

USER'S MANUAL

TIF280

**AUTOMOTIVE
MULTIMETER**

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1) SAFETY

This manual contains information and warnings that must be followed for operating the instrument safely and maintaining the instrument in a safe operating condition. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired.

TERMS IN THIS MANUAL

WARNING identifies conditions and actions that could result in serious injury or even death to the user.

CAUTION identifies conditions and actions that could cause damage or malfunction in the instrument.

INTERNATIONAL ELECTRICAL SYMBOLS



Attention ! Refer to the explanation in Manual



Dangerous Voltage



Ground



Double Insulation



Fuse



AC—Alternating Current



DC—Direct Current



Either DC or AC

Safety: The instruments meet the requirements for double insulation to IEC1010-1(1995), EN 61010-1(1995), UL3111-1(6.1994), CSA C22.2 NO. 1010-1-92 to:

terminal **+**: Installation category II, 750V ac.
Installation category II, 1000V dc.
terminal mA/A: Installation category II, 600V ac.
Installation category II, 250V dc.

E.M.C. : The instruments meet EN 55011(3.1991) and EN 50082-1(1992)

WARNING

To avoid electrical shock hazard or damage to the meter, do not exceed the overload level shown in **TABLE 1**

FUNCTION	TERMINALS	OVERLOAD LEVEL
DC VOLTAGE	+ & COM	1000VDC or Vpeak
AC VOLTAGE		
mV MILLI-VOLT		600VDC or VAC rms
Hz FREQUENCY		
Ω RESISTANCE		
AUDIBLE CONTINUITY		
ALTERNATOR TESTER		
FAULT CODE		
DTC-DECODER		
Δ° DWELL ANGLE		
% DUTY CYCLE		
ms INJECTION DETECTOR		
$^\circ\text{C}^\circ\text{F}$ TEMPERATURE		
O ₂ -SENSOR		
DIODE TEST		
RPM	RPM + & -	
mA A CURRENT	mA A & COM	10A*/600V

* 10A CONTINUOUS; 20A FOR 30 SECONDS MAXIMUM, 5 MINUTES COOL DOWN INTERVAL

TABLE 1

WARNING

To reduce the risk of fire or electric shock, do not expose this product to rain or moisture.

To avoid electrical shock hazard, observe the proper safety precautions when working with voltages above 60 VDC or 25 VAC rms. These voltage levels pose a potential shock hazard to the user. Do not touch test lead tips or the circuit being tested while power is applied to the circuit being measured.

Inspect test leads, connectors, and probes for damaged insulation or exposed metal before using the instrument. If any defects are found, replace them immediately. The screw on alligator clips test lead accessory provided is to be used in applications not greater than 30Vrms.

Never attempt a voltage measurement with the test lead inserted into the mA A input jack. You might be injured or damage the meter.

CAUTION

Disconnect the test leads from the test points before changing functions. Always set the instrument to the highest range and work downward for an unknown value if you are using manual ranging mode. Always use the correct replacement fuse. Check the manual for proper part number.

If the car engine has been running, do not place the instrument and its accessories near the engine or the exhaust manifold which might be hot and can damage the meter.

2) INTRODUCTION

The TIF 280 is a hand held, battery operated professional quality automotive meter for today's complex automotive electronic system diagnostic and troubleshooting. The measuring functions include DC Voltage, AC Voltage, DC Current, AC Current, Resistance, Frequency, Duty Cycle, RPM, Dwell Angle, Temperature, ms Fuel Injection Detector for both Port Fuel Injector (PFI) & Throttle Body Injector (TBI), Diode Tester, Continuity Tester, Fault Code detector, DTC-Decoder, O₂-Sensor tester, and Alternator Tester.

Pushbutton functions include 4000 Counts Fast Measuring mode, 40,000 Counts High Resolution Slow Measuring mode, Data Hold, Auto or Manual Ranging, 18 Data Store & Recall, Relative Zero mode, Relative Percent Change mode, 50ms Record mode, 1ms Crest mode, 2 Stroke & DIS or 4 Stroke Engine RPM, 4 Trigger Levels and trigger slope selection, number of cylinders selection, as well as Secondary Functions Selection.

Power on options include Line Filter Frequency 50/60Hz Selection for best noise rejection (normally only available in expensive bench top instruments), as well as Auto Power off Disable.

This series is housed inside a gasket sealed heavy duty casing which keeps out grease, oil, dirt and moisture to maintain superb accuracy and reliability. Besides, the casing is made of high impact thick wall fire retarded material to maximize durability of the meter, and safety to the user. In addition, a sealed battery compartment design keeps battery leakage contaminants off the PC board, which largely reduces the potential risks of shortages and degrading of accuracy due to the contaminants.

3) PRODUCT DESCRIPTION

3-1) PANEL ILLUSTRATION, See FIG 1

1. **LCD display** 4-3/4 digit 40000 counts + 4 digit 9999 counts dual display LCD
2. **±Trigger**
LEVEL Pushbutton. Press momentarily to select trigger levels, or Press and Hold for 1 second to toggle between positive and negative trigger slopes
3. **Cylinder**
RANGE Pushbutton to select Auto/Manual ranging in most functions, or number of cylinders on Dwell function
4. **RELΔ%** Pushbutton to select Relative Zero and Relative Percentage Change
5. **Recall**
***** Pushbutton. Press momentarily to turn on the LCD back light, or Press and Hold for 1 second to recall stored data
6. **Selector** Turn the Power On or Off and Select a function
7. **COM** Common (Ground reference) Input Jack for all functions except **RPM** function
8. **+** input Jack for all functions EXCEPT current and **RPM** functions
9. **mA A/RPM-** Input Jack (+) for current function, and ground reference (-) input Jack for **RPM** function

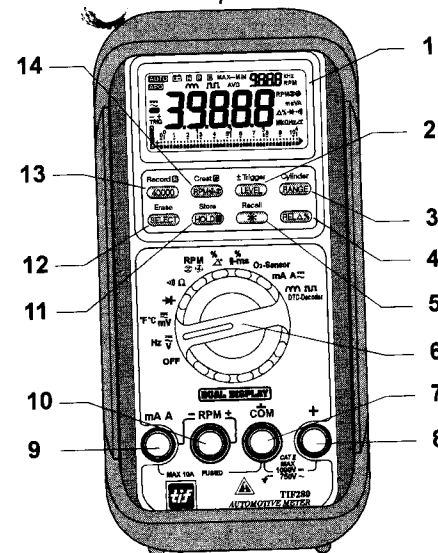


FIG 1. FRONT PANEL LAYOUT

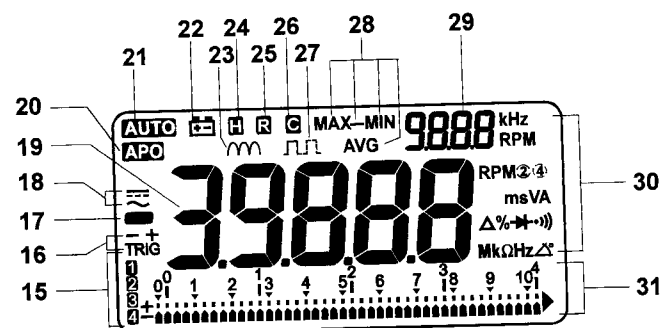

















FIG 2. LCD DISPLAY (SHOWN ACTUAL SIZE)

10. **RPM +** Input Jack (+) for **RPM** function
11.  Pushbutton. Press momentarily to activate HOLD, or press and hold for 1 second to store the data displayed for later recall
12.  Pushbutton. Press momentarily to select secondary functions, or Press and Hold for 1 second to Erase all stored data
13.  Pushbutton. Press momentarily to toggle between 40,000 and 4000 counts modes, or Press and Hold for 1 second to activate Record function
14.  Pushbutton. Press momentarily to toggle between **RPM**① and **RPM**② in **RPM** function, or Press and Hold for 1 second to activate Crest function

3-2) LCD ILLUSTRATION, See FIG 2

15. **TRIG 1 2 3 4** These annunciators indicate trigger level status
16.  These annunciators indicate positive (+) or negative (-) Trigger Slope is selected
17.  This symbol indicates Negative Polarity
18.  == annunciator indicates direct current (DC) is selected. ~ annunciator indicates alternating current (AC) is selected

19. **DATA** Main digital readings of data being measured
20. **APO** This annunciator indicates Auto Power Off is enabled
21. **AUTO** This annunciator indicates Autoranging
22.  Low Battery alert, replace the battery as soon as possible to ensure accuracy
23.  This annunciator indicates the Alternator tester function is selected
24.  This annunciator indicates data HOLD function is activated
25.  This annunciator indicates the Record function is activated
26.  This annunciator indicates the Crest function is activated
27.  This annunciator indicates the Fault Code Detector function is activated
28.  This annunciators indicate MAX (Maximum), MIN (Minimum), MAX-MIN (Maximum minus Minimum), or AVG (Average) reading is being displayed
29. **DATA** Secondary display for Dual Display data
30. **kHz...** These annunciators indicate the function being selected and/or the appropriate measurement units
31.  Analog bar graph with overload flag, polarity, and scale

4) OPERATION

4-1) DCV, ACV, Hz* functions

- 1) Set rotary switch to Hz $\frac{\text{mV}}{\text{V}}$ position
- 2) Default at **DC**. Press **SELECT** button momentarily to select **AC**, and press again to select **Hz** if required
- 3) Insert red (+) test lead into + jack and black (-) test lead into **COM** input jack
- 4) Connect test leads to voltage source and observe the digital display. See **FIG 3**
- 5) Set rotary switch to mV position for voltage application below 0.4V with similar operation procedures
- 6) Refer (4-2) for convenient dual display **RPM** function

*Note: 1. 4 trigger levels selectable through **LEVEL** push button for advanced applications in this function. Also refer (5-5) for more details

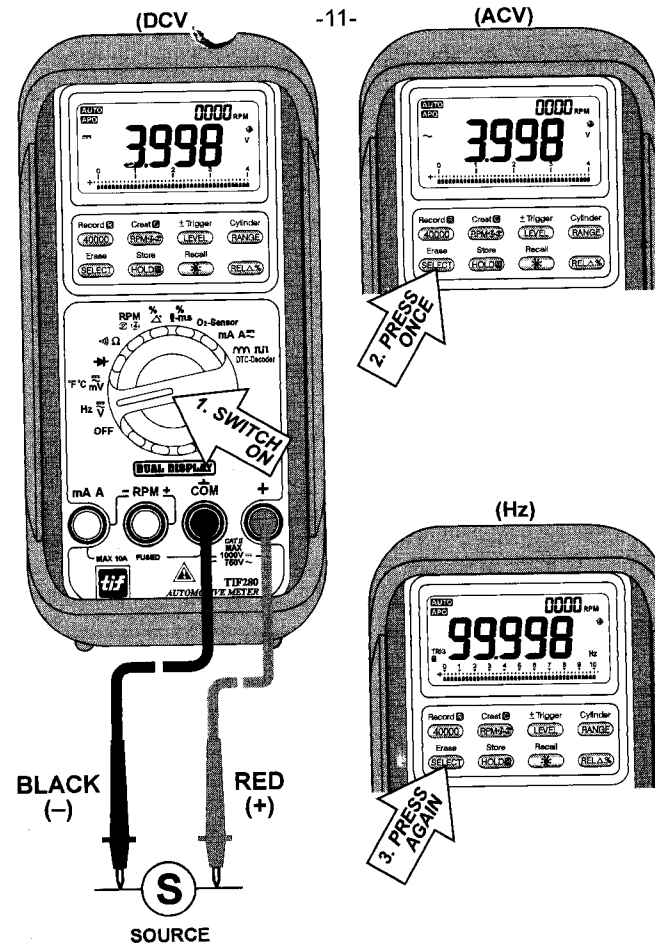


FIG 3. DCV, ACV, Hz FUNCTIONS

4-2) DUAL DISPLAY RPM function

- 1) Set the meter to the corresponding primary function. See note below for function availability
- 2) Press **RPM** button to toggle to **RPM** for 2-stroke and DIS engine, or to **RPM** for 4-stroke engine
- 3) Insert output plug of inductive pick up with the positive (red) into **RPM+** jack and the negative (black) into the **RPM-** jack
- 4) Clamp the inductive pick up to a spark plug wire with the arrow sign facing the spark plug. See **FIG 4**. Make sure that the pick up jaws are completely closed
- 5) Observe the secondary digital display for **RPM** readings

- Note: 1. This function is available to primary functions: DCV, ACV, Hz, Dwell, Fuel injection detector, & Duty cycle
2. When trigger level selection is required for advanced applications, use main display RPM function. See (4-6) for more details

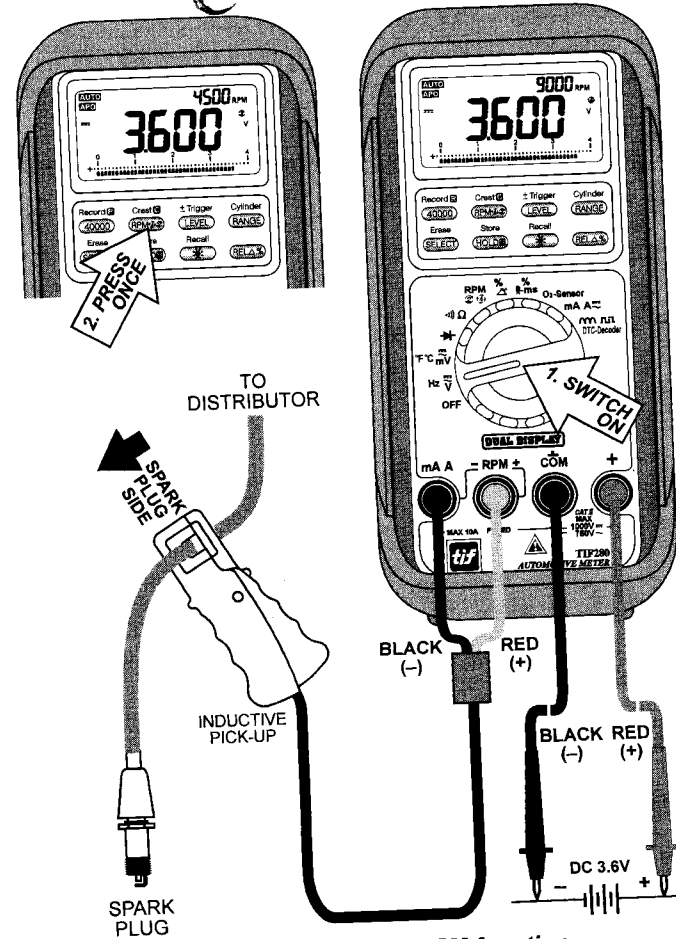


FIG 4. Dual Display RPM function

4-3) TEMPERATURE function

- 1) Set rotary switch to °F °C $\frac{mV}{mV}$ position
- 2) Press **SELECT** button momentarily two times to select temperature function
- 3) Without any temperature probe plugs into the input terminals (detect automatically by the meter), the secondary digital display displays the meter internal temperature reading in °C & °F alternatively
- 4) Insert banana plug K-type temperature bead probe with positive (+) plug into + jack and negative (-) plug into **COM** input jack. You can also use a plug adapter (optional accessory) with banana pins to K-type socket for the standard K type mini plug temperature probe
- 5) Touch the end of the thermo probe to the measurement surface and observe the digital display with °C in the main display, and °F in the second display. See **FIG 5**

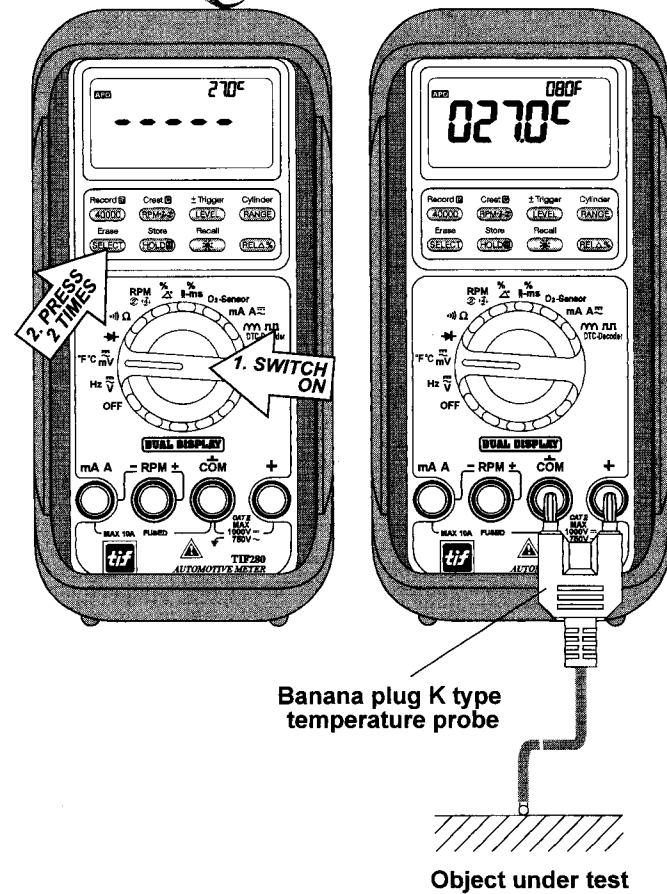


FIG 5. TEMPERATURE FUNCTION

4-4) \rightarrow DIODE TEST function

- 1) Set rotary switch to \rightarrow
- 2) Insert red (+) test lead into + jack and black (-) test lead into COM input jack
- 3) Connect the test leads as shown in FIG 6 and observe the digital display
- 4) Normal forward voltage drop (forward biased) for a good silicon diode is between 0.400V to 0.900V. A reading higher than that indicates a leaky diode (defective). A zero reading indicates a shorted diode (defective). An OL indicates an open diode (defective)
- 5) Reverse the test leads connections (reverse biased) across the diode
- 6) The digital display shows OL if the diode is good. Any other readings indicate the diode is resistive or shorted (defective)

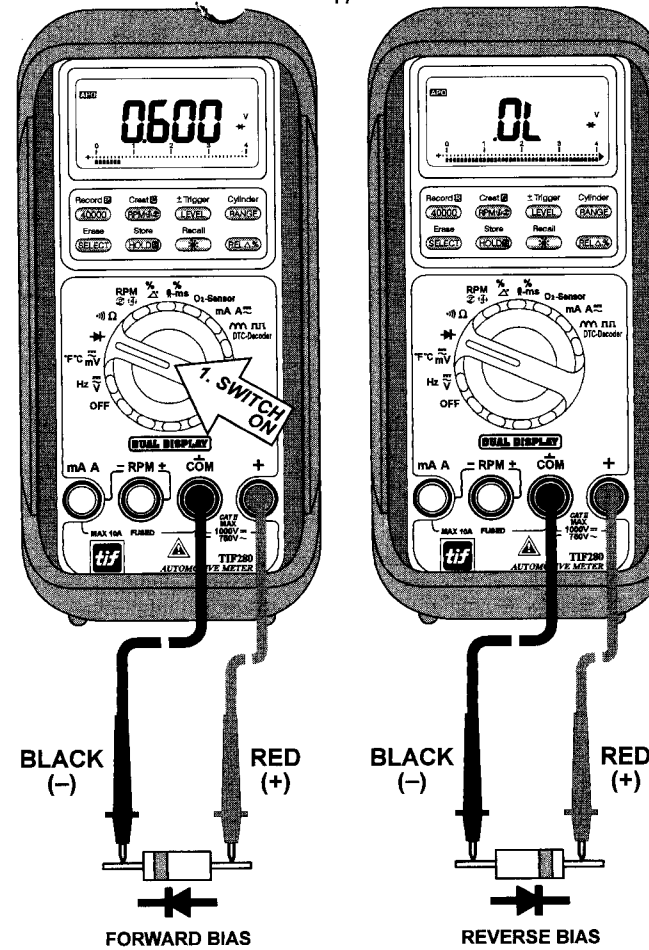


FIG 6. \rightarrow DIODE TEST FUNCTION

4-5) Ω RESISTANCE, \rightarrow) CONTINUITY functions

- 1) Set rotary switch to \rightarrow) Ω
- 2) Insert red (+) test lead into + jack and black (-) test lead into COM input jack
- 3) Connect the test leads as shown in **FIG 7** and observe the digital display
- 4) Default at Ω . Press **SELECT** button momentarily to select \rightarrow) Continuity function
- 5) A continuous beep tone indicates a complete wire. This is useful for checking wiring connections and operation of switches

CAUTION

Using resistance measurement function in a live circuit will produce false results and may damage the instrument. In many cases the suspect component must be disconnected from the circuit to obtain an accurate reading

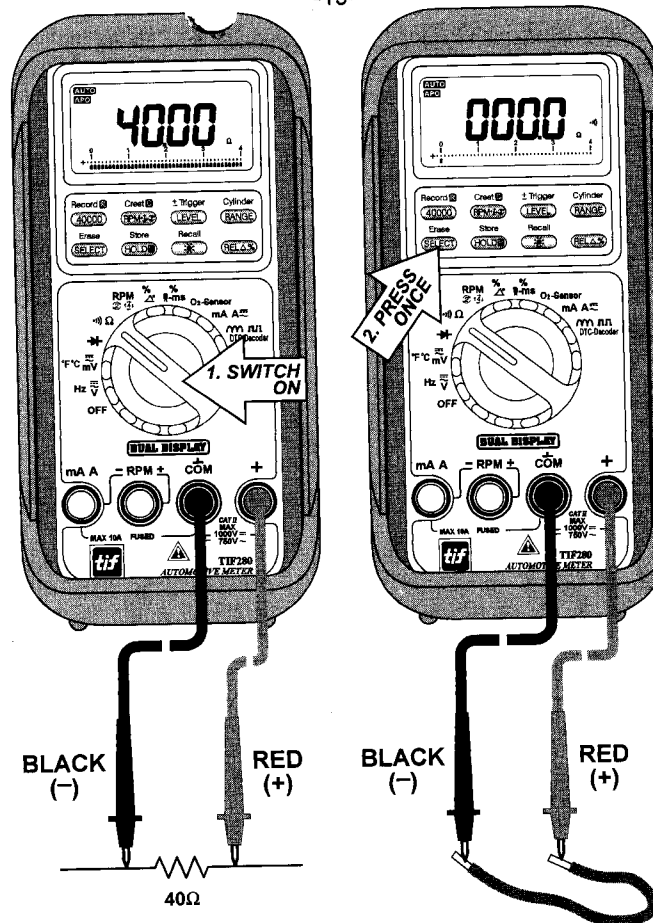


FIG 7. Ω RESISTANCE, \rightarrow) CONTINUITY FUNCTIONS

4-6) RPM function (main display)

- 1) Set rotary switch to **RPM**
- 2) Press **RPM** button to toggle to **RPM** for 2-stroke and DIS engine, or to **RPM** for 4-stroke engine
- 3) Insert output plug of inductive pick up with the positive (red) into **RPM+** jack and the negative (black) into the **RPM-** jack
- 4) Clamp the inductive pick up to a spark plug wire with the arrow sign facing the spark plug. See **FIG 8**. Make sure that the pick up jaws are completely closed
- 5) Observe the digital display for **RPM** readings

Note: 1. 4 trigger levels selectable through **LEVEL** push button for advanced applications in this function. Also refer (5-5) for more details

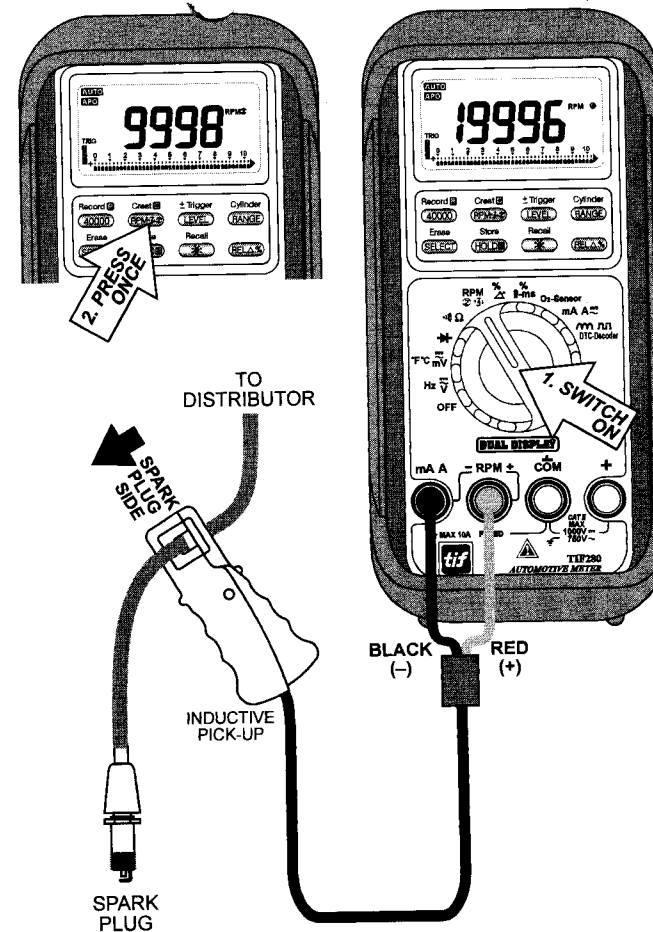


FIG 8. RPM FUNCTION (MAIN DISPLAY)

4-7) DWELL function

- 1) Set rotary switch to Δ
- 2) Default at 4 cylinders (4-C). Press cylinder (RANGE) button momentarily to display the cylinder setting on the secondary display, and press momentarily again within one second to select the number of cylinders from 1 through 12 to match the engine under test
- 3) Insert red (+) test lead into + jack and black (-) test lead into COM input jack
- 4) Connect the test leads as shown in FIG 9 and observe the digital display
- 5) Press **SELECT** button momentarily to display DWELL reading in terms of percentage if required
- 6) Refer (4-2) for convenient dual display RPM function
- 7) Adjust the dwell angle according to the procedures outlined in your vehicle service manual

- Note: 1. Re-check the timing whenever the dwell angle has been adjusted
2. 4 trigger levels selectable through **LEVEL** push button for advanced applications in this function. Also refer (5-5) for more details

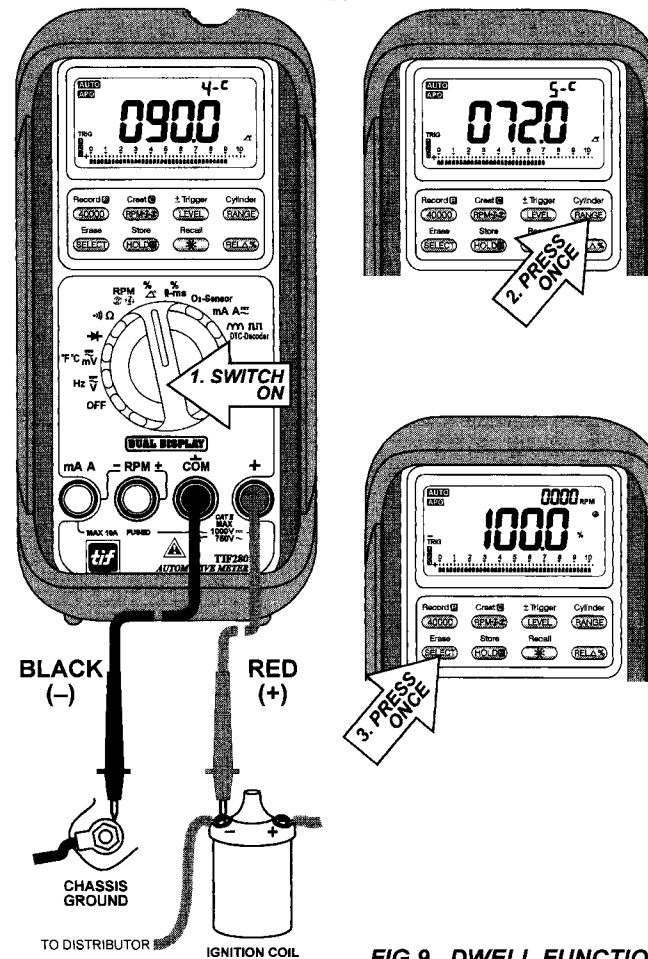


FIG 9. DWELL FUNCTION

4-8) FUEL INJECTION DETECTOR function

- 1) Set rotary switch to μ -ms
- 2) Insert red (+) test lead into + jack and black (-) test lead into COM input jack
- 3) Connect the test leads as shown in **FIG 10** and observe the digital display
- 4) Press **SELECT** button momentarily to display ms reading in terms of percentage (%) if required
- 5) Refer (4-2) for convenient dual display **RPM** function

- Note: 1. This μ -ms function applies to both Port Fuel Injectors (PFI) which operate with a single on time pulse and Throttle Body Injectors (TBI) which operate with twin pulses
2. 4 trigger levels selectable through **LEVEL** push button for advanced applications in this function. Also refer (5-5) for more details
 3. The fuel injection frequency can be displayed on the secondary display by pressing the **RPM** button

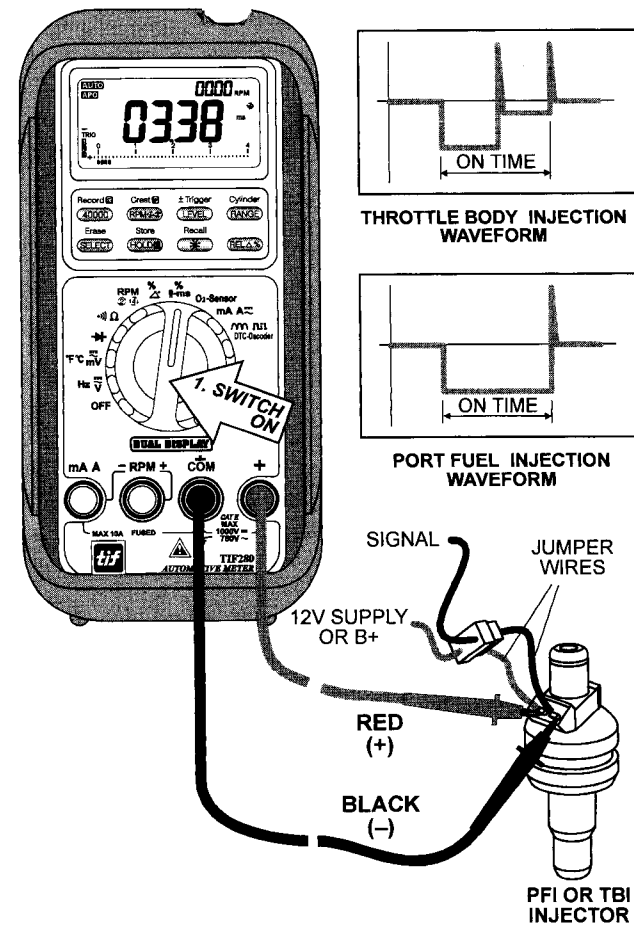


FIG 10. FUEL INJECTION DETECTOR

4-9) O₂-SENSOR TESTER function

- 1) Set rotary switch to O₂-Sensor position
- 2) Insert red (+) test lead into + jack and black (-) test lead into **COM** input jack
- 3) Connect test leads to the O₂ sensor dynamic output and observe the digital display. See **FIG 11**
- 4) The main digital display shows a symbolic waveform of the O₂ sensor dynamic output
- 5) The secondary digital display shows the cross count per second parameter, and a beep sound will alert the user on each cross count edge being detected. Nominal cross count number is 1 to 3 for a good O₂ sensor. The higher the cross count number, the more active the O₂ sensor is

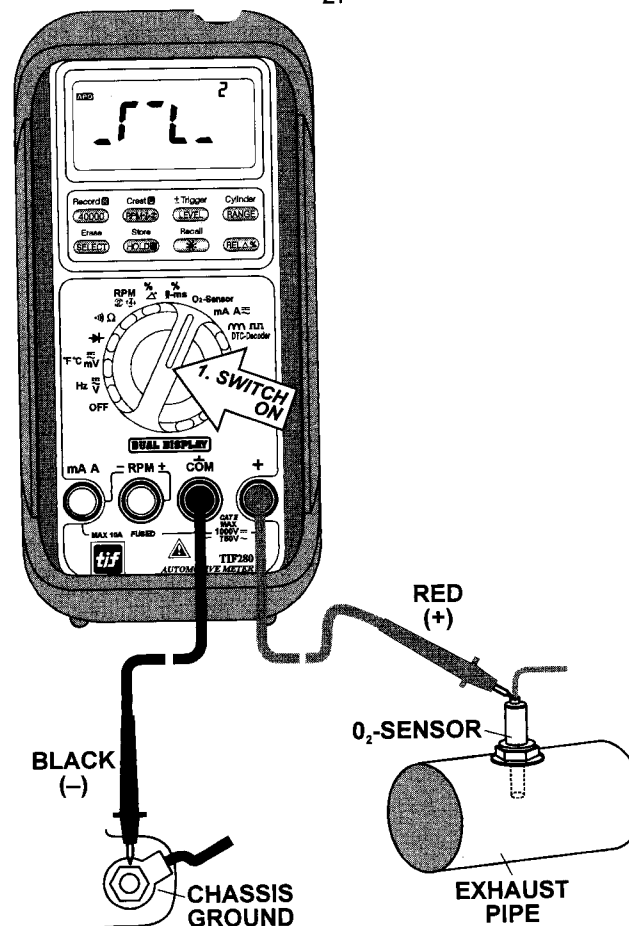


FIG 11. O₂-SENSOR TESTER

4-10) mA, A functions

- 1) Set rotary switch to **mA A** \sim
- 2) Insert red (+) test lead into **mA A** \sim jack and black (-) test lead into **COM** input jack
- 3) Default at **DC**. Press **SELECT** button momentarily to select **AC**
- 4) Connect the test leads as shown in **FIG 12** and observe the digital display

WARNING

Do not measure any circuit that draws more than the current rating of the protection fuse. If the fuse blows, replace it with the proper fuse. Failure to do this may result in injury or damage to the meter. Do not attempt a current measurement where the open circuit voltage is above 600V. Suspected open circuit voltage must be checked with voltage functions

Voltage output current clamp adapters are recommended to use with the meter voltage functions for making high current measurements

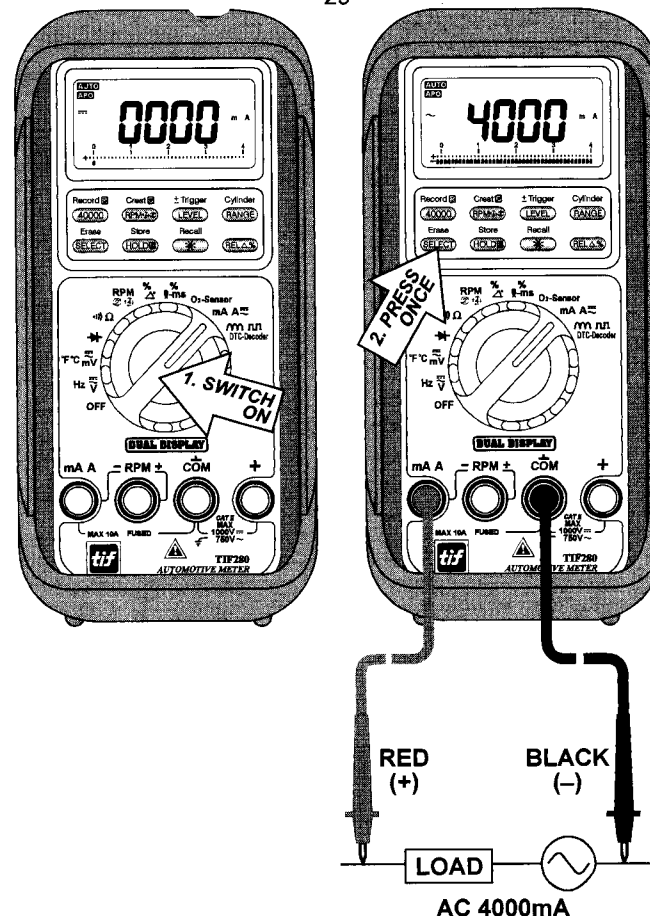


FIG 12. mA, A FUNCTIONS

4-11) **MM** ALTERNATOR TESTER function

- 1) Set rotary switch to **MM**
- 2) Insert red (+) test lead into + jack and black (-) test lead into **COM** input jack
- 3) Start the engine and operate it at about 2000 rpm
- 4) Connect the test leads as shown in **FIG 13** and observe the digital display
- 5) A reading of 0.45V (typical) or less indicates that the alternator and the associated rectifier diodes are in good condition, and 'good' will be displayed on the LCD. A display 'bad' together with continuous beep sound indicate any of the following faults may exist:
 - Defective rectifier diode(s)
 - Defective Alternator coils
 - Opened coil or rectifier connections
 - Neutral of 3-phase Y-connection alternator accidentally grounded to chassis

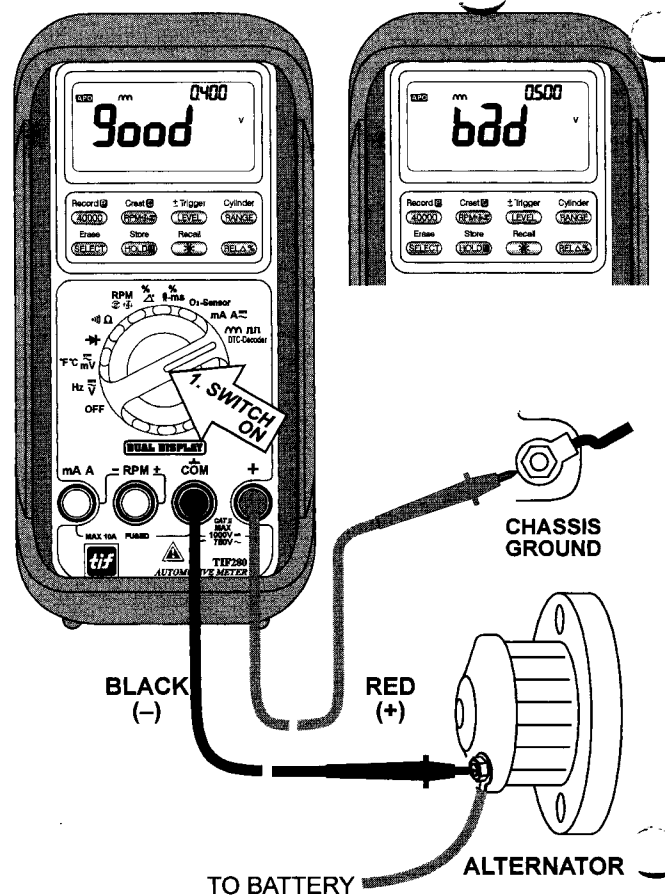


FIG 13. MM ALTERNATOR TESTER FUNCTION

12) **FL FAULT CODE DETECTOR function**

- 1) Set rotary switch to **FL** DTC-Decoder
- 2) Default at **FL**. Press **SELECT** button momentarily to select **FL**
- 3) Insert red (+) test lead into + jack and black (-) test lead into **COM** input jack. See **FIG 14**
- 4) Connect the test leads to the fault code signal pins of the diagnostic socket and then trigger the fault code output
- 5) Typical fault code output triggering procedure is to short (close circuit) the two trigger pins of the diagnostic socket and then turn the ignition key to the ON position. DO NOT start the engine
- 6) Location of the diagnostic socket, signal pins assignment, signal type, and procedures of triggering & clearing the fault code may be varied with car models. Consult your vehicle service manual for manufacturer's specifications. The display indicates a symbolic pulse and the beeper turns on when the blink code pulse is detected
- 7) Time interval between pulse signals and duration of pulse signal represent the blink type fault code numbers
- 8) As an example, some car manufacturers use long pulse for the first code digit, and short pulse for the second code digit. In this case, 2 long 'Beeps' followed by 5 short 'Beeps' represented fault code number 25. As another example, some car manufacturers use same time interval between pulse signals on the same code digit, and with longer time interval to separate the code digits. In this case 2 short 'Beeps' followed by a quiet interval and then followed by 5 short 'Beeps' represented fault code number 25
- 9) Please note that in some car models, fault code signal output is preceded by leading pulse signals
- 10) As a typical procedure for clearing the fault code stored in the memory. Turn the ignition key to the OFF position. Disconnect the negative (-) battery terminal from the car electrical system for about 1 minute, and the fault code will be cleared from memory. Some car models require specific procedure to clear the fault code stored, consult your vehicle service manual for details

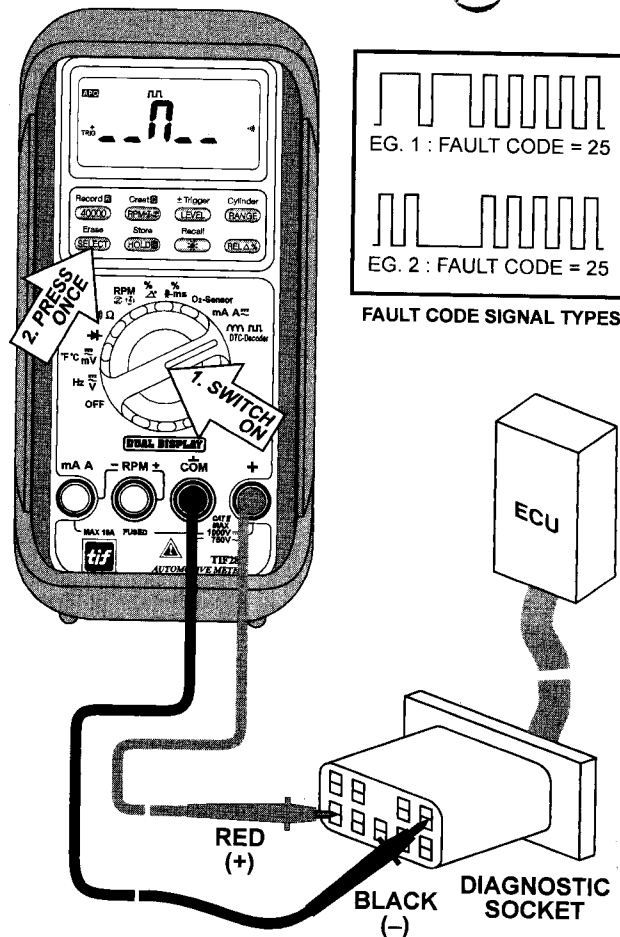


FIG 14. FL FAULT CODE DETECTOR FUNCTION

* 13) DTC-DECODER function

- 1) Set rotary switch to **MM LLI DTC-Decoder**
- 2) Default at **MM**. Press **SELECT** button two times to select **DTC-Decoder**
- 3) Insert Red (+) test lead into + jack and black (-) test lead into **COM** input jack. See **FIG 15**
- 4*) Connect the test leads to the signal pins of the data link connector. This function is a replacement of the impulse counter scan tool with wire connections **COM** for black (bk), and + for yellow (yw) as specified in the Mercedes-Benz Diagnostic Trouble Code Reference Guide. Since TIF280 is powered by internal battery, connection of the impulse counter red (rd) wire (to B+) for external power is not required
- 5*) Engine at idle
- 6) Trigger the DTC readout by Shorting (close circuit) the 2 signal pins of the data link connector for about 4 seconds until the secondary LCD shows "rdy". Then the meter is ready to scan the DTC readout automatically
- 7) During scanning the meter secondary display indicates a pulse symbol "U", and the beeper turns on when a DTC pulse is detected
If the DTC scanning is not successful, the meter secondary display will indicate "----" to alert the user. Re-check the wire connections, and start the trigger process again
If the DTC scanning is successful, the meter secondary display will indicate code "code" with 4 beep sounds, and the main display indicates the correct DTC readout
- 8) Read and note DTC readout displayed on the LCD
Display "1" = no fault stored,
Greater than "1" = fault in system
Repeat procedure 6). If there are no further faults in the system, the previously displayed DTC will be displayed
- 10) Repeat procedure 9) until the first DTC displayed is repeated

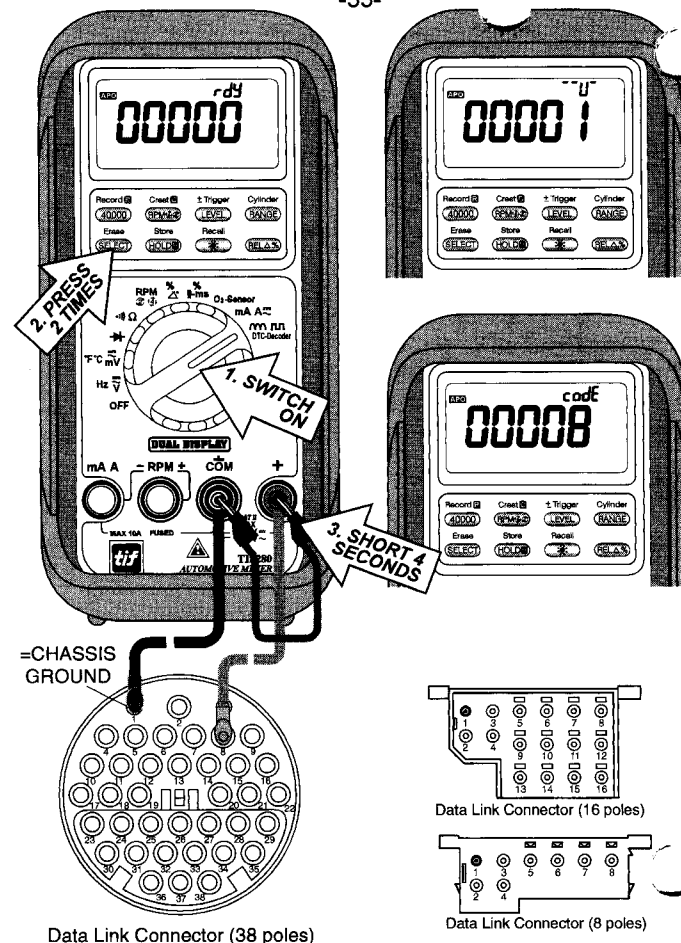


FIG 15. DTC-DECODER FUNCTION

- 1) Eliminate (repair) all noted faults (DTC readout) of the car according to troubleshooting chart and diagnostic tests
- 2) After eliminating a fault, the respective DTC may be cleared by repeating procedure 6) to get the DTC readout, and then short the 2 signal pins for another 6 to 10 seconds, then the DTC displayed is cleared. Please note that each DTC displayed must be cleared individually

*Note: 1. Consult your Mercedes Benz Diagnostic Trouble Code Reference Guide for signal pins assignments and engine precondition procedures before triggering the DTC readout. They might be different from car model to model, and function to function

5) ADVANCED OPERATION

Note : See TABLE 3 for features availability

5-1) 40,000 COUNTS HIGH RESOLUTION slow mode

Press the ^{Record}₄₀₀₀₀ button momentarily to enter the 4-3/4 digit high resolution slow mode with a maximum display

at 40,000 counts. Press the ^{Crest}_{RPM 3-2} button momentarily again to return to 3-3/4 digit fast mode

In 3-3/4 digit fast mode, the digital display updates 5 times per second nominal to give you the maximum measuring speed. In 4-3/4 digit slow mode, the digit display updates 1.25 times per second nominal to give you smooth readings as well as the full accuracy of the meter

5-2) RECORD mode

1) Perform measurements as described in BASIC OPERATION. Press and hold the **Record** button for 1 second or more to activate Record mode with LCD annunciators **MAX-MIN** and **AVG** turn on. The meter beeps when new maximum or minimum reading is updated. Press the button momentarily to read throughout the Maximum (MAX), Minimum (MIN), Maximum minus Minimum (MAX-MIN), and Average (AVG) readings. Press the button for 1 second or more to exit Record mode. See **FIG 16**

With the Auto-Ranging Record mode, you can easily track intermittent signals, capture turn-on/ turn-off surges, and monitor line voltage changes over a much wider dynamic range with the best resolution. It largely surpasses single range recording which is easily overflowed, or with insufficient resolution. The TIF280 features a fast single range sampling speed of 50ms for MAX, MIN, MAX-MIN and AVG readings. The faster the sampling speed, the more accurate the measurement of surges, spikes and sags will be. The true average AVG feature calculates all readings taken over time continually

- Note 1: Auto Power Off feature will be disabled automatically in this mode
- 2: To retain the readings after measurements, use **HOLD** function to stop updating the measurements before disconnecting the test leads. Use similar pushbutton procedures described above to read throughout the locked readings

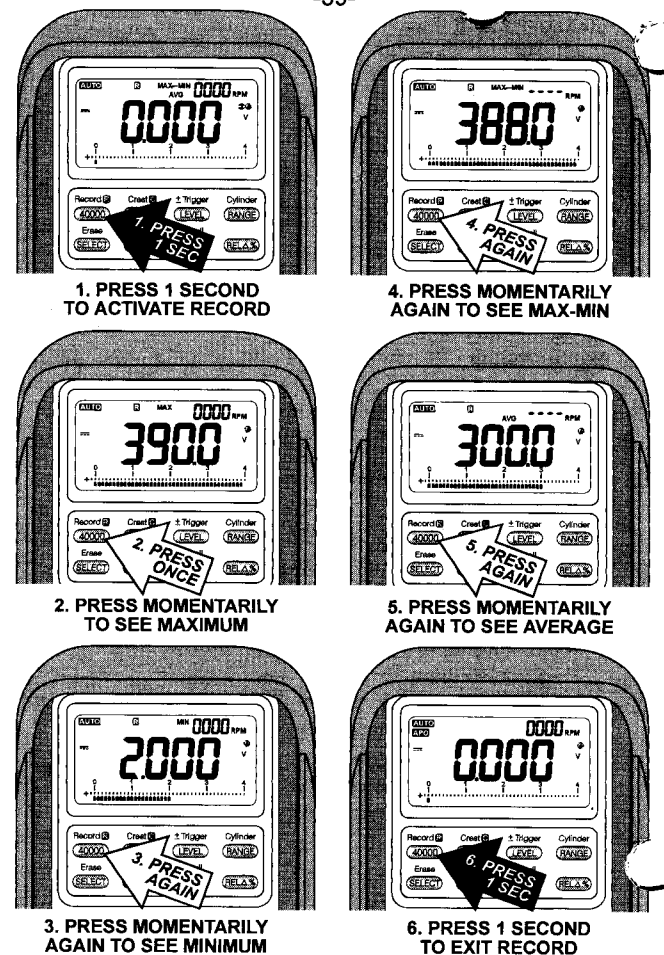


FIG 16. RECORD MODE

1) 3) RPM^{④②} selection

In the RPM function, the meter defaults to RPM^④ for conventional 4-stroke engine. Press ^{Crest}^④ ^{RPM-1-2} button momentarily to toggle to RPM^② for DIS or 2-stroke engine

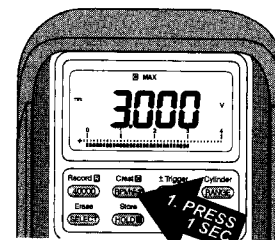
5-4) CREST ^④ (Instantaneous Peak Value) mode

Perform measurements as described in BASIC

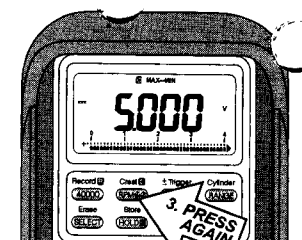
OPERATION. Press and hold the ^{Crest}^④ ^{RPM-1-2} button for 1 second or more to activate Crest mode with LCD annunciators ^④ MAX turn on. Press the button momentarily to read throughout the Maximum (MAX), Minimum (MIN), and Maximum minus Minimum (MAX-MIN) readings. Press the button for 1 second or more to exit Crest mode. See **FIG 17**

With the Crest mode, you can capture transient signal crest voltage (instantaneous peak value) as short as 1ms

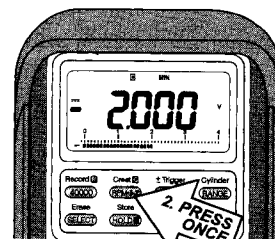
- Note: 1. Auto Power Off feature will be disable automatically in this mode
2. To retain the readings after measurements, use HOLD ^④ function to stop updating the measurements before disconnecting the test leads. Use similar pushbutton procedures described above to read throughout the locked readings



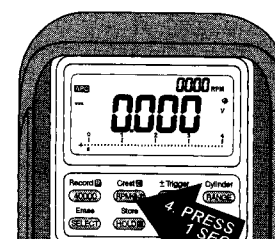
1. PRESS 1 SECOND TO ACTIVATE CREST (MAXIMUM)



3. PRESS MOMENTARILY AGAIN TO SEE CREST MAX-MIN (Vp-p)



2. PRESS MOMENTARILY TO SEE CREST MINIMUM



4. PRESS 1 SECOND TO EXIT CREST

FIG 17. CREST MODE

5) TRIGGER LEVEL selection

1) The TIF280 is set at selected trigger level as power up default on individual function for general application. However, car signal levels under test may vary due to aging of components, abnormal conditions, and different design from different car manufacturers. Therefore, a Trigger level selection function is designed to provide more flexibility to cope with your applications. The 4 trigger levels provided are carefully selected and tested to include all of the extreme conditions, and you virtually do not need more. More trigger levels will only decrease the ease of use and increase the measuring uncertainty as you may encounter in the old technology

If your measuring reading is unstable, select lower sensitivities (higher trigger level number) by pressing the **LEVEL** button momentarily. If your measuring reading shows zero, select higher sensitivities (lower trigger level number)

5-6) TRIGGER + - selection

Trigger + or - is to identify whether the on or off portion of the signal under test is of measuring interest. For example, as in duty cycle function, if you get a reading of 10% in the trigger + (on portion), you then will get a reading of 90% in trigger - (off portion)

To toggle between trigger + and -, Press and Hold the

±Trigger
LEVEL button for 1 second. SEE **FIG 18**

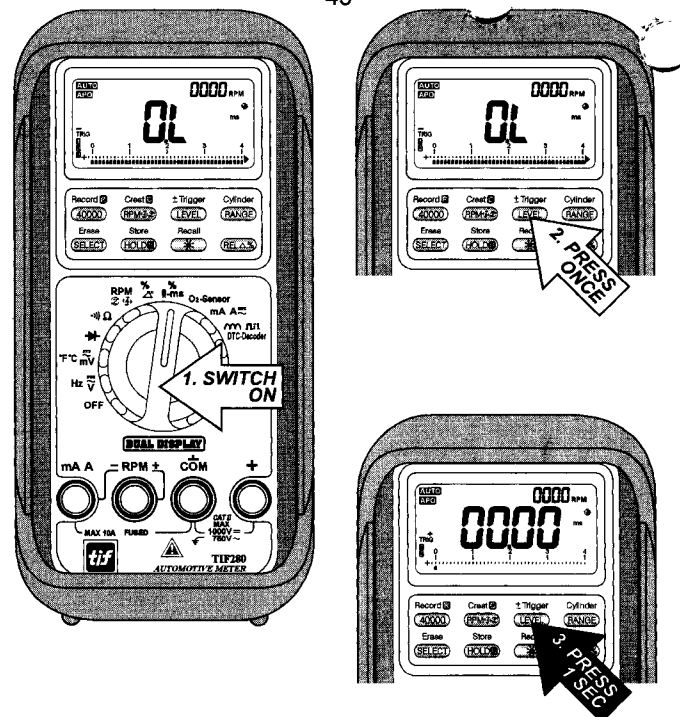


FIG 18. TRIGGER LEVER & TRIGGER + - SELECTION

5-7) MANUAL & AUTO RANGING

Press the ^{Cylinder}
(RANGE) button momentarily to select manual-ranging, and the meter will remain in the range it was in with LCD annunciator **AUTO** turns off. Press the button momentarily again to step through the ranges. Press and hold the button for 1 second or more to resume auto-ranging

In Δ Dwell function, Press the ^{Cylinder}
(RANGE) button momentarily to display the cylinder setting on the secondary display, and press momentarily again within one second to select the number of cylinders from 1 through 12 to match the engine under test

5-8) DATA STORE, RECALL & ERASE

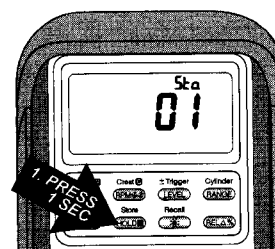
Press the ^{Store}
(HOLD) button for 1 second to store the displaying information. The LCD will show "Sta" and the memory data number to confirm storage. You can store up to 18 data by

repeating this procedure. Press the ^{Recall}
(*) button for 1 second to recall the last stored data. The LCD will show "rEc" and the last memory data number before displaying the recalled data. The annunciator **[]** will then turn on to identify that the recalled data is being displayed. Then

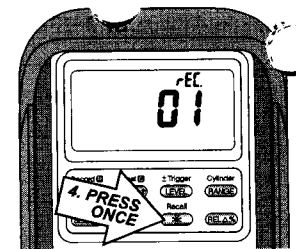
press the ^{Recall}
(*) button momentarily to retrieve other stored data. Press any other buttons momentarily EXCEPT ^{Recall}
(*)

to resume measurement. Press and Hold the ^{Erase}
(SELECT) button for 1 second to Erase all the stored data. See **FIG 19**

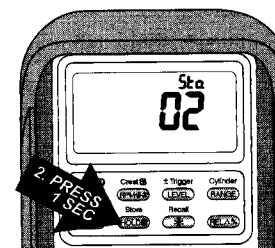
This feature stores the whole display data in memory for later recall. The memory will remain even in auto-power-off mode, and can also be recalled while you are in another meter function. The memory will be erased if the rotary switch is switched to the OFF position



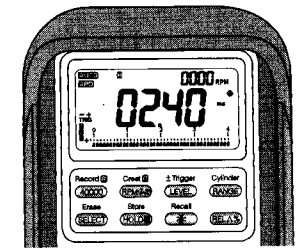
1. PRESS 1 SECOND TO STORE DATA 01



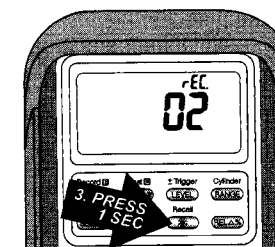
4. PRESS MOMENTARILY TO RECALL DATA 01



2. PRESS 1 SECOND TO STORE DATA 02



5. RECALLED DATA WITH **[]** TURNS ON



3. PRESS 1 SECOND TO RECALL DATA 02



6. PRESS 1 SECOND TO ERASE ALL DATAS

FIG 19. DATA STORE, RECALL & ERASE

5-9) SECONDARY FUNCTION selection

- 1) Press the **SELECT** button momentarily to select the secondary functions of a selected rotary switch position

5-10) HOLD

Press the **HOLD** button momentarily to activate the hold function with LCD annunciator **H** turns on. Press momentarily again to release. When in normal measuring modes, the hold feature freezes the display for later view. When in RECORD or CREST mode, however, the hold function stops updating the measurements, and you can read throughout the locked MAX, MIN, MAX-MIN, and AVG readings. Release the hold function to continue RECORD or CREST

5-11) RELATIVE $\Delta\%$ modes

Press the **REL $\Delta\%$** button momentarily to enter the Relative Zero (Δ) mode with LCD annunciator Δ turns on. Relative zero allows the user to offset the meter measurements with a relative reference value. Practically all displaying readings can be set as relative reference value including MAX, MIN, MAX-MIN, and AVG readings of RECORD functions. See **FIG 20**

Press the **REL $\Delta\%$** button momentarily again to enter the Relative Percentage Change (%) mode with LCD annunciators $\Delta\%$ turn on. In this mode, the readings show relative percentage changes with respect to the relative reference value. It simplifies zero, peaking, nulling measurements, and is excellent for fine adjustments and comparison. See **FIG 20**

Press and hold the **REL $\Delta\%$** button for 1 second or more to exit relative modes and resume normal measurements

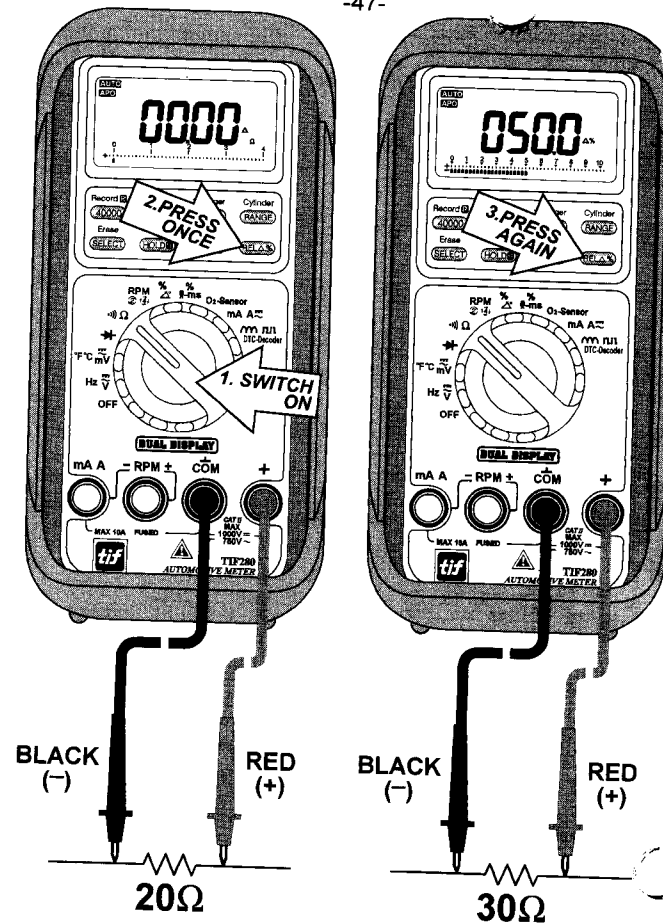







FIG 20. RELATIVE MODES $\Delta\%$

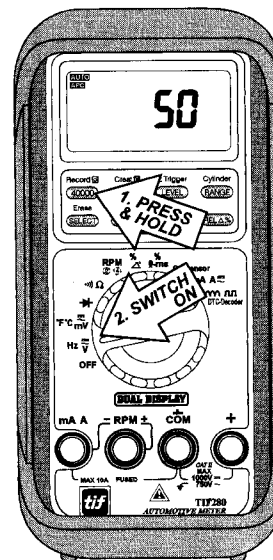
1) 12)BACK LIGHT feature

Press and hold the  button momentarily to toggle the backlight on and off. The backlight will also be off 55 seconds after each activation automatically to extend battery life.

5-13)LINE FILTER FREQUENCY 50 Hz or 60 Hz selection

The line filter frequency can be selected as a power-on option. Press the  button while turning the meter on to display the set frequency. Press the  button for 50 Hz or press the  button for 60 Hz selection. Then press the  button to store the selected frequency. See **FIG 21**

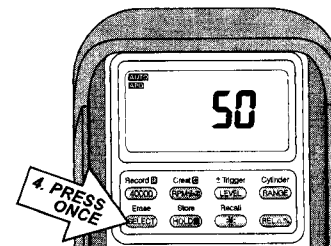
Selecting the appropriate line filter frequency to cope with your line frequency can maximize the meter's noise rejection ability. This is normally only available in expensive bench top multimeter



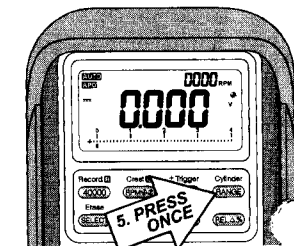
1. PRESS THE BUTTON WHILE
2. TURNING ON THE METER



3. PRESS MOMENTARILY
TO SELECT 60Hz



4. PRESS MOMENTARILY
TO SELECT 50Hz



5. PRESS MOMENTARILY
TO ENTER (SET)

FIG 21. LINE FILTER FREQUENCY 50Hz OR 60Hz SELECTION

1) 14) AUTO POWER OFF (APO)

The Auto Power Off (APO) mode turns the meter off automatically to extend battery life after 5 minutes of inactivities. The meter turns back on if the rotary switch is turned. Activities are specified as :

- 1) Rotary switch or push button operations
- 2) Significant measuring data readings

When enters the Record, Crest mode, the Auto Power Off will be disabled automatically, and the LCD annunciator **APO** will be off

The Auto Power Off feature can be disabled manually as a power-on option by pressing the ^{Crest}_{RPM-1-2} button while turning the meter on. The LCD annunciator **APO** will be off during operation

For maintenance purpose, the Auto Power Off timing can be shortened to 5 seconds by pressing the ^{Cylinder}_{RANGE} button while turning the meter on

- Note: 1. Stored data remains after Auto Power Off, but will be erased if the rotary switch is switched to the OFF position
2. Always turn the rotary switch to the OFF position when the meter is not in use. The meter will produce a beep sound to alert the user while turn off

	DATA HOLD	RANGE LOCK	40,000 COUNTS	RELATIVE Δ%	RECORD	CREST	± TRIGGER	TRIGGER LEVEL	CYLINDER	DUAL DISPLAY	STORE RECALL
DC VOLTAGE	•	•	•	•	•	•	•	•	•	•	•
AC VOLTAGE	•	•	•	•	•	•	•	•	•	•	•
TEMPERATURE	•	•	•	•	•	•	•	•	•	•	•
DC CURRENT	•	•	•	•	•	•	•	•	•	•	•
AC CURRENT	•	•	•	•	•	•	•	•	•	•	•
RESISTANCE	•	•	•	•	•	•	•	•	•	•	•
RPM	•	•	•	•	•	•	•	•	•	•	•
FREQUENCY	•	•	•	•	•	•	•	•	•	•	•
DUTY CYCLE	•	•	•	•	•	•	•	•	•	•	•
μ-ns	•	•	•	•	•	•	•	•	•	•	•
DWELL	•	•	•	•	•	•	•	•	•	•	•
O-Sensor	•	•	•	•	•	•	•	•	•	•	•
CONTINUITY	•	•	•	•	•	•	•	•	•	•	•
DIODE	•	•	•	•	•	•	•	•	•	•	•
ALTERNATOR	•	•	•	•	•	•	•	•	•	•	•
FAULT CODE	•	•	•	•	•	•	•	•	•	•	•
DTC-DECODER	•	•	•	•	•	•	•	•	•	•	•

TABLE 2. FEATURE AVAILABILITY SUMMARY

1) SPECIFICATIONS

GENERAL SPECIFICATIONS

Display : 3-3/4 digits 4000 counts or 4-3/4 digits 40000 counts selectable (5 digits 99999 counts for Hz), and 4 digits 9999 counts dual display LCD

Polarity : Automatic

Update Rate :

3-3/4D Data: 5 per second nominal;

4-3/4D Data: 1.25 per second nominal;

43 Segments Bar graph: 128 per second max

Temperature Coefficient : nominal 0.15 x (specified accuracy)/
°C @ (0°C-18°C or 28°C-40°C), or otherwise specified

Low Battery: The indicator appears when the battery voltage drops below approx. 7V

Operating Temperature : 0°C to 35°C, 0-80% R.H.; 35°C to 50°C, 0-70% R.H.

Storage Temperature : -20°C to 60°C, 80% R.H. (with battery removed)

Power Supply : Single Alkaline 9V battery; NEDA1604A, JIS6AM6 or IEC6LF22

APO Timing : Idle for 5 minutes

APO Consumption : 20 μ A

Dimension : L186mm X W87mm X H35.5mm (without holster)

Safety : Designed to EN61010-1, UL3111-1, CSA C22.2 NO.1010-1, and IEC1010-1 installation category II, Pollution
degree 1

E.M.C. : Meets EN55011 and EN50082-1

Overload Protections :

mA & A : 15A/600V Fuse, IR 100kA;
V : 780Vrms, 1000Vpeak;
mV : 600VDC/VAC rms;
Others : 600VDC/VAC rms

Sensing : Average responding

Power Consumption : 10 mA

Weight : 390 gm (without holster)

Accessories : Test leads (pair), inductive pick up, holster, temperature adapter, bead type temperature probe, battery (installed), and user's manual

ELECTRICAL SPECIFICATIONS

ACCURACY IS \pm (% READING DIGITS + NUMBER OF DIGITS) OR OTHERWISE SPECIFIED, AT 23°C \pm 5°C & LESS THAN 75% R.H.

DC Voltage

RANGE	Accuracy
40.00mV	0.8% + 6d
400.0mV, 4.000V, 40.00V, 400.0V	0.1% + 2d
1000V	0.1% + 4d

NMRR : >60dB @ 50/60Hz

CMRR : >120dB @ DC, 50/60Hz, Rs=1k Ω

Input Impedance : 10M Ω , 30pF nominal (100pF nominal for 40mV & 400mV ranges)

AC Voltage

RANGE	Accuracy
50Hz – 60Hz	
40.00mV*	1% + 10d
400.0mV, 4.000V, 40.00V, 400.0V, 750V	0.8% + 4d
40Hz – 1kHz	
40.00mV*	3.5% + 10d
400.0mV, 4.000V, 40.00V, 400.0V, 750V	2.5% + 5d
1kHz – 2kHz	
40.00mV*	4% + 10d
400.0mV, 4.000V, 40.00V, 400.0V, 750V	3.6% + 8d

CMRR : >60dB @ DC to 60Hz, $R_s=1k\Omega$

Input Impedance : $10M\Omega$, 30pF nominal (100pF nominal for
40mV & 400mV ranges)

*Specified from 25% to 100% of range

DC Current

RANGE	Accuracy
4000mA	1.2% + 6d
10.00A	0.8% + 4d

Burden Voltage 0.03V/A

AC Current

RANGE	Accuracy
50Hz – 60Hz	
4000mA*	1.2% + 6d
10.00A	1% + 3d
40Hz – 500Hz	
4000mA*	2.5% + 10d
10.00A	1.2% + 3d
500Hz – 1kHz	
4000mA*	3.5% + 10d
10.00A	1.5% + 3d

Burden Voltage 0.03V/A

*Accuracy specified from 25% to 100% of range

Ohms

RANGE	Accuracy
40.00 Ω	0.5% + 40d
400.0 Ω	0.15% + 4d
4.000k Ω , 40.00k Ω , 400.0k Ω	0.15% + 2d
4.000M Ω	0.3% + 2d
40.00M Ω	1.5% + 5d

Open Circuit Voltage : < 1.3VDC (<3.3VDC for 40 Ω &
400 Ω ranges)

1) Diode Tester

RANGE	Accuracy	Open Voltage
2.000V	0.5%+3d	< 3.2 VDC

Frequency

RANGE	Accuracy
99.999Hz, 999.99Hz, 9.9999kHz, 20.000kHz	0.002% + 4d

4 selectable trigger levels

RPM

	RANGE	Accuracy
RPM 4	120 – 20000 RPM	2 RPM
RPM 2	60 – 10000 RPM	2 RPM

Δ° Dwell

RANGE*	Accuracy
0.0° – 360.0°	1.2° /krpm + 1d
0.0% – 100.0%	0.04% /krpm/cyl + 2d

4 selectable trigger levels and ± trigger slopes

9 selectable number of cylinders 1, 2, 3, 4, 5, 6, 8, 10, & 12

*Specified ranges depend on ± trigger slopes, engine rpm and number of cylinders (cyl)

Fuel Injection Detector (Both TBI & PFI)

RANGE*	Accuracy
Multi-Point-Injection	
0.05ms – 250.0ms	0.05ms + 1d
0.0% – 100.0%	0.04% /krpm + 2d
Single-Point-Injection	
0.05ms – 250.0ms	0.05ms + 1d
0.0% – 100.0%	0.04% /krpm/cyl + 2d

4 selectable trigger levels and ± trigger slopes

*Specified ranges depend on ± trigger slopes, engine rpm and number of cylinders (cyl)

Temperature (K-type)

RANGE	Accuracy*
-20.0°C – 1000.0°C	0.2% + 3°C
-4°F – 1832°F	0.2% + 6°F

*Thermocouple accuracy not included

•)) Audible Continuity Tester

Application : For quick open-short test

Threshold : the beeper turns on when the measured resistance is lower than 10Ω, and turns off When greater than 60Ω. Response time < 200 μs

1) O₂ Sensor Tester

- Application : For O₂ Sensor dynamic test
- Main Display : Symbolic waveform display of O₂ Sensor dynamic output
- Mini display : Cross count per second parameter. A beep sound will alert the user on each significant cross count edge
- Sweep Rate : 10 per second

m Alternator tester

- Application : For quick alternator go / no go test
- Threshold : The display indicates "bad" and the beeper turns on when the measured ripple voltage is greater than 0.45VAC

П.1 Fault Code Detector

- Application : For blink type fault code detection
- Display : The display indicates a symbolic pulse and the beeper turns on when the blink code pulse is detected
- Threshold : 4.5VDC with selectable positive or negative pulse trigger (by \pm Trigger button)

DTC (Diagnostic Trouble Code) Decoder

- Application : A replacement of the Impulse Counter Scan Tool as specified in the Mercedes-Benz Diagnostic Trouble Code Reference Guide to scan the DTC Code readout automatically on the Mercedes-Benz car series

Special Features


- Dual display** : Plus individual RPM input & display
- Memory** : Store/Recall/Erase 18 data memories
- Record** : Max, Min, Max-Min, Avg readings
- Crest** : Peak Max, Min, Max-Min readings
- Relative** : Relative zero and relative % changes
- Level** : 4 selectable trigger levels
- \pm Trigger** : Selectable positive & negative trigger
- Cylinder** : 9 Selectable number of cylinders in Dwell
- Backlight** : Easy reading in dark working area
- Hold** : Freezes the display data for later view
- Range** : Manual / Auto ranging selection
- RPM 4** : For 4-stroke engine application
- RPM 2** : For DIS & 2-stroke engine application

7) MAINTENANCE

WARNING

TO AVOID ELECTRICAL SHOCK, REMOVE TEST LEADS AT ANY INPUT SIGNALS BEFORE OPENING THE CASE. DO NOT OPERATE WITH OPEN CASE. INSTALL ONLY THE SAME TYPE OF FUSE OR EQUIVALENT

7-1) BATTERY REPLACEMENT procedure

- 1) When the battery symbol  on the display is on, replace the battery as soon as possible to ensure accuracy. The meter uses a single standard 9V alkaline battery (NEDA1604A, JIS6AM6 or IEC6LF22)
- 1) Disconnect the meter from any circuit and remove the test leads from the input jacks
- 2) Turn the meter OFF
- 3) Loosen the four captive screws from the case bottom and turn the case over. See **FIG 22**
- 4) Lift the end of the case top nearest the input jacks until it unsnaps from the case bottom
- 5) Lift gently the battery from the battery compartment, and disconnect the battery from the battery connector
- 6) Snap the battery connector to the terminals of the replacement battery, and reinsert the battery into the battery compartment. Dress the battery leads so that they are properly seated in the compartment groove and will not be pinched between the case top and case bottom
- 7) Replace the case top, ensuring that all the gaskets are properly seated and the two snaps on the case top (near the LCD side) are engaged
- 8) Re-fasten the 4 captive screws

7-2) FUSE REPLACEMENT procedure

The meter uses a 600V/15A IR 100kA fast acting fuse for mA A input

- 1) Perform steps 1) through 4) of the battery replacement procedure
- 2) Replace the blown fuse
- 3) Perform step 7) through 8) of the battery replacement procedure

7-3) Cleaning and Storage

Periodically wipe the case with a damp cloth and mild detergent; do not use abrasives or solvents. If the meter is not to be used for periods of longer than 60 days, remove the battery and store it separately

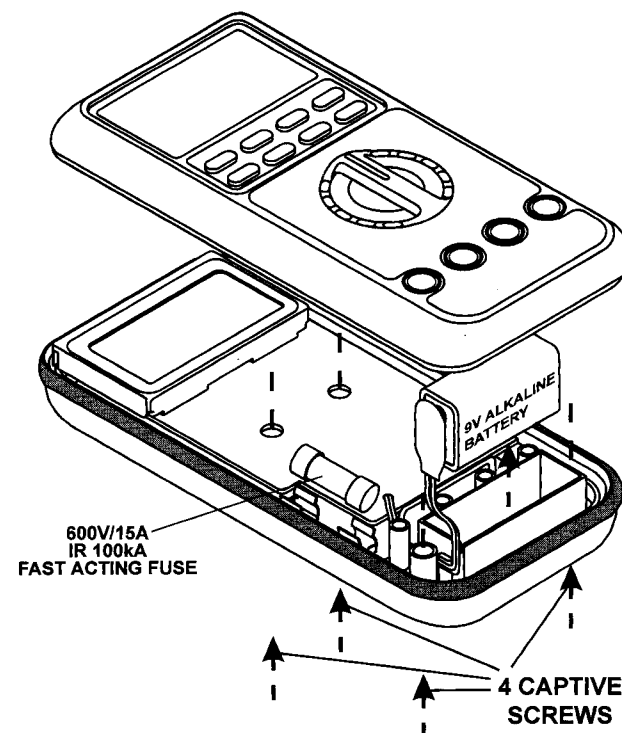


FIG 22. CHANGING BATTERY & FUSE