REVISED 11/94

INDEX
IMPORT PASS BOOK
VOLUME I

VOLUME 1

INTRODUCTION
Import Computer Control

The purpose of the Import Computer Controls Manual, Volume I is to guide the technician to an understanding of the communication between the computer and the transmission. Testing and diagnosing requires some working knowledge of this communication. Therefore, in this manual, we will attempt to simply identify and explain the inputs and outputs of the import computers. Special attention is given to testing transmission solenoids, R.P.M. sensors, and T.P.S. switches. Many import transmission controls can be checked using scanners and transmission testers. This book identifies which transmissions can be diagnosed with the help of such devices. Also a list of transmission computer trouble codes can be found at the end of each chapter. Each transmission is covered separately and testing procedures may be located using the index on page two.

Compiled by: FRANK MIETUS

ROBERT D. CHERRNAY
TECHNICAL DIRECTOR

DALE ENGLAND
FIELD SERVICE CONSULTANT

WAYNE COLONNA
TECHNICAL SUPERVISOR

ED KRUSE
TECHNICAL CONSULTANT

PETE LUBAN
TECHNICAL CONSULTANT

JIM DIAL
TECHNICAL CONSULTANT

GREGORY LIPNICK
TECHNICAL CONSULTANT

DAVID CHALKER
TECHNICAL CONSULTANT

AUTOMATIC TRANSMISSION SERVICE GROUP
9200 S. DADELAND BLVD.
SUITE 720
MIAMI, FL 33156
(305) 670-4161

ACURA COMPUTER DIAGNOSIS 1987-1990

Although most diagnostic procedures are the same in Acuras and Hondas, some differences must be noted. The location of the **A/T Controller** is not consistent with Acura from model to model. In some models it may be found under either seat or under the carpet. The Integra can have the controller under the dash, to the left of the steering column. It will be wise to locate the A/T controller by the good ol' visual inspection method. A flashing S3 light indicates that the A/T controller has one or more trouble codes stored in its memory. Codes may also be present with no flashing light. A flashing L.E.D. light on the controller itself will determine the code number. See **page 10** at the end of this chapter for trouble code translation. Electronically controlled Acura transmissions start in 4th gear if the controller fails to energize the shift solenoids. 2nd gear will still be hydraulically available with the selective lever. In the case of 4th gear starts, first check all the connections. Bad connections at the solenoid connector, the firewall, or even at the A/T Controller itself will interupt solenoid operation. A bad fuse or other loss of power to the A/T Controller (again a bad connection) will have the same result. Depending on the year and model, the A/T Controller connectors and pin identification can be in 2 general configurations. Checking individual circuits, sensors, and solenoids may be done at the sensors or at the **A/T Controller**. Wire color and pin location for testing can be found in Figure 1 and Figure 2. There are some minor variations year to year. Some of the values listed below are checked with the connector unplugged from the A/T Controller.

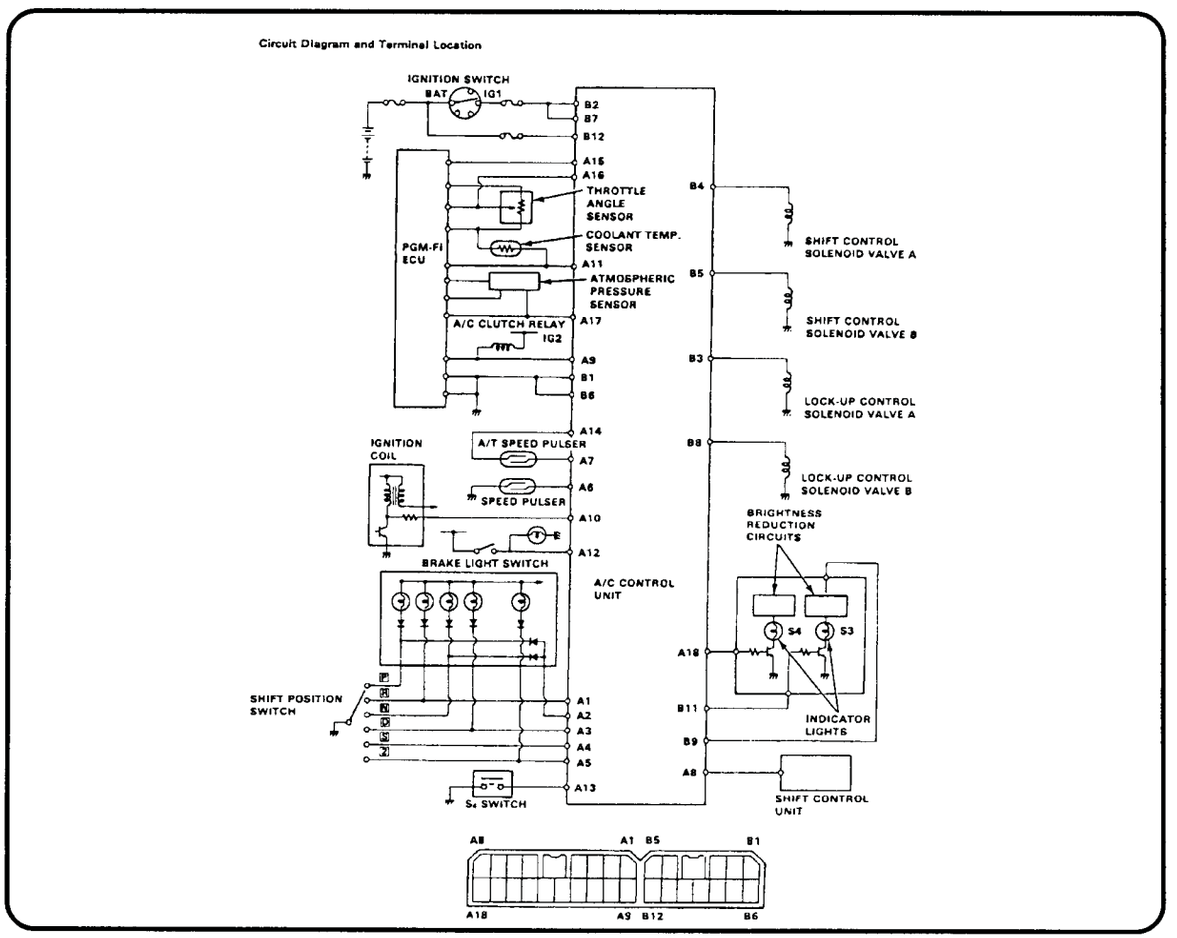


Figure 1.

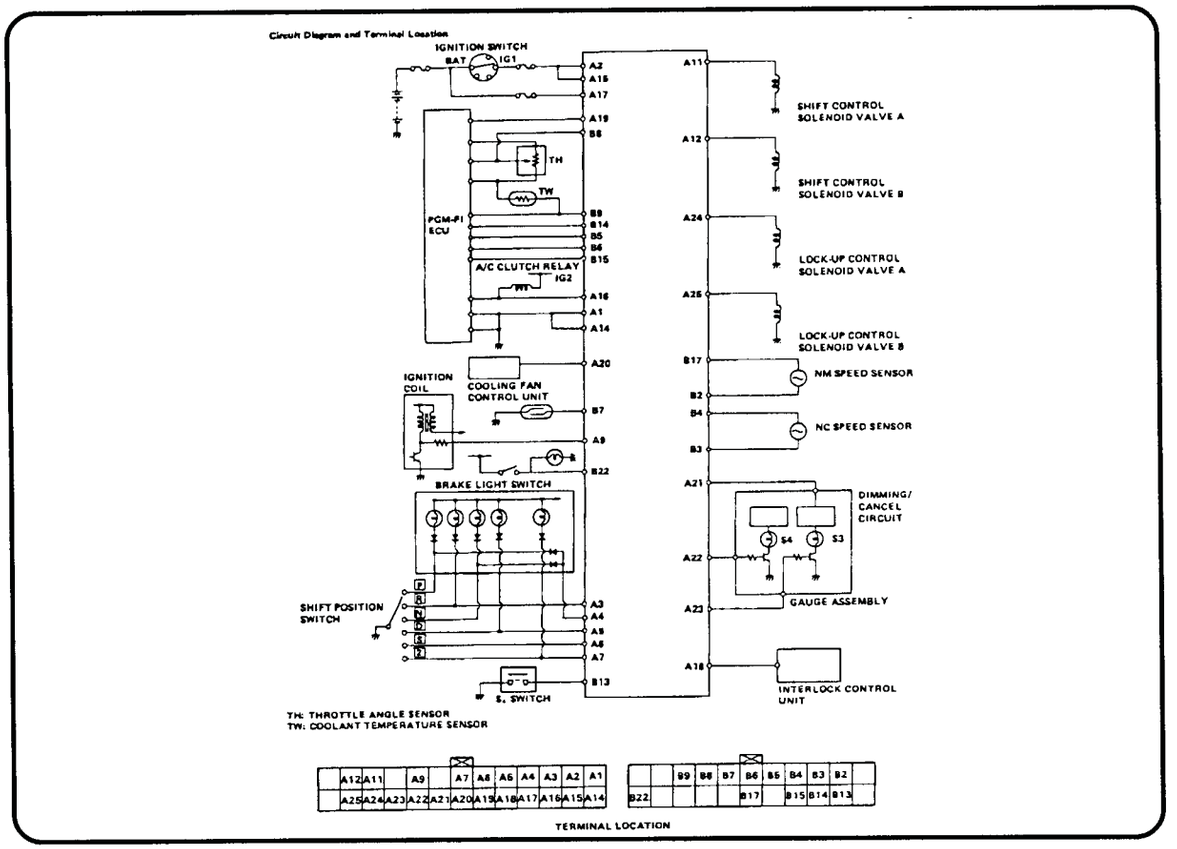


Figure 2.

CONTROLLER LOCATIONS

Typical Integra A/T Controller location and typical Legend A/T controller location can be found in Figure 3. The Legend may have the controller located under either the drivers seat or the passengers seat depending on whether it is a two door or a four door model. Be certain not to confuse it with the PGM-FI Controller which is larger and has 2 LED lights on it.

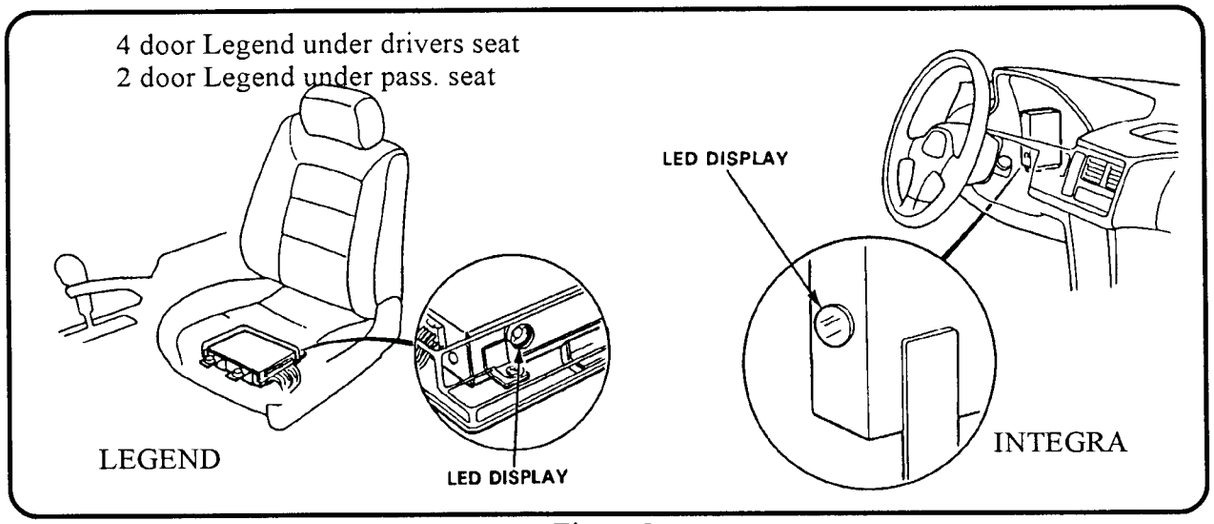


Figure 3.

CONTROLLER INPUTS

The **Speed Pulser** and the **A/T Speed Pulser** are two sensors that are important to proper transaxle operation. The A/T Speed Pulser is located on the transmission. The Speed Pulser is in the speedo head. One is driven by the speedometer gear and the other plugs in below the starter. See Figure 4. Both may be tested with an ohmmeter. While rotating the front wheels, an ohmmeter should alternately read continuity and no continuity across the 2 pin connector at the A/T Speed Pulser.

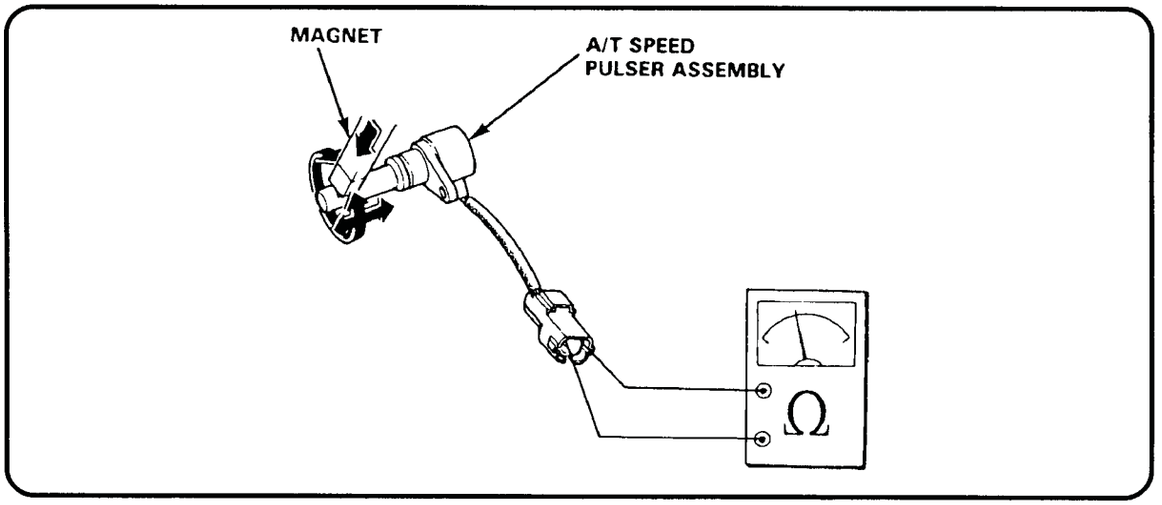


Figure 4.

The **NM** and **NC Sensors** that are used on the 1990 and up Legend vehicles replaces the Speed pusler used in earlier years . The NM (Main Shaft Pulse Generator) and the NC (Counter Shaft Pulse Generator) are on the end cover. Both sensors are the same and they can be checked with an ohmmeter. Each should have about 400 - 600 ohms of resistance when disconnected and checked across the two wire connector. The NM Sensor is located higher on the end cover. The NC Sensor is the lower one. Always be sure that the NM and NC Sensors are connected to the correct connectors. Mixing them up will cause no Torque Converter Clutch (TCC) and possible trouble codes 9 and 15. The NM Sensor connects to the orange - white wires, and the NC Sensor connects to the blue - green wires. See Figure 5 for NM and NC Sensor identification.

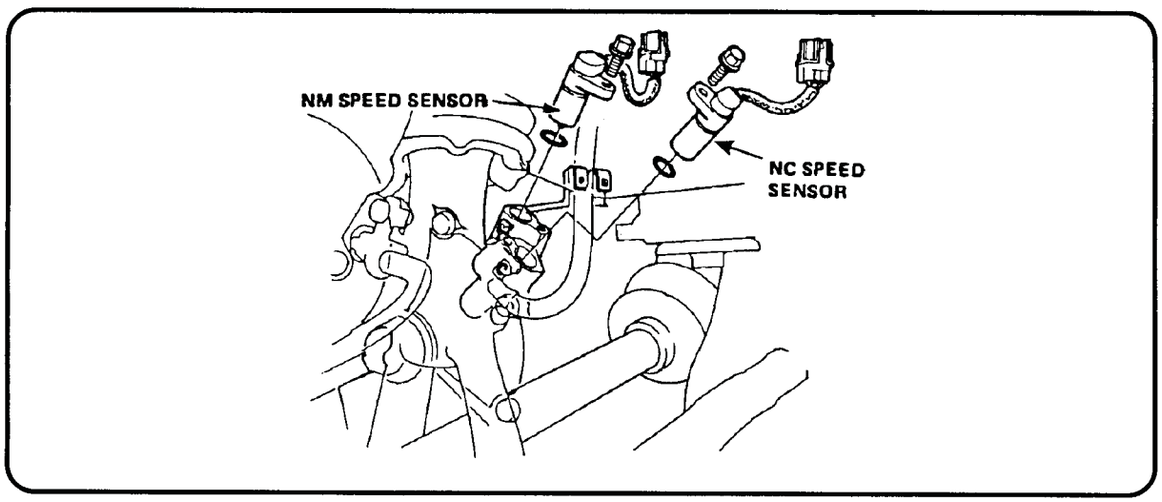


Figure 5.

The **Throttle Angle Sensor** is on the throttle body. It has a 3 pin connector. With the key on and the connector connected, there should be approximately 5 volts between the green/white and yellow/white wires. The center wire (red/yellow) should have about .5 volt at closed throttle and 4.5 volts at full open throttle. See Figure 6 for the Throttle Angle Sensor location.

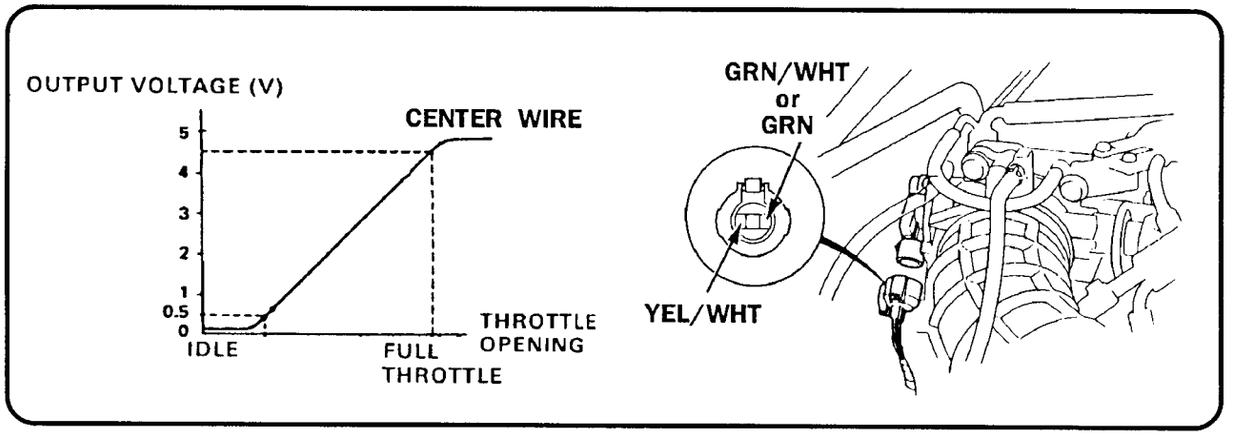


Figure 6.

The TA Sensor (Intake Air Temperature Sensor) is also important to proper transmission shift functions. The TA sensor is a temperature dependant resistor (thermistor). The resistance of the thermistor decreases as the intake air temperature increases as shown in Figure 7 .

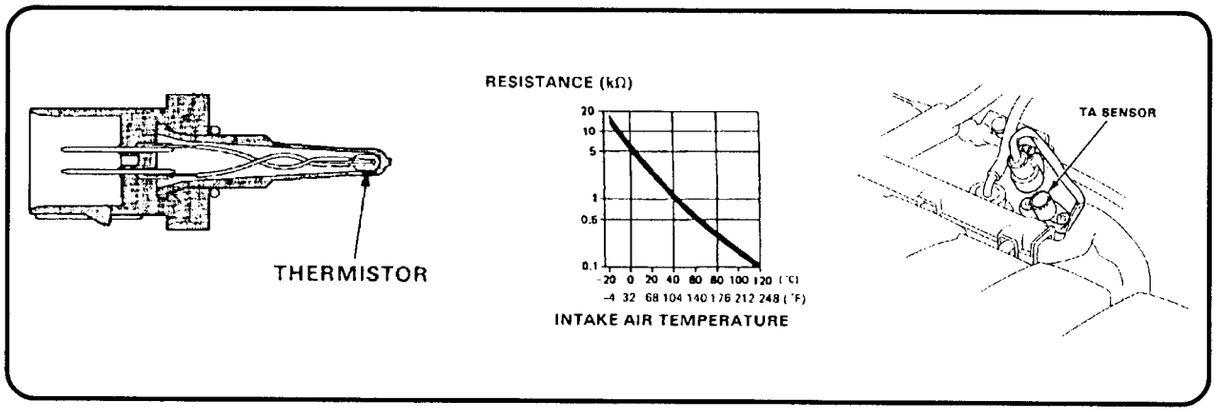


Figure 7.

The **Sports Shift Mode** button is on the shifter handle and will light the S3 or S4 light on the dash when it is depressed. This will slightly change the shift timing for a more sporty feel. If the button is disconnected, the A/T Control unit reverts to normal shifts.

The **WaterTemperature Sensor (TW)** on the engine also sends information to the A/T controller to modify shift strategy . It should read approximately 200 - 400 ohms resistance across the terminals with the engine warmed up and the connector disconnected. With the key on and the connector disconnected there should be about 5 volts across the wire harness connector going to the Water Temperature Sensor. See Figure 8.

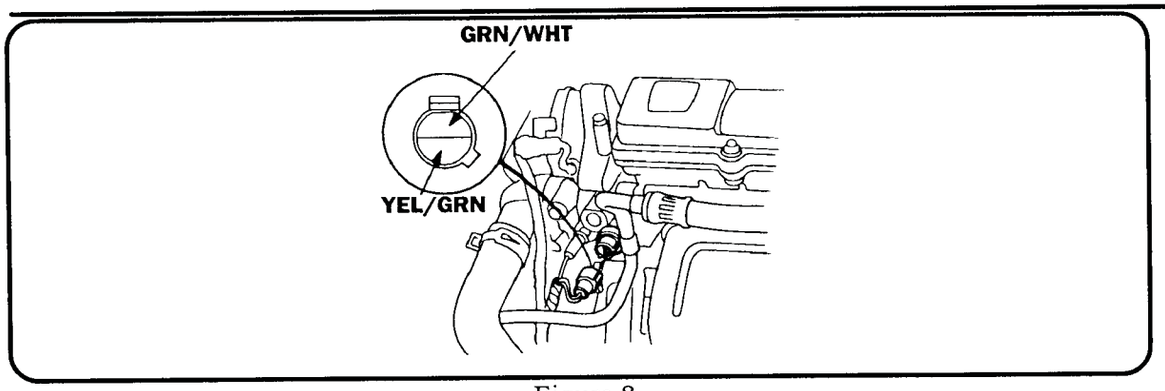


Figure 8.

A/T CONTROLLER OUTPUTS

Shift Solenoid A and Shift Solenoid B are on the outside of the transaxle. **Lock-up Solenoid A** and **Lock-up Solenoid B** are also on the outside of the transaxle. Solenoid identification for the Integra , as well as pin identification and ohms resistance checks can be found in Figure 9.

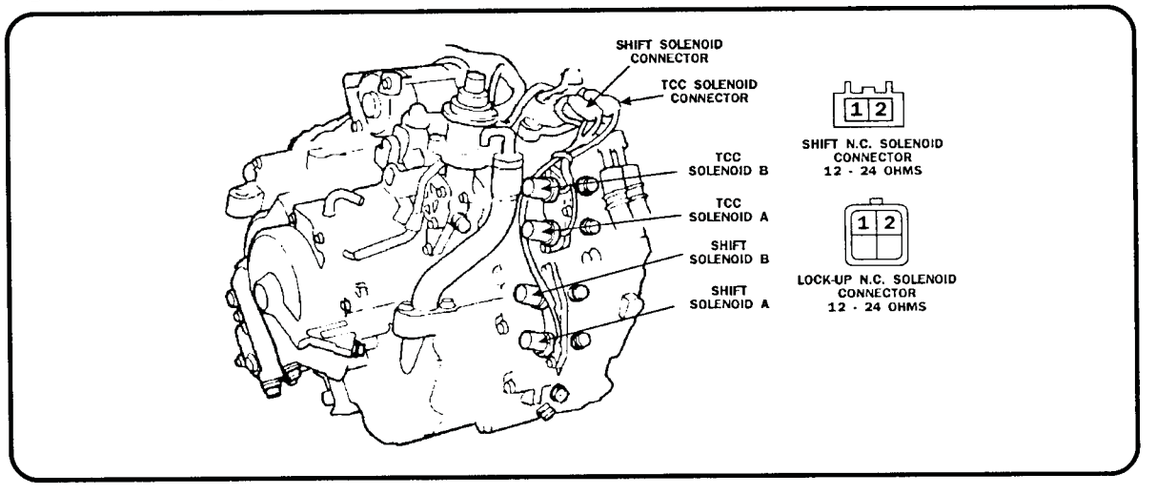


Figure 9.

Legend Shift Solenoids and **Lock-up Solenoids**, with ohms resistance checks at the wire connector, are identified in Figure 10.

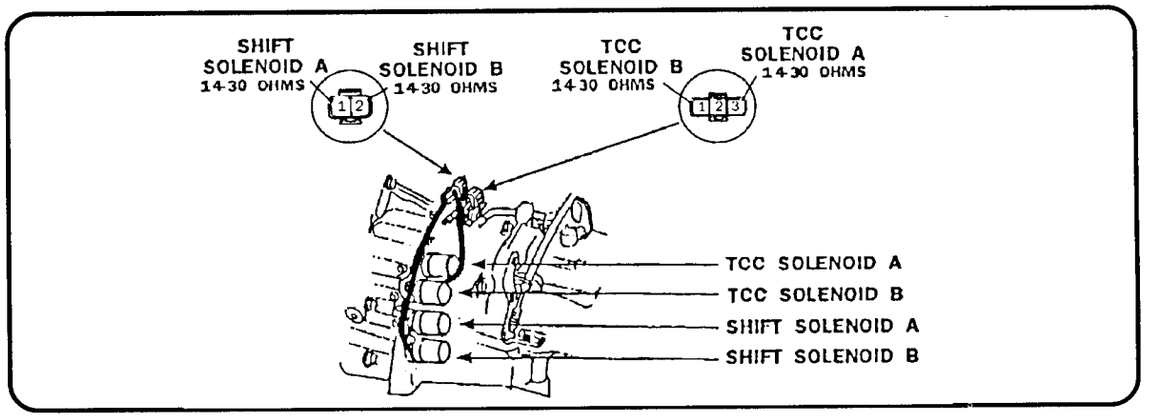


Figure 10.

The **Shift Solenoids** and the **Lock-up Solenoids** receive battery voltage from the A/T control unit to energize them. The order in which the solenoids are energized determines the gear selected, as well as lock-up operation. During a shift to lock-up, the A/T Controller first energizes Lock-up Solenoid A for partial lock-up, and then energizes Lock-up Solenoid B. Ohms checks and solenoid shift pattern is shown in Figure 11.

ACURA

GEAR	SHIFT SOL. A	SHIFT SOL. B	LU. SOL A	LU. SOL B
1st	OFF	ON	OFF	OFF
2nd	ON	ON	MAY BE ON OR OFF ACCORDING TO VEHICLE CONDITIONS	OFF
3rd	ON	OFF		
4th	OFF	OFF		
OHMS	12 - 24	12 - 24	14 - 30	14 - 30

Figure11.

When testing the operation of the solenoids and the transmission independently from the A/T Controller, energize both lock-up solenoids at the same time to achieve lock-up. See Figure 12 for and typical wire color.

ACURA - LEGEND

WIRE COLOR CODE	
SHIFT SOLENOID A	BLUE/GREEN
SHIFT SOLENOID B	GREEN/WHITE
LOCK-UP SOL. A	RED/WHITE
LOCK-UP SOL. B	WHITE/BLACK

ACURA - INTEGRA

WIRE COLOR CODE	
SHIFT SOLENOID A	BLUE
SHIFT SOLENOID B	GREEN
LOCK-UP SOL. A	RED
LOCK-UP SOL. B	GREEN/BLACK

Figure 12.

NOTE: The solenoids can be disconnected from the side of the transmission and checked with an ohmmeter. This is a good electrical test, but a solenoid with a clogged screen may test good and still not function properly. When in doubt, it is usually best to remove the solenoids and clean them.

If there is a **mechanical malfunction** of a solenoid, the A/T Controller may not respond with a trouble code. During such a mechanical malfunction, a different gear than that commanded by the A/T controller will be achieved. Figure 13 shows shifting properties during common malfunctions. Note that these are not electrical problems , but rather mechanical (stuck) malfunctions only.

GEAR COMMANDED	GEAR ACHIEVED DURING MALFUNCTION			
	SOL. B CLOSED	SOL. B OPEN	SOL. A CLOSED	SOL. A OPEN
1ST	STARTS IN 4TH	STARTS IN 1ST	STARTS IN 1ST	STARTS IN 2ND
2ND	SHIFTS TO 3RD	SHIFTS TO 2ND	STAYS IN 1ST	STAYS IN 2ND
3RD	STAYS IN 3RD	STAYS IN 2ND	SHIFTS TO 4TH	SHIFTS TO 3RD
4TH	SHIFTS TO 4TH	SHIFTS TO IST FEELS LIKE NEUTRAL	STAYS IN 4TH	STAYS IN 3RD

Figure 13.

Number of LED display flashes	S3 indicator light ⊕	Symptom	Probable Cause
1	Blinks	• Lock up clutch does not engage. • Lock up clutch does not disengage. • Frequent engine stalling.	• Disconnected lock-up control solenoid valve A connector. • Open or short lock-up control solenoid valve A wire. • Faulty lock-up control valve A.
2	Blinks	• Lock up clutch does not engage.	• Disconnected lock-up control solenoid valve B connector. • Open or short lock-up control solenoid valve B wire. • Faulty lock-up control valve B.
3	Blinks or OFF	• Lock up clutch does not engage.	• Disconnected throttle angle sensor connector. • Open or short in throttle angle sensor wire. • Faulty throttle angle sensor.
4	Blinks	• Lock up clutch does not engage.	• Disconnected speed pulser connector. • Open or short in speed pulser wire. • Faulty speed pulser.
5	Blinks	• Fails to shift other than 2nd-4th gear. • Lock up clutch does not engage.	• Short in shift position console switch wire. • Faulty shift position console switch.
6	OFF	• Fails to shift other than 2nd-4th gear. • Lock up clutch does not engage. • Lock-up clutch engages and disengages alternately.	• Disconnected shift position console switch connector. • Open or short in shift position console switch wire. • Faulty shift position console switch.
7	Blinks	• Fails to shift other than 1st-4th, 2nd-4th, 2nd-3rd gears. • Fails to shift (stuck in 4th gear).	• Disconnected lock-up control solenoid valve A connector. • Open or short lock-up control solenoid valve A wire. • Faulty lock-up control valve A.
8	Blinks	• Fails to shift (stuck in 1st or 4th gear).	• Disconnected lock-up control solenoid valve B connector. • Open or short lock-up control solenoid valve B wire. • Faulty lock-up control valve B.
9	Blinks	• Lock-up clutch does not engage.	• Disconnected A/T speed pulser. • Open or short in A/T speed pulser. • Faulty A/T speed pulser.
10	Blinks	• Lock-up clutch does not engage.	• Disconnected coolant temp sensor connector. • Open or short in coolant temp sensor wire. • Faulty coolant temp sensor.
11	OFF	• Lock-up clutch does not engage.	• Disconnected ignition coil connector. • Open or short in ignition coil wire. • Faulty ignition coil.
13*	Blinks	• Late lock-up clutch engagement.	• Disconnected PA sensor connector. • Open or short in PA sensor wire. • Faulty PA sensor.
14**	OFF	• Transmission jerks hard when shifting	• Short or open in FAS wire. • Trouble in PGM-FI unit.
15**	OFF	• Transmission jerks hard when shifting	• Disconnected NM speed sensor connector. • Short or open in NM speed sensor wire. • Faulty NM speed sensor.

* = INTEGRA ONLY.
**= LEGEND ONLY.
⊕ = S4 LIGHT LEGEND.

4HP22EH / 24EH
ELECTRICAL DIAGNOSIS

The BMW ZF 4HP22EH is fully computer controlled and is diagnosed using newer techniques than with previous hydraulic only versions. Since the 4HP24EH is in limited use, we will concentrate on the 4HP22EH for electrical diagnosis. We must use correct procedures to test electrical operation of solenoids and sensors and perform ohms tests for these components. This transmission has four solenoids and one force motor on the valve body. Refer to **Figure 1** for their names and locations.

UPPER VALVE BODY WITH SOLENOIDS AND WIRE COLORS

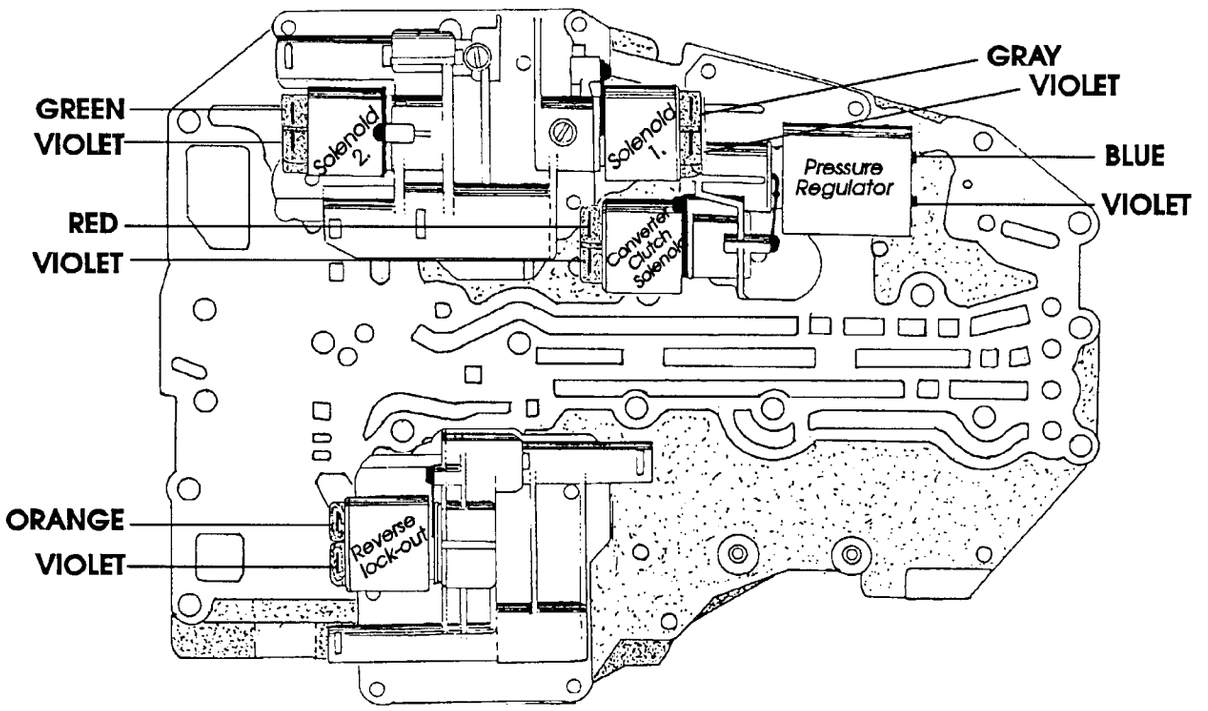


Figure 1

During an overhaul, the solenoids and the force motor should be checked with an ohmmeter. Refer to the chart in **Figure 2** for wire color and normal ohms readings. These ohms tests will determine if an electrical malfunction is present.

WIRE COLOR IDENTIFICATION

SOLENOID(1) - GRAY/VIOLET (Y1)
SOLENOID(2) - GREEN/VIOLET (Y2)
SOLENOID(3) - RED/VIOLET (Y3)
SOLENOID(4) - ORANGE/VIOLET (Y4)
PRESSURE REGULATOR(5) - BLUE/VIOLET (Y6)
PULSE TRANSMITTER - BROWN/BROWN (Y7)
HOT WIRE(12VOLTS) - VIOLET

OHMS TESTS AT ROOM TEMPERATURE

VIOLET TO GRAY 28-35 OHMS.
VIOLET TO GREEN 28-35 OHMS.
VIOLET TO RED 28-35 OHMS.
VIOLET TO ORANGE 28-35 OHMS.
VIOLET TO BLUE 2.8-4.5 OHMS.
BROWN TO BROWN 300-350 OHMS.

BMW SOLENOID DESIGNATION

Y1....SOLENOID 1
Y2....SOLENOID 2
Y3....CONVERTER CLUTCH SOLENOID
Y4....REVERSE LOCK-OUT SOLENOID
Y5....PRESSURE REGULATOR
Y6....PULSE(SPEED) SENSOR

Note: 4HP24EH HAS NO REVERSE LOCK-OUT SOLENOID

Figure 2

The four solenoids are normally (off) open and will exhaust fluid until they are energized. These solenoids may be checked with 12 volts and a ground signal. The force motor, or pressure regulator as BMW calls it, works differently. It has a 12 volt supply from the microprocessor but it gets a variable ground signal as well to control pressure. The force motor should not be checked using 12 volts and direct ground. This may result in electrical coil failure or spring and valve damage. Both solenoid and force motor activation are controlled by the microprocessor unit which is located behind left speaker in 1987 and behind the right kick panel in 1988. This unit has two long wire connectors on it. One is the input from the engine compartment and the other goes to the transmission. **Figure 3** shows the wire connector at the transmission and identifies the terminals.

4HP22EH

PIN IDENTIFICATION

PINS E & F... BROWN (Speed Sensor)
PIN M.....VIOLET (Hot Wire)
PIN L.....RED (Sol 3. Converter clutch)
PIN H.....GRAY (Sol 1. Shift)
PIN K.....GREEN (Sol 2. Shift)
PIN B.....BLUE (Pressure Reg. Force Motor)
PIN D.....ORANGE (Sol 4. Reverse Lock Out)

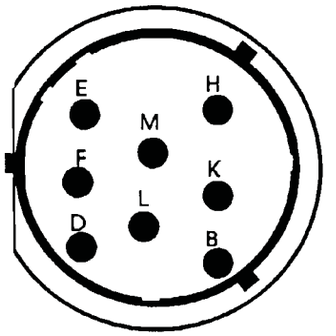


Figure 3

To test the transmission in the car separately from the computer, it is necessary to energize the solenoids in the proper order. **Figure 4** shows the solenoid on/off pattern.

SOLENOID ON/OFF CHART

	SOLENOID 1	SOLENOID 2	CONVERTER CL. SOLENOID	REVERSE LOCK-OUT SOLENOID
FIRST GEAR	**ON**	**ON**	*OFF*	ON ABOVE 10 M.P.H.
SECOND GEAR	*OFF*	**ON**	*OFF*	**ON**
THIRD GEAR	*OFF*	*OFF*	**ON** or *OFF*	**ON**
FOURTH GEAR	**ON**	*OFF*	**ON** or *OFF*	**ON**

✱ Pressure Regulator(Force Motor) receives varied(Pulse Width) ground signal in all gears for shift feel. Voltage will read from 0 to 5 volts depending upon computer signal.

Figure 4

The Violet wire should have 12 volts at all times. Ground is sent to solenoids 1 and 2 to put the transmission in first gear. In second gear solenoid 1 is turned off and solenoid 2 is left on. In third gear both solenoids are off. Solenoid 1 is turned back on for fourth gear. The 4HP24EH does not use the reverse lock-out solenoid. **Figure 5** shows the differences in the pins in the electrical connector for the 4HP22EH and the 4HP24EH as well as pin to pin connections for solenoid operation.

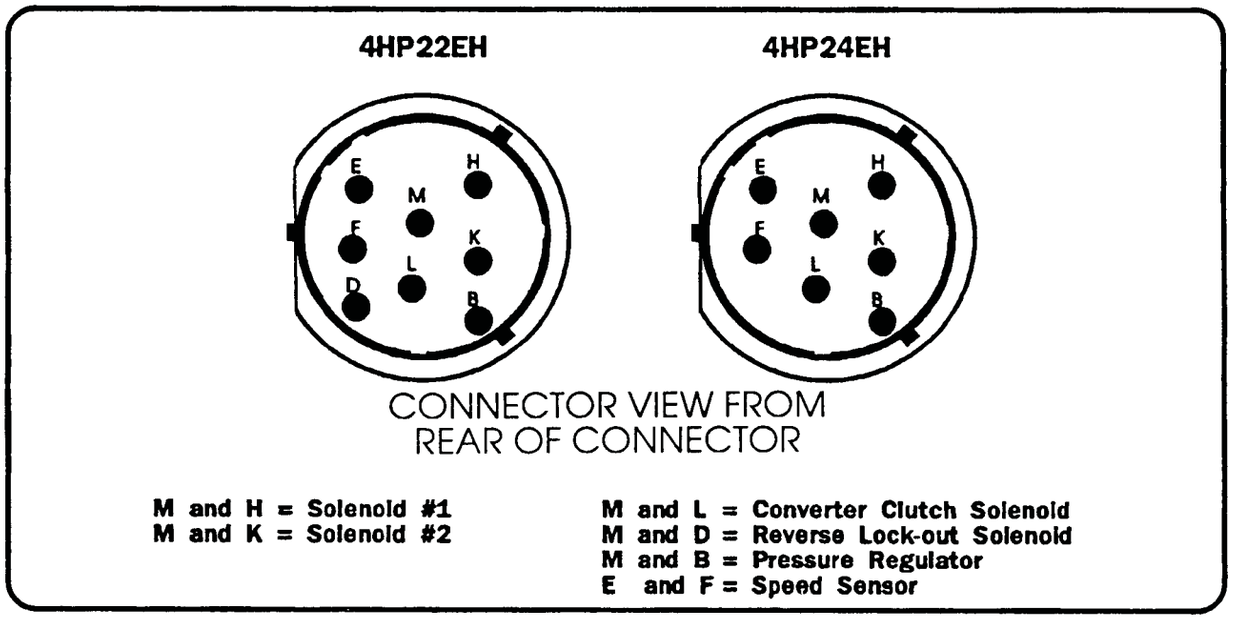


Figure 5

The 4HP24EH,used in some later models has the solenoid configuration changed considerably. This can make solenoid identification confusing. Although the solenoids in the 22EH and the 24EH are in different positions on the valve body, as shown in **Figures 6 and 7**, the wire colors remain the same to the solenoids and to the pressure regulator (force motor).

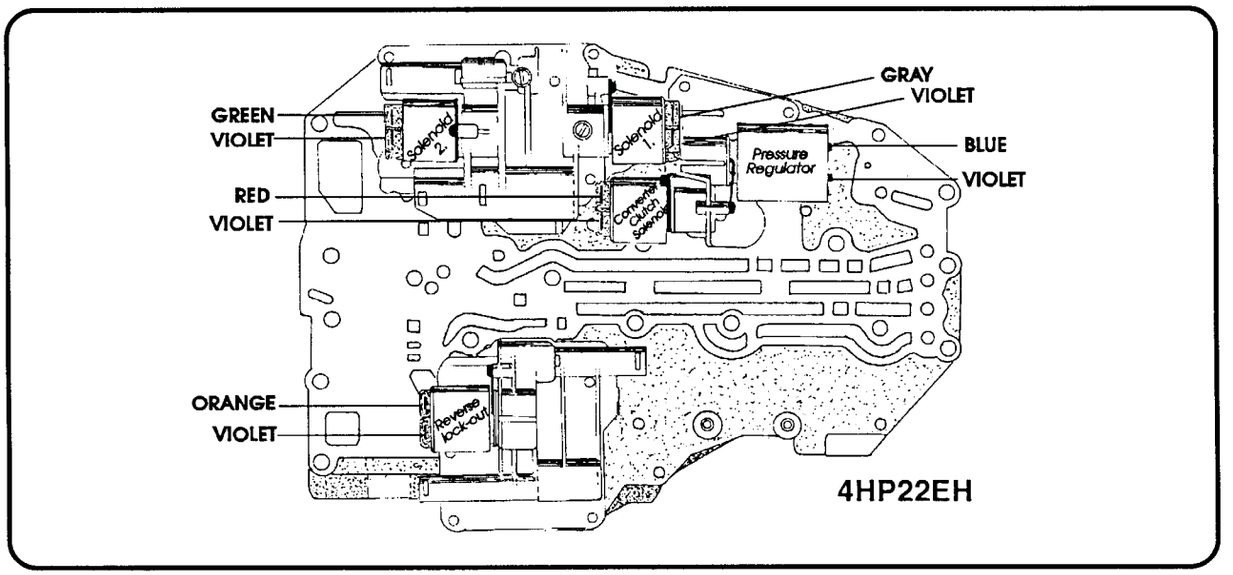


Figure 6

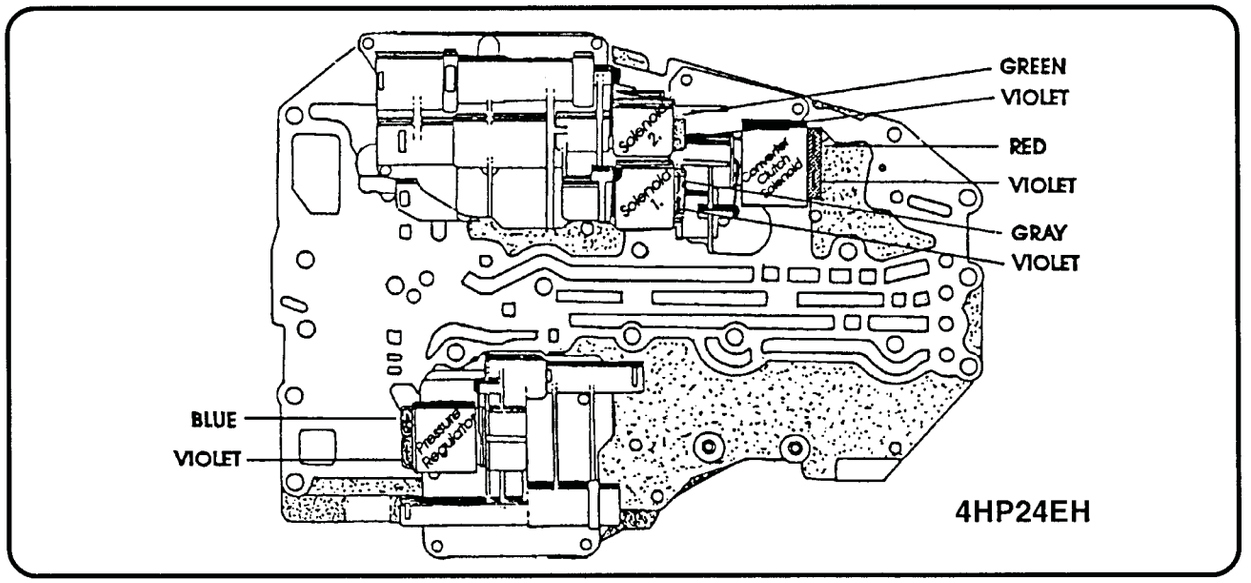


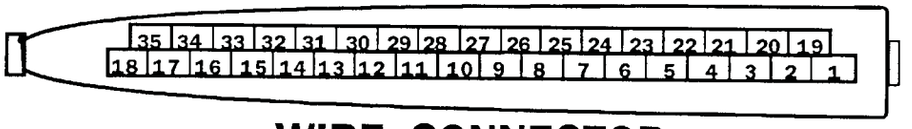
Figure 7

BMW ZF4HP22 EH CONTROLLER

The transmission controller for the electronic version of the 4HP22 is found up behind the left front speaker in 1987, and behind the right kick panel starting in 1988. After removing the kick panel, it will be necessary to open the glove box and pull it out toward the rear of the car. This will make the three bolts that hold the controller to the body accesible. The controller can then be removed by lowering it through the hole in the body under the kick panel. The controller has 35 pins to recieve and send signals.

Figure 8 identifies the pins by wire color and test voltage observed in park with the key on, engine off(KOEO). These voltage values are approximate any may vary slightly.

PIN	COLOR	VOLTAGE	PIN	COLOR	VOLTAGE
1	Violet	.5v.(batt volts KOER)	19	Brown	GROUND (Ovolts)
2	Grey \yellow	10.7 volts	20	Grey	11.7 volts
3	—	—	21	Brown \green	11.7 volts
4	Yellow \green - Grey	9 volts	22	Red	11.7 volts
5	Brown	0 volts	23	BRAIDED WIRE(WHITE)	0 volts
6	(2) Brown	0 volts	24	Brown \grey	4.5 volts
7	Yellow	.6v. idle 4.2v. wot.	25	(2) Dk Blue - Lt Blue	11.7 volts
8	Brown	0 volts	26	—	—
9	Black	4.8 volts	27	White	0 volts
10	—	—	28	Brown \black	11.6 volts
11	Black \white	10.9 volts	29	Blue \white	0 volts
12	White \violet	0 volts	30	Brown \white	0 volts
13	White \yellow	11.8 volts	31	—	—
14	Brown\r - Yellow\bl	.6 volt	32	—	—
15	Brown\wh -yellow\wh	9.9 volts	33	Grey \brown	0 volts
16	(2) Orange	.1 volt	34	Red	11.6 volts
17	Green	.1 volt	35	Red \blue	11.6 volts
18	(2) Blue \black	11.7 volts			



WIRE CONNECTOR

Figure 8

Pin 1 is the voltage signal sent to the transmission for all of the solenoids, as well as for the pressure regulator (force motor).

Pin 7 is the throttle return signal to the controller and varies with throttle opening from about .5 volts to 4.5 volts.

Pin 9 is the input reference voltage signal to the throttle sensor. It is always about 5 volts.

Pin 16 is the ground signal sent by the controller to Shift Solenoid #1.

Pin 17 is the ground signal sent by the controller to Shift Solenoid #2.

Pin 19 is a ground wire to the controller at all times and will show continuity to ground wheter or not it is connected to the controller.

Pin 20 is the ground signal sent by the controller to the reverse lock-out solenoid after the transmission controller senses the vehicle speed is over 8 MPH.

Pin 22 is the pulse width modulated signal that is sent to the pressure regulator (force motor). It is variable and can be observed as either A/C or D/C voltage with the transmission functioning.

Pin 23 is a white braided wire that becomes a ground when connected to the controller.

Pin 25 is the ground signal sent to the Converter Clutch Solenoid.

SPRINT / SUZUKI / AND 1990 & UP METRO

Electrical Diagnosis starts with the basics. Determine exactly what symptoms or conditions exist first. This transmission will start in 3rd gear if the controller fails to send an electrical signal to the transmission. Both solenoids must be energized to put the transmission into first gear. Trouble shooting can be split into two catagories. The first catagory is transmissions receiving no signal from the controller, and the second catagory is transmissions that shift incorrectly.

Transmission testing independently of the controller is accomplished by energizing the Direct Clutch and Second brake Solenoids with 12 volts in the proper order. See Chart 1. for the correct procedure.

COLOR	RED	YELLOW
GEAR	DIRECT CLUTCH SOLENOID	2nd GEAR SOLENOID
1st	ON	ON
2nd	ON	OFF
3rd	OFF	OFF
OHMS	11 - 15	11 - 15

Chart 1.

If the transmission can be made to shift with voltage sent to the proper solenoids, then the controller must be tested.

TEST CONTROLLER AS FOLLOWS

1. Disconnect the connector at the transmission controller under the instrument panel.

2. With the key on, there must be 12 volts Between terminals 10 and 12 of the controller connector. See Chart 2.

3. Terminals 4 and 12 must show CONTINUITY when the shift lever is in Drive.

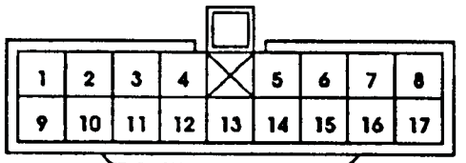
4. Terminals 6 and 12 must show NO continuity with accelerator pedal released.

5. Terminals 6 and 12 must show CONTINUITY with the accelerator fully depressed

6. With the engine running at idle, terminals 7 and 12, 14 and 12, and 15 and 12 must show NO continuity.

7. With the engine off, terminals 7 and 12, 14 and 12, and 15 and 12 must show CONTINUITY.

The Controller controls the second brake solenoid and the direct clutch solenoid by sending voltage to them to attain automatic gear shifts from 1st to 2nd, and 2nd to 3rd. Inputs sensed by the controller are the accelerator switch, vacuum switches (#1, 2 & 3), shift lever switch, and speed sensor. The controller opens and closes the valves of the solenoids according to these input signals. The controller is located at the left corner inside the instrument main panel.



Viewed from wire harness side.

PIN NUMBER	PIN LOCATION	WIRE COLOR
1	2nd BRAKE SOLENOID	GRAY/YELLOW
2	IDLE UP SOLENOID	BROWN/WHITE
3	NOT USED	NO WIRE
4	SHIFT LEVER SWITCH (D)	GREEN/BLUE
5	REVERSE INPUT	RED
6	ACCELERATOR SWITCH	LIGHT GREEN
7	VACUUM SWITCH #1	LIGHT GREEN/WHITE
8	SHIFT LEVER SWITCH	GREEN
9	DIRECT CLUTCH SOLENOID	GRAY/WHITE
10	12 VOLTS IN	BLACK/WHITE
11	NOT USED	NO WIRE
12	GROUND	BLACK/GREEN
13	SPEED SIGNAL	YELLOW/GREEN
14	VACUUM SWITCH #2	LIGHT GREEN/RED
15	VACUUM SWITCH #3	LIGHT GREEN/BLACK
16	START VOLTAGE	BLACK/RED
17	SHIFT LEVER SWITCH (2)	GREEN/RED

Chart 2.

The **Speed Sensor** is built into the speedometer and the magnet turns causing the frequency to increase and decrease in proportion with road speed. This signal is sent to the controller as pulse signals.

The **Vacuum Switches** are turned off (OPEN) as vacuum is supplied to them. Because each of the 3 switches has its own range, throttle position or load signal is sensed by the controller.

The **Shift Lever Switch** is linked to the selector lever and sends electric signals to the controller. In park and nuetral it allows the starter to function and in reverse it turn on the back up lights. It also signals positions D, 2, and L so that the contoller select the proper solenoid operation.

The **Accelerator Switch** is mounted on the accelerator pedal bracket. When the accelerator pedal is depressed more than 90% of its stroke, the switch turns ON and signals throttle valve opening to the controller.

The **Direct Clutch** and **Second Brake Solenoids** are located on the valve body and are turned ON and OFF by signals from the controller to actuate shift valves and control shifts.

Solenoid location and Solenoid connector identifiation for both the Sprint and the 1990+up Metro can be found in Figure 1.

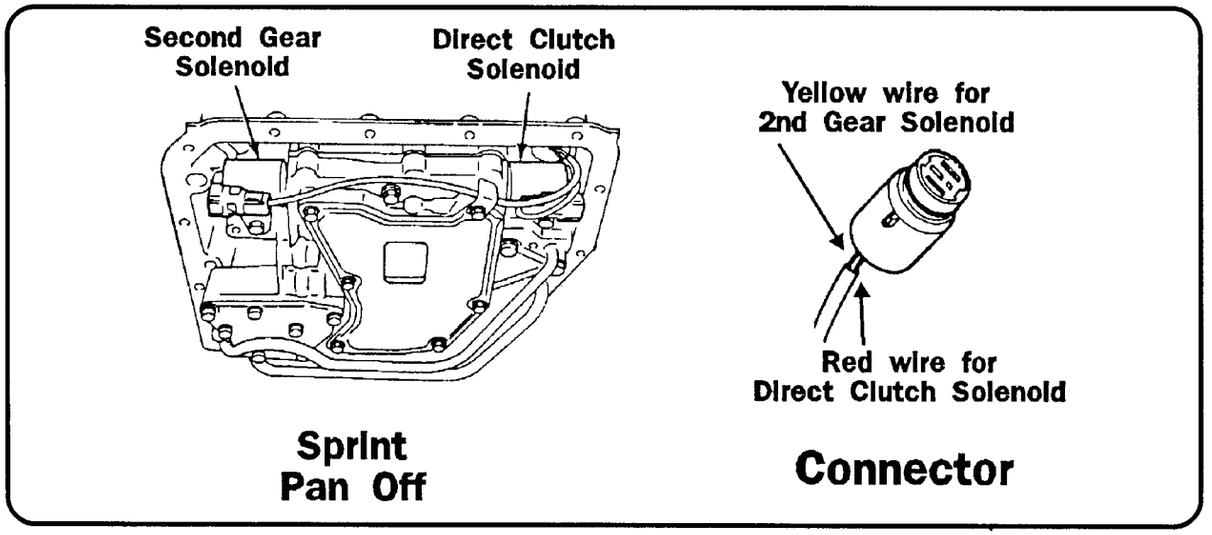


Figure 1

Common Complaints and Causes

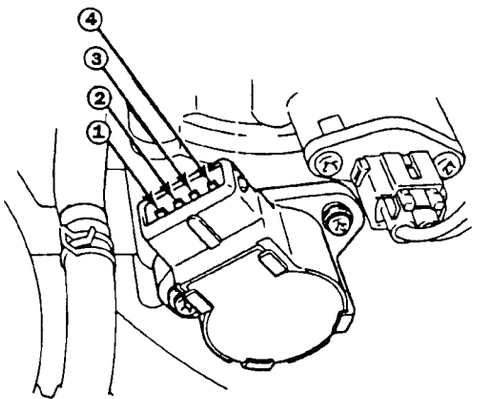
The transmission starts in 3rd gear but can be shifted manually.This usually means that there is no controller signal to the transmission. Cheek the wire connectors first.

The transmission starts in first but upshifts very early (usually about 10 and 15 MPH), even under heavy throttle. This is a vacuum switch problem. Check the connector at the vacuum switches on the firewall. Also check for pinched or collapsed vacuum hoses.

The transmission starts in first and doesn't upshift until about 30 MPH and 60MPH. The vacuum lines may be cracked or broken. The vacuum switches or accelerator switch may be defective.

Metro Computer Control Differences

The Geo Metro computer control transaxle operates just like a Chevy Sprint. There are, however, control system differences. With the Geo Metro the accelerator switch and vacuum switches were replaced with the throttle position sensor. See Figure 2.

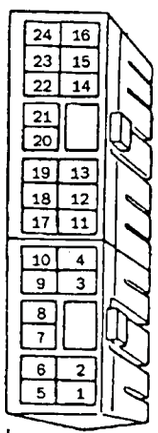


1. Ground
2. On/off Idle signal
3. Output voltage
4. Power suppy from ECM (Approx. 5.2volts)

Figure 2.

The Geo Metro A/T Control Module has a 10 pin and a 14 pin coupler. This controller is unique must be tested using procedures described in the factory service manual. For reference the pins at the rear of the A/T control Module are described in Chart 3.

1. Diagnostic switch
2. Reverse light from the lever switch
3 - 10. Not used
4. Ignition pulse signal from the coil
5. Shift lever switch 2nd position
6. Shift lever switch Drive position
7. Shift lever switch Low position
8 - 9. Shift lever switch P and R positions
11 -12. Not used
13. 12 volts from the ignition switch
14. Direct Clutch Solenoid
15. ECM signal
16. 2nd Clutch Solenoid
17 - 18 - 19. TPS signal from the ECM
20. Speed Sensor ground
21 - 22. Speed Sensor
23. Diagnostic monitor and light
24. Air conditioner



Viewed from wire harness side.

Chart 3.

GEO STORM ELECTRICAL DIAGNOSIS

The Geo Storm uses a fully electronically controlled transaxle that is made by Isuzu in Japan. This transaxle has five solenoids and a transmission oil temperature sensor (TOT) located on the valve body to control shifting, torque converter clutch engagement and to regulate oil pressure according to vehicle conditions. In order to properly diagnose electrical problems, it is important to determine exactly what is happening in the transaxle. This unit will start out in third gear if no electrical current is sent to the solenoids. No other forward range will be available in this situation. The ECU monitors the circuits of all five solenoids and 6 of the input components for the purpose of diagnosis.

When the ECU detects a fault, it may take action by:

(1) Making the "ECONO" lamp on the instrument panel flash on and off.

(2) Storing a trouble code in its constant power memory.

(3) Diplaying the stored trouble code when the technician makes the dignostic request.

(4) Providing back-up for the failed circuit in some cases.

Most transmission related ecectrical component locations are shown below in figure 1.

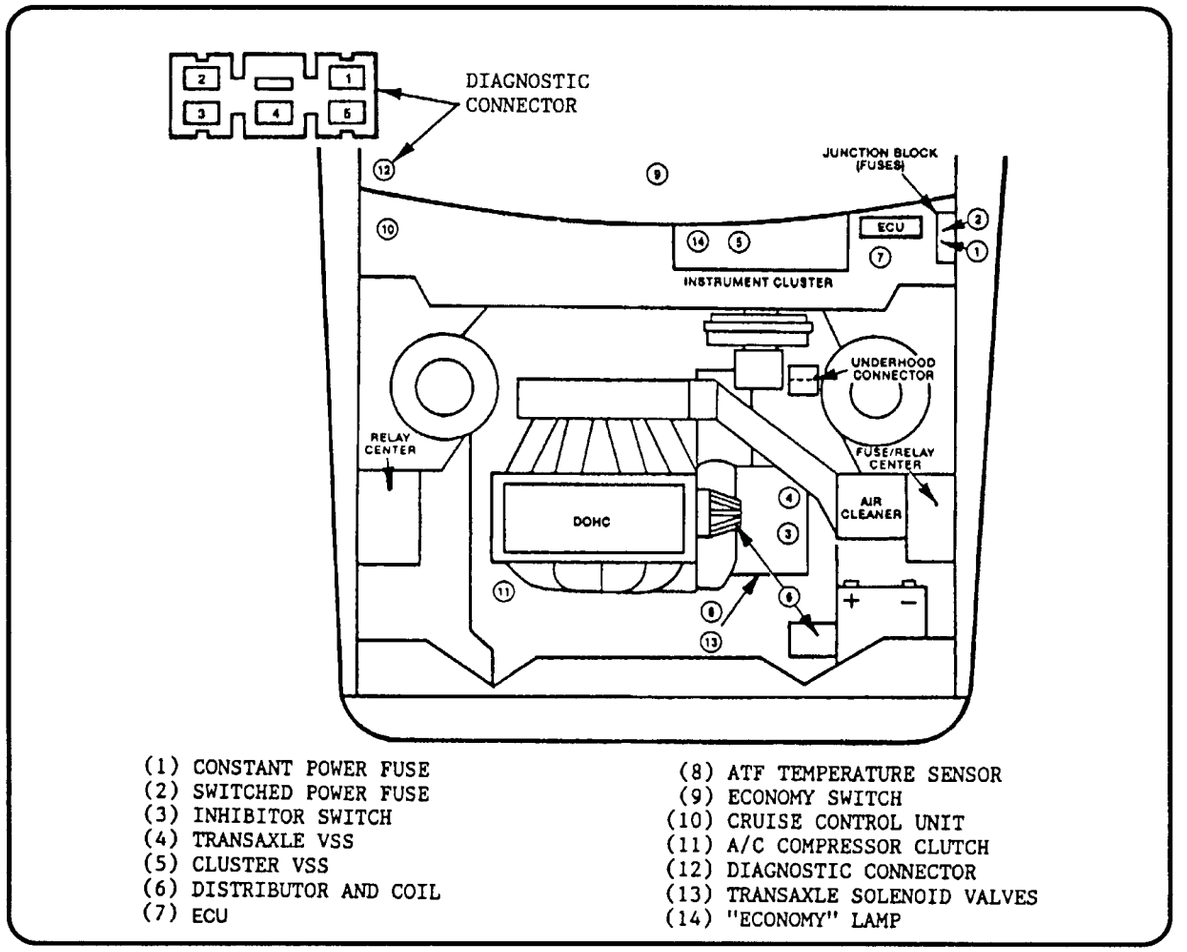


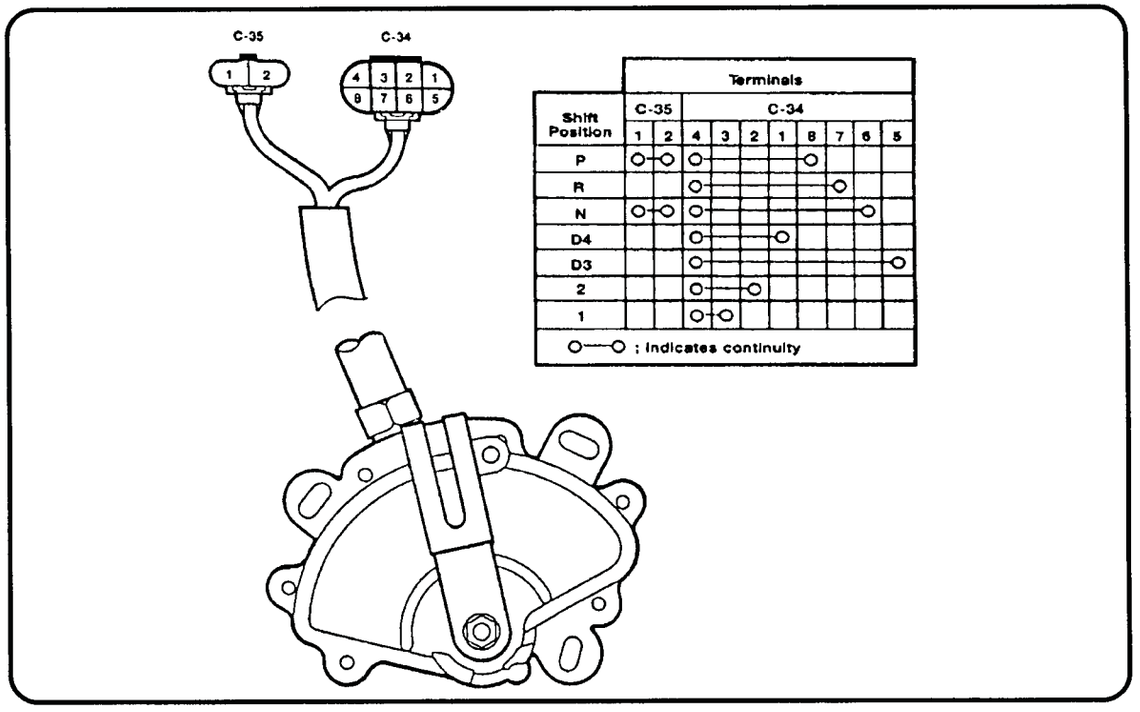
Figure 1.

DISPLAYING TROUBLE CODES

There are two ways to retrieve stored trouble codes. The first is with a hand held scanner. Follow the directions for that particular scanner. The second by jumping the diagnastic connector (See Figure 1) between terminals 1 and 2 with the ignition switch on. The diagnostic connector is located behind the right kick panel. The ECU will respond in one of two ways. First, if the "ECONO" lamp flashes at a steady speed, there are no truoble codes stored. Second, the "ECONO" lamp will flash in a sequence to indicate the code number "Tens" value, followed by the "Ones" value. See Page 28 for troble code translations and their description. The sequence will repeat in a continuous cycle three times for each trouble code stored.

TRANSMISSION INPUTS

The **Inhibitor Switch** is mounted to the transaxle where the manaul shaft rotates its contact arm. The ECU uses the inhibitor switch input signals for line pressure control,shift control, and TCC apply control. The inhibitor switch recieves power from the back-up/turn fuse and has seven pairs of contacts which provide six separate input circuits to the ECU. Each pair of contacts closes when the transaxle shift lever is in a different range position. There is also another pair of contacts that close in "P" or "N" range. Those contacts use a separate two terminal connector and are part of the starting relay circuit. See figure 2 for inhibitor switch connector information.



Shift Position	Terminals C-35 1	2	C-34 4	3	2	1	8	7	6	5
P	○	○	○				○			
R			○					○		
N	○	○	○						○	
D4			○				○			
D3			○							○
2			○			○				
1			○	○						

○—○ ; Indicates continuity

Figure 2

The **CLUSTER VSS** is the speed sensor that is mounted in the speedometer to tell the ECU vehicle speed so that it may provide the proper shift strategy. It is a 4 pole reed type switch and it can be checked at the ECU. To test the Cluster VSS connect an ohmmeter across terminals 5 and 13 at the ECU connector and rotate the speedometer cable. The ohmmeter should show alternate continuity and discontinuity 4 times in one revolution of the speedo cable. See figure 7 for ECU terminal identification.

The **Transaxle VSS** is mounted to the transaxle near the differential. It has an "O" ring to seal external leaks and is held in by a single bolt (See Figure 3). It also tells the ECU vehicle speed through an inductive pick up. It can be checked with an AC volt meter at either the ECU or the 2 wire connector shown in figure 3. It should show approximately five cycles with each complete revolution of the differential.

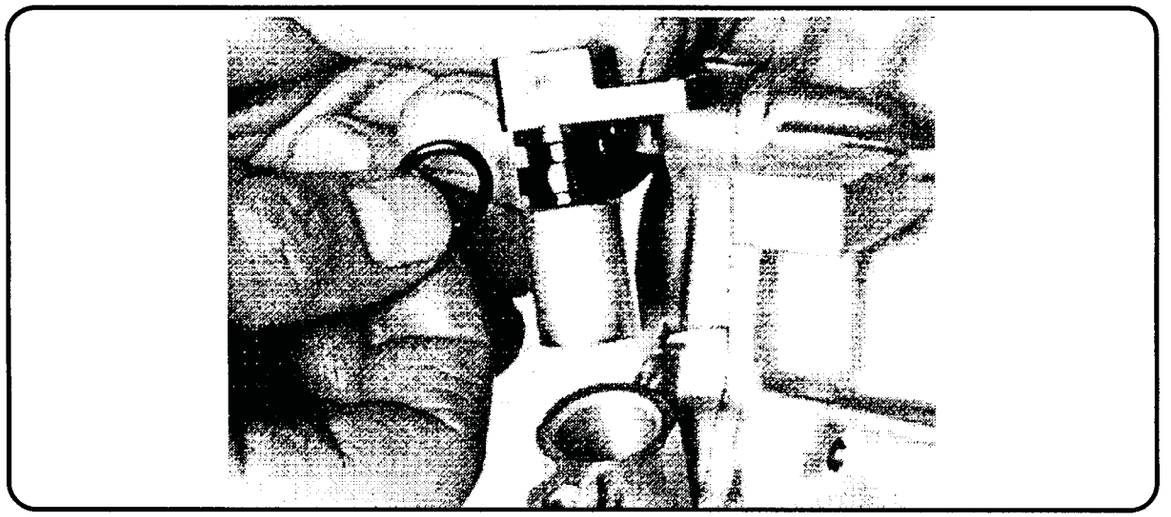


Figure 3.

The **Throttle Position Sensor** is located on the engine throttle body. It sends an analog (straight voltage) signal to the ECM. The ECM sends a five volt reference signal to to terminal B at the E-2 connector (See Figure 4) and also sends a ground through terminal A at the same connector. The TPS uses a third wire (C) to send the ECM a continuous signal that varies in voltage as the position of the throttle plate changes. When the throttle plate is closed, the signal voltage is low (Approximately **.5** volt). As the throttle is opened, the signal voltage increases. At wide open throttle the signal voltage is approximately **4.5** volts. The ECU monitors the signal that goes to the ECM to determine throttle position.

ECU = ELECTRONIC CONTROL UNIT ECM = ELECTRONIC CONTROL MODULE

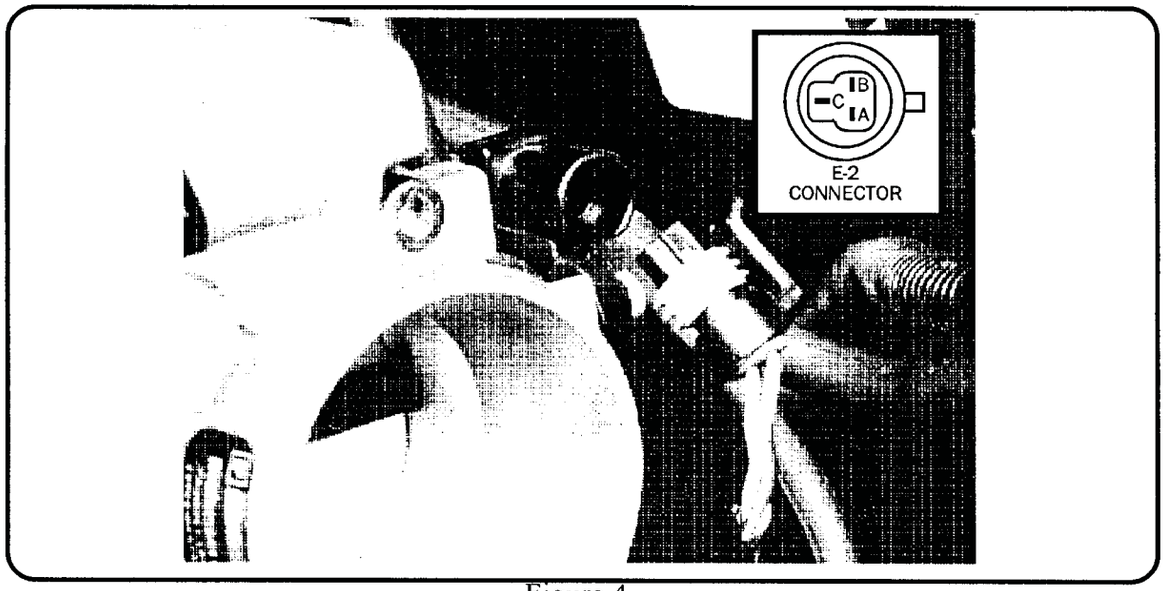


Figure 4.

The **Transmission Oil Temperature Switch** is on the valve body and it signals the ECU to determine Torque Converter Clutch availability. This switch can be checked at the ECU at terminal 19 of the C48 connector (See Figure 7). If this switch is electrically open, the ECU will prevent Torque Converter Clutch engagement.

ELECTRONIC CONTROL UNIT (ECU)

The Electronic Control Unit (ECU) is located under the dash, just to the left of the steering column. (See Figure 1). It recieves inputs from the sensors already described in this chapter, as well as other individual sensors. The ECU also monitors some signals from the ECM. All of these signals determine the strategy of the ECU for shift timing and feel. An overview of the system is shown below in figure 6.

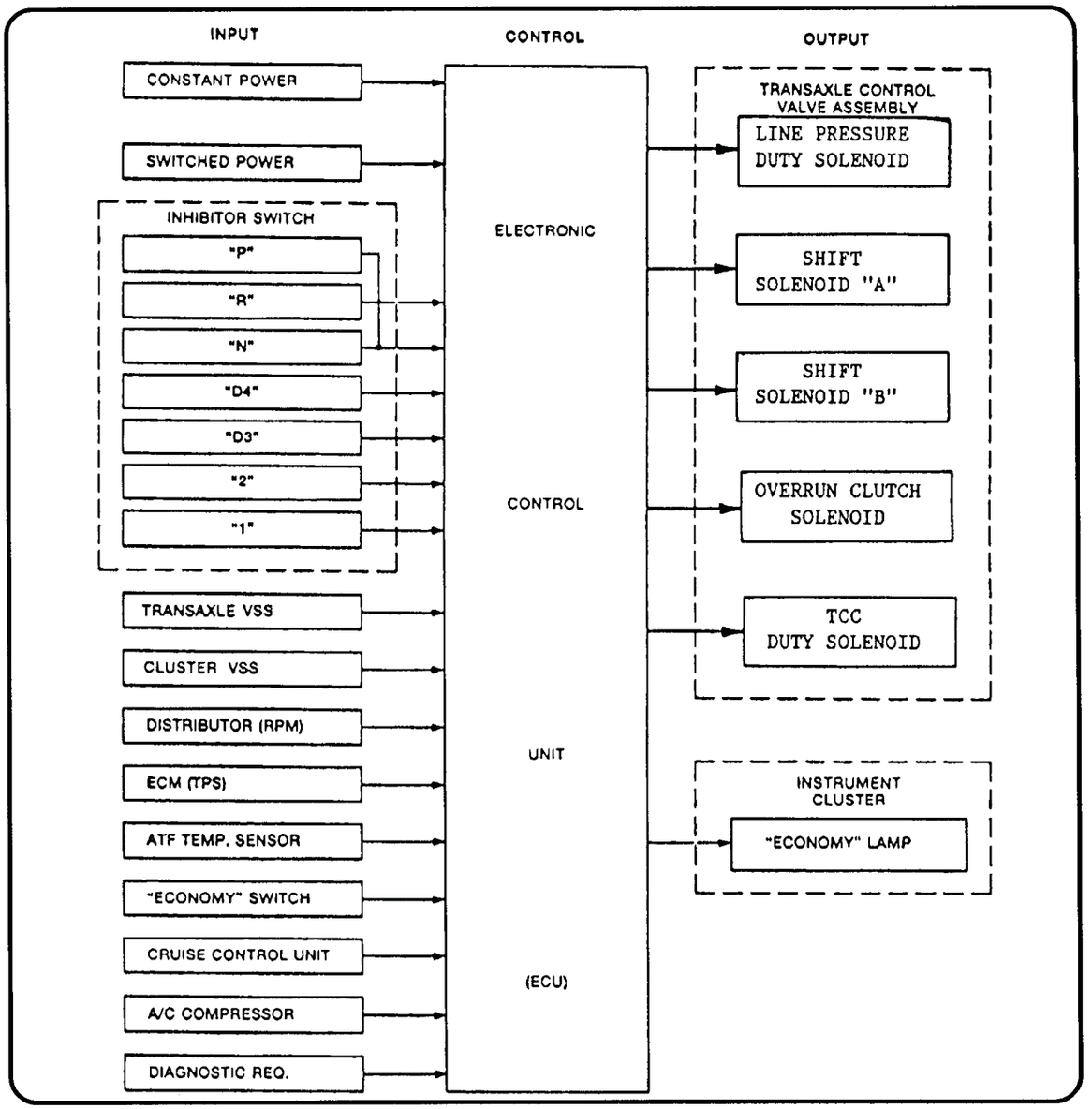


Figure 6.

The connectors for the ECU are called C48 and C49 and the pins are identified in figure 7. Voltage tests can be performed to check many of the input and output signals. Figures 8 and 9 describe the voltage readings that can be found at the connector pins. When making these checks at the ECU, it is important to remember that the connectors must remain connected during the checks, and that the pins are numbered as you look into the connector from the wire side.

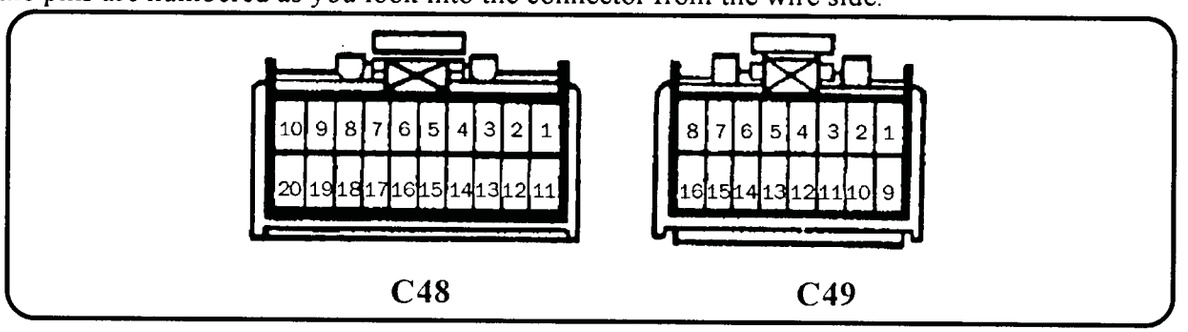


Figure 7.

PIN	DESCRIPTION	VOLTAGE / CONDITION
2	"ECONOMY" SWITCH	4 to 11 VDC (steady), with switch in "normal" position. Below 1 VDC, with switch in "economy" position.
3	"D3" INPUT	0 VDC, when transaxle is in ranges other than "D3". 12 VDC, when transaxle is in "D3" range.
5	CRUISE INPUT	4 to 11 VDC (steady), with no cruise control downshift request. Below 1 VDC, with cruise control downshift request.
6	DIAGNOSTIC REQUEST	4 to 11 VDC (steady), with ungrounded diagnostic connector. Below 1 VDC, with grounded diagnostic connector.
9	"1" INPUT	0 VDC, when transaxle is in ranges other than "1". 12 VDC, when transaxle is in "1" range.
10	"2" INPUT	0 VDC, when transaxle is in ranges other than "2". 12 VDC, when transaxle is in "2" range.
11	"D4" INPUT	0 VDC, when transaxle is in ranges other than "D4". 12 VDC, when transaxle is in "D4" range.
12	"P/N" INPUT	0 VDC, when transaxle is in ranges other than "P OR N". 12 VDC, when transaxle is in "P OR N".
14	A/C INPUT	0 VDC, when A/C compressor clutch is dis-energized. 12 VDC, when A/C compressor clutch is energized.
15	TRANSMISSION VSS	0 VDC, with 0 MPH. 0.5 to 5 VDC, with varying vehicle speed.
16	SENSOR LOW	Below 1 VDC, under all engine and vehicle conditions.
19	ATF TEMP. INPUT	Over 1.5 VDC, with ATF temperature below 20° C. 0.1 to 0.8, with ATF temperature between 80 and 120° C.
20	TPS INPUT	Above 6 VDC, with closed throttle. 0.5 to 6 VDC, varying with engine load.

Figure 8.

PIN	DESCRIPTION	VOLTAGE / CONDITION
1	CONSTANT B+	12 VDC, under all engine and vehicle conditions.
3	"R" INPUT	0 VDC, when transaxle is in ranges other than "R". 12 VDC, when transaxle is in "R" range.
4	ENGINE RPM	0 VDC, with engine not running. 4 to 8 VDC, with varying engine speed.
5	CLUSTER VSS	0 or 12 volts, with 0 MPH. 4 to 8 VDC, with varying vehicle speed.
6	"ECONOMY" LAMP	12 VDC, with "economy" lamp off. Below 1 VDC, with "economy" lamp on.
7	T.C.C. DUTY SOLENOID	Below 4 VDC, unless in "D4" /4th+TCC. Above 8 VDC, in "D4" /4th+TCC.
8	OVERRUN CL. SOLENOID	0 VDC, when overrun clutch is applied (except in "1" range). 12 VDC, when overrun clutch is released.
9	SHIFT SOLENOID "B"	0 VDC, in 3rd and 4th gear. 12 VDC, in 1st and 2nd gear.
10	SHIFT SOLENOID "A"	0 VDC, in 2nd and 3rd gear. 12 VDC, in 1st and 4th gear.
11	LINE PRESSURE SOLENOID	2 to 4 VDC, with light engine load. 0.1 to 3 VDC, with moderate to heavy engine load.
12	LINE PRESSURE SOLENOID	Above 11.5 VDC, with closed throttle and 0 MPH. 1.5 to 11.5 VDC, varying with engine load.
13	SYSTEM GROUND	Less than 1 volt, under all engine and vehicle conditions.
14	SYSTEM GROUND	Less than 1 volt, under all engine and vehicle conditions.
15	SWITCHED "B+"	12 VDC, under all engine and vehicle conditions.
16	SWITCHED "B+"	12 VDC, under all engine and vehicle conditions.

Figure 9.

ECU OUTPUTS

The **"ECONO"** lamp is on the instrument cluster to inform the driver of the position of the "Economy" switch. When the switch is open (off), the transaxle will follow a normal shift schedule and the "ECONO" lamp will be off. When the switch is closed or shorted, the transaxle will follow the "economy" mode shift schedule and the "ECONO" lamp will be lit. If the ECU detects a fault in in the control system, it will alert the driver by flashing the "ECONO" lamp on and off. When this lamp is flashing, trouble codes may be retrieved at the diagnostic connector shown in figure 1.

Shift Solenoid "A" and **Shift Solenoid "B"** are located on the valve body and control shifting of the four forward ranges. They are normally open when off and they drain fluid from their respective oil passages. When the ECU sends 12 volts to energize them, they close and allow pressure build up to stroke their respective valves. These solenoids can be electrically checked with an ohmmeter at the transaxle connector shown in figure 10. The ohms values for these solenoids should be approximately **24 ohms** resistance at room temperature. The "ON" and "OFF" shift pattern for Shift Solenoid "A" and Shift Solenoid "B" is shown in figure 11.The **Overrun Solenoid** is located on the valve body and it can be tested in the same fashion as the Shift Solenoids. It is energized by the ECU under certain conditions in 1st, 2nd, or 3rd gear to turn on the overrun clutch to provide engine braking. It can be identified in figure 10. and also ohms tests at approximately **24 ohms** at room temperature.

The **Torque Conveter Clutch Solenoid (T.C.C.)** is also controlled by the ECU to provide converter clutch operation. It is normally closed (OFF) and it opens when it is energized The T.C.C. Solenoid is on the valve body next to the Line Pressure Solenoid. This solenoid can be electrically checked at the harness connector. It should read approximately **13 ohms** resistance at room temperature. The conditions necessary for the ECU to energize the Torque Converter Clutch are :

1st: The vehicle must be in 4th gear.

2nd: Transmission oil temperature must be over 104° F.

3rd: Vehicle speed condition must be met.

4th: Throttle position must be correct in relation to the vehicle speed sensor.

The **Line Pressure Solenoid** is mounted on the valve body next to the T.C.C. Solenoid. It is normally closed and begins to open as it is energized. This solenoid operates at a variable duty cycle based on throttle position sensor input to the ECU. The duty cycle (time on /time off) translates into a variable voltage to control line pressure. The higher the voltage, the lower the pressure and the lower the voltage the higher the pressure. The Line Pressure Solenoid can be electrically checked at the harness connector. It should read approximately **3.3 ohms** resistance at room temperature.

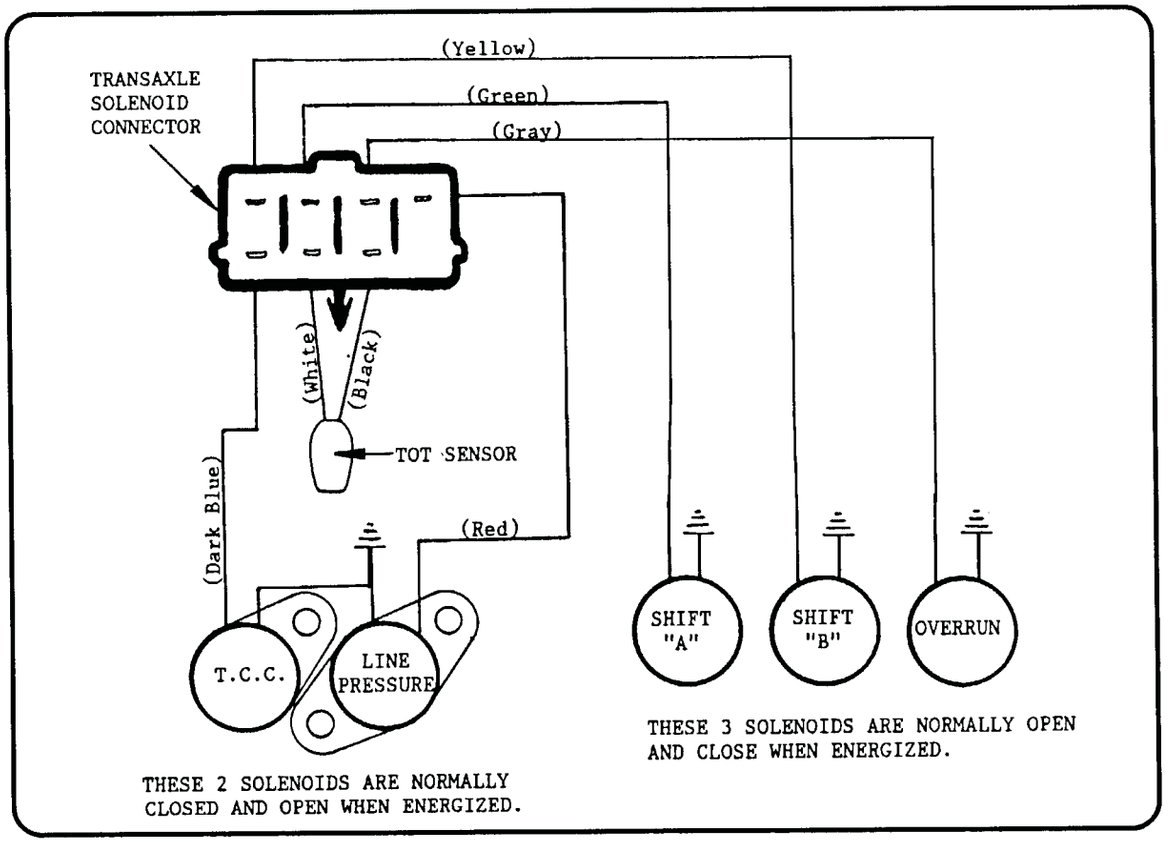


Figure 10.

GEAR	SHIFT SOLENOID "A"	SHIFT SOLENOID "B"	T.C.C. SOLENOID
1st	ON	ON	OFF
2nd	OFF	ON	OFF
3rd	OFF	OFF	OFF
4th	ON	OFF	ON*

*** MAY BE ON, BASED UPON:**
1 VEHICLE SPEED SENSOR AND THROTTLE POSITION SENSOR.
2 ATF TEMPERATURE (BELOW 104° F) SENSOR INPUT TO ECU.

Figure 11.

The **Wire Harness Connectors** are mounted to a single bracket on top of the transaxle. There are four connectors shown in figure 12. The Transaxle Solenoid Connector is brown plastic with tabs offset below the centerline. The Inhibitor Switch Connector is black plastic with tabs on the centerline.

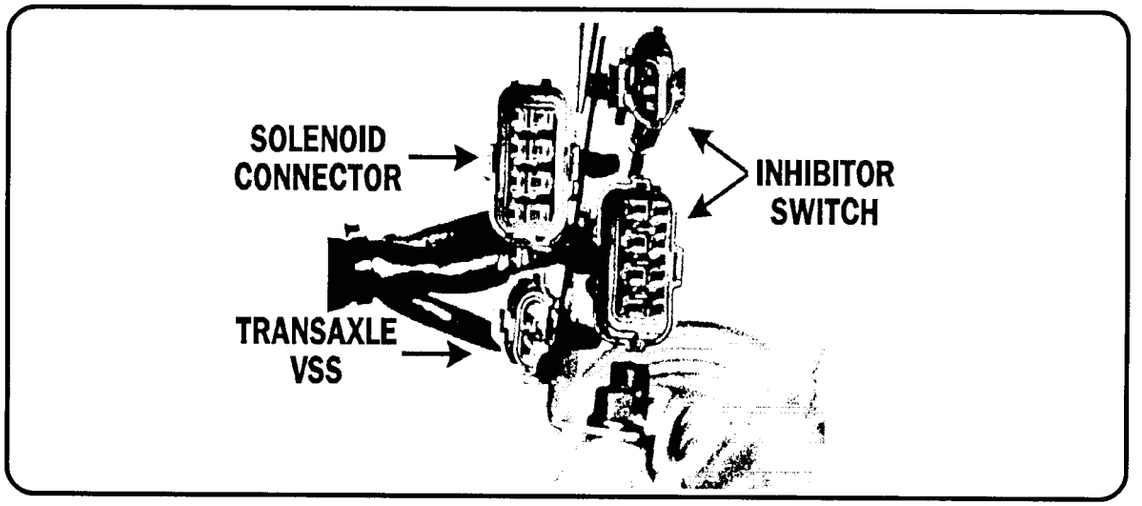


Figure 12.

For information on internal transaxle components or on the valves in the valve body, refer to the A.T.S.G. Techtran Manual for the Geo Storm.

TROUBLE CODE EXPLANATION

11 TRANSAXLE VSS (OPEN OR SHORT)

1. Will detect fault at approximately 30 MPH (Signal from Cluster VSS).
2. Will flash the "ECONO" lamp on dash to alert driver.
3. Will store trouble code 11 in memory (Display upon request).
4. Will use the cluster VSS as a back-up substitute input.
5. Will use normal line pressure control.
6. Will shift 1-2-3 ONLY in the "D4" range (No 4th Gear).
7. No converter clutch apply.

NOTE

THE ECU DOES NOT DETECT A FAILURE OF BOTH VSS INPUTS AT THE SAME TIME. IF SUCH A FAULT OCCURS, YOU WILL HAVE "NO UPSHIFT" IN ANY RANGES.

13 DISTRIBUTOR RPM (OPEN OR SHORT)

1. Will detect fault, based on TPS and VSS input information.
2. No driver alert with the flashing of "ECONO" lamp on dash.
3. Will store trouble code 13 in memory (Display upon request).
4. Will use close to normal line pressure control without response to shifting from "P" or "N" into "R" or "D4".
5. Will shift 1-2-3-4 in "D4" range (Will have 4th).
6. Will have converter clutch apply.

15 ATF TEMPERATURE SENSOR (OPEN)

1. Will detect fault at initial ignition cycle check.
2. No driver alert with the flashing of "ECONO" lamp on dash.
3. Will store trouble code 15 in memory (Display upon request).
4. Will use close to normal line pressure duty cycle control.
5. Will shift 1-2-3 ONLY in "D4" range (No 4th Gear).
6. No converter clutch apply.

21 THROTTLE POSITION SENSOR (OPEN OR SHORT)

1. Will detect fault at initial ignition cycle check.
2. Will flash the "ECONO" lamp on dash to alert driver.
3. Will store trouble code 21 in memory (Display upon request).
4. Will have higher than normal line pressure.
5. Will have higher than normal upshifts.
6. Will have engine braking in all gears except 4th.
7. No converter clutch apply.

24 CLUSTER VSS (OPEN OR SHORT)

1. Will detect fault at approximately 30 MPH (Signal from Transaxle VSS).
2. Will flash the "ECONO" lamp on dash to alert driver.
3. Will store trouble code 24 in memory (Display upon request).
4. Will use the transaxle VSS as the primary input.
5. Will use normal line pressure control.
6. Will shift 1-2-3-4 in "D4" range (Will have 4th).
7. Will have converter clutch apply.

NOTE

THE ECU DOES NOT DETECT A FAILURE OF BOTH VSS INPUTS AT THE SAME TIME. IF SUCH A FAULT OCCURS, YOU WILL HAVE "NO UPSHIFTS" IN ANY RANGES.

31 SHIFT SOLENOID "A" (OPEN OR SHORT)

1. Will detect fault at initial ignition cycle check.
2. Will flash the "ECONO" lamp on dash to alert driver.
3. Will store trouble code 31 in memory (Display upon request).
4. Will use normal line pressure control.
5. Will use "OFF" control for both shift solenoids (3rd gear starts in all forward ranges).
6. Will use overrun clutch solenoid "OFF" control (Clutch Applied).
7. No converter clutch apply.

32 SHIFT SOLENOID "B" (OPEN OR SHORT)

1. Will detect fault at initial ignition cycle check.
2. Will flash the "ECONO" lamp on dash to alert driver.
3. Will store trouble code 32 in memory (Display upon request).
4. Will use normal line pressure control.
5. Will use "OFF" control for both shift solenoids (3rd gear starts in all forward ranges).
6. Will use overrun clutch solenoid "OFF" control (Clutch Applied).
7. No converter clutch apply.

33 OVERRUN CLUTCH SOLENOID (OPEN OR SHORT)

1. Will detect fault when inhibit switch signals "D4" range selection.
2. Will flash the "ECONO" lamp on dash to alert driver.
3. Will store trouble code 33 in memory (Display upon request).
4. Will use normal line pressure control.
5. Will shift 1-2-3 ONLY in "D4" range (No 4th Gear).
6. Will use overrun clutch "OFF" control (Clutch Applied).
7. Will have converter clutch apply in 3rd gear, when in "D4" range.

34 TORQUE CONVERTER CLUTCH SOLENOID (OPEN OR SHORT)

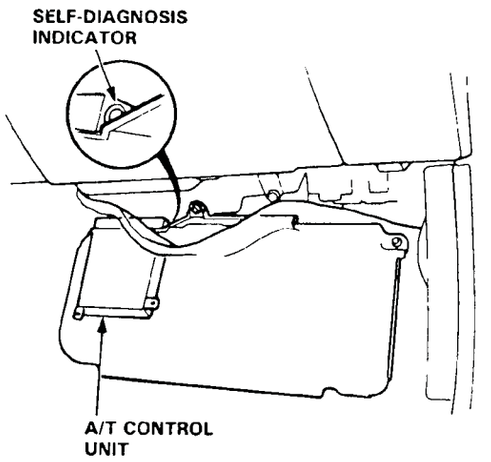
1. Will detect fault at initial ignition cycle check.
2. Will flash the "ECONO" lamp on dash to alert driver.
3. Will store trouble code 34 in memory (Display upon request)
4. Will use normal line pressure control.
5. Will shift 1-2-3-4 in "D4" range (Will have 4th).
6. No converter clutch apply.

35 LINE PRESSURE DUTY SOLENOID (OPEN OR SHORT)

1. Will detect fault at initial ignition cycle check.
2. Will flash the "ECONO" lamp on dash to alert driver.
3. Will store trouble code 35 in memory (Display upon request).
4. Will have MAXIMUM line pressure.
5. Will shift 1-2-3-4 in "D4" range (Will have 4th).
6. Will have converter clutch.

HONDA PRELUDE COMPUTER DIAGNOSIS

The electronically controlled Honda transmissions have four solenoids to control shifting and converter lock-up. Earlier models use two solenoids on the outside of the transmission for lock-up, and two solenoids inside of the transmission for shifting. Some of the later models and Civics have all four solenoids mounted externally. Pressure control for shift feel is achieved by means of a throttle cable. All of these units have a similar control system and they are diagnosed in the same fashion. The A/T Control Unit is usually located below the dash under the carpet on the passenger side of the car. However, the position of the A/T Control Unit may vary with Hondas other than Prelude. Figure 1 lists shows the Control Unit location. Note that the A/T Control unit is smaller than the Engine Programed Fuel Injection Computer, Which may be located near by.



UNDER CARPET ON THE PASSENGER FLOOR

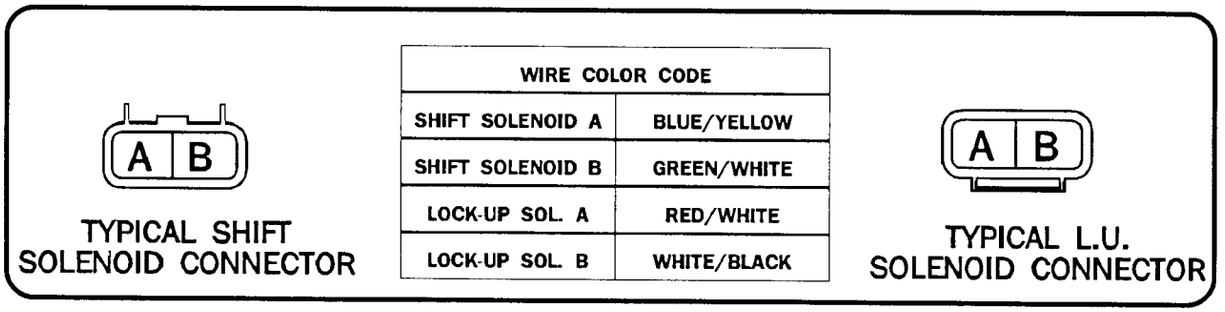
Figure 1

It contains a self diagnosis indicator (LED) lamp which flashes trouble codes if and when trouble is detected by the control unit. For trouble code translation refer to **page 37** of this book. Some trouble codes will cause the S3 light on the instrument panel to flash. Other trouble codes do not start the S3 light flashing. If trouble is suspected, road test the vehicle and then leave the ignition switch on while checking the LED light on the A/T Control Unit. This Transmission starts in 4th gear if the controller fails to energize the solenoids. 2nd gear will be available with the selector lever.

GEAR	SHIFT SOL. A	SHIFT SOL. B	LU. SOL. A	LU. SOL. B
1st	OFF	ON	OFF	OFF
2nd	ON	ON	MAY BE ON OR OFF ACCORDING TO VEHICLE CONDITIONS	OFF
3rd	ON	OFF		
4th	OFF	OFF		
OHMS	12 - 24	12 - 24	14 - 30	14 - 30

Figure 2.

If the transmission doesn't receive voltage to the solenoids then it will be necessary to energize the solenoids in the proper order to test the transmission. See Figure 2 for the correct solenoid shift schedule and for ohms tests. See Figure 3 for connector information and wire color.



WIRE COLOR CODE	
SHIFT SOLENOID A	BLUE/YELLOW
SHIFT SOLENOID B	GREEN/WHITE
LOCK-UP SOL. A	RED/WHITE
LOCK-UP SOL. B	WHITE/BLACK

Figure 3.

If there is a mechanical malfunction of a solenoid, the A/T Controller may not respond with a trouble code. During such a mechanical malfunction, a different gear than that commanded by the A/T controller will be achieved. Figure 4 shows shifting properties during common malfunctions. Note that these are not electrical problems , but rather mechanical (stuck) malfunctions only.

GEAR COMMANDED	GEAR ACHIEVED DURING MALFUNCTION			
	SOL. B CLOSED	SOL. B OPEN	SOL. A CLOSED	SOL. A OPEN
1ST	STARTS IN 4TH	STARTS IN 1ST	STARTS IN 1ST	STARTS IN 2ND
2ND	SHIFTS TO 3RD	SHIFTS TO 2ND	STAYS IN 1ST	STAYS IN 2ND
3RD	STAYS IN 3RD	STAYS IN 2ND	SHIFTS TO 4TH	SHIFTS TO 3RD
4TH	SHIFTS TO 4TH	SHIFTS TO 1ST FEELS LIKE NEUTRAL	STAYS IN 4TH	STAYS IN 3RD

Figure 4.

The **Throttle Angle Sensor** is on the throttle body. It has a 3 pin connector. With the key on and the wire harness connected, there should be approximately 5 volts between the green/white and yellow/white wires. The center wire (red/yellow) should have about .5 volt at closed throttle and 4.5 volts at full open throttle. Typical connector information is found in figure 5.

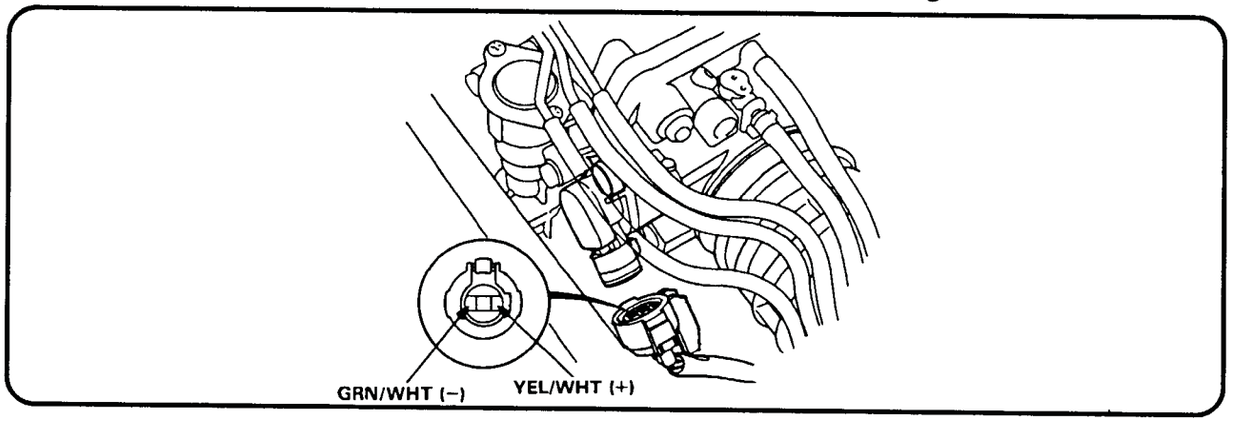


Figure 5.

The **Speed Sensor** and the **A/T Speed pulser** are two sensors that are important to proper transaxle operation. The A/T Speed Pulser is located on the transmission. The Speed Sensor is in the speedo head. One is driven by the speedometer gear and the other plugs in below the starter. See Figure 6. Both may be tested with an ohmmeter. While rotating the front wheels, an ohmmeter should alternately read continuity and no continuity across the 2 pin connector at the A/T Speed Pulser.

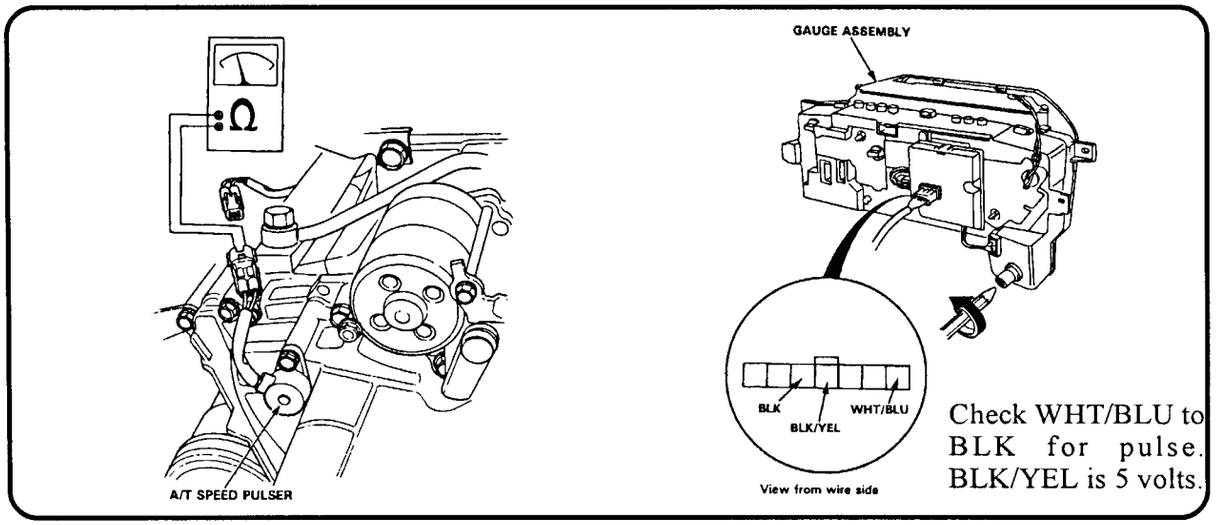


Figure 6

The **Shift Solenoids** are located inside the transmission on some models and outside on others. With those that have internal shift solenoids, Solenoid A will be found near the bottom and Solenoid B is farther up on the valve body. Those with external shift solenoids have Solenoid A closest to the bottom and Solenoid B just above it. These Solenoids are normally closed and they open to exhaust when they are energized. See Figures 7 and 8.

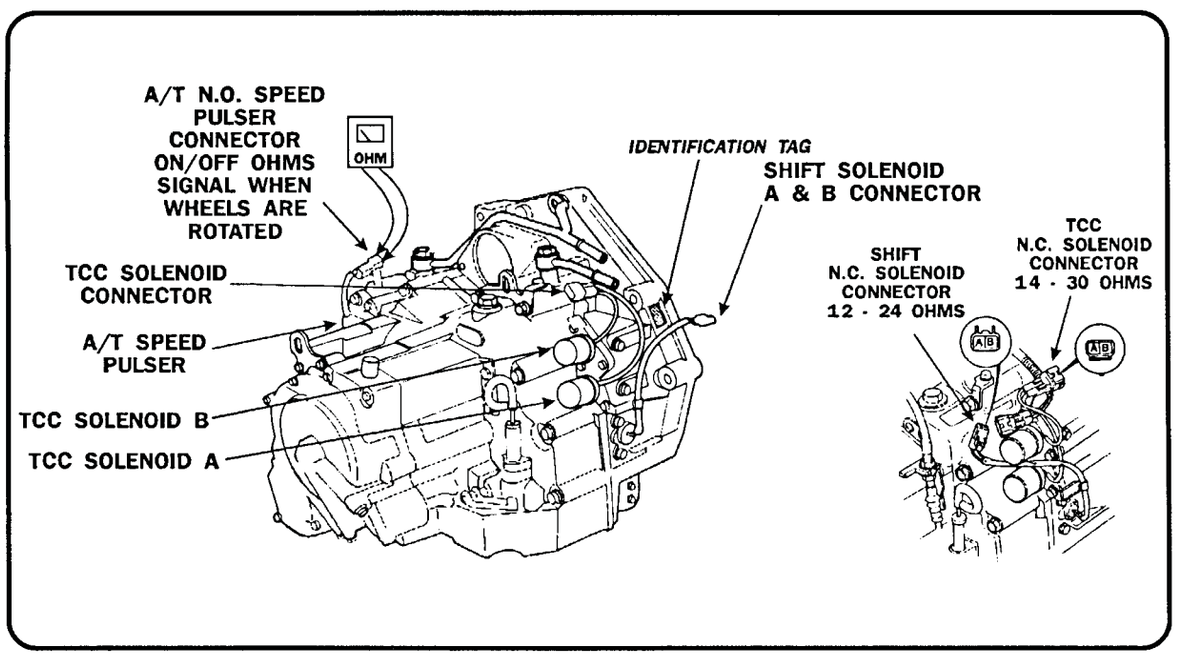


Figure 7.

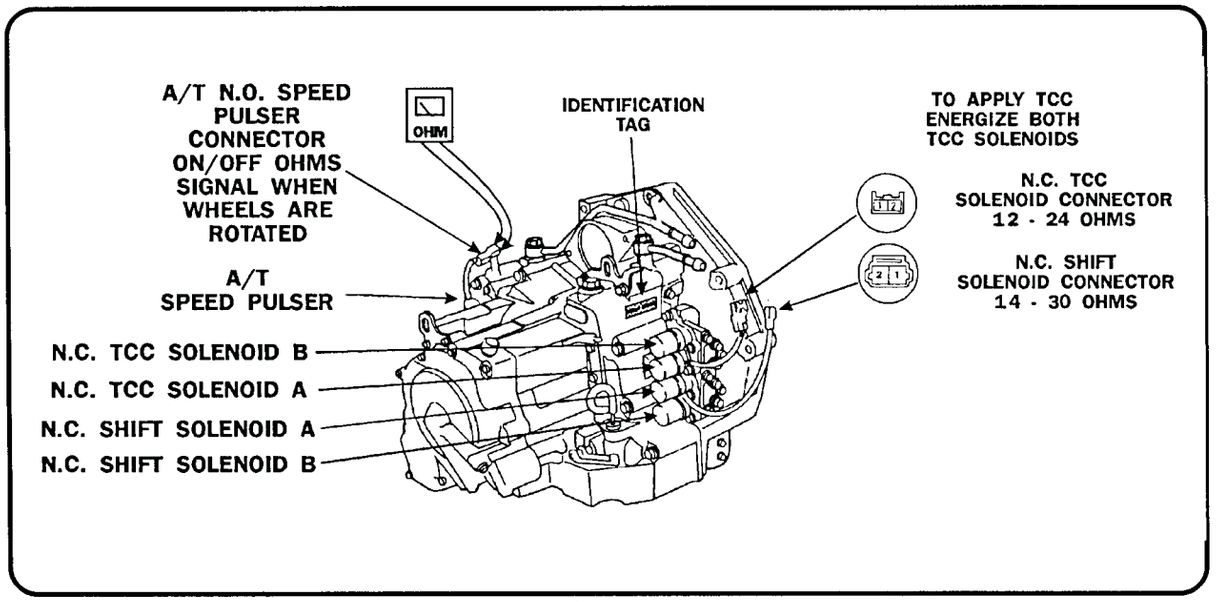


Figure 8.

Lock-up Solenoid A and Lock-up Solenoid B are external on all models. Lock-up Solenoid B is closest to the top of the transmission, and Lock-up Solenoid A is just below it. These solenoids are normally closed and they open to exhaust when they are energized.

The **Water Temperature Sensor (TW)** on the engine also sends information to the A/T Controller to modify shift strategy. It can be checked with an ohmmeter. See figure 9 for location and wire connector identification.

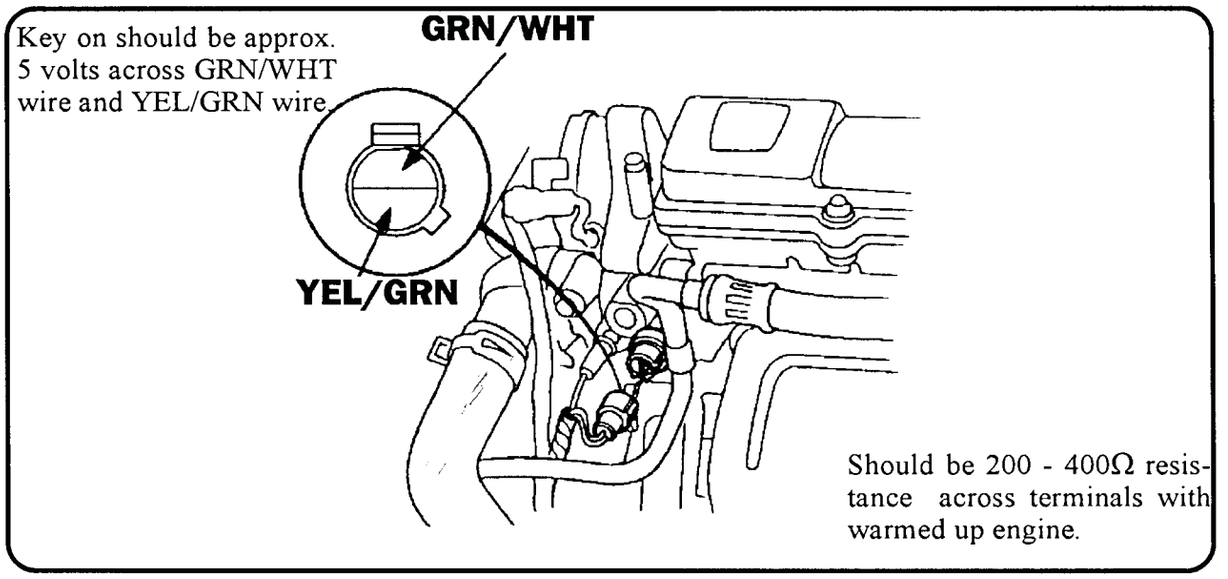
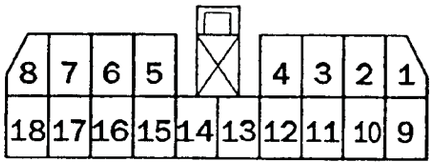


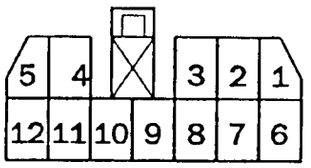
Figure 9

TYPICAL HONDA PRELUDE A/T CONTROLLER

Testing individual circuits, sensors, and solenoids may be done at the sensors or at the **A/T Controller**. Wire color and pin location for testing can be found in figure 10. Some of the values listed below are checked with the connector unplugged from the A/T Controller.



Connector A from wire side



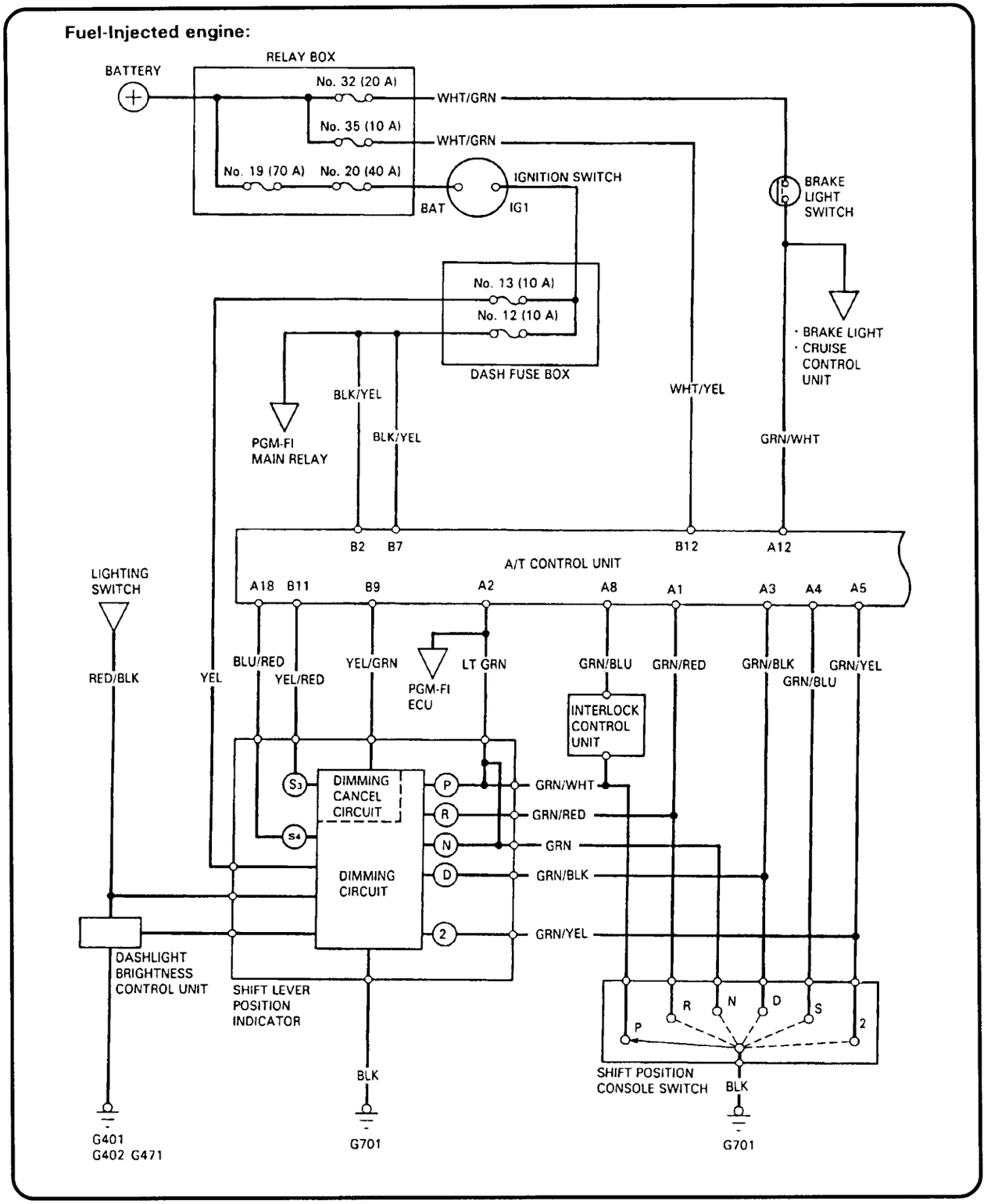
Connector B from wire side

PIN	DESCRIPTION	VALUE	WIRE COLOR
A1	SHIFT POSITION R	GROUND IN REVERSE	GREEN/RED
A2	SHIFT POSITION N	GROUND IN NEUTRAL	GREEN
A3	SHIFT POSITION D	GROUND IN DRIVE	GREEN/BLACK
A4	SHIFT POSITION S	GROUND IN S	GREEN/BLUE
A5	SHIFT POSITION 2	GROUND IN 2	GREEN/YELLOW
A6	SPEED SENSOR	A/C VOLTS OR PULSE	WHITE/BLUE
A7	A/T SPEED SENSOR	0 - 5 VOLTS UP AND DOWN	GRAY
A8	INTERLOCK (90-UP)	NO V. KEY ON,BRAKE ON*	GREEN/RED
A9	A/C DELAY (SOME)	12 V. ENG. ON,A/C OFF *	RED/BLUE
A10	IGNITION PULSE	9 - 12 V. ENGINE ON *	BLUE
A11	COOLANT TEMP. SENSOR	.5 - 1.6 VOLTS WARM	YELLOW/GREEN
A12	BRAKE SIGNAL	12 VOLTS W/BRAKES ON	GREEN/WHITE
A13	S4 SWITCH SIGNAL	GROUNDED W/SWITCH ON	BLUE/ GREEN
A14	USUALLY BLANK		
A15	SENSOR VOLTAGE SIGNAL	KEY ON 4.5 - 5.5 VOLTS	YELLOW/WHITE
A16	THROTTLE SENSOR	.4 - 5.7 VOLTS VARIABLE	RED/YELLOW
A17	BLANK		
A18	S4 LIGHT	VOLTAGE TO S4 LIGHT	BLUE/RED
B1	GROUND	GROUND	BROWN/ BLACK
B2	POWER SOURCE	12 VOLTS WITH KEY ON	BLACK/YELLOW
B3	LOCK-UP SOLENOID A	14-30 OHMS TO GROUND *	RED/WHITE
B4	SHIFT SOLENOID A	14-24 OHMS TO GROUND *	BLUE/YELLOW
B5	SHIFT SOLENOID B	14-24 OHMS TO GROUND *	GREEN/WHITE
B6	GROUND	GROUND	BROWN/BLACK
B7	POWER SOURCE	12 VOLTS WITH KEY ON	BLACK/YELLOW
B8	LOCK-UP SOLENOID B	14-30 OHMS TO GROUND *	WHITE/BLACK
B9	S3 DIMMING SIGNAL	GROUND TO LIGHT	YELLOW/GREEN
B10	BLANK		
B11	S3 LT. DRIVING SIGNAL	12 VOLTS / SWITCH ON *	YELLOW/RED
B12	POWER SOURCE(BATTERY)	12 VOLTS	WHITE/YELLOW

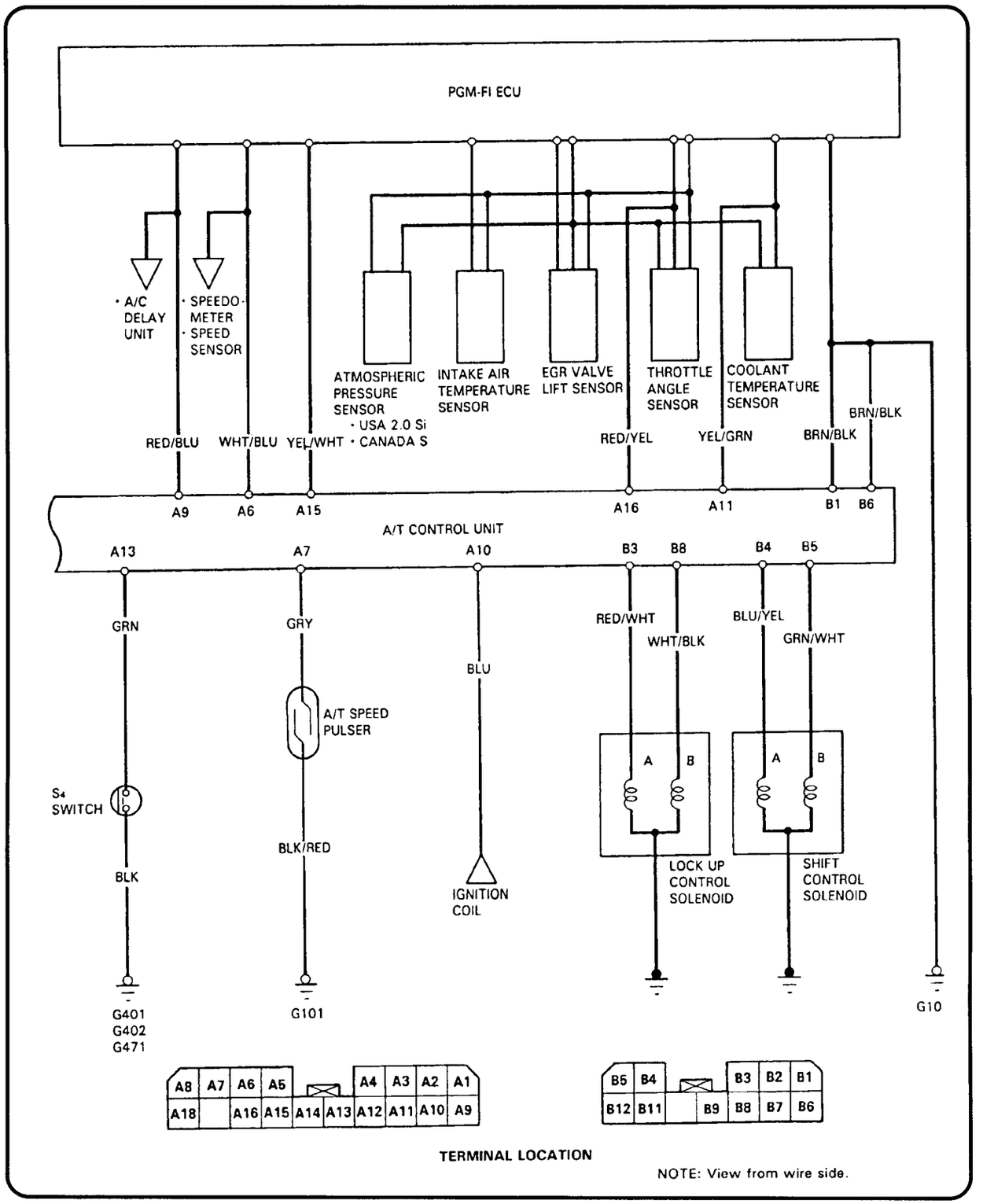
* CHECK WITH A/T CONTROLLER HARNESS UNPLUGGED

Figure 10.

HONDA PRELUDE FUEL INJECTED WIRE SCHEMATIC



HONDA PRELUDE FUEL INJECTED WIRE SCHEMATIC

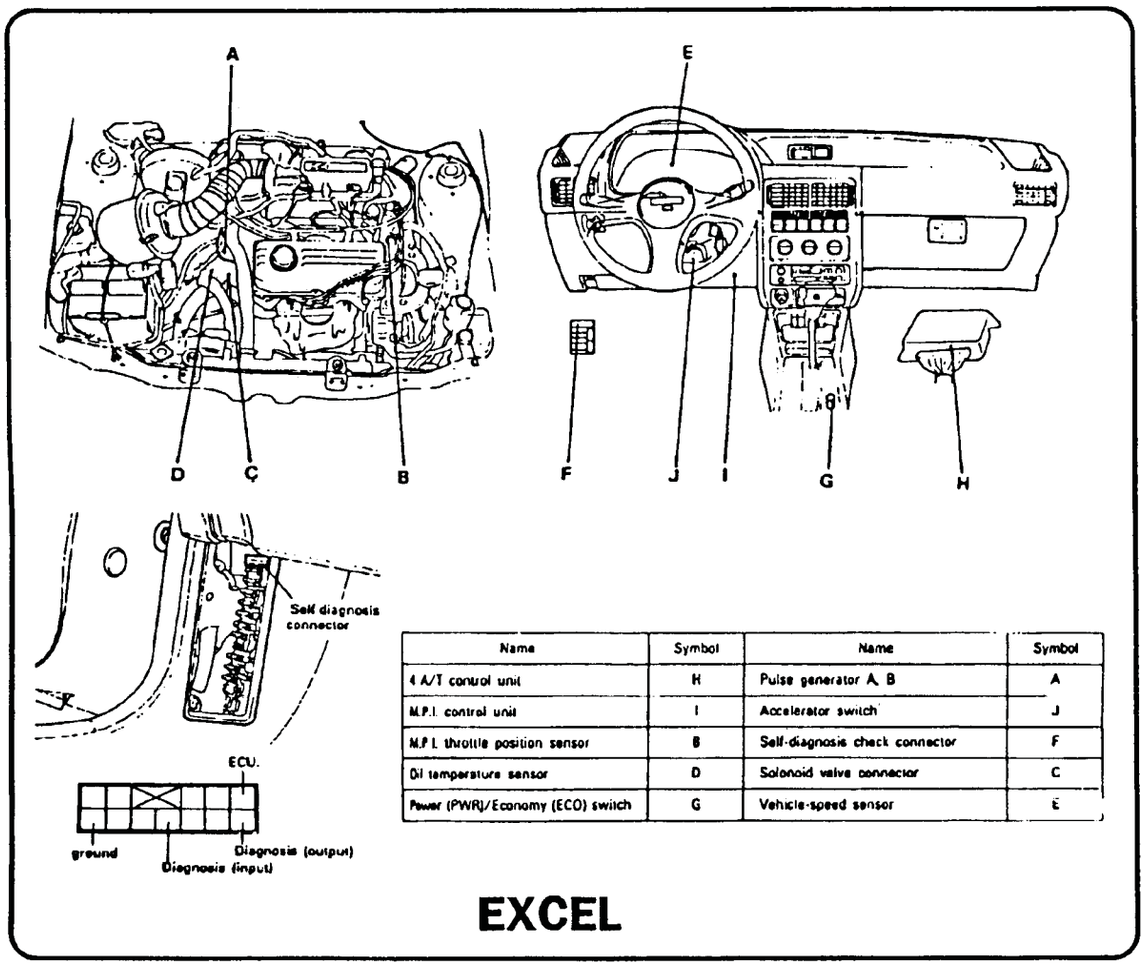


Number of LED display flashes	S3 indicator light ⊕	Symptom	Probable Cause
1	Blinks	• Lock up clutch does not engage. • Lock up clutch does not disengage. • Frequent engine stalling.	• Disconnected lock-up control solenoid valve A connector. • Open or short lock-up control solenoid valve A wire. • Faulty lock-up control valve A.
2	Blinks	• Lock up clutch does not engage.	• Disconnected lock-up control solenoid valve B connector. • Open or short lock-up control solenoid valve B wire. • Faulty lock-up control valve B.
3	Blinks or OFF	• Lock up clutch does not engage.	• Disconnected throttle angle sensor connector. • Open or short in throttle angle sensor wire. • Faulty throttle angle sensor.
4	Blinks	• Lock up clutch does not engage.	• Disconnected speed pulser connector. • Open or short in speed pulser wire. • Faulty speed pulser.
5	Blinks	• Fails to shift other than 2nd-4th gear. • Lock up clutch does not engage.	• Short in shift position console switch wire. • Faulty shift position console switch.
6	OFF	• Fails to shift other than 2nd-4th gear. • Lock up clutch does not engage. • Lock-up clutch engages and disengages alternately.	• Disconnected shift position console switch connector. • Open or short in shift position console switch wire. • Faulty shift position console switch.
7	Blinks	• Fails to shift other than 1st-4th, 2nd-4th, 2nd-3rd gears. • Fails to shift (stuck in 4th gear).	• Disconnected shift control solenoid valve A connector. • Open or short shift control solenoid valve A wire. • Faulty shift control valve A.
8	Blinks	• Fails to shift (stuck in 1st or 4th gear).	• Disconnected shift control solenoid valve B connector. • Open or short shift control solenoid valve B wire. • Faulty shift control valve B.
9	Blinks	• Lock-up clutch does not engage.	• Disconnected A/T speed pulser. • Open or short in A/T speed pulser. • Faulty A/T speed pulser.
10	Blinks	• Lock-up clutch does not engage.	• Disconnected coolant temp sensor connector. • Open or short in coolant temp sensor wire. • Faulty coolant temp sensor.
11	OFF	• Lock-up clutch does not engage.	• Disconnected ignition coil connector. • Open or short in ignition coil wire. • Faulty ignition coil.
13*	Blinks	• Late lock-up clutch engagement.	• Disconnected PA sensor connector. • Open or short in PA sensor wire. • Faulty PA sensor.
14**	OFF	• Transmission jerks hard when shifting	• Short or open in FAS wire. • Trouble in PGM-FI unit.
15**	OFF	• Transmission jerks hard when shifting	• Disconnected NM speed sensor connector. • Short or open in NM speed sensor wire. • Faulty NM speed sensor.

* = INTEGRA ONLY.
**= LEGEND ONLY.
⊕ = S4 LIGHT LEGEND.

HYUNDAI ELECTRICAL DIAGNOSIS

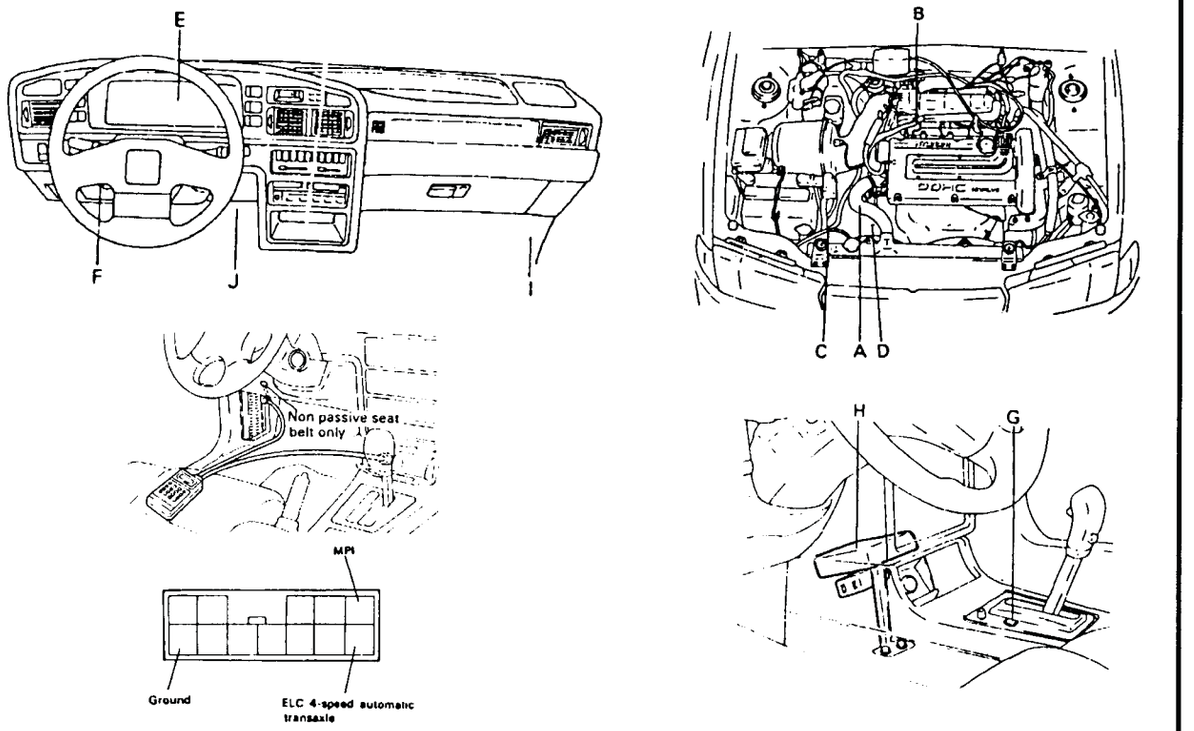
The KM175-7 transmissions found in the Hyundai is very similar to the Mitsubishi version. Most of the transmission sensors and solenoids are the same also. The ELC 4 speed control unit and its service connector are, however, quite different. This transmission does have self-diagnosis capability as long as the engine is not shut off after a malfunction has occured. The controller has no memory so any problems must be diagnosed immediatly after the malfunction occurs. There are two ways to retrieve trouble codes. A hand-held scanner can be plugged into the diagnostic check connector. Also the Self Diagnosis Check Connector can be jumped using an analog volt meter or LED light. See Figure 1 for the component locations and check connector pin identification for Excel models. See Figure 2 for component locations and check connector pin identification for Sonata models.Trouble code numbers read by a hand held scanner differ from those read with a voltmeter. Fault or trouble code translation can be found on Pages 59-62. In fail-safe mode or in the event of control unit failure, thts transmission will start in third gear. No other forward range can be selected.



Name	Symbol	Name	Symbol
4 A/T control unit	H	Pulse generator A, B	A
M.P.I. control unit	I	Accelerator switch	J
M.P.I. throttle position sensor	B	Self-diagnosis check connector	F
Oil temperature sensor	D	Solenoid valve connector	C
Power (PWR)/Economy (ECO) switch	G	Vehicle-speed sensor	E

EXCEL

Figure 1.



Name	Symbol	Name	Symbol
Pulse generator A, B	A	Self–diagnosis check connector	F
Throttle position sensor	B	Power/Normal switch	G
Solenoid valve connector	C	4 A/T control unit	H
Oil temperature sensor	D	M.P.I control unit	I
Vehicle speed sensor	E	Accelerator switch	J

SONATA

Figure 2.

The **Diagnostic Connector** is the same on the Excel and Sonata models even though some use more of the pins than others, depending on certain options. Also the Sonata Diagnastic Connector may be in one of two places. Those with the non passive seat belt (you hook it up yourself) have the Diagnostic Connector located on the lower dash to the left of the steering column, while the others have the diagnostic connector located at the fuse block.

Computer **pin identification** for most units can be found in figures 11 and 12, after the sensor and solenoid descriptions in this chapter.

The **ELC Control Unit** is under the seat on Excels and on the floor behind the center console on Sonatas. It recieves input signals from the engine and transaxle and determines the solenoid signals to be sent to the valve body. The ELC inputs are explained below and the simplest test information is provided for each.

The **Pulse Generators** mount to the top of the transmission, one recording input rotation speed and the other recording output rotation speed. This signal is sent to the ELC Control Unit to monitor transmission ratio and vehicle speed. They can be checked with an ohmmeter at the wire connector and at the ELC Control Unit. Both must have the same (or very close) reading. The normal resistance found in the Pulse Generators is **250 ohms**.

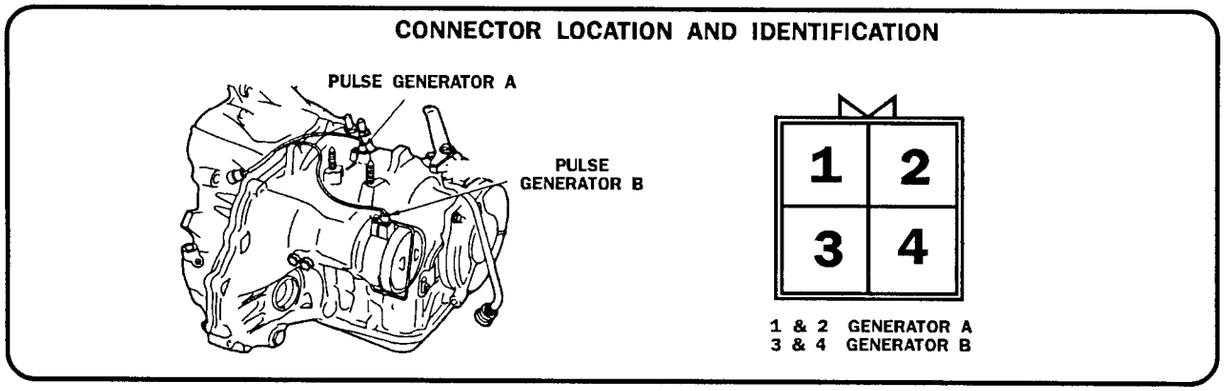


Figure 3

The **Throttle Position Sensor (TPS)** is located on the throttle body. It usually has a three wire connector and may be checked with an ohmeter or a voltmeter. Voltage checks are easiest and fine for testing purposes. With the key on and the TPS wire connector still connected, the number 1 lead should be approximatly 5 volts while the number 2 lead should be variable, starting at about .5 volt and increasing smoothly with throttle opening to about 4.5 volts at wide open throttle.

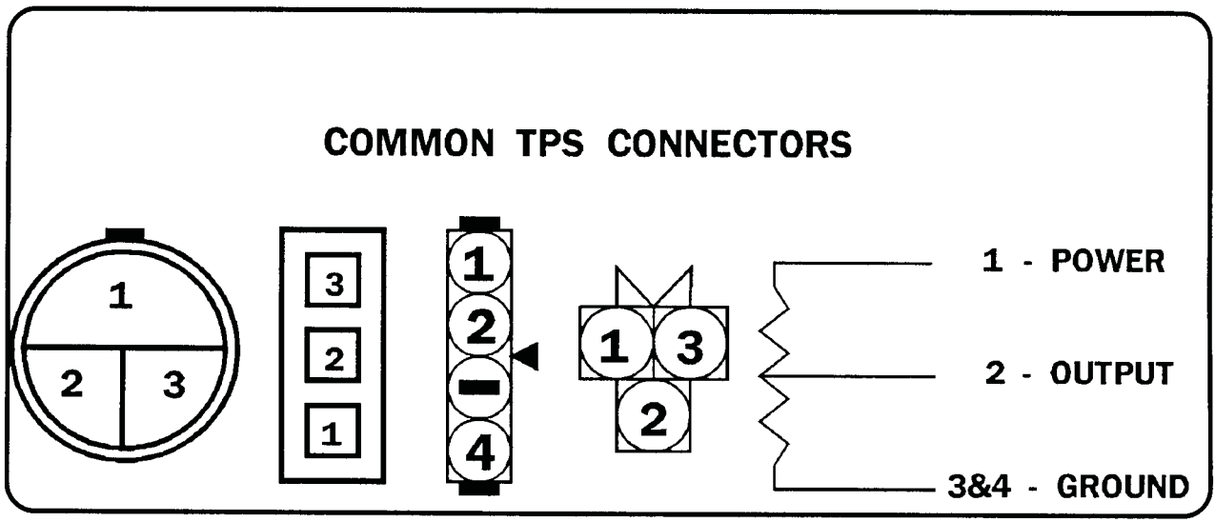


Figure 4.

The **Shift Solenoids** and the **Damper Clutch Control Solenoid** are mounted on the valve body and can be checked electrically with an ohmmeter. The solenoids can also be energized in the proper order to check transmission shifts and the converter clutch. Figure 5 and Figure 6 provide shift pattern, pin identification, and ohms readings for test purposes.

HYUNDAI KM-175-177

COLOR	ORANGE	YELLOW	RED	BLUE
GEAR	SOLENOID A	SOLENOID B	TCC SOL (SOME MODELS)	PRESSURE
1st	ON	ON	OFF	PULSE MODULATED BY COMPUTER
2nd	OFF	ON	ON*	
3rd	OFF	OFF	ON*	
4th	ON	OFF	ON*	
OHMS	20.8 - 23.8	20.8 - 23.8	2.6 - 3.2	2.6 - 3.2

* - AS DETERMINED BY COMPUTER

Figure 5

The **Pressure Control Solenoid** is on the valve body also and it receives a pulse signal from the ELC Control Unit to control transmission pressure. During the shifts, the control unit pulses a signal that is equivalent to about 3 volts. However, the voltage is turned off after the shifts to raise line pressure.

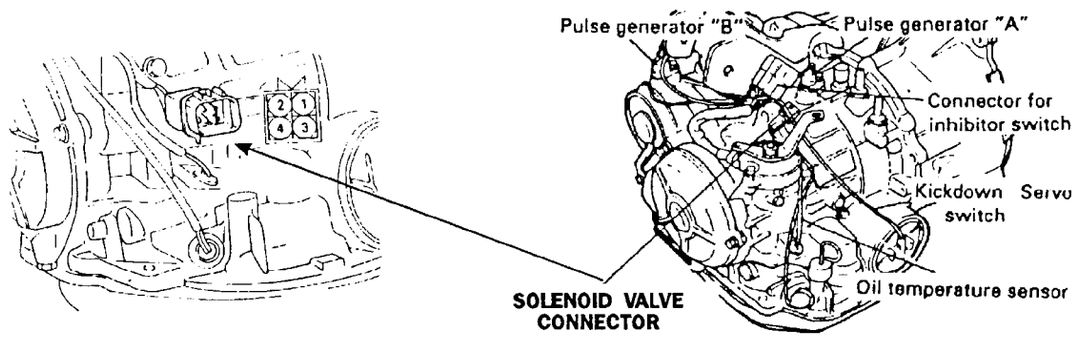


Figure 6

The **Vehicle Speed Sensor** is located in the speedometer head. It is a reed switch which alternately opens and closes four times with each revolution of the speedo cable. It can be checked with an ohmeter.

The **Kickdown Switch** is on the servo and tells the computer when the servo piston is pushing the band on. When the servo is released, this switch is grounded and as the piston moves, the switch opens. The computer uses this open or ground information to determine when to duty cycle the Pressure Control Solenoid for smooth shift feel. If this switch fails in a closed position, harsh shifts may occur. If this switch fails open or is disconnected, slide bump shifts may occur. The Kickdown switch has a single wire which may plug into a multi pin connector.

The **Accelerator Switch** is mounted above the accelerator pedal. The switch is closed when the pedal is released. This tells the computer to let the transmission stay in 2nd gear while the car is stopped. As soon as the accelerator is pushed, the switch opens and the transmission downshifts to first gear. Adjustment of this switch is critical to obtain the proper feel from a standing start. If this switch sticks closed, converter clutch operation will be inhibited. See figure 7 for connector and adjustment information.

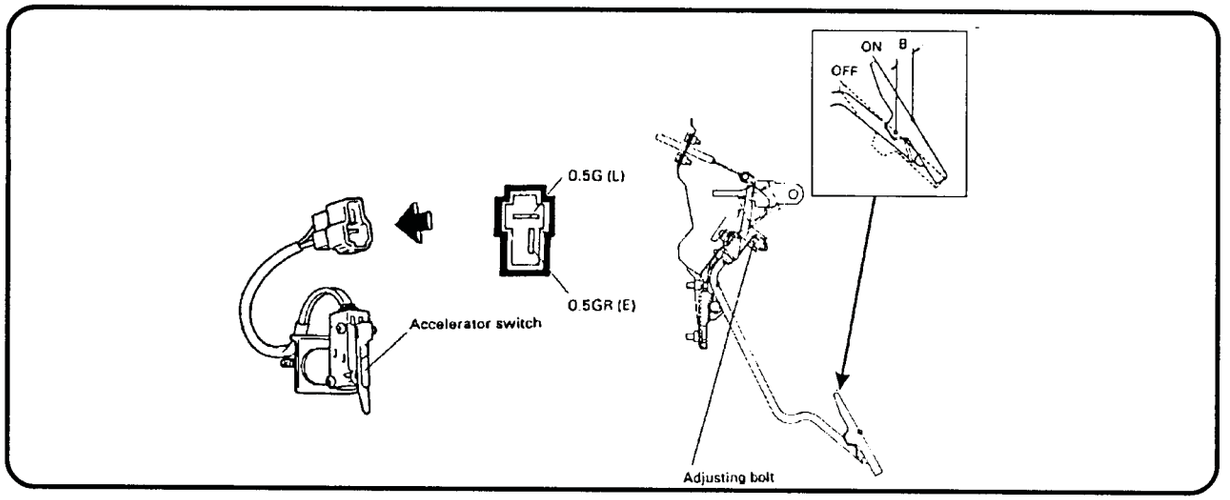
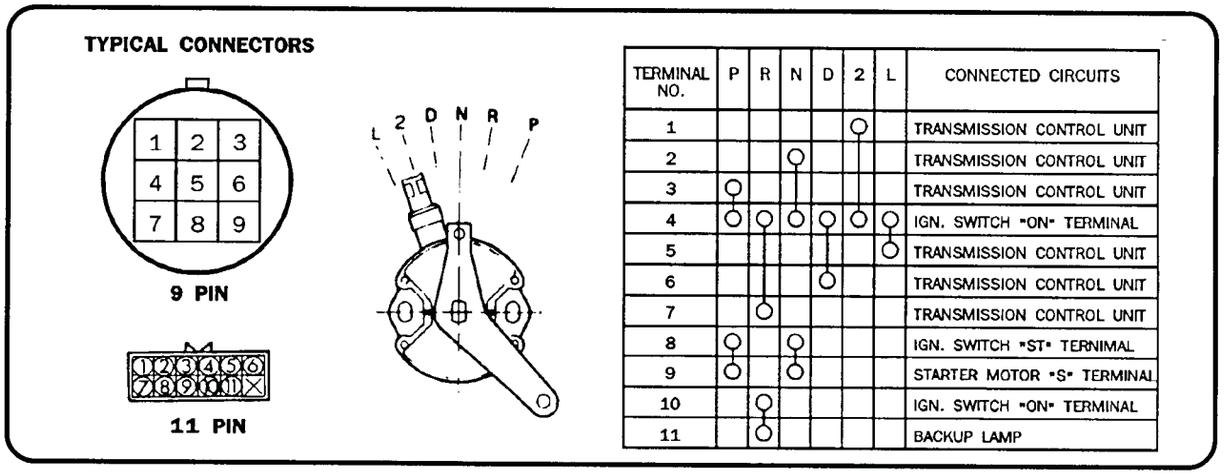


Figure 7.

The **Inhibitor Switch** is on the transmission case at the upper end of the manual control shaft. It completes a circuit in neutral and park so that the engine can be started. Other circuits detect and supply the computer with the selector lever position. For connector information see Figure 8.



TERMINAL NO.	P	R	N	D	2	L	CONNECTED CIRCUITS
1					○		TRANSMISSION CONTROL UNIT
2			○				TRANSMISSION CONTROL UNIT
3	○						TRANSMISSION CONTROL UNIT
4	○	○	○	○	○	○	IGN. SWITCH "ON" TERMINAL
5						○	TRANSMISSION CONTROL UNIT
6				○			TRANSMISSION CONTROL UNIT
7		○					TRANSMISSION CONTROL UNIT
8	○		○				IGN. SWITCH "ST" TERNIMAL
9	○		○				STARTER MOTOR "S" TERMINAL
10		○					IGN. SWITCH "ON" TERMINAL
11		○					BACKUP LAMP

Figure 8.

Shift Solenoid A and **Shift Solenoid B** are mounted on the valve body. They are normally closed solenoids and hold pressure when they are off. They open to exhaust when they are energized with battery voltage. For solenoid location on the valve body see figure 9.

The **Damper Clutch Control Solenoid**, or Lock-up Solenoid, is also mounted on the valve body. It is normally closed and it receives a pulse width signal from the ELC to engage the converter clutch. The rate, or speed of the clutch apply is determined by the pulse signal frequency.

The **Pressure Control Solenoid** is on the valve body. A pulse signal from the ELC determines the amount of reducing pressure sent to regulate pressure to the clutches and the band. This controls shift feel. It is nomally closed unless it receives the pulse signal (equivalent to about 3 volts) to exhaust.

Solenoid Valve	Lead wiring color
Damper clutch control sol. (TCC SOL.)	RED
Shift control solenoid valve A (SOL. A)	ORANGE
Shift control solenoid valve B (SOL. B)	YELLOW
Pressure control solenoid valve (PC SOL.)	BLUE

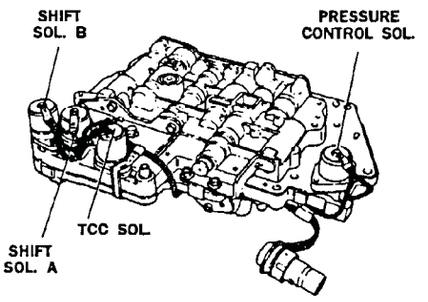


Figure 9.

The **Oil Temperature Switch** is mounted on the side of the transmission and it has a two wire connector. It tells the computer when when the oil is warm enough for converter clutch. High resistance is low temperature and low resistance is high temperature. If the switch is disconnected, torque converter clutch will be inhibited and a trouble code will be set. See Figure 10 for the Oil Temperature Switch location.

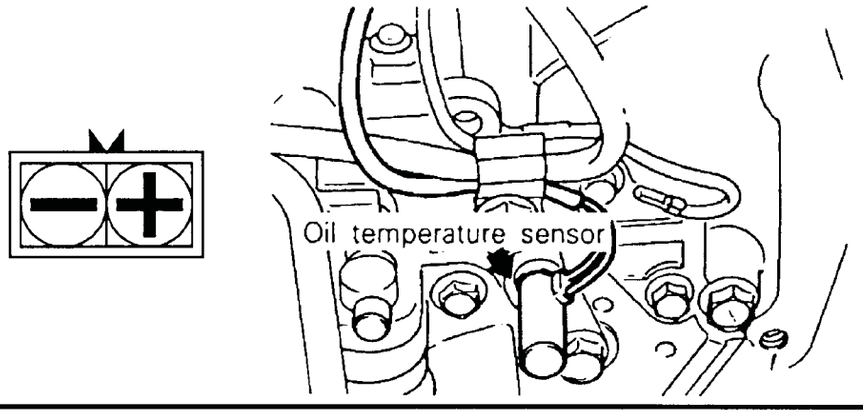


Figure 10.

MODELS WITHOUT DAMPER CLUTCH CONTROL SOLENOID

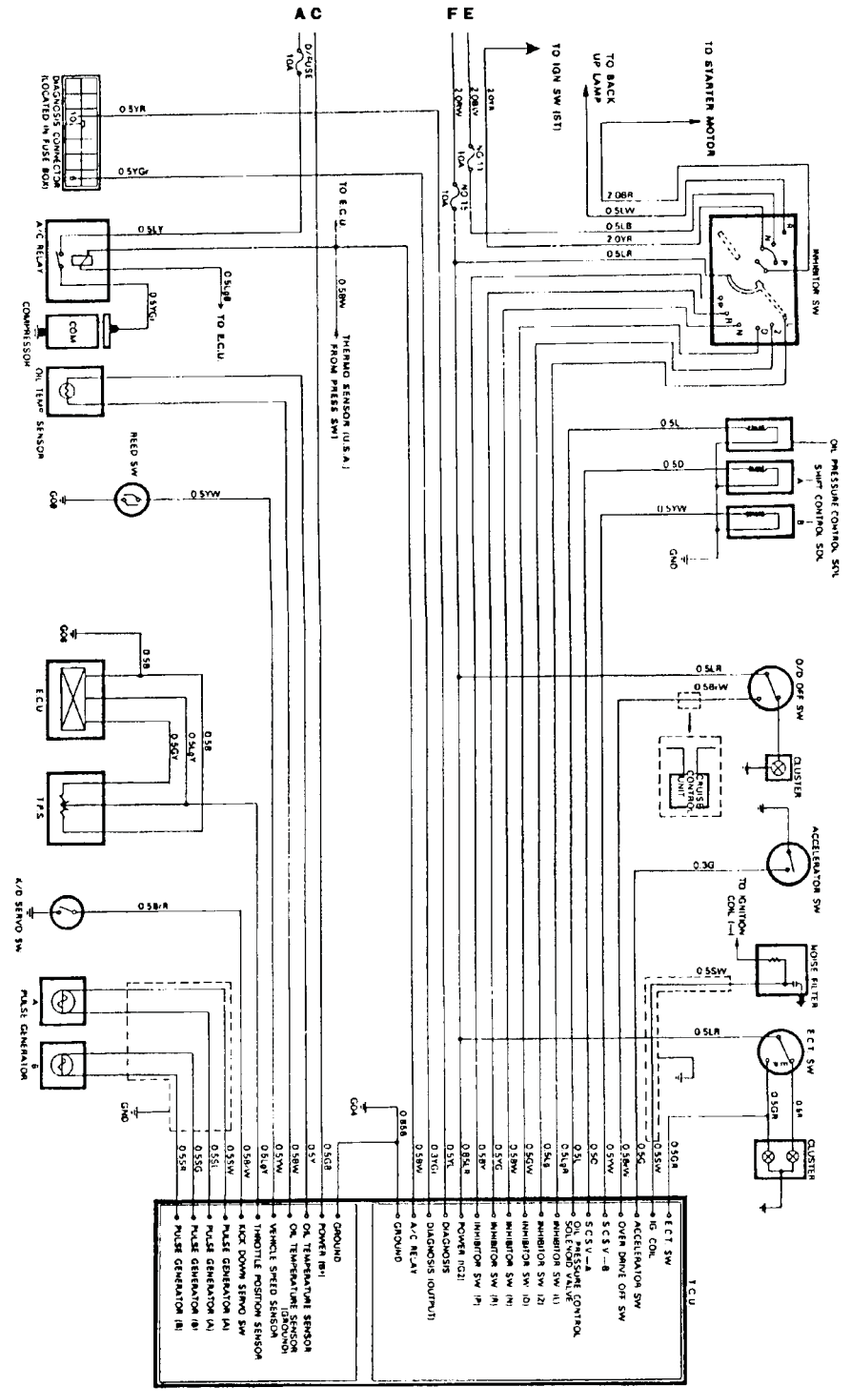


Figure 11.

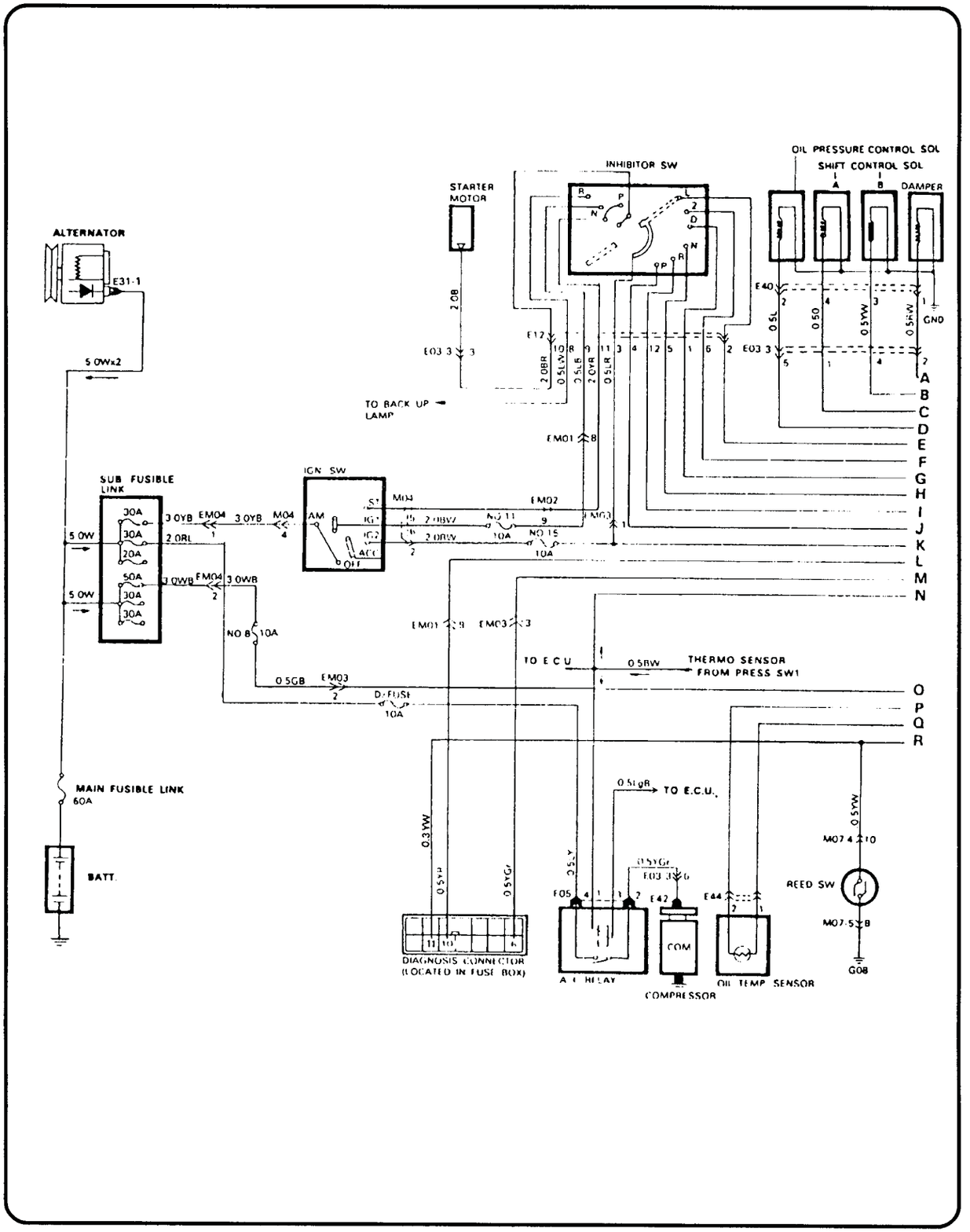

OIL PRESSURE CONTROL SOL
SHIFT CONTROL SOL
DAMPER
INHIBITOR SW
STARTER MOTOR
ALTERNATOR
E31-1
5.0W×2
2.0B
E03 3
E12
TO BACK UP LAMP
E40
GND
EM01
IGN SW
SUB FUSIBLE LINK
30A
20A
50A
5.0W
2.0RL
3.0YB
EM04
M04
AM
IG1
IG2
ACC
OFF
M03
EM02
NO.11
NO.15
10A
NO.8
EM03
TO E.C.U.
0.5BW
THERMO SENSOR
FROM PRESS SW1
D-FUSE
MAIN FUSIBLE LINK
60A
BATT.
0.5GR
TO E.C.U.
M07
REED SW
G08
DIAGNOSIS CONNECTOR
(LOCATED IN FUSE BOX)
A/C RELAY
COMPRESSOR
OIL TEMP. SENSOR
COM
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R

Figure 12.

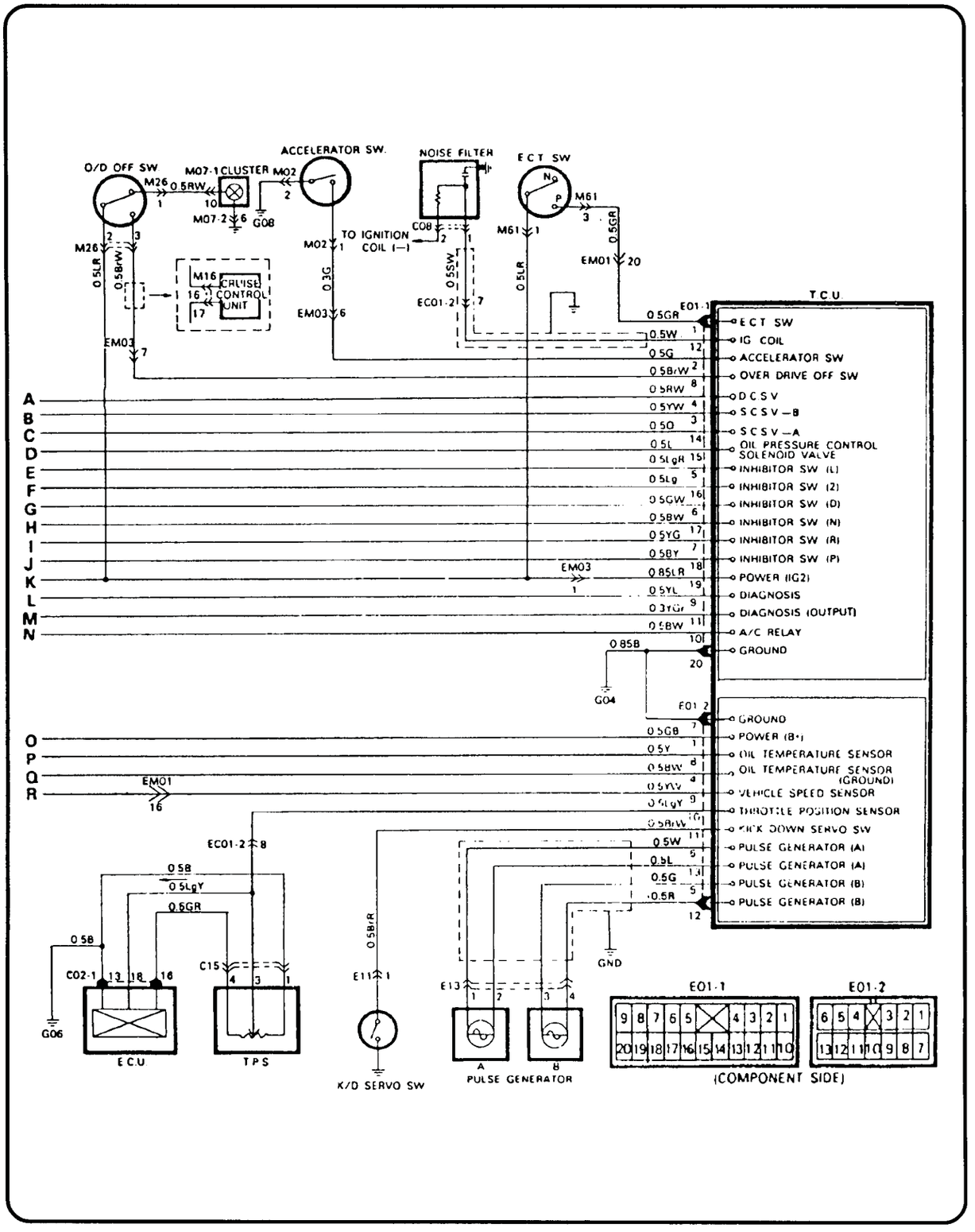

O/D OFF SW
ACCELERATOR SW.
NOISE FILTER
ECT SW
CLUSTER
TO IGNITION COIL (-)
CRUISE CONTROL UNIT
TCU
ECT SW
IG COIL
ACCELERATOR SW
OVER DRIVE OFF SW
D C S V
S C S V -B
S C S V -A
OIL PRESSURE CONTROL SOLENOID VALVE
INHIBITOR SW (1)
INHIBITOR SW (2)
INHIBITOR SW (D)
INHIBITOR SW (N)
INHIBITOR SW (R)
INHIBITOR SW (P)
POWER (IG2)
DIAGNOSIS
DIAGNOSIS (OUTPUT)
A/C RELAY
GROUND
GROUND
POWER (B+)
OIL TEMPERATURE SENSOR
OIL TEMPERATURE SENSOR (GROUND)
VEHICLE SPEED SENSOR
THROTTLE POSITION SENSOR
KICK DOWN SERVO SW
PULSE GENERATOR (A)
PULSE GENERATOR (A)
PULSE GENERATOR (B)
PULSE GENERATOR (B)
ECU
TPS
K/D SERVO SW
PULSE GENERATOR
A
B
GND
(COMPONENT SIDE)

Figure 12A.

MITSUBISHI ELECTRICAL DIAGNOSIS

The KM175-177 series transaxle is fully computer controlled and usually has four solenoids on the valve body. There are two solenoids for shifting, one for pressure control, and one for converter clutch engagement. Certain versions have only three solenoids and use no converter clutch. The ELC 4 Speed Control Unit and the diagnostic connector is located behind the glove box on 1985-1986 models, but on later models the Transmission Controller was moved to behind the console and the radio. The diagnostic connector was moved next to the fuse panel in 1988. The ELC 4 Speed Control Unit can store trouble codes after a malfunction occurs, but when the ignition is turned off the codes are erased. To retrieve codes the ignition must remain on after the malfunction has occurred. The codes can be retrieved with many hand held scanner tools, analog volt meter, or with an LED tester by jumping the pins as shown in Figure 1.

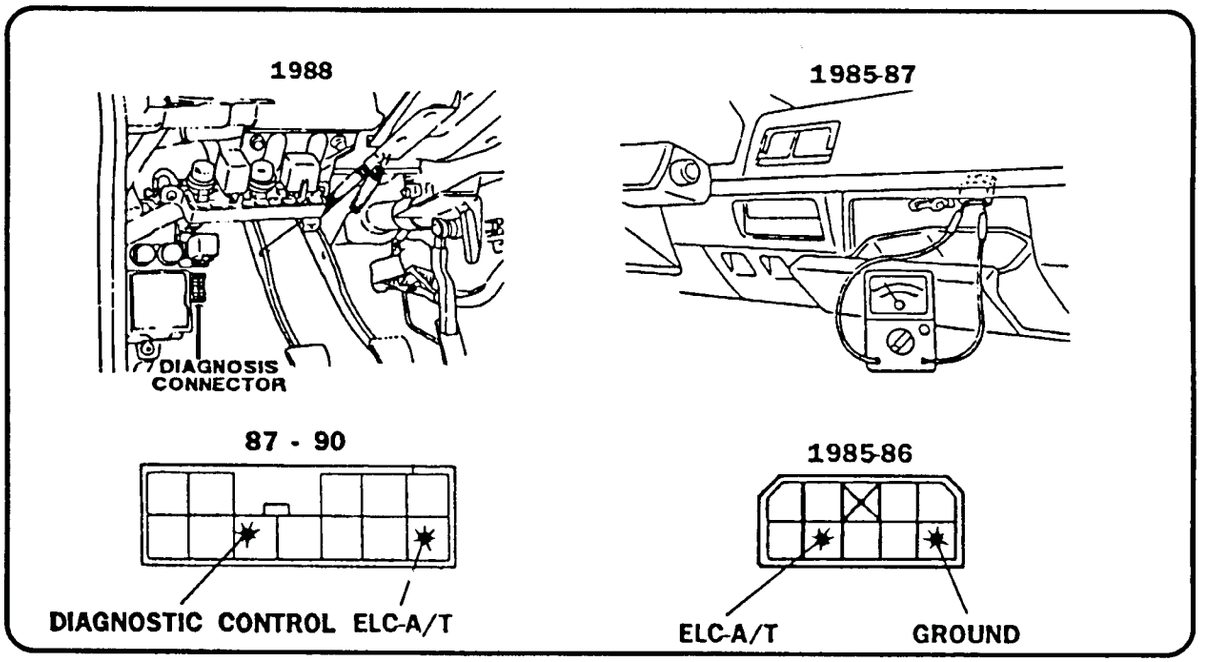


Figure 1

For trouble code translation refer to page 55 - 58. The codes and their meaning have changed year to year and it is very important to determine the model year that you are testing. This transmission will have 3rd gear only if electrical failure occurs or if the Transmission control Unit puts the transmission in fail safe. To test the transmission independently of the electrical system refer to Chart 1 for wire color and solenoid shift pattern.

COLOR	ORANGE	YELLOW	RED	BLUE
GEAR	SOLENOID A	SOLENOID B	TCC SOL	PRESSURE
1st	ON	ON	OFF	PULSE MODULATED BY COMPUTER
2nd	OFF	ON	PULSED*	
3rd	OFF	OFF	PULSED*	
4th	ON	OFF	PULSED*	
OHMS	20.8 - 23.8	20.8 - 23.8	2.6 - 3.2	2.6 - 3.2

* - AS DETERMINED BY COMPUTER

Chart 1.

Pulse Generator A and **Pulse Generator B** are mounted on top of the transmission. These AC voltage generators signal kickdown drum RPM and output shaft RPM to the computer. The pulse generators may be checked with an ohmmeter. Test across the wire terminals. 1985-86 pulse generators should test at approximately **520 ohms** at room temperature. Also be sure that there is no continuity between the wires and ground. Late 1986 and up pulse generators should test at approximately **250 ohms** resistance at room temperature. The input and output generator readings should have no more than 20 ohms difference between them. See figure 2 for pulse generator location and connector identification.

NOTE: Both of the pulse generators are connected to one wire connector. The pulse generator with the green wires must go behind the bell housing. The Pulse generator wires that are green with a black tracer go to the output shaft.If the pulse generators are in backwards, the transmission will go to fail safe (3rd gear starts) after attempting a shift.

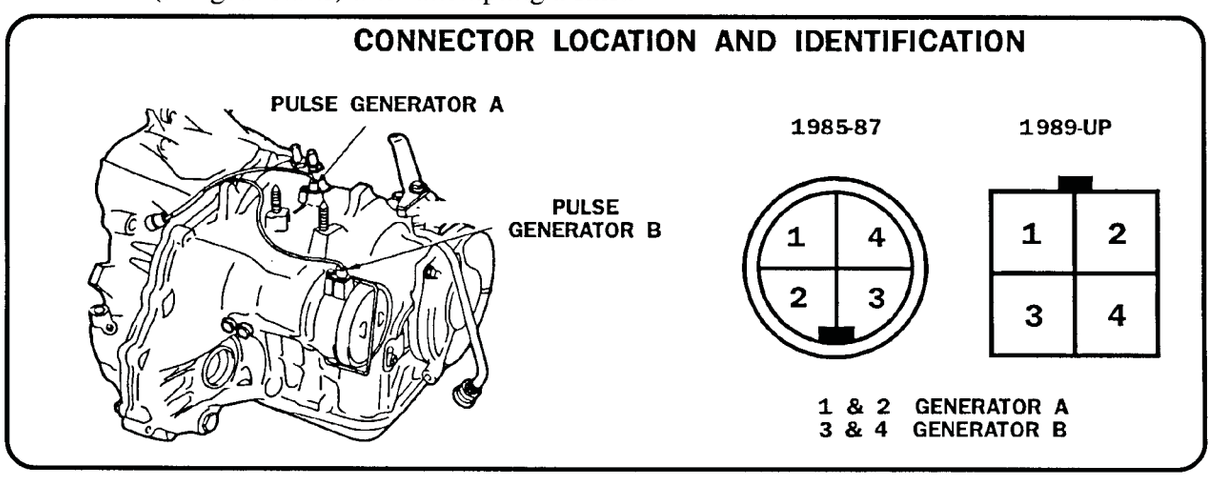


Figure 2

The Throttle Position Sensor (TPS) is on the throttle body on most models. Some with multi-port injection have the TPS at the air horn. The TPS receives a low voltage signal (approx. 5 v.) from the computer and using a resistor through ground it returns a variable voltage signal to the computer. See figure 3 for typical connector information. With the ignition on, voltage tests can be performed at the TPS connector.

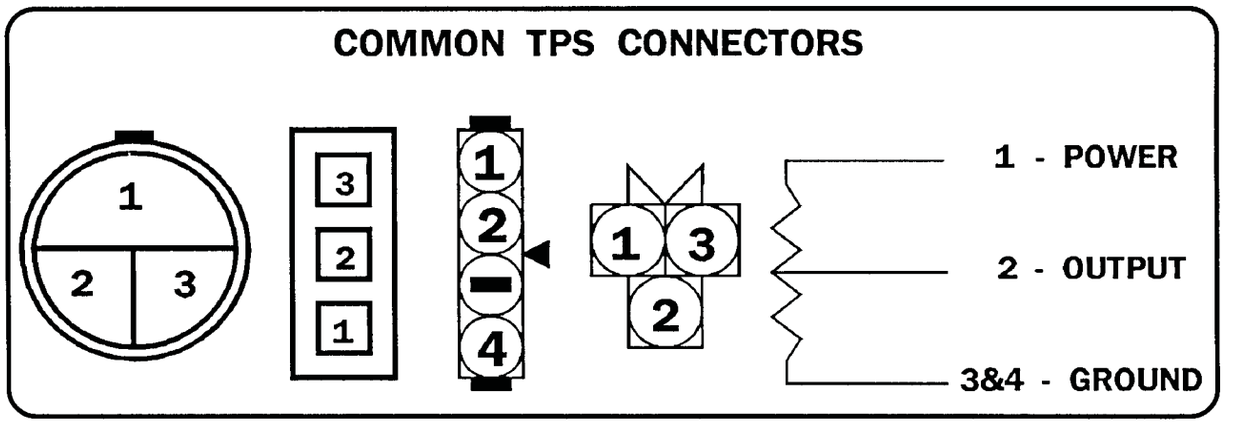
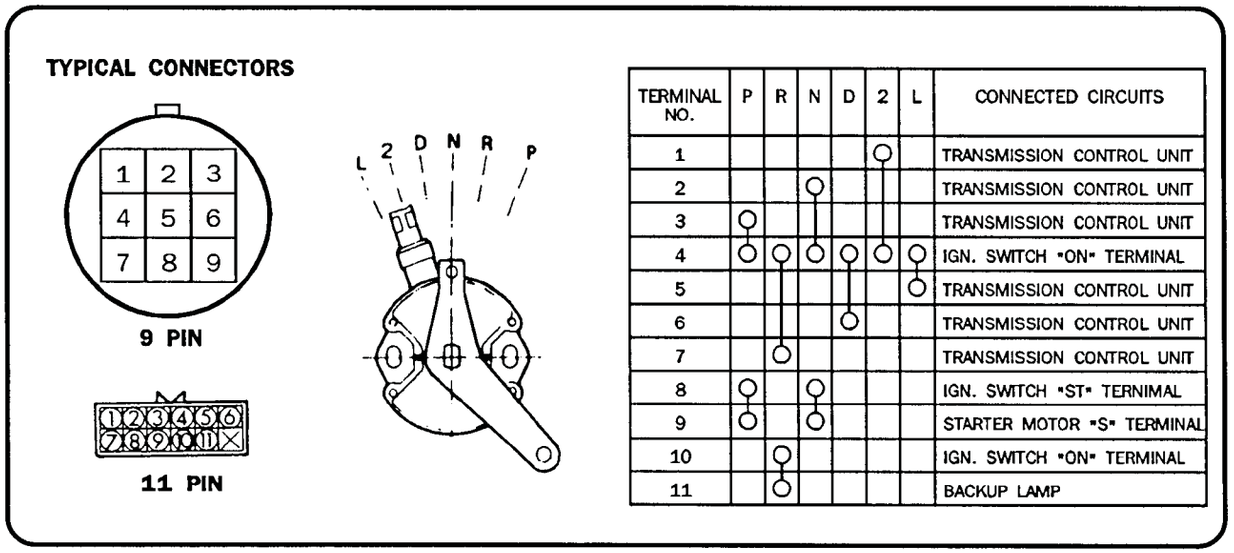


Figure 3

The **Kickdown Switch** on the servo is there to tell the computer if the servo is on. The Kickdown switch is a simple on/off grounding type switch. When the servo is released, the switch is grounded. When the servo is applied, the switch opens. This open or ground tells the computer the position of the servo. The computer uses this information to know when to duty cycle the Pressure Control Solenoid for smooth shift feel. If this switch fails in a closed position, harsh shifts may occur. If this switch fails open or is disconnected, slide bump shifts may occur.

The **Inhibitor Switch** is installed on the transmission case at the upper end of the manual control shaft. It completes a circuit in neutral and park so that the engine may be started. Other circuits detect and supply the ELC with the selector lever position. For connector information see figure 4.



TERMINAL NO.	P	R	N	D	2	L	CONNECTED CIRCUITS
1					○		TRANSMISSION CONTROL UNIT
2			○				TRANSMISSION CONTROL UNIT
3	○						TRANSMISSION CONTROL UNIT
4	○	○	○	○	○	○	IGN. SWITCH "ON" TERMINAL
5						○	TRANSMISSION CONTROL UNIT
6				○			TRANSMISSION CONTROL UNIT
7		○					TRANSMISSION CONTROL UNIT
8	○		○				IGN. SWITCH "ST" TERNIMAL
9	○		○				STARTER MOTOR "S" TERMINAL
10		○					IGN. SWITCH "ON" TERMINAL
11		○					BACKUP LAMP

Figure 4

The **Accelerator Switch** is mounted at the accelerator pedal. The switch is closed when the pedal is released. This tells the controller to let the transmission stay in 2nd gear while stopped. As soon as the accelerator is pushed, the switch opens and the transmission will start in 1st gear. Adjustment of this switch is critical to obtain the proper feel from a standing start. If this switch sticks closed, converter clutch operation will be inhibited. See figure 5 for connector and adjustment information.

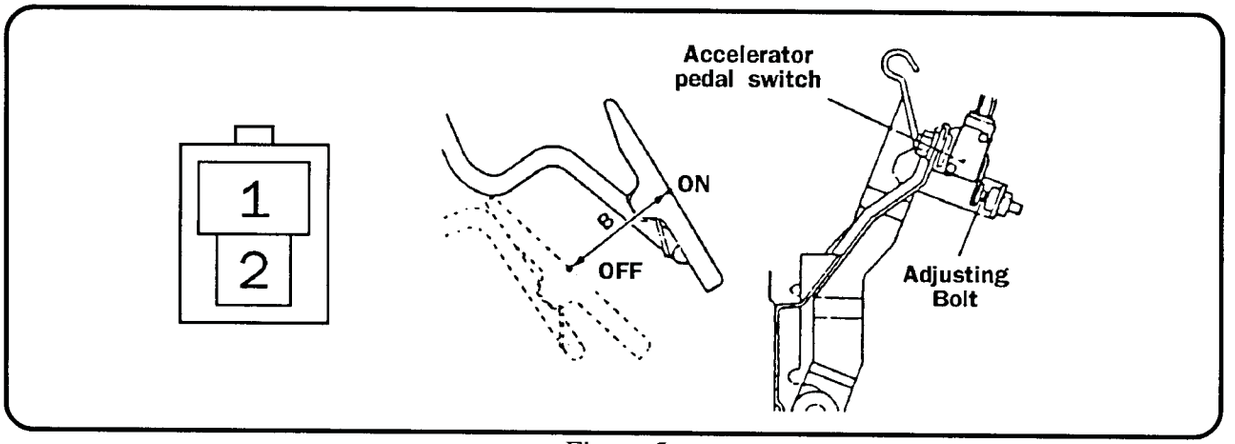


Figure 5

The **Vehicle Speed Sensor** is located in the speedometer unless the vehicle uses an LCD (digital type) display. See figure 6. This sensor can be tested at the ELC 4 speed control unit (ELC). An ohmmeter should see an alternately open and closed circuit four times with one revolution of the speedometer drive cable.

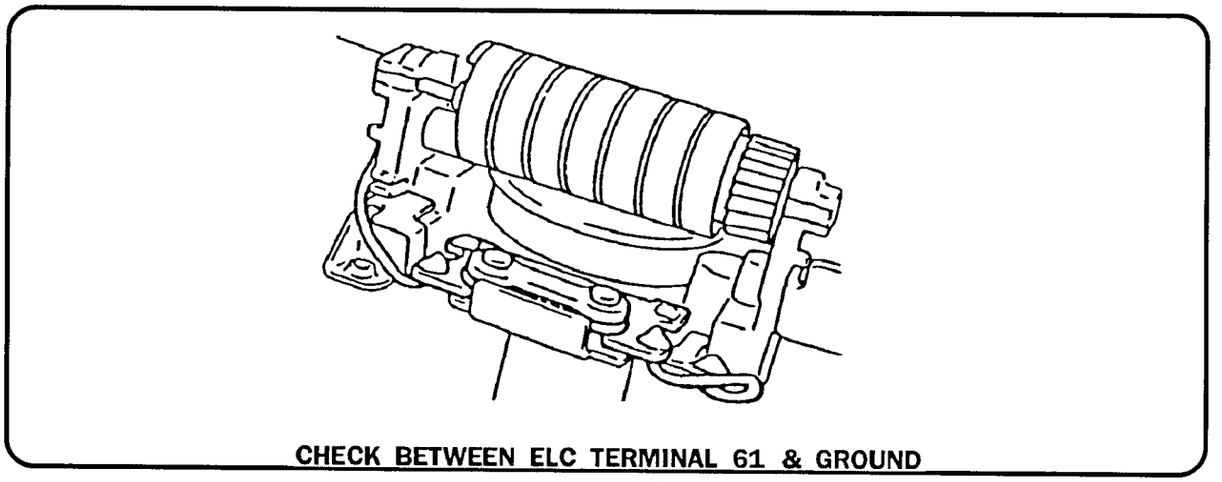


Figure 6

Solenoid Valve	Lead wiring color
Damper clutch control sol. (TCC SOL.)	RED
Shift control solenoid valve A (SOL. A)	ORANGE
Shift control solenoid valve B (SOL. B)	YELLOW
Pressure control solenoid valve (PC SOL.)	BLUE

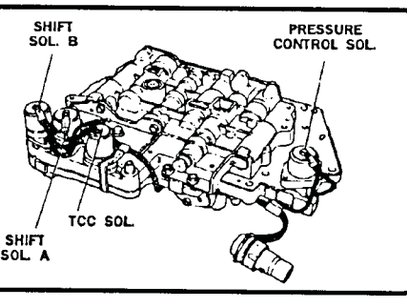


Figure 7

Shift Solenoid A and **Shift Solenoid B** are mounted on the valve body. They are normally closed solenoids and hold pressure when they are off. They open to exhaust when they are energized with battery voltage. For solenoid location on the valve body see figure 7.

The **Damper Clutch Control Solenoid**, or Lock-up Solenoid, is also mounted on the valve body. It is normally closed and it receives a pulse width signal from the ELC to engage the converter clutch. The rate, or speed of the clutch apply is determined by the pulse signal frequency.

The **Pressure Control Solenoid** is on the valve body. A pulse signal from the ELC determines the amount of reducing pressure sent to regulate pressure to the clutches and the band. This controls shift feel. It is nomally closed unless it receives the pulse signal (equivalent to about 3 volts) to exhaust.

The **ELC 4 Speed Control Unit (ELC)** used from 1985-1987 has a 13 pin and 17 pin connector. See figure 8 for pin Identification. In 1988 and up models, the ELC has a 20 pin and a 13 pin connector. See figure 9 for pin information. Models without the converter clutch refer to Figure 10.

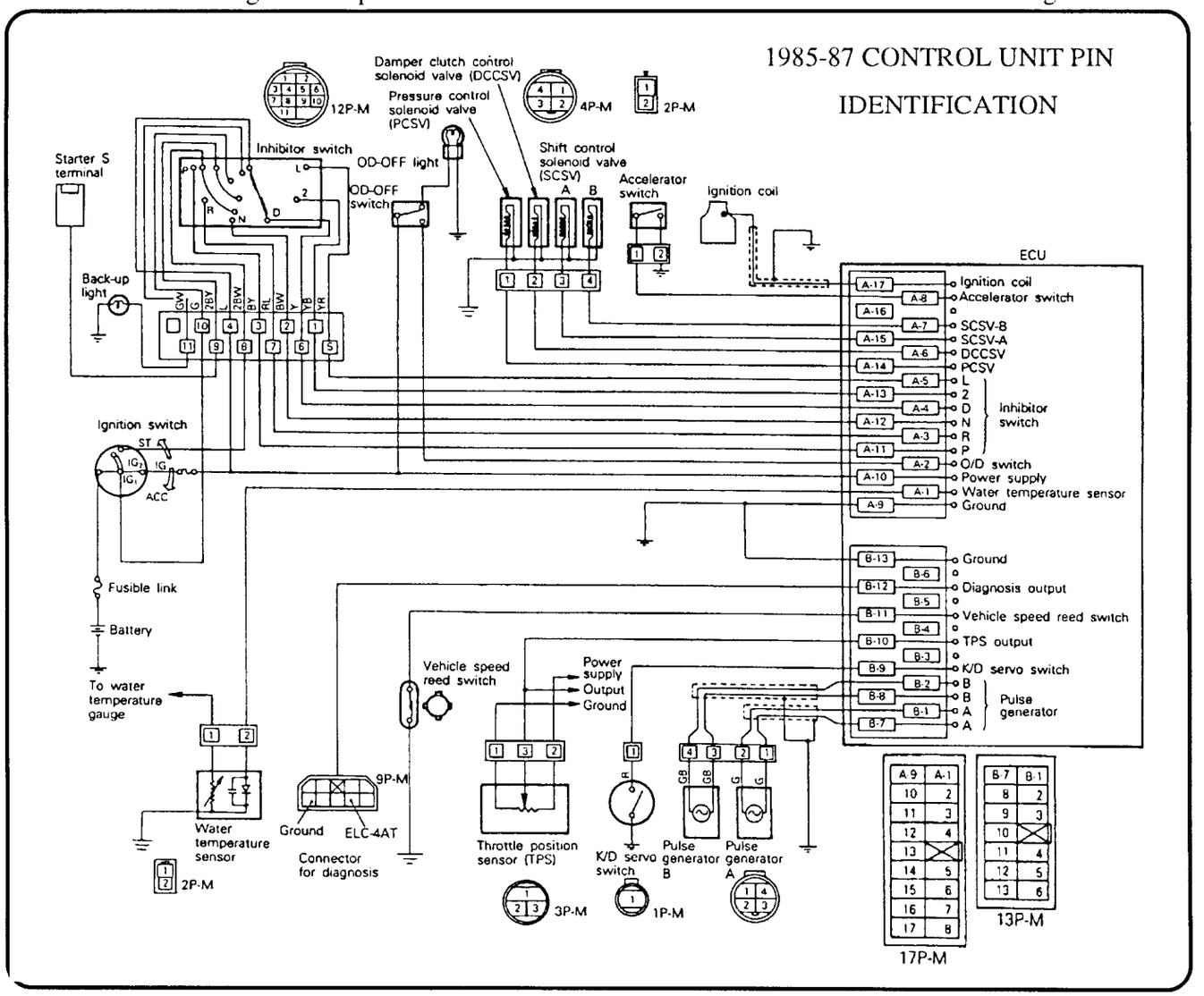


Figure 8

1989 -UP CONTROL UNIT PIN IDENTIFICATION

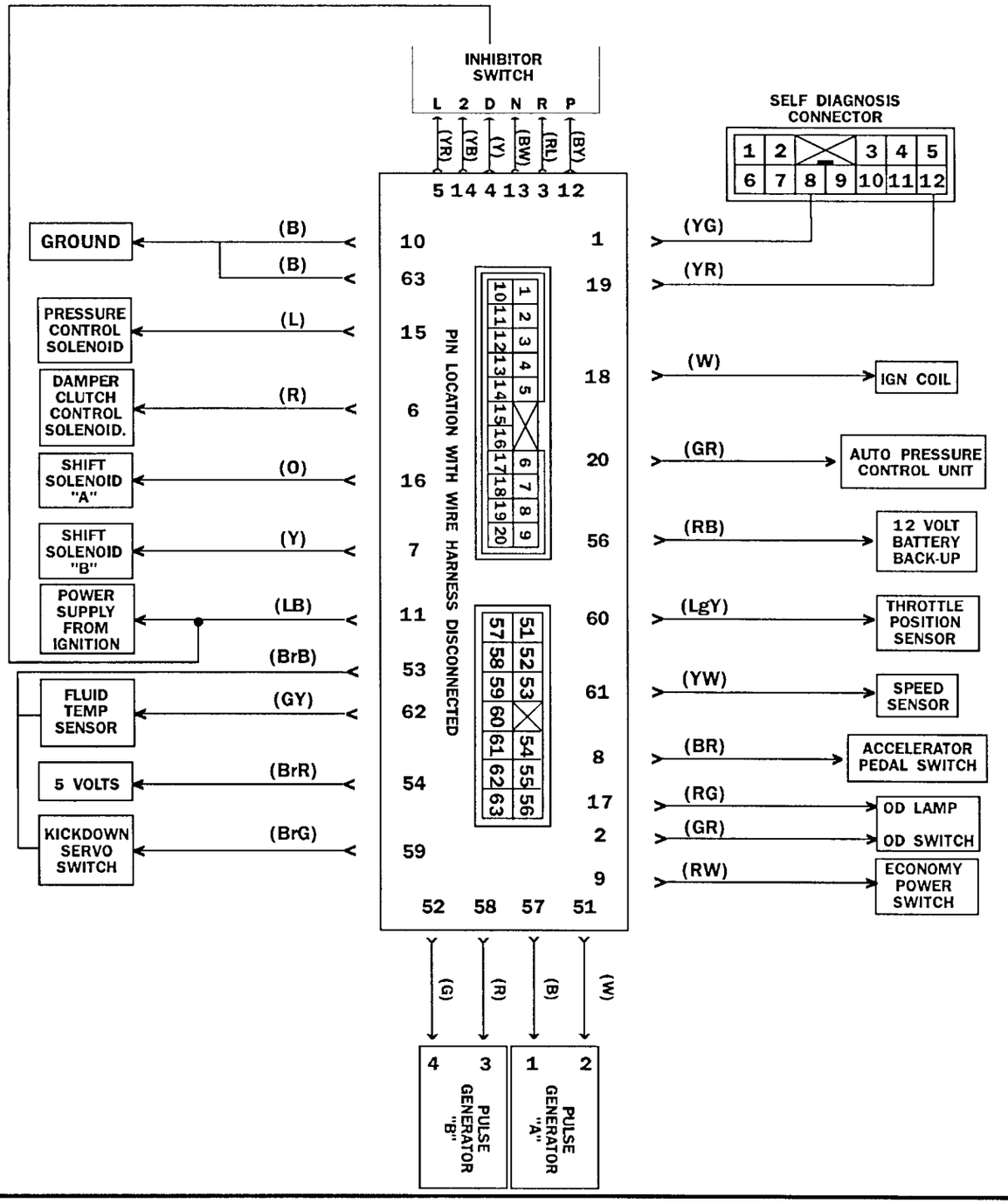


Figure 9

TYPICAL CONTROL UNIT
WITHOUT DAMPER CLUTCH CONTROL SOLENOID

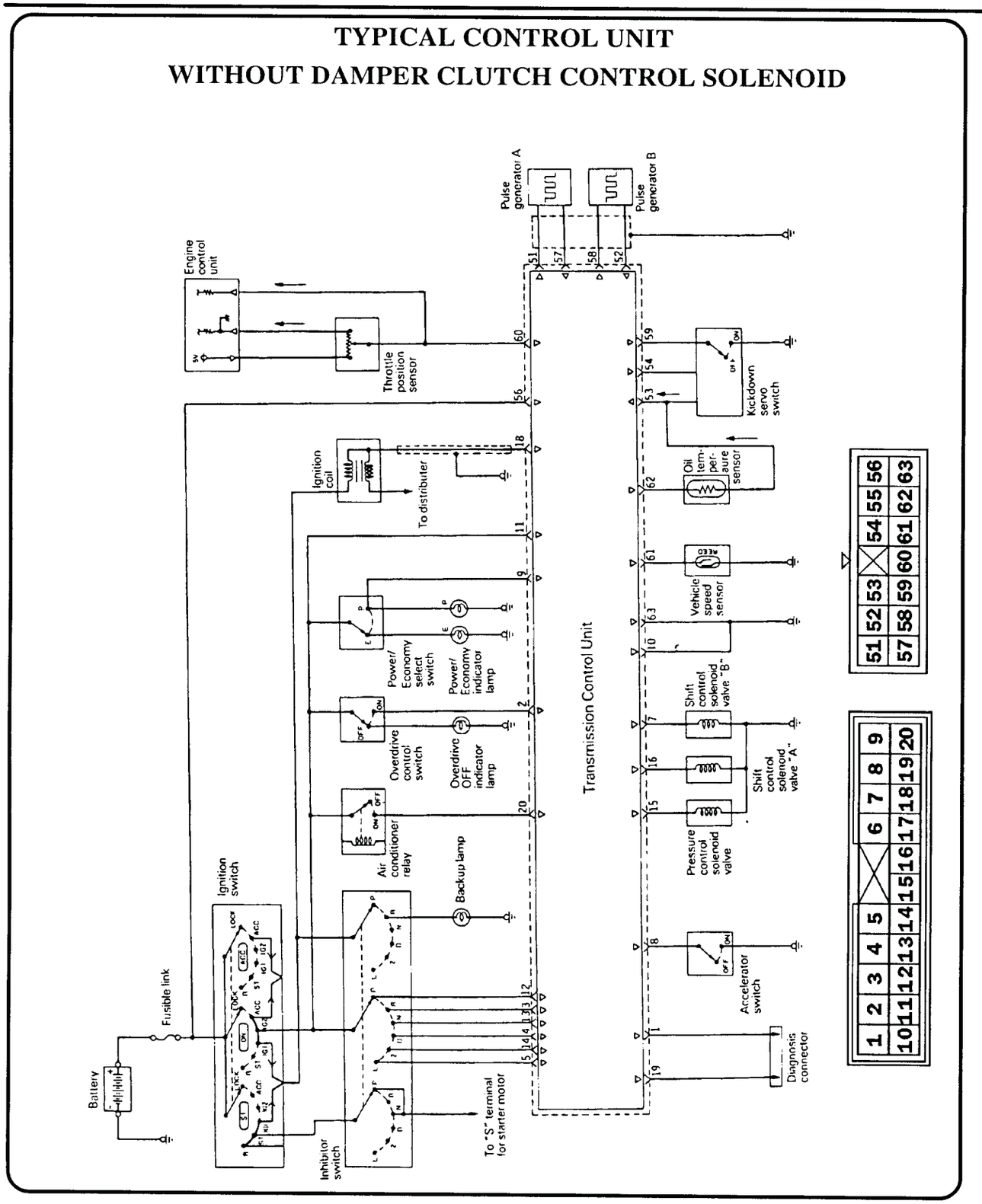


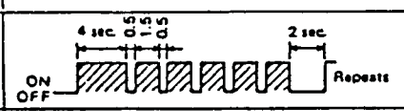
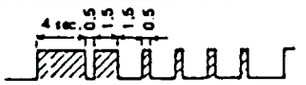
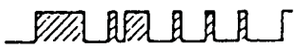
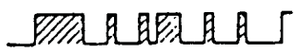
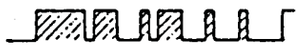
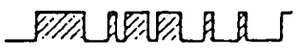
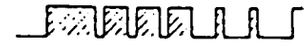
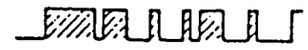
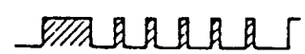
Figure 10

1985 GALANT

VOLTMETER TROUBLE CODE DESCRIPTION

THE "MALFUNCTION INDICATION CODE" ILLUSTRATIONS ARE WHAT WILL BE SEEN ON THE VOLTMETER DURING CODE RETRIEVAL

THE DIGITS IN THE "NUMBER" COLUMN ARE NOT CODES!

NUMBER	Malfunction indication code	Diagnosis	Assumed location
1		Microprocessor (computer) malfunction; not remedied by resetting.	• Low power-supply voltage (recharging system) • Computer
2		First gear signal is detected at high vehicle speed.	• Pulse generator B • Computer
3		Vehicle speed detected by pulse generator B is much lower than actual vehicle speed.	• Pulse generator B • Computer
4		Operation of shift-control solenoid valve A differs from computer command.	• Shift-control solenoid valve A • Computer
5		Operation of shift-control solenoid valve B differs from computer command.	• Shift-control solenoid valve B • Computer
6		Kickdown servo switch signal differs from actual gear engaged.	• Kickdown servo switch • Pressure-control solenoid valve • Computer
7		Shifting doesn't finish.	• Pulse generator A • Pressure-control solenoid valve • Computer
8		Pressure-control solenoid valve drive differs from computer command.	• Pressure-control solenoid valve • Computer
9		Engine speed is judged to be 6,500 rpm or more.	• Pulse generator B • Ignition coil (ignition signal system) • Computer
10		Kickdown drum rotation speed is judged to be 6,500 rpm or more.	• Pulse generators A · B • Computer
11		Damper clutch control solenoid valve is directly connected.	• Damper clutch control system • Computer
12		No ignition signal.	• Ignition coil • Ignition signal system • Computer

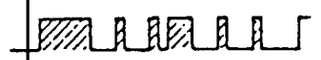
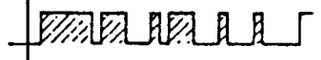
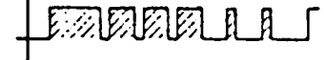
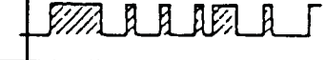
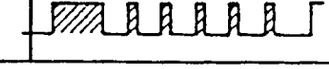
NOTE: ALWAYS VERIFY MODEL YEAR BY 10th VIN DIGIT
1985 GALANT VIN ID IS "F"

86 GALANT

VOLTMETER TROUBLE CODE DESCRIPTION

THE "MALFUNCTION INDICATION CODE" ILLUSTRATIONS ARE WHAT WILL BE SEEN ON THE VOLTMETER DURING CODE RETRIEVAL.

THE DIGITS IN THE "NUMBER" COLUMN ARE NOT CODES!

NUMBER		Malfunction indication code	Diagnosis	Assumed location
1	ON OFF		Microprocessor (computer) malfunction; not remedied by resetting.	• Low power-supply voltage (recharging system) • Computer
2			First gear signal is detected at high vehicle speed.	• Pulse generator B • Computer
3			Vehicle speed detected by pulse generator B is much lower than actual vehicle speed.	• Pulse generator B • Computer
4			Operation of shift-control solenoid valve A differs from computer command.	• Shift-control solenoid valve A • Computer
5			Operation of shift-control solenoid valve B differs from computer command.	• Shift-control solenoid valve B • Computer
6			Shifting doesn't finish.	• Pulse generator A • Pressure-control solenoid valve • Computer
7			Pressure-control solenoid valve drive differs from computer command.	• Pressure-control solenoid valve • Computer
8			Damper clutch control solenoid valve is directly connected.	• Damper clutch control system • Computer
9			No ignition signal.	• Ignition coil • Ignition signal system • Computer

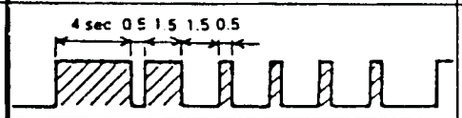
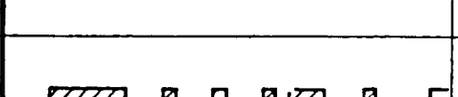
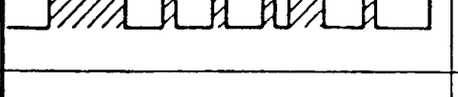
NOTE: ALWAYS VERIFY MODEL YEAR BY 10th VIN DIGIT
1986 GALANT VIN ID IS "G"

87 GALANT

VOLTMETER TROUBLE CODE DESCRIPTION

THE "MALFUNCTION INDICATION CODE" ILLUSTRATIONS ARE WHAT WILL BE SEEN ON THE VOLTMETER DURING CODE RETRIEVAL.

THE DIGITS IN THE "NUMBER" COLUMN ARE NOT CODES!

	Malfunction indication code	Diagnosis	Assumed location
1		Microprocessor (computer) malfunction; not remedied by resetting.	• Low power-supply voltage (recharging system) • TCU
2		First gear signal is detected at high vehicle speed.	• Pulse generator B • Vehicle speed sensor • TCU
3		Vehicle speed detected by pulse generator B is much lower than actual vehicle speed.	• Pulse generator B • Vehicle speed sensor • TCU
4		Operation of shift-control solenoid valve A differs from computer command.	• Shift-control solenoid valve A • TCU
5		Operation of shift-control solenoid valve B differs from computer command.	• Shift-control solenoid valve B • TCU
6		Kickdown servo switch signal differs from gear.	• Kickdown servo switch • Pressure-control solenoid valve • TCU
7		Shifting doesn't finish.	• Pulse generator A • Pressure-control solenoid valve • Valve body, clutch, brake, seal, etc. • TCU
8		Pressure-control solenoid valve drive differs from computer command.	• Pressure-control solenoid valve • Poorly grounded ground strap • TCU
9		Damper clutch control solenoid valve is directly connected.	• Damper clutch control system • TCU
10		No ignition signal.	• Ignition coil (ignition signal system) • TCU

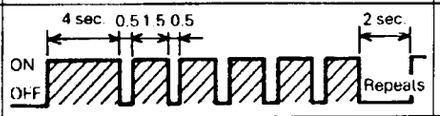
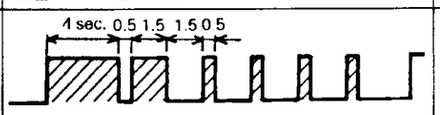
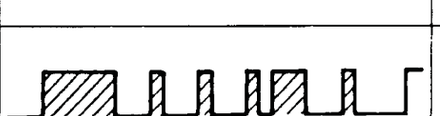
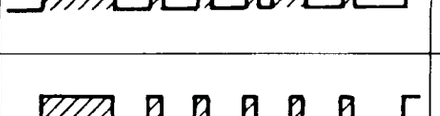
NOTE: ALWAYS VERIFY MODEL YEAR BY 10th VIN DIGIT
1987 GALANT VIN ID IS "H"

1988 GALANT & SIGMA

VOLTMETER TROUBLE CODE DESCRIPTION

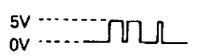
THE "MALFUNCTION INDICATION CODE" ILLUSTRATIONS ARE WHAT WILL BE SEEN ON THE VOLTMETER DURING CODE RETRIEVAL.

THE DIGITS IN THE "NUMBER" COLUMN ARE NOT CODES!

	Malfunction indication code	Diagnosis	Assumed location
1		Microprocessor (computer) malfunction; not remedied by resetting.	• Low power-supply voltage (recharging system) • TCU
2		First gear signal is detected at high vehicle speed.	• Pulse generator B • Vehicle speed sensor • TCU
3		Vehicle speed detected by pulse generator B is much lower than actual vehicle speed.	• Pulse generator B • Vehicle speed sensor • TCU
4		Operation of shift-control solenoid valve A differs from computer command.	• Shift-control solenoid valve A • TCU
5		Operation of shift-control solenoid valve B differs from computer command.	• Shift-control solenoid valve B • TCU
6		Kickdown servo switch signal differs from gear.	• Kickdown servo switch • Pressure-control solenoid valve • TCU
7		Shifting doesn't finish.	• Pulse generator A • Pressure-control solenoid valve • Valve body, clutch, brake, seal, etc. • TCU
8		Pressure-control solenoid valve drive differs from computer command.	• Pressure-control solenoid valve • Poorly grounded ground strap • TCU
9		No ignition signal.	• Ignition coil (ignition signal system) • TCU

NOTE: ALWAYS VERIFY MODEL YEAR BY 10th VIN DIGIT
1988 GALANT & SIGMA VIN ID IS "J"

1989-1990 GALANT & SIGMA
1989-1990 SONATA - 1990 EXCEL
SCANNER TROUBLE CODE DESCRIPTION
NUMBERS IN "FAULT CODE" COLUMN ARE WHAT WILL BE SEEN ON THE SCANNER SCREEN DURING CODE RETRIEVAL

Fault code	Fault code (for voltmeter)	Cause	Remedy
21		Abnormal increase of TPS output	o Check the throttle position sensor connector. o Check the throttle position sensor itself. o Adjust the throttle position sensor. o Check the accelerator switch (No.28: output or not). o Check the throttle position sensor output circuit harness.
22		Abnormal decrease of TPS output	
23		Incorrect adjustment of the throttle-position sensor system	
24		Damaged or disconnected wiring of the oil temperature sensor system	o Check the oil temperature sensor circuit harness. o Check the oil temperature sensor connector. o Check the oil temperature sensor itself.
25		Damaged or disconnected wiring of the kickdown servo switch system, or improper contact	o Check the kickdown servo switch output circuit harness. o Check the kickdown servo switch connector. o Check the kickdown servo switch it self
26		Short circuit of the kickdown servo switch system	
27		Damaged or disconnected wiring of the ignition pulse pick-up cable system	o Check the ignition pulse signal line.
28		Short circuit of the accelerator switch system or improper adjustment	o Check the accelerator switch output circuit harness. Check the accelerator switch connector. o Check the accelerator switch itself. o Adjust the accelerator switch.

NOTE: ALWAYS VERIFY MITSUBISHI MODEL YEAR BY 10th VIN DIGIT
1989 GALANT & SIGMA VIN ID IS "K"
1990 GALANT & SIGMA VIN ID IS "L"
ALWAYS VERIFY HYUNDAI MODEL YEAR BY 8th VIN DIGIT
1989 SONATA VIN ID IS "K"
1990 SONATA & EXCEL VIN ID IS "L"

1989-1990 GALANT & SIGMA
1989-1990 SONATA - 1990 EXCEL

SCANNER TROUBLE CODE DESCRIPTION

NUMBERS IN "FAULT CODE " COLUMN ARE WHAT WILL BE SEEN ON THE SCANNER SCREEN DURING CODE RETRIEVAL

Fault code	Fault code (for voltmeter)	Cause	Remedy
31		Malfunction of the microprocessor	o Replace the control unit.
32		First gear command during high--speed driving	o Replace the control unit.
33		Damaged or disconnected wiring of the pulse generator B system	o Check the pulse generator B output circuit harness. o Check pulse generator B itself. o Check the vehicle speed reed switch (for chattering).
41		Damaged or disconnected wiring of the shaft control solenoid valve A system	o Check the solenoid valve connector. o Check shift control solenoid valve A itself. o Check the shift control solenoid valve A drive circuit harness.
42		Short circuit of the shift-control solanoid valve A system	
43		Damaged or disconnected wiring of the shift control solenoid valve B system	o Check the solenoid valve connector. o Check shift control solenoid valve B itself. o Check the shift control solenoid valve B drive circuit harness.
44		Short circuit of the shift control solenoid valve B system	
45		Damaged or disconnected wiring of the pressure control solenoid valve system	o Check the solenoid valve connector. o Check the pressure control solenoid valve itself. o Check the pressure control solenoid valve drive circuit harness.
46		Short circuit of the pressure control solenoid valve system	

1989-1990 GALANT & SIGMA
1989-1990 SONATA - 1990 EXCEL

SCANNER TROUBLE CODE DESCRIPTION

NUMBERS IN "FAULT CODE" COLUMN ARE WHAT WILL BE SEEN ON THE SCANNER SCREEN DURING CODE RETRIEVAL

Fault code	Fault code (for voltmeter)	Cause	Remedy
47		Damaged or disconnected wiring of the damper clutch control solenoid valve system	o Check the solenoid valve connector. o Check the damper clutch control solenoid valve itself. o Check the damper clutch control solenoid valve drive circuit harness.
48		Short circuit of the damper clutch control solenoid valve system	
49		Malfunction of the damper clutch system	o Check the damper clutch control solenoid valve drive circuit harness. o Check the damper clutch hydraulic pressure system. o Check the damper clutch control solenoid valve itself. o Replace the control unit.
51		First gear non-synchronous	o Check the pulse generator output circuit harness. o Check the pulse generator connector. o Check pulse generator A and pulse generator B themselves. o Kickdown brake slippage.
52		Second gear non-synchronous	o Check the pulse generator A output circuit harness. o Check the pulse generator A connector o Check pulse generator A itself. o Kickdown brake slippage.
53		Third gear non-synchronous	o Check the pulse generator A output circuit harness. o Check the pulse generator connector. o Check pulse generator A and pulse generator B themselves. o Front clutch slippage. o Rear clutch slippage.
54		Fourth gear non-synchronous	o Check the pulse generator A output circuit harness. o Check the pulse generator A conector. o Check pulse generator A itself. o Kickdown brake slippage.

1989-1990 GALANT & SIGMA
1989-1990 SONATA - 1990 EXCEL

SCANNER FAILSAFE CODE DESCRIPTION

THE NUMBERS IN THE "CODE NO." COLUMN ARE WHAT WILL BE SEEN ON THE SCANNER SCREEN ALONG WITH THE RELATED "FAULT CODE" WHEN THAT RELATED "FAULT CODE" IS GENERATED 4 TIMES. IT IS THE "FAILSAFE CODE" THAT WILL ACTUALLY PUT THE TRANSAXLE INTO "LIMP MODE".

Output code		Description	Fail-safe	Note (relation to fault code)
Code No.	Output pattern (for voltmeter)			
11		Malfunction of the microprocessor	Locked in 3rd gear	When code No.31 is generated 4th time.
12		First gear command during high speed driving	Locked in 3rd (D) or 2nd (2, L) gear	When code No.32 is generated 4th time.
13		Damaged or disconnected wiring of the pulse generator B system	Locked in 3rd (D) or 2nd (2, L) gear	When code No.33 is generated 4th time.
14		Damaged or disconnected wiring, or short circuit, of shift control solenoid valve A	Locked in 3rd gear	When code No.41 or 42 is generated 4th time.
15		Damaged or disconnected wiring, or short circuit, of shift control solenoid valve B	Locked in 3rd gear	When code No.43 or 44 is generated 4th time.
16		Damaged or disconnected wiring, or short circuit, of the pressure control solenoid valve	Locked in 3rd (D) or 2nd (2, L) gear	When code No.45 or 46 is generated 4th time.
17		Shift steps non-synchronous	Locked in 3rd (D) or 2nd (2, L) gear	When either code No.51, 52 53 or 54 is generated 4th time.

1989-90 CONTROL SYSTEM MULTI-METER CHECKS

Inspection item	Inspection content		Possible cause (or remedy) for the abnormality
	Inspection condition	Criterion value	
Pulse generator B	D range, stopping state	0 rpm	• Defective pulse generator B or harness • Defective shield cable of pulse generator B • External noise invasion
	D range, 3rd speed, driving at 50 km/h (31 mph)	1,600 2,000 rpm	
	D range, 4th speed, driving at 50 km/h (31 mph)	1,600–2,000 rpm	
Pulse generator A	D range, 2nd speed, driving at 30 km/h (19 mph)	0 rpm	• Defective pulse generator A or harness • Defective shield cable of pulse generator A • External noise invasion • Slip of kick-down brake
	D range, 3rd speed, driving at 50 km/h (31 mph)	1,400–1,800 rpm	
	D range, 4th speed, driving at 50 km/h (31 mph)	0 rpm	
Throttle position sensor (TPS)	Accelerator is fully closed	0.5–0.6V	• If voltage is high at the full opening or closing, TPS is adjusted improperly. • If no variation is observed, TPS or circuit harness is defective. • If it does not vary smoothly, TPS or accelerator cable is defective.
	Slowly press in the accelerator pedal.	Variation of opening degree	
	Accelerator is fully opened.	4.5–5.0V	
Oil temperature sensor	When engine is cold (before starting)	Equivalent to atmospheric temperature	• Oil temperature sensor or circuit harness is defective.
	During engine warming-up driving	It gradually rises.	
	After engine is warmed up	80–110°C (176°F–230°F)	
Kick-down servo switch	L range, idling	ON	• Kick-down servo is adjusted improperly. • Kick-down servo switch or circuit harness is defective. • Defective kick-down servo
	D range, 1st or 3rd speed	ON	
	D range, 2nd or 4th speed	OFF	
Ignition signal cable	N range, idling	650–750 rpm	• Ignition system is defective. • Harness of ignition signal pick-up circuit is defective.
	N range, 2,500 rpm (read on the tachometer)	2,400–2,600 rpm	
Accelerator pedal switch	Accelerator is fully opened.	OFF	• Accelerator pedal switch is adjusted improperly. • Accelerator pedal switch or circuit harness is defective.
	Press in the accelerator pedal slightly.	ON	
Vehicle speed reed switch	The vehicle stops.	0 km/h (0 mph)	• If high speed signal is output when the vehicle stops, the vehicle speed reed switch is defective. • In other cases, vehicle speed reed switch or circuit harness is defective.
	Driving at 30 km/h (19 mph)	30 km/h (19 mph)	
	Driving at 50 km/h (31 mph)	50 km/h (31 mph)	
Inhibitor switch	Shift to P range	P	• Inhibitor switch is adjusted improperly. • Inhibitor switch or circuit harness is defective. • Manual control cable is defective.
	Shift to R range	R	
	Shift to N range	N	
	Shift to D range	D	
	Shift to 2 range	2	
	Shift to L range	L	
Overdrive switch	Turn on the overdrive switch	OD	• Overdrive switch or circuit harness is defective.
	Turn off the overdrive switch	OD - OFF	
Power/economy switch	Select the power pattern (Including E pattern control at the low oil temperature)	Power	• Power/economy switch or circuit harness is defective.
	Select the economy pattern.	Economy	
Air conditioner relay signal	D range, air conditioner idling-up state	ON	• Harness of circuit which detects the air conditioner power relay ON signal is defective.
	D range, air conditioner, switch-off state	OFF	
Transaxle gear position	D range, idling	C	• TCU is defective. • Accelerator pedal switch system is defective. • Inhibitor switch system is defective. • TPS system is defective.
	L range, idling	1ST	
	2nd range, 2nd speed	2ND	
	D range, O/D-OFF, 3rd speed	3RD	
	D range, O/D, 4th speed	4TH	
PCSV duty	D range, idling	50–70%	• If accelerator pedal is pressed in even slightly in the idling state of D range duty must become 100%. • TCU is defective. • TPS system is defective. • Accelerator pedal switch is defective.
	D range, 1st speed	100%	
	D range, gear shift	Variation depending on the state	
Damper clutch slip amount	D range, 3rd speed 1,500 rpm (read on the tachometer)	200–300 rpm	• Damper clutch is defective. • Ignition signal cable or pulse generator B system is defective. • Transaxle oil pressure is improper. • DCCSV is defective.
	D range, 3rd speed 3,500 rpm (read on the tachometer)	30–50 rpm	
DCCSV duty	D range, 3rd speed 1,500 rpm (read on the tachometer)	0%	• TCU is defective. • TPS system is defective. • Pulse generator B system is defective.
	D range, 3rd speed 3,500 rpm (read on the tachometer)	Variation depending the load	

Mazda G4A-EL Electrical Diagnosis

The Mazda G4A-EL Transaxle is found in the Mazda 626 automobiles as well as in the Ford probe. This 4 speed transaxle has computer controlled shifting and converter clutch functions. The pressure control system, however, has remained mechanical through the use of a throttle valve and cable connected to the throttle body on the engine. This transaxle will start in third gear if no power is supplied to the solenoids by the computer. If this condition occurs, first gear will be available with the manual lever in the 1 position. Also incorporated in the shift strategies is the hold mode. The hold button, when on, causes the transaxle to start in second gear in the drive range. Overdrive is inhibited in the hold mode as well. Manually, first and second gears may be selected when the hold mode is on. The computer control system (Known as EC-AT in Mazda units and 4EAT in Fords) has a self-diagnosis system integrated into it. The EC-AT or 4EAT Control Unit can diagnose malfunctions of the main input sensors, the solenoid valves in the transaxle, and the EC-AT or 4EAT Control Unit itself. Any malfunctions which have occurred or are continuing are memorized in the EC-AT memory as specific codes. These trouble codes can be retrieved using a variety of computer scanners including the EC-AT Tester, The OTC Monitor, and the Snap-On Scanner. Refer to page 71 for trouble code retrieval procedures and their translation.

The EC-AT or 4EAT Control Unit is mounted under the dash on the left side on most models. The Control unit is part of the Engine computer (ECA) on GL models. A 6 pin (usually blue) and a 1 pin test connector are provided for easier tester hook-up. The EC-AT 6 pin and 1 pin service connector are located near the control unit on LX and GT models and under the hood near the wiper motor on most GL models. See figure 1 for Control Unit and service connector locations.

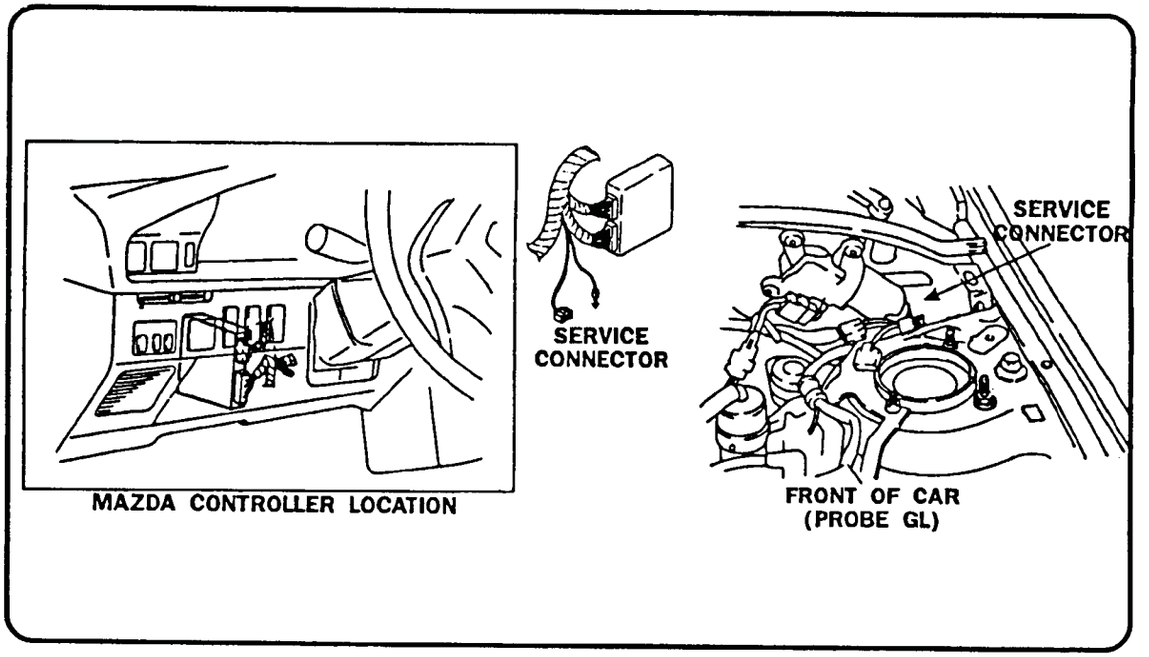
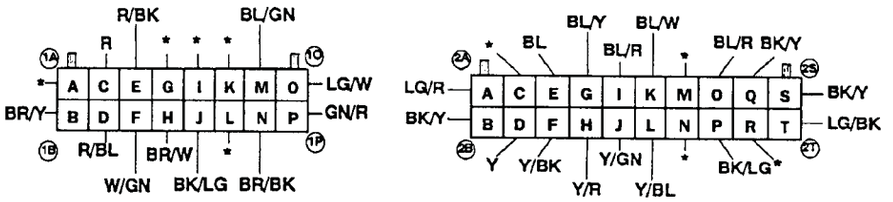


Figure 1

NOTE: To retrieve trouble codes, refer to the instructions provided with hand held scanners. Each type scanner has different procedures. Sometimes grounding the single pin connector at the control unit will cause the hold light to flash the stored trouble codes as shown on page 71.

The **EC-AT and the 4EAT Control Unit** have 2 connectors to receive information and send signals. The terminals at the larger connector are used for input signals, while the smaller connector terminals are mostly used for output signals and tester connections. Most of the sensors and solenoids can be checked at the Control Unit. Refer to Figures 2 and 3 for terminal identification, circuit functions, and testing voltage values.

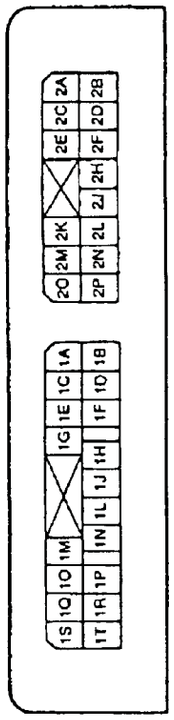


4EAT CONTROL MODULE CONNECTOR

PIN NUMBER	WIRE COLOR	CIRCUIT FUNCTION
1A	--	-
1B	BR/Y	Instrument Cluster
1C	R	Self-Test Connector
1D	R/BL	Electronic Control Assembly
1E	R/BK	Self Test Connector
1F	W/GN	Stop Lamp Switch
1G	--	-
1H	BR/W	Manual Mode Switch
1I	--	-
1J	BK/LG	Ground G103
1K	--	-
1L	-	-
1M	BL/GN	Transmission Fluid Temperature Switch
1N	BR/BK	Radiator Temperature Switch
1O	LG/W	Electronic Control Assembly
1P	GN/R	Vehicle Speed Sensor
2A	LG/R	Electronic Control Assembly
2B	BK/Y	Neutral Safety Switch
2C	--	-
2D	Y	Neutral Safety Switch
2E	BL	Solenoid Valve SS1.
2F	Y/BK	Neutral Safety Switch
2G	BL/Y	Solenoid Valve SS2.
2H	Y/R	Neutral Safety Switch
2I	BL/R	Solenoid Valve SS3.
2J	Y/GN	Pulse Generator
2K	BL/W	Solenoid Valve (CONVERTER CLUTCH)
2L	Y/BL	Pulse Generator
2M	--	--
2N	--	--
2O	BL/R	STOP Fuse (20A)
2P	BK/LG	Ground G103 (Ground G106: 3.0L)
2Q	BK/Y	Ignition Switch
2R	BK/LG	-
2S	--	Ignition Switch
2T	LG/BK	Electronic Control Assembly

Figure 2

EC-AT TERMINAL VOLTAGE CHART



CONNECTOR

Terminal	Connected to		Voltage	Condition
1A (Input)	Hold switch		Approx. 12V	Switch depressed
			Below 1.5V	Switch released
1B (Input)	Mode switch (Power side)		Below 1.5V	POWER mode
			Approx. 12V	ECONOMY mode
1C (Input)	Inhibitor switch	L range	Approx. 12V	L range
			Below 1.5V	Other ranges
1D (Input)		S range	Approx. 12V	S range
			Below 1.5V	Other ranges
1E (Input)		D range	Approx. 12V	D range
			Below 1.5V	Other ranges
1F (Input)		N and P range	Below 1.5V	N or P range
			Approx. 12V	Other ranges
1G (Input)	Water temperature switch		Approx. 12V	Above 72°C (162°F)
			Below 1.5V	Below 65°C (149°F)
1H	—		—	—
1I	—		—	—
1J	—		—	—
1K	—		—	—
1L (Input)	Idle switch		Below 1.5V	At idle
			Approx. 12V	Other speeds
1M	—		—	—
1N (Input)	Brake light switch		Approx. 12V	Brake pedal depressed
			Below 1.5V	Brake pedal released
1O (Input)	Throttle sensor		Approx. 5V	Ignition switch ON
			Below 1.5V	Ignition switch OFF
1P (Input)			Approx. 0.5—4.3V	Throttle valve fully closed to fully open
1Q (Input)	Vehicle speed sensor		Approx. 4.5V	During driving
			Approx. 4.5V or below 1.5V	Vehicle stopped
1R (Ground)	Throttle sensor		Below 1.5V	—
1S (Input)	Pulse generator		Approx. 12V	Engine running
			Below 1.5V	Engine stopped
1S (Ground)	Pluse generator		Below 1.5V	—
2A (Battery power)	Battery		Approx. 12V	Ignition switch ON
			Below 1.5V	Ignition switch OFF
2B (Ground)	Body ground		Below 1.5V	—
2C (Memory power)	Battery		Approx. 12V	—
2D (Ground)	Body ground		Below 1.5V	—
2E (Output)	1-2 shift solenoid valve		Approx. 12V	Refer to solenoid valve operation table
			Below 1.5V	
2F (Output)	2-3 shift solenoid valve		Approx. 12V	
			Below 1.5V	
2G	—		—	—
2H (Output)	3-4 shift solenoid valve		Approx. 12V	Refer to solenoid valve operation table
			Below 1.5V	
2I	—		—	—
2J (Output)	Lock-up solenoid valve		Approx. 12V	Lock-up
			Below 1.5V	Other
2K (Output)	Hold indicator		Below 1.5V	Hold mode
			Approx. 12V	Other modes
2L (Output)	Mode indicator		Approx. 12V	Hold mode
			Below 1.5V	Power or economy mode
2M (Output)	EC-AT Tester (malfunction code)		Approx. 12V	Normal
			Below 1.5V	If malfunction present
			Code signal	Self-diagnosis check connector grounded
2N	—		—	—
2O (Input)	Fluid temperature switch		Below 1.5V	Above 150°C (302°F)
			Approx. 10—12V	Below 143°C (289°F)
2P (Input)	EC-AT check connect		Approx. 12V	—

Figure 3

The **Vehicle Speed Sensor** is driven by the speedometer cable and is located in the speedometer head (Figure 4). If the Speedometer cable is disconnected, or the speed sensor sends no signal to the controller the transmission will still shift but the hold light will flash on and off to indicate that a fault is occuring. It can be tested at the Control Unit with a voltmeter. With the ignition on, test at the Control Unit between terminal 1Q and ground. Disconnect the speedo cable from the transaxle and slowly turn the cable **1** turn. The volt meter should show approx. 4.5 volts 4 times.

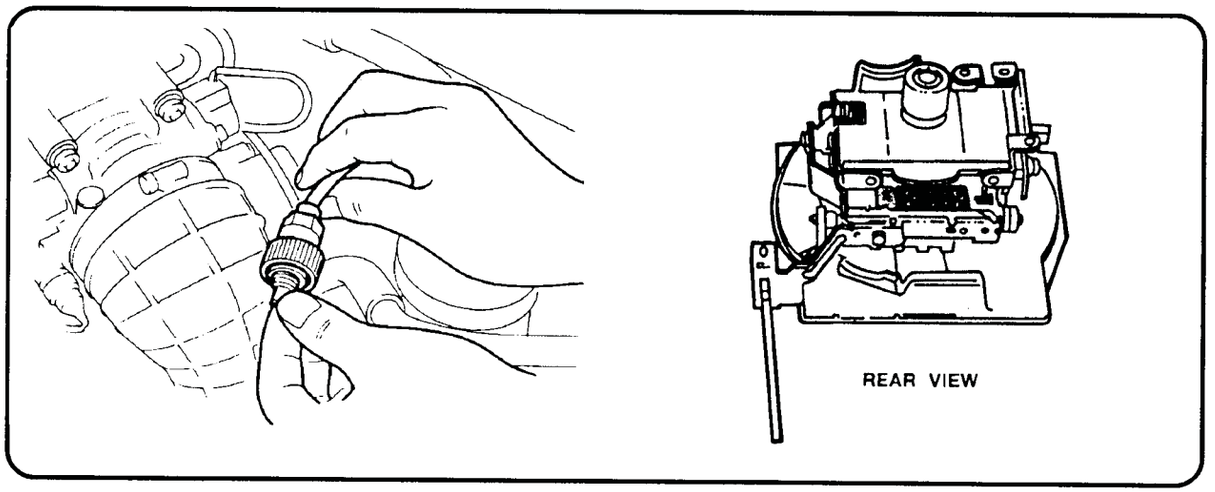
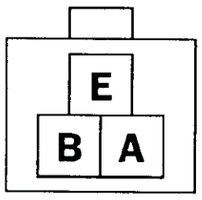
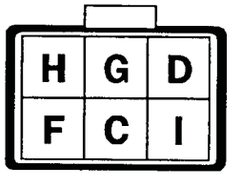


Figure 4

The **Inhibitor Switch** provides a neutral start safety feature but, far more than that, informs the EC-AT Control Unit which selector range has been chosen.This information is necessary so that the correct shift solenoid pattern will be sent to the transaxle by the EC-AT. The Inhibitor Switch can be checked by disconnecting the connector and testing for continuity at the correct terminals. Use figure 5 as a guide to terminal identification.



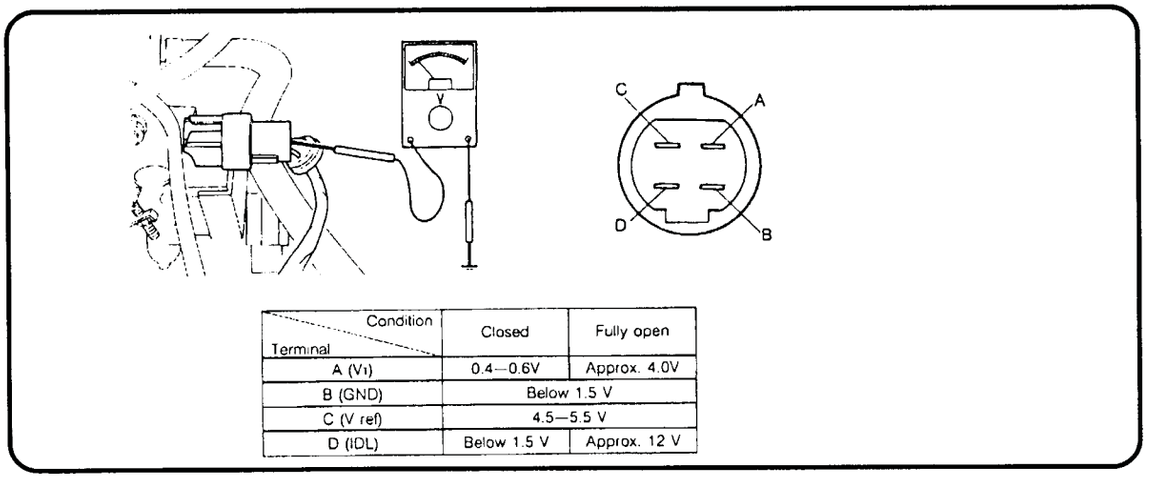


POSITION	CONNECTOR TERMINAL								
	A	B	C	D	E	F	G	H	I
P	o—o		o—o						
R			o—	—o					
N	o—o		o—			—o			
D			o—				—o		
S			o—					—o	
L			o—						—o

o—o INDICATES CONTINUITY

Figure 5

The **Hold Switch** tells the EC-AT or 4EAT when the Hold Mode has been selected. It is a normally closed (switch released). To test the switch, disconnect the switch wire connector and test for continuity. There should be continuity when the switch is released and there should be no continuity when the switch is depressed.



Condition / Terminal	Closed	Fully open
A (V$_T$)	0.4—0.6V	Approx. 4.0V
B (GND)	Below 1.5 V	
C (V ref)	4.5—5.5 V	
D (IDL)	Below 1.5 V	Approx. 12 V

Figure 6

The **Throttle Position Sensor** and the Idle Switch are located on the throttle body. The Throttle position sensor is a variable resistor that relays a voltage signal to the control unit. The Idle Switch is turned on when the throttle is closed and it also relays this signal to the control unit. Ford versions use a separate throttle position sensor and idle switch, but Mazda units use a single sensor and switch assembly. See figures 6 and 7 for common sensor-switch location and terminal identification.

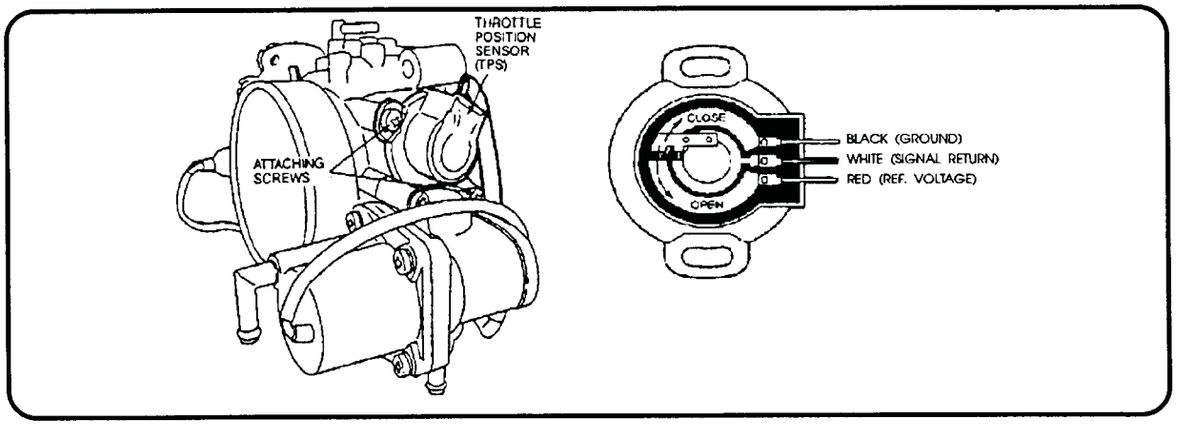


Figure 7

The **Pulse Generator** is located on the transaxle near the top and is held down by one bolt. To test the Pulse Generator, disconnect the connector and test the Ohms resistance between the terminals. There should be 200 - 400 Ohms resistance. See figure 8.

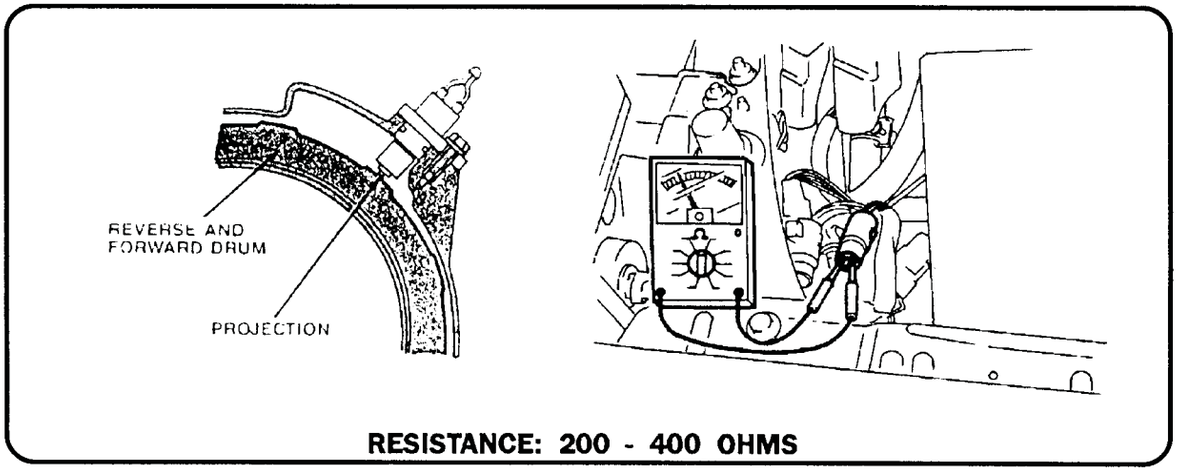
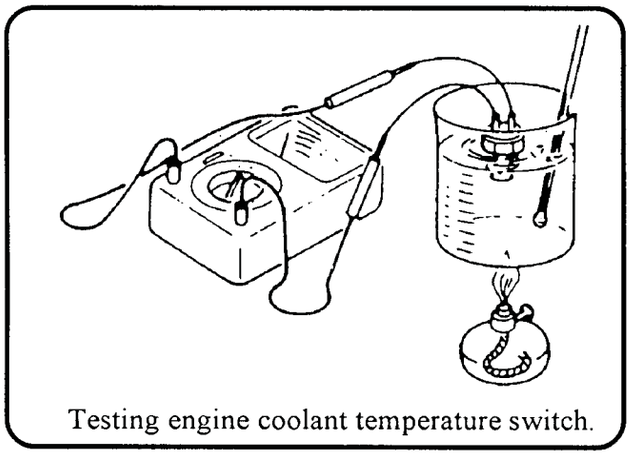


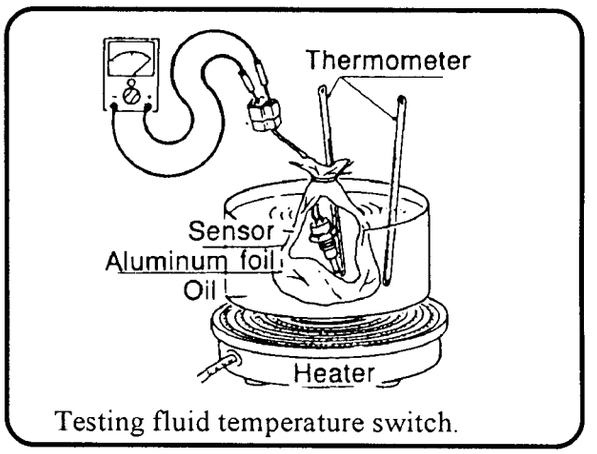
Figure 8

The **Engine Coolant Temperature Switch** is commonly located on the lower portion of the intake manifold and it signals the Control Unit when the engine temperature is below 149°F. If the coolant temperature switch fails it will usually cause the check engine light to come on . The trouble code for such a failure can be retrieved with a scanner that checks engine trouble codes. Testing this switch is shown in figure 9.



Testing engine coolant temperature switch.

Figure 9.

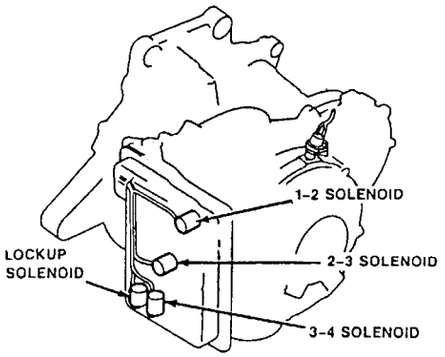


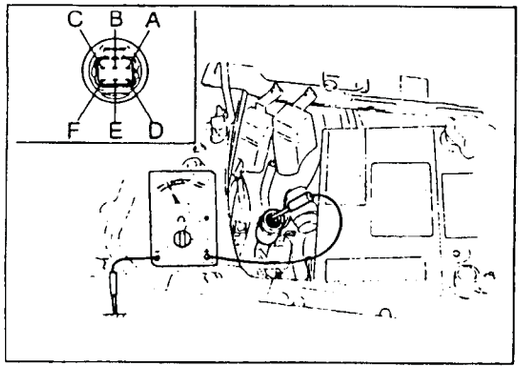
Testing fluid temperature switch.

Figure 10.

The **Fluid Temperature Switch** is located on the fluid pipe from the transaxle to the oil cooler. It signals the control unit when the ATF temperature is above 302°F. See Figure 10.

Some models have a **Mode Switch** that signals the control unit to alter its program slightly for power or economy operation.





Internal wire colors.
1-2 sol. wire in trans is green.
2-3 sol. wire in trans is blue.
3-4 sol. wire in trans is yellow.
LU. sol. wire in trans is red.

Inspection of Resistance
1. Disconnect the negative battery cable.
2. Disconnect the solenoid valve connector.
3. Measure the resistance of the terminals except (A) terminal, if necessary replace the solenoid valve.

Resistance: 13—27Ω

Note
1-2 solenoid valve : F
2-3 solenoid valve : C,E
3-4 solenoid valve : B
Lock-up solenoid valve : D

GEAR	1-2 SOL	2-3 SOL	3-4 SOL
FIRST	OFF	ON	ON
SECOND	ON	ON	ON
THIRD	*	OFF	OFF
FOURTH	ON	OFF	ON

* ON IN THIRD CANCELS ENGINE BRAKING

Figure 11

THERE ARE FOUR SOLENOIDS INSIDE OF THE TRANSAXLE.

There are three **Shift Solenoids** and one **Lock-up Solenoid**. These solenoids are normally closed allowing fluid pressure to act on the end of the shift valves. As they are energized (on), they open and drain pressure through exhaust ports. This allows the respective shift valves to stroke using spring tension on the opposite ends of the valves. Figure 11 shows solenoid and terminal identification as well as the on/off shift pattern for the solenoid.

TROUBLE CODES

(WARNING CODE RETRIEVAL)

Self-diagnosis Function

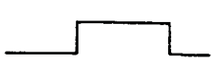
The self-diagnosis system, which is integrated in the EC-AT control unit, diagnoses malfunction of the main sensors (input) and solenoid valves (output), and the EC-AT control unit.
Malfunctions which have happened or are continuing are memorized in the EC-AT control unit as specific codes.

Code Number

Code number	Location of malfunction	Buzzer (EC-AT TESTER ONLY)
06	Vehicle speed sensor or circuit	
12	Throttle sensor or circuit	
55	Pulse genelator or circuit	
60	1-2 shift solenoid valve or circuit	
61	2-3 shift solenoid valve or circuit	
62	3-4 shift solenoid valve or circuit	
63	Lock-up solenoid valve or circuit	

06 → 4 second period →
55 → 4 second period →
63 → 4 second period →
Repeats above

When the service connector is not grounded

Malfunctions	YES NO	
Hold indicator flashing	YES NO	
Memory In control unit	YES NO	

General Note

If there is more than one malfunction, the code numbers will be displayed on the tester one by one in a numerical order. In the case of malfunctions, 55, 06, and 63, the code numbers are displayed in an order of 06, 55, then 63. The display is as shown.

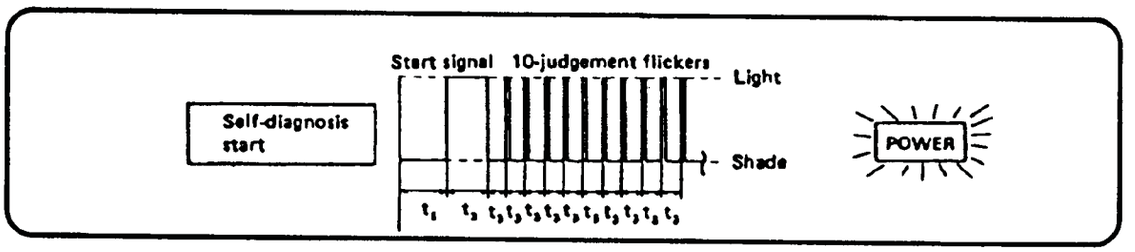
The hold indicator flashes to indicate the same pattern as the buzzer of the EC-AT Tester when the EC-AT service connector is grounded.
When the EC-AT service connector is not grounded, the indicator flashes in a constant frequency while a malfunction is occurring and goes out if the malfunction recovers. However, the warning code is memorized in the EC-AT control unit.

The EC-AT control unit has a built-in fail-safe function for the throttle sensor, the pulse generator, and the 1-2, 2-3, and 3-4 shift solenoid valves.
If a malfunction occurs, the EC-AT control unit will control operation of the remaining components according to a preset fail-safe program.
The vehicle may still be driven, although the driving performance will be slightly affected.

RE4F02A ELECTRICAL DIAGNOSIS

This Four speed front wheel drive transaxle is found in Nissan Maxima and some Sentra's starting in 1989. It is electronically controlled and has five solenoids on the valve body to control shifting, converter clutch apply, and oil pressure. When electrical diagnosis is necessary, it is important to know the difference between electrical and hydraulic malfunctions. The first step is to determine exactly what the transmission is doing or not doing. This transmission will start in third gear if no signal is sent to the transmission. When an electrical malfunction occurs, the Self-Test can be performed to help pinpoint the source of the problem. Current scanners on the market cannot retrieve transmission trouble codes for Nissan. To locate an electrical component, use figure 1 as a guide. The A/T Control Unit will store trouble codes related to sensor or solenoid malfunctions. If trouble occurs and the A/T Control unit is still functioning, use the self-test procedure described below to reveal the stored codes.

1. Warm engine to normal temperature.
2. Shut engine off.
3. Set selector switch to "auto".
4. Move selector lever to "P" range.
5. Turn ignition switch on. Does "power" lamp come on for about 2 seconds? If not then the . controller is not responding and it must be checked before going any further. If yes then . ... continue.
6. Turn ignition off.
7. Move selector lever to "D" range.
8. Set O/D switch to "OFF".
9. Turn ignition on and wait at least 2 seconds.
10. Move selector lever to "2" range.
11. Set O/D switch to "on:.
12. Move the selector lever to " 1 " range.
13. Set O/D switch to "off".
14. Depress accelerator pedal fully and then release it.
15. Set selector switch to "auto" position. Check "power" lamp.
16. See the chart below to interpret the flashing lamp.
17. For trouble code translations refer to Page 90 at the end of the RE4ROlA chapter



TYPICAL SYSTEM LAYOUT

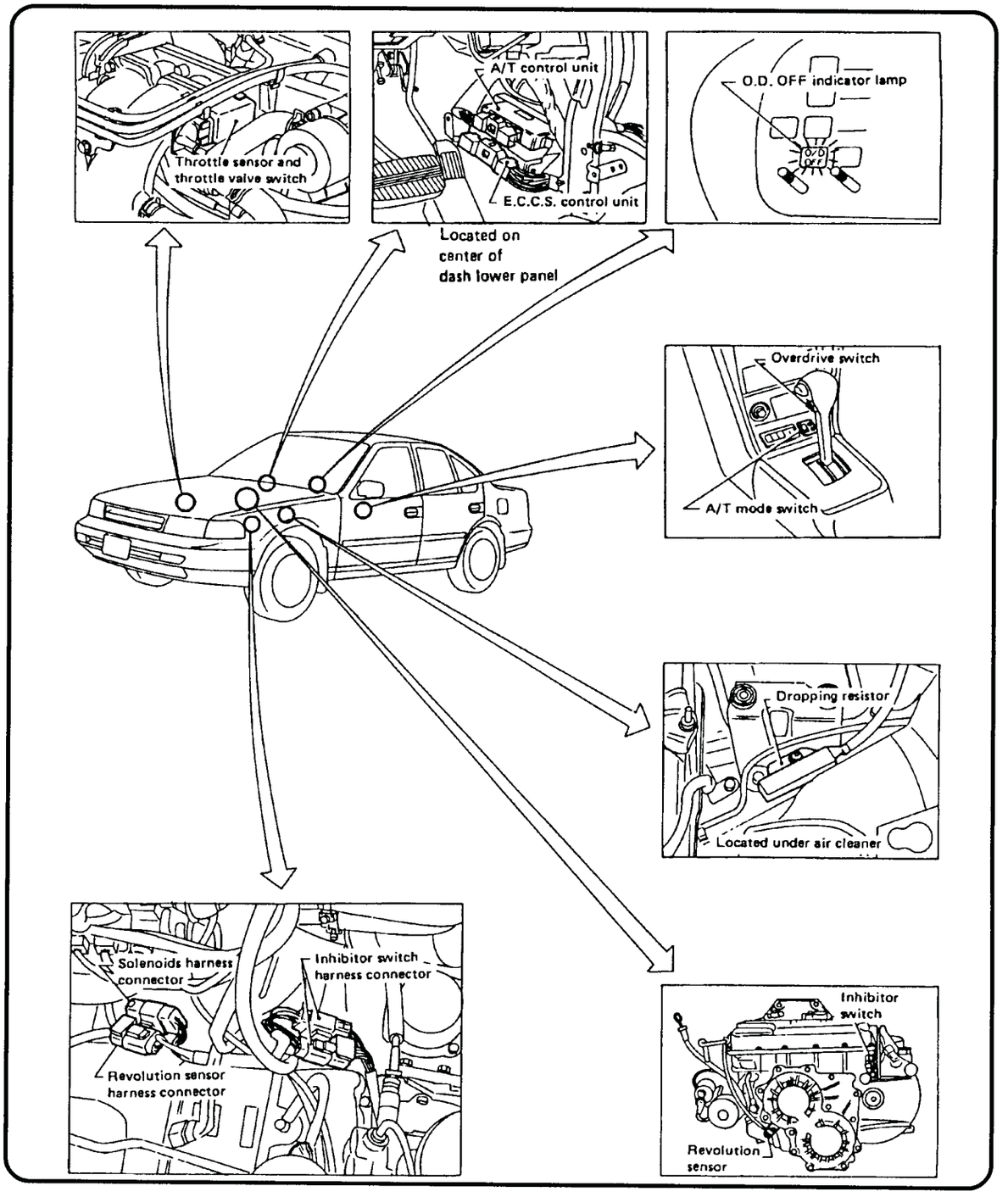
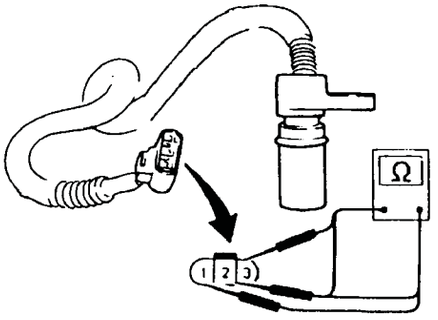


Figure 1

INPUT SENSOR DESCRIPTION

The Revolution Sensor is Mounted on the transfer gear cover and provides rotational speed information to the controller. Test according to figure 2.



TERMINALS 1 - 2 .... 500 - 650 OHMS
TERMINALS 2 - 3 .... NO CONTINUITY
TERMINALS 1 - 3 .... NO CONTINUITY

Figure 2

The **Speed Sensor** is driven by the speedometer cable and is located in the Speedometer head. It is a reed type switch and sends a pulse signal to the ECU (Engine Control Unit) which relays that signal to the A/T Control Unit.

The **Throttle Sensor**, the **Idle Switch**, and the **Full throttle Switch** are mounted on the throttle body. These switches use two connectors, but are all in one unit. The Throttle Sensor responds to the accelerator pedal movement. This sensor is kind of a potentiometer which transforms the throttle valve position into output voltage and emits the voltage signal to the ECU and the A/T Control Unit. The Idle and Full Throttle switches signal the A/T Control Unit for timing and self-diagnosis. Figure 3 identifies the throttle sensor terminals and related ohms tests.

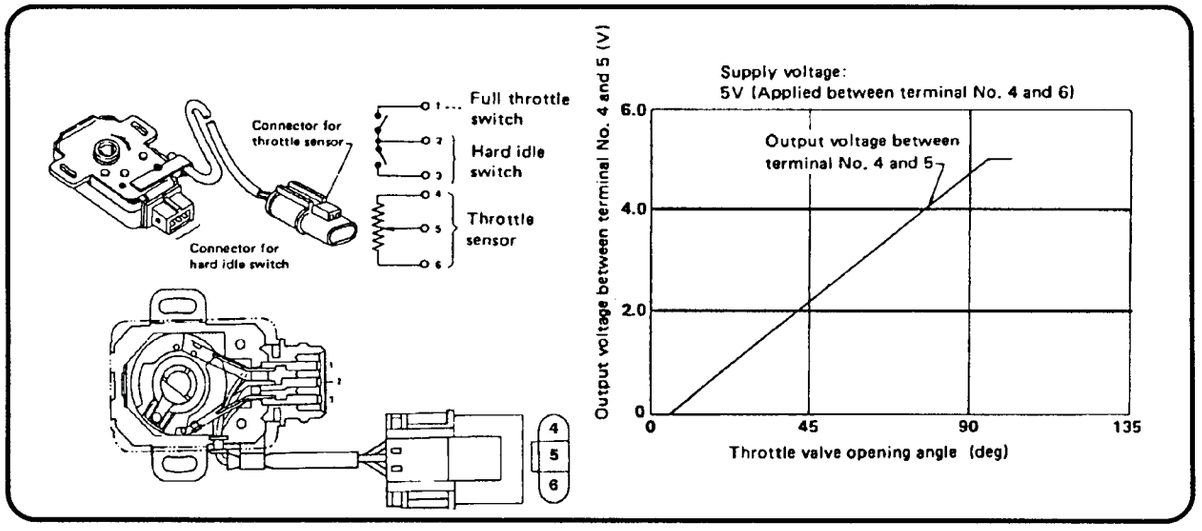


Figure 3

THE A/T CONTROL UNIT (TRANSMISSION CONTROL UNIT)

The A/T Control Unit is located on the center of the dash lower panel. It is smaller than the E.C.C.S. Control Unit (Engine Computer) and is usually mounted next to it. It recieves the input signals and turns the solenoid in the transmission on and off to control shifting. The chart below identifies the pin connector for the A/T Control Unit and gives voltage values for each terminal.

PIN	DESCRIPTION	CONDITION	VALUE
1	LINE PRESSURE SOLENOID WITHOUT RESISTOR	ENGINE WARM ACCELERATOR PEDAL RELEASED	1.5 - 2.5 VOLTS
		ENGINE WARM ACCELERATOR PEDAL DEPRESSED	0.5 VOLTS OR LESS
2	LINE PRESSURE SOLENOID WITH RESISTOR	ENGINE WARM ACCELERATOR PEDAL RELEASED	5 - 14 VOLTS
		ENGINE WARM ACCELERATOR PEDAL DEPRESSED	0.5 VOLTS OR LESS
3	POWER INDICATOR LAMP	A/T MODE SWITCH SET TO POWER	1 VOLT OR LESS
		A/T MODE SWITCH SET TO POWER	BATTERY VOLTAGE
4	POWER SOURCE	IGNITION SWITCH ON	BATTERY VOLTAGE
		IGNITION SWITCH OFF	1 VOLT OR LESS
5	LOCKUP SOLENOID	LOCK-UP SWITCH ON	8 - 15 VOLTS
		LOCK-UP SWITCH OFF	1 VOLT OR LESS
6	SHIFT SOLENOID A	SOLENOID ON	BATTERY VOLTAGE
		SOLENOID OFF	1 VOLT OR LESS
7	SHIFT SOLENOID B	SOLENOID ON	BATTERY VOLTAGE
		SOLENOID OFF	1 VOLT OR LESS
8	TIMING SOLENOID	SOLENOID ON	BATTERY VOLTAGE
		SOLENOID OFF	1 VOLT OR LESS
9	POWER SOURCE	IGNITION SWITCH ON	BATTERY VOLTAGE
		IGNITION SWITCH OFF	1 VOLT OR LESS
10	ECCS CONTROL UNIT	IGNITION SWITCH ON	
		IGNITION SWITCH OFF	
14	IDLE SWITCH	ACCELERATOR PEDAL RELEASED	8 - 15 VOLTS
		ACCELERATOR PEDAL DEPRESSED	1 VOLT OR LESS
15	GROUND	IGNITION SWITCH ON	.02 VOLTS OR LESS
16	INHIBITOR SWITCH RANGE "1"	INHIBITOR SWITCH TO "1"	BATTERY VOLTAGE
		INHIBITOR SWITCH TO OTHER RANGES	1 VOLT OR LESS
17	INHIBITOR SWITCH RANGE "2"	INHIBITOR SWITCH TO "2"	BATTERY VOLTAGE
		INHIBITOR SWITCH TO OTHER RANGES	1 VOLT OR LESS
18	INHIBITOR SWITCH RANGE "D"	INHIBITOR SWITCH TO "D"	BATTERY VOLTAGE
		INHIBITOR SWITCH TO OTHER RANGES	1 VOLT OR LESS
19	INHIBITOR SWITCH RANGE "N" OR "P"	INHIBITOR SWITCH TO "N" OR "P"	BATTERY VOLTAGE
		INHIBITOR SWITCH TO OTHER RANGES	1 VOLT OR LESS
20	INHIBITOR SWITCH RANGE "R"	INHIBITOR SWITCH TO "R"	BATTERY VOLTAGE
		INHIBITOR SWITCH TO OTHER RANGES	1 VOLT OR LESS
21	FULL THROTTLE SWITCH	ACCELERATOR PEDAL DEPRESSED MORE THAN HALF-WAY	8 - 15 VOLTS
		ACCELERATOR PEDAL RELEASED	1 VOLT OR LESS
23	POWER (BACK-UP)	IGNITION SWITCH ON OR OFF	BATTERY VOLTAGE
24	ENGINE REVOLUTION SENSOR	ENGINE RUNNING AT IDLE SPEED	0.9 VOLTS
		ENGINE RUNNING AT 3000 RPM	3.7 VOLTS
25	REVOLUTION SENSOR	VEHICLE SPEED IS 19 MPH	1 VOLT A/C OR MORE
		VEHICLE NOT MOVING	0 VOLTS
27	SPEED SENSOR	WHEN VEHICLE IS MOVING 1 -2 MPH FOR 3 FEET OR MORE	VARY FROM 0 - 5 VOLTS
31	TPS POWER		4.5 - 5.5 VOLTS
33	A/T FLUID TEMPERATURE SENSOR	ATF TEMPERATURE AT 68° F	1.56 VOLTS
		ATF TEMPERATURE AT 176° F	0.45 VOLTS
34	THROTTLE POSITION SENSOR (SIG. RETURN)	THROTTLE FULLY CLOSED	0.2 - 0.6 VOLTS
		THROTTLE FULLY OPEN	2.9 - 3.9 VOLTS
35	TPS GROUND	IGNITION SWITCH ON	.02 VOLTS OR LESS
36	A/T MODE SWITCH "POWER"	A/T MODE SWITCH SET TO POWER	BATTERY VOLTAGE
		A/T MODE SWITCH SET TO AUTO	1 VOLT OR LESS
39	OVERDRIVE SWITCH	OVERDRIVE SWITCH ON	BATTERY VOLTAGE
		OVERDRIVE SWITCH OFF	1 VOLT OR LESS
42	A/T MODE SWITCH "COMFORT"	A/T MODE SWITCH SET TO COMFORT	BATTERY VOLTAGE
		A/T MODE SWITCH SET TO AUTO	1 VOLT OR LESS
48	GROUND	IGNITION SWITCH ON	.02 VOLTS OR LESS

A/T CONTROL UNIT CONTINUED

As an overview to the wiring schematic a circuit diagram is provided for quick pinpoint checks. Figure 5 shows the A/T Control Unit with connections to the sensors, switches, and solenoids.

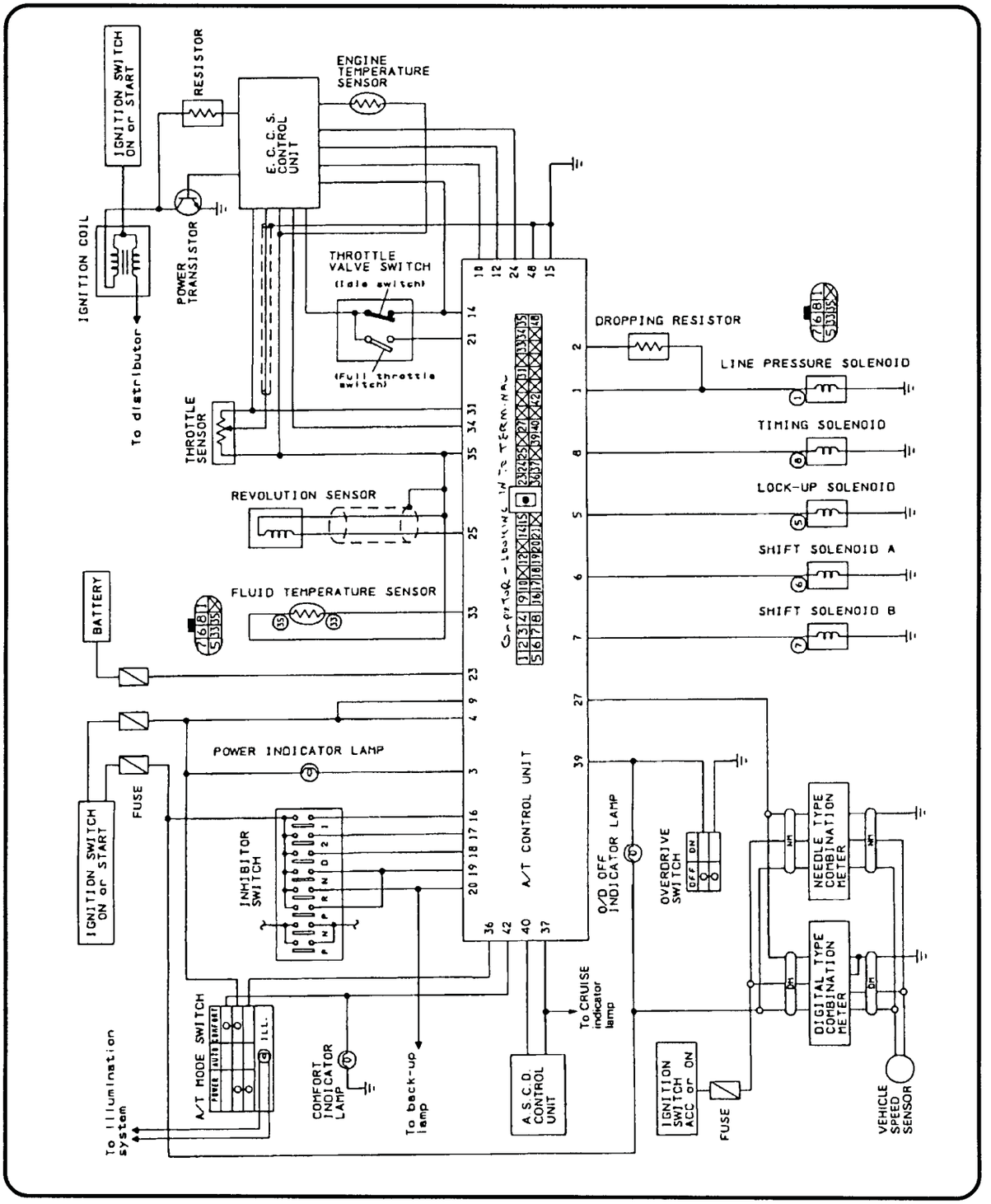


Figure 5

TRANSMISSION SOLENOIDS, SENSORS, AND SWITCHES

The **Shift Solenoids** are mounted on the valve body. They are normally open when off and drain line pressure from the shift valves or control valve. When they are energized, they close and allow line pressure to stroke their respective valve. The sequence in which they are energized determines which gear is selected. Figure 6 describes the proper shift solenoid pattern and may be used as a guide for testing the transmission independently from the controller.

The **Line Pressure Solenoid** is mounted on the valve body. It is operated by a pulse signal from the controller and this varied pulse or duty cycle controls pressure. These timed pulses translates to from .5 to 5.5 volts. There should never be full battery voltage to the line pressure solenoid.

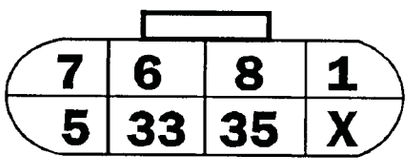
The **Dropping Resistor** is under the hood near the air cleaner . Its purpose is to fine tune the voltage signal to the line pressure solenoid according to temperature. It is identified in figure 7.

The **Lock-up Solenoid** is mounted on the valve body. It is normally closed when off and blocks the drain so that line pressure moves the lock-up control plug to the release position. When it is energized, it opens and drains pressure from the control plug.

The **Timing Solenoid** screws into the valve body to maintain good shift characteristics at different loads and speeds. It is identified in figure 8.

The **Fluid Temperature Sensor** in the transmission provides information to the A/T Control Unit to modify shifts and converter clutch engagement speed according to temperature. To test this sensor, use an ohmmeter to measure the resistance across terminals 33 and 35 of the connector described in figure 6. A good sensor will have about 2.5k ohms resistance at 68°F.

GEAR	SOLENOID A	SOLENOID B	LOCK-UP SOLENOID	TIMING SOLENOID	PRESSURE SOLENOID
1st	ON	ON	OFF	ACTIVATES UPON VARIOUS THRROTTLE OPENONGS	PULSE MODULATION CONTROLLED BY COMPUTER
2nd	OFF	ON	OFF		
3rd	OFF	OFF	OFF		
4th	ON	OFF	ON	OFF	
OHMS	20 - 30	20 - 30	10 - 16	20 - 30	2.5 - 5



Pin	Description	Wire Color
7	Shift Solenoid B.	Yellow
6	Shift Solenoid A.	Green
8	Overrun Solenoid.	Gray
1	Line Pressure Solenoid.	Red
5	Lock-up Solenoid.	Blue
33	Fluid Temp. Sensor.	White
35	Fluid Temp. Sensor.	Black

PIN SIDE OF 8 TERMINAL CONNECTOR GOING TO THE TRANSMISSION.

Figure 6

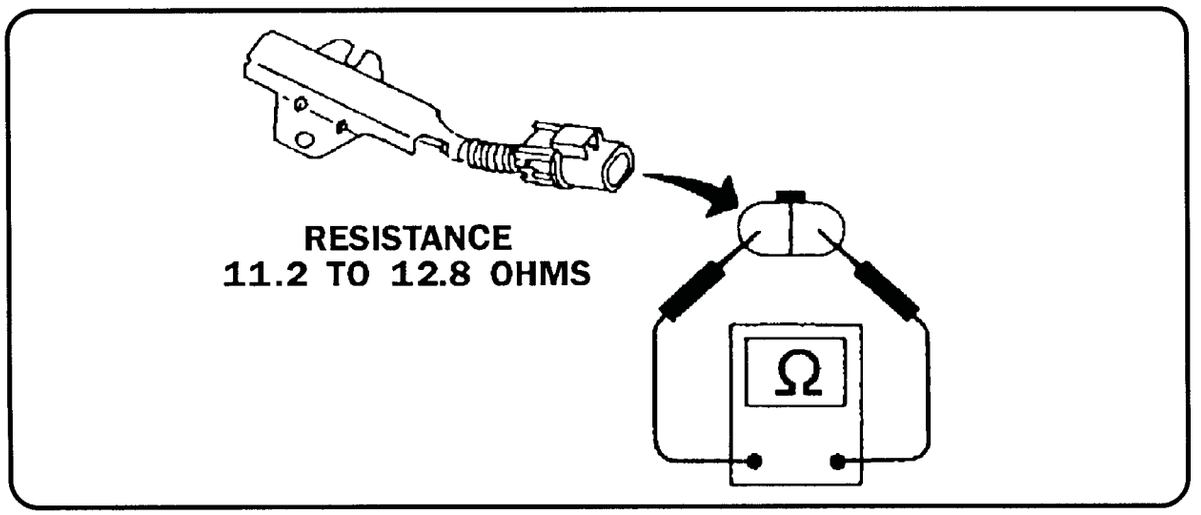


Figure 7

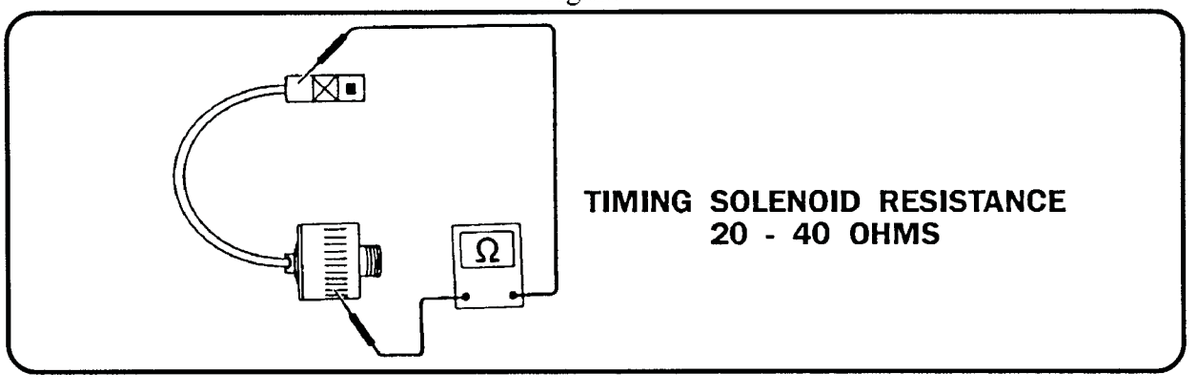


Figure 8

The **Inhibiter Switch** is located on the side of the transmission at the manual lever. It tells the A/T Control Unit which range has been selected. The three terminal connector controls the neutral safety function, while the six terminal connecter sends the range selection information to the control unit. Voltage values for testing the Inhibitor Switch can be found on the chart in figure 4. Switch location and continuity chart are found in figure 9.

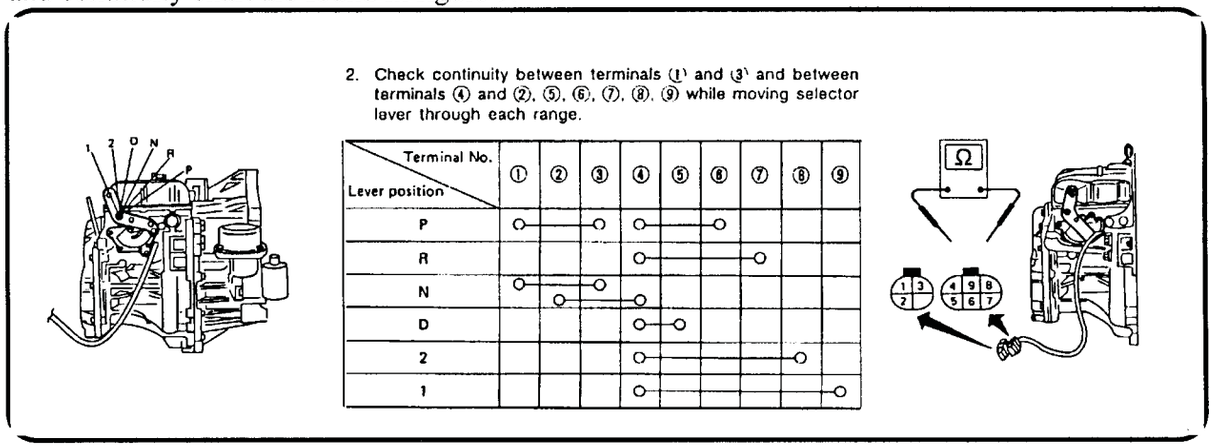
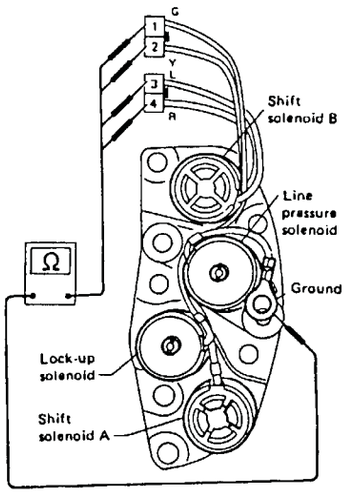


Figure 9

The **Fail Safe** or non-electrical mode provides for only two gear ranges. These are first and third ranges. If no signal comes from the controller, the transmission will start and stay in third gear unless the gear shift lever is placed into the 1 position. In the 1 position first gear is selected regardless of vehicle speed.

Individual pin point tests are often necessary to isolate electrical problems and test sensors. For quick tests, check either the controller or the terminal connectors for the proper ohms or voltage readings. Refer to the preceding pages for all of the test information. As a further help, the ATSG Techtran Manual for the RE4F02A is available from most parts suppliers or from ATSG directly.

INTERNAL SOLENOID IDENTIFICATION



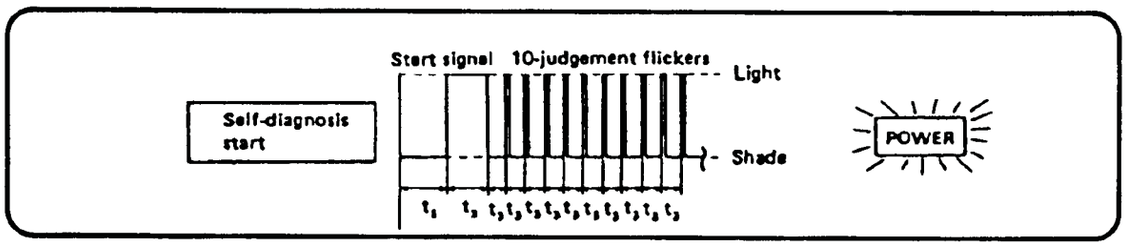
4-UNIT SOLENOID ASSEMBLY
SHIFT SOLENOID A, B, LOCK-UP SOLENOID AND LINE PRESSURE SOLENOID

Figure 10

NISSAN RE4R01A ELECTRICAL DIAGNOSIS

This four speed fully electronic automatic transmission has five solenoids on the valve body to control shifting, converter c]utch apply, and oil pressure. This transmissions used in passenger cars as well as in 2 wheel drive and 4 wheel drive trucks. Diagnostic procedures for both versions start with the basics. The first step is to determine exactly what the transmission is doing or not doing. This transmission will start in third gear if no signal is sent to the transmission. When an electrical malfunction occurs, the Self-Test can be performed to help pinpoint the source of the problem. The electrical parts locations can be in different places from trucks to cars. Figure 1 shows an overview of the system layout for trucks, and Figure 2 shows the typical layout for cars. If the transmission Control Unit (TCU) is still functioning, use the self test procedure described below. This test will reveal .stored trouble codes.

1. Warm engine to normal operating temperature.
2. Shut engine off.
3. Set POWER switch to "AUTO". (240X & 300ZX....Set O/D switch to "ON")
4. Selector to "PARK".
5. Turn ignition switch "ON". Power Lamp should come on for 2 seconds. (O/D lamp for 240SX) (A/T CHECK lamp for 300ZX)
6. Turn ignition switch off.
7. Move selector to "D".
8. Set O/D switch to "OFF". (1988-89 PICKUP & PATHFINDER...set SHIFT switch to "POWER".
9. Turn Ignition switch "ON"...Wait 2 seconds!
10. Move selector to "2".
11. Set O/D switch to "ON". (1988-89 PICKUP & PATHFINDER...set SHIFT switch to "AUTO")
12. Move selector to "1"
13. Set O/D switch to "OFF" (1988-89 PICKUP & PATHFINDER...Set Shift switch to "AUTO")
14. Depress accelerator pedal fully and release it.
15. 240SX ONLY...Set O/D switch to "ON"
16. PICKUP & PATHFINDER....Watch "POWER" lamp for codes.
    240SX...Watch O/D INDICATOR lamp for codes.
    300ZX...Watch A/T CHECK lamp for codes
17. For trouble code translation see PAGES 90-92.



IMPORT COMPUTER CONTROLS

TYPICAL SYSTEM LAYOUT USED ON TRUCKS

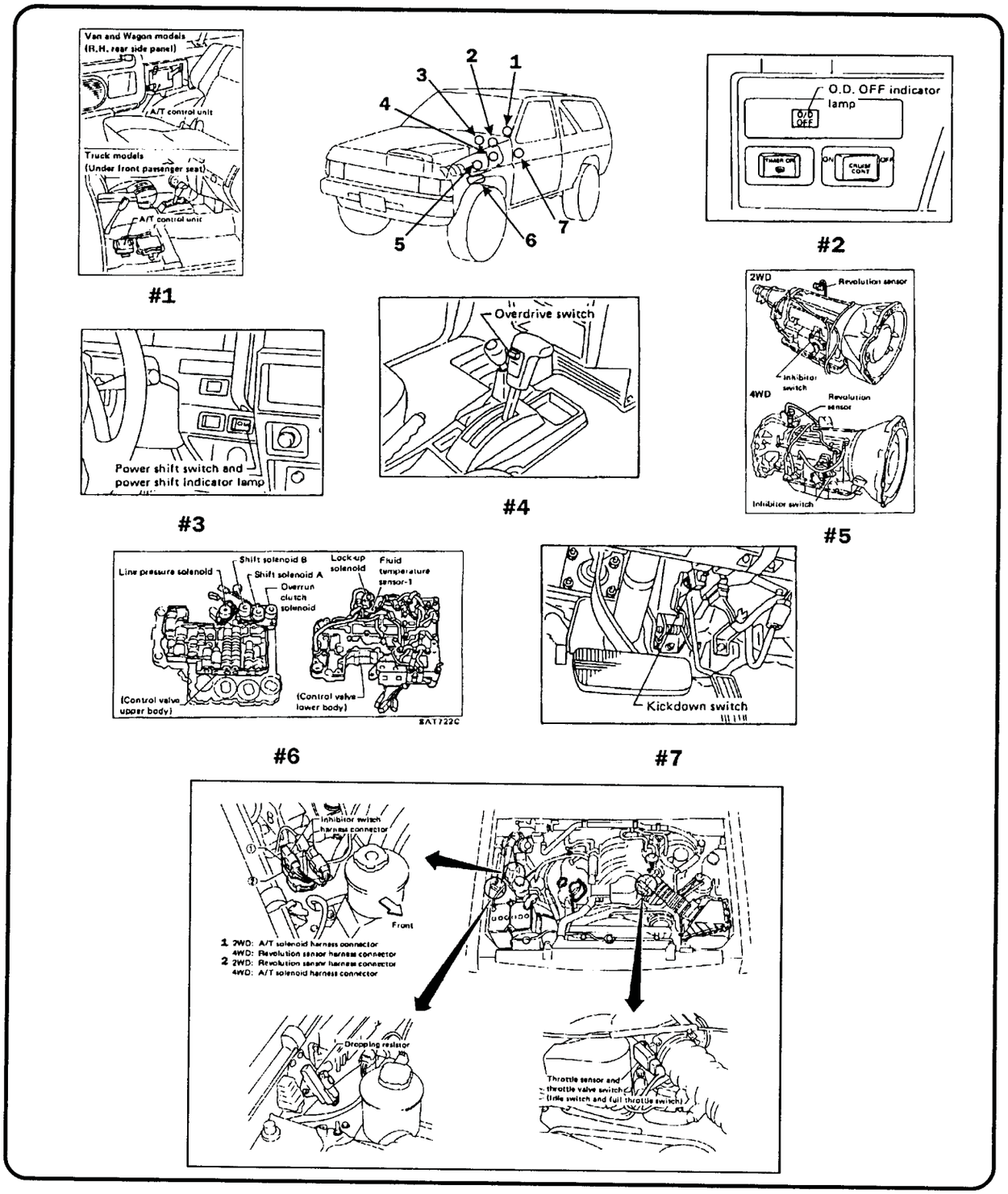


Figure 1

TYPICAL SYSTEM LAYOUT USED ON CARS

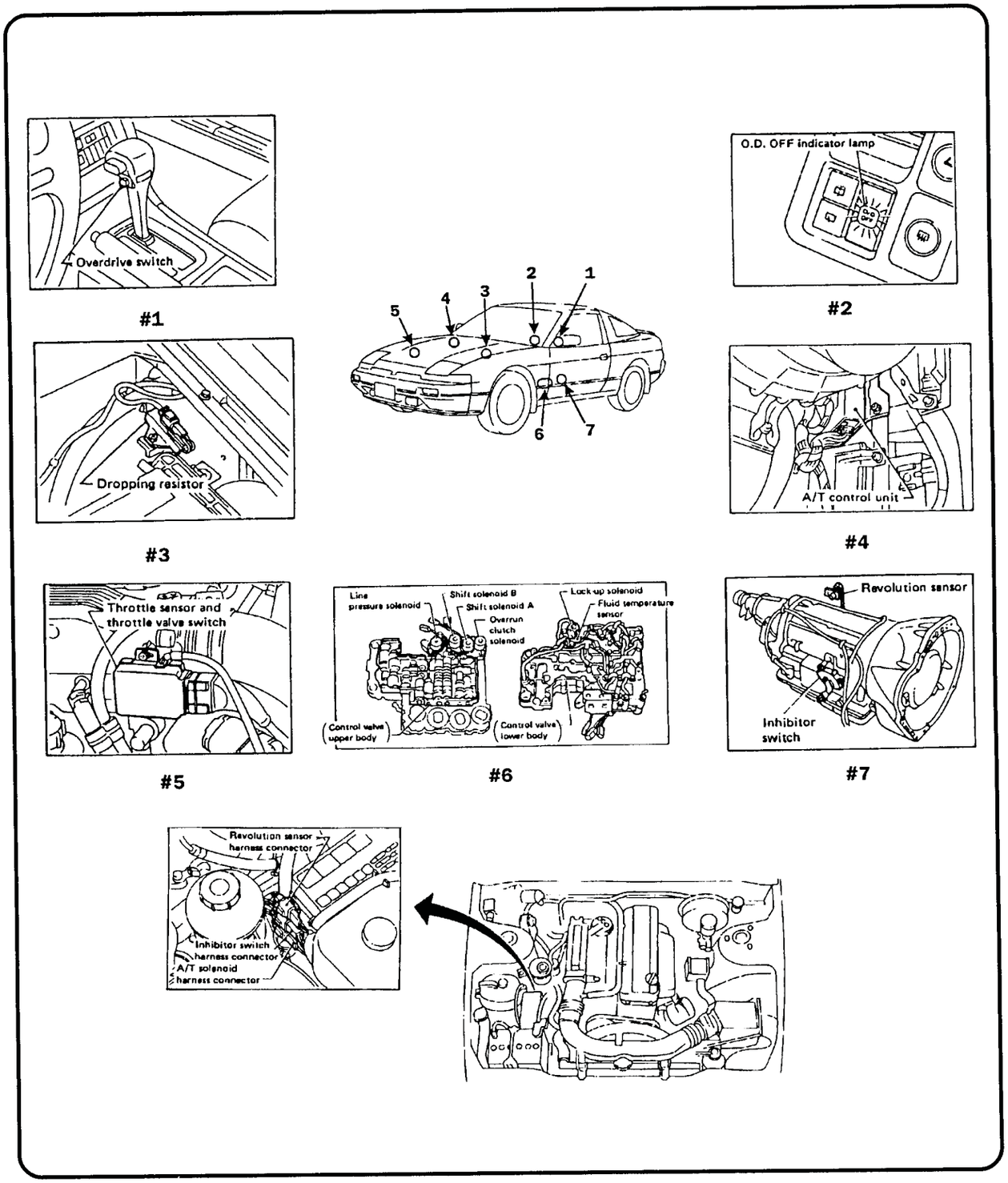


Figure 2

INPUT SENSOR DESCRIPTION

The **Speed Sensor** is driven by the speedo cable and is usually on the speedo head. It sends a pulse signal to the controller. If the speed sensor does not work, the transmission will shift from 1st to 2nd and 2nd to 3rd, but will not shift to 4th.

The **Revolution Sensor** is located on the tail housing on Nissan 2WD and 4WD transmissions. It generates A C voltage as the output shaft turns and sends it to the controller.

The **Kickdown Switch** is located above the accelerator pedal and it tells the TCU when a full throttle down shift is being commanded by the driver.

The **Cruise Control Switch** also signals the TCU when cruise control has been engaged. This will modify the TCU program to keep tip in downshifts to a minimum.

The **Idle Switch**, the **Full Throttle Switch**, and the **Throttle Sensor** are usually incorporated as a single unit. All give voltage signals to the controller to monitor driving conditions. Voltage values for these sensors at the TCU can be found on the Transmission Control Unit (TCU) pin chart.Figure 3 shows typical throttle sensors and related ohms tests.

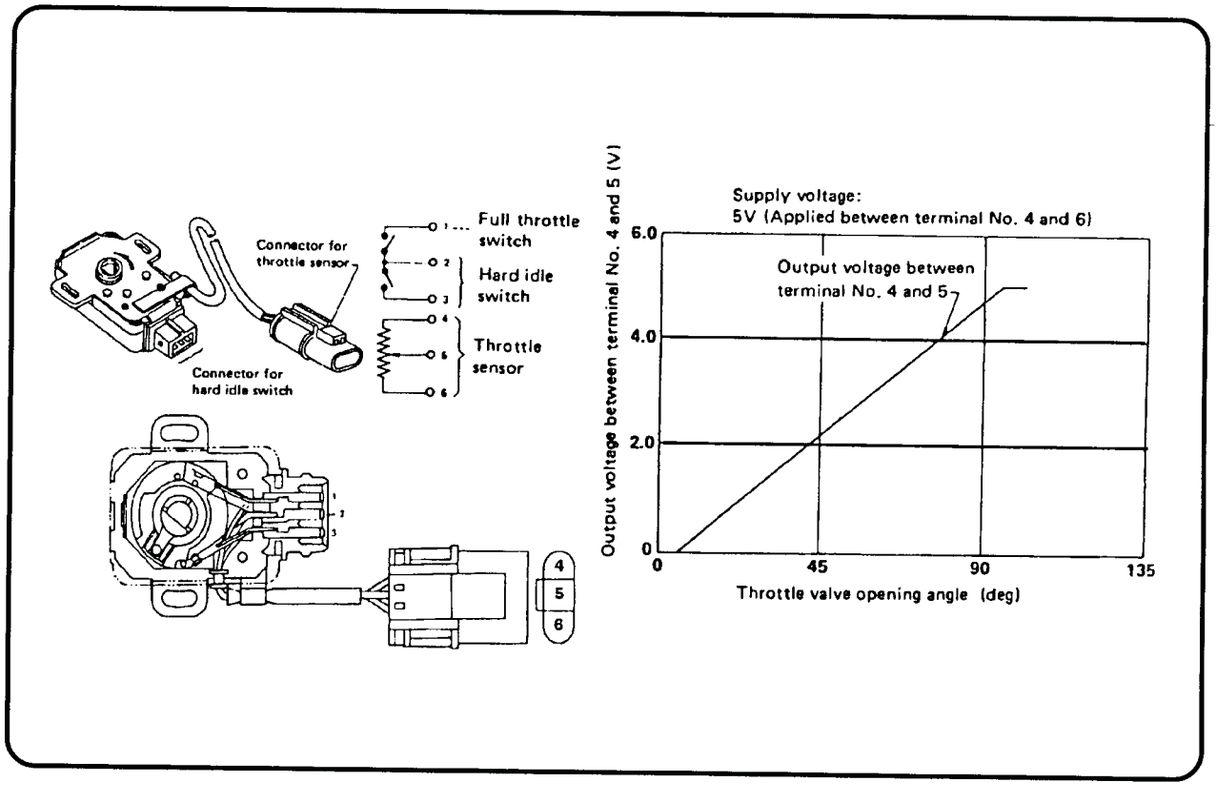
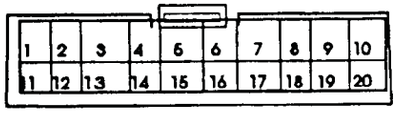


Figure 3

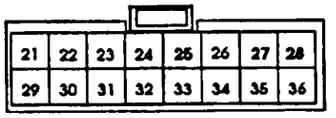
The **Overdrive Switch** or **Hold Switch** sends another signal to the controller to modify transmission shifts accordingly.

THE TRANSMISSION CONTROL UNIT (TCU) The TCU is located on the right side of the vehicle. It is usually way up behind the kick panel on cars, under the right seat on pick-ups, and next to the rear seat on Pathfinders. It turns the solenoids on and off to control shifting and pressure. See Figure 4 for the pin locations of the TCU inputs as well as outputs to the transmission solenoids.

20 Pin Connector



16 Pin Connector



Viewed from wire harness side.

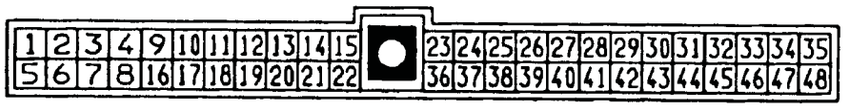
PIN NUMBER	PIN DESCRIPTION	VALUE
1	INHIBITOR SWITCH "2" RANGE	BATTERY VOLTAGE IN "2"
2	INHIBITOR SWITCH "1" RANGE	BATTERY VOLTAGE IN "1"
3	POWER SHIFT SWITCH *	1 VOLT OR LESS IN AUTO
4	IDLE SWITCH	IDLE 8-12 V. W.O.T. 1 V. OR LESS
5		
6	CRUISE CONTROL CUT SIGNAL	SWITCH ON 1VOLT OR LESS
7	KICKDOWN SWITCH	FULL THROTTLE 1 VOLT OR LESS
8	CRUISE CONTROL	CRUISE LIGHT ON BATT. VOLTAGE
9	OVERDRIVE SWITCH **	ON BATTERY VOLTAGE
10	THROTTLE SENSOR POWER	4.5 - 5.5 VOLTS
11	THROTTLE SENSOR	.2 VOLTS 4. VOLTS MIN. TO MAX.
12	FLUID TEMPERATURE SENSOR	APPROX. 1.56 VOLTS AT 68°
13		
14		
15	THROTTLE SENSOR	GROUND
16	REVOLUTION SENSOR	AC VOLTS WITH SPEED
17	FULL THROTTLE SWITCH	8 - 15 VOLTS AT W.O.T.
18		
19	INHIBITOR SWITCH "N" RANGE	BATTERY VOLTAGE IN "N" RANGE
20	INHIBITOR SWITCH "D" RANGE	BATTERY VOLTAGE IN "D" RANGE
21	OVERRUN CLUTCH SOLENOID	BATTERY VOLTAGE WHEN ON
22	LOCK-UP SOLENOID	BATTERY VOLTAGE IN LOCK-UP
23	O.D. OFF or POWER LAMP	OFF or POWER LESS THAN 1 VOLT
24	SPEED SENSOR	VOLTAGE VARIES 0 TO 5 VOLTS
25	ENGINE REVOLUTION SIGNAL	ENGINE RUNNING 9-12 VOLTS
26	INHIBITOR SWITCH "R" RANGE	BATTERY VOLTAGE IN "R" RANGE
27		
28	POWER SOURCE (BACK-UP)	BATTERY VOLTAGE
29-30	POWER SOURCE (IGN. SWITCH)	12 VOLTS IGNITION ON
31-32	GROUND	GROUND
33	LINE PRESSURE SOL. W/RESISTOR	AT IDLE 5 -14 VOLTS
34	LINE PRESSURE SOLENOID	AT IDLE 1.5 - 2.5 VOLTS
35	SHIFT SOLENOID "A"	BATT. VOLTAGE IN 1ST &4TH GEAR
36	SHIFT SOLENOID "B"	BATT. VOLTAGE IN 1ST &2ND GEAR

* - 1990 & UP PICKUP & PATHFINDER
** - 1988 - 89 PICKUP & PATHFINDER USE " POWER " SHIFT SWITCH

Figure 4

TRANSMISSION CONTROL UNIT (TCU)

The TCU on the **1989 300ZX** is located in the luggage compartment on the passenger side. The TCU on the **1990-92 300ZX** is located behind center console and the TCU on the **1993 300ZX** is located under the passenger side floorboard. See figure 4A for the pin locations of the input and ouput components.



Viewed from wire harness side

PIN NUMBER	PIN DESCRIPTION	VALUE
1	LINE PRESSURE SOLENOID	AT IDLE 1.5-2.5V / AT WOT .5V OR LESS
2	LINE PRESSURE SOLENOID W/RESISTOR	AT IDLE 5-14V / AT WOT .5V OR LESS
3	A/T CHECK LAMP	BATTERY VOLTAGE WHEN ON
4 & 9	POWER SOURCE	12V WHEN IGNITION SWITCH IS ON
5	LOCK-UP SOLENOID	BATTERY VOLTAGE IN 1st & 4th
6	SHIFT SOLENOID "A"	BATTERY VOLTAGE IN 3rd & 4th
7	SHIFT SOLENOID "B"	1V OR LESS WITH SOLENOID OFF
8	OVERRUN CLUTCH SOLENOID	BATTERY VOLTAGE IGNITION ON
10	ECCS CONTROL UNIT	CLOSED THROTTLE 8-15V WOT TV
14	GROUND	.2V OR LESS
15 & 48	INHIBITOR SWITCH "1"	BATTERY VOLTAGE IN "1"
16	INHIBITOR SWITCH "2"	BATTERY VOLTAGE IN "2"
17	INHIBITOR SWITCH "D"	BATTERY VOLTAGE IN "D"
18	INHIBITOR SWITCH "N" OR "P"	BATTERY VOLTAGE IN "N"
19	INHIBITOR SWITCH "R"	BATTERY VOLTAGE IN "R"
20	FULL THROTTLE SWITCH	8-15V WITH ½ THROTTLE OR MORE
21	POWER SOURCE (BACK-UP)	BATTERY VOLTAGE AT ALL TIMES
23	ENGINE REVOLUTION SIGNAL	IDLE .9V / 3000 APPROX. 3.7V
24	REVOLUTION SENSOR	AT 19 MPH 1V A/C OR MORE
25	VEHICLE SPEED SENSOR	AT 1-2 MPH FOR 3 FEET 0-5V
27	THROTTLE POSITION SENSOR	POWER SUPPLY 5V
31	A/T FLUID TEMP. SENSOR	AT 68°F 1.5V / AT A76°F 0.5V
33	THROTTLE POSITION SENSOR	IDLE 0.5V / WOT 4V
34	THROTTLE POSITION SENSOR	GROUND 0.2V OR LESS
35	CRUISE CONTROL	BATTERY VOLTAGE WITH CRUISE ON
39	OVERDRIVE SWITCH	BATTERY VOLTAGE WITH OD ON
40	ASCD OD CUT SIGNAL	5-8 V WHEN RELEASING "ACCEL"
41	KICKDOWN SWITCH	3-8V GAS PEDAL RELEASED

Figure 4a

INTERNAL TRANSMISSION CONTROLS

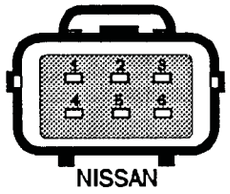
The Shift Solenoids and the Overrun Solenoid are mounted on the valve body. They are normally open when off and drain line pressure from the shift valves or control valve. When they are energized, they close and allow line pressure to stroke their respective valve. The sequence in which they are energized determines which gear is selected. Figure 6 describes the proper shift solenoid pattern and may be used as a guide for testing the transmission independently from the controller.

The **Line Pressure Solenoid** is mounted on the valve body. It is operated by a pulse signal from the controller and this varied pulse or duty cycle controls pressure. These timed pulses translates to from .5 to 5.5 volts after the signal goes through the dropping resistor. There should never be full battery voltage to the line pressure solenoid.

The **Lock-up Solenoid** is mounted on the valve body. It is normally closed when off and blocks the drain so that line pressure moves the lock-up control plug to the release position. When it is energized, it opens and drains pressure from the control plug.

The **TOT (Transmission Oil Temp.) Sensor** is located on the valve body but uses a separate wire harness. The wires in the separate connector are black and white. This sensor is normally open. It only closes if the oil temperature exceeds 300°F.

When it is necessary to test or energize the solenoids use Figure 6 for **Nissan** and figure 7 for **Mazda** to identify the proper pin location. Ohms test may also be found in Figures 6 and 7. Check with harness disconnected.



NISSAN

Pin	Description	Wire Color
1	Not Used.	
2	Shift Solenoid B.	Yellow
3	Line Pressure Solenoid.	Red
4	Shift Solenoid A.	Green
5	Overrun Solenoid.	Gray or Tan
6	Lock-up Solenoid.	Blue

PIN SIDE OF TERMINAL CONNECTOR GOING TO THE TRANSMISSION.

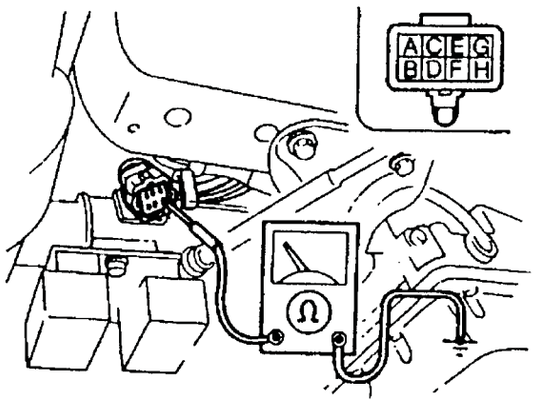
GEAR	SOLENOID A	SOLENOID B	LOCK-UP SOLENOID	OVERRUN SOLENOID	PRESSURE SOLENOID
1st	ON	ON	OFF	ACTIVATES UPON VARIOUS THRROTTLE OPENONGS	PULSE MODULATION CONTROLLED BY COMPUTER
2nd	OFF	ON	OFF		
3rd	OFF	OFF	OFF		
4th	ON	OFF	ON		
OHMS	20 - 30	20 - 30	10 - 16	20 - 30	2.5 - 5

Figure 6

The **Dropping Resistor** is under the hood near the air cleaner . Its purpose is to fine tune the voltage signal to the line pressure solenoid according to temperature. It is identified in figure 9.

MAZDA TRANSMISSION CONNECTORS

The **Mazda MPV** van also uses the RE4RO1A Transmission, but the connectors at the transmission are different. The Solenoid Wire Connector that comes from the transmission has 8 pins. The connector pins are identified in figure 7. The correct ohms check readings are also given below. These readings are taken with the connector disconnected and checked between the appropriate pin and ground.

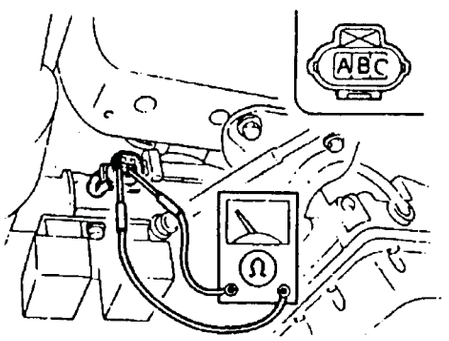


Note
- **Terminal A : ATF thermoswitch.**
- **Terminal G, H: ATF thermosensor.**

Terminal	Connected to	Resistance
B	Shift solenoid A	20—40Ω
C	Shift solenoid B	20—40Ω
D	Overrunning clutch solenoid	20—40Ω
E	Line pressure solenoid	2.5— 5Ω
F	Lockup solenoid	10—20Ω

Figure 7.

The **Speed Sensor** is also different on the Mazda transmission. It can be checcked with an ohmeter as shown in Figure 8.



Terminal	Resistance
A and B	504—616Ω
B and C	∞
A and C	∞

Figure 8.

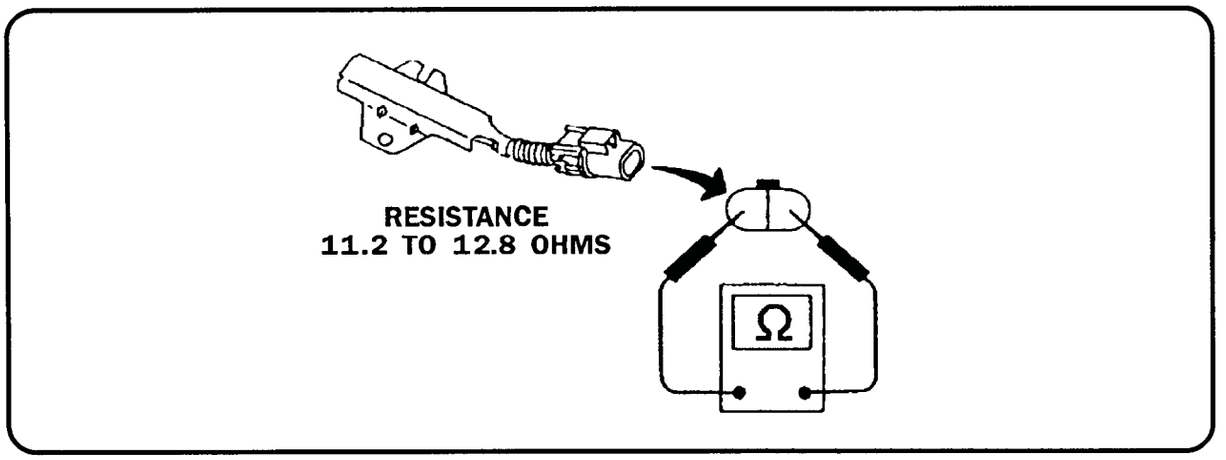


Figure 9

The **Inhibitor Switch** is located on the transmission manual lever shaft and tells the controller which range is selected. See figure 10 for switch terminal identification and continuity testing.

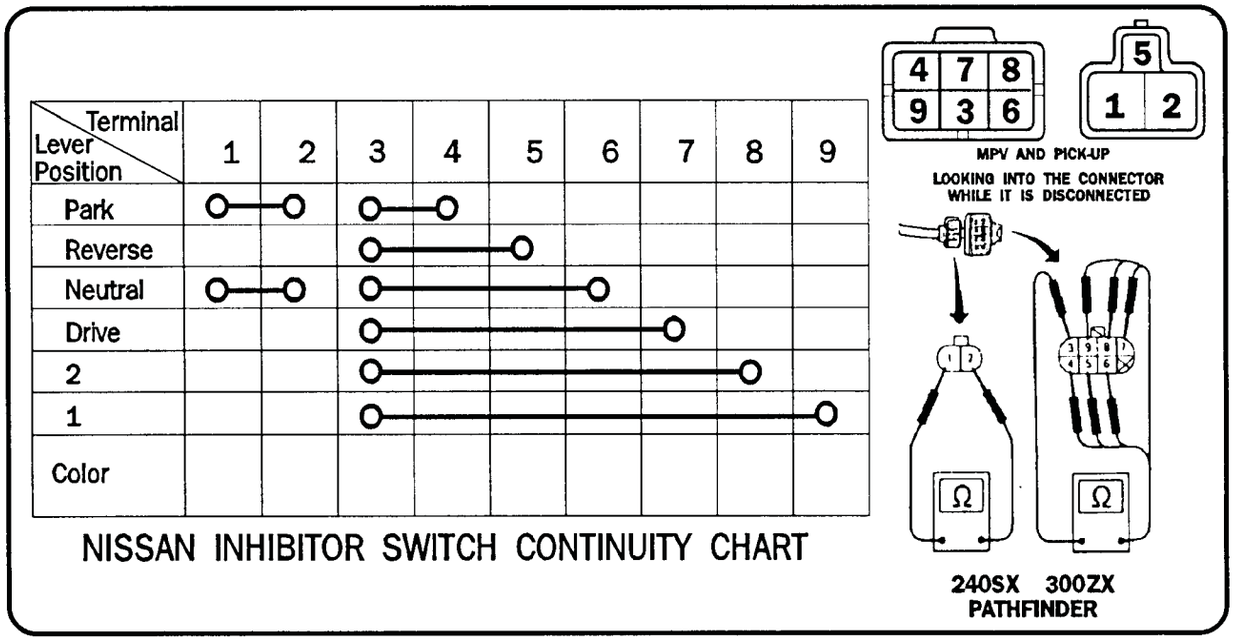


Figure 10

The **Fail Safe** or non-electrical mode provides for only two gear ranges. These are first and third ranges. If no signal comes from the controller, the transmission will start and stay in third gear unless the gear shift lever is placed into the 1 position. In the 1 position first gear is selected regardless of vehicle speed.

Individual pin point tests are often necessary to isolate electrical problems and test sensors. For quick tests check either the controller or the terminal connectors for the proper ohms or voltage readings.

PINPOINT TEST PROCEDURES

Throttle Position Sensor: Key on, engine off should be .2 to .6 volts with closed throttle. Voltage should gradually rise to 2.9 to 3.9 volts as throttle is fully opened. Test between pins 11 and 15.

Revolution Sensor: Engine running should be 0 A.C.volts with the wheels stopped and should gradually rise to about 1 volt or more at 19 M.P.H. Test between pin 16 and ground.

Speed Sensor: Engine running the voltage should vary from 0 to 5 volts as the wheels rotate slowly. Test Between pin 24 and ground .

Shift Solenoids and Overrun Solenoid : Key off ohms should be 20-30 between ground and respective pins. See figures 5 or 6.

Lock-up Solenoid: Key off ohms should be 10-16 between ground and respective pins. See figures 5 or 6.

Line Pressure Solenoid: Key off ohms should be 2.5-5 between ground and respective pins. See figures 5 or 6.

Inhibitor Switch: To test at the controller See Figure 4. To test at the switch connector use an ohmmeter to test for continuity .

PINPOINT TEST PROCEDURES

Throttle Position Sensor: Key on, engine off should be .2 to .6 volts with closed throttle. Voltage should gradually rise to. 2.9 to 3.9 volts as throttle is fully opened. Test between pins 11 and 15.

Revolution Sensor: Engine running should be 0 A.C.volts with the wheels stopped and should gradually rise to about 1 volt or more at 19 M.P.H. Test between pin 16 and ground.

Speed Sensor: Engine running the voltage should vary from 0 to 5 volts as the wheels rotate slowly. Test Between pin 24 and ground .

Shift Solenoids and Overrun Solenoid: Key off ohms should be 20-30 between ground and respective pins. See figures 5 or 6.

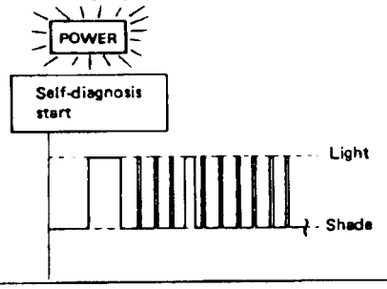
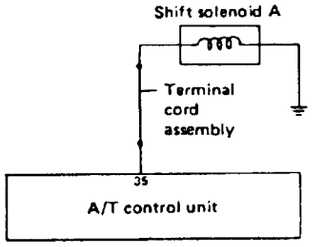
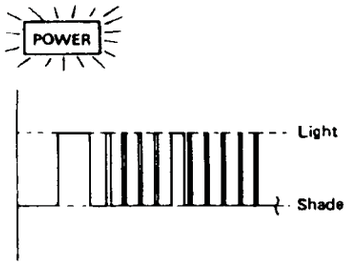
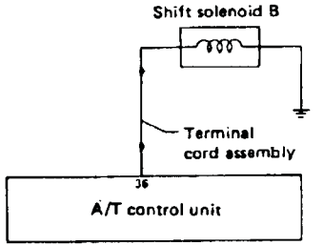
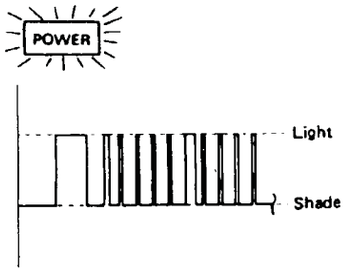
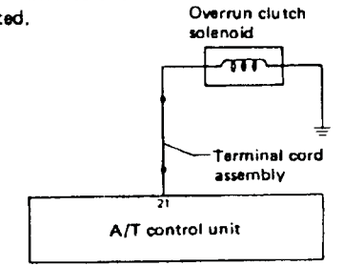
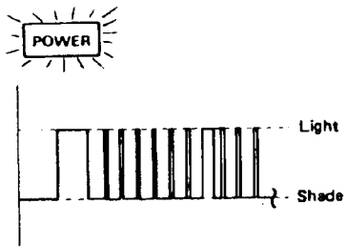
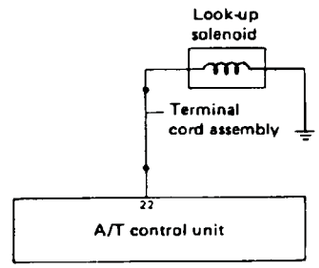
Lock-up Solenoid: Key off ohms should be 10-16 between ground and respective pins. See figures 5 or 6.

Line Pressure Solenoid: Key off ohms should be 2.5-5 between ground and respective pins. See figures 5 or 6.

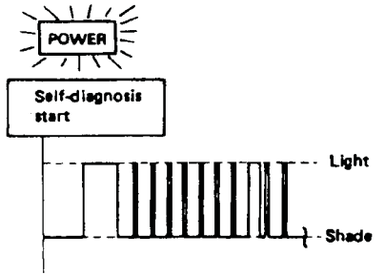
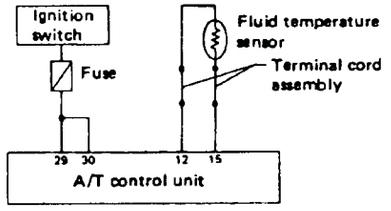
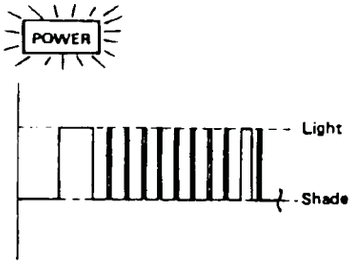
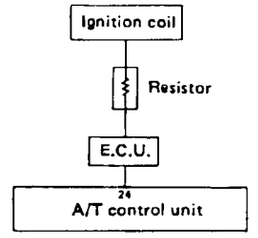
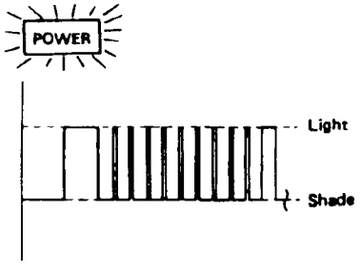
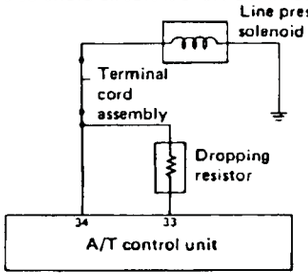
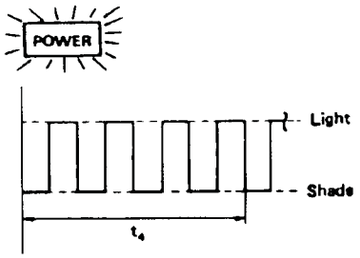
Inhibitor Switch: To test at the controller See Figure 4. To test at the switch connector use an ohmmeter to test for continuity .

EC-AT: The **EC-AT** unit in the **MPV** is locatid behind the instrument panel to the left of the steering column. The **EC-AT** in the **B2600I PICKUP** is located behind the drivers side kickpanel. Although the terminals and wiring are different in the **NISSAN**, their functions are very much the same.

TROUBLE CODE DESCRIPTION

Power shift indicator lamp:	Damaged circuit
4th judgement flicker is longer than others. 	Shift solenoid A circuit is short-circuited or disconnected.  ➡ CHECK SHIFT SOLENOID A CIRCUIT
5th judgement flicker is longer than others. 	Shift solenoid B circuit is short-circuited or disconnected.  ➡ CHECK SHIFT SOLENOID B CIRCUIT
6th judgement flicker is longer than others. 	Overrun clutch solenoid circuit is short-circuited or disconnected.  ➡ CHECK OVERRUN CLUTCH SOLENOID CIRCUIT
7th judgement flicker is longer than others. 	Lock-up solenoid circuit is short-circuited or disconnected.  ➡ CHECK LOCK-UP SOLENOID CIRCUIT

TROUBLE CODE DESCRIPTION

Power shift indicator lamp:	Damaged circuit
8th judgement flicker is longer than others. 	Fluid temperature sensor is disconnected or A/T control unit power source circuit is damaged.  ➡ CHECK FLUID TEMP SENSOR CIRCUIT AND A/T CONTROL UNIT POWER SOURCE CIRCUIT
9th judgement flicker is longer than others. 	Engine revolution signal circuit is short-circuited or disconnected.  ➡ CHECK ENGINE REVOLUTION SIGNAL CIRCUIT
10th judgement flicker is longer than others. 	Line pressure solenoid circuit is short-circuited or disconnected.  ➡ CHECK LINE PRESSURE SOLENOID CIRCUIT
Flickers as shown below. 	Battery power is low. Battery has been disconnected for a long time. Battery is connected conversely. (When reconnecting A/T control unit connectors. — This is not a problem.)

RENAULT COMPUTER DIAGNOSIS

The Renault MB and MJ Series transaxles have the same basic computer controls. The Tranaxle Computer receives basic inputs from the vehicle and in return controls starter relay functions, back-up lights, and the Solenoid Ball Valves for shift control. Although a diagnostic tester has been produced by AMC for this system, it is not readily available. Most tests of the electrical components can be easily accomplished with a volt/ohm meter. The Renault computer does not have built in diagnostic abilities and does not provide trouble codes. Should the computer system fail to energize the Ball Solenoids, this transmission will start and stay in 3rd gear in all forward ranges. Should the Ball Solenoids be installed backwards, the transmission will start in 2nd gear, shift to 3rd gear, and then shift back to 2nd gear. More about the Ball Solenoids will be presented later in this chapter.

COMPUTER

The Computer is located under the hood on the left side, either on the firewall or on the inner fender well. It is an electronic microprocessor that interprets information from the road speed sensor, the engine load potentiometer (TPS for those familiar with that term), and the multifunction switch. The Renault Computer's various inputs and outputs are shown in the overview in Figure 1.

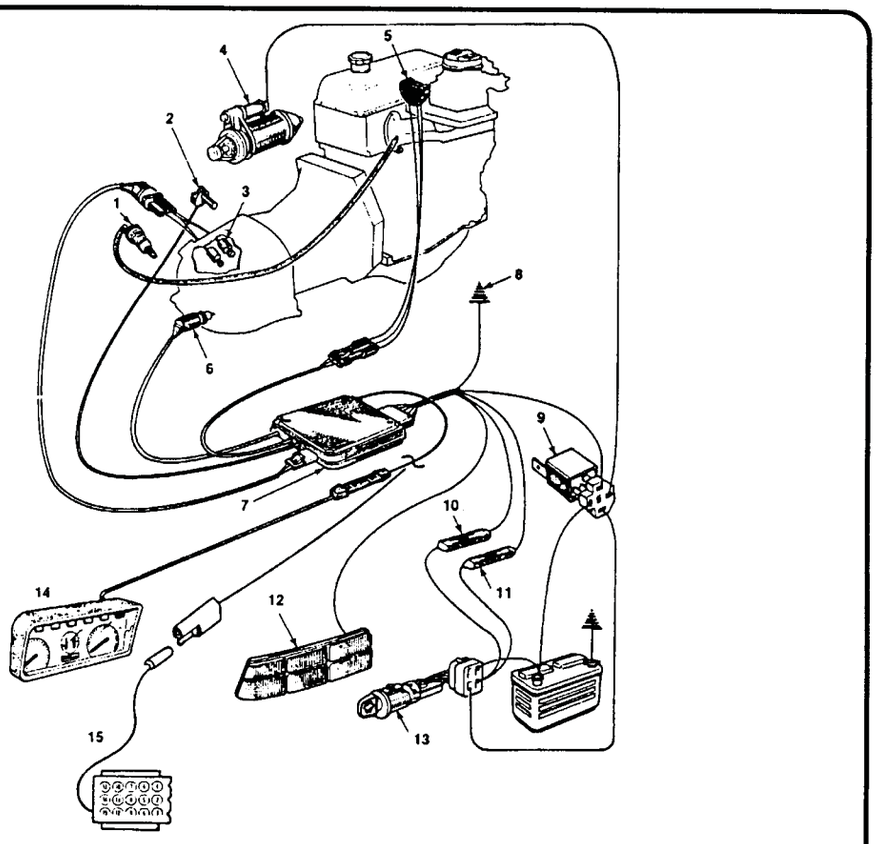
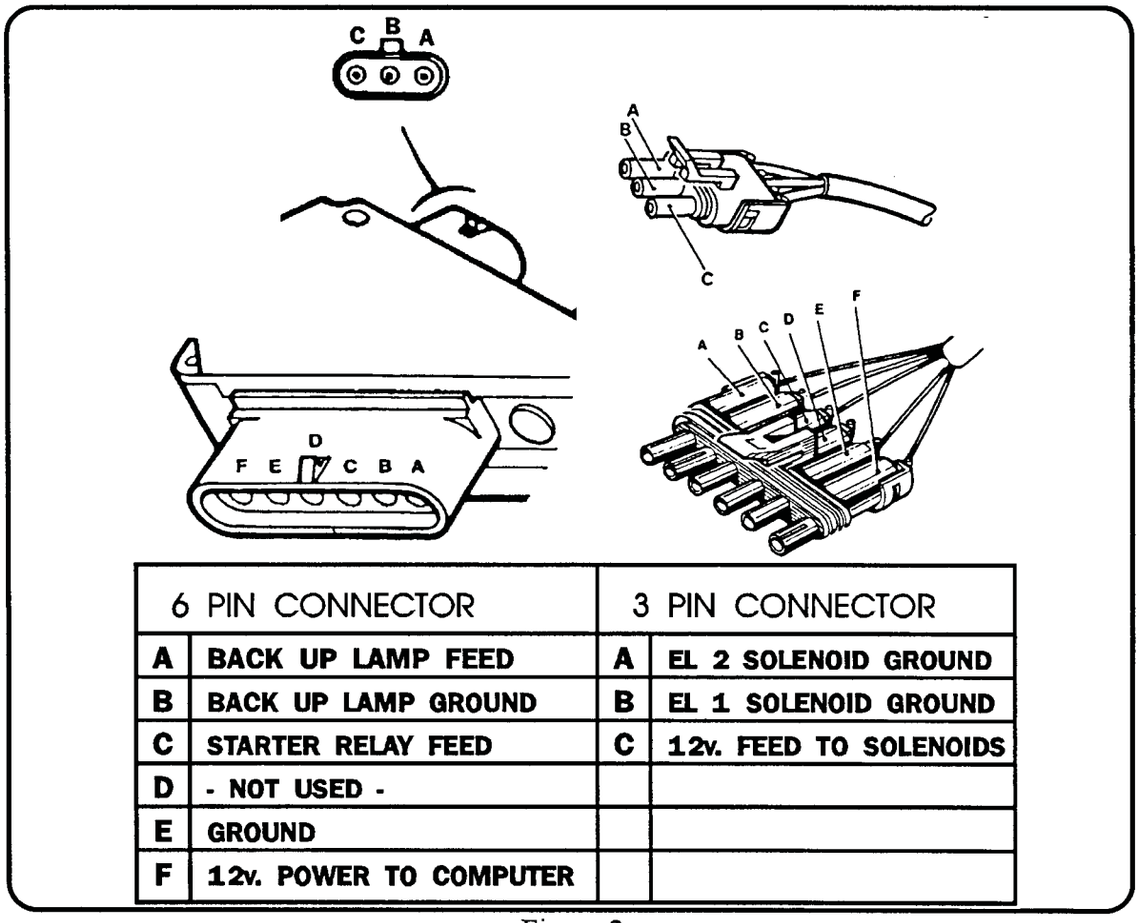


Figure 1.

There are two wire connectors that plug directly into the Renault Computer. One is a six pin connector and the other is a three pin connector. Figure 2 identifies these connectors as well as the function of each pin.

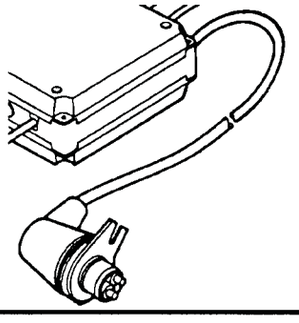


6 PIN CONNECTOR		3 PIN CONNECTOR	
A	BACK UP LAMP FEED	A	EL 2 SOLENOID GROUND
B	BACK UP LAMP GROUND	B	EL 1 SOLENOID GROUND
C	STARTER RELAY FEED	C	12v. FEED TO SOLENOIDS
D	- NOT USED -		
E	GROUND		
F	12v. POWER TO COMPUTER		

Figure 2.

COMPUTER INPUTS

The **Multifunction Switch** is mounted to the side of the transmission. It is connected directly to the Computer by an integrated wire harness. See Figure 3. Its function is to provide manual lever position information directly to the Computer. This information is used by the computer to turn on thr back up lights, trigger the starter relay for starting, and determine the forward range selected for shifting purposes



This Switch can be partially tested at the 6 pin connector on the Computer. If it is necessary to replace the Multifunction Switch, the wire harness must be cut and each wire must be spliced in individually.

Figure 3.

The **Engine Load Potentiometer** is mounted to the throttle plate lever of the carburator. It gets a voltage reference signal from the Computer and returns a voltage signal back that is in proportion to the throttle opening. It can be adjusted by loosening the two screws that hold it to the throttle body and rotating the potentiometer either direction to produce the correct effect. The Engine load Poentiometer can be checked using either a volt meter or an ohmmeter. To check it with an ohmmeter, unplug the potentiometer. Then check across C and B (See Figure 4). The correct reading should be **4KΩ ± 1**. Next check across A and B. The correct reading should be **2,5KΩ ± 1**. The potentiometer can also be tested with a voltmeter. Turn the ignition on, make sure that the potentiometer is plugged in, and check terminal B first, then C, then A. Terminal B should be a ground with no volt reading available. Terminal C (Yellow Wire) should have approximately **5** volts. Terminal A should show a variable voltage that is between approximately **.5** volt and **4.5** volts the goes up and down smootly with throttle opening.

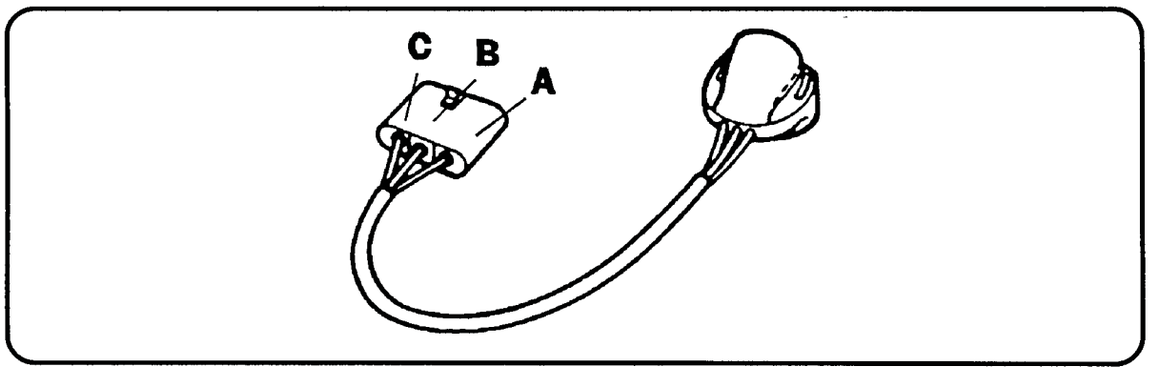


Figure 4.

The **Road Speed Sensor** is mounted to the transaxle and it senses vehicle speed by counting the magnetic pulses it receives as the park gear passes by it. The Road Speed Sensor harness is not detachable from the Computer. There is no way to test this sensor while it is connected to the solid state Computer. If the transmission starts in 1st gear but does no upshift at all, this sensor may be at fault. First be certain that the Engine Load Potentiometer is functioning correctly and that the Multifunction Switch is not loose or damaged. If there is still no upshift signal from the Computer, the Road Speed Sensor is the Probable cause. To replace this sensor, the wires must be cut and the new sensor spliced in. The Road Speed Sensor is identified in figure 5.

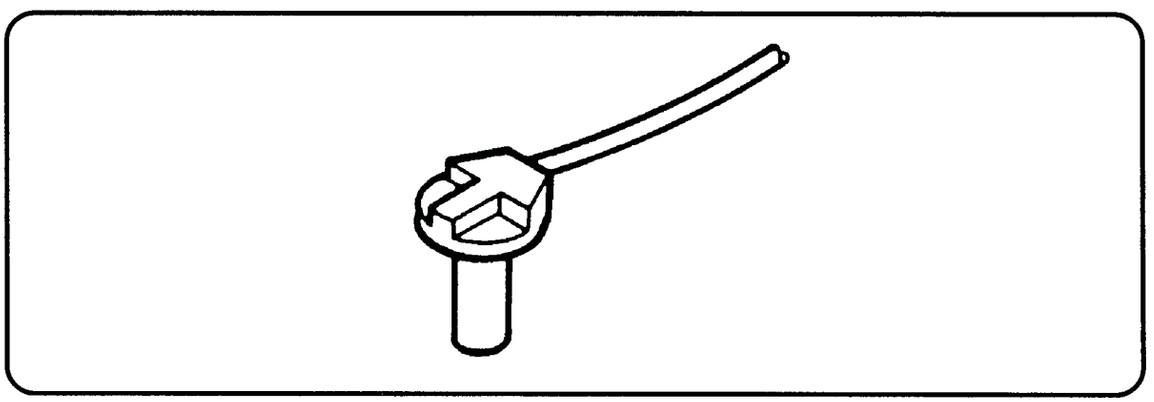


Figure 5.

COMPUTER OUTPUTS

Solenoid Valve "A" (EL2) and **Solenoid Valve "B" (EL1)** are mounted to the side of the valve body and are turned on and off in the proper sequence to achieve three forward ranges. Both solenoids are normally open and they close when they are energized. The Solenoid Valve shift

MB1-MJ3

WIRE COLOR	BLACK	RED	YELLOW
GEAR	SOLENOID A	SOLENOID B	12 VOLT SIGNAL
1st	ON	OFF	ALWAYS ON
2nd	ON	ON	
3rd	OFF	OFF	
OHMS	20 - 40	20 - 40	--

Figure 6.

schedule, along with wire color and ohms check information is shown in figure 6.

Because of the design of these solenoids, it is posible to easily install them on the valve body backwards. They connect to the case connector with a three pin plug as shown in figure 7. Both solenoids have a common wire that connects to the "C" terminal. Solenoid EL1 must connect to the "B" terminal and Solenoid EL2 must connect to the "A" terminal. If the solenoids are installed backwards, this transaxle will start in 2nd gear and shift to 3rd gear.

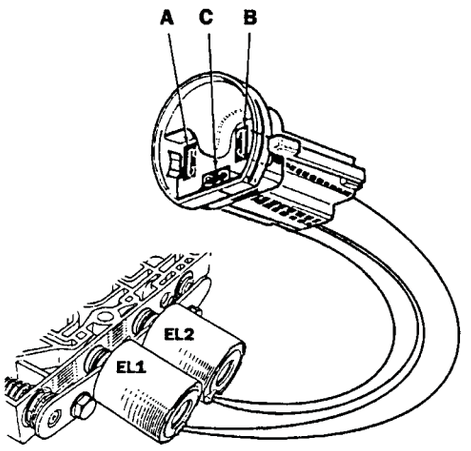


Figure 7.

Subaru Justy ECVT Diagnosis

The Justy ECVT transmission is electrically as well as hydraulically controlled. The ECVT computer senses inputs from the brake pedal, accelerator pedal, speed sensor, and engine signals. Voltage from the ECVT Computer to the pressure control solenoid assists the pressure regulator to fine tune the pulley ratio. The ECVT computer also feeds the signal to energize the Electromatic Powder Clutch. See figure 1 for an overview of the ECVT system.

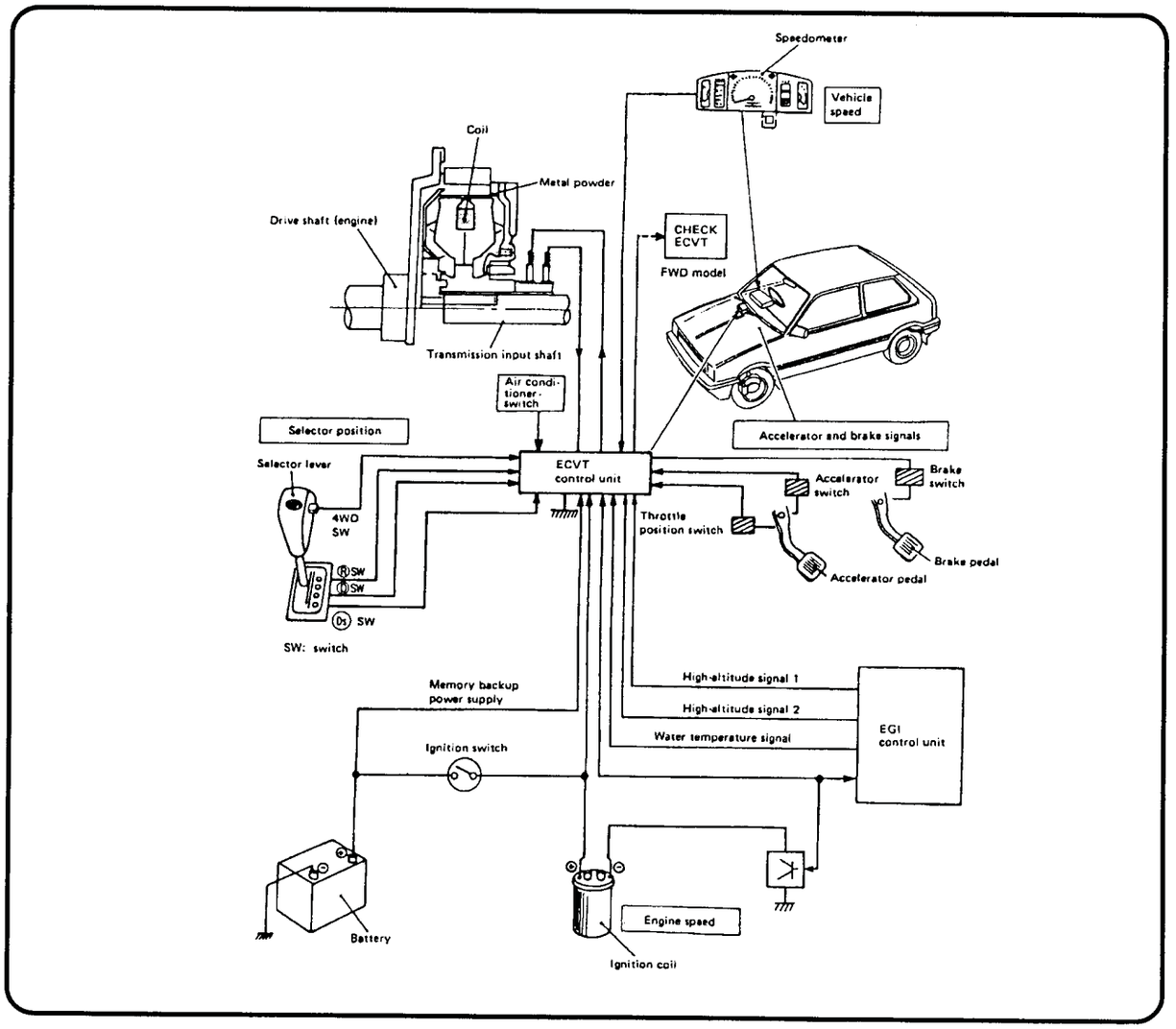


Figure 1.

The ECVT Control Unit does have self-diagnostic capabilities. When a problem occurs in the ECVT, the "CHECK ECVT" light will illuminate. Normally this light goes out after the engine is started. To retrieve trouble codes when there is a problem, connect the "check mode" connector (See Figure 2). Long flashes(1.2 sec.) indicate the first digit of the trouble code and short flashes(0.2sec.)indicate the second digit. There is a 2 second pause between codes. To erase trouble codes after repairs have been made, disconnect the memory back-up connector for about 1 minute. Refer to **Page 102** of this book for trouble code translations.

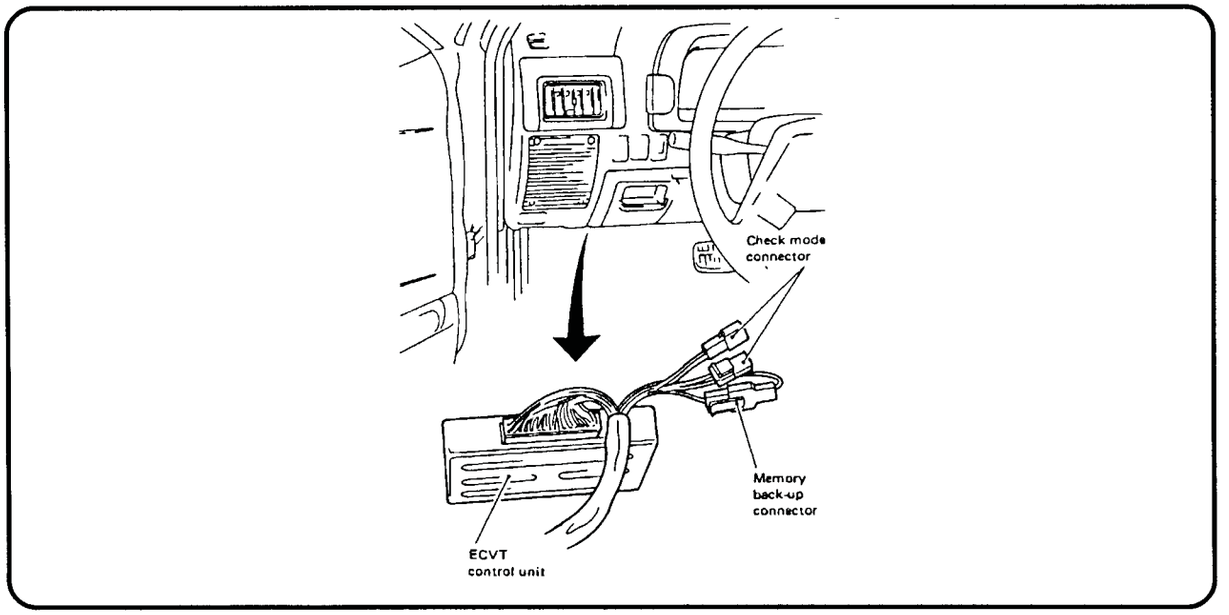


Figure 2.

Because this transmission works so differently from conventional automatic transmissions, care must be taken not to confuse electrical problems with hydraulic problems. The connection between the engine and transmission is done electrically.

The ECVT uses an **Electromatic Powder Clutch**. The Electromatic Powder Clutch, requires electrical current to maintain a connection between the engine and the transmission. Forward and reverse range are mechanically achieved using a shift lever and a fork. Unless the powder clutch is electrically disengaged, manual shifting will be very difficult if not impossible. According to vehicle conditions, the Electromatic Powder Clutch operates in one of five modes. The ECVT Control unit can send no current, low amperage current, higher amperage currents, or even reverse current for maximum release of the Powder Clutch. See figure 3 for normal Electromatic Powder Clutch output modes.

SHIFT POSITION	VEHICLE SPEED / ACCELERATOR	5 MPH →	7 MPH →	12 MPH →	14 MPH →	22 MPH →
N, P RANGE	———	REVERSE EXCITATION MODE				
D RANGE	RELEASED	DRAG MODE APPROX. .2 AMPS	ZERO MODE (NO CURRENT)			
Ds, R RANGE	RELEASED	DRAG MODE APPROX. .2 AMPS		DIRECT COUPLING MODE (APPROX 3.5 AMPS)		
D RANGE	PRESSED	STARTING MODE (APPROX. .4 - 1.8 AMPS)				
Ds, R RANGE	PRESSED	STARTING MODE (APPROX. .4 - 1.8 AMPS)				

Figure 3.

A fail-safe function is also provided to engage the Powder Clutch if sensor trouble occurs. When sensors fail to provide proper input to the ECVT Control Unit, The Electromatic Powder Clutch is energized at 1000-1200 RPM"s by the Fail-safe system.

The **Brush Holder** is located under the starter and it provides the electrical connection to the Electromatic Powder Clutch. It must be inspected periodically for wear. The starter must be removed in order to check the brush holder. Oil or dirt on the tip of the brushes will affect current to the Powder Clutch. Handle the Brush Holder as carefully as possible. See figure 4 for Brush Holder wear information.

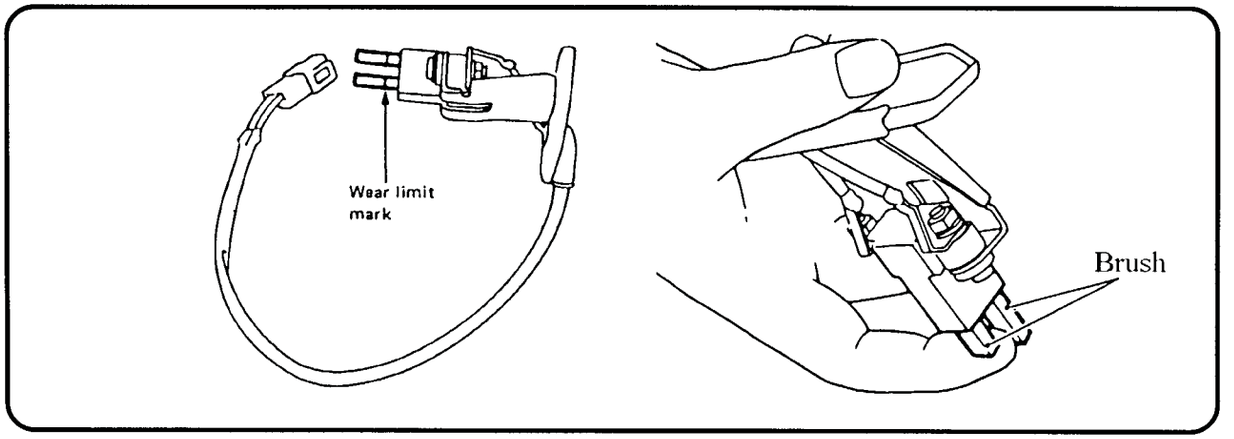


Figure 4.

The **Accelerator Switch** is a microswitch attached to the accelerator pedal. When starting, it is turned on to complete a ground circuit to the ECVT Control Unit. The control unit will then turn on current to the Electromatic Powder Clutch. When stopping, this signal is also used with the vehicle speed pulse to prevent engine stalling. See figure 4 for adjustment information.

The **Throttle Position Switch** senses when the accelerator pedal is pushed to a predetermined point. This switch completes a ground circuit to the ECVT Control Unit. The control unit will then supply the current required to directly couple the Electromatic Powder Clutch. See figure 5 for adjustment information.

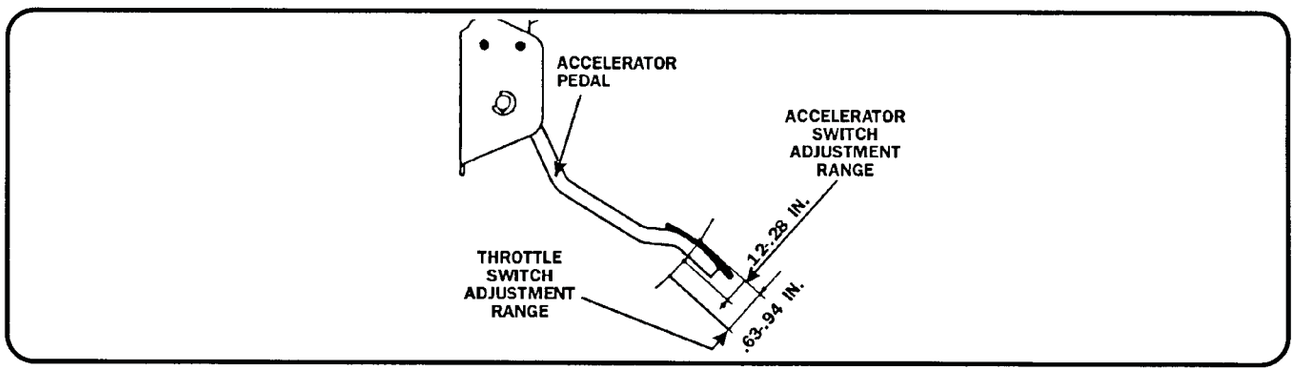


Figure 5.

The **Vehicle Speed Pulse** is a reed switch built into the speedometer. It is used by the ECVT Control unit to sense vehicle speed and send a proportional clutch current according to engine speed.

The **Water Temperature Switch** is on the engine. When it senses a cold engine, the ECVT Control Unit changes the clutch current characteristic so that the stall point is higher. This raises the point at which the clutch is directly coupled.

Other signal to the ECVT Controller are the **High Altitude Signals** (1 and 2) and the **Air Conditioner Signal**. Electromatic Powder Clutch current is tailored to accommodate these various conditions.

The **Inhibitor Switch** is mounted at the selector lever at the floor. Besides preventing the engine from being started in any range other than park or neutral, it sends lever position information to the ECVT Control Unit. This information affects the Electromatic Powder Clutch energization modes. Wire terminal identification may be found in figure 6.

TERMINAL NO.	P	R	N	D	Ds
1	●	●	●	●	●
2	●				
3		●			
4			●		
5				●	
6					●
7	●		●		
8	●		●		
9		●			
10		●			

1	2	3	4	5
6	7	8	9	10

Figure 6.

The **Line Pressure Solenoid** is located on the valve body. The ECVT Controller uses information from the Speed Pulser, Brake switch, Accelerator Switch, and the Throttle Switch to determine when the solenoid should be turned on. With voltage to the Line Pressure Solenoid, the pressure is reduced. This pressure control facilitates smooth response of the ratio pulleys when stopping and starting. When the solenoid is energized (on), line pressure travels through the solenoid to the pressure regulator valve. This helps to reduce line pressure. When the solenoid is off, the chamber to the pressure regulator is shut off and the pressure going to the solenoid is exhausted through the solenoid exhaust port. This system is shown in figure 7.

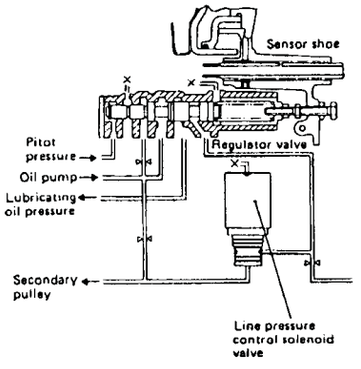


Figure 7.

The **ECVT Control Unit** is mounted under the dash on the left side. See figure 1 on the first page of this section for the exact location of the controller. It is an 8-bit 16K byte microcomputer. figure 8 identifies the control unit connector and pin usage.

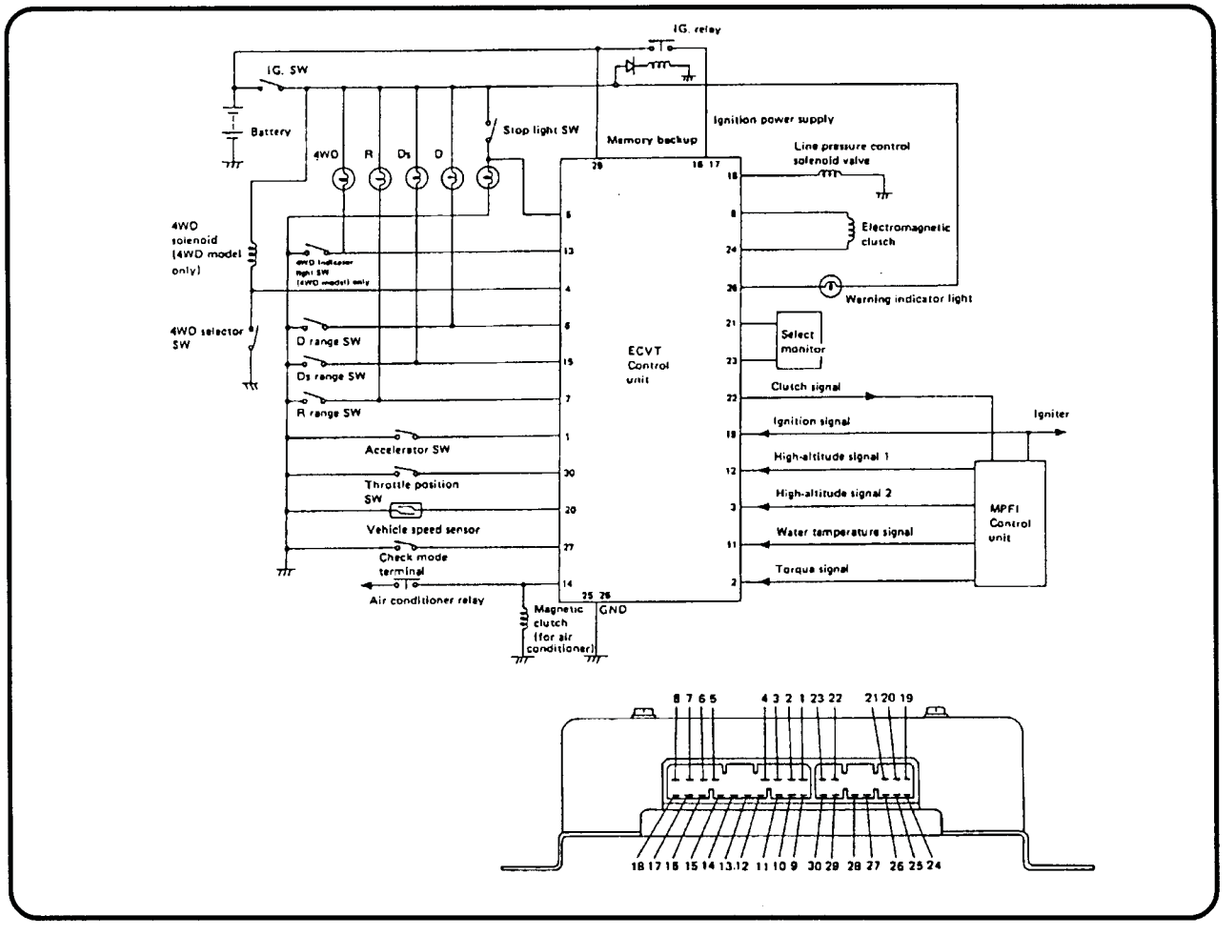


Figure 8.

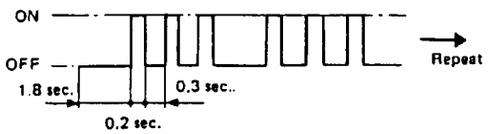
JUSTY TROUBLE CODES

Mode	CHECK ECVT warning indicator light				CHECK MODE connector	MEMORY BACK-UP connector
	Normal condition		Abnormal condition			
	Ignition switch "ON"	After engine starts	Ignition switch "ON"	After engine starts		
U-check	Remains "ON"	OFF	Remains "ON"	Remains "ON"	Disconnect at all times	Connect at all times
Read memory	Same as above	Emits vehicle and OK codes	Same as above	*Emits vehicle and trouble codes	Connect	Same as above
D-check	Same as above	Same as above	Same as above		Same as above	Same as above
(Clear memory)	—	—	—	—	Disconnect at all times	Disconnect for at least one minute before reconnecting

*Remains "ON" when ignition signal system is in trouble.

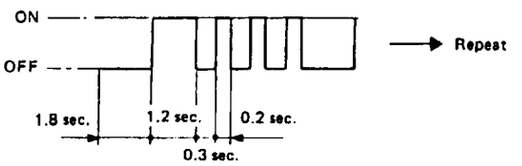
Example of code display

- **Vehicle code (Vehicle type identification code)**

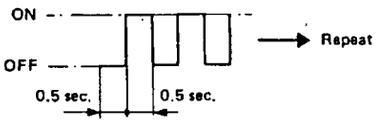


- **Trouble code**

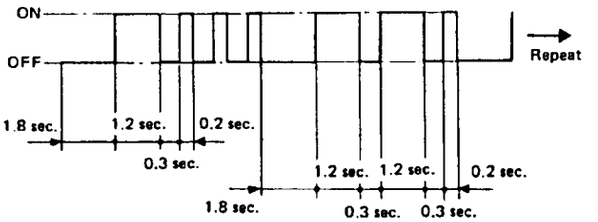
When one part becomes inoperative:
e.g.: Trouble code "13"



- **OK code**



When two or more parts become inoperative:
e.g.: Trouble codes "13" and "21"



JUSTY TROUBLE CODES

Trouble code (Blinks)	System in trouble	Probable cause	Parts to check
13	D-range switch signal system	D-range switch signal circuit open or shorted.	① Wire harness and connector ② D-range inhibitor switch ③ Control unit
14	Ds-range switch signal system	Ds-range switch signal circuit open or shorted.	① Wire harness and connector ② Ds-range inhibitor switch ③ Control unit
15	R-range switch signal system	R-range switch signal circuit open or shorted.	① Wire harness and connector ② R-range inhibitor switch ③ Control unit
21 (*1)	Torque signal system	Torque signal remains "ON" or "OFF".	① Wire harness and connector ② Control unit ③ EFC control unit
22	Water temperature signal system	Signal remains "ON" or "OFF".	① Wire harness and connector ② Control unit ③ EFC control unit
25	Slow cut solenoid system	Slow cut output circuit open or shorted.	① Wire harness and connector ② Slow cut solenoid ③ Control unit
31	Accelerator switch signal system	Accelerator switch signal circuit open or shorted.	① Wire harness and connector ② Accelerator switch ③ Control unit
32	Throttle position signal system	Throttle position signal circuit open or shorted.	① Wire harness and connector ② Throttle position switch ③ Control unit
33	Vehicle speed signal system	Vehicle speed signal not entered.	① Wire harness and connector ② Speedometer cable ③ Vehicle speed switch ④ Control unit
34	Clutch coil system	Current control does not occur for at least 3 seconds during standing start.	① Wire harness and connector ② Brush holder ③ Clutch ④ Control unit
35	Line pressure solenoid system	Line pressure solenoid output circuit open or shorted.	① Wire harness and connector ② Line pressure solenoid ③ Control unit
41	High altitude signal 1	High altitude signal 1 remains "ON" or "OFF".	① Wire harness and connector ② Control unit ③ EFC control unit
42	High altitude signal 2	High altitude signal 2 remains "ON" or "OFF".	① Wire harness and connector ② Control unit ③ EFC control unit
Trouble code (Blinks)	System in trouble	Probable cause	Parts to check
45 (*2)	Brake switch signal system	Brake signal switch circuit open or shorted.	1 Wire harness and connector 2 Brake switch 3 Control unit

METER SYMBOLS

mV = MILLI VOLTS

V = VOLTS

mA = MILLI AMPS

A = AMPS

Ω = OHM

Ω m = MILLI OHMS

Ω k = KILO OHMS

V = AC VOLTS

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