

Technical Seminar

Electronics

41TE (A604)

4L60-E

E40D

4L30-E

KM175

ZF

Mazda



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1997 Technical Seminar



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Table of Contents

Electronics

Check the Basic Electrical System—Battery Voltage.....	3
Battery Drain Test.....	4
Accessory Ground.....	5
Battery Cranking Voltage.....	6
Engine Ground.....	7
Charging Voltage.....	8
Diagnostic Trouble Codes.....	9
Throttle Position Sensors.....	10
Manual Lever Position Sensors.....	11
Pressure Switch Manifold.....	12
Speed Sensors.....	13
Temperature Sensors.....	14
Pressure Control Solenoids—The Basics.....	15
Force Motors and PWM Solenoids.....	16
Force Motors.....	17
Pressure Control Solenoids—Testing.....	18
Shift Solenoids.....	19
Testing a Shift Solenoid.....	20

41TE (A604)

Pressures and Pressure taps.....	25
Clutch Application Chart.....	25
Solenoid Patterns.....	25
Failsafe Mode.....	25
Gear Ratio.....	25
Checkball Locations.....	26
Transaxle Controllers.....	27
Flashable Controllers.....	28
Controllers Requiring Modification.....	29
Optional Modification.....	30
Electronic Pinion Factor.....	31
Neutral Safety and PRNODL Switch Check.....	32
Neutral Safety Switch Malfunction.....	34
NEW Transmission Range Sensor.....	35
NEW Autostick.....	37
Speed Sensing Problems.....	38
Solenoid Testing.....	40
Harness Repairs.....	42
Clutch Chatter.....	44
Cooler System and Bypass.....	45
Snap Ring Chart.....	46
UD/OD Pressure Plate.....	47

Table of Contents

4L60-E

Pressures and Pressure Taps.....	51
Clutch and Band Application	51
Solenoid Patterns	51
Failsafe Mode.....	51
Gear Ratios	51
Checkball Locations	52
Wrong Gear Starts	53
No 4th Gear.....	53
Valve Body Bolt Reference	54
Transmission Wiring Harness	55
The Major Electrical Components	56
Stack Shifts	57
DTC 16 or 72.....	58
Pump Changes.....	61
1996 Updates	63
1997 Updates	67

E4OD

Pressures and Pressure Taps.....	75
Clutch and Band Application	75
Solenoid Patterns	75
Failsafe Mode.....	75
Gear Ratios	75
Checkballs.....	76
How to Diagnose Stubborn Codes.....	79
TPS and FIPL Codes	80
MLPS Codes	81
Solenoid Codes.....	82
VSS and PSOM Codes	83

4L30-E

Clutch and Band Application	87
Checkball Location	88
Solenoid Pattern.....	89
Electrical Connectors	89
Code 32 Force Motor Low Voltage.....	90
Code 33 Force Motor High Voltage.....	92
Delayed Forward Engagement.....	94

Table of Contents

KM175

Clutch and Band Application	97
Gear Ratios	97
Failsafe Mode	97
Pressures and Pressure Taps	98
Adjusting Pressure	103
Checkball Locations	104
TCC Solenoid Change	105
Planet Failure	106
Third Gear Starts	107
End Clutch Drum Change	108
3-4 Shift Neutrals Out	109
Mainshaft Change	111
Harsh Coast Down Shifts	112
Third and Reverse Only	113
Delayed Forward Engagement	114
No Movement	115
2-3 Flare	116
No Forward	117

ZF

Identification	120
Clutch and Band Application	121
Gear Ratios	121
Orifice Placement	122
Hydraulic Schematic	123
Valve Descriptions	123
Orifice Location and Size	126
Valve Positions	128
Sprag Rotation	130
Cooling System	131
No Forward When Hot	132
Band Adjustment	133
Slips Forward	134
Slips on 2-3	134
Pressure Taps	135
Governor Distributor & Sleeve	136

Table of Contents

Mazda

Description	138
Clutch and Band Application	139
Pressure and Pressure Taps.....	139
Gear Ratios	139
Fail Safe Mode	139
Solenoid Pattern.....	139
Checkballs.....	140
Valves and Springs	144
Valve Body Bolts	146
Signal Monitor	147
Diagnostic Trouble Codes.....	148
Terminology.....	150
Inhibitor Switch.....	151
TPS/Idle Switch.....	152
Pulse Generator	153
Temperature Sensor	155
Solenoids.....	156
Brake Switch	158
Computer Location.....	159
Pinout Charts.....	160

Electronics

Check the Basic Electrical System—Battery Voltage.....	3
Battery Drain Test	4
Accessory Ground.....	5
Battery Cranking Voltage	6
Engine Ground	7
Charging Voltage	8
Diagnostic Trouble Codes.....	9
Throttle Position Sensors	10
Manual Lever Position Sensors	11
Pressure Switch Manifold.....	12
Speed Sensors.....	13
Temperature Sensors	14
Pressure Control Solenoids—The Basics	15
Force Motors and PWM Solenoids	16
Force Motors	17
Pressure Control Solenoids—Testing	18
Shift Solenoids	19
Testing a Shift Solenoid	20

Electronics

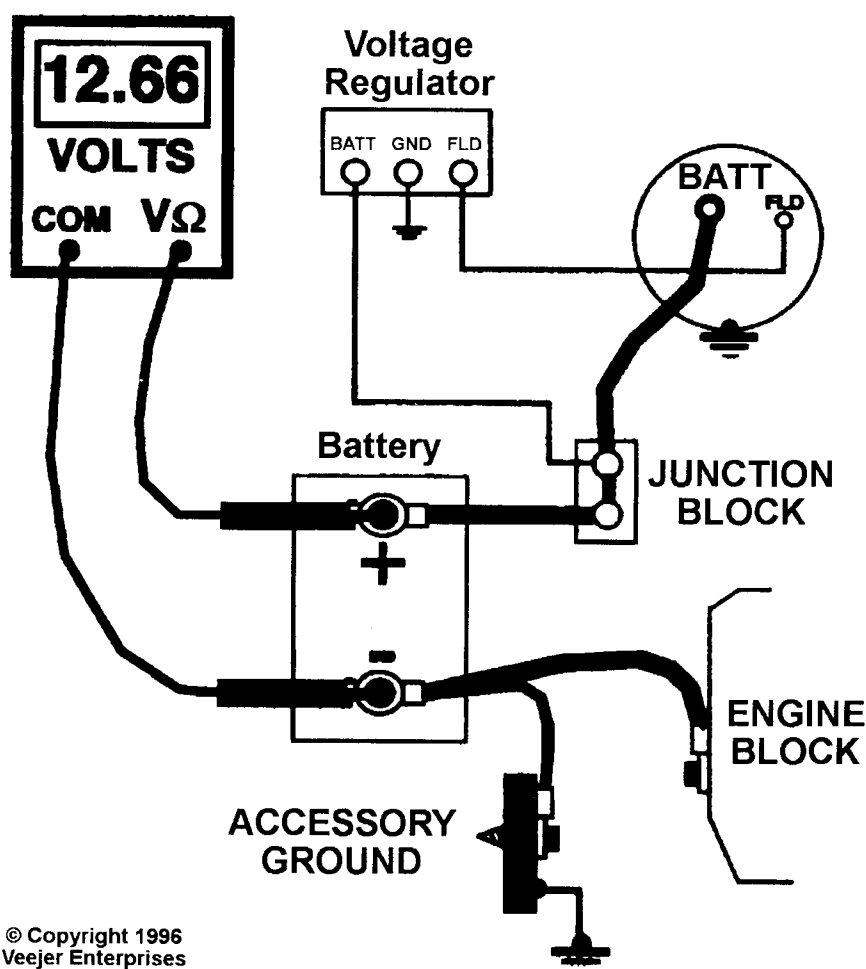


Check the State of the Basic Electrical System

This is as important to the proper function of the on board computer(s) as checking the fluid level of the transmission is to the transmission. If any problems appear in the basic electrical system, some if not all of the individual systems may not work properly. To properly check-out the basic electrical system do the following:

Battery Voltage

Measure battery voltage with a DVOM at the posts first, then the cables. The voltage should be between 12.45v and 12.66v at both the posts and the cables. If the voltages are different, you more than likely have a poor connection at the cables. Clean the cables and re-test.



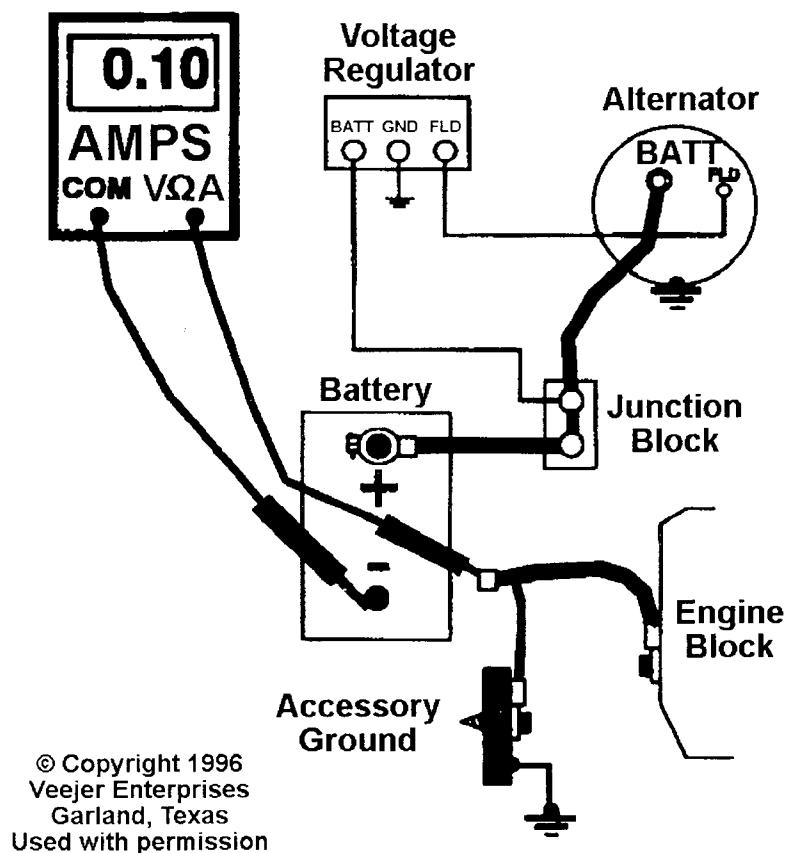
Battery Voltage	State of Charge
12.66	100%
12.45	75%
12.24	50%
12.06	25%
11.89	Discharge

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If battery voltage is low, try recharging the battery, then perform a battery drain test with the key off.

Battery Drain Test

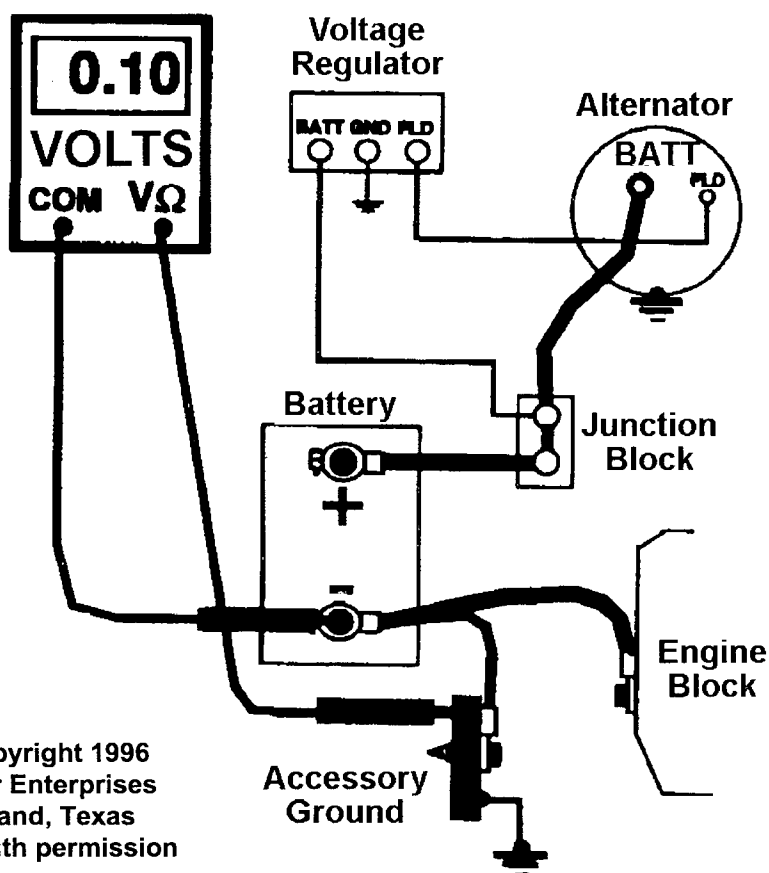
- To perform this test make sure the ignition key is off. Turn off all accessories.
- Remove the negative battery cable.
- Connect the red lead of an ammeter to the removed cable.
- Connect the black lead to the negative battery post.
- Read the current draw in milliamps. It should be no more than 60 milliamps. Any more than 100 milliamps constitutes a serious draw.
- If the current draw is too large, further tests to determine the source of the current draw will be needed.



- If the battery current draw is acceptable, measure the specific gravity of all six battery cells. If the battery is a sealed battery, this test cannot be performed.

Measure the Accessory Ground Voltage Drop

- Place the negative test lead on the battery negative post.
- Place the positive test lead on the vehicles accessory ground.
- Turn on the ignition (do not start engine)
- Turn on the high beam headlights, a/c or heater blower motor on high, electrical windshield wipers, and the radio.

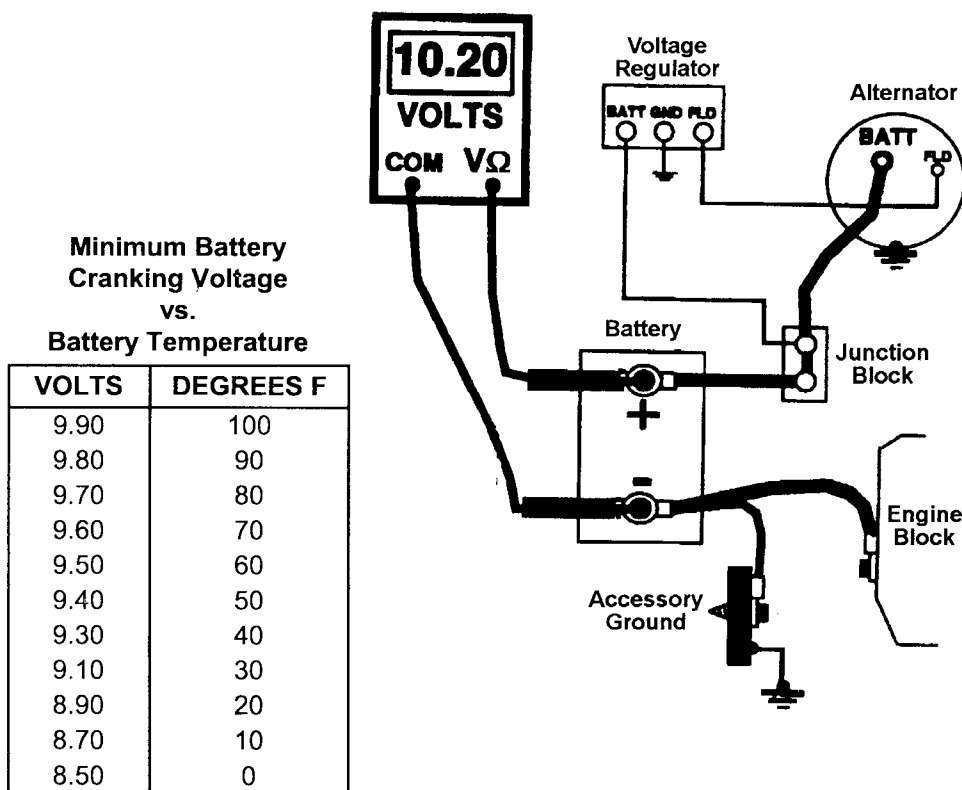


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- The voltage drop should be no more than .1v. Anything more indicates corrosion or poor connections in the accessory ground. Anything more than .3v is not acceptable. Cleaning or replacement of the accessory ground cable should reduce the voltage drop.
- When finished with this test, turn all electrical loads off.

Measure the Battery Post Cranking Voltage

- Connect the test leads of the DVOM to the battery posts, and crank the engine. Do not start the engine. Installing a spark plug on the ignition coil wire and grounding the plug to the engine is recommended: Failure to do so can damage the ignition module.
- The battery voltage will drop during cranking.



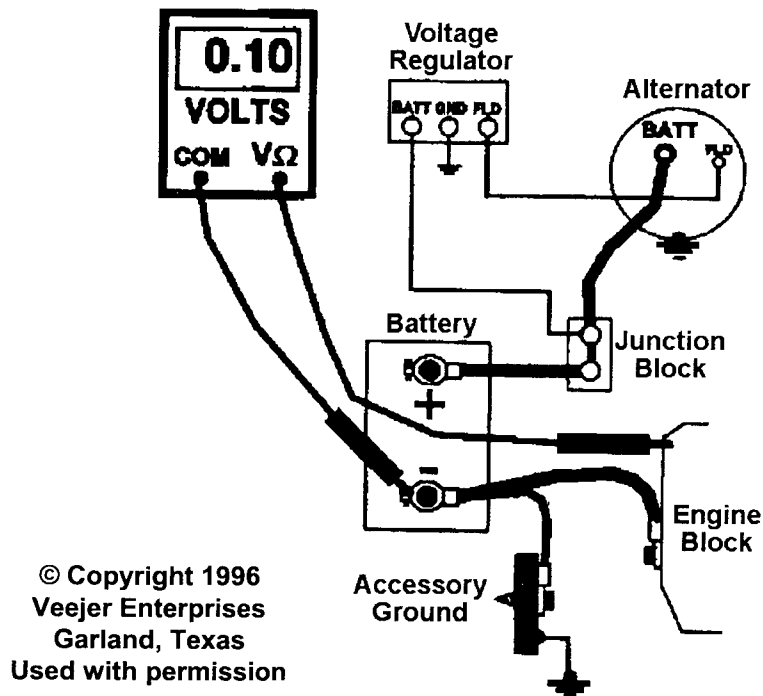
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- If the actual battery voltage is higher than in the chart, it indicates a healthy battery.
- If cranking voltage is low, the battery could be at fault or the starter current draw could be too high. Check the starter current draw with an inductive ammeter or an ammeter designed to withstand three to four hundred amps. Not a Digital Ammeter.

Note: Starter current draw can vary. Check the manufacturers specifications. These can be found in an electrical wiring diagram manual.

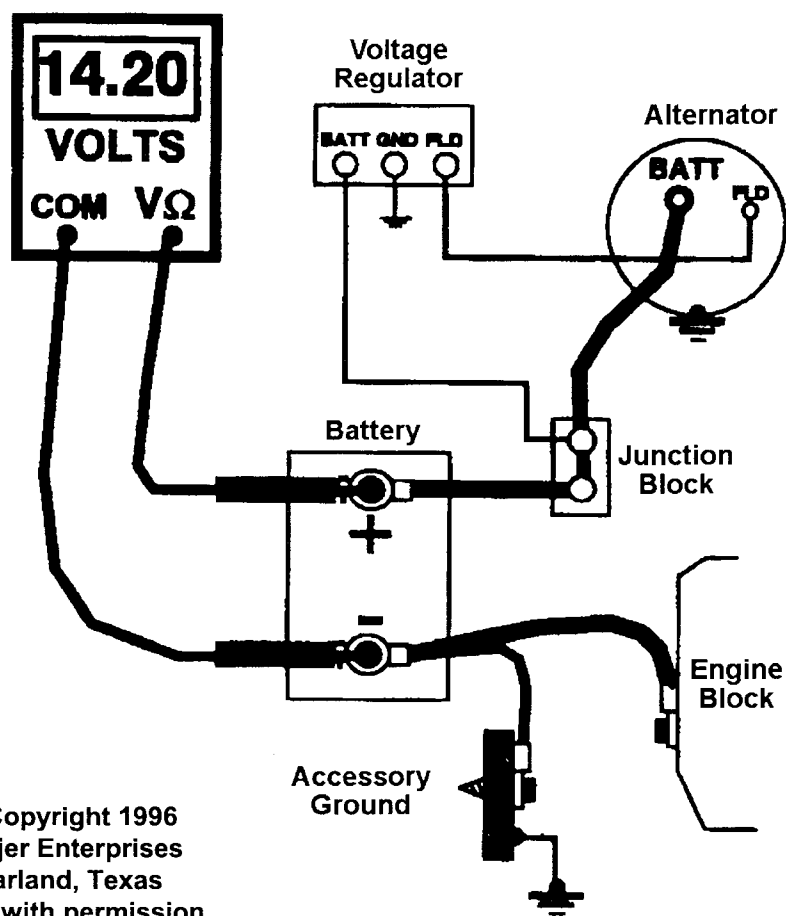
Measure Engine Ground Voltage Drop While Cranking

- To do this test simply connect the negative lead of a DVOM to the negative post of the battery.
- Connect the positive lead of the DVOM to the engine block.
- The allowable voltage drop is 0.1v. Any more than 0.1v indicates corrosion or a loose connection in the engine ground circuit. Any more than 0.3v is *not* acceptable. Cleaning or replacement of the engine ground cable would be in order before proceeding any further.



Measure the Charging Voltage at the Battery Terminals with Engine Cold

- This one is very simple to do. With the engine running about 1500 rpm, place the DVOM leads on the battery posts like you are going to check the voltage at the battery posts (positive lead to positive post, negative lead to negative post).
- The charging voltage is what you see on the meter. Normally, this voltage is about 2v more than the battery voltage with the engine off.



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NOTE: The only reading you can trust is the DVOM reading at the battery posts. Not a diagnostic machine or at the back of the alternator.

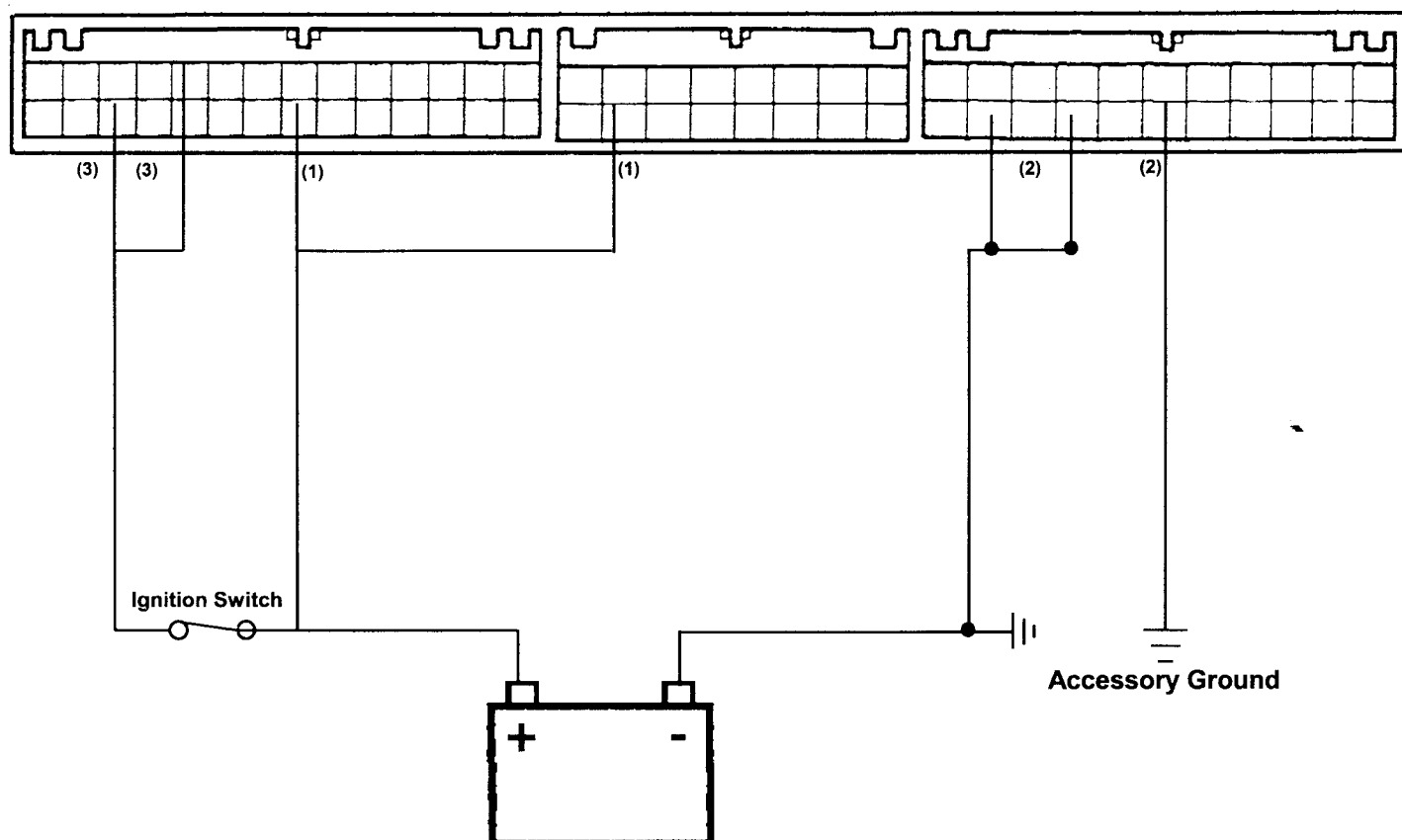
Check for Diagnostic Trouble Codes

Depending on the type of system, retrieving DTC's may be the next step. Example: A slipping 1-2 shift on a Nissan Maxima that has no trouble codes is not as important as a slipping 604 that is in fail safe with a gear ratio error code. The Nissan computer's strategy will not be affected by a slip since the DTC's it produces are related to open or shorted circuits. The 604 system is sensitive to gear slips and other problems. It will react to a variety of driving conditions and vary its operating strategy based on inputs received and outputs obtained.

When a DTC is retrieved and is determined to be related to the fault at hand then a complete test of the related circuit would be in order. If the circuit is electrical then the next section is for you. Note: A good habit to get into is checking the power and ground circuits of the computer before any other tests are done.

To check the power and ground circuits at the computer first locate the power leads going into the computer (1) and measure the voltage at the leads. This should be done with the harness connected to the computer. Next, measure the voltage at the ground leads (2). Turn on ignition switch and measure the voltage at the ignition leads (3). Re-test the voltage at (2). Voltage at the (1) and (3) should be: Battery voltage all the time at (1) and with the ignition switch on at (3). Ground voltage all the time (2) Battery voltage should be no less than 12.4v and ground voltage should be no more than 0.1v.

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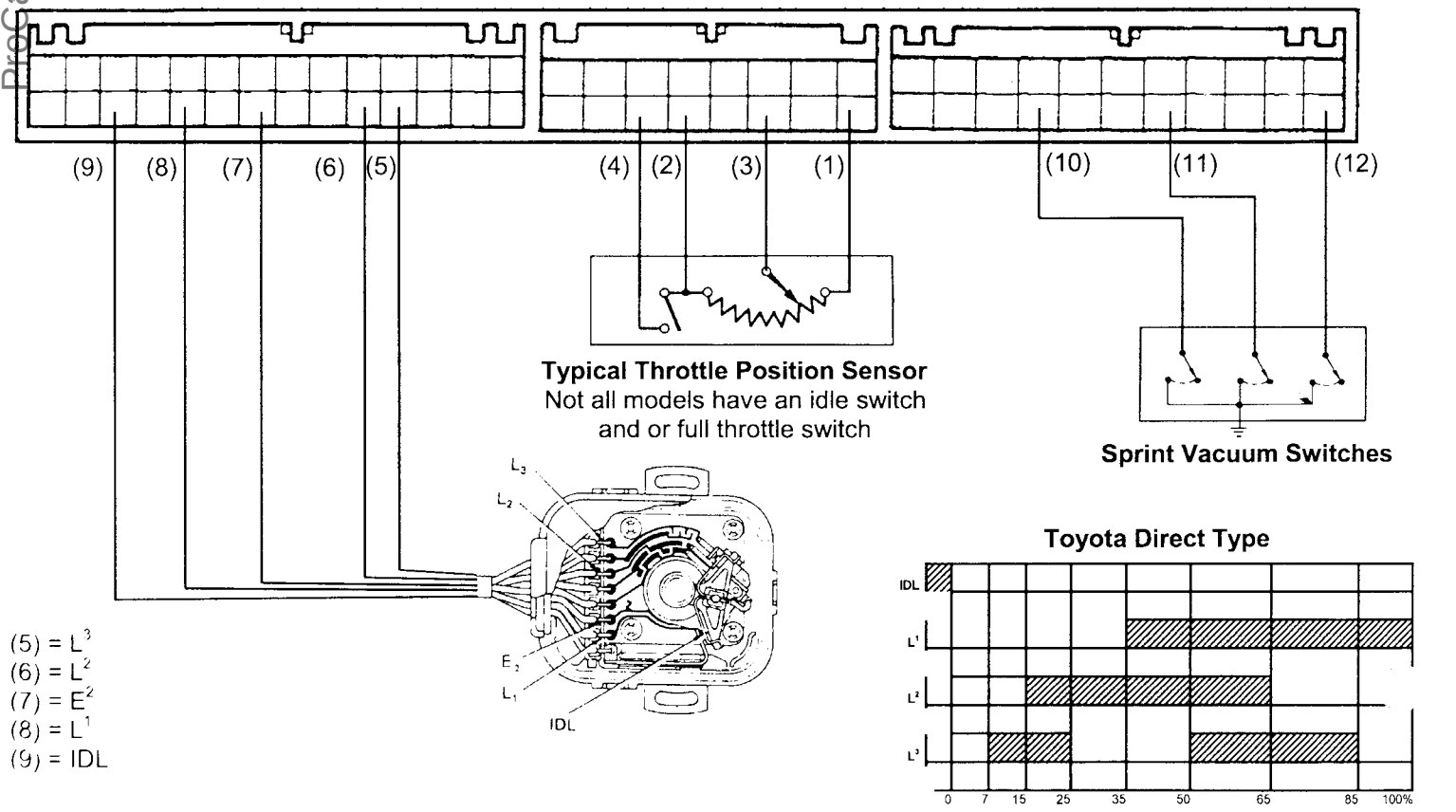


Testing TP Sensors and Switches

The most typical throttle position sensor is a 3 wire variable resistor. Some of these have variations such as an idle contact and/or a full throttle contact incorporated into the switch. The TP sensor still uses a 3 wire variable resistor. The contacts are independent of the 3 wire variable resistor. To test a TP sensor, measure the incoming voltage to the sensor (1) usually 5v. Next, measure the ground voltage (2). Then measure the sweep voltage at (3). Most voltage sweeps are .5v-4.5v. This should be done slowly so a smooth transition can be watched on a DVOM. Most idle contacts and full throttle contacts are open and closed switches. Check for a state of electrical change at (4) when throttle is moved from fully closed to fully open.

The Toyota direct type TP sensor uses a different approach. It will ground 4-5 different signals at different throttle angles to determine throttle position. Note the chart shows when the circuits are grounded to E2. (7) Example: Idl is grounded only at an Idle. L3 (5) is grounded only from 7% - 25% and 50% - 85%.

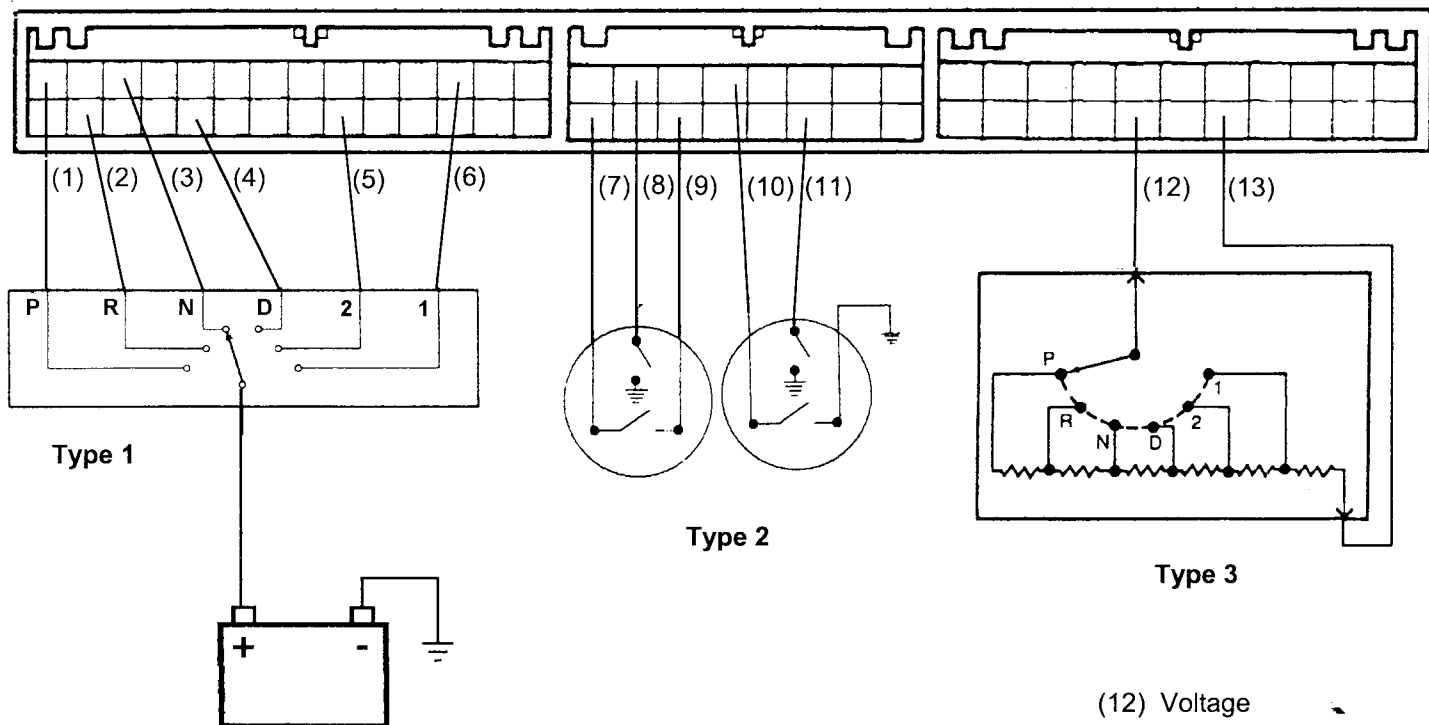
The switches that the sprint uses are vacuum sensitive. All three are normally grounded. As vacuum rises they open. The three switches are calibrated to open at different amounts of vacuum. Example: (10) may open at 2-3 inches and (11) may open at 6-7 inches and (12) at 11-12 inches. The computer feeds 12v to the switches. At 0 inches of vacuum the three circuits' voltages would be 0v. As vacuum rises each circuit will show 12v at different stages dependent upon engine vacuum.



Manual Lever Position Sensors

Manual lever position sensors come in a variety of styles. Some use multiple circuits to tell the computer what position the manual lever is in. Some use a single circuit. Some use pressure. Type 1 sensors are normally classified as inhibitor switches. Some of this type may not send all of the inputs to the computer. This is typical of an import. Example: (1) will send battery voltage only in park. (2) will send voltage in reverse. (3) through (6) in their respective positions. Type 2 is a Chrysler type used on both front wheel drives and rear wheel drives. The 604 uses two of these switches. The 42LE and 96 and later 604s use a similar type of signal incorporated into one switch. (7) may send out a voltage signal which will be received at (9) only in reverse and OD. (8) will have voltage in reverse, drive, 2 and L but not P or N. Type 3 is a Ford style manual lever position sensor. This type sends a voltage out on a single circuit (12) through a series of resistors to ground. (13) The computer measures this same circuit (12) for the remaining voltage. What is left over is the lever position. See the chart below.

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(12) Voltage

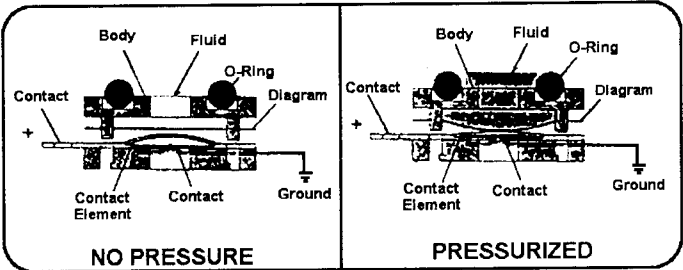
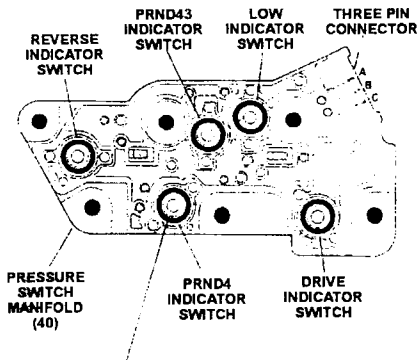
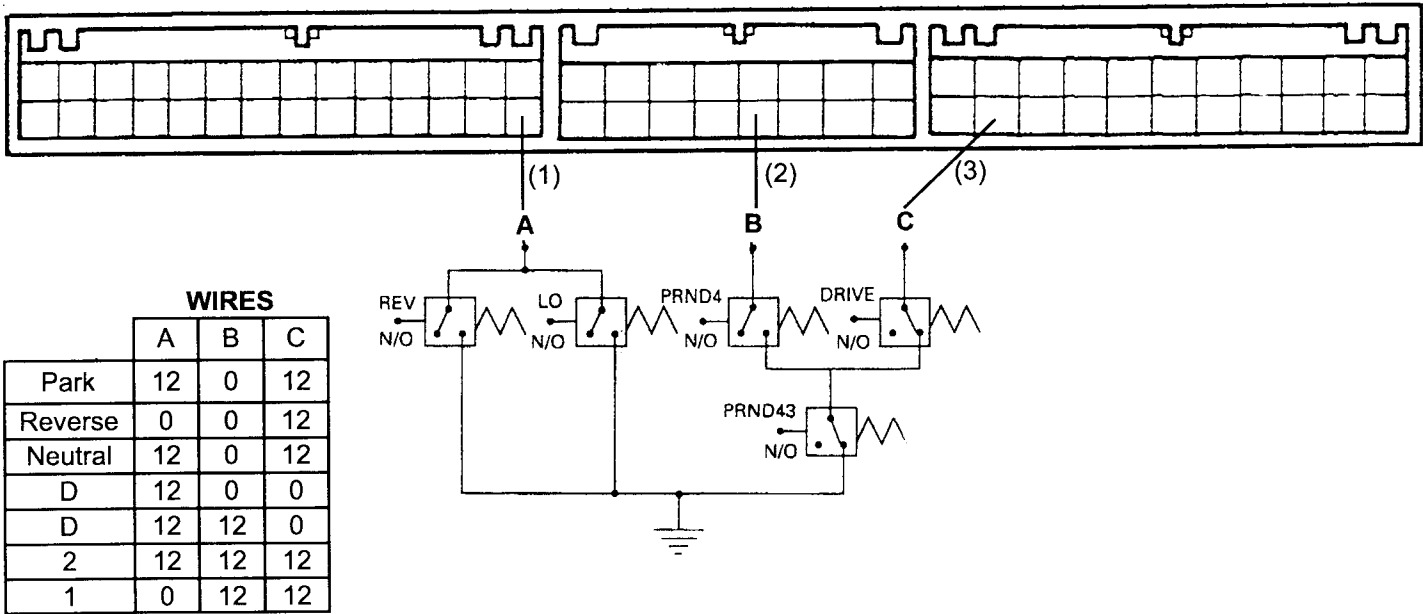
P	4.4v
R	3.5v
N	2.8v
D	2.1v
2	1.4v
1	0.7v

4L80E Pressure Switch Manifold

This type of manual lever position sensor uses pressure switches to tell the computer where the manual valve is. These five switches are connected on three circuits. These three circuits (1) (2) (3) will have 12v or 0v left on them depending on the state of the five switches. The example shown is the 4L80E Pressure Switch Manifold (PSM) in the D3 Range.

- (1) Will have 12 volts because the reverse and low switches are open due to no pressure in those circuits.
- (2) Will have 12 volts because the PRND4 pressure switch is open due to no pressure in that circuit.
- (3) Will have 0v because the Drive and PRND43 switches have pressure in those circuits. When the switches are pressurized they will close permitting current flow.

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NOTE: The 4L60E pressure switch assembly is similar.

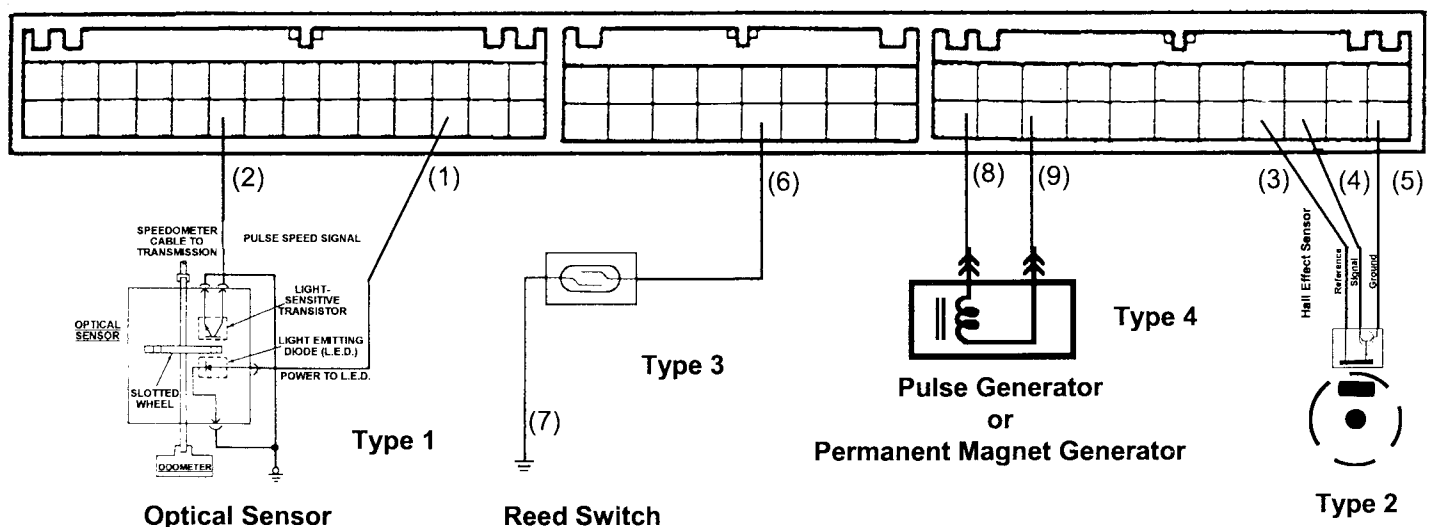
Speed Sensors

Speed sensors come in a variety of styles and are used to sense the speed of a drum, shaft, gear or cable. Type 1 is an optical sensor. The computer sends a voltage (1) to an LED (Light Emitting Diode) which produces a light source. The speedometer cable turns a wheel with slots in it. When the slot lines up with the LED, the light passes through and shines on a light sensitive transistor or photocell. This permits the voltage at (2) to go to ground. When the wheel blocks the LED the photocell turns off and the voltage at (2) remains. The computer would then count the pulses and divide them by how many slots are in the wheel to determine the speed of the wheel.

Type 2 is a hall effect type speed sensor. This type of sensor uses a slotted wheel, a magnet, a semiconductor material and a transistor. As voltage is sent out from the computer (3) (or another source) it passes through the semiconductor material and goes to the base of the transistor which turns the transistor on full pulling the voltage on (4) to ground (5). As the slot in the wheel passes in front of the magnet a magnetic flux interrupts the current flow in the semiconductor and reduces the voltage at the base of the transistor. This raises the voltage at (4). The computer counts the voltage changes and divides it by the number of slots in the wheel to determine the speed of the wheel.

Type 3 is a reed switch. This simple device uses a set of contacts which are brought together when a magnetic field is introduced. A voltage is sent by the computer at (6) and goes to ground (7) when the contacts are closed. The computer counts the voltage pulses and divides by the number of magnets to determine, the speed of the magnets which are usually connected to a shaft.

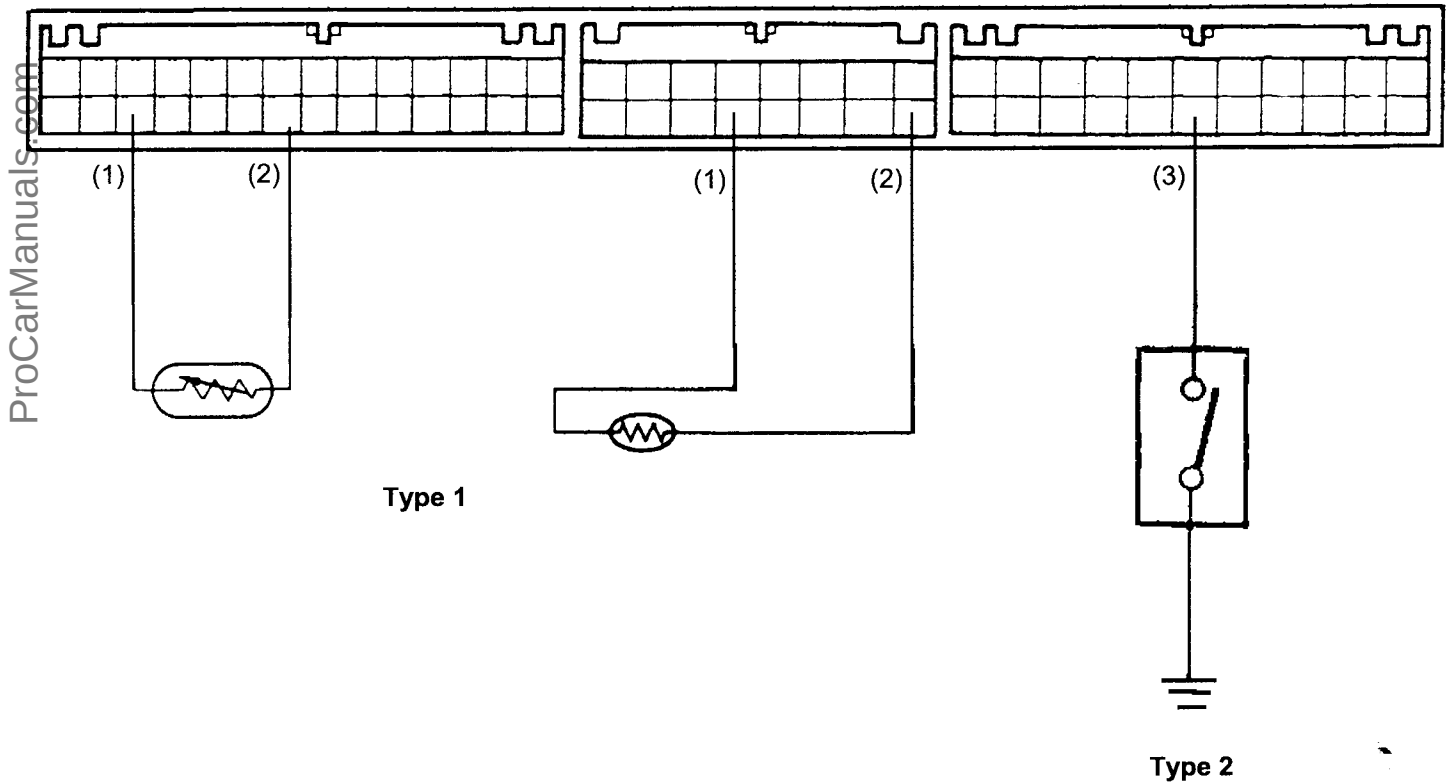
Type 1, 2 and 3 are a digital type sensor which put out a on-off type signal. Type 4 speed sensors are pulse generators. This type will produce an AC voltage. It consists of a permanent magnet wrapped by wire. When a metal that can conduct a magnetic field passes close to the magnet, a magnetic field, builds around the windings. When the metal passes away from the magnet the field collapses and produces an induction in the windings. This induction produces a current. The fluctuation of current building and collapsing produces an AC voltage signal. The computer measures the frequency or number of collapses of the AC voltage at (8) and (9) and determines the speed of the metal which is usually attached to a drum, shaft, cable or gear.



Temperature Sensors

These type of sensors are affected by temperature. Type 1 sensors are thermistors which are a variable resistor which changes resistance with temperature. A voltage is sent by the computer (1) and goes through the resistor to ground at (2). The computer measures the voltage left over at (1) to determine the temperature.

Type 2 sensors are a fixed temperature sensor. This type of sensor will open or close at a predetermined temperature. The computer sends a voltage at (3). Depending on the range of the sensor, the voltage will go to ground or will be ungrounded. The computer monitors the voltage and determines if the switch is open or closed.



Pressure Control Solenoids

Pressure control solenoids are used to regulate pressures inside the transmission. This is done by either varying the current or the pulse width of a signal to a magnet wrapped with wire (a coil) which will manipulate a shaft or plunger. The plunger will react to a pin, ball or valve pushing against the plunger. This type of solenoid is used in domestic transmissions as well as foreign.

Pulse width modulation is a means of controlling the pressure that the solenoid outputs by controlling the duty cycle while maintaining a constant frequency (cycles per second). What this means is the solenoid is turned on and off at a fixed amount of times per second. The ratio of on and off per cycle can change with in each second which is the duty cycle.



Example 1: This represents one cycle. The time frame or frequency is determined by how long it took to complete the cycle. Let's say it took one second. This would represent 1hz (cycles per second) with a duty cycle (ratio) of 50%. Off half the time and on half the time.

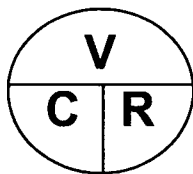


Example 2: This example shows the same second with a duty cycle (ratio) of 50% but the frequency has changed to 2 hz (2 times per second).



Example 3: This example shows the same 2 hz however the duty cycle has changed. The amount of off time has increased and the amount of on time has decreased. This would be considered a 20% duty cycle. If measuring the signal with a voltmeter. The duty cycle would determine the reading on the voltmeter. At 50% duty cycle the voltage would average to 50% or half of the source voltage. So 12 volts at 50% would show 6 volts. 75% duty cycle would show 9 volts. With the voltage reading changing this would mean that the current would also change. Remember the VCR chart (see below). If one changes so does another. Since the resistance of the solenoid remains the same, the current must change also. If the solenoid resistance is 3 ohms and we feed it 12v then the current would equal 4 amps. If the voltage dropped to 9 volts then the current would drop to 3 amps. A 100% duty cycle would produce 4 amps based on 12 volts. At 75% duty cycle would produce 3 amps based on 12 volts.

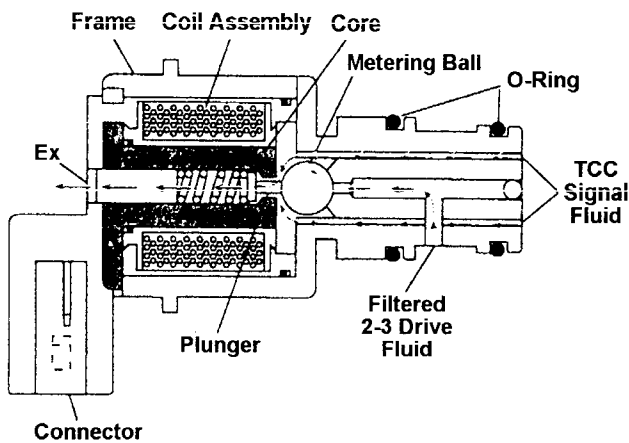
Example: 100% of 12 volts = 12 volts ÷ 3 ohms = 4 amps
 75% of 12 volts = 9 volts ÷ 3 ohms = 3 amps



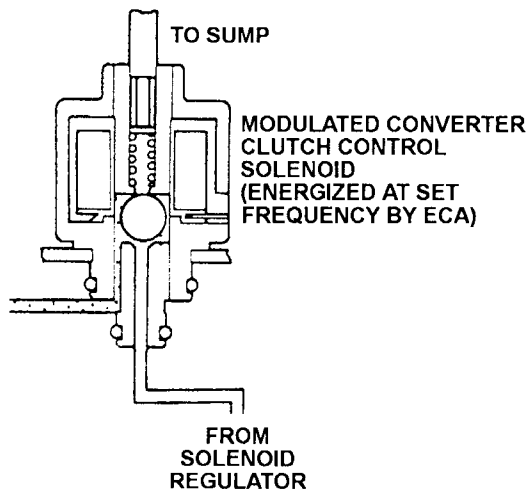
Force Motors and PWM Solenoids

These two types of solenoids are pressure control solenoids. The difference is that a PWM solenoid is usually constructed of a coil, plunger and a ball. The frequency is usually lower than that of a force motor. The 4L80-E PWM solenoid, for example, controls the pressure to the TCC regulator valve and the converter clutch shift valve (once in second gear). This pressure is called Torque Signal. This is done by turning the solenoid on and off 32 times per second (32 Hz). That means the plunger is moving in and out of the coil 32 times per second. When filtered 2-3 drive oil pressure is introduced to the solenoid, the ball blocks the oil from entering the Torque Signal circuit. When the solenoid pulses, the ball allows some of the filtered 2-3 drive oil pressure to enter the torque signal circuit. The idea here is to control the position of the two valves which will determine when lock up will occur and how it will feel. The “when” part is strictly when the solenoid turns on. The “how” depends on the duty cycle of the solenoid. The longer the duty cycle the firmer the apply. This type of solenoid is usually checked with a scanner or a DVOM that reads duty cycle (percentage of on time). It defaults to 0 PSI when off.

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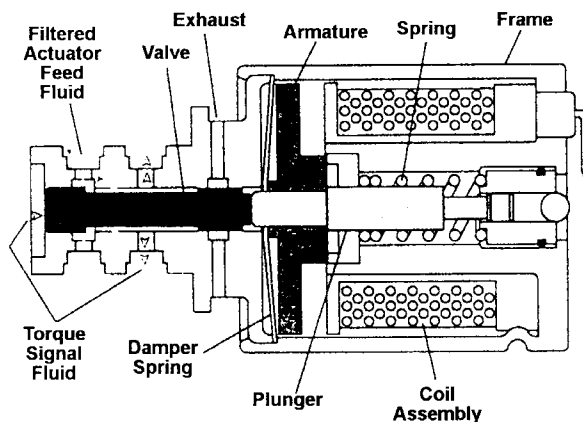
PWM (4L80E)



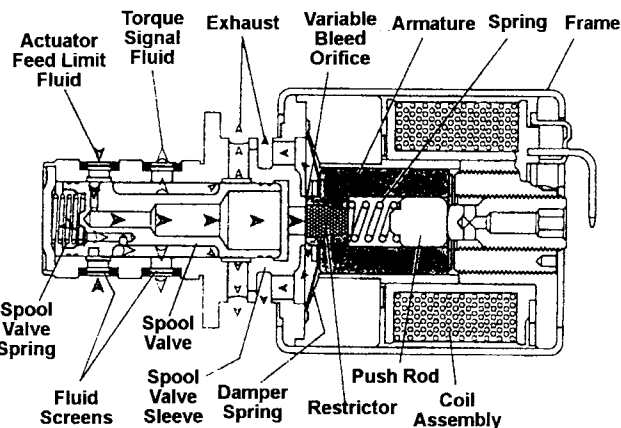
PWM (AXODE)

Force Motors

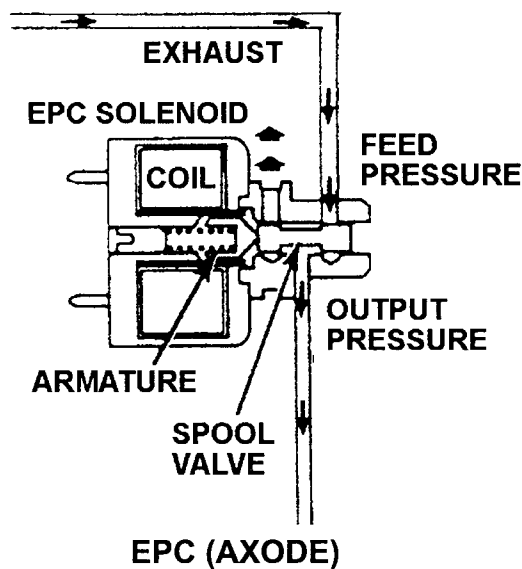
A force motor is usually constructed of a coil, plunger and either a valve or a pin. The force motor is very similar to a vacuum modulator in its operation. As vacuum rises in the modulator the modulator valve pushes against the plunger to lower the modulator pressure (TV pressure). As the current raises in the force motor, the valve pushes against the plunger (or the pin) and lowers the torque signal, EPC or line pressure control. The force motor in the 4L80E runs on a frequency of 295.5 Hz. This provides for a smoother operation of the valve or pin. The valve position in the force motor controls the pressure output of the solenoid. Typically this solenoid is never turned fully on or off. To control this solenoid the duty cycle is changed just like on the PWM solenoid. However the current flow is what is monitored or in some cases the voltage drop across the solenoid terminals.



FORCE MOTOR (4L80E BOSCH)



FORCE MOTOR (4L60E HOLLEY)



EPC (AXODE)

Pressure Control Solenoids

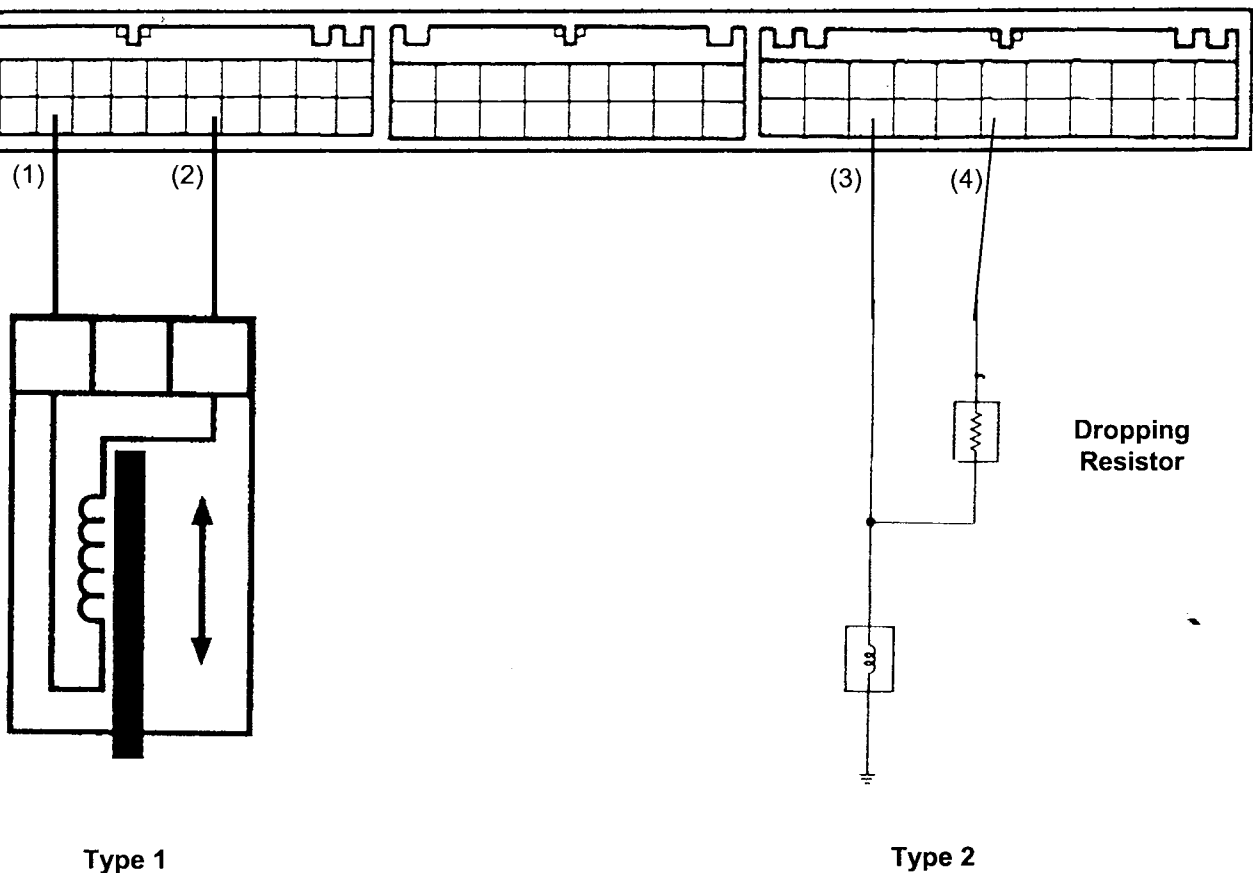
Two ways of controlling these solenoids are ground control and power control. Type 1 solenoids are usually ground controlled. The computer or an ignition source sends a voltage to the solenoid (1) and the computer regulates the ground side (2) to control current flow through the solenoid. Type 2 solenoids are normally grounded or power controlled. The computer regulates the current or voltage at (3) and the current or voltage passes through the solenoid to ground. Some of these solenoids are fed through a dropping resistor on (4), while (3) is still regulated by the computer.

Some transmissions use a similar solenoid to feed the clutches directly. Example: 604 and 42LE. Some manipulate a valve which will send pressure to a clutch. Example: Saturn.

These solenoids can be tested in several ways

1. Measure the voltage drop across the terminals; as voltage goes down, pressure goes up.
2. Measure the current flow in one wire; as current goes down, pressure goes up.
3. A PWM solenoid is usually monitored with a scanner, however a DVOM can verify the signal by watching the duty cycle.

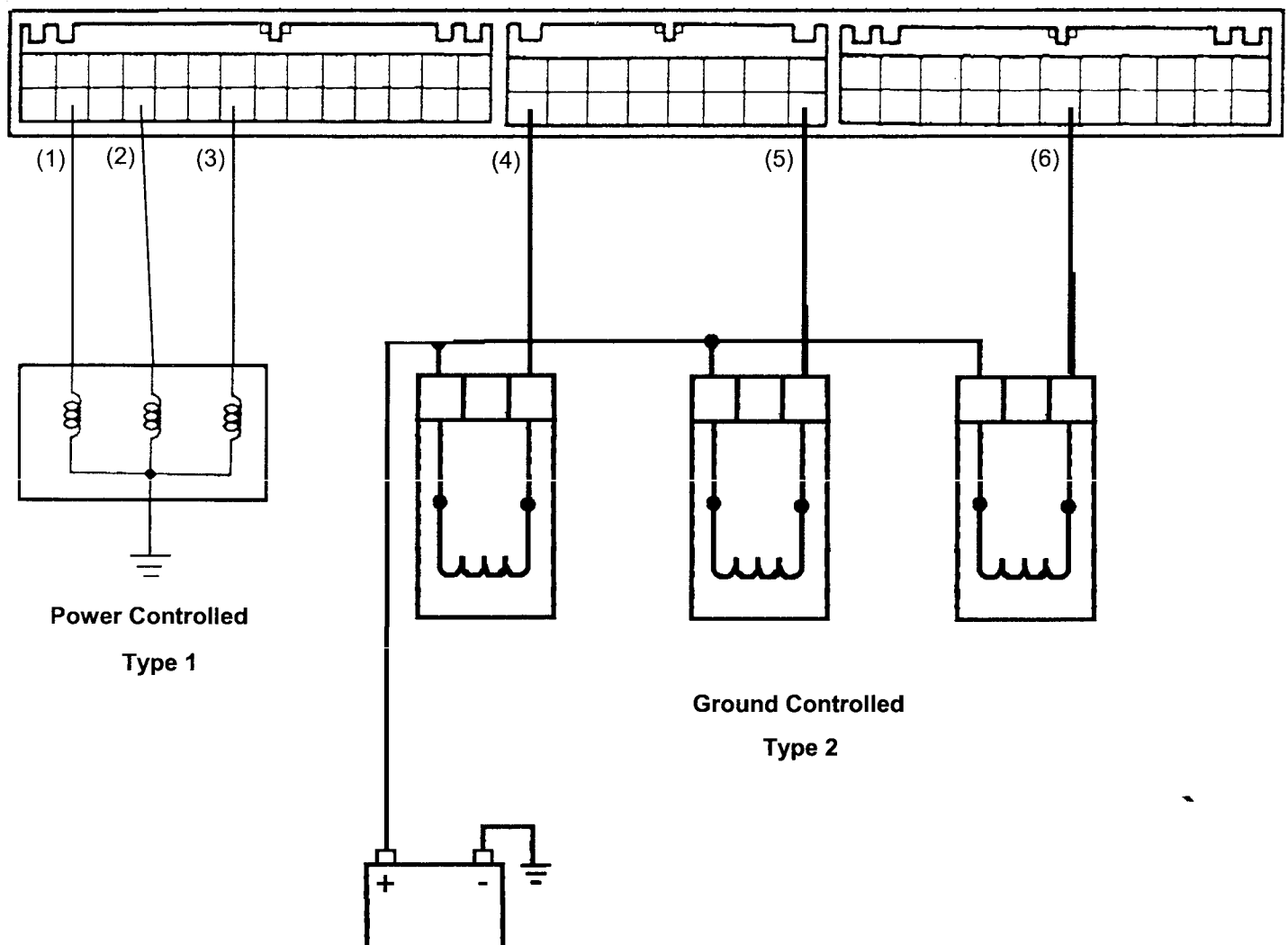
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Shift Solenoids

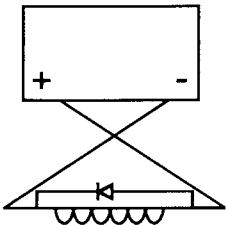
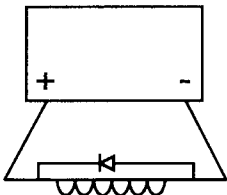
The computer will send a voltage signal to solenoids that are normally grounded such as type 1; (1) (2) and (3). The pattern of on or off solenoids determines the gear ratio of the transmission. A Type 2 solenoid is ground controlled, which usually receives voltage from a battery source such as an ignition switch or relay. The computer will ground (4) (5) and (6) to turn on the solenoids in a pattern which will determine the gear ratio of the transmission. These types of solenoids manipulate shift valves.

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How To Test A Solenoid

- Measure the resistance
- Measure the current flow
- Test the mechanical state
- Place the leads of an ohmmeter on the terminals of the solenoid; positive on one side, ground on the other side. If the reading is too high or too low, the solenoid is faulty. Some solenoids have a diode in them. Check them with a diode tester or an analog ohmmeter.



To do this, first connect the leads as in example #1. Then switch the leads as in example #2. Two different readings indicate a good diode. If the readings are the same, the diode is shorted or opened. When checking resistance on a solenoid with a diode, the higher resistance reading is the actual solenoid coil resistance.

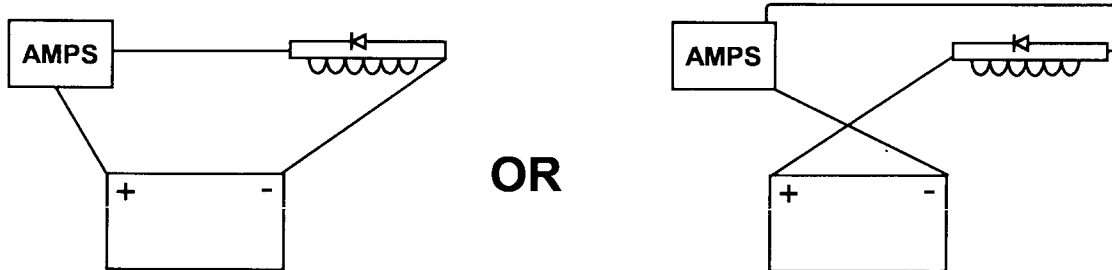
NOTE: To use the diode checking feature of a DVOM, the diode must be remove from the solenoid.

Current Flow

$$\text{Voltage} \div \text{Resistance} = \text{Current Flow}$$

To measure current flow connect an ammeter to one lead of the solenoid. Connect the other lead of the ammeter to the battery. The other lead of the solenoid is connected directly to the battery.

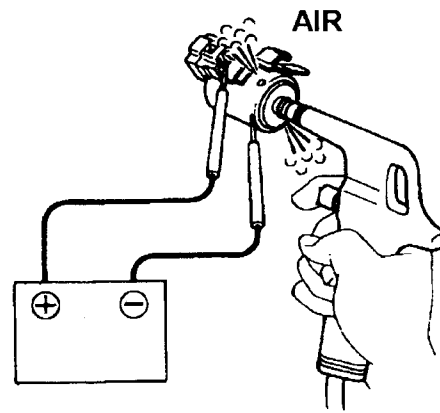
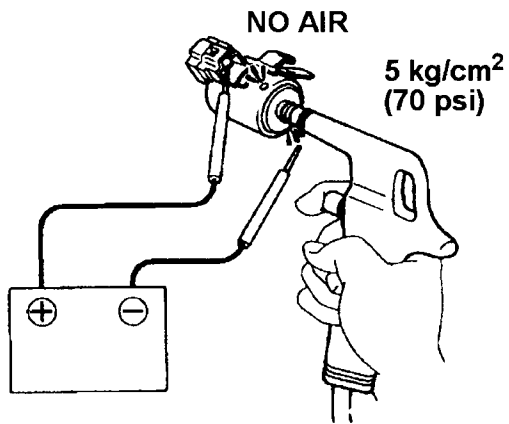
NOTE: Keep the polarity of the solenoid the same. Positive to the positive post and negative to the negative post.



If the current flow is too high the solenoid is shorted and should be replaced.

Mechanical State

The mechanical state of the solenoid can be checked while testing the current flow. When the solenoid is off, is there flow? When the solenoid is on, is there flow?

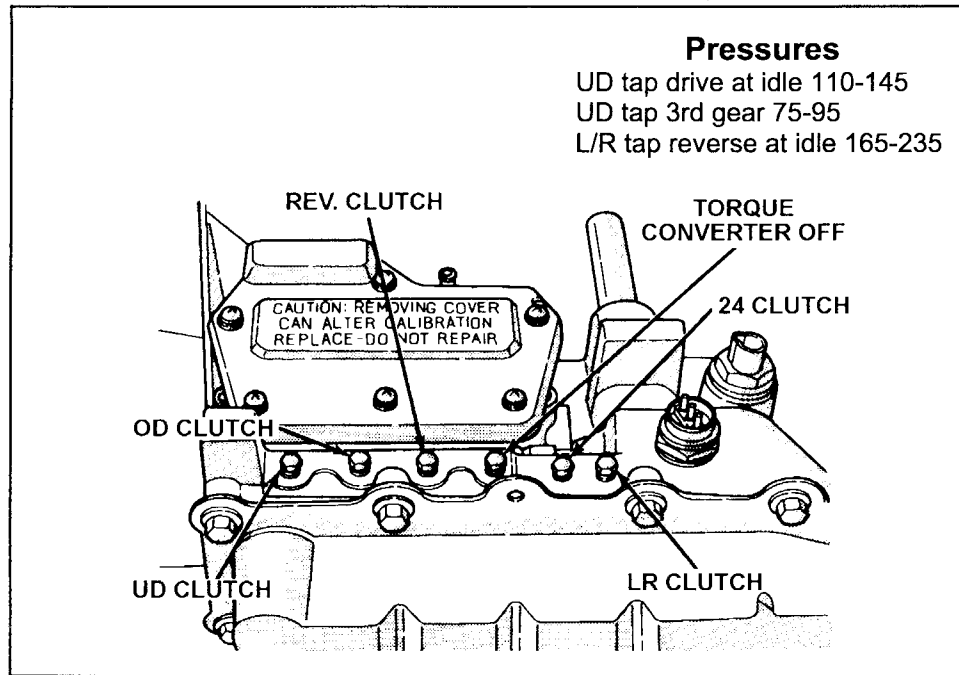


41TE (A604)

Pressures and Pressure taps	25
Clutch Application Chart.....	25
Solenoid Patterns	25
Failsafe Mode.....	25
Gear Ratio	25
Checkball Locations	26
Transaxle Controllers	27
Flashable Controllers	28
Controllers Requiring Modification	29
Optional Modification.....	30
Electronic Pinion Factor	31
Neutral Safety and PRNODL Switch Check.....	32
Neutral Safety Switch Malfunction.....	34
NEW Transmission Range Sensor	35
NEW Autostick	37
Speed Sensing Problems.....	38
Solenoid Testing	40
Harness Repairs	42
Clutch Chatter	44
Cooler System and Bypass	45
Snap Ring Chart.....	46
UD/OD Pressure Plate	47

41TE (A604)

4ITE (A604)



Range	Gear	LR/LU Sol	2-4/LR Sol	UD Sol	OD Sol	LR Clutch	2-4 Clutch	OD Clutch	UD Clutch	Rev Clutch
P-N										
R	Reverse									
D	1st									
	2nd									
	3rd									
	4th									

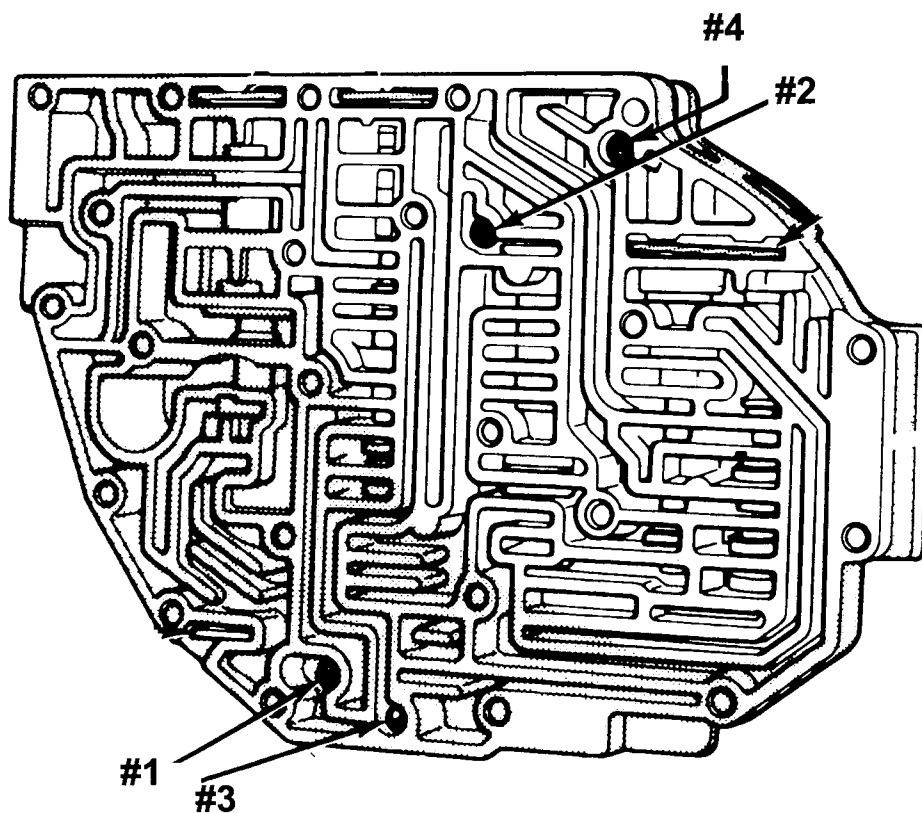
Failsafe Mode

D	2nd
D	2nd
1	2nd

Gear Ratios

1st	2.84
2nd	1.57
3rd	1.00
4th	.69
Reverse	2.21

Checkballs



- #1 LR Shuttle
- #2 UD Feed and Bypass—will not allow UD feed to bypass the UD solenoid. UD oil can bypass the solenoid during the release.
- #3 Keeps line oil out of the L/R circuit in 2nd, 3rd and 4th gear.
- #4 Reverse Clutch Orifice

Transaxle Controllers

Once again, Chrysler's ongoing efforts to keep their products operating as properly as possible have resulted in a new generation of transaxle controllers. The computer programming for the 1995 year model transaxles has corrected some complaints effectively enough that the designers have incorporated these changes into new controllers for all non-'flash programmable' year models and applications that use the 41TE or 42LE. Late model controllers can be re-programmed, or 'flashed' by **Chrysler's DRB diagnostic equipment and software**. This brings these controllers up to date with these latest refinements.

The section 'Identifying Flashable Controllers' later in this article explains how to tell whether you need to replace the controller, or have it re-programmed.

Application Chart

1989-1991	3.0 Engine	4796121
1990-1991	3.3 & 3.8 Engine	4796122
1992	3.0 Engine	4796123
1992	3.3 & 3.8 Engine	4796124
1993-1995	All 42LE	4797708
1993-1995	All 41TE w/ 3.0 and larger engine	4686606
1995	2.5 Engine (Cirrus/Stratus)	4606105

These new controllers correct many different complaints. Driving feel, or 'driveability' characteristics, as well as certain electrical sensing and diagnostic operations have been improved.

Complaints addressed are:

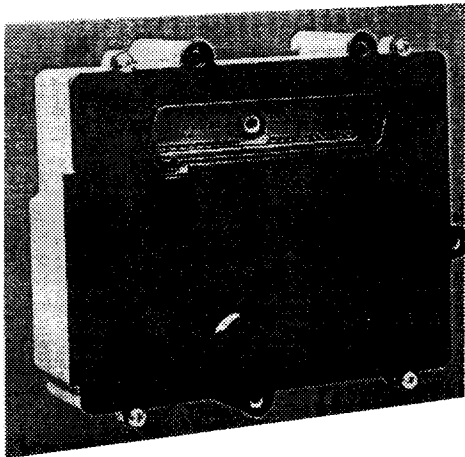
- TCC chatter during EMCC partial lock-up.
- Coastdown tip-in bump.
- Coastdown shift harshness.
- Harsh/delated engagement in some cases.
- Poor shift quality after battery disconnect.
- False solenoid body pressure switch fault codes.

Although there can be many internal causes of these complaints that should be eliminated first, the new controllers can help, if not, correct theses problems.

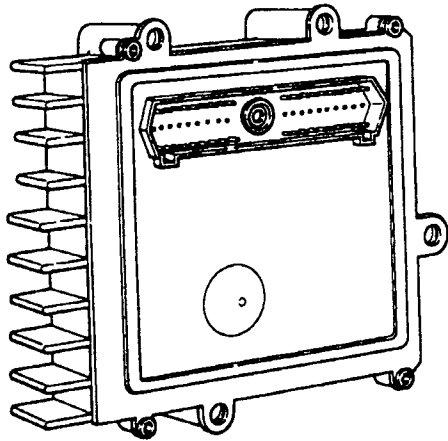
However, **according to the designers of these systems**, all calibrations used in these controllers still rely on the exclusive use of Mopar (Chrysler Parts) Type 7176 ATF.

Identifying Flashable Controllers

Any EATX controller that does not have cooling fins on the outside of the casing is not 'flash programmable'. Earlier controllers with cooling fins can also be 'non-flashable'. Check the part number list below to find out if your controller is 'un-flashable'. These controllers, and all controllers without cooling fins must be replaced to implement the updated programming.



Early—No Fins



Late—Has Fins

Non- Flashable TCM s with Cooling Fins

- 4686174
- 4686175
- 4686208
- 4686209
- 4686223
- 4686224
- 4686490
- 4686491

Controllers Requiring Modification

Certain models of the new generation of controllers will not be compatible with the older vehicle operations in one area. They will have a problem with unintentional shifting from fourth to third gear, or third to fourth gear (at fourth gear speeds) whenever the brake pedal is pushed. The part number of these controllers are:

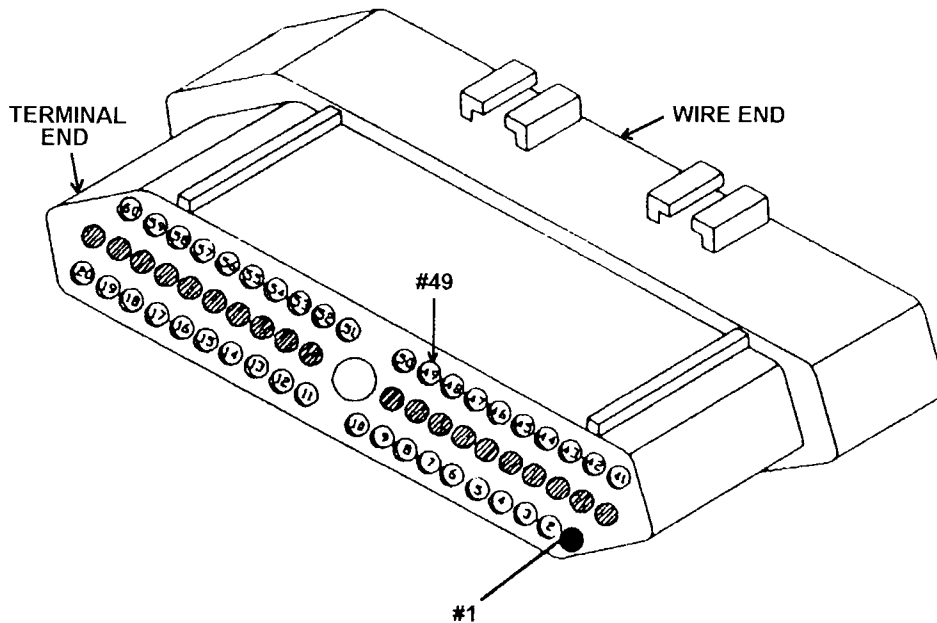
4796121

4796122

4796123

4796124

The modification to correct this problem is quite simple. Locate the wire at Pin #49 on the TCM harness connector. If there is no wire at this location, no modification is required. If there is a wire, cut the wire approx. 3" from the TCM connector. Fold 1" of each wire end back on itself. Slide a 2" piece of shrink tubing over each of the folded ends and shrink the tubing to seal the wire ends. The new TCM will now work properly.



Optional Modification on Vehicles with a Wire at Pin Number 49

This modification has NOT been approved by Chrysler.

(But it works pretty cool anyway.)

For New Generation controllers on pre-1993 vehicles.

The previous page covers a modification to prevent unintentional 3-4 and 4-3 shifts when you step on the brake pedal. The brake switch sends a 12 volt signal to Pin #49 of the TCM to cause this. While this can be very unnerving when stepping on the brake pedal, and the previous procedure corrects this, you might offer your customer an option of being able to lock out fourth gear at highway speeds (such as driving through the hills) without having to tolerate the late 2-3/3-2 shift pattern of the regular 'D' shifter position.

You need to mount a MOMENTARY connecting, not grounding, switch in the instrument panel, or somewhere approved by the customer. Run a 5 amp fused wire from a 12 volt circuit to one side of the switch. Run another wire from the other side of the switch to TCM Pin #49. Modification is complete.

Now, when you are in the 'O/D' shifter position, in fourth gear, if you hit the new switch the unit will shift to third and stay there as long as you don't downshift or come to a stop. If you want fourth gear back, (and you're still going fast enough) just hit the switch again.

Electronic Pinion Factor

Starting in 1993, Chrysler consolidated vehicle speed sensing systems in their vehicles. Prior to 1993, a pulse generator style speed sensor in the transaxle extension housing provided a speed signal to tell everything EXCEPT the transmission controller how fast the vehicle is going. The transmission controller used the output speed sensor on the side of the transmission for vehicle speed input.

Deciding that this was redundant, Chrysler reconfigured the system so that the transmission output speed sensor would be the one speed sensor signal for all vehicle systems (Except ABS).

One challenge was to make a small number of transmission controller models fit a large number of different applications. Different gear ratios and tire sizes required flexibility in this area. To accommodate these differences, the transaxle controller is programmed to condition the output speed sensor signal by multiplying it by a variable 'pinion factor' number, as well as a tire size value. The TCM converts output speed sensor values to equal 8000 pulses per mile and sends this conditioned signal to the PCM. This variable pinion factor and tire size is entered into TCM memory by the Chrysler DRB series diagnostic equipment whenever a controller is first installed into a vehicle. Setting the pinion factor and tire size factor calibrates the controller for that particular vehicle. This way, one particular controller part number can fit many different vehicle applications.

If this programming is not performed when a new controller is installed, there will be no vehicle speed signal, therefore no speedometer reading.

Calibration and inaccuracy problems can occur if a controller, programmed for one vehicle, is put into another. If the transfer gears, ring/pinion ratio, or tire size are not identical, you can count on an inaccurate speedometer reading. If you suspect a problem with the accuracy of the speedometer, but you don't have access to a Chrysler DRB II or III scanning tool, there is a way for you to check the accuracy of the vehicle speed signal the TCM is sending the PCM.

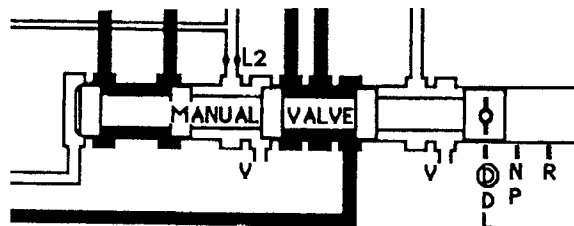
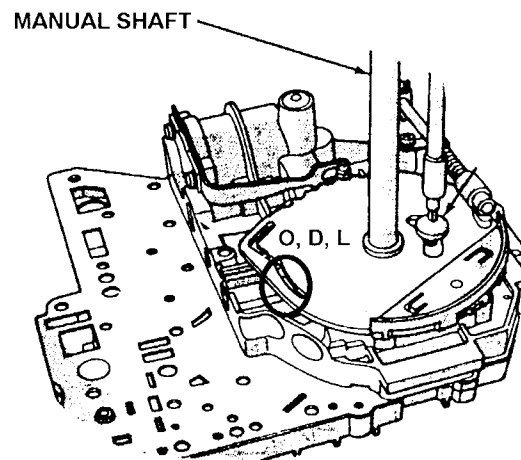
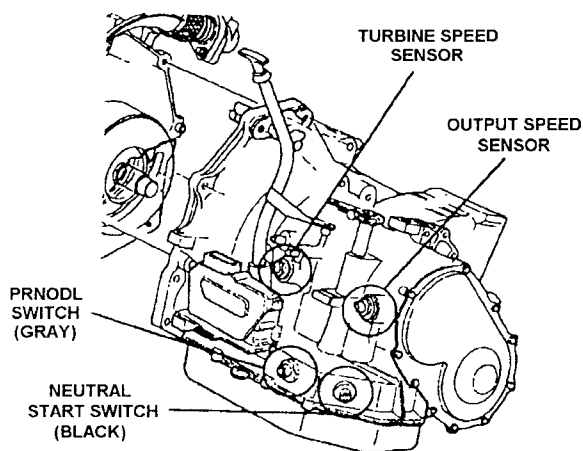
You will need a stop watch, a DVOM capable of reading frequency (hz) and a nearby stretch of highway that has little signs marking off each mile.

On the vehicle with the suspected wrong speedo reading, connect your DVOM positive lead to either TCM pin #58 or PCM pin #47 and ground the other lead. Use jumper wires if necessary so you can drive the vehicle while your passenger watches the meter. Using mile markers on the highway and your stop watch, go an exact indicated 60 mph as shown on your speedometer. At correctly calibrated speeds will have you passing a mile marker at exactly 60 second intervals. If it takes more than a couple of seconds shorter or longer than a minute to go from marker to marker, there is an accuracy problem. Find out what indicated speed you need to achieve to pass a marker every 60 seconds. This is true 60 mph. Take note of your meter's frequency readings at both indicated and true 60 MPH.

On a properly calibrated system, you should show a reading of 133 hertz at exactly 60 MPH. If you have an accuracy problem, and your meter shows 133 hertz at the indicated speed of 60 MPH, then the TCM is programmed with the wrong Pinion Factor, or tire size, or both. If your meter shows 133 hertz at the true speed of 60 MPH, then the TCM is sending out the correct signals to the PCM. The problem is not the TCM's pinion factor or tire size programming.

Neutral Safety/PRNODL Switch Check

Information from these two switches is one of the most important inputs to the EATX controller. The combined status of both switches provides the only way for the controller to know which forward gear the driver has selected.



Neutral Safety/PRNODL Switch Check (cont'd)

Keep in mind that a malfunction of these switches can cause problems, even if that malfunction is for a **very short time**. Possibly too short for you or your monitoring method to detect.

If you suspect a possible switch malfunction, it is far more practical from a diagnostic standpoint to install **two new switches** and retest for the malfunction.

During any testing with the shift linkage disconnected, keep in mind the *seventh shifter position*, past Manual Low, used to retain the park rod during valve body service. Do not inadvertently consider this to be the Low position. The chart below shows this as the (I)nstall position.

(For bench testing, Park is full CCW of shift lever.)

Neutral Safety Switch (furthest from sol. body)

Shifter Position	P	R	N	O	D	L	I
NS1-Center pin/Ground	C	O	C	O	O	O	O
RL1-Outer/Outer pins	O	C	O	C	O	O	O

P-R-N-O-D-L Switch (closer to sol. body)

Shifter Position	P	R	N	O	D	L	I
NS2-Center pin/Ground	C	O	O	O	O	C	O
RL2-Outer/Outer pins	O	C	C	O	C	O	C

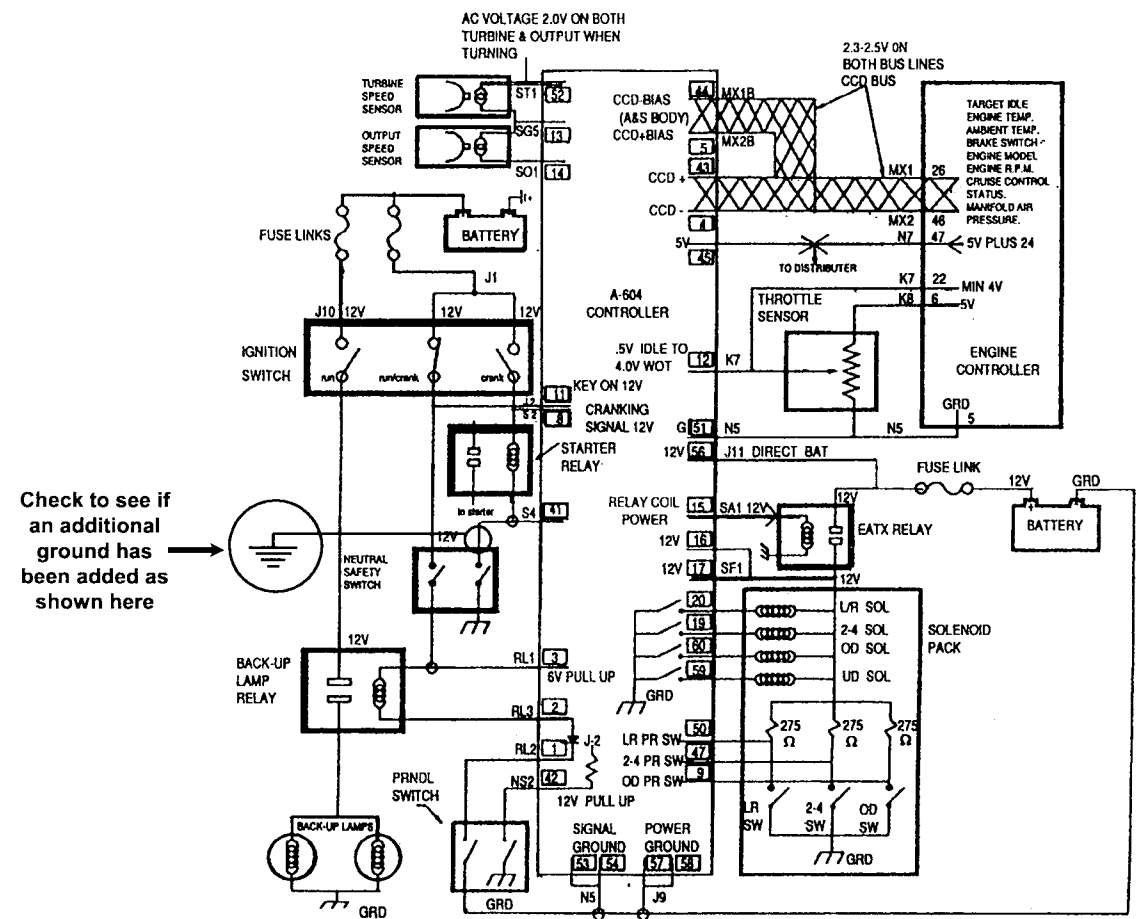
Don't forget position I, the VB installation position.

Neutral Safety Switch

When a malfunction of the NSS keeps the starter from operating, some technicians have been known to add a ground to the starter relay terminal to allow starting in any gear. While this will allow the engine to be started, it also sends erroneous information to the 41TE controller regarding shifter position information, causing a shift pattern malfunction in the forward ranges as a result of the NS1 circuit having a full time ground to TCM pin 41.

To test for this condition, check to see if the starter operates in all gear positions. If so, the starter relay has a full-time ground hooked up to it. Correct the problem with the NSS circuit, then disconnect this ground.

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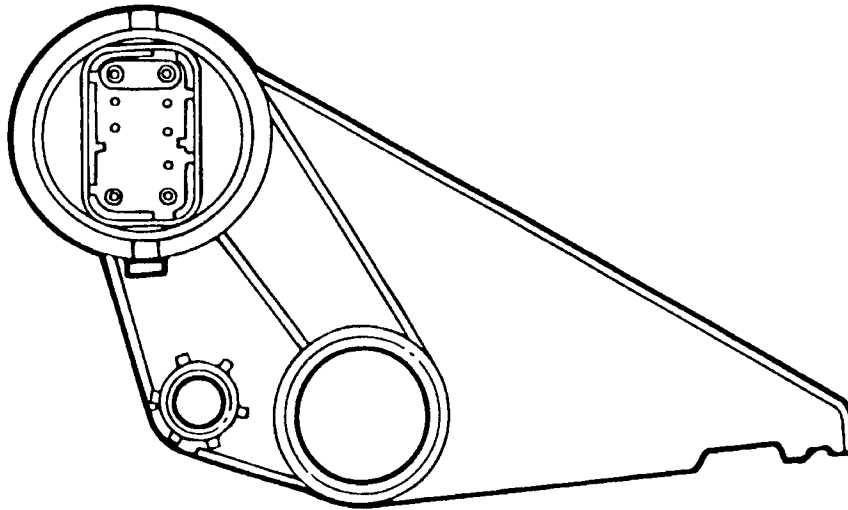


Transmission Range Sensor

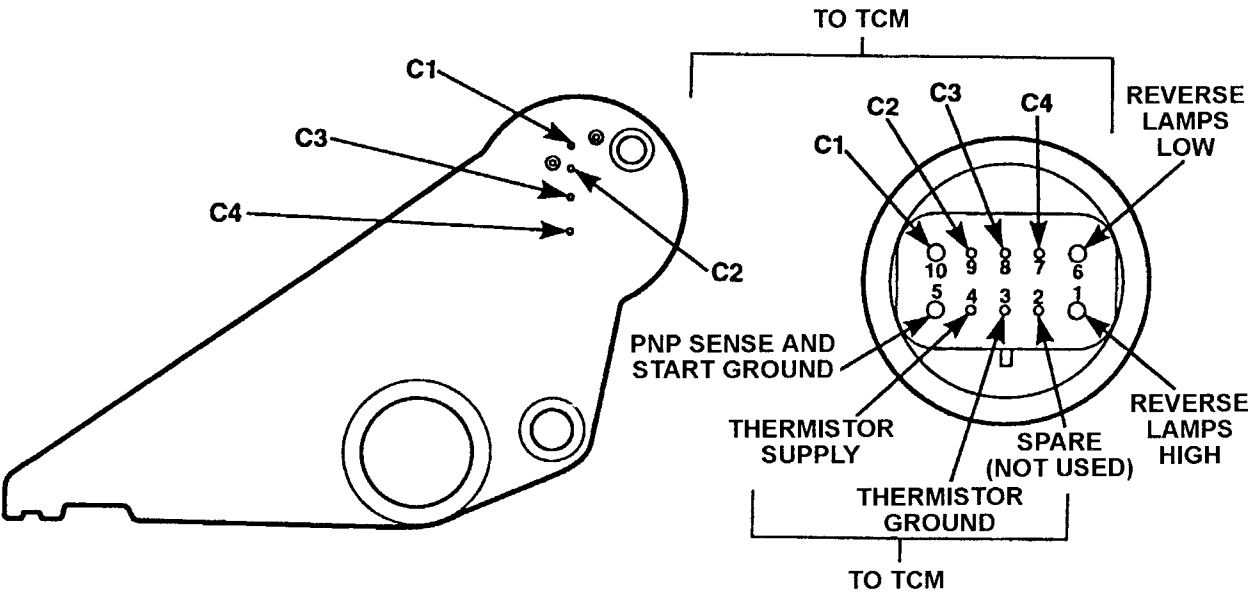
For the 97 model year, the transmission range sensor is located on top of the valve body. This sensor replaces the PRNODL position switch and the Neutral Safety Switch on 41TE/AE vehicles prior to the 96 model year. This sensor allows for accurate transaxle gear position measurement. This sensor is similar to the MVLPS that is currently on the 42LE transaxle.

Located within the sensor is a separate transmission temperature sensor. This sensor measures the transmission fluid sump temperature. The transmission temperature sensor is serviced with the transmission range sensor as a unit.

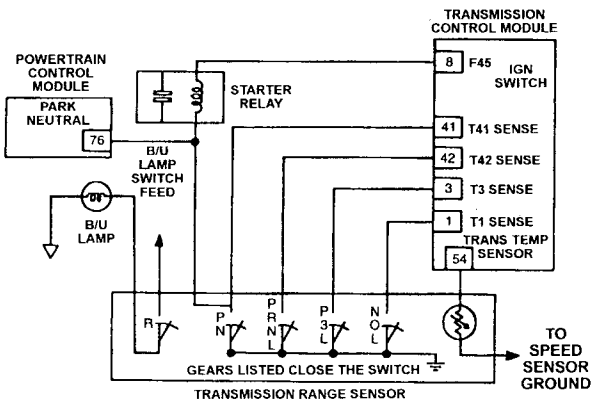
The transmission range sensor (on the valve body) sends signals to the TCM of the position of the transaxle manual valve lever. The TCM receives the switch signal and processes the data. The TCM sends the Shift Lever Position (SLP) information to the Body Control Module (BCM) and the Cluster electronic PRNDL display via the CCD bus. The Cluster electronic PRNDL display illuminates the appropriate shifter position indicator on the instrument cluster.



Transmission Range Sensor (cont'd)



PIN	CIRCUIT	OPERATION
10	T41 (C1 Sw.)	Grounded in P, N
9	T42 (C2 Sw.)	Grounded in P, R, N, L
8	T3 (C3 Sw.)	Grounded in P, 3, L
7	T1 (C4 Sw.)	Grounded in N, OD, L
6	L1 (Reverse Lamp Low)	Power Out to Back-Up Lamps
5	T41	PNP Sensor (To PCM) Starter Relay Coil Ground
4	T54	Thermister Supply (Temp. Sensor Signal)
3	T13	Thermistor (Temp. Sensor) Ground
2	Not Used	
1	F20 (Reverse Lamp High)	Fused Ignition Switch Output (Run)

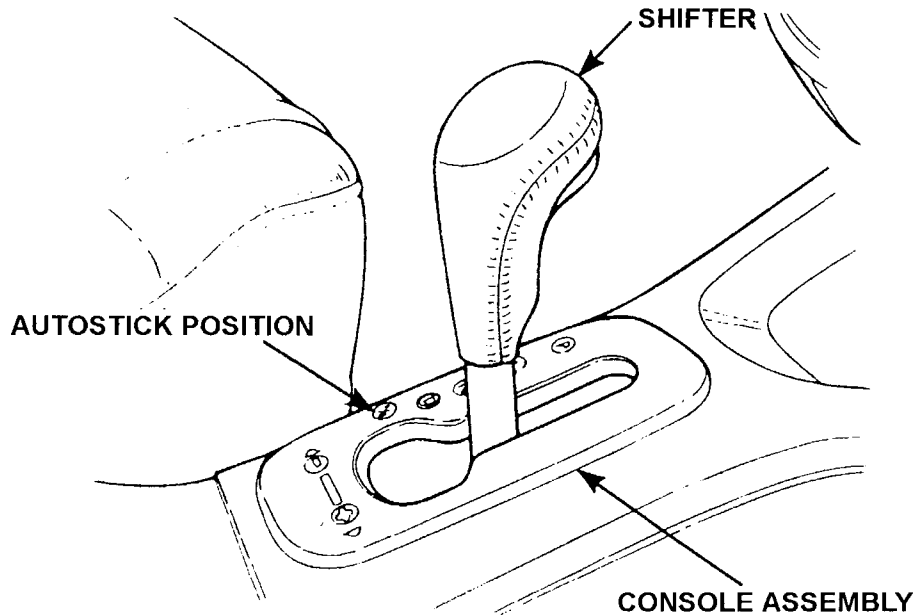


Autostick Operation

(Stratus)

Autostick is a driver-interactive automatic transaxle feature that offers manual gear shifting capability providing the driver more control.

The Autostick feature may be used for everyday driving and for special situations depending on driver preference. It offers the opportunity to maximize engine braking, eliminate undesirable upshifts and downshifts, and improve overall performance. Autostick can also provide more vehicle control during passing, city driving, slippery conditions, grades, trailer towing, and many other situations.



The Autostick position is located below the overdrive position and is identified by the A/S + or - symbol. When the shift lever is placed in the A/S position, it can be moved laterally. Pulling the lever toward the driver (-) triggers a downshift and pushing the lever toward the passenger (+) triggers an upshift. This allows for almost total control over desired gear engagement.

Drivers can shift into or out of Autostick mode at any time without lifting their foot off the accelerator. When the OD (overdrive) mode is selected, the transaxle operates automatically, shifting between the four available gears. When Autostick is desired, the driver simply moves the shift lever from overdrive to A/S. The transaxle remains in the current gear until the driver selects an upshift or downshift or a safety override is necessary. When shifting from Autostick to overdrive, the driver moves the shift lever forward into overdrive. The transaxle immediately begins shifting automatically.

When in Autostick mode, the selected gear 1, 2, 3 and 4 is displayed on the instrument cluster to inform the driver which transaxle gear is currently engaged.

4ITE (A604) Controllers

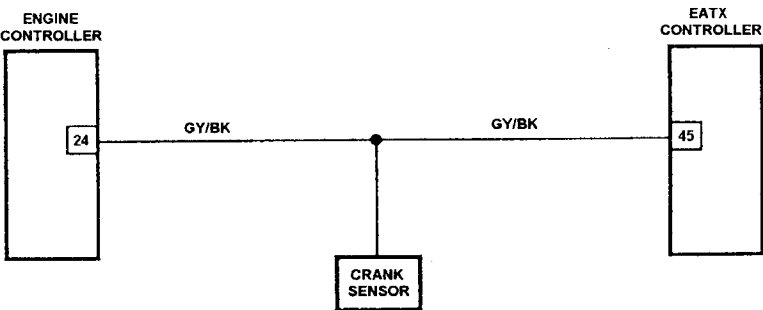
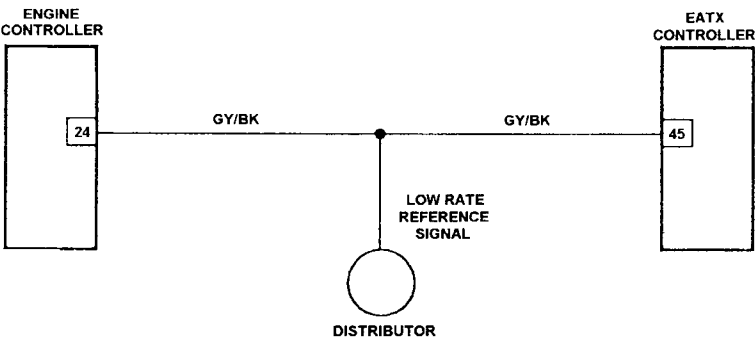
Engine Speed Sensing Problems

Between 1989 and 1992 there are different transaxle controller engine groups listed. A 3.0 liter engine group and a 3.3/3.8 liter engine group. Although the operating strategy and programming of the controllers does not differ between these two engine groups, there is one big difference between these two engine classifications. The difference is in the way that the transaxle controller reads engine RPM.

All versions of A604 controllers get two types of engine RPM signal. The controller gets a direct RPM signal from the engine, and gets a second RPM signal from across the CCD data bus. This way the controller can tell the difference between a stalled engine and an engine RPM sensor failure. If the direct signal quits, but the CCD bus signal doesn't, the controller knows that the direct signal is bad, and sets trouble code 18. If both signals show zero, this means that either the engine died, or the direct signal AND the CCD bus have failed, the former being much more likely.

The big difference between the 3.0 transaxle controller and the 3.3/3.8 controller is the type of direct engine RPM signal the controller receives. The 3.0 engine transaxle controller gets a low rate distributor reference signal directly from the distributor. However, the 3.3 and 3.8 engines have no distributor. Engine speed is read directly from a crankshaft position sensor.

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Engine Speed Sensing Problems (cont'd)

These two types of signal are quite different, and the transaxle controllers are programmed to understand either one or the other, but not both. If a crank sensor type controller gets installed in a distributor signal car, or vice-versa, the engine RPM data received won't make any sense to the controller. The unit will immediately go into failsafe, or 'Limp-In' mode.

Your scanner will show you obviously wrong engine speed readings when you check for trouble codes. It may show around 400 RPM even when you wind up the engine, or it may show 9600 RPM at any speed, even at idle. This will usually NOT set trouble code 18, which is the code for an engine speed signal problem. Direct engine speed signals need to be almost zero for this code to set.

If you need to order a new controller, compare the service part number listed in the 'New Controllers' section of this book with the vehicle year and engine size you are working on to be sure you have a matched set.

If a new computer you just installed gives you bogus engine RPM readings, or goes to immediate failsafe, double-check the part number of the controller you've got with the engine size it's supposed to fit. You may have the right year, but the wrong engine size group.

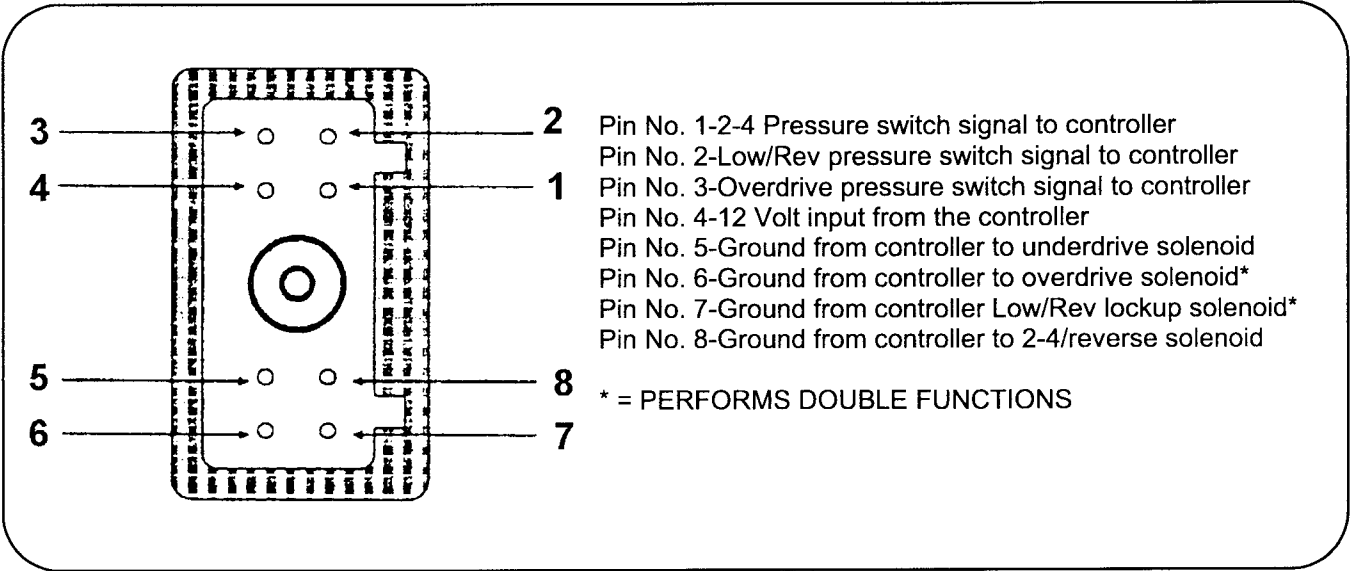
Solenoid Body Electrical Check

All solenoid body electrical functions can be checked in two stages.

The first check determines if the solenoids have a good circuit through the solenoid body to the proper ground paths.

The second check determines whether the solenoids have any improper ground paths, as well as checking pressure switch function and resistor integrity.

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Solenoid Body Connector

- Check 1: Connect one lead from your ohmmeter to solenoid body pin #4. Connect the other ohmmeter lead to pins 5, 6, 7 & 8 one at a time. If all readings show 3.0 to 3.1 ohms, the solenoids have good circuits through the solenoid body.
- Check 2: Connect one lead from your ohmmeter to the aluminum body of the solenoid body. Connect the other ohmmeter lead to solenoid body pins 5, 6, 7 & 8 one at a time. You should have no connection, or 'Out Of Limits' on all four pins.
- A. If you show a connection on any pin less than 300 ohms, you have a short to ground in a solenoid circuit. Replace the solenoid body.
 - B. If you show a connection on all pins between 300 and 325 ohms, you have a closed pressure switch circuit. Either replace the solenoid body, or disassemble and inspect it following the 'Solenoid Body Service' section of this program.

Solenoid Body Electrical Check (cont'd)

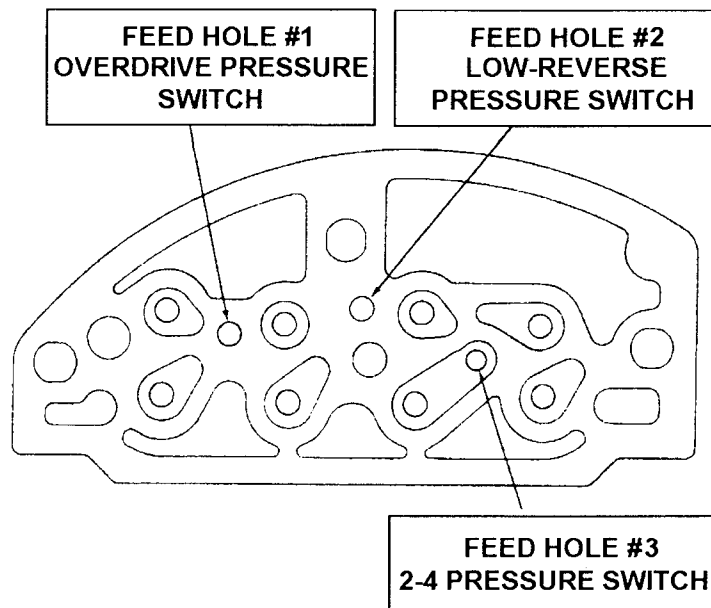
If all pins show no connection, leave your ohmmeter hooked up for the last pin check (one lead to ground, one lead to pin 8), and apply air pressure to the solenoid body ports shown in Figure 1 in the following manner:

Apply 60 psi air pressure to make sure that the pressure switches can close under minimal pressure conditions.

Apply 150 psi or more (up to 250 psi) to make sure that the circuits can handle the high pressures sometimes sent to the switches.

These pressures, when applied to each of the switch passages, should cause your ohmmeter to read between 300 and 325 ohms. As pressure is released, the ohmmeter reading must immediately change back to an open circuit. If your solenoid body shows you any readings other than those outlined here, either replace the body, or inspect it according to the 'Solenoid Body Service' section.

View of the Bottom of the Solenoid Assembly



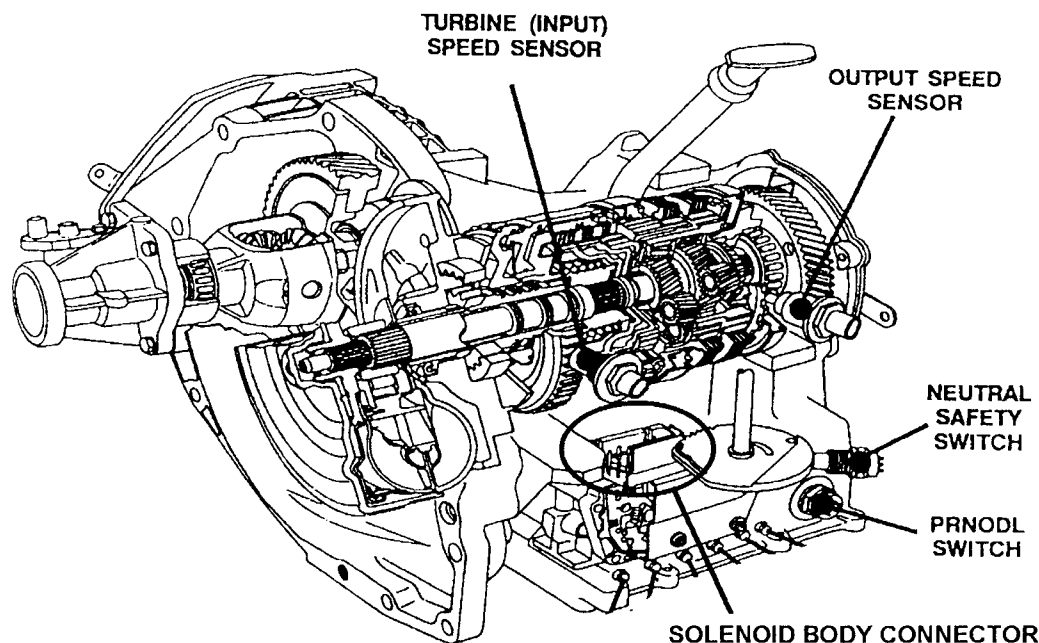
Harness Connection Repairs

Pin-to-pin connections can be a problem for the 41TE and 42LE unit control systems. Age, corrosive environments and repeated disconnecting and reconnecting can take their toll on the pin's ability to carry the proper amount of current and voltage.

These connections, due to the very high precision of the control systems, need to be in perfect working order or else some very difficult to diagnose problems will develop.

To help you meet this demand, Chrysler has provided repair kits for the harness connections that can cause trouble.

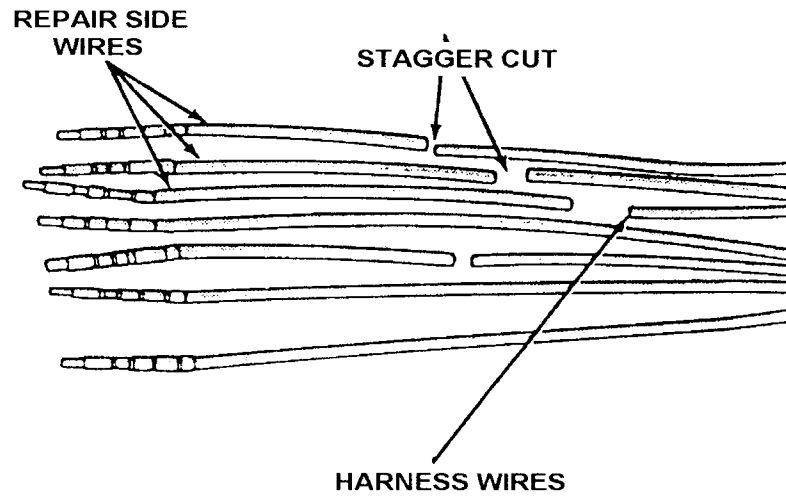
Speed sensor connector repair kits come under #4419478.



PRNODL and NSS switch connector kits come under #4638996. Keep in mind that this kit fits the late 'weather-proof' type connection. If your switches use the old exposed three pin hook-up, you will be needing new switches as well.

Solenoid body connector repair kits come under #4419476.

Harness Connection Repairs (cont'd)



TCM 60 pin connector repair kits come under #4419479. This kit comes with wires that have pins at both ends. Each of these wires are actually two repair wire ends. Cut them in half, and match up colors as best as you can. The plastic connector parts are not included in this kit.

Clutch/TCC Chatter Problems

Chatter problems during shifts and during TCC operation seem to be pretty easy to create during a rebuild. Here are some things you can do during a rebuild to help minimize the chance of this happening to you.

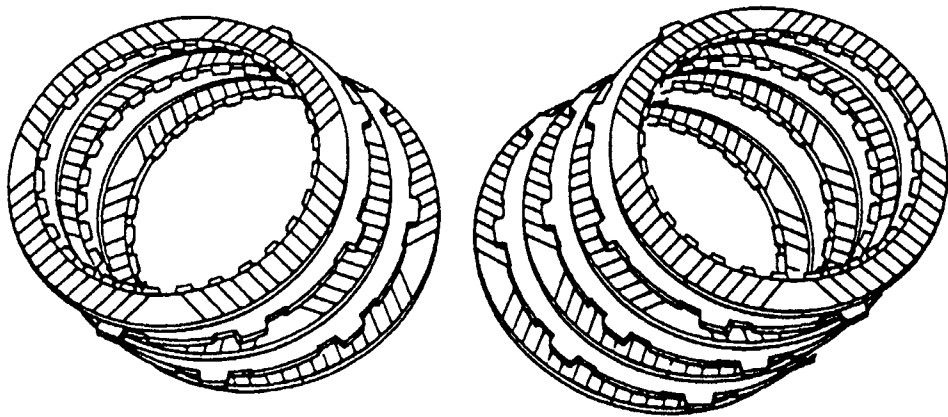
Use the proper fluid type. The readily available and common varieties of Dexron II/III and Mercon ATF are not specifically formulated to help combat chatter in the 41TE or the 42LE. Chrysler's Mopar 7176 ATF is. This formulation gives you the best odds for avoiding chatter. This fluid is available at the dealer under these part numbers:

Quart=4467721 Gallon=4467722

There are also additives available, such as the LubeGard HFM(tm) ATF supplement that provide an alternative.

Control your clutch stack thickness. The 41TE/42LE units are particularly sensitive to variations in assembled clutch pack thickness. To control this, sort the clutches and steels from your kit into separate piles for each clutch assembly. Take just the clutches from one pack and measure the thickness of that stack at four places around the stack. Rotate the plates in the stack until the thickness around the stack is within .001" at all four measured points.

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Using a felt marker, make line-up marks on the edge of the stack. Do the same to the steels for that clutch, then each of the other separate groups of clutches and steels. What may seem like a pain now will fade in time as you discover how well it works.

The steel plate teeth have sharp edges on one side. Round these off with a wire wheel.

Cooler Bypass Valve

The 41TE (604) has a crucial need for an uninterrupted flow of lube oil. One area that can cause problems with lube flow is the cooler circuit. Restrictions in the cooler circuit reduce the amount of oil returning from the converter to the transmission as lube oil, and this can cause destroyed gear train parts.

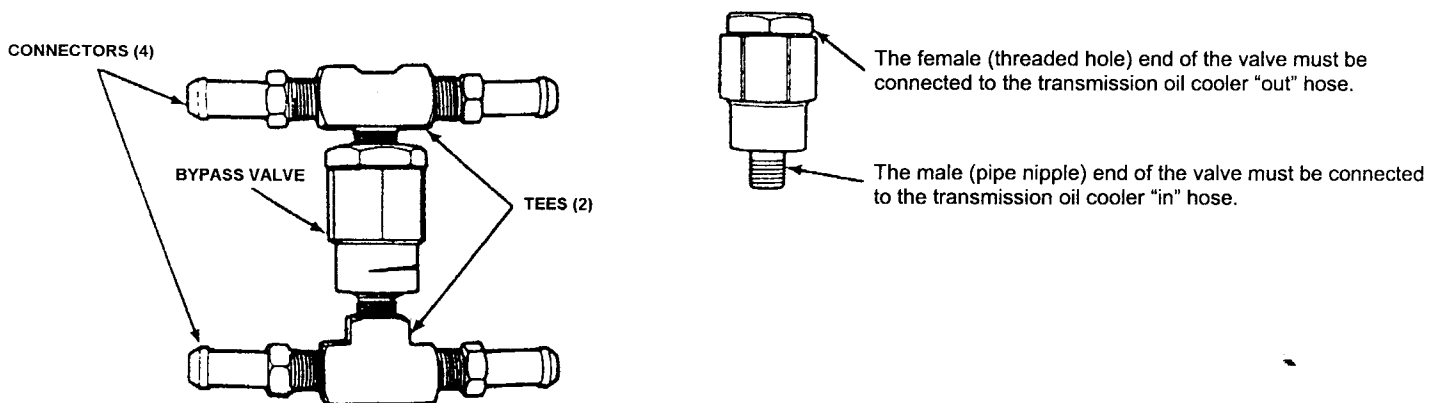
From 1989 through 1990, there was no provision for any cooler restrictions in the original design. It wasn't until almost 1991 that cooler restrictions were found to be the cause of most gear train failures.

Starting in 1991, a cooler bypass valve was installed into the case behind the pump gasket. If cooler restrictions caused outgoing cooler pressure to go above a certain point, this valve would give the excess pressure a way back to the cooler return line without having to go through the cooler. This keeps the lube circuit in the unit well charged at all times, regardless of the condition of the cooler flow.

For all previous units (1989-1990), a kit was designed that allows you to splice in a different style bypass valve into (between) the cooler lines. This provides the same protection as the designed-in valve. You can order this kit from Chrysler:

Part #5252836

Although this kit was designed to work on a Chrysler vehicle, you will find it quite useful on any unit suffering from lube failures caused by cooler restrictions, such as the Nissan RE4R01A, the Ford E4OD, the THM 4L60 (700), etc.

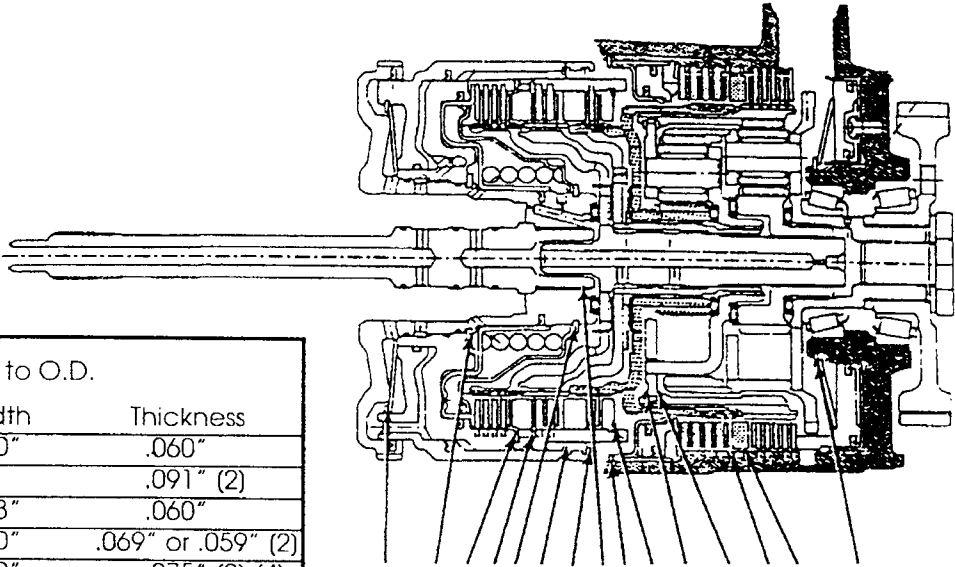


Chrysler Bypass Valve, #5252836

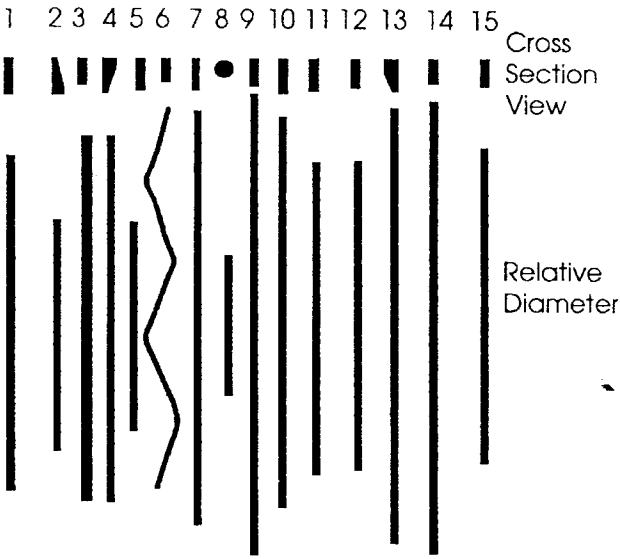
Snap Ring Chart

If you have a Chrysler 41TE apart, and you are not very familiar with the internal arrangement, one of the more confusing things you may encounter is the number and variety of snap rings you will find inside one of these units.

Here is a chart showing the approximate location and dimension of the different snap rings you'll find throughout the unit.



	Approx. Relaxed	I.D. to O.D.	
		Width	Thickness
1	5 1/4"	.220"	.060"
2	2 5/8"	(1)	.091" (2)
3	5 15/16"	.173"	.060"
4A	6 1/2"	.140"	.069" or .059" (2)
4B	6 1/2"	.140"	.075" (2) (4)
5	2 5/16"	(1)	.076"
6	7 1/16"	.109"	.061" (3)
7	7 1/2"	.109"	.071"
8	1 1/16"	Round	.062"
9	7"	.187"	.060"
10	5 3/4"	.153"	.062"
11	4 5/8"	.138"	.061"
12	4 5/8"	.138"	.061"
13	7 5/16"	.142"	.067" (2)
14	6 3/4"	.156"	.040"
15	3 7/16"	.260"	.061"
(1)	Tru-arc™		
(2)	Beveled		
(3)	Waved		
(4)	Upgrade snap ring with stepped pressure plate - see Bulletin #177.		



Underdrive/Overdrive Pressure Plate

Be certain you replace a broken or worn pressure plate with the right style for the drum you are using. One common mismatch involves using an early three O/D clutch input drum that needs a pressure plate. The most commonly available plate is the new style plates that come with the new thicker snap ring. This will not work properly in the early drum, because this drum has a much larger space between the pressure plate snap ring grooves. This means that the pressure plate will not be solidly locked into position, but instead will be free to move up and down between the snap rings. This is guaranteed to totally foul up the clutch clearances you THINK you are setting this unit up with.

If for some reason you absolutely must use an early three plate input drum, make sure you use one of the early, thickest group of selective plates. Pressure plate thicknesses:

6.52mm (.257")

7.01mm (.276")

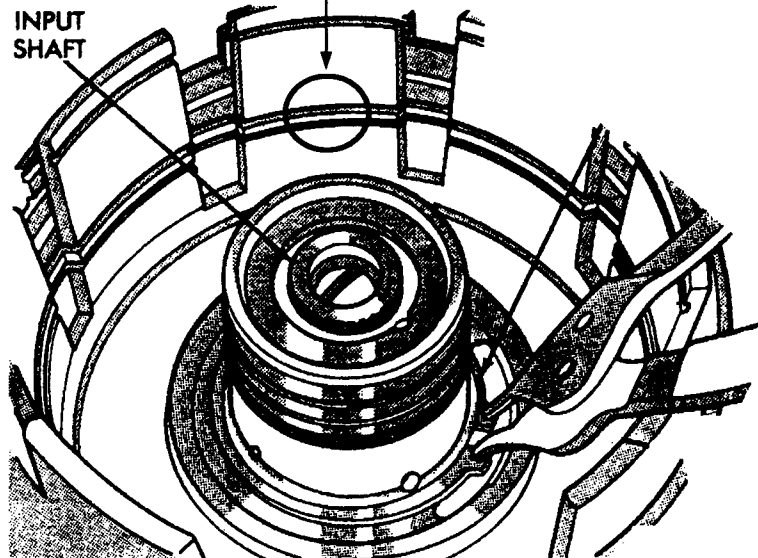
7.50mm (.295")

7.99mm (.315")

Measure the width of this rib to identify drum.

EARLY =
.125" BETWEEN GROOVES

LATE =
.085" BETWEEN GROOVES



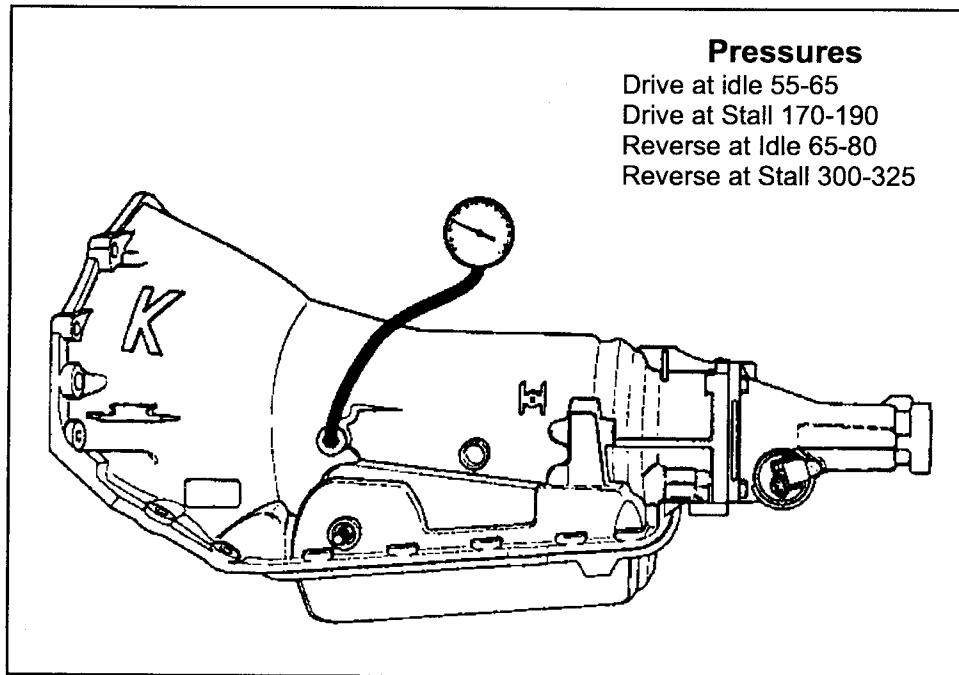
4L60-E

Pressures and Pressure Taps.....	51
Clutch and Band Application.....	51
Solenoid Patterns.....	51
Failsafe Mode.....	51
Gear Ratios.....	51
Checkball Locations.....	52
Wrong Gear Starts.....	53
No 4th Gear.....	53
Valve Body Bolt Reference.....	54
Transmission Wiring Harness.....	55
The Major Electrical Components.....	56
Stack Shifts.....	57
DTC 16 or 72.....	58
Pump Changes.....	61
1996 Updates.....	63
1997 Updates.....	67

4L60-E



4L60-E



Range	Gear	Sol A	Sol B	2-4 Band	Reverse Input Clutch	Overrun Clutch	Forward Clutch	Input Sprag	3-4 Clutch	Low Roller Clutch	Low Reverse Clutch
P-N											
R	Reverse										
D	1st										
	2nd										
	3rd										
	4th										
D	1st										
	2nd										
	3rd										
2	1st										
	2nd										
1	1st										
	2nd										

★ = Holding but ineffective due to overrun Clutch.

• = Holding but ineffective due to low reverse Clutch.

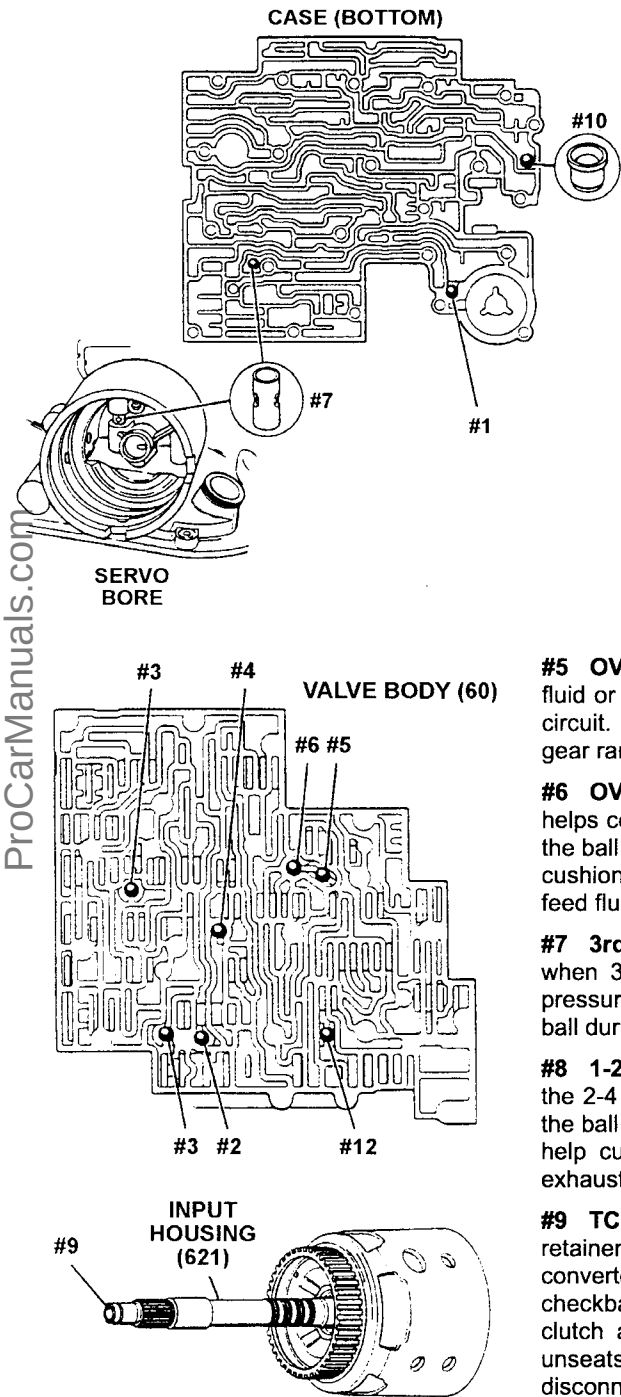
Failsafe Mode

D	3rd
D	3rd
2	2nd
1	2nd

Gear Ratios

1st	3.06
2nd	1.63
3rd	1.00
4th	.69
Reverse	2.29

Checkball Locations and Functions



#1 3-4 ACCUMULATOR: Located in the transmission case, the 3-4 accumulator checkball helps control the flow of accumulator fluid to the 3-4 accumulator. When the ball is seated, accumulator fluid is forced through the #18 orifice. This action helps control the 2-4 band release during a 4-3 downshift.

#2 3rd ACCUMULATOR: Located in the valve body, the 3rd accumulator checkball directs exhausting 3rd accumulator fluid through orifice #12 and to the 3-4 control valve. This helps control the 2-4 band apply during a 3-2 downshift. During a 3-4 upshift, 3-4 upshift, 3-4 clutch fluid unseats the ball for a quick feed into the 3rd accumulator fluid circuit.

#3 REVERSE INPUT: Located in the valve body, the reverse input checkball controls the reverse input clutch apply when engine speed is at idle. During these conditions, all reverse fluid feeding the reverse input fluid circuit is routed to the ball, seats the ball, and is forced through orifice #17. This slows the flow of reverse fluid to cushion the reverse input clutch apply. When the reverse input clutch releases, exhausting reverse input fluid unseats the ball for a quick exhaust of fluid.

#4 3-4 CLUTCH EXHAUST: Located in the valve body, this checkball helps control the 3-2 downshift. Exhausting 3-4 clutch and 3rd accumulator fluids seat the ball and are forced through orifice #13. This helps control the 3-4 clutch release rate and 2-4 band apply. During a 3-4 upshift, 3-4 signal fluid unseats the ball for a quick feed into the 3-4 clutch fluid circuit.

#5 OVERRUN CLUTCH FEED: Located in the valve body, it routes either overrun fluid or D2 fluid into the overrun clutch feed fluid circuit while blocking the other fluid circuit. Overrun clutch feed fluid feeds the overrun clutch fluid circuit in the Manual gear ranges to apply the overrun clutch.

#6 OVERRUN CLUTCH CONTROL: Located in the valve body, the #6 checkball helps controls the overrun clutch apply rate. Overrun clutch feed fluid pressure seats the ball and is forced through orifice #20. This orifice slows the flow of overrun fluid to cushion the overrun clutch apply. When the overrun clutch releases, overrun clutch feed fluid unseats the ball for a quick exhaust.

#7 3rd ACCUMULATOR EXHAUST: Located in the transmission case, it unseats when 3rd accumulator fluid exhausts from the 2-4 servo to prevent residual fluid pressure from accumulating. Also, before 3rd accumulator fluid pressure seats the ball during a 2-3 upshift, any air in the circuit exhausts past the ball.

#8 1-2 UPSHIFT: Located in the valve body, the 1-2 upshift checkball helps control the 2-4 band apply during a 1-2 upshift. During the upshift, 2nd fluid pressure seats the ball and is forced through the #16 orifice. This orifice slows the flow of 2nd fluid to help cushion the band apply. When the band releases during a 2-1 downshift, exhausting 2nd clutch fluid unseats, and exhausts past, the 1-2 upshift checkball.

#9 TCC APPLY: Located in the end of the turbine shaft, the #9 checkball is a retainer and ball assembly that helps control the converter clutch apply feel. As the converter clutch applies, exhausting release fluid seats, and is orificed around the checkball. This action slows the exhaust of release fluid to control the converter clutch apply feel. When the converter clutch is released, release fluid pressure unseats the checkball and flows freely past the ball to keep the pressure plate disconnected from the converter cover.

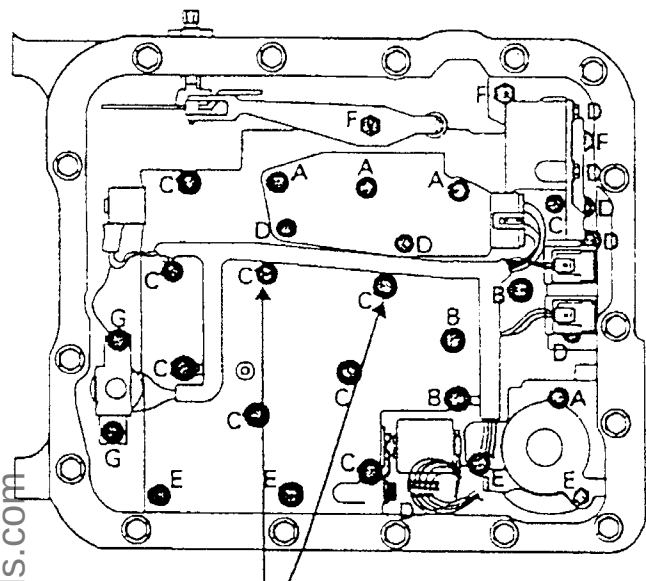
#10 LO/REVERSE CLUTCH APPLY: Located in the transmission case, the #10 checkball is a retainer and ball assembly that helps control the lo and reverse clutch apply feel. During the clutch apply, PR fluid pressure seats, and is orificed around the checkball. This orifice slows the increase of PR fluid pressure at the clutch piston to cushion the apply feel. When the clutch releases. Exhausting PR fluid unseats the checkball for a quick exhaust.

#11 FORWARD CLUTCH ACCUMULATOR: Located in the valve body, it helps controls the forward clutch apply when engine speed is at idle. During these conditions, all D4 feeding the forward clutch feed fluid circuit is routed to the ball, seats the ball, and is forced through orifice #22. This slows the increase of forward clutch feed fluid pressure to cushion the forward clutch apply. When the forward clutch releases, exhausting forward clutch feed fluid unseats the ball for a quick exhaust of fluid.

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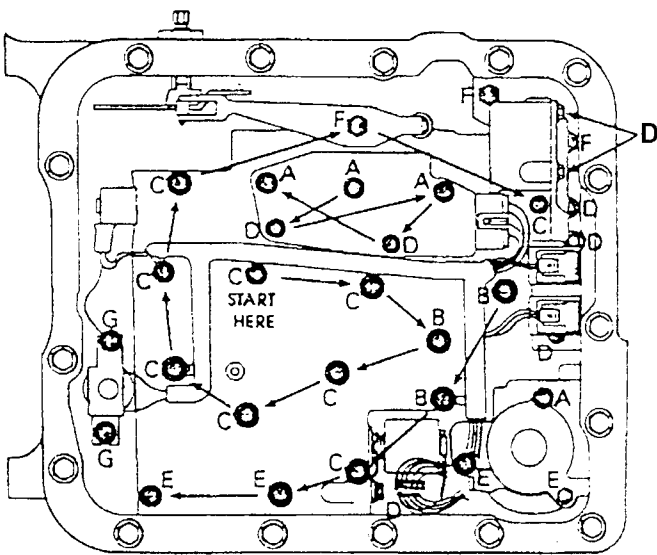
NOTE: If the shift solenoids leak when energized with 12 volts, they should be replaced.

Valve Body Bolt Reference



Bolt location.

Make sure these bolts are not too long.



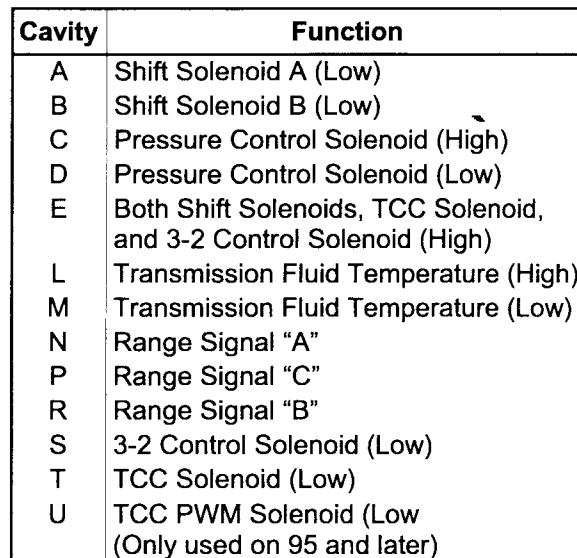
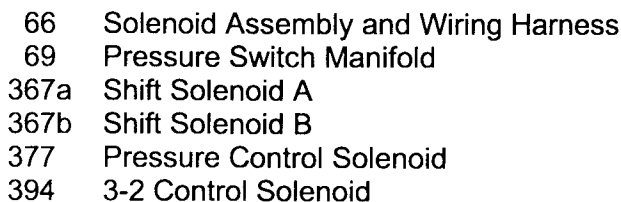
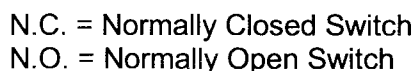
Torque Sequence.

A	65.0mm	
B	54.4mm	8mm head
C	47.5mm	
D	18.0mm	8mm head
E	35.0mm	
F	20.0mm	
G	12.0mm	8mm head

Torque all valve body bolts as shown, in a spiral pattern to 96 inch-pounds. Torque should be done in stages, 30-60 final 96-inch pounds.

NOTE: Improper bolt location can give you second gear starts, bind up in reverse, bind up in manual low and a bind on the 2-3 shift, and or shuttle shifting on 2-3 shift.

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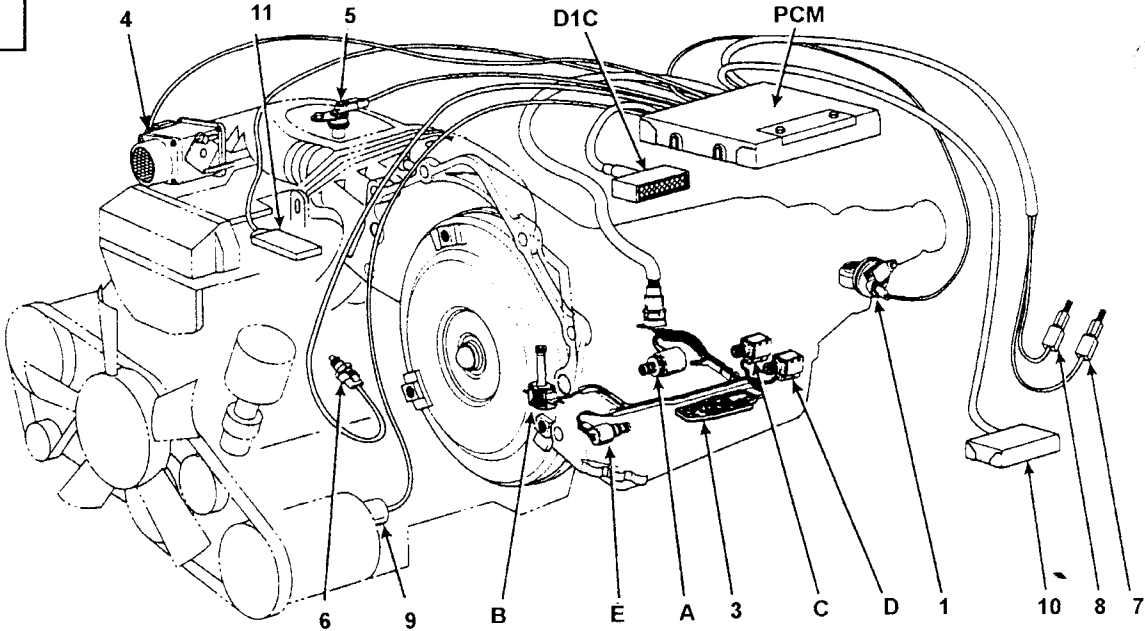


Electrical Components

°C	°F	RESISTANCE
-40	-40	100544
-28	-21	52426
-16	10	18580
-4	23	12300
0	32	9379
7	40	7270
19	58	3520
31	86	2232
43	110	1200
55	131	858
67	145	675
79	176	333
91	194	241
103	213	154
115	239	115
127	260	7*9
139	284	60
151	302	47

COMPONENT	WIRE COLOR	PASS-THRU PIN	RESISTANCE	CKT#
Shift Solenoid A	RED	E *	20-40 Ohms	1149B
	LT GRN	A		1222
Shift Solenoid B	RED	E *	20-40 Ohms	1149A
	YEL	B		1223
3-2 Control Solenoid	RED	E *	9-14 Ohms	1149C
	WHT	S		897
Pressure Control Solenoid	PPL	C	3.5-8 Ohms	1228
	LT BLU	D		1229
TCC Solenoid	RED	E *	20-40 Ohms	1149E
	BLACK	T		422A

* Spliced internally to Pin E



INFORMATION SENSORS

1. Vehicle Speed Sensor

2. Transmission Fluid Temperature Sensor

3. Fluid Pressure Switch Assembly (PSA)

4. Throttle Position Sensor (TPS)

5. Engine Speed Sensor

6. Engine Coolant Temperature Sensor

7. Brake Switch

8. 4 Wheel Drive Low Switch

9. Air Conditioning Request

10. Cruise Control Information

11. Manifold Absolute Pressure Sensor



ELECTRONIC CONTROLLERS

• Powertrain Control Module (PCM)



ELECTRONICALLY CONTROLLED TRANSMISSION COMPONENTS

A. Pressure Control Solenoid

B. Torque Converter Clutch Solenoid

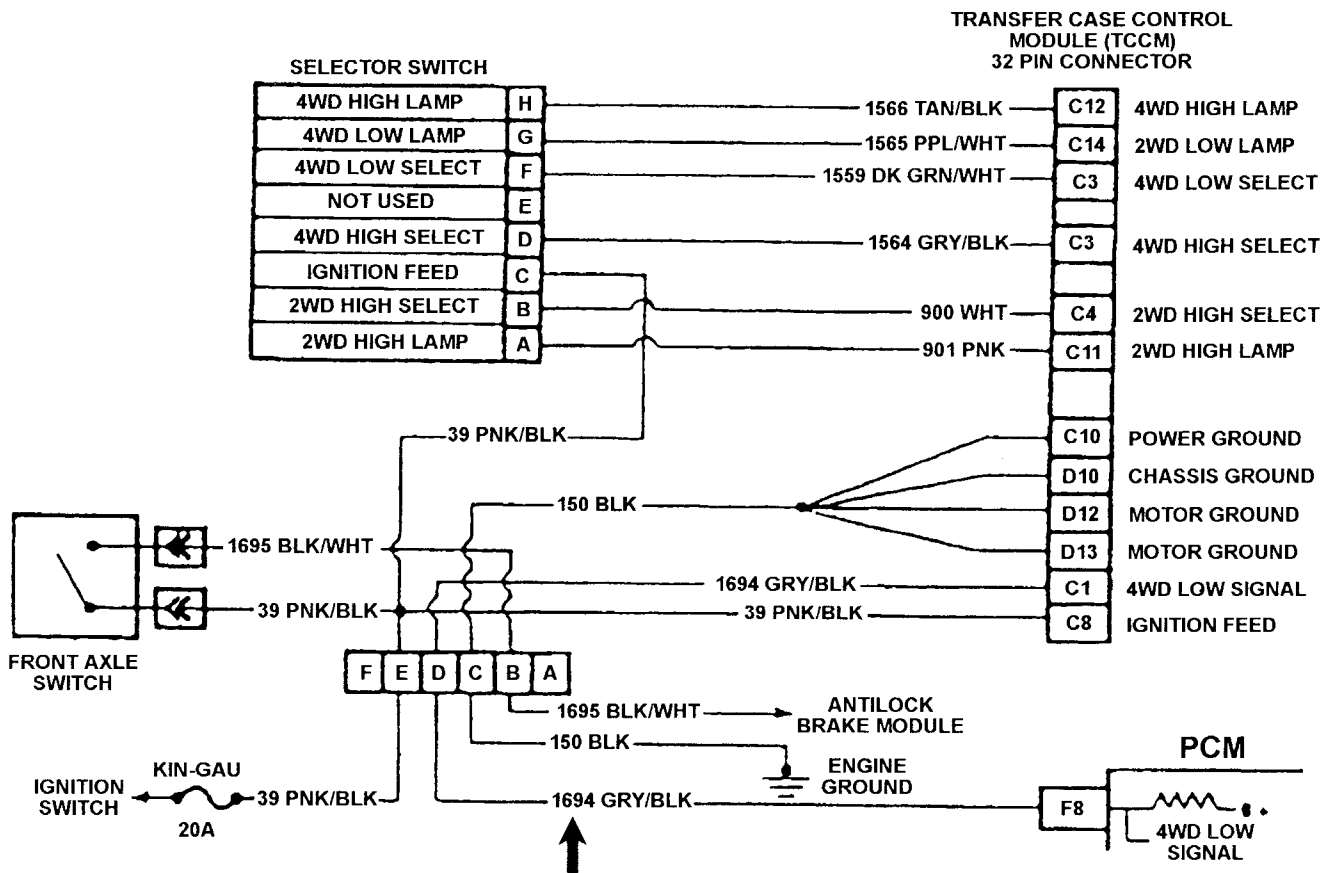
C. Shift Solenoid "A"

D. Shift Solenoid "B"

E. 3-2 Control Solenoid

Stack Shifts

Two wheel drive as well as four wheel drive units are equipped with the same wiring harness for the computer. If the shifts are stacked at all throttle angles, monitor circuit 1694. This is the four wheel drive low circuit. Circuit 1694 is grounded for a 4WD-Low signal. A grounded wire will cause stacked shifts.

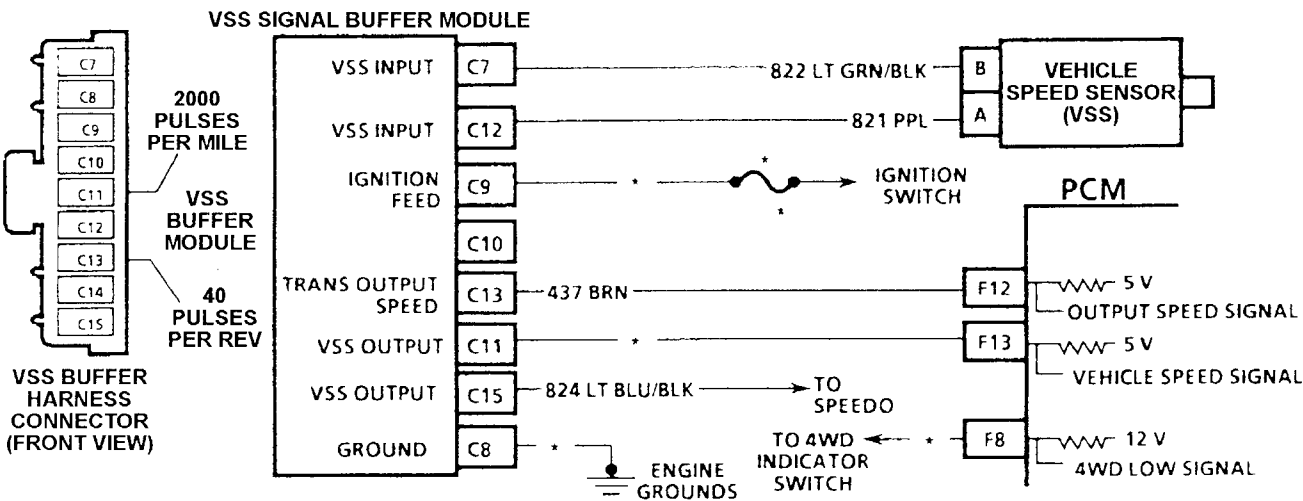


NOTE: 2WD models contain the 4WD-Low wire (1694) even though it is non-functional.

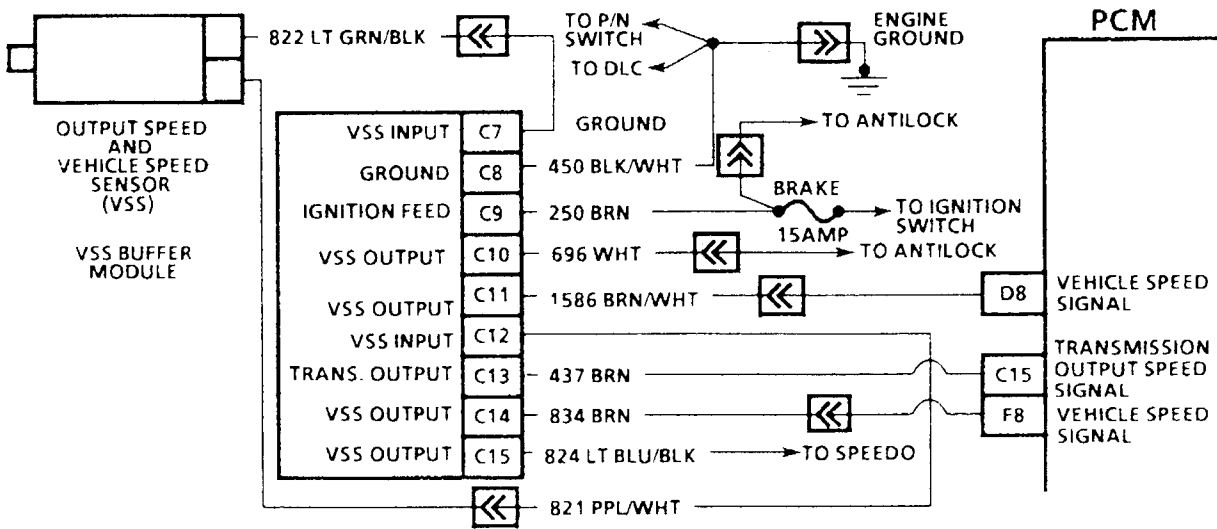
VSS Circuit Loss

Code 16 or 72

The V.S.S. buffer module can give us a number of shift concerns. The buffer converts the V.S.S. signal sent by the speed sensor into a D.C. signal to indicate transmission output speed.



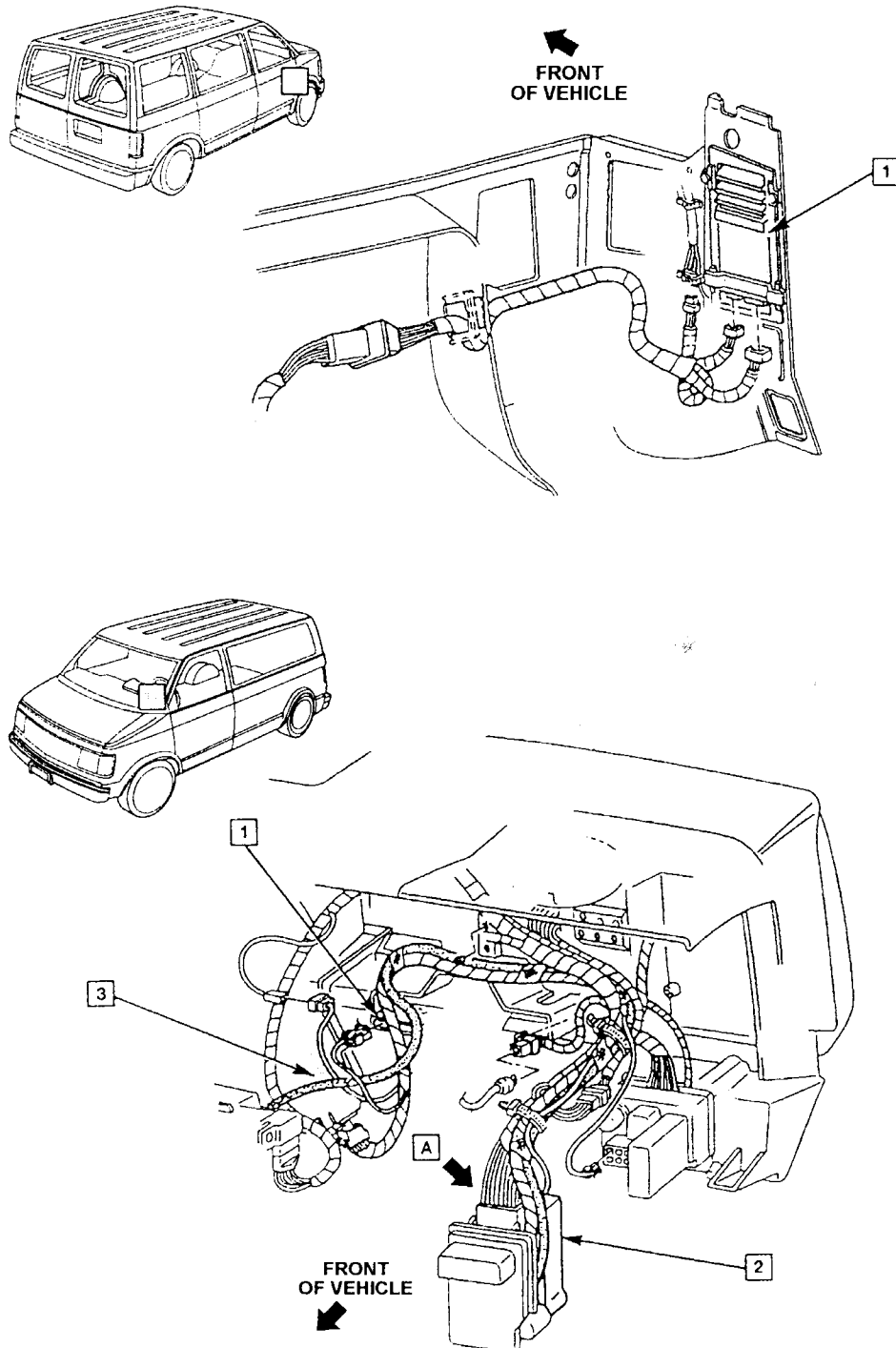
DTC 72 GAS—VEHICLE SPEED SENSOR (VSS) CIRCUIT LOSS



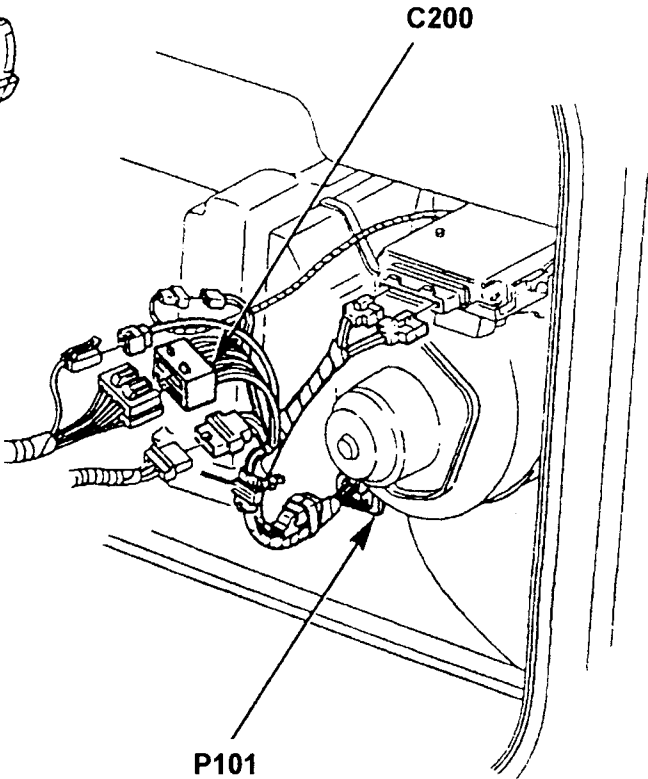
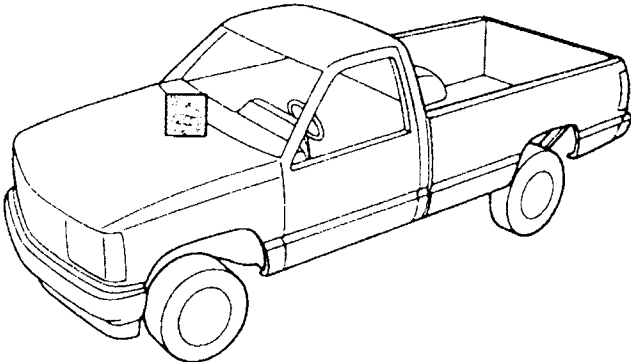
DTC 16 DIESEL

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Location of the PCM and the VSS Buffer Module M/L Van



Location of the PCM and the VSS Buffer Module C/K Trucks

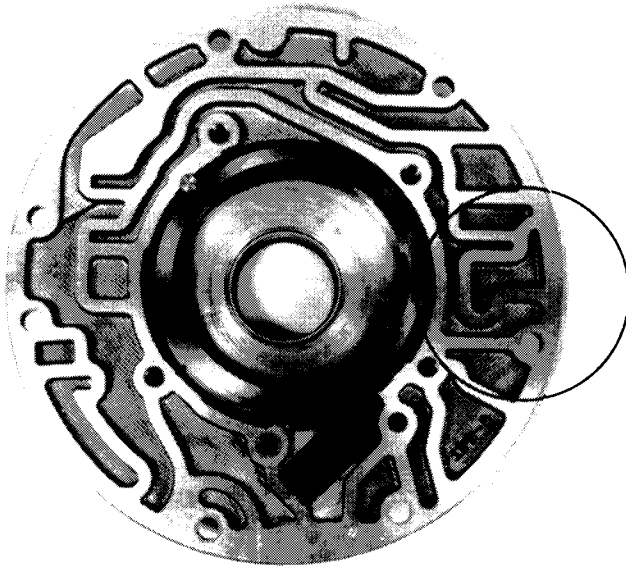


FRONT
OF VEHICLE

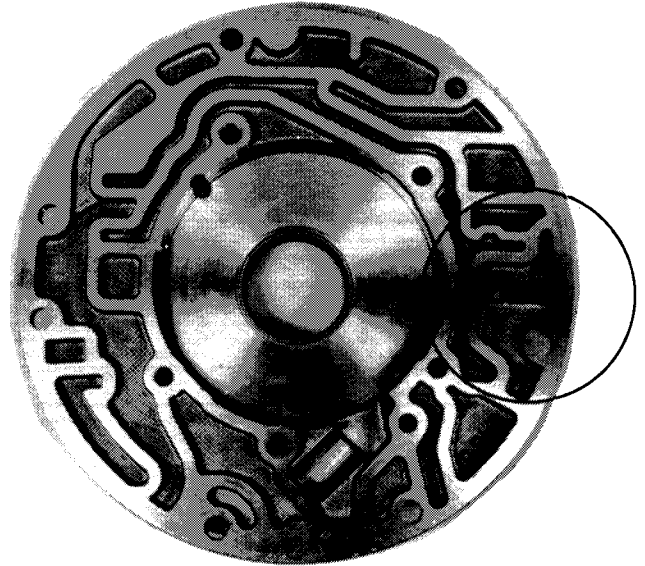


Pump Changes

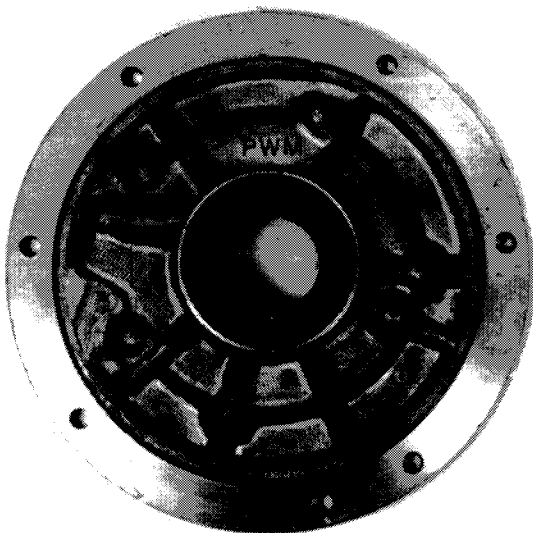
There are four types of oil pumps available at this time for the 4L60E. Non-modulated, modulated, modulated with bolt-on bell housing, and new for 1997 13 vane pump (shown on page 68). ID is simple.



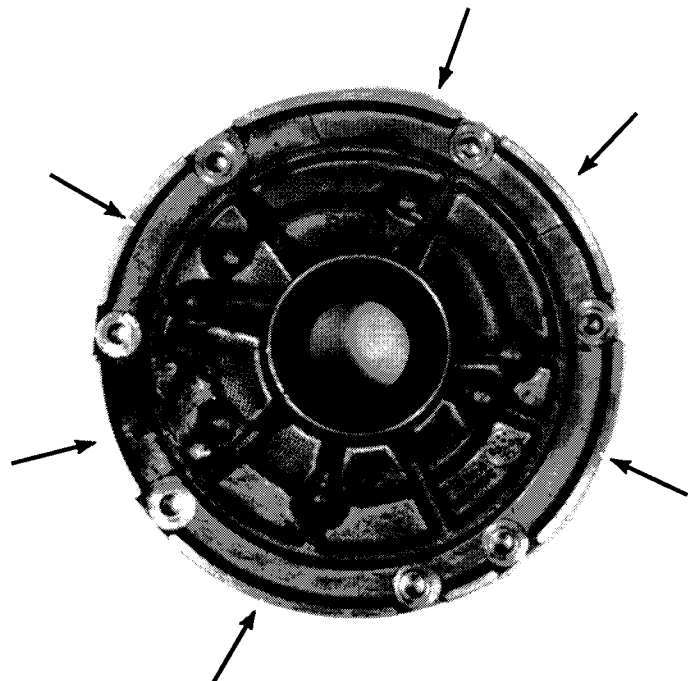
Non-PWM



PWM



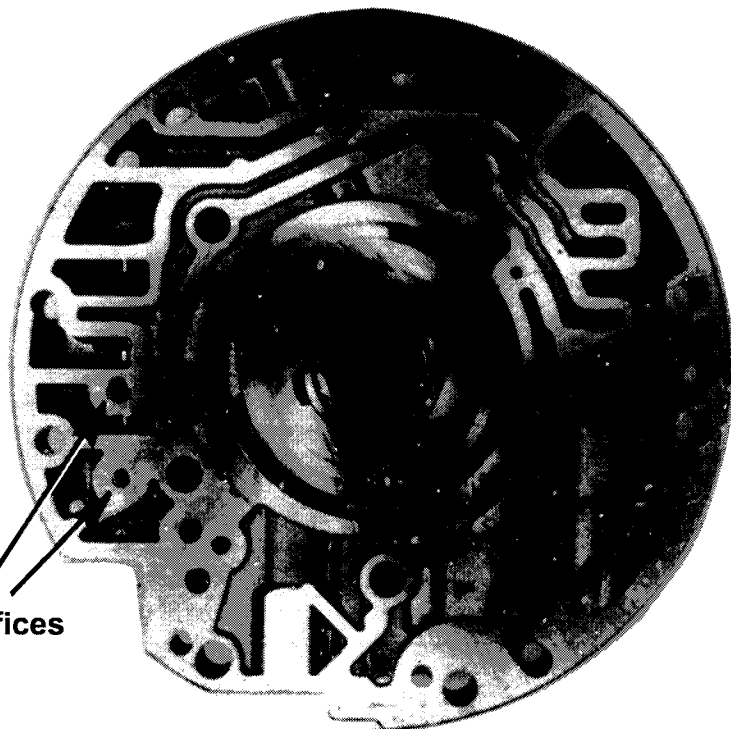
One Piece Case



Bolt-On Bellhousing
(Notice the support ridges)

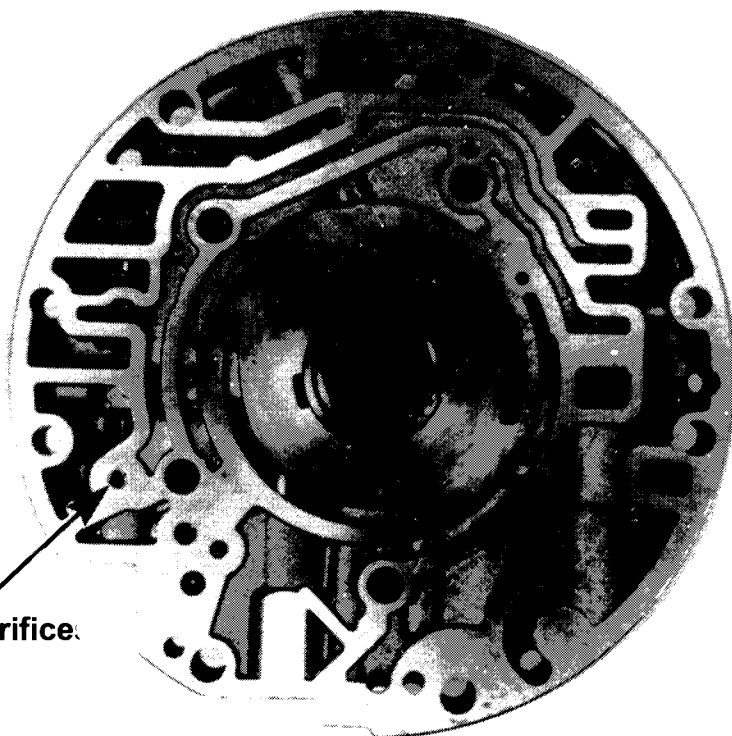
Pump Changes (cont'd)

Stator Support



Two Orifices

Non-PWM



One Orifice

PWM

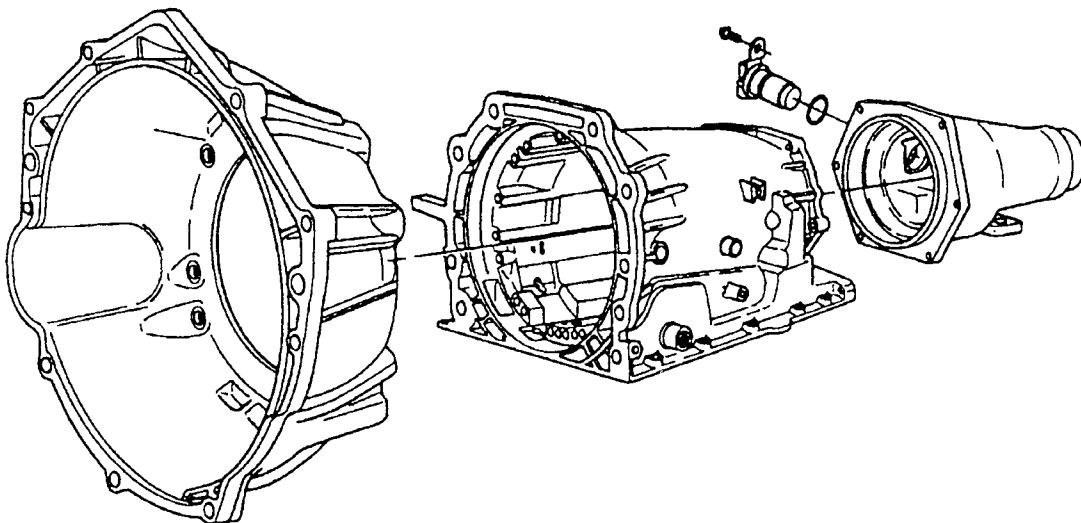
Changes for 1996

The Hydra-matic 4L60-E transmission has changed many areas for the 1996 Model Year:

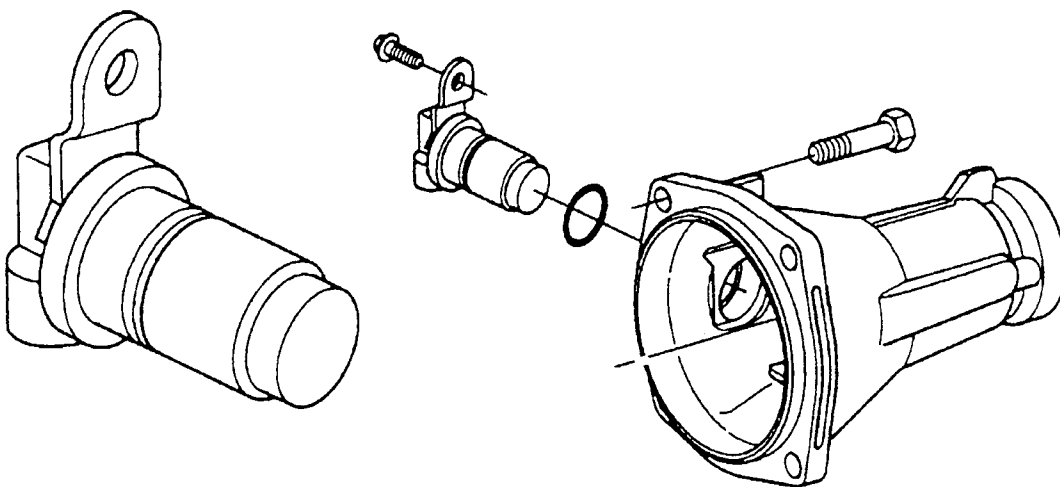
- Two piece case/enhanced flexibility for future applications
- Speed sensor/in-line, enhanced manufacturing and cost
- Extension assembly/right hand side mounted speed sensor and increased strength
- 3-2 Control line-up/discrete on/off solenoid and simplified design
- Manual valve/to ease linkage adjustment
- Forward clutch wave plate/enhanced gear shift and commonize parts
- Pump assembly/raised rib for two piece case
- Torque converter assembly/brazed turbine blades for increased strength
- Quick connect cooler fittings

Changes for 1996 (cont'd)

Two Piece Case & Case Extension

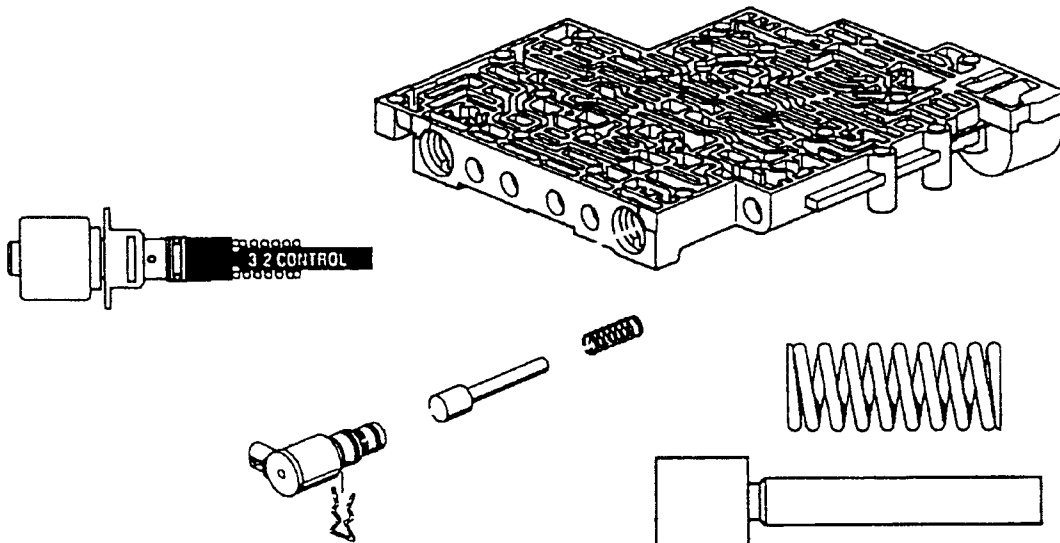


Case Extension & In-Line Speed Sensor

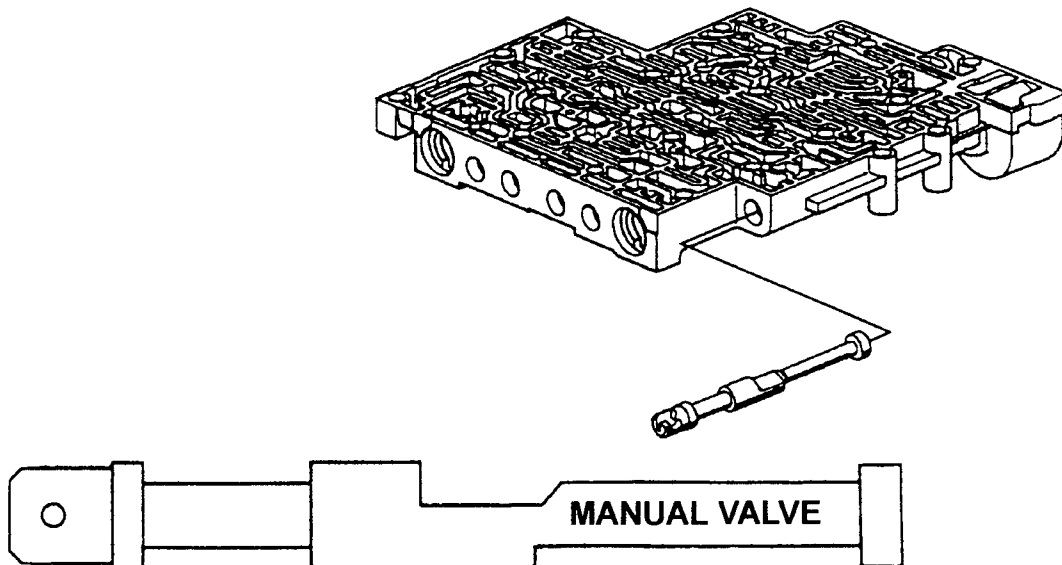


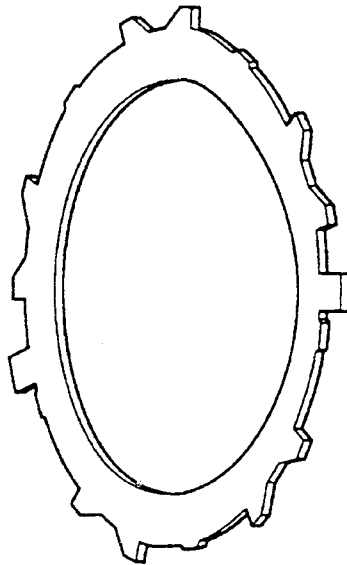
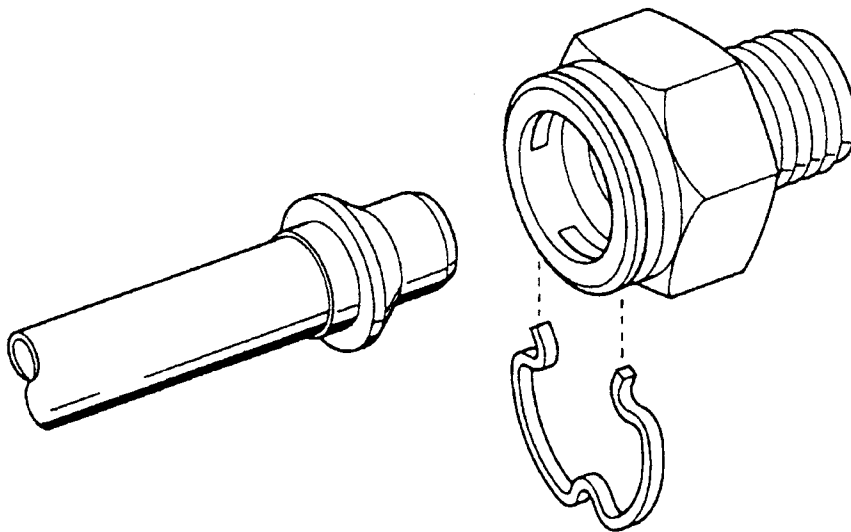
Changes for 1996 (cont'd)

3-2 On/Off Control



Manual Valve



Changes for 1996 (cont'd)**Forward Clutch Plate (Waved)****Quick Connect Cooler Fittings**

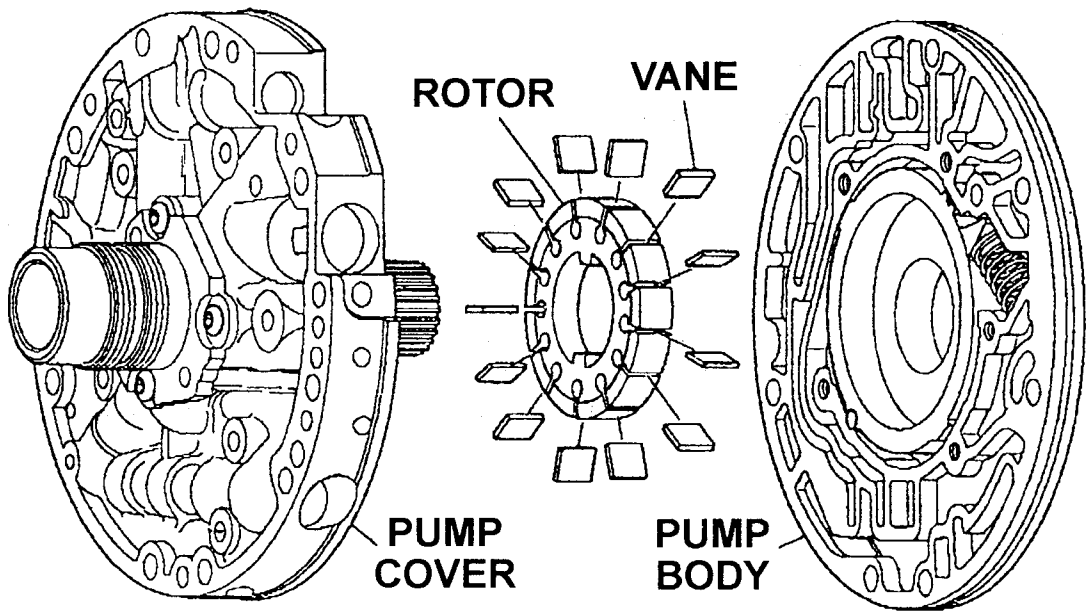
Changes for 1997

The HYDRA-MATIC 4L60-E transmission has received the following refinements for the 1997 model year:

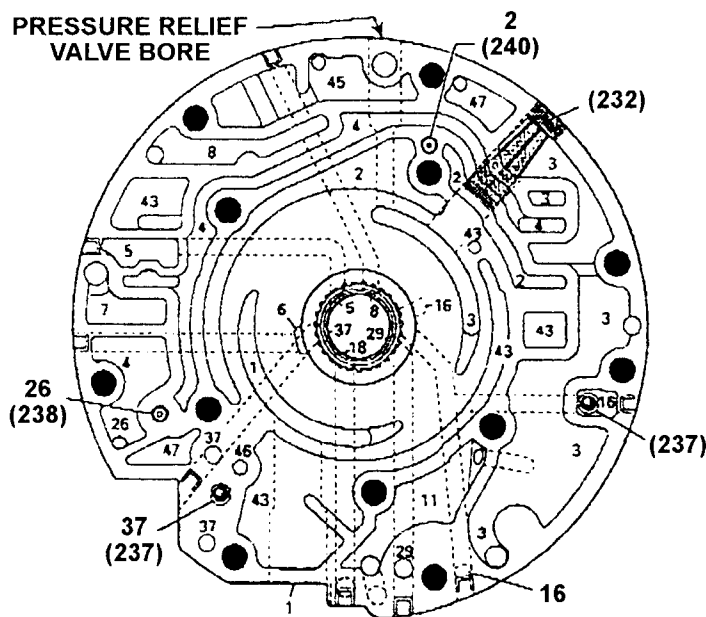
- Oil pump (13 vanes) / to balance pressure and reduce noise
- Channeling in pump cover / 13 vane pump
- Inputs stamped and bonded pistons (forward and overrun clutches) / eliminated forward clutch damage
- Spring assembly (overrun clutch) / bonded piston change
- Reverse and low & reverse clutch pack turbulator plates (slots in plates) / to improve cooling and lubrication
- 3-4 clutch friction plates / new material for improved durability
- 3-4 clutch steel plates / new material for improved durability
- Aluminum spool valves / anodized material to reduce leakage
- Wiring harness / push-on feature, positive pressure control solenoid connector to ease assembly
- Revised speed sensor bracket / new protective bracket for shipping

Changes for 1997 (cont'd)

Thirteen Vane Oil Pump

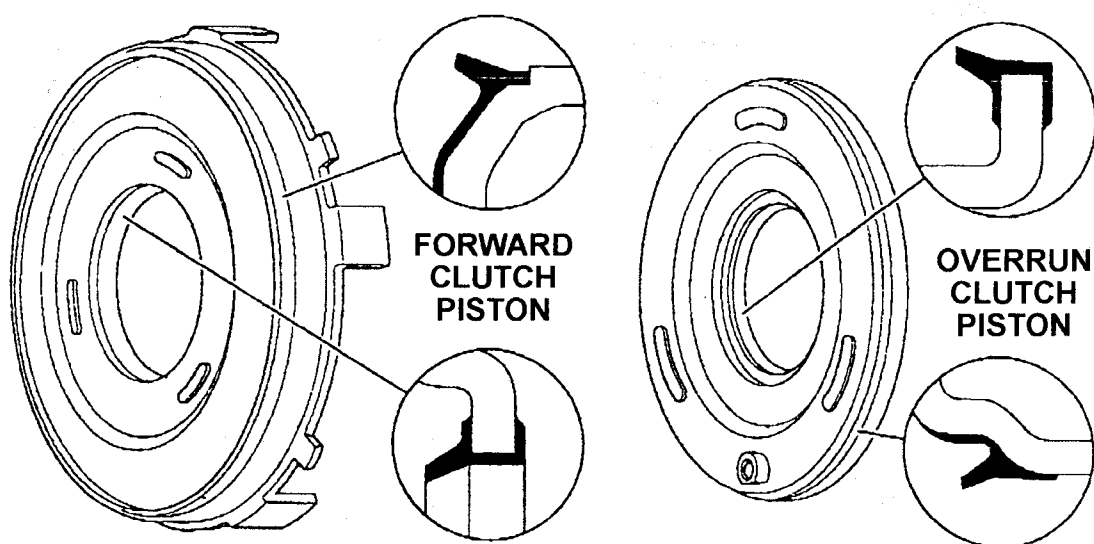


Channeling in Pump Cover

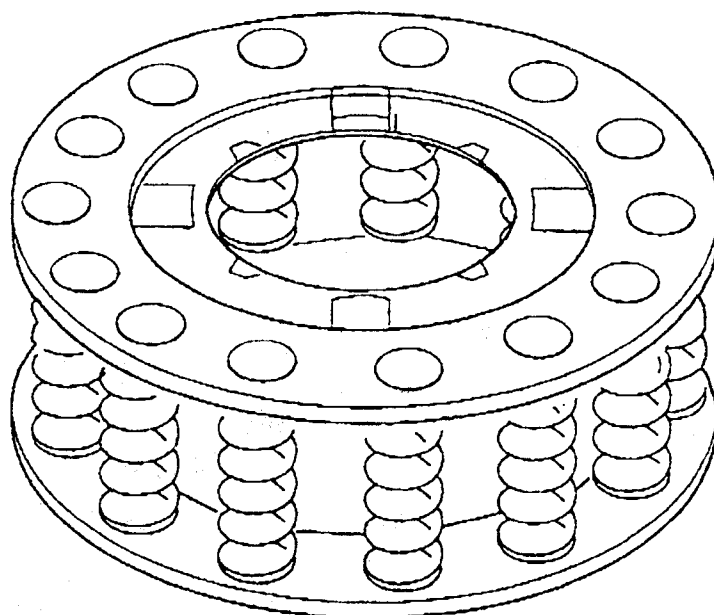


Changes for 1997 (cont'd)

Stamped and Bonded Pistons

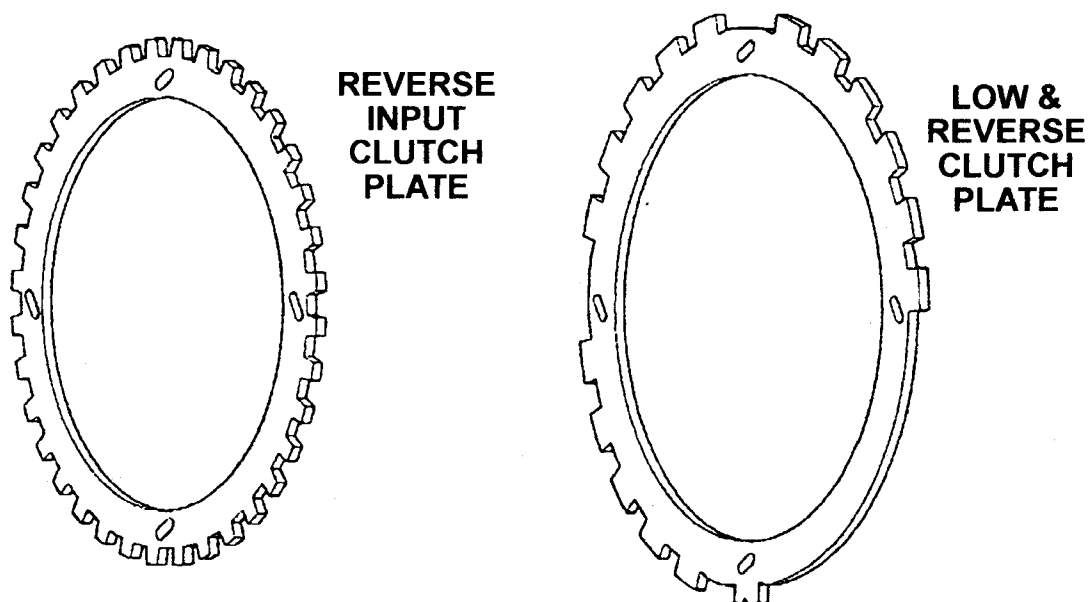


Spring Assembly (Overrun Clutch)

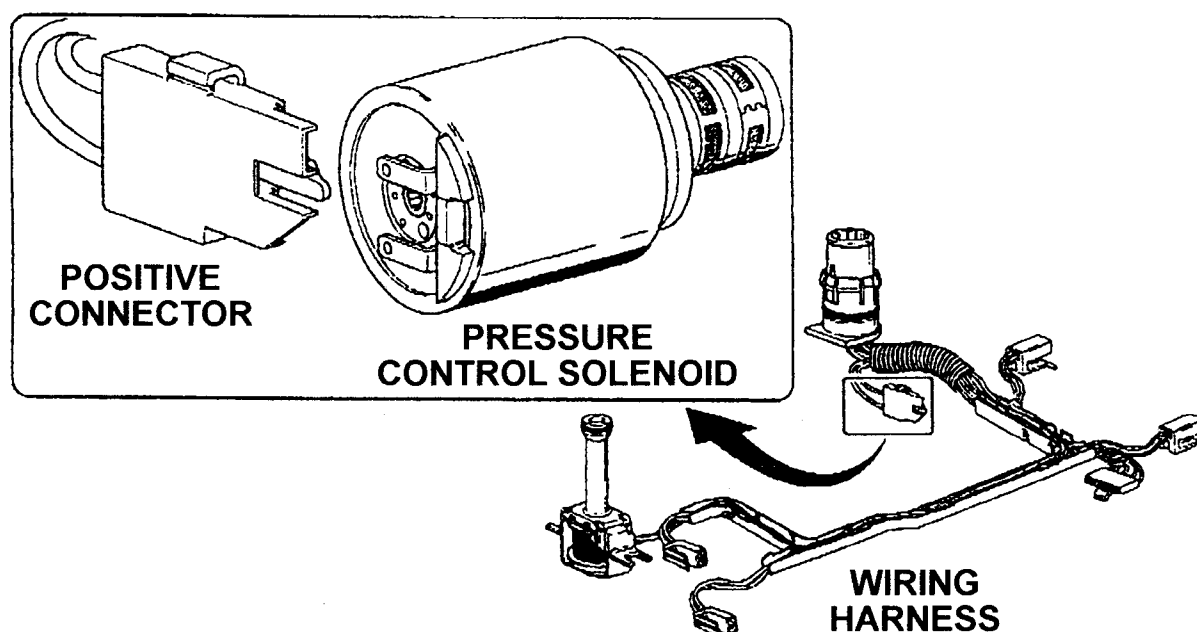


Changes for 1997 (cont'd)

Turbulator Plates (Slots in Plates)

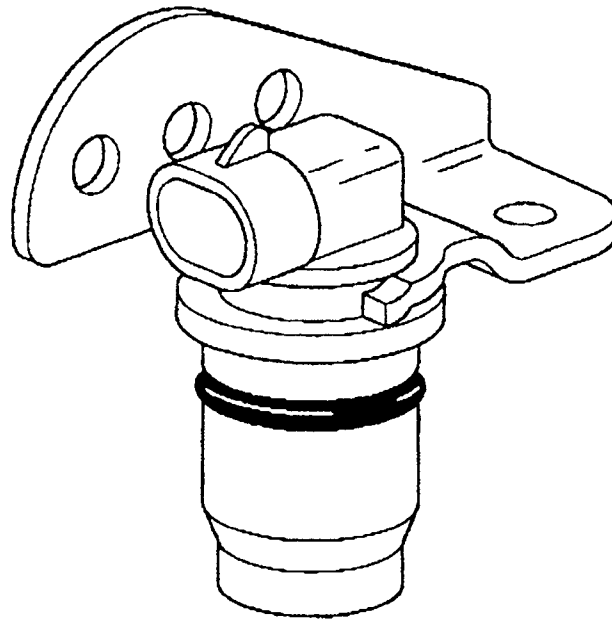


Wiring Harness/Push-On Feature, Positive Pressure Control Solenoid Connector



Changes for 1997 (cont'd)

New Protective Speed Sensor Bracket

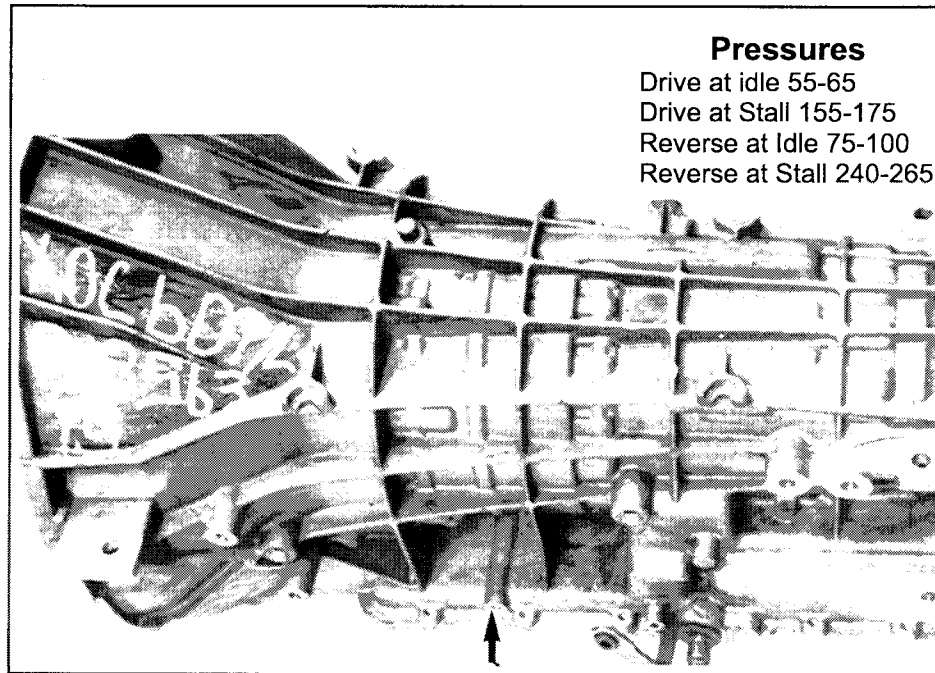


E4OD	
Pressures and Pressure Taps.....	75
Clutch and Band Application	75
Solenoid Patterns	75
Failsafe Mode.....	75
Gear Ratios	75
Checkballs.....	76
How to Diagnose Stubborn Codes.....	79
TPS and FIPL Codes	80
MLPS Codes	81
Solenoid Codes	82
VSS and PSOM Codes	83

E4OD



E40D



Range	Gear	Sol 1	Sol 2	Fwd Clutch	Overdrive Sprag	Overdrive Clutch	Coast Clutch	Int Clutch	Int Sprag	Int Band	Direct Clutch	Low Reverse Clutch	Low Roller Clutch
P-N													
R	Reverse												
D	1st						●						
	2nd						●						
	3rd						●						
	4th												
2	1st								★				
1	2nd												

- ★ = Holding but ineffective due to Band.
● = The coast clutch applies in **D** when the O/D cancel switch is preseed.

Failsafe Mode

D	4
2	2
1	2

Gear Ratios

1st	2.71
2nd	1.54
3rd	1.00
4th	.71
Reverse	2.18

Checkball Locations

Balls 1 through 9 used on all models.

- 1: Separate two and reverse flow at low reverse modulator valve. (Eliminated in 1996)
- 2: Separates manual two flow and reverse flow to the 4-3-2 timing valve and the coast clutch shift valve.
- 3: Forces direct clutch to exhaust through orifice during 3-2 downshift.
- 4: Forcing band servo apply pressure through orifice while bypassing the orifice on exhaust.
- 5: Forces intermediate clutch to exhaust through orifice during 2-1 downshift.
- 6: Feeds reverse flow through 4-3-2 shift timing valve.
- 7: Separates solenoid four flow from either the manual two flow or the reverse flow which shifts the coast clutch shift valve.
- 8: Forces coast clutch feed fluid through orifice for 4-3 downshift and manual 1 or 2 pull-ins while allowing free exhaust.
- 9: Forces overdrive clutch to exhaust through orifice during 4-3 downshift.

Balls 10 and 11 used on 1989 models only.

- 10: Separate reverse flow and direct clutch accumulator flow into the direct clutch.
- 11: Facilitates fast exhaust of direct clutch when coming out of reverse.

Balls 12 through 14 used on early 1989 models only.

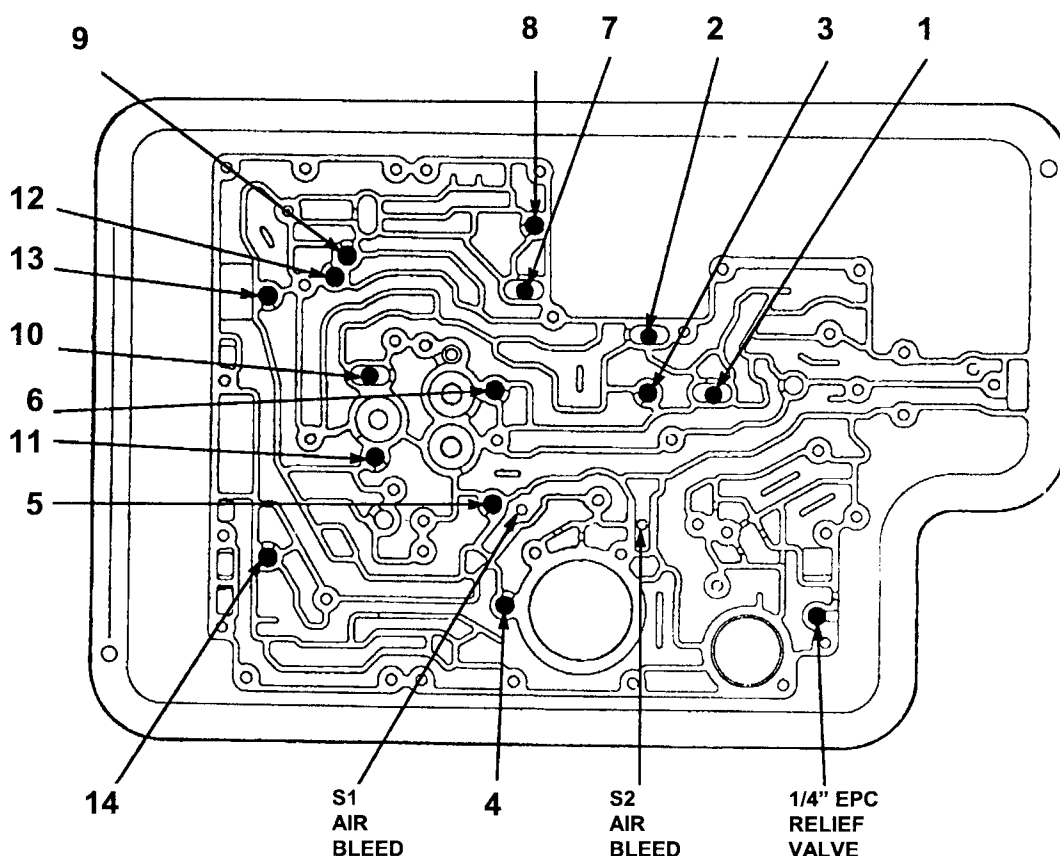
- 12: Bypasses direct accumulator plunger feed orifice during 3-2.
- 13: Bypass overdrive accumulator plunger feed orifice during 4-3.
- 14: Bypasses intermediate accumulator plunger feed orifice during 2-1.

- A: (Main Control Body) Separates manual two flow and solenoid two flow into the 1-2 manual transition valve which supplies flow to prevent 1-2 shift valve from shifting.
- B: (Main Control Body) Forces forward engagement pressure through orifice while allowing free exhaust.

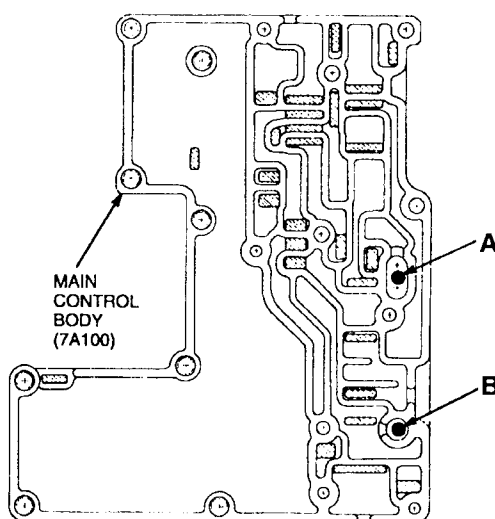
EPC Relief Valve (Spring and 1/4" Steel Ball)

Electronic Pressure Control blowoff valve controls EPC pressure to a maximum of 690 kPa (100~psi).

Checkball Locations



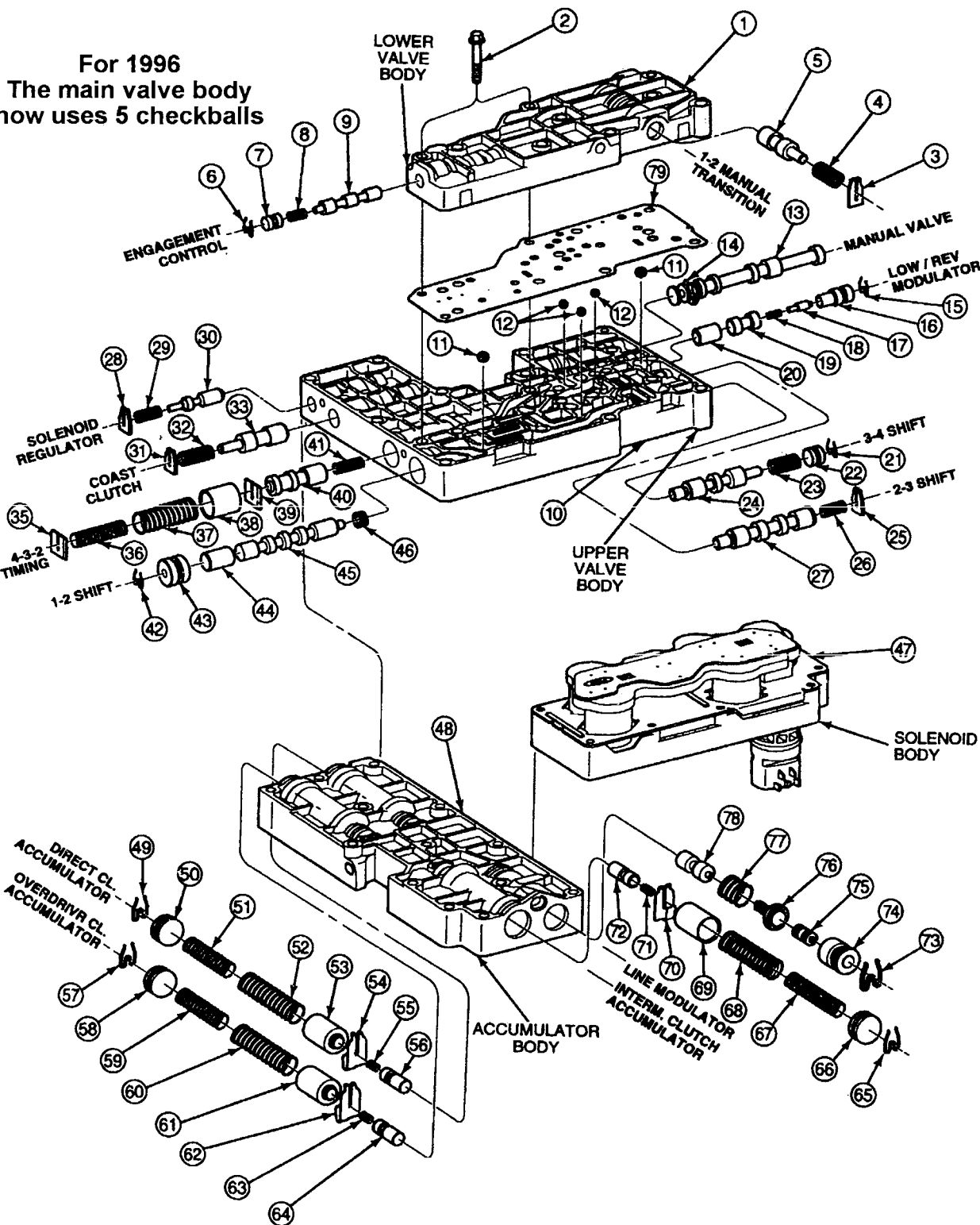
NOTE: Ball #1 eliminated in 1996



1989-1995
(For 1996, See next page)

1996 Valve Body Checkball Locations

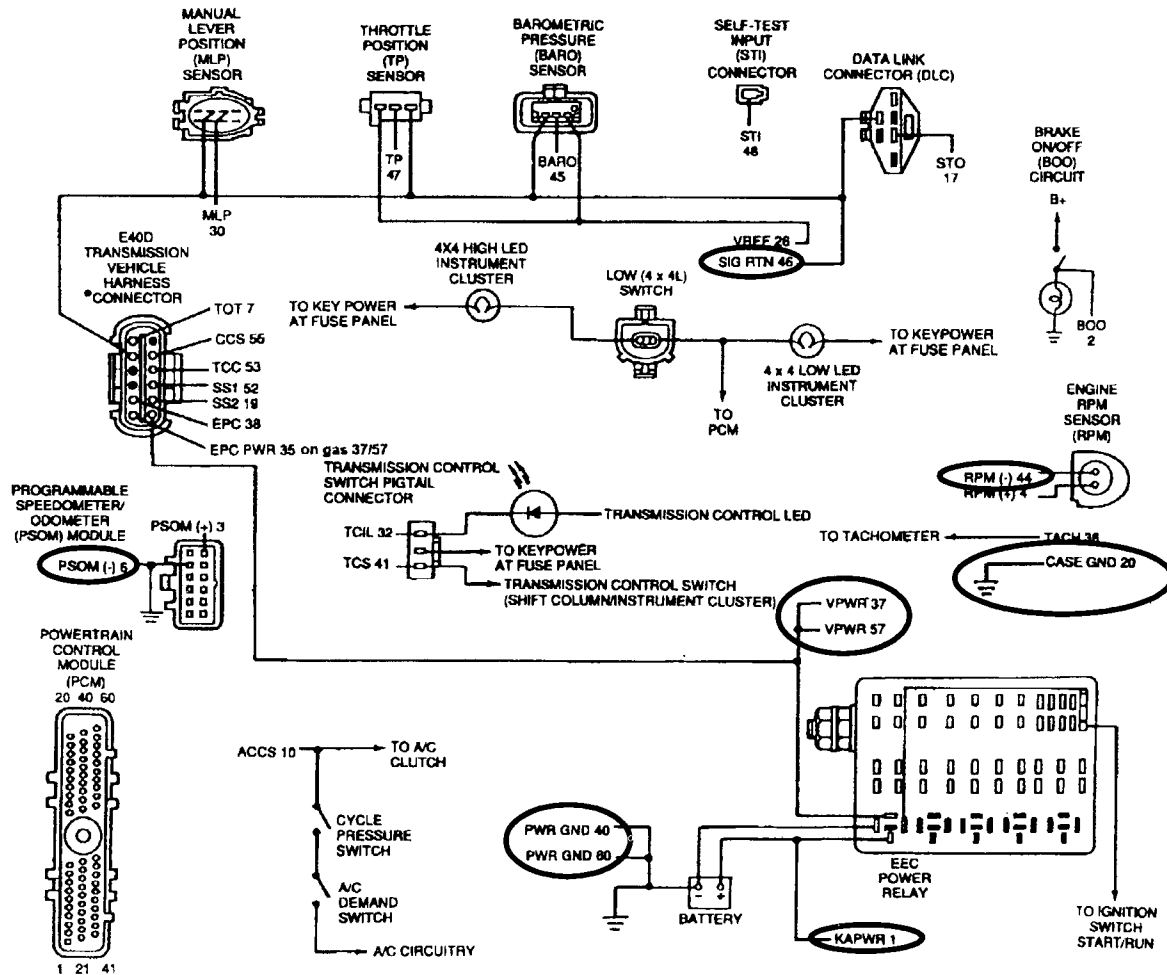
For 1996
The main valve body now uses 5 checkballs



How to Diagnose Stubborn Codes

EEC-IV Pre Diagnostic Tests

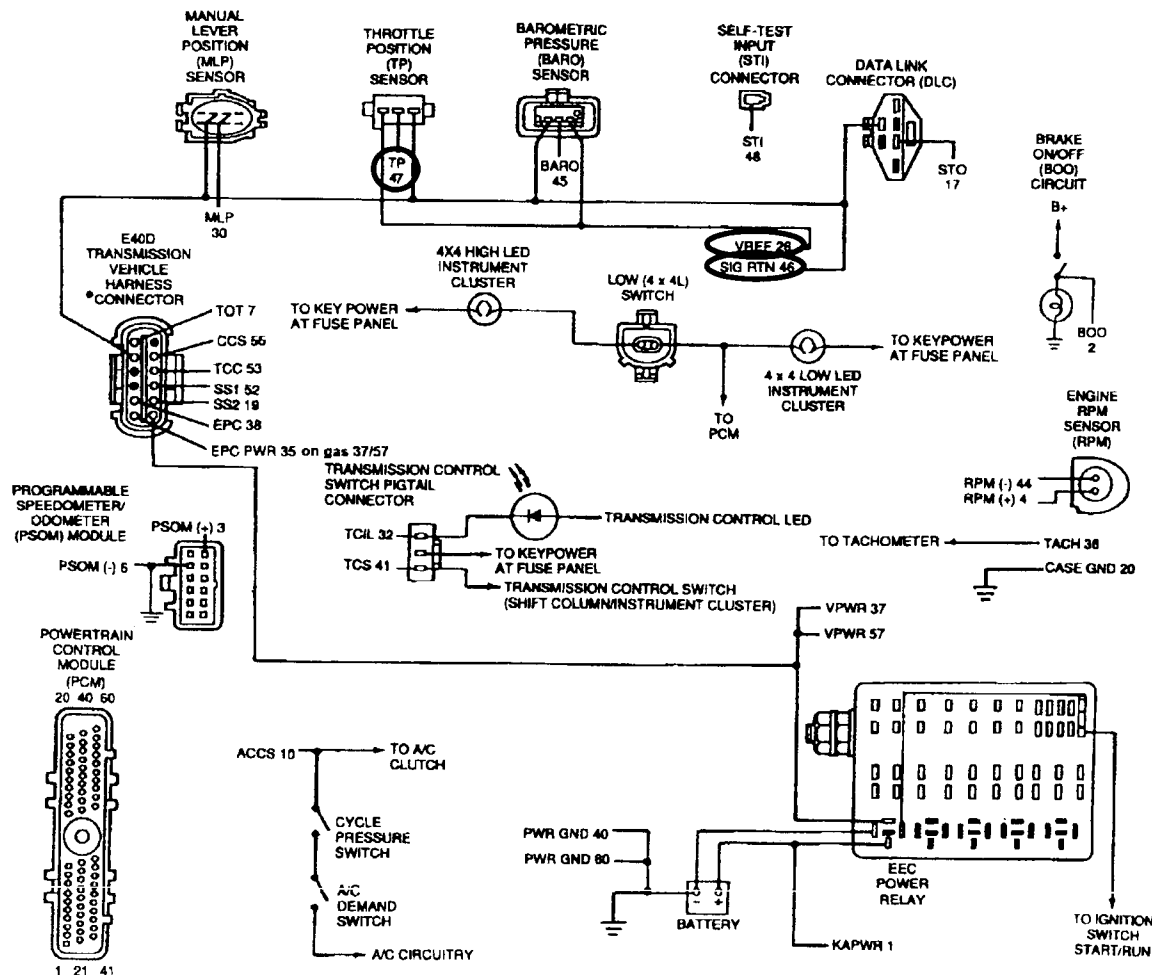
- Test the voltage at pin 1 of the 60 pin connector. Should be battery voltage
- Test the voltage at pins 20, 40, and 60 then test the voltage at pins 6, 16, 44, 46 and 49. All of these should have zero volts with the key on. Not all computers will use all of these pins.
- Test the voltage at pins 37 and 57 with the key on: Should be battery voltage.



How to Diagnose Stubborn Codes (cont'd)

TPS/FIPL Codes 23, 33, 43, 63, 73 / 122, 123, 124 and 125

- The voltage parameter of the TP/FIPL is greater than .73 volts and less than 4.84 volts. Voltage signals that do not fall within these specifications will set these codes.
- Check that the Throttle Lever/Injector pump lever travels all the way with throttle wide open.
- TPS / FIPL should have 5v on the input lead (pin 26) and less than 0.1v on the ground lead (pin 46).



NOTE: On diesel models, the accelerator pedal must be held at WOT during the KOEO test.

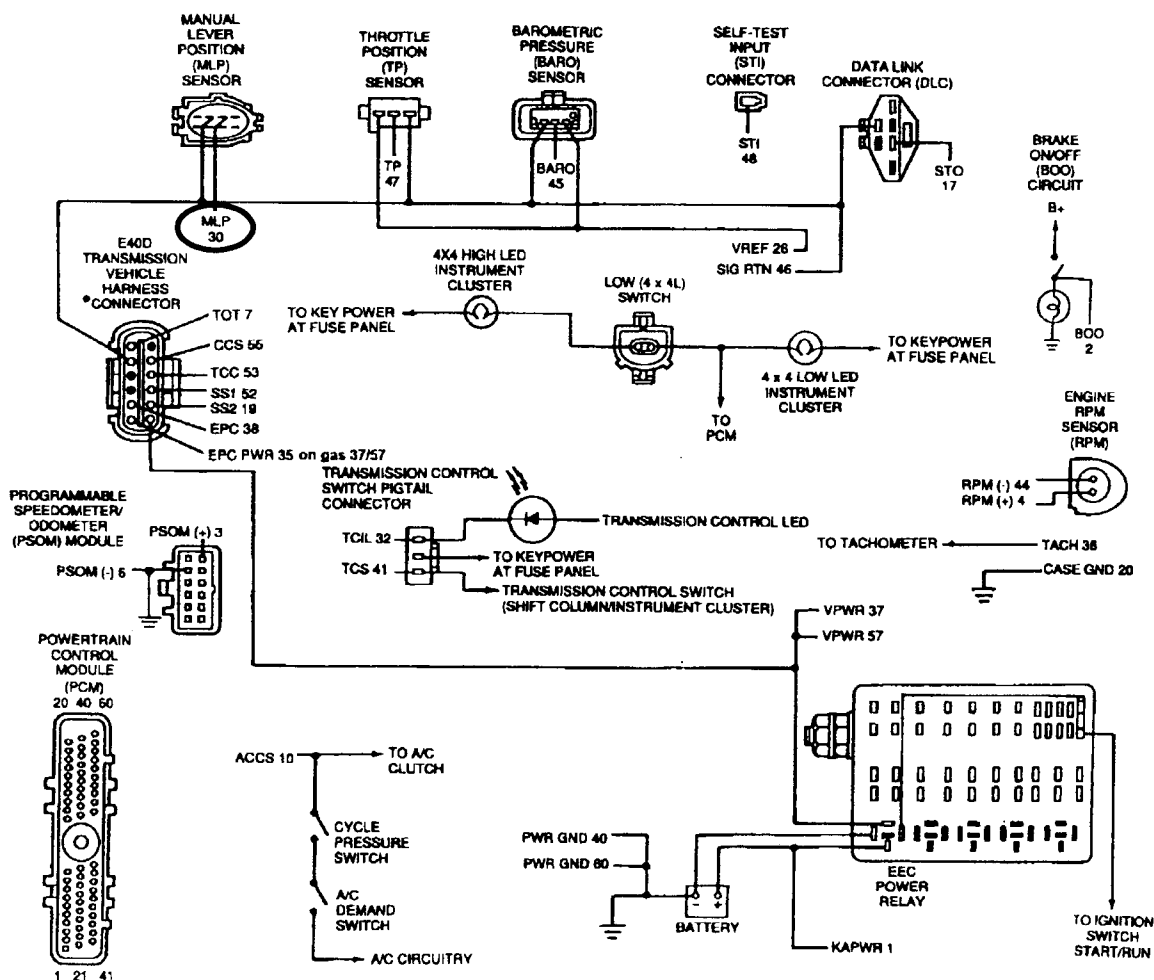
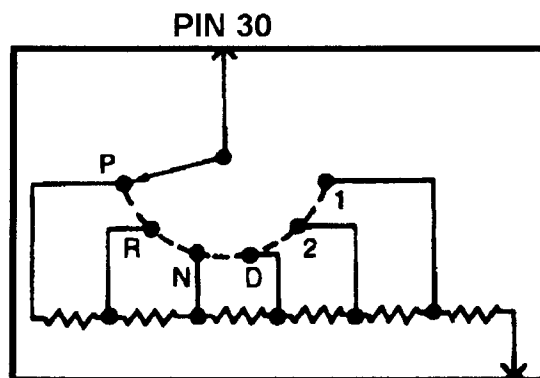
How to Diagnose Stubborn Codes (cont'd)

MLPS Codes 67 / 522, 634 and 654

- KOEO should be performed in park with all accessories off.
- Check for 4.4v in park at pin 30.

MLP Sensor Data* Voltage values calculated for VREF = 5.0v (These values may vary 15% due to sensor and VREF variations)

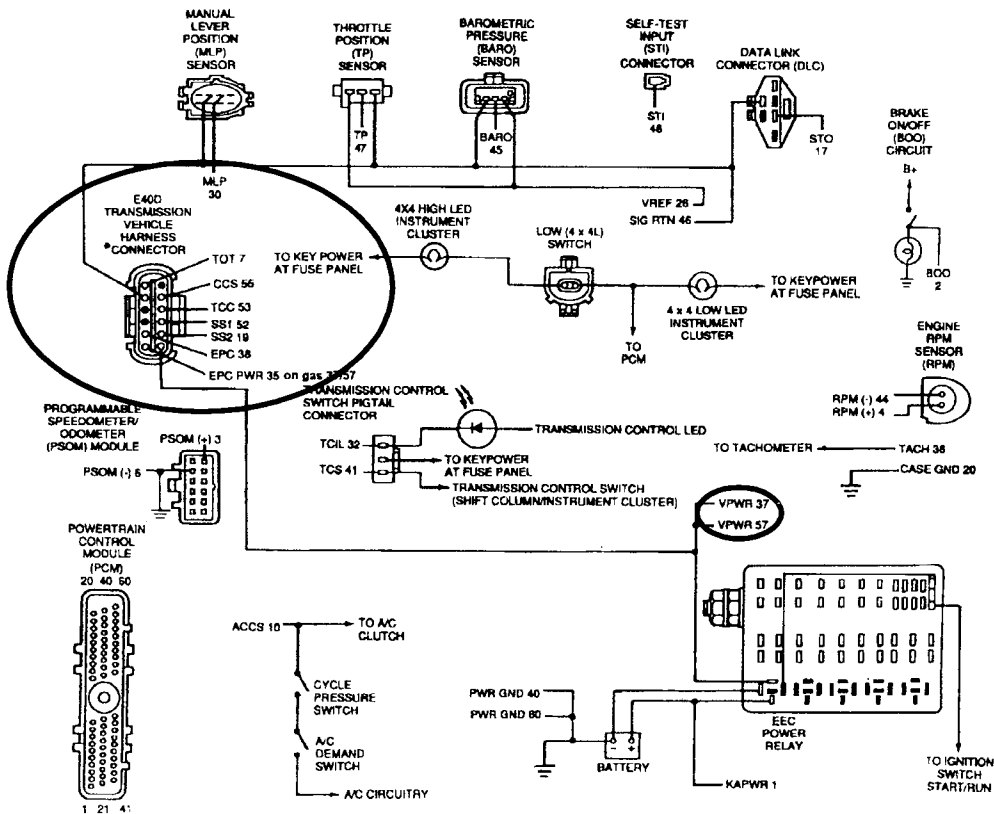
Transmission Shift Position	Voltage * Volts	Resistance Ohms
P	4.4	4.16K
R	3.5	1.44K
N	2.8	733
D	2.1	401
2	1.4	211
1	.7	81



How to Diagnose Stubborn Codes (cont'd)

Solenoids Codes 91, 92, 93, 94 / 621, 622, 624, 625, 626 and 629

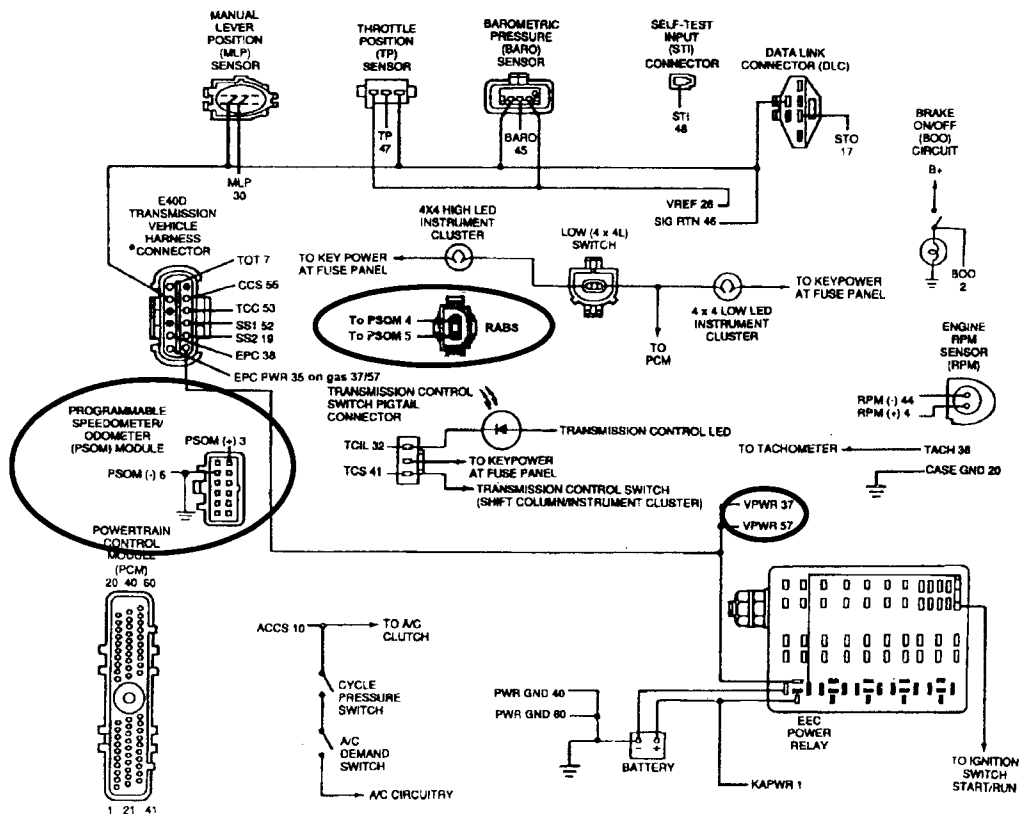
- Most of these codes are set during KOEO.
- Inspect the solenoid connector for poor connection or no connection.
- Disconnect the 60 pin EEC-IV processor.
- With the ignition off, connect the positive lead of a DVOM to pin 37 or 57.
- Connect the negative lead to a good ground (Battery negative post is best): There should be no voltage.
- Remove the negative lead of the DVOM from the battery and place it on pin 19. Switch the DVOM to ohms. Test the resistance of solenoid 2; pin 52 for solenoid 1; pin 53 for solenoid 3; and pin 55 for solenoid 4. The acceptable resistance should be 20-30 ohms.
- Next, test the resistance of the EPC solenoid by placing the negative lead of the DVOM on pin 38. On Diesel applications move the positive lead of the DVOM to pin 35. The acceptable resistance is 3-5 ohms.
- Perform a current draw test on the shift solenoids. First verify that pin 37 or 57 has battery voltage with the ignition on engine off.
- Next connect the positive lead of a digital ammeter to pin 19, 52, 53 or 55 and ground the negative lead to the battery negative post. Each solenoid should have approximately .5 amp draw.
- To test the current draw on the EPC connect the positive lead of the digital ammeter to pin 38 and ground the ammeter to the battery negative post. On a Diesel applications you will need to install a jumper wire between pins 37 and 35. Caution: do not leave the ammeter connected to the EPC solenoid for more than a few seconds. This may damage the solenoid. The current draw should be no more than 5 amps.



VSS / PSOM Code 29 / 452

- Test the voltage between pins 3 and 6 at the EEC-IV Processor.
- Test the frequency at pins 3 and 6. The frequency should raise from 0v Hz at 0 mph to about 67 Hz at 30 MPH.
- Test the AC voltage and frequency at the the VSS or the DSS. The AC voltage and frequency at the VSS should be same as at the computer. On 1992 and later the AC voltage and frequency at the DSS should be approximately 3.5v and 667hz at 30 mph. Note: When replacing the DSS do not use a sealant on the o-ring. This may move the sensor away from the sensor ring causing a loss of the signal.
- The VSS resistance should be between 190 and 250 ohms. The DSS resistance should be between 1300 and 1550 ohms.

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4L30-E

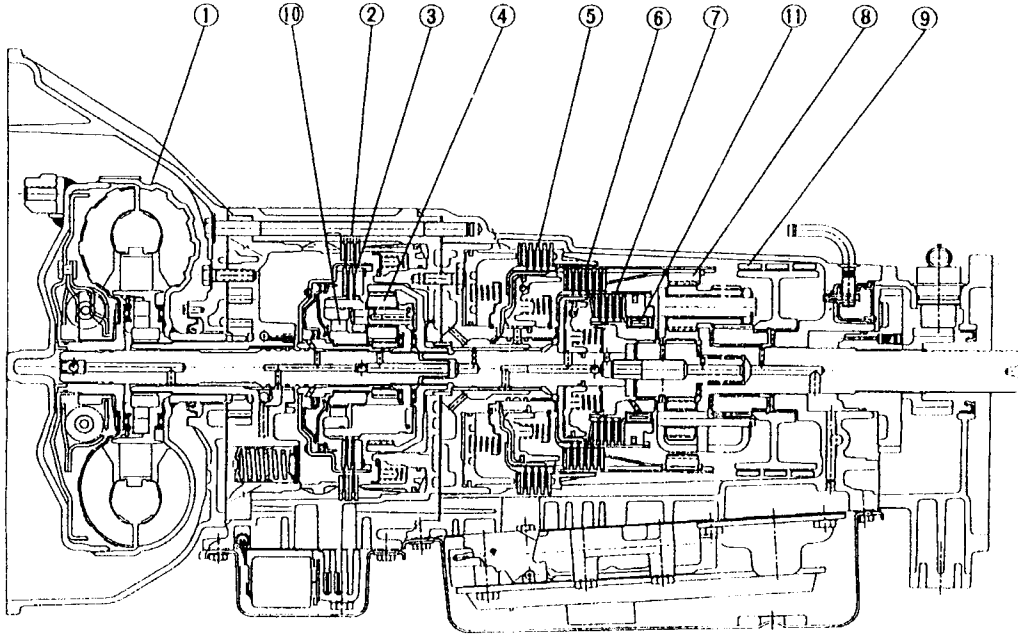
Clutch and Band Application	87
Checkball Location	88
Solenoid Pattern.....	89
Electrical Connectors	89
Code 32 Force Motor Low Voltage	90
Code 33 Force Motor High Voltage.....	92
Delayed Forward Engagement.....	94

4L30-E



4L30-E

Clutch and Band Application



- | | | |
|----------------------------------|----------------------------------|--|
| 1. TORQUE CONVERTER-CLUTCH (TCC) | 5. REVERSE CLUTCH (RC) | 9. BRAKE BAND (B) |
| 2. FOURTH CLUTCH (C4) | 6. SECOND CLUTCH (C2) | 10. OVERDRIVE FREE WHEEL
(ONE WAY CLUTCH) (OFW) |
| 3. OVERRUN CLUTCH (OC) | 7. THIRD CLUTCH (C3) | 11. SPRAG FREE WHEEL
(ONE WAY CLUTCH) (PFW) |
| 4. OVERDRIVE UNIT | 8. RAVINGNEAUX PLANETARY GEARSET | |

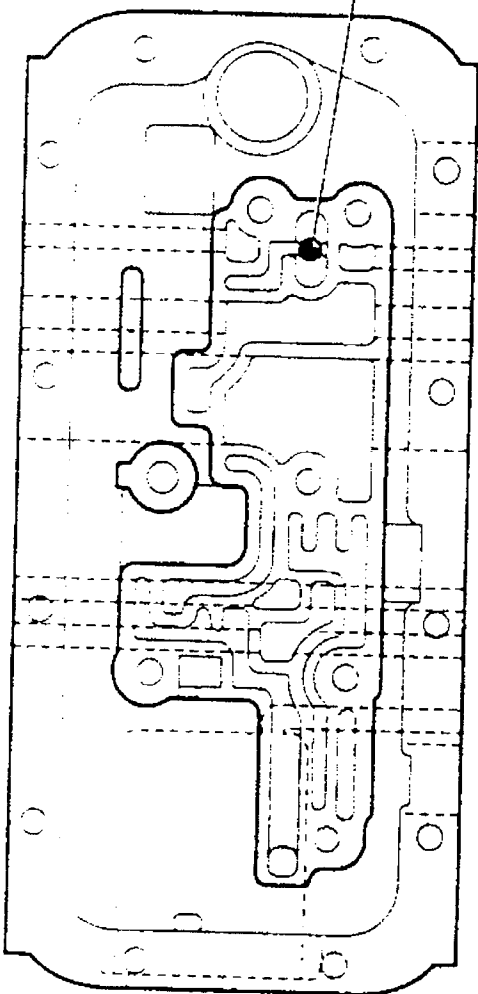
Range	Gear	RATIO	BAND	CLUTCHES					FREE WHEEL	
			B	C2	C3	C4	OC	RC	PFW	OFW
P / N	—	—	—	—	—	—	ON	—	—	—
D	1	2.856	ON	—	—	—	ON	—	LD	LD
	2	1.618	ON	ON	—	—	ON	—	—	LD
	3	1.00	—	ON	ON	—	ON	—	LC	LD
	4	0.723	—	ON	ON	ON	—	—	LC	—
3	3	1.00	—	ON	ON	—	ON	—	LC	LD
	2	1.618	ON	ON	—	—	ON	—	—	LD
	1	2.856	ON	—	—	—	ON	—	LD	LD
2	3	1.00	—	ON	ON	—	ON	—	LC	LD
	2	1.618	ON	ON	—	—	ON	—	—	LD
	1	2.856	ON	—	ON	—	ON	—	LD	LD
L	2	1.618	ON	ON	—	—	ON	—	—	LD
	1	2.856	ON	—	ON	—	ON	—	LD	LD
R	—	2.00	—	—	—	—	ON	ON	LD	LD

LC = LOCKED IN COAST

LD = LOCKED IN DRIVE

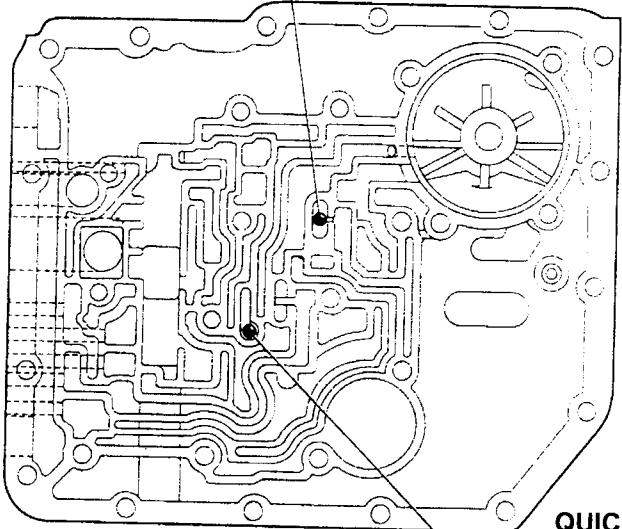
Checkballs

REVERSE
SHUTTLE



ADAPTER CASE
(AUX. VALVE BODY SIDE)

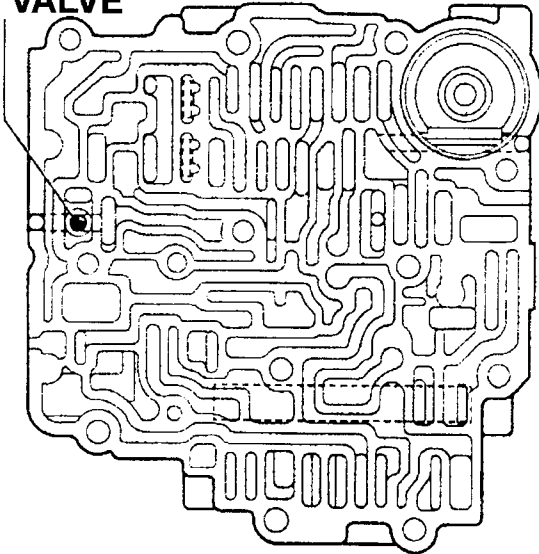
D 3 2
SHUTTLE



MAIN CASE
(TO VALVE BODY)

QUICK
DUMP
VALVE

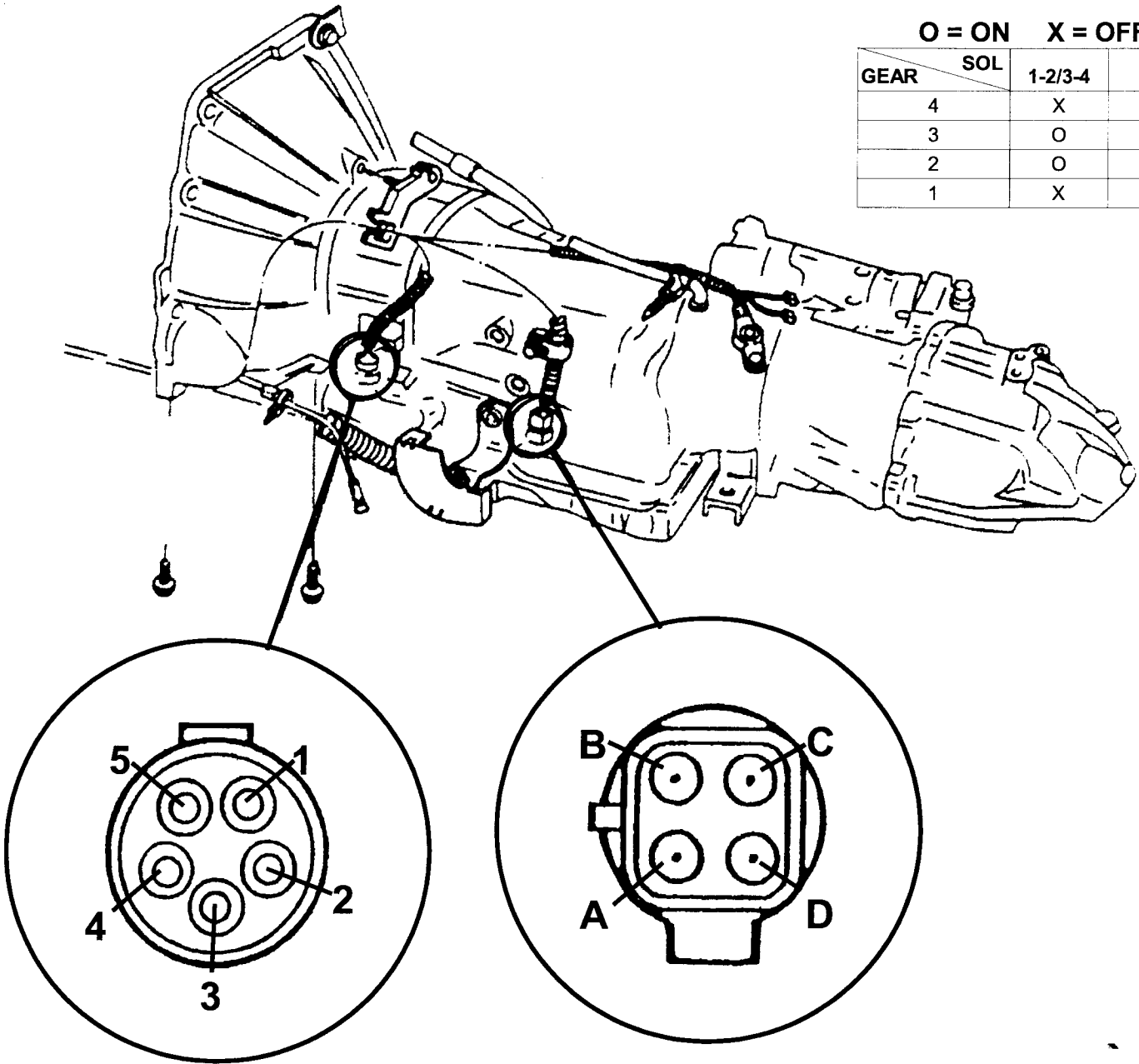
3RD CLUTCH
CHECK VALVE



VALVE BODY
(MAIN CASE)

Electrical Connectors

		O = ON	X = OFF
GEAR	SOL	1-2/3-4	2-3
4		X	X
3		O	X
2		O	O
1		X	O



PIN	COMPONENT	RESISTANCE
1	Lock-up Solenoid	17.5-18.5 ohms
2	Force Motor (+)	3.7-4.7 ohms
3	Force Motor (-)	
4	TOT	*
5	TOT	

PIN	COMPONENT	RESISTANCE
A	2-3 Solenoid	17.5-18.5 ohms
B	Band Apply Solenoid	9.5-10.5 ohms
C	Ground	—
D	1-2 / 3-4 Solenoid	17.5-18.5 ohms

* Varies with temperature

Code 32

Force Motor Solenoid Circuit (Signal Voltage Low)

Circuit Description

The force motor solenoid is a variable position solenoid whose plunger moves in relation to the current received from the TCM. The TCM uses the force motor solenoid to control line pressure. By changing the line pressure, the TCM controls shift feel. The TCM determines the proper gear by using electronic inputs to read engine load, engine speed, and vehicle speed. As operating conditions change, the TCM changes the plunger's position by varying the amount of current (amperage) sent through the solenoid.

Line pressure can vary from less than 50 psi to more than 200 psi. The line pressure varies inversely to the amount of current. High current causes low pressure and low current causes high pressure.

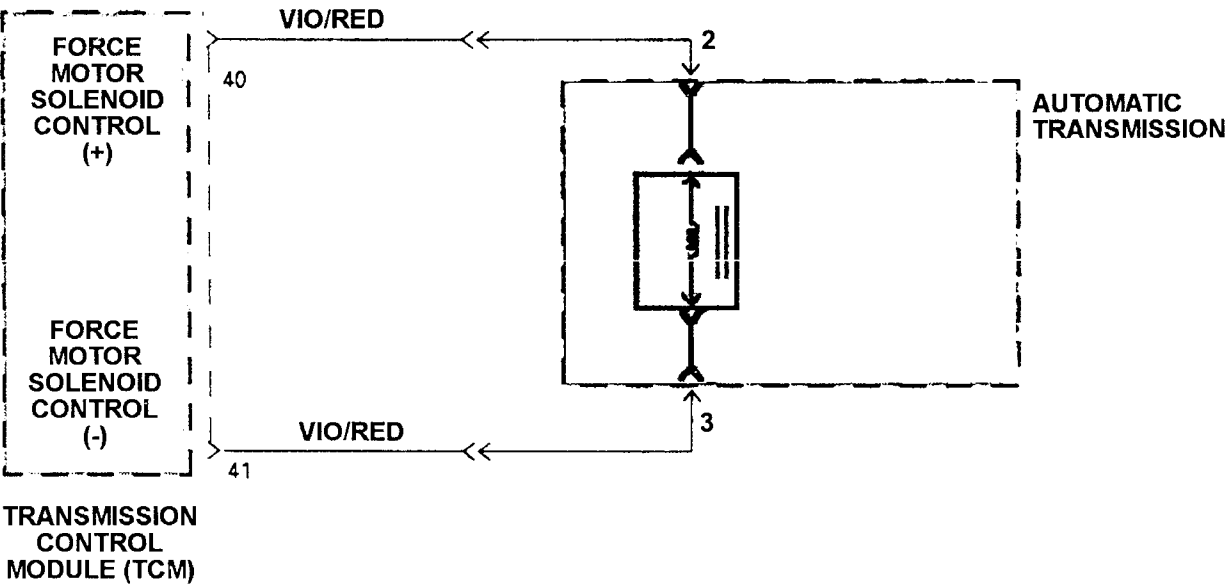
Test Description

Numbers below refer to circled numbers on the diagnostic chart.

- This test determines if the solenoid windings or wires to the solenoid are open.
- This test determines if the wiring or the solenoid is shorted.
- This test isolates the open circuit.

Diagnostic Aids

Fault Code 32 sets when the TCM detects a current draw less than 95 milliamps (0.095 amps) between terminals 40 and 41. Fault Code 33 sets when the TCM detects a current draw greater than 1.5 amps between terminals 40 and 41. In the event of an electrical failure, the force motor solenoid is turned off, allowing maximum fluid pressure.

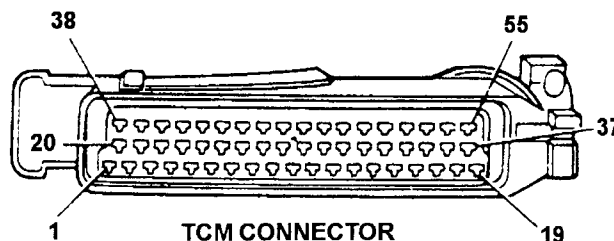


Code 32

Force Motor Solenoid Circuit (Signal Voltage Low)

- 1
- IGNITION SWITCH OFF.
 - DISCONNECT TCM CONNECTOR.
 - CONNECT OHMMETER BETWEEN TERMINALS 40 AND 41 OF TCM CONNECTOR.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES



NO

- 2
- CONNECT OHMMETER BETWEEN TERMINAL 40 OF TCM CONNECTOR AND GROUND.
- DOES DISPLAY INDICATE AN OPEN CIRCUIT?

YES

NO

- 2
- CONNECT OHMMETER BETWEEN TERMINAL 41 OF TCM CONNECTOR AND GROUND.
- DOES DISPLAY INDICATE AN OPEN CIRCUIT?

YES

NO

• CHECK FOR FAULTY TCM CONNECTION.
IF OK, REPLACE TCM.

• CHECK WIRING BETWEEN TERMINALS OF TCM CONNECTOR AND SOLENOID CONNECTOR FOR A SHORT.
IF OK, REPLACE FORCE MOTOR SOLENOID.

- 3
- DISCONNECT AUTOMATIC TRANSMISSION ADAPTER CASE CONNECTOR (FRONT)
 - CONNECT OHMMETER BETWEEN TERMINALS 2 AND 3 OF FEMALE HALF OF THE CONNECTOR.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES

NO

REPAIR WIRES FOR OPEN BETWEEN TERMINAL 40 OR 41 AND ADAPTER CASE CONNECTOR.

- 3
- DISCONNECT SOLENOID CONNECTOR.
 - CONNECT OHMMETER BETWEEN SOLENOID TERMINALS.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES

NO

REPAIR WIRES FOR OPEN BETWEEN ADAPTER CASE CONNECTOR AND SOLENOID CONNECTOR.

REPLACE FORCE MOTOR SOLENOID.

Code 33

Force Motor Solenoid Circuit (Signal Voltage High)

Circuit Description

The force motor solenoid is a variable position solenoid whose plunger moves in relation to the current received from the TCM. The TCM uses the force motor solenoid to control line pressure. By changing the line pressure, the TCM controls shift feel. The TCM determines the proper gear by using electronic inputs to read engine load, engine speed, and vehicle speed. As operating conditions change, the TCM changes the plunger's position by varying the amount of current (amperage) sent through the solenoid.

Line pressure can vary from less than 50 psi to more than 200 psi. The line pressure varies inversely to the amount of current. High current causes low pressure and low current causes high pressure.

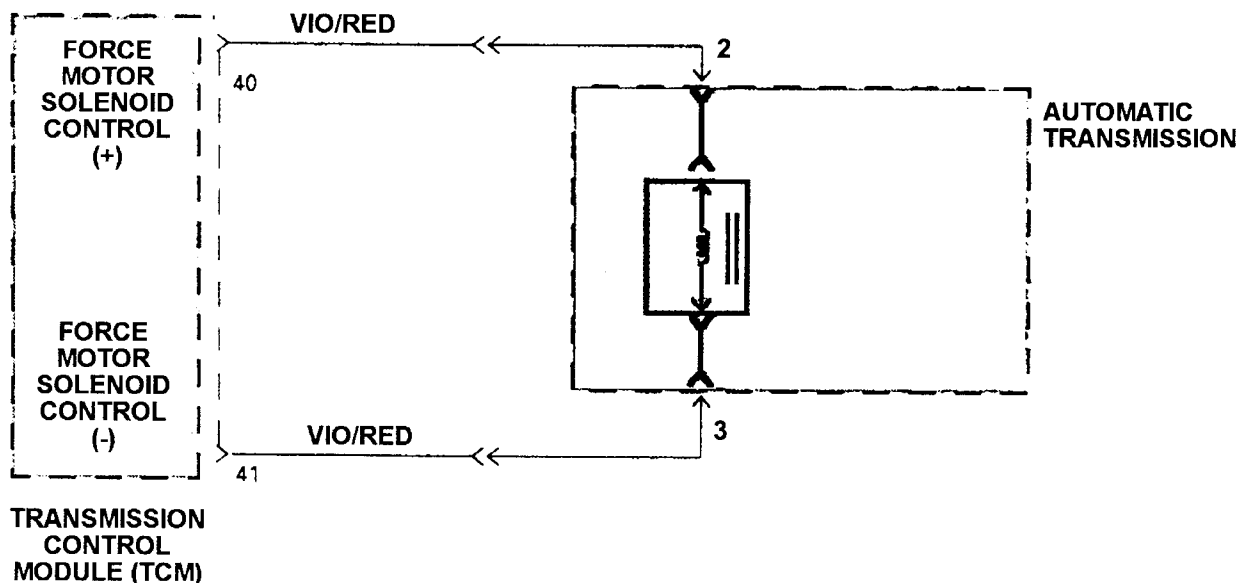
Test Description

Numbers below refer to circled numbers on the diagnostic chart.

1. This test determines if the solenoid windings or wires to the solenoid are open.
2. This test checks for a short to voltage at terminals 40 and 41 of TCM connector.
3. The wire between terminal 40 of the TCM connector may be shorted to a supply wire to another solenoid at the adapter case connector.
4. The wire between terminal 2 of the adapter case connector may be short to a supply wire to another solenoid at the adapter case connector.

Diagnostic Aids

Fault Code 32 sets when the TCM detects a current draw less than 95 milliamps (0.095 amps) between terminals 40 and 41. Fault Code 33 sets when the TCM detects a current draw greater than 1.5 amps between terminals 40 and 41. In the event of an electrical failure, the force motor solenoid is turned off, allowing maximum fluid pressure.



Code 33

Force Motor Solenoid Circuit (Signal Voltage High)

- 1
- IGNITION SWITCH OFF.
 - DISCONNECT TCM CONNECTOR.
 - CONNECT OHMMETER BETWEEN TERMINALS 40 AND 41 OF TCM CONNECTOR.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES

- 2
- CONNECT VOLTMETER BETWEEN TERMINAL 40 OF TCM CONNECTOR AND GROUND.
 - IGNITION SWITCH ON.
- DOES DISPLAY INDICATE APPROXIMATELY 0 VOLT?

YES

- CHECK FOR FAULTY TCM CONNECTION.
- IF OK, REPLACE TCM.

NO

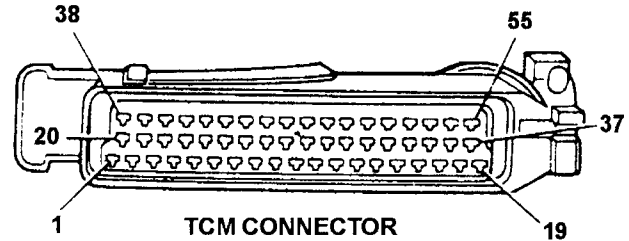
- 2
- CHECK WIRING BETWEEN TERMINALS OF TCM CONNECTOR AND SOLENOID CONNECTOR FOR A SHORT TO VOLTAGE.
- DOES DISPLAY INDICATE A SHORT TO +?

YES

- IF SHORT TO +:
1. BETWEEN TERMINAL 41 AND SOLENOID, REPAIR AND REPLACE TCM.
 2. BETWEEN TERMINAL 40 AND SOLENOID, REPAIR

NO

REPLACE FORCE MOTOR SOLENOID



NO

- 1
- DISCONNECT AUTOMATIC TRANSMISSION ADAPTER CASE CONNECTOR (FRONT).
 - CONNECT OHMMETER BETWEEN TERMINALS 2 AND 3 OF FEMALE HALF OF THE CONNECTOR.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES

- 3
- REPAIR WIRES FOR OPEN/SHORT BETWEEN TERMINAL 40 AND ADAPTER CASE CONNECTOR WIRE.

NO

- DISCONNECT SOLENOID CONNECTOR.
 - CONNECT OHMMETER BETWEEN SOLENOID TERMINALS.
- IS DISPLAY BETWEEN 3.7 AND 4.7 OHMS?

YES

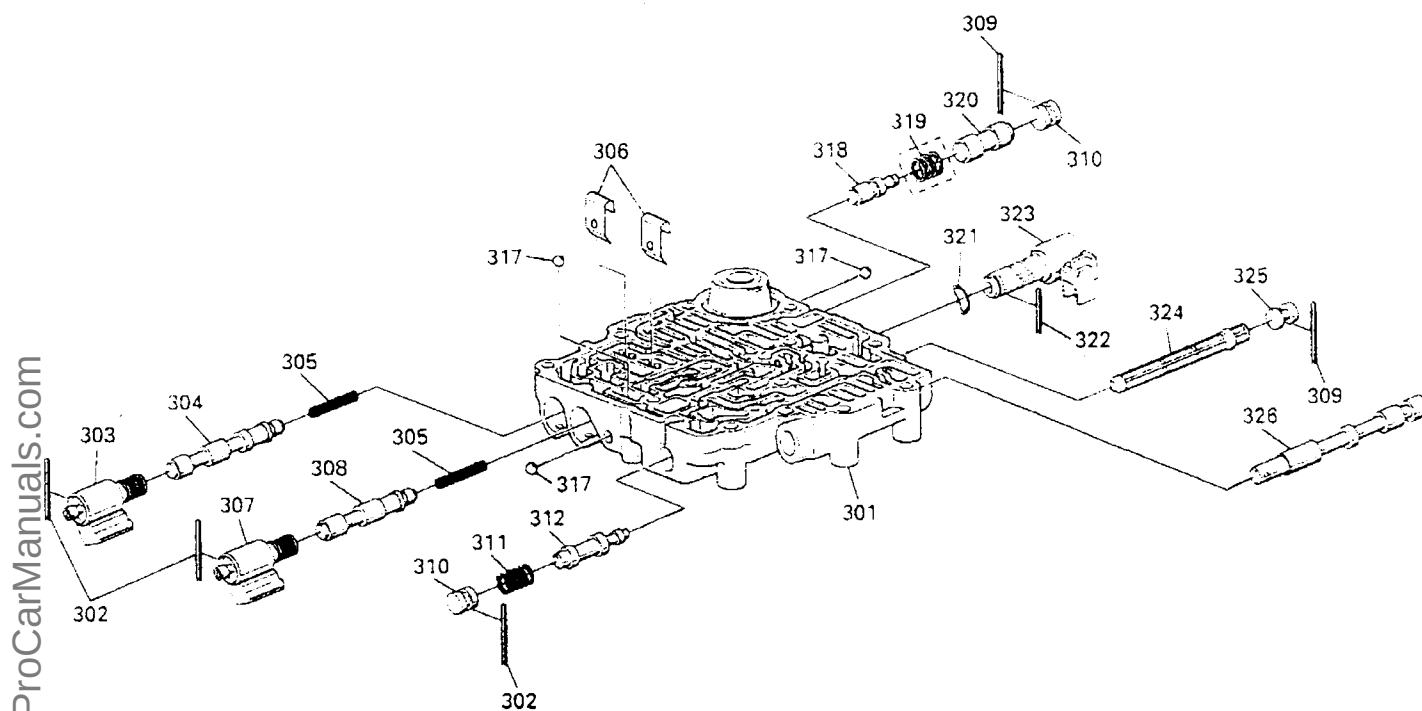
- 4
- REPAIR WIRES FOR OPEN/SHORT BETWEEN ADAPTER CASE CONNECTOR AND ANOTHER WIRE.

NO

REPLACE FORCE MOTOR SOLENOID.

Delays Forward

A delayed forward engagement condition can be caused by Band Control Solenoid (323). It is not uncommon for the solenoid feed screen (324) to break apart, clogging the solenoid. If the screen is broken, replace **both** the screen and the solenoid.



301 BODY, VALVE MAIN CASE
 302 PIN, SPRING
 303 SOLENOID ASSEMBLY, ON/OFF N.C.
 304 VALVE, 1-2 & 3-4 SHIFT
 305 SPRING, 1-2 & 3-4 (2-3) SHIFT
 306 RETAINER, VALVE
 307 SOLENOID ASSEMBLY, ON/OFF N.O.
 308 VALVE, 2-3 SHIFT
 309 PIN, SPRING
 310 PLUG, VALVE BORE
 311 SPRING, VALVE LOW PRESSURE CONTROL

312 VALVE, LOW PRESSURE CONTROL
 317 BALL, CHECK
 318 VALVE, 1-2 ACCUMULATOR CONTROL
 319 SPRING, 1-2 ACCUMULATOR CONTROL (OPTIONAL)
 320 VALVE, 1-2 ACCUMULATOR
 321 WASHER, WAVED PWM SOLENOID
 322 PIN, SOLENOID PWM
 323 SOLENOID ASSEMBLY, BAND CONTROL PWM
 324 SCREEN ASSEMBLY, PWM SOLENOID
 325 PLUG, SCREEN
 326 VALVE, MANUAL

Isuzu Part Numbers

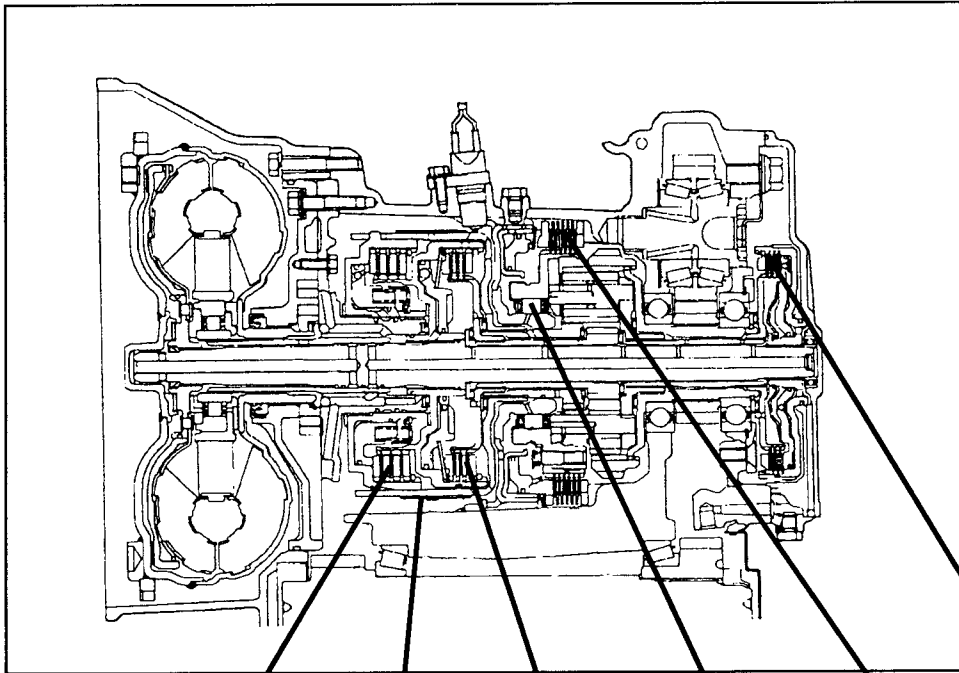
Band Apply Solenoid	8-96042-006-0
Band Apply Solenoid Screen	8-96041-012-0

KM175

Clutch and Band Application	97
Gear Ratios	97
Failsafe Mode.....	97
Pressures and Pressure Taps.....	98
Adjusting Pressure	103
Checkball Locations	104
TCC Solenoid Change	105
Planet Failure	106
Third Gear Starts	107
End Clutch Drum Change	108
3-4 Shift Neutrals Out.....	109
Mainshaft Change	111
Harsh Coast Down Shifts	112
Third and Reverse Only	113
Delayed Forward Engagement.....	114
No Movement.....	115
2-3 Flare	116
No Forward	117

KM175



KM175

Range	Gear	Direct (Front) Clutch	Inter-mediate Band	Forward (Rear) Clutch	Low Sprag	Low Reverse Clutch	End Clutch
R	Reverse	Applied or holding				Applied or holding	
D	1st			Applied or holding	Applied or holding		
	2nd		Applied or holding	Applied or holding			
	3rd	Applied or holding		Applied or holding			Applied or holding
	4th		Applied or holding				Applied or holding
2	1st			Applied or holding	Applied or holding		
	2nd		Applied or holding	Applied or holding			
L	1st			Applied or holding	Applied or holding ★	Applied or holding	

 = Applied or holding

★ = Ineffective due to Low Reverse Clutch

Gear Ratios

	Wide Ratio	Close Ratio
1st	2.846:1	2.551:1
2nd	1.581:1	1.488:1
3rd	1.0:1	11.0:1
4th	.685:1	.685:1
Reverse	2.176:1	2.776:1

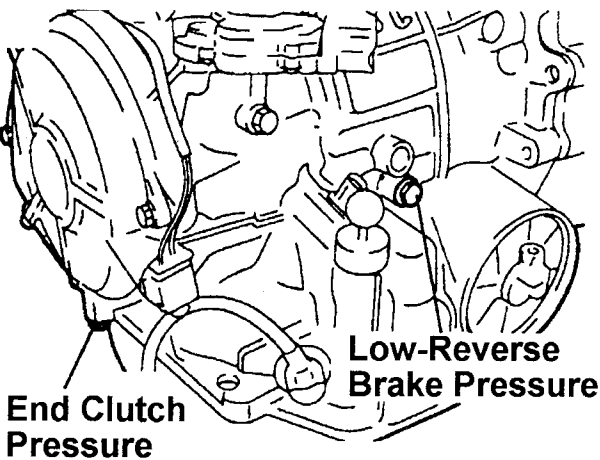
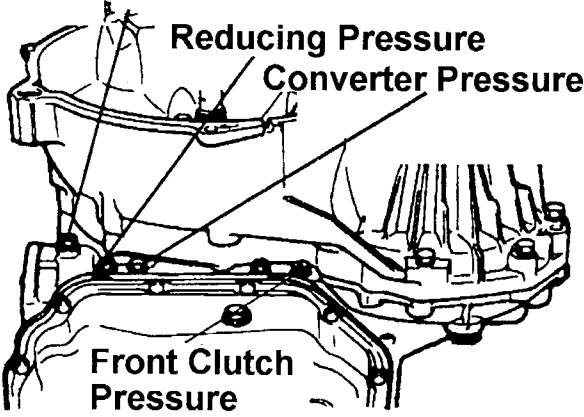
Failsafe Mode

D	3rd
2	3rd
1	3rd

Pressure Tap Locations

KM175-1 (1985-86 Galant)

Kickdown Brake Pressure



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Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Front Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Idling*	Neutral	36-56	•	•	•	•	••
N	Approx. 2500*	Neutral	36-56	•	•	•	•	29-34
D	Idling*	2nd gear	36-56	15-30	•	•	•	••
D (Sw-On)	Approx. 2500*	4th gear	36-56	89-97	•	89-97	•	••
D (Sw-Off)	Approx. 2500*	3rd gear	36-56	89-97	89-97	89-97	•	••
2	Approx. 2500*	2nd gear	36-56	89-97	•	•	•	••
L	Approx. 1000*	1st gear	36-56	•	•	•	43-60	••
R	Approx. 2500*	Reverse	36-56	•	165-251	•	165-251	••

- Must be less than 2 psi
- Pressure is present but not the standard value

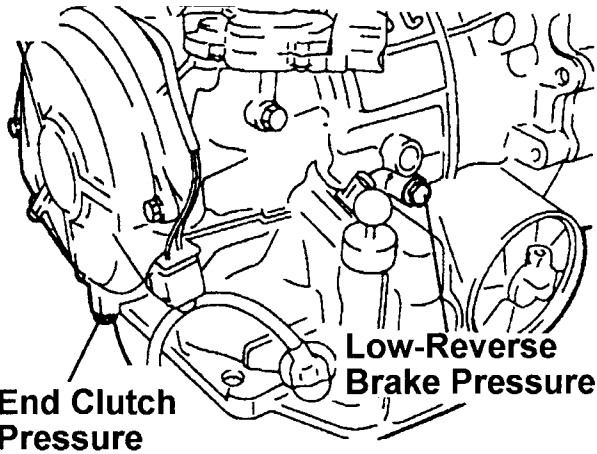
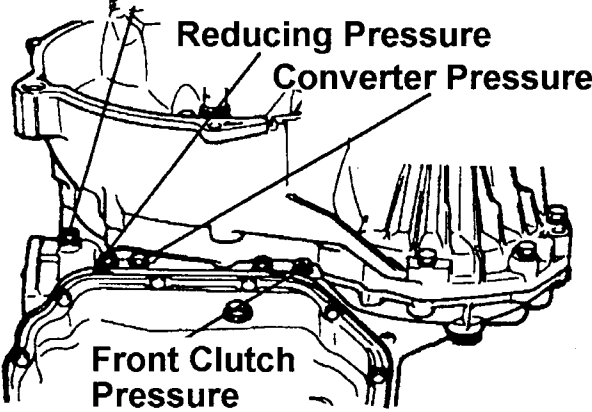
Pressure Specification Chart 2

KMI75-1 (1987 Galant)

Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Front Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Idling*	Neutral	48-72	•	•	•	•	••
N	Approx. 2500*	Neutral	48-72	•	•	•	•	50-64
D	Idling*	2nd gear	48-72	15-30	•	•	•	••
D (Sw-On)	Approx. 2500*	4th gear	48-72	118-128	•	118-128	•	••
D (Sw-Off)	Approx. 2500*	3rd gear	48-72	118-128	118-128	118-128	•	••
2	Approx. 2500*	2nd gear	48-72	118-128	•	•	•	••
L	Approx. 1000*	1st gear	48-72	•	•	•	43-60	••
R	Approx. 2500*	Reverse	48-72	•	234-319	•	234-319	••
	Approx. 1000*				214 or more	•	214 or more	

Pressure Tap Locations (cont'd)
KM175, KM176, KM177, F4A21, F4A22, F4A23
(1989-96 All)

Kickdown Brake Pressure

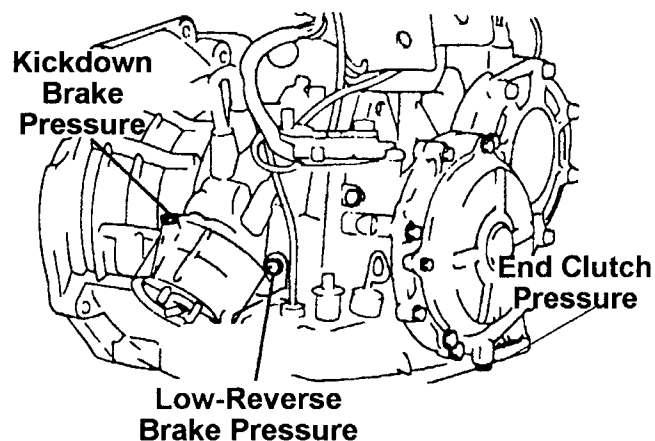
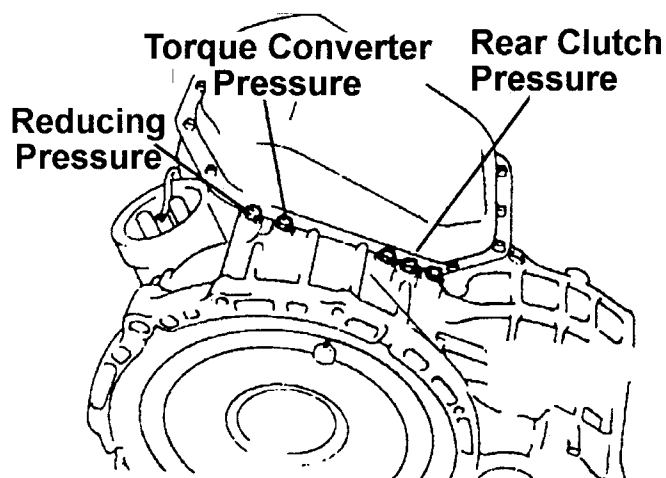


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Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Front Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Approx. 2500*	Neutral	52-71	•	•	•	•	••
D	Idling*	2nd gear	52-71	15-30	•	•	•	••
D (Sw-On)	Approx. 2500	4th gear	52-71	120-131	•	120-131	•	51-84
D (Sw-Off)	Approx. 2500	3rd gear	52-71	120-131	120-131	120-131	•	51-84
2	Approx. 2500	2nd gear	52-71	120-131	•	•	•	51-84
L	Approx. 1000*	1st gear	52-71	•	•	•	43-60	••
R	Approx. 2500	Reverse	52-71	•	238-325	•	238-325	51-84
	Approx. 1000*				218 or more		218 or more	

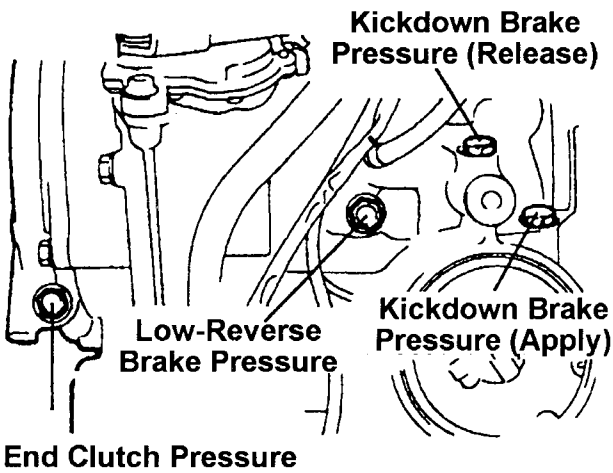
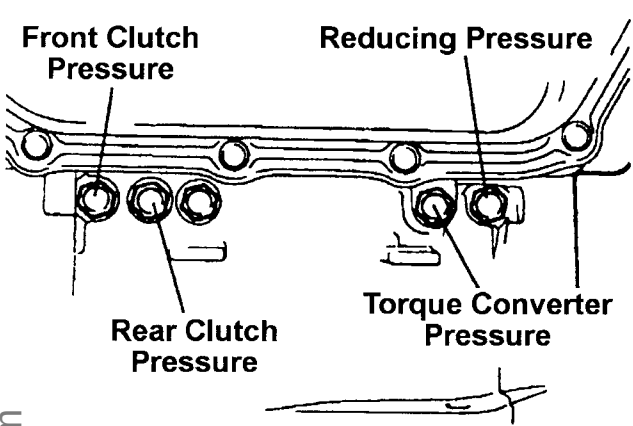
Pressure Tap Locations (cont'd)

A4AF1 ('93, '94 Scoupe)



Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Front Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Idling*	Neutral	53-70	•	•	•	•	••
D	Idling*	2nd gear	53-70	14-30	•	•	•	••
D (Sw-On)	Approx. 2500*	4th gear	53-70	118-128	•	118-128	•	56-84
D (Sw-Off)	Approx. 2500*	3rd gear	53-70	118-128	118-128	118-128	•	56-84
2	Approx. 2500*	2nd gear	53-70	118-128	•	•	•	56-84
L	Approx. 1000*	1st gear	53-70	•	•	•	43-63	••
R	Approx. 2500	Reverse	53-70	•	233-318	•	233-318	56-84
	Approx. 1000*				213 or more		213 or more	

Pressure Tap Locations (cont'd)
F4A33, W4A32, W4A33

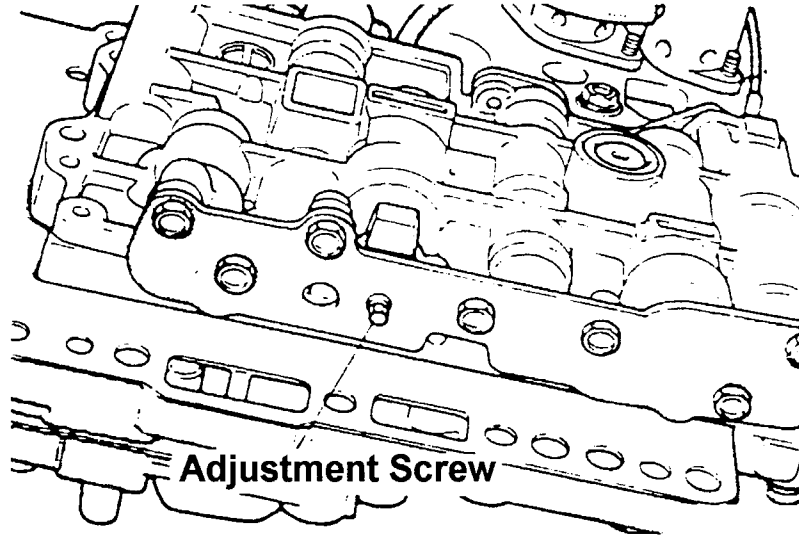


ProCarManuals.com

Lever Position	Engine Speed RPM	Shift Position	Reducing Pressure	Kickdown Brake Pressure (apply)	Kickdown Brake Pressure (apply)	Front Clutch Pressure	Rear Clutch Pressure	End Clutch Pressure	Low Reverse Brake Pressure	Torque Converter Pressure
N	Idling*	Neutral	52-70	.	.	.	.	.	.	..
D	Idling*	2nd gear	52-70	15-30	.	.	106-120	.	.	..
D (Sw-On)	Approx. 2500*	4th gear	52-70	120-131	.	.	.	120-131	.	65-94
D (Sw-Off)	Approx. 2500*	3rd gear	52-70	120-131	120-131	118-128	120-131	120-131	.	65-94
2	Approx. 2500*	2nd gear	52-70	120-131	.	.	120-131	.	.	65-94
L	Approx. 1000*	1st gear	52-70	.	.	.	120-131	.	44-65	..
R	Approx. 2500	Reverse	52-70	.	238-325	238-325	.	.	238-325	65-94
	Approx. 1000*				218 or more	218 or more			218 or more	

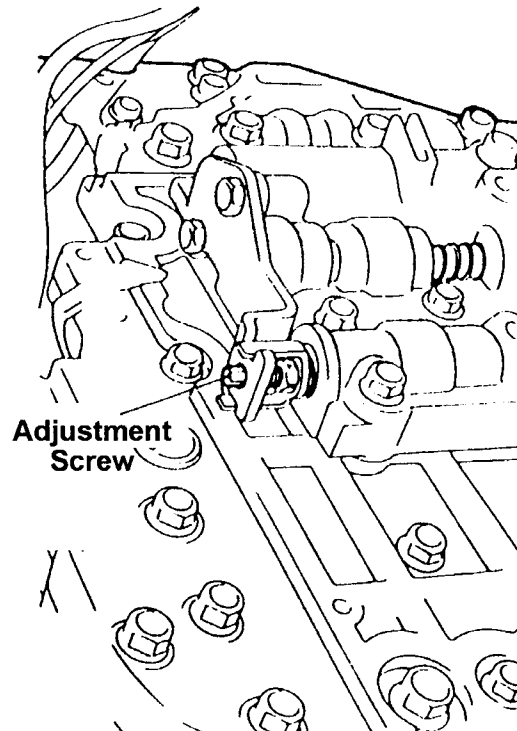
Pressure Adjustment

Main Line Pressure



NOTE:
Each turn of the
screw affects
pressure
approximately 5 psi.

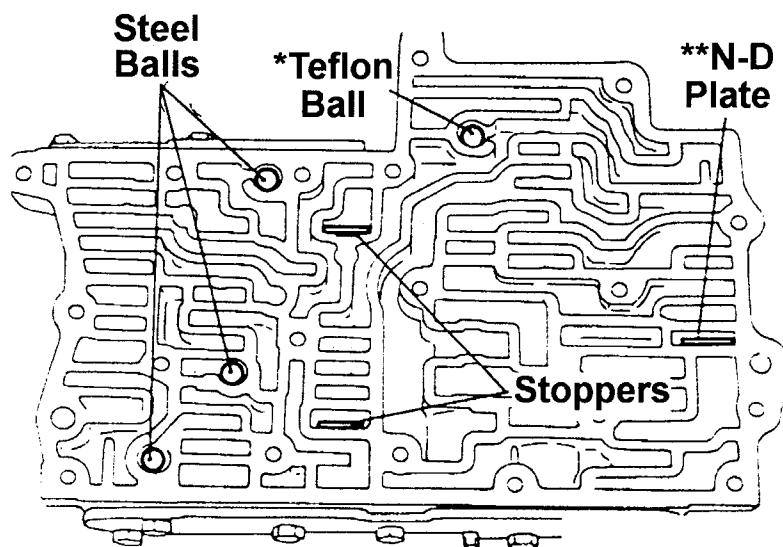
Reducing Pressure



NOTE:
Each turn of the
screw affects
pressure
approximately 6 psi.

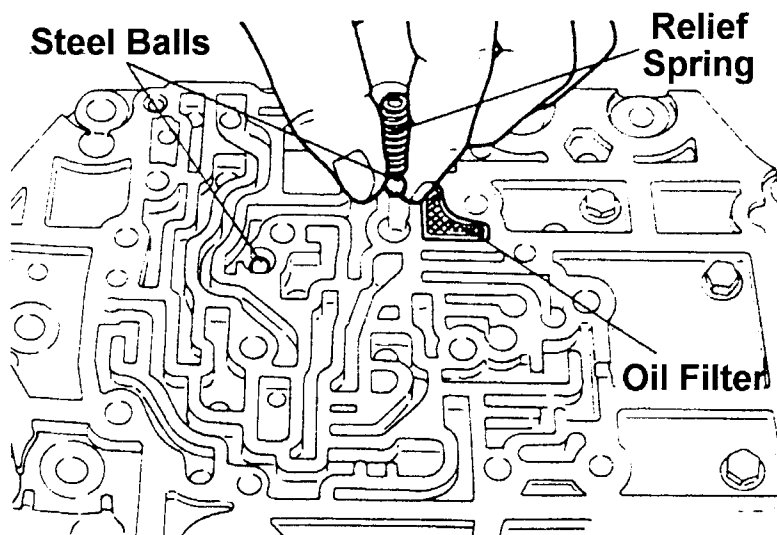
IMPORTANT: Reducing pressure is used, in part, to control shift feel.
Higher pressure will offer firmer shifts.

Checkballs



* 1985-90 models
use a steel ball

** Used with 1991
and later only.

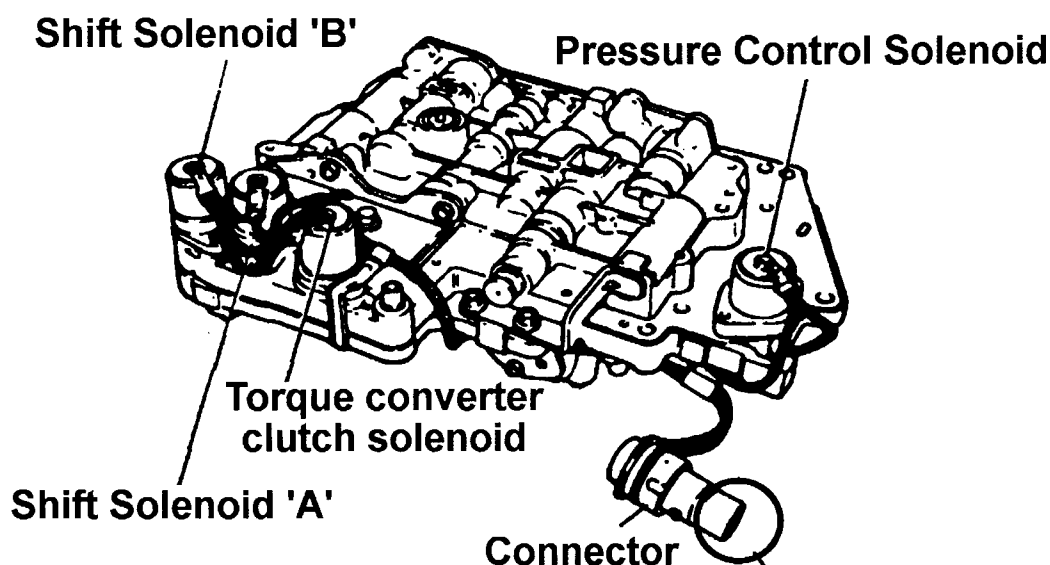


TCC Failure

TCC Solenoid Change

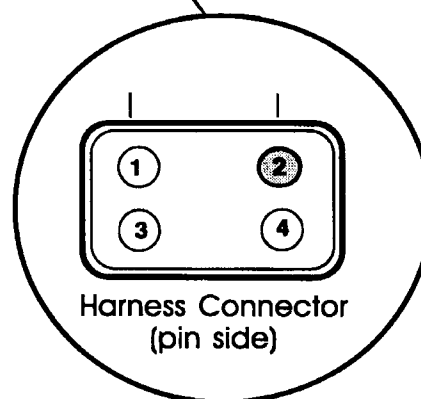
The TCC solenoid used on all 1993 and later Chrysler and Mitsubishi F4A and W4A transaxles (except Precis) is different than the solenoid used on earlier models. The resistance of the previous solenoid is 3 ohms. The new solenoid has a resistance of 13 ohms.

Caution should be taken when changing solenoids (or valve bodies) to prevent interchange of the solenoid types. Using the 3 ohm solenoid on a 1993 and later vehicle will damage the TCU (Transaxle Control Unit).



- 1 - Pressure Control Solenoid
- 2 - TCC Solenoid
- 3 - Shift Solenoid A
- 4 - Shift Solenoid B

NOTE: The 3 ohm solenoid uses a red wire. The 13 ohm solenoid uses a black wire.



Planet Failure

Often times the mainshaft will become clogged with friction material from the torque converter. The best way to clean the shaft is to remove the end plug, then blow air through the shaft at the end of the shaft and the lube feed hole.

The part number for the plug is:

MF 665531	10mm (.400")	1989-92
MD712132	8mm (.320")	1992-96

BLOW AIR
HERE



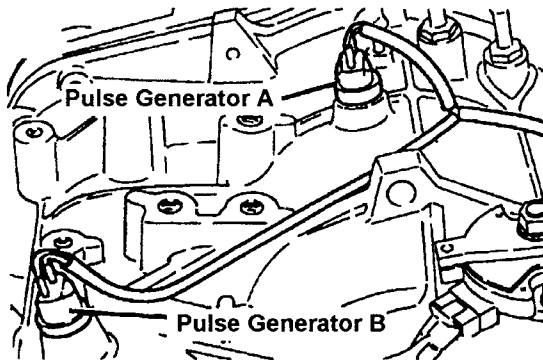
BLOW AIR
HERE

Third Gear Starts

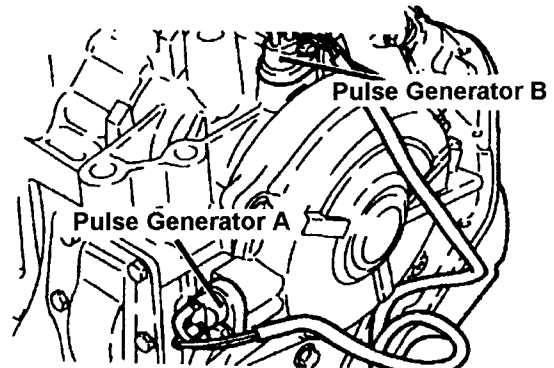
A third gear (limp-in) condition after rebuild can be caused by pulse generator 'A' and 'B' installed in the incorrect location.

Pulse generator 'A' senses the rpm of the sun gear shell (or the turbine shaft on some models) and has solid green wires leading to it. Pulse generator 'B' senses the rpm of the transfer shaft and has green wires with a black tracer. The length of the wires can vary from model to model. Do not install the pulse generators based on wire length.

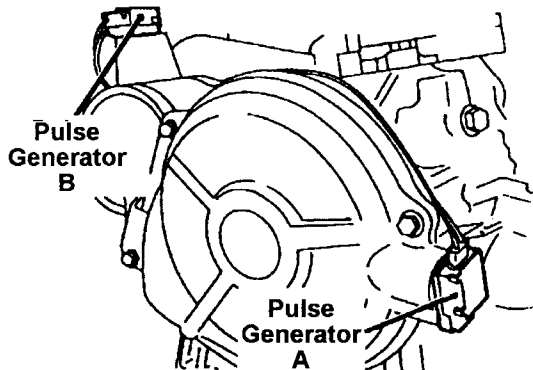
CAUTION: The first design (round) pulse generator connector has the same configuration as some mass airflow sensor connectors. The second design (rectangular) pulse generator connector has the same configuration as the second design solenoid harness connector. It is possible on some models to cross-connect the components resulting in limp-in mode (third gear only).



KM175, 176, 177, F4A21, 22, 23

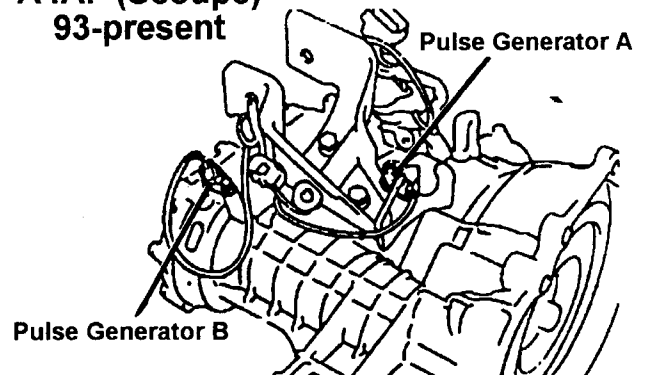


F4A33, W4A32, 33



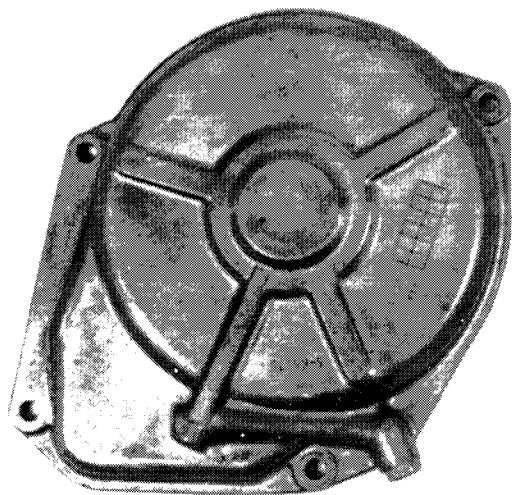
F4A21, 22, 23
(Select models, 93-present)

A4AF (Scoupe)
93-present

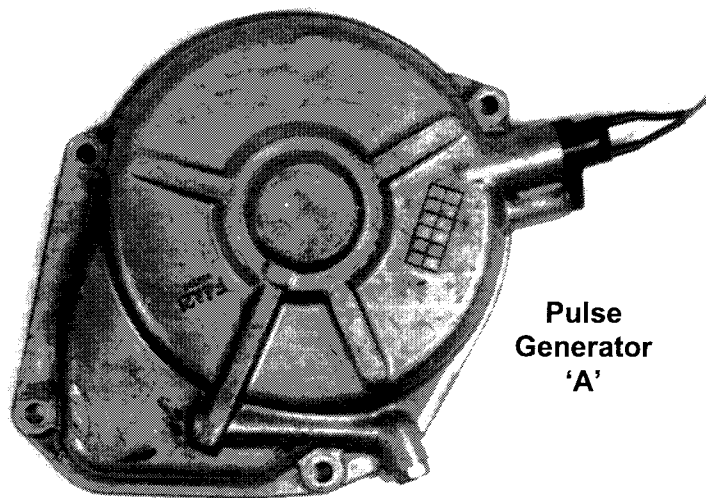


End Clutch Drum Change

The end clutch drum was modified in 1993 for models that used a pulse generator on the end clutch cover. The added length of the drum lugs is essential for proper pulse generator 'A' function.



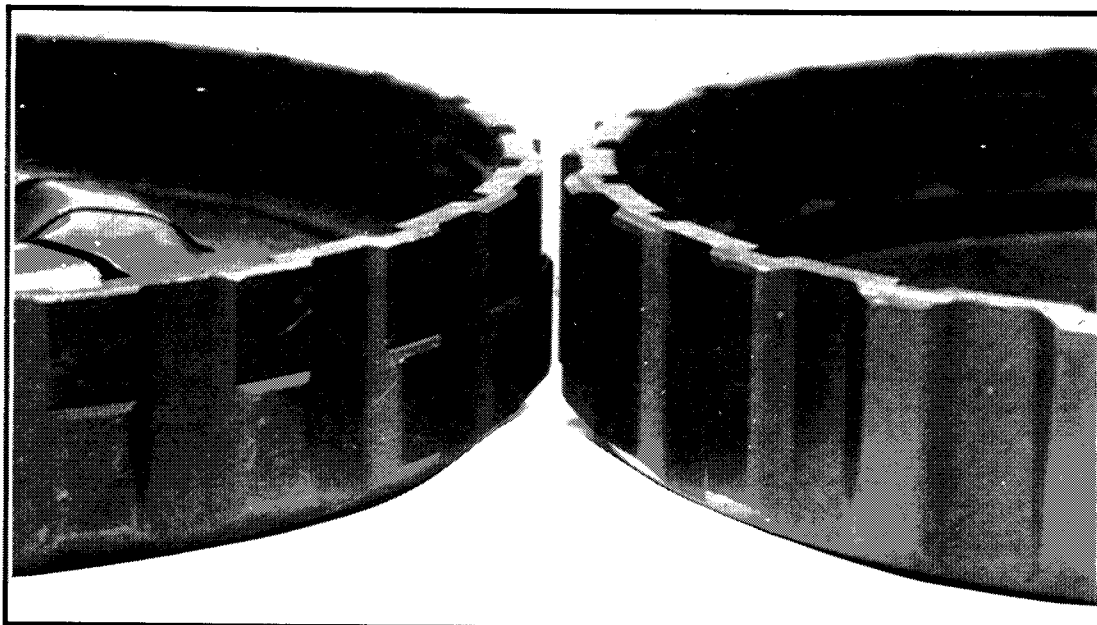
1989-92



Pulse
Generator
'A'

1993-ON

NOTE: All F4A33 and W4A32 & 33 units use the late style drum. Production of these units began in 1991.



1989-92
(Half-Length Lugs)

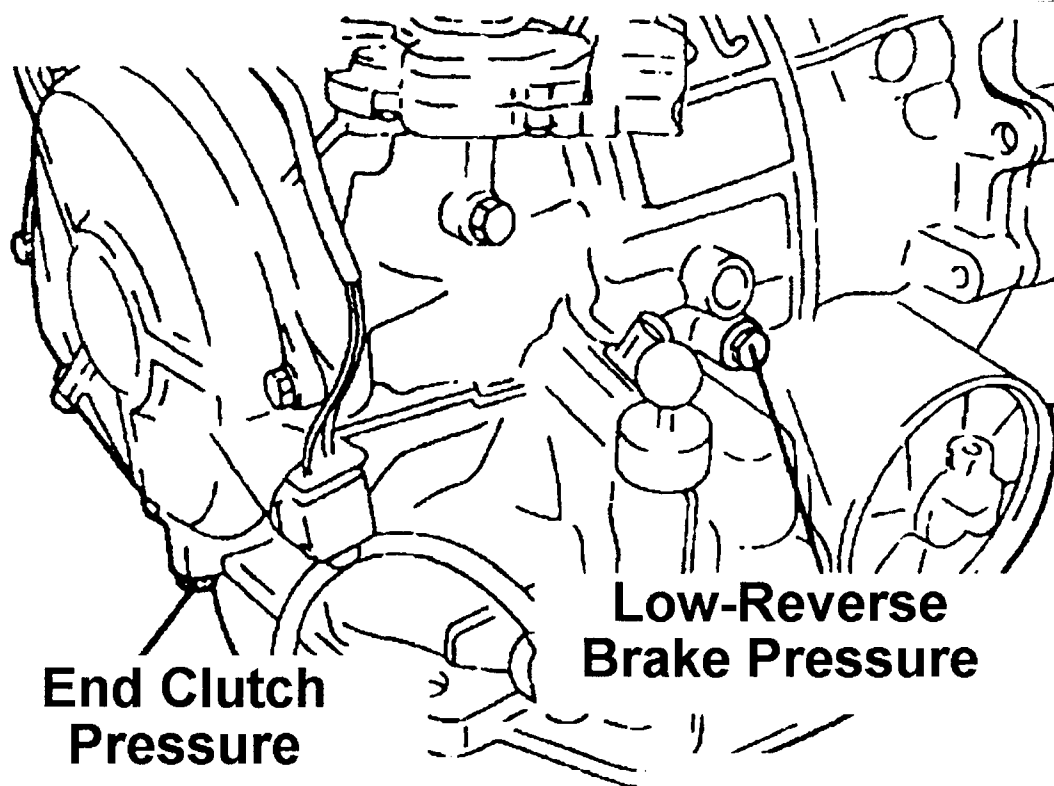
1993-ON
(Full-Length Lugs)

Shifts 1-2-3-Neutral

The KM Series four speed transaxles have an end clutch, which is applied in third and fourth gear. When the end clutch does not apply, the transaxle neutrals on the 3-4 shift. The following procedures should be performed to diagnose the end clutch.

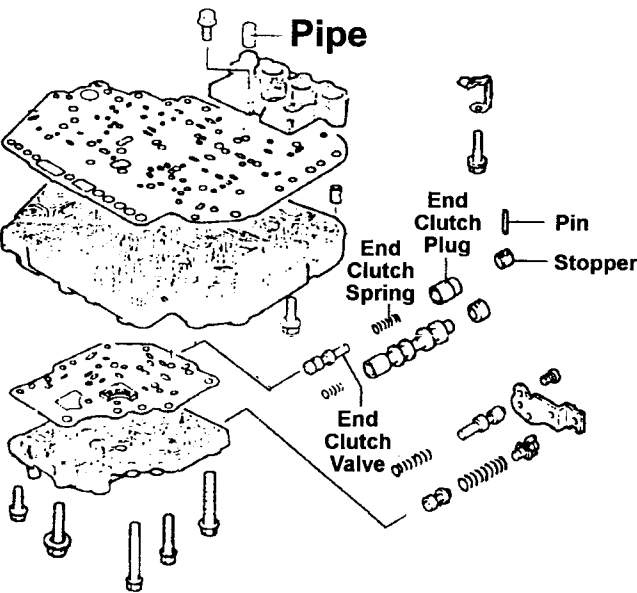
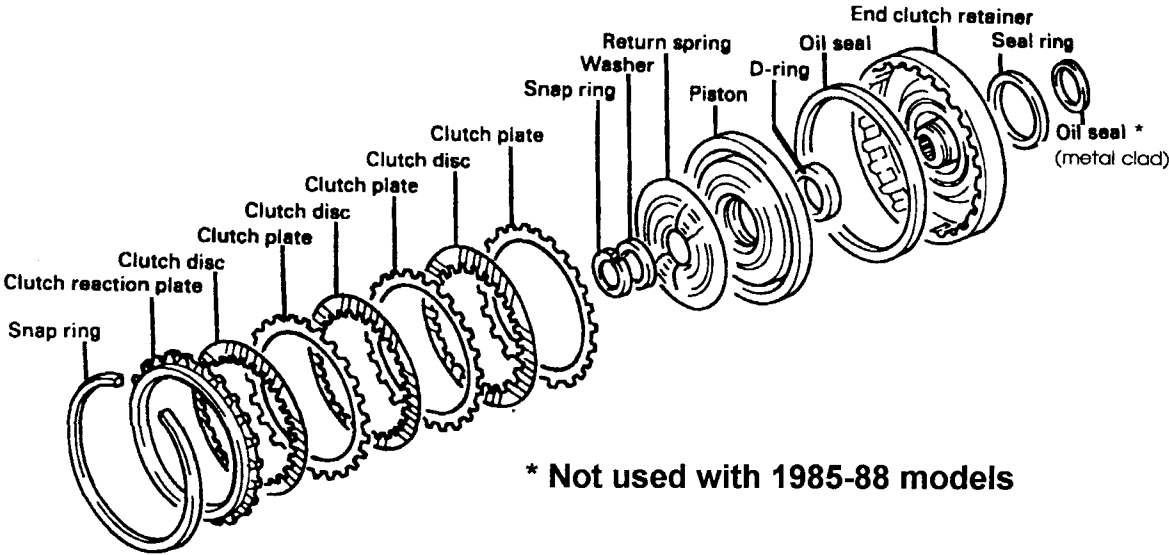
STEP 1 Install a pressure gauge on the end clutch tap

STEP 2 With the transaxle in third gear, end clutch pressure should be 118-128 psi (87-97 psi for 1985-86 Galant).



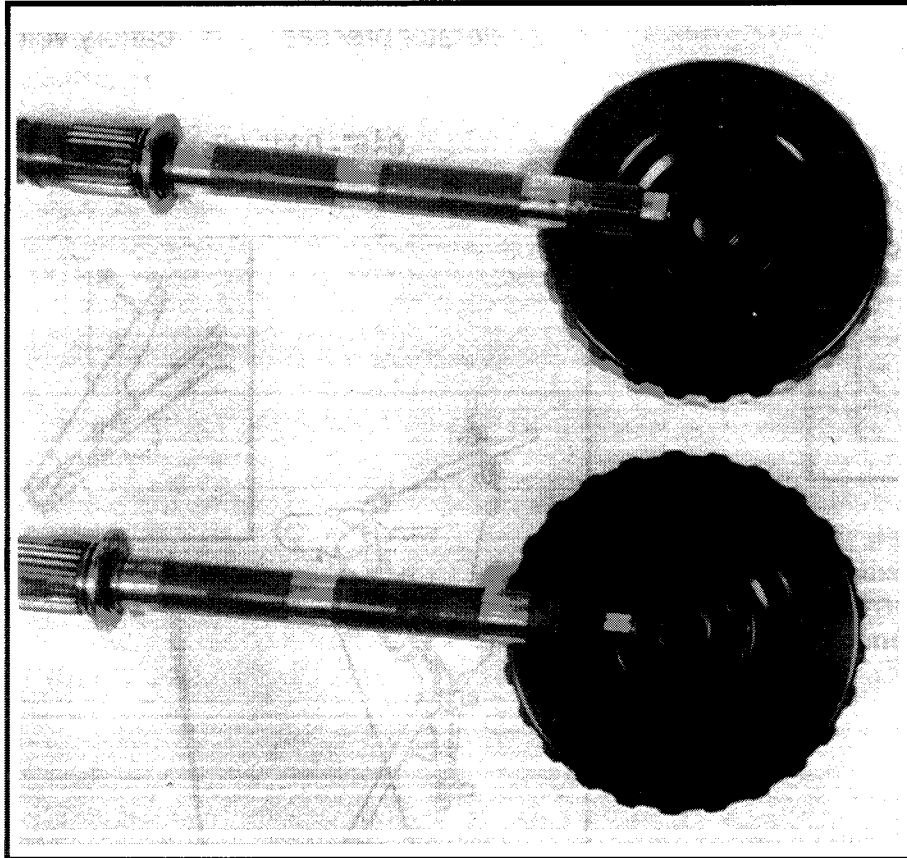
Shifts 1-2-3-Neutral (cont'd)

- STEP 3** If the pressure at the end clutch is low, the problem is usually caused by a leak in the end clutch piston seals, sealing ring or drum seal.
- STEP 4** If there is no pressure at the end clutch, the problem is usually caused by a stuck end clutch valve or missing valve body to case feed pipe.



Mainshaft Change

The mainshaft was modified toward the end of the 1992 production year. The end clutch seal journal diameter was reduced. The large and small journal shafts are interchangeable provided the seal is correct.



1989-91

1992-ON

1st Design Seal #MD722531

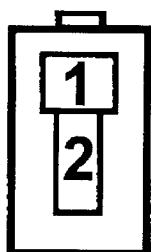
2nd Design Seal #MD736847

Harsh Coast-down Shifts

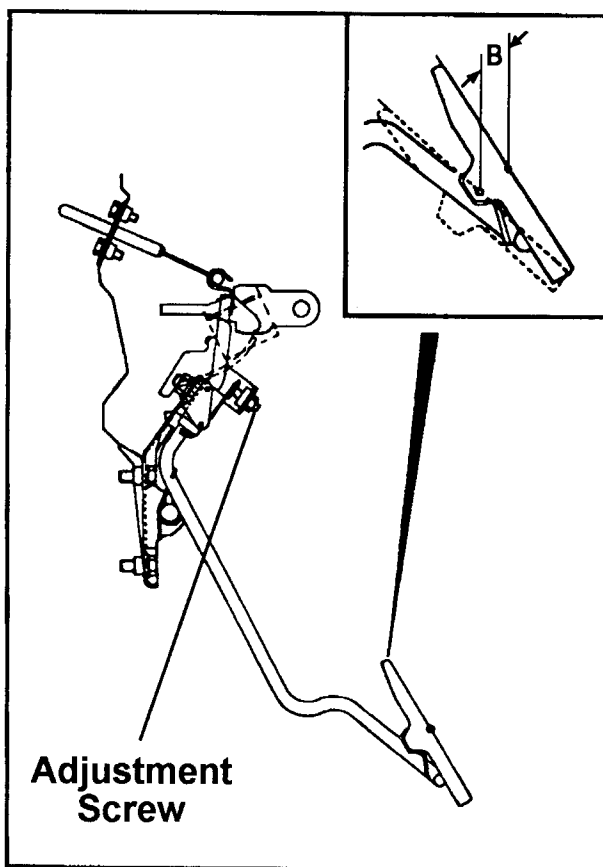
A harsh coast-down shift is usually caused by an accelerator switch that is out of adjustment. The accelerator switch is used to signal the TCU that the driver is or is not stepping on the accelerator. The test procedure is outlined below.

Voltage check between pins one and two ... accelerator released = zero volts (less than .1)
accelerator pressed = battery voltage

.016"-.031" (distance B)



Accelerator
Switch
Harness
Connector

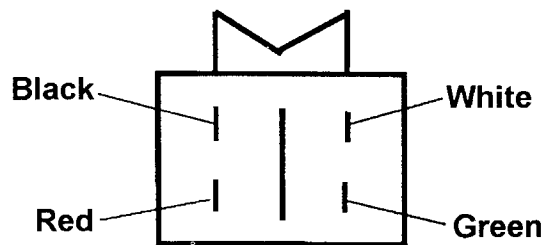


Third and Reverse Only

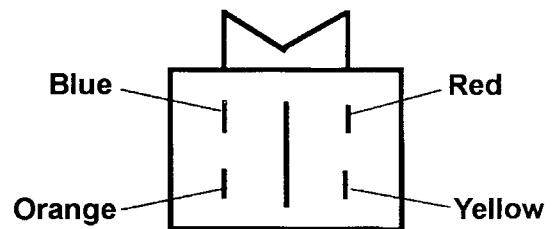
Multiple Codes

Some KM175 series transaxles may have multiple codes set in computer memory and have only third and reverse after overhaul.

This condition may be caused by plugging the pulse generator connector into the solenoid harness and the shift solenoid connector into the pulse generator harness. Use the figures below to correctly identify the harness connectors and locations.

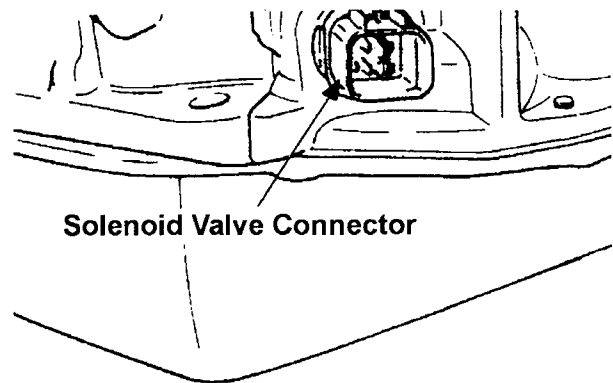
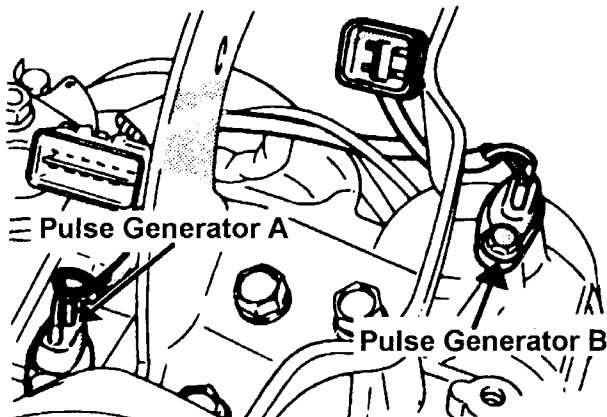


**Harness Connector for
Pulse Generator**



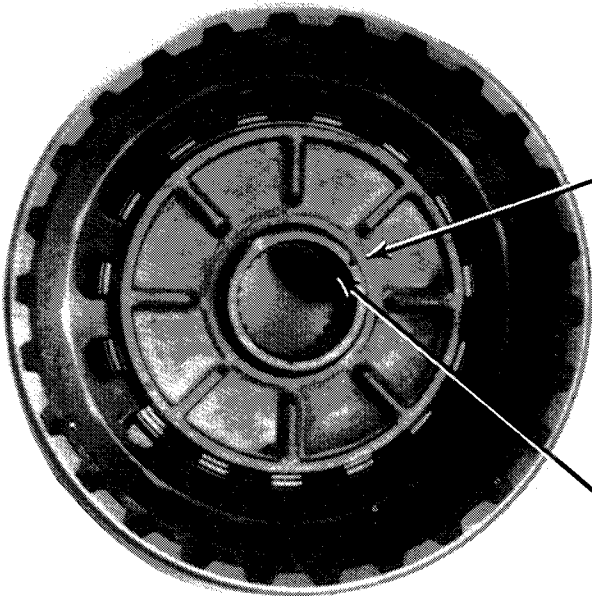
**Harness Connector for
Transaxle Solenoids***

** Some models may vary*



Delayed Forward Engagement

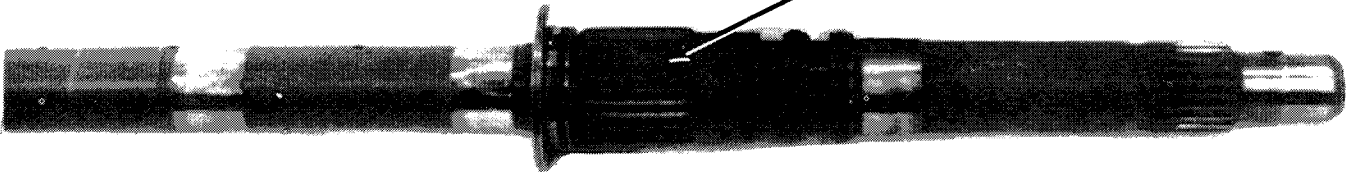
A delayed forward engagement can be the result of a mis-assembly of the rear clutch drum and input shaft. 1989 and later KM175 series transaxles (including the KM176, 177, F4A21, F4A22, F4A23, F4A33, W4A32 and W4A33) use three slots in the turbine shaft to feed the three holes in the rear clutch drum. It is important that the holes in the drum line-up with the slots on the shaft.



HINT: Line up one of the slots in the shaft with the ID mark in the drum.

The drum has three holes.

The shaft has three slots.



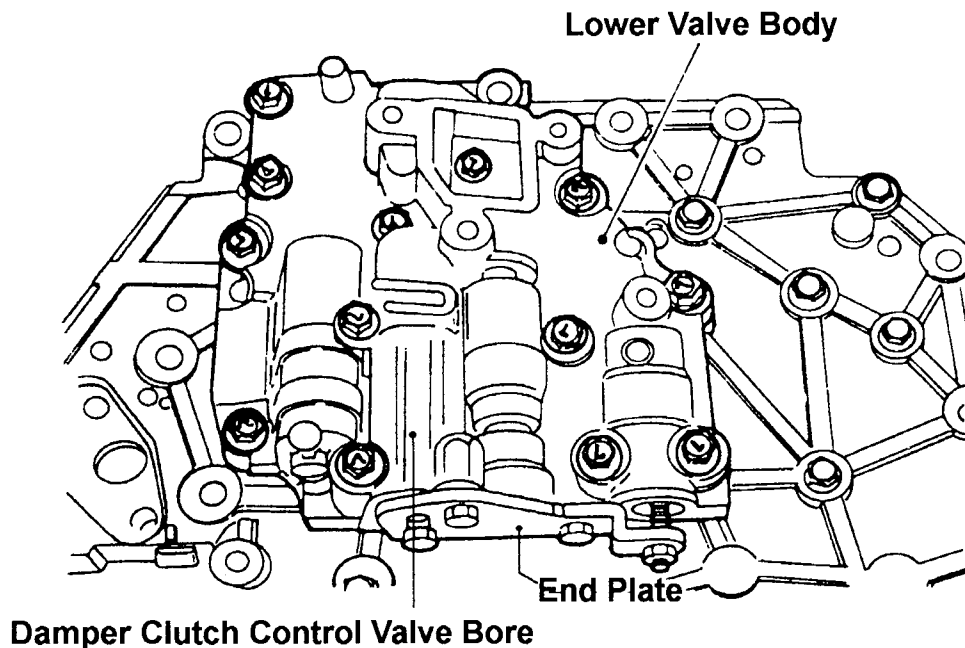
The slots in the shaft must line up with the holes in the drum

No Movement After Rebuild

No Torque Converter Charge

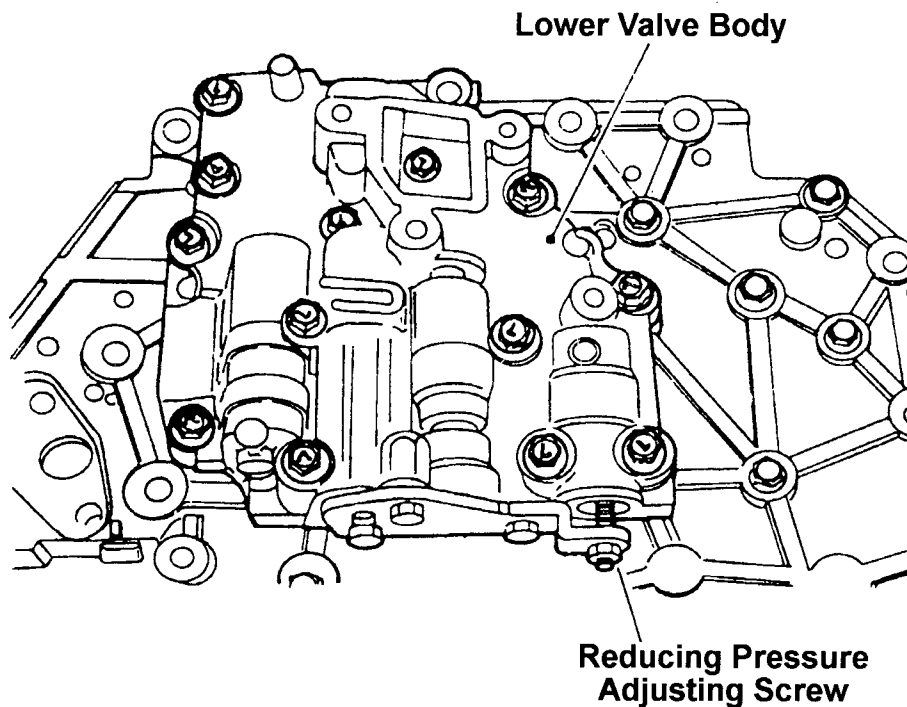
A no movement condition after rebuild can be caused by a stuck damper clutch control valve. The following procedure should be used to prevent the valve from sticking.

- STEP 1** Tighten the lower valve body bolts to 36-48 in. lbs.
- STEP 2** Remove the end plate that retains the damper clutch control valve.
- STEP 3** If the valve is dragging in the bore, loosen the bolts surrounding the valve until it moves smoothly.
- STEP 4** Attach the filter. Make sure the valve does not drag in the bore after the filter bolts are tightened.



2-3 Flare

The KM175 series valve body has no provisions for changing the shift feel of one shift without affecting the others. Assuming clutch clearance and servo travel are correct (and the front clutch air checks with low pressure), adjust reducing pressure higher. This will increase the pressure to all of the shifting elements. Provided the 1-2 shift, 3-4 shift and torque converter apply do not become aggressive, this adjustment will usually fix the complaint. However, often times, a 2-3 flare condition is due to the composition of the friction plates. If raising reducing pressure does not correct the 2-3 flare, check this list of factory frictions below.

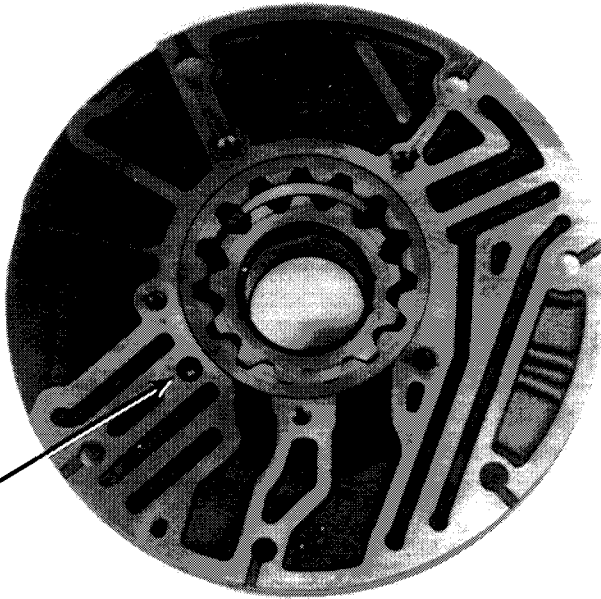


The following is a list of factory front clutch frictions

1985-88	MD 713655
1989-96	MD 737892
1991-96	MD 735828 (32 and 33 Series)

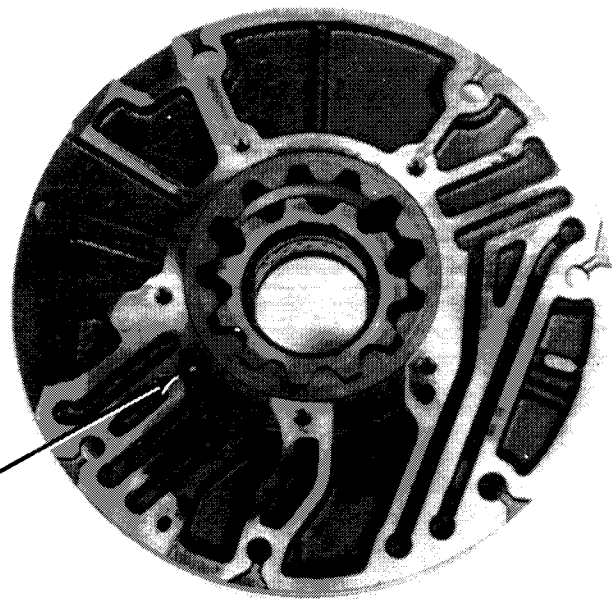
No Forward After Rebuild

A no forward condition after rebuild can be caused by a missing checkball between the pump halves. The checkball diameter is 9mm (.354") for 1985-90 models. 1991 and later models use a 5.5mm (.218") ball.



Checkball

1985-88



Checkball

1991-On

ZF

Identification	120
Clutch and Band Application	121
Gear Ratios	121
Orifice Placement	122
Hydraulic Schematic	123
Valve Descriptions	123
Orifice Location and Size	126
Valve Positions	128
Sprag Rotation	130
Cooling System	131
No Forward When Hot	132
Band Adjustment	133
Slips Forward	134
Slips on 2-3	134
Pressure Taps	135
Governor Distributor & Sleeve	136

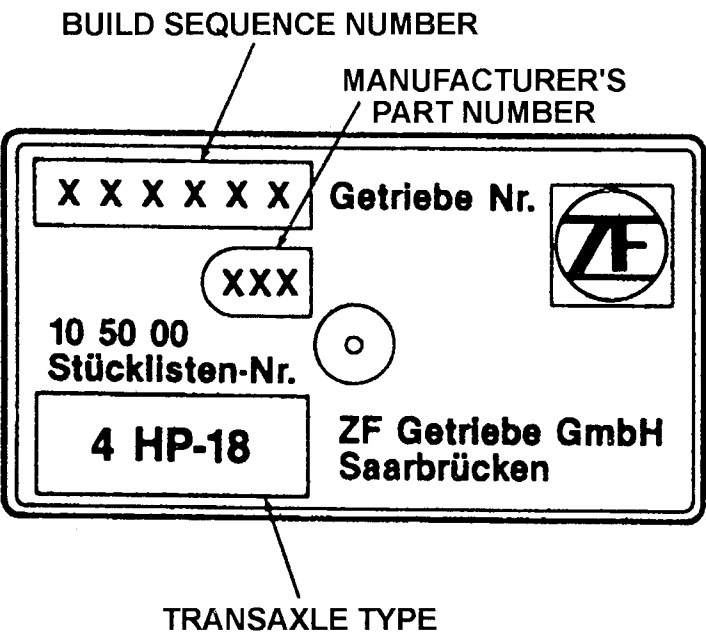
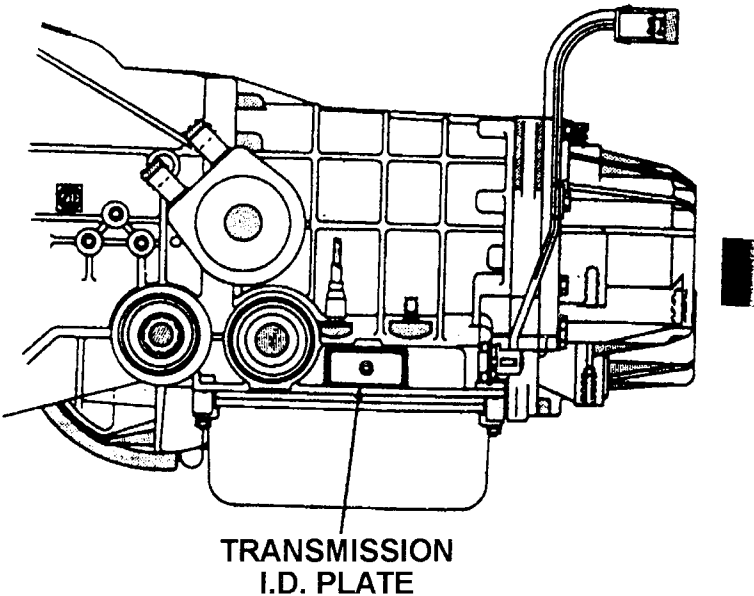
ZF



ZF-4

Transaxle Identification

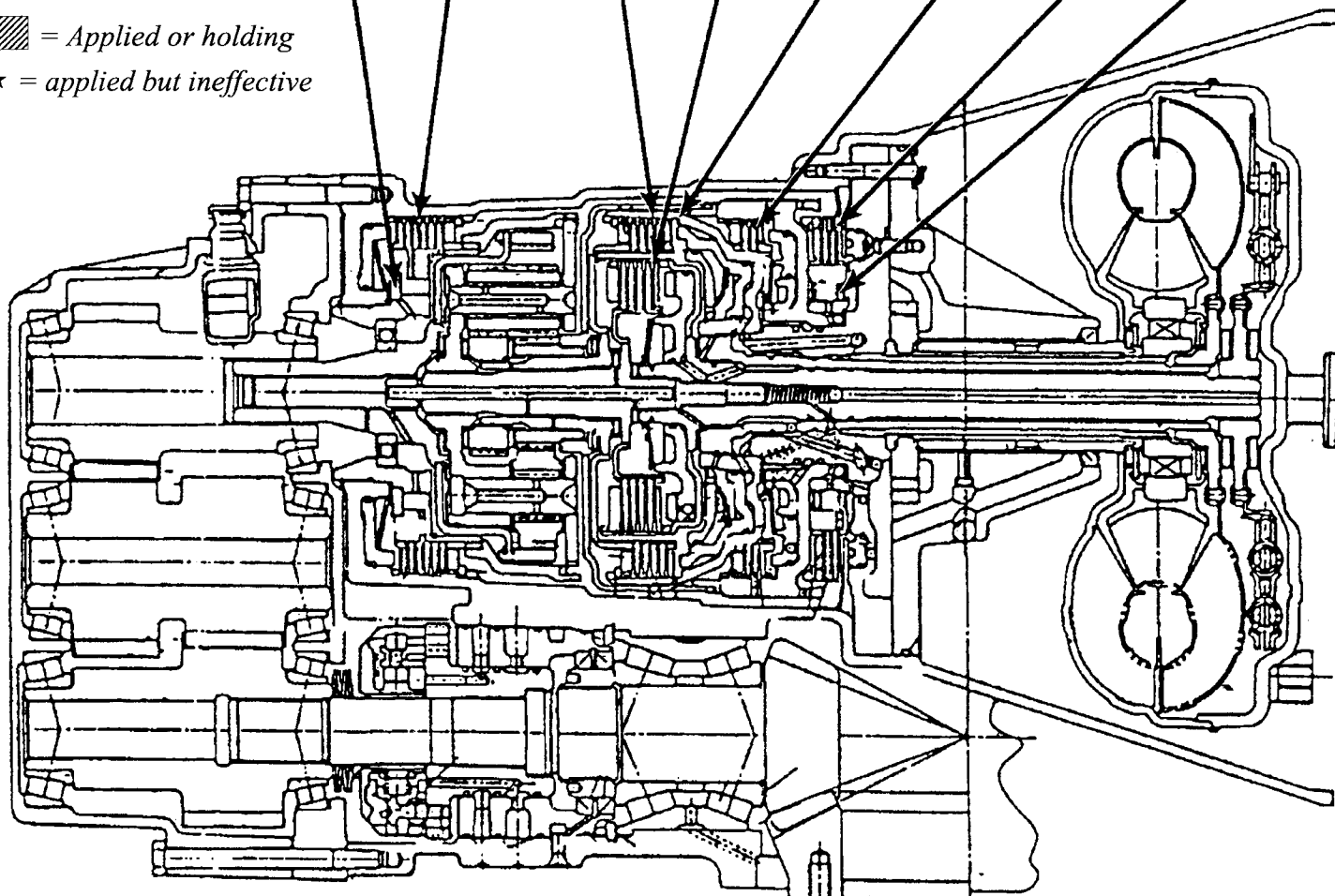
The transaxle identification plate is on the left side of the case above the oil pan. The information on the plate consists of the build sequence number, manufacturers part number and the transaxle type.



ZF

Range	Gear	Low Roller Clutch	"D" Low/Rev Brake	"A" Forward Clutch	"E" 3-4 Clutch	"C1" 2-4 Band	"B" Reverse Clutch	"C" Intermediate Brake	Intermdiate Sprag
R	Reverse								
D	1st								
	2nd								
	3rd								
	4th								
2	1st								
	2nd								
L	1st								

 = Applied or holding
 ★ = applied but ineffective

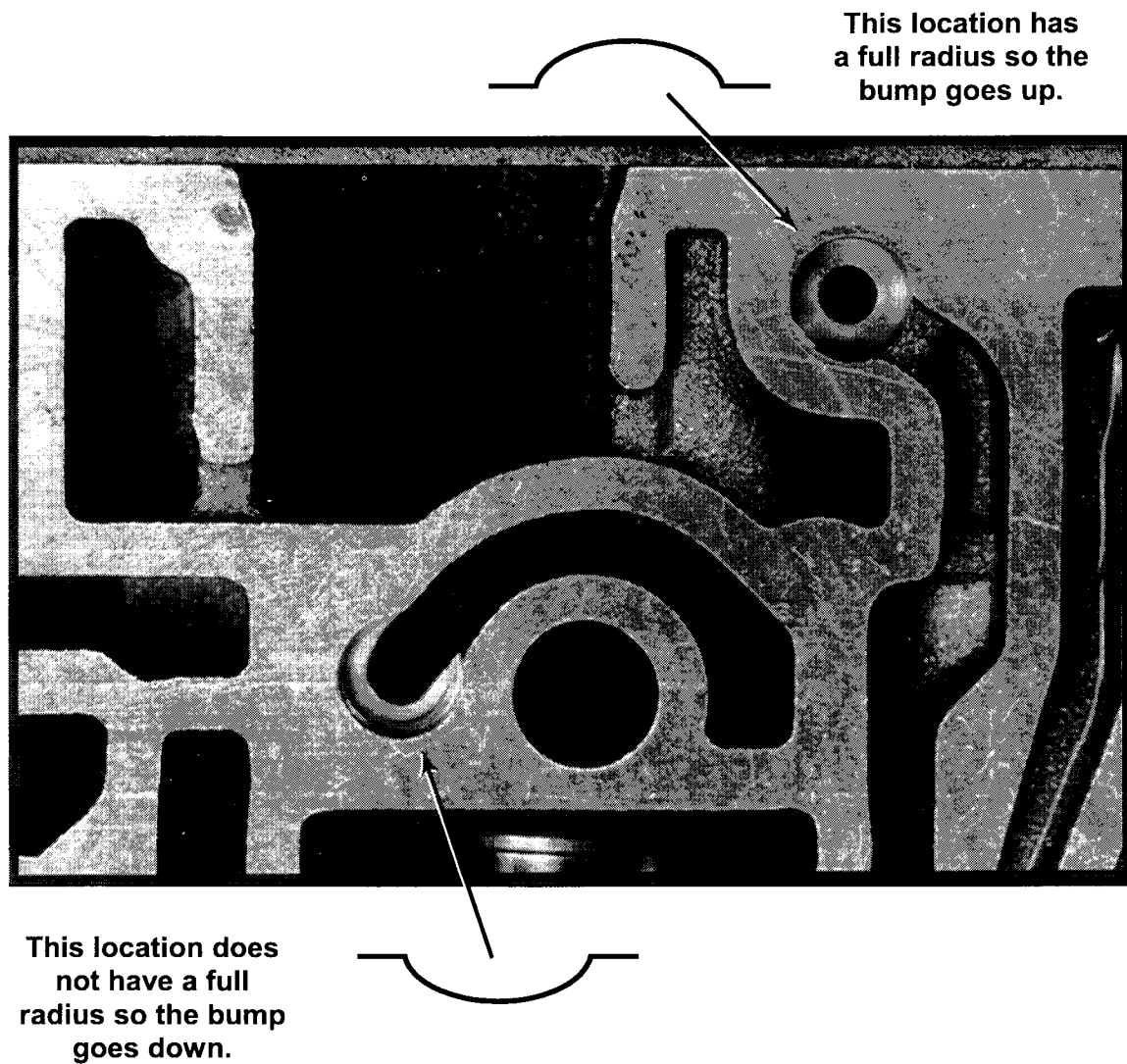
**Gear Ratios**

1st	2.58:1
2nd	1.41:1
3rd	1.00:1
4th	.74:1
Reverse	2.88:1

Orifice Placement

BMW, Peugeot, Volvo, Lincoln

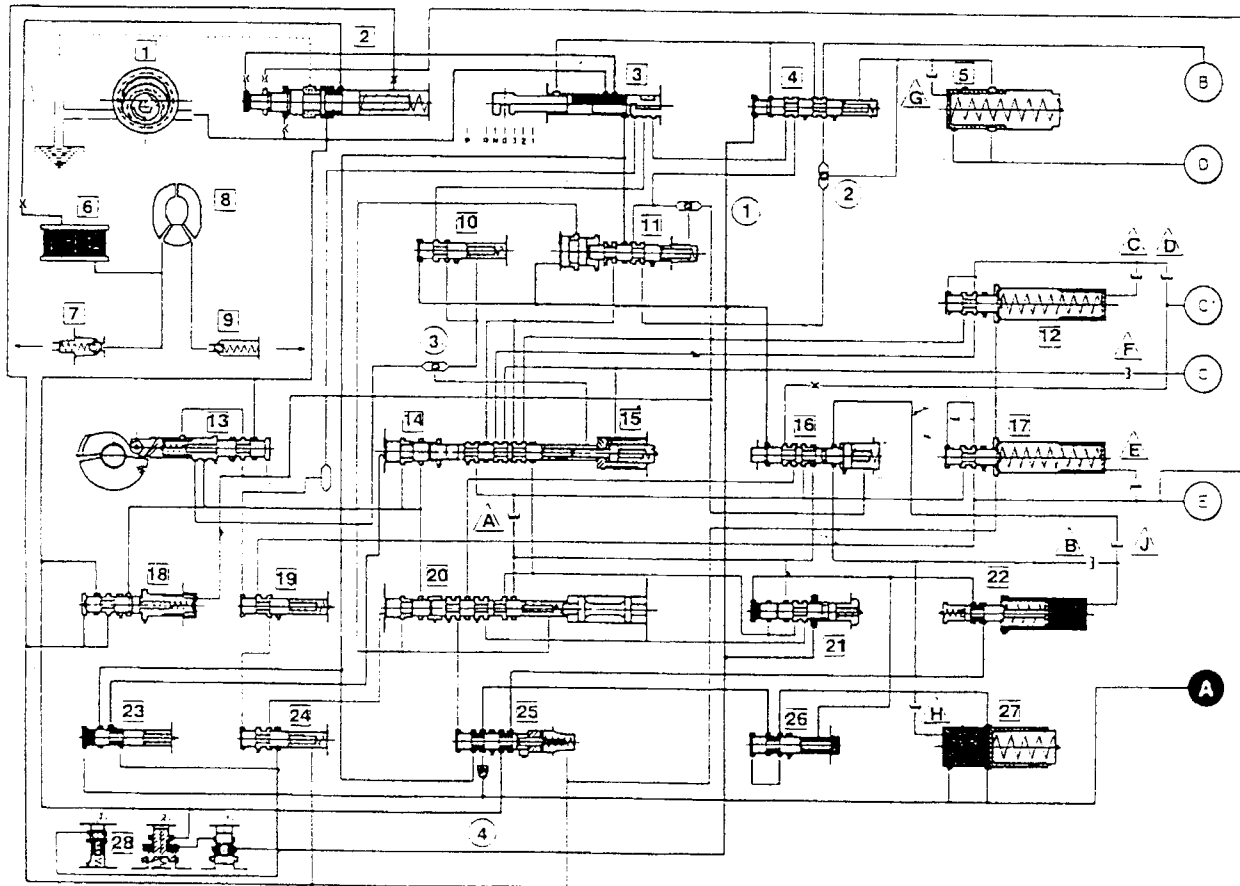
ZF uses removable orifices in their automatic transmission. Use the following information for proper orifice placement (bump up or bump down).



NOTE: Many reference manuals show these orifices upside down, always use this method for the proper placement.

Oil Chart, Valve Body

Eagle Premier, Peugeot



NOTE: For clarity we have renamed some of the valves to help indicate their true functions. Where this was done, the factory name will be listed in brackets.

VALVE DESCRIPTIONS

1. PUMP
2. PRESSURE REGULATOR VALVE
3. MANUAL CONTROL VALVE
4. LOW/REV LOCK-OUT VALVE—[1st Reverse lock-up valve]
This valve prevents the "D" clutch from applying above a certain speed. The "D" clutch is used for manual low and reverse.

Valve Descriptions (cont'd)

5. "D" DAMPER (ACCUMULATOR)
Feed to the "D" clutch is through orifice G until the damper bottoms out. At that time the orifice is bypassed. The spring controls how long it takes to bypass orifice G.
6. COOLER
7. CONVERTER RELIEF
8. TORQUE CONVERTER
9. DRAINBACK VALVE (IN THE LUBE CIRCUIT)
10. 2ND LOCK-OUT VALVE—[2nd lock-up valve]
This valve will not allow a 3-2 downshift above a certain speed.
11. 1-2 SHIFT VALVE
12. "C" CLUTCH VALVE & DAMPER (ACCUMULATOR)
Even though the "C" brake is a band, this is still called a clutch valve. During the initial apply of the band, the servo pressure is modulated through the clutch valve. As the damper is stroked, the servo feed pressure increases due to the increasing spring pressure applied to the clutch valve. The damper rate is controlled by orifice C.
13. THROTTLE VALVE
14. 2-3 SHIFT VALVE
15. 1-2-3 SEQUENCE VALVE—[Not named]
This valve will not allow the 2-3 shift valve to stroke until the 1-2 shift valve is in the 2nd gear position.
16. ORIFICE CONTROL VALVE
This valve is controlled by TV & Governor Pressure. When TV pressure is high, orifice A (3-4 shift feed) and orifice J (4-3 timing control valve feed) are bypassed. When governor pressure is high and TV pressure is low, oil is allowed to flow through these orifices.
17. "E" CLUTCH VALVE & DAMPER (ACCUMULATOR)
See "C" clutch valve & damper
18. MODULATOR VALVE
19. 4TH LOCK-OUT VALVE—[3rd lock-up valve]
This valve indirectly prevents a 3-4 shift in manual, 3 2 or 1 by blocking 3rd gear oil from the 2-3-4 sequence valve.
20. 3-4 SHIFT VALVE
21. 4-3 DOWNSHIFT VALVE
This valve controls the 4th gear oil exhaust during a 4-3 downshift. 4th exhaust oil is restricted until the 4-3 timing control valve signals the downshift valve at which point 4th gear exhaust is allowed to exhaust with no restrictions. This action controls the "C" band release during a 4-3 down shift.

Valve Descriptions (cont'd)

22. 4-3 TIMING CONTROL VALVE—[Time control valve]

This valve controls when the 4-3 downshift valve & the 4-3 capacity modulator valve will stop regulating. The speed at which this valve is stroked is controlled by orifice B and orifice J.

23. 4-3-2 SEQUENCE VALVE

This valve ensures that the downshifts will occur in the right sequence by replacing governor pressure with line oil at the 2-3 shift valve. This binds the 2-3 shift valve in the shifted position as long as the "A" clutch is not pressurized (4th gear).

24. 2-3-4 SEQUENCE VALVE

This valve blocks governor pressure from getting to the 3-4 shift valve until the "E" clutch is pressurized. This will ensure that the shifts occur in the right sequence.

25. A CLUTCH EXHAUST VALVE—[3-4 traction valve]

This valve is used to exhaust "A" clutch oil during a 3-4 shift.

26. 4-3 CAPACITY MODULATOR VALVE—[4-3 traction valve]

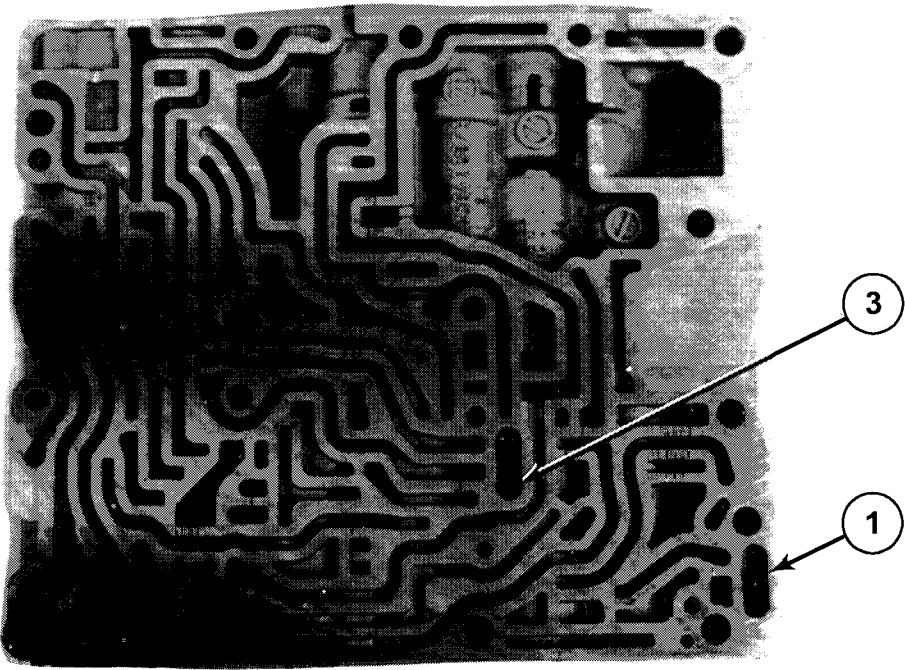
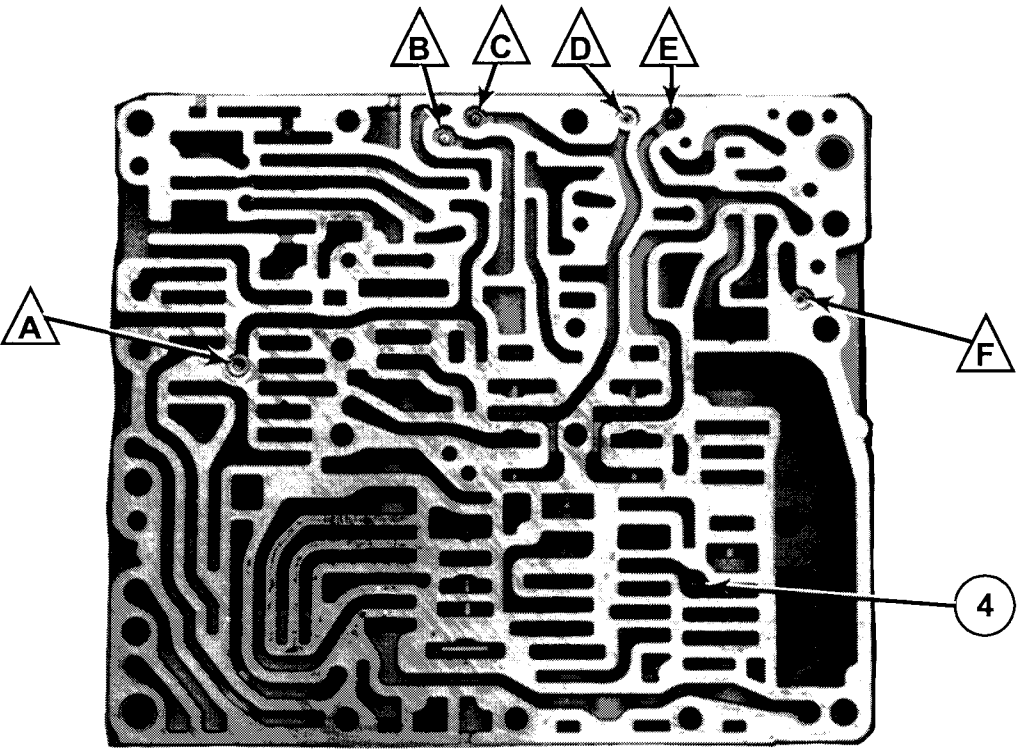
This valve modulates "A" clutch oil during a 4-3 downshift. After a 4-3 timing control valve signal is received, "A" clutch apply oil is no longer modulated.

27. "A" CLUTCH DAMPER (ACCUMULATOR)

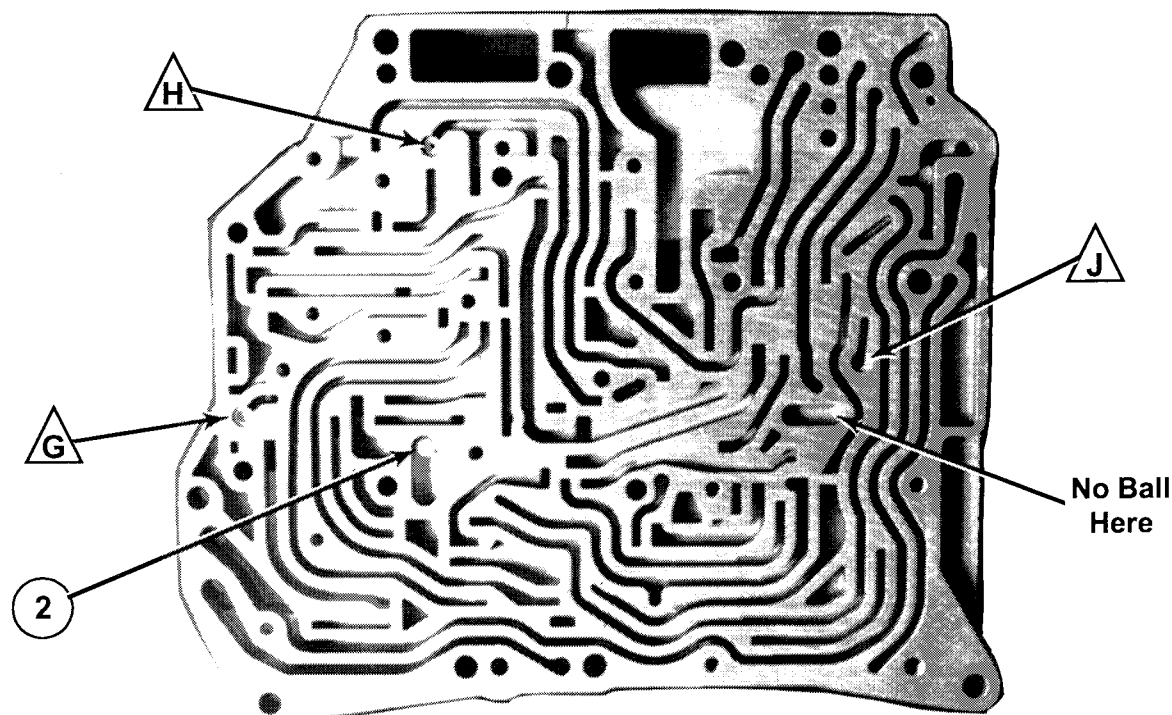
See "D" clutch damper (accumulator)

28. GOVERNOR

Orifice Locations & Size



Check Ball & Orifices Sizes



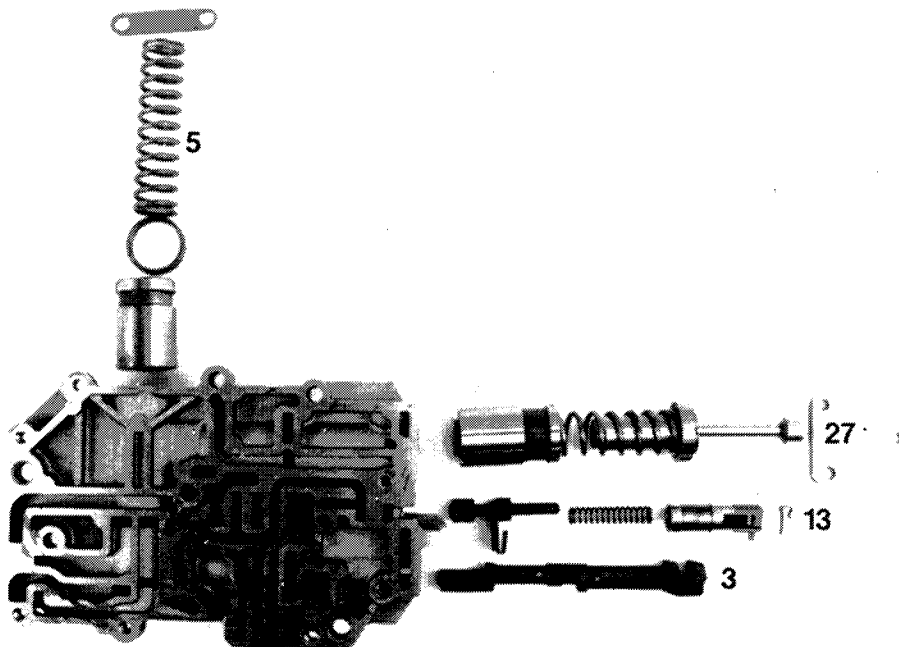
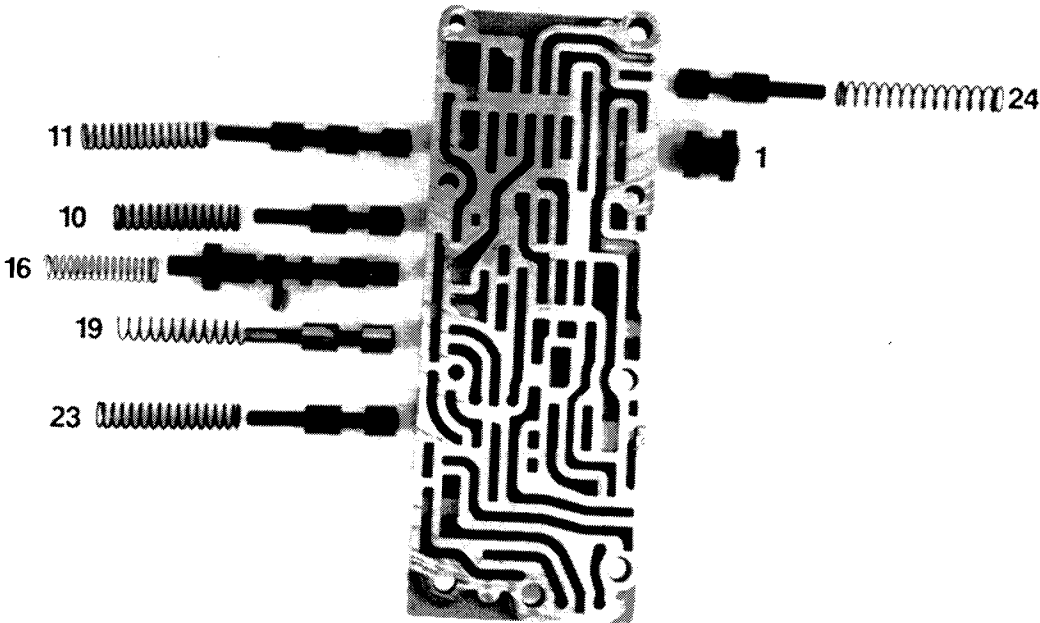
Check Ball & Orifice Sizes

- ① 4.5 mm (.178")
- ② 6 mm (.235")
- ③ 4.5 mm (.178")
- ④ 6 mm (.235")

- △A .024"
- △B .024"
- △C .031"
- △D .059"
- △E .031"
- △F .067"
- △G .026"
- △H .059"
- △J Not used on most models

NOTE: The orifice sizes here are for reference only. Yours may be slightly different.

Valve Positions

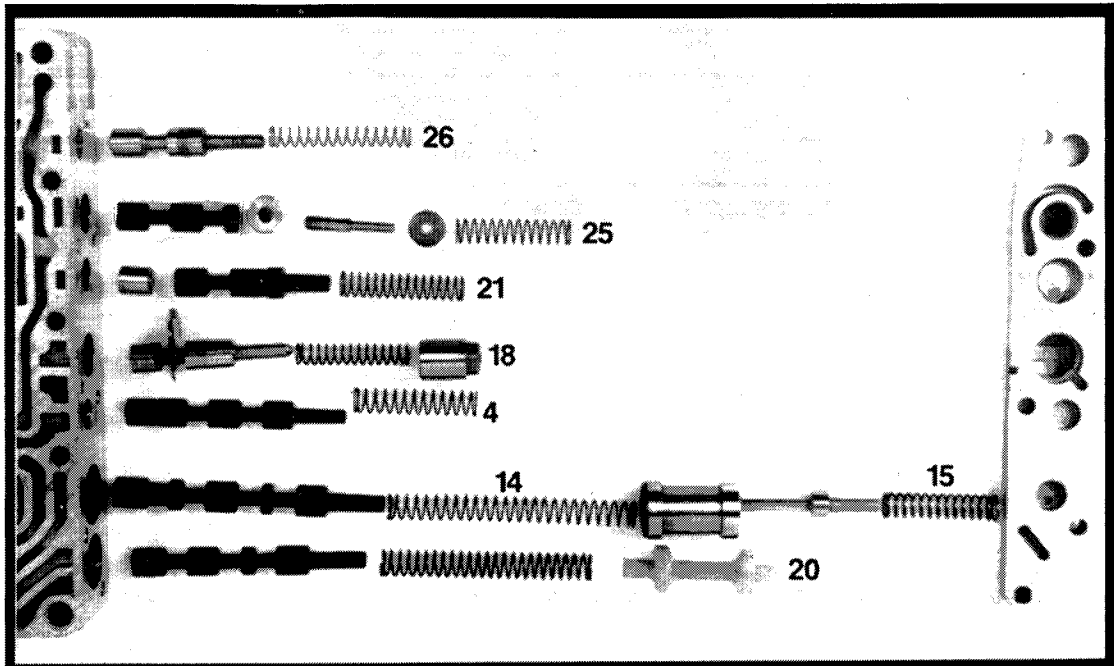
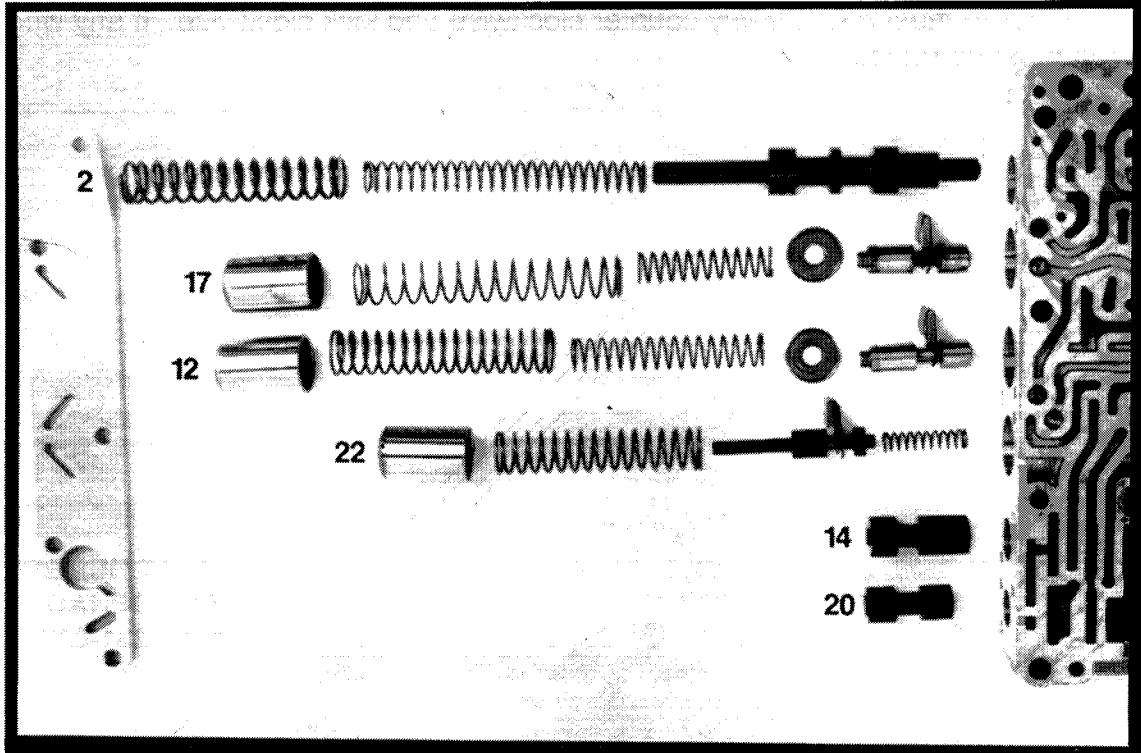


ZF Part Numbers

Case I.D.	Part Number
006	0732-042-211
010/015	0732-042-170
021	0732-042-185

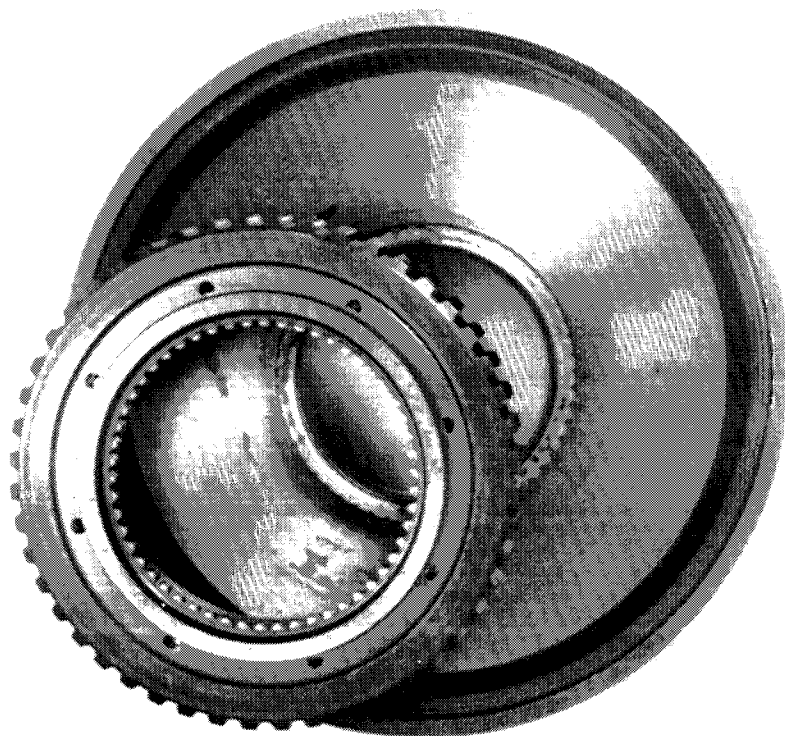
NOTE: A damaged or broken "A" clutch accumulator spring will result in harsh "A" clutch application.

Valve Positions



Sprag Rotation

The intermediate sprag must rotate freely counter clockwise and lock clockwise. If any wear is detected, sprag must be replaced.

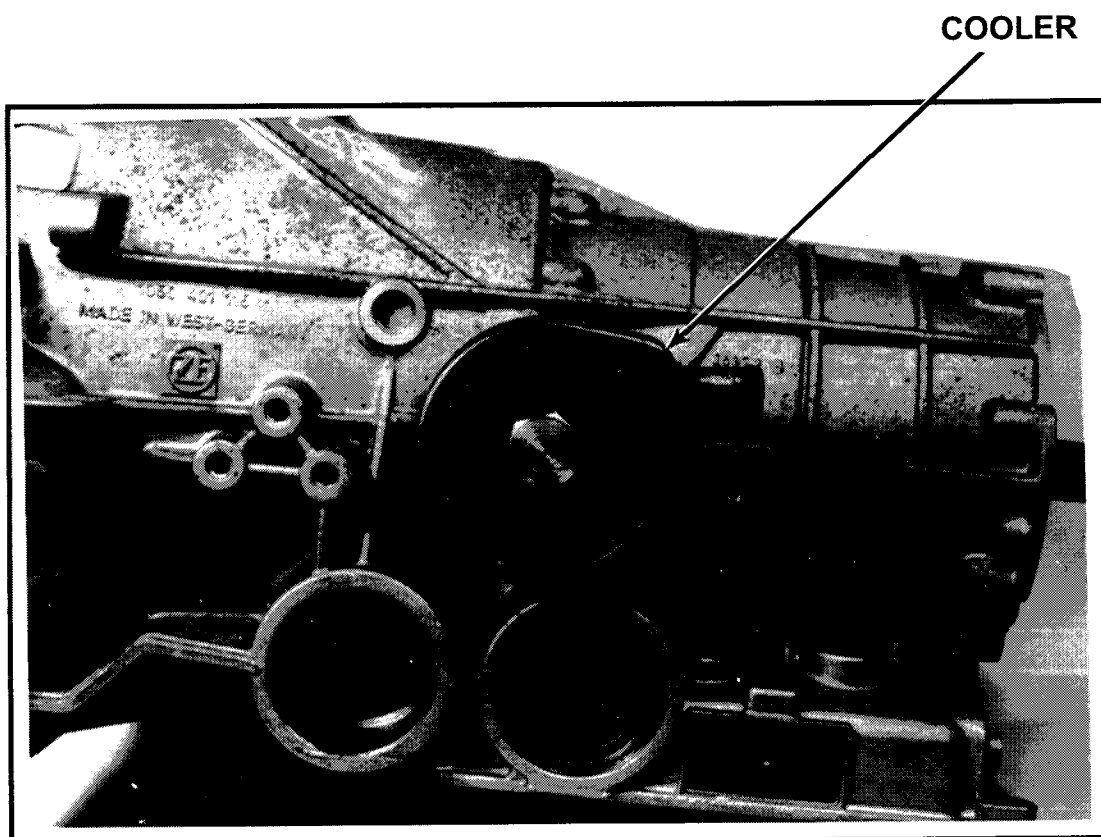


**ZF PART NUMBER
FOR SPRAG
1050-231-026**

NOTE: The low/rev roller clutch is indexed and may only be assembled one way.

Cooling System

The oil cooler that bolts to the side on the transmission is not serviceable! If the system is contaminated heavy with metal or fiber material the cooler must be changed.

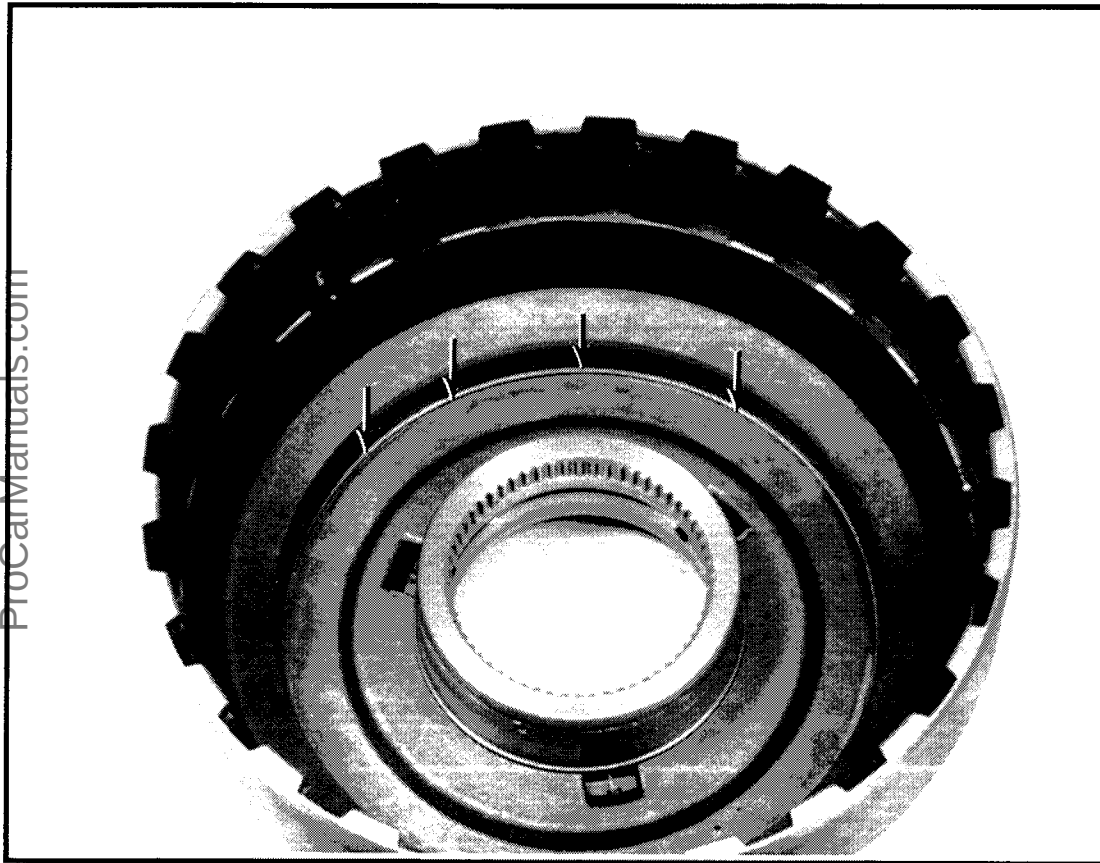


Chrysler Part Number for Cooler: 33004606

No Forward When Hot

This condition can be caused by a cracked "A" clutch drum. Carefully inspect the area shown below for cracks.

Note: A common cause for this is high pressure during a 4-3 downshift—due to a worn pressure regulator valve. Always inspect the PR bore for excessive wear.

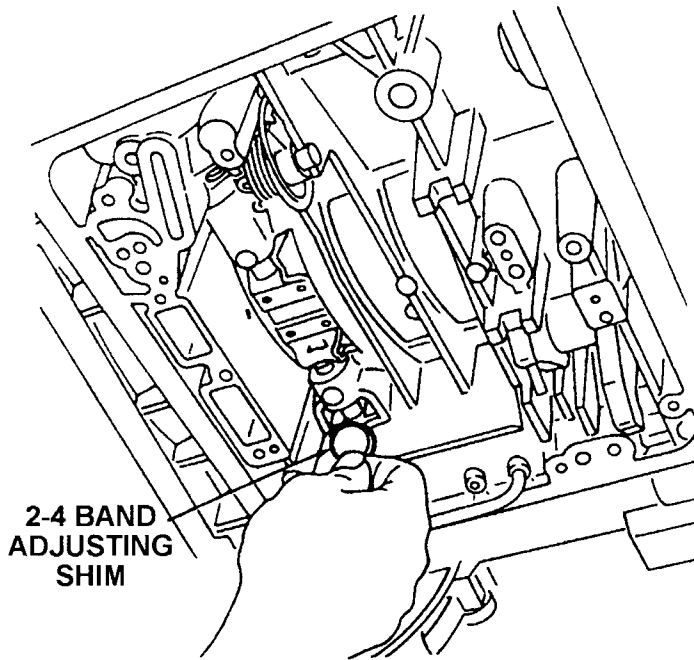


ZF PART NUMBER
FOR "A" CLUTCH
DRUM: 1050-302-023

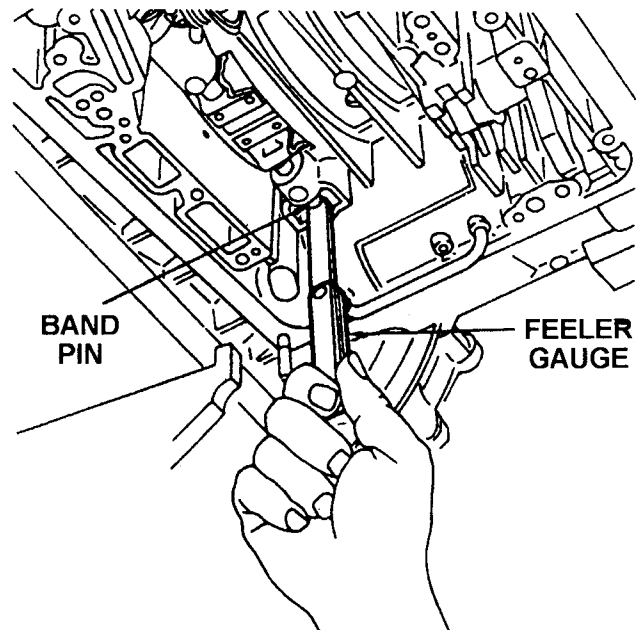
NOTE: Also check the internal splines for wear.

Band Adjustment

Servo travel is adjusted with a selective shim.



PART NUMBER	SHIM THICKNESS
1050 331 064	.256
1050 331 079	.246
1050 331 063	.236
1050 331 078	.226
1050 331 062	.217
1050 331 077	.207
1050 331 061	.197
1050 331 076	.187
1050 331 060	.177
1050 331 075	.167
1050 331 059	.157
1050 331 074	.148
1050 331 058	.138
1050 331 073	.128
1050 331 057	.118



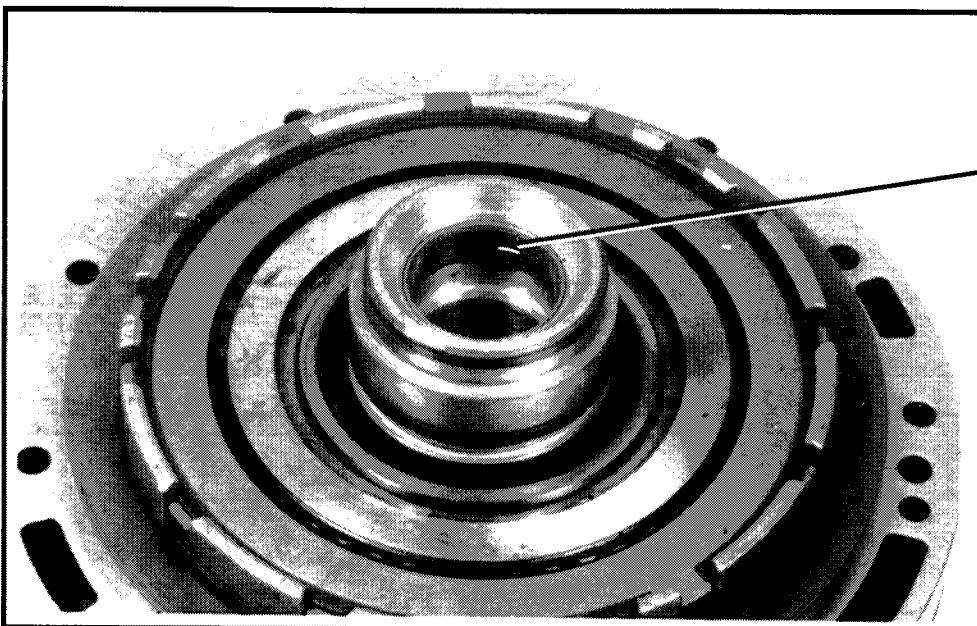
The clearance between the pin and the selective shim should be .049" - .059"

Slips Forward and on 2-3 Shift ("A" and "E" Clutch Failure)

Bushings are used in the pump stator as well as the "A" (forward) drum to provide the contact area for the sealing rings. These bushings should be replaced if there is any visible sign of wear at the sealing ring contact area.



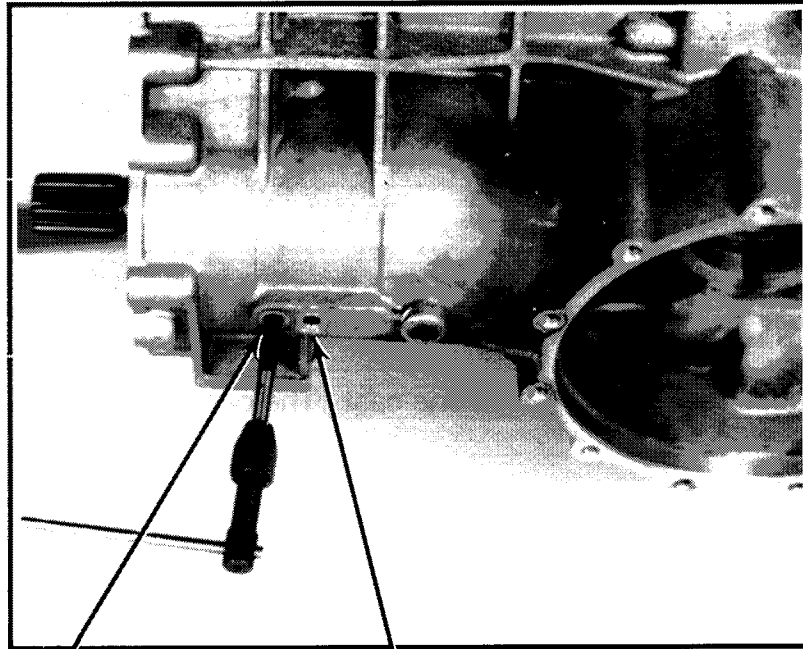
"E" CLUTCH DRUM
SEALING RING
CONTACT AREA



"A" CLUTCH DRUM
SEALING RING
CONTACT AREA

Line Pressure

The ZF4HP-18 that is used in the Premier and Monaco do not have pressure taps. However, there are two locations with plugs that can be removed—then tapped. This will offer a location for both line pressure and governor pressure.

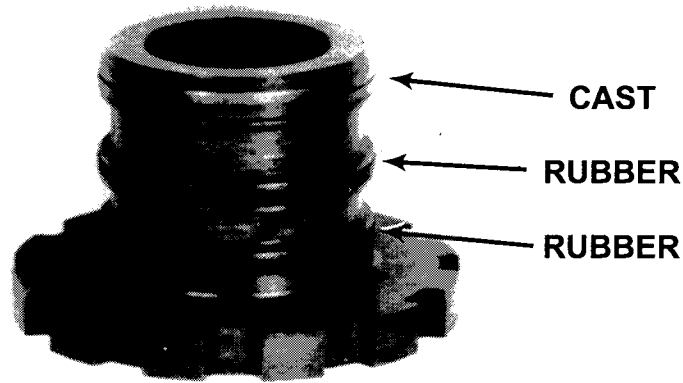


GOVERNOR
PRESSURE

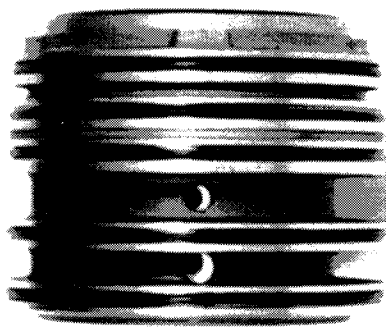
LINE
PRESSURE

NOTE: You need to be extremely careful when removing the plugs from the case. The holes should be tapped to 1/16 pipe thread.

Governor Distributor and Sleeve



The distributor uses two rubber sealing rings and one cast. The cast ring goes on the end closest to the pinion.



Always replace the five "O" rings of the governor sleeve.

Mazda

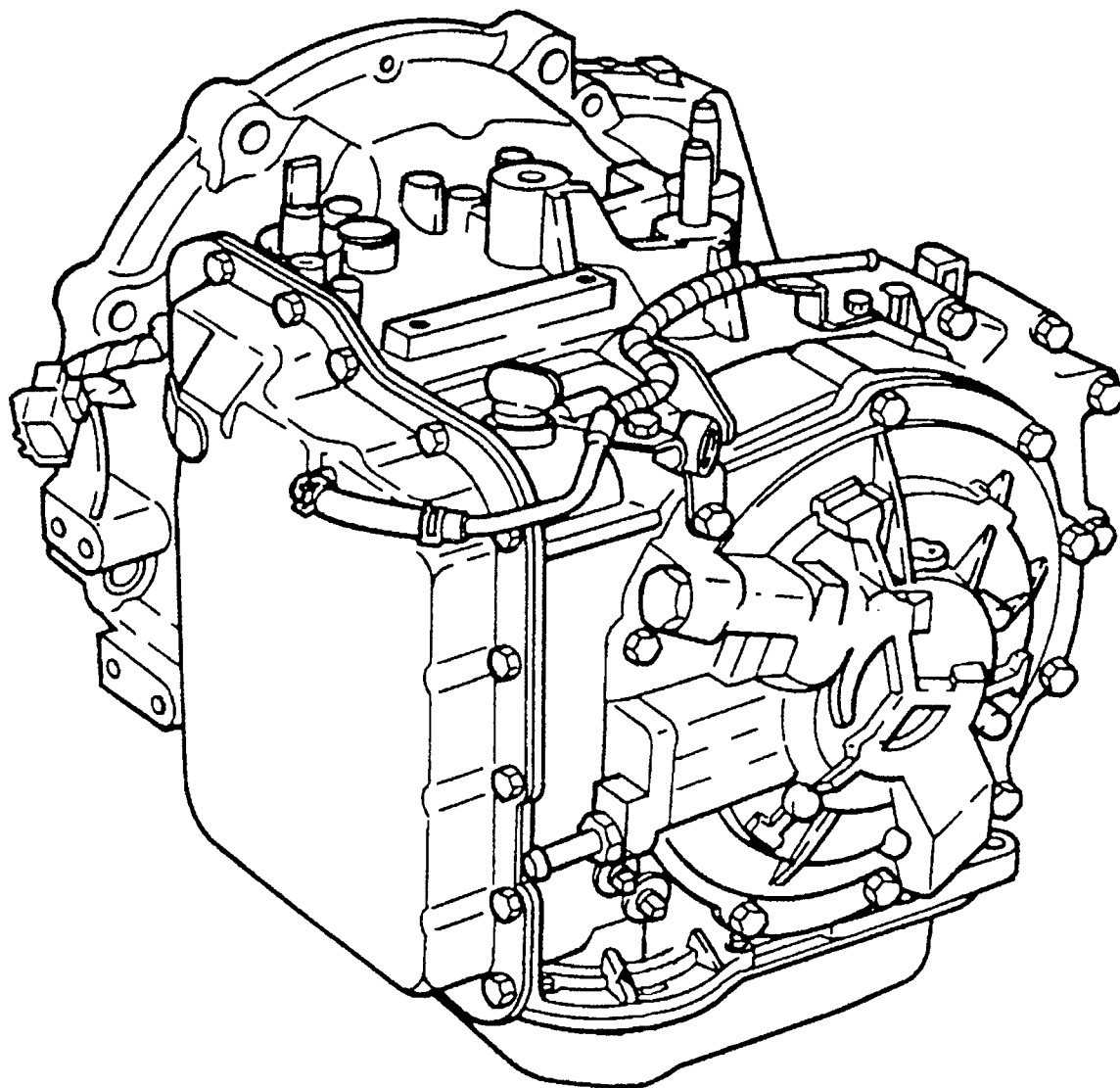
Description	138
Clutch and Band Application	139
Pressure and Pressure Taps	139
Gear Ratios	139
Fail Safe Mode	139
Solenoid Pattern.....	139
Checkballs.....	140
Valves and Springs	144
Valve Body Bolts	146
Signal Monitor	147
Diagnostic Trouble Codes.....	148
Terminology	150
Inhibitor Switch.....	151
TPS/Idle Switch.....	152
Pulse Generator	153
Temperature Sensor	155
Solenoids	156
Brake Switch	158
Computer Location.....	159
Pinout Charts	160

Mazda



GF4A-EL

The GF4A-EL was first introduced in 1993. It was used in the 2.0L and 2.5L Ford Probes and Mazda 626/MX6. In 1994 Ford and Mazda began using the CD4E with the 2.0L, while staying with the GF4AEL for the 2.5L V6. Although very similar to the G4AEL/4EAT some changes were made. This section will cover the major differences such as the seven solenoid valve body with computer controlled line pressure. We will also break down the different terminology used to describe sensors and switches.



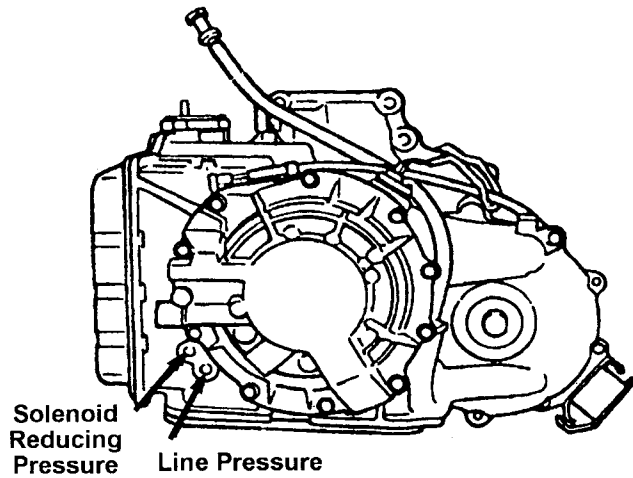
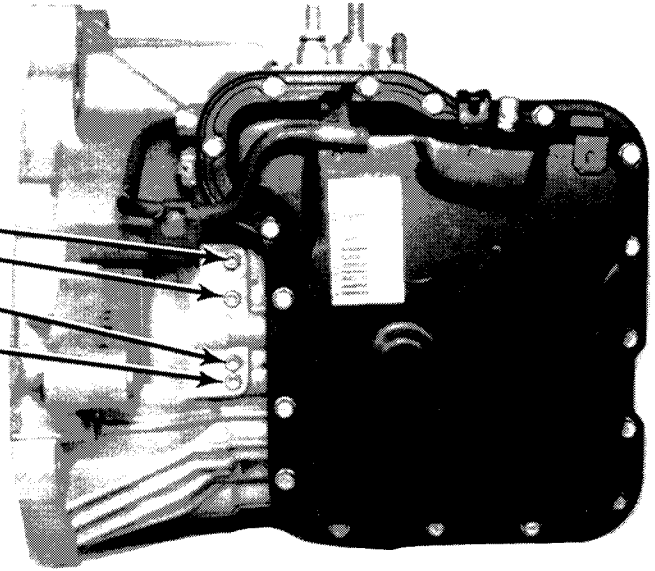
Line Pressure Specs

Range	Idle	Full Stall
D, 2, 1	60-78 PSI	160-170 PSI
REV	110-146 PSI	270-290 PSI

Solenoid Reducing Pressure

All	52-58 PSI
-----	-----------

Line Pressure
 Converter Release
 Converter Apply
 3-4 Clutch



Gear Ratios

1st	2.80
2nd	1.54
3rd	1.00
4th	.70
Reverse	2.33

Final Drive Ratio

2.0L - 3.842
2.5L - 4.157

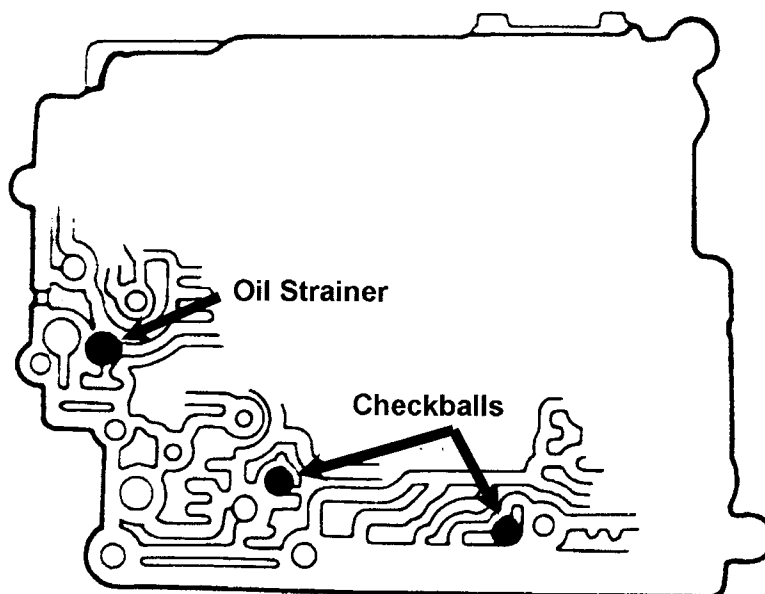
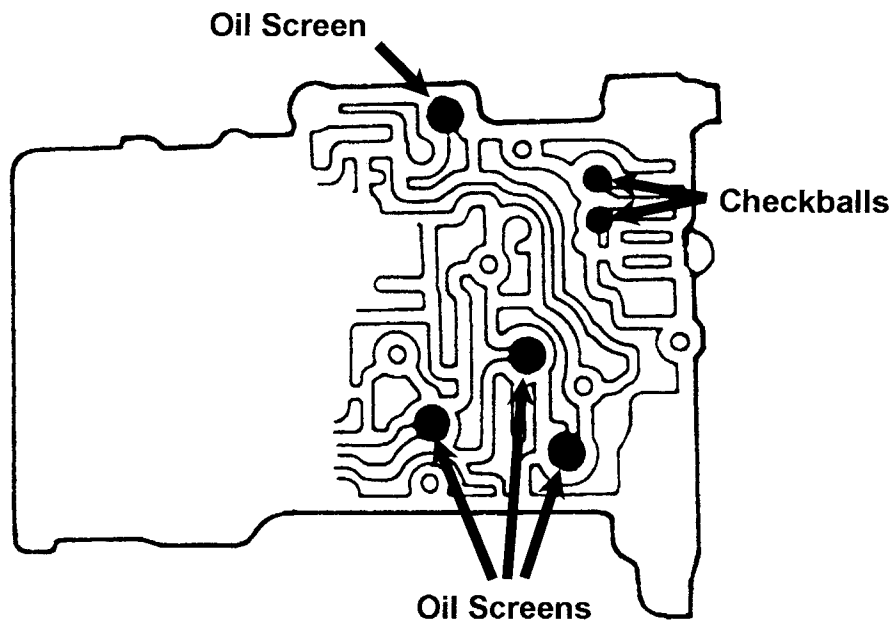
Failsafe Mode

D	3rd
2	3rd
1	1st

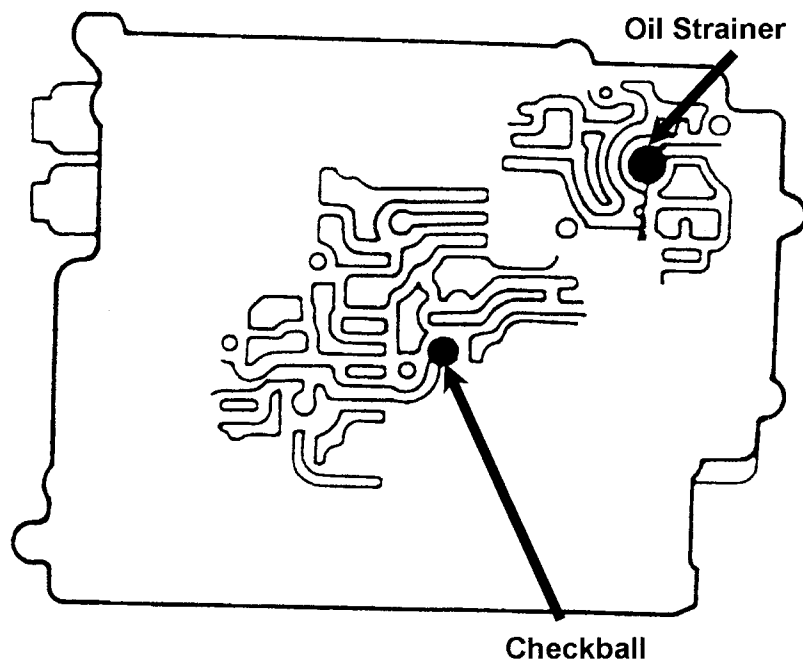
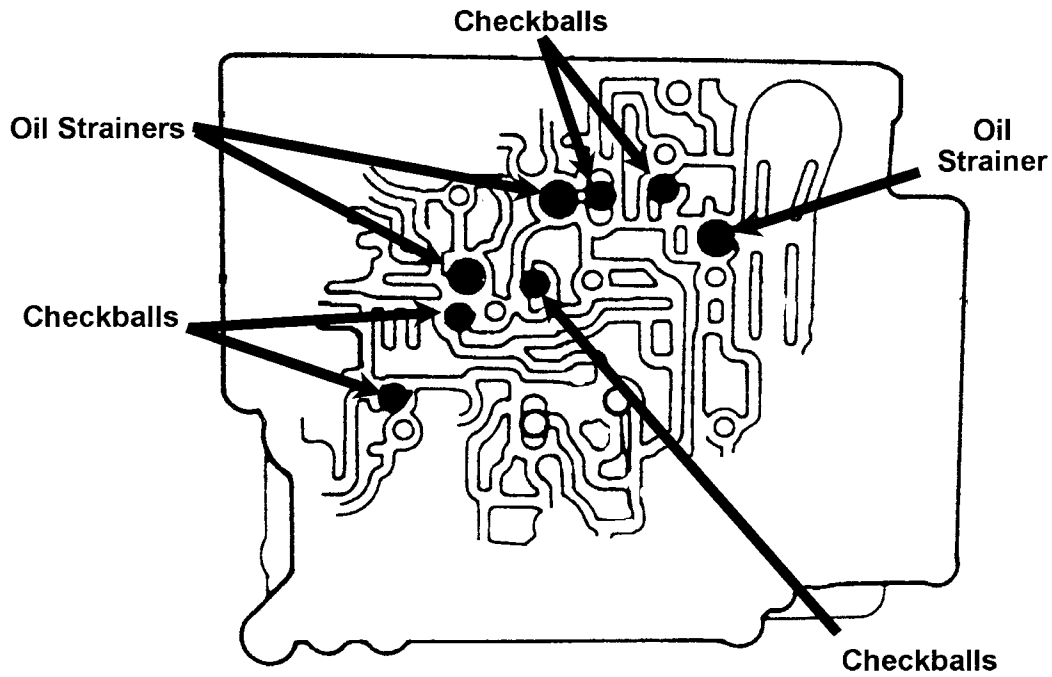
Range	Gear	1-2 Sol	2-3 Sol	3-4 Sol	Forward Clutch	Forward Sprag	Coast Clutch	2-4 Band	2-4 Servo Pressure		3-4 Clutch	Low Roller Clutch	Low Reverse Clutch	Reverse Clutch
									Apply	Release				
P														
R	Reverse													
N	<2mph													
N	>3mph													
D	1st													
	2nd													
	3rd													
	4th													
2	2nd													
	3rd													
1	1st											★		
	2nd													

★ = Holding but ineffective due to Low Reverse Clutch.

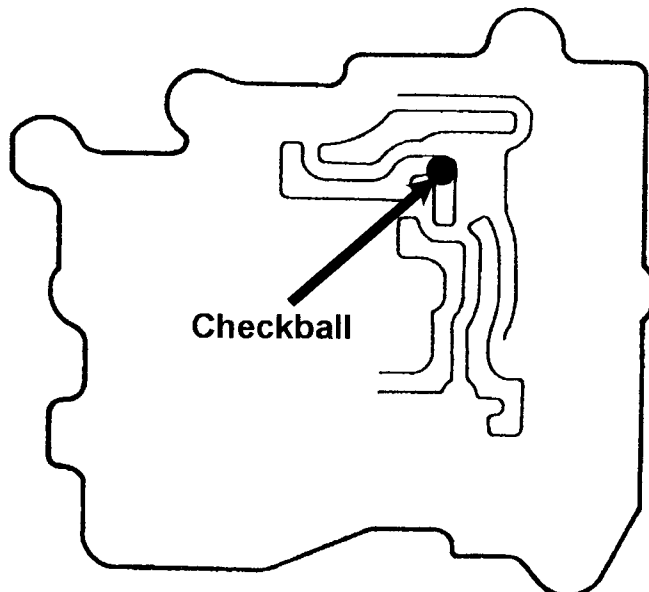
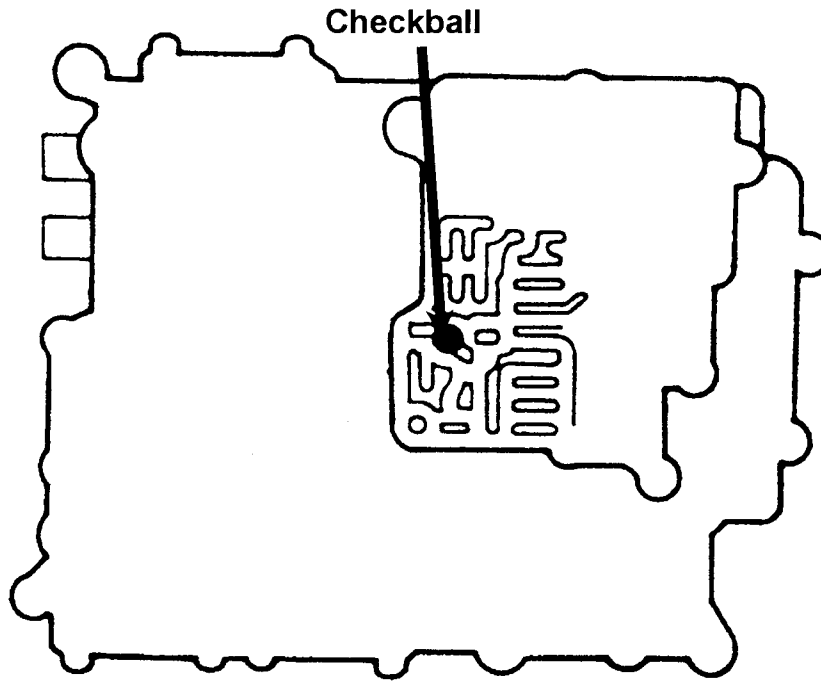
Check Ball and Screen Location



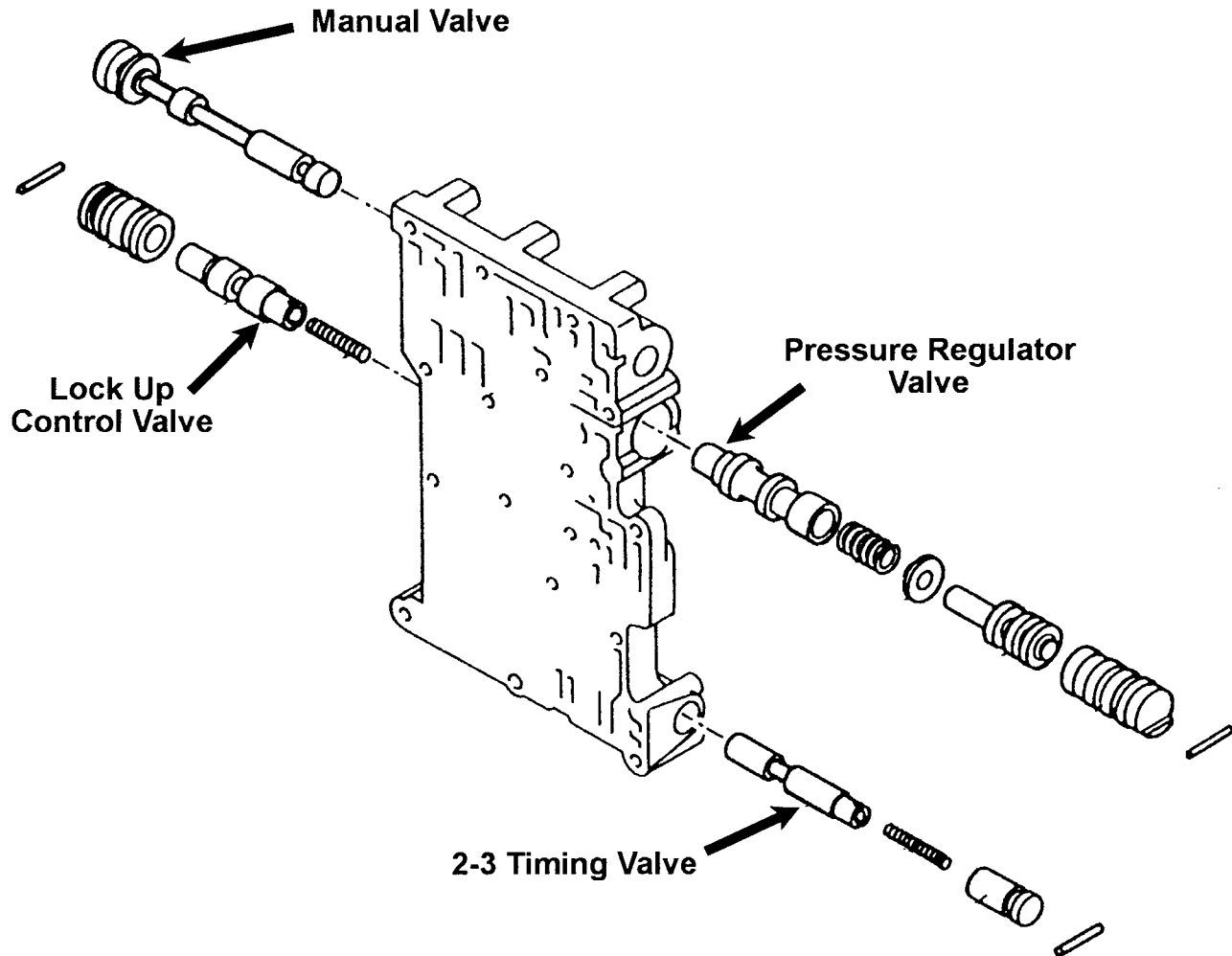
Check Ball and Screen Location



Check Ball and Screen Location



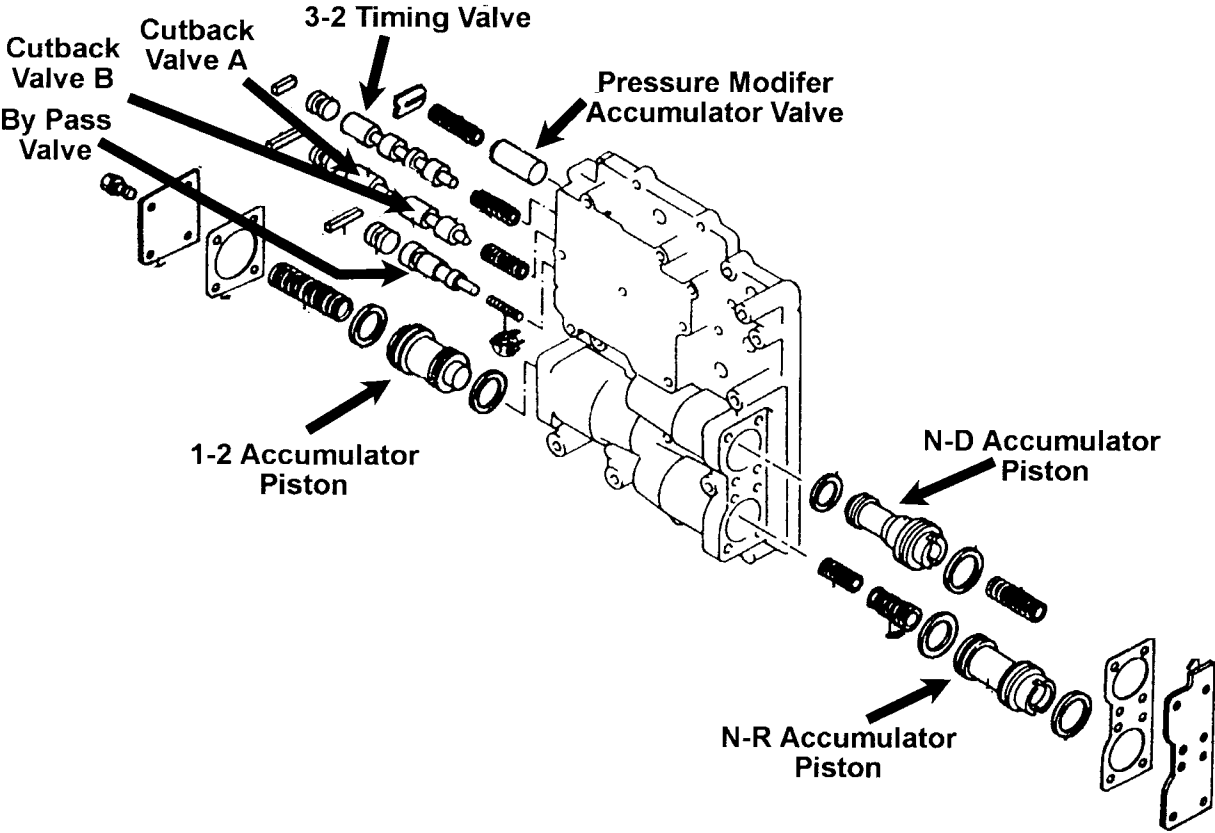
Valves and Springs



Spring \ Item	Outer Diameter mm (in)	Free Length mm (in)	No. of Coils	Wire Diameter mm (in.)	Identification Color
Pressure regulator Spring	12.0 (0.472)	33.9 (1.34)	7.0	1.1 (0.043)	Dark Blue
Lockup Control Spring	5.8 (0.23)	33.1 (1.30)	12.6	0.55 (0.022)	White
2-3 Timing Spring	4.7 (0.19)	22.3 (0.878)	14.0	0.65 (0.026)	White

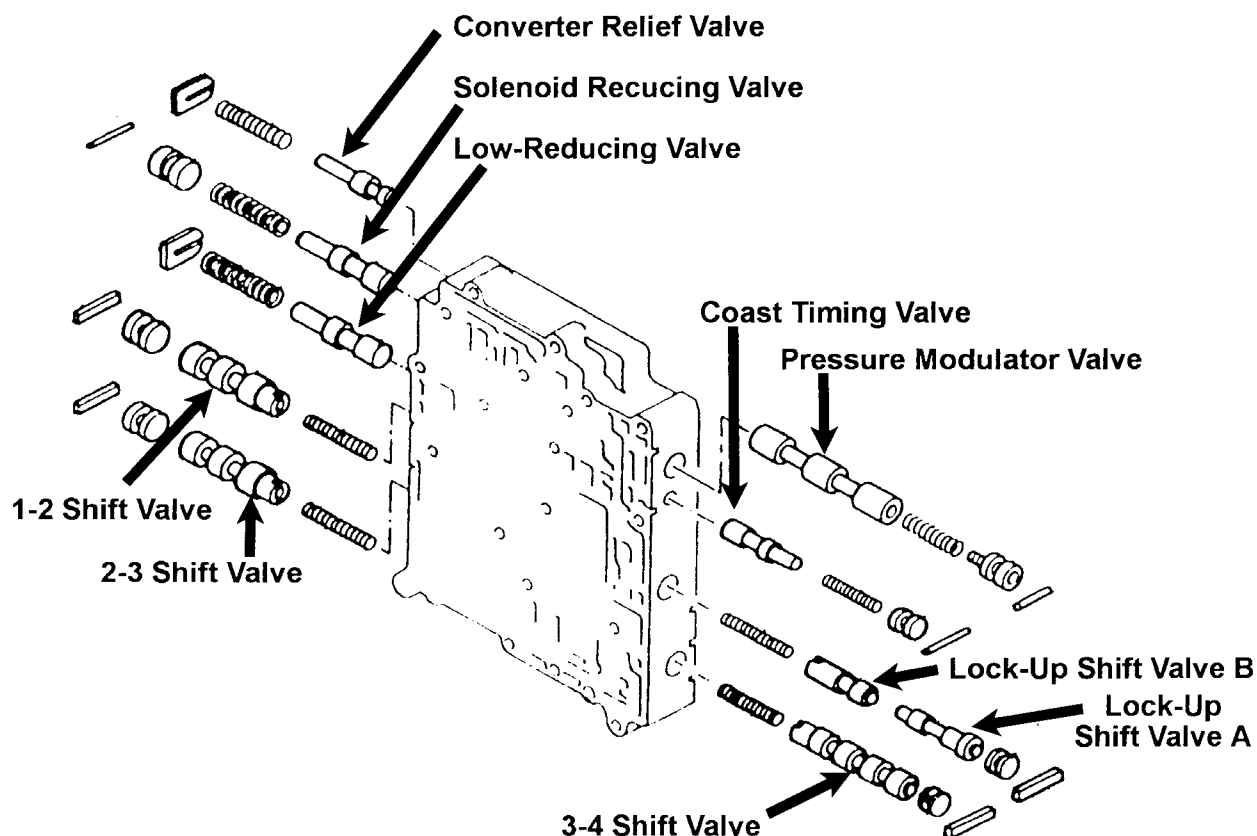
Valves and Springs

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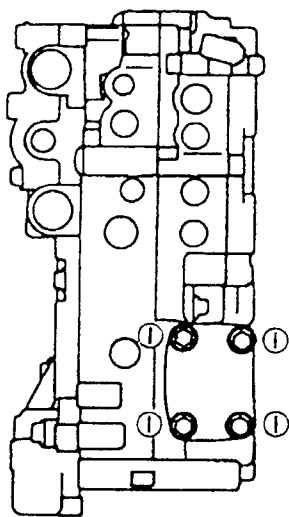
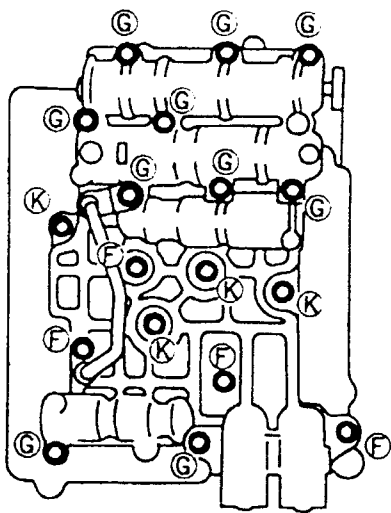
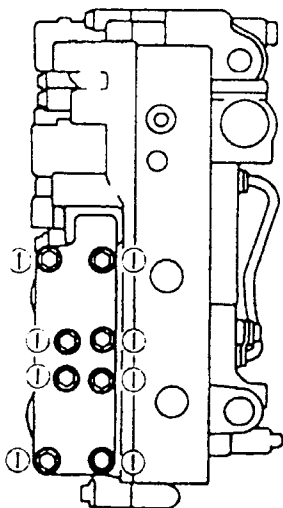
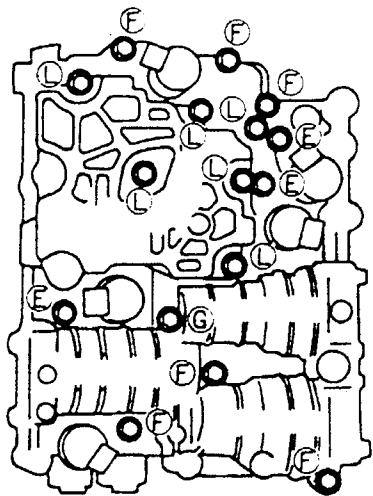
Item			Outer Diameter mm (in)	Free Length mm (in)	No. of Coils	Wire Diameter mm (in.)	Identification Color
Spring							
Pressure modifier accumulator spring			8.2 (0.32)	38.2 (1.50)	16.5	1.2 (0.047)	Light green
3-2 timing spring			8.25 (0.325)	35.4 (1.394)	12.5	0.85 (0.033)	Light blue
Cut back spring			8.2 (0.32)	29.8 (1.17)	7.4	0.6 (0.02)	Purple
Bypass spring			6.3 (0.25)	29.5 (1.16)	11.7	0.6 (0.02)	Dark green
1-2 accumulator spring	FS		20.2 (0.795)	74.6 (2.94)	11.7	2.5 (0.098)	Light blue
	KL	Small	14.8 (0.583)	81.6 (3.21)	17.7	1.7 (0.067)	Gray
		Large	20.2 (0.795)	81.6 (3.21)	12.5	2.3 (0.091)	Dark green
N-D accumulator spring			9.8 (0.39)	52.9 (2.08)	12.0	1.0 (0.039)	White
N-R accumulator spring		Small	7.2 (0.28)	60.1 (2.37)	26.2	1.0 (0.039)	Light blue
		Large	11.2 (0.441)	56.0 (2.20)	15.2	1.6 (0.063)	Red

Valves and Springs

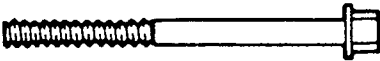


Spring \ Item	Outer Diameter mm (in)	Free Length mm (in)	No. of Coils	Wire Diameter mm (in.)	Identification Color
Convertor relief spring	7.4 (0.29)	32.3 (1.27)	13.5	1.1 (0.043)	—
Solenoid reducing spring	8.0 (0.31)	39.7 (1.56)	12.0	0.9 (0.03)	Red
Low reducing spring	8.7 (0.34)	38.3 (1.51)	12.5	0.9 (0.03)	Yellow
1-2 shift spring	7.4 (0.29)	36.6 (1.44)	12.0	0.8 (0.031)	Purple
2-3 shift spring	7.4 (0.29)	36.6 (1.44)	12.0	0.8 (0.031)	Purple
Coast timing spring	6.2 (0.24)	28.0 (1.10)	16.0	0.6 (0.02)	Light blue
Torque converter clutch shift spring	6.0 (0.24)	40.0 (1.57)	13.8	0.5 (0.02)	White
3-4 shift spring	7.4 (0.29)	36.6 (1.44)	12.0	0.8 (0.031)	Purple
Pressure modifier spring	5.0 (0.20)	19.0 (0.75)	12.7	0.6 (0.02)	—

Valve Body Bolt ID and Torque Specifications

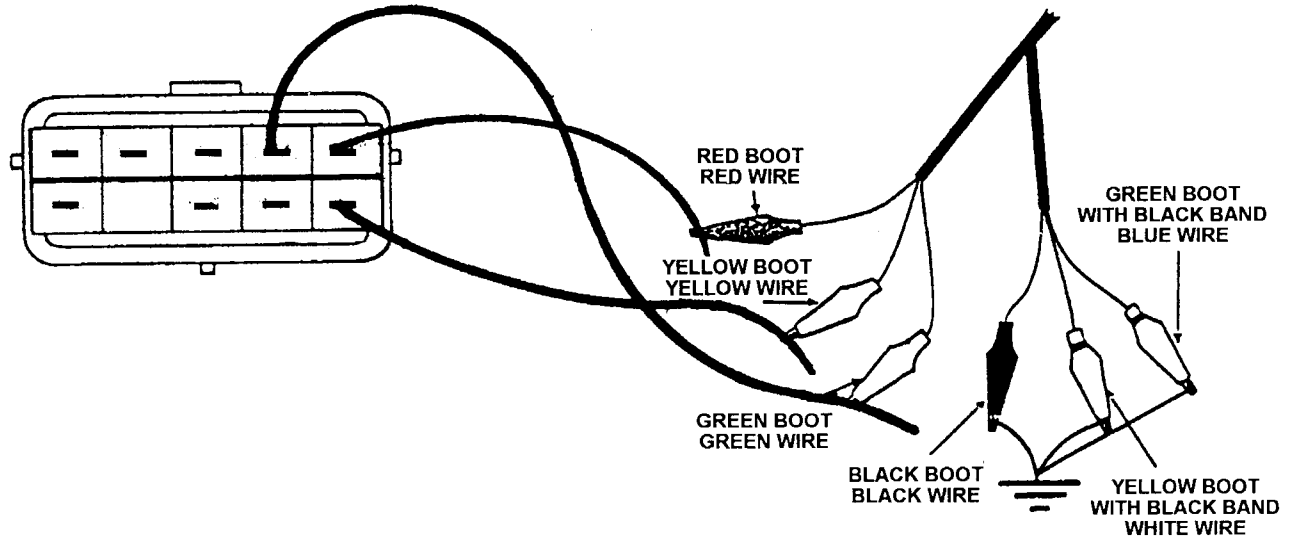


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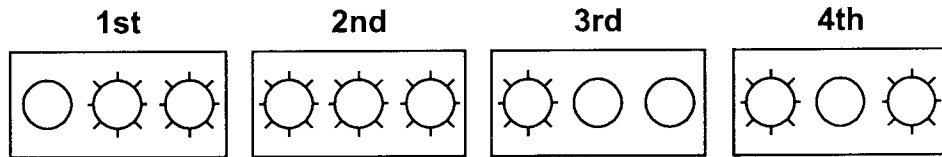
Identification Mark	Bolt	Length mm (in)	Tightening torque N-m (kgf-cm, iq-lb)
L		50 (2.0)	6.5—7.8 (66—80, 58—69)
G		40 (1.6)	
F		30 (1.2)	
K		20 (0.79)	
E		12 (0.47)	
I		16 (0.63)	

Mazda GF4A-EL

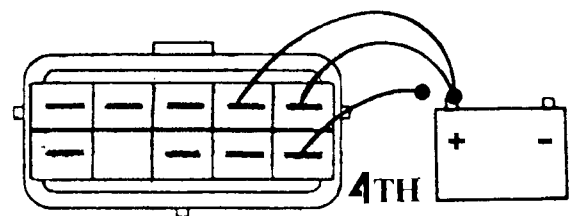
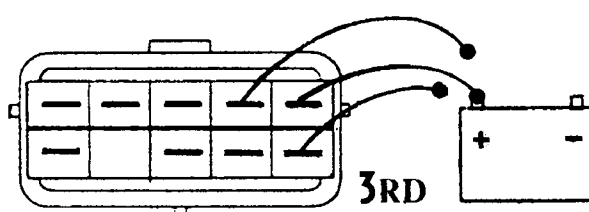
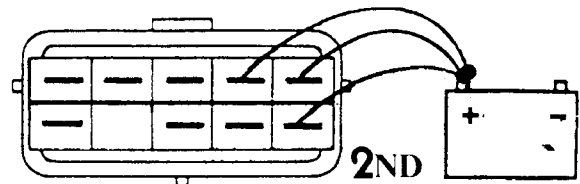
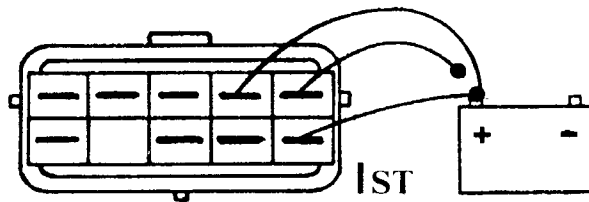
Signal Monitor



SOLENOID PATTERN	
GEAR	SOL 'ON'
1st	2-3 & 3-4
2nd	1-2, 2-3 & 3-4
3rd	1-2
4th	1-2 & 2-3



Making the Shifts



Diagnostic Trouble Code Retrieval

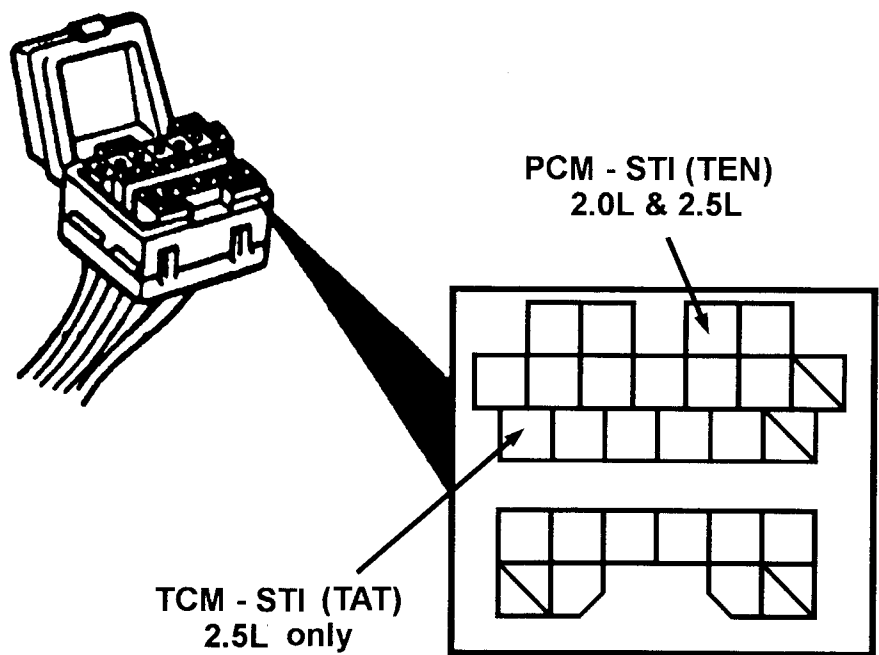
To retrieve trouble codes manually, ground the self test input (TEN or TAT) pin of the diagnostic connector. when the ignition is turned on, the check engine light or the hold light will begin blinking. A long flash represents the tens digits and a quick flash represents the ones digits. Two long flashes and four quick flashes for example would indicate a code 24.

Location: The diagnostic connector is located next to the battery.

1993 Vehicles equipped with a 2.0L use a PCM (Power Train Control Module) to control the engine and transmission.

Vehicles equipped with the 2.5L engine use a PCM to control the engine and a TCM (Transmission Control Module) to control the transmission. Both applications have the control modules located under the center console.

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Codes

TCM Diagnostic Trouble Code	Diagnostic Trouble Code Definition
01*	Crankshaft Position Sensor #1 (CKP1)
02	Crankshaft Position Sensor #2 (CKP2)
03	Cylinder Identification (CID) Sensor
04	Crankshaft Position Sensor #1 (CKP1)
05	Knock Sensor (KS)
06*	Vehicle Speed (VSS) Sensor
08	Measuring Core Volume Air Flow (MC-VAF) Sensor
09	Engine Coolant Temperature (ECT) Sensor
10	Intake Air Temperature (IAT) Sensor
12*	Throttle Position (TP) Sensor
14*	Barometric Pressure (BARO) Sensor
15	Left Heated Oxygen Sensor (LHO2S) Voltage Always Below 0.55V
16	EGR Valve Position (EVP) Sensor
17	Left Heated Oxygen Sensor (LHO2S) Voltage Does Not Change
23	Right Heated Oxygen Sensor (RHO2S) Voltage Always Below 0.55V
24	Right Heated Oxygen Sensor (RHO2S) Voltage Does Not Change
25	Fuel Pressure Regulator Control (FPRC) Solenoid
26	Canister Purge (CANP) Solenoid
28	EGR Control (ECRC) Solenoid
29	EGR Vent (EGRV) Solenoid
34	Idle Air Control (IAC) Solenoid
41	Variable Resonance Induction System (VRIS) Solenoid #1
46	Variable Resonance Induction System (VRIS) Solenoid #2
55*	Pulse Signal Generator (PSG)
56*	Transaxle Oil Temperature (TOT) Sensor
57*	Reduce Torque Signal #1 (RTS1) (To PCM)
58*	Reduce Torque Signal #2 (RTS2) (To PCM)
59*	Torque Reduce / Engine Coolant Temperature Signal (TRS) (From PCM)
60*	1-2 Shift Solenoid (SS1)
61*	2-3 Shift Solenoid (SS2)
62*	3-4 Shift Solenoid (SS3)
63*	Torque Converter Clutch Control (TCCC) Solenoid
64*	Downshift Solenoid (DSS)
65*	Torque Converter Clutch (TCC) Solenoid
66*	Line Pressure Solenoid (LPS)
67	Low Cooling Fan (LFAN) Relay
69	Cooling Fan Engine Coolant Temperature

* Transmission Related

Terminology Ford vs. Mazda

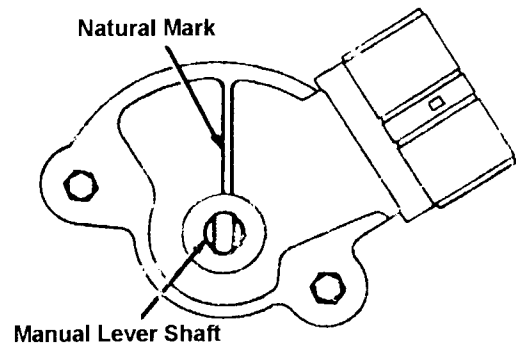
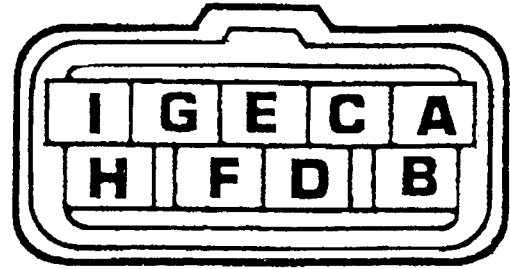
Mazda and Ford have changed the names of many sensors. Although most sensors still operate the same way, the following information will help to minimize confusion.

MAZDA	FORD
3-2 Control Solenoid	Downshift Solenoid
Inhibitor Switch (PRNDSL) Park/Neutral Switch (PRNDSL) Transaxle Range Switch (PRND21)	MLP (Manual Lever Position Sensor) (PRNOD1)
TPS (Throttle Position Sensor) TVO (Throttle Voltage Output)	TP Sensor
Pulse Generator Input/Turbine Speed Sensor	Pulse Signal Generator
Coolant Temperature Signal	Engine Coolant Temperature Signal
Brake Switch	BOO Switch
Hold Mode Switch O/D Off Switch	Hold Switch O/D Control Switch
Transaxle Fluid Temperature Sensor	TOT
1-2 Shift Solenoid Shift Solenoid A	1-2 Shift Solenoid
2-3 Shift Solenoid Shift Solenoid B	2-3 Shift Solenoid
3-4 Shift Solenoid Shift Solenoid C	3-4 Shift Solenoid

Inhibitor Switch

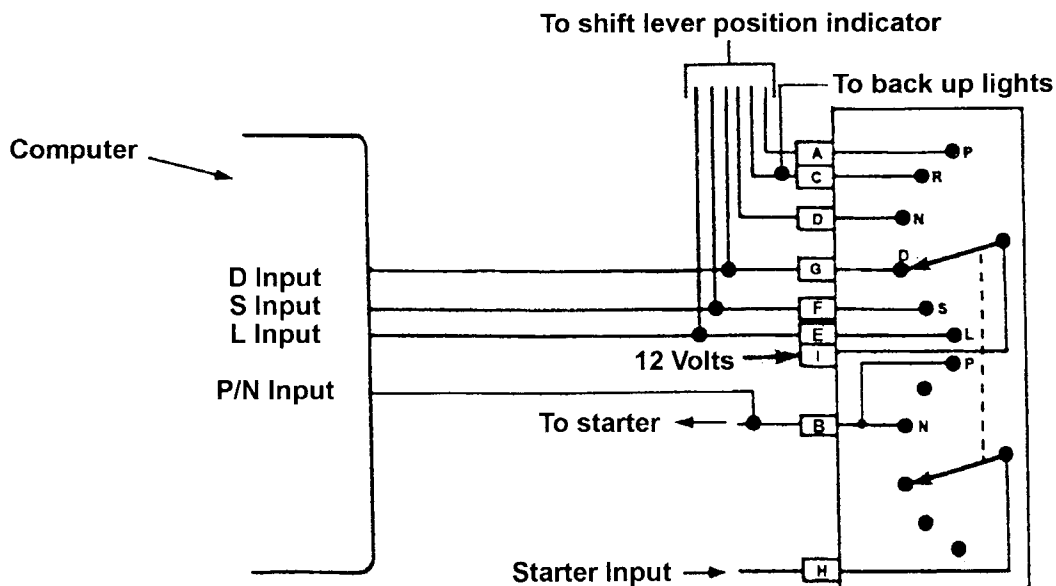
The computer uses information from the inhibitor switch to know what position the manual lever is in. There is no trouble code for the inhibitor switch however it may set a false code 6 (VSS). Other symptoms may include erratic shifts, 3rd gear starts, no third or fourth, and even no reverse.

	B	H	I	A	C	D	G	F	E
P			12	12	-	-	-	-	
R			12	-	12	-	-	-	-
N			12	-	-	12	-	-	-
D			12	-	-	-	12	-	-
S			12	-	-	-	-	12	-
L			12	-	-	-	-	-	12



	B	H	I	A	C	D	G	F	E
P	●	●	●	●					
R			●	●	●				
N	●	●	●	●	●	●			
D			●	●	●	●	●		
S			●	●	●	●	●	●	
L			●	●	●	●	●	●	●

Wiring Schematic

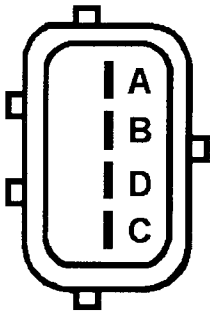
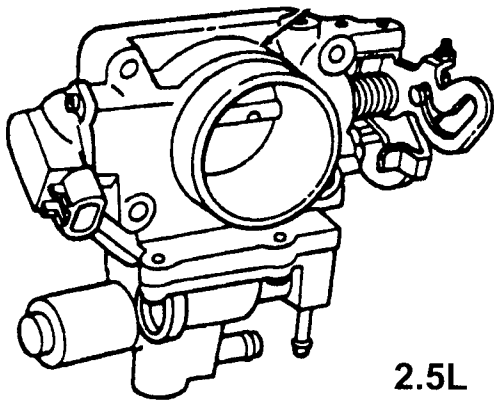
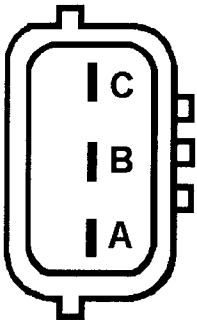
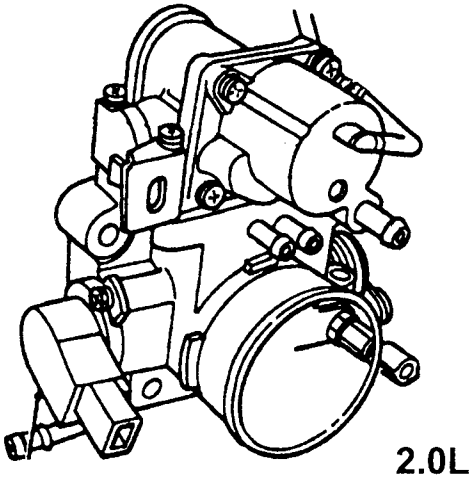


TPS/Idle Switch

Signals from the TPS (Throttle Position Sensor) are sent to the computer. This information is used to influence shift timing and line pressure rise.

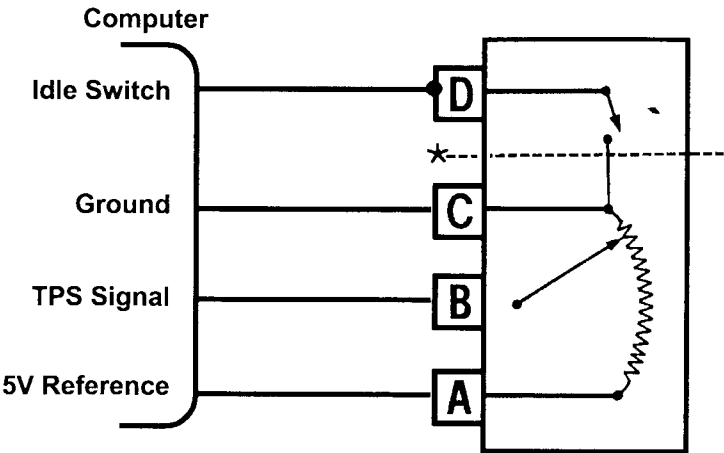
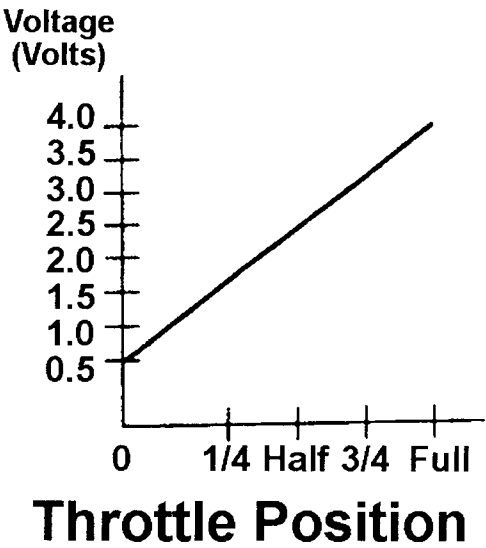
The signal from the idle switch is sent to the computer to cancel lock-up when the throttle is at idle position.

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A	5V Reference
B	TPS Signal
C	TPS Ground
D	Idle Switch *

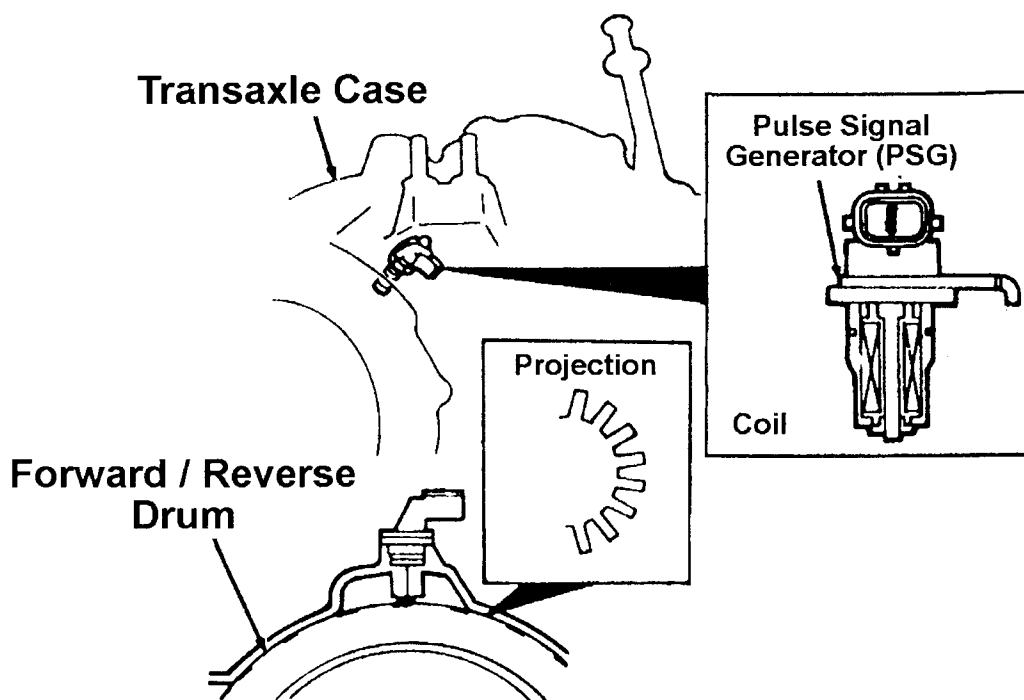
* = less than .10V at Idle



NOTE: The 2.0L uses an idle switch mounted separate from the TPS. The 2.5L idle switch is inside the TPS.

Pulse Generator

The pulse generator is a magnetic pickup located on the transaxle case to detect the Forward/Reverse drum speed. As the 32 projections, rotating around the drum, pass the tip of the pulse generator an A/C voltage is produced by the sensor. The pulse generator can be tested several ways. A/C voltage readings can be taken by probing the two wires with sensor connected or by unplugging and probing the two pins of the pulse generator. In neutral at Idle speed, voltage should be approximately 0.4 - 0.9 volts A/C with voltage rising with RPM. Although voltage is important, frequency (hertz) produced by the sensor is what is needed by the computer for accurate input speed readings.



Pulse Generator (cont'd)

The computer constantly monitors these frequencies and is programmed to calculate road speed by comparing them to the gear commanded much like the chart below.

Gear Commanded	RPM of Drum			
	1000	2000	3000	4000
1st	6 mph	12 mph	19 mph	25 mph
2nd	12 mph	23 mph	35 mph	46 mph
3rd	16 mph	33 mph	49 mph	65 mph
O/D	24 mph	47 mph	70 mph	93 mph

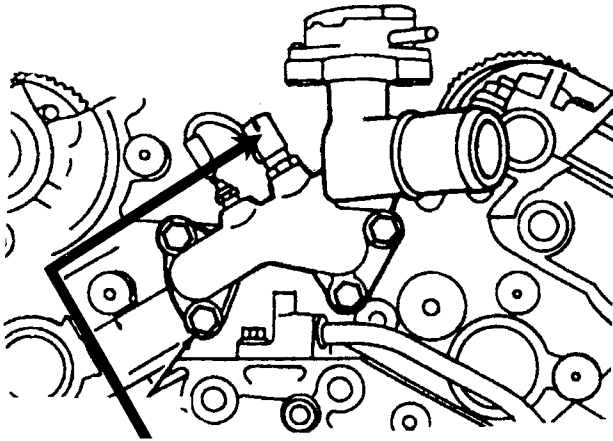
For Example: If input drum speed is 3000 RPM and the computer is currently commanding 2nd gear the computer calculates vehicle speed to be 35 mph. If the 2-4 band is broken the transaxle would stay in 1st gear. While the computer is assuming vehicle speed is 35 mph, actual vehicle speed is only 19 mph. When the computer commands 3rd gear and the transaxle makes a 1-3 upshift and input speed drops to approx 1200 rpm. Because the computer is not programmed to verify true speed by looking at the VSS it simply assumes the vehicle slowed to about 19 mph. When the computer commands the 3-2 down shift and input speed goes back to 3000 rpm in 1st gear repeating this scenario over and over again creating a symptom of a 1-3 shift hunt.

No codes will be set and if the solenoid signals are monitored by a technician it will appear to be an electrical problem. Many different internal transaxle failures can appear to be electrical. To help avoid hours of unnecessary electrical tests try unplugging the pulse generator. This will set a code 55. Now the computer will shift using the VSS which is not based on calculations. If the problem goes away one of two things are the cause. Either a pulse generator giving false information or there is a problem in the unit like shift solenoid, clutch slippage, sticky valves, etc.

NOTE: When code 55 is set, the computer is programmed to not command a 3-4 upshift or lock-up.

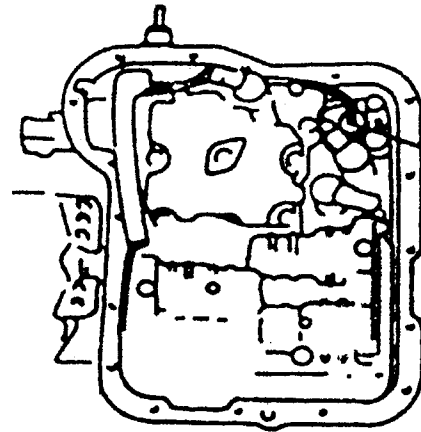
Temperature Sensors

The computer monitors temperature signals from the engine coolant sensor and the transaxle fluid temperature sensors to control many functions including line rise, torque converter clutch apply and 4th gear operations.



Engine Coolant Temperature Sensor

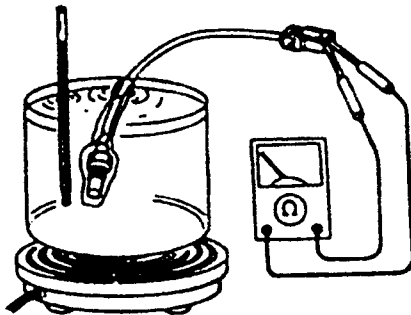
No Slip Lock-Up or Lock-Up below 60°C (140°F)



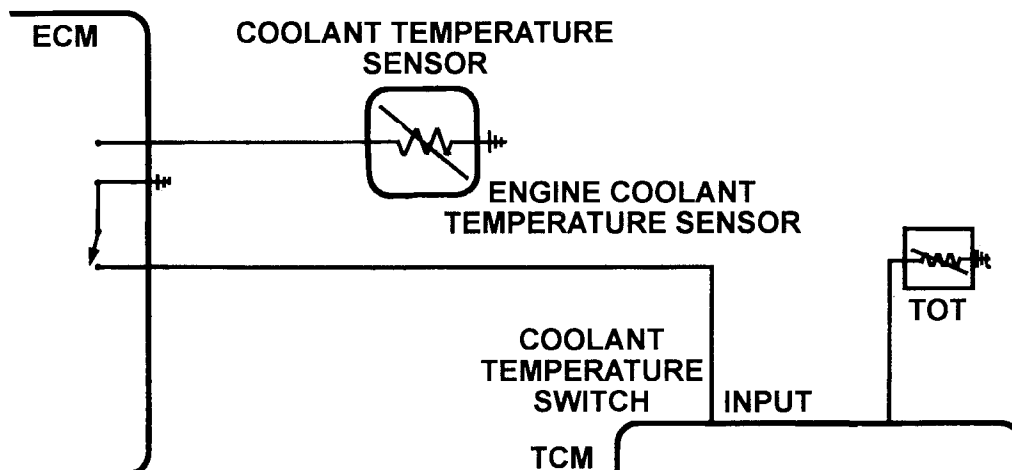
TRANSAXLE
FLUID
TEMPERATURE
SENSOR

No 4th gear below 10°C (50°F)

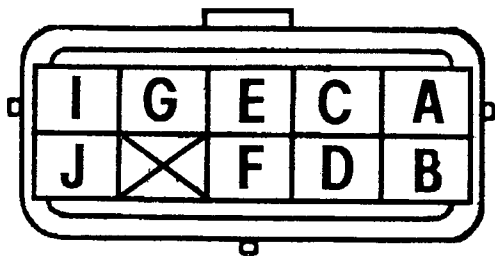
No slip lock-up below 20°C (68°F)



ATF Temperature °C (°F)	Resistance (k ohms)
-20 (-4)	13.47—17.17
0 (32)	5.445—6.678
20 (68)	2.441—2.894
40 (104)	1.193—1.374
60 (140)	0.6284—0.7048
80 (176)	0.3527—0.3865
100 (212)	0.2091—0.2245
120 (248)	0.1301—0.1372
130 (266)	0.1044—0.1090



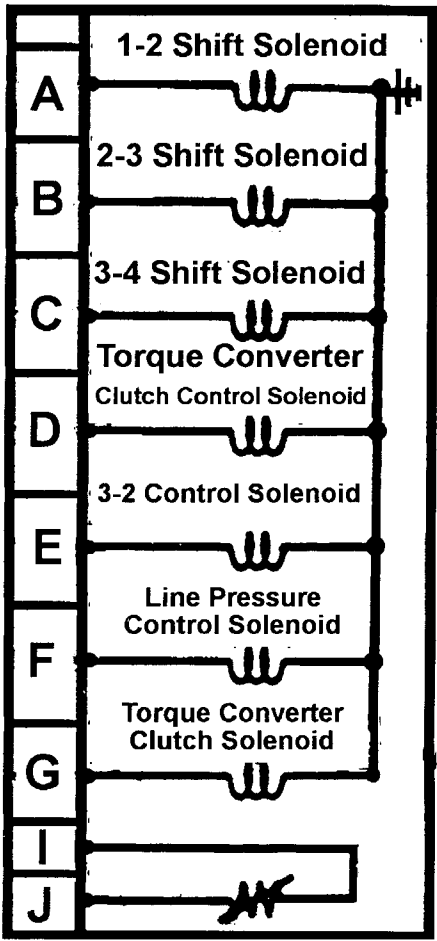
Solenoids



VIEW: Case Connector / Pin Side

Pin	Function	Trouble Code
A	1-2 Shift Solenoid	60
B	2-3 Shift Solenoid	61
C	3-4 Shift Solenoid	62
D	Torque Converter Clutch Control Solenoid	63
E	3-2 Control Solenoid	64
F	Line Pressure Control Solenoid	65
G	Torque Converter Clutch Solenoid	66
I	TOT	
J	TOT	

ProCarManuals.com



Pins “A” through “E”

Status: Normally Closed
Resistance: 11-27 ohms
Current: 0.5-1.2 amps @ 13.5 vdc
Signal: 12 volts

Line Pressure Control Solenoid

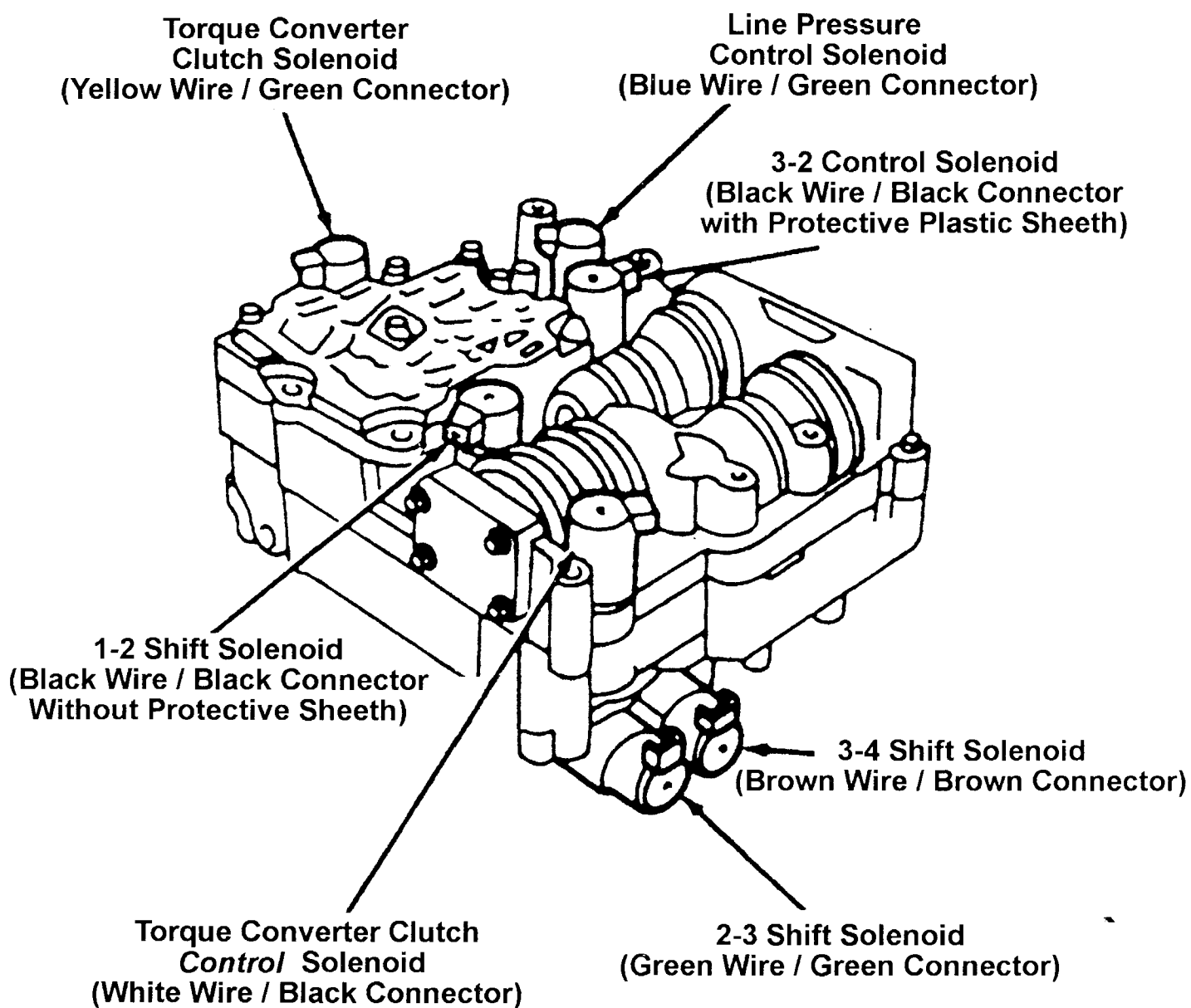
Status: Normally Closed
Resistance: 9-13 ohms
Signal: Idle-approx 8 volts / 67% duty cycle
Full Stall: Approx 1.6 volts / 0-10% duty cycle

TCC Solenoid (Torque Converter Clutch)

Status: Normally Closed
Resistance: 9-13 ohms
Signal: During slip TCC — 8-12 volts / 0-65% duty cycle
All other conditios: < 1.0 volts / 0% duty cycle

NOTE: Codes 60 through 66 are solenoid circuit errors.
Possible Causes: Bad solenoid, connection proglems, cut or shorted, wiring, low battery voltage, or computer.

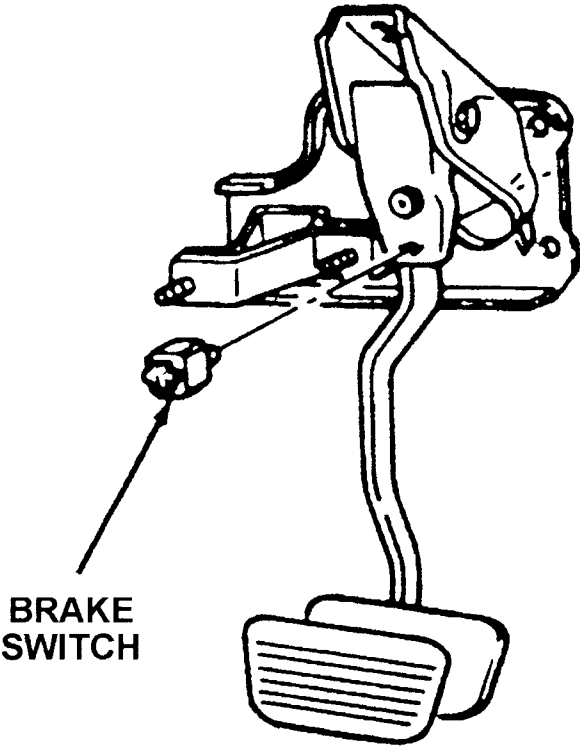
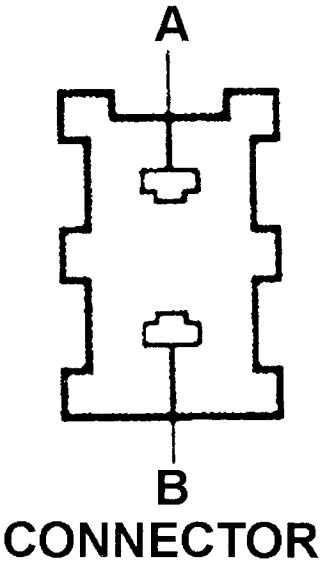
Solenoids



Brake Switch

The computer uses data from the brake switch to cancel lock-up.

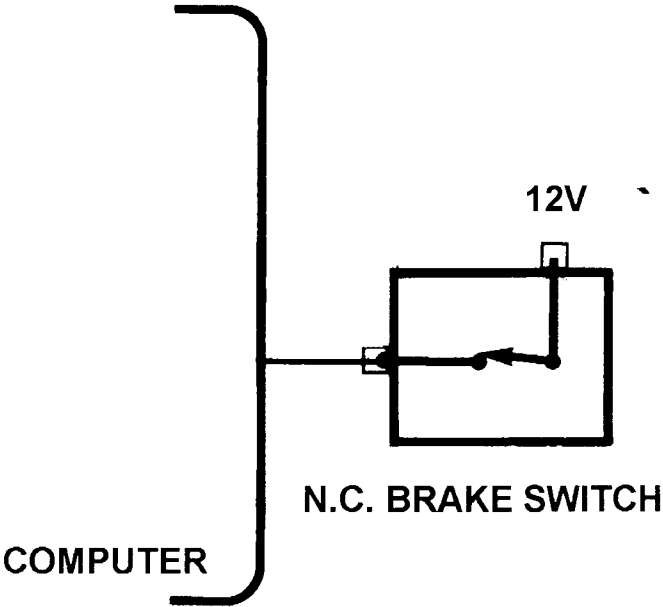
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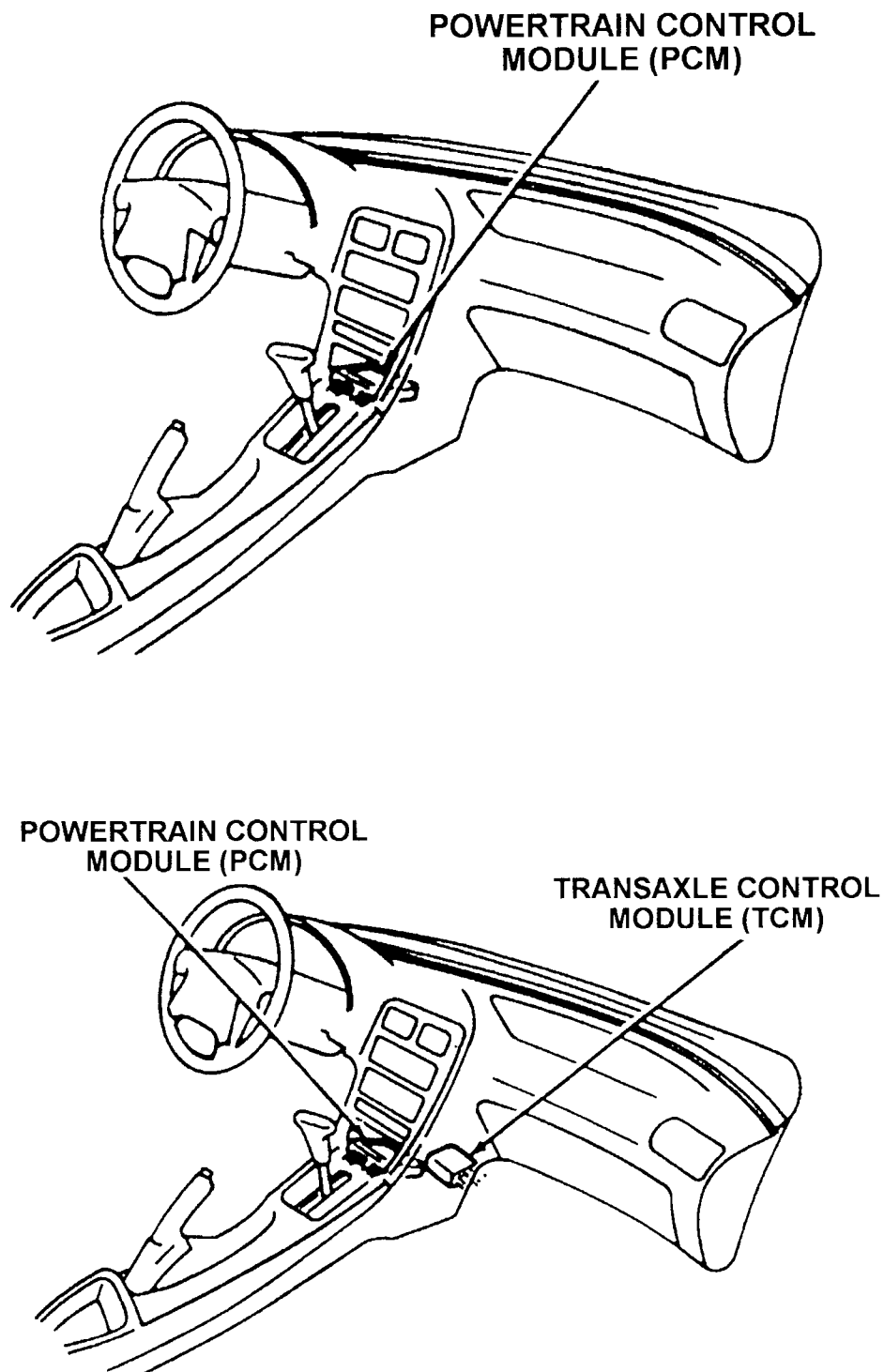
Brake	Continuity
Released	NO
Applied	YES

Brake	A	B
Released	12V	0V
Applied	12V	12V

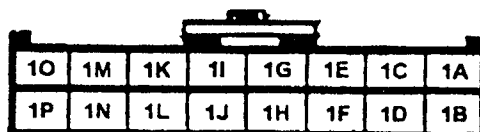
Voltage Chart



Computer Location



2.5L Pinout Chart



NOTE: < = Less Than

> = Greater Than

VOLTAGE

1A	AC Signal	AC Off AC On	12 < 1.0
1B	(93-94) Hold Indicator (95) O/D Off Indicator	In the Hold or O/D off mode All other	< 1.0 12
1C	STO (Diagnostics)		
1D	Inhibitor Switch (P/N)	In Park or Neutral Range All Other Ranges	< 1.0 12
1E	STI (Diagnostics)		
1F	Brake Switch	Brake Released Brake Depressed	0 12
1G	Fluid Temperature Sensor	3.5V at 68°F (20°C) 0.6V at 266°F (130°C)	Ranges 0.6 - 4.8
1H	(93-94) Hold Switch (95) O/D Off Switch	Switch Released Switch Depressed	12 < 1.0
1I	Inhibitor Switch (R) Torque Control	In Reverse Range In All Other Ranges	12 0
1J	Reduce Torque Signal 1	During a 1-2 or 2-3 Upshift Above ½ Throttle All Other Conditions	< 1.0 12
1K	Coolant Temperature Switch	Below 140°F (60°C) Above 140°F (60°C)	< 1.0 12
1L	Reduce Torque Signal 2	During All Downshifts Above 3/8 Throttle All Other Conditions	< 1.0 12
1M	Cruise Control	When Cruise Control is Accelerating All Other Conditions	< 1.0 12
1N	RPM Signal (engine)	Engine Running	2-3 Volts ★
1O	Idle Switch	Idle All Other Conditions	< 0.1 12
1P	VSS	Vehicle Stopped Vehicle Moving	0 or 5 2-3 ★

★ = Frequency varies with speed or RPM

2.5L Pinout Chart



20 PIN CONNECTOR

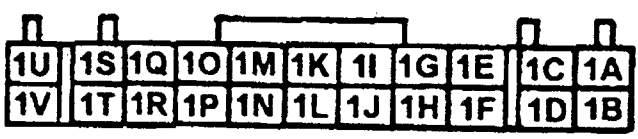
NOTE: < = Less Than

> = Greater Than

2A	TPS Reference	Key Off Key On	0 5
2B	Inhibitor Switch (P/N)	In Park or Neutral All Other Ranges	<1.0 12
2C	Converter Clutch Solenoid	During Slip TCC (Volts / + Duty Cycle) All Other Conditions (Volts/+ Duty Cycle)	8-12 / 65% <1.0 / 0%
2D	Inhibitor Switch (D)	In Drive Range All Other Ranges	12 0
2E	1-2 Shift Solenoid	Solenoid Off Solenoid On	<0.5 12
2F	Inhibitor Switch (S)	In "S" Range All Other Ranges	12 0
2G	2-3 Shift Solenoid	Solenoid Off Solenoid On	<0.5 12
2H	Inhibitor Switch (L)	In "L" Range All Other Ranges	12 0
2I	3-4 Shift Solenoid	Solenoid Off Solenoid On	<0.5 12
2J	Pulse Generator	Input Drum (Not Spinning) Input Drum (Spinning)	<0.1 ★ 0.5 - 4.0 (AC)
2K	Converter Clutch Control Solenoid	Solenoid Off Solenoid On	<0.5 12
2L	Pulse Generator Ground	Always	<0.1
2M	3-2 Timing Solenoid	Solenoid Off Solenoid On	<0.5 12
2N	Pressure Control Solenoid	Idle — 8.0 Volts / 67% + Duty Cycle Full Stall — 1.6 Volts / 0%	Ranges from 1.6V - 8.0V 0% - 67%
2O	Battery	Always	12
2P	Ground	Always	<0.1
2Q	Ignition	Key Off Key On	0 12
2R	Barometric Pressure Sensor		
2S	Ignition	Key Off Key On	0 12
2T	TPS	Idle Approx. 0.3 - 0.7 Full Throttle Approx. 4.0 - 4.4	0.3 - 4.4

★ = Frequency varies with speed or RPM

'93 2.0L Pinout Chart



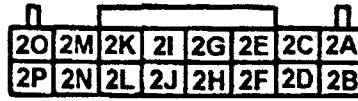
22 PIN CONNECTOR

NOTE: < = Less Than > = Greater Than

1A	Battery	Always	12
1B	Main Relay	Key Off Key On	0 12
1C			
1D	Start Signal	While Starting Engine All Other	12 < 1.0
1E	Not Used		
1F	Brake Switch	Brake Released Brake Applied	0 12
1G			
1H	Hold Mode Switch	Switch Released Switch Depressed	12 < 1.0
1I	Igniter (RPM Signal)	Engine Running	2.0 - 3.0 ★
1J	Headlight Switch	Head Lights Off Head Lights On	0 12
1K	Daytime Running Lights	Park Brake Released Park Brake Applied	12 0
1L			
1M	VSS	Vehicle Stopped Vehicle Moving	0.0 or 5.0 2.0 - 3.0 ★
1N	Power Steering Pressure Switch	While Steering Not Steering	< 1.0 12
1O	Rear Window Defrost Relay	Switch Off Switch On	12 < 1.5
1P	Blower Control Switch	In Off, 1st or 2nd Position In 3rd or 4th Position	12 < 1.0
1Q	Hold Indicator	In Hold Mode All Other	< 1.0 12
1R	AC Sensor	AC Off AC On	12 < 2.5
1S	AC Relay	AC Off AC On	12 < 2.5
1T	Idle Switch	Idle Above Idle	< 0.1 12

★ = Frequency varies with speed or RPM

'93 2.0L Pinout Chart



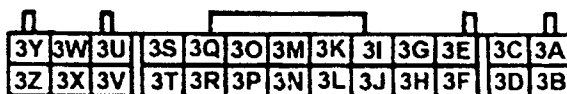
16 PIN CONNECTOR

NOTE: < = Less Than > = Greater Than

1U	Ignition	Key Off Key On	0 12
1V	Inhibitor Switch (P/N)	In Park or Neutral Range All Other Ranges	< 1.0 12
2A	Crankshaft Position Sensor	Engine Running	2.0 - 3.0 ★
2B	Cylinder Identification Sensor		
2C	Oxygen Sensor	Engine Running (After Warm Up)	0.5 - 1.5
2D	TPS	0.5 at Idle 4.2 at Full Throttle	(Ranges) 0.5 - 4.2
2E	Coolant Temperature Sensor		
2F	Intake Air Temperature Sensor	Approx 2.0V at 68°F (20°C)	Ranges
2G	Barometric Pressure Sensor	Sea Level Pressure Engine Off Sea Level	4.0
2H	Transaxle Oil Temperature Sensor	At 68°F (20°C) Approx 3.5 Volts At 266°F (130°C) Approx. 0.6 Volts	(Ranges) 0.6 - 3.5
2I	Reference Voltage	At Sea Level — Engine Off — Engine On	0.5 - 5.0
2J	EGR Temperature Sensor (California Only)		
2K			
2L	Mass Airflow Meter		Ranges 1.5 - 5.0
2M	Inhibitor Switch (R)	In Reverse Range All Other Ranges	12 0
2N	Inhibitor Switch (L)	In Low Range All Other Ranges	12 0
2O	Inhibitor Switch (S)	In "S" Range All Other Ranges	12 0
2P	Inhibitor Switch (D)	In "D" Range All Other Ranges	12 0

★ = Frequency varies with speed or RPM

'93 2.0L Pinout Chart



26 PIN CONNECTOR

NOTE: < = Less Than > = Greater Than

3A	Ground	Always	< 0.1
3B	Ground	Always	< 0.1
3C	Ground	Always	< 0.1
3D	Ground	Always	< 0.1
3E	Not Used		
3F	Pulse Generator	Input Drum (Not Spinning) Input Drum (Spinning)	0 0.5 - 4.0
3G	High Cooling Fan Relay		
3H	Pulse Generator Ground	Always	< 0.1
3I	Low Cooling Fan Relay		
3J	Not Used		
3K	EGR Vacuum Regulator Solenoid		
3L	Fuel Pump Relay	Key Off Key On	0 12
3M	Fuel Pressure Regulator Control Solenoid		
3N	Canister Purge Solenoid		
3O	Idle Air Control Solenoid		
3P	1-2 Shift Solenoid	Solenoid Off Solenoid On	Approx. 0.5 12
3Q	2-3 Shift Solenoid	Solenoid Off Solenoid On	Approx. 0.5 12
3R	3-4 Shift Solenoid	Solenoid Off Solenoid On	Approx. 0.5 12
3S	Converter Clutch Control Solenoid	Solenoid Off Solenoid On	Approx. 0.5 12
3T	3-2 Timing Solenoid		
3U	Converter Clutch Solenoid		
3V	Line Pressure Solenoid		
3W	Injector #1		
3X	Injector #2		
3Y	Injector #3		
3Z	Injector #4		

★ = Frequency varies with speed or RPM

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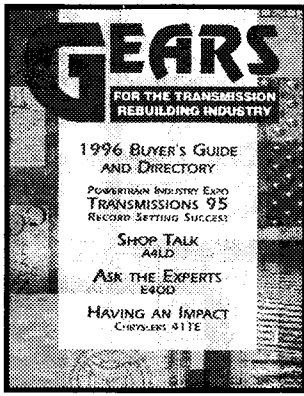
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