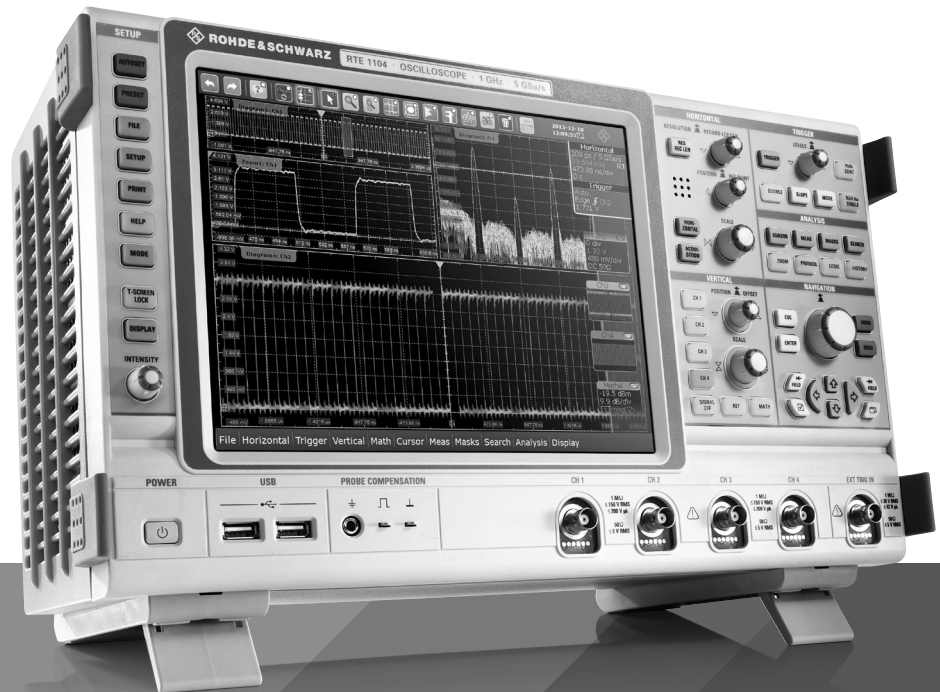


# R&S® RTE OSCILLOSCOPE

## Specifications

3  
year  
warranty



Data Sheet  
Version 21.00

**ROHDE & SCHWARZ**

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# Definitions

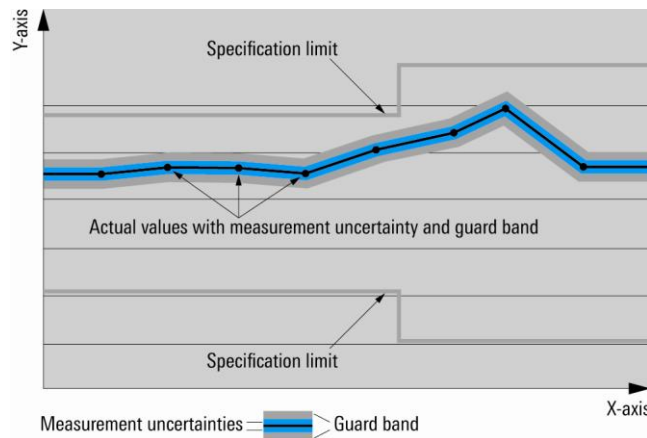
## General

Product data applies under the following conditions:

- Three hours storage at ambient temperature followed by 30 minutes warm-up operation
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

## Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



## Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by design.

## Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with  $<$ ,  $>$  or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

## Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (e.g. nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

## Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

## Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: "parameter: value".

Typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

# Base unit

## Vertical system

Input channels	R&S®RTE1022	2 channels
	R&S®RTE1024	4 channels
	R&S®RTE1032	2 channels
	R&S®RTE1034	4 channels
	R&S®RTE1052	2 channels
	R&S®RTE1054	4 channels
	R&S®RTE1102	2 channels
	R&S®RTE1104	4 channels
	R&S®RTE1152	2 channels
	R&S®RTE1154	4 channels
	R&S®RTE1202	2 channels
	R&S®RTE1204	4 channels
Input impedance		50 $\Omega \pm 1.5 \%$ 1 M $\Omega \pm 1 \%$    17 pF $\pm 1$ pF (meas.)
Analog bandwidth (–3 dB)	at 50 $\Omega$ input impedance	
	R&S®RTE1022 and R&S®RTE1024	$\geq 200$ MHz
	R&S®RTE1032 and R&S®RTE1034	$\geq 350$ MHz
	R&S®RTE1052 and R&S®RTE1054	$\geq 500$ MHz
	R&S®RTE1102 and R&S®RTE1104	$\geq 1$ GHz
	R&S®RTE1152 and R&S®RTE1154	$\geq 1.5$ GHz
	R&S®RTE1202 and R&S®RTE1204	$\geq 2$ GHz
	at 1 M $\Omega$ input impedance	
	R&S®RTE1022 and R&S®RTE1024	$\geq 200$ MHz (meas.)
	R&S®RTE1032 and R&S®RTE1034	$\geq 350$ MHz (meas.)
Analog bandwidth limits	max. –1.5 dB, min. –4 dB	200 MHz, 20 MHz
Rise time/fall time	10 % to 90 % at 50 $\Omega$ (calculated)	
	R&S®RTE1022 and R&S®RTE1024	< 1.75 ns
	R&S®RTE1032 and R&S®RTE1034	< 1 ns
	R&S®RTE1052 and R&S®RTE1054	< 700 ps
	R&S®RTE1102 and R&S®RTE1104	< 350 ps
	R&S®RTE1152 and R&S®RTE1154	< 233 ps
	R&S®RTE1202 and R&S®RTE1204	< 175 ps
Input VSWR	input frequency $\leq 500$ MHz	1.25 (meas.)
	input frequency > 500 MHz	1.4 (meas.)
Vertical resolution	digitizer	8 bit
	high definition mode	16 bit (without reduction of the sampling rate <sup>1)</sup> )
	high resolution decimation	16 bit (with reduction of the sampling rate)
Effective number of bits of digitizer	for full-scale sine-wave signal with frequency equal to or lower than –3 dB bandwidth	> 7.0 bit (meas.)
DC gain accuracy	offset and position set to 0 V, after self-alignment	
	input sensitivity > 5 mV/div	$\pm 1.5 \%$
	input sensitivity $\leq 5$ mV/div	$\pm 2 \%$
Input coupling	at 50 $\Omega$	DC, GND
	at 1 M $\Omega$	DC, AC (> 7 Hz), GND
Input sensitivity	at 50 $\Omega$	500 $\mu$ V/div to 1 V/div, entire analog bandwidth supported for all input sensitivities
	at 1 M $\Omega$	500 $\mu$ V/div to 10 V/div, entire analog bandwidth supported for all input sensitivities

<sup>1</sup> The maximum realtime sampling rate of the high definition mode is 2.5 Gsample/s.

Maximum input voltage	at 50 $\Omega$	5 V (RMS)	
	at 1 M $\Omega$	150 V (RMS), 200 V ( $V_p$ ), derates at 20 dB/decade to 5 V (RMS) above 250 kHz	
Position range		$\pm 5$ div	
Offset range at 50 $\Omega$	input sensitivity		
	200 mV/div to 1 V/div	$\pm 10$ V	
	50 mV/div to $\leq 200$ mV/div	$\pm(4.9 \text{ V} - \text{input sensitivity} \times 5 \text{ div})$	
	500 $\mu$ V/div to $\leq 50$ mV/div	$\pm(1.6 \text{ V} - \text{input sensitivity} \times 5 \text{ div})$	
Offset range at 1 M $\Omega$	input sensitivity		
	900 mV/div to 10 V/div	$\pm(129.5 \text{ V} - \text{input sensitivity} \times 5 \text{ div})$	
	80 mV/div to $\leq 900$ mV/div	$\pm(12.4 \text{ V} - \text{input sensitivity} \times 5 \text{ div})$	
	500 $\mu$ V/div to $\leq 80$ mV/div	$\pm(1.15 \text{ V} - \text{input sensitivity} \times 5 \text{ div})$	
Offset accuracy		$\pm(0.5 \% \times  \text{net offset}  + 1 \text{ mV} + 0.15 \text{ div} \times \text{input sensitivity})$ (net offset = offset – position $\times$ input sensitivity)	
DC measurement accuracy	after adequate suppression of measurement noise using high-resolution sampling mode or waveform averaging or a combination of both	$\pm(\text{DC gain accuracy} \times$ $ \text{reading} - \text{net offset} $ $+ \text{offset accuracy})$	
Channel-to-channel isolation (each channel at same input sensitivity)	input frequency $\leq 1$ GHz	$> 50$ dB	
	input frequency $> 1$ GHz	$> 40$ dB	
RMS noise floor at typ. 50 $\Omega$	input sensitivity	R&S®RTE1022, R&S®RTE1024	R&S®RTE1032, R&S®RTE1034
	500 $\mu$ V/div	0.04 mV	0.06 mV
	1 mV/div	0.04 mV	0.06 mV
	2 mV/div	0.07 mV	0.08 mV
	5 mV/div	0.13 mV	0.15 mV
	10 mV/div	0.20 mV	0.24 mV
	20 mV/div	0.30 mV	0.40 mV
	50 mV/div	0.75 mV	0.99 mV
	100 mV/div	1.46 mV	1.97 mV
	200 mV/div	2.81 mV	3.77 mV
	500 mV/div	7.84 mV	10.4 mV
	1 V/div	13.4 mV	17.9 mV
	input sensitivity	R&S®RTE1052, R&S®RTE1054	R&S®RTE1102, R&S®RTE1104
	500 $\mu$ V/div	0.08 mV	0.10 mV
	1 mV/div	0.08 mV	0.10 mV
	2 mV/div	0.10 mV	0.13 mV
	5 mV/div	0.18 mV	0.24 mV
	10 mV/div	0.27 mV	0.34 mV
	20 mV/div	0.45 mV	0.55 mV
	50 mV/div	1.13 mV	1.39 mV
	100 mV/div	2.23 mV	2.76 mV
	200 mV/div	4.31 mV	5.34 mV
	500 mV/div	11.9 mV	14.5 mV
	1 V/div	20.6 mV	25.4 mV
	input sensitivity	R&S®RTE1152, R&S®RTE1154	R&S®RTE1202, R&S®RTE1204
	500 $\mu$ V/div	0.13 mV	0.15 mV
	1 mV/div	0.13 mV	0.15 mV
	2 mV/div	0.16 mV	0.18 mV
	5 mV/div	0.27 mV	0.30 mV
	10 mV/div	0.38 mV	0.42 mV
	20 mV/div	0.60 mV	0.66 mV
	50 mV/div	1.51 mV	1.66 mV
	100 mV/div	3.01 mV	3.25 mV
	200 mV/div	5.81 mV	6.26 mV
	500 mV/div	15.8 mV	17.4 mV
	1 V/div	27.1 mV	29.8 mV

## Horizontal system

Timebase range		selectable between 50 ps/div and 5000 s/div, time per div settable to any value within range
Channel deskew		±100 ns
Reference position		0 % to 100 % of measurement display area
Trigger offset range	max.	+(memory depth/current sampling rate)
	min.	−10 000 s
Modes		normal, roll
Channel-to-channel skew		< 100 ps (meas.)
Timebase accuracy	after delivery/calibration, at +23 °C	±2 ppm
	during calibration interval	±4 ppm
Delta time accuracy	corresponds to time error between two edges on same acquisition and channel; signal amplitude greater than 5 divisions, measurement threshold set to 50 %, vertical gain 10 mV/div or greater; rise time lower than four sample periods; waveform acquired in realtime mode	$\pm(K/\text{realtime sampling rate} + \text{timebase accuracy} \times  \text{reading} )$ (peak) (meas.) where $K = 0.2$ (R&S®RTE1022, R&S®RTE1024) $K = 0.24$ (R&S®RTE1032, R&S®RTE1034) $K = 0.27$ (R&S®RTE1052, R&S®RTE1054) $K = 0.34$ (R&S®RTE1102, R&S®RTE1104) $K = 0.38$ (R&S®RTE1152, R&S®RTE1154) $K = 0.42$ (R&S®RTE1202, R&S®RTE1204)

## Acquisition system

Realtime sampling rate		max. 5 Gsample/s on each channel
Realtime waveform acquisition rate	max.	> 1 000 000 waveforms/s
Memory depth <sup>2</sup>	R&S®RTE1022, R&S®RTE1032, R&S®RTE1052, R&S®RTE1102, R&S®RTE1152, R&S®RTE1202	50 Msample on 2 channels, 100 Msample on 1 channel
	R&S®RTE1024, R&S®RTE1034, R&S®RTE1054, R&S®RTE1104, R&S®RTE1154, R&S®RTE1204	50 Msample on 4 channels, 100 Msample on 2 channels, 200 Msample on 1 channel
Decimation modes		selection valid for all channels
	sample	first sample in decimation interval
	peak detect	largest and smallest sample in decimation interval
	high resolution	average value of samples in decimation interval
Waveform arithmetic	root mean square	root of squared average of samples in decimation interval
		selection valid for all channels
	off	no arithmetic
	envelope	envelope of acquired waveforms
	average	average of acquired waveforms, max. average depth depends on decimation mode <sup>3</sup>
	sample	max. 16 777 215
	high resolution	max. 65 535
	root mean square	max. 255
Sampling modes	reset condition	no reset (standard), manual reset
	realtime mode	max. sampling rate set by digitizer
	interpolated time	enhancement of sampling resolution by interpolation; max. equivalent sampling rate is 2 Tsample/s
Interpolation modes		linear, sin(x)/x, sample&hold

<sup>2</sup> The maximum available memory depth depends on the bit depth of the acquired data and, therefore, on the settings of the acquisition system, such as decimation mode, waveform arithmetic, number of waveform streams or high definition mode.

<sup>3</sup> Waveform averaging is not compatible with peak detect decimation.

Ultra segmented mode	continuous recording of waveforms in acquisition memory without interruption due to visualization	
	max. realtime waveform acquisition rate	> 1 600 000 waveforms/s
	min. blind time between consecutive acquisitions	< 400 ns

## Differential signals

General description	Calculation of differential and common mode signals from p part and n part connected to separate input channels. Because of the R&S®RTE digital trigger concept, these signals can be used as a trigger input.	
Input channels		channel 1, channel 2, channel 3, channel 4
Differential signal	difference between two input channels	channel 1 and channel 3, channel 2 and channel 4
Common mode signal	sum of two input channels	channel 1 and channel 3, channel 2 and channel 4
Maximum number of outputs	differential signals	2
	common mode signals	2

## High definition mode

General description	The high definition mode increases the numeric resolution of the waveform signal by using digital filtering, leading to a reduced noise. Because of the R&S®RTE trigger concept, the signals with increased numeric resolution are used as input for triggering.	
Numeric resolution	bandwidth	bit resolution
	10 kHz to 30 MHz	16 bit
	50 MHz	14 bit
	100 MHz	13 bit
	200 MHz	12 bit
	300 MHz	11 bit
	500 MHz	10 bit
Realtime sampling rate		max. 2.5 Gsample/s on each channel
RMS noise floor at 50 Ω (meas.)	input sensitivity 1 mV/div	
	bandwidth	
	10 MHz	15 µV
	100 MHz	30 µV
	500 MHz	61 µV
	input sensitivity 10 mV/div	
	bandwidth	
	10 MHz	33 µV
	100 MHz	98 µV
	500 MHz	210 µV
	input sensitivity 100 mV/div	
	bandwidth	
	10 MHz	250 µV
	100 MHz	770 µV
	500 MHz	1.65 mV



## Trigger system

Sources	R&S®RTE1022, R&S®RTE1032, R&S®RTE1052, R&S®RTE1102, R&S®RTE1152, R&S®RTE1202	channel 1, channel 2
	R&S®RTE1024, R&S®RTE1034, R&S®RTE1054, R&S®RTE1104, R&S®RTE1154, R&S®RTE1204	channel 1, channel 2, channel 3, channel 4
Sensitivity		10 <sup>-4</sup> div, from DC to instrument bandwidth for all vertical scales
Trigger jitter	full-scale sine wave of frequency set to -3 dB bandwidth	< 1 ps (RMS) (meas.)
Coupling mode	standard	same as selected channel
	lowpass filter	cutoff frequency selectable from 50 kHz to 50 % of analog bandwidth
Sweep mode		auto, normal, single, n single
Event rate	max.	one event for every 800 ps time interval
Trigger level	range	±5 div from center of screen
Trigger hysteresis	modes	auto (standard) or manual
	sensitivity	10 <sup>-4</sup> div, from DC to instrument bandwidth for all vertical scales
Holdoff range	time	100 ns to 10 s, fixed and random
	events	1 event to 2 000 000 000 events

<b>Main trigger modes</b>		
Edge	triggers on specified slope (positive, negative or either) and level	
Glitch	triggers on glitches of positive, negative or either polarity that are shorter or longer than specified width	
	glitch width	200 ps to 1000 s
Width	triggers on positive or negative pulse of specified width; width can be shorter, longer, inside or outside the interval	
	pulse width	200 ps to 1000 s
Runt	triggers on pulse of positive, negative or either polarity that crosses one threshold but fails to cross a second threshold before crossing the first one again; runt pulse width can be arbitrary, shorter, longer, inside or outside the interval	
	runt pulse width	200 ps to 1000 s
Window	triggers when signal enters or exits a specified voltage range; triggers also when signal stays inside or outside the voltage range for a specified period of time	
Timeout	triggers when signal stays high, low or unchanged for a specified period of time	
	timeout	200 ps to 1000 s
Interval	triggers when time between two consecutive edges of same slope (positive or negative) is shorter, longer, inside or outside a specified range	
	interval time	200 ps to 1000 s
Slew rate	triggers when the time required by a signal edge to toggle between user-defined upper and lower voltage levels is shorter, longer, inside or outside the interval; edge slope may be positive, negative or either	
	toggle time	200 ps to 1000 s
Data2clock	triggers on setup time and hold time violations between clock and data present on any two input channels; monitored time interval may be specified by the user in the range from -100 ns to 100 ns around a clock edge and must be at least 200 ps wide	
Pattern	triggers when a logical combination (AND, NAND, OR, NOR) of the input channels stays true for a period of time shorter, longer, inside or outside a specified range	
State	triggers when a logical combination (AND, NAND, OR, NOR) of the input channels stays true at a slope (positive, negative or either) in one selected channel	
Serial pattern	triggers on serial data pattern up to 128 bit clocked by one input channel; pattern bits may be high (H), low (L) or don't care (X); clock edge slope may be positive, negative or either	
	max. data rate	< 1.25 Gbps
TV/video	triggers on baseband analog progressive and interlaced video signals including NTSC, PAL, PAL-M, SECAM, EDTV and HDTV broadcast standards as well as custom bi-level and tri-level sync video standards	
	trigger modes	all fields, odd fields, even fields, all lines, line number
Line	triggers with the frequency of the AC power line voltage	

<b>Advanced trigger modes</b>		
Sequence trigger (A/B trigger)	triggers on B event after occurrence of A event; delay condition after A event specified either as time interval or number of B events	
	A event	any trigger mode
	B event	edge, glitch, width, runt, window, timeout, interval, slew rate
Serial bus trigger	optional	see dedicated triggering and decoding options
External trigger input	input impedance	50 $\Omega$ $\pm$ 1.5 % (meas.), 1 M $\Omega$ $\pm$ 1 %    14 pF (meas.)
	max. input voltage at 50 $\Omega$	5 V (RMS)
	max. input voltage at 1 M $\Omega$	30 V (RMS) derates at 20 dB/decade to 5 V (RMS) above 5 MHz
	trigger level range	$\pm$ 5 V
	sensitivity, for input frequency $\leq$ 500 MHz	300 mV ( $V_{pp}$ )
	input coupling	AC, DC (50 $\Omega$ and 1 M $\Omega$ ), GND, HF reject (attenuates > 50 kHz), LF reject (attenuates < 50 kHz)
	trigger modes	edge (rise or fall)
Trigger out	functionality	a pulse is generated for every acquisition trigger event
	output voltage	0 V to 5 V at high impedance; 0 V to 2.5 V at 50 $\Omega$
	pulse width	selectable between 50 ns and 60 ms
	pulse polarity	low active or high active
	output delay	depends on trigger settings
	jitter	$\pm$ 600 ps (meas.)

## RF characteristics <sup>4</sup>

Sensitivity/noise density	at 1.001 GHz (measurement of the power spectral density at 1.001 GHz at input sensitivity 1 mV/div, corresponding to –36 dBm input range of the oscilloscope, using the FFT with center frequency 1.001 GHz, span 500 kHz, RBW 3 kHz)	–159 dBm (1 Hz) (meas.)
	at 100 kHz (measurement of the power spectral density at 100 kHz at input sensitivity 1 mV/div, corresponding to –36 dBm input range of the oscilloscope, using the FFT with center frequency 100 kHz, span 20 kHz, RBW 200 Hz)	–155 dBm (1 Hz) (meas.)
Noise figure	at 1.001 GHz (calculated based on the noise density above)	15 dB (meas.)
	at 100 kHz (calculated based on the noise density above)	19 dB (meas.)
Signal-to-noise ratio	measured for an input carrier with frequency 1 GHz and level 0 dBm at input sensitivity 70 mV/div, corresponding to 0 dBm input range of the oscilloscope, using the FFT with center frequency 1 GHz, span 100 MHz, RBW 400 Hz at +20 MHz from the center frequency	107 dB (meas.)
Absolute amplitude accuracy	0 to 1.5 GHz	±1 dB (meas.)
Spurious-free dynamic range	measured for an input carrier with frequency 450 MHz and level 0 dBm at input sensitivity 70 mV/div, corresponding to 0 dBm input range of the oscilloscope, using the FFT with center frequency 1 GHz, span 1 GHz, RBW 100 kHz	59 dBc (meas.)
Second-harmonic distortion	measured for an input carrier with frequency 450 MHz and level 0 dBm at input sensitivity 70 mV/div, corresponding to 0 dBm input range of the oscilloscope, using the FFT with center frequency 1 GHz, span 1 GHz, RBW 100 kHz	–52 dBc (meas.)
Third-harmonic distortion	measured for an input carrier with frequency 450 MHz and level 0 dBm at input sensitivity 70 mV/div, corresponding to 0 dBm input range of the oscilloscope, using the FFT with center frequency 1 GHz, span 1 GHz, RBW 100 kHz	–48 dBc (meas.)

<sup>4</sup> The RF characteristics are measured for an R&S®RTE1204 oscilloscope with 2 GHz bandwidth.

## Waveform measurements

General features	measurements	up to 8 measurements
	gate	delimits the display region evaluated for automatic measurements
	reference levels	user-configurable vertical levels define support structures for automatic measurements
	statistics	displays maximum, minimum, mean, standard deviation, RMS and measurement count for each automatic measurement
	track	measurement results displayed as continuous trace that is time-correlated to the measurement source
	long-term analysis	history of selected measurements as trace against count index
	histogram	available for each measurement independently
Measurement category	amplitude and time	amplitude, high, low, maximum, minimum, peak-to-peak, mean, RMS, sigma, positive overshoot, negative overshoot, area, rise time, fall time, positive width, negative width, period, frequency, positive duty cycle, negative duty cycle, delay, phase, burst width, pulse count, edge count, positive switching, negative switching, cycle area, cycle mean, cycle RMS, cycle sigma, setup time, hold time, setup/hold ratio, pulse train, delay to trigger, slew rate rising, slew rate falling, DC voltmeter (requires Rohde & Schwarz active probe with R&S®ProbeMeter functionality)
	eye diagram	extinction ratio (%), eye height, eye width, eye top, eye base, Q factor, noise RMS, S/N ratio, duty cycle distortion, eye rise time, eye fall time, eye bit rate, eye amplitude, jitter (peak-to-peak, 6-sigma, RMS)
	spectrum	channel power, bandwidth, occupied bandwidth, harmonic search, total harmonic distortion THD in dB and % using power values, total harmonic distortion variants THD <sub>a</sub> , THD <sub>u</sub> and THD <sub>r</sub> , using voltage, overall voltage and overall voltage root means square, peak list (THD <sub>a</sub> , THD <sub>u</sub> , THD <sub>r</sub> and peak list require R&S®RTE-K18 option)
Cursors	setup	up to 2 cursor sets on screen, each set consisting of two horizontal and two vertical cursors
	target	acquired waveforms (input channels), math waveforms, reference waveforms, XY diagrams
	operating mode	vertical measurements, horizontal measurements or both; vertical cursors either set manually or locked to waveform

Histogram	source	acquired waveform (input channels), math waveform, reference waveform
	mode	vertical (for timing statistics), horizontal (for amplitude statistics)
	automatic measurements	waveform count, waveform samples, histogram samples, histogram peak, peak value, upper peak, lower peak, maximum, minimum, median, range, mean, sigma, mean $\pm$ 1, 2 and 3 sigma, marker $\pm$ probability
Quick measurements	function	fast overview of user-configurable measurements from one channel
	number of measurements	up to 8 simultaneously
	measurements	amplitude, high, low, maximum, minimum, peak-to-peak, mean, RMS, sigma, overshoot, area, rise time, fall time, positive width, negative width, period, frequency, duty cycle, burst width, pulse count, edge count, positive switching, negative switching, cycle area, cycle mean, cycle RMS, cycle sigma, pulse train

## Mask testing

Test definition	number of masks	up to 8 simultaneously
	source	acquired waveforms (input channels), math waveforms, reference waveforms, XY graphs
	fail condition	sample hit or waveform hit
	fail tolerance	minimum number of fail events for test fail in range from 0 to 4 000 000 000
	action on error	acquisition stop, beep, print and save waveform, trigger out
	save/load to file	test and mask settings (.xml format)
Mask definition with segments	number of independent segments	up to 8
	segment definition	array of points and connecting rule (upper, lower, inner) define segment region
	segment input	point and click on touchscreen, editable list
Mask definition with tolerance tube	input signal	acquired waveform
	definition of tolerance tube	horizontal width, vertical width, vertical stretch, vertical position
Result statistics	category	completed acquisitions, remaining acquisitions, state, sample hits, mask hits, fail rate, test result (pass or fail)
Visualization options	waveform style	vectors, dots
	violation highlighting	hits (on/off), highlight persistence (50 ms to 50 s or infinite), waveform color (default: red)
	mask colors	configurable colors for mask without violation (default: translucent gray), mask with violation (default: translucent red), mask with contact (default: translucent pale red)

## Waveform math

General features	number of math waveforms	up to 4
	number of reference waveforms	up to 4
	waveform arithmetic	user-selectable average or envelope of consecutive waveforms
Algebraic expressions	user may define complex mathematical expressions involving waveforms and measurement results	
	math functions	add, subtract, multiply, divide, absolute value, square, square root, integrate, differentiate, $\log_{10}$ , $\log_e$ , $\log_2$ , rescale, sin, cos, tan, arcsin, arccos, arctan, sinh, cosh, tanh, autocorrelation, crosscorrelation
	logical operators	not, and, nand, or, nor, xor, nxor
	relational operators	Boolean result of =, $\neq$ , >, <, $\leq$ , $\geq$
	frequency domain	spectral magnitude and phase, real and imaginary spectra, group delay
	digital filter	lowpass, highpass
Optimized math	operators	add, subtract, multiply, absolute value, differentiate, $\log_{10}$ , $\log_e$ , $\log_2$ , rescale, FIR, FFT magnitude
Spectrum analysis	FFT magnitude spectrum	
	setup parameters	center frequency, frequency span, frame overlap, frame window (rectangular, Hamming, Hann, Blackman, Gaussian, Flattop, Kaiser Bessel), user-selectable spectrum averaging, RMS, envelope, max. hold and min. hold (max. hold and min. hold require R&S®RTE-K18 option)
	max. realtime waveform acquisition rate	> 500 waveforms/s

## Search and mark function

General description	scans acquired waveforms for occurrence of a user-defined set of events and highlights each occurrence	
Basic setup	source	acquired waveforms (input channels), math waveforms, reference waveforms
	search panels	up to 4, where each panel may manage multiple event searches
	search mode	manually triggered or continuous
	search conditions	
	supported events	edge, glitch, width, runt, window, timeout, interval, slew rate, data2clock, state, pattern
	event configuration	identical to corresponding trigger event
	event selection	single or multiple events on same source
Search oscilloscope	mode	current waveform, gated time interval
Result visualization	table	
	sort mode	horizontal position or vertical value
	max. result count	specifies max. table size
	zoom window	centered on highlighted event

## Display characteristics

Diagram types	Yt, XY, long-term measurement, spectrum, spectrogram (spectrogram requires R&S®RTE-K18 option)
Display interface configuration	display area can be split up into separate diagram areas by dragging and dropping signal icons; each diagram area can hold any number of signals; diagram areas may be stacked on top of each other and later accessed via the dynamic tab menu
Signal bar	accommodates timebase settings, trigger settings and signal icons; signal bar may be docked to left or right side of display area or hidden
Signal icon	each active waveform is represented by a separate signal icon on the signal bar; the signal icon displays the individual vertical and acquisition settings; a waveform can be minimized to its signal icon so that it appears as a realtime preview in miniature form; dialog boxes and measurement results may also be minimized to a signal icon
Axis label	X-axis ticks and Y-axis ticks labeled with tick value and physical unit
Diagram label	diagrams may be individually labeled with a descriptive user-defined name
Diagram layout	grid, crosshair, axis labels and diagram label may be switched on and off separately
Persistence	50 ms to 50 s, or infinite
Zoom	user-defined zoom window provides vertical and horizontal zoom; each diagram area supports multiple zoom windows; touchscreen interface simplifies resize and drag operations on zoom window
Signal colors	predefined or user-defined color tables for persistence display

## Input and output

<b>Front</b>		
Channel inputs		BNC-compatible, for details see Vertical system
	probe interface	auto-detection of passive probes, Rohde & Schwarz active probe interface
External trigger input		BNC-compatible, for details see Trigger system
Probe compensation output	signal shape	rectangle, $V_{\text{low}} = 0 \text{ V}$ , $V_{\text{high}} = 1 \text{ V}$ amplitude $1 \text{ V (V}_{\text{pp}}) \pm 5 \%$
	frequency	$1 \text{ kHz} \pm 1 \%$
	impedance	nom. $50 \Omega$
Ground jack		connected to ground
USB interface		2 ports, type A plug, version 2.0

<b>Rear</b>		
Trigger out		SMA, for details see Trigger system
USB interface		2 ports, type A plug, version 3.0
LAN interface		RJ-45 connector, supports 10/100/1000BASE-T
External monitor interface		DVI-D connector, output of oscilloscope display or extended desktop display
Reference input/output	connector	BNC female, software switch for selection of input/output
	input	
	impedance	nom. $50 \Omega$
	input frequency	10 MHz
	required level	$\geq 0 \text{ dBm}$ into $50 \Omega$
	output	
	impedance	nom. $50 \Omega$
	output frequency	nom. 10 MHz
GPIO interface	level	$> 7 \text{ dBm}$
		see R&S®RTE-B10 option
Security slot		for standard Kensington style lock

## General data

Display	type	10.4" LC TFT color display with touchscreen
	resolution	1024 × 768 pixel (XGA)

<b>Temperature</b>		
Temperature loading	operating temperature range	0 °C to +45 °C
	storage temperature range	−40 °C to +70 °C
Climatic loading		+25° C/+40 °C at 85 % rel. humidity cyclic, in line with IEC 60068-2-30

<b>Altitude</b>		
Operating		up to 3000 m above sea level
Nonoperating		up to 4600 m above sea level

<b>Mechanical resistance</b>		
Vibration	sinusoidal	5 Hz to 150 Hz, 1.8 g at 55 Hz, 0.5 g from 55 Hz to 150 Hz, in line with EN 60068-2-6
		5 Hz to 55 Hz, in line with MIL-PRF-28800F section 4.5.5.3.2 class 3
	random	10 Hz to 300 Hz, acceleration 1.2 g (RMS), in line with EN 60068-2-64
		5 Hz to 500 Hz, acceleration 2.058 g (RMS), in line with MIL-PRF-28800F section 4.5.5.3.1 class 3
Shock		40 g shock spectrum, in line with MIL-STD-810E, method no. 516.4, procedure I
		30 g functional shock, halfsine, duration 11 ms, in line with MIL-PRF-28800F section 4.5.5.4.1

<b>EMC</b>		
RF emission		in line with CISPR 11/EN 55011 group 1 class A (for a shielded test setup); the instrument complies with the emission requirements stipulated by EN 55011, EN 61326-1 and EN 61326-2-1 class A, making the instrument suitable for use in industrial environments
Immunity		in line with IEC/EN 61326-1 table 2, immunity test requirements for industrial environment <sup>5</sup>

<b>Certifications</b>		VDE-GS, cCSA <sub>US</sub>
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<b>Calibration interval</b>		1 year
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<sup>5</sup> Test criterion is displayed noise level within ±1.5 div for input sensitivity of 5 mV/div.



<b>Power supply</b>		
AC supply		100 V to 240 V at 50 Hz to 60 Hz and 400 Hz, max. 3.3 A to 1.5 A, in line with MIL-PRF-28800F section 3.5
Power consumption		max. 300 W
Safety		in line with IEC 61010-1, EN 61010-1, CAN/CSA-C22.2 No. 61010-1-04, UL 61010-1

<b>Mechanical data</b>		
Dimensions	W × H × D	427 mm × 249 mm × 204 mm (16.81 in × 9.80 in × 8.03 in)
Weight	without options, nominal	8.6 kg (18.96 lb)

# Options

## R&S®RTE-B1

Mixed signal option, additional 16 logic channels
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### Vertical system

Input channels		16 logic channels (D0 to D15)
Arrangement of input channels		arranged in two logic probes with 8 channels each, assignment of the logic probes to the channels (D0 to D7 or D8 to D15) is displayed on the probe
Input impedance		100 kΩ ± 2 %    ~4 pF (meas.) at probe tips
Maximum input frequency	signal with minimum input voltage swing and hysteresis setting: normal	400 MHz (meas.)
Maximum input voltage		±40 V (V <sub>p</sub> )
Minimum input voltage swing		500 mV (V <sub>pp</sub> ) (meas.)
Threshold groups		D0 to D3, D4 to D7, D8 to D11 and D12 to D15
Threshold level	range predefined	±8 V in 25 mV steps CMOS 5.0 V, CMOS 3.3 V, CMOS 2.5 V, TTL, ECL, PECL, LVPECL
Threshold accuracy		±(100 mV + 3 % of threshold setting)
Comparator hysteresis		normal, robust, maximum

### Horizontal system

Channel deskew	range for each channel	±200 ns
Channel-to-channel skew		< 500 ps (meas.)

### Acquisition system

Sampling rate	max.	5 Gsample/s on each channel
Realtime waveform acquisition rate	max.	> 200 000 waveforms/s
Memory depth		100 Msample for every channel
Decimation		pulses lost due to decimation are displayed

### Trigger system

Holdoff range	time	100 ns to 10 s, fixed and random
	events	1 event to 2 000 000 000 events

<b>Trigger modes</b>		
Edge	triggers on specified slope (positive, negative or either) in the source signal	
	sources	any channel from D0 to D15 or any logical combination of D0 to D15
Width	triggers on positive or negative pulse of specified width in the source signal; width can be shorter, longer, equal, inside or outside the interval	
	sources	any channel from D0 to D15 or any logical combination of D0 to D15
	pulse width	200 ps to 10 s
Timeout	triggers when the source signal stays high, low or unchanged for a specified period of time	
	sources	any channel from D0 to D15 or any logical combination of D0 to D15
	timeout	200 ps to 10 s
Data2clock	triggers on setup time and hold time violations between a clock signal and a data signal; monitored time interval with a max. width of 200 ns and a position of max. ±1 μs relative to the clock edge	
	data signal	any subset of channels from D0 to D15 or any user-defined bus signal
	clock signal	any channel from D0 to D15

Pattern	triggers when the source goes true or stays true for a period of time shorter, longer, equal, inside or outside a specified range	
	sources	any logical combination of D0 to D15 or any user-defined bus signal
	pulse width	200 ps to 10 s
State	triggers on the slope (positive, negative or either) of the clock signal when data signal matches a user-defined logical state	
	data signal	any logical combination of D0 to D15 or any user-defined bus signal
	clock signal	any channel from D0 to D15
Serial pattern	triggers on a serial data pattern of up to 32 bit; pattern bits may be high (H), low (L) or don't care (X); clock edge slope may be positive, negative or either	
	data signal	any channel from D0 to D15 or any logical combination of D0 to D15
	clock signal	any channel from D0 to D15 or any analog channel
	max. data rate	1.00 Gbps
	optional	see dedicated triggering and decoding options
	sources	any channel from D0 to D15

## Waveform measurements

General features		measurement panels, gate, statistics, long-term analysis and limit check; see features of the base unit
Measurement sources		all channels from D0 to D15 or any logical combination of D0 to D15
Automatic measurements		positive pulse width, negative pulse width, period, frequency, burst width, delay, phase, positive duty cycle, negative duty cycle, positive pulse count, negative pulse count, rising edge count, falling edge count
Additional cursor function		display of decoded bus value at the cursor position

## Waveform math

Function		any logical combination of D0 to D15
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## Search and mark functions

The search function will be available in a future software release.

## Display characteristics

Display of logical channels		selectable size and position on screen, diagram configuration by dragging and dropping signal icons
Bus decode	number of bus signals	4
	bus types	unclocked and clocked
	display types	decoded bus, logical signal, bus + logical signal, amplitude signal, amplitude + logical signal, tabulated list (decoded time interval selected with cursors)
	position and size	size and position on screen selectable
	data format of decoded bus	hex, unsigned integer, signed integer, fractional, binary
	data format of amplitude signal	unsigned integer, signed integer, fractional, binary offset
Channel activity display		independent of the oscilloscope acquisition, the state (stays low, stays high or toggles) of the channels from D0 to D15 is displayed in the signal icon

# R&S® RTE-B6

Arbitrary function/waveform generator, 2 analog channels, 8-bit pattern generator

## Analog channels

<b>General</b>		
Output channel		2 channels
Vertical resolution		14 bit
Operating modes		function generator, arbitrary waveform generator, modulation, frequency sweep

<b>Function generator</b>	output of predefined waveforms	
Sample rate		500 Msample/s
Waveforms	sine, square/pulse, ramp, DC, noise, sine cardinal (sinc), Gaussian pulse, Lorentz, exponential fall, exponential rise, cardiac	
Sine	frequency range	1 mHz to 100 MHz
	amplitude flatness (relative to 1 kHz)	
	$f \leq 100 \text{ kHz}$	$\leq \pm 0.1 \text{ dB}$
	$100 \text{ kHz} < f \leq 60 \text{ MHz}$	$\leq \pm 0.3 \text{ dB}$
	$60 \text{ MHz} < f \leq 100 \text{ MHz}$	$\leq \pm 0.5 \text{ dB}$
	total harmonic distortion (1 V ( $V_{pp}$ ) into 50 $\Omega$ )	
	$f \leq 100 \text{ kHz}$	$\leq -70 \text{ dBc}$ (=THD $\leq 0.032 \%$ )
	$100 \text{ kHz} < f \leq 15 \text{ MHz}$	$\leq -55 \text{ dBc}$
	$15 \text{ MHz} < f \leq 35 \text{ MHz}$	$\leq -40 \text{ dBc}$
	$35 \text{ MHz} < f \leq 100 \text{ MHz}$	$\leq -30 \text{ dBc}$
	nonharmonic spurious (1 V ( $V_{pp}$ ) into 50 $\Omega$ )	-65 dBc (meas.)
	phase noise (meas.)	
	$f \leq 25 \text{ MHz}$	$\leq -105 \text{ dBc}$ (1 Hz) at 1 kHz offset, $\leq -115 \text{ dBc}$ (1 Hz) at 10 kHz offset, $\leq -125 \text{ dBc}$ (1 Hz) at 100 kHz offset
	$25 \text{ MHz} < f \leq 100 \text{ MHz}$	$\leq -105 \text{ dBc}$ (1 Hz) at 1 kHz offset, $\leq -110 \text{ dBc}$ (1 Hz) at 10 kHz offset, $\leq -115 \text{ dBc}$ (1 Hz) at 100 kHz offset
Square/pulse	frequency range	1 mHz to 30 MHz
	duty cycle (if pulse width limit is not exceeded)	0.01 % to 99.99 %, 0.01 % resolution
	pulse width	$\geq 16.5 \text{ ns}$ , 0.1 ns resolution
	rise/fall time	
	$f \leq 10 \text{ Hz}$	90 $\mu\text{s}$ (meas.)
	$10 \text{ Hz} < f \leq 30 \text{ MHz}$	9 ns (meas.)
	overshoot	$\leq 2 \%$
	jitter (cycle-to-cycle)	$\leq 40 \text{ ps}$ (RMS) (meas.)
Ramp (triangle, sawtooth)	frequency range	1 mHz to 1 MHz
	linearity	$\leq 0.1 \%$ (meas.)
	variable symmetry	0 % to 100 %, 0.1 % resolution
DC	level range	
	into 50 $\Omega$	$\pm [3 \text{ V} - (\text{noise amplitude } [V_{pp}] / 2)]$
	into open circuit	$\pm [6 \text{ V} - (\text{noise amplitude } [V_{pp}] / 2)]$
Noise	amplitude	
	DC	0 V to 6 V ( $V_{pp}$ ) (into 50 $\Omega$ ) 0 V to 12 V ( $V_{pp}$ ) (into open circuit) 4 digits resolution
	all other waveforms	0 % to 100 % of AC signal amplitude, 1 % resolution
	bandwidth	$\geq 100 \text{ MHz}$
Sine cardinal (sinc)	frequency range	1 mHz to 2 MHz
Gaussian pulse	frequency range	1 mHz to 10 MHz
Lorentz	frequency range	1 mHz to 5 MHz
Exponential rise/fall	frequency range	1 mHz to 1 MHz
Cardiac	frequency range	1 mHz to 1 MHz

<b>Arbitrary waveform generator</b>	output of user-defined waveforms	
Waveform length		1 sample to 40 Msample on each channel
Sample rate		1 sample/s to 250 Msample/s
Filter bandwidth		100 MHz

<b>Modulation</b>		
Sample rate		500 Msample/s
Modulation types		amplitude modulation (AM), frequency modulation (FM), frequency-shift key modulation (FSK), pulse width modulation (PWM)
Carrier waveform	AM, FM, FSK	sine
	PWM	square/pulse
AM	modulation signals	sine, square, ramp (triangle, sawtooth)
	modulation frequency	1 mHz to 1 MHz
	depth	0 % to 100 %, 0.1 % resolution
FM	modulation signals	sine, square, triangle, ramp, inverse ramp
	modulation frequency	1 mHz to 1 MHz
	frequency deviation	1 mHz to 10 MHz
FSK	modulation signal	50 % duty cycle square wave
	range of frequency 1, frequency 2	1 mHz to 100 MHz
	hop rate	1 mHz to 1 MHz
PWM	modulation signals	sine, square, ramp
	depth	0 % to 99.99 % of the duty cycle, 0.01 % resolution

<b>Frequency sweep</b>	output of a sinusoidal waveform with the frequency changing linearly between the start frequency and the stop frequency within the sweep time	
	sample rate	500 Msample/s
	waveform	sine
	frequency range	1 mHz to 100 MHz
	direction	up (start frequency < stop frequency) down (start frequency > stop frequency)
	sweep time	1 ms to 500 s

<b>Two-channel operation</b>	operating modes	independent channels, coupled parameters, differential
	parameter coupling	none, frequency and/or amplitude
	relative phase	−180° to 180°, 0.1° resolution
	channel-to-channel skew	≤ 200 ps (meas.)
	channel-to-channel isolation (each channel with same output amplitude)	
	f ≤ 10 MHz	≥ 60 dB (meas.)
	10 MHz < f ≤ 100 MHz	≥ 40 dB (meas.)

<b>Outputs</b>		
Connectors		BNC female on the rear panel
Function		on, off, inverted
Output impedance		nom. 50 Ω
Overload protection		a short-circuit to ground is tolerated indefinitely, automatic shutoff in case of voltages ≥ +7 V or ≤ −7 V (meas.), automatic shutoff in case of overcurrent, max. −20 V to +20 V without damage (meas.), ESD protection

Amplitude range <sup>6</sup>	sine, square/pulse, ramp, pulse, exponential rise, exponential fall	
	into 50 $\Omega$	10 mV to 6 V ( $V_{pp}$ ) (frequency $\leq$ 50 MHz), 10 mV to 4 V ( $V_{pp}$ ) (frequency $>$ 50 MHz)
	into open circuit	20 mV to 12 V ( $V_{pp}$ ) (frequency $\leq$ 50 MHz), 20 mV to 8 V ( $V_{pp}$ ) (frequency $>$ 50 MHz)
	sine cardinal (sinc)	
	into 50 $\Omega$	10 mV to 3 V ( $V_{pp}$ )
	into open circuit	20 mV to 6 V ( $V_{pp}$ )
	Gauss, Lorentz	
	into 50 $\Omega$	10 mV to 2.5 V ( $V_{pp}$ )
	into open circuit	20 mV to 5 V ( $V_{pp}$ )
	arbitrary waveforms	
	into 50 $\Omega$	10 mV to 6 V ( $V_{pp}$ ) (sample rate $\leq$ 125 Msample/s), 10 mV to 4 V ( $V_{pp}$ ) (sample rate $>$ 125 Msample/s)
	into open circuit	20 mV to 12 V ( $V_{pp}$ ) (sample rate $\leq$ 125 Msample/s), 20 mV to 8 V ( $V_{pp}$ ) (sample rate $>$ 125 Msample/s)
DC offset range	resolution	1 mV
	accuracy	$\pm$ [1% of control + 1 mV ( $V_{pp}$ )] at 1 kHz
	sine, square/pulse, ramp, pulse, exponential rise, exponential fall	
	into 50 $\Omega$	$\pm$ [3 V – (amplitude [V ( $V_{pp}$ )] / 2)]
	into open circuit	$\pm$ [6 V – (amplitude [V ( $V_{pp}$ )] / 2)]
	sine cardinal (sinc), Gauss, Lorentz	
	into 50 $\Omega$	$\pm$ 0.5 V
Frequency accuracy	into open circuit	$\pm$ 1 V
	resolution	1 mV
	accuracy	$\pm$ (2 % of control + 2 mV)
		$ \Delta f  \leq [(\text{timebase accuracy}) \times (\text{nominal frequency}) + 1 \mu\text{Hz}]$ (timebase accuracy: see Horizontal system)

## 8-bit pattern generator

Function		output of user-defined patterns
Output channels		8 channels, coupled w.r.t. pattern length and data output rate
Pattern length		1 bit to 40 Mbit on each channel
Bit rate		1 bit/s to 40 Mbit/s

<b>Outputs</b>		
Connector		16-pin double row connector, 2.54 mm pitch, located on an adapter board, which is connected via a removable ribbon cable to the R&S® RTE-B6
Output impedance		nom. 330 $\Omega$
Overload protection	reverse input voltage without damage	–0.5 V to +6.5 V (meas.), ESD protection
Amplitude	low level output voltage ( $I = 100 \mu\text{A}$ )	
	output voltage	0 V +0,15 V /-0.02 V
	accuracy	$\leq$ 0.15 V (meas.)
	high level output voltage	
	setting range	1.2 V to 5.0 V
	resolution	0.1 V
Rise/fall time	accuracy	$\leq$ 0.05 V
		8 ns (meas.)
Overshoot		$\leq$ 5 % (meas.)

<sup>6</sup> Amplitude is the sum of the AC amplitude and the noise amplitude.

**R&S® RTE-B10**

<b>Additional GPIB interface</b>		
Function		interface in line with IEC 625-2 (IEEE 488.2)
Command set		SCPI 1999.0
Connector		24-pin Amphenol female
Interface functions		SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0

**R&S® RTE-B18**

<b>Additional removable solid state disk</b>		
Disk type		solid state disk
Disk size		nom. ≥ 240 Gbyte
Firmware		installed upon delivery

**R&S® RTE-K1**

<b>I<sup>2</sup>C serial triggering and decoding</b>		
Protocol configuration	bit rate	up to 3.4 Mbps (auto-detected)
	auto threshold setup	assisted threshold configuration for I <sup>2</sup> C triggering and decoding
	device list	associate frame address with symbolic ID
Trigger	source (clock and data)	any input channel or logical channel
	trigger event setup	start, stop, restart, missing ACK, address, data, address + data
	address setup	7 bit or 10 bit address (value in hex, decimal, octal or binary); ACK, NACK or either; read, write or either; R/W bit included in address value or apart; condition =, ≠, ≥, ≤, in range, out of range
	data setup	data pattern up to 8 byte (hex, decimal, octal or binary); condition =, ≠, ≥, ≤, in range, out of range; offset within frame in range from 0 byte to 4095 byte
Decode	source (clock and data)	any input channel, math waveform, reference waveform, logical channel
	display type	decoded bus, logical signal, bus + logical signal, tabulated list, decode layers
	color coding	frame, start/restart, address, R/W bit, data, ACK/NACK, stop, error
	address and data format	hex, decimal, octal, binary, ASCII; symbolic names for user-defined subset of addresses
	decode layer	off, edges, bits
Search	search event setup	combination of start, stop, restart, missing ACK, address, data, address + data
	event settings	same as trigger event settings

<b>SPI serial triggering and decoding</b>		
Protocol configuration	type	2-wire, 3-wire and 4-wire SPI
	bit rate	up to 50 Mbps (auto-detected)
	bit order	LSB first, MSB first
	word size	4 bit to 32 bit
	frame condition	SS, timeout
	polarity (MOSI, MISO, SS, CLK)	active high, active low
	phase (CLK)	first edge, second edge
Trigger	auto threshold setup	assisted threshold configuration for SPI triggering and decoding
	source (MOSI, MISO, SS, CLK)	any input channel or logical channel
	trigger event setup	start of frame, MOSI, MISO, MOSI + MISO
Decode	data setup	data pattern up to 256 bit (hex or binary); condition =, ≠; offset within frame in range from 0 bit to 32767 bit
	source (MOSI, MISO, SS, CLK)	any input channel, math waveform, reference waveform, logical channel
	display type	decoded bus, logical signal, bus + logical signal, tabulated list, decode layers
	color coding	frame, word, error
	data format	hex, decimal, octal, binary, ASCII
	decode layer	edges, bits, words
Search	search event setup	start of frame, MOSI, MISO, MOSI + MISO
	event settings	same as trigger event settings

## R&S® RTE-K2

<b>UART/RS-232/RS-422/RS-485 serial triggering and decoding</b>		
Protocol configuration	bit rate	300 bps to 20 Mbps
	signal polarity	idle low, idle high
	number of bits	5 bit to 9 bit
	bit order	LSB first, MSB first
	parity	odd, even, mark, space, none
	stop bit	1, 1.5 or 2 bit periods
	end of packet	word, timeout, none
	auto threshold setup	assisted threshold configuration for UART triggering and decoding
Trigger	source (TX and RX)	any input channel or logical channel
	trigger event setup	start bit, packet start, data, parity error, break condition
	data setup	data pattern up to 256 bit (hex, decimal, octal, binary or ASCII); condition =, ≠; offset within packet in range 0 bit to 32767 bit
Decode	source (TX and RX)	any input channel, math waveform, reference waveform, logical channel
	display type	decoded bus, logical signal, bus + logical signal, tabulated list
	color coding	packet, data payload, start error, parity error, stop error
	data format	hex, decimal, octal, binary, ASCII



**R&S® RTE-K3**

<b>CAN serial triggering and decoding</b>		
Protocol configuration	signal type	CAN_H, CAN_L
	bit rate	100 bps to 1 Mbps
	sampling point	5 % to 95 % within bit period
	device list	associate frame identifier with symbolic ID, load DBC file content
	auto threshold setup	assisted threshold configuration for CAN triggering and decoding
Trigger	source	any input channel or logical channel
	trigger event setup	start of frame, frame type, identifier, identifier + data, symbolic, error condition (any combination of CRC error, bit stuffing error, form error and ACK error)
	identifier setup	frame type (data, remote or both), identifier type (standard or extended); condition =, ≠, ≥, ≤, in range, out of range
	data setup	data pattern up to 8 byte (hex, decimal, octal or binary); big-endian or little-endian; condition =, ≠, ≥, ≤, in range, out of range
	symbolic setup	message name, signal name; numeric signal condition =, ≠, ≥, ≤, in range, out of range; enumerated signal condition =, ≠, ≥, ≤
Decode	source	any input channel, math waveform, reference waveform, logical channel
	display type	decoded bus, logical signal, bus + logical signal, tabulated list
	color coding	start of frame, identifier, DLC, data payload, CRC, end of frame, error frame, overload frame, CRC error, bit stuffing error
	data format	hex, decimal, octal, binary, ASCII, symbolic
Search	source	any input channel or logical channel
	search event setup	combination of start of frame, frame type, identifier, identifier + data, error condition (any combination of CRC error, bit stuffing error, form error and ACK error) or only symbolic
	event settings	same as trigger event settings

<b>LIN serial triggering and decoding</b>		
Protocol configuration	version	1.3, 2.x or SAE J602; mixed traffic is supported
	bit rate	standard bit rate (1.2/2.4/4.8/9.6/10.417/19.2 kbps) or user-defined bit rate in range from 1 kbps to 20 kbps
	device list	associate frame identifier with symbolic ID, data length and protocol version
	auto threshold setup	assisted threshold configuration for LIN triggering and decoding
Trigger	source	any input channel
	trigger event setup	start of frame (sync break), identifier, identifier + data, wakeup frame, error condition (any combination of checksum error, parity error and sync field error)
	identifier setup	range from 0d to 63d; select condition =, ≠, ≥, ≤, in range, out of range for trigger "identifier"; select single identifier and condition = for trigger "identifier + data"
	data setup	data pattern up to 8 byte (hex, decimal, octal or binary); condition =, ≠, ≥, ≤, in range, out of range
Decode	source (TX and RX)	any input channel, math waveform, reference waveform
	display type	decoded bus, logical signal, bus + logical signal, tabulated list
	color coding	frame, frame identifier, data payload, checksum, error condition
	data format	hex, decimal, octal, binary, ASCII
Search	search event setup	combination of start of frame (sync break), identifier, identifier + data, wakeup frame, error condition (any combination of checksum error, parity error and sync field error)
	event settings	same as trigger event settings

**R&S® RTE-K4**

<b>FlexRay™ serial triggering and decoding</b>		
Protocol configuration	signal type	single-ended, differential, logic
	channel type	channel A, channel B
	bit rate	standard bit rates (2.5/5.0/10.0 Mbps)
	device list	associate frame identifier with symbolic ID
	auto threshold setup	assisted threshold configuration for FlexRay™ triggering and decoding
	source	any input channel or logical channel
Trigger	trigger event setup	start of frame, header + data, symbol, wakeup, error condition (any combination of FSS error, BSS error, FES error, header CRC error and frame CRC error)
	header setup	indicator bits, identifier, payload length, cycle count
	indicator bits setup	payload preamble bit, null frame bit, sync frame bit and startup frame bit separately configurable (1, 0 or don't care)
	identifier setup	condition =, ≠, ≥, ≤, in range, out of range
	payload length setup	condition =, ≠, ≥, ≤, in range, out of range
	cycle count	condition =, ≠, ≥, ≤, in range, out of range; step parameter for selection of non-contiguous values within provided range
	data setup	data pattern up to 8 byte (hex, decimal, octal or binary); condition =, ≠, ≥, ≤, in range, out of range; offset within frame in range from 0 byte to 253 byte
Decode	source	any input channel, math waveform, reference waveform, logical channel
	display type	decoded bus, logical signal, bus + logical signal, tabulated list
	color coding	frame, frame header, identifier, payload length, header CRC, cycle count, data payload, frame CRC, error condition
	data format	hex, decimal, octal, binary, ASCII
Search	search event setup	combination of start of frame, header + data, symbol, wakeup, error condition (any combination of FSS error, BSS error, FES error, header CRC error and frame CRC error)
	event settings	same as trigger event settings

**R&S® RTE-K5**

<b>I<sup>2</sup>S serial triggering and decoding</b>		
Protocol configuration	signal type	I <sup>2</sup> S standard, left justified, right justified, TDM
	auto threshold setup	assisted threshold configuration for I <sup>2</sup> S triggering and decoding
Trigger	source	any input channel or logical channel
	trigger event setup	data, window, frame condition, word select, error condition
	data setup	data pattern of an audio channel up to 4 byte (hex, signed decimal, unsigned decimal, octal or binary); condition =, ≠, ≥, ≤, <, >, in range, out of range
	window setup	word count of data pattern of an audio channel up to 4 byte (hex, signed decimal, unsigned decimal, octal or binary); condition =, ≠, ≥, ≤, <, >, in range, out of range
	frame condition setup	combination of audio channels in a frame, up to 4 byte (hex, signed decimal, unsigned decimal, octal or binary); condition =, ≠, ≥, ≤, <, >, in range, out of range
	word select setup	rising or falling edge of word select input channel
	error condition setup	source of word select
Decode	source	any input channel, math waveform, reference waveform, logical channel
	display type	decoded bus, logical signal, bus and logical signal, tabulated list
	color coding	audio frame, frame error, incomplete frame
	data format	hex, unsigned decimal, signed decimal (two's complement), octal, binary, ASCII
Protocol measurements	audio display	display of audio waveform for specified audio channels
	long-term display	history of selected audio data as trace against measurements, waveforms and time index

**R&S® RTE-K6**

<b>MIL-STD-1553 serial triggering and decoding</b>		
Protocol configuration	signal type	single-ended
	bit rate	standard bit rate (1 Mbit/s)
	polarity	normal, inverted
	device list	associate frame identifier with symbolic ID
	auto threshold setup	assisted threshold configuration
	timing	min. gap (2 $\mu$ s to 262 $\mu$ s) or off; max. response (2 $\mu$ s to 262 $\mu$ s) or off
Trigger	trigger event setup	sync, word, data word, command/status word, command word, status word, error condition
	sync and word setup	all words, command/status word, data word
	data word setup	RTA (condition =, $\neq$ , $\geq$ , $\leq$ , in range, out of range); data pattern (condition =, $\neq$ , $\geq$ , $\leq$ , in range, out of range); payload data index (=, <, >, $\geq$ , $\leq$ , range); max length of data pattern is 4 byte
	command/status word setup	RTA (condition =, $\neq$ , $\geq$ , $\leq$ , in range, out of range); 11 bit pattern (condition =, $\neq$ , $\geq$ , $\leq$ , in range, out of range)
	command word setup	RTA (condition =, $\neq$ , $\geq$ , $\leq$ , in range, out of range); subaddress/mode (condition =, $\neq$ , $\geq$ , $\leq$ , in range, out of range); data word count/mode count (condition =, $\neq$ , $\geq$ , $\leq$ , in range, out of range); direction (T/R)
	status word	RTA (condition =, $\neq$ , $\geq$ , $\leq$ , in range, out of range); status flags (message error, instrumentation, service request, broadcast command, busy, subsystem flag, dynamic bus control, terminal flag)
	error condition	any combination of sync error, Manchester error, parity error, timing error (see protocol configuration)
Decode	source	any analog input channel, math waveform, reference waveform
	display type	decoded bus, logical signal, bus + logical signal, tabulated list
	color coding	frame (word), sync, RTA, status bit field, parity, data field, error condition
	data format	hex, octal, binary, ASCII, signed, unsigned
Search	search event setup	sync, word, data word, command/status word, command word, status word, error condition
	event settings	same as trigger event settings

**R&S® RTE-K7**

<b>ARINC 429 triggering and decoding</b>		
Protocol configuration	signal type	single-ended
	bit rate	high (100 kbit/s) low (12 kbit/s to 14.5 kbit/s)
	polarity	A leg, B leg
	device list	associate frame identifier with symbolic ID
	auto threshold setup	assisted threshold configuration
	timing	min. gap (0 bit to 100 bit) or off; max. gap (0 bit to 1000 bit) or off
Trigger	trigger event setup	word start, word stop, label + data, error condition
	label + data setup	label (condition =, ≠, ≥, ≤, in range, out of range); data (condition =, ≠, ≥, ≤, in range, out of range); SDI/SSM
	error condition	any combination of coding error, parity error, timing error (see protocol configuration)
Decode	source	any analog input channel, math waveform, reference waveform
	display type	decoded bus, logical signal, bus + logical signal, tabulated list
	color coding	frame (word), label, SDI, data, SSM, parity, error condition
	data format	hex, octal, binary, ASCII, signed, unsigned
Search	search event setup	word start, word stop, label + data, error condition
	event settings	same as trigger event settings

**R&S® RTE-K8**

<b>Ethernet serial decoding</b>		
Protocol configuration	signal type	one channel, differential
	bit rate	selectable/adjustable
	auto threshold setup	assisted threshold configuration
	full autoset	adjust horizontal and vertical resolution and perform auto threshold
	source (SDATA)	analog and math channels
	variants	10BASE-T, 100BASE-TX
Trigger	frame start	trigger at start of any MAC frame
	pattern	fast trigger for 10BASE-T MAC frames, 32 byte, index 0 to 65535
	frame	advanced trigger configuration for MAC frames only 48 bit destination address, 48 bit source address, 16 bit length/type, 32 bit frame check; conditions =, ≠, <, >, ≥, in range, out of range
	error	preamble error, length error, CRC error
Decode	display type	decoded bus, logical signal, bus + logical signal, tabulated list, details, decode layers
	color coding	preamble, frame, destination address, source address, data
	data format	hex, octal, binary, signed, unsigned
	decode layer	edges, binary
Search	search event setup	frame, error
	event settings	same as trigger event settings

**R&S® RTE-K9**

<b>CAN-FD serial triggering and decoding</b>		
Protocol configuration	signal type	CAN_H, CAN_L
	standard	ISO, non-ISO (Bosch)
	bit rate	
	arbitration rate	10 kbps to 1 Mbps
	data rate	10 kbps to 15 Mbps
	sampling point	5 % to 95 % within bit period; independent settings for arbitration phase and data phase
	device list	associate frame identifier with symbolic ID, load DBC file content
Trigger	auto threshold setup	assisted threshold configuration
	source	any input channel or logical channel
	trigger event setup	start of frame, frame type, identifier, identifier + data, symbolic, error condition (any combination of CRC error, bit stuffing error, form error and ACK error)
	identifier setup	frame type (data, remote or both), identifier type (standard or extended); condition =, ≠, ≥, ≤, in range, out of range
	FD bits	FDF, BRS and ESI (0, 1, X)
	data setup	data pattern up to 8 bytes in the complete data range (hex, decimal, octal or binary); condition =, ≠, ≥, ≤, in range, out of range
	symbolic setup	message name, signal name; numeric signal condition =, ≠, ≥, ≤, in range, out of range; enumerated signal condition =, ≠, ≥, ≤
Decode	source	any input channel, math waveform, reference waveform, logical channel
	display type	decoded bus, logical signal, bus + logical signal, tabulated list
	color coding	start of frame, identifier, FD bits, DLC, data payload, CRC, end of frame, error frame, overload frame, CRC error, bit stuffing error
	data format	hex, decimal, octal, binary, ASCII, symbolic
Search	source	any input channel or logical channel
	search event setup	combination of start of frame, frame type, identifier, identifier + data, error condition (any combination of CRC error, bit stuffing error, form error and ACK error) or only symbolic
	event settings	same as trigger event settings

**R&S® RTE-K10**

<b>SENT serial triggering and decoding</b>		
Protocol configuration	signal type	data signal
	clock period (clock tick)	1 µs to 100 µs
	clock tolerance	0 % to 25 %
	data nibbles	1 to 6
	serial message type	none, Short Serial Message and Enhanced Serial Message
	CRC version	Legacy (Feb 2008) and v2010 (latest)
	CRC calculation	SAE J2716 standard and TLE 4998X
	pause pulse	no, yes, for constant frame length
	frame length in clock ticks (applicable only when pause pulse = constant frame length)	104 to 922
Trigger	source	any analog input channel
	trigger event setup	calibration or sync, transmission sequence, serial message and error condition
	transmission sequence status nibble setup	from 0 to F, condition =, ≠, ≥, ≤, in range, out of range
	transmission sequence data nibbles setup	each nibble value from 0 to F, condition =, ≠, ≥, ≤, in range, out of range
	serial message identifier setup	from 00 to FF, condition =, ≠, ≥, ≤, in range, out of range
	serial message identifier type setup (applicable only when the serial protocol = Enhanced Serial Message in protocol configuration)	4 bit and 8 bit
	serial message data setup	00 to FF (Short Serial Message), 000 to FFF (Enhanced Serial Message with 8 bit ID), 0000 to FFFF (Enhanced Serial Message with 4 bit ID)
	error condition setup	form error, calibration pulse error, pulse period error, CRC error and irregular frame length error
Decode	source	any analog input channel,
	display type	decoded bus, tabulated list
	color coding	transmission sequence: sync/calibration, status, data bits, CRC, pause pulse (optional), calibration pulse error, pulse period error, irregular frame length error and CRC error. serial message: identifier, data, CRC, form error, CRC error
	data format	hex, decimal, octal, binary, ASCII
Search	source	any analog input channel
	search event setup	calibration or sync, transmission sequence, serial message and error condition
	event settings	same as trigger event settings



**R&S®RTE-K18**

<b>Spectrum analysis</b>		
General description	The R&S®RTE-K18 spectrum analysis allows advanced signal analysis in the frequency domain.	
Spectrogram	display characteristics	spectrogram display; a separate spectrogram can be created for each FFT display; each FFT segment of a captured acquisition is displayed in a separate spectrogram line
		support of logarithmic frequency x-axis
	number of spectrograms	up to 4
	signal colors	predefined or user-defined color tables for persistence display with the spectrogram
	time lines	in stop mode two separate time lines can be used to navigate through a spectrogram in time; for each time line the relevant FFT segment is displayed in a diagram; the difference in acquisition time between the timelines is displayed
Logarithmic frequency x-axis	display characteristics	logarithmic frequency x-axis for the FFT display with support of analysis tools like cursors and masks
		logarithmic frequency x-axis for the spectrogram display
Waveform measurements	measurement functions	total harmonic distortion variants $THD_a$ , $THD_u$ and $THD_r$ using voltage, overall voltage and overall voltage root means square
	peak list	peak list; diagram labels for easy identification of the peak list entries in the diagram
Waveform math		user-selectable max. hold and min. hold in addition to spectrum averaging, RMS and envelope

**R&S®RTE-K31**

<b>Power analysis</b>		
General description	The R&S®RTE-K31 power analysis option extends the R&S®RTE firmware with measurement functionality focused on switched mode power supplies (SMPS) and DC/DC converters.	
Input	quality	evaluation of power quality at an AC input; measures real power, apparent power, reactive power, power factor and phase angle of power, frequency, crest factor, RMS of voltage and current
	harmonics	measures up to the 40 <sup>th</sup> harmonic of the incoming line frequency; precompliance checking for IEC 61000-3-2 (A, B, C, D), RTCA DO-160, MIL-STD-1399, max. limit checks
	inrush current	measures peak inrush current; multiple measurement zones configurable with analysis of the post-inrush behavior
Switching/control loop	slew rate	The slope of current or voltage is measured at start and end of the switching cycle.
	modulation	measures modulation of switching frequency and duty cycle under steady state and start-up conditions
	dynamic on-resistance	measures resistance of the switching transistor(s) in active state
Power path	efficiency (only for 4 channel devices)	measures input and output power to calculate the efficiency of an SMPS
	loss	measures switching loss and conduction loss of a power device
	safe operating area (SOA)	checks violation of voltage and current limits in which a power device can operate without damage; current versus voltage view (linear or log); violation mask is user-defined and editable in linear and log-log views
	turn on/off	measures relationship between AC and DC current, when turning the SMPS off and on
Output	ripple	measures AC components of output voltage and current, AC RMS, frequency, duty cycles, min./max./peak-to-peak amplitude
	spectrum	FFT analysis of output, measurement of frequency peaks
	transient response	This measurement captures the device behavior between the event of load changes and stabilization. includes peak (voltage, time), settling time, rise time, overshoot and delay
Deskew	automated	By using the R&S®RT-ZF20 probe deskew and calibration test fixture and Rohde & Schwarz voltage and current probes, the skew between the voltage and current signal is compensated automatically.
Reporting	easy reporting: Click to save a measurement. Report generation using user-selected test results from historical and currently-active tests. Put repeated and/or different measurements in one report.	

## R&S®RTE-K35

<b>Bus analysis</b>		
General description	The R&S®RTE-K35 bus analysis option adds bus measurements and analysis functions for dedicated protocols.	
	supported protocol options	R&S®RTE-K1 (I <sup>2</sup> C, SPI), R&S®RTE-K2 (UART), R&S®RTE-K3 (CAN, LIN), R&S®RTE-K8 (Ethernet), R&S®RTE-K9 (CAN-FD), R&S®RTE-K10 (SENT), R&S®RTE-K57 (100BASE-T1)
Measurements	field value	allows for the selection of frame types and displays the value of a specified field; the value can be displayed as track and histogram
	frame to frame	measures the distance between the starts of two selectable frame types in seconds
	trigger to frame	measures the distance between the trigger event and the start of a selectable frame type in seconds; alternatively, it measures the distance between the start of a selectable frame type and the trigger event
	frame count	counts the total number of frames in each acquisition
	gap time	measures the distance between the end of a selectable frame type to the start of another selectable frame type in seconds
	bus idle ratio	measures the percentage of idle time on a bus; idle time is defined as the time where the bus is not occupied by frames
	main bit rate	measures the main bit rate of a protocol based on the relevant bits in a frame; if a protocol provides multiple bit rates, the most relevant bit rate is being measured
	secondary bit rate	for protocols with multiple bit rates, the secondary bit rate is available
	frame error count	counts the total number of erroneous frames in each acquisition
	frame error rate	measures the percentage of erroneous frames in relation to the total frames
	consecutive frame error rate	measures the percentage of follow up (consecutive) frame errors, ignoring all single frame errors

## R&S® RTE-K50

Manchester and NRZ serial triggering and decoding		
Protocol configuration	signal type	selectable, one channel, differential or single-ended, two channel, differential or single-ended
	bit rate	auto detected, selectable/adjustable
	auto threshold setup	assisted threshold configuration
	source (SDATA)	analog, math. channels, logical (only NRZ)
	bit encoding variants	Manchester, Manchester II, NRZ clocked, NRZ unclocked
	properties	active state, idle state, clock edge
	frame separation	gap, enable signal (only NRZ)
Frame format	frame	multiple frame management, frame identification and sync, variable length frames, variable number of cells
	cells	name, size (bits), numeric format, bit order, color
	file storage of frame format	save/load as xml files
Trigger	variants	all
	trigger event setup	frame start, pattern, advanced trigger
	frame start	gap, start bit
	pattern	up to 256 bit pattern within 65 535 bit frame <sup>7</sup>
	advanced trigger	frame type (with OR combinations), frame fields (with AND combinations), frame field data; conditions =, ≠, <, ≤, >, ≥, in range, out of range for data count, word count, data value; error types
Decode	display type	decoded bus, logical signal, bus signal, tabulated list, result details, decode layers
	color coding	according to cell configuration table
	data format	according to cell configuration table
	decode layer	edges, binary
Search	search event setup	frames and frame fields, errors
Filter	The filter function selects those decode events that shall be shown in the result table. Events that do not match the criteria set will not be displayed in the table when the filter is turned on.	
	settings	same as advanced trigger settings

<sup>7</sup> The pattern trigger will not be effective after Manchester violations.

**R&S® RTE-K55**

<b>MDIO serial triggering and decoding</b>		
Protocol configuration	bit rate	up to 5 Mbps (auto-detected)
	auto threshold setup	assisted threshold configuration for MDIO triggering and decoding
	device list	associate frame address with symbolic ID
Trigger	source (clock and data)	any input channel or logical channel
	trigger event setup	start, stop, ST, OP, PHY address, register address, data
	ST setup	01 (clause 22), 00 clause 45, any
	OP setup	address, write, post read, read, any
	PHY address setup	5 bit address (hex, decimal, octal or binary); equal
	PHY register (clause 22)/device type (clause 45) setup	5 bit value (hex, decimal, octal or binary); equal
	data (clause 22)/data/address (clause 45)	16 bit value (hex, decimal, octal or binary); equal
Decode	source (clock and data)	any input channel, math waveform, reference waveform, logical channel
	display type	decoded bus, logical signal, bus + logical signal, tabulated list, decode layers
	color coding	frame, PHY address, PHY register, address, data, turnaround
	PHYAD/PRTAD	symbolic names for user defined addresses
	address/data field format	hex, decimal, octal, binary, ASCII
	decode layer	edges, binary
Search	source (clock and data)	any input channel, math waveform, reference waveform, logical channel
	search event setup	start, stop, ST, OP, PHY address, register address, data
	event settings	same as trigger event settings

**R&S® RTE-K57**

<b>IEEE 100BASE-T1 serial triggering and decoding</b>		
Protocol configuration	signal type	one channel differential, two channels single-ended, optional additional use of reverse channels for signal improvement: one channel differential, two channels single-ended
	symbol rate	66.667 Msymbol/s, adjustable for testing
	thresholds	upper/lower, assisted threshold configuration
	source	any analog input channels, math waveforms, reference waveforms
	polarity	normal, inverted
	mode	slave, master
Trigger	trigger event setup	frame start MAC frame idle frame error conditions
	MAC frame setup	destination address (condition =, ≠, <, >, ≥, ≤, in range, out of range), source address (condition =, ≠, <, >, ≥, ≤, in range, out of range), length/type (condition =, ≠, <, >, ≥, ≤, in range, out of range), frame check (condition =, ≠, <, >, ≥, ≤, in range, out of range), data (condition =, ≠, <, >, ≥, ≤, in range, out of range), data index (condition =, <, >, ≥, ≤, range)
	error condition setup	preamble error, CRC error, SFD error
Decode	display type	decoded bus, tabulated list, details, decode layers
	color coding	for different cells types
	data format	hex, octal, binary, signed, unsigned
	decode layer	reversed bits, descrambled bits, scrambled bits, ternary symbols
Search	search event setup	frame start MAC frame idle frame error conditions
	event settings	same as trigger event settings

## R&S® RTE-K60

USB 1.0/1.1/2.0/HSIC serial triggering and decoding		
Protocol configuration	signal type	single-ended, differential
	protocol type	low, full, high speed and HSIC
	bit rate	standard bit rates (1.5/12/480 Mbit/s)
	source	any input channel
	probe type	
	for low and full speed	single-ended probe
	for high speed	differential probe (R&S®RT-ZDxx)
	for HSIC	single-ended probe(R&S®RT-ZSxx)
Trigger	auto threshold setup	assisted threshold configuration for USB triggering and decoding
	trigger event setup	start of packet, end of packet, PID token (IN, OUT, SETUP, SOF), PID data (Data0, Data1, Data2 <sup>8</sup> , MData <sup>8</sup> ), PID handshake (ACK, NAK, STALL, NYET <sup>8</sup> ), PID special (PRE <sup>9</sup> , ERR <sup>8</sup> , SPLIT <sup>8</sup> , PING <sup>8</sup> ); bus state (reset <sup>9</sup> , resume <sup>9</sup> , suspend <sup>9</sup> ); error condition
	address, endpoint and frame setup SC, port, SEU, ET check (SPLIT) <sup>8</sup>	condition =, ≠, ≥, ≤, in range, out of range
	data setup	data pattern up to 4 byte (hex, decimal, octal, binary or ASCII), bit separately configurable (1, 0 or don't care); condition =, ≠; position based or window based triggering (first occurrence in packet payload)
Decode	error condition	any error, PID error, CRC5 error, CRC16 error, bit stuffing error, unexpected PID, SE1 error <sup>9</sup> and glitching error
	source	any input channel, math waveform
	display type	decoded bus, logical signal, bus + logical signal, tabulated list
	color coding	packet identifier, payload length, frame, address, endpoint, data payload, CRC5, CRC16, error condition
Search	data format	hexadecimal, decimal, octal, binary, ASCII, unsigned
	search event setup	combination of start of packet, PID token (IN, OUT, SETUP, SOF), PID data (Data0, Data1, Data2 <sup>8</sup> , MData <sup>8</sup> ), PID handshake (ACK, NAK, STALL, NYET <sup>8</sup> ), PID special (PRE <sup>9</sup> , ERR <sup>8</sup> , SPLIT <sup>8</sup> , PING <sup>8</sup> ); error condition (any error, PID error, CRC5 error, CRC16 error, bit stuffing error, unexpected PID, SE1 error <sup>9</sup> and glitching error)
	address, endpoint and frame setup SC, port, SEU, ET check (SPLIT)	condition =, ≠, ≥, ≤, in range, out of range
	data setup	data pattern up to 4 byte (hex, decimal, octal, binary or ASCII), bit separately configurable (1, 0 or don't care); condition =, ≠; position based or window based triggering (first occurrence in packet payload)
	error condition	any error, PID error, CRC5 error, CRC16 error, bit stuffing error, unexpected PID, SE1 error <sup>9</sup> and glitching error

<sup>8</sup> Only available in high speed and HSIC.

<sup>9</sup> Only available in low and full speed.

**R&S® RTE-K63**

<b>USB power delivery serial triggering and decoding</b>		
Protocol configuration	signal type	one channel
	bit rate	auto detected
	source	any analog input channel, logical channels, math channels, reference channels
	thresholds	data, advertisements
	data details	detailed breakdown selectable
Trigger	trigger event setup	frame start
		frame content
		errors
	frame content	extended, NumDataObjs, MsgID, PwrRole/Plug, Rev, DataRole, MsgType, voltage advertisements (content conditions =, ≠, <, >, ≥, ≤, in range, out of range)
	errors	4b/5b, preamble, CRC, length, SOP warning
Decode	display type	decoded bus, logical signal, bus + logical signal, tabulated list, details, decode layers
		cell and frame types
		hex, octal, binary, signed, unsigned
		edges, bits, 4b5b symbols
Search	search event setup	frame start
		frame content
		errors
	event settings	same as trigger event settings



## R&S® RTE-K65

SpaceWire serial triggering and decoding		
Protocol configuration	signal type	two channels: strobe and data (differential or single-ended)
	bit rate	auto adjust (strobe + data)
	source	any analog input channels, logical channels <sup>10</sup> , math channels, reference channels
Trigger	trigger event setup	control frame, data pattern, null frame, time code, error condition
	control frame setup	any, FCT, EOP, EEP
	data pattern setup	8 bit (condition =, ≠, <, >, ≥, ≤, in range, out of range)
	time code setup	8 bit (condition =, ≠, <, >, ≥, ≤, in range, out of range)
	errors condition setup	parity, ESC
Decode	display type	decoded bus, logical signal, bus + logical signal, tabulated list, decode layers
	color coding	control frame, data frame, null frame, time code
	data format	hex
Search	search event setup	control frame, data pattern, null frame, time code, error
	event settings	same as trigger event settings

## R&S® RTE-K76

CXPI serial triggering and decoding		
Protocol configuration	signal type	one channel
	bit rate	auto-detected/adjustable
	auto threshold setup	assisted threshold configuration
	source (SDATA)	any input channels, math waveforms, reference waveforms or logical channels
Trigger	trigger event setup	frame start, frame types with frame content, error condition
	frame types	normal, normal poll, sleep, long, long poll, PID, PTYPE, PTYPE+PID
	frame content (depending on frame type)	frame ID, NW, CT, DLC, data pattern
	data pattern setup	up to 8 byte (condition =, ≠, <, >, ≥, ≤, in range, out of range), payload data index (=, <, >, ≥, ≤, range)
	error condition setup	IFS, IBS, CRC, length, parity, UART, DLC
Decode	display type	decoded bus, logical signal, bus + logical signal, tabulated list, details, decode layers
	color coding	for different cell types
	data format	hex, octal, binary, signed, unsigned
Search	search event setup	frame start, frame types with data, error types
	event settings	same as trigger event settings

<sup>10</sup> SpaceWire protocol trigger on logical channels is not available.

## Ordering information

Designation	Type	Order No.
Base unit (including standard accessories: R&S®RTE-ZP10 500 MHz passive probe per channel, accessories bag, quick start guide, CD with manual, power cord)		
<b>Oscilloscope</b>		
200 MHz, 5 Gsample/s, 50/100 Msample, 2 channels	R&S®RTE1022	1326.2000.22
200 MHz, 5 Gsample/s, 50/200 Msample, 4 channels	R&S®RTE1024	1326.2000.24
350 MHz, 5 Gsample/s, 50/100 Msample, 2 channels	R&S®RTE1032	1326.2000.32
350 MHz, 5 Gsample/s, 50/200 Msample, 4 channels	R&S®RTE1034	1326.2000.34
500 MHz, 5 Gsample/s, 50/100 Msample, 2 channels	R&S®RTE1052	1326.2000.52
500 MHz, 5 Gsample/s, 50/200 Msample, 4 channels	R&S®RTE1054	1326.2000.54
1 GHz, 5 Gsample/s, 50/100 Msample, 2 channels	R&S®RTE1102	1326.2000.62
1 GHz, 5 Gsample/s, 50/200 Msample, 4 channels	R&S®RTE1104	1326.2000.64
1.5 GHz, 5 Gsample/s, 50/100 Msample, 2 channels	R&S®RTE1152	1326.2000.72
1.5 GHz, 5 Gsample/s, 50/200 Msample, 4 channels	R&S®RTE1154	1326.2000.74
2 GHz, 5 Gsample/s, 50/100 Msample, 2 channels	R&S®RTE1202	1326.2000.82
2 GHz, 5 Gsample/s, 50/200 Msample, 4 channels	R&S®RTE1204	1326.2000.84
<b>Hardware options (plug-in)</b>		
Mixed signal option, 400 MHz, 5 Gsample/s, 16 channels, 100 Msample/channel	R&S®RTE-B1	1326.3570.02
Digital extension port for R&S®RT-ZVCxx usage with R&S®RTE oscilloscope, included in R&S®RTE-B1	R&S®RTE-B1E	1333.0750.02
Arbitrary waveform generator, 100 MHz, 2 analog channels, 8-bit pattern generator	R&S®RTE-B6	1326.3012.02
GPIO interface	R&S®RTE-B10	1317.4978.02
Replacement SSD hard disk, incl. firmware	R&S®RTE-B18	1317.7002.02
Bandwidth upgrade <sup>11</sup>		
Upgrade of R&S®RTE1022/1024 to 350 MHz bandwidth	R&S®RTE-B200	1326.1384.02
Upgrade of R&S®RTE1022/1024 to 500 MHz bandwidth	R&S®RTE-B201	1326.1390.02
Upgrade of R&S®RTE1022/1024 to 1 GHz bandwidth	R&S®RTE-B202	1326.1403.02
Upgrade of R&S®RTE1022/1024 to 1.5 GHz bandwidth	R&S®RTE-B203	1326.1410.02
Upgrade of R&S®RTE1022/1024 to 2 GHz bandwidth	R&S®RTE-B204	1326.1426.02
Upgrade of R&S®RTE1032/1034 to 500 MHz bandwidth	R&S®RTE-B205	1326.1432.02
Upgrade of R&S®RTE1032/1034 to 1 GHz bandwidth	R&S®RTE-B206	1326.1449.02
Upgrade of R&S®RTE1032/1034 to 1.5 GHz bandwidth	R&S®RTE-B207	1326.1455.02
Upgrade of R&S®RTE1032/1034 to 2 GHz bandwidth	R&S®RTE-B208	1326.1461.02
Upgrade of R&S®RTE1052/1054 to 1 GHz bandwidth	R&S®RTE-B209	1326.1478.02
Upgrade of R&S®RTE1052/1054 to 1.5 GHz bandwidth	R&S®RTE-B210	1326.1484.02
Upgrade of R&S®RTE1052/1054 to 2 GHz bandwidth	R&S®RTE-B211	1326.1490.02
Upgrade of R&S®RTE1102/1104 to 1.5 GHz bandwidth	R&S®RTE-B212	1326.1503.02
Upgrade of R&S®RTE1102/1104 to 2 GHz bandwidth	R&S®RTE-B213	1326.1510.02
Upgrade of R&S®RTE1152/1154 to 2 GHz bandwidth	R&S®RTE-B214	1326.1526.02
<b>Software options</b>		
Serial triggering and decoding		
I <sup>2</sup> C/SPI serial triggering and decoding	R&S®RTE-K1	1326.1178.02
UART/RS-232/RS-422/RS-485 serial triggering and decoding	R&S®RTE-K2	1326.1184.02
CAN/LIN serial triggering and decoding	R&S®RTE-K3	1326.1190.02
FlexRay™ serial triggering and decoding	R&S®RTE-K4	1326.1203.02
I <sup>2</sup> S serial triggering and decoding	R&S®RTE-K5	1326.1210.02
MIL-STD-1553 serial triggering and decoding	R&S®RTE-K6	1326.1226.02
ARINC 429 triggering and decoding	R&S®RTE-K7	1326.1232.02
Ethernet serial decoding	R&S®RTE-K8	1326.1332.02
CAN-FD serial triggering and decoding	R&S®RTE-K9	1326.1249.02
SENT serial triggering and decoding	R&S®RTE-K10	1326.1603.02
Manchester and NRZ serial triggering and decoding	R&S®RTE-K50	1326.1326.02
MDIO serial triggering and decoding	R&S®RTE-K55	1326.1255.02
IEEE 100BASE-T1 serial triggering and decoding	R&S®RTE-K57	1333.0609.02
USB 1.0/1.1/2.0/HSIC serial triggering and decoding	R&S®RTE-K60	1326.1610.02
USB power delivery serial triggering and decoding	R&S®RTE-K63	1326.3158.02
SpaceWire serial triggering and decoding	R&S®RTE-K65	1326.2845.02
CXPI serial triggering and decoding	R&S®RTE-K76	1326.3193.02

<sup>11</sup> The bandwidth upgrade is performed at a Rohde & Schwarz service center, where the oscilloscope will also be calibrated.

Designation	Type	Order No.
<b>Analysis</b>		
Spectrum analysis	R&S®RTE-K18	1326.3006.02
Power analysis	R&S®RTE-K31	1326.1278.02
Bus analysis	R&S®RTE-K35	1801.2852.02
<b>Probes</b>		
500 MHz, passive, 10:1, 1 MΩ    9.5 pF, max. 400 V	R&S®RT-ZP10	1409.7550.00
400 MHz, passive, high-voltage, 100:1, 50 MΩ    7.5 pF, 1 kV (RMS)	R&S®RT-ZH10	1409.7720.02
400 MHz, passive, high-voltage, 1000:1, 50 MΩ    7.5 pF, 1 kV (RMS)	R&S®RT-ZH11	1409.7737.02
1.0 GHz, active, 1 MΩ    0.8 pF	R&S®RT-ZS10E	1418.7007.02
1.0 GHz, active, 1 MΩ    0.8 pF, R&S®ProbeMeter, micro button	R&S®RT-ZS10	1410.4080.02
1.5 GHz, active, 1 MΩ    0.8 pF, R&S®ProbeMeter, micro button	R&S®RT-ZS20	1410.3502.02
3.0 GHz, active, 1 MΩ    0.8 pF, R&S®ProbeMeter, micro button	R&S®RT-ZS30	1410.4309.02
100 MHz, high-voltage, active, differential, 8 MΩ    3.5 pF, 1 kV (RMS) (CAT III)	R&S®RT-ZD01	1422.0703.02
1.0 GHz, active, differential, 1 MΩ    0.6 pF, R&S®ProbeMeter, micro button	R&S®RT-ZD10	1410.4715.02
1.5 GHz, active, differential, 1 MΩ    0.6 pF, R&S®ProbeMeter, micro button	R&S®RT-ZD20	1410.4409.02
3.0 GHz, active, differential, 1 MΩ    0.6 pF, R&S®ProbeMeter, micro button	R&S®RT-ZD30	1410.4609.02
10 MHz, current, AC/DC, 0.01 V/A, 150 A (RMS)	R&S®RT-ZC10	1409.7750K02
100 MHz, current, AC/DC, 0.1 V/A, 30 A (RMS)	R&S®RT-ZC20	1409.7766K02
120 MHz, AC/DC, 1 V/A, 5 A (RMS)	R&S®RT-ZC30	1409.7772K02
2 MHz, current, AC/DC, 0.01 V/A, 500 A (RMS), Rohde & Schwarz probe interface	R&S®RT-ZC05B	1409.8204.02
10 MHz, current, AC/DC, 0.01 V/A, 150 A (RMS), Rohde & Schwarz probe interface	R&S®RT-ZC10B	1409.8210.02
50 MHz, AC/DC, 0.1 V/A, 30 A (RMS), Rohde & Schwarz probe interface	R&S®RT-ZC15B	1409.8227.02
100 MHz, current, AC/DC, 0.1 V/A, 30 A (RMS), Rohde & Schwarz probe interface	R&S®RT-ZC20B	1409.8233.02
Multi-channel power probe, 2 × 2 voltage/current channels, for R&S®RTO2000/R&S®RTE	R&S®RT-ZVC02	1326.0259.02
Multi-channel power probe, 2 × 4 voltage/current channels, for R&S®RTO2000/R&S®RTE	R&S®RT-ZVC04	1326.0259.04
Probe set for E and H near-field measurements, 9 kHz to 1 GHz	R&S®HZ-14	1026.7744.03
<b>Probe accessories</b>		
Accessory set for R&S®RTE-ZP10 passive probe (2.5 mm probe tip)	R&S®RT-ZA1	1409.7566.02
Spare accessory set for R&S®RT-ZS10/10E/20/30	R&S®RT-ZA2	1416.0405.02
Pin set for R&S®RT-ZS10/10E/20/30	R&S®RT-ZA3	1416.0411.02
Mini clips	R&S®RT-ZA4	1416.0428.02
Micro clips	R&S®RT-ZA5	1416.0434.02
Lead set	R&S®RT-ZA6	1416.0440.02
Pin set for R&S®RT-ZD10/20/30	R&S®RT-ZA7	1417.0609.02
Pin set for R&S®RT-ZD40	R&S®RT-ZA8	1417.0867.02
Adapter SMA(f) to BNC(m)	R&S®RT-ZA10	1416.0457.02
Probe box to N/USB adapter	R&S®RT-ZA9	1417.0909.02
Probe power supply	R&S®RT-ZA13	1409.7789.02
External attenuator, incl. adjustment tool	R&S®RT-ZA15	1410.4744.02
Extended cable set for R&S®RT-ZVC, PCB probing, 1 current and voltage lead, length: 32 cm	R&S®RT-ZA30	1333.1686.02
Extended cable set for R&S®RT-ZVC, 4 mm probing, 1 current and voltage lead, length: 32 cm	R&S®RT-ZA31	1333.1692.02
Oscilloscope interface cable for R&S®RT-ZVC (included in R&S®RT-ZVC02/-ZVC04, 1326.0259.02/.04)	R&S®RT-ZA33	1333.1770.02
Extended cable set for R&S®RT-ZVC, 4 mm probing, 1 current and voltage lead, length: 1 m	R&S®RT-ZA34	1333.1892.02
Extended cable set for R&S®RT-ZVC, PCB probing, 1 current and voltage lead, length: 1 m	R&S®RT-ZA35	1333.1905.02
Solder-in cable set for R&S®RT-ZVC, 4 current and voltage solder-in cables, solder-in pins	R&S®RT-ZA36	1333.1911.02
Extended cable set for R&S®RT-ZVC, BNC connector, 1 current and voltage lead, length: 16 cm	R&S®RT-ZA37	1337.9130.02
<b>Accessories</b>		
Front cover, for R&S®RTO/RTE oscilloscopes	R&S®RTO-Z1	1317.6970.02
Soft case, for R&S®RTO/RTE oscilloscopes and accessories	R&S®RTO-Z3	1304.9118.02
Transit Case, for R&S®RTO/RTE oscilloscopes and accessories	R&S®RTO-Z4	1317.7025.02
Probe Pouch, for R&S®RTO/RTE oscilloscopes	R&S®RTO-Z5	1317.7031.02
Probe deskew and calibration test fixture	R&S®RT-ZF20	1800.0004.02
Power supply, required for usage of R&S®HZ-14 near-field probe	R&S®HZ-9	0816.1015.03
Compact probe set for E and H near-field measurements, 30 MHz to 3 GHz	R&S®HZ-15	1147.2736.02
3 GHz, 20 dB preamplifier, 100 V to 230 V power adapter, for R&S®HZ-15	R&S®HZ-16	1147.2720.02
19" rackmount kit, for R&S®RTO/RTE oscilloscopes with 6 HU	R&S®ZZA-RTO	1304.8286.02

Warranty		
Base unit		3 years
All other items <sup>12</sup>		1 year
Options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde & Schwarz sales office.
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	

**Extended warranty with a term of one and two years (WE1 and WE2)**

Repairs carried out during the contract term are free of charge <sup>13</sup>. Necessary calibration and adjustments carried out during repairs are also covered.

**Extended warranty with calibration coverage (CW1 and CW2)**

Enhance your extended warranty by adding calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated, inspected and maintained during the term of the contract. It includes all repairs <sup>13</sup> and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

**Extended warranty with accredited calibration (AW1 and AW2)**

Enhance your extended warranty by adding accredited calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated under accreditation, inspected and maintained during the term of the contract. It includes all repairs <sup>13</sup> and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

<sup>12</sup> For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

<sup>13</sup> Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.







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