INDEX

AUTOMATIC TRANSMISSION SERVICE GROUP
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INTRODUCTION

Domestic Computer Control

The purpose of this manual is to assist the technician in diagnosing computer controlled transmissions. It wil help guide the technician through individual electrical check on solenoids and sensors with the aid of a scanner and a multi-meter. It will cover where and how to retrieve codes using a scanner and a jumper lead where possible with a list of these codes and there explanations. Due to limited space, this book cannot cover in detail every year and every model vehicle. It does however, present enough material to allow the technician to diagnos the majority of domestic computer controlled transmissions.

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THE A604 ULTRADRIVE TRANSAXLE ELECTRICAL DIAGNOSIS

The A604 ultradrive transaxle controller is able to detect malfunctions with the electrical system as well as some of the hydraulic and mechanical malfunctions. When the controller detects a malfunction, it will cause the transaxle to automatically shift to second gear and stay there. This is known as the default or limp-in mode. When this function occurs, the controller will memorize a two digit fault code which can only be retrieved with a hand held scanner. A DRB II from Chrysler, a MONITOR 4000 E from OTC, or a SNAP-ON MT 2500 are a few of the scanners that can interface with the transaxle controller when the appropriate cartridge or card is used. Refer to figure 1 for the different diagnostic connector locations to ensure the proper hook-up of your scanner.

Location:

On the C body, this connector is located inside the vehicle, under the dash, just to the right of the steering column.

On the Y body, this connector is located inside the vehicle, under the dash, to the left of the steering column.

On the A, G, J, P and S bodies, the connector is located inside the vehicle, under the dash, on the extreme left, behind the fuse access panel.

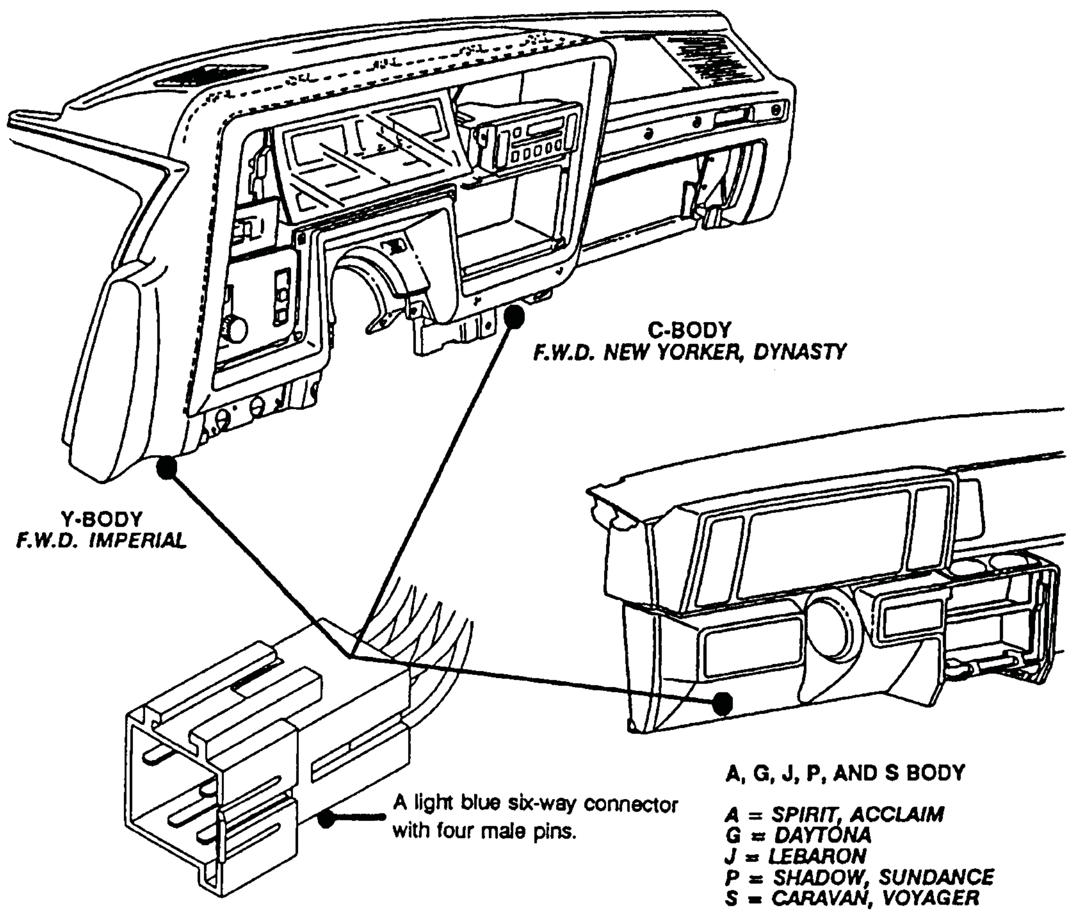


Figure 1

DECODING FAULT CODES

There may be times where the scanner will display an undefined fault code such as a "B9" or an "A6". The cause is due to the controller giving the fault code to the scanner in the "Hex Numbering System". This is where any number above nine becomes a letter. In this case it is the following:

A = 100
B = 110
C = 120
D = 130
E = 140
F = 150

To decode an unknown fault code, use this conversion table and proceed as follows:

1. Add the **"CONVERTED"** first digit to the second digit.
2. Subtract 80 (this is a control bit number) from the total, and you will have your fault code.

EXAMPLE OF FAULT CODE B9:

1. B = 110, PLUS 9, = 119.
2. 119 MINUS 80 = 39.
3. 39 IS YOUR TWO DIGIT FAULT CODE.

EXAMPLE OF FAULT CODE A6:

1. A = 100, PLUS 6, = 106.
2. 106 MINUS 80 = 26.
3. 26 IS YOUR TWO DIGIT FAULT CODE.

Once you have received the two digit fault code, refer to the following chart that references your numerical code to the actual fault itself. The ATSG Green update handbook on the A604 transaxle goes into greater detail on each of these fault codes and what could cause them.

CHRYSLER A604 DIAGNOSTIC FAULT CODE CHART

FAULT	CODE	LIMP - IN
INTERNAL A604 CONTROLLER	11	YES
BATTERY WAS DISCONNECTED	12	NO
INTERNAL A604 CONTROLLER	13	YES
EATX RELAY OUTPUT ALWAYS ON	14	YES
EATX RELAY OUTPUT ALWAYS OFF	15	YES
INTERNAL A604 CONTROLLER	16	YES
INTERNAL A604 CONTROLLER	17	YES
ENGINE SPEED SIGNAL CIRCUIT	18	YES
BUS COMMUNICATION WITH ENGINE CONTROLLER	19	NO
SWITCHED BATTERY	20	YES
OD PRESSURE SWITCH CIRCUIT	21	YES
2/4 PRESSURE SWITCH CIRCUIT	22	YES
2/4 AND OD PRESSURE SWITCH CIRCUITS	23	YES
L/R PRESSURE SWITCH CIRCUIT	24	YES
L/R AND OD PRESSURE SWITCH CIRCUITS	25	YES
L/R AND 2/4 PRESSURE SWITCH CIRCUITS	26	YES
ALL PRESSURE SWITCH CIRCUITS	27	YES
CHECK PRNDL SIGNAL	28	NO
THROTTLE POSITION SIGNAL	29	NO
OD HYDRAULIC PRESSURE SWITCH	31	YES
2/4 HYDRAULIC PRESSURE SWITCH	32	YES
OD AND 2/4 HYDRAULIC PRESSURE SWITCH	33	YES
FAULT IMMEDIATELY AFTER SHIFT	36	YES
SOLENOID SWITCH VALVE (STUCK IN LU POSITION)	37	NO
LOCKUP CONTROL	38	NO
GEAR RATIO ERROR	39	YES
L/R SOLENOID CIRCUIT ERROR	41	YES
2/4 SOLENOID CIRCUIT ERROR	42	YES
OD SOLENOID CIRCUIT ERROR	43	YES
UD SOLENOID CIRCUIT ERROR	44	YES
INTERNAL A604 CONTROLLER	45	NO
3-4 SHIFT ABORT	46	NO
SOLENOID SWITCH VALVE (STUCK IN L/R POSITION)	47*	YES
GEAR RATIO ERROR IN REVERSE	50*	YES
GEAR RATIO ERROR IN FIRST	51*	YES
GEAR RATIO ERROR IN SECOND	52*	YES
GEAR RATIO ERROR IN THIRD	53*	YES
GEAR RATIO ERROR IN FOURTH	54*	YES
TURBINE SENSOR ERROR	56*	YES
OUTPUT SENSOR ERROR	57*	YES
SENSORS GROUND ERROR	58*	YES
INADEQUATE L/R ELEMENT VOLUME	60*	NO
INADEQUATE 2/4 ELEMENT VOLUME	61*	NO
INADEQUATE OD ELEMENT VOLUME	62*	NO
INADEQUATE UD ELEMENT VOLUME	63*	NO

*DENOTES NEW FOR 1991

The solenoid assembly on this transaxle contains 4 solenoids, 3 pressure switches, and 3 resistors. These all can be and should be tested during overhaul. Care must be taken when removing the three 10mm bolts that hold the solenoid body to the case. These bolts have had their threads coated with lock-tite from the factory. Rapid removal of these bolts with an impact could result in broken bolts or stripped holes in the case.

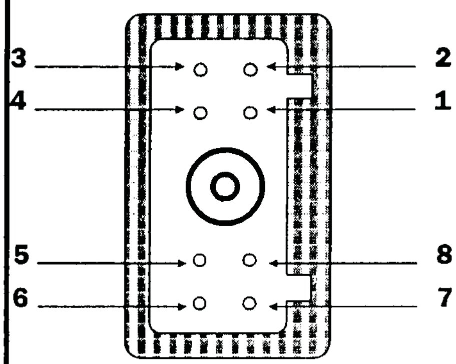
Once the body has been removed, the eight thimble screens that filter the oil into the body can be viewed across the bottom of the assembly. If they are deteriorated, no further testing is required, you need a new solenoid body. If they have not deteriorated, then perform the following electrical diagnosis using a digital ohmmeter.

SOLENOID CHECK - All four solenoids should have 1.5 ohms resistance. Refer to figure 2 for pin locations.

SOLENOID NO. 1 - Connect ohmmeter leads to pins 4 and 5.
SOLENOID NO. 2 - Connect ohmmeter leads to pins 4 and 6.
SOLENOID NO. 3 - Connect ohmmeter leads to pins 4 and 7.
SOLENOID NO. 4 - Connect ohmmeter leads to pins 4 and 8.

RESISTOR CHECK - All three resistors should have 270 - 330 ohms of resistance. Refer to figure 2 for pin locations.

O.D. RESISTOR - Connect ohmmeter leads to pins 4 and 3.
L/R RESISTOR - Connect ohmmeter leads to pins 4 and 2.
2-4 RESISTOR - Connect ohmmeter leads to pins 4 and 1.



Pin No. 1- 2-4 Pressure switch signal to controller
Pin No. 2- Low/Rev pressure switch signal to controller
Pin No. 3- Overdrive pressure switch signal to controller
Pin No. 4- 12 Volt input from the controller
Pin No. 5- Ground from controller to under drive solenoid
Pin No. 6- Ground from controller to overdrive solenoid*
Pin No. 7- Ground from controller Low/Rev lockup solenoid*
Pin No. 8- Ground from controller to 2-4/reverse solenoid

*= PERFORMS DOUBLE FUNCTIONS

Figure 2

PRESSURE SWITCHES - All three pressure switches are tested with 50 psi of air through the passages shown in figure 3. With no air applied to the switch, the ohmmeter should read no continuity. With the air applied, the ohmmeter should read 0 ohms.

O.D. SWITCH - Connect ohmmeter to pin 3 and ground.
L/R SWITCH - Connect ohmmeter to pin 2 and ground.
2-4 SWITCH - Connect ohmmeter to pin 1 and ground.

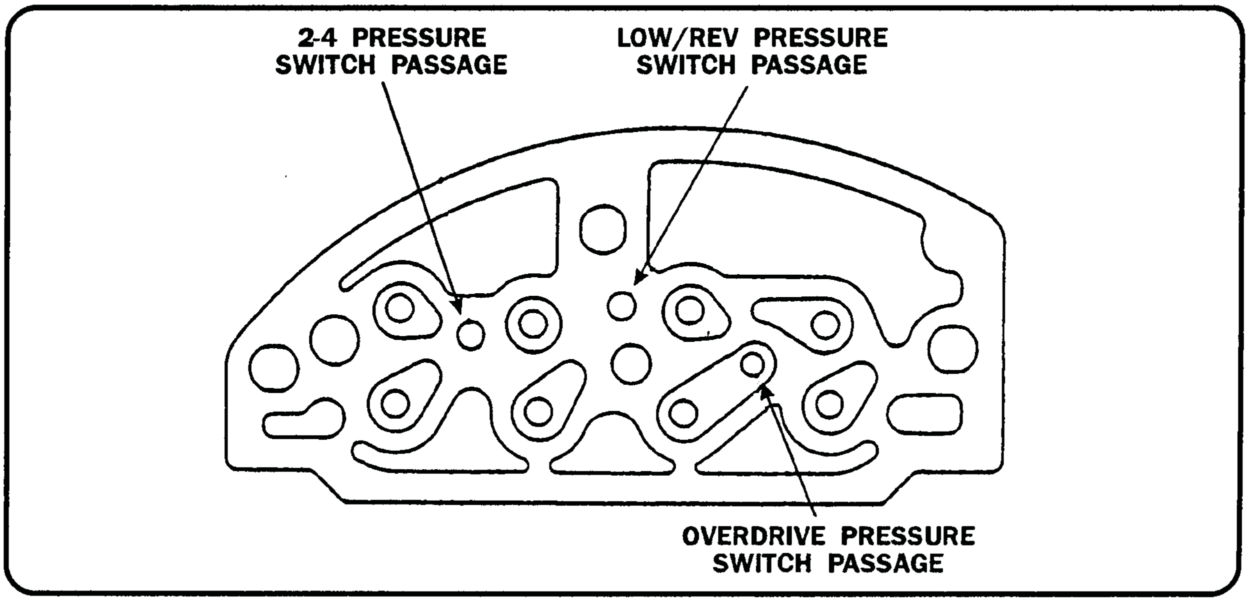


Figure 3

Another check that can be made quickly and easily are the plug connectors. There is an 8 way connector for the solenoid body, a 60 way connector for the transaxle controller (they only use 40 pins), and two 3 way connectors for the PRNDL and safety neutral switch. Check for drag in each pin cavity of the connectors for proper sizing by using the shank of an appropriate size drill bit. This way you can ensure tight connections of each terminal.

1. To check the 8 way connector, use the shank of a #43 drill bit or a .0890 guage. See figure 4.

2. To check the 60 pin connector for the transaxle controller, use the shank of a #53 drill bit or a .0595 guage. See figure 5.

3. To check both 3 way connector for PRNDL and safety nuetral switch, use a #42 drill bit or a .0935 guage. See figure 6.

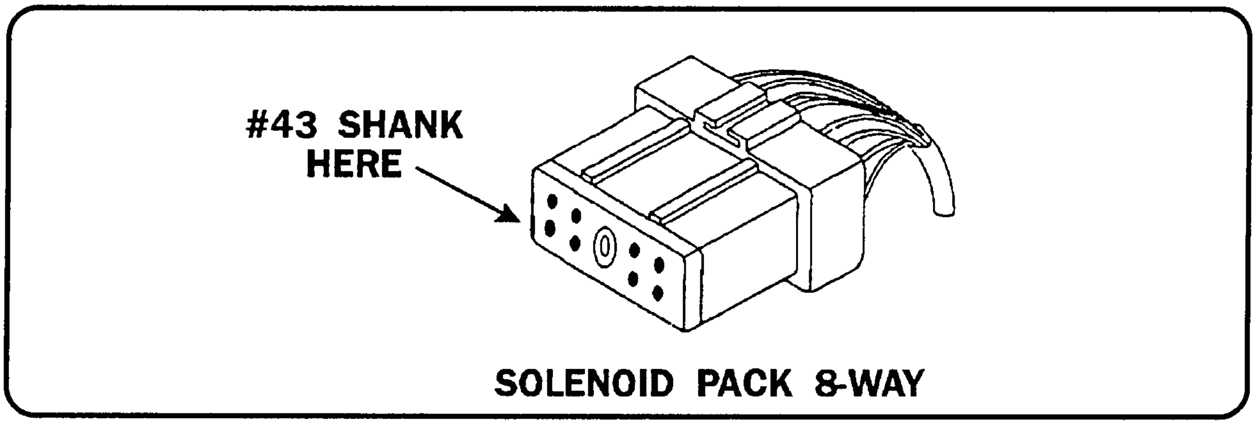


Figure 4

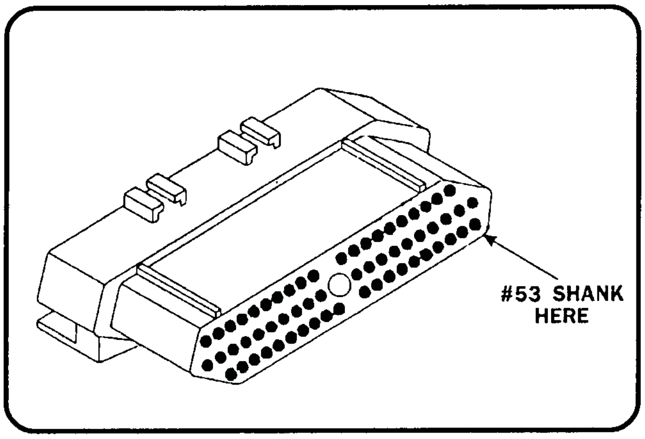


Figure 5

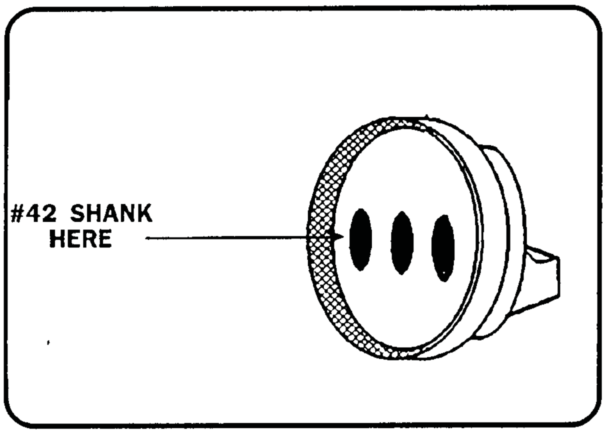


Figure 6

The transaxle controller receives direct input information from sensors and input information over the C2D bus system. The C2D bus system is a pair of twisted wires that relays information the engine control module uses with the transaxle controller and other vehicle controllers if so equipped. As shown in figure 7, some of the direct inputs to the transaxle controller is the throttle position sensor, battery feed, cranking signal, ignition run signal, engine speed, output speed sensor, input speed sensor, neutral safety switch, PRNDL switch, and the three pressure switches in the solenoid body. All the other inputs such as the coolant sensor, ambient sensor, brake switch, map sensor etc., come into the controller over the C2D link. (C2D=CEE SQUARED "D" = which also can be written as CCD)

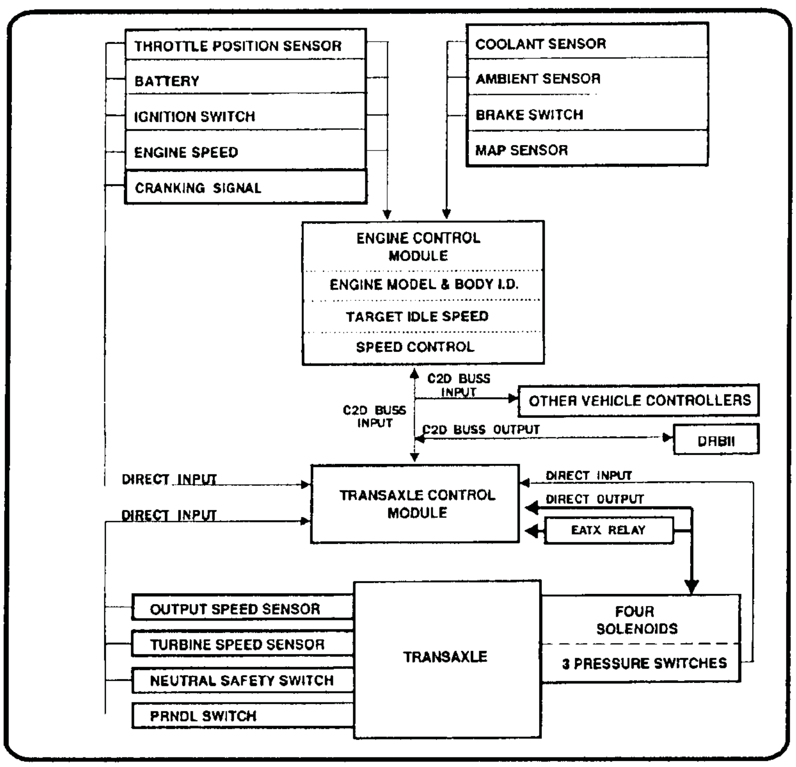


Figure 7

Once the controller receives this input, it then processes this information through logic circuits and sends output signals to control shift timing and shift feel of the transaxle. Similar to the input signals it has two output signals. A direct output signal is sent to the EATX relay and the solenoid body. The purpose of this relay is to make operating voltage available to the solenoid and switches located in the solenoid pack. The controller is constantly monitoring the system and if it recognizes a problem it opens the relay taking the voltage away from the solenoid body. This puts the transaxle in a limp-in mode. In figure 8 we show you where the EATX relay is located. The second output signal is over the C2D bus system where a hand held scanner can access the system for diagnostic purposes. In 1992 this link has been changed. Any previous year cartridge used in your scanner is unable to interface with this system, a specific 1992 and up cartridge is required.

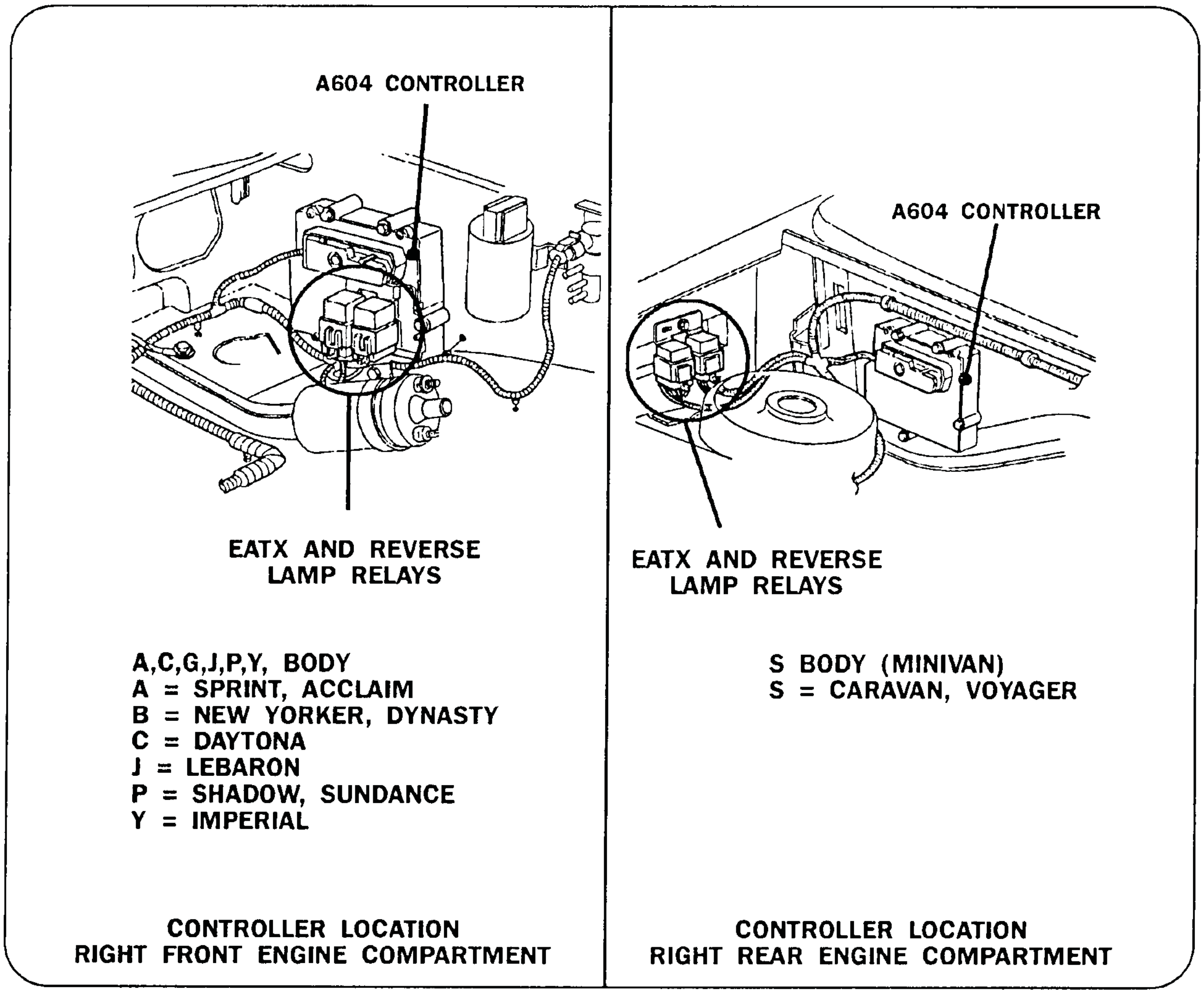


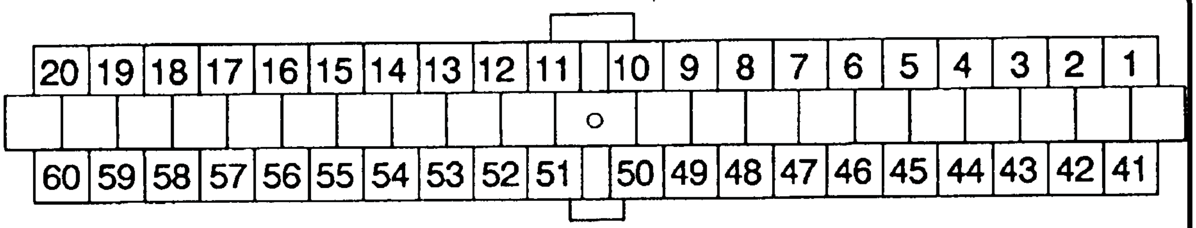
Figure 8

NOTE: Since the EATX and the reverse lamp relay connectors could be installed in either position, you must use the wire colors in the connectors to identify the correct relay.

(1) The EATX relay has a red and a green wire in its connector.

(2) The reverse lamp relay has a white and a violet wire in its connector.

Checks on open and shorted circuits, improper sensor and switch inputs, can be done using a multimeter at the 60 way connector. Figure 9 is this connector viewed from the wire end as it plugs into the transaxle controller. Below figure 9 is the accompanying chart showing each pin with its wiring circuit identified along with a brief description of its function. Testing information will be given on select circuits only. An electrical schematic is provided in figure 10 for further assistance to the technician.



(CONNECTOR VIEWED FROM WIRE END)

Figure 9

PIN #	CIRCUIT NAME	WIRE COLOR
1	RL2	LIGHT GREEN W/BLACK STRIPE
2	RL3	TAN W/BLACK STRIPE
3	RL1	VIOLET
4	MX2A	WHITE W/BLACK STRIPE
5	MX1B	BLACK W/VIOLET STRIPE
6	—	—
7	SX1	PINK
8	S2A	YELLOW
9	GP3	BLACK W/LIGHT GREEN STRIPE
10	—	—
11	J2P	DARK BLUE
12	K7A	ORANGE W/DARK BLUE STRIPE
13	SG5	DARK BLUE W/BLACK OR RED STRIPE
14	S01	LIGHT GREEN W/WHITE STRIPE
15	SA1	LIGHT GREEN
16	SF1A	RED
17	SF1B	RED
18	—	—
19	SC2	WHITE W/DARK BLUE STRIPE

20	SC1	LIGHT BLUE
41	S4A	BROWN W/YELLOW STRIPE
42	NS2	VIOLET W/WHITE STRIPE
43	MX1A	VIOLET W/BROWN OR BLACK STRIPE
44	MX2B	WHITE W/BLACK STRIPE
45	N7B	LIGHT GREEN OR GRAY W/BLACK STRIPE
46	SR1	PINK W/LIGHT BLUE STRIPE
47	GP2	YELLOW W/BLACK STRIPE
48	—	—
49	—	—
50	GP1	DARK GREEN
51	N5F	BLACK W/LIGHT BLUE STRIPE
52	ST1	RED W/BLACK STRIPE
53	N51A	BLACK W/ YELLOW STRIPE
54	N51B	BLACK W/ YELLOW STRIPE
55	—	—
56	J11D	BLACK W/ VIOLET OR RED W/WHITE STRIPE
57	J91A	BLACK W/RED STRIPE
58	J91B	BLACK W/ RED STRIPE
59	SC3	PINK OR PINK W/YELLOW STRIPE
60	SC4	BROWN OR DARK GRAY

1. This terminal is a ground path through the PRNDL switch to the battery. The ground is complete in reverse, neutral and drive only. In park, overdrive and low, battery voltage can be seen at this terminal and a drop in volts when the circuit is complete to ground.

2. This terminal is a ground path for the back up lamp relay.

3. This terminal receives battery voltage from the neutral switch and connects to the positive side of the back up lamp relay.

4. This terminal is where the negative C2D bus wire comes into the controller, it should have approximately 2-3 volts here. (see terminal # 43)

5. This terminal will be blank on models equipped with a body computer. If it doesn't have a body computer such as A & S body vehicles, there will be a positive lead wire at this terminal providing bus bias voltage. (see terminal # 44)

6. Blank

7. This terminal goes to the diagnostic connector on C & Y body vehicles.

8. This terminal is the cranking signal circuit, during engine cranking a voltage rise can be seen. Once the vehicle is running, there will be minimal voltage present, i.e., .10 volts.

9. This terminal connects to pin # 3 on the solenoid body and receives a signal from the overdrive pressure switch.

10. Blank

11. This terminal is the ignition switch start/run terminal. Battery voltage is present during engine cranking and engine running.

12. This terminal is the throttle position sensor signal which receives approximately .5 volts at idle and 4.0 volts at wide open throttle (WOT). (see terminal # 51)

13. This terminal receives a lead from both the turbine and the output speed sensors. Speed sensors are best checked with a scanner. (see terminal #'s 14 & 52)

14. This terminal connects to the second lead coming from the output speed sensor. When terminals 13 and 14 are checked together with the wheels spinning, there will be approximately 2.0 AC volts present not DC volts. (see terminal # 13)

15. This terminal is a direct battery supply circuit to the EATX relay coil from the controller to activate the relay during a circuit and relay check. Battery voltage can be seen at this terminal.

16. This terminal receives battery voltage from the EATX relay after the relay contacts are closed. This voltage is known as switched battery voltage and supplies power to the solenoid body.

17. This terminal is the same as terminal 16. These two terminals are used to monitor the relay function and applied battery voltage. Battery voltage can be seen at both terminals.

18. Blank

19. This terminal connects to pin # 8 on the solenoid body and makes a ground signal for the 2-4/low-reverse solenoid. This solenoid is referred to as the S4 solenoid and should have 1.5 ohms of resistance.

20. This terminal connects to pin # 7 on the solenoid body and makes a ground signal for the low-reverse/lockup solenoid. This solenoid is referred to as the S3 solenoid and should have 1.5 ohms of resistance.

41. This terminal receives battery voltage from the starter relay coil and it connects to the ground pin (middle pin) on the safety neutral switch. 10 to 12 volts can be seen here in reverse, overdrive, drive and low. In park and neutral there will be minimal voltage i.e., .10 volts.

42. This terminal connects to a ground circuit (middle pin) in the PRNDL switch. Approximately 10-12 volts can be seen in reverse, neutral, overdrive and drive. In park and low there will be minimal voltage i.e., .10 volts.

43. This terminal is where the positive C2D bus wire comes into the controller, it should have approximately 2-3 volts here. (see terminal # 4)

44. This terminal will be blank on models equipped with a body computer. If it doesn't have a body computer such as A & S body vehicles, there will be a negative lead wire at this terminal providing bus bias voltage. (see terminal # 5)

45. This terminal receives an engine speed signal from the distributer, 2 volts can bee seen here at idle. This sensor is best tested using a scanner where RPM's can be viewed.

46. Goes to the diagnostic connecter on some models only.

47. This terminal connects to pin # 1 at the solenoid body and receives a signal from the 2-4 pressure switch.

48. Blank

49. Blank

50. This terminal connects to pin # 2 at the solenoid body and receives a signal from the low reverse pressure switch.

51. This terminal provides a ground for the throttle position sensor. (see terminal # 12)

52. This terminal connects to the second lead coming from the turbine speed sensor. When terminals 13 and 52 are checked together with the wheels spinning, there will be approximately 2.0 AC volts present not DC volts. (see terminal # 13)

53. Ground circuit

54. Ground circuit

55. Blank

56. This terminal receives direct battery voltage through a fusible link. Battery voltage can be seen here.

57. Ground circuit

58. Ground circuit

59. This terminal connects to pin # 5 on the solenoid body and makes a ground signal for the underdrive solenoid. This solenoid is referred to as the S1 solenoid and should have 1.5 ohms resistance.

60. This terminal connects to pin # 6 on the solenoid body and makes a ground signal for the overdrive solenoid. This solenoid is referred to as the S2 solenoid and should have 1.5 ohms resistance.

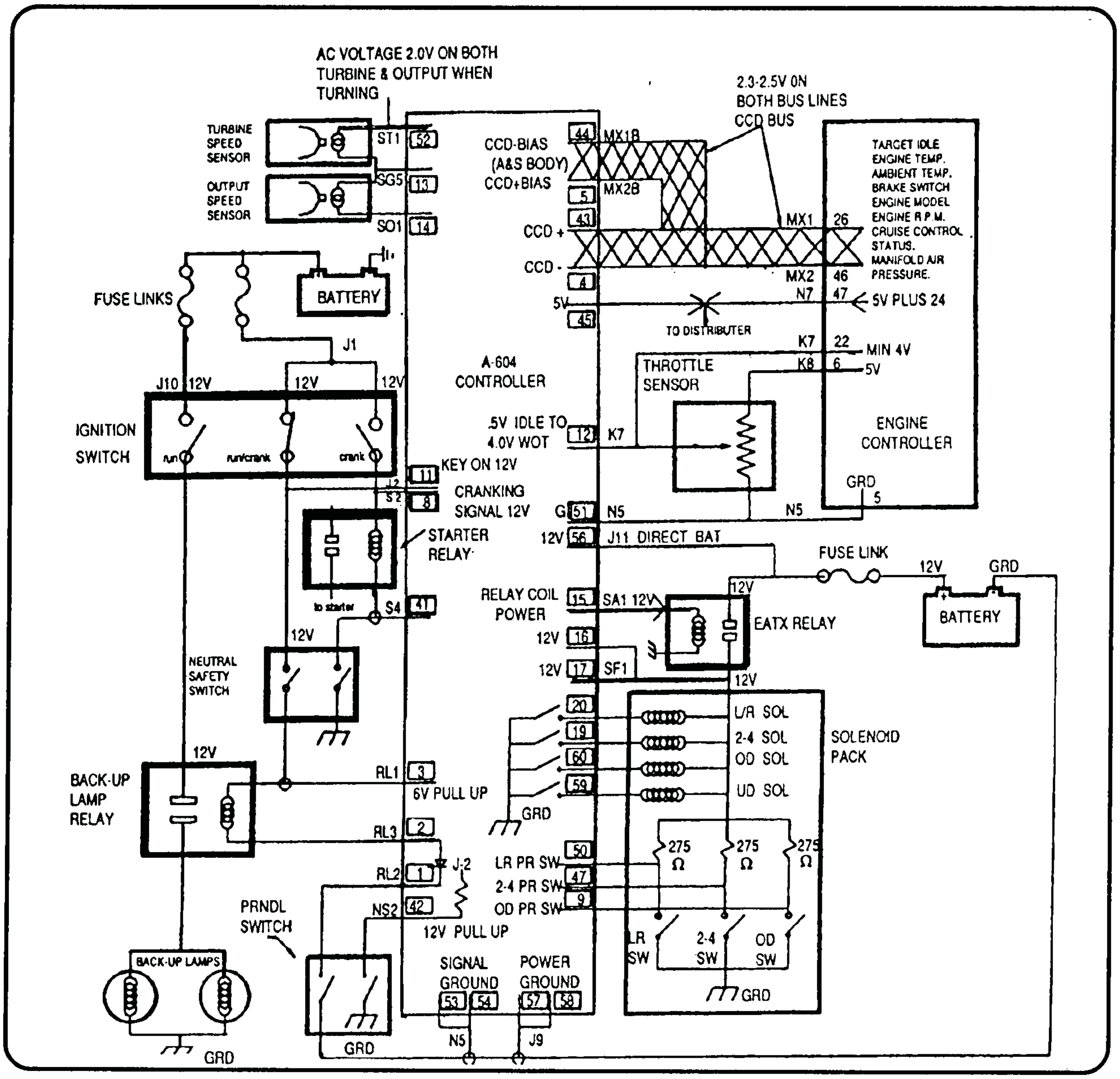


Figure 10

CHRYSLER A500/518 ELECTRICAL DIAGNOSIS

The A500 and A518 are both found in 1988 and up Ram Vans, Wagons, Pickups, Ramchargers and Dakota Trucks. The 3.9 liter engines were equipped with the A500 transmission. The 5.2 liters shared both the A500 and the A518 transmissions while the 5.9 liters had only the A518. Both the A500 and the A518 are rear wheel overdrive transmissions. The A500 has been equipped with a locking torque converter clutch since 1988 while the A518 transmission did not use a locking torque converter clutch until the start of 1992. Fourth gear and lock-up are both electronically controlled and hydraulically activated. The Single Module Engine Controller (SMEC) uses the following inputs to allow the shift to fourth gear and lock up in the torque converter to take place:

1. Coolant temperature sensor signal
2. Engine speed sensor signal
3. Vehicle speed sensor signal
4. Throttle position sensor signal
5. Map sensor signal

Both the lock up and overdrive solenoids share a common 12 volt supply which originates from the ignition switch. Once the SMEC receives the necessary information from the 5 inputs listed above, it makes a ground to complete the circuit for either the lock up or overdrive solenoid (Chrysler service manuals call the overdrive solenoid an overdrive lock-out solenoid and the lock up solenoid a part throttle unlock solenoid).

Figure 11 identifies the three terminals located in the case connector near the rear cooler fitting.

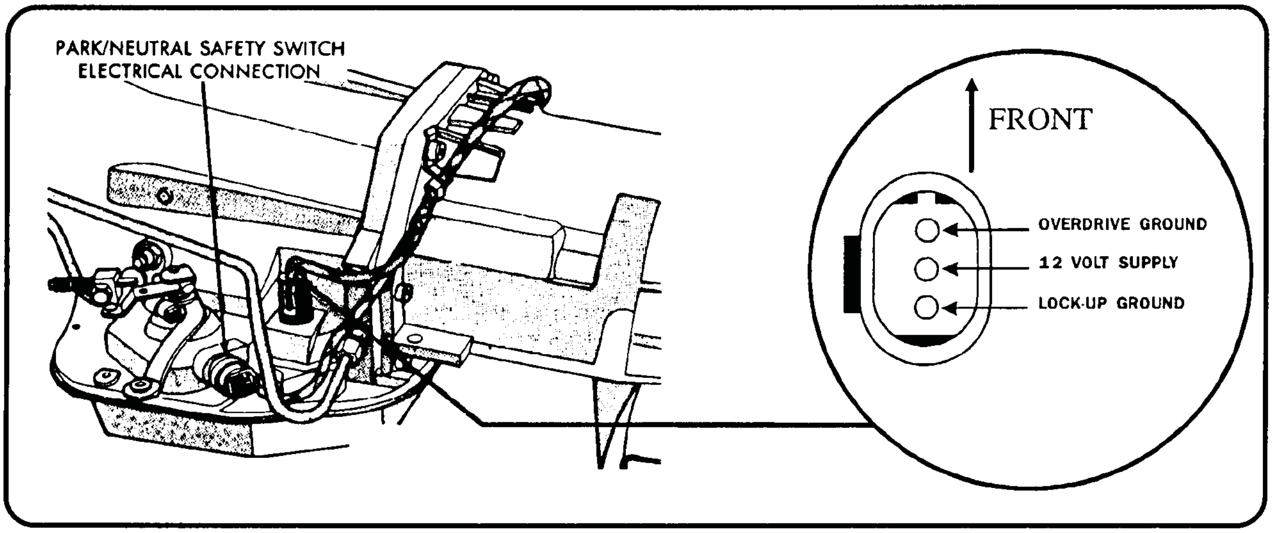


Figure 11

A quick check that can be made when the vehicle has lost lock up and overdrive is to supply your own 12 volts through a 20 amp fuse to the middle pin. When the vehicle is in third gear, ground the front pin. A shift to overdrive should be felt. When the rear pin is grounded, lock up should come on. If one or both operations has failed with this test, the problem is an internal one and will require a solenoid check. Both solenoids are normally open to exhaust and closes when energized and should have 25 to 35 ohms resistance at room temperature. When this check has been completed and the solenoids are in good working order, there is a non-electrical fault in the transmission causing the no overdrive or no lock up condition.

If the quick test shifted the transmission into overdrive and lock up came on, then an external electrical problem exists. A scanner will interface with the SMEC to retreive fault codes. Figure 12 is a view of both the diagnostic connector and the SMEC with its 60 way and 14 way connectors.

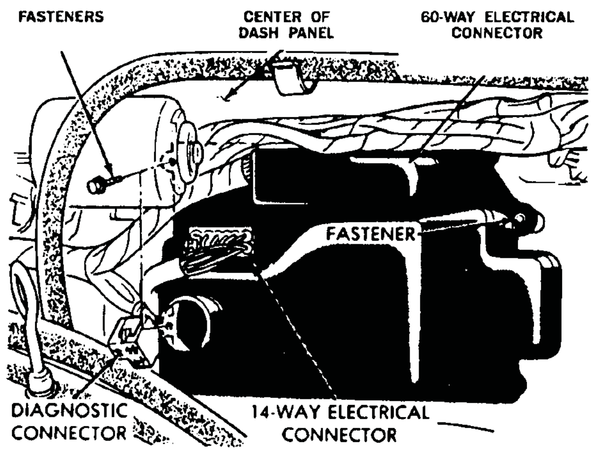


Figure 12

If a scanner is not available the SMEC may show fault codes by flashing a check engine lamp on the instrument cluster. To activate this function turn the ignition key on. The check engine lamp will come on for two seconds as a bulb check. Immediately following this it will display a fault code by flashing on and off. There is a short pause between flashes and a longer pause between digits.

An example of two codes is as follows:

1. Lamp on for two seconds, then turns off.
2. Lamp flashes four (4) times pauses, and then flashes once (1).
3. Lamp pauses for four seconds, flashes four (4) times, pauses and then flashes seven (7) times.

The two codes shown in this example is 41 and 47. The following chart is a list of the fault codes that can be stored in the memory of the SMEC.

DOMESTIC COMPUTER CONTROL

FAULT CODE	SCANNER DISPLAY	DESCRIPTION OF FAULT CODE
11	IGN Reference Signal	No distributor reference signal detected during engine cranking
12	No. of Key-ons since last fault or since faults were erased.	Direct battery input to controller disconnected within the last 50-100 ignition key-ons.
13 +**	MAP Pneumatic Signal or MAP Pneumatic Change	No variation in MAP sensor signal is detected. No difference is recognized between the engine MAP reading and the stored barometric pressure reading. MAP sensor input below minimum acceptable voltage.
14+**	MAP voltage too low or MAP voltage too low	MAP sensor input above maximum acceptable voltage.
15**	Vehicle Speed Sensor	No distance sensor signal detected during road load conditions.
16+**	Battery Input Sense	Battery voltage sense input not detected during engine running.
17	Low Engine Temp.	Engine coolant temperature remains below normal operating temperatures during vehicle travel (thermostat).
21**	Oxygen Sensor Signal	Neither rich or lean condition is detected from the oxygen sensor input.
22+**	Coolant voltage low or	Coolant temperature sensor input below minimum acceptable voltage.
	Coolant voltage high	Coolant temperature sensor input above maximum acceptable voltage.
23	T/B temp. voltage low or	Throttle body temperature sensor input below the minimum acceptable voltage (5.2L and 5.9L only).
	T/B temp. voltage high.	Throttle body temperature sensor input above the maximum acceptable voltage (5.2L and 5.9L only).
24+**	TPS voltage low or	Throttle position sensor input below the minimum acceptable voltage.
	TPS voltage high	Throttle position sensor input above the maximum acceptable voltage.
25**	ISC motor circuits	A shorted condition detected in one or more of the ISC control circuits.
26	INJ1 peak current or	High resistance condition detected in the INJ1 injector output circuit.
	INJ2 peak current	High resistance condition detected in the INJ2 injector output circuit.
27	INJ1 control circuit or INJ2 control circuit	INJ1 injector output driver stage does not respond properly to control signal INJ2 injector output driver stage does not respond properly to control signal

FAULT CODE	SCANNER DISPLAY	DESCRIPTION OF FAULT CODE
31**	Purge solenoid circuit	An open or shorted condition detected in purge solenoid circuit.
32**	EGR solenoid circuit or	An open or shorted condition detected in ERG solenoid circuit. (California emissions only).
	EGR system failure	Required change in fuel/air ratio not deteced during diagnostig test (California only).
33	A/C clutch relay circuit	An open or shorted condition detected in the A/C clutch relay circuit.
34	S/C servo solenoid	An open or shorted condition detected in the speed control vacuum or vent solenoid circuit.
35	Idle switch shorted or	Idle contact switch input circuit shorted to ground.
	Idle switch opened	Idle contact switch input circuit opened.
36	Air switch solenoid	An open or shorted condition detected in the air switching solenoid circuit.
37	PTU solenoid circuit	An open or shorted condition detected in the torque converter part throttle unlock solenoid circuit.
41	Charging system circuit	Output driver stage for alternator field does not respond properly to the voltage regulator control system.
42	ASD relay circuit or	An open or shorted condition detected in the auto shutdown relay circuit.
	Z1 voltage sense	No Z1 voltage sensed when the auto shutdown relay is energized.
43	Ignition control circuit	Output driver stage for ignition coil does not respond properly to the dwell control signal.
44	FJ2 voltage sense	No FJ2 voltage present at the logic board during controller operation.
45	Overdrive solenoid	An open or shorted condition detected in the overdrive solenoid circuit.
46**	Battery voltage high	Battery voltage sense input above target charging voltage during engine operation.
47	Battery voltage low	Battery voltage sense input below target charging voltage during engine operation.
51**	Air fuel at limit	Oxygen sensor signal input indicates lean fuel/air ratio condition during engine operation.
52**	Air fuel at limit or	Oxygen sensor signal input indicates rich fuel/air ratio condition during engine operation.
	Excessive leaning	Adaptive fule value leaned excessively due to a sustained rich condition
53	Internal self-test	Internal engine controller fault condition detected, complea-

FAULT CODE	SCANNER DISPLAY	DESCRIPTION OF FAULT CODE
62	EMR mileage accum	Unsuccessful attempt to update EMR mileage in the controller EEPROM.
63	EEPROM write denied	Unsuccessful attempt to write to an EEPROM location by the controller.
	Fault code error	An unrecognized fault ID recieved by DRB II.

\+ CHECK ENGINE LAMP ON

** CHECK ENGINE LAMP ON (CALIFORNIA ONLY)

Once a fault code or codes have been retrieved, the necessary repair or repairs can then be made. But if shorted circuits or open circuits have occurred, the replacement of sensors or switches will not correct the problem. To aid the technician in locating open and shorted circuits, figure 13 shows the 60 way connector viewed from the wire end as it plugs into the SMEC. Each terminal has been numbered for pin identification. The following chart provides information on the terminals that are transmission related only. Figure 14 is a wiring diagram of these terminals for further assistance to the technician.

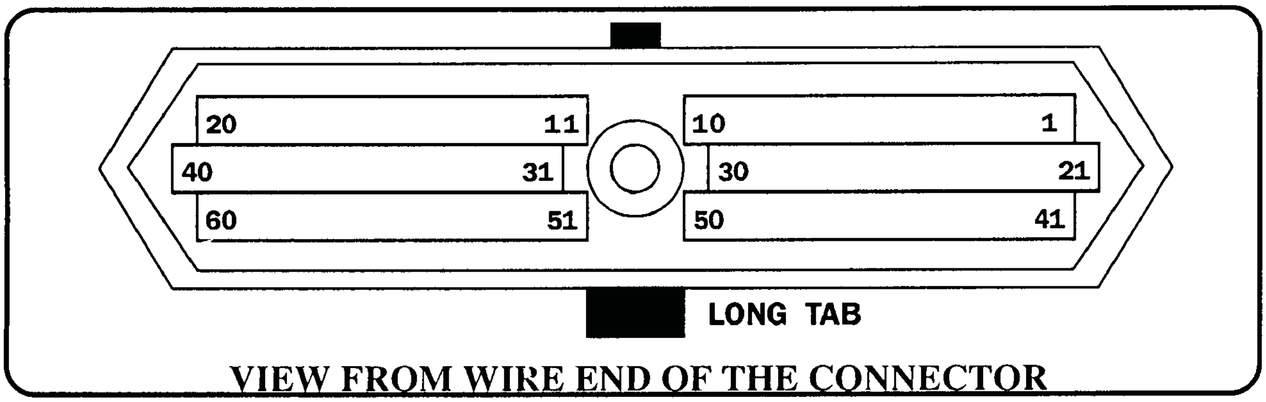


Figure 13

TERMINAL #	CIRCUIT NAME	WIRE COLOR
1	K4	Dark Blue With Red Tracer
3	K10	Tan With White Tracer
4	N5	Black With Light Blue Tracer
13	K8	Violet With White Tracer
22	K7	Orange With Dark Blue Tracer
30	S4	Brown With Yellow Tracer
38	U4	Orange With White Tracer
41	J11	Red
47	N7	Gray With Black Tracer
48	G7	White With Orange Tracer
55	U3	Orange With Black Tracer

TERMINAL 1-This is the MAP sensor signal to the SMEC.

TERMINAL 3- This is the engine coolant sensor ground signal.

TERMINAL 4- This is the engine coolant sensor ground return. With the connector unplugged, 7K to 13K ohms can be seen here between terminals 3 and 4 when the engine coolant sensor is at approximately room temperature (70° F). With the engine at operating temperature (200° F), 700 to 1,000 ohms should be seen.

TERMINAL 13- This is a 5 volt supply from the SMEC to both the MAP sensor and the Throttle Position Sensor. 5 volts should be seen here.

TERMINAL 22- This is the Throttle Position Sensor signal to the SMEC. At closed throttle approximately .10 volts can be seen. As the accelerator is depressed the voltage should rise smoothly to 4.5 to 5 volts at wide open throttle.

TERMINAL 30- This is a ground signal circuit for the SMEC from the middle terminal on the safety neutral switch. With the connector unplugged, there will be continuity at this terminal in Park and Neutral only.

TERMINAL 38- This is the ground circuit for the overdrive solenoid.

TERMINAL 41- This is the direct battery feed for the computer. 12 volts should be seen here.

TERMINAL 47- This is a reference signal from the distributer providing engine speed input.

TERMINAL 48- This is a vehicle speed input from the distance sensor (speedometer) on the transmission.

TERMINAL 55- This is the ground circuit for the lock up solenoid.

On the dash panel there is an overdrive cancel button. When the vehicle has been started, the overdrive light is on and a shift into overdrive will take place when the vehicle reaches operating temperature. If the driver chooses to cancel the overdrive operation, the button is simply pressed and the light goes out and overdrive is prohibited. This button cancels overdrive by opening the ground circuit that the SMEC provides for the overdrive solenoid through an Overdrive Control Module. On some vehicles this module is built into the switch and on others it is mounted on the right side of the brake support bracket (figure 15).

The switch or control module can malfunction in one or two ways. It could allow the transmission to shift into overdrive with no cancel abilities, or prevent overdrive from ever occurring. Figure 16a shows the wiring circuit for the Overdrive Control Module which is mounted on the brake support bracket. Figure 16b shows the wiring circuit for the Overdrive Control Module which is built into the O.D. cancel button.

With the overdrive button on allowing overdrive to take place, continuity should be seen with an ohm meter between terminals 8 and 9. When the overdrive button is in the canceled position, the ohm meter should read open between these two terminals. If terminals 8 and 9 always show continuity, there will be no ability to cancel overdrive. If terminals 8 and 9 always reads open, overdrive will not occur.

DOMESTIC COMPUTER CONTROL

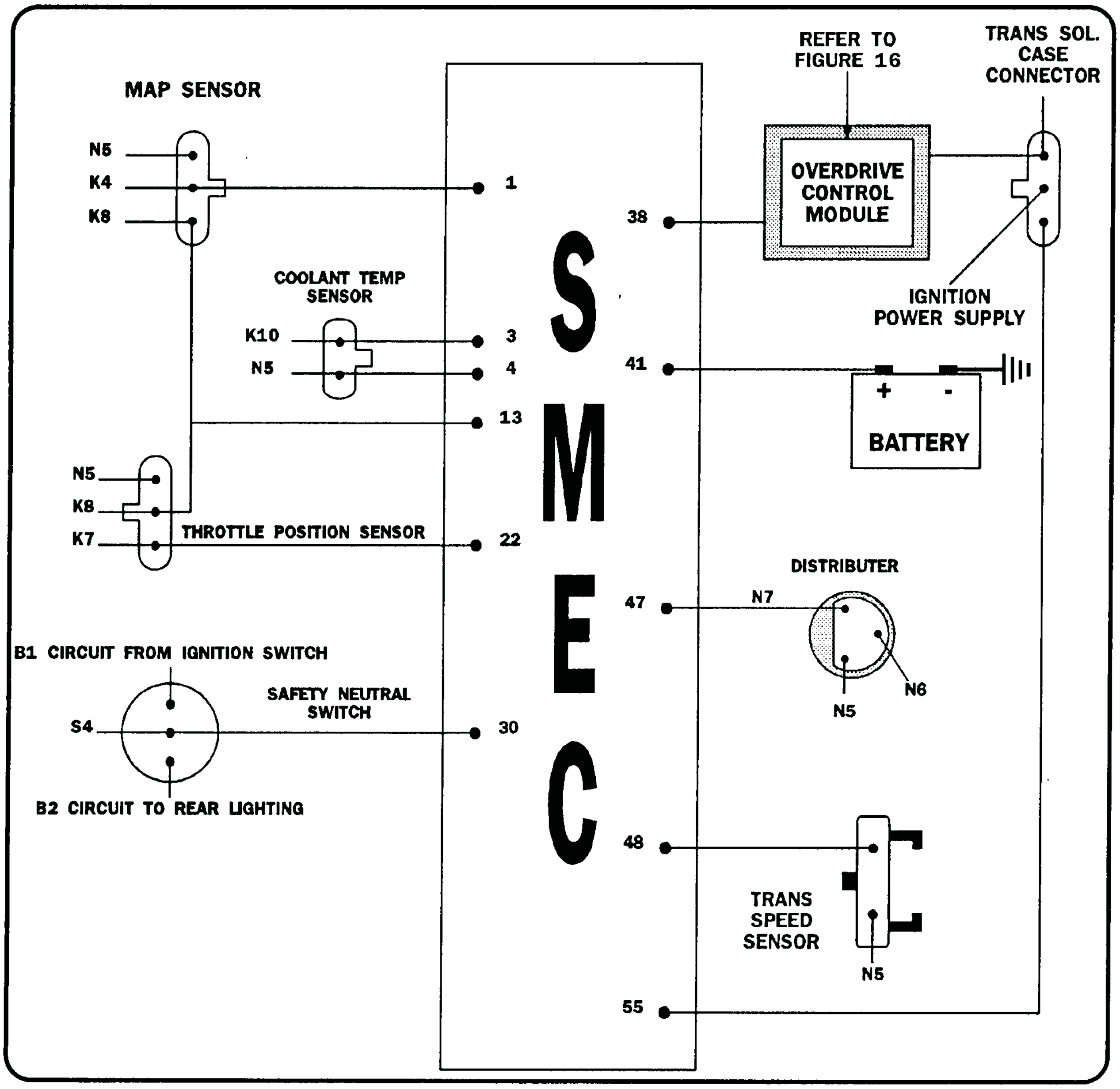


Figure 14

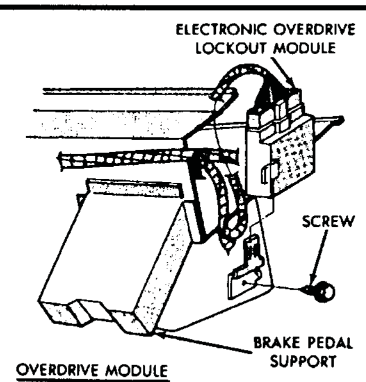


Figure 15

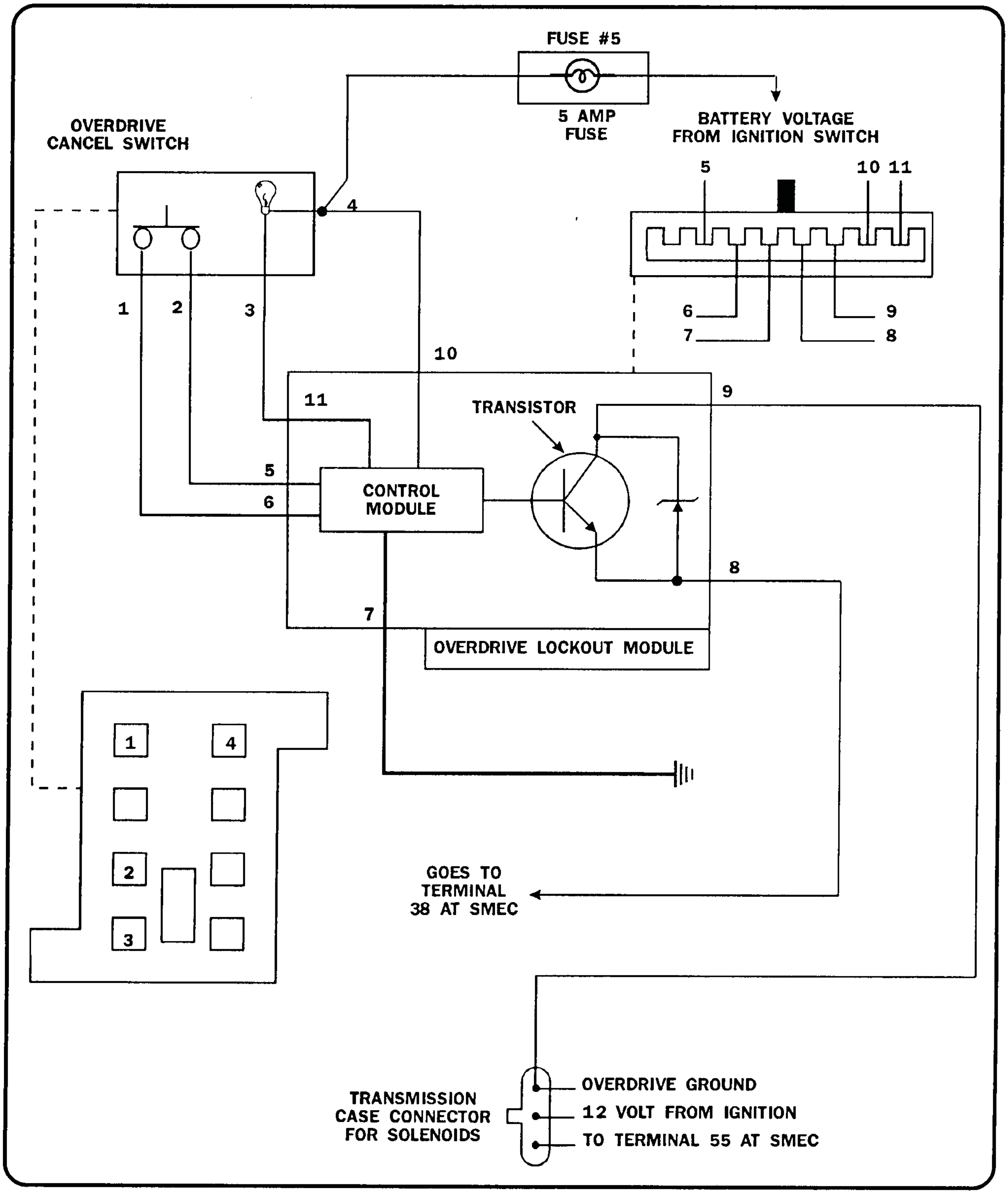

FUSE #5
5 AMP
FUSE
BATTERY VOLTAGE
FROM IGNITION SWITCH
OVERDRIVE
CANCEL SWITCH
5
10 11
4
1
2
3
6
7
9
8
10
11
TRANSISTOR
5
6
CONTROL
MODULE
8
7
OVERDRIVE LOCKOUT MODULE
1
4
2
3
GOES TO
TERMINAL
38 AT SMEC
TRANSMISSION
CASE CONNECTOR
FOR SOLENOIDS
OVERDRIVE GROUND
12 VOLT FROM IGNITION
TO TERMINAL 55 AT SMEC

Figure 16a

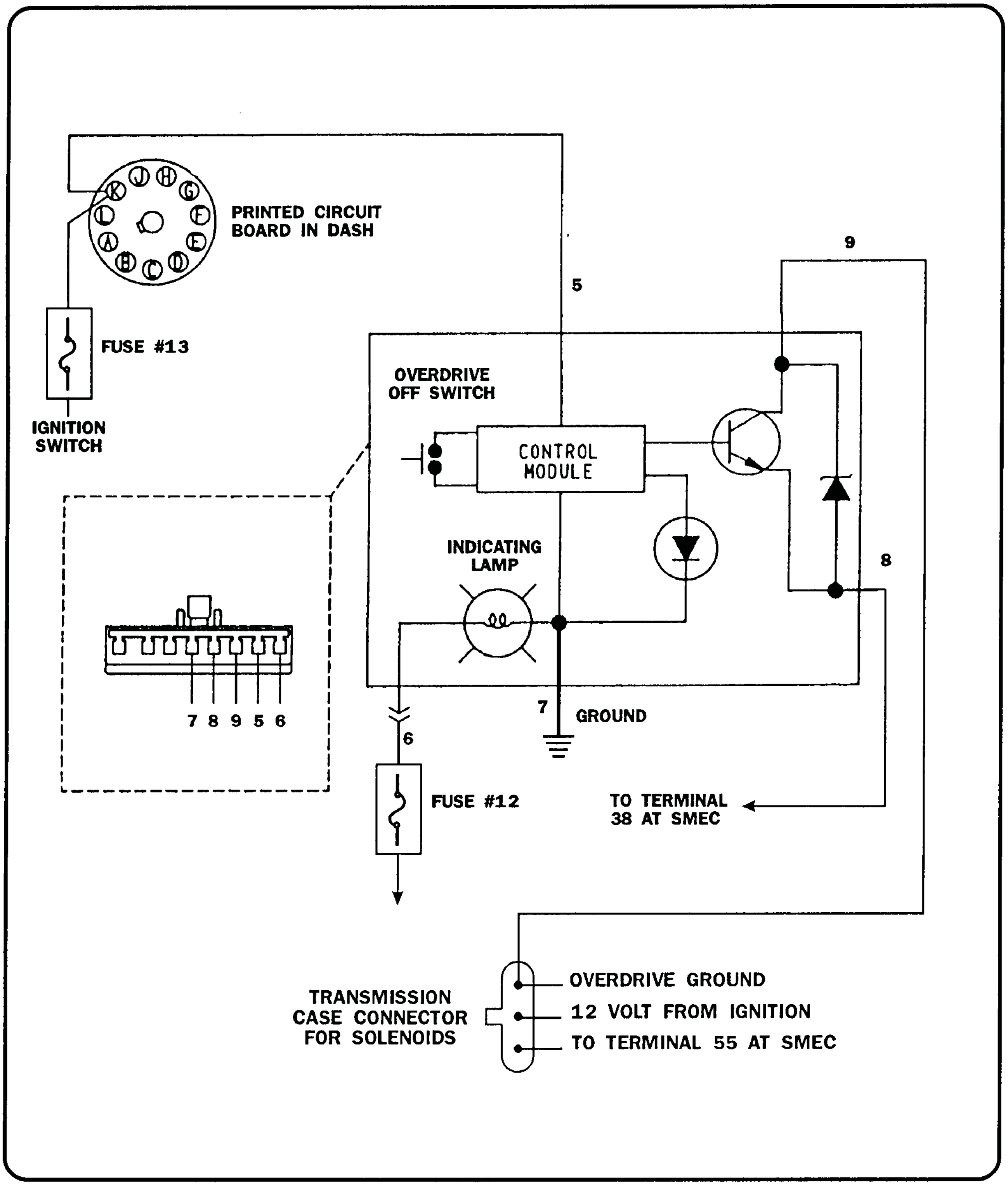

PRINTED CIRCUIT
BOARD IN DASH
K
J
H
G
L
F
A
E
B
C
D
FUSE #13
IGNITION
SWITCH
5
9
OVERDRIVE
OFF SWITCH
CONTROL
MODULE
INDICATING
LAMP
8
7 8 9 5 6
7
GROUND
6
FUSE #12
TO TERMINAL
38 AT SMEC
TRANSMISSION
CASE CONNECTOR
FOR SOLENOIDS
OVERDRIVE GROUND
12 VOLT FROM IGNITION
TO TERMINAL 55 AT SMEC

Figure 16b

FORD A4LD COMPUTER CONTROL DIAGNOSIS

The A4LD has an electronically controlled and hydraulically activated 3-4 upshift and convertor clutch lock up. This style A4LD went into production in late 1987 and is behind a variety of engine sizes in passenger vehicles, vans and light duty trucks. The computer that is used to operate the the 3-4 shift solenoid and the convertor clutch lock up solenoid is called the EEC-IV (Electronic Engine Control-System 4). The EEC-IV needs the following inputs to allow the 3-4 upshift and torque convertor lock up to occur:

1. Engine coolant temperature sensor (ECT)
2. Vehicle Speed sensor (VSS)
3. Throttle Position sensor (TPS)
4. Manifold Absolute Pressure (MAP) or the Mass Air Flow sensor (MAF), depending on the model vehicle.

A simple test that can be made if there is a no 3-4 shift condition or torque convertor lock up is to provide your own 12 volts to the middle pin of the case connector (see figure 17). When the transmission is in third gear, ground the rear pin. This will close the solenoid and allow the govenor to shift the transmission. A shift into overdrive should be felt. When the front pin is grounded the torque convertor should lock up.

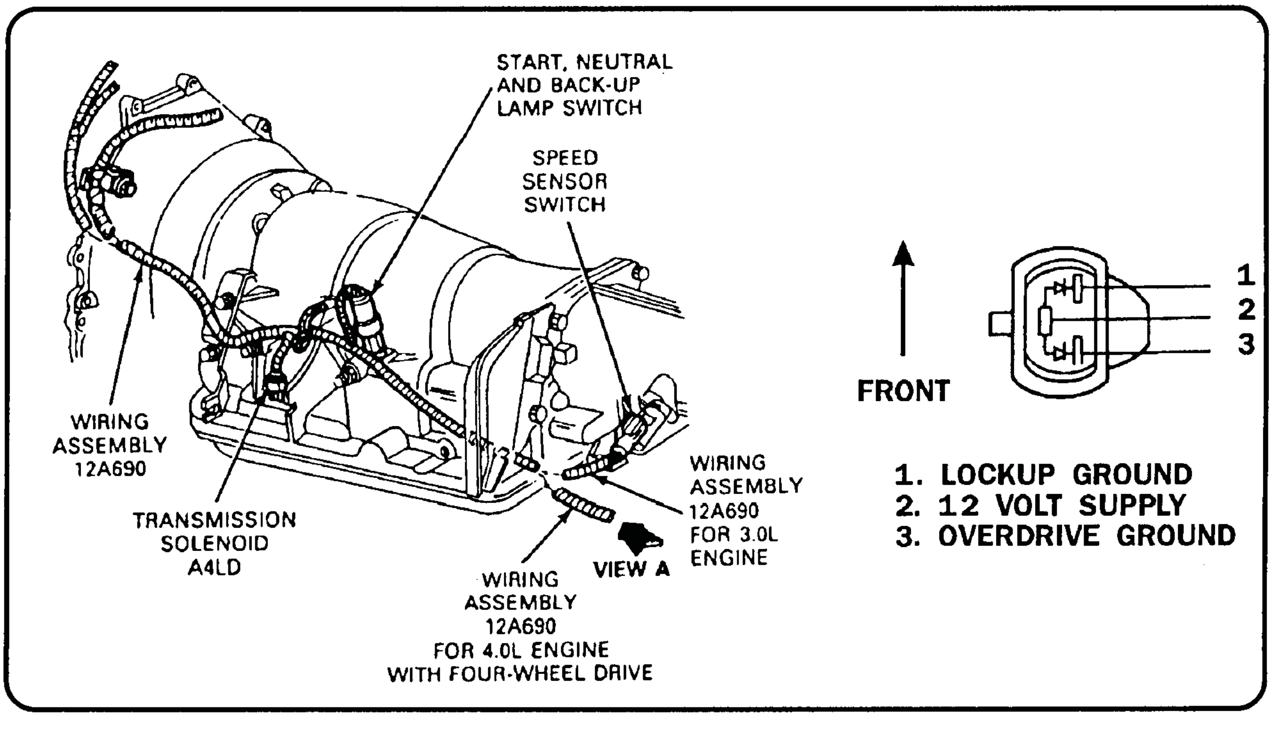


Figure 17

If one or both of these operations fails the test, a solenoid inspection is required. Both solenoids are normally open to exhaust and should close when energized. They also should have 26 to 40 ohms of resistance. If the inspection shows that the solenoids are working correctly, there is internal problems elsewhere in the transmission. If the transmission shifted into overdrive and lock up occured during the test, an external electrical problem is present. The EEC-IV can be interfaced with a scanner to retreive service codes that may have been stored in memory. The diagnostic connector is located in the engine compartment. If a scanner is unavailable, a jumper wire can be used to flash codes on the check engine or service soon light (see figure 18).

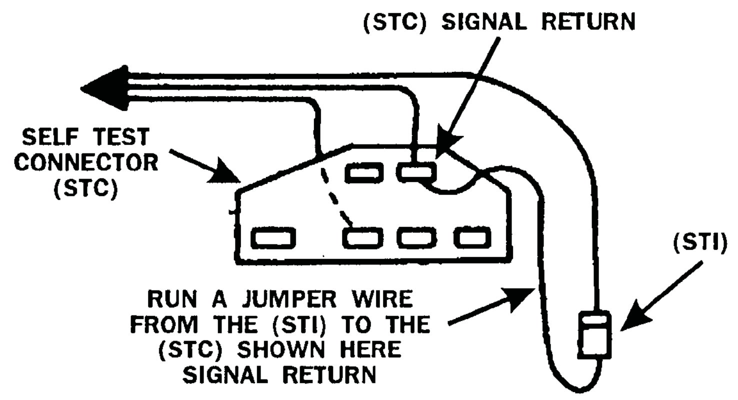


Figure 18

To run the key on engine off test (KOEO) with a jumper wire, bring the vehicle to operating temperature. Shut the engine off and hook a jumper wire from the STI to the STC signal return as shown in figure 18. Turn the ignition on with the engine off. The check engine or service engine soon light will begin to flash service codes. If your vehicle is earlier than 1991, you will have a two digit service code. If your vehicle is 1991 or later, a three digit code will be displayed. To determine a code by the flashing light there are pauses between flashes. A four second pause is between each service code and a two second pause is between each digit. An example of a two digit code is as follows:

A. 2 blinks with a 1/2 second pause between the blinks.

B. A 2 second pause.

C. 3 blinks with a 1/2 second pause between the blinks.

D. A 4 second pause indicating the end of this service code.

The example code shown here is service code 23. If this was the only code stored in memory it would be repeated after the 4 second pause. If other codes were stored in memory, they would also follow the 4 second pause and repeat themselves. The following chart provides both the two and three digit codes which are transmission related only.

87-90 TWO DIGIT CODES	91 & UP THREE DIGIT CODES	DESCRIPTION
74	536	BOO = BRAKE ON/OFF SWITCH REFER TO FIGURE #19
21-51-61	116-117 118	ECT = ENGINE COOLANT TEMPERATURE SENSOR REFER TO FIGURE #20
26-56-66 72	129-157-158 159-184-185	MAF = MAS AIR FLOW SENSOR REFER TO FIGURE #21
22-72	126-128 129	MAP = MANIFOLD ABSOLUTE PRESSURE
69-86	452	SS = 3/4 SHIFT SOLENOID REFER TO FIGURE #22 & 23
58-94	627-628	TCC = TORQUE CONVERTER CLUTCH SOLENOID REFER TO FIGURE #22 & 23
12-23-53 63-73-77	121-122-123 124-125-167	TPS = THROTTLE POSITION SENSOR REFER TO FIGURE #24
29	452	VSS = VEHICLE SPEED SENSOR REFER TO FIGURE #25

Figures 19 through 25 are provided for individual sensors, switch and solenoid checks. Each terminal on a specific sensor, switch or solenoid is lettered for identification. Information is given on each terminal as to which pin it is at the 60 way EEC-IV connector. Refer to figure 26a & 26b for the pin location at the 60 way connector.

BRAKE ON/OFF SWITCH (BOO)

Pin #2 at the 60 way connector is the brake on/off signal. Voltage can be seen when the brake pedal is depressed and no voltage when it is released.

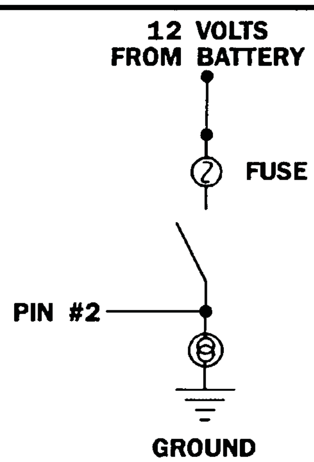


Figure 19

ENGINE COOLANT TEMPERATURE SENSOR (ECT)

Terminal A goes to pin #7 at the 60 way connector.

Terminal B goes to pin #46 at the 60 way connector.

Refer to the following chart fot the temperature sensor values.

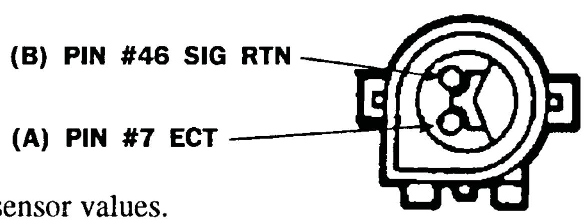
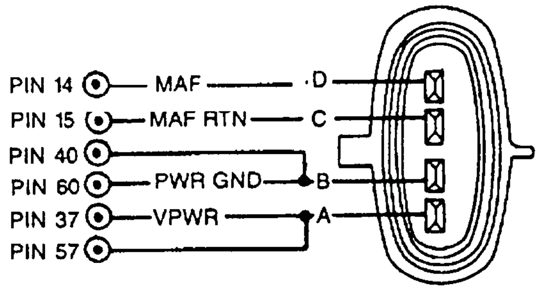


Figure 20

Temperature		Engine Coolant Temperature Sensor Values	
°F	°C	Voltage (volts)	Resistance (K ohms)
248	120	.27	1.18
230	110	.35	1.55
212	100	.46	2.07
194	90	.60	2.80
176	80	.78	3.84
158	70	1.02	5.37
140	60	1.33	7.70
122	50	1.70	10.97
104	40	2.13	16.15
86	30	2.60	24.27
68	20	3.07	37.30
50	10	3.51	58.75

MASS AIRFLOW SENSOR (MAF)



Terminal A goes to pin 37 and 57 of the 60 way connector and is a power supply for the sensor.

Terminal B goes to pin 40 and 60 of the 60 way connector and is a ground

Terminal C goes to pin 15 of the 60 way connector

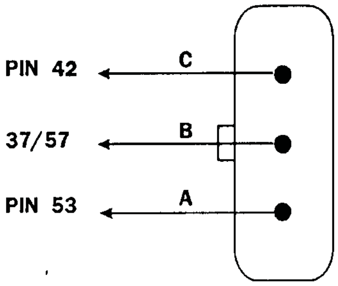
Cross pins B & C with a volt meter, at idle approximately .60 volts should be seen. Refer to the following chart for sensor data.

Figure 21

MAP SENSOR CHECK

Engine Condition	MAF Signal Voltage
IDLE	.60
20 mph	1.10
40 mph	1.70
60 mph	2.10

1988 CASE CONNECTOR



Terminal A goes to pin 53 of the 60 way connector for the converter clutch solenoid ground signal.

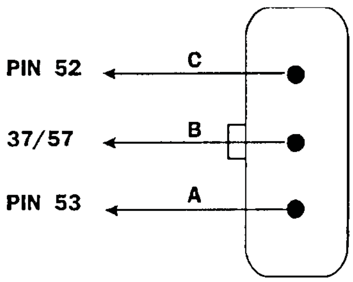
Terminal B goes to pin 37 & 57 of the 60 way connector for the 12 volt supply to both solenoids.

Terminal C goes to pin 42 of the 60 way connector for the 3/4 shift solenoid ground signal.

Ohms readings should be 26 to 40 for both solenoids.

Figure 22

1989 & UP CASE CONNECTOR



Terminal A goes to pin 53 of the 60 way connector for the converter clutch solenoid ground signal.

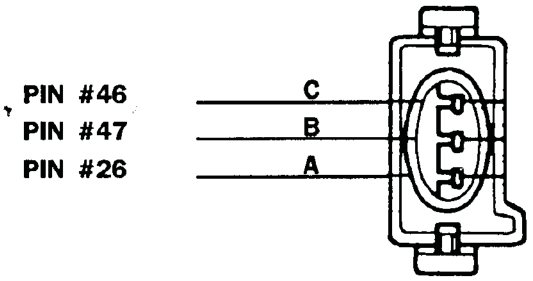
Terminal B goes to pin 37 & 57 of the 60 way connector for the 12 volt supply to both solenoids.

Terminal C goes to pin 52 of the 60 way connector for the 3/4 shift solenoid ground signal.

Ohms readings should be 26 to 40 for both solenoids.

Figure 23

THROTTLE POSITION SENSOR (TPS)



Terminal A goes to pin #26 at the 60 way connector. And is the 5volt supply to the TPS.

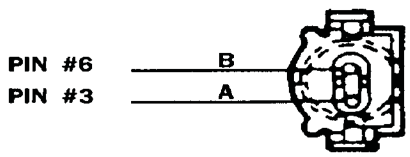
Terminal B goes to pin #47 at the 60 way connector. And is the variable return voltage from the TPS.

Terminal C goes to pin #46 at the 60 way connector. And is a ground signal.

To test the TPS, cross pins 46 & 47 with the key on-engine off. At closed throttle you should have approximately .6 volts, as the throttle is opened a smooth increase in voltage should be seen. At full throttle you should have approximately 4.5 volts.

Figure 24

VEHICLE SPEED SENSOR (VSS)

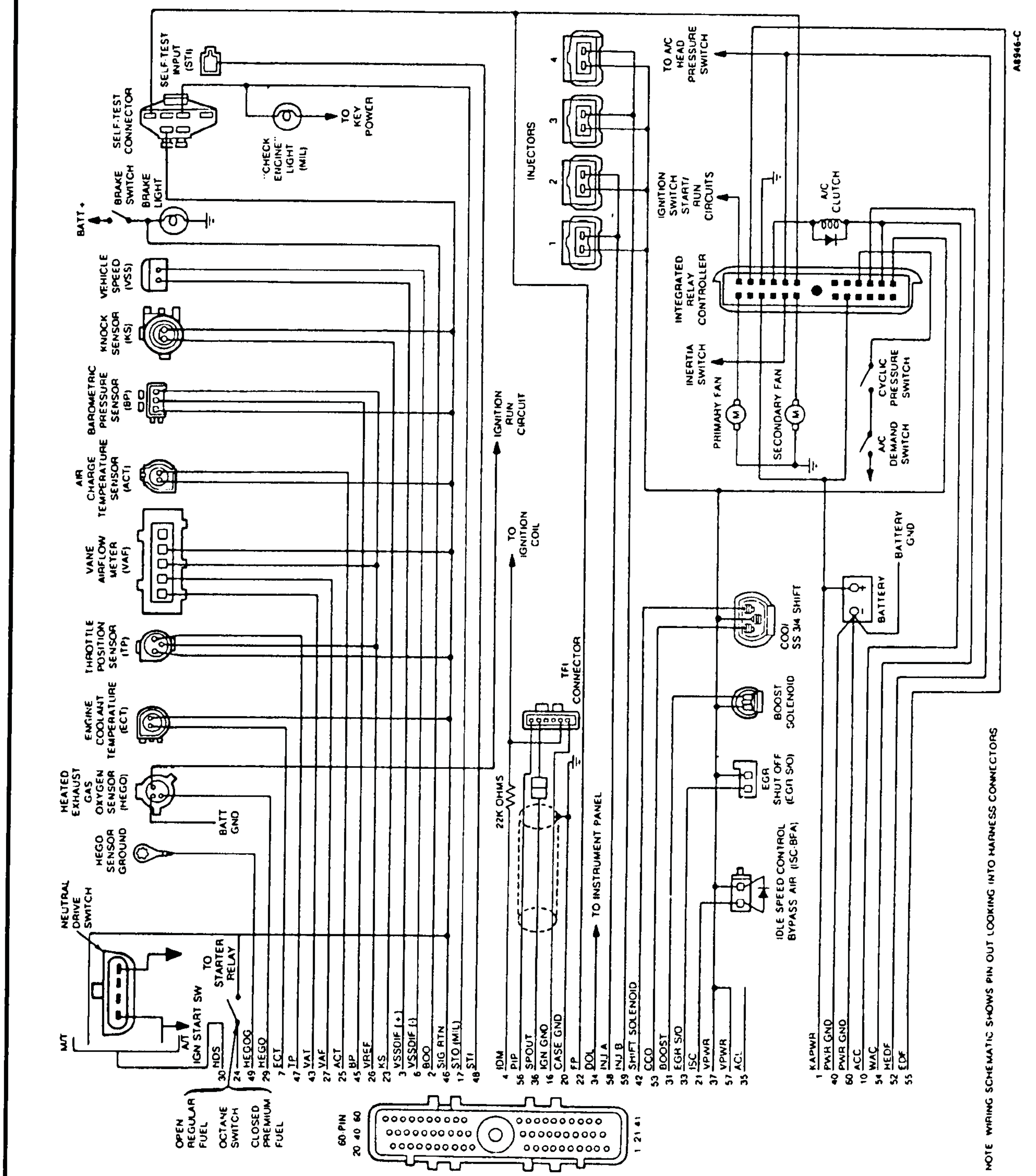


Terminal A goes to pin #3 at the 60 way connector.

Terminal B goes to pin #6 at the 60 way connector.

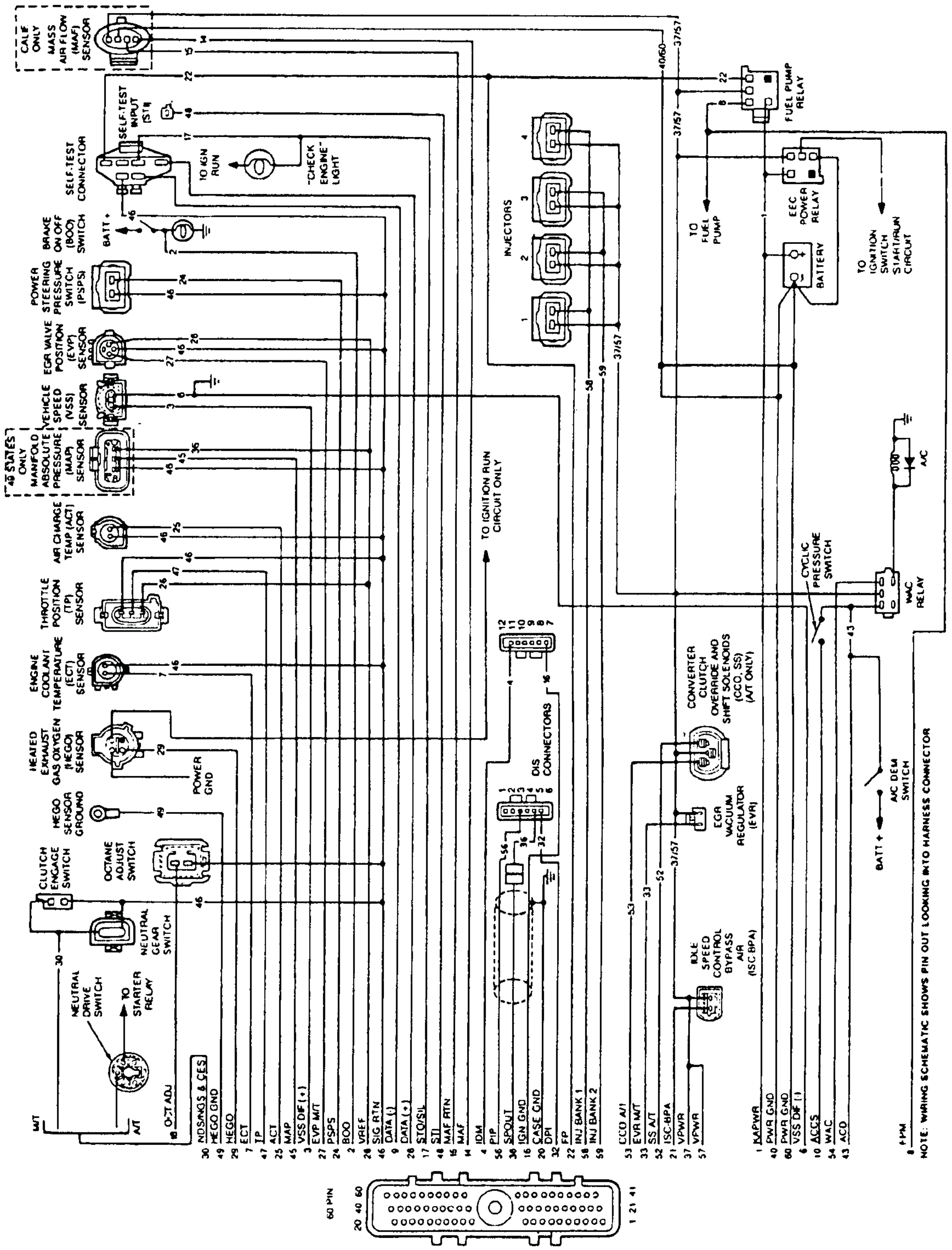
When testing the VSS, connect meter leads to terminals 3 & 6, you should have approximately 190 to 250 ohms.

Figure 25



1988 TYPICAL A4LD WIRING SCHEMATIC

Figure 26a



1989 & UP TYPICAL A4LD WIRING SCHEMATIC

Figure 26b

THE E4OD ELECTRICAL DIAGNOSIS

The Ford E4OD transmission began in the model year of 1989 and is currently found behind both gasoline and diesel engines in trucks, vans and commercial vehicles. The EEC-IV computer (Electronic Engine Control-system 4) is found in gasoline engine vehicles only. Built into this computer is an ECA processor (Electronic Control Assembly). The operation of the E4OD transmission is controlled by the EEC-IV's ECA processor. On vehicles equipped with diesel engines, the operation of the E4OD transmission is controlled by a Transmission ECA processor. Diesel vehicles are not equipped with an EEC-IV system. This Transmission ECA processor controls the E4OD transmission in the same way the ECA processor does for gasoline engines. However, some of the input sensors are different (see figure 27).

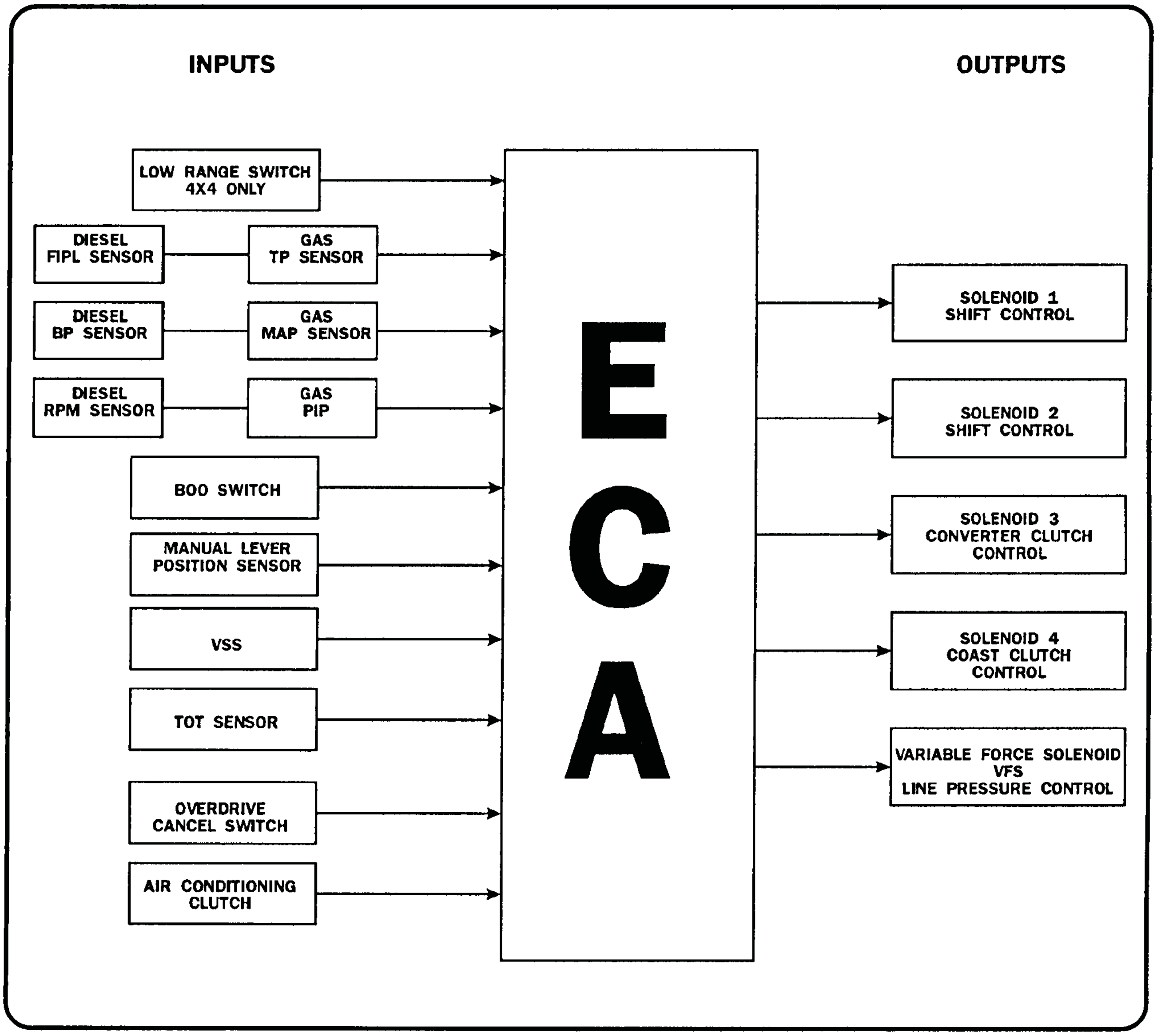


Figure 27

The ECA processor is not capable of putting this transmission into a fail safe or a limp-in mode if it detects an electrical problem. It will however, cause the transmission to malfunction and store a service code which can be retrieved with a scanner. The diagnostic connector the scanner uses is located under the hood. If a scanner is not available, this diagnostic connector can be jumped to flash the service codes (refer to page 24 and figure 18 for assistance in jumping the diagnostic connector). There are two digit codes for 89 to 90 vehicles and three digit codes for 91 and up. Figures 28 through 37 provide a description of each input, its function, the symptoms that can be caused, and the service codes it can produce. Page 40 provides a quick overview of all service codes. NOTE: If the transmission comes into your shop stuck in 4th gear and the overdrive light stays on, the power relay for the processor is probably bad. The power relay usually clips onto the driver side fender well. Refer to your local dealer for the part number.

VEHICLE SPEED SENSOR (VSS)

Description: The vehicle speed sensor is a variable reluctance sensor that sends a signal to the processor assembly. This VSS signal tells the processor assembly the vehicle speed in MPH (Figure 28).

Transmission function: Used as an input in determining shift scheduling and Electronic Pressure Control (EPC).

Symptoms: Harsh engagements, firm shift feel, abnormal shift schedule, unexpected downshifts may occur at closed throttle, convertor clutch engages only at Wide-Open Throttle (WOT).

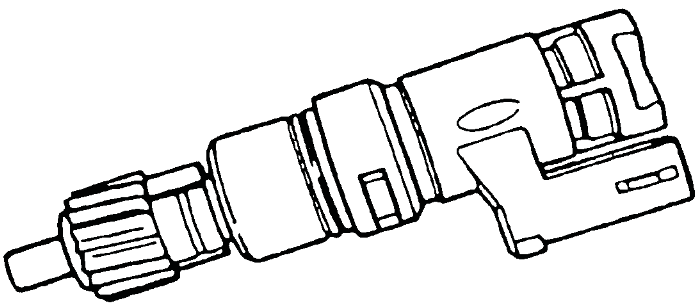


Figure 28

Fault Codes: 29 (two digit), 452 (three digit). Refer to page 28 for VSS check

BRAKE ON/OFF SWITCH (BOO)

Description: The brake on off switch tells the processor assembly when the brakes are applied. The switch is closed when the brakes are applied and open when they are released (Figure 29).

Transmission function: Disengages convertor clutch when the brake is applied.

Symptoms: Failed on or not connected - Convertor clutch will not engage at less than 1/3 throttle. Failed off - Convertor clutch will not disengage when brake is applied.

Fault Codes: 74 (two digit), 536 (three digit). Refer to page 25 for BOO check.

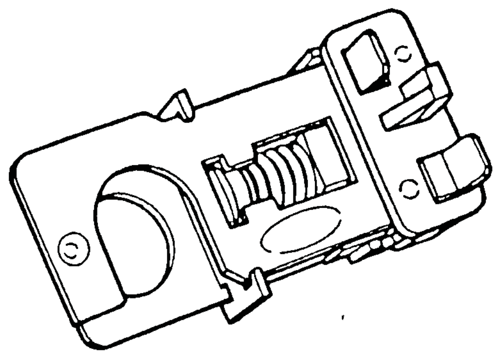


Figure 29

PROFILE IGNITION PICKUP SENSOR (PIP) - GASOLINE ENGINES
REVOLUTIONS PER MINUTE SENSOR (RPMS) - DIESEL ENGINES

Description: On gasoline engines, the Profile Ignition Pickup signal is produced by a Hall-Effect device in the distributor. It tells the processor assembly the engine RPM and the crankshaft position (Figure 30).

On diesel engines, the RPMS provides RPM to the processor assembly.

Transmission function: Used as an input in determining shift schedule and EPC.

Symptoms: Gasoline engines - PIP sensor failure, engine will not run. Diesel engines - Harsh engagements and shifts, late WOT upshifts, no convertor engagements.

Fault Codes: 14 (two digit) 211 (three digit).

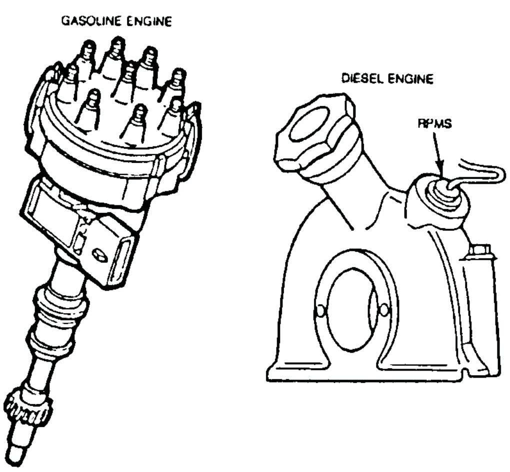


Figure 30

AIR CONDITIONING CLUTCH (ACC)

Description: The Air Conditioning Clutch is an electronic clutch that is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator-drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft (Figure 31).

Transmission function: Used as an input to determine EPC when the ACC is engaged to compensate for the additional load on the engine.

Symptoms: Failed on - EPC slightly low with A/C off. Failed off - EPC slightly high with A/C on.

Fault Codes: 67 (two digit), 539 (three digit).

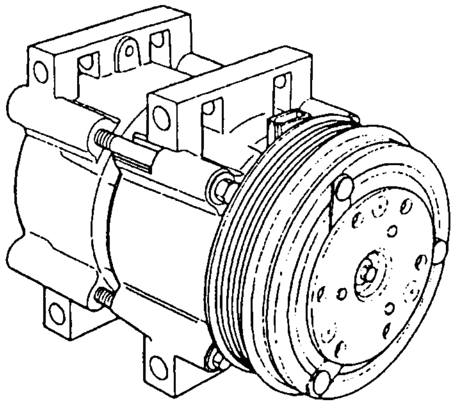


Figure 31

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP) - GASOLINE ENGINES
BAROMETRIC PRESSURE SENSOR (BP) - DIESEL ENGINES

Description: On gasoline engines, the Manifold Absolute Pressure sensor senses atmospheric pressure to produce an electrical signal. The frequency of this signal varies with intake manifold pressure. The MAP sensor sends this signal to the processor assembly. The processor assembly uses this signal to determine altitude. The processor then adjusts the E4OD shift schedule for the altitude (Figure 32).

On diesel engines, the Barometric Pressure sensor operates similar to the MAP sensor. It measures barometric pressure instead of intake manifold pressure. The transmission processor assembly uses the signal from the BP sensor to determine the altitude at which the vehicle is operating. The processor assembly then adjusts the E4OD shift schedule for the altitude.

Transmission function: Used as an input to determine shift schedule and EPC for altitude operation.

Symptoms: Firm shift feel, late shifts at high altitudes.

Fault Codes: 22, 72 (two digit), 126, 128, 129 (three digit).

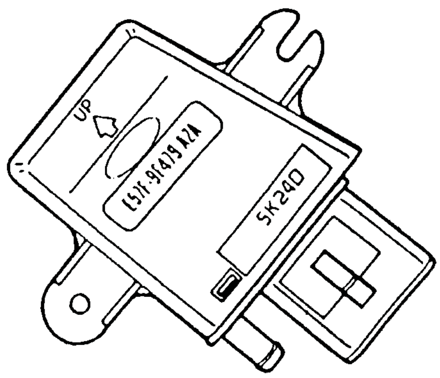


Figure 32

THROTTLE POSITION SENSOR (TPS) - GASOLINE ENGINES
FUEL INJECTION PUMP LEVER (FIPL) - DIESEL ENGINES

Description: On gasoline engines, the Throttle Position Sensor is a potentiometer mounted on the throttle body. The TPS detects the position of the throttle plate and sends this information to the processor assembly as a voltage signal (Figure 33).

On diesel engines, the Fuel Injection Pump Lever sensor is a potentiometer attached to the fuel injection pump. It is operated by the throttle lever and sends a voltage signal to the processor assembly. The processor can determine how much fuel is being delivered to the engine.

If a malfunction occurs in the TPS/FIPL circuit, the ECA processor recognize that the TPS/FIPL sensor signal is out of specification. The processor will then operate the E4OD transmission in a high capacity mode to prevent transmission damage. This high capacity mode causes harsh engagements, a signal or warning that transmission diagnosis is required.

Transmission function: Used as an input to determine shift scheduling and EPC.

Symptoms: Harsh engagements, firm shift feel, abnormal shift schedule, convertor clutch does not engage. Refer to page 28 for TPS & FIPL check.

Fault Codes: 23, 53, 63, 73 (two digit), 121, 122, 123, 167 three digit).

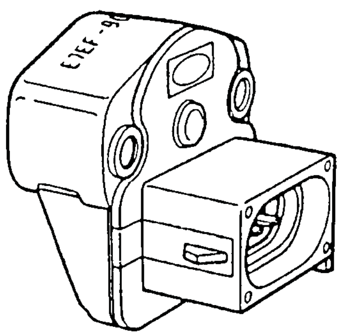


Figure 33

TRANSMISSION OPERATING TEMPERATURE SENSOR (TOT)

Description: The Transmission Operating Temperature sensor is located on the solenoid body in the transmission sump. It is a temperature-sensitive device called a thermistor. It sends a voltage signal to the processor assembly. The voltage signal varies with the transmission oil temperature. The processor uses this signal to determine whether a cold start shift schedule is necessary. The cold start shift schedule lowers shift speeds to allow for the reduced performance of cold engine operation (Figure 34).

Transmission function: Used as an input to determine shift schedule and EPC for temperature effects.

Symptoms: Convertor clutch and stabilized shift schedule happens too soon after cold start.

Fault Codes: 26, 56, 66 (two digit), 636, 637, 638 (three digit). Refer to page 42 for TOT check.

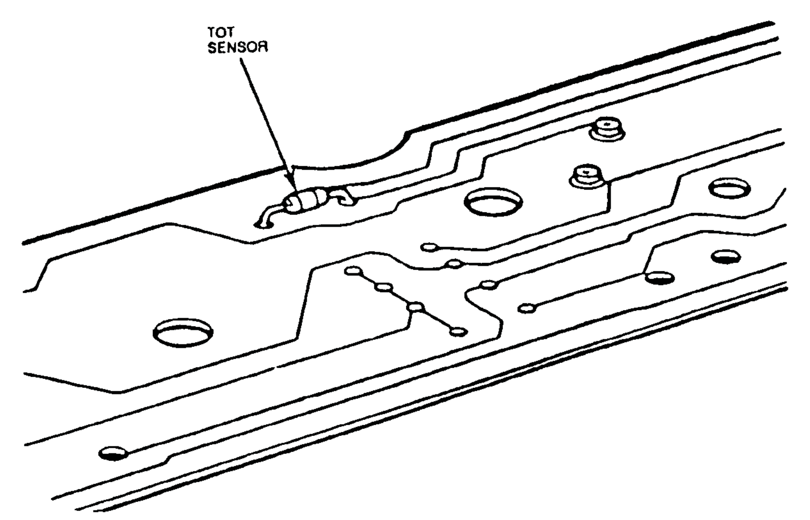


Figure 34

MANUAL LEVER POSITION SENSOR (MLPS)

Description: The Manual Lever Position Sensor sends a signal to the processor assembly. This indicates the position of the shift lever. The MLPS is located on the outside of the transmission at the manual lever (Figure 35).

Transmission function: Used as an input to determine the desired gear and EPC pressure.

Symptoms: Harsh engagements, firm shift feel.

Fault Codes: 67 (two digit), 634, 654 (three digit) (this code also displays if A/C is on during Self-Test or Self Test run in neutral). Refer to page 43 for MLPS check.

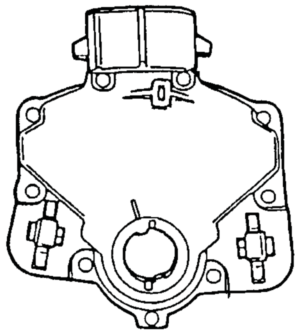


Figure 35

OVERDRIVE CANCEL SWITCH (OCS) and OVERDRIVE CANCEL INDICATOR LIGHT (OCIL)

Description: The Overdrive Cancel Switch is a momentary contact switch. When this switch is pressed, a signal is sent to the processor assembly. The processor then energizes the Overdrive Cancel Light and Solenoid 4, applying the coast clutch to provide engine braking and canceling fourth gear operation (Figure 36).

NOTE: The OCIL will also flash if the EPC circuit is shorted.

Sensor: Overdrive Cancel Switch (OCS).

Transmission function: Disable fourth gear operation.

Symptoms: No overdrive lockout when switch is cycled.

Fault Codes: 65 (two digit), 632 (three digit) (Key On Engine Running [KOER] test only).

Actuator: Overdrive Cancel Indicator Light (OCIL).

Transmission function: Indicates overdrive lockout mode (on) and EPC circuit failure (flashing).

Symptoms: Failed on - Overdrive lockout mode always indicated, no flashing for EPC circuit failure. Failed off - Overdrive lockout mode never indicated, no flashing for EPC circuit failure.

Fault Codes: 97 (two digit), 631 (three digit).

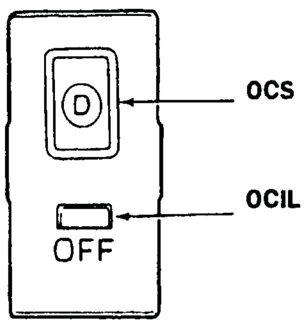


Figure 36

LOW RANGE SWITCH 4 X 4

Description: The low range switch is located on the transfer case assembly. It provides an indication of when the 4x4 transfer case gear system is in LOW range Figure 37.

Transmission function: Modifies shift schedule for 4x4L transfer case gear ratio.

Symptoms: Failed on - Early shift schedule in 4x2 and 4x4H. Failed off - Shifts delayed in 4x4L.

NOTE: If the 4x4 low indicator light fuse is blown, the transmission will shift according to 4x4 low shift schedule regardless of transfer case position.

Fault Codes: 47 (two digit), 633 (three digit).

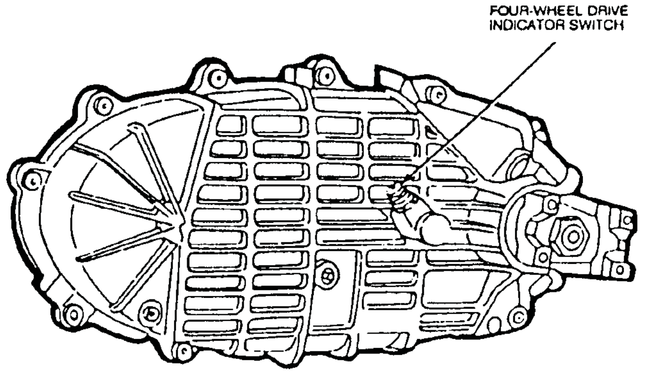


Figure 37

Once the ECA processor receives all the inputs as shown in figure 27, it then controls the E4OD transmission operation through the four on/off solenoids and one variable force solenoid (VFS). These solenoids and the TOT sensors are housed in the transmission solenoid body assembly (see figure 38).

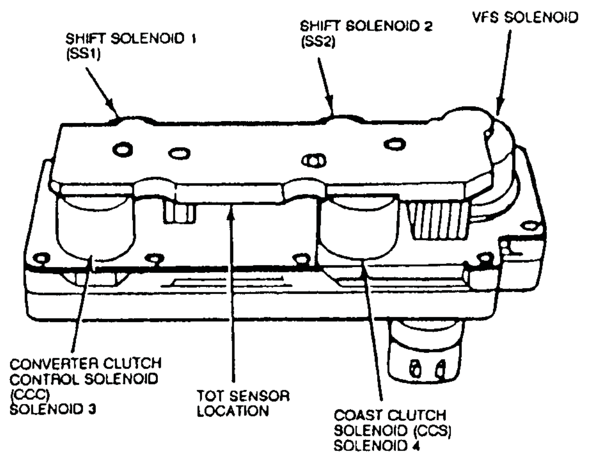


Figure 38

VARIABLE FORCE SOLENOID (VFS)

The Variable Force Solenoid is an electro-hydraulic actuator combining a solenoid and a regulating valve. It supplies Electronic Pressure Control (EPC) which regulates transmission line pressure. This is done by producing resisting forces to the main regulator circuit and the line modulator circuit. These two pressures control the clutch application pressures.

Transmission function: Regulates EPC pressure.

Symptoms: Failed on - Gasoline engines: minimum pressure (minimum transmission torque capacity). Limit engine torque (partial fuel shut-off, heavy misfire). Flashing OCIL.

Failed on - Diesel engine: cuts power to the VFS to produce maximum EPC pressure, harsh engagements and shifts, flashing OCIL.

Failed off - Gasoline and diesel engines: Maximum EPC pressure, harsh engagements and shifts.

Fault Codes: 98*, 99* (two digit) 998*, 624* (three digit). Refer to page 41 for VFS check.

SHIFT SOLENOIDS 1 AND 2

Shift solenoid 1 and 2 provide gear selection of first through fourth gears by controlling the pressure to the three shift valves.

Transmission function: Gear selection

Symptoms: Improper gear selection depending on failure mode and manual lever position.

Shift Solenoid 1 (SS1) Fault Codes: 91*, 49**, 69** (two digit), 621*, 617**, 618**, 619**, (three digit).

Shift Solenoid 2 (SS2) Fault Codes: 92*, 49**, 69** (two digit), 622*, 617**, 619** (three digit).

Refer to page 41 for shift solenoid check.

SOLENOID 3 (CCC)

Solenoid 3 provides torque converter clutch control by shifting the converter clutch control valve to apply or release the torque converter clutch.

Transmission function: Engages converter clutch.

Symptoms: Failed on - Engine stalls in drive at idle low speeds with brake applied or manual 2. Failed off - converter clutch never engages.

Fault Codes: 94*, 62** (two digit), 627*, 628** (three digit).Refer to page 41 for CCC check.

SOLENOID 4 (CCS)

Solenoid 4 provides coast clutch control by shifting the coast clutch shift valve. Solenoid 4 is activated by pressing the overdrive cancel switch or by selecting the 1 or 2 range with the transmission selector lever. In manual 1 and 2, the coast clutch is controlled by solenoid 4 and also hydraulically as a fail-safe to ensure engine breaking. In reverse, the coast clutch is controlled hydraulically and solenoid 4 is not on.

Transmission function: Engages coast clutch to provide engine braking in third gear when overdrive cancel is on.

Symptoms: Failed on - third gear engine braking with O/D range selected. Failed off - No third gear engine braking in overdrive cancel.

Fault Codes: 93* (two digit), 626* (three digit).Refer to page 41 for CCS check.

* Output circuit check, generated only by electrical condition.

** May also be generated by other non-electronic related transmission hardware condition.

*TPS (Gas)-FIPL (Diesel): 23, 53, 73, 121, 122, 123, 167.	PIP (Gas)-RPM (Diesel): 14, 211	MAP (Gas)-BP (Diesel): 22, 72, 126, 128, 129
ACC: 67, 539	BOO: 74, 536	OCS-OCIL: 65, 97, 631, 632
4x4 Low Switch: 47, 633	*VSS: 29, 452	*MLPS: 67, 634, 654
TOT: 26, 56, 66, 636, 637, 638	Transmission Solenoid Body: 91, 92, 93, 98, 99, 621, 622, 624, 625, 626, 627, 998, ** 49, 59, 62, 69, 617, 618, 619, 628	

* SENSORS THAT MAY NOT SET A CODE BUT CAN STILL CAUSE A TRANSMISSION CONCERN

** THESE CODES MAY BE CAUSED BY OTHER INTERNAL TRANSMISSION COMPONENTS SUCH AS VALVES, CLUTCHES,ETC..

SERVICE CODE OVERVIEW CHART

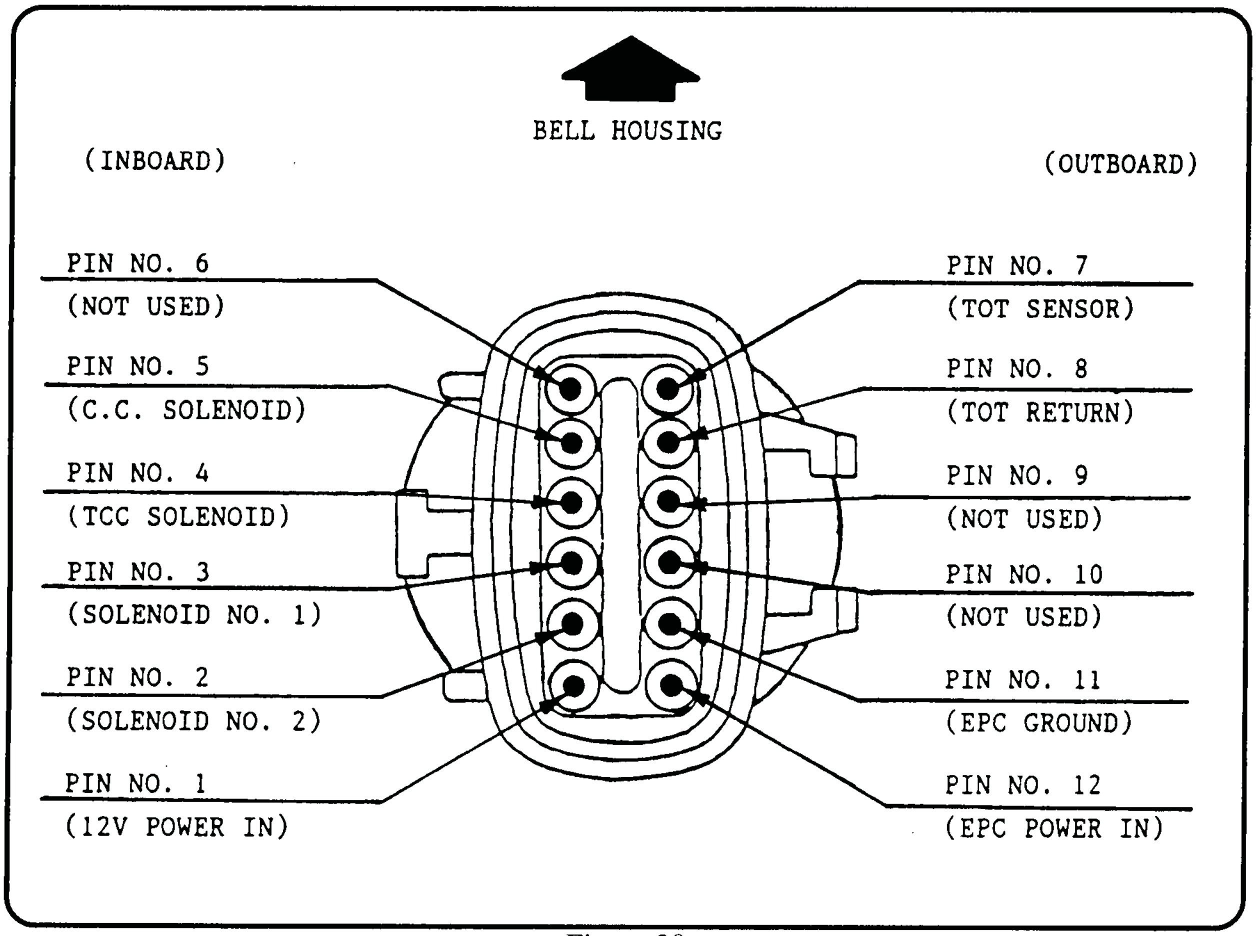


Figure 39

Using figure 39, resistance checks on all five of the solenoids can be done using a digital multimeter as follows:

SHIFT SOLENOID 1 - Connect the ohmmeter to pins 1 and 3. The resistance should be 20 - 30 ohms.

SHIFT SOLENOID 2 - Connect the ohmmeter to pins 1 and 2. The resistance should be 20 - 30 ohms.

COAST CLUTCH SOLENOID - Connect the ohmmeter to pins 1 and 5. The resistance should be 20 - 30 ohms.

TCC SOLENOID - Connect the ohmmeter to pins 1 and 4. The resistance should be 20 - 30 ohms.

VARIABLE FORCE SOLENOID - Connect the ohmmeter to pins 11 and 12. The resistance should be 4.25 - 6.50 ohms.

Shorts in the circuit board can be checked using figure 39 as follows:

1. Connect the ohmmeter between pin 1 and ground. There should be NO CONTINUITY.
2. Connect the ohmmeter between pin 2 and ground. There should be NO CONTINUITY.

3. Connect the ohmmeter between pin 3 and ground. There should be NO CONTINUITY.
4. Connect the ohmmeter between pin 4 and ground. There should be NO CONTINUITY.
5. Connect the ohmmeter between pin 5 and ground. There should be NO CONTINUITY.
6. Connect the ohmmeter between pin 11 and ground. There should be NO CONTINUITY.
7. Connect the ohmmeter between pin 12 and ground. There should be NO CONTINUITY.

Using figure 39 the Transmission Oil Temperature sensor (TOT) can be checked by connecting the ohmmeter between pins 7 and 8. Refer to the following chart for resistance readings:

32° F - 58° F	----	37K - 100K Ohms
59° F - 104° F	----	16K - 37K Ohms
105° F - 158° F	----	5K - 16K Ohms
159° F - 194° F	----	2.7K - 5K Ohms
195° F - 230° F	----	1.5K - 2.7K Ohms
231° F - 266° F	----	.8K - 1.5K Ohms

To evaluate whether an external problem exists or an internal problem exists, the transmission can be shifted with the aid of a test harness (part # T89T-7D100-A) and figure 39 using the following procedure:

1. Supply 12V through a fused (20 Amp) jumper wire to pin No. 1.
2. Ground only pin No. 3, = 1st Gear.
3. Ground pins 2 and 3, = 2nd Gear.
4. Ground only pin No. 2, = 3rd Gear.
5. Remove all grounds, = 4th Gear.
6. Anytime you are in a forward gear Ground pin No. 4, = Converter Clutch Apply

The Manual Lever Position Switch (MLPS) can also be checked using a digital multimeter to ensure that resistance is within proper specification. Refer to figure 40 for the MLPS pin identification and connect the ohmmeter leads to pins 2 and 3. The following resistance should be seen:

LEVER POSITION / RESISTANCE

P	3769 - 4608 OHMS
R	1303 - 1594 OHMS
N	660 - 807 OHMS
D	361 - 442 OHMS
2	190 - 232 OHMS
1	80 - 95 OHMS

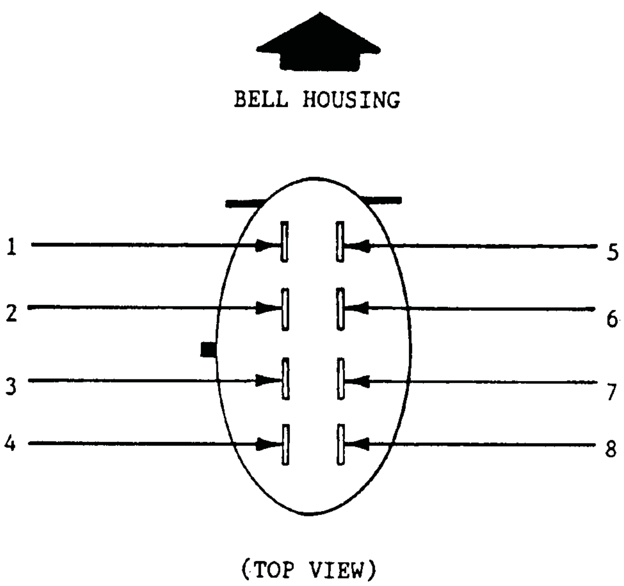
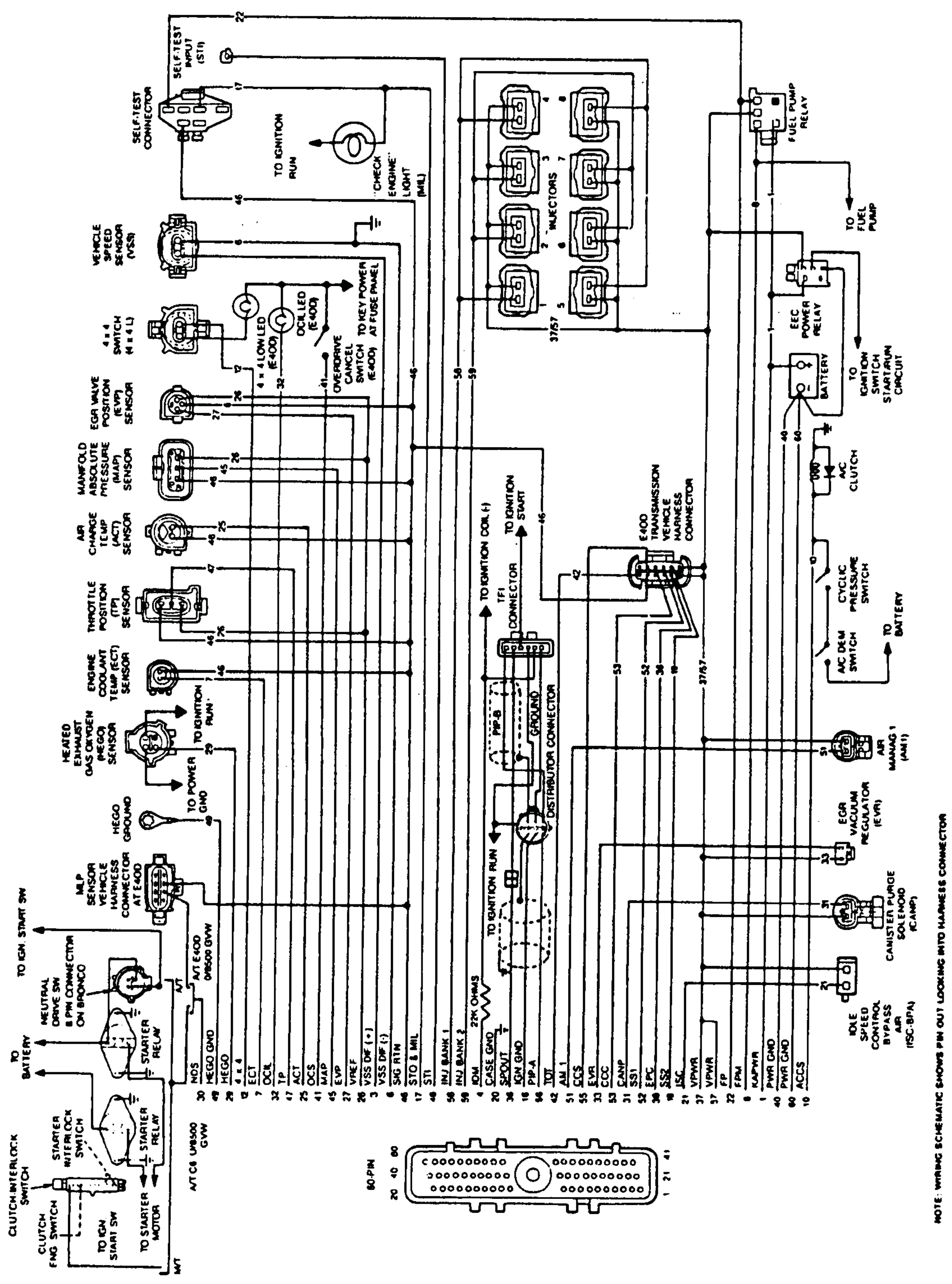


Figure 40

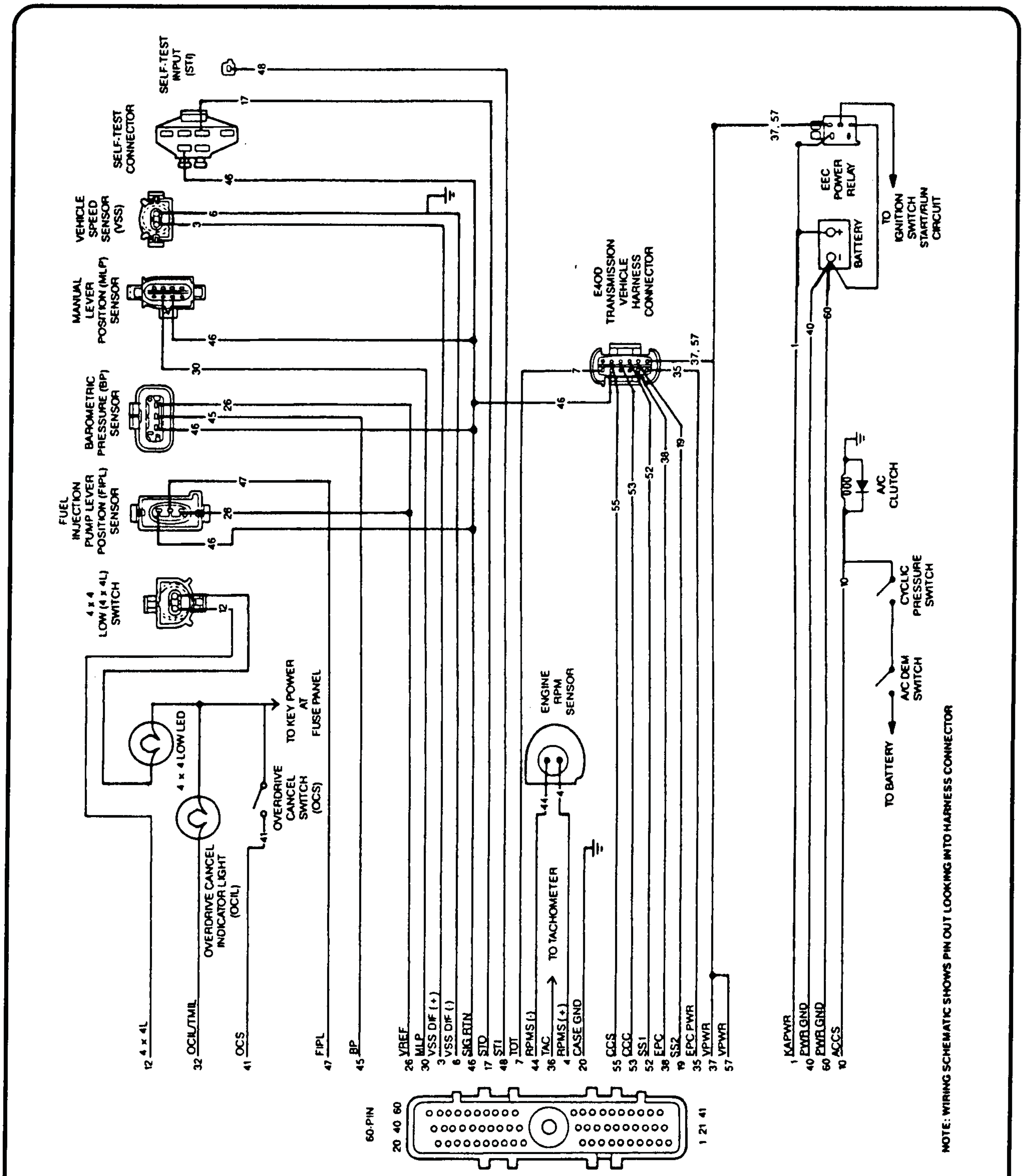
For further assistance to the technician in doing pin testing at the 60 way connector, figure 41 is a typical wiring schematic for gasoline engine vehicles. Figure 42 is a typical wiring schematic for diesel engine vehicles.

DOMESTIC COMPUTER CONTROL



"TYPICAL WIRING SCHEMATIC FOR GASOLINE ENGINES"

Figure 41



"TYPICAL WIRING SCHEMATIC FOR DIESEL ENGINES"

Figure 42

THE AODE ELECTRICAL DIAGNOSIS

The Ford AODE rear wheel drive computer controlled automatic transmission made its first appearance in the 1992 Lincoln Town Car. It is currently found in Crown Victoria and Mercury Marquis vehicles as well. Shift timing, shift feel (line pressure) and converter clutch control in the AODE are electronically controlled by the EEC-IV's ECA processor and its input/output network (see figure 43).

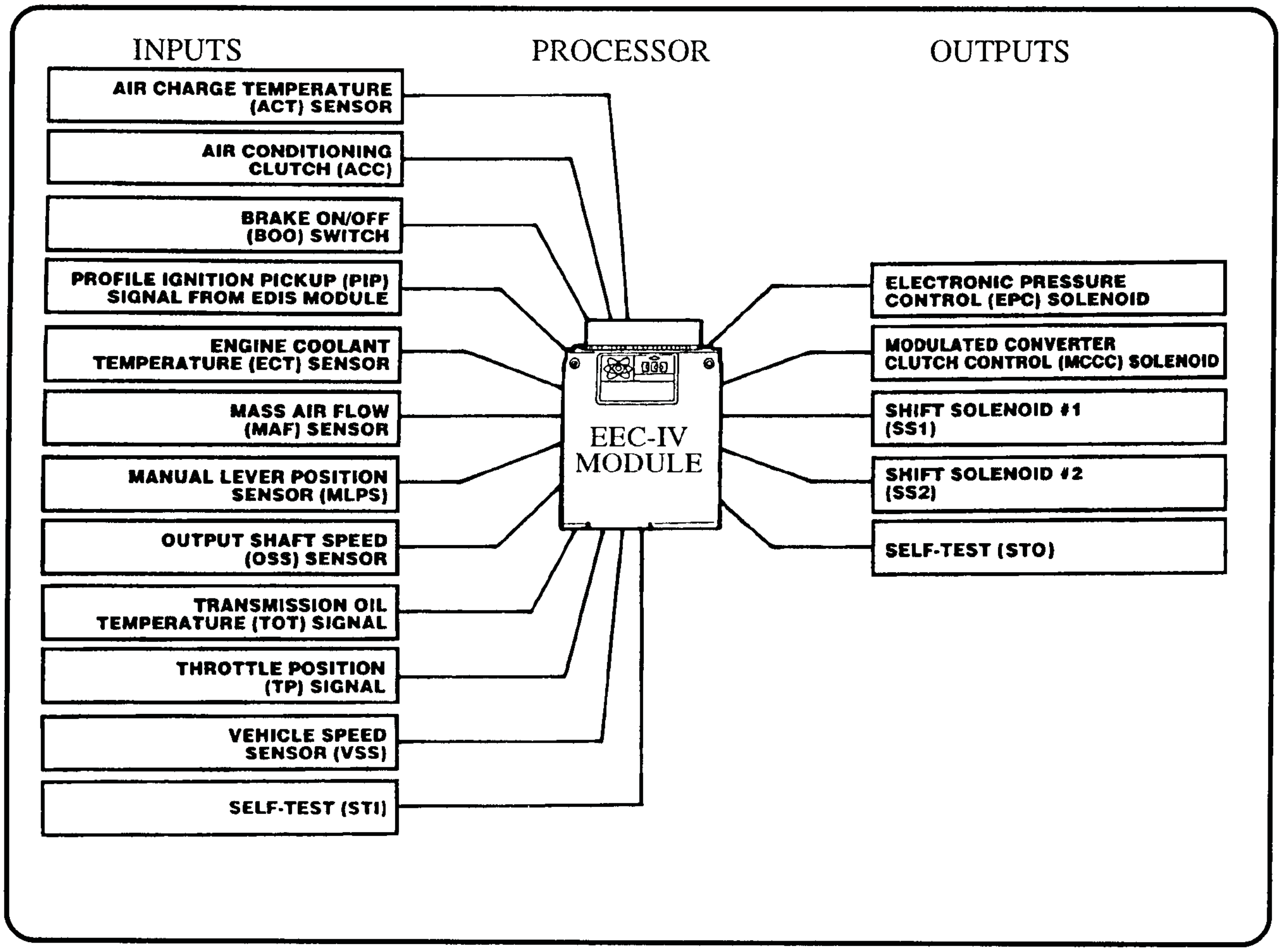


Figure 43

The ECA processor is not capable of putting the vehicle into a fail safe or a limp-in mode if it detects an electrical problem. It will however, cause the transmission to malfunction and store a fault code. Fault codes can be retrieved with use of a scanner and is highly recommended. If a scanner is not available, you can jump the diagnostic connector to blink the codes out on the check engine light. This method may be difficult because each of the fault codes are in three digits numbers. This makes reading the blinking light tricky. The diagnostic connector is located in the engine compartment, refer to page 24 and figure 18 for assistance in jumping the diagnostic connector. The following chart lists the fault codes that are transmission related only.

DOMESTIC COMPUTER CONTROLS

FAULT CODE	FAULT CODE IDENTIFICATION
111	NO FAULT DETECTED
511	EEC PROCESSOR READ ONLY MEMORY (ROM) TEST FAILED
512	EEC PROCESSOR KEEP ALIVE MEMORY (KAM) TEST FAILED
513	FAILURE IN EEC PROCESSOR INTERNAL VOLTAGE
452	VEHICLE SPEED SENSOR (VSS) CIRCUIT FAILURE
636	TRANSMISSION OIL TEMPERATURE (TOT) OUT OF SELF TEST RANGE
637	TOT INDICATED -40°C (140° F) OR CIRCUIT OPEN
638	TOT INDICATED 157°C (315° F) OR CIRCUIT GROUNDED
522	MANUAL LEVER POSITION SENSOR (MLPS) INDICATES VEHICLE IN GEAR
634	MLPS OUT OF RANGE
536	BRAKE ON/OFF SWITCH (BOO) CIRCUIT FAILURE
112	ACT INDICATE 125° C (254° F) OR CIRCUIT GROUNDED
113	ACT INDICATED -40° C (-40° F) OR CIRCUIT OPEN
114	ACT OUT OF SELF TEST RANGE
116	ENGINE COOLANT TEMPERATURE (ECT) OUT OF SELF TEST RANGE
117	ECT INDICATED 125° C (254° F) OR CIRCUIT GROUNDED
118	ECT INDICATED -40°C (-40° F) OR CIRCUIT OPEN
639	OUTPUT SHAFT SPEED SENSOR (OSS) CIRCUIT FAILURE
121	THROTTLE POSITION SENSOR (TPS) OUT OF SELF TEST RANGE
122	TPS BELOW MINIMUM VOLTAGE
123	TPS ABOVE MAXIMUM VOLTAGE
124	TPS OUTPUT HIGHER THAN EXPECTED
125	TPS OUTPUT LOWER THAN EXPECTED
167	INSUFFICIENT TPS CHANGE DURING DYNAMIC RESPONSE TEST
211	PROFILE IGNITION PICK UP (PIP) CIUCUIT FAILURE
212	IDM SIGNAL LOSS
213	SPOUT CIRCUIT OPEN
539	AIR CONDITIONING CLUTCH (ACC)
157 184 158 185 159	MASS AIR FLOW SENSOR (MAF)
519	POWER STEERING PRESSURE SWITCH (PSPS) CIRCUIT OPEN
521	PSPS - DID NOT ROTATE STEERING DURING TEST

FAULT CODE	FAULT CODE IDENTIFICATION
621*	SHIFT SOLENOID 1 (SS1) SHORTED OR OPEN CIRCUIT
645**	NO FIRST
646**	NO SECOND
647**	NO THIRD
648**	NO FOURTH
622*	SHIFT SOLENOID 2 (SS2) SHORTED OR OPEN CIRCUIT
645**	NO FIRST
646**	NO SECOND
641*	SHIFT SOLENOID 3 (SS3) SHORTED OR OPEN CIRCUIT
648**	NO FOURTH
628**	EXCESSIVE AMOUNT OF CONVERTER CLUTCH SLIPPAGE (MCCC)
629**	CONVERTER CLUTCH ENGAGED WHEN NOT SCHEDULED (MCCC)

* - Output circuit check, generated only by electrical conditions.

** - May also be generated by other non-electrical related transmission hardware condition.

A brief description of each non-transmission inputs and the symptoms they could produce if they malfunction are given following figure 44. Figure 44 provides a general location of these inputs.

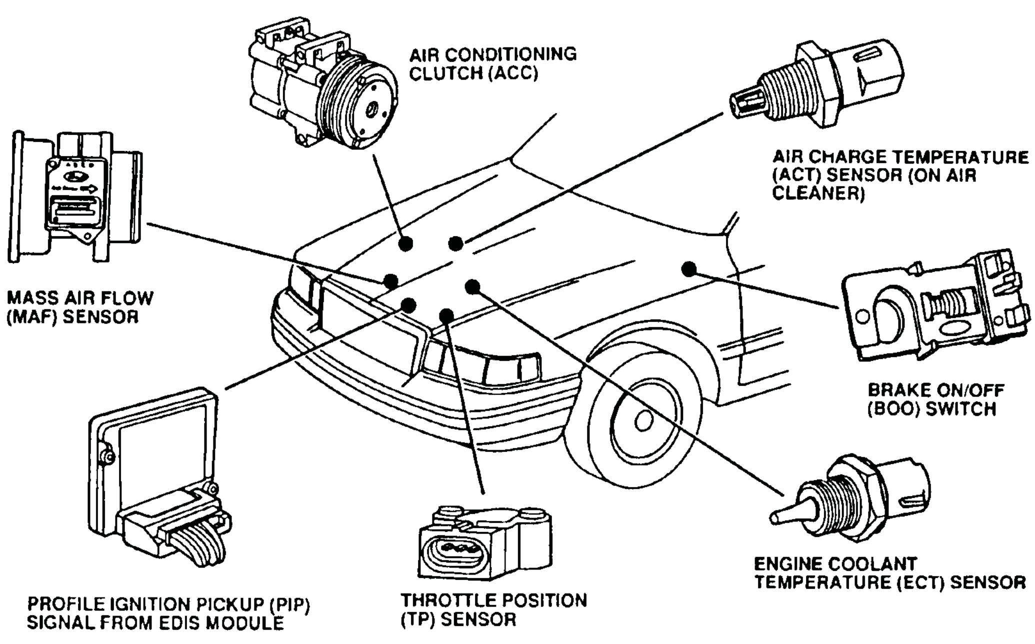


Figure 44

NON-TRANSMISSION INPUTS

Throttle Position Sensor - The TPS is a potentiometer mounted on the engine throttle body. This sensor uses a variable resistor to detect the throttle plate opening (accelerator pedal position), and sends this information to the processor as a varying voltage signal. When this malfunctions, harsh engagements, firm shift feel, abnormal shift schedule, convertor clutch does not engage, converter clutch cycling, no line rise can be some of the symptoms produced. Refer to page 28 for TPS check.

Mass Air Flow Sensor and Air Charge Temperature Sensor - The MAF sensor directly measures the mass of air flowing into the engine. The sensor output is a D. C. (analog) signal ranging from 0.5 volts to 5 volts used by the processor to calculate injector pulse width. For transmission strategies this sensor is used for EPC pressure control, shift and converter clutch scheduling. The ACT provides the electronic fuel injection system with fuel and air temperature information. Both of these sensors if they malfunctioned could cause high or low EPC pressure in the transmission. The MAF could also cause incorrect shift schedule, incorrect converter clutch engagement scheduling and symptoms similar to a TPS malfunction.

Electronic Distributorless Ignition System - The EDIS consists of a variable reluctance sensor (VRS), EDIS ignition module, two four coil packs and a processor assembly. The EDIS operates by sending crankshaft position information from the VRS to the EDIS module. The module generates a PIP signal (engine rpm) and sends it to the EEC-IV processor. The processor uses this rpm signal in the transmission strategy by controlling wide open throttle shift control, converter clutch control and EPC pressure. A malfunction can produce harsh engagements and shifts, late wide open shifts and no converter clutch engagement.

Engine Coolant Temperature Sensor - The ECT sensor is a thermistor that produces a voltage signal related to engine coolant temperature. The EEC-IV processor uses this information to determine if the engine is warm enough to allow for converter clutch application. If the temperature is too cold, the EEC-IV processor will keep the modulated converter clutch control (MCCC) solenoid turned off, preventing converter clutch application. If the sensor malfunctions, it could prevent converter clutch apply. Refer to page 25 for CTS check.

Air Conditioning Clutch - The EEC-IV processor receives a signal when the air conditioning compressor clutch is on. With the clutch on, the EEC-IV processor may adjust transmission EPC pressure to compensate for the change in torque supplied to the transmission. If it fails in an "on" state, the EPC pressure will be slightly low when the A/C is off. If it fails in an "off" state, the EPC pressure will be slightly high when the A/C is on.

Brake On/Off Switch - The BOO switch tells the EEC-IV processor whether the brakes are applied or not, to aid in converter clutch control. The switch is mounted on the brake pedal bracket and is normally open. When the brake pedal is applied, the switch is mechanically closed. If this switch fails in an "on" state, converter clutch will not engage at less than 1/3 throttle. If it fails in an "off" state or not connected, converter clutch will not disengage when the brake is applied. Refer to page 25 for BOO check.

A brief description of each of the transmission related inputs and the symptoms they could produce if they malfunction are given following figure 45. Figure 45 provides a general location of these inputs.

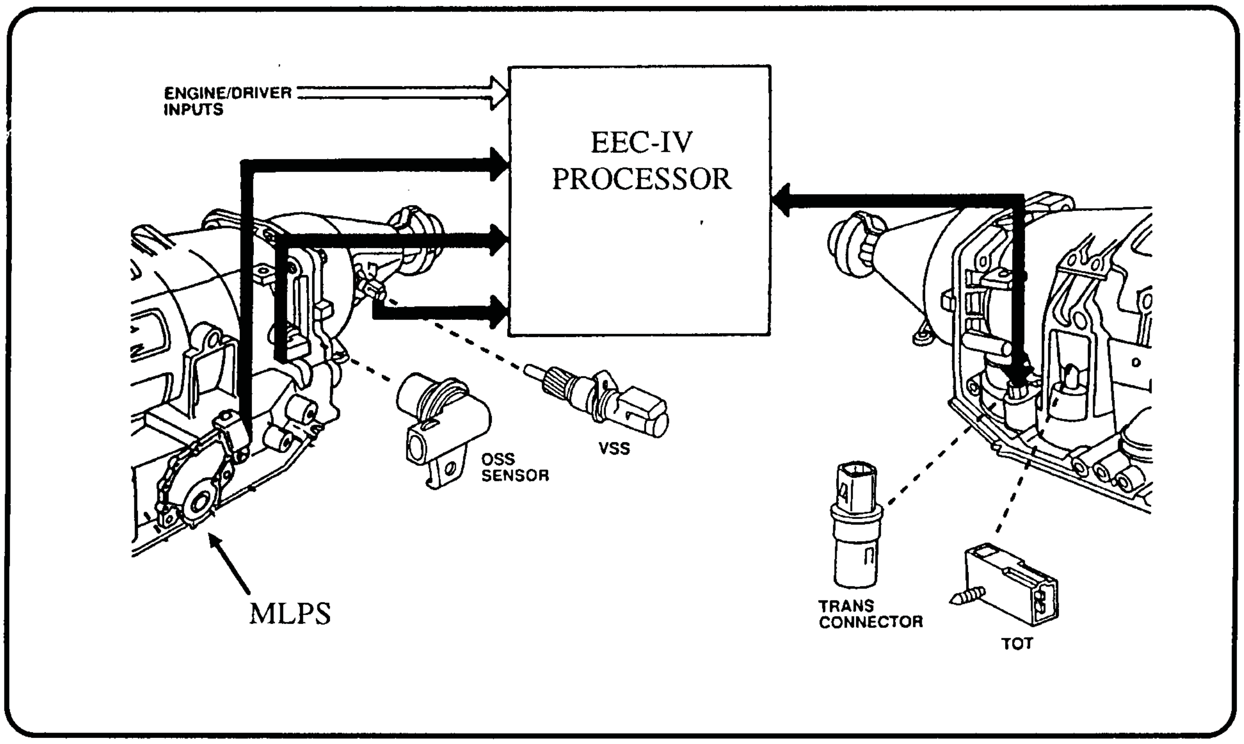


Figure 45

TRANSMISSION RELATED INPUTS

Manual Lever Position Sensor - The processor sends a voltage signal to the MLPS. The MLPS incorporates a series of step-down resistors which act as a voltage divider. The processor monitors this voltage which corresponds to the position of the manual lever (P, R, N, OD, D, 1). The MLPS is located on the outside of the transmission at the manual lever. If this sensor malfunctions, harsh engagements, firm shift feel, no crank in neutral, improper shifts could be some of the symptoms produced. Refer to page 54 for MLPS check.

Output Shaft Speed Sensor - The OSS sensor does electronically what the governor did hydraulically - that is, it tells the EEC-IV processor what the output speed of the transmission is. The OSS is a magnetic pickup. It sends a voltage signal to the EEC-IV processor that is proportional to output shaft ring gear rpm. The signal from this input is used for shift schedules, modulated converter clutch control and in determining EPC pressure. Harsh shifts, abnormal shift schedule, no converter clutch activation may occur if this sensor malfunctions. Refer to page 55 for OSS check.

Vehicle Speed Sensor - The VSS is a magnetic pickup mounted near the rear of the transmission and is driven through a small gear. It sends a voltage signal to the EEC-IV processor which is proportional to output shaft rpm. Its signal is used as an additional speed input to modify upshift scheduling only. (The OSS provides the main vehicle speed signal for transmission control). Converter clutch engages and shift busyness on grades could be symptoms of a bad VSS. Refer to page 55 for VSS check.

Transmission Oil Temperature Sensor - The TOT sensor is located on the transmission main control body. It is a temperature-sensitive device called a thermistor. The resistance value of the TOT will vary with temperature change. The processor monitors the voltage across the TOT to determine the temperature of the transmission. The EEC-IV processor uses the TOT sensor signal to determine if a "cold start" shift schedule is necessary. The shift schedule is compensated when the transmission fluid temperature is cold. The EEC-IV strategy will also prevent converter clutch engagement when the fluid is cold. If this sensor malfunctions, firm shifts, loss of converter clutch engagements may be some of the symptoms produced. Refer to pages 53 and 54 for TOT check.

When all of these inputs are operating correctly, the EEC-IV processor can then send the proper output signals to the solenoids for shift scheduling, shift feel and converter clutch engagement. There are three types of solenoids used as output devices in the AODE control system: a pulse-width modulated solenoid, on/off solenoids, and a variable force solenoid. A brief description of each solenoid is given and the symptoms they could produce if they malfunction.

OUTPUTS

Pulse-Width Modulated Solenoid - A PWM solenoid is used to control the apply and release of the torque converter clutch. A duty cycle signal controlled by the EEC-IV processor commands the PWM solenoid to allow an appropriate amount of pressure to flow to the converter clutch control valve. This provides for smoother clutch apply and release. This PWM solenoid is a normally closed solenoid and is referred to as the MODULATED CONVERTER CLUTCH CONTROL SOLENOID (MCCC). Erratic or no converter clutch apply, engine stalling in second gear (OD, D range) at low idle speeds with brake applied may occur if this solenoid malfunctions (see figure 46). Refer to page 53 for PWM check.

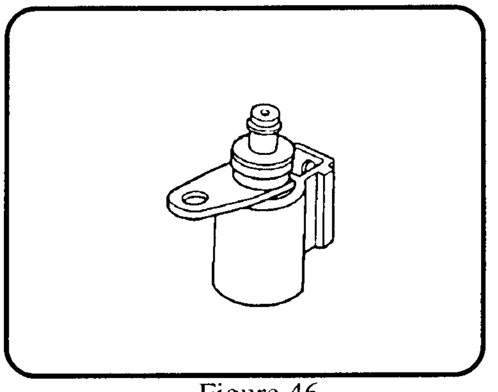


Figure 46

On/Off Solenoids - The two shift solenoids are simple on/off types used to either pressurize or exhaust fluid passages to the 1-2, 2-3 and 3-4 shift valves. They do not regulate the fluid that passes through, they can only turn the flow on or off. These two solenoids, called shift solenoid 1 (SS1) and shift solenoid 2 (SS2), are mounted in a single housing. These two solenoids are normally open to exhaust. When energized, they close to hold pressure. Improper gear selection and shift schedule may result with solenoid failure. Depending on which solenoid fails and what range the manual lever is in, improper shift scheduling may vary (see figure 47). Refer to page 53 for SS checks.

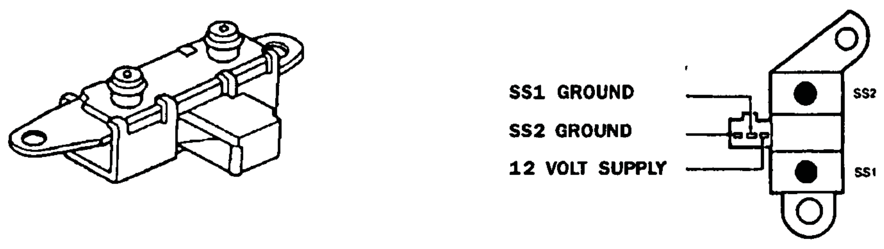


Figure 47

Variable Force Solenoid - A VFS solenoid is used to control shift feel by controlling line pressure. Based on the selective grounding action of the EEC-IV processor, the solenoid varies its output pressure. This VFS solenoid is referred to as the ELECTRONIC PRESSURE CONTROL SOLENOID (EPC). This sensor can fail and cause either high or low EPC pressure which can result in soft or harsh shifts (see figure 48). Refer to page 53 for EPC check.

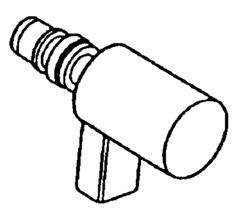


Figure 48

RESISTANCE CHECKS

Figure 49 is a view looking into the solenoid case connector at the terminals located on the right rear side of the case. The terminals are numbered for easy identification. Use the accompanying charts to perform a resistance check on each of the four solenoids and the TOT sensor with the use of a multimeter.

DOMESTIC COMPUTER CONTROLS

1992

ONLY

1993 may have the same pin configuration but the terminals may go to different solenoids

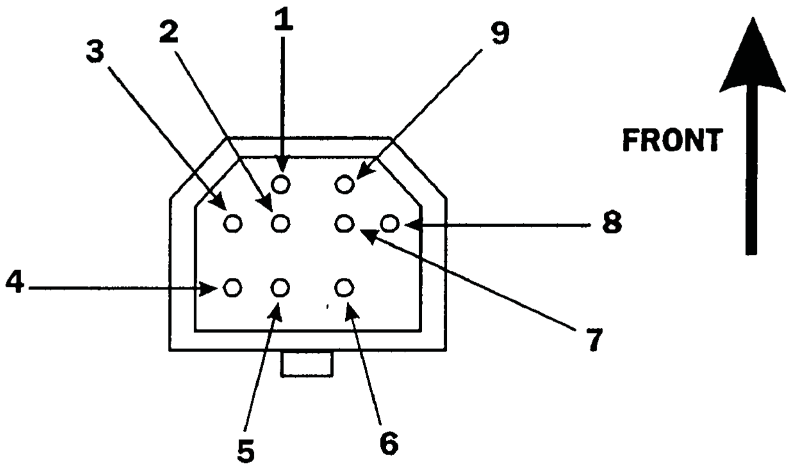


Figure 49

PIN #	IDENTIFICATION	INTERNAL WIRE COLOR	EXTERNAL WIRE COLOR	EEC-IV PIN #
1	TOT -	RED	GREY W/RED STRIPE	46
2	SS-2 GROUND SIGNAL	BLACK	PURPLE W/ORANGE STRIPE	52
3	TOT +	WHITE W/RED STRIPE	ORANGE W/BLACK STRIPE	49
4	SS-1 GROUND SIGNAL	WHITE	ORANGE W/YELLOW STRIPE	51
5	SS-1 AND SS-2 POWER SUPPLY	WHITE W/BLACK STRIPE	RED	37&57
6	MCCC GROUND SIGNAL	GREEN	TAN W/WHITE STRIPE	53
7	EPC POWER SUPPLY	WHITE W/BLUE STRIPE	RED	37&57
8	MCCC POWER SUPPLY	WHITE W/GREEN STRIPE	RED	37&57
9	EPC GROUND SIGNAL	BLUE	WHITE W/YELLOW STRIPE	38

TERMINAL IDENTIFICATION CHART

SOLENOID	PIN #	RESISTANCE
SS-1	4 & 5	20 - 30 OHMS
SS-2	2 & 5	20 - 30 OHMS
MCCC	6 & 8	1.0 - 3.0 OHMS
EPC	7 & 9	2.48 - 5.66 OHMS

SOLENOID RESISTANCE CHART

PIN #	°C	°F	RESISTANCE K OHMS
1 & 3	0-20	32-58	100K - 37K
	21-40	59-104	37K - 16K
	41-70	105-158	16K - 5K
	71-90	159-194	5K - 2.7K
	91-110	195-230	2.7K - 1.5K
	111-130	231-266	1.5K - 0.8K

TOT SENSOR CHART

The Manual Lever Position Switch (MLPS) can also be checked using a digital multimeter to ensure that resistance is within proper specification. Refer to figure 50 for the MLPS pin identification and connect ohmmeter leads to pins 2 and 3. The following resistance should be seen:

LEVER POSITION	RESISTANCE
P	3770 - 4607
R	1304 - 1593
N	660 - 807
OD	361 - 442
2/D	190 - 232
1	78 - 95

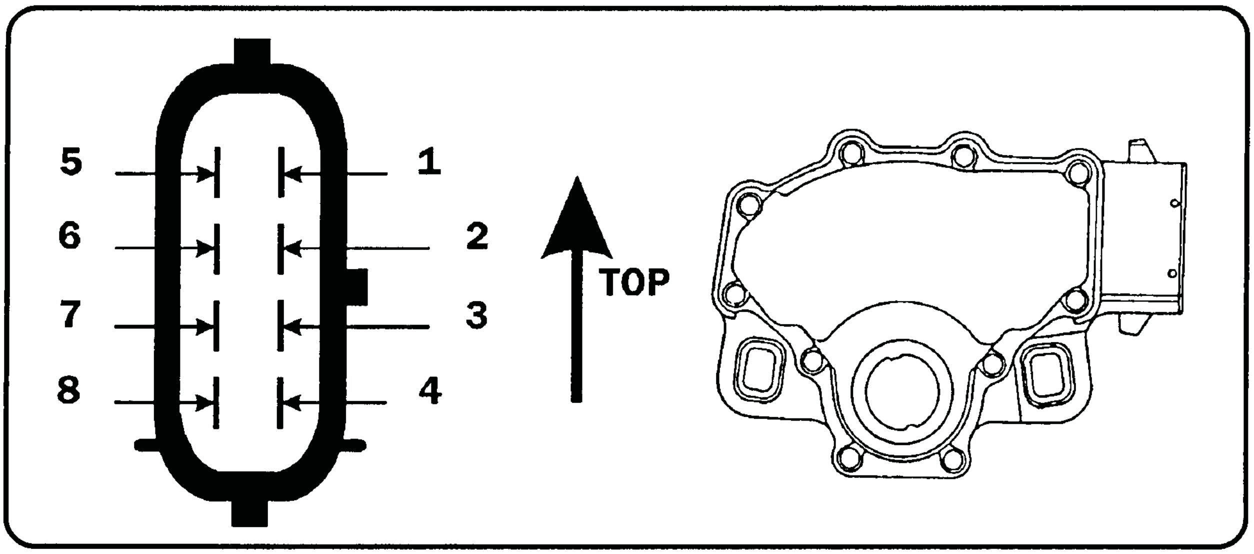


Figure 50

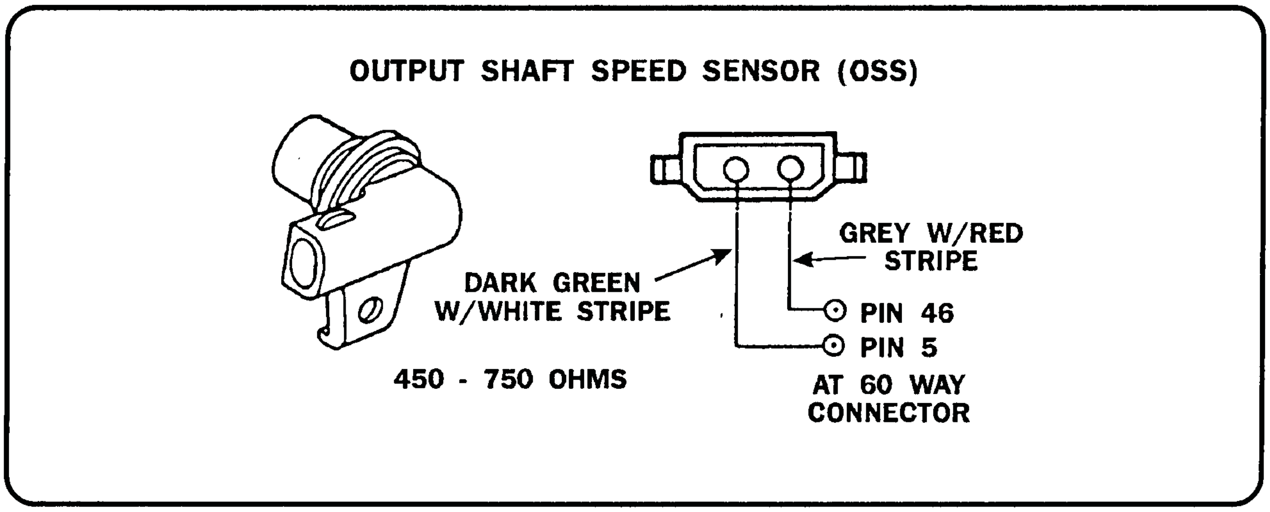


Figure 51

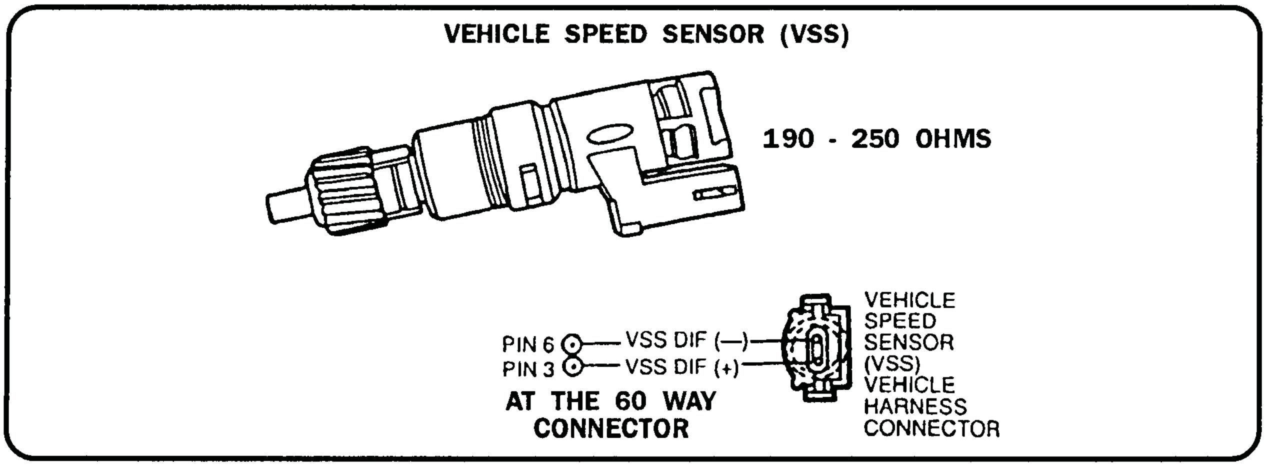


Figure 52

If the transmission is not shifting, a quick check can be made supplying your own electrical signal to the solenoids bypassing the computer. This way you can tell if the shift problem is computer or transmission related. Use figure 49 for terminal identification at the solenoid case connector and supply your own battery voltage to terminal # 5. Ground pins 2 and 4 in the following sequence:

1. 12V to pin 5
2. Ground pin 4 = 1st gear
3. Remove all grounds = 2nd gear
4. Ground pin 2 = 3rd gear
5. Ground pins 2 & 4 = 4th gear

For further aid to the technician, a general wiring schematic is provided in figure 53.

TYPICAL AODE WIRING SCHEMATIC

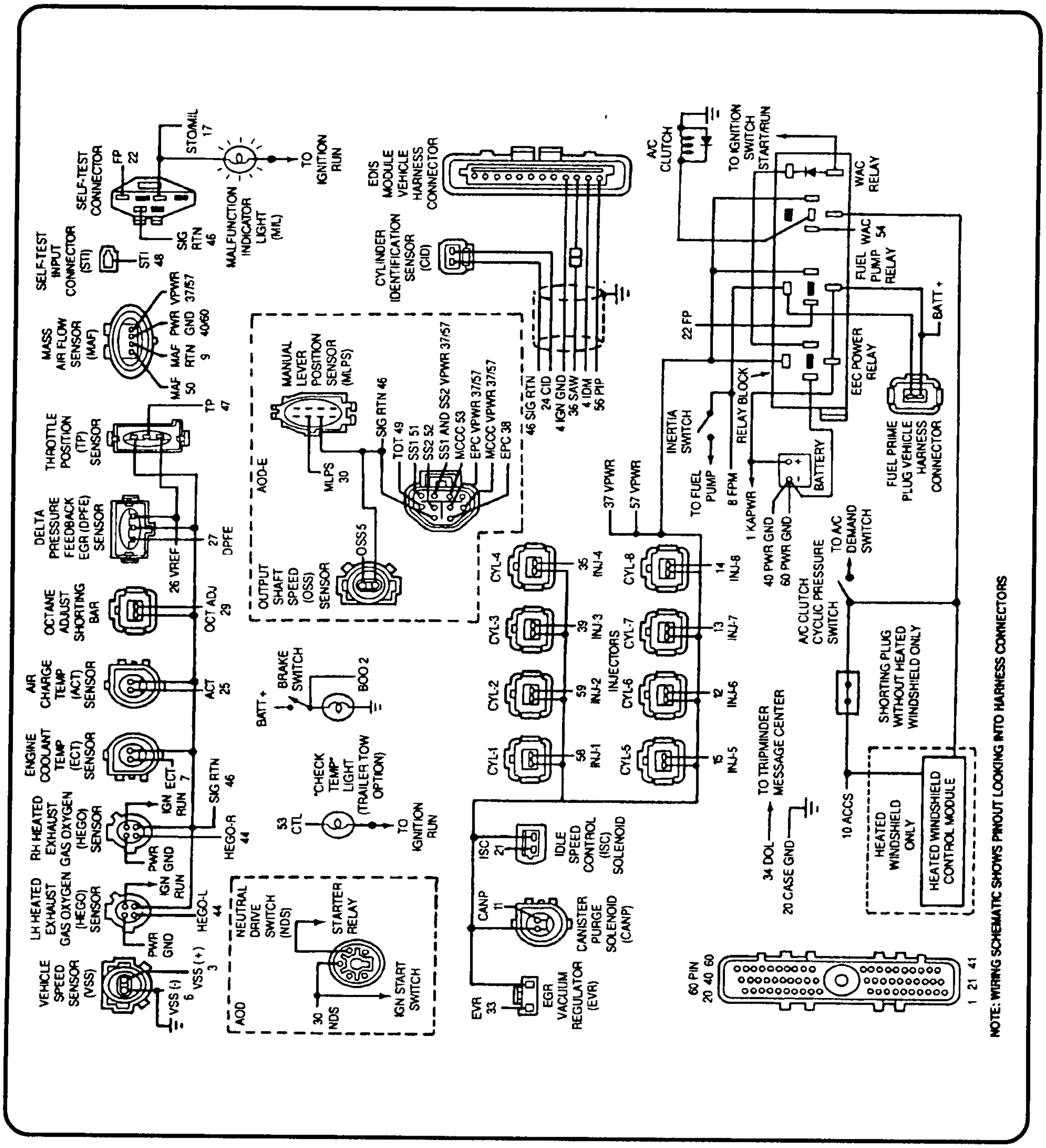


Figure 53

THE AXOD-E ELECTRICAL DIAGNOSIS

The Ford AXOD-E computer controlled automatic transaxle is currently found in 1991 and up Lincoln Continentals, Taurus's and Sables. The operation of the electrical system is controlled by the EEC-IV system. The EEC-IV's ECA (Electronic Control Assembly) receives information on both the engine and transaxle operation from the input components. The ECA processes this information and sends signals to operate the output components. Figure 54 shows the engine and transaxle inputs which the processor uses and the output components which ultimately control shift timing, shift feel (line pressure) and converter clutch engagement.

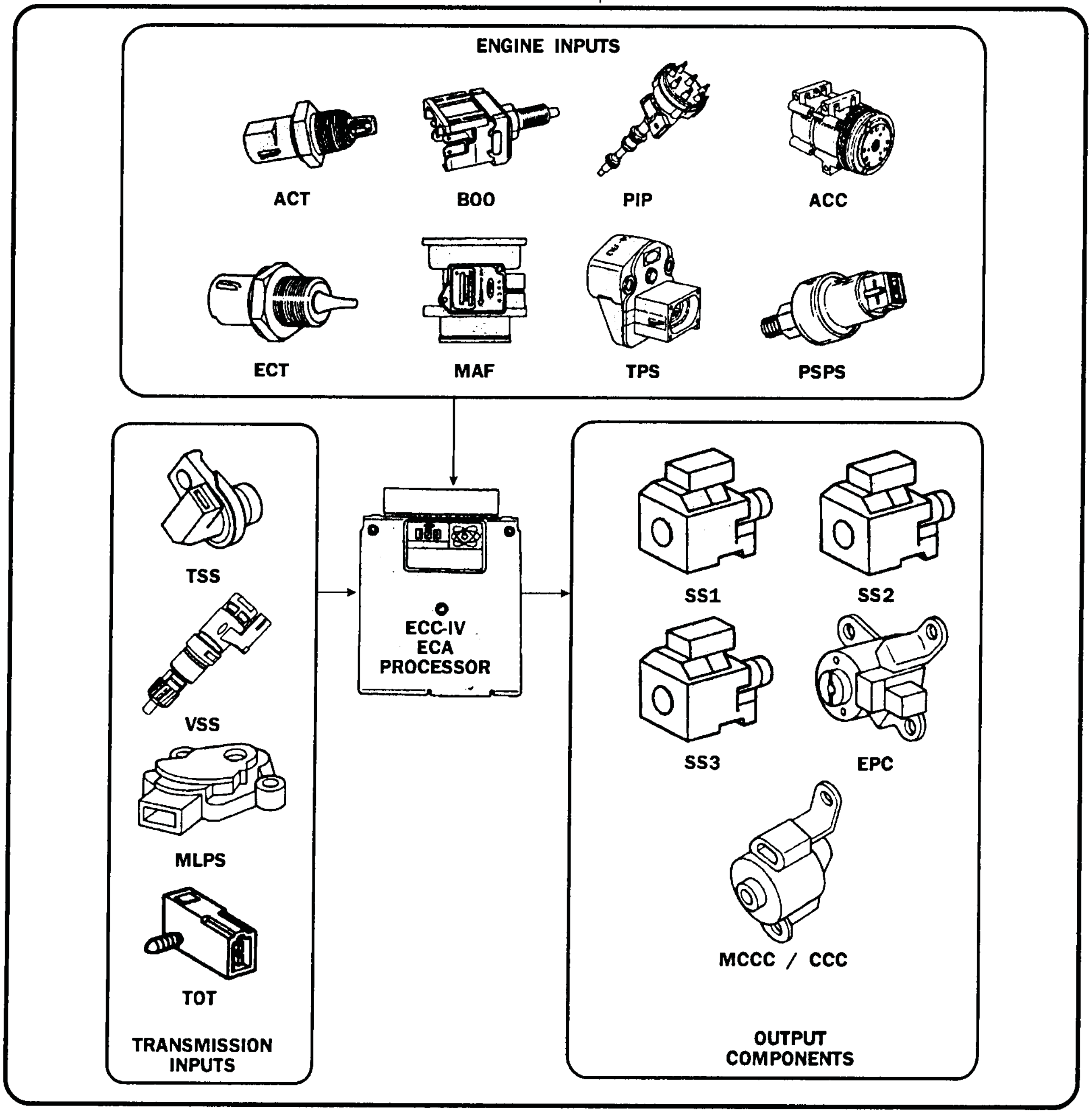


Figure 54

The ECA processor is not capable of putting the vehicle into a fail safe or a limp-in mode if it detects an electrical problem. It will however, cause the transmission to malfunction and store a fault code. Fault codes can be retrieved with use of a scanner and is highly recommended. If a scanner is not available, you can jump the diagnostic connector to blink the codes out on the check engine light. This method may be difficult because each of the fault codes are in three digits numbers. This makes reading the blinking light tricky. The diagnostic connector is located in the engine compartment, refer to page 24 and figure 18 for assistance in jumping the diagnostic connector. The following chart lists the fault codes that are transmission related only.

The following is a brief description of each of the non-transmission inputs (engine inputs) shown in figure 54, and the symptoms they could produce if they malfunction.

NON-TRANSMISSION INPUTS

Throttle Position Sensor - The TPS is a potentiometer mounted on the engine throttle body. This sensor uses a variable resistor to detect the throttle plate opening (accelerator pedal position), and sends this information to the processor as a varying voltage signal. When this malfunctions, harsh engagements, firm shift feel, abnormal shift schedule, convertor clutch does not engage, converter clutch cycling, no line rise can be some of the symptoms produced. Refer to page 28 for TPS check.

Mass Air Flow Sensor and Air Charge Temperature Sensor - The MAF sensor directly measures the mass of air flowing into the engine. The sensor output is a D. C. (analog) signal ranging from 0.5 volts to 5 volts used by the processor to calculate injector pulse width. For transmission strategies this sensor is used for EPC pressure control, shift and converter clutch scheduling. The ACT provides the electronic fuel injection system with fuel and air temperature information. Both of these sensors if they malfunctioned could cause high or low EPC pressure in the transmission. The MAF could also cause incorrect shift schedule, incorrect converter clutch engagement scheduling and symptoms similar to a TPS malfunction.

Profile Ignition Pulse - On gasoline engines, the PIP signal is produced by a Hall-Effect device in the distributor. It tells the processor assembly the engine rpm and crankshaft position. It uses this information for converter clutch control. If this sensor malfunctions, the result may be a no converter clutch engagement.

Power Steering Pressure Switch - The PSPS is used on certain applications to signal the ECA when the power steering pressure exceeds a specific limit. Then the ECA will adjust idle speed to compensate for this added load on the engine. For the transmission, this increase in engine RPM increases EPC pressure to the transmission. When this switch fails in an "on" state, EPC will be slightly high causing firm engagements, firm shifts and harsh coast down shifts. When this switch fails in an "off" state, EPC pressure will be slightly low during increased loading of the vehicle power steering.

FAULT CODE	FAULT CODE IDENTIFICATION
111	NO FAULT DETECTED
511	EEC PROCESSOR READ ONLY MEMORY (ROM) TEST FAILED
512	EEC PROCESSOR KEEP ALIVE MEMORY (KAM) TEST FAILED
513	FAILURE IN EEC PROCESSOR INTERNAL VOLTAGE
452	VEHICLE SPEED SENSOR (VSS) CIRCUIT FAILURE
636	TRANSMISSION OIL TEMPERATURE (TOT) OUT OF SELF TEST RANGE
637	TOT INDICATED -40°C (140° F) OR CIRCUIT OPEN
638	TOT INDICATED 157°C (315° F) OR CIRCUIT GROUNDED
522	MANUAL LEVER POSITION SENSOR (MLPS) INDICATES VEHICLE IN GEAR
634	MLPS OUT OF RANGE
536	BRAKE ON/OFF SWITCH (BOO) CIRCUIT FAILURE
112	ACT INDICATE 125° C (254° F) OR CIRCUIT GROUNDED
113	ACT INDICATED -40° C (-40° F) OR CIRCUIT OPEN
114	ACT OUT OF SELF TEST RANGE
116	ENGINE COOLANT TEMPERATURE (ECT) OUT OF SELF TEST RANGE
117	ECT INDICATED 125° C (254° F) OR CIRCUIT GROUNDED
118	ECT INDICATED -40°C (-40° F) OR CIRCUIT OPEN
639	OUTPUT SHAFT SPEED SENSOR (OSS) CIRCUIT FAILURE
121	THROTTLE POSITION SENSOR (TPS) OUT OF SELF TEST RANGE
122	TPS BELOW MINIMUM VOLTAGE
123	TPS ABOVE MAXIMUM VOLTAGE
124	TPS OUTPUT HIGHER THAN EXPECTED
125	TPS OUTPUT LOWER THAN EXPECTED
167	INSUFFICIENT TPS CHANGE DURING DYNAMIC RESPONSE TEST
211	PROFILE IGNITION PICK UP (PIP) CIUCUIT FAILURE
212	IDM SIGNAL LOSS
213	SPOUT CIRCUIT OPEN
539	AIR CONDITIONING CLUTCH (ACC)
157 184 158 185 159	MASS AIR FLOW SENSOR (MAF)
519	POWER STEERING PRESSURE SWITCH (PSPS) CIRCUIT OPEN
521	PSPS - DID NOT ROTATE STEERING DURING TEST

DOMESTIC COMPUTER CONTROLS

FAULT CODE	FAULT CODE IDENTIFICATION
621*	SHIFT SOLENOID 1 (SS1) SHORTED OR OPEN CIRCUIT
645**	NO FIRST
646**	NO SECOND
647**	NO THIRD
648**	NO FOURTH
622*	SHIFT SOLENOID 2 (SS2) SHORTED OR OPEN CIRCUIT
645**	NO FIRST
646**	NO SECOND
641*	SHIFT SOLENOID 3 (SS3) SHORTED OR OPEN CIRCUIT
648**	NO FOURTH
628**	EXCESSIVE AMOUNT OF CONVERTER CLUTCH SLIPPAGE (MCCC)
629**	CONVERTER CLUTCH ENGAGED WHEN NOT SCHEDULED (MCCC)
652*	MCCC SHORTED OR OPEN CIRCUIT
656**	EXCESSIVE SLIP ACROSS THE CONVERTER CLUTCH DETECTED (MCCC)
629*	CCC SHORTED OR OPEN CIRCUIT
998	FAILURE DETECTED IN ONE OR MORE CRITICAL INPUTS
624*	ELECTRONIC PRESSURE CONTROL (EPC) CIRCUIT FAILURE
625*	EPC DRIVER OPEN IN ECA

* - Output circuit check, generated only by electrical conditions.

** - May also be generated by other non-electrical related transmission hardware condition.

Engine Coolant Temperature Sensor - The ECT sensor is a thermistor that produces a voltage signal related to engine coolant temperature. The EEC-IV processor uses this information to determine if the engine is warm enough to allow for converter clutch application. If the temperature is too cold, the EEC-IV processor will keep the modulated converter clutch control (MCCC) solenoid turned off, preventing converter clutch application. If the sensor malfunctions, it could prevent converter clutch apply. Refer to page 25 for ECT check.

Air Conditioning Clutch - The EEC-IV processor receives a signal when the air conditioning compressor clutch is on. With the clutch on, the EEC-IV processor may adjust transmission EPC pressure to compensate for the change in torque supplied to the transmission. If it fails in an "on" state, the EPC pressure will be slightly low when the A/C is off. If it fails in an "off" state, the EPC pressure will be slightly high when the A/C is on.

Brake On/Off Switch - The BOO switch tells the EEC-IV processor whether the brakes are applied or not, to aid in converter clutch control. The switch is mounted on the brake pedal bracket and is normally open. When the brake pedal is applied, the switch is mechanically closed. If this switch fails in an "on" state, converter clutch will not engage at less than 1/3 throttle. If it fails in an "off" state or not connected, converter clutch will not disengage when the brake is applied. Refer to page 25 for BOO check.

A brief description of each of the transmission related inputs and the symptoms they could produce if they malfunction are given following figure 55. Figure 55 provides a general location of these inputs.

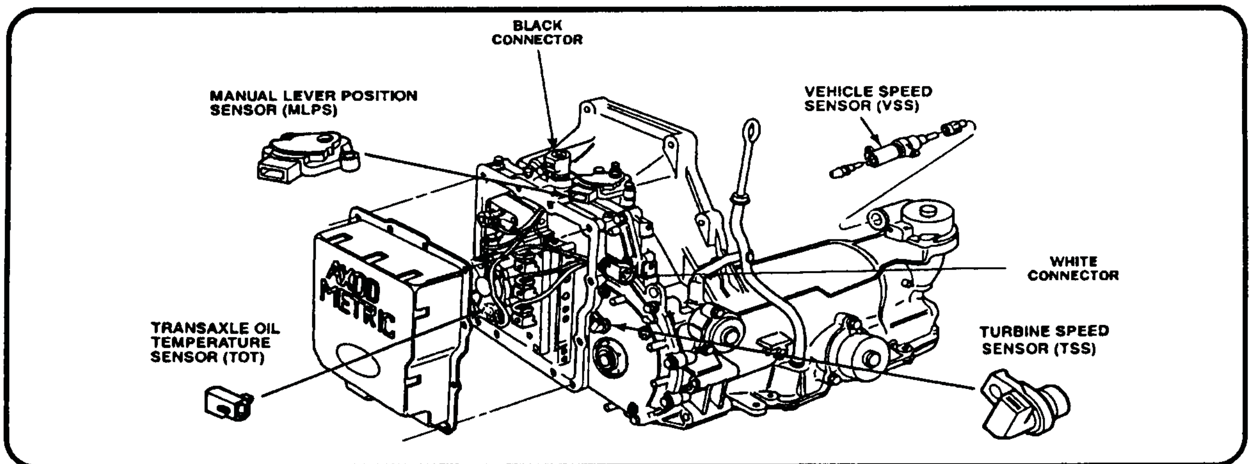


Figure 55

TRANSMISSION RELATED INPUT

Manual Lever Position Sensor - The processor sends a voltage signal to the MLPS. The MLPS incorporates a series of step-down resistors which act as a voltage divider. The processor monitors this voltage which corresponds to the position of the manual lever (P, R, N, OD, D, 1). The MLPS is located on the outside of the transmission at the manual lever. If this sensor malfunctions, harsh engagements, firm shift feel, no crank in neutral, improper shifts, no 3-4 shift and a sudden down shift to a lower gear could be some of the symptoms produced. Refer to page 68 for MLPS check.

Turbine Speed Sensor - A TSS is a magnetic pickup that sends a signal to the processor assembly that indicates transmission turbine shaft input speed. The processor uses this information for converter clutch control strategy and in determining static pressure settings. Increased engine RPM on engagements, harsh shifts (converter engaged), may be the result of a malfunctioning TSS. Refer to page 55 for TSS check.

Vehicle Speed Sensor - The VSS is a magnetic pickup which sends a voltage signal to the EEC-IV processor which is proportional to output shaft rpm (road speed). Harsh engagements, firm shift feel, abnormal shift schedule, unexpected downshifts may occur at closed throttle, and a loss of converter clutch may result with this sensor malfunctioning. Refer to page 55 for VSS check.

Transmission Oil Temperature Sensor - The TOT sensor is located on the transmission main control body. It is a temperature-sensitive device called a thermistor. The resistance value of the TOT will vary with temperature change. The processor monitors the voltage across the TOT to determine the temperature of the transmission. The EEC-IV processor uses the TOT sensor signal to determine if a "cold start" shift schedule is necessary. The shift schedule is compensated when the transmission fluid temperature is cold. The EEC-IV strategy will also prevent converter clutch engagement when the fluid is cold. If this sensor malfunctions, firm shifts, loss of converter clutch engagements may be some of the symptoms produced. Refer to page 64 for TOT check.

When all of these inputs are operating correctly, the EEC-IV ECA processor controls the AXOD-E through four on/off solenoids, and a electronic pressure control solenoid (EPC). Depending upon vehicle model, the on/off solenoid that controls the torque converter clutch may be a modulated (pulsed) solenoid. Following figure 56, a brief description of each solenoid is given and the symptoms they could produce if they malfunction. Figure 56 shows the output solenoid locations on the valve body assembly.

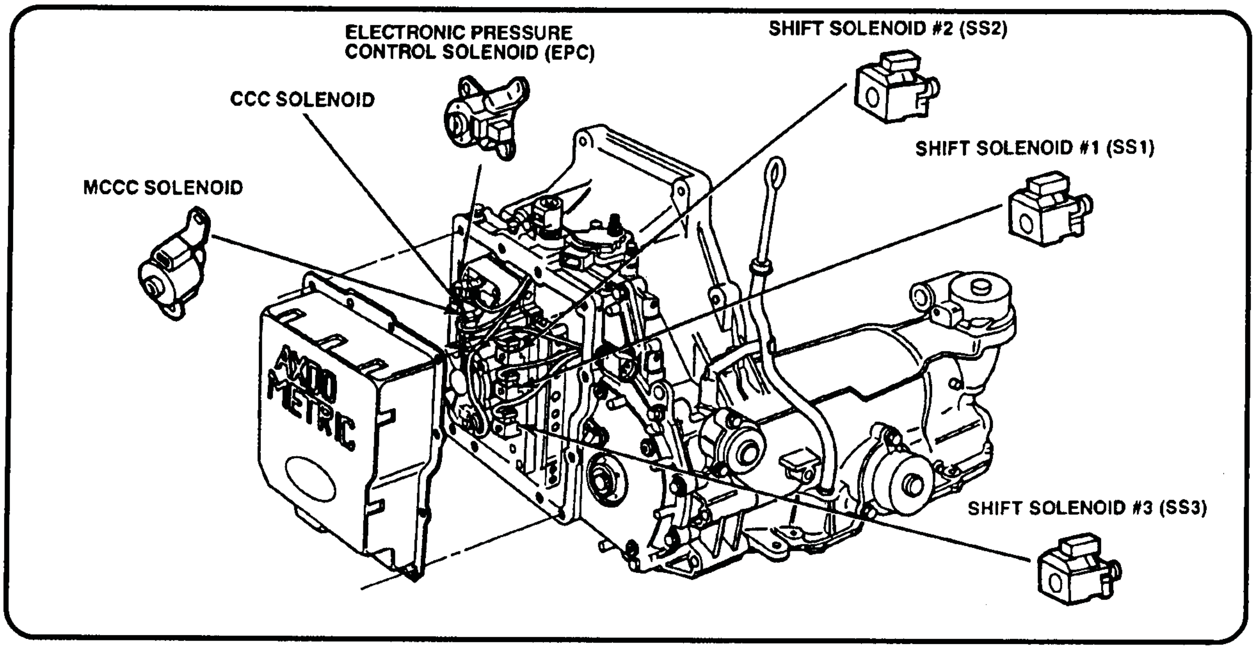


Figure 56

OUTPUTS

Converter Clutch Control Solenoid - This CCC solenoid is on Taurus and Sable vehicles, and is an on/off solenoid used in the transmission to control the application and release of the torque converter. When this normally open solenoid fails in an "on" state (closed), the engine will run rough due to converter shudder and/or, the engine stalls in drive at low idle speeds (2nd, 3rd, or 4th gear). When this solenoid fails in an "off" state (open), the converter clutch will not engage. Refer to page 64 for CCC check.

Modulated Converter Clutch Control Solenoid - This MCCC solenoid is currently found on Lincoln Continental vehicles only. This normally open solenoid is used to control the application, modulation and release of the torque converter clutch. The modulation of this solenoid provides a smooth engagement and release of the converter clutch. When this solenoid fails in an "on" (closed) state, the engine runs rough due to converter shudder and/or, the engine stalls in drive at low idle speeds (2nd, 3rd, or 4th gear). When this solenoid fails in an "off" (open) state, the converter clutch will not engage. Refer to page 64 for MCCC check.

Electronic Pressure Control Solenoid - The EPC solenoid receives a varying amount of current from the ECA. With no current applied, spring pressure holds the internal spool valve out, and maximum line pressure (feed pressure) flows out of the valve (output pressure). As the ECA applies more current to the solenoid, the spool valve is drawn in against spring tension. This opens the feed pressure to an exhaust passage, and the output pressure is reduced accordingly. A pressure fail safe valve in the valve body prevents a low line pressure condition in the event the EPC solenoid is stuck in the "on" position. If this solenoid failed in the "on" state, failsafe EPC pressure will be approximately 120 psi causing harsh engagements and shifts. If the solenoid fails in the "off" state, maximum EPC pressure (approximately 90 psi) will be exhibited causing harsh engagements and shifts. Refer to page 64 for EPC check.

Shift Solenoid Assemblies (SS1, SS2, SS3) - All three of these shift solenoids are normally open to exhaust and close when voltage is applied. These solenoids SS1, SS2, and SS3 provide gear selection of 1st through 4th by controlling the pressure of the three shift valves and the foward clutch control valve. Refer to page 64 for SS check.

<u>SS1 Symptoms</u>

If SS1 failed in the "on" (closed) state, the vehicle would have 2nd and 4th gear only. If it failed in the "off" (open) state, the vehicle would have 1st and 3rd gear only.

<u>SS2 Symptoms</u>

If SS2 failed in the "on" (closed) state, the vehicle would have 1st and 2nd gear only. If it failed in the "off" (open) state, the vehicle would have no 1st gear.

SS3 Symptoms

If SS3 failed in the "on" (closed) state, the vehicle will display harsh coast down shifts. If it failed in the "off" (open) state, the vehicle would have no 4th gear.

The 1991 to 1992 AXOD-E transaxle has two case connectors. A white connector on the side of the case and a black connector on the top of the case. The white connector contains 6 pins for the three shift solenoids. The black connector contains 6 pins which are for the EPC solenoid, CCC or MCCC solenoid and the TOT sensor (see figure 57). The 1993 models use only one case connector at the top of the transaxle with 9 pins in it for all the solenoids and TOT sensor (see figures 57A and 57B). Figure 57 identifies the 1991 to 1992 case connectors with each pin numbered and identified. Figure 57B on page 68 identifies each pin in the single case connector found in 1993 models. The chart below is provided for doing resistance checks on all the solenoids and TOT sensor. Following figure 57 is a chart for shifting the transaxle separate from the computer.

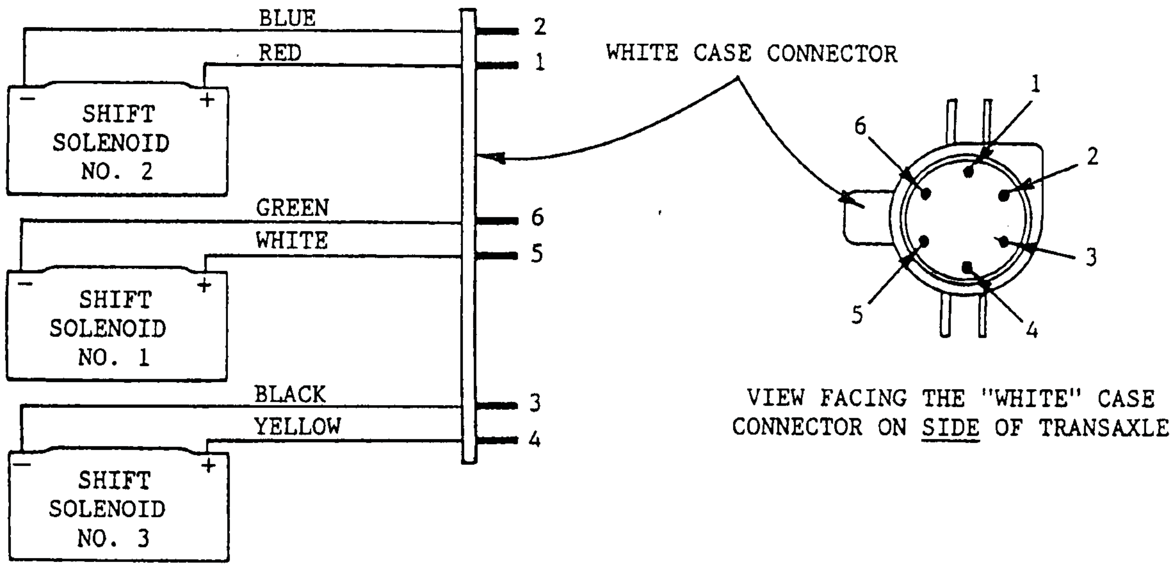
SOLENOID RESISTANCE CHECK

SOLENOID	CONNECTOR	PIN # (91-92)	PIN #(1993)	RESISTANCE
EPC	Black	1 & 6	1 & 2	2.5 - 6.5 ohms
MCCC	Black	4 & 5	2 & 4	.75 - 2.0 ohms
CCC	Black	4 & 5	2 & 4	16 - 40 ohms
S1	White	5 & 6	5 & 6	12 - 30 ohms
SS2	White	1 & 2	5 & 8	12 - 30 ohms
SS3	White	3 & 4	5 & 3	12 - 30 ohms

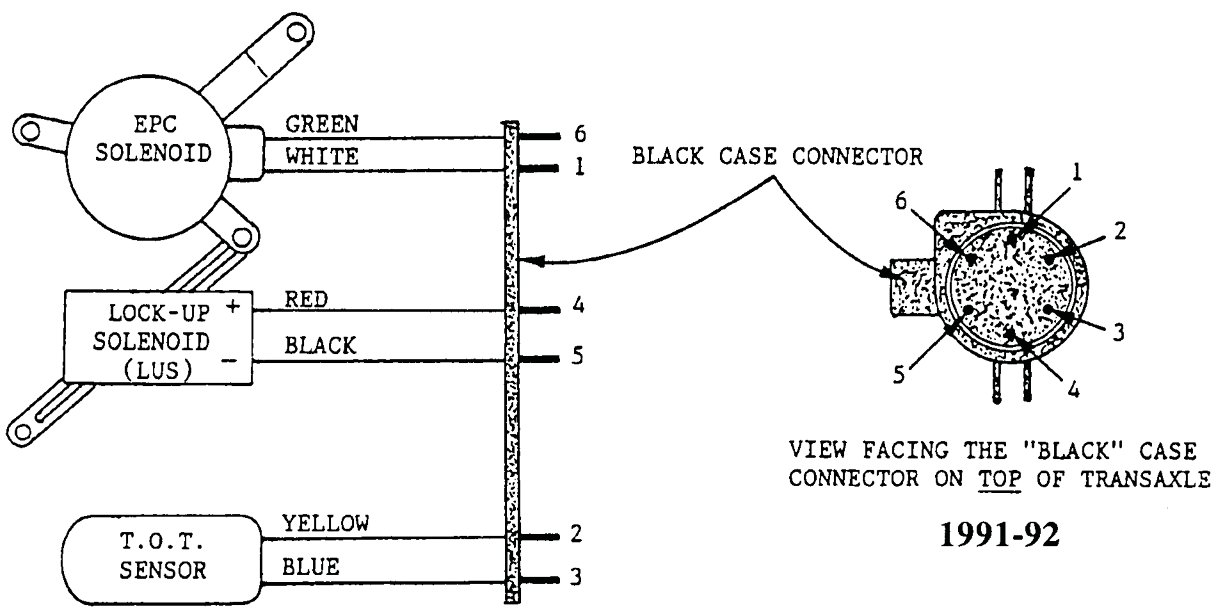
TOT SENSOR RESISTANCE CHECK

CONNECTOR	PIN #	DEGREES C	DEGREES F	RESISTANCE
BLACK	2 & 3	0-20	32-58	33.5k-107k
PIN # FOR 1993	7 & 9	21-40	59-104	14.5k-33.5k
		41-70	105-158	5.0k-14.5k
		71-90	159-194	2.5k-5.0k
		91-110	195-230	1.5k-2.5k
		111-130	231-266	0.8k-1.5k

AXOD-E CASE CONNECTOR IDENTIFICATION



THE AXOD-E TRANSAXLE HAS 2 CASE CONNECTORS, 1 WHITE ONE ON THE SIDE OF TRANSAXLE, AND 1 BLACK ONE ON THE TOP OF TRANSAXLE.



1991-92

Figure 57

Shifting the 1991-1992 transaxle seperate from the computer is best done with a transmission tester. However, the following method can be performed by supplying your own 12 volt supply and grounds.

Supply 12 volts to pins 1,4, and 6 at the white case connector. refer to the chart below for proper ground sequence.

GROUND PIN #2	= FIRST GEAR
GROUND PINS # 2&6	= SECOND GEAR
GROUND PIN #3	= THIRD GEAR
GROUND PINS #3&6	= FOURTH GEAR

1993 AXOD-E (Figure 57A & 57B) incorporated both case connectors into one. This new chain cover and wiring harness retro-fits back to 1991 and 1992 vehicles. You may get a 1991 or 1992 vehicle in your shop with this style connector since FORD recommends this service to dealership. Below are part numbers for the kit which costs approximately $180.00. Also there is individual part numbers for service on individual kit components.

KIT PART NUMBER F1DZ-76188-B

KIT CONTENTS

CHAIN COVER ASSEMBLY	F3DP-76188-DA
INTERNAL HARNESS AND CONNECTOR	F1DZ-76276-C
JUMPER HARNESS	FIDZ-7Z432-A
TIE WRAP	95873-S
INSTRUCTION SHEET	1.S. 6361A

Using figure 57B the 1993 shift pattern is accomplished as follows:
SUPPLY 12 VOLTS TO PIN 5:

GROUND PIN #8	=FIRST GEAR
GROUND PIN #6&8	=SECOND GEAR
GROUND PIN #3	=THIRD GEAR
GROUND PIN #3&6	=FOURTH GEAR

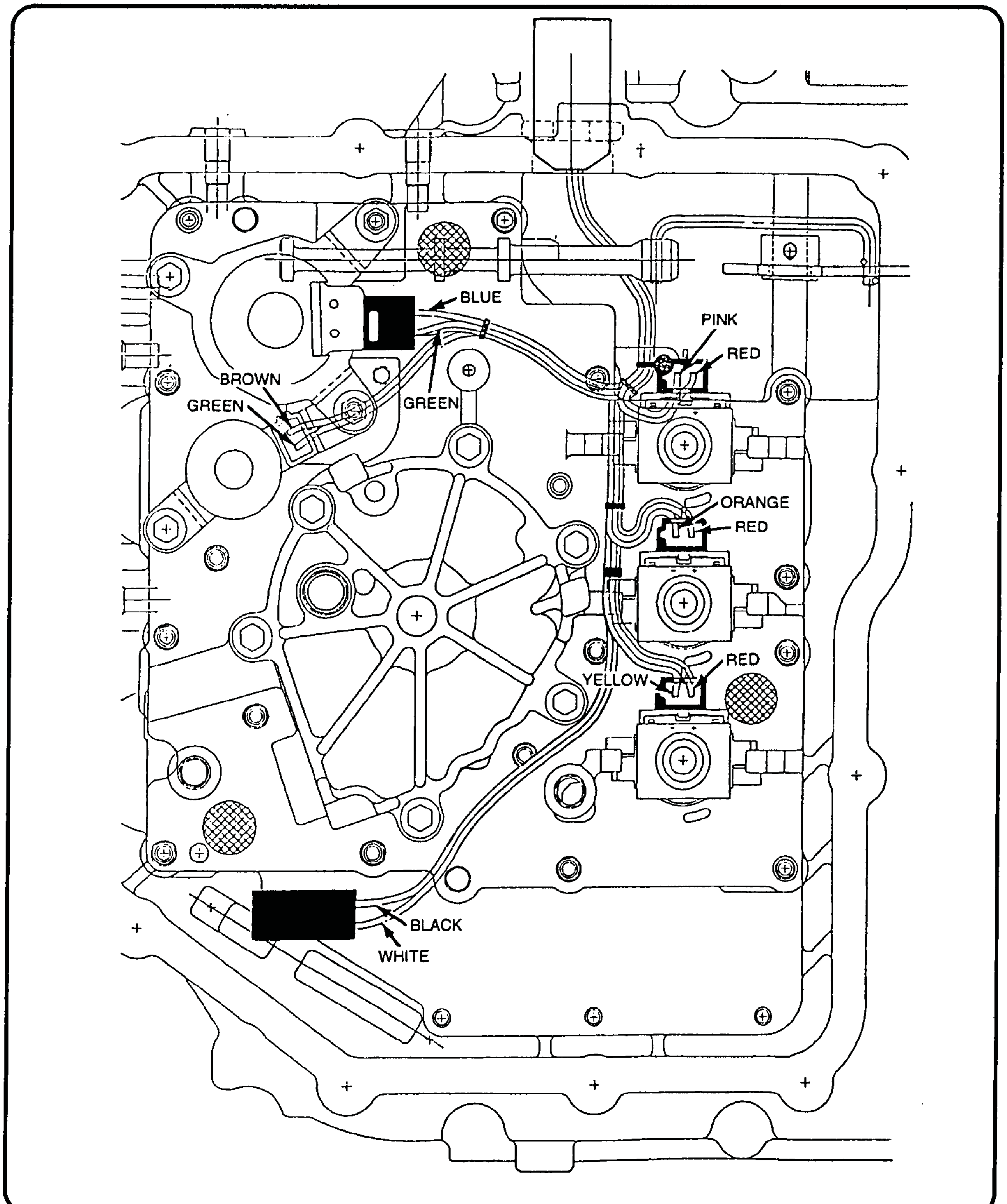
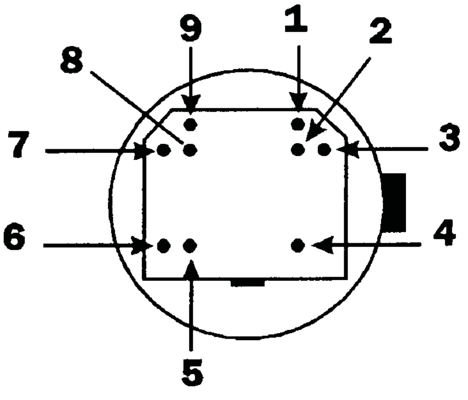


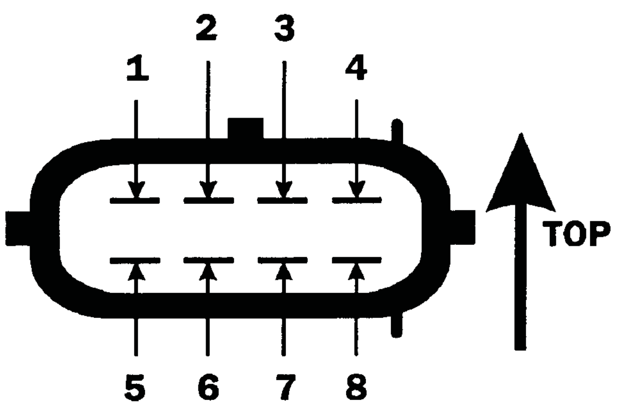
Figure 57A 1993 Wire Harness View



1 EPC GROUND (BLUE)
2 EPC/MCCC POWER (GREEN)
3 SS3 GROUND (YELLOW)
4 MCCC GROUND (BROWN)
5 SS1,2,3 POWER (RED)
6 SS1 GROUND (ORANGE)
7 TOT - (BLACK)
8 SS2 GROUND (PINK)
9 TOT + (WHITE)

FIGURE 57B 1993 AXODE CASE CONNECTOR VIEW

Check across pins 2 and 3 as shown in figure 58 to check the MLPS for proper resistance.



SELECTOR POSITION	RESISTANCE
P	3770 - 4607
R	1304 - 1593
N	660 - 807
OD	361 - 442
D	190 - 232
1	78 - 95

Figure 58

For further assistance to the technician a typical wire schematic is provided in figure 59a for Taurus & Sable and figure 59b for Continental.

DOMESTIC COMPUTER CONTROL

TYPICAL AXOD-E TAURUS / SABLE WIRING SCHEMATIC

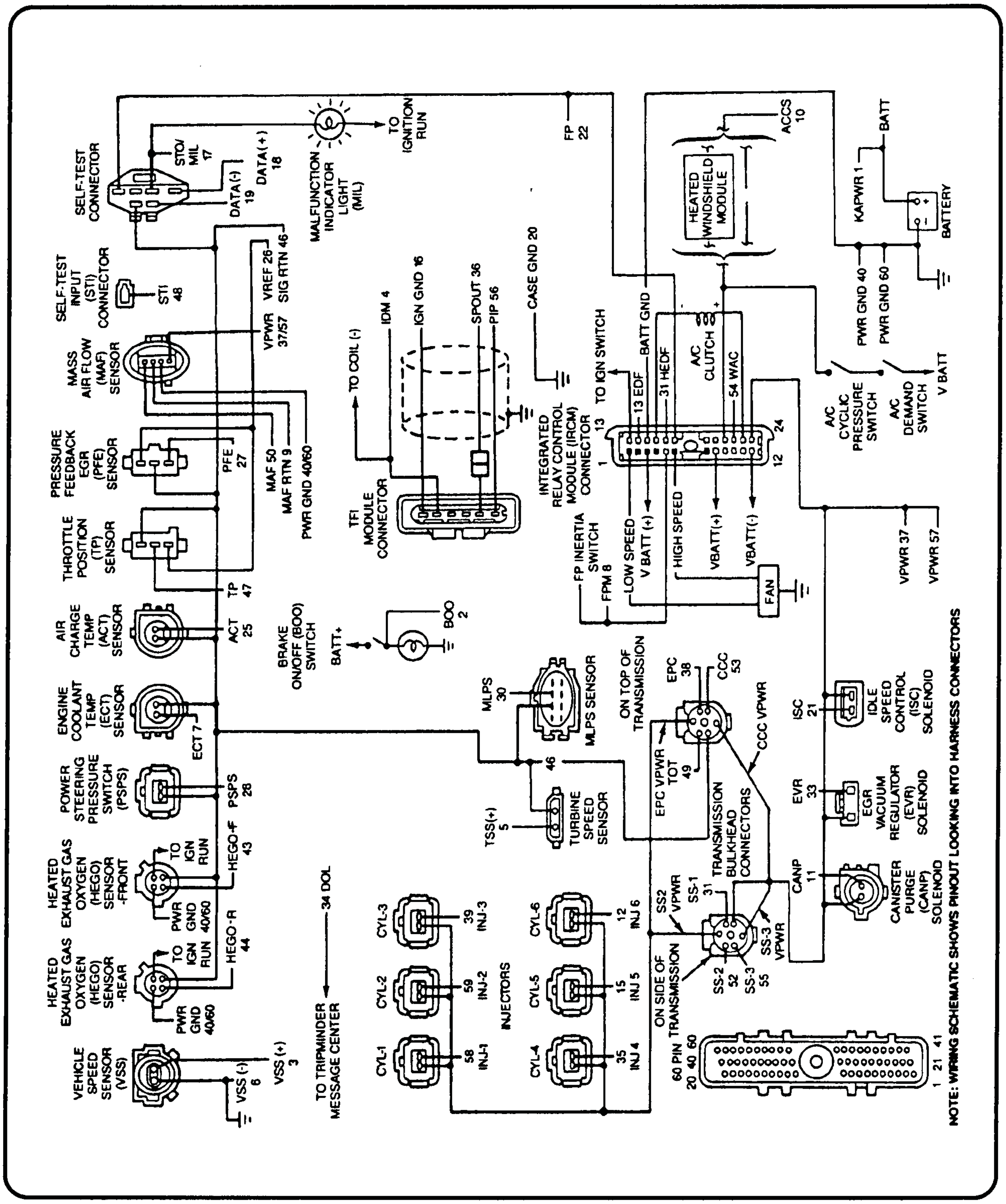


Figure 59a

TYPICAL AXOD-E CONTINENTAL WIRING SCHEMATIC

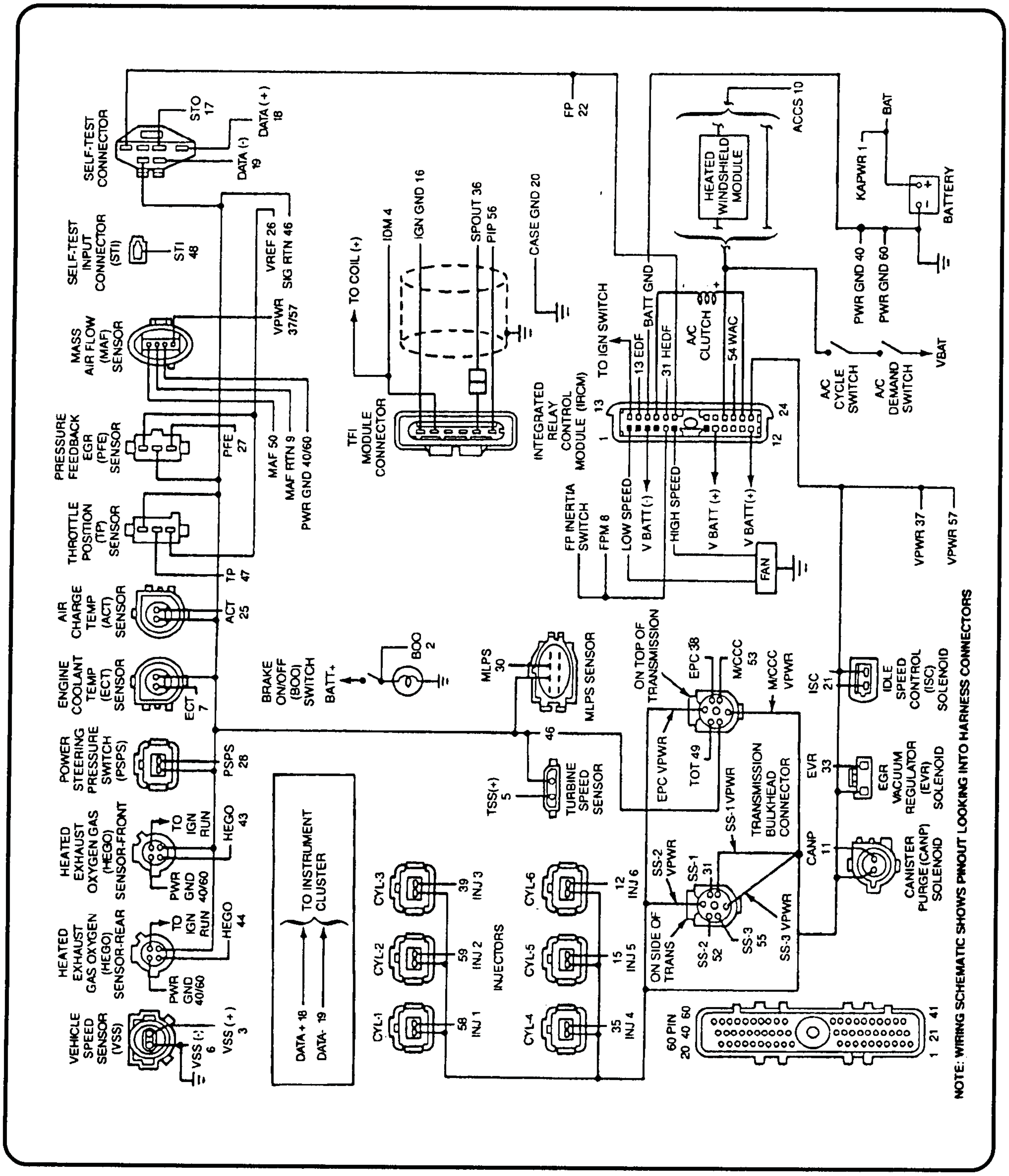


Figure 59b

THE FORD 4EAT COMPUTER CONTROL DIAGNOSIS

The 4EAT Automatic Transaxle is currently found in a variety of small Ford passenger cars (Probe, Capri, Escort and Tracer). This transaxle can be either a type G with the valve body on the side of the case, or a type F with the valve body located on the bottom of the case. The electronic system on both style transaxles control only the shift timing and torque converter lockup. Shift feel is controlled hydraulically in conjunction with the throttle cable. The information contained in this chapter will deal specifically with the 1991 and 1992 F type transaxle. However, the diagnostic connector location for both F & G style transaxle's are given. Although some of the information provided can be used in diagnosing the G type, more specific information on this style transaxle can be found in the Import Computer Control Pass Book.

The valve body consists of four solenoids, the lockup solenoid and shift solenoid 1, 2 and 3. There can be up to 9 inputs that the 4EAT control module uses to operate the transaxles solenoids for shift timing and torque converter lockup. These inputs vary in number and name depending on the model and engine size of the vehicle your working on, they are:

Vehicle Speed Sensor

Pulse Generator - Torque Converter Speed - Turbine Sensor

Throttle Position Sensor

Idle Switch

Coolant Temperature Switch - Water Thermo Signal

Fluid Temperature Switch (ATF)

Brakelamp Switch - Stoplamp Switch

Neutral Safety Switch - Gear Selector Switch

Manual Mode Switch

Service codes can be retrieved with the use of a scanner if an electrical problem has been detected. The diagnostic connector for the 4EAT control module comes in different configurations and locations. This is determined by engine size and model vehicle. The Probe (G type transaxle) is equipped with either one of three engines, a 3.0L LX, a 2.2L GT (Turbo), or a 2.2L GL (Non Turbo) engine. The Escorts and Tracer (F type transaxle) have either a 1.8L or 1.9L engine. The Capri (F type transaxle) comes with a 1.6L engine.

Figure 60 shows the diagnostic connector location and configuration for the Probe 3.0L LX and the 2.2L GT. Figure 61 shows the Probe 2.2L GL, figure 62 shows the Escort/Tracer 1.9L, figure 63 shows the Escort/Tracer 1.8L, and figure 64 shows the Capri 1.6L connector location.

If a scanner is not available, service codes can be retrieved with the use of an Analog Volt Ohm meter (VOM) for the 1.8L and 1.9L vehicles. On the 1.6L, 2.2L and 3.0L vehicles, the Manual Shift Light (MSL) can be used.

To activate the MSL (1.6L, 2.2L, 3.0L only), simply run a jumper wire from the STI (Self Test Input) connector to a body or engine ground. Turn the ignition on with the engine off, and the light will begin to flash out single and or double digit service codes. There will be a four second pause between codes. Refer to the appropriate figure number for the STI connector location.

Service code indications on 1.8L and 1.9L vehicles have a low DC voltage that can be read on VOMs with a 2 volt scale. Connect the positive lead to the Self Test Output line (STO) which is terminal A on 1.9L engines and terminal F on 1.8 liters. Put the negative lead to engine ground. When the volt meter reports a service code, it will represent itself as a pulsing or sweeping movement of the voltmeter's needle across the dial face. Therefore, a single digit code 3 would report itself as three sweeps of the needle. A double digit code 23 will have two sweeps, a one and a half second pause followed by three sweeps. There will be a four second pause between service codes. Refer to the appropriate figure number for STO connector location.

Once a service code has been retrieved, refer to the following chart for the code identification.

CODES	COMPONENT
01	Ignition Diagnostic Monitor (IDM)
03	Cylinder Identification Sensor or its control circuit (CID)
06	Vehicle Speed Sensor (VSS)
08	Vane Air Flow Sensor or its signal circuit (VAF)
09	Engine Coolant Temperature Sensor or its signal circuit (ECT)
10	Vane Air Temperature Sensor or its signal circuit (VAT)
12	Throttle Position Sensor or its signal circuit (TPS)
14	Barometric Pressure Sensor or its signal circuit (BPS)
15	Exhaust Gas Oxygen Sensor continually lean (EGO)
17	Exhaust Gas Oxygen Sensor Continually rich (EGO)
25	Pressure Regulator Control Valve (Engine) (PRCV)
26	Canister Purge Solenoid or its control circuit (CANP)
34	Idle Speed Control (ISC)
55	Torque Converter Speed [Pulse Generator] (TCS)
60	Shift Solenoid 1 (SS1)
61	Shift Solenoid 2 (SS2)
62	Shift Solenoid 3 (SS3)
63	Converter Clutch Solenoid (CCS)

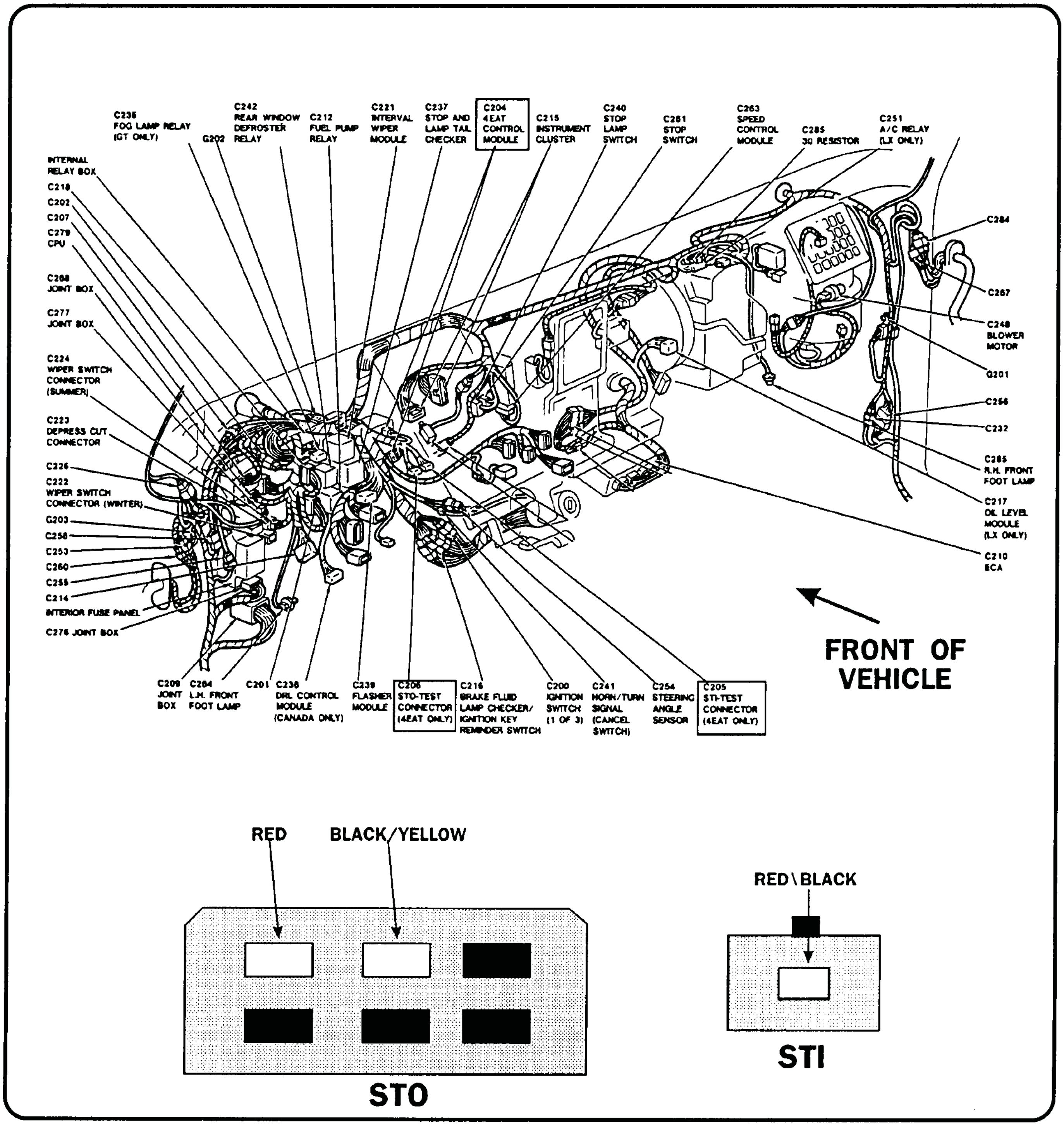


Figure 60

PROBE 3.0L AND 2.2L TURBO CONNECTOR LOCATION AND CONNECTOR FACE VIEW

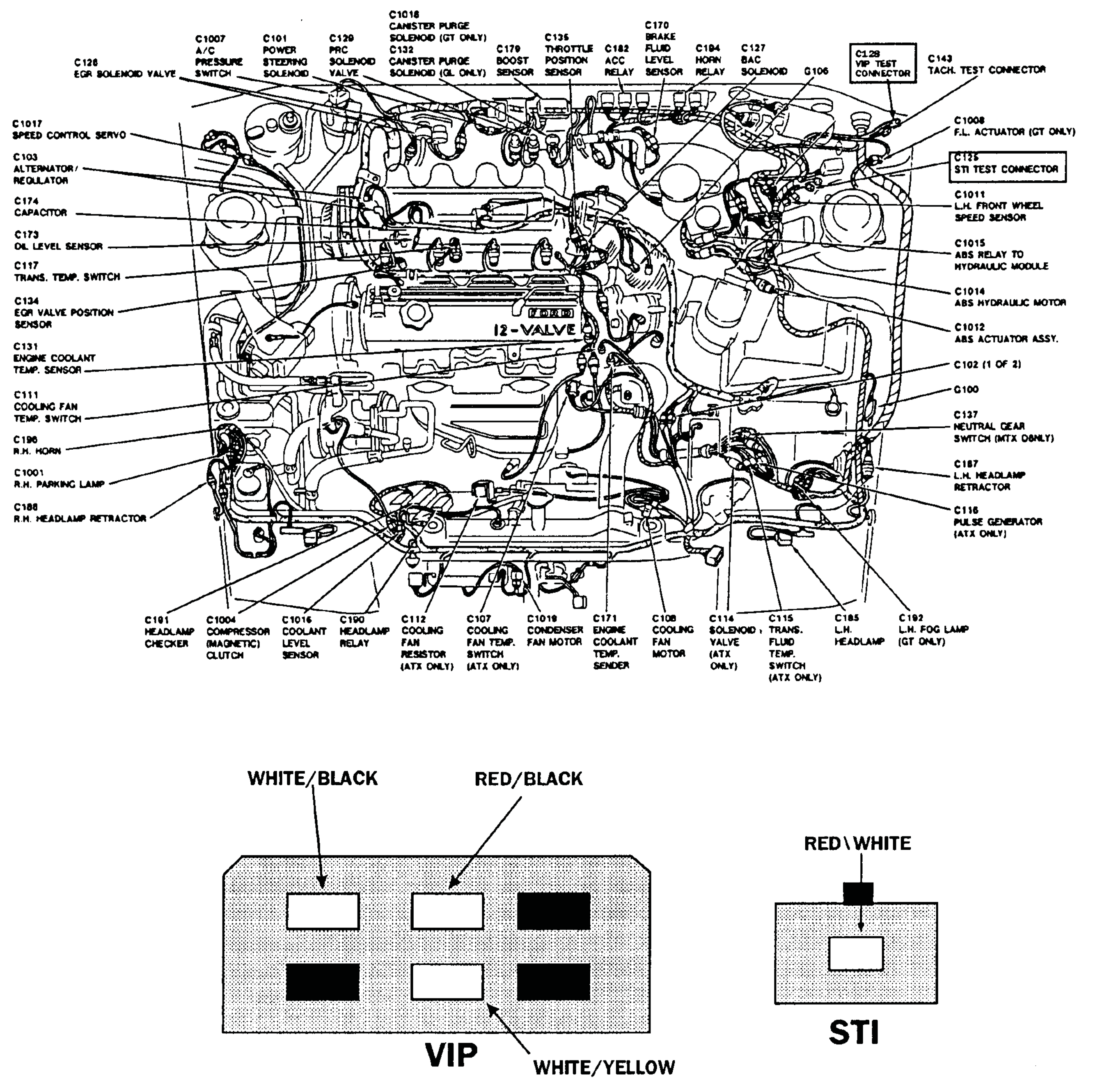
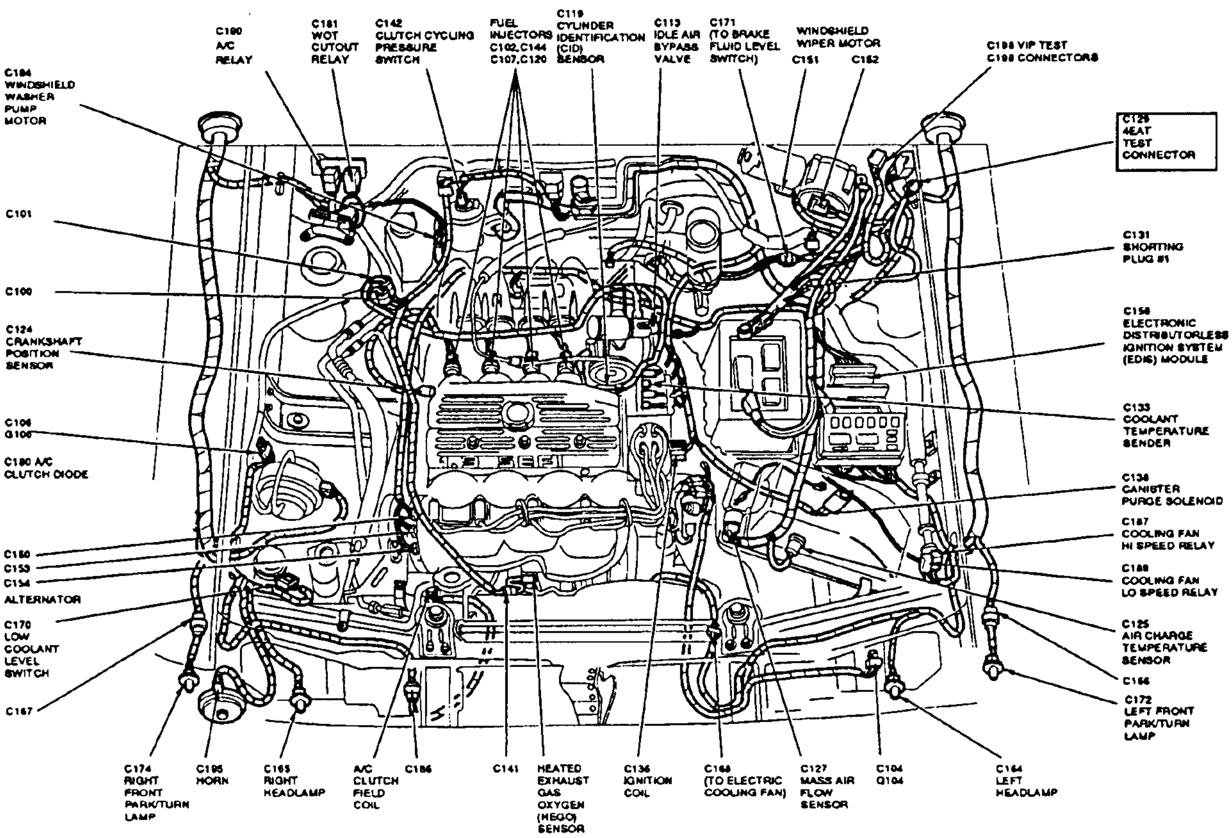
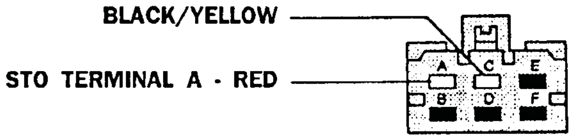


Figure 61

PROBE 2.2L NON-TURBO CONNECTOR LOCATION AND CONNECTOR FACE VIEW

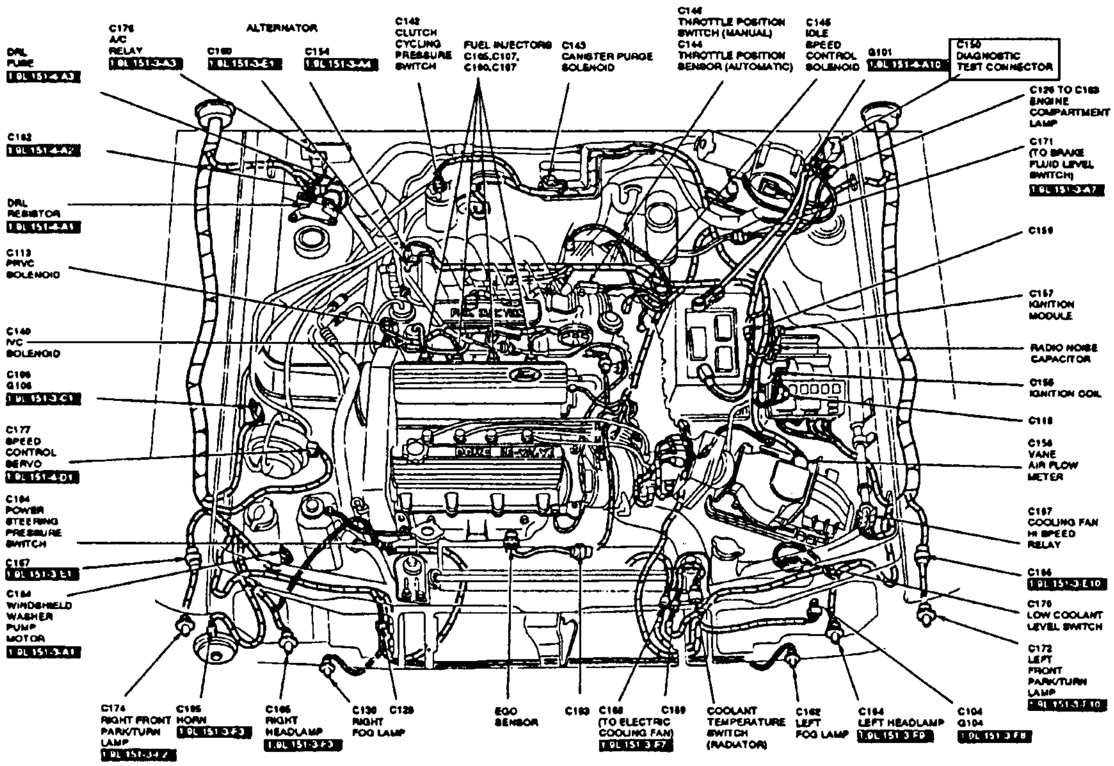




C129
4EAT TEST CONNECTOR
(1.9L ONLY)

Figure 62

ESCORT/TRACER 1.9L CONNECTOR LOCATION AND CONNECTOR FACE VIEW



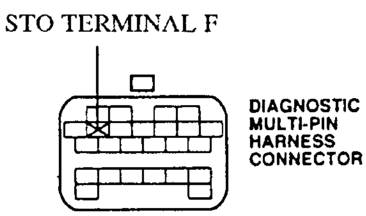


Figure 63

ESCORE/TRACER 1.8L CONNECTOR LOCATION AND CONNECTOR FACE VIEW

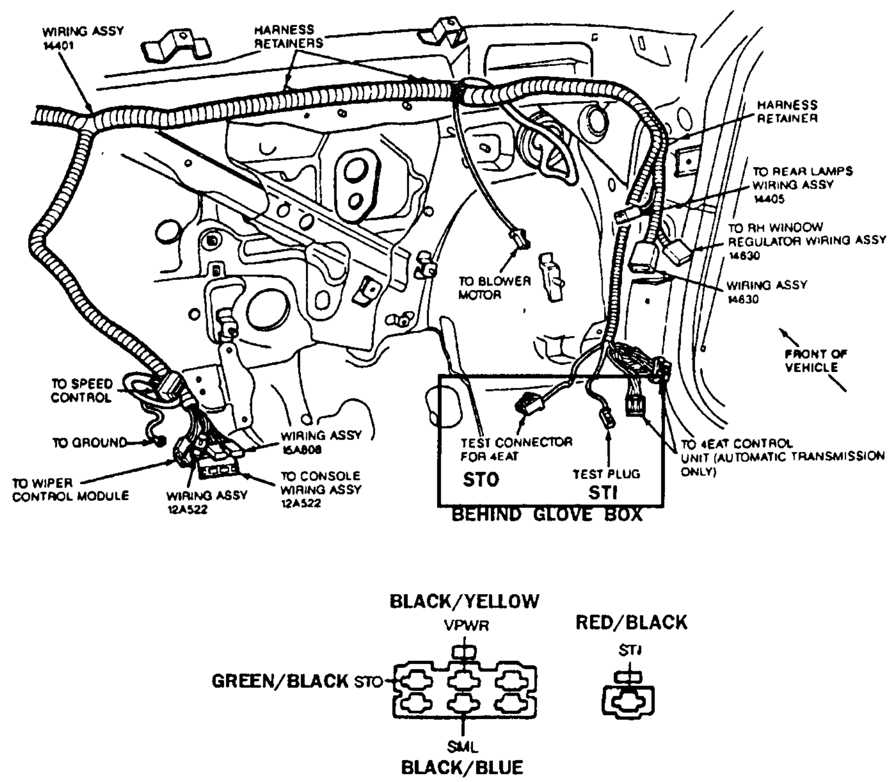


Figure 64

CAPRI 1.6L CONNECTOR LOCATION AND CONNECTOR FACE VIEW

ENGINE	4EAT STO	4EAT STI	4EAT TEST CONNECTOR LOCATION
3.0L	R	R/BK	Under the Instrument Panel on the LH Side of the Steering Column Near the 4EAT Module
2.2L Non-Turbo (1)	W/BK	R/W	Integrated with the EEC Connectors, LH Side of Engine Compartment
2.2L Turbo	R	R/BK	Under Instrument Panel on the LH Side of the Steering Column Near the 4EAT Module
1.9L	R	(3)	LH Side of Engine Compartment, Near EEC Self-Test Connectors
1.8L (2)	R	(3)	LH Side of Engine Compartment
1.6L Non-Turbo	R	R/BK	RH Side of Passenger Compartment Behind Glove Box

(1) The 4EAT module is integrated with the EEC control assembly and shares the same diagnostic connectors.
(2) STO and STI pins for EEC and 4EAT systems are integrated into one diagnostic connector.
(3) STI for 4EAT is always grounded within the control module.

SUMMARY OF CONNECTOR LOCATION

If the transaxle has come into the shop not shifting, or not shifting correctly, 12 volt jumper wires can be run to the solenoid case connector. This procedure will allow you to shift the transaxle independent of the computer to verify whether an internal or external problem exists. Refer to figure 65 for the Escort/Tracer case connector view identifying each terminal. The chart following figure 65 shows which terminals to supply voltage to for the correct shift pattern. Refer to figure 66 for the Capri case connector view and it's accompanying chart.

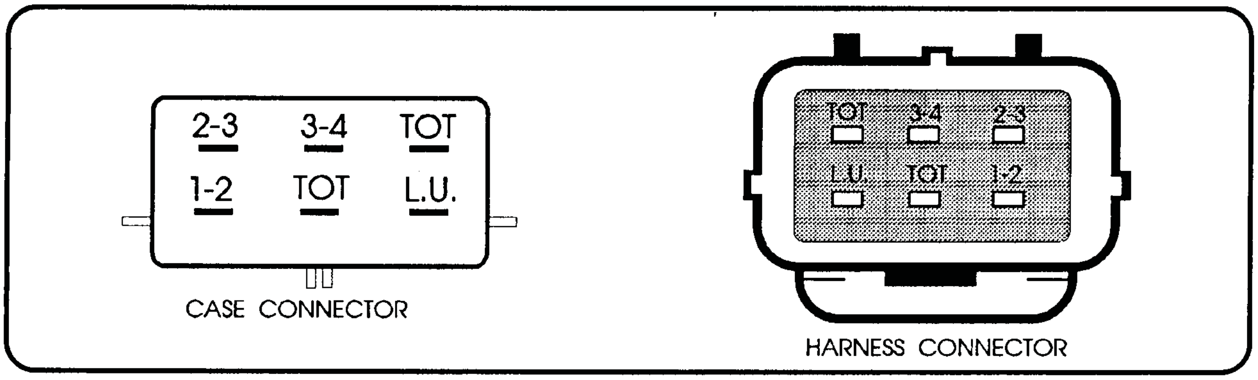
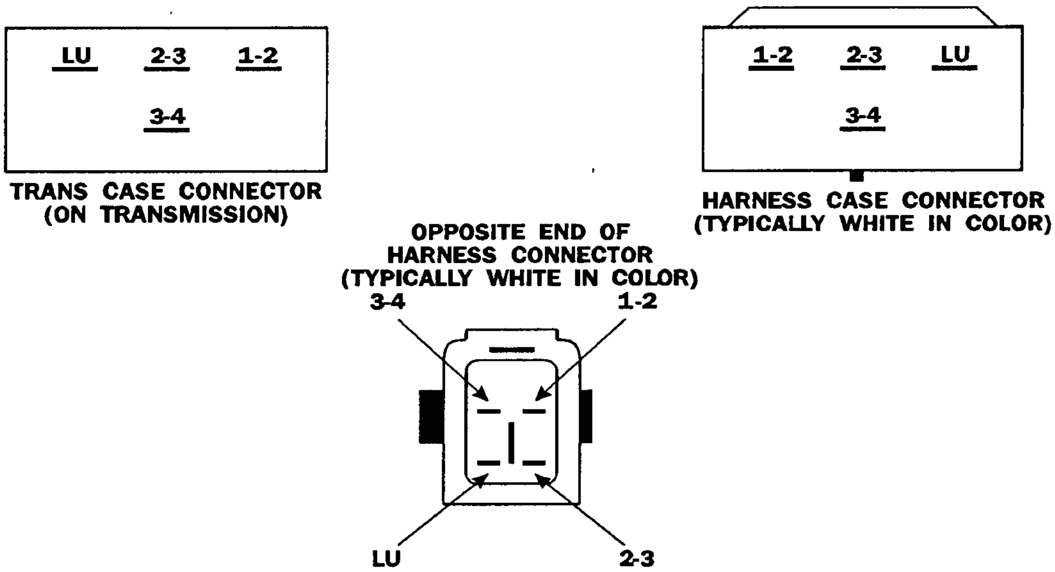


Figure 65 - Escort/Tracer connector view

SOLENOIDS	WIRE COLOR INSIDE	WIRE COLOR OUTSIDE
1-2 SOL.	GREEN	RED/YELLOW
2-3 SOL.	BLUE	BLUE
3-4 SOL.	YELLOW	BLUE/RED
L.U. SOL.	WHITE	BLUE/YELLOW
T.O.T.	(2) BLACK	GREEN/RED GREEN/WHITE

GEAR	1-2 SOL.	2-3 SOL.	3-4 SOL.	L.U. SOL.
1ST GEAR	OFF	ON	ON	OFF
2ND GEAR	ON	ON	ON	OFF
3RD GEAR	OFF	OFF	OFF	OFF
4TH GEAR	ON	OFF	ON	OFF
LOCK-UP	ON	OFF	ON	ON



SOLENOID	WIRE COLOR INSIDE	WIRE COLOR OUTSIDE
1-2	GREEN	GREEN/RED DOT
2-3	BLUE	GREEN/BLACK STRIPE
3-4	YELLOW	GREEN/WHITE STRIPE
LU	RED	GREEN/BLUE STRIPE

GEAR	1-2	2-3	3-4	LU
1		ON	ON	
2	ON	ON	ON	
3				
4	ON		ON	ON

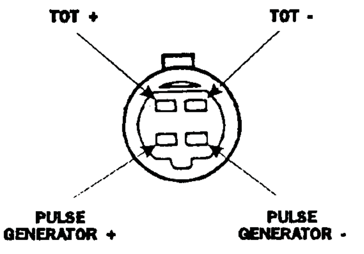
Figure 66 Capri Connector Views

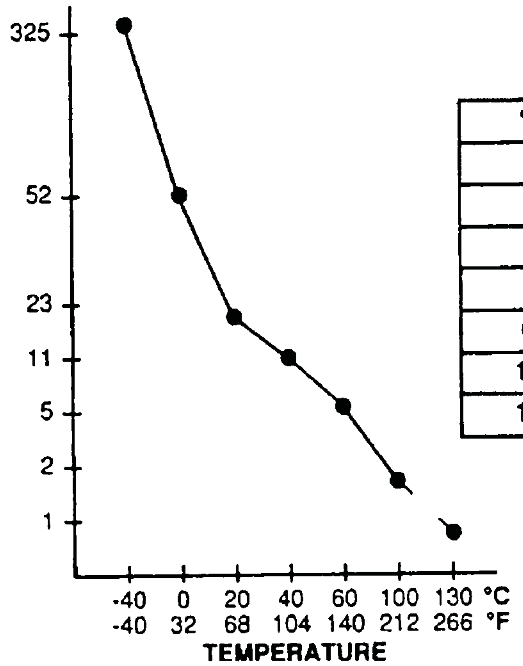
If the transaxle failed to shift properly with this test, an internal problem exists. The solenoids can first be checked for resistance at the case connector with an ohm meter. Put the negative meter lead to ground and probe each terminal with the positive lead. All four solenoids should have 13 - 27 ohms of resistance. If the resistance is out of range, solenoid replacement is necessary. If the resistance is within range, a mechanical inspection of the solenoids operation is needed. Each solenoid is normally closed and opens to exhaust when energized.

CHECKING INPUTS

The Transaxle Oil Temperature Sensor:

The pins to test the TOT sensor on Escort and Tracer vehicles are in the case connector with the pins for the shift solenoids (Refer to figure 65). The pins to test the TOT sensor for Capri vehicles are found in the connector used for the pulse generator (Refer to figure 67). An ohms test can be preformed on this sensor using the chart in figure 67.





°C	°F	kOHMS
-40	-40	325.50
0	32	52.00
20	68	23.00
40	104	11.00
60	140	5.60
100	212	1.71
130	266	0.86

Figure 67

The Pulse Generator:

The Pulse Generator should have 200 - 600 ohms resistance. Figure 67 shows the Pulse Generator pins for Capri Vehicles. The Pulse Generator on the Escort and Tracer Vehicles ties into a large 12 pin connector. There is however, a 2 pin connector prior to the 12 pin connector that can be used in checking the generator. Figure 68 shows both connectors.

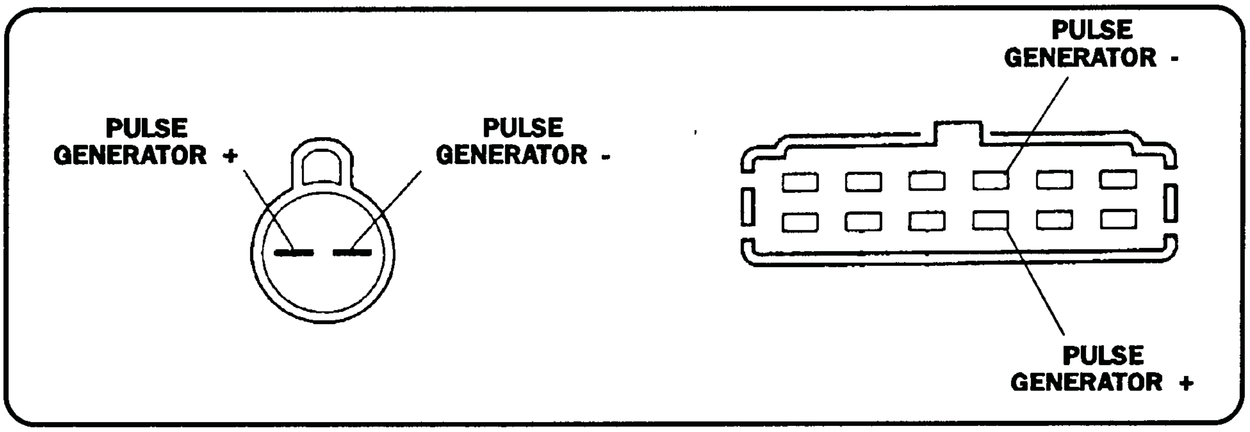


Figure 68

Throttle Position Sensor:

The TPS receives a 5 volt signal and can be checked using a multimeter. Figure 69 shows the TPS used on 1.6. 1.8 and 1.9 liter engines with pin identification. To check for voltage values set the multimeter to DC volts. Carefully back probe the Throttle Position wire (TP) with the positive lead from the meter. Using the negative lead, carefully back probe the signal return wire (SIGRTN). Turn the key to the on position with the engine off. Refer to the chart for the voltage values following figure 69. To check the TPS for resistance values, set the multimeter to ohms. Put the key in the off position and unplug the TPS. Connect the positive lead of the meter to the TP pin and the negative lead to the SIGRTN pin on the TPS. Refer to the chart following figure 69 for the resistance values.

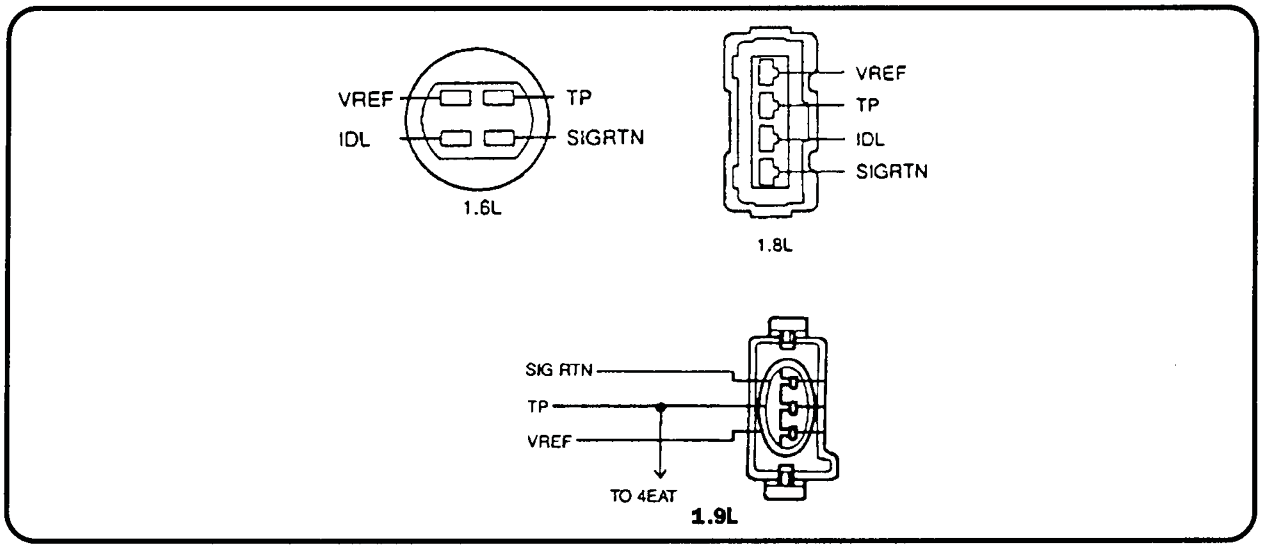
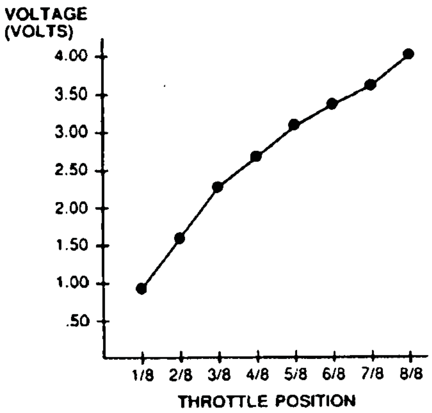
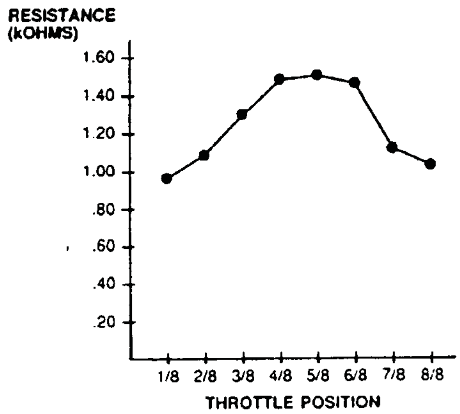


Figure 69

GRAPH





GRAPH DATA VALUES

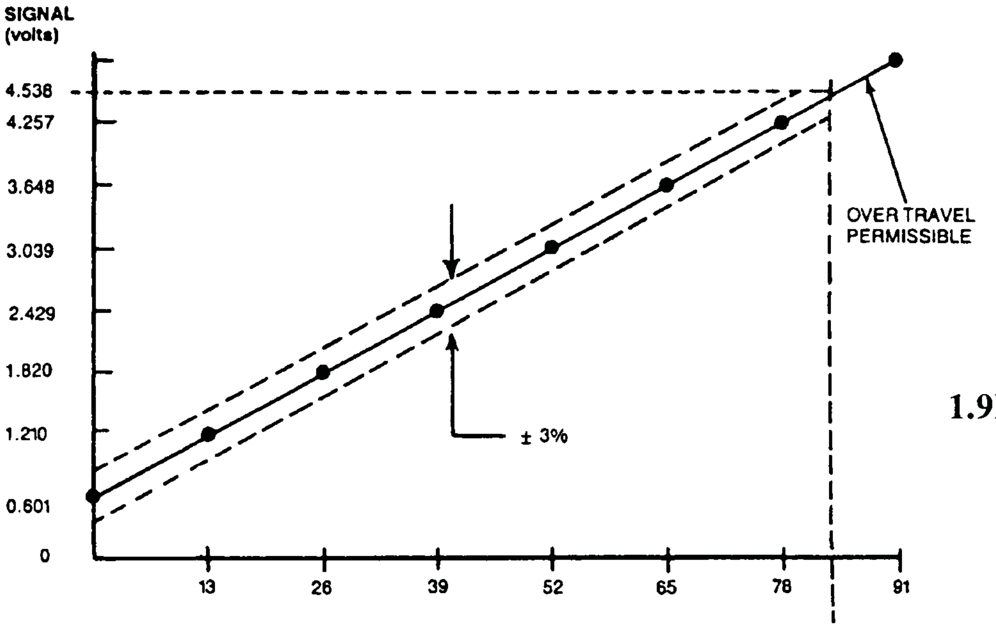
THROTTLE POSITION	VOLTS
1/8	.998
2/8	1.60
3/8	2.37
4/8	2.74
5/8	3.15
6/8	3.43
7/8	3.60
8/8	4.02

THROTTLE POSITION	kOHMS
1/8	.989
2/8	1.104
3/8	1.278
4/8	1.462
5/8	1.480
6/8	1.459
7/8	1.144
8/8	1.072

NOTE: Voltage and Resistance values may vary ± 15%.

NOTE: Voltage and Resistance values may vary ±15%

1.6L & 1.8L



1.9L

Vehicle Speed Sensor:

There are two types of speedometers, digital and analog. The digital speedometer will have a 2 pin wire connector by the speedometer gear. The analog speedometer will have a cable from the speedometer gear. The digital speed sensor can be checked in two places, at the speedometer gear wire connector and/or, at the instrument cluster harness connector by the speedometer head. The speed sensor on conventional analog speedometers can only be checked at the instrument cluster harness connector by the speedometer head. Figure 70 shows two connectors for the digital style speedometer and one connector for the analog style speedometer. The two pins that are needed to test the speed sensor is identified in each connector. With a multimeter set to ohms, connect the positive lead to the VSS pin. Take the negative lead and connect it to the ground pin. Remove the speedometer gear from the transaxle and turn the gear one revolution. On 1.6L vehicles, there should be 4 pulses per one revolution of the speedometer gear. On 1.8 and 1.9L vehicles, there should be 8 pulses per one revolution of the speedometer gear.

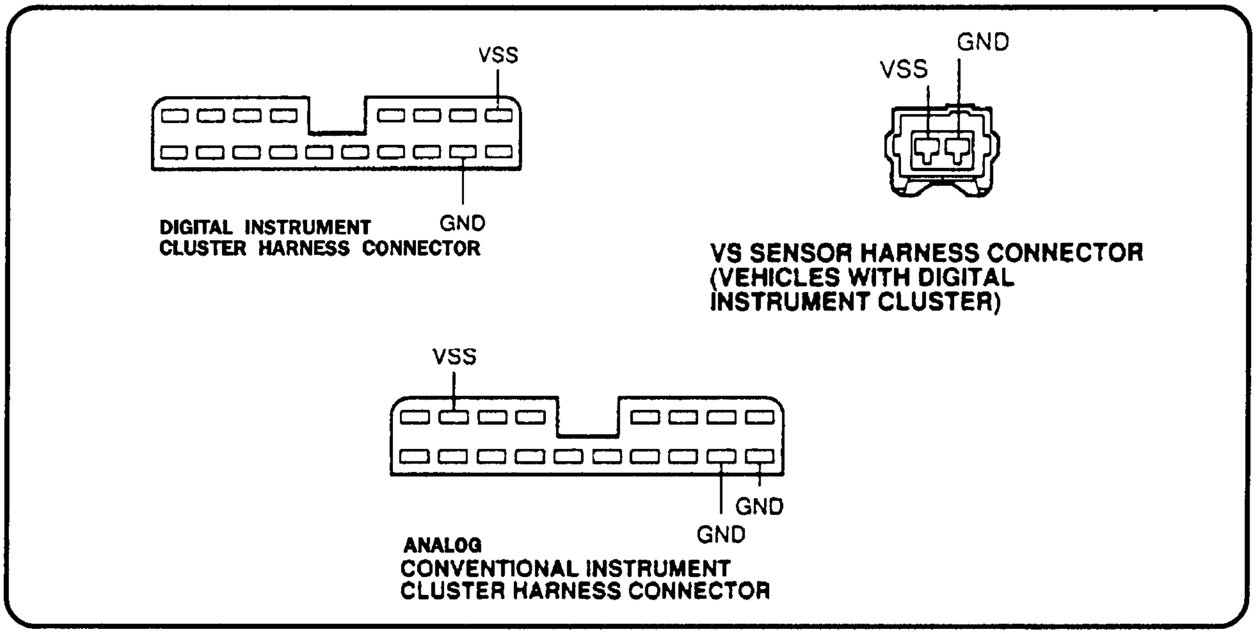


Figure 70

Brake On Off Switch: The Boo switch is a simple on off switch by the brake pedal. When the brake pedal is depressed, 12 volts should be seen at terminal 2. Refer to figure 71 for terminal identification.

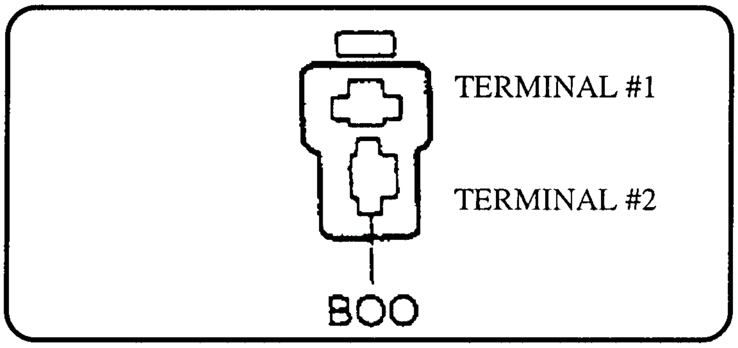


Figure 71

Engine Coolant Temperature Sensor: The ECT sensor can be checked using a multi-meter set to OHMS. Figure 72 shows the location of the sensor for 1.6L,1.8L, and 1.9L engines with connector views. Refer to the chart following figure 72 for the resistance values.

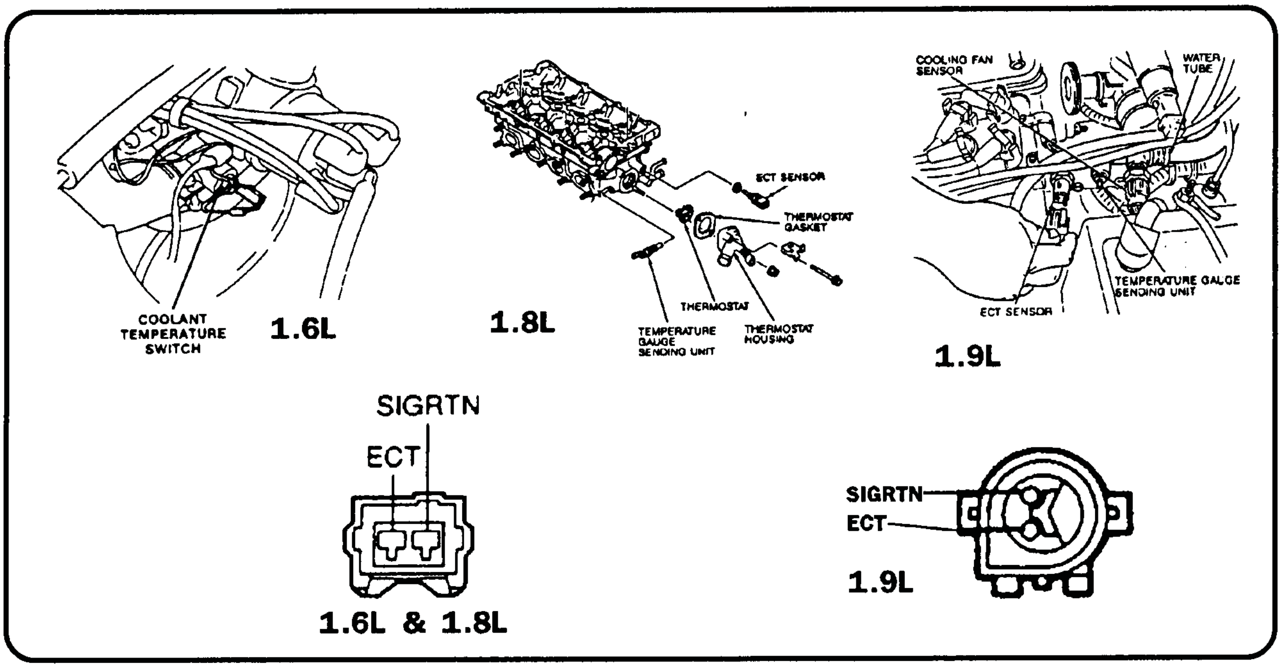


Figure 72

TEMPERATURE °F	TEMP SENSOR VALUES IN OHMS
248	1.18
230	1.55
212	2.07
194	2.80
176	3.84
158	5.37
140	7.70
122	10.97
104	16.15
86	24.27
68	37..30
50	58.75

1.6L & 1.8L

TEMPERATURE °F	TEMP SENSOR VALUES IN OHMS
-4	14.6 - 17.8
68	2.2 - 2.7
104	1.0 - 1.3
140	500 - 650
176	290 - 350

1.9L

HYDRA-MATIC 4L80-E ELECTRICAL DIAGNOSIS

General Motors Hydra-Matic 4L80-E is a 4 speed computer controlled rear wheel drive transmission currently found in 1991 and up C, K, P, R, V and G body trucks both gas and diesel engines. The transmission shift strategy is determined by a number of inputs which the PCM/TCM uses to control shift timing and feel (refer to figure 73 below). The PCM (Power Train Control Module) is in the gasoline engine vehicles and the TCM (Transmission Control Module) is found in the diesel run engines. The PCM/TCM can be found behind the glove box or under the driver seat.

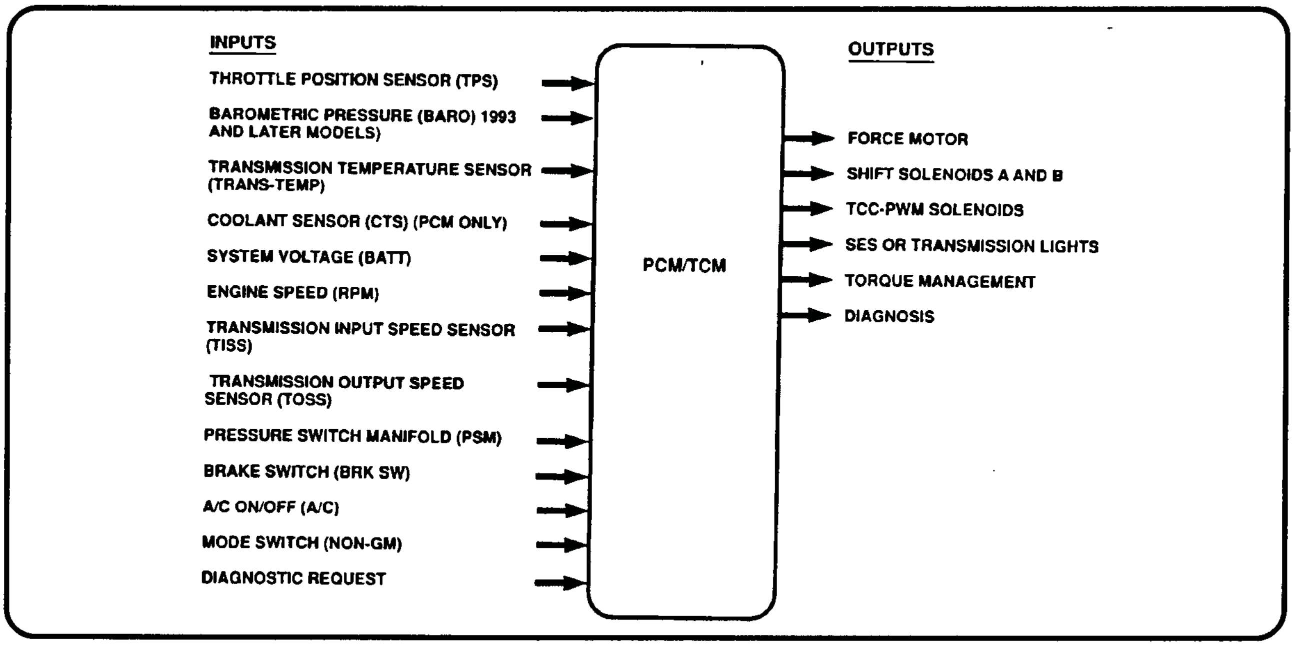


Figure 73

The PCM/TCM will store diagnostic codes if an electrical problem occurs. Some of the codes may cause the PCM/TCM to put the transmission into a 2nd gear fail-safe condition. A scanner is best used for retrieving these codes but a manual method is available if a scanner is not available. To manually access information codes, locate the ALDL (Assembly Line Diagnostic Link) connector (Figure 74). This connector contains 12 cavities and is located on the driver's side of the vehicle at the base of the dash assembly.

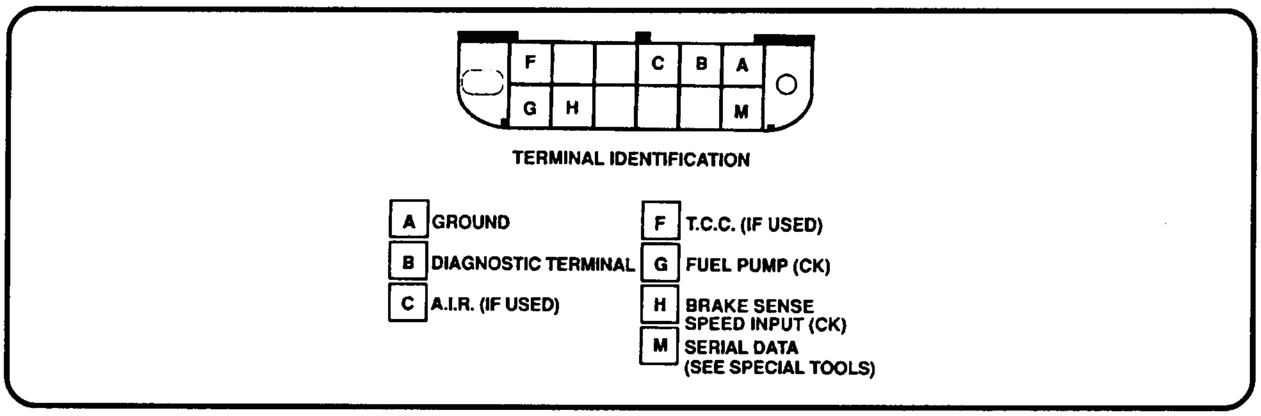


Figure 74

DOMESTIC COMPUTER CONTROL

Code display may be accessed as follows:
1. Install a jumper across ALDL terminals A and B.
2. Turn ignition to RUN position.
3. Note "Service Engine Soon" or "Trans" lights.
4. The sequence begins with the light flashing three code 12s, which indicates the PCM/TCM is capable of diagnostics.
5. Following code 12 displays, each stored code will be displayed three times in numeric order from lowest to highest.
6. When all codes have been displayed, code 12 will again begin to flash, this indicates the end of code display.
7. As long as the jumper wire remains installed, the code display will continue to repeat.

Refer to the chart below for the code description.

Code number	Description	Actions
14	Engine Temp High	PCM/TCM substitutes default temp of 90 C (195 F) and TCC applies when engine is cold
15	Engine Temp Low	Same as 14
21	TPS Voltage High	Maximum Line Pressure, Harsh/Firm shifts, Fixed Shift Points, 4th Gear inhibited, TCC Inhibited.
22	TPS Voltage Low	Same as 21
24	Output Speed Low	Maximum Line Pressure, 2nd Gear Operation Only High Line Pressure, 4th Gear Inhibited, TCC Inhibited
28	PSM Invalid Combination	
*33	BARO High	
*34	BARO Low	
*37	Brake Switch Stuck ON	
*38	Brake Switch Stuck OFF	
39	TCC Stuck OFF	NONE
53	System Voltage High	2nd Gear Only, Maximum Line Pressure, TCC Inhibited
58	Transmission Temp High	Substitutes Default Temp of 130 C (265 F), Harsh Shifts, TCC in 2nd, 3rd and 4th
59	Transmission Temp Low	Substitutes Default Temp of 130 C (265 F), Harsh Shifts, TCC in 2nd, 3rd and 4th
68	Overdrive Ratio Incorrect	High Line Pressure, 4th Gear Inhibited, TCC Inhibited
*69	TCC Stuck ON	
*71	Engine Speed Low	
*72	Output Speed Low	
73	Force Motor Incorrect	Maximum Line Pressure
*74	Input Speed Low	
75	System Voltage Low	Maximum Line Pressure, 2nd Gear Only, TCC Inhibited
*77	Mode Select Switch	
*79	Transmission Hot	
81	QDM Fault, B solenoid	Maximum Line Pressure, 2nd Gear Only, TCC Inhibited
82	QDM Fault, A solenoid	2nd and 3rd Gears Only or 1st and 4th Gears Only
83	QDM Fault, TCC	None
85	Undefined Ratio	Maximum Line Pressure
86	Solenoid B, Stuck ON	Actions Inhibited
87	Solenoid B, Stuck OFF	Actions Inhibited
*89	Maximum Adaptive Learning and Long Shift	

* = CODES HAVE BEEN MASKED AND ARE NOT AVAILABLE FOR SCAN OR MANUAL DIAGNOSTICS FOR THE 1991 MODEL YEAR.

Code 14 will set if the sensor signal voltage indicates coolant temperature is above 135°C (270°F) for more than six seconds.
Code 15 will set if the sensor signal voltage indicates coolant temperature is less than -33°C (-27°F) for more than 30 seconds.
Code 21 (Gas) will set if while the engine is running and the TPS signal voltage goes over 4.5 volts at any time for five seconds or more.
Code 21 (Diesel) will set if while engine is running and the TPS signal voltage is greater than 1.1 volts at any time or engine speed is less than 750 RPM . All conditions are met for five seconds or more.
Code 22 (Gas or Diesel) will set if while engine is running the TPS signal voltage is less than .2 volts for one second.
Code 24 will set if the input speed is at least 3000 RPM and output speed is less than 200 RPM for at least one second. The Pressure Switch Manifold must also be indicating that the transmission is in gear during this time.
Code 28 will set if an invalid pressure switch combination is recognized from the Pressure Switch Manifold. It will assume that the O.D. range has been selected regardless of what forward range has been chosen.
Code 33 and 34. The 1991-92 domestic vehicles do not use a BARO sensor as an input. Vehicles using a BARO as a transmission control input use a designated BARO sensor mounted in one of two locations: externally or internally on the PCM/TCM circuit board. The Barometric pressure sensor is used by the computer to adjust pressures according to change in altitude. At sea level, the sensor produces a voltage value between 4.7 and 4.9 volts. As the elevation increases, sensor voltage output decreases at the rate of approximately 0.1 volt/500 ft. At 10,000 feet above sea level, sensor voltage value is between 2.5 and 3.0 volts. The computer compares sensor signal voltage to a calibrated value programmed in the computer to determine actual altitude. Codes will set if the voltage values from the sensor is higher or lower than previously specified.
Code 37 and 38. The brake switch is operated by the brake pedal travel. The switch is normally closed when the brake is released. This applies battery voltage to the PCM/TCM signal line. When the brakes are applied, the computer receives a 0 volt signal which causes the TCC to be released. This brake input is used for line pressure and TCC control. Codes will set if the brake switch signal remains on or off.
Code 39 will set when 2nd and 3rd gear has occurred and the computer commands TCC to be full applied and TCC slip is calculated to be greater than 65 RPM for more than two seconds. This code will also set if TCC did not engage in third gear while in the DRIVE range.
Code 53 will set if the system voltage exceeds 19.5 volts for longer than two seconds.
Code 58 will set if the sensor signal voltage indicates that the transmission temperature is above 153°C (307°F) for more than one second.
Code 59 will set if the sensor signal voltage indicates that the transmission temperature is below -48°C (-54°F) for more than one second. If codes 58 or 59 is set, the PCM/TCM substitutes a default temperature value of 130°C (265°F).
Code 68 will set if the engine speed is 200 RPM higher than input speed for more than two seconds while in 4th gear and TCC is applied. This code will also set if TCC fails to apply in 4th (OD Range) or the Transmission Input Speed Sensor is faulty.
Code 69 will set if the input speed sensor and RPM sensor indicates to the PCM/TCM that TCC is stuck on.
Codes 71 and 72. Engine RPM is determined by a different method in gasoline powered vehicles than in diesel powered vehicles. In gasoline vehicles, the engine RPM is derived from reference pulses from the ignition module located within the distributor. As the engine components rotate,

the distributor shaft turns a toothed wheel called a timer core. As the timer core rotates, an AC voltage signal is induced within the distributor pickup coil assembly. This AC signal is sent to the ignition module. The ignition module then sends a digital square wave signal to the PCM. Within the PCM, this digital signal is compared to a fixed frequency clock signal to determine engine RPM. Note: the number of timer core teeth will vary depending on the number of cylinders.
In diesel vehicles, engine RPM is derived from an engine speed sensor mounted to the rear of the intake manifold. The diesel engine speed sensor consists of a four tooth timer core and a pickup coil assembly to indicate crankshaft speed. As the sensor shaft is rotated by the oil pump drive, an AC signal is produced. unlike gasoline engines, the AC signal from diesel engines is sent un buffered directly to the TCM. Within the TCM, the speed signal is converted to a digital signal and is then compared to a fixed frequency clock signal to determine engine RPM. This RPM signal for both gas and diesel is used for line pressure control, TCC engagements and wide open throttle upshifts. Codes will set if engine speed signals remain high or low.
Code 73 will set when the actual Force Motor current is higher or lower than the commanded Force Motor current by more than 0.16 amps for more than one second.
Code 74 will set if the input speed sensor is faulty or a slow turbine speed is indicated due to a bad torque converter. It may be possible for this code to change to code 68 if the transmission reaches 4th gear.
Code 75 will set if the system voltage drops below 6.7 volts at -40°C (-40°F), 8.6 volts at 90°C (194°F), 10.5 volts at 150°C (304°F) for longer than four seconds.
Code 77. Non-GM built vehicles made overseas which uses the 4L80-E transmission also features a Mode Switch located on the instruments cluster. Since this is not currently used on domestic vehicles, no information will be given.
Code 79. No information available at the time of printing.
Code 81. A Quad Driver Module (QDM) is located in the computer. Its purpose is to monitor the current draw. This is designed to protect the computer from any shorts or opens in the system. Code 81 will set if when the QDM is commanded "ON" for shift solenoid B, and the circuit voltage remains high for two seconds. (This indicates a short to power or a shorted solenoid). It will also set when the QDM is commanded "OFF," and the circuit voltage remains low for five seconds or more. (This indicates an open circuit or short to ground).
Code 82. Same as code 81 except this is the circuit for shift solenoid A.
Code 83 will set if the TCC duty cycle is commanded to 0% (OFF) and the TCC circuit voltage remains at a low voltage level for more than two seconds. This indicates an open circuit or short to ground. It will also set if the TCC duty cycle is commanded to 60% (ON) and the TCC circuit voltage remains at a higher voltage level for more than two seconds. This indicates a short to power or a shorted solenoid.
Code 85 will set when the PCM/TCM radiometric calculation produces an unknown gear ratio based on manual valve position via the PSM and speed sensor inputs for any gear but 4th for more than five seconds.
Code 86 will set when the VSS is above 7 mph, the throttle position sensor is more than 25% and the PCM/TCM commands 1st or 2nd gear and the combined ratio indicates transmission is at a 1-1 ratio or less (3rd or 4th gear). Conditions need to be met for at least six seconds.
Code 87 will set when the VSS is above 7 mph, the throttle position sensor is more than 25% and the PCM/TCM commands 3rd or 4th gear. If combined ratio indicates the vehicle remained in 1st or 2nd, a code 87 will result. All conditions must be met for six seconds.
Code 89. Adaptive learning allows adjustments to be made in line pressure based on the needs of the transmission to assure consistent shifting as the transmission wears. Shift overlap time (the amount of time it takes for a shift to be completed) increases as the transmission wears. The adaptive learning is achieved from monitoring the TPS, VSS, Transmission Temperature and the shift overlap times (usually measure between 0.4-1.35 seconds). The computer compares shift overlap times to

the other input values. Note: 1991 and 1992 has limited adaptive learning. These model years will be limited to 2 psi change. If the eight cells or memory blocks in the computer used to make these calculations indicates a fault, code 89 may be set.

TRANSMISSION SOLENOID AND SENSOR CHECKS

All the solenoids and the transmission temperature sensor can be checked at the case connector. Figure 75 identifies each terminal at the case connector. The chart following figure 75 shows you the resistance values for each solenoid and the temperature sensor.

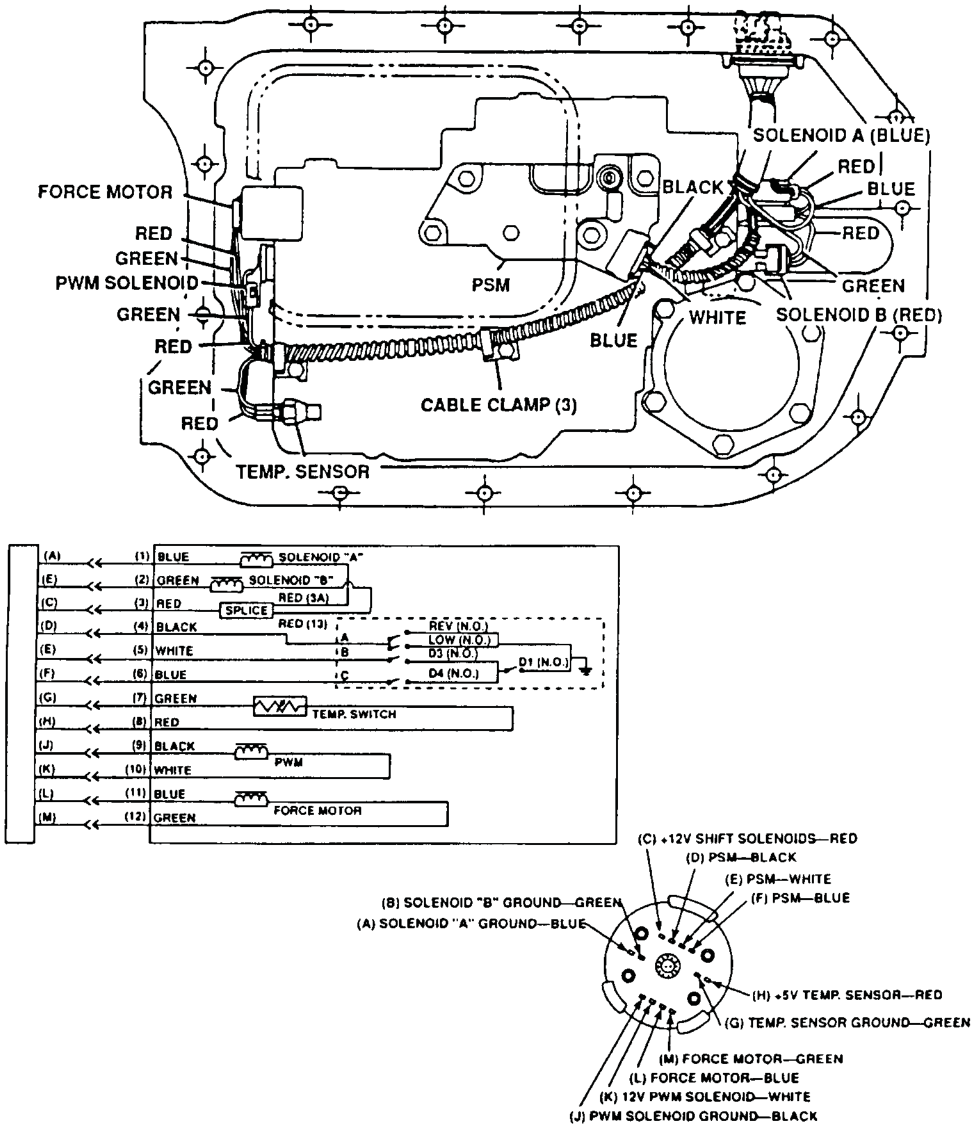


Figure 75

SOLENOIDS

SOLENOID	TERMINAL	RESISTANCE VALUE
FORCE MOTOR	L & M	3 - 5 ohms
TCC/PWM SOLENOID	K & J	10 - 15 ohms
SHIFT SOLENOID A	A & C	20 - 50 ohms
SHIFT SOLENOID B	B & C	20 - 50 ohms

TRANSMISSION TEMPERATURE SENSOR

TERMINAL	°C	°F	RESISTANCE VALUES
G - H	20°	68°	2981 - 4018 ohms
G - H	30°	86°	1915 - 2550 ohms
G - H	40°	104°	1260 - 1660 ohms
G - H	50°	122°	848.8 - 1105 ohms
G - H	60°	140°	584.1 - 753.4 ohms
G - H	70°	158°	410.3 - 524.2 ohms
G - H	80°	176°	293.7 - 371.7 ohms
G - H	90°	194°	213.9 - 268.2 ohms
G - H	100°	212°	158.1 - 196.8 ohms

SHIFTING THE TRANSMISSION

To shift the transmission at the case connector supply 12 volts through a 20 amp fuse to terminal C and keep it there. Ground terminal A to acquire first gear. Remove the ground from terminal A and a shift into second will be made. Ground the B terminal for third gear, and ground both A and B terminals for fourth gear. If the transmission does not shift correctly, the solenoids may be defective and will require inspection. The shift solenoids are normally open solenoids and close to hold pressure when they are energized.

GEAR	SSA	SSB
1	ON	OFF
2	OFF	OFF
3	OFF	ON
4	ON	ON

CHECKING INPUTS

The TISS and the TOSS

The Transmission Input Speed Sensor (TISS) and the Transmission Output Speed Sensor (TOSS) are both the same and will interchange (Figure 76).

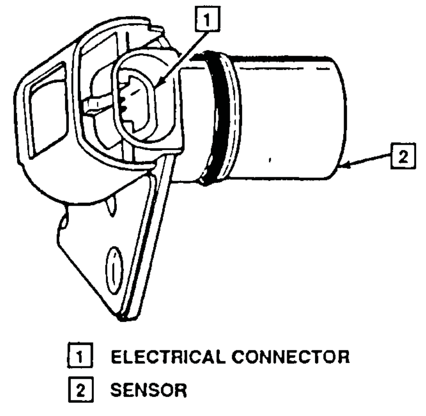


Figure 76

Both sensors should have 1260 - 1540 ohms when measured at approximately 68°F. These sensors are A.C. voltage generators and can also be checked with a volt meter set to **A.C. volts.**

To check the TISS, back probe the Gray/Red wire with one lead from your meter. With the other lead, back probe the Dark Blue/White wire. With the vehicle in gear and the brake on, 0 volts should be seen. When the brake is released and engine RPM is increased, the voltage produced from the TISS should also increase.

To check the TOSS, back probe the Purple/White wire with one lead from your meter. With the other lead, back probe the Light Green/Black wire. At 0 MPH you should see 0.00 volts. At 20 MPH you should see approximately 7.00 volts. At 25 MPH there will be approximately 8.50 volts. 30 MPH, approximately 9.75 volts.

A tip to keep in mind is that when the TISS goes bad, the transmission will usually shift from first to second and second to third but will loose overdrive and TCC. When the TOSS goes bad, the transmission will usually stay in first gear and not shift at all.

The Coolant Temperature Sensor

The Coolant Temperature Sensor (CTS) is only used on gasoline engine equipped vehicles and is mounted in the engine cooling system. The CTS is a negative temperature coefficient thermistor. Low coolant temperature produces high sensor resistance while high coolant temperature produces low sensor resistance. The PCM supplies a five volt signal to the sensor which then measures the voltage drop across the sensor, see figure 77. The PCM compares the reading to calibrated values programmed within the PCM to determine the actual temperature of the engine. At normal engine operation when temperature is approximately 184°F - 203°F, the voltage measures about 2.05 volts at the PCM. The PCM uses this information to inhibit or allow TCC as well as controlling line pressure and shift timing. Below figure 77 is a chart that can be used to check the CTS for resistance.

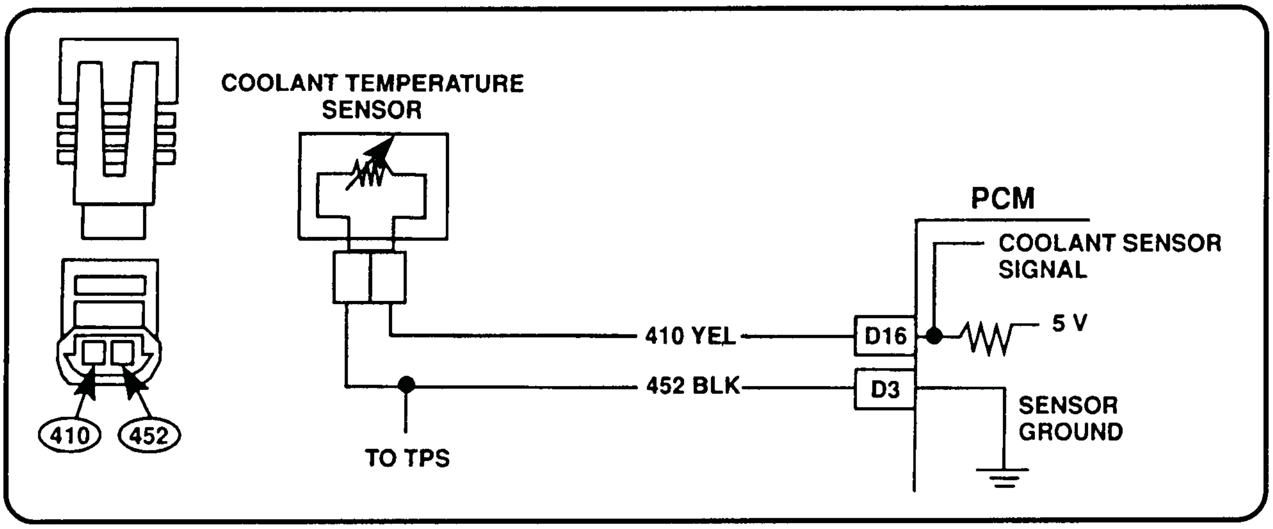


Figure 77

DEGREES °C	°F	SENSOR RESISTANCE (OHMS)
-40	-40	INF. TO LOOK
-8	+18	14570
0	32	9560
10	50	5910
20	68	3760
30	86	2300
40	104	1589
50	122	942
60	140	730
70	158	455
80	176	349
90	194	252
100	212	180
110	230	136
120	248	108

The Throttle Position Sensor

The Throttle Position Sensor (TPS) is mounted on the throttle body in gasoline engines and the injector pump on diesel engines (see figure 78). The sensor is a potentiometer with one end of the sensor resistor strip connected to a 5 volt supply from the PCM/TCM. The other end of the strip goes to ground. A third terminal is the signal circuit to the PCM/TCM. This terminal is connected to a movable contact inside the TPS which moves up or down the resistor strip which varies the voltage signal back to the PCM/TCM. As the throttle is depressed, the voltage increase from approximately 0.5 volts to 4.5 volts. This information is converted to a percentage value within the PCM/TCM and is used in determining shift timing and shift feel. To check the TPS, back probe terminals B and C with a volt meter set to D.C. volts at the TPS (figure 79). With the key on and engine off, approximately 0.5 volts should be seen. As the throttle is depressed, the voltage should increase smoothly. When full throttle is reached, approximately 4.5 volts should be seen.

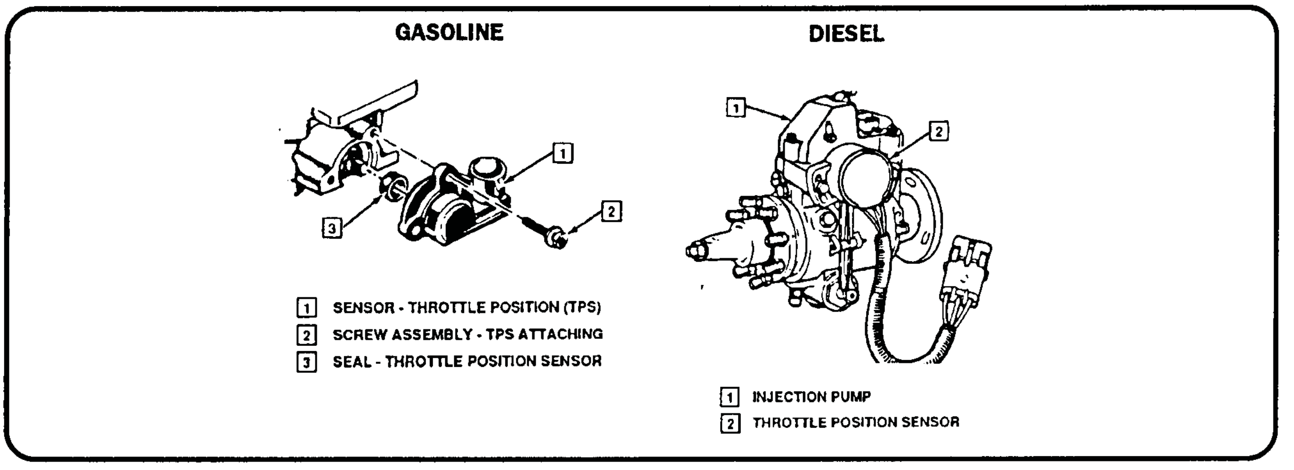


Figure 78

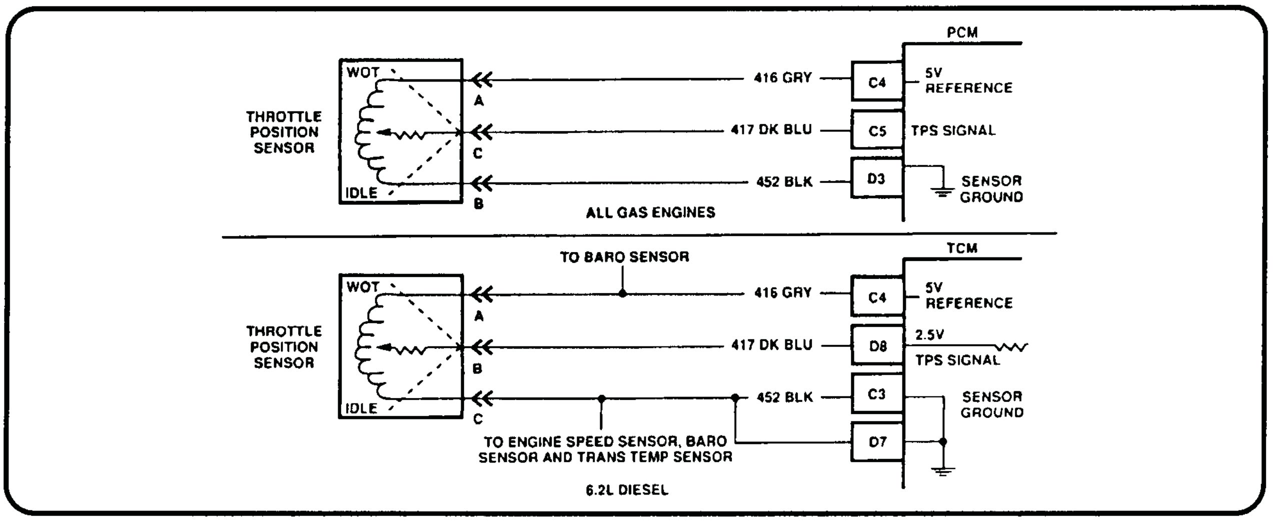


Figure 79

Pressure Switch Manifold

The Pressure Switch Manifold (PSM) contains 5 normally open pressure switch assemblies which are used to indicate the actual position of the manual valve. This input is used for line pressure, TCC and shift strategy. Each switch has two contact points around the outside diameter, see figure 80. To test each switch, place leads from an ohm meter across the switch on the contact points. The meter should read open (infinity). When you press down on the center of the switch, the meter should read continuity.

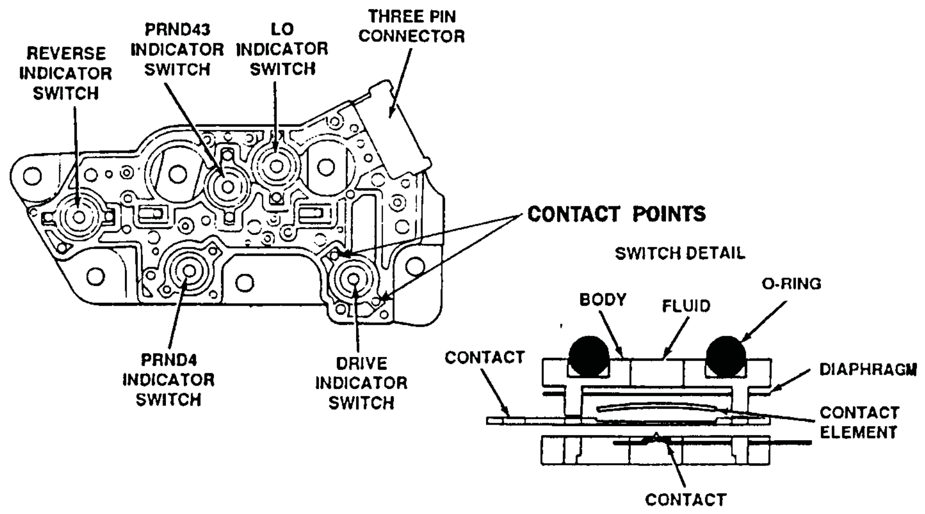


Figure 80

Brake Switch

The brake switch is normally closed when the brake is released. This applies battery voltage to the PCM/TCM signal line, see figure 81. When the brakes are applied the PCM/TCM receives a 0 volt signal and the TCC is released. To check the switch, place volt meter leads across the switch with key on engine off. Battery voltage should be seen. When the pedal is depressed, 0 volts should be seen.

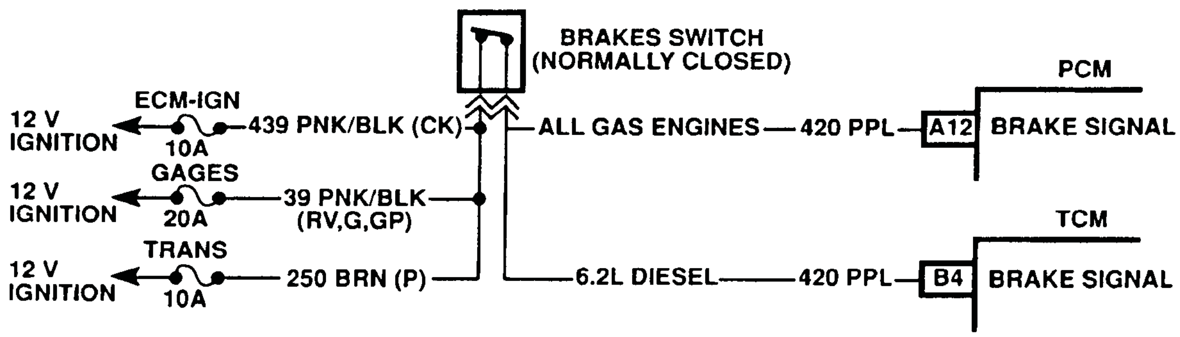


Figure 81

A/C On/Off Request Switch

The A/C Request Switch is used by the PCM/TCM as a discreet input regarding A/C pressure cycling switch status, see figure 82. When the pressure cycling switch closes, a voltage signal is sent from the cycling switch to the A/C compressor clutch and PCM/TCM. This signal is used by the PCM/TCM to adjust line pressure as well as shift timing to accomodate the added engine provided by the compressor. When the cycling switch closes, the PCM/TCM will see 12 volts. When it opens, a 0 volt signal is sent to the PCM/TCM. To test this switch, back probe the Dark Green wire coming off the switch with the positive lead of a volt meter. Put the negative lead to a ground. Run the engine with the air conditioner on. When the switch is closed, 12 volts should be seen. When the switch opens, 0 volts should be seen.

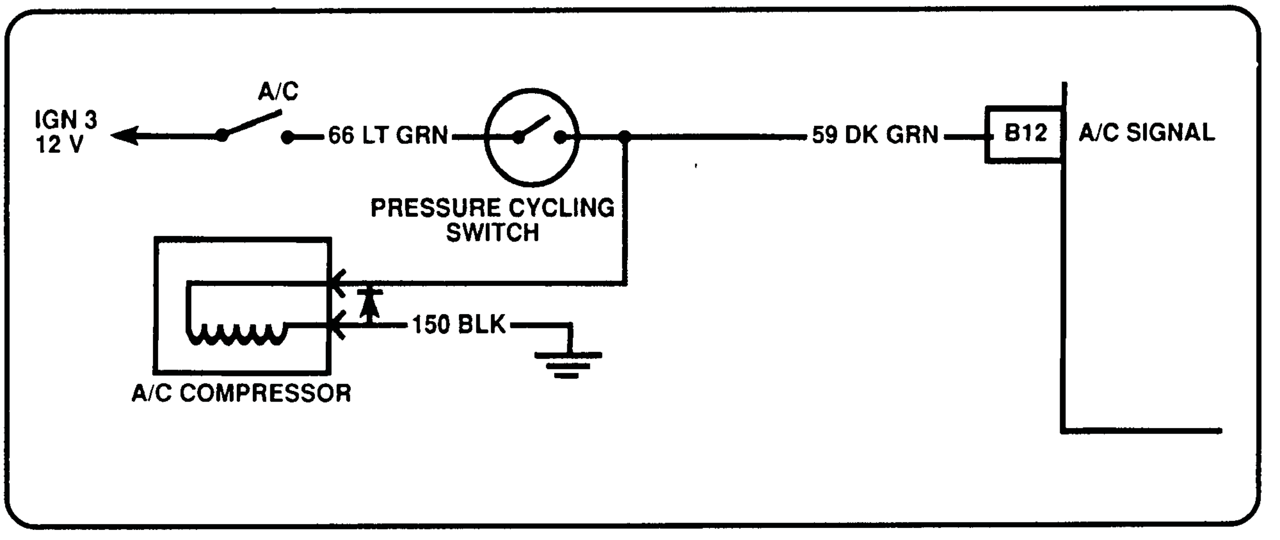


Figure 82

HYDRA-MATIC 4T60-E ELECTRICAL DIAGNOSIS

The G.M. Hydra-Matic 4T60-E front wheel drive transaxle is currently found in 1991 and up Cadillacs, Buicks, Oldsmobiles and Chevrolet passenger cars. It will eventually replace all 4T60 (440-T4) transaxels, with complete change over expected by 1993. Shift decisions at the solenoids are made by the Power Train Control Module (PCM), located behind the right hand side kick panel on 3800 C cars. On Cadillac models, the PCM is behind the right hand side of the instrument panel. It replaces the previous vehicle ECM, since management now includes the transaxel as well as the engine. On 3.4L DOHC vehicles, it is still known as the Electronic Control Module, or ECM. The ECM on these models can be found under the hood on the right side of the engine compartment. Figure 83 shows the inputs and outputs for both the PCM and ECM.

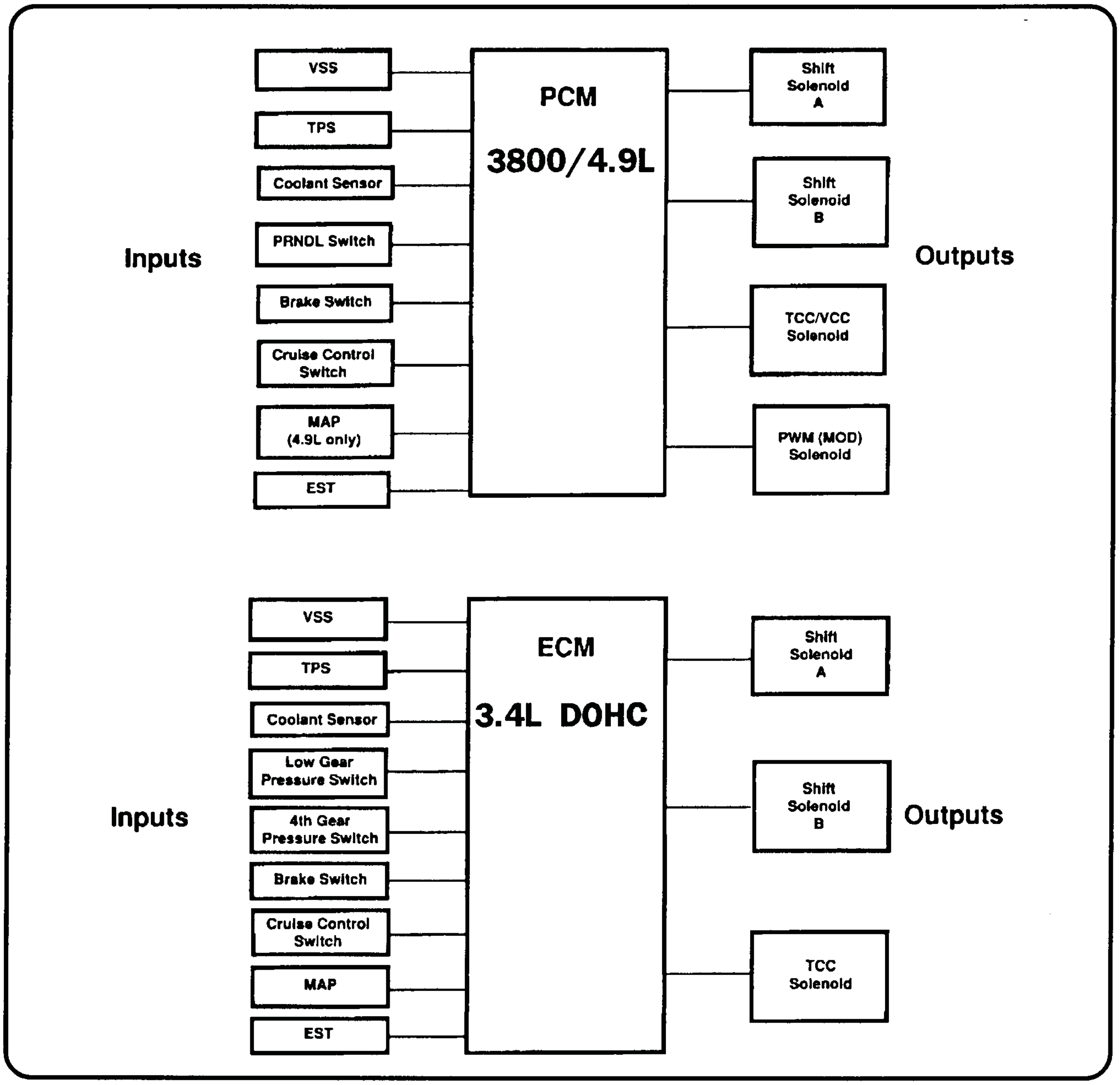


Figure 83

The PCM for 3800 and 4.9L engines operates four solenoids in the transaxle, two shift solenoids, a torque converter clutch solenoid (TCC) or viscous converter clutch solenoid (VCC) on Cadillacs, and a pulse-width modulated TCC solenoid which controls the feel of converter clutch apply and release. Shift points are made based on sensors input and information input regarding vehicle speed (VSS), throttle position (TPS), coolant temperature (CTS), brake switch operation, cruise control operation, manifold absolute pressure on 4.9L only (MAP), PRNDL switch operation and the electronic spark timing system pulse reference (EST).

The ECM for 3.4L DOHC engine operates only three solenoids, two shift solenoids and a torque converter clutch solenoid. Sensor inputs and information inputs for shift timing and TCC decisions are slightly different from the 3800 and 4.9L engines. The PRNDL switch is replaced by a low gear pressure switch and a 4th gear pressure switch.

When an electrical problem is detected, the PCM/ECM will store trouble codes which can be retrieved with the use of a scanner or jumping the ALDL connector(See Page 102). Trouble codes on Cadillacs are retrieved through the Climate Control Panel. See page 105 for instructions on retrieving codes.

If the PCM/ECM detects an electrical problem, it will force the transaxle into 3rd gear (failsafe) for Buick, Oldsmobile and Chevrolet models, and 2nd gear for all Cadillac models. Cadillac models go to 2nd gear to protect the Viscous Clutch (VCC) from overheating and causing damage. A Cadillac which is stuck in third gear means that a power loss to the PCM or shift solenoids has occurred.

INPUTS

Vehicle Speed Sensor:

The VSS is an A.C. voltage generator located on the final drive housing (figure 84). This sensor should measure 1200 to 1500 ohms. It can also be checked with a volt meter set to A.C. volts. With the vehicle stopped, 0 volts should be seen. As vehicle speed increases, voltage should increase. A code 24 will set if the vehicle speed drops from greater than 18 mph to 0 mph, with the brake not applied, in less than 2 seconds. It will also set if the vehicle speed is below 3 mph and the engine is operating above 3,000 rpm for more than 2 seconds while out of park or neutral. No code 31 is present which would indicate a bad PRNDL switch. Symptoms that could occur with a bad speed sensor would be stuck in first gear until codes are set, third gear starts after codes are set with a downshift into second gear only during WOT operation, and a loss of TCC. Cadillacs fail safe to second gear after codes are set.

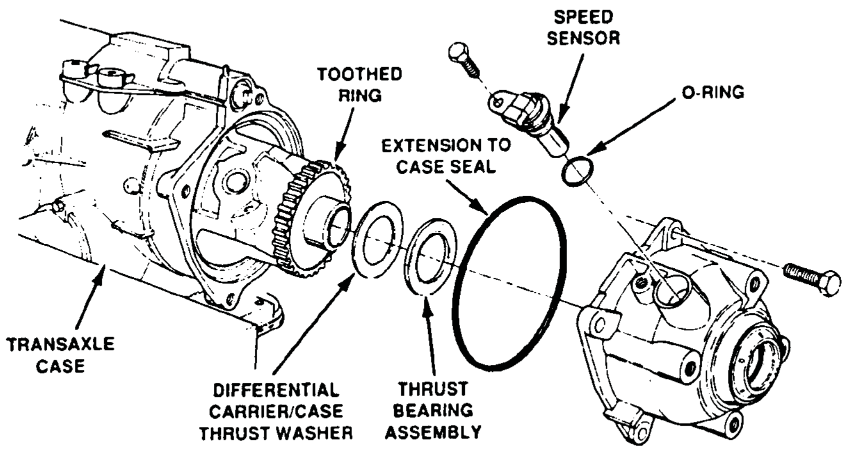


Figure 84

Throttle position sensor:
On 3800 C cars, the TPS is found mounted to the lower portion of the throttle body below the mass air flow sensor, see figure 85. On 3.4L engines, the TPS is on the rearward side of the throttle body. On 4.9L Cadillacs, the TPS is on top of the engine, on the rear of the throttle body. The sensor circuit found in figure 85 is from a 3800 C car and is used as an example for its operation. 5 volts is supplied to the TPS through terminal A. Terminal B is the signal return and terminal C is the ground circuit. With the key on engine off, probe terminal B and C with a volt meter set to D.C. volts. At closed throttle, approximately 0.4 volts should be seen. As the throttle is opened, a smooth increase in voltage should be seen. When wide open throttle is reached, approximately 4.5 to 4.9 volts should be seen. Codes 21 and 22 will set if the TPS circuit indicates a problem. Code 21 indicates voltage being too high and 22 indicates voltage being too low. Symptoms that could occur with a bad TPS is a loss of TCC, early or late shifts, no fourth gear, or sensitive passing gear.

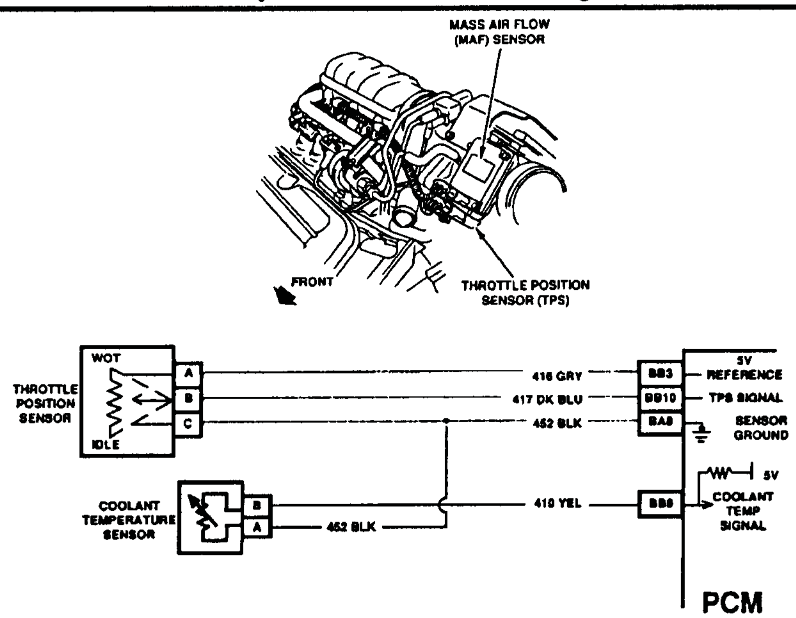


Figure 85

Coolant Temperature Sensor:
The CTS is used to adjust shift points and to determine when the TCC/VCC can be engaged. On 3.4L and 3800 engines, the CTS is found just below the throttle body as shown in figure 86. On Cadillac Eldorado and Seville models, it is on top left side of the engine behind the distributor. On Fleetwood and De Ville, it is on the top center of the engine also behind the distributor. To understand CTS circuit operation, the one found on 3800 C cars is provided in figure 85. Terminal A is the ground circuit. Terminal B is a 5 volt reference circuit. The CTS uses a thermistor to control this 5 volt signal voltage based on engine coolant temperature. When the engine is cold, sensor resistance causes high voltage (5 volts). When the engine reaches operating temperature, resistance lowers the level to 1.5 to 2.0 volts. Code 14 sets when coolant temperature is above 284° F for 0.4 seconds. This may indicate a possible short in circuit B or a bad sensor. Code 15 sets when the coolant temperature is less than -36° F for at least 4 seconds. This may indicate an open in either A or B circuits, or a bad sensor. If either code is set, the PCM/ECM will substitute a default temperature value to allow transaxle operation. To check the CTS, refer to the chart following figure 86 for resistance values at various temperatures.

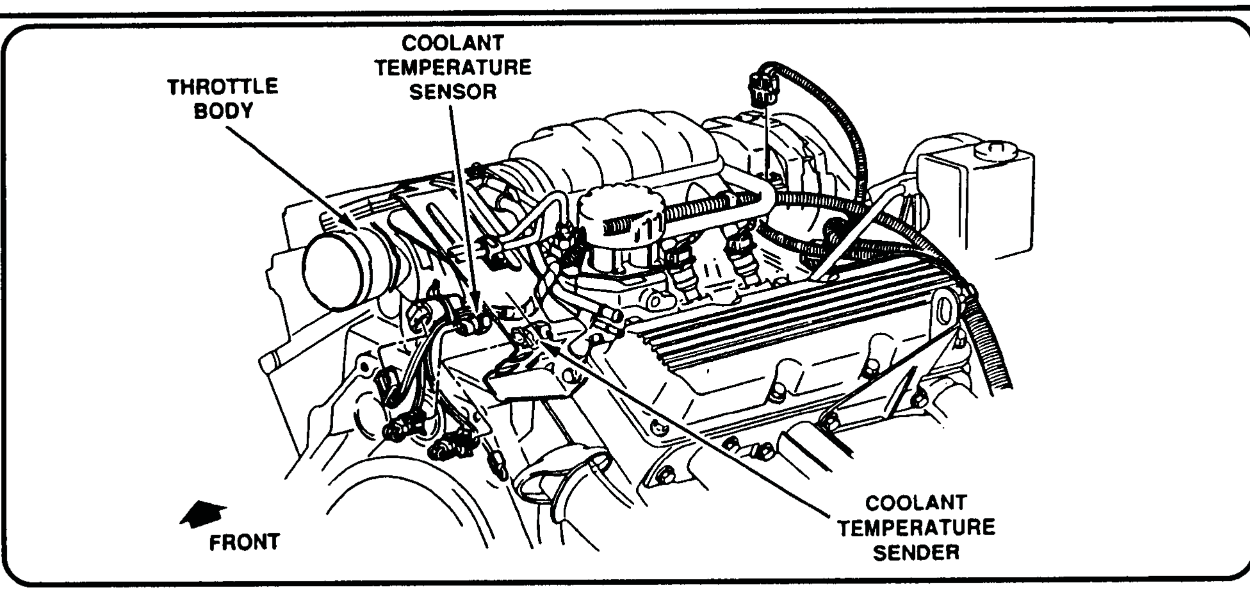


Figure 86

Coolant Temperature Sensor Chart

Degrees F	Degrees C	OHMS
212	100	185
158	70	450
100	38	1,800
68	20	3,400
40	4	7,500
20	-7	13,500

PRNDL Switch:
On models with 3800 or 4.9L engines, operating logic for the electronic shifting controls includes the PRNDL switch. This switch is also known as the position switch and is mounted on the case above the seal for the manual shaft. See figure 87. It tells the PCM which gear range has been selected by the driver. 3.4L DOHC versions do not use a PRNDL switch. A code 31 is the only trouble code related to the PRNDL switch operation. If this code sets, the PCM will default to the D4 shift pattern. If the switch is not properly aligned, manual low will be unattainable.

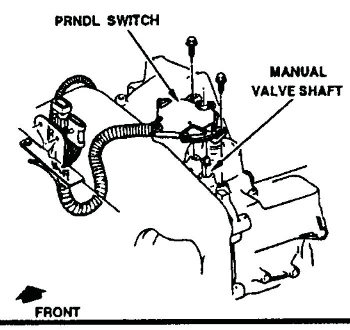


Figure 87

Brake Switch:
The brake switch disengages the TCC/VCC solenoid and is found near the upper portion of the brake pedal arm. If this switch fails, code 38 will set (code 90 on Cadillac models). Some of the symptoms that may occur will be: no TCC/VCC, no converter clutch release when stepping on the brake, or a loss of fourth gear.

Cruise Control Switch:
When engaged, cruise control alters the shift pattern by requiring a time limit to be met between 3-2/2-3 shifts and 4-3/3-4 shifts.

Engine speed:
Engine speed is determined by the ignition module reference pulses and is used for detent downshift patterns.

Manifold Absolute Pressure sensor:
Only the 3.4L and 4.9L engines use a MAP sensor which modifies shift points based on altitude and barometric pressure changes. See figure 88. The MAP sensor receives a 5 volt supply and varies the voltage according to manifold vacuum.

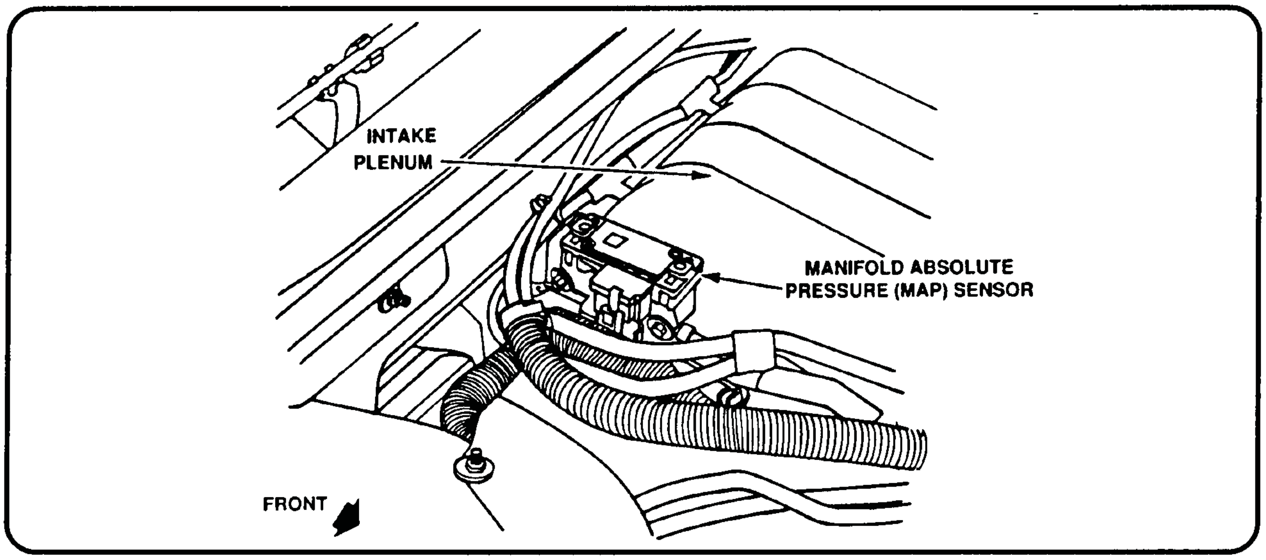


Figure 88

Pressure switches:

The pressure switches found only in the 3.4L DOHC engines are normally open discrete pressure switches (see figure 89). A continuity check can be made with an ohmmeter to verify switch operation. An open should be read without pressure introduced into the switch. When air pressure is introduced into the switch, continuity should be seen. The low pressure switch detects manual valve line pressure in low gear to notify the ECM that manual low has been selected by the driver. The fourth gear pressure switch reads line pressure in fourth gear only to notify the ECM to disable the TCC during 4-3 downshifts.

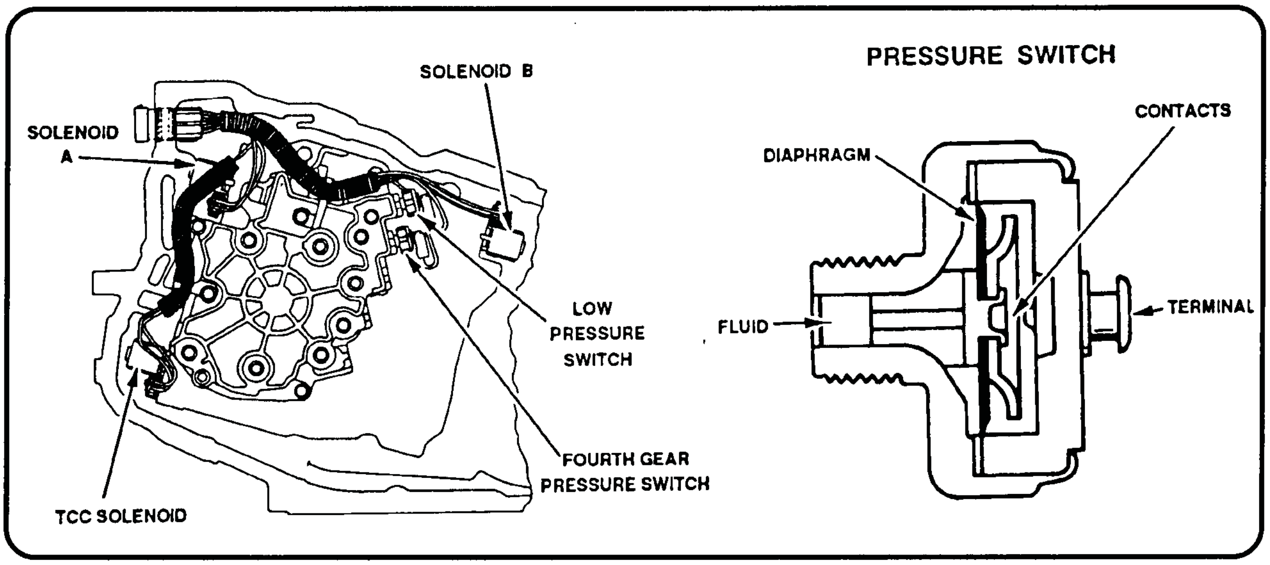


Figure 89

OUTPUTS

Figure 90 shows the solenoid locations and case connector view for the 3800/ 4.9L engines. Each solenoid can be checked at the case connector with an ohmmeter using the chart following figure 90.
Figure 91 shows the solenoid locations and case connector view for the 3.4L DOHC engines. Each solenoid can be checked at the case connector with an ohmmeter using the chart following figure 91.

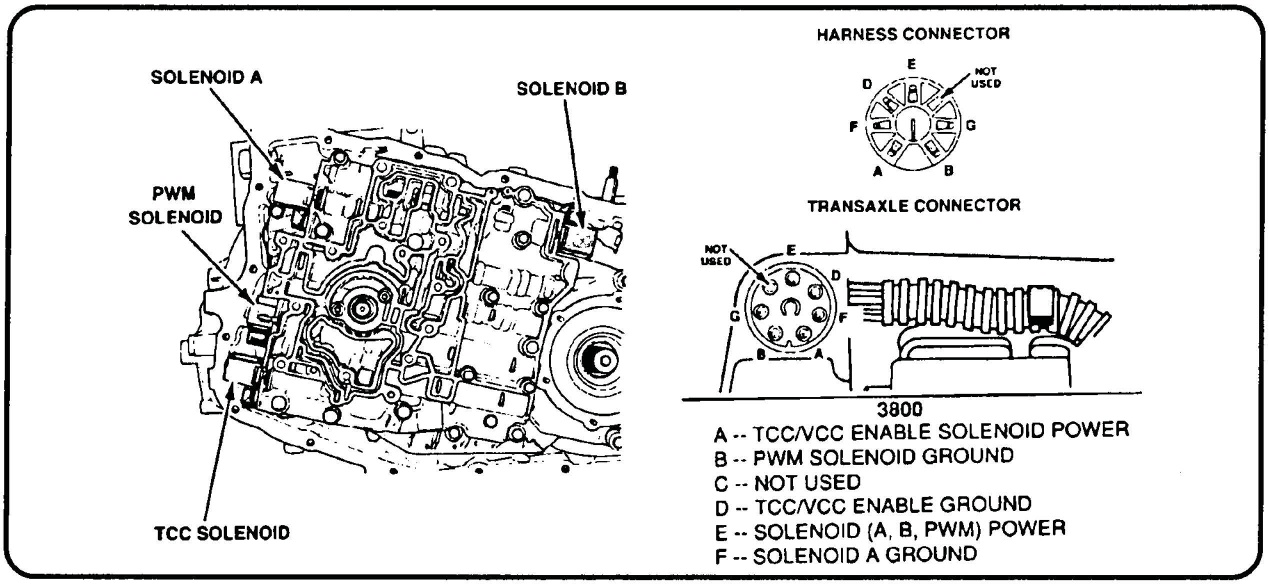


Figure 90

SOLENOID	POSITIVE LEAD	NEGATIVE LEAD	OHMS
PWM-TCC	Terminal E	Terminal B	10-15
TCC/VCC	Terminal A	Terminal D	20-40
SSA	Terminal E	Terminal F	20-40
SSB	Terminal E	Terminal G	20-40

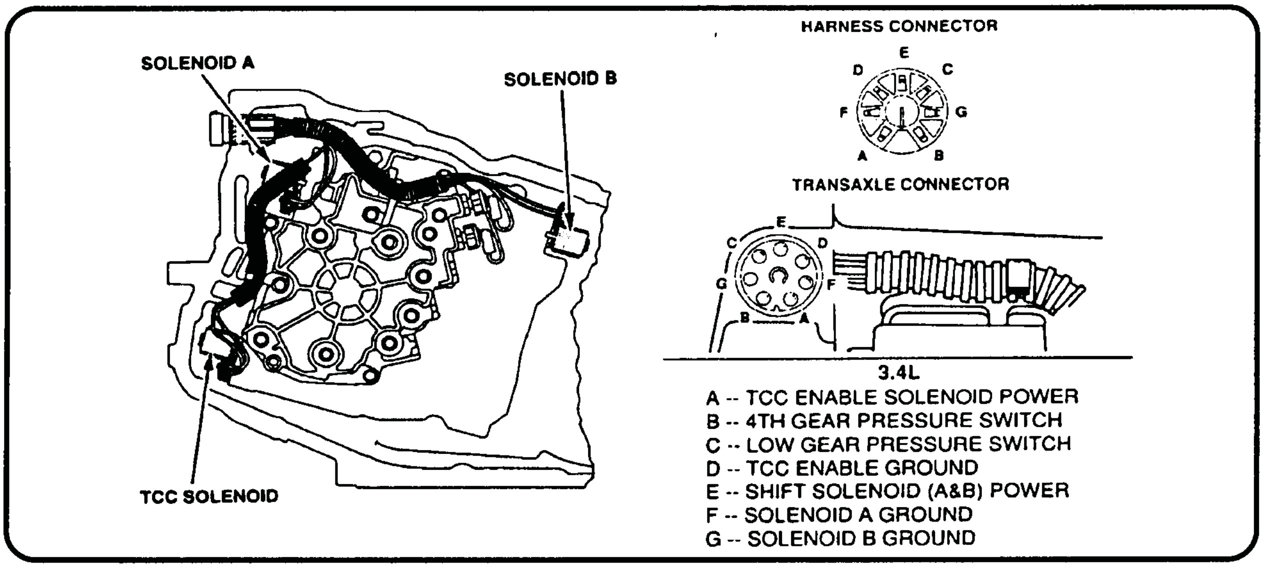


Figure 91

SOLENOID	POSITIVE LEAD	NEGATIVE LEAD	OHMS
TCC	Terminal A	Terminal D	20-40
SSA	Terminal E	Terminal F	20-40
SSB	Terminal E	Terminal G	20-40

The internal wiring harness has a built in diode for the TCC/VCC solenoid. This diode protects the engine powertrain control module from voltage spikes (see figure 92).

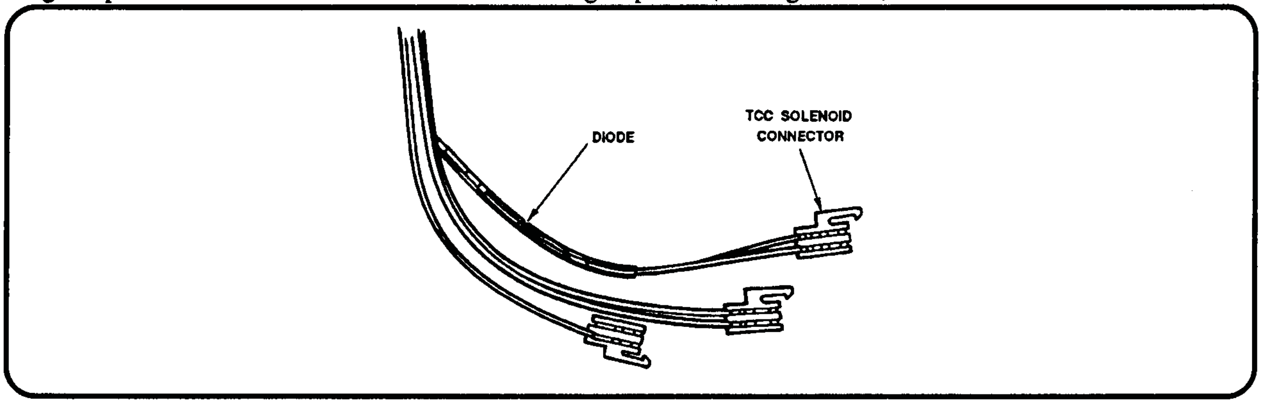


Figure 92

To shift the transaxle separate from the computer, supply 12 volts through a 20 amp fuse to terminal E. Ground terminals F and G for first gear. Remove the ground from terminal F and a shift into second gear will be made. Remove the ground from terminal G for a shift into third. Ground terminal F for a shift into fourth. Refer to the chart below. Cadillacs can preform this function through the Electronic Climate Control Panel, refer to the Star Car Chapter.

GEAR	SSA	SSB
1	ON	ON
2	OFF	ON
3	OFF	OFF
4	ON	OFF

If the transaxle fails to shift properly with this procedure, then an inspection of the solenoids is required. Both the shift solenoids and the TCC solenoid are normally open to exhaust and close to hold pressure when they are energized. The PWM solenoid for the TCC/VCC is a normally closed solenoid and opens to exhaust when energized.

Retrieving Trouble Codes

With Oldsmobile, Chevrolet and Buick vehicles (3800/3.4L), a hand held scanner will retrieve codes when hooked to the Assembly Line Diagnostic Link (ALDL) located under the driver side dash. If a scanner is not available, a manual method of retrieving codes is available by jumping terminals A and B in the ALDL connector, see figure 93.

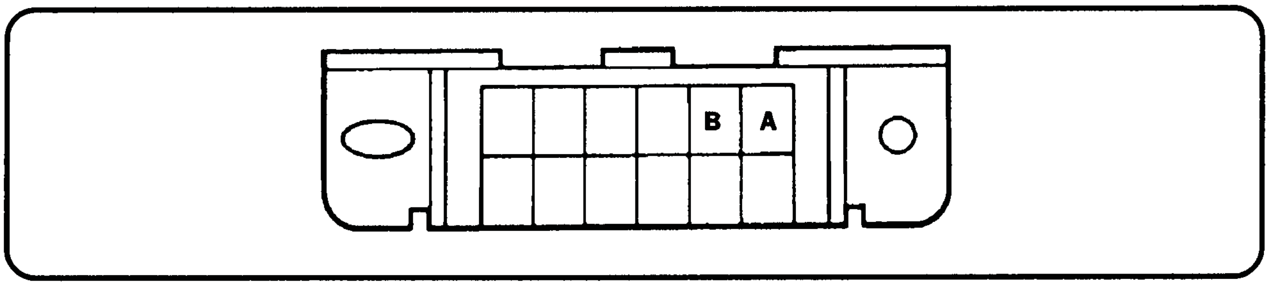


Figure 93

1. Jump terminal A to B.
2. Turn the ignition to the ON position **not** the START position.
3. Codes will appear at the "Service Engine Soon" (S.E.S.) light.
4. The sequence will begin with the S.E.S. light flashing out with a 12. Three 12's indicate that the PCM/ECM diagnostic function is operating.
5. Codes will output in order from the lowest to the highest.

The following chart provides codes for Oldsmobile, Chevrolet and Buick vehicles only. Cadillac code retrieval and code chart is found in the Star Car chapter.

CODE	CONDITION
14 & 15	COOLANT CENSOR CIRCUIT HIGH, LOW
16*	SYSTEM VOLTAGE MALFUNCTION
21 & 22	TPS CIRCUIT HIGH, LOW
24	VSS CIRCUIT MALFUNCTION
26*	QUAD DRIVER MALFUNCTION
31*	PRNDL SWITCH CIRCUIT
36*	SHIFT MALFUNCTION WITH SOLENOID B
38*	TCC BRAKE SWITCH CIRCUIT
	* = 3800 VERSIONS ONLY

STAR CARS

This chapter is devoted to aiding the technician in using the code retrieval method found in 1991 to 1992 Cadillac vehicles. Since Cadillacs on board computer system is capable of accessing many areas of the vehicle, this chapter will deal specifically with transmission related information only.

1991-1992 Fleetwood and De Ville

Code retrieval and parameter selection is accessed through the Electronic Climate Control Panel (ECC). The codes and parameters will be displayed in the Fuel Data Center, see figure 94.

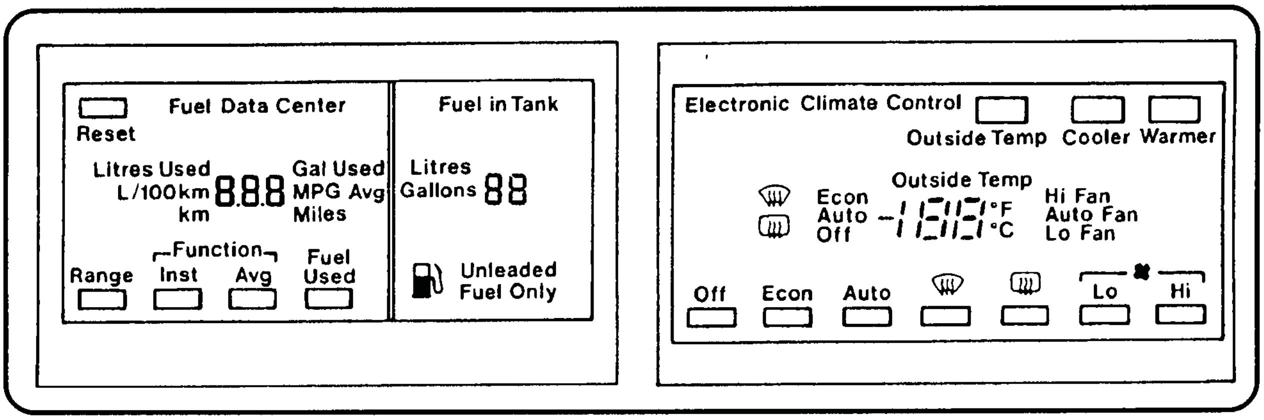


Figure 94

To enter the diagnostic mode, perform the following procedure:

1. To display the diagnostic codes, the ignition must be in the ON position or the engine running and the Cruise Control Switch in the ON position. Press the **OFF** and **WARMER** buttons simultaneously. Hold these buttons until 1.88 appears in the Electronic Climate Control Panel. Number 88 will also appear in the Fuel Data Center. When these numbers appear, release the buttons. The Check Engine and Service Soon lights will be on in the diagnostic mode.

2. If there are any codes in the system, they will be displayed in the Fuel Data Center. First an E will appear then the codes. They will be displayed from the lowest to the highest starting with PCM codes, followed by BCM codes. Refer to chart 1 for a list of the PCM codes only.

3. When all the codes have been displayed, a .7.0 number will appear. At this time you can enter the parameter mode by pressing the **Lo** button until you see E.9.0. When the button is released, a P.0.1 will appear which means you are in parameter number 1. To go up in parameters, push the **Hi** button like a door bell and you will move up to the next parameter. To go back down, press the **Lo** button. Refer to chart 2 for range information which will allow you to diagnose individual sensors. For example, parameter 1 will allow you to view the throttle position sensor. With the engine off and the ignition in the ON position, at closed throttle an approximate value of -10.0 degrees should be seen. As you step down on the throttle, the degrees should increase in direct proportion to throttle opening. When wide open throttle is reached, an approximate 90.0 degrees should be seen.

4. To exit the diagnostic mode, press the **AUTO** button in the Electronic Climate Control Panel.

5. **To clear the trouble codes**, re-enter the diagnostic mode as described in step 1. After the codes are displayed and .7.0 appears, press the **OFF** and **HI** buttons simultaneously. Hold these buttons until E.0.0 appears in the Fuel Data Center. When the buttons are released, .7.0 should be displayed. Press the **AUTO** button to exit the diagnostic mode.

PCM DIAGNOSTIC CODES

CODE	DESCRIPTION	TELLTALE STATUS
E12	No Distributor Signal	A
E13	Oxygen Sensor Not Ready	A,P
E14	Shorted Coolant Sensor Circuit	A
E15	Open Coolant Sensor Circuit	A
E16	Voltage Out Of Range [ALL SOL.]	B
E19	Shorted Fuel Pump Circuit	B
E20	Open Fuel Pump Circuit	B
E21	Shorted TPS Circuit [VCC]	A
E22	Open TPS Circuit [VCC]	A
E23	EST Signal Problem [EGR]	A
E24	VSS Circuit Problem [C/C, VCC]	A,Q
E26	Shorted Throttle Switch Circuit [EGR]	A
E27	Open Throttle Switch Circuit [EGR]	A
E30	ISC RPM Out Of Range	A
E31	Shorted MAP Sensor Circuit	A
E32	Open MAP Sensor Circuit	A
E34	MAP Sensor Signal Out Of Range	A
E37	Shorted MAT Sensor Circuit	A
E38	Open MAT Sensor Circuit	A
E39	VCC Engagement Problem [VCC]	A,F
E40	Power Steering Pressure Switch	A
E41	Cam Sensor Circuit Problem	A
E44	Oxygen Sensor Signal Lean	A,P
E45	Oxygen Sensor Signal Rich	A,P
E47	BCM—PCM Data Problem	A
E48	EGR Control Problem	A

CODE	DESCRIPTION	TELLTALE STATUS
E52	PCM Memory Reset	A
E53	Distributor Signal Interrupt	C
E55	TPS Misadjusted	C
E58	PASS Control Problem	C
E60	Cruise-Transmission Not In Drive [C/C]	C
E61	Cruise-Vent Solenoid Problem [C/C]	C
E62	Cruise-Vacuum Solenoid Problem [C/C]	C
E63	Cruise-Speed vs Set Speed [C/C]	C
E64	Cruise-Vehicle Acceleration [C/C]	C
E65	Cruise-S P S Failure [C/C]	C
E66	Cruise- RPM Out Of Range [C/C]	C
E67	Cruise-Switch Shorted At Enable [C/C]	C
E68	Cruise Command Problem [C/C]	C,Q
E70	Intermittent TPS	C
E71	Intermittent MAP	C
E73	Intermittent Coolant Sensor	C
E74	Intermittent MAT	C
E75	Intermittent VSS	C
E80	Fuel System Rich	A
E85	Throttle Body Service Required	A
E90	VCC Brake Switch Input Problem [C/C]	B
E91	PRNDL Switch Problem [C/C]	B
E92	Heated W/S Request Problem	B
E96	Torque Converter Over stress	C
E97	P/N To D/R Engagement Problem	C
E98	P/N To D/R ISC Engaged Problem	C
E99	Cruise Servo Apply Problem [C/C]	C

TELLTALE STATUS

A = 'SERVICE ENGINE SOON' Light ON.
B = 'SERVICE VEHICLE SOON' Light ON.
C = NO TELLTALE ON.
F = DISENGAGES VCC FOR IGNITION CYCLE
P = ENABLES CANISTER PURGE
Q = DISABLES CRUISE FOR IGNITION CYCLE
[ ] = BRACKETED SYSTEMS ARE DISABLED WHEN CODE IS CURRENT

M66001-8D1-EK-I

Chart 1

NUMBER	PARAMETER	DISPLAY RANGE	DISPLAY UNITS
.0.1	Throttle Position	-10.0- 90.0	Degrees
.0.2	MAP	14- 109	KPa
.0.3	Computed BARO	61- 103	KPa
.0.4	Coolant Temperature	- 40- 151	°C
.0.5	MAT	- 40- 151	°C
.0.6	Spark Advance	0- 90	Degrees
.0.7	Battery Voltage	0- 25.6	Volts
.0.8	Engine RPM	0- 6370	RPM ÷ 10
.0.9	Vehicle Speed	0- 225	MPH
.1.2	Injector Pulse Width	0- 99.6	ms
.1.4	Oxy Sensor Volts	0- .99	Volts
.1.6	Oxy Sensor Cross Counts	0- 255	Counts
.1.8	Integrator	0- 255	Counts
.2.0	Block Learn	0- 255	Counts
.2.1	Cruise Feedback	0- 99.6	%
.2.2	PRNDL1	00- 11	Code
.2.3	PRNDL2	00- 11	Code
.2.4	Ignition Cycles	0- 255	Number
.2.5	PROM ID Code	0- 999	Code

Chart 2

CODE	OVERRIDE	COOL	WARM
E.5.0	NO OVERRIDE	OFF	ON
E.5.1	VCC SOLENOID	OFF	ON
E.5.2	EGR SOLENOID	OFF	ON
E.5.3	ISC MOTOR *	RET	EXT
E.5.4	INJECTOR (1 THRU 8) *	OFF	SEL
E.5.5	FUEL PUMP RELAY	OFF	
E.5.6	NOT VALID	NA	NA
E.5.7	CRUISE SERVO	RET	EXT
E.5.8	COOLING FANS	LO	HI
E.5.9	FIXED SPARK *	RET	ADV
E.6.0	INJECTOR FLOW *	SEL	TEST
E.6.1	TRANSMISSION SHIFT *	UP	DWN

* 8.8.8 displayed if test cannot be performed

Chart 3

PCM OVERRIDES

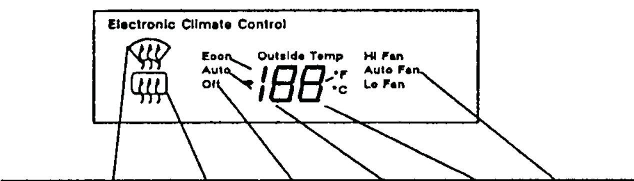
PCM Override allows you to override computer commands and activate specific functions for testing purposes. Chart 3 is a list of the overrides allowed.

Two of the functions allowed is to be able to override the VCC Solenoid and the Transmission Shift Solenoids. To activate this test, start the vehicle and enter the diagnostic mode by pressing the **OFF** and **WARMER** buttons simultaneously as described in step 1 at the beginning of this chapter. When the FDC (Fuel Data Center) displays .7.0, press the **HI** button on the ECC panel. The FDC should display a E.9.5, at this time press the **ECON** and **WARMER** buttons simultaneously. E.5.0 will be displayed on the FDC. In the PCM Override chart you can see that E.5.1 is the override mode for the VCC solenoid. To get into this mode the **HI** button is used to scroll up and the **LO** button is used to scroll down. Press the **HI** button once and the FDC will display E.5.1. You are now ready to activate this solenoid yourself. Simply press the **WARMER** button and the solenoid will be energized. The FDC should show you a number 99 if the solenoid was energized. If 00 was displayed, the solenoid was not energized.

To enter the transmission shift override mode, press the **Hi** button on and off and scroll up to the E.6.1 setting. The transmission will upshift one gear each time you press the **WARMER** button. The FDC will display the number of the gear selected. The transmission will downshift each time you press the **COOLER** button. The FDC will display the number of the gear selected. The PCM will prevent a downshift from 2nd to 1st above 30 mph and 3rd to 2nd above 60 mph. To exit the system, simply push the **AUTO** button and you are out.

When the vehicle is driven with the Electronic Climate Control Panel in the diagnostic mode, graphic display and lights in the panel indicate specific operation modes, see figure 95.

PCM STATUS LIGHT DISPLAY



INDICATOR			OFF	AUTO	ECON	AUTO FAN
FUNCTION	VCC OUTPUT	4TH GEAR COMMAND	THROTTLE SWITCH INPUT	PCM OPERATING MODE	OXYGEN SENSOR INPUT	ENGINE COOLING FAN
LIGHT ON	VCC ENABLED	IN 4TH GEAR	CLOSED THROTTLE	CLOSED LOOP	RICH	FAN ON
LIGHT OFF	VCC DISABLED	NOT IN 4TH GEAR	OPEN THROTTLE	OPEN LOOP	LEAN	FAN OFF

Figure 95

The **DEFOG** status indicator is used for the VCC. This graphic light only indicates whether the PCM is commanding the VCC solenoid to be energized. When it is off, the solenoid is de-energized. The actual operation depends on the integrity of the VCC system.

The **REAR DEFOG** status indicator is used for fourth gear. This graphic light should only be on when fourth gear is commanded.

The **OFF** status indicator is lite when the throttle is closed. The light should go off whenever the throttle is applied.

The **AUTO** status indicator is turned on whenever the PCM is operating in "Closed-Loop" fuel control. This light should come on after the coolant and oxygen sensors have reached normal operating temperatures.

The **ECON** status indicator is used for the oxygen sensor signal. The indicator is lite for a "rich" exhaust condition and off for a "lean" exhaust condition. The indicator light should toggle on and off with a warm engine and steady throttle.

The **AUTO FAN** status indicator is used for the engine cooling fans. The indicator should be lite when the cooling fans are operating.

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Code retrieval and parameter selection is accessed through the Electronic Climate Control Panel (ECC). The codes and parameters will be displayed in the Driver Information Center (DIC), see figure 96.

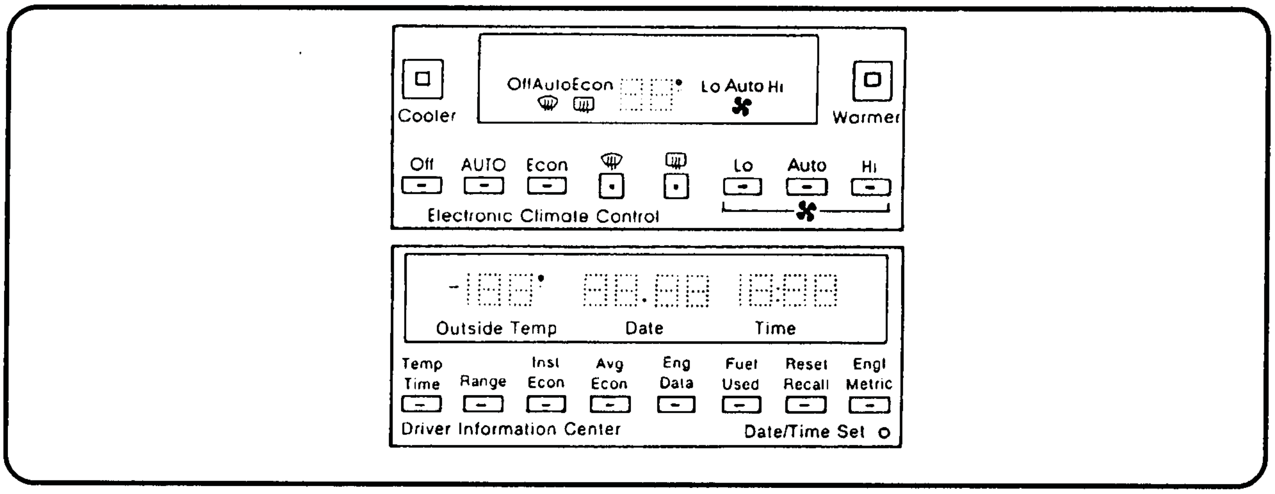


Figure 96

To enter the diagnostic mode, perform the following procedure:

1. Turn the ignition to the ON position or engine running.

2. Press the **OFF** and **WARMER** buttons simultaneously. The Check Engine and Service Soon lights will be on in the diagnostic mode.

3. The DIC will display any codes that may be stored in memory. Codes may be stored for the ECM/PCM (Engine Control Module or Powertrain Control Module), BCM (Body Computer Module), or SIR (Supplemental Inflatable Restraint). Each code will have a letter before the number indicating which code it is. Example: code E014 is an ECM/PCM code. It will also be followed by a letter "C" or "H". The "C": means the code is current and the "H" means the code is history. If no codes are present for a system, a "NO X CODE" message (with the X being the system i.e. NO E CODE or NO B CODE) will be displayed. To display the codes over again press the **OFF** button. Refer to chart 4 for a list of ECM/PCM codes.

4. **To exit the system at any time**, press the **RESET/RECALL** button on the DIC.

5. **After the codes are displayed the DIC will display "ECM?". This will allow you to enter the parameter mode**. At this time, press the **Hi** button and "ECM DATA?" will appear. If dashes should appear, this test is not allowed with the engine running. Press **Hi** again and ED01 will appear which means that you are now in parameter 1 which will allow you to view the throttle position sensor. To move up to the next parameter press the **Hi** button. To move back down to the previous parameter, press the **Lo** button. Refer to chart 5 for the list of parameters.

PCM DIAGNOSTIC CODES

CODE	DESCRIPTION	TELLTALE STATUS
E012	No Distributor Signal	A
E013	Right Oxygen Sensor Not Read	A,P
E014	Shorted Coolant Sensor Circuit	A
E015	Open Coolant Sensor Circuit	A
E016	Voltage Out Of Range [ALL SOL.]	B
E017	Left Oxygen Sensor Not Ready	A
E019	Shorted Fuel Pump Circuit	B
E020	Open Fuel Pump Circuit	B
E021	Shorted TPS Circuit [VCC]	A
E022	Open TPS Circuit [VCC]	A
E023	EST Signal Problem [EGR]	A
E024	VSS Circuit Problem [C/C, VCC]	A,Q
E026	Shorted Throttle Switch Circuit [EGR]	A
E027	Open Throttle Switch Circuit [EGR]	A
E030	ISC RPM Out Of Range	A
E031	Shorted MAP Sensor Circuit	A
E032	Open MAP Sensor Circuit	A
E034	MAP Sensor Signal Out Of Range	A
E037	Shorted MAT Sensor Circuit	A
E038	Open MAT Sensor Circuit	A
E039	VCC Engagement Problem [VCC]	A,F
E040	Power Steering Pressure Switch	A
E041	Cam Sensor Circuit Problem	A
E042	Left Oxygen Sensor Lean	A,P
E043	Left Oxygen Sensor Rich	A,P
E044	Right Oxygen Sensor Signal Lean	A,P
E045	Right Oxygen Sensor Signal Rich	A,P
E046	Right To Left Bank Fueling Problem	A
E047	BCM—PCM Data Problem	A

CODE	DESCRIPTION	TELLTALE STATUS
E048	EGR Control Problem	A
E051	MEM-CAL Error	A
E052	PCM Memory Reset	C
E053	Distributor Signal Interrupt	C
E055	TPS Misadjusted	C
E058	PASS Control Problem	C
E060	Cruise-Transmission Not In Drive [C/C]	C
E061	Cruise-Vent Solenoid Problem [C/C]	C
E062	Cruise-Vacuum Solenoid Problem [C/C]	C
E063	Cruise-Speed vs Set Speed [C/C]	C
E064	Cruise-Vehicle Acceleration [C/C]	C
E065	Cruise-S P S Failure [C/C]	C
E066	Cruise-RPM Out Of Range [C/C]	C
E067	Cruise-Switch Shorted At Enable [C/C]	C
E068	Cruise Command Problem [C/C]	C,Q
E070	Intermittent TPS	C
E071	Intermittent MAP	C
E073	Intermittent Coolant Sensor	C
E074	Intermittent MAT	C
E075	Intermittent VSS	C
E080	Fuel System Rich	A
E085	Throttle Body Service Required	A
E090	VCC Brake Switch Input Problem [C/C]	B
E091	PRNDL Switch Problem [C/C]	B
E092	Heated Windshield Problem	B
E096	Torque Converter Overstress	A
E097	High RPM P/N to D/R Shift	C
E098	High RPM P/N To D/R Shift Under ISC	C
E099	Cruise Servo Apply Problem [C/C]	C

TELLTALE STATUS

A = "SERVICE ENGINE SOON" Light ON.
B = "SERVICE CAR SOON" Message On DIC.
C = NO TELLTALE or Message.
F = DISENGAGES VCC FOR IGNITION CYCLE
P = ENABLES CANISTER PURGE
Q = DISABLES CRUISE FOR IGNITION CYCLE
[ ] = BRACKETED SYSTEMS ARE DISABLED WHEN CODE IS CURRENT

M66001-8D1-EK-I

Chart 4

PCM DATA

PARAMETER NUMBER	PARAMETER	DISPLAY RANGE	DISPLAY UNITS
ED01	Throttle Position	-10.0 - 90.0	Degrees
ED02	MAP	14 - 109	kPa
ED03	Computed BARO	61 - 103	kPa
ED04	Coolant Temperature	-40 - 151	°C
ED05	MAT	-40 - 151	°C
ED08	Spark Advance	0 - 52	Degrees
ED10	Battery Voltage	0 - 25.5	Volts
ED11	Engine RPM	0 - 6375	RPM
ED12	Vehicle Speed	0 - 255	MPH
ED19	Power Steering Switch	0 *	kPa
ED30	Left Injector Pulse Width	0 - 99.9	mSec
ED31	Rt. Injector Pulse Width	0 - 99.9	mSec
ED32	Left Oxygen Sensor Voltage	0 - 1.16	Volts
ED33	Rt. Oxygen Sensor Voltage	0 - 1.16	Volts
ED34	Left O_2 Sensor Cross Counts	0 - 255	Number/Sec
ED35	Rt. O_2 Sensor Cross Counts	0 - 255	Number/Sec
ED36	Left Fuel Integrator	0 - 255	Counts
ED37	Rt. Fuel Integrator	0 - 255	Counts
ED38	Left Block Learn Fuel	0 - 255	Counts
ED39	Right Block Learn Fuel	0 - 255	Counts
ED70	Cruise Feedback	0 - 99	%
ED71	PRNDL 1 Gray Code	00 11	Code
ED72	PRNDL 2 Gray Code	00 11	Code
ED98	Ignition Cycle Counter	0 - 50	Key Cycles
ED99	PCM PROM ID	0 - 9999	Code●

Chart 5

PCM OVERRIDES ■

OUTPUT OVERRIDE NUMBER	OUTPUT OVERRIDE	OVERRIDE VALUE COOLER	OVERRIDE VALUE WARMER
ES00	No Overrides	—	—
ES01	VCC Solenoid	ON	OFF
ES02	EGR Solenoid	OFF	ON
ES03	ISC Motor Control*	Retract	Exnd
ES04	Injector Control*	OFF	Cyl 1-8
ES05	Fuel Pump Relay	OFF	
ES06	AIR System	≡≡	≡≡
ES07	Cruise Servo Command	Relax	Apply
ES08	Cooling Fan Relay	LO	HI
ES09	Spark Advance	Retard	Advance
ES10	Injector Flow*	Inj 1-8	Open
ES11	Transmission Gear*	DOWN	UP

≡≡ *Test NOT valid or Wrong Test Conditions.*

Chart 6

6. After the parameter checks have been made, press the **OFF** button and "ECM INPUTS" will appear. Press the **Lo** button and "ECM OUTPUTS" will appear, press the **Lo** button again and "ECM OVERRIDE" will appear. **When the "ECM OVERRIDE" appears you can now enter the Override mode.** This will allow you to override the computer and shift the transmission yourself as well as energizing the VCC solenoid. Press the **Hi** button and "ES00" will be displayed, you are now in the Override mode. In the Override chart above you can see that the Override number for

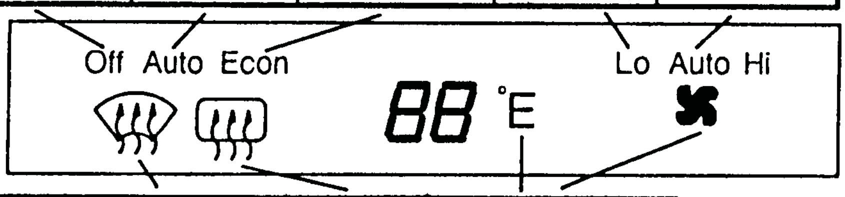
the VCC solenoid is ES01. To move up from ES00 to ES01, press the **Hi** button. Once ES01 appears, any time you press the **WARMER** button, the converter clutch solenoid is energized. To shift the transmission, press the **Hi** button on and off until ES11 appears. The transmission will upshift one gear each time you press the **WARMER** button. The DIC will display the number of the gear selected. The transmission will downshift each time you press the **COOLER** button. The DIC will display the number of the gear selected. The PCM will prevent a downshift from 2nd to 1st above 30 mph and a 3rd to 2nd above 60 mph. To exit the system see step 4, to clear all codes from the Override mode, press the **OFF** button and "ECM CLEAR CODES?" will appear. At this time you can press the **Hi** button and all codes will be erased.

7. To clear codes enter the diagnostic mode as described in steps 1 through 3. Once the codes are all displayed and "ECM?" appears, press the **Hi** button and "ECM DATA" will appear. Press the **Lo** button on and off slowly 4 times and stop, "ECM CLEAR CODES" should appear. At this time you can press the **Hi** button and all codes will be erased. To exit the system see step 4.

When the vehicle is driven with the Electronic Climate Control Panel in the diagnostic mode, graphic display and lights in the panel indicate specific operation modes, see figure 97.

PCM STATUS LIGHTS

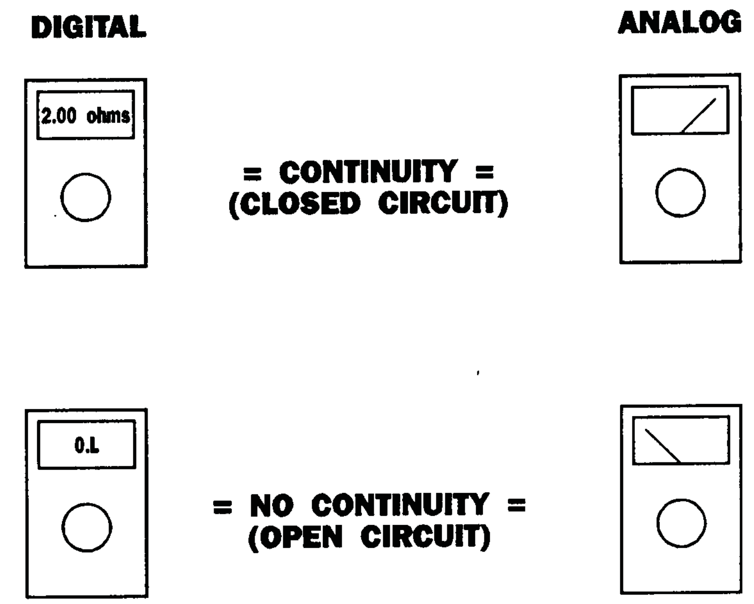
INDICATOR	OFF	AUTO	ECON	Lo	Auto
FUNCTION	LEFT OXYGEN SENSOR INPUT	OPERATING MODE	RT. OXYGEN SENSOR INPUT	THROTTLE SWITCH	P/N SWITCH
ON	RICH	CLOSED LOOP	RICH	CLOSED	P/N
OFF	LEAN	OPEN LOOP	LEAN	OPEN	NOT P/N

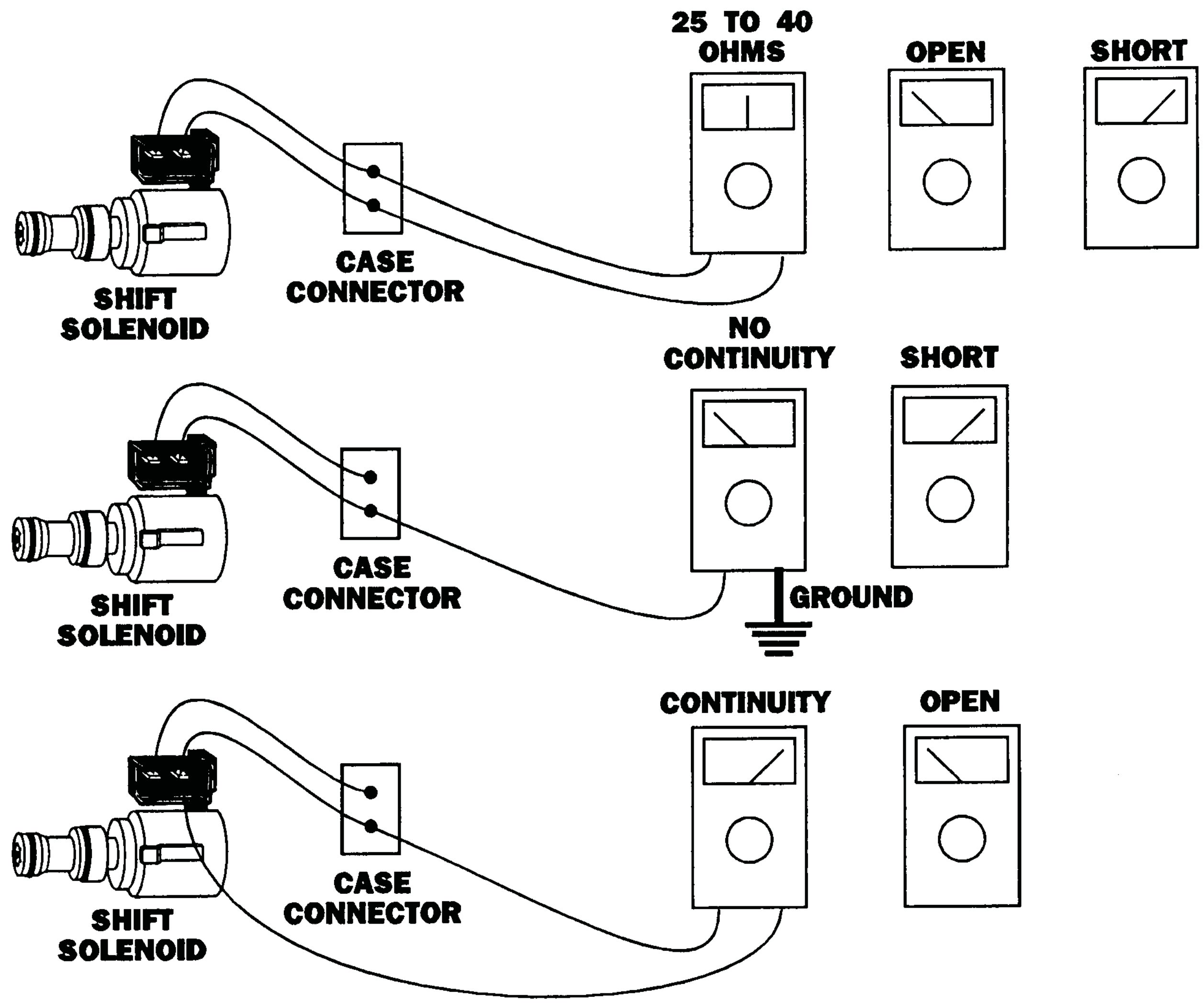


INDICATOR	FRONT DEF	REAR DEF	°E	
FUNCTION	A/C CLUTCH	VCC	3RD	4TH
LIGHT ON	ENERGIZED	ENABLED	°C	°F
LIGHT OFF	DE-ENERGIZED	DISABLED		

Figure 97

BASIC MULTIMETER READINGS





METER SYMBOLS

mV = MILLI VOLTS

V = VOLTS

mA = MILLI AMPS

A = AMPS

Ω = OHM

Ω m = MILLI OHMS

Ω k = KILO OHMS

$\tilde{V}$ = AC VOLTS

$\overline{V}$ = DC VOLTS

SUFFIX	SYMBOL	RELATION TO BASIC UNIT	EXAMPLES
MEGA	M	1 000 000	8M Ω (MEGOHMS) = 8 000 000 OHMS
KILO	k	1000	20 kv (KILOVOLTS) = 20 000 VOLTS
MILLI	m	0.001 OR 1/1000	50 mv (MILLIVOLTS) = 0.050 VOLTS
MICRO	µ	0.000 001 OR 1/1 000 000	18 µ a (MICRO AMPS) = 0.000 018 A
NANO	η	0.000 000 001	20 ηv (NANO VOLTS) = .000 000 020 VOLTS

MOVEMENT OF DECIMAL POINT TO AND FROM BASE UNITS

3	3		3	3
M (MEGA)	k (KILO)	BASE UNITS	m (MILLI)	µ (MICRO)
3	3		3	3