



RIGOL

# MSO/DS9000 Series

Digital Oscilloscope

Data Sheet

DSA40103-1110

Mar.2026

# 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 M $\Omega$ ), 1 mV/div to 1 V/div (50  $\Omega$ )
- 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<sup>[1]</sup>, 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<sup>[2]</sup>, Bode plot<sup>[3]</sup>, 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                                                                               |
|----------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <b>Analog Channel</b>                        | 4                                                                                  | 4                                                          | 4                                                                                     |
| <b>Digital Channel</b>                       | 16                                                                                 | 16                                                         | N/A                                                                                   |
| <b>Analog Bandwidth</b>                      | 2 GHz to 6 GHz                                                                     | 600 MHz to 2 GHz                                           | 3 GHz to 5 GHz                                                                        |
| <b>Max. Sample Rate</b>                      | 20 GSa/s                                                                           | 10 GSa/s                                                   | 20 GSa/s                                                                              |
| <b>Max. Memory Depth</b>                     | 2 Gpts (Option)                                                                    | 500 Mpts                                                   | 2 Gpts (Option)                                                                       |
| <b>Waveform Capture Rate</b>                 | >1,000,000 wfms/s                                                                  | >600,000 wfms/s                                            | >1,000,000 wfms/s                                                                     |
| <b>Max. Recording Frames</b>                 | 2,000,000 frames                                                                   | 450,000 frames                                             | 2,000,000 frames                                                                      |
| <b>LCD</b>                                   | 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                   |
| <b>Hardware Mask Test</b>                    | Standard                                                                           | Standard                                                   | Standard                                                                              |
| <b>Built-in Arbitrary Waveform Generator</b> | 2-CH, 50 MHz (standard, MSO model only);<br>2-CH, 200 MHz (option, MSO model only) | 2-CH, 25 MHz (option)                                      | N/A                                                                                   |
| <b>Built-in Digital Voltmeter</b>            | Standard                                                                           | Standard                                                   | Standard                                                                              |
| <b>Built-in Hardware Counter</b>             | 8-digit frequency counter + totalizer                                              | 6-digit frequency counter + totalizer                      | 8-digit frequency counter + totalizer                                                 |
| <b>Real-time Eye Diagram</b>                 | Option                                                                             | Option                                                     | Option                                                                                |
| <b>Jitter Analysis</b>                       | Option                                                                             | Option                                                     | Option                                                                                |
| <b>Serial Protocol Analysis</b>              | 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 |
| <b>Waveform Color Persistence</b>            | Standard                                                                           | Standard                                                   | Standard                                                                              |
| <b>FFT</b>                                   | FFT, standard                                                                      | FFT, standard                                              | FFT, standard                                                                         |
| <b>MATH</b>                                  | Displays 4 functions at the same time                                              | Displays 4 functions at the same time                      | Displays 4 functions at the same time                                                 |
| <b>Connectivity</b>                          | Standard: USB, LAN, HDMI                                                           | Standard: USB, LAN, HDMI<br>Option: USB-GPIB               | Standard: USB, LAN, HDMI<br>Option: USB-GPIB                                          |

# RIGOL Probes and Accessories Supported by the Series

## RIGOL Passive Probe

| Model                                                                                              | Type                         | Description                                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>PVP2150</p>   | High-impedance Probe         | <ul style="list-style-type: none"> <li>Attenuation ratio: 10:1/1:1</li> <li>1X BW: DC~35 MHz</li> <li>10X BW: DC~150 MHz</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                   |
|  <p>PVP2350</p>   | High-impedance Probe         | <ul style="list-style-type: none"> <li>Attenuation ratio: 10:1/1:1</li> <li>1X BW: DC~35 MHz</li> <li>10X BW: DC~350 MHz</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                   |
|  <p>PVP3150</p> | Passive High-impedance Probe | <ul style="list-style-type: none"> <li>Attenuation ratio: 10:1/1:1</li> <li>1X BW: DC~20 MHz</li> <li>10X BW: DC~150 MHz</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                   |
|  <p>RP3500A</p> | High-impedance Probe         | <ul style="list-style-type: none"> <li>Attenuation ratio: 10:1</li> <li>BW: DC~500 MHz</li> <li>Compatibility: MSO/DS7000, MSO8000/A, DHO4000/1000, MHO/DHO5000, MHO2000, DS70000/80000, MHO98, MHO900 Series, and MSO/DS9000.</li> </ul> |
|  <p>RP6150A</p> | Low-impedance Probe          | <ul style="list-style-type: none"> <li>BW: DC~1.5 GHz</li> <li>Compatibility: MSO/DS7000, MSO8000/A, DS70000/80000 Series, and MSO/DS9000.</li> </ul>                                                                                     |
|  <p>RP1300H</p> | High-voltage Probe           | <ul style="list-style-type: none"> <li>Attenuation ratio: 100:1</li> <li>BW: DC~300 MHz</li> <li>CAT I 2000 V (DC+AC)</li> <li>CAT II 1500 V (DC+AC)</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>       |

| Model                                                                                        | Type               | Description                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>RP1010H | High-voltage Probe | <ul style="list-style-type: none"> <li>Attenuation ratio: 1000:1</li> <li>BW: DC~40 MHz</li> <li>DC: 0 to 10 kV DC</li> <li>AC: pulse <math>\leq 20</math> kVp-p</li> <li>AC: sine <math>\leq 7\text{kV}_{\text{rms}}</math></li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul> |
| <br>RP1018H | High-voltage Probe | <ul style="list-style-type: none"> <li>Attenuation ratio: 1000:1</li> <li>BW: DC~150 MHz</li> <li>DC+AC<sub>peak</sub>: 18 kV CAT II</li> <li>AC<sub>rms</sub>: 12 kV CAT II</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                                 |

## RIGOL Active & Current Probe

| Model                                                                                          | Type                                          | Description                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>PVA8700  | Single-ended/<br>Differential Active<br>Probe | <ul style="list-style-type: none"> <li>BW: DC~7 GHz</li> <li>30 V<sub>peak</sub> CAT I</li> <li>Compatibility: DS70000/80000 Series and MSO/DS9000.</li> </ul>                                                   |
| <br>PVA8350 | Active Differential<br>Probe                  | <ul style="list-style-type: none"> <li>BW: DC~3.5 GHz</li> <li>30 V<sub>peak</sub> CAT I</li> <li>Compatibility: DS70000/80000 Series and MSO/DS9000.</li> </ul>                                                 |
| <br>PVA7250 | Single-ended/<br>Differential Active<br>Probe | <ul style="list-style-type: none"> <li>BW: DC~2.5 GHz</li> <li>30 V<sub>peak</sub> CAT I</li> <li>Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000, and MSO/DS9000.</li> </ul> |

| Model                                                                                           | Type                                          | Description                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>RP7150     | Single-ended/<br>Differential Active<br>Probe | <ul style="list-style-type: none"> <li>BW: DC~1.5 GHz</li> <li>30 V<sub>peak</sub> CAT I</li> <li>Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul>           |
| <br>RP7080     | Single-ended/<br>Differential Active<br>Probe | <ul style="list-style-type: none"> <li>BW: DC~800 MHz</li> <li>30 V<sub>peak</sub> CAT I</li> <li>Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul>           |
| <br>PHA0150    | High-voltage<br>Differential Probe            | <ul style="list-style-type: none"> <li>BW: DC~70 MHz</li> <li>Max. voltage <math>\leq</math> 1500 V<sub>pp</sub></li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                   |
| <br>PHA1150  | High-voltage<br>Differential Probe            | <ul style="list-style-type: none"> <li>BW: DC~100 MHz</li> <li>Max. voltage <math>\leq</math> 1500 V<sub>pp</sub></li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                  |
| <br>PHA2150  | High-voltage<br>Differential Probe            | <ul style="list-style-type: none"> <li>50X BW: DC~160 MHz</li> <li>500X BW: DC~200 MHz</li> <li>Max. voltage <math>\leq</math> 1500 V<sub>pp</sub></li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul> |
| <br>PHA1150B | High-voltage<br>Differential Probe            | <ul style="list-style-type: none"> <li>BW: DC~100 MHz</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                                                                              |
| <br>PHA2150B | High-voltage<br>Differential Probe            | <ul style="list-style-type: none"> <li>BW: DC~200 MHz</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                                                                              |

| Model                                                                                          | Type                            | Description                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>PHA5150B  | High-voltage Differential Probe | <ul style="list-style-type: none"> <li>BW: DC~500 MHz</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                                                                                                                                                                  |
| <br>RP7150S   | Single-ended Active Probe       | <ul style="list-style-type: none"> <li>BW: DC~1.5 GHz</li> <li>30 V<sub>peak</sub> CAT I</li> <li>Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul>                                                                                               |
| <br>RP7080S   | Single-ended Active Probe       | <ul style="list-style-type: none"> <li>BW: DC~800 MHz</li> <li>30 V<sub>peak</sub> CAT I</li> <li>Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul>                                                                                               |
| <br>PVA8150S | Single-ended Active Probe       | <ul style="list-style-type: none"> <li>BW: DC~1.5 GHz</li> <li>30 V<sub>peak</sub> CAT I</li> <li>Compatibility: MSO8000, DS70000, DHO4000, MSO/DS9000.</li> </ul>                                                                                                                                                    |
| <br>PCA1030 | Current Probe                   | <ul style="list-style-type: none"> <li>BW: DC~50 MHz (-3dB)</li> <li>Max. continuous input range: 30 A<sub>rms</sub></li> <li>Max. peak-peak current value: 50 A peak, non-continuous</li> <li>Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul>  |
| <br>PCA2030 | Current Probe                   | <ul style="list-style-type: none"> <li>BW: DC~100 MHz (-3dB)</li> <li>Max. continuous input range: 30 A<sub>rms</sub></li> <li>Max. peak-peak current value: 50 A peak, non-continuous</li> <li>Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul> |

| Model                                                                                              | Type              | Description                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>PCA1030B</p>  | Current Probe     | <ul style="list-style-type: none"> <li>• BW: DC~50 MHz (-3dB)</li> <li>• Max. continuous input range: 30 A<sub>rms</sub></li> <li>• Max. peak-peak current value: 50 A peak, non-continuous</li> <li>• Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul>              |
|  <p>PCA2030B</p>  | Current Probe     | <ul style="list-style-type: none"> <li>• BW: DC~100 MHz (-3dB)</li> <li>• Max. continuous input range: 30 A<sub>rms</sub></li> <li>• Max. peak-peak current value: 50 A peak, non-continuous</li> <li>• Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul>             |
|  <p>PCA1150</p>  | Current Probe     | <ul style="list-style-type: none"> <li>• BW: DC~10 MHz (-3dB)</li> <li>• Max. continuous input range: 150 A</li> <li>• Max. peak-peak current value: 300 A (non-continuous), 500 A (pulse width ≤ 30 μs)</li> <li>• Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul> |
|  <p>PCA1500</p> | Current Probe     | <ul style="list-style-type: none"> <li>• BW: DC~2 MHz (-3dB)</li> <li>• Max. continuous input range: 500 A<sub>rms</sub></li> <li>• Max. peak-peak current value: 700 A peak, non-continuous</li> <li>• Compatibility: MSO/DS7000, MSO8000/A, DHO4000, MHO/DHO5000, MHO2000, DS70000/80000 Series, and MSO/DS9000.</li> </ul>             |
|  <p>RP1000P</p> | 4-CH Power Supply | Power supply for RP1003C, RP1004C, RP1005C, and RP1006C; supporting 4 channels.                                                                                                                                                                                                                                                           |

| Model                                                                                          | Type          | Description                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>RP1003C   | Current Probe | <ul style="list-style-type: none"> <li>BW: DC~50 MHz</li> <li>Maximum Input</li> <li>AC P-P: 50 A (non-continuous)</li> <li>AC RMS: 30 A</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> <li>Required to order RP1000P power supply.</li> </ul>                                                 |
| <br>RP1004C   | Current Probe | <ul style="list-style-type: none"> <li>BW: DC~100 MHz</li> <li>Maximum Input</li> <li>AC P-P: 50 A (non-continuous)</li> <li>AC RMS: 30 A</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> <li>Required to order RP1000P power supply.</li> </ul>                                                |
| <br>RP1005C  | Current Probe | <ul style="list-style-type: none"> <li>BW: DC~10 MHz</li> <li>Maximum Input</li> <li>AC P-P: 300 A (non-continuous), 500 A (@pulse width <math>\leq 30</math> us)</li> <li>AC RMS: 150 A</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> <li>Required to order RP1000P power supply.</li> </ul> |
| <br>RP1006C | Current Probe | <ul style="list-style-type: none"> <li>BW: DC~2 MHz</li> <li>Maximum Input</li> <li>AC P-P: 700 A peaks, non-continuous</li> <li>AC RMS: 500 A</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> <li>Required to order RP1000P power supply.</li> </ul>                                           |
| <br>RP1001C | Current Probe | <ul style="list-style-type: none"> <li>BW: DC~300 kHz</li> <li>Maximum Input</li> <li>DC: <math>\pm 100</math> A</li> <li>AC P-P: 200 A</li> <li>AC RMS: 70 A</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                                                             |

| Model                                                                                              | Type                            | Description                                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>RP1002C</p>   | Current Probe                   | <ul style="list-style-type: none"> <li>BW: DC~1 MHz</li> <li>Maximum Input</li> <li>DC: <math>\pm 70</math> A</li> <li>AC P-P: 140 A</li> <li>AC RMS: 50 A</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul> |
|  <p>RP1025D</p>   | High-voltage Differential Probe | <ul style="list-style-type: none"> <li>BW: DC~25 MHz</li> <li>Max. voltage <math>\leq 1400</math> Vpp (DC + AC P-P)</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                        |
|  <p>RP1050D</p>   | High-voltage Differential Probe | <ul style="list-style-type: none"> <li>BW: DC~50 MHz</li> <li>Max. voltage <math>\leq 7000</math> Vpp (DC + AC P-P)</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                        |
|  <p>RP1100D</p> | High-voltage Differential Probe | <ul style="list-style-type: none"> <li>BW: DC~100 MHz</li> <li>Max. voltage <math>\leq 7000</math> Vpp (DC + AC P-P)</li> <li>Compatibility: All models of RIGOL's digital oscilloscopes</li> </ul>                                       |
|  <p>PIA1020</p> | Optically isolated probes       | <ul style="list-style-type: none"> <li>BW: DC~200 MHz</li> <li>Compatibility: MSO8000, DHO4000, MSO/DS9000.</li> </ul>                                                                                                                    |
|  <p>PIA1050</p> | Optically isolated probes       | <ul style="list-style-type: none"> <li>BW: DC~500 MHz</li> <li>Compatibility: MSO8000, DHO4000, MSO/DS9000.</li> </ul>                                                                                                                    |
|  <p>PIA1100</p> | Optically isolated probes       | <ul style="list-style-type: none"> <li>BW: DC~1 GHz</li> <li>Compatibility: MSO8000, DHO4000, MSO/DS9000.</li> </ul>                                                                                                                      |

| Model                                                                                            | Type                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>PLA3204</p> | Active Logic Analyzer Probe | <ul style="list-style-type: none"> <li>No. of Input Channels: 4</li> <li>Threshold Range: <math>\pm 15</math> V</li> <li>Min. Voltage Swing: 500 mVpp</li> <li>Min. Detectable Pulse Width: 5 ns</li> <li>Max. Input Voltage: <math>\pm 40</math> V (Peak)</li> <li>Max. Input Dynamic Range: <math>\pm 10</math> V + Threshold</li> <li>Input Impedance: <math>100\text{ k}\Omega \pm 1\%</math></li> <li>Input Capacitance: about 11 pF</li> <li>Compatibility: MHO5000 series and MSO9000 series</li> </ul> |

# 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<br>(50 Ω, -3 dB)                           | 2 GHz                                                                                                                                                                                                                                                                                                   | 2.5 GHz                                                                                                                                                                          | 4 GHz   | 6 GHz (half-channel <sup>[2]</sup> )<br>4 GHz (all-channel <sup>[3]</sup> ) | 4 GHz   |
| Analog Bandwidth (1 MΩ, -3 dB)                              | 500 MHz                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                  |         |                                                                             |         |
| Calculated Rise Time under 50 Ω <sup>[1]</sup><br>(10%-90%) | ≤210 ps                                                                                                                                                                                                                                                                                                 | ≤210 ps                                                                                                                                                                          | ≤110 ps | ≤73 ps                                                                      | ≤110 ps |
| Number of Channels                                          | DS9202: 2 analog channels +1 EXT channel<br>DS9204: 4 analog channels +1 EXT channel<br>DS9404: 4 analog channels +1 EXT channel<br>DS9604: 4 analog channels +1 EXT channel<br>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 <sup>[2]</sup> : 20 GSa/s<br>all-channel <sup>[3]</sup> : 10 GSa/s                                                                                                  |         |                                                                             |         |
| Max. Memory Depth                                           | 10 Mpts (all-channel <sup>[3]</sup> )                                                                                                                                                                                                                                                                   | Standard: 500 Mpts (half-channel <sup>[2]</sup> ), 200 Mpts (all-channel <sup>[3]</sup> )<br>Option: 2 Gpts (half-channel <sup>[2]</sup> ), 1 Gpts (all-channel <sup>[3]</sup> ) |         |                                                                             |         |
| 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 $\Omega$                                                                                                                                                                                       | DC                                                                                                                                                                                                                                    |
|                         | 1 M $\Omega$                                                                                                                                                                                      | DC, AC <sup>[4]</sup> or Ground (DC, AC, GND)                                                                                                                                                                                         |
| Input Impedance         | 1 M $\Omega$ $\pm$ 1%, 50 $\Omega$ $\pm$ 2%                                                                                                                                                       |                                                                                                                                                                                                                                       |
| Input Capacitance       | 18 pF $\pm$ 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 M $\Omega$                                                                                                                                                                                      | CAT I 300V <sub>rms</sub> , 400Vpk                                                                                                                                                                                                    |
|                         | 50 $\Omega$                                                                                                                                                                                       | 5 V <sub>rms</sub>                                                                                                                                                                                                                    |
|                         | The probe is technically capable of supporting higher-voltage measurements. The standard probe RP3500A 10:1 supports 300 V <sub>rms</sub> $\pm$ 400 V <sub>Max</sub> . (DC + V <sub>Peak</sub> ). |                                                                                                                                                                                                                                       |
|                         | Remarks                                                                                                                                                                                           | No transient overvoltage allowed for 50 $\Omega$ or 1 M $\Omega$ inputs whether the probe is used or not.<br><br>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 <sup>[5]</sup>   | 1 M $\Omega$ | 1 mV/div to 10 V/div<br>20 MHz bandwidth limit @ $\leq 4$ mV/div                                                                                                                                                                                        |
|                                             | 50 $\Omega$  | 1 mV/div to 1 V/div<br>200 MHz bandwidth limit @ $\leq 4$ mV/div                                                                                                                                                                                        |
| Offset Range                                | 1 M $\Omega$ | $\pm 0.8$ V ( $\leq 80$ mV/div)<br>$\pm 4$ V ( $> 80$ mV/div, $\leq 320$ mV/div)<br>$\pm 18$ V ( $> 320$ mV/div, $\leq 3.2$ V/div)<br>$\pm 100$ V ( $> 3.2$ V/div, $\leq 10$ V/div)                                                                     |
|                                             | 50 $\Omega$  | $\pm 0.6$ V ( $\leq 150$ mV/div)<br>$\pm 2.2$ V ( $> 150$ mV/div, $\leq 370$ mV/div)<br>$\pm 3.8$ V ( $> 370$ mV/div)                                                                                                                                   |
| Dynamic Range                               |              | $\pm 4$ div                                                                                                                                                                                                                                             |
| Bandwidth Limit <sup>[6]</sup><br>(Typical) | 1 M $\Omega$ | 20 MHz, 200 MHz, 500 MHz (OFF)                                                                                                                                                                                                                          |
|                                             | 50 $\Omega$  | DS9202: 200 MHz, 500 MHz, 1 GHz, 2 GHz (OFF)<br>DS9204: 200 MHz, 500 MHz, 1 GHz, 2 GHz, 2.5 GHz (OFF)<br>MSO9402/DS9404: 200 MHz, 500 MHz, 1 GHz, 2 GHz, 3 GHz, 4 GHz (OFF)<br>DS9604: 200 MHz, 500 MHz, 1 GHz, 2 GHz, 3 GHz, 4 GHz, 5 GHz, 6 GHz (OFF) |
| DC Gain Accuracy <sup>[5]</sup>             | 1 M $\Omega$ | $\pm 2\%$ FullScale                                                                                                                                                                                                                                     |
|                                             | 50 $\Omega$  | $\pm 3\%$ FullScale ( $< 5$ mV/div); $\pm 2\%$ FullScale ( $\geq 5$ mV/div)                                                                                                                                                                             |
| DC Vertical Offset Accuracy                 |              | $\geq 2$ mV/div, $\leq 200$ mV/div ( $\pm 0.1$ div $\pm 2$ mV $\pm 1.5\%$ offset value)                                                                                                                                                                 |
|                                             |              | $> 200$ mV/div ( $\pm 0.1$ div $\pm 2$ mV $\pm 1.0\%$ offset value)                                                                                                                                                                                     |
| Channel-to-channel Isolation                |              | $> 100:1$ (from DC to 1 GHz), $> 30:1$ ( $> 1$ GHz)                                                                                                                                                                                                     |
| ESD Tolerance                               |              | $\pm 8$ kV (BNC input)                                                                                                                                                                                                                                  |

|                                                                                               |                   |     |
|-----------------------------------------------------------------------------------------------|-------------------|-----|
| ENOB [ measured at 50 $\Omega$ , 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<sup>[7]</sup>

### Vertical System-Digital Channels

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

## Noise Floor<sup>[8]</sup>

### Noise Floor AC RMS at 50 $\Omega$

| Vertical Scale    | 2.5 GHz BW             | 4 GHz BW               | 6 GHz BW               |
|-------------------|------------------------|------------------------|------------------------|
| 1 mV/div @200 MHz | 0.12 mV <sub>rms</sub> | 0.12 mV <sub>rms</sub> | 0.12 mV <sub>rms</sub> |

**Noise Floor AC RMS at 50  $\Omega$** 

|                   |                        |                        |                        |
|-------------------|------------------------|------------------------|------------------------|
| 2 mV/div @200 MHz | 0.12 mV <sub>rms</sub> | 0.12 mV <sub>rms</sub> | 0.12 mV <sub>rms</sub> |
| 5 mV/div          | 0.40 mV <sub>rms</sub> | 0.70 mV <sub>rms</sub> | 0.90 mV <sub>rms</sub> |
| 10 mV/div         | 0.70 mV <sub>rms</sub> | 0.90 mV <sub>rms</sub> | 1.1 mV <sub>rms</sub>  |
| 20 mV/div         | 1.2 mV <sub>rms</sub>  | 1.5 mV <sub>rms</sub>  | 1.7 mV <sub>rms</sub>  |
| 50 mV/div         | 2.8 mV <sub>rms</sub>  | 3.2 mV <sub>rms</sub>  | 3.4 mV <sub>rms</sub>  |
| 100 mV/div        | 4.4 mV <sub>rms</sub>  | 4.8 mV <sub>rms</sub>  | 5.0 mV <sub>rms</sub>  |
| 200 mV/div        | 11 mV <sub>rms</sub>   | 14 mV <sub>rms</sub>   | 16 mV <sub>rms</sub>   |
| 500 mV/div        | 20 mV <sub>rms</sub>   | 26 mV <sub>rms</sub>   | 30 mV <sub>rms</sub>   |
| 1 V/div           | 33 mV <sub>rms</sub>   | 40 mV <sub>rms</sub>   | 45 mV <sub>rms</sub>   |

**Noise floor at 1 M $\Omega$  (500 MHz Bandwidth)**

| Vertical Scale    | Noise Floor AC RMS     |
|-------------------|------------------------|
| 1 mV/div @ 20 MHz | 0.14 mV <sub>rms</sub> |
| 2 mV/div @ 20 MHz | 0.13 mV <sub>rms</sub> |
| 5 mV/div          | 0.15 mV <sub>rms</sub> |
| 10 mV/div         | 0.27 mV <sub>rms</sub> |
| 20 mV/div         | 0.36 mV <sub>rms</sub> |
| 50 mV/div         | 0.76 mV <sub>rms</sub> |
| 100 mV/div        | 3.00 mV <sub>rms</sub> |
| 200 mV/div        | 6.70 mV <sub>rms</sub> |
| 500 mV/div        | 12.8 mV <sub>rms</sub> |
| 1 V/div           | 18.0 mV <sub>rms</sub> |
| 2 V/div           | 32.8 mV <sub>rms</sub> |
| 5 V/div           | 115 mV <sub>rms</sub>  |
| 10 V/div          | 168 mV <sub>rms</sub>  |

## 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                                      | $\pm 1.0$ ppm $\pm 1$ ppm/year                                                                           |                                                                                                              |
| Time Interval ( $\Delta T$ ) Measurement (using Cursor) | $\pm (\text{Time Base Accuracy} \times \text{Readout}) \pm (0.001 \times \text{Screen Width}) \pm 20$ ps |                                                                                                              |
| Channel-to-channel Deskew Range                         | $\pm 100$ ns, in 1 ps step                                                                               |                                                                                                              |
| Analog Channel-to-Channel Delay <sup>[9]</sup>          | $\leq 200$ 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 $\geq 50$ 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     | $\pm 5$ ns |

## Acquisition System

### Acquisition System

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

## Acquisition System

|                                      |                                                                                                                                                                                                                   |                                           |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
|                                      | DS9202: Standard: 10 Mpts (all-channel <sup>[3]</sup> )                                                                                                                                                           |                                           |
| Max. Memory Depth of Analog Channels | DS9204/MSO9402/DS9404/DS9604:<br>Standard: 500 Mpts (half-channel <sup>[2]</sup> ), 200 Mpts (all-channel <sup>[3]</sup> )<br>Option: 2 Gpts (half-channel <sup>[2]</sup> ), 1 Gpts (all-channel <sup>[3]</sup> ) |                                           |
| 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 $\pm$ 20% (analog channel trigger only)  |
|                       | HF Reject                                                              | Cut-off frequency ~ 75 kHz $\pm$ 20% (analog channel trigger only) |
|                       | LF Reject                                                              | Cut-off frequency ~ 75 kHz $\pm$ 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 M $\Omega$ | $\leq 2$ mV/div: 0.5 div, 0.7 div (with noise rejection enabled)<br>$> 2$ mV/div: 0.4 div, 0.6 div (with noise rejection enabled)                                                                                                                                                                      |
|                     | Internal Trigger-Analog Channel 50 $\Omega$  | $< 2$ mV/div: 1.9 div, 2.8 div (with noise rejection enabled)<br>$\geq 2$ mV/div, $< 10$ mV/div: 1.2 div, 1.6 div (with noise rejection enabled)<br>$\geq 10$ mV/div, $< 20$ mV/div: 0.6 div, 0.9 div (with noise rejection enabled)<br>$> 20$ mV/div: 0.5 div, 0.7 div (with noise rejection enabled) |
|                     | External Trigger                             | 240 mVpp @DC to 100 MHz<br>500 mVpp @100 MHz to 200 MHz                                                                                                                                                                                                                                                |
|                     | Input Impedance                              | 1 M $\Omega$    20 pF $\pm 1\%$ , BNC connector                                                                                                                                                                                                                                                        |
| EXT TRIG            |                                              | 200 ps rms                                                                                                                                                                                                                                                                                             |
|                     | Trigger Jitter                               | Normal acquisition, Edge trigger, trigger level located near 50% of EXT input signal                                                                                                                                                                                                                   |
| Trigger Level Range | Internal                                     | $\pm 4.5$ div from center screen                                                                                                                                                                                                                                                                       |
|                     | External                                     | $\pm 8$ 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<br>Option: FlexRay, LIN, I2S (for 4-CH models), CAN-FD, MIL-STD-1553B |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## Trigger Type

|              |                                                                                                                                                                                                                                                                                                                                                                            |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Zone Trigger | <p>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.</p> <p>Modes supported at update rates above 10,000 wfms/s: Normal, Peak Detect, Average, and High Resolution</p> <p>Source channel: CH1 to CH4</p>                                                    |
| Edge         | <p>Triggers on the threshold of the specified edge of the input signal. The edge types can be Rising, Falling, or Either.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>, EXT, or AC Line</p>                                                                                                                                                                  |
| Pulse Width  | <p>Triggers on the positive or negative pulse, whose time duration is less than a value, greater than a value, or inside a time range.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                                                                     |
| Slope        | <p>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.</p> <p>Source channel: CH1 to CH4</p>                                                                                                                                                                   |
| Video        | <p>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.</p> <p>Source channel: CH1 to CH4</p>            |
| Pattern      | <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                               |
| Duration     | <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p> |
| Timeout      | <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                                                          |
| Runt         | <p>Triggers when the pulses pass through one threshold but fail to pass through another threshold.</p> <p>Source channel: CH1 to CH4</p>                                                                                                                                                                                                                                   |

| Trigger Type     |                                                                                                                                                                                                                                                                                                                                                                            |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Window           | <p>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.</p> <p>Source channel: CH1 to CH4</p>                                                                                                                                |
| Delay            | <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                  |
| Setup/Hold       | <p>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).</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                                                                  |
| Nth Edge         | <p>Triggers on the Nth edge after the specified idle time. The edge can be specified as Rising or Falling.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                                                                                                 |
| RS232/UART       | <p>Triggers on the Start, Error, Check Error, or Data frame of the RS232/UART bus (up to 20 Mb/s).</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                                                                                                         |
| I2C              | <p>Triggers on the Start, Stop, Restart, MissedACK, Address (7 bits, 8 bits, or 10 bits), Data, or Address Data of the I2C bus.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                                                                            |
| SPI              | <p>Triggers on the specified pattern of the specified data width (4 to 32) of SPI bus. CS and Timeout are supported.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                                                                                       |
| CAN              | <p>Triggers on the start of a frame, end of a frame, Remote ID, Overload, Frame ID, Frame Data, Data&amp;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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>        |
| CAN-FD (Option)  | <p>Triggers on the start of a frame, end of a frame, Remote ID, Overload, Frame ID, Frame Data, Data&amp;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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p> |
| FlexRay (Option) | <p>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).</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                             |

## 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).<br>Source channel: CH1 to CH4, D0 to D15 <sup>[7]</sup> .                                             |
| 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.<br>Source channel: CH1 to CH4, D0 to D15 <sup>[7]</sup> . |
| 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.<br>Source channel: CH1 to CH4, D0 to D15 <sup>[7]</sup> .                   |

## 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 ( $\Delta Y$ )                                                                            |
|                      |                   | Time deviation between cursors ( $\Delta X$ )                                                                               |
|                      |                   | Reciprocal of $\Delta X$ (Hz) ( $1/\Delta X$ )                                                                              |
|                      | 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<br>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, T <sub>vmax</sub> , T <sub>vmin</sub> , +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<br><br>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 $F_s/2$ , $F_s$ 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, $\mu \pm \sigma$ , $\mu \pm 2\sigma$ , and $\mu \pm 3\sigma$<br>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<br>Failure action includes "Screenshot", "Beeper", and "Stop Fail"                                                                                                                                         |

## Waveform Analysis

|                             |                                  |                                                                                                                        |
|-----------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Jitter Analysis<br>(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<br>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.<br>Source channel: CH1 to CH4, D0 to D15 <sup>[7]</sup>     |
| 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).<br>Source channel: CH1 to CH4, D0 to D15 <sup>[7]</sup> . |
| I2C              | Decodes the address (with or without the R/W bit) of the I2C bus, data, and ACK.<br>Source channel: CH1 to CH4, D0 to D15 <sup>[7]</sup> .                                                 |
| SPI              | Decodes the MISO/MOSI data (4 to 32 bits) of the SPI bus. Timeout and CS are supported.<br>Source channel: CH1 to CH4, D0 to D15 <sup>[7]</sup> .                                          |

## Serial Decoding

|                               |                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAN                           | <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                   |
| LIN (Option)                  | <p>DS9000-AUTOA Option</p> <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                                    |
| CAN-FD (Option)               | <p>DS9000-AUTOA Option</p> <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p> |
| FlexRay (Option)              | <p>DS9000-FLEXA Option</p> <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                             |
| I2S (Option, for 4-CH models) | <p>DS9000-AUDIOA Option</p> <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                  |
| MIL-STD-1553B (Option)        | <p>DS9000-AEROA Option</p> <p>Decodes the MIL-STD-1553B bus signal's data word, command word, and status word (address+last 11 bits).</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>                                                                                                                                                           |
| SENT (Option)                 | <p>DS9000-SENTA Option</p> <p>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.</p> <p>Source channel: CH1 to CH4, D0 to D15<sup>[7]</sup>.</p>    |

# Function/Arbitrary Waveform Generator (AFG)<sup>[10]</sup>

| 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<br>Built-in waveforms: DC, Sinc, Exp.Rise, Exp.Fall, ECG1, Gauss, Lorentz, and Haversine<br>Self-define: Arbitrary waveform |

**AFG (technical specifications are typical values)**

|      |                              |                                                                                                                                                                                          |
|------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sine | Frequency Range              | 1 $\mu$ Hz to 50 MHz (standard)<br>1 $\mu$ Hz to 200 MHz (option)                                                                                                                        |
|      | Flatness                     | Typical (0 dBm, relative to 1 kHz sine)<br>< 10 MHz: $\pm 0.1$ dB<br>$\geq 10$ MHz to < 50 MHz: $\pm 0.2$ dB<br>$\geq 50$ MHz to < 100 MHz: $\pm 0.5$ dB<br>$\geq 100$ MHz: $\pm 1.0$ dB |
|      | Harmonic Distortion          | Typical (0 dBm)<br>10 Hz to < 10 MHz: < -55 dBc<br>$\geq 10$ MHz to < 50 MHz: < -50 dBc<br>$\geq 50$ MHz: < -40 dBc                                                                      |
|      | Spurious (non-harmonics)     | Typical (1 Vpp)<br>10 Hz to < 10 MHz: < -65 dBc<br>$\geq 10$ MHz to < 50 MHz: < -60 dBc<br>$\geq 50$ 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)<br>< 100 MHz: < -35 dBc<br>$\geq 100$ MHz: < -25 dBc                                                                                               |
|      | Phase                        | -360° to +360°, 0.1° resolution                                                                                                                                                          |

**AFG (technical specifications are typical values)**

|                       |                 |                                                                                                                          |
|-----------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------|
| Square                | Frequency Range | 1 $\mu$ Hz to 10 MHz (standard)<br>1 $\mu$ Hz to 50 MHz (option)                                                         |
|                       | Rise/Fall Time  | Typical (amplitude $\leq 2$ Vpp, 50 $\Omega$ load), $\leq 9$ 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           | $-360^\circ$ to $+360^\circ$ , $0.1^\circ$ resolution                                                                    |
| Ramp                  | Frequency Range | 1 $\mu$ Hz to 2 MHz (standard)<br>1 $\mu$ Hz to 5 MHz (option)                                                           |
|                       | Linearity       | Typical (frequency 1 kHz, amplitude 1 Vpp, symmetry 100%): $\leq 1\%$ of peak output (within 10% to 90% amplitude range) |
|                       | Symmetry        | 0.1% to 99.9%                                                                                                            |
|                       | Phase           | $-360^\circ$ to $+360^\circ$ , $0.1^\circ$ resolution                                                                    |
| Noise                 | Type            | White Noise                                                                                                              |
|                       | -3 dB           | Typical (0 dBm), $> 200$ MHz bandwidth                                                                                   |
| Pulse                 | Frequency Range | 1 $\mu$ Hz to 20 MHz (standard)<br>1 $\mu$ Hz to 20 MHz (option)                                                         |
|                       | Rise/Fall Time  | Min. 9 ns, adjustable                                                                                                    |
|                       | Duty            | 10% to 90%, adjustable                                                                                                   |
|                       | Phase           | $-360^\circ$ to $+360^\circ$ , $0.1^\circ$ resolution                                                                    |
| Arbitrary<br>Waveform | Frequency Range | 1 $\mu$ Hz to 20 MHz (standard)<br>1 $\mu$ Hz to 50 MHz (option)                                                         |
|                       | Waveform Length | 16 kpts/CH                                                                                                               |
|                       | File Type       | CSV                                                                                                                      |
| Frequency             | Accuracy        | $\pm 2$ ppm                                                                                                              |
|                       | Resolution      | 1 $\mu$ Hz or 6 digits                                                                                                   |

**AFG (technical specifications are typical values)**

|                  |                                                              |                                                                                                                                                                     |
|------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Amplitude        | Amplitude Range (into 50 $\Omega$ )                          | $\leq 50$ MHz: 1 mVpp to 10 Vpp<br>$\leq 100$ MHz: 1 mVpp to 5 Vpp<br>$\leq 200$ MHz: 1 mVpp to 2 Vpp                                                               |
|                  | Amplitude Range (into HighZ)                                 | $\leq 50$ MHz: 2 mVpp to 20 Vpp<br>$\leq 100$ MHz: 2 mVpp to 10 Vpp<br>$\leq 200$ MHz: 2 mVpp to 4 Vpp                                                              |
|                  | Accuracy (1 kHz sine, offset 0 V)                            | $\pm(1\%$ of setting + 2 mVpp) (into 50 $\Omega$ )<br>$\pm(1\%$ of setting + 5 mVpp) (into HighZ)                                                                   |
|                  | Resolution                                                   | 1 mVpp or 3 digits (take the lower value)                                                                                                                           |
|                  | Unit                                                         | Vpp                                                                                                                                                                 |
|                  |                                                              |                                                                                                                                                                     |
| DC Offset        | Range                                                        | $\pm 5$ Vpk(ac+dc) (into 50 $\Omega$ )<br>$\pm 10$ Vpk(ac+dc) (into HighZ)                                                                                          |
|                  | Accuracy                                                     | $\pm (1\%$ of  offset setting  + 2 mV + 0.5% of amplitude (Vpp)) (into 50 $\Omega$ )<br>$\pm (1\%$ 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 $\Omega \pm 1\%$ |                                                                                                                                                                     |

## 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<sup>[11]</sup>

### Bode Plot

|                                |                                            |
|--------------------------------|--------------------------------------------|
| Start Frequency                | 10 Hz to 5 MHz                             |
| Stop Frequency <sup>[12]</sup> | 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<br>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/<br>1000Base-T                        | DS9000-ENETC Option<br>100Base-T. Test Item: Output Voltage, Amplitude Symmetry, Rise/Fall Time, Rise/Fall Time Symmetry, Overshoot, Distortion Based on Duty Cycle, Eye, and Jitter<br>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<br>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<br>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 <sub>RMS</sub> , AC <sub>RMS</sub>                                                                        |
| 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 <sup>[7]</sup> 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                                                                                                                          |
|               | $V_o(H) \geq 2.5\text{ V}$ open circuit, $\geq 1.0\text{ V}$ 50 $\Omega$ to GND                                                                       |
|               | $V_o(L) \leq 0.7\text{ V}$ to load $\leq 4\text{ mA}$ , $\leq 0.25\text{ V}$ 50 $\Omega$ 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 $\leq 1.5\text{ ns}$                                                                                                                        |

## I/O

|                                   |                  |                                                                                                       |
|-----------------------------------|------------------|-------------------------------------------------------------------------------------------------------|
| 10 M Reference<br>Clock<br>In/Out | Input Interface  | 1, BNC connector on the rear panel                                                                    |
|                                   | Output Interface | 1, BNC connector on the rear panel                                                                    |
|                                   | Input Mode       | 50 $\Omega$ , with the amplitude 130 mVpp to 4.1 Vpp (-10 dBm, 20 dBm), frequency 10 MHz $\pm$ 10 ppm |
|                                   | Output Interface | 50 $\Omega$ , 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<br>Video Output              |                  | 1 on the rear panel, HDMI 1.4, A plug; used to connect an external monitor or projector               |
| Probe<br>Compensation<br>Output   |                  | 1 kHz frequency, 0 to 3 V amplitude, Square, Rise Time < 1 $\mu$ s                                    |

## 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<br>Range | Operating     | -10°C to +50°C                             |
|                      | Non-operating | -30°C to +60°C                             |
| Humidity Range       | Operating     | below +50°C, 90% RH (without condensation) |
|                      | Non-operating | below +65°C, 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<br>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                                                                                    |
| Vibration | CAN/CSA-22.2 No. 61010-031-07:201                                                                                   |
|           |                                                                                                                     |
| Shock     | Meets GB/T 6587; class 2 random                                                                                     |
|           | Meets MIL-PRF-28800F and IEC60068-2-6; class 3 random                                                               |
|           | Meets GB/T 6587-2012; class 2 random                                                                                |
| Shock     | 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 <sup>[13]</sup> | 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:

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

[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  $\leq 4$  mV/div, the bandwidth limit of 50  $\Omega$  is fixed at 200 MHz; the bandwidth limit of 1 M $\Omega$  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.      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Model</b>                                                                                                                                           |                |
| 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        |
| <b>Standard Accessories</b>                                                                                                                            |                |
| Power cord (based on destination country)                                                                                                              | — —            |
| RP3500A 500 MHz Passive Probes (2/4, consistent with the number of analog channels on the host)                                                        | — —            |
| <b>Memory Depth Upgrade Option</b>                                                                                                                     |                |
| 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 |
| <b>Serial Protocol Analysis Option</b>                                                                                                                 |                |
| 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   |
| <b>Advanced Analysis Option</b>                                                                                                                        |                |
| 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 |
| <b>Bundle Options</b>                                                                                                                                  |                |
| 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    |
| <b>Protocol Compliance Test Options</b>                                                                                                                |                |

| 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   |
| <b>Recommended Accessories</b>                                           |                |
| 4 sets of 4-channel logic analyzer probes PLA3204 for MSO Series PLA3204 |                |

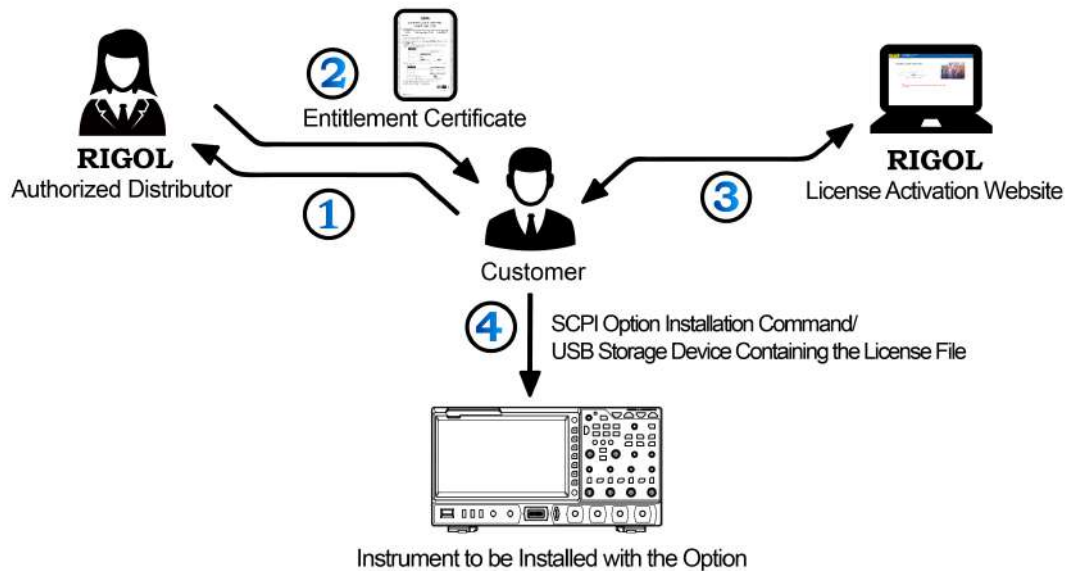
## NOTE:

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:

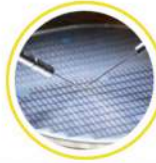
If any problems occur during the option installation process, please contact **RIGOL** technical team.

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## HEADQUARTER

**RIGOL TECHNOLOGIES CO., LTD.**  
No.8 Keling Road, New District,  
Suzhou, JiangSu, P.R.China  
Tel: +86-400620002  
Email: info-cn@rigol.com

## JAPAN

**RIGOL JAPAN CO., LTD.**  
5F, 3-45-6, Minamitsuka, Toshima-Ku,  
Tokyo, 170-0005, Japan  
Tel: +81-3-6262-8932  
Fax: +81-3-6262-8933  
Email: info.jp@rigol.com

## EUROPE

**RIGOL TECHNOLOGIES EU GmbH**  
Friedrichshafener Str. 5  
82205 Gilching  
Germany  
Tel: +49(0)8105-27292-21  
Email: info-europe@rigol.com

## KOREA

**RIGOL KOREA CO., LTD.**  
5F, 222, Gonghang-daero,  
Gangseo-gu, Seoul, Republic of Korea  
Tel: +82-2-6953-4466  
Fax: +82-2-6953-4422  
Email: info.kr@rigol.com

## NORTH AMERICA

**RIGOL TECHNOLOGIES, USA INC.**  
10220 SW Nimbus Ave.  
Suite K-7  
Portland, OR 97223  
Tel: +1-877-4-RIGOL-1  
Email: sales@rigol.com

## For Assistance in Other Countries

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