VDS8000 Series Automotive Oscilloscope
User Manual

Jun. 2026 edition V1.0.0

Copyright © LILLIPUT Company. All rights reserved.

The LILLIPUT's products are under the protection of the patent rights, including ones which have already obtained the patent rights and those which are applied for. The information in this manual will replace all materials published.

The information in this manual was correct at the time of printing. However, LILLIPUT will continue to improve products and reserves the rights to change specification at any time without notice.

OWON® is the registered trademark of the LILLIPUT Company.

Fujian LILLIPUT Optoelectronics Technology Co., Ltd.

No. 19, Heming Road

Lantian Industrial Zone, Zhangzhou 363005 P.R. China

Tel: +86-596-2130430 **Fax:** +86-596-2109272

Web: www.owon.com **E-mail:** info@owon.com.cn

Table of Contents

I. General Safety Requirements 1
II. Safety Terms and Signs 2
1. Components & Controls 5
2. Interface 6
3. Probe Compensation 10
4. Self-Calibration 12
5. How to Connect 14
6. How to select CH1/CH2/CH3/CH4 Channel 16
7. How to select MATH/REF Channel 17
8. Horizontal Settings 18
9. Vertical Settings 18
10. Trigger Setting 20
11. Auto-Set 24
12. Measure 24
13. Save 26
14. Display 27
15. Userset 28
16. Zoom 28
17. Cursor 29
18. Phase Ruler 30
19. Automotive Operations 31
20. MATH 32
21. REF 33
22. Bus decoding(S1/S2) 33
23. Secondary 35
23. Primary 38
III.Technical Specifications 42
IX. Appendix 45
Appendix A. Device Accessory List 45
Appendix B. Device Maintenance 45

I. General Safety Requirements

! Before using the device, strongly recommend to browse “**Safety Warnings**” carefully and completely, so as to avoid any possible human body injury, or any damages to the device, or its accessories, or communicating facility. !

Safety Warnings

i. The device only been allowed to work within specified application scenario.

ii. Before communicating the device with PC, please refer to user manual to familiarize the allowed rating value completely.

iii. Making sure the allowed rating value of all terminals been well-followed, so as to avoid any potential short circuit or electric shock.

iv. NO direct human body touch with any naked conductor of device when working the device. The naked conductor covers joints, connecting probe tip, communication interface, and others.

v. No further operation is allowed provided any undetermined failure appears when working the device, better to seek the assistance of qualified technicians.

vi. DO NOT work the device in humid environment.

vii. DO NOT work the device in the explosive atmospheres.

viii. Keep the device in good ventilation environment, and always keep the device surface clean and dry.

ix. Better to send the device to qualified technicians for necessary maintenance.

II. Safety Terms and Signs

Safety Terms

Terms in this user manual. It covers,

Warning: which indicates the condition or the operation may cause body injury or permanent life loss.

Caution: which indicates the condition or the operation may cause device damage, or its accessory damage, or communicated facility damage.

Terms on the device. It covers,

Danger: which indicates the operation may result in the immediate human body injury.

Warning: which indicates the operation may result in potential human body injury.

Caution: which indicates the operation may result in potential damage to the device, or its accessory, or communicating facility.

Safety Signs

Signs on the device. It covers,

 Hazardous Voltage

 (please refer to user manual for further details)

 Protective Earth Terminal

 Chassis Ground

 Communication Interface Ground

To avoid possible human body injury, and / or device damage, and / or its accessory or communicating facility damage, before working the device, strongly recommend to read the following safety information,

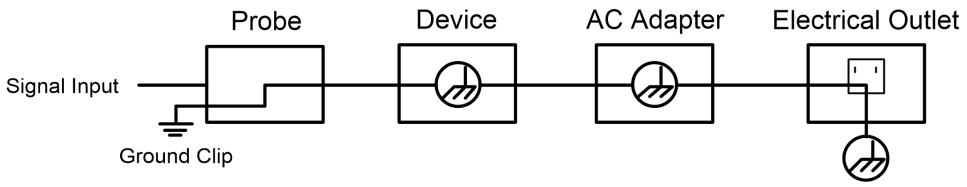
Warning

To avoid any potential short circuit or electric shock, DO use the power adapter of original local standard, or recommended

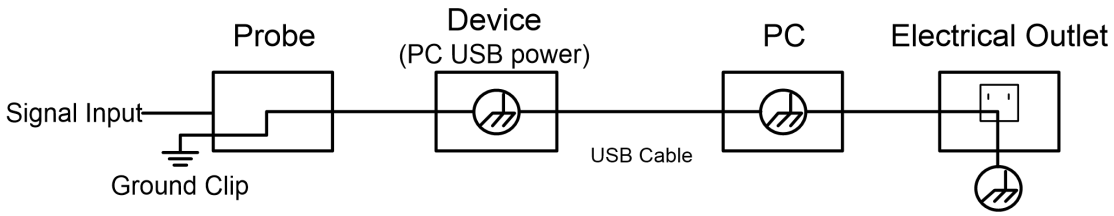
Warning

The channels of the device is non-isolated electrically. When working the device, to avoid possible short circuit, the ground of two probes are NOT allowed to connect to 2 different non-isolated DC level.

The illustration of the device's built-in ground wire connection -



When the device communicating with PC via USB communication interface (with PC powered by AC power source), the illustration of the ground wire connection -



It is NOT allowed to measure AC power when the device been powered by AC power source through the adapter, or when the device powered by PC through USB connection cable (via USB communication interface of PC, with PC powered by AC power source).

Warning

When the device input is getting through the voltage larger than 42 Vp-p (30Vrms), or on circuit of 4800+VA, to avoid any potential short circuit or electric shock -

i. DO use probes and adapter come along with the original device, or those ones recommended.

ii. Before working the device, DO check probes and accessories carefully to see whether any mechanical damages exists, making sure probes and accessories in normal-working status.

iii. When device in non-working condition, to remove probes and accessories firstly, then put them in suitable places.

iv. When working the device in CAT II environment,

- DO NOT get the 40+ V input voltage from earth surface through any non-isolated input;
- DO NOT get the 40+ V input voltage of dropout voltage through any non-isolated input

v. DO NOT input the voltage larger than the rated one, especially when probe attenuation set in 1:1, since the voltage from probe tip will go through to the device itself.

vi. NO NOT contact the exposed part of metal BNC terminal directly by hand or any other human body part.

vii. DO NOT insert any metal object into connectors.

- Note -
i). The rated voltage mentioned in point v. is the fixed value of working voltage, matching VACrms / 50 - 60Hz under AC sine wave application, and VDC under DC sine wave application;

ii). CAT II indicates local level for electrical appliance and portable device.

1. Components & Controls



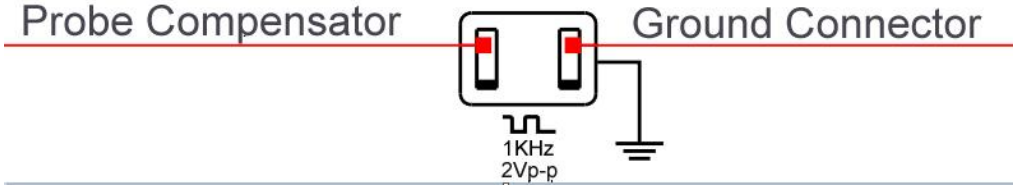
1- Channel 1

2- Channel 2

3- Channel 3

4- Channel 4

5- Fixed signal generator, Generate a square signal with fixed 1K frequency.



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.

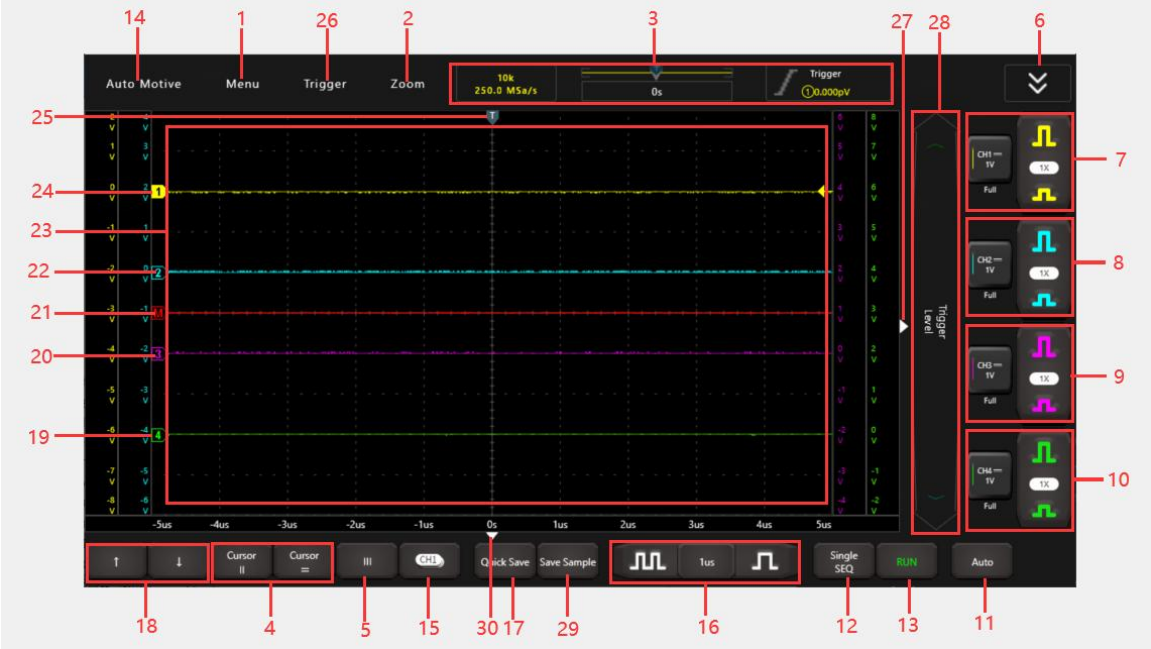
7- USB device (type-C), for PC or computer tablet communication, Connect to the diagnostic tool via USB cable so that the signal can be displayed on the diagnostic tool.

Note: when the device powered by PC or computer tablet USB connection cable (via USB communication interface of PC or computer table, with PC or computer table powered), without adapter connection, the input current should reach 1.5A or above, 2A recommended.

8- DC IN port (type-C), Provides power to it via the battery cable clamps.

2. Interface

Tap the application icon and the following screen will appear:



1- Menu

Includes the following options:

- Measure: It provides 23 parametric measurement items.
- Save: It allows you to save the current setup before you close the software.
- Display: Sets the display mode of the waveform.
- Setting: The following items are available: Depth, Factory Reset, Self-Adjust (self-calibration) and Customization.
- About: Displays the detailed information of the app.

2- 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 right, or left.

3- Information of the current status

Readouts indicate the storage depth, sample rate, cursor position indicator and trigger information.

4- 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.

5- Phase ruler

Tap this button once to activate it. Tap it again to exit.See Chapter 19 for details.

6- 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.

7- 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.

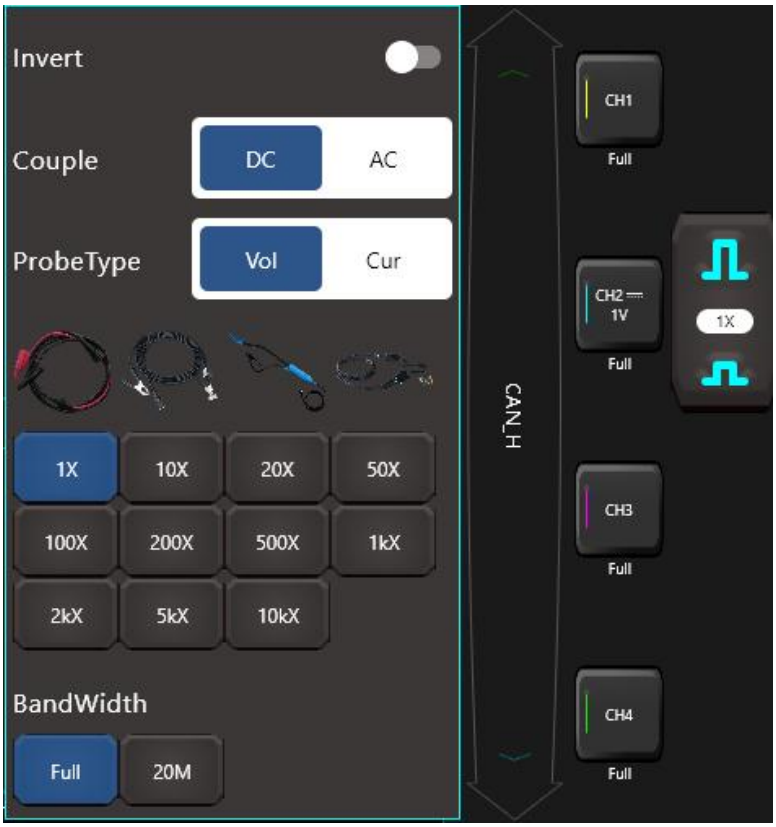
Tap 

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.

NOTE: Items 8, 9 and 10 refer to the above description

11- Auto

It automatically adjusts the vertical scale, horizontal scale and trigger settings.

12- Single SEQ

In this mode, it only acquires the waveform that generates for the first time the trigger conditions are met, and then stops after finishing capture.

13- RUN/STOP/WAIT

- WAIT: All pre-triggered data has been acquired and the Oscilloscope is ready to accept a trigger.
- STOP: The Oscilloscope has stopped acquiring waveform data.
- RUN: The Oscilloscope is running.

14- Automotive

Provides all kinds of the testing applications on the automotive parts (including circuits, sensors, actuators, ignition etc.) and detailed connection methods. Tap this button once to enter the submenu. Tap it again to fold the submenu.

15- 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.

16- Horizontal settings

Controls the time base. Tap this button once to enter the submenu. Tap it again to fold the submenu.

17- 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.

18- 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 .

19- CH4 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.

20- 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.

21- Math marker

Shows the reference points of the displayed waveforms. If there is no marker, the channel is turned off and not displayed. The MATH channel is hidden under the  tab.

22- CH2 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.

23- Waveform display area

24- CH1 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.

25- Horizontal trigger position marker

Shows the reference position of the trigger.

26- Trigger settings menu

Includes the following options:

- Common: It provides trigger Hold-Off and Mode items.
- Edge: Set edge triggering conditions.
- PulseWidth: Set pulse width triggering conditions.
- S1 LIN/CAN: Set the triggering conditions for the bus1.
- S2 LIN/CAN: Set the triggering conditions for the bus2.

27- Hide the menu bar on the right

Click on the triangle symbol to hide or unhide the menu bar on the right

28- Trigger level position of Channel

You can slide or click the arrow to move up and down to trigger the level position

29- Save sample settings menu

Shortcut for “Settings/Customizations” items, which enables quick saving of current oscilloscope acquisition settings for the next recall.

30- Hide the menu bar below

Click on the triangle symbol to hide or unhide the menu bar below

3. 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.

- Power the Oscilloscope on: Plug one end of the battery cable clamps into the DC-IN port of the Oscilloscope, 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 Oscilloscope via USB cable. If the diagnostic tool can supply enough power to the Oscilloscope, please ignore this step.

- Connect the B-shaped plug of the USB cable to the USB port of the Oscilloscope, and the other end to the USB port of the diagnostic tool.
- Launch the Max4Scope App to run it.

- From the "Vertical Setting" panel, select the corresponding channel and set the Probe attenuation to 10X.



Refer to the following description for attenuation proportion：

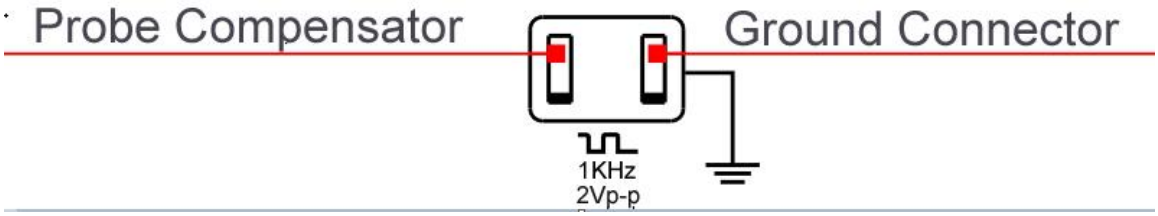
1x：1:1

10x：10:1

1kx：1000:1

10kx：10000:1

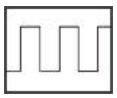
- Set the switch to "X10" (the default is X1) on the probe and connect it to the CH1 of the Oscilloscope.
- Attach the probe tip to the Probe Compensator and the ground nip of the reference lead to the ground connector. When using the probe hook-tip, insert the tip onto the probe compensator firmly to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

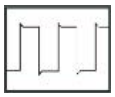


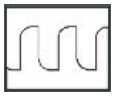
- Tap the Auto button located on the bottom of the screen, a square wave (approximately 1KHz 2V peak-to-peak) will be displayed within several seconds.

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

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

  : Correctly Compensated

  : Over Compensated, 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, 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.

  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.

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

4. Self-Calibration

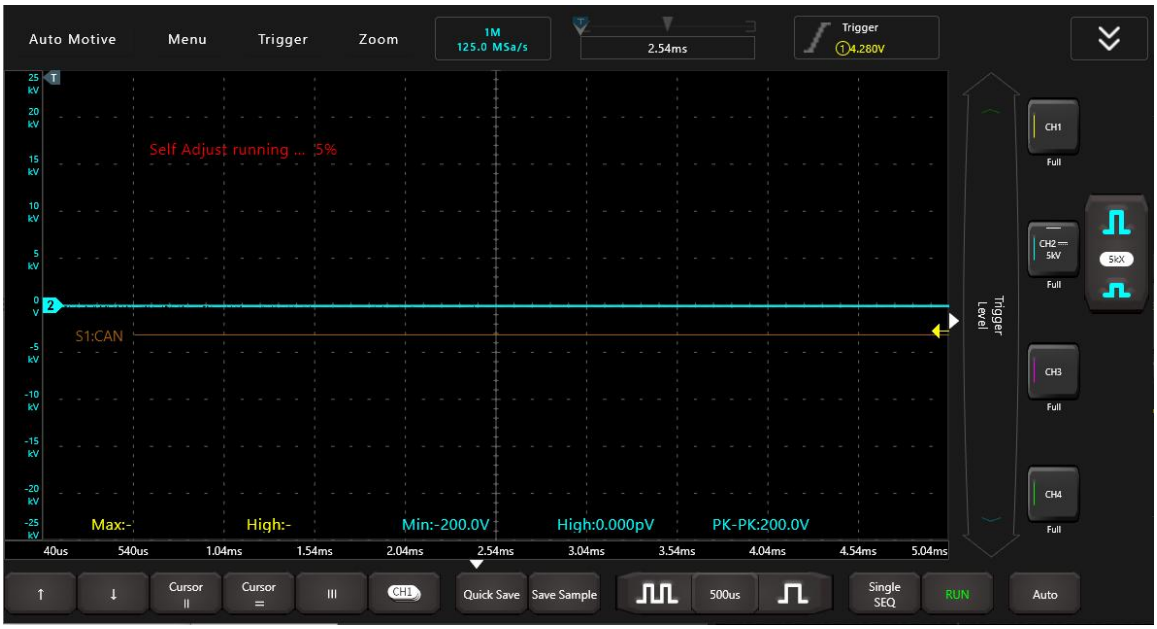
The self-calibration routine lets you optimize the oscilloscope signal path for measurement accuracy. You can run the routine at any time but you should always run the routine if the ambient temperature changes by 10°C or more.

For accurate calibration, power on the Oscilloscope 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 -> Userset, tap Self Adjust.

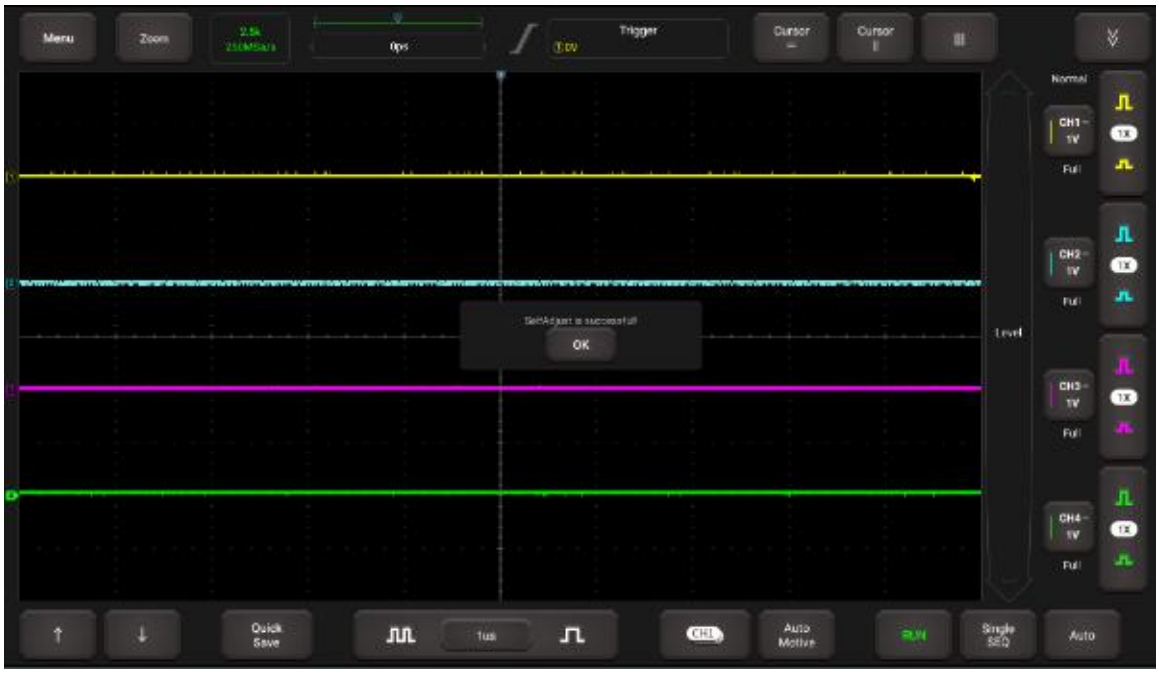


Tap OK on the pop-up message box to start calibration. The LED on the Oscilloscope starts flashing and the prompt message “Self Adjust is running” will appear on the upper left corner of the screen.



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.



Tap OK to finish the self-calibration.

5. How to Connect

For different applications, the connection methods may vary.

1. Power the Oscilloscope on: Plug one end of the battery cable clamps into the DC-IN port of the Oscilloscope, 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 Oscilloscope via USB cable. If the diagnostic tool can supply enough power to the Oscilloscope, please ignore this step.

2. Connect the B-shaped plug of the USB cable to the USB port of the Oscilloscope, 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):

- 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.

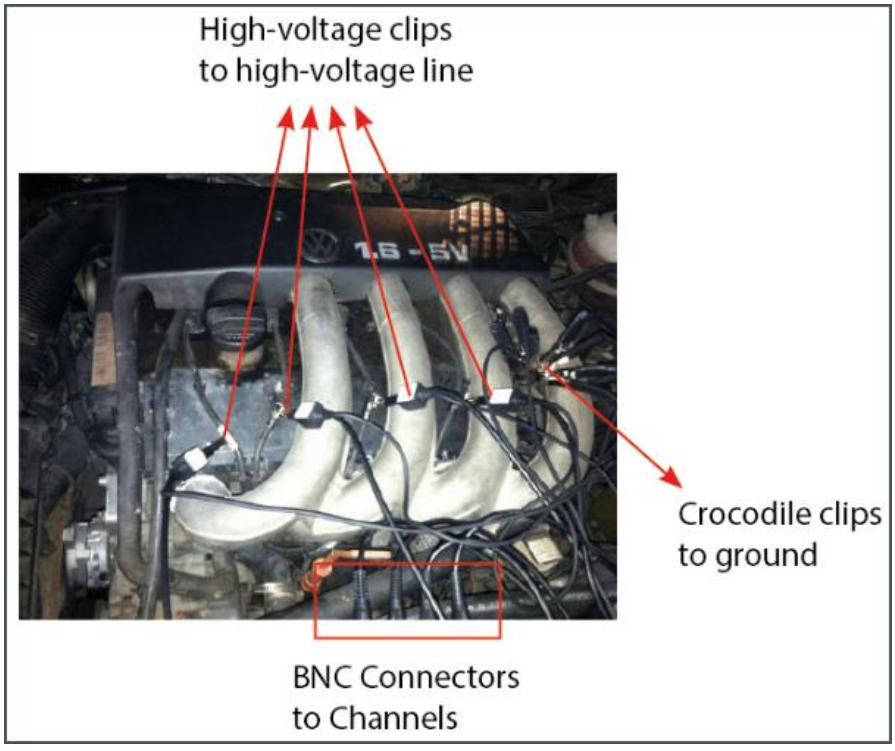


- Connect the black terminal and signal wire (its other end connected to the red 4mm connector) of the 6-way breakout lead to the GND and signal terminal of the vehicle sensor.

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 Oscilloscope, and clamp the crocodile clips and high-voltage clips onto the vehicle ground and high-voltage line respectively.

The connection is as follows:

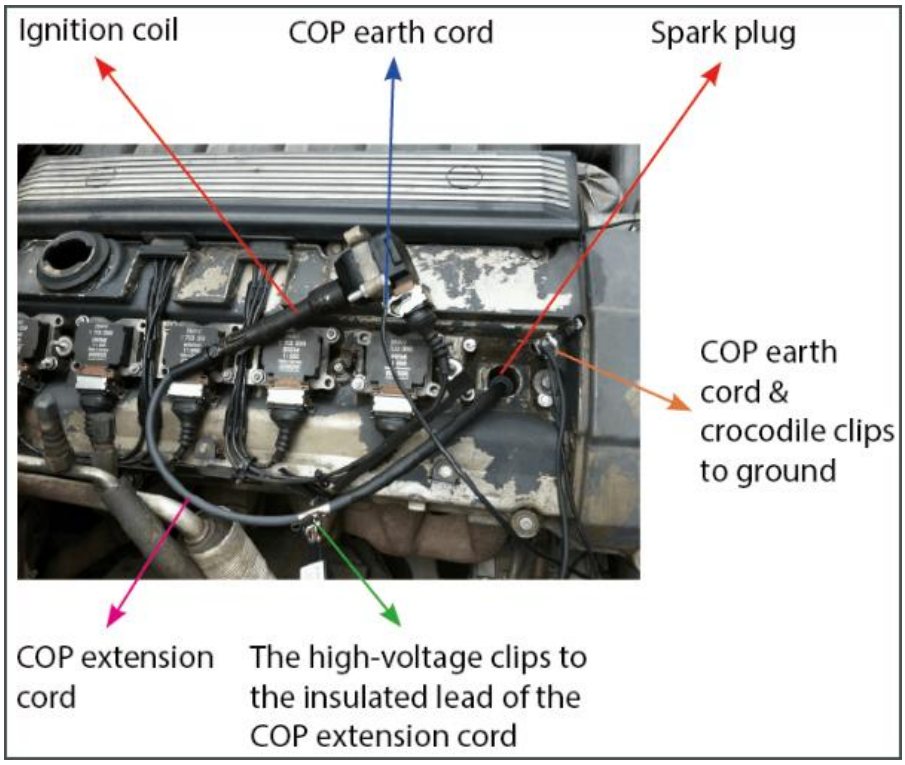


C. While testing Secondary-direct ignition analysis,

3. When the high-voltage wire is exposed, plug the BNC end of secondary ignition pickup into CH1/CH2/CH3/CH4 channel of Oscilloscope, 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 (optional) 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 Oscilloscope, and then connect the high-voltage clip to high-voltage line, and crocodile clips to ground.

The connection is as follows:



6. How to select CH1/CH2/CH3/CH4 Channel

- Tap the channel tab shown on the right edge of the screen.



- Tap 

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.

7. How to select MATH/REF Channel

Tap  .



Note: For detailed operations on the Channel MATH and REF, refer to Chapter 4.9

The Oscilloscope 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.

8. 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.



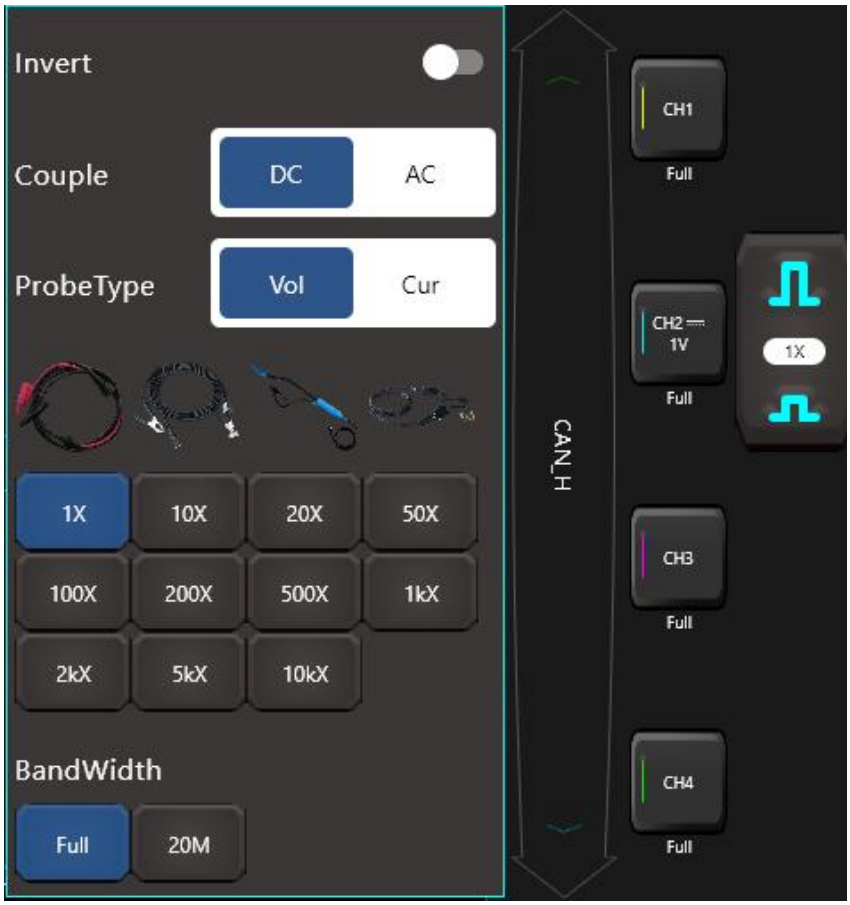
If the waveform acquisition is stopped, the time/division selector (/) expands or compresses the waveform.

9. Vertical Settings

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

1-Invert:

ON: Turn on the invert function

OFF: Restore to the original display of the waveform.

2-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.

3-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 Oscilloscope 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.

10. Trigger Setting

Trigger indicates that when certain waveform meets the conditions that are predefined according to the requirements, the Oscilloscope 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 Oscilloscope behaves in the absence of a trigger event. The Oscilloscope provides two trigger modes: Auto, Normal.



1-Auto:

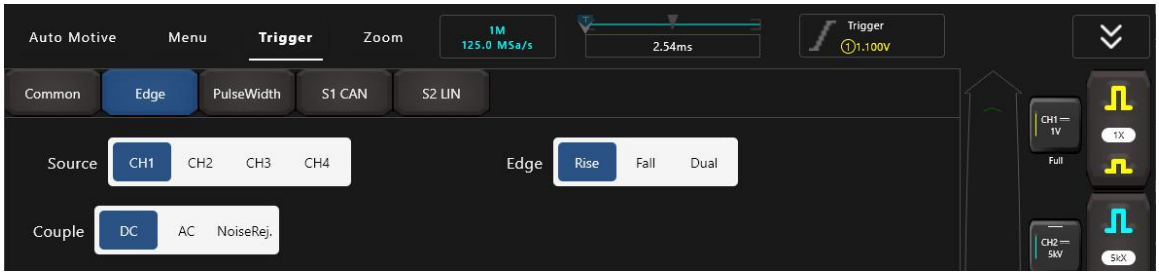
It allows the Oscilloscope to acquire waveforms even when it does not detect a trigger condition. If no trigger condition occurs while the Oscilloscope is waiting for a specific period, it will force itself to trigger.

When forcing invalid triggers, the Oscilloscope 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.

2-Normal:

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

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



1-Source：

Select which channel as trigger signal.

2-Edge：

Rise: Trigger on rising edge.

Fall: Trigger on falling edge.

Dual: Trigger on dual edges

3-Couple：

Trigger coupling determines what part of the signal passes to the trigger circuit.

4-Noise Rejection：

Reject high frequency noise when selected.

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):



1-Source:

Select which channel as trigger signal.

2-Condition:

To select pulse condition. It mainly includes: +More, +Less, +Equal, -More, -Less, -Equal etc.

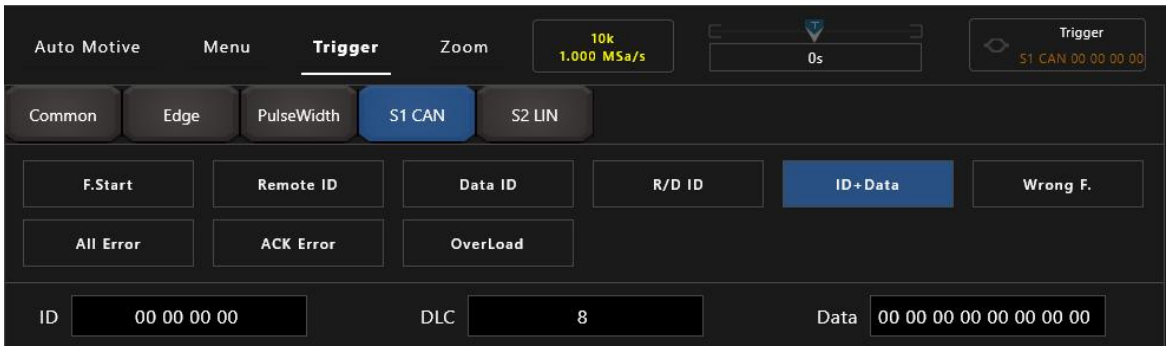
3-Pulse Width:

Set required pulse width.

4-Noise Rejection:

Reject high frequency noise when selected.

If decoding trigger (S1/S2) is selected, when the channel setting S1/S2 selects CAN decoding, the S1/S2 in the trigger menu will display as CAN decoding trigger:



CAN stands for Controller Area Network and is an ISO standardized serial communication protocol.

Triggered using the CAN bus, it can be triggered based on the frame start, frame type, identifier, data, ID and data, end frame, loss confirmation, or bit padding error of the signal. Please specify the source, signal type, sampling point, and signal rate.

1-frame start

Triggered at the beginning of the frame in the data frame

2- Remote Frame ID

Trigger the selection of ID format as extension type

3- Data frame ID

Choose the format of the ID as the trigger for standard types

4- Remote frame/data frame ID

Trigger the selection of ID format as standard or extended type

5- Data frame ID and data

Select ID format as standard type and trigger with correct data

6-Error frame

Set the trigger condition as an error frame

7- All errors

Set the trigger condition to all errors

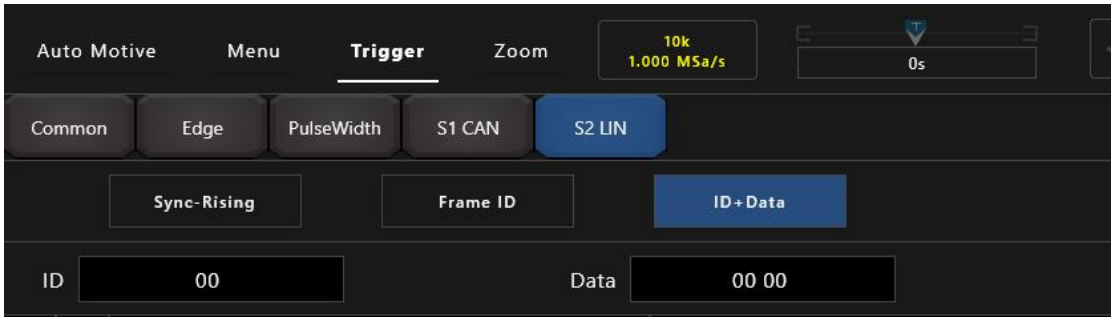
8- Confirmation error

Set the trigger condition as confirmation error

9-Overload frame

Set the triggering condition as overload frame

If decoding trigger (S1/S2) is selected, when the channel setting S1/S2 selects LIN decoding, the S1/S2 in the trigger menu will display as LIN decoding trigger:



If LIN is chosen, its full name is Local Interconnect Network. Its main function is to provide auxiliary functions for the CAN bus network.

1-Synchronous rising edge

Set the triggering condition as synchronous rising edge

2-Frame ID

Set the trigger condition as frame ID

3-Frame ID and Data

Set the triggering conditions as frame ID and data

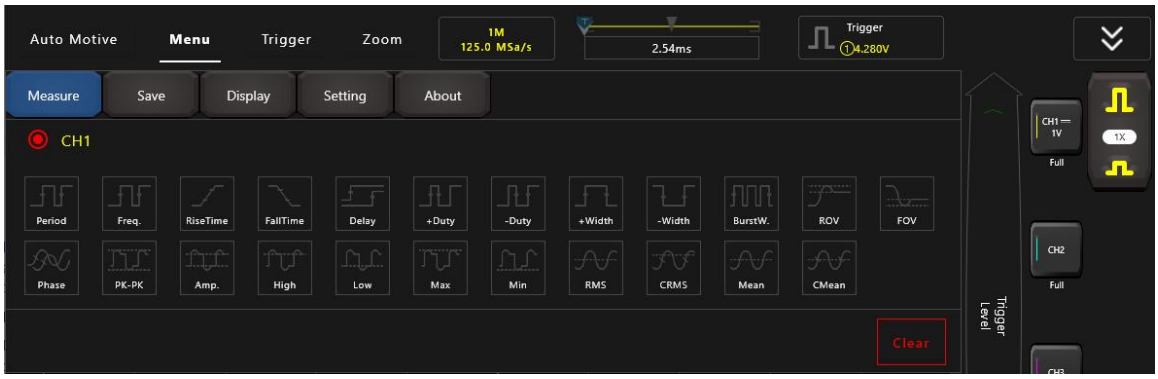
11. Auto-Set

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

Tap Auto, the Oscilloscope 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.

12. Measure

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



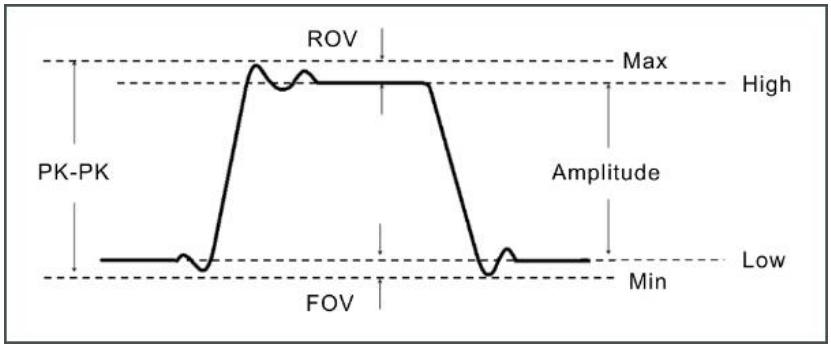
Tap to select the desired measurement item (10 items can be selected at the same time). All selected items will be shown on the left side (see red field shown below) of the Clear button.

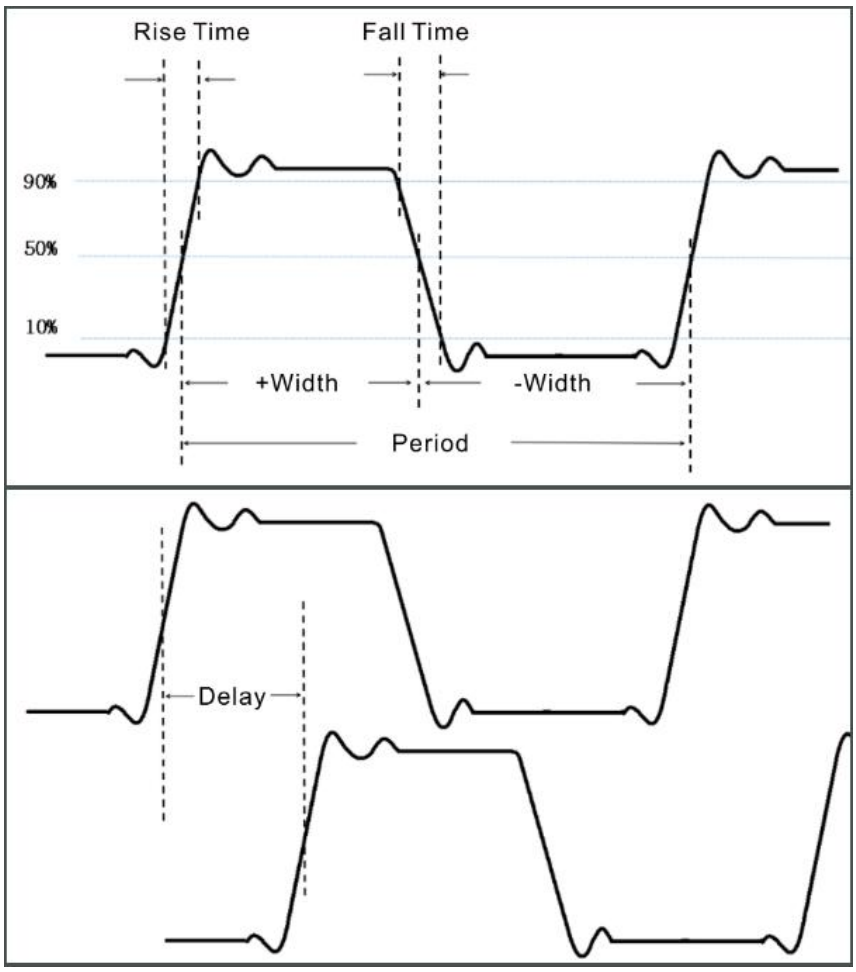


Tap it to remove the measurement item. The values corresponding to the selected items will be displayed on the bottom of the screen.

- 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 level, measured over the entire waveform.
- Low: Voltage of the statistical minimum level, measured over the entire waveform.
- Max: Voltage of the absolute 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. 10 results could be displayed at the same time.

13. Save

This function allows you to save the waveforms of the channels.

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 Userset –> Save Recovery) for reference and play back.

14. 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.

15. Userset

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



It mainly includes the following options:

Depth: Storage depth.

Factory Reset: The Oscilloscope 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 measurement accuracy. Refer to Chapter 3.3 for detailed operations.

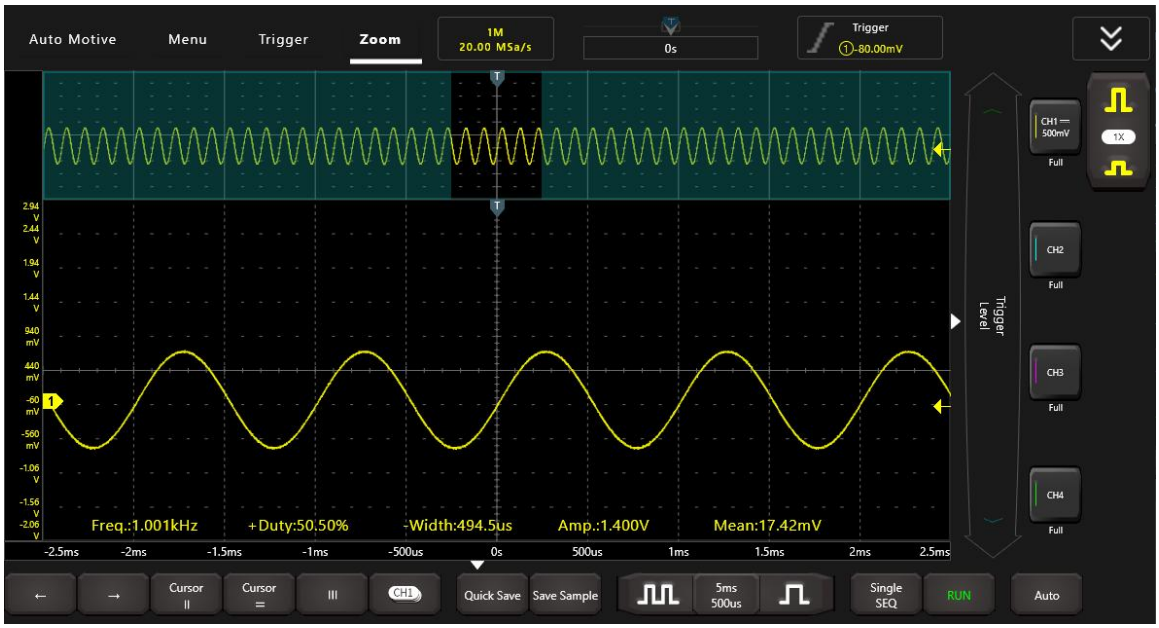
Save & Recovery: Save allows user to save some settings that have been made as a system configuration file. Recovery allows user to directly recall the configuration file to avoid repeated setups.

16. 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.



17. Cursor

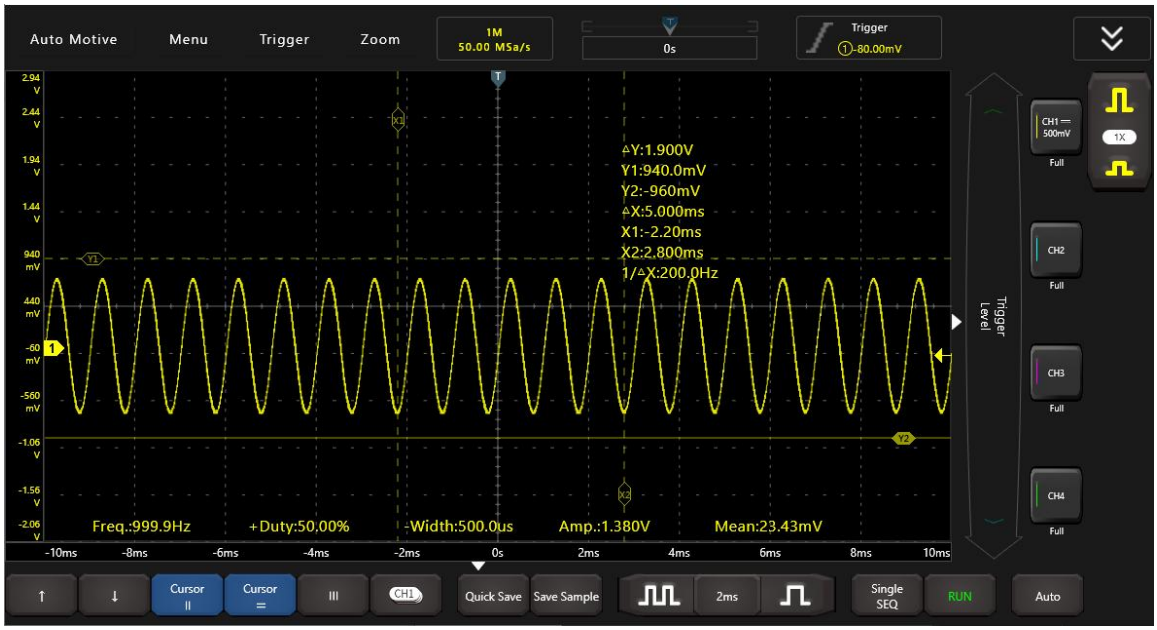
The Cursor function can be used for assisting in measurement.

Tap Cursor / Cursor 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 Cursor / Cursor 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.

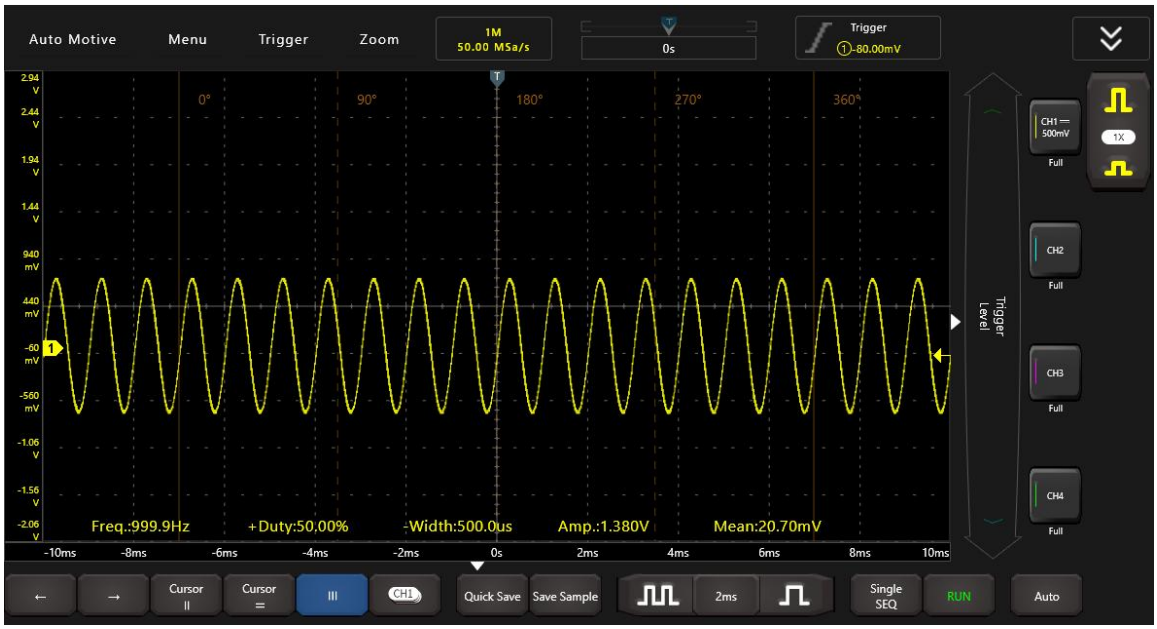
The time reading after X1, X2: indicates the position of the activated cursor in the vertical cursor relative to the trigger point.

1/△X: Frequency.

18. 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.

19. 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.

20. 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

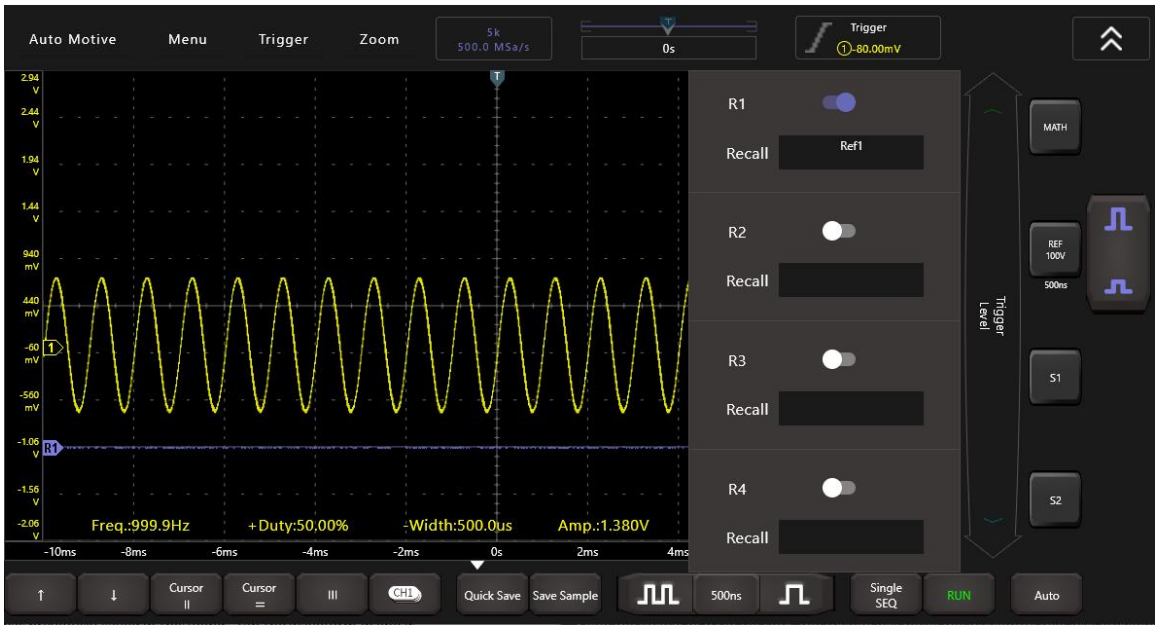
- If the analog channel or math function is clipped (not completely displayed on the screen), the resulting math function will also be clipped.
- After the math waveform is displayed, tap the channel marker to close the source channel to better view the math waveform.

- 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.

21. REF

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

Tap REF, the following screen will appear:

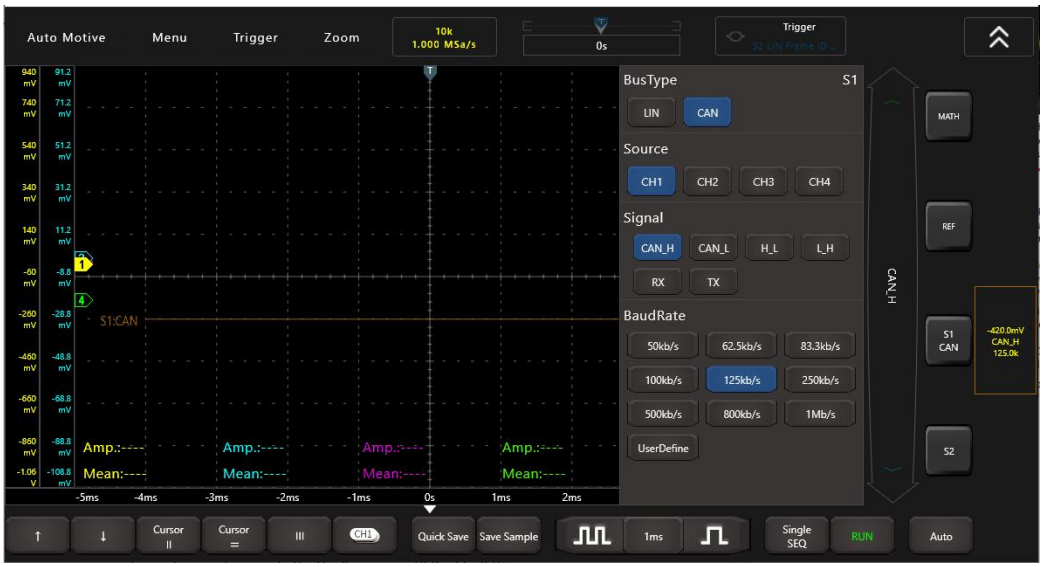


Slide the switch of R1/R2/R3/R4, the system will recall the waveform that was previously saved in this folder. Tap the waveform in line with the Recall, a small window displaying this waveform will pop up on the screen.

22. Bus decoding(S1/S2)

The decoding channel can be selected and set, and the bus type can be selected as CAN/LIN.

If the bus type is selected as CAN decoding



1-Source

CH1/CH2/CH3/CH4 can be selected

2- Signal

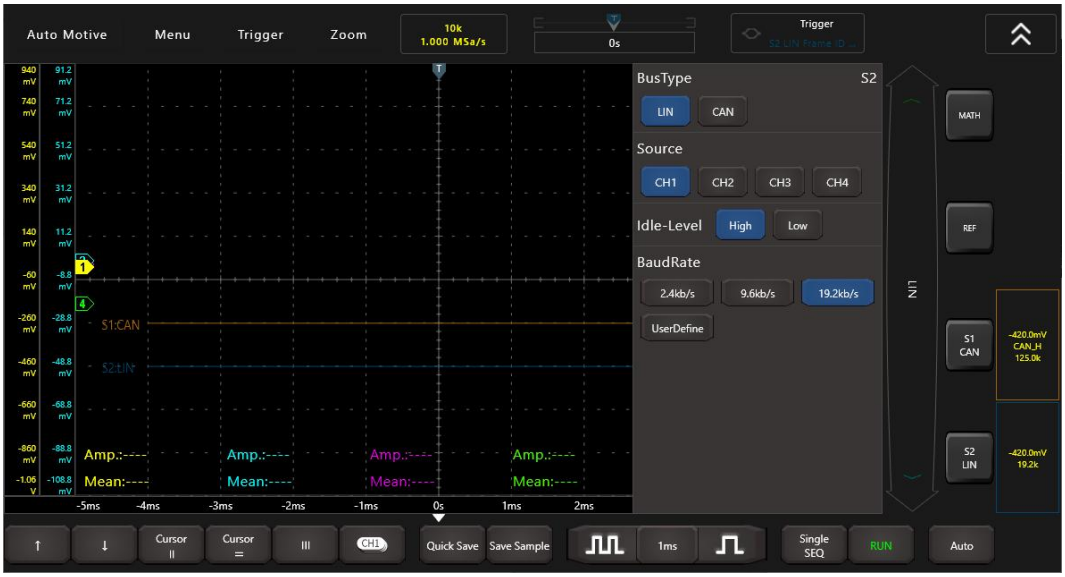
Optional CAN-H, CAN_L, H_L, L_H, RX, TX

3- Baud rates

Optional 50kb/s, 62.5kb/s, 83.3kb/s, 100kb/s, 125kb/s, 250kb/s, 500kb/s, 800kb/s, 1Mb/s, custom (range 10kb/s -5Mb/s)

Optional CAN-H, CAN_L, H_L, L_H, RX, TX

If the bus type is selected as LIN decoding:



1-Source:

CH1/CH2/CH3/CH4 can be selected

2-Idle level

Idle level can choose high or low

3-Baud rate

Optional 2.4kb/s, 9.6kb/s, 19.2kb/s, custom (range 2.4kb/s-625.0kb/s)

23. Secondary

Connection:

- Power the Oscilloscope on: Plug one end of the battery cable clamps into the DC-IN port of the Oscilloscope, 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 Oscilloscope via USB cable. If the diagnostic tool can supply enough power to the Oscilloscope, please ignore this step.

- Connect the B-shaped terminal of the USB cable to the USB port of the Oscilloscope, and the other end to the USB port of the diagnostic tool.
- When the high-voltage wire is exposed, plug the BNC end of secondary ignition pickup into CH1/CH2/CH3/CH4 channel of Oscilloscope, then connect the high-voltage clip to high-voltage line, and crocodile clips to ground.
- If no high-voltage wire is exposed, dismantle ignition coil of tested cylinder. Connect one end of the COP extension cord (optional) to the ignition coil which should be grounded via COP earth cord, and insert the other end into the cylinder to join with spark plug. Then plug the BNC end of secondary ignition pickup into CH1/CH2/CH3/CH4 channel of Oscilloscope, and then connect the high-voltage clip to high-voltage line, and crocodile clips to ground. The connection is as follows:

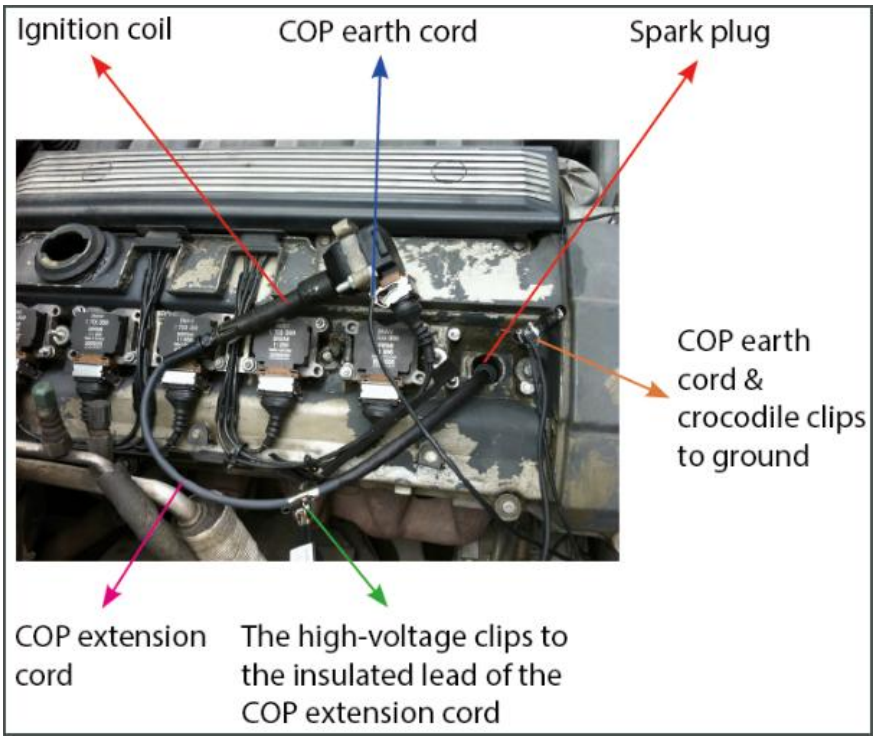


Fig. 1 shows the normal secondary (the upper one) and (the lower one) primary ignition waveform of direct ignition system. Because the on/off of primary circuit is not opening/closing of mechanical contact, but the conduction of transistor. The primary voltage has no obvious oscillations within the duration, 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.

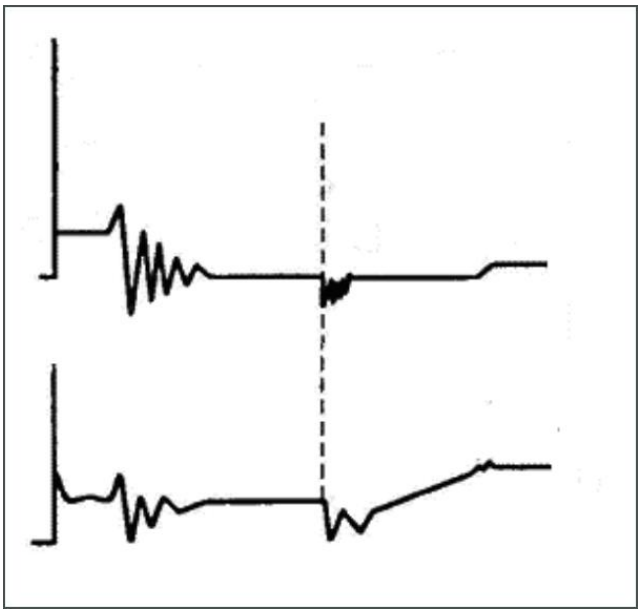


Fig. 1

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

- Analyze the ignition dwell angle of single cylinder (ignition coil charging time).
- Analyze the capability of ignition coil and secondary high tension circuit (from ignition line to ignition voltage line).
- Find the improper mixture A/F ratio of single cylinder (from combustion line).
- Analyze the capability of capacitance (platinum or ignition system).
- 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 the ignition coil and capacitor (on Platinum or ignition system) are normal.

23. Primary

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. 2, appears to be a lot 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.

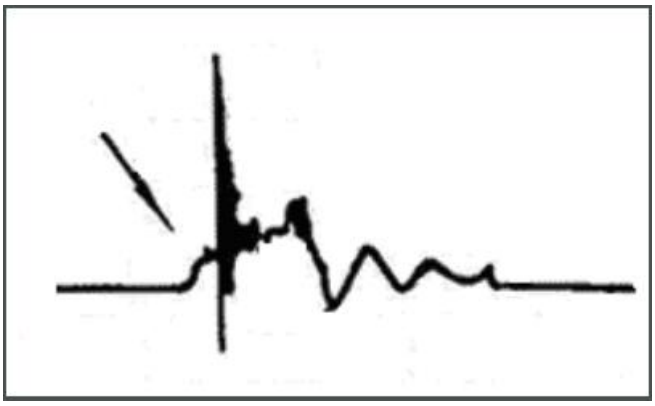


Fig. 2

For the primary voltage waveform shown on Fig.3, the damped attenuation cycles obviously reduced on the spark period, the amplitude became lower, which is evidently caused by capacitor leakage.

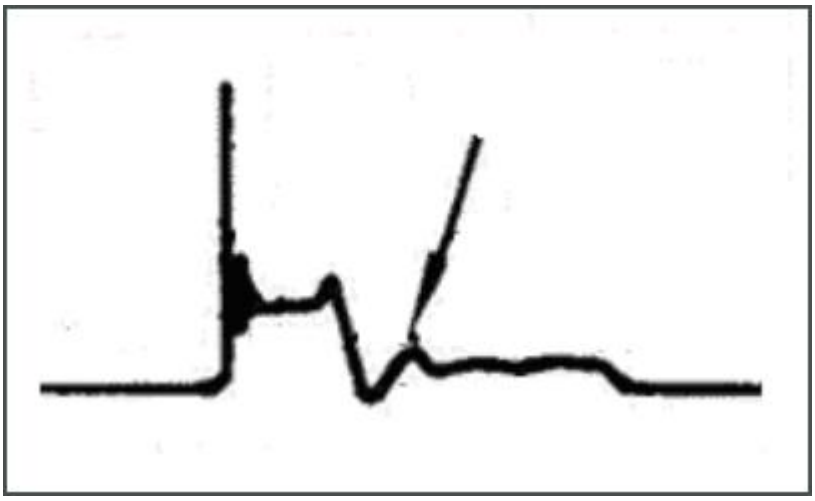


Fig. 3

The waveform on Fig. 4 shows the accidental pumping during contact closing period. The irregular beating is caused by insufficient spring force.

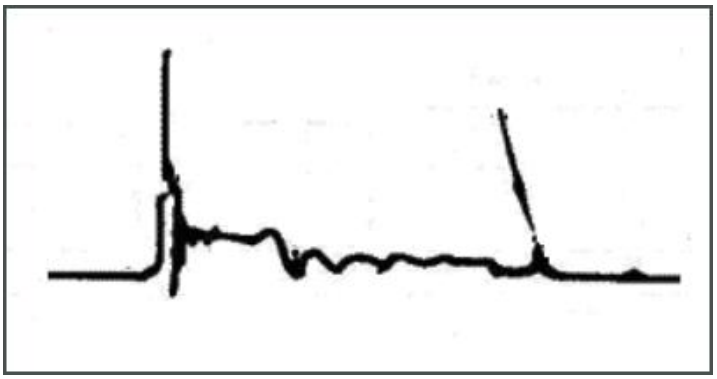


Fig. 4

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

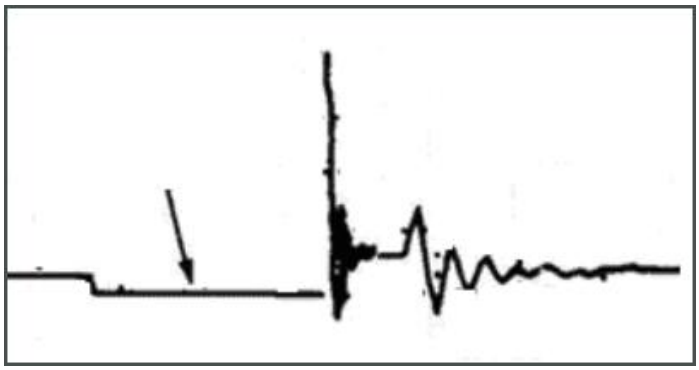


Fig. 5

A lot of clutter will be displayed on the horizontal section of primary waveform if contact has poor grounding, as shown below Fig. 6.

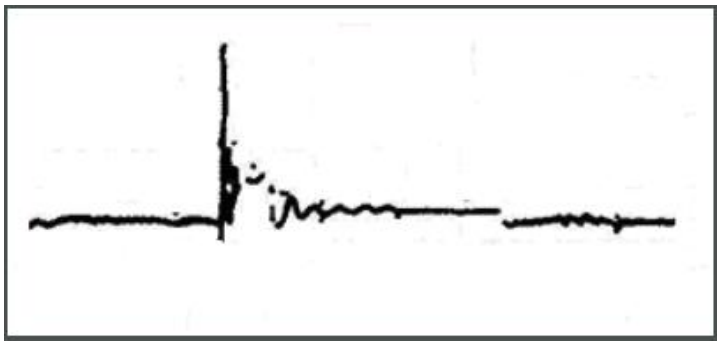


Fig. 6

Fig. 7 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.

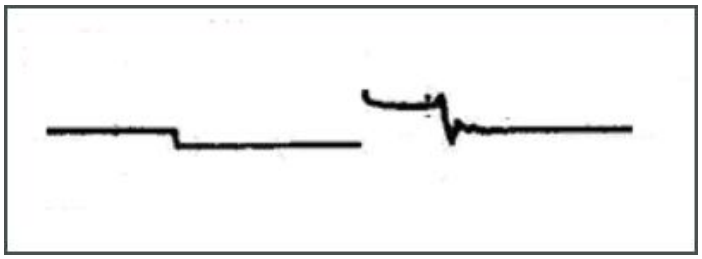
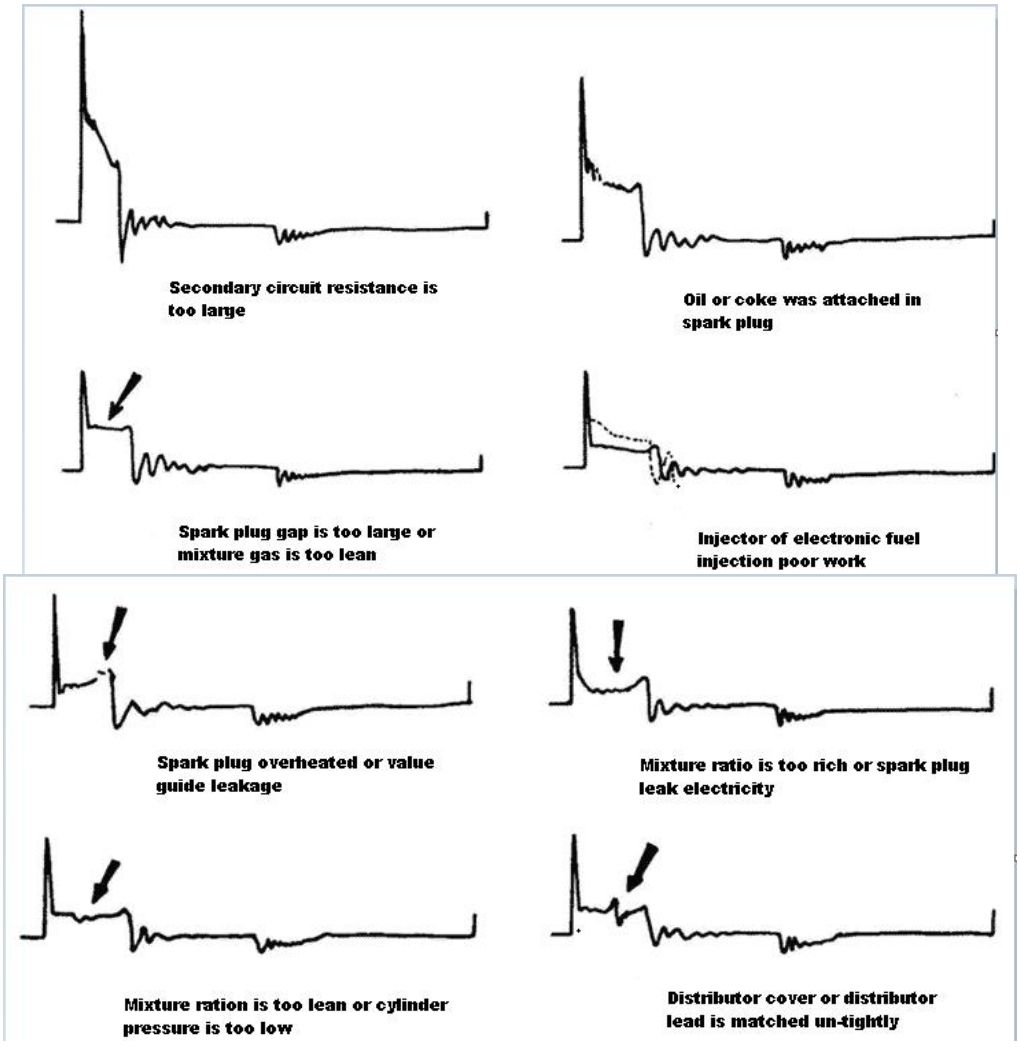


Fig. 7

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. 8 just shows the major possible factors for the failures.



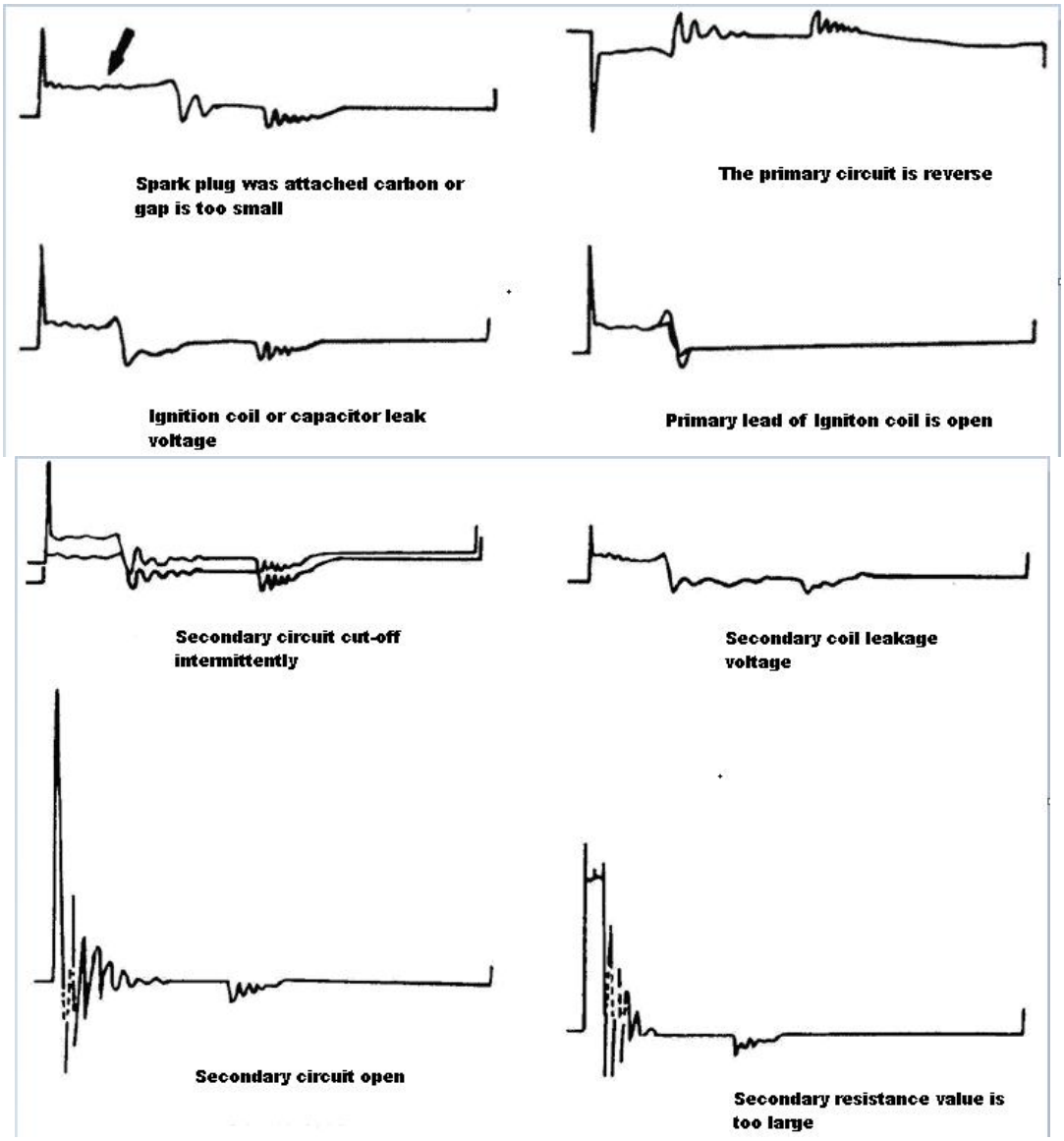

Spark plug was attached carbon or gap is too small
The primary circuit is reverse
Ignition coil or capacitor leak voltage
Primary lead of Igniton coil is open
Secondary circuit cut-off intermittently
Secondary coil leakage voltage
Secondary circuit open
Secondary resistance value is too large

Fig. 8

III.Technical Specifications

i. Set the probe compensation at x10 for physical probe;
ii. Under suitable operation temperature, work the device for 30+ minutes without interval;
iii. Provided the environment temperature gets 5 degrees more, or less, to self-calibrate the device through Utility menu, via “Self Cal” option (please refer to Self-Calibration).

The following technical specifications been measured on the basis of above operation,

Oscilloscope Part -

Bandwidth		100MHz	
Vertical Resolution (A/D)		8 bits	
Channel Q'nty		4	
Acquisition	Mode	sample, peak detect	
	Sampling Rate	4-CH working	250 MSa/s
		2-CH working	500 MSa/s
		1-CH working	1 GSa/s
Input	Input Coupling	DC, AC	
	Input Impedance	1 MΩ ± 1.5%, in parallel with 15 pF ± 5 pF	
	Supported Probe	x1, x10, x100, x1000	
	Max Input Voltage	40V (DC + AC Peak)	
	Bandwidth Limit	20MHz, or fullband	
	Channel Isolation	100 : 1 @ 50Hz; 40 : 1 @ 10MHz	
	Time Delay Between Channel (typical)	150 ps	

Horizontal System	Sampling Rate	4-CH working	1 Sa/s - 250 MSa/s
		2-CH working	1 Sa/s - 500 MSa/s
		1-CH working	1 Sa/s - 1 GSa/s
	Interpolation	sin (x)/x	
	Record Length	Auto、10k、100k、1M、10M	
	Scanning Speed (s/div)	1 ns/div - 1k s/div, step by 1 - 2 - 5	

	Sampling Rate / Relay Time Accuracy	±20ppm (typical, Ta = +25℃)
	Interval (△T) Accuracy (DC - 100MHz)	Single: ±(1 interval time + 20ppm x reading + 0.6ns); Average>16: ±(1 interval time + 20ppm x reading + 0.4ns)
Vertical System	Sensitivity	5 mV/div - 10 V/div, step by 1 - 2 - 5
	Displacement	± 2.5 V (5 mV/div - 200 mV/div) ± 120 V (500 mV/div - 10 V/div)
	Analog Bandwidth	100 MHz
	Low Frequency (AC coupling, -3dB)	≥10 Hz (at BNC)
	Rise Time (at BNC, typical)	≤ 3.5 ns
	DC Accuracy	±3%
	DC Accuracy (average)	the voltage difference of any 2 points from the captured signal, after taking the average from ≥16 captured signals (△V): ±(2% rdg + 0.05 div)
	waveform inverted ON / OFF	

Measurement	Cursor Measurement	△V / △T / (△V and △T) between Cursor 1 and Cursor 2, auto cursor
	Automatic Measurement	Vpp, Vmax, Vmin, Vtop, Vbase, Vamp, Vavg, Vrms, Overshoot, Preshoot, Frequency, Period, Rise Time, Fall Time, Delay A→B⇂, Delay A→B↳, +Width, -Width, +Duty, -Duty,etc.
Communication Interface	USB device (type-B)	

Trigger

Trigger Level Range	Internal	±5 divisions from the screen center
Trigger Level Accuracy (typical) (working for signal with rise time / fall time ≥ 20ns)	Internal	±0.3 division

Trigger Displacement	changing according to different record length and time base	
Trigger Hold-off Range	100ns - 10s	
Edge Trigger	Slope	rising, falling, either edge
Pulse Trigger	Trigger Condition	positive pulse: >, <, =, ≠ negative pulse: >, <, =, ≠
	Pulse Width Range	30ns - 10s
BUS Trigger	CAN	F.Start, Remote ID, Data ID, R/D ID, ID+Data, Wrong F., All Error, ACK Error, OverLoad
	LIN	Sync-Rising, Frame ID, ID+Data

Power

Power Source	5 VDC / 2A
Power Consumption	≤ 8W

Environment

Temperature	working temperature: 0 ℃ - (+20 ℃) storage temperature: (-20 ℃) - (+70 ℃)
Relative Humidity	≤ 90%
Height	operating: 3,000 m non-operating: 15,000 m
Cooling Method	air convection (cross-ventilation)

Mechanical

Device Dimension	185mm(W)*40mm(H)*153mm(D)
Weight	Approx. 0.55kg

Device Calibration Time Interval

After the device been operated for every 12 natural months (calculated from the first operation day), better to calibrate it one time.

IX. Appendix

Appendix A. Device Accessory List

Accessories -

- 4 x passive probe
- 1 x USB cable C to B (for connecting android tablet)
- 1 x USB cable A to B (for connecting PC)
- 1 x USB cable A to C (for charging)
- 1 x power adaptor 5V/2A
- 1 x quick guide

Appendix B. Device Maintenance

Storage

To avoid any possible damage to the device, and probe, keep these items FAR AWAY from sprays, liquids, or solvents.

Surface Cleaning

As per the operation condition requirements, DO check the device and probe surface from time to time.

When cleaning the device / probe surface, please follow up with operation steps as follows

i. Before the surface cleaning, making sure the device been powered off, without any accessory / outer facility connected; making sure probe not working with device / outer facility.

ii. Use non-electrostatic soft cloth to remove the surface dust.

iii. For further surface cleaning, recommend to use a wet-but-no-water-dripping soft cloth, or soft detergent.

Note: To avoid permanent damage to the surface of device and probe, DO NOT introduce any corrosive chemical cleaner / detergent.



Warning:
After device surface cleaning, before working the device for next time, please confirm that the device surface in a relative dry condition, so as to avoid any short circuit risk, or possible human body injury caused by electric conduction from the wet surface.