AUTOMOTIVE SCOPE METER

Model S2800

User's Manual

UNISource Corporation

ETS2800_020918_021224_R02

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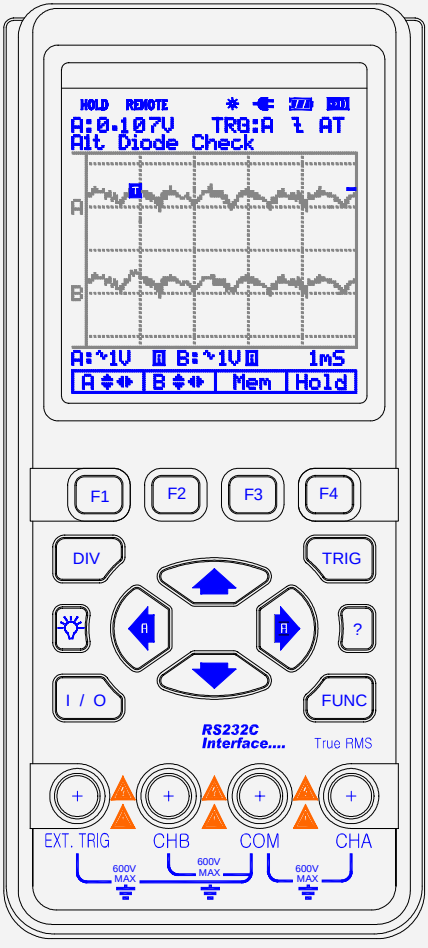
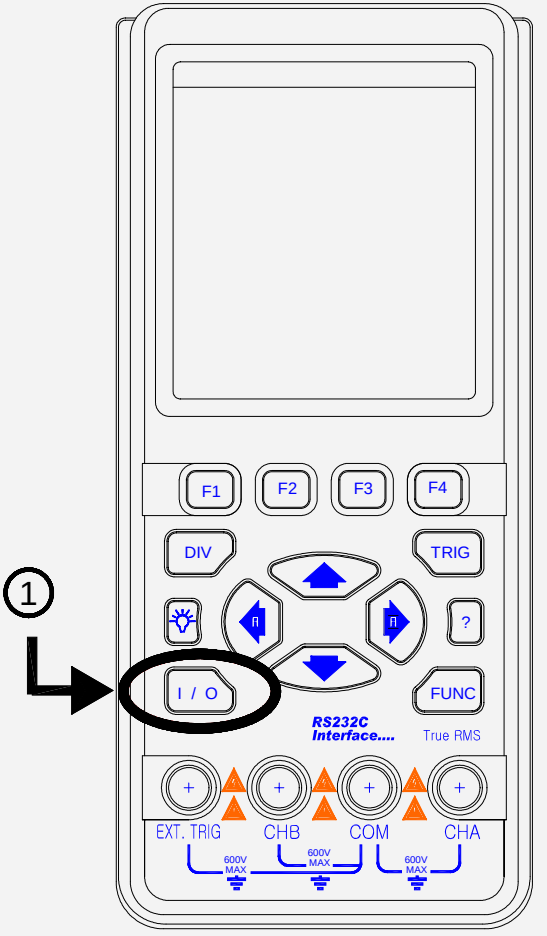
1. Easy Manual



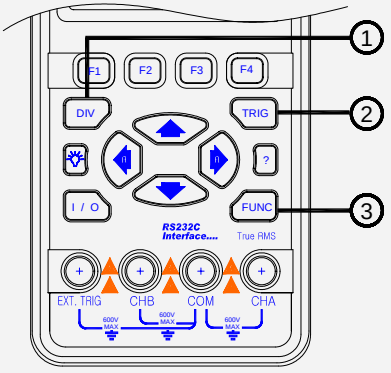
Front View

Turning on and off



① Pressing this button for 2 to 3 seconds will turn the unit on. Pressing this button again for 2 to 3 seconds will turn the power off.

Division, Trigger, and Function key

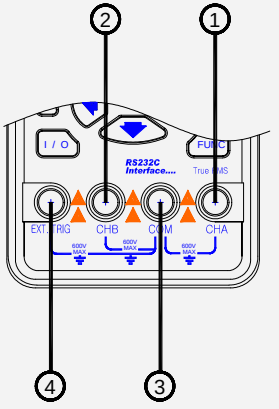


① Division key:
Adjusts vertical division or Horizontal division.

② Trigger key:
Adjusts Trigger level.
Selects Single shot mode.
Selects trigger setup.

③ Function key:
Selects Scope Setup.
Selects Automotive scope setup.
Selects general setup.

Input Terminals



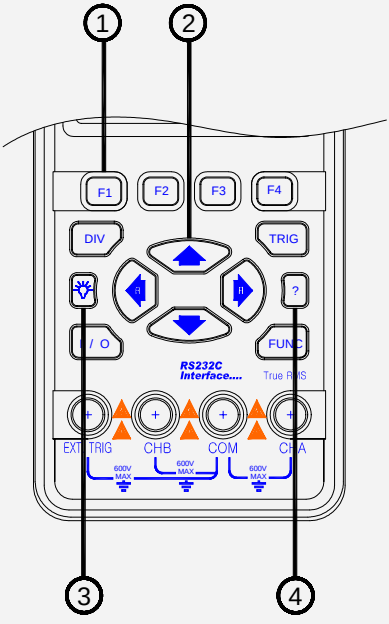
① Channel A:
You can always use the red channel A for all single input measurements possible with the meter.

② Channel B:
For measurements on two different signals you can use the channel B together with the Channel A.

③ Common:
You can use the black common as single ground for low frequency measurements, and for ACV, DCV, Ohm, Continuity, and RPM measurements

④ External trigger:
The EXT.TRIG input accepts external trigger signals.

Command, Arrow, Backlight, and Help key



① Command keys: These four keys are command buttons. They are labeled F1-F4. These keys will have various functions.

② Four arrow keys: These keys serve as the primary means of navigating the instrument's menus and operating displays.

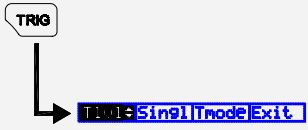
③ Display back light: Press this button to turn on the backlight. To turn the back light off, press this button again.

④ Help key: Supplemental information is available for each separate component test by pressing the help key.

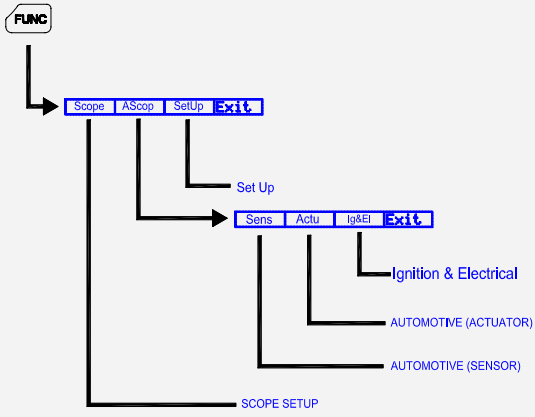
Primary Menu Map

Default Menu

Division Menu

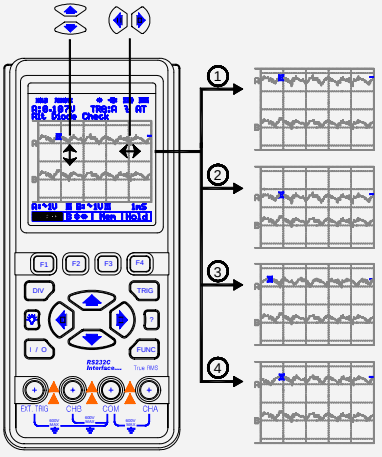


Trigger Menu



Function Menu

Positioning the waveform on the screen



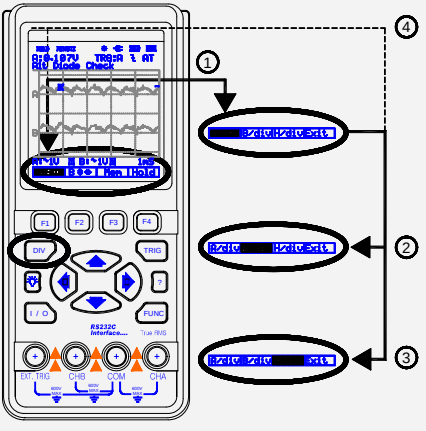
① Pressing moves the waveform up.

② Pressing moves the waveform down.

③ Pressing moves the waveform left.

④ Pressing moves the waveform right.

Division key map



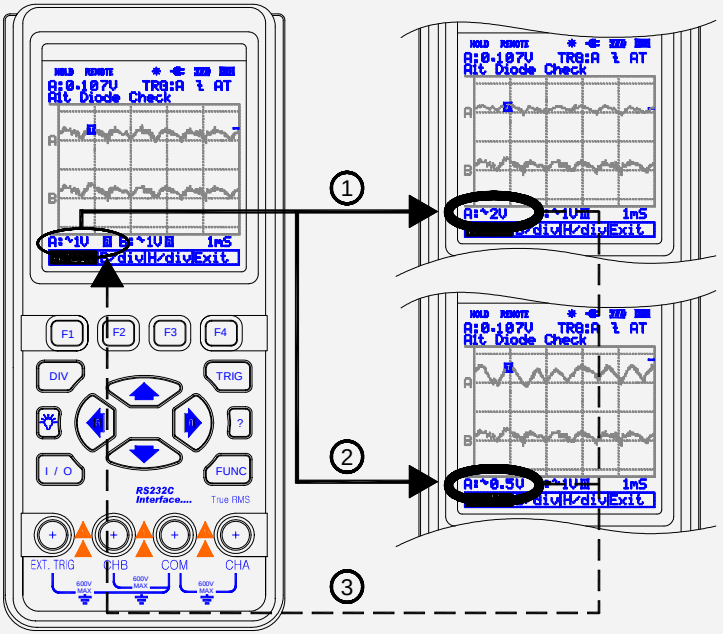
① Pressing DIV calls up the default division menu.

② Press F2 to control the Channel B Vertical Division.

③ Press F3 to change the Horizontal Division.

④ Press F4 to exit.

Changing Vertical (A/div or B/div) division

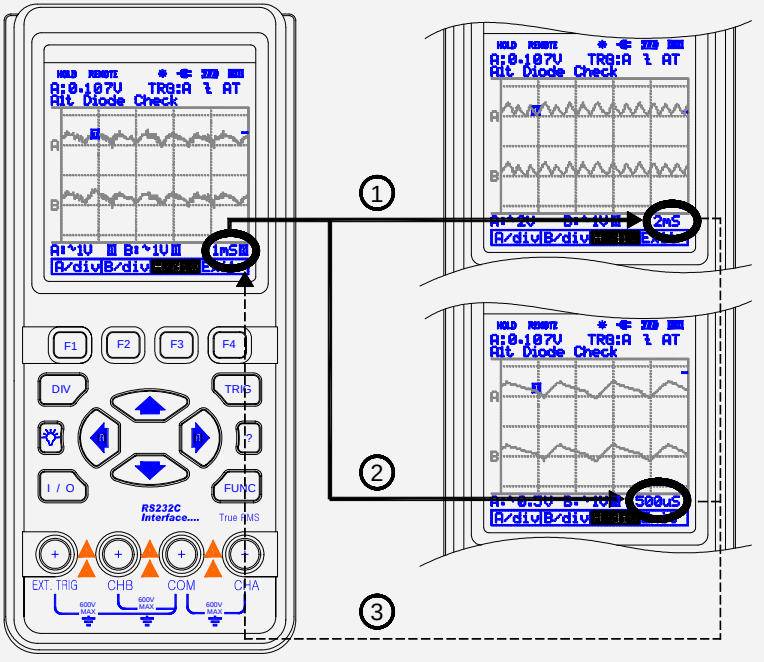


① Pressing button increases CHA vertical division (A/div).

② Pressing button decreases CHA vertical division (A/div).

③ Pressing or key will change Div from MANUAL to AUTO(A).

Changing Horizontal division

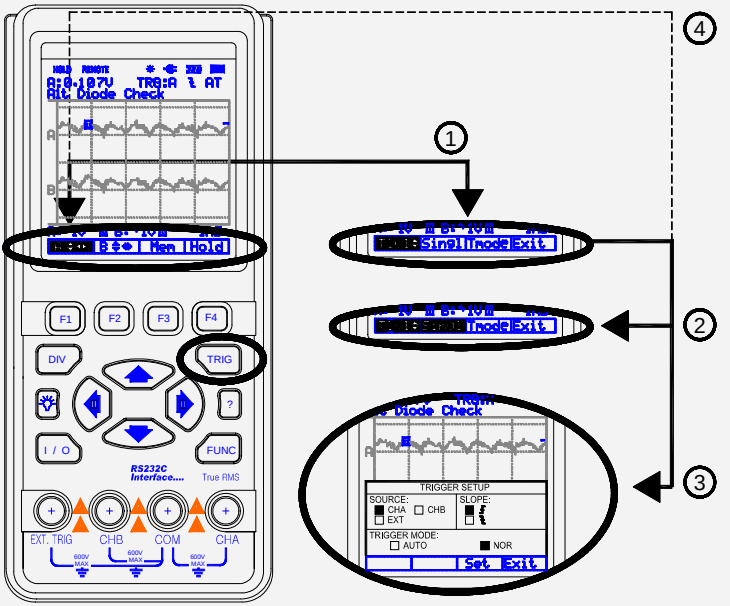


① Pressing  button increases Horizontal division (H/div).

② Pressing  button decreases Horizontal division (H/div).

③ Pressing  or  key will change Div from MANUAL to AUTO(A).

Trigger key map



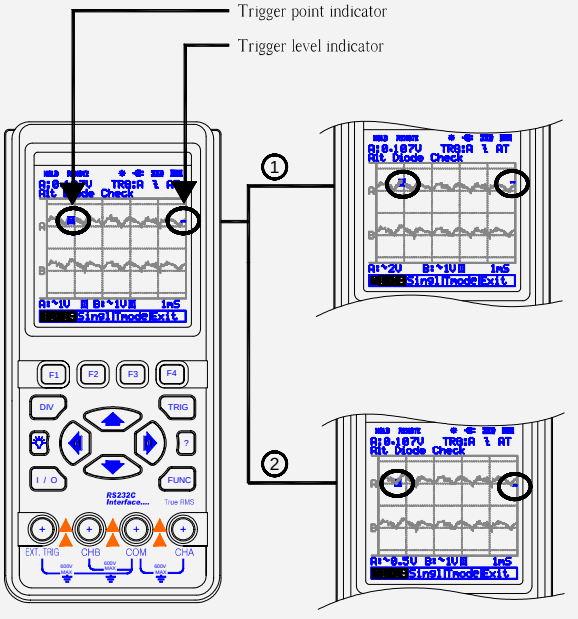
① Press TRIG key to display the TRIGGER default menu.

② Press F2 key for Single shot mode.

③ Press F3 key for TRIGGER SETUP.

④ Press F4 to exit.

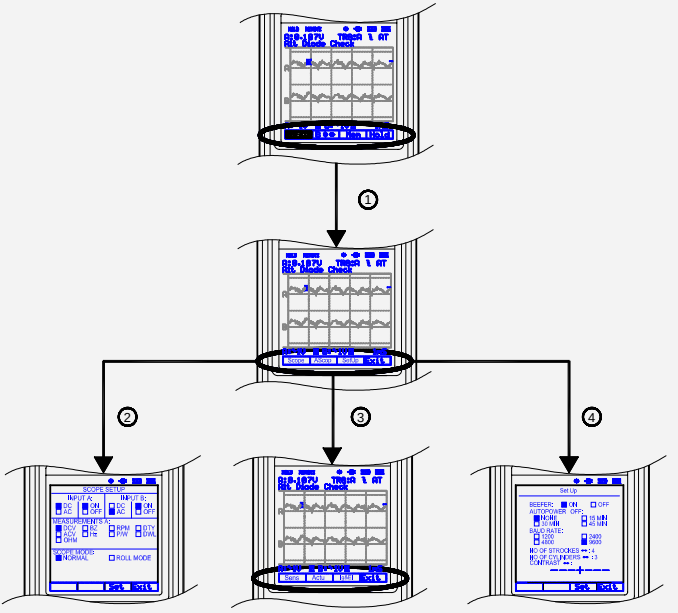
Trigger level control



① Pressing  button increases the Trigger level.

② Pressing  button decreases the Trigger level.

Function key map



① Press FUNC key to display the FUNCtion default menu.

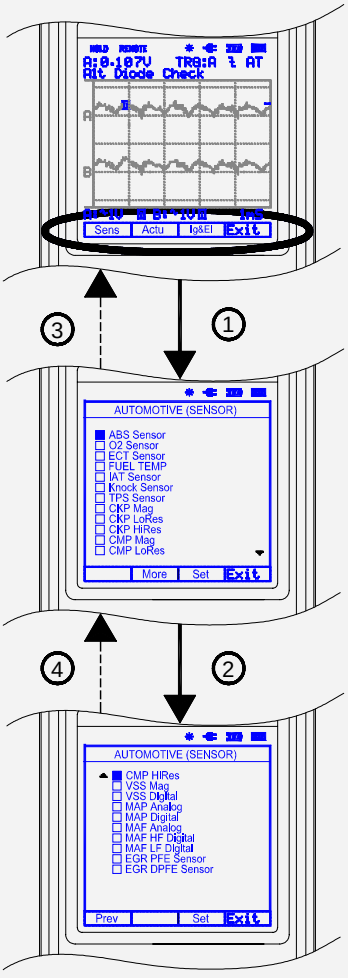
② Press F1 key for SCOPE SETUP.

③ Press F2 key for AUTOMOTIVE SCOPE SETUP.

④ Press F3 for general SETUP.

⑤ Press F4 to exit.

Sensor tests



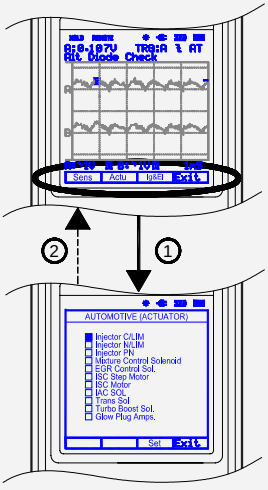
① Press F1 key to display automotive sensor tests.

② Press F2 key for more sensor tests.

③ Press F4 to exit.

④ Press F1 key for previous sensor tests.

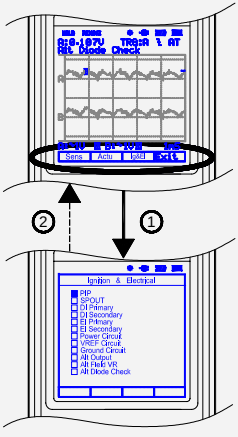
Actuator tests



① Press F2 key for Actuator tests.

② Press F4 to exit.

Ignition & Electrical



① Press F3 key for Ignition & Electrical tests.

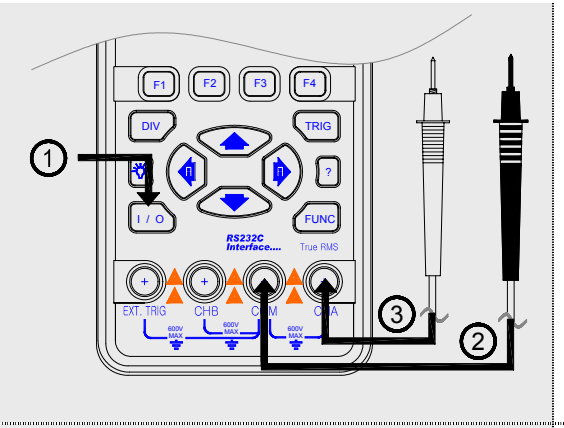
② Press F4 to exit.

2. Test Examples

- Battery Voltage Test
- O2 Sensor Test

Battery Voltage test

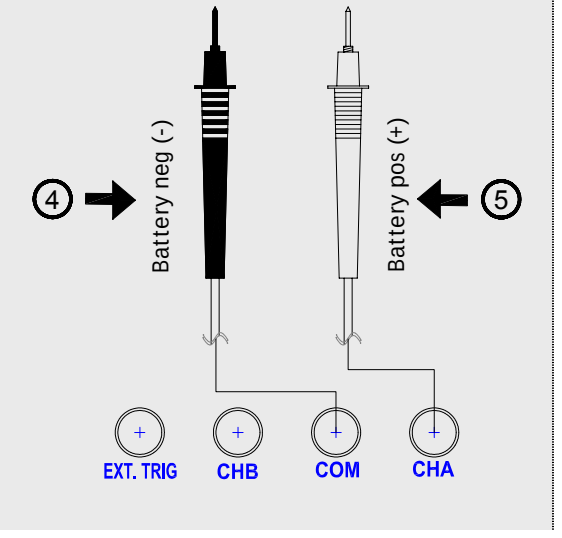
Battery location and test



① Press I / O for about 3 sec. to turn on the meter.

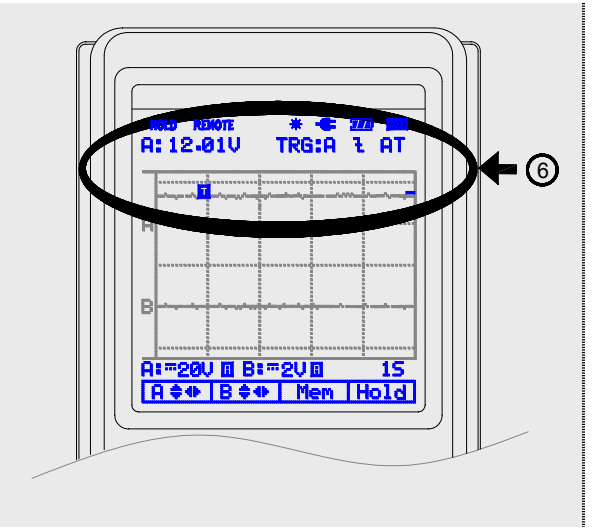
② Insert the black lead in the COM input socket.

③ Insert the red lead in the CHA input socket.



④ Connect the black probe to the negative (-) circuit or to ground.

⑤ Connect the red probe to the circuit coming from the power source.



⑥ Check the measurement voltage.

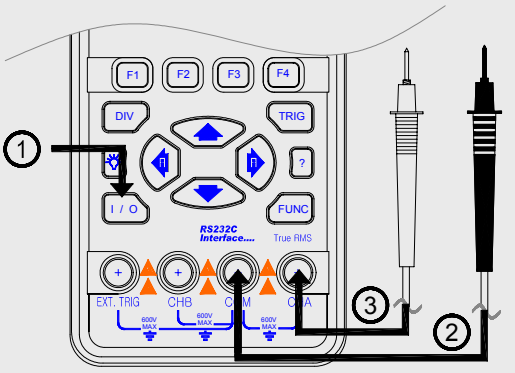
Note

If the meter reads negative, the battery has been reverse charged (has reversed polarity) and should be replaced, or the meter has been connected incorrectly.

Battery voltage (V)	**State of charge**
12.6 or higher	100% charged
12.4	75% charged
12.2	50% charged
12.0	25% charged
11.9 or lower	Discharged

O2 Sensor (Oxygen Sensor)

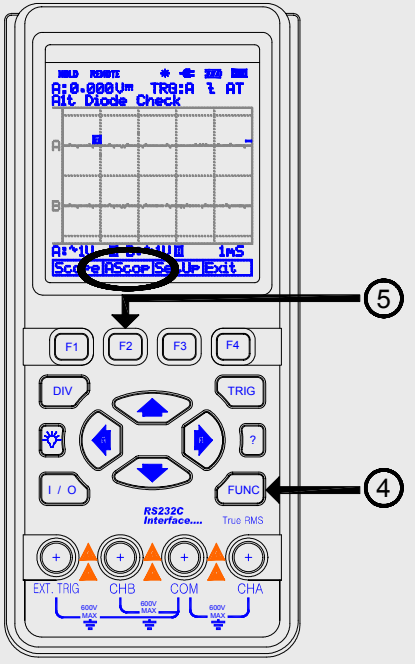
O2 Sensor location and test



① Press I / O for 3 seconds to turn on the meter.

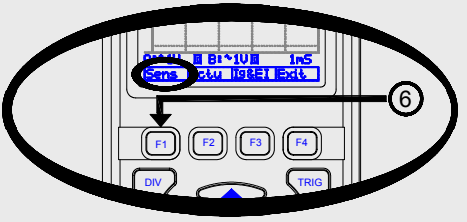
② Insert the black lead in the COM input socket.

③ Insert the red lead in the CHA input socket.



④ Press FUNC.

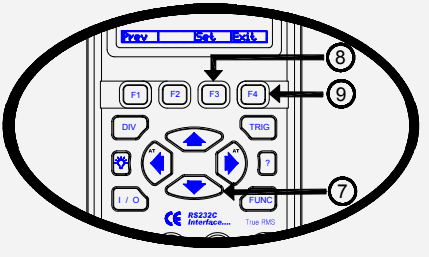
⑤ Press F2 (ASCOP).



⑥ Press F1 (Sens)

AUTOMOTIVE (SENSOR)			
☐ ABS Sensor			
☐ O2 Sensor			
☐ ECT Sensor			
☐ FUEL TEMP			
☐ IAT Sensor			
☐ Knock Sensor			
☐ TPS Sensor			
☐ CKP Mag			
☐ CKP LoRes			
☐ CKP HiRes			
☐ CMP Mag			
☐ CMP LoRes			▼
Prev		Set	Exit

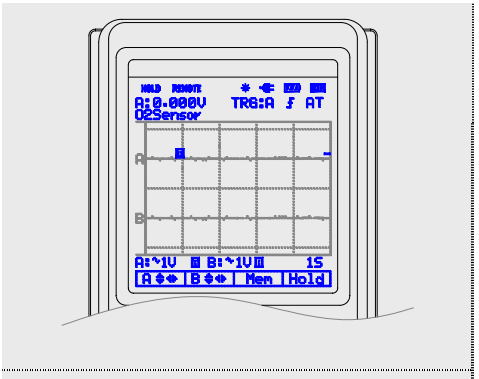
Automotive (SENSOR) is displayed as left.



⑦ Select O2senosr by using button.

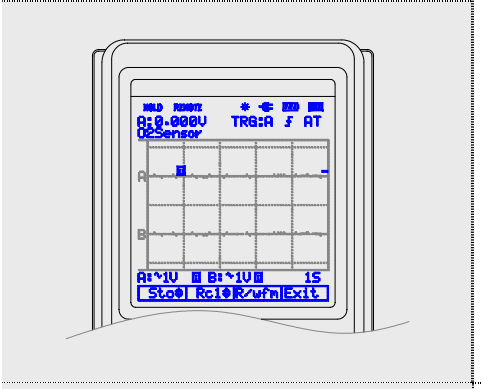
⑧ Press F3 (Set) button.

⑨ Press F4 button to return to the default menu.

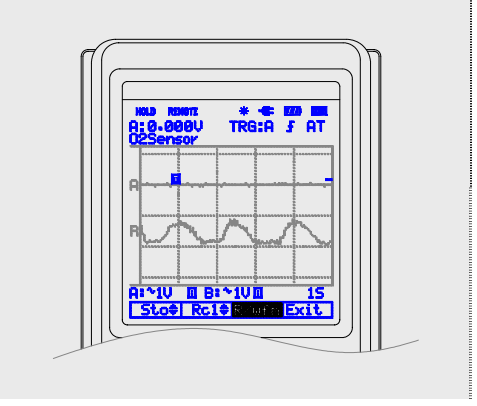


Default menu is displayed as left.

⑩ Press F3 (MEM) button to display the memory menu as below.

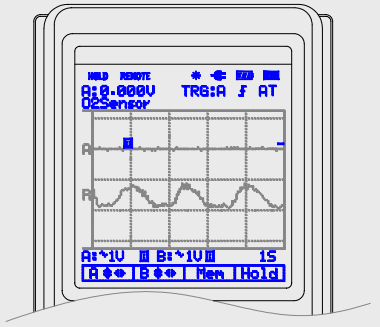


Memory menu is displayed as left.

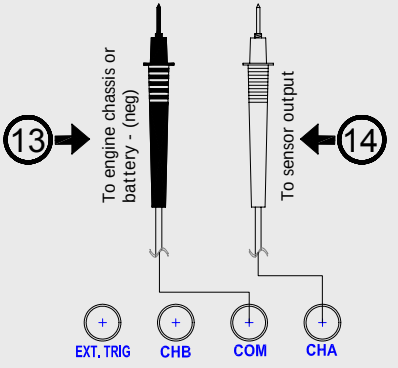


⑪ Pressing F3 (R/WFM) button displays the General O2 Sensor waveform as left.

⑫ Press F4 button to return to the default menu.

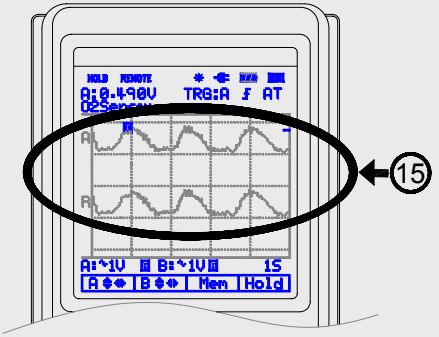


O2 sensor waveform is displayed in the default menu.



⑬ Connect the black test lead to engine chassis.

⑭ Connect the red test lead to O2sensor output.



⑮ Compare measurement waveform with general O2 Sensor waveform.

Note

*Refer to Easy manual for changing the Vertical division or Horizontal division.

*Refer to Easy manual for triggering on a waveform.

Note

The oxygen sensor output voltage is used to control the fuel system air/fuel ratio. The output of the sensor varies depending on the oxygen level sensed in the engine exhaust gases and the operation of the closed loop fuel system.

3. Introduction

Main Features

This Automotive programmable Scope Meter offers enhanced features that similar type test instruments on the market today don't have. All the functions are designed to be very convenient to use. You can quickly get used to working with this METER and many great functions integrated inside. This instrument features:

No	Features
1	**RS-232C** interface for transferring measurement data and waveform.
2	45 short reference waveform memory:
3	Dual Channel and Auto Calibration.
4	**Automatically setting** for horizontal and vertical division.
5	DC to 1MHz oscilloscope band width
6	Built-in auto ranging **True-RMS** digital MultiMeter.
7	Component test for checking component signals on sensor, actuators, ignition and electrical.
8	Real time Update and Auto range.
9	Data holds and run mode.
10	Back light display and Low battery indication.
11	Display Type: Super-Twist 132 x 128 pixels.
12	Designed to comply with safety standard for UL3111, CSA C22.2 No.1010-1

Unpacking the Test Tool Kit

The following items are included in your test tool kit.

Note
When new, the rechargeable Ni-MH battery pack is not fully charged.

■ STANDARD

#	Description <Cont.>
1	Industrial Scope Meter Test Tool <1>
2	Holster <1>
3	Ni-MH Battery Pack (installed) <1>
4	AC Power & Rechargeable Adaptor <1>
5	Test Leads; Red <1>, Black <1>, White <1> and Blue <1>
6	Alligator Clips; Red <1>, Black <1>, White <1> and Blue <1>
7	Users Manual (this book) <1>
8	RS-232 Cable <1>
9	Scope Meter Software for Windows <1>

■ OPTION

1	Carrying case <1>
2	Inductive Pick-up <1>
3	Capacitive Pick-up <1>

Specification

General Specifications

1) Operational Temperature:
   0°C to +50°C (+32°F to +122°F) at a relative humidity 75% or less

2) Storage Temperature:
   -20°C to +60°C (-4°F to +140°F) with a relative humidity of 75% less

3) Temperature Coefficient:
   0.1 x (Specified Accuracy) per °C for temperature <18°C to >28°C

4) Max. Voltage between any Input and Ground: DC or AC 600Vrms

5) Basic DC Accuracy: 0.3%

6) Band width: 1MHz

7) Meter AC Band width: 20kHz

8) Power Supply: Ni-MH Battery 4.8V (1.2V x 4 cell)

9) Battery Life Time:
   4 Hours without Backlight on,
   3 Hours with Backlight on.

10) Battery Change Time: About 3 Hours

11) Battery Change:
   Class-2 transformer,
   Input: 120V AC 60Hz,
   Output: 9V DC 1A

12) Display Type: Super-Twist 132 x 128 pixels

13) Equipment Dimension:

90mm (width) x 195mm (depth) x 40 mm (height)

14) Equipment Weight: About 460g

Note:

The accessories may be changed to improve the product quality without notifying the customers.

Technical Specification

1) Oscilloscope Function

(1) Horizontal

Sample Rate	25 MS/s (Dual CH mode) 50 MS/s (Single CH mode)
Record Length	512 in single shot mode 256 in all other modes
Sample / Division	25
Modes	Single shot, Roll, Normal
Accuracy	0.01%
Sweep Rate	1uS to 5S in 1, 2, 5 sequence

(2) Vertical

Bandwidth	1MHz
Resolution	8 Bit
Channels	Dual
Coupling	AC, DC
Input impedance	1 MΩ
Accuracy	3%
Max. Input Volts	DC or AC 600Vrms
Volt / Division	0.5V to 500V in 1, 2, 5 sequence and 500V to 50kV for Ignition Secondary

(3) Triggering

Type	CHA, CHB, External
Coupling	AC, DC
Slope	Rising (↑) or Falling (↓) edge
Internal Trigger Sensitivity	2 / 20 Division

(4) Other

Wave Form Memory	8 Shot
REF Wave From Memory	45 Shot

2) Digital MultiMeter Function

(1) DC V

Range	Resolution	Accuracy	Impedance
5V	0.001V	± (0.3%+3)	1 MΩ
50V	0.01V		
500V	0.1V	± (0.5%+5)	
1000V	1V		

(2) AC V

Range	Resolution	Accuracy			Impedance
		50~450Hz	0.45k~5kHz	5k~20kHz	
3V	0.001V	±(0.75%+5)	±(2%+5)	±(2.5%+5)	1 MΩ
30V	0.01V				
300V	0.1V				
750V	1V			N/A	

(3) OHM

Range	Resolution	Accuracy	Over Load Protection
5 kΩ	0.001 kΩ	± (0.5%+5)	600V DC or AC Peak
50 kΩ	0.01 kΩ		
500 kΩ	0.1 kΩ		
5 MΩ	0.001 MΩ	±(0.75%+10)	

(4) Continuity Buzzer

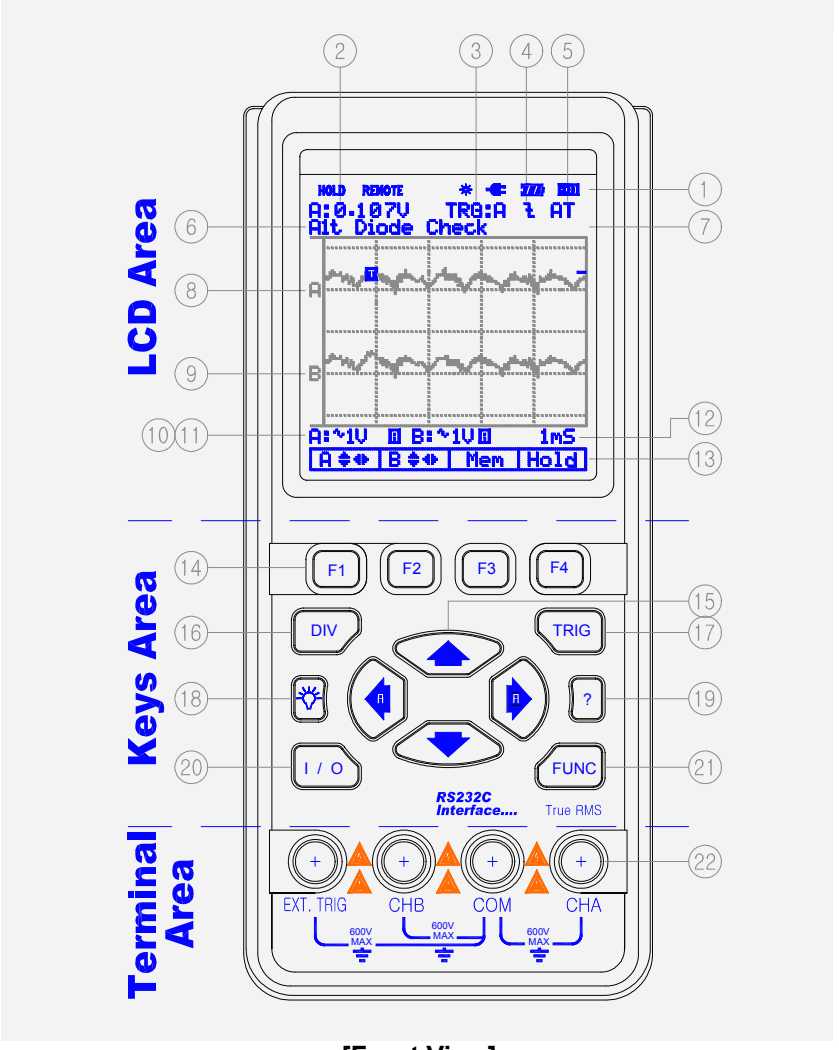
Test Voltage	Threshold	Over Load Protection
1.7V	100 digits	600V DC or AC Peak

(5) RPM

Function	Range	Resolution	Accuracy
RPM	120 - 12,000	1RPM	± 2RPM
% Duty	1% - 98%		
Dwell	3.6° - 352.8°		
Pulse Width	2 uS - 450 mS (Pulse Width > 2 uS)		
Frequency	2Hz - 1MHz		

4. Product Description

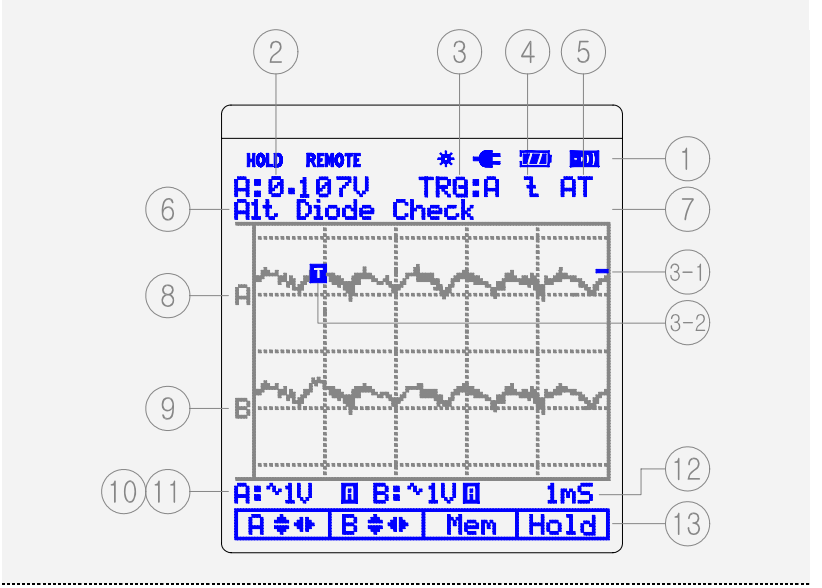
In this chapter, the LCD, front panel buttons, controls and terminals are described.



[Front View]

Display Area description

The screen is divided into five areas: Indicator area, Reading area, Waveform area, Setting area and Menu area. Refer to Figure below.



[LCD Display]

1) Indicator
   - **HOLD:** Freezes display in the LCD
   - **REMOTE:** RS232 Output indicator
   - **BACK LIGHT(☼): ** Back light indicator
   - **BUZZER(BUZ): ** Buzzer indicator
   - **Charging LINE(⏚): ** Charging Battery indicator
   - **BATTERY(▭): ** Low battery indicator

2) Primary Numerical Field (DMM Function)
   Displays the numerical readings. Because only input A is on, you will see the input A reading only.

3) Trigger selection
- Channel A, B and External

3-1) Trigger level indicator

3-2) Trigger Cursor

4) Trigger Slope
- Rising or Falling edge

5) Trigger mode: Normal or AUTO

6) Automotive Function
- Sensor
- Actuator
- Ignition
- Electrical

7) Memory Address
- 0 to 7

8) Live Scope Display (Channel A)
Displays real time waveforms and freezes held captures.

9) Channel B or Reference Display

10) Channel A Vertical Division

11) Channel B Vertical Division

12) Horizontal Division (Time base)

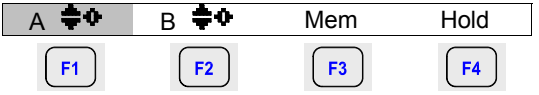
13) Command Menu Field

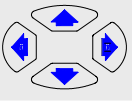
Button Keys Area description

14) F1 F2 F3 F4 Command Menu keys

All Keys are command buttons. They are labeled F1~F4. These keys will have various functions.

① Default (Command Menu)



15)  Arrow keys

Use the black arrow keys to highlight the item.

①		The cursor to be changed is moved to up with this button. Pushing the button will increase the value or position.
②		The cursor to be changed is moved to down with this button. Pushing the button will decrease the value or position.
③		The cursor to be changed is moved to left with this button. Pressing this button changes Vertical division or horizontal division from MANUAL to AUTO.
④		The cursor to be changed is moved to right with this button. Pressing this button changes Vertical division or horizontal division from MANUAL to AUTO.

16) DIV Division key

Set Channel A, B and Horizontal Division

① **DIV**

A/div	B/div	H/div	Exit
F1	F2	F3	F4

17) TRIG Trigger key

Set Trigger level, Single mode and Setup

① **TRIG**

Tlvl ▲▼	Singl	Tmode	Exit
F1	F2	F3	F4

② **F3**

TRIGGER SETUP			
SOURCE: ■ CHA ☐ CHB ☐ EXT		SLOPE: ☐ ƒ ■ ƒ	
TRIGGER MODE: ☐ AUTO ■ NOR			
		Set	Exit
F1	F2	F3	F4

18) Back light key

Activates Back Light for the LCD
Toggles backlight ON and OFF.

19)  Help key

Aids the technician in correct operation and efficient use of the meter.

20)  Power switch

Turns the instrument ON or OFF.

21)  Function Key

Set Scope, Auto Scope and Setup of the METER

① **FUNC**

Scope	AScop	SetUp	Exit
F1	F2	F3	F4

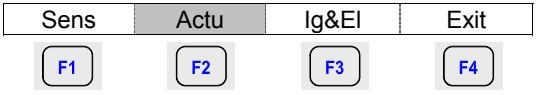
▪ **Scope Setup**

① **FUNC➔F1** (Scope)

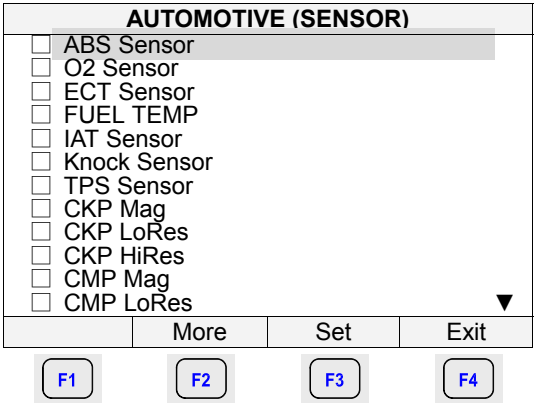
SCOPE SETUP			
INPUT A:		INPUT B:	
■ DC ☐ AC	■ ON ☐ OFF	■ DC ☐ AC	■ ON ☐ OFF
MEASUREMENTS A: ■ DCV ☐ BZ ☐ RPM ☐ DTY ☐ ACV ☐ Hz ☐ P/W ☐ DWL ☐ OHM			
SCOPE MODE: ■ NORMAL ☐ ROLL MODE			
		Set	Exit
F1	F2	F3	F4

▪ Automotive Scope Sensor

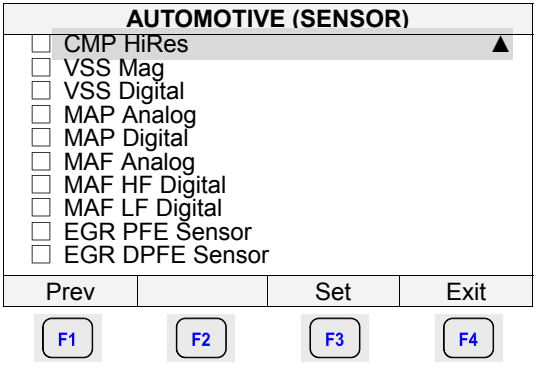
① **FUNC➔F2** (Automotive Scope)



② **FUNC➔F2** (Automotive Scope)➔**F1** (Sensor)

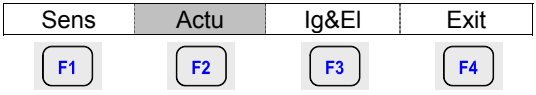


③ **FUNC➔F2** (Automotive Scope)➔**F1** (Sensor)➔**F2** (More)

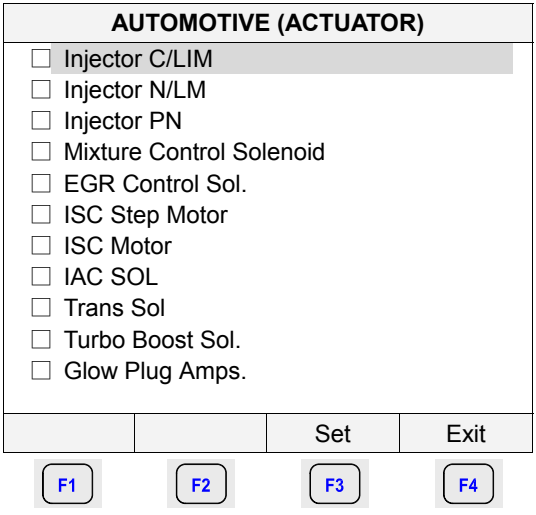


▪ Automotive Scope Actuator

① **FUNC➔F2** (Automotive Scope)

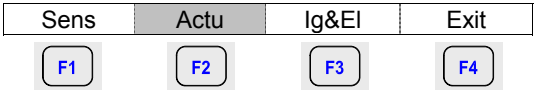


② **FUNC➔F2** (Automotive Scope)➔F2 (Actuator)

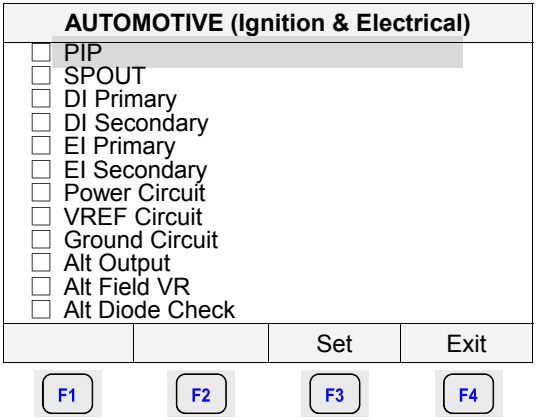


▪ Automotive Scope Ignition & Electrical

① **FUNC➔F2** (Automotive Scope)

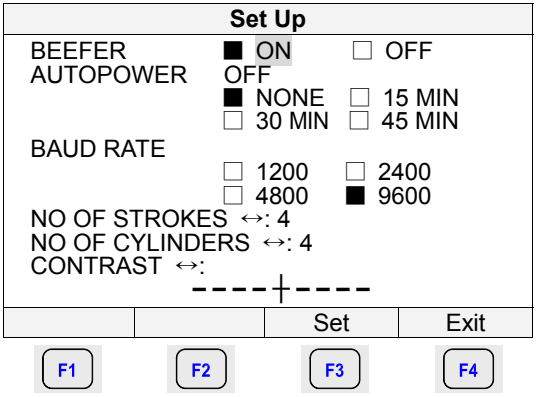


② **FUNC➔F2** (Automotive Scope)**➔F3** (Ignition & Electrical)

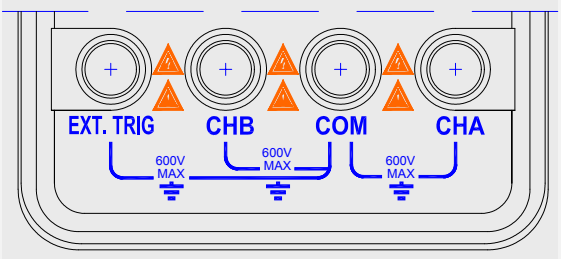


▪ Setup of the Meter

① **FUNC➔F3** (Set Up)



22) Terminal Area description



- **Looking at the Measurement Connections**
  Look at the bottom of the METER. The METER provides 4 input jacks.

① CHA: Channel A
You can always use the red channel A for all single input measurements possible with the Meter.

② COM: Common
You can use the black COMMON as single ground for DCV, ACV, Ohm, Continuity, frequency, and RPM measurements.

③ CHB: Channel B
For measurements on two different signals you can use the channel B together with the red channel A.

④ EXT. TRIG
External trigger.

5. Using The METER

Safely Using the Test Tool

Attention
Carefully read the following safety information before using the test tool.

Safety Precautions
Specific warning and caution statements, where they apply, will be found throughout the manual.

A Caution identifies conditions and actions that may damage the test tool. A Warning identifies conditions and actions that pose hazard(s) to the user.

Symbols used on the test tool and in this manual are explained in the next table.

⚠ Warning
To avoid electrical shock, use only specific power supply, Model (Power Adapter used as a Battery Charger).

	See explanation in manual
	Dangerous Voltage
	Double Insulation (Protection Class)
	Earth (Ground)
	Either AC or DC
	DC – Direct Current
	AC – Alternating Current
	Fuse

Powering the METER

Follow the procedure to power the Meter from a standard ac outlet.

①		Power Adaptor is inserted in to AC outlet.
②		Power Adaptor➔ the Meter.
③		Turn the Meter on by pressing this button for about 3 seconds.

The meter powers up in its last setup configurations.

Changing Backlight

After power-up, the screen has a high bright display.
To save battery power, the screen has an economic brightness display when operated on the battery pack (no power adapter connected).

To change the brightness of the display, do the following:

①		Brighten the backlight.
②		Dim the backlight again.

The high brightness increases when you connect the power adapter.

Note

Using dimmed display lengthens maximum battery power operation time by about one hour.

Making Selections in a Menu

Subsequently follow steps ① to ⑤ to open a menu and to choose an item.

① FUNC — Open the **FUNCTION** menu.

Scope	AScop	SetUp	Exit
F1	F2	F3	F4

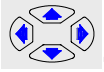
② F1 — Open the **Scope Setup** menu.

SCOPE SETUP			
INPUT A:		INPUT B:	
■ DC	■ ON	■ DC	■ ON
□ AC	□ OFF	□ AC	□ OFF
MEASUREMENTS A:			
■ DCV	□ BZ	□ RPM	□ DTY
□ ACV	□ Hz	□ P/W	□ DWL
□ OHM			
SCOPE MODE:			
■ NORMAL	□ ROLL MODE		
		Set	Exit
F1	F2	F3	F4

③  — Use the arrow keys to highlight the item.

④ F3 — Select proper the item.

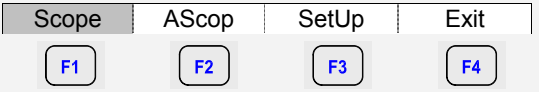
⑤ F4 — Exit.

Key: FUNC → F1 →  → F3 → F4

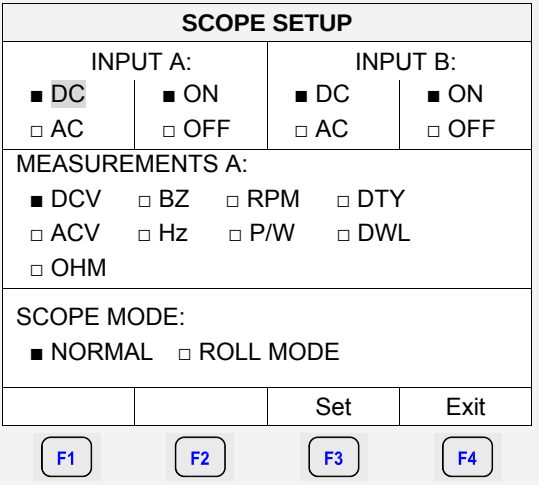
Displaying only CHA

Subsequently follow steps ① to ⑤ to open a menu and to choose an item.

① Open the **FUNCTION** menu.



② Open the **Scope Setup** menu.



③ Highlight OFF of INPUT B to turn off the CHB.

④ Select current SCOPE SETUP.

⑤ Exit.

Now, you will see only CHA on the screen.

Key: FUNC → F1 → → F3 → F4

1) To choose a **Frequency** measurement for **CHA**, do the following:

①		Plug the **black** test lead into the **COM** input jack.
②		Plug the **red** test lead into the **CHA** input jack.
③	FUNC	Open the **FUNCTION** menu. Scope | AScop | SetUp | Exit F1 F2 F3 F4
④	F1	Open the **Scope Setup** menu. **SCOPE SETUP** INPUT A: ■ DC □ AC ■ ON □ OFF INPUT B: ■ DC □ AC ■ ON □ OFF MEASUREMENTS A: ■ DCV □ BZ □ RPM □ DTY □ ACV □ Hz □ P/W □ DWL □ OHM SCOPE MODE: ■ NORMAL □ ROLL MODE Set | Exit F1 F2 F3 F4
⑤		Highlight **Hz** (□ **Hz**)
⑥	F3	Select **Hz** (■ **Hz**)
⑦	F4	Exit.

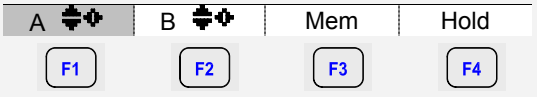
Observe that **Hz** is now the main reading.

Key: FUNC → F1 → → F3 → F4

Freezing the screen

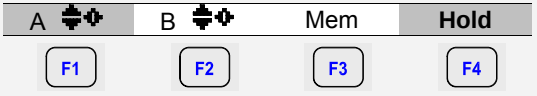
You can freeze the screen (all readings and waveforms) at any time.

Default (Command Menu) Display:



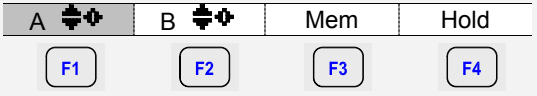
① Press F4

Freeze the screen. Highlighted **Hold** appears at the bottom of the Command Menu area.



② Press F4

Resume your measurement

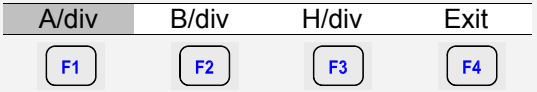


Changing the Graphic Representation on the Screen

1) Changing the vertical division

① Press DIV

Open the Command Menu.



② Press F1 or F2 — Change the vertical division. (CH A or CH B)

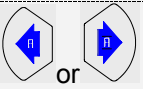
③ Press ▲ — Increase the vertical division. Div is changed to manual mode.

④ Press ▼ — Decrease the vertical division. Div is changed to manual mode.

⑤ Press ◄ or ► — Change Div from Manual mode to AUTO mode.

Available settings are from 0.5 V/div to 500 V/div in normal mode.

2) Changing the Time Base

①	DIV	Open the Command Menu. A/div | B/div | H/div | Exit F1 F2 F3 F4
②	F3	Change the Horizontal division. A/div | B/div | H/div | Exit F1 F2 F3 F4
③		Increase the number of periods. Div is changed to manual mode.
④		Decrease the number of periods. Div is changed to manual mode.
⑤	 or	Change Div from Manual mode to AUTO mode.

Available settings are from 1 uS/div to 5 S/div in normal mode.

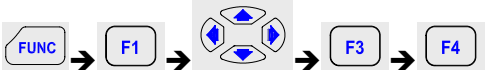
Acquiring the Waveform

①	FUNC	Open the **FUNCTION** menu. Scope | AScop | SetUp | Exit F1 F2 F3 F4
②	F1	Open the **Scope Setup** menu. **SCOPE SETUP** INPUT A: ■ DC □ AC ■ ON □ OFF INPUT B: ■ DC □ AC ■ ON □ OFF MEASUREMENTS A: ■ DCV □ ACV □ OHM □ BZ □ Hz □ RPM □ P/W □ DTY □ DWL SCOPE MODE: ■ NORMAL □ ROLL MODE Set | Exit F1 F2 F3 F4

1) Recording Slow Signals over a Long Period of Time

③		Highlight ROLL MODE.
④		Set ROLL MODE.
⑤		Exit.

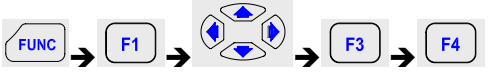
The roll mode function supplies a visual log of waveform activity and is especially useful when you measure lower frequency waveforms.

Key: 

2) Selecting AC-Coupling for INPUT A

③		Highlight **AC** for INPUT A.
④		Accept **AC**-coupling for INPUT A.
⑤		Exit.

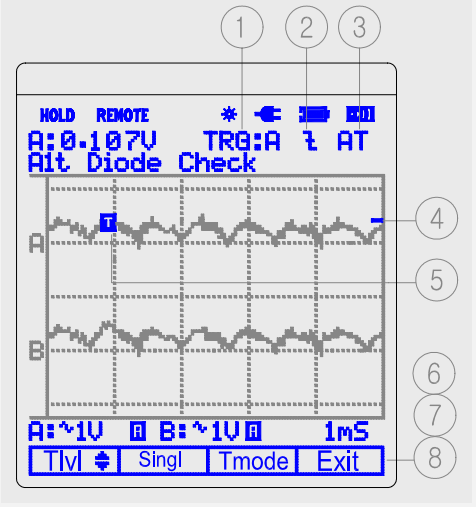
Use AC-coupling when you wish to observe a small AC signal that rides on a DC signal.

Key: 

6. Triggering on a Waveform

Triggering tells the METER when to begin displaying the waveform. You can select which input signal should be used, on which edge this should occur, and you can define the condition for a new update of the waveform.

The right-top line of the LCD identifies the trigger parameters being used. Trigger icons on the screen indicate the trigger level and slope.

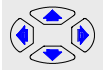


Screen with all Trigger Information

(1) Trigger Channel: Channel A or B
(2) Slope: rising or falling
(3) Trigger mode: Trigger setting mode (Auto or Normal)
(4) Trigger Level indicator
(5) Trigger Cursor
(6) Command Menu: Trigger level
(7) Command Menu: Single shot
(8) Command Menu: Trigger mode (Setup)

1) Setting **Trigger** level (on NORmal trigger mode)

①	TRIG	Open the Trigger menu Tlvl ⇕ | Singl | Tmode | Exit F1 F2 F3 F4
③		Adjust the Trigger Level continuously. Observe the trigger icon on the second time division line indicates the trigger level.
⑤	F4	Exit.

Key: TRIG →  → F4

2) Making a single acquisition

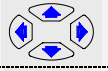
To catch single events, you can perform a single shot. (One time screen update.) To set up the test tool for a single shot on the input A waveform, do following:

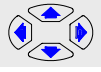
* Connect the probe to the signal to be measured.

①	TRIG	Open the default Trigger menu Tlvl ⇕ | Singl | Tmode | Exit F1 F2 F3 F4
②	F2	Highlight Singl (SINGLE SHOT) Tlvl ⇕ | Singl | Tmode | Exit F1 F2 F3 F4 Test tool performs a single shot. (One time screen update)
③	F2	Return to normal Trigger mode. Tlvl ⇕ | Singl | Tmode | Exit F1 F2 F3 F4

Key: TRIG → F2 → F2

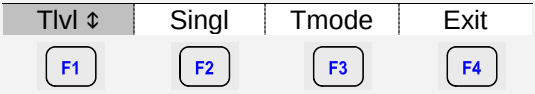
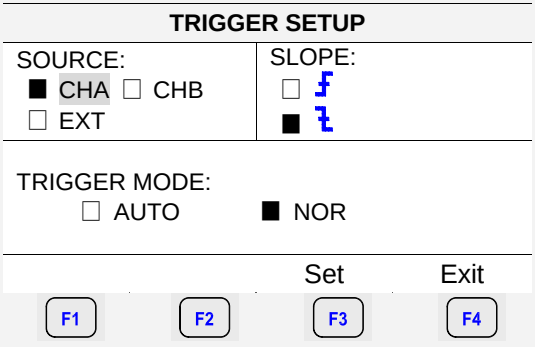
3) Setting Trigger mode (**Tmode**)

①	TRIG	Open the Trigger menu Tlvl ↕ | Singl | **Tmode** | Exit F1 F2 F3 F4
②	F3	Open the Trigger Setup **TRIGGER SETUP** SOURCE: ■ CHA □ CHB □ EXT SLOPE: □ ■ TRIGGER MODE: □ AUTO ■ NOR | | Set | Exit F1 F2 F3 F4
③		Highlight the **ITEM** you want.
④	F3	Set the **ITEM**.
⑤	F4	Exit.

Key: TRIG → F3 →  → F3 → F4

4) Setting **AUTO Trigger** mode

For quick operation, use the AUTO trigger mode to trigger on nearly all signals automatically. To optimize trigger slope manually, do the following:

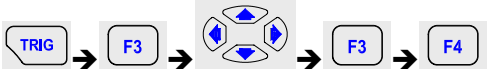
①	TRIG	Open the Trigger menu 
②	F3	Open the Trigger Setup 
③		Highlight **AUTO**.
④	F3	Set **AUTO**.
⑤	F4	Exit.

Key: TRIG → F3 → → F3 → F4

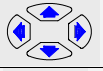
5) Setting **Normal Trigger** mode

③		Highlight **NOR**.
④		Set **NOR**.
⑤		Exit.

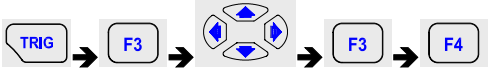
*		Adjust the Trigger Level continuously. Observe the trigger icon on the second time division line indicates the trigger level.

Key: 

6) Setting Trigger Slope

③		Highlight  or  .
④		Set  or  .
⑤		Exit.

*	 or  .	Trigger on either positive Slope or negative Slope of the chosen waveform.

Key: 

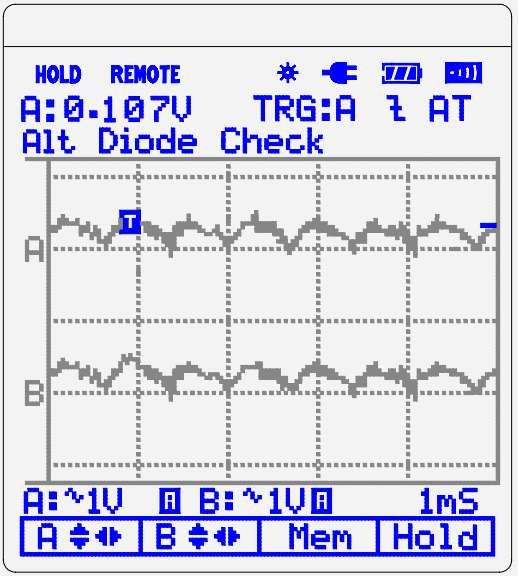
7. Storing or Recalling Setups and Waveforms

You can store setups and waveforms to memory, and recall them again from memory. Eight (0-7) setup and waveform memories are available. Store waveforms when you want to use the present waveform images for future reference.
Store setups when you need the present operating configuration for your future measurements.

* Refer to Test Examples for Reference Waveform Setup.

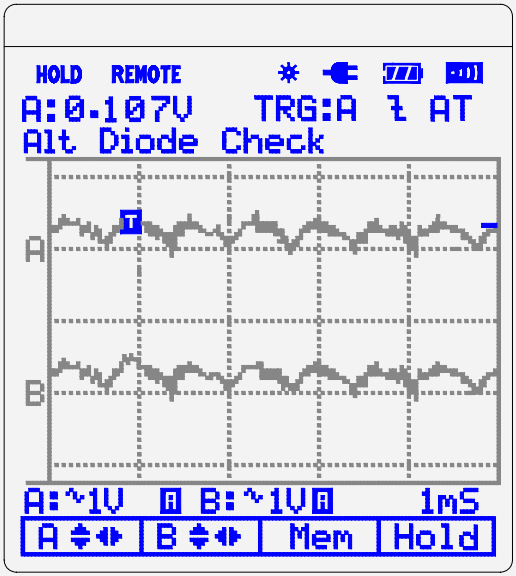
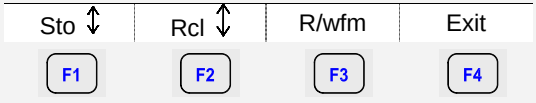
Storing a setup and a waveform

To store a setup and a waveform, do the following:

①	**Default**	
②	F3	Open the memory (Mem) menu Sto Rcl R/wfm Exit F1 F2 F3 F4
		Memory field (**M;0**) appears at the top-right corner of the display area.
③		Select the memory address you want to store in.
④	F1	Store the actual setup and waveform

1) Recalling a setup and a waveform

To recall a setup and a waveform, do the following:

①	**Default**	
②	F3	Open the **memory** menu 
		Memory field (**M;0**) appears at the top-right corner of the display area.
③		Select the memory address you want to recall from.
④	F2	View the saved setup and waveform.

The image is presented as a picture that can no longer be changed.

8. Using RS232 Software

1) Hardware and Software requirement:
   (1) IBM PC/XT/AT or Compatible Computer.
   (2) Microsoft Windows VER 3.1 or Windows 95, 98.
   (3) Serial Port for Connection with Instrument.

2) Installation of supplied software
   (1) Insert the supplied diskette into the Drive A. (or B).
   (2) Click the mouse on **"MY COMPUTER"** or **"FILE MANAGER"** ICON, then Floppy Drive A icon
   (3) When the file names are displayed click on SETUP.EXE.
   (4) Monitor program is installed and create a new directory named **"Model No."** automatically in Hard Disk.

3) Connection of PC and Instrument:
   Connect the RS-232 cable to the built-in RS-232 connector in the Instrument and to the PC serial port.

4) Communication with PC
   This section will help the user load the Meter software correctly.
   (1) Connect the RS232c cable between PC and equipment. Start the program by clicking the mouse on the icon.
   (3) Click on the SetUp button to open the setup dialog. Then select appropriate Serial Port and Baud Rate and click on the OK button.
   (4) Click on the S TIME button and type in the appropriate sampling time.
   (5) Turn off the equipment.
   (6) Turn on the equipment.
   (7) Click the "START" button with mouse to start the program.
      Start: Starts the program.
      Stop: Stops the program.

9. Maintaining the test tool

About this Chapter

This chapter covers basic maintenance procedures that can be performed by the user.

Cleaning the Test Tool

Clean the test tool with a damp cloth and a mild soap to avoid abrasion of text on the test tool. Do not use abrasives, solvents, or alcohol.

Storing the Test Tool

If you are storing the test tool for an extended period of time, charge the NI-MH battery pack before storing. It is not necessary to remove the battery pack.

Replacing and Disposing of the NI-MH Battery Pack

Warning

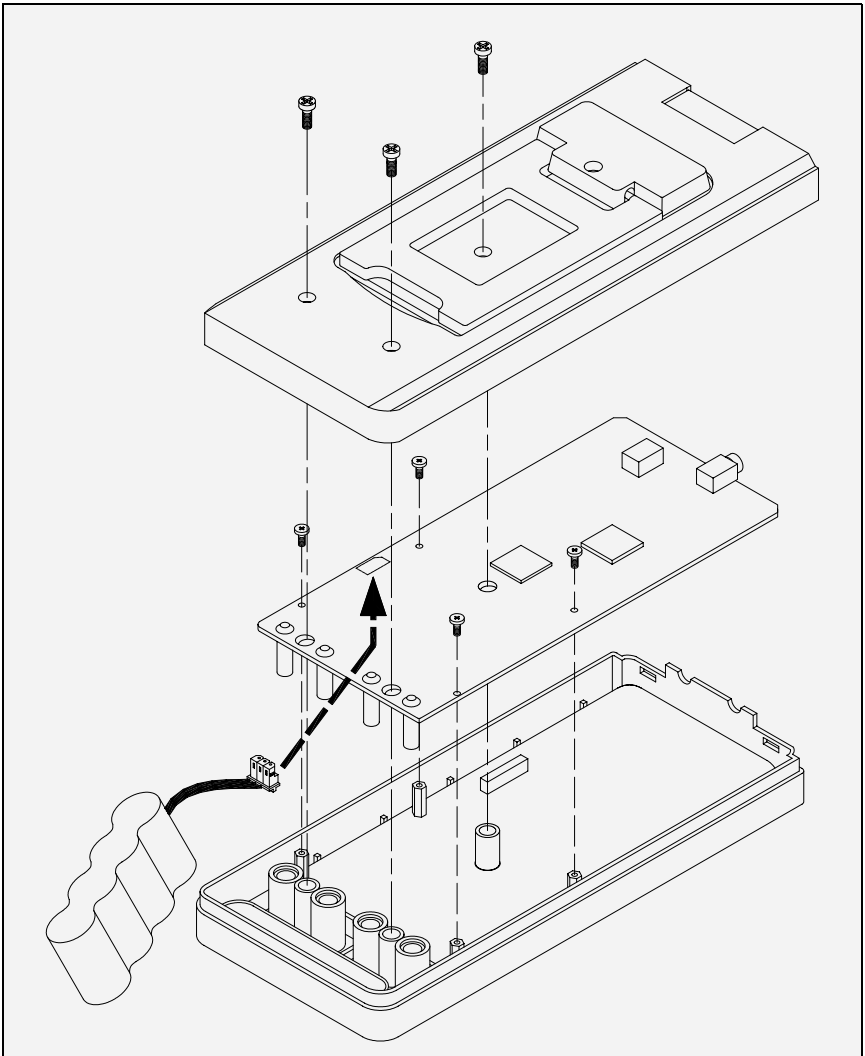
To avoid electrical shock, remove the test leads and probes before replacing the battery pack.

Note

This instrument contains NI-MH battery pack. Do not dispose of this battery pack with other solid waste. Used batteries should be disposed of by a qualified recycler or hazardous materials handler. Contact your authorized Service Center for recycling information.

To replace the battery pack, do the following:

1. Disconnect the test leads and probes both at the source and at the meter.
2. Loosen the screw with a screwdriver.
3. Lift the rear cover away from the test tool.
4. Take the battery pack out of the battery compartment.
5. Remove the battery plug from the connector.
6. Install a new battery pack.
7. Reinstall the rear cover and secure the screw.



Replacing the Battery

Appendices

Appendix A

- ✓ **Automotive test setup**
  - **Sensor function test**
  - **Actuator function test**
  - **Ignition & electrical test**
  - **Automotive setup test**

Appendix B

- ✓ **Troubleshooting**
  - **Troubleshooting guide**

Appendix A. Automotive test setup

Engine

SENSOR function test

- ABS sensor
- O2 Sensor
- ECT Sensor
- FUEL PRESS
- IAT Sensor
- Knock Sensor
- TPS Sensor
- CKP Mag
- CKP LoRes
- CKP HiRes
- CMP Mag
- CMP LoRes
- CMP HiRes
- VSS Mag
- VSS Digital
- MAP Analog
- MAP Digital
- MAF Analog
- MAF HF Digital
- MAF LF Digital
- EGR PFE Sensor
- EGR DPFE Sensor

ABS sensor

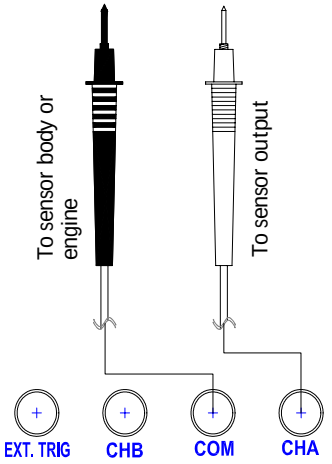
Measures and compares the alternating current signal from magnetic wheel speed sensor used in Anti Lock Brake Systems.

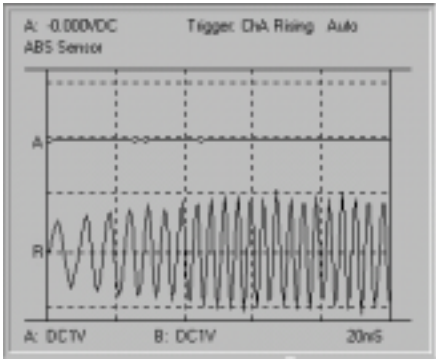
Path: FUNC ➔ F2 ➔ F1 ➔ **ABS Sensor**

ABS SENSOR

BLACK TO SENSOR BODY OR ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal ABS Sensor waveform

O2 Sensor

Measures and compares the oxygen sensor output voltage that is used to control the fuel system air and fuel ratio. The output varies depending on the oxygen level.

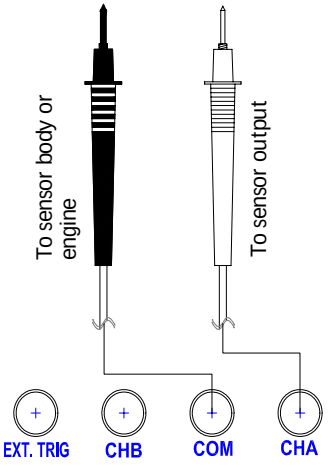
Path: FUNC ➔ F2 ➔ F1 ➔ **O2 Sensor**

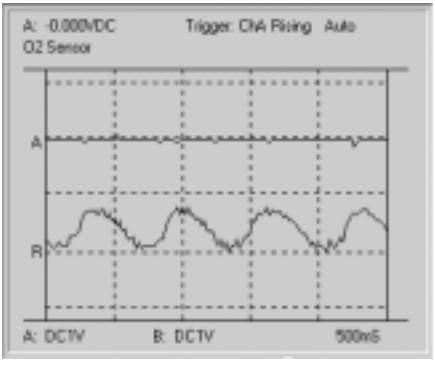
O2 SENSOR

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform varies depending on the oxygen level.

Normal O2 Sensor waveform

ECT Sensor

Measures and compares the signal from coolant temperature sensors.

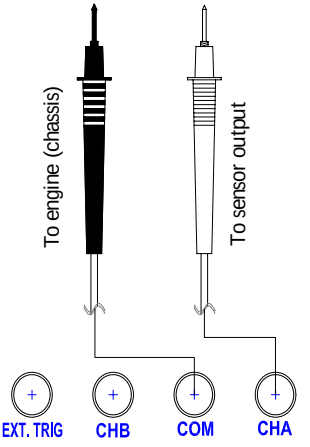
Path: FUNC ➔ F2 ➔ F1 ➔ **ECT Sensor**

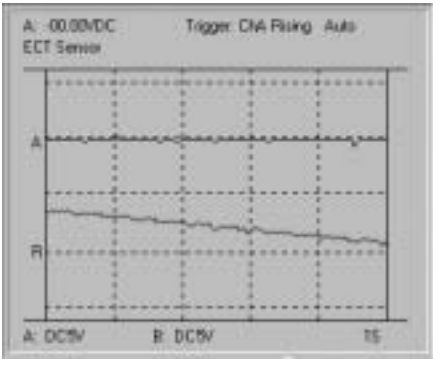
ECT SENSOR

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform decreases as engine temperature increases.

Normal ECT Sensor waveform

Fuel Temp

Measures and compares the signal from the fuel temperature sensors.

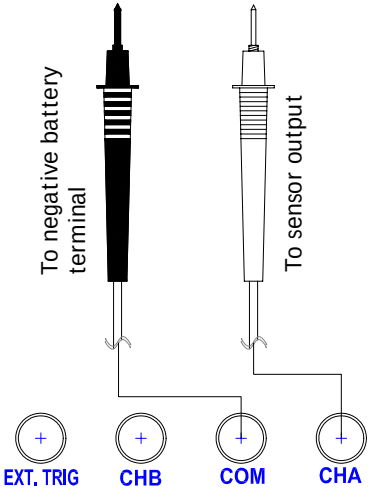
Path: FUNC ➔ F2 ➔ F1 ➔ **Fuel Temp**

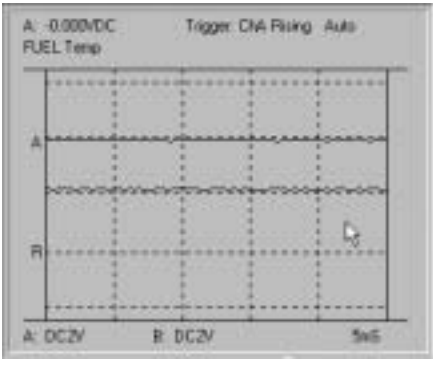
FUEL PRES

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Check that the fuel temperature changes as the vehicle is operated.

Normal Fuel Temp waveform

IAT Sensor

Measures and compares the signal from air temperature sensors.

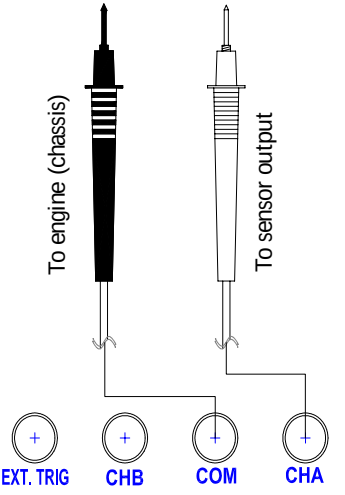
Path: FUNC ➔ F2 ➔ F1 ➔ **IAT Sensor**

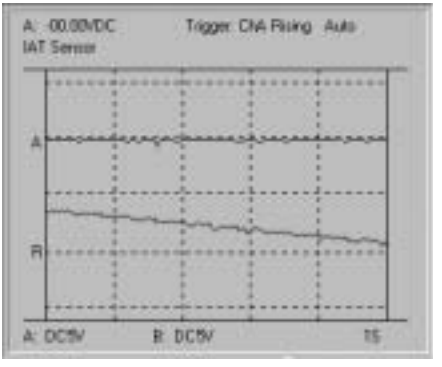
IAT SENSOR

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform decreases as the sensor heats up.

Normal IAT Sensor waveform

Knock Sensor

Measures and compares the alternating current signal from engine knock sensors.

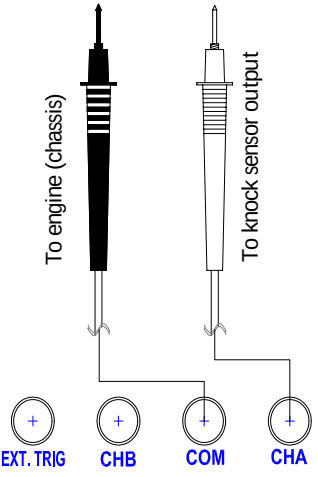
Path: FUNC ➔ F2 ➔ F1 ➔ **Knock Sensor**

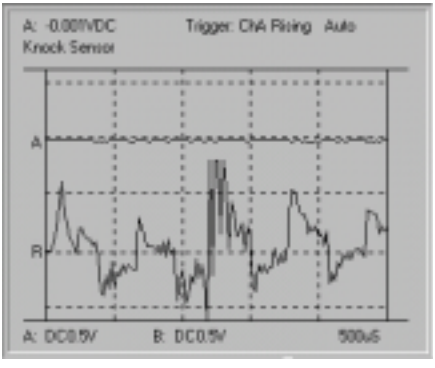
KNOCK SENSOR

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Tapping on the engine block near the sensor makes the sensor to produce a voltage.

Normal KNOCK Sensor waveform

TP Sensor

Measures and compares the waveform of Throttle Position sensors.

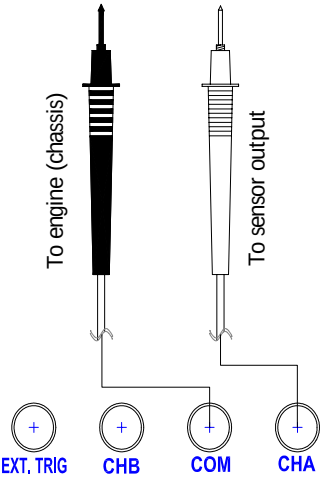
Path: FUNC ➔ F2 ➔ F1 ➔ **TP Sensor**

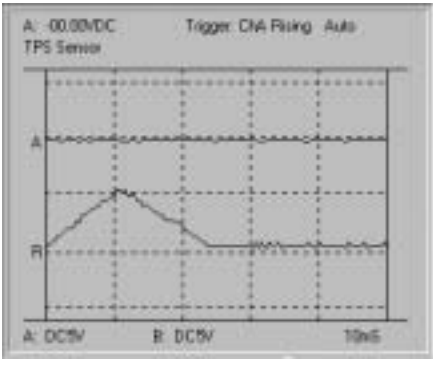
TP SENSOR

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Spikes in the slope of measured waveform indicate a worn TPS carbon track.

Normal TP Sensor waveform

CKP MAG

Measures and compares the Crankshaft magnetic sensor signal.

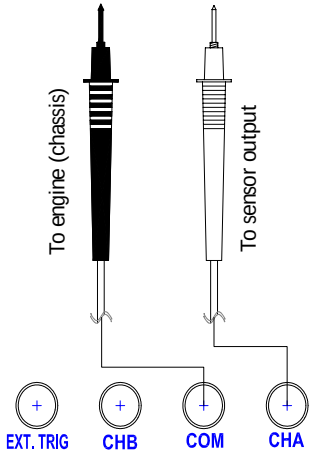
Path: FUNC ➔ F2 ➔ F1 ➔ **CKP MAG**

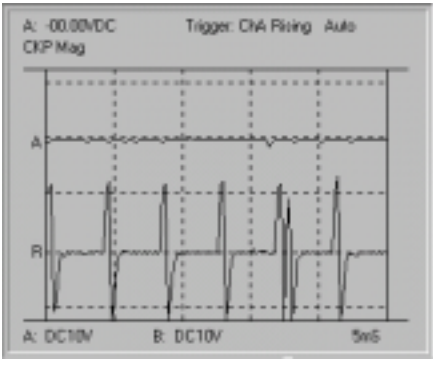
CKP MAG

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal CKP Mag Sensor waveform

CKP LoRes

Measures and compares the Crankshaft low accuracy sensor signal.

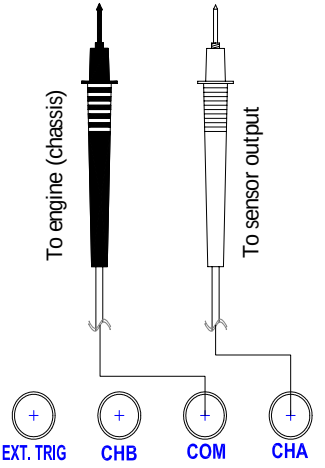
Path: FUNC ➔ F2 ➔ F1 ➔ **CKP LoRes**

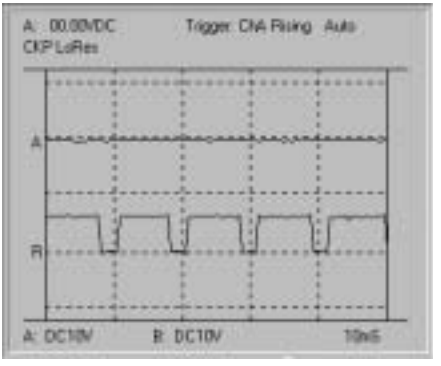
CKP LoRes

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal CKP LoRes Sensor waveform

CKP HiRes

Measures and compares the Crankshaft high accuracy sensor signal.

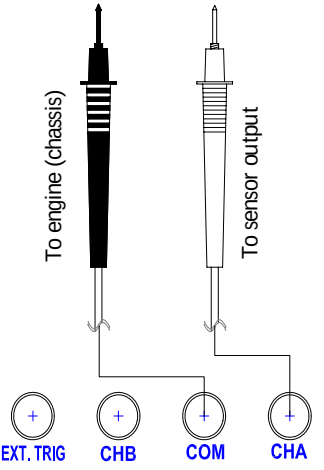
Path: FUNC ➔ F2 ➔ F1 ➔ **CKP HiRes**

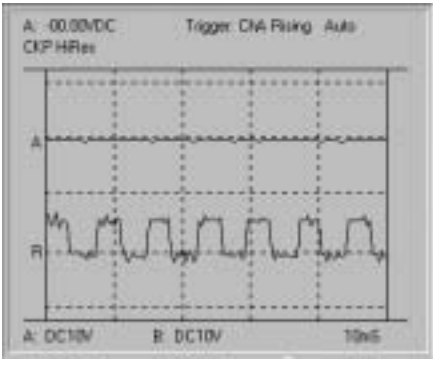
CKP HiRes

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal CKP HiRes Sensor waveform

CMP MAG

Measures and compares the Camshaft magnetic sensor signal.

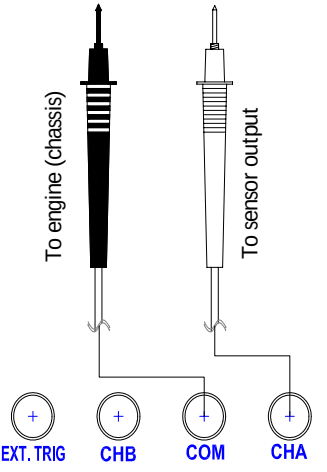
Path: FUNC ➔ F2 ➔ F1 ➔ **CMP MAG**

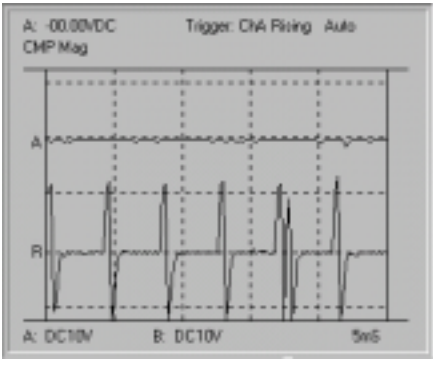
CMP MAG

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal CMP Mag Sensor waveform

CMP LoRes

Measures and compares the Camshaft low accuracy sensor signal.

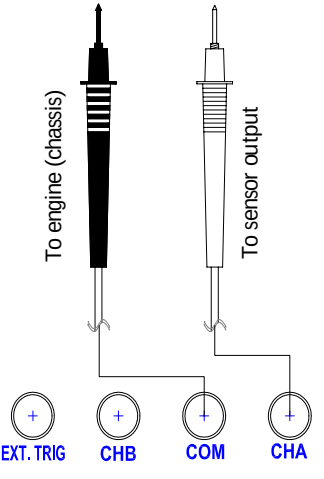
Path: FUNC ➔ F2 ➔ F1 ➔ **CMP LoRes**

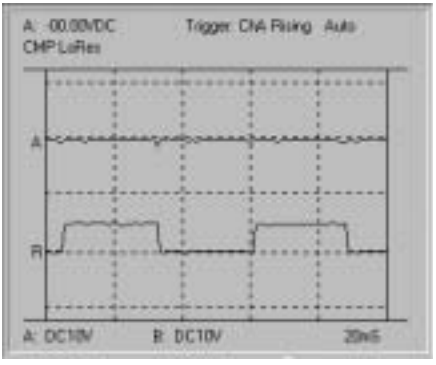
CMP LoRes

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal CMP LoRes Sensor waveform

CMP HiRes

Measures and compares the Camshaft high accuracy sensor signal.

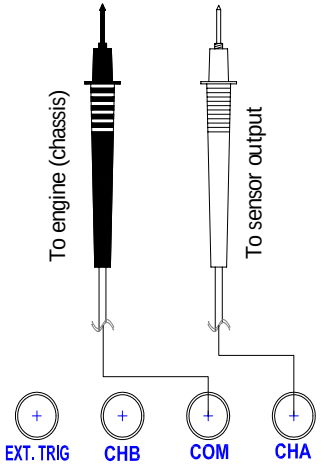
Path: FUNC ➔ F2 ➔ F1 ➔ **CMP HiRes**

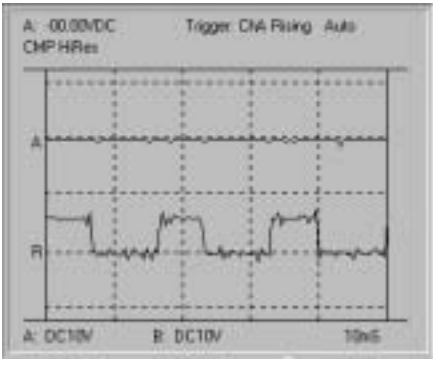
CMP HiRes

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal CMP HiRes Sensor waveform

VSS MAG

Measures and compares vehicle speed sensor-magnetic signal.

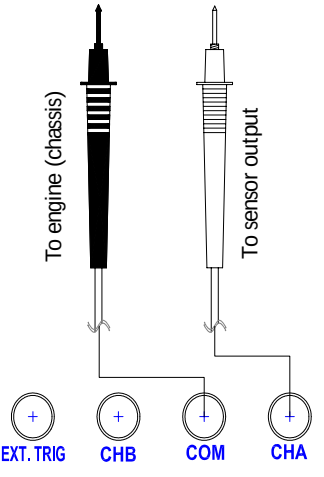
Path: FUNC ➔ F2 ➔ F1 ➔ **VSS MAG**

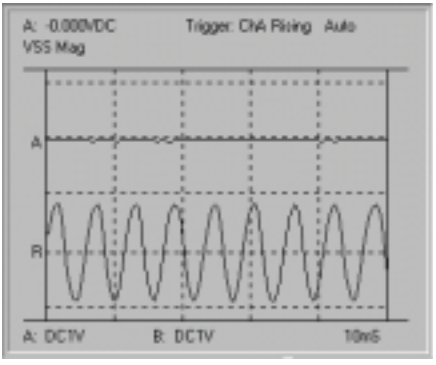
VSS MAG

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal VSS Mag Sensor waveform

VSS Digital

Measures and compares Vehicle Speed Sensor signal - Digital.

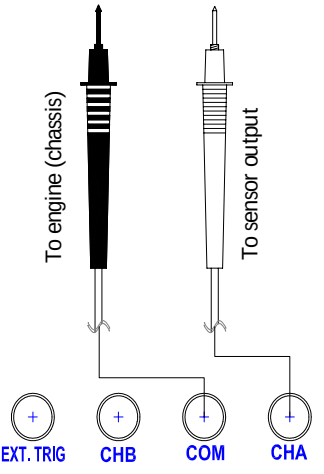
Path: FUNC ➔ F2 ➔ F1 ➔ **VSS MAG**

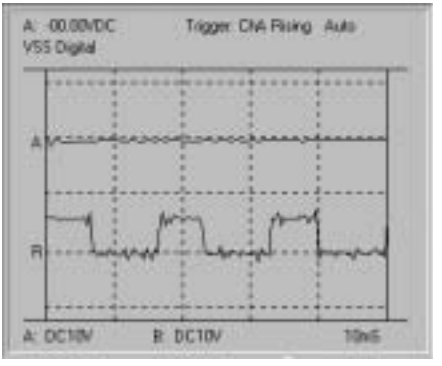
VSS DIGITAL

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal VSS Digital waveform

MAP Analog

Measures and compares signals from MAP sensor with an analog continuous voltage output signal.

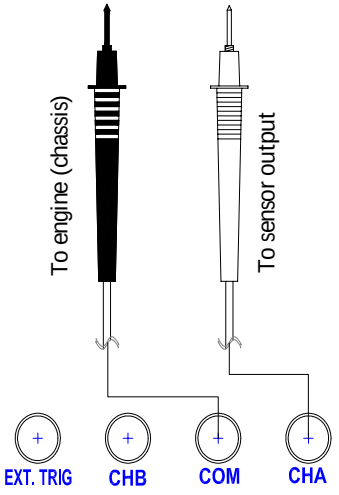
Path: FUNC ➔ F2 ➔ F1 ➔ **MAP Analog**

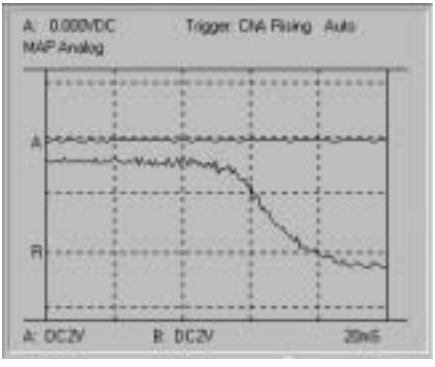
MAP ANALOG

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform rises as the intake manifold absolute pressure rises.

Normal Map Analog Sensor waveform

MAP Digital

Measures and compares signals from MAP sensor with a digital voltage output signal.

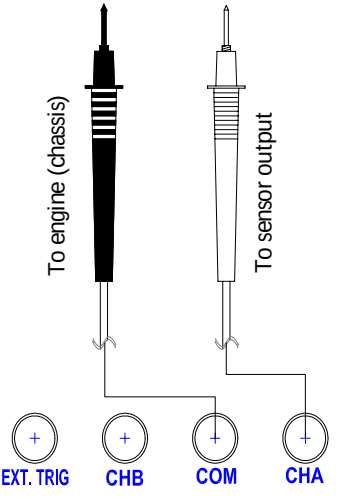
Path: FUNC ➔ F2 ➔ F1 ➔ **MAP Digital**

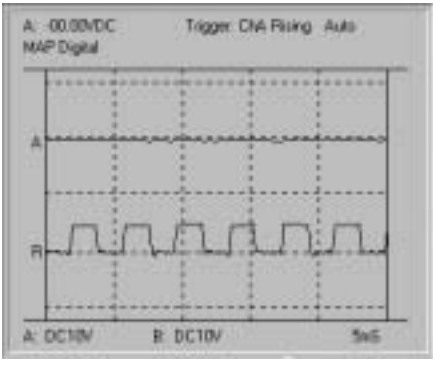
MAP DIGITAL

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal Map Digital Sensor waveform

MAF Analog

Measures and compares the MAF sensors signal with an analog continuous voltage output.

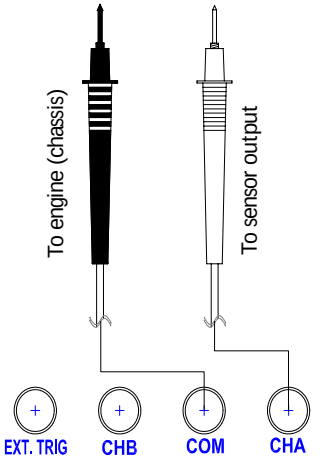
Path: FUNC ➔ F2 ➔ F1 ➔ **MAF Analog**

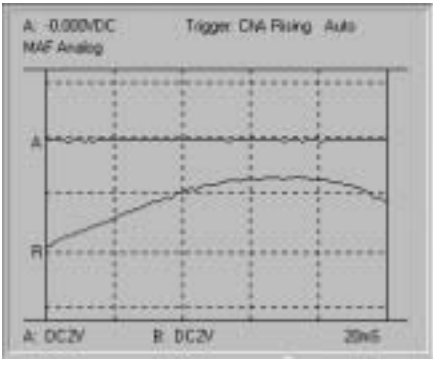
MAF Analog

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform rises as more air flows in the engine.

Normal MAF Analog Sensor waveform

MAF HF Digital

Measures and compares the MAF sensors signal with a high frequency digital output.

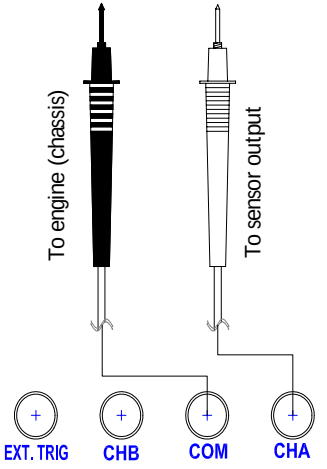
Path: FUNC ➔ F2 ➔ F1 ➔ **MAF HF Digital**

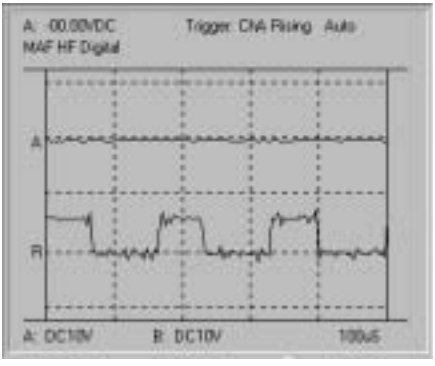
MAF HF DIGITAL

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal MAF HF Digital waveform

MAF LF Digital

Measures and compares the MAF sensors signal with a low frequency digital output.

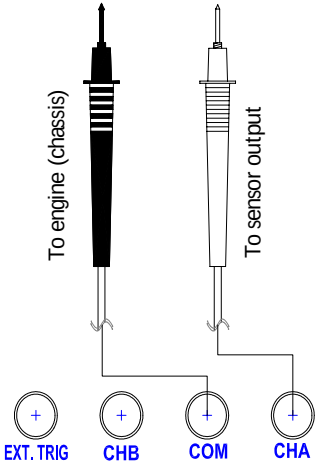
Path: FUNC ➔ F2 ➔ F1 ➔ **MAF LF Digital**

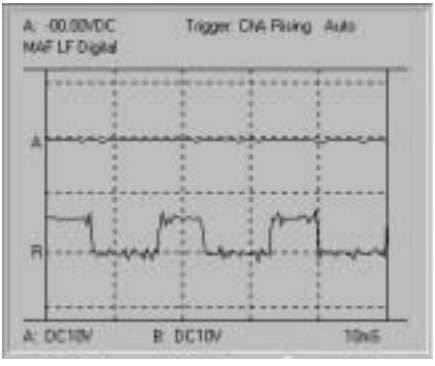
MAF LF DIGITAL

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Measured waveform should be stable.

Normal MAF LF Digital waveform

EGR PFE

Measures and compares an EGR PFE sensor signal used to control the Exhaust Gas Re-circulation solenoid valves.

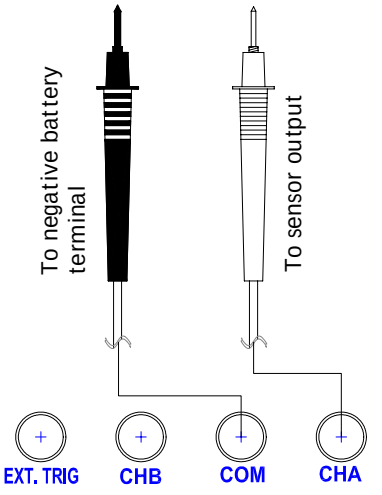
Path: FUNC ➔ F2 ➔ F1 ➔ **EGR PFE**

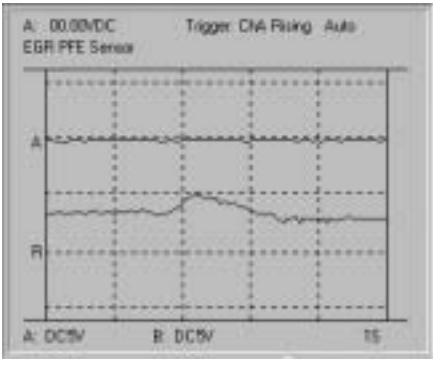
EGR PFE

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Sensor voltage varies with different engine.

Normal EGR PFE Sensor waveform

EGR DPFE

Measures and compares EGR-DPFE sensor signals used to control the Exhaust Gas Re-circulation solenoid valves.

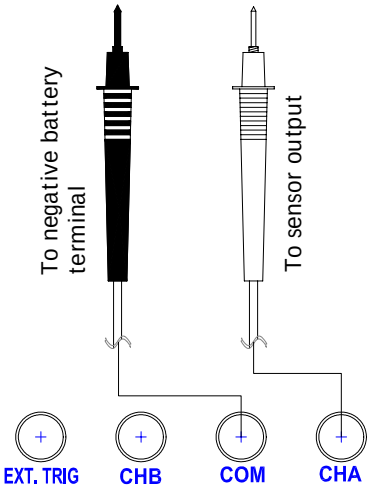
Path: FUNC ➔ F2 ➔ F1 ➔ **EGR DPFE**

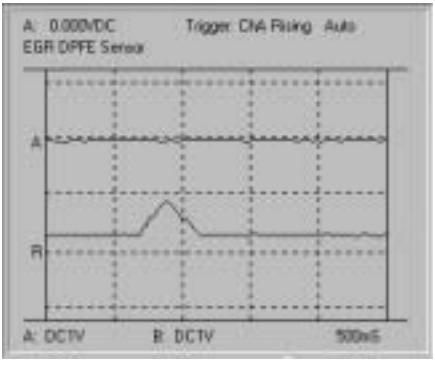
EGR DPFE

BLACK TO SENSOR BODY OR

ENGINE (CHASSIS)

RED TO SENSOR OUTPUT





Sensor voltage varies with different engine.

Normal EGR DPFE Sensor waveform

ACTUATOR Function Test

- **Injector C/LIM**
- **Injector N/LIM**
- **Injector PNP**
- **Mixture Control Sol.**
- **EGR Control Sol.**
- **ISC STEP Motor**
- **ISC Motor**
- **ISC solenoid**
- **Trans Shift Sol.**
- **Turbo Boost Sol.**
- **Glow Plug Amp.**

Injector C/LIM

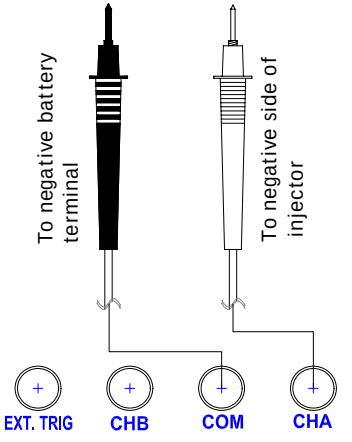
Measures and compares the signal from fuel injection systems that uses C/LIM type.

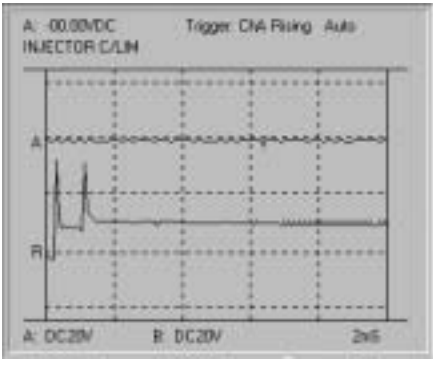
Path: FUNC ➔ F2 ➔ F2 ➔ **Injector C/LIM**

INJECTOR C/LIM

BLACK TO NEGATIVE BATTERY TERMINAL

RED TO NEGATIVE SIDE OF INJECTOR





Verify all injectors are similar.

Normal Injector C/LIM waveform

Injector N/LMT

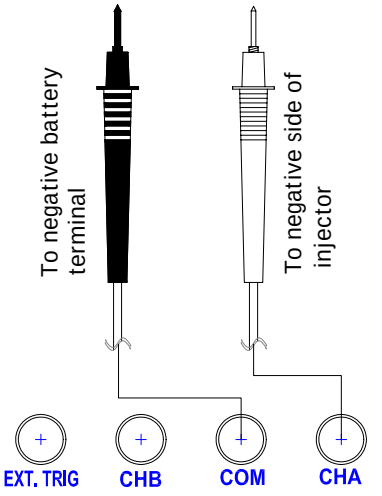
Measures and compares the signal from fuel injection systems that uses N/LMT type.

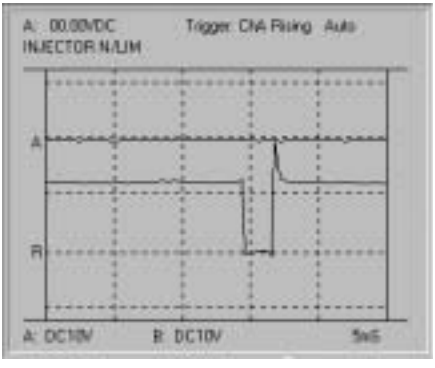
Path: FUNC ➔ F2 ➔ F2 ➔ **Injector N/LMT**

INJECTOR N/LMT

BLACK TO NEGATIVE BATTERY TERMINAL

RED TO NEGATIVE SIDE OF INJECTOR





Verify all injectors are similar.

Normal Injector N/LMT waveform

Injector Positive Negative Positive

Measures and compares the signal from fuel injection systems that uses PNP type.

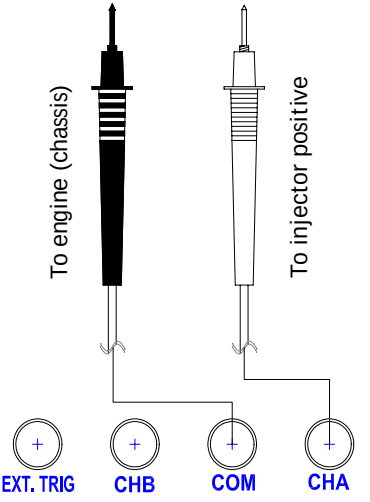
Path: FUNC ➔ F2 ➔ F2 ➔ **Injector PNP**

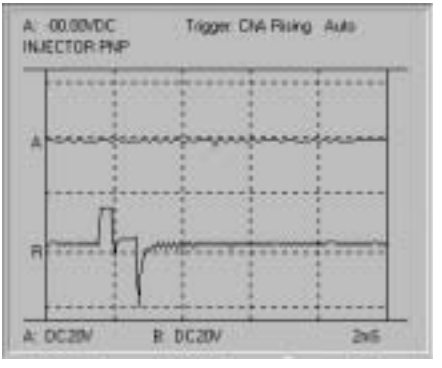
INJECTOR PNP

BLACK TO ENGINE

RED TO INJECTOR POSITIVE

CONNECTION





Verify all injectors are similar.

Normal Injector PNP waveform

Mixture Solenoid

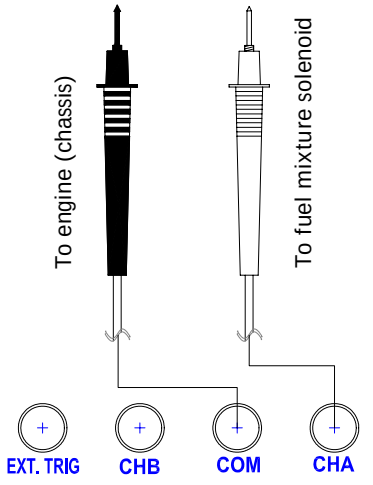
Measures and compares pulse-width-modulated signals that control fuel mixture solenoids.

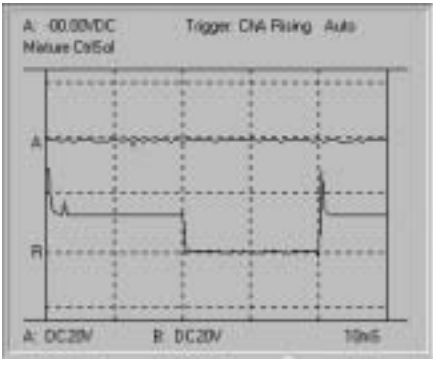
Path: FUNC ➔ F2 ➔ F2 ➔ **Mixture Solenoid**

MIXTURE SOLENOID

BLACK TO ENGINE CHASSIS

RED TO SOLENOID





Normally duty cycle should be approximately 50%.

Normal Mixture Solenoid waveform

EGR Control Sol

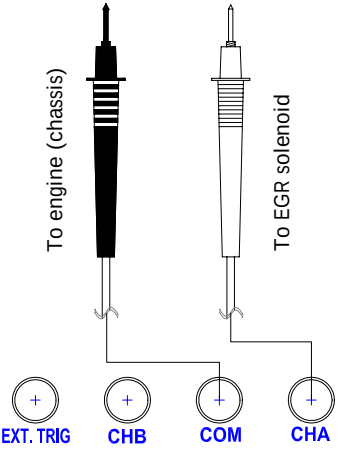
Measures and compares Pulse Width Modulated signals that control exhaust gas re-circulation solenoid valves.

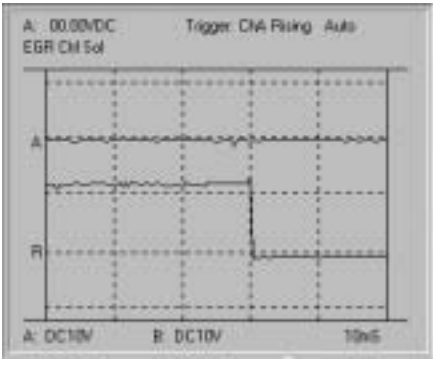
Path: FUNC ➔ F2 ➔ F2 ➔ **EGR Control sol.**

EGR CONTROL SOL

BLACK TO ENGINE

RED TO SOLENOID





Duty cycle changes with engine conditions.

Normal EGR Control sol. waveform

ISC Step Motor

Measures and compares an idle speed control step motor signal.

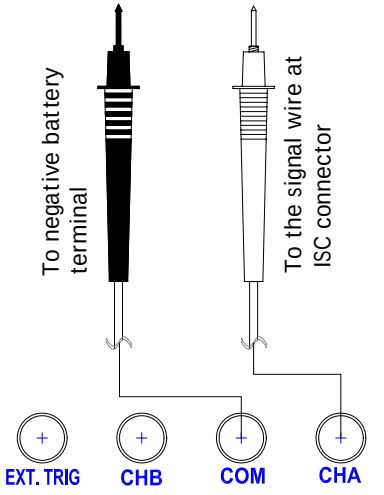
Path: FUNC ➔ F2 ➔ F2 ➔ **ISC Step Motor**

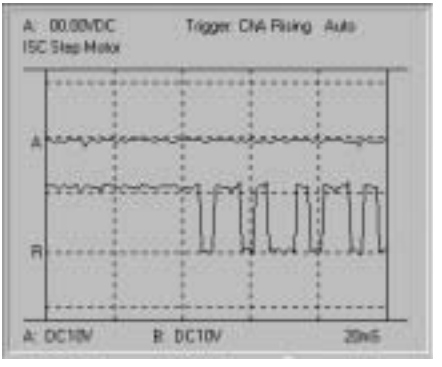
ISC STEP MOTOR

BLACK TO ENGINE

RED TO THE SIGNAL WIRE AT

ISC CONNECTOR





Check for asynchronous waveform.

Normal ISC Motor waveform

ISC Motor

Measures and compares an idle speed control step motor signal.

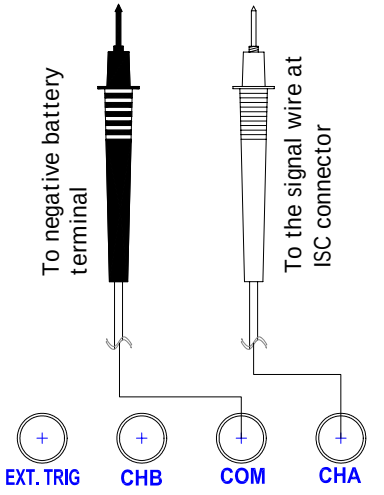
Path: FUNC ➔ F2 ➔ F2 ➔ **ISC Motor**

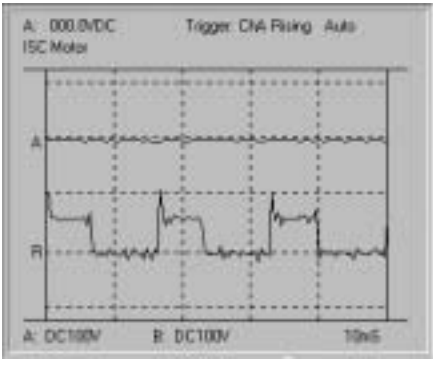
ISC MOTOR

BLACK TO ENGINE

RED TO THE SIGNAL WIRE AT

ISC CONNECTOR





Check for asynchronous waveform.

Normal ISC Motor waveform

ISC SOL

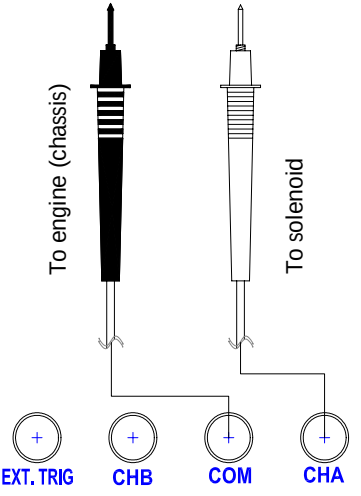
Measures and compare an idle speed control solenoid signal.

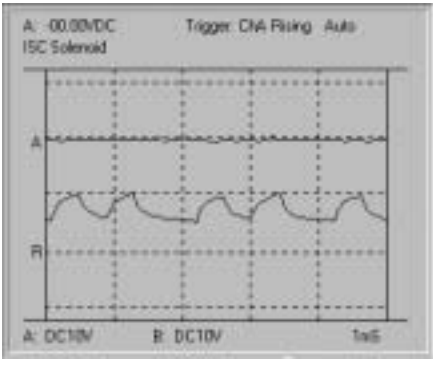
Path: FUNC ➔ F2 ➔ F2 ➔ **ISC SOL**

ISC SOL

BLACK TO ENGINE (CHASSIS)

RED TO SOLENOID





As the solenoid drive current increases, DC level decreases.

Normal IAC SOL waveform

Trans Sol

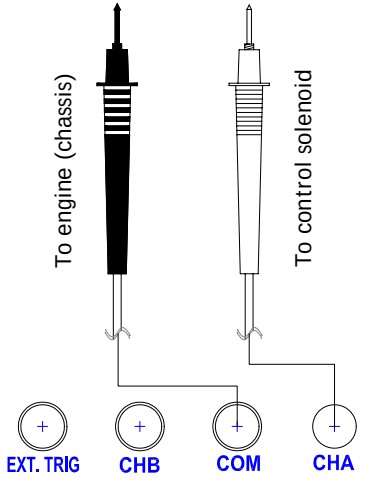
Measures and compares Pulse Width Modulated signals used to control the various pressure valve solenoids found in electronically controlled automatic transmissions.

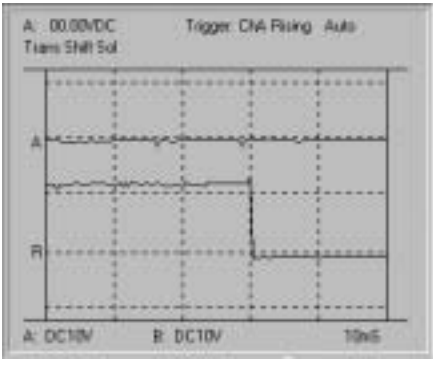
Path: FUNC ➔ F2 ➔ F2 ➔ **Trans Sol**

TRANS SOL.

BLACK TO ENGINE

RED TO SOLENOID





Measures PWM signals used to control the various pressure valve solenoid

Normal Trans Sol waveform

Turbo Boost Sol

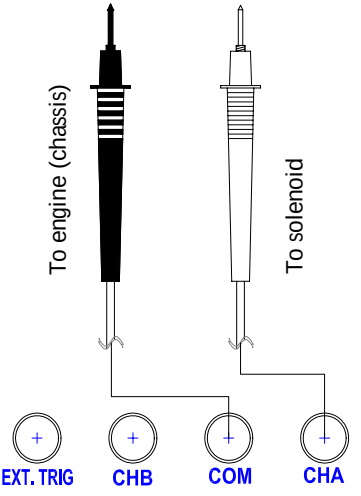
Measures and compares the pulse width modulated signal that controls the solenoid regulating the boost pressure.

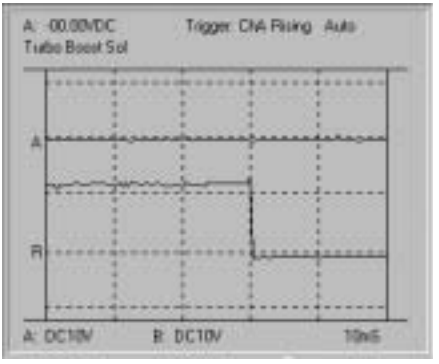
Path: FUNC ➔ F2 ➔ F2 ➔ **Turbo Boost**

TURBO BOOST

BLACK TO ENGINE

RED TO SOLENOID





Measures PWM signal that controls the solenoid regulating the boost pressure

Normal Turbo Boost waveform

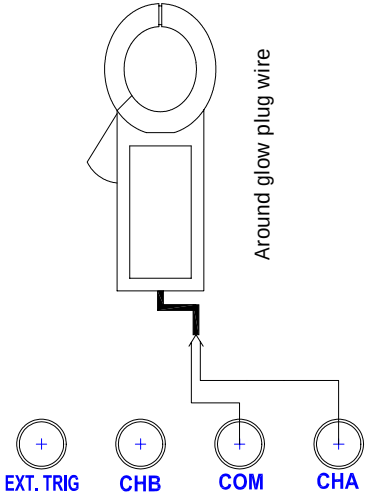
Glow Plug Amp

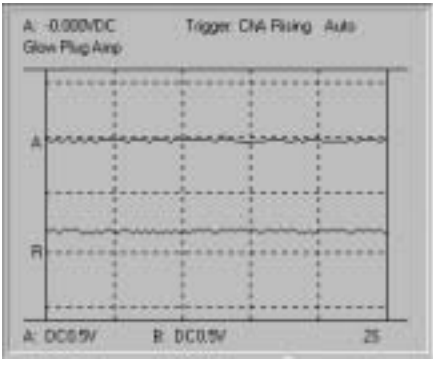
Measures and compares the current draw from glow plugs when the ignition is turned on with a cold engine.
* You need optional DC clamp adaptor to measure Glow Plug Amp.

Path: FUNC ➔ F2 ➔ F2 ➔ **Glow Plug Amp.**

TURBO BOOST

CONNECT THE DC CLAMP ADAPTOR TO GLOW PLUG WIRE.





Glow Plug Current is an indicator of proper glow plug function.

Normal Glow Plug Amp waveform

IGNITION & ELECTRICAL Function Test

- **PIP**
- **SPOUT**
- **DI Primary**
- **DI Secondary**
- **EI Primary**
- **EI Secondary**
- **Power Circuit**
- **VREF Circuit**
- **Ground Circuit**
- **Alt Output**
- **Alt Field VR**
- **Alt Diode Check**

PIP

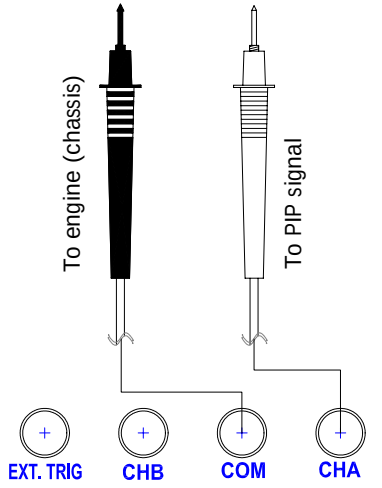
Measures and compares a Profile Ignition Pick-up signal.

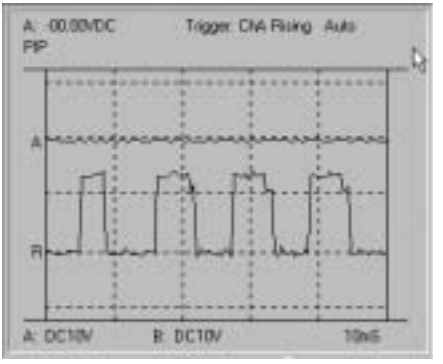
Path: FUNC ➔ F2 ➔ F3 ➔ **PIP**

PIP

BLACK TO ENGINE CHASSIS

RED TO PIP SIGNAL





Check the timing relationship between reference waveform and measured waveform.

Normal PIP waveform

SPOUT

Measure and compare a Spark Out signal.

Path: FUNC ➔ F2 ➔ F3 ➔ **SPOUT**

SPOUT

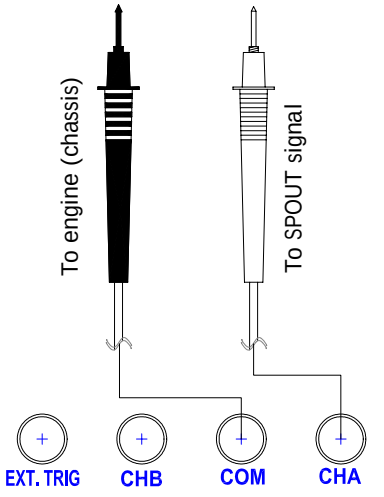
BLACK TO ENGINE CHASSIS

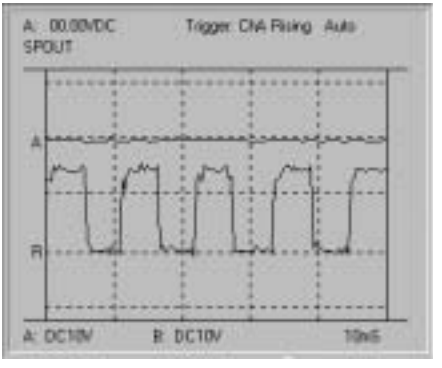
RED TO SPOUT SIGNAL

TEST: RUN THE ENGINE AT

DIFFERENT RPM LEVELS OR

UNDER LOAD.





Check the timing relationship between reference waveform and measured waveform.

Normal SPOUT waveform

DI Primary

Measures and compares the ignition waveforms for all cylinders on standard Distributor ignition systems.

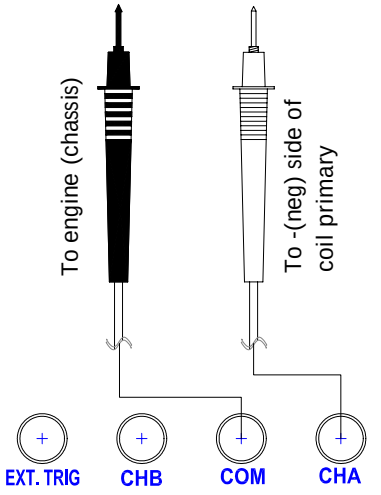
Path: FUNC ➔ F2 ➔ F3 ➔ **DI Primary**

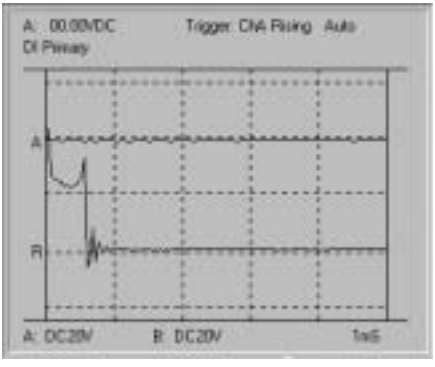
DI PRIMARY

BLACK TO ENGINE CHASSIS

RED TO NEGATIVE SIDE OF

THE IGNITION COIL





Look for abnormally long or short dwell periods in the waveform.

Normal DI Primary waveform

DI Secondary

Measures and compares distributor ignition secondary waveforms.
* You need optional capacitive pick-up to measure DI Secondary.

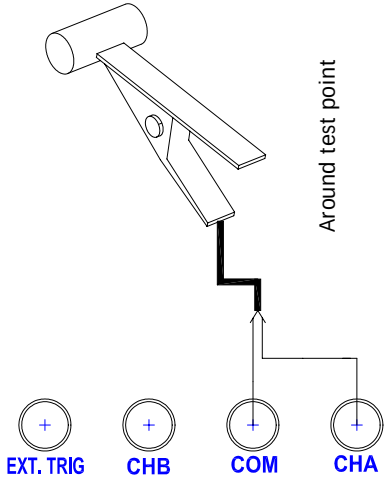
Path: FUNC ➔ F2 ➔ F3 ➔ **DI Secondary**

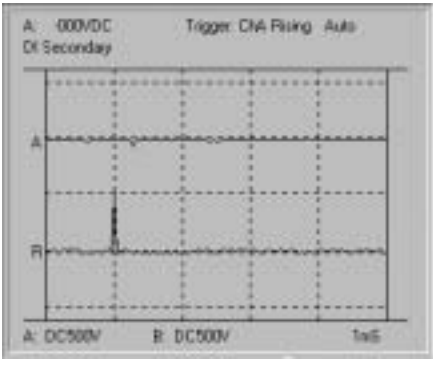
DI SECONDARY

CONNECT THE SECONDARY

ADATOR, CAPACITIVE PICKUP,

AND INDUCTIVE PICKUP





Compare measured waveform with reference waveform.

Normal DI Secondary waveform

EI Primary

Measures and compares electrical ignition primary waveforms.

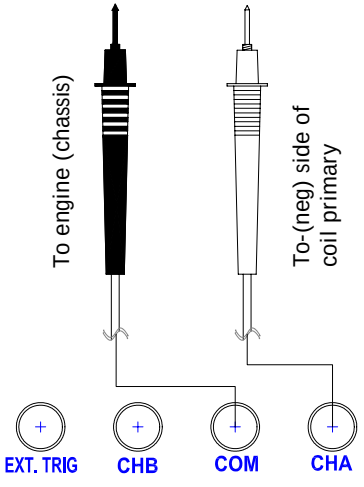
Path: FUNC ➔ F2 ➔ F3 ➔ **EI Primary**

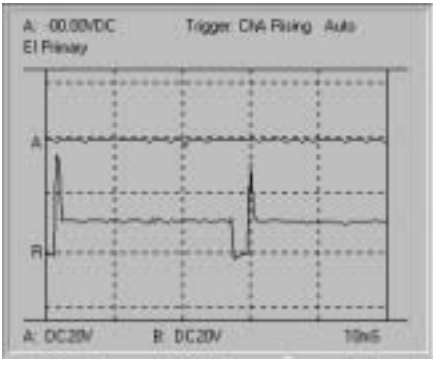
EI PRIMARY

BLACK TO ENGINE CHASSIS

RED TO NEGATIVE SIDE OF

THE COIL PRIMARY





Look for abnormally long or short dwell periods in the waveform.

Normal EI PRI waveform

EI Secondary

Measures and compares electrical ignition secondary waveforms.
Measures and compares distributor ignition secondary waveforms.
* You need optional capacitive pick-up to measure EI Secondary.

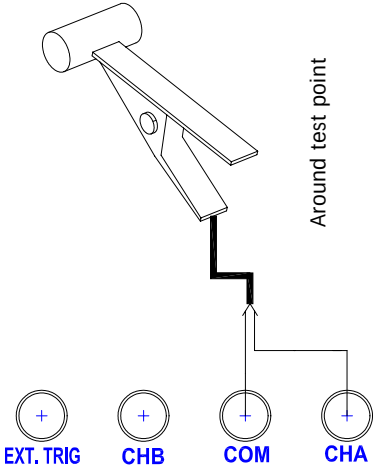
Path: FUNC ➔ F2 ➔ F3 ➔ **EI Secondary**

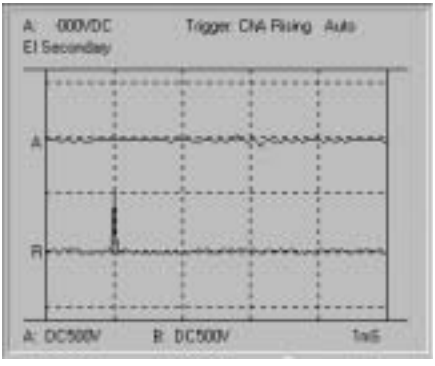
EI SECONDARY

CONNECT THE SECONDARY

ADATOR, CAPACITIVE PICKUP,

AND INDUCTIVE PICKUP





Compare measured waveform with reference waveform.

Normal EI Secondary waveform

Power Circuit

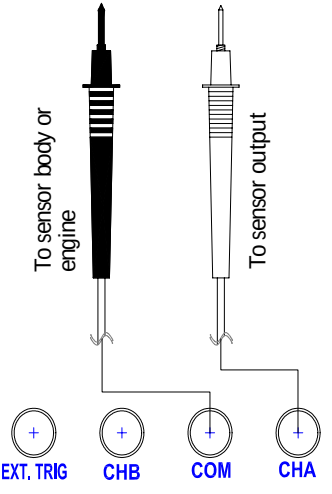
Measures and compares the + 12V battery voltage of a device.

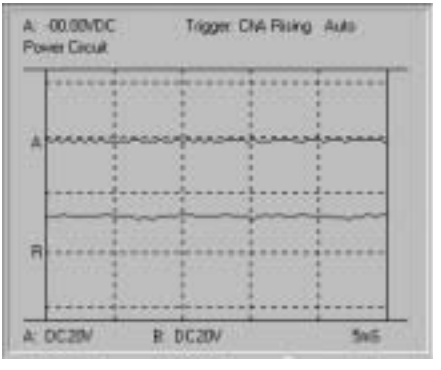
Path: FUNC ➔ F2 ➔ F3 ➔ **Power Circuit**

POWER CIRCUIT

BLACK TO BATTERY –(NEG)

RED TO POWER CONNECTION





Monitor the +12V battery voltage of a device.

Normal Power Circuit waveform

VREF Circuit

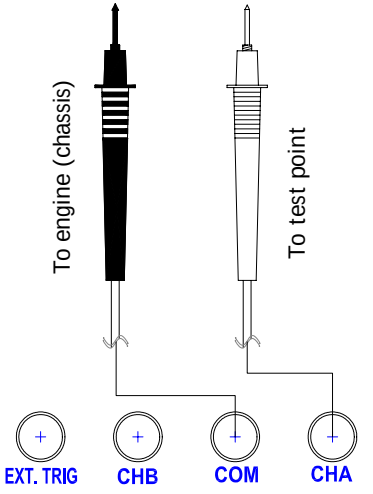
Measures and compares the reference voltage of a device.

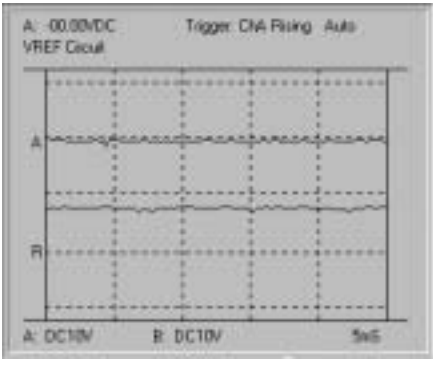
Path: FUNC ➔ F2 ➔ F3 ➔ **Vref Circuit**

VREF CIRCUIT

BLACK TO ENGINE CHASSIS

RED TO TEST POINT





Level should not change more than 200 mV under the regular operation.

Normal Vref Circuit waveform

Ground Circuit

Measures and compares the ground connection voltage of a device.

Path: FUNC ➔ F2 ➔ F3 ➔ **Ground Circuit**

GROUND CIRCUIT

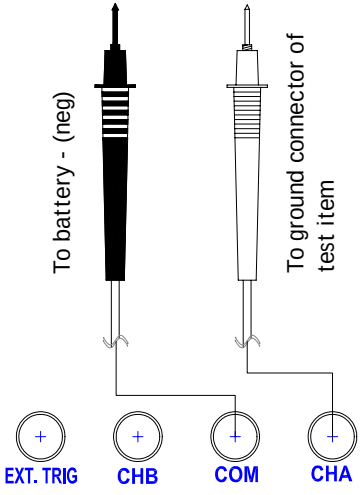
BLACK TO BATTERY – (NEG).

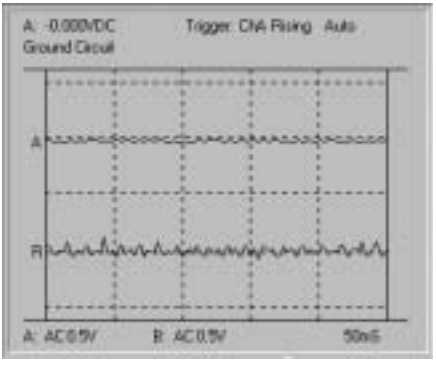
RED TO GROUND CONNECTOR

OF THE SENSOR OR TEST

POINT.

TEST: RUN THE ENGINE.





Monitor the voltage drop that should be less than 0.1V.

Normal Ground Circuit waveform

Alt Output

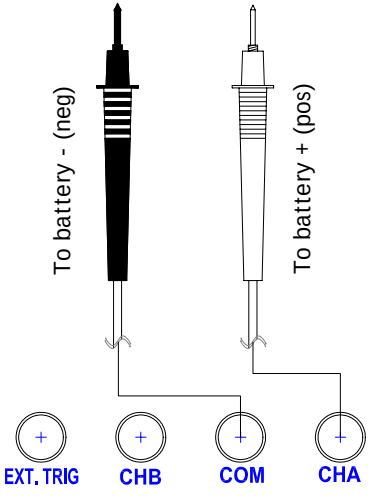
Measures and compares the alternator output voltage with the engine running.

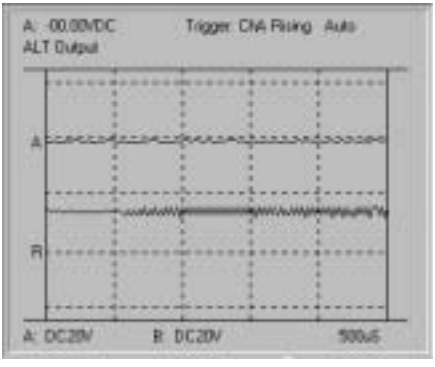
Path: FUNC ➔ F2 ➔ F3 ➔ **Alt Output**

ALT OUTPUT

BLACK TO BATTERY – (NEG)

RED TO BATTERY + (POS)





Conduct this test with engine running and A/C off.

Normal Alt Out waveform

Alternator Field VR

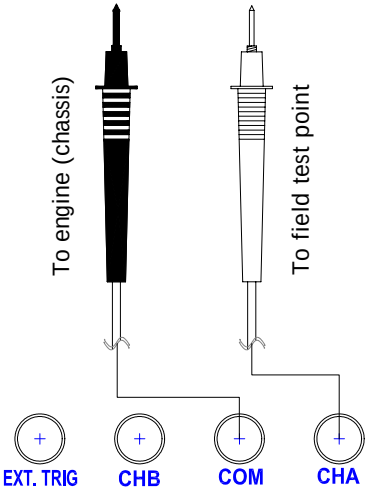
Measures and compares the pulse width modulated field control signal used by the alternator to regulate the output.

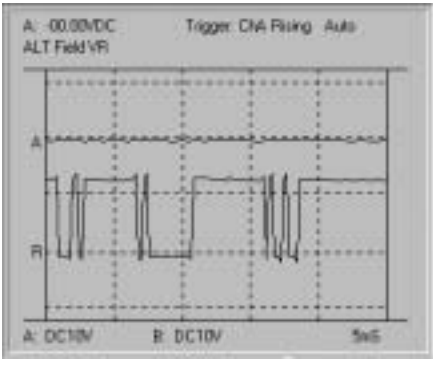
Path: FUNC ➔ F2 ➔ F3 ➔ **Alt Field VR**

ALT FIELD VR

BLACK TO ENGINE (CHASSIS)

RED TO FIELD TEST POINT





Measures PWM field control signal to regulate its output.

Normal Alt F/VR waveform

Alternator Diode

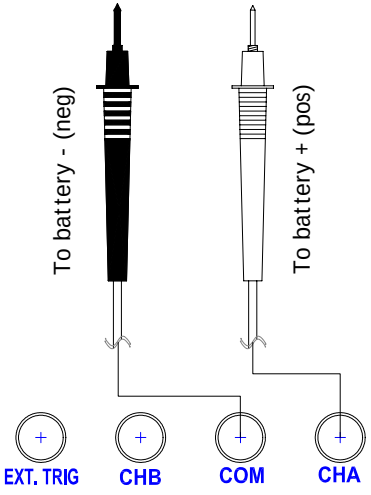
Measure and compares alternator diode waveforms
Alternator diode allows current to pass in one direction.

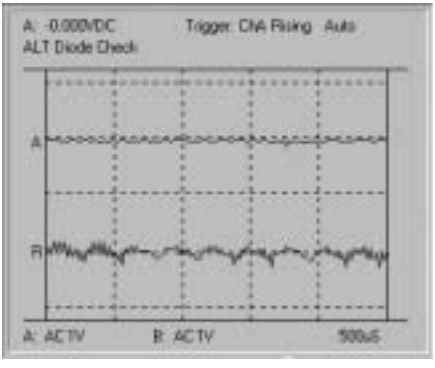
Path: FUNC ➔ F2 ➔ F3 ➔ **Alt Diode**

ALT DIODE

BLACK TO BATTERY – (NEG)

RED TO BATTERY +(POS)





If the diodes are defective, it produces high AC voltage.

Normal Alt Diode waveform

Automotive test setup table

	SENSOR TESTS	ACTUATOR TESTS	ELECTRICAL & IGNITION
1	ABS Sensor	Injector C/LIM	PIP
2	O2 Sensor	Injector N/LIM	SPOUT
3	ECT Sensor	Injector PNP	DI Primary
4	FUEL TEMP	Mixture ctrl sol	DI Secondary
5	IAT Sensor	EGR CTRL sol	EI Primary
6	Knock Sensor	ISC Step Motor	EI Secondary
7	TPS Sensor	ISC Motor	Power Circuit
8	CKP Mag	ISC Solenoid	VREF Circuit
9	CKP LoRes	Trans shift Sol	Ground Circuit
10	CKP HiRes	Turbo boost sol	Alt Output
11	CMP Mag	Glow plug Amps	Alt Field VR
12	CMP LoRes		Alt Diode check
13	CMP HiRes		
14	Vss Mag		
15	Vss Digital		
16	MAP Analog		
17	MAP Digital		
18	MAF Analog		
19	MAF HF Digital		
20	MAF LF Digital		
21	EGR PFE Sensor		
22	EGR DPFE Sensor		
T	22	11	12

Appendix B. Troubleshooting

Troubleshooting guide

If you experience trouble with your instrument, try these corrective actions before concluding that the instrument needs repair.

1. Make sure you are using fresh NI-MH battery pack or fully charged rechargeable battery pack. If you are using the AC/DC power adapter, make sure the adapter is plugged into an appropriate live power source.

2. If the buttons do not respond to your control or the contrast is set such that the display is unreadable, remove the power source while the instrument is on. Wait 15 minutes, and then restore power and try operations.

3. If you still experience difficulty, check your connections and reread the usage instructions.

4. If meter is frozen while you control the trigger level:

   If you set the trigger level to normal (NOR) mode, trigger level must be the same level of waveform. Meter does not trigger if trigger level set above or below waveform.

   If you set the trigger level to Auto (AT) mode, you do not need to control the trigger level.

   In rare cases, your instrument may require servicing. There are no user-serviceable parts inside the instrument. For service, return the instrument to your customer service center.

MEMO

MEMO

MEMO

MEMO