MDO-2000E Series
Introduction

GW INSTEK
Made to Measure

GOOD WILL INSTRUMENT CO., LTD.

MDO-2000E series

200/100/70MHz DSO with

Spectrum analyzer and

Dual channel AWG ,DMM ,power supply functionalities

MDO-2000E series

	Spectrum	25MHz Dual CH AWG	5,000 counts DMM	1A/5V power supply
MDO-2000EG	V	V		
MDO-2000EX	V	V	V	V

MDO-2000EX is the only oscilloscope to equip with a DMM and a power supply .

Key Features

- 200/100/70MHz bandwidth selections ;2 or 4 channels
- Real time sample rate for each channel is 1GSa/s (2 channel models)
  Maximum real time sample rate is 1 GSa/s (4 channel models)
- Maximum 10M memory depth and VPO waveform display technology
- Waveform update rate up to 120,000 wfms/s
- Maximum 1M FFT provides higher frequency domain resolution measurements
- High pass and low pass filter functions
- 29,000 segmented memories and waveform search functions
- I^2C/SPI/UART/CAN/LIN serial bus trigger and decoding function
- Data log function is able to track signal changes up to 100 hours
- 8 ” WVGA TFT LCD display
- Network storage function
- Mask test function
- MDO-2000EG equips with a spectrum analyzer and a dual channel 25MHz AWG
- MDO-2000EX equips with a spectrum analyzer ; a dual channel 25MHz AWG; DMM and power supply.

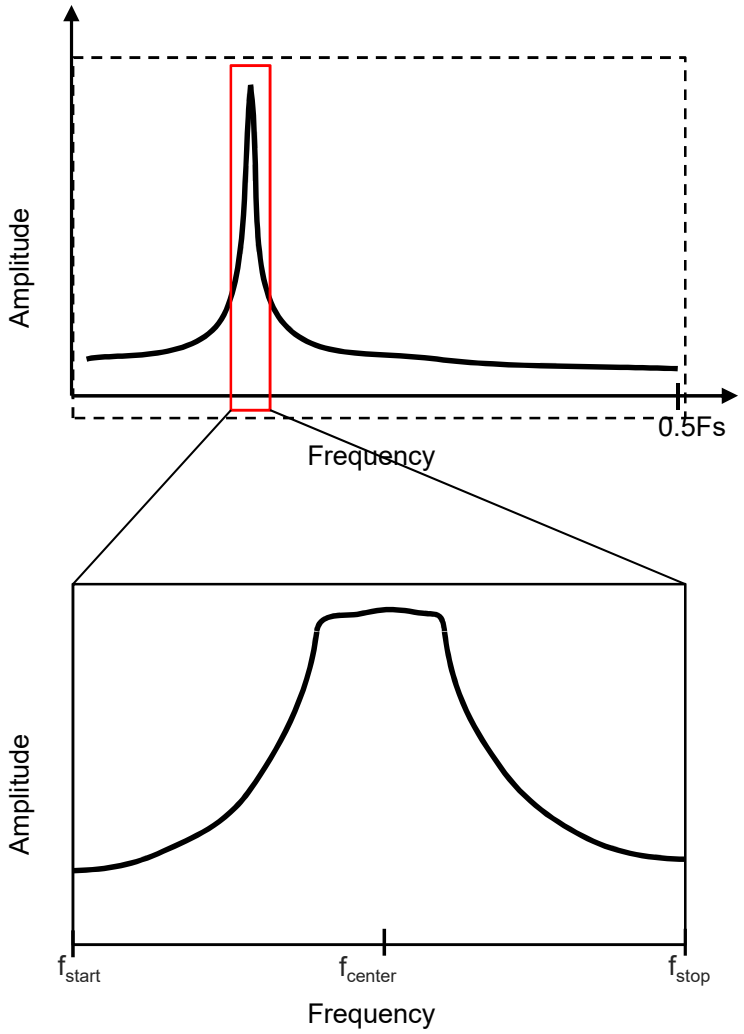
MDO-2000E


GW INSTEK MDO-2104E
Digital Storage Oscilloscope
100 MHz 1 GS/s
VPO
Freq & Span
Center
Span
Start
Stop
To Center
Source CH1
Spectrum Traces
Detection Auto
Freq & Span
Bandwidth
Amplitude
Quit
VARIABLE
Measure
Cursor
APP
Acquire
Display
Help
Save/Recall
Utility
Autoset
Run/Stop
Single
Default
HORIZONTAL
POSITION
SCALE
Select
Search
Set/Clear
Zoom
VERTICAL
TRIGGER
MATH
REF
BUS
CH1
CH2
CH3
CH4
Menu
50 %
Force-Trig
POWER
2V
1MΩ // 16pF
300Vpk MAX
CAT I

The limitation in the general FFT in the DSO

- The operational logic of FFT function is restricted by the sample rate setting of source channels and FFT calculation points.
- A correct spectrum cannot be observed if the horizontal scale can’ t be appropriately setup.
- Insufficient calculation efficiency of CPU platform will also restrain oscilloscopes’ capabilities in providing FFT measurements.

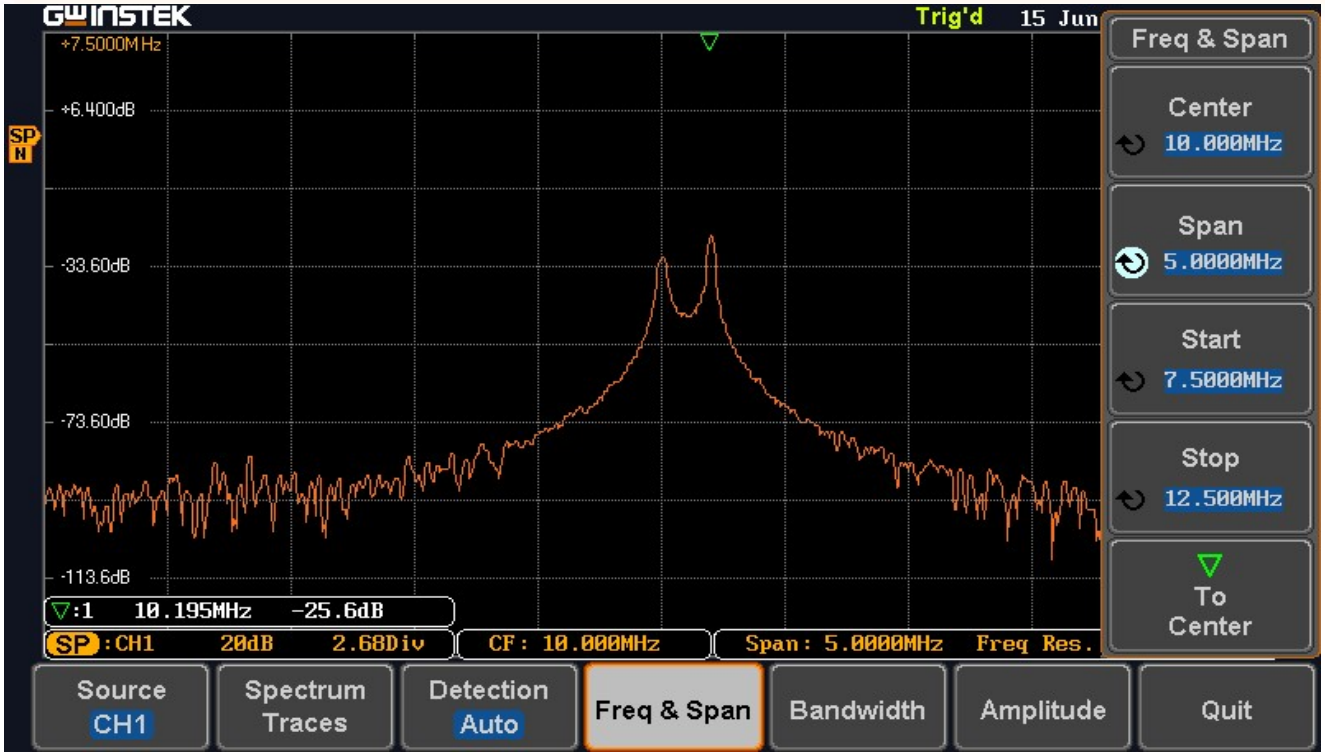
Comparison between conventional FFT and MDO-2000E's SA function



- 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 multi-point FFT calculation. (above figure)

- MDO-2000E analyzes signal spectrum of interest. Compared with oscilloscope' FFT, MDO-2000E series allows engineers to effectively conduct signal measurements on frequency domain. (below figure).

SA display from MDO-2000E

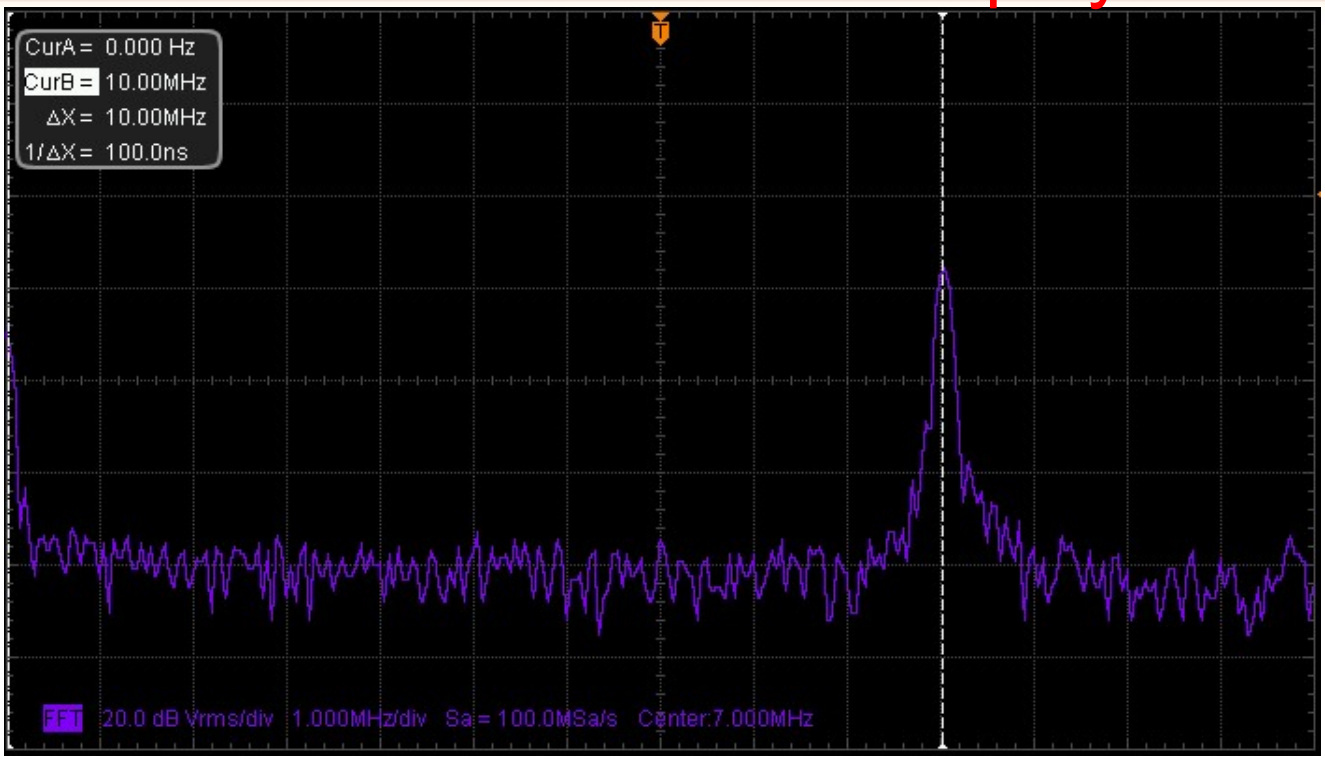


The input signal is FSK 500mV$_{pp}$ sine wave

- f_{max}: 10.2MHz,
- f_{min}: 10.0MHz,
- bit rate: 10.0kHz.

Users can directly input Center and Span Frequency by an intuitive and swift setting. f_{max} and f_{min} can be clearly identified from the screen display by MDO-2000E.

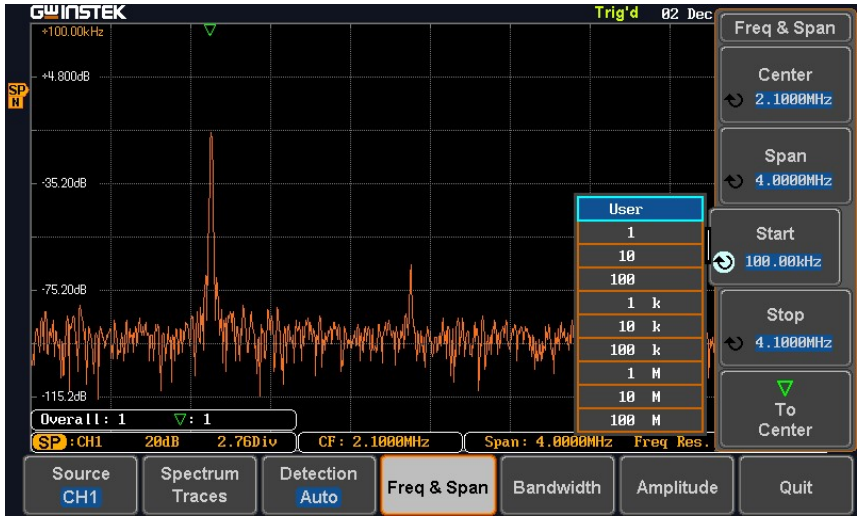
General DSO's FFT display

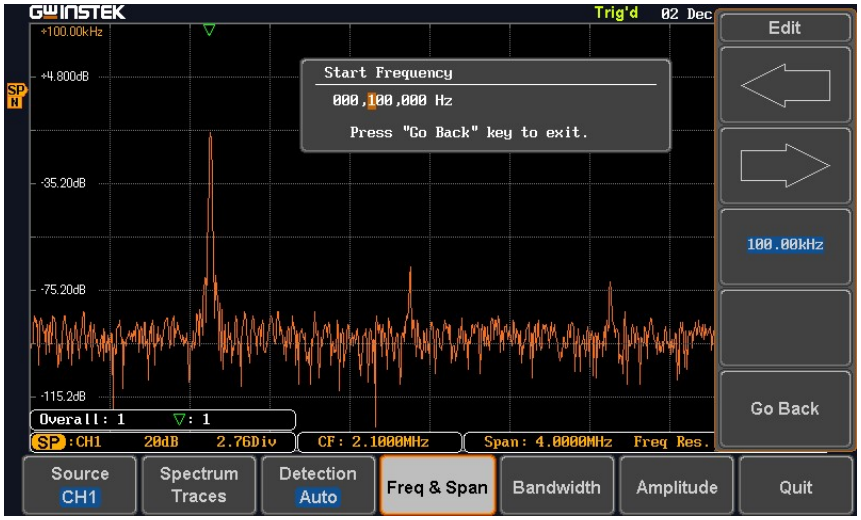


- The boundary started from DC (low frequency signal) and the maximum frequency on the right is half of the sample rate.
- The users can't set Span ,the Span setting for spectrum can only be switched by fixed 1-2-5 multiplying factors
- Only conduct Zoom In/Out calculation on the original FFT spectrum
- The important f_{max} and f_{min} of spectrum can't be identified.

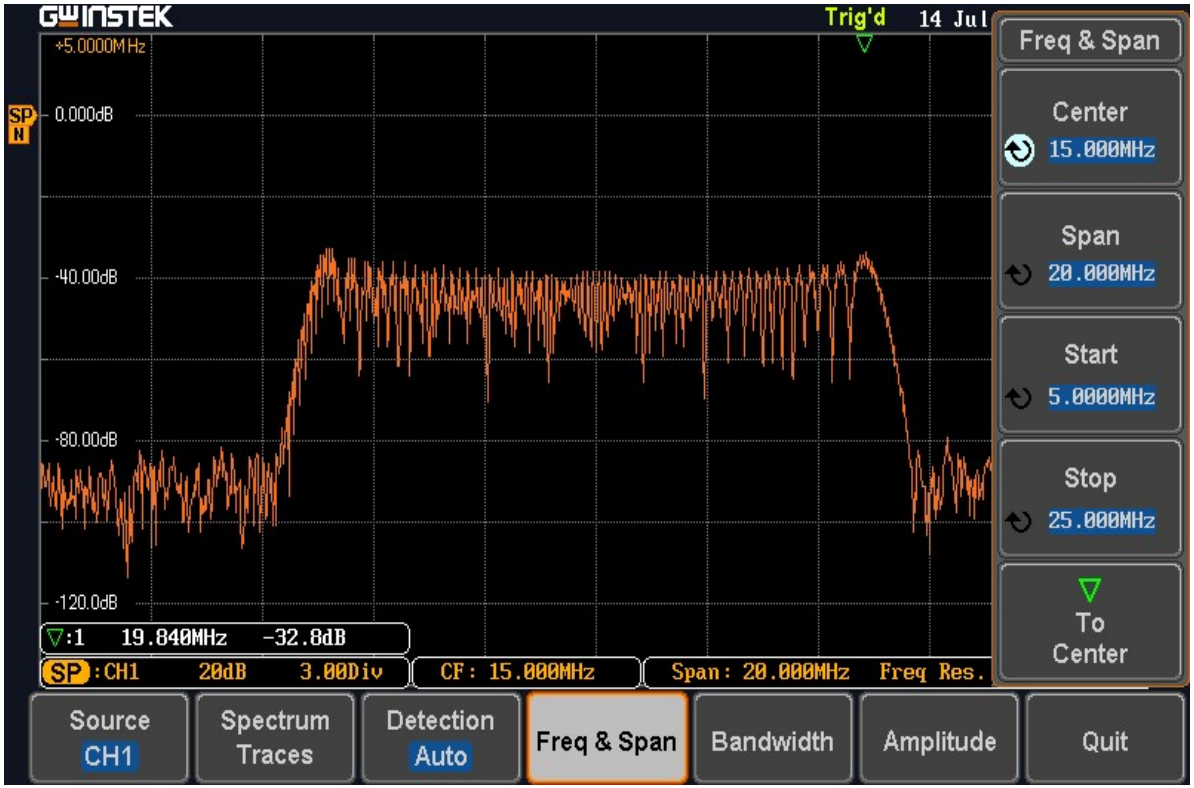
Spectrum analyzer introduction

- To enhance original FFT’ s UI. To provide frequency domain display as the spectrum analyzer.
- Frequency setup allow to set Center/Span or Start/Stop
- The unit of amplitude display is dB .
- Allow to use maker to display the test frequency



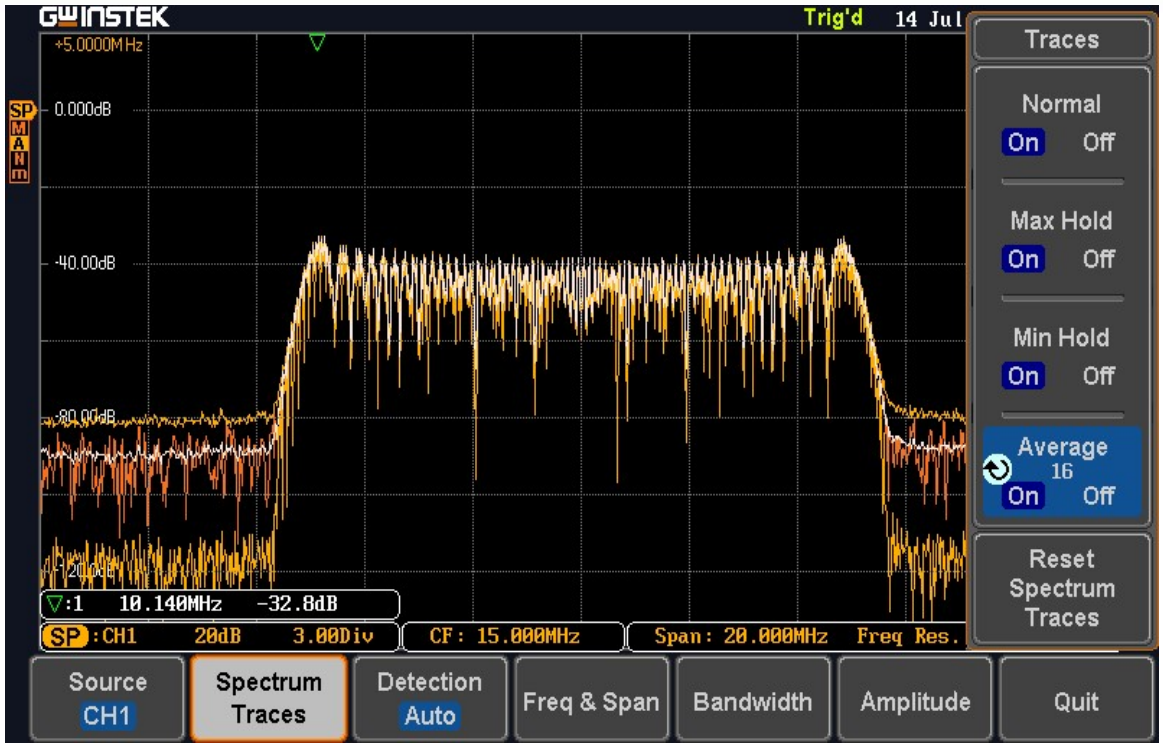


Frequency Setup



The user is allow to set Start Frequency, Stop Frequency, Center Frequency, and Span to intuitively and rapidly identify the desired frequency range

Spectrum trace type setting



In order to allow users to experience genuine Spectrum Analyzer, MDO-2000E also includes Spectrum Trace Type settings (Normal, Max-hold, Min-hold, and Average). Users can freely simultaneously select various Spectrum Traces.

The advantages of SA function in MDO-2000E

1. Compare to normal Spectrum Analyzer ,MDO-2000E is allow to test the frequency below 9kHz and test DC+AC signal. (The applications of less than 9kHz are main in vibration and audio).
2. The test speed is faster than normal Spectrum Analyzer.
3. Users can directly input Center and Span Frequency by an intuitive and swift setting. Frequency components can be clearly identified.

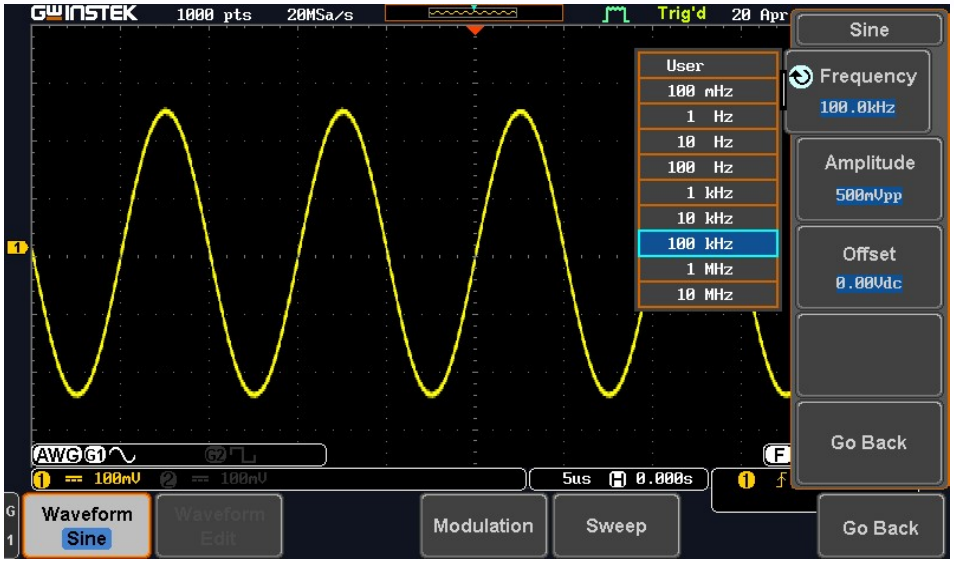
Dual CH 25MHz AWG specifications

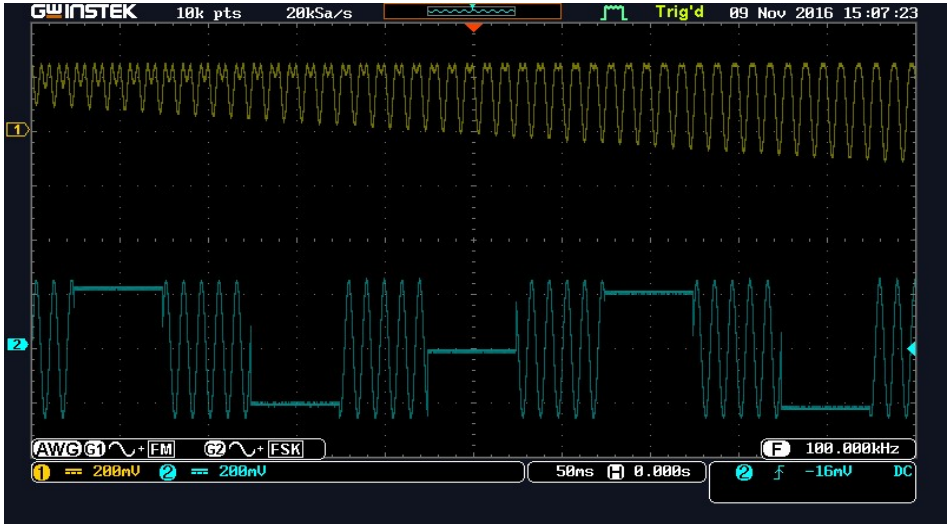
Sample Rate	200 MSa/s
Vertical Resolution	14 bits
Max. Frequency	25 MHz
Standard Waveform	Sine, Square, Pulse, Ramp, DC, Noise
Built-in Waveform	Sinc, Gaussian, Lorentz, Exponential Rise, Exponential Fall, Haversine, Cardiac
Output range	20 mVpp to 5 Vpp, HighZ
	10 mVpp to 2.5 Vpp, 50 Ω
Output Resolution	1mV
Output Accuracy	2% (1 kHz)
Offset range	±2.5 V, HighZ
	±1.25 V, 50 Ω
Offset Resolution	1mV
Sine	
Frequency range	100 mHz to 25 MHz
Flatness	±0.5 dB (relative to 1 kHz)
Harmonic Distortion	-40 dBc
Stray (Non-harmonic)	-40 dBc
Total Harmonic Distortion	1%
S/N Ratio	40 dB
Square/Pulse	
	Square: 100 mHz to 15 MHz
Rise/Fall Time	< 15ns
Overshoot	< 3 %
Duty Cycle	Square: 50%
	Pulse: 0.4% to 99.6%
Min. Pulse Width	30ns
Jitter	500 ps
Ramp	
Frequency range	100 mHz to 1MHz
Linearity	1%
Symmetry	0 to 100%

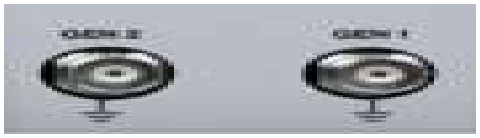
Modulation Function List

Modulation Function List						
Carrier Waveform / Modulation Type	Sine	Square (Fix Duty)	Ramp	Pulse (Adjustable Duty)	Noise & DC	Arb & Built in Waveform
AM	√	√	√	√	x	√
FM	√	√	√	x	x	x
FSK	√	√	√	x	x	x
sweep	√	√	√	x	x	x

Dual channel 25MHz AWG







- Dual channel 25MHz arbitrary waveform generator ,which equips the modulation functions
- 13 different waveforms are built-in
- AM/FM/FSK modulation functions

Arbitrary waveform setup

User is allow to load and create arbitrary waveform on the MDO-2000E series .

MDO-2000EX

Front view
Provide 5,000 counts DMM

MDO-2000EX

Back view

(Including dual power supply output and AWG output)

MDO-2000EX-DMM function

MDO-2000EX equips with DMM and power supply.

•DMM provide 5,000 Counts high resolution.
•DMM functions are including
ACV;DCV;ACA;DCA;Resistance;
Diode and temperature.

- Each DMM setting level is calibrated by precision calibration procedures.
- The DVM of the general oscilloscopes is only the functional extension of Auto measurement, which has a basic measurement error of approximately DC Gain Accuracy 3% and its accuracy cannot compete with the actual DMM.
- The highly accurate DMM can strengthen DSO's capabilities of voltage and current measurement accuracy.

MDO-2000EX-power supply function

•Dual channel DC power supply
•Continuously Adjustable 1~5V output
(0.1V step)
•Over load protection

- Allow to supply power for the development board and IoT (Internet of Things) module of the often used 8051/Arduino/ESP8266/MSP430 in Microprocessors and Microcontrollers experiment courses.

DSO Key features introduction

- 10M memory depth
- Faster waveform update rate of 120,000wfm/s
- 1M FFT
- Waveform search
- Segmented memory
- Provide I2C/SPI/UART/CAN/LIN serial bus trigger and decoding function.
- High pass ,low pass and band pass filter
- MASK function

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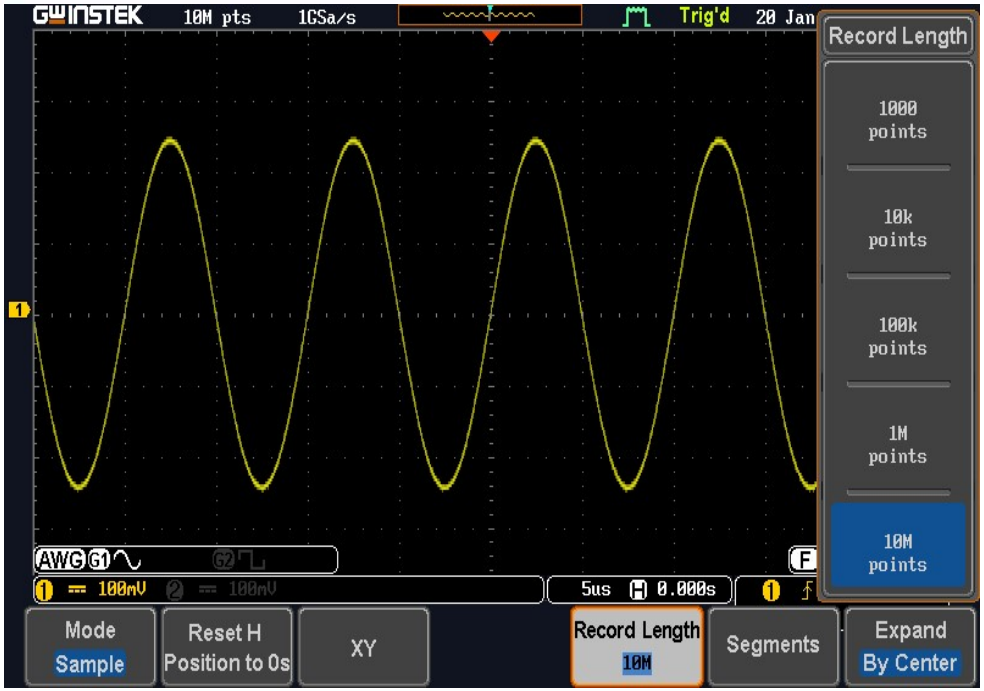
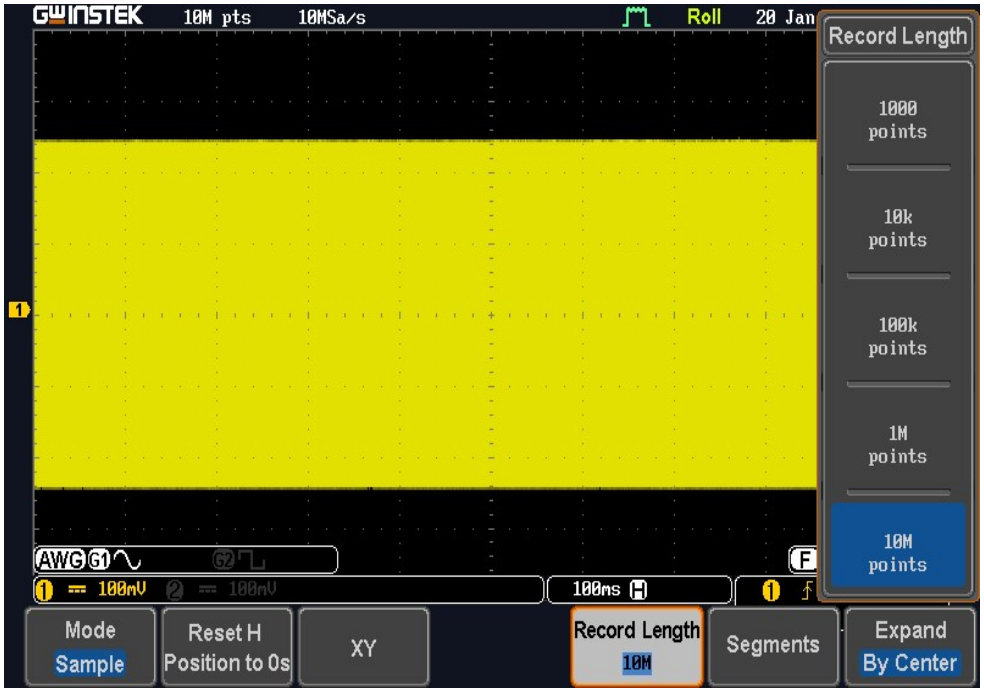
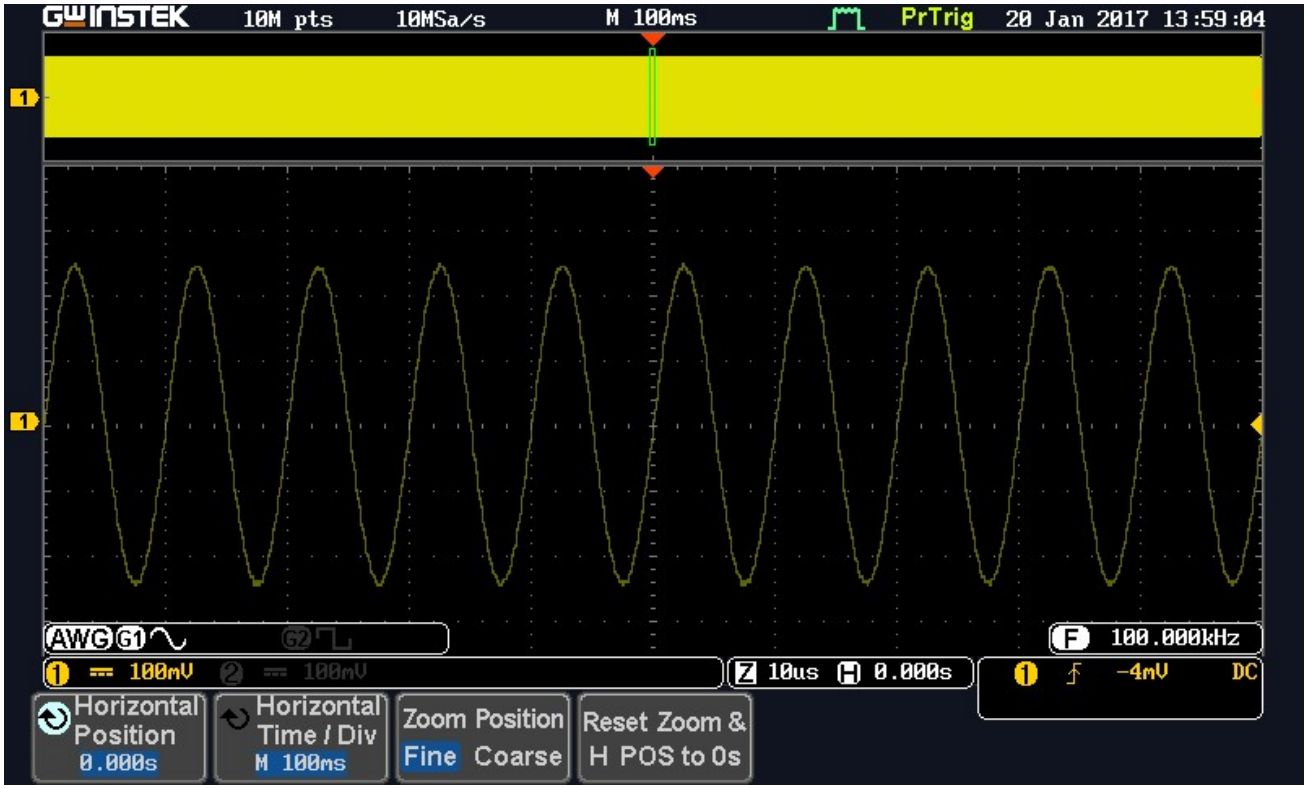
10M Memory depth





•User is allow to select 1K/10K/100K/1M/10M memory depth in normal trigger/ auto trigger or in the Roll mode.



•After Zoom in to observe roll mode's waveform ,the waveform will not distortion .
•This is the way to compare long or short memory depth .

Key features introduction

- 10M memory depth
- Faster waveform update rate of 120,000wfm/s
- 1M FFT
- Waveform search
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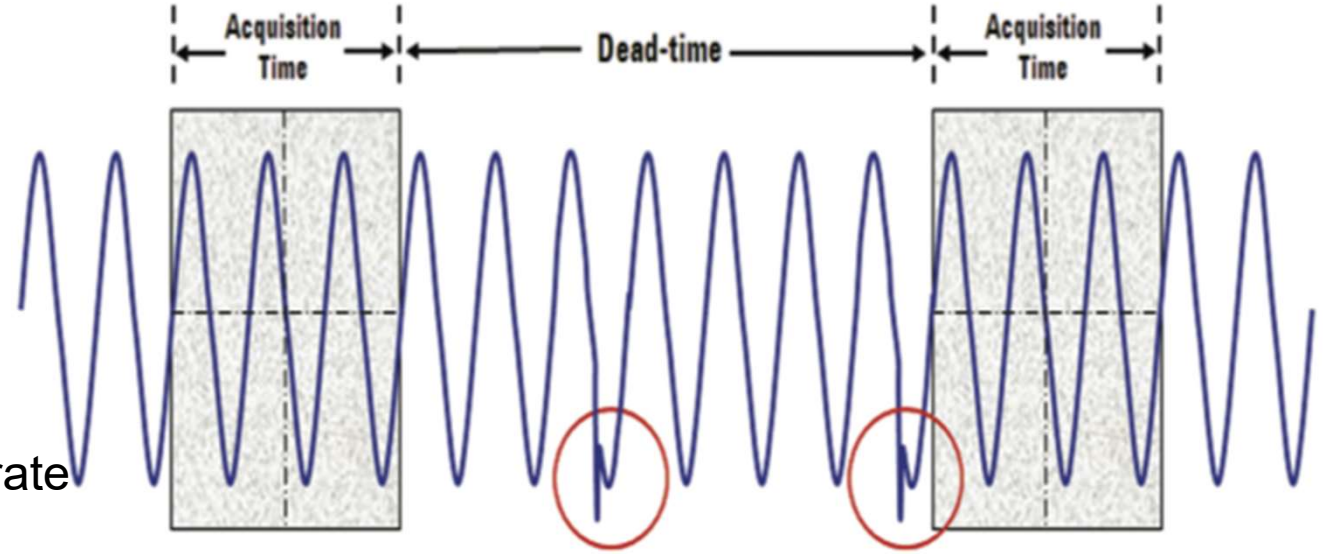
- Provide I2C/SPI/UART/CAN/LIN serial bus trigger and decoding function.
- High pass ,low pass and band pass filter
- MASK function

Waveform Update Rate

	GW Instek MDO-2000E	Rigol DS2000	Keysight X2000
Update Rate	120,000	50,000	50,000



Faster waveform update rate
will reduce dead-time
to capture more complete waveform.

With higher waveform update rate ,MDO-2000E allow user to easily and completely observe inrush signals and rare transient waveform.

Key features introduction

- 10M memory depth
- Faster waveform update rate of 120,000wfm/s
- 1M FFT
- Waveform search
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- Provide I2C/SPI/UART/CAN/LIN serial bus trigger and decoding function.
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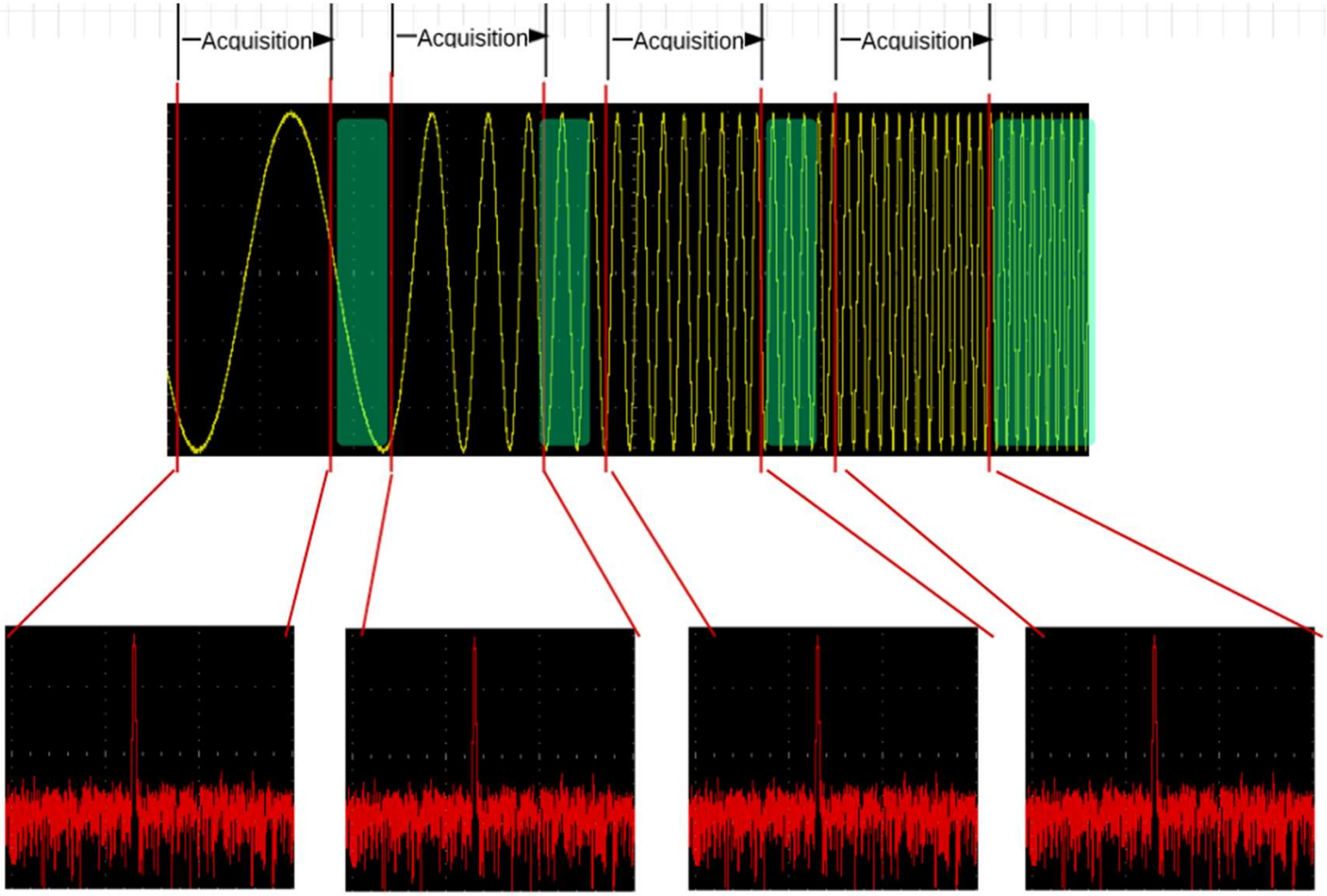
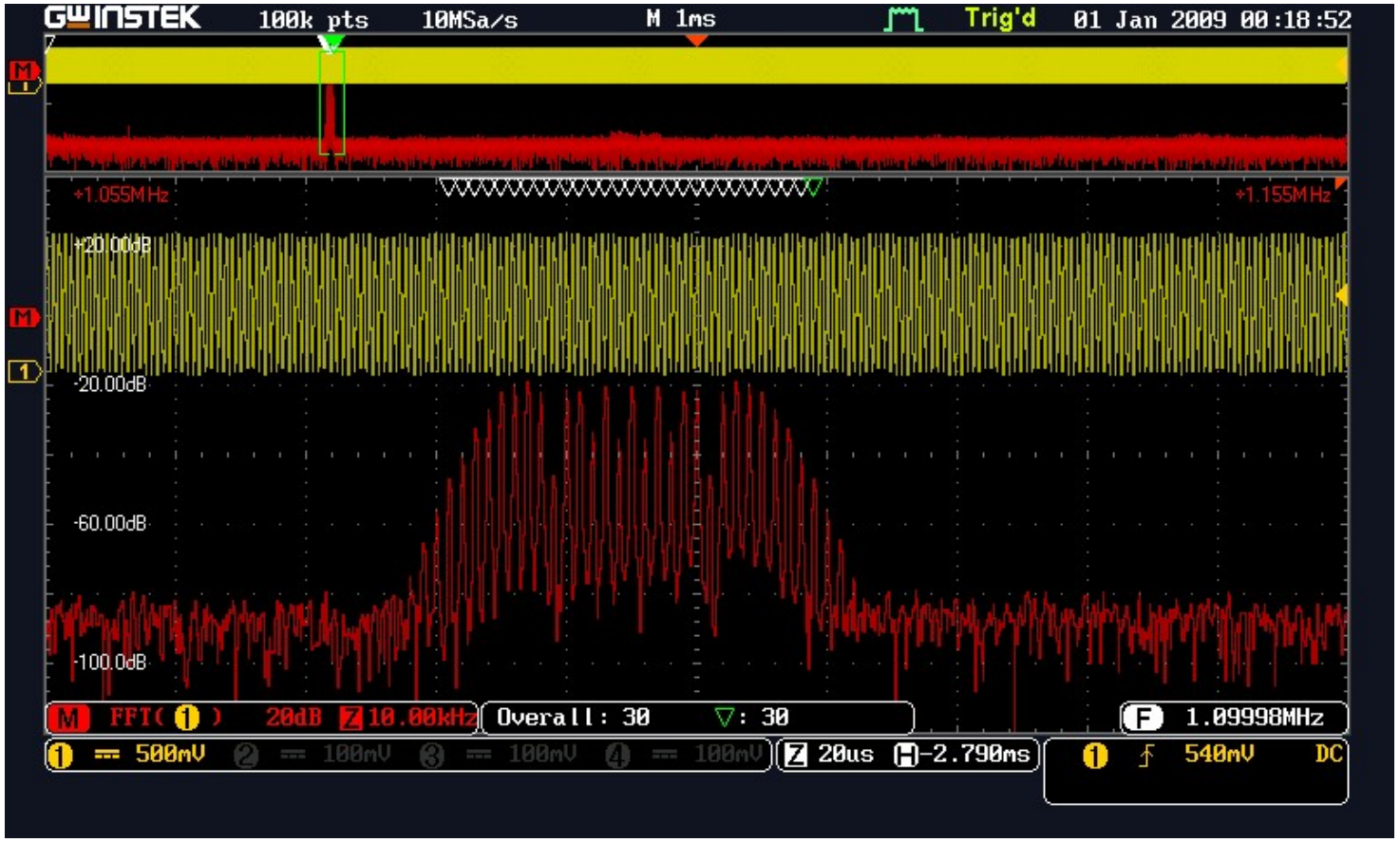
Real Time FFT



1M High Resolution FFT



- User can precisely observe the test results of frequency domain.
- Also allow to Zoom in FFT and search FFT peak.

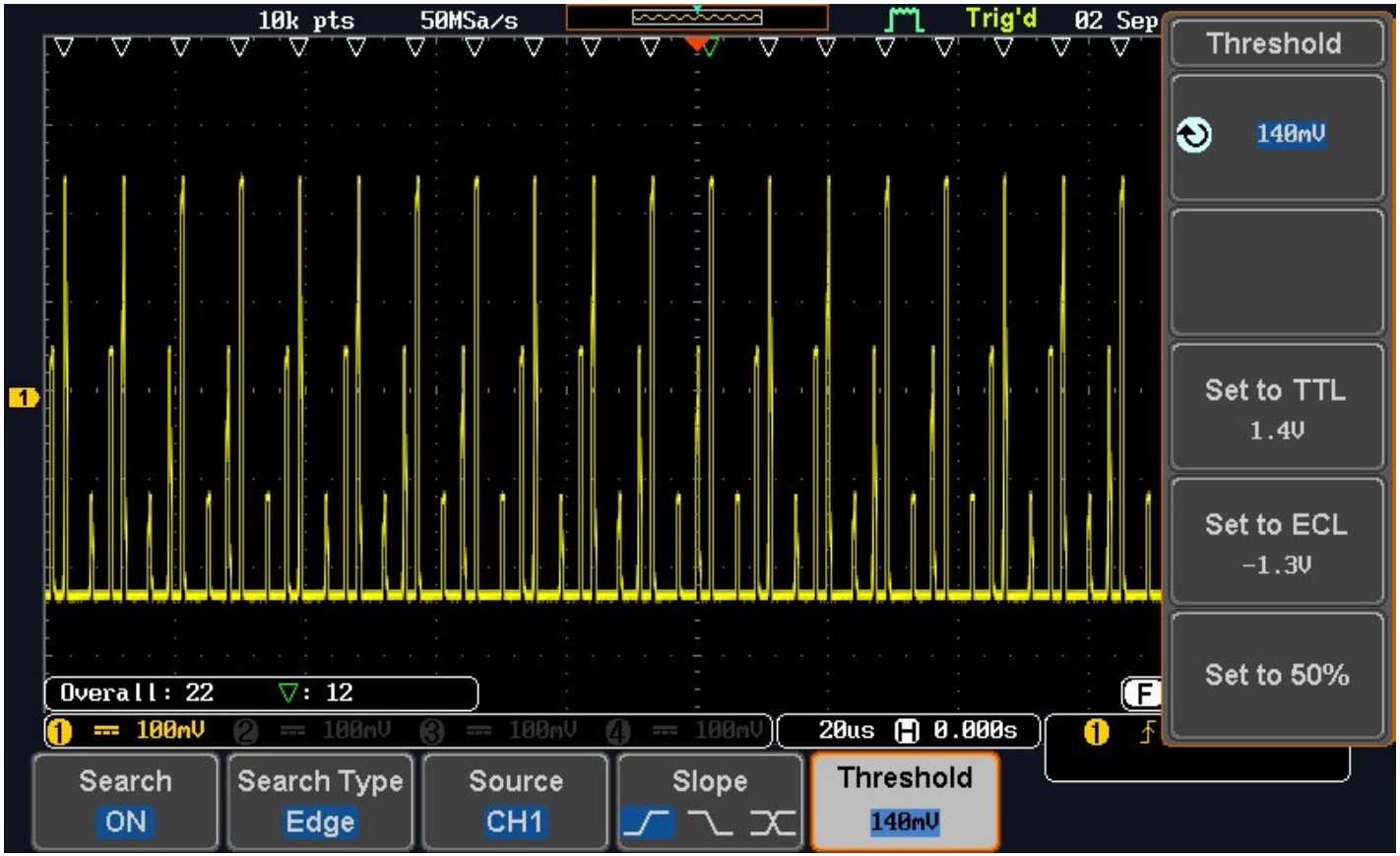
Key features introduction

- 10M memory depth
- Faster waveform update rate of 120,000wfm/s
- 1M FFT
- Waveform search
- Segmented memory
- Provide I2C/SPI/UART/CAN/LIN serial bus trigger and decoding function.
- 25MHz dual channel arbitrary waveform generator
- High pass ,low pass and band pass filter
- MASK function

Waveform search

- 10M memory depth and build in waveform search function
- After turn on search function ,The left corner of monitor will display Overall to show how many events already trigged
- Available to setup Edge ,pulse width ,Runt and Rise/Fall trigger condition to search interested event
- Available to save all marks then search next trigger event.

Waveform Search

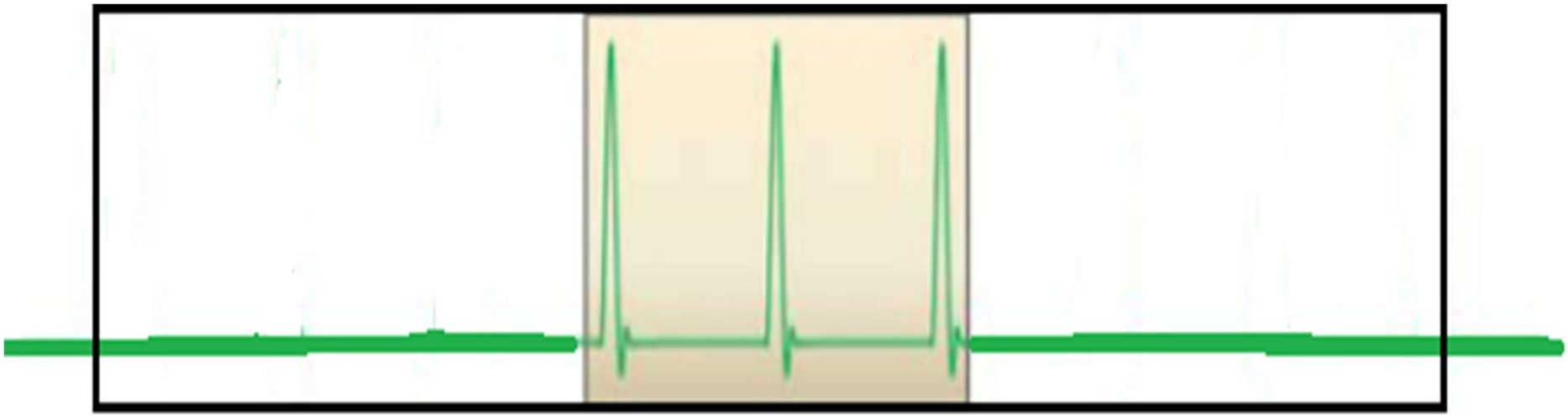


•From Waveform search function ,the user available to easy find out each trigged waveform.

Key features introduction

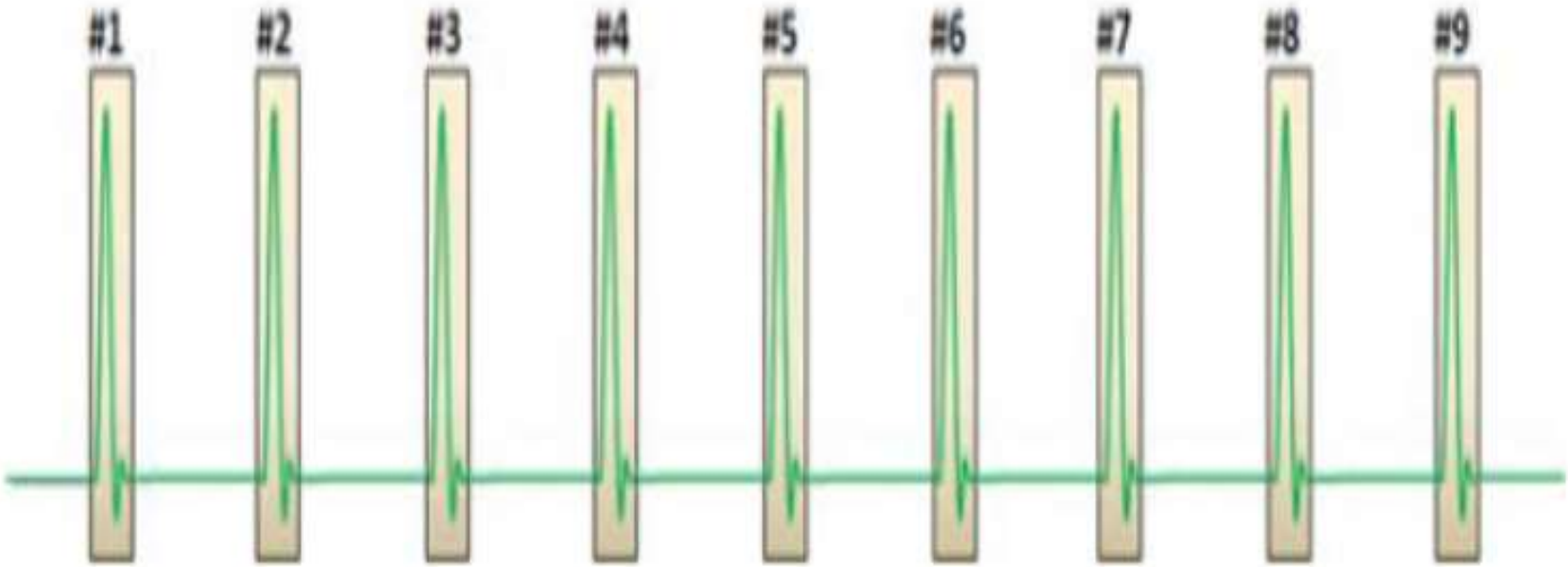
- 10M memory depth
- Faster waveform update rate of 120,000wfm/s
- 1M FFT
- Waveform search
- Segmented memory
- Provide I2C/SPI/UART/CAN/LIN serial bus and parallel bus trigger and decoding function.
- High pass ,low pass and band pass filter
- MASK function

Traditional capture method



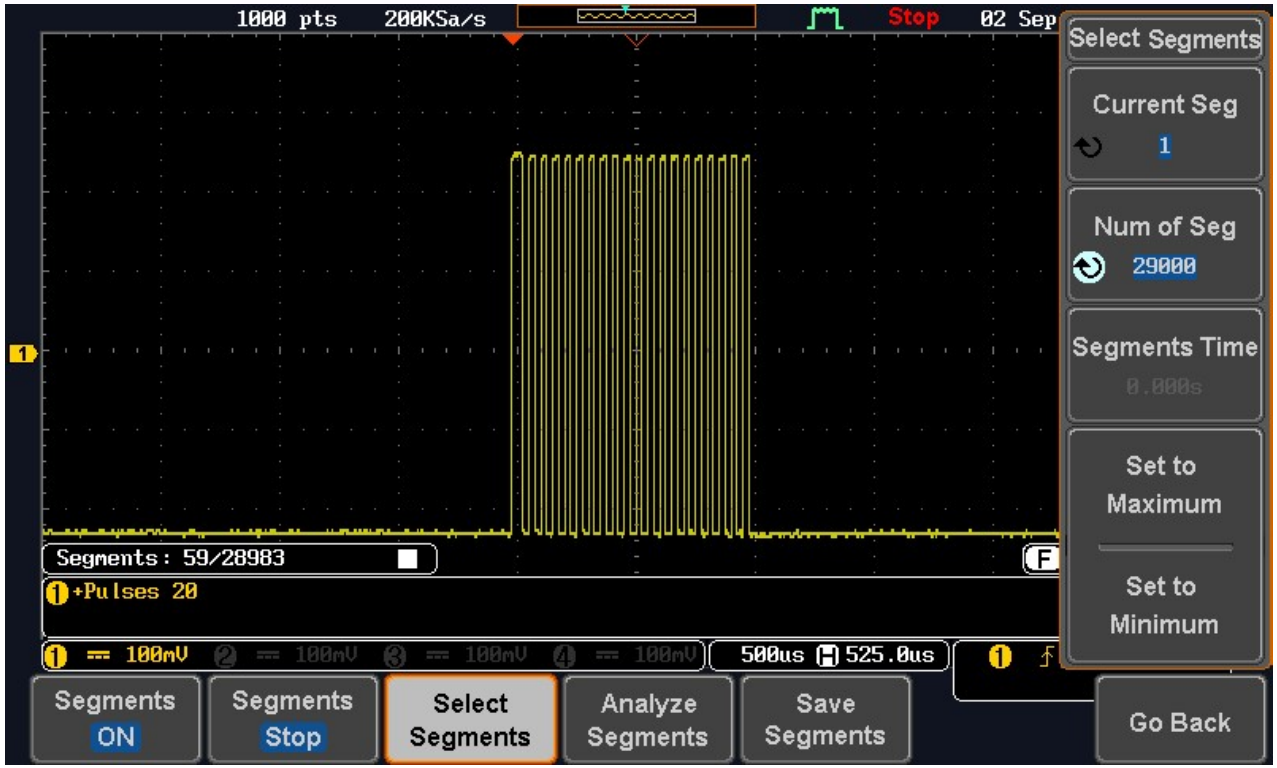
•Can not ignore the blind area, the length of the memory is limited, the user only can capture a limited trigger signal.
•Due to the short memory ,the user only available to capture limited waveform or interested events.

Segmented Memory Acquisition



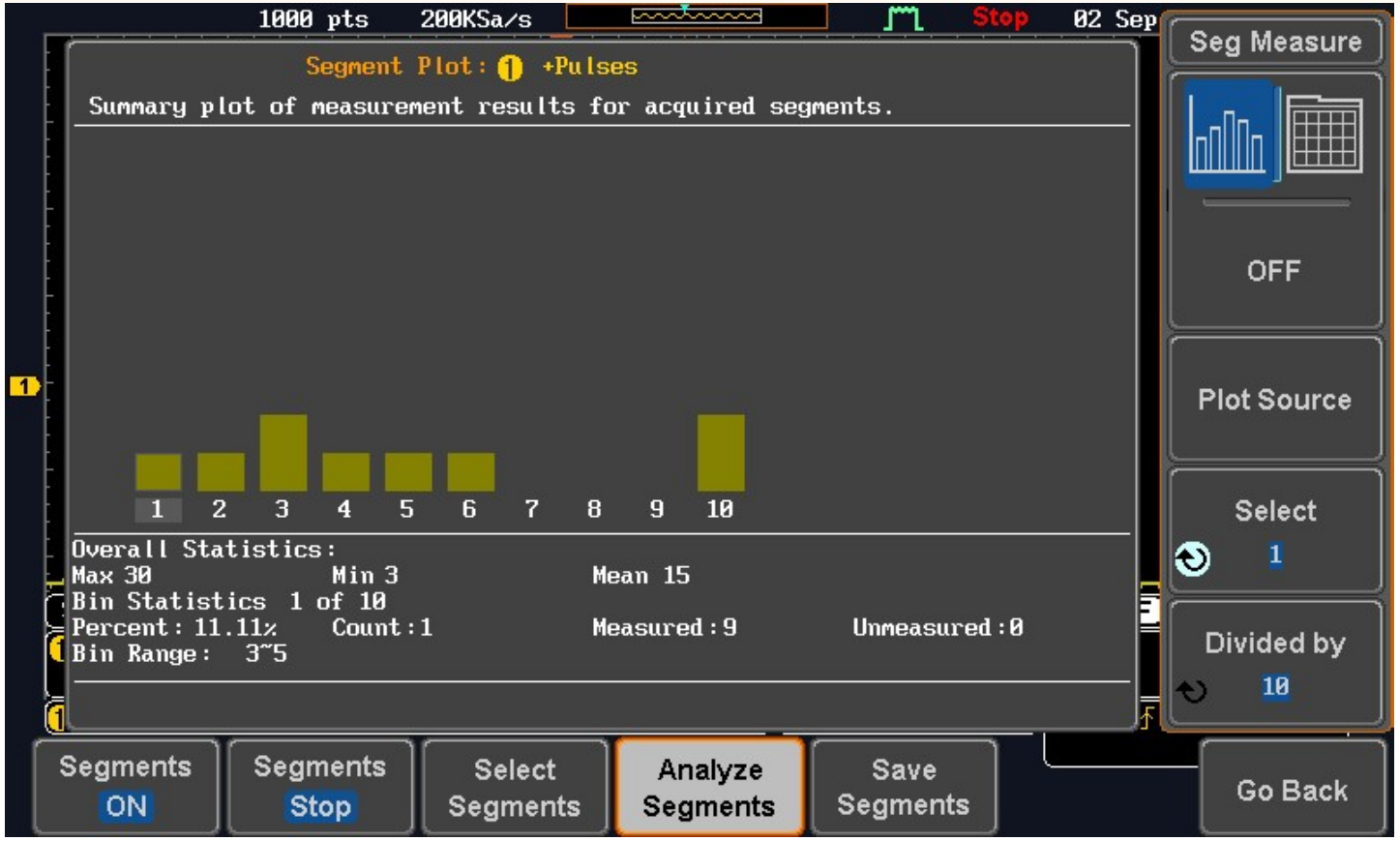
• Available to ignore the blind area that only capture and display trigger events.
• Selectively captures more waveform using the same memory depth.

Segmented memory



- Optimized acquisition memory
- Capture up to 29,000 successive waveform segments
- Segments include all analog and digital channels of acquisition
- Segments include serial bus decoding

To analyze segmented memory



•Available to analyze the value of Max ,Min ,Mean data of the segmented memory.

Key features introduction

- 10M memory depth
- Faster waveform update rate of 120,000wfm/s
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- Waveform search
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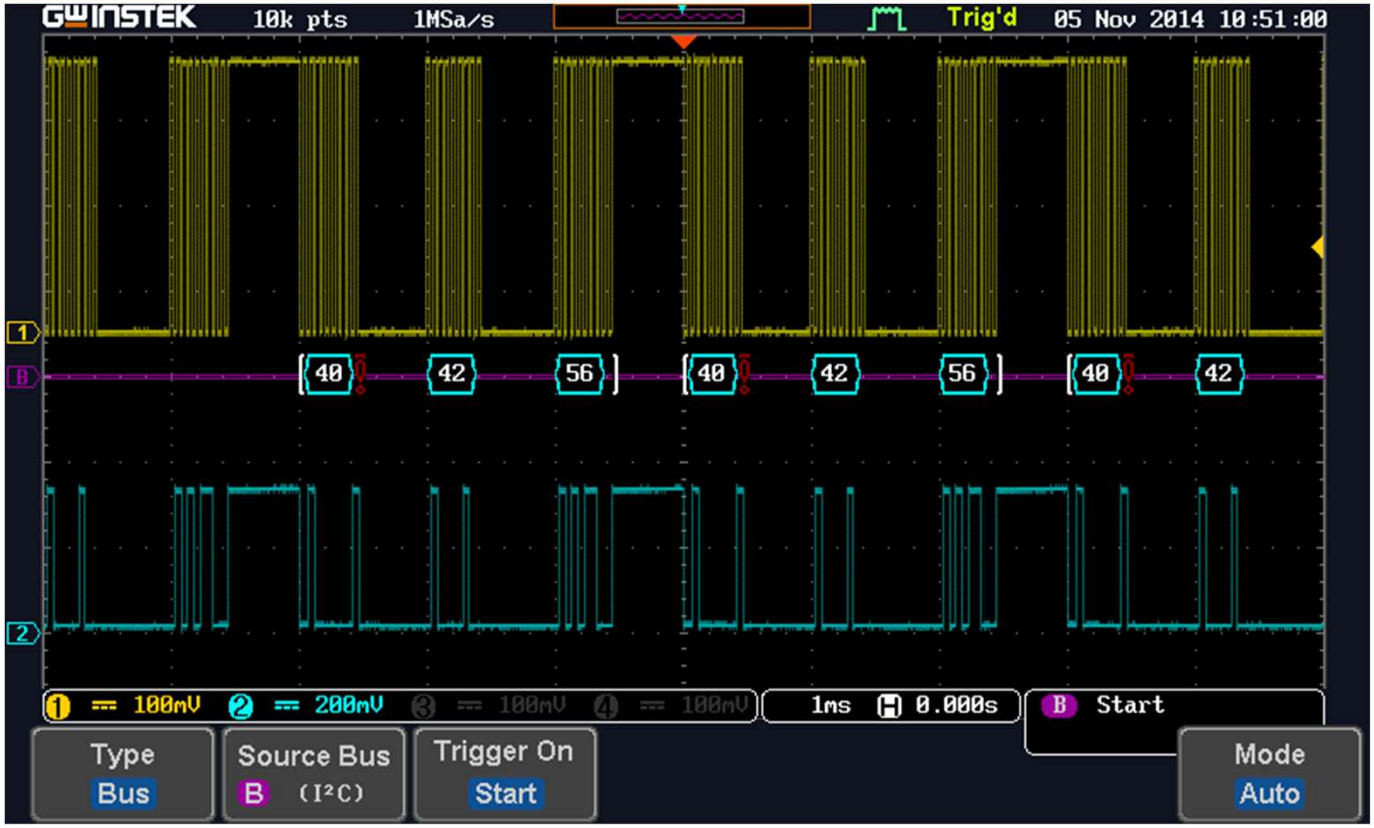
- 25MHz dual channel arbitrary waveform generator
- High pass ,low pass and band pass filter
- MASK function

Bus trigger

The bus types include the following options.

Bus type	Option
UART	Tx Start Bit, Rx Start Bit, Tx End of Packet, Rx End of Packet, Tx Data, Rx Data, Tx Parity Error, Rx Parity Error
I^2C	Start, Repeat Start, Stop, Missing Ack, Address, Data, Address/Data
SPI	SS Active, MOSI, MISO, MOSI&MISO
CAN	Start of Frame, Type of Frame, Identifier, Data, Id & Data, End of Frame, Missing Ack, Bit Stuffing Err
LIN	Sync, Identifier, Data, Id and Data, Wakeup Frame, Sleep Frame, Error

Bus decode



- The IoT devices connecting sensors and the peripheral components are using serial bus such as UART, I2C, and SPI.
- MDO-2000E series features standard serial bus decode and trigger function (including CAN, LIN bus decode), making the series the ideal choice for IoT experiment courses for the educational institutions.

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- High pass ,low pass and band pass filter
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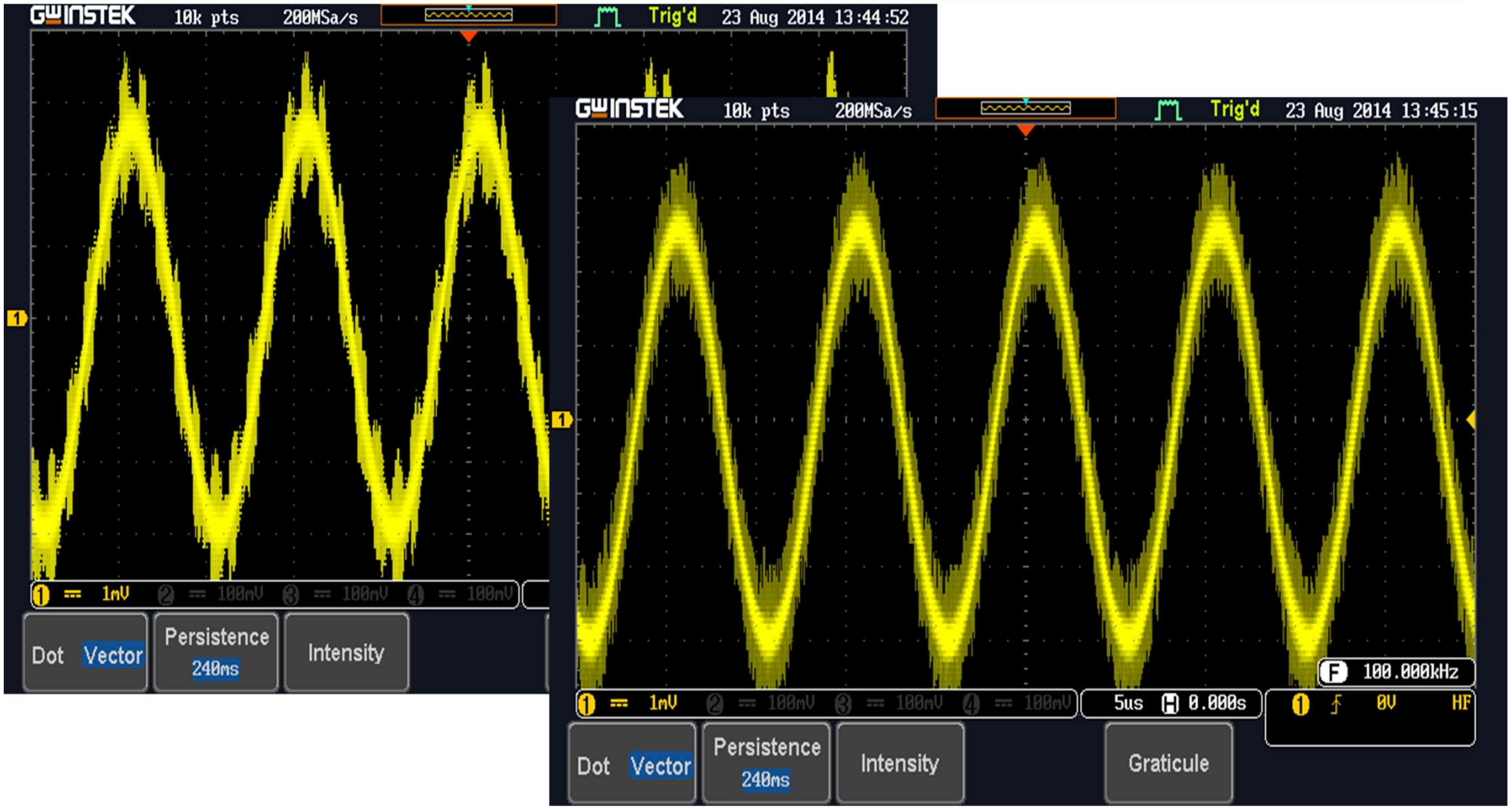
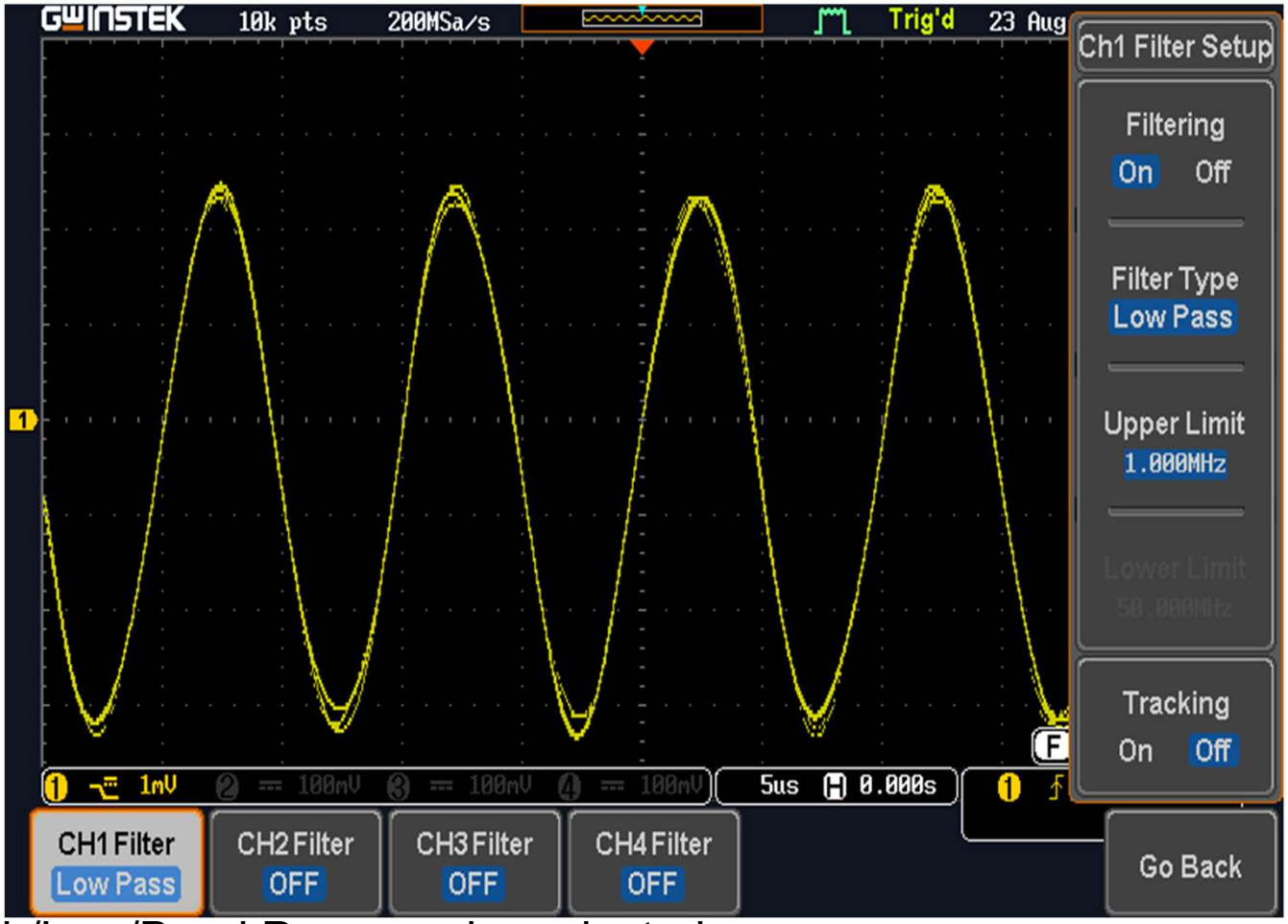
Noisy Signal without filter



Digital Filter



- High/Low/Band Pass can be selected
- Each channel can be set independently
- Allow to set upper limit/lower limit frequency depend on user's request .

Key features introduction

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- 1M FFT
- Waveform search
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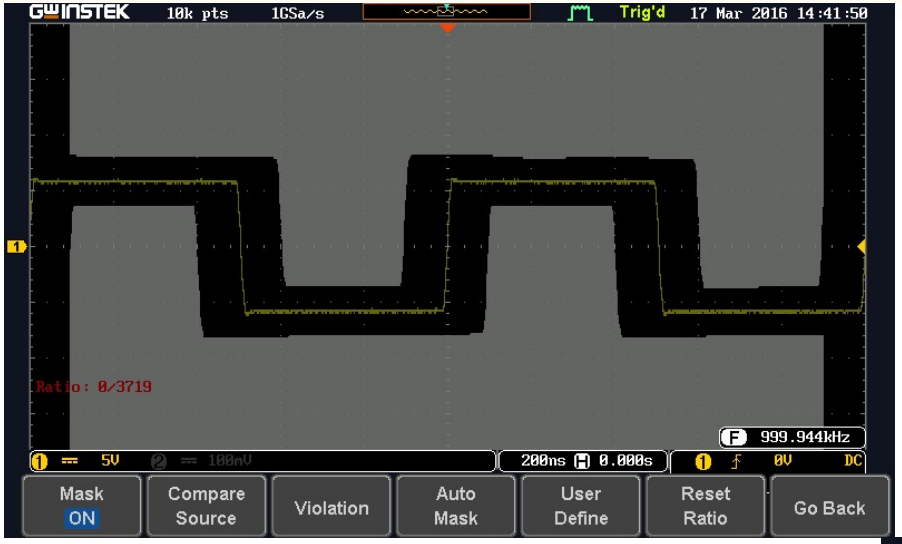
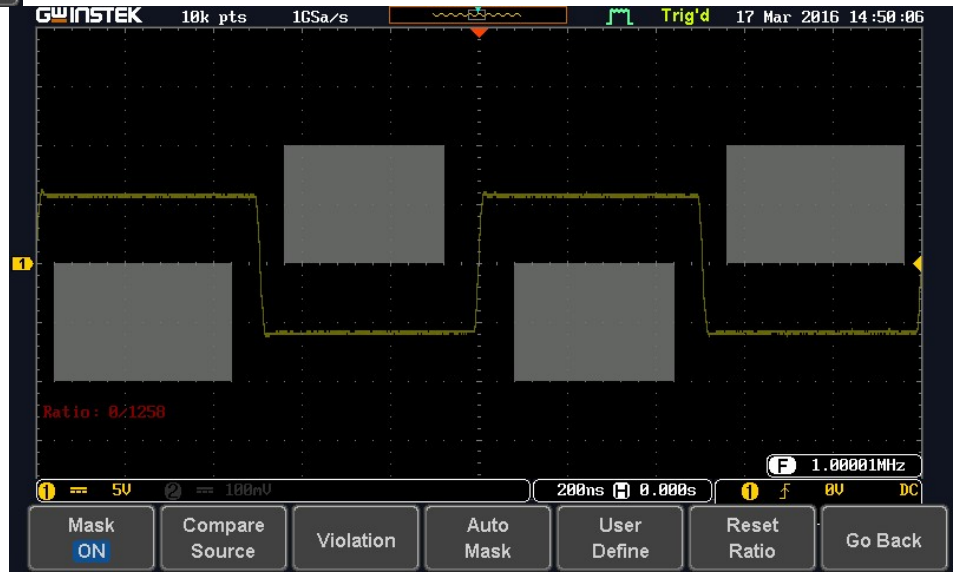
- High pass ,low pass and band pass filter
- MASK function

MDO-2000E provide Mask function





•Allow user 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

Thank You.