UNI-T

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MSO2000X Series Mixed Signal Oscilloscope

Datasheet

V1.2

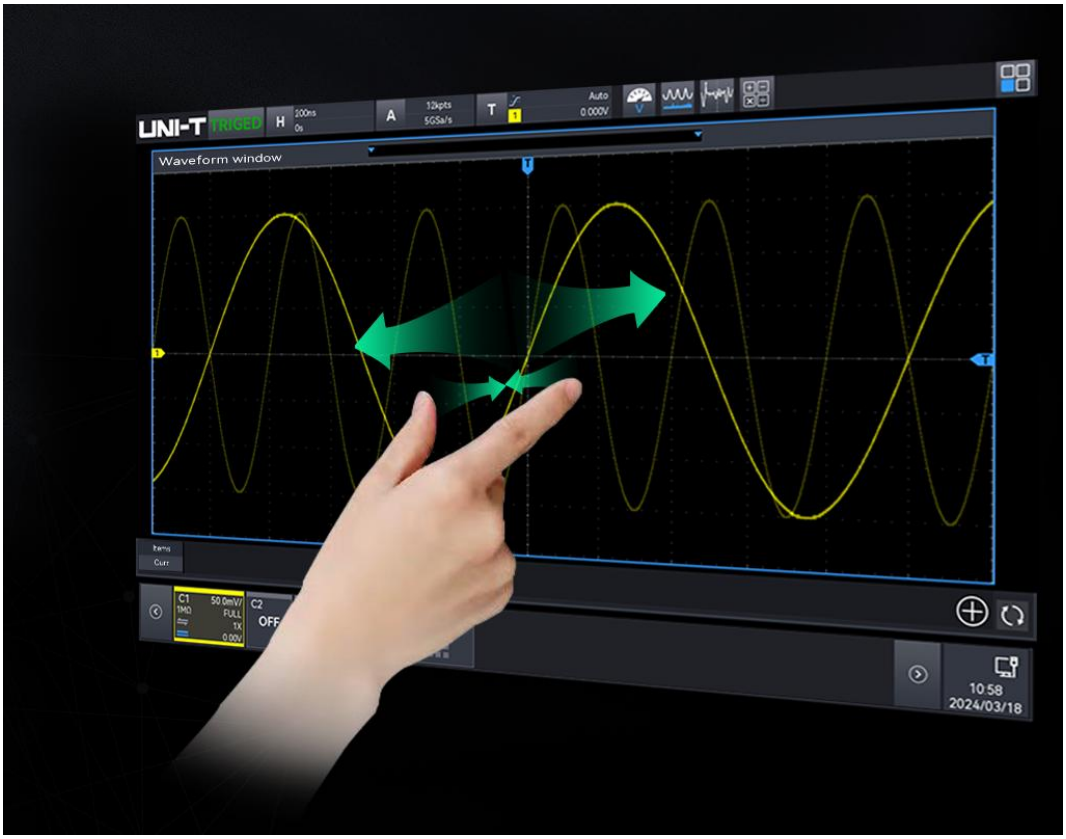
November 2024

Product Introduction

MSO2000X series mixed signal oscilloscope with the maximum bandwidth of 300 MHz, maximum sampling rate of 5 GSa/s and equipped with 4 analog channels and 16 digital channels, the memory depth up to 100 Mpts/CH. MSO2000X has unique Ultra Phosphor 3.0 technology, the waveform capture rate is up to 2,000,000 wfms/s, 256 grey temperature color, innovative digital trigger system with high trigger sensitivity and low jitter. This oscilloscope supports multiple advanced triggers, serial bus trigger and decoding, and supports the advanced sampling and analysis mode of spectrum analyzing, power analysis, histogram, waveform recording, enhanced resolution (ERES), hardware acceleration template testing, Search and Navigate. In addition, this oscilloscope has multiple measurements and mathematical operations. The MSO2000X series features a 10.1-inch capacitive touch screen that supports multiple gestures for common waveform operations. With the addition of one-touch keys on the front panel, this design significantly enhances oscilloscope operation efficiency and elevates the overall user experience.

Mainstream touchscreen design, intelligent interactive experience

The 10.1-inch HD capacitive multi-touch screen supports a variety of gesture operations, including touch, drag, zoom, and rectangle drawing, making the interface more intuitive and user-friendly. While retaining traditional key and knob controls, the instrument also supports mouse and keyboard input, offering versatile operation options and significantly enhancing the interactive experience.



Brand new appearance design

Innovative instrument appearance, double thinning design; The display is horizontal with the panel, improving the touch operation texture and visual range; Screen edge black frame decoration + white body, the whole machine introduction atmosphere.

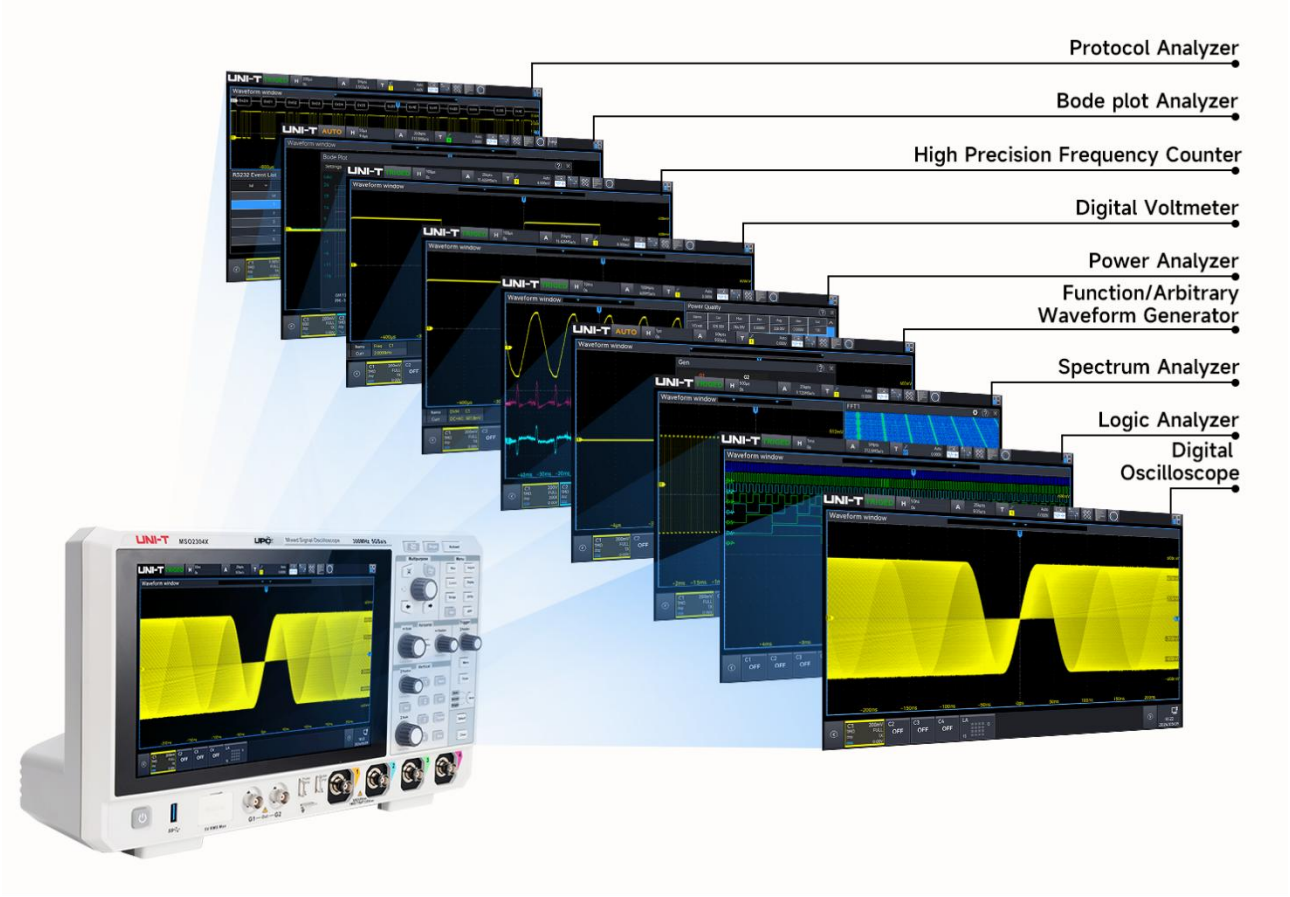
Features and advantage

- Analog channel bandwidth: 300 MHz/200 MHz/100 MHz
- Real-time sampling rate of the analog channel is up to 5 GSa/s. The maximum sampling rate of the digital channel is 1.25 GSa/s
- 4 analog channels, 16 digital channels. Maximum memory depth: 100 Mpts
- The maximum waveform capture rate is 500,000 wfms/s (sequence mode: 2,000,000 wfms/s)
- 9 instrument functions: Digital Oscilloscope, Logic Analyzer (requires UT-M15), Function/Arbitrary Waveform Generator (option), Spectrum Analyzer, Digital Voltmeter, Frequency Counter, Protocol Analyzer, Bode Plot Analyzer and Power Analyzer (option)
- Built-in dual-channel 50MHz function/arbitrary waveform generator. Supports loading on-screen oscilloscope data for real-time arbitrary waveform output. Additionally, it includes multiple built-in arbitrary waveforms, enhancing its versatility and functionality.
- Bode plot loop test analysis to analyze the system stability
- Parameter measurement adds histogram and line graph display
- Up to 125,000 frames of uninterrupted hardware real-time waveform recording and analysis, with USB memory export support waveform recording and analyze
- Maximum 4 Mpts enhanced FFT, supporting the spectrum analyzer function of frequency setting, waterfall curve, detection setting and marker
- 54 kinds of parameter measurement
- Multi-channel 7-digit hardware frequency counter, supporting adjustable frequency refresh time and effective digit
- 4-digit Digital Voltmeter (DVM): DC, AC RMS and DC+AC RMS
- Multiple trigger types: edge, pulse width, ramp, runt pulse, over-amplitude pulse, delay, timeout, duration, setup & hold, Nth edge and code pattern
- Protocol trigger and decoding functions. Included: RS232/UART, I2C, SPI. Optional: CAN, CAN-FD, LIN, FlexRay, AUDIO, SENT
- Zone triggering for capturing accidental signal and observing complicated signal
- Ultra Phosphor 3.0 super phosphor display effect, up to 256 grey display
- 10.1-inch 1280x800 HD capacitive multi-touch screen, supporting gesture control: click, slide, zoom, edit and drag
- Multiple peripheral interfaces: USB 3.0 Host, USB 3.0 Device, LAN, EXT Trig, AUX Out (Trig Out, Pass/Fail, DVM), Gen Out, HDMI
- SCPI (Standard Command for Programmable Instrument)
- Built-in Webserver for accessing and controlling the instrument through browser, supporting PC/Mobile phone device for cross-platform access to the instrument

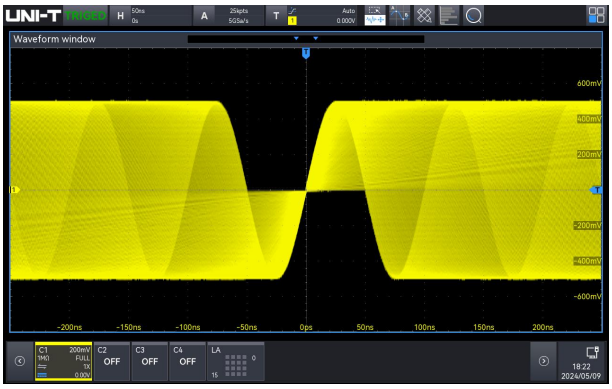
Design Features

Cost-effective Nine-in-One integrated oscilloscope

MSO2000X series integrates 9 instrument functions, which includes Digital Oscilloscope, Logic Analyzer, Function/Arbitrary Waveform Generator, Spectrum Analyzer, Digital Voltmeter, High-Precision Frequency Counter, Protocol Analyzer, Bode plot Analyzer and Power Analyzer. This oscilloscope offers a cost-effective solution for users.



Digital Oscilloscope



- Bandwidth: 100 MHz/200 MHz/300 MHz
- Maximum real-time sampling rate: 5GSa/s
- Maximum memory depth: 100 Mpts
- 4 analog channels, 1 external trigger channel

Logic Analyzer (Option)

- 16-channel logic analyzer can be used with purchase of a UT-M15 logic analyzer probe (option)
- Logic analyzer software already installed
- Maximum sampling rate: 1.25 GSa/s
- Maximum memory depth: 100 Mpts
- Minimum detectable pulse width 800ps
- Digital probe provides high 8-bit and low 8-bit signal input port, it simplifies the connection of DUT. When connecting to a square pins, UT-M15 can be connected directly to 8x2 square pins 2.54 mm

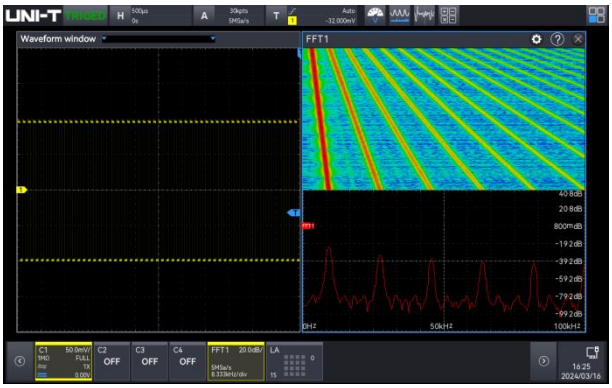
- Logic analyzer probe UT-M15 has great electrical feature, the input impedance is 101 Ω±1%, but the capacitive load is only 9.0 pF

Function/Arbitrary Waveform Generator (Option)

- 50 MHz equivalent performance dual channel Output
- Sampling rate: 250 MSa/s
- Vertical resolution: 16-bit
- Built-in multiple standard waves: Sine, square, pulse, ramp, arbitrary, noise and DC
- AM, FM, ASK, FSK and sweep output

Spectrum Analyzer

- Standard enhanced FFT, up to 4 Mpts, 4 channels signal analysis
- Frequency range: 0 Hz to 1.25 GHz
- Waterfall curve
- 4 traces and 4 detections
- Mark type: Auto, manual and threshold
- Marker point list

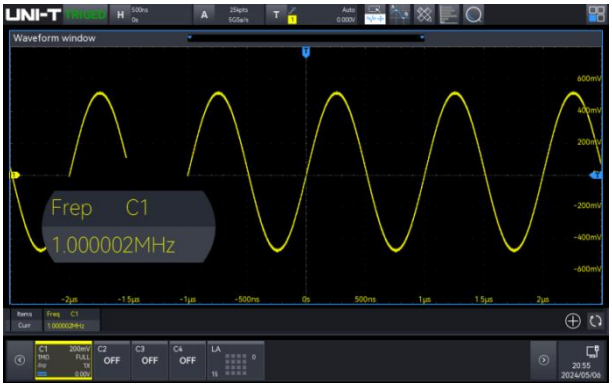


Digital Voltmeter

- 4-digit voltmeter
- DC/ACRMS/AC+DCRMS
- Limit alarm

High-Precision Frequency Counter

- 7-digit hardware frequency counter
- Adjustable frequency counter refresh time and effective digit
- Totalizer



Bode Plot Analyzer

- Included with Function/Arbitrary Waveform Generator option
- Frequency response analysis
- Loop stability analysis
- Filter analysis
- Amplifier analysis

Protocol Analyzer

- 9 kinds of trigger protocol and decoding, including computer serial bus, embedded serial bus, automobile, aerospace and audio
- Decoding can be operated in the pause and record modes
- Event list and search function

Option name	Description	Option model	Standard/Option
Computer serial bus triggering and decoding	RS-232/422/485/UART	-	Standard
Embedded serial bus triggering and decoding	I2C, SPI	-	Standard
Automobile serial bus triggering and decoding	CAN	MSO2000X-CAN	Option
Automobile serial bus triggering and decoding	LIN	MSO2000X-LIN	Option
Automobile serial bus triggering and decoding	CAN-FD	MSO2000X-CAN-FD	Option
Automobile serial bus triggering and decoding	FlexRay	MSO2000X-FLEX	Option
Automobile sensor bus triggering and decoding	SENT	MSO2000X-SENT	Option
Audio serial bus triggering and decoding	Audio	MSO2000X-AUDIO	Option

Power Analyzer (Option)

With the development of chip technology, the power supply system requirements are also increased. When the power supply network of small voltage and high current has been the trend, especially for the chip or the power supply network composed of precision components, the requirements of the various parts of the circuit reliable power supply and noise suppression, but also to ensure that the integrity of the signal transfer between the chip, the power supply test has ushered in a greater challenge. The designer is more concerned about the energy-saving power supply and the response speed to ensure that the power supply is stable and clean.

Based on the currently tendency, the power integrity testing is particularly important, it directly affects the signal integrity, and in turn the signal quality also reflects the power quality, and even

power quality will cause a series of electromagnetic interference problems, which makes the designer more headaches. So having an oscilloscope that can analyze the power supply is undoubtedly your most correct choice.

MSO2000X provides a full range of power analysis tools and evaluation results, you only need to select the appropriate analysis type, connecting the voltage probe and the current probe to the test point of power system or specified test fixtures as shown in the diagram, connecting to the channel that you want to observe, and then finally make appropriate fine-tuning to get the results you want.

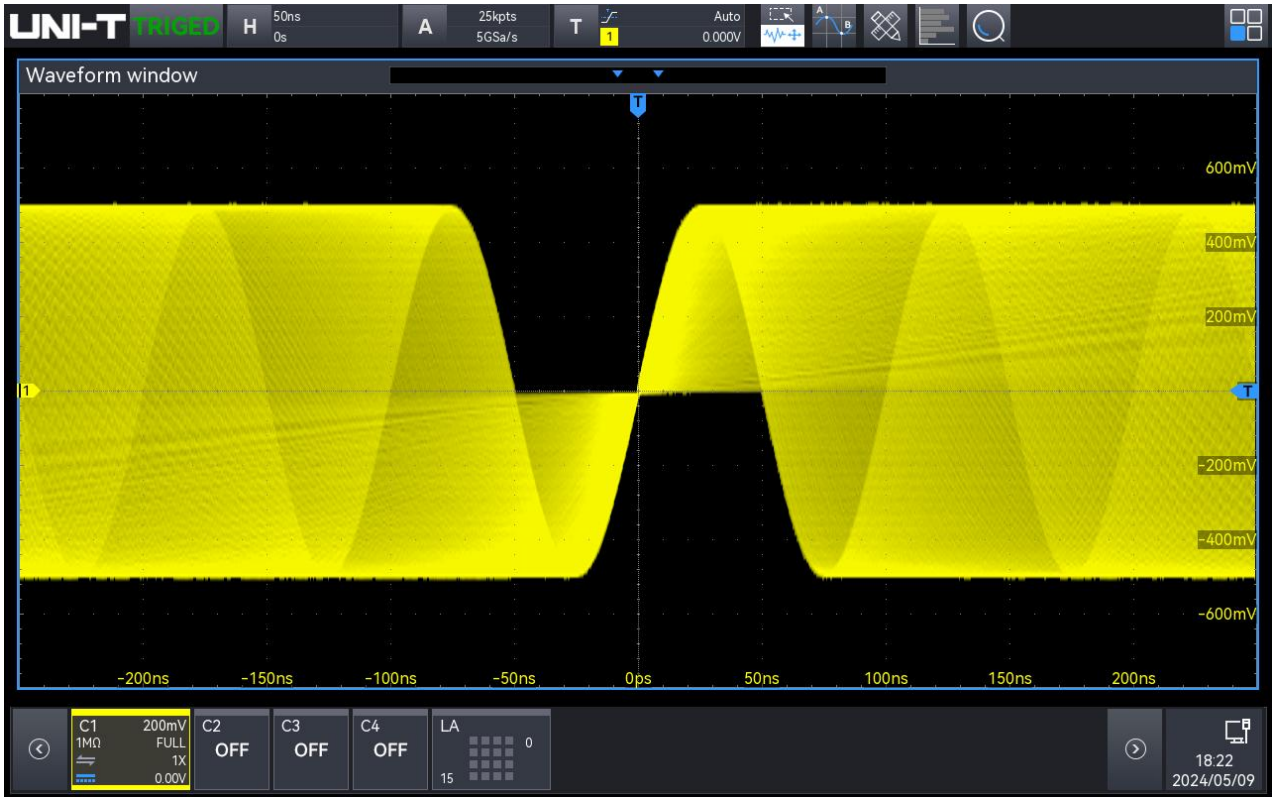
- Power quality
- Harmonic analysis
- Safety operation area*
- Ripple wave analysis
- Loop analysis

* Power analysis support is subject to the latest firmware on the official website.

Ultra Phosphor 3.0

When you try to find and debug the occasional or intermittent anomalies in the signal, the waveform capture rate is a very important indicator. The capture rate of an oscilloscope is the ability to capture how many waveforms per unit of time, it reflects the oscilloscope speed of the process and analysis signal.

MSO2000X adopts advanced software and hardware architecture to achieve data processing that is 5 to 10 times higher than the previous version. It is equipped with Ultra Phosphor 3.0, which supports 8-channel parallel graph mapping, the processing rate is up to 20 Gbps, the waveform capture rate is up to 500,000 wfms/s, and up to 2,000,000 wfms/s in the sequence mode. Compared with the traditional oscilloscope, the dead time of MSO2000X can be < 1μs, that is, capture 1.17 ns fast edge signal of 2,000,000 per second, so the accidental signal can be captured easily and correctly.



Multi-Windows

Multi-Windows can be freely dragged and extended.

Brand new quick Autoset strategy

Fuzzy control is an intelligent control method based on fuzzy set theory, fuzzy linguistic variables and fuzzy logic reasoning. The advantages of the algorithm are fewer iterations, faster speed, and better anti-interference ability.

In the past, the oscilloscope performed Autoset to find the appropriate signal amplitude and frequency to display, but the response speed of oscilloscopes is very different due to different solutions adopted by each oscilloscope manufacturer. This affected the experience of using oscilloscopes.

UNI-T redefines the execution of Autoset by adopting fast fuzzy algorithm based on analog signals and multi-channel parallel processing technology, combined with a 7 bits high-precision hardware frequency counter, which allows the oscilloscope to quickly find and process the amplitude and frequency of the unknown signals displayed when executing the Autoset strategy. It takes less than 1.5s to open the whole channel, and less than 1s to open a single channel, which greatly improves the working efficiency and reduces the risk of errors for users who need to change test objects frequently and need to test quickly.

Multiple parameter measurements

The parameter measurement is a very important function for engineer when using an oscilloscope. MSO2000X series provides 54 kinds of measurement parameters and added 27 measurement parameter can be displayed at the same time. Each page of measurement statistics displays 9 measurement parameters, and it can be displayed in histogram and tendency chart. The histogram can visually show the possibility distribution of the parameter. The tendency chart can reflect the parameter changing with time.

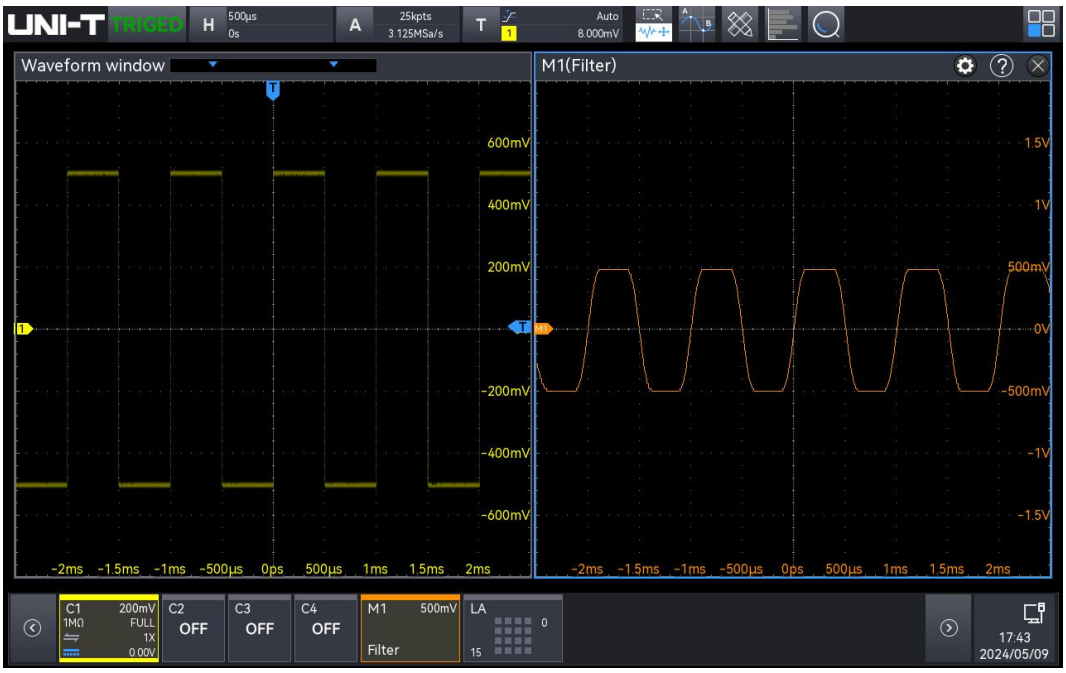
The parameter snapshot displays 39 kinds of test items for a single channel measurement. The parameter of parameter snapshot includes the measurement parameter of voltage and time in single channel, the measured result will be constantly refreshed during the process.

MSO2000X series adds a new strategy of amplitude calculation, top and bottom. These enhancements simplify the use of the parameter measurement function for engineers. In addition, the added burst function of MSO2000X series can display the burst parameter, so that the channel measured data can be learned accurately and immediately.

Waveform math

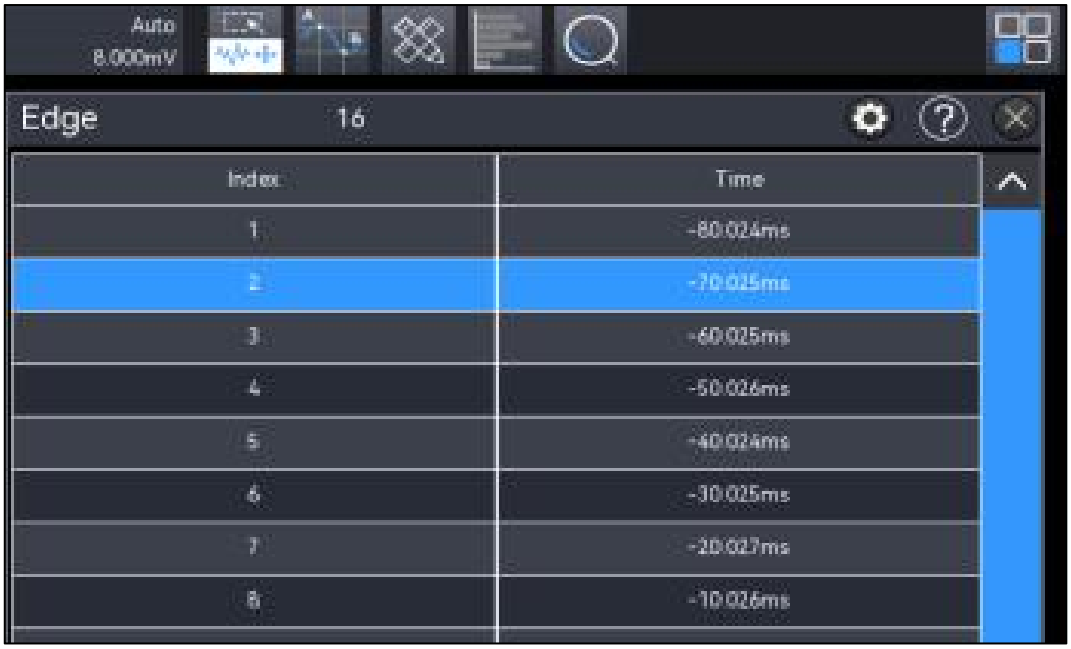
MSO2000X provides a system of algorithms for complex waveform math that you can use to further process your waveforms and display the results directly on the oscilloscope.

- Basic operation: +, -, *, ÷
- Digital filter (high-pass, low-pass, band-pass and band-limit)
- Custom function operation: analog channel, reference waveform



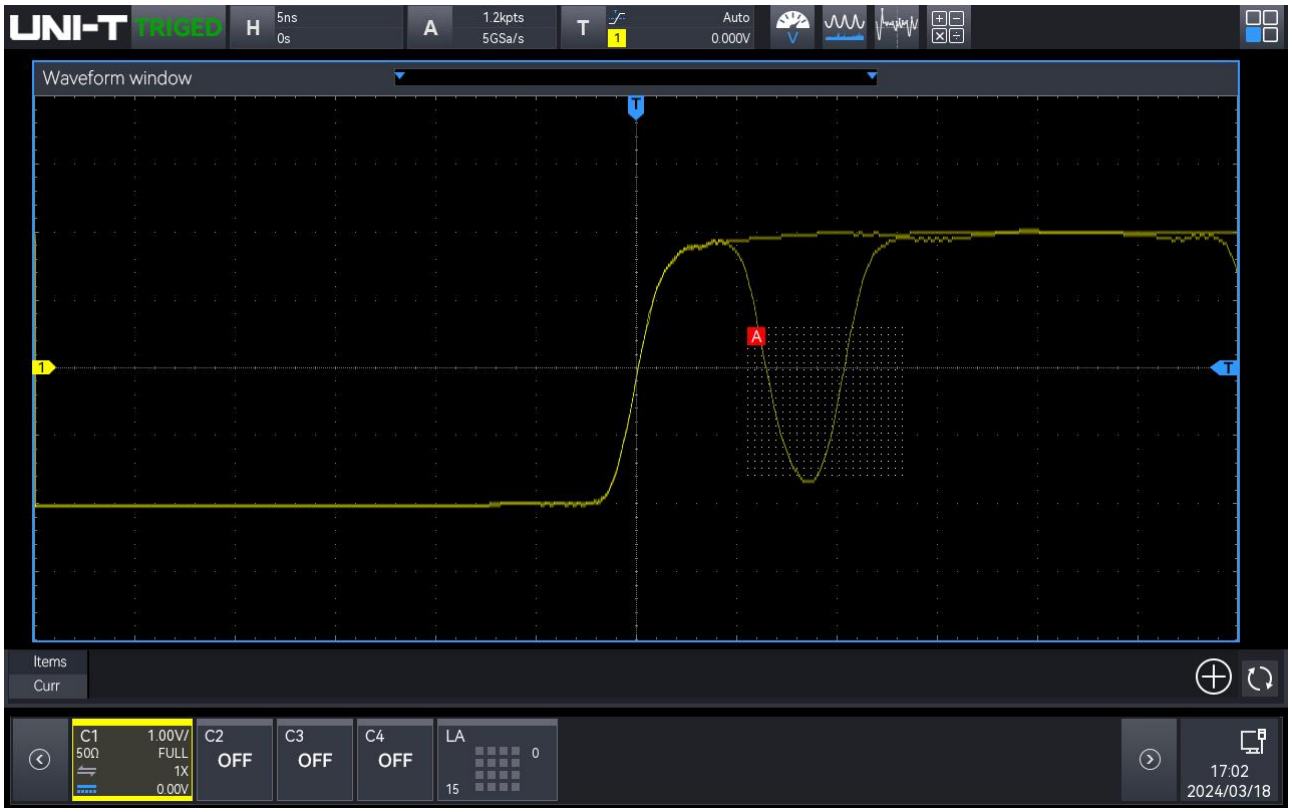
Navigate and Search

The memory depth of MSO2000X series is upgraded to 100 Mpts, and the high memory depth can capture tens of thousands of waveforms in one capture. It takes a lot of time for engineers to search the waveform by themselves. Uni-T offers search conditions that can be customized, which is very useful for searching the sampled signal and finding the waveform of interest. With the analysis function, the event can be analyzed in detail, eliminating the time consuming and inconvenience of manual search.



Zone triggering

The zone triggering function offers two key advantages: isolating occasional abnormal signals and stabilizing the waveform display. A stable trigger is essential for a consistent waveform display, and this feature ensures engineers can effectively manage complex and variable signals during debugging. Designed for ease of use, the zone triggering function allows engineers to quickly separate a signal for observation with a simple rectangle drawing gesture. Unlike traditional triggering methods, this function doesn't require the waveform to be completely stable; it can capture a signal that meets specific conditions and stabilize it for triggering, saving time and improving efficiency.



Various connections

MSO2000X series offers a wide range of connection with flexibility and convenience.

USB 3.0 host ports on the front and rear panel that allow you to easily transfer screenshots, detailed instrument configuration information and waveform data to a storage device, and support USB, keyboard and mouse access for intuitive data entry and control.

USB 3.0 device port on the rear-panel allows you to remotely control the oscilloscope from a PC.

The HDMI port allows the oscilloscope's high-resolution display to be projected in real time on other external monitors, ideal for teaching and teamwork.

Webserver

- SCPI for remote control
- Remotely check and control
- Export waveform file
- Browse user manual on-line
- PC/Mobile phone access

Performance Characteristics

All specifications are guaranteed, except those marked "typical".

Unless otherwise stated, all the Performance Characteristics are suitable for the probe that the attenuation switch set to 10x and MSO2000X series mixed signal oscilloscope.

To meet these specifications, the oscilloscope should first meet the following conditions.

- The instrument must be operated continuously for at least thirty minutes at the specified operating temperature.
- The self-calibration must be performed when the operating temperature reaches or exceeds 5 °C.

Model	MSO2304X	MSO2204X	MSO2104X
Analog bandwidth	300 MHz	200 MHz	100 MHz
Calculated rise time (10 to 90%) (typical)	≤1.17 ns	≤1.80 ns	≤3.50 ns
Input/output channel number	4 analog channels		
	16 digital channels		
	2-channel signal output		
Sampling mode	Real-time sampling		
Acquisition mode	Normal, peak detect, high resolution, averaging, sequential sampling		
ERES	Enhanced bit: 1, 1.5, 2, 2.5, 3, 4 (8 to 12-bit)		
Maximum sample rate	Analog channel: 5 GSa/s (interweave mode), 2.5 GSa/s (non-interweave mode) Digital channel: 1.25 GSa/s		
Average	After all channels have reached N samples simultaneously, the number of N times can be selected from 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192.		
Memory depth	Auto (limit to 5 Mpts), 25 kpts, 250 kpts, 500 kpts, 5 Mpts, 50 Mpts, 100 Mpts		
Maximum waveform capture rate	500,000 wfms/s		
	2,000,000 wfms/s (sequence mode)		
Sequential sampling	Maximum 125,000 frames, minimum two trigger interval < 500 ns		
Hardware real-time waveform recording	125,000 frames		

and playing	
Screen	10.1-inch 1280x800 HD capacitive touch screen
Vertical System (Analog channel)	
Input coupling	DC, AC, GND
Input impedance	(1 MΩ±2%) ‖ (16 pF±3 pF) 50 Ω± 1.5%
Probe attenuation factor	Voltage probe ratio: 0.001X, 0.01X, 0.1X, 1X, 10X, 100X, 1000X, Custom Current probe ratio: 5 mV/A, 10 mV/A, 50 mV/A, 100 mV/A, 200 mV/A, 500 mV/A, 1V/A, Custom
Maximum input voltage	1MΩ: 400 V (DC+ACVpk) 135 V_{RMS} 50 Ω: 5 V_{RMS} Max
Vertical resolution	8-bit (ERES is enabled with a maximum of 12-bit)
Vertical scale	500 μV/div to 10 V/div (1 MΩ) 500 μV/div to 1 V/div (50 Ω)
Offset range	500 μV/div to 50 mV/div: ±2 V (50 Ω and 1 MΩ) 100 mV/div to 1 V/div: ±5 V (50 Ω) 100 mV/div to 1 V/div: ±25 V (1 MΩ) 2 V/div to 10 V/div: ±250 V (1 MΩ) Vertical offset reading: V
Band limit (typical)	50 Ω: 20 MHz, Full, Custom 1 MΩ: 20 MHz, Full, Custom
Low-frequency response	(AC coupling, -3 dB); ≤5 Hz (on BNC)
DC gain accuracy	<5 mV: ±3% full scale, ≥5 mV: ±2% full scale
DC offset accuracy	±(2%+0.1 div+2 mV)
Unit	W, A, V, and U. default: V
Channel-to-channel isolation(typical)	DC to maximum bandwidth: >40 dB
Digital channel	
Threshold	8-channel in one group
Threshold selection	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 Custom
Threshold range	±20.0 V, 20 mV stepping
Threshold accuracy	±(100 mV + threshold setting of 3%)
Dynamic range	±10 V + threshold
Input impedance	(101 kΩ±1%) || (9 pF ± 1 pF)
Minimum voltage swing	500 mVpp
Minimum detectable pulse width(typical)	800 ps
Vertical resolution	1 bit
Channel-to-channel deskew range	±100 ns
Horizontal System (Analog channel)	
Time base range	100 MHz (2 ns/div to 1 ks/div) 200 MHz (2 ns/div to 1 ks/div) 300 MHz (1 ns/div to 1 ks/div) (simultaneously display the current sampling rate and memory depth)
Time base accuracy	±1 ppm (original accuracy); ±1 ppm (the aging rate of first year); ±3.5ppm (the aging rate of ten years)
Time base delay time range	Pre-trigger (negative delay) ≥ 1 screen width Post-trigger (positive delay): 1 s to 5 ks
Time base mode	Y-T (default)
	X-Y (CH1-CH2, CH1-CH3, CH1-CH4, CH2-CH3, CH2-CH4, CH3-CH4)
	Roll, time base ≥ 50 ms/div, using the horizontal rotary knob to enter or exit Roll mode
	Scan, time base ≥ 50 ms/div, user can select Roll or Scan mode
Trigger	
Trigger Sensitivity	CH1 to CH4: ≤10mV/div, The larger value of 1div or 5mVpp >10mV/div, 0.5div EXT: 400mVpp, DC to 10MHz 800mVpp, 10MHz to External trigger bandwidth frequency (250 MHz)

	Enable the noise rejection, with trigger sensitivity reducing half
Trigger level range	Internal: ± 5 div from the center of the screen EXT: ± 7 V
Trigger modes	Auto, Normal, Single
Trigger holdoff range	0 ps to 10 s
Trigger coupling (typical)	DC: all signal can pass
	AC: block DC component of input signal
	HF reject: suppress high-frequency components of signals above 40 kHz
	LF reject: suppress low-frequency components of signals below 40 kHz
Noise reject	Suppress the high-frequency noise of signal, to reduce the error-touched possibility
Zone Triggering	
Zone	2 Zones; source: CH1 to CH4; feature: Must Intersect, Must Not Intersect
Edge	
Slope	Rising, Falling, Either
Source	CH1 to CH4, AC Line, EXT, D0 to D15
Runt	
When	>, <, ≤ ≥, None
Polarity	Positive, Negative
Pulse width	3.2 ns to 10 s
Source	CH1 to CH4, D0 to D15
Window	
Polarity	Rising, Falling, Any
When	Enter, Exit, Time
Set	3.2 ns to 10 s
Source	CH1 to CH4
Nth edge	
Slope	Rising, Falling
Idle time	3.2 ns to 10 s
Edge number	1 to 65535
Source	CH1 to CH4, D0 to D15
Delay	
Edge type	Rising, Falling
When	>, <, ≤ ≥, > <
Delay time	3.2 ns to 10 s

Source	CH1 to CH4, D0 to D15
Timeout	
Slope	Rising, Falling, Any
Timeout	3.2 ns to 10 s
Source	CH1 to CH4, D0 to D15
Duration	
Code pattern	H, L, X
When	>, <, ⩽ ⩾
Duration	3.2 ns to 10 s
Source	CH1 to CH4, D0 to D15
Setup and Hold	
Clock edge	Rising, Falling
Data type	H, L
Setup	3.2 ns to 10 s
Hold	3.2 ns to 10 s
Source	CH1 to CH4, D0 to D15
Pulse width	
Polarity	Positive, Negative
When	>, <, ⩽ ⩾
Pulse Width	0.8 ns to 4 s
Source	CH1 to CH4, AC Line, EXT, D0 to D15
Slope	
Slope	Positive, Negative
When	>, <, ⩽ ⩾
Time	3.2 ns to 1 s
Source	CH1 to CH4
Video	
Standard	PAL, NTSC, SECAM, 525p/60, 625p/50, 720p/24, 720p/25, 720p/30, 720p/50, 720p/60, 1080i/25, 1080i/30, 1080p/24, 1080p/25, 1080p/30, 1080pfs/24
Source	CH1 to CH4
Pattern	
Code pattern	H, L, X, Rising, Falling
Source	CH1 to CH4, D0 to D15
RS232/UART	
When	Start, FrameErr, CheckErr, Data
Baud rate	2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200

	bps, custom
Data bit	5 bits, 6 bits, 7 bits, 8 bits
Source	CH1 to CH4, D0 to D15
I2C	
When	Start, Restart, Stop, Loss, Address, Data, Address & Data
Addr mode	7 bits, 10 bits
Addr range	0 to 7F, 0 to 3 FF
Byte length	1 to 5
Source	CH1 to CH4, D0 to D15
SPI	
Mode	Timeout, CS
When	Start, Data
Timeout	100 ns to 1 s
Data bit	4 bits to 32 bits
Source	CH1 to CH4, D0 to D15
CAN	
Signal type	CAN_H, CAN_L
When	Start, Data Frame, Remote Frame, Error Frame, Over-Load, Identifier, Data, Identifier & Data, End of Frame, Missing Ack, Bit Error, CRC Error, ALL Errors
Data rate	10 kbps, 19.2 kbps, 20 kbps, 33.3 kbps, 38.4 kbps, 50 kbps, 57.6 kbps, 62.5 kbps, 83.3 kbps, 100 kbps, 115.2 kbps, 125 kbps, 230.4 kbps, 250 kbps, 490.8 kbps, 500 kbps, 800 kbps, 921.6 kbps, 1 Mbps, 2 Mbps, 3 Mbps, 4 Mbps, 5 Mbps, custom
Source	CH1 to CH4, D0 to D15
CAN-FD	
Signal type	CAN_H, CAN_L
When	Start, Data Frame, Remote Frame, Error Frame, Over-Load, Identifier, Data, Identifier & Data, End, Lost, Bit Error, CRC Error, ALL Errors
Data rate	10 kbps, 19.2 kbps, 20 kbps, 33.3 kbps, 38.4 kbps, 50 kbps, 57.6 kbps, 62.5 kbps, 83.3 kbps, 100 kbps, 115.2 kbps, 125 kbps, 230.4 kbps, 250 kbps, 490.8 kbps, 500 kbps, 800 kbps, 921.6 kbps, 1 Mbps, 2 Mbps, 3 Mbps, 4 Mbps, 5 Mbps, custom
FD data rate	250 kbps, 500 kbps, 800 kbps, 1 Mbps, 1.5 Mbps, 2 Mbps, 4 Mbps, 5 Mbps, 6 Mbps, 8 Mbps, custom
Source	CH1to CH4, D0 to D15
LIN	
Trigger condition	Sync, Identifier, Data, Identifier & Data, Wake Frame, Sleep Frame, Error

Version	v1.x, v2.x, Either
Baud rate	1.2 kbps, 2.4 kbps, 4.8 kbps, 9.6 kbps, 10.417 kbps, 19.2 kbps, 20 kbps, custom
Data length	1 to 8
Source	CH1 to CH4, D0 to D15
FlexRay	
When	Start, Indicators, Identifier, Cycle, Heade, Data, Identifier & data, End frame, Error
Polarity	BM, BDiff/BP
Baud rate	2.5M bps, 5M bps, 10M bps, custom
Source	CH1 to CH4, D0 to D15
Audio	
When	Word, Left, Right, Either
Format	Standard, Left Aligned, Right Aligned, TDM
Source	CH1 to CH4, D0 to D15
SENT	
When	Fast: Sync, Status, Data, CRC, STAT+Data, S&D+CRC, F_ CRC Error, CONT Pul Err Slow: Sync, Short ID, Short Data, Short CRC, Short ID & data, Enh ID, Enh Data, Enh CRC, Enh ID & data, SLO CH CRC error
Source	CH1 to CH4, D0 to D15
Decoding	
Number of decodes	4
Decoding type	Standard: RS232/UART, I2C, SPI
	Option: CAN, CAN-FD, LIN, FlexRay, Audio, SENT
Parallel	Up to 18 bits parallel bus decoding, supports the combination of analog channel and digital channel and supports custom time setting
Source	CH1 to CH4, D0 to D15
Measurement	
Cursor	Voltage difference between cursors (△Y) Time difference between cursors (△X) Reciprocal of △X (Hz) (1/△X)
	Voltage and time of waveform point
	Display the cursor in the automatic measurement
Automatic measurements	**Analog channel: 54 kinds of parameters** Maximum, Minimum, Top, Base, Amplitude, Middle, Peak-Peak, Average, Average-Cycles, RMS, RMS-Cycles, AC RMS, AC RMS-Cycles, Area,

	Area-Cycles, +Area, -Area, +Area-Cycles, -Area-Cycles, +Overshoot, -Overshoot, +Preshoot, -Preshoot, Period, Frequency, Rise time, Fall time, +Width, -Width, +Duty, -Duty, +Pulse count, -Pulse count, Rising edge count, Falling edge count, Burst width, Burst Interval, Burst Period, Burst Per count, Ratio, Period Ratio, Setup time, Hold time, Setup & Hold Ratio, FRFR, FRFF, FFFR, FFFF, FRLF, FRLR, FFLR, FFLF, Phase(r-r), Phase(f-f) **Digital channel: 10 kinds of parameters** Frequency, Period, +Width, -Width, +Duty, -Duty, rising delay A→B, falling delay A→B, phase A→B, phase B→A
Measurement mode	Common measurement and accuracy measurement (Full memory hardware measurements)
Measurement type	Simultaneously display 27 kinds of parameter measurement
Measurement range	Main time base, Zoom time base, Cursor area
Measurement statistics	Mean, Maximum, Minimum, Std Dev, Count, Tendency chart, Histogram
XY measurement	Time, Cartesian, Polar, Product, Ratio
Analysis	Frequency Counter, DVM, Pass/Fail, Waveform recording, Bode plot, Power Analysis
Math	
Waveform math	A+B, A-B, A×B, A÷B, advanced, Filter
Filter	Low pass, High pass, Band pass, Band stop
Operation	0,1,2,3,4,5,6,7,8,9, (+, -, *, /, ^, >, <, &&, ||, ==, !=)
Function	sin, cos, sinc, tan, sqrt, exp, lg, ln, floor, abs, acos, asin, atan, sinh, tanh, ceil, cosh, fabs, intg, diff
FFT	
Channel number	4
Window types	Hanning, Hamming, Rectangle, Blackman
FFT count	Up to 4 Mpts
FFT vertical scale	Vrms, dB
FFT	Waterfall: ON, OFF
	Spectrum range: Start frequency, Stop frequency, Center frequency, Span
	Four traces: Normal, Average, Max Hold, Min Hold
	Marker: Marker type, Marker Points, Marker list
Storage	
Setting	Set Status (.set)
Waveform	Waveform data (*.dat) (*.csv) (*.bsv)

Image	Image storage (*.bmp) (*.png) (*.jpg)
Report	Decoding Event List (*.csv) (*.pdf) (*.html)
Function/AWG Gen（Option)	
Channel	2
Sample rate	250 MSa/s
Vertical resolution	16-bit
Maximum frequency	50 MHz
Standard	Sine, Square, Ramp, Noise, DC and Arbitrary wave
Built-in arbitrary	200 types including Sinc, ExpRise, ExpFall, Cardiac, Gauss, Lorentz, and HaverSine
Sine wave	Frequency range: 1 μHz to 50 MHz
	Flatness: ±0.5 dB (relative 1 kHz)
	Harmonic distortion: -40 dBc
	Non-harmonic spurious (typ): -40 dBc
	Total harmonic distortion: 1% (DC to 20 kHz, 1Vpp)
	SNR: 40 dB
Square wave/Pulse wave	Frequency range Square wave: 1 μHz to 15 MHz; Pulse wave: 1 μHz to 15 MHz
	Rising/falling time: <13 ns (typical 1kHz, 1Vpp, 50 Ω)
	Overshoot: typical 2% (1 kHz, 1 Vpp, 50 Ω)
	Duty ratio Square wave: 1% to 99%, adjustable; Pulse wave: 1% to 99%, adjustable
	Resolution of duty ratio: 1% or 10 ns (take the greater value of both)
	Minimum pulse width: 20 ns
	Resolution of pulse width: 10 ns
	Jitter: 2 ns
Ramp wave	Frequency range: 1 μHz to 400 kHz
	Linearity: 1%
	Symmetry: 0.1% to 99.9%
Noise	Bandwidth: 50 MHz (typical)
Arbitrary wave	Frequency range: 1 μHz to 5 MHz
	Waveform length: 8 k
	Internal save position: 200
Frequency	Accuracy: ±1 ppm (original accuracy); ±1ppm (the aging rate of first year); ±

	3.5ppm (the aging rate of ten years)
	Resolution: 1 μHz
Amplitude	Output range: 20 mVpp to 6 Vpp (high resistance); 10 mVpp to 3 Vpp (50 Ω)
	Resolution: 1 mV
	Accuracy (Typical value: 1 kHz, sine wave, 0V, deviation): ± (5%+2 mVpp)
DC offset	Range: ±3 V (high resistance); ±1.5 V (50 Ω)
	Resolution: 1 mV
	Accuracy: ± (offset set value 5%+2 mV)
AM	
Carrier wave	Sine, Square, Ramp, Arbitrary wave
Source	Internal
Modulated wave	Sine, Square, Rising ramp, Falling ramp, Noise, Arbitrary wave
Modulation frequency	2 mHz to 50 kHz
Modulation depth	0% to 120%
FM	
Carrier wave	Sine, Square, Ramp, Arbitrary wave
Source	Internal
Modulated wave	Sine, Square, Rising ramp, Falling ramp, Noise, Arbitrary wave
Modulation frequency	2 mHz to 50 kHz
Deviation	12.5 MHz (maximum)
ASK	
Carrier wave	Sine, Square, Ramp, Arbitrary wave
Modulated wave	Square wave (Duty ratio 50%)
Modulation frequency	2 mHz to 50 kHz
FSK	
Carrier wave	Sine, Square, Ramp, Arbitrary wave
Modulated wave	Square wave (Duty ratio 50%)
Modulation frequency	2 mHz to 50 kHz
Hopping frequency	Any frequency within the range of the Carrier wave signal
Sweep	
Mode	Linear, Logarithmic

Sweep time	1 ms to 500 s
Start and stop frequency	Any frequency within the range of the waveform
Display	
Screen	10.1-inch multi-touch capacitive screen
Resolution	1280×RGB×800 vertical pixel
Color	24-bit true colors
Persistence	Auto, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 5 s, 10 s, 20 s, infinite, close
Display type	Point, Vector
Real-Time clock	Time and data (user-defined)
Waveform Intensity	1% to 100% (default 50%)
Grid Intensity	0% to 100% (default 50%)
Backlight Intensity	1% to 100% (default 50%)
Transparent	0% to 100% (default 50%)
Bode plot (Included with AWG Option)	
Start frequency	50 Hz to 50 MHz
Stop frequency	60 Hz to 50 MHz
Count	1 to 1000
Amplitude	High resistance: 20 mVpp to 6 Vpp 50Ω: 10 mVpp to 3 Vpp
DVM (typical)	
Source	Analog channel
Mode	DC, AC+DC RMS, AC RMS
Resolution	4-bit
Buzzer	Beeps when the specified limit values are reached or exceeded
Frequency Counter	
Source	any analog channel and digital channel
Measurement	Frequency, Period, Totalizer
Counter	The maximum effective digits are 7, and the refresh time and effective digits are adjustable.
Maximum measurement frequency	Maximum bandwidth of analog channel
Time reference	Internal reference: ±1 ppm (original accuracy); ±1ppm (the aging rate of first year); ±3.5ppm (the aging rate of ten years)

Interface	
USB-Host 3.0	1 on the front panel, 2 on the rear panel
USB-Device 3.0	1 on the rear panel
LAN	LAN (VXI11), 10/100/1000 Base, RJ-45
AUX Out	Trig Out, Pass/Fail, DVM
Gen Out	2 on the front panel
10MHz reference input	50 Ω, amplitude 400 mVpp to 4.5 Vpp (-3.979 dBm, 17.044 dBm), frequency 10 MHz ±10 ppm
10MHz reference output	50 Ω, 1.65 Vpp square wave
HDMI[1]	1 port for external display or projector
General technical specification	
Probe compensator output	
Output voltage	3 Vpp
Frequency	10 Hz ,100 Hz, 1 kHz (default), 10 kHz
Power Source	
Power source voltage	100 V to 240 VAC (fluctuate: ±10%), 50 Hz/60 Hz 100 V to 120 VAC (fluctuate: ±10%), 400 Hz
Power consumption	120 W Max
Fuse	3 A, F-class, 250 V
Environmental	
Temperature	Operating: 0°C to +40°C
	Non-operating: -20°C to +70°C
Cooling	Forced cooling by fan
Humidity	Operating: below +35 °C, relative humidity ≤90%; non-operating: +35 °C to +40 °C, relative humidity ≤60%
Altitude	Operating: below 3,000 meters; non-operating: below 15,000 meters
Pollution degree	2
Operating environment	Indoor
Mechanical Specifications	
Dimension (W×H×D)	378 mm×218 mm×120 mm
Weight	3.83 kg
Calibration interval	
Calibration	1 year

interval

Safety Regulations			
Electromagnetic compatibility	Compliance with EMC directive (2014/30/EU), compliance with or superior to IEC 61326-1:2021/ EN61326-1:2021, IEC 61326-2-1:2021/ EN61326-2-1:2021		
	Conducted disturbance	CISPR 11/EN 55011	CLASS B group 1, 150 kHz-30 MHz
	Radiation disturbance	CISPR 11/EN 55011	CLASS B group 1, 30 MHz-1 GHz
	(ESD)	IEC 61000-4-2/EN 61000-4-2	4.0 kV (contact), 8.0 kV (air)
	Radio sensitivity	IEC 61000-4-3/EN 61000-4-3	0V/m (80 MHz to 1 GHz); 3V/m (1.4 GHz to 2 GHz); 1V/m (2.0 GHz to 2.7GHz)
	Electrical fast transient (EFT)	IEC 61000-4-4/EN 61000-4-4	2kV (AC input)
	Surge	IEC 61000-4-5/EN 61000-4-5	1kV (live to zero) 2kV (live/zero to ground)
	Radio continuous sensitivity	IEC 61000-4-6/EN 61000-4-6	3V, 0.15-80 MHz
	Voltage dip and short-term interruption	IEC 61000-4-11/EN 61000-4-11	Voltage dip: 0% UT during 1 cycle; 40% UT during 10/12 cycles; 70% UT during 25/30 cycles Short-term interruption: 0% UT during 250/300 cycles
Safety specification	EN 61010-1:2010+A1:2019 EN IEC61010-2-030:2021+A11:2021 BS EN61010-1:2010+A1:2019 BS EN IEC61010-2-030:2021+A11:2021		

Remarks

1: only support standard HDMI, not support other adapters.

Order information

	Description	Order No.
Model	MSO2304X (300 MHz, 5 GSa/s, 4 analog channels)	MSO2304X
	MSO2204X (200 MHz, 5 GSa/s, 4 analog channels)	MSO2204X
	MSO2104X (100 MHz, 5 GSa/s, 4 analog channels)	MSO2104X
Standard accessories	National standard power cable x 1	
	USB3.0 cable x 1	UT-D30
	BNC-BNC direct-through line x 1	UT-L45
	BNC-red and black alligator connecting wire x 1	UT-L02A
	Passive probe (300 MHz/200 MHz/100 MHz) x 4	UT-P06/UT-P05/UT-P04
Optional accessories	100MHz Upgrade to 300MHz Bandwidth	MSO2000X-BW1MT3M
	200MHz Upgrade to 300MHz Bandwidth	MSO2000X-BW2MT3M
	100MHz Upgrade to 200MHz Bandwidth	MSO2000X-BW1MT2M
	All serial bus triggering and decoding options	MSO2000X-BND
	Automobile serial bus triggering and decoding option (CAN, CAN-FD, LIN, FlexRay, SENT)	MSO2000X-AUTO
	Automotive serial bus triggering and decoding option CAN	MSO2000X-CAN
	Automotive serial bus triggering and decoding option CAN-FD	MSO2000X-CAN-FD
	Automotive serial bus triggering and decoding option LIN	MSO2000X-LIN
	Automotive Serial Bus Trigger and decoding Option FlexRay	MSO2000X-FLEX
	Automotive sensor serial bus triggering and decoding option SENT	MSO2000X-SENT
	Audio serial bus triggering and decoding option Audio	MSO2000X-AUDIO
	Dual channel function/arbitrary waveform generator (includes Bode Plot Analyzer)	MSO2000X-AWG
	Power analysis	MSO2000X-PWR
	Isolation transformer	UT-ISOT
	High voltage probe	UT-V23/UT-P21/UT-P20
	High voltage differential probe	UT-P30/UT-P31/UT-P32/

		UT-P33/UT-P35/UT-P36
	Current probe	UT-P40/UT-P41/UT-P42/ UT-P43/UT-P44/UT-P403 0D/UT-P4150/UT-P4500/ P4100A/P4100B
	16-channel logic analyzer probe	UT-M15

Remarks: Please order all instruments, accessories and options from your local UNI-T distributor.

Oscilloscope probes and accessories

Passive probe

Model	Type	
UT-P01 	High resistance probe	1X: DC to 8 MHz 10X: DC to 25 MHz Oscilloscope compatibility: all series of UNI-T
UT-P03 	High resistance probe	1X: DC to 8 MHz 10X: DC to 60 MHz Oscilloscope compatibility: all series of UNI-T
UT-P04 	High resistance probe	1X: DC to 8 MHz 10X: DC to 100 MHz Oscilloscope compatibility: all series of UNI-T
UT-P05 	High resistance probe	1X: DC to 8 MHz 10X: DC to 200 MHz Oscilloscope compatibility: all series of UNI-T
UT-P06 	High resistance probe	1X: DC to 8 MHz 10X: DC to 300 MHz Oscilloscope compatibility: all series of UNI-T
UT-P07A 	High resistance probe	10X: DC to 500 MHz Input resistance: 10 MΩ Maximum of operating voltage: <600V pk Oscilloscope compatibility: all series of UNI-T

UT-P08A 	High resistance probe	10X: DC to 350 MHz Input resistance: 10 MΩ Maximum of operating voltage: <600V pk Oscilloscope compatibility: all series of UNI-T
UT-P20 	High resistance probe	DC to 100 MHz Probe coefficient 100:1 Maximum of operating voltage: 1500 Vrms Oscilloscope compatibility: all series of UNI-T
UT-V23 	High voltage probe	DC to 100 MHz Probe coefficient 100:1 Input resistance: 100 MΩ±2% Maximum of operating voltage: 2000 Vpp Oscilloscope compatibility: all series of UNI-T
UT-P21 	High voltage probe	DC to 50 MHz Probe coefficient 1000:1 Maximum operating voltage: DC 15 kVrms. AC 10kV (sine wave) Oscilloscope compatibility: all series of UNI-T

Current probe

Model	Type	
UT-P40 	Current probe	DC to 100 kHz Range: 50 mV/A, 5 mV/A Current range: 0.4 A to 60 A Maximum of operating voltage: 600 Vrms Oscilloscope compatibility: all series of UNI-T
UT-P41 	Current probe	DC to 100 kHz Range: 100 mV/A, 10 mV/A Current range: 0.4 A to 100 A Maximum of operating voltage: 600 Vrms Oscilloscope compatibility: all series of UNI-T

UT-P42 	Current probe	DC to 150 kHz Range: 100 mV/A, 10 mV/A Current range: 0.4 A to 200 A Maximum of operating voltage: 600 Vrms Oscilloscope compatibility: all series of UNI-T
UT-P43 	Current probe	DC to 25 MHz Range: 100 mV/A Maximum test current: 20 A Rising time: 14 ns Oscilloscope compatibility: all series of UNI-T
UT-P44 	Current probe	DC to 50 MHz Range: 50 mV/A Maximum test current: 40 A Rising time: 7 ns Oscilloscope compatibility: all series of UNI-T
UT-P4030D 	High-frequency current probe	Bandwidth: DC to 100 MHz Rising time: ≤3.5 ns Range selection: 30 A/5 A Maximum test current: 30A Voltage of insulated line: 300V CAT I Oscilloscope compatibility: all series of UNI-T
UT-P4150 	High-frequency current probe	Bandwidth: DC to 12 MHz Rising time: ≤29 ns Range selection: 150 A/30 A Maximum test current: 150 A Voltage of insulated line: 600V CAT II 300 V CAT III Oscilloscope compatibility: all series of UNI-T
UT-P4500 	High-frequency current probe	Bandwidth: DC to 5 MHz Rising time: ≤70 ns Range selection: 500 A/75 A Maximum test current: 500 A Voltage of insulated line: 600V CAT II 300 V CAT III Oscilloscope compatibility:

		all series of UNI-T
UT-P4100A 	Low-frequency current probe	Bandwidth: DC to 600 kHz Rising time: ≤583 ns Maximum test current: 100 A Range selection: 100 A/10 A Range sensitivity: 0.1 V/A, 0.01 V/A Common-mode voltage RMS: CAT I 600 V CAT II 600V CAT III 300V Oscilloscope compatibility: all series of UNI-T
UT-P4100B 	Low-frequency current probe	Bandwidth: DC to 2 MHz Rising time: ≤175 ns Maximum test current: 100 A Range selection: 100 A/10 A Range sensitivity: 0.1 V/A, 0.01 V/A Common-mode voltage RMS: CAT I 600 V CAT II 600 V CAT III 300 V Oscilloscope compatibility: all series of UNI-T

Active probe

Model	Type	
UT-P30 	High voltage differential probe	DC to 100 MHz Attenuation ratio: 100:1, 10:1 Input differential-mode voltage: ±800Vpp Oscilloscope compatibility: all series of UNI-T
UT-P31 	High voltage differential probe	DC to 100 MHz Attenuation ratio: 1000:1, 100:1 Input differential-mode voltage: ±1.5 kVpp Oscilloscope compatibility: all series of UNI-T

UT-P32		
	High voltage differential probe	DC to 50 MHz Attenuation ratio: 1000:1, 100:1 Input differential-mode voltage: ±3 kVpp Oscilloscope compatibility: all series of UNI-T
UT-P33		
	High voltage differential probe	DC to 120 MHz Attenuation ratio: 100:1, 10:1 Input differential-mode voltage: ±14 kVpp Oscilloscope compatibility: all series of UNI-T
UT-P35		
	High voltage differential probe	DC to 50 MHz Attenuation ratio: 500:1, 50:1 Rising time: 7 ns Accuracy: 2% Input differential-mode voltage: 1/50:130 (DC+peakAC) 1/500:1300 (DC+peakAC) Input common-mode voltage: 100 Vrms, CAT I 600 Vrms, CAT II Oscilloscope compatibility: all series of UNI-T
UT-P36		
	High voltage differential probe	DC to 50 MHz Attenuation ratio: 2000:1, 200:1 Rising time: 3.5 ns Accuracy: 2% Input differential-mode voltage: 1/200:560 (DC+peakAC) 1/2000:5600 (DC+peakAC) Input common-mode voltage: 2800 Vrms, CAT I 1400 Vrms, CAT II Oscilloscope compatibility: all series of UNI-T

Options ordering and installation

1. **Purchase options:** Based on your requirements, please purchase the specified function options from Uni-t Sales Personnel and provide the serial number of the instrument that needs the option installed.
2. **Receive certificate:** You will receive the license certificate based on the address provided in the order.
3. **Register and obtain license:** Visit the Uni-t official website license activation session for registration. Use the license key and instrument serial number provided in the certificate to obtain the option license code and license file.
4. **Install the option:** Download the option license file to the root directory of a USB storage device, and connect the USB storage device to the instrument. Once the USB storage device is recognized, the Option Install menu will be activated. Press this menu key to begin installing the option.

Limited Warranty and Liability

Uni-T guarantees that the Instrument product is free from any defect in material and workmanship within three years from the purchase date. This warranty does not apply to damages caused by accident, negligence, misuse, modification, contamination, or improper handling. If you need a warranty service within the warranty period, please contact your seller directly. Uni-T will not be responsible for any special, indirect, incidental, or subsequent damage or loss caused by using this device. For the probes and accessories, the warranty period is one year. Visit instrument.uni-trend.com for full warranty information.

Learn more at: www.uni-trend.com

Register your product to confirm your ownership. You will also get product notifications, update alerts, exclusive offers and all the latest information you need to know.

Headquarter

Uni-Trend Technology (China) Co., Ltd.
Addresses: No.6, Industrial North 1st Road, Songshan Lake Park, Dongguan City, Guangdong Province, China
Tel: (86-769) 8572 3888

Europe

UNI-TREND TECHNOLOGY EU GmbH
Addresses: Affinger Str. 12
86167 Augsburg Germany
Tel: +49 (0)821 8879980

North America

Uni-Trend Technology US INC.
Addresses: 3171 Mercer Ave STE 104, Bellingham, WA 98225
Tel: +1-888-668-8648