Product Datasheet - Technical Specifications
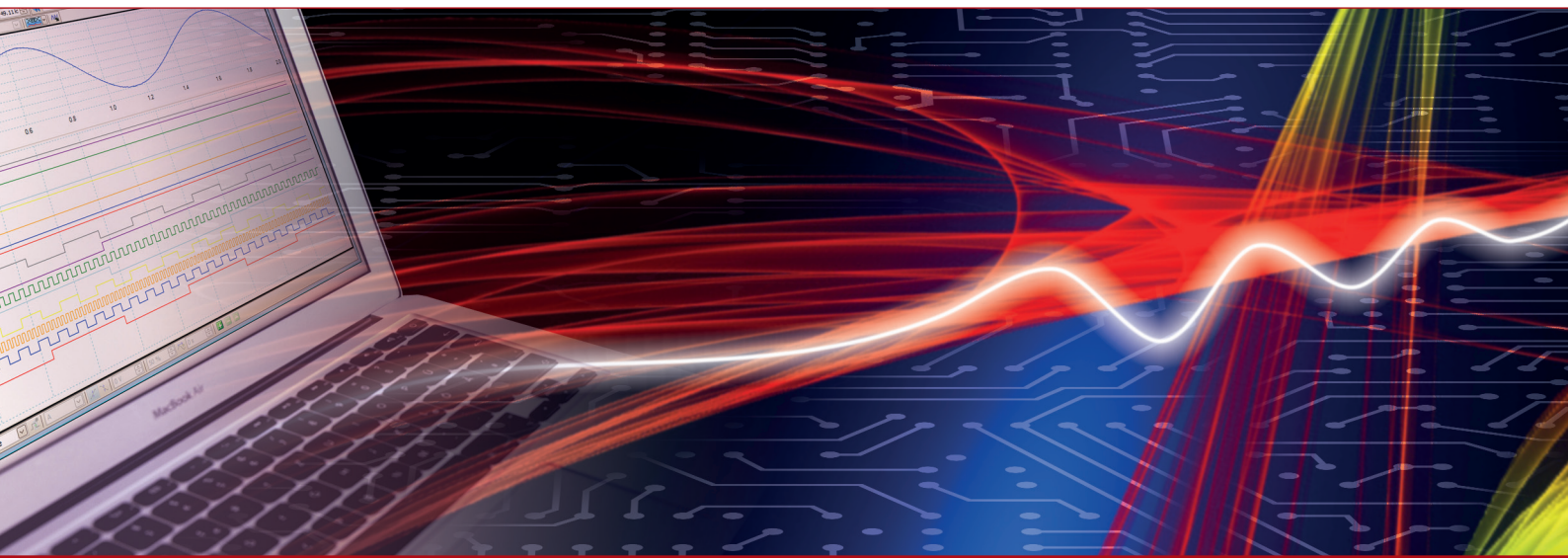

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RIGOL

User's Guide

DS6000 Digital Oscilloscope Demo Board

July 2011

RIGOL Technologies, Inc.

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Chapter 1   Overview

This manual introduces the functions and using methods of DS6000 Demo board. This Demo board is used to illustrate the basic functions of the oscilloscope. It is powered through USB port and can output 25 kinds of signals for the illustration of oscilloscope functions.

25 kinds of signals:

Common Signals
- Square waveform
- Sine waveform
- Digital-to-analog (DA) signal
- Unfiltered digital-to-analog (DA) signal
- Differential Signal
- PAL video signal
- NTSC video signal
- Amplitude modulation (AM) signal

Special Signals
- Sine signal superimposed with noise
- Slow sweep signal
- Fast sweep signal
- Phase deviation signal
- Rare abnormal signal
- Frequent abnormal signal
- Manual abnormal signal
- Manual burst
- Narrow pulse
- Sine signal superimposed with glitch
- Square signal superimposed with glitch
- Crosstalk signal

Digital signal
- RS232/UART signal
- I2C signal
- SPI signal
- CAN signal
- Signals for testing logic analyzer

Note: introductions in this edition are based on the V2.1 version demo board.

Chapter 2   Quick Start

This chapter briefly introduces the layout, the connection and the power-on of the Demo board.
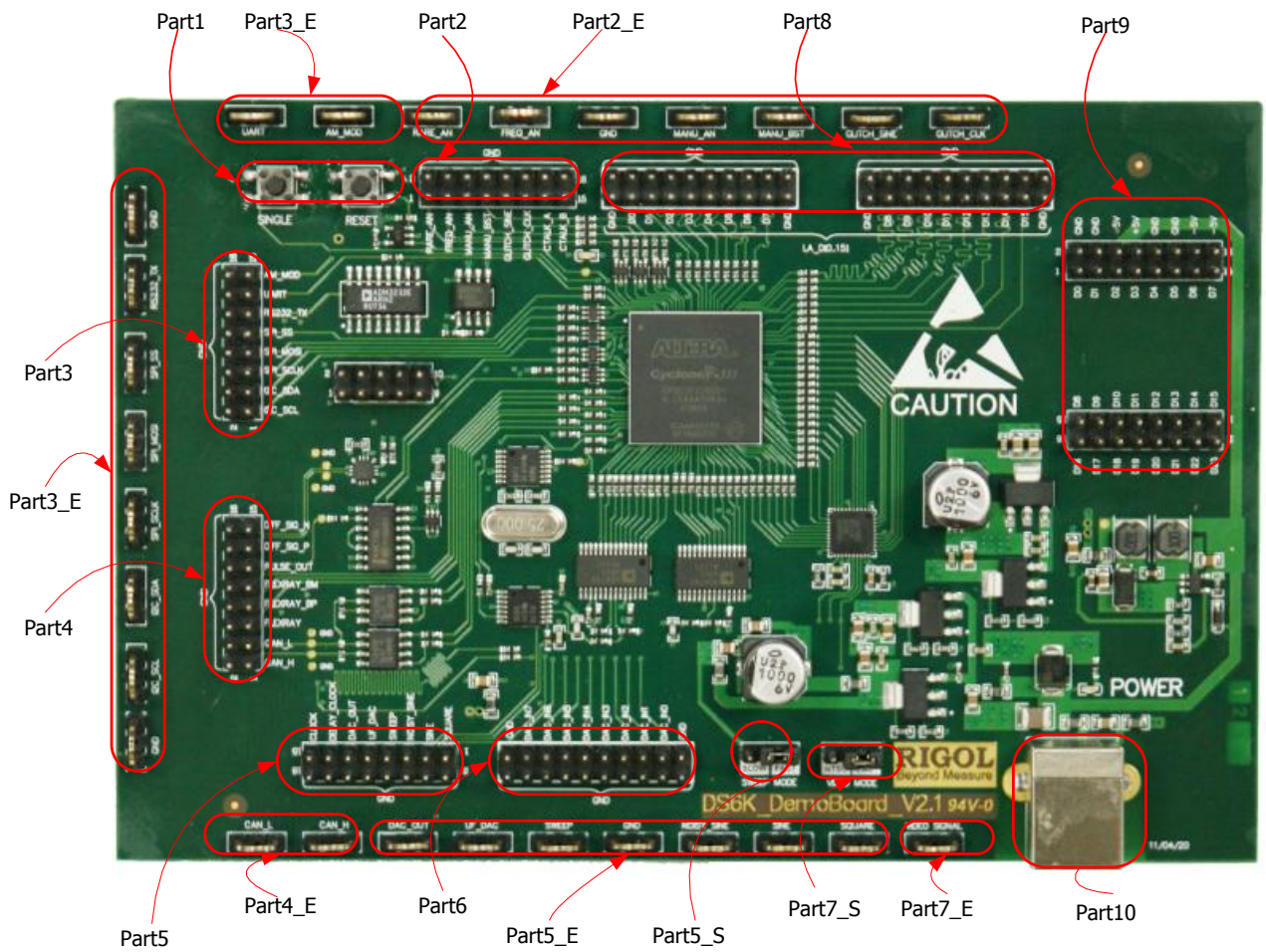
2.1 Demo Board Layout

Figure 2-1   Board Layout

Table 2-1 Board Layout Explanation

Diagrams	Pins	Definitions	Detailed Explanations
Part1	SINGLE	Manual trigger key	Used to trigger manual abnormal signal (MANU_AN), manual Burst signal (MANU_BST) and crosstalk signal.
	RESET	Manual reset key	Press this key to reset the MCU on the Demo board. When protocol (such as CAN) signal error occurs due to MCU program runaway, press this key to bring the MCU system back to normal working state.
Part2	RARE_AN	Rare abnormal signal	Output a 1MHz square waveform. Narrow pulse occurs every 100ms and the pulse width is not greater than 5 ns.
	FREQ_AN	Frequent abnormal signal	Output a 1MHz square waveform. Narrow pulse occurs every 1ms and the pulse width is not greater than 5 ns.
	MANU_AN	Manual abnormal signal	Controlled by the manual trigger key SINGLE. Apart from the 1.25MHz square waveform, a narrow pulse with 40ns pulse width is also output each time the SINGLE key is pressed.
	MANU_BST	Manual Burst signal	Output 25 bursts each time the SINGLE key is pressed. Each burst contains 100cyc high level, 3cyc low level, 1cyc high level, 3cyc low level and 100cyc high level. The time of each cyc is 8ns.
	GLITCH_SINE	Sine glitch signal	Output 500kHz sine signal on which glitches with 2ns width are superimposed. The glitch occurs about every 90 us and its position is not fixed.
	GLITCH_CLK	Square glitch signal	Output 1MHz square signal on which glitches with 2ns width are superimposed. The glitch position is not fixed.
	CTALK_A	Crosstalk signal 1	Output 1MHz low-frequency square waveform. A 125MHz high-frequency crosstalk signal is also output each time the SINGLE key is pressed.
	CTALK_B	Crosstalk signal 2	
Part2_E	RARE_AN	Part2 pins extension	——
	FREQ_AN		——
	MANU_AN		——
	MANU_BST		——
	GLITCH_SINE		——
	GLITCH_CLK		——

(Continued) Table 2-1 Board Layout Explanation

Part3	AM_MOD	Amplitude modulation signal	Output amplitude modulation signal with 500kHz carrier frequency and 10kHz modulating frequency.
	UART	Asynchronous serial transmission signal	The output signal shares the same characteristics (except polarity (positive polarity)) with the signal output from RS232_TX.
	RS232_TX	RS232 signal	Output a RS232 signal with 9600Bps baud rate, 1 start bit, 8 data bits, 1 stop bit, LSB output, negative polarity and none check bit. The content of the output data is the character string "RIGOL DS6000".
	SPI_SS	SPI SS signal	The signal rate is 1.25MHz and the output data steadily increases from 0 to 255.
	SPI_MOSI	SPI MISO signal	
	SPI_SCLK	SPI MOSI signal	
	I2C_SDA	I2C data signal	Output signal of I2C data bus. The content of the data is the character string "RIGOL" but the data frame head and read/write bits will change.
	I2C_SCL	I2C clock signal	Clock signal of I2C protocol. The clock frequency is 125kHz.
Part3_E	AM_MOD	Part3 pins extension	——
	UART		——
	RS232_TX		——
	SPI_SS		——
	SPI_MOSI		——
	SPI_SCLK		——
	I2C_SDA		——
	I2C_SCL		——
Part4	DIFF_SIG_N	Differential signal	Output random sequence. The frequency is 25MHz and the level logic is low-voltage differential signal (LVDS).
	DIFF_SIG_P		
	PULSE_OUT	Narrow pulse output	Output pulse signal with 100us period and 2ns pulse width.
	FLEXRAY_BM	Test signal of FlexRay vehicle-carried network communication protocol	Not supported.
	FLEXRAY_BP		
	FLEXRAY		
	CAN_L	Differential data bus of CAN protocol	Output CAN signal with 1MHz signal rate. Its data frame ID is 0x6C7, the data frame length is 5 Bytes and the data is the character string "RIGOL".
	CAN_H		

(Continued) Table 2-1 Board Layout Explanation

Part4_E	CANL	Part4	——
	CANH	pins extension	
Part5	CLOCK	Phase deviation signal	50mV, 1MHz clock signal.
	DELAY_CLOCK		660mV, 1MHz clock signal. The delay time cannot exceed 4ns.
	DAC_OUT	Digital-to-analog output	8 bits digital signal with 10kHz signal frequency and 25MHz sample frequency. Output the converted and filtered sine waveform.
	UF_DAC	Unfiltered digital-to-analog output	8 bits digital signal with 10kHz signal frequency and 25MHz sample frequency. Output the converted and unfiltered sine waveform.
	SWEEP — SLOW	Slow sweep	Output a sweep signal of which the frequency is from 1kHz to 100kHz. The sweep period is 40s and the sweep mode is log.
	SWEEP — FAST	Fast sweep	Output a sweep signal of which the frequency is from 10kHz to 1MHz. The sweep period is 8s and the sweep mode is log.
	NOISY_SINE	Noisy sine signal	Output sine signal with 500kHz frequency and 1Vpp amplitude. A sine waveform with 125MHz frequency and 300mVpp amplitude is superimposed on this sine signal.
	SINE	Sine	Output sine signal with 500kHz frequency and 1Vpp amplitude.
	SQUARE	Square	Output square waveform signal with 1MHz frequency, 3.3Vpp amplitude, 50% duty cycle and 10% overshoot.
Part5_S	SLOW	Slow sweep	Select "Slow" or "Fast" sweep.
	FAST	Fast sweep	
Part5_E	DAC_OUT	Part5 pins extension	——
	UF_DAC		
	SWEEP		
	NOISY_SINE		
	SINE		
	SQUARE		

(Continued) Table 2-1 Board Layout Explanation

Part6	DAC_IN7	Digital-to-analog input	Provide 8 bits digital signal as DAC input.
	DAC_IN6		
	DAC_IN5		
	DAC_IN4		
	DAC_IN3		
	DAC_IN2		
	DAC_IN1		
	DAC_IN0		
Part7_S	NTSC	NTSC video signal	Select the standard of the output signal of the VIDEO_SIGNAL pin. Select NTSC to output a NTSC video signal. Select PAL to output a PAL/SECAM video signal. The signal amplitude is 1Vpp.
	PAL	PAL video signal	
Part7_E	VIDEO_SIGNAL	Video signal output	——
Part8	LA_D0	Signals for testing Logic analyzer, 16-channel parallel data	Output 12.5MHz square waveform.
	LA_D1		Output 6.25MHz square waveform.
	LA_D2		Output 3.125MHz square waveform.
	LA_D3		Output 1.562MHz square waveform.
	LA_D4		Output 781.2kHz square waveform.
	LA_D5		Output 390.6kHz square waveform.
	LA_D6		Output 195.3kHz square waveform.
	LA_D7		Output 97.66kHz square waveform.
	LA_D8		Output 48.83kHz square waveform.
	LA_D9		Output 24.4kHz square waveform.
	LA_D10		Output 12.2kHz square waveform.
	LA_D11		Output 6.1kHz square waveform.
	LA_D12		Output 3.05kHz square waveform.
	LA_D13		Output 1.525kHz square waveform.
	LA_D14		Output 762.2Hz square waveform.
	LA_D15		Output 381.1Hz square waveform.

(Continued) Table 2-1 Board Layout Explanation

	GND	Ground terminal	——
	GND	Ground terminal	——
	+5V	+5V DC voltage	——
	+5V	+5V DC voltage	——
	GND	Ground terminal	——
	GND	Ground terminal	——
	-5V	-5V DC voltage	——
	-5V	-5V DC voltage	——
Part9	D0	24 bits digital input terminal	24 bits digital input terminal. It can input digital data stream and be used for function extension.
	D1		
	D2		
	D3		
	D4		
	D5		
	D6		
	D7		
	D8		
	D9		
	D10		
	D11		
	D12		
	D13		
	D14		
	D15		
	D16		
	D17		
	D18		
	D19		
	D20		
	D21		
	D22		
	D23		
Part10	——	USB Device	USB port, used for demo board power supply.

2.2 Measurement Connection

Connect the signal output terminals of the Demo board to the corresponding input terminals of the oscilloscope before using the Demo board.

Connection Method:
1. Connect the BNC terminal of the probe to one of the BNC connectors of input channels (CH1-CH4) at the front panel of the oscilloscope.
2. Connect the probe tip to the corresponding signal output pin on the Demo board and connect the ground alligator clip of the probe to the ground terminal (GND) of the Demo board.

2.3 Demo Board Power-on

The Demo board can be powered through the USB port. Connect the **USB DEVICE** interface of the Demo board with the **USB HOST** interface of the oscilloscope or PC using USB data cable.

Note: The icon at the upper-right corner of the board indicates that static electricity would cause Demo board damage and the board should be used in anti-static environment as far as possible.

Chapter 3   Demo Board Applications

In this chapter, the Demo board is used to demonstrate the functions of the oscilloscope and the demonstration results of 25 kinds of signals are presented.

3.1 Common Signal Applications

3.1.1 Square Signal

1. **Signal Explanation**
   - **Signal Output Pin:** SQUARE
   - Square waveform with 1MHz frequency, 3.3Vpp amplitude and 50% duty cycle.

2. **Functions**
   Basic signal, edge trigger, duty cycle measurement

3. **Demonstration and Result**
   - Connect the signal output pin SQUARE and GND to CH1 of the oscilloscope properly using the probe;
   - Set the trigger type to "Edge", the trigger mode to "Auto" and the vertical scale to "2 V"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably; enable "+Duty" and "Vpp" measurements and enable statistic function. The demonstration result is as shown in the figure below.
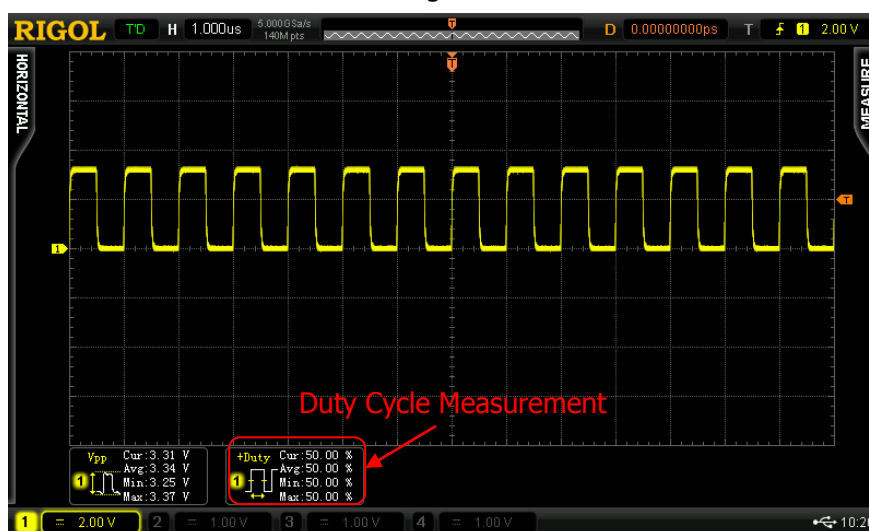
Figure 3-1 Demonstration Result of Square Waveform

3.1.2 Sine Signal

1. **Signal Explanation**
    - **Signal Output Pin:** SINE
    - Sine signal with 500 KHz frequency and 1 Vpp amplitude.

2. **Functions**
    Basic signal, edge trigger, FFT

3. **Demonstration and Result**
    - Connect the signal output pin SINE and GND to CH1 of the oscilloscope properly using the probe;
    - Set the trigger type to "Edge", the trigger mode to "Auto" and the vertical scale to "500 mV"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably. The demonstration result is as shown in the figure below.
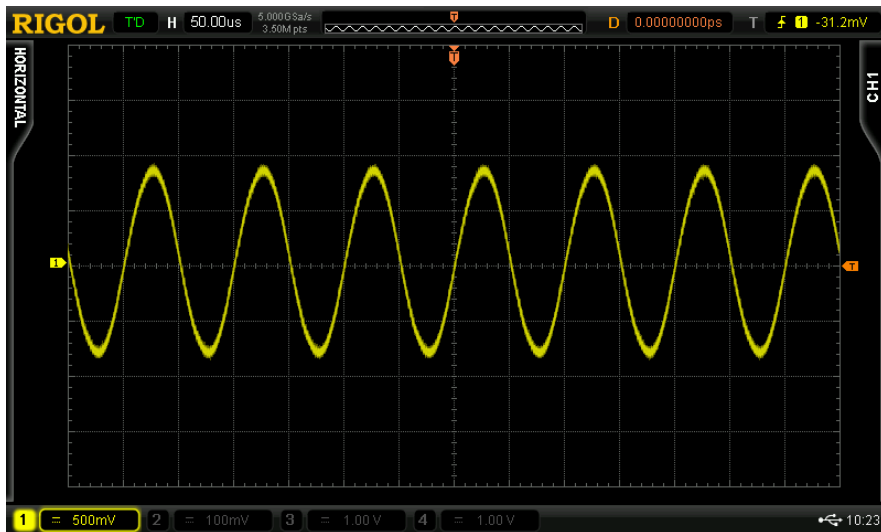
Figure 3-2 Demonstration Result of Sine Signal

- Enable "FFT" operation and the signal frequency is 500 kHz as shown in the figure below.
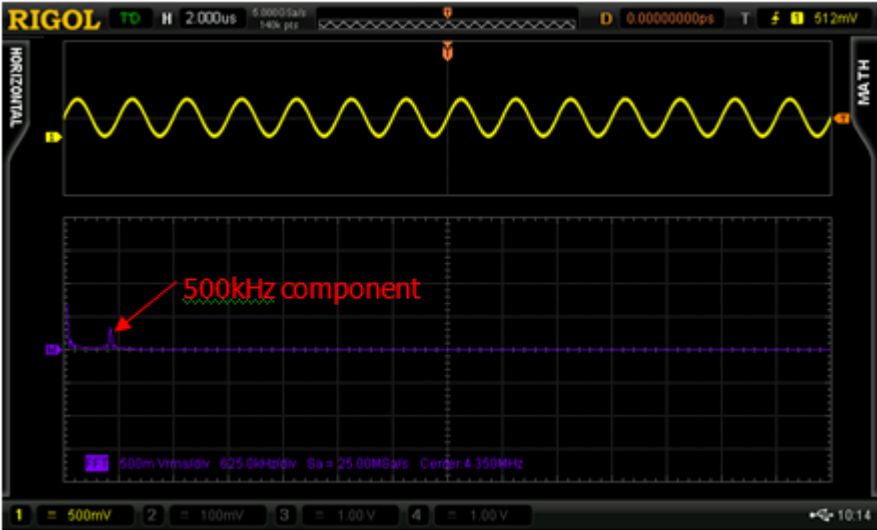
Figure 3-3 FFT Operation Result of Sine Signal

3.1.3 DA Output Signal

1. **Signal Explanation**
    ● **Signal Output Pin:**
       UF_DAC (output the converted and unfiltered sine waveform)
       DAC_OUT (output the converted and filtered sine waveform)
    ● The input of DA conversion are 8 bits, 10kHz digital signals (the signal pins are DAC IN7 to DAC IN0)
    ● The sample frequency is 25MHz.

2. **Functions**
    MSO, Digital-Analog conversion

3. **Demonstration and Result**
    ● The digital input signals are as shown in the figures below:
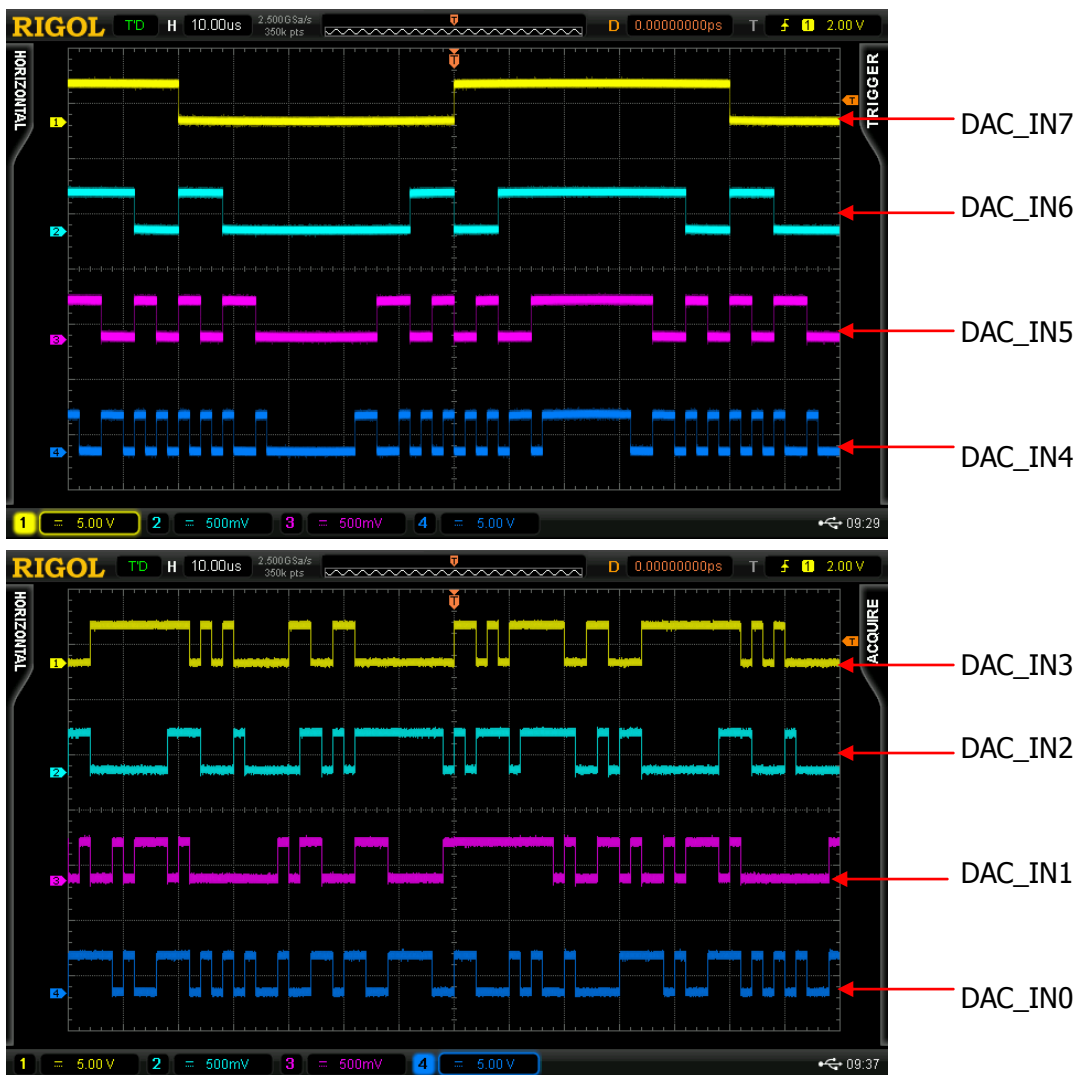
Figure 3-4 Digital Input Signals

Note: in the figure above, the probe ratio of CH1 and CH4 is "×10".

- Connect the signal output pin UF_DAC and GND to CH1 of the oscilloscope properly using the probe;
- Set the trigger type to "Edge", the trigger mode to "Auto" and the vertical scale to "1V"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably. The analog signal is as shown in the figure below. This signal is the converted and unfiltered analog signal and the waveform has apparent "steps" as shown in the figure below.
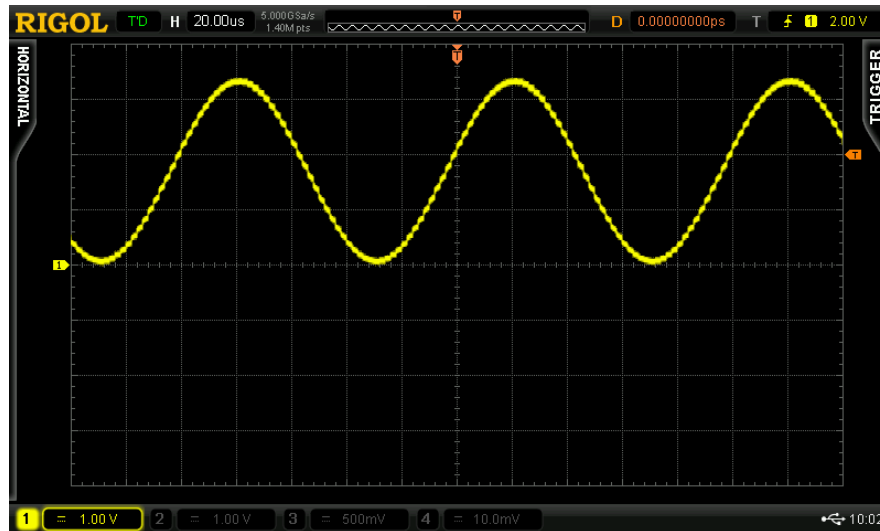
Figure 3-5 Unfiltered Analog Output Signal

- Connect the signal output pin DAC_OUT and GND to CH2 of the oscilloscope properly using the probe;
- Set the vertical scale to "1V" and adjust the vertical position and trigger level to make the oscilloscope trigger stably. The analog signal is as shown in the figure below. This signal is the converted and filtered analog signal and the waveform is relatively smoother as shown in the figure below.
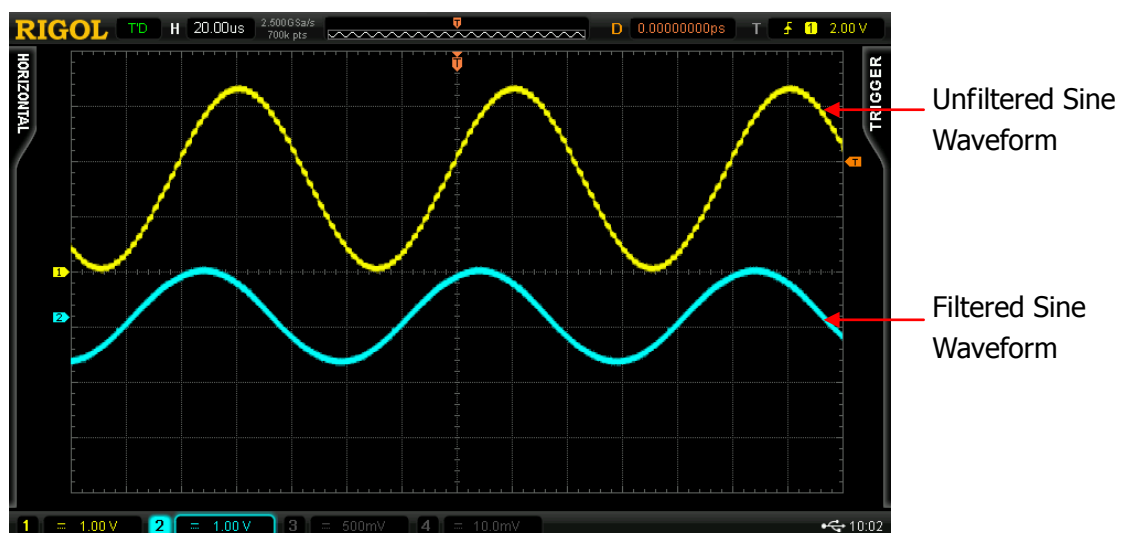
Figure 3-6 Analog Output Signal

3.1.4 Differential Signal

1. **Signal Explanation**
    - **Signal Output Pin:** DIFF_SIG_N, DIFF_SIG_P
    - Output 25 MHz random sequence and the level logic is low-voltage differential signal (LVDs).

2. **Functions**
    Differential probe measurement, rising/falling edge trigger, MATH function

3. **Demonstration and Result**
    - Connect DIFF_SIG_P and DIFF_SIG_N with CH2 using differential probe and the oscilloscope identifies the differential probe automatically. Set the "Probe Type" to "Diff-Probe". Set the trigger type to "Edge", the trigger mode to "Auto" and the vertical scale to "500 mV"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably. The demonstration result is as shown in the figure below.
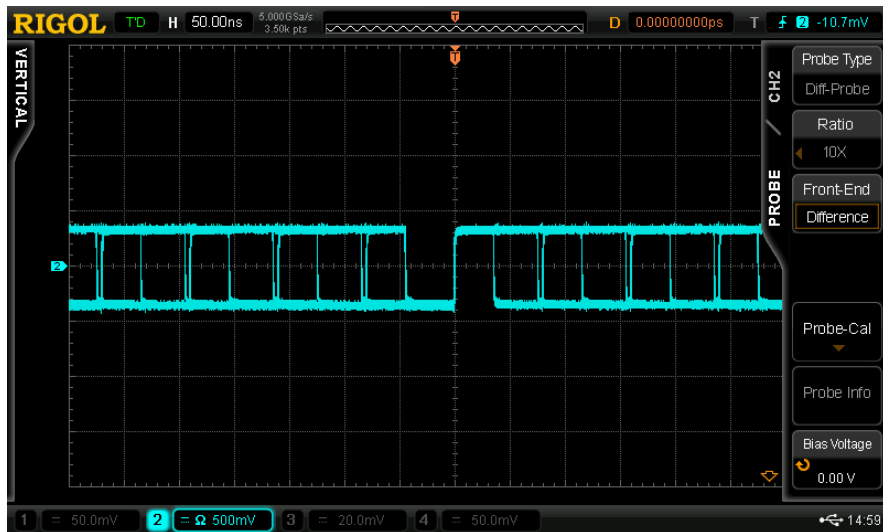

Figure 3-7 Differential Signal Measurement Using Differential Probe

- Connect DIFF_SIG_P and GND to CH1 of the oscilloscope using single-ended probe;
- Connect DIFF_SIG_N and GND to CH2 of the oscilloscope using single-ended probe;
- Set the trigger type to "Edge", the trigger mode to "Single" and the vertical scale to "500 mV"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably. The demonstration result is as shown in the figure below.
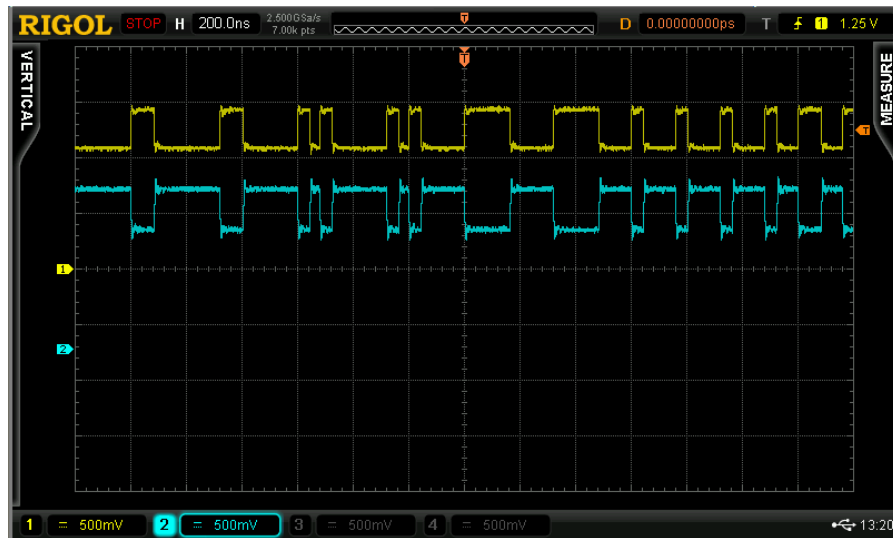

Figure 3-8 Differential signal Demonstration Using Single-ended Probe

- Enable MATH function (A-B). Set source A to CH1 and source B to CH2. The operation result is as shown in the figure below.
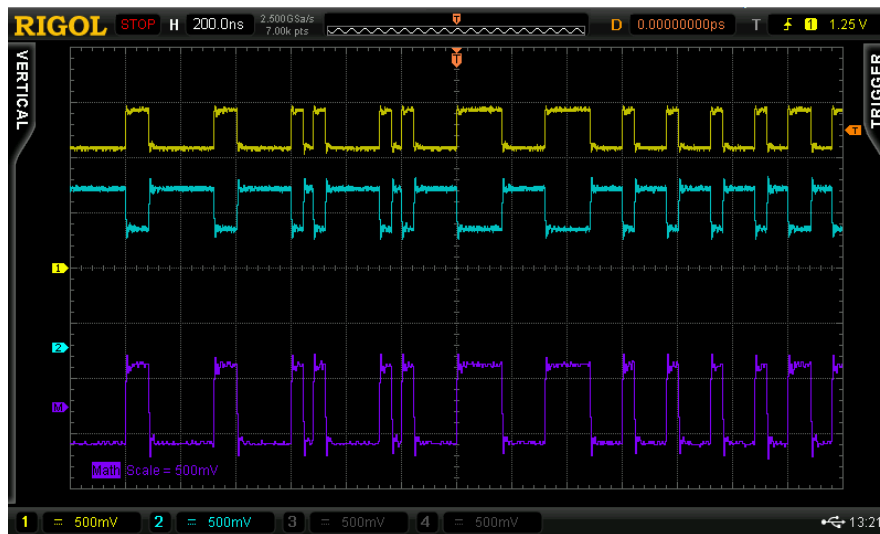
Figure 3-9 MATH Function Demonstration Using Single-ended Probe

3.1.5 PAL Video Signal

1. **Signal Explanation**
   - **Signal Output Pin:** VIDEO_SIGNAL (select PAL)
   - The signal amplitude is 1Vpp.

2. **Functions**
   Video Trigger

3. **Demonstration and Result**
   - Select PAL from VIDEO MODE of the demo board. Connect the signal output pin VIDEO SIGNAL and GND to CH1 of the oscilloscope properly using the probe;
   - Set the trigger type to "Video", the video standard to "PAL/SECAM", the video polarity to "Positive", the synchronization to "Line number", the line number to "1" and the vertical scale to "500 mV"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably. The demonstration result is as shown in the figure below.
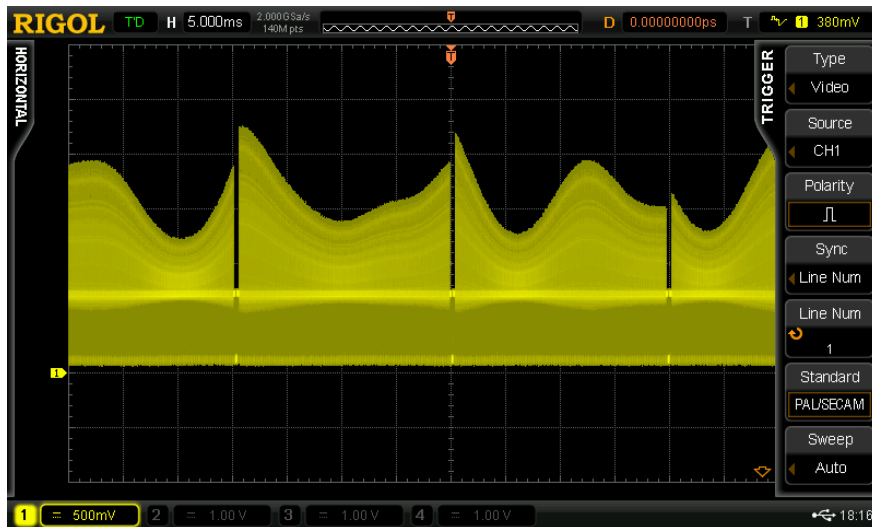

Figure 3-10 PAL Video Signal

3.1.6 NTSC Video Signal

1. **Signal Explanation**
   - **Signal Output Pin:** VIDEO_SIGNAL (select NTSC)
   - The signal amplitude is 1Vpp.

2. **Functions**
   Video trigger

3. **Demonstration and Result**
   - Select NTSC from VIDEO MODE of the demo board. Connect the signal output pin VIDEO SIGNAL and GND to CH1 of the oscilloscope properly using the probe;
   - Set the trigger type to "Video", the video standard to "NTSC", the video polarity to "Positive", the synchronization to "Line number", the line number to "1" and the vertical scale to "500 mV"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably. The demonstration result is as shown in the figure below.
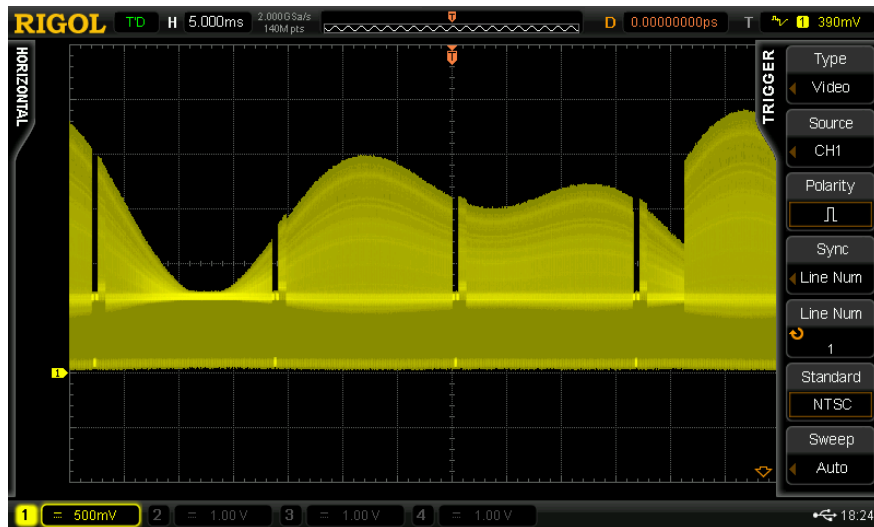
Figure 3-11 NTSC Video Signal

3.1.7 Amplitude Modulation Signal

1. **Signal Explanation**
    *   **Signal Output Pin:** AM_MOD
    *   Carrier waveform: 500kHz, 1Vpp sine waveform;
        Modulating waveform: 10kHz, 1.6Vpp sine waveform.

2. **Functions**
    Trigger holdoff, FFT

3. **Demonstration and Result**
    *   Connect the signal output pin AM_MOD and GND to CH1 of the oscilloscope properly using the probe;
    *   Set the trigger type to "Edge", the trigger mode to "Auto", the trigger holdoff to "70us" and the acquisition mode to "Normal"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably. The demonstration result is as shown in the figure below.
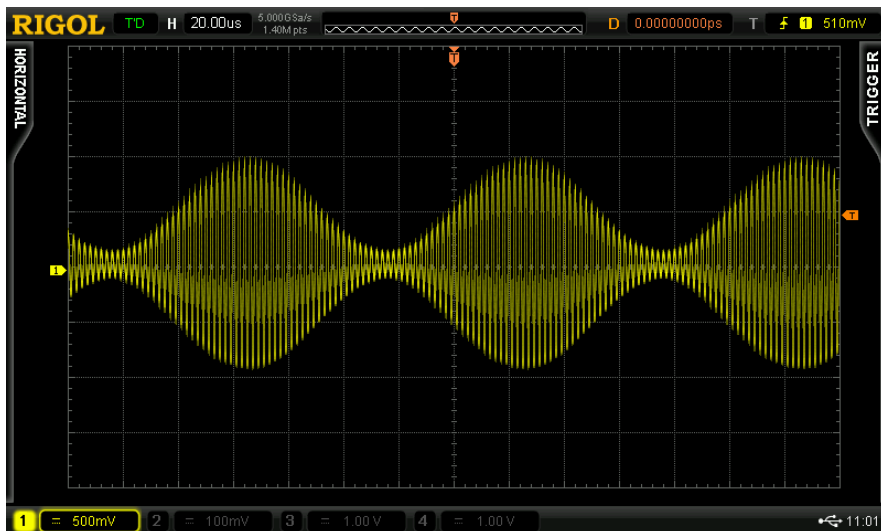

Figure 3-12 Amplitude Modulation Signal

● Enable FFT operation function. Set the vertical scale to 100mVrms/div and the center frequency to 500 KHz. The operation result is as shown in the figure below.
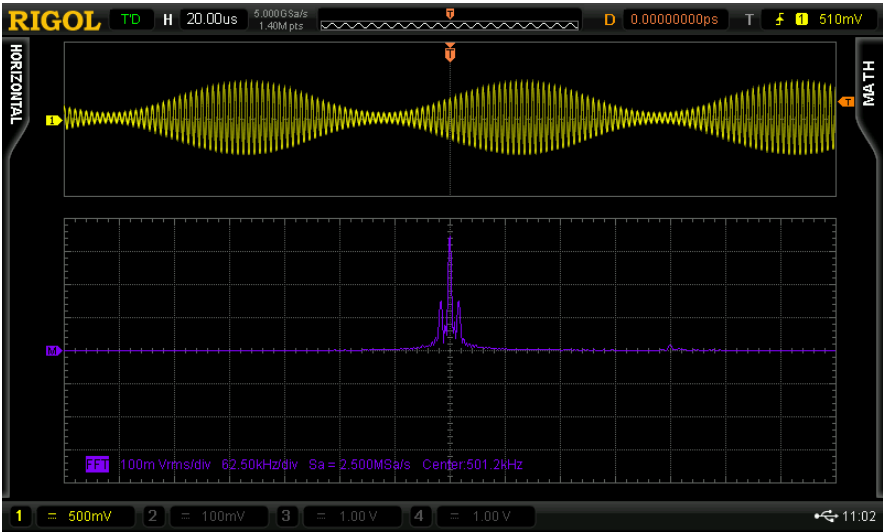
Figure 3-13 FFT Operation Result of Amplitude Modulation Signal

3.2 Special Signal Applications

3.2.1 Noisy Sine Signal

1. **Signal Explanation**
   - **Signal Output Pin:** NOISY_SINE
   - 500 kHz, 1Vpp sine waveform on which a 25MHz, 300mVpp high-frequency noise is superimposed.

2. **Functions**
   High-frequency reject, bandwidth limit, FFT

3. **Demonstration and Result**
   - Connect the signal output pin NOISY_SINE and GND to CH1 of the oscilloscope properly using the probe;
   - Set the trigger type to "Edge", the trigger holdoff to "600us", the sample mode to "Normal" and the vertical scale to "500 mV"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably. The demonstration result is as shown in the figure below.
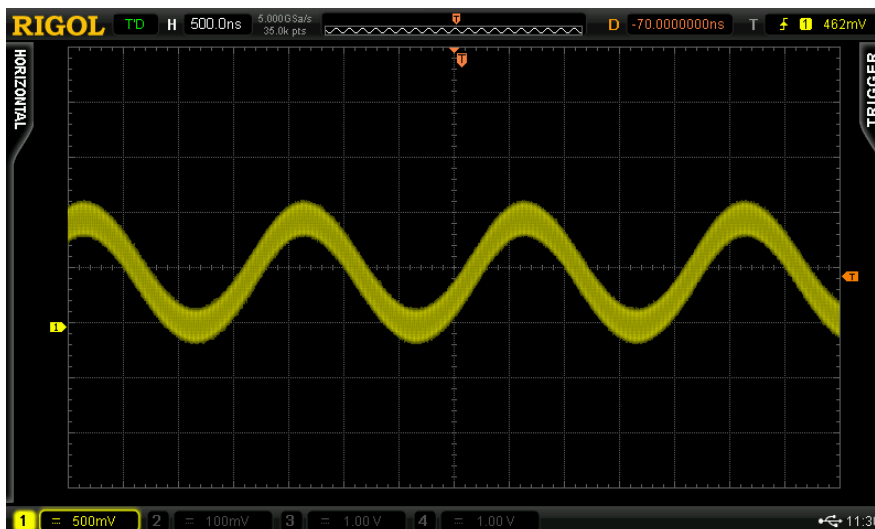
Figure 3-14 Sine Signal Superimposed with Noise

● Adjust the horizontal time base to "20 ns" and the waveform is as shown in the figure below.
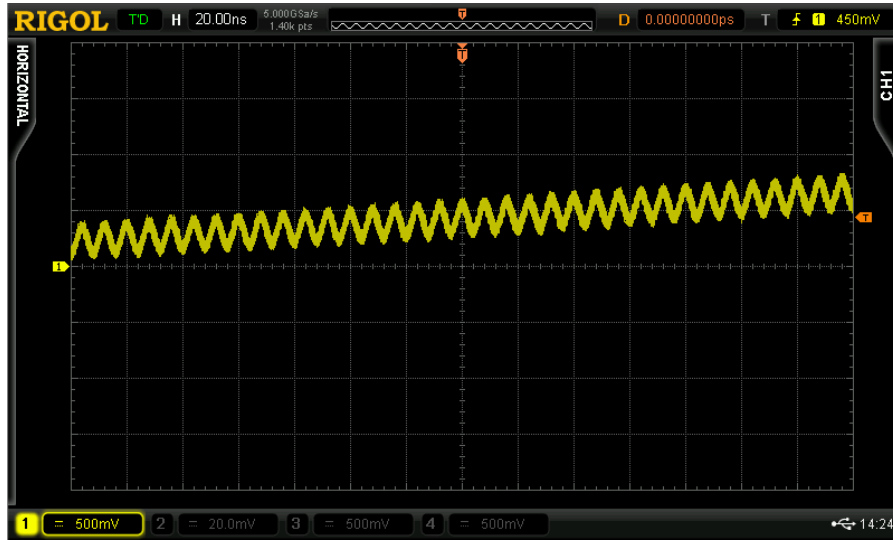
Figure 3-15 High-frequency Noise Details

● Enable FFT operation. Set the signal source to "CH1", the window function to "Rectangle", the vertical scale unit to "Vrms", the vertical scale to "100 mVrms" and the horizontal scale to "62.5MHz". The operation result is as shown in the figure below.
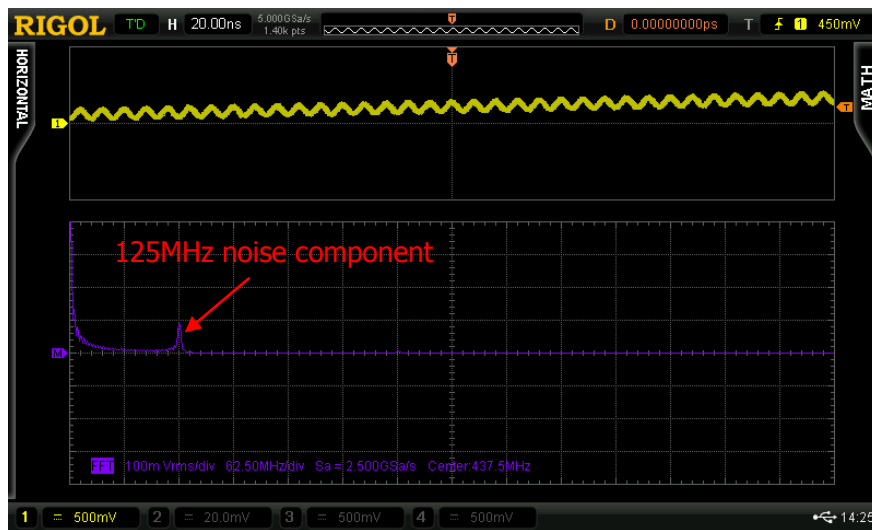
Figure 3-16 FFT Operation Result of Noisy Sine Signal

- Disable FFT operation, adjust the horizontal time base to "500 ns" and enable "HF Reject" and "Bandwidth Limit". The demonstration result is as shown in the figure below.
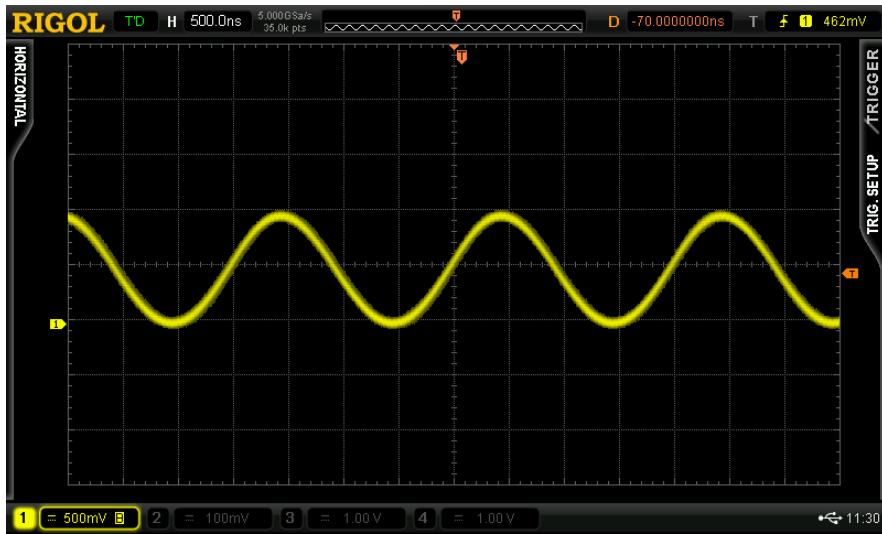
Figure 3-17 Signal after Noise Reject

- Adjust the horizontal time base to "20ns" again. Enable FFT operation and set the related parameters as above. The operation result is as shown in the figure below (the noise component is basically rejected).
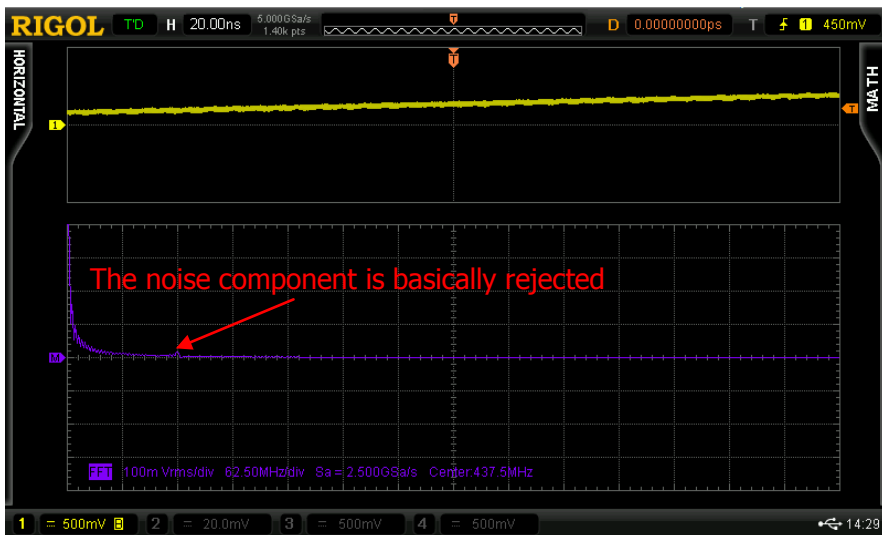
Figure 3-18 FFT Operation Result after Noise Reject

3.2.2 Slow Sweep Signal

1. **Signal Explanation**
   - **Signal Output Pin:** SWEEP (select SLOW)
   - The frequency range of the sweep is from 1kHz to 100kHz, the sweep time is 40s and the sweep mode is log.

2. **Functions**
   Measurement statistic, persistence display

3. **Demonstration and Result**
   - Set the "SWEEP MODE" to "SLOW" from the demo board; connect the signal output pin SWEEP to the oscilloscope properly using the probe.
   - Press **Auto** at the front panel of the oscilloscope to set the oscilloscope parameters automatically. Enable frequency measurement and statistic function. Basically, the frequency range of the sweep can be determined through the maximum and minimum of the statistic function as shown in the figure below.
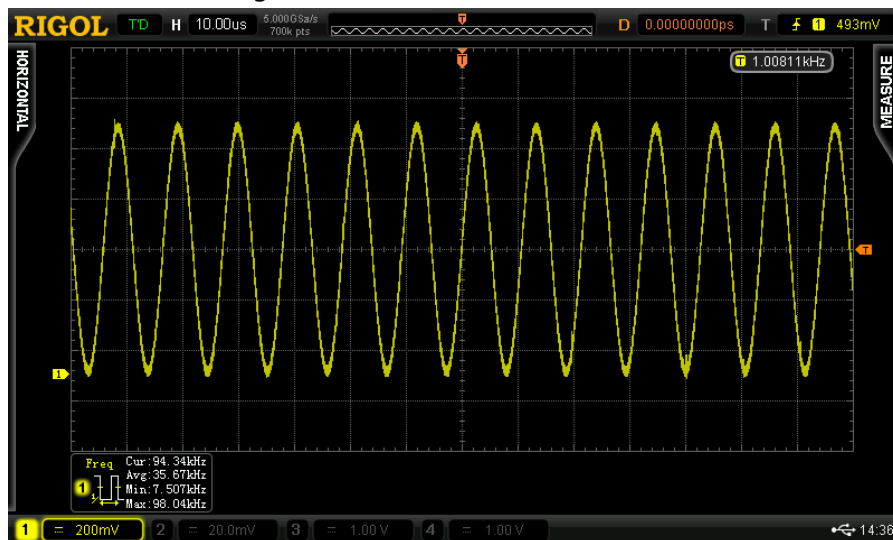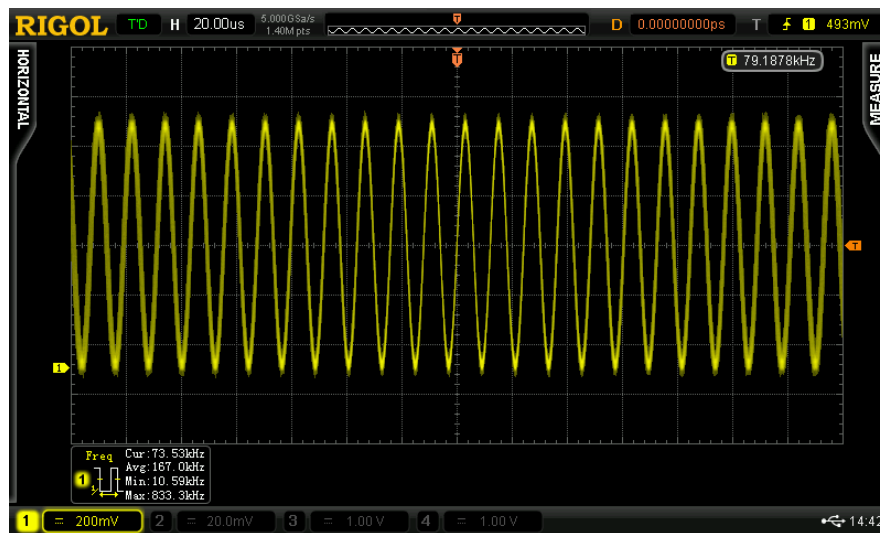

Figure 3-19 Slow Sweep Signal

● Adjust the "Persistence Time" to 20s and the sweep trace of the sweep signal is clearly displayed as shown in the figure below.
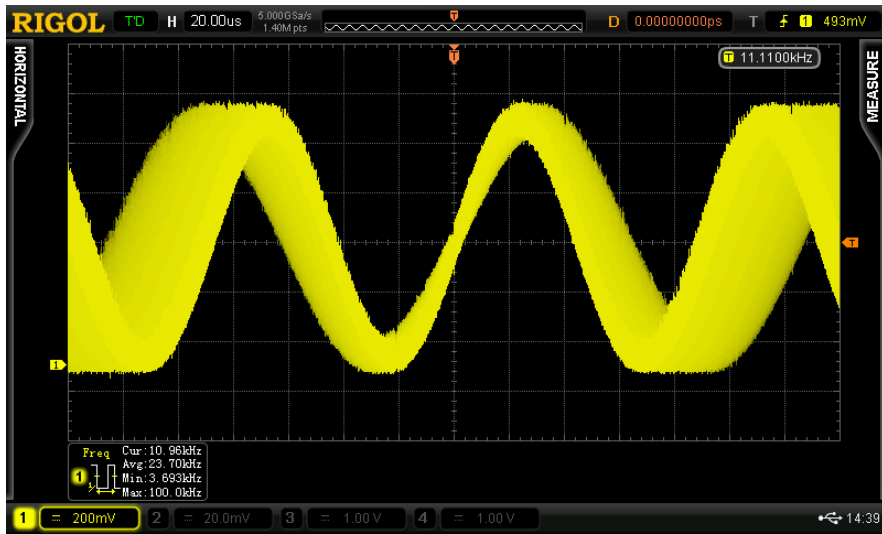
Figure 3-20 Sweep Trace of the Slow Sweep Signal

3.2.3 Fast Sweep Signal

1. **Signal Explanation**
   - **Signal Output Pin:** SWEEP (FAST)
   - The frequency range of the sweep is from 10kHz to 1MHz and the sweep time is 8s.

2. **Functions**
   Measurement statistic, persistence display

3. **Demonstration and Result**
   - Set the "SWEEP MODE" to "FAST" from the demo board; connect the signal output pin SWEEP and GND to the oscilloscope properly.
   - Press **Auto** at the front panel of the oscilloscope to set the oscilloscope parameters automatically. Enable frequency measurement and statistic function. Basically, the frequency range of the sweep can be determined through the maximum and minimum in the statistic function as shown in the figure below.

Figure 3-21 Fast Sweep Signal

● Adjust the "Persistence Time" to 500ms and the sweep trace of the sweep signal is clearly displayed.
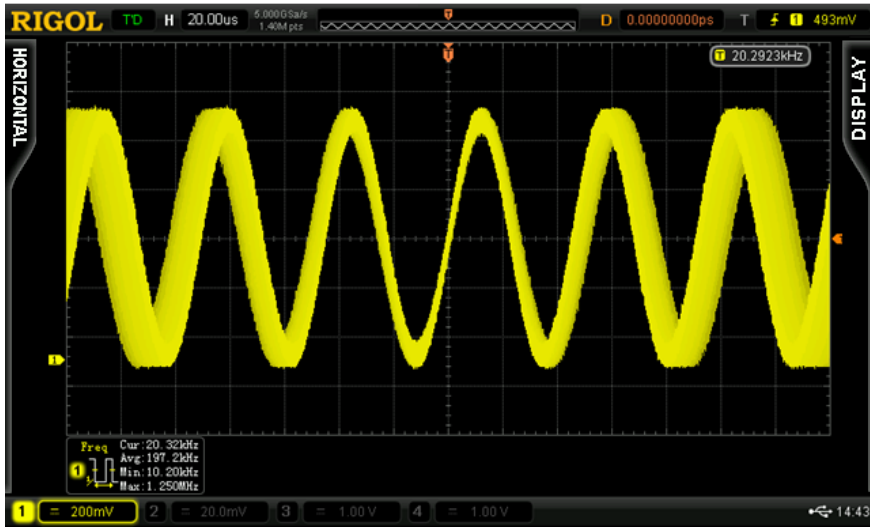
Figure 3-22 Sweep Trace of the Fast Sweep Signal

3.2.4 Phase Deviation Signal

1. **Signal Explanation**
    ● **Signal Output Pin:** CLOCK, DELAY_CLOCK
    ● The clock frequency is 1 MHz and the delay time cannot exceed 4ns.

2. **Functions**
    Channel delay measurement

3. **Demonstration and Result**
    ● Connect CLOCK and GND to CH1 of the oscilloscope using the probe; enable CH1, set the vertical scale to "100 mV", the vertical position to "0", the trigger type to "Edge", the trigger source to "CH1", the edge type to "Leading" and the trigger mode to "Auto"; adjust the trigger level to an appropriate value to make the oscilloscope trigger stably.
    ● Connect DELAY_CLOCK and GND to CH2 the probe; enable CH2, set the vertical scale to "100 mV" and vertical position to "0".
    ● Enable delay measurement of the rising edge as well as statistic function. The demonstration result is as shown in the figure below.
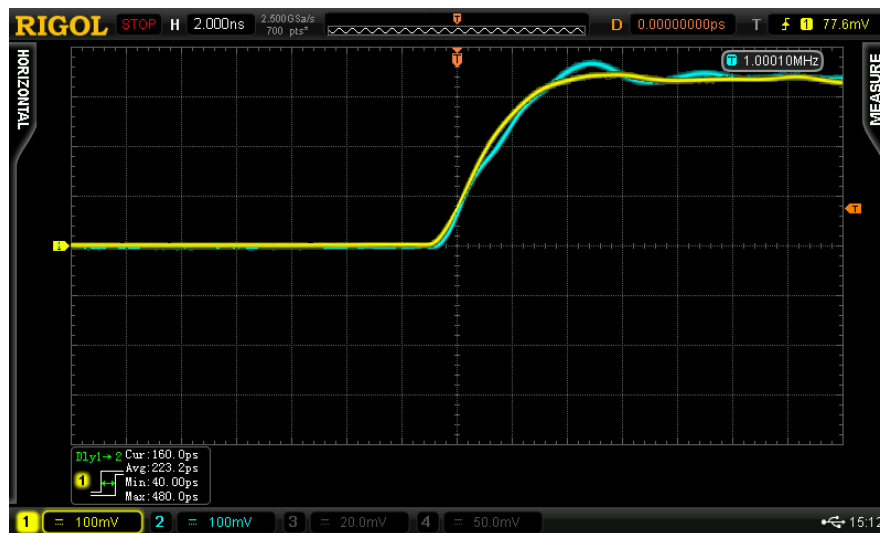
Figure 3-23 Channel Delay Measurement

3.2.5 Rare Abnormal Signal

1. **Signal Explanation**
    - **Signal Output Pin:** RARE_AN
    - Square waveform with 1MHz frequency. Narrow pulse occurs every 100ms and the pulse width cannot exceed 5ns.

2. **Functions**
    Waveform capture rate, waveform record and analysis

3. **Demonstration and Result**
    - Connect the signal output pin RARE_AN and GND to CH1 of the oscilloscope properly using the probe;
    - Set the trigger type to "Edge", the trigger mode to "Single", the horizontal time base to 5ns, the waveform capture rate to 180kHz, the memory depth to "Auto". Set the persistence time to 20s and the capture result of abnormal signal is as shown in the figure below.
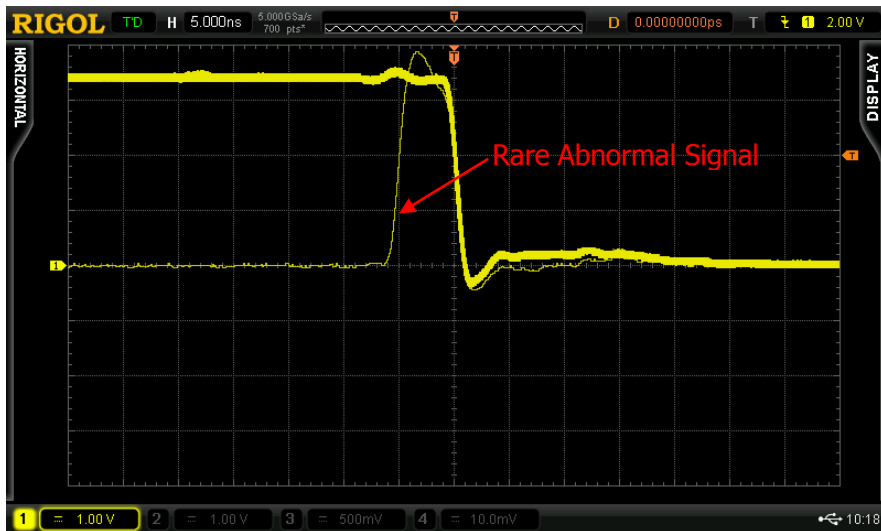
Figure 3-24 Rare Abnormal Signal

● Enable the waveform record function. After the record finishes, use the waveform playback and analysis function to analyze the accidental pulse.
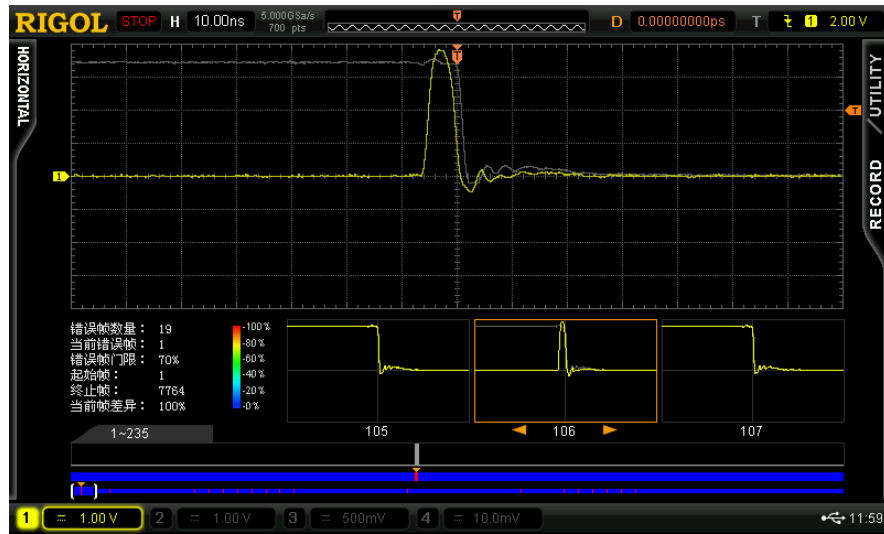

Figure 3-25 Waveform Record and Analysis

3.2.6 Frequent Abnormal Signal

1. **Signal Explanation**
   - **Signal Output Pin:** FREQ_AN
   - Square waveform with 1MHz frequency. Narrow pulse occurs every 1ms and the pulse width cannot exceed 5ns.

2. **Functions**
   Pass/Fail, pulse trigger

3. **Demonstration and Result**
   - Connect the signal output pin FREQ_AN and GND to CH1 of the oscilloscope properly using the probe.
   - Set the trigger type to "Pulse", the trigger condition to <6ns the trigger mode to "Auto" and the trigger level to 500mV. At this point, the abnormal signals can be observed stably as shown in the figure below.
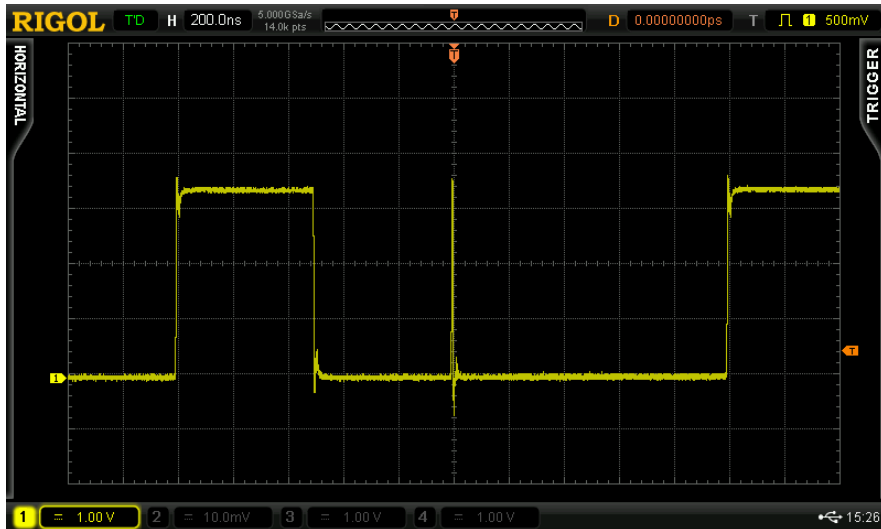
Figure 3-26 Stable Display of Frequent Abnormal Signal

- Enable Pass/Fail mode. Set X mask to 0.24div and Y mask to 0.50div. The demonstration result is as shown in the figure below.
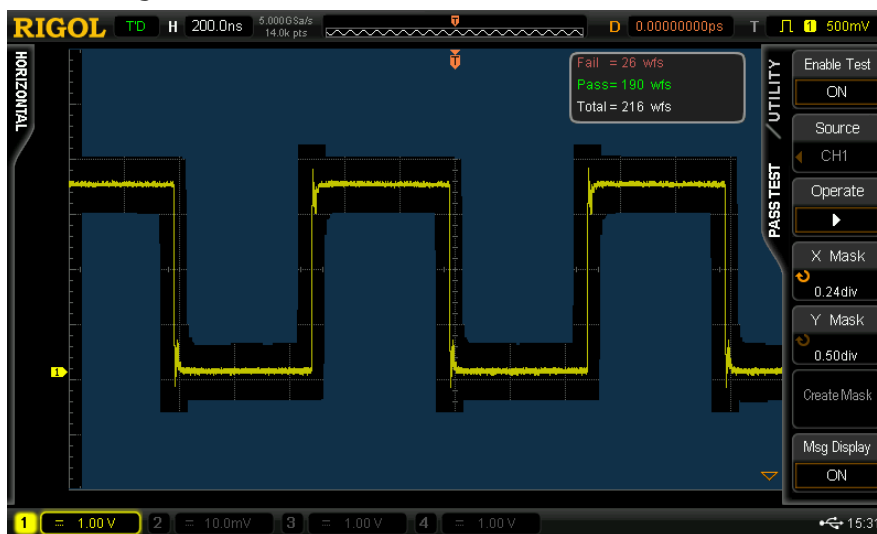

Figure 3-27 Pass/Fail Test of Frequent Abnormal Signal

3.2.7 Manual Abnormal Signal

1. **Signal Explanation**
    - **Signal Output Pin:** MANU_AN
    - Square waveform with 1.25MHz frequency. Narrow pulse with 40ns pulse width is output every time the key is pressed.

2. **Functions**
    Pulse trigger

3. **Demonstration and Result**
    - Connect the signal output pin MANU_AN to CH1 of the oscilloscope properly using the probe.
    - Set the trigger type to "Pulse", the trigger condition to <40ns, the trigger mode to "Normal" and the vertical scale to "1 V"; adjust the vertical position and trigger level to appropriate values. The demonstration result is as shown in the figure below.
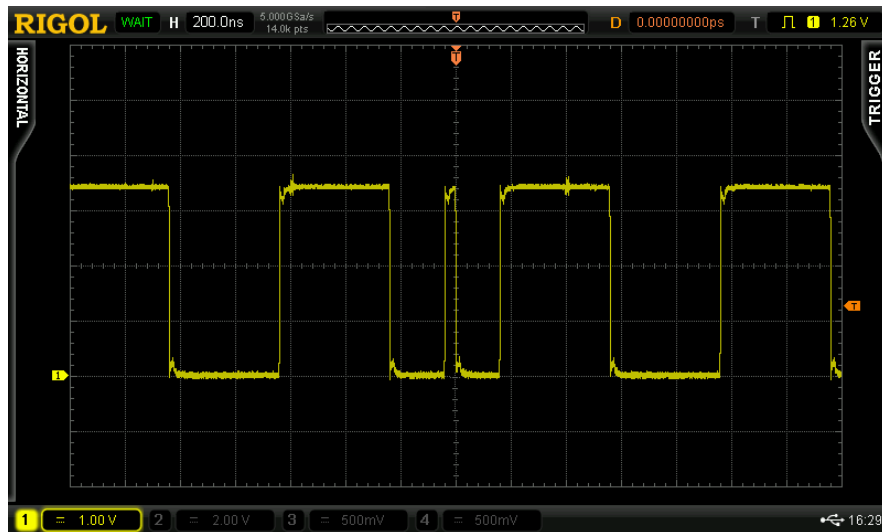
Figure 3-28 Manual Abnormal Signal

3.2.8 Manual Burst Signal

1. **Signal Explanation**
   - **Signal Output Pin:** MANU_BST
   - 25 bursts. Each burst contains high level and low level.

2. **Functions**
   Pulse trigger, high sample rate, deep memory

3. **Demonstration and Result**
   - Connect the signal output pin MANU_BST and GND to CH1 of the oscilloscope properly using the probe.
   - Set the time base to 5ms. At this point, the sample rate is 2GSa/s and the memory depth is 140Mpts. Under single trigger, every burst can be captured as shown in the figure below.
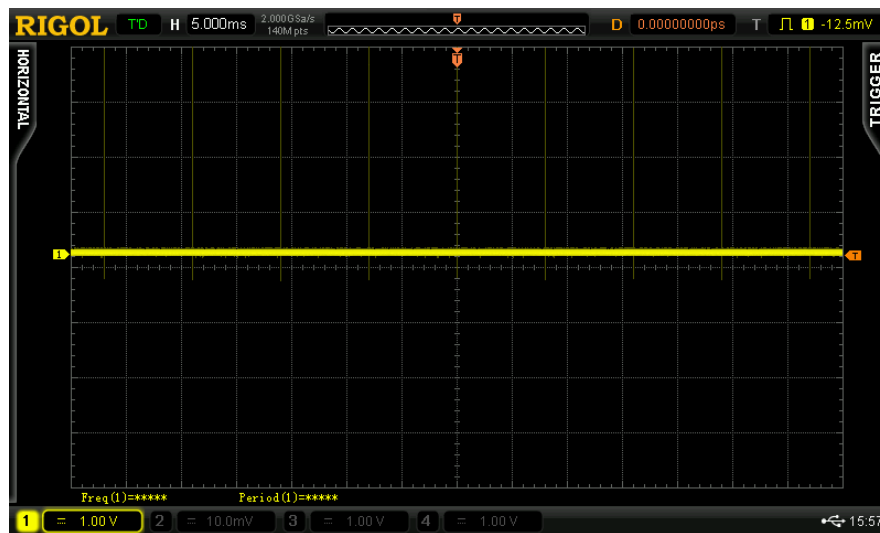
Figure 3-29 Manual Burst Signal

●   Adjust the time base to 200ns/div when the oscilloscope is in STOP state and amplify the waveform captured. As shown in the figure below, all the waveform details are successfully captured. As DS6000 provides a 140Mpts deep memory, users can adjust the horizontal position to view relatively longer waveform stored.
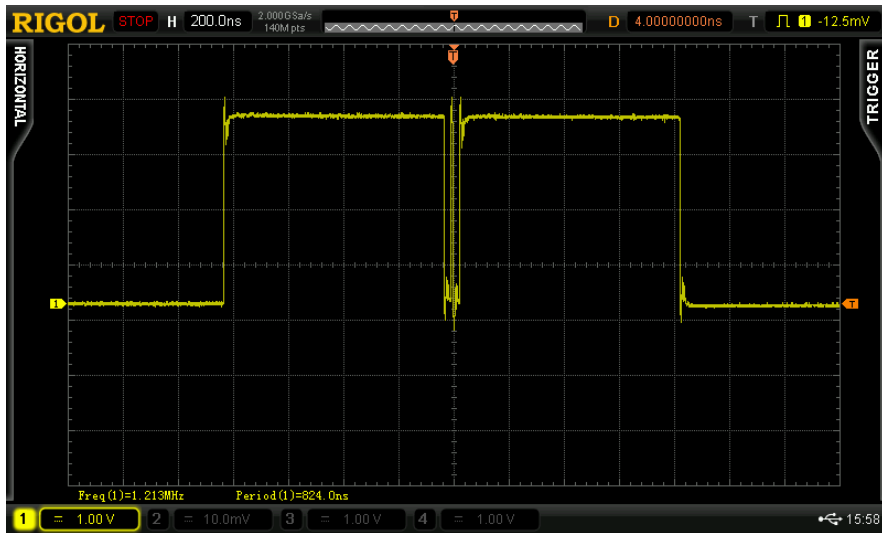

Figure 3-30 Burst Details

3.2.9 Narrow Burst Signal

1. **Signal Explanation**
   - **Signal Output Pin:** PULSE_OUT
   - Narrow pulse signal with 100us period and 2ns width.

2. **Functions**
   Pulse trigger

3. **Demonstration and Result**
   - Connect the signal output pin PULSE_OUT and GND to CH1 of the oscilloscope properly using the probe.
   - Set the trigger type to "Pulse", the trigger condition to <4ns, the trigger mode to "Auto" and the vertical scale to "1 V"; adjust the vertical position and trigger level to appropriate values. The demonstration result is as shown in the figure below.
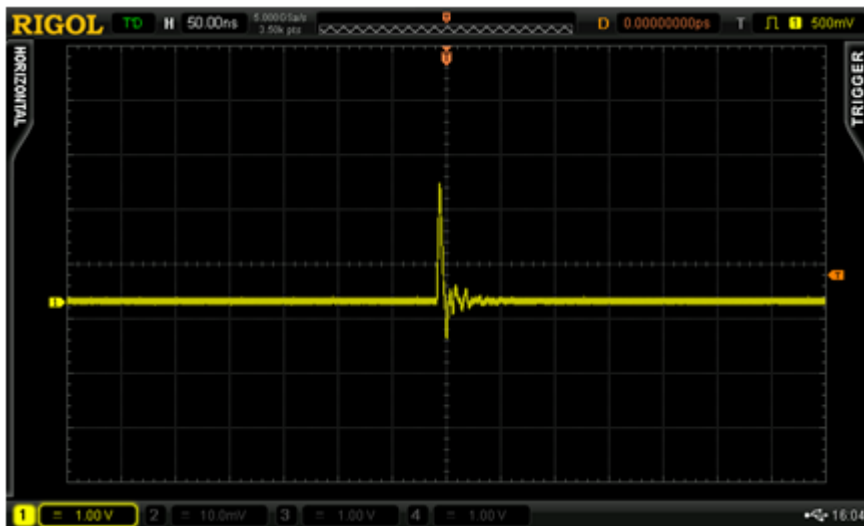
Figure 3-31 Narrow Pulse

3.2.10 Glitch Signal of Sine

1. **Signal Explanation**
   - **Signal Output Pin:** GLITCH_SINE
   - The sine frequency is 500kHz, the glitch width is 2ns, the glitch occurrence period is about 90us and the position of the glitch is not fixed.

2. **Functions**
   Pulse trigger, multi-level gray scale

3. **Demonstration and Result**
   - Connect the signal output pin GLITCH_SINE and GND to CH1 of the oscilloscope properly using the probe;
   - Set the trigger type to "Pulse", the trigger condition to <10ns and the trigger mode to "Auto"; adjust the time base to 100us and set the acquisition mode to "Normal" and the vertical scale to "500 mV"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably. The demonstration result is as shown in the figure below and users can view the interval time between glitches. All the adjacent glitches can be captured.
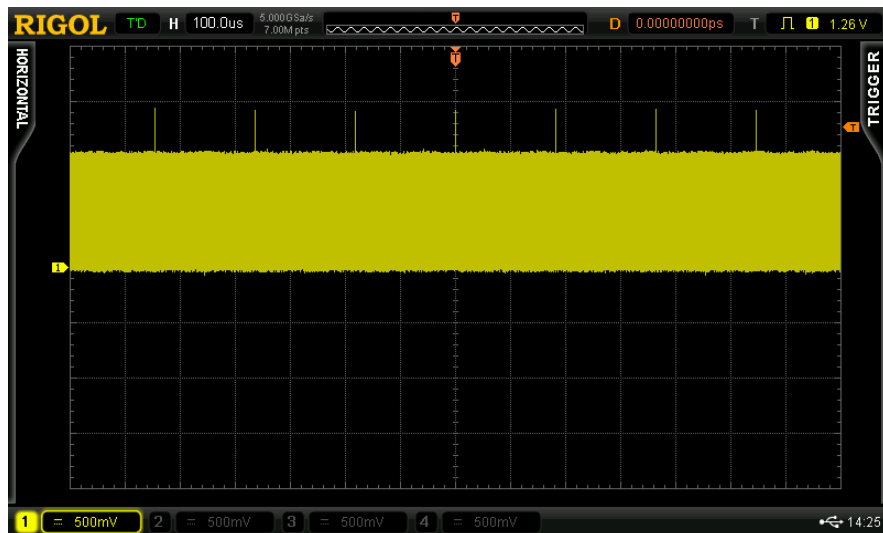

Figure 3-32 Sine Glitch Signal

● Set the time base to 2us. The demonstration result is as shown in the figure below and the positions of the glitches on the sine waveform are clearly displayed.
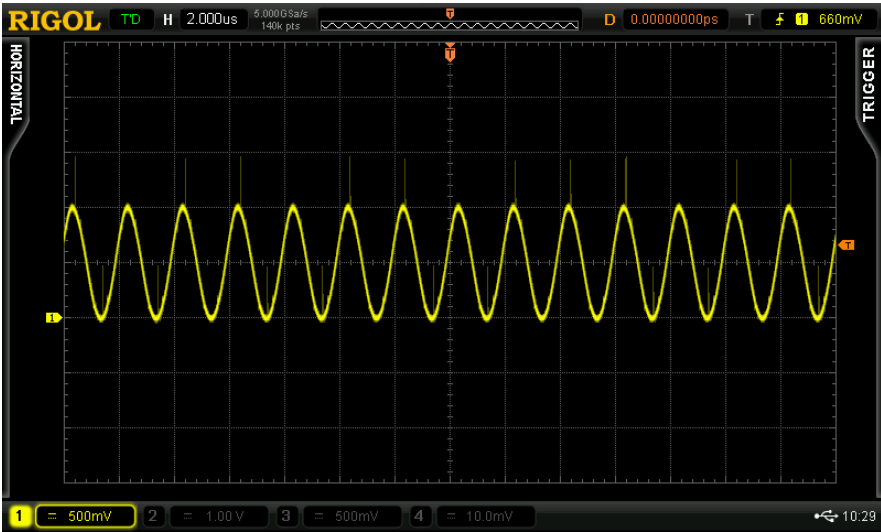

Figure 3-33 Sine Glitch Signal (Details)

3.2.11 Glitch Signal of Square Waveform

1. **Signal Explanation**
   - **Signal Output Pin:** GLITCH_CLK
   - The frequency of the square waveform is 1MHz, the glitch width is 2ns and the position of the glitch is not fixed.

2. **Functions**
   Edge trigger, pulse trigger

3. **Demonstration and Result**
   - Connect the signal output pin GLITCH_CLK and GND to CH1 of the oscilloscope properly using the probe;
   - Set the trigger type to "Edge", the signal source to "CH1", the edge type to "Leading", the trigger mode to "Normal" and the vertical scale to "500 mV"; adjust the vertical position and trigger level to appropriate values. The demonstration result is as shown in the figure below.
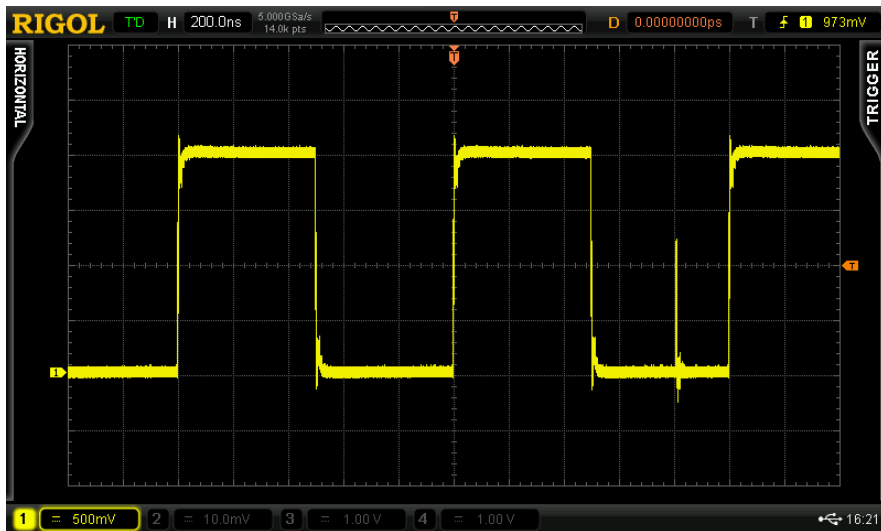

Figure 3-34 Square Waveform Glitch Signal

- Set the trigger type to "Pulse", the pulse condition to <10ns, the trigger mode to "Normal" and the time base to 2us; the demonstration result is as shown in the figure below and users can view the interval time between glitches.
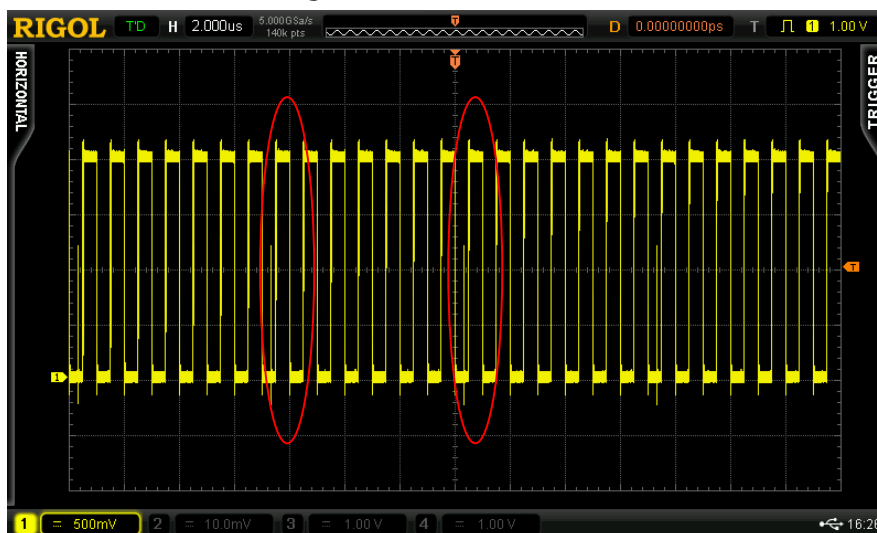

Figure 3-35 Time Interval between Glitches

3.2.12 Crosstalk Signal

1. **Signal Explanation**
   - **Signal Output Pin:** CTALK_A, CTALK_B
   - The two pins output 1 MHz low-frequency square waveforms. Press SINGLE to trigger the 125 MHz high-frequency signal.

2. **Functions**
   Bandwidth limit, crosstalk demonstration

3. **Demonstration and Result**
   - Connect CTALK_B and GND to CH1 of the oscilloscope using the probe;
   - Connect CTALK_A and GND to CH2 of the oscilloscope using the probe;
   - Set the vertical scale of CH1 and CH2 to "2 V", the trigger type to "Edge", the signal source to "CH1", the edge type to "Leading" and the trigger mode to "Auto"; adjust the trigger level to an appropriate value to make the oscilloscope trigger stably. The demonstration result is as shown in the figure below. As the frequency measurement result in the figure shows, the frequency of the signal is 1 MHz.
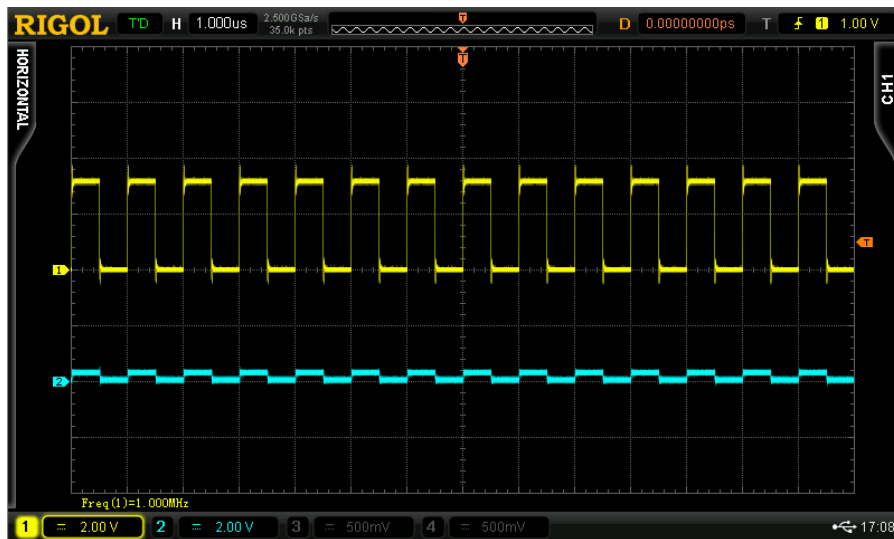

Figure 3-36 CTALK_A and CTALK_B Output Signals

● Press SINGLE to trigger the 125 MHz high-frequency signal. The demonstration result is as shown in the figure below.
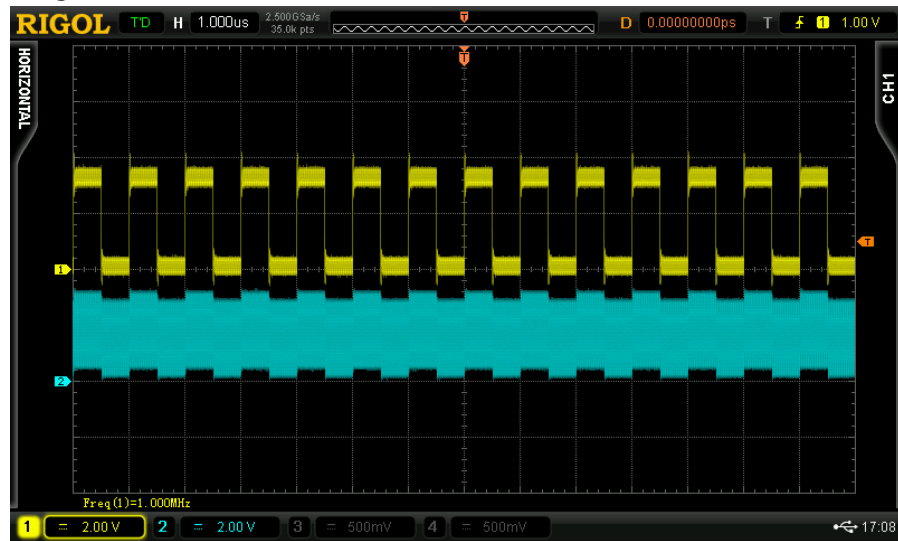

Figure 3-37 Crosstalk Signal Demonstration Result

● Enable the 20MHz bandwidth limit of CH1 and press SINGLE to trigger the 125 MHz high-frequency signal. The demonstration result is as shown in the figure below.
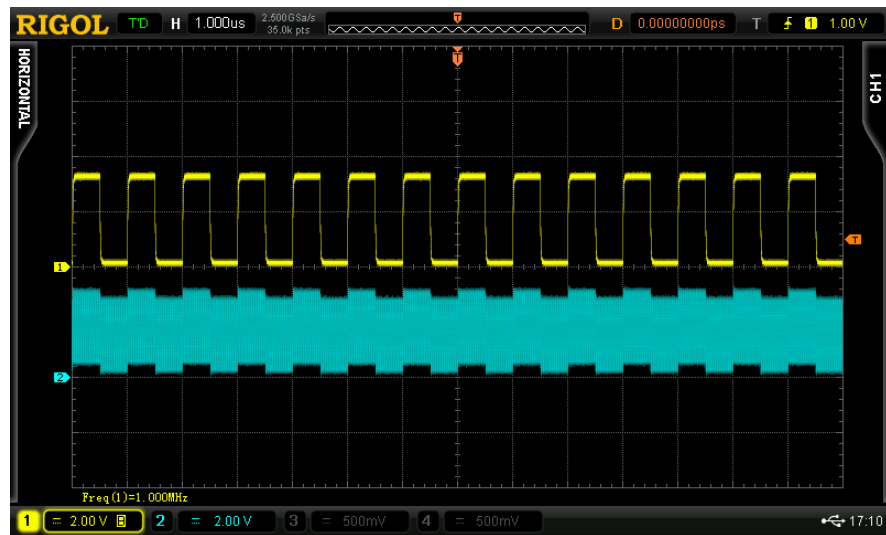

Figure 3-38 Enable 20MHz Bandwidth of CH1

● Enable the 20MHz bandwidth limit of CH2 and press SINGLE to trigger the 125 MHz high-frequency signal. The demonstration result is as shown in the figure below.
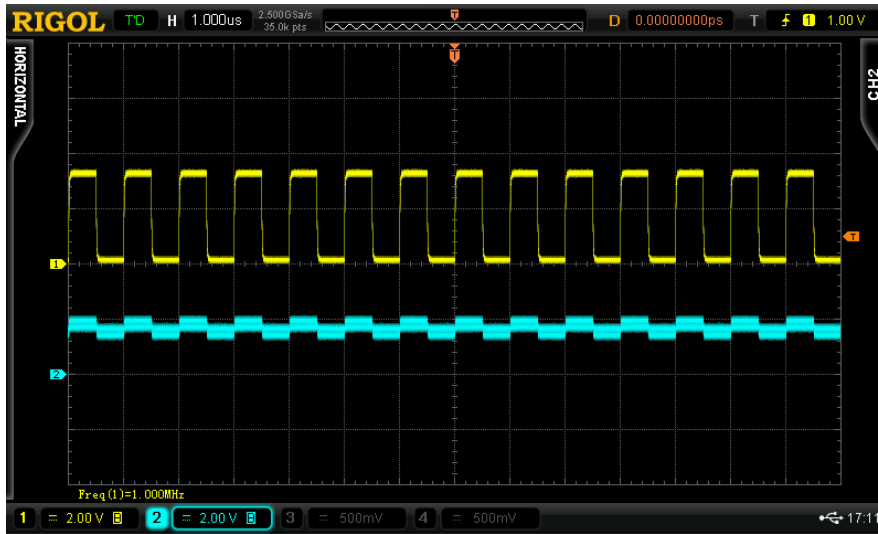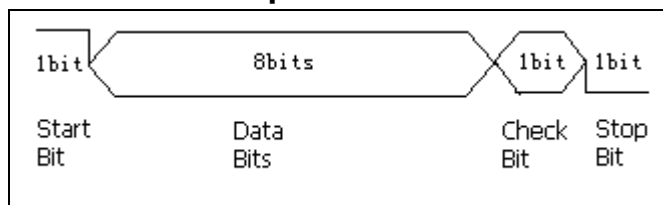

Figure 3-39 Enable 20MHz Bandwidth Limit of CH2

3.3 Digital Signal Applications

3.3.1 RS232/UART Signal

1. **RS232 Protocol Explanation**

- The start bit is always high level; the data bits is always 6bits, 7bits or 8bits. It is fixed at 8bits in this Demo board;
- By default, the data polarity is negative (namely high level stands for logic 0 and low level stands for logic 1);
- Check bit usually contains odd check, even check and none. For this Demo board, RS232 signal does not have check bit;
- Stop bit is always 1bit, 1.5bits or 2bits. For this Demo board, the stop bit of RS232 signal is 1bit.

2. **Signal Explanation**
    - **Signal Output Pin:** RS232_TX
    - Rate: 9600bps; Data: RIGOL DS6000; Frame structure: 1bit start bit+ 8bits data bits+ 1bit stop bit; LSB output; negative polarity, none (check bit)

3. **Functions**
    RS232 trigger, RS232 decoding

4. **Demonstration and Result**
    - Connect the signal output pin RS232_TX and GND to CH1 of the oscilloscope properly using the probe;
    - Set the trigger type to "RS232", the signal source to "CH1", the trigger condition to "Start", the baud rate to "9600bps" and the trigger mode to "Auto"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably;
    - When the oscilloscope is in T'D mode, set the decoding type to "RS232", TX to "CH1", RX to "OFF", the polarity to "-"(negative), the data bits to "8", the stop bit to "1 bit", the even-odd check bit to "None", the ary to "ASCII" and TX threshold to 1.36V. Set the BUS status to "ON" and the demonstration result is as shown in the figure on the next page.
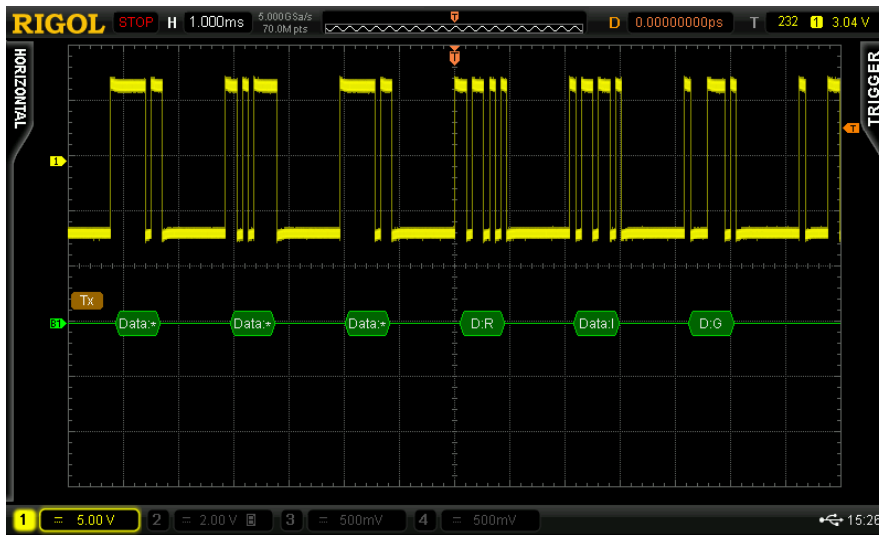
Figure 3-40 RS232 Trigger and Decoding

- Set the trigger condition to "Data" and the data to "54" (the ASCII code value of "6"). The corresponding data can be captured stably.
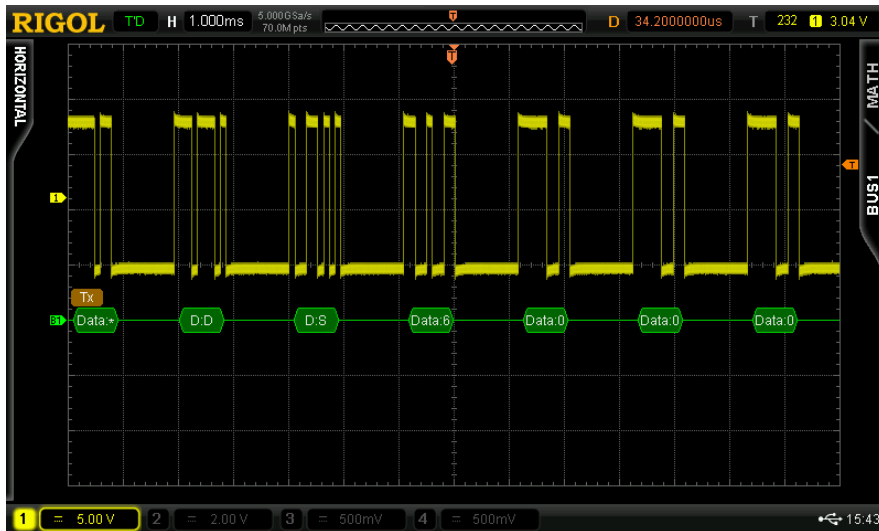

Figure 3-41 RS232 Trigger and Decoding (Data Trigger)

● Set the check mode to "Odd" in the decoding menu during the above-mentioned data trigger. As data on the Demo board does not contain check bit, red error identifier is displayed.
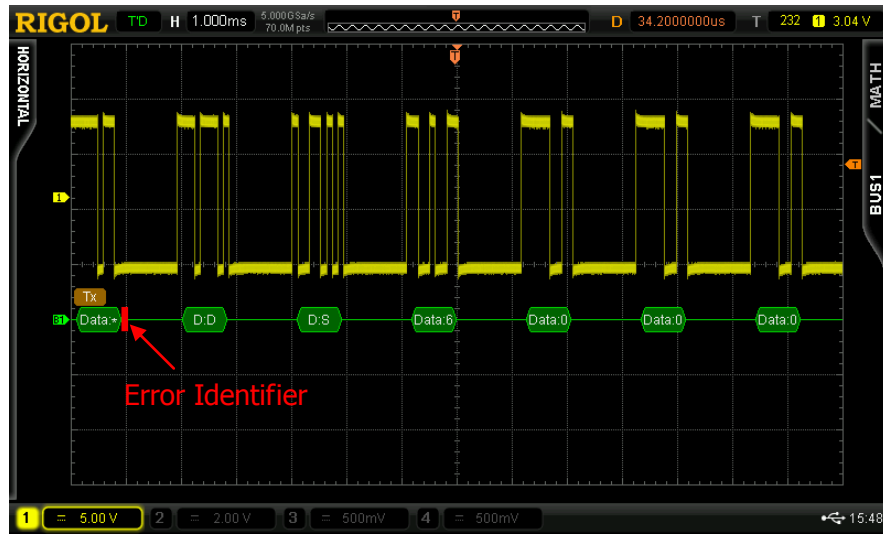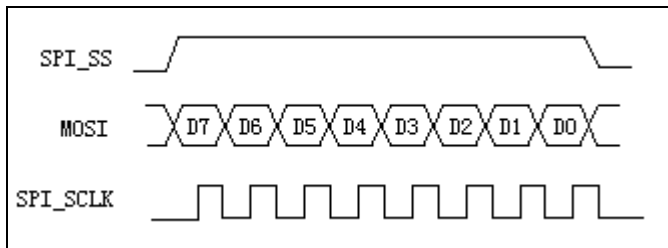

Figure 3-42 RS232 Trigger and Decoding (Odd Check)

Note: the output signal of pin UART is the same with the RS232_TX signal except that its polarity is positive. The same demonstration result can be obtained using the above method (set the polarity to "+" in protocol decoding).

3.3.2 SPI Signal

1. **Protocol Explanation**

- Clock signal and data appears synchronously. Sample the data on the rising edge of the clock signal.
- The continuous clock or data is one frame.
- SS: select positive or negative polarity. When positive polarity is selected, the oscilloscope starts decoding when the SS pin is logic low.. When negative polarity is selected, the oscilloscope starts decoding when the SS pin is logic high.
- For the data bus, every 8bit is a byte and every frame can contain 1 byte, 2 bytes or 3 bytes. In the figure above, the frame contains 1 byte.

2. **Signal Explanation**
- **Signal Output Pin:** SPI_SS, SPI_MOSI, SPI_SCLK
- The output Data increases steadily from 0 to 255 and the bits of every frame of data can be 8/16/24/32

3. **Functions**
   SPI trigger, SPI decoding

4. **Demonstration and Result**
- Connect SPI_SCLK and GND to CH1 using the probe; connect SPI_MOSI and GND to CH2 using the probe;
- Set the trigger type to "SPI", SCL to "CH1", SDA to "CH2", the trigger condition to "Timeout", the bits to 8, the data to "LLLH LLLH" and the clock edge to "Leading".
- When the oscilloscope is in T'D mode, set the decoding type to "SPI", SS and MISO to "OFF", SCLK to "CH1", MOSI to "CH2", the data bits to 8, the endian to MSB and the ary to hex. Set the BUS status to "ON" and the demonstration result is as shown in the figure on the next page.
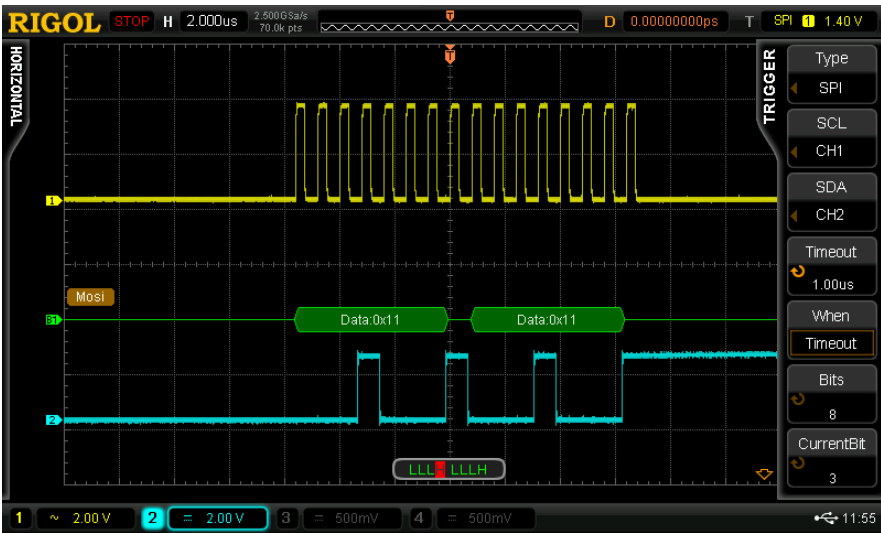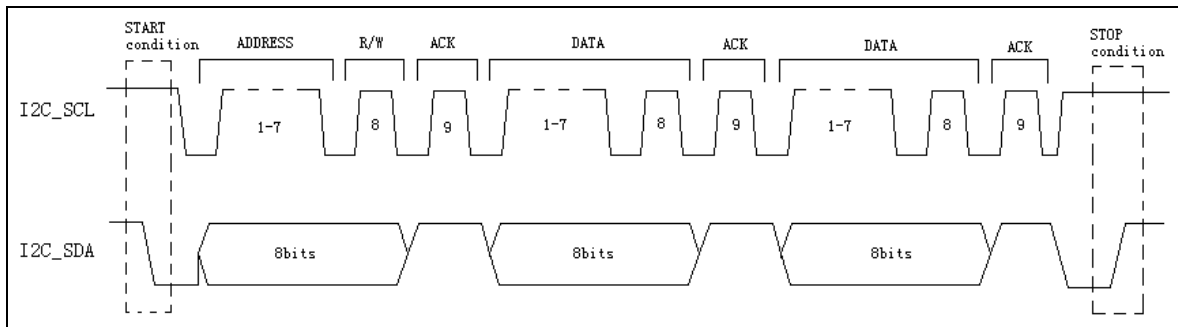
Figure 3-43 SPI Trigger and Decoding

3.3.3 I2C Signal

1. **Protocol Explanation**

- The start condition: when SCL is high level and SDA switches from high level to low level.
- The stop condition: when SCL is high level and SDA switches from low level to high level.
- The 8bits following the start condition is the slave device address and the read/write bit. The address bit can also be 10bits and at this point, it occupies two bytes.
- When the read/write bit is 0, the oscilloscope sends data (write); and when it is 1, the oscilloscope reads data (read).
- Every time a byte is sent by the host device, the slave device is asked to send a answer signal and at this point, the host device restores to the high level; if the signal is successfully received by the slave device, the level of the answer bit drops and if the signal is not successfully received, the answer bit holds in high level.

2. **Signal Explanation**
- **Signal Output Pin:** I2C_SCL, I2C_SDA
- I2C signal with 125 kHz rate. The content is "RIGOL". The data frame head and the read/write bit would change.

3. **Functions**
    I2C trigger, I2C decoding

4. **Demonstration and Result**
- Connect I2C_SCL and GND to CH1 properly using the probe; connect I2C_SDA and GND to CH2 properly using the probe.
- Set the trigger type to "I2C", SCL to "CH1", SDA to "CH2", the trigger condition to "Data", the data to "LHLH LLHL" (namely the decimal number 82 and the ASCII code of the character "R") and the trigger mode to "Auto"; adjust the vertical position and trigger level to appropriate values to make the oscilloscope trigger stably.
- When the oscilloscope is in T'D state, set the decoding type to "I2C", the ary to "ASCII", the SCLK threshold to "1.00V" and the SDA threshold to "1.00V". Set the BUS status to "ON" and the demonstration result is as shown in the figure on the next page.
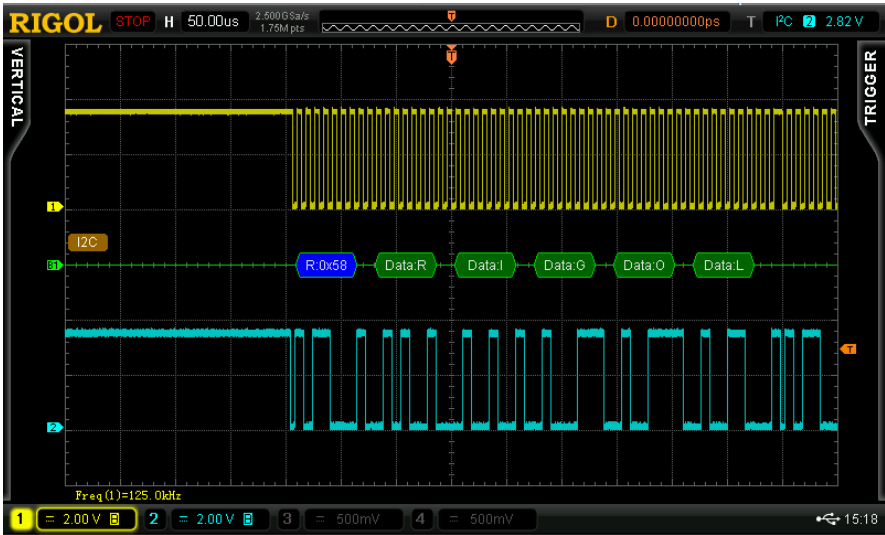
Figure 3-44 I2C Trigger and Decoding

3.3.4 CAN Signal

1. Protocol Explanation

1) The frame types include data frame, remote frame, error frame, overload frame and frame interval.

2) Standard format of data frame:

SOF	Identifier	DLC	Data	CRC	ACK	EOF

SOF: represents frame start;

Identifier: represents the ID of the data frame and is used to determine the priority of the frame;

DLC: represents the length of the data;

Data: data segment. It can contain 0 to 8 bytes of data and is output from MSB (the highest bit);

CRC: CRC check segment;

ACK: used to determine whether the data is successfully received or not.

2. Signal Explanation

● **Signal Output Pin:** CAN_L, CAN_H

● CAN signal with 1MHz signal rate. The data is the character string "RIGOL"; the data length is 5; the signal uses CRC check and does not have ACK segment.

3. Functions

CAN trigger, CAN decoding

4. Demonstration and Result

● Connect the signal output pin CAN_H and GND to CH1 of the oscilloscope properly using the probe;

● Set the trigger type to "CAN", the signal source to "CH1", the signal type to "CAN_H", the trigger condition to "SOF", the baud rate to "1Mb/s" and the trigger mode to "Auto".

● When the oscilloscope is in T'D state, set the decoding type to "CAN" and the ary to ASCII. Set the BUS status to "ON" and the demonstration result is as shown in the figure below.
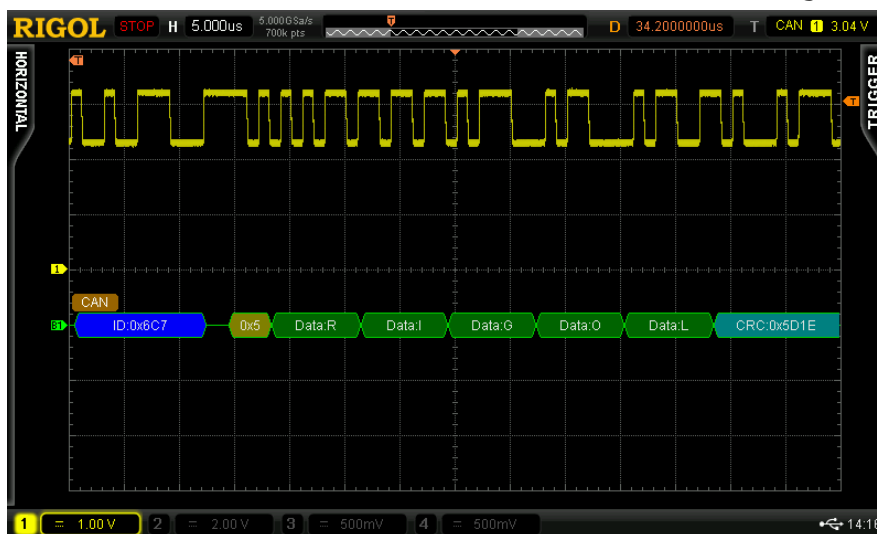

Figure 3-45 CAN Trigger and Decoding

3.3.5 Signals for Testing Logic Analyzer

1. **Signal Explanation**
   - **Signal Output Pin:** LA_D0~LA_D15
   - 16-channel parallel data (from D0 to D15). Wherein, the frequency of D0 is a half of 25MHz, the frequency of D1 is a half of the frequency of D0 and so on.

2. **Functions**
   Logic analyzer

3. **Demonstration and Result**
   - Connect LA_D0 and GND to CH1 of the oscilloscope using the probe; connect LA_D1 and GND to CH2 of the oscilloscope using the probe. The demonstration result is as shown in the figure below.
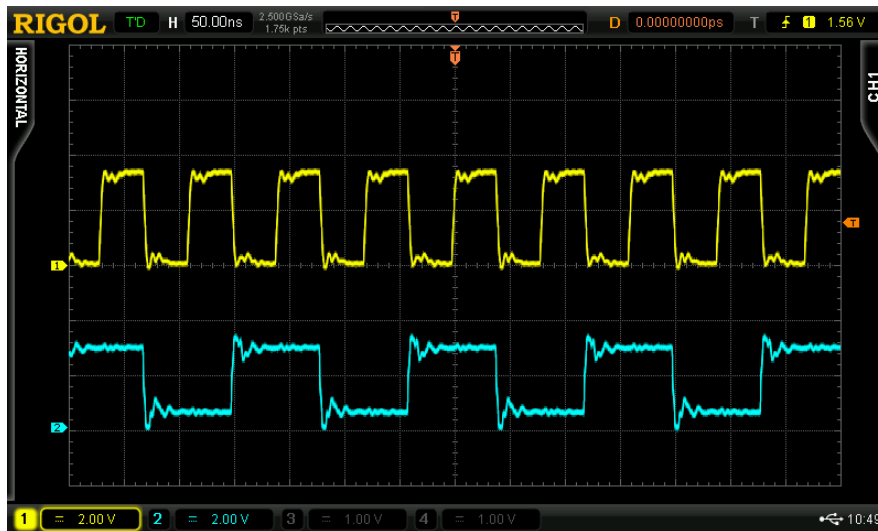

Figure 3-46 LA_D0 and LA_D1 Output Signals

- Set the trigger mode to "Pattern" (pattern trigger uses the logic relation between the two channels as trigger condition) and the trigger positions of CH1 and CH2 to "Leading" and "X", respectively. The oscilloscope can trigger stably as shown in the figure below.
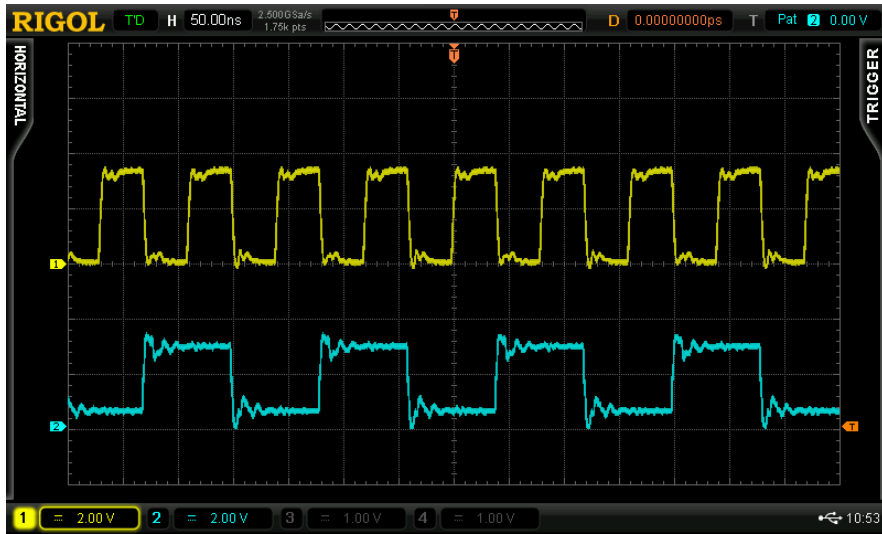

Figure 3-47 LA_D0 and LA_D1 Output Signals (Pattern Trigger)