RIGOL

MSO/DS9000 Series

Digital Oscilloscope

Data Sheet

DSA40103-1110

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Product Features

Product Features

- Based on RIGOL's brand new self-developed module
- Up to 4 analog channels, 1 EXT channel
- Max. 6 GHz Analog Bandwidth
- Max. real-time sampling rate of 20 GSa/s
- Max. memory depth of 2 Gpts
- Max. waveform capture rate of 1,000,000 wfms/s in fast recording mode
- Vertical resolution: 8 to 16 bits selectable
- Vertical sensitivity range: 1 mV/div to 10 V/div (1 MΩ), 1 mV/div to 1 V/div (50 Ω)
- Time base range: 50 ps/div to 500 s/div
- Up to 2,000,000 hardware real-time waveform continuously recording and playing function
- Integrates various independent instruments into 1, including digital oscilloscope, function/arbitrary waveform generator[1], digital voltmeter, 8-digit frequency counter and totalizer, and protocol analyzer (option)
- Comprehensive trigger and bus decoding functions: Edge, Pulse, Slope, Video, Pattern, Duration, Timeout, Runt, Window, Delay, Setup/Hold, Nth edge, RS232, I2C, SPI, CAN, CAN-FD (option), FlexRay (option), LIN (option), I2S (option), MIL-STD-1553 (option), SENT Decode (option)
- Search and navigation, mask testing, and zone trigger functions enable users to quickly identify abnormal signal events and locate them accurately
- Auto measurements of 41 waveform parameters
- Supports Ethernet, Automotive Ethernet, USB2.0, MIPI D-PHY, and other protocol compliance analysis functions (option)
- Supports multiple functions, including digital signal analysis[2], Bode plot[3], and histogram
- Supports optional real-time eye diagram, jitter analysis, and power analysis
- Multiple interfaces available: USB HOST & DEVICE, HDMI, AUX OUT, LAN(LXI), Web Control
- 10.1" 1280*800 HD touch screen display, portable design
- User-friendly Flex Knobs for a smoother, more intuitive user experience

MSO/DS9000 series digital oscilloscope is designed to meet mainstream application needs in design, debugging, and testing. Adopting RIGOL's brand-new self-developed module, the oscilloscope achieves a fast waveform capture rate of 1,000,000 wfms/s in the fast recording mode, 2 Gpts memory depth, 8 to 16-bit vertical resolution, all combined with excellent noise floor performance and vertical accuracy to meet your requirements for more accurate measurements, delivering an exceptional test and measurement experience.

NOTE:

[1]: The function/arbitrary waveform generator is available for MSO9402.

[2]: The digital signal analysis is available for MSO9402.

[3]: The Bode plot function is available for MSO9402.

Overview of RIGOL's Medium and High-end Series Products

	MSO/DS9000	MSO8000	DS70000
Analog Channel	4	4	4
Digital Channel	16	16	N/A
Analog Bandwidth	2 GHz to 6 GHz	600 MHz to 2 GHz	3 GHz to 5 GHz
Max. Sample Rate	20 GSa/s	10 GSa/s	20 GSa/s
Max. Memory Depth	2 Gpts (Option)	500 Mpts	2 Gpts (Option)
Waveform Capture Rate	>1,000,000 wfms/s	>600,000 wfms/s	>1,000,000 wfms/s
Max. Recording Frames	2,000,000 frames	450,000 frames	2,000,000 frames
LCD	10.1-inch capacitive multi-touch screen	10.1-inch capacitive multi-touch screen	15.6'' capacitive multi-touch screen with one-button electronic tilt
Hardware Mask Test	Standard	Standard	Standard
Built-in Arbitrary Waveform Generator	2-CH, 50 MHz (standard, MSO model only); 2-CH, 200 MHz (option, MSO model only)	2-CH, 25 MHz (option)	N/A
Built-in Digital Voltmeter	Standard	Standard	Standard
Built-in Hardware Counter	8-digit frequency counter + totalizer	6-digit frequency counter + totalizer	8-digit frequency counter + totalizer
Real-time Eye Diagram	Option	Option	Option
Jitter Analysis	Option	Option	Option
Serial Protocol Analysis	RS232/UART, I2C, SPI, CAN, LIN, FlexRay, I2S, CAN-FD, MIL-STD-1553, SENT	RS232/UART, I2C, SPI, CAN, LIN, FlexRay, I2S, MIL-STD-1553	RS232/UART, I2C, SPI, CAN, CAN-FD, LIN, FlexRay, I2S, MIL-STD-1553, MIPI-RFFE, USB2.0
Waveform Color Persistence	Standard	Standard	Standard
FFT	FFT, standard	FFT, standard	FFT, standard
MATH	Displays 4 functions at the same time	Displays 4 functions at the same time	Displays 4 functions at the same time
Connectivity	Standard: USB, LAN, HDMI	Standard: USB, LAN, HDMI Option: USB-GPIB	Standard: USB, LAN, HDMI Option: USB-GPIB

RIGOL Probes and Accessories Supported by the Series

RIGOL Passive Probe

Model	Type	Description
 PVP2150	High-impedance Probe	• Attenuation ratio: 10:1/1:1 • 1X BW: DC~35 MHz • 10X BW: DC~150 MHz • Compatibility: All models of RIGOL's digital oscilloscopes
 PVP2350	High-impedance Probe	• Attenuation ratio: 10:1/1:1 • 1X BW: DC~35 MHz • 10X BW: DC~350 MHz • Compatibility: All models of RIGOL's digital oscilloscopes
 PVP3150	Passive High-impedance Probe	• Attenuation ratio: 10:1/1:1 • 1X BW: DC~20 MHz • 10X BW: DC~150 MHz • Compatibility: All models of RIGOL's digital oscilloscopes
 RP3500A	High-impedance Probe	• Attenuation ratio: 10:1 • BW: DC~500 MHz • Compatibility: MSO/DS7000, MSO8000/A, DHO4000/1000, MHO/DHO5000, MHO2000, DS70000/80000, MHO98, MHO900 Series, and MSO/DS9000.
 RP6150A	Low-impedance Probe	• BW: DC~1.5 GHz • Compatibility: MSO/DS7000, MSO8000/A, DS70000/80000 Series, and MSO/DS9000.
 RP1300H	High-voltage Probe	• Attenuation ratio: 100:1 • BW: DC~300 MHz • CAT I 2000 V (DC+AC) • CAT II 1500 V (DC+AC) • Compatibility: All models of RIGOL's digital oscilloscopes

Model	Type	Description
 RP1010H	High-voltage Probe	• Attenuation ratio: 1000:1 • BW: DC~40 MHz • DC: 0 to 10 kV DC • AC: pulse ≤20 kVp-p • AC: sine ≤ 7kV_{rms} • Compatibility: All models of RIGOL's digital oscilloscopes
 RP1018H	High-voltage Probe	• Attenuation ratio: 1000:1 • BW: DC~150 MHz • DC+AC_{peak}: 18 kV CAT II • AC_{rms}: 12 kV CAT II • Compatibility: All models of RIGOL's digital oscilloscopes

RIGOL Active & Current Probe

Model	Type	Description
 PVA8700	Single-ended/ Differential Active Probe	• BW: DC~7 GHz • 30 Vpeak CAT I • Compatibility: DS70000/80000 Series and MSO/DS9000.
 PVA8350	Active Differential Probe	• BW: DC~3.5 GHz • 30 Vpeak CAT I • Compatibility: DS70000/80000 Series and MSO/DS9000.
 PVA7250	Single-ended/ Differential Active Probe	• BW: DC~2.5 GHz • 30 Vpeak CAT I • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000, and MSO/DS9000.

Model	Type	Description
 RP7150	Single-ended/ Differential Active Probe	• BW: DC~1.5 GHz • 30 Vpeak CAT I • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.
 RP7080	Single-ended/ Differential Active Probe	• BW: DC~800 MHz • 30 Vpeak CAT I • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.
 PHA0150	High-voltage Differential Probe	• BW: DC~70 MHz • Max. voltage ≤ 1500 Vpp • Compatibility: All models of RIGOL's digital oscilloscopes
 PHA1150	High-voltage Differential Probe	• BW: DC~100 MHz • Max. voltage ≤ 1500 Vpp • Compatibility: All models of RIGOL's digital oscilloscopes
 PHA2150	High-voltage Differential Probe	• 50X BW: DC~160 MHz • 500X BW: DC~200 MHz • Max. voltage ≤ 1500 Vpp • Compatibility: All models of RIGOL's digital oscilloscopes
 PHA1150B	High-voltage Differential Probe	• BW: DC~100 MHz • Compatibility: All models of RIGOL's digital oscilloscopes
 PHA2150B	High-voltage Differential Probe	• BW: DC~200 MHz • Compatibility: All models of RIGOL's digital oscilloscopes

Model	Type	Description
 PHA5150B	High-voltage Differential Probe	• BW: DC~500 MHz • Compatibility: All models of RIGOL's digital oscilloscopes
 RP7150S	Single-ended Active Probe	• BW: DC~1.5 GHz • 30 Vpeak CAT I • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.
 RP7080S	Single-ended Active Probe	• BW: DC~800 MHz • 30 Vpeak CAT I • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.
 PVA8150S	Single-ended Active Probe	• BW: DC~1.5 GHz • 30 Vpeak CAT I • Compatibility: MSO8000, DS70000, DHO4000, MSO/DS9000.
 PCA1030	Current Probe	• BW: DC~50 MHz (-3dB) • Max. continuous input range: 30 A_{rms} • Max. peak-peak current value: 50 A peak, non-continuous • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.
 PCA2030	Current Probe	• BW: DC~100 MHz (-3dB) • Max. continuous input range: 30 A_{rms} • Max. peak-peak current value: 50 A peak, non-continuous • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.

Model	Type	Description
 PCA1030B	Current Probe	• BW: DC~50 MHz (-3dB) • Max. continuous input range: 30 A_{rms} • Max. peak-peak current value: 50 A peak, non-continuous • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.
 PCA2030B	Current Probe	• BW: DC~100 MHz (-3dB) • Max. continuous input range: 30 A_{rms} • Max. peak-peak current value: 50 A peak, non-continuous • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.
 PCA1150	Current Probe	• BW: DC~10 MHz (-3dB) • Max. continuous input range: 150 A • Max. peak-peak current value: 300 A (non-continuous), 500 A (pulse width ≤ 30 μs) • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.
 PCA1500	Current Probe	• BW: DC~2 MHz (-3dB) • Max. continuous input range: 500 A_{rms} • Max. peak-peak current value: 700 A peak, non-continuous • Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.
 RP1000P	4-CH Power Supply	Power supply for RP1003C, RP1004C, RP1005C, and RP1006C; supporting 4 channels.

Model	Type	Description
 RP1003C	Current Probe	• BW: DC~50 MHz • Maximum Input AC P-P: 50 A (non-continuous) AC RMS: 30 A • Compatibility: All models of RIGOL's digital oscilloscopes • Required to order RP1000P power supply.
 RP1004C	Current Probe	• BW: DC~100 MHz • Maximum Input AC P-P: 50 A (non-continuous) AC RMS: 30 A • Compatibility: All models of RIGOL's digital oscilloscopes • Required to order RP1000P power supply.
 RP1005C	Current Probe	• BW: DC~10 MHz • Maximum Input AC P-P: 300 A (non-continuous), 500 A (@pulse width ≤ 30 us) AC RMS: 150 A • Compatibility: All models of RIGOL's digital oscilloscopes • Required to order RP1000P power supply.
 RP1006C	Current Probe	• BW: DC~2 MHz • Maximum Input AC P-P: 700 A peaks, non-continuous AC RMS: 500 A • Compatibility: All models of RIGOL's digital oscilloscopes • Required to order RP1000P power supply.
 RP1001C	Current Probe	• BW: DC~300 kHz • Maximum Input DC: ±100 A AC P-P: 200 A AC RMS: 70 A • Compatibility: All models of RIGOL's digital oscilloscopes

Model	Type	Description
 RP1002C	Current Probe	• BW: DC~1 MHz • Maximum Input DC: ±70 A AC P-P: 140 A AC RMS: 50 A • Compatibility: All models of RIGOL's digital oscilloscopes
 RP1025D	High-voltage Differential Probe	• BW: DC~25 MHz • Max. voltage ≤ 1400 Vpp (DC + AC P-P) • Compatibility: All models of RIGOL's digital oscilloscopes
 RP1050D	High-voltage Differential Probe	• BW: DC~50 MHz • Max. voltage ≤ 7000 Vpp (DC + AC P-P) • Compatibility: All models of RIGOL's digital oscilloscopes
 RP1100D	High-voltage Differential Probe	• BW: DC~100 MHz • Max. voltage ≤ 7000 Vpp (DC + AC P-P) • Compatibility: All models of RIGOL's digital oscilloscopes
 PIA1020	Optically isolated probes	• BW: DC~200 MHz • Compatibility: MSO8000, DHO4000, MSO/DS9000.
 PIA1050	Optically isolated probes	• BW: DC~500 MHz • Compatibility: MSO8000, DHO4000, MSO/DS9000.
 PIA1100	Optically isolated probes	• BW: DC~1 GHz • Compatibility: MSO8000, DHO4000, MSO/DS9000.

Model	Type	Description
 PLA3204	Active Logic Analyzer Probe	• No. of Input Channels: 4 • Threshold Range: ±15 V • Min. Voltage Swing: 500 mVpp • Min. Detectable Pulse Width: 5 ns • Max. Input Voltage: ±40 V (Peak) • Max. Input Dynamic Range: ±10 V + Threshold • Input Impedance: 100 kΩ ± 1% • Input Capacitance: about 11 pF • Compatibility: MHO5000 series and MSO9000 series

Specifications

All the specifications are guaranteed except the parameters marked with "Typical" and the oscilloscope needs to operate for more than 30 minutes under the specified operation temperature.

Overview of the MSO/DS9000 Series Technical Specifications

Overview of the MSO/DS9000 Series Technical Specifications					
Model	DS9202	DS9204	DS9404	DS9604	MSO9402
Analog Bandwidth (50 Ω, -3 dB)	2 GHz	2.5 GHz	4 GHz	6 GHz (half-channel[2]) 4 GHz (all-channel[3])	4 GHz
Analog Bandwidth (1 MΩ, -3 dB)	500 MHz				
Calculated Rise Time under 50 Ω[1] (10%-90%)	≤210 ps	≤210 ps	≤110 ps	≤73 ps	≤110 ps
Number of Channels	DS9202: 2 analog channels +1 EXT channel DS9204: 4 analog channels +1 EXT channel DS9404: 4 analog channels +1 EXT channel DS9604: 4 analog channels +1 EXT channel MSO9402: 2 analog channels +1 EXT channel +16 digital channels +2 function/arbitrary waveform generator output channels				
Sampling Mode	Real-time sampling				
Max. Sample Rate of Analog Channels	10 GSa/s	half-channel[2]: 20 GSa/s all-channel[3]: 10 GSa/s			
Max. Memory Depth	10 Mpts (all-channel[3])	Standard: 500 Mpts (half-channel[2]), 200 Mpts (all-channel[3]) Option: 2 Gpts (half-channel[2]), 1 Gpts (all-channel[3])			
Max. Waveform Capture Rate	1,000,000 wfms/s (in fast recording mode)				
Vertical Resolution	8 bits (9-16 bits in high-resolution mode)				

Overview of the MSO/DS9000 Series Technical Specifications	
Hardware Real-time Waveform Recording and Playing	2,000,000 frames @ 2Gpts
Peak Detect	Capture glitches as narrow as 200 ps
Display Size and Type	10.1-inch capacitive multi-touch display
Display Resolution	1280×800

Vertical System-Analog Channels

Vertical System-Analog Channels		
Input Coupling	50 Ω	DC
	1 MΩ	DC, AC[4]or Ground (DC, AC, GND)
Input Impedance	1 MΩ ± 1%, 50 Ω ± 2%	
Input Capacitance	18 pF ± 3 pF	
Probe Attenuation Ratio	Probe ratio	0.001x, 0.002x, 0.003x, 0.005x, 0.01x, 0.02x, 0.03x, 0.05x, 0.1x, 0.2x, 0.3x, 0.5x, 1x, 2x, 3x, 5x, 10x, 15x, 20x, 50x, 100x, 150x, 200x, 500x, 1000x, 1500x, 2000x, 5000x, 10000x, 15000x, 20000x, 50000x, User
Probe Recognition	Auto-recognized RIGOL probe	
Maximum Input Voltage	1 MΩ	CAT I 300V_{rms}, 400Vpk
	50 Ω	5 V_{rms}
	Remarks	The probe is technically capable of supporting higher-voltage measurements. The standard probe RP3500A 10:1 supports 300 V_{rms} ±400 $V_{Max.}$ (DC + V_{Peak}). No transient overvoltage allowed for 50 Ω or 1 MΩ inputs whether the probe is used or not. Use this instrument only for measurements within its specified measurement category (not rated for CAT II, III, IV).
Vertical Resolution		8 bits (9-16 bits selectable in high-resolution mode)

Vertical System-Analog Channels		
Vertical Sensitivity Range[5]	1 MΩ	1 mV/div to 10 V/div 20 MHz bandwidth limit @ ≤ 4 mV/div
	50 Ω	1 mV/div to 1 V/div 200 MHz bandwidth limit @ ≤ 4 mV/div
Offset Range	1 MΩ	±0.8 V (≤ 80 mV/div) ±4 V (> 80 mV/div, ≤ 320 mV/div) ±18 V (> 320 mV/div, ≤ 3.2 V/div) ±100 V (> 3.2 V/div, ≤ 10 V/div)
	50 Ω	±0.6 V (≤ 150 mV/div) ±2.2 V (> 150 mV/div, ≤ 370 mV/div) ±3.8 V (> 370mV/div)
Dynamic Range		±4 div
Bandwidth Limit[6] (Typical)	1 MΩ	20 MHz, 200 MHz, 500 MHz (OFF)
	50 Ω	DS9202: 200 MHz, 500 MHz, 1 GHz, 2 GHz (OFF) DS9204: 200 MHz, 500 MHz, 1 GHz, 2 GHz, 2.5 GHz (OFF) MSO9402/DS9404: 200 MHz, 500 MHz, 1 GHz, 2 GHz, 3 GHz, 4 GHz (OFF) DS9604: 200 MHz, 500 MHz, 1 GHz, 2 GHz, 3 GHz, 4 GHz, 5 GHz, 6 GHz (OFF)
DC Gain Accuracy[5]	1 MΩ	±2% FullScale
	50 Ω	±3% FullScale (< 5mV/div); ±2% FullScale (≥ 5mV/div)
DC Vertical Offset Accuracy		≥ 2 mV/div, ≤ 200 mV/div (±0.1 div ± 2 mV ± 1.5% offset value)
		> 200 mV/div (±0.1 div ± 2 mV ± 1.0% offset value)
Channel-to-channel Isolation		> 100:1 (from DC to 1 GHz), > 30:1 (> 1 GHz)
ESD Tolerance		± 8 kV (BNC input)

ENOB [measured at 50 Ω, 100 mV/div, 10 MHz input signal with 95% full scale (meas.)]	200 MHz bandwidth	6.4
	500 MHz bandwidth	6.3
	1 GHz bandwidth	6.2
	2 GHz bandwidth	6.0
	3 GHz bandwidth	5.8
	4 GHz bandwidth	5.5
	6 GHz bandwidth	5.2

Vertical System-Digital Channels[7]

Vertical System-Digital Channels	
Number of Channels	16 input channels (D0 to D15) (D0 to D3, D4 to D7, D8 to D11, D12 to D15)
Threshold Range	±15.0 V, in 10 mV step
Threshold Accuracy	±(100 mV + 3% of threshold setting)
Threshold Selection	TTL (1.4 V), CMOS5.0 (2.5 V), CMOS3.3 (1.65 V), CMOS2.5 (1.25 V), ECL (-1.3 V), PECL (3.7 V), LVDS (1.2 V) User Defined (adjustable threshold for 4 channels in a group)
Max. Input Voltage	± 40 V peak CAT I; transient overvoltage 800 Vpk
Max. Input Dynamic Range	±10 V + threshold
Min. Voltage Swing	500 mVpp
Input Impedance	100 kΩ ± 1%
Probe Load	Approximately 11 pF
Vertical Resolution	1 bit

Noise Floor[8]

Noise Floor AC RMS at 50 Ω			
Vertical Scale	2.5 GHz BW	4 GHz BW	6 GHz BW
1 mV/div @200 MHz	0.12 mV_{rms}	0.12 mV_{rms}	0.12 mV_{rms}

Noise Floor AC RMS at 50 Ω			
2 mV/div @200 MHz	0.12 mV_{rms}	0.12 mV_{rms}	0.12 mV_{rms}
5 mV/div	0.40 mV_{rms}	0.70 mV_{rms}	0.90 mV_{rms}
10 mV/div	0.70 mV_{rms}	0.90 mV_{rms}	1.1 mV_{rms}
20 mV/div	1.2 mV_{rms}	1.5 mV_{rms}	1.7 mV_{rms}
50 mV/div	2.8 mV_{rms}	3.2 mV_{rms}	3.4 mV_{rms}
100 mV/div	4.4 mV_{rms}	4.8 mV_{rms}	5.0 mV_{rms}
200 mV/div	11 mV_{rms}	14 mV_{rms}	16 mV_{rms}
500 mV/div	20 mV_{rms}	26 mV_{rms}	30 mV_{rms}
1 V/div	33 mV_{rms}	40 mV_{rms}	45 mV_{rms}

Noise floor at 1 MΩ (500 MHz Bandwidth)	
Vertical Scale	Noise Floor AC RMS
1 mV/div @ 20 MHz	0.14 mV_{rms}
2 mV/div @ 20 MHz	0.13 mV_{rms}
5 mV/div	0.15 mV_{rms}
10 mV/div	0.27 mV_{rms}
20 mV/div	0.36 mV_{rms}
50 mV/div	0.76 mV_{rms}
100 mV/div	3.00 mV_{rms}
200 mV/div	6.70 mV_{rms}
500 mV/div	12.8 mV_{rms}
1 V/div	18.0 mV_{rms}
2 V/div	32.8 mV_{rms}
5 V/div	115 mV_{rms}
10 V/div	168 mV_{rms}

Horizontal System-Analog Channels

Horizontal System-Analog Channels		
Time Base Range		50 ps/div to 500 s/div
		Time base fine adjustment setting available
Time Base Resolution		0.5 ps
Time Base Accuracy		±1.0 ppm ± 1 ppm/year
Time Interval (ΔT) Measurement (using Cursor)		±(Time Base Accuracy x Readout) ± (0.001 x Screen Width) ± 20 ps
Channel-to-channel Deskew Range		±100 ns, in 1 ps step
Analog Channel-to-Channel Delay[9]		≤200 ps
Analog Channel-to-Channel Jitter		10 ps rms
Horizontal Offset Range		- (Memory depth/current sampling rate/2) to +5 ks
Horizontal Mode	MAIN (YT)	Default mode
	XY	On channel 1/2/3/4
	ZOOM	Zoom in
	ROLL	Time base ≥ 50 ms/div, available to enter or exit the ROLL mode by turning the horizontal timebase knob

Horizontal System-Digital Channels

Horizontal System-Digital Channels	
Min. Detectable Pulse Width	5 ns
Max. Input Frequency	200 MHz
Channel-to-Channel Skew	± 5 ns

Acquisition System

Acquisition System	
Max. Sample Rate of Analog Channels	DS9202: 10 GSa/s DS9204/MSO9402/DS9404/DS9604: 20 GSa/s (half-channel[2]), 10 GSa/s (all-channel[3])

Acquisition System		
Max. Memory Depth of Analog Channels	DS9202: Standard: 10 Mpts (all-channel[3]) DS9204/MSO9402/DS9404/DS9604: Standard: 500 Mpts (half-channel[2]), 200 Mpts (all-channel[3]) Option: 2 Gpts (half-channel[2]), 1 Gpts (all-channel[3])	
Acquisition Mode	Normal	Default mode
	Peak Detect	Captures glitches as narrow as 200 ps
	Average	Selectable from 2, 4, 8, 16...to 65,536
	High Resolution	9-16 bits
Real-time Acquisition Mode	Capture Rate	Max. 25,000 wfms/s
Record Mode	Continuous recording until the memory is full	Supported in fast recording mode
	Max. Waveform Capture Rate	1,000,000 wfms/s (in fast recording mode)
	Max. Recording Frames	2,000,000 frames @ 2 Gpts

Trigger System

Trigger System		
Trigger Sources		Analog channel, EXT TRIG, AC Line
Trigger Mode		Auto, Normal, Single, and Force
Trigger Coupling	DC	Default mode
	AC	Cut-off frequency ~ 10 Hz ±20% (analog channel trigger only)
	HF Reject	Cut-off frequency ~ 75 kHz ±20% (analog channel trigger only)
	LF Reject	Cut-off frequency ~ 75 kHz ±20% (analog channel trigger only)
Noise Rejection		Increase delay for the trigger circuit (internal trigger only), on/off
Trigger Holdoff Range		100 ns to 10 s

Trigger System		
Trigger Bandwidth	Analog Channel Trigger	Analog bandwidth
Trigger Sensitivity	Internal Trigger-Analog Channel 1 MΩ	≤ 2 mV/div: 0.5 div, 0.7 div (with noise rejection enabled) ＞ 2 mV/div: 0.4 div, 0.6 div (with noise rejection enabled)
	Internal Trigger-Analog Channel 50 Ω	< 2 mV/div: 1.9 div, 2.8 div (with noise rejection enabled) ≥ 2 mV/div, ＜ 10 mV/div: 1.2 div, 1.6 div (with noise rejection enabled) ≥ 10 mV/div, ＜ 20 mV/div: 0.6 div, 0.9 div (with noise rejection enabled) >20 mV/div: 0.5 div, 0.7 div (with noise rejection enabled)
	External Trigger	240 mVpp @DC to 100 MHz 500 mVpp @100 MHz to 200 MHz
EXT TRIG	Input Impedance	1 MΩ || 20 pF ±1%, BNC connector
	Trigger Jitter	200 ps rms Normal acquisition, Edge trigger, trigger level located near 50% of EXT input signal
Trigger Level Range	Internal	±4.5 div from center screen
	External	±8 V
	AC Line	fixed at 40%-60%
	Trigger Mode	Edge (Rising or Falling)

Trigger Type

Trigger Type	
Trigger Type	Standard: Edge trigger, Pulse trigger, Slope trigger, Video trigger, Pattern trigger, Duration trigger, Timeout trigger, Runt trigger, Window trigger, Delay trigger, Setup/Hold trigger, Nth Edge trigger, RS232/UART, I2C, SPI, CAN Option: FlexRay, LIN, I2S (for 4-CH models), CAN-FD, MIL-STD-1553B

Trigger Type	
Zone Trigger	Trigger on a user-defined zone drawn on the display. Set the trigger condition to waveform "Intersect" or "Not intersect" the zone, with a maximum of two zones. Modes supported at update rates above 10,000 wfms/s: Normal, Peak Detect, Average, and High Resolution Source channel: CH1 to CH4
Edge	Triggers on the threshold of the specified edge of the input signal. The edge types can be Rising, Falling, or Either. Source channel: CH1 to CH4, D0 to D15[7], EXT, or AC Line
Pulse Width	Triggers on the positive or negative pulse, whose time duration is less than a value, greater than a value, or inside a time range. Source channel: CH1 to CH4, D0 to D15[7].
Slope	Triggers on the positive or negative slope of the specified time (1 ns to 10 s), whose time is less than a value, greater than a value, or inside a time range. Source channel: CH1 to CH4
Video	Trigger on all lines, specified line, odd/even fields that conform to the video standards. The supported video standards include NTSC, PAL/SECAM, 480p/60Hz, 576p/50Hz, 720p/60Hz, 720p/50Hz, 720p/30Hz, 720p/25Hz, 720p/24Hz, 1080p/60Hz, 1080p/50Hz, 1080p/30Hz, 1080p/25Hz, 1080p/24Hz, 1080i/60Hz, and 1080i/50Hz. Source channel: CH1 to CH4
Pattern	Identifies a trigger condition by searching for a specified pattern. The pattern is a combination of multiple selected channel sources. The logic pattern of each channel is H, L, X, Rising, or Falling. Source channel: CH1 to CH4, D0 to D15[7].
Duration	Triggers when the specified pattern meets the specified duration condition. The pattern is a combination of multiple selected channel sources. The logic pattern of each channel is H, L, and X. The duration is less than a value, greater than a value, inside a time range, or outside a time range. Source channel: CH1 to CH4, D0 to D15[7].
Timeout	Triggers when duration of a certain event exceeds the specified time (1 ns to 10 s). The event can be specified as Rising, Falling, or Either. Source channel: CH1 to CH4, D0 to D15[7].
Runt	Triggers when the pulses pass through one threshold but fail to pass through another threshold. Source channel: CH1 to CH4

Trigger Type	
Window	Triggers in a specified window state when the rising edge of the signal crosses the upper threshold or the falling edge crosses the lower threshold. The window state can be Enter, Exit, or Time. Source channel: CH1 to CH4
Delay	Triggers when the time difference between the specified edges of Source A and Source B meets the preset time. The delay time is less than a value, greater than a value, inside a time range, or outside a time range. Source channel: CH1 to CH4, D0 to D15[7].
Setup/Hold	When the setup time or hold time between the input clock signal and the data signal is smaller than the specified time (1 ns to 10 s). Source channel: CH1 to CH4, D0 to D15[7].
Nth Edge	Triggers on the Nth edge after the specified idle time. The edge can be specified as Rising or Falling. Source channel: CH1 to CH4, D0 to D15[7].
RS232/UART	Triggers on the Start, Error, Check Error, or Data frame of the RS232/UART bus (up to 20 Mb/s). Source channel: CH1 to CH4, D0 to D15[7].
I2C	Triggers on the Start, Stop, Restart, MissedACK, Address (7 bits, 8 bits, or 10 bits), Data, or Address Data of the I2C bus. Source channel: CH1 to CH4, D0 to D15[7].
SPI	Triggers on the specified pattern of the specified data width (4 to 32) of SPI bus. CS and Timeout are supported. Source channel: CH1 to CH4, D0 to D15[7].
CAN	Triggers on the start of a frame, end of a frame, Remote ID, Overload, Frame ID, Frame Data, Data&ID, Frame Error, Bit Fill, Answer Error, Check Error, Format Error, and Random of the CAN signal (up to 5 Mb/s). The supported CAN bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1 to CH4, D0 to D15[7].
CAN-FD (Option)	Triggers on the start of a frame, end of a frame, Remote ID, Overload, Frame ID, Frame Data, Data&ID, Frame Error, Bit Fill, Answer Error, Check Error, Format Error, and Random of the CAN-FD signal (up to 10 Mb/s). The supported CAN-FD bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1 to CH4, D0 to D15[7].
FlexRay (Option)	Triggers on the specified position (TSS End, FSS_BSS End, FES End, DTS End), frame (null, Syn, Start, All), symbol (CAS/MTS and WUS), error (Head CRC Err, Tail CRC Err, Decode Err, and Random Err) of the FlexRay signal (up to 10 Mb/s). Source channel: CH1 to CH4, D0 to D15[7].

Trigger Type	
LIN (Option)	Triggers on the Sync, ID, Data (length settable), Data&ID, Wakeup, Sleep, and Error of the LIN bus signal (up to 20 Mb/s). Source channel: CH1 to CH4, D0 to D15[7].
I2S (Option, for 4-CH models)	Triggers on two's complement data of audio left channel, right channel, or either channel (=, ≠, >, <, <>, ><). The available alignment modes include I2S, LJ, and RJ. Source channel: CH1 to CH4, D0 to D15[7].
MIL-STD-1553B (Option)	Triggers on Sync (Data Sync, Cmd/Status Sync, and All Sync), Data, RTA, RTA +11Bit, and Error (Sync Error and Check Error) of the MIL-STD-1553B bus. Source channel: CH1 to CH4, D0 to D15[7].

Search & Navigate

Search & Navigate	
Type	Edge, Pulse
Source	Analog channels
Copy	Copy to/from trigger; independent settings including threshold setting and search condition setting
Result Display	Be displayed as an event list or exported to external/internal memory
Navigate	Time: view acquired waveforms in time order
	Event: use the navigation controls to go to found search events

Waveform Measurement

Waveform Measurement		
Cursor	Number of Cursors	2 pairs of XY cursors
	Manual Mode	Voltage deviation between cursors (ΔY) Time deviation between cursors (ΔX) Reciprocal of ΔX (Hz) (1/ΔX)
	Track Mode	Fixes Y-axis to track X-axis waveform point's voltage and time values Fixes X-axis to track Y-axis waveform point's voltage and time values
	Auto Measurement	Allows cursors to be displayed during auto measurement
	XY Mode	Measures the voltage parameters of the corresponding channel waveforms in XY time base mode X = Channel 1, Y = Channel 2

Waveform Measurement		
Auto Measurement	Number of Measurements	41 auto measurements; and up to 14 measurements can be displayed at a time.
	Measurement Source	CH1 to CH4, D0 to D15, Math1 to Math4
	Measurement Range	Main, Zoom, Cursor
	All Measurements	Displays 33 measurement items (vertical and horizontal) for the current measurement channel
	Vertical	Vmax, Vmin, Vpp, Vtop, Vbase, Vamp, Vupper, Vmid, Vlower, Vavg, VRMS, Per. VRMS, Overshoot, Preshoot, Area, Period Area, and AC RMS.
	Horizontal	Period, Frequency, Rise Time, Fall Time, +Width, -Width, +Duty, -Duty, Positive Pulse Count, Negative Pulse Count, Rising Edge Count, Falling Edge Count, Tvmax, Tvmin, +Slew Rate, and -Slew Rate
	Others	Delay (A↑-B↑), Delay (A↑-B↓), Delay (A↓-B↑), Delay (A↓-B↓), Phase (A↑-B↑), Phase (A↑-B↓), Phase (A↓-B↑), and Phase (A↓-B↓)
	Statistics	Items: Current, Average, Max, Min, Standard Deviation, Count Statistical times settable

Waveform Math

Waveform Math	
Number of Math Functions	4, displays 4 math functions simultaneously
Arithmetic	A+B, A-B, A×B, A/B, FFT, A&&B, A||B, A^B, !A, Intg, Diff, Lg, Ln, Exp, Sqrt, Abs, AX+B, LowPass, HighPass, BandPass, and BandStop
Color Grade	FFT supported

Waveform Math		
FFT	Record Size	Up to 1 Mpts
	Window Type	Rectangular, Blackman-Harris, Hanning (default), Hamming, Flattop, and Triangle
	Peak Search	A maximum of 15 peaks, confirmed by the settable threshold and offset threshold set by users
	Frequency Range	DC to Fs/2, Fs is the current sampling rate

Waveform Analysis

Waveform Analysis		
Waveform Recording		Store the signal under test in segments according to the trigger events, i.e. save all the sampled waveform data as a segment to the RAM for each trigger event. The maximum number of the sampled segments reaches 2,000,000.
	Source	All enabled analog channels and digital channels
	Analysis	Support playing frame by frame or continuous playing; capable of calculating, measuring, and decoding the played waveforms
	Waveform Export	Saves the recorded frames of waveforms and exports the waveform files in the format of "*.csv".
Pass/Fail Test		Compare the signal under test with the user-defined mask to provide the test results: the number of successful tests, failed tests, and the total number of tests. The pass/fail event can enable immediate stop, beeper, and the screenshot.
	Source	Any analog channel

Waveform Analysis		
Histogram		The waveform histogram provides a group of data, showing the number of times a waveform hits within the defined region range on the screen. The waveform histogram not only shows the distribution of hits, but also the ordinary measurement statistics.
	Source	Any analog channel or automatic measurement item
	Type	Horizontal, Vertical, and Measure Histogram
	Measurement	Histogram data statistic: Sum, Peaks, Max, Min, Pk_Pk, Mean, Median, Mode, Bin width, Sigma, μ±σ, μ±2σ, and μ ±3σ Measurement histogram statistics: Type, Sum, Peaks, Max, Min, Pk_Pk, Mean, Median, Mode, Bin width, Sigma, XScale
	Sampling Mode	All modes are supported, except the ZOOM window, XY mode, and ROLL mode
Color Grade		A dimensional view for color grade waveforms, color grade >16, 256-level color scale display
	Source	Any analog channel
	Color Theme	Temperature and intensity
	Mode	All modes available
Real-time Eye Diagram (Option)	Source	Any analog channel or math channel
	Clock Recovery	Supports software, constant clock, first/second/third-order PLL, external clock, external first/second/third-order PLL
	Type	Fully automatic, semi automatic, and manual
	Eye Cursor	Supports measuring the time and voltage parameters
	Eye Measurement Item	one level, zero level, eye height, eye width, eye amplitude, crossing percentage, Q Factor, crossing time, rise time, fall time, bit rate, etc.
	Eye Template	Standard Template, Import Template, or Edit a user-defined template Failure action includes "Screenshot", "Beeper", and "Stop Fail"

Waveform Analysis		
Jitter Analysis (Option)		Performs long-term measurements on clock or data signals and analyzes the variance of the technical specifications.
	Source	Any analog channel
	Clock Recovery	Supports software, constant clock, first/second/third-order PLL, external clock, external first/second/third-order PLL
	Type	Fully automatic, semi automatic, and manual
	Basic Jitter Measurement	TIE, Period to Period, +width to +width, -width to -width, Duty Cycle
	Basic Jitter Measurement Display	Trend, histogram, and spectrum

Serial Decoding

Serial Decoding	
No. of Decodings	4, decodes and enables/disables four protocol types simultaneously
Decoding Type	Standard: Parallel, RS232/UART, I2C, SPI, and CAN Option: CAN-FD, FlexRay, I2S (for 4-channel models), LIN, MIL-STD-1553B, SENT
Parallel	Up to 4 bits of Parallel decoding, available for any analog channel. User-defined clock and auto clock settings are supported. Source channel: CH1 to CH4, D0 to D15[7]
RS232/UART	Decodes the RS232/UART (up to 20 Mb/s) bus's TX/RX data (5 to 9 bits), parity (Odd, Even, or None), and stop bits (1 to 2 bits). Source channel: CH1 to CH4, D0 to D15[7].
I2C	Decodes the address (with or without the R/W bit) of the I2C bus, data, and ACK. Source channel: CH1 to CH4, D0 to D15[7].
SPI	Decodes the MISO/MOSI data (4 to 32 bits) of the SPI bus. Timeout and CS are supported. Source channel: CH1 to CH4, D0 to D15[7].

Serial Decoding	
CAN	Decodes the remote frame (ID, byte number, CRC), overload frame, and data frame (standard/extended ID, control domain, data domain, CRC, and ACK) of the CAN bus (up to 5 Mb/s). The supported CAN bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1 to CH4, D0 to D15[7].
LIN (Option)	DS9000-AUTOA Option Decodes the protocol version (1.X or 2.X) of the LIN bus (up to 20 Mb/s). The decoding displays sync, ID, data, and check sum. Source channel: CH1 to CH4, D0 to D15[7].
CAN-FD (Option)	DS9000-AUTOA Option Decodes the remote frame (ID, byte number, CRC), overload frame, and data frame (standard/extended ID, control domain, data domain, CRC, and ACK) of the CAN-FD bus (up to 10 Mb/s). The supported CAN-FD bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1 to CH4, D0 to D15[7].
FlexRay (Option)	DS9000-FLEXA Option Decodes the frame ID, PL (payload length), Header CRC, Cycle Count, Data, Tail CRC, and DTS of the FlexRay bus (up to 10 Mb/s). The supported signal types include BP, BM, and RX/TX. Source channel: CH1 to CH4, D0 to D15[7].
I2S (Option, for 4-CH models)	DS9000-AUDIOA Option Decodes I2S audio bus left channel data and right channel data, supporting 4 to 32 bits. The available alignment modes include I2S, LJ, and RJ. Source channel: CH1 to CH4, D0 to D15[7].
MIL-STD-1553B (Option)	DS9000-AEROA Option Decodes the MIL-STD-1553B bus signal's data word, command word, and status word (address+last 11 bits). Source channel: CH1 to CH4, D0 to D15[7].
SENT (Option)	DS9000-SENTA Option Decodes the SENT bus signal's data on fast-channel and slow-channel, automatically detects the Sync/Calibration pulse, and calculates the Tick time. Perform frame-by-frame analysis and list display for fields such as Status, data nibbles, CRC, and Pause. Source channel: CH1 to CH4, D0 to D15[7] .

Function/Arbitrary Waveform Generator (AFG)[10]

AFG (technical specifications are typical values)	
Number of Channels	2
Output Type	Dual-channel output
Max. Sample Rate	1.25 GSa/s
Vertical Resolution	16-bit
Max. Bandwidth	50 MHz (standard); 200 MHz (option)
Output Waveform	Standard waveforms: Sine, Square, Ramp, Noise, Pulse Built-in waveforms: DC, Sinc, Exp.Rise, Exp.Fall, ECG1, Gauss, Lorentz, and Haversine Self-define: Arbitrary waveform

AFG (technical specifications are typical values)		
Sine	Frequency Range	1 µHz to 50 MHz (standard) 1 µHz to 200 MHz (option)
	Flatness	Typical (0 dBm, relative to 1 kHz sine) < 10 MHz: ±0.1 dB ≥ 10 MHz to < 50 MHz: ±0.2 dB ≥ 50 MHz to < 100 MHz: ±0.5 dB ≥ 100 MHz: ±1.0 dB
	Harmonic Distortion	Typical (0 dBm) 10 Hz to < 10 MHz: < -55 dBc ≥10 MHz to < 50 MHz: < -50 dBc ≥50 MHz: < -40 dBc
	Spurious (non-harmonics)	Typical (1 Vpp) 10 Hz to < 10 MHz: < -65 dBc ≥10 MHz to < 50 MHz: < -60 dBc ≥50 MHz: < -50 dBc + 6 dBc/octave
	Total Harmonic Distortion	Typical (1 Vpp) 10 Hz to 20 kHz: < 0.1%
	Phase Noise	Typical (amplitude 1 Vpp, offset 10 kHz) 20 MHz: < -110 dBc/Hz
	Residual Clock Noise	Typical (0 dBm), -60 dBm
	Channel-to-Channel Crosstalk	Typical (1 Vpp amplitude, 0 V offset) <100 MHz: <-35 dBc ≥ 100 MHz: < –25 dBc
	Phase	-360° to +360°, 0.1° resolution

AFG (technical specifications are typical values)		
Square	Frequency Range	1 μHz to 10 MHz (standard) 1 μHz to 50 MHz (option)
	Rise/Fall Time	Typical (amplitude ≤ 2 Vpp, 50 Ω load), ≤ 9 ns
	Overshoot	Typical (amplitude 0 dBm, frequency > 1 kHz), < 5%
	Duty	10% to 90%, adjustable
	Jitter (rms)	Typical (amplitude 0 dBm, frequency > 1 kHz), 250 ps
	Phase	-360° to +360°, 0.1° resolution
Ramp	Frequency Range	1 μHz to 2 MHz (standard) 1 μHz to 5 MHz (option)
	Linearity	Typical (frequency 1 kHz, amplitude 1 Vpp, symmetry 100%): ≤ 1% of peak output (within 10% to 90% amplitude range)
	Symmetry	0.1% to 99.9%
	Phase	-360° to +360°, 0.1° resolution
Noise	Type	White Noise
	-3 dB	Typical (0 dBm), >200 MHz bandwidth
Pulse	Frequency Range	1 μHz to 20 MHz (standard) 1 μHz to 20 MHz (option)
	Rise/Fall Time	Min. 9 ns, adjustable
	Duty	10% to 90%, adjustable
	Phase	-360° to +360°, 0.1° resolution
Arbitrary Waveform	Frequency Range	1 μHz to 20 MHz (standard) 1 μHz to 50 MHz (option)
	Waveform Length	16 kpts/CH
	File Type	CSV
Frequency	Accuracy	± 2 ppm
	Resolution	1 μHz or 6 digits

AFG (technical specifications are typical values)		
Amplitude	Amplitude Range (into 50 Ω)	≤ 50 MHz: 1 mVpp to 10 Vpp ≤ 100 MHz: 1 mVpp to 5 Vpp ≤ 200 MHz: 1 mVpp to 2 Vpp
	Amplitude Range (into HighZ)	≤ 50 MHz: 2 mVpp to 20 Vpp ≤ 100 MHz: 2 mVpp to 10 Vpp ≤ 200 MHz: 2 mVpp to 4 Vpp
	Accuracy (1 kHz sine, offset 0 V)	±(1% of setting + 2 mVpp) (into 50 Ω) ±(1% of setting + 5 mVpp) (into HighZ)
	Resolution	1 mVpp or 3 digits (take the lower value)
	Unit	Vpp
DC Offset	Range	±5 Vpk(ac+dc) (into 50 Ω) ±10 Vpk(ac+dc) (into HighZ)
	Accuracy	± (1% of |offset setting| +2 mV + 0.5% of amplitude (Vpp)) (into 50 Ω) ± (1% of |offset setting| +5 mV + 1% of amplitude (Vpp)) (into HighZ)
	Resolution	1 mV or 4 digits
Output Impedance	Typical (amplitude 0 dBm, offset 0 Vdc), 50 Ω±1%	

AFG (technical specifications are typical values)		
Modulation	Amplitude Modulation (AM)	Modulation Waveform: Sine, Square, Triangle, UpRamp, DnRamp, Noise
		Carrier waveform: Sine, Square, Ramp, Sinc, Exp.Rise, Exp.Fall, ECG1, Gauss, Lorentz, and Haversine
		Modulation Source: Internal
		Modulation Depth: 0% to 120%
		Modulation Frequency: 2 mHz to 1 MHz
	Frequency Modulation (FM)	Modulation Waveform: Sine, Square, Triangle, UpRamp, DnRamp, Noise
		Carrier waveform: Sine, Square, Ramp, Sinc, Exp.Rise, Exp.Fall, ECG1, Gauss, Lorentz, and Haversine
		Modulation Source: Internal
		Frequency Deviation: 1 mHz to the set carrier frequency (limited by the carrier frequency setting; the sum of the frequency deviation and carrier frequency shall not exceed the upper limit of the carrier frequency)
		Modulation Frequency: 2 mHz to 1 MHz
	Phase Modulation (PM)	Modulation Waveform: Sine, Square, Triangle, UpRamp, DnRamp, Noise
		Carrier waveform: Sine, Square, Ramp, Sinc, Exp.Rise, Exp.Fall, ECG1, Gauss, Lorentz, and Haversine
		Modulation Source: Internal
		Phase shift: 0° to 360°, 0.1° resolution, default 90°
		Modulation Frequency: 2 mHz to 1 MHz

Bode Plot[11]

Bode Plot	
Start Frequency	10 Hz to 5 MHz
Stop Frequency[12]	100 Hz to 50 MHz
Points/Decade	10 to 100
Output Amplitude	20 mV to 10 V (HighZ); 10 mV to 5 V (Load)

Protocol Compliance Analysis

Protocol Compliance Analysis (Option)		
Protocols	USB 2.0	DS9000-USBSQA Option Test Item: sync width, EOP width, signal rate, rise time, fall time, edge monotonicity, rise edge rate, fall edge rate, paired JK jitter, paired KJ jitter, consecutive jitter, eye diagram
	100Base-T/ 1000Base-T	DS9000-ENETC Option 100Base-T. Test Item: Output Voltage, Amplitude Symmetry, Rise/Fall Time, Rise/Fall Time Symmetry, Overshoot, Distortion Based on Duty Cycle, Eye, and Jitter 1000Base-T. Test Items: Peak Voltage, Maximum Falling and Template, Master Mode Jitter, Slave Mode Jitter, Transmit distortion and common mode output voltage
	MIPI	DS9000-DPHY12C Option Test items: Electrical characteristics test for low speed signals (including output high/low/level, rise/fall time, oscillation rate and load capacitance); Electrical characteristics test for high speed signals (including differential voltage, single-ended output high/low/level, quiescent common mode voltage, rise/ fall times, etc.); signal timing consistency test; eye diagram test for high speed signals
	100M/1000M Automotive Ethernet Consistency Test	DS9000-AUTOC Option Test Items: Output Falling Test, Clock Frequency, Timed Jitter - Master Jitter, Timed Jitter - Slave Jitter, Transmitter Distortion, MDI Return Loss, MDI Output Jitter, Power Spectral Density Test, MDI common-mode emission, MDI mode conversion loss, peak differential output
Report	Measurement data include: test item, test results, data range, reference standards, pass/fail test results; supporting exporting the report in HTML format	

Auto

Auto	
AutoScale	Minimum voltage greater than 10 mVpp, duty cycle greater than 1%, and frequency over 35 Hz

Digital Voltmeter

Digital Voltmeter	
Source	Any analog channel
Function	DC, AC+DC_{RMS}, AC_{RMS}
Resolution	ACV/DCV: 3 bits
Limits Beeper	Supports upper/lower limit settings; sounds an alarm when the voltage value is inside or outside of the limit range

Frequency Counter

Frequency Counter		
Source		Any analog channel or digital channel[7] and EXT
Measurement		Frequency, period, totalize
Counter	Resolution	3-8 digits, user-defined
	Max. Frequency	Maximum analog bandwidth
Statistics Function		Max, Min, Average
Totalizer		48-bit totalizer
		Counts the number of the rising edges
Time Reference		Internal Reference

Command Set

Command Set	
Common Commands Support	Standard SCPI commands
Error Message Definition	Error Message
Support Status Report Mechanism	Status Reporting
Support Sync Mechanism	Synchronization

Display

Display	
LCD	10.1-inch capacitive multi-touch gesture-enabled display

Display	
Resolution	1280x800 (Screen Region) 16:9
Graticule	10 horizontal divisions x 8 vertical divisions
Persistence	Off, Infinite, variable persistence (100 ms to 10 s)
Brightness	256 intensity levels (LCD, HDMI)

Processor System

Processor System	
Processor	Cortex-A72 1.8 GHz + Cortex-A53 1.4 GHz Six-core
System Memory	4 GB RAM
Operating System	Android
Internal Non-volatile Memory	128 GB

I/O

I/O		
USB3.0 Host		1 on the front panel
USB3.0 Device		1 on the rear panel
LAN Port		1 on the rear panel, 10/100/1000 Base-T, supporting LXI-C
Web Control		Supports Web Control interface (input the IP address of the oscilloscope into the Web browser to display the operation interface of the oscilloscope)
AUX Out		BNC output on the rear panel Vo (H)≥2.5 V open circuit, ≥1.0 V 50 Ω to GND Vo (L)≤0.7 V to load ≤4 mA, ≤0.25 V 50 Ω to GND
	TrigOut	Outputs a pulse signal when the oscilloscope is triggered
	Pass/Fail	Outputs a pulse signal when a pass/fail event occurs. Support user-defined pulse polarity and pulse time (100 ns to 10 ms)
	Rise Time	≤ 1.5 ns

I/O		
10 M Reference Clock In/Out	Input Interface	1, BNC connector on the rear panel
	Output Interface	1, BNC connector on the rear panel
	Input Mode	50 Ω, with the amplitude 130 mVpp to 4.1 Vpp (-10 dBm, 20 dBm), frequency 10 MHz ± 10 ppm
	Output Interface	50 Ω, 1.5 Vpp sine waveform
EXT TRIG	Input Interface	1, BNC connector on the rear panel. Used to input the external trigger signal to the oscilloscope.
HDMI Video Output		1 on the rear panel, HDMI 1.4, A plug; used to connect an external monitor or projector
Probe Compensation Output		1 kHz frequency, 0 to 3 V amplitude, Square, Rise Time < 1 μs

Power Supply

Power Supply	
Power Voltage	AC 100 to 240 V, 50/60 Hz
Power	400 VA maximum (connect various interfaces, USB storage device, and active probes)
Fuse	5 A, T-type, 250 V

Environment

Environment		
Temperature Range	Operating	-10℃ to +50℃
	Non-operating	-30℃ to +60℃
Humidity Range	Operating	below +50℃, 90% RH (without condensation)
	Non-operating	below +65℃, 90% RH (without condensation)
Altitude	Operating	Below 3,000 m
	Non-operating	Below 15,000 m

Warranty and Calibration Interval

Warranty and Calibration Interval	
Warranty	Three years for the mainframe, excluding the probes and accessories.
Recommended Calibration Interval	18 months

Regulations

Regulations		
Electromagnetic Compatibility	Compliant with EMC DIRECTIVE 2014/30/EU, compliant with or higher than the standards specified in IEC 61326-1:2013/EN 61326-1:2013 Group 1 Class A	
	CISPR 11/EN 55011	
	IEC 61000-4-2:2008/EN 61000-4-2	±4.0 kV (contact discharge), ±8.0 kV (air discharge)
	IEC 61000-4-3:2002/EN 61000-4-3	3 V/m (80 MHz to 1 GHz); 3 V/m (1.4 GHz to 2 GHz); 1 V/m (2.0 GHz to 2.7 GHz)
	IEC 61000-4-4:2004/EN 61000-4-4	1 kV power line
	IEC 61000-4-5:2001/EN 61000-4-5	0.5 kV (phase-to-neutral voltage); 1 kV (phase-to-earth voltage); 1 kV (neutral-to-earth voltage)
	IEC 61000-4-6:2003/EN 61000-4-6	3 V, 0.15-80 MHz
	IEC 61000-4-11:2004/EN 61000-4-11	Voltage dip: 0% UT during half cycle; 0% UT during 1 cycle ; 70% UT during 25 cycles short interruption: 0% UT during 250 cycles

Regulations	
Safety	EN 61010-1:2019 EN 61010-031:2015 IEC 61010-1:2016 IEC 61010-2-030:2017 UL 61010-1:2012 R7 UL 61010-2-31:2017 R2 CAN/CSA-22.2 No. 61010-1-12:2017 CAN/CSA-22.2 No. 61010-2-30:2018 CAN/CSA-22.2 No. 61010-031-07:201
Vibration	Meets GB/T 6587; class 2 random Meets MIL-PRF-28800F and IEC60068-2-6; class 3 random
Shock	Meets GB/T 6587-2012; class 2 random Meets MIL-PRF-28800F and IEC 60068-2-27; class 3 random In non-operating conditions: 30 g, half-sine wave, 11 ms duration, 3 shocks along the main axis, total of 18 shocks

Mechanical Characteristics

Mechanical Characteristics	
Dimensions	358 mm (W) x 215 mm (H) x 125 mm (D)
Rack Mount Kit	5U
Weight[13]	Package excluded: 5.3 kg
	Package included: 6.3 kg

Non-volatile Memory

Non-volatile Memory		
Data/File Storage	Setup/Image	setup (*.stp), image (*.png, *.bmp, *.jpg)
	Waveform Data	CSV waveform data (*.csv), binary waveform data (*.bin), waveform data (*.csv, *.bin, *.dat), list data (*.csv), and reference waveform data (*.ref, *.csv, *.bin)
	SMB Storage	Supports network storage for setup, image, and waveform data files.

Non-volatile Memory	
Internal Capacity	128 GB
Reference Waveform	Displays 10 internal waveforms
Setting	Limited by size of USB drive
USB Capacity	Industry standard flash drives, recommended FAT32 format

NOTE:

[1]: The total rise time of the measuring system is calculated as:

$$T_{System} = \sqrt{T_{scope}^2 + T_{probe}^2}$$

[2]: CH1 and CH2 are considered as a group; CH3 and CH4 are considered as another group. If one of the two channels in each group is enabled, it is called half-channel mode.

[3]: CH1 and CH2 are considered as a group; CH3 and CH4 are considered as another group. If two channels in either one of the groups are enabled, it is called all-channel mode.

[4]: AC coupling is available to signals with frequencies above 10 Hz.

[5]: 1 mV/div and 2 mV/div are a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 1 mV/div and 2 mV/div sensitivity setting.

[6]: For vertical scale ≤ 4 mV/div, the bandwidth limit of 50 Ω is fixed at 200 MHz; the bandwidth limit of 1 MΩ is fixed at 20 MHz.

[7]: Digital channel is only available for MSO model when a Logic Analysis probe is connected.

[8]: Noise floor data is measured at full sampling rate, 200 ns/div horizontal time base, and 100 kpts memory depth setting.

[9]: For any channel, under the same input impedance with DC-coupled, the Volts/div setting is the same for 100 mV/div and 200 mV/div setting.

[10]: The function/arbitrary waveform generator is available for MSO model.

[11]: The Bode plot is available for MSO model.

[12]: The end frequency needs to be greater than the start frequency.

[13]: Standard configuration.

Order Information and Warranty Period

Order Information

Order Information	Order No.
Model	
2 GHz, 10 GSa/s, 8-bit, 2-CH digital oscilloscope	DS9202
2.5 GHz, 20 GSa/s, 8-bit, 4-CH digital oscilloscope	DS9204
4 GHz, 20 GSa/s, 8-bit, 4-CH digital oscilloscope	DS9404
6 GHz, 20 GSa/s, 8-bit, 4-CH digital oscilloscope	DS9604
4 GHz, 20 GSa/s, 8-bit, 2+16CH digital oscilloscope	MSO9402
Standard Accessories	
Power cord (based on destination country)	— —
RP3500A 500 MHz Passive Probes (2/4, consistent with the number of analog channels on the host)	— —
Memory Depth Upgrade Option	
DS Series 4-CH 2 Gpts Memory Depth Upgrade Option	DS9004-RLU-20
MSO Series 2-CH 2 Gpts Memory Depth Upgrade Option	MSO9000-RLU-20
Serial Protocol Analysis Option	
Automotive Serial Bus Trigger and Analysis (CAN-FD, LIN)	DS9000-AUTOA
MIL-STD-1553B Serial Bus Trigger and Analysis Option	DS9000-AEROA
FlexRay Bus Trigger and Analysis Option	DS9000-FlexA
Audio Serial I2S Bus Trigger and Analysis Option (4-CH model)	DS9000-AUDIOA
SENT Serial Protocol Analysis Option	DS9000-SENTA
Advanced Analysis Option	
Power Analysis Option (PC Software)	DS9000-PWRA
Eye Diagram and Jitter Analysis Option (DS9202 is not supported)	DS9000-JITTA
Eye Diagram Analysis Option (For DS9202 only)	DS9000-EYEA
Built-in 2-CH 200 MHz Function Generator Option	MSO9000-AFG200
Bundle Options	
DS9000 Series Function and Application Bundle Option, including all decoding options: AUTOA/AEROA/AUDIOA/FlexA/SENTA options	DS9000-BND
MSO9000 Series Function and Application Bundle Option, including AFG bandwidth option and all decoding options: AFG200/AUTOA/AEROA/FlexA/SENTA options	MSO9000-BND
Protocol Compliance Test Options	

Order Information	Order No.
USB2.0 Compliance Test (PC Software)	DS9000-USBSQA
MIPI D-PHYv1.2 Compliance Test (PC Software)	DS9000-DPHY12C
Automotive Ethernet Compliance Test (PC Software)	DS9000-AUTOC
100M/1000M Ethernet Compliance Test (PC Software)	DS9000-ENETC
Recommended Accessories	
4 sets of 4-channel logic analyzer probes PLA3204 for MSO Series	PLA3204

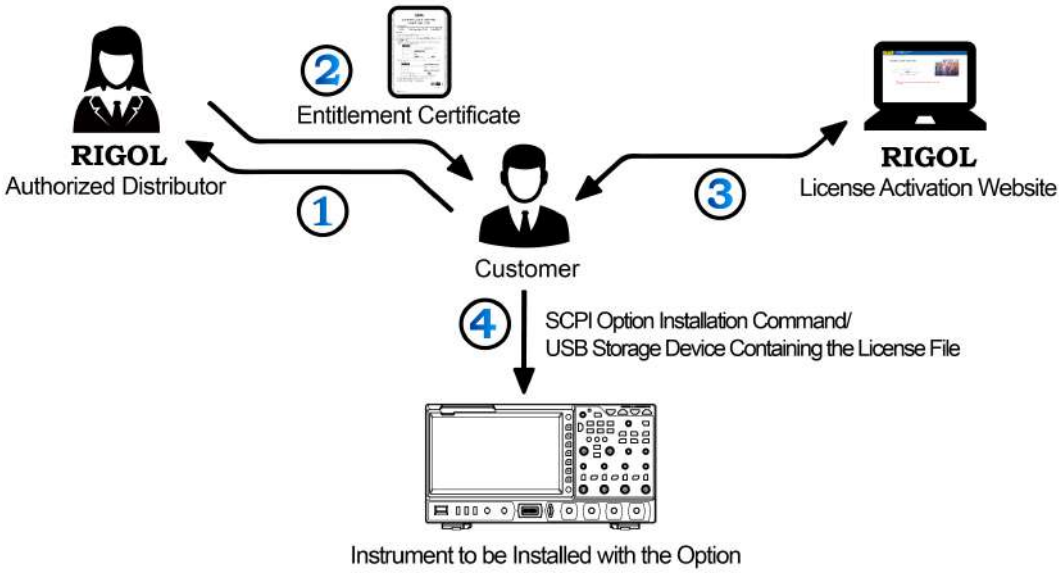
NOTE:

For all the base units, accessories, and options, please contact the local office of RIGOL.

Warranty Period

Three years for the mainframe, excluding the probes and accessories.

Option Ordering and Installation Process



1. According to the usage requirements, please purchase the specified function options from **RIGOL Sales Personnel**, and provide the serial number of the instrument that needs to install the option.
2. After receiving the option order, the **RIGOL** factory will mail the paper software product entitlement certificate to the address provided in the order.
3. Log in to **RIGOL** official website for registration. Use the software key and instruments serial number provided in the entitlement certificate to obtain the option license code and the option license file.
4. Install the option by running the SCPI command concerning the option installation. You can also save the option license file to the root directory of the USB storage device. Then insert it to the instrument. After being recognized, follow the instructions to install the option.

NOTE:

If any problems occur during the option installation process, please contact **RIGOL** technical team.

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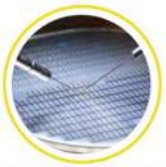

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