

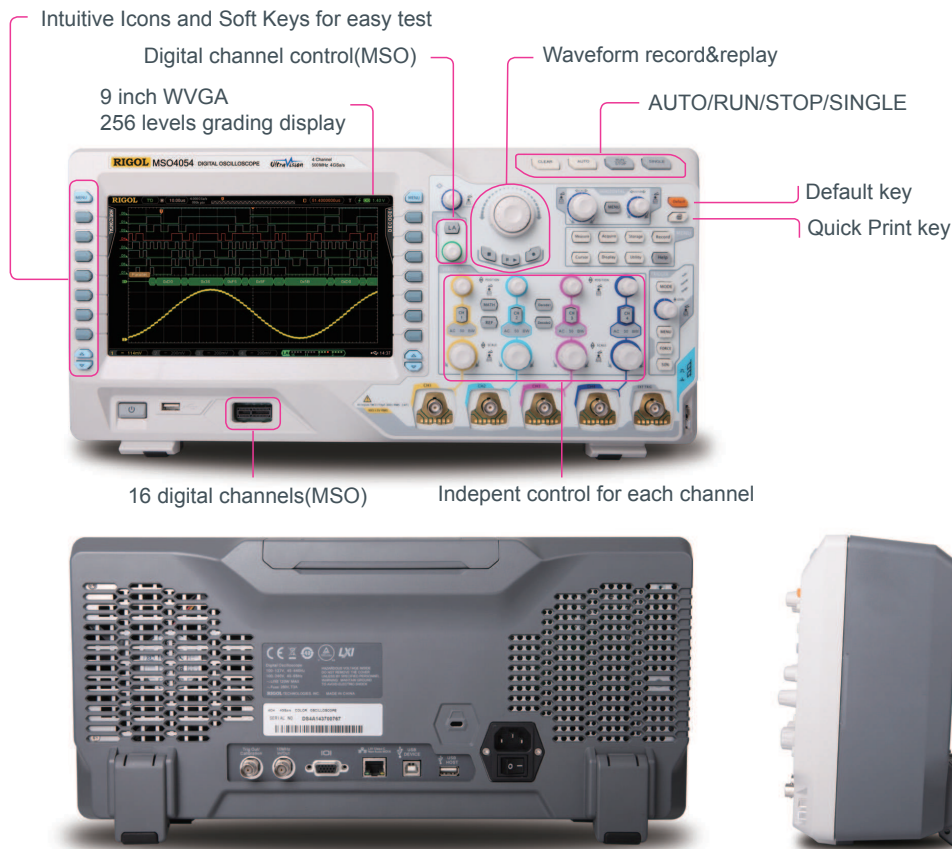
## MSO/DS4000 Series Digital Oscilloscope

- Bandwidth 500MHz, 350MHz, 200MHz, 100MHz
- Sample Rate: Analog channel up to 4 GSa/s, Digital channel up to 1 GSa/s(MSO)
- Standard Memory depth: Analog channel up to 140 Mpts, Digital channel up to 28 Mpts(MSO)
- 2 or 4 Analog channels, 16 Digital channels(MSO)
- Waveform capture rate Up to 110,000 waveforms per second,
- Real Time Waveform Record, Replay & Analysis (Std. up to 200,000 frames)
- Lower noise floor, the Min. vertical sensitivity is 1mV/div
- Innovative "UltraVision" technology
- A variety of Trigger functions
- Support serial bus trigger(Std.) and decoding(Opt.) for both analog and digital channels
- Support bandwidth update for 200MHz and 350MHz bandwidth models
- Complete Connectivity: USB Host& Device, LAN(LXI-C), VGA, AUX, USB-GPIB(Opt.)
- 9 inch WVGA(800X480), 256 level intensity grading display

MSO/DS4000 Series is the new mainstream digital scope to meet the customer's applications with its innovative technology, industry leading specifications, powerful trigger functions and broad analysis capabilities.



# MSO/DS4000 Series Digital Oscilloscope



Product Dimensions: Width X Height X Depth = 440.0mm X 218.0 mm X 130.0 mm Weight: 4.8 kg ± 0.2 kg (Without Package)

## ► Innovative UltraVision technology(Analog Channel)



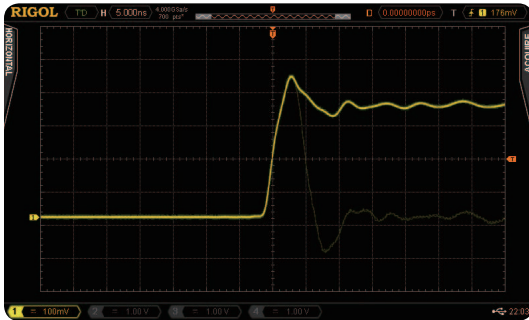
- Deeper Memory Depth(Std.140M pts)
- Higher Waveform capture rate (Up to 110,000wfms/s)
- Real Time waveform record & replay(Up to 200,000 frames)
- Multi-level intensity grading display(Up to 256 levels)

## ► Models and key Specs

Model Number	DS4054	DS4052	DS4034	DS4032	DS4024	DS4022	DS4014	DS4012
	MSO4054	MSO4052	MSO4034	MSO4032	MSO4024	MSO4022	MSO4014	MSO4012
Analog BW	500 MHz		350 MHz		200 MHz		100 MHz	
Aanalog Channels	4	2	4	2	4	2	4	2
Digital Channels(MSO)	16							
Max. Sample rate	Analog Channel: Max. 4 GSa/s single channel, 2GSa/s dual channel Digital Channel: Max. 1 GSa/s per channel							
Max. Memory Depth	Analog Channel: Std. up to 140 Mpts single channel,70 Mpts dual channel Digital Channel: Std. up to 28 Mpts per channel							
Waveform Capture rate	Up to 110,000 wfms/s(Digital channel Closed); 85,000 wfms/s(Digital channel Opened)							
Real Time waveform Record, Replay and Analysis function	Analog channel:Up to 200,000 frames(Std.) Digital channel:Up to 64,000 frames(Std.)							
Std. Probes	2 or 4 sets RP3500A 500MHz BW Passive Probe; 1 set RPL2316 LA Probe(MSO only)							

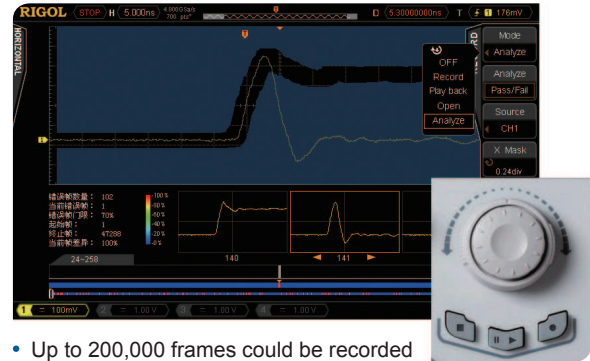
## ► Features and Benefits

UltraVision: Up to 110K Waveforms/s Waveform capture rate



Find the infrequent problem easily

UltraVision: Realtime waveform record, replay, analysis function (std.)



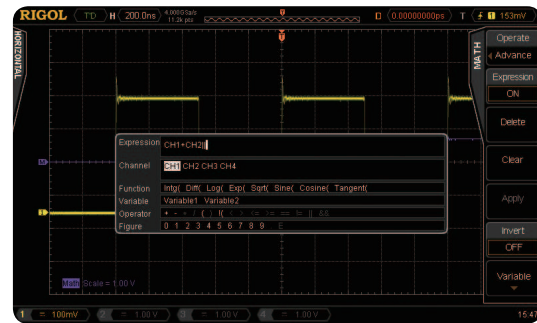
- Up to 200,000 frames could be recorded
- “WaveFinder”-Dedicated data search knob
- Replay and analyze the recorded waveforms

UltraVision: Deeper Memory with up to 256-Level intensity grading display



Provide the capability to see both the panorama and detail simultaneously

Advanced math function (user defined)

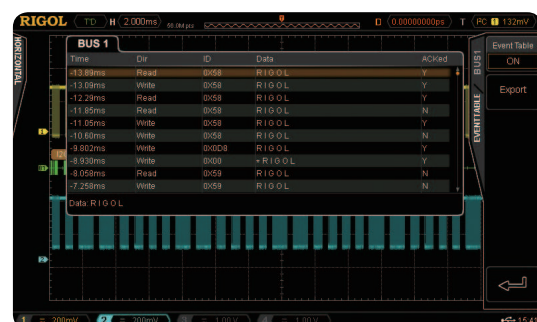


Mask test functions



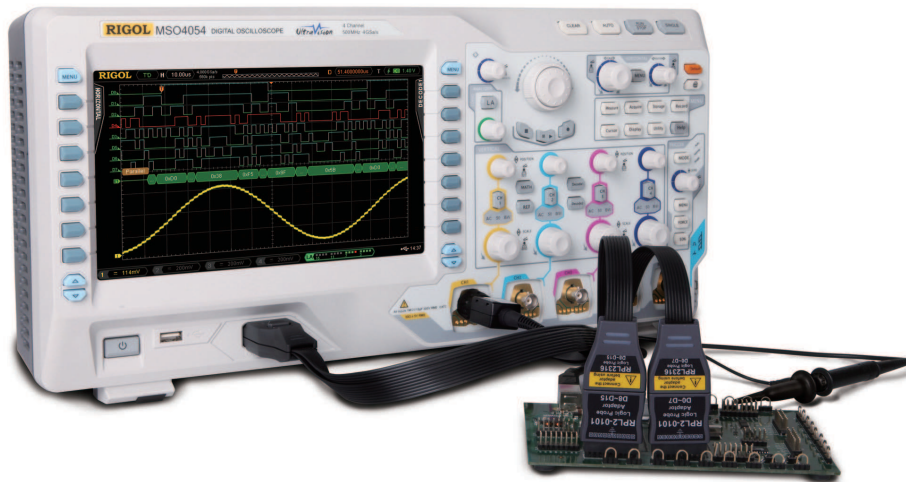
User defined Mask, Pass/Fail counts, Stop on Fail, Fail Alarm

Serial bus Triggering and Decoding (Support both Analog and Digital channels)





## ► MSO4000 Series Mixed Signal Oscilloscope



Besides the powerful functions of DS4000, you could get more from MSO4000 with:

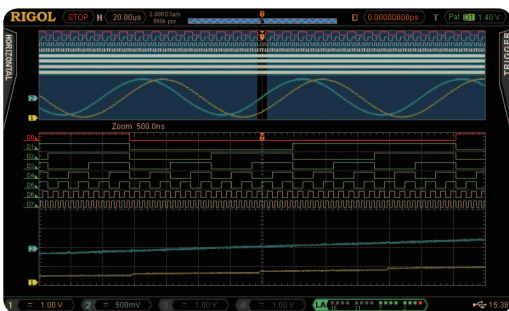
- 16 Digital channels
- Sample rate of Digital channel up to 1 GSa/s
- Memory depth of Digital channel up to 28Mpts per channel
- Waveform capture rate of Digital channel up to 85,000wfms/s
- Real Time Waveform Record, Replay and analysis functions, up to 64,000 frames
- Triggering and Decoding across Analog and Digital channels
- Easy to be grouped for digital channels
- Support a variety of logic levels
- Time correlation display for both analog and digital signals

Innovative UltraVision technology(Digital Channel)

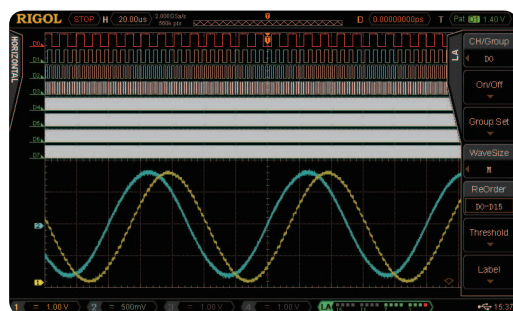
*UltraVision*

- Deeper Memory Depth(Std.28M pts per channel)
- Higher Waveform capture rate (Up to 85,000wfms/s)
- Real Time waveform record & replay(Up to 64,000 frames)
- Multi-level intensity grading display

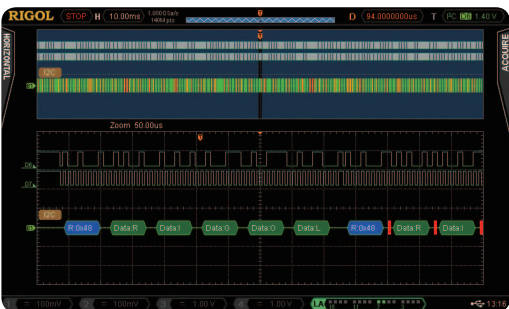
Mixed Signal Analysis with analog and digital channels



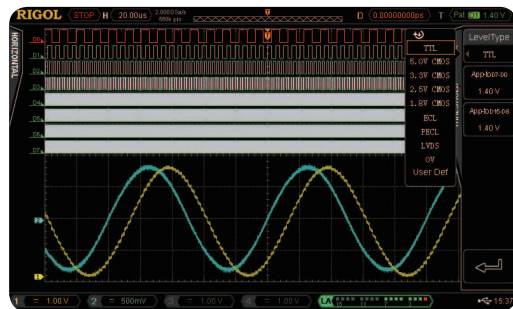
Easy to be grouped and labeled for digital channels



Serial bus triggering and decoding on digital channels












Support a variety of logic levels



# RIGOL Digital Scope Probes

## ► RIGOL Passive Probes

Model Number	Type	Description
 RP2200	High Z Probe	1X: DC~7MHz 10X:DC~150MHz Compatibility: All RIGOL Scopes.
 RP3300A	High Z Probe	10X:DC~350MHz Compatibility: All RIGOL Scopes.
 RP3500A	High Z Probe	DC~500MHz Compatibility: All RIGOL Scopes.
 RP5600A	High Z Probe	DC~600MHz Compatibility: DS4000,6000 Series.
 RP6150A	Low Z Probe	DC~1.5GHz Compatibility: DS4000,6000 Series.
 RP1300H	High Voltage Probe	DC~300MHz CATI 2000V(DC+AC), CATII 1500 V(DC+AC) Compatibility: All RIGOL Scopes.
 RP1010H	High Voltage Probe	DC~40MHz DC:0~10kV DC AC:Pulse ≤ 20kVpp AC:Sine ≤ 7kVrms Compatibility: All RIGOL Scopes
 RP1018H	High Voltage Probe	DC~150MHz DC+AC peak 18kV AC RMS 12kV Compatibility: All RIGOL scopes
 RPL2316		Logic analysis Probe(For MSO2000A and MSO4000)

## ► RIGOL Active & Current Probes

Model Number	Type	Description
 RP7150	Differential /Single ended Probe	BW:DC~1.5GHz,30V Peak, CAT I Compatibility: DS4000, 6000 series.
 RP1001C	Current Probe	BW:DC~300kHz, Max.DC: ± 100A, AC P-P:200A,AC RMS:70A Compatibility: All RIGOL Scopes.
 RP1002C	Current Probe	BW:DC~1MHz, Max.DC: ± 70A, AC P-P:140A,AC RMS:50A Compatibility: All RIGOL Scopes.
 RP1003C	Current Probe	BW:DC~50MHz, Max.AC RMS:30A AC Peak:50A(Noncontinuous) Compatibility: All RIGOL Scopes. Must order RP1000P Power supply.
 RP1004C	Current Probe	BW:DC~100MHz, Max. AC RMS:30A, AC Peak:50A(Noncontinuous) Compatibility: All RIGOL Scopes. Must order RP1000P Power supply.
 RP1005C	Current Probe	BW:DC~10MHz, Max.150 A rms, 300 A peak (Noncontinuous), 500 A peak (@pulse width ≤30 ms) Compatibility: All RIGOL Scopes. Must order RP1000P Power supply.
 RP1000P	Power Supply	Power supply for RP1003C,RP1004C,RP1005C, support 4 channels.
 RP1025D	High Voltage Differential Probe	BW:25MHz; Max. Voltage ≤ 1400Vpp Compatibility: All RIGOL Scopes.
 RP1050D	High Voltage Differential Probe	BW:50MHz; Max. Voltage ≤ 7000Vpp Compatibility: All RIGOL Scopes.
 RP1100D	High Voltage Differential Probe	BW:100MHz; Max. Voltage ≤ 7000Vpp Compatibility: All RIGOL scopes

## ► Specifications

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

### Sample

Sample Mode	Real-time sample
Real-time Sample Rate	Analog channel: 4.0 GSa/s (single-channel); 2.0 Gsa/s (dual-channel) Digital channel: 1.0 Gsa/s
Peak Detect	Analog channel: 250 ps (single-channel); 500 ps (dual-channel) Digital channel: 1 ns
Averaging	After all the channels finish N samples at the same time, N can be 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096 or 8192.
High Resolution	12 bit of resolution When $\geq 5 \mu\text{s}/\text{div}$ @ 4 GSa/s (or $\geq 10 \mu\text{s}/\text{div}$ @ 2 GSa/s).
Memory Depth	Analog channel: Single-channel: Auto, 14k pts, 140k pts, 1.4M pts, 14M pts and 140M pts are available Dual-channel: Auto, 7k pts, 70k pts, 700k pts, 7M pts and 70M pts are available Digital channel: maximum 28 M pts

### Input

Number of Channels	MSO40X4: four-analog-channel + 16-digital-channel MSO40X2: dual-analog-channel + 16-digital-channel DS40X4: four-channel DS40x2: dual-channel
Input Coupling	DC, AC or GND
Input Impedance	Analog channel: $(1\text{M}\Omega \pm 1\%) \parallel (14 \text{ pF} \pm 3 \text{ pF})$ or $50 \Omega \pm 1.5\%$ Digital channel: $(101 \text{ k}\Omega \pm 1\%) \parallel (9 \text{ pF} \pm 1 \text{ pF})$
Probe Attenuation Coefficient	Analog channel: 0.01X-1000X 1-2-5 step
Max Input Voltage (1M $\Omega$ )	Maximum input voltage of the analog channel CAT I 300 Vrms, CAT II 100 Vrms, transient overvoltage 1000 Vpk With RP2200 10:1 probe: CAT II 300 Vrms With RP3300 10:1 probe: CAT II 300 Vrms With RP3500 10:1 probe: CAT II 300 Vrms With RP5600 10:1 probe: CAT II 300 Vrms Digital channel: CAT I 40Vrms, transient overvoltage 800 Vpk

### Horizontal

Time Base Scale	MSO405X/DS405X: 1 ns/div to 1000 s/div MSO403X/DS403X: 2 ns/div to 1000 s/div MSO402X/DS402X: 2 ns/div to 1000 s/div MSO401X/DS401X: 5 ns/div to 1000 s/div
Time Base Accuracy	$\leq \pm 4 \text{ ppm}$
Time Base Drift	$\leq \pm 2 \text{ ppm/Year}$
Delay Range	Pre-trigger (negative delay): $\geq 1$ screen width Post-trigger (positive delay): 1 s to 1000 s
Time Base Mode	Y-T, X-Y, Roll, Delayed
Number of X-Ys	2 paths at the same time (four-channel model)
Waveform Capture Rate <sup>1</sup>	110,000 wfms/s(Dots display, Digital channel Closed); 85,000 wfms/s(Digital channel Opened)

### Vertical(Analog Channel)

Bandwidth (-3dB)	MSO405X/DS405X: DC to 500 MHz MSO403X/DS403X: DC to 350 MHz MSO402X/DS402X: DC to 200 MHz MSO401X/DS401X: DC to 100 MHz
Single Bandwidth	MSO405X/DS405X: DC to 500 MHz MSO403X/DS403X: DC to 350 MHz MSO402X/DS402X: DC to 200 MHz MSO401X/DS401X: DC to 100 MHz
Vertical Resolution	Analog channel: 8 bit, two channels sample at the same time Digital channel: 1bit

Vertical Scale	1 mV/div to 5 V/div (1 M $\Omega$ ) 1 mV/div to 1 V/div (50 $\Omega$ )
Offset Range	1 mV/div to 124 mV/div: $\pm 1.2$ V (50 $\Omega$ ) 126 mV/div to 1 V/div: $\pm 12$ V (50 $\Omega$ ) 1 mV/div to 225 mV/div: $\pm 2$ V (1M $\Omega$ ) 230 mV/div to 5 V/div: $\pm 40$ V (1M $\Omega$ )
Bandwidth Limit <sup>2</sup>	MSO405X/MO403X/DS405X/DS403X: 20 MHz/100 MHz/200 MHz MSO402X/DS402X: 20 MHz/100 MHz MSO401X/DS401X: 20 MHz
Low Frequency Response (AC coupling, -3dB)	$\leq 5$ Hz (on BNC)
Rise Time <sup>2</sup>	MSO405X/DS405X: 700 ps MSO403X/DS403X: 1 ns MSO402X/DS402X: 1.8 ns MSO401X/DS401X: 3.5 ns
DC Gain Accuracy	$\pm 2\%$ full scale
DC Offset Accuracy	200 mV/div to 5 V/div: 0.1 div $\pm 2$ mV $\pm 0.5\%$ offset 1 mV/div to 195 mV/div: 0.1 div $\pm 2$ mV $\pm 1.5\%$ offset
ESD Tolerance	$\pm 2$ kV
Channel to Channel Isolation	DC to maximum bandwidth: $>40$ dB

## Vertical (Digital Channel)

Threshold	1 group with 8 channels adjustable threshold
Threshold selected	TTL (1.4 V) 5.0 V CMOS (+2.5 V), 3.3 V CMOS (+1.65 V) 2.5 V CMOS (+1.25 V), 1.8 V CMOS (+0.9 V) ECL (-1.3 V) PECL (+3.7 V) LVDS (+1.2 V) 0 V User
Threshold range	$\pm 20.0$ V, with 10 mV step
Threshold accuracy	$\pm 100$ mV+3% of threshold setting
Dynamic range	$\pm 10$ V + threshold
Min Voltage Swing	500 mVpp
Vertical resolution	1 bit

## Trigger

Trigger Level Range	Internal	$\pm 6$ div from the center of the screen
	EXT	$\pm 0.8$ V
Trigger Mode	Auto, Normal, Single	
Holdoff Range	100 ns to 10 s	
High Frequency Rejection <sup>2</sup>	50 kHz	
Low Frequency Rejection <sup>2</sup>	5 kHz	
<b>Edge Trigger</b>		
Edge Type	Rising, Falling, Rising&Falling	
<b>Pulse Trigger</b>		
Pulse Condition	Positive Pulse Width (greater than, lower than, within specified interval) Negative Pulse Width (greater than, lower than, within specified interval)	
Pulse Width Range	4 ns to 4 s	
<b>Runt Trigger</b>		
Pulse Condition	None, > (greater than), < (lower than), <> (within the specified interval)	
Polarity	Positive, Negative	
Pulse Width Range	4 ns to 4 s	
<b>Nth Edge Trigger</b>		
Edge Type	Rising, Falling	
Idle Time	40 ns to 1 s	
Number of Edges	1 to 65535	
<b>Slope Trigger</b>		
Slope Condition	Positive Slope (greater than, lower than, within specified interval) Negative Slope (greater than, lower than, within specified interval)	
Time Setting	10 ns to 1 s	

Video Trigger	
Signal Standard	Support standard NTSC, PAL and SECAM broadcasting standards Support 480P, 576P, 720P, 1080P and 1080I HDTV standards
Pattern Trigger	
Pattern Setting	H, L, X, Rising Edge, Falling Edge
RS232/UART Trigger	
Trigger Condition	Start, Error, Check Error, Data
Polarity	Normal, Invert
Baud	2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, User
Data Bits	5 bit, 6 bit, 7 bit, 8 bit
I2C Trigger	
Trigger Condition	Start, Restart, Stop, Missing Ack, Address, Data, A&D
Address Bits	7 bit, 8 bit, 10 bit
Address Range	0 to 127, 0 to 255, 0 to 1023
Byte Length	1 to 5
SPI Trigger	
Trigger Condition	CS, TimeOut
Timeout Value	100 ns to 1 s
Data Bits	4 bit to 32 bit
Data Line Setting	H, L, X
Clock Edge	Rising edge, Falling edge
CAN Trigger	
Signal Type	Rx, Tx, CAN_H, CAN_L, Differential
Trigger Condition	SOF, EOF, Frame Type, Frame Error
Baud	10 kbps, 20 kbps, 33.3 kbps, 50 kbps, 62.5 kbps, 83.3 kbps, 100 kbps, 125 kbps, 250 kbps, 500 kbps, 800 kbps, 1 Mbps, User
Sample Point	5% to 95%
Frame Type	Data, Remote, Error, OverLoad
Error Type	Bit Fill, Answer Error, Check Error, Format Error, Random Error
FlexRay Trigger	
Baud	2.5 Mb/s, 5 Mb/s, 10 Mb/s
Trigger Condition	Frame, Symbol, Error, TSS
USB Trigger	
Signal Speed	Low Speed, Full Speed
Trigger Condition	SOP, EOP, RC, Suspend, ExitSuspend

## Measure

Cursor	Manual mode	Voltage deviation between cursors ( $\Delta V$ ) Time deviation between cursors ( $\Delta T$ ) Reciprocal of $\Delta T$ (Hz) ( $1/\Delta T$ )
	Track mode	Voltage and time values of the waveform point
	Auto mode	Allow to display cursors during auto measurement
Auto Measurement	Measurements of Maximum, Minimum, Peak-Peak Value, Top Value, Bottom Value, Amplitude, Average, Mean Square Root, Overshoot, Pre-shoot, Area, Period Area, Frequency, Period, Rise Time, Fall Time, Positive Pulse Width, Negative Pulse Width, Positive Duty Cycle, Negative Duty Cycle, Delay A→B $\uparrow$ , Delay A→B $\downarrow$ , Phase A→B $\uparrow$ , Phase A→B $\downarrow$	
Number of Measurements	Display 5 measurements at the same time	
Measurement Range	Screen Region or Cursor Region	
Measurement Statistic	Average, Max, Min, Standard Deviation, Number of Measurements	
Counter	Hardware 6 bits counter (channels are selectable)	

## Math

Waveform Operation	A+B, A-B, A×B, A/B, FFT, Editable Advanced Operation, Logic Operation
FFT Window	Rectangle, Hanning, Blackman, Hamming
FFT Display	Split, Full Screen
FFT Vertical Scale	dB, Vrms
Logic Operation	AND, OR, NOT, XOR
Math Function	Intg, Diff, Log, Exp, Sqrt, Sine, Cosine, Tangent
Number of Buses for Decoding	2
Decoding Type	Parallel (standard), RS232 /UART (option), I2C (option), SPI (MSO4XX4/DS4XX4 option), CAN (option), FlexRay (option)



## Display

Display Type	9 inches (229 mm) TFT LCD display
Display Resolution	800 horizontal×RGB×480 vertical pixel
Display Color	160,000 color
Persistence Time	Min, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s, 5 s, 10 s, 20 s, Infinite
Display Type	Dots, Vectors
Real-time Clock	Time and Date (user adjustable)

## I/O

Standard Ports	Dual USB HOST, USB DEVICE, LAN, VGA output, 10MHz input/output, Aux output (TrigOut, Fast, GND, PassFail, Calibration)
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## General Specifications

<b>Probe Compensation Output</b>		
Output Voltage <sup>2</sup>	About 3 V, peak-peak	
Frequency <sup>2</sup>	1 kHz	
<b>Power</b>		
Power Voltage	100-120 V/50Hz/60Hz/400Hz 100-240 V/50 Hz/60Hz	
Power	Maximum 120 W	
Fuse	3 A, T degree, 250 V	
<b>Environment</b>		
Temperature Range	In operation: 0°C to +50°C Out of operation: -40°C to +70°C	
Cooling Method	Fan	
Humidity Range	0°C to 30°C : ≤95°C relative humidity +30°C to +40°C : ≤75°C relative humidity +40°C to +50°C : ≤45°C relative humidity	
Altitude	In operation: under 3,000 meters Out of operation: under 15,000 meters	
<b>Mechanical</b>		
Dimensions <sup>3</sup>	Width×Hight×Depth =440.0 mm× 218.0 mm×130.0 mm	
Weight <sup>4</sup>	Without package	4.8 kg ± 0.2 kg
	With package	7.1 kg ± 1.0kg
<b>Adjustment Interval</b>		
The recommended calibration interval is one year.		
<b>Regulation Standards</b>		
Electromagnetic Compatibility	2004/108/EC Execution standard EN 61326-1:2006 EN 61326-2-1:2006	
safety	UL 61010-1:2004; CAN/CSA-C22.2 NO. 61010-1-2004; EN 61010-1:2001; IEC 61010-1:2001	

1. Maximum value. In single-channel mode, sine signal with 10 ns horizontal scale, 4 div input amplitude and 10 MHz frequency, edge trigger.

2. Typical.

3. Tilt tabs and handle folded, knob height included, front panel cover excluded.

4. Standard configuration.

## ► Ordering Information

	Description	Order Number	
Model	DS4012(100 MHz, 4 GSa/s, 140Mpts, 2-channel Digital Oscilloscope)	DS4012	
	DS4014(100 MHz, 4 GSa/s, 140Mpts, 4-channel Digital Oscilloscope)	DS4014	
	DS4022(200 MHz, 4 GSa/s, 140Mpts, 2-channel Digital Oscilloscope)	DS4022	
	DS4024(200 MHz, 4 GSa/s, 140Mpts, 4-channel Digital Oscilloscope)	DS4024	
	DS4032(350 MHz, 4 GSa/s, 140Mpts, 2-channel Digital Oscilloscope)	DS4032	
	DS4034(350 MHz, 4 GSa/s, 140Mpts, 4-channel Digital Oscilloscope)	DS4034	
	DS4052(500 MHz, 4 GSa/s, 140Mpts, 2-channel Digital Oscilloscope)	DS4052	
	DS4054(500 MHz, 4 GSa/s, 140Mpts, 4-channel Digital Oscilloscope)	DS4054	
	MSO4012(100 MHz, 4 GSa/s, 140Mpts, 2+16 channel Digital Oscilloscope)	MSO4012	
	MSO4014(100 MHz, 4 GSa/s, 140Mpts, 4+16 channel Digital Oscilloscope)	MSO4014	
	MSO4022(200 MHz, 4 GSa/s, 140Mpts, 2+16 channel Digital Oscilloscope)	MSO4022	
	MSO4024(200 MHz, 4 GSa/s, 140Mpts, 4+16 channel Digital Oscilloscope)	MSO4024	
	MSO4032(350 MHz, 4 GSa/s, 140Mpts, 2+16 channel Digital Oscilloscope)	MSO4032	
	MSO4034(350 MHz, 4 GSa/s, 140Mpts, 4+16 channel Digital Oscilloscope)	MSO4034	
	MSO4052(500 MHz, 4 GSa/s, 140Mpts, 2+16 channel Digital Oscilloscope)	MSO4052	
	MSO4054(500 MHz, 4 GSa/s, 140Mpts, 4+16 channel Digital Oscilloscope)	MSO4054	
	Standard Accessories	Power Cord conforming to the standard of the country	-
		Front Panel Cover	FPCS-DS4000
USB Data Cable		CB-USBA-USBB-FF-150	
2 or 4 Passive Probes (500 MHz)		RP3500A	
1 Set logic analysis probe		RPL2316	
Quick Guide		-	
Optional Accessories	Resource CD (User's Guide and Application Software)	-	
	Active Differential Probe (1.5 GHz)	RP7150	
	Rack Mount Kit	RM-DS4000	
Decoding options	RS232/UART Decoding Kit	SD-RS232-DS4000	
	I2C/SPI Decoding Kit	SD-I2C/SPI-DS4000	
	CAN Decoding Kit	SD-CAN-DS4000	
	FlexRay Decoding Kit	SD-FlexRay-DS4000	
Bandwidth update option	Bandwidth upgrade form 200MHz to 350MHz for MSO/DS402x	BW2T3-MSO/DS4000	
	Bandwidth upgrade form 200MHz to 500MHz for MSO/DS402x	BW2T5-MSO/DS4000	
	Bandwidth upgrade form 350MHz to 500MHz for MSO/DS403x	BW3T5-MSO/DS4000	

## Warranty

Three –year warranty, excluding probes and accessories.



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[www.rigol.com](http://www.rigol.com)

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