

# Vehicle Measurement Interface

Ver. 04. 06. 2010





## Introduction to VMI



Module: A-07-001 (p.01)

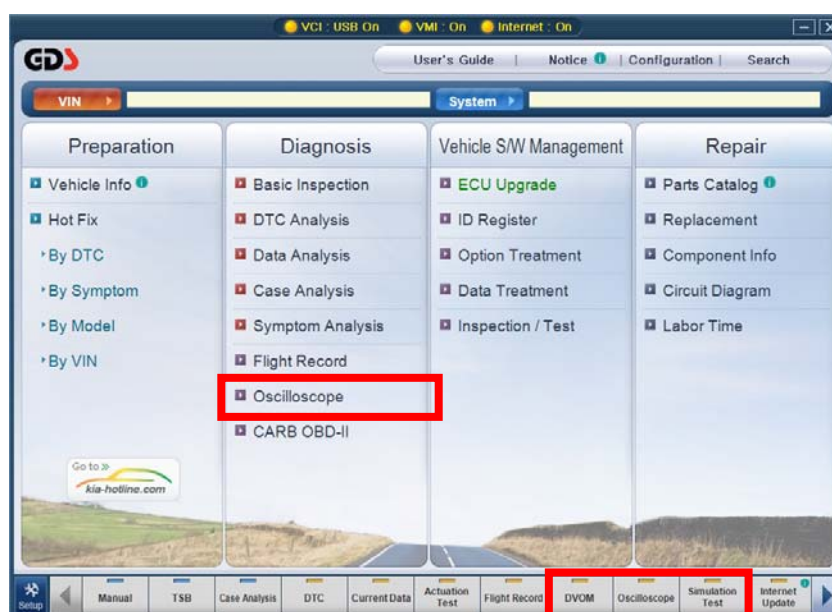
“VMI”(Vehicle Measurement Interface) is a Module for performing measurements (DVOM, Oscilloscope, etc.).

DVOM (Digital Volt Ohm Meter) uses oscilloscope probes to measure Voltage, Resistance, frequency, Duty(+), Duty(-), Pulse(+), Pulse(-)”, and shows current output data with MAX(+PEAK), MIN(-PEAK), AVG(AVERAGE) at the same time.

Oscilloscope function has two channel modes when taking measurements, which are 2CH(CH-A, CH-B)mode and 4CH(CH-A1, CH-A2, CH-B1, CH-B2)mode.

Simulation function supports “Actuator driving test” and “Simulation test”.

To activate DVOM, Oscilloscope, Simulation functions, VMI must be turned “ON” using supplied battery extension cable.





### Safety Warnings and Cautions before Use



Module: A-07-002 (p.01)

This section contains WARNINGS and CAUTIONS for safe usage of GDS. Before use, the user should read the following information.



## WARNING

This indicates items for which incorrect handling may result in a major accident involving death or serious injury.

- The VMI should be secured in a safe location when operating the vehicle to avoid interference with other vehicle equipment.
- When connecting VMI module with a DC adapter, do not use the adapters other than specified DC adapter (7~35VDC).
- Ensure all cables are properly connected during operation. Do not disconnect USB cable or power cable unless finished with the equipment.
- Ensure that the module is installed in a safe and secure location to avoid interference with other vehicle equipment.
- Do not disassemble the VMI module.
- Do not measure 110V or 220V alternating voltages with VMI module.
- Do not measure data using AC/DC adapter on oscilloscope 2 or 4 channel mode.



## CAUTION

This indicates items for which incorrect handling may lead to injury or damage to property. Under certain conditions more serious consequences may result.

- Do not remove the rubber shield from the VMI. Keep liquids and other contaminants away from the VMI.
- Do not place or hang VMI module near incandescent light, which might cause a fire and damage to the VMI.
- Do not drop the VMI.
- Do not place any objects (tools, manuals, etc.) on the VMI.
- Observe correct polarity when connecting the power supply cable.
- When connecting cables under the hood, secure the cables to avoid damaged caused by hot or moving parts.
- Unplugging Cable-mini USB from the VMI module must only be done after releasing the cable connector lock tab(s).
- When removing channel cables, be sure to unlock the tab by sliding insert end before pulling the cable out. Refer to [Figure 5] at "Cable connection method and Applications".
- Cable-mini USB must be connected to VMI module in order to VMI is in use.
- Properly store all components when not in use.
- Do not use cables as carrying handles.



## Disposal of Old Electrical and Electronic Equipment



### Overview

Module: A-07-003 (p.01)

WEEE (Waste Electrical and Electronic Equipment) symbol shown in [Figure 1] is indicated on the back of the VCI main module, VMI main module, and Trigger module.

Please follow the regulation guide for disposal of Waste Electrical and Electronic Equipment. Use caution disposing of the Trigger module; it contains a lithium battery. Users must follow the regulations when replacing or discarding this battery.

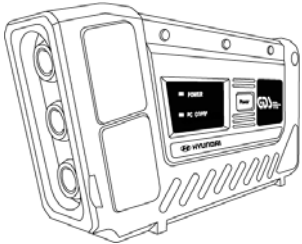
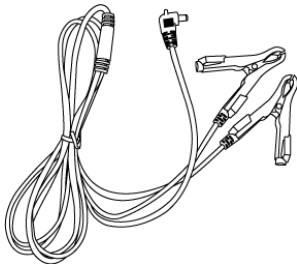
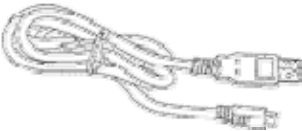


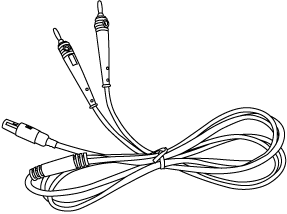
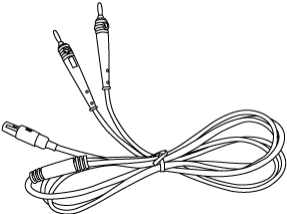
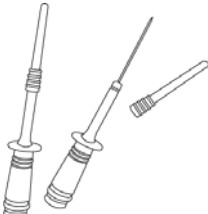
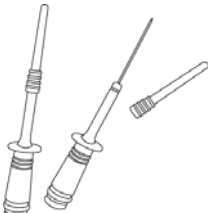
**Figure 1. WEEE Symbol**

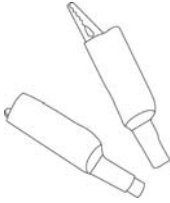
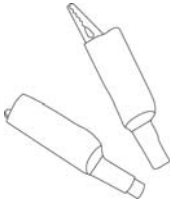
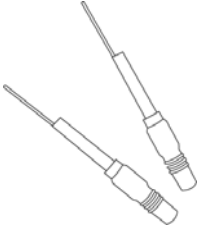
Disposal of Old Electrical & Electronic Equipment (Applicable in the European Union and other European countries with separate collection systems)

This symbol on the product or on its packaging indicates that this product shall not be treated as household waste. Instead it shall be handed over to the applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. The recycling of materials will help to conserve natural resources. For more detailed information about recycling of this product, please contact your local city office, your household waste disposal service or the shop where you purchased the product.

VMI Hardware Components

Part name	Part number	Description	Qty.
<p>Assy.-VMI module</p> 	GHDM - 310000	VMI module for DVOM, Oscilloscope and simulation test.	1
<p>Cable - VMI Power</p> 	GHDM-340000	Supplies DC power to VMI from the vehicles battery terminals directly. Length 6m.	1
<p>Cable-Mini USB</p> 	GHDM-360000	Cable for communication between VMI and Information Terminal. Length 3.5m.	1

Part name	Part number	Description	Qty.
Scope Cable (CH-A) - Red 	GHDM-321000	Scope Cable (CH-A) - Red is used for Oscilloscope and Actuation functions and supports both Differential and Single ended. The connector end has 2keys and the probe is colored in red. Length 1.5m.	1
Scope Cable (CH-B) - Yellow 	GHDM - 322000	Scope Cable (CH-B) - Yellow is used for DVOM and Simulation test functions and supports both differential and Single ended. The connector end has 2keys and the probe is colored in yellow. Length 1.5m.	1
Scope Pin - Red 	GHDM-351000	When measuring data with back probe, use these in front of supplied Scope cables. These are colored in red.	2
Scope Pin - Black 	GHDM-352000	When measuring data with back probe, use these in front of supplied Scope cables. These are colored in black.	2

Part name	Part number	Description	Qty.
<p>Scope Clip - Red</p> 	GHDM-353000	When measuring data at the specific area, use these in front of supplied Scope cables. These are colored in red.	2
<p>Scope Clip - Black</p> 	GHDM-354000	When measuring data at the specific area, use these in front of supplied Scope cables. These colored in black.	2
<p>Spring Pin</p> 	GHDM-355000	When measuring data with back probe, use these in front of supplied Scope cables.	2





## Specifications and Features



Module: A-07-005 (p.01)

### 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	$\pm 400\text{ mV}$ , $\pm 800\text{ mV}$ , $\pm 2\text{V}$ , $\pm 4\text{V}$ , $\pm 8\text{V}$ , $\pm 20\text{V}$ , $\pm 40\text{V}$ , $\pm 80\text{V}$ , $\pm 200\text{V}$ , $\pm 400\text{V}$
	4CH	$\pm 4\text{V}$ , $\pm 8\text{V}$ , $\pm 20\text{V}$ , $\pm 40\text{V}$ , $\pm 80\text{V}$ , $\pm 200\text{V}$ , $\pm 400\text{V}$
Vertical Resolution		10 Bit
Measurable	$\pm 400\text{ mV} \sim \pm 2\text{V}$	$\pm 20\text{V}$ <sup>1)</sup>
Differential DC	$\pm 4\text{V} \sim \pm 80\text{V}$	$\pm 200\text{V}$
Voltage Range	$\pm 200\text{V} \sim \pm 400\text{V}$	$\pm 400\text{V}$
Sampling Modes		Normal mode / Peak mode
AC/DC Coupling		Supported
Input Impedance		2 M $\Omega$ respect to power ground
Time Range	2CH	100 $\mu\text{s}$ , 200 $\mu\text{s}$ , 500 $\mu\text{s}$ , 1 ms, 2 ms, 5ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, 1s, 2s, 5s
	4CH	200 $\mu\text{s}$ , 400 $\mu\text{s}$ , 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)

1) Using 2CH Differential Mode, in case of measuring voltage is set in over the 20V, the VMI cannot recognize under 400 mV(800 mV or 2V) even if the chosen voltage range is in  $\pm 400\text{ mV}$ (800 mV or 2V), In this case, the user must change the voltage range to measurable range.

**DVOM Features**

Item	Specifications
DC Voltage Range	$\pm 400 \text{ mV}$ , $\pm 4\text{V}$ , $\pm 40\text{V}$ , $\pm 400\text{V}$
AC Voltage Range	Not Supported. DO NOT Measure AC Outlet (110V or 220V)
Resistance Range	$400\Omega$ , $4 \text{ k}\Omega$ , $40 \text{ k}\Omega$ , $400 \text{ k}\Omega$ , $10 \text{ M}\Omega$
Frequency Range	1 Hz ~ 10 kHz (Threshold Level: $2.5\pm0.5\text{V}$ )
Duty Range	0.1% ~ 99.9% @ 1 Hz ~ 100 Hz
	1.0% ~ 99.0% @ 100 Hz ~ 1 kHz
	3.0% ~ 97.0% @ 1 kHz ~ 3 kHz
	5.0% ~ 95.0% @ 3 kHz ~ 5 kHz
	10.0% ~ 90.0% @ 5 kHz ~ 10 kHz
Pulse Width Range	$10 \mu\text{s}$ ~ 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	1 Hz ~ 999 Hz
	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	1 Hz ~ 999 Hz
	Duty Range	1% ~ 99% @ 1 Hz ~ 99 Hz (1% or 10% per step)
		10% ~ 90% @ 100 Hz ~ 999 Hz (Only 10% per step)
	Pulse Width	Depends on frequency or duty
	Allowable Current	Max. 2A±0.3A

**FCC/CE Notification**

Contains FCC ID: NI3-IS20V35

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.



## Main Components

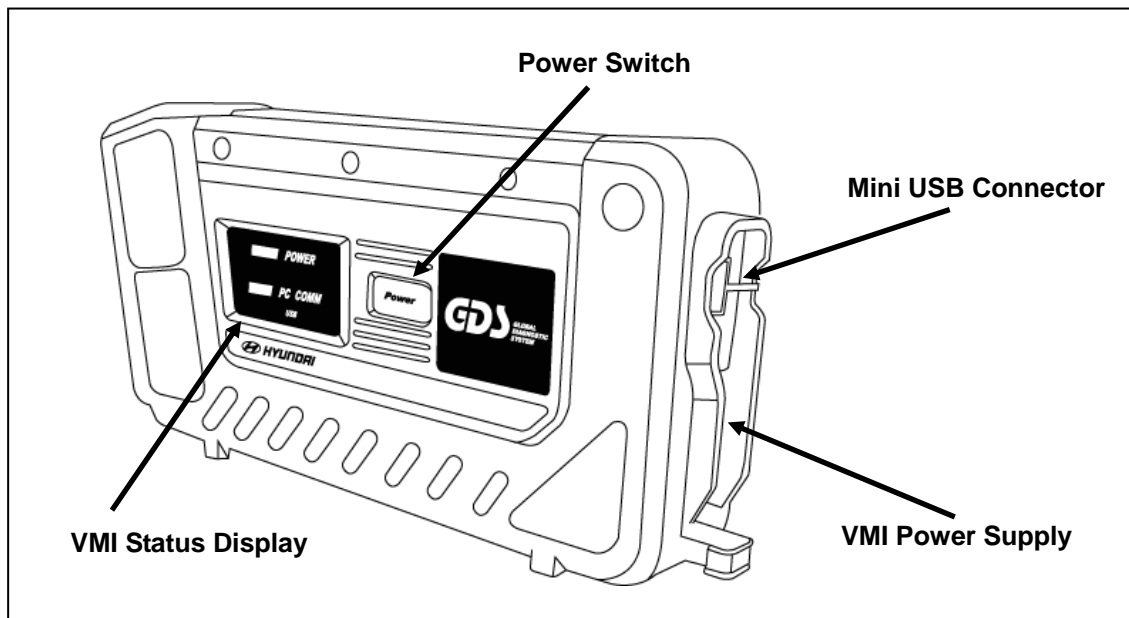


Figure 1. Component Identification (RIGHT)

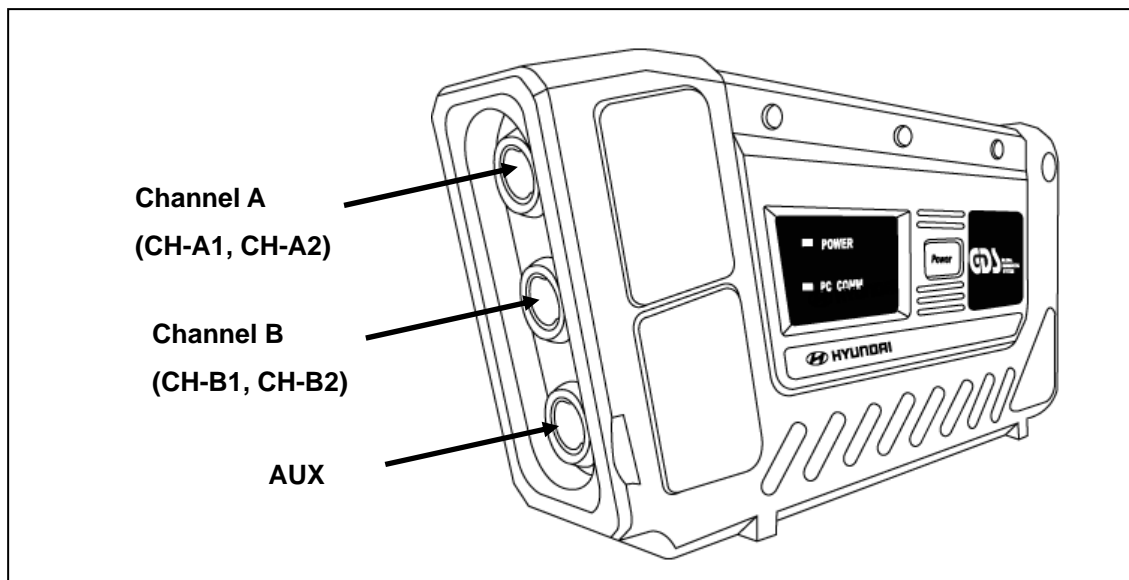


Figure 2. Component Identification (LEFT)



## Cable connection method and Applications



Hardware

Module: A-07-006 (p.01)



### CAUTION

- VMI uses only USB port as its medium and does not support W/LAN protocol.

#### Installation of Power Cable

To turn on the VMI module, first connect the power cable from the battery to the VMI and press the main power switch. VMI uses vehicle's battery for its power source.

Connect red and black cables to positive(+) and negative(-) terminals of the vehicle battery respectively.

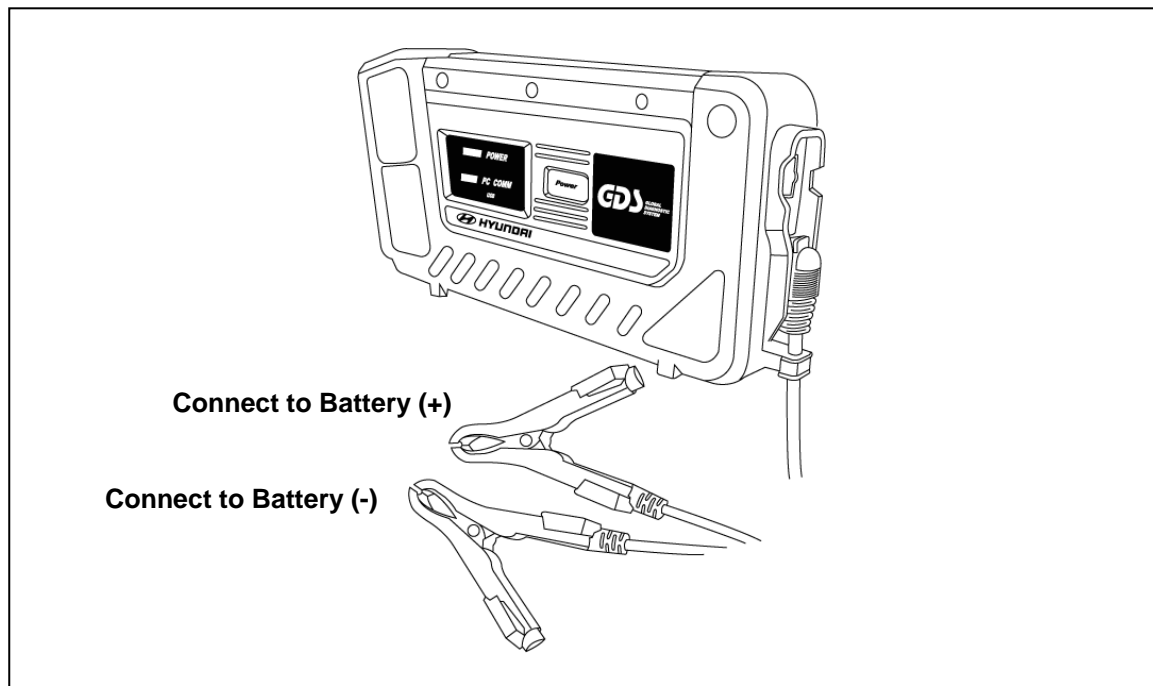


Figure 1. Connecting the Cable-VMI Power

The Rubber Shroud is designed to hold the fitted battery power extension cable, to minimize the interference with other cables. Battery clamps are insulated to prevent short between (+), (-) ends. Clamp handles are designed with probe inserting holes for the users convenience.

With the VMI connected to the battery properly, pressing the POWER button located in the middle of the VMI to turn on the VMI. To turn off the VMI press the POWER button for more than 3 seconds, the VMI power will be turned off.

### VMI Display Operation

The VMI equipment has an LED display for checking VMI operating conditions.

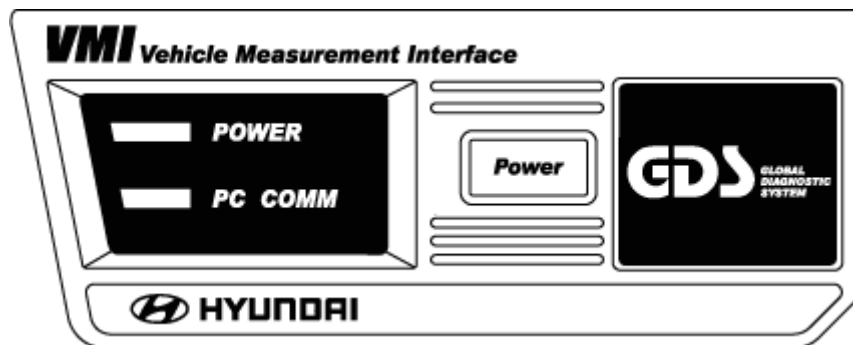


Figure 2. LED status on VMI Module

#### POWER

LED is turned on RED when VMI is in normal operating mode.

#### PC COMM

Connecting condition between PC and VMI is confirmed based on LED blinking.

During VMI firmware update, Power and PC COMM LED is turned on ORANGE.



## WARNING

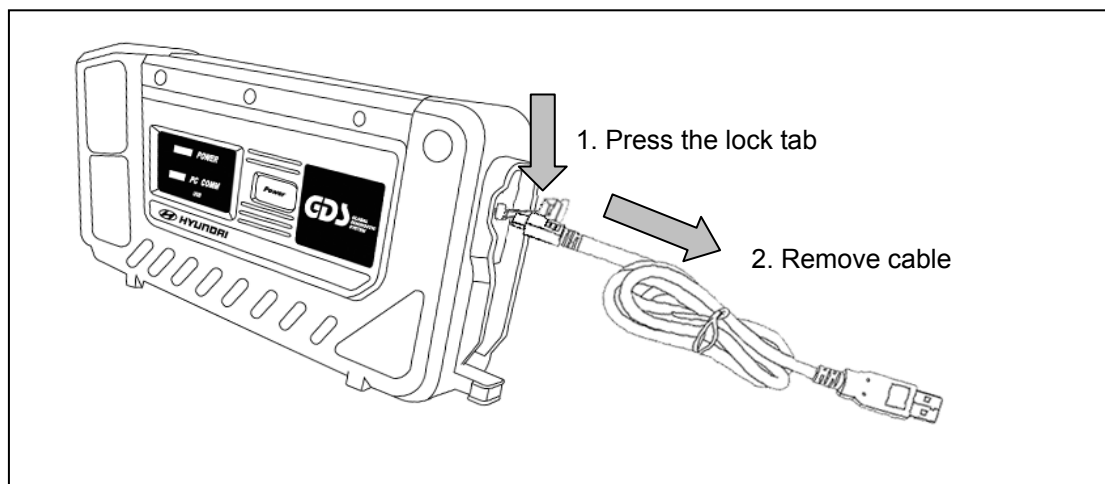
- Using other cables or adapter rather than provided cable-VMI power and adapter can cause fatal damage to the VMI.
- Do not reverse the polarity when connecting the VMI module to vehicle battery.

### Installation of Cable - mini USB

VMI must be connected with USB cable, and this means that it is not support wireless LAN between Information Terminal and VMI module.

While installing the USB cable to the VMI module, the USB cable must be tightly connected in order to avoid communication loss.

When removing the USB cable, press the connector lock tab first, and then disconnect the cable.



**Figure 3. Connecting the Cable-Mini USB to the VMI module**

There are no lock tabs at the Information Terminal side connector on the USB cable, therefore use caution when checking the connecting condition between the USB cable and Information Terminal.



## Installation of Scope Cables

VMI can be fitted with CH-A, CH-B and AUX scope cables and their applications are as below.

CH-A : Supports 2 Channel with CH-A and 4 Channel with CH-A1 and CH-A2 in Oscilloscope Function. And also supports (+) and (-) in Duty Output function during the Simulation Test.

CH-B : Supports 2 Channel with CH-B and 4 Channel with CH-B1, CH-B2 in Oscilloscope Function. And also supports DVOM function and Voltage/Frequency output during the Simulation Test.

AUX : Used for connecting cables for exclusive channel.

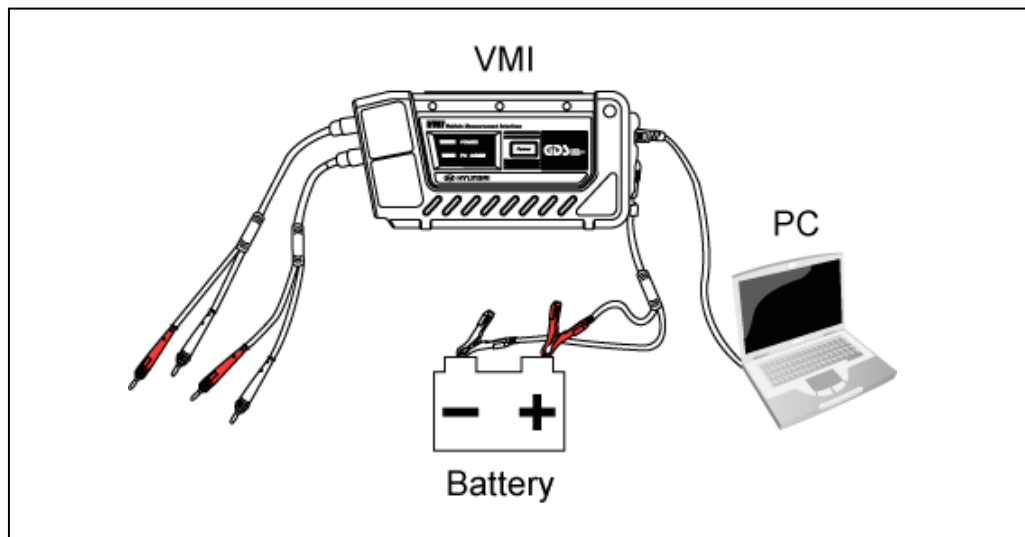


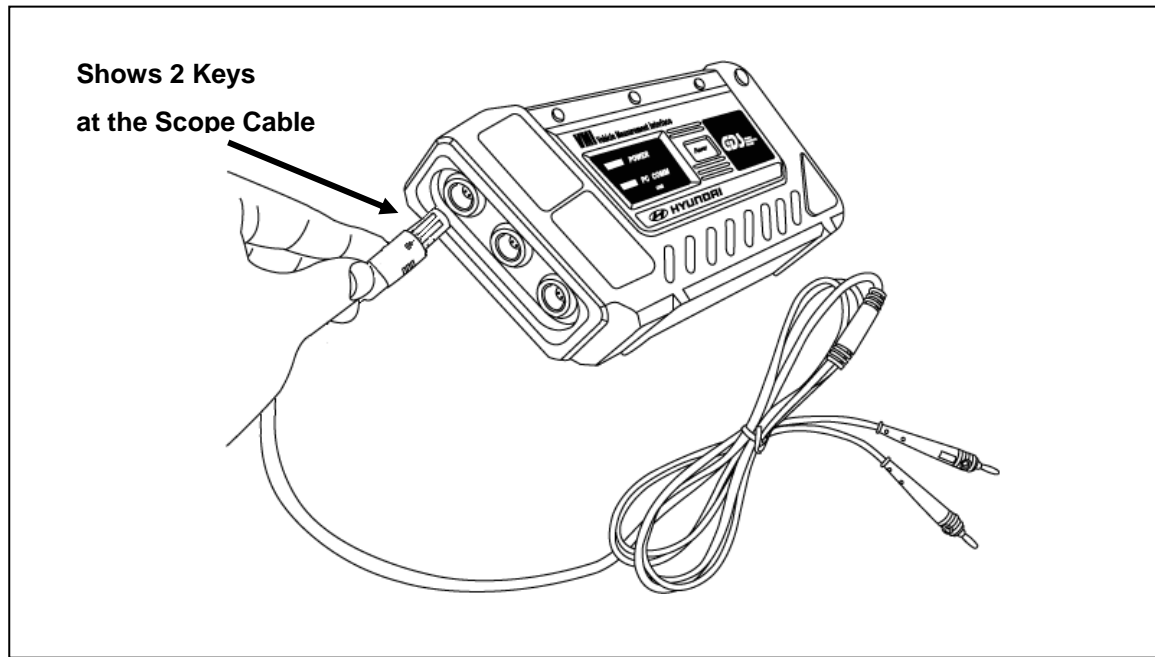
Figure 4. Connecting the Cables



## WARNING

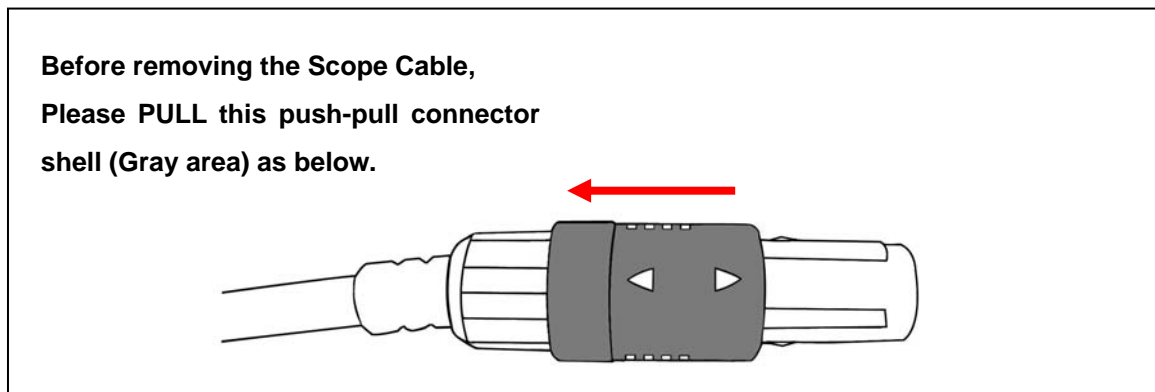
- Use only provided scope cable, scope pin, scope clip and spring pin to take measurements, and they must to be installed in appropriate place.
- Do not use any accessories except ones that are provided from GIT and all products must be used in allowed area. If it is not, VMI can be damaged seriously.
- Do not use adapters other than provided DC adapter from GIT.

The Scope Cables (2 keys) & the AUX Probe (1 key) are keyed differently to prevent them from being inserted in the wrong position on the VMI module and scope cable for the users. Refer to [Figure 4].



**Figure 5. 2 Key Structure and Application**

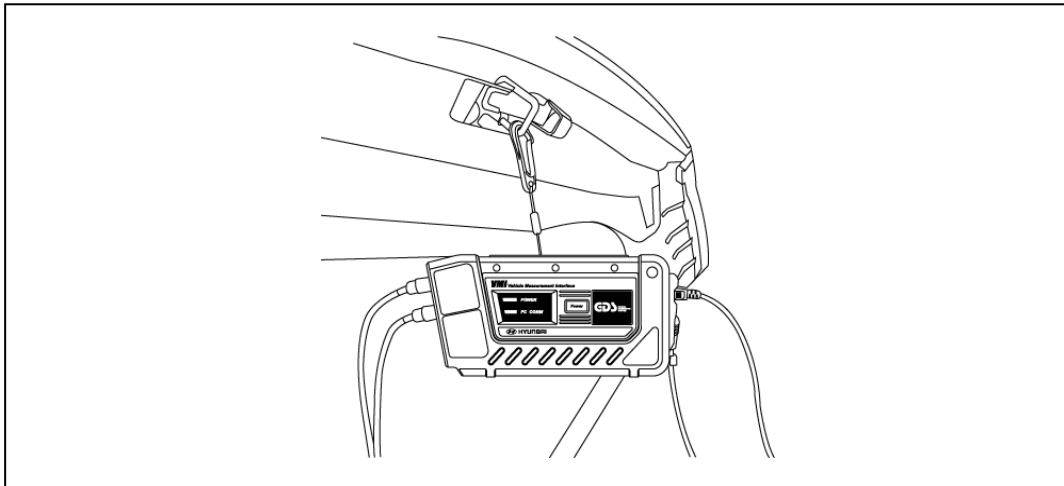
When unplugging the scope cables, be sure to unlock the push-pull connector shell(Refer to [figure 6]) by sliding insert end before pulling the cable out.



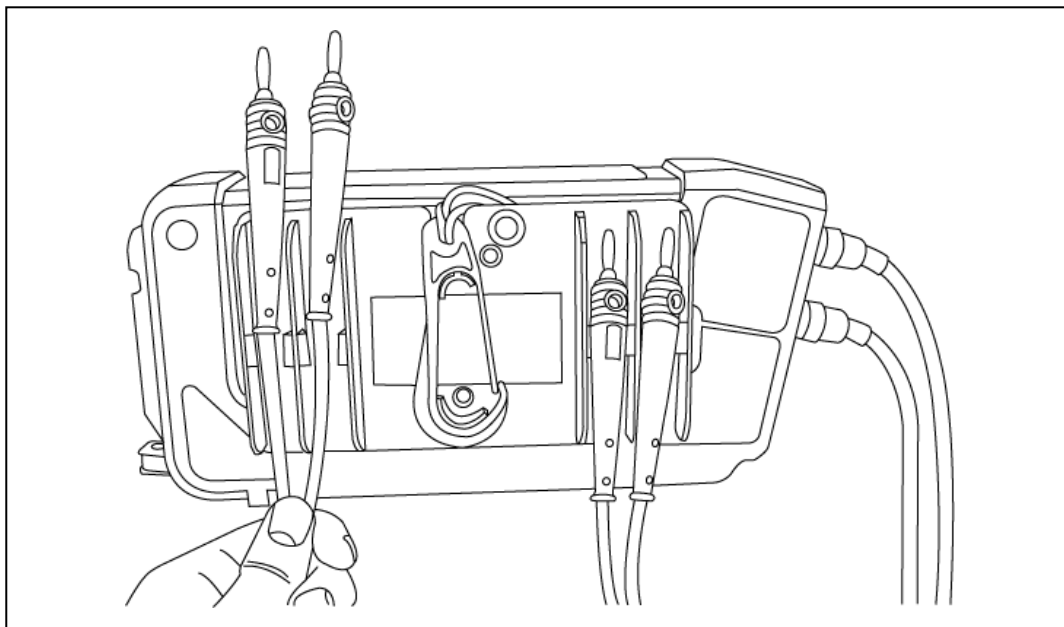
**Figure 6. Removing the Scope Cable**

### Probe Hanger and Hood Buckle Instruction

Probe hanger and hood buckle have been designed for the users convenience during usage of VMI in the workstation.



**Figure 7. Using Hood Buckle Instruction**



**Figure 8. Probe Hanger Instruction**



## WARNING

- Do not place or hang VMI module near incandescent light.
- Check the location of keys and insert when connecting scope cables.
- When removing the cable-mini USB, press the lock tab first at VMI module side and then pull the cable-mini USB connector.
- When removing scope cables, be sure to unlock the tab by sliding insert end before pulling the cable out. Refer to [Figure 5] at “Cable connection method and Applications”.
- When hooking up cables like USB, DC power supply and scope cables, be sure to secure the cables so that cables do not interfere with other actuators (cooling fan, fan belt, etc).



## VMI Firmware Update



Module: A-07-007 (p.01)

### Check Version and VMI Firmware Update

VMI Firmware version can be reviewed at Configuration of GDS and uses same update method as VCI.

### VMI Firmware

“VMI Firmware” item represents the version of the “Firmware” in the VMI module.

### VMI Update

It is a function for downloading the latest VMI Module “Firmware”. It establishes settings for the communication between the PC and VMI through a USB cable, and downloads the latest “Firmware” from the PC to the VMI module when the user presses the “Firmware Update” button.

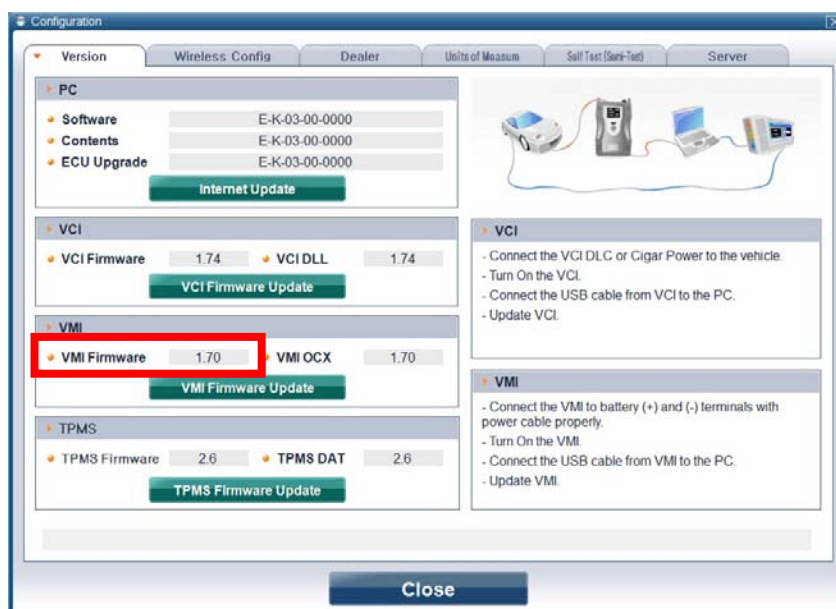


Figure 1. Configuration – VMI Firmware Update

Only Channel B is used when the DVOM Mode is selected. Measurements of Voltages, Resistance, Frequency, DUTY(+), DUTY(-), Pulse(+) and Pulse(-) can be configured to display current data with MAX(maximum), AVG(average) and MIN(minimum) at the same time.

BLACK probe applies to Minus (-) probe and RED probe applies to Plus (+) probe. DVOM display range is set to Auto Range.

During vehicle communication, this pop-up window will enable MULTIMETER function. This window can be dragged and closed.

This function cannot be used during Oscilloscope and Simulation tests.

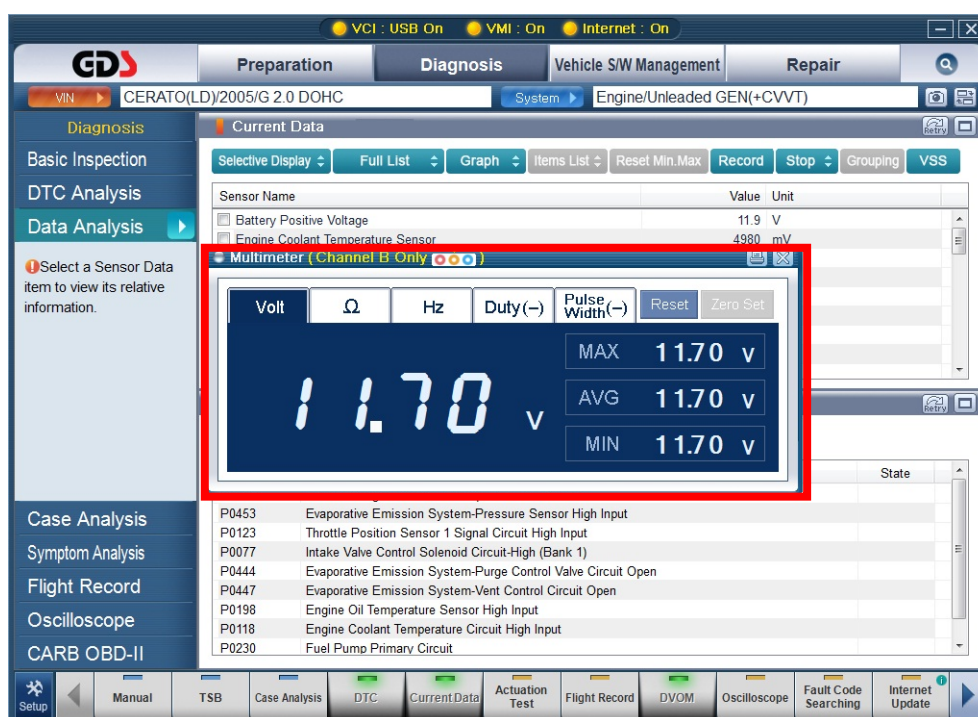


Figure 1. Pop-up Screen of DVOM Function



## Voltage

Voltage measurements can be made using CH-B and output is shown in (MAX)/(MIN)/(AVG). Use Minus (–) probe and Plus (+) probe to find differential voltage between the two.

“Reset” will reset all voltage values (MAX)/(MIN) and (AVG) to Zero. Then display the new current data received by the VMI.

Zero Set is not supported in Voltmeter mode.



Figure 2. Measuring Voltage



## CAUTION

- MULTIMETER measures DC VOLTAGES ONLY.
- Only measure Resistance with the **Power OFF** to that circuit.

## Resistance

Resistance can be measured using CH-B. It displays in (MAX)/(MIN)/(AVG). This function can be used when measuring resistance between the two probes.

“Reset” will reset all values (MAX)/(MIN) and (AVG) to Zero. Then display the new current data received by the VMI.

“Zero Set” is used to calibrate the meter reading to a Zero (0) Ohm's before making a resistance measurement.

“OL” indicates, “Overload” and shows Out of Range status.



Figure 3. Measuring Resistance

To get an accurate measurement always zero the meter before making any measurements. Just press the Zero Set button while shorting the positive (+) and negative (-) probes together.

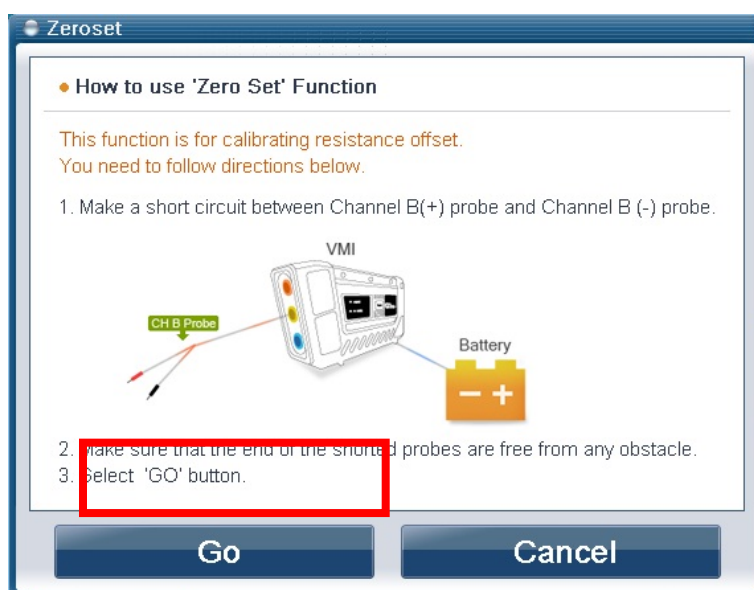
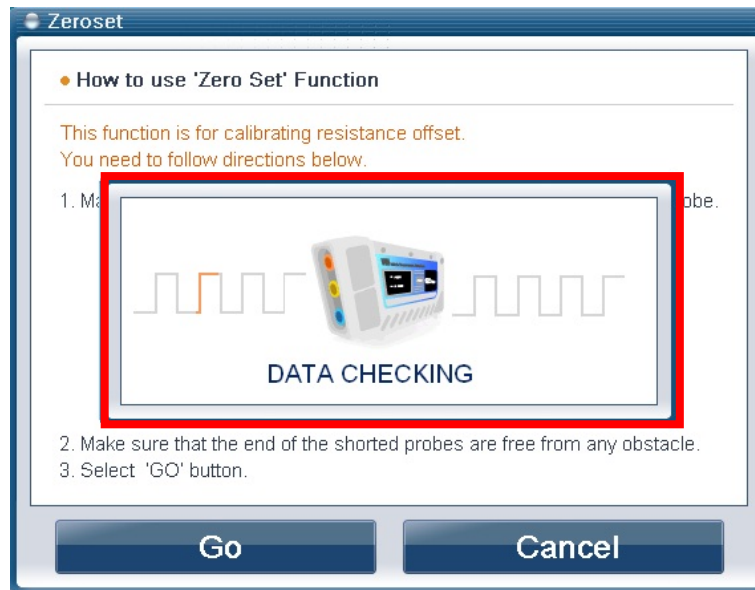


Figure 4. Zero Set Function



**Figure 5. Zero Set Function**

When zero set has succeeded, following pop-up will show. Press OK and continue measuring resistance.

**Figure 6. Zero Set Succeed**

## CAUTION

- Resistance measurements are affected with temperature and scope cable connection, therefore user should always zero the meter first before measuring resistance.
- Internal VMI circuit can be damaged when inflow of more than 5V through scope cable is continued over 1HR in RESISTANCE MODE.

## Frequency

Frequency can also be measured using CH-B. Frequency is displayed as Hertz or the number of cycles that have occurred during a 1-second period of time. If the display shows 182.2Hz, this implies that 182.2 cycles have taken place during a 1-second period of time.

“Reset” will reset all values (MAX)/(MIN) and (AVG) to Zero. Then display the new current data received by the VMI.

Resets AVG (average) value back to the basis of current data by pressing the reset button.

Zero Set is not supported in the Frequency mode.

“OL” indicates, “Overload” and shows Out of Range status.



Figure 7. Measuring frequency

## Duty

Duty cycle can be measured with CH-B and this will display (+) Duty and (-) Duty as a percentage from 0% to 100%.

Click Duty once to activate and click Duty (-) again to change (-) negative values to (+) positive values.

“Reset” will reset all values (MAX)/(MIN) and (AVG) to Zero. Then display the new current data received by the VMI.

Zero Set is not supported in the Duty cycle mode.



Figure 8. Measuring (-) Duty



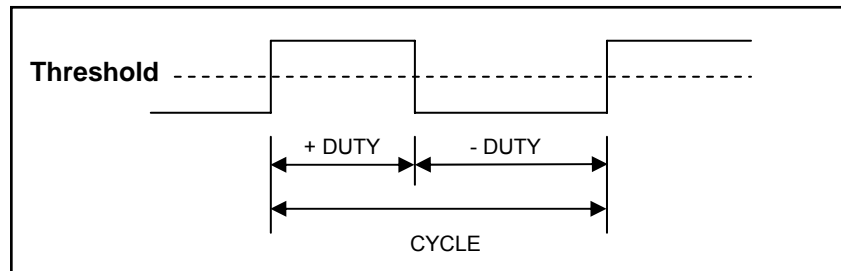
Figure 9. Measuring (+) Duty

**\* TIPS**

(+) DUTY : This implies the percentage rate of pulse ABOVE the basis of threshold voltage.

(-) DUTY : This implies the percentage rate of pulse BELOW the basis of threshold voltage.

This will display the on/off duty cycle time of the component being tested.



**Figure 10. (+) Duty and (-) Duty in 1 Cycle**

## Pulse Width

This function uses CH-B and measures PULSE WIDTH as a function of time in seconds.

Click Pulse Width once to activate and click Pulse (-) again to change (-) negative pulse width values to read (+) positive pulse width or (-) minus pulse width values.

"Reset" will reset all values (MAX)/(MIN) and (AVG) to Zero. Then display the new current data received by the VMI.

Zero Set is not supported in the Pulse Width mode.



Figure 11. Measuring (-) Pulse Width



Figure 12. Measuring (+) Pulse Width

**\* TIPS**

(+)Pulse Width : This implies the duration of pulse ABOVE the basis of threshold voltage.

(-)Pulse Width : This implies the duration of pulse BELOW the basis of threshold voltage.

This will display the on/off duty cycle time of the component being tested.

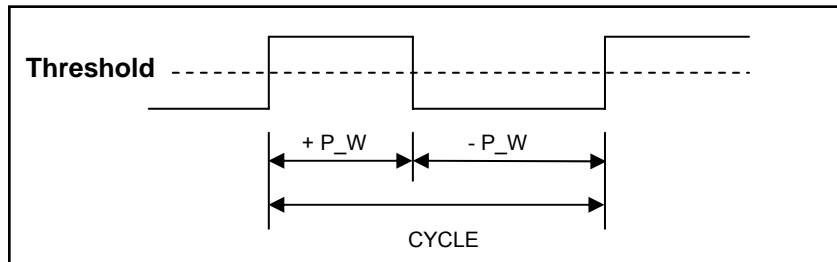


Figure 13. (+) Pulse Width and (-) Pulse Width in 1 Cycle

Oscilloscope uses 4 channels in total, and there is a 2CH mode and a 4CH mode. The available channels that can be shown on the screen are 1 to 5 channels including AUX channel.

The output data value of cursor a or cursor b, and (MAX)/(AVG)/(MIN)/(FREQUENCY)/(DUTY) value between cursor a and b, can be determined.

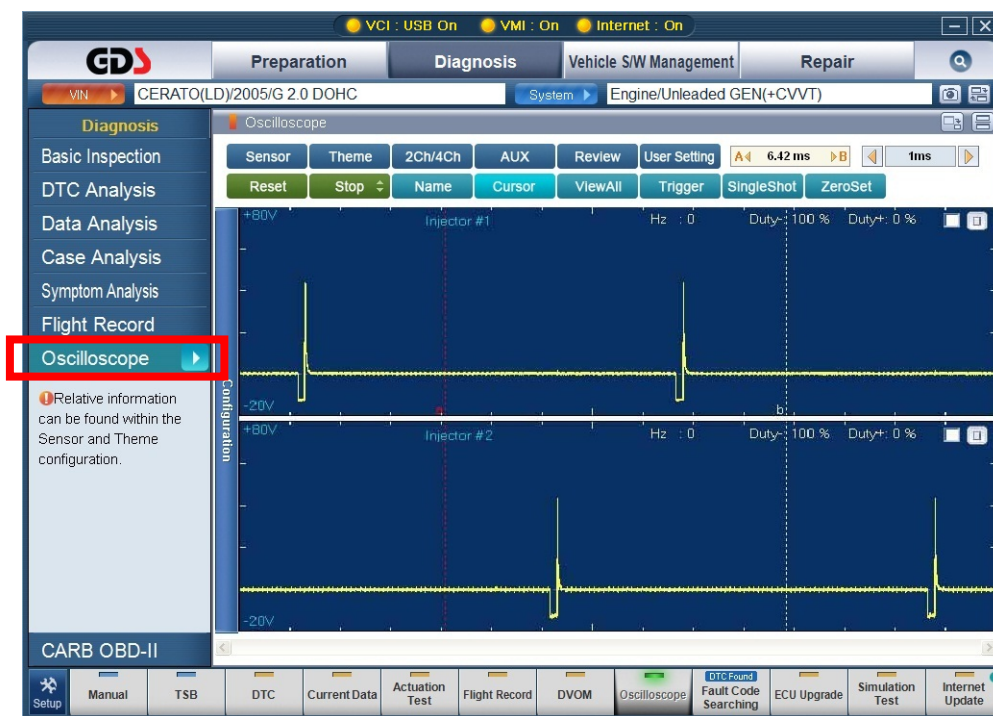

















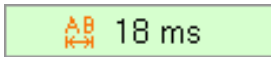
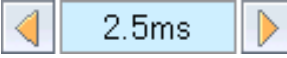
Figure 1. Oscilloscope Function

## Main Screen Menu

## Icon Description

Icon	Description
	Enters SENSOR mode
	Enters THEME mode
	Switch between 2CH mode and 4CH mode.
	Enter to AUX mode
	Shows data review.
	Resets measured data to appropriate setting.
	Buttons control "STOP" or "RUN" (resume) of current waveform.
	Renaming selected channels
	This button activates between two cursors. Every time the button is clicked, cursor A is set to cursor B or, cursor B is set to cursor A.
	Shows piled up waveforms.
	Trigger button which controls "Trig UP" ↔ "Trig DOWN" ↔ "NO TRIG".
	Switch button for single shot mode. Single shot button which controls "Trig UP" ↔ "Trig DOWN" ↔ "NO TRIG".



Icon	Description
	Enters zero set at the AUX function. This icon will be enabled when using AUX.
	Move to data saving. This icon will be shown when current waveforms are stopped.
	Used to move graph to the left or to the right. This is only applicable when the display is in paused mode and review mode.
	Show duration between the two cursors.
	Buttons change the graph time resolution

## Sensor

Sensor function shows the waveform in its most optimized form that the user intends to measure. This function prompts a new setting window that the user can select various options, which help properly display the setting for waveform analysis.

It supports Engine and Transmission.

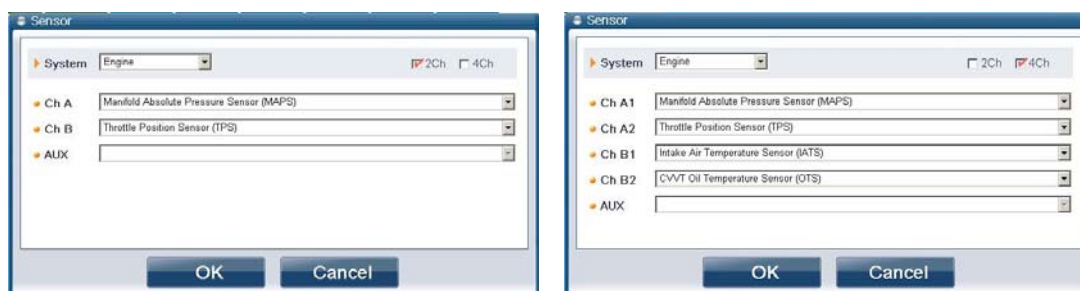
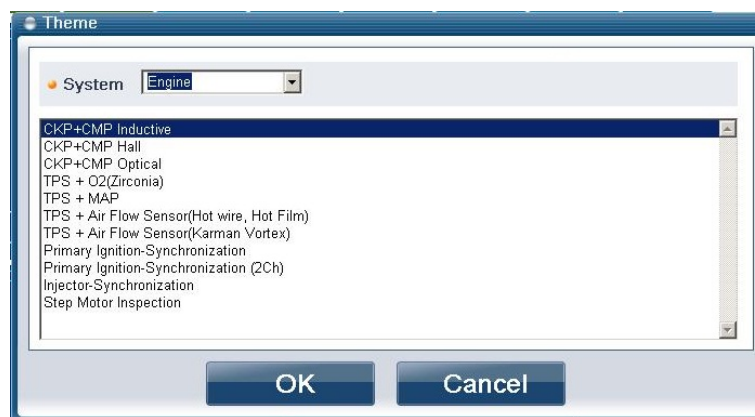


Figure 2. Sensor mode setting

## Theme

When analyzing more than two waveforms at the same time, this option allows the user to see the most optimized output which the user will be able to analyze more easily.



**Figure 3. Theme mode setting**

## Explanation of Check box Function

When using SENSOR and THEME mode, users can select the check box to display the selected information on Component Location, General Description, Waveform, Component Inspection, Component Circuit and Full Circuit

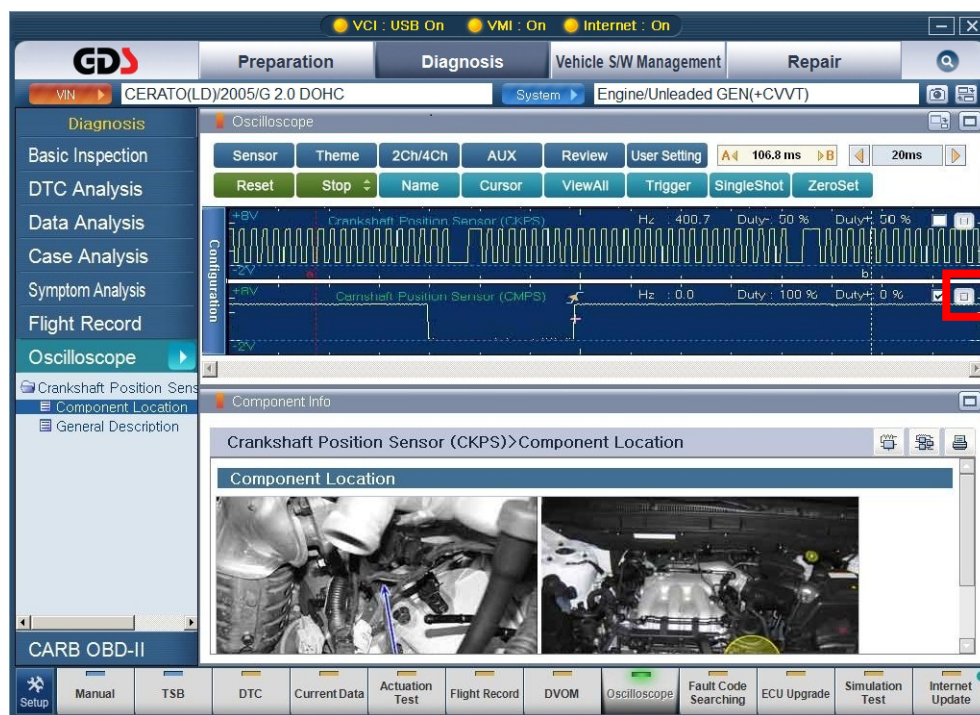


Figure 4. Choose the Waveform in Sensor or Theme

**2CH/4CH**

Channels available for measuring waveforms are 4channels (CH-A1, CH-A2, CH-B1, CH-B2), plus the SENSOR channel, for total of 5channels.

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. (Differential Mode)

In 4CH mode, each one of CH-A1, CH-A2, CH-B1, CH-B2 probes become available channels. Therefore, a total of 4 channels becomes available (Single Ended Mode), and in this case the ground will be the battery (-) terminal of the vehicle.

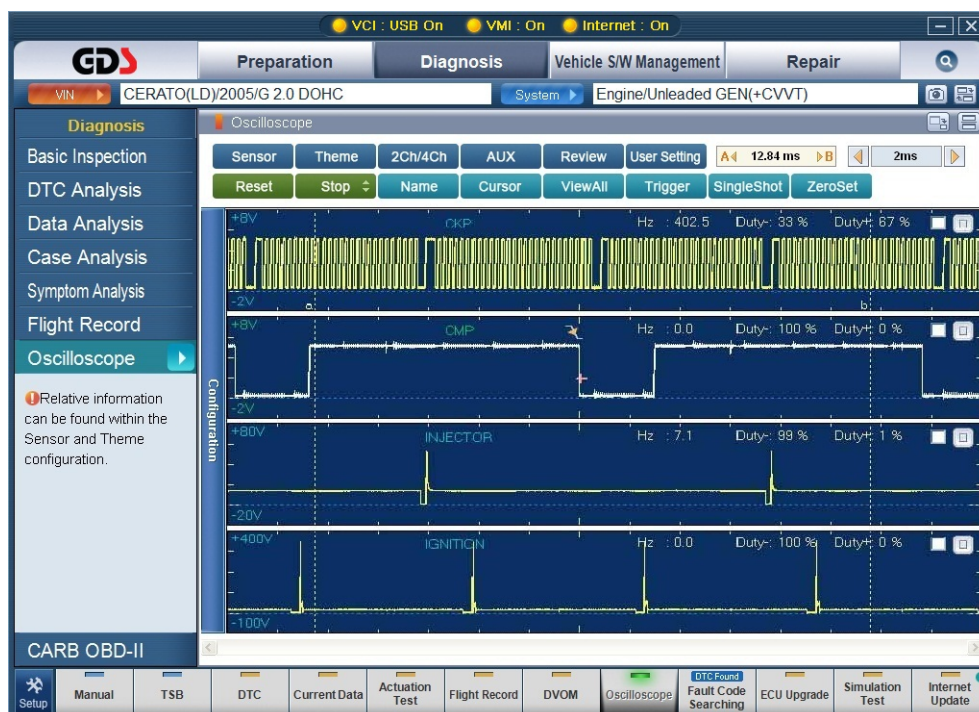


Figure 5. Display 4 Channel Mode

**\* TIPS**

2CH Differential Mode measures differences between (-) probe and (+) probe, and 4CH Single Ended Mode measures voltages using each 4 positive probes. The VMI module becomes the Ground. Refer to [Figure 6].

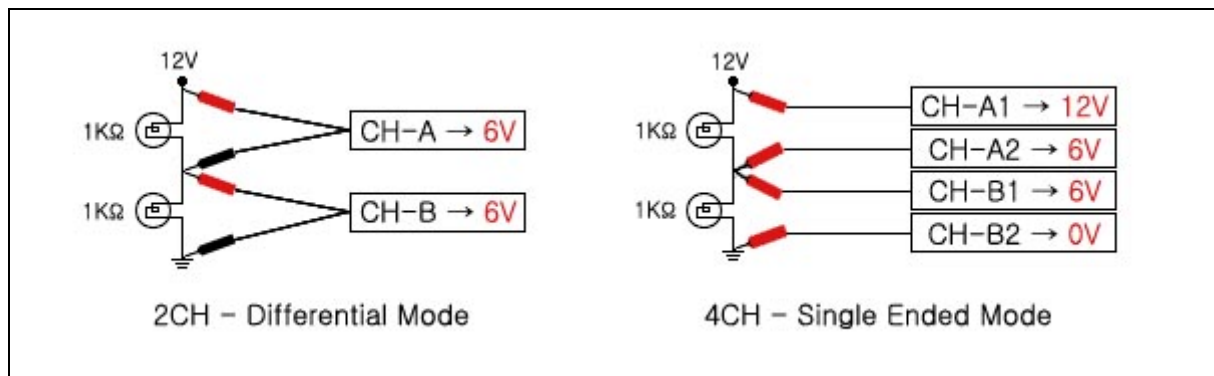


Figure 6. 2CH Differential Mode and 4CH Single Ended Mode

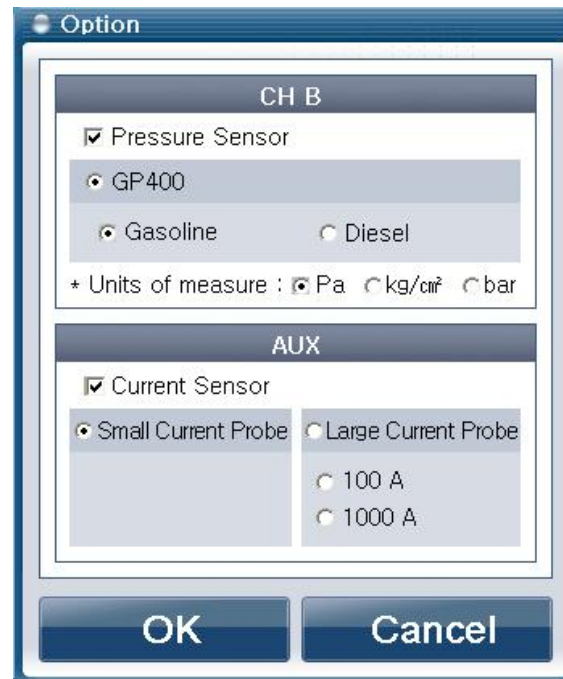


## CAUTION

- Probes that are not being occupied must be connected to Battery (-) Terminal in case of using 4CH mode to prevent unnecessary inflows.

**AUX**

This channel is for connecting exclusive channel probes for measuring current, engine vacuum.



**Figure 7. AUX setting display**

## Pressure sensor

Pressures in engine cylinders can be measured by connecting Pressure sensor (GP400) CHB socket of VMI module.

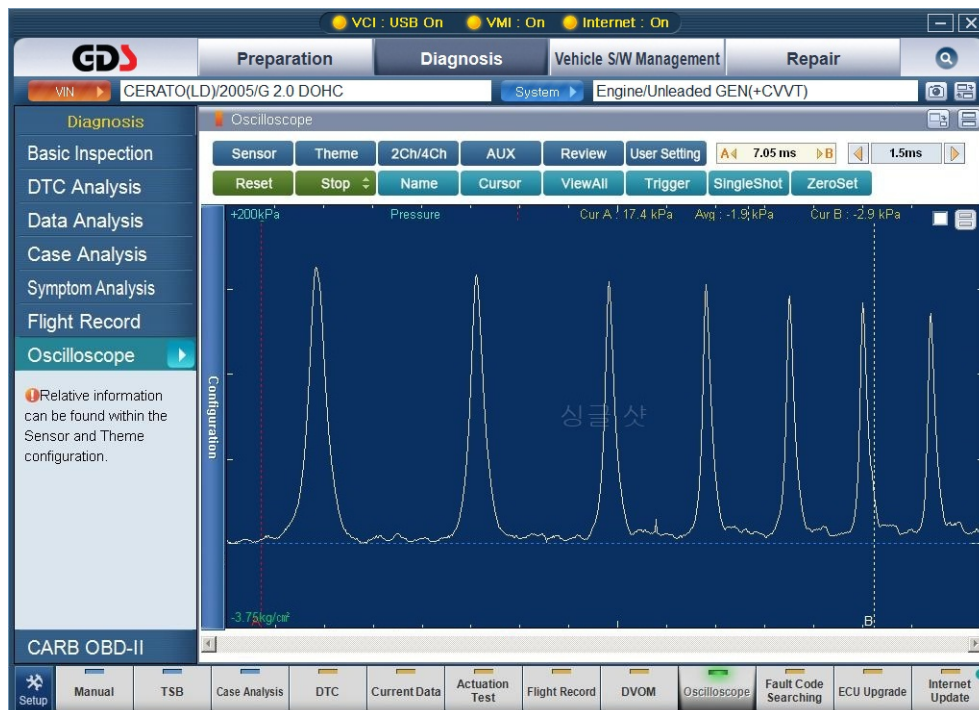


Figure 8. Pressure measure display



## Small Current Sensor

Small current in injectors can be measured by connecting “Small Current Probe” into AUX socket of VMI module.

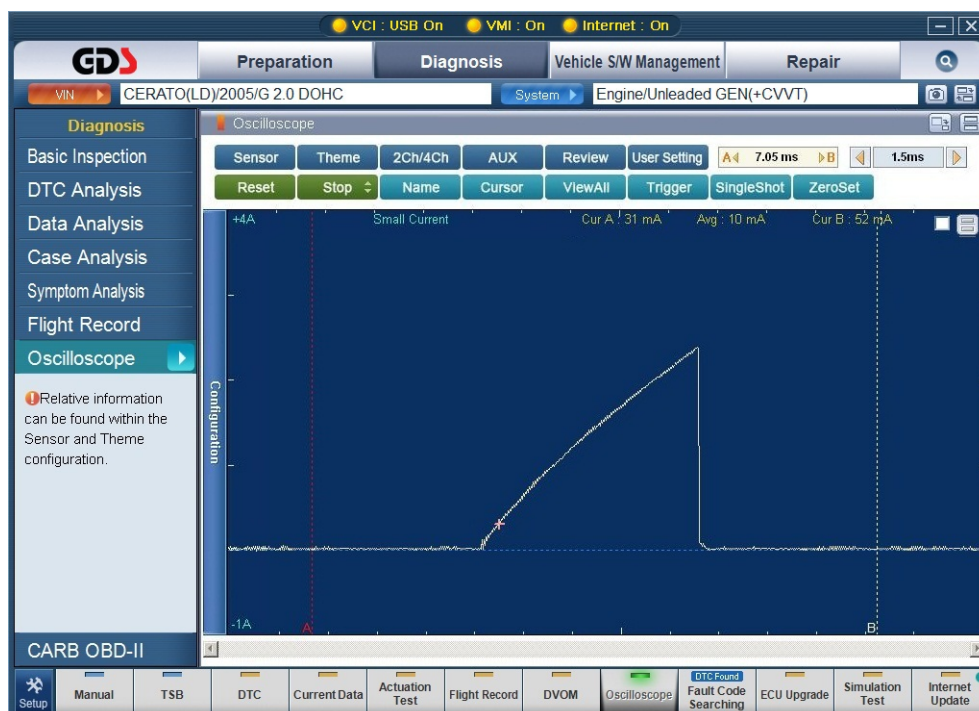


Figure 9. small current measure display



## Large Current Sensor

Large currents, usually over 30A (amperes generated in the battery CCA during cranking the engine, or amperes generated by generator) can be measured by connecting “Large Current Probe” into AUX socket of VMI. Amperes upto 100A and 1000A can be measured.

Switch to 100A or 1000A depending on the measured ranges.

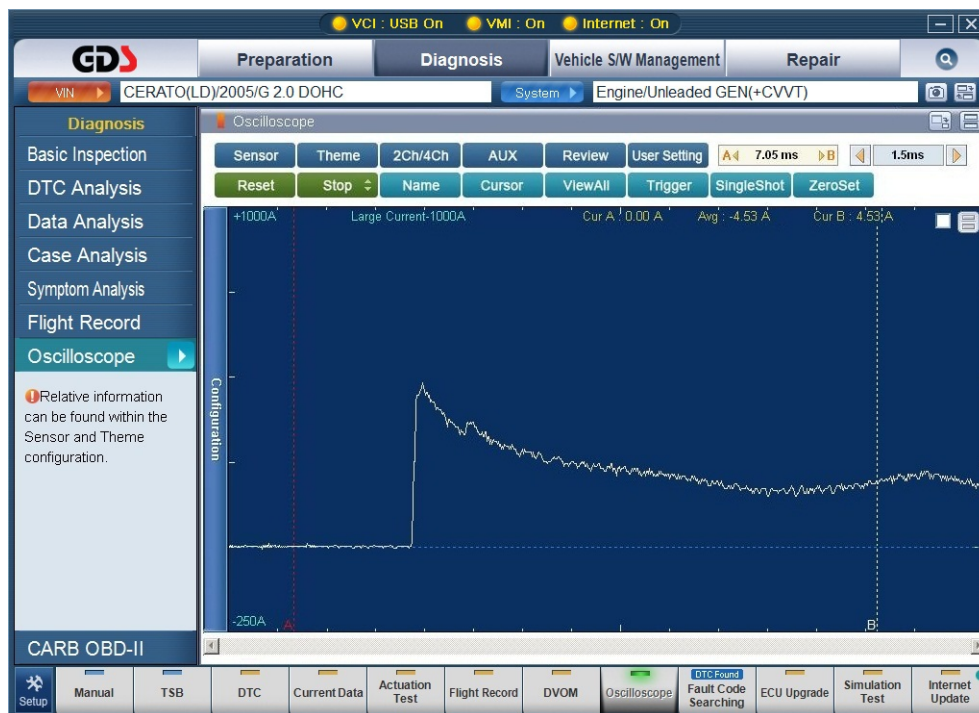


Figure 10. large current measure display

## Review

This function retrieves the saved data for review.

## Reset

This function optimizes the output waveform display in Time (x axis) and Voltage (y axis). After reset, Trigger and Single shot will be cancelled automatically.

## Start/Stop

Users can stop and analyze waveform data at the users discretion.

## Name

Users can customize a name selected waveform data to preferred name subdividing waveforms so that users know exactly what they have recorded.



Figure 11. Renaming each channel

## Cursor

Cursor a and b can be selected by clicking two cursor button. The selected cursor is highlighted with red dotted lines and cursor is moveable. The left out cursor is highlighted dimmer with dotted lines and cursor is fixed.

If the wavelength between the two cursors are less than a one cycle, the frequency and the duty (-) will not be displayed.

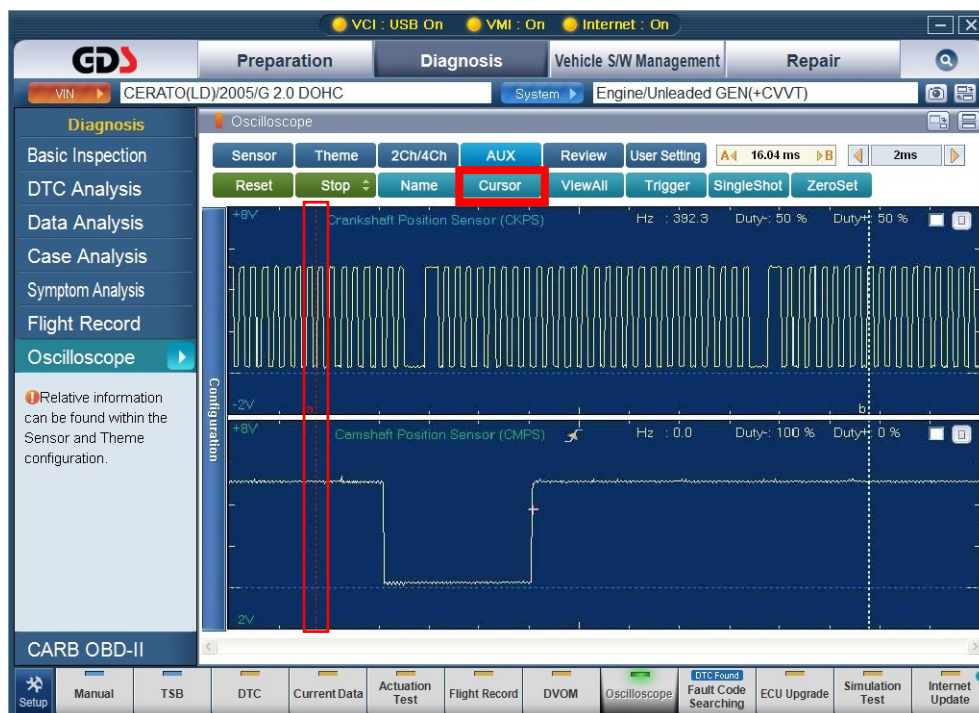


Figure 12. Activates Cursor A

## View All

While retrieving saved data or measuring, this overlaps all waveforms in one screen so that the user can easily examine the waveform data.

Color of each waveform and their names are shown in different colors so that users can distinguish the differences.

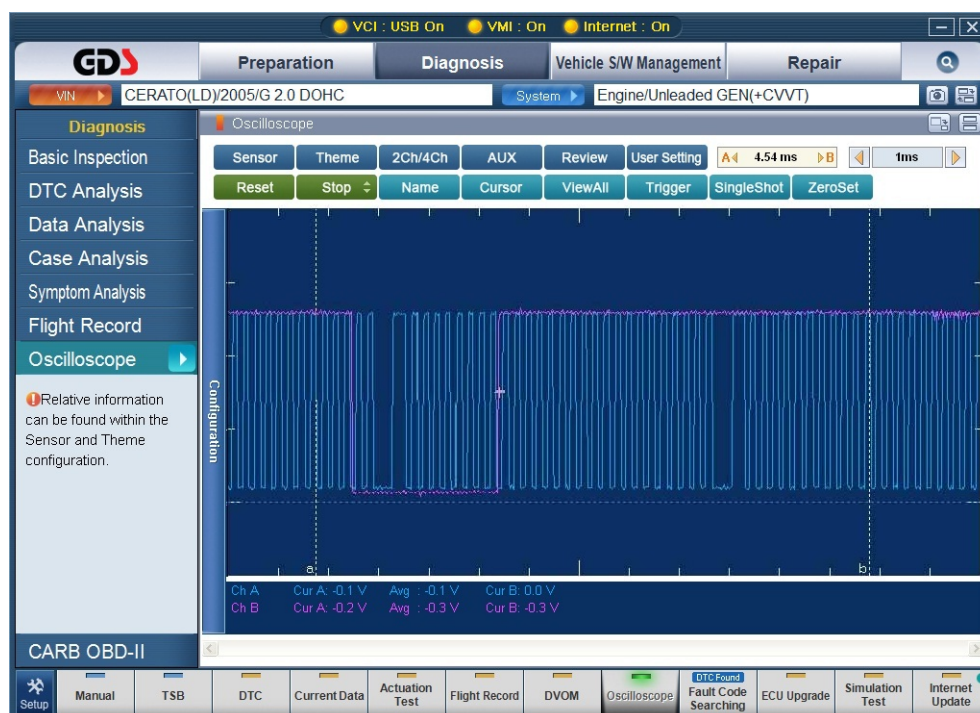


Figure 13. View All Main Screen

## Trigger

Trigger will show the running waveform signal at the one position it can be done by clicking (by mouse or stylus pen) at a cursor area that the user prefers to analyze.

It is possible to set the trigger function to trigger waveforms that are rising or descending. Click TRIGGER icon to enter trigger mode and confirm the trigger point by placing mouse cursor on waveform that user wants to trigger on.

When you select the trigger function, you will automatically trigger on the positive going waveforms or the (rise). Touching the trigger a second time, you get a trigger point on the descending or fall of the waveform. Touch the trigger point a third time turns the trigger function off.

If users fail to trig, "No Trig" sign will show.

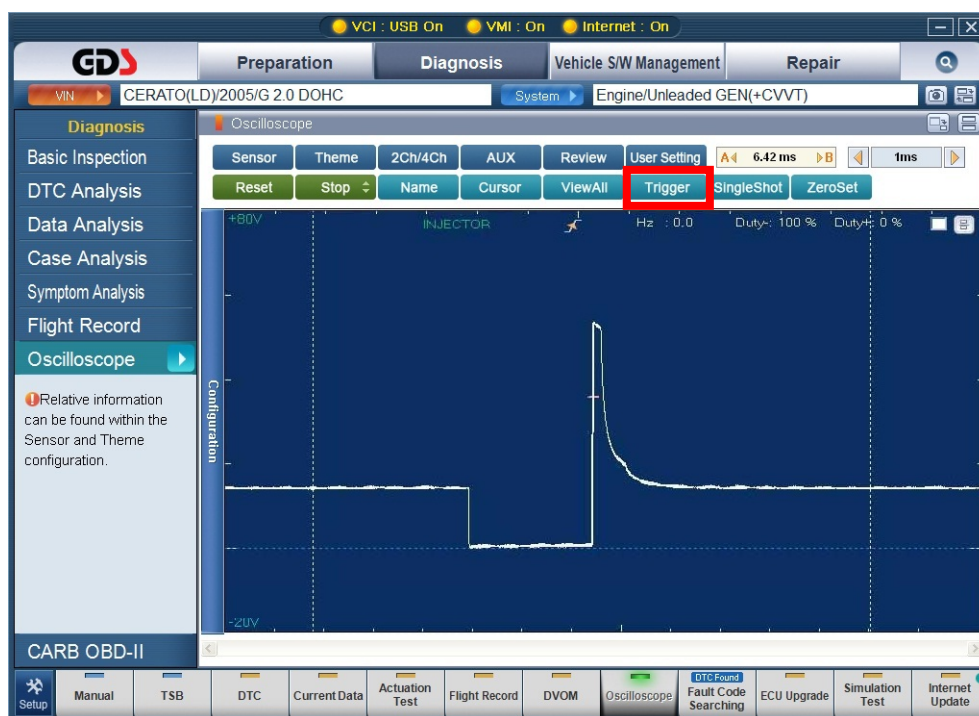


Figure 14. Trigger Mode

## Single Shot

Single Shot mode stops and displays a waveform signal automatically if the signal level matches the level that the user selected automatically.

To be able to see periodic waveforms like TPS or MAP, use Single Shot mode. This helps users to see the changing point of waveforms more easily.

After clicking Single Shot Icon, Single Shot Start button will blink if the movable cross cursor is placed on the waveform, then press Single Shot Start button to start data check. [Figure. 11]

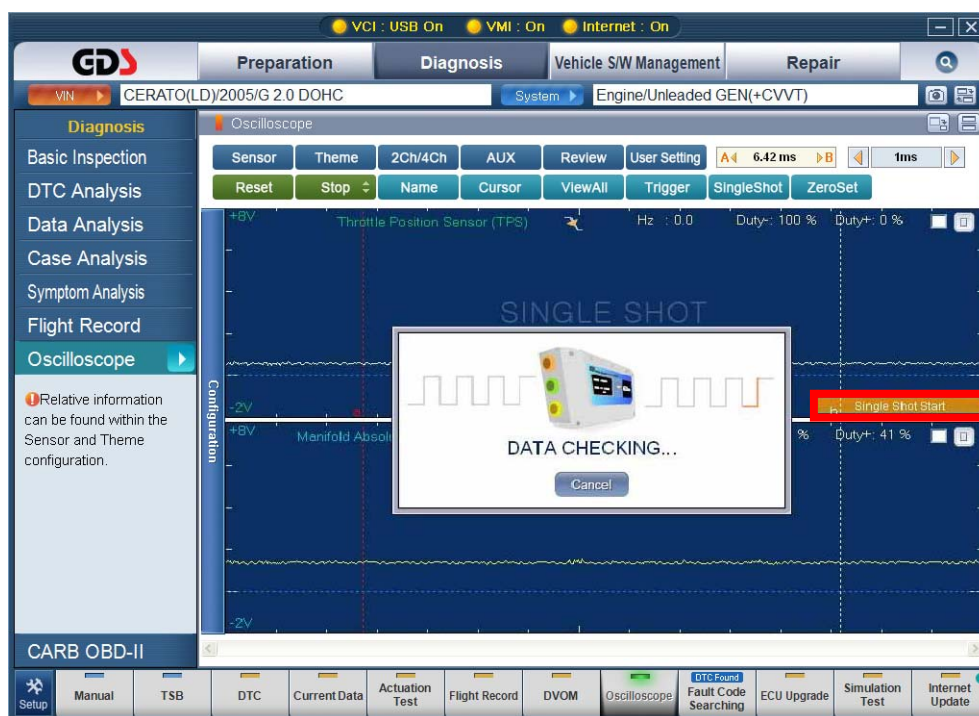


Figure 15. Now Data Checking



When DATA CHECKING is finished, triggered waveform will appear on the oscilloscope screen in freeze mode. [Figure12]



Figure 16. Single Shot Display

## Zero Set

This function sets the data back to initial setting while using AUX channel.

## Two cursor Duration

Shows the time duration between the two cursors.

## Duration adjustment

Showing time selects and sets the time unit per one grid (DIVISION).

## Configuration Screen Menu

Users can change the setting for each channel (VOLTAGE RANGE, UNI/BI, PEAK/NORMAL, DC/AC, AUTO/MANUAL) by clicking "Configuration" from the main screen of Oscilloscope. Refer to [Figure 13].

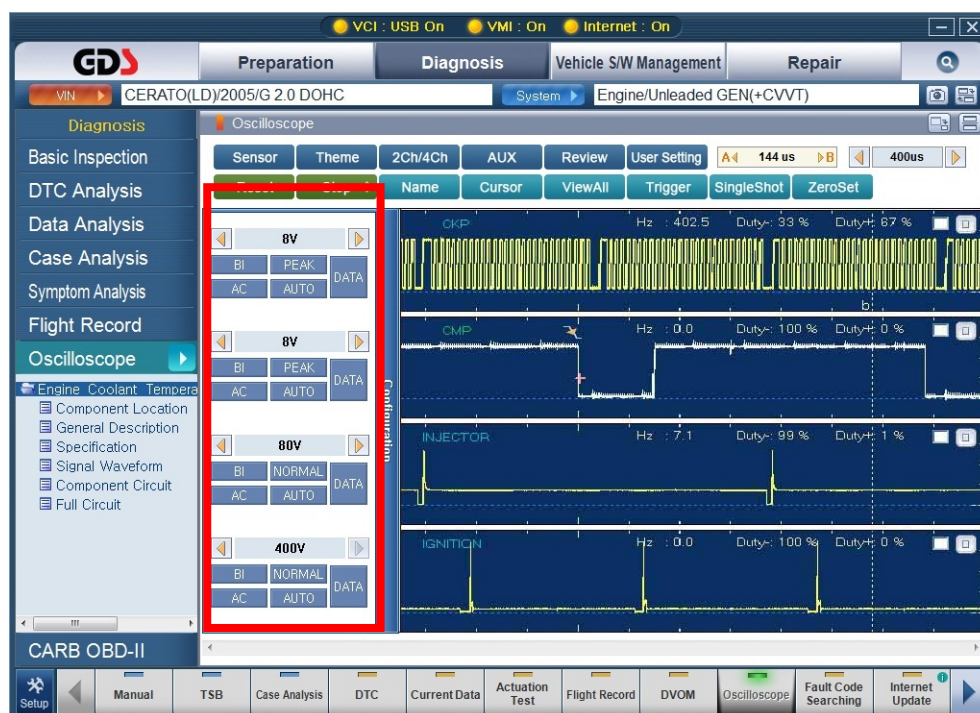
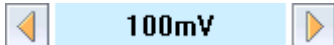







Figure 17. Activating the Configuration window



## Icon Description

Icon	Description
	Adjusting channel voltage for each waveform.
	Switches between "Bipolar" mode and "Unipolar" mode.
	Switches between "PEAK" mode and "NORM" mode.
	Switches between "Alternate current" ↔ "Direct current".
	Adjusts the Voltage (y axis) into optimized setting.
	Shows MAX / MIN / AVG or Hz / Duty(-) / Duty (+) or Cursor a / Cursor b / AVG from outputted waveforms.

### **Adjusting Channel Voltage**

Using the arrow keys, users can change the Y axis (Voltage) and the total input voltage value.

### **UNI (Unipolar)**

Output only shows (+) area from the base of "0" level and is used to measure waveform of various sensors, actuator and electric sources.

### **BI (Bipolar)**

Screen output is showing (+), (-) area, on the basis of ground potential or 0V. This mode is used to measure signals off inductive form of CKP, ABS wheel speed sensor, Automatic TR pulse generator A, B and 2<sup>nd</sup> ignition coil.

### **PEAK**

It must be in PEAK mode to measure instant signals like surge voltage in devices like Injector, Ignition coil and various solenoid valve devices for better accuracy.

### **NORM(Normal)**

This mode is to show minimum data depending on the sampling speed (Time/Division). Because this mode does not sample like short period surging, it is convenient for measuring slow signal devices like O<sub>2</sub> sensor.

### **AC(Alternate Current)**

Because automotive alternators are alternating current and associated systems are direct current, it will show waveforms at the power source regulated down to "0" if direct current frequency is set to alternating current. Therefore it is rarely used except for measuring ripple voltage from the alternator diodes,

**DC(Direct Current)**

Most waveforms are measured in DC.

**Auto**

Displays outputted waveforms on screen at its optimized form.

**DATA**

By clicking the “DATA” button, it can display [MAX / MIN / AVG] or [Hz / Duty(-) /Duty (+)] or [Current A / Current B / AVG] of outputted waveforms.

**Full Screen Waveform Show Mode**

Displays the individually selected waveform on screen.

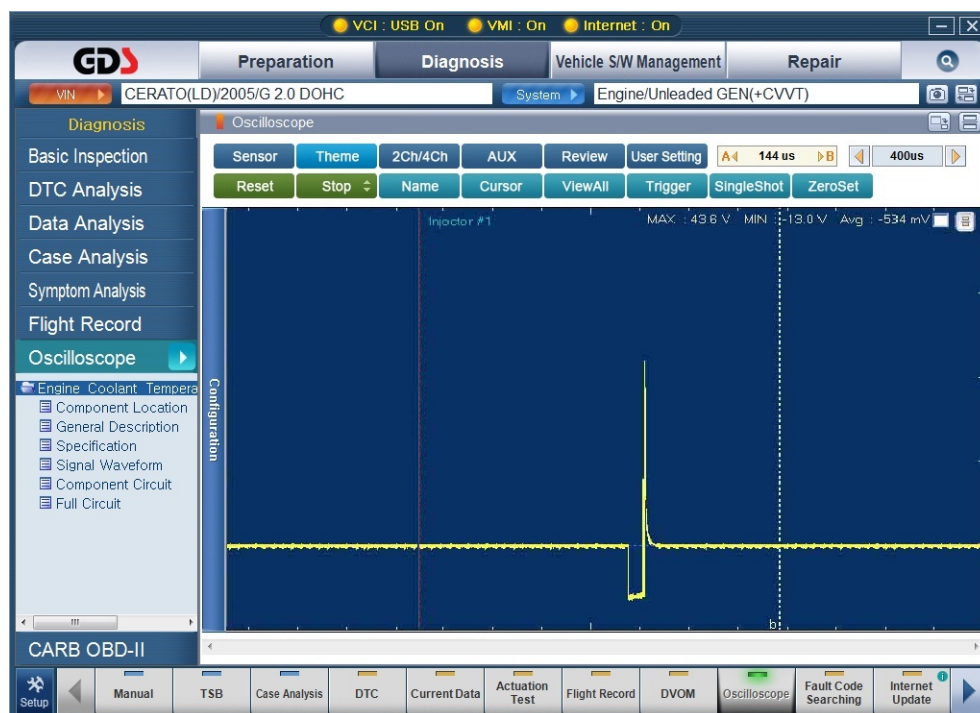


Figure 18. Full Screen Display



## Simulation Test



VMI

Module: A-07-010 (p.01)

Simulation is used for checking solenoid and sensor circuit operation by inputting the appropriate Voltage/Pulse in the ECM fields.

Voltage and Pulse output use CH-B, and Duty Output uses CH-A only.

If the Simulation test fails, the output “OL(over load)” will be indicated.



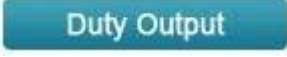


Voltage, Pulse or Duty will be inputted automatically to circuit by clicking the arrow keys.



Figure 1. Simulation Test

## Main Screen Menu

## Icon Description

Icon	Description
	Inputting the Voltage that is set by user in the ECM fields.
	Inputting the Pulse that is set by user in the ECM fields.
	Ground Control signal is outputted. Usually used to drive injectors or other solenoid actuations.
 	Used for starting or stopping selected Voltage/Pulse/Duty output from each modes.



## WARNING

- Excessive forced simulation test and actuation test can cause malfunctioning of the actuator.
- Forcing an injector over a certain period of time will generate a Wall film effect, which deteriorates operating of spark plug.
- Forcing a solenoid over a certain period of time will deteriorate the function of solenoid.
- Simulation and actuation test has to be completed in a short period to minimize the chances of actuators getting deteriorated.
- When driving a simulation test, if voltage within the circuit does not meet within the range (higher or less), then this feedback values (Voltages or OL) will be shown in RED text and simulation test will be self aborted.

## Voltage(V) Output

Voltage output uses CH-B only and it checks ECU by sending Voltages instead of a sensor. Using the arrow keys, the input voltage can be adjusted by 1V or 0.1V.







Figure 2. Voltage Output Main Screen



## CAUTION

- At a certain voltage output using the Voltage output mode, if input values are not changing, the values at sensor could be higher than selected input voltage or ECM has PULL-UP voltage value. Therefore it is not a system error.
- Do not apply probe (+) and probe (-) in reverse.
- During the Voltage or Pulse Output function, sensor connector has to be disconnected. If not the input signal (Voltage or Pulse Output) could be mixed with sensor signal.

## Icon Description

Icon	Description
	When setting output VOLTAGE, raise the value by 1V
	When setting output VOLTAGE, low the value by 1V
	When setting output VOLTAGE, raise the value by 0.1V
	When setting output VOLTAGE, low the value by 0.1V

During the Voltage Output function, VMI is using the circuit as below. Refer to [Figure 3].

When user starts to output the specific voltage(setting by user) with CH-B1, this output signal will be sent from CPU to D/A Converter as an analog signal. The D/A Converter will convert this analog signal to digital signal and send it to CH-B1 through the Output Circuit. In this moment, CH-B2 has to be connected to battery (-) terminal.

Voltage Output function has voltage feedback circuit also, and it uses checking voltage from actual sensor circuit that the user wants to test at the vehicle. Then if this feedback signal(Voltage) does not meet within specific value, then the feedback values(Voltage) will be shown in RED text at the setting window, and simulation test will be self aborted.

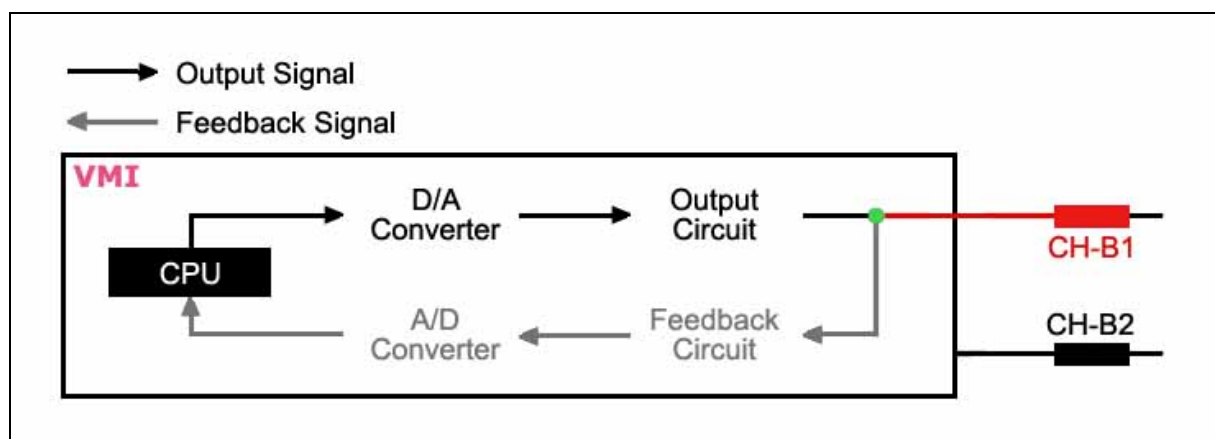


Figure 3. Voltage Output Block Diagram

Voltage Output uses CH-B only; the connecting methods are as below.

Disconnect sensor connector.

CH-B1 (+) : Connect to Sensor Control Circuit

CH-B2 (-) : Connect to Sensor Ground Circuit

Refer to [Figure 4].

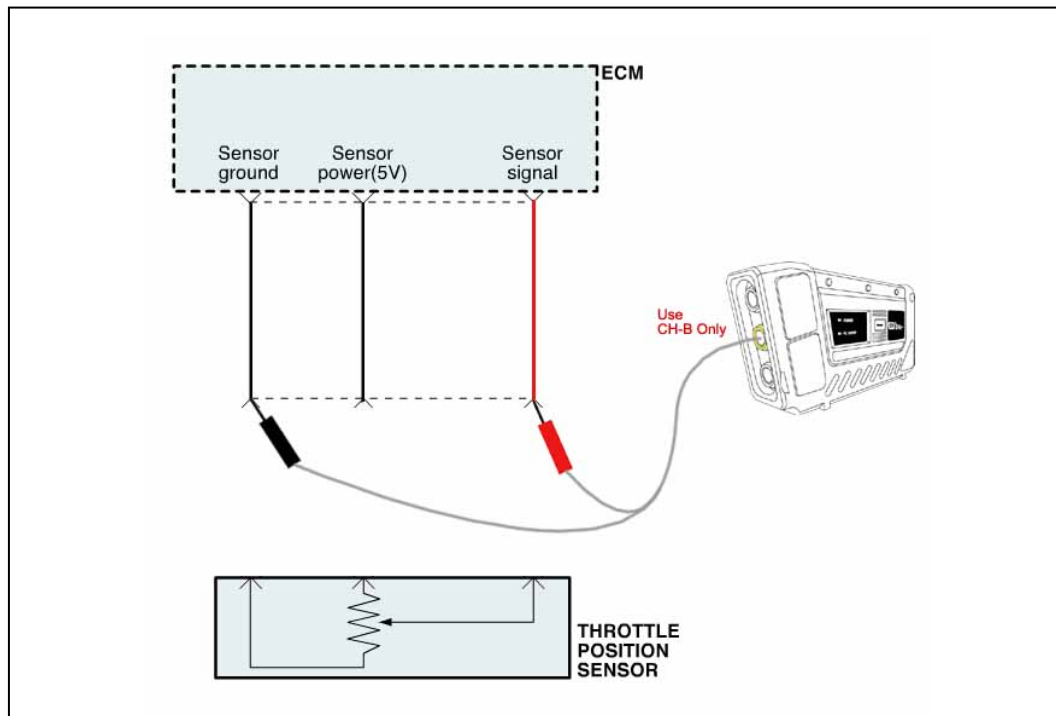


Figure 4. Probe Connecting Method for Simulation Test



## Pulse Output

A duty cycle signal (in Hertz) made by Pulse output function is sent to an ECU instead of the signal from a specific sensor.

Using the arrow keys, the input pulse can be adjusted by 1Hz or 10Hz.

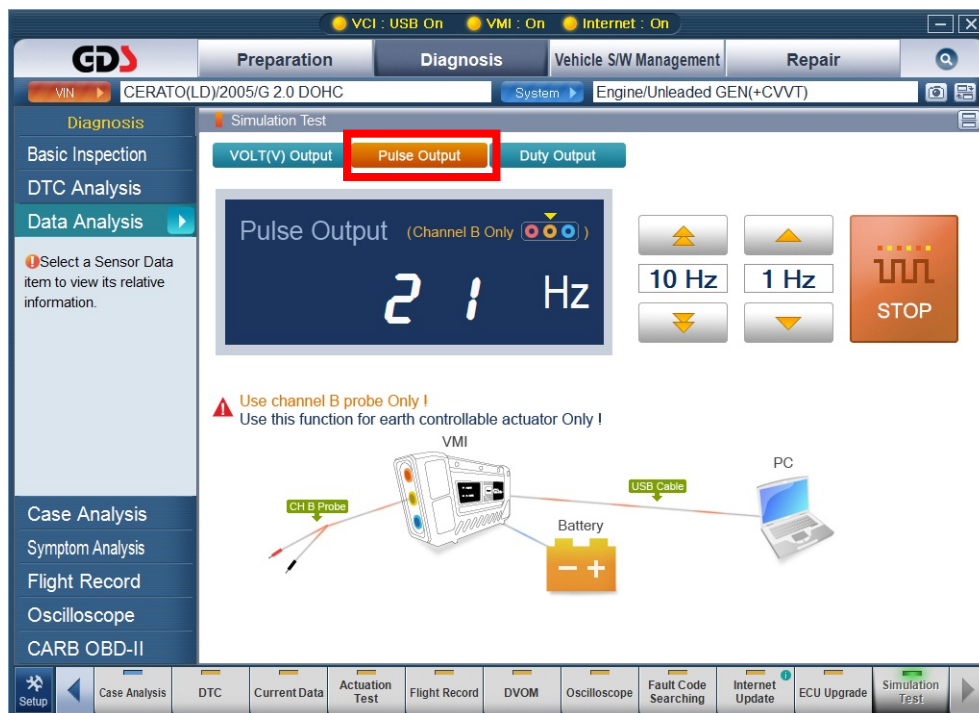






Figure 5. Pulse Output Main Screen

## Icon Description

Icon	Description
	When setting output FREQUENCY, raise the value by 10Hz.
	When setting output FREQUENCY, low the value by 10Hz.
	When setting output FREQUENCY, raise the value by 1Hz.
	When setting output FREQUENCY, low the value by 1Hz.

During the Pulse Output function, VMI is using the circuit as below. Refer to [Figure 6].

When user starts to output the specific pulse signal(setting by user) with CH-B1, this output signal will be sent from CPU to D/A Converter as an analog signal. The D/A Converter will convert this analog signal to digital signal and send it to CH-B1 through the Output Circuit. In this moment, CH-B2 has to be connected to battery (-) terminal.

Pulse Output function has voltage feedback circuit also, and it uses checking voltage from actual sensor circuit that the user wants to test at the vehicle. Then if this feedback signal(Voltage) does not meet within specific value, then the feedback value(OL) will be shown in RED text at the setting window, and simulation test will be self aborted.

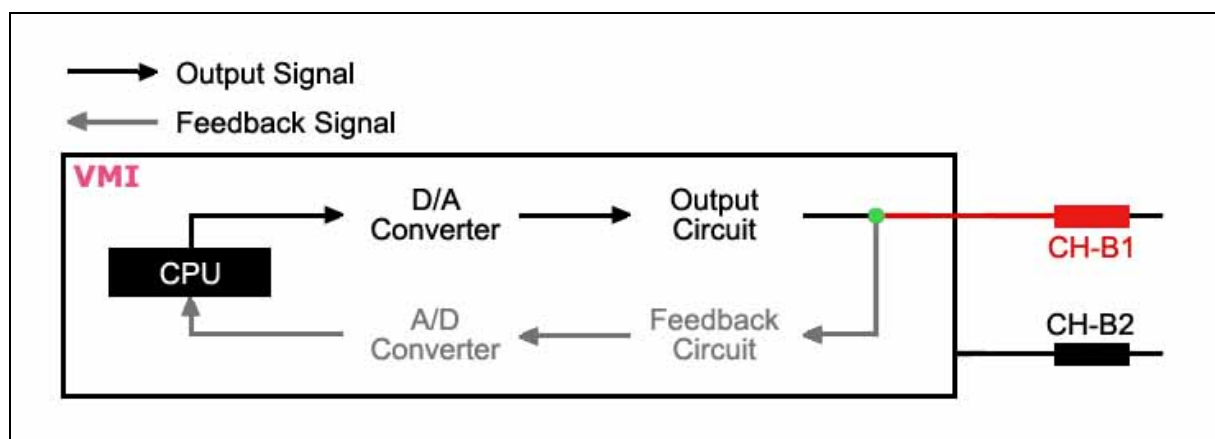


Figure 6. Pulse Output Main Screen

Pulse Output uses CH-B only; the connecting methods are as below.

Disconnect sensor connector.

CH-B1 (+) : Connect to Sensor Control Circuit

CH-B2 (-) : Connect to Battery (-) Terminal

Refer to [Figure 7].

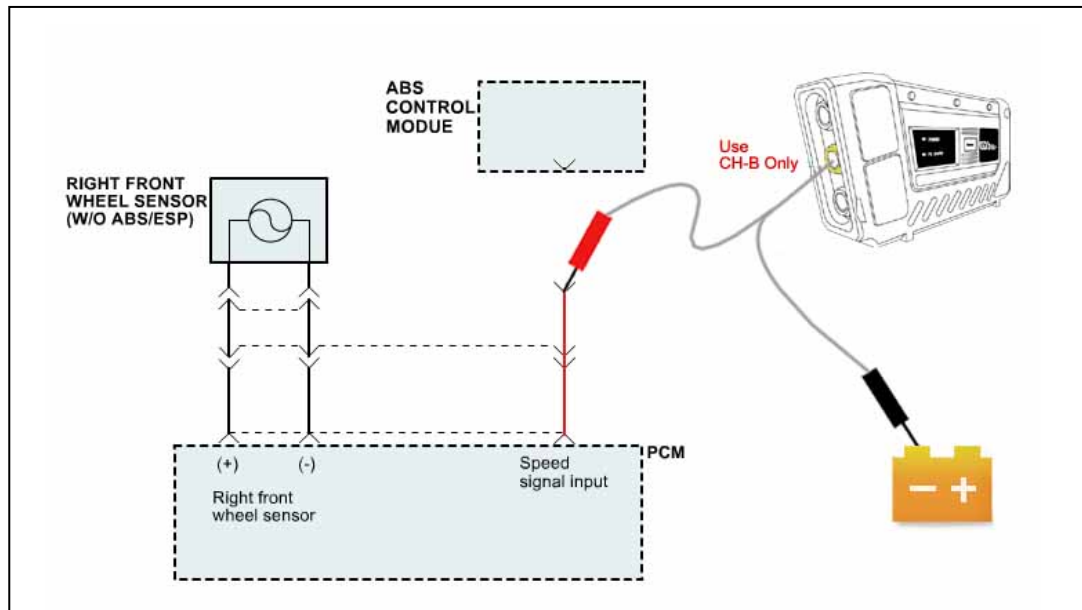


Figure 7. Probe Connecting Method for Simulation Test

## Duty Output

Duty Output function forces the actuator to operate with the user-preferred setting Hertz and Duty(-) to determine whether actuation is working properly or not.

Probes should be connected as shown in [Figure 10] and select appropriate signals (Duty & Hz), then press Start button to start the test.

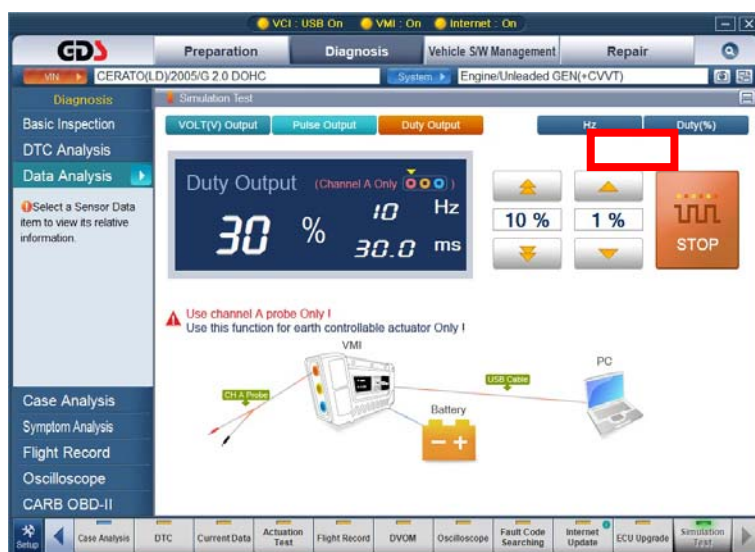


Figure 8. Duty Output Main Screen

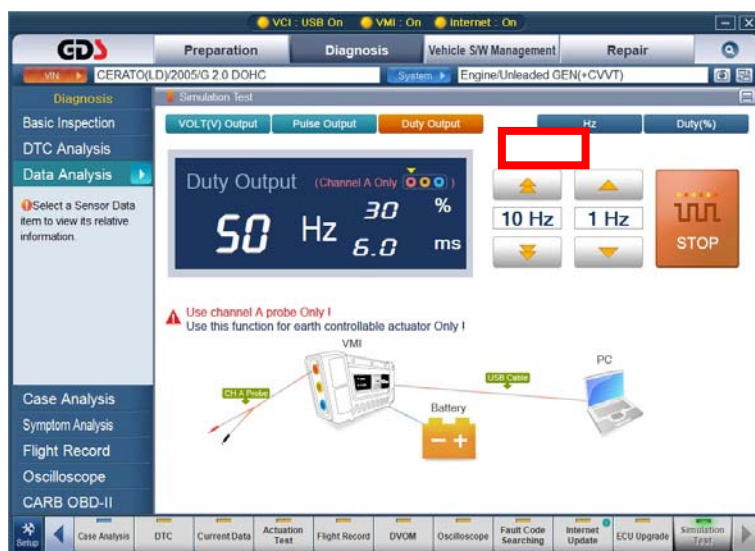

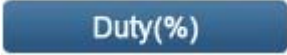






Figure 9. Hertz Output Main Screen

## Icon Description

Icon	Description
	Button for adjusting output frequency. After pressing this button, control with UP / DOWN button.
	Button for adjusting output duty. After pressing this button, control with UP / DOWN button.
	When setting output FREQUENCY/DUTY, raise the value by 10Hz/%.
	When setting output FREQUENCY/DUTY, low the value by 10Hz/%.
	When setting output FREQUENCY/DUTY, raise the value by 1Hz/%.
	When setting output FREQUENCY/DUTY, low the value by 1Hz/%.

Actuation Test uses CH-A channel, the connecting methods are as below.

CH-A1 (+) : Connect to Actuator Control Circuit

CH-A2 (-) : Connect to battery (-) terminal

Refer to [Figure 10].

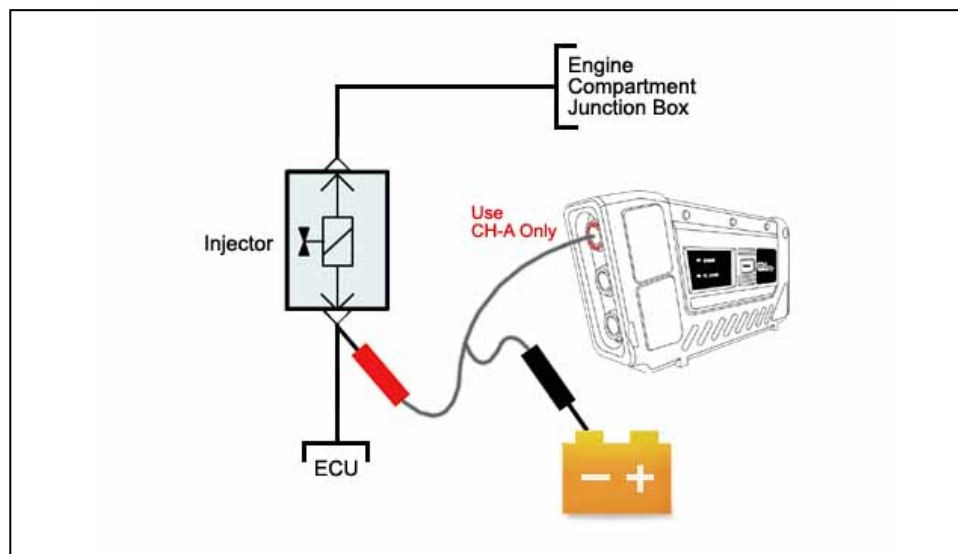


Figure 10. Probe Connecting Method for Actuation Test

Actuation test is applied input signal to control circuits like [Figure 11]. Instead of ECU sending input signal, VMI can send duty signal to test whether actuator is working properly or not.

If sensor circuit, which is user, wants to test, has more than 2A present, the Duty Output will be self aborted to prevent circuit damage refer to [Figure 12].

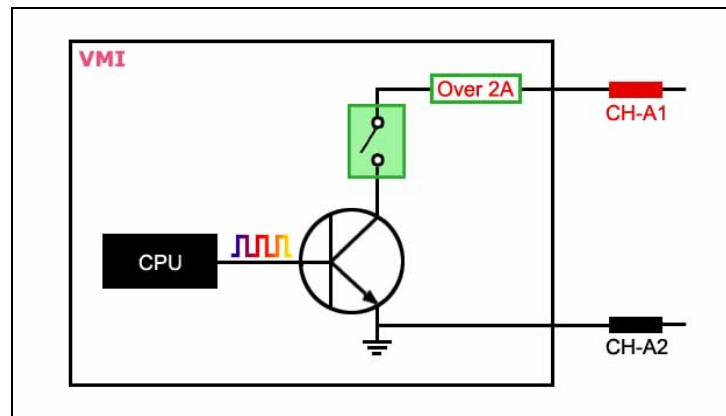


Figure 11. General Idea of Duty Output

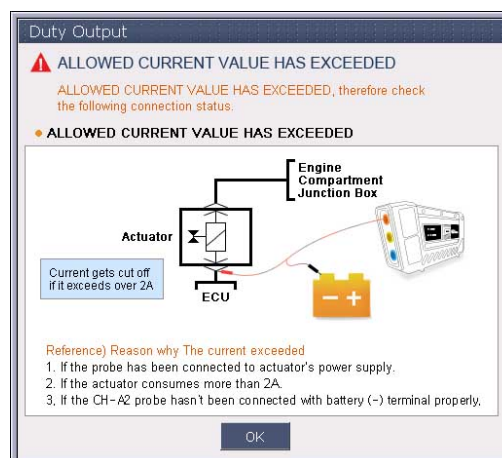


Figure 12. Allowed Current Value Has Exceeded



## CAUTION

- To prevent circuit damage, actuator function has certain limits on voltages and current.
- Scope cable must be firmly connected before starting actuator test.
- Do not apply probe (+) and probe (-) in reverse.