R&S®RTO2000 OSCILLOSCOPE

Turn your signals into success

3 year warranty

HD 16 bit

Multi Domain

ROHDE & SCHWARZ

Make ideas real

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.

BENEFITS

Best oscilloscope performance
► page 4

Widest range of capabilities
► page 7

Advanced user interface
► page 10

Engineered for power measurements
► page 16

Engineered for multi-domain challenges
► page 19

Extensible for future applications
► page 40

Powerful probes
► page 41

Extensive range of accessories
► page 42

Models

Base unit	Channels	Sampling rate	Acquisition emory	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 waveforms 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

▶ 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

## 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 50 Ω [1]	RMS noise floor at 50 Ω in % of measurement range [1]
10 mV measurement range (1 mV/div)		
1 GHz bandwidth	100 µV	1%
100 MHz bandwidth (HD)	10 µV	0.1%
100 mV measurement range (10 mV/div)		
1 GHz bandwidth	200 µV	0.2%
500 MHz bandwidth (HD)	110 µV	0.11%
1 V measurement range (100 mV/div)		
4 GHz bandwidth	3.6 mV	0.36%
6 GHz bandwidth	3.7 mV	0.37%

[1] Typical values.

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 a configurable hardware lowpass filter, increasing the vertical resolution to up to 16 bit and 9.4 ENOB. Since filtering reduces quantizing noise, signal details become visible.
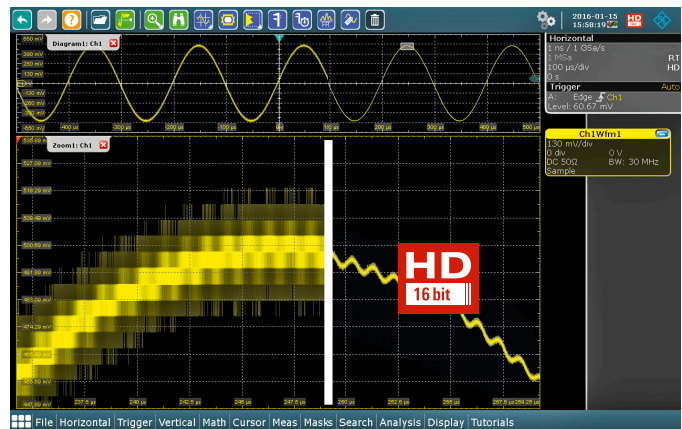

Trigger on any signal detail you can see

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. The trigger system runs in HD mode with up to 16-bit vertical resolution. This results in a very high trigger sensitivity. You can reliably isolate even the smallest signal details.
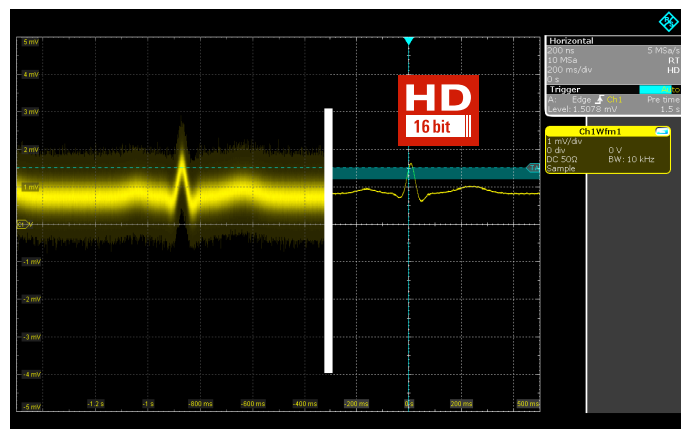
Quickly find signal faults with 1 million waveforms/s

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.
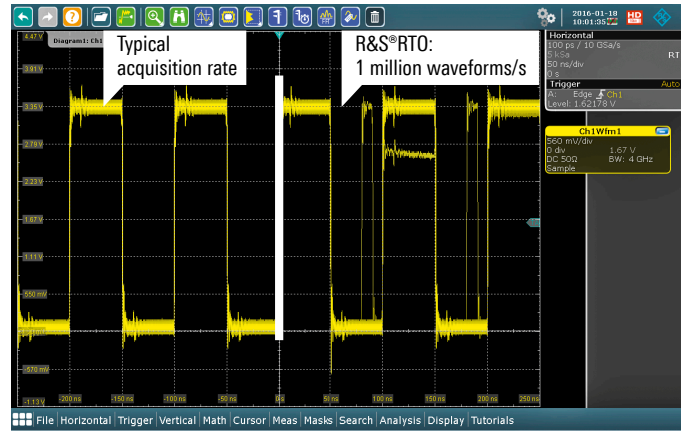
Integrated spectrum analysis

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.
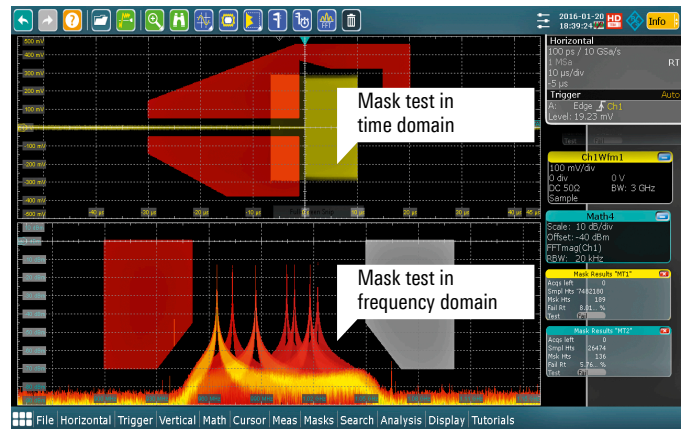
Flat frequency response and deembedding for accurate measurement results

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
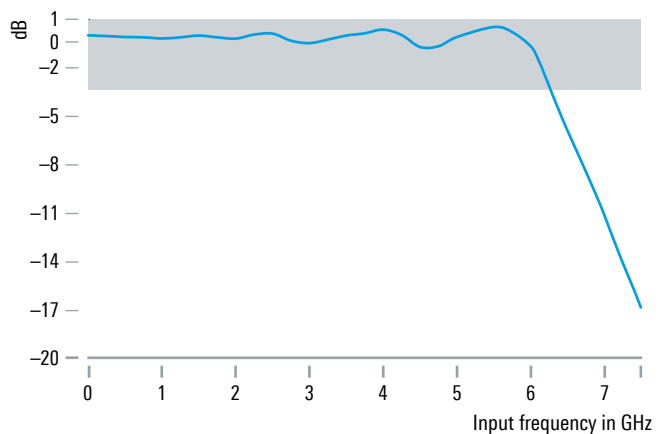
Deembedding for precise results

In addition, transmission losses caused by the signal path can be corrected by activating the deembedding software. For this, a cascade of signal path blocks can be defined. The individual blocks are described by S parameters that can be derived from simulation or measured with a vector network analyzer. The deembedding software automatically calculates the correction filter for the overall system response.

Real-time math for differential signals

The R&S®RTO features a math module directly before the trigger system. It supports add, subtract and common mode calculation for two input channels. This enables fast analysis of differential signals, including triggering on the differential or common mode voltage. Additionally, the math module allows inversion of the input signals.

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.
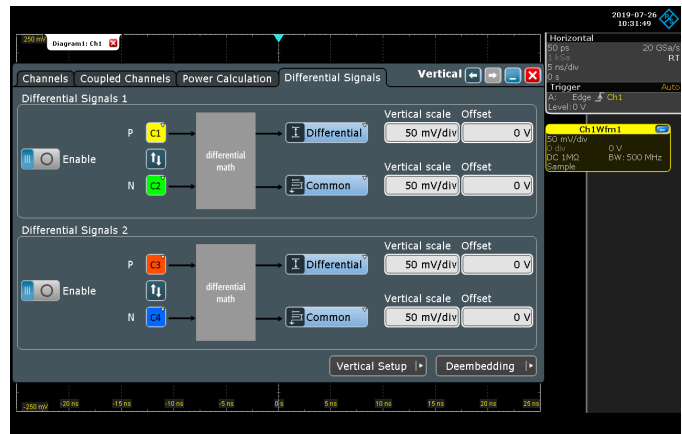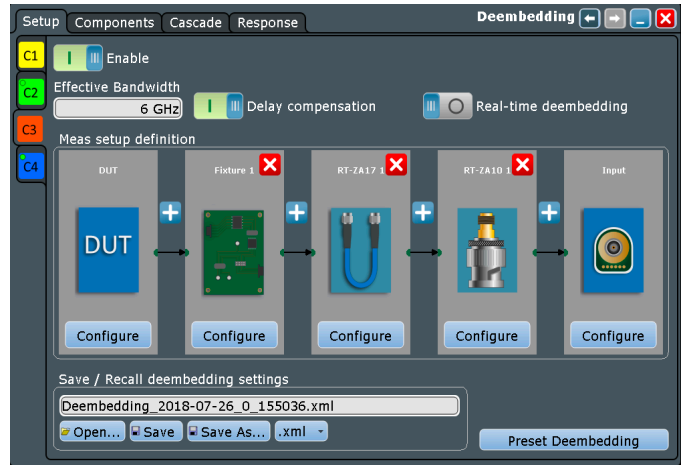
Excellent shielding to ensure low crosstalk even with high-frequency signals
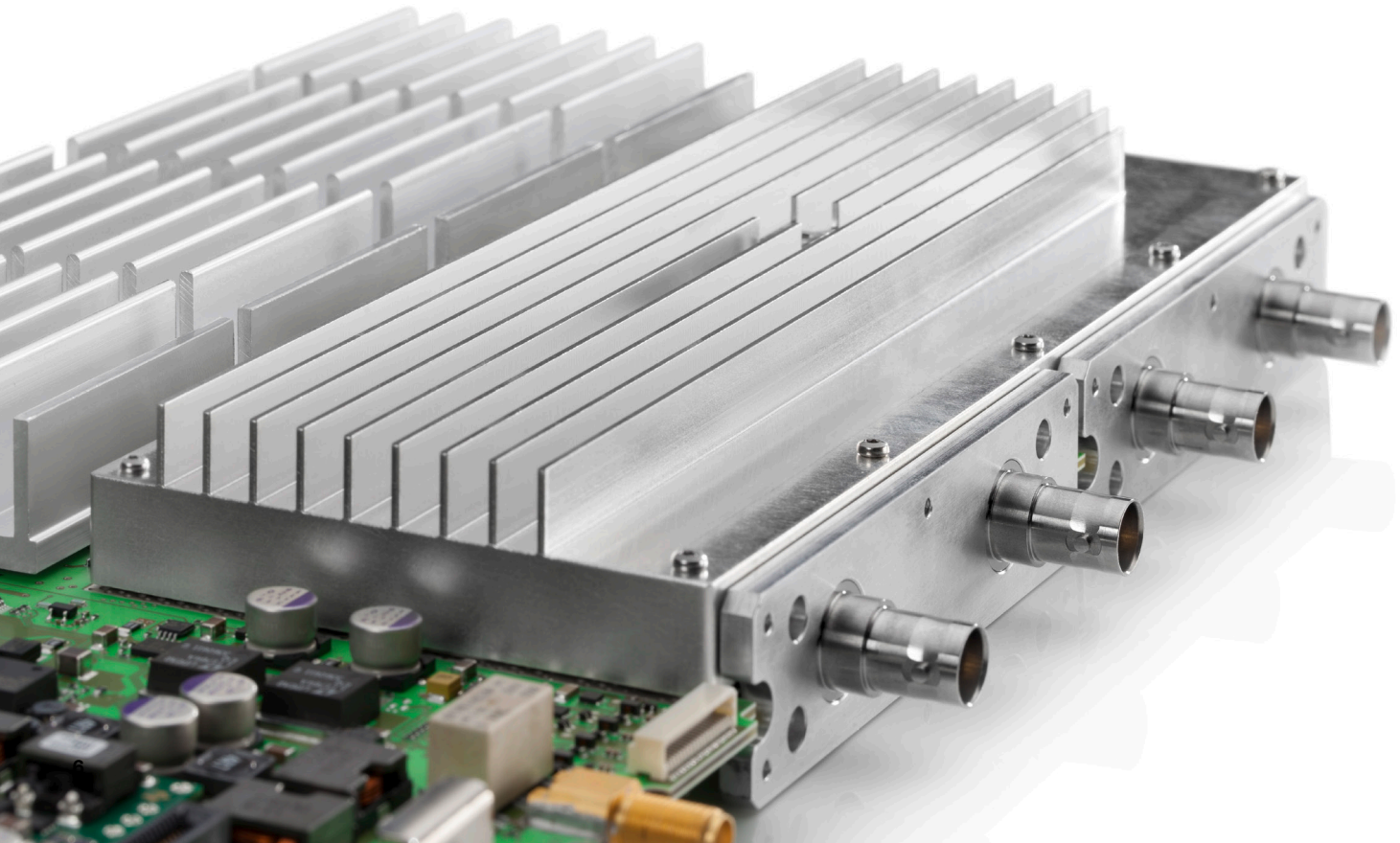
WIDEST RANGE OF CAPABILITIES

▶ **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**

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.

Oscilloscope performance comparison

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

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	

1   10   100   1000   10 000   100 000 1 000 000

Acquisition rate in waveforms/s

■ R&S®RTO   ■ Typical oscilloscope

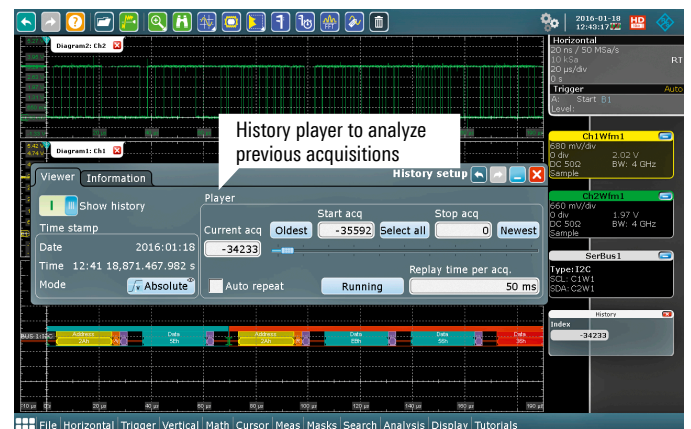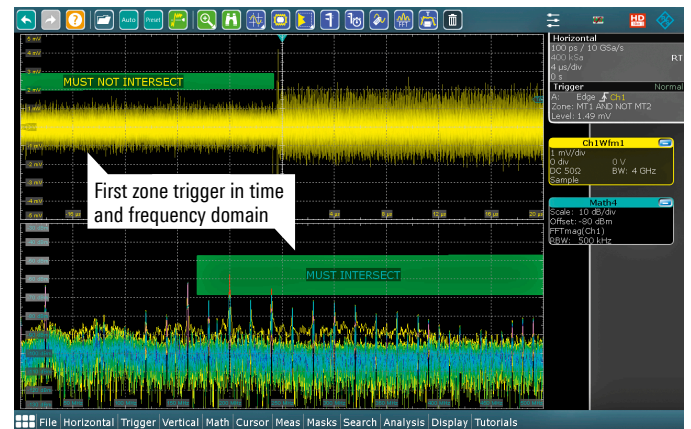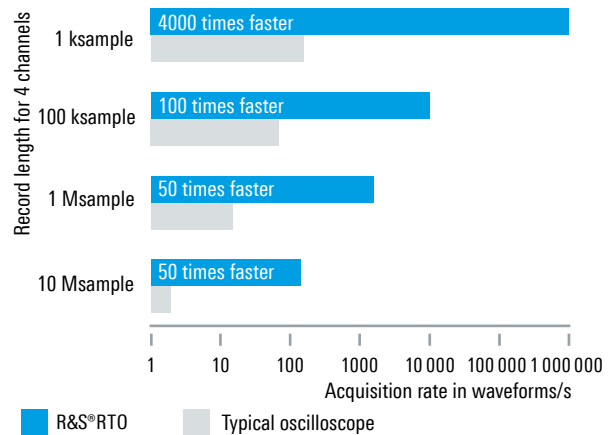## First zone trigger in time and frequency domain

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.

First zone trigger in time and frequency 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.


History player to analyze previous acquisitions

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.
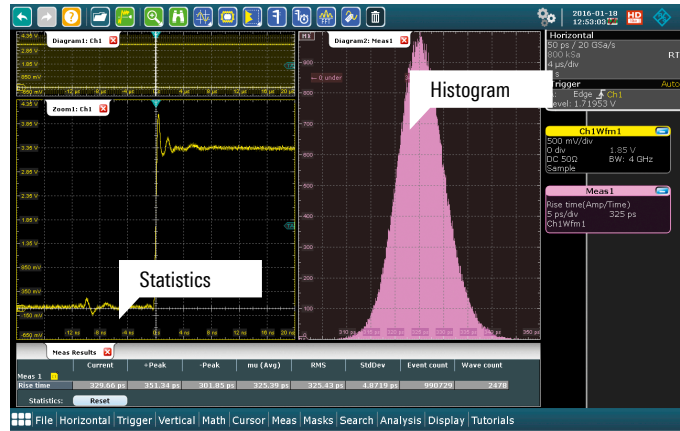

Available signal analysis options	
Statistics	display of average value, minimum/maximum value and standard deviation
Histogram	graphic display of events as histogram; definition of measurement range and resolution for the histogram (manual or automatic)
Trend	long-term trend function for analyzing slowly 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.
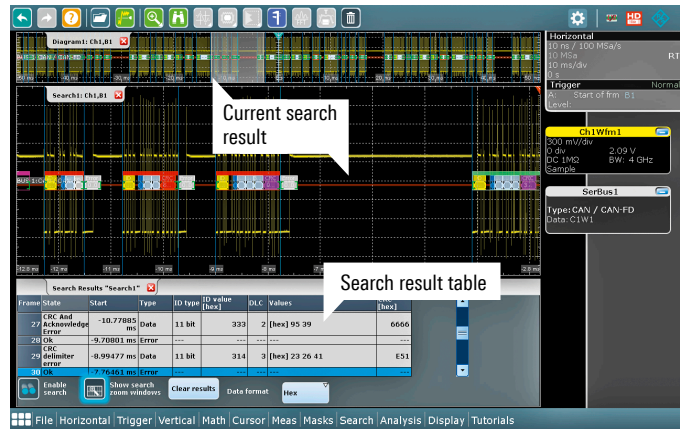
Industry-leading mask test: quick configuration – reliable results

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.
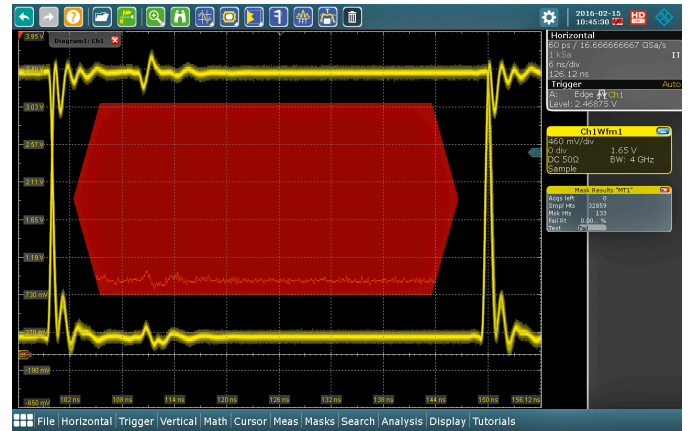
Save results fast

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		
Onefile	complete	stores waveform, setup, math channels, reference waveforms in one zip file
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**
▶ **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**

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.

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.
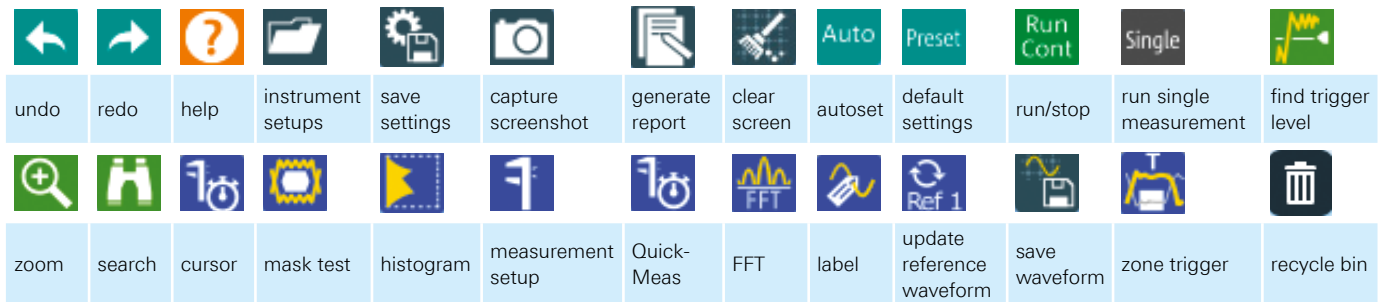

Labeled scales

Freely configurable display
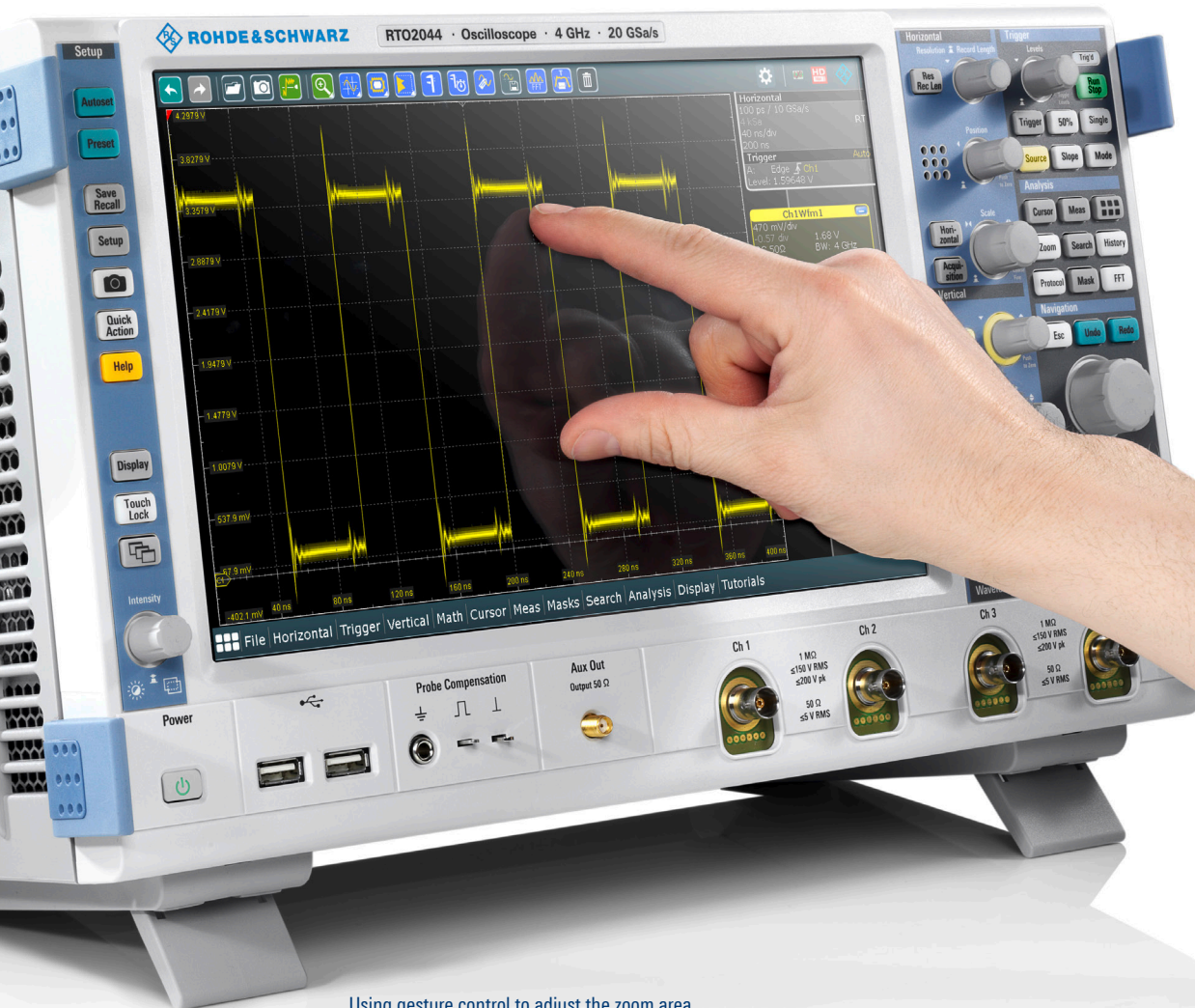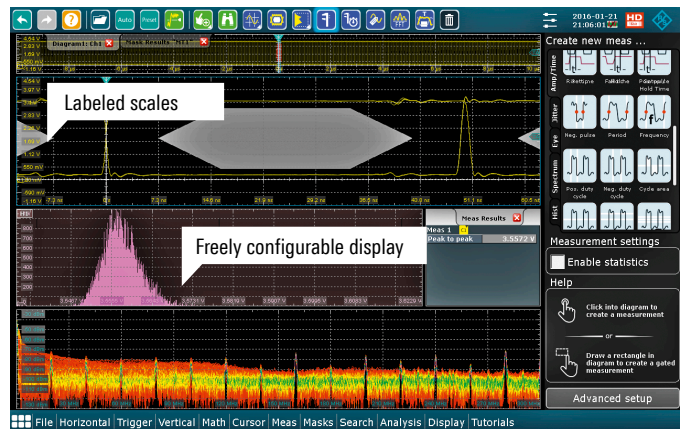
Using gesture control to adjust the zoom area

10

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	measurement setup	Quick-Meas	FFT	label	update reference 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
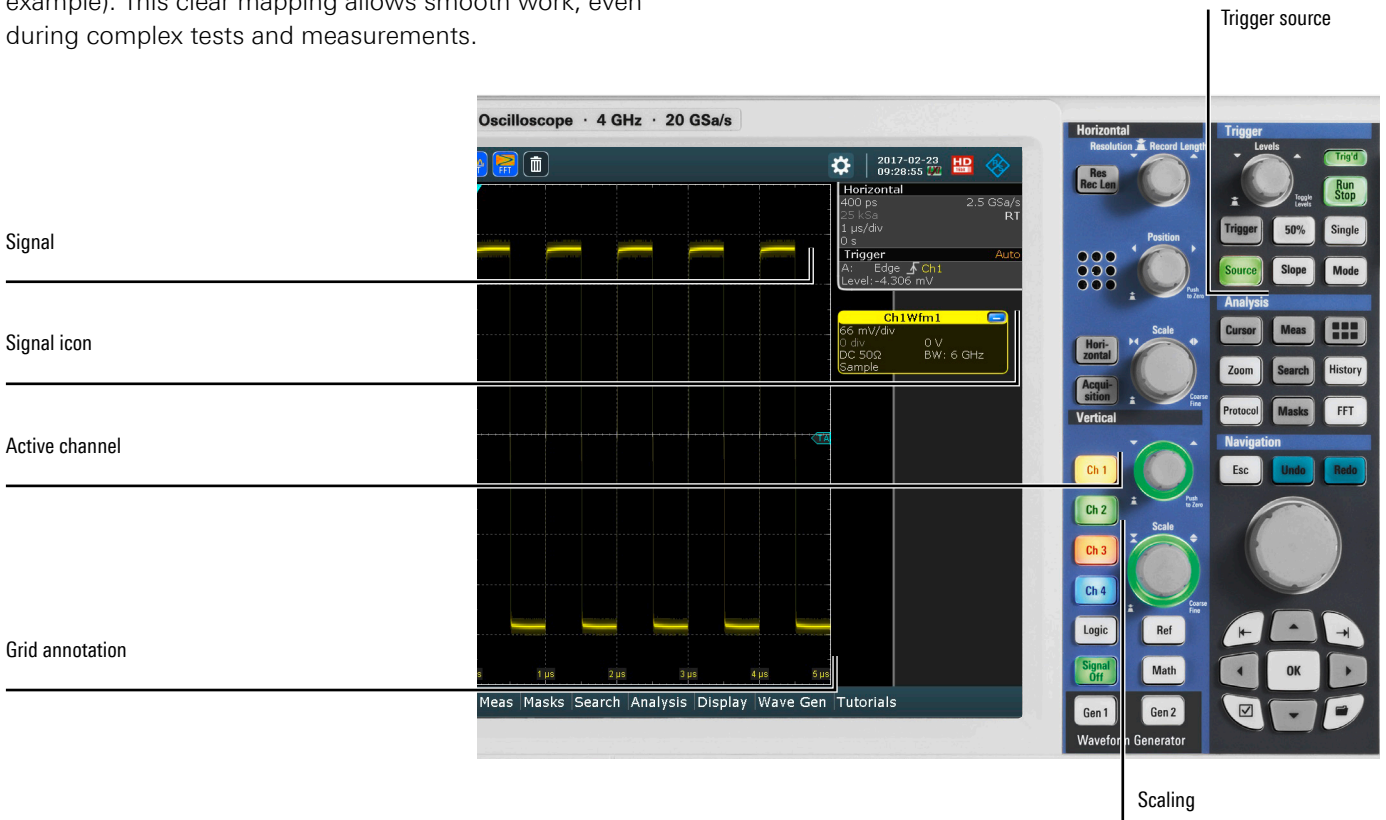
## App cockpit to quickly set up analysis functions

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
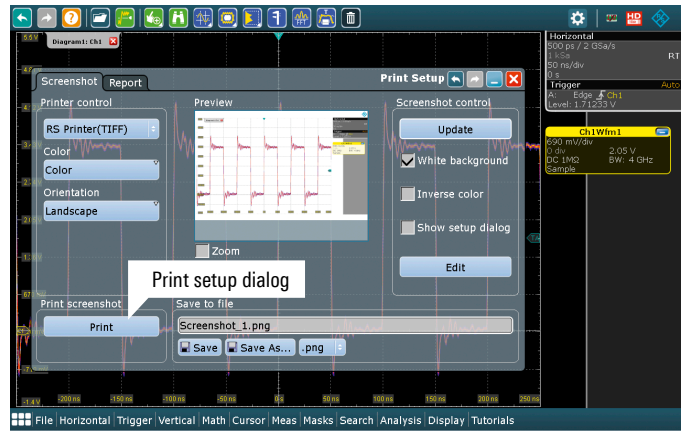
Dialog boxes with signal flow diagrams

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.
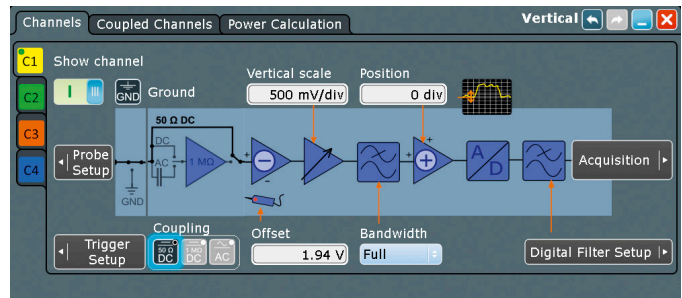
Easy selection of instrument setup

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.
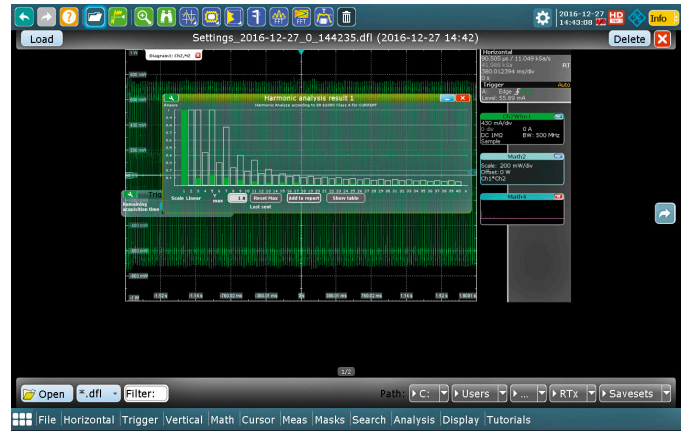
Remote control access, anytime

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
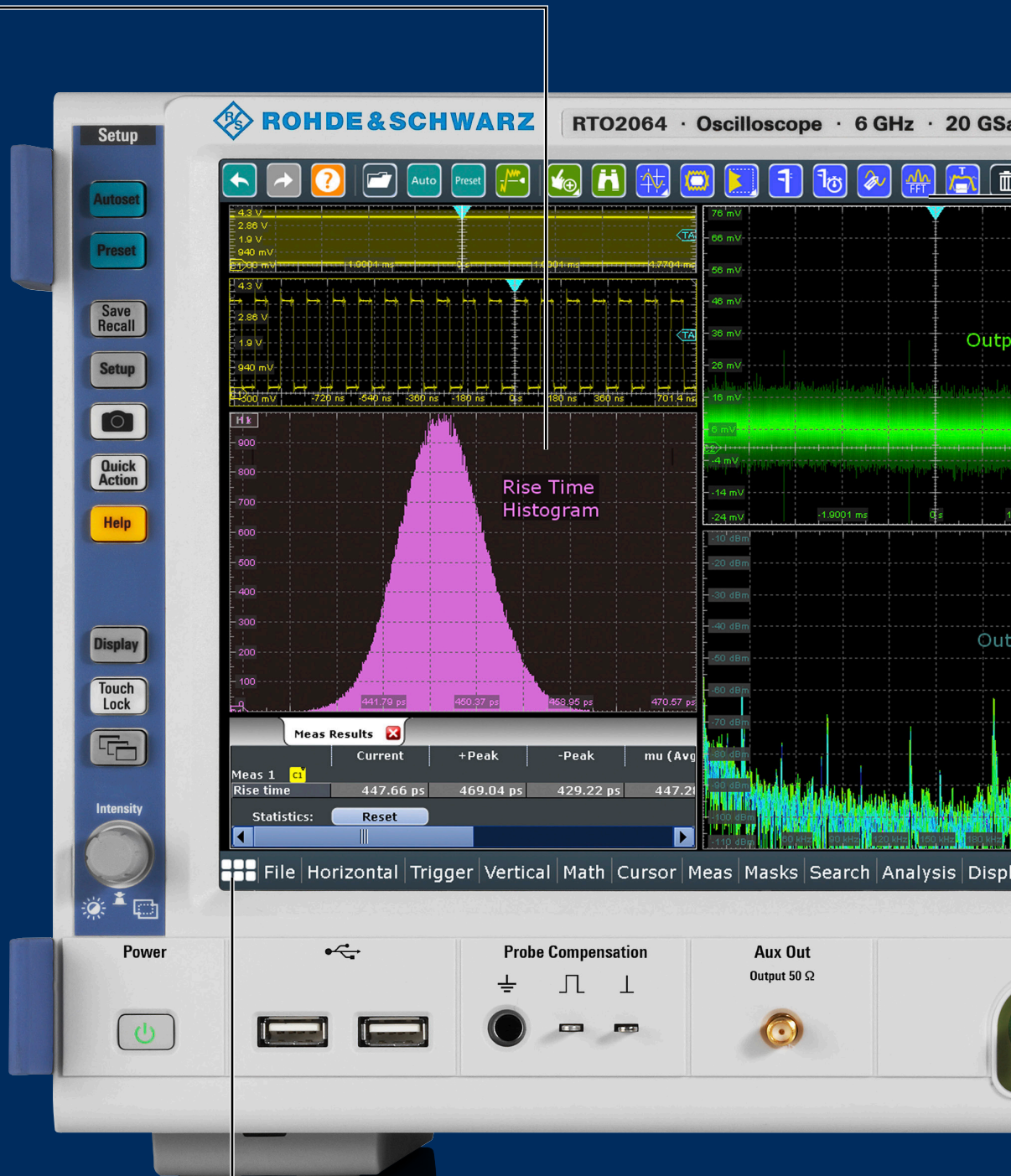
App cockpit to quickly set up analysis functions

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

Fast access to important tools
- ▶ Toolbar for quick access to functions
- ▶ Sidebar for easy configuration of a measurement

High-resolution capacitive touchscreen with gesture support
- ▶ Brilliant 12.1" screen
- ▶ Capacitive touchscreen
- ▶ Drag & drop signal placement
- ▶ Use gestures to scale and zoom

Clear orientation thanks to color coding
- ▶ Color-coded controls indicate the currently selected channel
- ▶ 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.
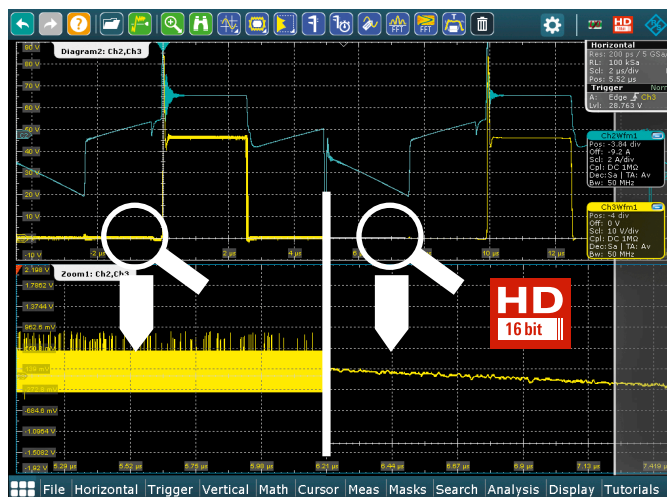
Analyze sporadic disturbances with the industry´s fastest oscilloscope

R&S®RTO oscilloscopes are optimized for fast results. They display up to 1 million waveforms/s. The fast 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.
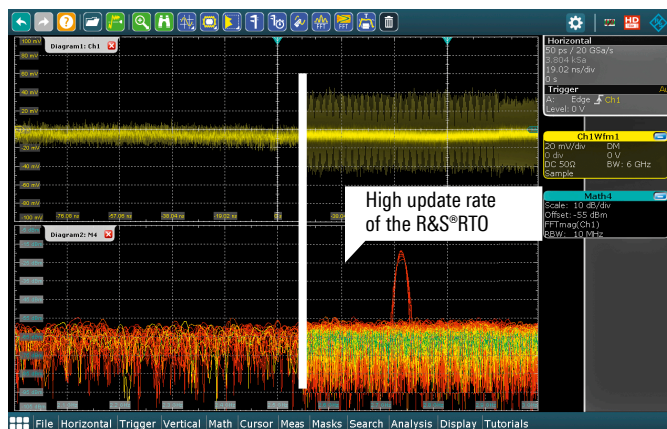
Complete probe portfolio for power measurements

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.
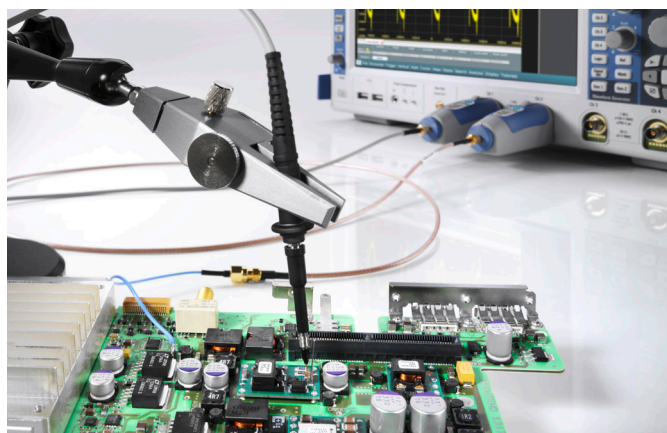
POWER INTEGRITY MEASUREMENTS

► **Large DC offsets with high-fidelity probes**
► **Accurately measure ripple and PARD**
► **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.
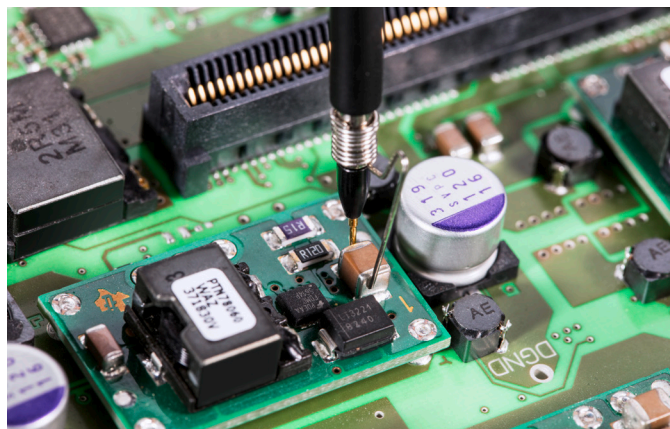
Accurately measure ripple and PARD

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.
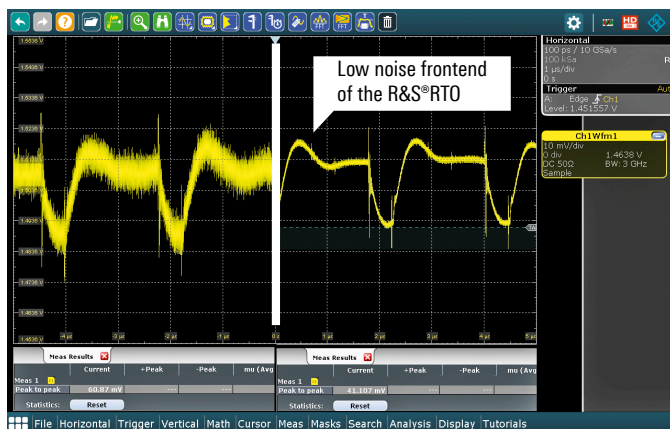
Find coupled sources

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.
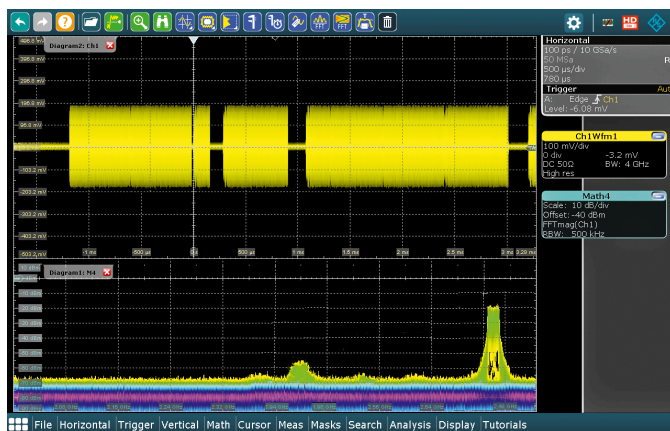
POWER MEASUREMENTS AND ANALYSIS

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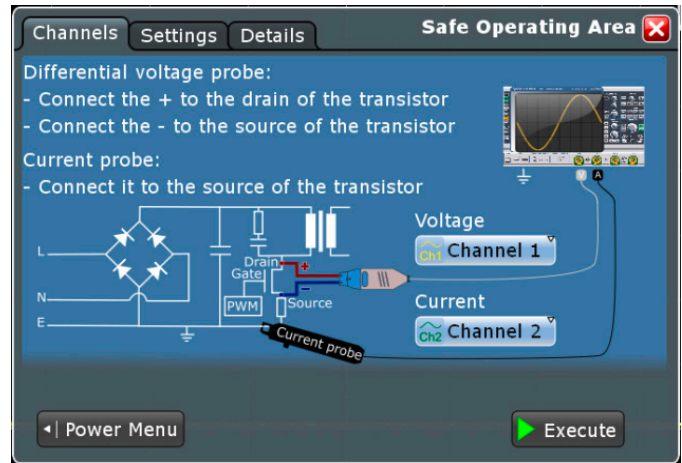
Harmonic current analysis in line with EN, MIL and RTCA standards

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 stan-
dards: EN 61000-3-2 classes A, B, C, D, MIL-STD-1399 and
RTCA DO-160.
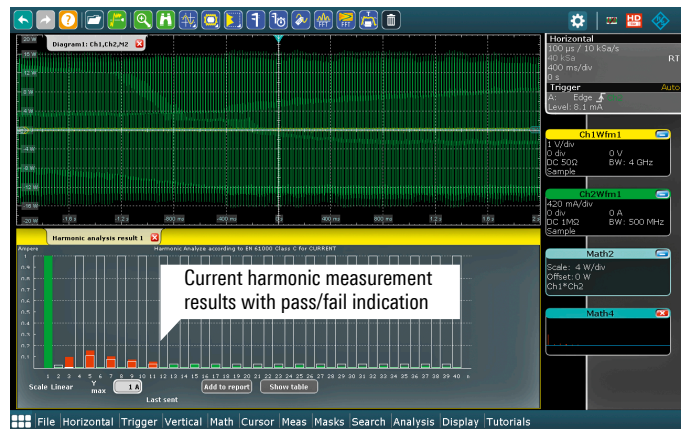
Easy and clear documentation of measurement results

Add each result to the test report by simply pressing a but-
ton. The test report documents the setup and configura-
tion. 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.
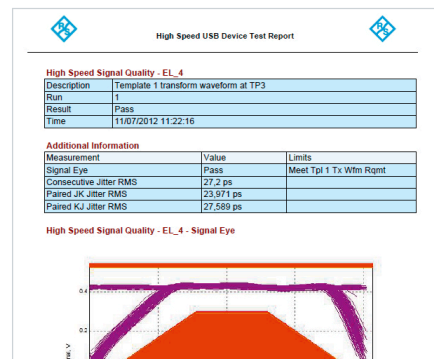
ENGINEERED FOR MULTI-DOMAIN CHALLENGES

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 appreciate 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

Analog
► Voltage and time measurements

Logic
► Data verification
► Timing verification
► Bus decoding

Protocol
► Protocol decoding
► Protocol triggering
► Symbol mapping

Frequency
► Spectrum analysis
► Signal analysis
► EMI debugging

Power
► Power consumption
► Power sequencing
► Power integrity

Generator
► Reference clock
► Arbitrary waveforms
► Modulated signals
► Protocol pattern

Pulse source
► Input characterization
► Deskew
► TDR/TDT

MSO ANALYSIS: UNRIVALED IN ITS CLASS

▶ **Every R&S®RTO can be enhanced to include a mixed signal option**
▶ **More signal details thanks to high time resolution over the entire memory depth**
▶ **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.

Zoom of 2 ns glitch at −93 ms

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.
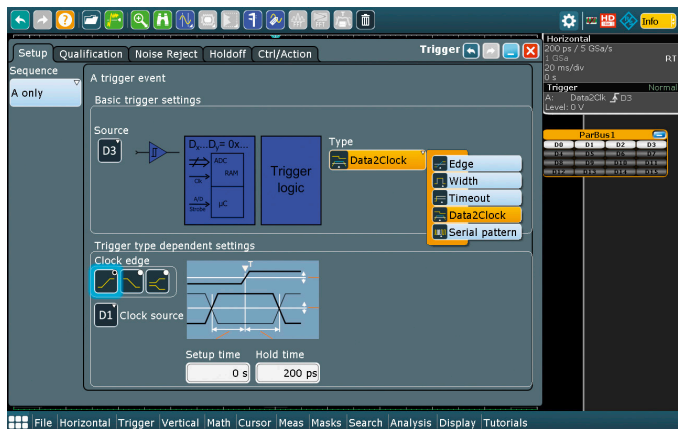
Straightforward display of digital signals

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
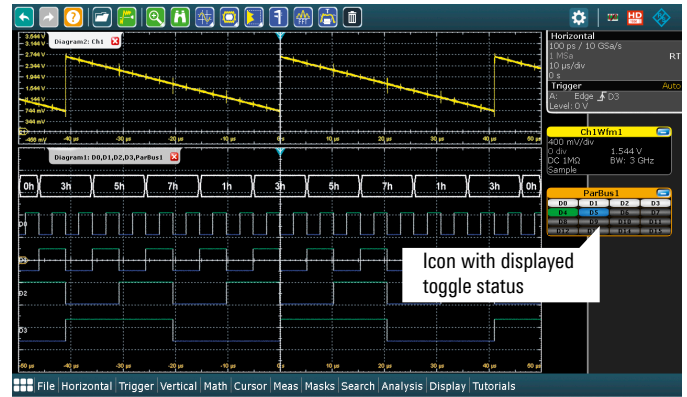
R&S®RTO-B1 MSO option

▶ 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

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 I^{2}C.

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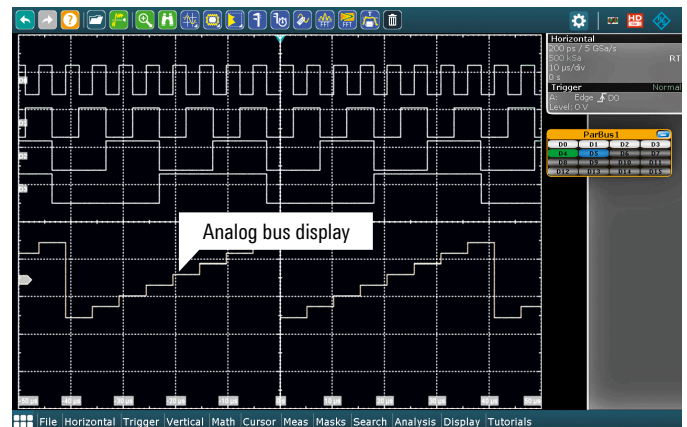
Low test point loading due to active probe solution

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.

HD 16 bit
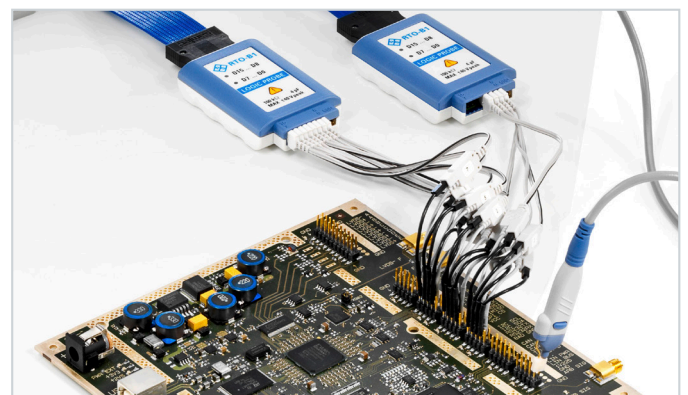
HIGH DEFINITION: SEE MORE WITH UP TO 16-bit RESOLUTION

▶ **Increased resolution for precise measurement of small signal amplitudes**
▶ **16-bit vertical resolution available**
▶ **No aliasing**
▶ **Real-time 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.
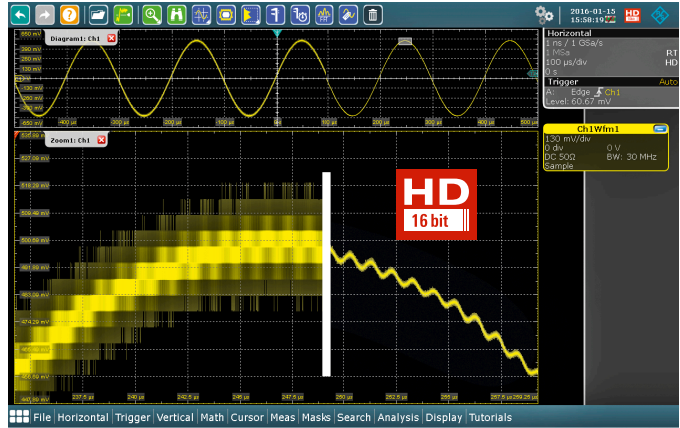
16-bit vertical resolution available

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 real time, 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.
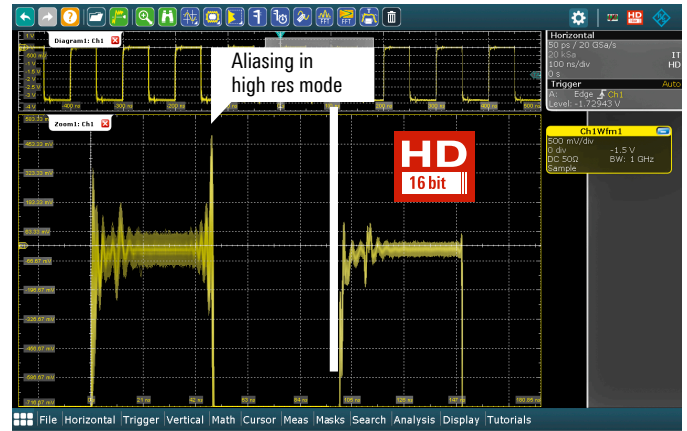
Real-time triggering on smallest signal details

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.
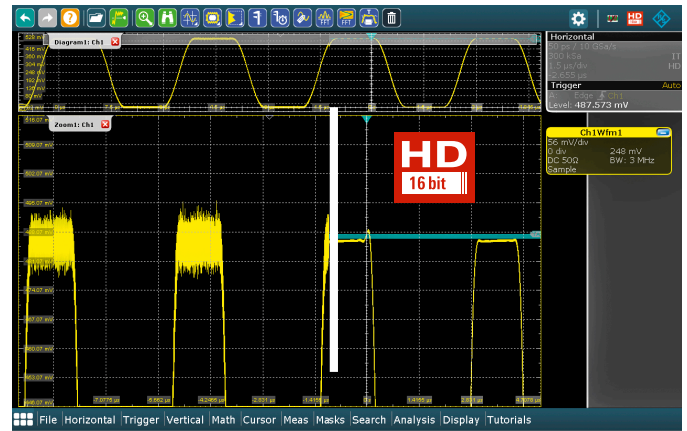
High acquisition rate and full functionality for fast measurement results

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 real time 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 [1]

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

[1] At 1 Msample, 2.5 Gsample/s.

Waveform update rate in waveforms/s

■ R&S®RTO   ■ Typical oscilloscope
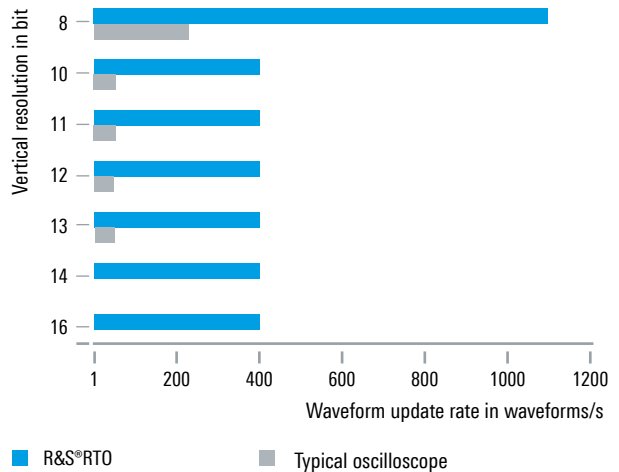
SPECTRUM ANALYSIS

► **Multichannel spectrum analysis**
► **Set up as a spectrum analyzer**
► **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.
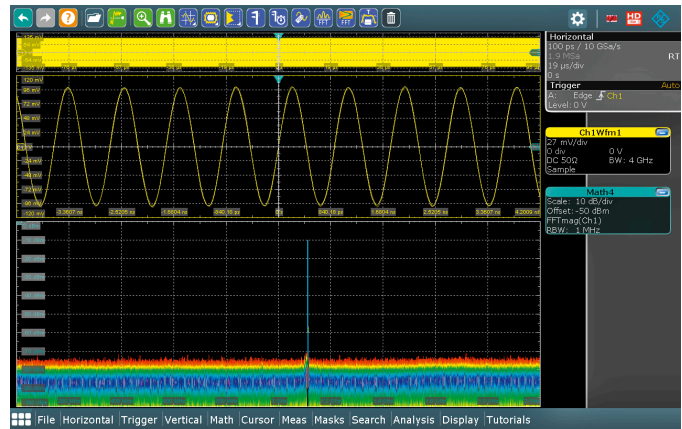
Set up as a spectrum analyzer

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.
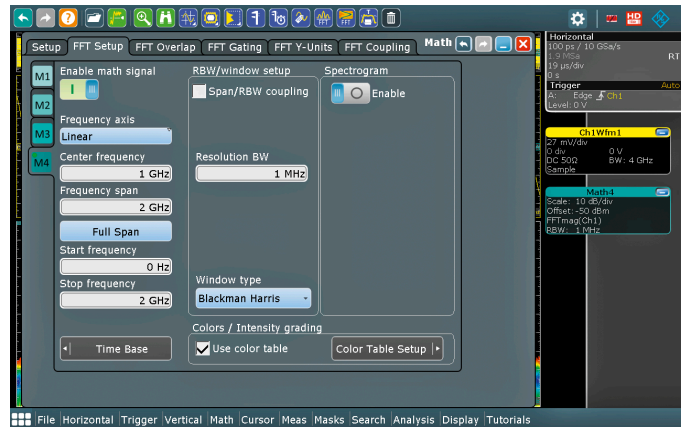
Zone trigger for time and frequency domain

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 oscilloscope.

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

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.
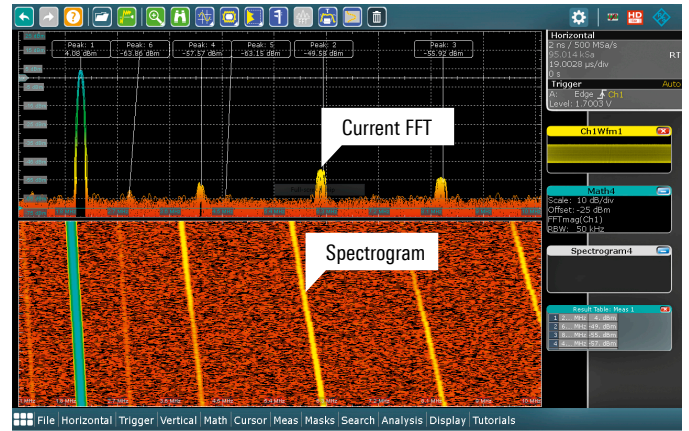
Frequency analysis with logarithmic display

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.
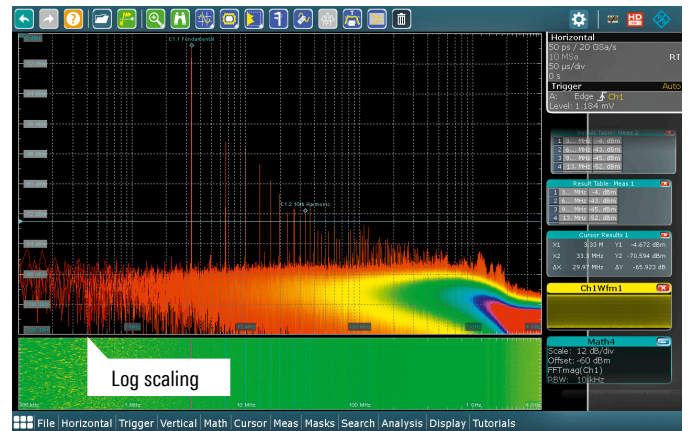
Fast results with automatic peak list measurement

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.
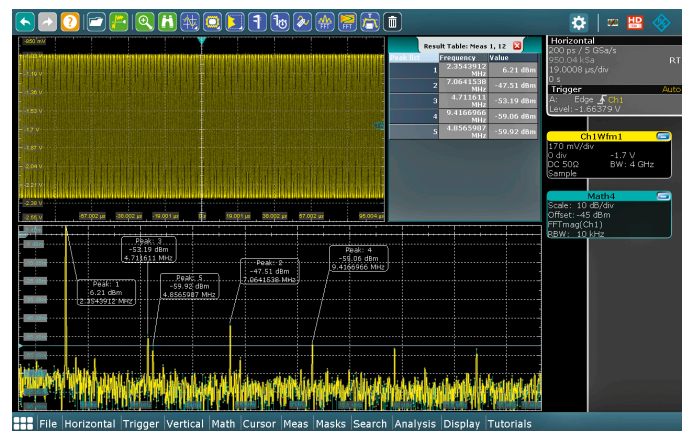
EMI DEBUGGING

► **EMI tests during development**
► **High dynamic range and sensitivity**
► **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.
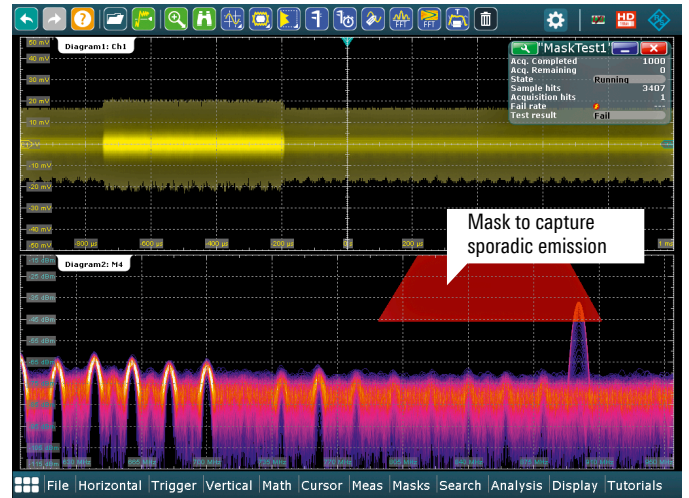
Correlation between frequency and time

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.
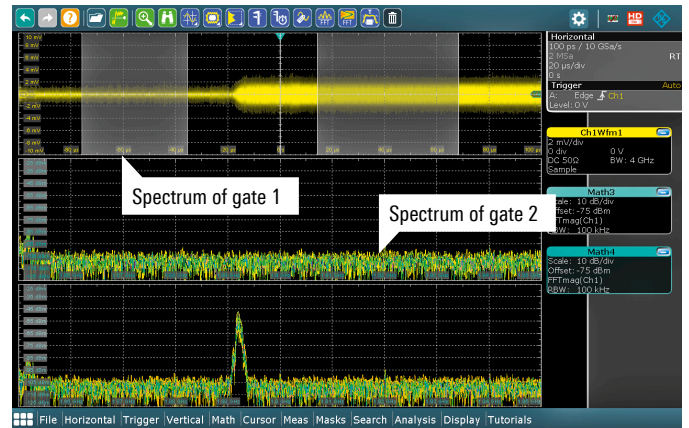
SIGNAL ANALYSIS

▶ **Real-time conversion of modulated signals to I/Q data**
▶ **Precise wideband RF signal analysis**
▶ **Advanced signal analysis**

Real-time 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 real time. The I/Q data can be processed with the dedicated R&S®VSE vector signal explorer software tool or with MATLAB®.
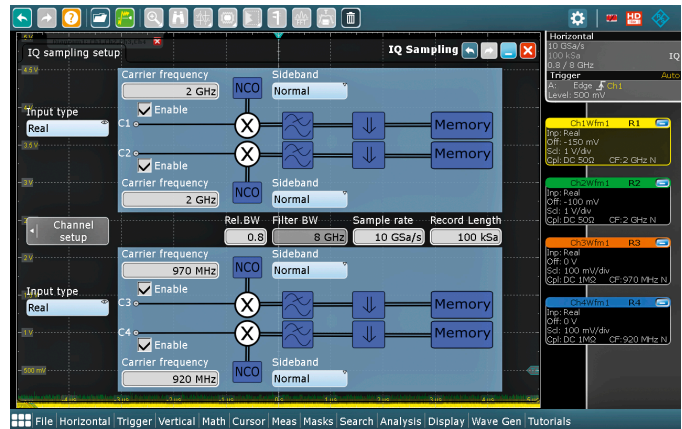
Precise wideband RF signal analysis

The R&S®RTO lets you perform precise multichannel wideband RF measurements up to 6 GHz. For measurements with an RF carrier frequency between 50 GHz and 110 GHz, combine the R&S®RTO with the R&S®FS-Zxx harmonic mixers to achieve an analysis bandwidth of up to 5 GHz.

The RF characteristic of the R&S®RTO is outstanding. With a sensitivity of –159 dBm (1 Hz) and an SNR of 112 dB, the R&S®RTO is qualified to accurately analyze the RF signal.

RF analysis

Analysis bandwidth

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

R&S®RTO oscilloscope with R&S®FS-Zxx harmonic mixers up to 5 GHz analysis bandwidth with f_c from 50 GHz to 110 GHz

RF frequency
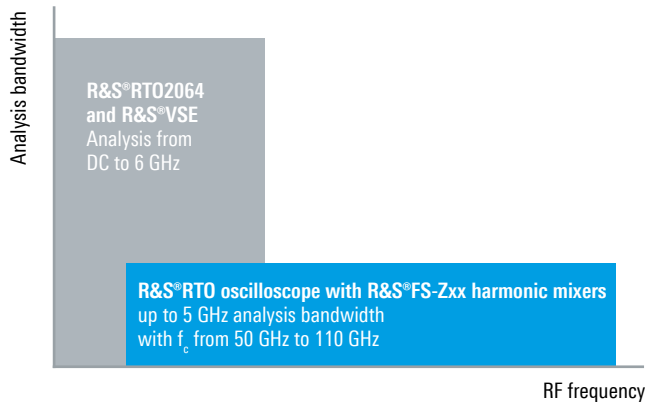
Advanced signal analysis

To analyze complex signals such as OFDM radar and 5G MIMO signals, extend the functionality of the R&S®RTO with application software such as the R&S®VSE vector signal explorer software. 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 LTE, 5G NR and WLAN.

R&S®VSE vector signal explorer software

Analysis option	Typical measurements	Waveform mode	I/Q mode [1]
R&S®VSE base software I/Q analyzer	baseband I/Q analysis	●	●
R&S®VSE-K6	pulse measurements	●	●
R&S®VSE-K6a	multichannel pulse analysis	●	●
R&S®VSE-K7	modulation analysis of AM/FM/PM modulated single carriers	●	●
R&S®VSE-K10	GSM/EDGE/EDGE Evolution signal analysis		●
R&S®VSE-K60	transient analysis	●	●
R&S®VSE-K70	analysis of digitally modulated signals	●	●
R&S®VSE-K72	3GPP WCDMA uplink and downlink signal analysis, including HSDPA, HSUPA and HSPA+		●
R&S®VSE-K91	WLAN signal analysis, in line with the WLAN IEEE 802.11a/b/g/n/p/ac/ax standard		●
R&S®VSE-K96	analysis of user-defined OFDM and OFDMA signals	●	●
R&S®VSE-K100/-K102/-K104	LTE and LTE advanced signal analysis		●
R&S®VSE-K106	LTE narrowband IoT analysis		●
R&S®VSE-K144	5G signal analysis		●
R&S®VSE-K146	5G NR MIMO downlink signal analysis		●

[1] R&S®RTO-K11 I/Q software interface required.

Advanced RF analysis capabilities with the R&S®RTO oscilloscope
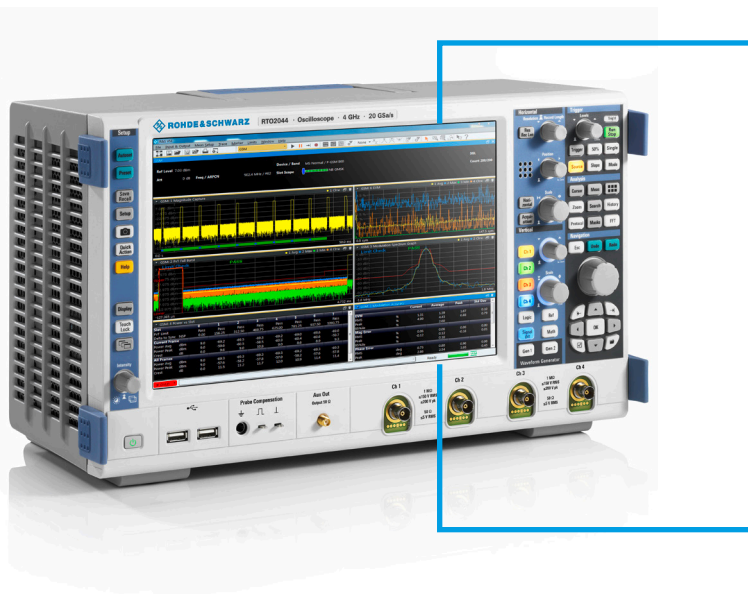
R&S®VSE vector signal explorer software
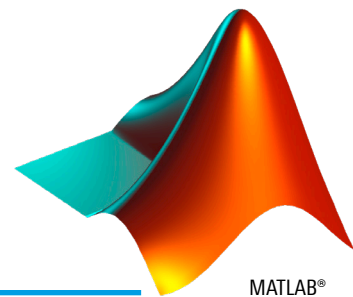
MATLAB®

INTEGRATED ARBITRARY WAVEFORM GENERATOR

► **Every R&S®RTO can be enhanced to include a 100 MHz arbitrary waveform generator**
► **Single-ended and differential interface stimulation**
► **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	► Function generator (sine, square, ramp, DC, pulse, cardinal sine, cardiac, Gauss, Lorentz, exponential rise/fall) ► Modulation generator (AM, FM, FSK) ► Sweep generator ► 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.
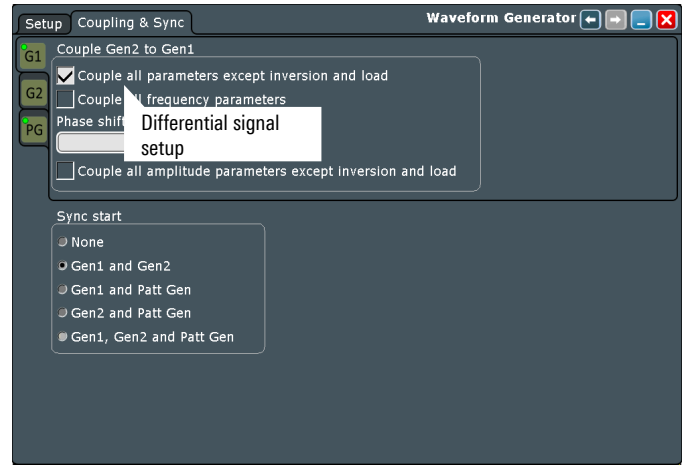
Test your device with native signals

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.
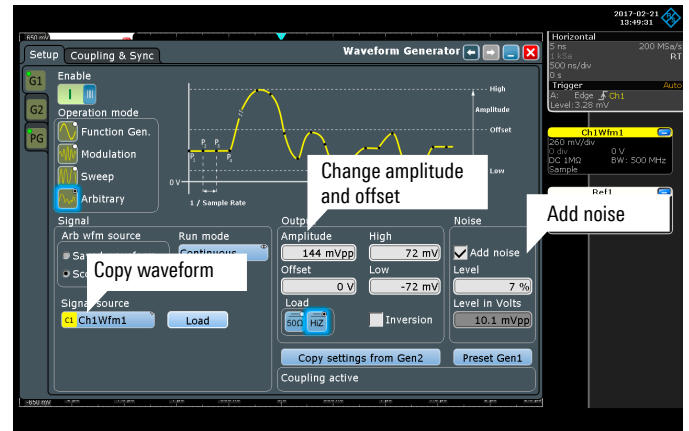
Fully automated compliance tests

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.
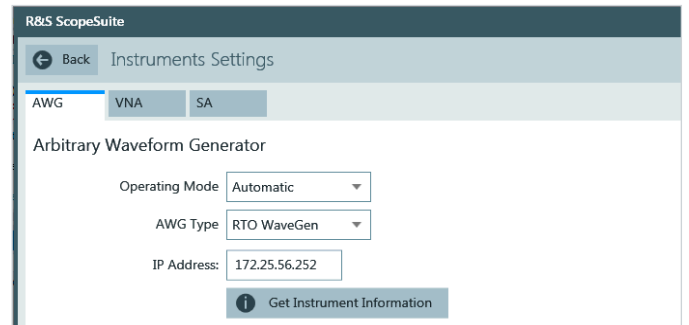
16 GHz DIFFERENTIAL PULSE SOURCE

► **Differential pulse signal with configurable parameters**
► **Application as DUT stimulus or for deskewing**
► **TDR/TDT analysis**

Differential pulse signal with configurable parameters

The R&S®RTO-B7 pulse source provides a highly symmetrical differential pulse signal with a steep rise time of 22 ps.

The key parameters of the pulse source are user adjustable. The output level ranges from –50 mV to –200 mV and can be set in 10 mV steps. The pulse repetition rate and the duty cycle are programmable in the range of 5 Hz to 250 MHz and 10% to 90% respectively. The pulse source can be locked to the R&S®RTO reference clock or set to free running mode in order to avoid deterministic conditions for certain test applications.

Application as DUT stimulus or for deskewing

The R&S®RTO-B7 is easily set up as a stimulus for devices under test. For example as a precise clock or as a pulse input with a fast rise time for testing receiver characteristics. With an output skew of < 0.5 ps, the R&S®RTO-B7 also provides an accurate source for deskewing the measurement setup with multiple channels. Due to its differential nature, the R&S®RTO-B7 is ideal for deskewing cables and probes for differential measurements.

TDR/TDT analysis

The R&S®RTO-K130 option combines the R&S®RTO-B7 pulse source and the analog input channels of the R&S®RTO oscilloscope to create a time domain reflection (TDR) and transmission (TDT) analysis system that supports the characterization and debugging of signal paths, including PCB traces, cables and connectors. The option allows both single-ended and differential measurements. The TDR/TDT software includes a wizard that guides the user through setup, calibration and analysis. The resulting waveforms can be displayed as impedance or reflection coefficient over time or distance. All oscilloscope analysis tools such as cursor and automated measurements can be used.

Parameter	Value range
Analog bandwidth, rise time	> 16.5 GHz, 22 ps
Skew	< 0.5 ps
Output low level	–200 mV to –50 mV, 10 mV steps
Repetition rate	
Locked	5/10/20/50/100/200/500 Hz, 1/5/10/25/50/100/250 MHz
Free running	5/10/20/50/100/200/500 Hz, 1/5/10/25/50 MHz
Duty cycle	
Repetition rate < 5 MHz	10% to 90%, 10% steps
Repetition rate > 5 MHz	50% (const.)
Clock mode	locked, unlocked/free running

Analysis of the time-domain transmission characteristics of a differential signal path based on a comparison of the rise time and pulse shape at the reference outputs versus the signal path outputs.

Multi Domain

SERIAL PROTOCOLS: EASY TRIGGERING AND DECODING

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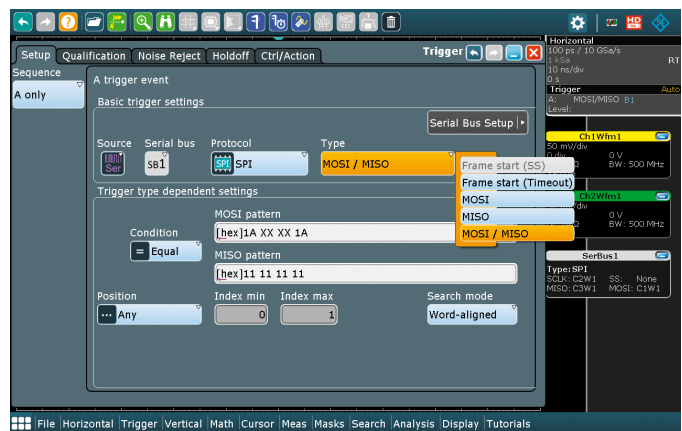
Symbols support standard CAN-dbc and FIBEX formats

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.
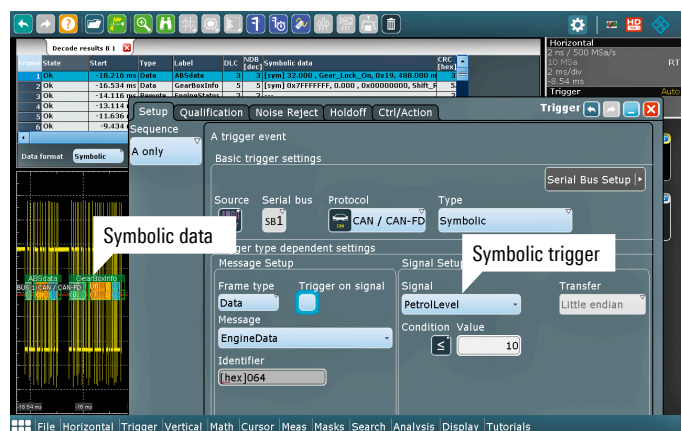
Bus analysis

Specific bus measurements are available for in-depth analysis of the decoded data. Quickly determine the stability of your bus by measuring the frame error rate including consecutive frame errors. For analysis of bus timing you can measure the delay between frames or between any trigger event and the bus frame. When measured on the automotive Ethernet, the error rates and the frame timing are measured simultaneously. These are both very important to the development of automotive applications, such as autonomous driving.

Frame-to-frame time histogram

Frame error rate
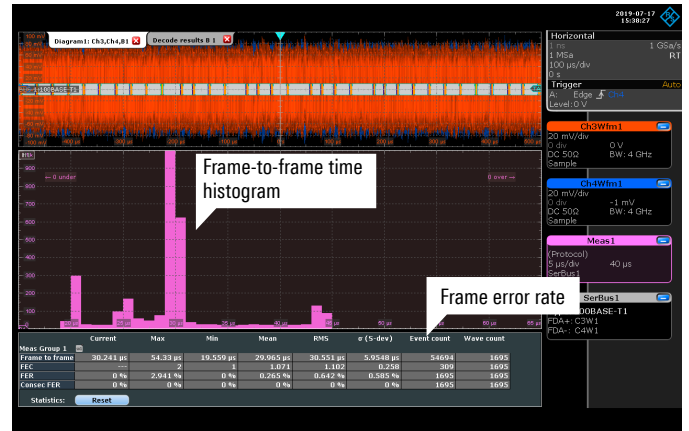
Rapid telegram data search

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.

Search results

Result details
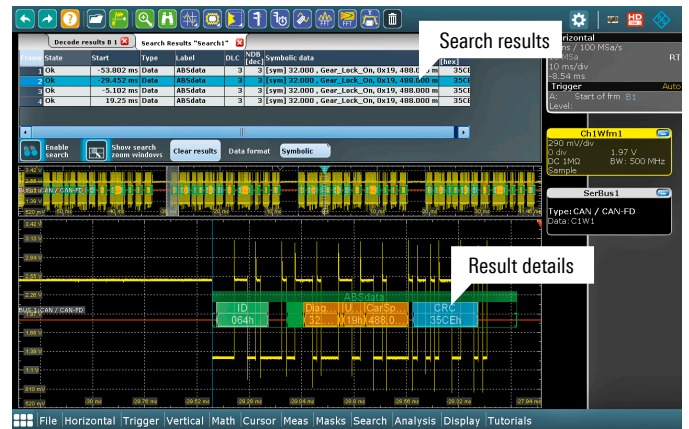
Options for triggering and decoding									
Application	**Serial standard**	**Option R&S®**	**Decode**	**Decode table**	**Trigger**	**Label support**	**Symbolic T&D**	**Search**	**Bus analysis**
Embedded	I²C/SPI	RTO-K1	●	●	●	●		●	●
	UART/RS-232/422/485	RTO-K2	●	●	●				●
	Ethernet	RTO-K8	●	●	●	●		●	●
	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	●	●	●	●		●	●
	1000BASE-T1	RTO-K58	●	●	●	●		●	●
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

► **Easy configuration and automatic control**
► **Flexible test execution**
► **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.
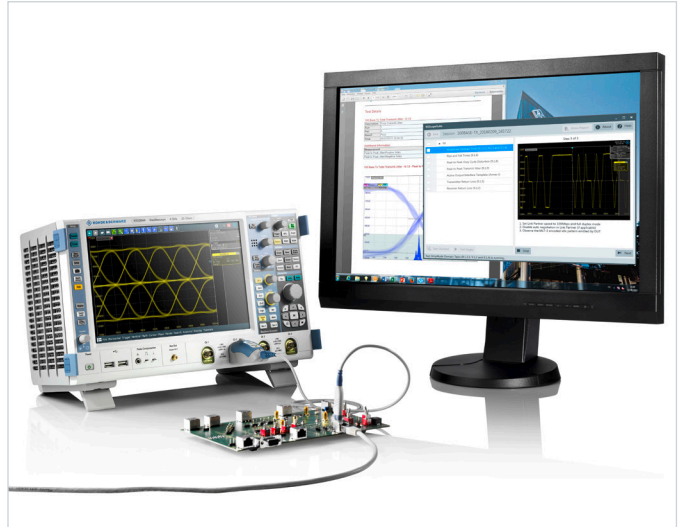
Flexible test execution

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.
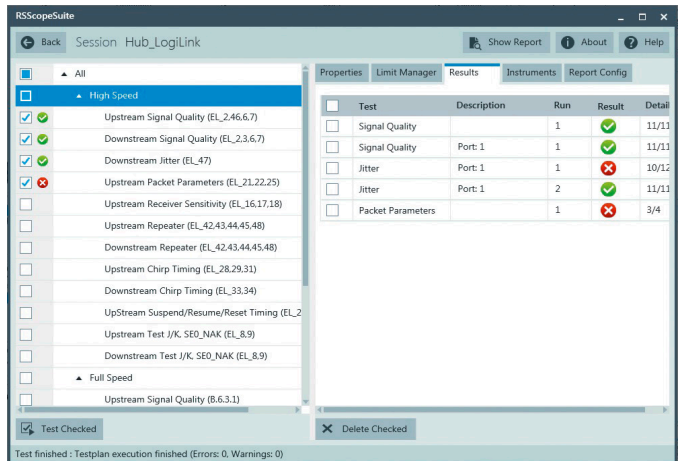
Straightforward, configurable reports

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.
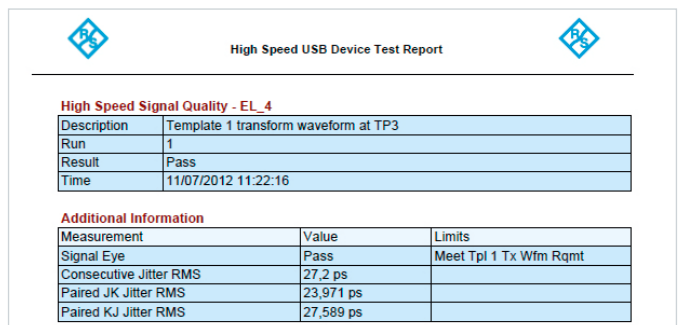
Test fixture sets made by Rohde & Schwarz

The different interface standards define the connection between the measuring equipment and the device under test. Rohde & Schwarz offers the required test fixture sets.
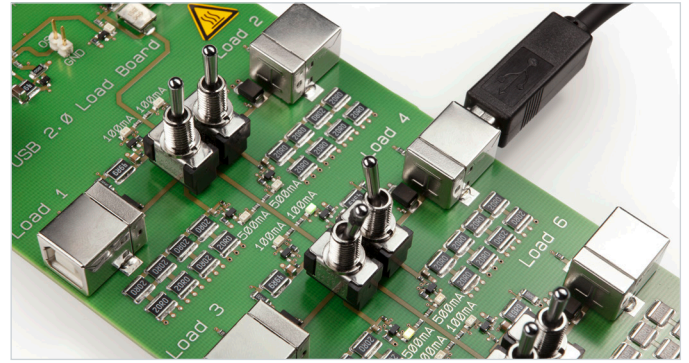
Interface standard	Compliance test option	Test fixture set	Recommended instruments, minimum bandwidth	Recommended probes
USB				
USB 1.0/USB 1.1	R&S®RTO-K21	R&S®RT-ZF1	R&S®RTO, 600 MHz	2 × R&S®RT-ZS10 1 × R&S®RT-ZD10 1 × R&S®RT-ZC20
USB 2.0	R&S®RTO-K21	R&S®RT-ZF1	R&S®RTO, 2 GHz; 1 × dual-channel arbitrary 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				
10BASE-T1S/L Ethernet	R&S®RTO-K89	R&S®RT-ZF8 R&S®RT-ZF7A	R&S®RTO, 600 MHz R&S®RTO-B4, R&S®RTO-B6 R&S®ZND with R&S®ZND-K5	
100BASE-T1 BroadR-Reach® Ethernet	R&S®RTO-K24	R&S®RT-ZF8, R&S®RT-ZF7A and 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	
1000BASE-T1 Ethernet	R&S®RTO-K87	R&S®RT-ZF8, R&S®RT-ZF7A and 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	
MultiGBASE-T1 Ethernet (up to 2.5G)	R&S®RTO-K88	R&S®RT-ZF8, R&S®RT-ZF7A	R&S®RTO, 4 GHz R&S®RTO-B4, R&S®RTO-B6 R&S®ZND with R&S®ZND-K6	
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
DDR3	R&S®RTO-K91		R&S®RTO, 4 GHz; R&S®RTO-K19 R&S®RTO-K12, R&S®RTO-K121	4 × R&S®RT-ZM60, 4 × R&S®RT-ZMA30
Test system integration				
R&S®ScopeSuite Automation	R&S®RTO-K99		R&S®RTO-K22 (100BASE-TX), R&S®RTO-K24, R&S®RTO-K87	

SIGNAL INTEGRITY ANALYSIS

- ▶ **Powerful basic jitter analysis functions**
- ▶ **Deep system insights with jitter and noise decomposition**
- ▶ **Powerful analysis options**
- ▶ **Clock data recovery for analyzing embedded clock signals in real time**

Powerful basic jitter analysis functions

R&S®RTO oscilloscopes offer a wide range of basic jitter analysis functions enabled by the R&S®RTO-K12 option. Automated jitter measurements like cycle-to-cycle jitter and time interval error (TIE) are essential for jitter analysis on clock and data signals and for investigating further signal details with additional tools such as track, long-term trend and FFT on track. For example, frequency interference can be determined by applying FFT analysis to the cycle-to-cycle TIE jitter measurement track.

Deep system insights with jitter and noise decomposition

Gain more insights into individual jitter and noise components of your transmitter interface to characterize the jitter and noise budget and identify the root causes of failures. The R&S®RTO-K133 and R&S®RTO-K134 options decompose jitter and noise into random (RJ/RN) and deterministic components such as data dependent (DDJ/DDN) and periodic (PJ/PN) or other bounded uncorrelated components (OBUJ/OBUN). The Rohde & Schwarz decomposition algorithm calculates the step responses that fully characterize the deterministic behavior of the transmission system. The user benefits from accurate measurement results even for relatively short signal sequences.

The R&S®RTO-K133 and R&S®RTO-K134 options provide additional functions to reconstruct synthetic eye diagrams and to calculate and display BER bathtub curves for selected components to understand their relevance to the overall system behavior. For in-depth analysis, the individual jitter and noise components can be displayed in histogram, track and spectrum view. The lower screenshot displays the step response, individual jitter and noise components in histograms, period jitter spectrum, synthetic eye diagram and jitter and noise BER bathtub curves of a 5 Gbps USB3.1 Gen1 signal.

Jitter and noise measurement functions

R&S®RTO-K134 option		
R&S®RTO-K133 option	TJ (meas.)	TN (meas.)
	TJ (at BER)	EH (at BER)
R&S®RTO-K12 option	RJ	RN RN + OBUN
Standard functions	cycle-to-cycle jitter	RJ + OBUJ	DN
	N-cycle jitter	DJ	DDN
Period	cycle-to-cycle width	DJ (δδ)	ISIN
Frequency	cycle-cycle duty	DDJ	LD
Setup	cycle	ISI	PN
Setup/hold time	time interval error	DCD	DDN + PN
Setup/hold ratio	data rate	PJ	OBUN
	unit interval	DDJ + PJ	OBUN (δδ)
	skew delay	OBUJ	
	skew phase	OBUJ (δδ)	
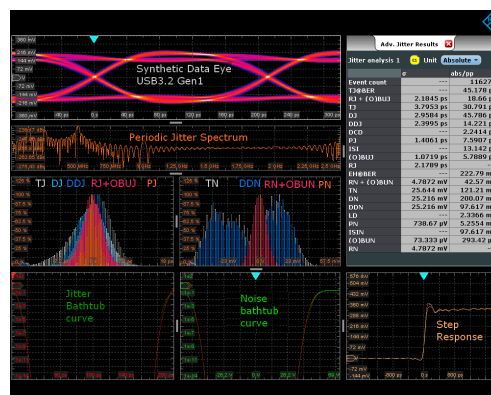
Clock data recovery for analyzing embedded clock signals in real time

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 real-time 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.
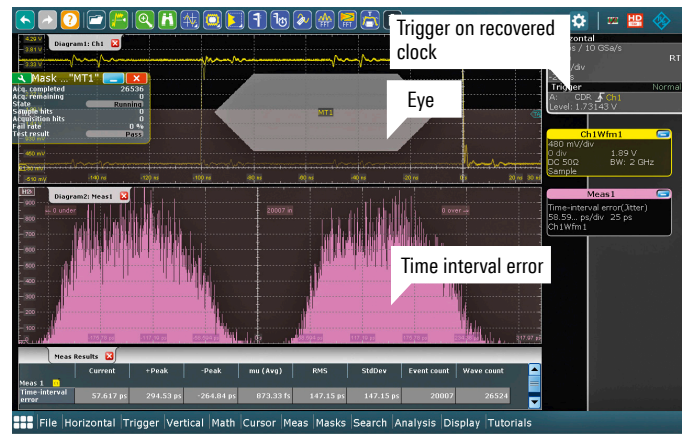
Serial pattern trigger

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.
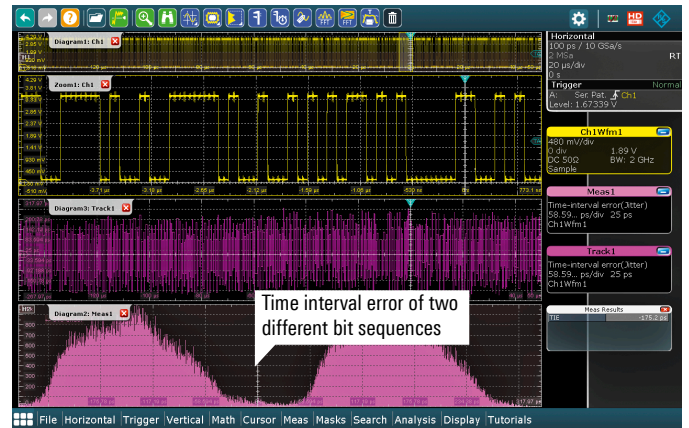
EXTENSIBLE FOR FUTURE APPLICATIONS

▶ **On-site configuration of hardware options**
▶ **Software applications on demand**
▶ **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:

▶ Easy extensibility for future tasks
▶ On-site installation of options in minutes
▶ 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:

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

▶ Extensive probe range for all measurement tasks
▶ Addressing high speed probing challenges
▶ 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 16 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-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 16 GHz	R&S®RT-ZM15, R&S®RT-ZM30, R&S®RT-ZM60, R&S®RT-ZM90, R&S®RT-ZM130, R&S®RT-ZM160
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 Probes and accessories for Rohde & Schwarz 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 oscilloscopes	R&S®RTO-Z1
Soft case, for R&S®RTO/RTE oscilloscopes and accessories	R&S®RTO-Z3
Transit case, with trolley function, for R&S®RTO/RTE oscilloscopes and accessories	R&S®RTO-Z4
Probe pouch, for R&S®RTO/RTE oscilloscopes	R&S®RTO-Z5
19" rackmount kit, for R&S®RTO/RTE 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

Real-time 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

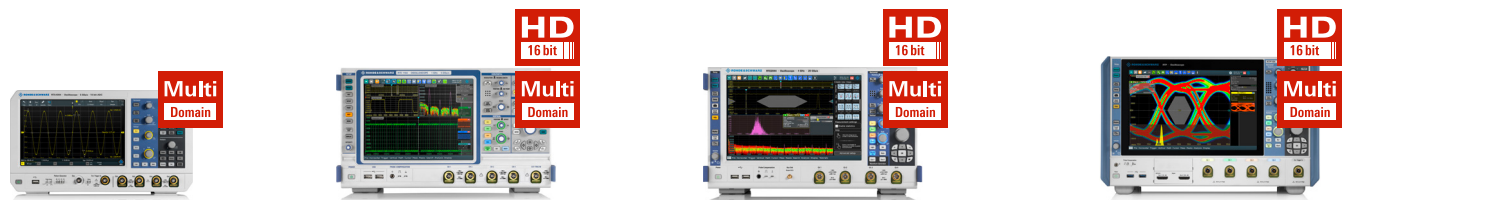|		
Dimensions	W × H × D	427 mm × 249 mm × 204 mm (16.81 in × 9.8 in × 8.03 in)
Weight		9.6 kg (21.2 lb)
Screen		12.1" LC TFT capacitive color touchscreen, 1280 × 800 pixel (XGA)
Interfaces		1 Gbps LAN, type A: 2 × USB 3.1, 2 × USB 2.0, type B: 1 × USB 3.1, GPIB (optional), DVI and display port for external monitor, external trigger, trigger output

OSCILLOSCOPE PORTFOLIO

R&S®	RTH1000	RTC1000	RTB2000	RTM3000
Vertical				
Bandwidth	60/100/200/350/500 MHz [1]	50/70/100/200/300 MHz [1]	70/100/200/300 MHz [1]	100/200/350/500 MHz/1 GHz [1]
Number of channels	2 plus DMM/4	2	2/4	2/4
Resolution	10 bit	8 bit	10 bit	10 bit
V/div 1 MΩ	2 mV to 100 V	1 mV to 10 V	1 mV to 5 V	500 µV to 10 V
V/div 50 Ω	–			500 µV to 1 V
Horizontal				
Sampling rate per channel (in Gsample/s)	1.25 (4-channel model); 2.5 (2-channel model); 5 (all channels interleaved)	1; 2 (2 channels interleaved)	1.25; 2.5 (2 channels interleaved)	2.5; 5 (2 channels interleaved)
Max. memory (per channel/1 channel active)	125 ksample (4-channel model); 250 ksample (2-channel model); 500 ksample (50 Msample in segmented memory mode [2])	1 Msample; 2 Msample	10 Msample; 20 Msample (160 Msample in segmented memory mode [2])	40 Msample; 80 Msample (400 Msample in segmented memory mode [2])
Segmented memory	option	–	option	option
Acquisition rate (in waveforms/s)	50 000	10 000	50 000 (300 000 in fast segmented memory mode [2])	64 000 (2 000 000 in fast segmented memory mode [2])
Trigger				
Options	advanced, digital trigger (14 trigger types) [2]	elementary (5 trigger types)	basic (7 trigger types)	basic (10 trigger types)
Mixed signal option				
No. of digital channels [1]	8	8	16	16
Sampling rate of digital channels (in Gsample/s)	1.25	1	1.25	two logic probes: 2.5 on each channel; one logic probe: 5 on each channel
Memory of digital channels	125 ksample	1 Msample	10 Msample	two logic probes: 40 Msample per channel; one logic probe: 80 Msample per channel
Analysis				
Cursor meas. types	4	13	4	4
Stand. meas. functions	37	31	32	32
Mask test	elementary (tolerance mask around the signal)	elementary (tolerance mask around the signal)	elementary (tolerance mask around the signal)	elementary (tolerance mask around the signal)
Mathematics	elementary	elementary	basic (math on math)	basic (math on math)
Serial protocols triggering and decoding [1]	I²C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, CAN-FD, SENT	I²C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN	I²C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN	I²C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, I²S, MIL-STD-1553, ARINC 429
Display functions	data logger	–	–	–
Applications [1], [2]	high-resolution frequency counter, advanced spectrum analysis, harmonics analysis, user scripting	digital voltmeter (DVM), component tester, fast Fourier transform (FFT)	digital voltmeter (DVM), fast Fourier transform (FFT), frequency response analysis	power, digital voltmeter (DVM), spectrum analysis and spectrogram, frequency response analysis
Compliance testing [1], [2]	–	–	–	–
Display and operation				
Size and resolution	7", color, 800 × 480 pixel	6.5", color, 640 × 480 pixel	10.1", color, 1280 × 800 pixel	10.1", color, 1280 × 800 pixel
Operation	optimized for touchscreen operation, parallel button operation	optimized for fast button operation	optimized for touchscreen operation, parallel button operation	
General data				
Dimensions in mm (W × H × D)	201 × 293 × 74	285 × 175 × 140	390 × 220 × 152	390 × 220 × 152
Weight in kg	2.4	1.7	2.5	3.3
Battery	lithium-ion, > 4 h	–	–	–

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

	RTA4000	RTE1000	RTO2000	RTP
Bandwidth	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]	4/6/8/13/16 GHz[1]
Channels	4	2/4	2/4 (only 4 channels in 4 GHz and 6 GHz models)	4
Resolution	10 bit	8 bit (up to 16 bit with HD mode)	8 bit (up to 16 bit with HD mode)[2]	8 bit (up to 16 bit with HD mode)[2]
	500 µV to 10 V	500 µV to 10 V	1 mV to 10 V (500 µV to 10 V)[2]	
	500 µV to 1 V	500 µV to 1 V	1 mV to 1 V (500 µV to 1 V)[2]	1 mV to 1 V
Sample rate	2.5; 5 (2 channels interleaved)	5	10; 20 (2 channels interleaved in 4 GHz and 6 GHz model)	20; 40 (2 channels interleaved)
Memory	100 Msample; 200 Msample (1 Gsample in segmented memory mode)	50 Msample/200 Msample	standard: 50 Msample/200 Msample; max. upgrade: 1 Gsample/2 Gsample	standard: 50 Msample/200 Msample; max. upgrade: 1 Gsample/2 Gsample
	standard	standard	standard	standard
Waveforms	64 000 (2 000 000 in fast segmented memory mode)	1 000 000 (1 600 000 in ultra-segmented memory mode)	1 000 000 (2 500 000 in ultra-segmented memory mode)	750 000 (3 200 000 in ultra-segmented memory mode)
Trigger	basic (10 trigger types)	advanced, digital trigger (13 trigger types)	advanced (includes zone trigger), digital trigger (14 trigger types)[2]	advanced, digital trigger (14 trigger types) with real-time deembedding[2], high speed serial pattern trigger incl. 8/16 Gbps CDR[2], zone trigger[2]
Logic channels	16	16	16	16
	two logic probes: 2.5 on each channel; one logic probe: 5 on each channel	5	5	5
	two logic probes: 100 Msample per channel; one logic probe: 200 Msample per channel	100 Msample	200 Msample	200 Msample
	4	3	3	3
	32	47	47	47
Mask test	elementary (tolerance mask around the signal)	advanced (user-configurable, hardware based)	advanced (user-configurable, hardware based)	advanced (user-configurable, hardware based)
Math	basic (math on math)	advanced (formula editor)	advanced (formula editor)	advanced (formula editor)
Serial protocols	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, USB Power Delivery, automotive Ethernet 100BASE-T1	I²C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, I²S, MIL-STD-1553, ARINC 429, FlexRay™, CAN-FD, MIPI RFFE, USB 2.0/HSIC, MDIO, 8b10b, Ethernet, Manchester, NRZ, SENT, MIPI D-PHY, SpaceWire, MIPI M-PHY/UniPro, CXPI, USB 3.1 Gen1, USB-SSIC, PCIe 1.1/2.0, USB Power Delivery, automotive Ethernet 100BASE-T1/1000BASE-T1	I²C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, MIL-STD-1553, ARINC 429, CAN-FD, MIPI RFFE, USB 2.0/ HSIC, MDIO, 8b10b, Ethernet, Manchester, NRZ, MIPI D-PHY, SpaceWire, MIPI M-PHY/UniPro, USB 3.1 Gen1/Gen2, USB-SSIC, PCIe 1.1/2.0/3.0, USB Power Delivery, automotive Ethernet 100BASE-T1/1000BASE-T1
	–	histogram, trend, track[2]	histogram, trend, track[2]	histogram, trend, track
Applications	power, digital voltmeter (DVM), spectrum analysis and spectrogram, frequency response analysis	power, 16-bit high definition mode (standard), advanced spectrum analysis and spectrogram	power, 16-bit high definition mode, advanced spectrum analysis and spectrogram, jitter, jitter and noise decomposition, clock data recovery, I/Q data, RF analysis, deembedding	16-bit high definition mode, advanced spectrum analysis and spectrogram, jitter, jitter and noise decomposition, I/Q data, RF analysis, real-time deembedding, TDR/TDT analysis
	–	–	various options available (see PD 3607.2684.22)	various options available (see PD 5215.4152.22)
Display	10.1", color, 1280 × 800 pixel	10.4", color, 1024 × 768 pixel	12.1", color, 1280 × 800 pixel	12.1", color, 1280 × 800 pixel
	optimized for touchscreen operation, parallel button operation			
Dimensions	390 × 220 × 152	427 × 249 × 204	427 × 249 × 204	441 × 285 × 316
Weight	3.3	8.6	9.6	18
	–	–	–	–

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
Arbitrary waveform generator	R&S®RTO-B6

Step 3: choose software options			
Triggering and decoding		**Compliance**	**Test fixture set**
Trigger and decode bundle	R&S®RTO-TDBNDL		
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®RTO-K99	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	–
DDR3		R&S®RTO-K91	
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	–	–
10BASE-T1S Ethernet		R&S®RTO-K89	R&S®RT-ZF8, R&S®RT-ZF7A or R&S®RT-ZF2
10BASE-T1L Ethernet		R&S®RTO-K89	R&S®RT-ZF7A, R&S®RT-ZF8
100BASE-T1/BroadR-Reach® Ethernet	R&S®RTO-K57	R&S®RTO-K24, R&S®RTO-K99	▶ Compliance: R&S®RT-ZF8, R&S®RT-ZF7A or R&S®RT-ZF2, R&S®RT-ZF3 ▶ Trigger & decode: R&S®RT-ZF7 or R&S®RT-ZF5
1000BASE-T1	R&S®RTO-K58	R&S®RTO-K87, R&S®RTO-K99	R&S®RT-ZF8, R&S®RT-ZF7A or R&S®RT-ZF2, R&S®RT-ZF6
MultiGBASE-T1 Ethernet (up to 2.5G)		R&S®RTO-K88	R&S®RT-ZF7A, R&S®RT-ZF8
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	–	–
Bus analysis	R&S®RTO-K35		
Analysis			
I/Q software interface	R&S®RTO-K11		

Step 3: choose software options

Jitter analysis	R&S®RTO-K12
Jitter decomposition	R&S®RTO-K133
Jitter and noise decomposition	R&S®RTO-K134
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
Deembedding	R&S®RTO-K121
TDR/TDT analysis	R&S®RTO-K130

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
Multichannel pulse analysis	R&S®VSE-K6a
Modulation analysis for AM/FM/PM modulated single carriers	R&S®VSE-K7
GSM/EDGE/EDGE Evolution signal analysis	R&S®VSE-K10
Transient analysis	R&S®VSE-K60
Analysis of digitally modulated signals	R&S®VSE-K70
3GPP WCDMA uplink and downlink signal analysis	R&S®VSE-K72
WLAN signal analysis	R&S®VSE-K91
OFDM vector signal analysis software	R&S®VSE-K96
LTE and LTE advanced signal analysis	R&S®VSE-K100/-K102/-K104
LTE narrowband IoT analysis	R&S®VSE-K106
5G signal analysis	R&S®VSE-K144
5G NR MIMO downlink signal analysis	R&S®VSE-K146
Software maintenance	R&S®VSE-SWM
OFDM vector signal analysis software	R&S®FS-K96PC

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 Probes and accessories for Rohde & Schwarz oscilloscopes (PD 3606.8866.12).

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

Step 6: choose warranty and services

Warranty	
Base unit	3 years
All other items [2]	1 year
Options	
Extended warranty, one/two year(s)	
Extended warranty with calibration coverage, one/two year(s)	Please contact your local Rohde & Schwarz sales representative.
Extended warranty with accredited calibration coverage, one/two year(s)	

[1] R&S®RTO-K11 option required.

[2] 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.

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