User’s Manual

UT-M13X Oscilloscope Signal Protocol Demonstration

Version 1.1, July 2024

1. Warranty and Statement

Copyright

Brand Mark Information

UNI-T is the registered trademark of Uni-Trend Technology (China) Co., Ltd.

File Number

V1.01

Statement

- UNI-T products are protected by patents (including obtained and pending) in China and other countries and regions.
- UNI-T reserves the right to change specifications and prices.
- The information provided in this manual supersedes all previous publications.
- The information provided in this manual is subject to change without notice.
- **UNI-T** shall not be liable for any errors that may be contained in this manual. For any incidental or consequential damages arising out of the use of the information and functions provided in this manual.
- No part of this manual shall be photocopied, reproduced or adapted without the prior written permission of **UNI-T**.

Product Certification

UNI-T has certified that the product conforms to China national product standard and industry product standard as well as ISO9001:2015 standard and ISO14001:2015 standard. UNI-T will go further to certificate product to meet the standard of other member of the international standards organization.

2. Overview

This service manual is to introduce the function and the use of demo board. This demo board is a tool for demonstrating the basic functions of an oscilloscope. It is powered by a USB port and can output 40 types of signals, as follows.

Note: The signals are written in the following format: Chinese (English translation) (English abbreviation).

NormalWave

■ Sine（Sine）	■ Triangle（Triangle）	■ FSK
■ Square（Square）	■ ASK	
■ Sawtooth（Sawtooth）	■ PSK	

RareWave

■ Sine with Noise（SwN）	■ Repetitive Pulse with Ringing（RepPulseRing）	■ Edge Transition Violation Signal（EdgeTranViol）
■ Phase Shifted Sine（PSSine）	■ Single-Shot Pulse with Ringing（SSPulseRing）	■ Setup & Hold Violation Signals（SHViolSigs）
■ Sine with Glitch（SwGlitch）	■ Clock with Infrequent Glitch（ClkInfrGlch）	■ Non-Monotonic Edge Signal（NonMonoEdge）
■ Sine with Harmonic Distortion（SwHarmDist）	■ Clock with Jitter（ClkJitter）	■ Nth Edge（Nth Edge）
■ Real-Time Eye（RTEye）	■ Serial Data with Jitter（SerDataJit）	■ Fast Scan（FastScan）
■ Sine with Sinusoidal Noise Coupling（SwSinNoise）	■ Runt Pulses（RuntPulses）	■ Slow Scan（SlowScan）

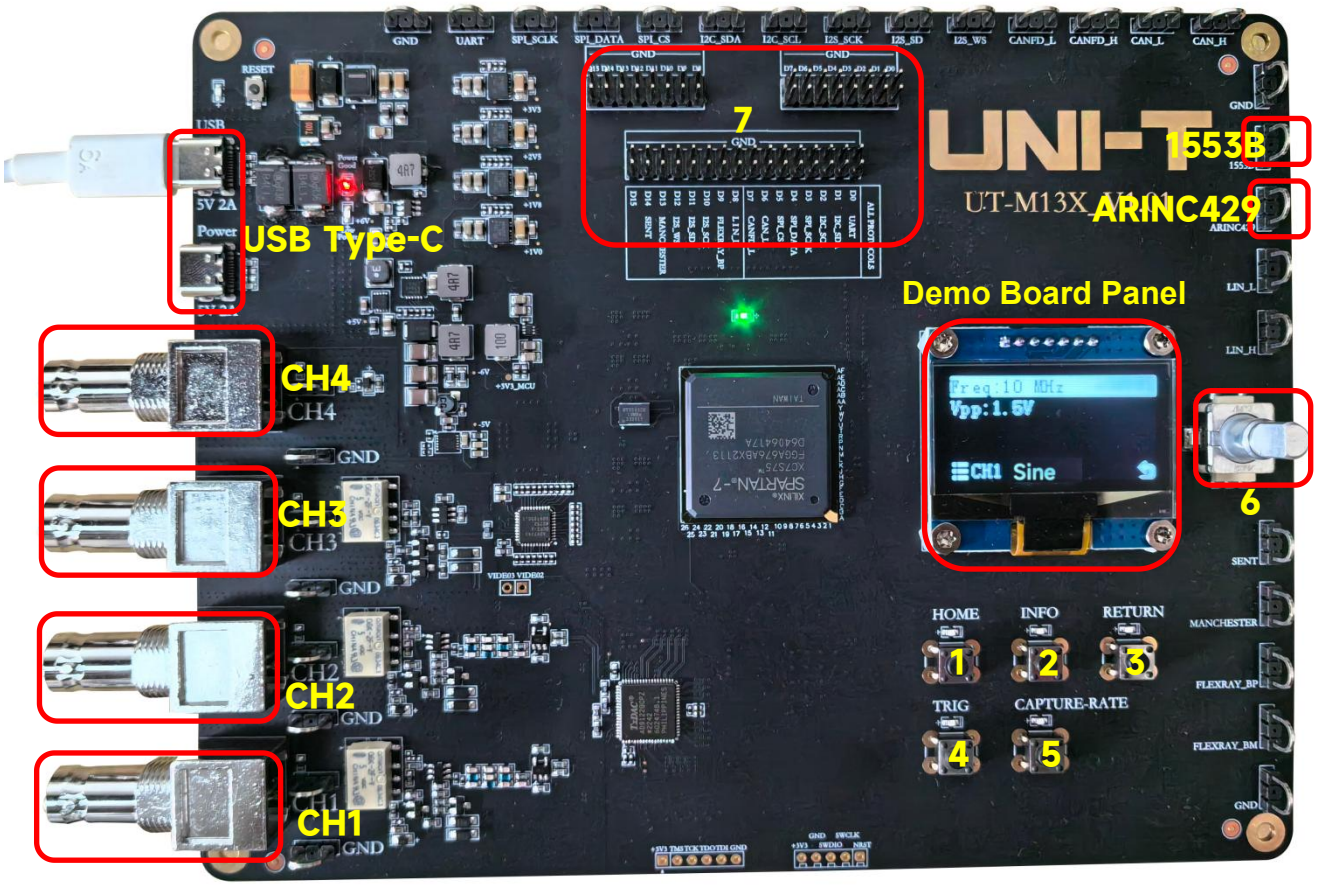
Protocol

■ UART	■ CAN	■ FlexRay	■ SENT
■ I2C	■ CAN-FD	■ I2S	■ Manchester
■ SPI	■ LIN	■ 1553B	■ ARINC429

VideoParam（VideoParam）
Capture Rate（Capture）
Logic analyzer（LA）

3. Signal Board

3.1. Demo Board



No.	Description
1	HOME key: press this key to go back to the home page
2	INFO key: press this key to check the signal when the first page has an output signal.
3	RETURN key: press this key to return to the previous page
4	TRIG key: when select a rare signal of single-shot pulse with ringing, press this key to generate one single-shot pulse with ringing
5	CAPTURE RATE key: press this key to generate one single double-pulse signal
6	Multi-purpose rotary knob: rotate this rotary knob to switch the selection, press this rotary knob to select the option
7	LA connector: used for inputting an LA signal or selecting different pins for inputting the decoding signal.

3.2. Power supply

USB Type-C power supply: 5V 2A

3.3. Measurement Connection

Before using the demo board, the signal output of the demo board should be connected to the input port of the oscilloscope.

Connection steps

- Use a BNC to connect the signal output channel （CH1-CH4）of the demo board to the input channel of the oscilloscope.
- Connect the probe to the signal output pin of the demo board, attach the alligator clip to the GND of the demo board, and then connect the probe's BNC to the BNC connector of the input channel (CH1-CH4) on the front panel of the oscilloscope.

3.4. Power-on

The demo board can be powered through the USB Type-C port.

Connect the USB DEVICE connector of the demo board to the USB HOST connector of the oscilloscope or computer with the USB Type-C data cable.

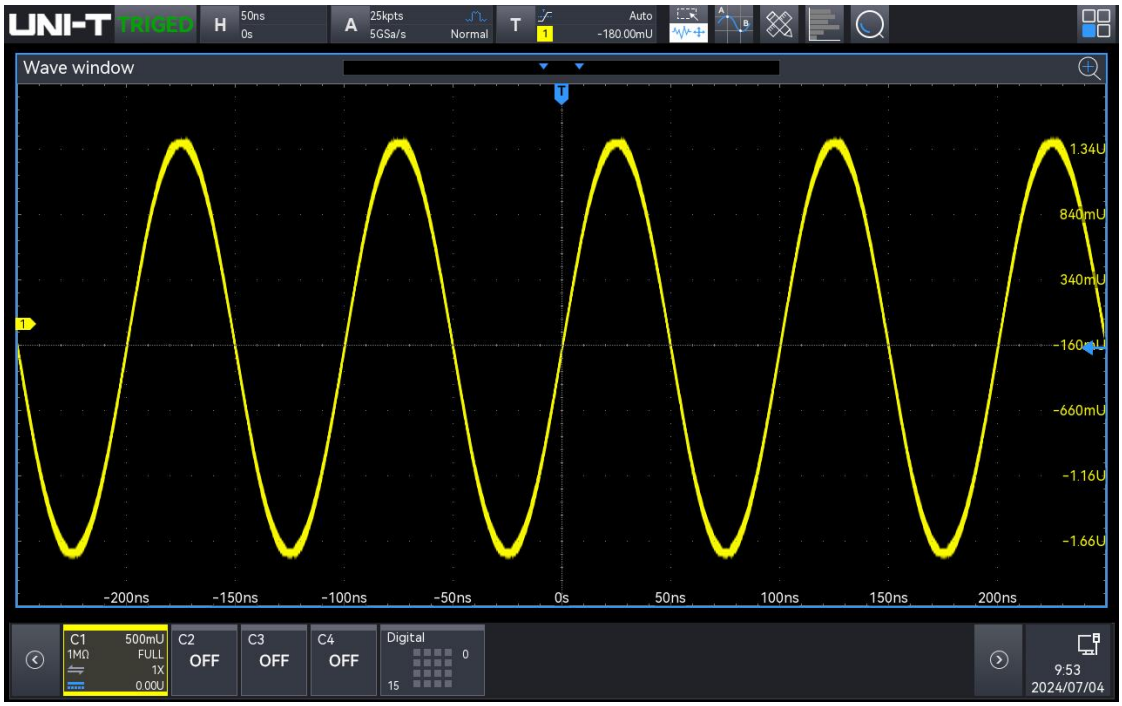
Note: Static electricity can damage the demo board, so testing should be carried out in an anti-static area if possible.

4. Demo Board Application

4.1. Normal Signal

4.1.1. Sine Wave

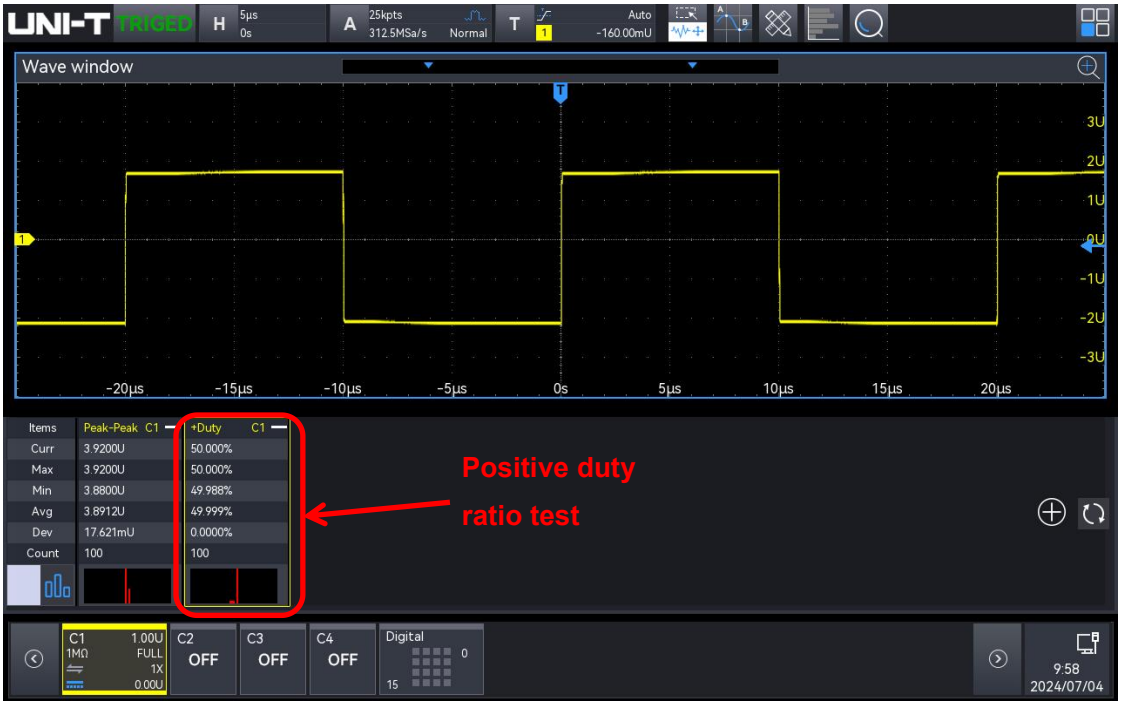
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to sine wave
   - A sine wave signal with a frequency of 10 MHz and an amplitude of 3.25 Vpp
2. Demo content
   - Basic signal
   - Edge trigger
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "1 V". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Demo result of sine wave

4.1.2. Square Wave

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to square wave
   - A sine wave signal with a frequency of 50 kHz and an amplitude of 3.88 Vpp
2. Demo content
   - Basic signal
   - Edge trigger
   - Positive duty ratio
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "1 V". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Enable "Positive duty ratio" and "Peak-to-peak" measurements and statistics. Demo result is shown in the following figure.



Demo result of square wave

4.1.3. Sawtooth Wave

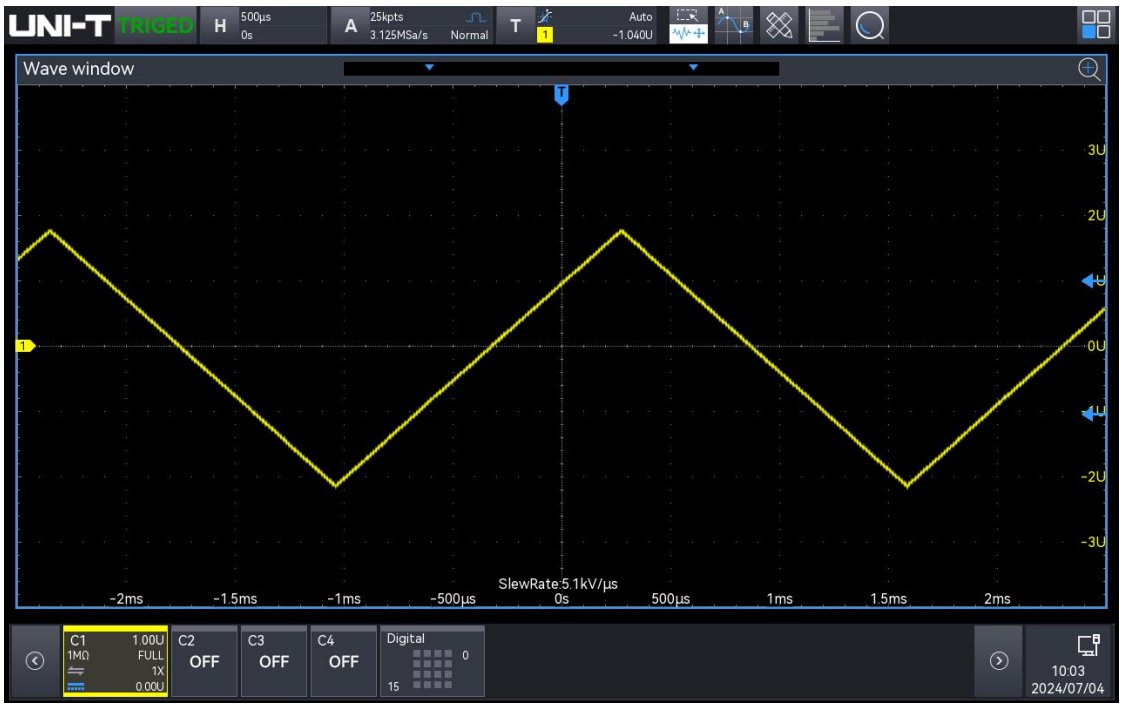
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to sawtooth wave
   - A sine wave signal with a frequency of 762.94Hz and an amplitude of 3.9 Vpp

2. Demo content
   - Basic signal
   - Slope trigger
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger type to "Slope trigger", the trigger mode to "Auto", and the vertical scale to "1 V". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.

Demo result of sawtooth wave

4.1.4. Triangular Wave

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to triangular wave
   - A sine wave signal with a frequency of 381.46Hz and an amplitude of 3.9 Vpp
2. Demo content
   - Basic signal
   - Slope trigger
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger type to "Slope trigger", the trigger mode to "Auto", and the vertical scale to "1 V". Adjust the appropriate vertical shift and trigger level (high/low) to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Demo result of triangular wave

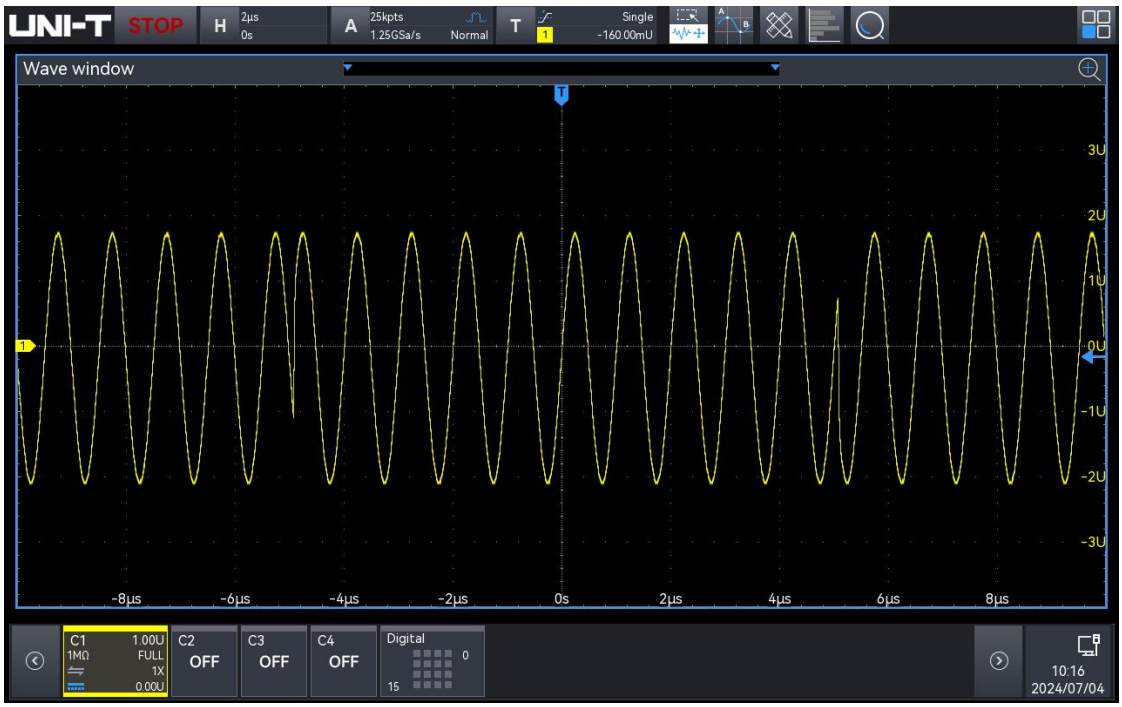
4.1.5. ASK

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to ASK
   - A sine wave signal with a frequency of 390 kHz and an amplitude of 3.9 Vpp
2. Demo content
   - Basic signal
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "1 V". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.

Demo result of ASK

4.1.6. PSK

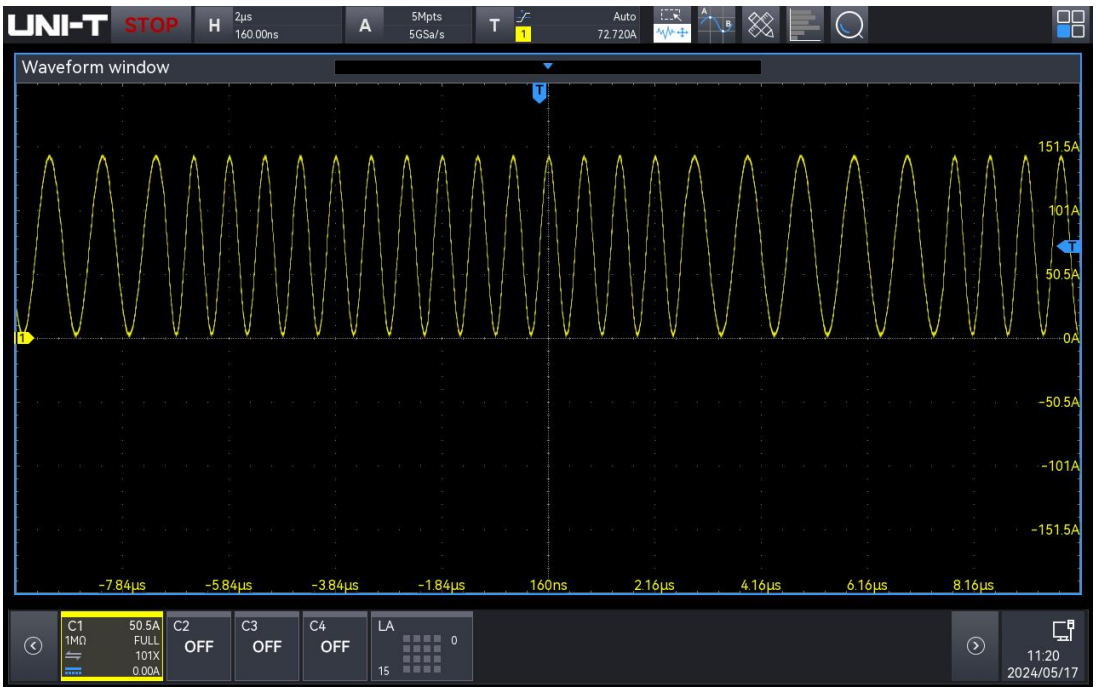
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to PSK
   - A sine wave signal with a frequency of 1.274 MHz and an amplitude of 3.9 Vpp
2. Demo content
   - Basic signal
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "1 V". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Demo result of PSK

4.1.7. FSK

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to FSK
   - A sine wave signal with a frequency of 1.3125 MHz and an amplitude of 3.9 Vpp
2. Demo content
   - Basic signal
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "1 V". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.

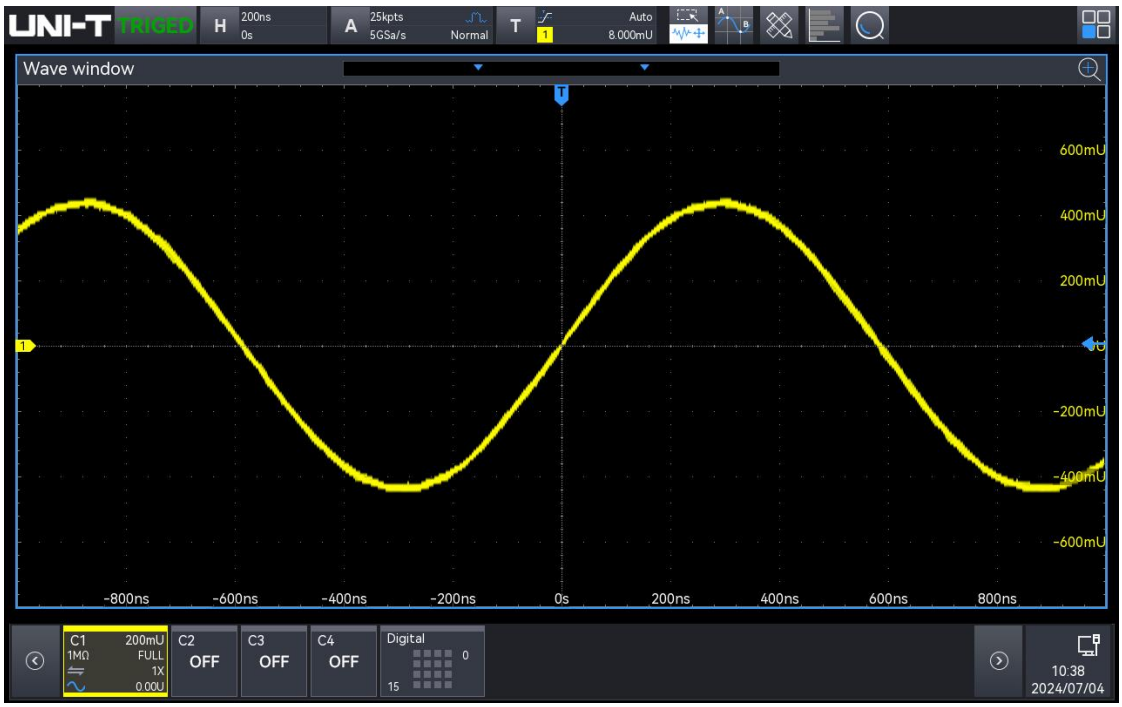


Demo result of FSK

4.2. Rare Signal

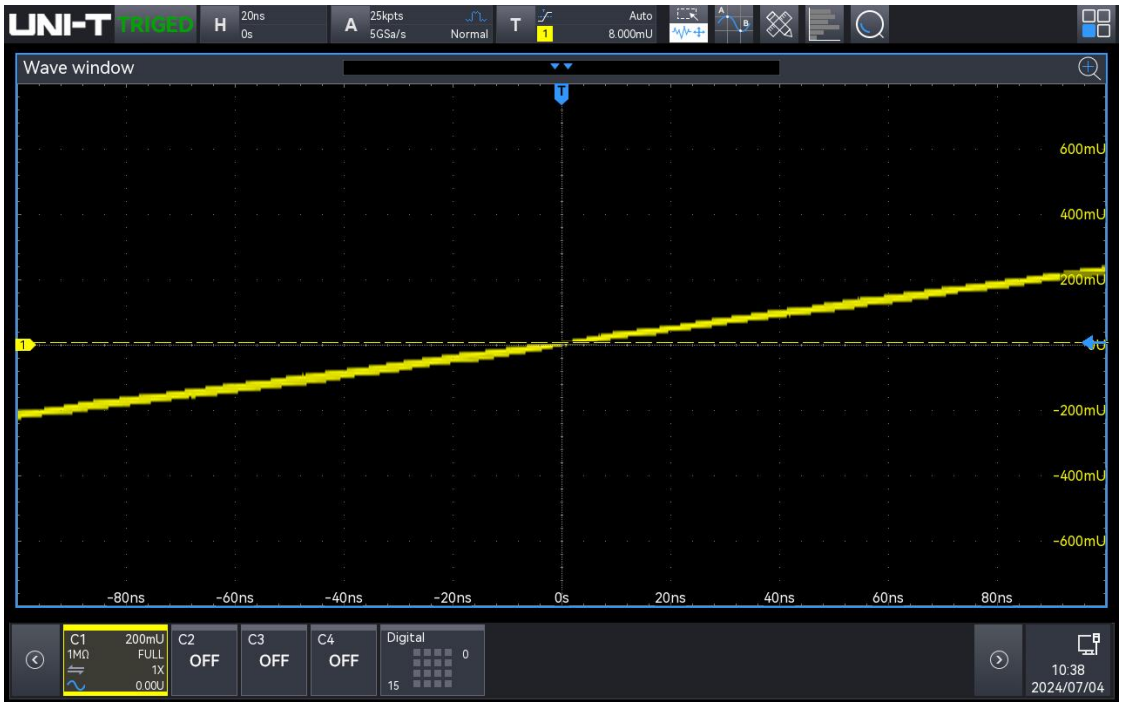
4.2.1. Sine with Noise

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to sine with noise
   - A sine wave with a frequency of 855 kHz, an amplitude of 1.28 Vpp and overlay a high-frequency noise with a frequency of 25 MHz, an amplitude of 350 mVpp
2. Demo content
   - HF rejection
   - Bandwidth limit
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger mode to "Edge trigger", the trigger holdoff to "600 us", the sampling mode to "Normal", the vertical scale to "500 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



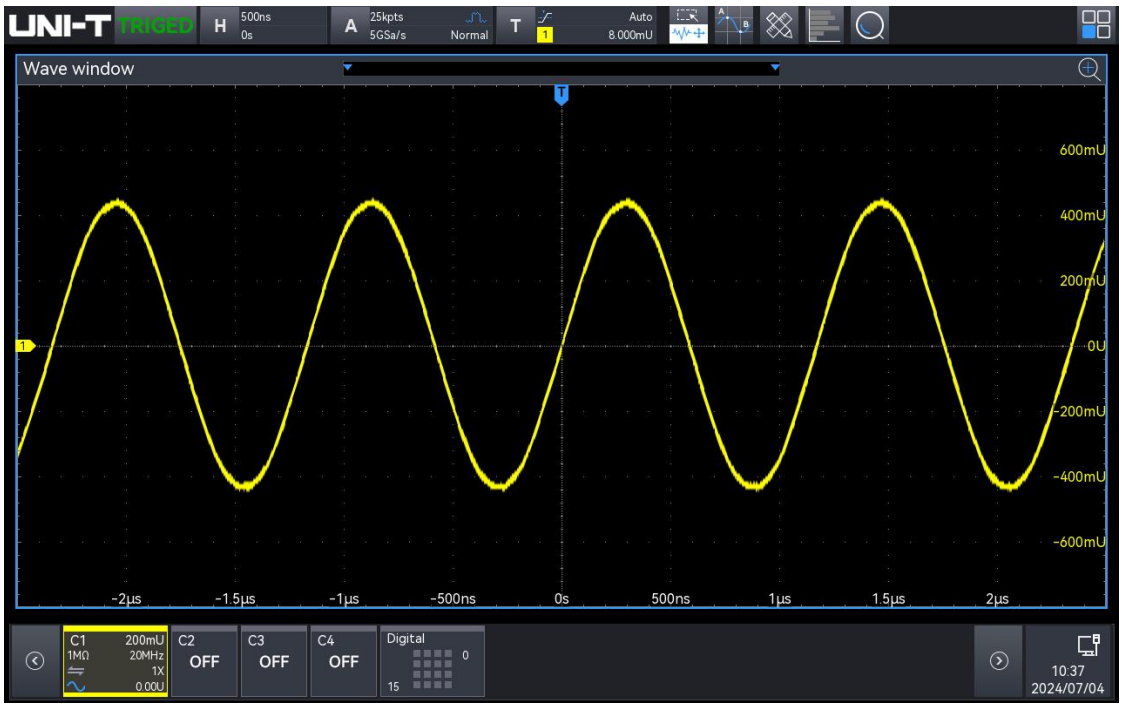
Sine with noise

- Adjust the horizontal time base to "20 ns", The waveform is shown in the following figure.



High-frequency noise details

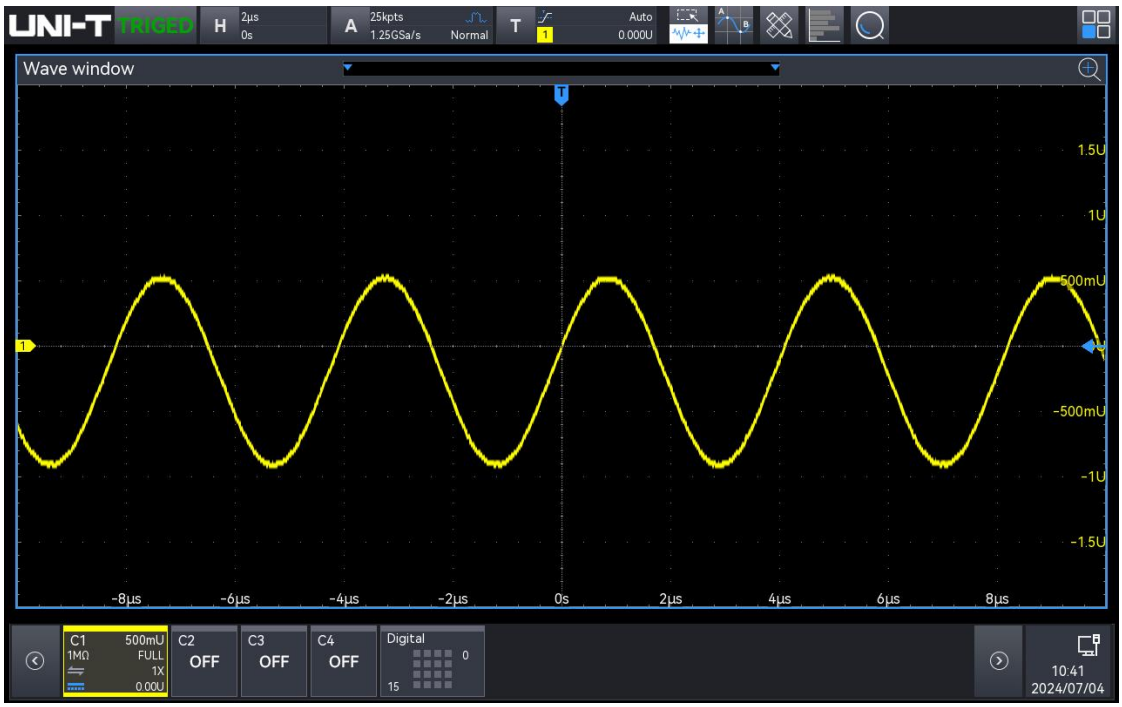
- Adjust the horizontal time base to "500 ns", enable "LF reject" and "Bandwidth limit". Demo result is shown in the following figure.



Signal after noise rejection

4.2.2. Phase Shifted Sine

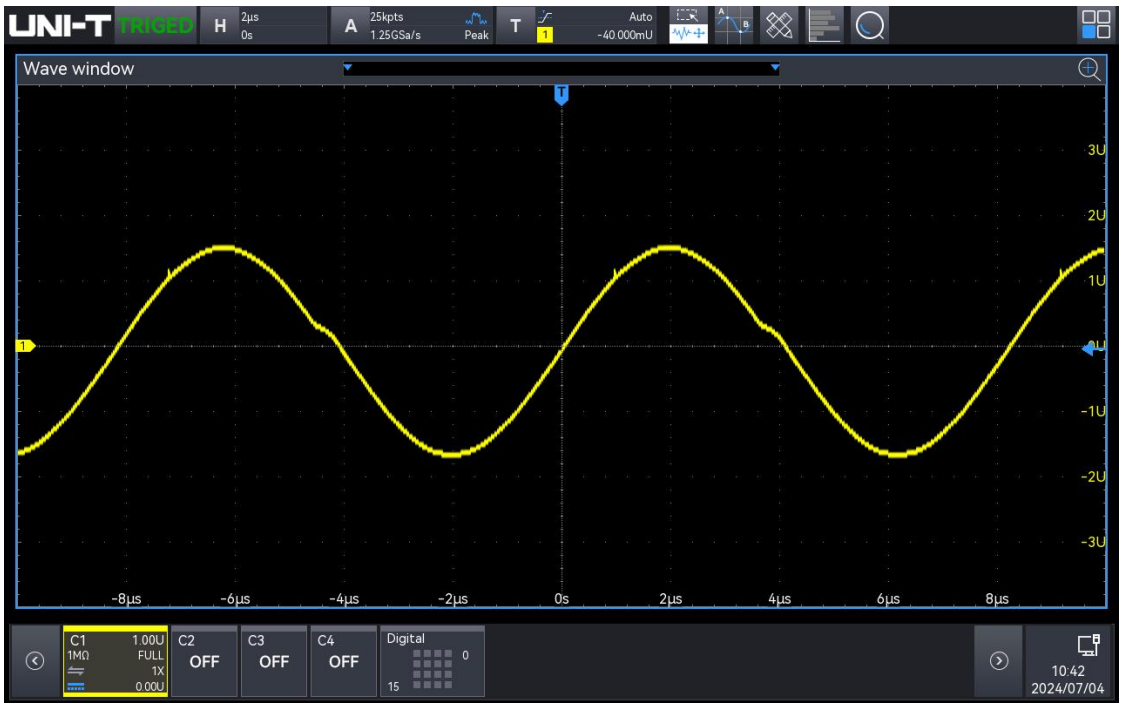
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to phase shifted sine
   - A sine wave signal with a frequency of 245 kHz and an amplitude of 600 mVpp
2. Demo content
   - Rare signal
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "500 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Phase shifted sine

4.2.3. Sine with Glitch

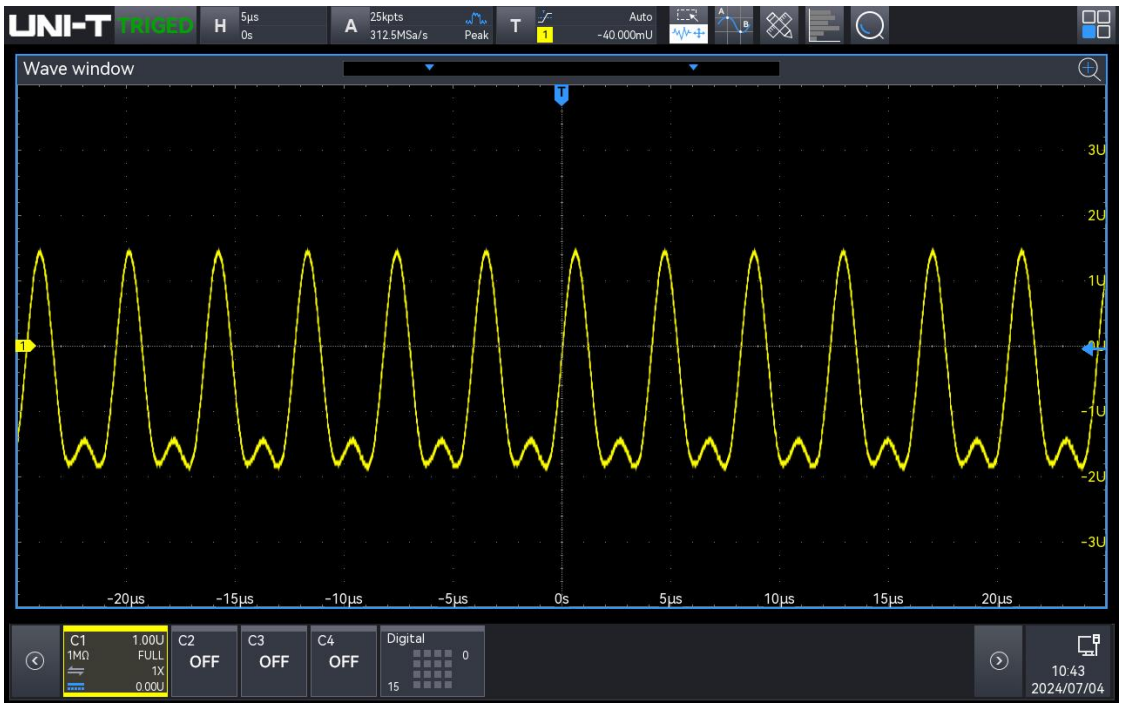
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to sine wave with glitch
   - A sine wave signal with a frequency of 122 kHz and an amplitude of 4.69 Vpp
2. Demo content
   - Peak sampling
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger mode to "Edge trigger", the trigger mode to "Auto", the vertical scale to "1 V", and the sampling to "Peak". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Sine with glitch

4.2.4. Sine with Harmonic Distortion

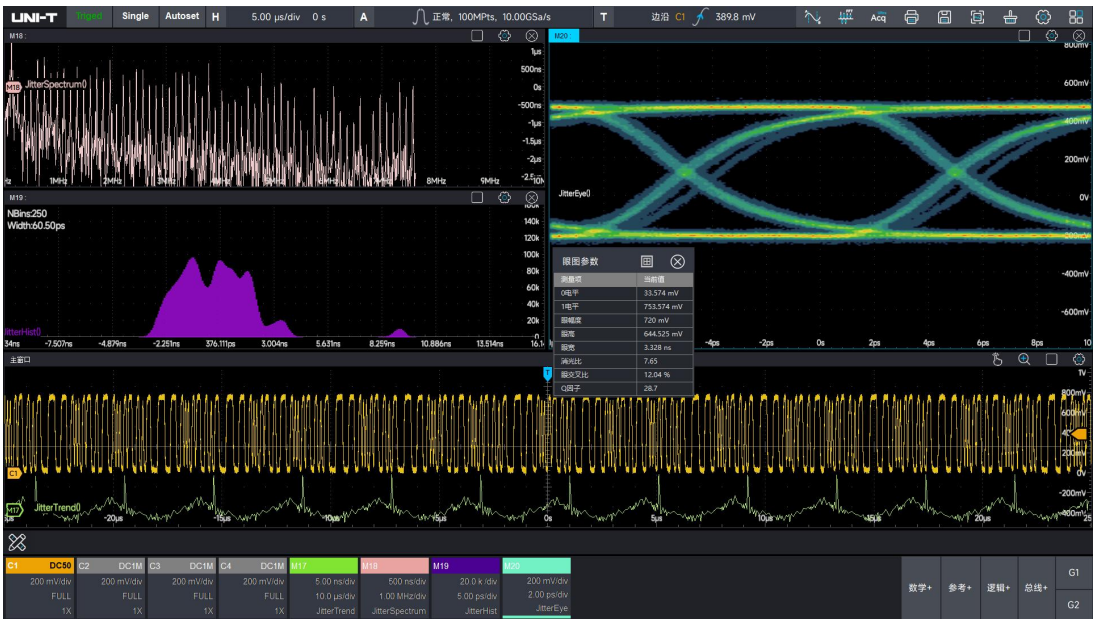
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to sine with harmonic distortion
   - A sine wave signal with a frequency of 244 kHz and an amplitude of 4.82 Vpp
2. Demo content
   - FFT
   - The advantages of using the zoom function for gating measurement
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger mode to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "1 V". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Sine with harmonic distortion

4.2.5. Real-time Eye Diagram

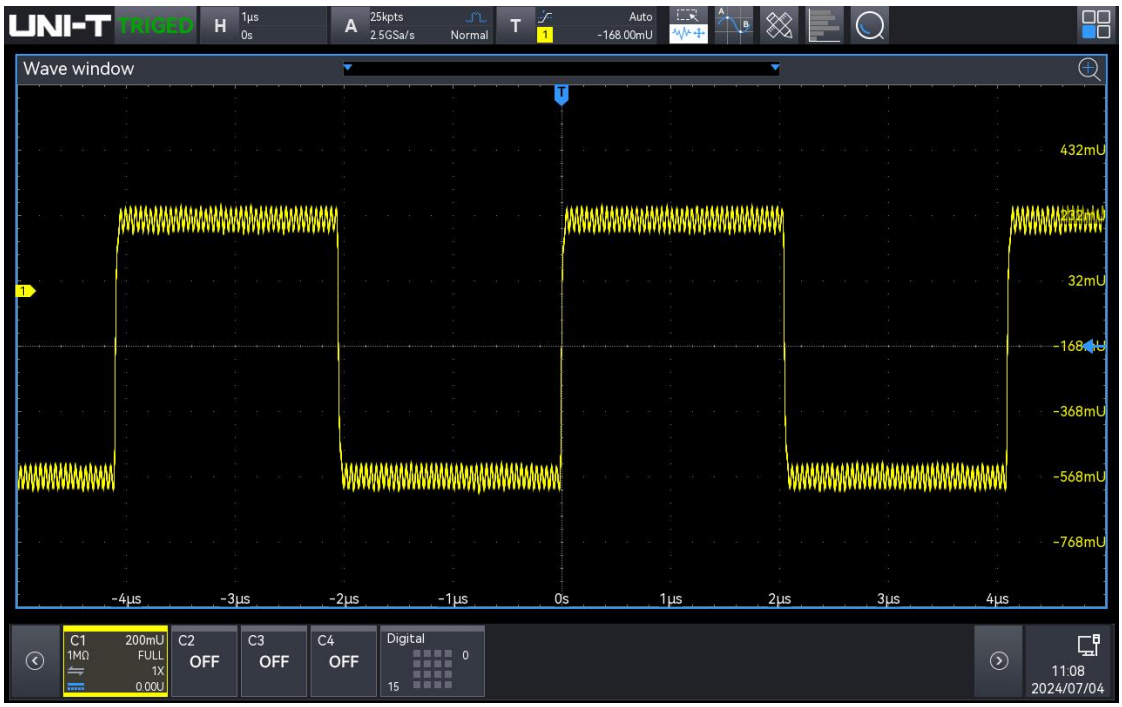
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to real-time eye diagram
   - A sine wave signal with a frequency of 10 MHz and an amplitude of 4.35 Vpp
2. Demo content
   - Demonstrating the advantage of real-time eye diagram
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger mode to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "1 V". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Real-time eye diagram

4.2.6. Sine with Sinusoidal Noise Coupling

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to sine with sinusoidal noise coupling
   - A sine wave signal with a frequency of 244 kHz and an amplitude of 1.32 Vpp
2. Demo content
   - Demonstrate the advantages of using the FFT function on an oscilloscope to find signals coupled to a device under test (DUT).
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "200 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Sine with sinusoidal noise coupling

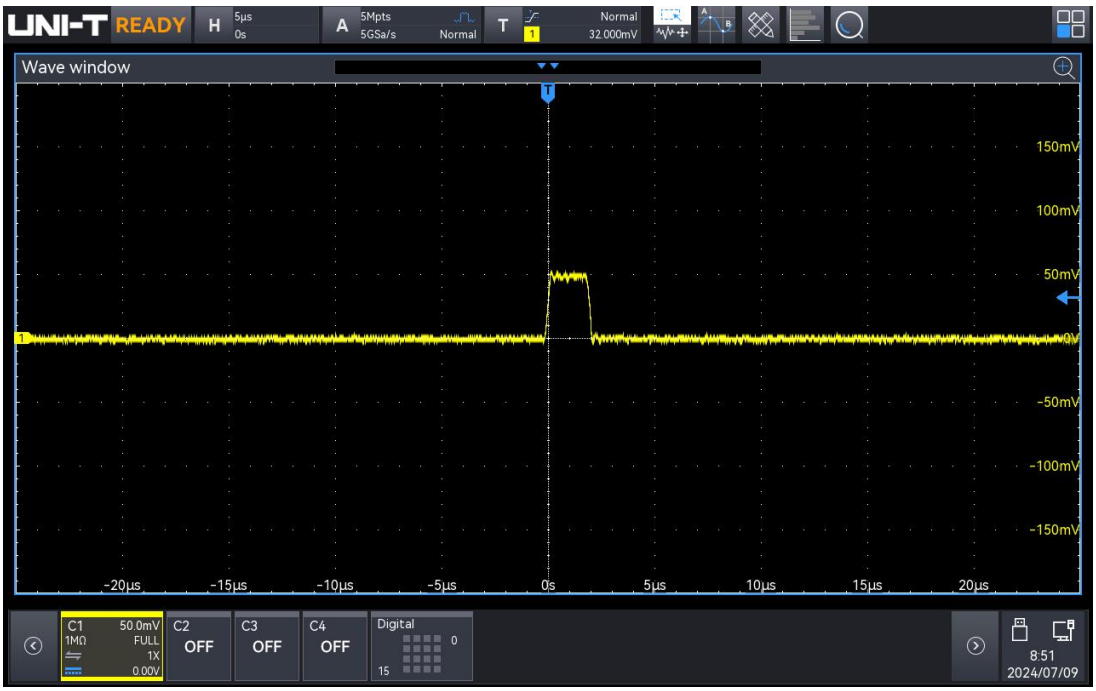
4.2.7. Repetitive Pulse with Ringing

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to repetitive pulse with ringing
   - A sine wave signal with a frequency of 610 kHz and an amplitude of 1.87 Vpp
2. Demo content
   - Auto pulse parameter measurement, such as rising time, falling time, overshoot
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "500 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.

Repetitive pulse with ringing

4.2.8. Single-Shot Pulse with Ringing

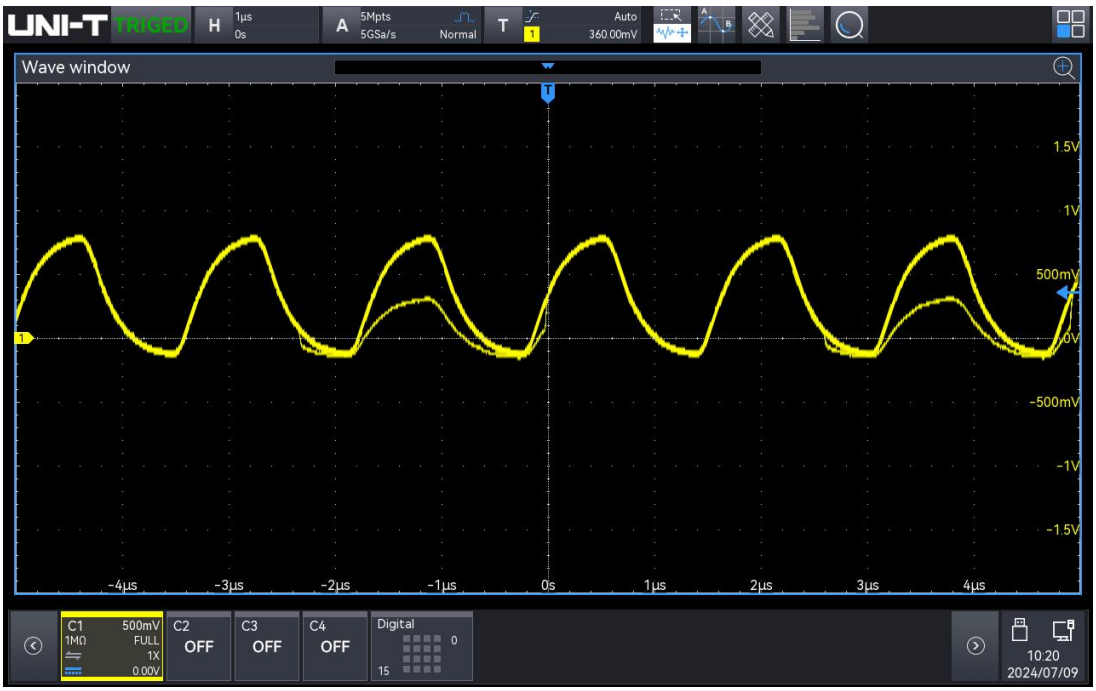
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to single-shot pulse with ringing
   - The pulse width of the sine signal is approximately 1.96 us and the amplitude is 75 mVpp
   - A single-shot pulse with ringing can only be generated by pressing the TRIG key on the demo board
2. Demo content
   - Normal trigger
   - Single trigger
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger mode to "Edge trigger", the trigger mode to "Normal / Single", and the vertical scale to "50 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Press the TRIG key on the demo board to output a single -shot pulse with ringing, the oscilloscope will capture and display this signal. Demo result is shown in the following figure. (take the trigger mode "Normal" as an example).



Single-shot pulse with ringing

4.2.9. Clock with Infrequent Glitch

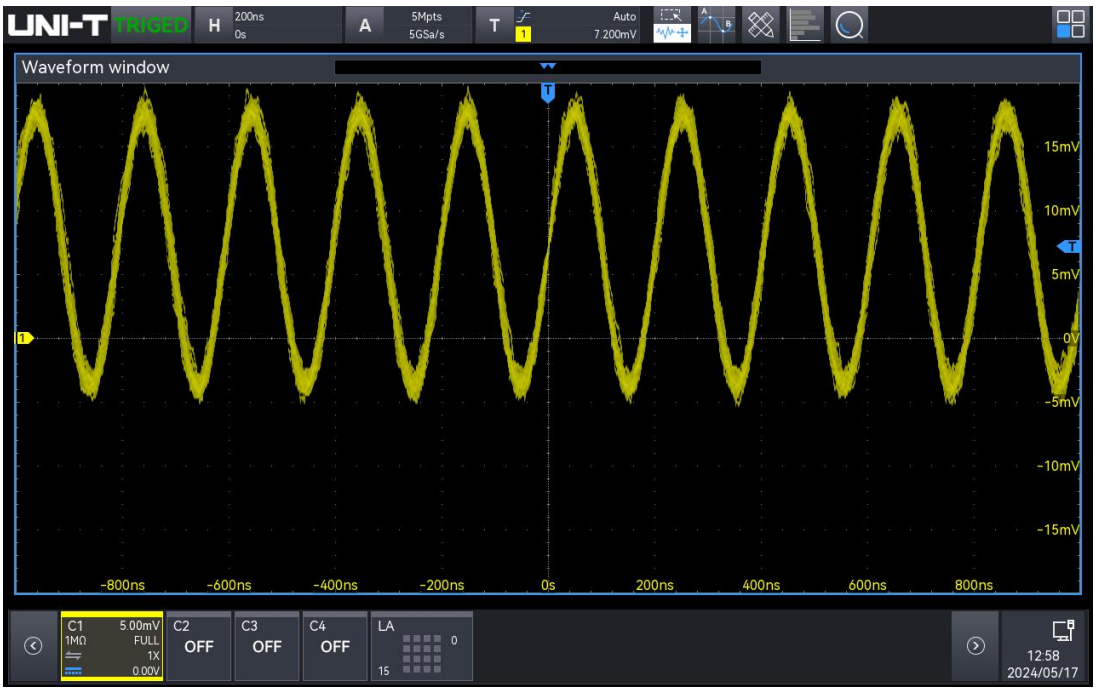
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to clock with infrequent glitch
   - A sine wave signal with a frequency of 120 kHz and an amplitude of 1.38 Vpp
2. Demo content
   - Refresh rate of fast wave
   - Pulse width
   - Template test
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "500 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Clock with infrequent glitch

4.2.10. Clock with Jitter

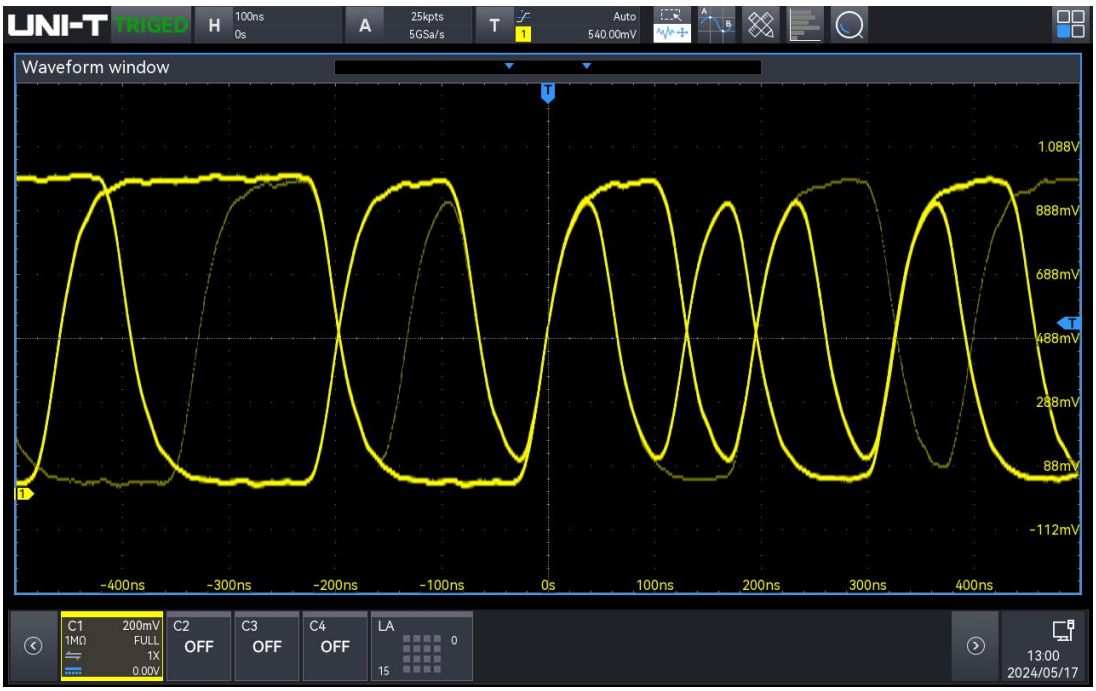
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to clock with jitter
   - A sine wave signal with a frequency of 5 MHz and an amplitude of 23 mVpp
2. Demo content
   - Demonstrate the advantage of using jitter analysis to identify jitter source
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "5 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Clock with jitter

4.2.11. Serial Data with Jitter

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to serial data with jitter
   - A sine wave signal with a frequency of 7.6 MHz and an amplitude of 480 mVpp
2. Demo content
   - Demonstrate the advantage of using jitter analysis to identify jitter source and real-time eye
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "200 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Serial data with jitter

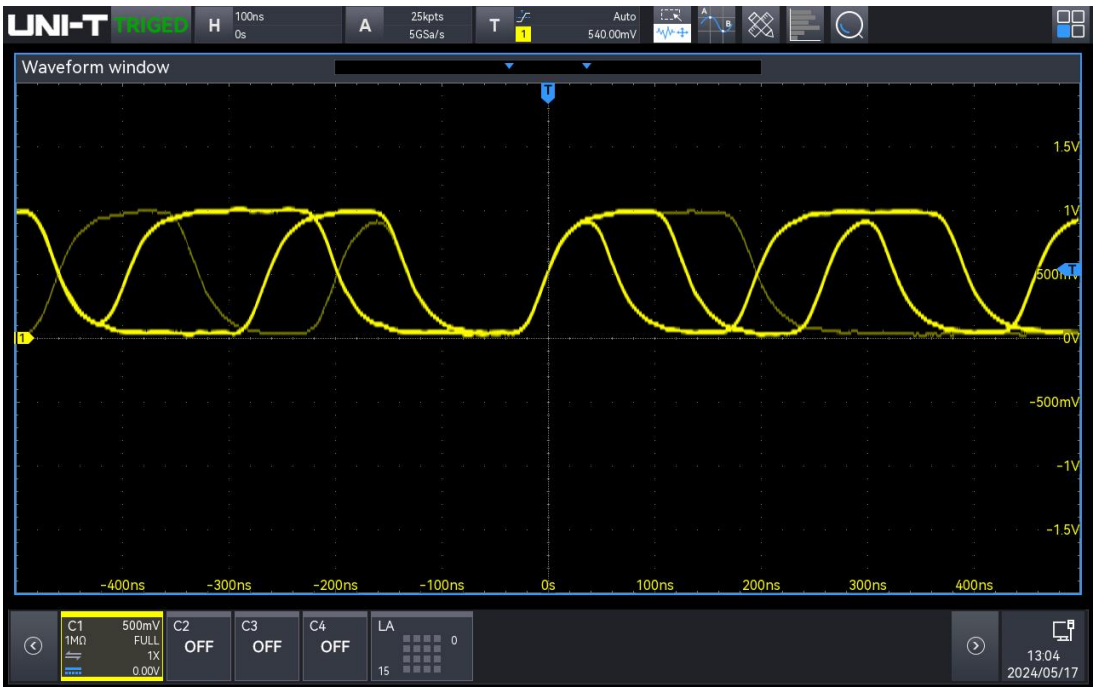
4.2.12. Runt Pulses

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to runt pulses
   - A sine wave signal with a frequency of 7.89 MHz and an amplitude of 950 mVpp
2. Demo content
   - Demonstrate the advantage of runt trigger and runt search
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "200 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.

Runt pulses

4.2.13. Edge Transition Violation Signal

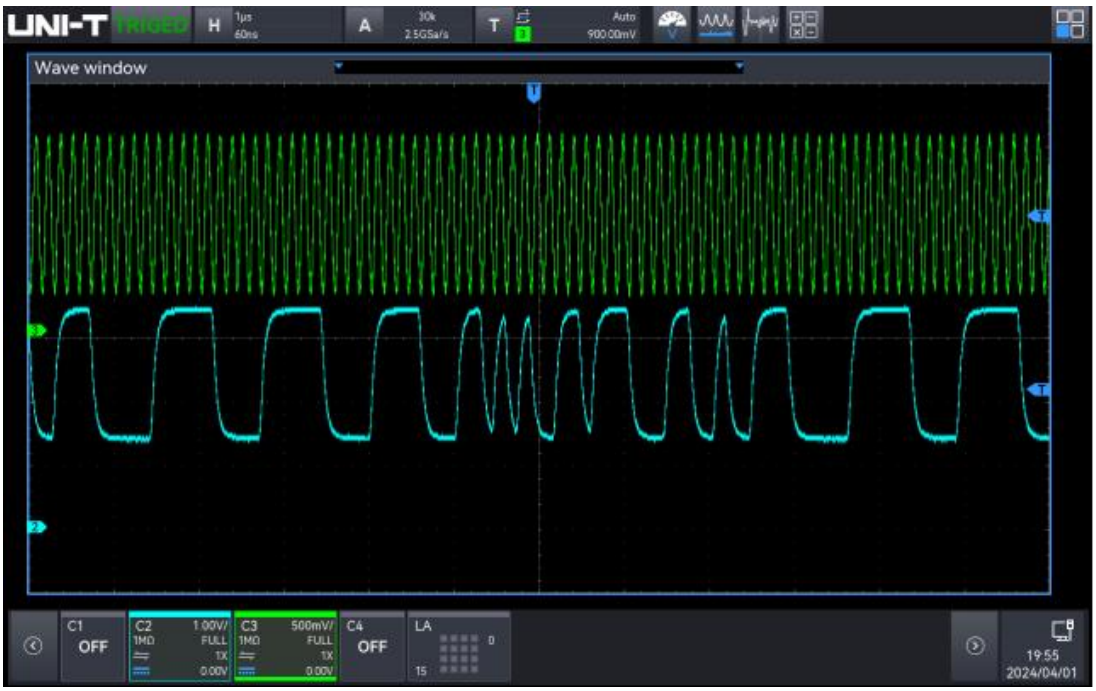
1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to edge transition violation signal
   - A sine wave signal with a frequency of 5.1 MHz and an amplitude of 950 mVpp
2. Demo content
   - Rising/falling time trigger
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger edge to "Edge trigger", the trigger mode to "Auto", and the vertical scale to "500 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Edge transition violation signal

4.2.14. Setup & Hold Signal

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) , and set the signal to setup&hold signal. CH2: Data signal; CH1: Clock signal
   - A sine wave signal with a frequency of 1 MHz and an amplitude of 1.38 Vpp
2. Demo content
   - Demonstrate the advantage of setup & hold trigger and trigger holdoff
3. Demo result
   - Use a BNC cable to correctly connect the signal, and connect CH1, CH2 output to the oscilloscope's CH2, CH3
   - Set the trigger mode to "Setup & Hold", the trigger mode to "Auto", the vertical scale to "1 V", clock source: CH2, data source: CH3, clock edge: rising edge, data type: H, setup: 1 ms, trigger hold off: 8us. Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Setup & Hold signal

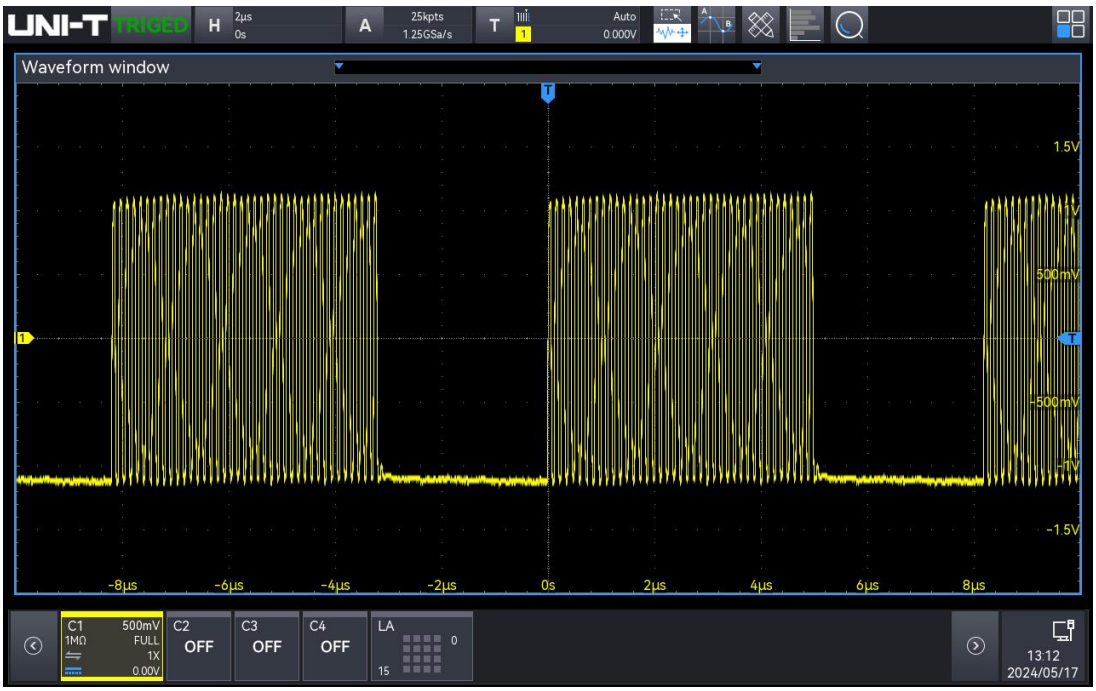
4.2.15. Non-Monotonic Edge Signal

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to non-monotonic edge signal
   - A sine wave signal with a frequency of 1 MHz and an amplitude of 1.38 Vpp
2. Demo content
   - Demonstrate the advantage of region trigger
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger mode to "Edge trigger", the trigger mode to "Auto" and the vertical scale to "1 V". Draw a region trigger box and set the condition to "Intersect", that is, only the waveform that meets condition can be triggered. Demo result is shown in the following figure.

Non-monotonic edge signal

4.2.16. Nth Edge

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to Nth edge
   - Single edge cycle: 126.03 ns, frequency: 7.93 MHz, with 40 pulse strings
2. Demo content
   - Nth edge trigger
   - Burst width, burst interval, burst cycle and burst cycle number measurements
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Set the trigger mode to "Nth edge", the trigger mode to "Auto", the vertical scale to "50 0 mV". Adjust the appropriate vertical shift and trigger level to make the oscilloscope trigger stably. Demo result is shown in the following figure.



Nth edge trigger

- Enable the measurement and statistics of burst width, burst interval, burst cycle and burst cycle number. Demo result is shown in the following figure.

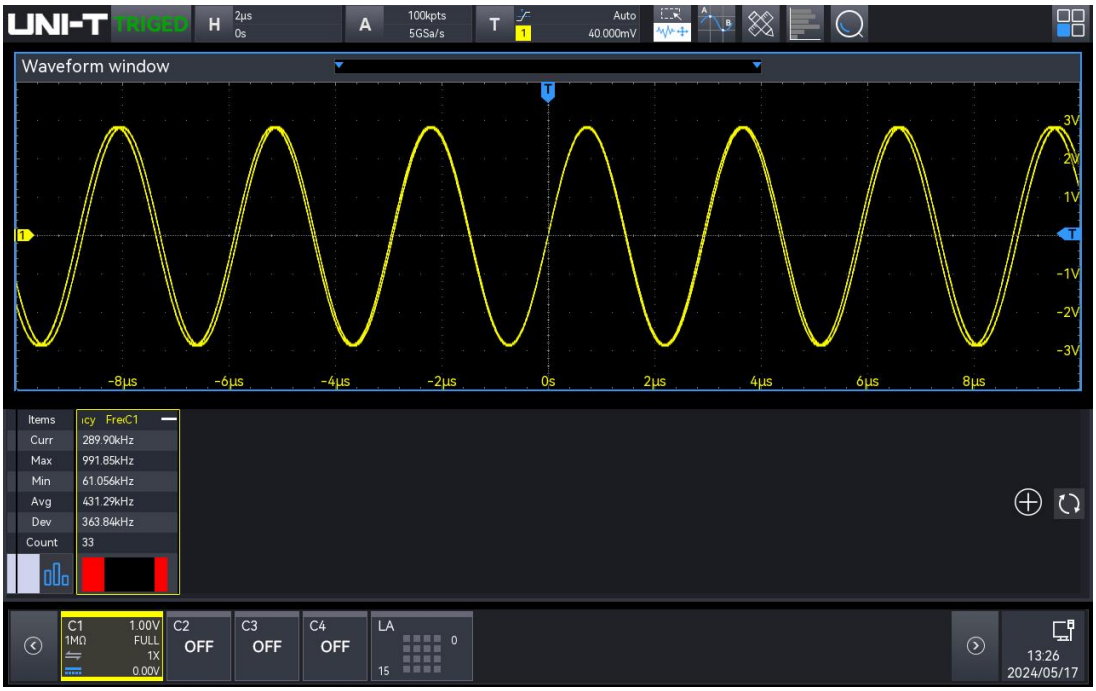
4.2.17. Fast Scan

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to fast scan
   - Frequency scanning range: 4 kHz-999 kHz, scanning time: 2.6s
2. Demo content

- Measurement statistics
- Persistence

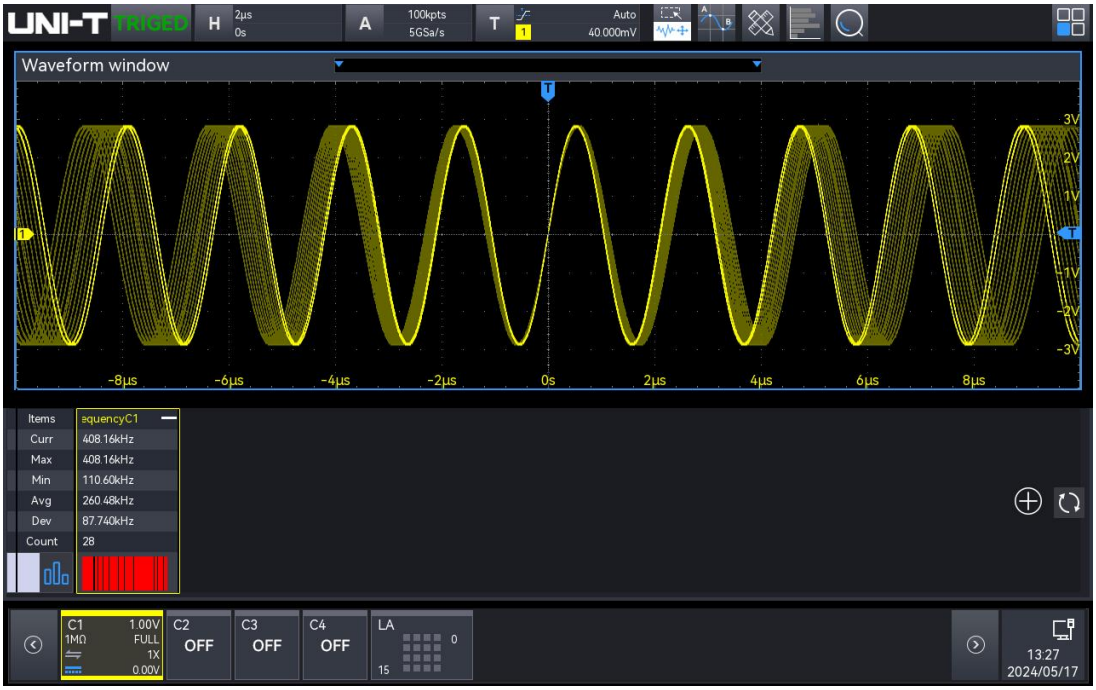
3. Demo result

- Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
- Press the AUTO key on the front panel of the oscilloscope, then the parameter will be set automatically. Enable the measurement and statistics of the frequency, use the maximum and minimum value of the statistics to determine the frequency range.



Fast scan

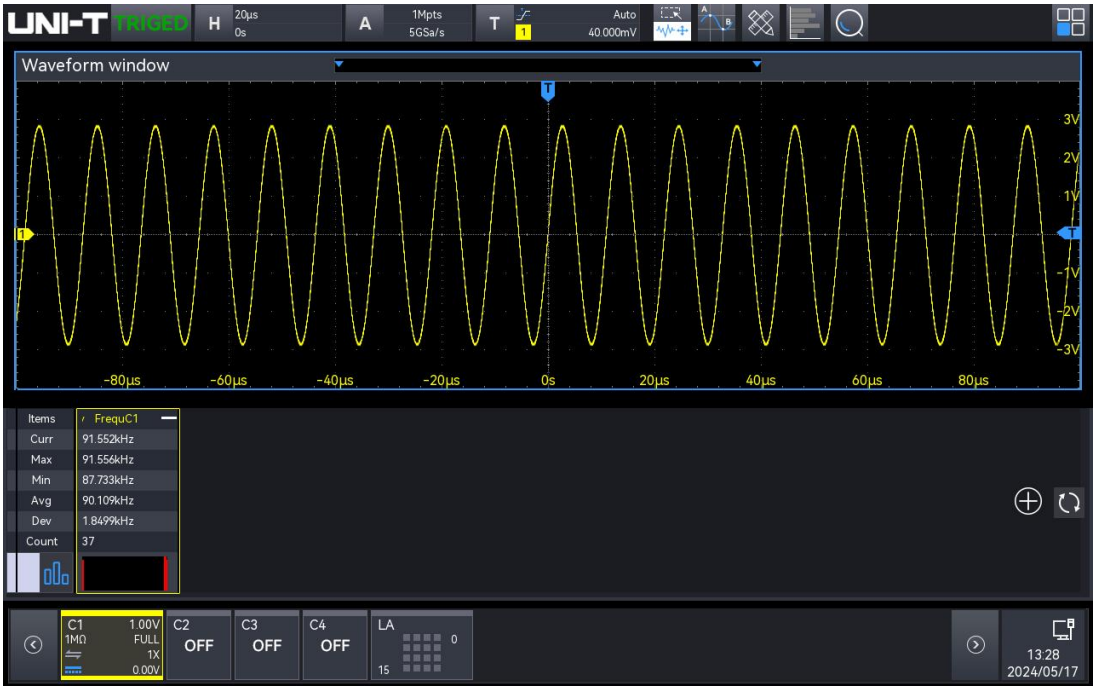
- Adjust the "Persistence" to 500 ms, as shown in the following figure. The scan trace of the sweep signal can be clearly observed.



Scan trace of fast scan

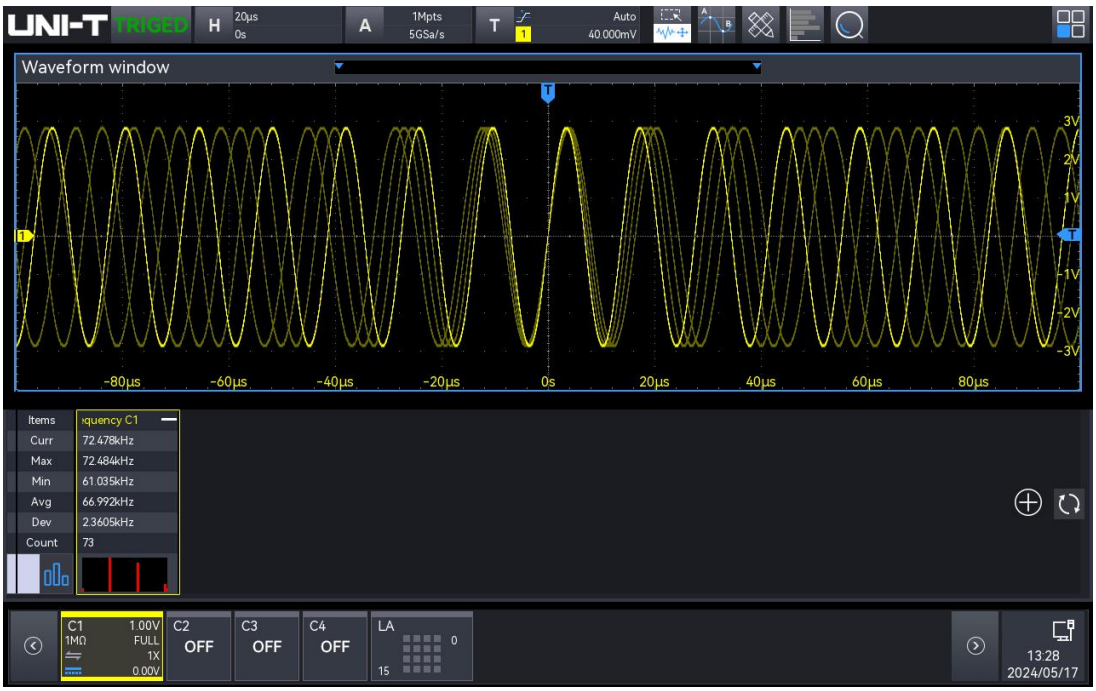
4.2.18. Slow Scan

1. Signal
   - Signal output: Select the channel for signal output (CH1 or CH2) and set the signal to slow scan
   - Frequency scanning range: 4 kHz-99 kHz, scanning time: 26s, scanning mode: logarithm
2. Demo content
   - Measurement statistics
   - Persistence
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Press the AUTO key on the front panel of the oscilloscope, then the parameter will be set automatically. Enable the measurement and statistics of the frequency, use the maximum and minimum value of the statistics to determine the frequency range, as shown in the following figure.



Slow scan

   - Adjust the "Persistence" to 20s, as shown in the following figure. The scan trace of the sweep signal can be clearly observed.

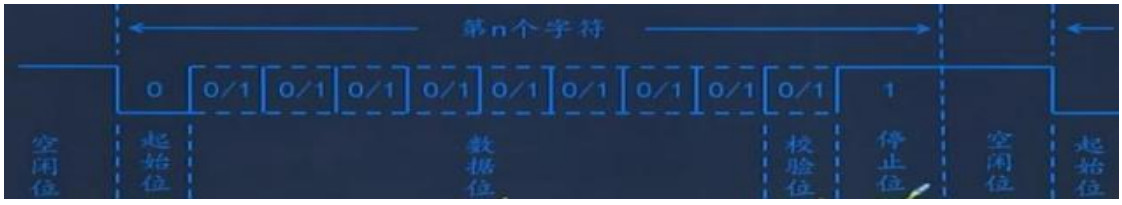


Scan trace of slow scan

4.3. Protocol Signal

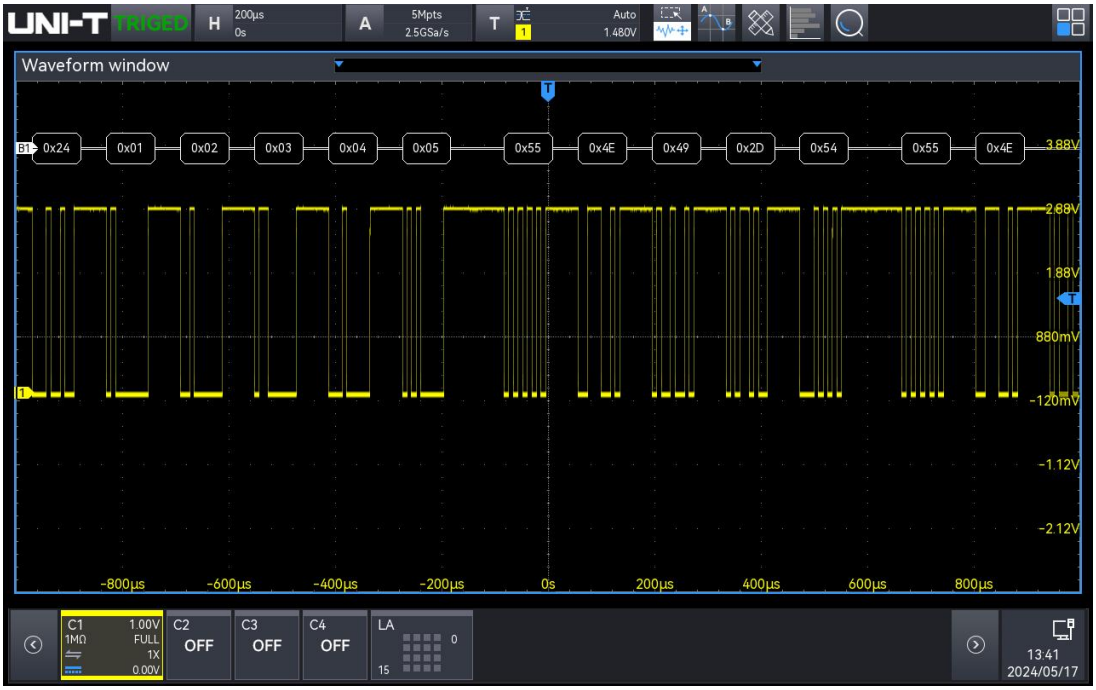
4.3.1. RS232/UART

1. Signal
   - Signal output: Select the channel for signal output （CH1-CH4）, and set the signal to UART, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - RS232/UART trigger
   - RS232/UART decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1.
   - Select UART trigger and UART decoding, the specific parameter setting, see the table below.



Type	Description
Output	CH1-CH4 , UART pin
Parameter	Baud rate: 115200 Polarity: Positive Parity check bit: No parity check bit Data bit width: 8 bits Bit sequence ： LSB
Data	Hexadecimal data: 55, 4E, 49, 2D, 54； 55, 4E, 49, 2D, 54； 55, 4E, 49, 2D, 54; 55, 4E, 49, 2D, 54, 0A； 55, 4E, 49, 2D, 54, 21 ； （15-24），01, 02, 03, 04, 05；

- Stable trigger and decoding result is shown in the following figure.

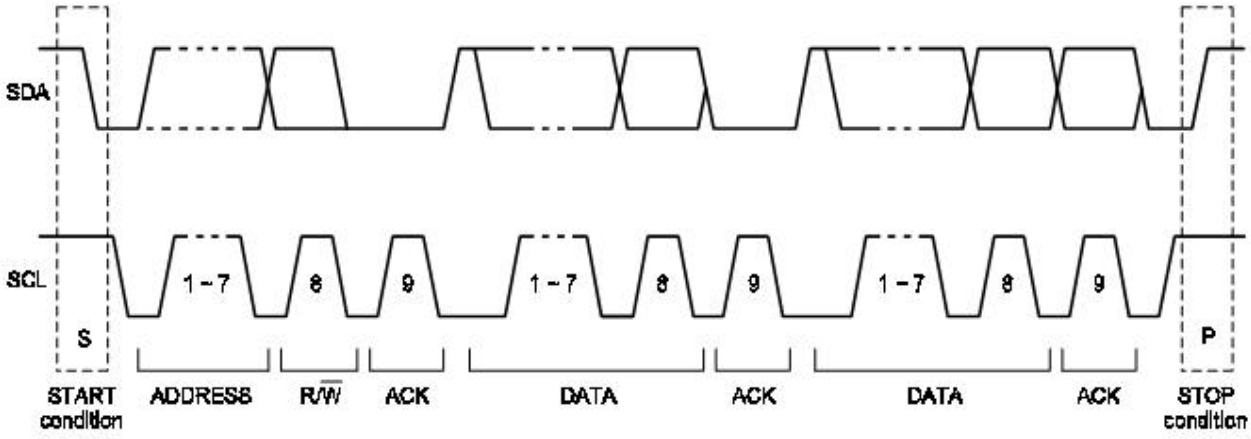


UART trigger and decoding

4.3.2. I²C

1. Signal
   - Signal output: Select the channel for signal output （CH1, CH2），and set the signal to I²C, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - I²C trigger
   - I²C decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1, CH2.

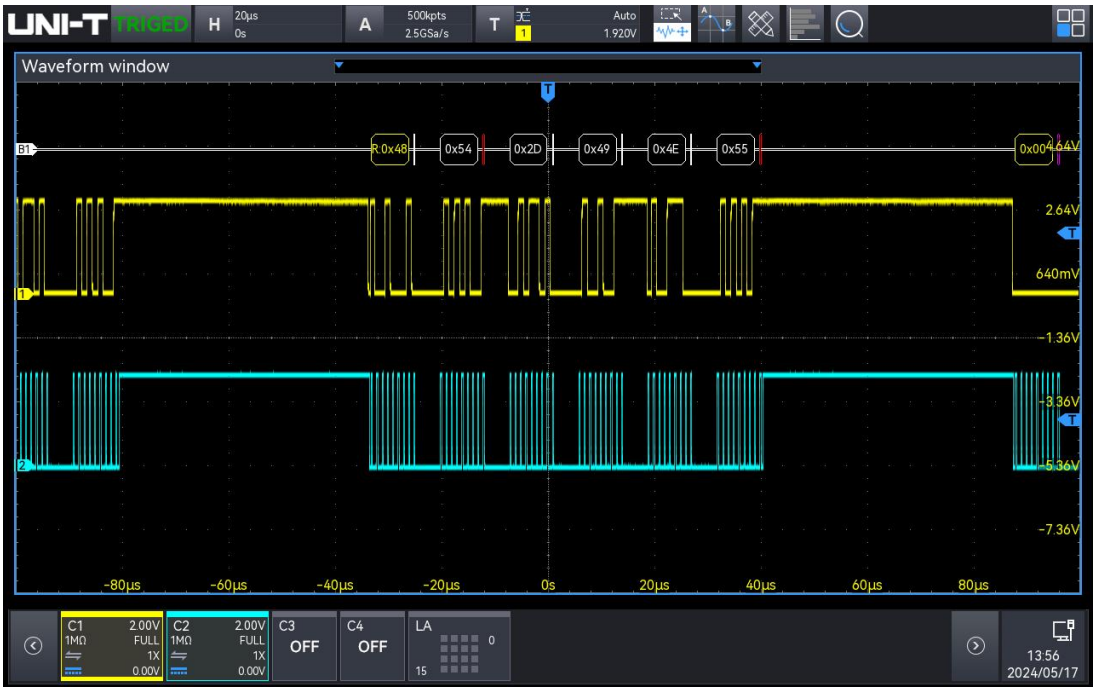
- Select I^2C trigger and I^2C decoding, the specific parameter setting, see the table below.



Type	Description
Output	CH1:SCL CH2:SDA I^2C pin
Data	7-bit address : 1001000 (48h) (the address does not include R) 10010000 (90h) (the address includes R/W) Hexadecimal data: 55, 4E, 49, 2D, 54; 7-bit address : 1001000 (48h) (the address does not include W) 10010000 (90h) (the address includes R/W) Hexadecimal data: 54, 2D, 49, 4E, 55; 7-bit address : 0000000 (00h) (the address does not include R) 00000000 (00h) (the address includes R/W) Hexadecimal data: 90, 55; 7-bit address : 0100111 (27h) (the address does not include R) 01001110 (4Eh) (the address includes R/W) Hexadecimal data: 49, 2D, 54; 7-bit address : 1111010 (7Ah) (the address does not include R) 111101010 (F5h) (the address includes R/W) Hexadecimal data: 90 ; 10-bit address : 10 1001 0000 (290h) (the address does not include W) 7-bit address : 1111010 (7Ah) (the address does not include W)

	111101010（F5h） (the address includes R/W) Hexadecimal data：55, 4E, 49, 2D, 54； 7-bit address ：1111010（7Ah） (the address does not include R) 111101010（F5h） (the address includes R/W) 10-bit address ：10 1001 0000（290h） (the address does not include R) Hexadecimal data： (90), 54, 2D, 49, 4E, 55；

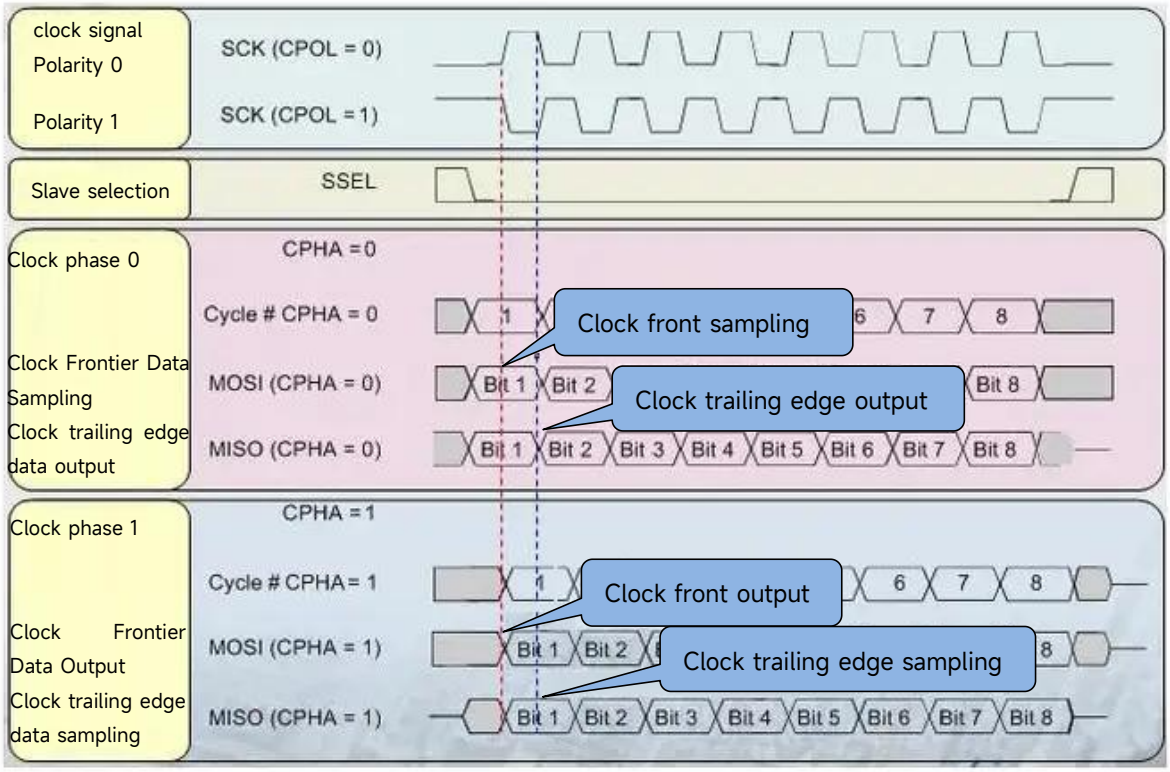
- I^2C stable trigger and decoding result is shown in the following figure.



I^2C trigger and decoding

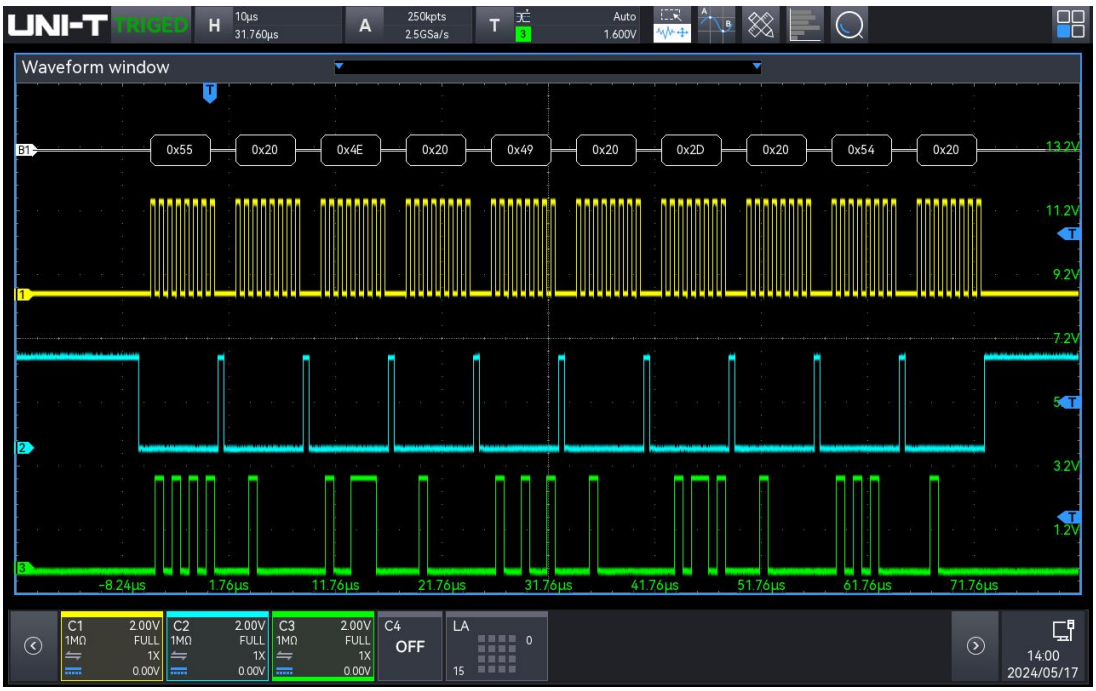
4.3.3. SPI

1. Signal
   - Signal output: Select the channel for signal output （CH1-CH3）, and set the signal to SPI, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - SPI trigger
   - SPI decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1, CH2, CH3.
   - Select SPI trigger and SPI decoding, the specific parameter setting, see the table below.



Type	Description
Output	CH1: WS CH2: SCL CH3: MOSI SPI pin
Parameter	Bit width : 8 bits Bit sequence : MSB ClK polarity : Positive WS polarity : Negative DATA polarity : Positive Trigger condition : Chip selection
Data	Hexadecimal data: MOSI: 55, 20, 4E, 20, 49, 20, 2D, 20, 54, 20;

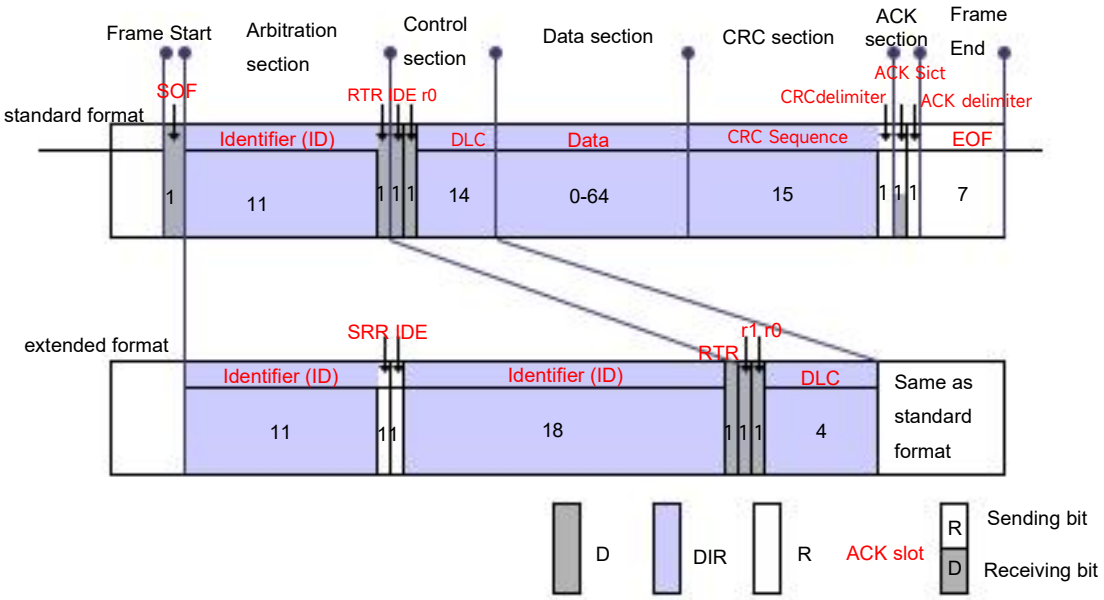
■ SPI stable trigger and decoding result is shown in the following figure.



SPI trigger and decoding

4.3.4. CAN

1. Signal
   - Signal output: Select the channel for signal output （CH2, CH3）, and set the signal to CAN, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - CAN trigger
   - CAN decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1 - CH4.
   - Select CAN trigger and CAN decoding, the specific parameter setting, see the table below.

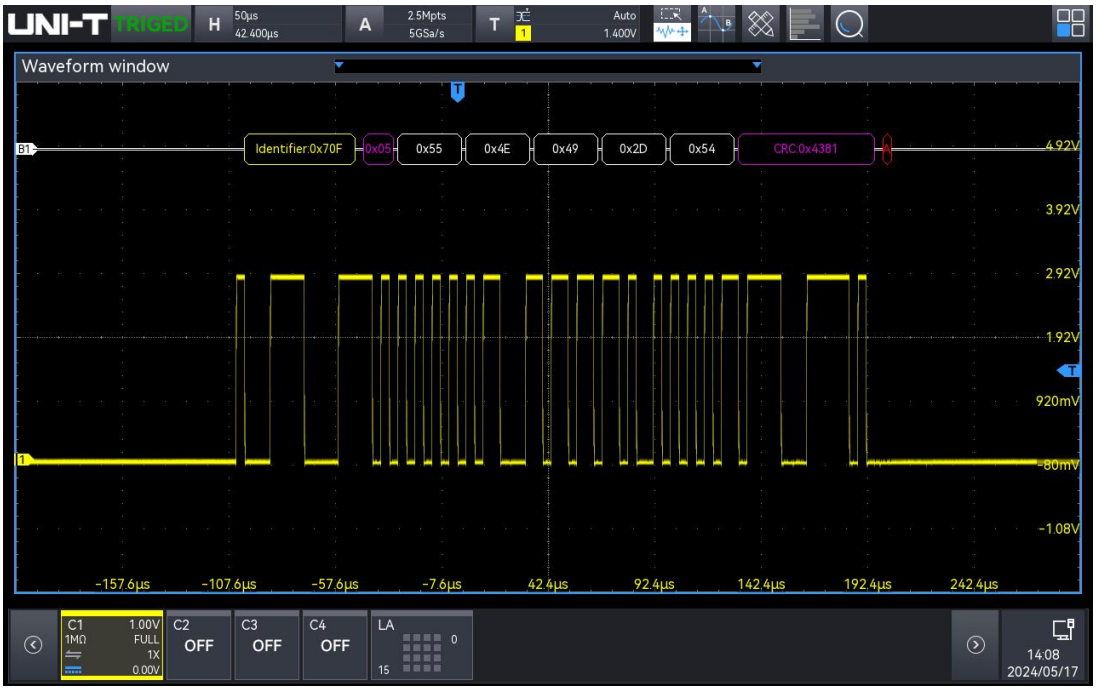


The remote frame does not have a data segment.

Type	Description
Output	CH1: CAN-L CH2: CAN-H CAN pin
Parameter	Baud rate ： 250K Signal type： CAN_L
Data	

Name	ID	DLC	DATA	CRC	ACK
Standard error frame	70F	5	55, 4E, 49, 2D, 54	4381	0
Extend data frame	1C3FF3F3	5	55, 4E, 49, 2D, 54	7261	0
Standard remote frame	70F	0	None	6BB9	1 (error)
Extend remote frame	1C3FF3F3	0	None	58BF	1 (error)
Bit filling error	ERROR				
Error frame, overload frame	E/F, O/L				

- CAN stable trigger and decoding result is shown in the following figure.



CAN trigger and decoding result

4.3.5. CAN-FD

1. Signal
   - Signal output: Select the channel for signal output （CH1-CH4）, and set the signal to CAN-FD, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - CAN-FD trigger
   - CAN-FD decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1 - CH4.
   - Select CAN-FD trigger and CAN-FD decoding, the specific parameter setting, see the table below.

Type	Description
Pin	CH1: CANFD-L CANFD pin
Parameter	CAN baud rate: 500K FD baud rate: 5M Signal type: CANFD_L Sampling point: 75%

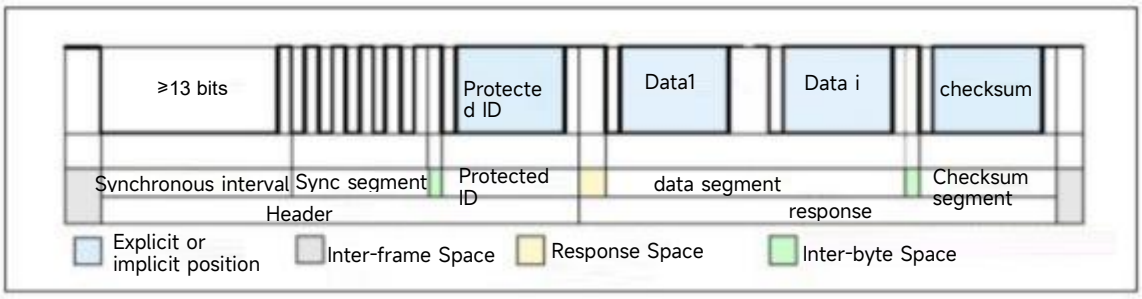
Name	ID	DLC	DATA	CRC	ACK
FD standard data frame	70F	5	55, 4E, 49, 2D, 54	0381	0

- CAN stable trigger and decoding result is shown in the following figure.

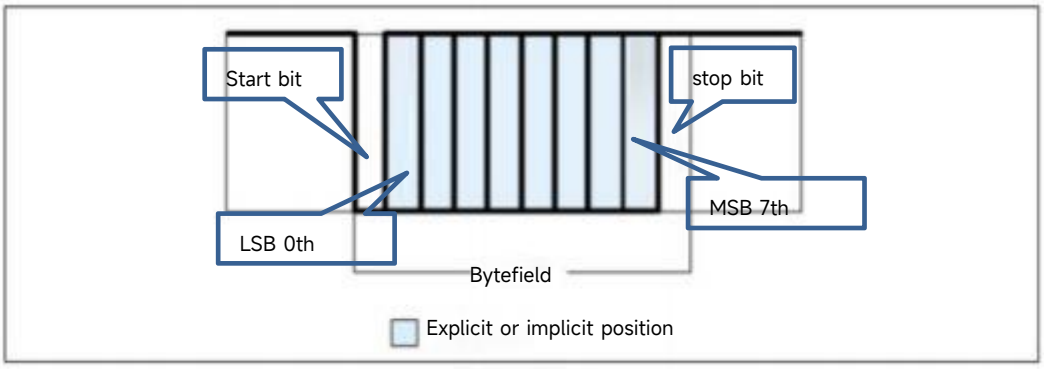
CAN-FD trigger and decoding

4.3.6. LIN

1. Signal
   - Signal output: Select the channel for signal output （CH1, CH2）, and set the signal to LIN, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - LIN trigger
   - LIN decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1 - CH4.
   - Select LIN trigger and LIN decoding, the specific parameter setting, see the table below.



Frame structure



Type	Description
Pin	CH1: LIN-L LIN pin
Parameter	Baud rate: 20K Signal type: LIN_L Polarity: Normal
Data	

Name	SYNC	ID	DATA	CHECKSUM
Wake up frame				
Sleep frame	55	3C	00, FF, FF, FF, FF, FF, FF, FF	54 (error)
Sync error	15 (error)	20/B0 (error)	55, 4E, 49, 2D, 54, 54, 54, 58	DF (V2.X)
Data	55	30/B0 (error)	55, 4E, 49, 2D, 54, 54, 54, 58	90DF (V1.X)

Data	55	30/B0 (error)	55, 4E, 49, 2D, 54, 54, 54, 58	DF
Data	55	30/B0 (error)	55, 4E, 49, 2D, 54, 54, 54, 58	DF

- LIN stable trigger and decoding result is shown in the following figure.

LIN trigger and decoding

4.3.7. FlexRay

1. Signal
   - Signal output: Select the channel for signal output (CH1, CH2), and set the signal to FlexRay, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - FlexRay trigger
   - FlexRay decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1 - CH4.
   - Select FlexRay trigger and FlexRay decoding, the specific parameter setting, see the table below.

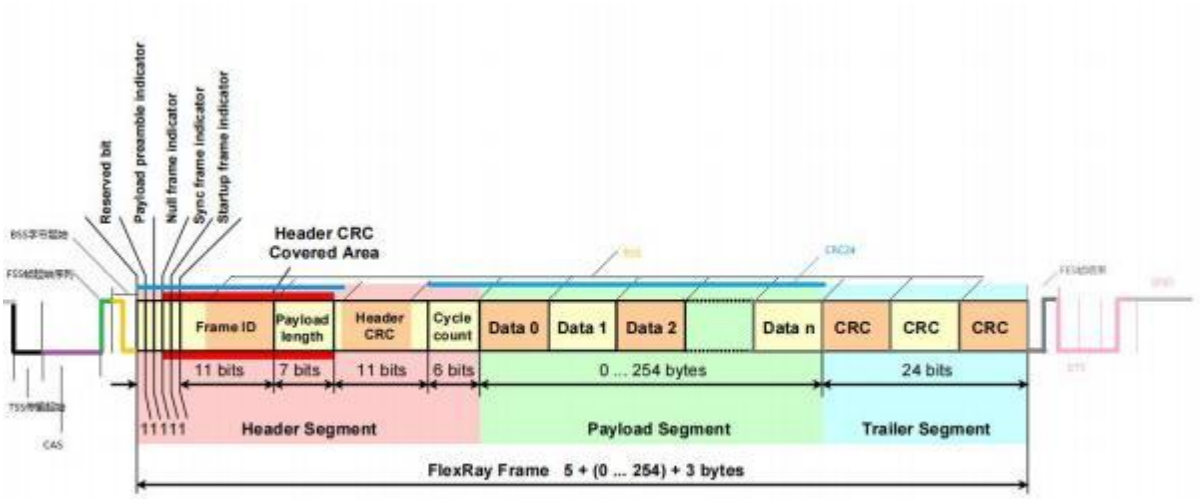
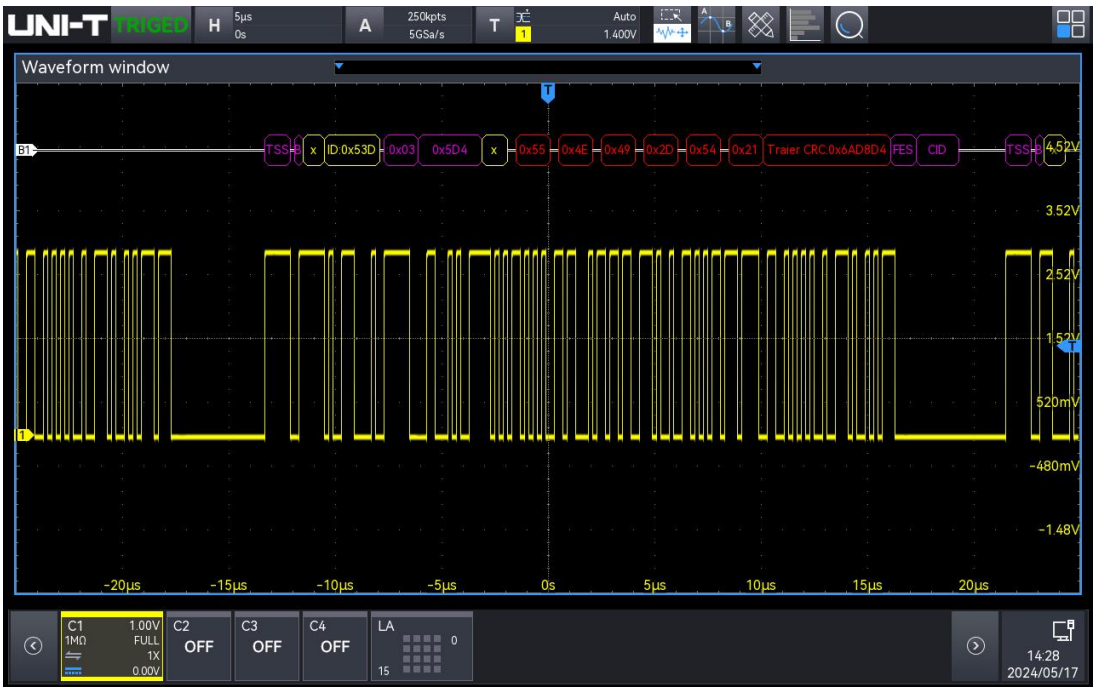


Figure 4-1: FlexRay frame format.

Type	Description
Output	CH1: FLEXRAY-BP CH2: FLEXRAY-BM FLEXRAY pin
Parameter	Baud rate: 5M Signal type: FLEXRAY_BP
Data	

Name	Indicating bit	ID	LENGTH / dlc	HCRC	CYCLE	DATA	TCRC
Normal	4	53D	3	5D4	A	55, 4E, 49, 2D, 54, 21	6AD8D4 (error)
Payload	C	53D	3	5D4	A	55, 4E, 49, 2D, 54, 21	6AD8D4 (error)
Null frame dynamic	0	53D	3	5D4	A	00, 00, 00, 2D, 54, 21	6AD8D4 (error)
Null frame static	0	53D	3	5D4	A	55, 4E, 49, 2D, 54, 21	6AD8D4 (error)
Start, sync	7	53D	3	5E8 (error)	A	55, 4E, 49, 2D, 54, 21	8142d4 (error)
Start no sync	5	53D	3	5D4 (error)	A	55, 4E, 49, 2D, 54, 21	95d86d (error)

- FlexRay stable trigger and decoding result is shown in the following figure.

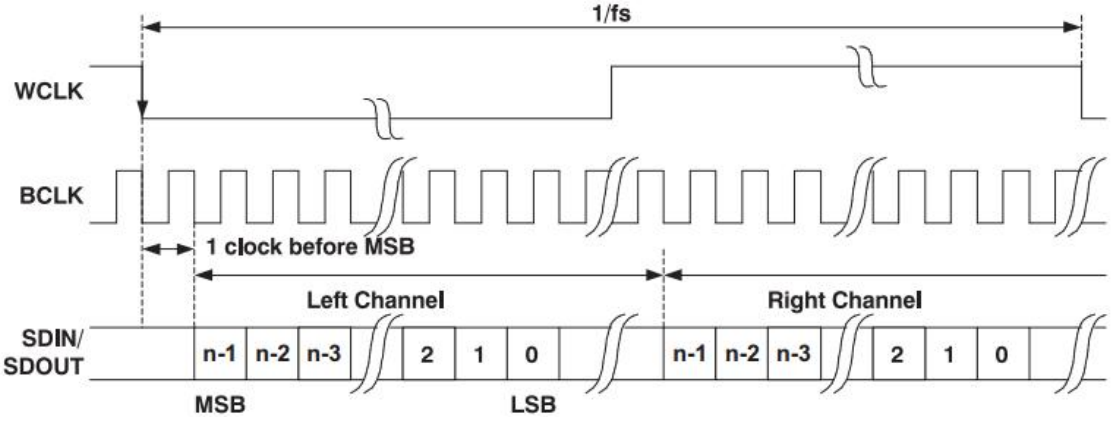


FlexRay trigger and decoding

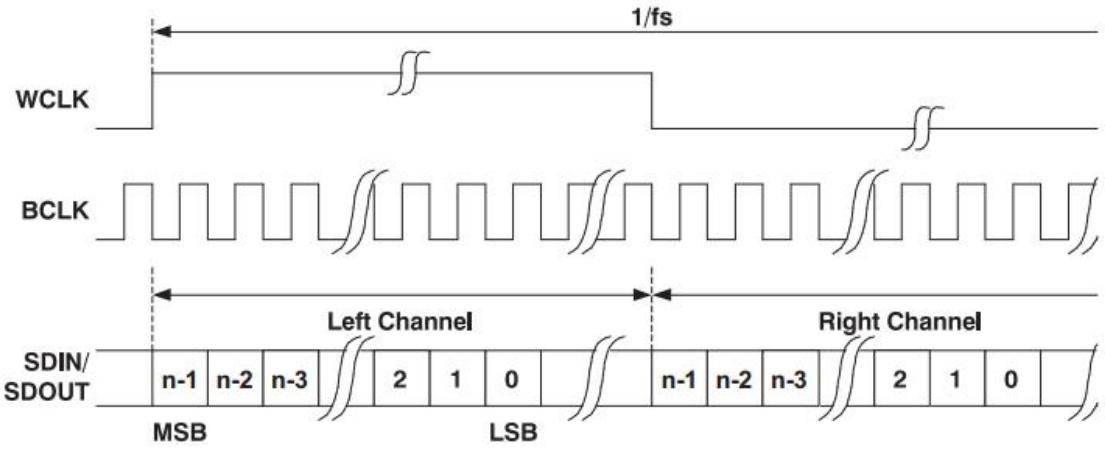
4.3.8. I2S/LJ/RJ/TDM

1. Signal
   - Signal output: Select the channel for signal output （CH1 ~ CH3）, and set the signal to I2S, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - I2S trigger
   - I2S decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1, CH2, CH3.
   - Select I2S trigger and I2S decoding, the specific parameter setting, see the table below.

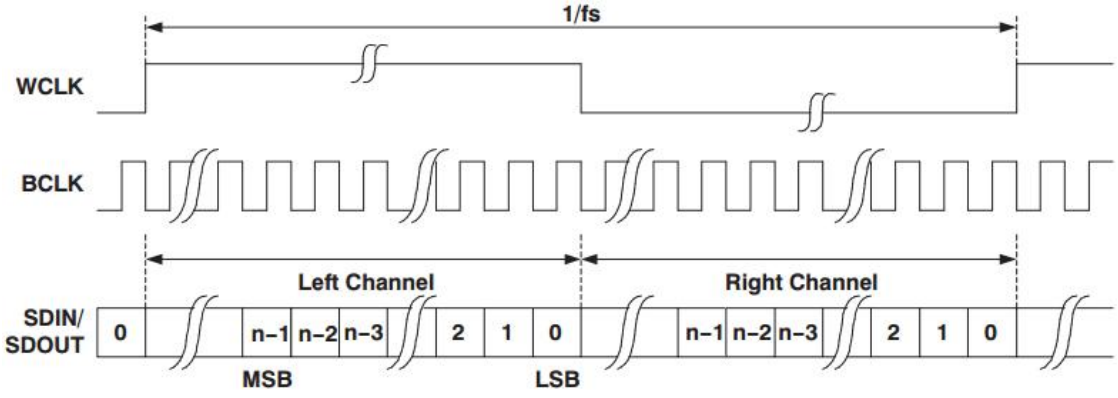
I2S standard format



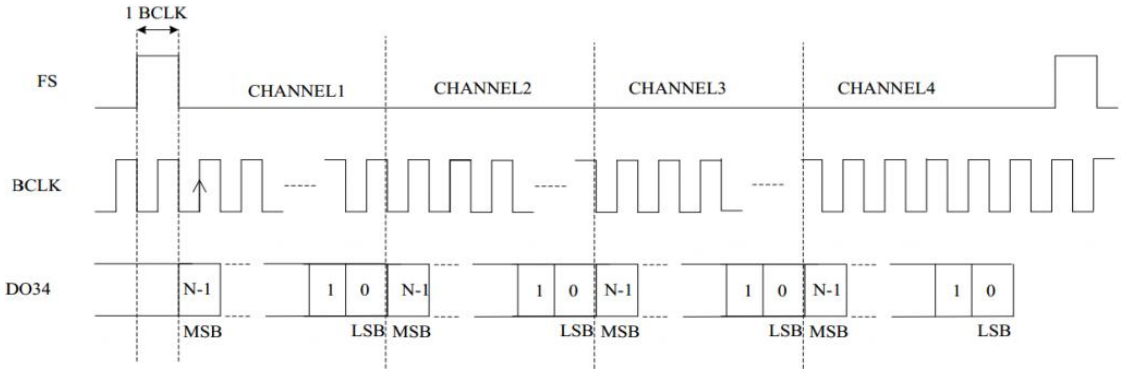
Left justifying



Right justifying



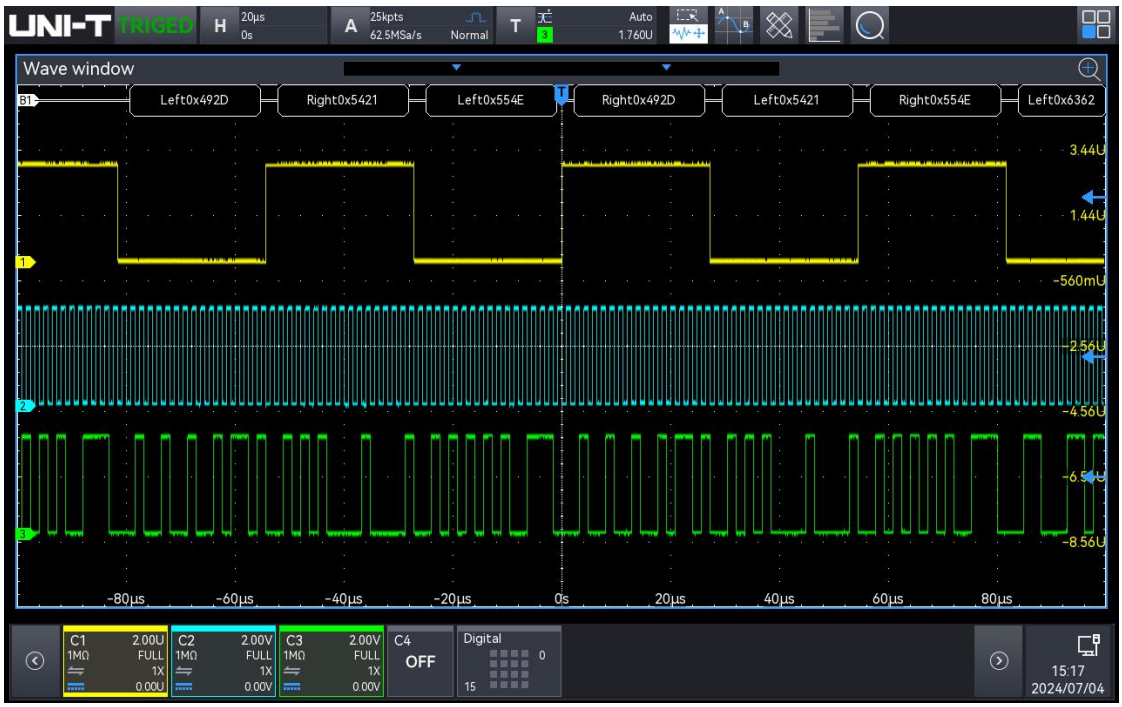
TDM



Type	Description
Output	CH1: WS CH2: SCL CH3: SDA I2S pin
Parameter	I2S:

	Bit size : 16 bits Bit clock : Rising edge WS Polarity : Normal Data : High=1 Bit sequence : MSB LJ/ RJ: Bit size : 16 bits Bit clock : Rising edge WS Polarity: Normal Data : High=1 Bit sequence : MSB
	TDM: Data bit per channel: 16 bits Clock bit per channel: 16 bits Channel per frame : 4 Bit delay : 0 bit Bit clock : Rising edge Sync polarity : Rising edge Data : High=1 Bit sequence : MSB
Data	**I2S:** 554E_492D_5421_554E_492D_5421_554E_6362_6160; **LJ:** 554E_492D_5421_554E_492D_5421_554E_6766_6564; **RJ:** 554E_492D_5421_554E_492D_5421_554E_7170_6968; **TDM:** 554E_492D_5421_554E_492D_5421_554E_7574_7372;

- I2S stable trigger and decoding result is shown in the following figure.



I2S trigger and decoding

4.3.9. MIL-STD-1553B

1. Signal
   - Signal output pin: MIL-STD-1553B
2. Demo content
   - 1553B trigger
   - 1553B decoding
3. Demo result
   - Use a probe to correctly connect the signal output pin 1553B and GND to the oscilloscope's CH1.
   - Select 1553B trigger and 1553B decoding, the specific parameter setting, see the table below.

Note: Set the display format to check the specific data

Type	Description
Output	CH1-CH4: not supported 1553 pin
Parameter	Polarity: Positive When the format is command character, the decoded data will be all the command characters. The state character is the same. When the block control is Data block, the format is valid and there is no distinction between command words and status words.
Data	

Name	RT Address (hex)	T/R Bit	Sub address (hex)	Word Count (hex)	Data (hex)	Status data
Cmd	0x16	0	0x0D	0x03		
Data					554E	
Data					492D	
Data					5421	
Status	0x16					000-000-00000
Cmd	0x16	0	0x0D	0x03		
Data					554E	
Data					492D	
Data					5421	
Status	0x16					000-000-00000
Cmd	0x16	1	0x0D	0x05		
Data					554E	
Data					492D	
Data					5421	
Status	0x16					000-000-01010
Cmd	0x00	1	0x0D	0x13		
Cmd	0x16	0	0	0x00		
Data					554E	
Data					492D	
Data					5421	
Cmd	0x06	0	0x0D	0x03		
Cmd	0x00	1	0x0D	0x06		
Cmd	0x16	0	0x05	0x00		
Data					554E	
Status	0x16					000-000-00000
Cmd	0x00	1	0x01	0x00		
Cmd	0x16	0	0x00	0x00		

Cmd	0	1	0x03	0x13		
Cmd	0x00	0	0x00	0x00		
Data					554E	
Cmd	0x00	0	0x07	0x11		
Data					5544	
Cmd	0x16	0	0x00	0x00		

■ 1553B data stable trigger and decoding result is shown in the following figure.

1553B data trigger and decoding

Name	Payload (block hex) (combined data and regardless of type)
C/S	B1A3
Data	554E
Data	492D
Data	5421
C/S	B000
C/S	B1A3
Data	154E
Data	492D
Data	5421
C/S	B000
C/S	B5A5
Data	554E
Data	492D
Data	5421
C/S	B00A
C/S	05B3
C/S	B000
Data	554E
Data	492D
Data	5421
C/S	1200
C/S	1200
C/S	1210
Data	554E
C/S	B020
C/S	0420
C/S	B000
C/S	0473
C/S	B000
Data	554E
C/S	00F1
Data	5544
C/S	B000

- 1553B data block stable trigger and decoding result is shown in the following figure.

1553B data block trigger and decoding

4.3.10. SENT

1. Signal
   - Signal output: Select the channel for signal output （CH1-CH4）, and set the signal to SENT, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - SENT trigger
   - SENT decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1 - CH4.
   - Select SENT trigger and SENT decoding, the specific parameter setting, see the table below.

Type	Description
Output	CH1-CH4 , SENT pin
Parameter	Clock cycle ： 3 us Tolerance ： 30% Half byte ： 6 Pause mode ： ON
Data	

STATUS (hex)	DATA (hex)	CRC (hex)	POUSE (hex/ ticks)	STATUS: (slow speed) bit3, bit2	
Fast mode				Slow mode	
0x0C	5,5,4,E,4,9	0x02	0x15	2'b11	Short ID: 4'h A
0x00	5,5,4,E,4,9	0x02	0x21	2'b00	
0x04	5,5,4,E,4,9	0x02	0x1D	2'b01	
0x00	5,5,4,E,4,9	0x02	0x21	2'b00	
0x00	5,5,4,E,4,9	0x02	0x21	2'b00	Short data: 8'h 4E
0x04	5,5,4,E,4,9	0x02	0x1D	2'b01	
0x00	5,5,4,E,4,9	0x02	0x21	2'b00	
0x00	5,5,4,E,4,9	0x02	0x21	2'b00	
0x04	5,5,4,E,4,9	0x02	0x1D	2'b01	
0x04	5,5,4,E,4,9	0x02	0x1D	2'b01	
0x04	5,5,4,E,4,9	0x02	0x1D	2'b01	
0x00	5,5,4,E,4,9	0x02	0x21	2'b00	
0x04	5,5,4,E,4,9	0x02	0x1D	2'b01	Short crc: 4'h D
0x04	5,5,4,E,4,9	0x02	0x1D	2'b01	
0x00	5,5,4,E,4,9	0x02	0x21	2'b00	
0x04	5,5,4,E,4,9	0x02	0x1D	2'b01	
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	B Long crc: 6'h 05
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x00	5,5,4,E,4,9	0x02	0x21	2'b00	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	B Long id: 4'h 9
0x04	5,5,4,E,4,9	0x02	0x1D	2 'b01	
0x00	5,5,4,E,4,9	0x02	0x21	2 'b00	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x00	5,5,4,E,4,9	0x02	0x21	2 'b00	B Long data: 16'h 554E
0x00	5,5,4,E,4,9	0x02	0x21	2 'b00	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x04	5,5,4,E,4,9	0x02	0x1D	2 'b01	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	

0x00	5,5,4,E,4,9	0x02	0x21	2 'b00	
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	A Long crc: 6'h 05
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x00	5,5,4,E,4,9	0x02	0x21	2 'b00	
0x04	5,5,4,E,4,9	0x02	0x1D	2 'b01	
0x08	5,5,4,E,4,9	0x02	0x19	2 'b10	A Long id: 8 'h 95
0x04	5,5,4,E,4,9	0x02	0x1D	2 'b01	
0x00	5,5,4,E,4,9	0x02	0x21	2 'b00	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x00	5,5,4,E,4,9	0x02	0x21	2 'b00	
0x00	5,5,4,E,4,9	0x02	0x21	2 'b00	A Long data: 12 'h 54E
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x04	5,5,4,E,4,9	0x02	0x1D	2 'b01	
0x0C	5,5,4,E,4,9	0x02	0x15	2 'b11	
0x00	5,5,4,E,4,9	0x02	0x21	2 'b00	

■ SENT stable trigger and decoding result is shown in the following figure.

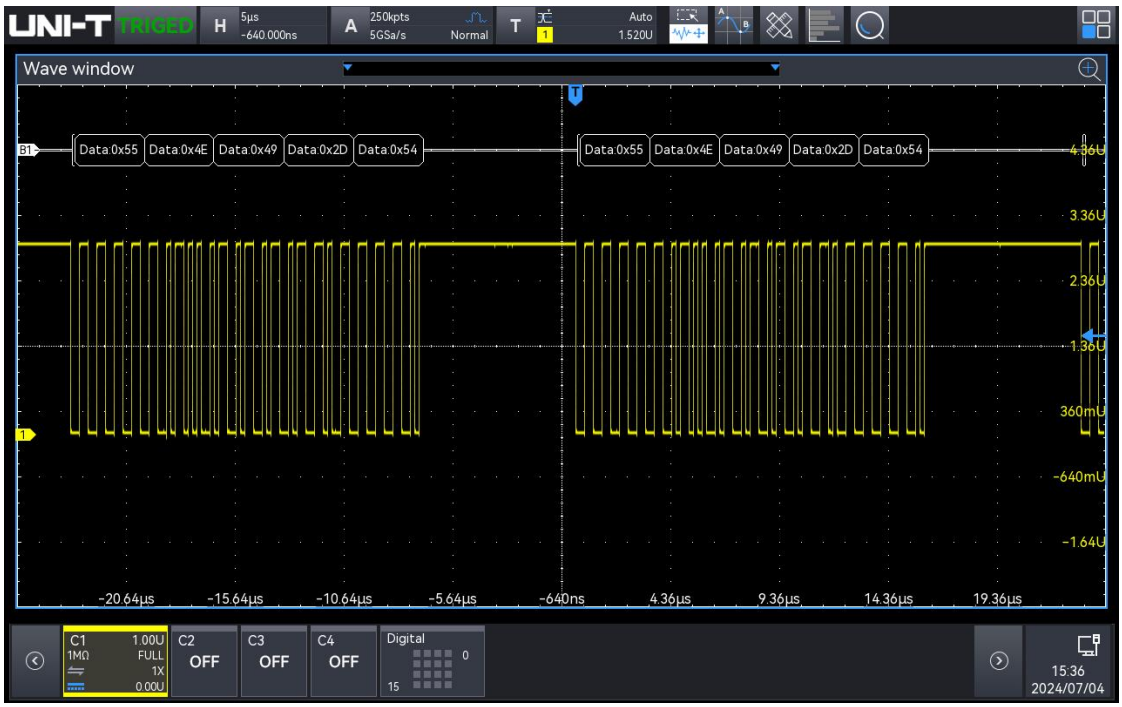
SENT trigger and decoding

4.3.11. MANCHESTER

1. Signal
   - Signal output: Select the channel for signal output （CH1-CH4）, and set the signal to Manchester, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
2. Demo content
   - Manchester trigger
   - Manchester decoding
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1 - CH4
   - Select Manchester trigger and Manchester decoding, the specific parameter setting, see the table below.

Type	Description
Output	CH1-CH4 MANCHESTER pin
Parameter	Baud rate: 2.5M Encode mode=: G.E Idle state=: 1 Bit sequence: MSB Start frame bit: 1 Sync segment: 0 Middle segment 1: 0 Header segment: 0 Middle segment 2: 0 Data bit: 5 Data word size: 8 Middle segment 3: 0 Tail segment: 0 Interval frame: 5
Data	Binary system: 01010101, 01001110, 101001001, 00101101, 01010100 Hexadecimal system: 55, 4E, 49, 2D, 54

   - Manchester stable trigger and decoding result is shown in the following figure.



Manchester trigger and decoding

4.3.12. ARINC429

1. Signal
   - Signal output pin: ARINC429
2. Demo content
   - ARINC429 trigger
   - ARINC429 decoding
3. Demo result
   - Use a probe to correctly connect the signal output pin (ARINC429), and output to the oscilloscope's CH1-CH4.
   - Select ARINC429 trigger and ARINC429 decoding, the specific parameter setting, see the table below.

Type	Description
Output	ARINC429 pin
Parameter	Baud rate: 100k
Data	

Label (OCT hexadecimal)	SDI (LSB)	Data (LSB)	SSM (LSB)	P	Type
8'O 115	2'b00	19'H00002	2'b00	0	Normal
8'O 112	2'b10	19'H000A6	2'b00	0	Check error
8'O 111	2'b00	19' H2369B	2'b00	0	Normal
					Bit error
8'O 076	2'b00	19' H00041	2'b00	0	Normal
					GAP error

- ARINC429 stable trigger and decoding result is shown in the following figure.

ARINC429 trigger and decoding

4.4. Video Signal

4.4.1. Video Trigger Signal

1. Signal
   - Signal output: Select the channel for signal output CH3, and select "Video" to set the video format, and then output the signal to the oscilloscope.
2. Demo content
   - Video trigger
3. Demo result
   - Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1 - CH4.
   - Select the video trigger, the specific parameter setting, see the table below.

Type	Description	
Output	Channel 4	
Supported format	0:PAL	8:720p (24 Hz)
	1:NTSC	9:1035i (60 Hz)
	2:525p (60 Hz)	10:1080i (30 Hz)
	3:625p (50 Hz)	11:1080i (25 Hz)
	4:720p (60 Hz)	12:1080p (30 Hz)
	5:720p (50 Hz)	13:1080p (25 Hz)
	6:720p (30 Hz)	14:1080p (24 Hz)
	7:720p (25 Hz)	15:1080Psf (24 Hz)

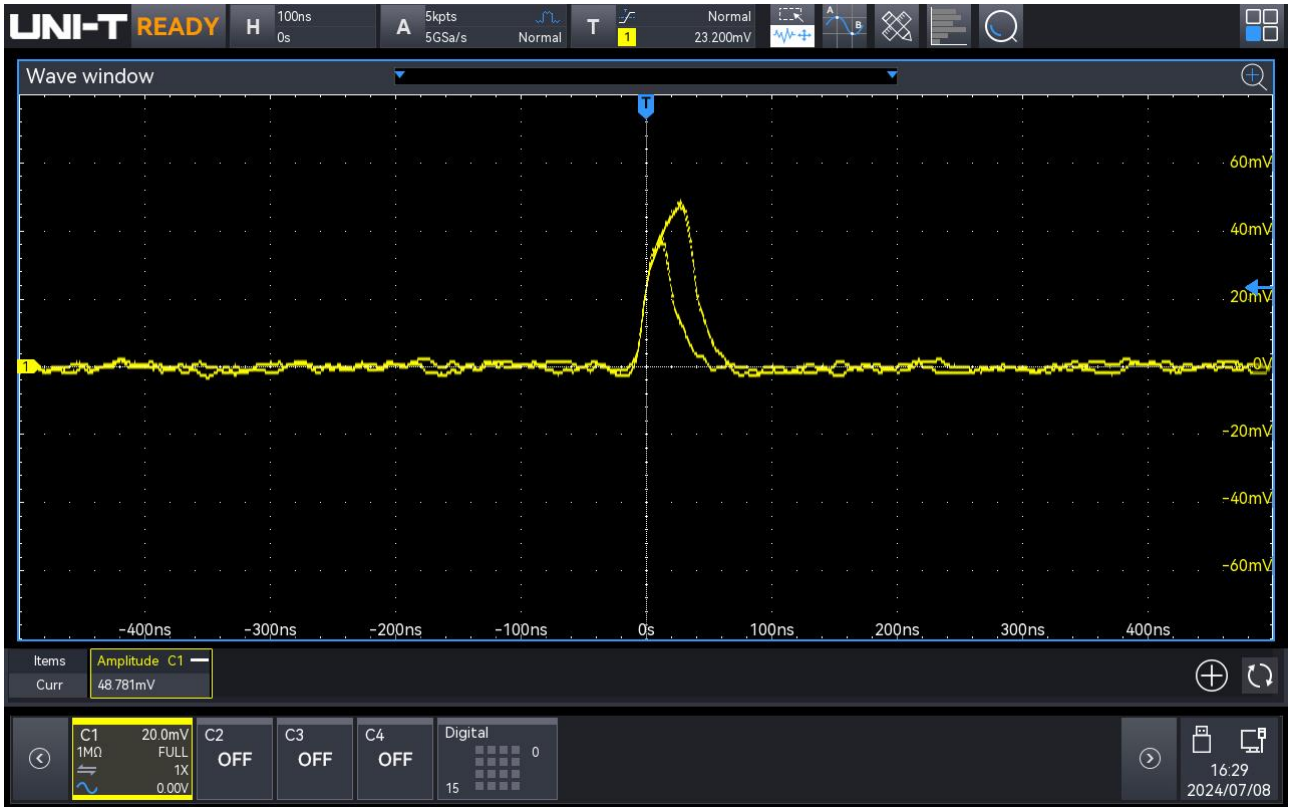
- The stable video trigger result is shown in the following figure (take PAL as an example).

Video signal

4.5. Capture Rate

1. Signal
   - Signal output: Select the channel for signal output （CH1, CH2）, select "Capture rate" and the output signal frequency, connect to the channel as indicated on the panel and output the signal to the oscilloscope.
   - A single double-pulse signal can only be triggered by pressing the CAPTURE RATE key on the front panel of the demo board.
2. Demo content
   - Test the capture rate of the oscilloscope
3. Demo result

- Use a BNC cable to correctly connect the signal output to the oscilloscope's CH1 - CH4. Select "Point", "Single channel", "Auto storage depth", "Volt/div 20 mV", "Trigger mode: normal". Press the CAPTURE RATE key on the front panel of the demo board, the oscilloscope captures the double-pulse signal, i.e. the frequency of input signal is the capture rate of the test.



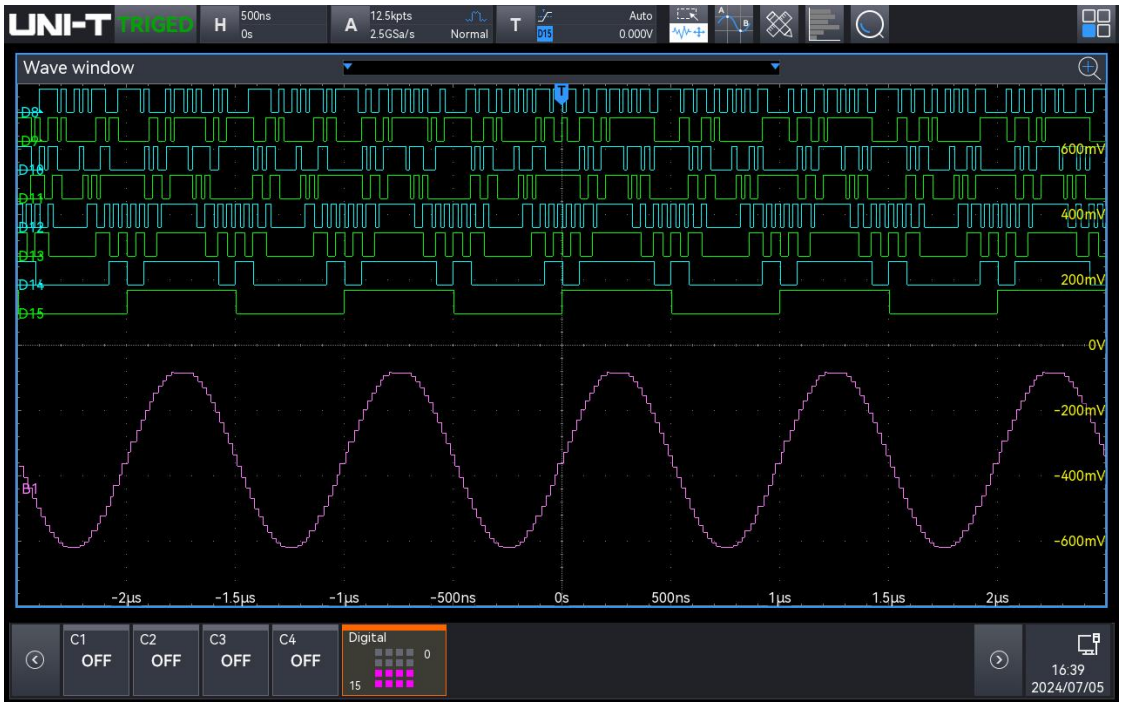
4.6. LA Test Signal

Type	Description
Pin	LA pin
Wave	7 waves: Sine wave, square wave, triangular wave, sawtooth wave, ASK, PSK, and FSK
	Frequency: 1 M, 1.25 M, 1.5 M, 1.75 M, 2 M, 2.25 M, 2.5 M, 2.75 M, 3 M, 3.25 M, 3.75 M, 4 M, 4.25 M, 4.5 M, 4.75 M
Protocols	UART, I2C, SPI, CAN_L, CANFD_L, LIN, FlexRay_BP, I2S, Manchester, SENT

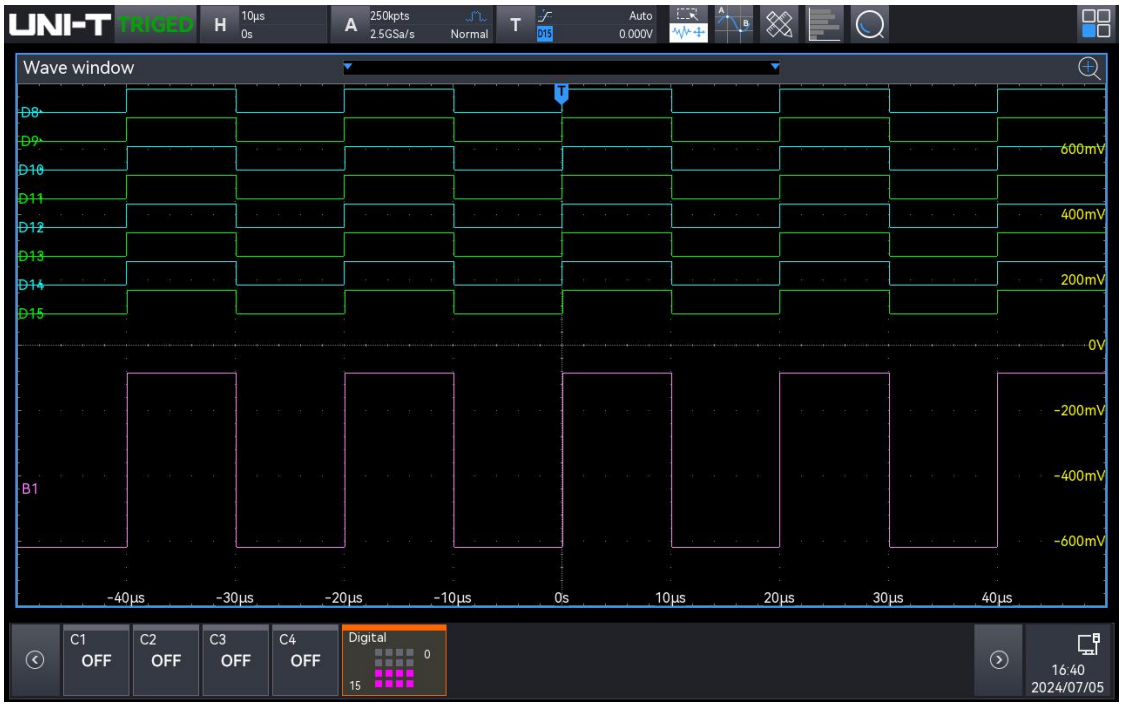
When LA accesses the protocol signals, please follow the name at ALL PROTOCOLS on the demo board, wire and set the signals correctly to output the correct protocol signals. Note: If there are glitches, please adjust the jitter suppression. If the configuration is correct and the waveform is messy, please adjust the time base.

LA different waveforms demo result is shown the following figure, take frequency: 1 M for an example.

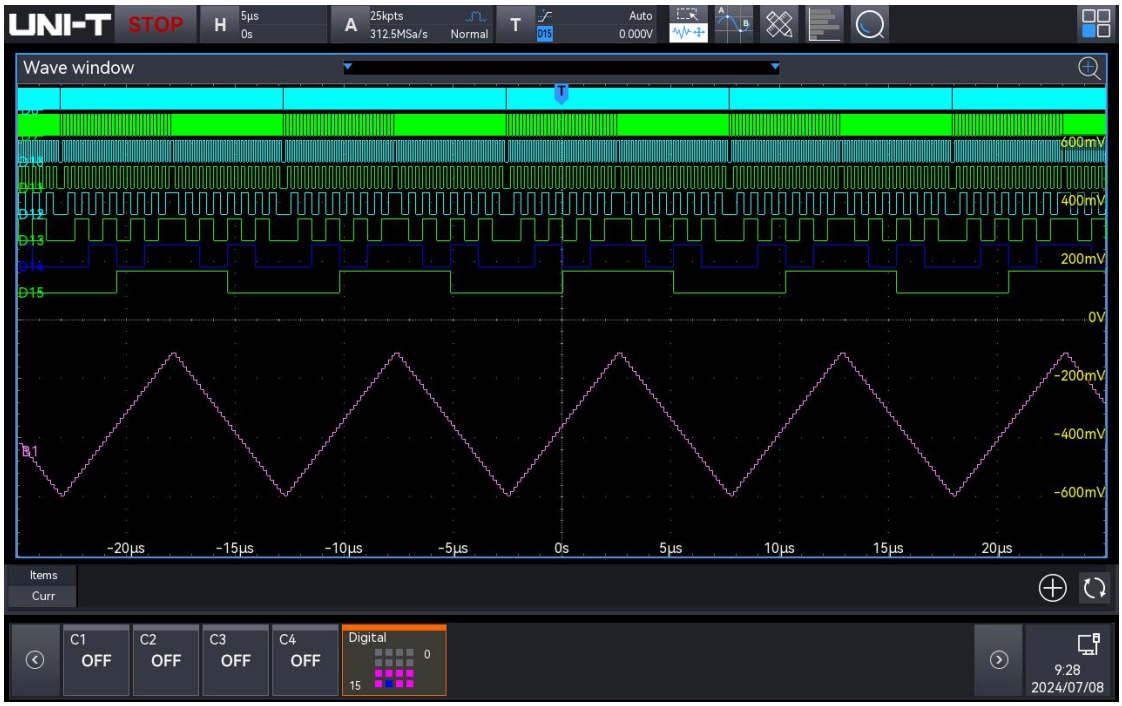
4.6.1. Sine Wave



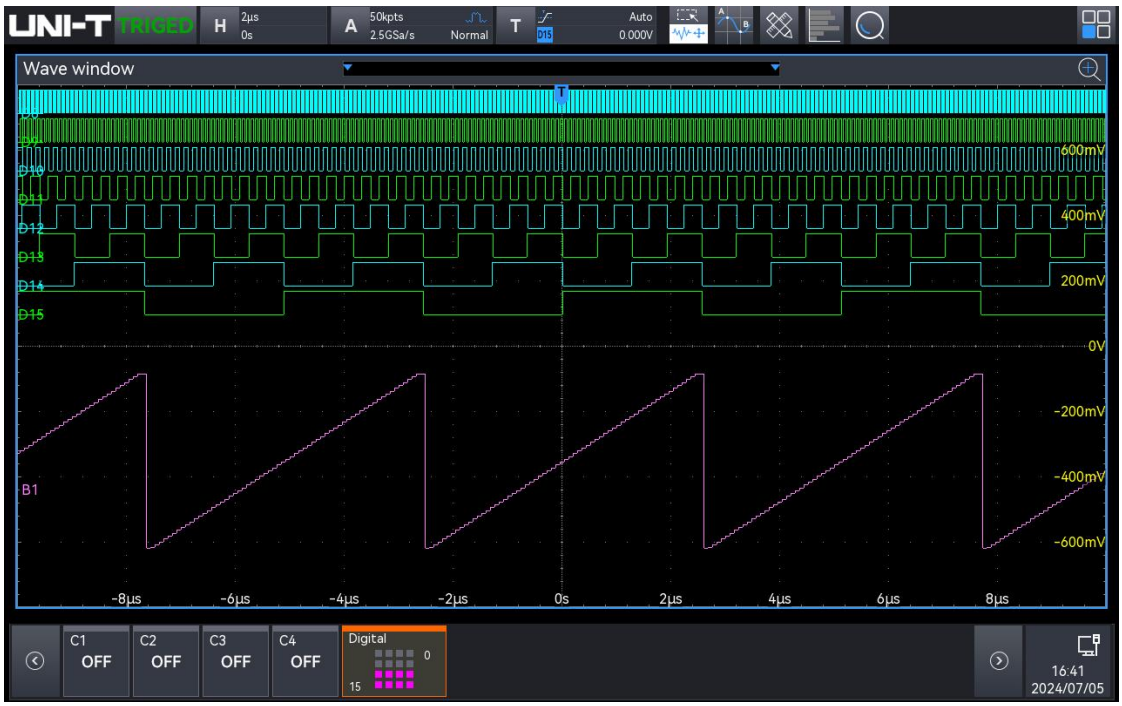
4.6.2. Square Wave



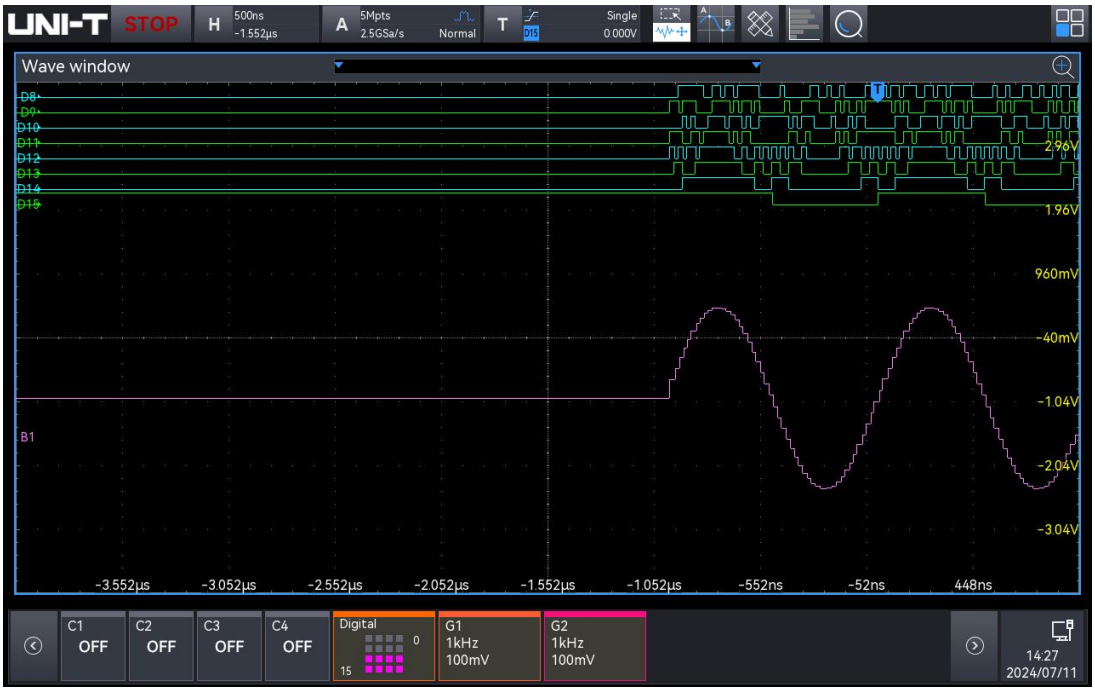
4.6.3. Triangular Wave



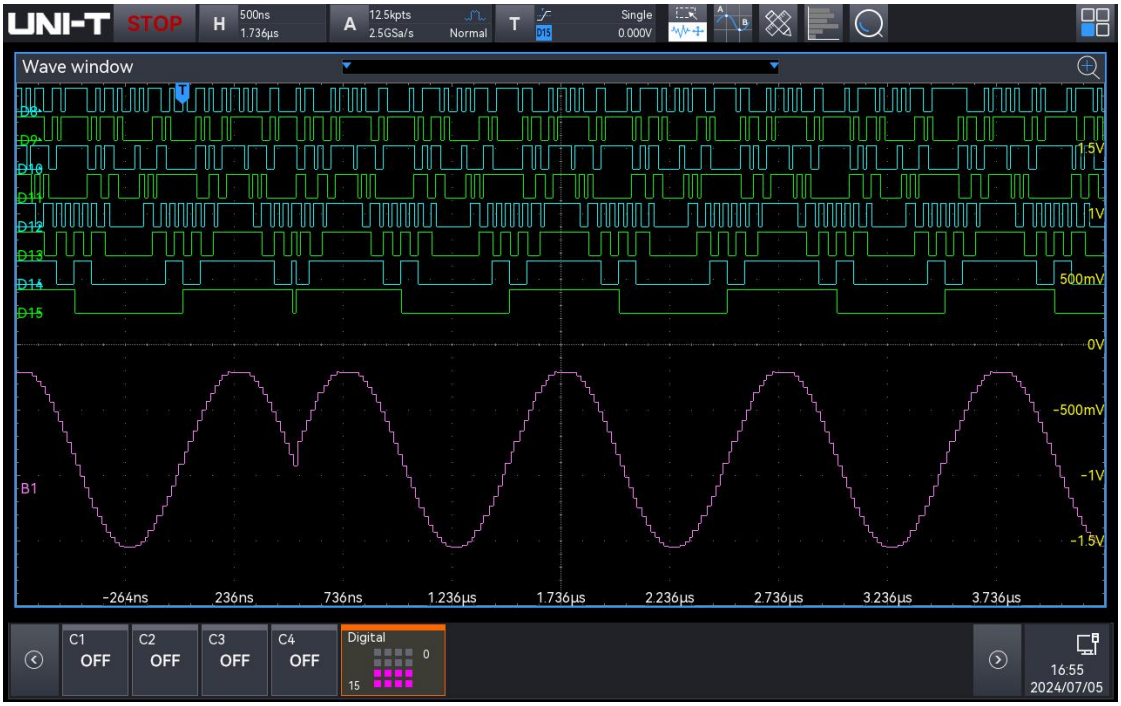
4.6.4. Sawtooth Wave



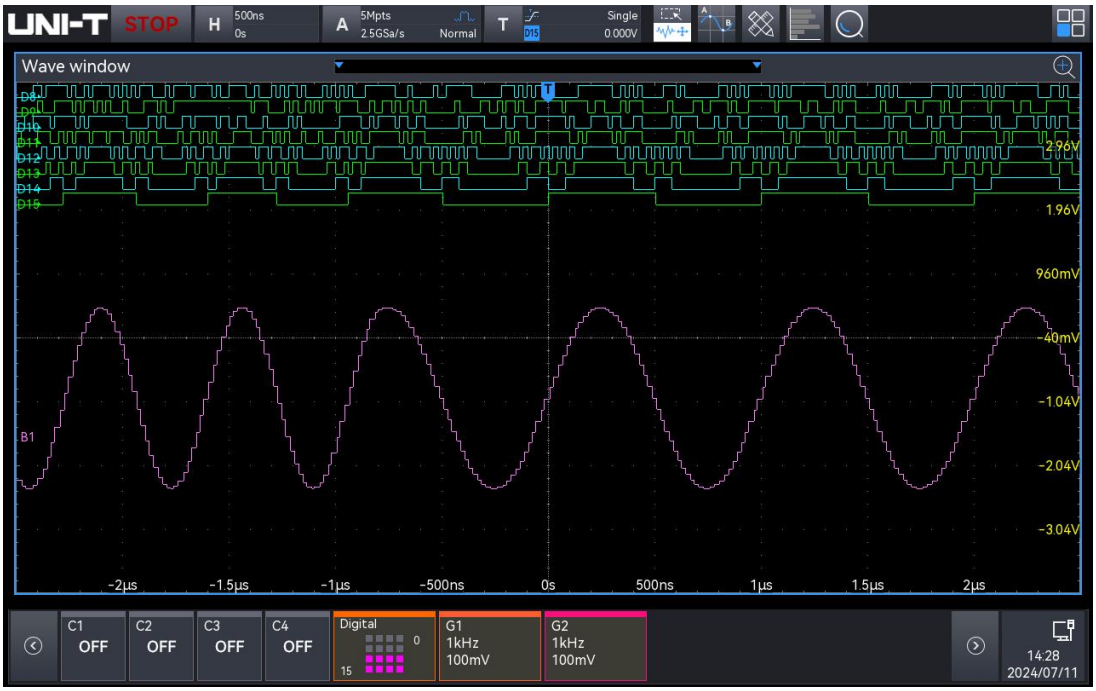
4.6.5. ASK



4.6.6. PSK



4.6.7. FSK



4.7. Others

The 1553B and ARINC429 signals can only be output through the pins, and this is only used to show the information about the 1553B and ARINC429 protocol signals.

Note: Modification Description

- In Rare Signal, Nth Edge (Edge Then Edge) (EdgeThenEdge) change to Nth Edge (Nth Edge) (Nth Edge).