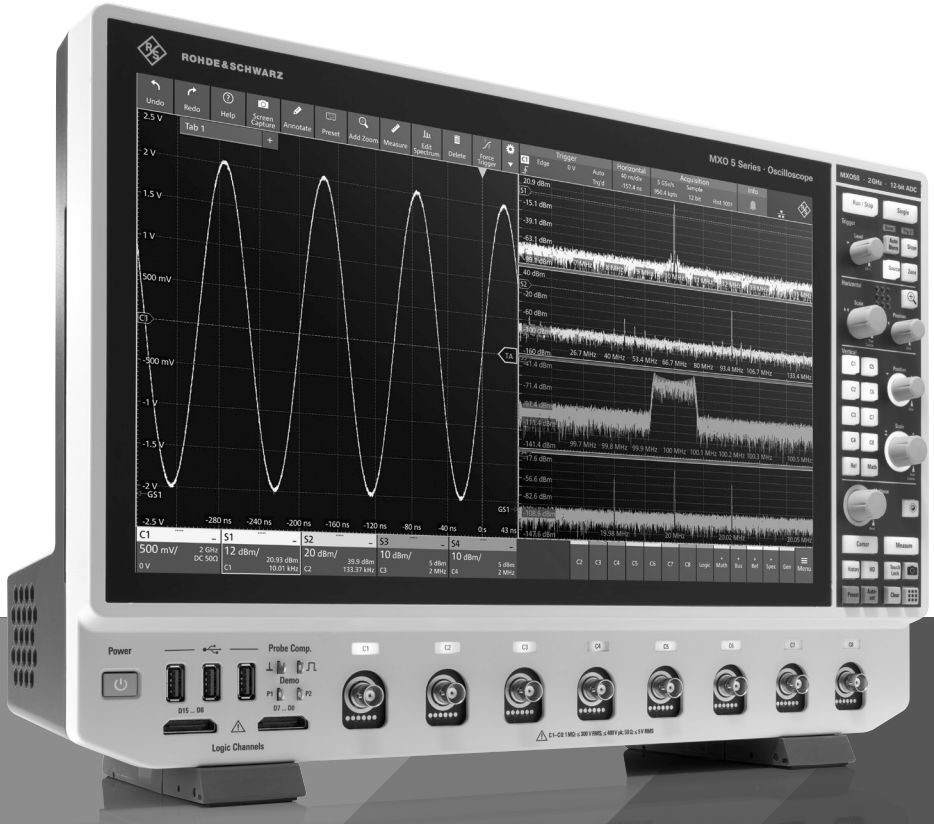
MXO 5 Series
OSCILLOSCOPE

Specifications



Specifications
Version 08.00

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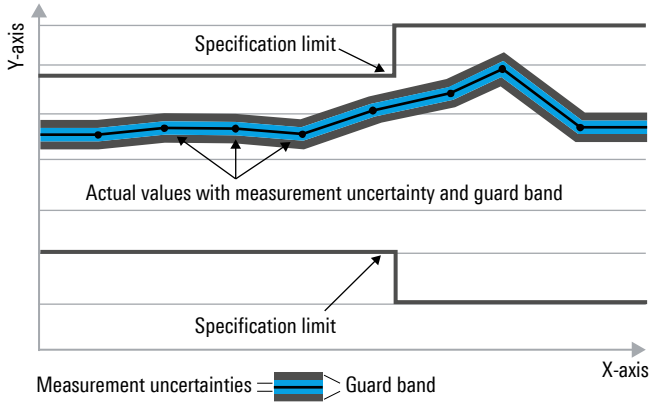
Definitions

General
Product data applies under the following conditions:

- Three hours of storage at ambient temperature followed by 60 minutes of 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 <, ≤, >, ≥, ± 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.



Non-traceable specifications with limits (n. trc.)
Represent product performance that is specified and tested as described under “Specifications with limits” above. However, product performance in this case cannot be warranted due to the lack of measuring equipment traceable to national metrology standards. In this case, measurements are referenced to standards used in the Rohde & Schwarz laboratories.

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 designated with the format “parameter: value”.

Non-traceable specifications with limits, typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

In line with the 3GPP standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bit per second (Gbps), million bit per second (Mbps), thousand bit per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

Base unit

Vertical system: analog channels

Input channels		4 channels or 8 channels
Input impedance		50 Ω ± 1.5 %, 1 MΩ ± 1 % || 12 pF (meas.)
Analog bandwidth (–3 dB)	4-channel instrument	
	at 50 Ω input impedance	
	MXO 54	≥ 350 MHz
	MXO 54 with -B245 option	≥ 500 MHz
	MXO 54 with -B2410 option	≥ 1 GHz
	MXO 54 with -B2420 option	≥ 2 GHz
	at 1 MΩ input impedance	
	MXO 54	≥ 350 MHz (meas.)
	MXO 54 with -B245 option	≥ 500 MHz (meas.)
	MXO 54 with -B2410 option	≥ 700 MHz (meas.) [1]
	MXO 54 with -B2420 option	≥ 700 MHz (meas.) [1]
	8-channel instrument	
	at 50 Ω input impedance	
	MXO 58	≥ 100 MHz
	MXO 58 with -B282 option	≥ 200 MHz
	MXO 58 with -B283 option	≥ 350 MHz
	MXO 58 with -B285 option	≥ 500 MHz
	MXO 58 with -B2810 option	≥ 1 GHz
	MXO 58 with -B2820 option	≥ 2 GHz [2]
	at 1 MΩ input impedance	
	MXO 58	≥ 100 MHz (meas.)
	MXO 58 with -B282 option	≥ 200 MHz (meas.)
	MXO 58 with -B283 option	≥ 350 MHz (meas.)
	MXO 58 with -B285 option	≥ 500 MHz (meas.)
	MXO 58 with -B2810 option	≥ 700 MHz (meas.) [1]
	MXO 58 with -B2820 option	≥ 700 MHz (meas.) [1]
Additional bandwidth filters available up to instrument bandwidth		1 GHz, 500/350/200/100/50/20 MHz (meas.)
Rise/fall time (calculated)	10 % to 90 % at 50 Ω	
	4-channel instrument	
	MXO 54	< 1.75 ns
	MXO 54 with -B245 option	< 700 ps
	MXO 54 with -B2410 option	< 350 ps
	MXO 54 with -B2420 option	< 175 ps
	8-channel instrument	
	MXO 58	< 3.5 ns
	MXO 58 with -B282 option	< 1.75 ns
	MXO 58 with -B283 option	< 1 ns
	MXO 58 with -B285 option	< 700 ps
	MXO 58 with -B2810 option	< 350 ps
	MXO 58 with -B2820 option	< 175 ps [2] (interleaved), < 350 ps (non-interleaved)
Vertical resolution		12 bit, 18 bit for high definition (HD) mode
Effective number of bits (meas.)	at 50 Ω, 50 mV/div, with HD mode and digital filters, 10 MHz sine signal with 80 % full-scale	
	10 MHz	10.0
	20 MHz	9.6
	100 MHz	8.7
	200 MHz	8.3
	300 MHz	8.0
	500 MHz	7.7
	1 GHz	7.0

[1] With R&S®RT-ZP11 passive probe.

[2] 2 GHz analog bandwidth in interleave mode with 5 Gsample/s real-time sampling rate.

Input sensitivity	at 50 Ω	0.5 mV/div to 3 V/div, entire analog bandwidth supported for all input sensitivities
	at 1 MΩ	0.5 mV/div to 10 V/div, entire analog bandwidth supported for all input sensitivities
DC gain accuracy	offset and position set to 0 V, after self-alignment	
	input sensitivity > 5 mV/div	±1 % full scale
	input sensitivity ≤ 5 mV/div to ≥ 1 mV/div	±1.5 % full scale
	input sensitivity 500 µV/div	±2.5 % full scale
Input coupling	at 50 Ω	DC
	at 1 MΩ	DC, AC (> 7 Hz)
Maximum input voltage	at 50 Ω	5 V (RMS), 30 V (V_p)
	at 1 MΩ	300 V (RMS), 400 V (V_p), derates at 20 dB/decade to 5 V (RMS) above 250 kHz
	at 1 MΩ with R&S®RT-ZP11 passive probe	400 V (RMS), 1650 V (V_p), 300 V (RMS) CAT II; for derating and details, see R&S®RT-Zxx Standard Probes specifications (PD 3607.3851.22)
Position range		±5 div
Offset range at 50 Ω	input sensitivity	
	120 mV/div to 3 V/div	±(15 V – input sensitivity × position)
	33 mV/div to < 120 mV/div	±(7 V – input sensitivity × position)
	0.5 mV/div to < 33 mV/div	±(2 V – input sensitivity × position)
Offset range at 1 MΩ	input sensitivity	
	800 mV/div to 10 V/div	±200 V
	80 mV/div to < 800 mV/div	±50 V
	0.5 mV/div to < 80 mV/div	±(5 V – input sensitivity × position)
Offset accuracy		±(0.35 % × |net offset| + 0.5 mV + 0.1 div × input sensitivity); (net offset = offset – position × input sensitivity)
DC measurement accuracy	after adequate suppression of measurement noise using high definition (HD) mode or waveform averaging or a combination of both	±(DC gain accuracy × |reading – net offset| + offset accuracy)
Channel-to-channel isolation (each channel at same input sensitivity)	input frequency inside instrument bandwidth	> 60 dB (1:1000)

RMS noise floor [3]							
At 50 Ω (meas.)	Input sensitivity	Analog bandwidth (–3 dB)					
		100 MHz	200 MHz	350 MHz	500 MHz	1 GHz	2 GHz
	0.5 mV/div	19 µV	26 µV	33 µV	39 µV	66 µV	111 µV
	1 mV/div	24 µV	33 µV	42 µV	51 µV	85 µV	141 µV
	2 mV/div	25 µV	35 µV	44 µV	53 µV	89 µV	146 µV
	5 mV/div	34 µV	46 µV	59 µV	71 µV	116 µV	182 µV
	10 mV/div	66 µV	89 µV	115 µV	138 µV	226 µV	350 µV
	20 mV/div	134 µV	181 µV	233 µV	280 µV	461 µV	713 µV
	50 mV/div	324 µV	436 µV	563 µV	677 µV	1.12 mV	1.78 mV
	100 mV/div	610 µV	815 µV	1.05 mV	1.26 mV	2.08 mV	3.25 mV
	200 mV/div	1.26 mV	1.69 mV	2.17 mV	2.60 mV	4.31 mV	6.74 mV
	500 mV/div	4.21 mV	5.54 mV	6.94 mV	8.21 mV	12.93 mV	18.63 mV
	1 V/div	6.88 mV	9.20 mV	11.71 mV	14.02 mV	22.57 mV	32.89 mV
	2 V/div	11.45 mV	15.21 mV	19.45 mV	23.21 mV	37.85 mV	54.59 mV
	3 V/div	15.77 mV	20.78 mV	26.54 mV	31.71 mV	51.80 mV	73.68 mV
At 1 MΩ (meas.)	Input sensitivity	Analog bandwidth (–3 dB)					
		100 MHz	200 MHz	350 MHz	500 MHz	700 MHz	
	0.5 mV/div	35 µV	40 µV	46 µV	54 µV	85 µV	
	1 mV/div	36 µV	42 µV	49 µV	57 µV	89 µV	
	2 mV/div	38 µV	45 µV	54 µV	64 µV	101 µV	
	5 mV/div	47 µV	58 µV	77 µV	92 µV	141 µV	
	10 mV/div	68 µV	89 µV	126 µV	152 µV	229 µV	
	20 mV/div	120 µV	161 µV	235 µV	285 µV	428 µV	
	50 mV/div	297 µV	401 µV	592 µV	719 µV	1.08 mV	
	100 mV/div	678 µV	892 µV	1.25 mV	1.47 mV	2.16 mV	
	200 mV/div	1.21 mV	1.62 mV	2.33 mV	2.77 mV	4.09 mV	
	500 mV/div	2.88 mV	3.88 mV	5.68 mV	6.76 mV	10.01 mV	
	1 V/div	6.11 mV	8.08 mV	11.54 mV	13.56 mV	18.51 mV	
	2 V/div	11.42 mV	15.20 mV	22.04 mV	25.98 mV	35.39 mV	
	5 V/div	29.10 mV	38.75 mV	56.46 mV	66.60 mV	90.40 mV	
	10 V/div	44.33 mV	58.62 mV	85.77 mV	101.12 mV	137.86 mV	

Vertical system: digital channels

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 and 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_p)
Minimum input voltage swing		500 mV (V_{pp}) (meas.)
Threshold groups		D0 to D3, D4 to D7, D8 to D11 and D12 to D15
Threshold level	range	±8 V in 25 mV steps
	predefined	CMOS 5.0 V, CMOS 3.3 V, CMOS 2.5 V, TTL, ECL, PECL, LVPECL
Threshold accuracy	threshold level between ±4 V	±(100 mV + 3 % of threshold setting)
Comparator hysteresis		normal, robust, maximum

[3] HD mode active for bandwidth ≤ 500 MHz.

Horizontal system

Timebase range		selectable between 200 ps/div and 10000 s/div, time per div settable to any value within range
Deskew range (channel deskew)	between analog channels	±20 ms
	between digital channels	±100 ns
Reference position		0 % to 100 % of measurement display area
Horizontal position range (trigger offset range)	max.	+(memory depth/current sampling rate)
	min.	–5000 s
Modes		normal
Channel-to-channel skew	between analog channels	< 100 ps (meas.)
	between digital channels	< 500 ps (meas.)
Timebase accuracy	after delivery/calibration, at +23 °C	±0.2 ppm
	during calibration interval	±1 ppm
Delta time accuracy	corresponds to time error between two edges on same acquisition and channel; signal amplitude greater than five divisions, measurement threshold set to 50 %, vertical gain 10 mV/div or greater; rise time lower than four sample periods; waveform acquired in real-time mode	±(0.20/real-time sampling rate + timebase accuracy × |reading|) (peak) (meas.)

Acquisition system

Sampling rate	analog channels (real time)	max. 5 Gsample/s on 4 channels, max. 2.5 Gsample/s on 8 channels
	analog channels (interpolated)	max. 5 Tsample/s
	digital channels	max. 5 Gsample/s on each channel
Waveform acquisition rate	max.	> 4 500 000 waveforms/s
Trigger rearm time	min.	< 21 ns
Memory depth [4]	standard	
	analog channels only	with 8 active channels: • max. 500 Mpoints (single capture) • max. 250 Mpoints (run continuous) with 4 active channels: • max. 500 Mpoints (single capture and run continuous)
	digital channels only (MSO)	with 16 digital channels: • max. 500 Mpoints (single capture) with 8 digital channels: • max. 500 Mpoints (run continuous)
	mix analog and digital	with 2 analog and 8 digital channels: • max. 500 Mpoints (single capture) • max. 250 Mpoints (run continuous)
	with R&S®MXO5-B110 memory option 1 Gpoints	
	analog channels only	with 4 active channels: • max. 1 Gpoints (single capture) with 2 active channels: • max. 1 Gpoints (run continuous)
	digital channels only (MSO)	with 16 digital channels: • max. 500 Mpoints (single capture) • max. 250 Mpoints (run continuous) with 8 digital channels: • max. 1 Gpoints (single capture) • max. 500 Mpoints (run continuous)
	mix analog and digital	with 2 analog and 8 digital channels: • max. 500 Mpoints (single capture) • max. 250 Mpoints (run continuous)

[4] The maximum available memory depth depends on the bit resolution of the acquired data and, therefore, on the acquisition system settings such as decimation mode, use of waveform arithmetics or high definition (HD) mode. Interleave channels of the MXO 58 are on C1 and C5, C2 and C6, C3 and C7 as well as C4 and C8. For the MXO 54, all 4 channels run with 5 Gsample/s and maximum bandwidth.

Acquisition modes	sample	middle sample in decimation interval
	peak detect	largest and smallest sample in decimation interval
	average	average value of samples in decimation interval
	number of averaged waveforms	2 to 16 777 215
	envelope	envelope of acquired waveforms
Sampling modes	real-time mode	max. sampling rate set by digitizer
	interpolated time	enhancement of sampling resolution by interpolation; max. sampling rate is 5 Tsample/s
Interpolation modes		linear, sin(x)/x, sample & hold
Fast segmentation mode	continuous recording of waveforms in acquisition memory without interruption due to visualization	
	max. real-time waveform acquisition rate	> 4 600 000 waveforms/s
	min. blind time between consecutive acquisitions	< 21 ns

High definition mode

General description	The high definition mode increases the bit resolution of the waveform signal by using digital filtering, leading to reduced noise. Because of the digital trigger concept of the MXO 5, signals with increased numeric resolution are used as the input for triggering.	
Numeric resolution	bandwidth, at 5 Gsample/s	bit resolution
	1 kHz to 10 MHz	18 bit
	100 MHz	16 bit
	200 MHz	15 bit
	500 MHz	14 bit
Real-time sampling rate	all models	max. 2.5 Gsample/s on 4 channels, max. 1.25 Gsample/s on 8 channels

Trigger system

Trigger sources		analog channels (C1 to C8), digital channels (D0 to D15), trigger input, line trigger, serial bus
Trigger level range		±5 div from center of screen
Trigger modes		auto, normal, single, n single
Trigger sensitivity		0.0001 div, from DC to instrument bandwidth for all vertical scales, user adjustable
Trigger jitter	full-scale sine wave of frequency set to –3 dB bandwidth	< 1 ps (RMS) (meas.)
Coupling mode	standard	same as selected channel
	HF reject	cutoff frequency selectable from 1 kHz to 500 MHz
	LF reject	attenuates frequencies < 50 kHz
Trigger hysteresis	modes	auto (default setting) or manual
	adjustment resolution	0.0001 div, from DC to instrument bandwidth for all vertical scales
Holdoff range	time	100 ns to 10 s, fixed and random

Main trigger modes		
Edge	triggers on specified edge (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 a specified range	
	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 a specified range	
	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	0 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 a specified range; edge slope may be positive, negative or either	
	toggle time	0 ps to 1000 s
Setup & hold	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 s to 100 s 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	

Advanced trigger modes		
Zone trigger	triggers on user-defined zones drawn on the display	
	source	acquired waveforms (input channels), math waveforms (including power analysis waveforms), spectrum waveforms, XY plots
	number of zones/areas	up to 4 zones with up to 8 areas each
	area shapes	polygons with up to 16 points
	area types	must intersect, must not intersect
	combination of zones	logical combination of zones of multiple sources using Boolean expressions
	trigger compatibility	requires sequence trigger A -> zone trigger where primary A condition can be: edge, glitch, width, runt, window, timeout, interval, slew rate, setup & hold, state, pattern
Sequence trigger (A/B/R trigger)	triggers on B event after occurrence of A event; delay condition after A event specified as time interval; an optional R event resets the trigger sequence to A	
	trigger sources	analog channels (C1 to C8)
	A event	edge, glitch, width, runt, window, timeout, interval, slew rate
	B event	edge, glitch, width, runt, window, timeout, interval, slew rate
	R event	edge, glitch, width, runt, window, timeout, interval, slew rate
Serial bus trigger	optional	see dedicated triggering and decoding options
Trigger input	input impedance	50 Ω (meas.) or 1 MΩ (meas.) || 11 pF (meas.)
	max. input voltage at 50 Ω	30 V (V_p)
	max. input voltage at 1 MΩ	300 V (RMS), 400 V (V_p), derates at 20 dB/decade to 5 V (RMS) above 250 kHz
	trigger level	±5 V
	sensitivity	
	input frequency ≤ 500 MHz	300 mV (V_{pp}) (meas.)
	input coupling	AC, DC (50 Ω and 1 MΩ)
	trigger filter	HF reject (attenuates > 50 kHz), LF reject (attenuates < 50 kHz), noise reject
	trigger modes	edge (positive, negative or either)

Trigger output	functionality	A pulse is generated for each event triggering signal acquisition.
	output voltage	0 V to 5 V (nom.) at high impedance; 0 V to 2.5 V (nom.) at 50 Ω
	pulse width	selectable between 16 ns and 50 ms
	pulse polarity	low active or high active
	output delay	depends on trigger settings

Spectrum analysis

General description	Spectrum analysis allows up to four signal analysis in the frequency domain.	
Spectrum	sources	channel 1 to channel 8
	setup parameters	center frequency, frequency span, resolution bandwidth (automatic or manual), gate position, gate width, vertical scaling, vertical position
	scaling	dBm, dBV, dBµV, V (RMS)
	span	1 Hz to 1.8 GHz [5]
	resolution bandwidth (RBW)	(span/4) ≥ RBW ≥ (span/6000)
	windows	flat top, Hanning, Hamming, Blackman, rectangular, Kaiser Bessel, Gaussian
	trace types	normal, max. hold, min. hold, average
	max. real-time waveform acquisition rate	> 40 000 waveforms/s
Gate	delimits the display region used for spectrum analysis	
Peak list	The values in the peak list are also shown in the diagram to allow easy correlation.	

RF characteristics

Sensitivity/noise density	at 1 GHz (measurement of the power spectral density at 1 GHz at input sensitivity 2 mV/div, corresponding to –30 dBm input range of the oscilloscope, using spectrum analysis with center frequency 1 GHz, span 500 kHz, RBW 3 kHz)	–160 dBm (1 Hz) (meas.)
Noise figure	at 1 GHz (calculated based on the noise power density above)	14 dB (meas.)
Dynamic range	measured for a 1 GHz input carrier with level –3 dBm at input of oscilloscope, using spectrum analysis with center frequency 1 GHz, span 2 MHz, RBW 400 Hz at +20 MHz from center frequency	106 dB (meas.)
Absolute amplitude accuracy	0 Hz to 1.2 GHz	±1 dB (meas.)
Spurious-free dynamic range (excluding harmonics)	measured for a 250 MHz input carrier with level –3 dBm at input sensitivity 50 mV/div, using spectrum analysis with center frequency 900 MHz, span 1.8 GHz, RBW 300 kHz	67 dBc (meas.)
Second harmonic distortion	measured for a 250 MHz input carrier with level –3 dBm at input sensitivity 50 mV/div, using spectrum analysis with center frequency 900 MHz, span 1.8 GHz, RBW 300 kHz	–65 dBc (meas.)
Third harmonic distortion	measured for a 250 MHz input carrier with level –3 dBm at input sensitivity 50 mV/div, using spectrum analysis with center frequency 900 MHz, span 1.8 GHz, RBW 300 kHz	–49 dBc (meas.)

[5] The stop frequency depends on the analog bandwidth of the instrument.

Waveform measurements

Automatic measurements	measurements on acquired waveforms (input channels), math waveforms, reference waveforms	amplitude, high, low, maximum, minimum, peak-to-peak, mean, RMS, sigma, positive overshoot, negative overshoot, area, rise time, fall time, positive pulse width, negative pulse width, period, frequency, positive duty cycle, negative duty cycle, delay, phase, burst width, pulse count, edge count, pulse train, positive switching, negative switching, cycle area, cycle mean, cycle RMS, cycle sigma, setup, hold, setup/hold time, setup/hold ratio, slew rate rising, slew rate falling, delay to trigger
	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 and measurement count for each automatic measurement
	number of active measurements	24
Cursor measurements	available cursors	up to four cursor sets on screen, each set with two horizontal and two vertical cursors
	target waveforms	acquired waveforms (input channels), math waveforms, reference waveforms, XY diagrams
	operating modes	vertical measurements, horizontal measurements, or both; vertical cursors either set manually or locked to waveform

Waveform math

General features	number of math equations	up to 8
	number of reference waveforms	up to 8
	sources	channel 1 to 8, math waveforms 1 to 8, reference waveforms 1 to 8
Functions	operators	add, subtract, multiply, divide, absolute value, square, square root, integrate, differentiate, $\log_{10}$, $\log_e$, $\log_2$, reciprocal, invert, lowpass, highpass, rescale ($a \cdot x + b$)
	filters	lowpass, highpass
	filter types	Gaussian, rectangular
	gate	delimits the display region used for waveform math

Digital voltmeter

Accuracy		related to channel settings of voltmeter source
Measurements		DC, DC RMS, AC RMS
Sources	MXO 54	C1, C2, C3, C4
	MXO 58	C1, C2, C3, C4, C5, C6, C7, C8
Number of measurements		up to 4
Resolution		up to 6 digits
Bandwidth		up to 20 MHz

Display characteristics

Diagram types	Yt, XY, zoom, spectrum
Display configuration (waveform layout)	The display area can be split into separate diagram areas by dragging and dropping signal icons. Each diagram can hold any number of signals. Diagrams can be stacked on top of each other and later accessed via dynamic tabs (Tab 1, etc.)
Signal icons	Each active waveform is represented by a signal icon on the signal bar; the signal icon displays the individual vertical and acquisition settings.
Toolbar	Enables quick access to important tools; allows to set the most common parameters directly in a simple menu and gives access to more detailed parameters in the main menu. User-defined selection of tools in the toolbar.
Upper menu bar	Displays trigger, horizontal and acquisition system settings; allows quick access to these settings.
Main menu	Provides access to all instrument settings in a compact menu structure.
Axis label	The x-axis and y-axis are labeled with values and physical unit.
Diagram label	Diagrams can be individually labeled with a descriptive, user-defined name.
Diagram layout	The grid, crosshair, axis labeling and diagram labeling can be switched on and off separately.
Persistence	50 ms to 50 s, or infinite
Zoom	vertical and horizontal; touch interface simplifies resize and drag operations on zoom window
Signal colors (waveform coding)	predefined or user-defined color tables for persistence display

History and segmented memory

Acquisition memory	automatic	automatic setting of segment size and sample rate	
	manual	user-defined setting of segment size and sample rate	
Memory segmentation	function	memory segments for the acquisition	
	number of segments	record length	segments [6] (up to)
		1 kpoints	1 048 575
		2 kpoints	524 287
		5 kpoints	262 143
		10 kpoints	131 071
		20 kpoints	65 535
		50 kpoints	32 767
		100 kpoints	16 383
		200 kpoints	9 361
		500 kpoints	4 095
		1 Mpoints	2 113
		2 Mpoints	1 056
		5 Mpoints	427
		10 Mpoints	213
		20 Mpoints	106
		50 Mpoints	41
		100 Mpoints	20
		200 Mpoints	9
		500 Mpoints	3
		1 Gpoints	1
	Segmentation is available on all analog and logic channels, protocol decoding and spectrum analysis.		
Fast-segmented mode	continuous recording of waveforms in acquisition memory without interruption due to visualization; blind time between consecutive acquisitions, see Acquisition system		
History mode	function	The history mode is an always-on function and provides access to past acquisitions in the segmented memory.	
	timestamp resolution	1 ns	
	history player	replays the recorded waveforms; repetition possible; adjustable speed; manual next/previous segment; numerical segment number input	
	analyze options	overlay all segments, average all segments, envelope all segments	

[6] With R&S®MXO5-B110 memory option. The maximum number of segments depends on the number of active channels and the bit resolution of the acquired data and, therefore, on the acquisition system settings such as decimation mode, use of waveform arithmetics or high definition (HD) mode. The maximum number of segments without the R&S®MXO5-B110 memory option is limited to 10 000.

Mask testing

Test definition	number of masks	up to 8 simultaneously
	source	acquired waveforms (input channels), math waveforms, reference waveforms, spectrum waveforms, XY plots
	fail condition	waveform hit
	test rate	up to 4 million waveforms/s
	action on error	acquisition stop, beep, save waveform, pulse on trigger out
Mask definition with segments	number of segments per mask test	up to 8
	segment definition	array of at least 3 points defines an inner region
Result statistics	category	total completed acquisition, failed acquisition, passed acquisition, fail rate, overall test result (pass/fail)
Visualization options	waveform style	vectors, dots
	mask colors	predefined colors for mask without violation (translucent gray), mask with violation (translucent red)

Miscellaneous

Remote control	web interface	full operation of the instrument's touch interface, keys and multifunction wheel via web browser
	VNC	control of the instrument through virtual network computing
	SCPI	standard instrument programming interface through VISA
	WebDAV	support for the web distributed authoring and versioning (WebDAV) protocol, which provides secure access through an application proxy
Languages	available languages for the user interface	English, German, French, Simplified Chinese, Traditional Chinese, Japanese, Russian, Spanish, Italian, Portuguese, Korean, Czech, Polish
	online help on the instrument	English

Input and output

Front		
Channel inputs		BNC; for details, see Vertical system
	probe interface	auto detection of passive probes, Rohde & Schwarz active probe interface
Trigger input		BNC; for details, see Trigger system
	probe interface	auto detection of passive probes
Waveform generator outputs (requires R&S®MXO5-B6 option)		BNC; for details, see R&S®MXO5-B6, waveform generator, demo lugs and GND lug
Digital channel inputs	D15 to D8, D7 to D0	interface for R&S®RT-ZL04 logic probe
Probe compensation output	signal shape	rectangle, V_{low} = 0 V, V_{high} = 3.3 V amplitude 3.3 V (V_{pp}) ± 5 % (meas.)
	frequency	1 kHz ± 1 % (meas.)
USB interfaces		3 × USB 3.1 Gen 1 ports, type A plug

Rear		
Trigger out		BNC; for details, see Trigger system
USB interface		1 × USB 3.1 Gen 1 port, type B plug
Reference input	connector	BNC
	impedance	50 Ω (nom.)
	input frequency	10 MHz (±20 ppm)
	sensitivity	≥ –10 dBm into 50 Ω, ≤ 10 dBm at 10 MHz
Reference output	connector	BNC

	impedance	50 Ω (nom.)
	output signal	10 MHz (specified with timebase accuracy), 8 dBm (nom.)
Security slot		for standard Kensington style lock
VESA mount	via R&S®MXO5-Z7 VESA adapter	VESA compatibility mounting interface, 100 mm × 100 mm pattern size, according FDMI MIS-D, up to 14 kg with M4x10 screws

Right side		
Ground jack		connected to ground
USB interfaces		2 × USB 3.1 Gen 1 ports, type A plug
LAN interface		RJ-45 connector, supports 10/100/1000BASE-T
External monitor interface		HDMI 2.0 and DisplayPort++ 1.3, output of oscilloscope display

General data

Display	type	15.6" LC TFT color display with capacitive touchscreen
	resolution	1920 × 1080 pixel (Full HD)

Temperature		
Temperature range	operating temperature range	0 °C to +50 °C
	storage temperature range	–40 °C to +70 °C
		in line with MIL-PRF-28800F section 4.5.5.1.1.1 class 3 tailored to +45 °C for operation
Climatic resistance	damp heat	+25 °C/+50 °C at 85 % relative humidity cyclic, in line with IEC 60068-2-30

Altitude		
Operating		up to 3000 m above sea level
Nonoperating		up to 4600 m above sea level

Mechanical resistance		
Vibration	sinusoidal	5 Hz to 150 Hz, max. 1.8 g at 55 Hz; 0.5 g from 55 Hz to 150 Hz, in line with EN 60068-2-6
		10 Hz to 55 Hz, in line with MIL-PRF-28800F, section 4.5.5.3.2, class 3
	random	8 Hz to 500 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-810G, method no. 516.6, procedure I
		30 g functional shock, half sine, duration 11 ms, in line with MIL-PRF-28800F, section 4.5.5.4.1

Electromagnetic compatibility (EMC)		
RF emissions		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 [7]

Certifications		VDE, $_{C}CSA_{US}$, KC

Calibration interval		1 year

[7] Test criterion is displayed noise level within ±1 div for an input sensitivity of 5 mV/div.

Power supply		
AC supply		100 V to 240 V ± 10 % at 50 Hz to 60 Hz and 400 Hz ± 5 %, max. 4 A to 2.5 A, in line with MIL-PRF 28800F, section 3.5
Power consumption	standby mode	1.6 W
	all channels on, without probes	180 W (typ.)
	max.	360 W
Safety		in line with IEC 61010-1, IEC 61010-2-030, CAN/CSA-C22.2 no. 61010-1, UL 61010-1, CAN/CSA C22.2 no. 61010-2-030

Mechanical data		
Dimensions	W × H × D	445 mm × 314 mm × 153 mm (17.51 in × 12.36 in × 6.02 in)
Weight	without options, nominal	9.0 kg (19.85 lb)
Rackmount height	with R&S®ZZA-MXO5 rackmount kit	8 HU

Options

R&S®MXO5-B1 mixed signal option

Mixed signal capability is a standard functionality of the MXO 5 series oscilloscopes. The R&S®MXO5-B1 mixed signal option provides 16 digital channels with two R&S®RT-ZL04 probes.

R&S®MXO5-B6 arbitrary waveform generator

Arbitrary function/waveform generator, 2 analog channels

General		
Output channel		2 channels
Vertical resolution		16 bit
Operating modes		function generator, arbitrary waveform generator, modulation, frequency sweep

Function generator	output of predefined waveforms	
Sample rate		625 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)	≤ ±0.5 dB (meas.)
	total harmonic distortion (into 50 Ω)	
	f ≤ 10 MHz	≤ –60 dBc (meas.)
	f > 10 MHz	≤ –40 dBc (meas.)
	nonharmonic spurious	–75 dBc (meas.)
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	≥ 16.5 ns, 0.1 ns resolution
	rise/fall time	9 ns (meas.)
	overshoot	≤ 2 % (meas.)
	jitter (cycle-to-cycle) (≥ 0.2 V (V_{pp}))	≤ 40 ps (RMS) (meas.)
Ramp (triangle, sawtooth)	frequency range	1 mHz to 1 MHz
	variable symmetry	0 % to 100 %, 0.1 % resolution
DC	level range	
	into 50 Ω	± 2.5 V
	into open circuit	± 5 V
	resolution	1 mV
Noise	amplitude	
	DC	0 V to 5 V (V_{pp}) (into 50 Ω), 0 V to 10 V (V_{pp}) (into open circuit), 1 mV resolution
	all other waveforms	0 % to 100 % of AC signal amplitude, 1 % resolution
	bandwidth	≥ 100 MHz
Sine cardinal (sinc)	frequency range	1 mHz to 5 MHz
Gaussian pulse	frequency range	1 mHz to 25 MHz
Lorentz	frequency range	1 mHz to 10 MHz
Exponential rise/fall	frequency range	1 mHz to 10 MHz
Cardiac	frequency range	1 mHz to 1 MHz

Arbitrary waveform generator	output of user-defined waveforms	
Waveform length		1 sample to 40 Msample on each channel
Sample rate		1 sample/s to 312.5 Msample/s
Filter bandwidth		100 MHz

Modulation		
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

Frequency sweep	output of a sinusoidal waveform with the frequency changing linearly between the start frequency and the stop frequency within the sweep time	
	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

Two-channel operation	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 (each channel with same output amplitude)	≤ 200 ps (meas.)
	channel-to-channel isolation (each channel with same output amplitude)	≥ 70 dB (meas.)
Outputs		
Connectors		BNC; on the front of the instrument
Function		on/off, inverted
Output impedance		50 Ω (nom.)
Overload protection	V_{pp} > 200 mV into open circuit	a short-circuit to ground is tolerated indefinitely, automatic shutoff in case of voltages ≥ +12 V or ≤ –12 V (meas.)
	V_{pp} ≤ 200 mV into open circuit	a short-circuit to ground is tolerated indefinitely, automatic shutoff in case of voltages ≥ +4 V or ≤ –4 V (meas.)
Amplitude range [8]	sine, square/pulse, ramp, exponential rise/fall, arbitrary waveforms, sine cardinal (sinc), Gaussian, Lorentz, cardiac	
	into 50 Ω	5 mV to 5 V (V_{pp})
	into open circuit	10 mV to 10 V (V_{pp})
	resolution	1 mV
	accuracy	±1 % at 1 kHz

[8] Amplitude is the sum of the AC amplitude and the noise amplitude.

DC offset range	sine, square/pulse, ramp, exponential rise/fall, arbitrary waveforms	
	into 50 Ω	±2.5 V (V_{pp} > 100 mV), ±1.25 V (V_{pp} ≤ 100 mV)
	into open circuit	±5.0 V (V_{pp} > 200 mV), ±2.5 V (V_{pp} ≤ 200 mV)
	sine cardinal (sinc): DC offset range is signal amplitude dependent	
	into 50 Ω	–2.823 V to +2.177 V (V_{pp} = 1 V)
	into open circuit	–5.323 V to +4.677 V (V_{pp} = 1 V)
	Gaussian, Lorentz: DC offset range is signal amplitude dependent	
	into 50 Ω	–3.000 V to +2.000 V (V_{pp} = 1 V)
	into open circuit	–5.500 V to +4.500 V (V_{pp} = 1 V)
	cardiac: DC offset range is signal amplitude dependent	
	into 50 Ω	–2.814 V to +2.186 V (V_{pp} = 1 V)
	into open circuit	–5.314 V to +4.686 V (V_{pp} = 1 V)
	resolution	1 mV
	accuracy	±(1 % of control + (0.5 % of amplitude) + 2 mV)
Frequency accuracy		| Δf | ≤ [(timebase accuracy) × (nominal frequency) + 1.1 µHz] (calc.) (timebase accuracy, see Horizontal system)

R&S®MXO5-K31 power analysis

Power analysis (requires R&S®MXO5-K31 option)		
General description	The R&S®MXO5-K31 power analysis option extends the MXO 5 firmware with measurement functionality focused on switched mode power supplies (SMPS) and DC/DC converters. Up to six sets of power analysis measurements are possible.	
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 334th 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
Deskew	automated	automated compensation of the propagation delay
Zero offset	automated	automatic compensation of input offset

R&S®MXO5-K36 frequency response analysis

Frequency response analysis (requires R&S®MXO5-B6 option)		
Stimulus	frequency mode	single sweep or repeated sweep
	frequency range	10 mHz to 100 MHz
	amplitude mode	fixed or amplitude profile
	amplitude level	10 mV to 10 V into high Z
		5 mV to 5 V into 50 Ω
Input and output sources		channel 1, channel 2, channel 3, channel 4
Number of test points		10 points to 500 points per decade
Measurement		dual pair of tracking gain and phase cursors
Diagram types	manually changeable vertical window size	parallel display of result window and input and output signal view
Result table		navigation and export functions
Scaling	during and after test	auto scale and manual scaling and positioning

R&S®MXO5-K510 low speed serial buses

I²C triggering and decoding		
Protocol configuration	bit rate	auto detected
Trigger (hardware based)	source (clock and data)	any analog 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 or binary); read, write or either; condition =, ≠, ≥, ≤, in range, out of range
	data setup	data pattern up to 8 byte (hex or binary); condition =, ≠; offset within frame in range from 0 byte to 4095 byte
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	write, read, 10 bit write, 10 bit read
	write	address; conditions =, ≠, <, ≤, >, ≥, in range, out of range; ACK-A; value 0, 1 data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range; Ack-D word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; Ack-D index: selects the specific data word; conditions =, in range
	read	address; conditions =, ≠, <, ≤, >, ≥, in range, out of range; ACK-A; value 0, 1 data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range; Ack-D word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; Ack-D index: selects the specific data word; conditions =, in range
	10 bit write	address; conditions =, ≠, <, ≤, >, ≥, in range, out of range; ACK-A, ACK-A2; value 0, 1 for each of these options; data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range; Ack-D word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; Ack-D index: selects the specific data word; conditions =, in range

	10 bit read	Address; conditions =, ≠, <, ≤, >, ≥, in range, out of range; ACK-A; value 0, 1 data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range; Ack-D word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; Ack-D index: selects the specific data word; conditions =, in range
	error condition	no stop bit, 10 bit read address different, unknown
Decode	source (clock and data)	any input channel, logical channel
	display type	decoded bus, tabulated list
	color coding	frame, start/restart, address (read/write), data, ACK/NACK, stop, error
	data format	hex, decimal, octal, binary, ASCII
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

SPI triggering and decoding		
Protocol configuration	type	2-wire, 3-wire and 4-wire SPI
	bit rate	auto detected
	bit order	LSB first, MSB first
	word size	4/8/12/16/20/24/28/32 bit
	frame condition	CS, timeout
	polarity (MOSI, MISO, CS, CLK)	active high, active low
	phase (CLK)	first edge, second edge
Trigger (hardware based)	source (MOSI, MISO, CS, CLK)	any analog input channel or logical channel
	bit rate	up to 50 Mbps
	trigger event setup	start of frame, end of frame, MOSI, MISO
	data setup	data pattern up to 32 bit (hex or binary); condition =, ≠; offset within frame in range from 0 bit to 4095 bit
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	MISO, MOSI, MISOMOSI
	MISO	data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range
	MOSI	data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range
	MISOMOSI	data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range
	error condition	void, length
Decode	source (MOSI, MISO, CS, CLK)	any input channel, logical channel
	display type	decoded bus, tabulated list
	color coding	frame, word, error
	data format	hex, decimal, octal, binary, ASCII
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

QUAD-SPI triggering and decoding		
Protocol configuration	source (CS, SCLK, IO0 to IO3)	analog, logical, math, reference channels
	bit rate	auto detected
	polarity (SCLK)	rising, falling
	polarity (CS, IO0 to IO3)	active high, active low
	instruction mode	single, dual, quad
	opcode	configurable list for opcode translation opcode list can be saved and loaded
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	data
	data	opcode, addr, alt, dummy; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range
	error condition	length, opcode
Decode	display type	decoded bus, tabulated list
	color coding	frame, word, error
	data format	hex, decimal, octal, binary, ASCII
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

UART/RS-232/RS-422/RS-485 triggering and decoding		
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
	end of packet	timeout, none
Trigger (hardware based)	source (TX and RX)	any analog input channel or logical channel
	trigger event setup	start bit, packet start, data, parity error, stop error, break condition
	data setup	data pattern (hex, decimal, octal, binary or ASCII); condition =, ≠; offset within packet in range 0 word to 4095 words
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	TX, RX
	TX	data; conditions =, ≠, <, ≤, >, ≥, in range, out of range
	RX	data; conditions =, ≠, <, ≤, >, ≥, in range, out of range
	error condition	start, stop, parity, break
Decode	source (TX and RX)	any input channel, logical channel
	display type	decoded bus, tabulated list
	color coding	packet, data payload, start error, parity error, stop error
	data format	hex, decimal, octal, binary, ASCII
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

R&S®MXO5-K520 automotive protocols

CAN FD/XL triggering and decoding		
Protocol configuration	signal type	CAN_H, CAN_L
	bit rate	
	nominal bit rate	100 kbps to 1 Mbps
	FD data rate	100 kbps to 15 Mbps
	XL data rate	100 kbps to 15 Mbps
	sampling point	30 % to 90 % within bit period; independent settings for nominal bit rate, FD data rate and XL data rate
	device list	associate frame identifier with symbolic ID, load DBC file content
Trigger (hardware based)	source	any analog input channel or logical channel
	trigger event setup	start of frame, frame type, identifier, identifier + data, error condition (any combination of CRC error, bit stuffing error, form error and ACK error)
	identifier setup	identifier type (standard or extended); condition =, ≠, ≥, ≤, in range, out of range
	FD bits	FDF, BRS and ESI (0, 1, X)
	XL setup	SDT, VCID, AF; condition =, ≠, ≥, ≤, in range, out of range
	data setup	data pattern up to 8 byte (hex, decimal, octal, binary or ASCII); condition =, ≠
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	CBFF, CBFF-R, CEFF, CEFF-R, FBFF, FEFF, XLFF, overload, error
	CBFF	ID, DLC; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range
	CBFF-R	ID, DLC; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options
	CEFF	EXT-ID, DLC; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range
	CEFF-R	EXT-ID, DLC; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options
	FBFF	ID, DLC; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; BRS, ESI; value 0, 1 for each of these options; data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range

	FEFF	ID, DLC; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; BRS, ESI; value 0, 1 for each of these options; data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range
	XLFF	Priority ID, SDT, DLC, VCID, AF; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; SEC; value 0, 1; data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range
	error condition	EOF, ack delimiter, no ack, CRC delimiter, CRC, stuff count, form, bit stuffing, unknown
Decode	source	any input channel, logical channel
	display type	decoded bus, tabulated list
	color coding	start of frame, identifier, DLC, ADS, SDT, VCID, AF, data payload, CRC, end of frame, error frame, overload frame, CRC error, bit stuffing error
	data format	hex, decimal, octal, binary, ASCII, symbolic
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

LIN triggering and decoding		
Protocol configuration	version	1.3, 2.x or SAE J602; mixed traffic is supported
	bit rate	1 kbps to 20 Mbps
Trigger (hardware based)	source	any analog input channel or logical channel
	trigger event setup	start of frame (sync break), identifier, identifier + data, wake-up frame, error condition (any combination of checksum error, parity error and sync field error)
	identifier setup	range from 0d to 63d; condition =, ≠, ≥, ≤, in range, out of range
	data setup	data pattern up to 8 byte (hex, decimal, octal, binary or ASCII); condition =, ≠
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	data, wake up, unknown
	data	Id; conditions =, ≠, <, ≤, >, ≥, in range, out of range; data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range
	error condition	checksum, parity, start, sync, length

Decode	source	any input channel, logical channel
	display type	decoded bus, tabulated list
	color coding	frame, frame identifier, data payload, checksum, error condition
	data format	hex, decimal, octal, binary, ASCII
	filter	filter result table on frame types and field values
	result export	export of all result data into CSV, XML, HTML and Py file formats

SENT triggering and decoding		
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 (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	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 input channel, logical 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
	filter	filter result table on frame types and field values
	result export	export of all result data into CSV, XML, HTML and Py file formats

R&S®MXO5-K530 aerospace protocols

ARINC 429 triggering and decoding		
Protocol configuration	bit rate	high (100 kbps) low (12.0 kbps to 14.5 kbps)
	signal polarity	A leg, B leg
	min. gap	0 to 100 bit, off
	max. gap	0 to 1000 bit, off
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	ARINC429-word
	ARINC429-word	label, SDI, data, SSM; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options
	error condition	coding, parity, unknown, gap
Decode	source	analog channel, math waveform, reference waveform
	display type	decoded bus, tabulated list, decode layers
	color coding	for different cell types
	data format	hex, decimal, octal, binary, ASCII
	decode layer	off, ternary symbols, bits, words
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

MIL-STD-1553 triggering and decoding		
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 µs to 262 µs) or off; max. response (2 µs to 262 µs) or off
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame Type	command, status, cmd/status, data
	command	RTA, Info; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; P value 0, 1
	status	RTA, Info; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; P value 0, 1
	cmd/Status	RTA, Info; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; P value 0, 1
	data	data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range; P value 0, 1
	error condition	sync, Manchester coding, parity, gap, response timeout
Decode	source	analog 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

R&S®MXO5-K550 MIPI low speed protocols

SPMI triggering and decoding		
Protocol configuration	bit rate	auto detected
	supported version	2.0
	GSID	selectable in range 0 to 15
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	register 0 write, register write, register read, extended register write, extended register read, extended register write long, extended register read long, main write, main read
	register 0 write setup	sub address, data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; ack
	register write/read	sub address, register address, data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; ack (write only)
	extended register write/read	sub address, byte count, register address, data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, in range; ack (write only)
	extended register write long/read long	sub address, byte count, register address, register address 2, data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; data index: selects the specific data word; conditions =, ≠, <, ≤, >, ≥, in range; ack (write only)
	main write/read	main address, register address, data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; frame byte; conditions =, ≠, <, ≤, >, ≥, in range; ack (write only)
	error condition	no response, ack, bus park, parity, length, arbitration, SSC, command, coding
Decode	source (SCLK and SDATA)	any input channel, logical channel, math waveform, reference waveform
	display type	decoded bus, tabulated list, details, decode layers
	color coding	arbitration sequence, command sequence, sequence start condition, device address, command, byte count, register address, data payload, parity bits, bus park cycle, ack, error
	data format	hex, decimal, octal, binary, ASCII
	decode layer	off, edges, bit
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

RFFE triggering and decoding		
Protocol configuration	signal type	two channel, single-ended
	bit rate	auto-detected
	source (SCLK, SDATA)	any two input channels, math waveforms, reference waveforms, or logical channels
	supported version	1.X, 2.0,2.1 and 3.1
	read mode	standard or read mode
	glitch filter	configurable glitch filter
	gap detection	detect gaps between sequences
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	trigger event setup	sequence start, sequence stop, register 0 write, register write, register read, extended register write, extended register read, extended register write long, extended register read long, error condition types
	sequence start setup	4 bit sub device address; conditions =, ≠, <, ≤, >, ≥, in range, out of range
	sequence stop setup	4 bit sub device address; conditions =, ≠, <, ≤, >, ≥, in range, out of range
	register 0 write setup	4 bit sub device address, 7 bit data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options
	register write/read	4 bit sub device address, 5 bit register address, 8 bit data word; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options
	extended register write/read	4 bit sub device address; 8 bit address, byte count: 0 to 15 (inclusive), data pattern: 1 to 16 byte (hex or binary); conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; index: 1 to 16 selects the specific data frame byte; conditions =, ≠, <, ≤, >, ≥, in range
	extended register write long/read long	4 bit sub device address, 8 bit address, byte count: 0 to 7 (inclusive), data pattern: 0 to 8 byte (hex or binary); conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; index: 1 to 8 selects the specific data frame byte; conditions =, ≠, <, ≤, >, ≥, in range
	interrupt summary and notification	4 bit sub device address, bit count 0 to 32, notification and interrupt bits
	masked write	4 bit sub device address; 8 bit address, 8 bit mask, 8 bit data pattern; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; frame byte; conditions =, ≠, <, ≤, >, ≥, in range
	main device ownership handover	2 bit MID; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; frame byte; conditions =, ≠, <, ≤, >, ≥, in range
	main device write/read	2 bit MID, 8 bit address, 16 bit data pattern; conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; frame byte; conditions =, ≠, <, ≤, >, ≥, in range
	main device context transfer write/read	2 bit MID, 8 bit byte count, 8 bit address, data pattern: 1 to 8 byte (hex or binary);

		conditions =, ≠, <, ≤, >, ≥, in range, out of range for each of these options; index: 1 to 256 selects the specific data frame byte; conditions =, ≠, <, ≤, >, ≥, in range
	error condition	SSC error; length error, bus park error, parity error, no response, unknown sequence, version error, min. gap between frames: 1 ns to 10 us
Decode	display type	decoded bus, logical signal, bus + logical signal, tabulated list, decode layers
	color coding	sequence, frame, error
	data format	hex, octal, binary, ASCII, signed, unsigned
	decode layer	off, edges, bit
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

R&S®MXO5-K560 automotive Ethernet protocols

10BASE-T1S triggering and decoding		
Protocol configuration	source	any analog input channel, math waveform, reference waveform
	threshold	upper/lower
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	MAC, COMMIT, BEACON or unknown
	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), data (condition =, ≠, <, >, ≥, ≤, in range, out of range), data index (condition =, in range)
	error condition setup	preamble, SFD, ESD, CRC
Decode	display type	decoded bus, tabulated list, details, decode layers
	color coding	for different cells types
	data format	hex, decimal, octal, binary, signed, unsigned, ASCII
	decode layer	reversed bits, descrambled bits, scrambled bits, ternary symbols
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

100BASE-T1 triggering and decoding		
Protocol configuration	source	any analog input channel, math waveform, reference waveform
	polarity	normal, inverted
	mode	main, subordinate, auto
Trigger (software based)	primary event trigger (hardware based)	edge, glitch, width, runt, windows, timeout, interval, slew rate
	frame type	MAC, fill, idle or unknown
	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), data (condition =, ≠, <, >, ≥, ≤, in range, out of range), data index (condition =, in range)
	error condition setup	preamble, SFD, length, CRC, uncorrelated
Decode	display type	decoded bus, tabulated list, details, decode layers
	color coding	for different cells types
	data format	hex, decimal, octal, binary, signed, unsigned, ASCII
	decode layer	reversed bits, descrambled bits, scrambled bits, ternary symbols
	filter	filter result table on frame types, field values, status
	result export	export of all result data into CSV, XML, HTML and Py file formats

Ordering information

Designation	Type	Order No.
MXO 5 series, base models		
Oscilloscope, 350 MHz, 4 channels	MXO 54	1802.1008K04
Oscilloscope, 100 MHz, 8 channels	MXO 58	1802.1008K08
Base unit (including standard accessories: 700 MHz passive probe (10:1) per channel, accessories bag, quick start guide, power cord)		
Choose your bandwidth upgrade		
Upgrade of MXO 54 to 500 MHz bandwidth	R&S®MXO5-B245	1802.0676.02
Upgrade of MXO 54 to 1 GHz bandwidth	R&S®MXO5-B2410	1802.0682.02
Upgrade of MXO 54 to 2 GHz bandwidth	R&S®MXO5-B2420	1802.0699.02
Upgrade of MXO 58 to 200 MHz bandwidth	R&S®MXO5-B282	1802.0701.02
Upgrade of MXO 58 to 350 MHz bandwidth	R&S®MXO5-B283	1802.0718.02
Upgrade of MXO 58 to 500 MHz bandwidth	R&S®MXO5-B285	1802.0724.02
Upgrade of MXO 58 to 1 GHz bandwidth	R&S®MXO5-B2810	1802.0730.02
Upgrade of MXO 58 to 2 GHz bandwidth	R&S®MXO5-B2820	1802.0747.02
Choose your options		
Mixed signal option, for MXO 5 series with 16 digital channels	R&S®MXO5-B1	1802.0660.02
Arbitrary waveform generator, 100 MHz, 2 analog channels	R&S®MXO5-B6	1802.0753.02
Additional M.2 SSD	R&S®MXO5-B19	1803.0205.02
Memory option 1 Gpoints	R&S®MXO5-B110	1803.0211.02
Power analysis	R&S®MXO5-K31	1802.0799.02
Frequency response analysis	R&S®MXO5-K36	1802.1943.02
Low speed serial buses (I^2C/SPI/QuadSPI/UART/RS-232/RS-422/RS-485)	R&S®MXO5-K510	1802.1243.02
Automotive protocols (CAN/CAN FD/CAN XL/LIN/SENT)	R&S®MXO5-K520	1802.1920.02
Aerospace protocols (ARINC 429, MIL-STD-1553)	R&S®MXO5-K530	1802.1266.02
MIPI low speed protocols (SPMI/RFFE)	R&S®MXO5-K550	1802.1272.02
Automotive Ethernet protocols (10BASE-T1S/100BASE-T1)	R&S®MXO5-K560	1802.1250.02
Application bundle, consists of the following options: R&S®MXO5-B6, R&S®MXO5-K31, R&S®MXO5-K36, R&S®MXO5-K510, R&S®MXO5-K520	R&S®MXO5-PK1	1803.0257.02
Choose your additional probes		
Single-ended passive probes		
700 MHz, 10 MΩ, 10:1, 400 V, 9.5 pF, 2.5 mm	R&S®RT-ZP11	1803.0005.02
500 MHz, 10 MΩ, 10:1, 400 V, 9.5 pF, 2.5 mm	R&S®RT-ZP10	1409.7550.00
500 MHz, 10 MΩ, 10:1, 300 V, 10 pF, 5 mm	R&S®RT-ZP05S	1333.2401.02
38 MHz, 1 MΩ, 1:1, 55 V, 39 pF, 2.5 mm	R&S®RT-ZP1X	1333.1370.02
Active broadband probes: single-ended		
1.0 GHz, active, 1 MΩ, Rohde & Schwarz probe interface	R&S®RT-ZS10E	1418.7007.02
1.0 GHz, active, 1 MΩ, R&S®ProbeMeter, micro button, Rohde & Schwarz probe interface	R&S®RT-ZS10	1410.4080.02
1.5 GHz, active, 1 MΩ, R&S®ProbeMeter, micro button, Rohde & Schwarz probe interface	R&S®RT-ZS20	1410.3502.02
Active broadband probes: differential		
1.0 GHz, active, differential, 1 MΩ, R&S®ProbeMeter, micro button, incl. 10:1 external attenuator, 1 MΩ, 60 V DC, 42.4 V AC (peak), Rohde & Schwarz probe interface	R&S®RT-ZD10	1410.4715.02
1.5 GHz, active, differential, 1 MΩ, R&S®ProbeMeter, micro button, Rohde & Schwarz probe interface	R&S®RT-ZD20	1410.4409.02
Power rail probe		
2.0 GHz, 1:1, 50 kΩ, ±0.85 V, ±60 V offset, Rohde & Schwarz probe interface	R&S®RT-ZPR20	1800.5006.02
High voltage probes: passive		
250 MHz, 100:1, 100 MΩ, 850 V, 6.5 pF	R&S®RT-ZH03	1333.0873.02
400 MHz, 100:1, 50 MΩ, 1000 V, 7.5 pF	R&S®RT-ZH10	1409.7720.02
400 MHz, 1000:1, 50 MΩ, 1000 V, 7.5 pF	R&S®RT-ZH11	1409.7737.02
High voltage probes: differential		
200 MHz, 250:1/25:1, 5 MΩ, 750 V (peak), 300 V CAT III, Rohde & Schwarz probe interface	R&S®RT-ZHD07	1800.2307.02
100 MHz, 500:1/50:1, 10 MΩ, 1500 V (peak), 1000 V CAT III, Rohde & Schwarz probe interface	R&S®RT-ZHD15	1800.2107.02
200 MHz, 500:1/50:1, 10 MΩ, 1500 V (peak), 1000 V CAT III, Rohde & Schwarz probe interface	R&S®RT-ZHD16	1800.2207.02
100 MHz, 1000:1/100:1, 40 MΩ, 6000 V (peak), 1000 V CAT III, Rohde & Schwarz probe interface	R&S®RT-ZHD60	1800.2007.02

Designation	Type	Order No.
Current probes		
20 kHz, AC/DC, 0.01 V/A and 0.001 V/A, ±200 A and ±2000 A, BNC interface	R&S®RT-ZC02	1333.0850.02
100 kHz, AC/DC, 0.1 V/A, 30 A, BNC interface	R&S®RT-ZC03	1333.0844.02
2 MHz, AC/DC, 0.01 V/A, 500 A (RMS), Rohde & Schwarz probe interface	R&S®RT-ZC05B	1409.8204.02
10 MHz, AC/DC, 0.01 V/A, 150 A (RMS), BNC interface	R&S®RT-ZC10	1409.7750K02
10 MHz, 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, AC/DC, 0.1 V/A, 30 A (RMS), BNC interface	R&S®RT-ZC20	1409.7766K02
100 MHz, AC/DC, 0.1 V/A, 30 A (RMS), Rohde & Schwarz probe interface	R&S®RT-ZC20B	1409.8233.02
120 MHz, AC/DC, 1 V/A, 5 A (RMS), BNC interface	R&S®RT-ZC30	1409.7772K02
EMC near-field probe		
Probe set for E and H near-field measurements, 30 MHz to 3 GHz	R&S®HZ-15	1147.2736.02
Logic probe [9]		
400 MHz logic probe, 8 channels	R&S®RT-ZL04	1333.0721.02
Probe accessories		
Accessory set for R&S®RT-ZP11 passive probe (2.5 mm probe tip)	R&S®RT-ZA1	1409.7566.00
Probe power supply for R&S®RT-ZC10/-ZC20/-ZC30	R&S®RT-ZA13	1409.7789.02
External attenuator 10:1, 2.0 GHz, 1.3 pF, 60 V DC, 42.4 V AC (peak), for R&S®RT-ZD20/-ZD30 probes	R&S®RT-ZA15	1410.4744.02
Probe pouch for the logic probes	R&S®RT-ZA19	1335.7875.02
Power deskew and calibration test fixture	R&S®RT-ZF20	1800.0004.02
3D positioner with central tensioning knob for easy clamping and positioning of probes (span width: 200 mm, clamping range: 15 mm)	R&S®RT-ZAP	1326.3641.02
Bipod probe positioner	R&S®RT-ZA29	1801.4803.02
Choose your accessories		
Rackmount kit, for MXO 5 series with 8 HU	R&S®ZZA-MXO5	1802.3181.02
Front cover	R&S®MXO5-Z1	1803.0240.02
Soft case (W × H × D: 550 mm × 300 mm × 340 mm)	R&S®MXO5-Z3	1803.0228.02
Transit case (W × H × D: 613 mm × 478 mm × 337 mm)	R&S®MXO5-Z4	1803.1560.02
VESA adapter	R&S®MXO5-Z7	1803.0457.02
VESA mount (compatible with standard 100 mm × 100 mm pattern)	Choose industry standard mounts according to FDMI MIS-D, up to 14 kg with M4x10 screws	

Warranty and service

Warranty		
Base unit		1 year
All other items		1 year
Service options		
	Service plans	**On demand**
Calibration	up to five years [10]	pay per calibration
Warranty and repair	up to five years [10]	standard price repair
Contact your Rohde & Schwarz sales office for further details.		

[9] The R&S®MXO5-B1 mixed signal option contains two R&S®RT-ZL04 logic probes.

[10] For extended periods, contact your Rohde & Schwarz sales office.

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- Energy efficiency and low emissions
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ISO 9001

Certified Environmental Management
ISO 14001

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PD 3683.8196.22 | Version 08.00 | December 2024 (sk)
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Data without tolerance limits is not binding | Subject to change