

**RIGOL** Product Training

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2018.4.20

Tina. Yuan

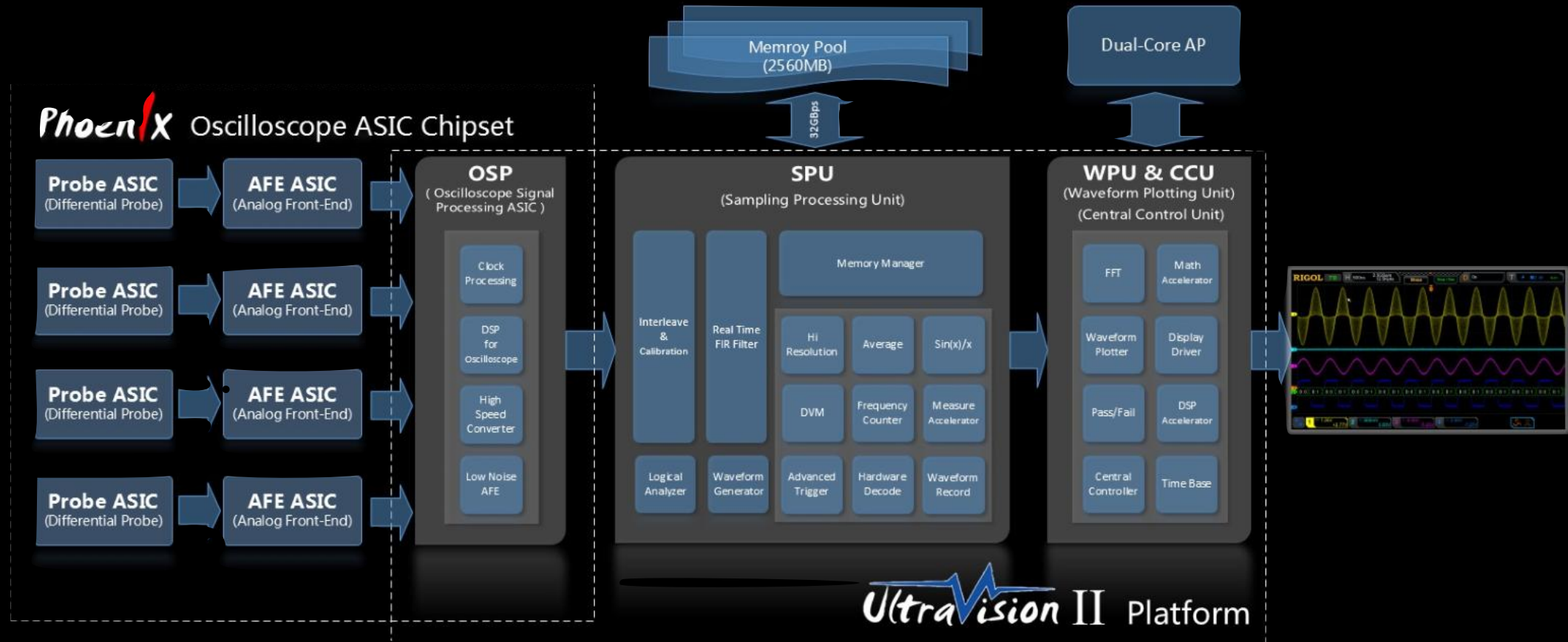
**MSO/DS7000 Series**

# Catalog

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- Technical Platform Introduction
- Product Introduction
- Product Features and Application

# Upgraded Technical Platform



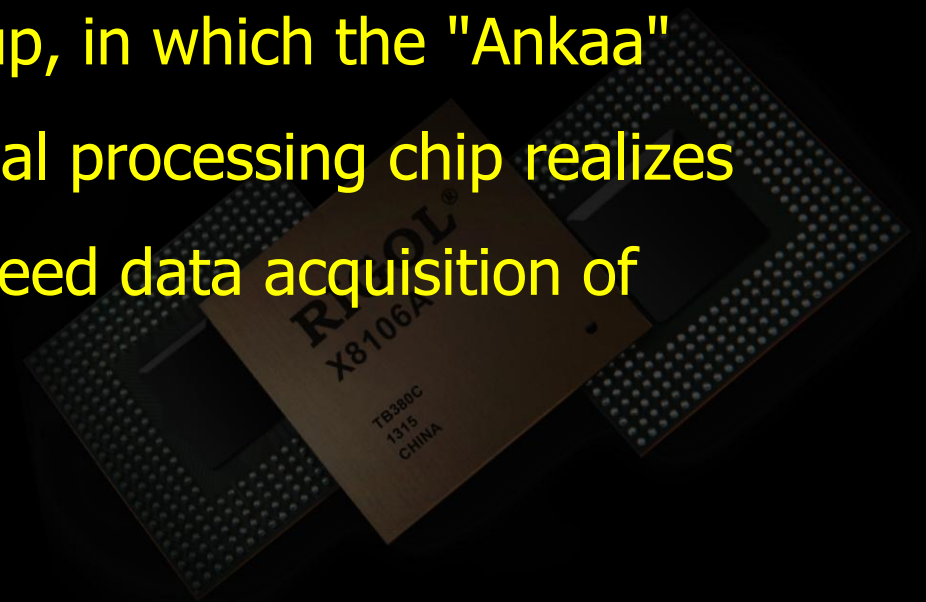
# Upgraded Technical Platform

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## Higher Sampling Rate

H

The latest developed Phoenix oscilloscope special chip group, in which the "Ankaa" oscilloscope signal processing chip realizes the ultra high speed data acquisition of 10Gsps



# Upgraded Technical Platform

## Faster Capture Rate

F

UltraVision II technical platform achieves a breakthrough rate of 600 kwfm/s, and the capture rate is increased by **300%** compared with the 180 kwfm/s of the first UltraVision

# Upgraded Technical Platform

## Preciser Waveform Measurement

P

UltraVision II technical platform implements the traditional software measurement algorithm through FPGA device, which can quickly calculate all the waveform data of the measured signal, making the result more accurate

# Upgraded Technical Platform

## Smaller Trigger Jitter

S

The implementation of pure digital triggering technology on the UltraVision II platform ensures that the smaller signal jitter, the smaller temperature drift, and the higher trigger bandwidth

# Flamingo

Equipped with Phoenix and Ultra Vision II





# Product Introduction



Flamingo, including MSO7000 and DS7000 model series. Based on the *UltraVision II* technical platform, it is a low cost four channel mixed signal oscilloscope with a maximum bandwidth of 500MHz and a maximum sampling rate of 10GSa/s.

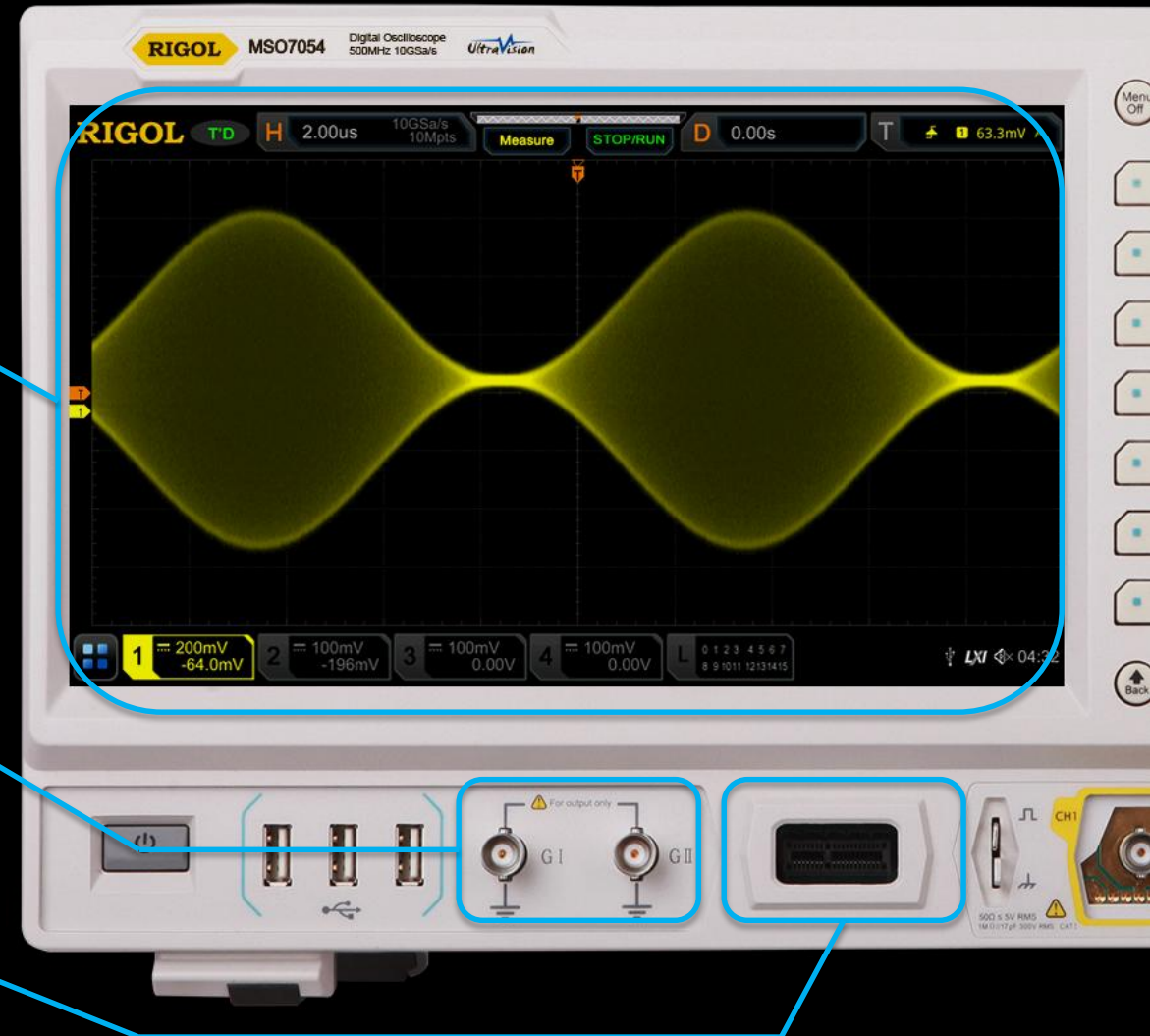
It integrates the oscilloscope, the 16 channel logic analyzer, the dual channel arbitrary waveform generator, the digital voltmeter, the counter and totalizer, and the protocol analyzer.

# Product Introduction

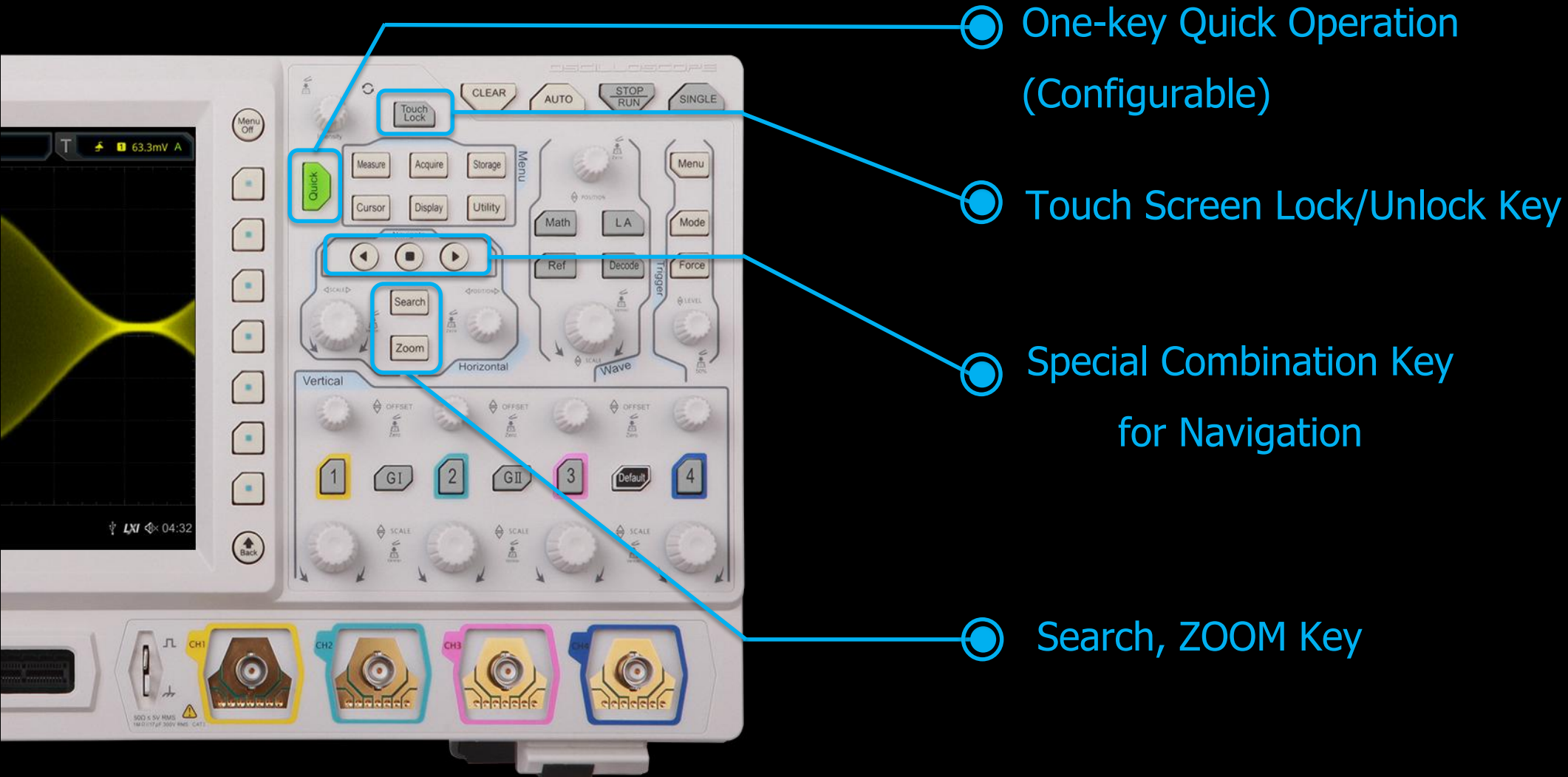
10.1" WVGA (1024\*600) Capacitive  
Multi-touch Screen, 256-level  
Intensity Grading Display

25MHz 2-channel Arbitrary  
Waveform Generator Output

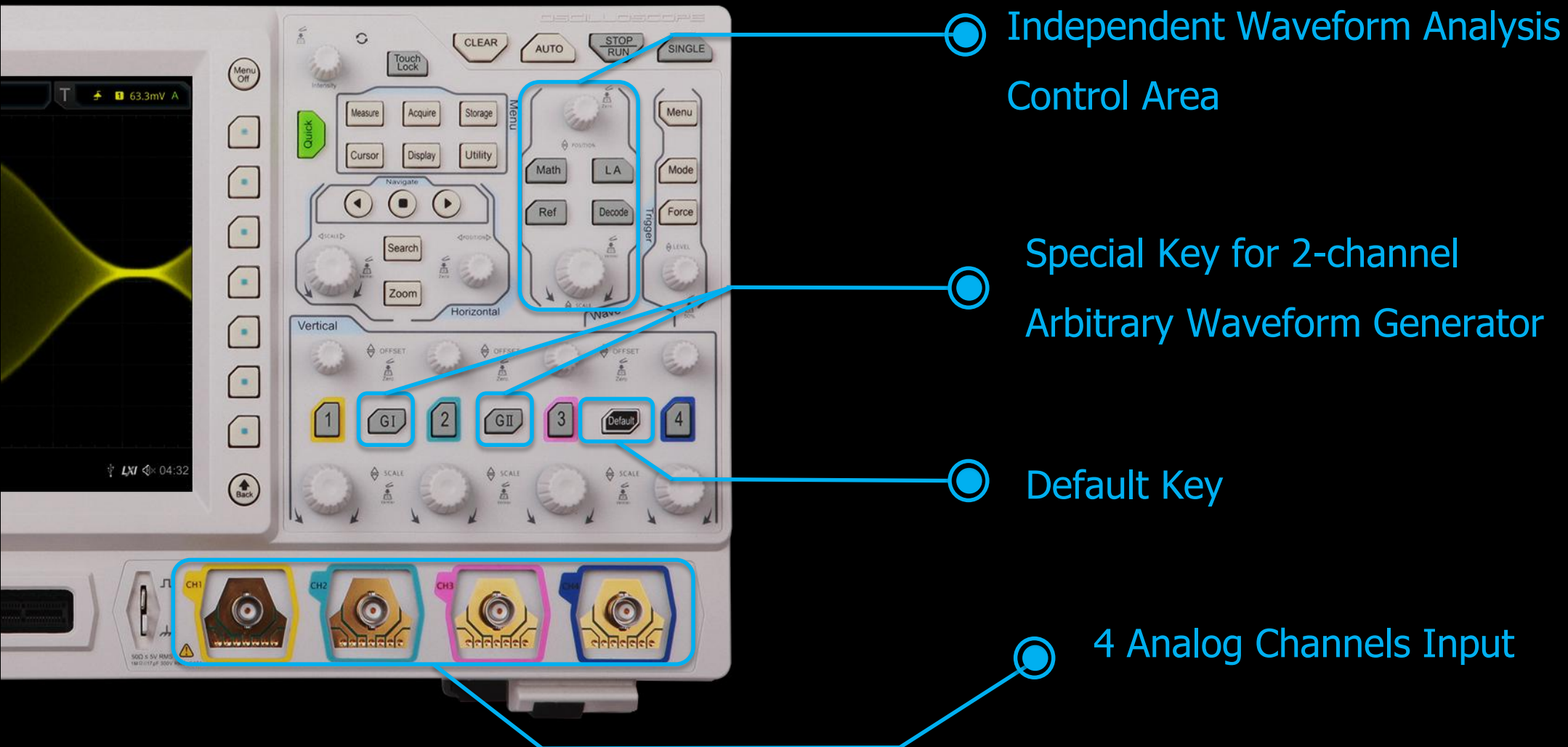
16-channel Logic Analyzer  
Interface



# Product Introduction



# Product Introduction





# Product Introduction

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- HDMI Video Output
- USB HOST Interface (the other 3 in the front panel)
- USB DEVICE  
Communication Interface
- LAN Interface, is in Compliance with the Standards Specified in LXI-C

# Product Introduction

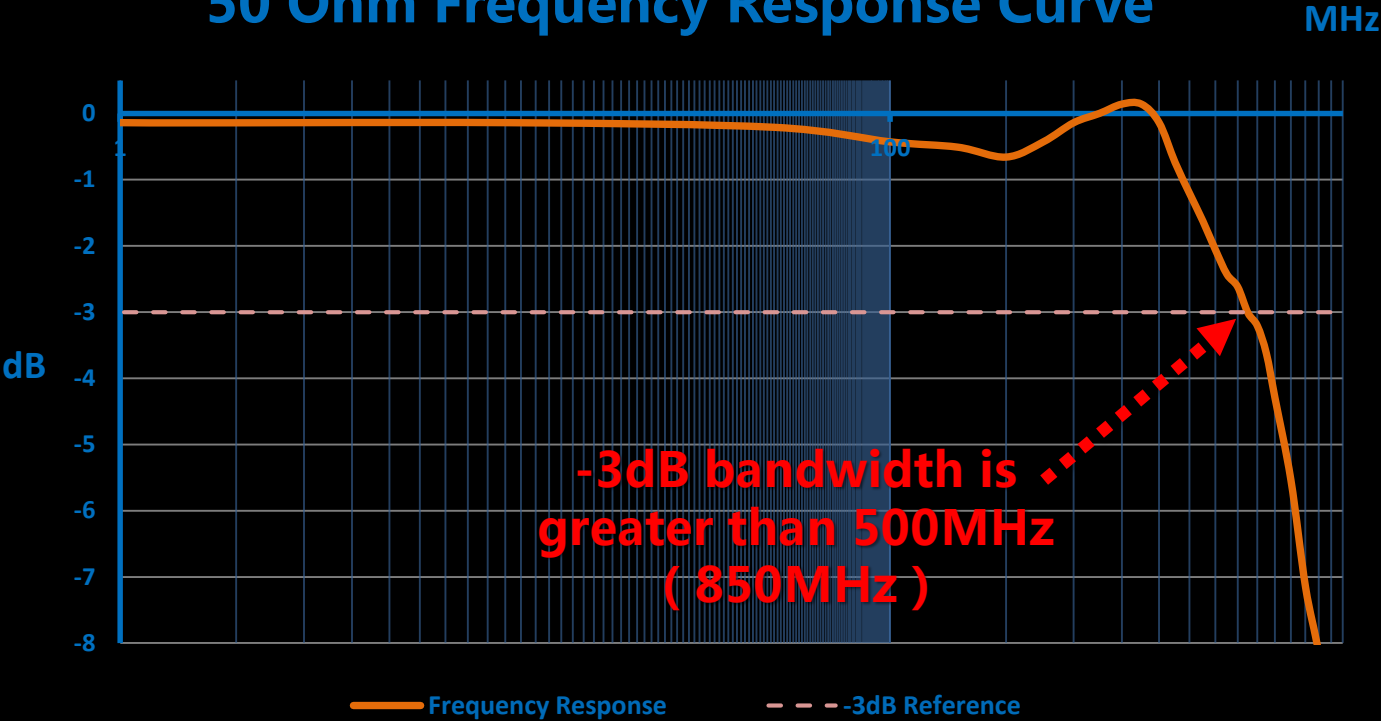
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# Key Specifications—Bandwidth

500MHz

50 Ohm Frequency Response Curve



DS7054	500MHz
DS7034	350MHz
DS7024	200MHz
DS7014	100MHz
MSO7054	500MHz
MSO7034	350MHz
MSO7024	200MHz
MSO7014	100MHz

## Key Specifications—Bandwidth

The problems of deficient bandwidth?

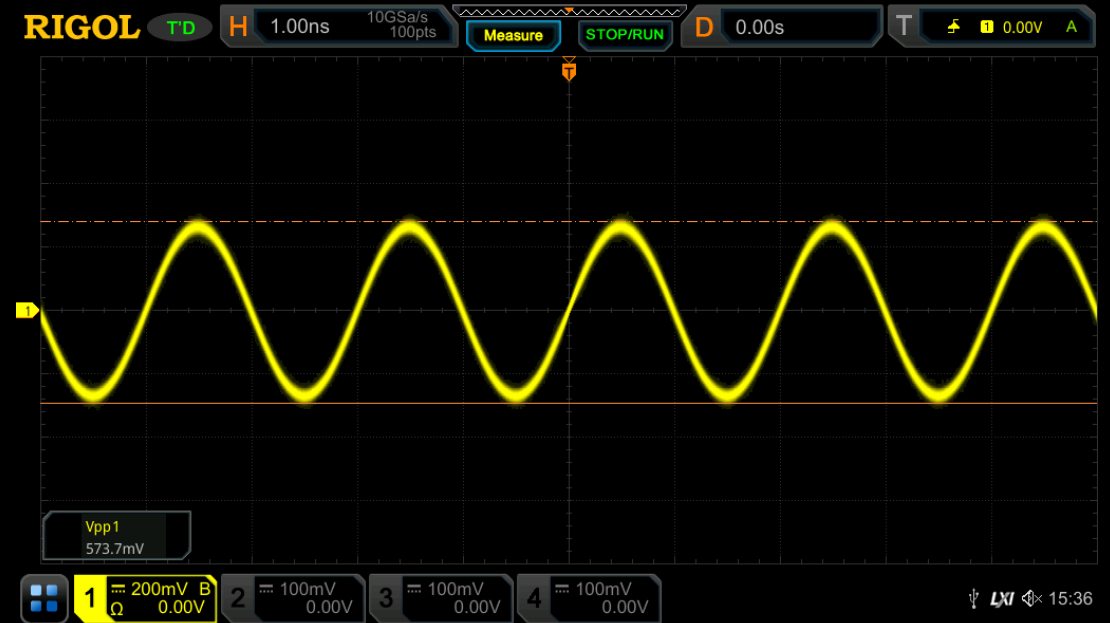


# Key Specifications—Bandwidth

## □ Amplitude of High Frequency Signals Decreased



500 MHz Sine, Full Bandwidth



500 MHz Sine, Insufficient Bandwidth

# Key Specifications—Bandwidth

❑ High-frequency components disappeared

Advantage: filter out high-frequency noise

MSO7014 00.01.01.05.04 DS7F201200026 Build : Tue January 24 09:55:32 2017



50 ns Narrow Pulse, Full Bandwidth

MSO7014 00.01.01.05.04 DS7F201200026 Build : Tue January 24 09:55:41 2017



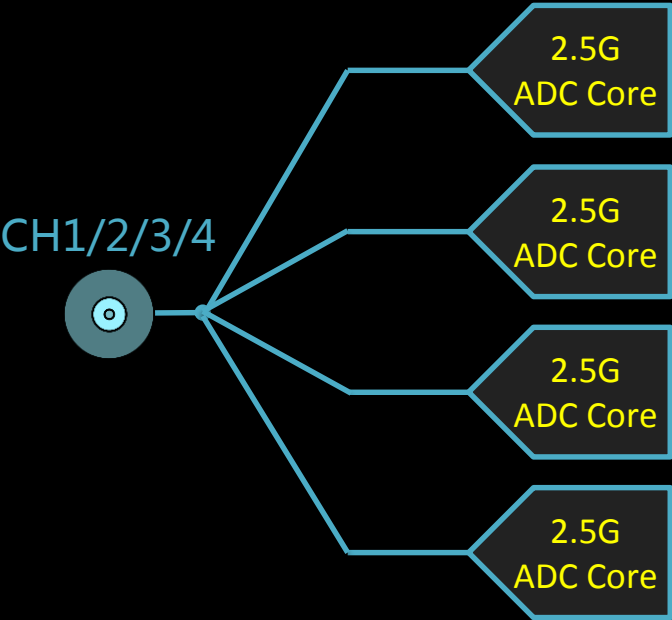
50 ns Narrow Pulse, Insufficient Bandwidth

# Key Specifications—Sample Rate

10G

Single-channel Mode Diagram

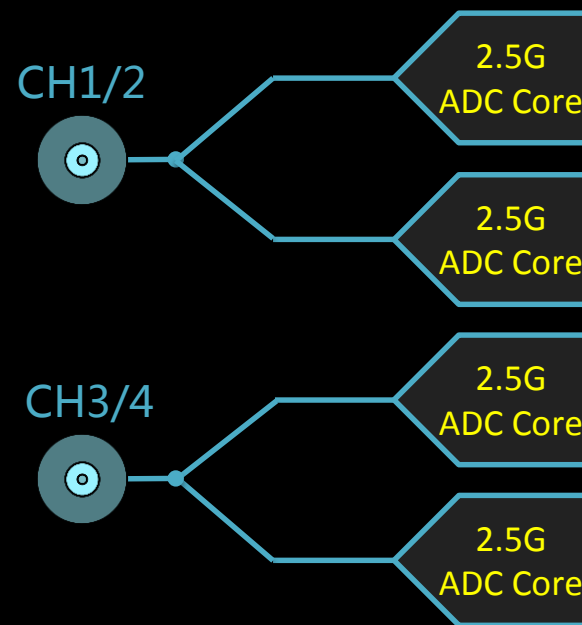
	Single-channel	Dual-channel	Four-channel
MSO/DS7054	10 GSa/s	5 GSa/s	2.5 GSa/s
MSO/DS7034	10 GSa/s	5 GSa/s	2.5 GSa/s
MSO/DS7024	10 GSa/s	5 GSa/s	2.5 GSa/s
MSO/DS7014	10 GSa/s	5 GSa/s	2.5 GSa/s



# Key Specifications—Sample Rate

	Single-channel	Dual-channel	Four-channel
MSO/DS7054	10 GSa/s	5 GSa/s	2.5 GSa/s
MSO/DS7034	10 GSa/s	5 GSa/s	2.5 GSa/s
MSO/DS7024	10 GSa/s	5 GSa/s	2.5 GSa/s
MSO/DS7014	10 GSa/s	5 GSa/s	2.5 GSa/s

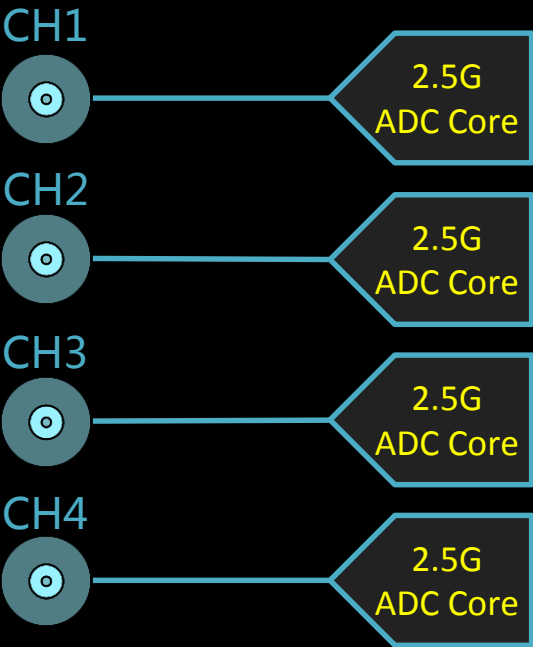
Dual-channel Mode Diagram



# Key Specifications—Sample Rate

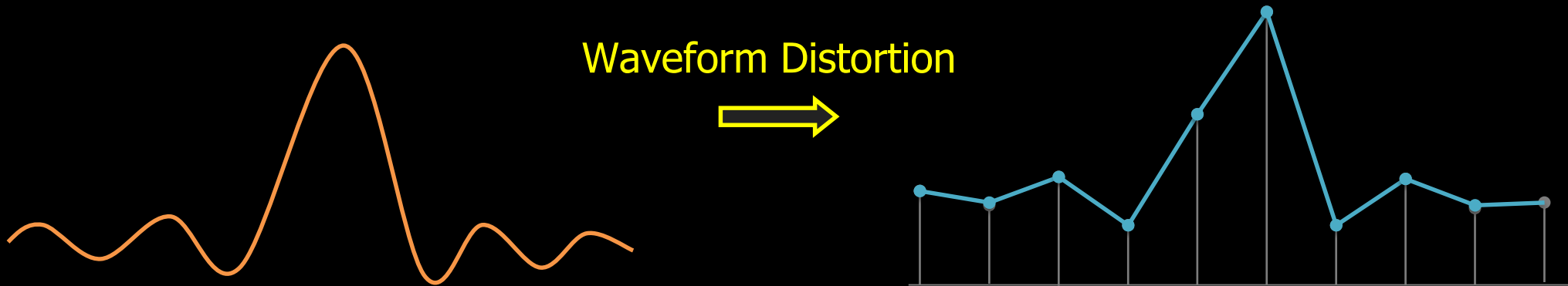
	Single-channel	Dual-channel	Four-channel
MSO/DS7054	10 GSa/s	5 GSa/s	2.5 GSa/s
MSO/DS7034	10 GSa/s	5 GSa/s	2.5 GSa/s
MSO/DS7024	10 GSa/s	5 GSa/s	2.5 GSa/s
MSO/DS7014	10 GSa/s	5 GSa/s	2.5 GSa/s

Four-channel Mode Diagram



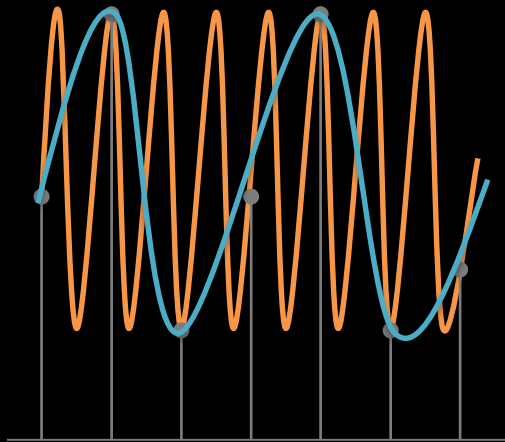
# Key Specifications—Sample Rate

## Insufficient Sample Rate?!

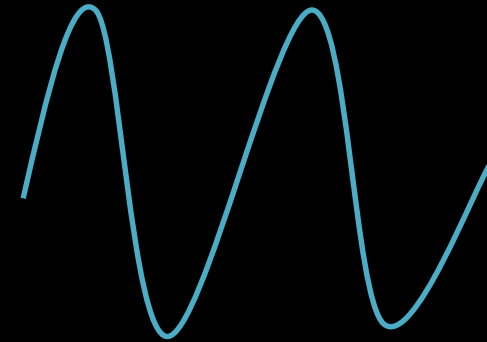


# Key Specifications—Sample Rate

## Insufficient Sample Rate?!



Waveform Aliasing  
→



# Key Specifications—Sample Rate



## Insufficient Sample Rate?!





# Key Specifications—Memory Depth

500M

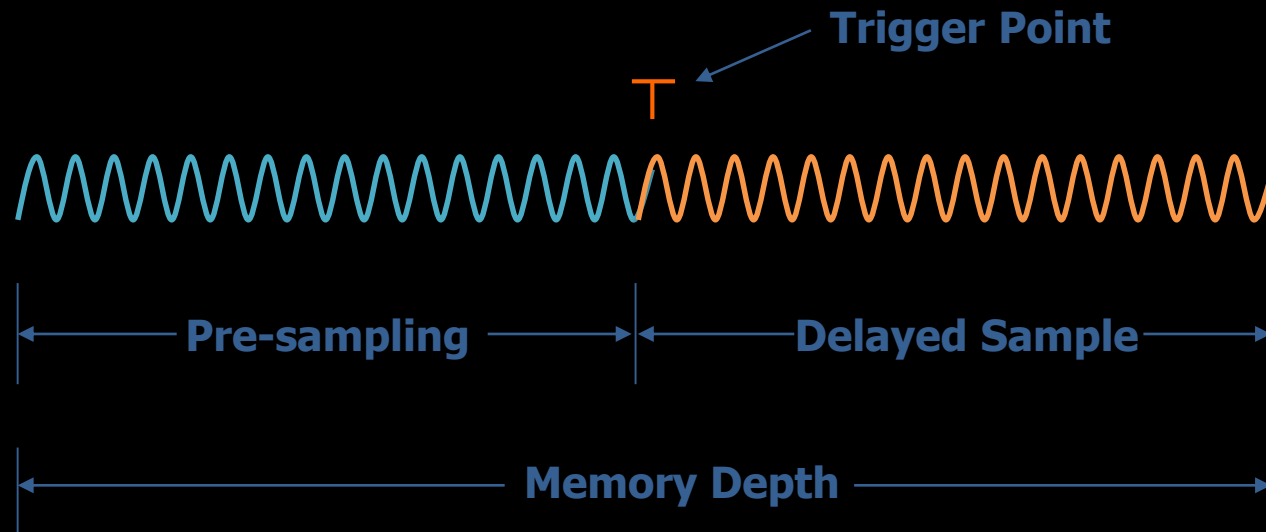
	Single-channel	Dual-channel	Four-channel
5RL 	500 Mpts	250 Mpts	125 Mpts
2RL 	250 Mpts	125 Mpts	50 Mpts
Standard	100 Mpts	50 Mpts	25 Mpts

# Key Specifications—Memory Depth

Waveform Memory Time =  
Memory Depth / Sample Rate

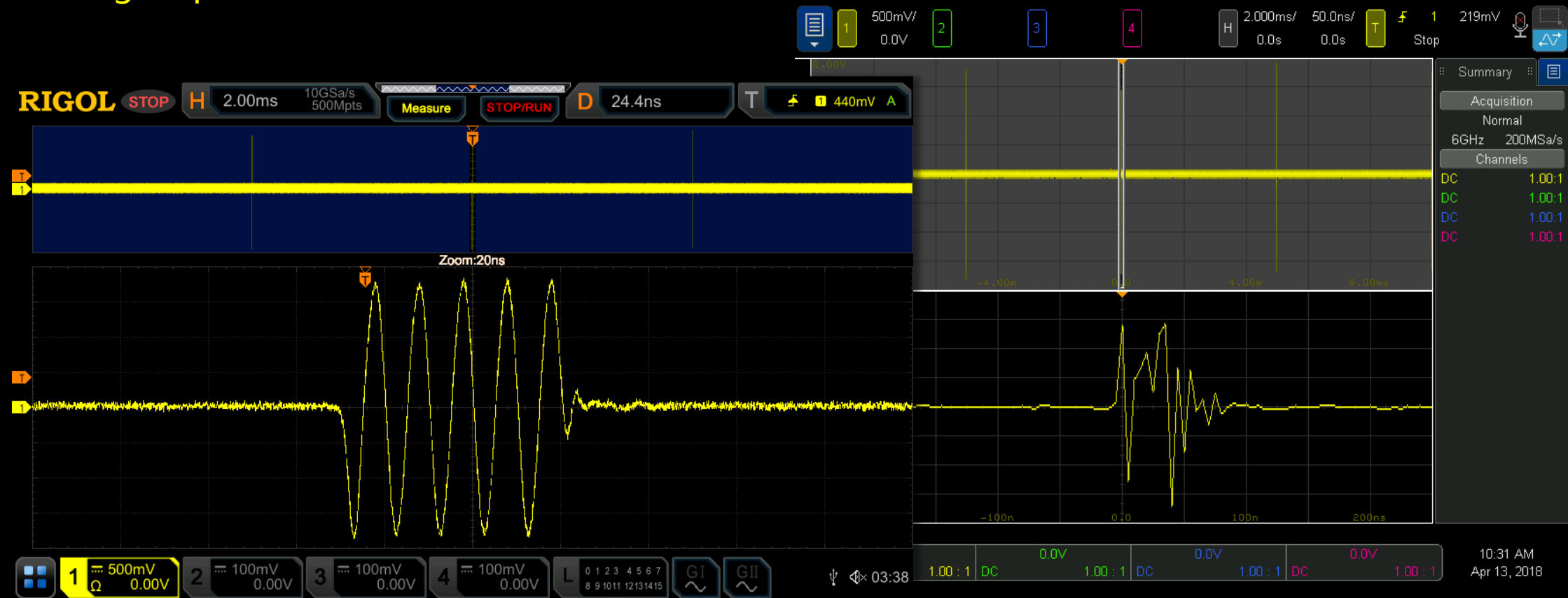


**Deep Memory = High Sample**



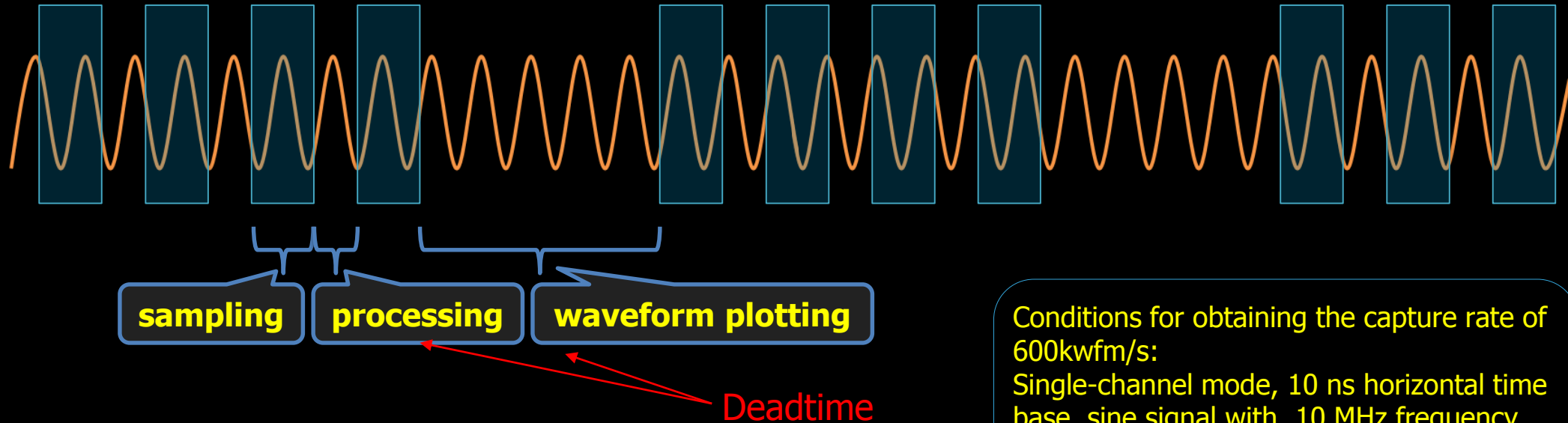
# Key Specifications—Memory Depth

Signal pulse width is 5 ns



# Key Specifications—Waveform Capture Rate

600k



Conditions for obtaining the capture rate of 600kwfm/s:

Single-channel mode, 10 ns horizontal time base, sine signal with 10 MHz frequency, Edge trigger, keep other settings as defaults

# Key Specifications—Waveform Capture Rate

- Quickly Capture the Occasional Exceptional Events



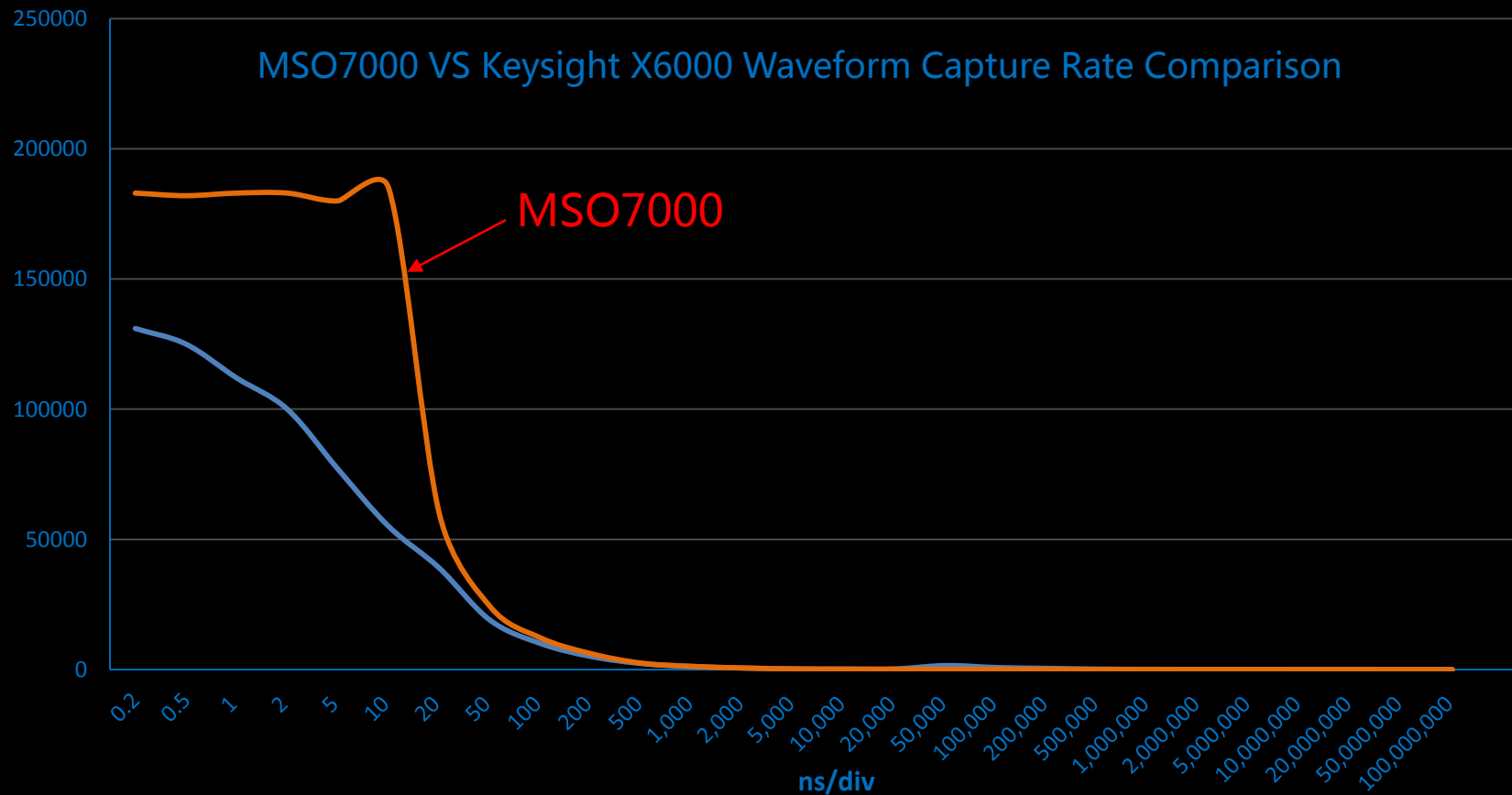
# Key Specifications—Waveform Capture Rate

- Clearly Observe the Changes of Each Frame



# Key Specifications—Waveform Capture Rate

- Keep a Higher Rate Though Not at the Fast Mode



# Comparison of Key Specifications

	MSO/DS1000Z	MSO/DS2000A	MSO/DS4000	DS6000	MSO/DS7000
Channels	4 + 16	2 + 16	2 or 4 + 16	2 or 4	4 + 16
Analog BW	50 MHz to 100 MHz	100 MHz to 300 MHz	100 MHz to 500 MHz	600 MHz to 1 GHz	100 MHz to 500 MHz
Max sample rate	1 GSa/s	2 GSa/s	4 GSa/s	5 GSa/s	10GSa/s
Oversampling rate@500MHz	—	—	8	—	20
Max memory depth	24 Mpts (opt)	56 Mpts (opt)	140Mpts	140Mpts	100Mpts(std) 500 Mpts (opt)
Waveform update rate	> 30,000wfms/s	> 50,000wfms/s	> 110,000wfms/s	> 180,000wfms/s	> 600,000wfms/s
Display	7 inch	8 inch	9 inch	10.1 inch	10.1 inch
Touch	NO	NO	NO	NO	YES



# Comparison of Key Specifications

	Rigol MSO/DS7000	Tektronix MDO 3000	Keysight MSO 3000T X	R&S RTM3000	Siglent SDS3000/E	GWINSTEK GDS3000	Lecroy WaveSurfer 3000	ZLG ZDS3000/4000
Channels	4 + 16	2 or 4 + 16	2 or 4 + 16	2 or 4 + 16	2 or 4 + 16	2 or 4	2 or 4 + 16	4
Analog BW	100 MHz to 500 MHz	100 MHz to 1 GHz	100 MHz to 1 GHz	100 MHz to 1 GHz	350 MHz to 1 GHz	150 MHz to 500 MHz	200 MHz to 750 MHz	200 MHz to 500 MHz
Max sample rate	10 GSa/s	5 GSa/s	5 GSa/s	5 GSa/s	4 GSa/s (SDS3000) 2 GSa/s (SDS3000E)	5 GSa/s (≤350MHz) 4 GSa/s	4 GSa/s	4 GSa/s
Oversampling rate@500MHz	20	10	10	10	8	8	8	8
Max memory depth	100Mpts(std) 500 Mpts (opt)	10 Mpts	4 Mpts	80Mpts	10Mpts/CH	25kpts	10Mpts	512Mpts
Waveform update rate	> 600,000wfms/s	>280,000 wfm/s	> 1,000,000wfms/s	> 100,000wfms/s	> 250,000wfms/s		> 130,000wfms/s	> 1,000,000wfms/s
Display	10.1 inch	9 inch	8.5 inch	10.1 inch	10.1 inch	8 inch	10.1 inch	9 inch
Touch	YES	NO	YES	YES	YES	NO	YES	YES

# Options & Accessories

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## □ Bandwidth Upgrade

BW1T2	Bandwidth upgrades from 100 MHz to 200 MHz
BW1T3	Bandwidth upgrades from 100 MHz to 350 MHz
BW1T5	Bandwidth upgrades from 100 MHz to 500 MHz
BW2T3	Bandwidth upgrades from 200 MHz to 350 MHz
BW2T5	Bandwidth upgrades from 200 MHz to 500 MHz
BW3T5	Bandwidth upgrades from 350 MHz to 500 MHz

# Options & Accessories

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## □ Memory Depth Upgrade

2RL      Maximum memory depth up to 250 Mpts

5RL      Maximum memory depth up to 500 Mpts

# Options & Accessories

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## □ Measurement Application Option

BND	Application bundle option (including the following independent options)	
COMP	PC serial bus trigger and analysis (RS232/UART)	<i>Trail</i>
EMBD	Embedded serial bus trigger and analysis (I2C, SPI)	<i>Trail</i>
AUTO	Auto serial bus trigger and analysis (CAN, LIN)	<i>Trail</i>
FLEX	FlexRay serial bus trigger and analysis	<i>Trail</i>
AUDIO	Audio serial bus trigger and analysis (I2S)	<i>Trail</i>
AERO	MIL-STD-1553 serial bus trigger and analysis	<i>Trail</i>
AWG	Dual-channel 25 MHz Arbitrary Waveform Generator (only for MSO model)	
PWR	Built-in power analysis	

# Options & Accessories

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## □ Option Installation

Method 1: install with the USB storage device (recommended)

Method 2: install with remote commands



# Options & Accessories

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## □ Standard Accessories



Power cord	1
USB cable	1
RP35000A passive probes (500 MHz)	4
Logic analyzer probe (only MSO)	1
Front panel cover	1
Quick guide (hard copy)	1

# Features—Multiple Languages

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## □ 13 Languages Available for the System Menu



# Features—Touch Screen

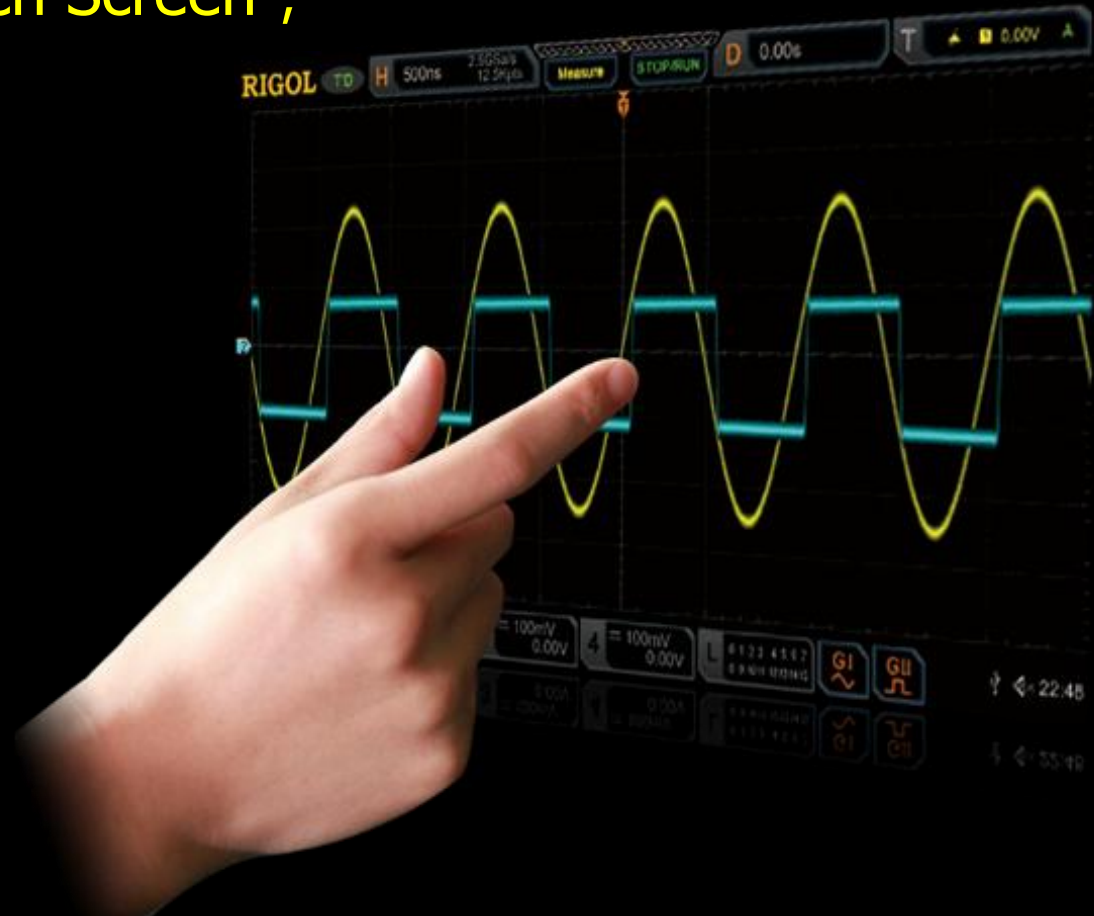
- 10.1-inch Capacitive Multi-touch Screen ,  
Gesture Enabled Operation

Tap

Pinch & Stretch

Drag

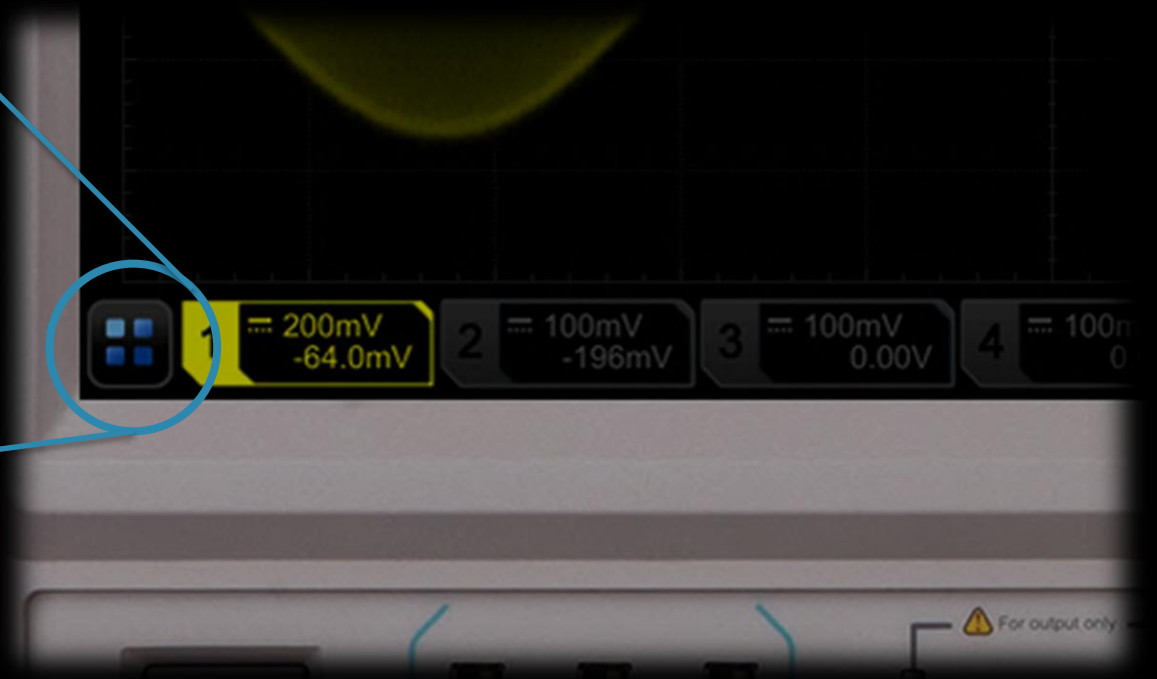
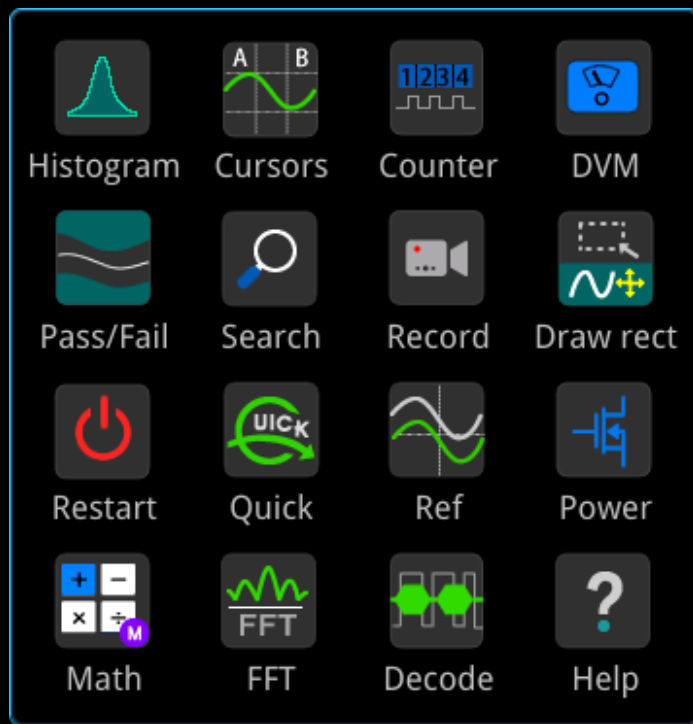
Rectangle Drawing





# Features—Touch Screen

## ❑ Exclusively Designed for the Touch Screen—Function Navigation



# Features—Touch Screen

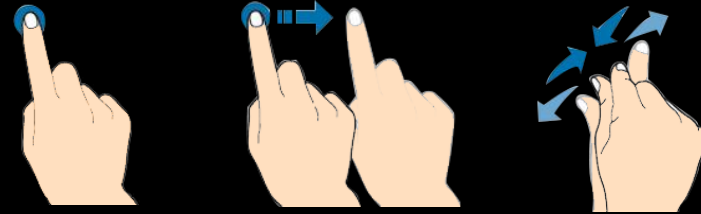
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## □ Switchover Between Common Touch Gestures and Rectangle Drawing



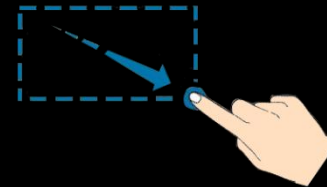
Draw rect

Common Touch Gestures  
Tap, Drag, Pinch & Stretch



Draw rect

Rectangle Drawing  
Draw a rectangular area



# Features—Touch Screen

□ Tap



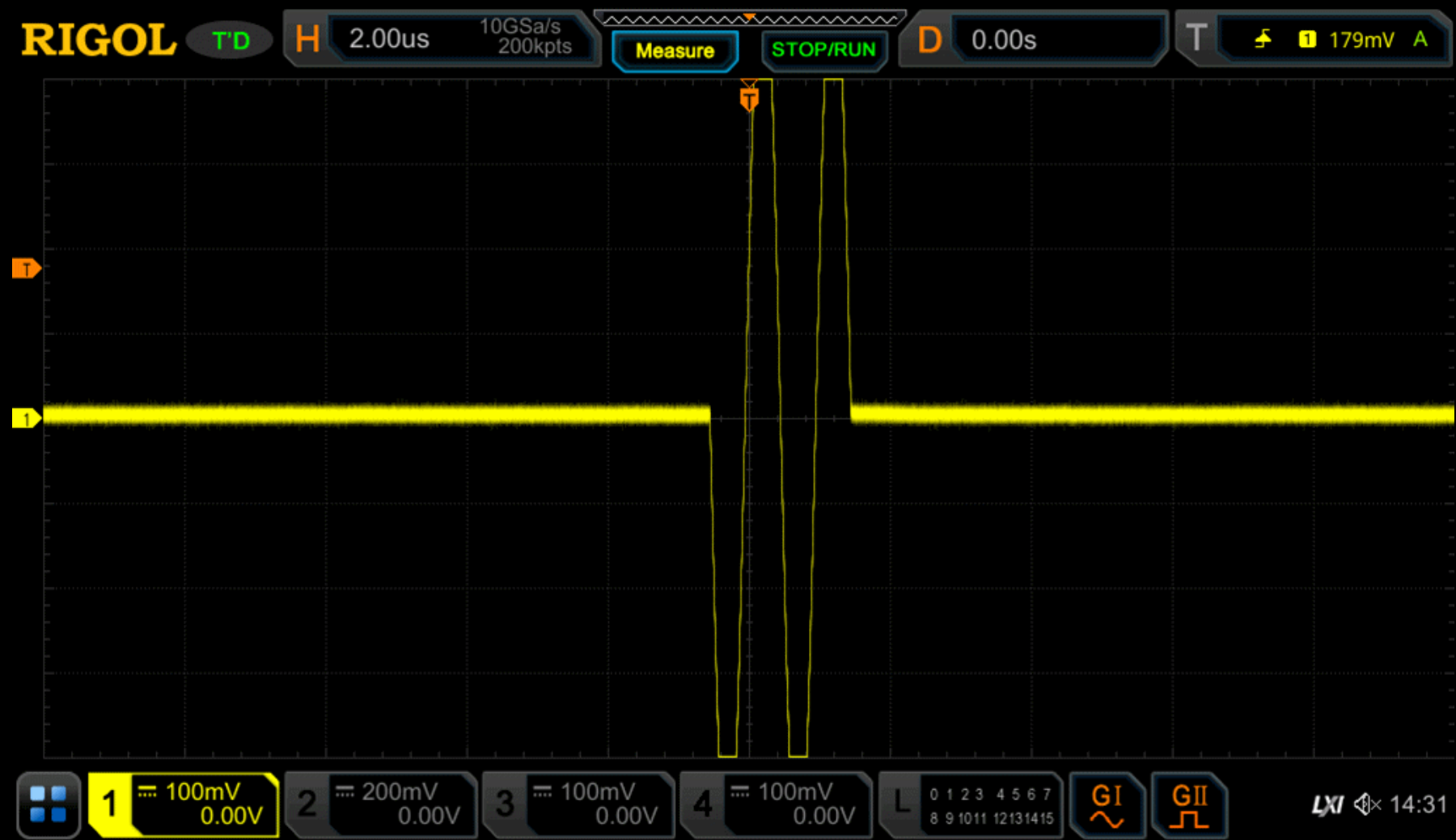
# Features—Touch Screen

□ Drag



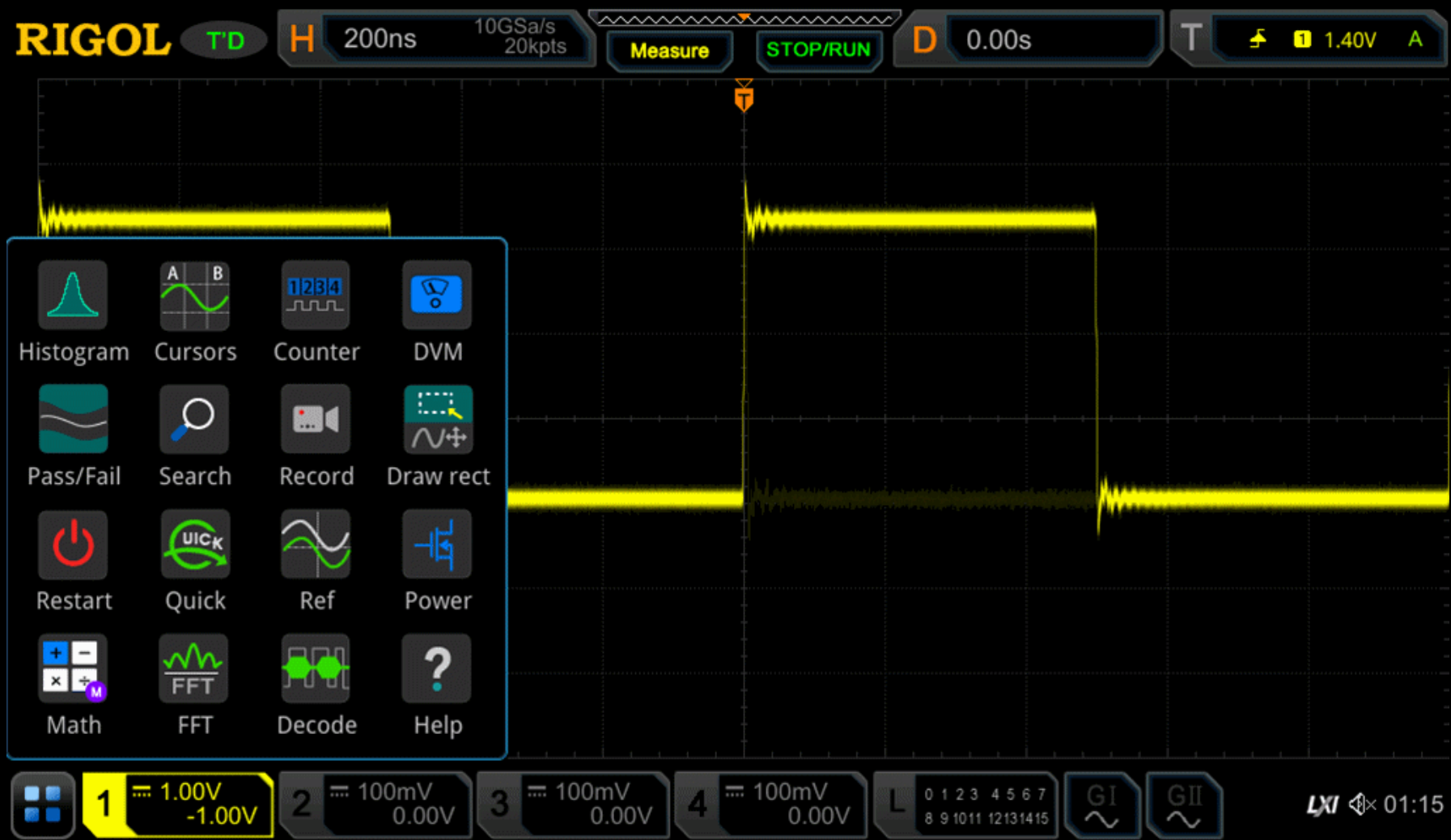
# Features—Touch Screen

Pinch & Stretch



# Features—Touch Screen

## □ Rectangle Drawing



# Features—6 into 1

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## **Oscilloscope**

500MHz 10GSa/s

## **Logic Analyzer**

16 CH

## **Wave Generator**

2CH 25MHz

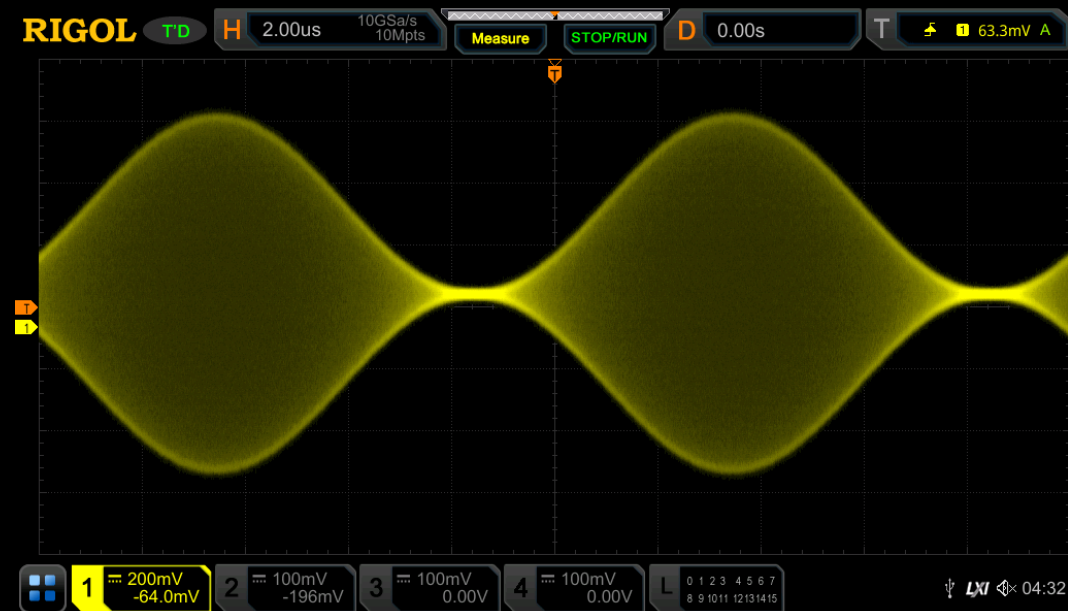
## **Digital Voltmeter**

## **Counter and Totalizer**

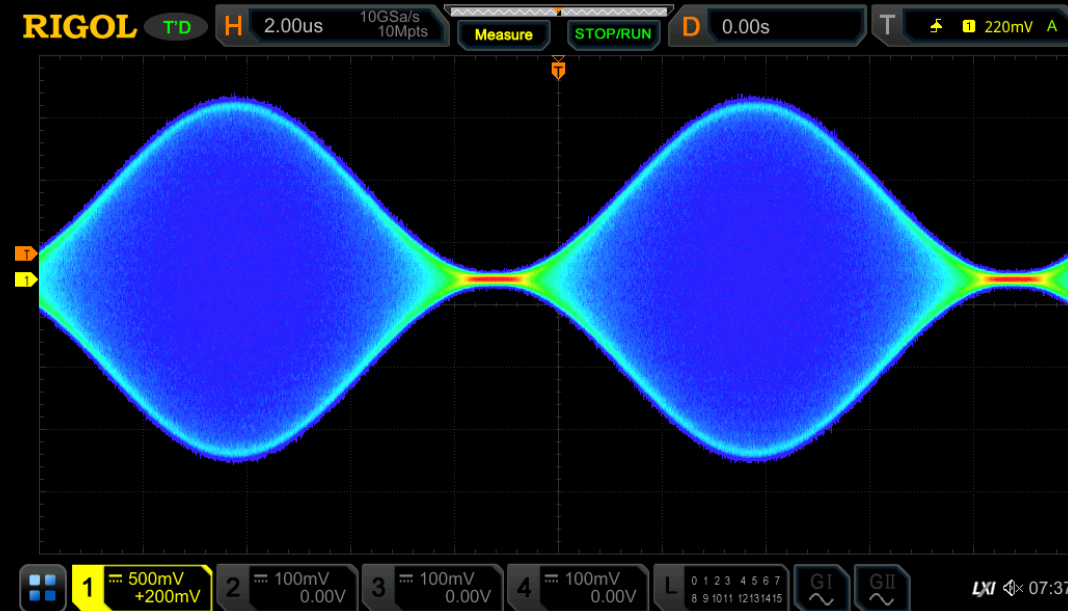
## **Protocol Analyzer**

# Oscilloscope—Display

## □ Brightness



## □ Color Grade





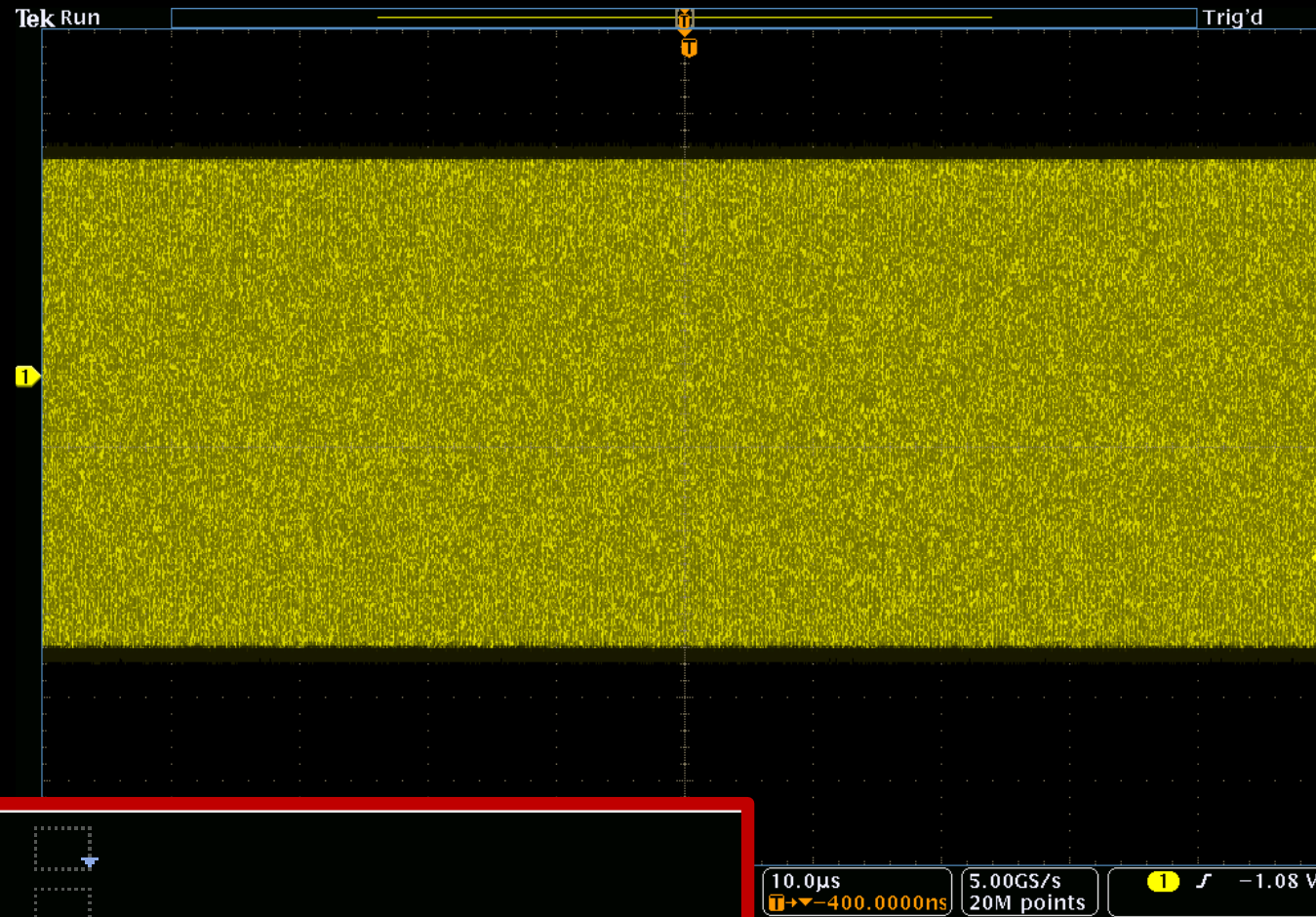
# Oscilloscope—Normal Measurement



# Oscilloscope—Precision Measurement



# Oscilloscope—Precision Measurement



31 May 2017  
04:18:57

# Oscilloscope—Precision Measurement



# Oscilloscope—Trigger

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## □ Support 21 Trigger Types

Edge Pulse Slope Video

Pattern Duration Timeout

Runt Window Delay

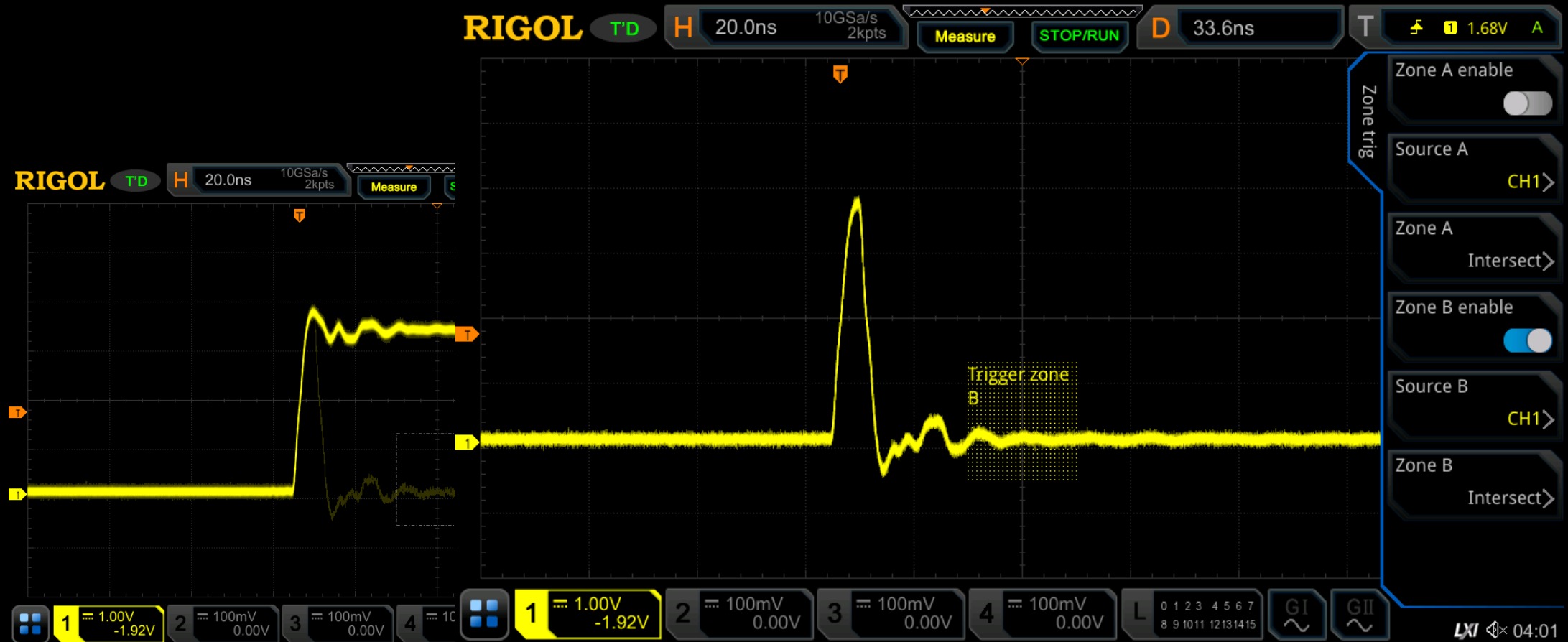
Setup/Hold Nth

RS232 UART I2C SPI

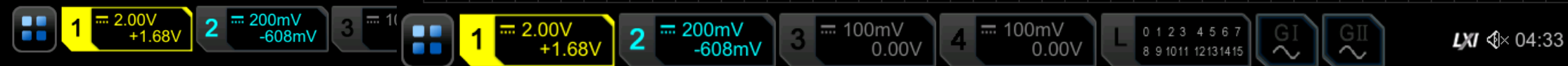
CAN LIN FlexRay I2S

MIL-STD 1553

# Oscilloscope—Zone Trigger



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# Oscilloscope—Navigation

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Waveform — Memory Playing  
— Zoom Playing

Recording — Recording Playback

Search — Event Navigation

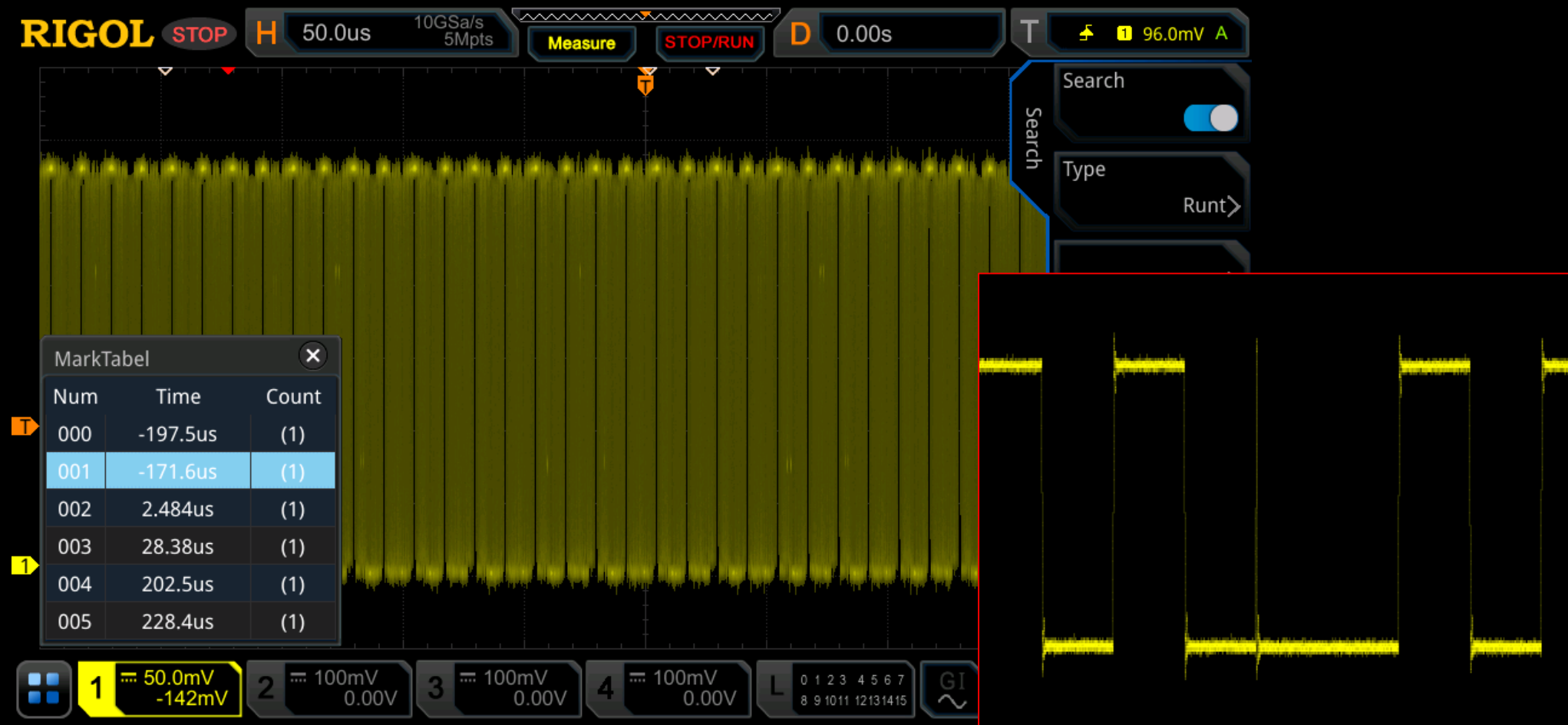




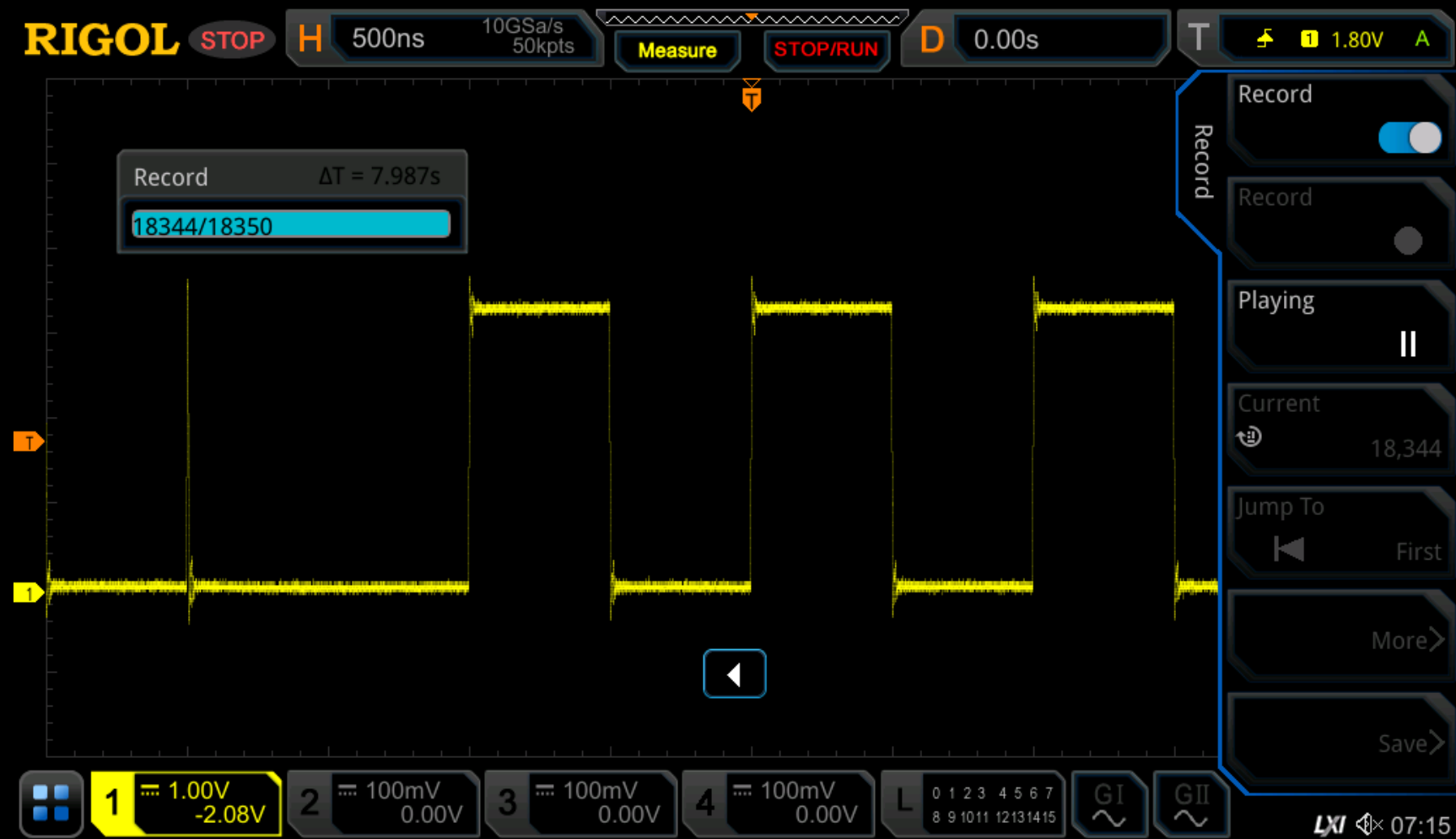
# Oscilloscope—Waveform & Navigation



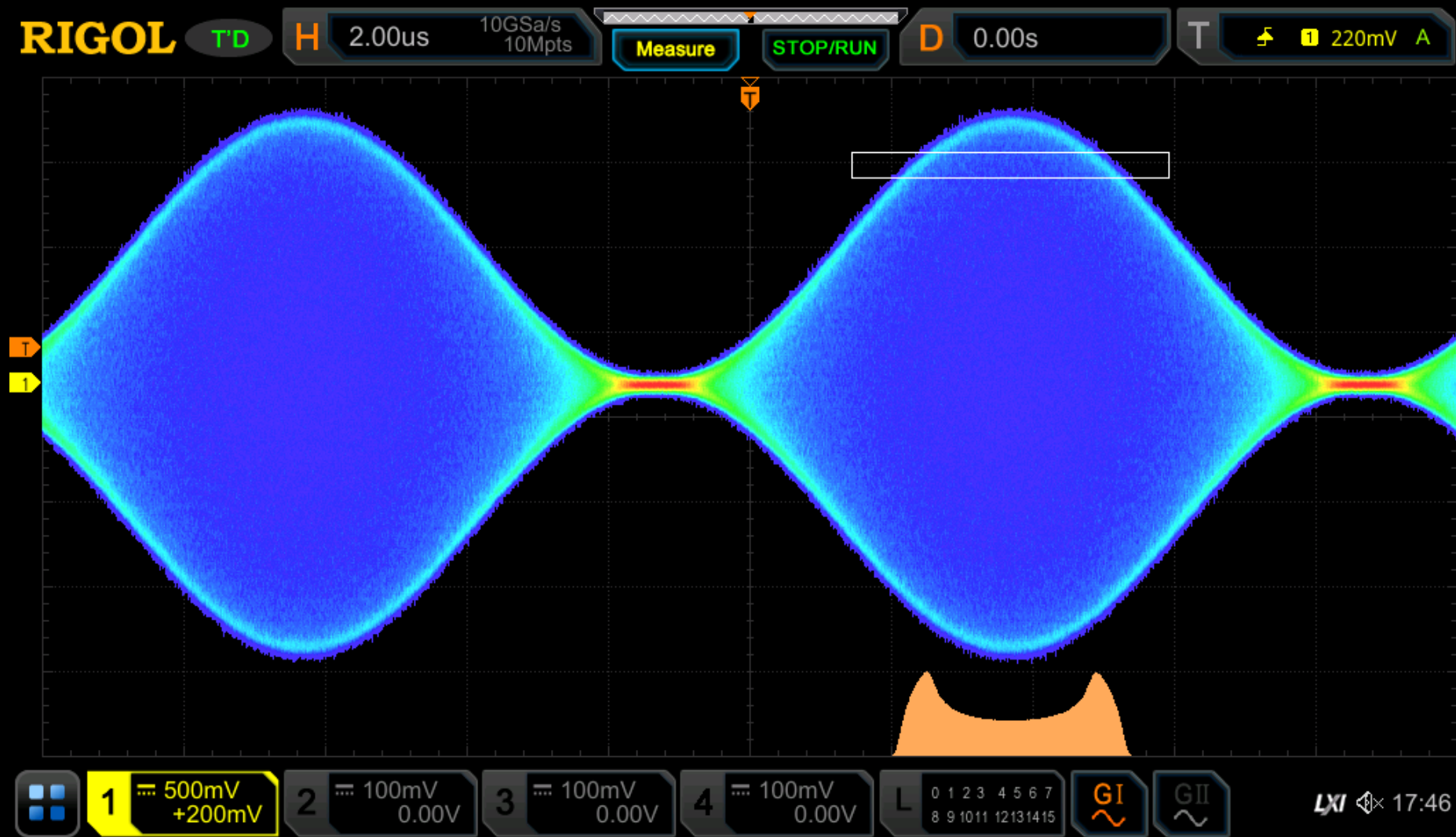
# Oscilloscope—Search & Navigation



# Oscilloscope—Record & Navigation



# Oscilloscope—Histogram



# Oscilloscope—Histogram

Sum: the sum of the samples.

Peaks: the number of peaks.

Max: the value of the most right column.

Min: The value of the most left column.

Pk-Pk: delta between the max and min.

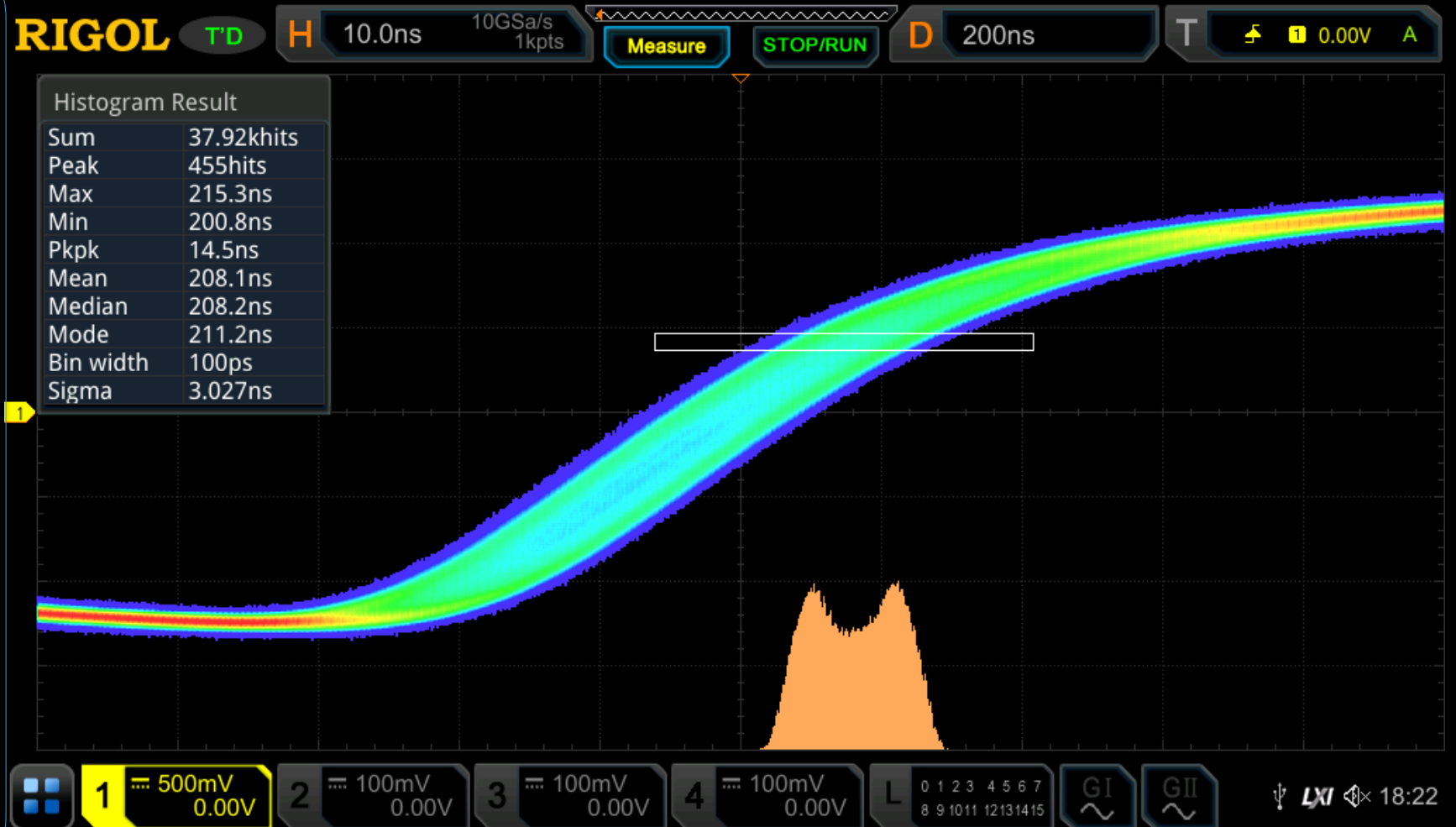
Mean: the mean value of data.

Median: median of the histogram.

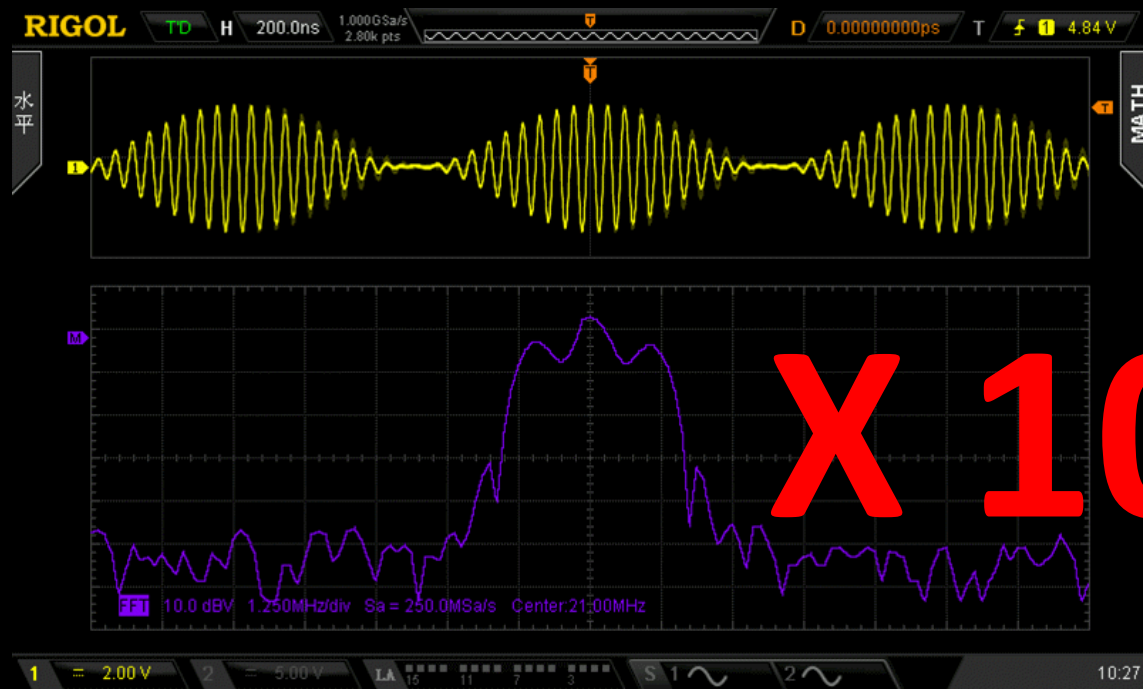
Mode: the value of the maximum sample size.

Bin width: the width of each column.

Sigma: standard deviation of the histogram.



# Oscilloscope—FFT



RIGOL history product

1 kpts



MSO/DS7000

1 Mpts

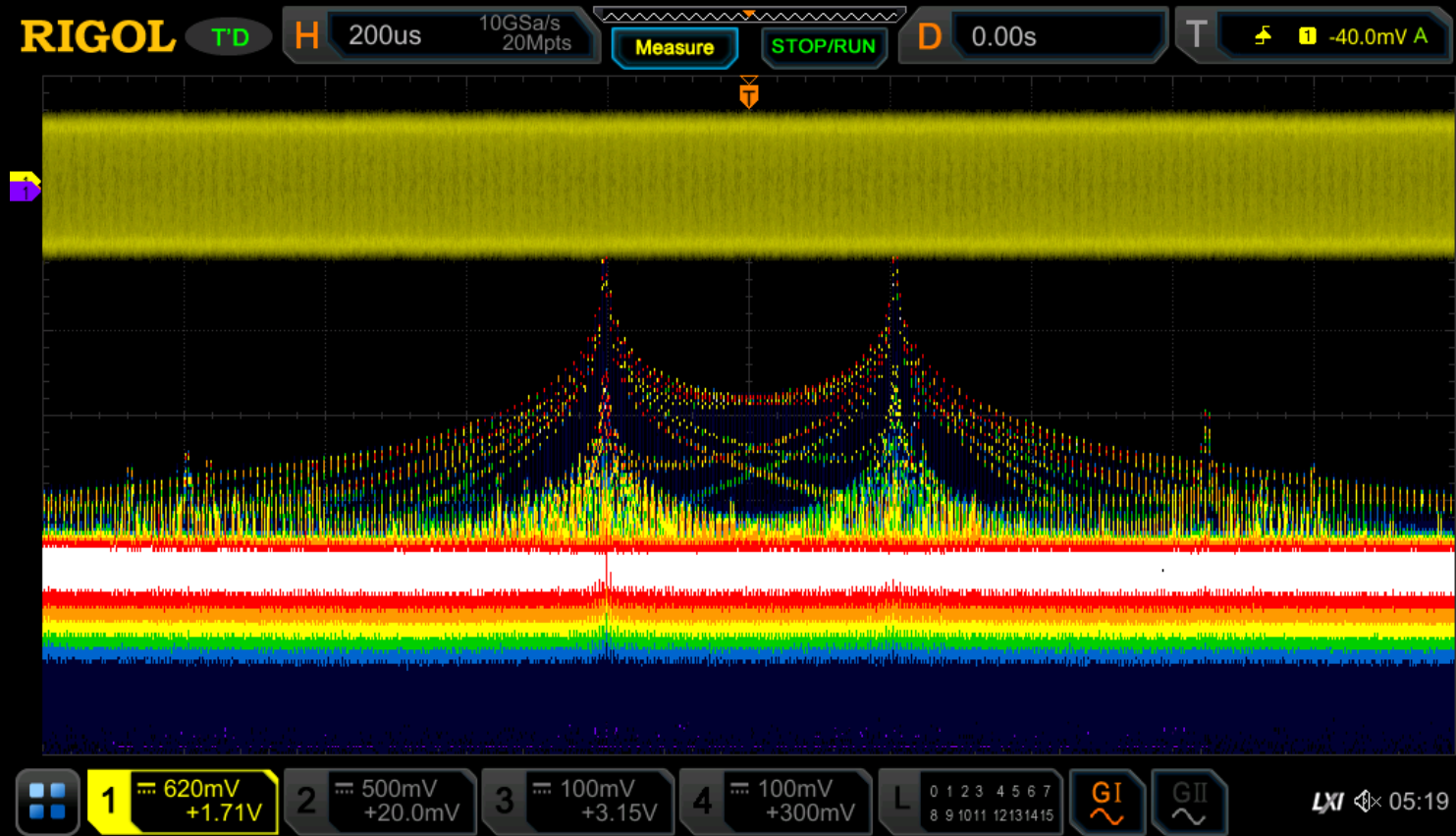


# Oscilloscope—FFT



EMI debugging with MSO/DS7000

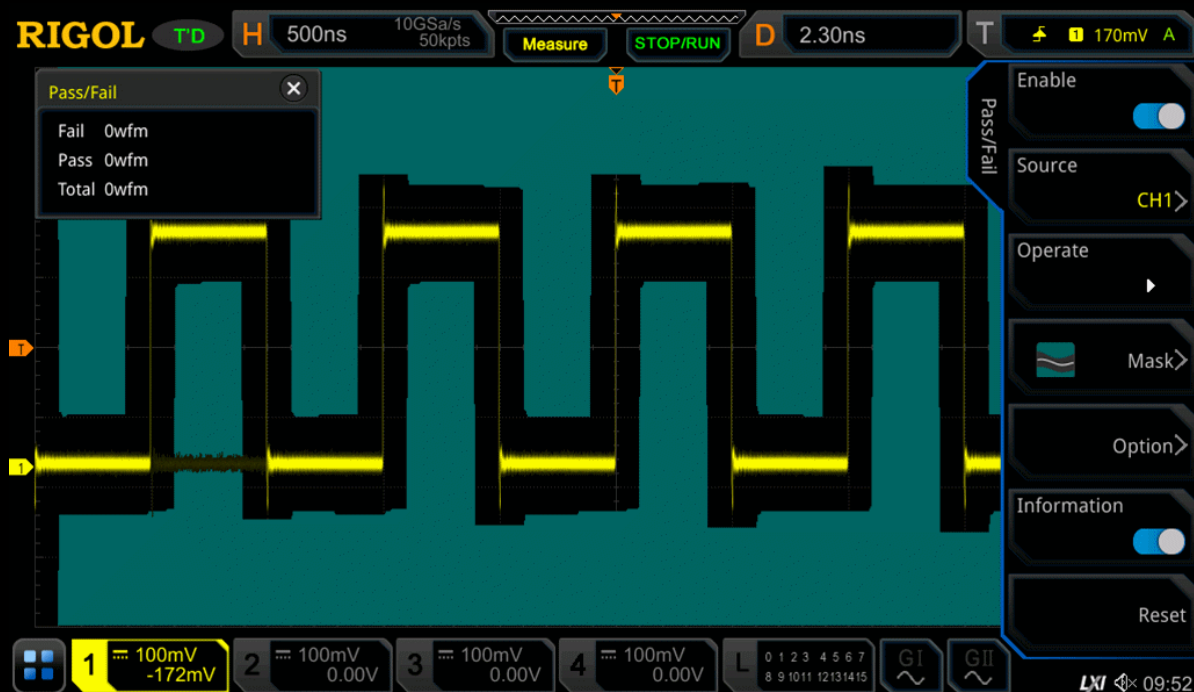
# Oscilloscope—FFT



FFT with Color Grade



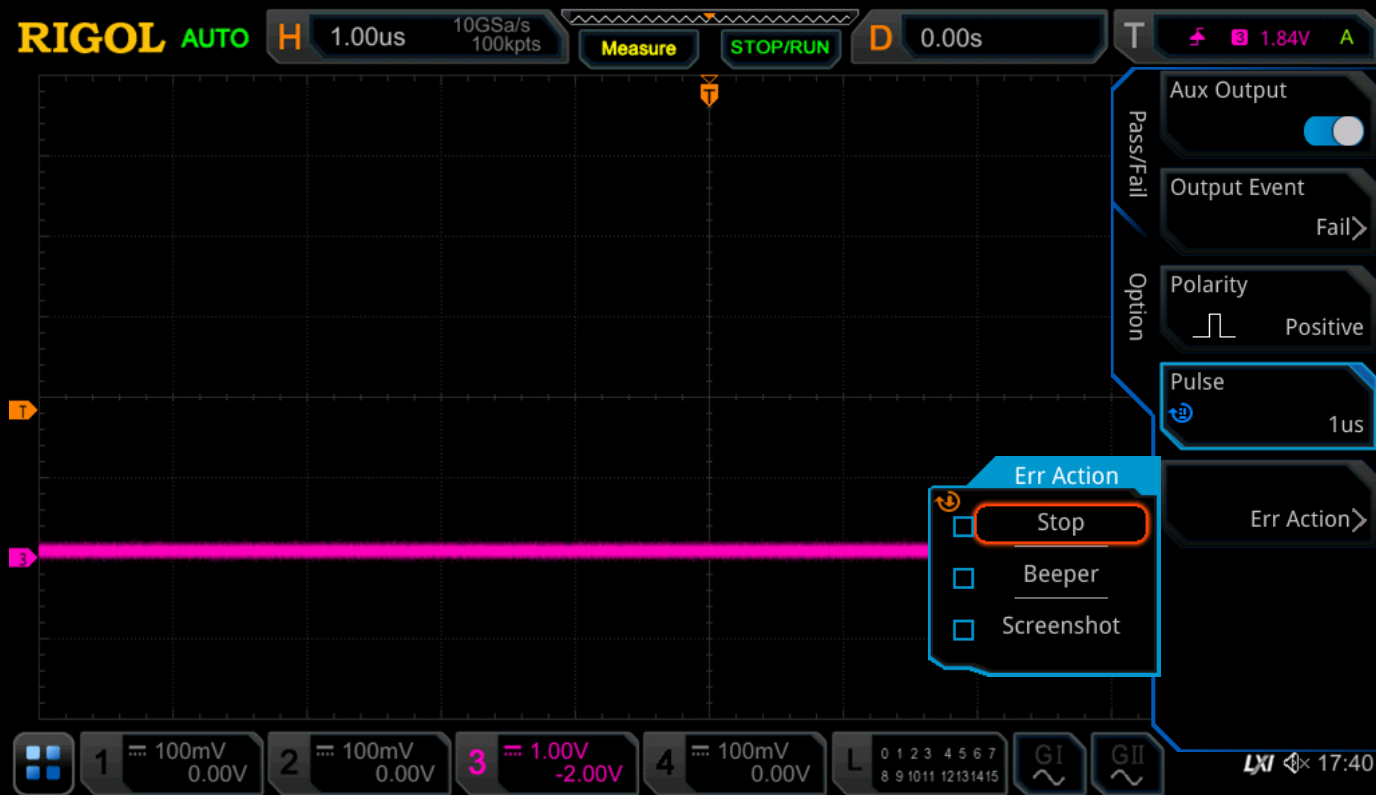
# Oscilloscope—PASS/FAIL



Every time a failed/passed waveform is detected, a pulse output is generated

# Oscilloscope—PASS/FAIL

## ❑ User-defined output



Once a pulse output is generated, we see it.

No must 'Normal' trigger mode.

But the K Corp. can't.

# Oscilloscope—Auto ROLL



When the time base is adjusted to 200ms/div, it automatically enters the ROLL mode.

Compatible with Tektronix.



When the time base is adjusted to 200ms/div, it automatically enters the SLOW SCAN mode.

Keep the tradition of RIGOL.



# Oscilloscope—Storage

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## □ Image — Only Save

Format — \*.bmp, \*.png, \*.jpg, \*.tif

## □ Waveform — Save and Recall

Format — \*.wfm, \*.ref (save and recall)

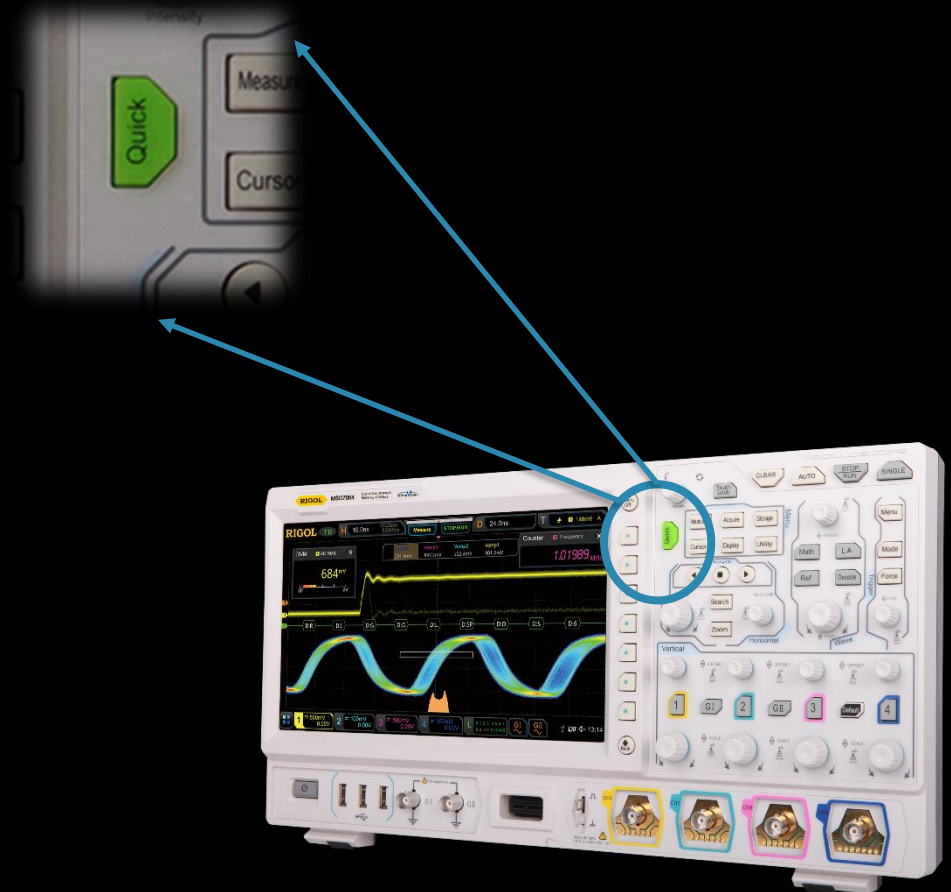
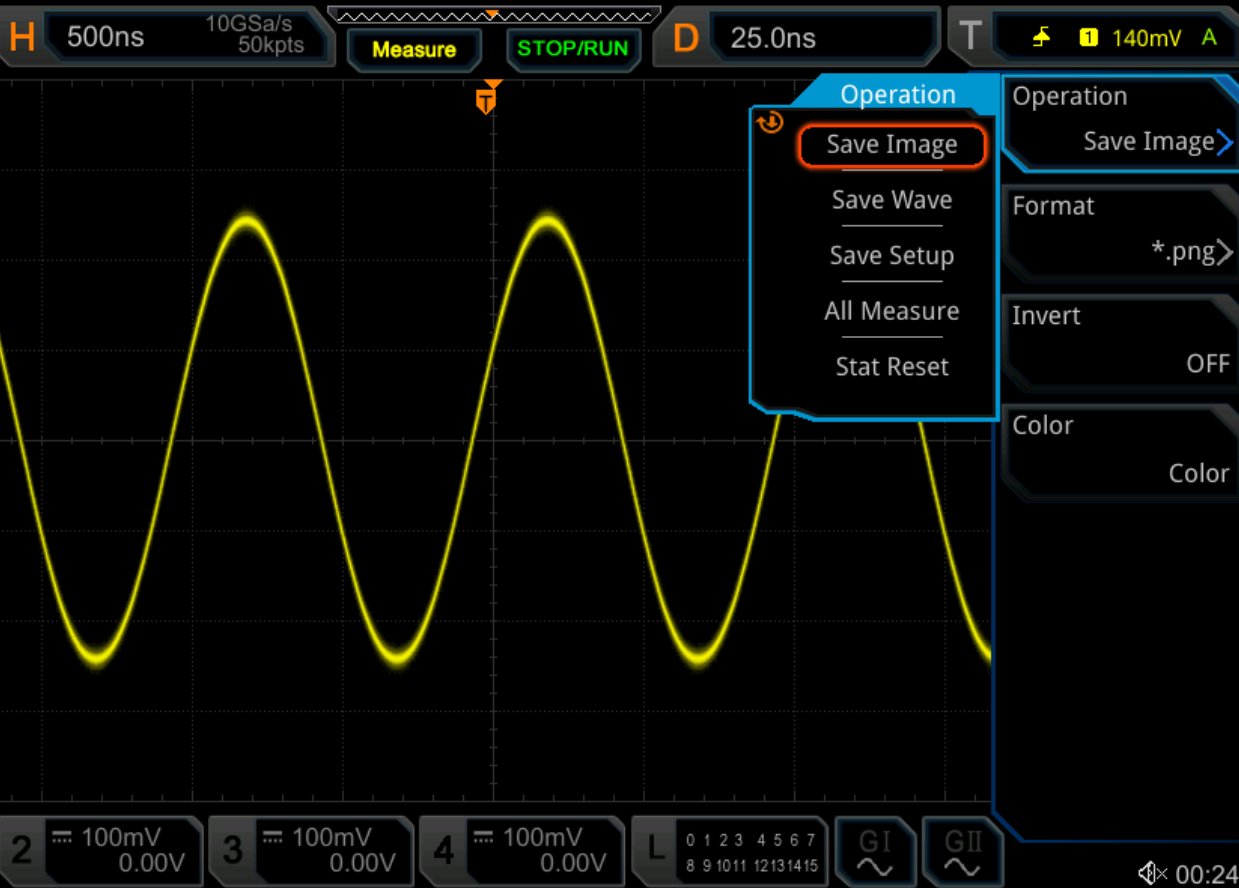
\*.bin, \*.csv (only save)

## □ Setup — Save and Recall

Format — \*.stp



# Oscilloscope—Storage

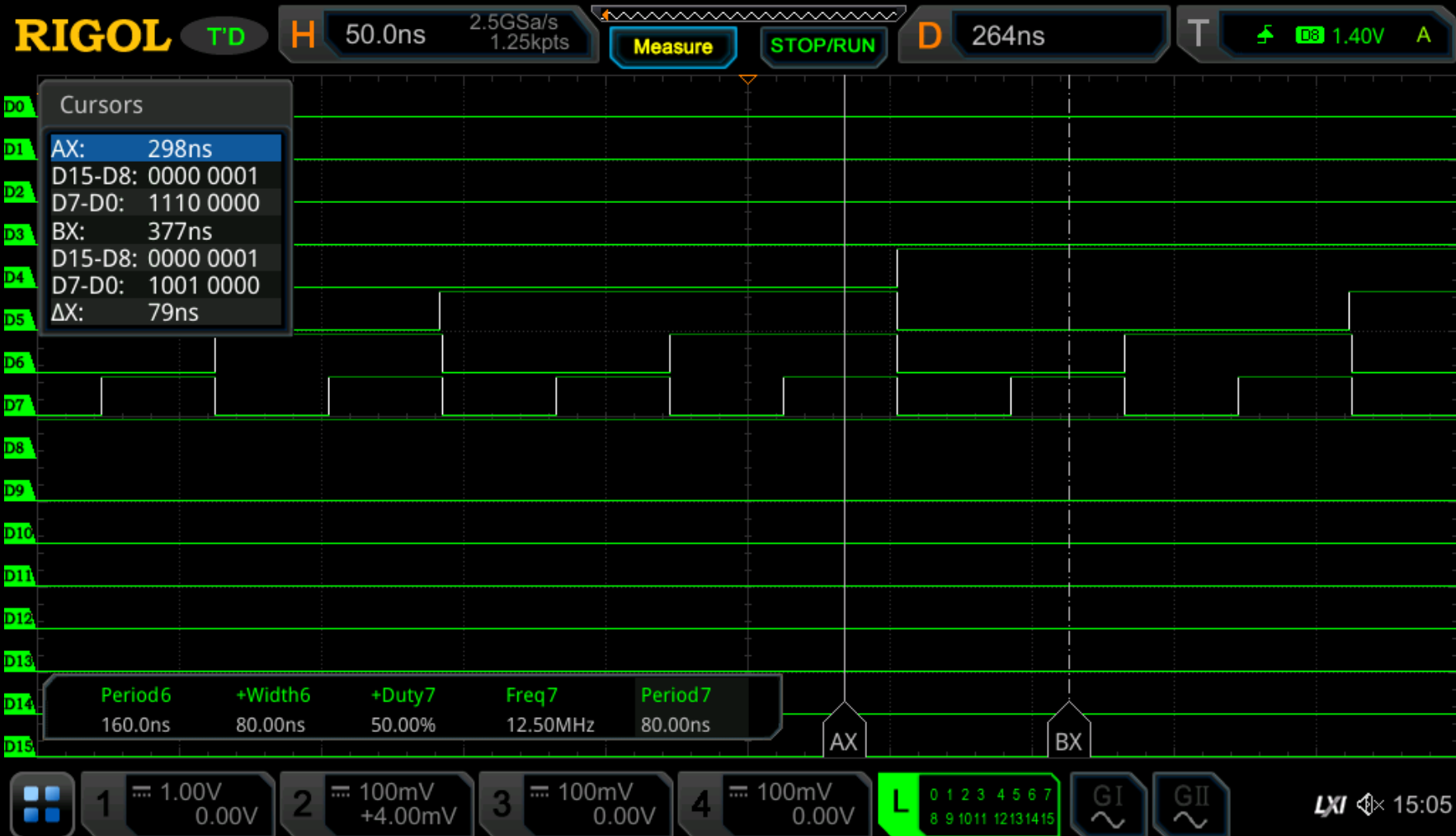


# Oscilloscope—Storage

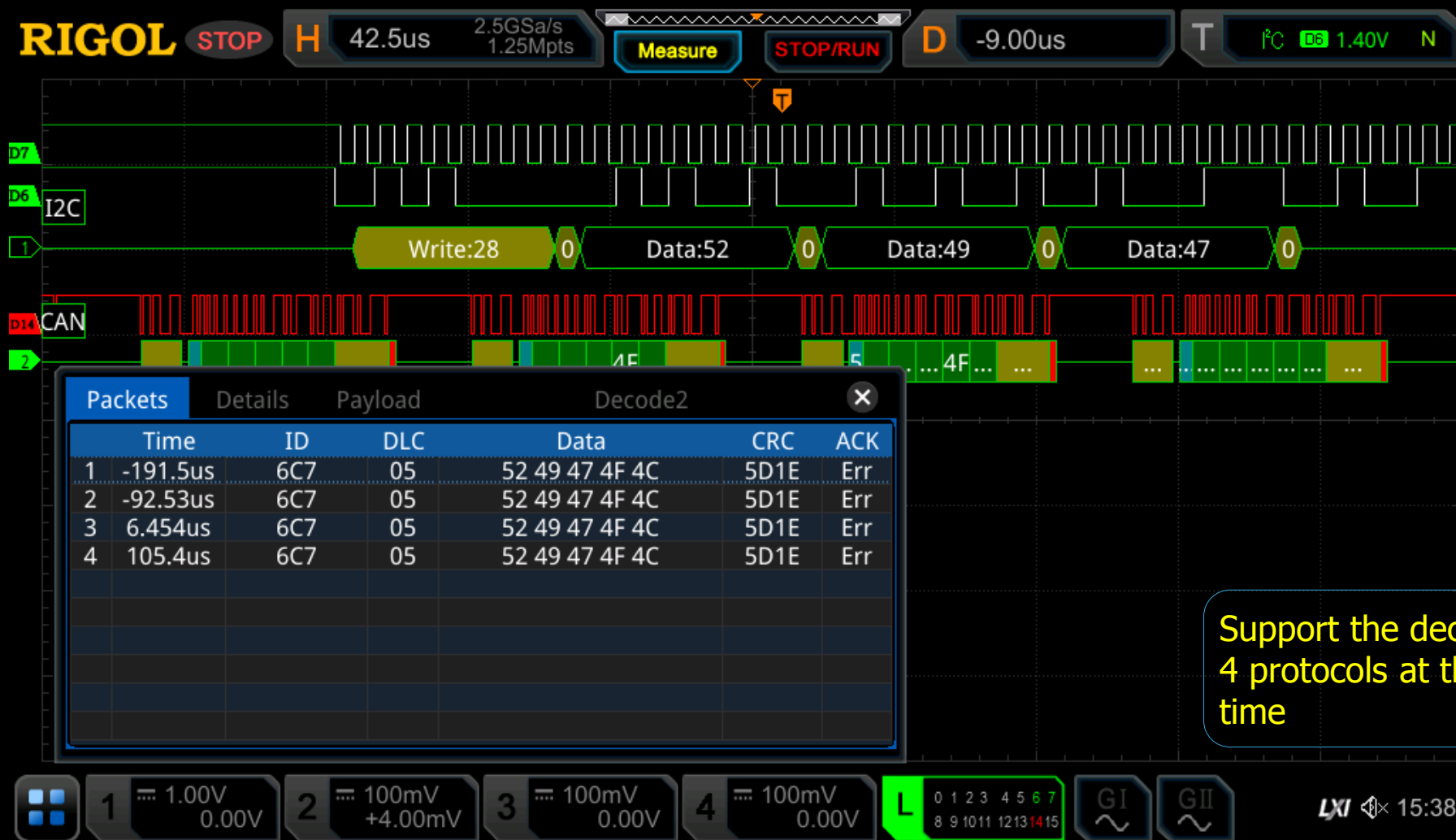
---

U Disk	Memory Size	10 Mpts	25 Mpts	100 Mpts	250 Mpts	500 Mpts
*.bin	File Size	10 M	25 M	100 M	250 M	500 M
	Time	7"	16"	56"	2' 18"	4' 36"
*.wfm	File Size	12 M	31 M	125 M	312 M	625 M
	Time	7"	17"	1' 2"	2' 29"	4' 56"
*.CSV	File Size	150 M	375 M	1 G	3 G	7.5 G
	Time	25"	59"	3' 54"	9' 48"	≈32'

# Logic Analyzer—Measure



# Logic Analyzer—Trigger & Decode



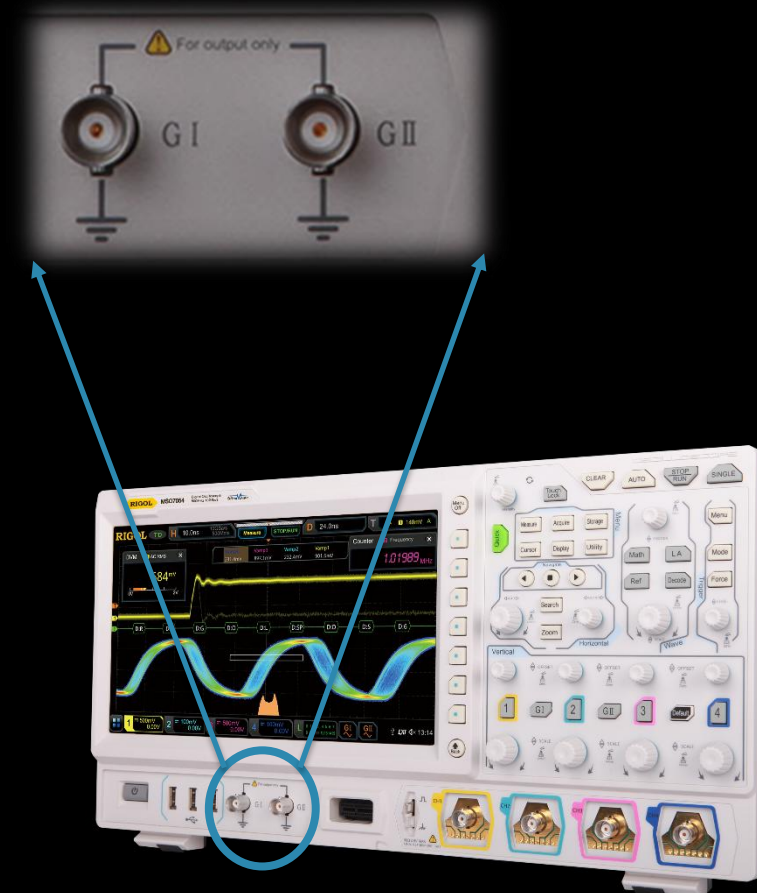
Support the decoding of 4 protocols at the same time



# Arbitrary Waveform Generator

## 25 MHz AWG Option (only for MSO model)

Standard	Sine	Square	Ramp	Pulse	DC
	Noise				
Built-in	Sinc	Exp.Rise	Exp.Fall	ECG	Gauss
	Lorentz	Haversine			
Arb	User-defined Waveform				



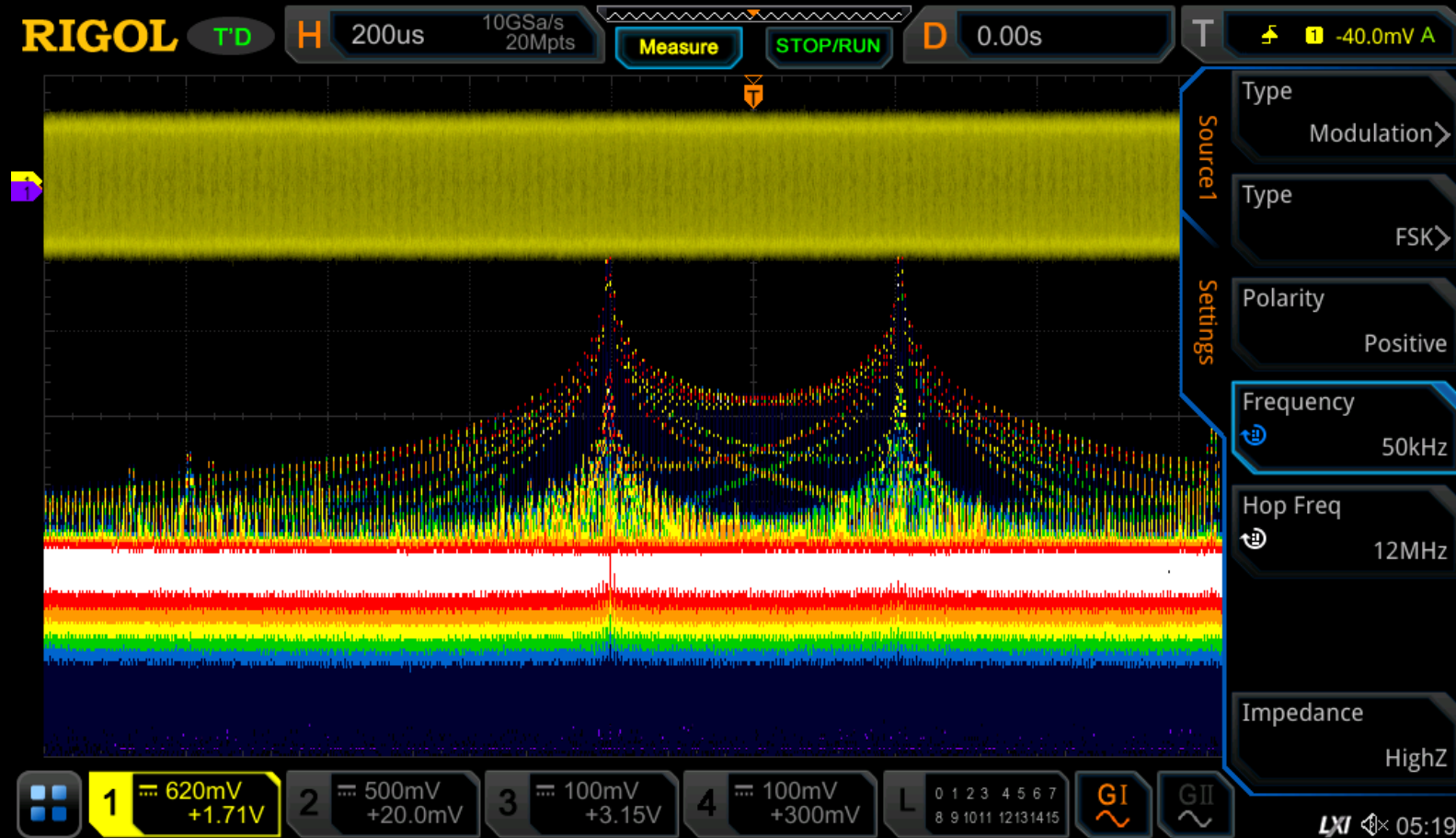
# Arbitrary Waveform Generator

## Arbitrary

Support load the waveform from analog channels 1~4



# Arbitrary Waveform Generator



# Arbitrary Waveform Generator



Type

None

Modulation

Sweep

Burst

Type Sweep>

Sweep Type Linear>

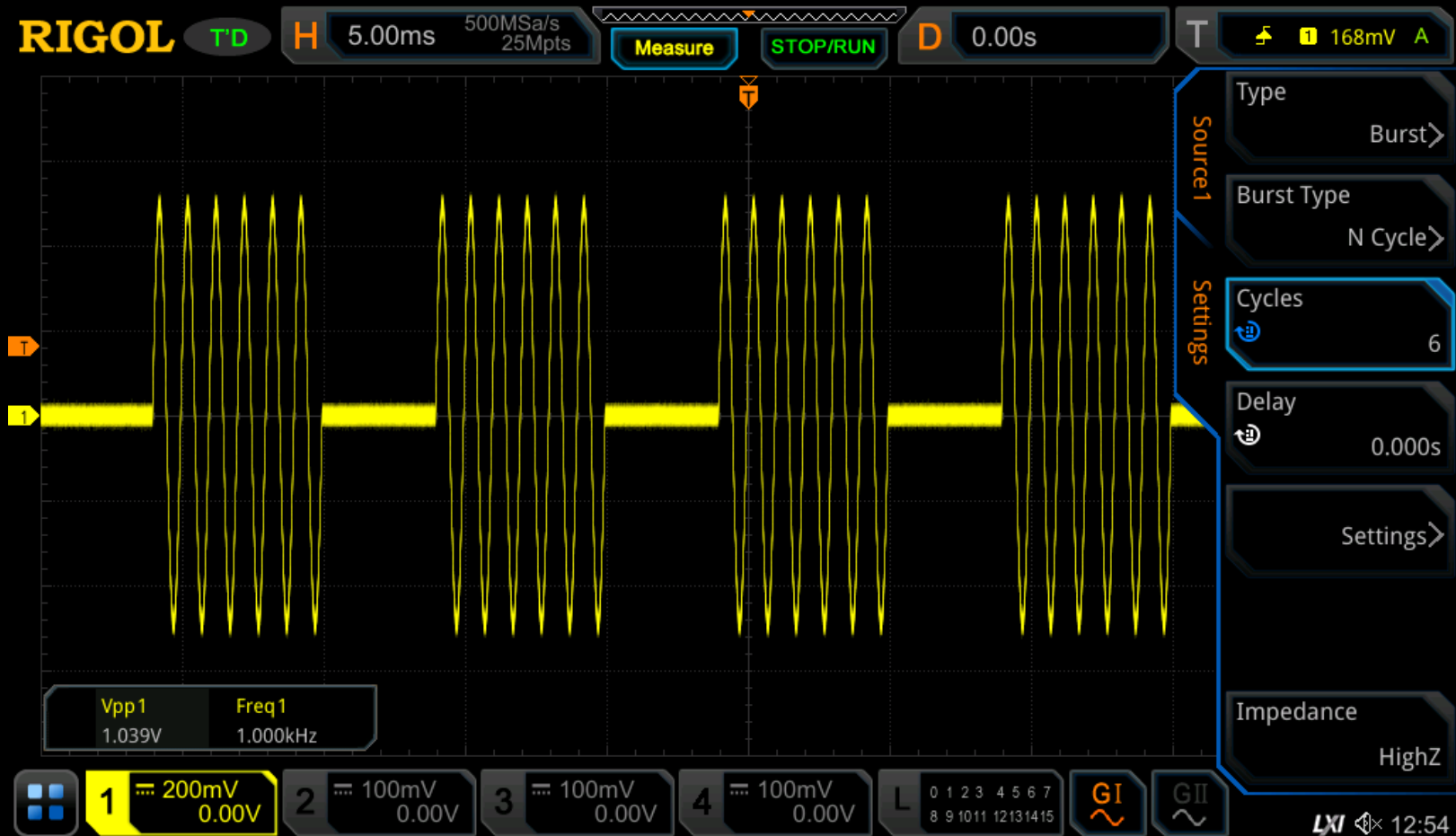
Sweep Time 1ms

Return Time 0.000s

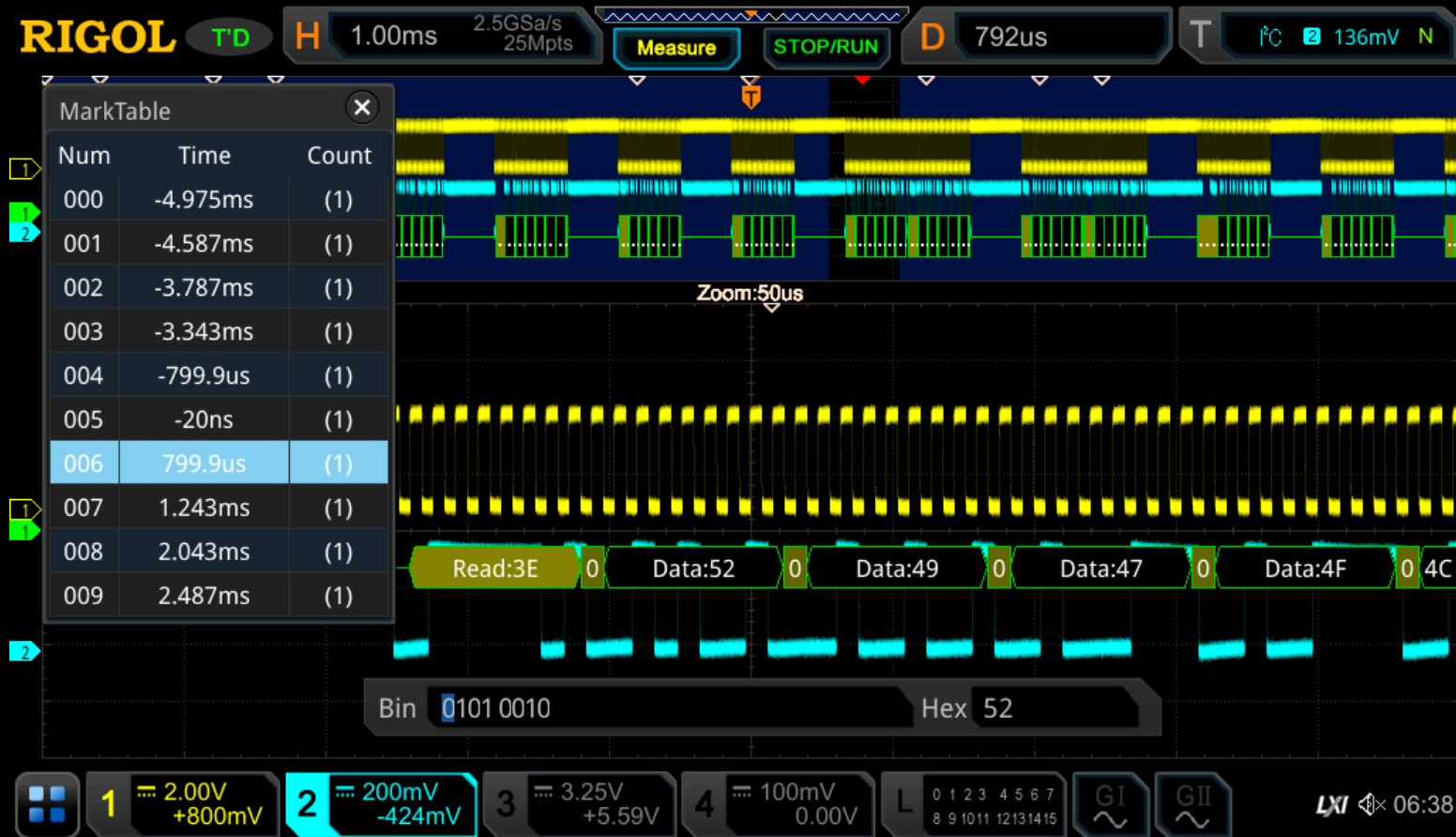
Settings>

Impedance HighZ

# Arbitrary Waveform Generator



# Protocol Analyzer



8 Serial Protocol Types:

RS232/UART

I2C

SPI

CAN

LIN

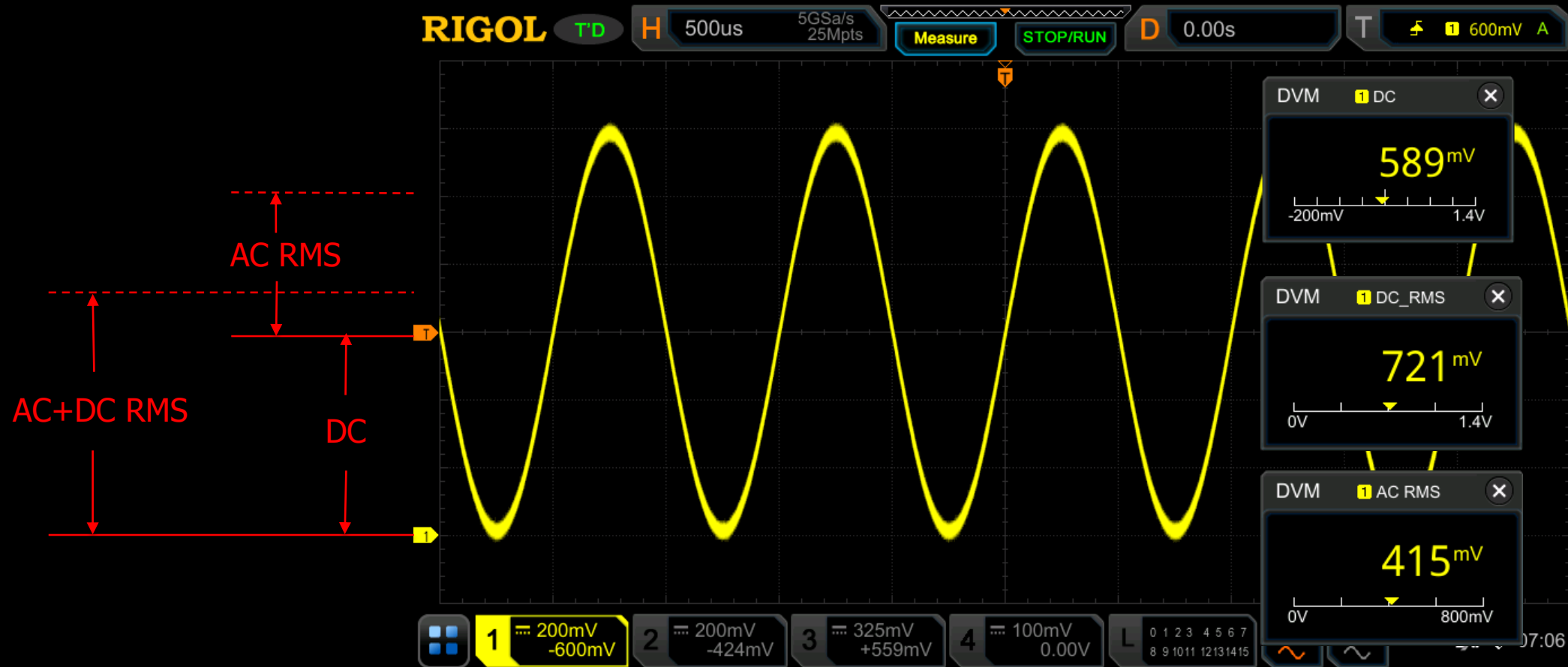
FlexRay

I2S

MIL-STD-1553

Support the trigger, decode and search

# 3-bit Digital Voltmeter



# Frequency Counter and Totalizer



Using the 48-bit totalizer, we can count the number of low frequency incidental signals.

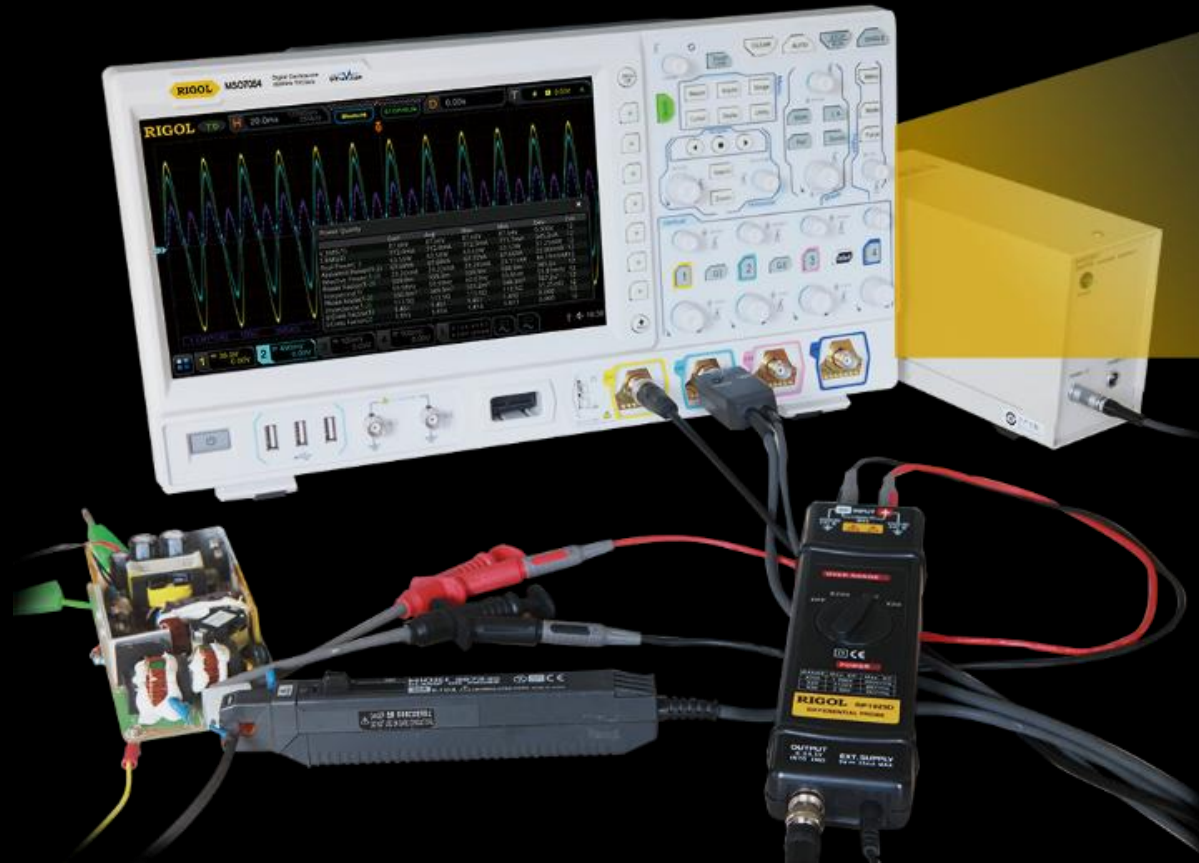


# Features

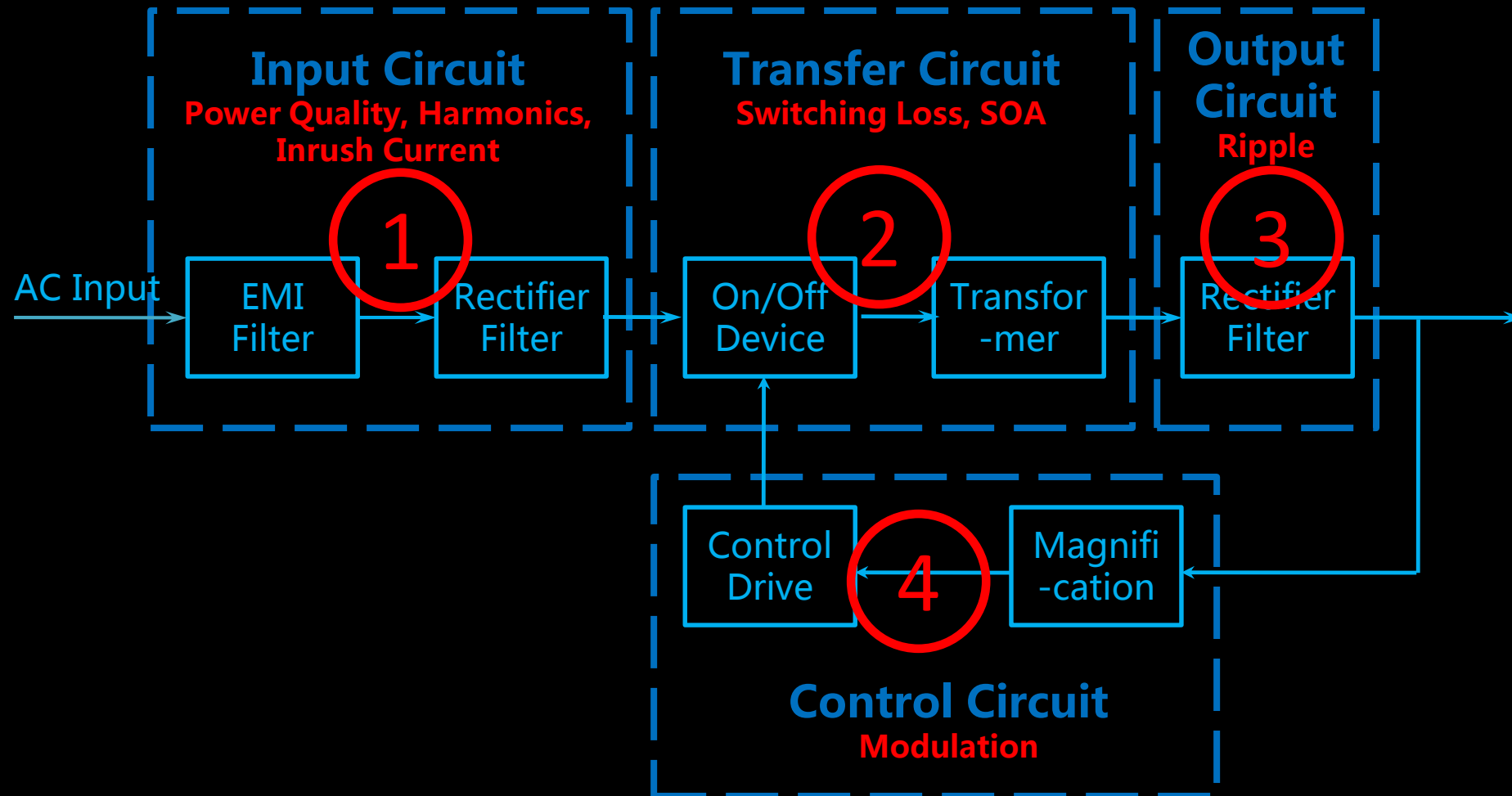
---

APP Function

# Power Analyzer



# Power Analyzer



# Power Analyzer

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MSO/DS7000

Ultra Power Analyzer

Power quality	DS7000-PWR	Support
Output Ripple	DS7000-PWR	Support
Current harmonics		Support
Inrush current		Support
Switching Loss		Support
Safe operating area		Support
Modulation		Support

# Power Analyzer

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## □ Choose the Correct Probes



High Voltage Differential  
Probe – RP1025D  
25MHz, 500 Vrms



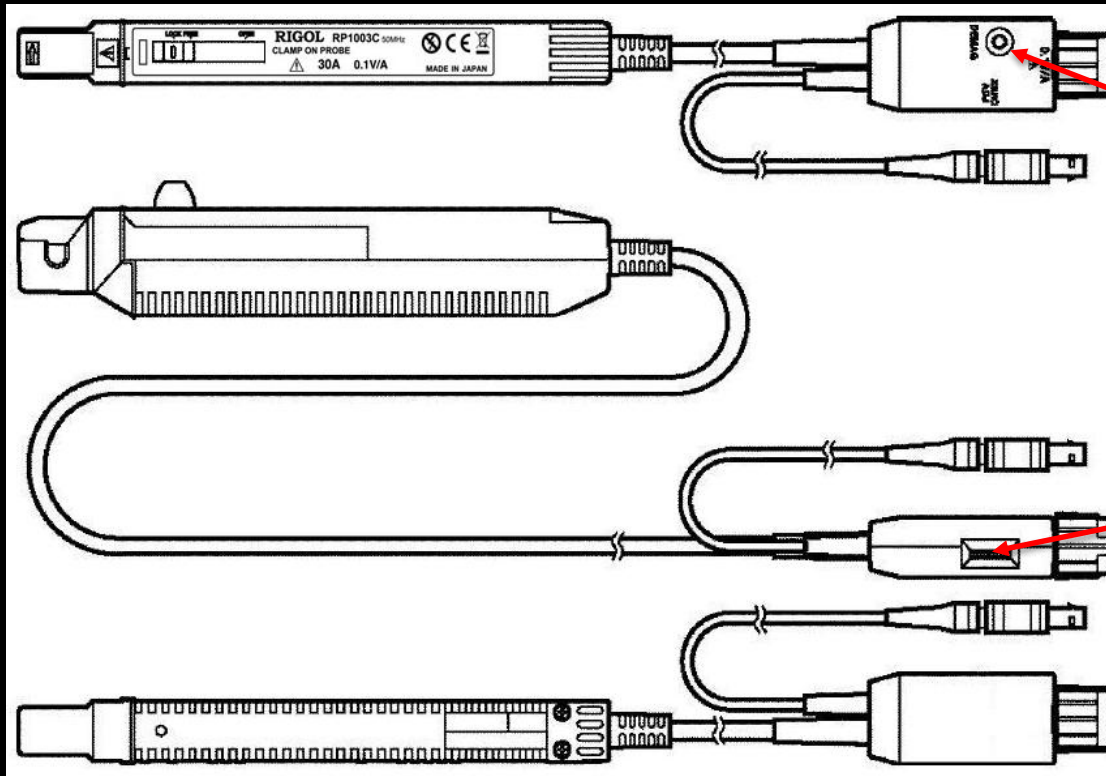
Current Probe – RP1003C  
50MHz, 30 Arms



Passive Probe – PVP2150  
1X, 35 MHz, Max. Input 150 Vrms

# Power Analyzer

## □ Make a More Accurate Measurement

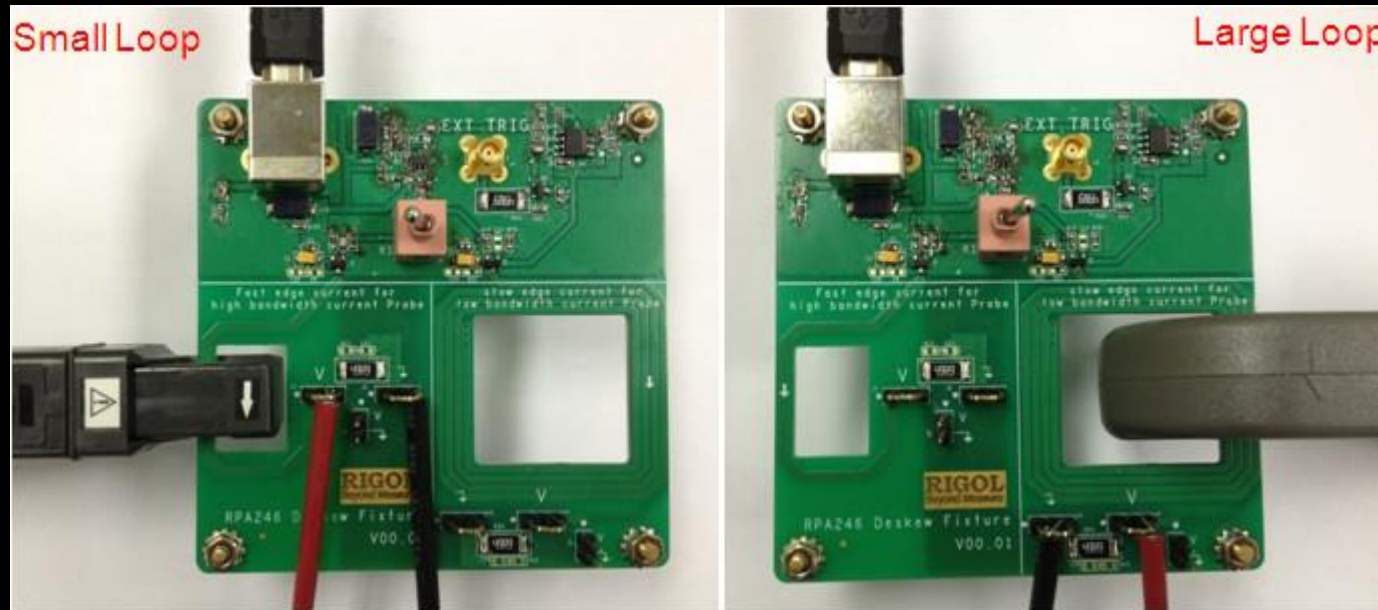


Demagnetizing  
Switch (DEMAG)

Zero adjustment dial  
(ZERO ADJ)

# Power Analyzer

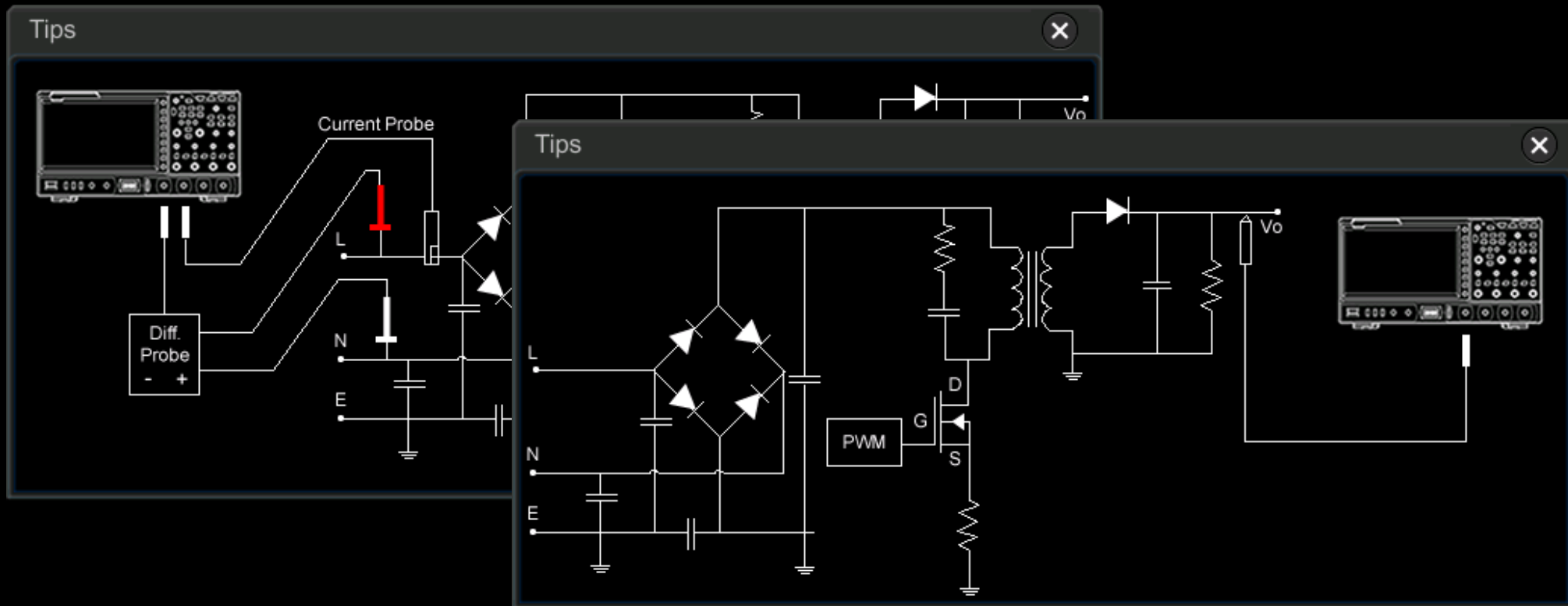
## □ Make a More Accurate Measurement



Perform Channel Deskew – RPA246

# Power Analyzer

## □ Make Connection





# Power Analyzer

## □ Power Quality Analysis



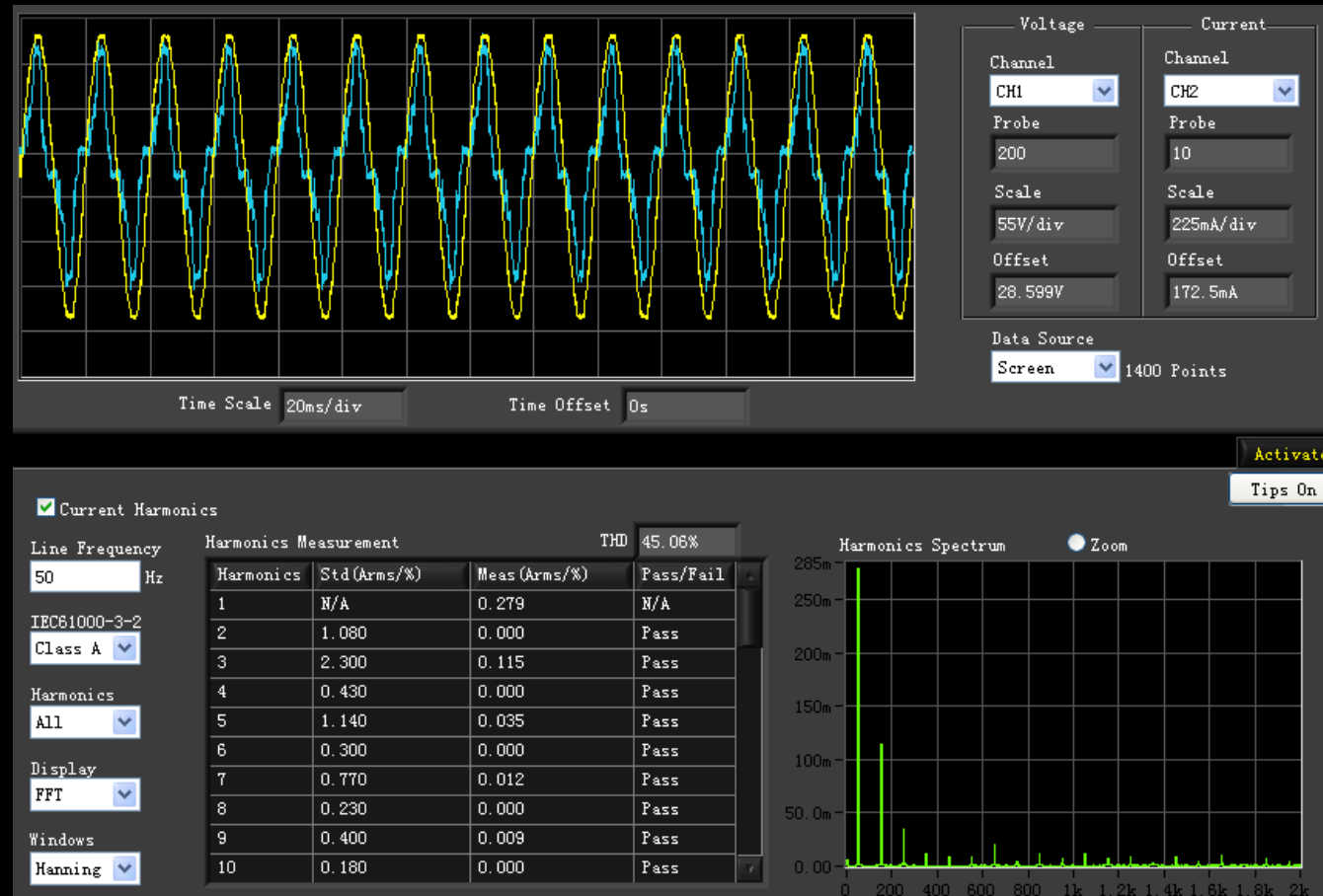
# Power Analyzer

## Output Ripple Analysis



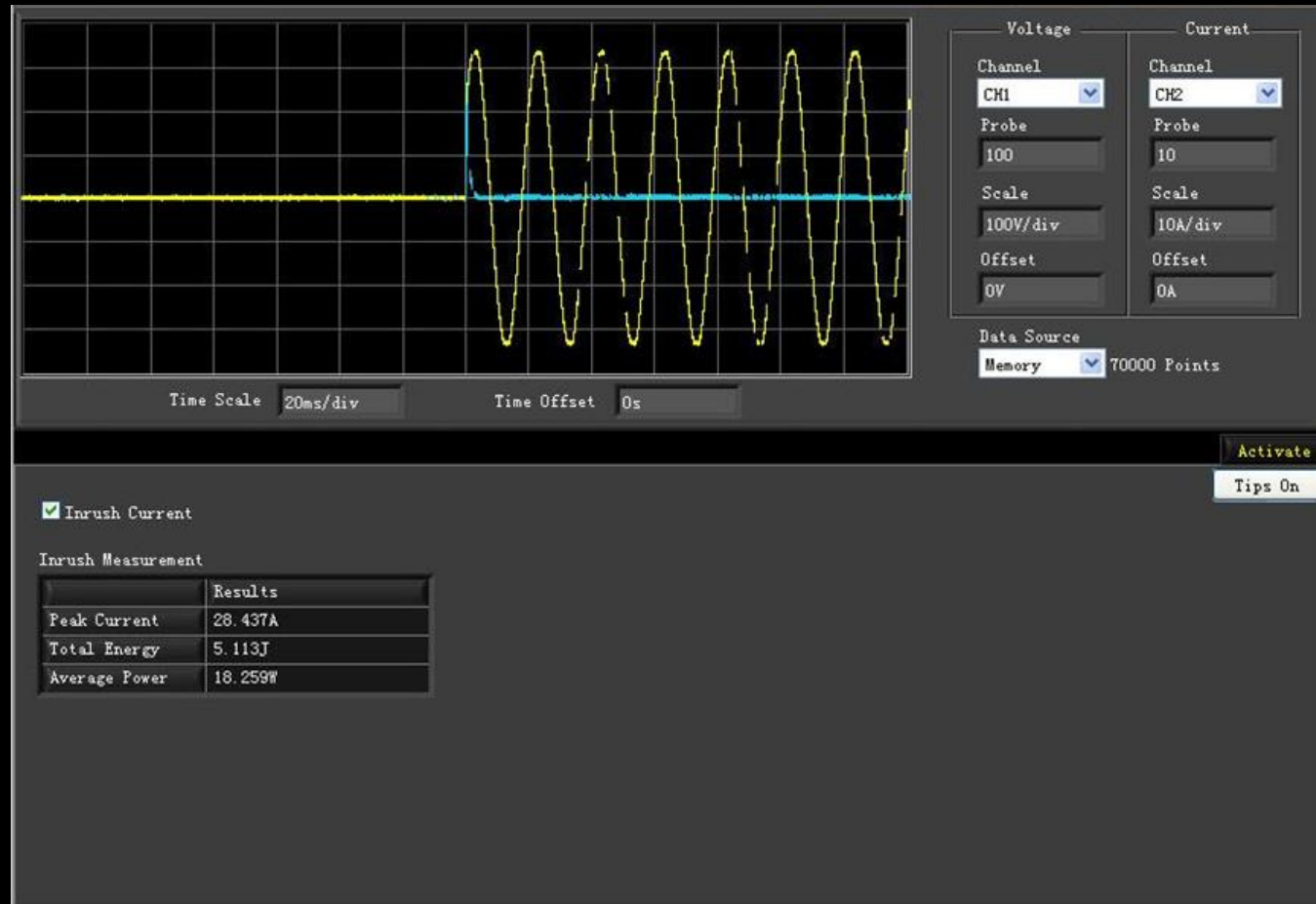
# Power Analyzer

## □ Current Harmonics Analysis



# Power Analyzer

## □ Inrush Current Analysis



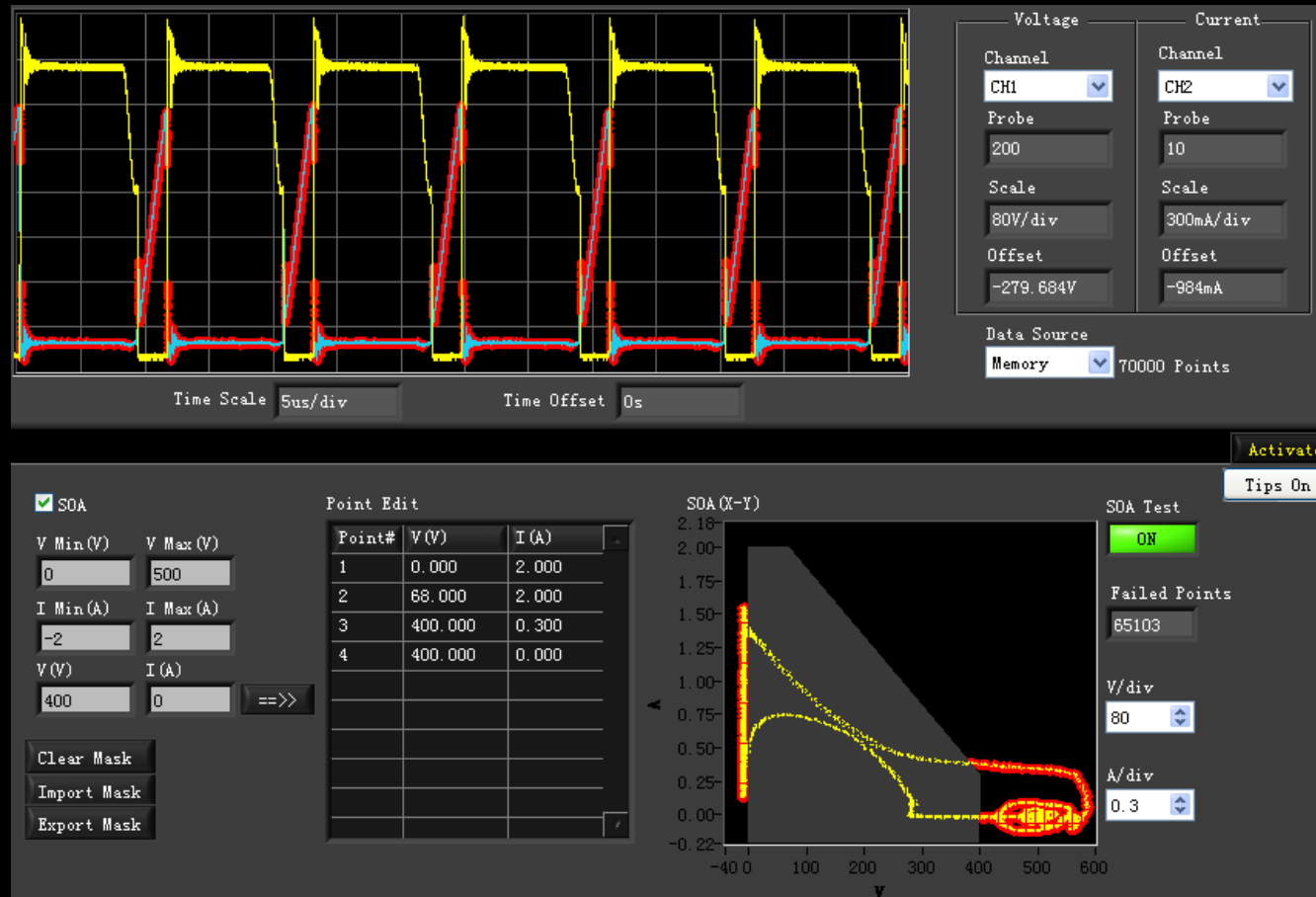
# Power Analyzer

## Switching Loss



# Power Analyzer

## □ Safe Operating Area



# Power Analyzer

## □ Modulation Analysis



# Power Analyzer

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Power Industry

New Energy Industry





# Power Analyzer

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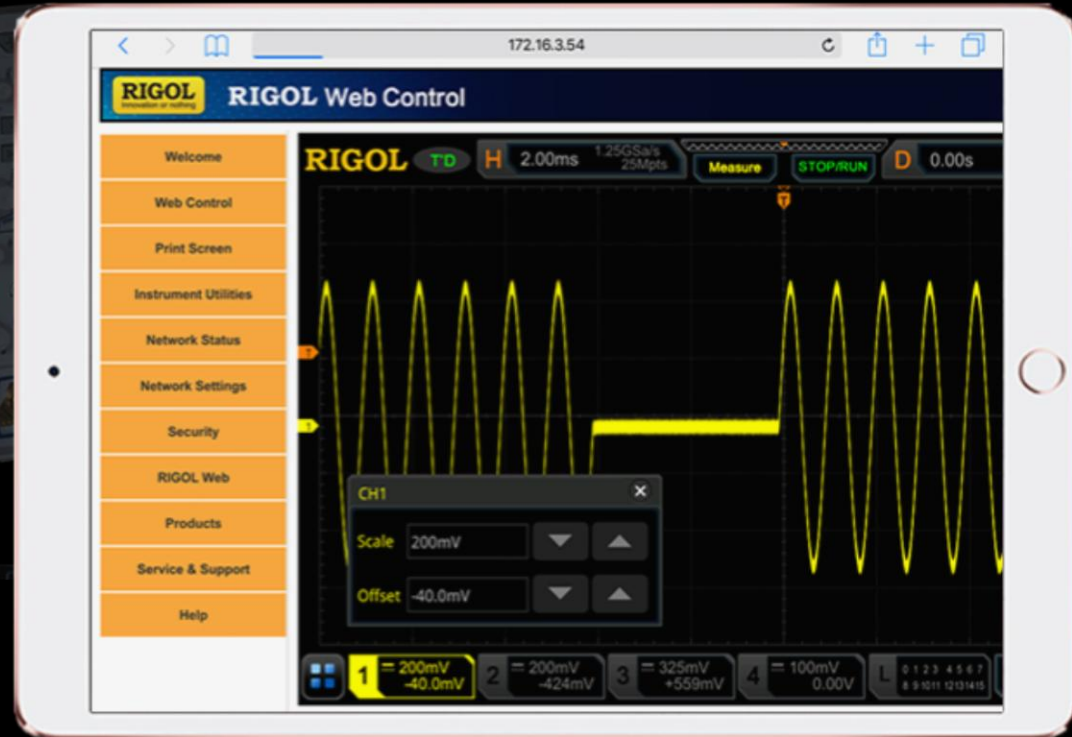
MSO/DS7000

Keysight 3000TX

Tek MDO3000

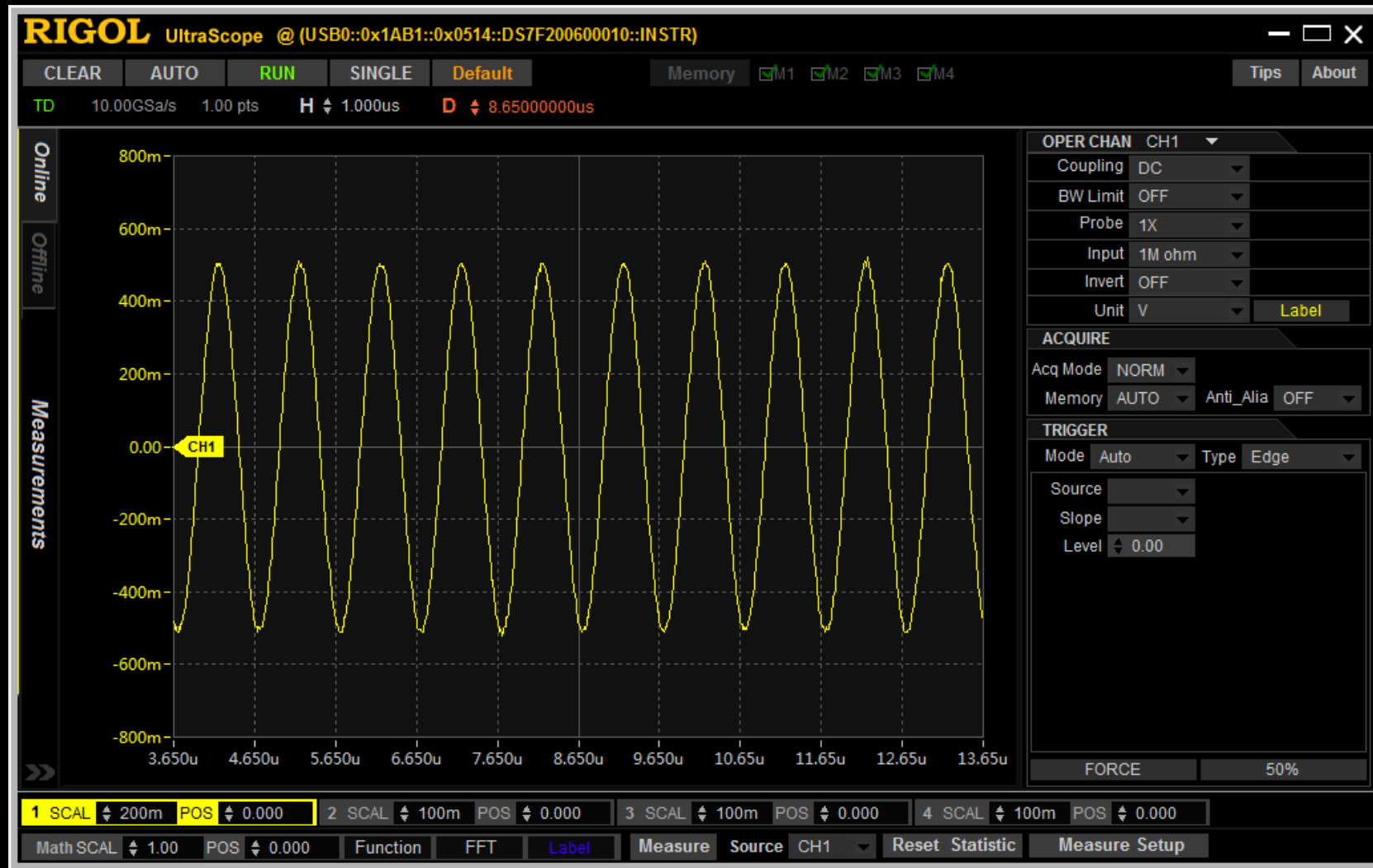
Power quality	DS7000-PWR	DSOX3PWR	MDO3PWR
Current harmonics	PC	DSOX3PWR	MDO3PWR
Inrush current	PC	DSOX3PWR	—
Switching Loss	PC	DSOX3PWR	MDO3PWR
Safe operating area	PC	—	MDO3PWR
Slew Rate	—	DSOX3PWR	MDO3PWR
Output Ripple	DS7000-PWR	DSOX3PWR	MDO3PWR
Modulation	PC	DSOX3PWR	MDO3PWR
Frequency response	—	DSOX3PWR	—

# Web Control



Remote touch control

# Ultra Scope Software



# Features

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The Last Point

# Basic Information

The image shows the RIGOL oscilloscope interface with a yellow sine wave on the screen. The top bar displays the RIGOL logo, a 'T'D' button, a horizontal scale of 500us, a sampling rate of 5GSa/s at 25Mpts, a 'Measure' button, a 'STOP/RUN' button, a vertical scale of 0.00s, and a trigger level of -336mV. A central menu is open, showing various functions: Histogram, Cursors, Counter, DVM, Pass/Fail, Search, Record, Draw rect, Restart, Quick, Ref, Power, Math, FFT, Decode, and Help (circled in red). On the right, a 'Help' menu is open, showing options: About, Language (English), Option list, Option setup, Help, Online upgrade, and Local upgrade. Annotations with arrows point to these options: 'System information' points to 'About'; 'View the option list and install options' points to 'Option list'; 'Open the help' points to 'Help'; and 'Firmware upgrade' points to 'Online upgrade'.

**RIGOL** T'D H 500us 5GSa/s 25Mpts Measure STOP/RUN D 0.00s T -336mV A

**Help Menu:**

- About → System information
- Language English>
- Option list → View the option list and install options
- Option setup
- Help → Open the help
- Online upgrade → Firmware upgrade
- Local upgrade

**Function Menu:**

- Histogram
- Cursors
- Counter
- DVM
- Pass/Fail
- Search
- Record
- Draw rect
- Restart
- Quick
- Ref
- Power
- Math
- FFT
- Decode
- Help

**Bottom Bar:**

- 1 40.0V 0.00V
- 2 200mA 0.00A
- 3 100mV 0.00V
- 4 100mV 0.00V
- L 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
- GI GII
- LXI 15:29



谢谢