Version: V1.00.000

Revision Date: 03-13-2023

Copyright Information

Trademark Information

Important safety and operation information

To avoid personal injury, property loss, or accidental damage to the product, please read all the information in this section before using the product.

Handle device carefully.

Do not drop, bend, puncture, insert foreign objects, or place heavy objects on the device. The inside fragile components may be damaged.

Connect and Disconnect Properly.

Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Observe All Terminal Ratings.

To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Use Proper Probe.

To avoid shock hazard, use a properly rated probe for your measurement.

Avoid Circuit or Wire Exposure.

Do not touch exposed connections and components when power is on.

Do Not Operate With Suspected Failures.

If suspected damage occurs with the device, have it inspected by qualified service personnel before further operations.

Do not operate in Wet/Damp Conditions.

Do not operate in an Explosive Atmosphere.

Keep product surfaces Clean and Dry.

Do not disassemble or refit the device.

The device is a sealing device and there are no end-user serviceable parts inside. All internal repairs must be carried out by authorized maintenance agencies or authorized technicians. Attempts to disassemble or refit the device will void the warranty.

Do not try to replace the internal battery.

The internal rechargeable battery must be replaced by authorized maintenance agencies or authorized technicians.

Precautions for vehicle ECU operation

When performing diagnostic operations on a vehicle equipped with the ECU, pay attention to the following items:

- When the ignition switch is turned on, the vehicle internal electrical units must not be disconnected. Otherwise, a high instantaneous voltage will be generated due to the self-inductance of the coil, which will cause damage to the sensor and ECU.
- Do not place magnetic objects such as radio speakers close to the computer, because the speaker magnets can damage the circuits and components in the ECU.
- Do disconnect the ECU system power supply when welding on the vehicle.
- When performing repair work near a computer or sensor, pay more attention to avoiding damage to the ECU and sensor.

- Ground yourself when you disassemble the programmable ROM. Otherwise, ECU circuits can be damaged by static electricity.
- Unless otherwise specified in the test procedure, the ECU and sensor should not be tested with a pointer ohmmeter, but with a high-impendence digital meter.
- Do not use test lamps to test ECU related electrical units in order to prevent ECU or sensor damage, unless otherwise noted.
- When people enter or exit the vehicle, the electrostatic discharge of human body can generate a high voltage of up to 10000V. Therefore, when performing maintenance operations on the digital meter controlled by the ECU or near this meter, be sure to wear a grounded metal strap with one end around the wrist and the other end clamped on the vehicle body.
- Reliably connect the ECU harness connector to avoid damage to the electronic components such as the integrated circuits inside the ECU.

FCC Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

TABLE OF CONTENTS

1 Introduction

1.1 Product Introduction

The Scopebox is an optional add-on module, including automotive oscilloscope and automotive ignition waveform.

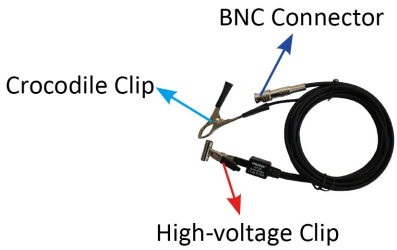
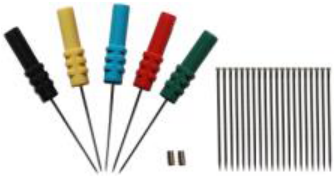
Automotive oscilloscope can make the auto repair technician to quickly judge the faults on automotive electronic equipment and wiring, and the oscilloscope sweep speed is far greater than the signal frequency of such vehicles, usually 5-10 times of the measured signal. The automotive oscilloscope not only can quickly acquire the circuit signal, but also can slowly display the waveform to observe and analyze. It can also record and store the tested signal waveform.

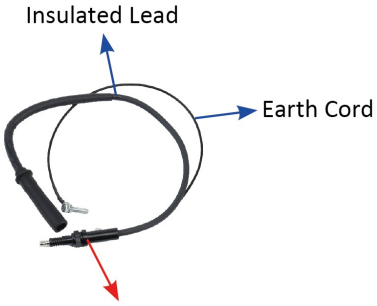
The electronic signal can be compared and judged via measuring five parameters indexes. The five parameters are the amplitude (the maximum voltage of signal), the frequency (the cycle time of signal), the shape (the appearance of signal), the pulse width (the duty cycle or the time range of signal), and the array (the repetition characteristic of signal). These parameters can be tested, displayed, saved by the automotive oscilloscope to detect the circuit fault on sensors, actuators, circuits, and electronic control units, etc.

1.2 Accessory Checklist

Common accessories are same, but for different destinations, the accessories may vary. Please consult from the local agency or check the package list supplied with this tool together.

No.	Name	Picture
1	BNC to 4mm Test Leads	 Test lead of a male BNC connector to (2) 4mm connectors. It is a kind of special line for assisting the Scopebox to test various types of signals. 4mm connectors are coded in two colors: black (earth wire) and red (positive pole which should be connected with the 6-way Breakout Leads). Moreover, it can also work with the 20:1 Attenuator.
2	20:1 Attenuator	 Allows the Scopebox to measure fuel injector and primary ignition waveforms. *Note: Please note this attenuator should be not used for any high voltage measurements other than fuel injectors and primary ignition.

3	Battery clamps cable	 Supplies power to the Scopebox through connection to vehicle's battery.
4	Secondary ignition pick-up	 This ignition pick-up is applied in the following situations: Secondary-distributor ignition analysis, Secondary-simultaneous ignition analysis and Secondary-direct ignition analysis. It has three ends: BNC connector (for connecting to CH1/CH2/CH3/CH4), crocodile clip (for Grounding) and high-voltage clip (for connecting high-voltage line), near which has an attenuator equipped for high-pressure attenuation to prevent the Scopebox from being impacted. *Notes: 1). The high voltage clip should be clamped on the insulated lead (COP Extension Cord) instead of on the spark plug to prevent breakdown and electric shock. 2). Please try to keep a distance of 2 inches from other high-voltage lines to avoid the interference.
5	Multimeter probes	
6	Crocodile clips	 Designed to connect the bare terminals or leads.
7	Back Probe Pins Suite	 Used for piercing the insulation of wires to allow for

		automotive electrical measurements without causing damage to the wires. Additionally, they can be used as pin-tip probes while working with small circuit boards.
8	USB Cable (optional)	 Connects the Scopebox to the diagnostic tool so that the sampled signal can be displayed on the diagnostic tool.
9	User Manual	
The following items are not included in this package box, which are available as an optional extension pack. User can make an order for it separately.		
1	6-way Breakout Leads (optional)	 Each lead has 6 blades wired to 6 sockets, allowing you to insert it between a plug and socket pair. The other ends are 6 (4 mm) sockets which can be connected to the BNC to 4mm Test Lead. With these 6-way leads, you will be able to test most of the sensors and actuators on all makes and models of vehicle, including MAP, temperature, throttle position and airflow sensors, fuel pumps, primary ignition circuits and fuel injectors.
2	COP (Coil-on-Plug) Extension Cord (optional)	 Coil-on-Plug extension cord (including earth cord) allows you to take accurate secondary ignition measurements on secondary-direct (Coil-on-Plug) ignition systems. It can be applied in the condition that there are no, or limited access to any spark plug leads.

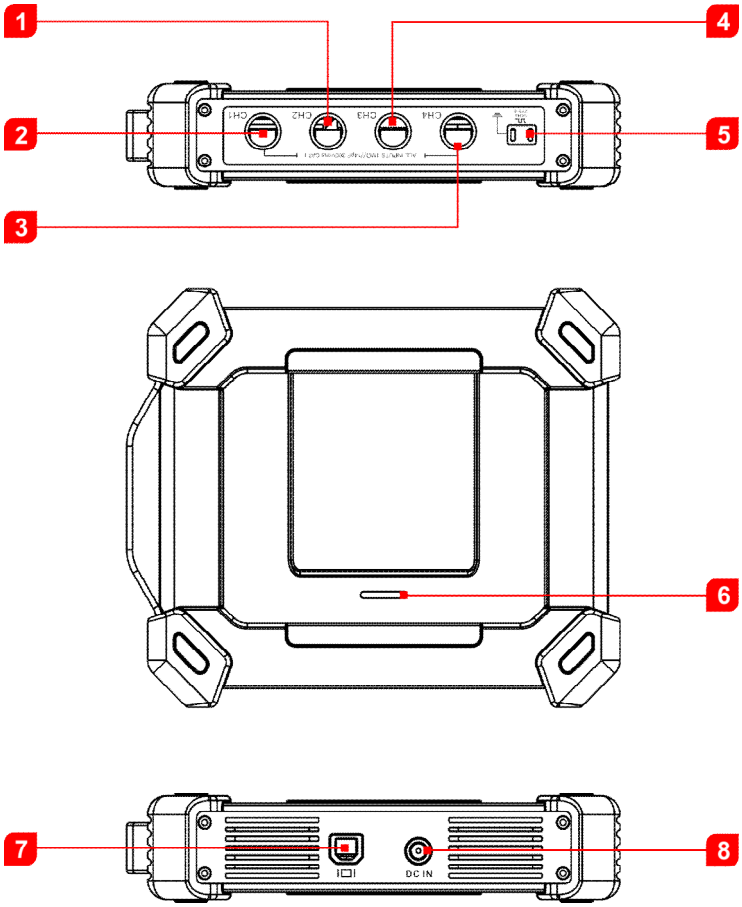
3	COP (Coil-on-Plug) and Signal Probe (optional)	 Enables you to catch the ignition waveform of automobile engine easily. The ignition waveform is a window, through which you can see what happened in the engine combustion chambers.
4	CC-650 AC/DC Current Clamp (optional)	 Enables your Scopebox to measure the current waveforms and allows your multimeter to measure current data. Its current transducer is composed by perm alloy and hall element, which linearly transform the AC or DC current to AC or DC current voltage. And if connected to an Scopebox by BNC type connector, you're able to observe the current waveforms; if connected to a multimeter by banana type connector, you can obtain the current data. AC/DC frequency range: Up to 400Hz Effective Measurement Range: 20mA to 650A DC
5	CC-65 AC/DC Current Clamp (optional)	 Functions same as the CC-650 AC/DC Current Clamp. AC/DC frequency range: Up to 20 kHz Effective Measurement Range: 20mA to 65A DC

1.3 Technical Parameters

Item	Range
Channels	4
Bandwidth	100MHz
Rising time	≤3.5ns (typical)
Max. sample rate	1G (for four channels)
Input impedance	1MΩ±1.5%
Storage depth	10M (for four channels)

Sample bit	8bit
DC gain accuracy	± 3%
Vertical scale	5mV~10V
Vertical offset range	± 2.5V (in case of probe switch “x1”, <500mV/div), ±120V (in case of probe switch “x1”, ≥500mV/div)
Invert	Support
Coupling	DC, AC
Timebase	1ns~1ks
Timebase precision	20ppm
Acquisition mode	Normal
Line decoding	CAN, LIN
Trigger type	Edge, Pulse width
Trigger mode	Normal, Auto and Single SEQ
Trigger Coupling	DC, Noise rejection
Display	YT, Zoom, Roll
Roll mode	200ms/div~1000s/div
Auto set	Support
Auto measurement items	23
Cursor	Horizontal cursor, Vertical cursor
Power interface	USB port, DC IN port
Data exchange via	USB
Compatible operating system	Android
Automotive	Circuits, sensor, actuators, ignition
Working temperature	0℃~50℃
Storage temperature	-20℃~60℃

2 Components & Controls

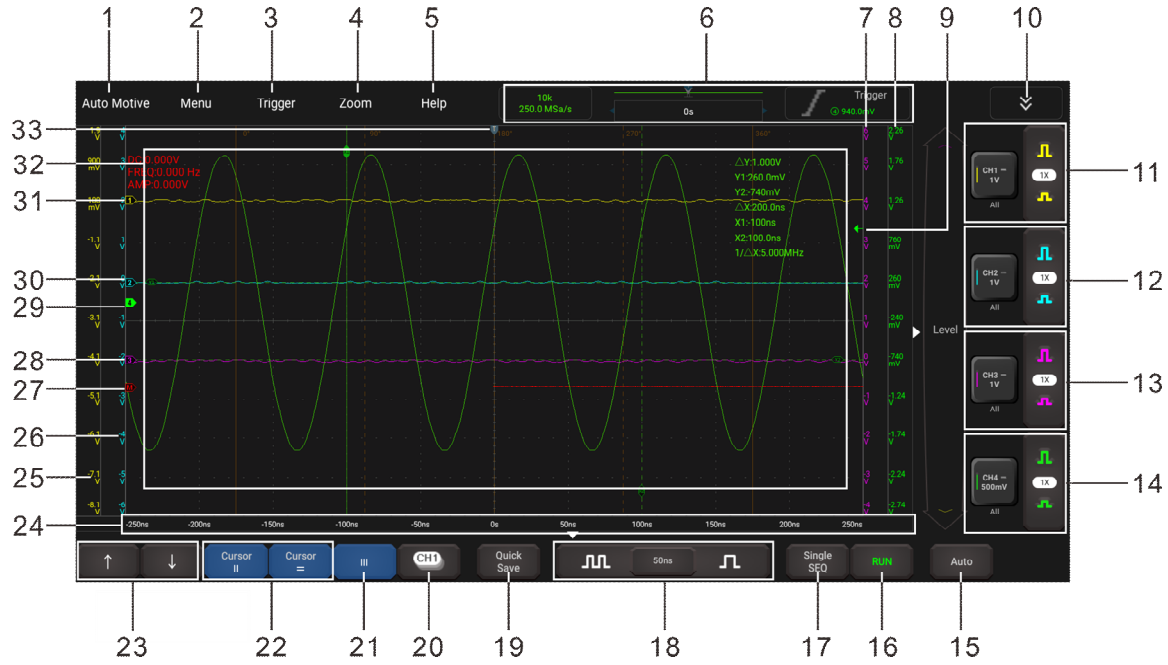


No.	Name	Description
1	CH2	Channel 2
2	CH1	Channel 1
3	CH4	Channel 4
4	CH3	Channel 3
5	Fixed signal generator	Generate a square signal with fixed 1K frequency. Probe Compensator Ground Connector 1KHz 2Vp-p
6	Working LED	• Illuminates solid green when it is powered up. • Flashes when it is communicating with the diagnostic tool. If an error occurs, it will flash more quickly.
7	B-shaped USB Port	Connect to the diagnostic tool via USB cable so that the signal can be displayed on the diagnostic tool.
8	DC IN port	Provides power to it via the battery clamps cable.

3 Initial Use

3.1 Getting Started

Tap the application icon and the following screen will appear:



No.	Descriptions	Operation tips
1	**Automotive**	Provides all kinds of the testing applications on the automotive parts (including circuits, sensors, actuators, ignition etc.).
2	**Menu** Includes the following options: • **Measure:** It provides 23 parametric measurement items. • **Save:** It allows you to save the current waveform as a reference waveform for future comparison. • **Display:** Sets the display mode of the waveform. • **UserSetting:** The following items are available: storage depth, factory reset, self-adjust (self-calibration) and save & recovery. • **About:** Displays the detailed information of the app.	Tap this button once to enter the submenu. Tap it again to fold the submenu. For detailed operations on the submenus, refer to Chapter 4.4.
3	**Trigger**	In this panel, the user can change the trigger mode, sweep mode and source channel.

4	**Zoom** The user can change the waveform display by adjusting the scale and position. When you change the scale, the waveform display will increase or decrease in size. When you change the position, the waveform will move up, down, right, or left.	Tap this button once to enter the submenu. Tap it again to fold the submenu.
5	**Help**	View the online help file of the application.
6	**Trigger information of the current channel** Readouts indicate the storage depth, sample rate, cursor position indicator and trigger information.	It shows the working status and cannot be adjusted by tapping it directly.
7	Level scale of the Channel 3	
8	Level scale of the Channel 4	
9	Edge trigger level marker	
10	**More channel settings** Sets more channels. It includes: MATH, REF, S1 LIN and S2 LIN.	Tap this button once to enter the submenu. Tap it again to fold the submenu.
11	**Channel 1 Vertical Settings Panel** Controls the amplitude of the displayed signal. User can change Invert, coupling and probe attenuation of the CH1.	Take Channel 2 for example to explain how to operate the vertical setting panel. Tap  **once** – turns on the channel and sets it as the current channel.  Tap  **twice** – Calls out the channel vertical settings. Tap  **three times** - turns off the channel.
12	**Channel 2 Vertical Settings Panel** Controls the amplitude of the displayed signal. User can change Invert, coupling and probe attenuation of the CH2.	
13	**Channel 3 Vertical Settings Panel** Controls the amplitude of the displayed signal. User can change Invert, coupling and probe attenuation of the CH3.	
14	**Channel 4 Vertical Settings Panel** Controls the amplitude of the displayed signal. User can change Invert, coupling and probe attenuation of the CH4.	
15	**Auto** It automatically adjusts the vertical scale, horizontal scale and trigger settings.	Tap this button to start auto-set.
16	**RUN/STOP/WAIT** • **WAIT**: All pre-triggered data has been acquired and the Scopebox is ready to accept a trigger.	

	• **STOP**: The Scopebox has stopped acquiring waveform data. • **RUN**: The Scopebox is running.	
17	**Single SEQ**	
18	**Horizontal settings** Controls the time base. If the waveform acquisition is stopped, this setting expands or compresses the waveform.	Tap this button once to enter the submenu. Tap it again to fold the submenu.
19	**Quick Save** Quickly saves the waveforms of all channels as the reference waveforms and capture the current screen as screenshots. To change the save path and file type, go to **Menu** -> **Save**.	
20	CH1 **Channel selection button** Tap it to select the desired channel.	Tap this button once, the channel (only the channels that have been turned on) selection pop-up will appear. Tap it again to fold the submenu.
21	**Phase ruler**	Tap this button once to activate it. Tap it again to exit. See Chapter 4.10 for details.
22	**Cursor settings** Turn on/off the horizontal/vertical cursor measurement function. When set to ON, two horizontal/vertical reference lines named with Y1 & Y2/X1 & X2 will be displayed on the waveform display area. The user can use ↑/↓ or ←/→ to fine tune the line or drag the line directly to move it.	Tap this button once to start the cursor calculation function. Tap it again to disable it.
23	↑/↓ **or** ←/→ **Fine-tuning button** Fine tunes the vertical/horizontal reference line.	When the horizontal cursor is ON, the fine tuning buttons display ↑ and ↓. If the vertical cursor is ON, the fine tuning buttons will change into ← and →.
24	**Horizontal time base scale**	
25	**Level scale of the Channel 1**	
26	**Level scale of the Channel 2**	
27	**Math marker** Shows the reference points of the displayed waveforms.	The MATH channel is hidden under the ⌄⌄ tab.

	If there is no marker, the channel is turned off and not displayed.	
28	**CH3 marker** Shows the reference points of the displayed waveforms. If there is no marker, the channel is not displayed.	If the marker is displayed as ▷, it indicates the channel is not the current channel. Tap the marker ▷, it will change into ▶; it indicates the channel is the current channel.
29	**CH4 marker** Shows the reference points of the displayed waveforms. If there is no marker, the channel is not displayed.	
30	**CH2 marker** Shows the reference points of the displayed waveforms. If there is no marker, the channel is not displayed.	
31	**CH1 marker** Shows the reference points of the displayed waveforms. If there is no marker, the channel is not displayed.	
32	**Waveform display area**	
33	**Horizontal trigger position marker**	Horizontal position changes the displayed waveform position, relative to the trigger point. The user can drag it on the screen to change the horizontal position.

3.2 Probe Compensation

Perform this function to match the characteristics of the probe (optional) and the channel input. The probe that has not been compensated may cause measurement tolerance or error.

1. Power the Scopebox on: Plug one end of the battery clamps cable into the DC-IN port of the Scopebox, and then clamp the other two terminals to the vehicle's battery (Red to +, and Black to -) respectively.

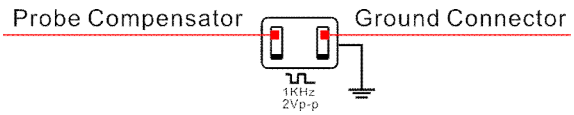
   Note: This connection only applies to the condition that the diagnostic tool cannot provide enough power to the Scopebox via USB cable. If the diagnostic tool can supply enough power to the Scopebox, please ignore this step.

2. Connect the B-shaped plug of the USB cable to the USB port of the Scopebox, and the other end to the USB port of the diagnostic tool.
3. Launch the Scopebox App to run it.
4. From the "Vertical Setting" panel, select the corresponding channel and set the Probe attenuation to **10X**.

Settings	Corresponding attenuation proportion
1x	1:1
10x	10:1
20x	20:1

	50x	50:1
	100x	100:1
	200x	200:1
	500x	500:1
	1kx	1000:1
	2kx	2000:1
	5kx	5000:1
	10kx	10000:1

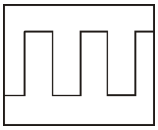
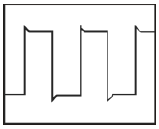
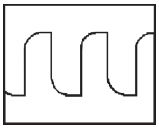
5. Set the switch to "X10" (the default is X1) on the probe and connect it to the CH1 of the Scopebox.
6. Attach the probe tip to the Probe Compensator and the ground nip of the reference lead to the ground connector. When using the probe hook-tip, insert the tip onto the probe compensator firmly to ensure a proper connection.



7. Tap the **Auto** button located on the bottom of the screen, a square wave (approximately 1KHz 2V peak-to-peak) will be displayed within several seconds.

Note: The above steps also can be applied to check whether the signal input/output of other Channels are normal or not.

8. Check the shape of the displayed waveform to determine whether the probe is correctly compensated.

Correctly Compensated		
Over Compensated		Note: If necessary, use a non-metallic tool to adjust the trimmer capacitor of the probe for the fattest square wave being displayed on the diagnostic tool.
Under Compensated		

Warning: To avoid electric shock while using the probe, make sure the insulated cable is perfect, and do not touch the metallic portions of the probe head while it is connected with a high-voltage source.

9. Inspect CH2, CH3 and CH4 with the same method.

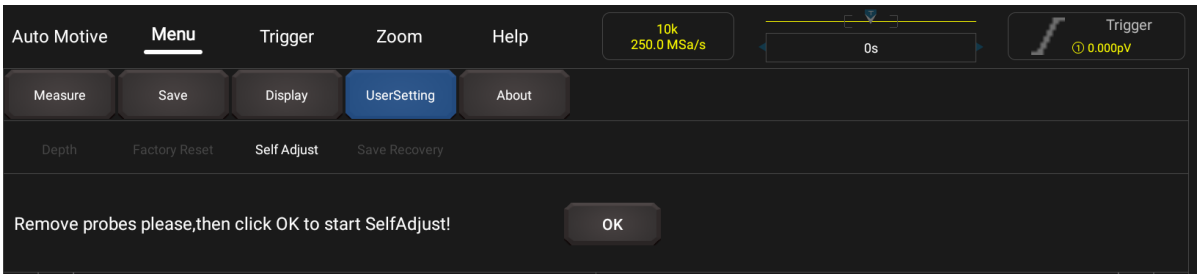
3.3 Self-Calibration

The self-calibration routine lets you optimize the oscilloscope signal path for maximum measurement accuracy. You can run the routine at any time but you should always run the routine if the ambient temperature changes by 10°C or more.

For accurate calibration, power on the Scopebox and wait twenty minutes to ensure it is warmed up.

Note: To compensate the signal path, disconnect any probes or cables from the input connectors.

Then, access **Menu -> UserSetting**, tap **Self Adjust**.



Tap **OK** on the message box to start calibration. The LED on the Scopebox starts flashing and the prompt message “Self Adjust is running” will appear on the upper left corner of the screen.

Note: While calibrating, a lock icon will appear on the upper right corner of the screen. In this case, no operations are allowed to perform until the calibration process is successfully finished. After the calibration is complete, the lock icon will disappear.

The self-calibration routine takes several minutes. After calibration is complete, the prompt message “Self Adjust is successful” will pop up on the screen.

3.4 Connection

For different applications, the connection methods may vary.

1. Power the Scopebox on: Plug one end of the battery clamps cable into the DC-IN port of the Scopebox, and then clamp the other two terminals to the vehicle's battery (Red to +, and Black to -) respectively.

   Note: This connection only applies to the condition that the diagnostic tool cannot provide enough power to the Scopebox via USB cable. If the diagnostic tool can supply enough power to the Scopebox, please ignore this step.

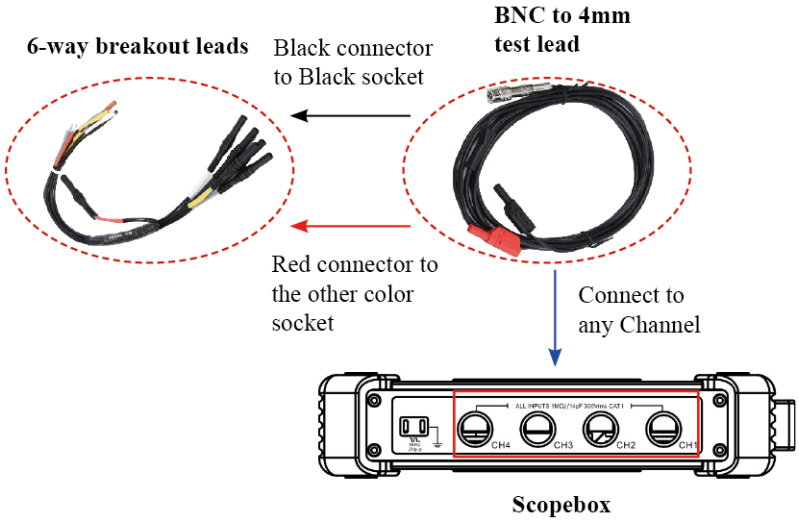
2. Connect the B-shaped plug of the USB cable to the USB port of the Scopebox, and the other end to the USB port of the diagnostic tool.

A. While testing sensors or actuators,

3. Connect the BNC connector of the BNC to 4mm test lead to the CH1/CH2/CH3/CH4, and plug the red (SIGNAL) 4mm connector into one of the back probe pins.
4. Pierce the back probe pin through the signal wire of the vehicle sensor.

Note: Alternatively, user can follow the steps below to make the connection via the 6-way breakout leads (optional):

1. Connect the BNC connector of the BNC to 4mm test lead to the CH1/CH2/CH3/CH4, and plug the black (GND) and red (SIGNAL) 4mm connectors into the Black (GND) and other color (SIGNAL) banana sockets of the 6-way breakout leads (optional) respectively.

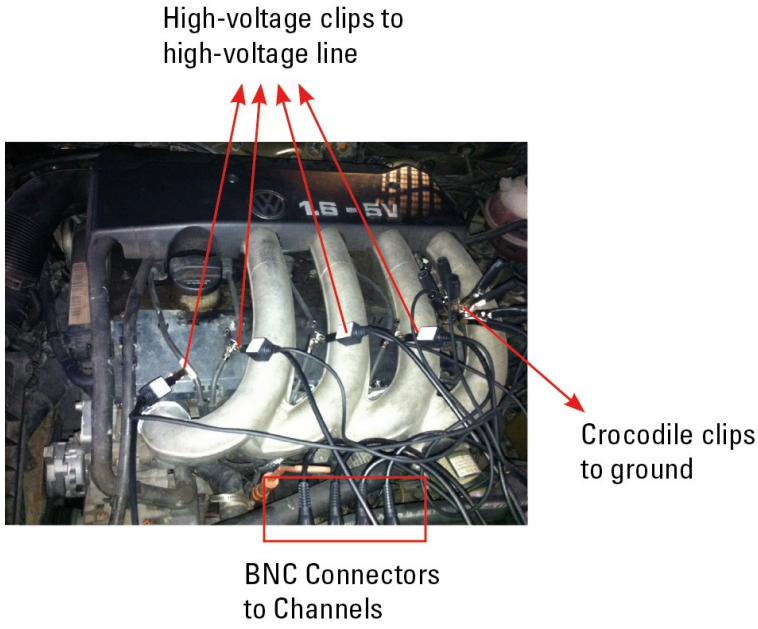


2. Connect the black terminal and signal wire (its other end connected to the red 4mm connector) of the 6-way breakout lead to the GND and signal terminal of the vehicle sensor.

B. While testing Secondary-distributor ignition analysis/Secondary-simultaneous ignition analysis,

3. Connect the BNC connector of the secondary ignition pick-up to any channel of the Scopebox, and clamp the crocodile clips and high-voltage clips onto the vehicle ground and high-voltage line respectively.

   The connection is as follows:



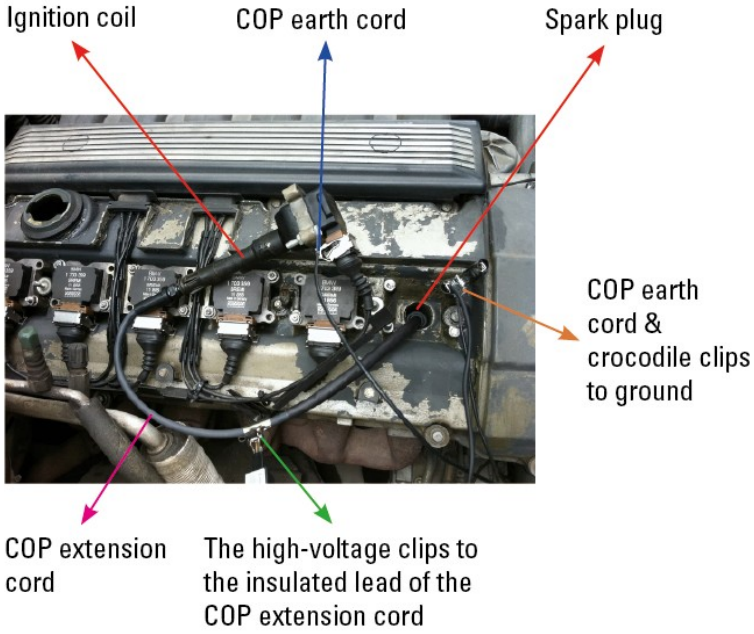
   For detailed operations, please refer to Chapter 5.

C. While testing Secondary-direct ignition analysis,

3. *When the high-voltage wire is exposed*, plug the BNC end of secondary ignition pickup into CH1/CH2/CH3/CH4 channel of Scopebox, then connect the high-voltage clip to high-voltage line, and crocodile clips to ground.
4. *If no high-voltage wire is exposed*, dismantle ignition coil of tested cylinder. Connect one end of the COP extension cord to the ignition coil which should be grounded via COP earth cord, and insert the other end into the cylinder to joint with spark plug. Then plug the BNC end of secondary ignition pickup into CH1/CH2/CH3/CH4 channel of Scopebox, and then connect the high-voltage clip to high-voltage

line, and crocodile clips to ground.

The connection is as follows:



For detailed operations, please refer to Chapter 5.

4 Operations

4.1 Channel Selection

A total of 6 channels are availabe. By default, 4 channels (CH1, CH2, CH3 and CH4) are displayed on the right side of the screen. MATH and REF are rarely used and folded, which can be called out by tapping .

Follow the methods to select a channel:

Select CH1/CH2/CH3/CH4	Select Channel MATH/REF
There are two methods for your opt: A. Tap the channel tab shown on the right edge of the screen.  B. Tap CH1 to select the desired channel. In this mode, only the channels that are turned on can be selected. Note: For better comparison and identification, each channel and waveform are marked in different colors.	Tap .  Note: For detailed operations on the Channel MATH and REF, refer to Chapter 4.9.

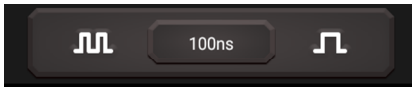
The Scopebox can display multiple waveforms simultaneously, but only one waveform is allowed to display at top. The top channel is called current channel. The marker of the current channel is displayed as , otherwise it is non-current channel.

4.2 Channel Attributes & Trigger Setting

Channel attributes can be set via horizontal settings and vertical settings.

4.2.1 Horizontal Settings

User can change the horizontal time/division scale by tapping or directly or by tapping the time/division value to select it from the pull-down list.



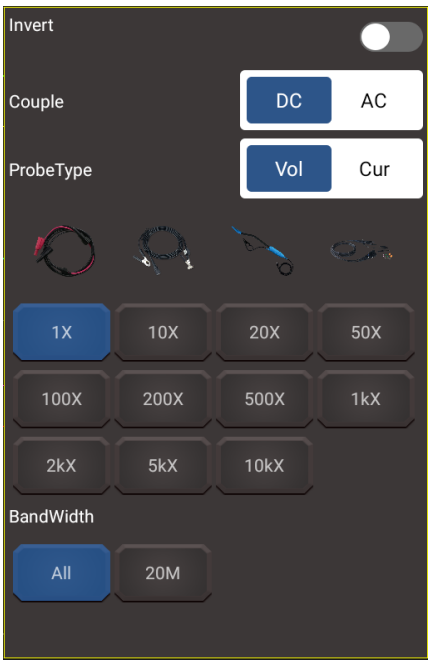
If the waveform acquisition is stopped, the time/division selector ( ) expands or compresses the waveform.

4.2.2 Vertical Settings

The trigger determines when the Scopebox starts to acquire data and display a waveform. When a trigger is set up properly, it can convert unstable displays or blank screens into meaningful waveforms.

When the Scopebox starts to acquire a waveform, it collects enough data so that it can draw the waveform to the left of the trigger point. The Scopebox continues to acquire data while waiting for the trigger condition to occur. After it detects a trigger, the Scopebox continues to acquire enough data so that it can draw the waveform to the right of the trigger point.

Tap certain channel to call out the vertical setting option.



Options descriptions:

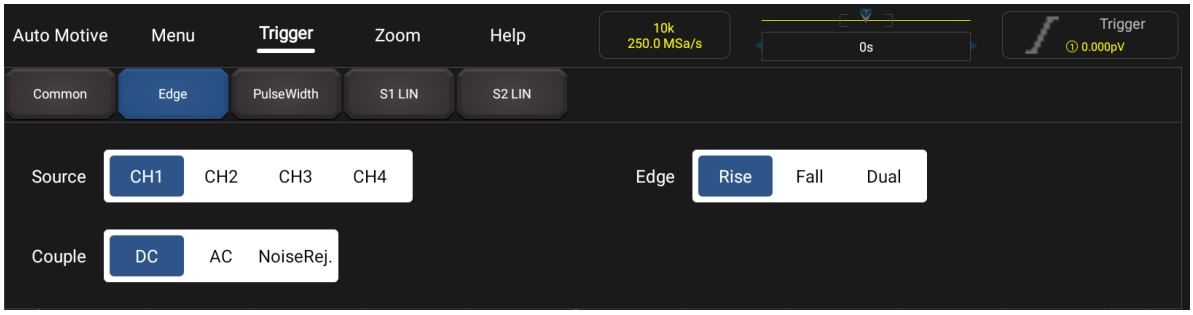
Menu	Comments/Settings
Invert	The invert function turns the displayed waveform 180 degrees, with respect to the ground level. When the oscilloscope is triggered on the inverted signal, the trigger is also inverted. ON: Turn on the invert function. OFF: Restore to the original display of the waveform.
Couple	Trigger coupling determines what part of the signal passes to the trigger circuit. AC and DC are included: AC: Blocks the DC component of the input signal. DC: Passes both AC and DC components of the input signal.

Probe Type	Choose the probe type. Vol and Cur are included: Vol: Voltage probe. Cur: Current probe. After choosing the desired probe type, the system will automatically configure to the preset attenuation factor. The attenuation factor changes the vertical scaling of the Scopebox so that the measurement results reflect the actual voltage levels at the probe tip. The user also can set the factor from the options manually or tapping the  to change it.
Bandwidth	Select the desired bandwidth.

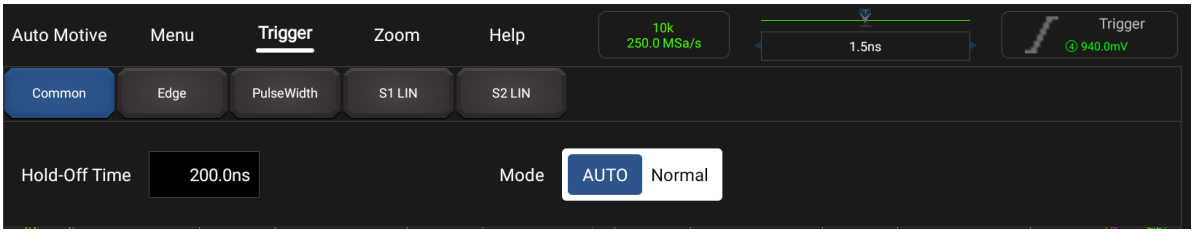
4.2.3 Trigger Setting

Trigger indicates that when certain waveform meets the conditions that are predefined according to the requirements, the Scopebox acquires the waveform and its adjacent section, and then presents it on the screen.

Go to **Menu -> Trigger**, the following screen will appear:



Common allows you to set the sweep mode. The sweep mode determines how the Scopebox behaves in the absence of a trigger event. The Scopebox provides two trigger modes: Auto, Normal.

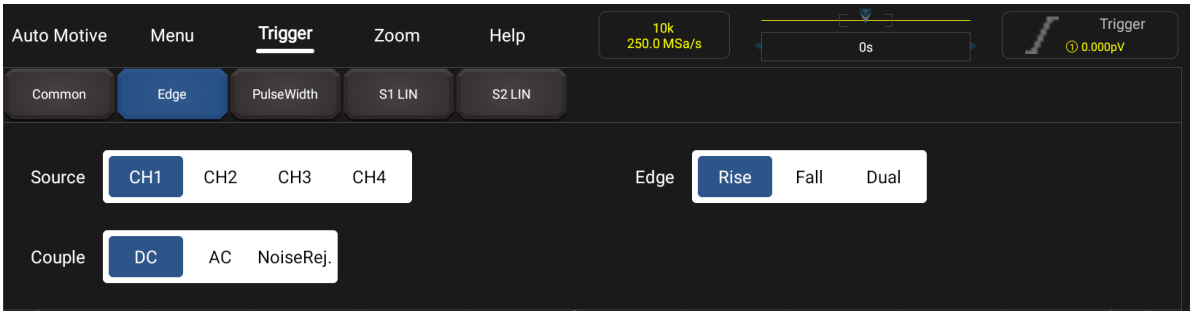


Auto: It allows the Scopebox to acquire waveforms even when it does not detect a trigger condition. If no trigger condition occurs while the Scopebox is waiting for a specific period, it will force itself to trigger.

When forcing invalid triggers, the Scopebox can not synchronize the waveform, and then waveform seems to roll across the display. If valid triggers occur, the display becomes stable on the screen.

Normal: This mode allows the Scopebox to acquire a waveform only when it is triggered. If no trigger occurs, the Scopebox keeps waiting, and the previous waveform, if any, will remain on the display.

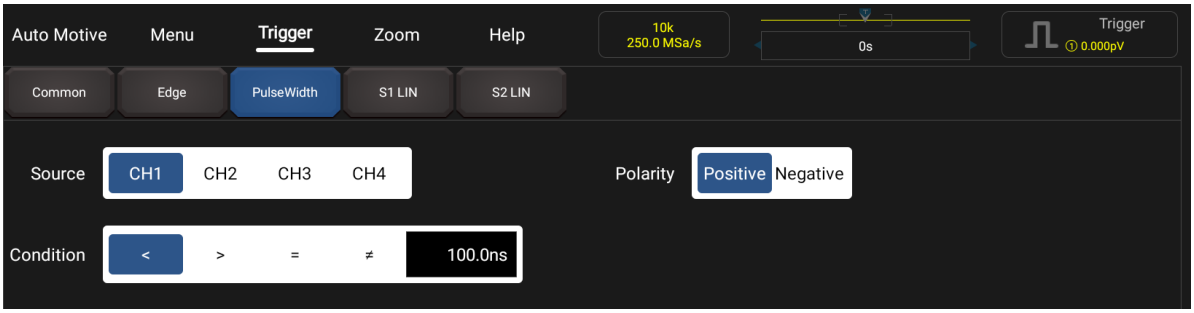
If **Edge** trigger is selected (An edge trigger determines whether the Scopebox finds the trigger point on the rising/falling/dual edge of a signal.):



Menu	Comments/Settings
Source	Select which channel as trigger signal.
Edge	Rise: Trigger on rising edge. Fall: Trigger on falling edge. Dual: Trigger on dual edges.
Couple	It can be set as DC or Noise Rejection.

In this mode, the user can set the trigger level by directly dragging the Level scroll bar or the icon ◄— on the right side of the waveform display area.

If **Pulse Width** trigger is selected (Pulse trigger occurs according to the width of pulse. The abnormal signals can be detected through setting up the pulse width condition):



Menu	Comments/Settings
Source	Select which channel as trigger signal.
Polarity	Set +pulse width or –pulse width.
Condition	To select pulse condition.

S1 LIN and **S2 LIN** refer to the measurement settings of LIN and CAN, which are used in the automotive communication BUS.

4.3 Auto-Set

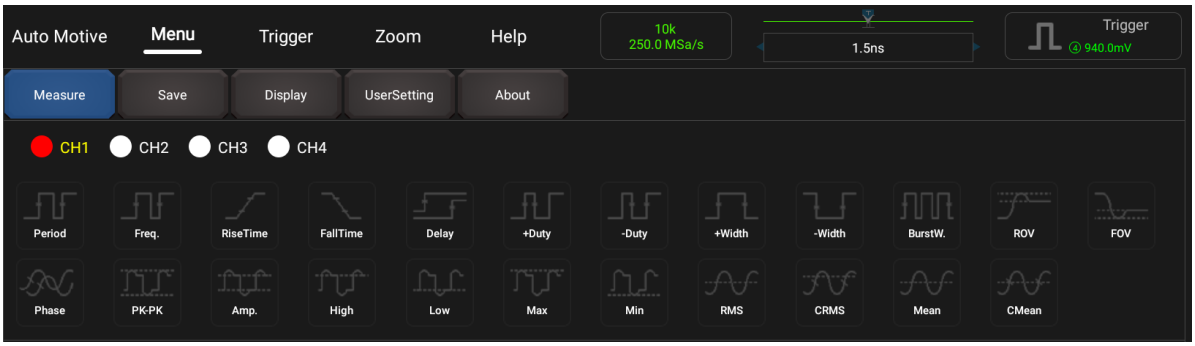
The Scopebox has an Auto-set feature that sets up the Scopebox automatically to display the input signal in a best fit.

Tap **Auto**, the Scopebox may change the current settings to display the signal. It automatically adjusts the vertical and horizontal scaling, as well as the trigger coupling, position, slope, level and mode settings.

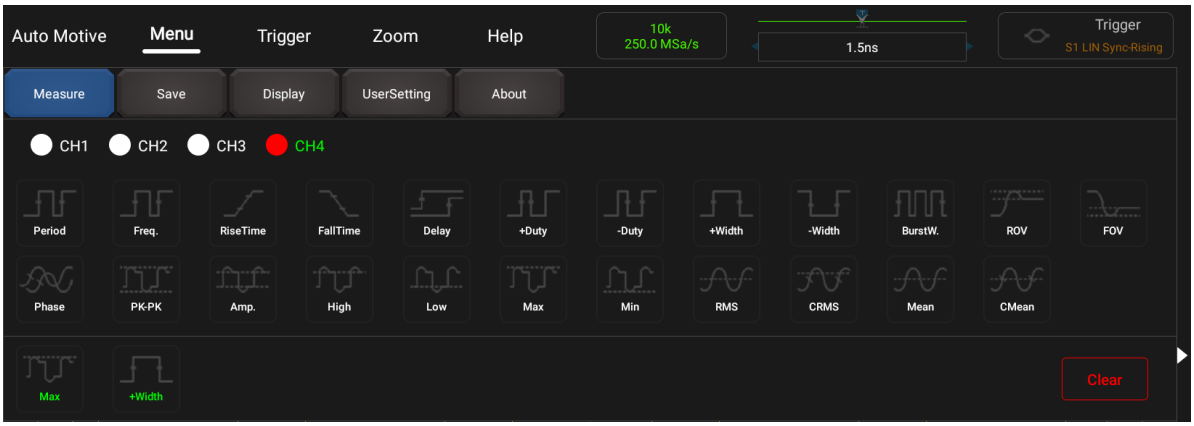
4.4 Menu Operations

4.4.1 Measure

The Scopebox provides 23 parametric auto measurements. Tap **Measure**, the following screen will appear:



Tap to select the desired measurement item (Maximum 10 items can be selected at the same time). All selected items will be shown on the left side of the **Clear** button.

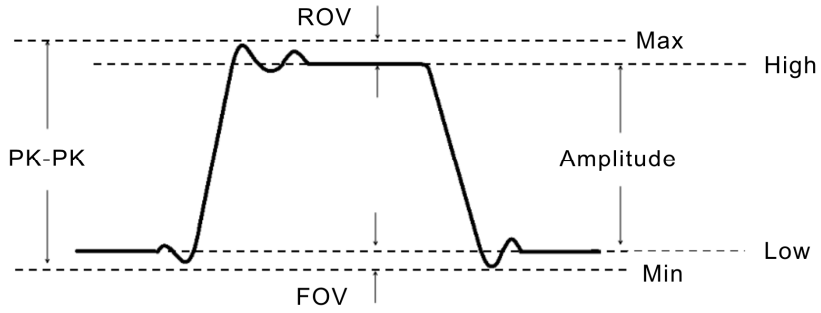


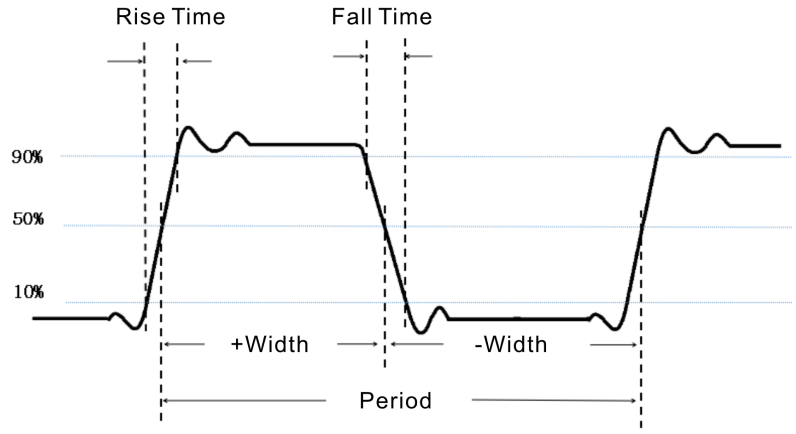
Tap it to remove the measurement item. The values corresponding to the selected items will be displayed on the bottom of the screen.

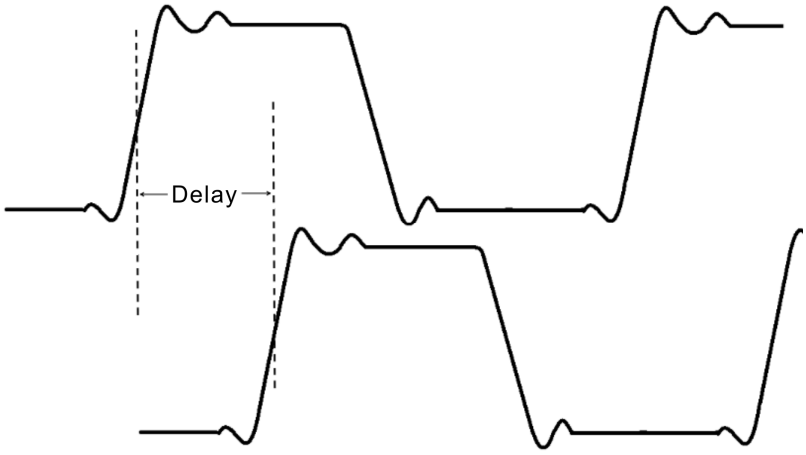
- Period: Time for the first signal cycle to complete in the waveform.

- Frequency: Reciprocal of the period of the first cycle in the waveform.
- Rise Time: Time taken from lower threshold to upper threshold.
- Fall Time: Time taken from upper threshold to lower threshold.
- +Duty: Positive Duty Cycle = (Positive Pulse Width)/Period x 100%, Measured of the first cycle in waveform.
- -Duty: Negative Duty Cycle = (Negative Pulse Width)/Period x 100%, Measured of the first cycle in waveform.
- +Width: Measured of the first positive pulse in the waveform. The time between the 50% amplitude points.
- -Width: Measured of the first negative pulse in the waveform. The time between the 50% amplitude points.
- PK-PK: Peak-to-peak = Max-Min, measured over the entire waveform.
- Amp.: Amplitude = Base-Top, measured over the entire waveform.
- High: Voltage of the statistical maximum level, measured over the entire waveform.
- Low: Voltage of the statistical minimum level, measured over the entire waveform.
- Max: Voltage of the absolute maximum level, measured over the entire waveform.
- Min: Voltage of the absolute minimum level, measured over the entire waveform.
- RMS: The Root Mean Square voltage over the entire waveform.
- Mean: The arithmetic mean over the entire waveform.
- CMean: Cycle Mean. The arithmetic mean over the first cycle in the waveform.

The following illustrations explain some common measurement items for your reference.







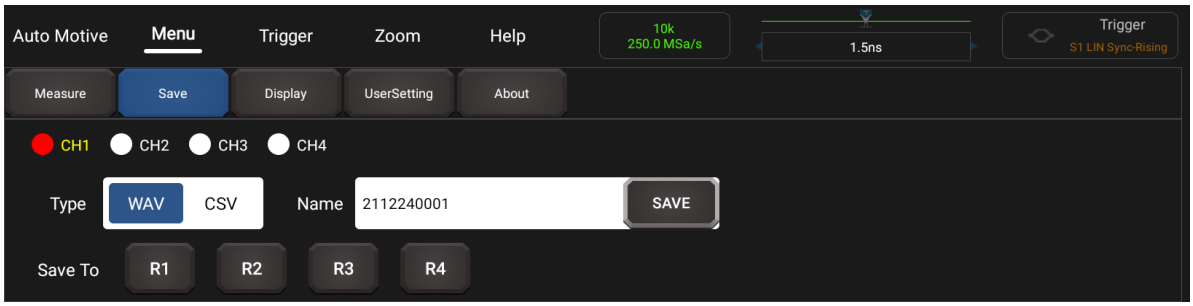
Tap **Clear** to clear all measurement items on the screen.

Note: The results of the automatic measurements will be displayed on the bottom of the screen. Maximum 10 results could be displayed at the same time.

4.4.2 Save

This function allows you to save the waveforms of the channels for future reference.

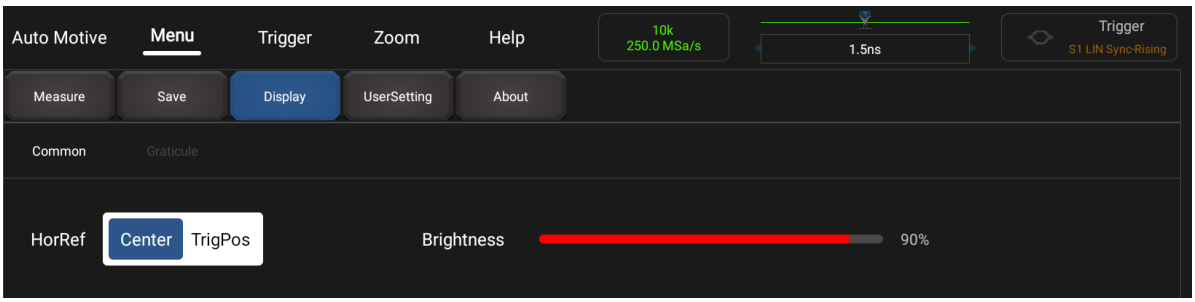
Tap **Save**, the following screen will appear:



Select the desired measurement channel and save type (.WAV or .CSV), tap the default file name to revise it. Tap **Save** to save it. Alternatively, the user can save the waveform files to the designated folder (R1, R2, R3 and R4). If the files are saved under the folder, the user can recall the saved files (go to **-> REF –> Recall**) for reference.

4.4.3 Display

This function enables you to set the display form in which the waveforms are displayed. Tap **Display**, the following screen will appear:



There are two options available: Common and Graticule.

Common allows you to set the horizontal reference, brightness of the waveform.

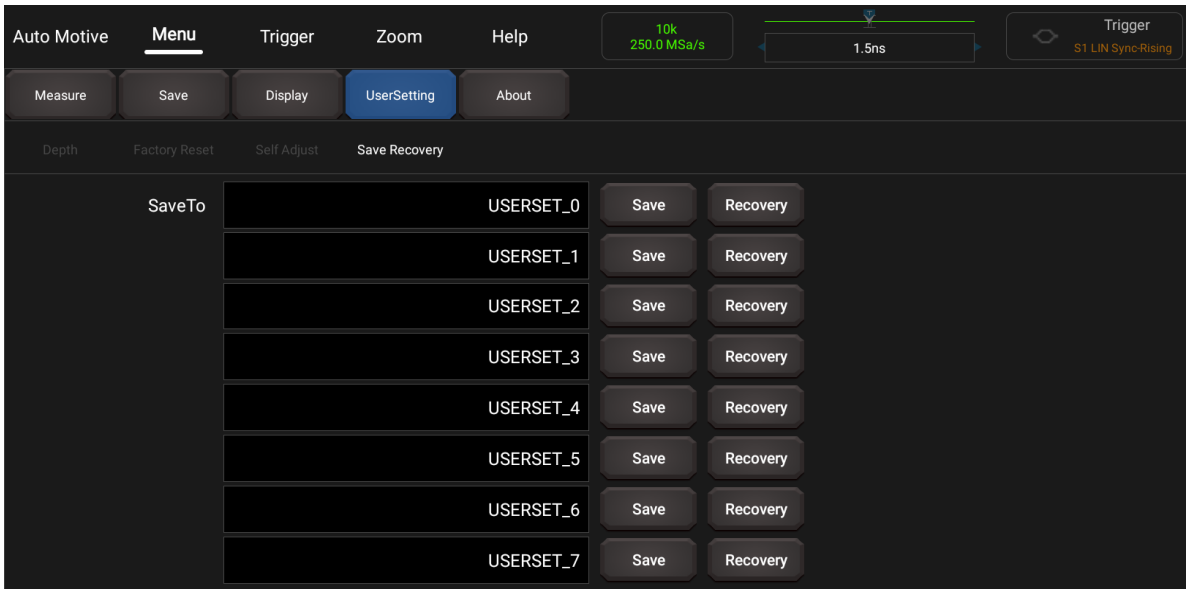
Graticule includes the display mode settings (including Full, Grid, Retical and Frame) and waveform color intensity.

4.4.4 Trigger

This function is used to set the trigger condition and settings. For details, refer to Chapter 4.2.3.

4.4.5 UserSetting

This function enables you to make some system settings. Tap **UserSetting**, the following screen will appear:



It mainly includes the following options:

Depth: Storage depth.

Factory Reset: The Scopebox app is set up for normal operation when it is shipped from the factory. This is the factory setup. This option allows you to recall this setup.

Self Adjust: The self-calibration routine lets you optimize the oscilloscope signal path for maximum measurement accuracy. Refer to Chapter 3.3 for detailed operations.

Save & Recovery: Save allows you to permanently save the current system setup before exiting the application. Recovery allows you to directly recall the desired saved setup before the Scopebox was running to avoid repeated setups.

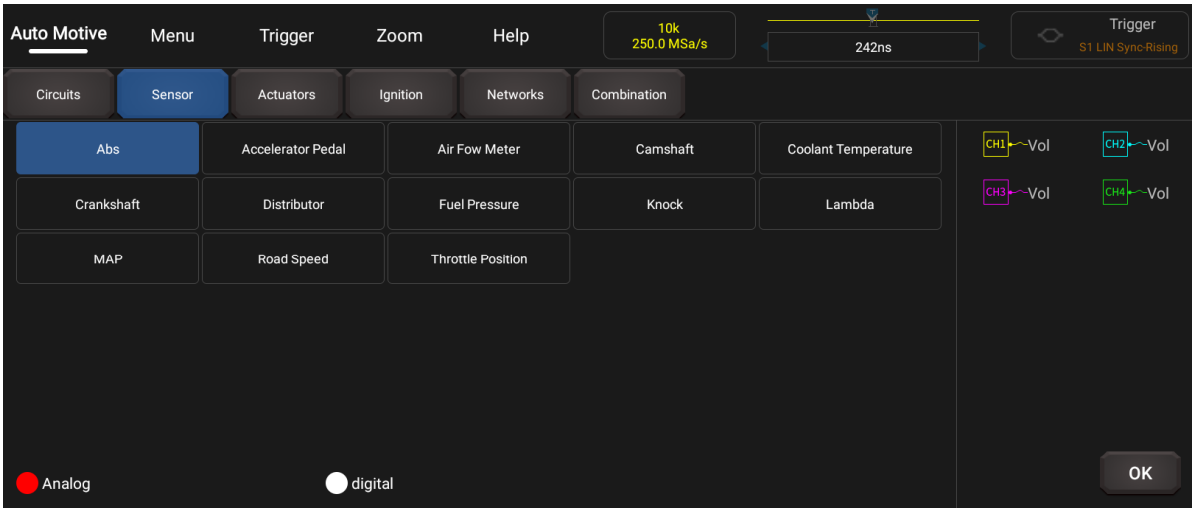
4.4.6 About

Displays the basic information of the app.

4.5 Automotive Operations

This function provides all kinds of the testing applications on the automotive parts (including circuits, sensors, actuators, ignition etc.) and detailed connection methods.

Tap **Automotive**, the following screen will appear:



Tap to select the desired automotive part, the system will automatically configure the option to the preset parameters. The user does not need to make any settings. Just follow the on-screen instructions to make connections and proceed.

4.6 Zoom

If the displayed waveform contains some valuable information of the collected data, the user can stop acquiring data and zoom in to analyze. Meanwhile, the Zoom mode also allows user to observe the whole waveform and partial details in case of larger storage depth.

Zoom mode provides one main window and one Zoom window. The selected segment of the main window will be zoomed in and displayed in the Zoom window.

Note: This function only applies to the acquired data or the data that has been stopped.

4.7 Cursor Operations

The Cursor function can be used for assisting in measurement.

Tap = / || to turn on the cursor function and place the cursor on the measurement point to read the waveform measurement value.

There are two types of cursors: horizontal cursor and vertical cursor. The horizontal cursor measures the value in the vertical direction, and the vertical cursor can measure the value in the horizontal direction.

When set to ON, two horizontal/vertical reference lines named with Y1 & Y2/X1 & X2 will be displayed on the waveform display area. The user can use ↑/↓ or ←/→ to fine tune the line or drag the line directly to move it.

Tap = / || again to turn it off.

Notes:

△Reading: indicates the difference between the two cursor positions.

The voltage reading after Y1, Y2: indicates the position of the activated cursor in the horizontal cursor relative to the zero level.

The time reading after X1, X2: indicates the position of the activated cursor in the vertical cursor relative to the trigger point.

1/△X: Frequency

4.8 Quick Save

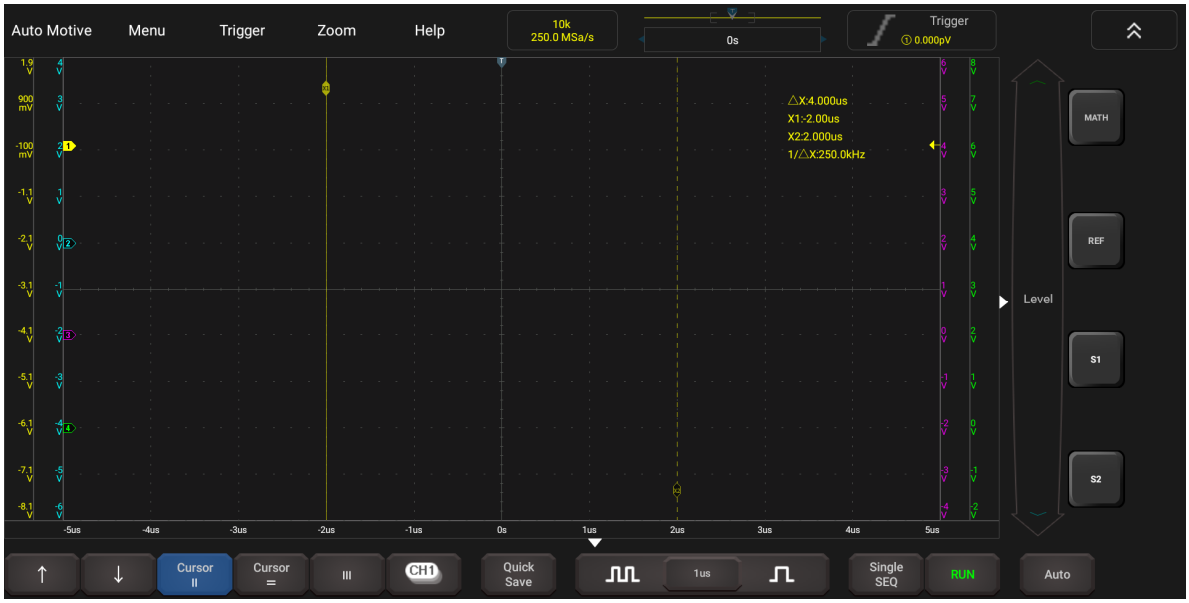
This function is used to quickly save the currently running measurement waveform. The Scopebox can save the analog channel or math channel waveform to the local folder, and the file type can be WAV or CSV.

The Scopebox provides 4 reference (REF) channels (R1, R2, R3 and R4). The user can load WAV files into the REF channel, and open the REF channel to display the reference waveform.

4.9 MATH & REF

MATH and REF are rarely used and folded, which can be called out by tapping ⌄⌄.

Tap ⌄⌄, the following screen will appear:



4.9.1 MATH

In this function, the user can use the addition, subtraction, multiplication and FFT function to operate and analyze the waveform.

Tap **MATH**, the MATH channel will work as the current channel and the  marker will appear on the screen.

Four Types:

A + B Add source 1 and source 2

A - B Subtract source 2 from source 1

A × B Multiply source 1 by source 2

A ÷ B Divide source 2 with source 1

FFT Convert a time-domain signal into its frequency components (spectrum).

Select operate type, Source 1 and 2, then adjust the vertical scale to view the math channel clearly. The mathematic result can be measured by the measure and the cursor.

Tips on MATH calculations

- If the analog channel or math function is clipped (not completely displayed on the screen), the resulting math function will also be clipped.
- After the math waveform is displayed, tap the channel marker to close the source channel to better view the math waveform.
- You can adjust the vertical sensitivity and offset of each channel participating in the math function to facilitate viewing and measuring math waveforms.
- Use the **Cursor** and **Measure** to measure math function waveforms.

4.9.2 REF

This function enables you to load the reference waveform from the R1/R2/R3/R4 from your tool.

Tap **REF**, the following screen will appear:

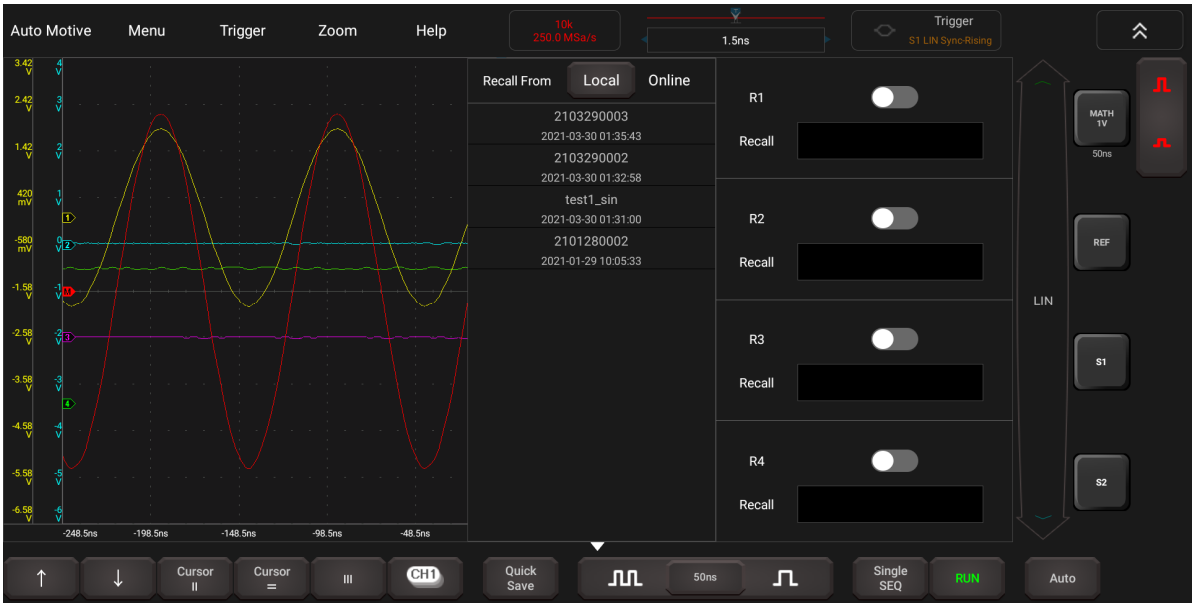
Slide the switch of R1/R2/R3/R4, the system will recall the waveform that was previously saved in this folder. Tap the waveform in line with the Recall, a small window displaying this waveform will pop up on the screen.

Tap **Recall**, the following screen will appear. There are three options available for you opt.

Recall From: Loads the saved waveform into the reference channel from the external storage device.

Local: Loads the saved waveform into the reference channel from the local folder stored on the tool.

Online: Recalls the online waveform into the reference channel.



4.10 Phase Ruler

It can be used to help measure the timing time of the cyclic waveform.

Tap , a dialog box will pop up on the screen. Set the number of cylinder and angle, tap **OK** to confirm.

You can drag the two phase rulers to the appropriate position to mark the start and end of the loop. The bottom of the ruler shows the default phase start point 0° and end point 360°, which can be edited to any value. For example, when measuring the timing of a four-stroke cylinder, the end of the phase is usually displayed as 720°, because one cycle includes two crankshaft rotations.

5 Ignition

The ignition system has greatest impact on the engine performance. The ignition system includes distributor and distributorless. Distributorless includes independent ignition and simultaneous ignition.

1. Distributor ignition system i.e. contact breaker with contact-controlled ignition system (commonly known as the platinum) and contact breaker with noncontact-controlled ignition system combined with magnet, hall components or infrared.
2. Independent ignition system: crankshaft sensor send out the ignition timing signal and cylinder identification signal so that the ignition system can send out ignition signal to specified cylinder in specified time, each cylinder has its independent ignition coil.
3. Simultaneous ignition system: two cylinders share one ignition coil, when two cylinder pistons reach top dead center at the same time (one is compression, another is the exhaust), two spark plugs will be ignited at the same time, at this time, the ignition for the former cylinder is in high-pressure low temperature gas mixture, the ignition is valid, while for the latter one is in low-pressure high temperature exhaust gas, the ignition is invalid.

This app can test and analyze the secondary signal for various engine ignition systems.

5.1 Secondary-distributor ignition analysis

The following connection should be made before performing it:

1. Power the Scopebox on: Plug one end of the battery clamps cable into the DC-IN port of the Scopebox, and then clamp the other two terminals to the vehicle's battery (Red to +, and Black to -) respectively.

   Note: This connection only applies to the condition that the diagnostic tool cannot provide enough power to the Scopebox via USB cable. If the diagnostic tool can supply enough power to the Scopebox, please ignore this step.
2. Connect the B-shaped terminal of the USB cable to the USB port of the Scopebox, and the other end to the USB port of the diagnostic tool.
3. Plug the BNC end of secondary ignition pickup into CH1/CH2/CH3/CH4 channel of the Scopebox, and connect the high-voltage clip to high-voltage line, and crocodile clips to ground.

Note: Common ignition sequence (the specific sequence is subject to the actual engine ignition sequence)

Four-stroke in-line four-cylinder: 1-2-4-3, or 1-3-4-2

Four-stroke in-line six-cylinder: 1-5-3-6-2-4, or 1-4-2-6-3-5

Four-stroke in-line eight-cylinder: 1-8-4-3-6-5-7-2

Five-cylinder: 1-2-4-5-3

V 6 engine: generally speaking, based on the person sitting on the driver cab, if the right side cylinder numbers on the right side, from the front to the back are as follows: 1, 3, 5; and the cylinder numbers on the left side, from the front to the back are as follows: 2, 4, 6; then the ignition sequence is: 1-4-5-2-3-6. If the cylinder numbers on the right side, from the front to the back are as follows: 2, 4, 6; and cylinder numbers on the left side, from the front to the back are as follows:1, 3, 5; then the ignition sequence is: 1-6-5-4-3-2.

Figure 5-1 below shows the normal ignition waveform of distributor ignition system, the upper one is the secondary waveform, and the lower one is the primary waveform.

The secondary waveform

A section is contact open period; B section is make contact period, which is the magnetizing field of ignition coil.

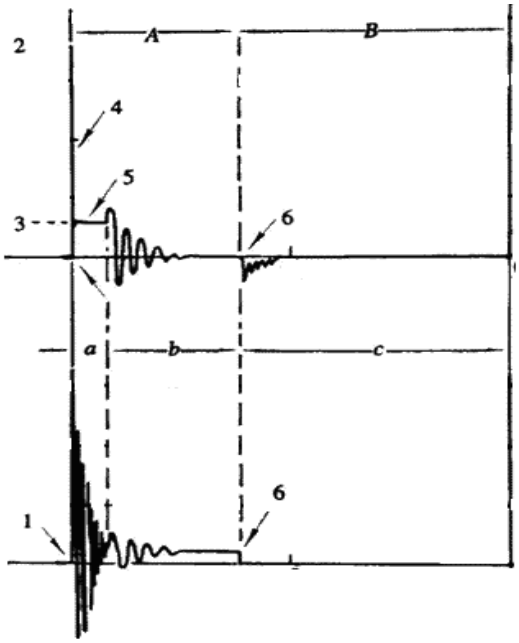


Fig. 5-1

1) Contact break point: the primary circuit of ignition coil cut off, the secondary voltage was sensed and increased sharply.
2) Ignition voltage: secondary coil voltage overcome the damper of high voltage line, the contact breaker gap and the spark plug gap to release magnetizing energy, 1-2 section is the breakdown voltage
3) Spark voltage: For the capacitor discharge voltage
4) Ignition voltage pulse: For the charge and discharge sections
5) Spark line: The inductance discharge process, i.e. the mutual inductance voltage of ignition coil maintains the conduction of secondary circuit
6) Contact point close the current flow into primary coil, the primary coil oscillates due to the mutual inductance.

Primary ignition waveform

Section **a** shows the voltage oscillation on the primary circuit due to the magnetic induction of spark in the duration;

Section **b** shows the damped oscillation generated by remaining magnetic field energy after the spark;

Section **c** shows the make contact magneting period of primary coil.

Seen from the waveform, the amplitudes of breaker contact closed angle, break angle and breakdown voltage and spark voltage are very clear, besides, the spark delay period and two oscillations can also be tested. For the ignition system without faults, compared with the whole cycle, the contact closed angle just 45%-50% (four-cylinder), 63%-70% (six-cylinder), or 64%-71% (eight-cyliner); the breakdown voltage is over 15kv; the spark voltage is about 9kV, the spark period is greater than 0.8ms. If these values or waveform are abnormal, it means there is fault or the system needs to be adjusted.

5.2 Secondary-simultaneous ignition analysis

The following connection should be made before performing it:

1.Power the Scopebox on: Plug one end of the battery clamps cable into the DC-IN port of the Scopebox, and then clamp the other two terminals to the vehicle's battery (Red to +, and Black to -) respectively.

Note: This connection only applies to the condition that the diagnostic tool cannot provide enough power to the Scopebox via USB cable. If the diagnostic tool can supply enough power to the Scopebox, please ignore this step.

2. Connect the B-shaped terminal of the USB cable to the USB port of the Scopebox, and the other end to the USB port of the diagnostic tool.
3. Connect the BNC connector of the secondary ignition pick-up to any channel of the Scopebox, and clamp the crocodile clips and high-voltage clips onto the vehicle ground and high-voltage line respectively.

   The connection is as follows:

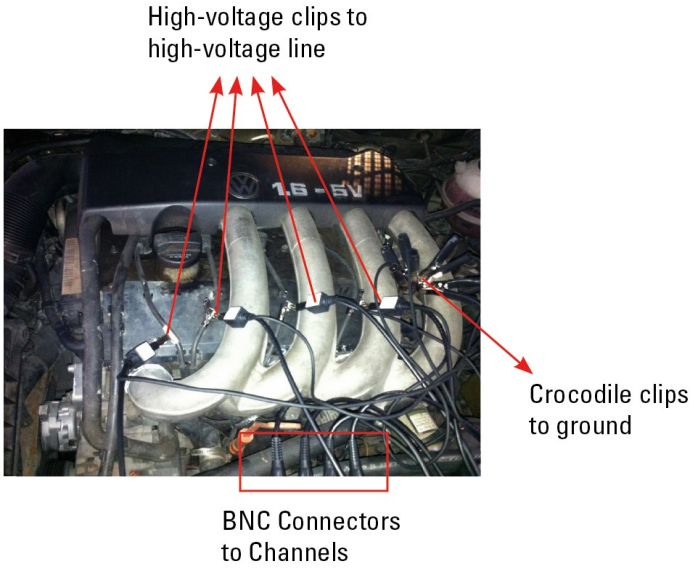


Fig. 5-2 below shows the valid and invalid ignition waveforms. Under the working status of valid ignition, the breakdown voltage and spark voltage are higher because the cylinder is filled with fresh combustible mixture gas, which has a lower ionization level and vice versa.

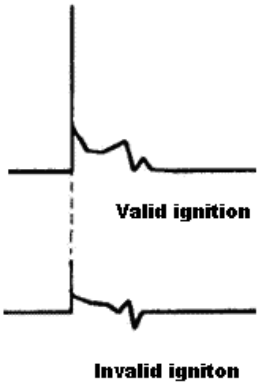


Fig. 5-2

5.3 Secondary-direct ignition analysis

Connection：

1. Power the Scopebox on: Plug one end of the battery clamps cable into the DC-IN port of the Scopebox, and then clamp the other two terminals to the vehicle's battery (Red to +, and Black to -) respectively.

   Note: This connection only applies to the condition that the diagnostic tool cannot provide enough power to the Scopebox via USB cable. If the diagnostic tool can supply enough power to the Scopebox, please ignore this step.
2. Connect the B-shaped terminal of the USB cable to the USB port of the Scopebox, and the other end

to the USB port of the diagnostic tool.

3. *When the high-voltage wire is exposed*, plug the BNC end of secondary ignition pickup into CH1/CH2/CH3/CH4 channel of Scopebox, then connect the high-voltage clip to high-voltage line, and crocodile clips to ground.
4. *If no high-voltage wire is exposed*, dismantle ignition coil of tested cylinder. Connect one end of the COP extension cord to the ignition coil which should be grounded via COP earth cord, and insert the other end into the cylinder to joint with spark plug. Then plug the BNC end of secondary ignition pickup into CH1/CH2/CH3/CH4 channel of Scopebox, and then connect the high-voltage clip to high-voltage line, and crocodile clips to ground.

   The connection is as follows:

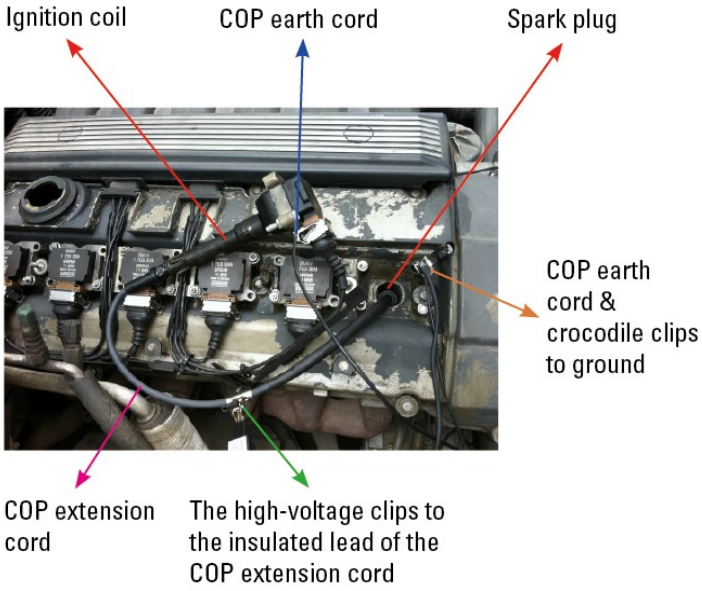


Fig. 5-3 shows the normal secondary (the upper one) and (the lower one) primary ignition waveform of direct ignition system. Beause the on/off of primary circuit is not opening/closing of mechanical contact, but the conduction of transistor. The primary voltage has no obvious oscillations within the duration, but the voltage increases during the magnetization process due to current limiting, and this change can cause corresponding fluctuations of secondary voltage line as a result of induction of ignition coil.

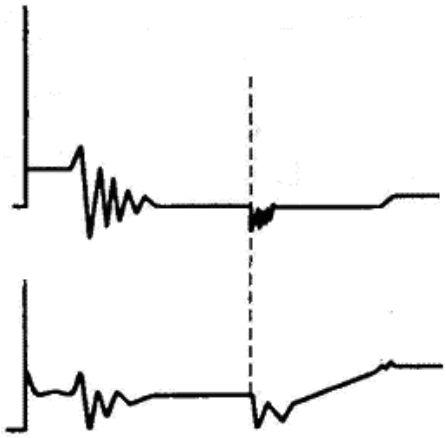


Fig. 5-3

5.4 Waveform analysis mode

The ignition secondary single-cylinder waveform test is mainly used to:

a. Analyze the ignition dwell angle of single cylinder (ignition coil charging time)
b. Analyze the capability of ignition coil and secondary high tension circuit (from ignition line to ignition voltage line).
c. Find the improper mixture A/F ratio of single cylinder (from combustion line).
d. Analyze the capability of capacitance (platinum or ignition system).
e. Find the spark plug that causes misfire of the cylinder (from combustion line).

This test can provide very meaningful information about the combustion quality for each cylinder. If necessary, this test can also be performed during driving. Since the secondary ignition waveform is significantly affected by different engines, fuel systems and ignition conditions, it is useful for detecting the faults of engine mechanical parts, fuel system components, and ignition system components. Different parts of the waveform can specify that some components and systems on the specific cylinder have faults. Refer to the instructions for various parts of waveform for the related component working status of specific waveform section.

Test methods and conditions:

Start the engine or drive the vehicle according to the driving performance fault or poor ignition, etc. Confirm the consistence of judgment standard (the amplitude, frequency, shape and pulse width, etc., for each cylinder), check the fault of the waveform for corresponding components.

Waveform results: observe the ignition coil at the beginning of charging, the relative consistent falling edge represents the dwell angle and ignition timing of each cylinder are precise.

Ignition line:

Observe the height consistence of flashover voltage. Too high flashover voltage represents a high resistance existed in the ignition secondary circuit (for example, open circuit, or damaged spark plug or high voltage line, or too large time gap on spark plug), while the too short sparking voltage represents the resistance of ignition secondary circuit is lower than normal value (due to pollutant and broken spark plug or the high voltage line of spark plug has electrical leakage, etc.).

Spark or combustion voltage:

Observe the consistence of spark or combustion voltage, as it represents the consistence of spark plug and the air-fuel ratio of each cylinder. In case that the mixing ratio is too lean, the combustion voltage will be lower than normal value.

Combustion line:

Observe the spark or the combustion line which shall be clean with few clutter, as lots of clutter indicates the cylinder has poor ignition due to ignite too early, damaged nozzle, pollutant spark plug, or other reasons. The duration of combustion line indicates the mixing ratio of the cylinder is abnormal lean or rich. Too long combustion line (usually greater than 2ms) means that the mixing ratio is rich, whereas too short of combustion line (usually less than 0.75ms) means that the mixing ratio is lean.

Ignition coil oscillation:

Observe at least two oscillation waveforms after the combustion line, which will be better if more than three oscillation waveforms, as it indicates that the ignition coil and capacitor (on Platinum or ignition system) are normal.

Primary voltage analysis

According to the faulty primary voltage waveform collected by the ignition analysis, the related components and mechanical equipment status of ignition system electrical circuit can be analyzed, which provides a reliable basis for the adjustment and maintenance of power circuit to avoid the blind demolition.

The waveform shown on Fig. 5-4, appear to be of clutter on the contact break point, which is obviously caused by the serious erosion on contact break point. It can be verified via burnishing the contact or changing the circuit breaker.

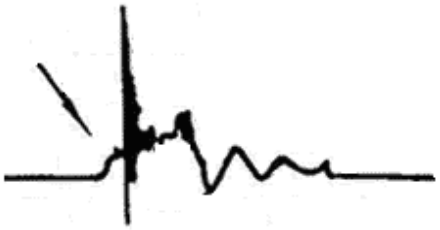


Fig. 5-4

For the primary voltage waveform shown on Fig. 5-5, the damped attenuation cycles obviously reduced on the spark period, the amplitude became lower, which is evidently caused by capacitor leakage.

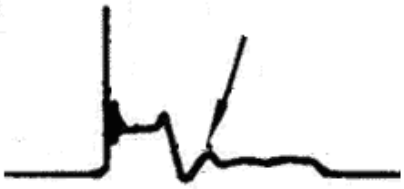


Fig. 5-5

The waveform on Fig. 5-6 shows the accidental pumping during contact closing period. The irregular beating is caused by insufficient spring force.

Fig. 5-6

The curve on Fig. 5-7 shows the contact angle is too small during the magnetizing period, which is caused by too large of a contact gap.

Fig. 5-7

A lot of clutter will be displayed on the horizontal section of primary waveform if contact has poor grounding, as shown below Fig. 5-8.

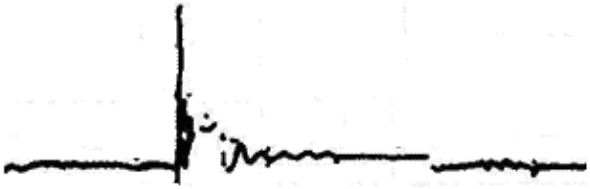
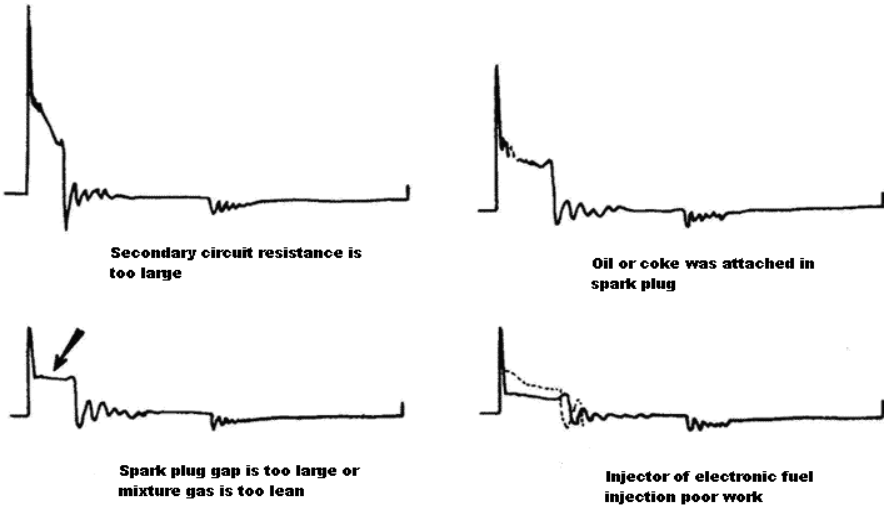


Fig. 5-8

Fig. 5-9 shows the fault of low-voltage waveform in electronic ignition system. The voltage does not rise during magnetizing, which indicates that the effect of limitation of the circuit failed and no components on distributorless ignition system can be adjusted. When this waveform is abnormal, you can only replace the ignition coils, igniter, ignition signal generator and cam position sensor, etc., one by one, to find out the faulty component or module.

Fig. 5-9

The secondary waveform is also affected by the spark plug, the combustion process, mixture gas composition, the engine thermal state of the ignition coil, etc., which is more complicated. The following lists a large number of measured secondary faulty waveform for reference. Since various factors lead to the failures, Fig. 5-10 just shows the major possible factors for the failures.



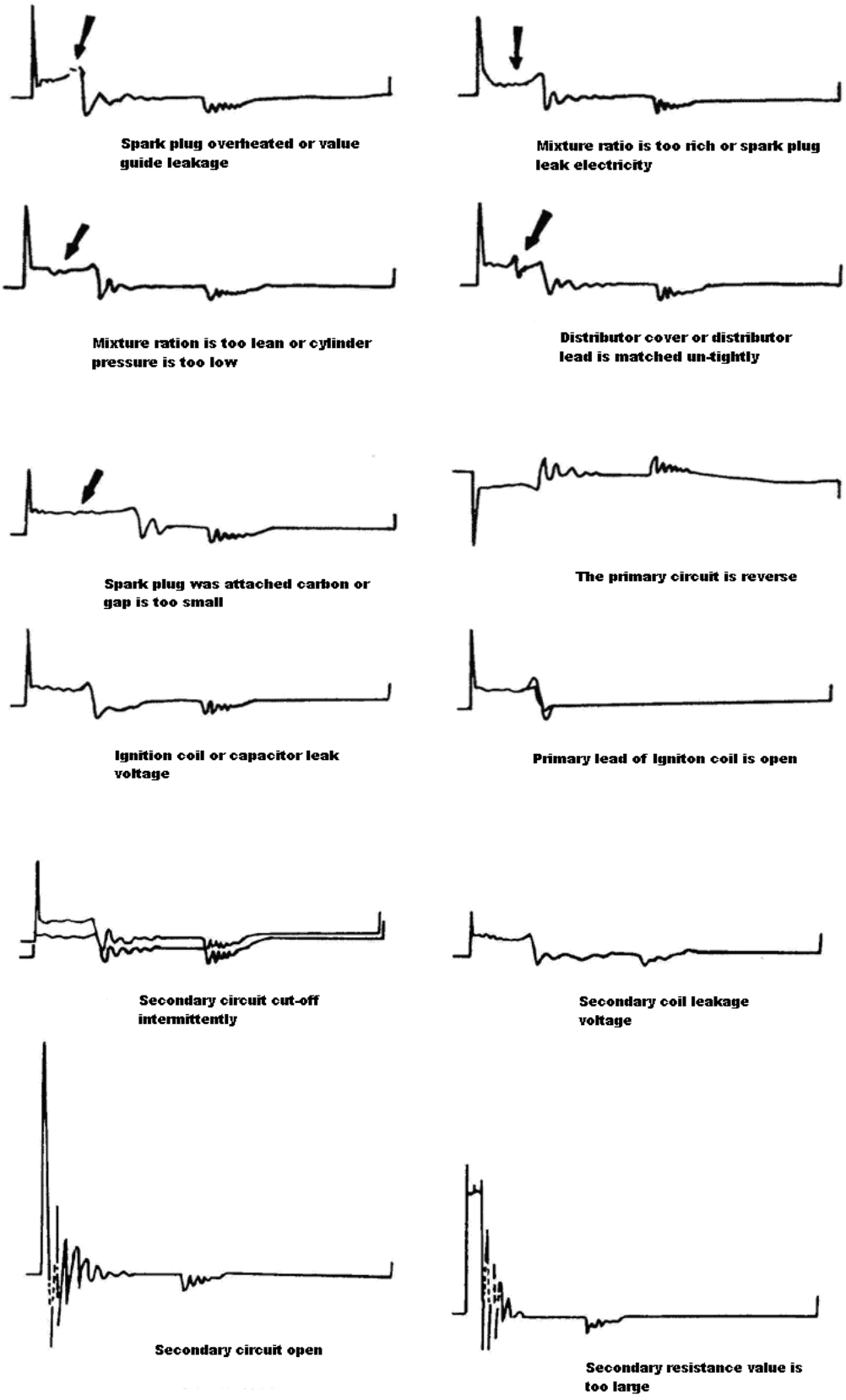

Spark plug overheated or value guide leakage
Mixture ratio is too rich or spark plug leak electricity
Mixture ration is too lean or cylinder pressure is too low
Distributor cover or distributor lead is matched un-tightly
Spark plug was attached carbon or gap is too small
The primary circuit is reverse
Ignition coil or capacitor leak voltage
Primary lead of Igniton coil is open
Secondary circuit cut-off intermittently
Secondary coil leakage voltage
Secondary circuit open
Secondary resistance value is too large

Fig. 5-10

6 Care & Maintenance

General Care

Do not store or leave the Scopebox where the device will be exposed to direct sunlight for long periods of time.

Caution

To avoid damages to the device or probes, do not expose them to sprays, liquids or solvents.

Cleaning

Inspect the device and probes as often as operating conditions require. Make sure the device is disconnected form all power sources.

To clean the exterior surface, perform the following steps:

1. Remove loose dust on the outside of the Scopebox and probes with a lint-free cloth. Use care to avoid scratching the clear glass display filter.
2. Use a soft cloth dampened with water to clean the device.

Caution

To avoid damages to the surface of the device or probes, do not use any abrasive or chemical cleaning agents.

Warranty

THIS WARRANTY IS EXPRESSLY LIMITED TO PERSONS WHO PURCHASE LAUNCH PRODUCTS FOR PURPOSES OF RESALE OR USE IN THE ORDINARY COURSE OF THE BUYER'S BUSINESS.

LAUNCH electronic product is warranted against defects in materials and workmanship for one year from date of delivery to the user.

This warranty does not cover any part that has been abused, altered, used for a purpose other than for which it was intended, or used in a manner inconsistent with instructions regarding use. The exclusive remedy for any automotive meter found to be defective is repair or replacement, and LAUNCH shall not be liable for any consequential or incidental damages.

Final determination of defects shall be made by LAUNCH in accordance with procedures established by LAUNCH. No agent, employee, or representative of LAUNCH has any authority to bind LAUNCH to any affirmation, representation, or warranty concerning LAUNCH automotive meters, except as stated herein.

Disclaimer

The above warranty is in lieu of any other warranty, expressed or implied, including any warranty of merchantability or fitness for a particular purpose.

Purchase Order

Replaceable and optional parts can be ordered directly from your LAUNCH authorized tool supplier. Your order should include the following information:

Order quantity
Part number
Part name

Customer Service

Any question during the operation, please call 86-755-84557891.
If your unit requires repair service, return it to the manufacturer with a copy of the sales receipt and a note describing the problem. If the unit is determined to be in warranty, it will be repaired or replaced at no charge. If the unit is determined to be out of warranty, it will be repaired for a nominal service charge plus return freight. Send the unit pre-paid to:

Attn: Customer Service Department
LAUNCH TECH CO., LTD.
Launch Industrial Park,
North of Wuhe Avenue,
Banxuegang, Bantian,
Longgang, Shenzhen, Guangdong
P.R.China, 518129
Launch website: http://www. cnlaunch.com
http://www.x431.com

Statement: Launch reserves the rights to change the product design and specifications without prior notice. The appearance and color of the actual product may be different from those shown in the manual. Please refer to the actual product. We have tried our best to make all the descriptions in the manual accurate, but it is still inevitable that there are inadequacies. If you have any questions, please contact the dealer or Launch after-sales service center. We will not bear any consequences arising from misunderstanding.

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安全警告

请仔细阅读以下安全注意事项，以免造成人身伤害和本产品或其他想连接产品的损坏，为避免出现可能的伤害和危险，本产品只可在规定的范围内使用。

小心处理设备

请勿掉落、折弯、刺穿、插入异物或在设备上放置重物。内部的易损组件可能会遭到损坏。

避免火灾或人身伤害。

正确连接和断开。

- 当探头或测试端连接到电压源上时请勿拔插。
- 在探头连接到测试电路之前，先将探头输出连接到测量仪器。将探头和测试仪器断开之前，先将探头输入及探头基准导线与测试电路断开。

使用正确的探头。为了避免过大电流的冲击，请使用正确的额定探头进行测量。

避免电路外露。当电源接通后，请勿接触任何外露的接头和元件。

当您怀疑产品出现故障时，请勿操作。如果您怀疑产品出现故障时，请合格的维修人员进行检查。

保持通风。保持您的产品适当的通风。

请勿在潮湿的环境下操作。

请勿在易燃易爆的环境操作。

请保持产品表面的清洁和干燥。

请勿拆开或改装设备

设备是一个密封装置，内部没有最终用户可维修的部件。必须由授权的维修机构或授权的技术人员进行所有内部维修。尝试拆开或改装设备将使保修无效。

请勿尝试更换内部电池

必须由授权的维修机构或授权的技术人员更换内部的充电电池。

操作汽车 ECU 注意事项

- 当点火开关接通时，请不要随意断开汽车内部电器装置，以免造成ECU或设备的损坏。
- 请不要将磁性物体置于靠近电脑的地方，以免造成ECU中的电路和部件故障。
- 当在汽车上进行焊接作业时，须先断开ECU系统电源。
- 在靠近电脑或传感器的地方进行修理作业时，应倍加注意，以免损坏ECU和传感器。
- 在拆装可编程只读存储器时，作业人员应戴上搭铁金属带，将其一端缠在手腕上，另一端夹在车身上。以免静电造成ECU电路故障。
- 应可靠地连接ECU线束接头，以免损坏ECU内部的集成电路等电子元件。

目录

1 产品概述

1.1 产品介绍

该示波器模块由硬件和软件两部分组成，硬件包括示波器模块和连接线束等。软件安装在诊断设备上，兼容示波器和点火分析两个功能。

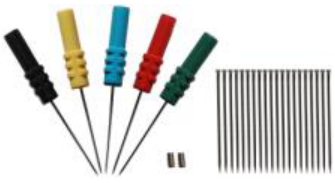
汽车示波器可使汽车修理技术人员快速判断汽车电子设备及线路故障，示波器的扫描速度远远大于汽车该类信号的频率，通常是被测信号的5-10倍。汽车示波器不仅可以快速捕捉电路信号，还可以用较慢的速度来显示这些波形，以便一面观察，一面分析。它还可以将测试的信号波形进行存储记录，通过回放来观察已经发生过的快速信号，极大方便了故障分析。无论是高速信号(例如：喷油嘴、间歇性故障信号)，还是慢速信号(如：节气门位置变化及氧传感器信号)，通过汽车示波器都可以观察到恰当的波形。

电子信号一般都可以通过对五个参数指标的测量来进行对比判断，这五个参数指标分别是幅值（信号最高电压）、频率（信号循环时间）、形状（信号的模样）、脉宽（信号的占空比或所占时间）和阵列（信号的重复特性）。汽车示波器包含了汽车点火波形，而且可以检测、显示、保存所有电子信号的这五种参数，通过波形分析可进一步检测出电路中传感器、执行器以及电路、电控单元等各部分的故障。

1.2 附件清单

由于产品配置不同，产品中所包括的配件与本说明书中所列可能有所不同，产品中具体包括的配件以实际装箱单为准。

编号	名称	图片及描述
1	BNC至4mm接口测试线	 用于连接传感器和示波器，测试汽车的各种信号的专用线。宽量程的探头，夹子和挂勾能够插进线的末端的4mm的连接器。此外，它还可以与20:1的衰减器配合使用。
2	20:1衰减器	 该衰减器能够让示波器测量喷油嘴和初级点火波形。该衰减器是一个无源的20:1衰减器。这说明输入一个20V的信号，就输出1V的信号。因为信号被衰减，因此该衰减器可以让示波器测量电压高于其输入范围*20V。 *备注：当把此衰减器用于示波器测量感应信号时，它提供增强的输入过载保护。千万不要把它用于次级点火测试。

3	双钳电源线	 用于连接车辆电瓶给示波器供电。
4	次级点火拾取线	 次级点火拾取线是一种感应式电容探头，用来测试火花塞点火器的一次重叠波，二次重叠波等参数，从而达到检测，诊断发动机之点火状态，使每个汽缸的点火电压随时间的变化直观地从示波器上显示出来。 该拾取线有三个端头，一头为BNC接头（接示波器通道），一头为夹子（接地），一头为拾取夹子（接高压线）。拾取夹子边上是一个衰减器，用于将拾取的高压衰减为低压，从而保护示波器不受电冲击。 使用时请注意： 1). 测试夹不应直接夹在火花塞，应夹在连接火花塞的绝缘的导线（独立点火延长线）上，以防止击穿和造成电击。 2). 要距离其它高压线至少2英寸的距离，以免产生干扰。 3). 该拾取线探针衰减可达10000：1。
5	万用表探针	
6	鳄鱼夹头	 连接接头用，可以夹住裸露的接线柱或导线。
7	刺针套装	 连接传感器及BNC至4mm接口测试线，可以隔着绝缘层刺入导线中。

8	USB线（选配）	 用于连接示波器和诊断设备，将示波器采集的信号发送给诊断设备进行波形显示。
9	用户手册	
以下配件为扩展包，未包含在该包装箱中，用户可根据实际需要单独购买。		
1	6路多功能通用引线（选配）	 该引线用于接入现有的汽车线束接口上，方便读取各种传感器的信号。输出信号从引线另一端的4mm香蕉接头通过BNC至4mm接口测试线接入示波器的输入（CH）口。
2	COP独立点火延长线(选配)	 该延长线用于准确地测试独立点火系统的次级电路。在没有高压线的点火系统中或不容易接近的点火系统中，该延长线可以接到任何火花塞上，然后把次级点火拾取夹在该扩展线上进行次级高压测量。 该延长线使用简单：只需把延长线两端分别连接在点火线圈包和火花塞上，再把次级拾取夹住该延长线，示波器就会显示准确的次级点火波形。
3	COP独立点火探头(选配)	 通过COP独立点火探头可以简单快捷地获取汽车发动机点火波形，而点火波形是一扇窗，透过这扇窗，我们可以看见发动机燃烧室所发生的情况，从而判断火花塞是否需要更换或清洗，电喷系统喷油器工作是否良好等。

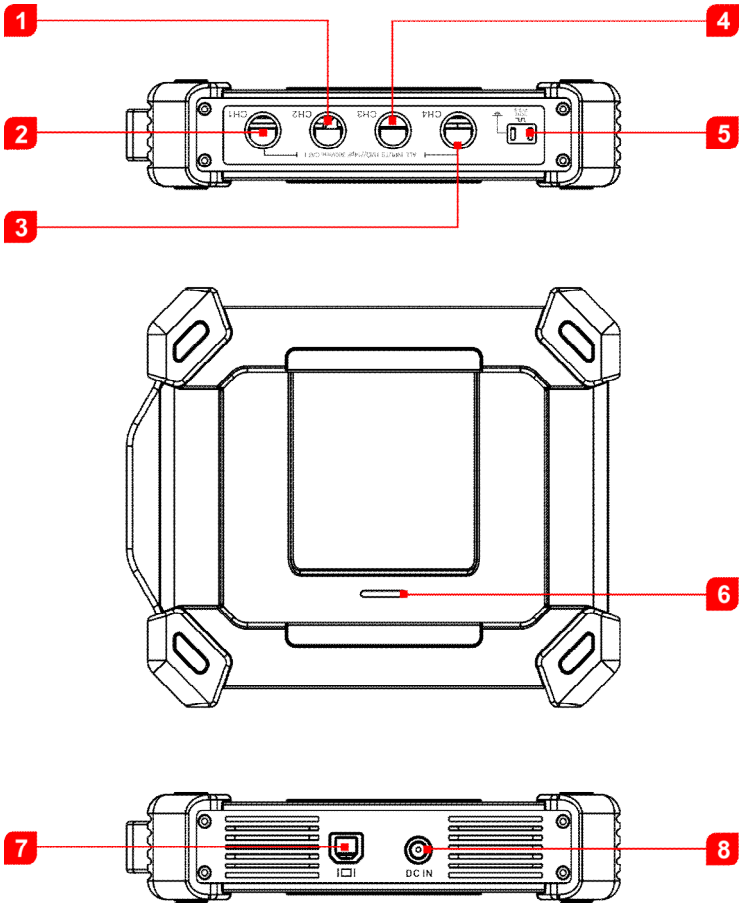
4	交/直流电流钳CC-650(选配)	 可配合示波器测量电流波形，可配合万用表测量电流数据。由坡莫合金和霍尔元件组成的电流传感器，将直流或交流电流线性地转换为直流或交流电压，可以通过BNC接头接到示波器上，观察电流波形；也可以通过香蕉接头接到万用表上，获取电流数据。 直流/交流：0 ~ 400Hz 可测电流范围：20 mA ~ 650 A
5	交/直流电流钳CC-65(选配)	 功能与交/直流电流钳CC-650相同。 直流/交流：0 ~ 20 kHz 可测电流范围：20mA ~ 65A

1.3 技术参数

参数名称	具体描述
通道数量	4
带宽	100MHz
上升时间	≤3.5ns (典型)
最大采样率	1GSa/s
输入阻抗	1MΩ±1.5%
存储深度	10Mpts
采样位数	8bit
垂直精度	± 3%
垂直档位	5mV~10V
垂直偏置范围	± 2.5V (探针倍数 X1 下，＜500mV/div), ±120V (探针倍数 X1 下，≥500mV/div）
反相	支持
通道耦合	DC, AC
时基档位	1ns~1ks
时基精度	20ppm

采样模式	正常
总线解码	CAN, LIN
触发类型	边沿, 脉宽
触发模式	正常、自动、单序列
触发耦合	DC、噪声抑制
显示	YT, Zoom, Roll
Roll 模式	200ms/div~1000s/div
自动设置	支持
自动测量	23 项
光标	水平光标、垂直光标
供电	USB 口, DC 口
数据传输方式	USB
适配操作系统	Android
汽车配置选项	电路、传感器、执行器、点火测试、通讯测试和组合测试
工作温度	0℃~50℃
存储温度	-20℃~60℃

2 组成及控件

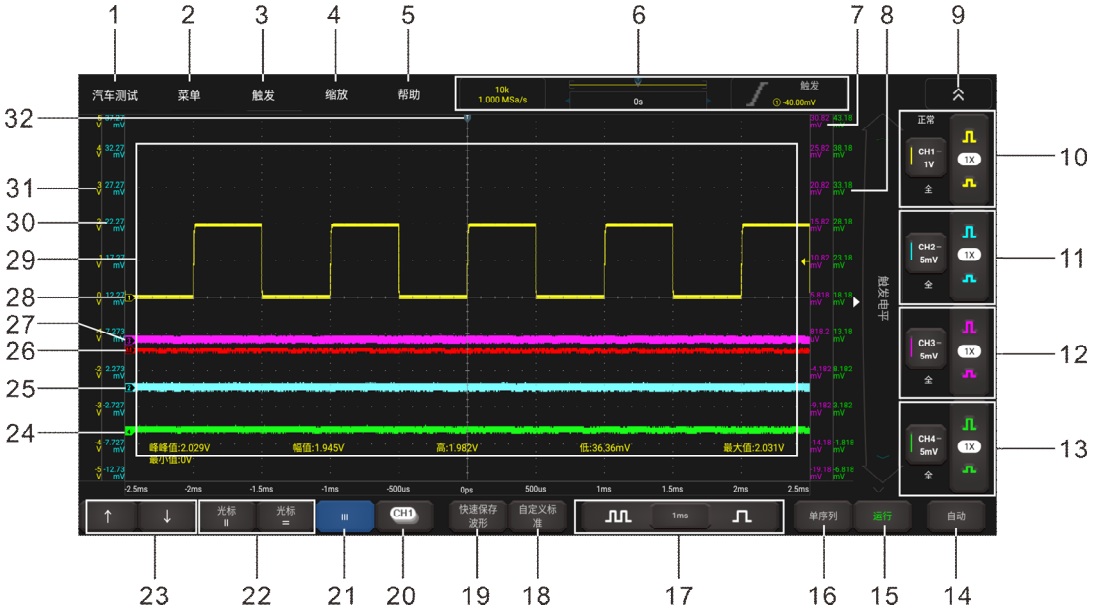


编号	名称	具体描述
1	CH2	通道2
2	CH1	通道1
3	CH4	通道4
4	CH3	通道3
5	固定信号发生器	发出一个固定1K频率的方波信号。
6	工作指示灯	• 上电时显示为绿色。 • 与诊断设备通讯时闪烁。出现错误时，会不停快速闪烁。
7	B型USB孔	通过USB线可将其与诊断设备相连。
8	DC IN插孔	通过双钳电源线给其供电。

3 首次使用

3.1 开始启动

点击示波器模块 App 启动，出现如下界面：



编号	描述	操作提示
1	**汽车测试** 提供有各种汽车相关的测试内容（如电路、传感器、执行器、点火测试等）及对应测试的连接方法。	点击一次可展开子菜单。再次点击可收起子菜单。
2	**菜单** 包括如下选项： • **测量**：提供23个参数测量项。 • **保存**：设置保存通道波形保存格式和保存路径。 • **显示**：设置波形显示样式。 • **设置**：提供有记录长度，出厂设置，自动校准和示波器参数自定义等功能。 • **关于**：显示该程序的具体信息。	点击一次可展开子菜单。再次点击可收起子菜单。 关于子菜单的具体操作，请参照第4.4章节。
3	**触发** 可设置触发模式和触发通道。	
4	**缩放** 用户可通过调整刻度和位置放大和缩小波形显示。	点击一次可展开子菜单。再次点击可收起子菜单。
5	**帮助**	

	查看示波器具体操作方法。	
6	**当前通道的触发信息** 读数分别表示存储长度，采样率，光标位置指示器和触发信息。	
7	**通道3电平刻度**	
8	**通道4电平刻度**	
9	**“更多”通道设置** 设置更多其它通道。其它通道包括： MATH（数学通道）, REF（参考通道）, S1 LIN和S2 LIN。	点击一次可展开子菜单。再次点击可收起子菜单。
10	**通道1垂直设置面板** 控制显示信号的振幅。用户可设置反相、耦合方式、探针衰减系数和带宽。	系统默认只显示CH1、CH2、CH3和CH4。用户可点击调出MATH（数学通道）和REF（参考通道）。这六个通道操作方法相同。以“通道2”为例讲解如何循环实现功能切换。 点击 CH2 一次 - 打开该通道并将其设置为当前通道。  再次点击 CH2 5mV - 调出通道垂直设置菜单。  三次点击 CH2 5mV - 关闭当前通道。
11	**通道2垂直设置面板** 功能同“通道1垂直设置面板”。	
12	**通道3垂直设置面板** 功能同“通道1垂直设置面板”。	
13	**通道4垂直设置面板** 功能同“通道1垂直设置面板”。	
14	**自动** 点击打开自动量程功能。自动量程功能打开时，示波器会	点击启动自动设置功能。

	自动设置各种参数，包括：垂直档位，水平时基，触发电平等，当信号接上时，这些参数会自动变化，且信号变化后无需再次操作，示波器会自动识别并做出相应的改变。	
15	**运行/停止/等待** • **等待**: 已获取所有预触发的数据，示波器准备接收触发。 • **停止**: 停止采集数据。 • **运行**: 表示示波器正在运行。	
16	**单序列** 捕捉一次触发，完成采集，然后停止。	
17	**水平设置** 控制水平时基。	点击一次可展开子菜单。再次点击可收起子菜单。
18	**自定义标准** 通过保存当前界面上的参数创建新的预设测试参数。	
19	**快速保存波形** 可快速保存当前打开通道的测量波形。 如需修改和保存路径和文件类型，进入“菜单”->“保存”。	
20	CH1 **通道选择按钮** 点击选择目标通道。	点击一次可调出通道（只显示已开启的通道）选择弹窗。再次点击可关闭弹窗。
21	**相位测量开关**	点击一次开启相位测量。再次点击关闭该功能。 更多操作细节，请参考第4.10章。
22	**光标设置** 打开/关闭水平/垂直方向测量光标开关。开启时，屏幕波箱显示区会出现两条名为Y1 & Y2/X1 & X2的参考线。用户可使用↑/↓ 或 ←/→进行微调或直接拖移。	点击一次开启光标测量功能。再次点击关闭该功能。
23	**↑/↓或←/→ 微调按钮** 微调垂直/水平参考线。	当水平光标打开时，微调按钮显示为↑和↓。如垂直光标打开时，微调按钮显示为←和→。
24	**通道4标记** 表示显示波形的参考点。如果没有标记，表示通道已关闭且不会显示。	如果通道显示为▷标记,表示该通道不是当前通道。点击▷标记可将该通道切换为当前通道，此时其会变成▶。
25	**通道2标记** 功能同“CH4标记”。	同“CH4标记”。

26	**数学通道标记** 功能同“CH4标记”。	该通道可通过点击按钮调出。
27	**通道3标记** 功能同“CH4标记”。	同“CH4标记”。
28	**通道1标记** 功能同“CH4标记”。	同“CH4标记”。
29	**波形显示区**	
30	**通道2电平刻度**	
31	**通道1电平刻度**	
32	**水平触发位置标记**	

3.2 探头补偿

初次将探头（非标配）与任一通道连接时，需要进行探头检查，使探头与输入通道相配。未经补偿或补偿偏差的探头会导致测量误差或错误。

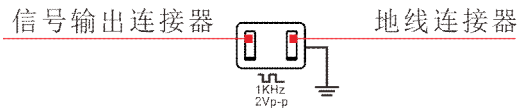
10. 给示波器上电：将双钳电源线一端连接至示波器的DC-IN插孔中，另一端接到车辆电瓶上进行取电（红色连正极，黑色连负极）。

    备注：如果诊断设备无法通过USB线给示波器供电，则可以使用此种连接方法。如果诊断设备能直接给示波器供电，请忽略此步。

11. 将USB线的B型端子连接至示波器的USB孔中，另一端连接至诊断设备的USB孔中。
12. 启动示波器模块App。
13. 在垂直设置控制面板中选择对应的通道，并将“探头”选项设置为“X10”（默认至为X1）。

设置项	对应的衰减比例
1x	1:1
10x	10:1
20x	20:1
50x	50:1
100x	100:1
200x	200:1
500x	500:1
1kx	1000:1
2kx	2000:1
5kx	5000:1
10kx	10000:1

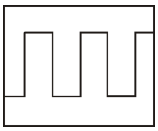
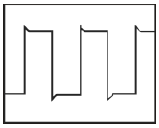
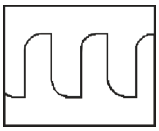
14. 将探头衰减系数滑动开关推至“X10”端，然后将探头与示波器任一通道连接。
15. 将探头端部与探头补偿器的信号输出连接器相连，基准导线夹夹到探头补偿器的地线连接器上。



16. 点击屏幕下方“自动”按钮，屏幕会自动设置并显示频率为1KHz，峰峰值为2V的方波信号。

备注：使用此种方法也可检测通道的信号输入输出是否正常。

17. 通过观察显示波形的形状，来判断探头补偿是否正确。

补偿正常		
补偿过度		备注：如必要，用非金属质地的改锥调整探头上的可变电容，直到屏幕显示的波形如上图“补偿正常”所示。
补偿不足		

警告：为避免使用探头时被电击或触电，请确保探头的绝缘导线完好，并且连接高压源时请不要接触探头的金属部分。

18. 对其它通道重复以上步骤。

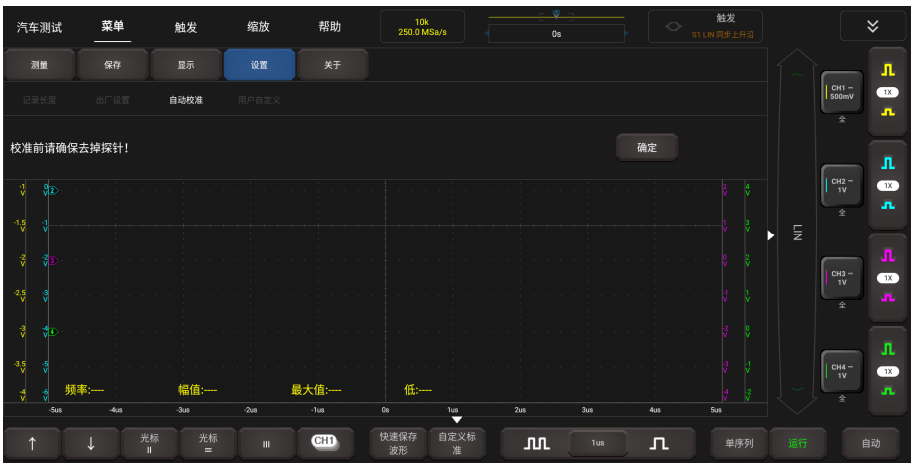
3.3 自动校准

自动校准程序可以以最大测量精度优化示波器信号路径。用户可在任何时候运行此程序，但是如果环境温度变化超过10°C或更多时则应当运行此程序。

为了校正更精确，示波器必须上电，预热20分钟后再进行自动校准。校正内容主要包括模拟通道的校正、触发电路中触发电压的校正和水平基线移位非线性的校正。

备注：自动校准时，请务必保证CH1 / CH2 / CH3 / CH4的输入端不要输入任何信号，否则可能损坏仪器。

点击**“菜单”-> “用户设置”**，然后点击“自动校准”。



点击弹窗上的“确定”按钮开始校准。示波器上的指示灯开始闪烁，同时屏幕左上角会出现“自校准正在进行中”的提示信息。

备注：自校准时，屏幕右上角会出现图标。此时，系统不允许进行任何操作。待自校准结束后，该图标会自动消失。

自校准一般需要几分钟时间完成。

3.4 连接

不同的应用场景，其连接方式也不同：

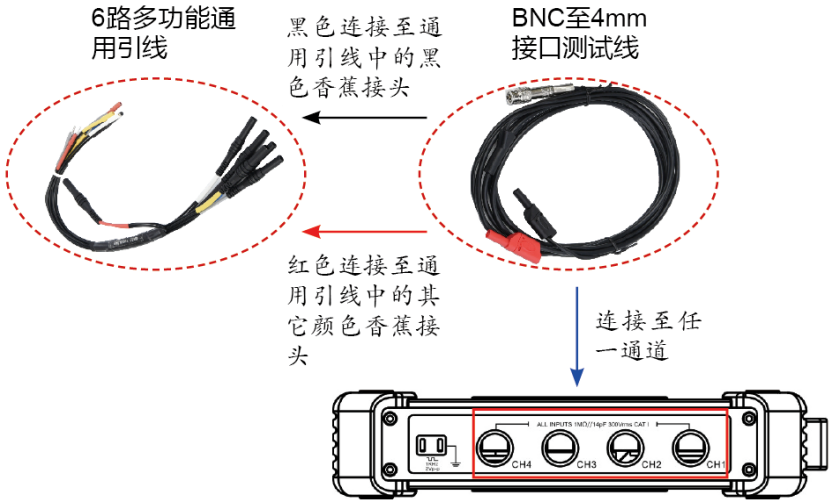
1. 给示波器上电：将双钳电源线一端连接至示波器的DC-IN插孔中，另一端接到车辆电瓶上进行取电（红色连正极，黑色连负极）。

   备注：如果诊断设备无法通过USB线给示波器供电，则可以使用此种连接方法。如果诊断设备能直接给示波器供电，请忽略此步。

2. 将USB线的B型端子连接至示波器的USB孔中，另一端连接至诊断设备的USB孔中。

A. 检测传感器时:

3. 将BNC至4mm接口测试线的一端连接至示波器CH1、CH2、CH3、CH4通道（根据情况选择通道号与通道数），另一端黑色4mm香蕉接头连接至6路多功能通用引线中的黑色香蕉接头（接地线）；另一端红色4mm香蕉接头连接至6路多功能通用引线中的其它颜色的香蕉接头（信号线）。

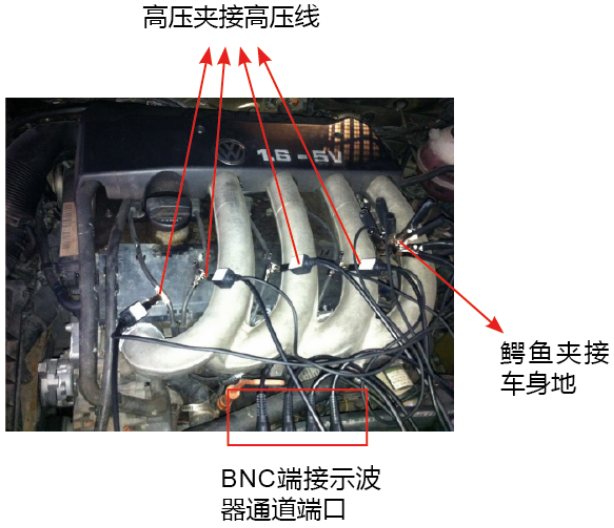


4. 将6路多功能通用引线中另一端的黑色端子接至车辆传感器地线端口中，找到连接至红色4mm香蕉接头的对应颜色信号线，并将其插入到车辆传感器的信号端子上。

B. 次级-分电器点火分析/次级-双缸点火分析时:

3. 次级点火拾取线BNC连接端接示波器的CH1 / CH2 / CH3 / CH4通道，另一端次级高压夹接中心高压线、鳄鱼夹接车身地。

实物连接如下图所示：



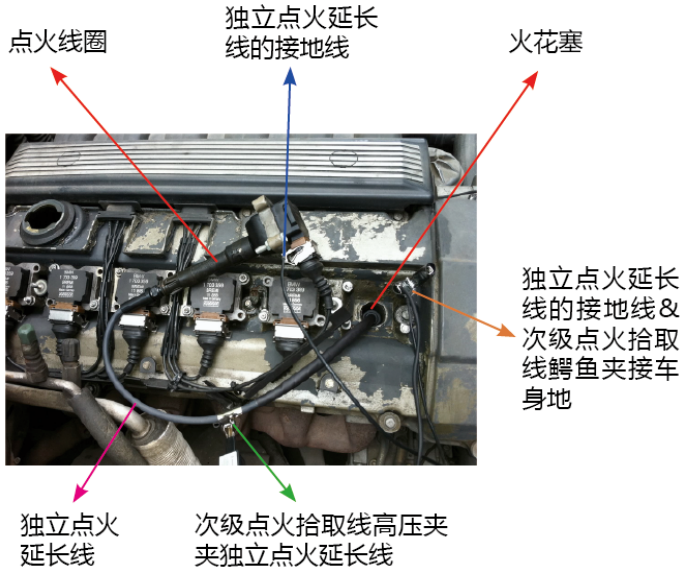
具体操作，请参照第5章。

C. 次级-独立点火分析时:

3. 高压线外露时，次级点火拾取线BNC连接端接示波器的CH1/CH2/CH3/CH4通道，另一端次级高压夹接中心高压线、鳄鱼夹接车身地。

4. 无高压线外露时，拆下被测试气缸的点火线圈，使用独立点火延长线，一端连接点火线圈，另一端插入气缸连接火花塞，并且点火线圈要通过独立点火接地线接车身地，然后使用次级点火拾取线BNC连接端接示波器的CH1/CH2/CH3/CH4通道，另一端次级高压夹接独立点火延长线上、鳄鱼夹接车身地。

实物连接如下图所示：



具体操作，请参照第5章。

4 如何操作

4.1 选择通道

系统共有 6 条通道。系统默认只显示 CH1、CH2、CH3 和 CH4 四条通道。用户可点击调出 MATH（数学通道）和 REF（参考通道）。

按照如下方法选择通道：

选择 CH1/CH2/CH3/CH4 通道	选择 MATH（数学）/REF（参考）通道
共有两种方法供选择： B. 点击屏幕右边的通道按钮。  B. 点击CH1选择目标通道。该方法仅适用于已打开的通道。 备注：为方便用户更好地对比和区分，每个通道和波形均以不同颜色进行标注。	Tap .  备注：MATH（数学通道）和 REF（参考通道）的具体操作，请参照第 4.9 章。

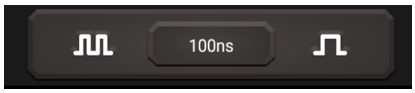
示波器可同时显示多条波形，但只允许有一条波形优先显示在最上层。被优先显示在最上层的通道称为当前通道，其会带有标识。无该标识的通道为非当前通道。

4.2 通道属性和触发设置

通道属性设置可以通过水平设置，垂直设置来实现。

4.2.1 水平设置

水平设置可以设置横轴单位刻度时间大小（时基值）。点击（单位刻度时间增大）或（单位刻度时间减小）微调水平时基值或点击时基值从下拉列表中直接选择。



如果已停止波形捕捉，使用时基选择器()可放大和缩小波形。

4.2.2 垂直设置

触发定义示波器何时开始获取数据和显示波形。如果触发设置合理，其可将失常的显示内容或白屏转换成具有实际意义的波形。

示波器开始获取波形时，其会采集足够的数据以便画出触发点左侧的波形。在等待触发条件发生时，示波器继续采集数据。在检测到触发后，示波器继续获取足够的数据以便画出触发点右侧的波形。

点击目标通道调出垂直设置面板。

垂直设置选项说明：

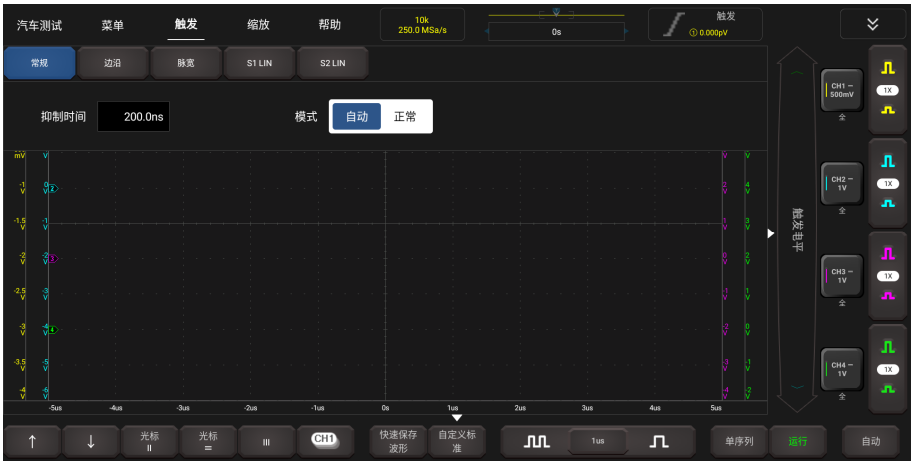
菜单选项	描述/设置
反相	反相开关打开之后，所显示的波形的电压值被反相。反相会影响通道的显示方式。在使用基本触发时，需要调节触发电平才能使波形保持稳定触发。
耦合方式	触发耦合用于定义哪部分信号通过触发电路。通道耦合方式包括： DC：直流耦合。被测信号含有的直流分量和交流分量都能通过，可用于查看低至0Hz且没有较大DC偏移的波形。 AC：交流耦合。被测信号的直流信号被阻隔，只允许交流分量通过，可用于查看具有较大DC偏移的波形。
探针类型	选择探针类型。探针类型分为电压探针和电流探针。 选择完目标探针类型后，系统会自动切换为预设的衰减系数。 衰减系数改变示波器的垂直比例，以便测量结果反映探头处的真实电压值。

	用户可手动从衰减系数列表中选择目标系数，也可点击/进行设置。

4.2.3 触发设置

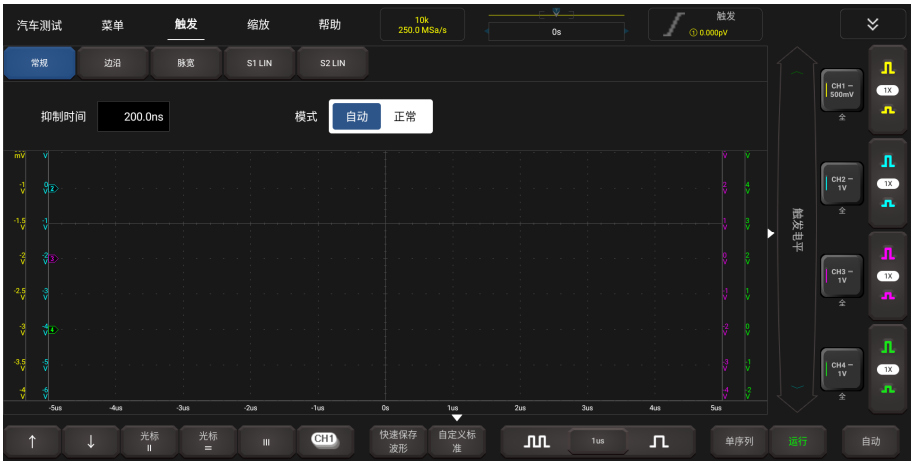
触发是指：按照需求设置一定的触发条件，当波形流中的某一个波形满足这一条件时，示波器即实时捕获该波形和其相邻部分，并显示在屏幕上。

点击**“菜单”-> “触发”**，系统进入如下界面：



A. 常规

常规选项用于设置扫描模式。在示波器未检测到触发条件时，可选择“自动”或“正常”触发模式来定义示波器捕获数据的方式。

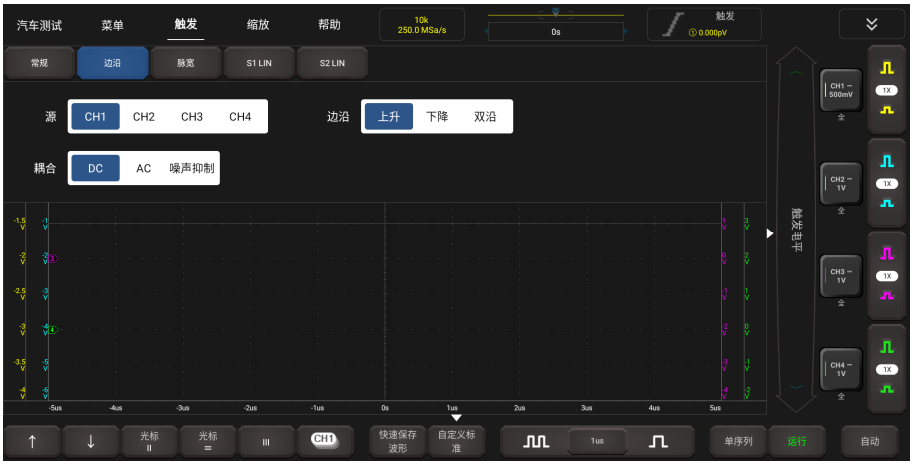


自动：自动触发是指不管是否满足触发条件，都实时刷新波形。如果不满足触发条件，示波器会等待一段特定时间然后强制触发。如果出现无效触发，则示波器无法同步波形，此时诊断设备屏幕上的波形通常看起来是晃动的。如果为有效触发，则屏幕上的波形显示是稳定的。

正常：正常触发是指满足触发条件才触发，否则波形会静止不动。

B. 边沿触发

此触发模式是最常用最有效的触发方式，绝大多数的应用都是用边沿触发来触发波形。边沿触发是指通过查找波形上的指定沿（上升沿、下降沿、双沿）和电压电平来识别触发。当被测信号的电压变化方向与设定相同，其值变化到与触发电压相同时，示波器被触发并捕捉波形。



菜单选项	描述/设置
源	选择触发信号的通道源。
边沿	上升：在上升沿触发。 下降：在下降沿触发。 双沿：在双沿触发。
（触发）耦合	可设置为直流、交流或噪音抑制。

C.脉宽触发

脉冲触发将示波器设置为在指定宽度的正脉冲或负脉冲上触发。通过设置脉宽条件可检测异常信号。

菜单选项	描述/设置
源	选择触发信号的通道源。
条件	选择脉宽条件。主要包括<、>、=和≠。
极性	设置所需脉宽极性。

D.LIN触发

LIN 触发（汽车通讯总线中使用）可以在 LIN 单线总线信号（标志着消息帧的开始）的同步中断出口、帧 ID、或者帧 ID 和数据的上升沿触发。

菜单选项	描述/设置
同步上升沿	当同步上升沿结束时，示波器触发。
帧 ID	示波器将在检测到其 ID 等于设定值的帧时触发。直接使用虚拟键盘输入 ID 值。
帧 ID 和数据	示波器将在检测到其 ID 和数据等于设定值的帧时触发。直接使用虚拟键盘输入 ID 值和数据。

4.3 自动设置

示波器具有自动设置功能，此功能可设置示波器自动以最佳的方式显示波形。

点击“自动”，系统自动调整示波器的水平和垂直标定，触发的耦合、类型、位置等设置内容，从而获得稳定的波形显示。

4.4 菜单操作

4.4.1 测量

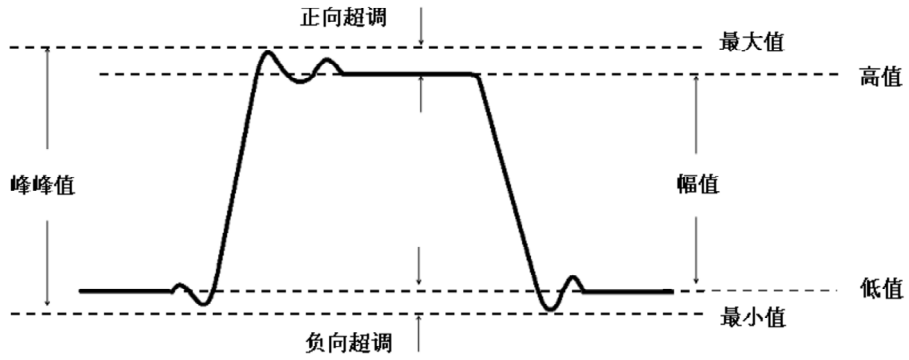
示波器提供 23 种参数自动测量功能。一次最多可以显示 10 种。

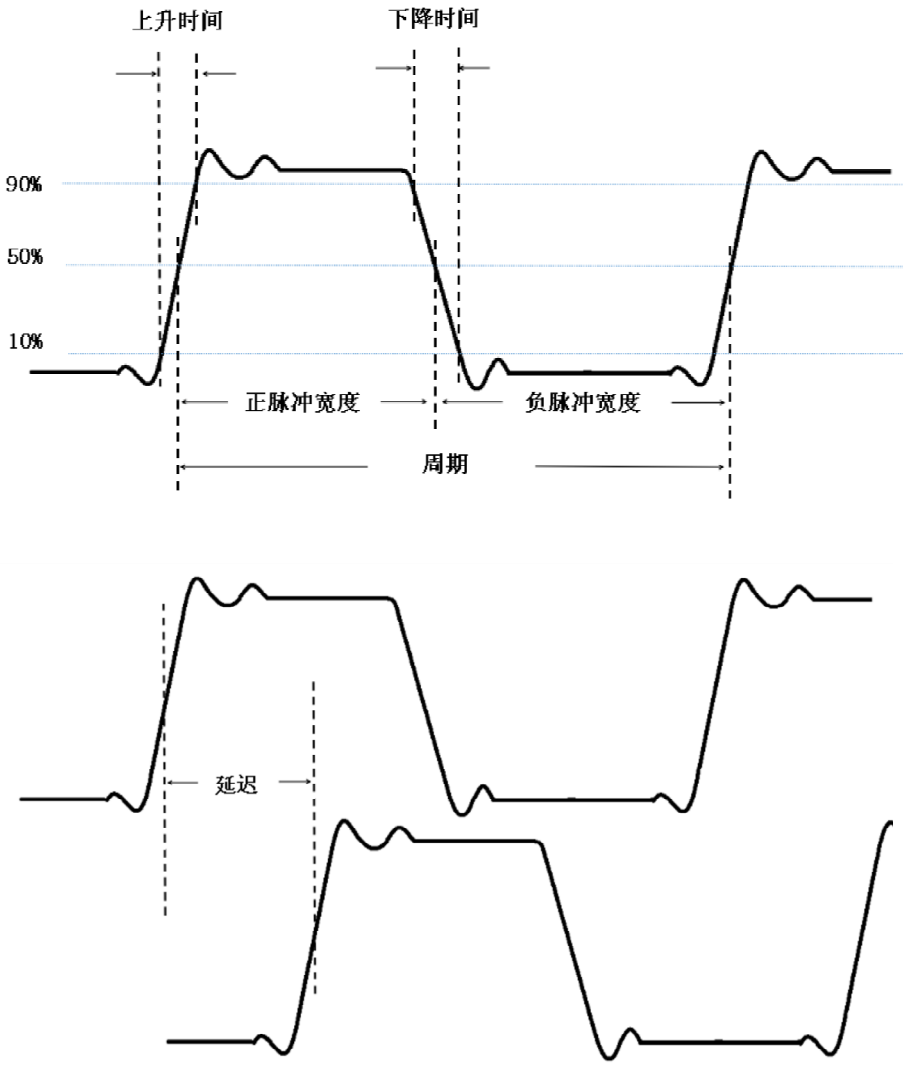
点击选择测量功能。所有选中的测量功能会显示在屏幕中间的“清除”按钮的左侧。其对应的数值会显示屏幕底部。

如需移除测量功能，再次点击即可。

参数类型	描述
周期	两个连续、同级性边沿的门限中间值之间的时间。
频率	周期的倒数。
上升时间	波形幅度从 10%上升至 90%所经历的时间。
下降时间	波形从 90% 下降至 10% 所经历的时间。
正占空比	正脉宽与周期的比值。
负占空比	负脉宽与周期的比值。
正脉宽	正脉冲在 50%幅度时的脉冲宽度。
负脉宽	负脉冲在 50%幅度时的脉冲宽度。
突发脉冲串	测量这个波形持续的时间。
正向超调	定义为波形上升前，（最小值-底端值）/幅度。
负向超调	定义为波形下降后，（最小值-底端值）/幅度。
峰峰值	波形最高点波峰到最低点的电压值。
幅值	波形顶端至底端的电压值。
高	波形平顶至 GND（地）的电压值。
低	波形平底至GND（地）的电压值。
最大值	波形最高点至 GND（地）的电压值。
最小值	波形最低点至GND（地）的电压值。
均方根	即有效值。依据交流信号在一周期所换算产成的能量，对应于产成等值能量的直流电压及均方根值。
C 均方根	1 个周期内信号的均方根值。
平均值	整个波形或选定区域上的算术平均值。
C 平均值	1 个周期内信号的平均幅值。

下图解释部分测量项的含义，仅供参考。





点击“清除”关闭所有测量项。

4.4.2 保存

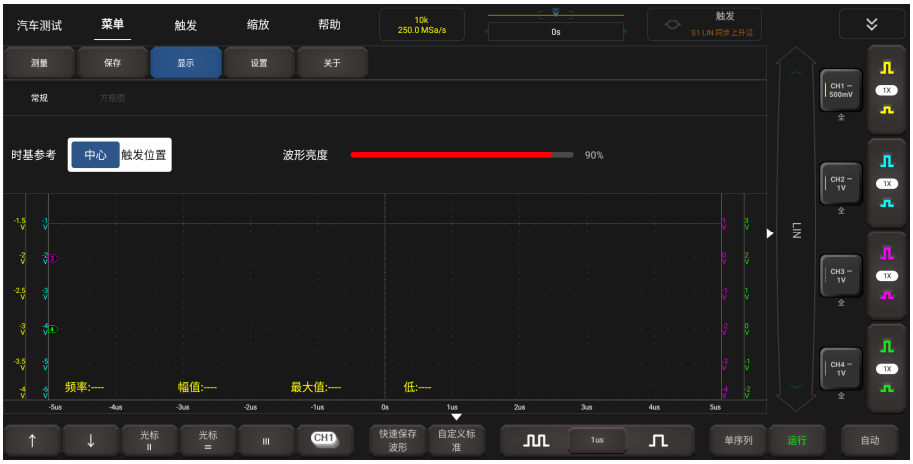
保存选项用于保存通道的波形。

点击“保存”，屏幕显示如下所示：

先选择测量通道，再选择测量类型 WAV 或 CSV，再修改名字然后保存，最后选择保存到 R1/R2/R3/R4 之中。保存的文件可通过“参考”通道进行调用进行参考和回放。

4.4.3 显示

显示选项用于设置背景坐标显示形式、时基参考、波形亮度、坐标轴显示强度，坐标类型有“满”、“栅格”、“十字准线”和“框架”。



4.4.4 设置

用户设置选项可设置记录长度、出厂设置、波形显示自动校准和示波器参数存储与恢复等。

点击“用户设置”，屏幕显示如下所示：

选项说明：

记录长度：设置记录长度。

出厂设置：示波器出厂前已为各种正常操作进行了预先设定。任何时候用户都可根据需要调出默认设置。

自动校准：自动校准可以以最大测量精度优化示波器信号路径。具体操作，请参考第 3.3 章。

用户自定义：通过保存当前界面上的系统参数创建新的预设测试参数。

4.4.5 关于

显示示波器模块信息和在线升级固件。

4.5 汽车测试

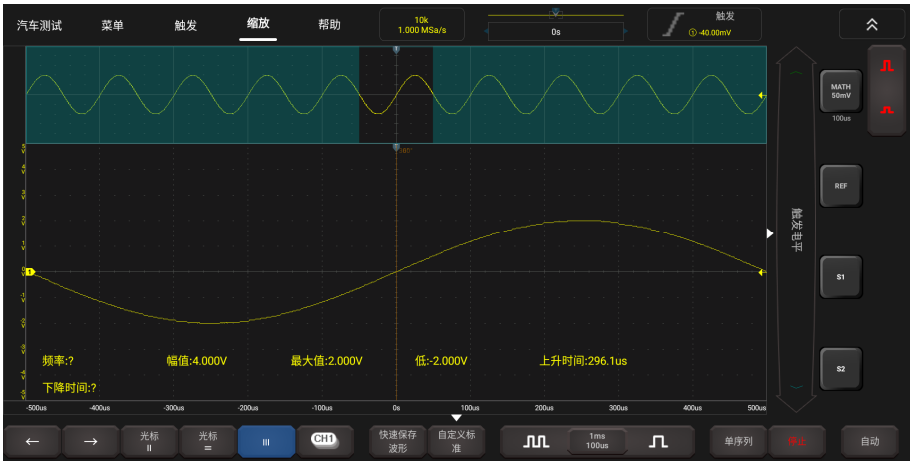
“汽车测试”选项中有各种汽车相关的测试内容（包括电路、传感器、执行器、点火测试、通信测试和组合测试）按钮，当用户根据需要选择好测试内容后，示波器会自动设置好相应的参数，可以达到快速设置的目的，选择功能后请根据右边小框提示接线测试。

4.6 缩放

如果显示的波形包含一些有用的采样数据信息，用户可以停止采集波形然后通过缩放模式进行分析。

缩放模式可让用户在较大的存储深度下同时观察整条波形和局部细节。该模式同时提供一个主窗口和一个缩放窗口。

备注：该功能仅适用已采集的数据或已被停止采集的数据。

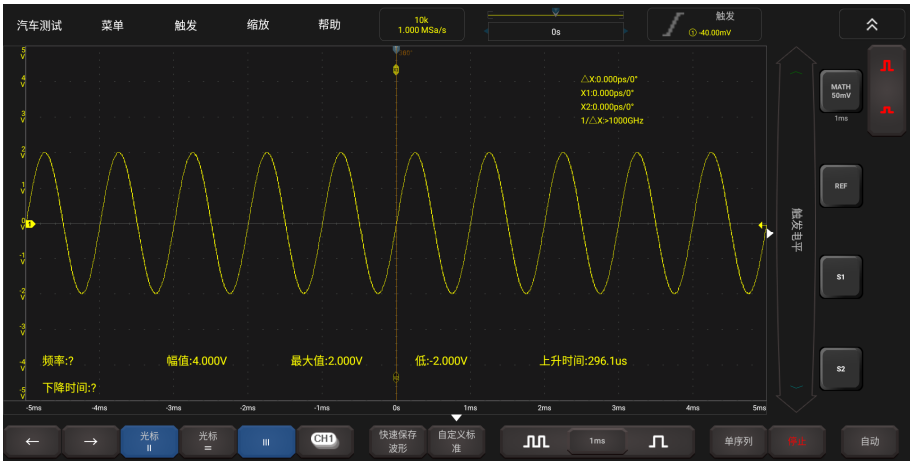


4.7 光标

“光标”选项可用于辅助测量。打开光标，将光标放到测量点可以读出波形测量值。光标有水平光标和垂直光标两种，水平光标〓测量垂直方向量值，垂直光标||可以测量水平方向的量值。

点击光标选项〓/||打开，界面会出现两条水平Y1 & Y2/垂直光标X1 & X2测量线，点击相关线条并拖动即可移动线条位置，或者点击左下角↑/↓或←/→按键微调线条位置。

再次点击该“光标”选项，该功能关闭且辅助线消失。



备注：

△读数：表示两条光标位置之间的差值。

Y1，Y2 后的电压读数：表示水平光标中被激活的光标相对于零电位的位置。

X1，X2 后的时间读数：表示垂直光标中被激活光标相对于触发点的位置。

1/△X：频率

4.8 快速保存波形

“快速保存”选项可以快速保存当前打开通到的测量波形，示波器可将模拟通道或数学通道波形保存到本地，文件类型可选择WAV或CSV。

示波器提供4个参考通道，可通过调用，将WAV类型的文件载入到参考通道，打开参考通道显示参考波形。相关设置可在“菜单”中找到。

4.9 MATH（数学）& REF（参考）

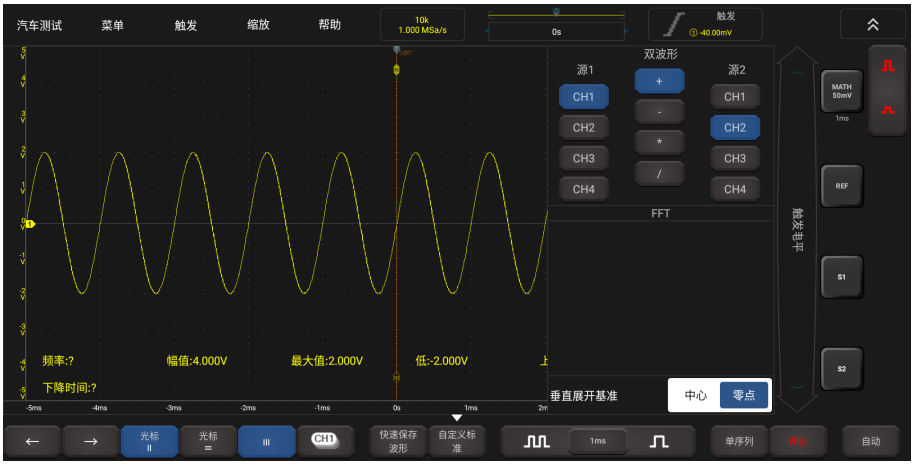
MATH（数学）和 REF（参考）很少使用，其被隐藏在选项中。

用户可点击将其调出。

4.9.1 MATH（数学）

“MATH”选项支持多种模拟通道波形之间的数学运算。包括加法（+），减法（-），乘法（x），除法（÷）和 FFT。

选择需要进行数学运算的通道源，然后选择加法、减法、乘法或除法操作，由此产生的数学运算波形显示在屏幕上，并标记为。



FFT运算：

FFT是使用模拟输入通道计算快速傅立叶变换。使用“FFT”模式可将时域（YT）信号转换为它的频率分量（频谱）。选择FFT功能，绘制的FFT谱显示了dB和频率的关系。水平轴的读数从时间变为频率（赫兹），垂直读数从V变为dB。数学计算功能可以将时域波形的2048个中心点转换为FFT谱。最终的FFT谱中含有从直流（0 Hz）到奈奎斯特频率的1024个点。通常，显示屏将FFT谱水平压缩到250点，但可以使用“FFT缩放”来扩展FFT谱以便更清晰地看到FFT谱中1024个数据点每处的频率分量。FFT运算可用于以下工作：

- 测量系统中的谐波含量和失真
- 表现直流电源中的噪音特性
- 分析振动

使用窗口函数时，频率泄露可以大大降低。该示波器提供四种不同特征的FFT窗口函数，适用于测量不同波形。用户需要根据不同的波形和它们的特性选择窗口函数。请仔细阅读下表，根据输入信号做出适当的选择。

窗口	测量	特性
矩形窗	暂态和短脉冲波形	不连续波形的专用窗口。与不加窗口的情况基本类似。
哈明窗	瞬态和短脉冲波形	稍好于汉宁窗口的频率分辨率。
布莱克曼	单频信号，寻找更高次谐波	最好的幅度分辨率，最差的频率分辨率。
汉宁窗	周期波形	较好的频率分辨率，较差的幅度分辨率。

数学运算提示：

1)、如果显示的模拟通道或数学函数波形被削波（波形未完全显示在屏幕上），由此产生的数学函数也将被削波。

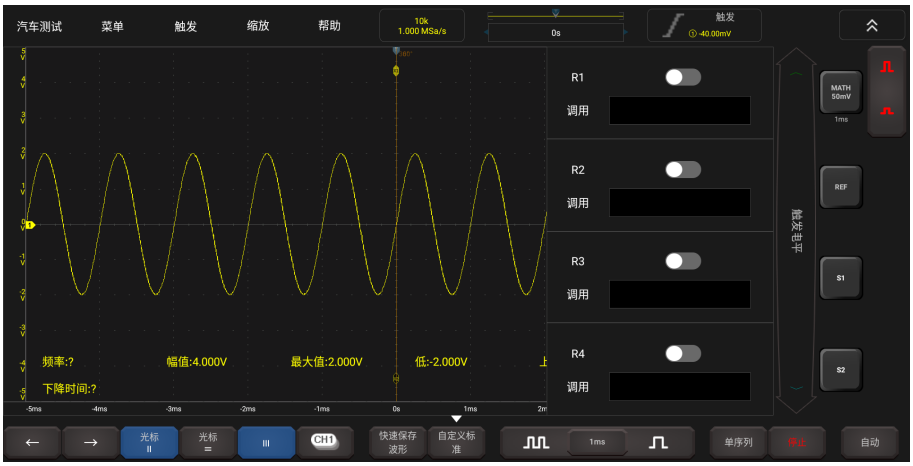
2)、数学波形显示后，可以轻点通道图标关闭源通道，以便更好地查看数学波形。

3)、可以调整每个参与数学函数的通道的垂直灵敏度和偏移以便于查看和测量数学波形。

4)、可使用“光标”和“测量”测量数学函数波形。

4.9.2 REF（参考）

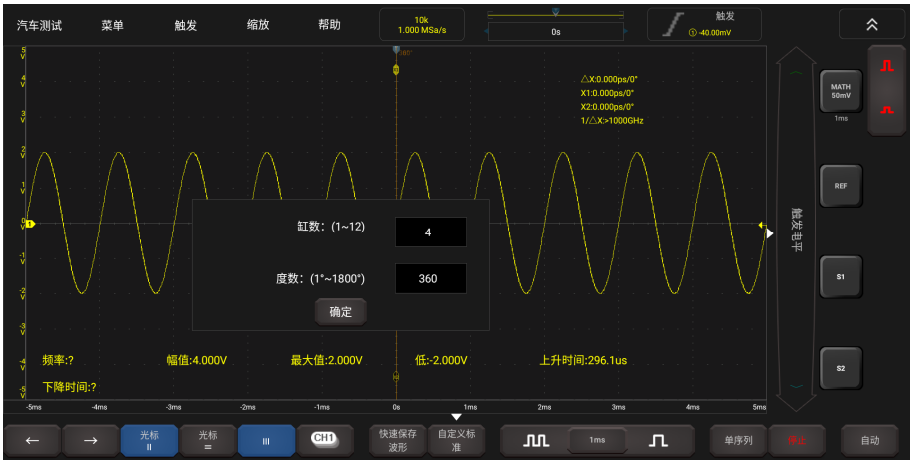
示波器提供 4 个参考通道，可通过调用，将之前保存的 WAV 类型的文件载入到参考通道，打开参考通道显示参考波形。



4.10 相位测量

用于辅助测量循环波形的正时时间。

点击 ，屏幕上会弹出缸数和角度设置弹窗，设置完成后，点击“确定”。



用户可以将两个相位标尺拖动到适当的位置以标记循环的开始和结束。标尺底部显示默认相位起点 0° 和终点 360° ，可编辑为任意值。例如，测量四冲程气缸的正时时，相位结束通常显示为 720° ，因为一个周期包括两次曲轴旋转。

4.11 自定义设置

该功能同“菜单”->“设置”->“用户自定义”一样。

5 点火分析

在汽油机各系统中点火系统对发动机的性能影响最大，统计数字表明有将近一半的故障是电气系统工作不良而引起的，因此发动机性能检测往往从点火系统开始。现用点火系统大体分为有分电器和无分电器，无分电器中有独立点火和双缸点火：

1、有分电器点火系统：即传统有断电器（俗称白金）触点式点火系统和由电磁、红外或霍尔元器件构成的非接触式断电器无触点点火系统。

2、独立点火系统：曲轴传感器送来点火时刻信号和气缸识别信号，从而使点火系统能向指定的汽缸在指定的时刻送去点火信号，每缸配有独立的点火线圈。

3、双缸点火系统：两缸共用一个点火线圈，当两个缸活塞同时接近上止点时（一个是压缩另一个是排气），由于两个火花塞共用同一个点火线圈所以同时点火，这时候一个是有效点火另一个则是无效点火，前者处于高压低温的混合气之中，后者处于低压高温的废气中。

该模块可以对发动机各种点火系统的次级信号进行测试分析。

5.1 次级-分电器点火分析

参照第3.4章节所述方法进行连接。

提示：常见点火顺序（具体以实际发动机点火顺序为准）

四行程直列四缸：1-2-4-3或1-3-4-2

四行程直列六缸：1-5-3-6-2-4或1-4-2-6-3-5

四行程直列八缸：1-8-4-3-6-5-7-2

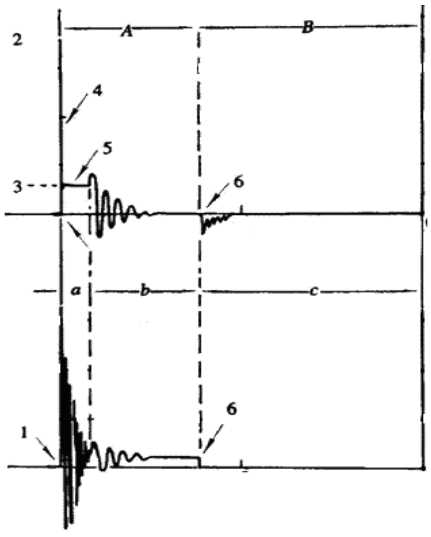
五缸：1-2-4-5-3

V 6发动机：一般而言，人坐在驾驶室内，如果气缸顺序是右边自前往后为：1、3、5，左边自前往后为2、4、6。点火顺序一般是：1-4-5-2-3-6。如果右边自前往后为：2、4、6，左边自前往后为1、3、5。点顺次序一般是：1-6-5-4-3-2。

下图为分电器型点火系统的正常点火波形，上面为次级波，下面为初级波。

次级波形图

A部分为触点开启段；B部分为触点闭合段，为点火线圈的充磁区。



1) 触点开启点：点火线圈一次回路切断，次级电压被感应急剧上升；

2) 点火电压：次级线圈电压克服高压线阻尼、断电器间隙和火花塞间隙而释放充磁能量，1-2段为击穿电压；

3) 火花电压：为电容放电电压；

4) 点火电压脉冲：为充电、放电段；

5) 火花线：电感放电过程，即点火线圈的互感电压能维持二次回路导通；

6) 触点闭合：电流流入初级线圈，因初级线圈的互感而产生振荡。

初级点火波形：

a部分为在火花持续期内因磁感应而在初级线路上产生电压振荡；

b部分是火花期后，剩余的磁场能量产生的衰减振荡；

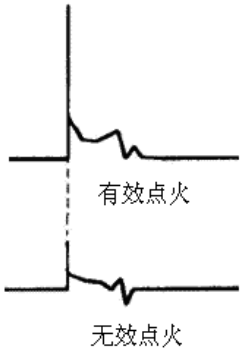
c部分是初级线圈触点闭合充磁段。

从这一波形图上我们可以清晰地看到断电器触点闭合角、开起角以及击穿电压和火花电压的幅值，并可以测试到火花的延迟期和两次振荡过程。对于无故障点火系统，触点闭合角为全周期的 45%-50%（四缸机）或 63%-70%（六缸机），八缸机约为 64%-71%，击穿电压超过 15kv，火花电压 9kV 左右，火花时间大于 0.8ms。如果这些数值或波形异常，那么意味着出现故障或系统需要调整。

5.2 次级-双缸点火分析

参照第3.4章节所述方法进行连接。

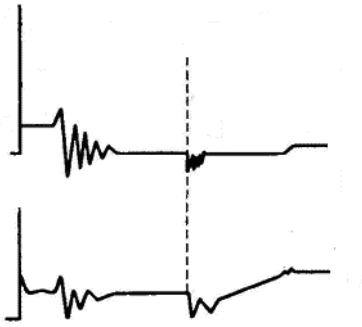
下图是有效点火和无效点火的波形。有效点火工况下因气缸内充入新鲜可燃混合气，其电离程度低，因此击穿电压和火花电压较高；无效点火工况下因气缸内为燃烧废气，电离程度高，因而击穿电压及火花电压较低，检测时应加以区分。



5.3 次级-独立点火分析

参照第3.4章节所述方法进行连接。

下图是独立点火系统的次级（上）和初级（下）正常点火波形，因其初级电路的通断不是机械触点的合与开，而是晶体管的导通，持续期内初级电压没有明显的振荡，而充磁过程中因限流作用电压有所升高，这一变动因点火线圈的感应引起次级电压线相应的波动。



5.4 波形分析模式

点火次级单缸波形测试主要用来：

a. 分析单个气缸的点火闭合角(点火线圈充电时间)；

b. 分析点火线圈和次级高压电路性能(从点火线至点火电压线)；

c. 查出单缸不适当的混合气空燃比(从燃烧线)；

d. 分析电容性能(白金或点火系统)；

e. 查出造成气缸失火的火花塞(从燃烧线)。

这个测试能提供非常有价值的关于每个气缸燃烧质量的资料。如果有必要甚至可以在行驶条件下进行此项测试。由于点火次级波形明显受不同发动机、燃油系统和点火条件影响，它对检测发动机机械部分和燃油系统部件及点火系统部件的故障是有用的。波形的不同部分能指明任一特定气缸的某些部件和系统的故障。参照波形各部分的指示看波形特定段的相关部件运行状况。

测试条件和方法：

按照行驶性能故障或点火不良等情况出现的要求来起动发动机或驾驶汽车。确认各缸幅值、频率、形状和脉冲宽度等判定性尺度的一致性，检查对应特定部件的波形部分的故障。

波形结果：观察点火线圈在开始充电时，保持相对一致的波形的下降沿，这表明各缸一致的闭合角及点火正时的精确。

点火线：

观察跳火电压的高度一致性，一个太高的跳火电压(它甚至超过了示波器的显示屏)表明在点火次级电路中存在着高电阻(例如开路或损坏的火花塞、高压线或是火花塞过大时间隙)，一个太短的跳火电压线，表明点火次级电路电阻低于正常值(污浊和破裂的火花塞和漏电的火花塞高压线等)。

火花或燃烧电压：

观察火花或燃烧电压保持相对一致性，这表明火花塞工作的一致性和各缸空燃比，如果混合比太稀，燃烧电压就比正常值低一些。

燃烧线：观察火花或燃烧线应十分“干净”，没有过多的杂波在燃烧线上，过多的杂波表明气缸点火不良，由于点火过早、喷油器损坏、污浊火花塞或其它原因。燃烧线的持续时间长度表明汽车缸内异常稀或异常浓的混合比。过长的燃烧线(通常超过2毫秒)表示混合气浓，过短的燃烧线(通常少于0.75毫秒)表示混合气稀。

点火线圈振荡：

观察在燃烧线后面最少两个，最好多于三个的振荡波，这表明点火线圈和电容器(在白金或点火系统)是好的。

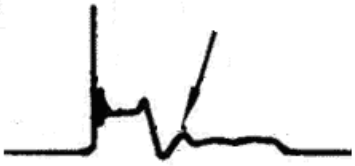
初级电压分析

根据点火分析所采集到的故障初级电压波形，可以分析点火系断电电路有关电气元件和机械装置的状态，

为断电电路的调整和维修提供可靠的依据，以避免盲目拆卸。

下图所示波形在触点开启点出现大量杂波，显然是触点严重烧蚀而造成的，打磨触点或更换断电器即可证实。

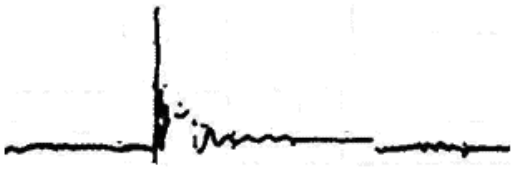
下图所示的初级电压波形在火花期间的衰减周期数明显减少，幅值也变低，显然是电容器漏电造成的。



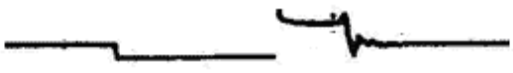
下图所示波形在触点闭合阶段有意外的跳动，造成这种现象的原因是触点因弹簧力不足引起不规则跳动。

下图所示曲线的充磁期即触点闭合角太小，一般由触点间隙过大造成。

如果触点接地不良就会引起初级波形水平部分的大面积杂波，如下图所示。



下图所示为电子点火系统的低压故障波形，在充磁阶段电压没有上升，说明电路的限流作用失效，无分电器点火系统无元件可调整，当这一波形严重失常时只能逐个更换诸如点火线圈、点火器、点火信号发生器和凸轮位置传感器等，找出故障器件或模块。



二次波形还受火花塞、燃烧过程、混合气成分、发动机热状态、点火线圈等等的影响，情况较为复杂。以下列举出大量实测的二次故障波形供用户参考，因导致故障的因素是多方面的，下图所示故障解释只是故障成因的主要可能因素。

次级电路电阻过大

火花塞上有机油或积碳

火花塞间隙太大或混合气太稀

电喷系统喷油嘴工作不良

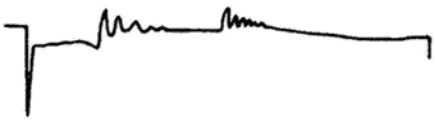
火花塞过热或气门漏气

混合比过浓或火花塞漏电

混合比太稀或气缸压力过低

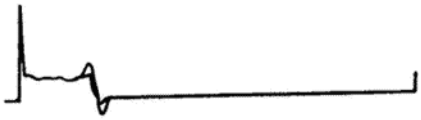
分电盘盖或分火头松动

火花塞积碳或间隙太小



初级电路反接

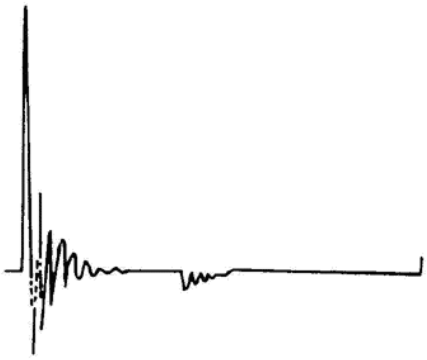
点火线圈或电容器漏电



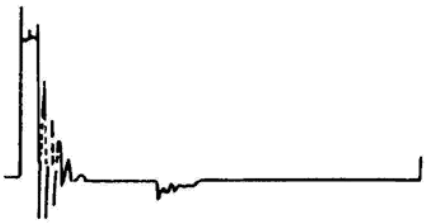
点火线圈初次级接头开路

次级线路有间歇性断电

次级线圈漏电



次级电路断路



次级电阻值过大

6 保养&维护

注意：为避免损坏示波器或探头，请勿将其置于雾气，液体或溶剂中。

清洁

按照操作条件的要求，经常检查示波器和探头，请按照下述步骤清洁仪器的外表面：

1. 使用不起毛的抹布清洁示波器和探头外部的浮尘。
2. 使用一块用水浸湿的软布清洁示波器。

注意：为避免损坏示波器或探头的表面，请勿使用任何腐蚀性试剂或化学清洁试剂。

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可更换之零部件和可选配件可直接向元征公司授权的供应商订购，订货时请注明：

- 订购数量；
- 零件编号；
- 零件名称

客户服务中心

设备操作过程中遇到任何问题，请致电全国服务热线：400-066-6666。

设备需要维修时，请将设备寄至元征公司，并附上购买发票及问题说明。若设备在保修范围之内，元征公司将免费维修；若设备在保修范围之外，元征公司将收费维修并加收回程运费。

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