6 CYL VK COMMODORE AND CALAIS — LEADED ELECTRONIC SPARK TIMING (EST)

The 1984-85 carburettor equipped VK Commodore and Calais utilise a Bosch electronic spark timing (EST) system which replaces the timing function of the distributor. The conventional vacuum and centrifugal advance mechanisms are not used. The EST control unit is located behind the left hand side cowl panel *(see Fig. 3-69)*.

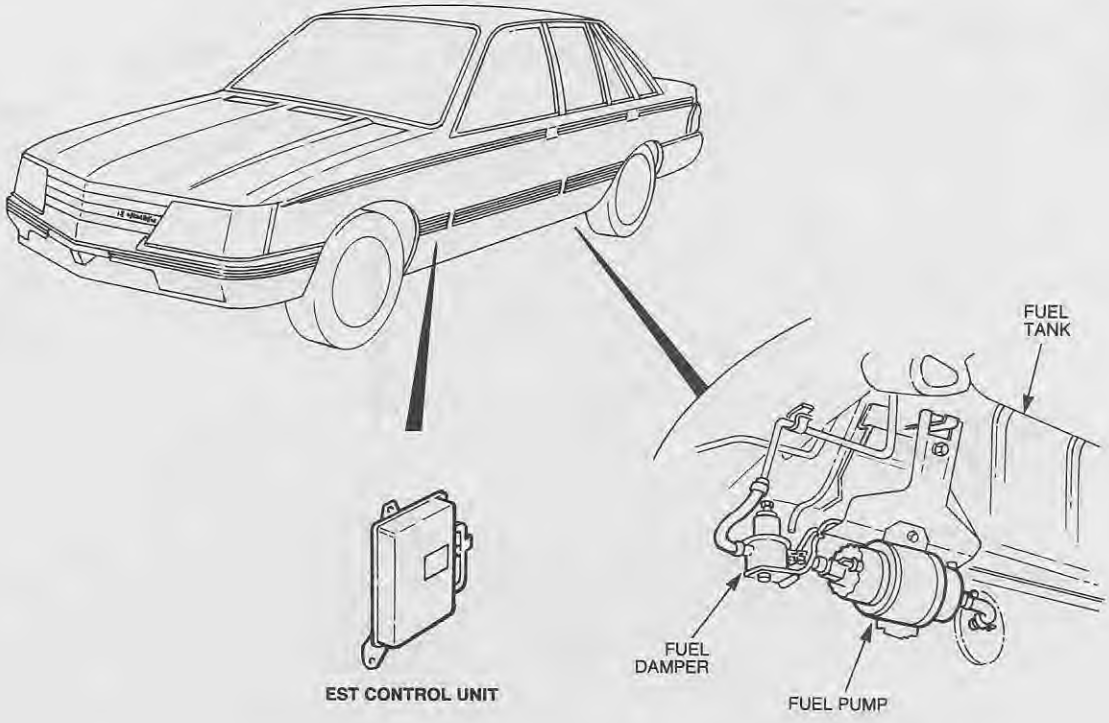


Figure 3-69

The EST control unit determines the optimum ignition timing for engine speed and load, based on information supplied by various engine sensors, which are illustrated in *Fig. 3-70.*

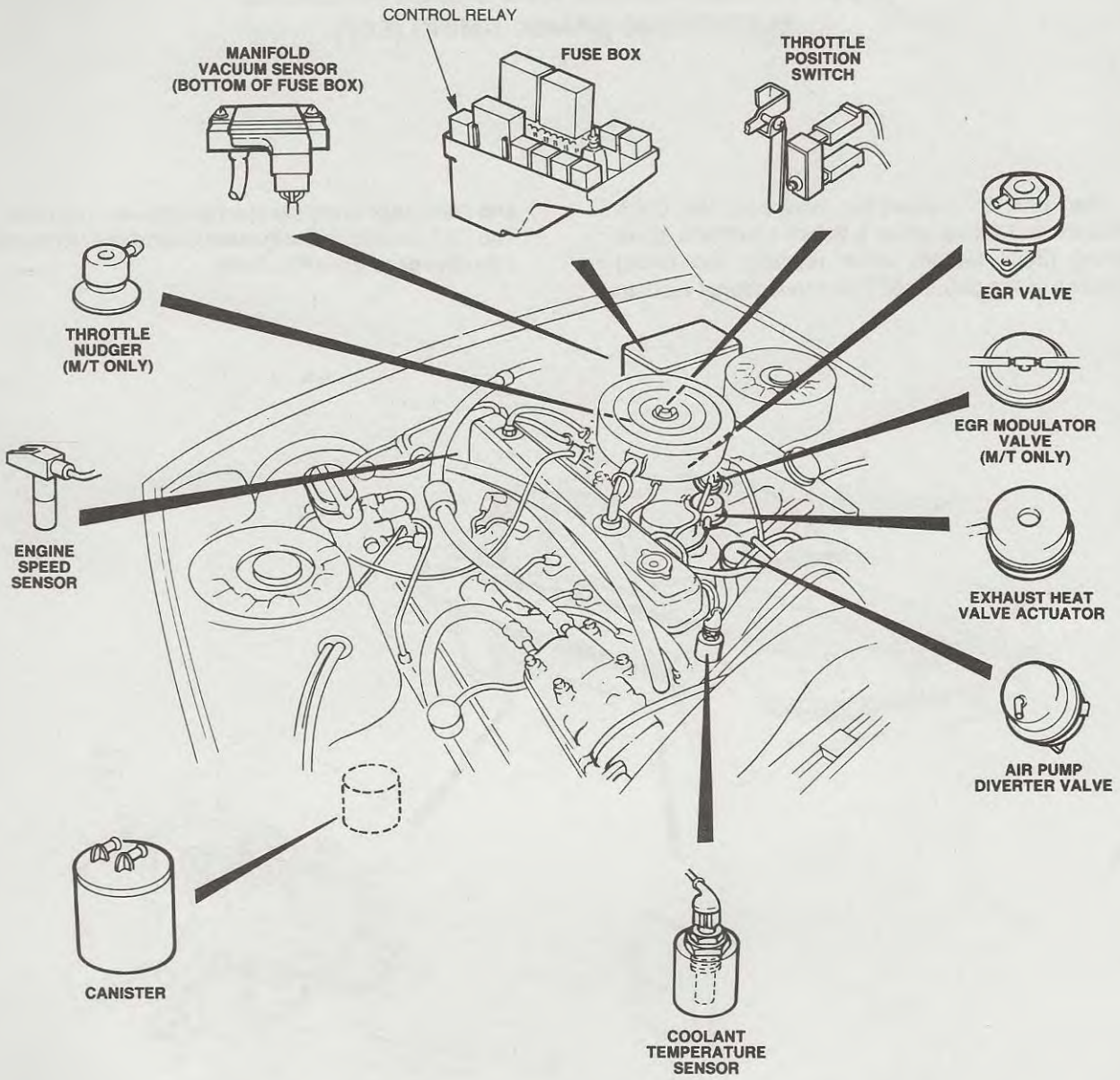


Figure 3-70

The vacuum hose layout for a manual transmission is illustrated in *Fig. 3-71* and for an automatic transmission in *Fig. 3-72*.

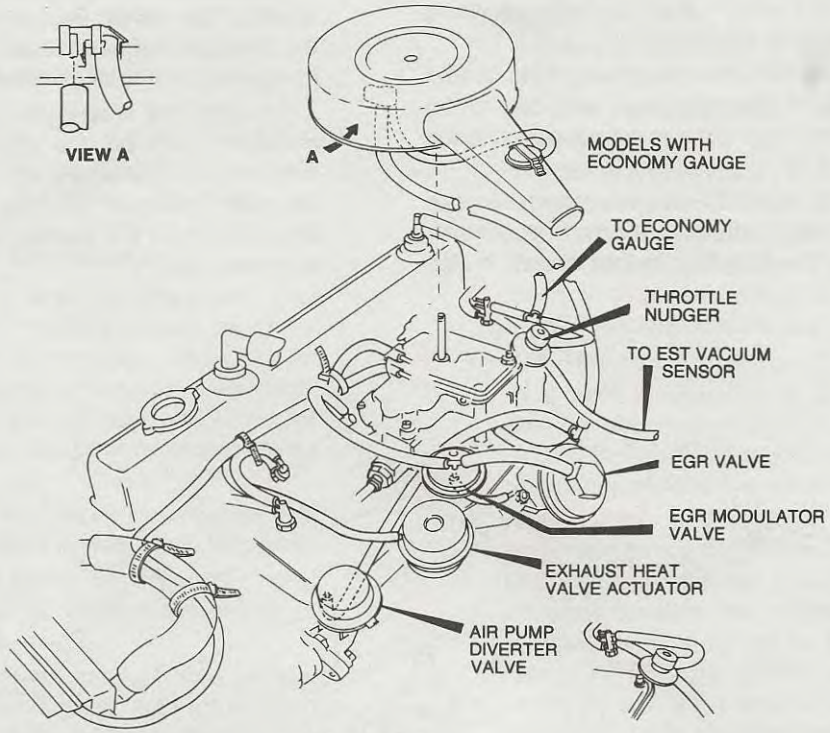


Figure 3-71

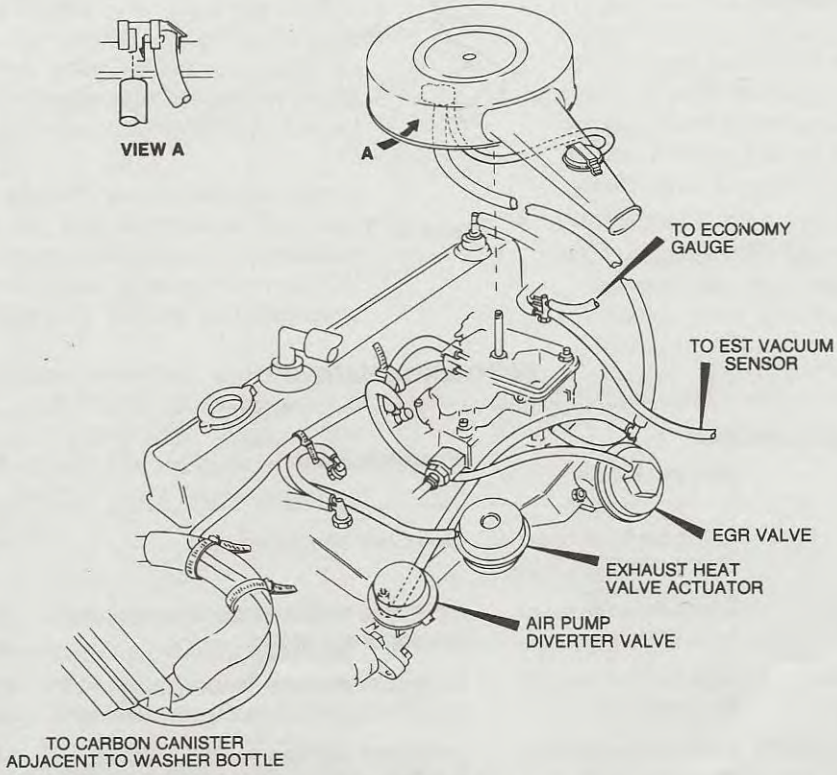


Figure 3-72

When the EST system is operating normally, the dash-mounted limp home lamp is on during engine cranking and while the engine is not running but with the ignition ON. It will go out a few seconds after the engine starts if everything is operating normally. If the light does not come on at all, the bulb, the wiring or the control module may be faulty.

The lamp will illuminate while driving if the control module detects an operating fault with one of the EST system sensors, or there is a malfunction in the control module itself.

Situated within the EST engine wiring harness assembly is a single connector body and terminal, taped back to the wiring harness as shown in *Fig. 3-73.* With the aid of a jumper lead fitted with alligator clips, this allows the connection of the connector body terminal to a suitable earth point on the engine, which activates the diagnostic limp light.

The diagnostic limp light is located within the dash warning light panel. By means of a coded flashing, the limp light defines the source of the EST system component failure as detailed in the decoding chart.

To reset the diagnostic lamp for normal mode condition, turn off the ignition and remove the jumper lead. Restart the vehicle and, if the fault has not been corrected, the diagnostic lamp will come on again when the appropriate test conditions are re-established.

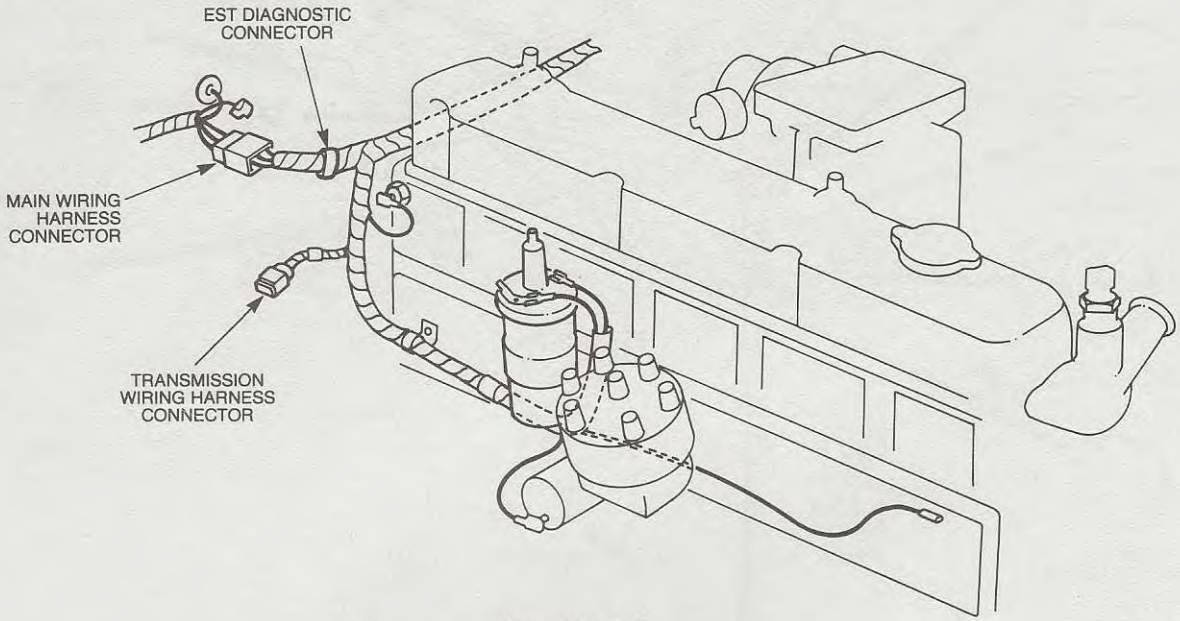


Figure 3-73

DECODING CHART

Limp Light Condition		Possible Fault	Corrective Action
Diagnostic Mode	**Normal Mode**		
Lamp uncontrolled (usually off)	Lamp on (until reset successfully)	Defective control module	Refer to para. a
One flash of the lamp every eight seconds	Lamp on (until reset successfully)	Defective engine coolant temperature sensor or associated wiring	Refer to paras. b and g.
Two flashes of the lamp every eight seconds	Lamp on (until reset successfully)	Defective vacuum sensor, throttle position switch or associated wiring	Refer to paras. c and g.
Three flashes of the lamp every eight seconds	Lamp on (until reset successfully)	Defective vacuum sensor, throttle position switch or associated wiring	Refer to paras. c. and g.

NOTE

1. Before proceeding with any tests on the EST system, read the warnings detailed on page ii.
2. Replacement procedures are not described in this text. However, due to the accuracy required with the distributor on the VK models, this procedure has been included.

Fig. 3-84 illustrates the EST system for the VK Commodore and Calais and should be utilised when carrying out the test procedure. However, the following preliminary checks should be carried out before commencing the test procedure:

a. Inspect the engine and the electronic fuel injection system (EFI) wiring (where fitted) for damage and faulty connections. Check for air leaks at the inlet manifold and at the air intake system, and check the fuel lines and air hoses for damage or leaks. Repair or replace parts as necessary.
b. Check the condition of the air cleaner element. Replace the element if it is clogged or damaged.
c. Inspect the ignition wiring for damage or faulty connections. Repair or replace the wiring as necessary.
d. Ensure that the spark plugs, high tension ignition cables, distributor cap and rotor are in good working condition. Check the coil for cracks around the tower and for oil leaks. Replace any defective parts.
e. Ensure that the engine is in good mechanical condition, i.e. the engine compression pressures and the valve clearances are to specification. Also ensure that the battery is fully charged and that there is fuel (petrol) in the fuel tank.
f. Ensure that the crankcase ventilation system is free from air leaks, and that the oil filler cap, dipstick and by-pass hose are properly installed and seal correctly. Also ensure that the PCV valve (where fitted) is secure and operating correctly.

In addition to standard workshop equipment, a digital multimeter, a 0-100°C thermometer, a hand-operated vacuum pump with gauge, a set square and a means of heating water to test thermal sensors will be required to isolate faults within the various electrical circuits.

Test Procedure

a. Control Module.
   1. If the control module (microprocessor) fails, a limp home mode is activated and the warning light is turned on. Limp home mode is provided to minimise the likelihood of the owner being stranded. Spark timing is very retarded in this mode (6° BTDC always) and this will cause increased fuel consumption, poor engine response and higher engine operating temperatures. Prolonged operation in this mode should be avoided. Monitor engine temperature regularly if limp mode operation is necessary at high ambient temperatures or while towing. Stop if necessary.
   2. If the microprocessor starts operating normally, the light will be turned off in normal and diagnostic modes, provided no other faults have been detected. If the diagnostic light is on continuously in normal mode and does not flash a recognisable code in diagnostic mode, the EST control module should be replaced.
b. Coolant Temperature Sensor.
   1. If a fault is detected in the temperature sensor circuit, the light is on in normal mode. In diagnostic mode, the light flashes on for one second in every eight seconds.
   2. The control module does not check the temperature sensor circuit until the ignition has been on for eight minutes. From eight minutes onwards the module continuously checks for a temperature between 50°C and 125°C. If the ignition is switched on without starting the engine the temperature may be outside the specified limits without a fault being present, eight minutes after ignition 'ON'.
   3. To check for this false indication, switch the ignition off, start the engine and check the light in eight minutes. If the light comes on again, it may be due to either an open circuit, a short circuit or a faulty temperature sensor. A faulty sensor may give the same symptoms as an open or short circuit.
   4. To test the sensor, proceed as follows:
      (a) Disconnect the battery earth lead then disconnect the wiring harness connector from the temperature sensor *(see Fig. 3-74)*.

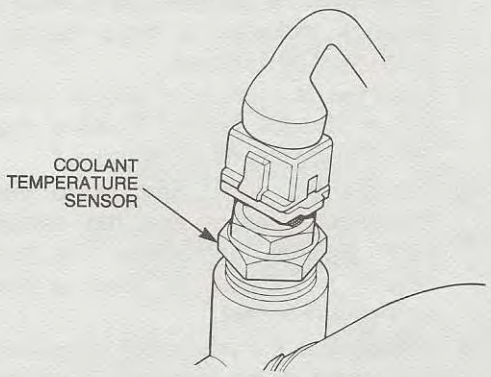


Figure 3-74

(b) Drain the coolant from the engine to below the sensor level, then remove the sensor from the thermostat housing.

(c) Suspend the sensor in a container filled with a 50/50 solution of glycol and water, ensuring that the sensor does not touch the container. Place a thermometer, with at least a 0-100 °C scale, in the container and apply heat to the container *(see Fig. 3-75)*.

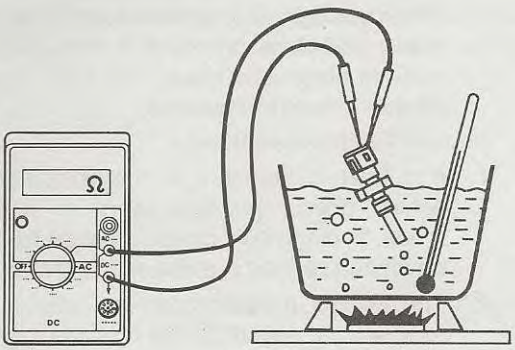


Figure 3-75

(d) Using an ohmmeter, record the resistance across the sensor terminals at various temperatures. Check the results with the following chart.

Temperature °C	Resistance ohms
Zero (if possible)	5.4 to 6.3 k
20	2.3 to 2.7 k
80	300 to 350
100	170 to 210

(e) Any deviation in the resistance values recorded at the nominated temperature readings indicates a faulty sensor, which must be replaced.

(f) Apply the recommended sealant to the sensor threads before installing the sensor in the thermostat housing.

(g) Connect the wiring harness to the temperature sensor and the battey earth lead as appropriate. Fill the radiator and check for leaks at the temperature sensor.

(h) In addition to the information contained in the para. g. the following will assist when testing for wiring defects:

(1) Short Circuit. If a short circuit is present, the temperature appears very high (130 °C) to the module. In the eight minutes between the ignition being turned on and the detection of the fault, the module will increase idle spark advance as if the temperature really were high. This is done to increase idle speed for improved engine cooling. After the eight minute period is complete, the module detects the fault, turns the warning light on (or flashes the diagnostic code in diagnostic mode) and assumes a normal temperture (95 °C). The light remains on continuously in normal mode (or continues to flash in diagnostic mode) until the ignition is switched off. When the light comes on, the idle speed will return to normal as the very high temperature is no longer seen.

(2) Open Circuit. If an open circuit fault is present, the temperature appears very low (–14 °C) to the module. If the temperature is low when the ignition is turned on, the idle low temperature compensation is enabled. For the first twelve minutes of engine operation, idle spark advance is increased for improved idle quality. Note that this will cause the idle speed of a warm engine to fluctuate about 900 rpm. This is because additional advance is only present at idle, which is defined as engine speed less than 900 rpm and idle switch closed. If the speed is above 900 rpm, the advance is slowly removed and the engine slows. If it is below 900 rpm, the advance increases and the speed increases. This provides engine idle speed governing at 900 rpm. After eight minutes of operation with the open circuit fault, the module turns the light on (or flashes the code in diagnostic mode), assumes a normal operating temperature and continues to provide additional spark advance at idle until twelve minutes after the ignition is turned on.

(i) If the fault condition is still indicated after testing the temperature sensor and associated wiring, replace the control module.

c. Manifold Vacuum Sensor and Throttle Position Switch.

1. Whenever the engine is operating, the control module checks the vacuum sensor and the throttle position switch for two different fault conditions. If the throttle position switch is closed and the engine speed exceeds 1500 rpm, the module expects to see a manifold vacuum greater than -30 kPa. If the module detects a vacuum of less than -30 kPa under these conditions, it will turn the diagnostic light on (or give two flashes every eight seconds in diagnostic mode) and assume the manifold vacuum is zero at all times.

2. If the engine is switched off and re-started, the light will go out until the engine speed exceeds 1500 rpm while the throttle position switch is closed. If the vacuum is again seen by the control module as less than -30 kPa, the light will be turned on again. This fault will be indicated if the hose comes off the vacuum sensor, if the signal wires in the vacuum sensor harness are shorted together or if the vacuum sensor is faulty. This fault may also be indicated if the throttle position switch wires are shorted together or to earth or the switch itself is badly adjusted or short circuited. For example, the engine may be operating at 1600 rpm wide open throttle and with zero vacuum. If the throttle position switch is operating normally, it will be open and no fault will be recorded. If the throttle position switch wires are shorted together, the control module sees the same input as a closed switch and records a fault condition. It is necessary to assume the engine is operating at zero vacuum all the time this fault is present. This is to prevent the control module from giving the engine excessive advance at wide open throttle and causing detonation damage.

3. In the second test, if the throttle position switch is closed and the engine speed is between 825 and 900 rpm, the module expects to see a manifold vacuum of between -10 kPa and -75 kPa. If the module detects a vacuum outside these limits it will turn the diagnostic light on (or give three flashes every eight seconds in diagnostic mode) and assume the manifold vacuum is at zero at all times.

4. If the engine is switched off and re-started, the light will go out until the check conditions are met and the fault re-detected. This fault will be indicated if the electrical connector comes off the vacuum sensor, a vacuum sensor wire is broken or the vacuum sensor is faulty. It may also be indicated if the throttle position switch wires are shorted together or to earth or the switch itself is short circuited.

5. To test the manifold vacuum sensor, proceed as follows:

   (a) Remove the air cleaner.

   (b) Disconnect the sensor vacuum hose from the inlet manifold adapter and connect a hand vacuum pump to the hose *(see Fig. 3-76)*.

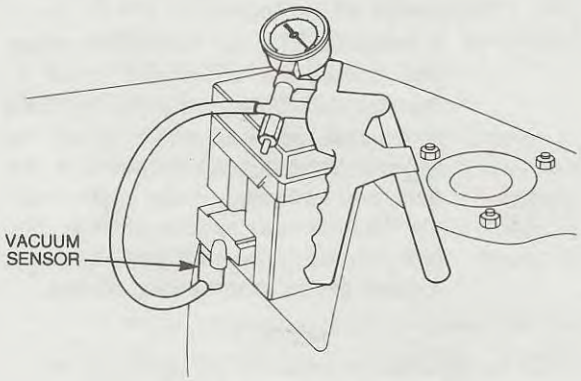


Figure 3-76

   (c) Connect a voltmeter, set to a suitable DC range, to the sensor terminals CA and CB. Switch on the ignition and check that, while varying the vacuum with the hand pump, the output voltage varies in accordance with the following table.

Vacuum Applied kPa	Output Voltage Volts
0	4.4 to 5.3
25	3.2 to 3.8
50	2.0 to 2.5
75	0.7 to 1.1

   (d) Any deviation in the output voltage figure with the nominated applied vacuum, indicates a faulty sensor, which must be replaced.

   (e) Connect the vacuum hose between the inlet manifold adapter and sensor, then install the air cleaner.

6. To test the throttle position switch, proceed as follows:

   (a) Remove the air cleaner.

(b) Disconnect the throttle position switch wiring connectors and connect them together, thus simulating a closed switch. Connect an ohmmeter across the switch terminals.

(c) Start the engine and push the throttle until the switch opens, which will be indicated by the ohmmeter reading infinity.

(d) Depress the spring loaded button on the throttle nudger and close the throttle. With the throttle lever resting on the extended nudger shaft, the ohmmeter should indicate zero ohms.

(e) Switch off the engine.

(f) If necessary, loosen the switch mounting screws and adjust the switch as required to obtain a reading of infinity when the fast idle screw is on the second highest step of the fast idle cam, and a reading of zero ohms when the fast idle screw sits on the third highest step of the cam *(see Fig. 3-77)*. Tighten the switch mounting screws.

NOTE

On vehicles with manual transmissions, for the engine to return to idle, it is essential that whenever the throttle closes onto the extended throttle nudger shaft, the throttle position switch must be closed. If the throttle closes onto the extended nudger without closing the throttle position switch, the engine will run at approximately 1400 rpm.

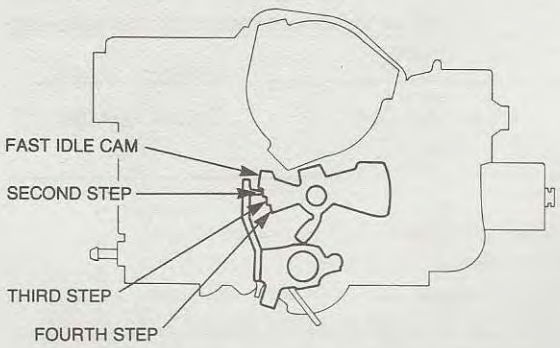


Figure 3-77

(g) Reconnect the switch wiring and install the air cleaner.

(h) If the fault condition is still indicated after testing the vacuum sensor, the throttle position switch and associated wiring, replace the control module.

d. Distributor.

1. Removal.

(a) Ensure that the ignition is turned OFF, then remove the distributor cap.

(b) Rotate the crankshaft until the distributor rotor aligns with No. 1 cylinder timing mark on the distributor body, and the timing mark on the crankshaft pulley (torsional damper) aligns with the TDC mark on the timing cover.

(c) Clean the area around the base of the distributor and clamp plate. Remove the clamp bolt, clamp and the distributor.

2. Installation.

(a) Ensure that the engine No. 1 cylinder is at TDC at the end of the compression stroke.

(b) Align the protruding end of the gear retaining pin with the raised mark on the distributor body *(see Fig. 3-78)*.

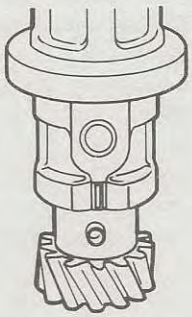


Figure 3-78

(c) Install the distributor into the engine block, then if necessary, rotate the distributor so that the centre line of the distributor cap clamps is at 45 degrees to the centre line of the crankshaft *(see Fig. 3-79)*.

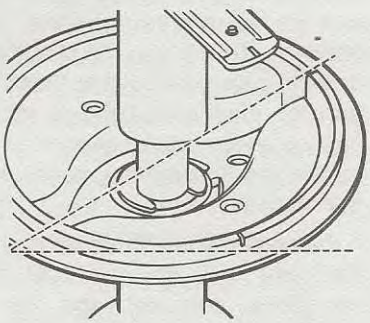


Figure 3-79

(d) Position a set square across the top face of the distributor body, then rotate the distributor (if necessary) until the centre mark on the rotor aligns with the No. 1 cylinder mark on the distributor body *(see Fig. 3-80)*.

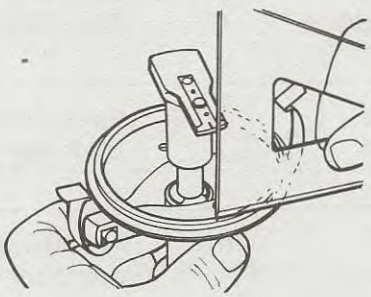


Figure 3-80

(e) Tighten the clamp bolt and install the distributor cap.

e. Engine Speed Sensor.

1. Disconnect the sensor wiring harness connection, located at the fuse box inside of the rocker cover *(see Fig. 3-81)*.

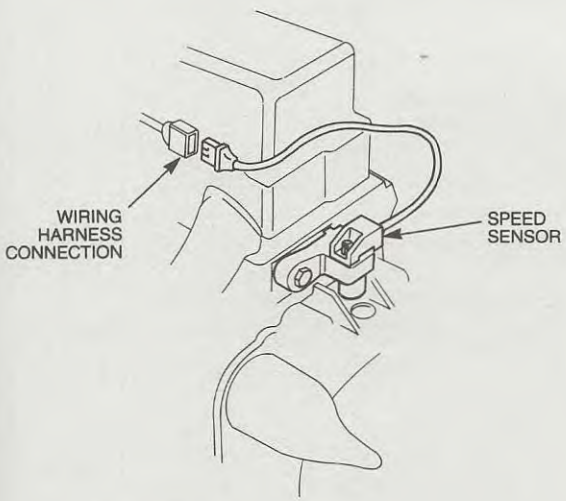
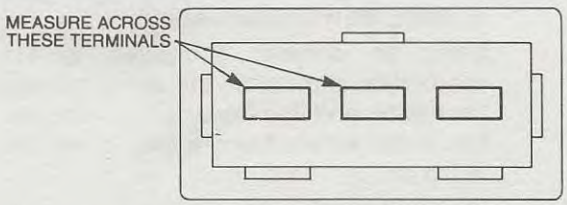


Figure 3-81

2. Connect an ohmmeter across the sensor terminals shown in *Fig. 3-82*. The resistance indicated should be in the range of 1-1.2 kohms. Replace the speed sensor if it is out of specification.



FRONT VIEW OF CONNECTION LEAD TO ENGINE SPEED SENSOR

Figure 3-82

3. If the fault condition is still indicated after testing, the speed sensor and associated wiring, replace the control module.

f. Idle Speed and Idle Mixture Adjustment.

1. Connect a timing light and tachometer to the engine, then start the engine and allow it to warm up to normal operating temperature. Check that the idle speed is 850 ± 50 rpm and the ignition timing is 6° ± 4° BTDC.

   If necessary, adjust the idle speed with the mixture by-pass adjustment screw. Turn the ignition OFF.

NOTE

The idle mixture adjustment is preset. To maintain designed emission levels, do not adjust the idle stop screw or idle mixture screw. If adjustment becomes necessary, replace the carburettor.

e. Wiring Harness.

1. Disconnect the battery earth lead, then remove the control module and disconnect the wiring harness from the module. As the terminal numbers are not marked on the wiring harness connector, *Fig. 3-83* illustrates the layout of the connector terminals.

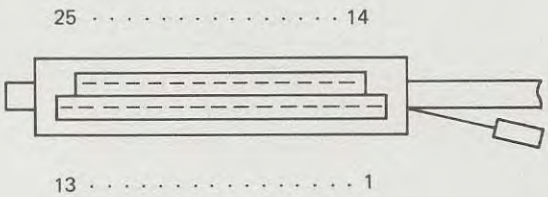


Figure 3-83

2. Before testing any wiring, remove the wiring harness connector from the sensor to which the test is directed.

3. The following table and *Fig. 3-84* will assist in testing the wiring harnesses.

   Using an ohmeter connected to the appropriate terminal on the wiring harness connector and the terminal on the disconnected sensor harness plug, check the wiring for:

   (a) Short circuit.
   (b) Open circuit.
   (c) Short circuit to earth.

Sensor	Terminal No.	Harness Connector Terminal
Speed Sensor	22 5	Black Wire Black/White wire
Coolant Temperature Sensor	3 6*	Black wire Black/White wire
Throttle Position Switch	6 4	Black/White wire Black wire
Ignition Vacuum Sensor	15	— coil terminal connector
Engine Vaccum Sensor	21 24 19	A B C

* Remove wiring connectors from throttle position switch before checking.

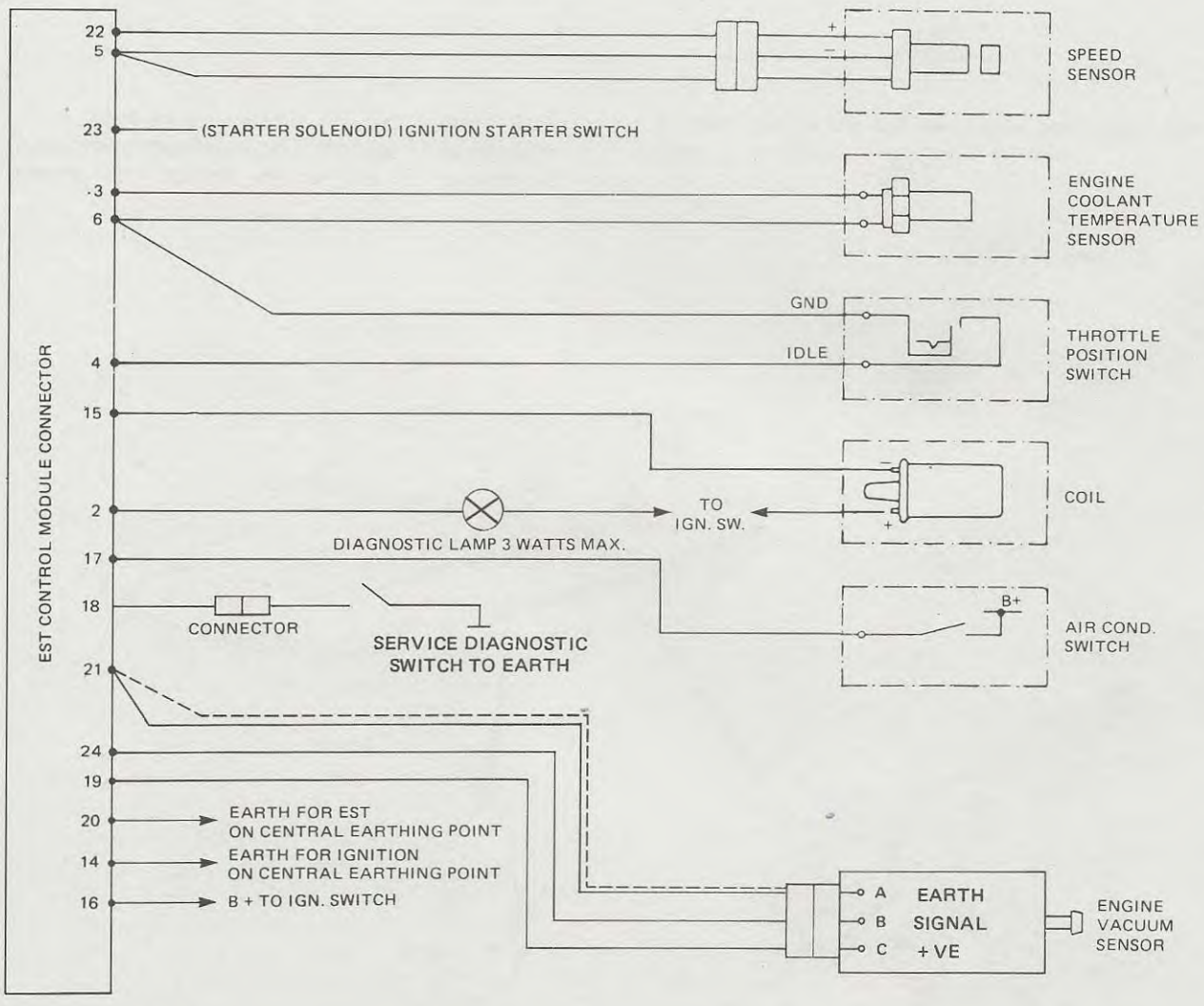

EST CONTROL MODULE CONNECTOR
22
5
23
3
6
4
15
2
17
18
21
24
19
20
14
16
(STARTER SOLENOID) IGNITION STARTER SWITCH
SPEED SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
GND
IDLE
THROTTLE POSITION SWITCH
COIL
TO IGN. SW.
DIAGNOSTIC LAMP 3 WATTS MAX.
CONNECTOR
SERVICE DIAGNOSTIC SWITCH TO EARTH
B+
AIR COND. SWITCH
EARTH FOR EST ON CENTRAL EARTHING POINT
EARTH FOR IGNITION ON CENTRAL EARTHING POINT
B + TO IGN. SWITCH
A EARTH
B SIGNAL
C +VE
ENGINE VACUUM SENSOR

Figure 3-84