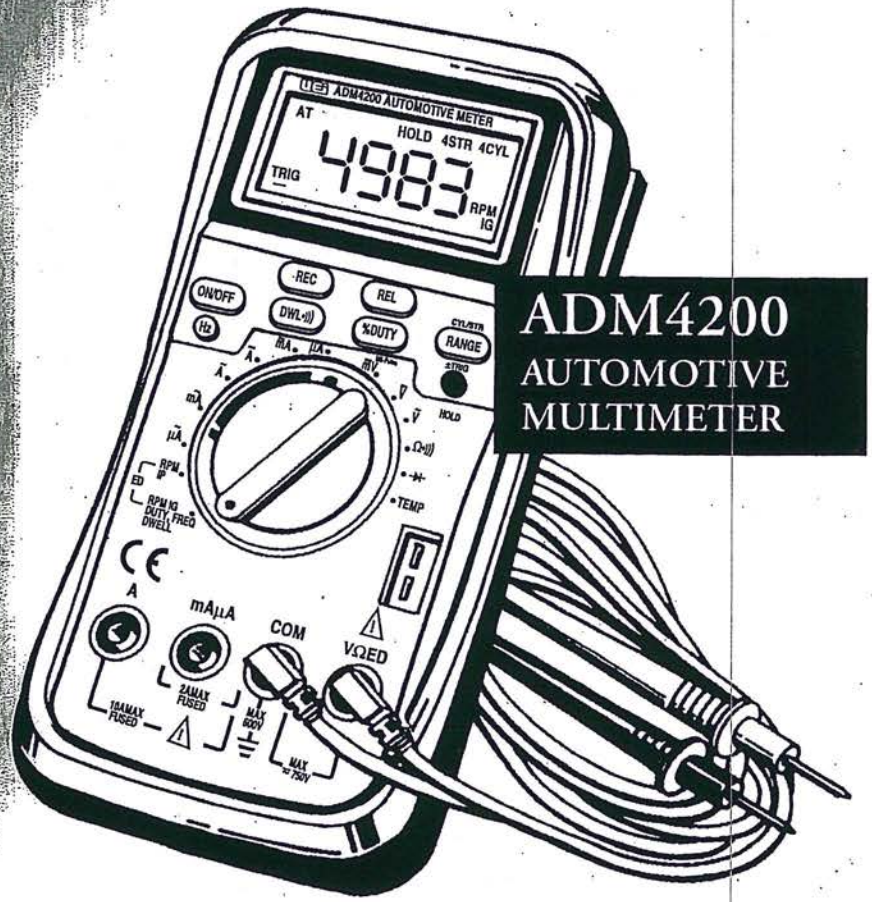
INSTRUCTION MANUAL

Technical Solutions Series™



ADM4200
AUTOMOTIVE MULTIMETER

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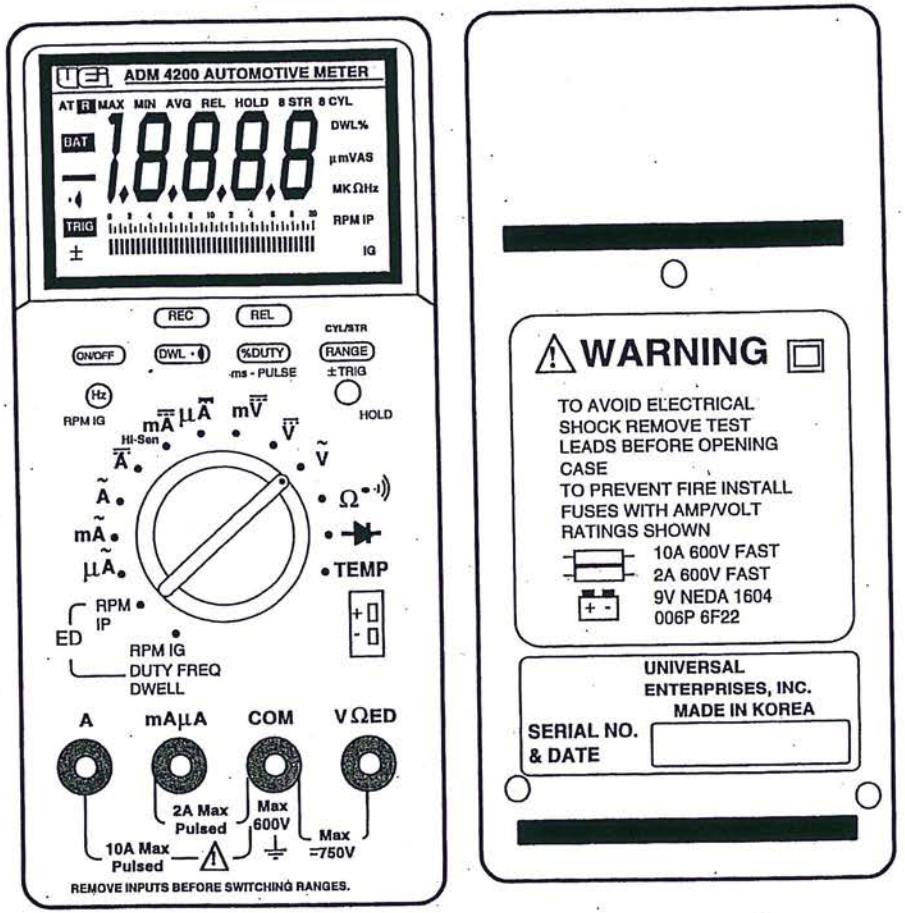
ADM4200 FRONT AND BACK VIEW



SAFETY RULES

⚠ Warning!

Observe all safety precautions when measuring higher voltages or currents. Turn off the power to the circuit under test. Set the ADM4200 to the desired function and range, and connect the test leads to the circuit under test. Reapply power. If an erroneous reading is observed, disconnect power immediately and recheck all settings and connections. Transient voltages (e.g. noise spikes) and harmonics can result in peak voltages that exceed the voltage rating of this instrument. Do not use it if you suspect either of these conditions exist.

INTERNATIONAL SYMBOLS

⚠	Dangerous Voltage	⏚	Ground
~	AC- Alternating Current	⚠	See Explanation
⎓	DC-Direct Current	▣	Double Insulation (Protection Class II)
≂	Either DC or AC	⎓	Fuse

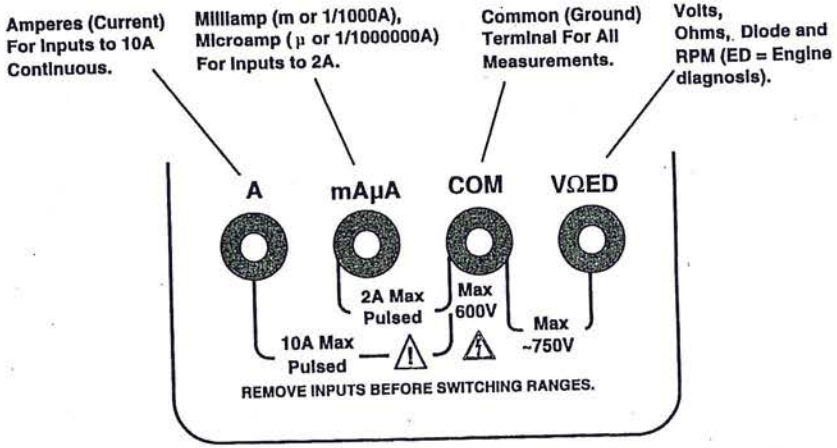
SAFETY TIPS

- Voltage above 60V DC or 25V AC RMS is extremely dangerous to human body. Such voltages pose a shock hazard when measured
- Disconnect the power and let all high-voltage capacitors discharge before testing the Ω functions
- Do not use this meter if it appears to be damaged
- Inspect the test leads for damaged insulation or exposed metal. Check test lead continuity. Damaged leads should be replaced
- Select the proper function and range for the measurement you are taking
- Always avoid working alone
- When using the test leads, keep your fingers away from the contacts. Keep your fingers behind the finger guards on the test leads
- Disconnect the live probe before disconnecting the common probe
- When measuring current, turn off the power before connecting this meter in the circuit
- Before measuring current transformer secondary or motor winding current, check fuses of this meter. An open fuse allows high voltage build-up, which is potentially hazardous
- When measuring circuits exceeding 10A, use clamp-on probes

METER INPUT TERMINALS

Input Terminals

This meter has four input terminals that are protected against the overload limits shown in the specifications.



⚠ WARNING!

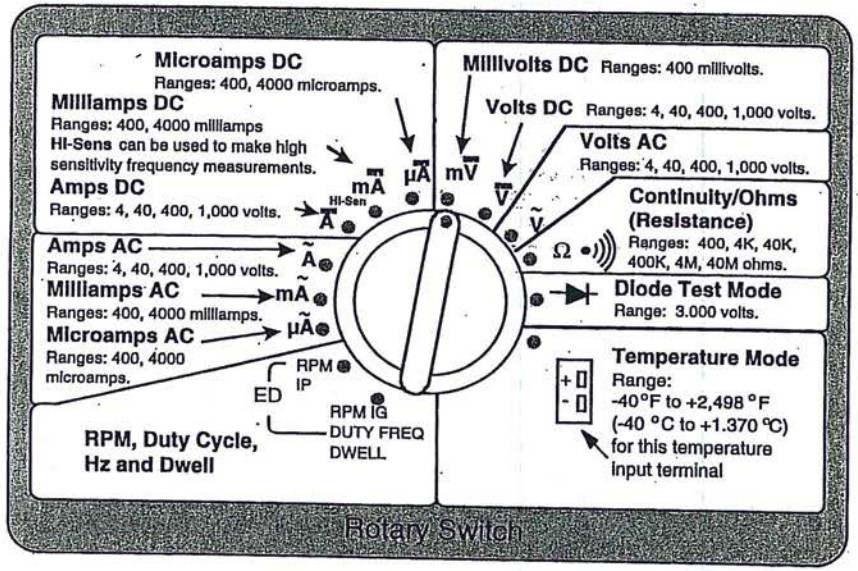
Never attempt a voltage measurement if a test lead is in the ampere (A) or milliampere (mA) input terminal. You might be injured or damage this meter.

ON/OFF SWITCH

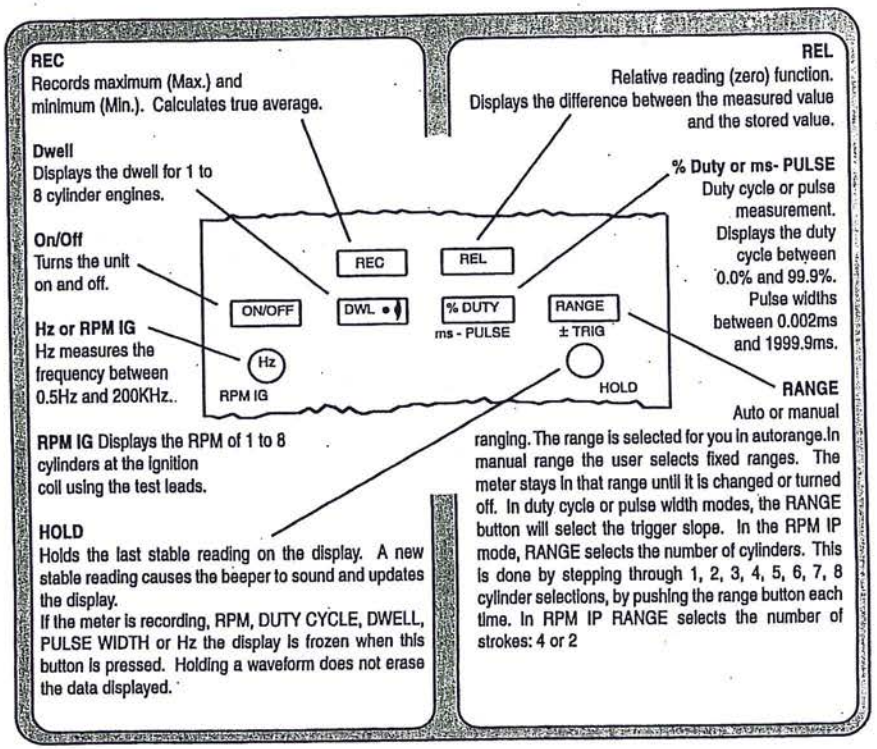
Turn the meter on by pressing the (ON/OFF) push button. All segments on the liquid crystal display (LCD) will turn on for one second as part of a self test routine. The meter is ready for normal operation when digital readout appears.

ROTARY SWITCH

Turn the rotary switch pictured below to change modes.

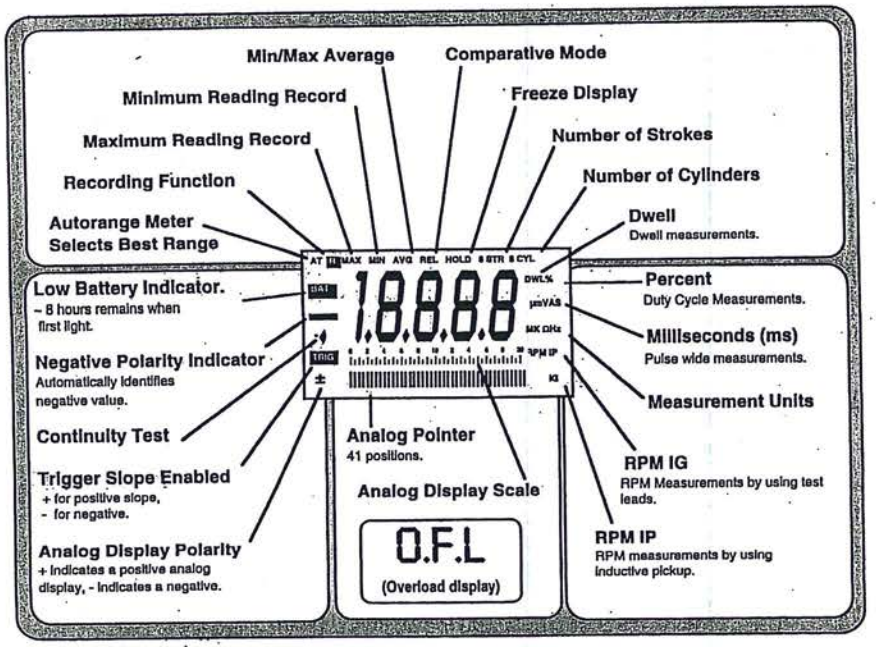


FUNCTION BUTTONS



METER DISPLAY

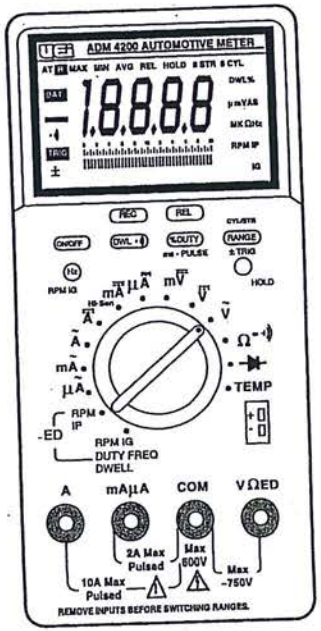
This meter combines the speed and versatility of a high resolution analog display with the precision of a digital meter. If the inputs are stable, the digital display offers the more accurate reading; if the inputs are rapidly changing, read the analog pointer. If a measurement is too large to be displayed, OFL (overflow) is shown on the digital display and the entire bar graph illuminates ON. In Duty Cycle, OFL (overflow) is displayed if the input signal stays high or low.



MULTIMETER OVERVIEW

Measurements and Features:

- The meter autoranges in most measurements, but can be manually set, as well
- There are audible and visual continuity (resistance) indicators
- Each time a measurement is selected, the meter confirms with a BEEP. (This can be turned off.) (See page 9.)
- The meter automatically powers off after a period of time, but this can be overridden. (See page 9.)
- Temperature can be measured directly in degrees °C or °F
- This meter features an analog bar graph to help detect fast signal changes
- This meter can monitor the MAX and MIN of any measurement and save it for later review
- This meter makes standard electrical measurements, plus RPM, FREQUENCY, DUTY-CYCLE, DWELL, and millisecond PULSE-WIDTH



MULTIMETER OVERVIEW (CONT.)

Automatic Power Off:
- Each time the instrument is turned ON the Automatic Power Off feature is active
- When no control switch/button has been used for 30 minutes, the battery saving internal timer will turn OFF the display panel
- Any control switch/button activity will turn the display panel back ON
- Automatic Power Off is disabled when the (REC) (Record) function is active

Manual Over-ride of Automatic Power Off:
- When the instrument is OFF, hold down the (RANGE) button and at the same time press the power ON button. This action cancels the Automatic Power Off feature

Beep Tones:
- Each valid control adjustment is announced by a beep

Manual Over-ride of Beep Tones:
- When the instrument is OFF, hold down the (% DUTY) button and at the same time press the power ON button. This action disables the Beep Tones

Temperature - Fahrenheit/Centigrade:
- The instrument defaults to Fahrenheit (°F) temperature readings

Manual Selection of Centigrade Readings:
- When the instrument is OFF, hold down the (DWL•))) button, and at the same time press the power ON button. This action enables Centigrade (°C) temperature readings

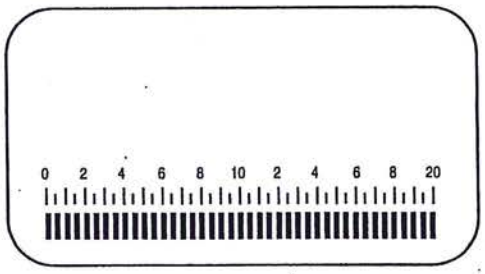
ANALOG BAR GRAPH

The segmented bar graph at the bottom of the display panel is designed to simulate the behavior of the needle of an analog volt-ohm meter. Momentary circuit fluctuations can often be detected by observing the bar graph.
- A stable readout and a stable bar graph at the same value imply an unchanging value

Circuits that are rapidly pulsed ON/OFF by a computer or electronic module, or circuits that have an intermittent spike, short or glitch can show up as:
- A stable readout and a changing bar graph
- A changing readout and a stable bar graph
- A changing readout and a changing bar graph

If either the bar graph or the display panel readout is not stable, we recommend use of the ADL7100 or ADL7000 labscope to properly evaluate the circuit.

NOTE: Some voltage irregularities happen in a manner that can not be detected by a DMM. Stable voltage and bar graph readouts are not absolute proof that no problem exists. If in doubt, use a labscope to test the circuit.



RECORD FUNCTION

Several features are available to the ADM4200 user under the RECORD function. The meter will record:

- The MAXimum reading during the recording time
- The MINimum reading during the recording time
- The average reading during the recording time

Procedure:

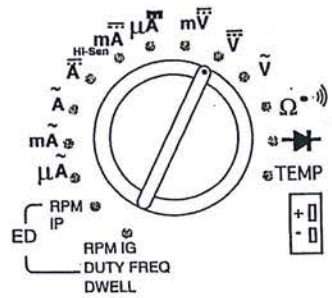
1. Connect the test leads to the meter - The RECORD feature can be enabled when testing:
   Volts, Ohms, Amps, RPM, Temperature, Duty Cycle, Pulse Width, Frequency
2. Turn the rotary function switch to select the parameter to be measured. (If you are measuring resistance be sure that power in the circuit under test is OFF.)
3. Turn the meter ON.
4. Connect to the circuit under test.
5. The meter will autorange and the display panel readout will show the present value.
6. If necessary, manually adjust the RANGE for your measurement.
7. Press the (REC) button to begin the recording ("R" is displayed in the upper left corner).
8. Each time a new MIN or MAX value is measured a beep tone will sound.
9. When sufficient time has passed for the events of interest to occur - press the (REC) button.
   - The MAX reading is displayed
   - Press (REC) again - the MIN reading is displayed
   - Press (REC) again - the AVG (average) reading over time is displayed

NOTE: The record feature can be turned off/reset by pressing the (REC) button for three seconds. The meter will not auto range while in record mode - stays in present range when record function selected.

MEASUREMENT OVERVIEW

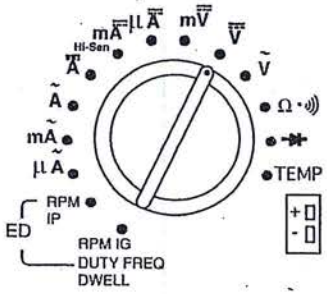
Standard DMM Measurements:

- DC Voltage Measurements
- AC Voltage Measurements
- Resistance Measurements
- DIODE Testing
- Current Measurements
- Temperature Measurements



MEASURING DC VOLTAGE

1. Press the (ON/OFF) button to turn the meter ON.
2. Turn the rotary function switch to "DC V" (Volts).
3. Connect the test leads to the multimeter.
   a. Plug the black lead into the COM input.
   b. Plug the red lead into the VΩ ED input.
4. Connect the black COM probe tip to the ground (-) side of the circuit under test.
5. Connect the red probe tip to the positive (+) side of the circuit.

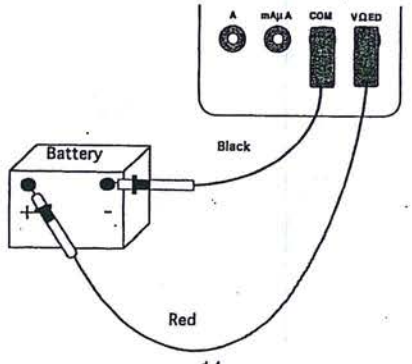


- The voltage present in the circuit is shown on the display panel readout
- The instrument will indicate the polarity of the red lead connection displayed on the left side of the voltage readout

When measuring small voltages (less than .4 volt):

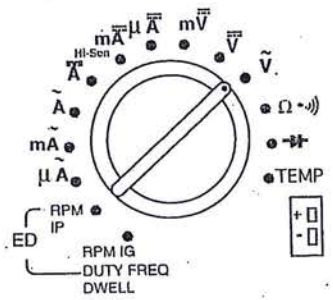
- Turn the rotary function switch to the "DC mV" (millivolt) position
- The maximum reading in the "DC mV" position is 399.9 mV (A display panel readout "OF.L" means voltage exceeds 399.9 mV and is out of range - switch to "DC V" (Volts) rather than millivolts)

NOTE: If the voltage reading is not stable and /or the bar graph indicator is fluctuating - further evaluation of the circuit using a labscope, model ADL7100 or ADL7000 is recommended.



MEASURING AC VOLTAGE

1. Press the (ON/OFF) button to turn the meter ON.
2. Use the rotary function switch to select "AC V" (Volts).
3. Connect the test leads to the multimeter.
   a. Plug the black lead into the COM input.
   b. Plug the red lead into the VΩ input.
4. Connect the probe tips to the circuit under test. For AC voltage measurements with a multimeter it is not necessary to observe polarity.

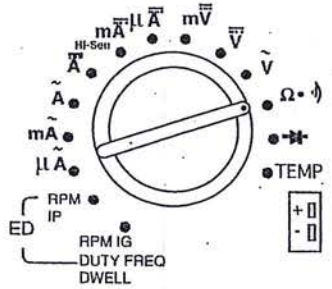


NOTE: If the voltage reading is not stable and/or the bar graph indicator is fluctuating - further evaluation of the circuit using a labscope, model ADL7100 or ADL7000 is recommended.

MEASURING RESISTANCE (OHMS Ω)

Overview:

- Sends a voltage from its own power (battery) into the connected circuit
- Measures exactly how much the voltage is reduced by resistance in the circuit under test
- Displays circuit resistance (in OHMS)



⚠ WARNING:
The circuit being tested MUST be OFF with NO VOLTAGE PRESENT!

Verify the circuit under test is completely OFF and no voltage is present (Use the DC/voltage test capability of the ADM4200 to make that verification):

1. Turn the rotary function switch to the Ω position to measure resistance.
2. Connect the test leads across the load or circuit to be tested.
3. The autorange feature will determine the most appropriate scale for OHMS display -
   Ω (OHMS),
   KΩ (Kilo or thousands of OHMS),
   MΩ (Millions of OHMS).
4. The operator can manually select the scale by pressing the (RANGE) button.

The AUDIBLE CONTINUITY feature allows the operator to do a quick resistance test without looking at the display panel.

- Press the (DWL•))) button to enable/disable the audible beep
- The audible beep will sound only if resistance is under 100Ω
- The Bar Graph disappears when continuity is detected

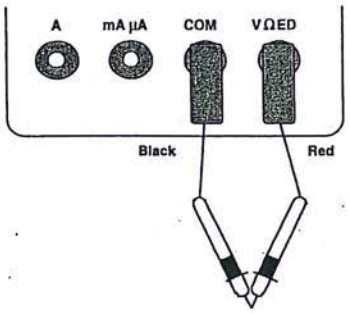
COMPENSATING FOR RESISTANCE IN THE TEST LEADS

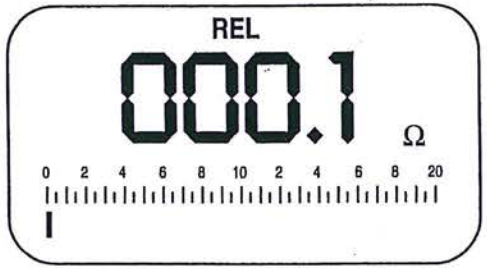
Overview:
The test leads may have some measureable resistance, usually between 0.1 and 1.0 OHM. When measuring small amounts of resistance an accurate reading is important.

For the most accurate (0 - 199 OHM) measurement - use the (REL) (relative) mode to subtract test lead resistance:

1. Turn the instrument ON.
2. With the test leads connected to the instrument for a resistance measurement - connect the red and black probe tips together.
3. Turn the rotary function switch to the Ω test position.
   If the readout is 000.0 no adjustment is necessary - continue with your testing.
4. To prevent resistance in the test leads from being added to the circuit under test - press the (REL) button. This will zero the reading and any resistance in the leads will not be added to the circuit you are testing.

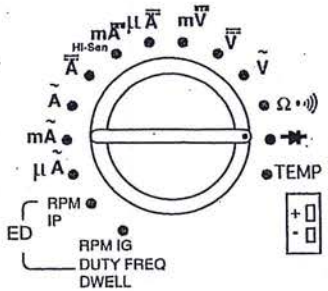
When the Relative Mode is active (REL) shows at the top center of the display panel.





DIODE CHECK

Overview:
A diode functions like a gate, allowing voltage to pass in one direction only.



Multimeter:
- Sends voltage from its own power (battery) into the diode
- The display panel readout shows the voltage passing through the diode

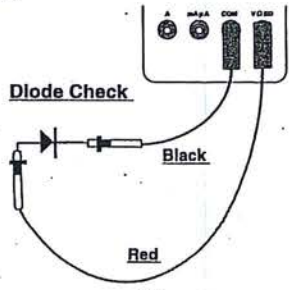
Failure modes include:
- Voltage passes in either direction
- No voltage can pass in either direction

⚠ WARNING:
The diode must be isolated from any circuitry for the test to be accurate.

After verifying that the diode is isolated (Use the DC/AC test capability of the ADM4200 to make that verification):

1. Turn the rotary function switch to the ⊣◀ position.
2. Connect the meter probe tips to the leads of the diode following the manufacturers' test procedures. Note the voltage reading.
3. Reverse the test lead connections at the diode. Note the voltage reading.

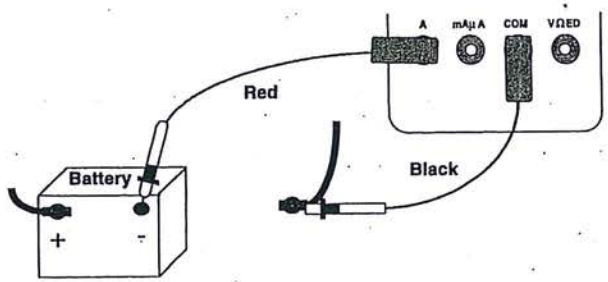
A good diode will have a low (0.9 volt or less) reading and a high reading (2.5 volts or more).
A defective diode will have two high readings or two low readings.
A shorted diode will read 0.000V.
An open diode will read OFL.



CURRENT

Overview:
The procedure for measuring CURRENT is different from measuring voltage.
- When measuring VOLTAGE, the meter leads are connected to the points in the circuit being tested. Very little power (current) is drawn into the meter
- When measuring CURRENT, the meter is connected in series and becomes part of the circuit being tested. All the power in the circuit flows through the meter

Example:



Measuring Current

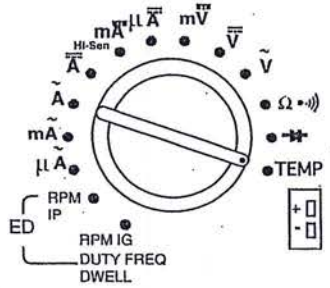
1. Press the ON/OFF button to turn the meter ON.
2. Turn the rotary function switch to "DC A" (amps).
3. Connect the test leads to the multimeter;
   a. Plug the black lead into the COM input,
   b. Plug the red lead into the A (Amp) input.
   WARNING: Turn OFF power in the circuit before going to step 4 The ADM4200 should NOT be used to check current flow exceeding 10A. If you expect 10 Amps or more to be present in the circuit we recommend using the ACM6100 current probe. DO NOT connect the meter directly to the circuit if current will exceed 10A.
4. Connect the test leads in series with the load under measurement. (See illustration.)
5. Turn power to the circuit ON.*
6. When measurements are complete, turn circuit power OFF before removing meter from the circuit.

***After step 5, if your reading is 0.399 amp or less - Turn the rotary function switch to "mA" (milliamps) for the most precise reading, then if your reading is 0.399 mA or less switch to "μA" (microamps).**

TEMPERATURE - FAHRENHEIT/CENTIGRADE

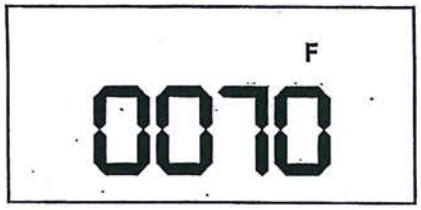
Overview:
The DMM includes a built-in K-style thermocouple input. As the thermocouple tip changes temperature, the current flowing through it changes proportionately.

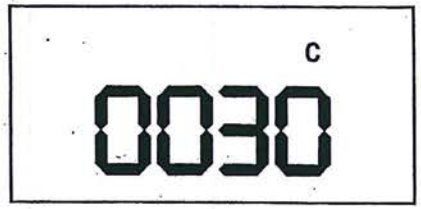
- The instrument defaults to Fahrenheit (°F) temperature readings.



Manual selection of Centigrade readings:

- When the instrument is OFF, hold down the (DWL) button and at the same time press the power (ON/OFF) button. This action enables Centigrade (°C) temperature readings





AUTOMOTIVE MEASUREMENT OVERVIEW

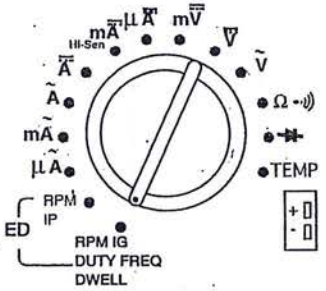
- Triggering - What is it and when to use it
- Starting and Charging Tests
  - State of Charge
  - Current Leakage
  - Parasitic Load
  - Voltage Drop
  - Battery - Cranking Voltage
  - Operating Voltage Test
  - Alternator - Diode Test Overview
- Ignition Component Tests
- RPM Measurements
- Sensor and Component Testing
  - Measuring AC Voltage
  - Potentiometer Testing
  - Using Min/Max Mode
  - Pulse Width Measurements
  - Frequency Measurement
  - Duty Cycle Measurement

TRIGGERING SLOPE

This meter allows the user to adjust the trigger during the following measurements:

- DWELL (in degrees)
- DUTY CYCLE (in percent)
- FREQUENCY (in hertz)

When making these measurements, the operator can choose to trigger on a rising (+) or falling (-) voltage slope. The default mode for the instrument is (-) negative slope.



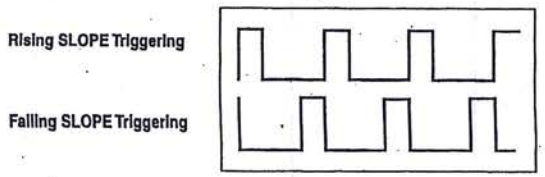
To select RPM, DUTY CYCLE, PULSE-WIDTH or FREQ:

1. Turn the rotary function switch to the "RPM IG" position.
2. Press the (%DUTY) button to choose from RPM, DUTY CYCLE, PULSE-WIDTH or FREQ measurement(s).
3. To return to RPM function, press round blue (Hz) button.

To select DWELL measurement: (The meter defaults to a (-) negative trigger for this measurement.)

During dwell measurement the trigger slope actually displays degrees of signal high or low depending on trigger selection. Most dwell reading specifications are given in degrees of signal low (- trigger slope), which is the default setting for this DMM.

1. Turn rotary function switch to DWELL.
2. Press the DWELL function button to switch from RPM IG to DWELL function, if needed.
3. Press the RANGE function button to select the correct number of cylinders.
4. The DWELL reading is displayed (in degrees of crankshaft rotation).



TRIGGERING SLOPE (CONT.)

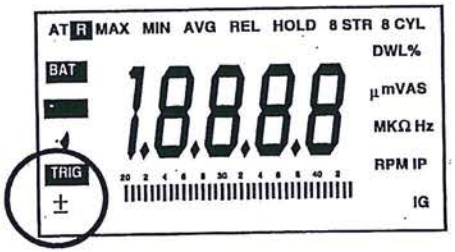
Operator Action:

The instrument defaults to triggering on falling (-) Slope.

1. Change to rising (+) Slope by pressing the (RANGE) button.
2. Toggle back to falling Slope by pressing the (RANGE) button again.

Annunciator Action:

The instrument displays the slope - or + selection under the "TRIG" readout at the lower left corner of the display panel.



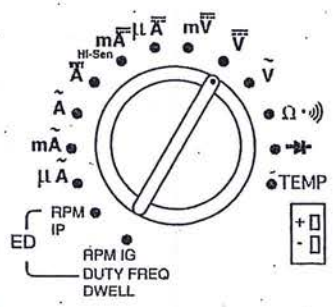
Application:

- Dwell: Trigger on falling (-) slope to measure ON-TIME (in degrees)
- Duty Cycle: Measurement is in percent, default trigger is (-) negative
- Pulse-width: Measured in milliseconds, voltage ON time or OFF time
- Frequency: Measured in Hertz. Trigger slope doesn't affect frequency measurement

STARTING AND CHARGING SYSTEM TESTING - QUICK TESTS

State of Charge

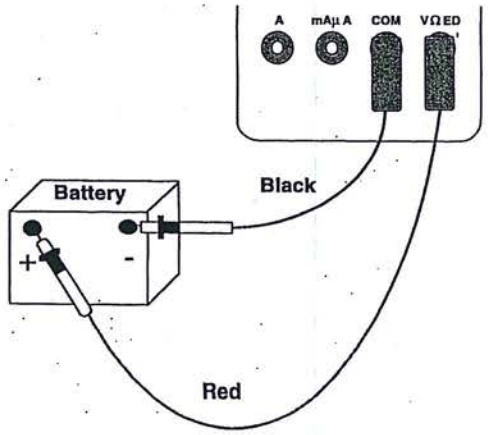
- The first step when conducting starting and charging system tests is to verify that the battery is fully charged



Battery - State of Charge Test

1. Place the vehicle ignition switch in the OFF position.
2. Turn the headlights ON for 30 seconds to dissipate the battery surface charge.
3. Turn the vehicle lights and accessories OFF.
4. Set the meter to read "DC V" (Volts).
5. Connect the black COM lead probe tip to the battery negative (-) post.
6. Connect the red volts lead probe tip to the battery positive (+) post.

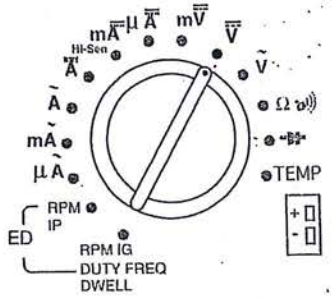
- A fully charged battery will read 12.6 volts or more
- A reading of 12.4 to 12.5 is considered about 75% charged
- If the reading is 12.3 volts or less, charge the battery before making further starting and charging system tests



CURRENT LEAKAGE

Parasitic Load

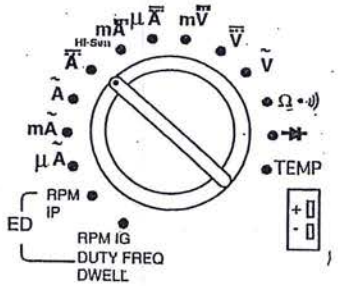
- Several devices on a modern vehicle are continuously using small amounts of current to function and retain their memory. A battery with sufficient reserve capacity to match the vehicle requirements is unaffected by this
- A mismatched battery, a drain of current caused by a device left on, or an electrical short can cause a discharged battery. The normal battery load is less than 30mA with the ignition and accessories turned off. This can vary - check the vehicle service manual or other reliable reference source to verify the specifications for the vehicle with which you are working



- Remember - Some computer-managed systems may stay active for several minutes or even hours after the vehicle is turned off

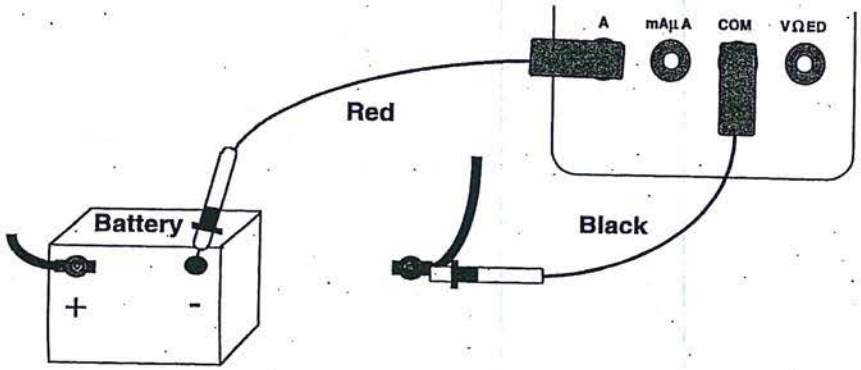
CURRENT LEAKAGE (CONT.)

Battery - Parasitic Load Test



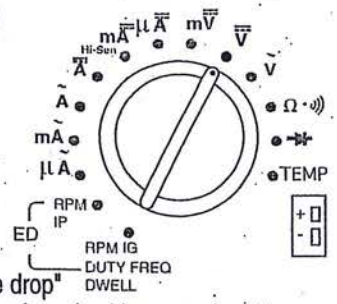
1. Place the ignition switch and all vehicle accessories in the OFF position.
2. Verify total current draw is under 10 amps using a clamp-on current adapter (ACM6100 or equivalent).
3. Disconnect the vehicle battery negative (-) cable.
4. Turn the meter ON.
5. Turn the rotary function switch to "DC A" (Amps).
6. Plug the black test lead into the COM input.
7. Plug the red test lead into the "A" input.
8. Connect the black COM lead probe tip to the battery negative post.
9. Connect the red "A" lead probe tip to the battery negative cable - this will complete a circuit allowing the measurement of parasitic load.

After verifying the parasitic load is under 2 amps; you may turn the rotary function switch to "DC mA" and move the red lead to the "mAμA" input. This will change the readout from amps to milliamps and give the most accurate reading for small current flow.



VOLTAGE DROP MEASUREMENTS

Overview:



- A resistance (ohms) measurement does not tell us the maximum current (amperage) that can pass through a wire/cable or connection
- We can test the voltage at the beginning of the wire and compare that voltage with the voltage at the other end of the wire while the circuit is under load (working) to learn if enough current can pass through that part of the circuit
- The voltage lost due to overcoming resistance in the wire/cable or connection is called "voltage drop"
- Loose or corroded connections and undersized or frayed cable can reduce the amount of current that can flow, resulting in hard starting and low battery voltage

Voltage Drop Test: Negative (-) (Ground) Side of Battery

- Set meter to measure DC V (Volts)
- Press the (REC) button to initiate min./max. recording
- Place the black lead in the com port and the red lead in the VΩED port
- To measure voltage drop from the battery negative post to the cable connection at the post, in parallel with the battery cable:
  1. Disable ignition or fuel, so the engine will crank but not run.
  2. Touch/connect the black COM lead probe tip to the negative (-) battery post.
  3. Touch/connect the red volts lead probe tip to the negative (-) battery cable connection.
  4. Crank the engine while observing the meter reading.
  5. Press (REC) button to view maximum voltage. Reading should not exceed 0.1 volt - a higher reading indicates a poor connection. (Consult vehicle service procedures for exact specifications.)
- To measure voltage drop from the battery negative post to the engine block:
  1. Same procedures as above, but connect the red volts lead probe tip to the engine block.
  2. Reading should not exceed 0.2 volts during cranking (allow 0.1 volt of drop per connection). (Consult vehicle service procedures for your exact specifications.)
  3. Poor connections usually respond to a thorough cleaning - if not, they should be replaced.

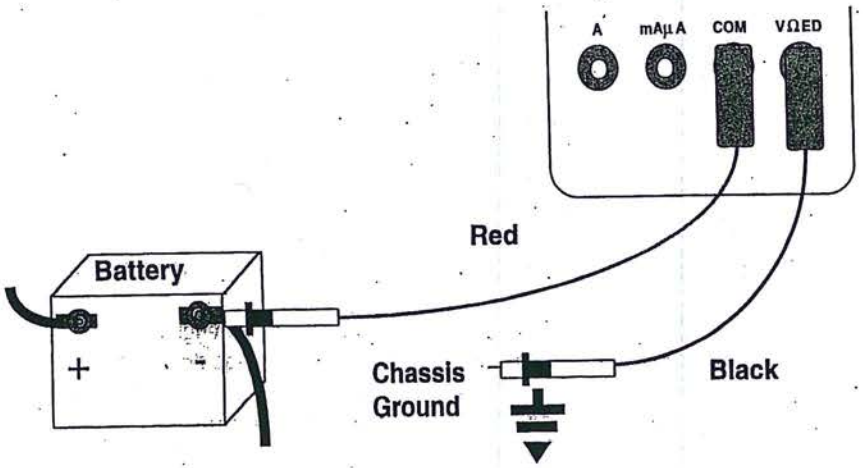
VOLTAGE DROP MEASUREMENTS (CONT.)

Voltage Drop: Positive (+) Side of Battery

- Set meter to measure DC V
- Press REC button to initiate MIN/MAX
- To measure voltage drop from the battery positive post to the starter motor. (This tests all the battery to starter connections at one time.)

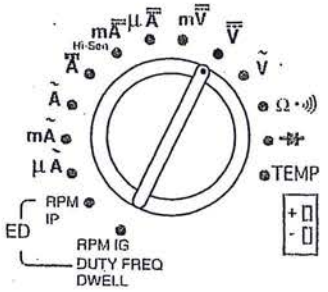
Procedure:

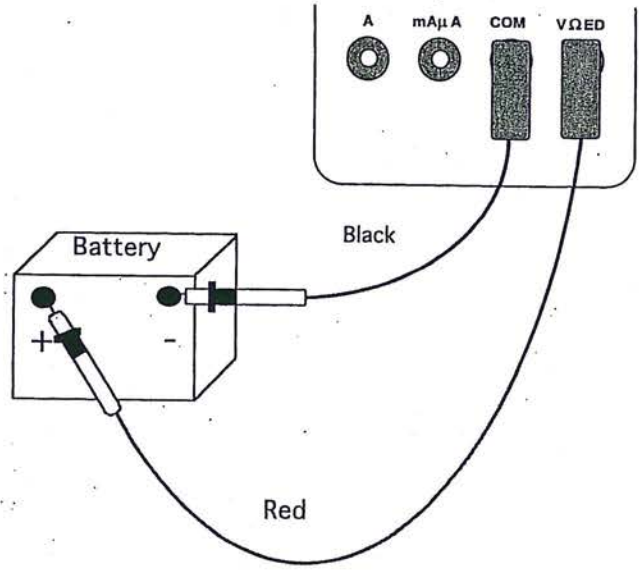
1. Disable ignition or fuel, so the engine will crank but not run.
2. Connect the red VΩED lead probe tip to the battery positive (+) post.
3. Connect the black COM lead probe tip to the positive battery cable connection at the starter.
4. Crank the engine while observing the meter reading.
5. Press REC button to view max. Allow 0.1 volt per connection and 0.2 volt for current passing through the starter solenoid. (Consult vehicle service procedures for exact specifications.)
6. Poor connections should be cleaned or replaced.



CRANKING VOLTAGE TEST

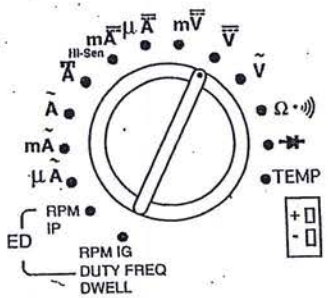
1. Disable ignition or fuel, so the engine will crank but not run.
2. Set meter to read "DC V" (Volts).
3. Connect black COM lead probe tip to battery negative (-) terminal.
4. Connect red volts lead probe tip to the battery positive (+) terminal.
5. Crank engine while observing meter reading.
6. Look for a reading of 9.6 volts or higher when testing at 70°F.
   In colder conditions, allowing 0.1 volt less for each 10° drop in temperature is accepted practice. (Usually if the battery drops below 9 volts the vehicle won't start reliably.) Consult the repair procedures for your vehicle.





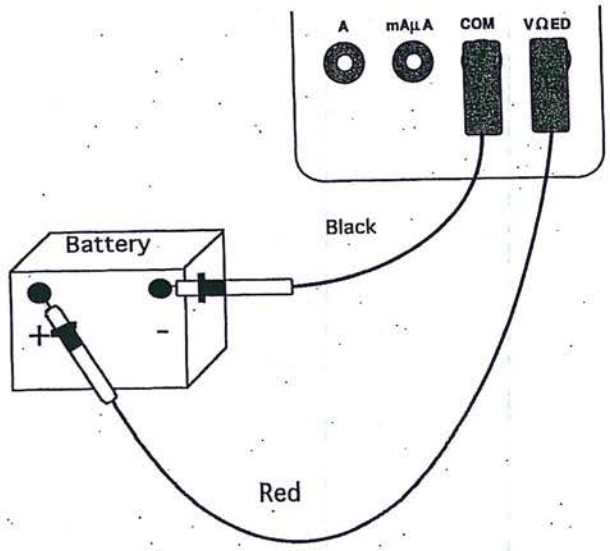
REGULATED OPERATING VOLTAGE TEST

NOTE: Perform test on page 24 first.



1. Set meter to read "DC V" (Volts).
2. Connect black COM lead probe tip to battery negative (-) terminal.
3. Connect red volts lead probe tip to battery positive (+) terminal.
4. Verify that battery is fully charged.
5. Start engine.
6. Turn all vehicle electrical accessories OFF, run engine at idle. Be sure engine is at operating temperature.
7. System voltage reading should be 13.1 volts to 14.2 volts. Check your vehicle service manual for exact specifications.

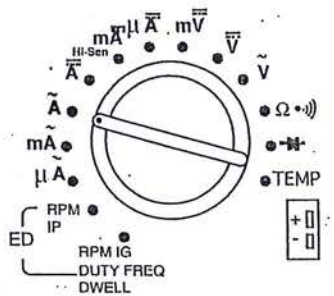
Low voltage - check connections, drive belt, faulty regulator, and alternator
High voltage - usually indicates a faulty voltage regulator.



ALTERNATOR - DIODE TEST

Overview:

The alternator produces AC voltage and current. The battery requires DC voltage and current to charge properly. Diodes located within the alternator change (rectify) the AC to DC. However, a small amount of AC can still be present and no harm is done. Problems can develop when alternator diode faults permit unacceptable amounts of AC to pass into the vehicle electrical system.



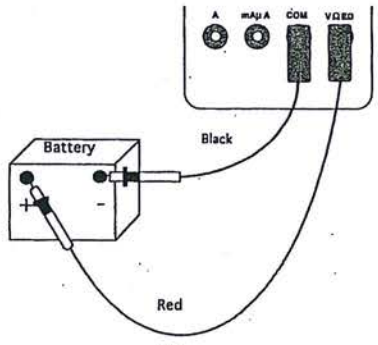
Those problems can include:

Undercharged battery, stalling, rough idle

Alternator - Diode Test

1. Set the meter to read "AC V" (Volts).
2. Connect the black COM lead probe tip to the battery negative post.
3. Connect the red volts lead probe tip to the battery positive post
4. Run the engine at 1500 RPM.
5. Turn ON all electrical accessories, including high beam lights.
6. Your meter reading should not exceed 0.09 volts (90mV) AC.
7. Turn engine and accessories OFF. Disconnect meter leads.

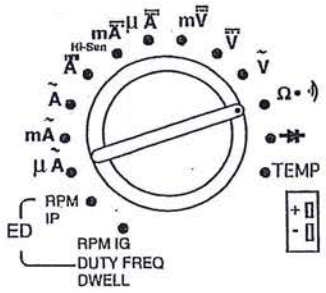
NOTE: If your meter reading exceeds 90mV AC, use a labscope to verify that ripple voltage spikes do not exceed one volt peak to peak.

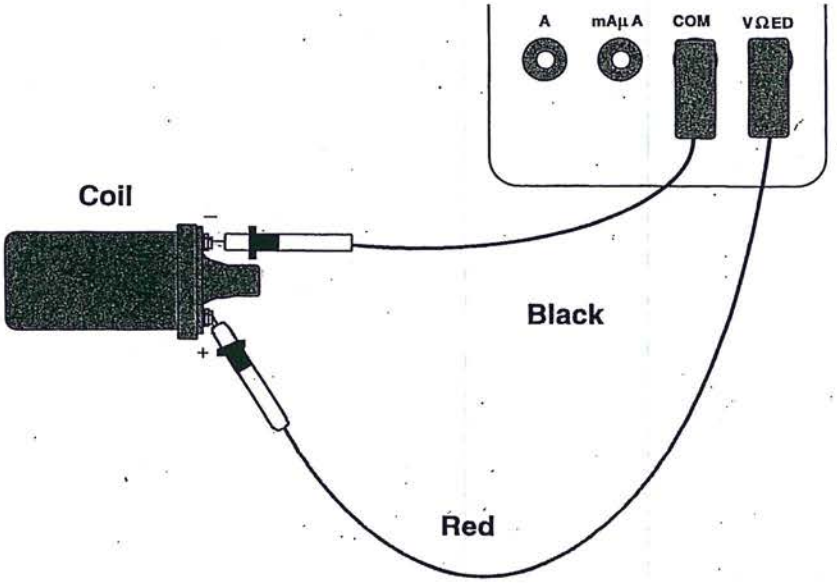


IGNITION COMPONENT TESTING

Ignition Coil - Primary Resistance

1. Disconnect connections to ignition coil.
2. Set meter to measure OHMs "Ω".
3. Connect meter probe tips together and press (REL) to zero the reading.
4. Connect black COM lead probe tip to coil negative terminal.
5. Connect red (V/Ω) lead probe tip to coil positive terminal.
6. Most specifications call for under 1Ω of resistance in the primary circuit of the coil - consult the specifications for the specific coil you are testing

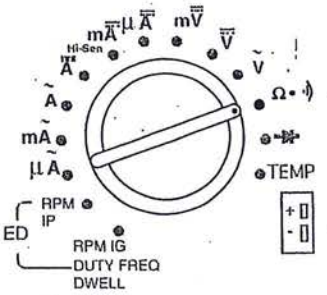


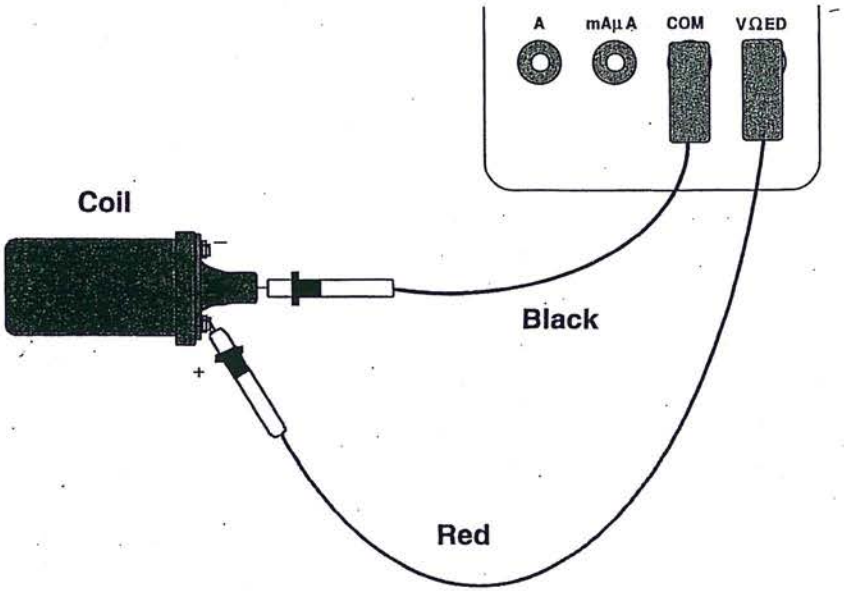


IGNITION COMPONENT TESTING (CONT.)

Ignition Coil - Secondary Resistance

1. Disconnect connections to ignition coil.
2. Set meter to measure OHMs "Ω".
3. Connect the black COM lead probe tip to the secondary terminal.
4. Connect red V/Ω lead probe tip to coil positive terminal.
5. Most specifications call for several thousand OHMs - verify the specifications for the specific coil you are testing.



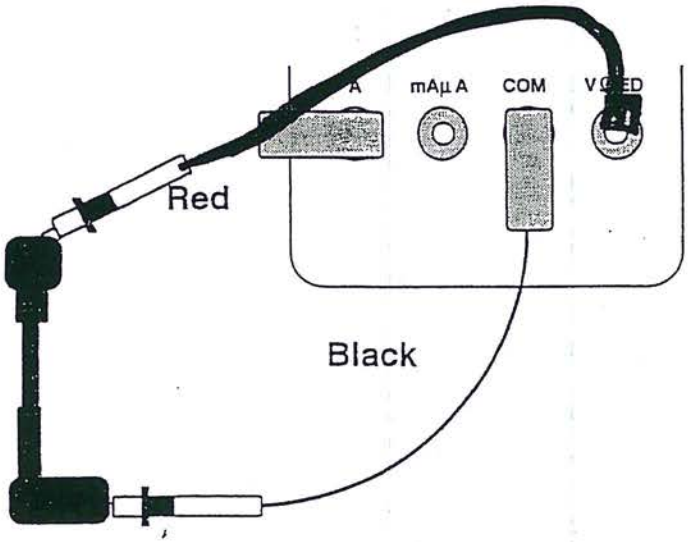


IGNITION COMPONENT TESTING (CONT.)

Spark-Plug / Ignition Wire - Resistance
Use this test to look for open circuits or excessive resistance in ignition wires.

1. Set meter to measure OHMs "Ω".
2. Connect black COM lead probe tip to either end of the ignition wire.
3. Connect the red volts/Ω lead probe tip to the other end of the ignition wire.
4. Expect more than 1K OHMs per foot of wire, but verify with your plug wire manufacturers' specifications.
5. Gently move and turn the wire while observing the meter reading.
6. A reading of "O.FL" indicates "open" in the wire.

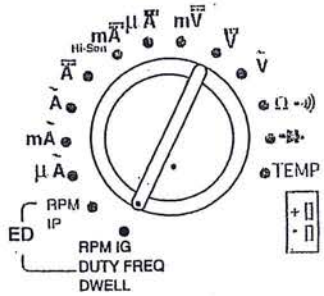
NOTE: The most effective ignition system testing is with a lab scope, such as the ADL7100 or ADL7000. Remember, verifying proper resistance in an ignition wire does not reveal the effectiveness of the wires insulation. Lab scopes test the system under load and at operating temperature, when failures are most noticeable.



RPM MEASUREMENTS

RPM Measurement Using Test Leads
Your ADM4200 can make RPM measurements on some vehicles using standard test leads. By direct connection to the tach output, you can read engine RPM.

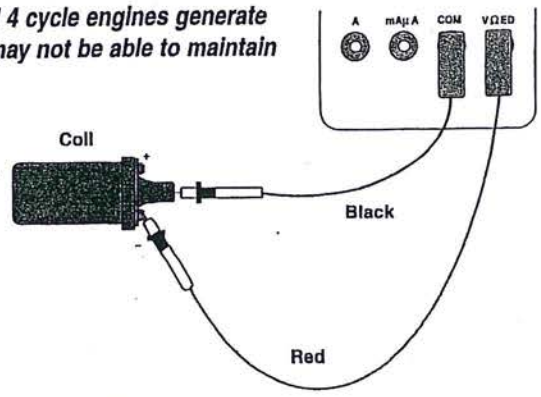
Measuring RPM using standard DMM test leads:



1. Turn the rotary function switch to "RPM IG".
2. Turn the meter ON.
3. The display panel shows "0000 RPM". The meter defaults to 4 STR (Stroke) and 4 CYL (Cylinder). If you are not testing a 4 cylinder vehicle, press the (RANGE) button to choose the number of cylinders for the vehicle being tested.
4. Connect the black COM lead probe tip to a good vehicle ground.
5. Connect the red volts lead probe tip to the coil negative (tach) terminal.
6. Start the engine.
7. Display is now engine RPM. Compare with manufacturer's specifications.
8. When testing is complete turn engine OFF, disconnect meter.

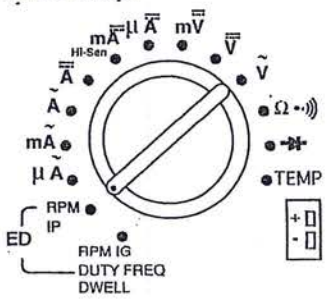
NOTE: To select a 2-stroke engine, move the rotary knob to the RPM IP selection, then press the RANGE function button. Turn Rotary knob back to RPM IG.

NOTE: Some 2 cycle and small 4 cycle engines generate excessive EMI and the meter may not be able to maintain a stable RPM readout.



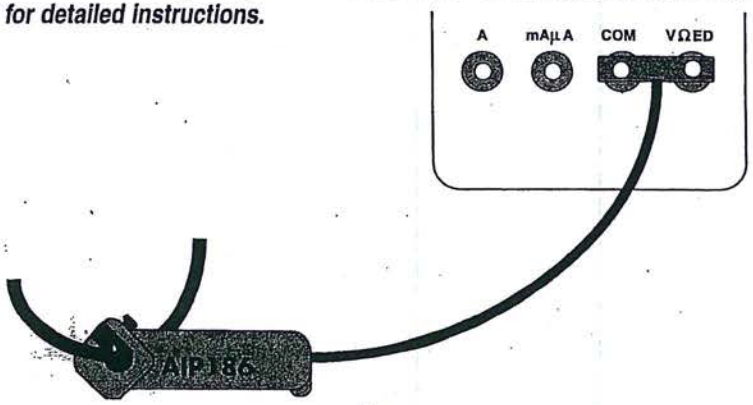
RPM MEASUREMENTS (CONT.)

Procedure to Measure RPM using the AIP186 Inductive Pickup:



1. Turn the rotary function switch to "RPM IP".
2. Turn the meter ON.
3. The display panel shows "0000 RPM IG". The meter defaults to 4 STR (Stroke) and that is also displayed in the readout. If you are testing a 2 stroke engine - press (RANGE) once, the readout will change to "2STR". Press (RANGE) again and the meter goes back to 4 stroke.
4. Insert the AIP186 Inductive Pickup banana plug connector into the meter. Observe polarity. The side with the small ear is the COM (ground) side.
5. To measure RPM on a distributor engine - connect the Inductive pickup to any spark plug wire. Be sure the side marked "SPARK PLUG SIDE" is facing the spark plug.
6. On some DIS vehicles (with waste spark), the meter may need to be set up as a 2-STROKE engine to yield correct RPM readings.

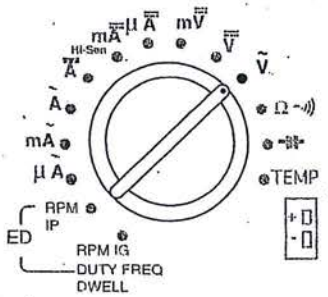
NOTE: Some engines produce a harsh EMI environment. If the RPM reading seems unstable using the Inductive Pickup, you may be able to make an accurate, stable RPM reading using the test leads. See "RPM measurement using test leads" for detailed instructions.



SENSOR AND COMPONENT TESTING

Measuring AC Voltage

Some sensors report rotational speed by generating AC voltage when two magnetic materials move toward and then away from each other. The pick-up coil in a distributor, many crankshaft sensors and anti-lock brake sensors use this principle of operation.



Pick-up Coil, Crank Sensor, Anti-Lock Brake Sensor

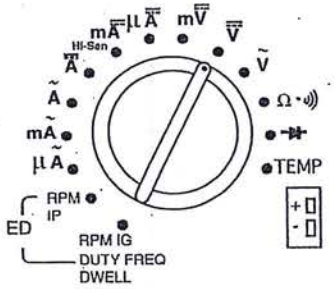
- AC voltage produced by an induction-type sensor will vary in proportion to engine/wheel speed
- Devices that produce AC voltage usually has two wires (+ & -) carrying the signal
- Many service manuals give specifications for resistance testing of these sensors
- Resistance testing alone is incomplete. A weak magnet, producing less voltage will not be revealed, nor will excessive air gaps
- Using the DMM to verify voltage during actual engine operation/wheel turning is a more reliable test
- Because DMM voltage is averaged, the voltage can read as expected but not be the clean signal that is needed by the module or computer
- The most reliable test of an AC-type pulse generator sensor is made using a lab-scope. We recommend the ADL7100 or ADL7000 labscope for this type of testing

If a lab scope is unavailable, induction type sensors may be tested for AC voltage output as follows:

1. Set your meter to read "AC V" (Volts).
2. Connect the black COM lead probe tip to a sensor lead.
3. Connect the red volts lead probe tip to the other sensor lead (polarity will not matter).
4. OBSERVE SAFETY RULES - BE CERTAIN THAT WIRES AND LEADS AS WELL AS YOUR CLOTHING AND HANDS ARE CLEAR OF MOVING PARTS. WHEN CHECKING WHEEL SENSORS BE SURE WHEELS ARE FREE TO ROTATE AND NOT MOVE VEHICLE OR CAUSE DAMAGE.
5. Run the device you are testing.
6. Observe the voltage reading and compare with factory specifications.

POTENTIOMETER TESTING

Variable resistance, three wire potentiometers are used as sensors in several areas of computer engine control. Common applications are Throttle Position Sensor and Vane Air Flow meter. These components can be tested on the vehicle during actual function by measuring DC volts to - and from - the device. (Using a lab scope yields a more accurate assessment of these type sensors.



Throttle Position Sensor - Testing

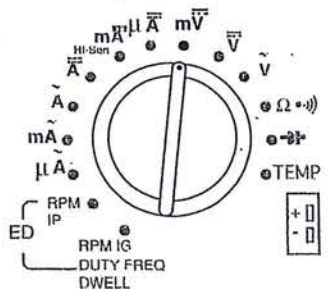
1. Set meter to read "DC V" (Volts).
2. Connect black COM lead probe tip to a known good ground near the TPS sensor or the sensor ground wire.
3. Connect red volts lead probe tip to the TPS Reference voltage wire.
4. Turn ignition ON. Do NOT start engine.
5. Look for 5 volt reading - (some manufacturers may differ - verify correct reference voltage for the specific vehicle being tested).
6. If reference voltage is too high or too low, look for problem with wiring harness or PCM.
7. After establishing reference voltage is O.K. connect red volts lead probe tip to the TPS signal return to PCM lead.
8. Look for low voltage at idle position, smoothly increasing as you gradually apply throttle. Any fluctuation of the meter Bar Graph or erratic voltage readout indicates a bad sensor. Verify factory specs for low voltage (idle) setting, even one tenth off can make a difference in vehicle performance. The high (full throttle) voltage should reach at least 80% of the reference voltage.
9. Verify actual voltage levels with manufacturer's specifications.

Vane Airflow Meter - Testing

1. Test procedures for these airflow sensors are similar to those for TOS testing.
2. Connect the red test lead to the wire going from the airflow sensor to the computer.
3. Connect the black test lead to a good ground.
4. Follow the same test and inspection criteria in steps 5-9 above.

USING MIN/MAX MODE

The REC mode allows the operator to observe the display panel readout showing the live reading, while the meter stores the highest reading (MAX), the lowest reading (MIN), as well as the average (AVG) reading during the entire time of the test.



The REC feature is useful for testing many sensors, such as the oxygen sensor. The oxygen sensor, when functioning normally, will continuously cycle between low (about 100mV) and high (about 900 mV) voltages.

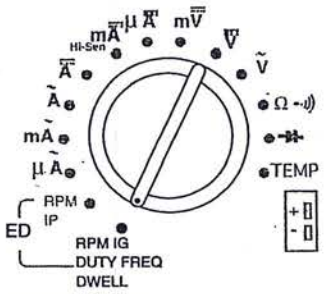
Oxygen Sensor Testing - Min/Max

To verify high/low switching performance of the oxygen sensor:

1. Set meter to read "DC mV" (Millivolts).
2. Connect the red volts lead probe tip to the O_2 signal to PCM wire.
3. Connect the black COM lead probe tip to the O_2 sensor ground wire (or good ground if it is a single wire sensor).
4. Start the engine and allow time for the sensor to get hot. (Closed Loop.) Run the engine at about 1000 RPM.
5. To start the recording of sensor voltage activity - Press the (REC) button once.
6. You should snap throttle at least once to encourage a lean/rich situation.
7. When you are satisfied that sufficient time for the test has elapsed - Press the (REC) button, this will display the MAX voltage reached during the test.
8. Press the (REC) button one more time - the MIN voltage reached during the test is displayed.
9. Press the (REC) button again and the AVG voltage since the start of the test is displayed.

PULSE-WIDTH MEASUREMENTS

Many automotive devices are switched ON/OFF very quickly. Many traditional instruments are unable to make accurate measurement of these ON-OFF times, which can be as brief as one millisecond.



Monitoring the ON time of a fuel injector can help determine if the PCM has control of fuel management.

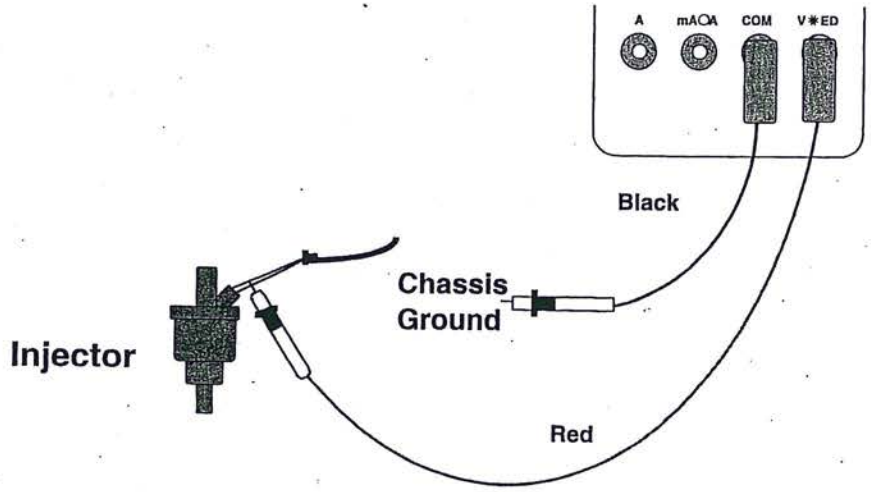
- Fuel injector ON time during cranking of a cold engine can be 20 to 50ms
- Fuel injector ON time during acceleration can be as high as 15ms
- Fuel injector ON time during idle of a warm engine may be only 1 to 3ms
- All of these measurements are subject to manufacturers' individual specifications

PULSE-WIDTH MEASUREMENTS (CONT.)

Fuel Injector - ON Time Measurement (Pulse Width)

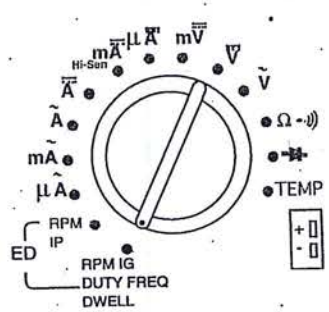
1. Turn the rotary function switch to "RPM IG".
2. Turn the meter ON.
3. The display panel shows "0000 RPM". Press the (%DUTY) button twice, to select the Millisecond pulse-width function.
4. The display panel readout should be "OF.L ms".
5. Connect the meter's black COM lead probe tip to a good vehicle ground.
6. Connect the meter's red probe tip to the injector signal return to PCM wire.
7. Start the engine and observe meter readings.

NOTE: Some fuel injector strategies involve complex circuits (peak and hold) or very high-speed pulsing (microseconds) of the fuel injector. Accurate testing of those injectors requires the use of a lab scope. We recommend the ADL7100 or ADL7000 to properly test all injectors.



FREQUENCY MEASUREMENT

Overview:
On modern computer managed engines there are usually several devices that are turned ON and OFF many times per second. The number of times the ON and OFF switching occurs each second is called the Frequency.

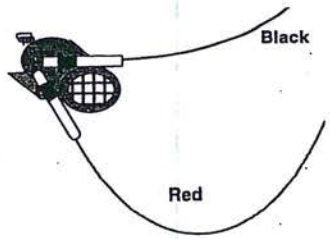


The Frequency measurement of a device is an important clue to its proper operation. When a device is not operating at the designed frequency it may be faulty, the computer controlling the device may be faulty, or inputs to the computer may be faulty. Appropriate testing can help determine the source of the problem.

Digital Mass Airflow Sensor
Digital MAF sensors send digital (on/off) pulses to the PCM. The number of pulses are proportional to the amount of air flowing through the MAF. More air = more pulses...and more fuel.

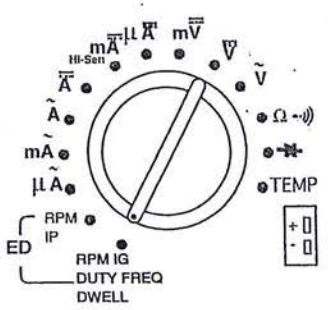
MAF - Frequency Measurement

1. Turn the rotary function switch to "RPM IG".
2. Turn the meter ON.
3. The display panel is shows "0000 RPM". Press the (%DUTY) button three times.
4. The display panel readout should be "00.00 Hz".
5. Connect the meter's black COM lead probe tip to a good vehicle ground or the sensor ground wire.
6. Connect the meter's red probe tip to the MAF return to PCM signal wire.
7. Start the engine and observe the frequency reading at idle.
8. Gradually apply throttle - look for smooth frequency increase. A fluctuating or erratic frequency reading might imply a faulty MAF.



DUTY CYCLE MEASUREMENT

The solenoid devices that the PCM controls manage spark, fuel distribution, and emissions operate at a fixed or unchanging frequency. However, the proportion of ON to OFF time during each ON and OFF cycle may change. This ratio is called DUTY CYCLE and it is another way we can check the behavior of sensors and solenoids.



The term "Duty Cycle" refers to the percent of time a device is actually ON during the ON and OFF cycle.

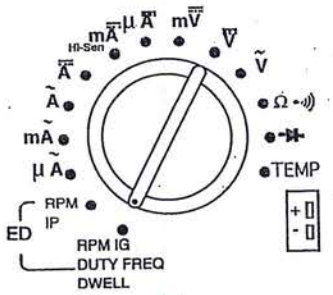
Examples of devices that can operate at an unchanging frequency but vary their Duty Cycle are:

- Mixture Control Solenoid
- Electronic EGR Solenoid
- Frequency Valve
- Electronic Fuel (Canister) Purge

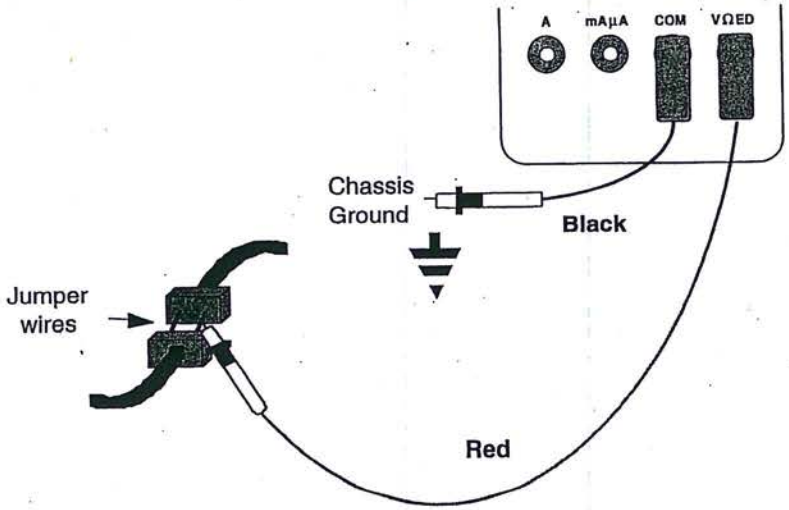
Mixture Control Solenoid (M/C Solenoid)
Computer Controlled Carburetors utilize an electronic mixture control solenoid, which cycles ON and OFF. Fuel metering is achieved by varying the amount of time the solenoid is open. Since the M/C solenoid is spring loaded in the open position, the solenoid must be energized to close and stop the flow of fuel. The percent of time the M/C solenoid is energized is referred to as the Duty Cycle. In the case of the M/C solenoid, more duty cycle = less fuel.

DUTY CYCLE MEASUREMENT (Cont.)

Mixture Control Solenoid - Duty Cycle Testing

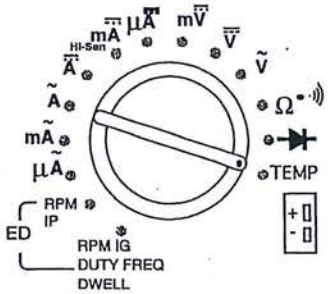


1. Turn the rotary function switch to "RPM IG".
2. Turn the meter ON.
3. The display panel will show "0000 RPM". Press the (%DUTY) button once.
4. The display panel readout should be "OF.L %".
5. Connect the meter's black COM lead probe tip to a good vehicle ground.
6. Connect the meter's red volts lead probe tip to the M/C Solenoid wire that returns to the PCM wire.
7. Start the engine and allow it to warm-up and go to closed-loop operation. Observe the meter reading. More duty cycle means less fuel - less duty cycle means more fuel. Check vehicle manufacturer's service specifications for proper ratio.



TEMPERATURE MEASUREMENT

The ADM4200 is equipped with a K-Type thermocouple input on the instrument front housing. Use the thermocouple probe tip to contact the component you wish to measure. Additional probes for air, fluids and surface contact measurements are all available to make temperature measurements easier and safer.



Temperature Testing - Air Conditioning/Heating Duct Temperature

1. Connect the temperature probe to the ADM4200, narrow blade on top, wide blade on bottom.
2. Turn rotary switch to "TEMP".
3. Turn meter ON.
4. Position probe tip in airflow of A/C-heating duct.
5. At this point you may want to engage the RECORD function, to monitor MAX, MIN and AVG temperature during the test period.
6. Start the engine and set the vehicle temperature controls for your test.
7. At the completion of testing, press the meter (REC) button to show MAX, MIN and AVG temperature during the test. Because of the rapid reading and sensitivity of the ADM4200 and K-Type thermocouple you will notice higher high readings and lower low readings then are possible with dial type thermometers.

SERVICE AND MAINTENANCE

Battery Replacement

When meter displays BAT, the battery must be replaced to maintain proper operation.

1. Disconnect and remove all test probes from any live source and meter.
2. Open the bottom case.
3. Remove the old battery and install a new battery into the holder.
4. Assemble the case.
5. Test the battery by turning on the meter.

FUSE REPLACEMENT

1. Disconnect and remove all test probes from any live source and meter.
2. Open the case.
3. Remove circuit board assembly.
4. Locate the defective fuse and remove it by gently prying loose one end of the fuse and sliding the fuse out of the fuse bracket.
5. Install a new fuse of the same size and rating.
6. Assemble the case.

WARRANTY

The ADM4200 is warranted to be free from defects in materials and workmanship for a period of **five** years from the date of purchase. If within the warranty period your meter should become inoperative from such defects, the unit will be repaired or replaced at UEI's option. This warranty covers normal use and does not cover damage which occurs in shipment or failure which results from alteration, tampering, accident, misuse, abuse, neglect or improper maintenance. A purchase receipt or other proof of date of original purchase date will be required before warranty repairs will be rendered. Instruments out of warranty will be repaired for a service charge. Return the unit postage paid and insured to:

UEI Service Department
5500 SW Arctic Drive, Beaverton, OR 97005
(503) 644-8723

This warranty gives you specific legal rights. You may also have other rights which vary from state to state.

SPECIFICATIONS AT A GLANCE

FUNCTION	RANGE	RESOLUTION	ACCURACY	IMPEDANCE
DC Volts	4.000V 40.00V 400.0V 1000V	0.001V 0.01V 0.1V 1V	±0.3% rdg ± 2 digits ± 0.75% rdg + 3 digits	10MΩ
DC Millivolts	400.0mV	0.1mV	± 0.3% rdg + 2 digits	10mΩ
AC Volts	4.000V 40.00V 400.0V 750V	0.001V 0.01V 0.1V 1V	±0.75% rdg + 5 digits	10MΩ
DC Amps	400.0µA 4000µA 40.00mA 400.0mA	0.1µA 1µA 0.01mA 0.1mA	±0.75% rdg + 2 digits	
	4.000A 10.00A	0.01A 0.1A	±1% rdg + 5 digits	
AC Amps	400.0µA 4000µA 40.00mA 400.0mA	0.1µA 1µA 0.01mA 0.1mA	±1% rdg ± 3 digits	
	4.000A 10.00A	0.001A 0.01A	1.5% rdg + 5 digits	
Ohms	400.0Ω 4.000kΩ 40.00kΩ 400.0kΩ 4.000MΩ 40.00MΩ	0.1Ω 0.001kΩ 0.01kΩ 0.001MΩ 0.01MΩ 0.01MΩ	±0.5% rdg + 3 digits ±1% rdg + 10 digits	
Continuity	3V, 1000 digits			
Diode Check	3V, 2.5mA			

STANDARD ACCESSORIES

Fuse, 2A @ 600V AF112
Fuse, 15A @ 600V AF113
Protective Rubber Boot (Blue) . AH200
Test Leads ATL55
Automotive Test Manual . . .ADM4200M
Thermocouple ATT2329
Inductive Tach Probe AIP186
Soft Carrying Case ADM4200P

OPTIONAL ACCESSORIES

Temperature Probes:
Right Angle Surface Probe ATH2337
Surface Probe (8" tip) ATH2336
Oversized Carrying Case ADL7100LC
Alligator Style Test Leads (4') ATL55
DC High Current Clamp ACM6100
Probe Alligator Clips AAC3

GLOSSARY

AC	Alternating current.
Accuracy	How precisely the DMM displays the actual reading. Usually expressed as a percentage of reading or full range.
Annunciator	A screen icon meter function or measurement range.
Averaging DMM	A meter that assumes it is connected to a sine wave signal - if not, readings are inaccurate. Not for automotive use.
Autoranging	Meters ability to analyze incoming signals and voltage and select the best range.
Auto Power Off	When meter is not used for a specified length of time, the meter 'powers down'.
Common	The input on a meter (and lab scopes) that is ground - usually color-keyed black.
Condenser	(Capacitor) - A pair of plates separated by a dielectric film. Stores energy before it is sent to the coil (primary in older ignition systems).
Continuity	The ability to conduct current in a closed circuit.
Counts	Usually a number in the thousands - specifies largest numeric value a meter can display.
Current Probe	Usually a device that clamps around a conductor and converts current flow to voltage for display on a DMM or scope.
DC	Direct current.

GLOSSARY (CONT.)

DMM	Digital Multi Meter - An instrument utilizing an analog-to-digital converter to convert voltage, current, resistance and other measurement to screen readings.
Diode	A device that converts AC to pulsating DC current. Test functions for diode test can be found on many DMM's.
EMI	Electro - Magnetic Interference. spurious signal or "noise generated that can impair testing and/or reception.
MAF Sensor	Mass Airflow Sensor. A sensor that informs the engine management computer of the amount of air being consumed.
Min/Max	A meter (or scope) function that samples the device under test at a faster than normal rate.
O_2 Sensor	A sensor that measures the amount of oxygen in the exhaust gasses.
Parasitic load	Amount of current flowing from a vehicle battery when ignition (and accessories) are turned off. Usually under 1 volt.
Range	How large - or small - a measurement that can be detected and displayed on a DMM or scope.
Resolution	The smallest change in a measurement that a DMM (or scope) can display.
Thermocouple	A bi-metallic metal substance that generates current flow proportional to the temperature of both metals.
Transistor	A small micro-electric switch controlled by a computer.

To receive a FREE catalog of our complete line of diagnostic equipment, call our UEI sales office at (503) 644-8723.

Find more test instrument information on the internet at www.ueitest.com or email info@ueitest.com.

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ADM4200-MAN 6/98