

R&S® RTO

Digital Oscilloscope

Getting Started



1304.6048.02 – 02

This manual describes the following R&S®RTO models:

- R&S®RTO1012 (1304.6002K12)
- R&S®RTO1014 (1304.6002K14)
- R&S®RTO1022 (1304.6002K22)
- R&S®RTO1024 (1304.6002K24)

The firmware of the instrument makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" 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.

© 2010 Rohde & Schwarz GmbH & Co. KG

Muehldorfstr. 15, 81671 Munich, Germany

Phone: +49 89 41 29 - 0

Fax: +49 89 41 29 12 164

E-mail: info@rohde-schwarz.com

Internet: <http://www.rohde-schwarz.com>

Printed in Germany – Subject to change – Data without tolerance limits is not binding.

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG.

Trade names are trademarks of the owners.

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 attached EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any intention 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 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.

Symbols and safety labels

							
Notice, general danger location Observe product documentation	Caution when handling heavy equipment	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Be careful when handling electrostatic sensitive devices

					
ON/OFF supply voltage	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double (reinforced) insulation

Tags and their meaning

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

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

These tags 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 tags described here are always used only in connection with the related product documentation and the related product. The use of tags 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, pollution severity 2, overvoltage category 2, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of $\pm 10\%$ shall apply to the nominal voltage and $\pm 5\%$ to the nominal frequency.
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 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 death.

Electrical safety

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

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with an earthing contact and protective earth connection.
3. Intentionally breaking the protective earth connection 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 the product does not have a power switch for disconnection from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 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, a disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not 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 fused 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. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages $V_{\text{rms}} > 30 \text{ V}$, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE 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 fused 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.

Basic Safety Instructions

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", 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. 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).

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, PE 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. Keep cells and batteries out of the hands of children. If a cell or a battery has been swallowed, seek medical aid immediately.
5. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
6. 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.
7. 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.
8. 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

1. 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.
2. 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.

Informaciones elementales de seguridad

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

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

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

Informaciones elementales de seguridad

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.

Símbolos y definiciones de seguridad

							
Aviso: punto de peligro general Observar la documentación del producto	Atención en el manejo de dispositivos de peso elevado	Peligro de choque eléctrico	Advertencia: superficie caliente	Conexión a conductor de protección	Conexión a tierra	Conexión a masa	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)

					
Tensión de alimentación de PUESTA EN MARCHA / PARADA	Indicación de estado de espera (Standby)	Corriente continua (DC)	Corriente alterna (AC)	Corriente continua / Corriente alterna (DC/AC)	El aparato está protegido en su totalidad por un aislamiento doble (reforzado)

Palabras de señal y su significado

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



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



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



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



AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo.

En la documentación del producto se emplea de forma sinónima el término CUIDADO.

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

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, grado de suciedad 2, categoría de sobrecarga eléctrica 2, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de $\pm 10\%$ sobre el voltaje nominal y de $\pm 5\%$ sobre la frecuencia nominal.
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, pueden causarse lesiones o 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, se deberá considerar el enchufe del cable de conexión como interruptor. En estos casos se deberá asegurar que el enchufe siempre sea de fácil acceso (de acuerdo con la longitud del cable de conexión, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión $U_{\text{eff}} > 30 \text{ V}$ se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
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", punto 1.

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. 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).

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. Mantener baterías y celdas fuera del alcance de los niños. En caso de ingestión de una celda o batería, avisar inmediatamente a un médico.
5. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.

Informaciones elementales de seguridad

6. 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.
7. 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).
8. 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.

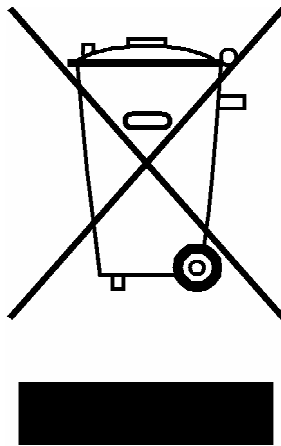
Eliminación

1. 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.
2. 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.

Customer Information Regarding Product Disposal

The German Electrical and Electronic Equipment (ElektroG) Act is an implementation of the following EC directives:

- 2002/96/EC on waste electrical and electronic equipment (WEEE) and
- 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).



Product labeling in accordance with EN 50419

Once the lifetime of a product has ended, this product must not be disposed of in the standard domestic refuse. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.

Rohde & Schwarz GmbH & Co. KG has developed a disposal concept for the environmental-friendly disposal or recycling of waste material and fully assumes its obligation as a producer to take back and dispose of electrical and electronic waste in accordance with the ElektroG Act.

Please contact your local service representative to dispose of the product.



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.

Europe, Africa, Middle East

Phone +49 89 4129 12345
customersupport@rohde-schwarz.com

North America

Phone 1-888-TEST-RSA (1-888-837-8772)
customer.support@rsa.rohde-schwarz.com

Latin America

Phone +1-410-910-7988
customersupport.la@rohde-schwarz.com

Asia/Pacific

Phone +65 65 13 04 88
customersupport.asia@rohde-schwarz.com



Qualitätszertifikat

Certificate of quality

Certificat de qualité

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde&Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde&Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO9001 und ISO14001 zertifiziert.

Der Umwelt verpflichtet

- ▮ Energie-effiziente, RoHS-konforme Produkte
- ▮ Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ▮ ISO 14001-zertifiziertes Umweltmanagementsystem

Dear Customer,

You have decided to buy a Rohde&Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards. The Rohde&Schwarz quality management system is certified according to standards such as ISO9001 and ISO14001.

Environmental commitment

- ▮ Energy-efficient products
- ▮ Continuous improvement in environmental sustainability
- ▮ ISO 14001-certified environmental management system

Cher client,

Vous avez choisi d'acheter un produit Rohde&Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde&Schwarz a été homologué, entre autres, conformément aux normes ISO9001 et ISO14001.

Engagement écologique

- ▮ Produits à efficience énergétique
- ▮ Amélioration continue de la durabilité environnementale
- ▮ Système de gestion de l'environnement certifié selon ISO 14001



ROHDE & SCHWARZ

CE Declaration of Conformity



Certificate No.: 2010-45

This is to certify that:

Equipment type	Stock No.	Designation
RTO	1304.6002.XX	RTO

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (2006/95/EC)
- relating to electromagnetic compatibility (2004/108/EC)

Conformity is proven by compliance with the following standards:

EN 61010-1: 2001
EN 61326-1: 2006
EN 61326-2-1: 2006
EN 55011: 2007 + A2: 2007, Class A
EN 61000-3-2: 2006
EN 61000-3-3: 1995 + A1: 2001 + A2: 2005

For the assessment of electromagnetic compatibility, the limits of radio interference for Class A equipment as well as the immunity to interference for operation in industry have been used as a basis.

ROHDE & SCHWARZ GmbH & Co. KG
Mühlldorfstr. 15, D-81671 München

Munich, 2010-05-26

Central Quality Management MF-QZ / Radde

1304.6002.XX

CE

E-1

Contents

1	Preface	7
1.1	Key Features	7
1.2	Documentation Overview	7
1.3	Conventions Used in the Documentation	8
1.3.1	Typographical Conventions.....	8
1.3.2	Conventions for Procedure Descriptions.....	9
2	Preparing for Use	10
2.1	Unpacking and Checking the Instrument	10
2.2	Positioning the Instrument	10
2.2.1	Standalone Operation.....	11
2.2.2	Rackmounting.....	11
2.3	Starting the Instrument	12
2.3.1	Powering On.....	12
2.3.2	Starting Up and Shutting Down.....	13
2.3.3	Powering Off.....	13
2.3.4	EMI Suppression.....	14
2.4	Connecting External Devices	14
2.4.1	Connecting USB Devices.....	14
2.4.2	Connecting an External Monitor.....	15
3	Instrument Tour	16
3.1	Front Panel	16
3.1.1	Touch Screen Display.....	17
3.1.2	SETUP Controls.....	18
3.1.3	HORIZONTAL Controls.....	20
3.1.4	TRIGGER Controls.....	21
3.1.5	VERTICAL Controls.....	22
3.1.6	ANALYZE Keys.....	23
3.1.7	NAVIGATION Controls.....	25
3.1.8	POWER key.....	26
3.1.9	Connectors.....	26
3.1.10	Input Channels.....	27

3.2	Rear Panel.....	27
4	Trying Out the Instrument.....	30
4.1	Displaying a Basic Signal.....	30
4.2	Acquiring Data.....	32
4.3	Organizing the Display.....	33
4.4	Changing the Waveform Scaling and Position.....	37
4.5	Zooming into the Display.....	41
4.6	Displaying the Waveform History.....	43
4.7	Showing Basic Measurement Results.....	44
4.7.1	Performing a Cursor Measurement.....	44
4.7.2	Performing an Amplitude vs. Time Measurement.....	45
4.7.3	Displaying a Histogram.....	47
4.8	Performing an FFT Analysis.....	49
4.9	Performing Mathematical Calculations.....	51
4.10	Performing a Mask Test.....	52
4.11	Performing a Search.....	55
4.12	Printing and Saving Results.....	57
4.13	Saving Data.....	58
5	Operating the Instrument.....	60
5.1	Means of Manual Interaction.....	60
5.2	Understanding Display Information.....	61
5.3	Working with Waveforms.....	63
5.4	Displaying Results.....	66
5.5	Using the Signal bar.....	66
5.6	Toolbar.....	68
5.7	Accessing the Functionality.....	70
5.8	Entering Data.....	71
5.9	Getting Information and Help.....	73
6	Setting Up the Instrument.....	76
6.1	Performing a Self-alignment.....	76
6.2	Aligning the Touch Screen.....	76
6.3	Adjusting Passive Probes.....	77

Index.....78

1 Preface

1.1 Key Features

The R&S RTO Digital Oscilloscope provides the fastest signal acquisition and analysis on the market. Outstanding key features are:

- 1 million waveforms per second waveform acquisition rate
- Unprecedented processing ASIC
- Deepest standard memory of 20 MSA per channel
- Innovative and advanced digital trigger system
- Excellent measurement accuracy and high measurement speed, even for complex analysis functions
- Lowest noise in its class
- Easy and intuitive to operate
- High quality line of probes

For a detailed specification refer to the data sheet.

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

- Find the most elusive glitches with no trade-offs for measurement and analysis due to highest acquisition rate and shortest blind time.
- Get fastest results even with maximum data with hardware supported processing for trace arithmetics, math functions, mask testing.
- The real-time digital trigger system can capture closest successive events. It works with high trigger sensitivity at full bandwidth and very low trigger jitter.
- Get the right accuracy you need due to lowest noise in its class and best in class vertical resolution.
- Easy to use
 - Flat and straightforward menu structure
 - Color-coded control elements for clear user guidance
 - Signal icons with drag & drop functionality
 - Multilevel Undo / Redo
 - Toolbar with frequently used functionality

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
- Documentation CD-ROM with:

- Getting Started
- User Manual
- Service manual
- Data sheet and product brochure
- Links to useful sites on the R&S 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

This manual is delivered with the instrument in printed form and in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the instrument. Basic operations and typical measurement examples are described. The manual includes also general information, e.g., Safety Instructions.

User Manual

The User Manual is available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In this manual, all instrument functions are described in detail. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands with programming examples. Information on maintenance, instrument interfaces and error messages is also given.

Service Manual

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

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.

Convention	Description
File names, commands, program code	File names, commands, coding samples and screen output are distinguished by their font.
<i>Input</i>	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 touch screen 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 device 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 device or on a keyboard.

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 prevent control elements and connectors from being damaged.

2.2 Positioning the Instrument

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

⚠ CAUTION**Risk of injury**

The instruments are not designed to be stacked on top of each other because their surface area is too small. The instruments must be installed in a rack to avoid the risk of personal injury and material damage.

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**

The feet may fold in if they are not folded out completely or if the instrument is shifted. Fold the feet completely in or completely out to ensure stability of the instrument and personal safety. To avoid injuries, never shift the instrument when its feet are folded out. When the instrument is standing on its folded-out feet, do not work under the instrument and do not put anything under it, otherwise injuries or material damage could occur. The feet may 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**

For rack installation, make sure that all fan openings are unobstructed and that the airflow perforations are unimpeded. This helps to prevent the instrument from overheating.

2.3 Starting the Instrument

NOTICE

Risk of instrument damage

Before switching on the instrument, make sure that the following conditions are met:

- Instrument casing is closed and all fasteners are tightened.
- 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 operated in the horizontal position on an even surface.
- 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.

Failure to meet these conditions may cause damage to the instrument or other devices in the test setup.

2.3.1 Powering On

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.

⚠ WARNING

Shock hazard

Do not open the instrument casing. As a rule, normal operation of the instrument does not require opening the casing. Observe the general safety instructions and regulations at the beginning of the manual.

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

1. Connect the instrument to the AC power supply using the AC power cable delivered with the instrument.
2. Switch the main power switch at the rear of the instrument to position I.



You can leave the AC power on permanently. Powering off is required only 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 XP 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).

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. 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.

Always first press the POWER key to shut down the application properly.

2.3.4 EMI Suppression

To suppress generated Electromagnetic Interference (EMI), operate the instrument only while it is closed, with all shielding covers fitted. Note the EMC classification in the data sheet.

Use appropriate shielded cables to ensure successful control of electromagnetic radiation during operation, especially for the following connector types:

- USB: Use double-shielded USB cables and ensure that external USB devices comply with EMC regulations.
- GPIB (IEEE/IEC 625): Use a shielded GPIB cable.
- LAN: Use CAT6 or CAT7 cables.

Observe also the connector, cable, and cable length requirements provided with the description of the individual connectors.

2.4 Connecting External Devices

The following interfaces for external devices are provided:

- USB connectors, see also ["USB"](#) on page 26
- Monitor connector, see also [chapter 3.2, "Rear Panel"](#), on page 27

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:

- Memory stick 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

Installing USB devices is easy under Windows XP, because all USB devices are plug&play. After a device is connected to the USB interface, Windows XP automatically searches for a suitable device driver.

If Windows XP does not find a suitable driver, it will prompt 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 subsequently disconnected from the R&S RTO, Windows XP immediately detects the change in hardware configuration and deactivates the corresponding driver.

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

Connecting a memory stick or CD-ROM drive

If installation of a memory stick or CD-ROM drive is successful, Windows XP 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 is manufacturer-dependent.

Connecting a keyboard

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

Use the "Start > Control Panel > Keyboard" or the "Regional and Language Options" menu of Windows XP to configure the keyboard properties. To access Windows XP, press the Windows key on the external keyboard.

Connecting a mouse

The mouse is detected automatically when it is connected.

Use the "Start > Control Panel > Mouse" menu of Windows XP to configure the mouse properties. To access Windows XP, press the Windows key on the external keyboard.

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 required, printer driver installation is initiated using Windows XP's "Add 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 memory stick 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 "Add Printer" wizard on the "Start > Settings > Printer and Faxes" menu to install the driver. To access Windows XP, press the Windows key on the external keyboard.

2.4.2 Connecting an External Monitor

You can connect an external DVI monitor to the DVI connector on the instrument's rear panel. See also: "[MONITOR \(DVI-D\)](#)" on page 29.

NOTICE

Connecting a monitor

Before connecting a monitor, make sure that the instrument is switched off. Otherwise, correct operation cannot be assured.

To use a VGA monitor, an active DVI-VGA adapter is required.

3 Instrument Tour

This chapter describes the front and rear panels of the instrument including all function keys and connectors, and also the touch screen 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 touch screen. Below, various connectors are located.



Fig. 3-1: Front panel of RTO 1024 with 4 input channels

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

3.1.1 Touch Screen Display

The touch screen 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 [figure 3-2](#) shows the touch screen display on a glance.

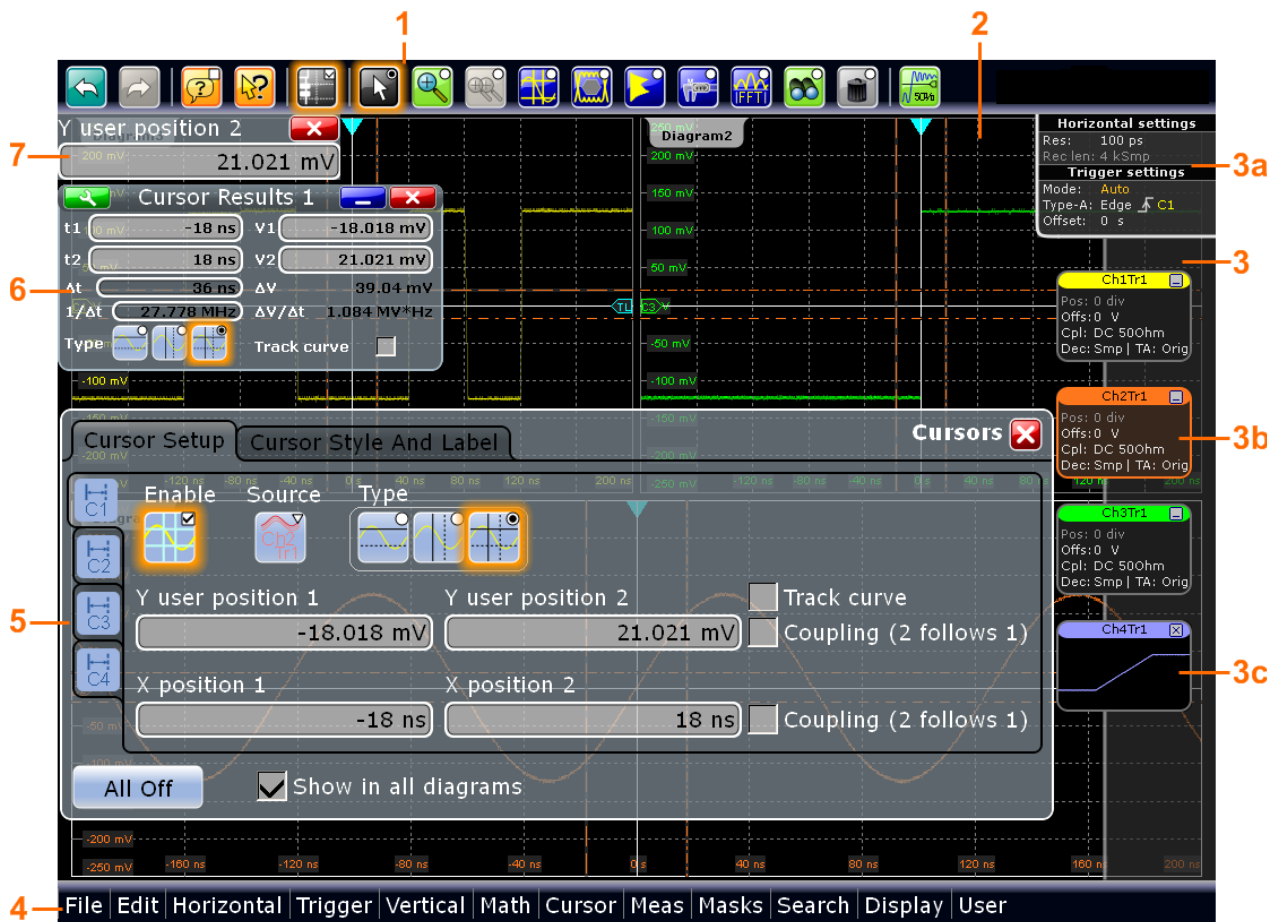


Fig. 3-2: Touch screen display

- 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 = Data 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 5.6, "Toolbar"](#), on page 68.

Diagram area

The diagram area shows the diagrams with waveforms. For a detailed description, refer to [chapter 5.2, "Understanding Display Information"](#), on page 61.

Signal bar

The signal bar is the control center for all enabled waveforms. On the top, the horizontal and trigger labels show the current basic 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 5.3, "Working with Waveforms"](#), on page 63 for a detailed description.

You can also adjust the behaviour of the signal bar in various ways, see [chapter 5.5, "Using the Signal bar"](#), on page 66.


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 70.

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. With the  icon, you can open the corresponding dialog box to adjust the settings.

For details, see [chapter 5.4, "Displaying Results"](#), on page 66.

Data input box

The data input box appears if you adjust a value with one of the rotary knobs, or by dragging it on the screen. The data input box shows the current value, and you can enter the exact numerical value in this field. The field title shows the name of the currently adjusted parameter. This is helpful when using the multi-function rotary knobs - POSITION knobs, INTENSITY and RESOLUTION/RECORD LENGTH. You can also change the step size and - if available - autoselect the value directly in the data input box.



See also: [chapter 5.8, "Entering Data"](#), on page 71.

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 obtains appropriate horizontal, vertical, and trigger settings to display stable waveforms.

PRESET

Resets the instrument to the default state. All measurements, mask tests, zoom, and all other individual settings are deleted, all channels except for channel 1 are disabled.

FILE

Opens 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 the "Setup" dialog box, where you can:

- Configure the touch screen
- Access MS Windows configuration and install firmware updates
- Configure remote connection
- Check and install option keys
- Find information on hardware and configuration in case of service
- Configure LXI

PRINT

Configures and starts the printing.

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

Shows a list of installed options. By default, installed options are active. You can deactivate an option if it is not needed, and activate it again.

T-SCREEN LOCK

Locks the touch screen to prevent unintended use. When the touch screen is off, the key is illuminated. Press again to unlock the touch screen.

DISPLAY

Opens the "Display" dialog box to configure the appearance of the waveforms, grid, persistence, and also the calibration of the touch screen.

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 data 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

The key opens the "Resolution" tab in the "Horizontal" dialog box, where you can set the resolution or the record length.

HORIZONTAL

The key opens the "Time Base" tab in the "Horizontal" dialog box, where you can:

- Adjust the time scale, trigger offset and reference point

ACQUISITION

The key opens the "Acquisition" tab in the "Horizontal" dialog box, where you can:

- Configure up to three waveforms per channel
- Define the acquisition processing

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 data 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 trigger offset or the reference point. Press the knob to toggle the setting. The controlled parameter and its value are shown in the data input box in the upper left corner of the screen.

The trigger offset is the horizontal position of the trigger point in relation to the reference point. Turn clockwise to move the trigger point to the right.

The reference point is the zero point of the time scale. If the trigger offset is zero, the trigger point matches the reference point. Turn clockwise to move the reference point to the right.

SCALE

The rotary knob adjusts the horizontal scale for all signals, 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 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 triggers

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 part of the signal bar on the touch screen.

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 and set "Acquisitions". 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 keys are illuminated with the correspondent channel color, if the channel is on.

The effect of the keypress depends on state of the channel:

- If channel is off: Pressing the key turns the channel on 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. The horizontal axis and the selected waveform are moved vertically. Press the knob to toggle the setting. The controlled parameter and its value are shown in the data input box in the upper left corner of the screen.

- Position indicates the vertical location in divisions. Turn clockwise to move the waveform up.
- Offset moves the vertical center of the selected channel to the offset value. Turn clockwise to move the waveform down.

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

SCALE

This rotary knob adjusts the vertical scale for the selected waveform. Turn clockwise to stretch the waveform. Doing so, the scale value V/div decreases.

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

SIGNAL OFF

Turns the selected signal off 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 ANALYZE Keys

The keys in the ANALYZE 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 is opened.

In this dialog box you can:

- Configure up to four 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 vs. time measurements, eye/jitter measurements, 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 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 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. 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

The key is only relevant, if at least one of the options RTO-K1 to RTO-K4 is installed. The "Protocol" dialog box contains the configuration and trigger conditions of serial bus systems.

USER

Corresponds to the "User" menu and is 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 "History" dialog box, where you can view the stored acquisitions and use them for further analysis. The button is illuminated as long as a history acquisition or replay is displayed. Press the button to close the dialog box and to open it again.

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.



Navigation rotary knob

The navigation knob has various functions:

- In numeric entry fields: turn clockwise to increase 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 data 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.

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 data input box.

ENTER

The ENTER key has various functions:

- In tables: the key activates the edit mode. If the field is in edit mode, the key confirms the value, quits the edit mode and moves to the next line.
- In data input boxes: the key toggles the parameter.

FIELD LEFT, FIELD RIGHT

In dialog boxes and tables: move the focus.

In lists: moves the focus

CHECKMARK

- In dialog boxes and lists: selects the option with the focus, opens a list.
- In tables: activates the edit mode.

TAB

Switches the vertical and horizontal tabs.

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.

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.

See also: [chapter 2.3, "Starting the Instrument"](#), on page 12.

3.1.9 Connectors

The most important connectors are placed at the bottom of the front panel.




USB

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

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.

3.1.10 Input Channels

Input channels are the connectors for active and passive probes. The input impedance is selectable, the values are 50 Ω and 1 MΩ.

⚠ CAUTION**Risk of injury**

If the input voltages are higher than 30 V RMS or 42 V peak or 60 V DC, use appropriate protective measures to preclude direct contact with the measurement setup.

⚠ CAUTION**Risk of injury and instrument damage**

The instrument complies with measuring category I; make sure that the input voltage 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 higher than category I, make sure that no such overvoltages reach the R&S RTOR&S RTO input. To ensure this, 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 overvoltages higher than category I are applied to the instrument. For detailed information, refer to the documentation and safety information of the probe manufacturer.

Explanation: According to section 6.7.4 of EN61010-1, measuring category I is intended for measurements on circuits which are not connected to the mains system.

3.2 Rear Panel

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

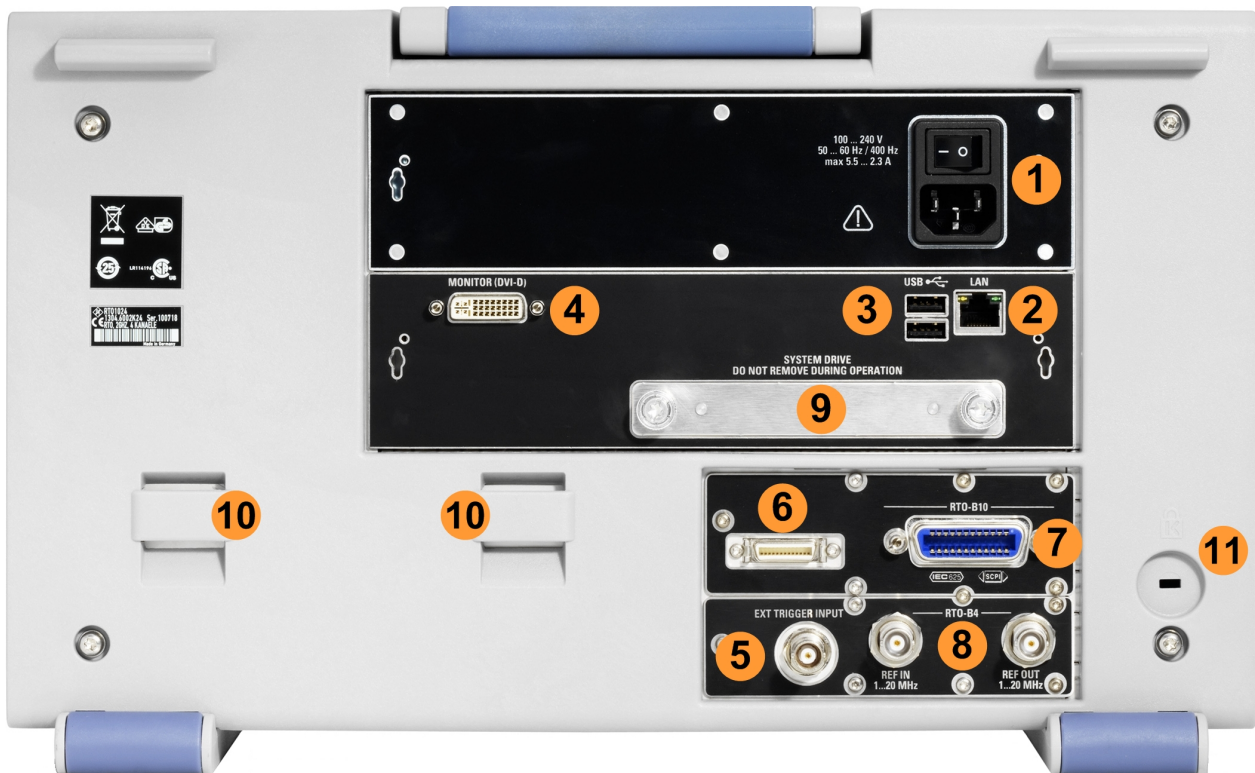


Fig. 3-3: Rear panel view of R&S RTO

- 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 = Connector for future applications
- 7 = Optional GPIB connector (option R&S RTO-B10)
- 8 = Optional OCXO with input and output of the reference signal (option R&S RTO-B4)
- 9 = Optional exchangeable hard disk (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

The AC main power switch disconnects the instrument from the AC power line. 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.

LAN

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

USB

Same type of USB connectors as the front panel USB connectors, see "USB" on page 26.

MONITOR (DVI-D)

Digital connector for an external monitor. The monitor shows the complete content of the instrument's screen.

The touch screen of the R&S RTO has a screen resolution of 1278x768 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 1278x768 area of the monitor display. For full screen display, adjust the monitor's screen resolution.

EXT TRIGGER INPUT

The female connector for external trigger input is used to control the measurement by means of an external signal. The input impedance is selectable, the values are 50 Ω and 1 M Ω . The trigger level can be set from -10 V to 10 V. The maximum input voltage is 30 V RMS at 1 M Ω input impedance and 7 V RMS at 50 Ω input impedance.

RTO-B10

Optional GBIP connector coming with option R&S RTO-B10 GBIP Interface.

RTO-B4

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

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 60.

Prerequisites

- The instrument is set up, connected to the mains system, and started up as described in [chapter 2, "Preparing for Use"](#), on page 10.
- A probe is connected to the instrument.

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:

• Displaying a Basic Signal	30
• Acquiring Data	32
• Organizing the Display	33
• Changing the Waveform Scaling and Position	37
• Zooming into the Display	41
• Displaying the Waveform History	43
• Showing Basic Measurement Results	44
• Performing an FFT Analysis	49
• Performing Mathematical Calculations	51
• Performing a Mask Test	52
• Performing a Search	55
• Printing and Saving Results	57
• Saving Data	58

4.1 Displaying a Basic Signal

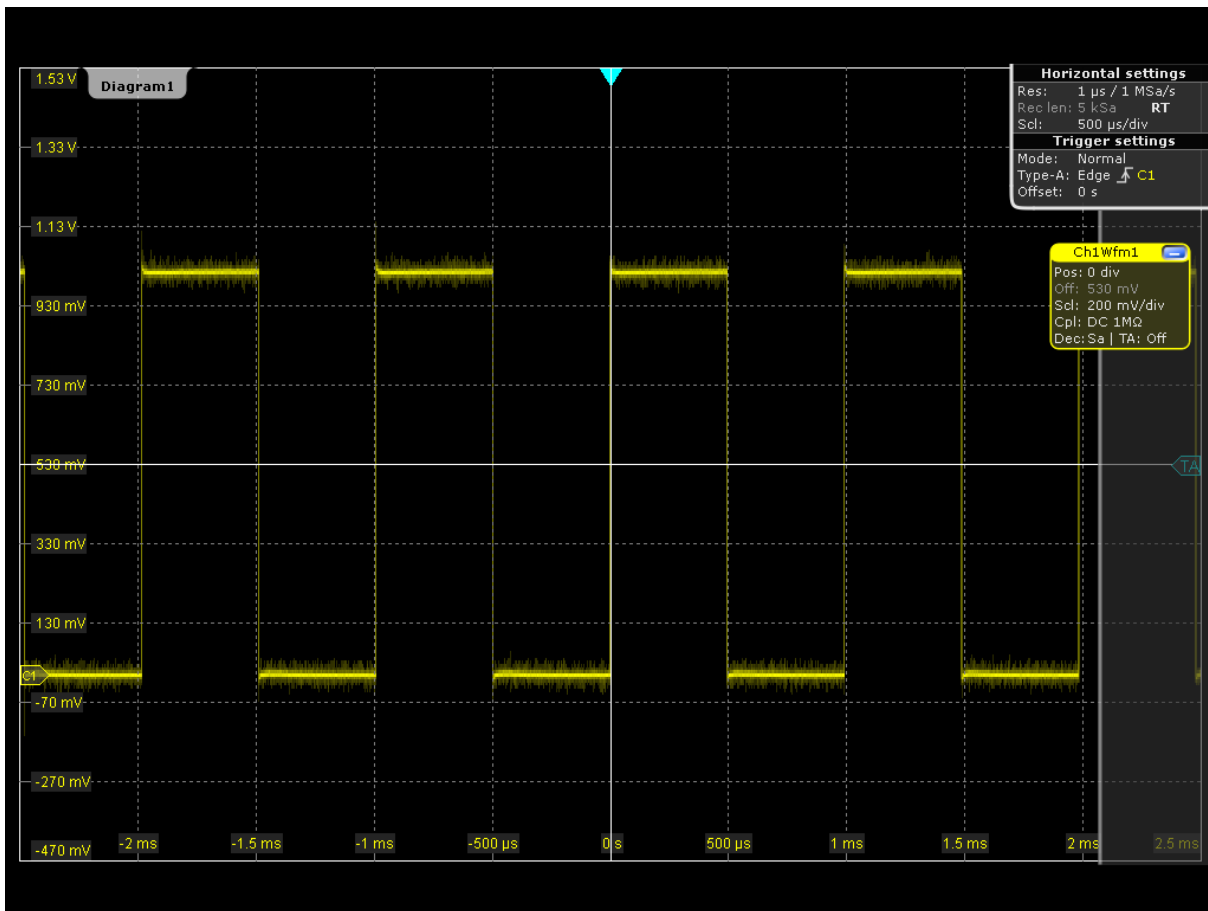
Displaying the input from a signal channel is very simple and straightforward. Furthermore, you get to know some basic trigger functions. The R&S RTO provides wide-ranging trigger functions to find various signal anomalies, which are described in the "User Manual".

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.

The instrument recognizes the probe. A square wave signal is displayed in the diagram, and a signal icon appears on the right of the screen.

3. Press the AUTOSSET 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 waveform. The trigger is set to edge trigger on rising edge with normal trigger mode.

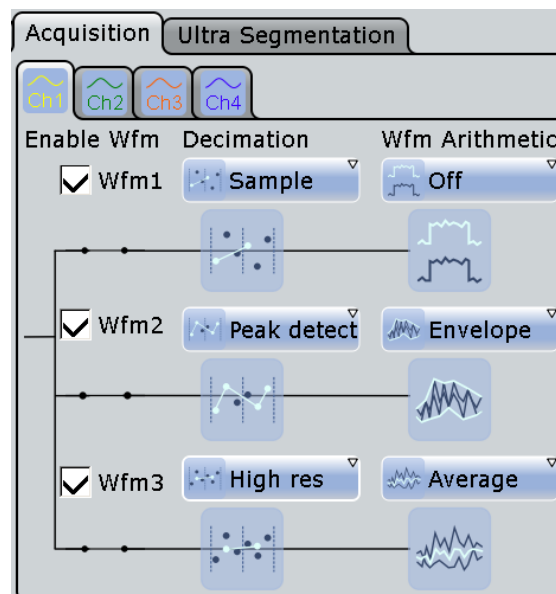


4. If necessary, compensate the passive probe as described in [chapter 6.3, "Adjusting Passive Probes"](#), on page 77.
5. Press the SOURCE key in the TRIGGER area of the front panel and switch the trigger source to *CH2*.
The waveform is no longer refreshed, and the "Wait for trigger" message box appears.
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 *Auto*, and an unstable waveform is displayed. In auto mode, the instrument triggers repeatedly after a time interval if no real trigger occurs.
7. Tap the "Undo" icon on the toolbar repeatedly until the trigger mode is reset to *Normal* 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" label.

4.2 Acquiring Data

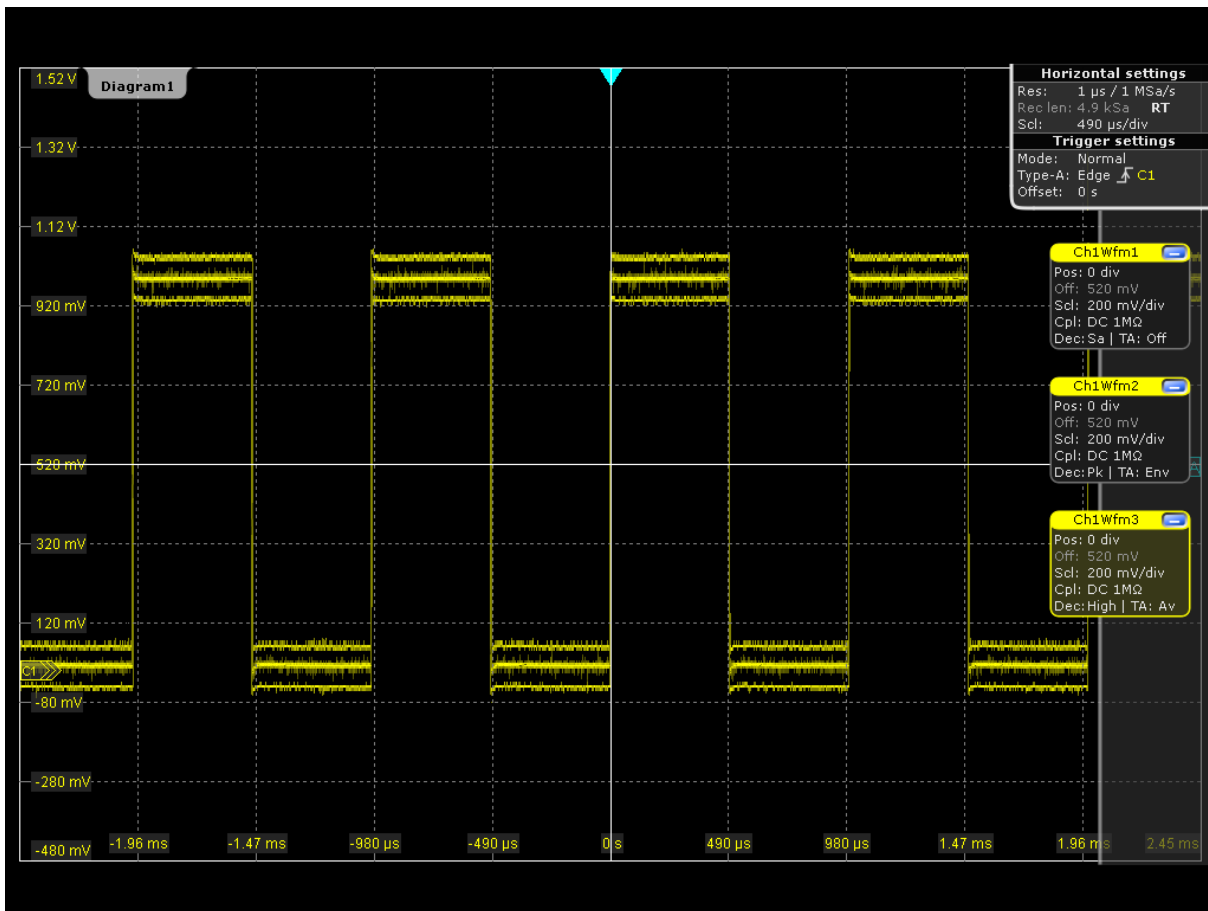
Although you are only using one input channel, you can acquire the calibration data using three different arithmetic methods and display the results in separate waveforms.

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 "Decimation" type *Peak detect* and the "Wfm Arithmetic" *Envelope*.
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.



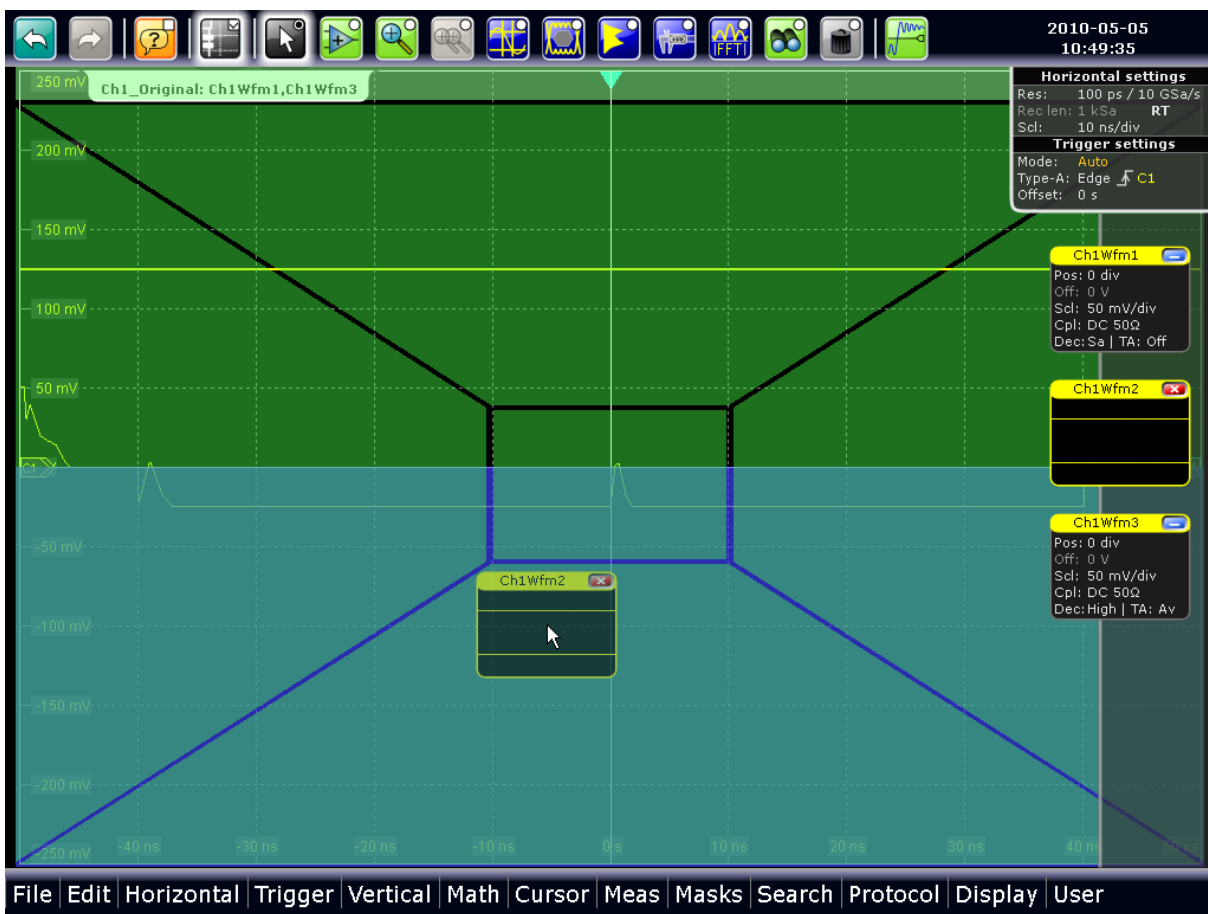
4.3 Organizing the Display

Meanwhile, the display has become very 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.

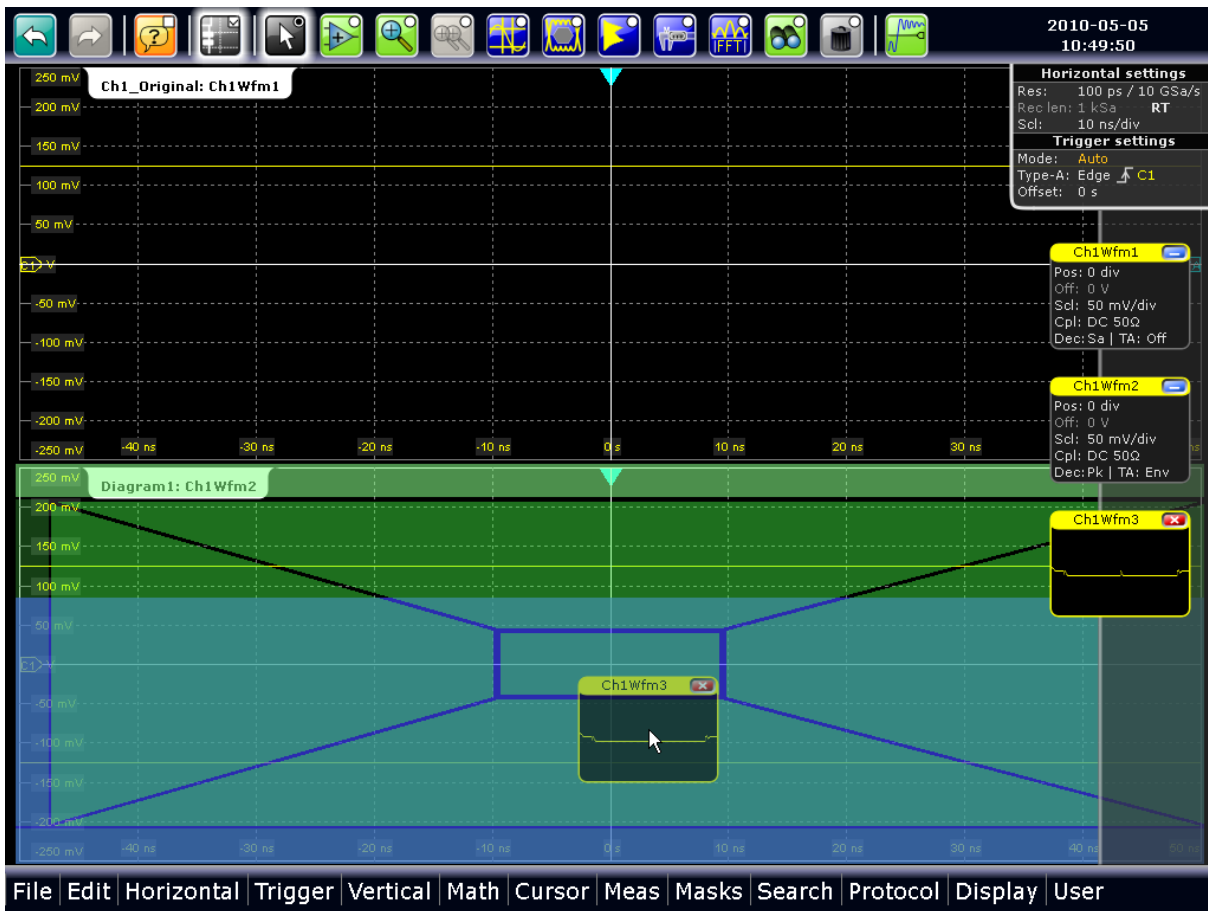
To manage several diagrams

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.



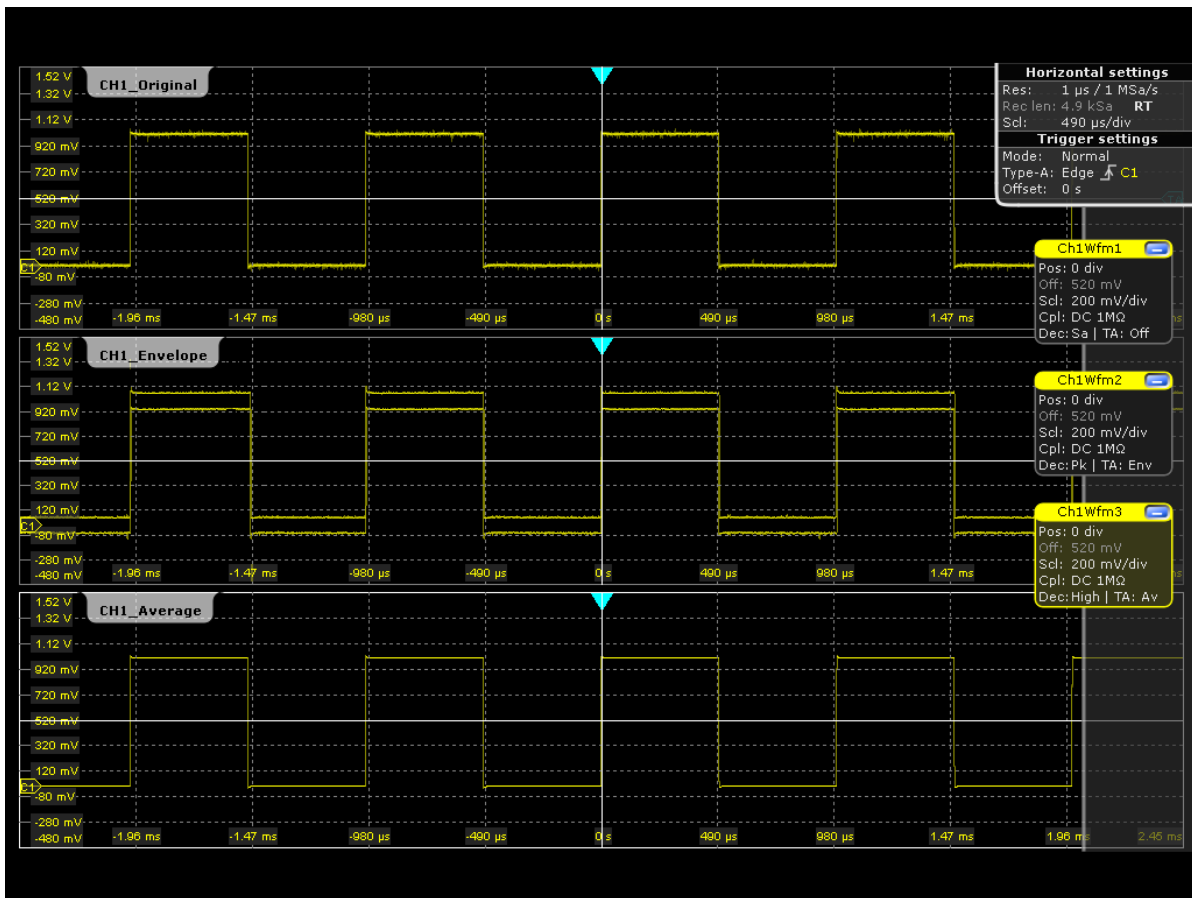
2. Drag the signal icon for "Ch1Wfm3" to the bottom half of the diagram so it covers an area beneath "Ch1Wfm2" and drop it there.



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: Ch1Wfm1".
 - b) In the online keyboard, enter *Ch1_Original*.
 - c) Tap ENTER.
 - d) Repeat these steps to rename "Diagram 2: Ch1Wfm2" to *Ch1_Envelope*.
 - e) Rename "Diagram 3: Ch1Wfm3" to *Ch1_Average*.

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



To delete waveform diagrams

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

- Minimize the waveform in diagram "CH1_Envelope": tap the "Ch1Wfm2" signal icon.
The diagram is removed and the signal icon in the signal bar displays a live view of the signal.
- Tap the Close button of the signal icon for "Ch1Wfm2".
The signal icon is removed from the signal bar, the waveform is switched off.
- Switch off the "CH1_Average" waveform by means of the toolbar function:
 - Tap the "Delete" icon on the toolbar.

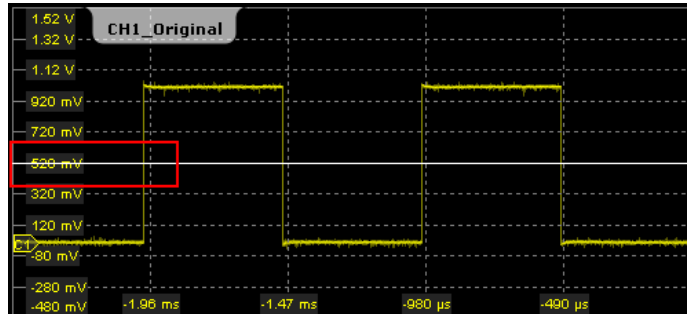


- Tap the waveform in the "CH1_Average" diagram.

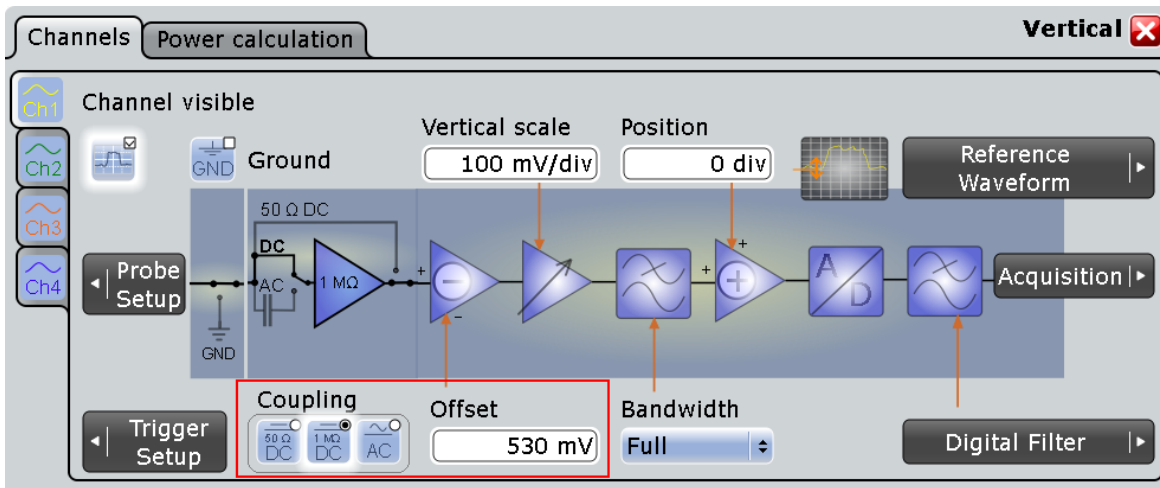
The waveform is switched off, its signal icon and the empty diagram are removed.

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 520 mV.



This value is also indicated in the "Vertical" settings dialog box that is displayed when you press the key for the input channel 1 (CH1), as well as in the signal icon ("Off"). The offset is the DC component of the signal.

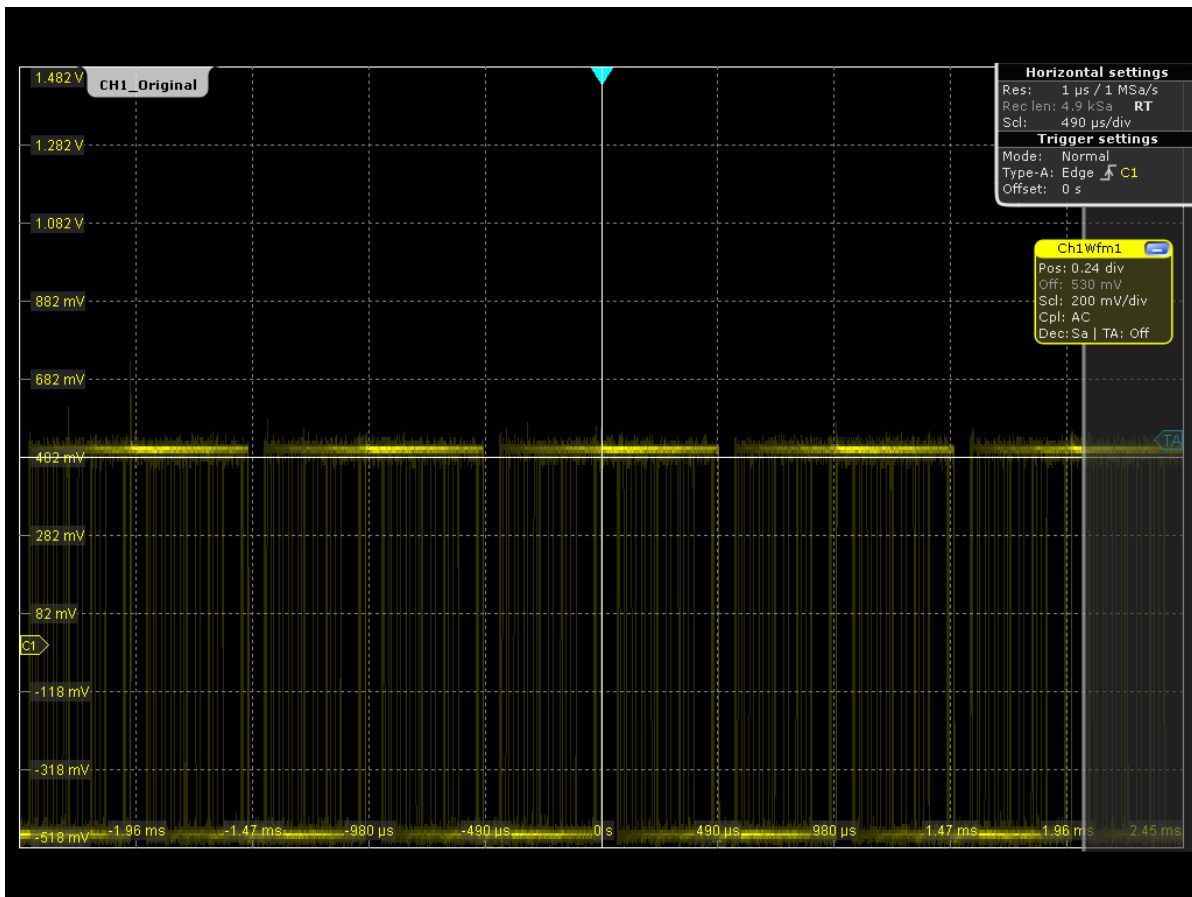


In the following example, you will filter the DC component by using the AC Coupling function, then quickly find the new trigger level, and try out the scaling functions.

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.

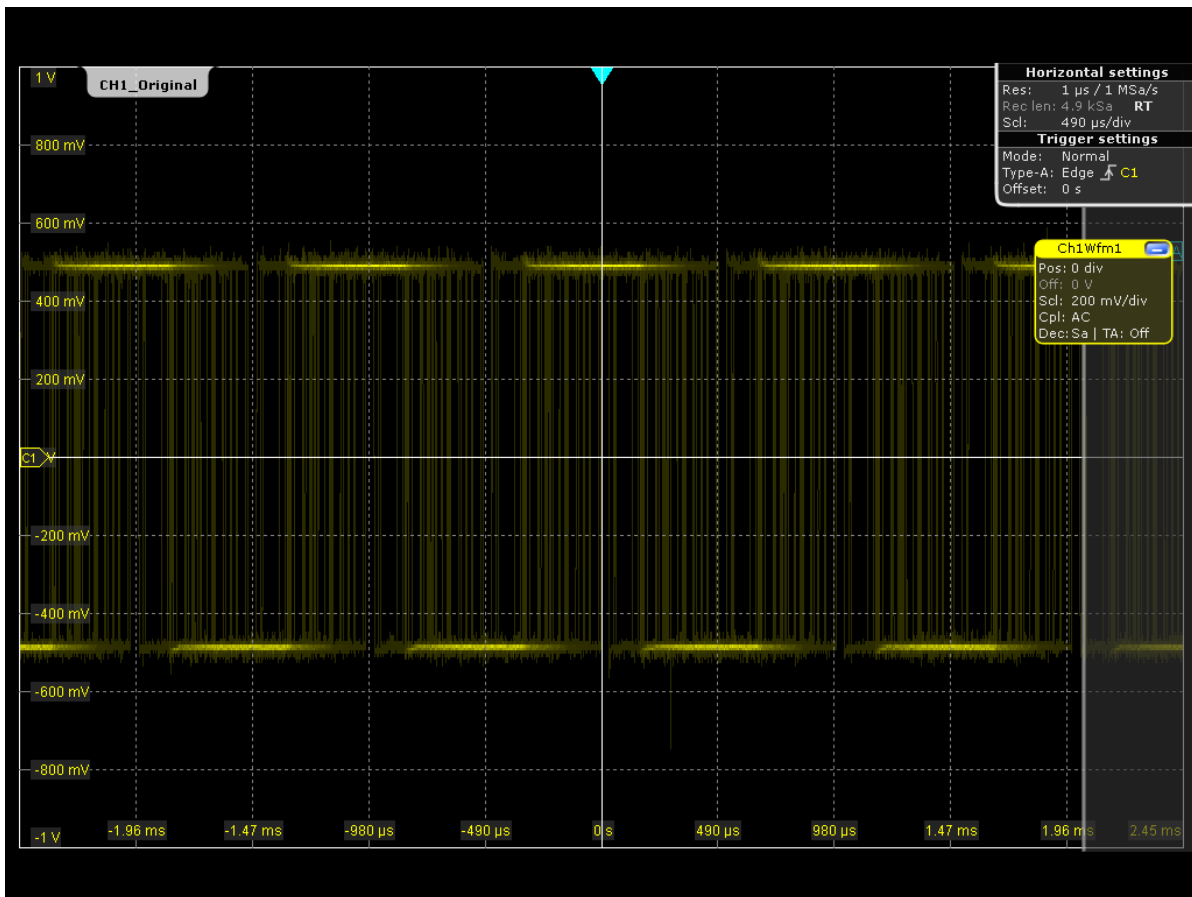
The DC component of the signal is eliminated; the waveform position moves down vertically and is now centered around 0 V.

Changing the Waveform Scaling and Position



3. In order to move the waveform back to the center of the screen, you must eliminate the offset in the vertical settings, as well.
4. Press the CH1 key on the front panel (in the VERTICAL area) to display the "Vertical" dialog box.
5. 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.

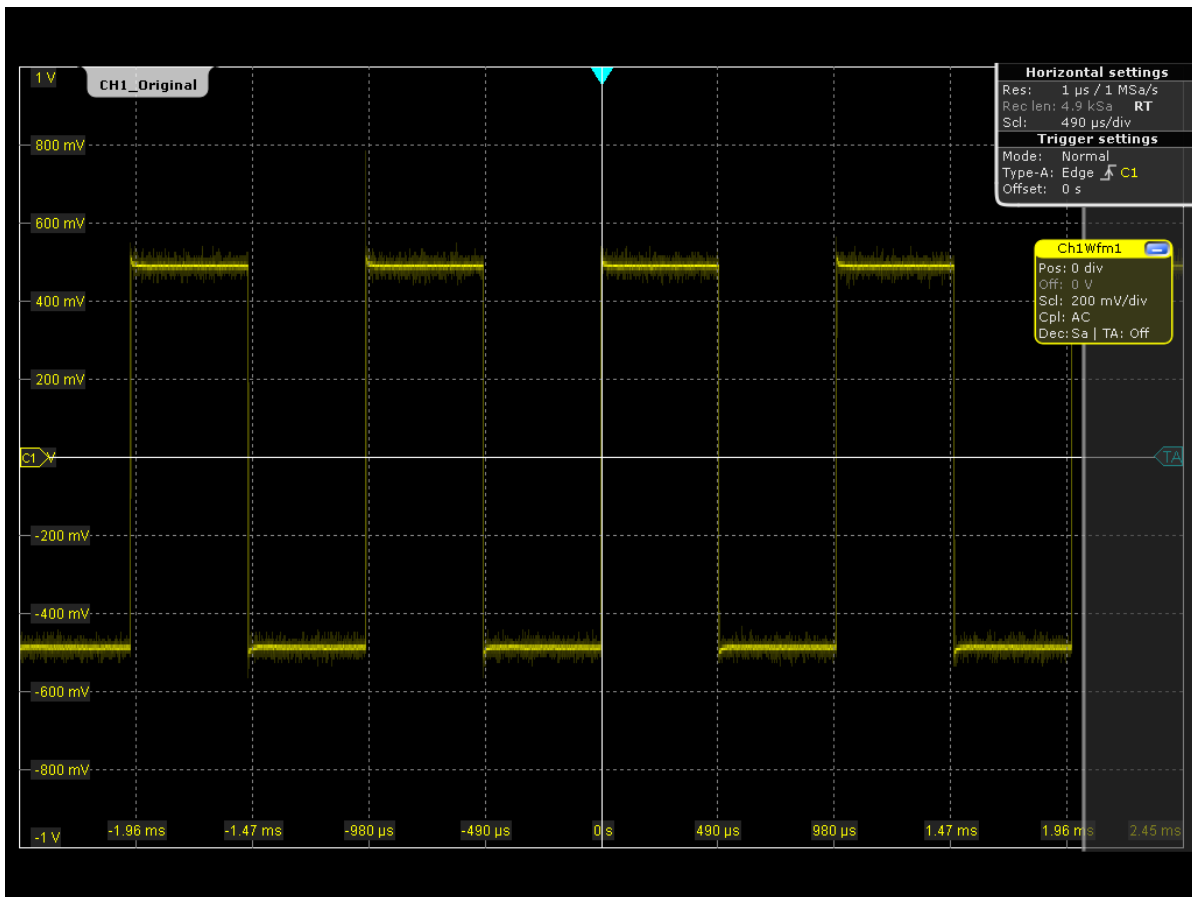


- Another problem remains, however: the signal is very unstable, as the used trigger level is no longer correct. Tap the "Find level" icon on the toolbar to quickly find the new trigger level automatically.

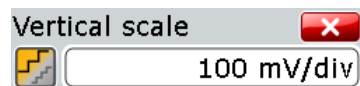


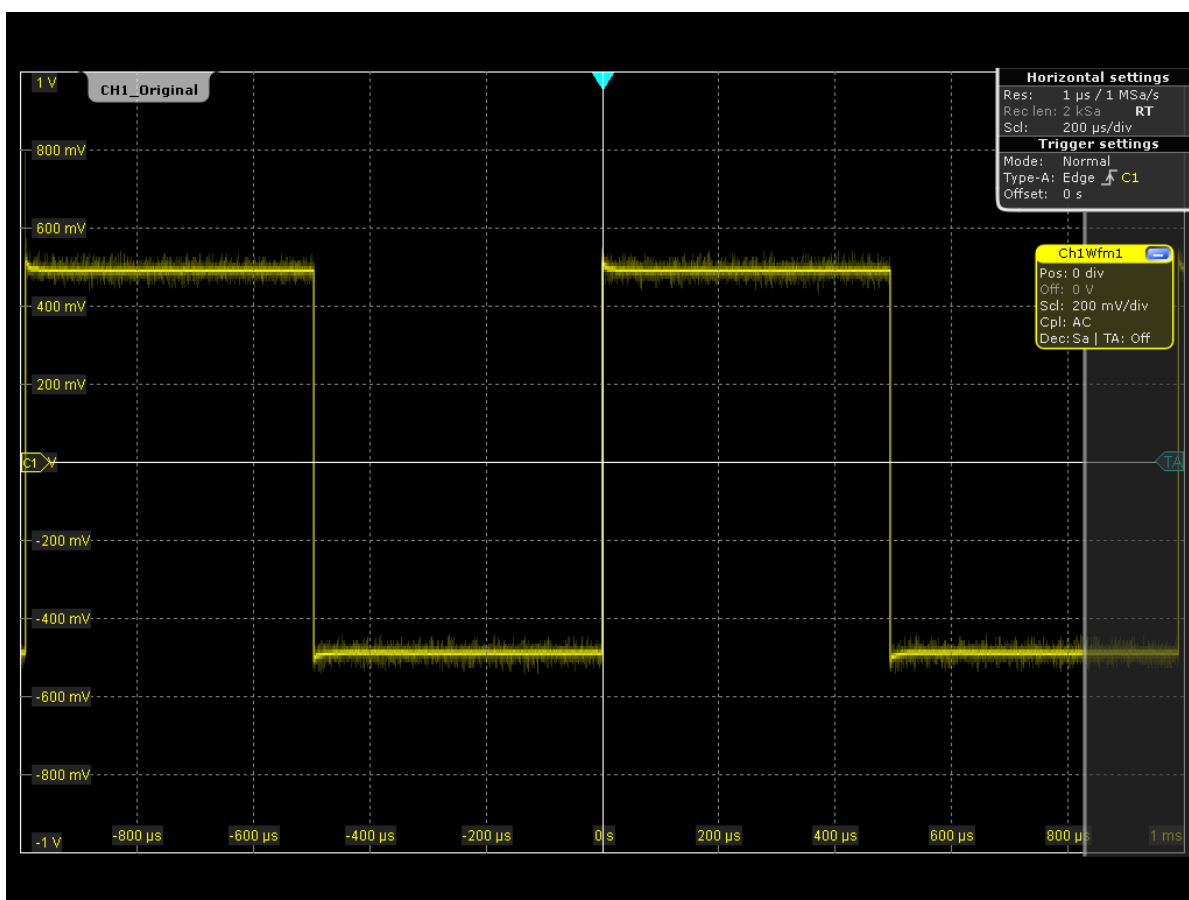
The waveform is now displayed as expected.

Changing the Waveform Scaling and Position



7. 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 lefthand 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.





8. 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 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.

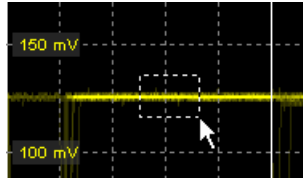
4.5 Zooming into the Display

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 the zoom function.

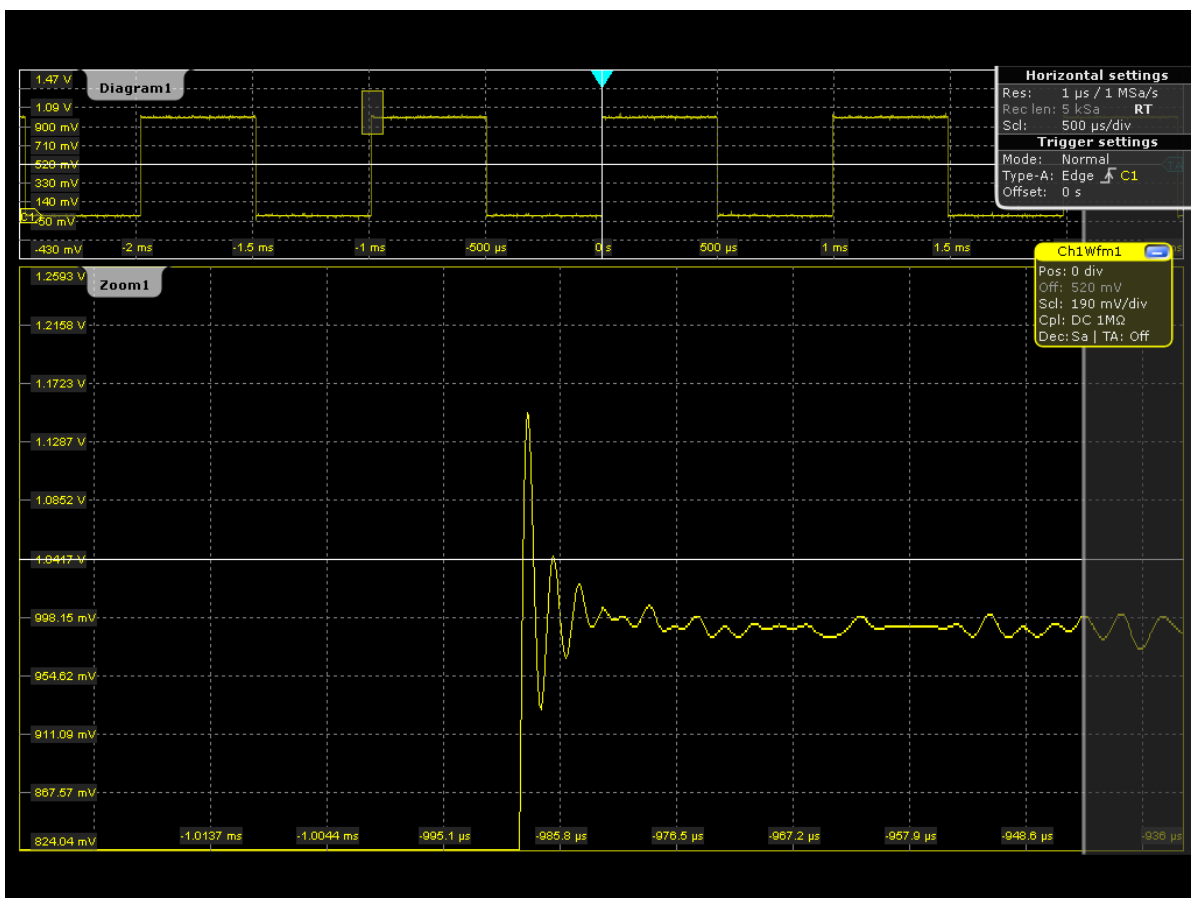
1. Restore the default signal channel settings by pressing the PRESET and AUTO-SET keys.
2. On the toolbar, tap the "Zoom" icon.



- 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 touch screen, 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.



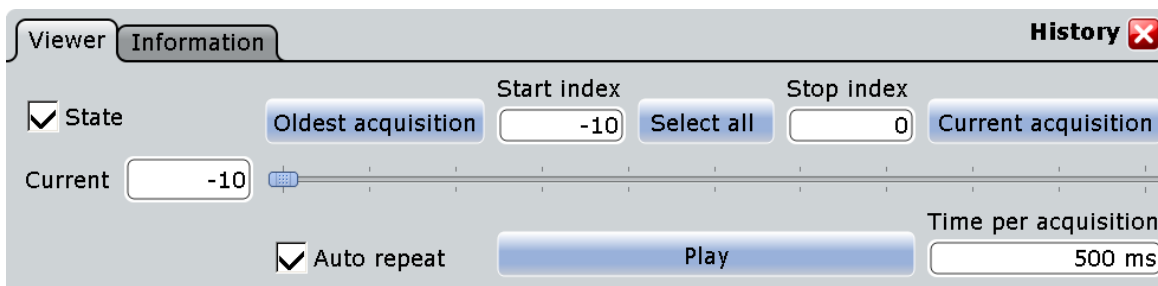
- To remove the zoom window and make room on the display for other results, tap the "Delete" icon and then the zoom window.

4.6 Displaying the Waveform History

During a continuous acquisition, the acquired data is stored in the sample 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 \times 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 \times 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 diagrams.
5. Press the HISTORY key on the front panel (in the ANALYZE area).
6. In the "History" dialog, tap the "Oldest acquisition" button to enter -10 in the "Start index" field, then tap "Current acquisition" to enter 0 in the "Stop index" field.
7. In the "Time per acquisition" field, enter 1 s to display each waveform for one second.
8. Enable the "Auto repeat" option so the ten waveforms are displayed repeatedly.



9. Press the "Play" button to start the display of the ten waveforms one after the other. The currently displayed waveform is indicated in the "Current" field.
Tip: you can close the "History" dialog box while the display is running so you can see the waveform better. However, you then do not see which waveform is currently being displayed, and you have to display the dialog box again (by pressing the HISTORY key) to stop the display.
10. Press the "Play" button again (now labeled "Running" due to the running display) to stop the display.

4.7 Showing Basic Measurement Results

Using the R&S RTO you can perform and display different measurements simultaneously, based on the active signal or math waveforms. The color of the results in the result table corresponds with the source waveform color.

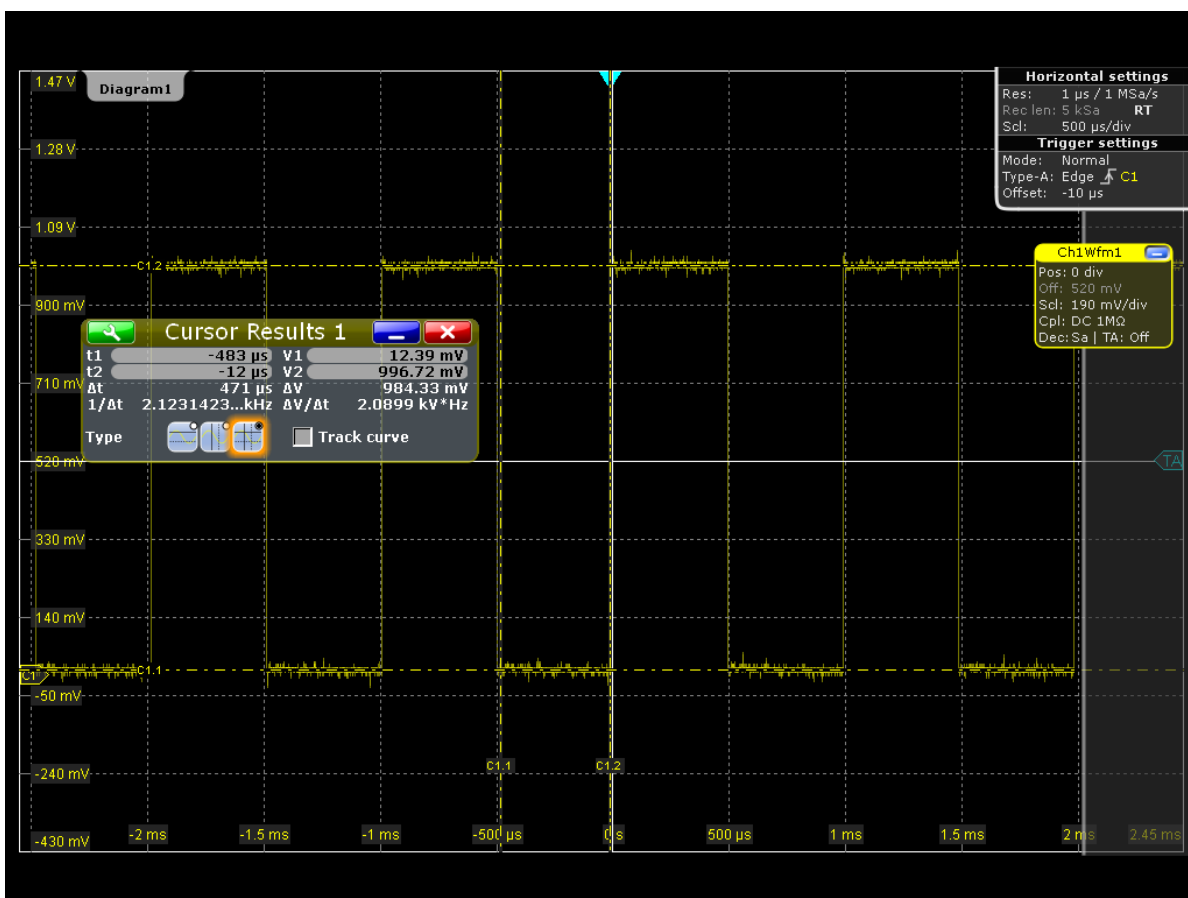
4.7.1 Performing a Cursor Measurement

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



3. Tap the waveform for 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 selected diagram and the "Cursor Results" box opens. The measured values of the waveform at the cursor positions are displayed.



You can move the cursor lines in the diagram manually, or adjust the cursor type and position in the result box.

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

Cursor Resu...1	
X1	-4.5 ns
X2	4.5 ns
Y1	-22.5 mV
Y2	22.5 mV
ΔY	45 mV

5. 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 vs. Time Measurement

In order to measure the amplitude of a pulse quickly, perform a simple Amplitude vs. Time measurement.


1. Restore the default signal channel settings by pressing the PRESET and AUTO-SET keys.
2. Tap the "Measurement" icon on the toolbar.



3. Tap the waveform for 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 "Amplitude" measurement is selected and enabled, using the active 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 ANALYZE area).

The "Measurements" dialog box is displayed.

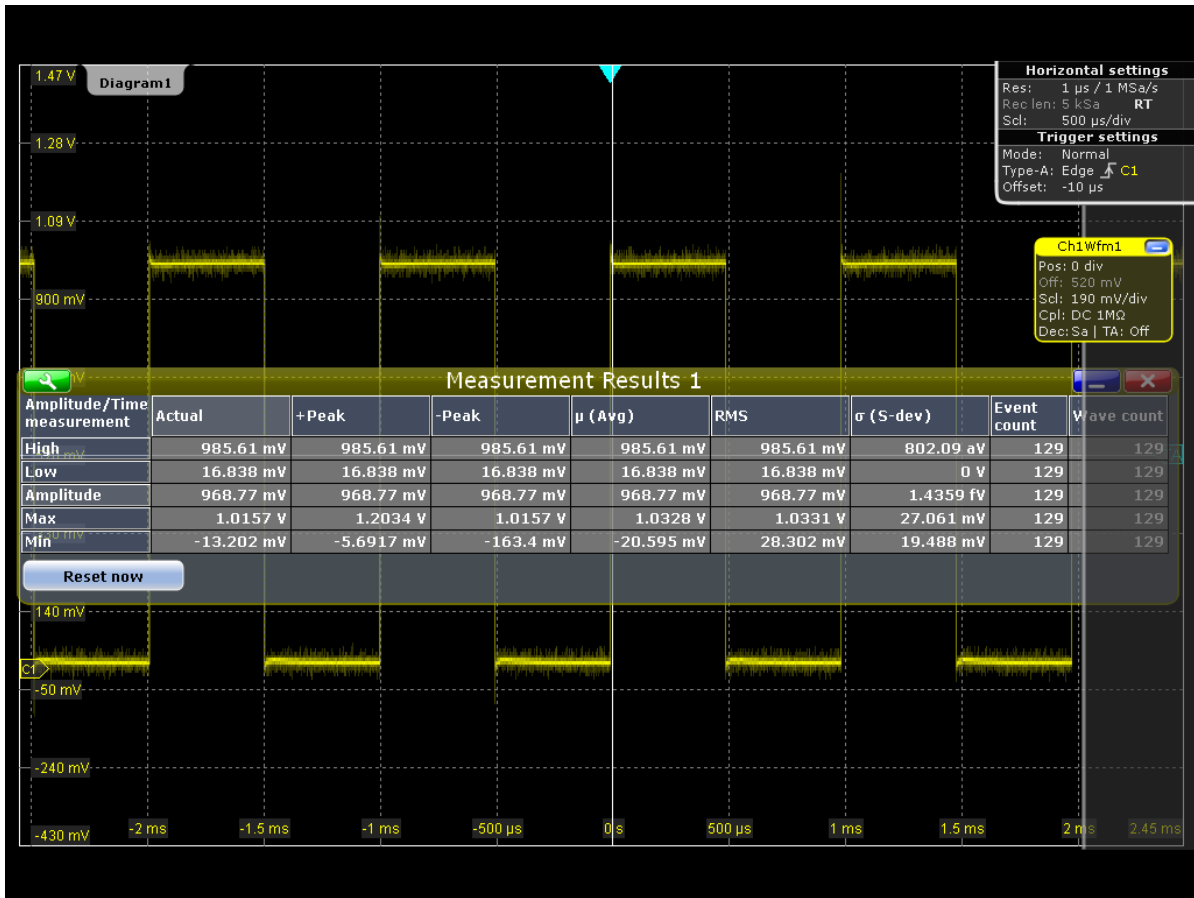
5. Enable the "Statistics" option.

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

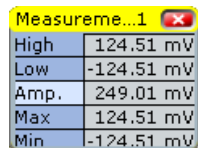
6. To display further measurement results for the amplitude vs. time diagram, tap the  icon in the result box, or press the MEAS key on the front panel to display the "Measurements" dialog box.

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

The measurement results are displayed in the result box.

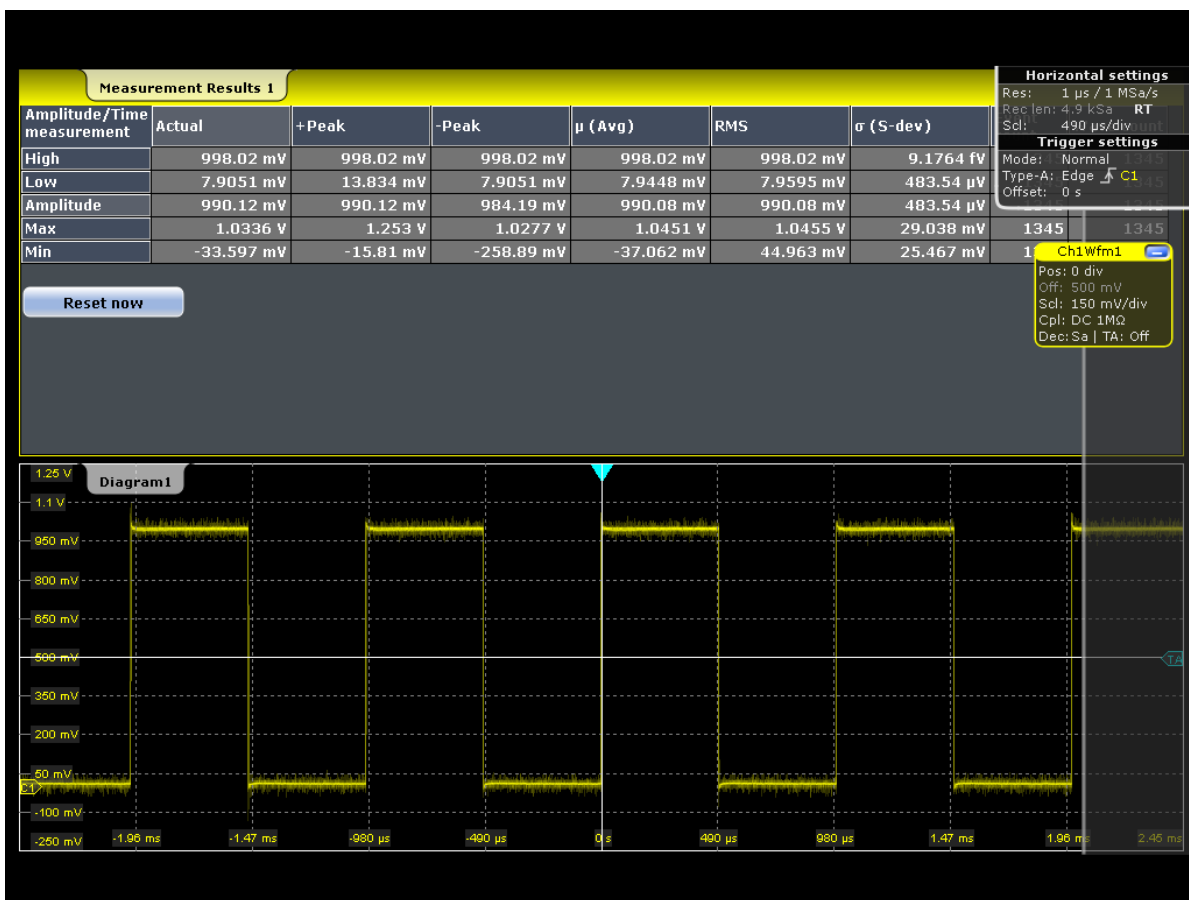


8. To save space in the display, minimize the result box. The most important results are displayed and updated in the result icon, as well.



9. To view all measurement results without covering part of the waveform display, move the result table to its own diagram area:
 - a) Tap the result icon and drag it to the diagram area.
 - b) Drop the waveform in the target area.

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



10. Minimize the measurement results display, but do not close it, as you require the results for the Search example (see [chapter 4.11, "Performing a Search"](#), on page 55).

4.7.3 Displaying a Histogram

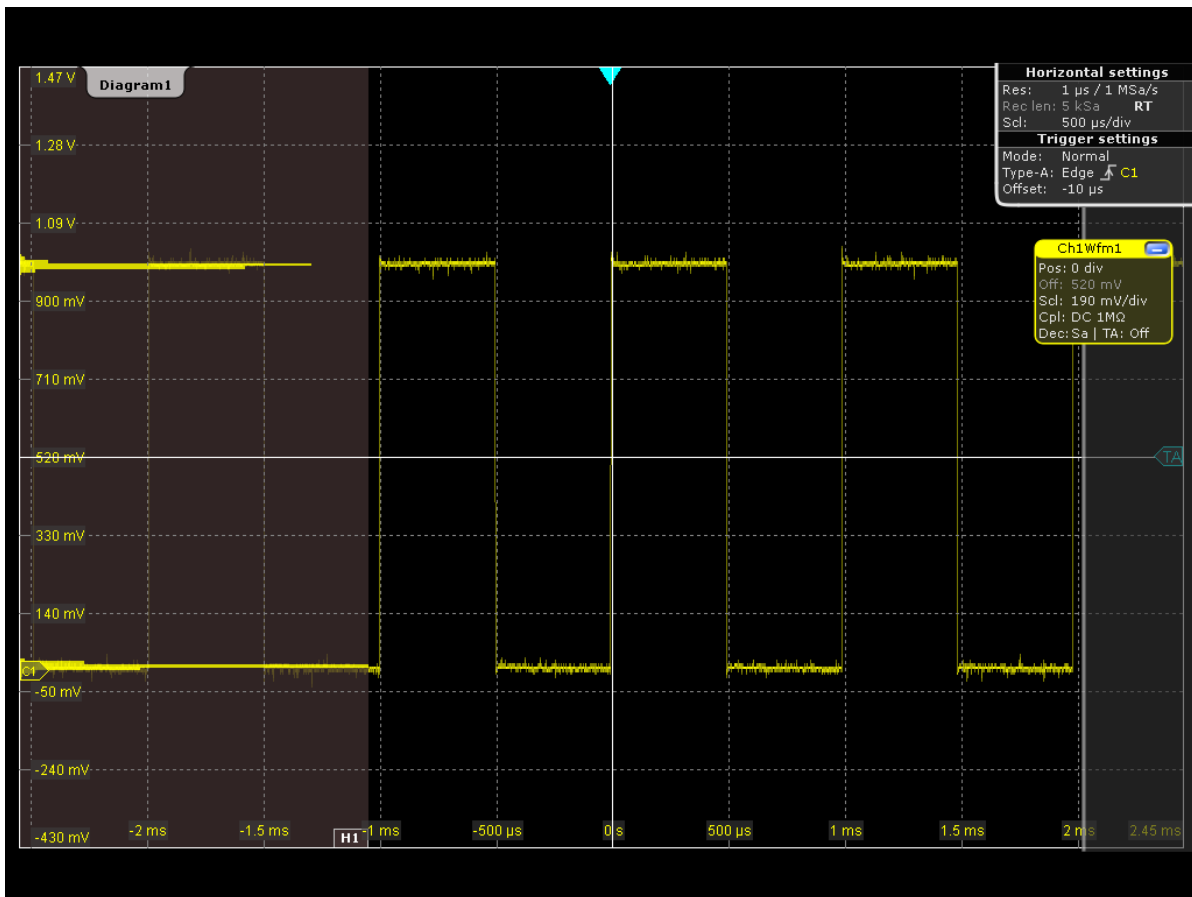
Histograms are useful to analyze the occurrence of measurement values statistically.

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




2. Tap the waveform for 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.



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



- Tap the histogram.
The waveform count for the histogram is displayed.
- 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.
- Under "Additional histogram measurements", tap "Activate..." and select the required results.
The histogram measurement results are displayed in a result box.



- To close the measurement results display, tap the "Delete" icon on the toolbar and then the results.



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.

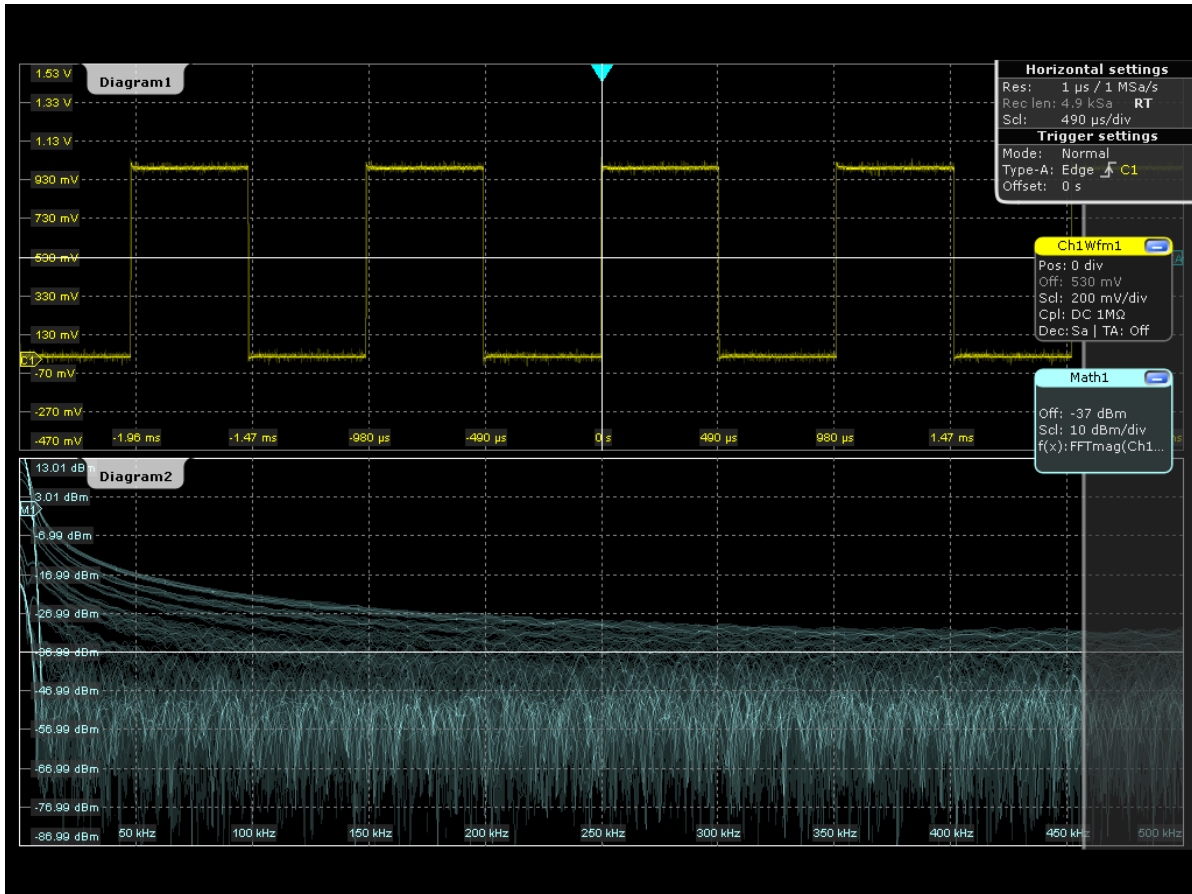
4.8 Performing an FFT Analysis

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.

- Restore the default signal channel settings by pressing the AUTOSSET key.
- Tap the "FFT" icon on the toolbar, then tap the waveform for channel 1.



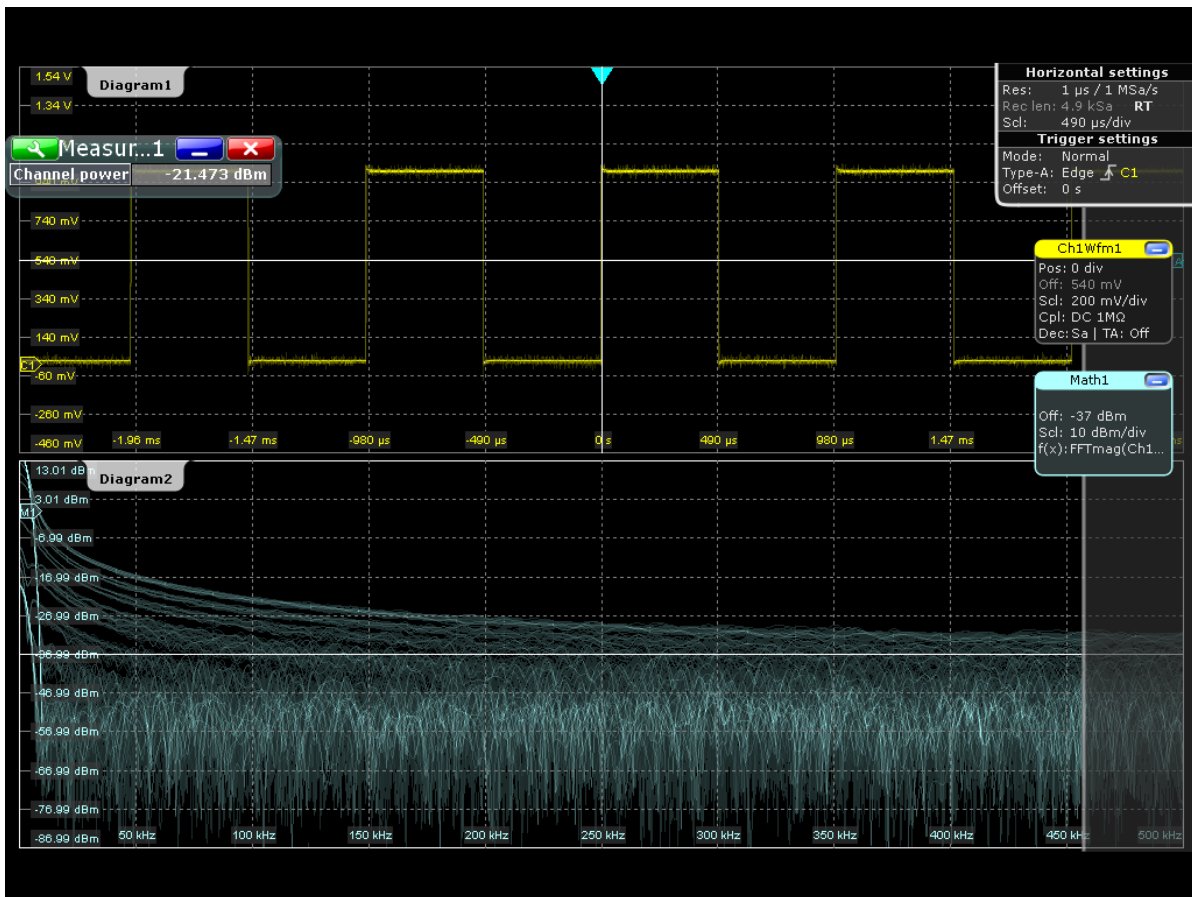
A math waveform is configured to use "Ch1Wfm1" as a source and the "Mag(FFT(x))" operator and is enabled. The FFT waveform is displayed in a new diagram.



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



- Tap the FFT waveform.
The spectrum measurement results are displayed in a result box.



- To remove the FFT results, tap the "Delete" icon and then the math icon in the signal bar.



4.9 Performing Mathematical Calculations

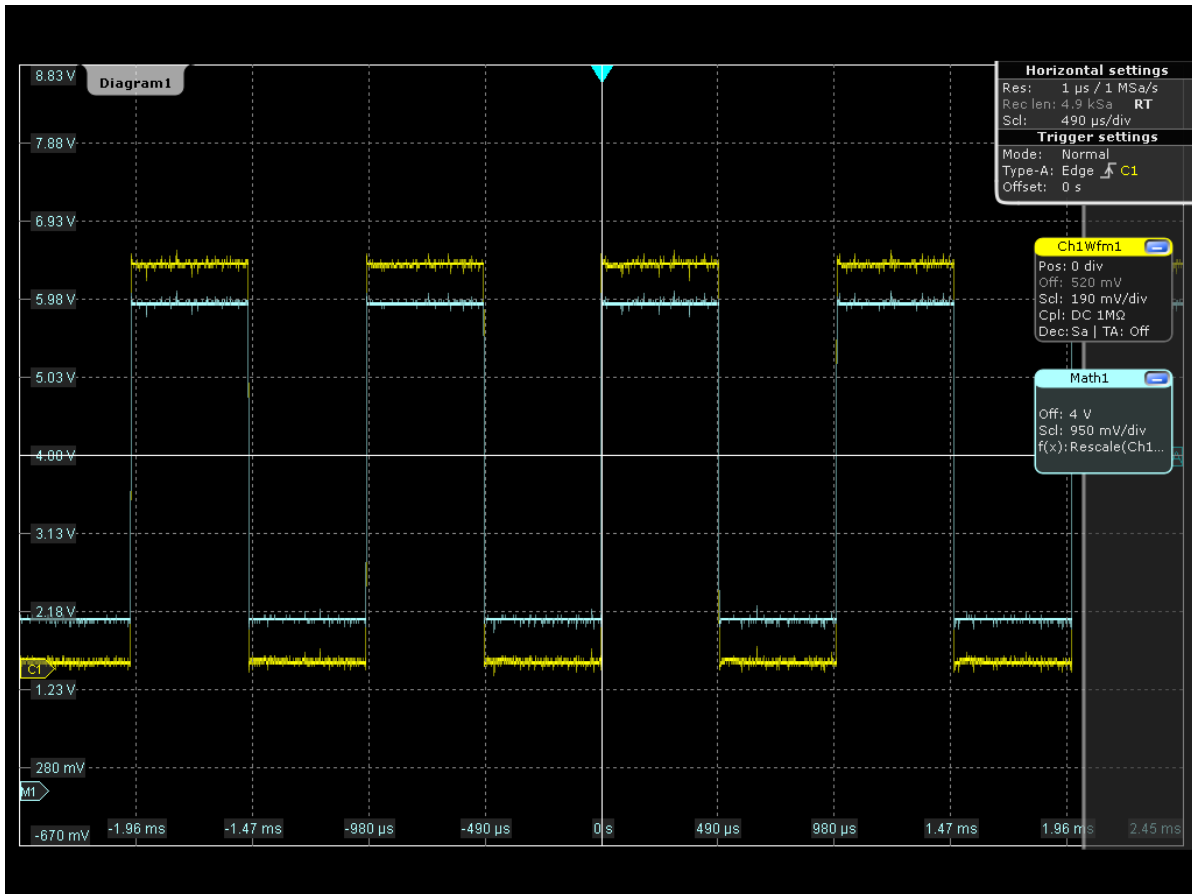
In addition to the measured waveforms, you can display calculated data to compare the current measurement result with.

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

- Press MATH to display the "Mathematics" menu.
- In the "Setup" tab, select the "Optimized" tab.
- Tap the "Source1" icon and select *Ch1Wfm1*.
- Tap the "Operator" icon and select *Rescale ax+b*.
- Under "a", enter the vertical scaling factor, e.g. 4.

6. Under "b", enter the vertical position offset, e.g. 2.
7. Press "Enable" to display the first math waveform.

The original and the rescaled waveforms are displayed.



8. To remove the math waveform, tap the "Delete" icon and then the math icon in the signal bar.



4.10 Performing a Mask Test

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

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



2. Tap the corner points of the first mask segment on the touch screen. 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.
3. To define the further mask test settings, press the MASKS key on the front panel (in the ANALYZE area).

MaskTest1

Units

Horizontal unit: s Vertical unit: V

Mask segments

Segment	State	Region
1	<input checked="" type="checkbox"/>	Inner
2	<input checked="" type="checkbox"/>	Upper
3	<input checked="" type="checkbox"/>	Lower
4	<input checked="" type="checkbox"/>	Inner

Definition of segment: 2

Point	X	Y
1	-470 μ s	100 mV
2	-20 μ s	100 mV
3	-470 μ s	960 mV
4	-20 μ s	960 mV

Rescale

Offset X: 0 s

Factor X: -2


Offset Y: 0 V

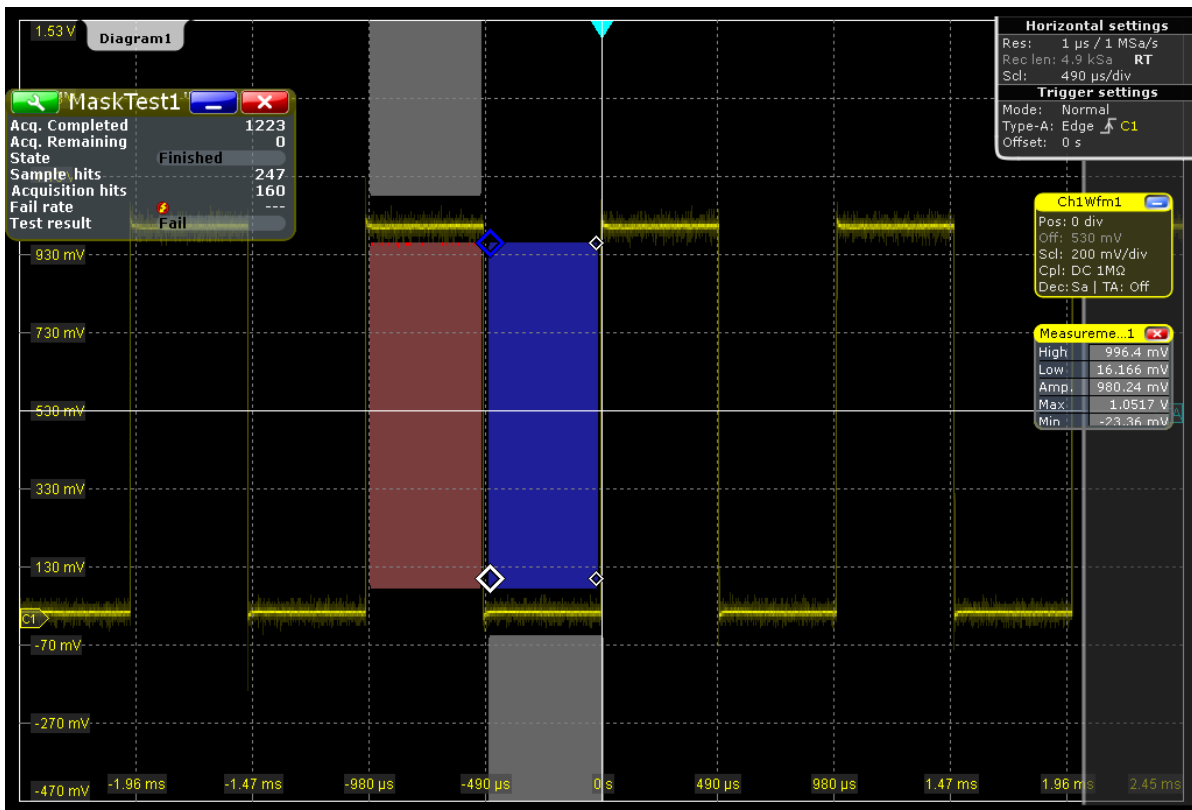
Factor Y: 1

Buttons: Insert, Append, Remove, Recalculate

4. 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.
5. 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 and define a mask line.
 - d) Enter the x and y-values to define a line beneath which the values of the positive pulse should remain.
6. Insert another mask segment graphically beneath the negative pulse:
 - a) Close the dialog box and tap one of the mask segments on the touch screen. The blue color indicates that the segment is selected.
 - b) Tap the "Masks" icon on the toolbar.



- c) Tap the first point of a line above which the values of the negative pulse should remain.
 - d) Double-tap the second point of this line.
 - e) Tap outside the mask to deselect the mask segments.
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 "Enable test".
 11. Select the "Event Action / Reset" tab.
 12. For the "Stop acquisition" action select *On violation*. If the signal enters the mask area, the acquisition will be stopped.



The results of the mask test are indicated in a mask test box during the next acquisition. Mask hits are also indicated as red points in the mask segment in the diagram. Close the mask test box by tapping the red cross in the label.

4.11 Performing a Search

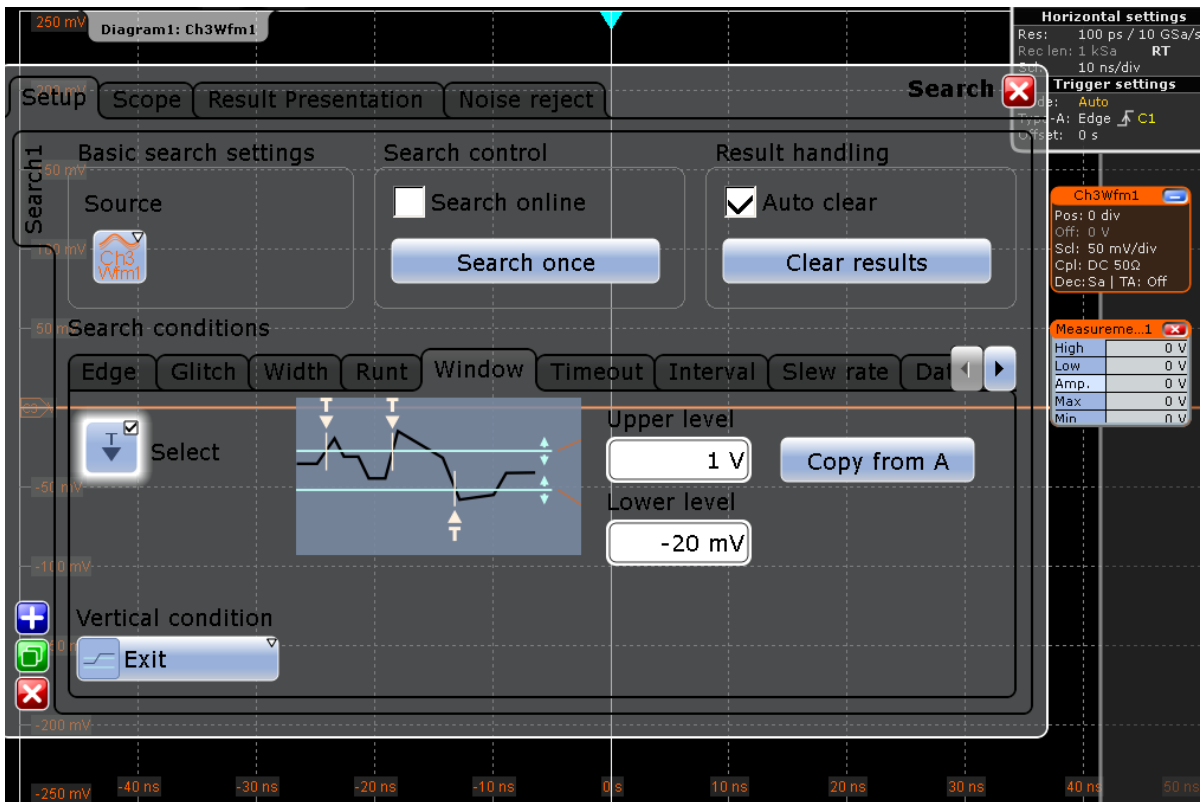
In the following search, you will detect positive and negative overshoots, i.e. values that exceed the high or low levels. To determine the search conditions you can use the results of the measurement example described in [chapter 4.7.2, "Performing an Amplitude vs. Time Measurement"](#), on page 45

To configure a search for overshoots

1. Press the SEARCH key on the front panel (ANALYZE area) to open the "Search" dialog box.
2. Tap the "Add" icon to create a new tab for the new search configuration.

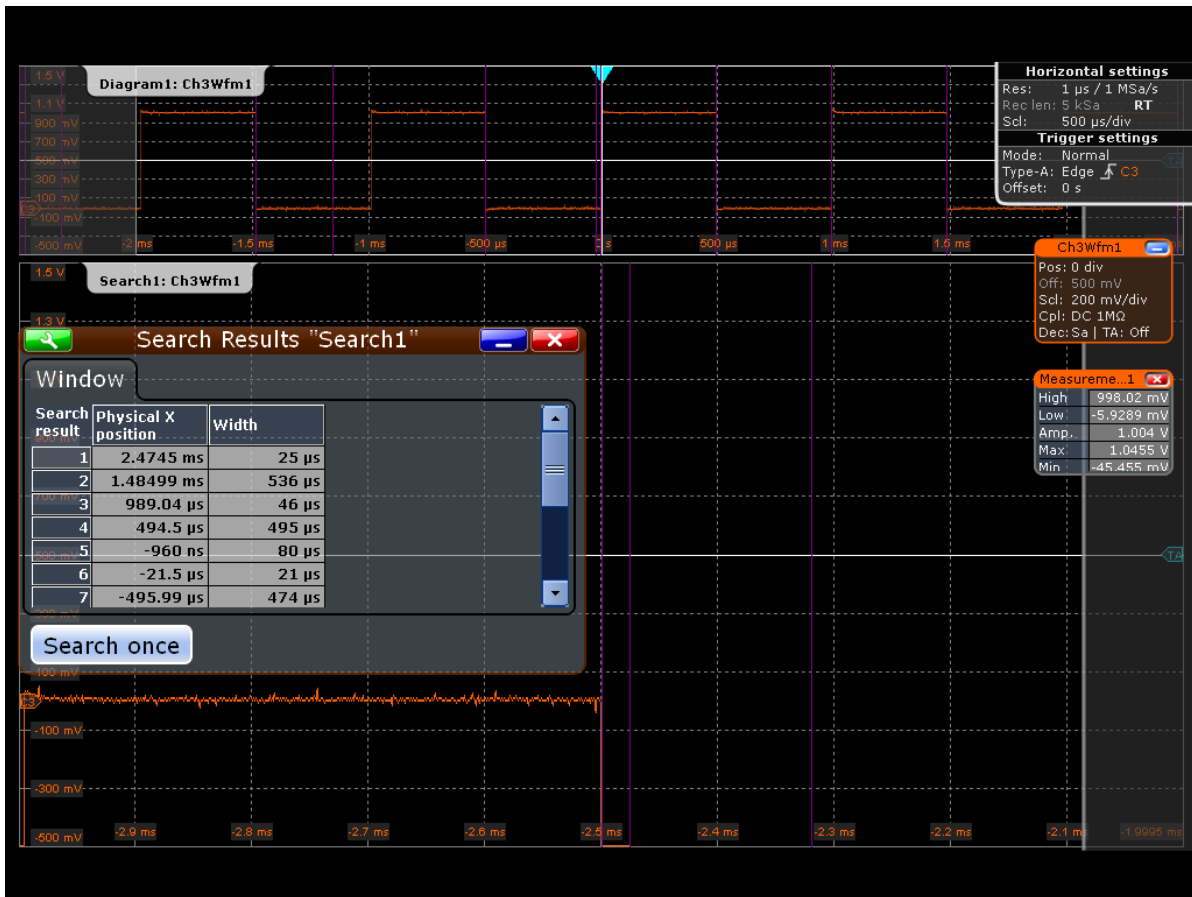


3. Enter a name for the search configuration using the displayed on-screen keyboard.
4. Select channel 1 as the "Source".
5. Define the search conditions for the search:
 - a) Select the "Window" tab.
 - b) As the "Upper level", enter the result for the "High" level measurement.
 - c) As the "Lower level", enter the result for the "Low" level measurement.
 - d) As the "Range", select *Exit* to find values that are outside the range defined by the high and low levels.
 - e) Tap "Select" to include the search condition in the search.



6. Tap "Clear results".
7. Select "Search once" to perform the search on the acquired data.
8. On the "Results presentation" tab, select "Show search zoom windows" to show a zoom window for the for the currently selected search result.

The detected overshoots are listed in the search result table and the last result that was found is displayed in the search zoom window. The time values for which a result was found are indicated by vertical lines.



4.12 Printing and Saving Results

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. Press the PRINT key on the front panel (in the SETUP area on the left) to display the "Print" dialog box.
2. Tap the printer selection box to select an installed printer.
3. Tap the "Color" selection box and select *Black and white*.
4. Enable the "Inverse color" option.
5. To add a textual comment or highlight a special area of the waveform, tap the "Edit image" button.

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 below.

6. Tap the "Print" button to print the image to the selected printer.
7. Tap the "Save" button to save the image to a file.

The image of the current display is saved to the `C:\Documents and Settings\All Users\Documents\Rohde-Schwarz\RTO\` directory. The saved file name is `RTOScreenshot_<date>_<index>_<time>.png`.

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 device settings in order to repeat or restore previous measurements.

In the following example you will save the waveform data to a file.

In the second example you will save the device settings of the current measurement, then reset the device and load the device settings again to repeat the initial measurement.

Example 1: Saving waveform data

1. Press the FILE key on the front panel (in the SETUP area on the left).
2. Select the "Save/Recall" tab.
3. Select the "Waveforms" tab.
4. Under "Save a waveform as a reference waveform to file", tap the "Save As" button to open the file selection dialog box.
5. Select the storage directory `C:\Documents and Settings\All Users\Documents\Rohde-Schwarz\RTO\Waveforms` in the file selection dialog box.
6. Tap the keyboard icon and enter *Meas1_Results* in the online keyboard.



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

The waveform data is saved to the file `C:\Documents and Settings\All Users\Documents\Rohde-Schwarz\RTO\Waveforms\Meas1_Results.dfl`.

Example 2: 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:\Documents and Settings\All Users\Documents\Rohde-Schwarz\RTO\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. Press the FILE key on the front panel.
8. Select the "Save/Recall" tab.
9. Select the "Settings" tab to load instrument settings.
10. Tap "Open" and select `C:\Documents and Settings\All Users\Documents\Rohde-Schwarz\RTO\Settings_Meas1.dfl` from the file selection dialog box.
11. Tap "Select".

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

5 Operating the Instrument

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

- **Manual operation:**
Use the touch screen, hard 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".
- **Remote operation from a computer:**
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.
The Remote Desktop Connection of the Windows operating system is not supported for instrument control. It can be used for file transfer from and to the instrument.

5.1 Means of Manual Interaction

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

- **Touch screen:**
This 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 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 touch screen. 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 touch screen and navigation keys is described in detail in the following sections.

5.2 Understanding Display Information

The touch screen display of the instrument shows not only waveforms, but also information, measurement results and everything 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, "Touch Screen Display"](#), on page 17.

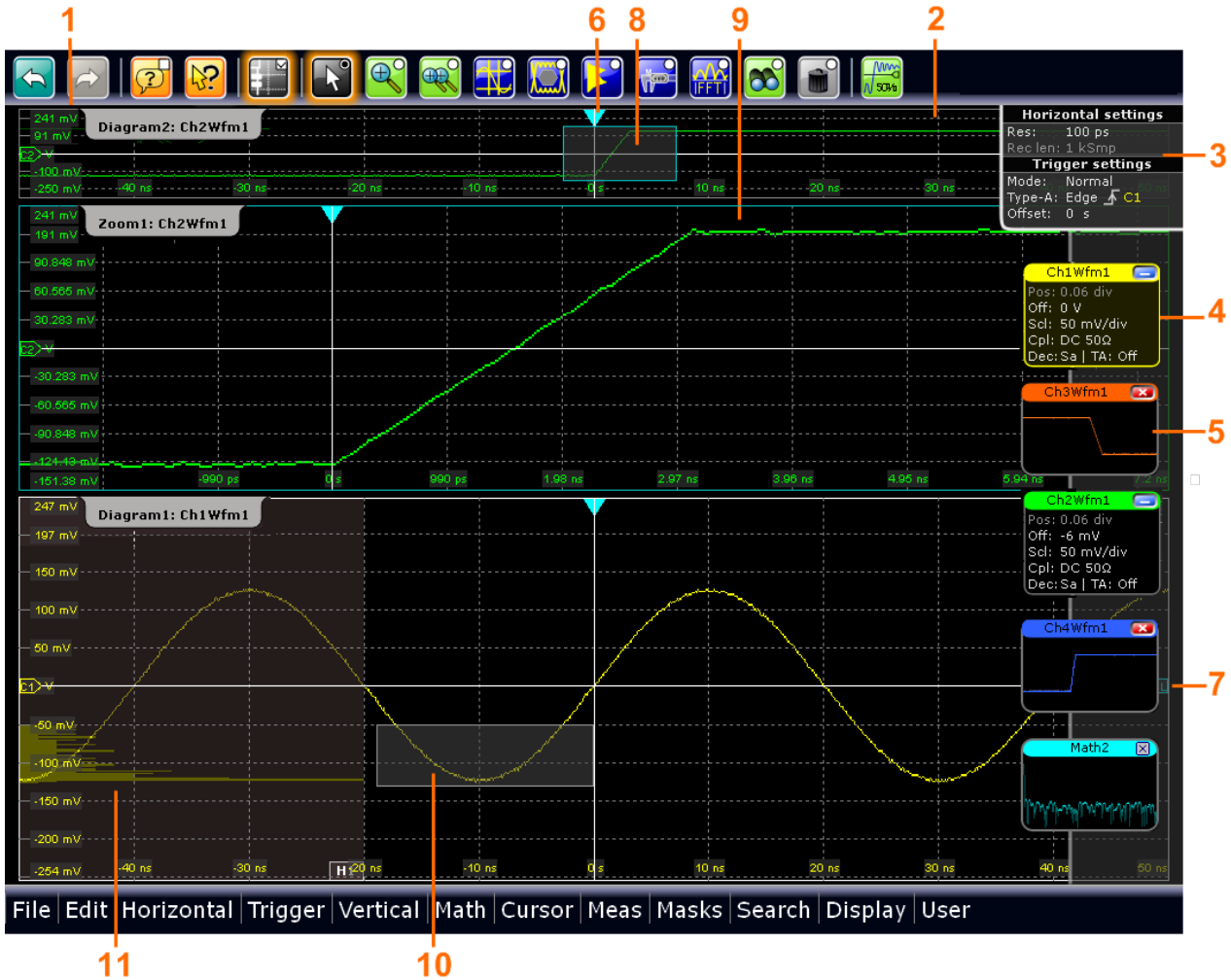


Fig. 5-1: Display information

- 1 = Diagram
- 2 = Grid
- 3 = Horizontal and trigger label
- 4 = Signal icon with label
- 5 = Signal icon with minimized live signal view
- 6 = Trigger position
- 7 = Trigger level
- 8 = Zoom area
- 9 = Zoom diagram
- 10 = Histogram area
- 11 = Histogram label

Diagrams

A diagram shows one or more waveforms: channel waveforms, 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 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"](#) on page 64.

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 double-tap a label, the relevant dialog box opens with the tab used at last.

Signal icons

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. The icon can also display a signal view, that is the minimized live waveform.

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.

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, several 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.

5.3 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 by means of 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 is build from the voltage values of two source waveforms.

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.
- 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 can have several tabs showing different waveforms. 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
- Minimized: The waveform is shown as real-time signal view in its signal icon

- **Selected:** One of the active waveforms that has the focus. All waveform-specific settings are applied to the selected waveform. The vertical POSITION and SCALE knobs and the SIGNAL OFF key are illuminated with the color of the selected waveform. If the selected waveform is displayed in a diagram with other waveforms, it appears "on top" in the diagram, and the grid labels have 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.

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.

- ▶ To switch a channel waveform on, press the channel button. Alternatively, in the dialog box, tap the "Enable" icon of the waveform.



The waveform is now active and appears in the diagram.

To minimize a waveform

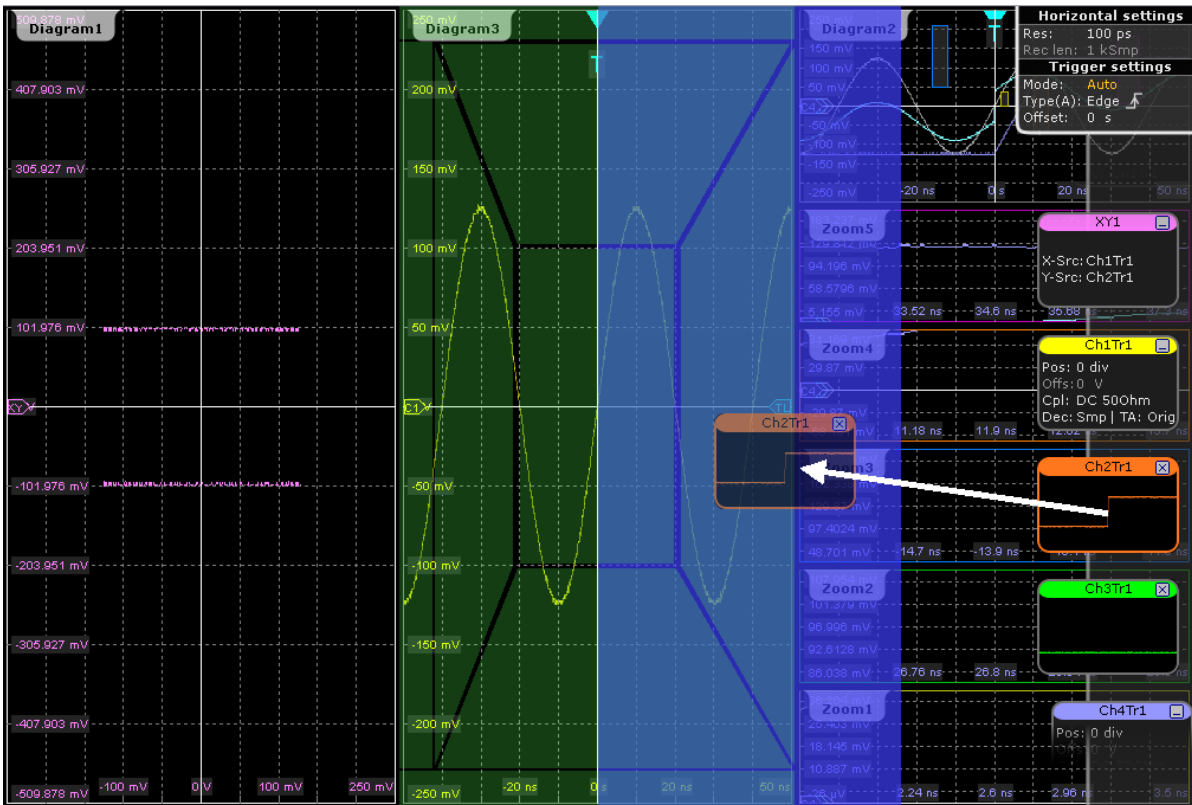
- ▶ Tap the signal label of the waveform in the signal bar. The waveform disappears from the diagram and the minimized signal view is shown in the signal icon.

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

To arrange a waveform

You can arrange active and minimized waveforms in one of the existing diagrams, in a separate new tab in the diagram or in a new diagram.

1. Drag the waveform from 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.



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.

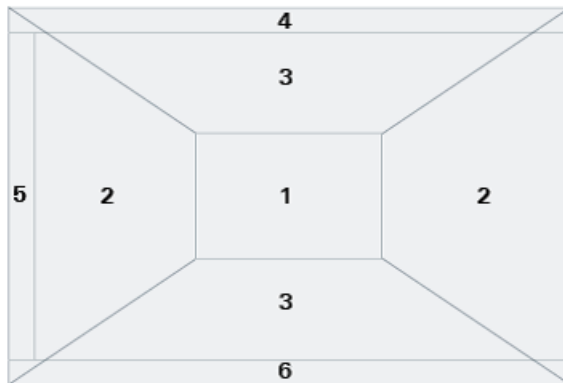


Fig. 5-2: SmartGrid positions

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

To switch a waveform off

- ▶ Do one of the following:
 - 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 waveform is switched off.


5.4 Displaying Results

The results of automatic or cursor measurements, mask tests, and searches are displayed immediately in a result box. By default, the result box is displayed in front of the other diagrams. 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.

To configure the result box display

1. Tap the "Minimize" icon in the initial result box.
The result box is closed, and a result icon with the result values appears on the signal bar.
2. Drag the result icon from the signal bar to the diagram area and drop it in the dedicated target area, as you would do with a waveform.
The results are displayed in a table in the specified area of the screen.
3. To switch the result table back to the signal bar, tap the table tab and drag it a little.

To open the setup dialog box

- ▶ In the result box, tap the  icon.
The dialog box with corresponding settings opens.

5.5 Using the Signal bar

The signal bar can hold a large number of signal and result icons. Signal icons represent the waveforms, while result icons are minimized result boxes showing measurement and search results. If the signal bar contains more than five icons, not all icons are visible on the display.

To scroll the signal bar

- ▶ Touch the signal bar between the icons and move it up or down until the required icon appears.

If you need the complete screen to see the diagrams, you can switch off the signal bar completely or fade it automatically.

To switch the signal bar on and off

- ▶ 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 and trigger label on the top and drag the signal bar to the opposite side of the screen.

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 is not hidden 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 opacity": Opacity of the hidden signal bar on a scale from 30% (high transparency) to 80% (lower transparency and better visibility)
 - 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's 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.

5.6 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.

To use toolbar functions

1. Tap the icon to activate the function.
2. For analyzing functions, tap the required waveform, or drag a rectangle on the diagram to mark the area to be analyzed.



You can remove redundant icons and the date/time display from the toolbar with "Display" menu > "Toolbar".



The following description of the toolbar functions provides more details.



UNDO

Undoes the last setting actions step by step. Some actions cannot be revoked: locking the touch screen with T-SCREEN LOCK, changing the trigger MODE (auto/normal), save and recall, and finishing the mask definition with the "Select" icon.



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 left corner of the tooltip. See also: [chapter 5.9, "Getting Information and Help"](#), on page 73.



Show signal bar

Shows and hides the signal bar. The look and the behavior of the signal bar can be configured, see [chapter 5.5, "Using the Signal bar"](#), on page 66.



Select

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

**Hardware zoom**

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.

**Zoom**

Displays a magnified section of the diagram in an additional zoom diagram.

Tap the icon and then 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.

**Coupled zoom**

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.

**Cursor**


Displays vertical and horizontal cursors and performs a cursor measurement.

Tap the icon and then tap the waveform where you want to set the cursors, or draw a rectangle in the diagram to position the cursor lines. The cursor lines appear and the "Cursor Results" box opens. You can adjust the cursor type and position in the result box, or by dragging the cursor lines 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**

Enables the Histogram mode.


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

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

**Measurement**

Starts the *default* measurement for the selected waveform and displays the "Measurement" result box.

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.

To recall a previously configured measurement, do not use the "Measurement" icon, but rather the "Meas > Setup" menu item.



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 the waveform to be transformed.

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



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 the waveform to be searched.



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, diagram, or waveform to be deleted.




Find level

Sets the trigger level for the A event to 50%.

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 touch screen. This section provides an overview of the accessing methods.

To open a dialog box

- ▶ Perform any 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.
 - Touch and hold the horizontal or trigger label to open the "Horizontal" or "Trigger" dialog box, respectively.

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 FIELD LEFT and FIELD RIGHT 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 data input box appears with the parameter name and current value.

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

Using rotary knobs

1. Turn the knob to change the value.
2. Tap the "Steps" icon to toggle the increment.
3. Tap the "Auto" icon to set the parameter to the autoset value.

**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:
 - a) Tap the "Inc" button to increase the displayed value in fixed steps, or "Dec" to decrease the value. To toggle between small steps and large steps, tap the "Steps" icon.



Tap "Auto" to use the default value, if available.

Tap "Cur" to use the currently defined value, that is, the value that was used before the keypad was displayed.

- b) Tap the arrow buttons to move the cursor left or right.
Tap "Bksp" to delete the last character before the cursor.
 - c) Tap ± to change the sign of the value.
3. Tap the unit button to complete the entry.

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 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:

- Tooltips give a short description of the parameter.
- The item help provides complete information on a setting.
- The general help explains a dialog box, provides instructions, and general information.

To display tooltips and item 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 left corner of the tooltip.
The "Help" window opens. You can browse the help for further information.
Note: With touch screen, 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 off. 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.

Using the Help window

The Help window contains three tabs:

- "Contents" - contains a table of help contents
- "View" - contains a specific help topic
- "Index" - contains index entries to search for help topics

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 touch screen. Alternatively, you can also use the navigation keys on the front panel.

To search for a topic

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

1. Switch to the "Index" tab.
2. Tap 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 close the Help window

- ▶ Tap 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:

- [chapter 6.1, "Performing a Self-alignment"](#), on page 76
- [chapter 6.2, "Aligning the Touch Screen"](#), on page 76
- [chapter 6.3, "Adjusting Passive Probes"](#), on page 77

6.1 Performing a Self-alignment

When putting the instrument into operation for the first time, and when data from several input channels is displayed at the same time, it may be necessary to align the data vertically and horizontally in order to synchronize the time bases, amplitudes and positions. This is the case, for example, when strong temperature changes occur ($> 5^\circ$).

The self-alignment process includes a basic hardware check.



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.

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 Touch Screen

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

Alignment of the touch screen 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 blinking cross until it stops blinking.
Repeat this action for the crosses in the other corners.
5. Tap the RTO button in the task bar to display the instrument's user interface.

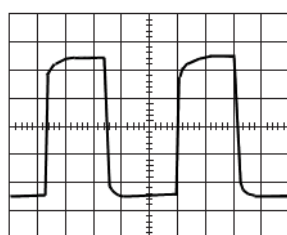
6.3 Adjusting Passive Probes

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.

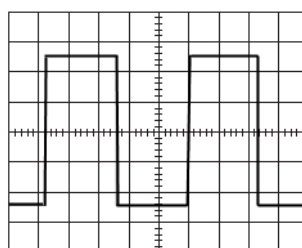
If you use other passive probes, the R&S RTO allows you to compensate it when it is connected to the instrument the first time. Compensation matches the probe cable capacitance to the oscilloscope input capacitance to assure good amplitude accuracy from DC to upper bandwidth limit frequencies. A poorly 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.

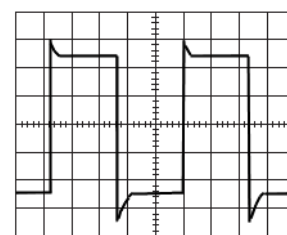
1. Connect the BNC connector of the probe to input CH1.
2. Connect the probe's ground connector to the right compensation pin, and the tip with the left pin.
3. Press AUTOSET.
A square wave appears on the display.
4. Adjust the compensation trimmer of the probe to optimum square wave response.
For details, refer to the documentation of your probe.



undercompensated



optimum



overcompensated

Index

A

AC Coupling	
trying out	37
Acquisition	
single, multiple	22
start	22
stop	22
trying out	32
ACQUISITION	20
Active waveform	63
Aligning	
input channels	76
Amplitude vs. time measurements	
minimizing results	45
trying out	45
Arranging waveforms	64
Auto-hide	
configure	67
AUTOSET	19
Auto trigger mode	21

B

Bench top operation	11
---------------------	----

C

Cable, USB	26
CD-ROM drive	15
Channel	
connector	27
offset	23
waveforms	63
Compensation, passive probes	77
Connectors	
front panel	26
rear panel	27
Coupled zoom	
quick access	69
Cursor	
quick access	69
CURSOR	23
Cursors	
minimizing results	45
trying out	44

D

Data entry	71
Data input field	17
Delete	70
Diagram area	17
Diagrams	62
Dialog box, usage	70
Display	
signal bar	66
trying out	33
DISPLAY	19
Display elements	
data input field	17
diagram area	17
menu bar	17
result box	17

signal bar	17
toolbar	17
Display information	61
DVI connector	29

E

EMI suppression	14
External monitor	29
External trigger connector	29

F

FFT	70
trying out	49
FILE	19
Find level	70

G

GBIP connector	29
Grid	62

H

Hardware zoom	69
Help	
open	73
search for topic	74
HELP	19
Histogram	
area	63
diagram	63
quick access	69
Histogram measurements	
trying out	47
Histograms	
configuring	47
defining	47
trying out	47
History	
trying out	43
HISTORY	25
Horizontal	
controls	20
display settings	62
HORIZONTAL	20

I

Information on display	61
Input	27
INTENSITY	19
Intensity of waveforms	19

K

Keyboard	
connecting	15
on-screen	71
usage	60
Keypad	71
Keys	
ACQUISITION	20

AUTOSET	19
CURSOR	23
DISPLAY	19
FILE	19
HELP	19
HISTORY	25
HORIZONTAL	20
LEVEL	21
MASKS	24
MATH	23
MEAS	24
MODE	19
MODE (trigger)	21
PRESET	19
PRINT	19
PROTOCOL	24
REDO	25
REF	22
RES / REC LEN	20
RUN CONT	22
RUN N× SINGLE	22
SEARCH	24
SETUP	19
SIGNAL OFF	23
SLOPE	21
SOURCE	21
T-SCREEN LOCK	19
TRIGGER	21
UNDO	25
USER	24
ZOOM	24
L	
LAN	
connector	28
LEVEL	21
Lock touch screen	19
M	
Markers	
example	41
Masks	
quick access	69
MASKS	24
Mask test	
trying out	52
MATH	23
Math waveforms	23, 63
trying out	51
MEAS	24
Measurement	
quick access	69
Memory stick	15
Minimized waveform	63
MODE	19
MODE (trigger)	21
Monitor	15, 29
Mouse	
connecting	15
usage	60
N	
Navigation	
controls	25
Normal trigger mode	21
Numeric data entry	71
O	
OCXO	29
Offset	
channel	23
trigger	20
trying out	37
Operation	
concepts	60
manual	60
P	
Position	
horizontal	20
vertical	23
Power	28
PRESET	19
PRINT	19
Printer	15
Printing	
trying out	57
Probe Compensation connectors	27
Probes	
passive, compensation	77
PROTOCOL	24
R	
Rackmounting	11
Record length	
rotary knob	20
Redo	68
REDO	25
REF	22
Reference point	20
Reference waveforms	22, 63
Remote control	60
Remote Desktop	60
Remote operation	60
RES / REC LEN	20
Resolution	
rotary knob	20
Result box	17
Results	
configuring display	66
Rotary knobs	
trying out	37
Run	22
RUN CONT	22
RUN N× SINGLE	22
S	
Saving	
trying out	57, 58
Scale	
horizontal, rotary knob	21
vertical, rotary knob	23
Scaling	
trying out	37
Screen resolution	29
Search	
quick access	70

trying out	55	mode	21
SEARCH	24	offset	20
Select	68	slope	21
Selected waveform	63	source	21
Self-alignment		TRIGGER	21
performing	76	Trigger settings	
results	76	display	62
Setup		U	
keys	18	Undo	
SETUP	19	toolbar	68
Shut down	13	UNDO	25
Signal bar	17	Unlock touch screen	19
adjusting	66	USB	
auto-hide	67	cable	26
hide and show	67	connecting	14
Signal icons	62	connector	26
Signal label	62	USER	24
SIGNAL OFF	23	V	
Signal view	62	Vertical	
SLOPE	21	controls	22
SmartGrid	64	VNC	60
SOURCE	21	W	
Spectrum measurements		Waveforms	
trying out	49	arrange	64
Start up	13	channel	63
Switch off		display intensity	19
instrument	13	math	63
waveform	66	minimize	64
Switch on		overview and usage	63
instrument	12	reference	63
waveform	64	states	63
T		XY	63
T-SCREEN LOCK	19	zoom	63
Temperature		X	
changes	76	XY-waveforms	63
Text entry	71	Z	
Toolbar	68	Zoom	
Coupled zoom	69	diagram	62
Cursor	69	on the touch screen	41
Delete	70	quick access	69
FFT	70	trying out	41
Find level	70	ZOOM	24
Hardware zoom	69	Zoom area	62
Histogram	69	Zoom waveforms	63
Masks	69		
Measurement	69		
Redo	68		
Search	70		
Select	68		
Show signal bar	68		
Show tooltips	68		
Undo	68		
Zoom	69		
Tooltips	68		
show	73		
Touch screen			
adjusting	76		
compared with mouse	60		
display overview	17		
lock, unlock	19		
Transparency	19		
Trigger			
controls	21		
external input	29		
level	21		