MSO-2000E Series

VPO Visual Persistence Oscilloscope

200/100/70MHz Mixed-signal Oscilloscope

FEATURES

- 200/100/70MHz Bandwidth Selections : 2 or 4 Channels
- Real Time Sample Rate Per Channel : 1GSa/s (2 Channel Models); Maximum Real Time Sample Rate : 1 GSa/s (4 Channel Models)
- MSO-2000E Equips with a 16 Channel Logic Analyzer
- MSO-2000EA Equips with a 16 Channel Logic Analyzer and a Dual Channel 25MHz Arbitrary Waveform Generator
- Free Frequency Response Analyzer Software for MSO-2000EA
- Per Channel 10M Memory Depth and VPO Waveform Ddisplay Technology
- Waveform Update Rate up to 120,000 wfm/s
- 8 ” WVGA TFT LCD
- Maximum 1M FFT Provides Higher Frequency Domain Resolution Measurements
- High Pass, Low Pass and Band Pass Filter Functions
- 29,000 Segmented Memory Sections and Waveform Search Function
- I²C/SPI/UART/CAN/LIN Serial Bus Trigger and Decoding Functions
- Data Log Function is Able to Track Signal Changes up to 1000 Hours
- Mask Test Function
- Network Storage Function

GW INSTEK
Simply Reliable

PLUG-IN Electronic GmbH • Am Sonnenlicht 5 • 82239 Alling • Tel.: +49 (0) 8141 3697-0 • info@plug-in.de • www.plug-in.de

Economical and Multi-Functional MSO

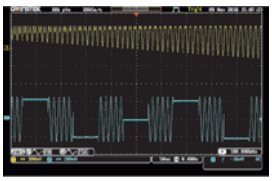
The MSO-2000E series is a mixed-signal oscilloscope, which offers dual analog channels + 16 digital channels or 4 analog channels + 16 digital channels. The MSO-2000E series includes MSO-2000E and MSO-2000EA. MSO-2000E has a built-in 16-channel logic analyzer and MSO-2000EA has a built-in 16-channel logic analyzer and a dual channel 25MHz arbitrary waveform generator. The entire series features bandwidth selections of 200MHz, 100MH, and 70MHz. Dual analog channel models provide 1GSa/s real-time sampling rate per channel; four analog channel models provide 1GSa/s maximum real-time sampling rate. The 8-inch 800*480 TFT LCD and the minimum 1mV/div vertical range allow the MSO-2000E series to measure complex feeble signals and clearly display measurement results.

For analog channels, the MSO-2000E series provides 10M long memory for users to completely retrieve and analyze waveforms. Users, based upon the application requirements, can select 1k, 10k, 100k, 1M or 10M memory depth. Short memory depth collocating with the high sampling rate allows users to observe fast-changing waveforms and, on the other hand, long memory depth aims for continuously changing waveforms. The MSO-2000E series is equipped with waveform search and segmented memory functions to expand the flexible applications of 10M long memory. The segmented memory can be divided the maximum into 29,000 sections for users to bypass any unimportant waveforms so as to swiftly search all required waveforms. With the segmented memory function, more meaningful waveforms can be saved and target waveforms can be displayed rapidly. Users, by using the waveform search function, can rapidly search desired waveforms according to the required trigger conditions.

16-channel logic analyzer has a memory depth of 10Mpts per channel, which can retrieve more and longer digital signals as well as clearly display digital signals to obtain sufficient information for analysis. The minimum input swing of logic analyzer represents the minimum operating voltage of ±250 mV, which demonstrates that digital channels are highly sensitive with respect to input. The standard bus trigger and decoding functions include serial and parallel bus such as I^2C, SPI, UART (RS232/422/485) and CAN/LIN bus for automotive communications. The parallel bus function is only for digital channels. Bus waveforms can be triggered and decoded in real time. The MSO-2000E series offers complete analysis and debugging capabilities with the economical pricing.

CAN Bus Trigger and Decode

In addition to a 16-channel logic analyzer, MSO-2000EA has a built-in dual channel 25MHz arbitrary waveform generator with the modulation capability and also features 14 bits vertical resolution; sample rate of 200MSa/s; 13 standard output waveforms Sine, Square, Pulse, Ramp, DC, Noise, Sinc, Gaussian, Lorentz, Exponential Rise, Exponential Fall, Haversine, Cardiac ; AM/FM/FSK modulation and sweep function. The user friendly interface is the ideal choice for applications such as circuit simulation and education tests.

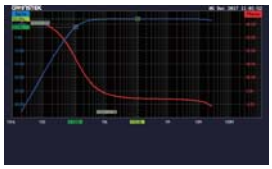


Dual Channel Arbitrary Waveform Generator

MSO-2000EA also provide the frequency response analysis function (Bode plot). The FRA software can be directly downloaded from GW Instek website. Via arbitrary waveform generator, oscilloscope, and FRA software, users can obtain DUT's FRA characteristic curve plot. FRA has a very wide application range, including product circuit and component performance verification and analysis such as Feedback of Circuit Design, Filter Design, Amplifier Design, Resonant Circuit Design, Cable Frequency Response, and Signal Transformer Performance. Via FRA, users can preliminarily verify product and analyze component's characteristics without the expensive instrument.

FRA of RC high-pass filter

The frequency range of FRA is from 20Hz to 25MHz; the number of test point can be selected from 10 to 90 points per decade. After completing the Bode plot, users can select measurement curve by Cursor so as to retrieve each point's amplitude and phase on the curve.

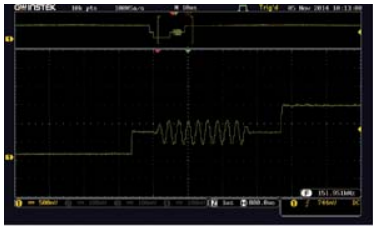


Cursor measurement for the determination at 3dB cut-off frequency of the high-pass filter.

A. 120,000wfm/s WAVEFORM UPDATE RATE AND VPO WAVEFORM DISPLAY TECHNOLOGY

The MSO-2000E series oscilloscope allows users to easily and completely observe inrush signals and rare transient waveforms to increase waveform debugging efficiency by using features, including advanced VPO (Visual Persistence Oscilloscope) signal processing technology, waveform update rate as high as 120,000 wfm/s, and multi-layered afterglow display to enhance waveform display efficiency. Oscilloscope with VPO technology displays signals with three dimensional waveforms constructed by amplitude, time and signal strength to show each waveform point. 256 color gradients yield clear waveform changes. Comparing with the conventional digital storage oscilloscope, the MSO-2000E series provides more natural and more genuine signal display effect which is very close to the original analog signal.

B. DUAL DISPLAY SCREEN ZOOM-IN AND PLAY/PAUSE FUNCTIONS

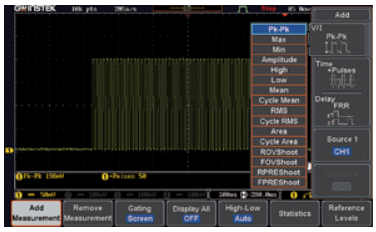


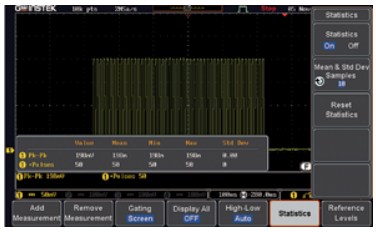
The MSO-2000E series provides the dual display screen zoom-in function to simultaneously display waveforms and major target areas. Users can zoom in display area by adjusting time/div. Under zoom-in mode, waveform can be played or paused so as to automatically view all input waveforms on the moving zoom-in screen. User can swiftly identify each desired event. Manual control play speed and direction can be adjusted according to users' requirements. Press “Pause” to stop the play function. With “waveform search”, all desired events from different stages can be rapidly identified and examined back and forth. The MSO-2000E series is capable of swiftly searching signals and observing signals' details. 10M long memory depth provides the function of complete waveform retrieval and analysis.

C. 1M FFT FREQUENCY DOMAIN DISPLAY FUNCTION

The FFT function of the MSO-2000E Series provides the maximum 1M display for more precision frequency domain display. The function supports four-window displays, including Rectangular, Hamming, Hanning, and Black-harris. Users select window display for frequency domain analysis according to test requirements. The MSO-2000E series not only provides the FFT function but also FFTrms, vertical adjustment, and local zoom-in functions for users to adjust waveforms of frequency domain by their requirements. Via rapid waveform update rate and waveform search functions, users can precisely observe the test results of frequency domain.

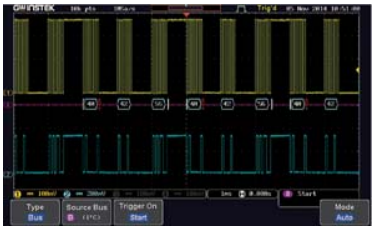
D. 38 ITEMS OF AUTO MEASUREMENT SELECTION AND THE STATISTICS FUNCTION





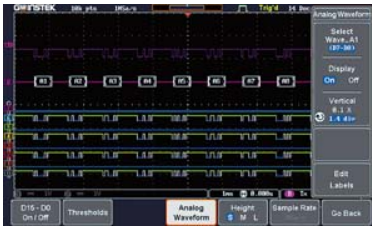
The MSO-2000E series soundly provides 38 measurement items. Based upon the parameters such as voltage, current, time, frequency, and delay measurement, users can decide which measurement items to choose. On the single display screen, the MSO-2000E series provides 8 measurement selections. The statistics mode can also be selected for users to analyze the mean value, the maximum, the minimum, and standard deviation of the retrieved waveforms to ensure signal's integrity and identify abnormal waveforms.

E. SUPPORT I²C , SPI, UART, CAN, LIN BUS TRIGGER AND DECODING FUNCTION



Decode by Analog Channel

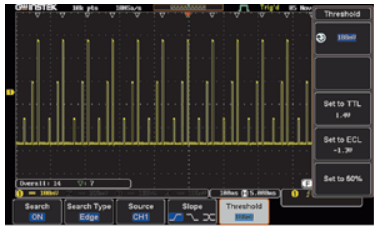
Decode by digital Channel



Display analog waveform converted from digital signal

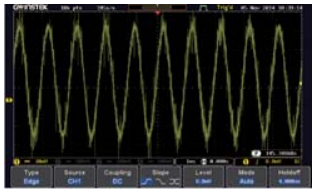
The serial bus technology has been widely applied in the present embedded application design. To rapidly and correctly trigger and analyze serial bus data has posed a difficult challenge to engineers. The MSO-2000E series provides parallel and serial bus analysis function with 10M long memory depth. Users can select either analog or digital channles to trigger, decode, and analyze frequently used I^2C, SPI and UART serial bus and CAN/LIN bus, which is often used by automotive communications. While using digital channels, the analog waveform converted from digital channels can be observed so as to examine and analyze time-related analog and digital signals. The above-mentioned funciton can verify and analyze the conversion between analog and digial signals. Currently, many embedded designs are digital signals. The MSO series also provides digital channels for parallel bus analysis and decoding. The above standard serial and parallel bus functions are the best test platform for school courses and embedded circuit designs.

F. WAVEFORM SEARCH FUNCTION



Users can rapidly search desired waveforms according to the trigger condition. After activating the search function, hollow inverted triangles will show the location met the trigger condition. The upper left hand corner Overall will show the total number of waveforms met the trigger condition. Users can set waveform search by the trigger condition such as Edge, pulse width, Runt, Rise/Fall, and Bus. When the trigger condition is met, hollow inverted triangles will appear. Users can save all marks to compare with the next input signal. The front panel of the MSO-2000E series controls waveform zoom-out and play/pause function to swiftly identify each desired event. The function allows users to conveniently complete waveform search and save marks for rapid comparison and analysis.

G. DIGITAL FILTER FUNCTION

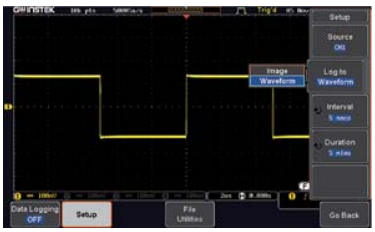


Unfiltered Waveform with Noise Interference

Filtered Waveform, Noise Removed

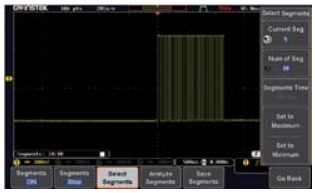
Engineers are often troubled by noise interference while measuring signals in the electric circuit tests. The MSO-2000E series features the digital filter function which can be set to high pass or low pass digital filter. Digital filter allows users to independently set filter frequency for each channel. The tracking on function rapidly sets same filter frequency for all channels.

H. DATA LOG FUNCTION



Users, via the data log function, can observe waveform changes in long periods of time to ensure product reliability or measure sporadically appeared signals. The data log function, based on the requirements, can set record time and interval. Record time can be selected from 5 minutes to 1000 hours, and record interval is 5 seconds, the minimum. Waveform type for record data and CSV file format for each channel can also be selected. Data can be stored in USB drive, the MSO-2000E series or the remote computer via LAN.

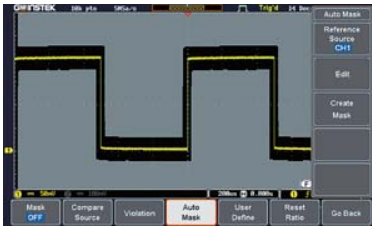
I. SEGMENTED MEMORY FUNCTION

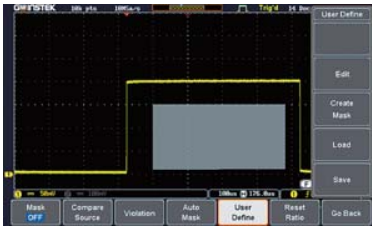


Users Can Also Select "Analyze Segments" to Conveniently Obtain The Analysis Results.

To achieve the most ideal application for memory depth, the MSO-2000E series has the built-in segmented memory function. The segmented memory function allows users to select the desired important signals for observation. Hence, insignificant signals can be neglected and serial bus decoding; pulse or inrush signals can be identified when retrieving signals. The segmented memory function of the MSO-2000E series allows users to select the number of sections. The maximum sections can be selected are 29,000. After activating the function, users can select and observe waveform for each segment by turning the Variable knob. The ultimate application of memory depth, therefore, is completely realized.

J. MASK FUNCTION





The MSO-2000E series provides the Mask function, which allows users to apply Auto Mask and user-defined Mask to determine whether the quality of the product meets the regulation. Via user-defined mask, users can set up to 8 areas and each area is up to 10 points to meet test requirements. Users can also refer to the examples from user manual to edit Mask by the PC to satisfy all test needs. By setting Save On, users can log and monitor signals, which violate test conditions.

PANEL INTRODUCTION

CE | USB high Speed | PC Software | Labview Driver | Ethernet | PictBridge Compatible

1. Hardcopy Key
2. Autoset, Run/Stop, Single & Default Keys
3. Search and Zooming Controls
4. Trigger Controls
5. Math, Reference & Bus Keys
6. Probe Calibration Output
7. USB Host Port
8. Option Key
9. Menu Off Key
10. Logic Analyzer Probe Connector
11. USB Device Port
12. LAN Port
13. Go-NoGo Output
14. Calibration Output
15. Dual Channel Arbitrary Waveform Generator (MSO-2000EA only)
16. GTL-16E : 16-Channel Logic Analyzer Probe
17. GCP-201 : Probe Clip , 20PCS

MSO-2000E Series SELECTION GUIDE							MSO-2000EA Series SELECTION GUIDE					
Model	MSO-2204E	MSO-2202E	MSO-2104E	MSO-2102E	MSO-2074E	MSO-2072E	MSO-2204EA	MSO-2202EA	MSO-2104EA	MSO-2102EA	MSO-2074EA	MSO-2072EA
Bandwidth	200MHz	200MHz	100MHz	100MHz	70MHz	70MHz	200MHz	200MHz	100MHz	100MHz	70MHz	70MHz
Channels	4	2	4	2	4	2	4	2	4	2	4	2
Record Length	10M / ch	10M / ch	10M / ch	10M / ch	10M / ch	10M / ch	10M / ch	10M / ch	10M / ch	10M / ch	10M / ch	10M / ch
Real-time Sampling Rate	Max. 1 GSa/s	Per channel 1 GSa/s	Max. 1 GSa/s	Per channel 1 GSa/s	Max. 1 GSa/s	Per channel 1 GSa/s	Max. 1 GSa/s	Per channel 1 GSa/s	Max. 1 GSa/s	Per channel 1 GSa/s	Max. 1 GSa/s	Per channel 1 GSa/s
Built-in	16 Channel Logic Analyzer						16 Channel Logic Analyzer and Dual Channel 25MHz Arbitrary Waveform Generator					

SPECIFICATIONS

		MSO-2072E(A)	MSO-2074E(A)	MSO-2102E(A)	MSO-2104E(A)	MSO-2202E(A)	MSO-2204E(A)
VERTICAL SENSITIVITY	Channels	2Ch+EXT	4Ch	2Ch+EXT	4Ch	2Ch+EXT	4Ch
	Bandwidth Calculated Rise Time Bandwidth Limit	DC~70MHz(-3dB) 5ns 20MHz		DC~100MHz(-3dB) 3.5ns 20MHz		DC~200MHz(-3dB) 1.75ns 20M/100MHz	
	Vertical Resolution Input Coupling Input Impedance DC Gain Accuracy Polarity Maximum Input Voltage Offset Position Range Waveform Signal Process	8 bits : 1mV ~ 10V/div AC, DC, GND 1MΩ// 16pF approx. ±(3% when 2mV/div or greater is selected ; ±(5%) when 1mV/div is selected Normal & Invert 300Vrms , CAT I (300Vrms CAT II with GTP-070B-4/100B-4/200B-4, 10 : 1 probe) 1mV/div ~ 20mV/div : ±0.5V ; 50mV/div ~ 200mV/div : ±5V ; 500mV/div ~ 2V/div : ±25V ; 5V/div~10V/div : ±250V + , - , × , ÷ , FFT, Uesr Defined Expression FFT : 1Mpts ; FFT : Spectral magnitude. Set FFT Vertical Scale to Linear RMS or dBV RMS ; FFT Window Displays : Rectangular, Hamming , Hanning, Blackman-Harris					
TRIGGER	Source Trigger Mode Trigger Type Trigger Holdoff Range Coupling Sensitivity	CH1 ,CH2, CH3, CH4, Line, EXT* ; *dual channel models only. Auto (Supports Roll Mode for 100 ms/div and slower), Normal, Single Sequence Edge, Pulse Width(Glitch), Video, Pulse Runt, Rise & Fall(Slope), Alternate, Time out, Event-Delay(1~65,535 events),Time-Delay(Duration;4ns~10s), Bus 4ns ~ 10s AC, DC, LF rej. , Hf rej. , Noise rej. 1div					
EXT TRIGGER	Range Sensitivity Input Impedance	±15V DC ~ 100MHz Approx. 100mV; 100MHz ~ 200MHz Approx. 150mV 1MΩ±3%, ~16pF					
HORIZONTAL	Time Base Range Pre-trigger Post-trigger Time Base Accuracy Real Time Sample Rate Record Length Acquisition Mode Peak Detection Average	1ns/div ~ 100s/div (1-2-5 increments); ROLL : 100ms/div ~ 100s/div 10 div maximum 2,000,000 div maximum ±50 ppm over any ≥ 1 ms time interval Max. : 1GSa/s (4ch model); Per channel 1GSa/s (2ch model) 10Mpts/CH Normal, Average, Peak Detect, Single 2ns (typical) Selectable from 2 to 256					
X-Y MODE	X-Axis Input Y-Axis Input Phase Shift	Channel 1 ; Channel 3* (* : four channel models only) Channel 2 ; Channel 4* (* : four channel models only) ±3° at 100kHz					

SPECIFICATIONS

		MSO-2072E(A)	MSO-2074E(A)	MSO-2102E(A)	MSO-2104E(A)	MSO-2202E(A)	MSO-2204E(A)
CURSORS AND MEASUREMENT	**Cursors**	Amplitude, Time, Gating Available; Unit : Seconds(S), Hz(1/S), Phase (Degrees), Ratio(%)					
	Automatic Measurement	38 sets : Pk-Pk, Max, Min, Amplitude, High, Low, Mean, Cycle Mean, RMS, Cycle RMS, Area, Cycle Area, ROVShoot, FOVShoot, RPREShoot, FPREShoot, Frequency, Period, RiseTime, FallTime, +Width, -Width, Duty Cycle, +Pulses, -Pulses, +Edges, -Edges, %Flicker, Flicker Idx., FRR, FRF, FFR, FFF, LRR, LRF, LFR, LFF, Phase Cursors measurement					
	Control Panel Function	Cursors measurement					
	Auto Counter	6 digits, range from 2Hz minimum to the rated bandwidth					
	Autoset	Single-button, automatic setup of all channels for vertical, horizontal and trigger systems, with undo Autoset					
	Save Setup	20set					
	Save Waveform	24set					
DISPLAY SYSTEM	**TFT LCD Type**	8" TFT LCD WVGA color display					
	Display Resolution	800 horizontal x 480 vertical pixels (WVGA)					
	Interpolation	Sin(x)/x					
	Waveform Display	Dots, Vectors, Variable persistence(16ms~10s), Infinite persistence					
	Waveform Update Rate	120,000 waveforms per second, maximum					
	Display mode	YT ; XY					
	Display Graticule	8 x 10 divisions					
INTERFACE	**USB Port**	USB 2.0 High-speed host port x 1, USB 2.0 High-speed device port x 1					
	Ethernet Port (LAN)	RJ-45 connector, 10/100Mbps with HP Auto-MDIX					
	Go/NoGo BNC	5V Max/10mA TTL open collector output					
	Kensington Style Lock	Rear-panel security slot connects to standard Kensington-style lock					
LOGIC ANALYSER SPECIFICATIONS	**Sample Rate**	Per Channel 1GSa/s					
	Bandwidth	200MHz					
	Record Length	Per Channel 10M pts (max)					
	Input Channels	16 Digital (D15 - D0)					
	Trigger Type	Edge, Pattern, Pulse Width, Serial bus (I_2C, SPI, UART(RS232/422/485), CAN, LIN), Parallel Bus					
	Thresholds Quad	D0~D3, D4~D7,D8~D11 ,D12~D15 Thresholds					
	Threshold Selections	TTL, CMOS(5V,3.3V,2.5V), ECL, PECL,0V ,User Defined					
	User-defined Threshold Range	±5V					
	Maximum Input Voltage	±40 V					
	Minimum Voltage Swing	±250 mV					
	Input Impedance	101KΩ probe loading 8pF					
	Vertical Resolution	1 bit					
AWG SPECIFICATIONS (MSO-2000EA only)	**Channels**	2					
	Sample Rate	200 Msa/s					
	Vertical Resolution	14 bits					
	Max. Frequency	25 MHz					
	Waveforms	Sine, Square, Pulse, Ramp, DC, Noise, Sinc, Gaussian, Lorentz, Exponential Rise, Exponential Fall, Haversine, Cardiac					
	Output Range	20 mVpp to 5 Vpp, HighZ;10 mVpp to 2.5 Vpp, 50 **Ω**					
	Output Resolution	1mV					
	Output Accuracy	2% (1 kHz)					
	Offset Range	±2.5 V, HighZ;±1.25 V, 50 **Ω**					
	Offset Resolution	1mV					
FREQUENCY RESPONSE ANALYSIS	**Dynamic Range**	> 80 dB (typical)					
	Input and Output Sources	Channel 1 or 2 (3 or 4 for four channel model)					
	Frequency Range	20 Hz to 25 MHz					
	Number of Test Points	10 to 90 points per decade					
	Test Amplitude	20 mVpp to 5 Vpp into High-Z Fixed amplitude across entire sweep					
	Test Results	Logarithmic overlaid gain and phase plot					
	Manual Measurements	Two pairs of tracking gain and phase markers					
	Plot Scaling	Auto-scaled during test					
POWER SOURCE MISCELLANEOUS	**Line Voltage Range**	AC 100V ~ 240V, 50Hz ~ 60Hz, auto selection					
	Multi-Language Menu	Available					
	On-Line Help	Available					
	Time clock	Time and date, provide the date/time for saved data					
	Operation Environment	Temperature: 0°C to 50°C. Relative Humidity: ≤80%, 40°C or below; ≤45%, 41°C ~ 50°C					
DIMENSIONS & WEIGHT	384(W) X 208(H) X 127.3(D)mm, Approx. 2.8 kg						

Note : Three-year warranty, excluding probes & LCD display panel.

Specifications subject to change without notice. MSO2000EGD2BH

ORDERING INFORMATION

MSO-2204E(A) 200MHz, 4 + 16 Channel, Mixed-signal Oscilloscope
MSO-2202E(A) 200MHz, 2 + 16 Channel, Mixed-signal Oscilloscope
MSO-2104E(A) 100MHz, 4 + 16 Channel, Mixed-signal Oscilloscope
MSO-2102E(A) 100MHz, 2 + 16 Channel, Mixed-signal Oscilloscope
MSO-2074E(A) 70MHz, 4 + 16 Channel, Mixed-signal Oscilloscope
MSO-2072E(A) 70MHz, 2 + 16 Channel, Mixed-signal Oscilloscope
"(A)" have built-in a Dual Channel 25MHz Arbitrary Waveform Generator

ACCESSORIES

User manual CD x 1,Power cord x 1
GCP-201 : Probe Clip, 20PCS **GTL-16E** : 16-Channel Logic Analyzer Probe
GTP-070B-4 : 70MHz(10:1/1:1)Switchable passive probe for MSO-2072E(A)/2074E(A)(one per channel)
GTP-100B-4 : 100MHz(10:1/1:1)Switchable passive probe for MSO-2102E(A)/2104E(A)(one per channel)
GTP-200B-4 : 200MHz(10:1/1:1)Switchable passive probe for MSO-2202E(A)/2204E(A)(one per channel)

OPTIONAL ACCESSORIES

GTL-16E	16-Channel Logic Analyzer Probe	**GCP-530**	50MHz/30A Current probe
GRA-426	Rack Mount Kit	**GCP-500**	500kHz/150A Current probe
GAK-003	50Ω Impedance Adapter	**GCP-1030**	100MHz/30A Current probe
GSC-008	Soft Carrying Case	**GCP-1000**	1MHz/7A Current probe
GTL-246	USB Cable, USB 2.0, A-B Type, 1200mm	**GCP-206P**	Power supply for current probe (2 input channel)
GDB-03	Oscilloscope Education & Training Kit	**GCP-425P**	Power supply for current probe (4 input channel)
GTP-033A	Oscilloscope Probe, 35MHz 1:1 Passive Probe, BNC(P/M)	**GCP-201**	Probe Clip, 20PCS
		GDP-025	25MHz High voltage differential probe
GCP-020	Current Probe, 40Hz ~ 40kHz, 240A	**GDP-050**	50MHz High voltage differential probe
GCP-300	300kHz/200A Current probe	**GDP-100**	100MHz High voltage differential probe

FREE DOWNLOAD

PC Software OpenWave software **Driver** USB driver ; LabView driver

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