

# RIGOL



## MSO5000 Series Digital Oscilloscope

- Analog bandwidth: 350 MHz, 200 MHz, 100 MHz, and 70 MHz; bandwidth upgrade option supported
- 2 or 4 analog channels (upgradable), standard 16 digital channels(LA probe required)
- Up to 8 GSa/s real-time sample rate
- Up to 200 Mpts memory depth (option)
- High waveform capture rate (over 500,000 wfm/s)
- Auto measurement of 41 waveform parameters; full-memory hardware measurement function
- A variety of serial protocol triggers and decodes
- Up to 450,000 frames of hardware real-time and ceaseless waveforms recording and playback functions
- Independent search, navigation keys, and event table
- Built-in advanced power analysis software (option)
- Bode plot for loop test analysis (option)
- Integrates 7 independent instruments into 1, including a digital oscilloscope, a logic analyzer, a spectrum analyzer, an arbitrary waveform generator, a digital voltmeter, a frequency counter and totalizer, and a protocol analyzer
- 9-inch capacitive multi-touch screen, 256-level intensity grading display, with color persistence
- Multiple interfaces available: USB HOST&DEVICE, LAN(LXI), HDMI, TRIG OUT, and USB-GPIB
- Web Control remote command
- Unique online version upgrade
- Novel and delicate industrial design, easy to operate

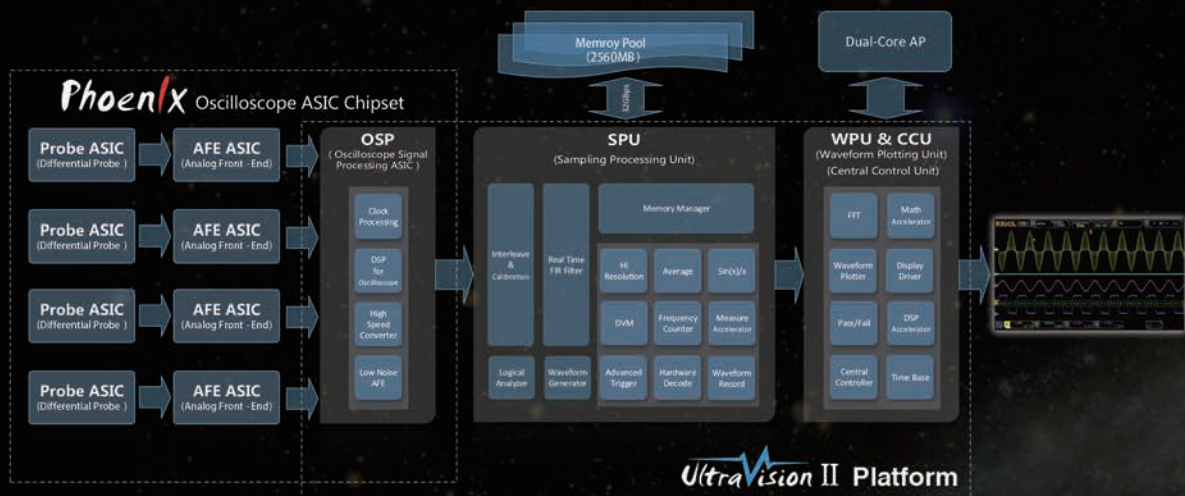
MSO5000 series digital oscilloscope is a high-performance oscilloscope model designed based on RIGOL UltraVision II technology. With a 9-inch capacitive multi-touch screen, the MSO5000 series integrates 7 independent instruments into one, delivering super sample bandwidth ratio, extremely high memory depth, and other excellent specifications. It is compact and portable in design, and all of the MSO series products support multiple channels, bandwidths, and the upgrade of the analysis software. As it integrates many functions of multiple instruments, different user groups can have more choices in selecting their desired product based on their needs, helping them save their budget to a large extent while enjoying the superior test support and user experience.

# MSO5000 Series Digital Oscilloscope

## UltraVision II Technology Platform Brings Excellent Specifications

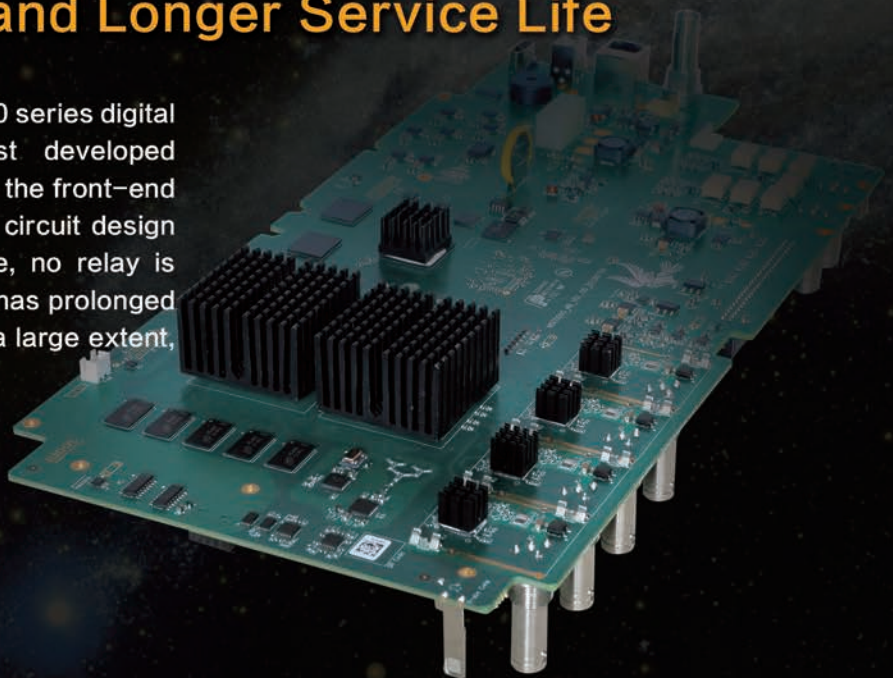
The UltraVision II platform integrates RIGOL's latest research achievements in the digital oscilloscope's signal processing, data analysis, and waveform visualization, with higher waveform capture rate, full digital trigger technology, and full memory hardware measurement technology. The MSO5000 series digital oscilloscope is equipped with the UltraVision II technical platform, and also integrates 7 general instruments in the electronics measurement industry, offering extraordinary user experience at an unprecedented price point.

- High sample rate (maximum sample rate: 8 GSa/s)
- High memory depth (maximum memory depth of 200 Mpts, optional)
- High waveform capture rate (over 500,000 waveforms per second)
- Real-time waveform recording and playback functions (up to 450,000 frames)
- Full memory hardware measurement technology
- Full digital trigger technology



## Higher Reliability and Longer Service Life

The main board circuit of the MSO5000 series digital oscilloscope adopts RIGOL's latest developed dedicated ASIC chipset, which makes the front-end circuit enjoy a higher integration, the circuit design more simple and reliable. Meanwhile, no relay is added to the MSO5000 series, which has prolonged the service life of the oscilloscope to a large extent, indirectly reducing the usage cost for users and further highlighting its cost-effective advantage.





## Available for Software Upgrade with Options According to User's Demands

Want more functions within your limited budget? The MSO5000 series suffices! It has been fully configured with 4 analog channels, hardware analog bandwidth, 16-channel logic analyzer and dual-channel AWG hardware circuit before leaving the factory. If you have more demands in the future, purchase the desired option for expansion through relevant channels. Only a license code is enough. So easy!



- **Standard 4 analog channels in hardware**

The MSO5XX2 model can be upgraded to 4-CH at any time. The model remains unchanged.

- **Supports the highest analog bandwidth in hardware**

Any MSO5000 low bandwidth model can be upgraded to higher bandwidth at any time. The model remains unchanged. For example, the MSO5072 can be upgraded to 350 MHz bandwidth.

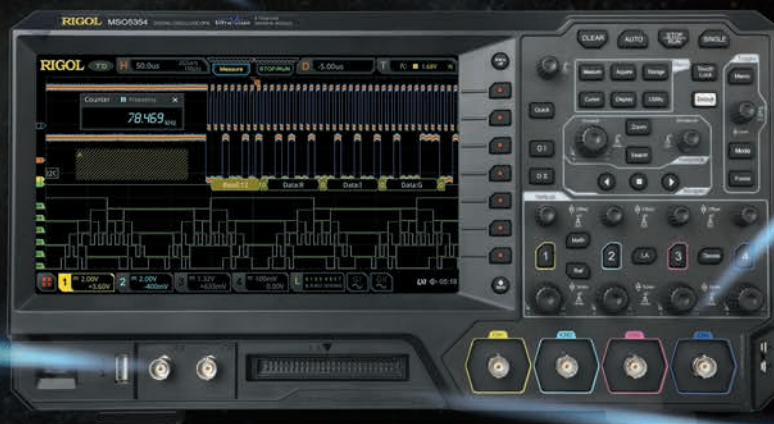
- **Standard logic analyzer interface in hardware**

Any MSO5000 standard with 16-CH logic analyzer interface and function software, and only a PLA2216 probe is required to be ordered.

- **Standard AWG output port in hardware**

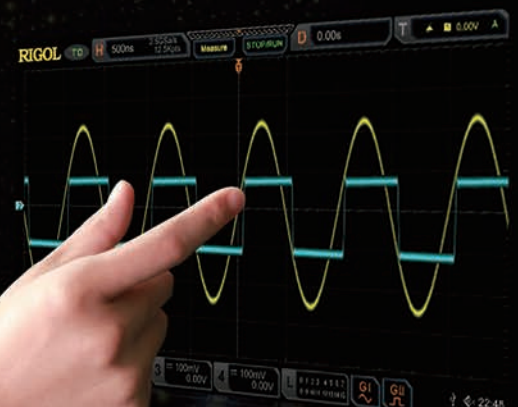
Any MSO5000 standard with 2-CH arbitrary waveform generator output port, and only AWG software is required to be ordered.

4 Channel  
350MHz 8GSa/s



## Mainstream Touch Screen Design Offers You Supreme User-friendly Experience

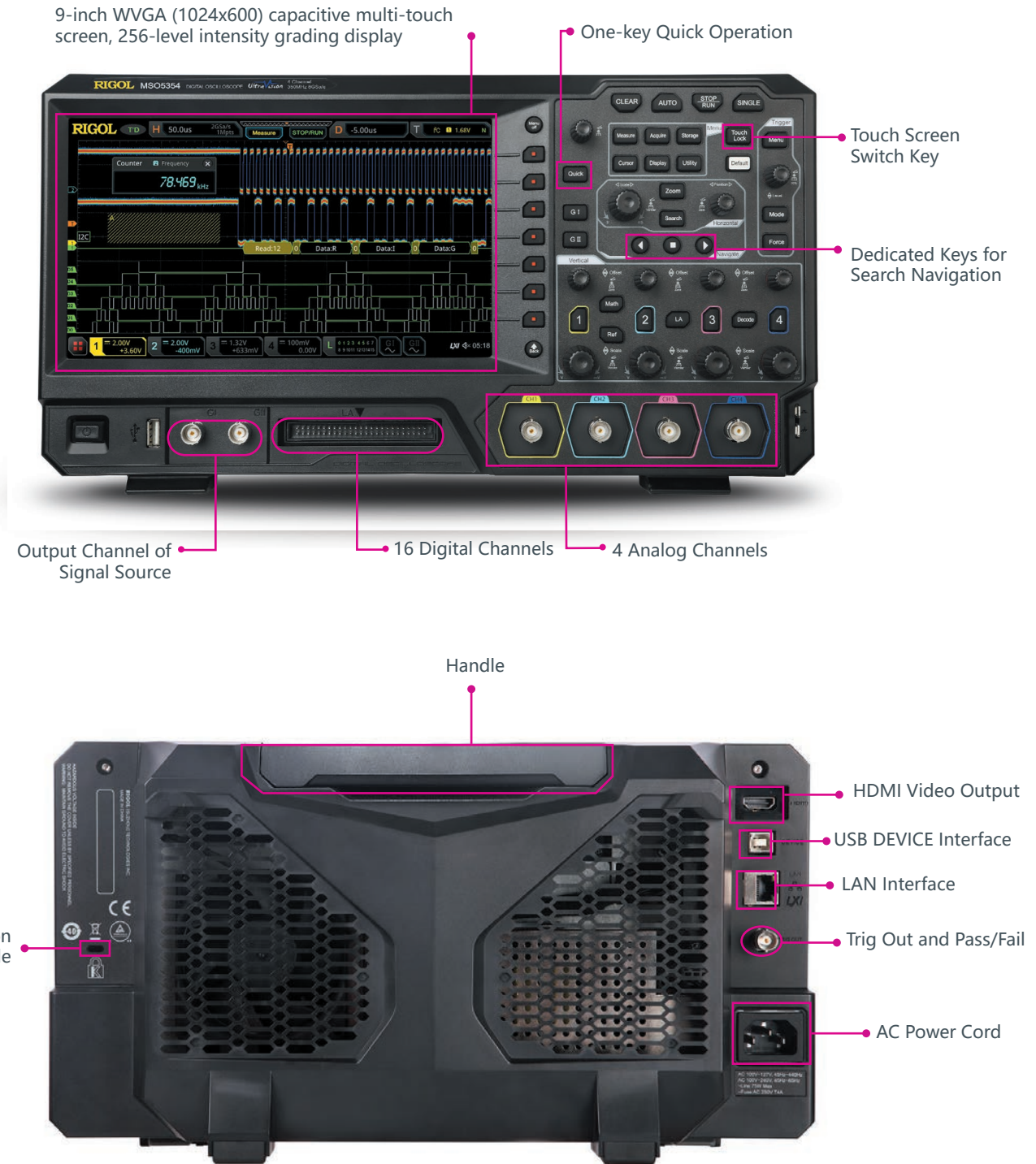
The 9-inch capacitive multi-touch screen supports various touch gestures, making it always keep up with the mainstream development trend for screen operation. Various multi-touch gestures such as Tap, Drag, Pinch & Stretch, and Rectangle Drawing are supported, making the measurement actions more smooth, convenient, and easy for users to operate. Meanwhile, the MSO5000 series digital oscilloscope still keeps the knob and key operation as what RIGOL traditional digital oscilloscopes have, optimizing the user-friendly interactive experience to a large extent.





## ► Small Body, Big Use

The innovative physical appearance of the instrument and the thin design in both sides of the instrument not only make its LCD display prominent but also keeps its shape delicate, making it portable and easy to operate.



## ► Overview of RIGOL's Medium-end Series Products



|                                       | MSO/DS2000A                                     | MSO/DS4000                                           | MSO5000                                                        | DS6000                                          | MSO/DS7000                                                     |
|---------------------------------------|-------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------|----------------------------------------------------------------|
| Analog Channel+Digital Channel        | 2+16                                            | 4+16                                                 | 2/4+16                                                         | 4                                               | 4+16                                                           |
| Analog Bandwidth                      | 70 MHz to 300 MHz                               | 100 MHz to 500 MHz                                   | 70 MHz to 350 MHz                                              | 600 MHz to 1 GHz                                | 100 MHz to 500 MHz                                             |
| Max. Sample Rate                      | 2 GSa/s                                         | 4 GSa/s                                              | 8 GSa/s                                                        | 5 GSa/s                                         | 10 GSa/s                                                       |
| Max. Memory Depth                     | 56 Mpts (optional)                              | 140 Mpts                                             | 200 Mpts (optional)                                            | 140 Mpts                                        | 500 Mpts (optional)                                            |
| Waveform Capture Rate                 | > 52,000 wfms/s                                 | > 110,000 wfms/s                                     | >500,000 wfms/s                                                | > 180,000 wfms/s                                | > 600,000 wfms/s                                               |
| Max. Frames of Waveform Recording     | 65,000                                          | 200,000                                              | 450,000                                                        | 200,000                                         | 450,000                                                        |
| LCD                                   | 8"                                              | 9"                                                   | 9" capacitive multi-touch screen                               | 10.1"                                           | 10.1" capacitive multi-touch screen                            |
| Hardware Mask Test                    | Standard                                        | Standard                                             | Standard                                                       | Standard                                        | Standard                                                       |
| Built-in Arbitrary Waveform Generator | 2 CH, 25 MHz (optional)                         | None                                                 | 2 CH, 25 MHz (optional)                                        | None                                            | 2 CH, 25 MHz (optional)                                        |
| Built-in Digital Voltmeter            | None                                            | None                                                 | Standard                                                       | None                                            | Standard                                                       |
| Built-in Hardware Counter             | 6-digit frequency counter                       | 6-digit frequency counter                            | 6-digit frequency counter + totalizer                          | 6-digit frequency counter                       | 6-digit frequency counter + totalizer                          |
| Search and Navigation                 | None                                            | None                                                 | Standard, supporting table display                             | None                                            | Standard, supporting table display                             |
| Power Analysis                        | PC (optional)                                   | PC (optional)                                        | Built-in UPA (optional)                                        | PC (optional)                                   | Built-in UPA (optional)                                        |
| Serial Protocol Analysis              | RS232/UART, I2C, SPI, CAN, and USB              | RS232/UART, I2C, SPI, CAN, FlexRay, and MIL-STD-1553 | RS232/UART, I2C, SPI, CAN, LIN, FlexRay, I2S, and MIL-STD-1553 | RS232/UART, I2C, SPI, CAN, and FlexRay          | RS232/UART, I2C, SPI, CAN, LIN, FlexRay, I2S, and MIL-STD-1553 |
| Waveform Color Persistence            | None                                            | None                                                 | Standard                                                       | None                                            | Standard                                                       |
| Histogram                             | None                                            | None                                                 | Standard                                                       | None                                            | Standard                                                       |
| FFT                                   | Standard                                        | Standard                                             | Enhanced FFT, Standard                                         | Standard                                        | Enhanced FFT, Standard                                         |
| MATH                                  | Displays 1 function at the same time            | Displays 1 function at the same time                 | Displays 4 functions at the same time                          | Displays 1 functions at the same time           | Displays 4 functions at the same time                          |
| Connectivity                          | standard: USB, LAN, and VGA<br>option: USB-GPIB | standard: USB, LAN, and VGA<br>option: USB-GPIB      | standard: USB, LAN, and HDMI<br>option: USB-GPIB               | standard: USB, VGA, and LAN<br>option: USB-GPIB | standard: USB, LAN, and HDMI<br>option: USB-GPIB               |

# Design Features

## ►7-into-1 Integrated Digital Oscilloscope



In today's integrated design field, a highly integrated comprehensive digital oscilloscope has become a useful tool for design engineers. The MSO5000 series digital oscilloscope launched by RIGOL this time integrates 7 independent instruments into 1, including one digital oscilloscope, one 16-channel logic analyzer, one spectrum analyzer, one arbitrary waveform generator, one digital voltmeter, one high-precision frequency counter and totalizer, and one protocol analyzer. The MSO5000 series offers you a flexible and economical solution to address your actual needs.

### 1. Digital Oscilloscope

- Four bandwidth models: 350 MHz, 200 MHz, 100 MHz, and 70 MHz; with the bandwidth upgradeable
- Up to 8 GSa/s real-time sample rate
- 2 or 4 analog channels (upgradeable), 16 digital channels (standard)
- Up to 200 Mpts memory depth (option)
- Maximum waveform capture rate of 500,000 wfms/s
- 350 MHz passive voltage probe for each channel (standard)



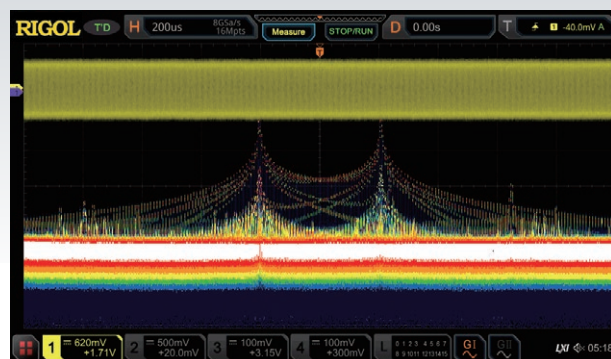
### 2. Logic Analyzer

- Standard 16 digital channels, just buy a PLA2216 active logic probe
- 25 Mpts memory depth for the waveforms of all the digital channels
- Up to 1 GSa/s sample rate
- Hardware real-time waveform recording and playback functions supported
- Mixed (analog channel and digital channel) trigger and decode supported
- Convenient digital channel grouping and group operation



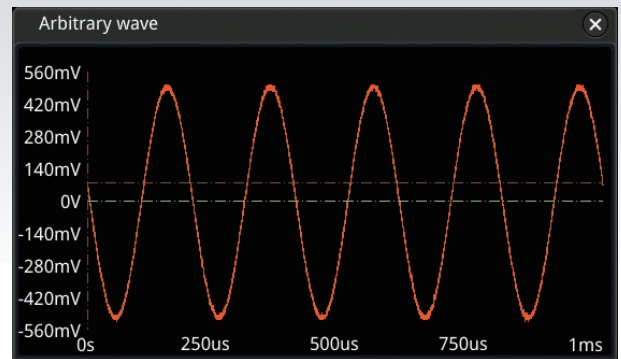
### 3. Spectrum Analyzer

- Standard configuration of enhanced FFT, real-time operation for max. 1 Mpts waveform data
- Max. frequency range: oscilloscope analog bandwidth
- Up to 4 groups of operations can be displayed at the same time
- Independent FFT color persistence view supported
- Up to 15 peaks available for the peak search function; event table available to be exported



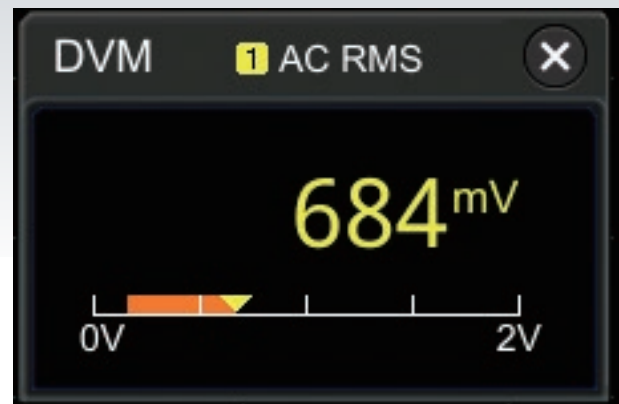
#### 4.Arbitrary Waveform Generator (Option)

- Standard configuration of 2 waveforms output channels for the hardware, and only AWG option is required to be ordered
- 13 pre-defined waveforms
- Up to 25 MHz frequency
- Up to 200 MSa/s sample rate
- Advanced modulation, sweep, and burst signal output supported



#### 5.Digital Voltmeter

- 3–digit DC/AC, RMS/AC+DC RMS voltage measurement
- Sound an alarm for reaching or exceeding the limits
- Display the latest measurement results in the form of a diagram, and display the extrema over the last 3 seconds



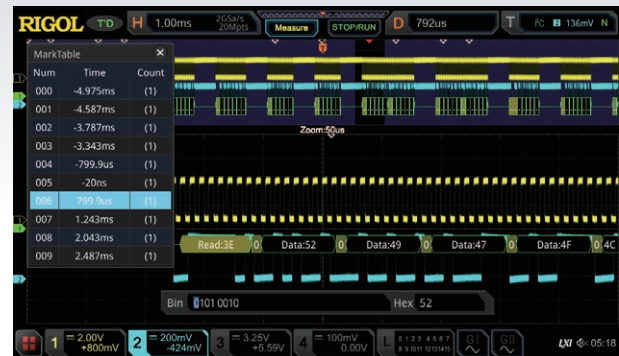
#### 6.High-precision Frequency Counter and Totalizer

- 3 to 6–digit (selectable) high–precision frequency counter
- Support the statistics on the maximum and minimum values of the frequency
- 48–bit totalizer (standard)



#### 7.Protocol Analyzer (Option)

- Support RS232/UART, I2C, SPI, CAN, LIN, I2S, FlexRay, and MIL–STD–1553 serial bus





## ► Super High Sample Bandwidth Ratio

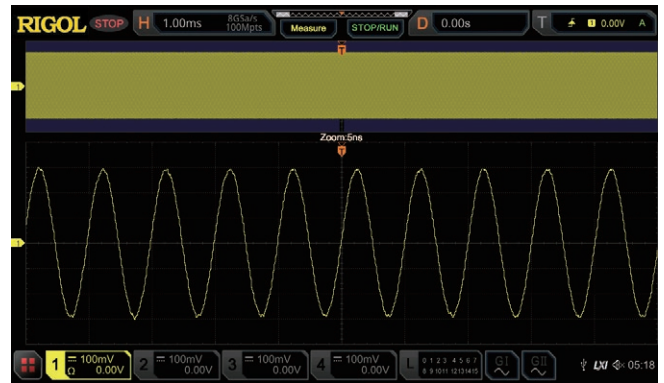
Bandwidth and the sample rate are two key technical specifications that engineers take priority in choosing the digital oscilloscope. Bandwidth determines the maximum frequency that the oscilloscope can acquire. The higher the bandwidth of the oscilloscope, the better the oscilloscope can keep the steep, fast, abundant harmonics components and energies of the signal under test. Whereas the sample rate determines the time interval of the sample points, that is, determines the refinement of the outlined waveforms. The MSO5000 series provides a maximum of 8 GSa/s real-time sample rate and 23X sample rate/bandwidth ratio for 350 MHz bandwidth, which makes itself far ahead of the same level products.

While maintaining the super high sample rate of 8 GSa/s, the MSO5000 series also has a maximum of 200 Mpts memory depth, enabling itself to capture more events in one acquisition. This provides sufficient time for users to observe while retaining the waveform details to a large extent. Thus, users can not only get the detailed information about the waveforms, but also can take an overview of the waveforms.

## ► 500,000 wfms/s Capture Rate

Engineers often have to spend a lot of time and efforts in locating the problem in design and debugging. Therefore, a proper debugging tool will help engineers to work more efficiently. MSO5000 series digital oscilloscope can provide the waveform capture rate of up to 500,000 wfms/s, so that the glitches and infrequent events in waveforms can be quickly identified, greatly improving the debugging efficiency for the engineers.

256-level intensity grading display can reflect the occurrence frequencies of the infrequent events. Its newly added color persistence function can highlight the signal of different probabilities with a different color grading. You can set the persistence time to control the duration time for the waveforms to be displayed on the screen, so that the display capability of the infrequent events can be further enhanced.



*With up to 100 M memory depth, you can capture 12.5 ms of waveforms while maintaining a sample rate of 8 G, without causing the waveforms to be distorted.*



*Capture occasional exceptional signals in a highly refresh mode.*



*Changes of each frame of waveforms of the sweep signal can be clearly observed in the highly refresh mode.*



## ► Hardware Full Memory Auto Measurement

The auto measurement is the basic tool for engineers to make a rapid analysis of the signals, and it requires more efficient measurement process and accurate measurement results. MSO5000 supports hardware full memory auto measurement, provides measurements of 41 waveform parameters, supports displaying the statistics and analysis of the measurement results for 10 items. In addition, the auto measurement function also supports auto cursor indicator and measurement range selection. You can also set the threshold for each measurement source independently, making the waveform measurement more flexible. To get a quick view about how to make measurements, we provide you with detailed help documents and diagrams to better illustrate the measurement methods for each item.

Based on the different data sources, auto measurement consists of two modes: Normal and Precision. In Normal mode, the data volume increases from 1 k to 1 M, realizing the optimization of the basic measurement function. In Precision mode, the oscilloscope provides hardware full-memory auto measurement, greatly improving the precision of the waveform measurement.



*Observe and accurately measure two signals with great frequency deviations. The full-memory hardware measurement can measure accurate frequency value of the waveforms with 340k rising edges.*

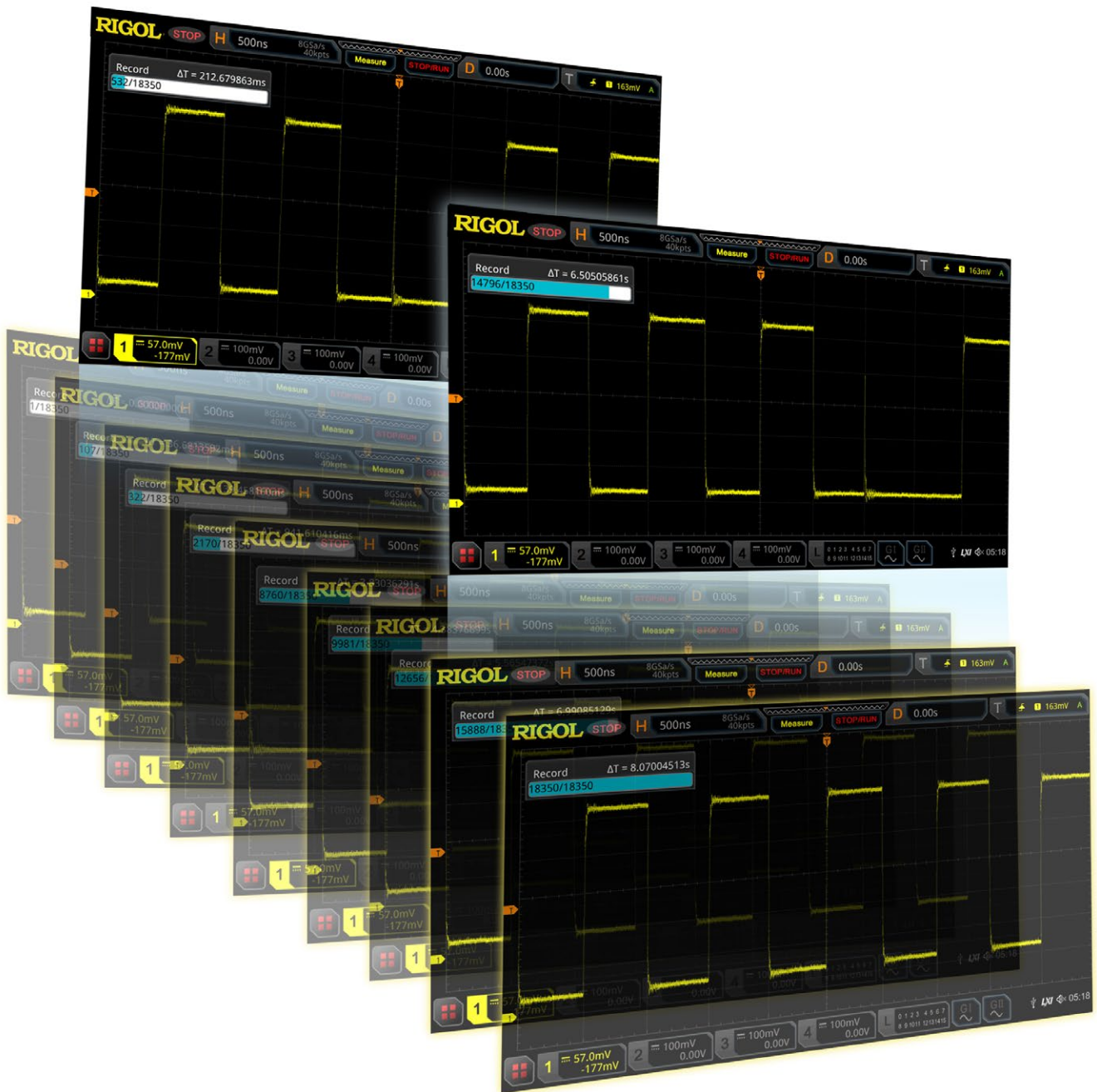


*The ordinary 1 Mpts software measurement can no longer measure the accurate frequency of the high-frequency signal.*

## ► Hardware Waveform Recording and Playback

The memory depth is one of the key specifications of the oscilloscope. However, whatever high the memory depth, it cannot be guaranteed that all the signals that users are concerned about can be captured in one time. This is especially true for the occurrence of the infrequent signals during debugging design or locating specific events from the long captured complicated signals. In addition, the long memory depth will be bound to reduce the response time for the oscilloscope. The hardware waveform recording and playback function can address this issue.

The MSO5000 series provides ceaseless recording and playback for a maximum of 450,000 frames of hardware real-time waveforms. This specification is second to none in the industry. The hardware waveform recording function adopts the segmented storage technology. With the technology, you can set the trigger conditions to make a selective choice in capturing and saving the signals that you are interested in, then mark the time on the signal. This has not only ensured the high capture efficiency, but also prolonged the overall observation time for the waveforms. The hardware waveform playback function enables you to have sufficient time to take a careful view and analysis of the recorded segment of the waveforms.





## ► Hardware Pass/Fail Test

The MSO5000 series is equipped with hardware pass/fail test function as the standard configuration, which can be used in signal monitoring for a long time, signal monitoring during design, and signal test in the production line. You can set the test mask based on the known "standard" waveform, and then compare the signal under test with the "standard" waveform to display the statistics on the test results. When a successful or failed test is detected by the oscilloscope, you can choose to immediately stop monitoring, enable the beeper to sound an alarm, or save the current screen image. Also, you can choose to continue monitoring.



*The Pass/Fail test function can quickly make statistics on the occurrence probability of the signal exceptions.*

## ► Enhanced FFT Analysis

The MSO5000 series can analyze 1 Mpts of FFT, which improves the frequency resolution to a large extent, convenient for you to better analyze the disturbance noise in the circuit under test. To adjust the spectrum waveforms to be observed, set the center frequency and the span; or set the start frequency and the stop frequency. The MSO5000 series also provides the peak search function, which can auto mark up to 15 peaks and display their frequencies and amplitudes in the form of a list. Such information and the non-peak section in the frequency-domain cursor measurement can greatly improve the working efficiency of the engineers.

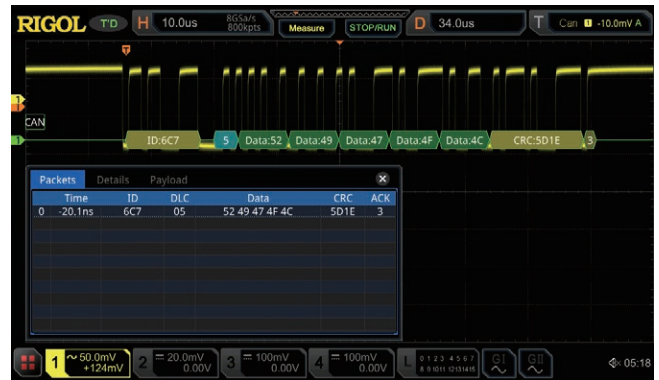


*With the near-field probe, you can easily observe the spectrum peak in the frequency domain when the probe approaches to the radiation leakage point.*

## ► A Variety of Triggers and Protocol Decodings

MSO5000 series digital oscilloscope provides powerful trigger functions, including 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, and serial protocol trigger. These triggers can help engineers accurately and quickly capture and identify the signals of great interest.

The optional serial protocol decoding is capable of decoding 4 serial buses simultaneously. The full memory data analysis and the decoding event table display can help engineers quickly find out the system failure and locate the symbol error waveforms, greatly improving the debugging efficiency of the overall system signals. The MSO5000 series also provides optional decodings such as RS232/UART, I2C, SPI, CAN, LIN, I2S, FlexRay, and MIL-STD-1553. These serial bus decodings can help engineers make a deep analysis on the waveforms, and they are widely applied to the auto electronics, aerospace, and other fields. Besides, the oscilloscope has a standard parallel bus decoding, which is capable of performing the debugging test for the mixed signals of up to 20 channels (analog channel and digital channel) simultaneously.



## ► Zone Trigger

In face of the complex and variable circuit signal in the circuit debugging, it is easy for us to find the transient occasional exception signals on the oscilloscope with a high waveform capture rate. However, it is not easy to isolate the exceptional signal from the complex circuit signals and trigger them stably. You have to spend more time on the usage of some advanced trigger types, and sometimes even the powerful advanced trigger is unable to make it. The MSO5000 series is specially equipped with touch screen-based zone trigger function, which can help users accelerate the signal isolation process. The zone trigger function is easy to operate. You only need to use the specified rectangle drawing gesture to draw one or two rectangular zones on the corresponding signal section, then you can quickly isolate the signal for observation. The zone trigger can work with other 20 trigger types, and it also supports the decoding, waveform recording, and pass/fail test functions. This is conducive to the debugging of the complex signals.



*Draw a rectangle on the transient exception signal and select Trigger zone B.*



*Quickly isolate the exceptional signal with Edge trigger and Zone trigger.*



## ► Power Analysis (Option)

To cater to the increasing test demand for the switch power supply and the power component, we configure the MSO5000 series with the optional built-in power analysis software. The current power analysis software can complete the power quality analysis and ripple analysis. The power analysis software can help engineers analyze the commonly used power parameters rapidly and accurately, without needing to make tedious configurations manually or do complicated formula calculation.



## ► Bode Plot (Option)

The stability of the switch power supply affects the reliability of the whole system. MSO5000 series can generate the sweep signal of the specified range by controlling the built-in signal generator module and output the signal to the switch power supply to carry out loop analysis test. The bode plot generated from the test can display the gain and phase variations of the system under different frequencies, enabling engineers to get a clear view about data from the bode plot. By analyzing the phase margin (PM), gain margin (GM), and other parameters, they can judge whether the system is stable. The MSO5000-AWG option needs to be installed to activate this function.

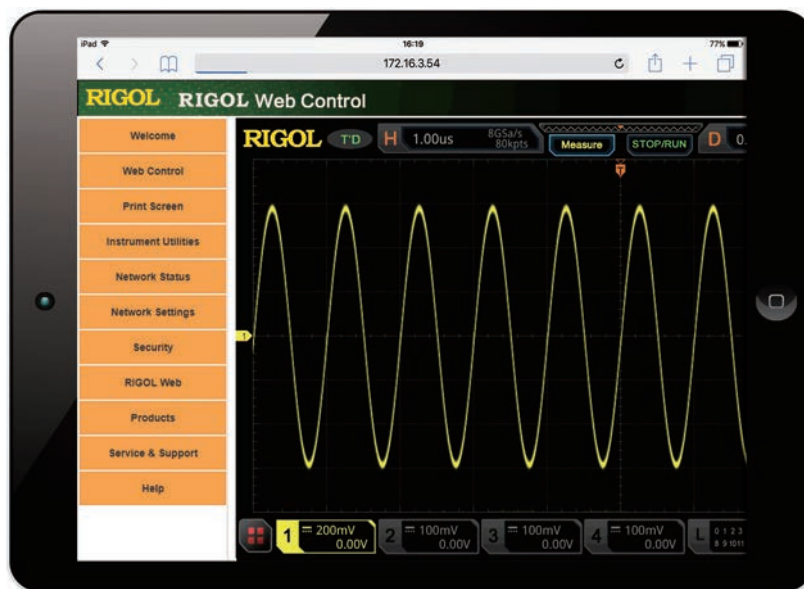


## ► Remote Control Software

The Web Control software is a standard configuration for the MSO5000 series. You can use the software to migrate the instrument control and waveform analysis to the PC, and then click the mouse to operate easily.

You only need to input the IP address of the oscilloscope into the address bar of the Web browser to open the Web Control software. The display of the waveform interface and instrument

control in the software are consistent with that in the MSO5000 series. You can use the mouse to tap the keys or knobs in the Web Control interface to complete the waveform control, measurement, and analysis. In the Web Control interface, the basic information of the instrument is displayed, and you can also upload or download the files of the oscilloscope, control with the SCPI commands, set or modify the network status.



## ► User-defined One-key Quick Operation

There is a dedicated Quick key on the front panel of the MSO5000 series, enabling you to customize the function of the key and complete the commonly used operation quickly. With the customized setting of the Quick key, you can quickly capture the screen image, realize waveform saving, setup saving, all measurement, reset measurement statistics, reset pass/fail test statistics, printing, email sending, waveform recording, group saving, and etc.





# RIGOL Probes and Accessories Supported by the MSO5000 Series

## • RIGOL Passive Probes

| Model | Type | Description |
|-------|------|-------------|
|-------|------|-------------|



PVP2150

High-impedance Probe

1X: DC ~ 35 MHz  
10X: DC ~ 150 MHz  
Compatibility: All models of **RIGOL**'s digital oscilloscopes



PVP2350

High-impedance Probe

1X: DC ~ 35 MHz  
10X: DC ~ 350 MHz  
Compatibility: All models of **RIGOL**'s digital oscilloscopes



RP3500A

High-impedance Probe

DC ~ 500 MHz  
Compatibility: All models of **RIGOL**'s digital oscilloscopes



RP1300H

High-voltage Probe

DC ~ 300 MHz  
CAT I 2000 V (DC+AC)  
CAT II 1500 V (DC+AC)  
Compatibility: All models of **RIGOL**'s digital oscilloscopes

| Model | Type | Description |
|-------|------|-------------|
|-------|------|-------------|



RP1010H

High-voltage Probe

DC ~ 40 MHz  
DC: 0 ~ 10 kV DC  
AC: pulse  $\leq 20$  kVp-p  
AC: sine wave  $\leq 7$  kVrms  
Compatibility: All models of **RIGOL**'s digital oscilloscopes



RP1018H

High-voltage Probe

DC ~ 150 MHz  
DC+AC Peak: 18 kV CAT II  
AC RMS: 12 kV CAT II  
Compatibility: All models of **RIGOL**'s digital oscilloscopes

## • RIGOL Active and Current Probes

| Model                                                                                          | Type          | Description                                                                                                                                                                                                                            | Model                                                                                           | Type                            | Description                                                                                                       |
|------------------------------------------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------|
| <br>RP1001C   | Current Probe | BW: DC ~ 300 kHz<br>Maximum Input<br>DC: $\pm 100$ A<br>AC P-P: 200 A<br>AC RMS: 70 A<br>Compatibility: All models of <b>RIGOL</b> 's digital oscilloscopes                                                                            | <br>RP1000P    | Power Supply                    | Power supply for RP1003C, RP1004C, and RP1005C; supporting 4 channels.                                            |
| <br>RP1002C   | Current Probe | BW: DC ~ 1 MHz<br>Maximum Input<br>DC: $\pm 70$ A<br>AC P-P: 140 A<br>AC RMS: 50 A<br>Compatibility: All models of <b>RIGOL</b> 's digital oscilloscopes                                                                               | <br>RP1025D   | High-voltage Differential Probe | BW: 25 MHz<br>Max. voltage $\leq 1400$ Vpp<br>Compatibility: All models of <b>RIGOL</b> 's digital oscilloscopes  |
| <br>RP1003C   | Current Probe | BW: DC ~ 50 MHz<br>Maximum Input<br>AC P-P: 50 A (noncontinuous)<br>AC RMS: 30 A<br>Compatibility: All models of <b>RIGOL</b> 's digital oscilloscopes<br>Required to order RP1000P power supply.                                      | <br>RP1050D   | High-voltage Differential Probe | BW: 50 MHz<br>Max. voltage $\leq 7000$ Vpp<br>Compatibility: All models of <b>RIGOL</b> 's digital oscilloscopes  |
| <br>RP1004C | Current Probe | BW: DC ~ 100 MHz<br>Maximum Input<br>AC P-P: 50 A (noncontinuous)<br>AC RMS: 30 A<br>Compatibility: All models of <b>RIGOL</b> 's digital oscilloscopes<br>Required to order RP1000P power supply.                                     | <br>RP1100D | High-voltage Differential Probe | BW: 100 MHz<br>Max. voltage $\leq 7000$ Vpp<br>Compatibility: All models of <b>RIGOL</b> 's digital oscilloscopes |
| <br>RP1005C | Current Probe | BW: DC ~ 10 MHz<br>Maximum Input<br>AC P-P: 300 A (noncontinuous), 500 A (@pulse width $\leq 30$ us)<br>AC RMS: 150 A<br>Compatibility: All models of <b>RIGOL</b> 's digital oscilloscopes<br>Required to order RP1000P power supply. | <br>PLA2216 | Active Logic Probe              | Active logic probe (dedicated probe for MSO5000 series)                                                           |

# Specifications

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

## Overview of the MSO5000 Series Technical Specifications

| Model                                             | MSO5072                                                                                                                                                                                                       | MSO5074 | MSO5102 | MSO5104 | MSO5204  | MSO5354 |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|---------|----------|---------|
| Analog Bandwidth                                  | 70 MHz                                                                                                                                                                                                        | 70 MHz  | 100 MHz | 100 MHz | 200 MHz  | 350 MHz |
| Rising Time (typical)                             | ≤5 ns                                                                                                                                                                                                         | ≤5 ns   | ≤3.5 ns | ≤3.5 ns | ≤1.75 ns | ≤1 ns   |
|                                                   | 2                                                                                                                                                                                                             | 4       | 2       | 4       | 4        | 4       |
| No. of Input/Output Channels                      | 16 input digital channels (PLA2216 probe option is required to be ordered)<br>Dual-channel arbitrary waveform generator output (required to install the MSO5000-AWG option to activate the software function) |         |         |         |          |         |
| Sampling Mode                                     | Real-time sampling                                                                                                                                                                                            |         |         |         |          |         |
| Max. Sample Rate of Analog Channel                | MSO5354/MSO5204/MSO5104/MSO5074:<br>8 GSa/s (single-channel), 4 GSa/s (half-channel <sup>[1]</sup> ), 2 GSa/s (all channels)<br>MSO5102/MSO5072:<br>8 GSa/s (single-channel), 2 GSa/s (all channels)          |         |         |         |          |         |
| Max. Memory Depth                                 | 2RL(option)<br>Analog channel:<br>200 Mpts (single-channel), 100 Mpts (half-channel <sup>[1]</sup> ), 50 Mpts (all channels)<br>Digital channel: 25 Mpts (all channels)                                       |         |         |         |          |         |
| Max. Waveform Capture Rate <sup>[2]</sup>         | ≥500,000 wfms/s                                                                                                                                                                                               |         |         |         |          |         |
| Hardware Real-time Waveform Recording and Playing | ≥450,000 wfms (single-channel)                                                                                                                                                                                |         |         |         |          |         |
| Peak Detection                                    | Under all the time base settings, capture 500 ps glitches                                                                                                                                                     |         |         |         |          |         |
| LCD Size and Type                                 | 9-inch capacitive multi-touch screen/gesture enabled operation                                                                                                                                                |         |         |         |          |         |
| Display Resolution                                | 1024 × 600                                                                                                                                                                                                    |         |         |         |          |         |

## Vertical System Analog Channel

| Vertical System Analog Channel            |                                                                                                                                                                                        |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Coupling                            | DC, AC or GND                                                                                                                                                                          |
| Input Impedance                           | 1 MΩ ± 1%                                                                                                                                                                              |
| Input Capacitance                         | 17 pF ± 3 pF                                                                                                                                                                           |
| Probe Attenuation Coefficient             | 0.0001X, 0.0002X, 0.0005X, 0.001X, 0.002X, 0.005X, 0.01X, 0.02X, 0.05X, 0.1X, 0.2X, 0.5X, 1X, 2X, 5X, 10X, 20X, 50X, 100X, 200X, 500X, 1000X, 2000X, 5000X, 10000X, 20000X, and 50000X |
| Maximum Input Voltage                     | CAT I 300 Vrms, 400 Vpk, Transient Overvoltage 1600 Vpk                                                                                                                                |
| Vertical Resolution                       | 8 bits                                                                                                                                                                                 |
| Vertical Sensitivity Range <sup>[3]</sup> | 500 μV/div~10 V/div                                                                                                                                                                    |
| Offset Range                              | ± 1 V (500 μV/div~50 mV/div)<br>± 30 V (51 mV/div~260 mV/div)<br>± 100 V (265 mV/div~10 V/div)                                                                                         |
| Dynamic Range                             | ± 5 div (8 bits)                                                                                                                                                                       |
| Bandwidth Limit (Typical)                 | 20 MHz, 100 MHz, 200 MHz; selectable for each channel                                                                                                                                  |
| DC Gain Accuracy <sup>[3]</sup>           | ± 3% of full scale                                                                                                                                                                     |
| DC Offset Accuracy                        | <200 mV/div (± 0.1 div ± 2 mV ± 1.5% of offset value)<br>>200 mV/div (± 0.1 div ± 2 mV ± 1.0% of offset value)                                                                         |
| Channel-to-Channel Isolation              | 40 dB, from DC to maximum rated bandwidth of each model                                                                                                                                |
| ESD Tolerance                             | ± 8 kV (on input BNCs)                                                                                                                                                                 |

## Vertical System Digital Channel

| Vertical System Digital Channel |                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of Channels              | 16 input channels (D0~D15)<br>(D0~D7, D8~D15)                                                                                                                                       |
| Threshold Range                 | ± 15.0 V, in 10 mV step                                                                                                                                                             |
| Threshold Accuracy              | ± 100 mV + 3% of the threshold setting                                                                                                                                              |
| Threshold Selection             | TTL(1.4 V), COMS5.0(2.5 V), COMS3.3(1.65 V), COMS2.5(1.25 V), COMS1.8(0.9 V), ECL(-1.3 V), PECL(3.7 V), LVDS(1.2 V), 0.0 V<br>User (adjustable threshold for 8 channels in a group) |
| Max. Input Voltage              | ± 40 V peak CAT I; transient overvoltage 800 Vpk                                                                                                                                    |
| Max. Input Dynamic Range        | ± 10 V + threshold                                                                                                                                                                  |
| Minimum Voltage Swing           | 500 mVpp                                                                                                                                                                            |



|                     |                      |
|---------------------|----------------------|
| Input Impedance     | About 101 k $\Omega$ |
| Probe Load          | $\approx 8$ pF       |
| Vertical Resolution | 1 bit                |

## Horizontal System--Analog Channel

| Horizontal System--Analog Channel        |                                                                                                                                                       |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                          | 70 MHz                      100 MHz                      200 MHz                      350 MHz                                                         |
| Range of Time Base                       | 5 ns/div~1 ks/div                      5 ns/div~1 ks/div                      2 ns/div~1 ks/div                      1 ns/div~1 ks/div                |
|                                          | Support fine adjustment                                                                                                                               |
| Time Base Resolution                     | 10 ps                                                                                                                                                 |
| Time Base Accuracy                       | $\pm 10$ ppm $\pm 10$ ppm/year                                                                                                                        |
| Time Base Delay Range                    | before triggering $\geq 1/2$ screen width                                                                                                             |
|                                          | after triggering 1 s or 100 div, whichever is greater                                                                                                 |
| Time Interval ( $\Delta T$ ) Measurement | $\pm (1 \text{ sample interval}) \pm (2 \text{ ppm} \times \text{readout}) \pm 50 \text{ ps}$                                                         |
| Inter-channel Offset Correction Range    | $\pm 100$ ns                                                                                                                                          |
| Horizontal Mode                          | YT Default                                                                                                                                            |
|                                          | XY X = Channel 1, Y = Channel 2                                                                                                                       |
|                                          | SCAN Time base $\geq 200$ ms/div, available to enter or exit the SCAN mode by rotating the Horizontal SCALE knob                                      |
|                                          | ROLL Time base $\geq 200$ ms/div, available to enter or exit the ROLL mode by rotating the Horizontal SCALE knob (enable the auto ROLL mode at first) |

## Horizontal System--Digital Channel

| Horizontal System--Digital Channel |                                                                                                                                                                                                     |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Min. Detectable Pulse Width        | 5 ns                                                                                                                                                                                                |
| Maximum Input Frequency            | 200 MHz (accurately copied as the sine wave of the maximum frequency of the logic square wave; input amplitude is the minimum swing; the shortest the ground cable is required for the logic probe) |
| Inter-channel Time Delay           | 2 ns (typical), 5 ns (maximum)                                                                                                                                                                      |

## Acquisition System

| Acquisition System                   |                 |                                                                                                                                                                                                      |
|--------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Max. Sample Rate of Analog Channel   |                 | MSO5354/MSO5204/MSO5104/MSO5074:<br>8 GSa/s (single-channel), 4 GSa/s (half-channel) <sup>[1]</sup> , 2 GSa/s (all channels)<br>MSO5102/MSO5072:<br>8 GSa/s (single-channel), 2 GSa/s (all channels) |
| Max. Memory Depth of Analog Channel  | Standard        | 100 Mpts (single-channel), 50 Mpts (half-channel) <sup>[1]</sup> , 25 Mpts (all channels)                                                                                                            |
|                                      | 2RL(option)     | 200 Mpts (single-channel), 100 Mpts (half-channel) <sup>[1]</sup> , 50 Mpts (all channels)                                                                                                           |
| Max. Sample Rate of Digital Channel  |                 | 1 GSa/s (all channels)                                                                                                                                                                               |
| Max. Memory Depth of Digital Channel |                 | 25 Mpts (all channels)                                                                                                                                                                               |
| Acquisition Mode                     | Normal          | Default                                                                                                                                                                                              |
|                                      | Peak Detection  | Capture 500 ps glitches                                                                                                                                                                              |
|                                      | Average Mode    | 2, 4, 8, 16...65536 are available for you to choose, averaging point by point                                                                                                                        |
|                                      | High Resolution | 12 bits (max .)                                                                                                                                                                                      |

## Trigger System

| Trigger System      |                                                                                                 |
|---------------------|-------------------------------------------------------------------------------------------------|
| Trigger Source      | Analog channel (1~4), digital channel (D0~D15), AC Line                                         |
| Trigger Mode        | Auto, Normal, Single                                                                            |
| Trigger Coupling    | DC DC coupling trigger                                                                          |
|                     | AC AC coupling trigger                                                                          |
|                     | High Frequency Rejection High frequency rejection, cut-off frequency~55 kHz (internal only)     |
|                     | Low Frequency Rejection Low frequency rejection, cut-off frequency~55 kHz (internal only)       |
| Noise Rejection     | Increase delay for the trigger circuit (internal only), On/Off                                  |
| Holdoff Range       | 8 ns to 10 s                                                                                    |
| Trigger Bandwidth   | Analog bandwidth                                                                                |
| Trigger Sensitivity | 1 div or 5 mVpp, whichever is larger, <10mV/div                                                 |
|                     | 0.5 div, $\geq 10$ mV/div<br>Enable the noise rejection, with trigger sensitivity reducing half |

|               |           |                                           |
|---------------|-----------|-------------------------------------------|
| Trigger Level | Internal: | $\pm 5$ div from the center of the screen |
| Range         | AC Line   | Fixed 50%                                 |

## Trigger Type

| Trigger Type        |                                                                                                                                                                                                                                                                                                                                                          |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Zone Trigger        | Trigger in the rectangle area drawn manually, supporting trigger zone A and trigger zone B. The trigger conditions can be "Intersect" or "Not intersect"<br>Source channel: CH1~CH4; only one analog channel is triggered each time                                                                                                                      |
| 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, and Nth Edge trigger<br>Option: RS232, UART, I2C, SPI, CAN, FlexRay, LIN, I2S, and MIL-STD-1553                                                                |
| Edge                | Trigger on the threshold of the specified edge of the input signal. The edge types can be Rising, Falling, or Either.<br>Source channel: CH1~CH4, D0~D15, or AC Line                                                                                                                                                                                     |
| Pulse               | Trigger on the positive or negative pulse with a specified width. The pulse width is greater or smaller than a certain value or within a certain time range.<br>Source channel: CH1~CH4, D0~D15                                                                                                                                                          |
| Slope               | Trigger on the positive or negative slope of the specified time (800 ps~10 s). The slew time is greater or smaller than a certain value or within a certain time range.<br>Source channel: CH1~CH4                                                                                                                                                       |
| Video               | Trigger on all lines, specified line, add field, or even field that conforms to the video standards. The supported video standards include NTSC, PAL/SECAM, 480P, 576P, 720P, 1080P, and 1080i.<br>Source channel: CH1~CH4                                                                                                                               |
| Pattern             | Identifies a trigger condition by searching for a specified pattern. The pattern is a combination of multiple selected channel sources. The logic pattern of each channel is H, L, X, Rising, or Falling.<br>Source channel: CH1~CH4, D0~D15                                                                                                             |
| Duration            | Trigger 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, X. The duration is greater or smaller than a certain value, or within a certain time range, or outside a certain time range.<br>Source channel: CH1~CH4, D0~D15 |
| Timeout             | Trigger when duration of a certain event exceeds the specified time (16 ns~10 s). The event can be specified as Rising, Falling, or Either.<br>Source channel: CH1~CH4, D0~D15                                                                                                                                                                           |
| Runt                | Trigger when the pulses pass through one threshold but fail to pass through another threshold. The channel only supports analog channels<br>Source channel: CH1~CH4                                                                                                                                                                                      |
| Window              | Trigger 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.<br>Source channel: CH1~CH4                                                                                                                             |
| Delay               | Trigger when the time difference between the specified edges of Source A and Source B meets the preset time. The duration is greater or smaller than a certain value, or within a certain time range, or outside a certain time range.<br>Source channel: CH1~CH4, D0~D15                                                                                |
| Setup/Hold          | When the setup time or hold time between the input clock signal and the data signal is smaller than the specified time (8 ns~1 s).<br>Source channel: CH1~CH4, D0~D15                                                                                                                                                                                    |
| Nth Edge            | Trigger on the Nth edge that appears after the specified idle time. The edge can be specified as Rising or Falling.<br>Source channel: CH1~CH4, D0~D15                                                                                                                                                                                                   |
| RS232/UART (Option) | MSO5000-COMP option<br>Trigger on the Start, Error, Check Error, or Data frame of the RS232/UART bus (up to 20 Mb/s).<br>Source channel: CH1~CH4, D0~D15                                                                                                                                                                                                 |
| I2C (Option)        | MSO5000-EMBD option<br>Trigger on the Start, Stop, Restart, MissedACK, Address (7 bits, 8 bits, or 10 bits), Data, or Address Data of the I2C bus.<br>Source channel: CH1~CH4, D0~D15                                                                                                                                                                    |
| SPI (Option)        | MSO5000-EMBD option<br>Trigger on the specified pattern of the specified data width (4~32) of SPI bus. CS and Timeout are supported.<br>Source channel: CH1~CH4, D0~D15                                                                                                                                                                                  |
| CAN (Option)        | MSO5000-AUTO option<br>Trigger on the start of a frame, end of a frame, Remote ID, Overload, Frame ID, Frame Data, Data&ID, Frame Error, Answer Error, Check Error, Format Error, Bit Fill, and Random of the CAN signal (up to 5Mb/s). The supported CAN bus signal types include CAN_H, CAN_L, TX/RX, and DIFF.<br>Source channel: CH1~CH4, D0~D15     |
| FlexRay (Option)    | MSO5000-FLEX option<br>Trigger 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).<br>Source channel: CH1~CH4, D0~D15                                                     |
| LIN (Option)        | MSO5000-AUTO option<br>Trigger 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~CH4, D0~D15                                                                                                                                                                      |

|                       |                                                                                                                                                                                                                                                                                                                            |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I2S (Option)          | MSO5000–AUDIO option<br>Trigger on 2'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~CH4, D0~D15 (only available for the MSO5XX4 model or the model installed with the MSO5000–4CH option) |
| MIL–STD–1553 (Option) | MSO5000–AERO option<br>Trigger 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–1553 bus.<br>Source channel: CH1~CH4                                                                                                                        |

## Search&Navigation

| Search, Navigation, and Table |                                                                                                                                                    |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Type                          | Edge, Pulse, Runt, Slope, RS232, I2C, and SPI                                                                                                      |
| Source                        | Any analog channel                                                                                                                                 |
| Copy                          | Copy the search settings to the trigger settings, and copy from the trigger settings                                                               |
| Result Display                | Event table or navigation. Go to the specific event through the event table index                                                                  |
| Navigation                    | Memory playing: view the memory waveforms with the navigation keys by scrolling through stored waveform data, supporting viewing at three speeds.  |
|                               | ZOOM playing: view the details of waveforms with the navigation keys by panning the ZOOM window automatically, supporting viewing at three speeds. |
|                               | Recording playback: play back the recorded waveforms with the navigation keys.                                                                     |
|                               | Event navigation: use the navigation keys to scroll through the event search results.                                                              |

## 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             | Fix Y–axis to track X–axis waveform point's voltage and time values<br>Fix X–axis to track Y–axis waveform point's voltage and time values                                                         |
| Auto Measurement     | Auto Measurement       | Allow to display cursors during auto measurement                                                                                                                                                   |
|                      | XY Mode                | Measure the voltage parameters of the corresponding channel waveforms in XY time base mode.<br>X = Channel 1, Y = Channel 2                                                                        |
|                      | Number of Measurements | 41 auto measurements; and up to 10 measurements can be displayed at a time.                                                                                                                        |
|                      | Measurement Source     | CH1~CH4, Math1~Math4, and D0~D15                                                                                                                                                                   |
|                      | Measurement Mode       | Normal and Precision (full–memory hardware measurement)                                                                                                                                            |
|                      | Measurement Range      | Main, Zoom, and Cursor                                                                                                                                                                             |
|                      | All Measurement        | Display 33 measurement items for the current measurement channel; the measurement results are updated continuously; you can switch the measurement channel.                                        |
|                      | Vertical               | Vmax, Vmin, Vpp, Vtop, Vbase, Vamp, Vupper, Vmid, Vlower, Vavg, VRMS, Per.VRMS, Overshoot, Preshoot, Area, Per.Area, and Std.Dev.                                                                  |
|                      | Horizontal             | Period, Frequency, Rise Time, Fall Time, +Width, –Width, +Duty, –Duty, Positive Pulse Count, Negative Pulse Count, Rising Edge Count, Falling Edge Count, Tvmax, Tvmin, +Slew Rate, and –Slew Rate |
|                      | Others                 | Delay(A ↑ –B ↑), Delay(A ↑ –B ↓), Delay(A ↓ –B ↑), Delay(A ↓ –B ↓), Phase(A ↑ –B ↑), Phase(A ↑ –B ↓), Phase(A ↓ –B ↑), and Phase(A ↓ –B ↓)                                                         |
|                      | Analysis               | Counter, DVM, Bode, and UPA                                                                                                                                                                        |
|                      | Statistics             | Current, Average, Max, Min, Standard Deviation, Count<br>Statistical times settable                                                                                                                |

## Waveform Calculation

| Waveform Calculation  |                                                                                                                                     |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| No. of Math Functions | 4; 4 math functions available to be displayed at a time                                                                             |
| Operation             | A+B, A–B, A × B, A/B, FFT, A&&B, A  B, A^B, !A, Intg, Diff, Sqrt, Lg, Ln, Exp, Abs, AX+B, LowPass, HighPass, BandPass, and BandStop |
| Source                | CH1~CH4, D0~D15 (only available for A&&B, A  B, !A, and A^B), Math1~Math4, and Ref1~Ref10                                           |
| Color Grade           | Support Math and FFT                                                                                                                |



|              |               |                                                                                              |
|--------------|---------------|----------------------------------------------------------------------------------------------|
| Enhanced FFT | Record Length | Max. 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 |

## Waveform Analysis

| Waveform Analysis  |             |                                                                                                                                                                                                                                                           |
|--------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Waveform Recording |             | Store the signal under test in segments according to the trigger events, i.g. save all the sampled waveform data as a segment to the RAM for each trigger event. The maximum number of the sampled segments reaches 450,000.                              |
|                    | 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                                                                                                                                |
| 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                                                                                                                                                                                                                                        |
| 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 auto measurement item                                                                                                                                                                                                               |
|                    | Type        | Horizontal, Vertical, or Measure                                                                                                                                                                                                                          |
|                    | Measure     | Sum, Peaks, Max, Min, Pk_Pk, Mean, Median, Mode, Bin width, Sigma, and XScale                                                                                                                                                                             |
| Color Grade        | Mode        | Support all modes, except the Zoom, XY, and ROLL modes                                                                                                                                                                                                    |
|                    |             | Provide a dimensional view for color grade waveforms                                                                                                                                                                                                      |
|                    | Source      | Any analog channel                                                                                                                                                                                                                                        |
|                    | Color Theme | Temperature and intensity                                                                                                                                                                                                                                 |
|                    | Mode        | Support all modes                                                                                                                                                                                                                                         |

## Serial Decoding

| Serial Decoding     |                                                                                                                                                                                                                                                                                                                     |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of Decodings | 4, four protocol types can be supported at the same time                                                                                                                                                                                                                                                            |
| Decoding Type       | Standard: Parallel                                                                                                                                                                                                                                                                                                  |
|                     | Option: RS232, UART, I2C, SPI, LIN, CAN, FlexRay, I2S, and MIL–STD–1553                                                                                                                                                                                                                                             |
| Parallel            | Up to 20 bits of Parallel decoding, supporting the combination of any analog channel and digital channel. Support user-defined clock and auto clock settings.<br>Source channel: CH1~CH4, D0~D15                                                                                                                    |
| RS232/UART          | MSO5000–COMP option<br>Decode the RS232/UART (up to 20 Mb/s) bus's TX/RX data (5–9 bits), parity (Odd, Even, or None), and stop bits (1–2 bits)<br>Source channel: CH1~CH4, D0~D15                                                                                                                                  |
| I2C                 | MSO5000–EMBD option<br>Decode the address (with or without the R/W bit) of the I2C bus, data, and ACK.<br>Source channel: CH1~CH4, D0~D15                                                                                                                                                                           |
| SPI                 | MSO5000–EMBD option<br>Decode the MISO/MOSI data (4–32 bits) of the SPI bus. The available mode includes "Timeout" and "CS".<br>Source channel: CH1~CH4, D0~D15                                                                                                                                                     |
| LIN                 | MSO5000–AUTO option<br>Decode 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.<br>Source channel: CH1~CH4, D0~D15                                                                                                                             |
| CAN                 | MSO5000–AUTO option<br>Decode 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.<br>Source channel: CH1~CH4, D0~D15 |
| FlexRay             | MSO5000–FLEX option<br>Decode the frame ID, PL (payload), 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.<br>Source channel: CH1~CH4, D0~D15                                                                             |
| I2S                 | MSO5000–AUDIO option<br>Decode I2S audio bus left channel data and right channel data, supporting 4–32 bits. The alignment modes include I2S, LJ, and RJ.<br>Source channel: CH1~CH4, D0~D15 (only available for the MSO5XX4 model or the model installed with the MSO5000–4CH option)                              |

|              |                                                                                                                                                         |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| MIL-STD-1553 | MSO5000-AERO option<br>Decode the MIL-STD-1553 bus signal's data word, command word, and status word (address+last 11 bits).<br>Source channel: CH1~CH4 |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|

## Auto

|           |                                                                                   |
|-----------|-----------------------------------------------------------------------------------|
| Auto      |                                                                                   |
| AutoScale | Min voltage greater than 5 mVpp, duty cycle greater than 1%, frequency over 35 Hz |

## Arbitrary Waveform Generator

| Arbitrary Waveform Generator (technical specifications are typical values) (option) |                                                                                        |                                                        |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------|
| Number of Channels                                                                  | 2                                                                                      |                                                        |
| Output Mode                                                                         | Normal (2-channel output)                                                              |                                                        |
| Sample Rate                                                                         | 200 MSa/s                                                                              |                                                        |
| Vertical Resolution                                                                 | 14 bits                                                                                |                                                        |
| Max. Frequency                                                                      | 25 MHz                                                                                 |                                                        |
| Standard Waveform                                                                   | Sine, Square, Ramp, Pulse, DC, Noise                                                   |                                                        |
| Built-in Waveform                                                                   | Sinc, Exp.Rise, Exp.Fall, ECG, Gauss, Lorentz, Haversine                               |                                                        |
| Sine                                                                                | Frequency Range                                                                        | 100 mHz to 25 MHz                                      |
|                                                                                     | Flatness                                                                               | ± 0.5 dB (relative to 1 kHz)                           |
|                                                                                     | Harmonic Distortion                                                                    | -40 dBc                                                |
|                                                                                     | Spurious (non-harmonics)                                                               | -40 dBc                                                |
|                                                                                     | Total Harmonic Distortion                                                              | 1%                                                     |
|                                                                                     | S/N Ratio                                                                              | 40 dB                                                  |
| Square/Pulse                                                                        | Frequency Range                                                                        | Square: 100 mHz to 15 MHz<br>Pulse: 100 mHz to 1 MHz   |
|                                                                                     | Rise/Fall Time                                                                         | <15 ns                                                 |
|                                                                                     | Overshoot                                                                              | <5%                                                    |
|                                                                                     | Duty                                                                                   | Square: always be 50%<br>Pulse: 10% to 90%, adjustable |
|                                                                                     | Duty Cycle Resolution                                                                  | 1% or 10 ns (whichever is greater)                     |
|                                                                                     | Min. Pulse Width                                                                       | 20 ns                                                  |
|                                                                                     | Pulse Width Resolution                                                                 | 10 ns or 5 bits (whichever is greater)                 |
|                                                                                     | Jitter                                                                                 | 5 ns                                                   |
| Ramp                                                                                | Frequency Range                                                                        | 100 mHz to 100 kHz                                     |
|                                                                                     | Linearity                                                                              | 1%                                                     |
|                                                                                     | Symmetry                                                                               | 1% to 100%                                             |
| Noise                                                                               | Bandwidth                                                                              | >25 MHz                                                |
| Built-in Waveform                                                                   | Frequency Range                                                                        | 100 mHz to 1 MHz                                       |
| Arbitrary Waveform                                                                  | Frequency Range                                                                        | 100 mHz to 10 MHz                                      |
|                                                                                     | Waveform Length                                                                        | 2~16 kpts                                              |
|                                                                                     | Support loading channel waveforms (screen range and cursor range) and stored waveforms |                                                        |
| Frequency                                                                           | Accuracy                                                                               | 100 ppm (<10 kHz), 50 ppm (>10 kHz)                    |
|                                                                                     | Resolution                                                                             | 100 mHz or 4 bits (whichever is greater)               |
| Amplitude                                                                           | Output Range                                                                           | 20 mVpp~5 Vpp (HighZ), 10 mVpp~2.5 Vpp (50 Ω)          |
|                                                                                     | Resolution                                                                             | 100 uV or 3 bits (whichever is greater)                |
|                                                                                     | Accuracy                                                                               | ± (2% of setting+1 mV) (Frequency=1 kHz)               |
| DC Offset                                                                           | Range                                                                                  | ± 2.5 V (HighZ), ± 1.25 V (50 Ω)                       |
|                                                                                     | Resolution                                                                             | 100 uV or 3 bits (whichever is greater)                |
|                                                                                     | Accuracy                                                                               | ± (2% of offset setting+5 mV+0.5% of amplitude)        |

|            |                                   |                                                          |
|------------|-----------------------------------|----------------------------------------------------------|
| Modulation | AM, FM, FSK                       |                                                          |
|            | AM                                | Modulating Waveforms: Sine, Square, Triangle, and Noise. |
|            |                                   | Modulation Frequency: 1 Hz to 50 kHz                     |
|            |                                   | Modulation Depth: 0% to 120%                             |
|            | FM                                | Modulating Waveforms: Sine, Square, Triangle, and Noise. |
|            |                                   | Modulation Frequency: 1 Hz to 50 kHz                     |
|            |                                   | Modulation Offset: 1 Hz to carrier frequency             |
|            | FSK                               | Modulating Waveforms: 50% duty cycle square              |
|            |                                   | Modulation Frequency: 1 Hz to 50 kHz                     |
|            |                                   | Hopping Frequency: 100 mHz to max. carrier frequency     |
| Sweep      | Linear, Log, and Step             |                                                          |
|            | Sweep Time                        | 1 ms to 500 s                                            |
|            | Start Frequency and End Frequency | Any frequencies within the waveform range                |
| Burst      | N Cycle, Infinite                 |                                                          |
|            | Cycle Count                       | 1 to 1000000                                             |
|            | Burst Period                      | 1 $\mu$ s to 500 s                                       |
|            | Burst Delay                       | 0 s to 500 s                                             |
|            | Trigger Source                    | Internal, Manual                                         |

## Digital Voltmeter

Digital Voltmeter (technical specifications are typical values)

|                   |                                                                                                                  |
|-------------------|------------------------------------------------------------------------------------------------------------------|
| Source            | Any analog channel                                                                                               |
| Function          | DC, AC+DC RMS, and AC RMS                                                                                        |
| Resolution        | ACV/DCV: 3 bits                                                                                                  |
| Limits Beeper     | Sound an alarm when the voltage value is within or outside of the limit range.                                   |
| Range Measurement | Display the latest measurement results in the form of a diagram, and display the extrema over the last 3 seconds |

## High-precision Frequency Counter

High-precision Frequency Counter

|                |                                        |                                      |
|----------------|----------------------------------------|--------------------------------------|
| Source         | Any analog channel and digital channel |                                      |
| Measure        | Frequency, period, totalizer           |                                      |
| Counter        | Resolution                             | Max. 6 bits, user-defined            |
|                | Max. Frequency                         | Max. bandwidth of the analog channel |
| Totalizer      | 48-bit totalizer                       |                                      |
|                | Edge                                   | Count the number of the rising edges |
| Time Reference | Internal Reference                     |                                      |

## Customization for Quick Key

Customization for Quick Key

|                           |                                                                                                                        |
|---------------------------|------------------------------------------------------------------------------------------------------------------------|
| Quick Screenshot          | Quickly save the screen image to the specified path based on the current image storage menu settings.                  |
| Quick Waveform Save       | Quickly save the screen or memory waveforms to the specified path based on the current waveform storage menu settings. |
| Quick Save Settings       | Quickly save the setup file to the specified path based on the current setup storage menu settings.                    |
| Quick All Measurement     | Display all the prompt message windows for all the measurement of the waveforms.                                       |
| Quick Reset of Statistics | Quickly reset all the measurement statistics data and measurement counts.                                              |
|                           | Quickly reset all the statistics information in PassFail function.                                                     |
| Quick Waveform Recording  | Quickly start or stop the waveform recording.                                                                          |
| Quick Email Sending       | Quickly send the Email based on the set email address.                                                                 |
| Quick Print               | Quickly perform the print operation based on the current printer settings.                                             |
| Quick Group Saving        | Quickly perform the group saving function based on the currently selected item for saving.                             |



## Command Set

| Command Set                     |                    |
|---------------------------------|--------------------|
| Common Commands Support         | IEEE488.2 Standard |
| Error Message Definition        | Error messages     |
| Support Status Report Mechanism | Status reporting   |
| Support Syn Mechanism           | Synchronization    |

## Display

| Display     |                                                                |
|-------------|----------------------------------------------------------------|
| LCD         | 9-inch capacitive multi-touch screen/gesture enabled operation |
| Resolution  | 1024 × 600 (Screen Region)                                     |
| Graticule   | (10 vertical divisions) × (8 horizontal divisions)             |
| Persistence | Off, Infinite, variable persistence (100 ms to 10 s)           |
| Brightness  | 256 intensity levels (LCD,HDMI)                                |

## I/O

| I/O                          |                                                                                                                                                  |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| USB 2.0 Hi-speed Host Port   | 1 on the front panel                                                                                                                             |
| USB 2.0 Hi-speed Device Port | 1 on the rear panel, compatible with USB Test and Measurement Class (USBTMC)                                                                     |
| LAN                          | 1 on the rear panel, 10/100/1000-port, supporting LXI-C                                                                                          |
| GPIB                         | GPIB-USB adapter (option)                                                                                                                        |
| Web Remote Control           | Support VNC Web 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.<br>Vo (H) ≥ 2.5 V open circuit, ≥ 1.0 V 50 Ω to GND<br>Vo (L) ≤ 0.7 V to load ≤ 4 mA; ≤ 0.25 V 50 Ω to GND         |
|                              | Trigger Output      Output a pulse signal when the oscilloscope is triggered.                                                                    |
|                              | Pass/Fail              Output a pulse signal when a pass/fail event occurs. Supports user-defined pulse polarity and pulse time (100 ns~10 ms).  |
| HDMI video output            | 1 on the rear panel, HDMI 1.4b, A plug. used to connect to an external monitor or projector                                                      |
| Probe Compensation Output    | 1 kHz, 3 Vpp square waveform                                                                                                                     |

## Power

| Power Supply  |                                                |
|---------------|------------------------------------------------|
| Power Voltage | 100 V~240 V, 45 Hz~440 Hz                      |
| Power         | Max. 75 W (connect to various interfaces, USB) |
| Fuse          | 4 A, T degree, 250 V                           |

## Bode

| Bode (option)    |                                           |
|------------------|-------------------------------------------|
| Start Frequency  | 10 Hz to 25 MHz                           |
| Stop Frequency   | 100 Hz to 25 MHz                          |
| Points/Decade    | 10 to 300                                 |
| Output Amplitude | HighZ: 20 mV to 5 V; 50 Ω: 10 mV to 2.5 V |

## Environment

| Environmental Stress |               |                                                |
|----------------------|---------------|------------------------------------------------|
| Temperature Range    | Operating     | 0°C~+50°C                                      |
|                      | Non-operating | -30°C~+70°C                                    |
| Humidity Range       | Operating     | Below +30°C: ≤90% RH (without condensation)    |
|                      |               | +30°C to +40°C, ≤75% RH (without condensation) |
|                      | Non-operating | +40°C to +50°C, ≤45% RH (without condensation) |
|                      |               | Below 65°C: ≤90% RH (without condensation)     |
| Altitude             | Operating     | Below 3,000                                    |
|                      | Non-operating | Below 15,000                                   |

## Warranty and Calibration Interval

| Warranty and Calibration Interval |           |
|-----------------------------------|-----------|
| Warranty                          | 3 years   |
| 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 $\pm 4.0$ kV (contact discharge), $\pm 8.0$ 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                                                                                                                                                                      |
| Safety                        | 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                                                  |
|                               | IEC 61010-1:2010 (Third Edition)/EN 61010-1:2010, UL 61010-1:2012 R4.16 and CAN/CSA-C22.2 NO. 61010-1-12+ GI1+ GI2                                                                                                         |
| Vibration                     | Meet GB/T 6587; class 2 random<br>Meets MIL-PRF-28800F and IEC60068-2-6; class 3 random                                                                                                                                    |
| Shock                         | Meet GB/T 6587-2012; class 2 random<br>Meet MIL-PRF-28800F and IEC60068-2-27; class 3 random<br>(in non-operating conditions: 30 g, half sine, 11 ms duration, 3 vibrations along the main axis, a total of 18 vibrations) |

## Mechanical Characteristics

| Mechanical Characteristics |                                      |
|----------------------------|--------------------------------------|
| Dimensions <sup>[4]</sup>  | 367 mm (W) × 200 mm (H) × 130 mm (D) |
| Weight <sup>[5]</sup>      | Package Excluded      <3.5 kg        |
|                            | Package Included      <5.8 kg        |
| Rack Mount Kit             | 5U                                   |

## Non-volatile Memory

| Non-volatile Memory |                                                                                                                                                                                          |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data/File Storage   | Setup/Image      setup (*.stp), image (*.png, *.bmp, *.tif, *.jpg)                                                                                                                       |
|                     | Waveform Data      CSV waveform data (*.csv), binary waveform data (*.bin, *.wfm), list data (*.csv), reference waveform data (*.ref, *.csv, *.bin), and arbitrary waveform data (*.arb) |
| Reference Waveform  | Display 10 internal waveforms, and its storage is limited by the capacity                                                                                                                |
| Setting             | Storage is limited by the capacity                                                                                                                                                       |
| USB Capacity        | Support the USB storage device that conforms to the industry standard                                                                                                                    |

Note[1]: Half-channel mode: CH1 and CH2 are considered as a group; CH3 and CH4 are considered as another group. Each group share the same ADC sample, and either one of the channels in each group is enabled.

Note[2]: Maximum value, single-channel, 10 ns horizontal time base, input amplitude 4 div, sine wave signal with 10 MHz frequency. Others are default settings.

Note[3]: 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.

Note[4]: Supporting legs and handle folded, knob height included, front protective cover excluded.

Note[5]: Standard configuration.

# Order Information

| Order Information                                                                                                                                                   | Order No.           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Model</b>                                                                                                                                                        |                     |
| MSO5354 (350 MHz, 8 GSa/s, 100 Mpts, 4+16 CH MSO)                                                                                                                   | MSO5354             |
| MSO5204 (200 MHz, 8 GSa/s, 100 Mpts, 4+16 CH MSO)                                                                                                                   | MSO5204             |
| MSO5104 (100 MHz, 8 GSa/s, 100 Mpts, 4+16 CH MSO)                                                                                                                   | MSO5104             |
| MSO5102 (100 MHz, 8 GSa/s, 100 Mpts, 2+16 CH MSO)                                                                                                                   | MSO5102             |
| MSO5074 (70 MHz, 8 GSa/s, 100 Mpts, 4+16 CH MSO)                                                                                                                    | MSO5074             |
| MSO5072 (70 MHz, 8 GSa/s, 100 Mpts, 2+16 CH MSO)                                                                                                                    | MSO5072             |
| <b>Standard Accessories</b>                                                                                                                                         |                     |
| Power cord conforming to the standard of the destination country                                                                                                    | –                   |
| USB cable                                                                                                                                                           | CB-USBA-USBB-FF-150 |
| 2 or 4 passive probes (350 MHz)                                                                                                                                     | PVP2350             |
| Quick guide (hard copy)                                                                                                                                             | –                   |
| <b>Optional Accessories</b>                                                                                                                                         |                     |
| 16 digital channels active logic probe (dedicated probe for MSO5000 series)                                                                                         | PLA2216             |
| Front panel cover                                                                                                                                                   | MSO5000-FPC         |
| Rack mount kit                                                                                                                                                      | MSO5000-RM          |
| USB-GPIB interface converter                                                                                                                                        | USB-GPIB            |
| Near-field probe                                                                                                                                                    | NFP-3               |
| Power analysis phase difference correction jig                                                                                                                      | RPA246              |
| Digital oscilloscope demonstration plate                                                                                                                            | DK-DS6000           |
| <b>Bandwidth Upgrade Option</b>                                                                                                                                     |                     |
| Bandwidth upgrades from 70 MHz to 100 MHz                                                                                                                           | MSO5000-BW0T1       |
| Bandwidth upgrades from 70 MHz to 200 MHz                                                                                                                           | MSO5000-BW0T2       |
| Bandwidth upgrades from 70 MHz to 350 MHz                                                                                                                           | MSO5000-BW0T3       |
| Bandwidth upgrades from 100 MHz to 200 MHz                                                                                                                          | MSO5000-BW1T2       |
| Bandwidth upgrades from 100 MHz to 350 MHz                                                                                                                          | MSO5000-BW1T3       |
| Bandwidth upgrades from 200 MHz to 350 MHz                                                                                                                          | MSO5000-BW2T3       |
| <b>Memory Depth Option</b>                                                                                                                                          |                     |
| Maximum memory depth up to 200 Mpts                                                                                                                                 | MSO5000-2RL         |
| <b>Channel Number Upgrade Option</b>                                                                                                                                |                     |
| Upgrade the number of analog channels to 4 (only available for the MSO5XX2 model)                                                                                   | MSO5000-4CH         |
| <b>Bundle Option</b>                                                                                                                                                |                     |
| Function and application bundle option, including MSO5000-COMP, MSO5000-EMBD, MSO5000-AUTO, MSO5000-FLEX, MSO5000-AUDIO, MSO5000-AERO, MSO5000-AWG, and MSO5000-PWR | MSO5000-BND         |
| <b>Serial Protocol Analysis Option</b>                                                                                                                              |                     |
| PC serial bus trigger and analysis (RS232/UART)                                                                                                                     | MSO5000-COMP        |
| Embedded serial bus trigger and analysis (I2C and SPI)                                                                                                              | MSO5000-EMBD        |
| Auto serial bus trigger and analysis (CAN and LIN)                                                                                                                  | MSO5000-AUTO        |
| FlexRay serial bus trigger and analysis (FlexRay)                                                                                                                   | MSO5000-FLEX        |
| Audio serial bus trigger and analysis (I2S, only available for the MSO5XX4 model or the model installed with the MSO5000-4CH option)                                | MSO5000-AUDIO       |
| MIL-STD-1553 serial bus trigger and analysis (MIL-STD-1553)                                                                                                         | MSO5000-AERO        |
| <b>Measurement Application Option</b>                                                                                                                               |                     |
| Dual-channel 25 MHz arbitrary waveform generator                                                                                                                    | MSO5000-AWG         |
| Built-in Power Analysis                                                                                                                                             | MSO5000-PWR         |

Note: For all the mainframes, accessories and options, please contact the local office of **RIGOL**.

## Warranty Period

Three years for the mainframe, excluding the probes and accessories

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