R&S®RTO2000
Digital Oscilloscope
Turn your signals into success

HD
16 bit

Multi
Domain

3 year warranty

ROHDE & SCHWARZ

R&S®RTO
Digital Oscilloscope
At a glance

R&S®RTO oscilloscopes combine excellent signal fidelity, up to 16-bit vertical resolution and high acquisition rate in a compact device format in the 600 MHz to 6 GHz class. They offer a fully integrated multi-domain test solution with frequency, protocol and logic analysis functions. The brilliant touchscreen makes the oscilloscopes very comfortable to use.

R&S®RTO oscilloscopes are optimized to perform precise measurements at a high input sensitivity and very low inherent noise. The unique high definition mode enables up to 16-bit resolution. With an acquisition rate of up to one million waveforms per second, the R&S®RTO oscilloscopes detect sporadic signal faults lightning fast.

R&S®RTO oscilloscopes are engineered for multi-domain challenges and facilitate debugging of systems with different signal types. The oscilloscopes enable simultaneous time, frequency, logic and protocol analysis and display the results referenced over time. For the first time, a special tool is available for these applications: a zone trigger that can be used in both the time domain and in the frequency domain.

R&S®RTO oscilloscopes are extremely easy to use. Gesture operation simplifies measurement tasks. You can even customize the waveform display thanks to R&S®SmartGrid technology. The app cockpit provides fast access to all available applications.
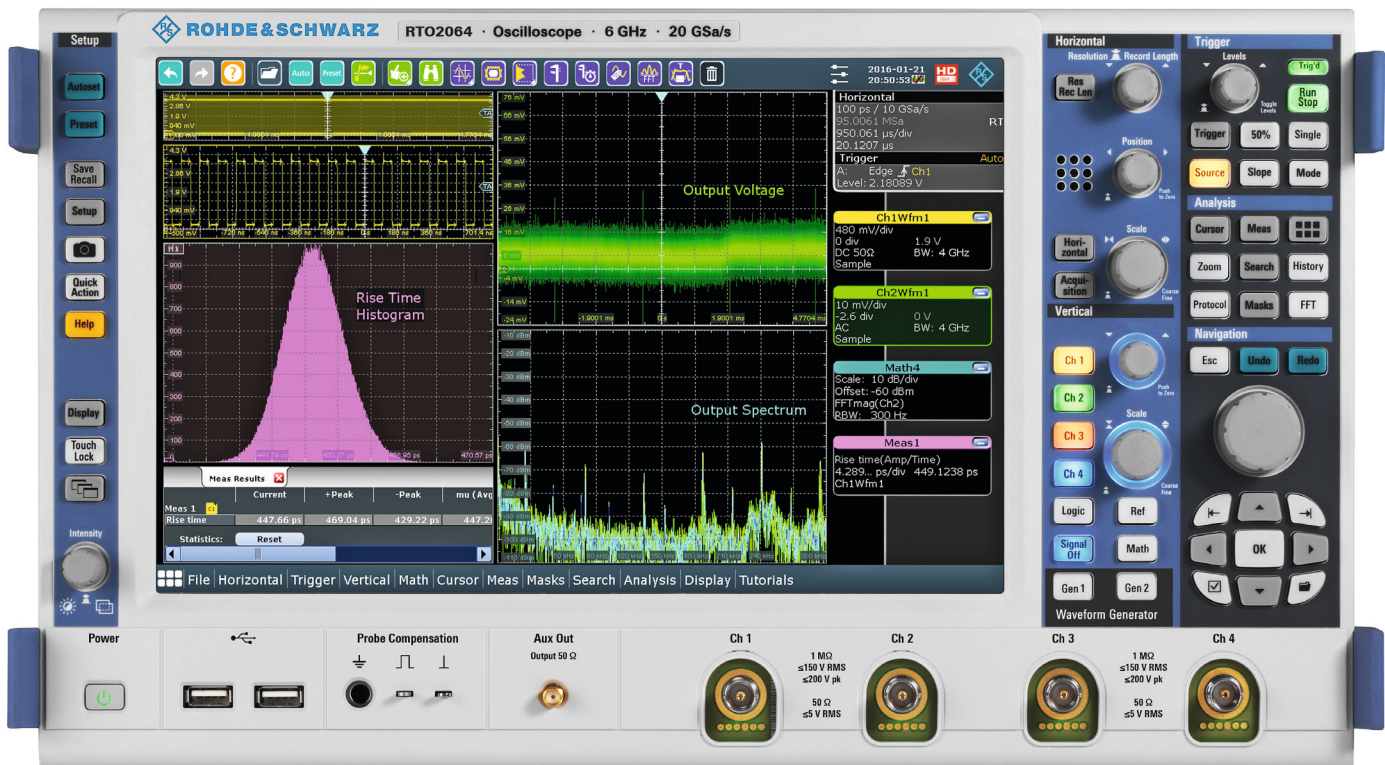
R&S®RTO Digital Oscilloscope
Benefits and key features

Best oscilloscope performance
▪ Precise measurements due to very low noise level
▪ Up to 16-bit vertical resolution
▪ Trigger on any signal detail you can see
▪ Quickly find signal faults with 1 million waveforms/s
▪ Integrated spectrum analysis
▷ page 4

Widest range of capabilities
▪ Industry-leading 2 Gsample deep memory
▪ First zone trigger in time and frequency domain
▪ Analyze previous acquisitions – always available in history buffer
▪ Deep toolset for signal analysis
▷ page 7

Advanced user interface
▪ High-resolution capacitive touchscreen with gesture support
▪ Easily customizable waveform display with R&S®SmartGrid technology
▪ Fast access to important tools
▪ Clear orientation thanks to color coding
▪ App cockpit to quickly set up analysis functions
▷ page 10

Engineered for power measurements
▷ page 16

Engineered for multi-domain challenges
▪ MSO analysis: unrivaled in its class
▪ High definition: see more with up to 16-bit resolution
▪ Spectrum analysis
▪ EMI debugging
▪ Signal analysis
▪ Integrated arbitrary waveform generator
▪ Serial protocols: easy triggering and decoding
▪ Automatic compliance tests
▪ Signal integrity measurement with jitter analysis
▷ page 19

Powerful probes
▷ page 39

Extensive range of accessories
▷ page 40

Models					
Base unit	Channels	Sampling rate	Acquisition memory	Acquisition rate	Mixed signal analysis (MSO)
R&S®RTO2064 (6 GHz bandwidth) [1]	4	20 Gsample/s	50 Msample per channel, max. 2 Gsample	1 million wave-forms per second	400 MHz bandwidth, 5 Gsample/s sampling rate, 200 Msample memory depth
R&S®RTO2044 (4 GHz bandwidth)	4	20 Gsample/s			
R&S®RTO2034 (3 GHz bandwidth)	4	10 Gsample/s			
R&S®RTO2032 (3 GHz bandwidth)	2				
R&S®RTO2024 (2 GHz bandwidth)	4				
R&S®RTO2022 (2 GHz bandwidth)	2				
R&S®RTO2014 (1 GHz bandwidth)	4				
R&S®RTO2012 (1 GHz bandwidth)	2				
R&S®RTO2004 (600 MHz bandwidth)	4				
R&S®RTO2002 (600 MHz bandwidth)	2				

[1] 6 GHz on 2 channels, 4 GHz on 4 channels.

Best oscilloscope performance

ı **Precise measurements due to very low noise level**
ı **Up to 16-bit vertical resolution**
ı **Trigger on any signal detail you can see**
ı **Quickly find signal faults with 1 million waveforms/s**
ı **Integrated spectrum analysis**

Precise measurements due to very low noise level

Minimizing noise was a key goal when designing the R&S®RTO. All aspects were considered, from balanced BNC-compatible inputs with 18 GHz bandwidth to extremely low-inherent-noise frontends to high-precision A/D converters. The result: precise measurements even at the smallest vertical resolutions.

Oscilloscope measurement range and bandwidth	RMS noise floor at typ. 50 Ω	RMS noise floor at typ. 50 Ω in % of measurement range
10 mV measurement range (1 mV/div), 1 GHz bandwidth	100 µV	1%
100 mV measurement range (10 mV/div), 1 GHz bandwidth	200 µV	0.2%
1 V measurement range (100 mV/div), 4 GHz bandwidth	3.6 mV	0.36%
1 V measurement range (100 mV/div), 6 GHz bandwidth	3.7 mV	0.37%

Up to 16-bit vertical resolution

The low-noise frontend and 10 GHz single-core A/D converter are the foundation for the extraordinarily high measurement accuracy and dynamic range of the R&S®RTO oscilloscopes. The high definition mode (HD mode) activates configurable lowpass filtering of the signal after the A/D converter, increasing the vertical resolution to up to 16 bit. Since filtering reduces quantizing noise, signal details become visible.
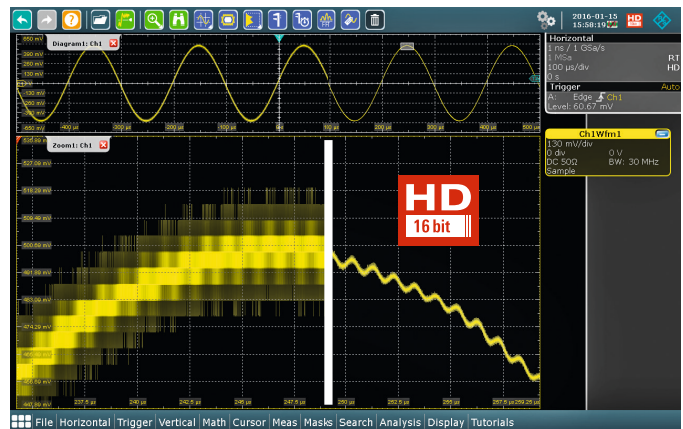

Trigger on any signal detail you can see

The unique digital trigger system from Rohde & Schwarz uses the sampling points of the A/D converter in the acquisition path so that the trigger system's input data is identical to the displayed signal. This results in minimal trigger jitter without postprocessing correction as well as high sensitivity that can be extended up to 16 bit in HD mode. Now you can reliably isolate even the smallest signals.


Accurate width trigger on a 50 ps overshoot

Quickly find signal faults with 1 million waveforms/s

R&S®RTO oscilloscopes display up to 1 million waveforms/s. To make this possible, Rohde & Schwarz developed an ASIC with optimized signal processing. R&S®RTO oscilloscopes enable you to quickly and reliably detect sporadic signal faults. A high acquisition rate is even available when histograms, masks or cursor measurements are active.
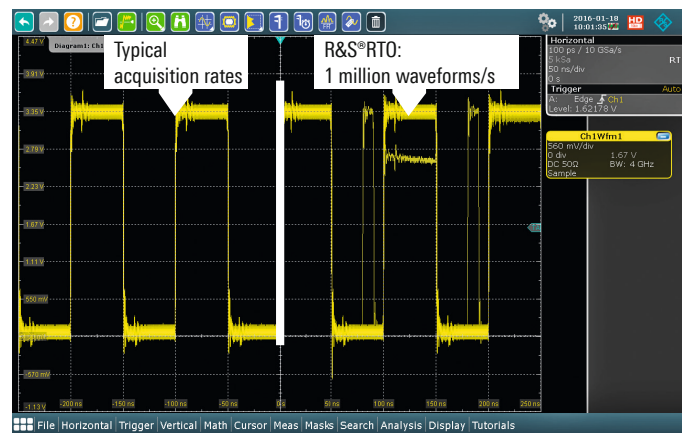

Integrated spectrum analysis

Frequency analysis is easy. Simply set the center frequency, span and resolution bandwidth on the R&S®RTO oscilloscopes for up to four analog signals – just like on a spectrum analyzer. Thanks to many years of experience in RF development, the R&S®RTO oscilloscopes offer an outstanding dynamic range. The FFT-based spectrum analyzer is ultrafast, making it ideal for capturing sporadic disturbance signals. For debugging, R&S®RTO oscilloscopes simultaneously display the spectrum and the associated signal path and correlate events. The spectrogram mode, different detectors (such as max. hold) and mask tests offer further analysis capabilities.
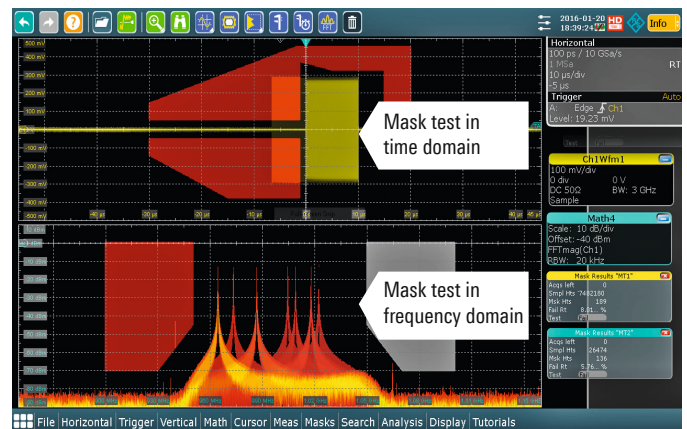
## Flat frequency response for accurate measurement results

The flat frequency response ensures accurate signal acquisition over the R&S®RTO oscilloscope's entire specified bandwidth.

Measured frequency response of the R&S®RTO2064
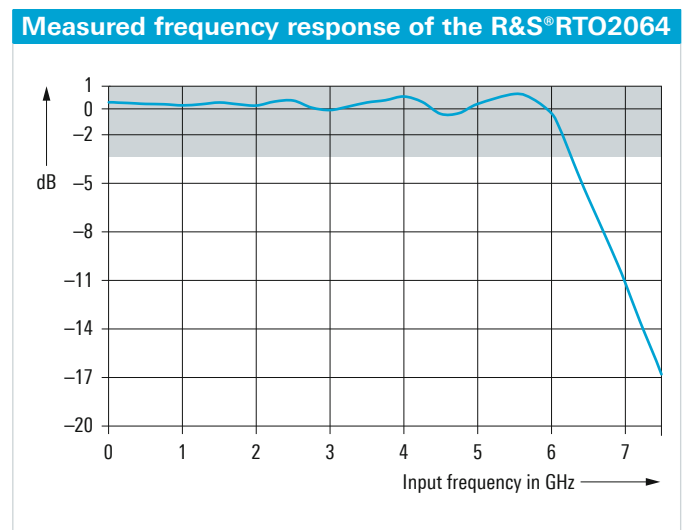
Low crosstalk even with high-frequency signals

The excellent channel-to-channel isolation in R&S®RTO oscilloscopes ensures that the measurement signal from one channel has the least possible influence on neighboring channels' signals. Their characteristic of > 60 dB up to 2 GHz is outstanding.

Excellent shielding to ensure low crosstalk even with high-frequency signals.
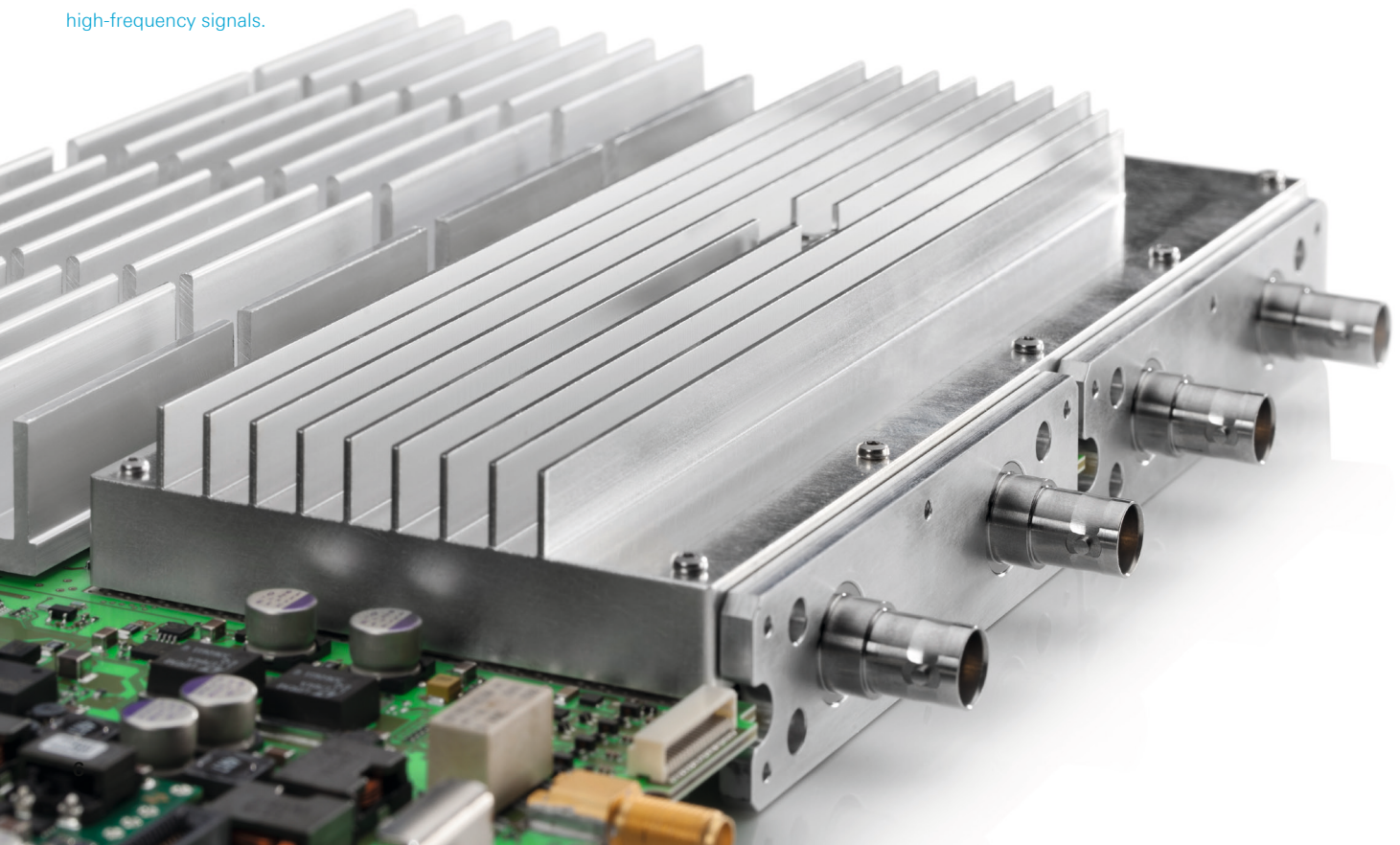
Widest range of capabilities

ı **Industry-leading 2 Gsample deep memory**
ı **First zone trigger in time and frequency domain**
ı **Analyze previous acquisitions – always available in history buffer**
ı **Deep toolset for signal analysis**

Industry-leading 2 Gsample deep memory

In the basic configuration, R&S®RTO oscilloscopes offer 50 Msample acquisition memory per channel. Applications such as seamless acquisition of long pulse or protocol sequences often require even deeper memory. The R&S®RTO oscilloscopes' acquisition memory can be extended up to 2 Gsample. Signal processing in the ASIC ensures a smooth workflow even with deep memory.

R&S®RTO versus conventional oscilloscopes

Record length for 4 channels

- 1 ksample — **4000 times faster**
- 100 ksample — **100 times faster**
- 1 Msample — **50 times faster**
- 10 Msample — **50 times faster**

Acquisition rate in waveforms/s →

■ R&S®RTO   ☐ Typical oscilloscope

R&S®RTO oscilloscopes enable smooth work, even with deep memory.

First zone trigger in time and frequency domain

The R&S®RTO oscilloscopes' zone trigger lets you graphically separate events. Define up to eight zones of any shape and logically combine them over multiple channels or by using math functions. Depending on how the zones are defined, a trigger signal is activated when a signal either intersects or does not intersect the zone. This makes it possible to separate read/write sequences from the memory interfaces in the time domain.


Analyze previous acquisitions – always available in history buffer

The R&S®RTO oscilloscopes' history function ensures that previous waveforms stored in memory can always be accessed. A trigger timestamp allows time correlation. You can view all saved signals and analyze them with tools such as zoom, measurement, math and spectrum analysis functions.
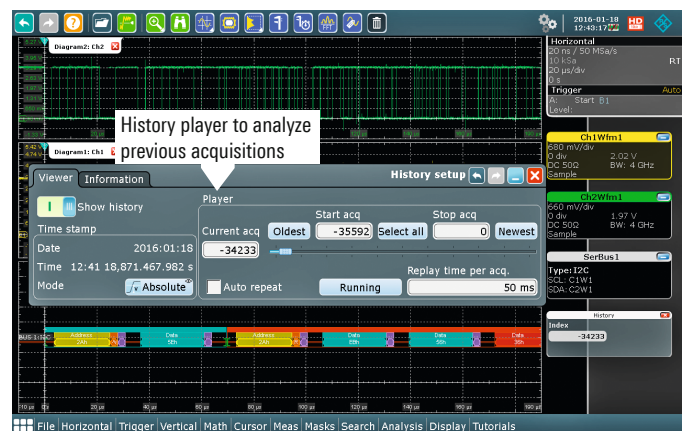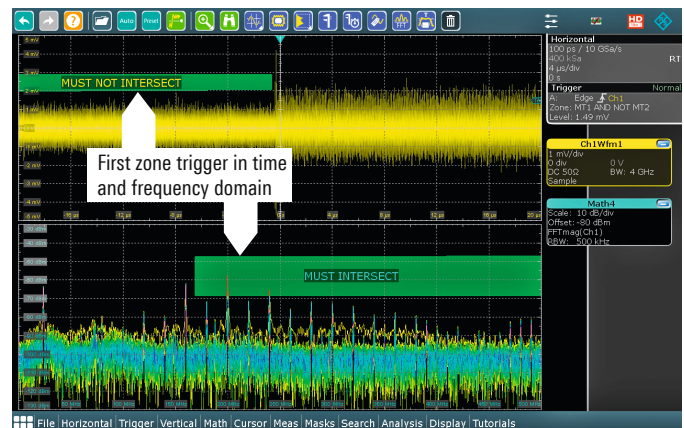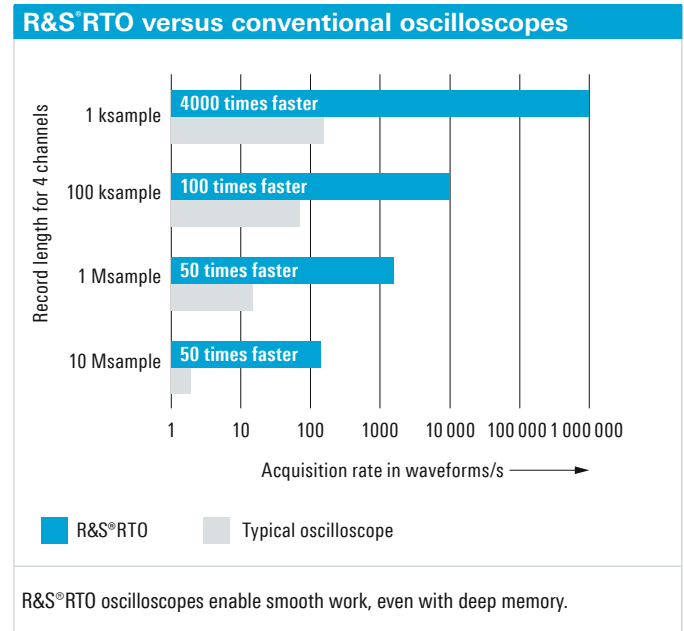
Deep toolset for signal analysis

R&S®RTO oscilloscopes offer over 90 measurement functions. The functions are organized by type into amplitude and time measurements, jitter, eye, histogram and spectral measurements. Statistics, histograms, and trend and track functions facilitate detailed analysis of the measurement results. The measurement results can also be used in math functions.
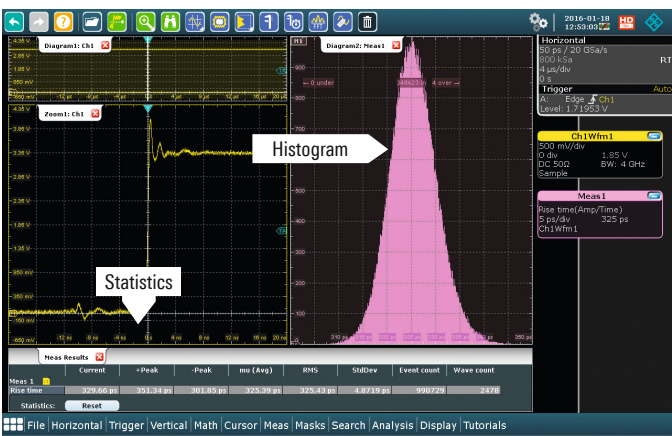
Available signal analysis options	
Statistics	display of average value, minimum/maximum value and standard deviation
Histogram	graphic display of events as histogram; definition of measurement range and resolution for the histogram (manual or automatic)
Trend	long-term trend function for analyzing slowly developing variations in measurement results (easy identification of thermal dependencies within measurement results)
Track	analysis of rapidly changing measurement results, e.g. periods; display of results over the entire acquisition period
Gating	restriction of the measurement range to a specific signal range (manually defined or linked to existing cursor or zoom ranges)
Reference lines	definition of reference lines (manual, automatic or averaged); optional display in the waveform
Waveform	graphic display of the results on the waveform, e.g. for documentation purposes
Multiple measurements	definition of the maximum number of measurements per waveform

Search and navigation: find faults fast

Comprehensive search functions simplify the analysis of long signal sequences. Search for waveforms based on different criteria, such as signal fault, signal pattern and protocol contents. Search on analog or digital channels, on reference or math waveforms and on serial, protocol-based buses as needed for your specific application. All detected events are shown in a table with timestamps. Examine the individual events in a zoom window and navigate between events. View details such as the number of glitch errors in a table, with each individual glitch in the waveform correlated with other signals.
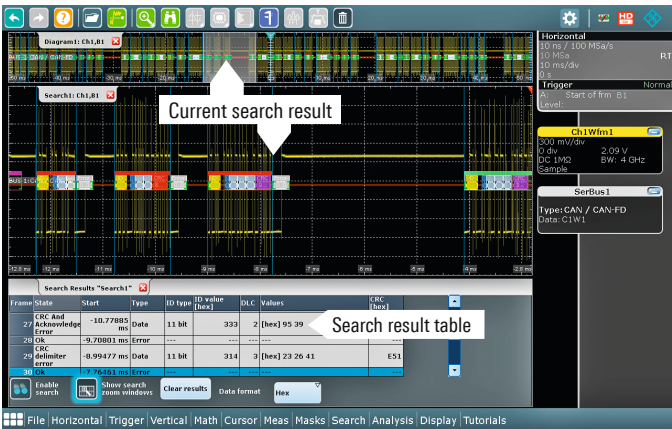
Industry-leading mask test: quick configuration – reliable results

Mask tests quickly reveal whether a specific signal lies within defined tolerance limits, providing pass/fail evaluation to assess the quality and stability of a device under test. Signal anomalies and unexpected results are easy to identify by stopping the measurement if the mask is violated. Defining masks is easy and flexible with the R&S®RTO. With just a few keystrokes, generate a mask from a reference signal or define masks consisting of up to eight segments. To get started quickly, use the mouse or your finger to generate the mask segments on the screen. Optimize the positions of the mask points later in the mask test dialog box.

Save results fast

Save waveforms in various file formats or download them via Ethernet for later analysis with MATLAB® or Excel, for example. You can also print or save the screen content. The download feature on the R&S®RTO is unique. When set to a special operating mode, the oscilloscopes continuously acquire 100 waveforms per second, evaluate the waveforms and transmit them to a PC via Ethernet.
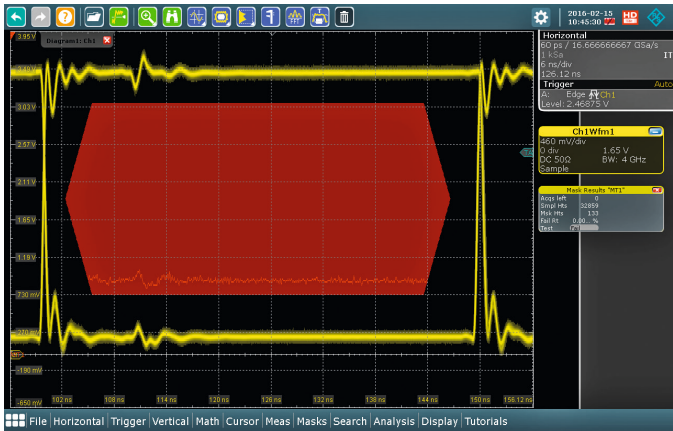
Storage options		
Contents	waveform	complete
		selection (zoom, cursor, gate, manual)
		number of acquisitions
		history memory
Evaluation		histograms
		measurement results
		long-term trend
Format	measurement data	binary, XLS, CSV, 1 to 4 channels
	graphics	PNG, JPG, BMP, TIF, PDF
	reports	PDF, HTML, DOC
Drivers		VXi, LabView, LabWindows, .NET

Advanced user interface

High-resolution capacitive touchscreen with gesture support

Select and activate functions with your finger. Simply drag and drop signals into place and use control gestures to scale and zoom – quickly and accurately thanks to the high-resolution 12.1" capacitive touchscreen.
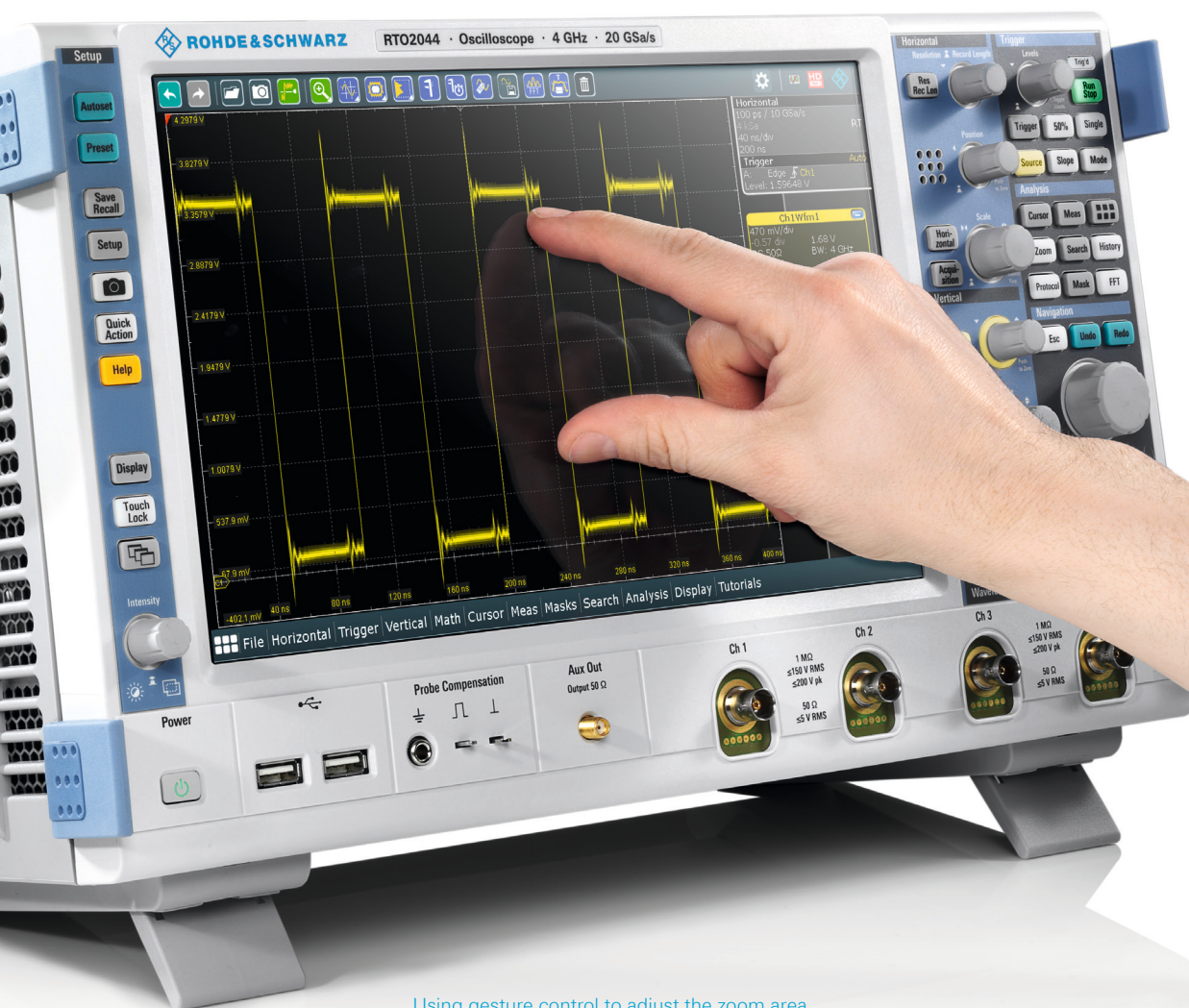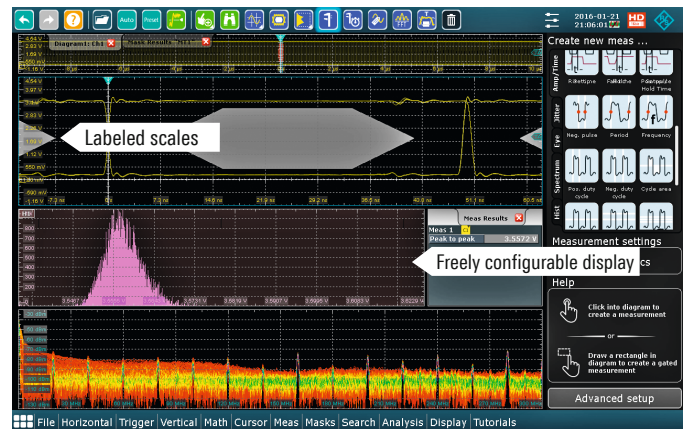
ı **High-resolution capacitive touchscreen with gesture support**
ı **Easily customizable waveform display with R&S®SmartGrid technology**
ı **Fast access to important tools**
ı **Clear orientation thanks to color coding**
ı **App cockpit to quickly set up analysis functions**

Easily customizable waveform display with R&S®SmartGrid technology

Use the R&S®SmartGrid function to configure the display. For complex measurement tasks where several screen displays are helpful, you can superposition windows in multiple tabs. All measurement diagrams have labeled scales so you can immediately read important signal characteristics.

Using gesture control to adjust the zoom area.

Fast access to important tools

The toolbar at the top of the screen provides access to frequently used functions such as measurements, zoom and FFT. Configure measurement in a few seconds by simply activating the measurement setup in the toolbar and choosing the desired measurement function and source channel in the sidebar.

1. Select measurement setup

2. Select desired measurement

3. Select channel
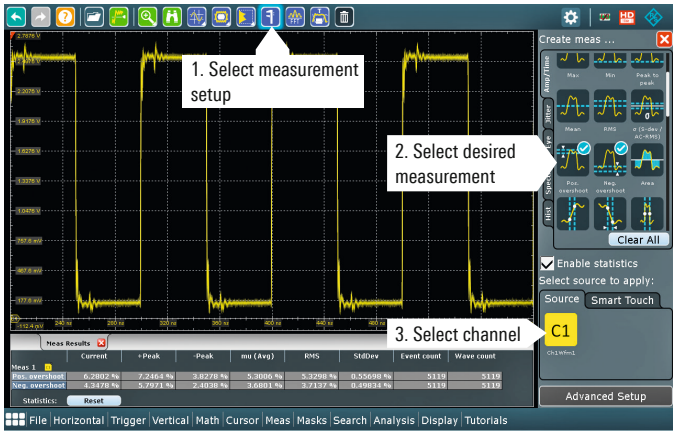
Fast access to important tools

undo	redo	help	instrument setups
save settings	capture screenshot	generate report	clear screen
autoset	default settings	run/stop	run single measurement
find trigger level	zoom	search	cursor
mask test	histogram	measure-ment setup	Quick-Meas
FFT	label	update refer-ence waveform	save waveform
zone trigger	recycle bin		

Clear orientation thanks to color coding

The controls for vertical settings and the trigger are color-coded. Multicolor LEDs around the rotary knobs visualize the channel that is currently in focus. The color coding corresponds to the signal display on the screen (see example). This clear mapping allows smooth work, even during complex tests and measurements.

Trigger source

Signal

Signal icon

Active channel

Grid annotation

Scaling

## App cockpit to quickly set up analysis functions

Access all analysis functions such as spectrum, jitter or power analysis from the app cockpit. Add your own analysis applications, such as MATLAB™ runtime executables, to the user tab. Start all these functions by just pressing a button in the app cockpit.

## Documentation at the press of a button

R&S®RTO oscilloscopes help you document measurements:
▪ Print and save screenshots of the screen content, including waveforms and results
▪ Print and save screenshots as a report, including instrument setup
▪ Easily read signal characteristics thanks to clear grid annotations
▪ Use color-coded labels to highlight anomalies in the diagram
▪ Save waveforms, histograms and measurement results in binary, XLS or CSV format for signal analysis on a PC
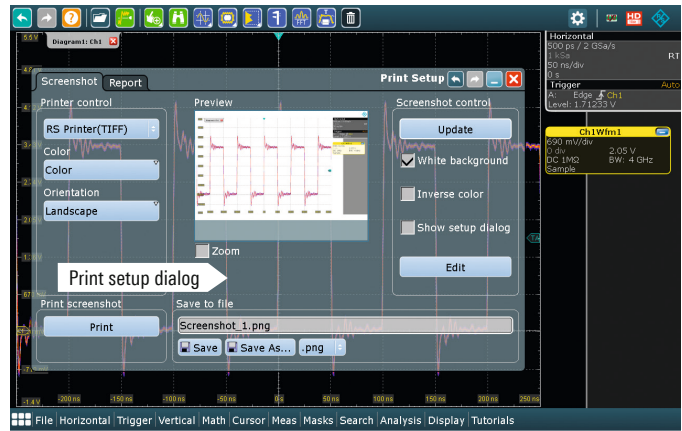
Dialog boxes with signal flow diagrams

Signal flow diagrams in the dialog boxes visualize the signal processing, making it easier to configure measurements. Crosslinks take you directly to logically related settings. Forward/back buttons help you navigate quickly between dialog boxes. Semi-transparent dialog boxes are an elegant way of keeping everything in view. The intensity button lets you set the level of transparency. You can also minimize a dialog box to the active input field and position it anywhere on the screen.
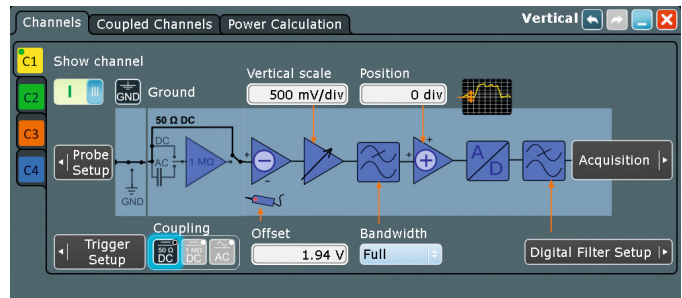
Easy selection of instrument setup

The R&S®RTO can save instrument setups for repetitive measurements. Each instrument setup is saved along with a screenshot of the most recent oscilloscope display. To later select a desired instrument setup, simply scroll through the screenshots to find the right configuration.
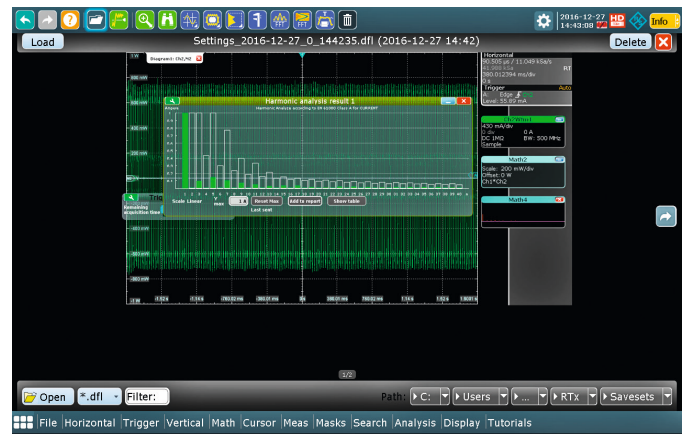
Remote control access, anytime

The R&S®RTO can be fully remote controlled from a web browser using a PC or mobile device. You see the same user interface as on the oscilloscope itself. All oscilloscope functions are also available remotely via Ethernet, GPIB or the USB interface.

Selection of languages

The R&S®RTO oscilloscope's user interface supports multiple languages. It takes just a few seconds to change the language while the instrument is running, making the oscilloscope a truly international instrument.

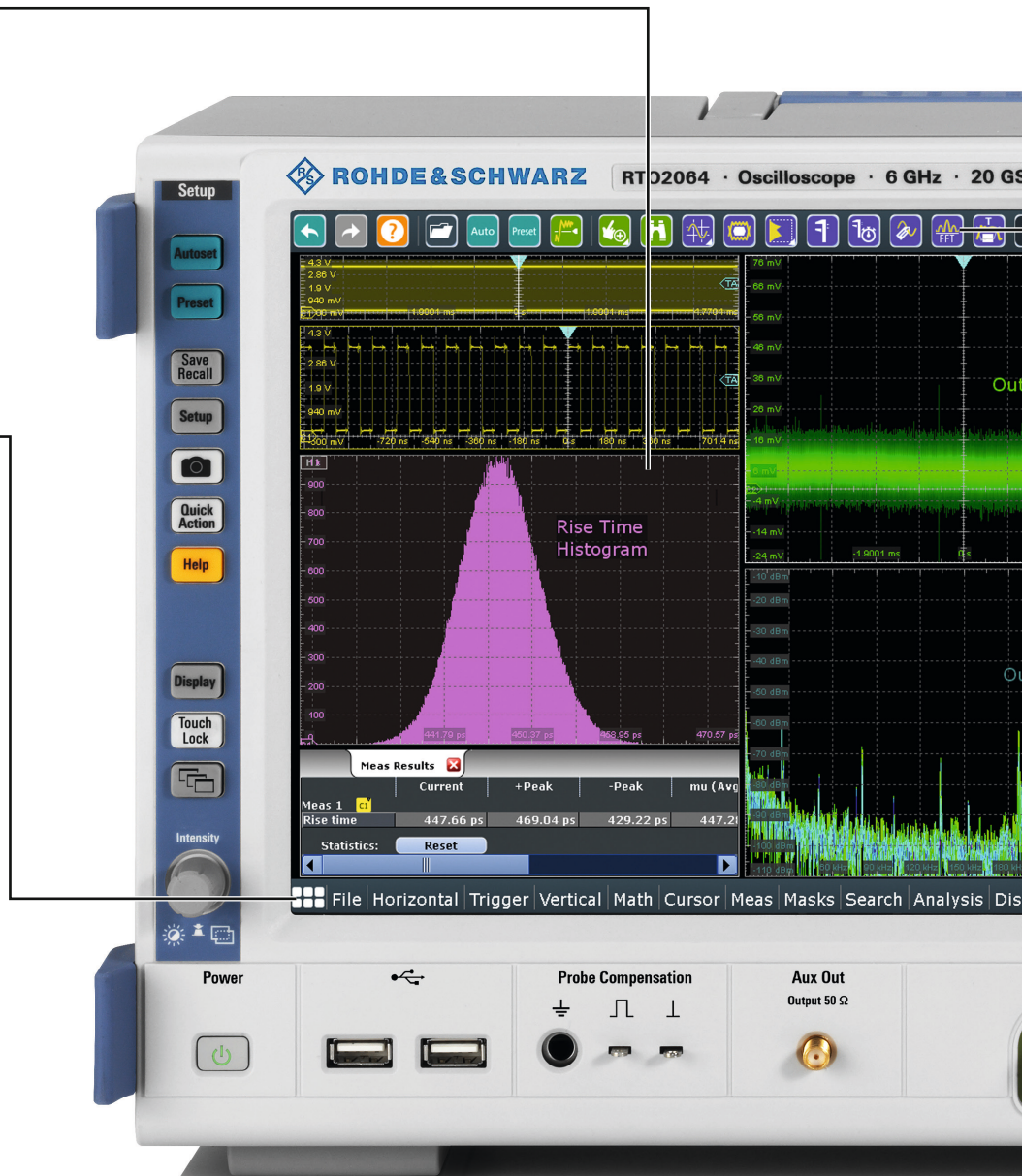# Advanced user interface

Easily customizable waveform display with R&S®SmartGrid technology

❙ Configure the display with R&S®SmartGrid
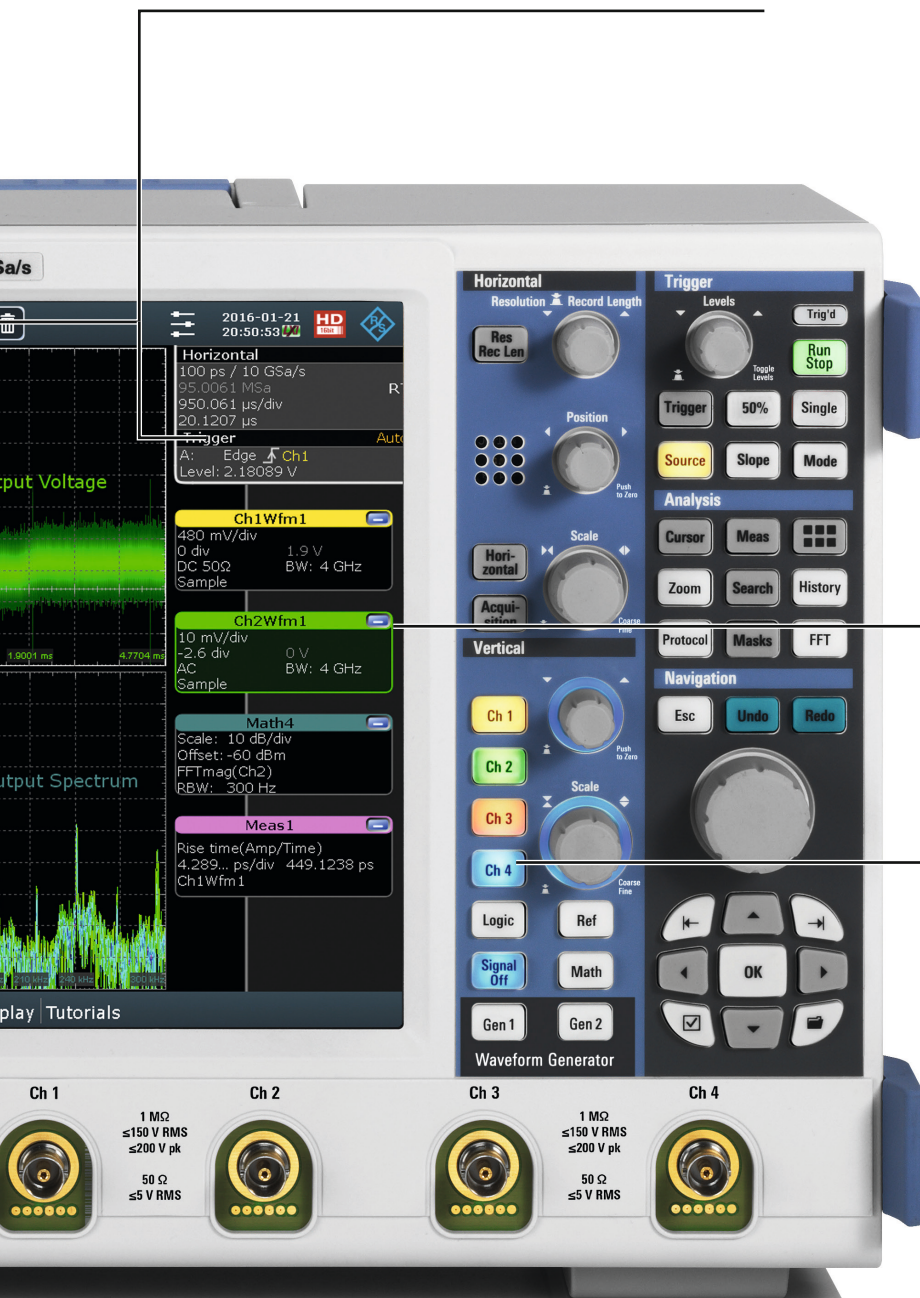❙ Superposition windows in multiple tabs
❙ Scales labeled on all axes

App cockpit to quickly set up analysis functions

❙ Directly access all analysis functions
❙ Easily add user applications
❙ Decode protocols in seconds

Fast access to important tools

ı Toolbar for quick access to functions
ı Sidebar for easy configuration of a measurement

High-resolution capacitive touch-screen with gesture support

ı Brilliant 12.1" screen
ı Capacitive touchscreen
ı Drag & drop signal placement
ı Use gestures to scale and zoom

## Clear orientation thanks to color coding

ı Color-coded controls indicate the currently selected channel
ı Color coding of trigger source

Engineered for power measurements

Whether you are working with a motor drive, SMPS or power rails, making fast and precise power measurements can be challenging. The many unique R&S®RTO oscilloscope features enable you to make better and faster power measurements.

See power signal details with up to 16 bit resolution

Even the smallest signal details of a high dynamic signal matter for power measurements. Verification of RDS_{on} of a MOSFET is one example. The high definition mode (HD mode) of the R&S®RTO oscilloscopes increases the vertical resolution to up to 16 bit so that previously unseen signal details become visible and can be measured. With 16-bit resolution, the HD mode enables verification of RDS_{on} as the slope of the drain-to-source-voltage while the switch is closed.
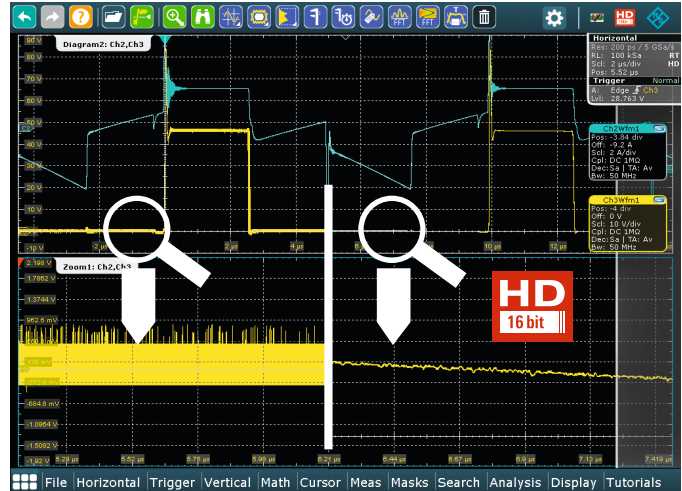
Analyze sporadic disturbances with the industry´s fastest scope

R&S®RTO oscilloscopes are optimized for fast results. They display up to 1 million waveforms/s. The unique hardware accelerated FFT analysis allows you to capture, analyze and display the frequency analysis results of more than 1000 waveforms/s. This helps you find infrequent disturbances on the power rail or during EMI debugging. Use the first zone trigger to isolate these disturbances for detailed analysis in the time and frequency domain.
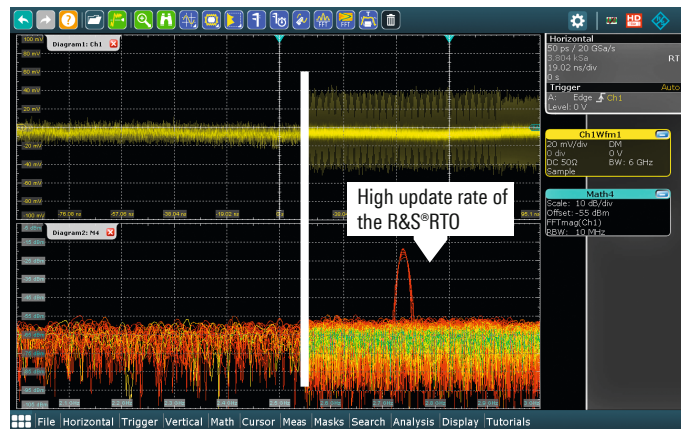
Complete probe portfolio for power measurements

Accurate voltage and current probes with a suitable measurement range are critical for power measurements. Rohde & Schwarz offers a complete probe portfolio, from µA to kA and from µV to kV, for the different power measurement applications.
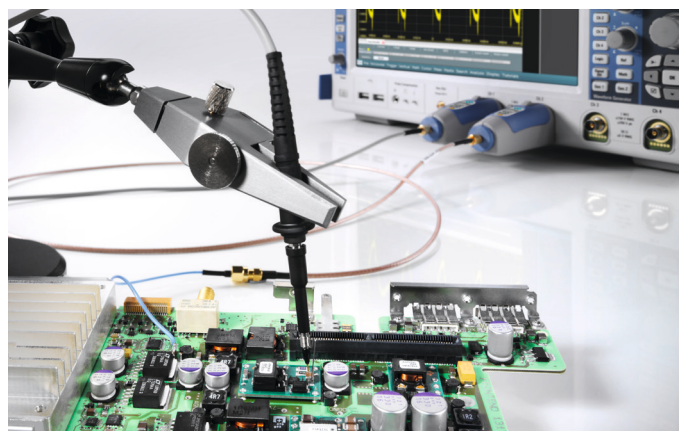
Power integrity measurements

ı **Large DC offsets with high-fidelity probes**
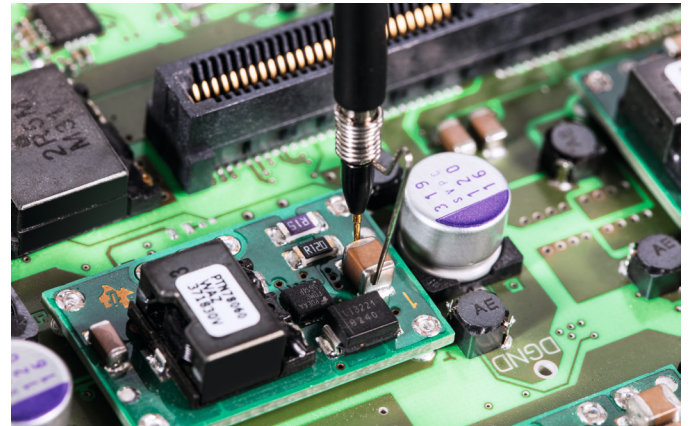ı **Accurately measure ripple and PARD**
ı **Find coupled sources**

Large DC offsets with high-fidelity probes

Designed specifically for power rail measurements, the R&S®RT-ZPR20 probe includes an industry best ±60 V built-in offset so you can zoom in on small signals with large offsets. The probe delivers superior measurements and also features low noise with a 1:1 attenuation ratio, excellent DC loading, excess of 2 GHz bandwidth and an integrated, high-precision voltmeter.

Accurately measure ripple and PARD

As power rail tolerance levels get smaller, it becomes difficult to accurately measure ripple. The inherent low noise of R&S®RTO oscilloscopes makes them ideal for accurate power integrity measurements where every millivolt matters. The oscilloscopes' fast update rate lets you quickly see infrequent and worst-case ripple as well as periodic and random disturbance (PARD) anomalies.

Low noise frontend of the R&S®RTO
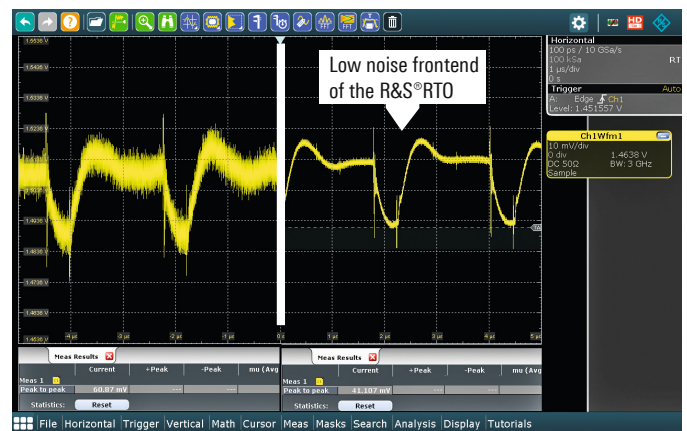
Find coupled sources

With the industry's most capable FFT, you can see switching characteristics or quickly scan for sources coupled onto the power rail such as a 3G or Wi-Fi signal. The algorithm used in the FFT calculation allows you to analyze the spectrum independently of the time domain settings. This quickly gives you a comprehensive picture of your power rails.
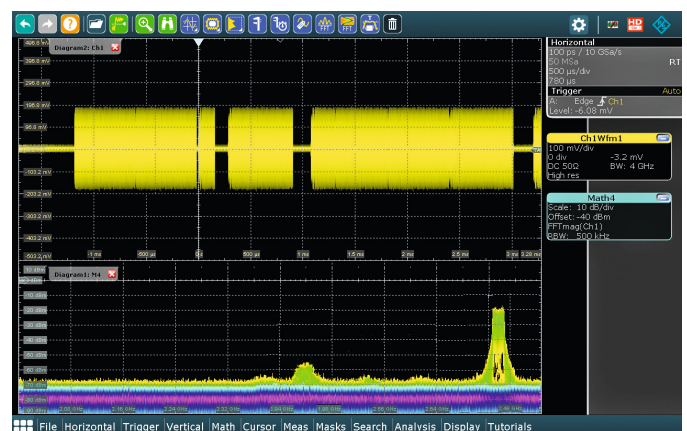
Power measurements and analysis

- Measurement wizard for fast results
- Harmonic current analysis in line with EN, MIL and RTCA standards
- Easy and clear documentation of measurement results

Measurement wizard for fast results

After you select a measurement function, the measurement wizard guides you through the test setup. Detailed illustrations help you make the correct connections. The oscilloscope then configures itself automatically and delivers quick results. You can modify the configuration or completely manually configure the oscilloscope in order to document specific signal details.
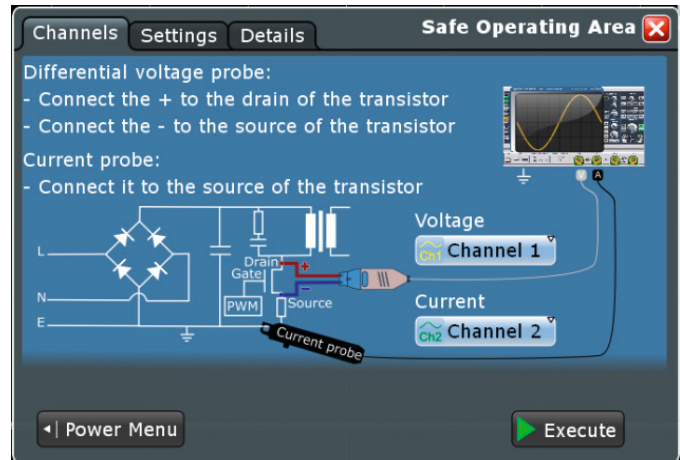
Harmonic current analysis in line with EN, MIL and RTCA standards

Different standards for limiting the harmonic current must be met when developing switched-mode power supplies. The R&S®RTO-K31 option helps you test all common standards: EN 61000-3-2 classes A, B, C, D, MIL-STD-1399 and RTCA DO-160.
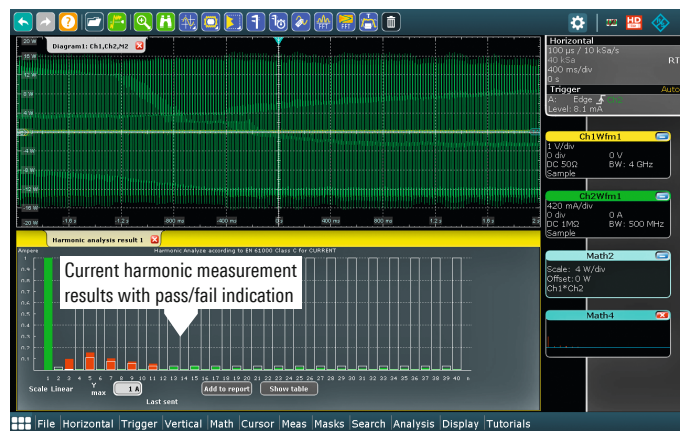
Easy and clear documentation of measurement results

Add each result to the test report by simply pressing a button. The test report documents the setup and configuration. Define the level of detail in the report and customize the layout, for example by adding a company logo. The available output formats are PDF and RTF.

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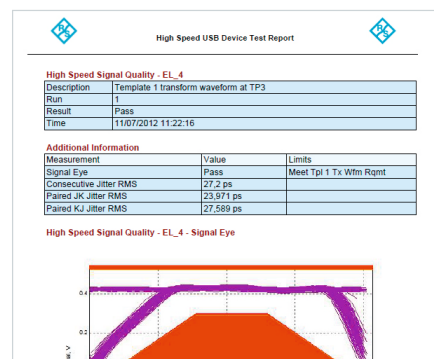
Engineered for multi-domain challenges

Your need

New challenges often arise when testing modern embedded designs. Various functional units such as the voltage supply, processor, sensor technology, digital I/Os and radio interfaces are connected with each other at the IC or board level, making them susceptible to mutual interference. For debugging, the different input and outputs signals such as current, voltage, data telegrams, reference clock, sensor and wireless data need to be synchronized. Until now, dedicated measuring instruments were used for measurements in the time domain, for spectrum, logic and protocol analysis and for clock and data generation.

Rohde & Schwarz solution

R&S®RTO oscilloscopes are the first to integrate a powerful waveform generator. They offer a fully integrated multi-domain test solution with frequency, protocol and logic analysis functions. You will appreciat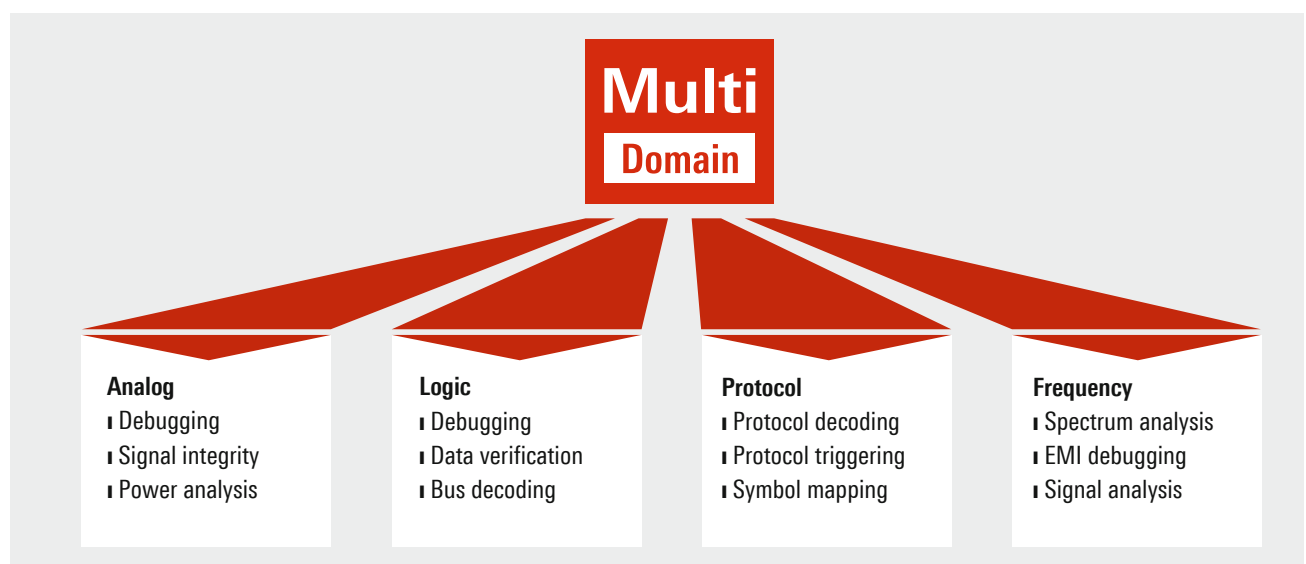e the standardized user interface with consistent, simple operation of all functions and the fact that all analysis functions are synchronized. The following example clearly demonstrates the benefits. Sporadic failures of embedded design functions are often caused by interference from the internal voltage supply. R&S®RTO oscilloscopes analyze the quality of the voltage supply in the time and frequency domain based on processor and interface activity. The integrated waveform generator can be used to program the DUT or to provide signals for the test. This one-box solution makes it possible to quickly detect errors even in complex designs.

R&S®RTO oscilloscopes offer a complete multi-domain test solution

Multi Domain

Analog
▮ Debugging
▮ Signal integrity
▮ Power analysis

Logic
▮ Debugging
▮ Data verification
▮ Bus decoding

Protocol
▮ Protocol decoding
▮ Protocol triggering
▮ Symbol mapping

Frequency
▮ Spectrum analysis
▮ EMI debugging
▮ Signal analysis

MSO analysis: unrivaled in its class

ı **Every R&S®RTO can be enhanced to include a mixed signal option**
ı **More signal details thanks to high time resolution over the entire memory depth**
ı **Precise triggering on signal events**

Every R&S®RTO can be enhanced to include a mixed signal option

The unique plug & play concept of the R&S®RTO makes upgrading easy. The R&S®RTO-B1 MSO option to add 16 digital channels is quick to install on site without opening the oscilloscope. Simply insert it into the slot on the rear panel.

More signal details thanks to high time resolution over the entire memory depth

With a sampling rate of 5 Gsample/s, the R&S®RTO-B1 mixed signal option (MSO) provides a maximum time resolution of 200 ps for all digital channels. This sampling rate is available over the entire memory depth of 200 Msample per channel. As a result, the MSO option is capable of detecting critical events such as narrow or widely separated glitches.

Precise triggering on signal events

The R&S®RTO-B1 option offers numerous triggers for debugging and analysis, such as edge, width, pattern and serial pattern. These triggers can be combined with holdoff conditions. Choose either individual digital channels or bus signals as the trigger source. The digital channel resolution of 200 ps makes these channels a precise trigger source.
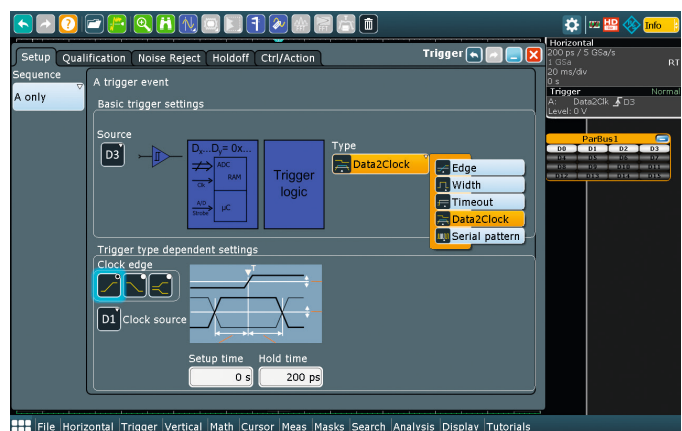
Straightforward display of digital signals

The R&S®RTO-B1 option supports 16 digital channels and simultaneous decoding of up to four parallel buses. Each bus is represented by an icon on the edge of the screen. The R&S®SmartGrid function lets you simply drag and drop icons onto the screen. The icons clearly show the current status of all activated logic channels (high, low, toggle) irrespective of the other oscilloscope settings.

Icon with displayed toggle status

Analysis of parallel and serial protocols with digital channels
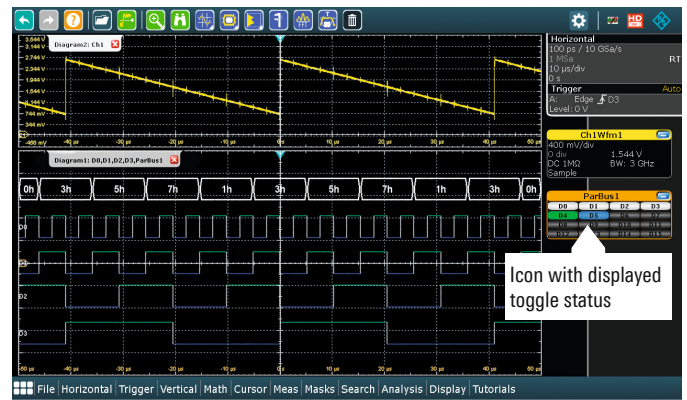
Use the digital channels to decode parallel buses. They are displayed in a digital bus format or as an analog waveform. For clocked parallel buses, the decoded contents can also be displayed in a table. You can also use the digital channels of the R&S®RTO-B1 option to decode serial interface protocols such as SPI and I²C.

Analog bus display
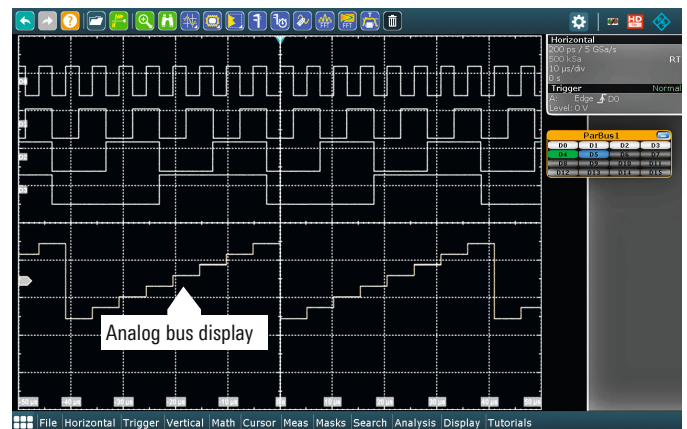
Low test point loading due to active probe solution

The 16 digital inputs are grouped into two logic probes with eight channels each. High input impedance combined with low input capacitance of 100 kΩ || 4 pF ensures low loading of the test points.
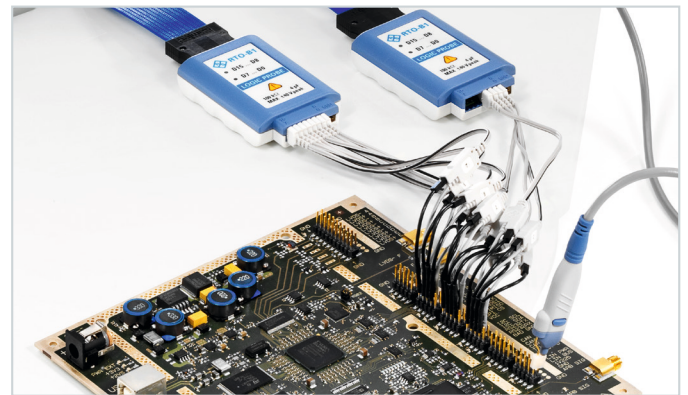
R&S®RTO-B1 MSO option
- 16 digital channels (2 logic probes)
- 100 kΩ || 4 pF input impedance
- Max. 400 MHz signal frequency
- Max. 5 Gsample/s per channel sampling rate
- Max. 200 Msample per channel acquisition memory

High definition: see more with up to 16-bit resolution

ı **Increased resolution for precise measurement of small signal amplitudes**
ı **16-bit vertical resolution available**
ı **No aliasing**
ı **Realtime triggering on smallest signal details**

Increased resolution for precise measurement of small signal amplitudes

The high definition mode increases the vertical resolution up to 16 bit. This is required to analyze signal details on a signal with high amplitude variations. One example is the characterization of switched-mode power supplies. Here you need to measure smallest signal elements on a several hundred volt signal. A resolution higher than 8 bit is a must for precise measurements in such situations.

16-bit vertical resolution available

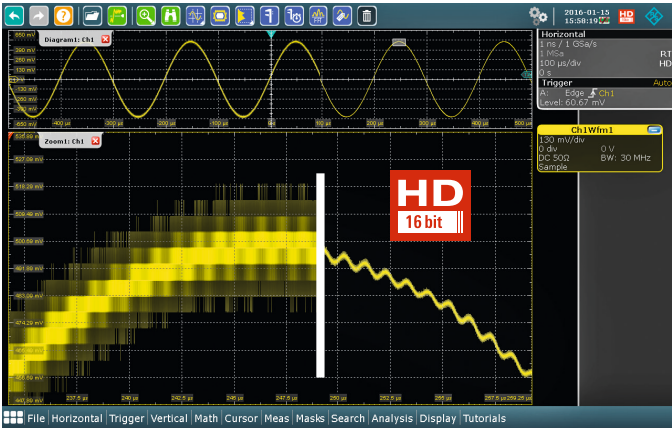The R&S®RTO-K17 software option increases the vertical resolution of the R&S®RTO oscilloscopes to up to 16 bit – a 256-fold improvement over 8-bit resolution. To achieve this higher resolution, the signal is lowpass filtered after the A/D converter. The hardware-implemented filter reduces the noise in realtime, thereby increasing the signal-to-noise ratio without any reduction of the update rate. You can adjust the bandwidth of the lowpass filter from 10 kHz to 2 GHz to match the characteristics of the applied signal. The lower the filter bandwidth, the higher the resolution.

The increase in resolution results in sharper waveforms, showing signal details that would otherwise be masked by noise.

Resolution as a function of the filter bandwidth	
Filter	**Resolution**
Inactive	8 bit
2 GHz [1]	10 bit
500 MHz	12 bit
300 MHz	12 bit
200 MHz	13 bit
100 MHz	14 bit
50 MHz to 10 kHz	16 bit

[1] 2 GHz for 20 Gsample/s, 1 GHz for 10 Gsample/s.

No aliasing

The high definition mode offers crucial advantages over high-resolution decimation (also supported by the R&S®RTO oscilloscopes). You know exactly what signal bandwidth is available due to explicit lowpass filtering, and there are no unexpected aliasing effects. Since the high definition mode is not based on decimation, the increase in resolution is not accompanied by a reduction in the sampling rate. When the high definition mode is on, the full sampling rate is still available, ensuring the best possible time resolution.
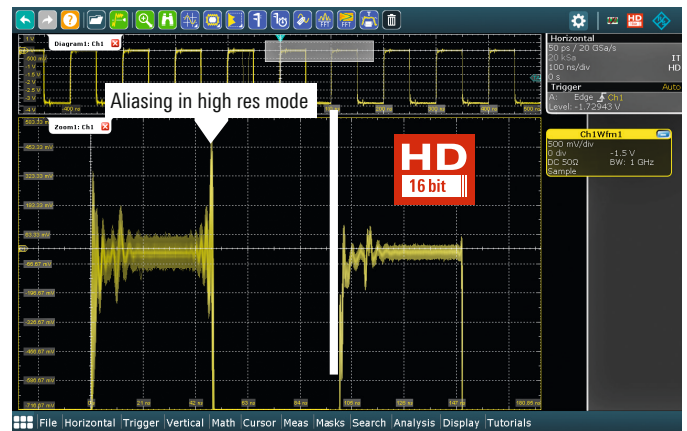
Realtime triggering on smallest signal details

The increased resolution in high definition mode makes it possible to reveal even the smallest signal details. The unique Rohde & Schwarz digital trigger design allows you to trigger on signals with increased resolution. Each of the up to 16-bit samples is checked against the trigger condition and can initiate a trigger. This means that R&S®RTO oscilloscopes are able to trigger on even the smallest signal amplitudes and isolate relevant signal events.

High acquisition rate and full functionality for fast measurement results

Switching on high definition mode does not compromise measurement speed or functions. Since the lowpass filtering, which improves resolution and noise suppression, is implemented in realtime in the oscilloscope's ASIC, the acquisition and processing rates remain high. The oscilloscope enables smooth operation, and measurement results are available quickly.

You can use all analysis tools, such as automatic measurements, FFT and the history mode, in high definition mode.

Waveform update rate versus vertical resolution
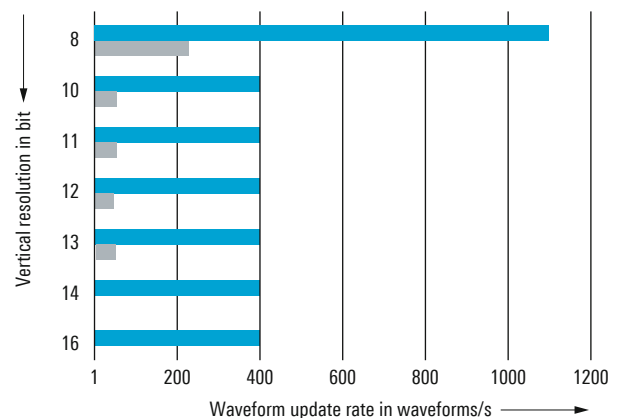
■ R&S®RTO   ■ Typical oscilloscope

At 1 Msample, 2.5 Gsample/s

R&S®RTO oscilloscopes enable smooth work, even with high resolution and deep memory.

Spectrum analysis

ı **Multichannel spectrum analysis**
ı **Set up as a spectrum analyzer**
ı **Zone trigger for time and frequency domain**

Multichannel spectrum analysis

All R&S®RTO oscilloscopes come with powerful multichannel spectrum analysis for up to four signals in parallel. The low-noise frontend and the A/D converter's high effective number of bits (> 7) provide an outstanding spurious-free dynamic range, so that even weak signals can be identified without difficulty.
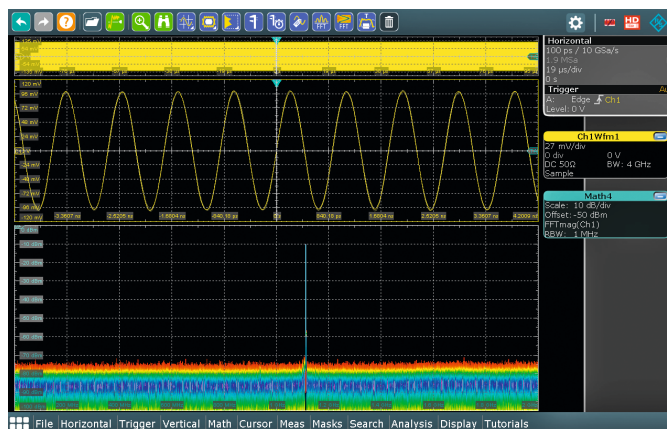
Set up as a spectrum analyzer

Operate the frequency analysis function of the R&S®RTO like a spectrum analyzer. Simply enter the typical parameters: center frequency, span and resolution bandwidth. Select the window type, FFT overlap, gating and logarithmic or linear Y-axis scaling based on the application requirements.
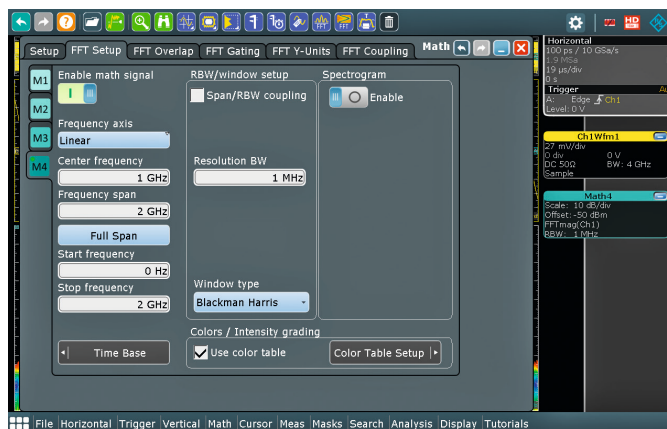
Zone trigger for time and frequency domain

R&S®RTO oscilloscopes offer the first zone trigger that works in the time and frequency domain. In either domain, you can graphically create up to eight zones and use them for the trigger condition of the scope.

A unique feature is that the zone trigger can also be applied in the frequency domain. Typical applications include fast detection and analysis of unwanted emissions, frequency hopping patterns and radar bursts.

Trigger zones

24
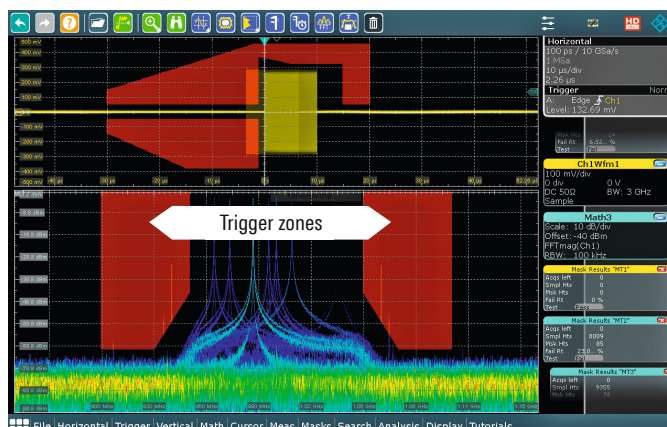
Display of change in power and frequency over time

Use the R&S®RTO-K18 spectrum analysis option to analyze time-varying signals in the frequency domain. A spectrogram is a color-coded frequency timing diagram in which the frequency domain is plotted over time. How the signal varies over time is indicated by the intensity and color of each point in the two-dimensional diagram. R&S®RTO oscilloscopes allow you to quickly analyze voice and AM/FM modulated signals as well as signals from radar and frequency hopping systems.
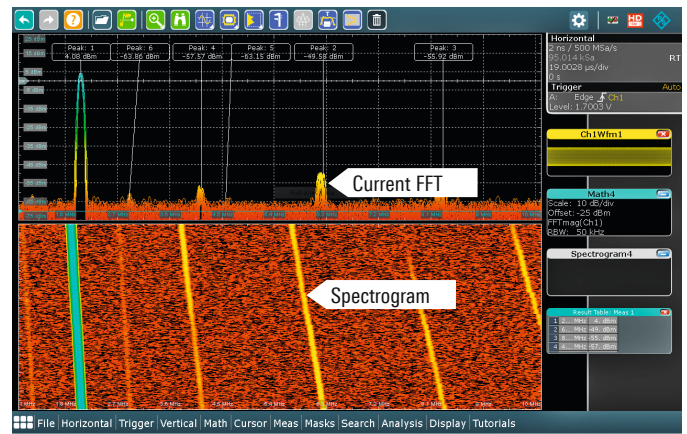
Frequency analysis with logarithmic display

For many measurements, logarithmic scaling of the frequency axis is helpful to better display values of several orders of magnitude. The R&S®RTO-K18 spectrum analysis option supports this function for the spectrum and spectrogram.
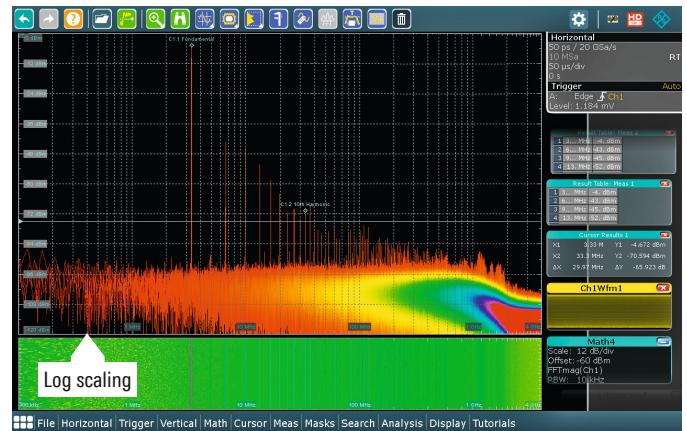
Fast results with automatic peak list measurement

Use the peak list measurement function to automatically measure frequency peaks. The frequency peak list is displayed in a table. The power and frequency of the highest peaks can be marked in the spectrum.
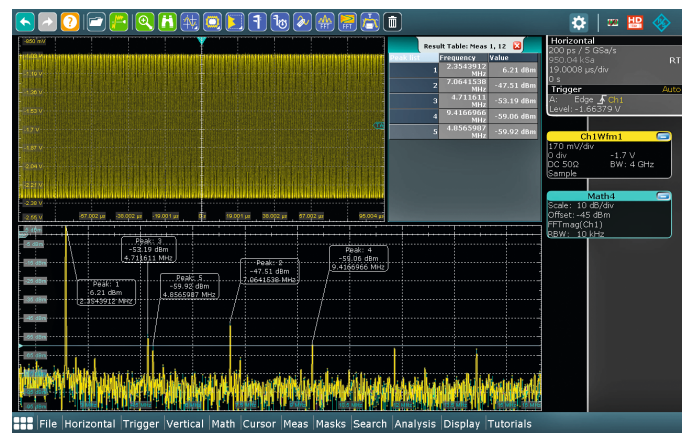
EMI debugging

ı **EMI tests during development**
ı **High dynamic range and sensitivity**
ı **Visualizing sporadic emissions**

EMI tests during development

When debugging EMI problems in electronic circuits, development engineers face the challenging problem of quickly and accurately identifying and eliminating the sources of unwanted emissions. One of the most important test instruments during circuit development is the oscilloscope. Many problems can be eliminated during development by using oscilloscopes for EMI debugging.

High dynamic range and sensitivity

The R&S®RTO oscilloscope is a powerful tool for EMI debugging. Its high dynamic range and input sensitivity of 1 mV/div at full measurement bandwidth make it possible to detect even weak emissions. The powerful FFT implementation is well suited for the required analysis in the frequency domain thanks to its easy operation, high acquisition rate and functions such as color coding of the spectral display according to the frequency of occurrence. In combination with a near-field probe, EMI problems can be quickly located and analyzed.

Visualizing sporadic emissions

One special feature is overlap FFT. The oscilloscope splits the captured time domain signal into overlapping segments and calculates an individual spectrum for each segment. These spectra are then color-coded according to their frequency of occurrence and combined to a complete spectrum. The complete spectrum provides a very good overview of the type and frequency of occurrence of EMI emissions. Even sporadic signals are visible.

Another highlight is that you can use the mask function to define masks in the frequency domain. The stop-on-violation condition stops the acquisition exactly at the signal that violated the frequency mask. This solves the most challenging EMI problem – detecting and analyzing sporadic emissions.

Mask to capture sporadic emission
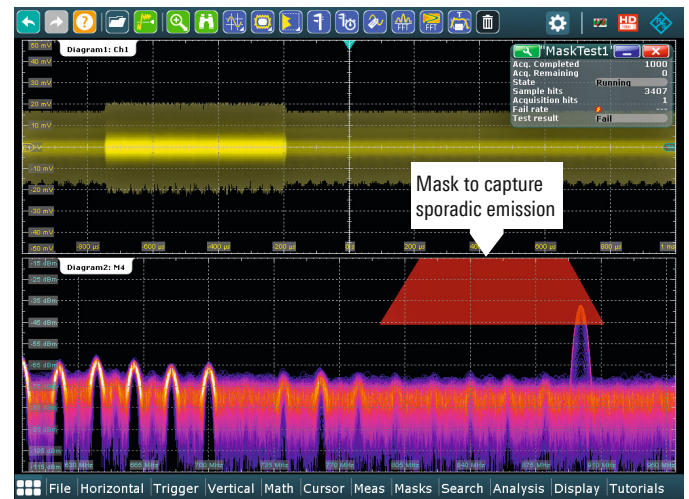
Correlation between frequency and time

Use the R&S®RTO oscilloscopes' gated FFT function to restrict FFT analysis to a user-defined region of the captured time domain signal. Then move this time window across the entire signal to determine which segments of the time domain signal correlate to which events in the spectrum. Use this function, for example, to correlate unwanted emissions from switched-mode power supplies to overshoots from the switching transistor.

Spectrum of gate 1

Spectrum of gate 2
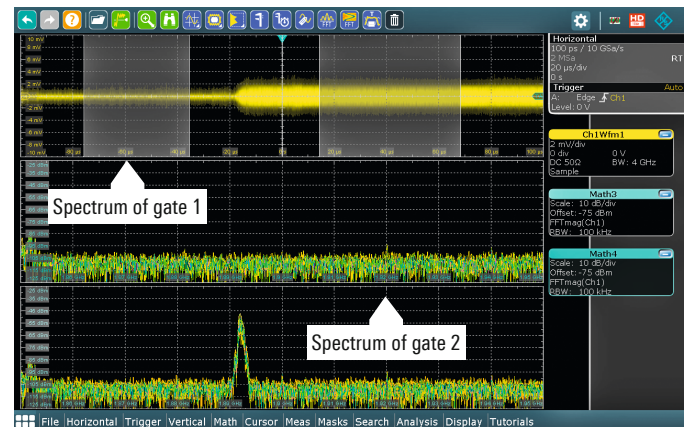
Signal analysis

❙ **Realtime conversion of modulated signals to I/Q data**
❙ **Precise and wideband RF analysis**
❙ **Advanced signal analysis**

Realtime conversion of modulated signals to I/Q data

The R&S®RTO-K11 I/Q interface significantly simplifies analysis of modulated signals. This option converts modulated signals to I/Q data in realtime. The I/Q data can be processed with the dedicated R&S®VSE vector signal explorer software tool or with MATLAB®.

Precise and wideband RF analysis

Thanks to the frontend's extremely low inherent noise and the high-precision, single-core A/D converter, the R&S®RTO measures in the frequency domain with high accuracy. Measure over the entire bandwidth of the oscilloscope and on up to four channels in parallel. For measurements with an RF frequency between 4.5 GHz and 86 GHz, combine the oscilloscope with an R&S®FSW signal and spectrum analyzer to achieve an analysis bandwidth of 2 GHz.

RF analysis

R&S®RTO2064 and R&S®VSE Analysis from DC to 6 GHz

R&S®FSW-B2000 with R&S®RTO2044 2 GHz analysis from 4.5 GHz to 86 GHz (minimum f_C = 5.5 GHz)
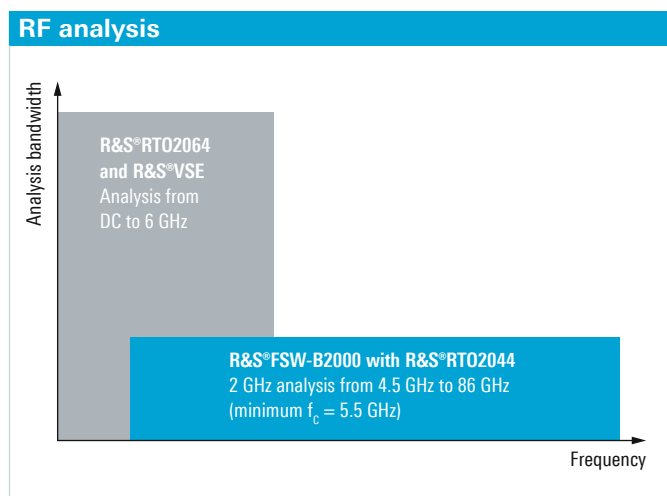
Advanced signal analysis

To analyze complex signals such as OFDM radar and LTE MIMO signals, extend the functionality of the R&S®RTO with application software such as the R&S®VSE vector signal explorer software packages. The software offers a wide range of analysis tools for debugging and optimizing circuit designs. Use the R&S®VSE software together with R&S®RTO oscilloscopes to analyze analog and digitally modulated signals. Analyze pulsed and analog modulated signals, generic I/Q and vector signals as well as wireless and mobile communications standards such as GSM, LTE and WLAN.

Expansion of extensive analysis options

R&S®VSE
Vector signal explorer software

R&S®FS-K96PC
OFDM vector signal analysis software

R&S®FS-K10xPC
EUTRA/LTE and LTE-Advanced signal analysis software
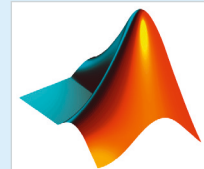
MATLAB®

Integrated arbitrary waveform generator

ı **Every R&S®RTO can be enhanced to include a 100 MHz arbitrary waveform generator**
ı **Single-ended and differential interface stimulation**
ı **Test your device with native signals**

Every R&S®RTO can be enhanced to include a 100 MHz arbitrary waveform generator

The R&S®RTO oscilloscopes are the first in this class to offer a fully integrated two-channel 100 MHz function generator, arbitrary waveform generator and eight-channel pattern generator. With 500 Msample/s and 14-bit resolution, the generator is suitable for education as well as design and R&D. The integrated generator saves space on the test bench and provides both standard and arbitrary stimulus to the DUT. The generator can be operated as a pattern, function or modulation generator. It also supports sweep mode and the playback of arbitrary waveform files.

R&S®RTO-B6 specifications in brief	
Analog output	2 channels
Bandwidth	100 MHz
Sampling rate	500 Msample/s
Operating modes	ı Function generator (sine, square, ramp, DC, pulse, cardinal sine, cardiac, Gauss, Lorentz, exponential rise/fall) ı Modulation generator (AM, FM, FSK) ı Sweep generator ı Arbitrary waveform generator
Pattern generator	8 channels
Memory	40 Msample per channel
Resolution	14 bit

Single-ended and differential interface stimulation

For testing differential devices, the generators can be coupled and offset from each other. With the offset capability of amplitude and phase in coupled mode, you can simulate both ideal and non-ideal conditions. Differential devices, such as differential amplifiers or I/Q mixers, can be tested against amplitude impairments and phase imbalances.
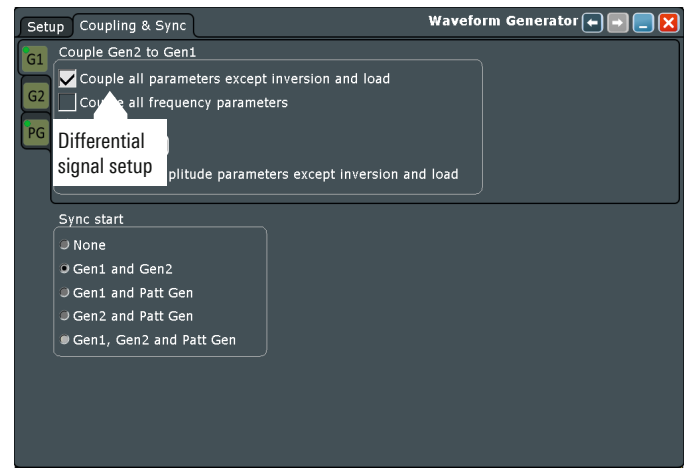
Test your device with native signals

Testing your device with real-world signals opens up a new method to test the margins of your design. The R&S®RTO-B6 arbitrary waveform generator lets you play back waveforms that are captured on the oscilloscope. The captured waveforms can be manipulated by changing the amplitude and offset level or be superimposed with noise to evaluate a device against design criteria.
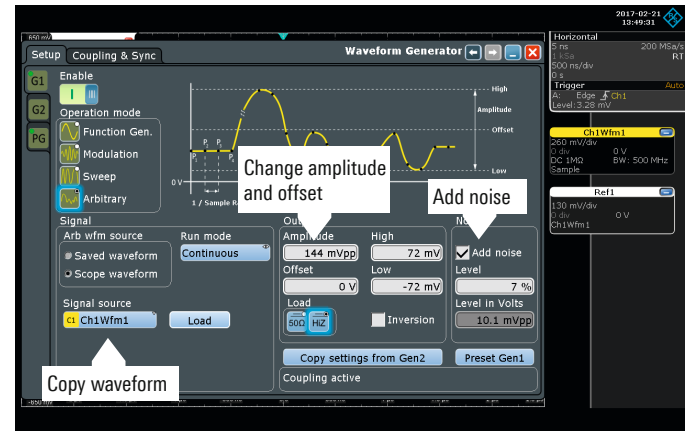
Fully automated compliance tests

Compliance tests can be fully automated utilizing the R&S®RTO-B6 arbitrary waveform generator, eliminating the need for an external signal source. R&S®ScopeSuite is able to control the waveform generator and provide, for instance, the disturbing signal needed for Ethernet compliance testing. As a result, the R&S®RTO is the most compact compliance test solution on the market.
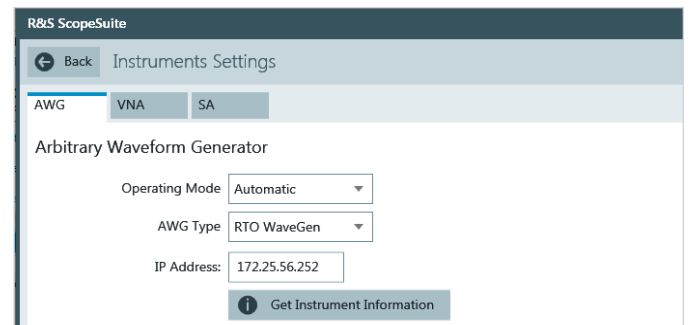
Serial protocols: easy triggering and decoding

l **Easy configuration with the app cockpit**
l **Isolate protocol events with the protocol-specific trigger**
l **Symbols support standard CAN-dbc and FIBEX formats**

Easy configuration with the app cockpit

R&S®RTO oscilloscopes offer a variety of tools for serial interface analysis. The configuration for any given protocol is accomplished in just a few steps starting from the app cockpit. Just select the bus you want to decode, configure the bus settings and set the reference levels to 50%.

Isolate protocol events with the protocol-specific trigger

Protocol-specific definition of the trigger conditions is very important for tracking down protocol errors. The R&S®RTO offers hardware-based triggering on specific protocol content, e.g. addresses or data, as well as on protocol errors.
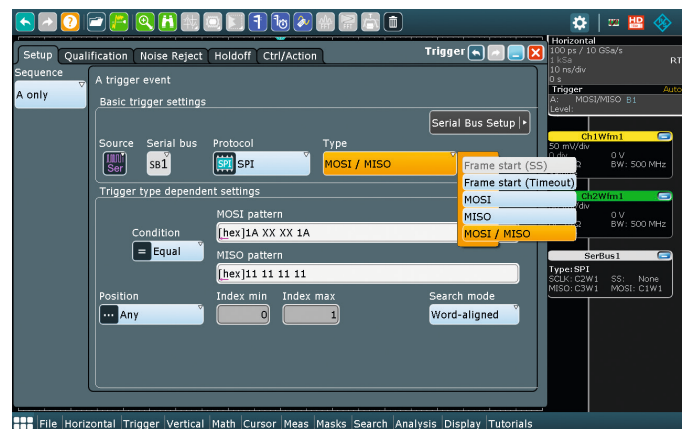
Symbols support standard CAN-dbc and FIBEX formats

Bus decoding is much easier with labeled frames. You can add labels to each frame via a .csv file. The standard file formats CAN-dbc and FIBEX are also supported. They allow additional symbolic data to be displayed. The symbols are displayed both on the waveform and in the decode table. You can also trigger on symbolic data while decoding CAN, CAN-FD or SENT formats.
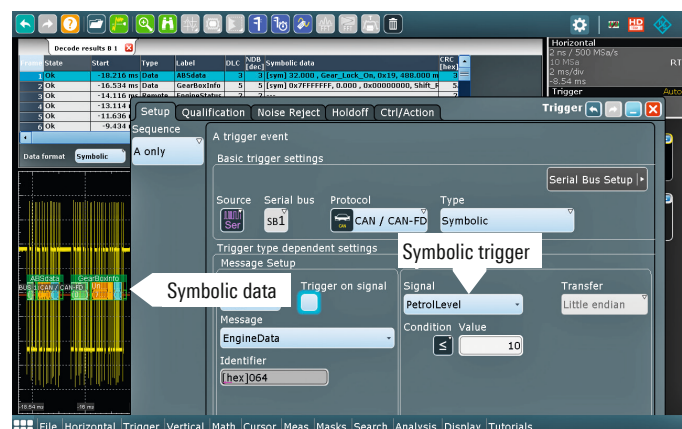
Clear display of data

When displaying decoded data, the individual protocol areas within the logical signals are color-coded, and address and data content can be displayed in hex, bin or ASCII format. The R&S®SmartGrid function supports flexible placement of the signals in a suitable diagram. You can also display the telegrams in a user-designed table.
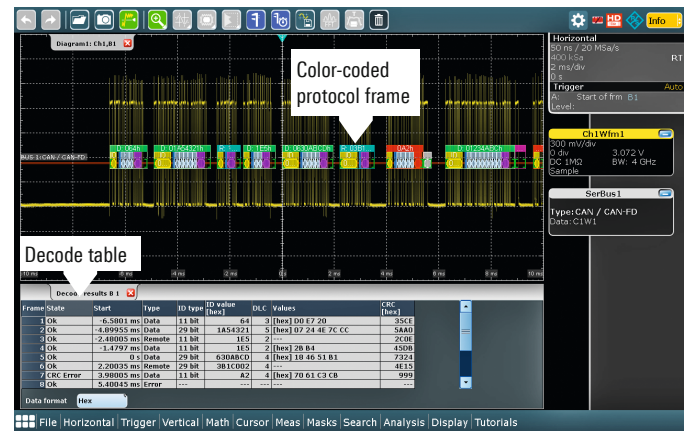
Rapid telegram data search

Comprehensive search functions simplify the analysis of long signal sequences. Quickly isolate specific telegram types, content and errors. All detected events are shown in a table with timestamps. Examine individual events in a zoom window with the proper timing correlation and navigate between the events.
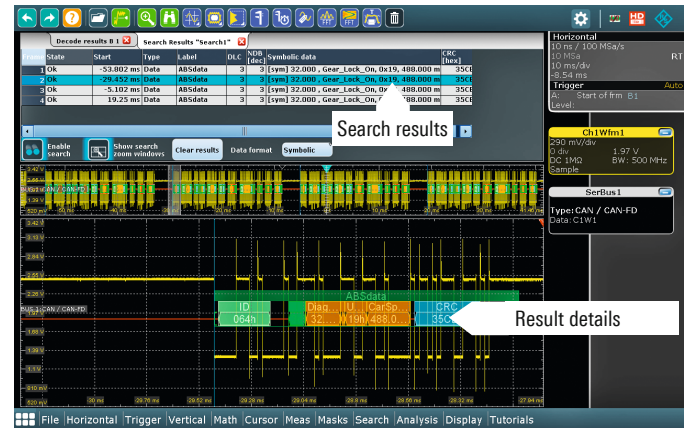
Options for triggering and decoding

Application	Serial standard	Option R&S®	Decode	Decode table	Trigger	Label support	Symbolic T&D	Search
Embedded	I²C/SPI	RTO-K1	●	●	●	●		●
	UART/RS-232/422/485	RTO-K2	●	●	●			●
	Ethernet	RTO-K8	●	●	●	●		●
	8b10b	RTO-K52	●	●	●			●
	MDIO	RTO-K55	●	●	●			●
	USB 1.0/1.1/2.0/HSIC	RTO-K60	●	●	●			●
	USB 3.1 Gen 1	RTO-K61	●	●	●			●
	USB-PD	RTO-K63	●	●	●			●
	USB-SSIC	RTO-K64	●	●	●	●		●
	PCIe 1.x/2.x	RTO-K72	●	●	●			●
Automotive, industrial	CAN/LIN (CAN-dbc)	RTO-K3	●	●	●	●	●	●
Automotive	CAN-FD (CAN-dbc)	RTO-K9	●	●	●	●	●	●
	SENT	RTO-K10	●	●	●	●		●
	FlexRay™ (FIBEX)	RTO-K4	●	●	●	●		●
	CXPI	RTO-K76	●	●	●			●
	100BASE-T1/BroadR-Reach®	RTO-K57	●	●	●	●		●
Audio	I²S/LJ/RJ/TDM	RTO-K5	●	●	●			●
Aerospace	MIL-STD-1553	RTO-K6	●	●	●	●		●
	ARINC 429	RTO-K7	●	●	●	●		●
	SpaceWire	RTO-K65	●	●	●			●
Mobile communications	MIPI RFFE	RTO-K40	●	●	●	●		●
	MIPI D-PHY	RTO-K42	●	●	●	●		●
	MIPI M-PHY	RTO-K44	●	●	●	●		●
Configurable	Manchester, NRZ	RTO-K50	●	●	●			

Automatic compliance tests

ı **Easy configuration and automatic control**
ı **Flexible test execution**
ı **Straightforward, configurable reports**

Easy configuration and automatic control

R&S®ScopeSuite is generic compliance test software that runs on the R&S®RTO oscilloscope or on a separate PC.

R&S®ScopeSuite controls the measurement settings and test sequence on the R&S®RTO and guides you through all selected tests based on the test setup. Detailed, image-based instructions make it easy to correctly connect the oscilloscope and the probes to the test fixture and the device under test. User data, all test setup settings and measurement report definitions are easy to configure. The limit editor lets you individually adjust standard-specific test limits.
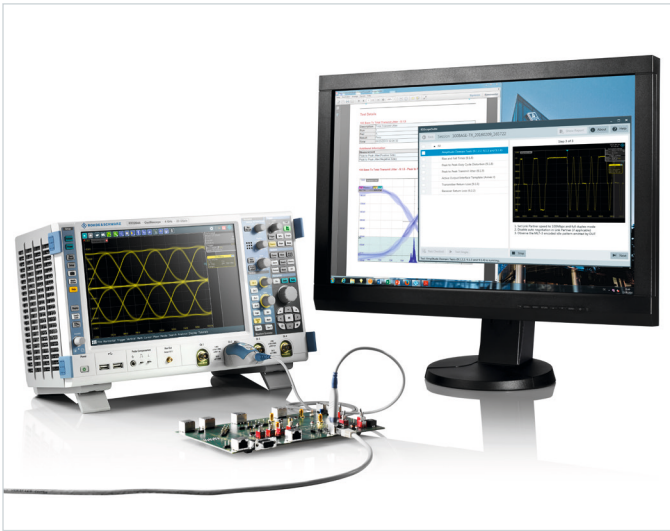
Flexible test execution

For debugging during development or for stability tests, you can repeat single tests or a sequence of tests as often as required. Between single tests, you can change limit lines or other parameters for every test and compare their impact on the result. For documentation purposes, R&S®ScopeSuite generates a test report from the test results you select.
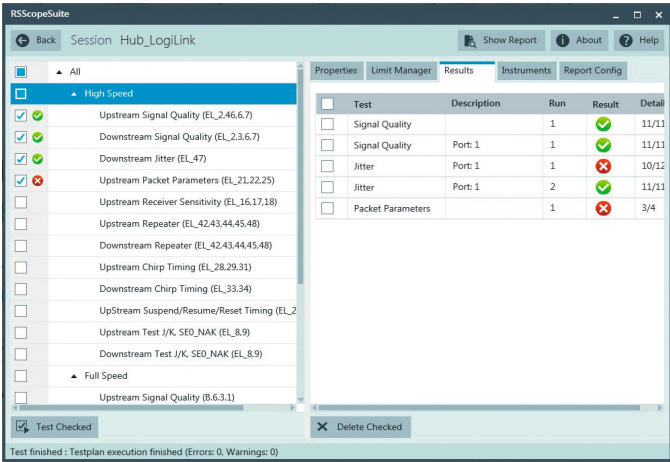
Straightforward, configurable reports

Documenting the measurement results is an essential part of compliance tests. R&S®ScopeSuite offers an extensive range of documentation functions. You can add measurement details and screenshots to the pass/fail results. The available output formats are PDF, DOC and HTML.

Test fixture sets made by Rohde&Schwarz

The different interface standards define the connection between the measuring equipment and the device under test. Rohde&Schwarz offers the required test fixture sets.
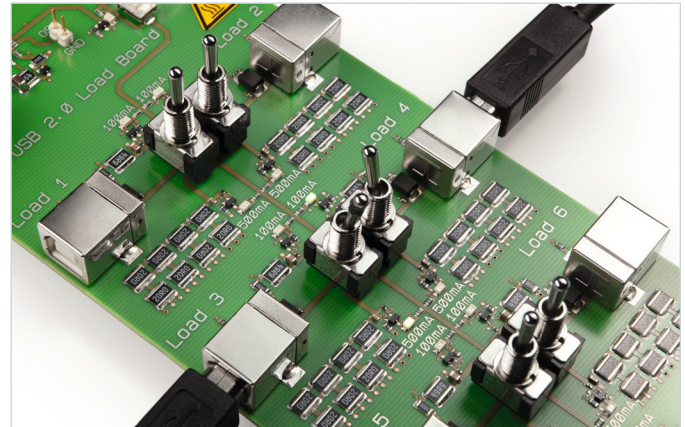
Interface standard	Compliance test option	Test fixture set	Recommended instruments, minimum bandwidth	Recommended probes
USB				
USB 1.0/USB 1.1	R&S®RTO-K21	R&S®RT-ZF1	R&S®RTO, 600 MHz	2 × R&S®RT-ZS10 1 × R&S®RT-ZD10 1 × R&S®RT-ZC20
USB 2.0	R&S®RTO-K21	R&S®RT-ZF1	R&S®RTO, 2 GHz; 1 × dual-channel arbitrary waveform generator (recommended Tabor WX2182B)	2 × R&S®RT-ZS30 1 × R&S®RT-ZD30 1 × R&S®RT-ZC20
Ethernet				
10/100 Mbit Ethernet	R&S®RTO-K22	R&S®RT-ZF2	R&S®RTO, 600 MHz	1 × R&S®RT-ZD10
1 Gbit Ethernet	R&S®RTO-K22	R&S®RT-ZF2 R&S®RT-ZF2C	R&S®RTO, 600 MHz; R&S®RTO-B6	1 × R&S®RT-ZD10
2.5G/5GBASE-T Ethernet	R&S®RTO-K25	R&S®RT-ZF2	R&S®RTO, 600 MHz	1 × R&S®RT-ZD10
10 Gbit Ethernet	R&S®RTO-K23	R&S®RT-ZF2	R&S®RTO, 2 GHz	1 × R&S®RT-ZD30
10M/100M/1GBASE-T Energy Efficient Ethernet	R&S®RTO-K86	R&S®RT-ZF4 R&S®RT-ZF5	R&S®RTO, 600 MHz	1 × R&S®RT-ZD10
Automotive Ethernet				
100BASE-T1 BroadR-Reach® Ethernet	R&S®RTO-K24	R&S®RT-ZF2 R&S®RT-ZF3	R&S®RTO, 600 MHz; R&S®RTO-B4, R&S®RTO-B6; R&S®ZND with R&S®ZND-K5	1 × R&S®RT-ZD10
1000BASE-T1 Ethernet	R&S®RTO-K87	R&S®RT-ZF2 R&S®RT-ZF6	R&S®RTO, 2 GHz; R&S®RTO-B4, R&S®RTO-B6; R&S®ZND with R&S®ZND-K5	1 × R&S®RT-ZD30
PCI Express				
PCIe Express 1.0/1.1	R&S®RTO-K81	PCI-SIG CCB/CLB (order from www.pcisig.com)	R&S®RTO, 6 GHz	1 × R&S®RT-ZM60
MIPI				
D-PHY	R&S®RTO-K26	Reference termination board (order from www.iol.unh.edu)	R&S®RTO, 4 GHz	3 × R&S®RT-ZD40
Memory interfaces				
eMMC (HS200, HS400)	R&S®RTO-K92		R&S®RTO, min. 1 GHz	4 × R&S®ZS10

Signal integrity measurement with jitter analysis

ı **Precise results**
ı **Wizard for easy configuration of measurements**
ı **Powerful analysis options**
ı **Clock data recovery for analyzing embedded clock signals in realtime**

Precise results

R&S®RTO oscilloscopes are ideally suited for jitter measurements. The sensitive, broadband, low-noise frontend combined with the high-precision, single-core A/D converter ensures exact results. Another strength of R&S®RTO oscilloscopes is their wide range of analysis options. For example, FFT analysis of the track for the cycle-cycle jitter lets you determine interference frequencies.
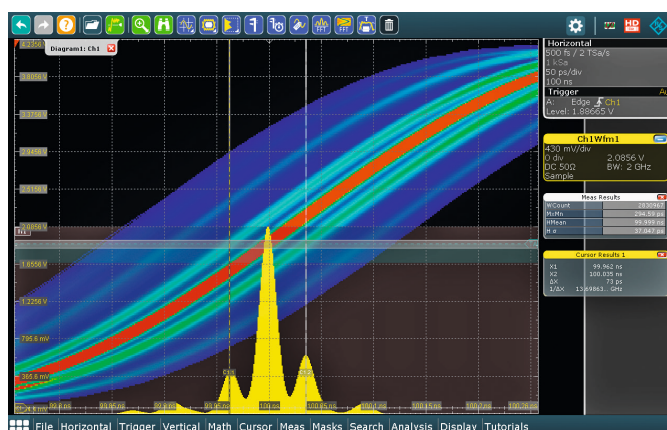
Wizard for easy configuration of measurements

All automatic jitter measurements are combined into a single group. Use the jitter wizard to configure typical measurements in just seconds. You decide how the results will be displayed, e.g. as a histogram.

Powerful analysis options

R&S®RTO oscilloscopes simplify detailed investigation of signals by providing a variety of graphical display options. The following displays and analysis options are available:

❙ Long-term trend: display of measurement results from different acquisitions in a separate figure to permit detection of slowly developing trends, such as thermal changes (automatic or manual scaling)

❙ Track: graphic display of a measurement over the entire acquisition time, e.g. frequency; display of results versus acquisition time

❙ Histogram: summation of measurement results in a bar graph; automatic or manual setting of number of histogram bins

❙ FFT on track: FFT analysis on the track curve of a measurement result; derivation of additional information such as the frequency of interference sources through jitter analysis

Jitter measurement functions	
Standard functions	**R&S®RTO-K12 option**
Period	cycle-cycle jitter
Frequency	N-cycle jitter
Setup	cycle-to-cycle width
Setup/hold time	cycle-cycle duty cycle
Setup/hold ratio	time interval error
	data rate
	unit interval
	skew delay
	skew phase

Clock data recovery for analyzing embedded clock signals in realtime

A number of serial interfaces use an embedded clock. The receiver must use clock data recovery to recover the clock signal from the transmitted signal. The R&S®RTO-K13 clock data recovery option simplifies characterization of these types of signals. It is part of the unique digital trigger architecture of the R&S®RTO and permits realtime clock recovery. As a result, eye and histogram measurements can be run continuously over a long period of time without postprocessing. The advantage: the hardware-based clock data recovery functions at the full acquisition rate without restricting the oscilloscope functions. A unique feature is the option to display the recovered embedded clock and analyze it in detail using all jitter measurements.

Serial pattern trigger

Combine the R&S®RTO with the optional hardware-based clock data recovery or the parallel clock signal to trigger on any serial interface telegram pattern of up to 16 byte with bit rates between 100 kbit and 2.5 Gbit. All analysis options remain available. Use jitter measurements, for example, to determine the influence of specific bit sequences on the protocol clock.

Extensible for future applications

ı **On-site configuration of hardware options**
ı **Software applications on demand**
ı **Always up-to-date thanks to firmware updates**

On-site configuration of hardware options

The R&S®RTO is easy to adapt to new requirements. The unique plug & play concept makes it easy to upgrade and retrofit options. All hardware options, such as the digital channels for logic analysis or the 10 MHz OCXO reference clock, are simply inserted into the slots on the rear panel without opening the oscilloscope. This approach has many advantages:

ı Easy extensibility for future tasks
ı On-site installation of options in minutes
ı No need for alignment or recalibration after installation of options

Software applications on demand

The base unit features all functions of a state-of-the-art oscilloscope for general applications. Add software options at any time to cover special requirements:

ı Triggering and decoding of serial protocols such as I^{2}C, SPI and CAN
ı Automatic compliance tests on fast interfaces, including USB and Ethernet
ı Detailed options for jitter analysis and power analysis
ı Spectrum and signal analysis

Always up-to-date

Rohde & Schwarz continually offers regular firmware updates to add additional basic functions to the R&S®RTO oscilloscopes. The oscilloscope's firmware is updated using a USB storage device or the LAN port. Simply downlad the free firmware updates at www.rohde-schwarz.com. Your R&S®RTO oscilloscope always remains up-to-date.

Exchangeable solid state disk

No tools are needed to exchange the R&S®RTO hard disk. Confidential data remains protected.

Easy bandwidth upgrading for faster signals

Sometimes investment budgets are limited, or not all future bandwidth requirements are known at the time of purchase. Options are available to upgrade the bandwidth of all R&S®RTO oscilloscopes. An R&S®RTO2004 oscilloscope with 600 MHz bandwidth, for example, can be upgraded to 6 GHz. All upgrade options include a complete check of the instrument and calibration at a Rohde & Schwarz service center.

No tools are needed to remove the hard disk.

Powerful probes

ı **Extensive probe range for all measurement tasks**
ı **Addressing high-speed probing challenges**
ı **Complete probe portfolio for power measurements**

Extensive probe range for all measurement tasks

Rohde & Schwarz offers a complete portfolio of high-quality passive and active probes for all measurement tasks. The crucial parameters for probes are bandwidth, input impedance and dynamic range. With an input impedance of 1 MΩ, the active probes put only a minimum load on a signal source's operating point. And the very large vertical dynamic range, even at high frequencies, prevents signal distortion – for example: 16 V (V_{pp}) at 1 GHz for the active single-ended probes.

Addressing high-speed probing challenges

The R&S®RT-ZM modular probe system delivers high performance in combination with flexible and configurable connectivity. It includes probe tip modules for various measurement tasks and conditions. The probe tip modules can be connected to amplifier modules with bandwidths ranging from 1.5 GHz to 9 GHz. The modular probe system also offers multimode functionality so you can switch between the different measurement modes: single ended, differential and common mode. Perform high-precision DC voltage measurements with 0.01 % measurement accuracy with the integrated R&S®ProbeMeter.

Complete portfolio for power measurements

Dedicated probes for power measurements include active and passive probes for the different voltage and current ranges from µA to kA and from µV to kV. In addition, Rohde & Schwarz offers dedicated power rail probes to detect even small or sporadic distortions on DC power rails.

Recommended probes

Probe type	Ideal for measuring	Recommended probes
Standard passive	single-ended voltages, max. 500 MHz	R&S®RT-ZP10, R&S®RT-ZP1x, R&S®RT-ZP03
Passive broadband	single-ended, up to 8 GHz	R&S®RT-ZZ80
Active broadband	single-ended and differential voltage, up to 6 GHz	R&S®RT-ZS10E, R&S®RT-ZS10, R&S®RT-ZS20, R&S®RT-ZS30, R&S®RT-ZS40, R&S®RT-ZS60
		R&S®RT-ZD10, R&S®RT-ZD20, R&S®RT-ZD30, R&S®RT-ZD40
Modular broadband	differential, single-ended or common mode voltage, up to 9 GHz	R&S®RT-ZM15, R&S®RT-ZM30, R&S®RT-ZM60, R&S®RT-ZM90
Power integrity	disturbance on power rail with high offset signals	R&S®RT-ZPR20
Multi-channel power	multichannel power consumption	R&S®RT-ZVC02, R&S®RT-ZVC04
High voltage	high voltage single-ended and differential, up to 1 kV (RMS)	R&S®RT-ZH10, R&S®RT-ZH11, R&S®RT-ZD01
Current	current measurements	R&S®RT-ZC05B, R&S®RT-ZC10, R&S®RT-ZC10B, R&S®RT-ZC15B, R&S®RT-ZC20, R&S®RT-ZC20B, R&S®RT-ZC30
EMC near-field	EMI debugging, up to 3 GHz	R&S®HZ-15

▷ For more information, see the product brochure: Probes and accessories; Rohde & Schwarz digital oscilloscopes (PD 3606.8866.12).

Extensive range
of accessories

Safe transport and easy rackmounting

Thanks to an extensive selection of storage and transport accessories, the R&S®RTO is always fully protected and easy to transport. The rackmount kit makes it easy to install the oscilloscope in systems. Store active, passive and logic probes in a special pouch on the rear panel of the R&S®RTO for easy accessibility.

Accessories	
Front cover, for R&S®RTO/RTE digital oscilloscopes	R&S®RTO-Z1
Soft case, for R&S®RTO/RTE digital oscilloscopes and accessories	R&S®RTO-Z3
Transit case, with trolley function, for R&S®RTO/RTE digital oscilloscopes and accessories	R&S®RTO-Z4
Probe pouch, for R&S®RTO/RTE digital oscilloscopes	R&S®RTO-Z5
19" rackmount kit, for R&S®RTO/RTE digital oscilloscopes with 6 HU	R&S®ZZA-RTO

Specifications in brief

Specifications in brief			
Vertical system			
Number of channels	R&S®RTO2002/2012/2022/2032	2	
	R&S®RTO2004/2014/2024/2034/2044/2064	4	
Analog bandwidth (–3 dB) and rise time at 50 Ω	R&S®RTO2002 and R&S®RTO2004	600 MHz	583 ps
	R&S®RTO2012 and R&S®RTO2014	1 GHz	350 ps
	R&S®RTO2022 and R&S®RTO2024	2 GHz	175 ps
	R&S®RTO2032 and R&S®RTO2034	3 GHz	116 ps
	R&S®RTO2044	4 GHz	100 ps
	R&S®RTO2064	on 4 channels: 4 GHz, on 2 channels: 6 GHz	76 ps
All instruments can be extended to up to 6 GHz bandwidth.			
Impedance		50 Ω ± 1.5%, 1 MΩ ± 1% at 15 pF (meas.)	
Input sensitivity	max. bandwidth in all ranges	50 Ω: 1 mV/div to 1 V/div, 500 µV to 1 V (optional); 1 MΩ: 1 mV/div to 10 V/div, 500 µV to 10 V (optional)	
ENOB of A/D converter	full-scale sine wave, < –3 dB frequency bandwidth	> 7 bit (meas.)	
Acquisition system			
Realtime sampling rate	R&S®RTO200x/201x/202x/203x	max. 10 Gsample/s on each channel	
	R&S®RTO2044/2064	max. 10 Gsample/s on 4 channels, max. 20 Gsample/s on 2 channels	
Acquisition memory	standard configuration, per channel/1 channel active	R&S®RTO 2-channel model: 50/100 Msample, R&S®RTO 4-channel model: 50/200 Msample	
	max. upgrade (R&S®RTO-B110 option), per channel/1 channel active	R&S®RTO 2-channel model: 1/2 Gsample, R&S®RTO 4-channel model: 1/2 Gsample	
Max. acquisition rate	continuous acquisition and display, 10 Gsample/s, 1 ksample	1 000 000 waveforms/s	
	ultra-segmented mode	< 300 ns blind time	
Decimation mode	any combination of decimation mode and waveform arithmetics on up to 3 waveforms per channel	sample, peak detect, high resolution, root mean square	
Waveform arithmetics		off, envelope, average	
Interpolation modes		linear, sin(x)/x, sample & hold	
Horizontal system			
Timebase range		25 ps/div to 10 000 s/div	
Accuracy	after delivery/calibration	±5 ppm	
	R&S®RTO-B4 option	±0.02 ppm	
Trigger system			
Trigger types		edge, glitch, width, runt, window, timeout, interval, slew rate, data2clock, pattern, state, serial pattern, TV/video, serial bus trigger (optional), zone trigger (optional)	
Zone trigger (optional)		logical combination of max. 8 polygons, intersect or not intersect source: measurement channels, spectrum, math functions	
Sensitivity	definition of trigger hysteresis	automatic or manually adjustable from 0 div to 5 div	
General data			
Dimensions	W × H × D	427 mm × 249 mm × 204 mm (16.81 in × 9.8 in × 8.03 in)	
Weight		9.6 kg (21.2 lb)	
Screen		12.1" LC TFT capacitive color touchscreen, 1280 × 800 pixel (XGA)	
Interfaces		1 Gbps LAN, type A: 2 × USB 3.1, 2 × USB 2.0, type B: 1 × USB 3.1, GPIB (optional), DVI and display port for external monitor, external trigger, trigger output	

Oscilloscope portfolio

R&S® family	RTH1000	HMO1002	HMO1202	RTB2000	HMO3000
Vertical					
Bandwidth	60/100/200/350/500 MHz [1]	50/70/100 MHz [1]	100/200/300 MHz [1]	70/100//200/300 MHz [1]	300/400/500 MHz [1]
Number of channels	2 plus DMM/4	2		2/4	2/4
V/div 1 MΩ	2 mV to 100 V	1 mV to 10 V		1 mV to 5 V	1 mV to 5 V
V/div 50 Ω	–	–	1 mV to 10 V	–	1 mV to 5 V
Horizontal					
Sampling rate	1.25 Gsample/s per channel (4-channel model); 2.5 Gsample/s per channel (2-channel model); 5 Gsample/s (all channels interleaved)	500 Msample/s per channel 1 Gsample/s (2 channels interleaved)	1 Gsample/s per channel 2 Gsample/s (2 channels interleaved)	1.25 Gsample/s per channel; 2.5 Gsample/s (2 channels interleaved)	2 Gsample/s per channel; 4 Gsample/s (2 channels interleaved)
Max. memory (per channel/1 channel active)	125 ksample (4-channel model); 250 ksample (2-channel model); 500 ksample	500 ksample; 1 Msample	1 Msample; 2 Msample	10 Msample; 20 Msample (160 Msample in segmented memory mode [2])	4 Msample; 8 Msample
Segmented memory	option	–		option	option
Acquisition rate	50 000 waveforms/s	10 000 waveforms/s		50 000 waveforms/s	5000 waveforms/s (200 000 waveforms/s in segmented memory mode [2])
Trigger					
Options	advanced, digital trigger (14 trigger types) [2]	elementary (5 trigger types)		basic (6 trigger types)	basic (9 trigger types)
Mixed signal option					
No. of digital channels [1]	8			16	16
Sampling rate of digital channels	1.25 Gsample/s	500 Msample/s	1 Gsample/s	1.25 Gsample/s	1 Gsample/s
Max. memory of digital channels	125 ksample	500 ksample	1 Msample	10 Msample	2 Msample
Analysis					
Cursor meas. types	3	11		13	12
Stand. meas. functions	33	31			
Mask test	elementary (tolerance mask around the signal)				
Mathematics	elementary		basic (math on math)	elementary	
Serial protocols triggering and decoding [1]	I²C, SPI, UART/RS-232/RS-422/RS-485, CAN/LIN				
Display functions	data logger	–		–	–
Applications [1]	high resolution frequency counter, advanced spectrum analysis, harmonics analysis	–		–	–
Compliance testing [1]	–	–		–	–
Display and operation					
Size and resolution	7", color, 800 × 480 pixel	6.5", color, 640 × 480 pixel		10.1", color, 1280 × 800 pixel	6.5", color, 640 × 480 pixel
Operation	optimized for touchscreen operation, parallel button operation	optimized for fast button operation		optimized for touchscreen operation, parallel button operation	optimized for fast button operation
General data					
Size in mm (W × H × D)	201 × 293 × 74	285 × 175 × 140		390 × 220 × 152	285 × 175 × 220
Weight in kg	2.4	2.5		2.5	3.6
Battery	lithium-ion, > 4 h	–		–	–

[1] Upgradeable.   [2] Requires an option.

RTM2000	RTE1000	RTO2000
200/350/500 MHz/1 GHz [1]	200/350/500 MHz/1/1.5/2 GHz [1]	600 MHz/1/2/3/4/6 GHz [1]
2/4	2/4	2/4 (only 4 channels in 4 GHz and 6 GHz model)
1 mV to 10 V	500 µV to 10 V	1 mV to 10 V (500 µV to 10 V) [2]
1 mV to 2 V	500 µV to 5 V	1 mV to 1 V (500 µV to 1 V) [2]
2.5 Gsample/s per channel; 5 Gsample/s (2 channels interleaved)	5 Gsample/s per channel	10 Gsample/s per channel; 20 Gsample/s (2 channels interleaved in 4 GHz and 6 GHz model)
10 Msample; 20 Msample (460 Msample in segmented memory mode [2])	standard: 10 Msample/40 Msample; max. upgrade: 50 Msample/200 Msample	standard: 50 Msample/200 Msample; max. upgrade: 1 Gsample/2 Gsample
option	standard	standard
12 500 waveforms/s (200 000 waveforms/s in segmented memory mode [2])	1 000 000 waveforms/s (2 000 000 waveforms/s in ultra-segmented memory mode)	1 000 000 waveforms/s (3 000 000 waveforms/s in ultra-segmented memory mode)
basic (7 trigger types)	advanced, digital trigger (13 trigger types)	advanced, digital trigger (14 trigger types), zone trigger [2]
16	16	16
2.5 Gsample/s	5 Gsample/s	5 Gsample/s
10 Msample; 20 Msample	100 Msample	200 Msample
14	3	3
31	47	47
elementary (tolerance mask around the signal)	advanced (freely configurable, hardware-based)	
basic (math on math)	advanced (formula editor)	advanced (formula editor)
I²C, SPI, UART/RS-232/RS-422/RS-485, CAN/LIN, I²S, MIL-STD-1553, ARINC 429	I²C, SPI, UART/RS-232/RS-422/RS-485, CAN/LIN, I²S, MIL-STD-1553, ARINC 429, FlexRay™, CAN FD, USB 2.0/HSIC, Ethernet, Manchester, NRZ, SENT, SpaceWire, CXPI, Broad-R Reach®	I²C, SPI, UART/RS-232/RS-422/RS-485, CAN/LIN, I²S, MIL-STD-1553, ARINC 429, FlexRay™, CAN FD, USB 2.0/HSIC, Ethernet, Manchester, NRZ, SENT, SpaceWire, CXPI, Broad-R Reach®, MIPI RFFE, MDIO, 8b 10b, MIPI D-PHY, MIPI M-PHY, MIPI M-PHY/UniPro, serial pattern trigger
track [2]	histogram, trend, track [2]	
power, digital voltmeter (DVM), spectrum analysis and spectrogram	R&S®RTM applications + 16-bit high definition, advanced spectrum analysis and spectrogram	R&S®RTE applications + jitter, clock data recovery, I/Q data, RF analysis
–	–	various options available, for details see data sheet (PD 3607.2684.22)
8.4", color, 1024 × 768 pixel	10.4", color, 1024 × 768 pixel	12.1", color, 1280 × 800 pixel
optimized for fast button operation	optimized for touchscreen operation, parallel button operation	
403 × 189 × 142	427 × 249 × 204	427 × 249 × 204
4.9	8.6	9.6
–	–	–

Ordering information

Step 1: choose needed bandwidth and channels

	2 channels	4 channels
600 MHz	R&S®RTO2002	R&S®RTO2004
1 GHz	R&S®RTO2012	R&S®RTO2014
2 GHz	R&S®RTO2022	R&S®RTO2024
3 GHz	R&S®RTO2032	R&S®RTO2034
4 GHz	–	R&S®RTO2044
6 GHz	–	R&S®RTO2064

Step 2: choose most frequently used options

Mixed signal option	R&S®RTO-B1
OCXO 10 MHz	R&S®RTO-B4
High definition mode	R&S®RTO-K17
Arbitrary waveform generator	R&S®RTO-B6

Step 3: choose software options

Triggering and decoding		Compliance	Test fixture set
Embedded			
I²C/SPI	R&S®RTO-K1	–	–
UART/RS-232/422/485	R&S®RTO-K2	–	–
10/100 Mbit Ethernet	R&S®RTO-K8	R&S®RTO-K22	R&S®RT-ZF2
1 Gbit Ethernet	–	R&S®RTO-K22	R&S®RT-ZF2, R&S®RT-ZF2C
10 Gbit Ethernet	–	R&S®RTO-K23	R&S®RT-ZF2
10M/100M/1GBASE-T Energy Efficient Ethernet	–	R&S®RTO-K86	R&S®RT-ZF4, R&S®RT-ZF5
2.5G/5GBASE-T Ethernet	–	R&S®RTO-K25	R&S®RT-ZF2
8b10b	R&S®RTO-K52	–	–
MDIO	R&S®RTO-K55	–	–
USB 1.0/1.1/2.0/HSIC	R&S®RTO-K60	R&S®RTO-K21	R&S®RT-ZF1
USB 3.1 Gen 1	R&S®RTO-K61	–	–
USB-PD	R&S®RTO-K63	–	–
USB-SSIC	R&S®RTO-K64		
PCIe 1.x/2.x	R&S®RTO-K72	R&S®RTO-K81	–
eMMC (HS200, HS400)	–	R&S®RTO-K92	–
Automotive			
CAN/LIN (CAN-dbc)	R&S®RTO-K3	–	–
CAN-FD (CAN-dbc)	R&S®RTO-K9	–	–
SENT	R&S®RTO-K10	–	–
FlexRay™ (FIBEX)	R&S®RTO-K4	–	–
100BASE-T1/BroadR-Reach® Ethernet	R&S®RTO-K57	R&S®RTO-K24	ꞏ Compliance: R&S®RT-ZF2, R&S®RT-ZF3 ꞏ Trigger & decode: R&S®RT-ZF5
1000BASE-T1		R&S®RTO-K87	R&S®RT-ZF2, R&S®RT-ZF6
Audio			
I²S/LJ/RJ/TDM	R&S®RTO-K5	–	–
Aerospace			
MIL-STD-1553	R&S®RTO-K6	–	–
ARINC 429	R&S®RTO-K7	–	–
SpaceWire	R&S®RTO-K65	–	–
Mobile communications			
MIPI RFFE	R&S®RTO-K40	–	–
MIPI D-PHY	R&S®RTO-K42	R&S®RTO-K26	–
MIPI M-PHY	R&S®RTO-K44	–	–
Configurable			
Manchester, NRZ	R&S®RTO-K50	–	–
Analysis			
I/Q software interface	R&S®RTO-K11		
Jitter analysis	R&S®RTO-K12		
Clock data recovery	R&S®RTO-K13		
Spectrum analysis	R&S®RTO-K18		
Zone trigger	R&S®RTO-K19		
Power analysis	R&S®RTO-K31		

Step 3: choose software options

Signal analysis

Vector signal explorer software [1]	R&S®VSE
License dongle	R&S®FSPC
Pulse measurements	R&S®VSE-K6
Analog demodulation analysis	R&S®VSE-K7
GSM measurements	R&S®VSE-K10
Vector signal analysis	R&S®VSE-K70
3GPP FDD measurements	R&S®VSE-K72
IEEE 802.11a/b/g measurements	R&S®VSE-K91
IEEE 802.11n measurements	R&S®VSE-K91N
IEEE 802.11ac measurements	R&S®VSE-K91AC
IEEE 802.11p measurements	R&S®VSE-K91p
EUTRA/LTE FDD	R&S®VSE-K100
EUTRA/LTE-Advanced and MIMO	R&S®VSE-K102
EUTRA/LTE TDD	R&S®VSE-K104
Software maintenance	R&S®VSE-SWM
OFDM vector signal analysis software	R&S®FS-K96PC

[1] R&S®RTO-K11 option required.

Step 4: choose hardware options

GPIB Interface	R&S®RTO-B10
Replacement SSD (Windows 7)	R&S®RTO-B19
Memory upgrade	
100 Msample per channel	R&S®RTO-B101
200 Msample per channel	R&S®RTO-B102
400 Msample per channel	R&S®RTO-B104
1 Gsample per channel	R&S®RTO-B110

Step 5: choose probe and accessories

Standard accessories: R&S®RT-ZP10, accessories bag, quick start guide, power cord

Additional probes

▷ For more information, see the product brochure: Probes and accessories, Rohde & Schwarz digital oscilloscopes (PD 3606.8866.12).

Accessories

Front cover, for R&S®RTO/RTE digital oscilloscopes	R&S®RTO-Z1
Soft case, for R&S®RTO digital oscilloscopes and accessories	R&S®RTO-Z3
Transit case, for R&S®RTO/RTE digital oscilloscopes and accessories	R&S®RTO-Z4
Probe pouch, for R&S®RTO digital oscilloscopes	R&S®RTO-Z5

Step 6: choose warranty and services

Warranty		
Base unit		3 years
All other items [1]		1 year
Options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde & Schwarz sales representative.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended Warranty with Accredited Calibration Coverage, one year	R&S®AW1	
Extended Warranty with Accredited Calibration Coverage, two years	R&S®AW2	

[1] For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

Sustainable product design

▪ Environmental compatibility and eco-footprint
▪ Energy efficiency and low emissions
▪ Longevity and optimized total cost of ownership

Certified Quality Management	Certified Environmental Management
ISO 9001	ISO 14001

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