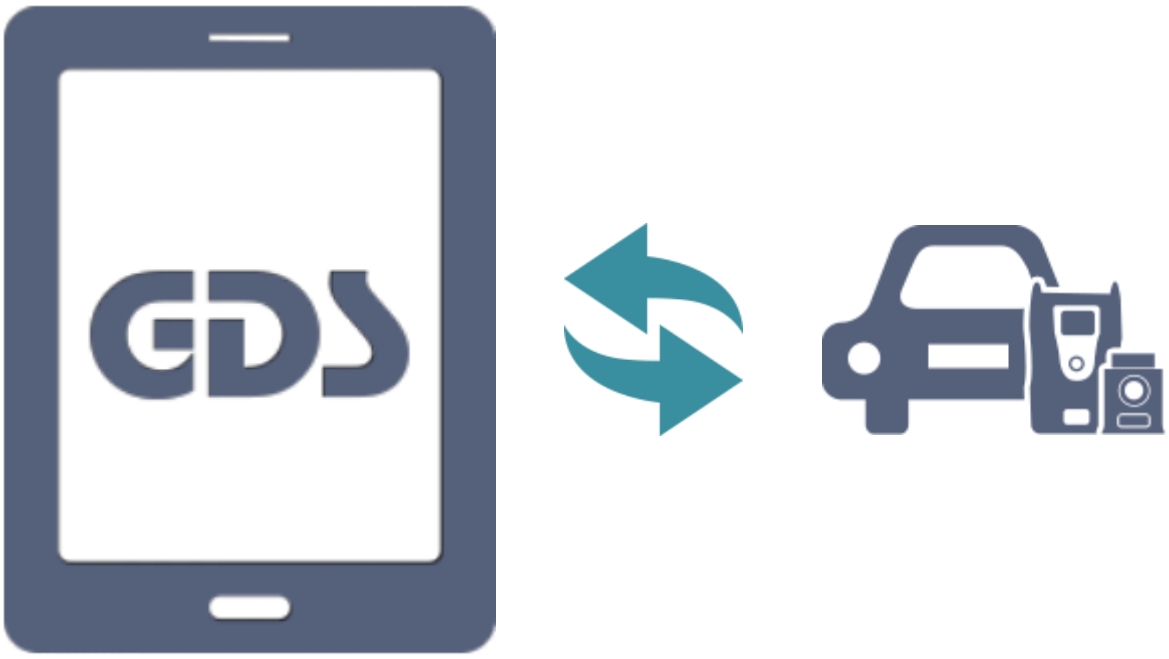
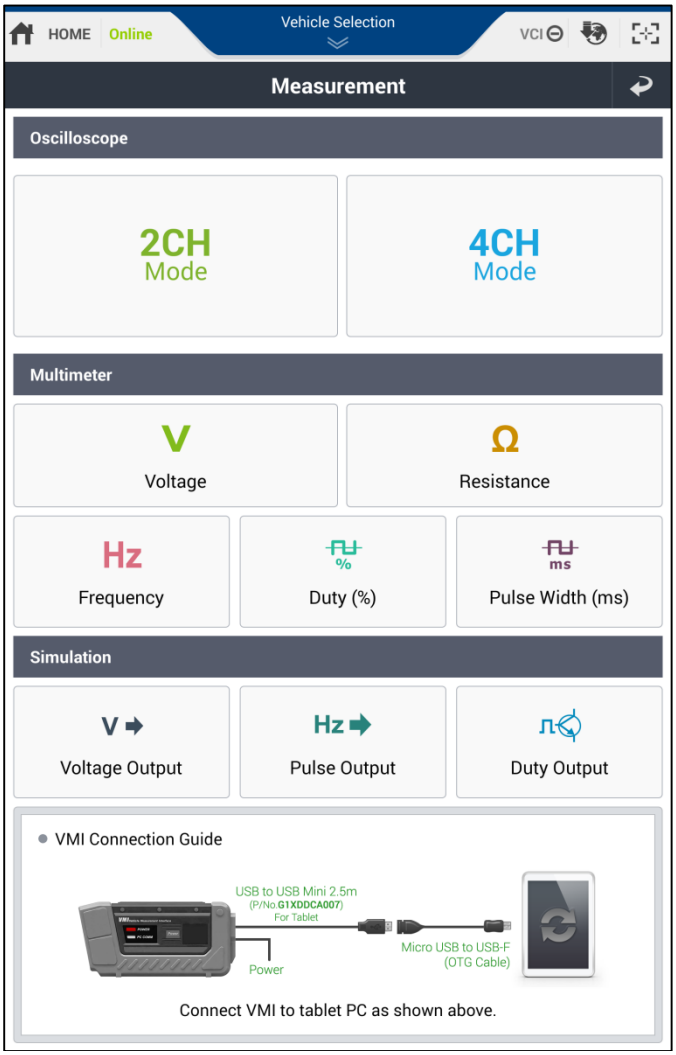
Measurement



Measurement

VMI is a diagnostic module for measuring Sensors and Actuators using functions of Multi-Meter, Oscilloscope and Simulation.



Oscilloscope	Graphs out signals by voltage and time.
Multimeter	Measures voltage, resistance, frequency, duty cycle (+/-) and pulse width (+/-).
Simulation	Outputs Voltage, Pulse(Hz), and Duty signals to actuators and to simulate sensor signals.

VMI Specifications

◈ General Features

Item		Specifications
Micro Controller		ARM9 (S3C2410A) @ 208MHz
Memory		RAM 32MByte ROM 32Mbyte
Operating Voltage		7~35V DC
Temperature	Operating	0℃ ~ 50℃ (32˚F ~ 122˚F)
	Storage	-20℃ ~ 80℃ (-4˚F ~ 176˚F)
Relative Humidity	Operating	Noncondensing @ 0℃ ~ 10℃ (32˚F ~ 50˚F)
		95%RH @ 10℃ ~ 30℃ (50˚F ~ 86˚F)
		70%RH @ 30℃ ~ 50℃ (86˚F ~ 122˚F)
	Storage	Noncondensing @ -20℃ ~ 80℃ (-4˚F ~ 176˚F)
Operating Mode		Oscilloscope, DVOM, Simulation Test
Power Consumption		Typical 5W @12V(Oscilloscope, 20V Range)
Dimension		235mm × 109mm × 60 mm (9.25inch × 4.29inch × 2.36 inch)
Weight		0.73 kg (1.61 lbs)

◈ PC Interface

Item	Specifications
Wire protocol	USB 1.1

◈ Oscilloscope Features

Item		Specifications
Voltage Range	2CH	±400 mV, ±800 mV, ±2V, ±4V, ±8V, ±20V, ±40V, ±80V, ±200V, ±400V
	4CH	±4V, ±8V, ±20V, ±40V, ±80V, ±200V, ±400V
Vertical Resolution		10 Bit
Measurable Differential DC Voltage Range	±400 mV ~ ±2V	±20V [1)]
	±4V ~ ±80V	±200V
	±200V ~ ±400V	±400V
Sampling Modes		Normal mode / Peak mode
AC/DC Coupling		Supported
Input Impedance		2 MΩ respect to power ground
Time Range	2CH	100 μs, 200 μs, 500 μs, 1 ms, 2 ms, 5ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, 1s, 2s, 5s
	4CH	200 μs, 400 μs, 1 ms, 2 ms, 4ms, 10 ms, 20 ms, 40 ms, 100 ms, 200 ms, 400 ms, 1s, 2s, 4s
Sampling Speed	2CH	Max. 500k sps per channel simultaneously (Peak mode)
	4CH	Max. 250k sps per channel simultaneously (Peak mode)

When measuring voltage in 2-channel mode for a commercial vehicle which uses more than 20V, if the user set the Range of the oscilloscope to 400mV ~ 2V, it will not be properly measured even if actual measurement is between 400mV to 2V.

When it comes to the vehicles which use more than 20V, please measure it after changing the oscilloscope voltage range to 4V ~ 80V.

ex) If the voltage between generator B terminal of the commercial vehicle and battery + terminal generates 500mV, Voltage Range of the oscilloscope should be set to 4V ~ 80V(not to 400mV ~ 2V.)

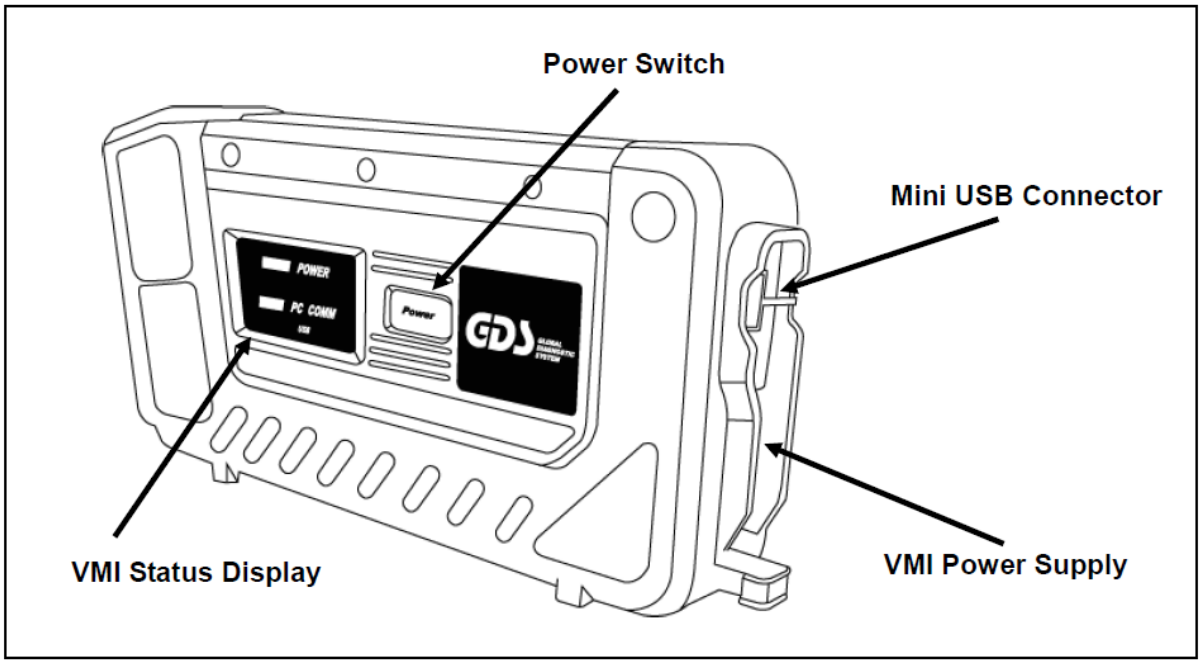
◈ Multimeter Features

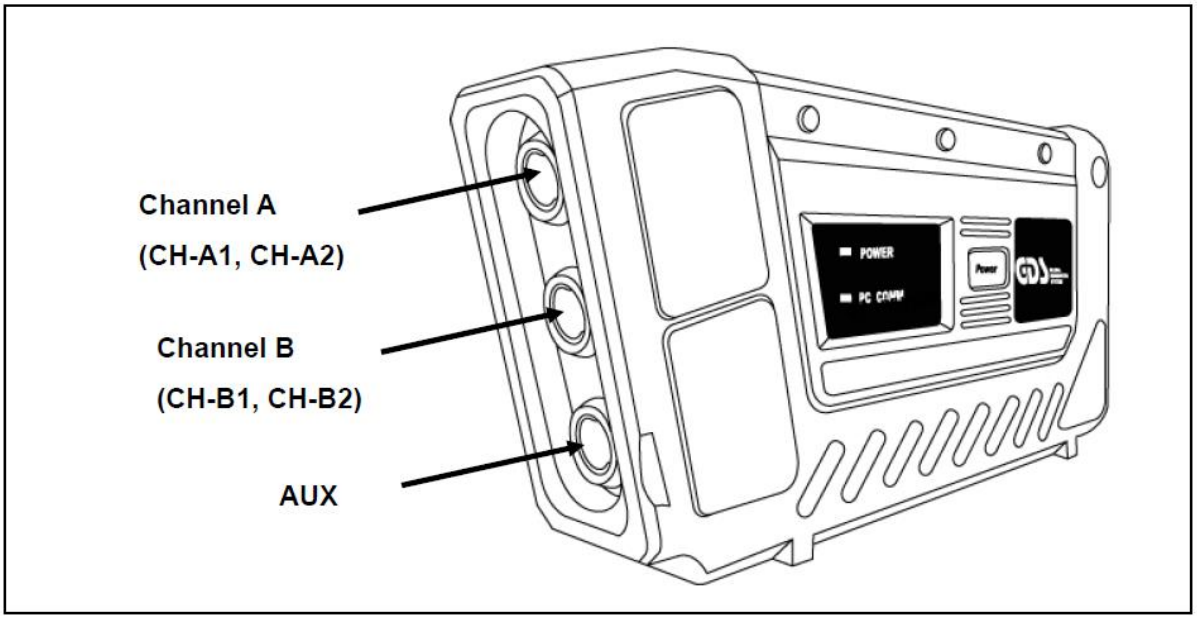
Item	Specifications
DC Voltage Range	± 400mV, ± 4V, ± 40V, ± 400V
AC Voltage Range	Not Supported. DO NOT Measure AC Outlet (110V or 220V)
Resistance Range	400Ω, 4㏀, 40㏀, 400㏀, 10㏁
Frequency Range	1Hz ~ 10kHz (Threshold Level: 2.5±0.5V)
Duty Cycle Range	0.1% ~ 99.9% @ 1Hz ~ 100Hz
	1.0% ~ 99.0% @ 100Hz ~ 1kHz
	3.0% ~ 97.0% @ 1kHz ~ 3kHz
	5.0% ~ 95.0% @ 3kHz ~ 5kHz
	10.0% ~ 90.0% @ 5kHz ~ 10kHz
Pulse Width Range	10㎲ ~ 1000ms

◈ Simulation Test Features

Item		Specifications
Voltage Output	Output Range	0.0V ~ 5.0V
	Forced Stop	When output data is out of output range (0.0V~5.0V).
Frequency Output	Output Range	1Hz ~ 999Hz
	Duty	50%
	Voltage Level	High: 5V, Low: 0V
	Forced Stop	When output data is out of voltage range between (-) 1.0V and 6.0V respect to power ground.
Duty Output	Frequency Range	1Hz ~ 999Hz
	Duty Range	1% ~ 99% @ 1Hz ~ 99Hz (1% or 10% per step)
		10% ~ 90% @ 100Hz ~ 999Hz (Only 10% per step)
	Pulse Width	Depends on frequency or duty
	Allowable Current	Max. 2A±0.3A

VMI Instruction



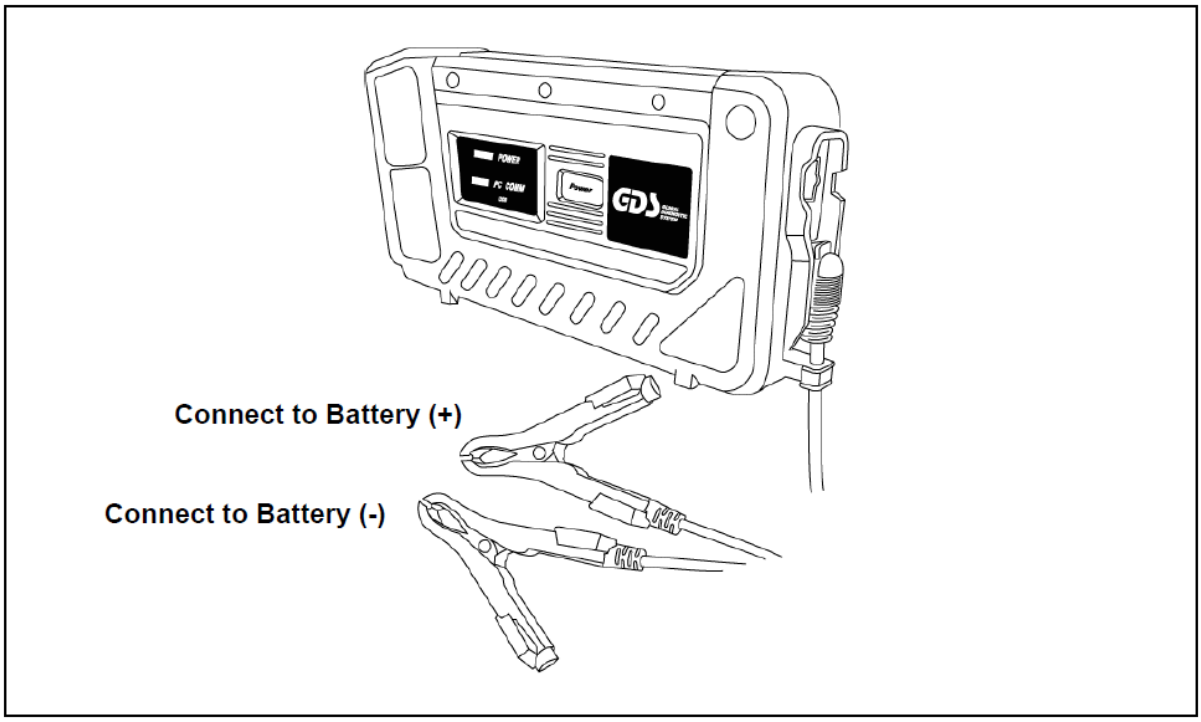


Installation of Power Cable

To power up VMI module, connect VMI Battery Cables to the battery of the vehicle and to VMI. VMI uses the vehicle battery as a power source.

When connecting the power cable to VMI main body, the user can hold it by a built-in rubbers shroud. Connect red cable to positive (+) terminal and black cable to negative (-) terminal respectively.

VMI battery cables are insulated to prevent short circuits when connecting to the vehicle and there is a hole for inserting a channel probe on each tongs.



Press the POWER button located in the middle of the VMI to turn on the module. To turn off the VMI, press and hold the POWER button for more than 3 seconds.

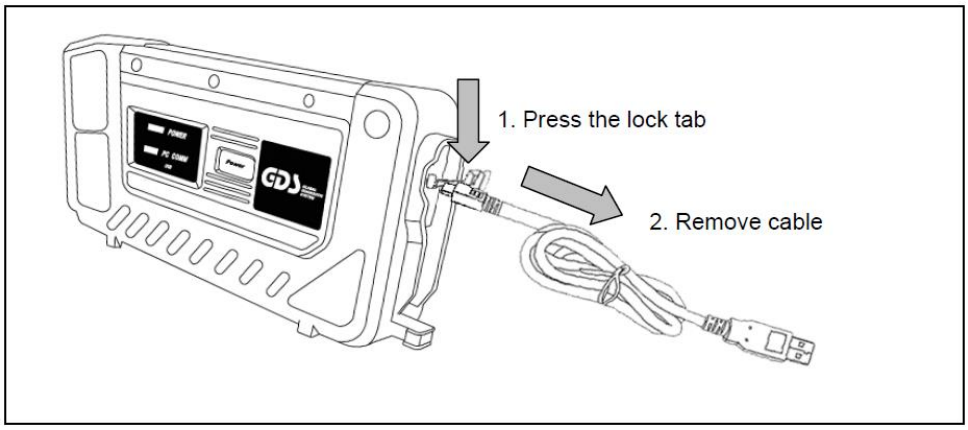
Warning

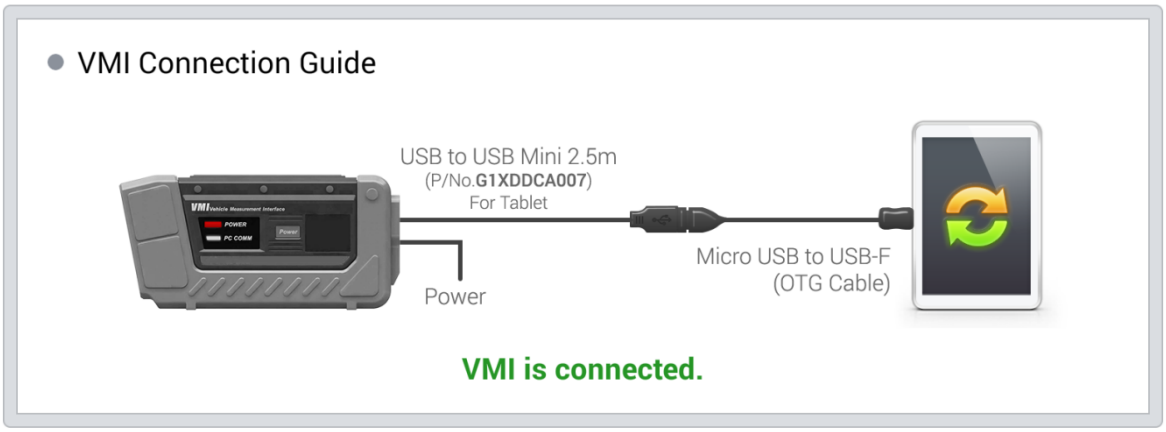
☞ **Use only the Power Cable provided by GIT.**

Installation of USB Cable

VMI must be connected to the GDS Mobile tablet with the Mini USB cable.
※ **VMI does not support wireless network.**

The USB Mini must be latched into the VMI to avoid communication loss. When removing the Mini USB cable, press the connector lock tab first, and then disconnect the cable. Use the OTG cable (USB-F to USB Micro) to connect the USB cable to the GDS Mobile.





The above screen will be shown on Measurement Main screen when VMI is properly connected.

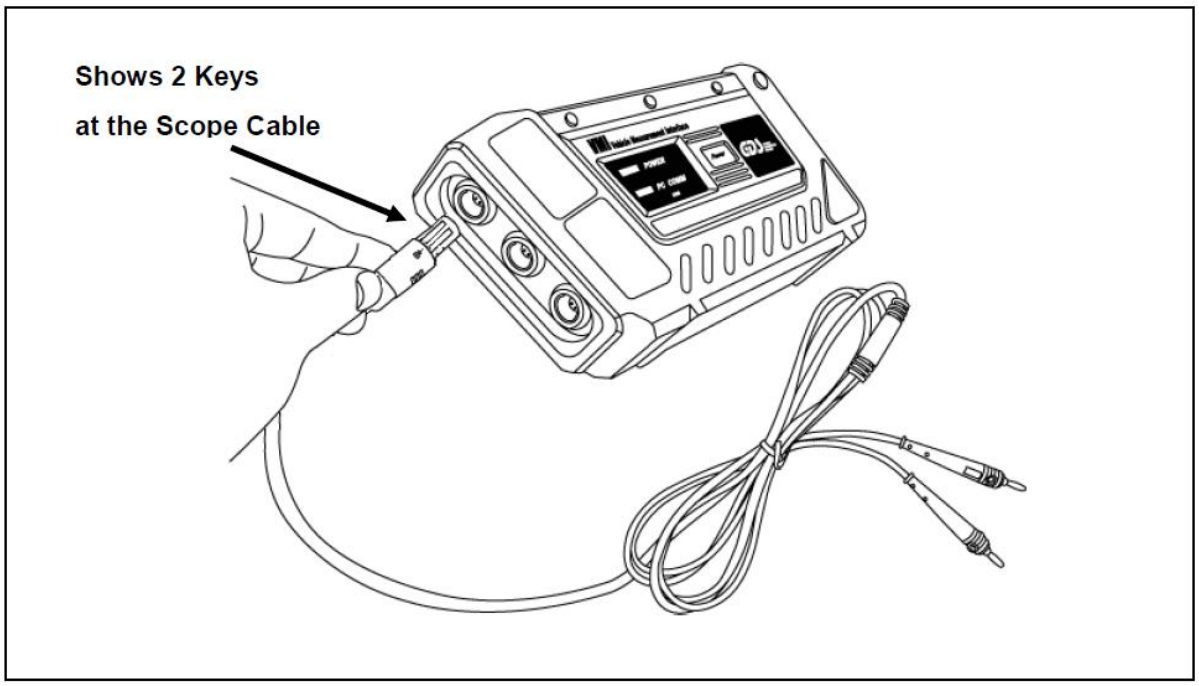
Check the connection between the USB cables to avoid disconnection.

Warning

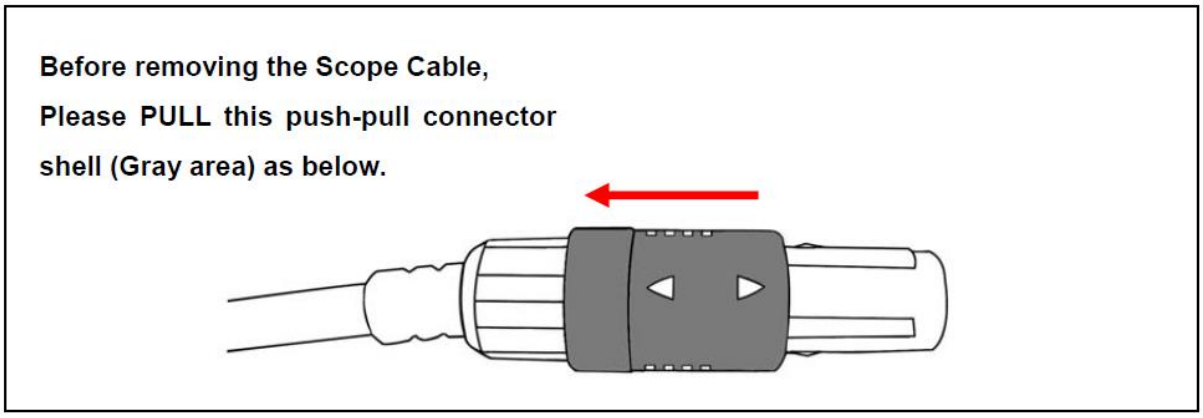
☞ **Do not use other cables other than provided USB Cable (USB Mini 2.5 meter cable.) Otherwise it may cause instability of USB connection.**

Installation of Channel Probe

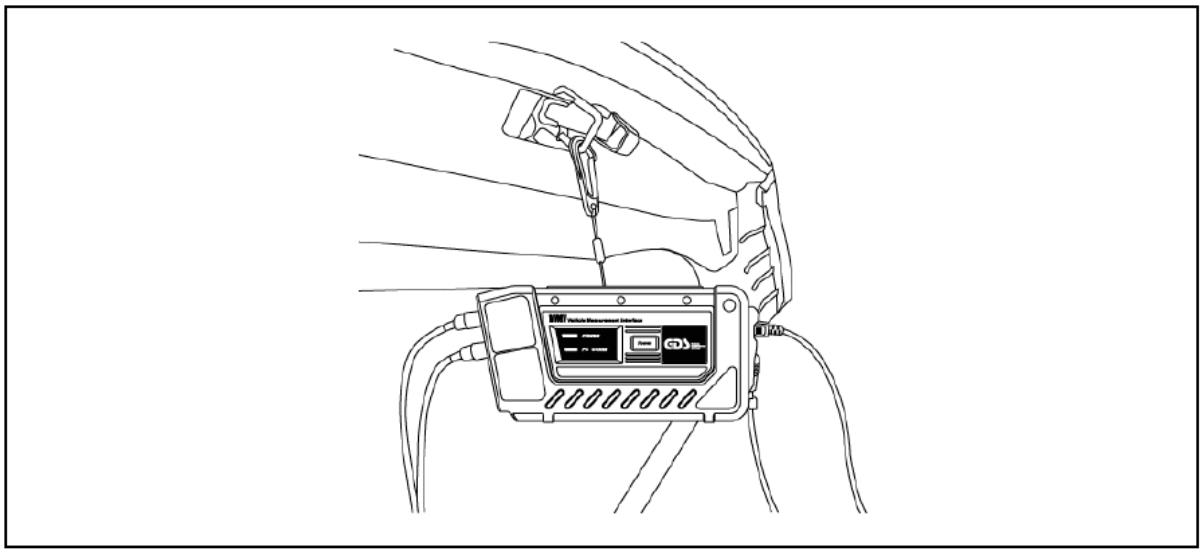
Channel Probe and AUX Probe are keyed differently to prevent them from being inserted in the wrong position on VMI module. The Channel Probes have 2 keys and AUX Probe has 1 key.



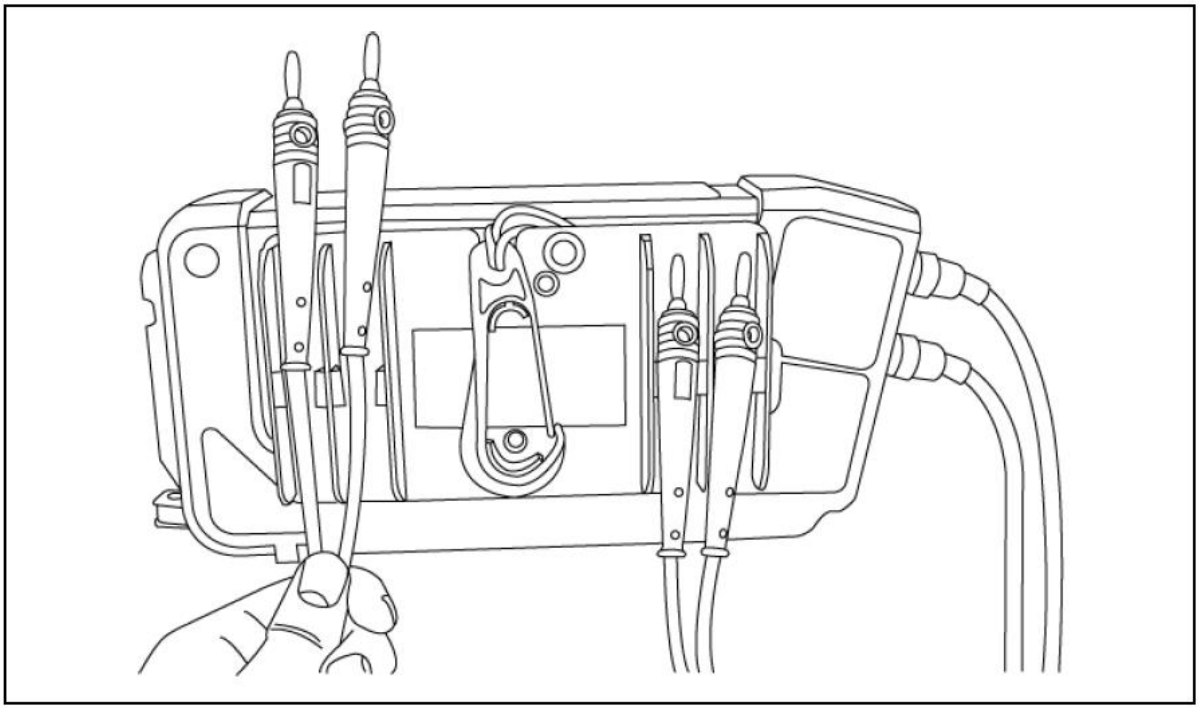
Before removing the Channel Probe, pull the “push-pull” connector shell (gray area) as shown below.



Hood Buckle and Probe Hanger Instruction



< Hood Buckle >



< Probe Hanger >

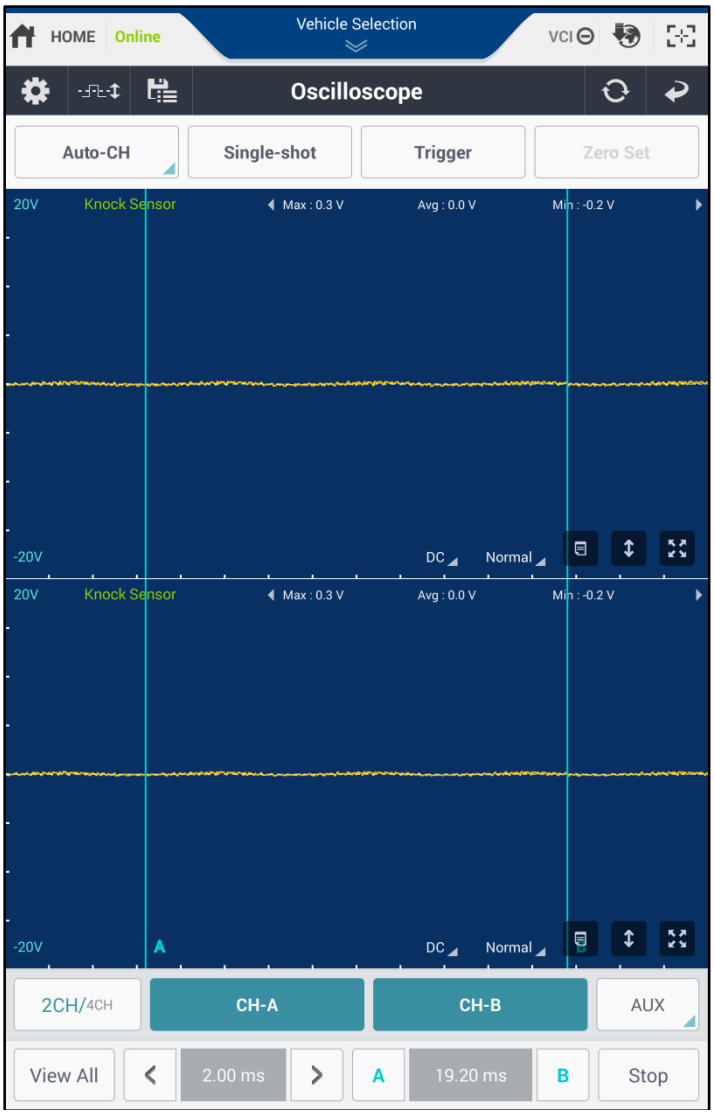
Warning

- **Do not place or hang VMI module near incandescent light.**
- **Check the location of keys and insert when connecting Channel Probe.**
- **When removing the Mini USB Cable, press the lock tab first at VMI module side and then pull the Mini USB Cable connector.**
- **When measuring, be sure to secure the cables such as USB Cable, DC power supply and Channel Probe so that cables do not interfere with other actuators (cooling fan, fan belt, etc.)**
- **Do not measure 110V or 220V alternating voltages with VMI module. It could cause damage to the VMI.**
- **When using Oscilloscope, the power source for VMI must be supplied by the vehicle's battery.**

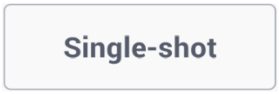
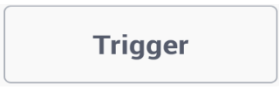
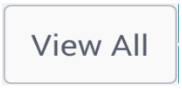
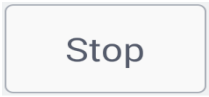
Oscilloscope

The Oscilloscope features:

- **2 channel and 4 channel modes.**
- **2 cursors to measure time and voltage**
- **Displays MAX, AVG, MIN voltage values**
- **Displays Frequency, Duty(+/-), Cursor A & B voltage values**



Icon Description

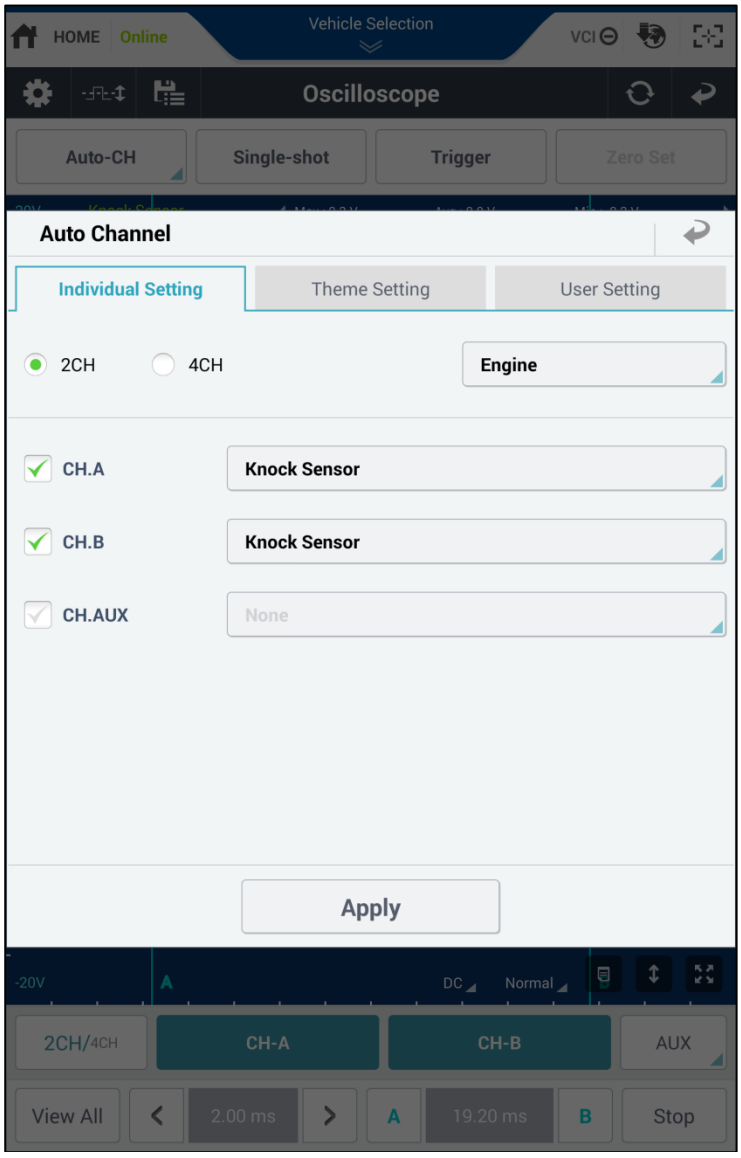
Icon	Description
	Opens Individual Setting, Theme Setting and User Setting. Presets time and voltage ranges for sensors, actuators and systems.
	Locks onto and displays a single waveform. This can be used for TPS signal in the sudden acceleration test mode.
	Toggles between Rising, Falling and No triggers.
	Button for zero set. This icon will be enabled in AUX mode.
	Switches between 2CH and 4CH modes.
	Turns CH-A On/Off. The color of this icon will be changed when it is enabled.
	Turns CH-B On/Off. The color of this icon will be changed when it is enabled.
	Turns AUX mode On/Off. The color of this icon will be changed when it is enabled.
	Allows viewing of all traces in one graph
	Allows changing of the time scale.
	Selection of cursors and time between the cursors
	Stops the waveform. This icon toggles between [Stop] button and [Start] button. When stopped, past data is recorded. Allows playback of recorded data.
	Allows Voltage and other settings
	Allows adjusting Threshold Setting
	Allows opening saved data.
	Resets voltage scale, Trigger setup, etc.

Auto Channel

Auto Channel function pre-sets the time and voltage scales for Sensors, Actuators and Systems.

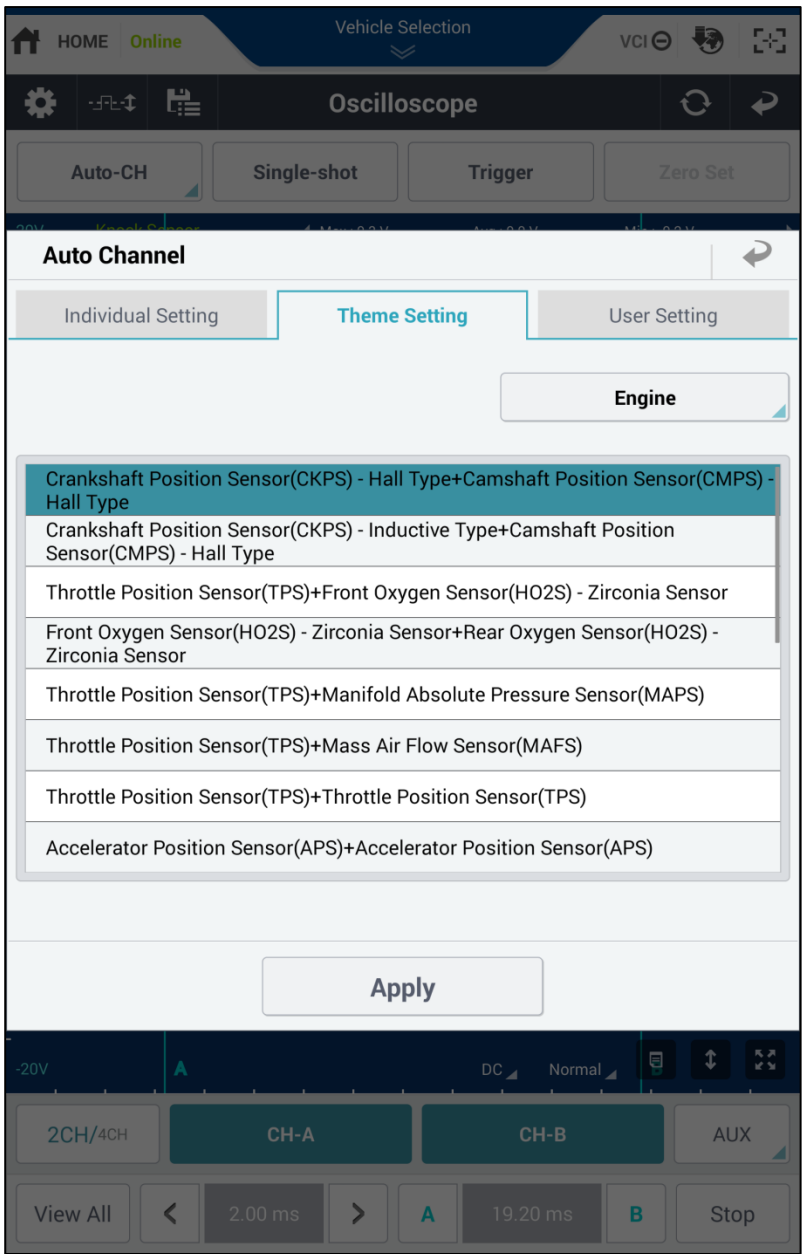
◈ Individual Setting

Select the Sensor or Actuator to be tested for each channel.



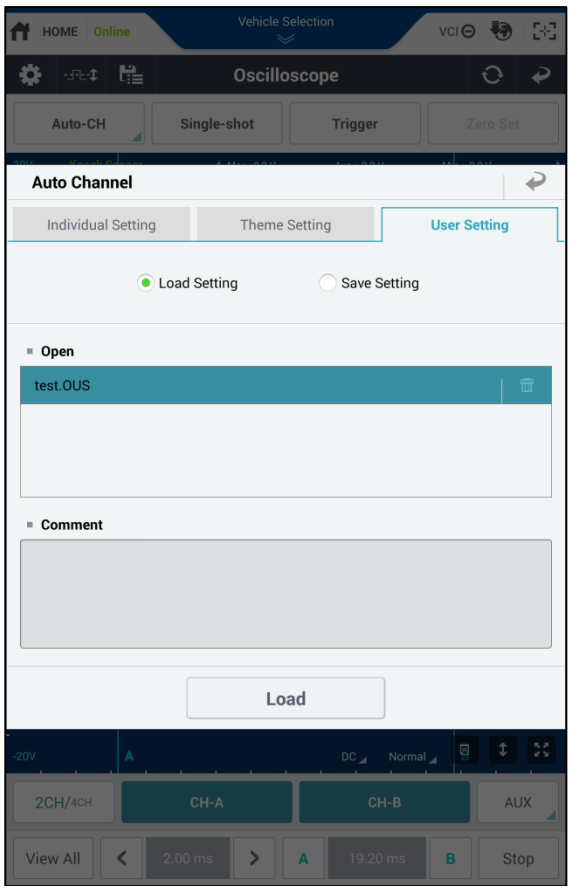
◈ Theme Setting

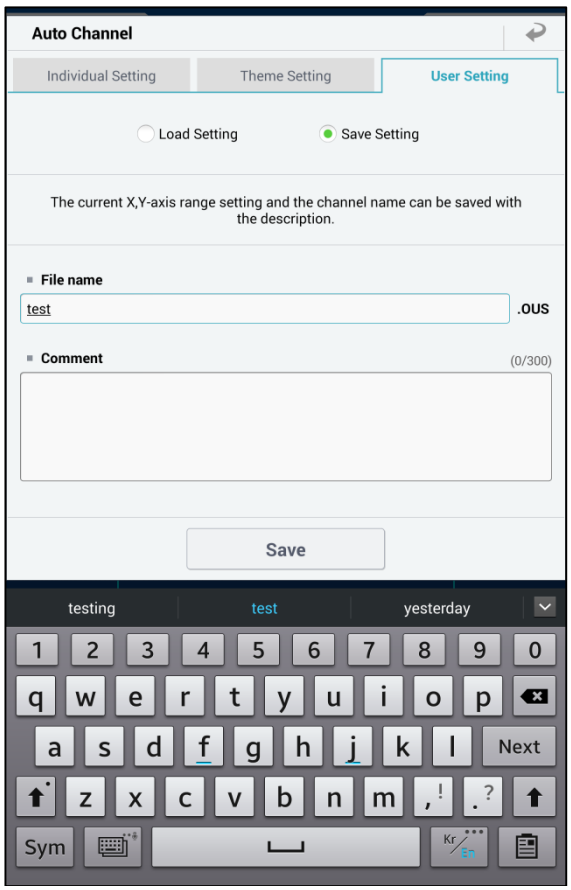
Select the Theme to be tested. The Time and Voltage scales will be pre-set for the sensors.



◈ User Setting

Save settings used for circuits and systems. After setting up the scope for a particular function, the settings can be saved.

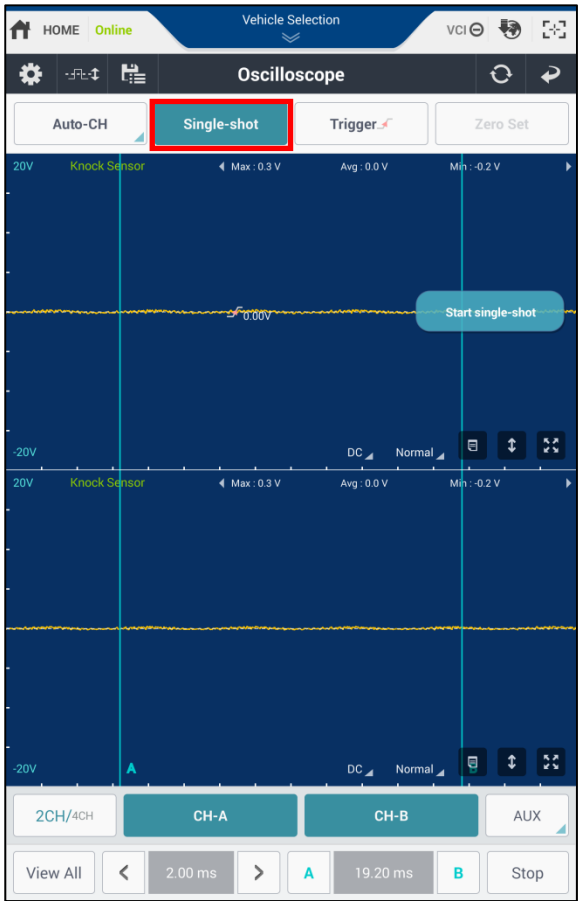


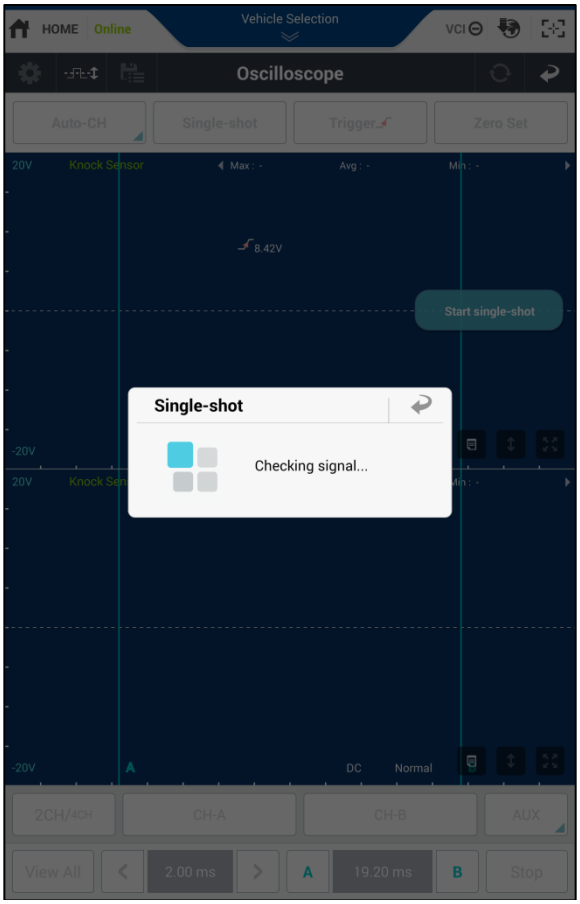


Single Shot

Single Shot mode locks onto and displays a single waveform. This can be used for TPS signal in the sudden acceleration test mode.

After selecting [Single-shot] button, [Start Single Shot] button will appear. Press [Start single-shot] button to start the function.





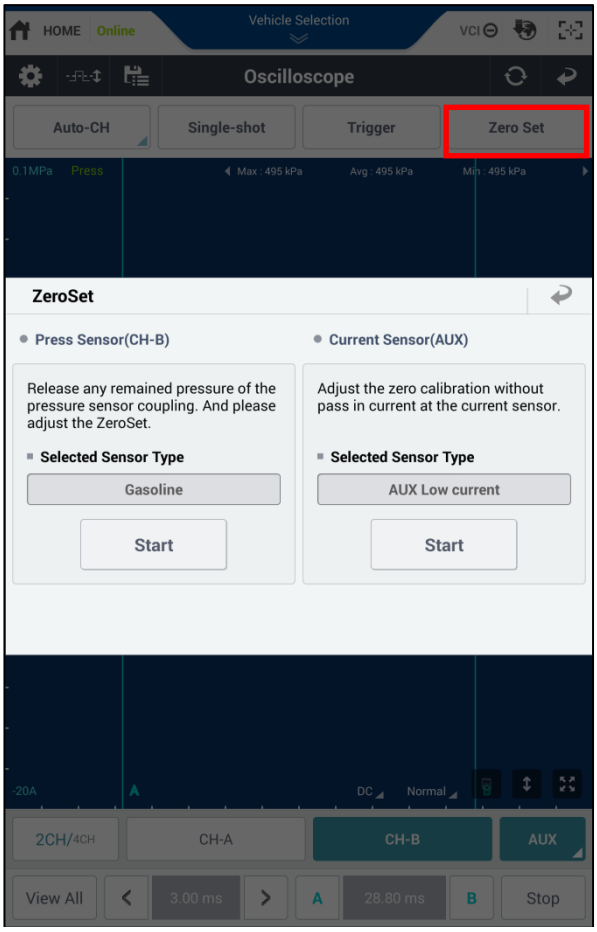
Trigger

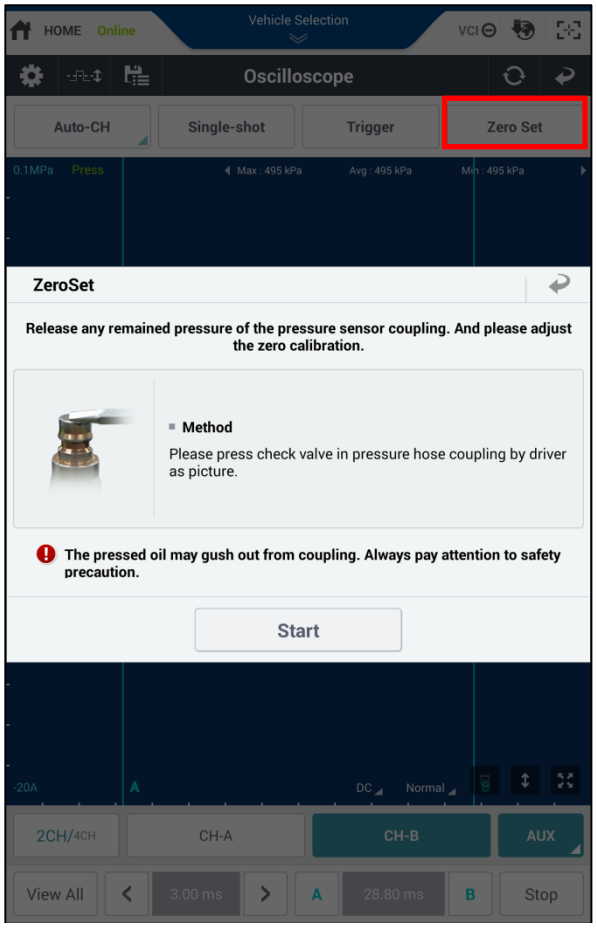
The Trigger function allows the technician to hold the waveform from moving across the screen. Without a trigger, the waveform will continually move across the screen. By setting a trigger, the waveform can be held steady. The trigger can be set on the rising or falling edge of the waveforms.

Select the [Trigger] button to enter trigger mode. The Trigger button will toggle through No trigger, Rising, and Falling edge. The Rising Trigger will lock onto the waveform on the rising edge while the Falling Trigger will lock onto the falling edge. Touch the screen while in Trigger mode to move the trigger. Moving the trigger up or down will change the voltage that the trigger is looking for.

Zero Set

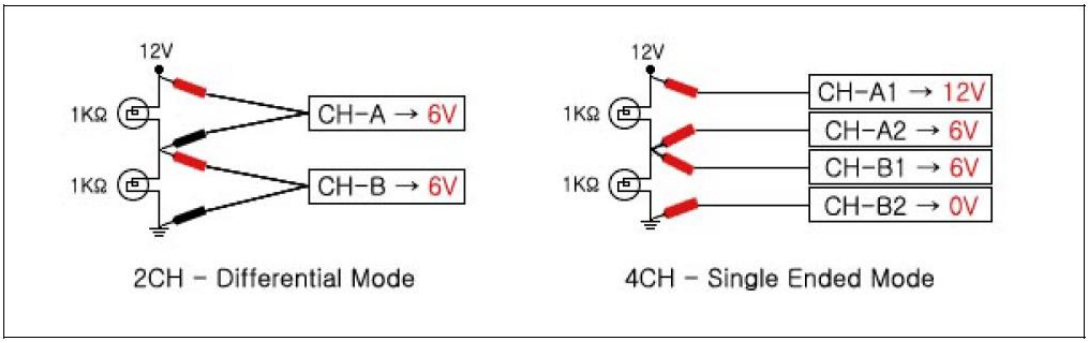
This function sets the data to zero while using Press Sensor or Current Sensor.

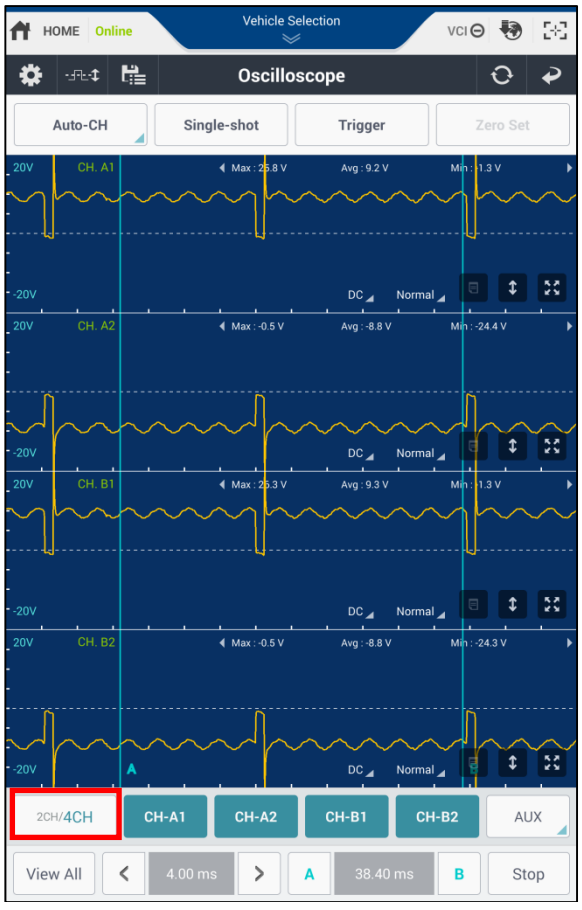




2CH/4CH

In 2CH mode, CH-A forms one channel and CH-B forms the other channel for a total of two channels for measuring two different signals. The (-) probes are usually attached to ground while the (+) probes are attached to the signal circuits. For Differential Mode the (-) probes are attached to the signal circuit to view voltage drops.
In 4CH mode, each of the probes (CH-A1, CH-A2, CH-B1, CH-B2) are used for its own channel. The battery (-) ground clamp is used as the ground for the 4 channels.



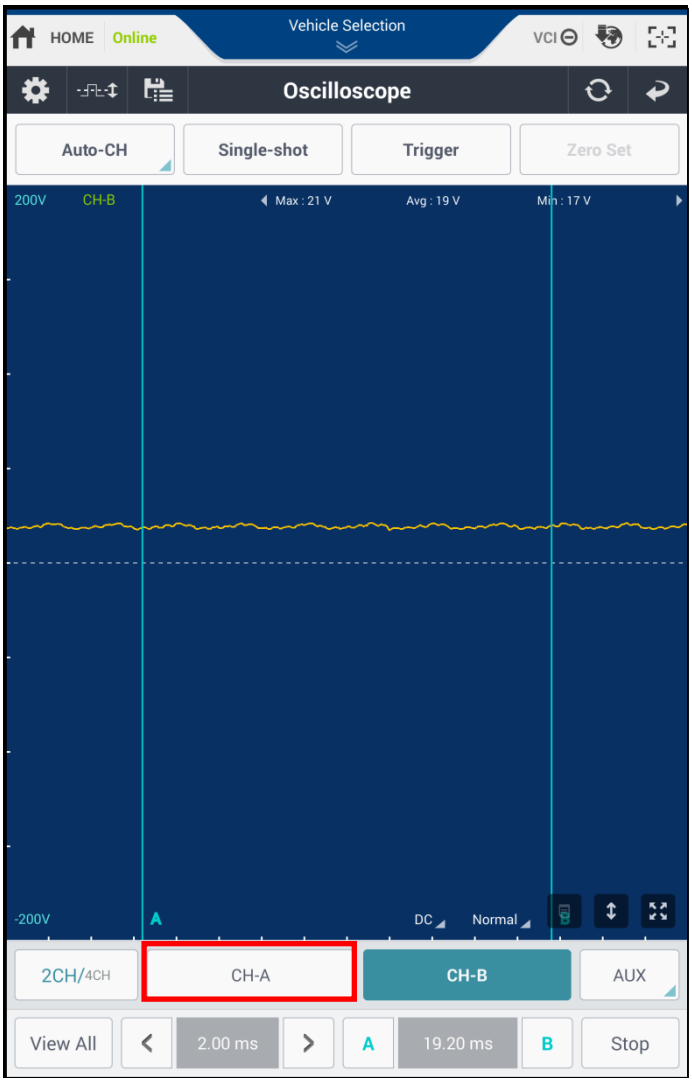


Channel

[CH-A] button turns the Channel A On and Off.

◈ Channel A

CH-A	Button for CH-A On/Off.

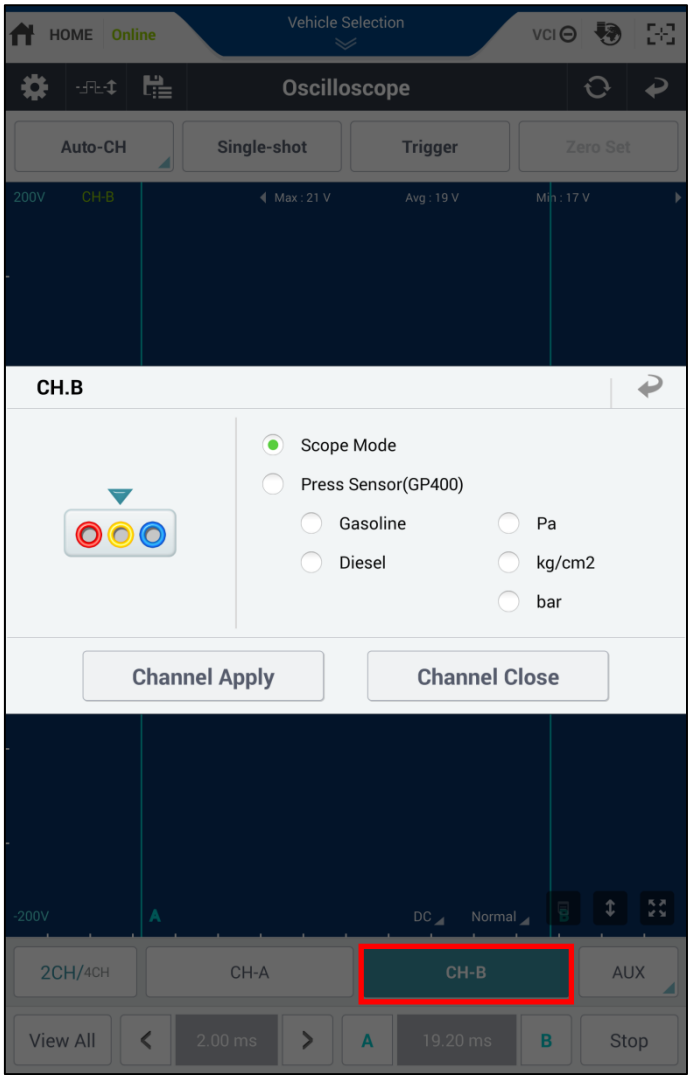


<Channel A OFF>

◈ Channel B

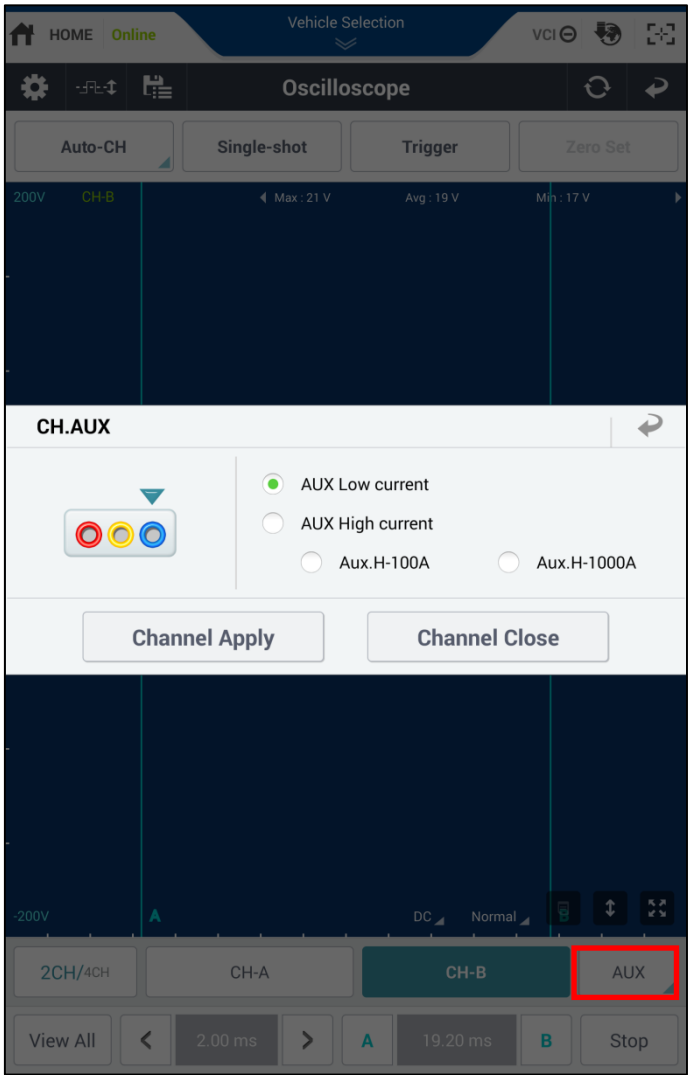
[CH-B] button allows Channel B to be turned On and Off. An option for a Pressure Sensor is not available in most markets.

CH-B	Button for CH-B On/Off or enable Press Sensor.



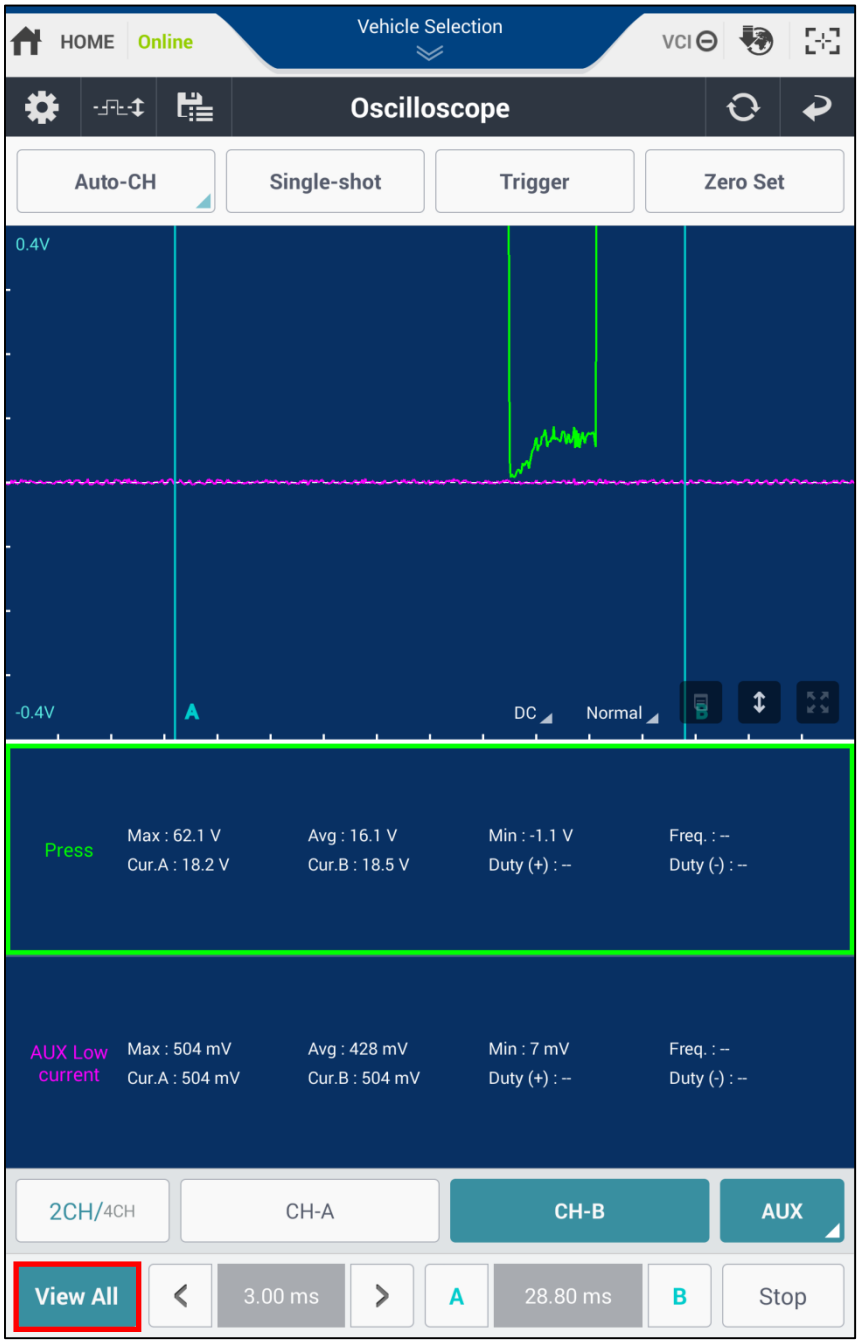
◈ AUX

	Button for AUX Low Current or AUX High(100A or 1000A) Current On/Off.



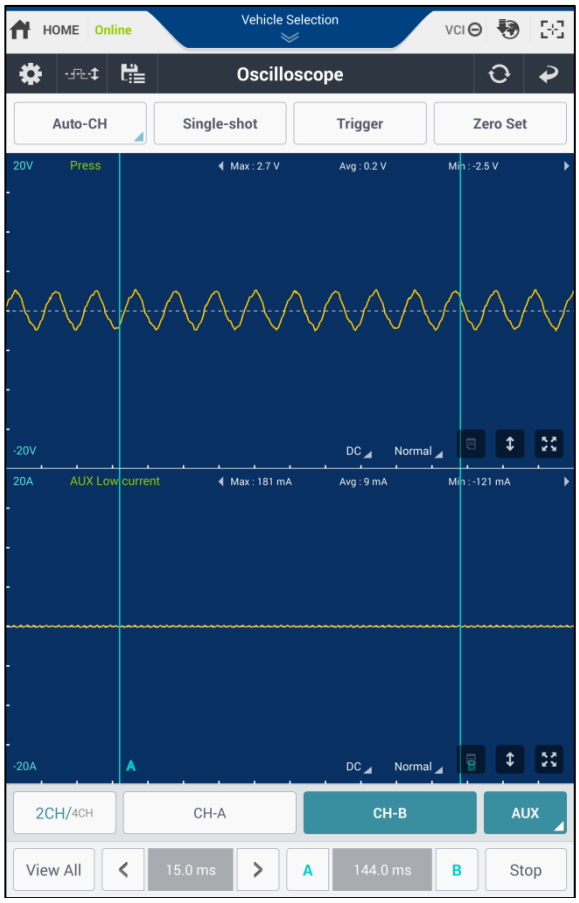
View All

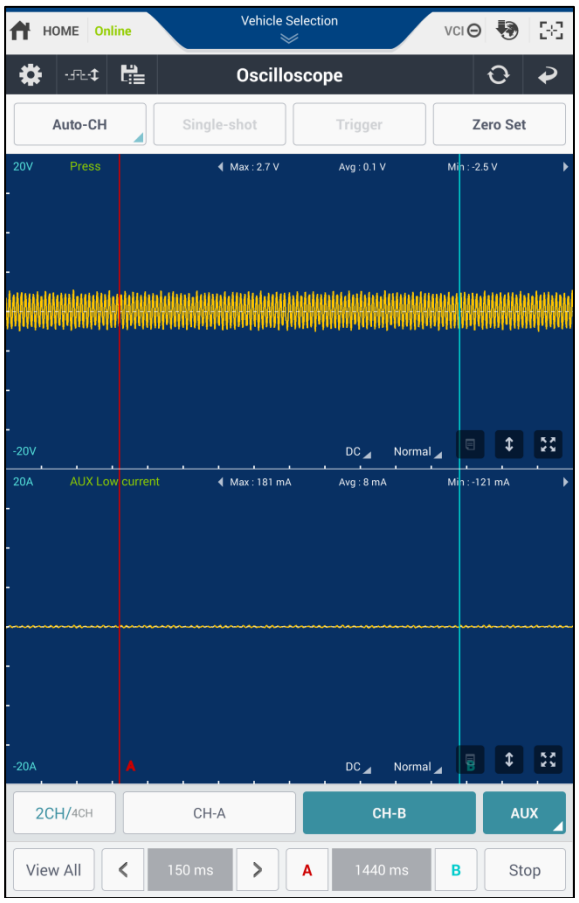
It is a function to show all waveforms on one screen. The waveforms are laid one on top of the other. Each waveform and their names are shown in different colors so that users can distinguish one waveform from another. This function is helpful when checking timing with different signals.



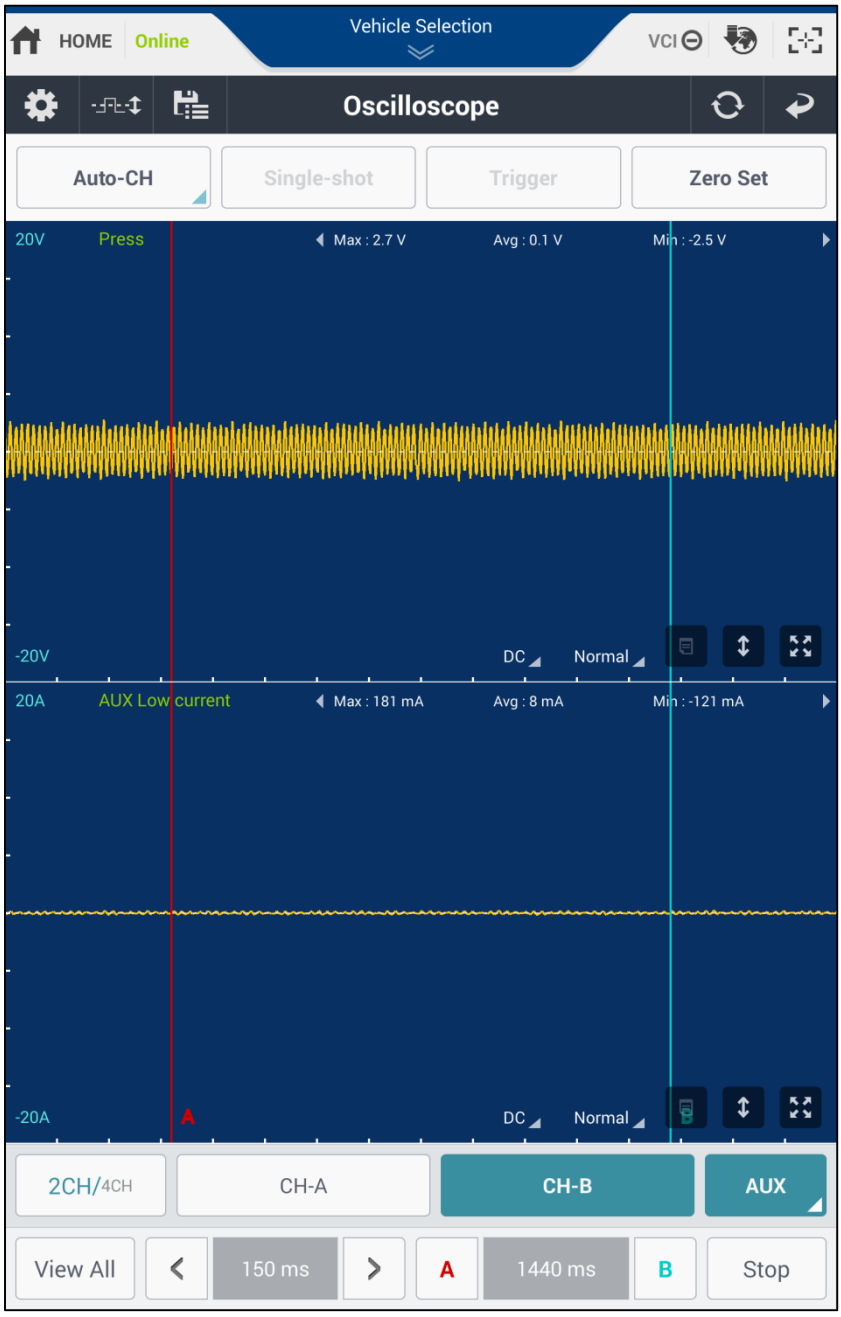
Setting Time Scale

Increasing or decreasing Time/Division when displaying a waveform.





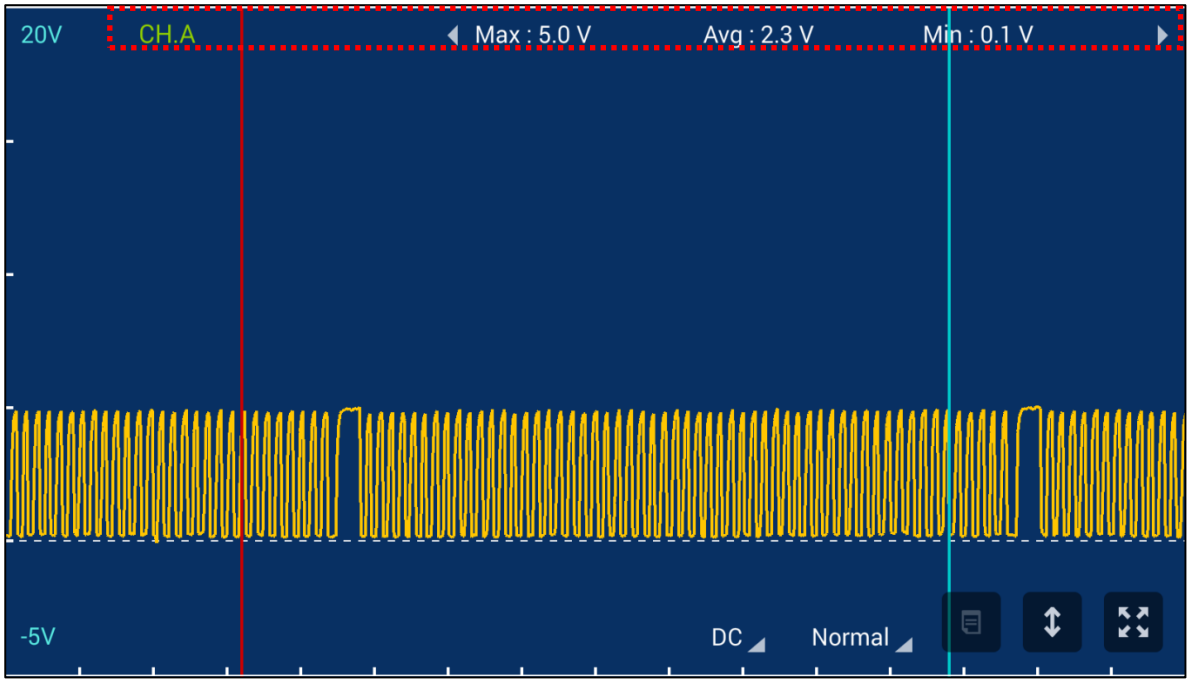
Cursor



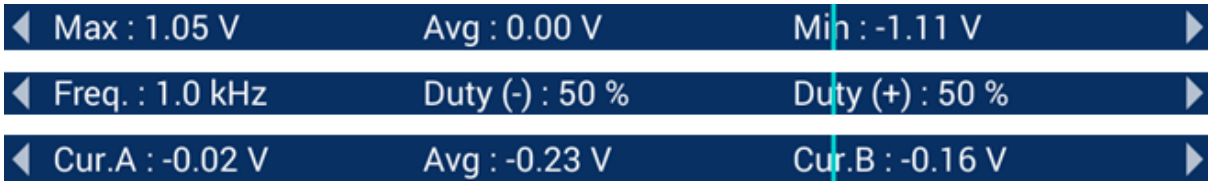
A	Enables cursor A and move the position. It turns red when it is enabled. Touch screen to move cursor.
4800 us	Shows duration (time) between cursors A and B.
B	Enables cursor B and move the position. It turns red when it is enabled. Touch screen to move cursor.

Description of Oscilloscope Screen Shot

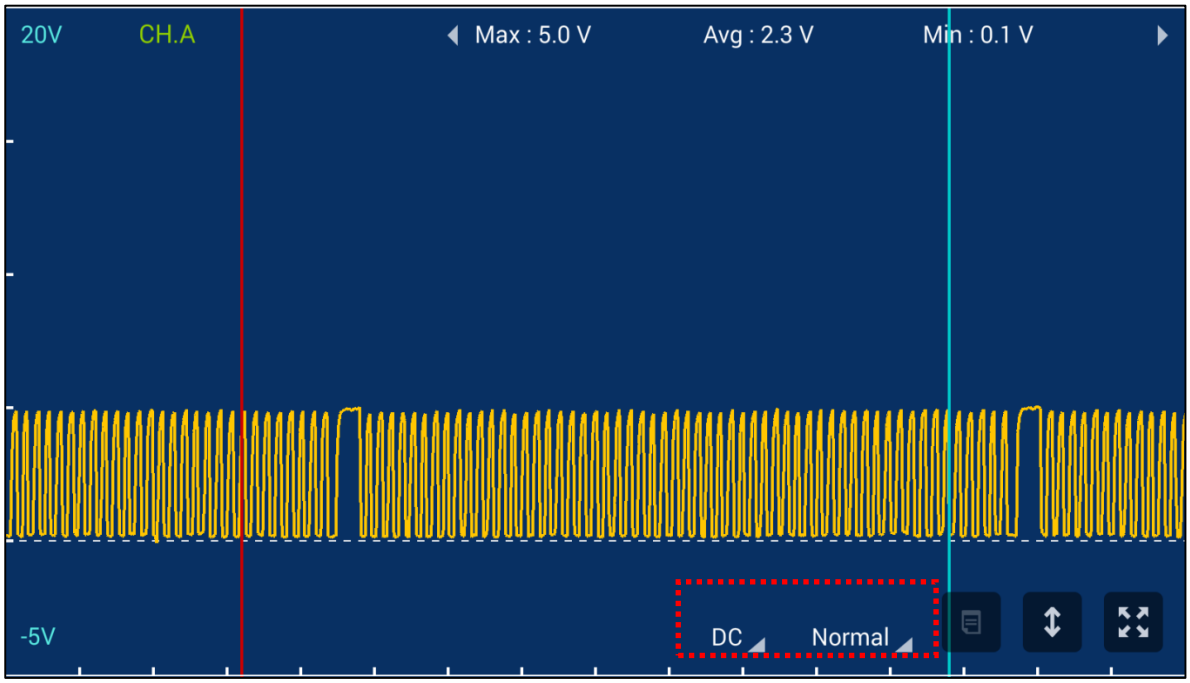
◈ Channel Name and Data



The Description displays the channel name and data on the top of the screen. The 3 groups of data rotate (right/left) through “Min/Max” to Cur-A/Cur-B to Freq/Duty.



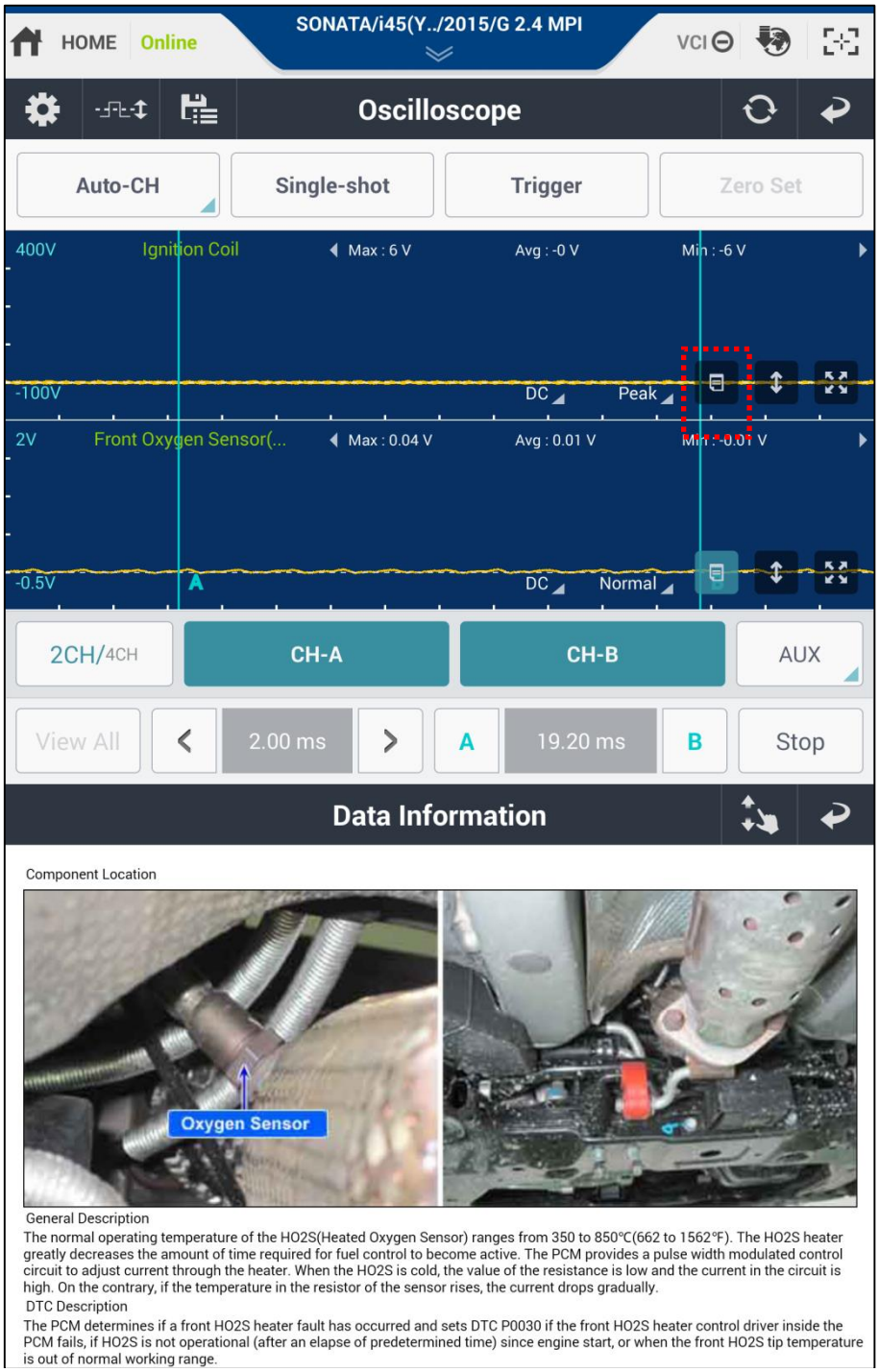
◈ Change Mode



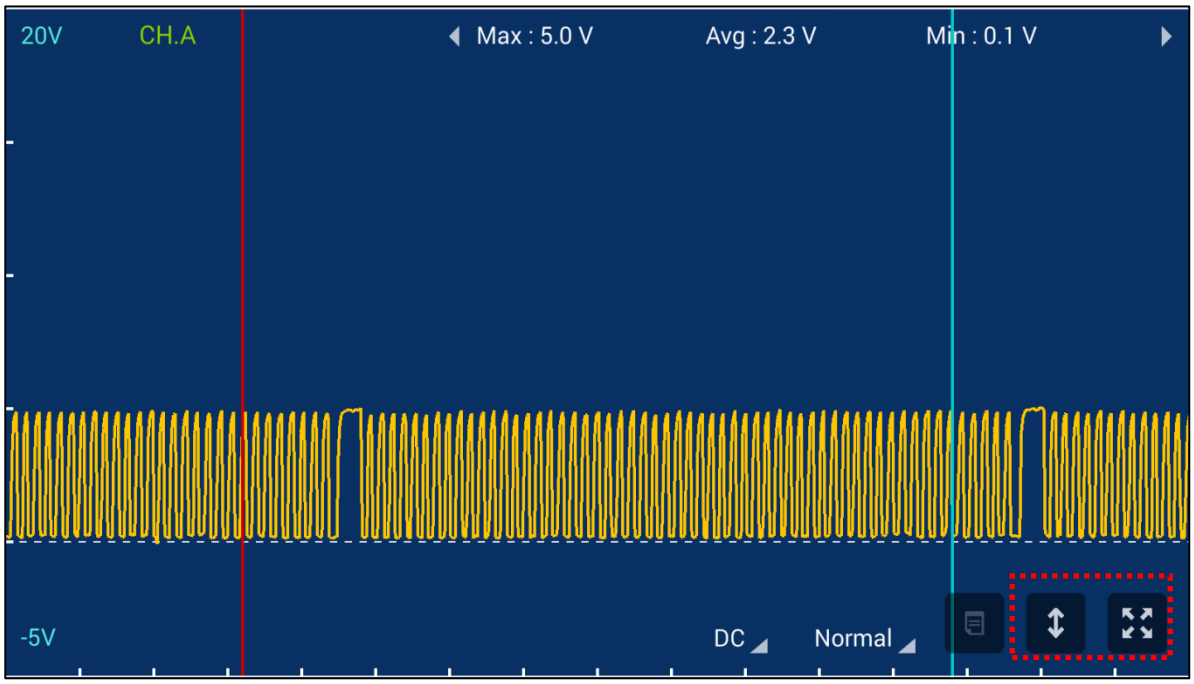
DC	DC is commonly used when measuring most sensors and actuator.
AC	AC is used when measuring an AC signal that has both positive and negative voltage (above and below the zero line). AC can also be used to see variations on a DC signal (alternator output).
Normal	This mode is to show minimum data depending on the sampling speed (Time/Division). Because this mode does not sample short period surging, it is convenient for measuring slow signal devices like O_2 sensor.
Peak	This mode is to measure instant signals like surge voltage in devices like Injector, Ignition coil and various solenoid valve devices for better accuracy.

◈ Sensor Information

When in “Individual Setting” or “Theme Setting” this function will display reference information for the circuit being tested.



- *Auto Range and Channel Adjustment*



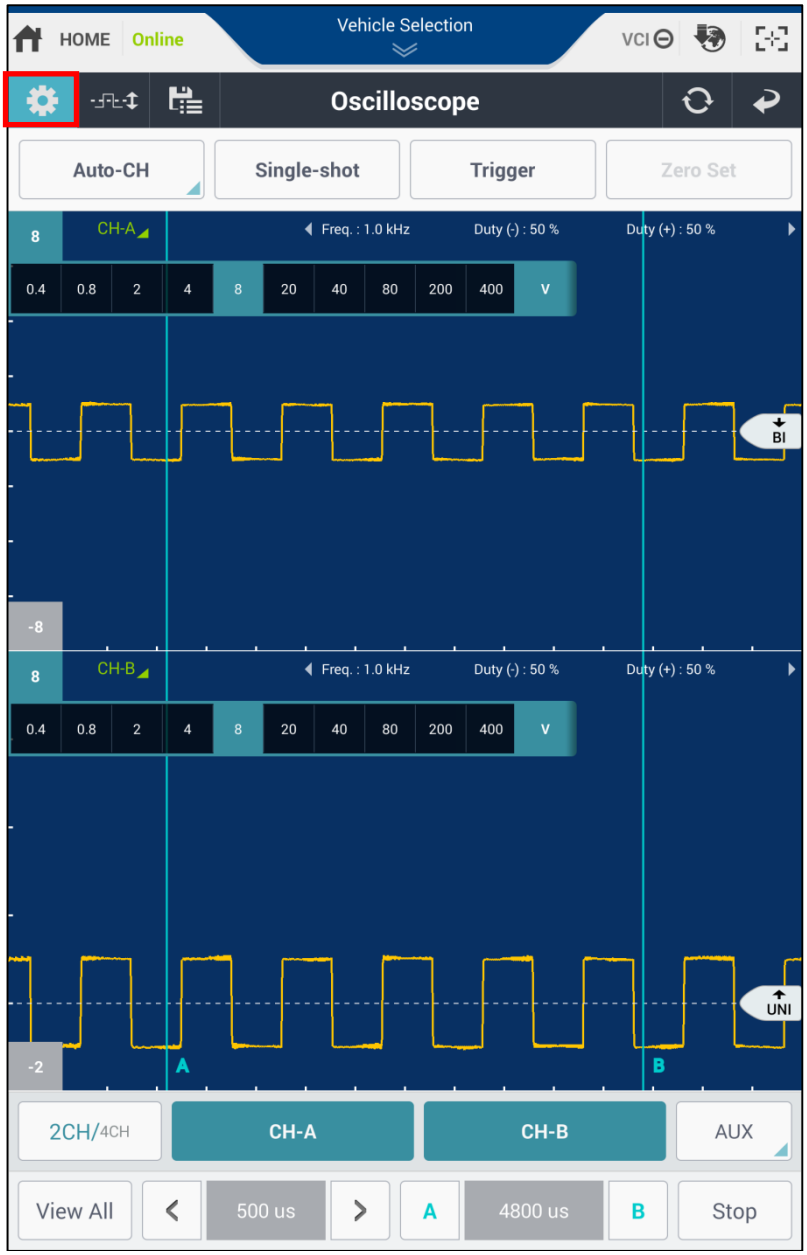
	Displays waveforms on screen at its optimized form.
	Returns back to the user's voltage setup range.
	Displays this channel in full screen.
	Returns back to the normal screen size.

Settings

Selecting the [Setting] button on the left top of the screen will display voltage ranges, Freq/Duty tool and UNI/BI to move waveform on the screen.

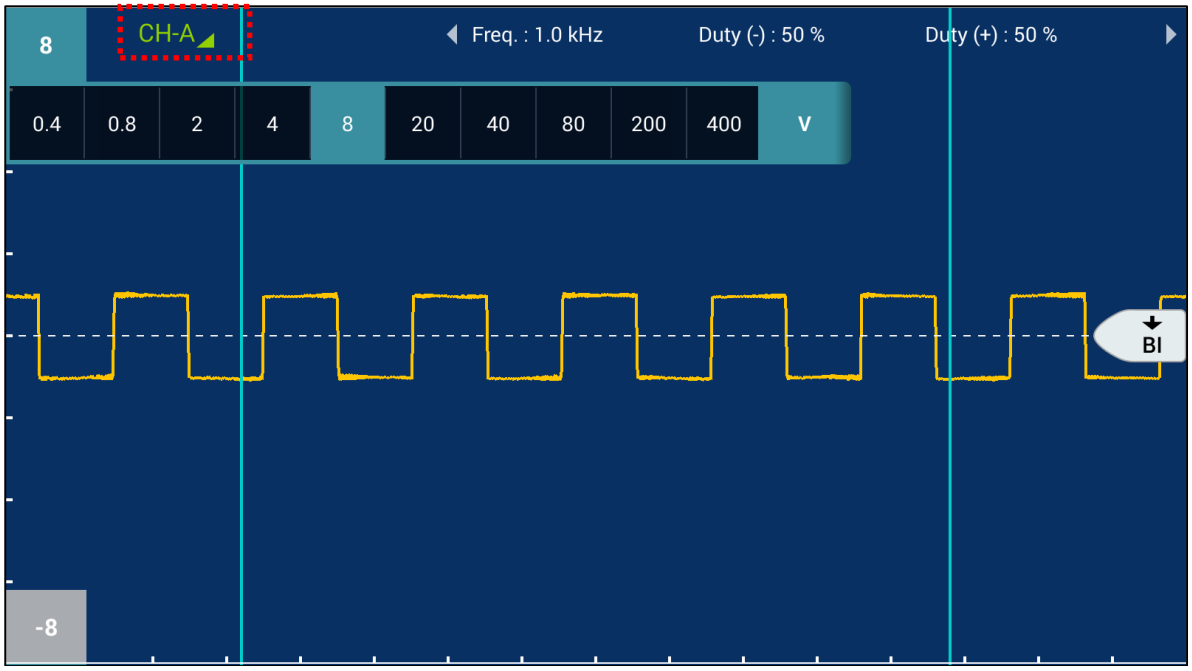
- **Select the desired voltage to change voltage range**
- **Move the Frequency tool over the waveform to read frequency and duty. The value is viewed in the Description data.**

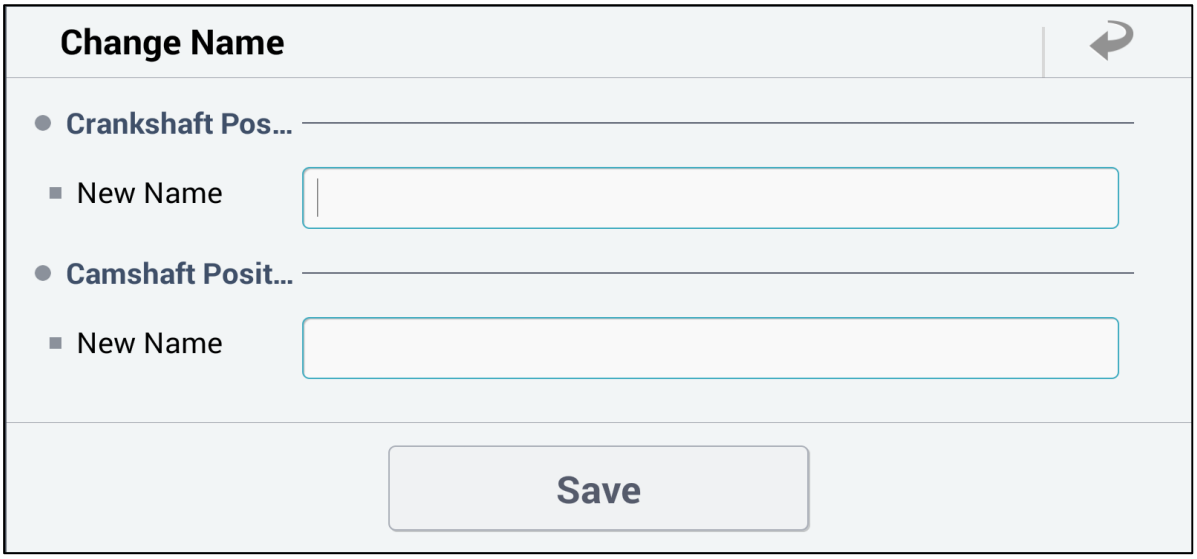
  Freq. : 658.7 Hz Duty (-) : 53 % Duty (+) : 46 %
- **Selecting the UNI / BI buttons will move the zero line in the screen.**



◈ Channel Name

By clicking the name of the channel in the Setting mode, the channel name can be changed.



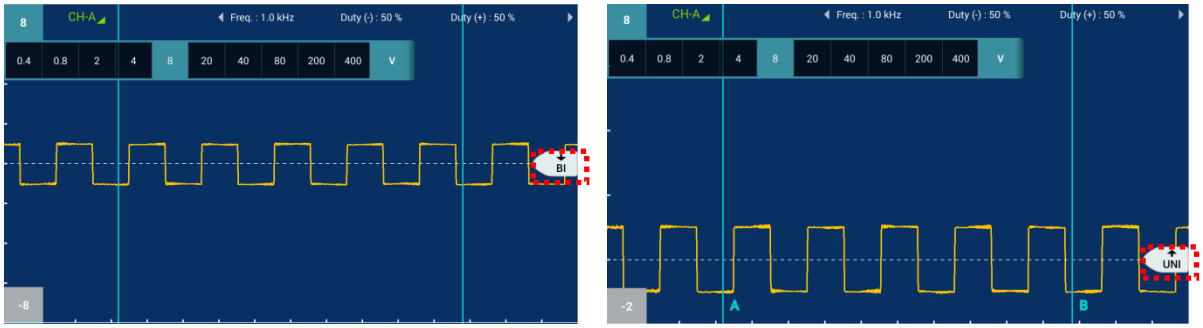


- *Range*

By selecting another voltage, the voltage range of the screen is changed.

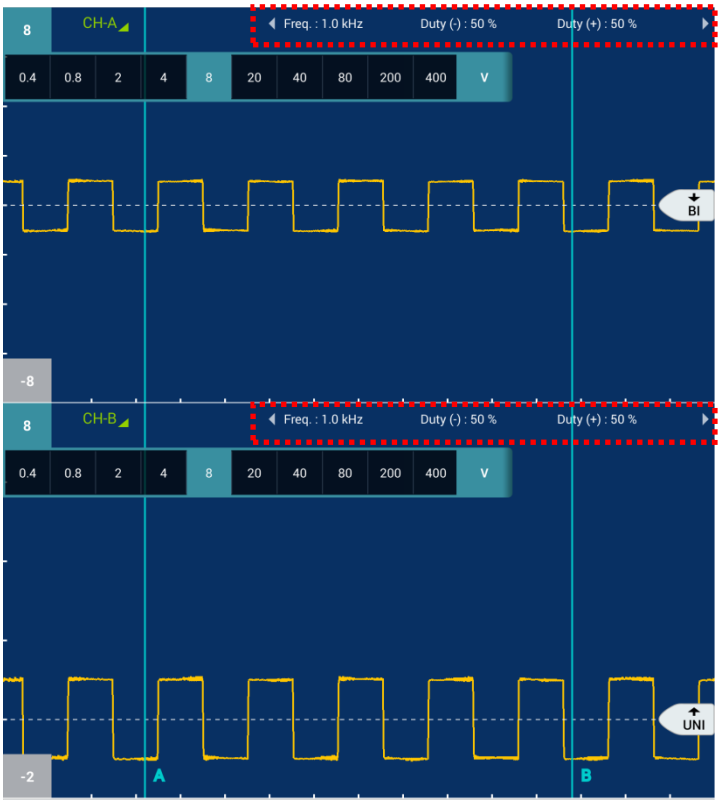
- *Zero Set*

Selecting the “Zero Set” will move the zero line in the screen.



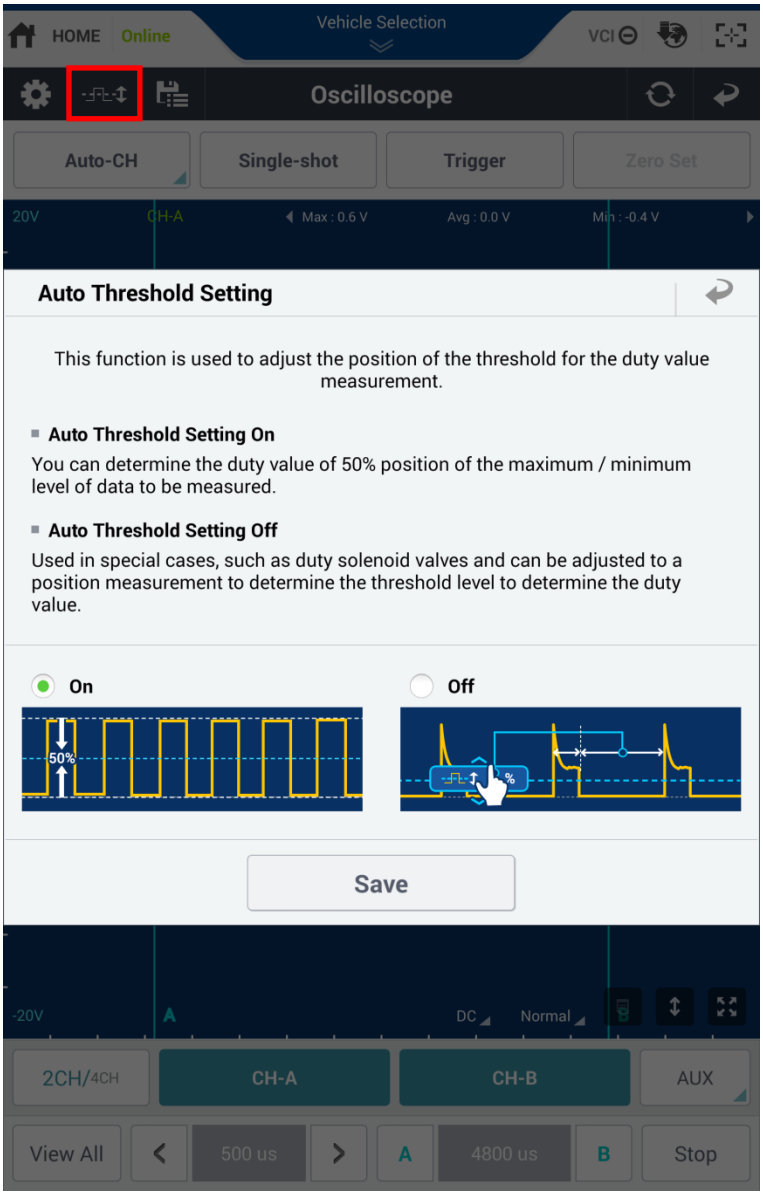
- *Frequency tool*

Move the Frequency tool over the waveform to read frequency and duty. The value is viewed in the Description data.



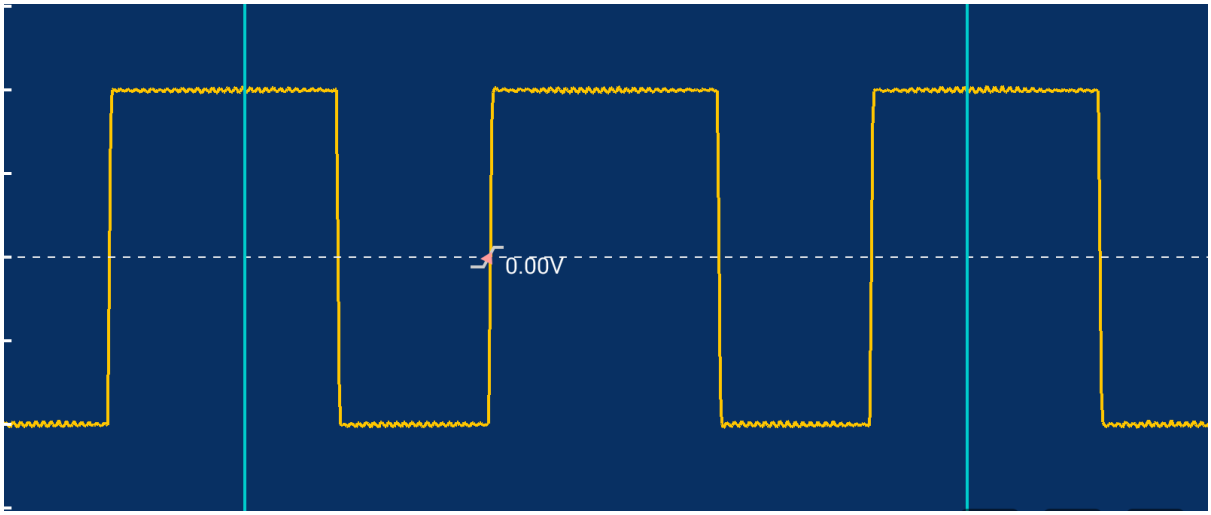
Threshold

It is a function to adjust threshold position for the duty value measurement.
The default value is “Auto Threshold Setting On.”



◈ Auto Threshold Setting On

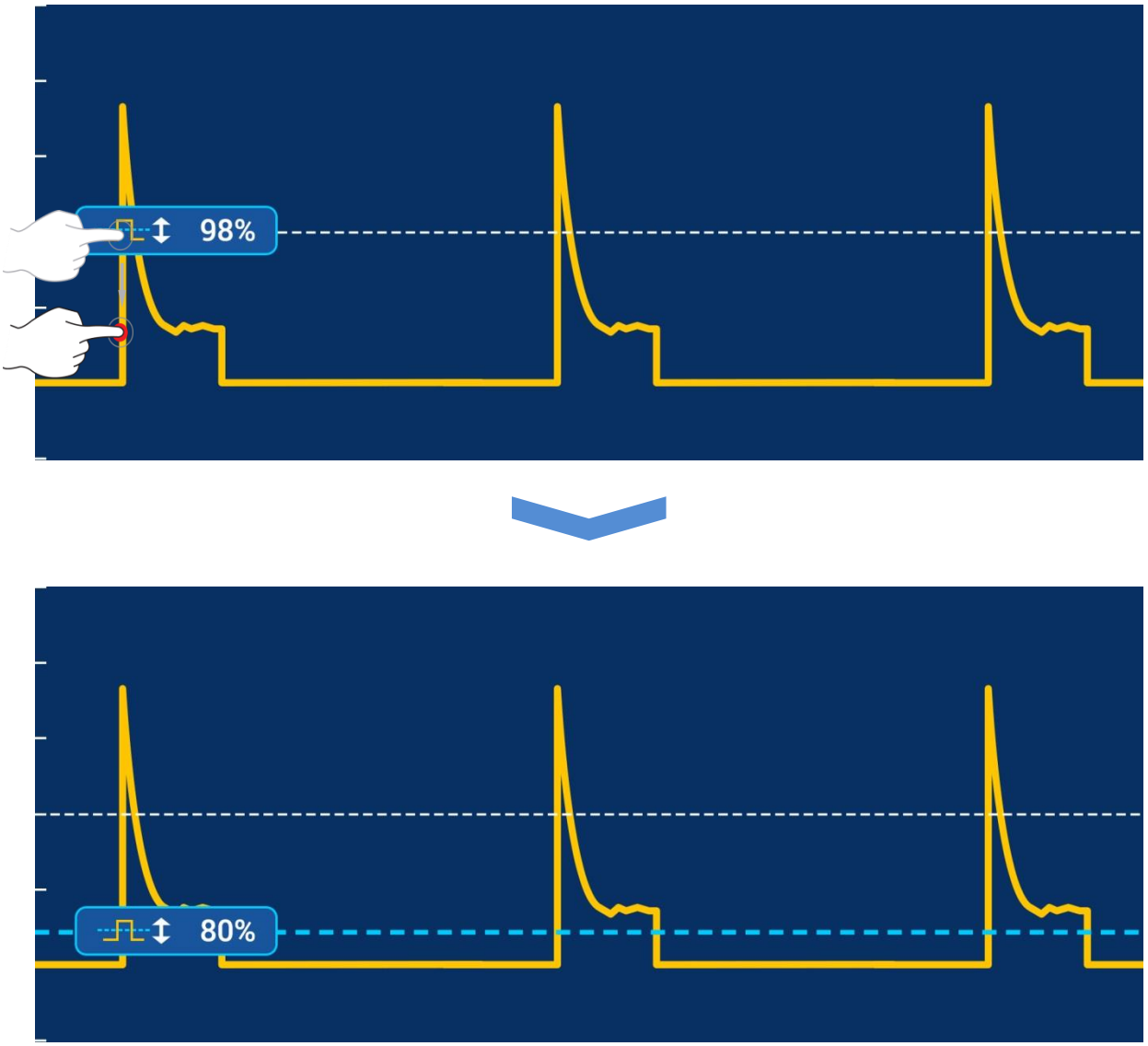
The threshold is automatically placed on the center.



◈ Auto Threshold Setting Off

In special cases, the users who need to change the setting may use this function. To adjust the position of the threshold, move 

icon up or down.
Duty(-) value percentage also displays the icon.

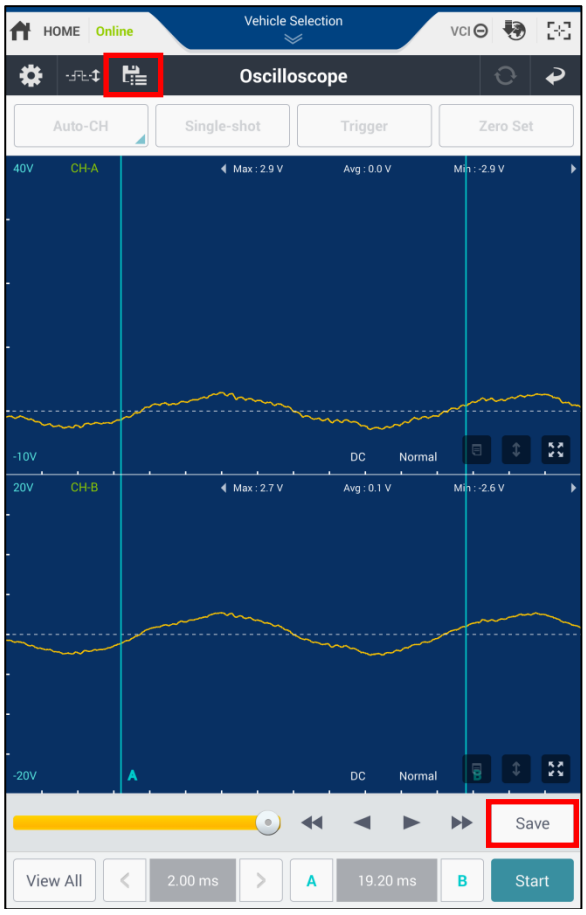


Save and Open Data

◈ Save

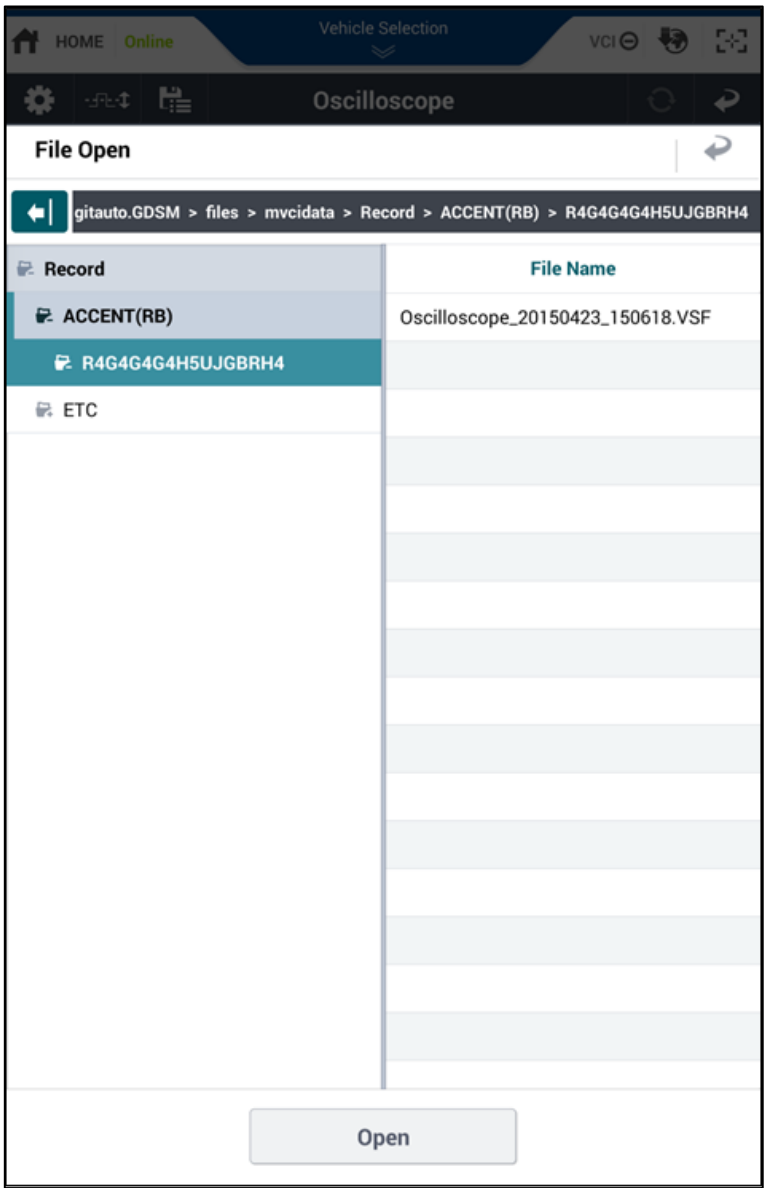
After selecting [STOP] button, the waveform/data can be saved by selecting the [Save] button.

Click  button to open “Recorded Data.”



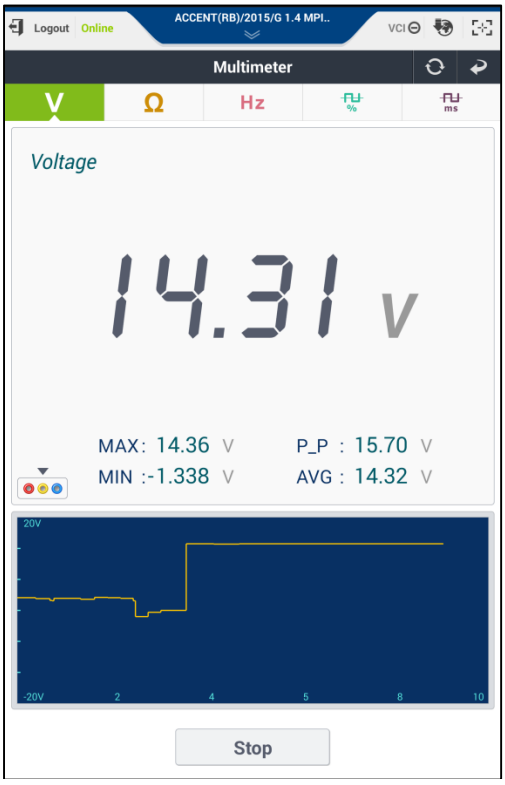
◈ Recorded Data

Saved waveform data will be opened using the Oscilloscope function.



Voltage

Voltage can be measured using CH-B and checks the difference between (-) probe and (+) probe. Displayed is the current voltage along with Max, Min, P_P-[Peak (+) to Peak (-)] and Avg.(Average) voltage. The graph on the bottom shows changes in voltage over time. Reset all data using  button.



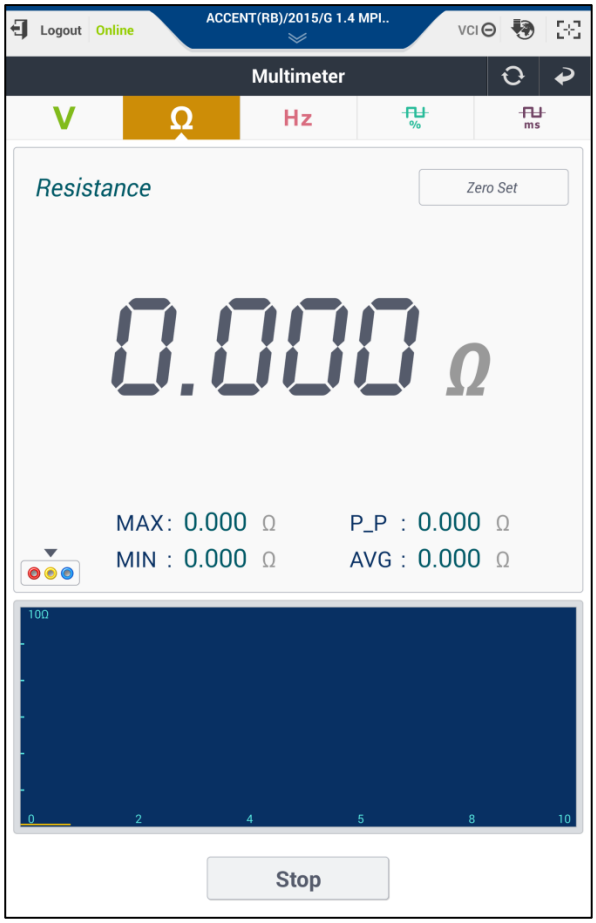
Warning

☞ **Do not measure AC voltage of 110V or 220V. It may cause damage to the VMI.**

Resistance

Resistance can be measured using CH-B and displays the resistance between the (-) probe and (+) probe. Displayed is the current resistance along with Max, Min, P_P- [Peak (+) to Peak (-)] and Avg(Average) resistance. The graph on the bottom shows changes in resistance over time. Reset all data using  button.

Before making a resistance measurement, click [Zero Set] button to zero out the reading. Touch the (+) probe to the (-) probe then click [Zero Set] button.



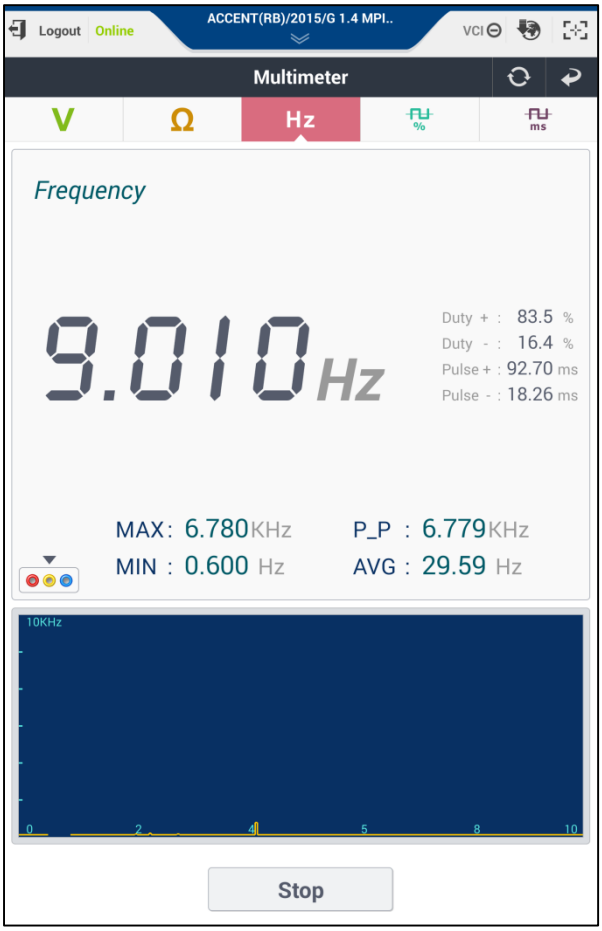
Warning

- ☞ **Only measure Resistance with the Power OFF to that circuit. VMI circuit can be damaged when power through channel probe.**
- ☞ **Resistance measurements are affected with temperature and scope cable connection, therefore user should always zero the meter first before measuring resistance.**

Frequency

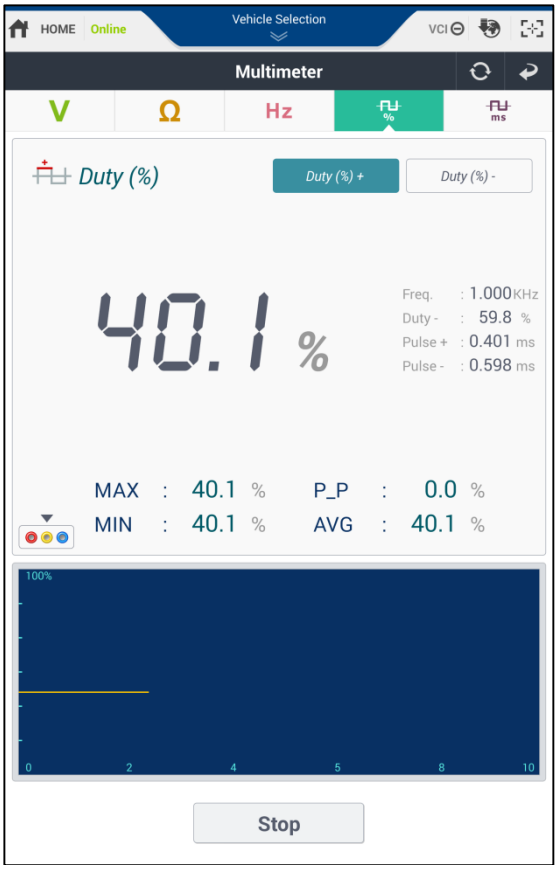
Frequency can be measured using CH-B. Displayed is the current frequency along with Max, Min, P_P-[Peak (+) to Peak (-)] and Avg(Average) frequency. The graph on the bottom shows changes in frequency over time. Reset all data using  button.

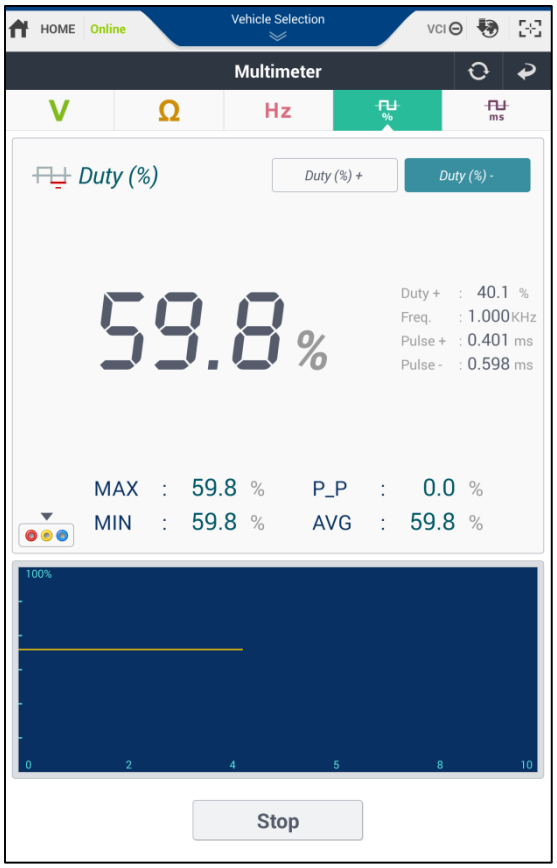
Frequency is displayed as Hertz which is the number of cycles that occur in one second. If the display shows 60Hz, this implies that 60 cycles have taken place during a 1-second period of time.

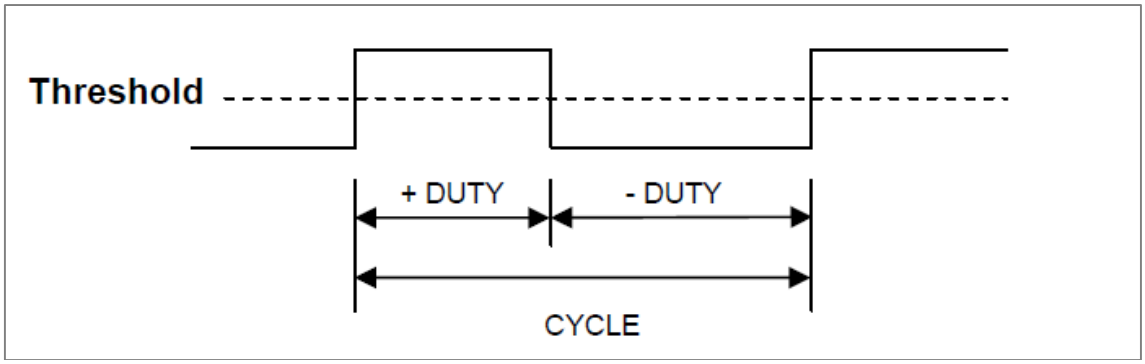


Duty Cycle

Duty Cycle can be measured using CH-B. Displayed is the current Duty Cycle along with Max, Min, P_P-[Peak (+) to Peak (-)] and Avg(Average) Duty Cycle. The graph on the bottom shows changes in Duty over time. Reset all data using  button. Duty Cycle is the percentage of time the signal is high verses low. Duty is displayed from 0% to 100%. Duty can be displayed as high (+) or low (-) - [Duty (%)+] and [Duty(%)-].



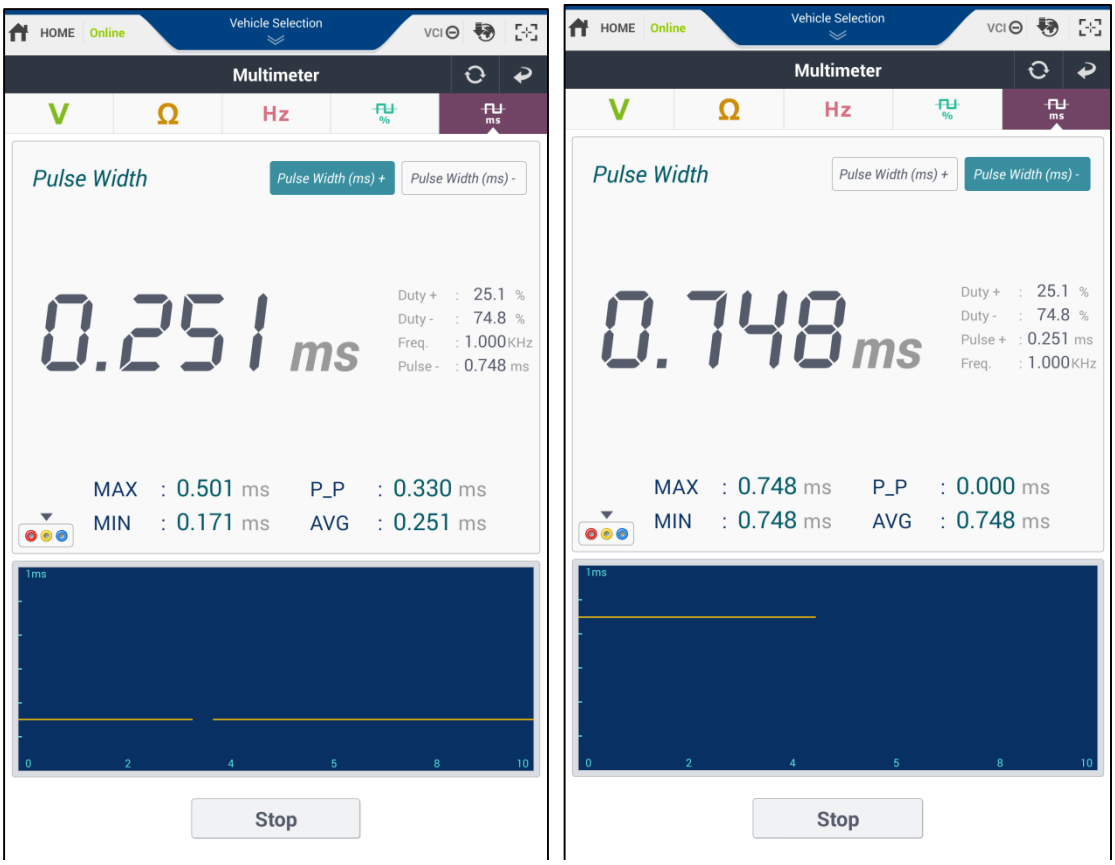


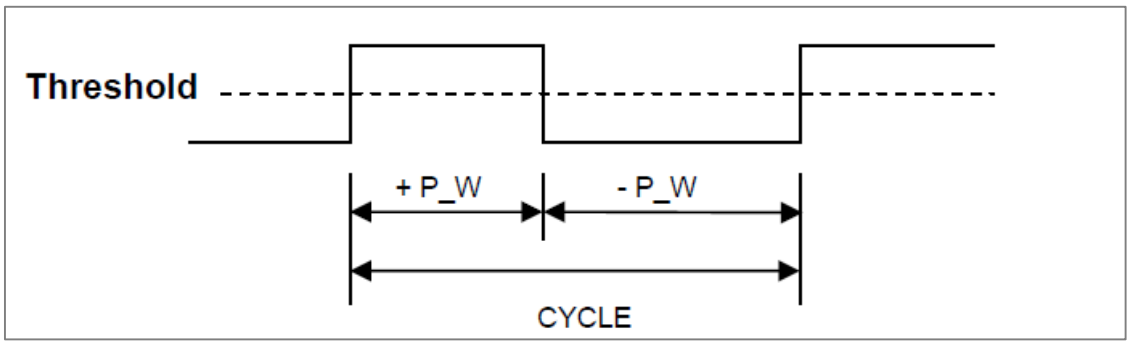


Pulse Width

Pulse Width can be measured using CH-B. Displayed is the current Pulse Width along with Max, Min, P_P-[Peak (+) to Peak (-)] and Avg(Average). Pulse Width. The graph on the bottom shows changes in Pulse Width over time. Reset all data using  button.

Pulse Width is the time the signal is high or low. Pulse Width can be displayed as high (+) or low (-) - [Pulse Width (ms)+ and Pulse Width (ms) -.



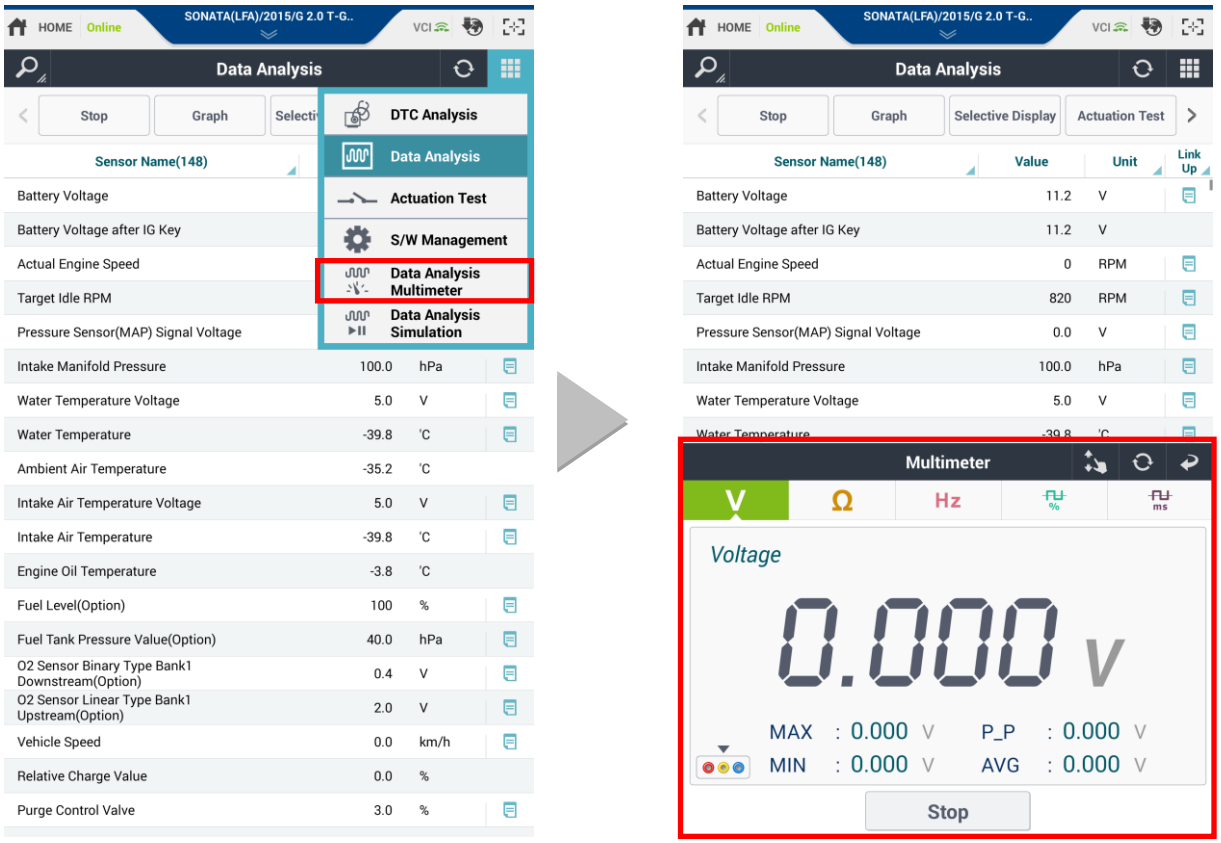


Dual Mode

GDS Mobile Users may use “Data Analysis” and “Multimeter” functions at the same time.

Tap  button on the top right-hand corner of the screen, and click [Data Analysis Multimeter] button. Multimeter screen will be displayed on the bottom screen.

◈ Data Analysis Multimeter



Simulation

The Simulation function is used for checking sensor circuit operation by inputting the appropriate Voltage/Pulse in the PCM or using a Duty Cycle to operate a solenoid.

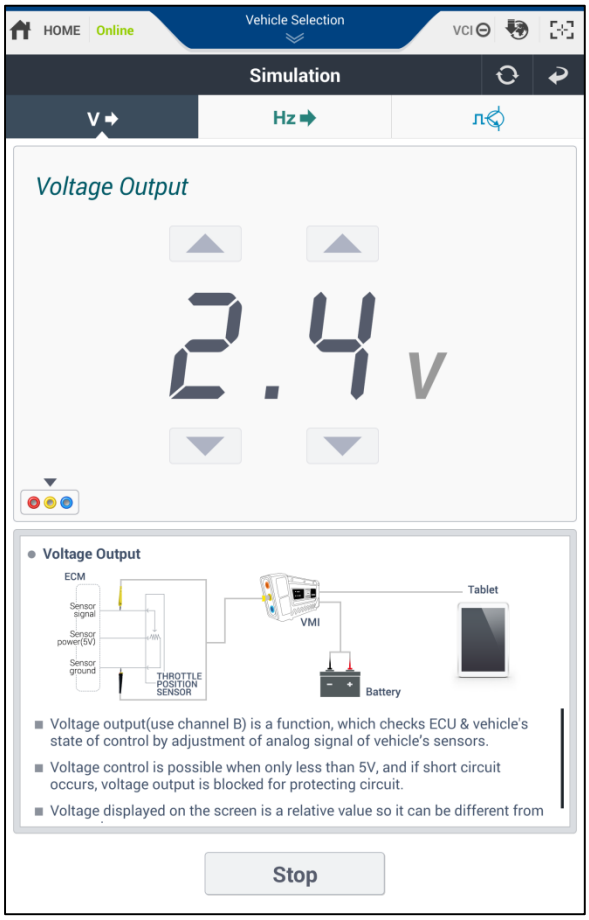
Use CH-A for Actuator Control
Use CH-B for Voltage and Pulse output

Warning

- **Excessive forced simulation test and actuation test may cause malfunctioning of the actuator.**
- **Forcing a solenoid over a certain period of time may deteriorate the function of solenoid.**
- **Simulation and actuation test has to be completed in a short period to minimize the chances of actuators damage.**

Voltage Output

Voltage Output uses CH-B and is used to simulate a voltage to substitute a sensor signal to the ECU. Maximum voltage output is 5V. Using the arrow keys, the input voltage can be adjusted by 1V or 0.1V.

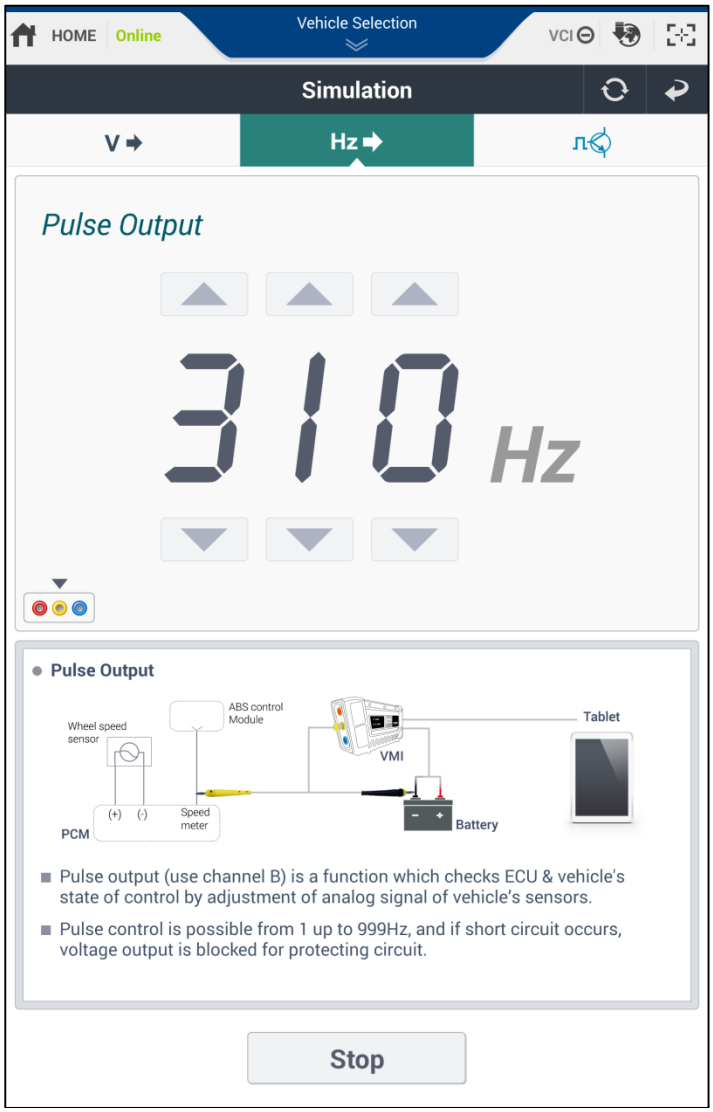


Warning

- **Do not apply probe (+) and probe (-) in reverse.**
- **During simulation test, if voltage signal does not meet within specific value, the feedback value will be shown in RED text then simulation test will be stopped.**
- **During the Voltage or Pulse Output function, sensor connector has to be disconnected.**
- **When simulation test ends, delete error code causing by connector disconnection.**
- **If input signal (Voltage or Pulse Output) when sensor connector is connected, it could be mixed with sensor signal and inputted as ECU.**

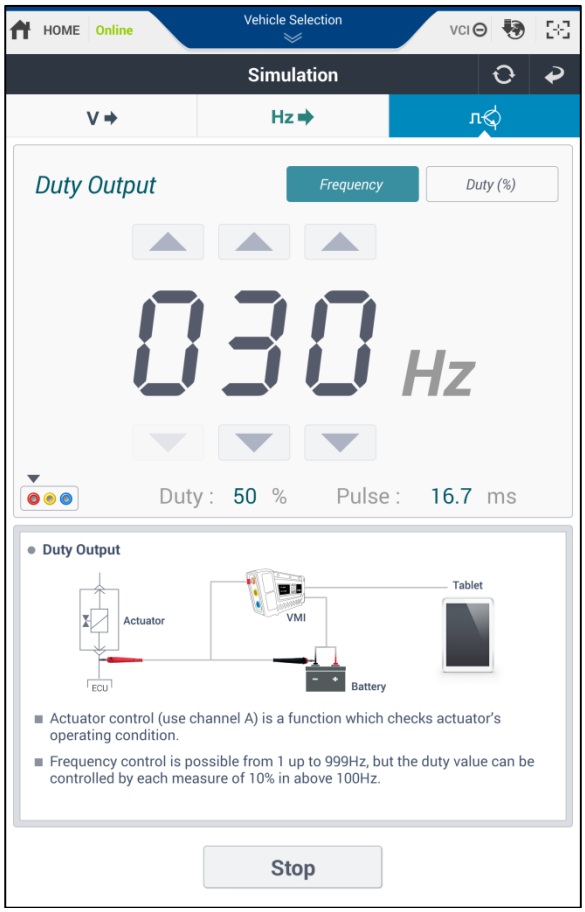
Pulse Output

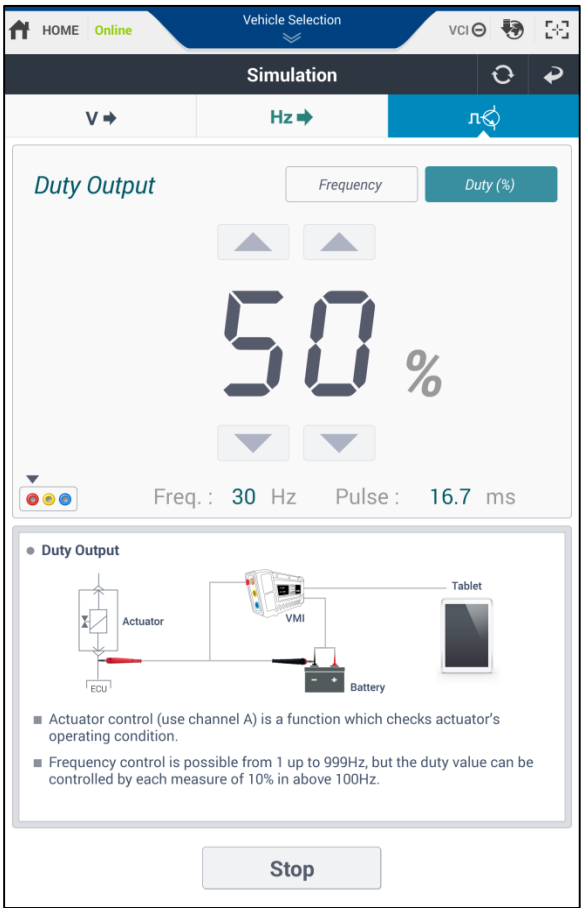
Pulse Output uses CH-B and is used to simulate a pulse to substitute a sensor signal to the ECU. Maximum pulse output is 999Hz. Using the arrow keys, the input voltage can be adjusted by 1Hz, 10Hz or 100Hz.



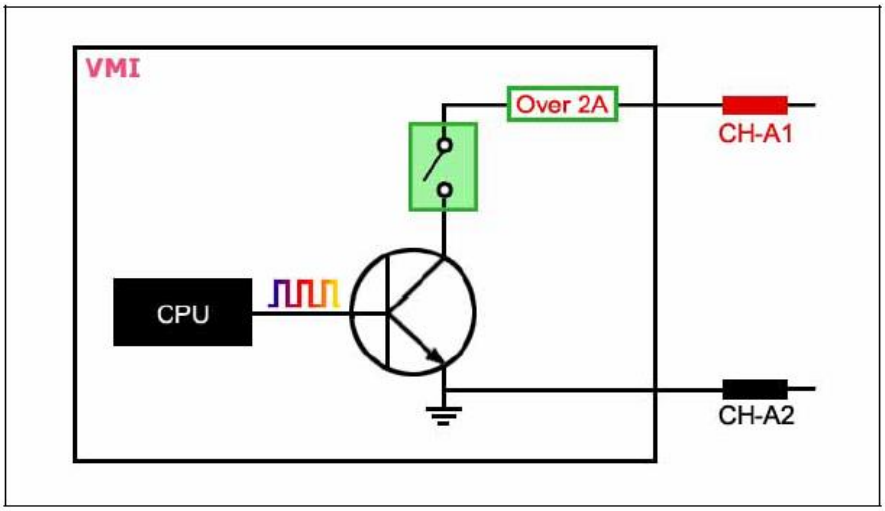
Actuator Control

Actuator Control uses CH-A and is used to operate actuators using Hertz and Duty(-) to test the operation of the actuator.

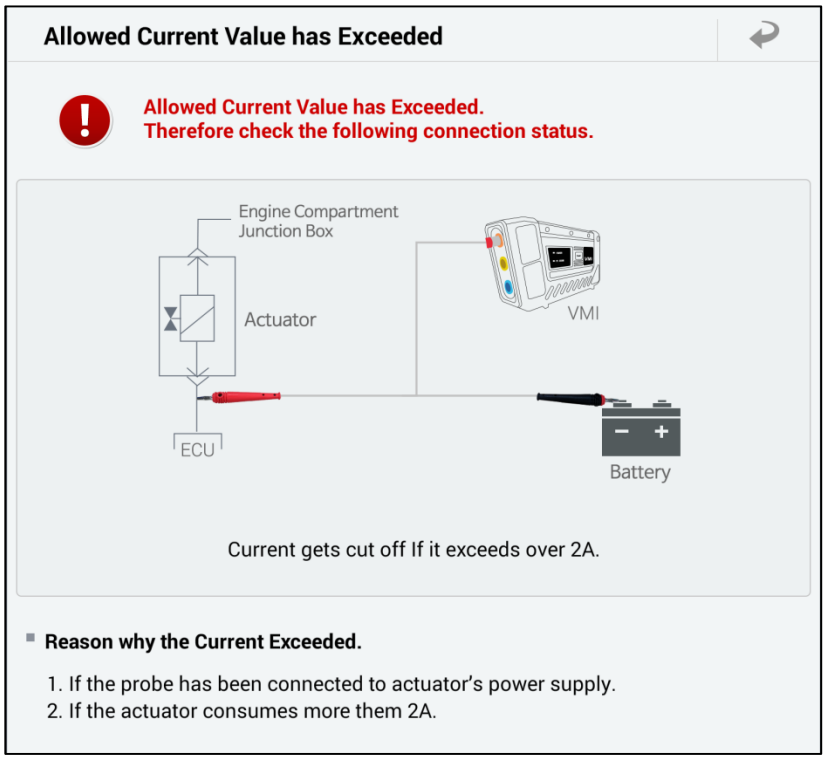




The Actuator test applies a pulse to an actuator to test the component. Instead of the ECU sending the signal, the VMI can be used to send the signal.



If the circuit draws more than 2 Amps, the Actuator Control function will stop to prevent circuit damage.



Dual Mode

GDS Mobile Users may use “Data Analysis” and “Simulation” functions at the same time.

Tap  button on the top right-hand corner of the screen, and click [Data Analysis Simulation] button. Simulation screen will be displayed on the bottom screen.

◈ Data Analysis Simulation