MDO-2000E Series

VPO Visual Persistence Oscilloscope

200/100 MHz Mixed-domain Oscilloscope

FEATURES

- 200/100 MHz Bandwidth Selections: 2 or 4 Channels
- Real Time Sample Rate Per Channel: 1 GSa/s (2 Channel Models); Maximum Real Time Sample Rate: 1 GSa/s (4 Channel Models)
- MDO-2000EG Equips with a Spectrum Analyzer and a Dual Channel 25 MHz AWG
- MDO-2000EX Equips with a Spectrum Analyzer ; a Dual Channel 25 MHz AWG; DMM and Power Supply
- Per Channel 10M Memory Depth and VPO Waveform Display Technology
- Waveform Update Rate up to 120,000 wfm/s
- 8 " WVGA TFT LCD
- Free Frequency Response Analyzer Software
- Maximum 1 M FFT Provides Higher Frequency Domain Resolution Measurements
- High Pass, Low Pass and Band Pass Filter Functions
- 29,000 Segmented Memory Sections and Waveform Search Functions
- I^2C/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
- True RMS Measurement in DMM Function

GW INSTEK
Simply Reliable

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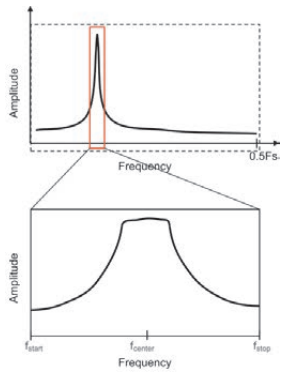
One Oscilloscope ,Two Domains

MDO-2000E series is multi-functional mixed domain oscilloscope. The series includes two feature combinations : MDO-2000EG and MDO-2000EX. MDO-2000EG models have a built-in spectrum analyzer and a dual channel 25 MHz arbitrary waveform generator and MDO-2000EX models feature a built-in a spectrum analyzer, arbitrary waveform generator, a 5,000 count DMM, and a 5V/1A power supply. The first of its kind, MDO-2000EX is the only oscilloscope to equip with a DMM and a power supply in the T&M industry.

While entering the spectrum mode, MDO-2000E series will display a full screen of frequency domain. Users can input Center frequency, Span, Start frequency, and Stop frequency based upon test requirements so as to rapidly and intuitively observe required frequency range that allows users to experience the user interface of a real spectrum analyzer. While observing frequency domain display, engineers can observe waveform characteristics, which are not easily to be seen from time domain waveforms, for instance, the harmonic composition of a waveform and the frequency characteristics of a modulation signal. Compared with oscilloscope' FFT, MDO-2000E series allows engineers to effectively conduct signal measurements on frequency domain.



Conventional DSO's FFT always calculates the entire signal bandwidth up to half the sampling rate (Fs). However, the insufficient calculation capability can't conduct FFT calculation with more points. Users can't have the signal's detailed frequency information due to the insufficient frequency resolution from the calculation result. Whereas MDO-2000E series analyzes signal spectrum of interest. Compared with oscilloscope' FFT, MDO-2000E series allows engineers to effectively conduct signal measurements on frequency domain. Right illustration shown the conventional DSO's FFT (above figure) VS. MDO-2000E's Spectrum analyzer (below figure).

MDO-2000E series frequency domain also includes Spectrum Trace Type settings (Normal, Max-hold, Min-hold, and Average) (Figure 1). Users can freely select various Spectrum Traces for simultaneous display. Detection method (Sample, +Peak, -Peak, and Average) (Figure 2) can be individually set for each Trace. Additionally, users, via Cursor, can manually mark the corresponding positions to reflect Frequency and Amplitude. The Search function can also be applied to log spectrum's Peak Table. Amplitude is displayed with dB and Marker can obtain measurement data. Users can use the Search function to search and mark the amplitude and frequency of spectrum signal. Search methods include Max. peak and threshold. Measurement results can be displayed and saved. (Figure 3)

Figure 1

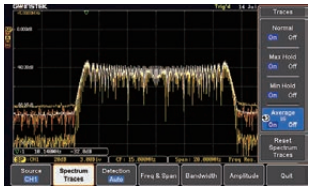


Figure 2

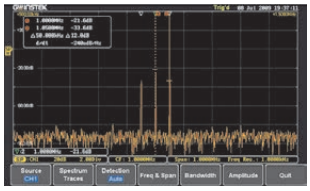
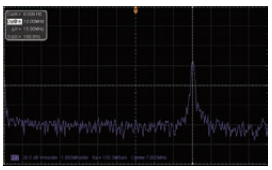


Figure 3

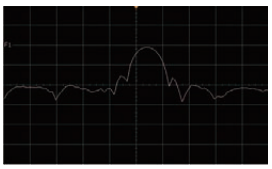
Compared with the general spectrum analyzer, the spectrum function of MDO-2000E series can test below~9kHz signals, which is applicable to the frequency domain analysis of audio frequency and vibration. MDO-2000E series can also test the frequency domain signal with DC component without damaging the instrument. With respect to frequency domain waveform display, MDO-2000E series, featuring the same capability of a real-time spectrum analyzer, is faster than the general spectrum analyzer. Why? It is because MDO-2000E series utilizes digital circuit and software to calculate FFT. The general spectrum analyzer can only process the signal of a narrow frequency bandwidth at a time by frequency sweeping. Each sweeping will take several ms to dozens of ms. Hundreds and thousands of frequency sweepings are gathered to form a spectrum. Therefore, the displayed spectrum is not obtained at the same time. MDO-2000E series obtains spectrum display at the same time by utilizing digital circuit and software to calculate FFT that is faster than the frequency sweeping method. The FFT settings of oscilloscopes are based upon horizontal scale (sample rate) setting, which is totally different from the frequency range setting of MDO-2000E series. Most instruments will have insufficient frequency resolution due to insufficient FFT points while conducting spectrum measurement by FFT. Compared with the FFT of oscilloscopes, MDO-2000E series satisfies users with signal measurement requirements under 9kHz; a better setting interface, measurement resolution and measurements speed.

Three screen displays on the right show the spectrum results of MDO-2000E's spectrum analyzer and the FFT of two different branded oscilloscopes after testing the same FSK signal. The parameters of FSK signal: 500 mVpp sine wave, fmax: 10.2 MHz, fmin: 10.0 MHz, bit rate: 10.0 kHz.The upper right screen display is the spectrum of MDO-2000E's spectrum analyzer. Users can directly input Center and Span Frequency by an intuitive and swift setting. Fmax and fmin can be clearly identified from the screen display.

The right screen display is an often seen spectrum from a general oscilloscope's FFT. The left boundary started from DC (low frequency signal) and the maximum frequency on the right is half of the sample rate (can be extended to the right or even out of the boundary). The Span setting for spectrum can only be switched by fixed 1-2-5 multiplying factors. Therefore, users can't set Span according to their requirements that is extremely inconvenient for the operation. In fact, switching multiplying factor is to conduct Zoom In/Out calculation on the original FFT spectrum and the sample rate remains the same during the calculation process. Users can easily encounter the upper and lower boundary limits that is totally different from the general spectrum analyzer in terms of operational experience. Most importantly, no matter how setting is changed the important fmax and fmin of spectrum can't be identified.



The right screen display is the FFT spectrum from a well-known oscilloscope manufacturer. It also provides Span setting (adjustable 1-2-5 multiplying factor) but the result is the same as the previous case, which only conducts Zoom In/Out calculation on FFT spectrum and FFT calculation points have not increased. This method is absolutely unhelpful on increasing frequency resolution. Therefore, its fmax and fmin can't be identified as well.

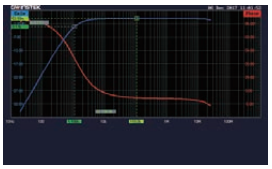


Users will see fmax and fmin appearing on the screen alternatively if the conventional swept tuned spectrum analyzer is used to conduct the measurement on the previous signal. The reason is that each frequency component is not obtained at the same time frame and it will take a longer time to process.

FRA of RC high-pass filter

MDO-2000E 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.

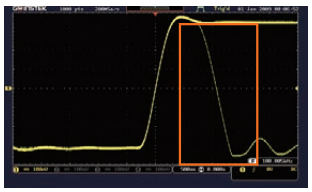
The frequency range of FRA is from 20 Hz to 25 MHz; the number of test point can be selected from 10 to 90 points per decade. After completing the Bode plot, users can select measurement curve by Cursor so as to retrieve each point's amplitude and phase on the curve.



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

Other than the new functionalities, the hardware characteristics of MDO-2000EG and MDO-2000EX are identical to those of GDS-2000E Series. MDO-2000EG and MDO-2000EX are equipped with 8-inch display and feature bandwidth selections of 200 MHz, 100 MHz, and 70 MHz. Models with two analog channels provide 1 GSa/s real-time sampling rate per channel; models with four analog channels provide 1 GSa/s maximum real-time sampling rate. The waveform update rate of 120,000 wfm/s and the minimum 1mV/div vertical range allow MDO-2000EG series MDO-2000EX to measure complex feeble signals and clearly display measurement results. With respect to the memory depth, MDO-2000E series provide 10 M long memory for users to completely retrieve and analyze waveforms. Users, based upon the application requirements, can select 1 k, 10 k, 100 k, 1 M or 10 M memory depth. 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 function, more meaningful waveforms can be saved and target waveforms can be displayed rapidly. With the waveform search function, users can rapidly search desired waveforms according to the required trigger conditions. MDO-2000E series also provides 1M FFT display that allows users to correctly and efficiently acquire measurement results of the frequency domain. MDO-2000E series, enhancing by the high waveform update rate of 120,000 wfm/sec, Window Zoom and Peak Search, becomes the optimal choice of the economical and multi-function mixed domain oscilloscope.

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

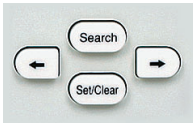


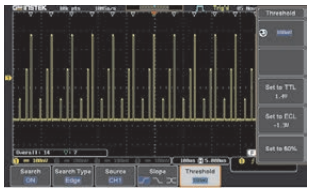
The MDO-2000E series oscilloscope allows users to easily and completely observe inrush signals and rare transient waveforms to increase waveform debugging efficiency by using features, including advanced VPO (Visual Persistence Oscilloscope) signal processing technology, waveform update rate as high 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 MDO-2000E series provides more natural and more genuine signal display effect which is very close to the original analog signal.

B. SUPPORT I^2C ,SPI ,UART,CAN, LIN BUS TRIGGER AND DECODING FUNCTIONS

The serial bus technology has been widely applied in the present embedded application design. The IoT devices connecting sensors and the peripheral components are using serial bus such as UART, I^2C, and SPI. To rapidly and correctly trigger and analyze serial bus data has posed a difficult challenge to engineers. The MDO-2000E series provides serial bus analysis function with 10M long memory depth. Users can trigger, decode, and analyze frequently used I^2C, SPI and UART serial bus and CAN/LIN bus, which is often used by automotive communications.

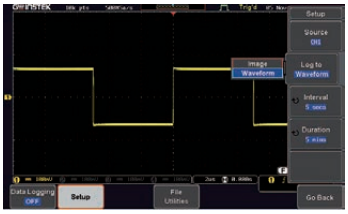
C. WAVEFORM SEARCH FUNCTION





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 MDO-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.

D. DATA LOG FUNCTION



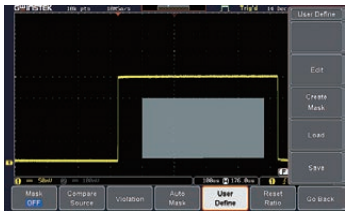
Users, via the data log function, can observe waveform changes in long periods of time to ensure product reliability or measure sporadically appeared signals. The data log function, based on the requirements, can set record time and interval. Record time can be selected from 5 minutes to 1000 hours, 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 MDO-2000E series or the remote computer via LAN.

E. SEGMENTED MEMORY FUNCTION

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

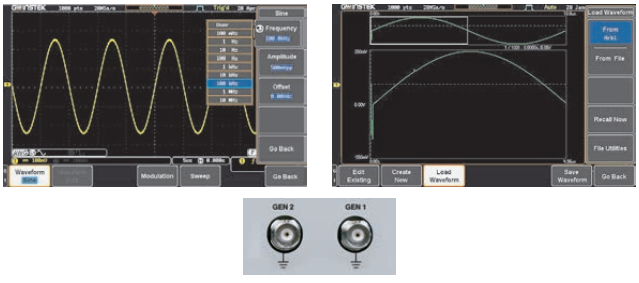
To achieve the most ideal application for memory depth, the MDO-2000E series has the built-in segmented memory function. The segmented memory function allows users to select the desired important signals for observation. Hence, insignificant signals can be neglected and serial bus decoding; pulse or inrush signals can be identified when retrieving signals. The segmented memory function of the MDO-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.

F. MASK FUNCTION



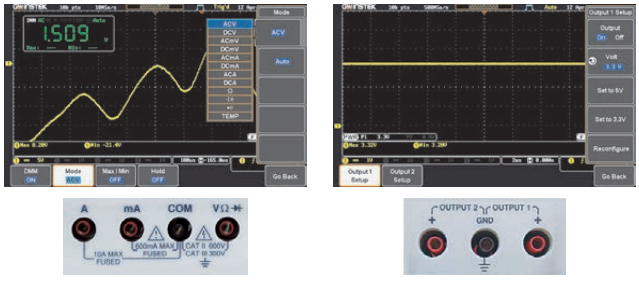
The MDO-2000E series provides the Mask function, which allows users to apply Auto Mask and user-defined Mask to determine whether the quality of the product meets the regulation. Via user-defined mask, users can set up to 8 areas and each area is up to 10 points to meet test requirements. Users can also 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.

G. 25 MHz DUAL CHANNEL ARBITRARY WAVEFORM GENERATOR



With respect to signal source, MDO-2000E features a built-in dual channel 25MHz arbitrary waveform generator with modulation capability and also provides 14 bits vertical resolution; sample rate of 200 MSa/s; 13 output waveforms (Sine, Square, Pulse, Ramp, DC, Noise, Sinc, Gaussian, Lorentz, Exponential Rise, Exponential Fall, Haversine, Cardiac); and AM/FM/FSK modulation and sweep function. The friendly user interface is the ideal choice for education and applications such as circuit simulation tests. Arbitrary waveform generator provides users with 16k memory length. Users can upload basic waveforms, including Sine, Square, Pulse, Ramp, and Noise to edit arbitrary waveforms. Normal and Function Edit can edit waveforms. The edited waveforms can be saved as UAW file for data access.

H. POWER SUPPLY AND DMM FUNCTIONS(MDO-2000EX only)



MDO-2000EX has expanded its capabilities by incorporating a 5,000 count DMM and a 5 V/1 A power supply. DMM provides tests for ACV, DCV, ACA, DCA resistance, diode and temperature. The highly accurate DMM can strengthen DSO's capabilities of voltage and current measurement accuracy. Power supply provides 5 V/1 A; 0.1 V incremental adjustment which can supply power for the development board and IoT (Internet of Things) module of the often used 8051/Arduino/ESP8266/MSP430 in Microprocessors and Micro controllers experiment courses. For education and digital circuit tests, it can satisfy the voltage input requirements of 5 V or 3.3 V. Each increment is 0.1 V and over load protection is available.

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. DMM Test Input (MDO-2000EX only)
11. USB Device Port
12. LAN Port
13. Go-NoGo Output
14. Calibration Output
15. Dual Channel Arbitrary Waveform Generator
16. Power Supply Output (MDO-2000EX only)

SELECTION GUIDE

Model	MDO-2104E(G/X)	MDO-2102E(G/X)	MDO-2204E(G/X)	MDO-2202E(G/X)
Bandwidth	100MHz	100MHz	200MHz	200MHz
Channels	4	2	4	2
Record Length	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
Built-in	MDO-2000EG : Spectrum Analyzer ; Dual Channel 25MHz Arbitrary Waveform Generator MDO-2000EX : Spectrum Analyzer ; Dual Channel 25MHz Arbitrary Waveform Generator ; Power Supply and DMM			

SPECIFICATIONS

		MDO-2102E(G/X)	MDO-2104E(G/X)	MDO-2202E(G/X)	MDO-2204E(G/X)
VERTICAL SENSITIVITY	Channels	2Ch+EXT	4Ch	2Ch+EXT	4Ch
	Bandwidth Calculated Rise Time Bandwidth Limit	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 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 and FFT Window to Rectangular, Hamming , Hanning, or Blackman			
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

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
CONTROL PANEL FUNCTION	**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	20 sets
	Save Waveform	24 sets
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~4s), 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
SPECTRUM ANALYZER SPECIFICATIONS	**Frequency Range**	DC~500MHz(Max.) (Max. bandwidth ~500MHz uncalibrated)
	Span	1kHz ~ 500MHz(Max.)
	Resolution Bandwidth	1Hz ~ 500kHz(Max.)
	Reference Level	-50 dBm to +40dBm in steps of 5dBm
	Vertical Units	dBV RMS; Linear RMS; dBm
	Vertical Position	-12divs to +12divs
	Vertical Scale	1dB/div to 20dB/div in a 1-2-5 Sequence
	Display Average Noise Level	1V/div < -50dBm, Avg : 16 ; 100mV/div < -70dBm, Avg : 16 ; 10mV/div < -90dBm, Avg : 16
	Spurious Response	2nd harmonic distortion< 40dBc ; 3rd harmonic distortion< 45dBc
	Frequency Domain Trace Types	Normal ; Max Hold ; Min Hold ; Average (2 ~ 256)
	Detection Methods	Sample ; +Peak ; -Peak ; Average
	FFT Windows	FFT Factor : Hanning 1.44 ; Rectangular 0.89 ; Hamming 1.30 ; Blackman 1.68
AWG SPECIFICATIONS	**Channels**	2
	Sample Rate	200 Msa/s
	Vertical Resolution	14 bits
	Max. Frequency	25 MHz
	Waveforms	Sine, Square, Pulse, Ramp, DC, Noise, Sinc, Gaston, Lorentz, Exponential Rise, Exponential Fall, Haversine, Cardiac
	Output Range	20 mVpp to 5 Vpp, High Z; 10 mVpp to 2.5 Vpp, 50Ω
	Output Resolution	1mV
	Output Accuracy	2% (1 kHz)
	Offset Range	±2.5 V ac+dc, High Z; ±1.25 V ac+dc, 50Ω
	Offset Resolution	1mV
	Sine	Frequency Range: 100mHz~25MHz ; Flatness(relative to 1kHz): ±0.5 dB<15MHz; ±1 dB 15MHz~25MHz; Harmonic Distortion: -40 dBc ; Stray(Non-harmonic): -40 dBc ; Total Harmonic Distortion: 1% ; S/N Ratio: 40 dB
	Square/Pulse	Frequency Range: 100mHz~15MHz ; Rise/Fall time: <15ns ; Overshoot: <3% ; Duty cycle Square: 50% & Pulse: 0.4%~99.6% ; Min. Pulse Width: 30 ns ; Jitter: 500 ps
	Ramp	Frequency Range: 100mHz~1MHz ; Linearity: 1% ; Symmetry: 0~100%
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
DMM SPECIFICATIONS (MDO-2000EX only)	**Reading**	5,000 counts
	Voltage Input	CAT II 600 Vrms, CAT III 300 Vrms ; Below are the basic conditions required to operate the DMM within specifications: *Calibration: Yearly. *Operating Temperature Specification: 18˚C to 28˚C (64.4˚F to 82.4˚F). *Relative humidity: 80 %. (Non condensing) *AC measurement are based on a 50 % duty cycle.
	DC Voltage	50 mV, 500 mV, 5 V, 50 V, 500 V, 1000 V, 6 ranges
	Accuracy	50 mV, 500 mV, 5 V, 50 V, 500 V, 1000 V : ±(0.1 % reading + 5 digits)
	Input Impedance	10 MΩ
	DC Current	50 mA, 500 mA, 10 A, 3 ranges
	Accuracy	50 mA to 500 mA : ±(0.5 % reading + 0.05 mA) ; 10 A : ±(0.5 % reading + 50 mA)
	AC Voltage*	50 mV, 500 mV, 5 V, 50 V, 750 V, 5 range. * : AC voltage measurements above 700 V are not guaranteed to meet specifications.
	Accuracy	50 mV, 500 mV, 5 V, 50 V, 750 V : ±(1.5 % reading + 15 digits) at 50 Hz to 1 kHz
	AC Current	50 mA, 500 mA, 10 A, 3 ranges
	Accuracy*	50 mA, 500 mA: ±(1.5 % reading + 0.05 mA) at 50 Hz to 1 kHz ; 10 A: ±(3 % reading + 50 mA) at 50 Hz to 1 kHz ; * : Measure range: > 10 mA
	Resistance*	50 Ω, 500 Ω, 5 kΩ, 50 kΩ, 500 kΩ, 5 MΩ, 50 MΩ, 7 range. *: In resistance measurements, the 50 Ω and 50 MΩ ranges are not guaranteed to meet specifications.
	Accuracy	500 Ω, 5 kΩ, 50 kΩ, 500 kΩ, 5 MΩ: ±(0.3 % reading + 3 digits) ; 5 MΩ: ±(0.5 % reading + 3 digits)
	Diode Test	Maximum forward voltage 1.5 V, Open voltage 2.8 V
	Temperature (Thermocouple)*	Range: -50 °C to + 1000 °C; Resolution: 0.1 °C *: Specifications do not include probe accuracy.
	Continuity Beeper	15 Ω
POWER SUPPLY SOECIFICATIONS (MDO-2000EX only)	**Output Channel**	CH1 & CH2
	Output Voltage Range	1.0V~5.0V
	Output Current (Max.)	1A
	Voltage Step	0.1V Continuously Adjustable
	Output Voltage Accuracy	±3%
	Ripple and Noise	50mVrms
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% at 40°C or below; ⩽45%, 41°C ~ 50°C
DIMENSIONS & WEIGHT	384(W) X 208(H) X 127.3(D)mm, Approx. 3 kg	

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

Specifications subject to change without notice. MDO2000EGD5BH-202507

ORDERING INFORMATION

MDO-2204E(G/X)	200MHz,4Channel,Digital Storage Oscilloscope, Spectrum Analyzer,Dual Channel 25MHz AWG
MDO-2202E(G/X)	200MHz,2Channel,Digital Storage Oscilloscope, Spectrum Analyzer,Dual Channel 25MHz AWG
MDO-2104E(G/X)	100MHz,4Channel,Digital Storage Oscilloscope, Spectrum Analyzer,Dual Channel 25MHz AWG
MDO-2102E(G/X)	100MHz,2Channel,Digital Storage Oscilloscope, Spectrum Analyzer,Dual Channel 25MHz AWG

"(X)" built in 5,000 counts DMM and power supply

ACCESSORIES

Power cord x 1, **GTL-110** BNC-BNC cable x 2, **GTL-105A** Alligator Clip test lead(only on MDO-2000EX), **GTL-207A** Banana plug test lead (only on MDO-2000EX)
GTP-100B-4 : 100MHz(10:1/1:1)Switchable passive probe for MDO-2102E(X)/2104E(X)(one per channel)
GTP-200B-4 : 200MHz(10:1/1:1)Switchable passive probe for MDO-2202E(X)/2204E(X)(one per channel)

OPTIONAL ACCESSORIES

GRA-426	Rack Adapter Panel	**GCP-530**	50 MHz/30 A Current probe
GAK-003	50 Ω Impedance Adapter	**GCP-500**	500 kHz/150 A Current probe
GTL-246	USB Cable, USB 2.0, A-B Type, 1200 mm	**GCP-1030**	100 MHz/30 A Current probe
GTL-205A	Temperature probe adaptor with thermocouple (K type)	**GCP-1000**	1 MHz/70 A Current probe
GDP-025	25 MHz High voltage differential probe	**GCP-206P**	Power supply for current probe (2 input channel)
GDP-050	50 MHz High voltage differential probe	**GCP-425P**	Current Probe - Power Supply, 4 Channel Power Supply for GCP-530/1030
GDP-100	100 MHz High voltage differential probe		
GSC-008	Soft Carrying Case		
GTP-033A	Oscilloscope Probe, 35 MHz 1:1 Passive Probe, BNC(P/M)	**GCP-0275**	2 MHz/750 A Current probe
		GCP-0550	5 MHz/500 A Current probe
GCP-300	300 kHz/200 A Current probe	**GCP-2525**	25 MHz/250 A Current probe

FREE DOWNLOAD

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

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