Specifications

Sample

Sample Mode	Real-time sample
Real-time Sample Rate	Analog channel: 4.0 GSa/s (interleaved); 2.0 GSa/s (non-interleaved) Digital channel: 1.0 GSa/s
Peak Detect	Analog channel: 250 ps (interleaved); 500 ps (non-interleaved) 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 ≥5 μs/div @ 4 GSa/s (or ≥10 μs/div @ 2 GSa/s).
Minimum Detectable Pulse Width	Digital channel: 5 ns
Memory Depth	Analog channel: Interleaved: Auto, 14 kpts, 140 kpts, 1.4 Mpts, 14 Mpts and 140 Mpts are available Non-interleaved: Auto, 7 kpts, 70 kpts, 700 kpts, 7 Mpts and 70 Mpts are available Digital channel: maximum 28 Mpts

Input

Number of Channels	MSO40X4: 4-analog-channel + 16-digital-channel MSO40X2: 2-analog-channel + 16-digital-channel DS40X4: 4-channel DS40X2: 2-channel
Input Coupling	DC, AC or GND
Input Impedance	Analog channel: (1 MΩ±1%) || (15 pF±3 pF) or 50 Ω±1.5% Digital channel: (101 kΩ±1%) || (9 pF±1 pF)
Probe Attenuation Coefficient	Analog channel: 0.01X to 1000X, in 1-2-5 step
Maximum Input Voltage (1 MΩ)	Analog channel: CAT I 300 Vrms, CAT II 100 Vrms, transient overvoltage 1000 Vpk with RP2200 10:1 probe: CAT II 300 Vrms with RP3300A 10:1 probe: CAT II 300 Vrms with RP3500A 10:1 probe: CAT II 300 Vrms with RP5600A 10:1 probe: CAT II 300 Vrms Digital channel: CAT I 40 Vrms, transient overvoltage 800 Vpk

Horizontal

Time Base Scale	MSO405X/DS405X: 1 ns/div to 1 ks/div MSO403X/DS403X: 2 ns/div to 1 ks/div MSO402X/DS402X: 2 ns/div to 1 ks/div MSO401X/DS401X: 5 ns/div to 1 ks/div
Deviation between Channels	1 ns (typical), 2 ns (maximum)
Max. Recording Length	140 Mpts
Time Base Accuracy	≤ ±4 ppm
Time Base Drift	≤ ±2 ppm/year
Delay Range	Pre-trigger (negative delay): Memory Depth/Sample Rate Post-trigger (positive delay): 1 s to 100 ks
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	110,000 wfms/s (digital channels are turned off, dots display) or 85,000 wfms/s (digital channels are turned on, dots display)
Zero Offset	±0.5 div*minimum time base scale

Vertical (Analog Channel)

Bandwidth (-3 dB) (50 Ω)	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 (50 Ω)	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: 1 bit
Vertical Scale	1 MΩ input impedance: 1 mV/div to 5 V/div 50 Ω input impedance: 1 mV/div to 1 V/div
Offset Range	1 MΩ input impedance: 1 mV/div to 225 mV/div: ±2 V 230 mV/div to 5 V/div: ±40 V 50 Ω input impedance: 1 mV/div to 124 mV/div: ±1.2 V 126 mV/div to 1 V/div: ±12 V
Dynamic Range	±5 div
Bandwidth Limit	MSO405X/DS405X: 20 MHz/100 MHz/200 MHz MSO403X/DS403X: 20 MHz/100 MHz/200 MHz MSO402X/DS402X: 20 MHz/100 MHz MSO401X/DS401X: 20 MHz
Low Frequency Response (AC coupling, -3 dB)	≤5 Hz (on BNC)
Calculated Rise Time	MSO405X/DS405X: 700 ps MSO403X/DS403X: 1 ns MSO402X/DS402X: 1.8 ns MSO401X/DS401X: 3.5 ns
DC Gain Accuracy	±2% full scale
DC Offset Accuracy	200 mV/div to 5 V/div: ±0.1 div ± 2 mV ± 0.5% offset 1 mV/div to 195 mV/div: ±0.1 div ± 2 mV ± 1.5% offset
ESD Tolerance	±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	±20.0 V, with 10 mV step
Threshold Accuracy	±(100 mV + 3% of threshold setting)
Dynamic Range	±10 V + threshold
Min Voltage Swing	500 mVpp
Input Resistance	//101 kΩ
Probe Load	≈8 pF
Vertical Resolution	1 bit

Trigger

Trigger Level Range	Internal: ±6 div from center of the screen EXT: ±0.8 V
Trigger Mode	Auto, Normal, Single
Holdoff Range	100 ns to 10 s
High Frequency Rejection	50 kHz
Low Frequency Rejection	5 kHz
Edge Trigger	
Edge Type	Rising, Falling, Rising&Falling
Pulse Trigger	
Pulse Condition	Positive Pulse Width (greater than, lower than, within specific interval); Negative Pulse Width (greater than, lower than, within specific interval)
Pulse Width Range	4 ns to 4 s
Runt Trigger	
Pulse Polarity	Positive, Negative
Qualifier	None, >, <, <>
Pulse Width Range	4 ns to 4 s
Nth Edge Trigger	
Edge Type	Rising, Falling
Idle Time	40 ns to 1 s
Number of Edges	1 to 65535
Slope Trigger	
Slope Condition	Positive Slope (greater than, lower than, within specific interval); Negative Slope (greater than, lower than, within specific interval)
Time Setting	10 ns to 1 s
Video Trigger	
Polarity	Positive, Negative
Synchrony	All Lines, Line Num, Odd Field, Even Field
Signal Standard	NTSC, PAL/ECAM, 480P, 576P, 720P, 1080P and 1080I
Pattern Trigger	
Pattern Setting	H, L, X, Rising Edge, Falling Edge
RS232/UART Trigger	
Polarity	Normal, Invert
Trigger Condition	Start, Error, Check Error, Data
Baud	2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, 230400 bps, 460800 bps, 921600 bps, 1Mbps, 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, o 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, Exit Suspend

Measure

Cursor	Manual mode: Voltage deviation between cursors (△V), time deviation between cursors (△T), reciprocal of △T (Hz) (1/△T) Track mode: voltage and time values of the waveform point Auto mode: allow to display cursors during auto measurement
Auto Measurement	Analog channel: Maximum, Minimum, Peak-Peak Value, Top Value, Bottom Value, Amplitude, Average, Vrms–N, Vrms-1, Overshoot, Pre-shoot, Area, Period Area, Period, Frequency, Rise Time, Fall Time, Positive Pulse Width, Negative Pulse Width, Positive Duty Cycle, Negative Duty Cycle, Delay A→B, Delay A→B, Delay A→B, Delay A→B, Phase A→B, Phase A→B, Phase A→B, Phase A→B Digital channel: Frequency, Period, Positive Pulse Width, Negative Pulse Width, Positive Duty Cycle, Negative Duty Cycle, Delay A→B, Delay A→B, Delay A→B, Delay A→B, Phase A→B, Phase A→B, Phase A→B, Phase A→B
Number of Measurements	Display 5 measurements at the same time.
Measurement Range	Screen Region, Cursor Region
Statistic Mode	Extremum, Difference
Measurement Statistic	Average, Max, Min, Standard Deviation, Number of Measurements
Frequency Counter	Hardware 6 bits frequency counter (channels are selectable)

Math Operation

Waveform Operation	A+B, A-B, A×B, A÷B, FFT, Digital Filter, Editable Advanced Operation, Logic Operation
FFT Window	Rectangle, Hanning, Blackman, Hamming
FFT Display	Split, Full Screen
FFT Vertical Scale	Vrms, dB
Logic Operation	AND, OR, NOT, XOR
Math Function	Intg, Diff, Lg, Ln, Exp, Abs, Square, Sqrt, Sine, Cosine, Tangent

Decoding

Number of Buses	2
Decoding Type	Parallel (standard), RS232/UART (optional), I2C (optional), SPI (optional), CAN (optional), FlexRay (optional)
Parallel	Combine the sample data of the source channel waveforms as a parallel multi-channel bus and display the data as a single bus value
RS232/UART	Display the input signal(s) of the TX source channel or/and RX source channel as bus
I2C	Display the input signal of the SDA source channel as bus
SPI	Display the input signal(s) of the MISO source channel or/and MOSI source channel as bus
CAN	Display the input signal of the source channel (Rx, Tx, CAN_H, CAN_L or differential) as bus
FlexRay	Display the input signal of the source channel (BP, BM or RX/TX) as bus

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, 10 MHz Input/Output, Aux Output (TrigOut, Fast, PassFail, GND)
Printer Compatibility	PictBridge

General Specifications

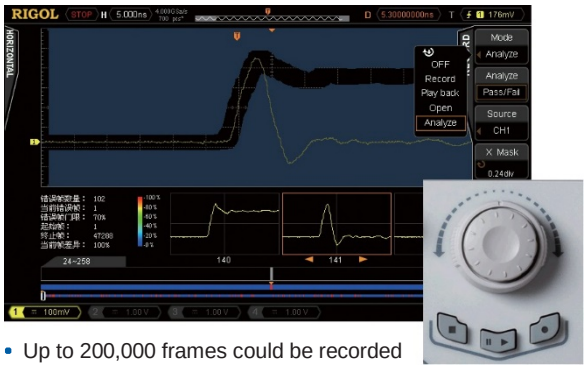
Probe Compensation Output		
Output Voltage	About 3 V, peak-peak	
Frequency	1 kHz	
Power		
Power Voltage	100 to 127 V, 45 to 440Hz 100 to 240 V, 45 to 65Hz	
Power	Maximum 120 W	
Fuse	3 A, T degree, 250 V	
Environment		
Temperature Range	Operating: 0℃ to +50℃	
	Non-operating: -40℃ to +70℃	
Cooling Method	Fan	
Humidity Range	0℃ to +30℃ : ≤95% relative humidity	
	+30℃ to +40℃ : ≤75% relative humidity	
	+40℃ to +50℃ : ≤45% relative humidity	
Altitude	Operating: under 3,000 meters	
	Non-operating: under 15,000 meters	
Physical Characteristics		
Size	Width×Height×Depth = 440.0 mm×218.0 mm×130.0 mm	
Weight	Package Excluded	4.8 kg±0.2 kg
	Package Included	7.1 kg±1.0 kg
Adjustment Interval		
The recommended calibration interval is one year.		
Regulatory Information		
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	

Features and Benefits

UltraVision: up to 110,000 wfms/s waveform capture rate

Find the infrequent problem easily

UltraVision: real-time waveform record, playback and analysis functions (standard)

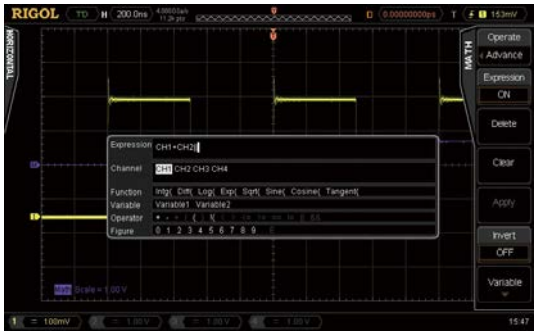


- Up to 200,000 frames could be recorded
- "WaveFinder"-dedicated data search knob
- Play back and analyze the recorded waveforms

UltraVision: deeper memory with up to 256-level intensity grading display

Provide the capability to see both the panorama and detail simultaneously

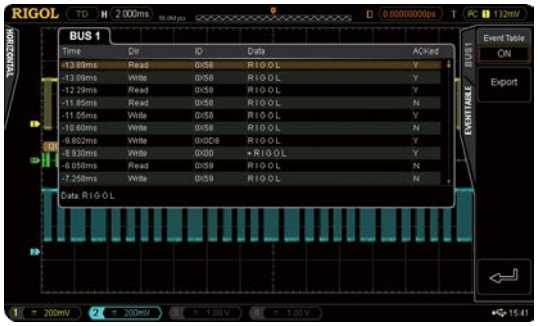
Advanced math function (user defined)



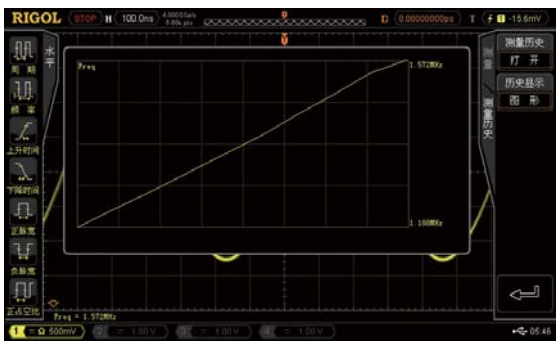
Mask test functions

User defined mask, Pass/Fail counts, stop on fail, fail alarm

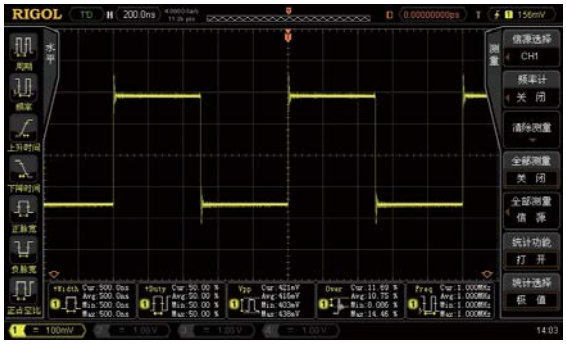
Serial bus triggering and decoding (supports both analog and digital channels)



Automatic measurements with statistics



Measurement history: show the trend of the parameters

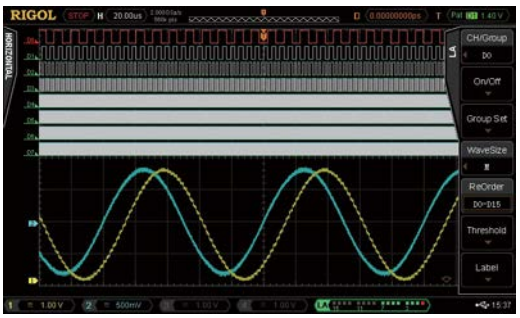


MSO Series Mixed Signal Oscilloscope

- 16 digital channels
- Sample rate of digital channel up to 1 GSa/s
- Memory depth of digital channel up to 28 Mpts per channel
- Waveform capture rate of digital channel up to 85,000 wfms/s
- Hardware real-time waveform record and playback functions, up to 64,000 frames can be recorded
- Triggering and decoding across analog and digital channels
- Easy to be grouped for digital channels
- Supports a variety of logic levels
- Time correlated display for both analog and digital channel waveforms

Mixed signal analysis with analog and digital channels

Easy to be grouped and labeled for digital channels



Deeper memory depth for the digital channels, serial bus triggering and decoding on digital channels

Supports a variety of logic levels