2004 TECHNICAL SEMINAR

50th ANNIVERSARY 1954 2004

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The 4L60E-Late Shift Correction Package 1998 & up (K4L60E-L)

The 4L60E-L Kit helps to eliminate the following problems: ✔ Code 1870 ✔ Delayed engagements ✔ Slide bump 2nd & 3rd ✔ 3-4 clutch burn-up ✔ Help for worn plates ✔ Provides more lube oil ✔ Regular and Heavy duty applications ✔ Improves overall transmission performance

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- Includes oversized checkballs to give new life to the original worn separator plate.

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The Chrysler 42/46/47-RE Late Shift Correction Package helps eliminate the following problems: ✔ Premature band failure ✔ Inadequate line pressure ✔ Slow engagements ✔ Premature clutch failure ✔ Lower 2-3 shift RPM ✔ Full time lube ✔ Rapid fill manual valve ✔ Regular, Heavy Duty, Gas & Diesel

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The

Automatic Transmission Rebuilders Association

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Dennis Madden
Chief Executive Officer

Welcome to the 2004 ATRA Technical Seminar! As you're probably already aware, this is ATRA's 50th year of serving the automatic transmission industry.

As with any major milestone, this year's anniversary has caused us to examine the changes that have taken place over the last half century. And nowhere are those changes more evident than in this, our annual technical seminar program.

This year — our 50th year — marks another milestone in the evolution of the ATRA technical seminar. Because this year, for the first time, the ATRA seminar manual has been developed and printed in full color!

Having worked on several seminar manuals myself I know what it takes to produce a seminar. Lance Wiggins and the ATRA Technical staff have really pull out all the stops this year; another sign of the new things coming out of the "New" ATRA.

This seminar, along with everything else at ATRA is a group effort, with a lot of effort in the background that nobody ever sees. I could not be more delighted with the staff here at ATRA.

ATRA is changing all the time: with the new items like the 3-year Golden Rule warranty, to give your customer that added peace of mind; point-of-sale items to make your shop look even more professional; Nation-wide advertising and referral services, getting more consumers into ATRA Members' shops. These are just a few of the changes you've seen in the past year, and it's only the beginning.

On behalf of the ATRA staff, and the ATRA Chapters that work so hard to bring you this seminar, welcome.

Sincerely,

Dennis Madden,

ATRA, CEO

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820344	Chrysler	Torqueflight 8 (727) .090" thick	1.96 ea.	5
820350	Chrysler	A404, A413, A470	1.38 ea.	5
820351	Chrysler	A404, 413 Sprocket CVR	1.79 ea.	5
820352	Chrysler	404 FWD Gear Box	1.83 ea.	5
820345	Chrysler	A604 Ultradrive Oil Pan	1.93 ea.	5
820353	Chrysler	A604 Diff Oil Pan	1.57 ea.	5
820354	Chrysler	A604 End Cover	1.43 ea.	5
820355	Chrysler	42LE / A606	2.42 ea.	5
820356	Ford	C-6	1.85 ea.	5
820357	Ford	C-4	1.18 ea.	5
820359	Ford	Jatco 3N71B (17 Bolt)	1.98 ea.	5
820360	Ford	AOT, AOD, FIOD	1.78 ea.	5
820361	Ford	ATX Valve Body Cover	2.10 ea.	5
820362	Ford	ATX Oil Pan	1.90 ea.	5
820346	Ford	A4LD W/4 Notches	1.78 ea.	5
820289	Ford	AXOD Oil Pan (1986-96)	3.78 ea.	5
820323	Ford	AXOD Control Cover (1986-96)	2.56 ea.	5
820394	***Ford***	***AX4S Oil Pan (1996 & up)***	***5.10 ea.***	***3***
820395	***Ford***	***AX4S Control Cover (1996 & up)***	***4.35 ea.***	***3***
820364	Ford	Probe 4EAT	1.98 ea.	5
820348	Ford	E4OD (1989-95)	3.10 ea.	5
820396	***Ford***	***4R100 (1996 & up)***	***5.90 ea.***	***3***
820365	Ford	AODE	3.98 ea.	5
820366	Ford	CD4E Main Control CVR	3.58 ea.	5
820367	Ford	AX4N Oil Pan (Early)	3.98 ea.	5
820397	***Ford***	***AX4N Oil Pan (1995 & up)***	***6.90 ea.***	***3***
820368	Ford	AX4N Main Control CVR (Early)	3.58 ea.	5
820398	***Ford***	***AX4N Main Control Cover (1995 & up)***	***5.90 ea.***	***3***
820369	GM	Powerglide	1.98 ea.	5
820370	GM	TH-350, 350C, 250, 250C	1.44 ea.	5
820371	GM	TH-400	1.74 ea.	5
820372	GM	TH-180, 180C	1.82 ea.	5
820373	GM	TH-200, 200C	1.62 ea.	5
820374	GM	T-125, 125C	1.86 ea.	5
820375	GM	TH-125, 125C Sprocket CVR	1.50 ea.	5
820376	GM	TH-200–4R	2.18 ea.	5
820377	GM	TH-440 Side Case Cover	2.24 ea.	5
820349	GM	TH700R4	1.50 ea.	5
820378	GM	TH-440-T4 Oil Pan	2.28 ea.	5
820379	GM	4T60E	2.07 ea.	5
820182	GM	4T80E	2.70 ea.	5
820380	Mitsubishi	KM170 Combo	1.69 ea.	5
820381	Mitsubishi	KM 177	3.00 ea.	5
820382	Mitsubishi	F4A33	1.80 ea.	5
820383	Nissan	RL3F01A, RN3F01A FWD	1.90 ea.	5
820384	Nissan	RE4R03A	1.98 ea.	5
820385	Subaru	4 Spd	2.24 ea.	5
820386	Toyota	3 & 4 Spd. A40, A40D	1.60 ea.	5
820387	Toyota	A-340	2.30 ea.	5
820388	Toyota	A-540-E	2.56 ea.	5
820389	Toyota	A540 93-ON	2.54 ea.	5

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Program Contents

Lance Wiggins
Technical Director

This year ATRA is proud to be celebrating its 50th year serving the automatic transmission repair industry. A lot of changes have taken place over five decades of transmission repair, and those changes are coming faster every year.

It's because of those changes that technical training has become an integral part of today's transmission repair industry. It's just not possible anymore to get by with a measure of common sense and a decent technical aptitude. To remain profitable, today's technicians need up-to-date training on an ongoing basis.

To that end, ATRA is pleased to present its 2004 Technical Seminar. Packed with countless hours of research and development, writing, editing, photography and layout, this year's seminar will stand out as one of the most demanding and useful technical training programs ever developed for this industry.

And, for the first time, this year's technical manual has been produced in *full color*. With over 300 pages of up-to-the-minute technical information, the 2004 Technical Seminar Manual will remain a valuable resource long after the seminar is just a memory.

We're confident that you'll find this year's seminar presentation and technical manual both informative and profitable. In fact, we're so sure you'll be satisfied with what you learn in this program, we guarantee it!

So, on behalf of the entire ATRA staff, the international board of directors, and all of the ATRA members worldwide, we'd like to thank you for helping to make our first 50 years memorable. And we're happy to welcome you as we ring in the next half-century of transmission repairs, by taking part in the 50th anniversary edition of the ATRA 2004 Technical Seminar.

Lance Wiggins

ATRA Technical Team (continued)

Randall Schroeder
Senior Technician
and Seminar Speaker

Bill Brayton
Technical Advisor and
Seminar Speaker

David Skora
Senior Technician,
Semimar Speaker

Mike Brown
Technical Advisor

Pete Huscher
Technical Advisor

Frank Pasley
GEARS Magizine

Steve Garrett
Technical Advisor, Seminar
Speaker, Service Engineer

Kelly Hilmer
Director of
Online Director

Mike VanDyke
Technical Advisor
and Seminar
Speaker

Larry Frash
Technical Advisor,
Seminar Speaker,
Design Artist

Shaun Velasquez
Web Designer

ATRA Staff

It's difficult enough getting the seminar book researched, written, pictured, edited, and printed let alone getting it out to the seminar attendees. This is where the ATRA Staff comes in.

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Without the ATRA team, it would be very hard to accomplish the task at hand. Please enjoy the seminar.

Lance Wiggins
ATRA, Technical Director

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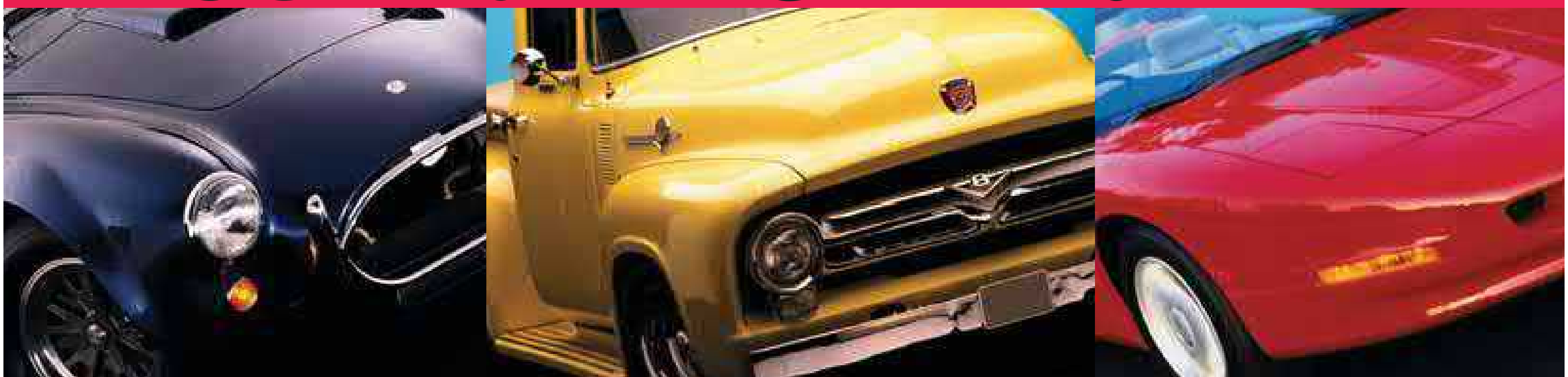

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General Motors Contents

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ALL GM Applications

2ND Calibration Website Available

Condition/Cause/Correction: In our example we are looking at updates for the 4L65E application, hard shift complaints. We are going to search the following complaint vehicle VIN 3GNEK13T13G159032 a 2003 Chevrolet Avalanche. GM now has another web site available which looks and operates a little different from the one you may be familiar. The other site is still in operation. Access to this web site is still free and should be accessed before attempting to repair most OBD II vehicles. This web site will give you information regarding updates for various controllers on your vehicle as well as what the update was designed to address. The web site is located on a different server than before and can be accessed by searching the following from your web browser search bar.
Search for the following: http://calid.gm.com

All GM

Vehicles with EPC

Clearing the vehicle shift adapts

Harsh shifts after overhaul may be caused by the incorrect shift pressure command. It is necessary to always clear the shift adapts with your scanner anytime repair work has been done.

Clearing the adapts can also be done by disconnecting the battery and touch the positive cable to the negative cable. If you choose to clear the adapts by disconnecting the battery, please note that ALL PCM adapts will be lost and the vehicle will operate erratically. Typically, the EGR valve will open and close erratically causing the vehicle to surge back and fourth.

DTC Changes,

New DTCs For 2004

The following charts represent which DTC's are new for 2004 as well as new updated 2004 DTC numbers for previous year applications
* **INDICATES THAT THE DTC IS NOT USED ON ALL OF THE MODEL APPLICATIONS**

DTC	DESCRIPTION	5L40/50E	AF23/33	HONDA	VT25E	4T40/45E	4L60E/65E /80/85E	4T65E	4T80E
P0115	ECT sensor/circuit	C							
P0120	TP sensor/circuit	B							
P0501	VSS preformance			A					
P0572	Cruise Brake SW Low Voltage	C				C			
P0573	Cruise Brake SW High Voltage	C				C			
P0718	Input speed Intermittent			B					
P0746	PCS 1 stuck OFF			B					
P0747	PCS 1 stuck ON			B					
P0776	PCS 2 stuck OFF			B					
P0777	PCS 2 stuck ON			B					
P0780	Incorrect shift pattern			B					
P0787	3-2 Solenoid Circuit Low Voltage						B		
P0788	3-2 Solenoid Circuit High Voltage						B		
P0815	Upshift switch circuit	C *				C		C *	
P0816	Downshift switch circuit	C *				C		C *	
P0826	Up/Down shift switch circuit	C *				C		C *	
P0847	TFP Switch 2 Circuit Low Voltage			C					
P0848	TFP Switch 2 Circuit High Voltage			C					
P0872	TFP Switch 3 Circuit Low Voltage			C					
P0873	TFP Switch 3 Circuit High Voltage			C					
P0897	Transmission Fluid Life								C

DTC Changes,

New DTCs For 2004

The following charts represent which DTC's are new for 2004 as well as new updated 2004 DTC numbers for previous year applications

* **INDICATES THAT THE DTC IS NOT USED ON ALL OF THE MODEL APPLICATIONS**

DTC	DESCRIPTION	5L40/50E	AF23/33	HONDA	VT25E	4T40/45E	4L60E/65E/80/85E	4T65E	4T80E
P0962	PCS 1 Circuit Voltage Low		A	A	B				
P0963	PCS 1 Circuit Voltage High		A	A	B				
P0966	PCS 2 Circuit Voltage Low		A	A	B				
P0967	PCS 2 Circuit Voltage High		A	A	B				
P1740	Torque Reduction Signal Circuit	B							
P1750	1-2 Shift Valve Performance					C		C *	
P1876	Up and Down Shift Switch Performance	C *				C			
P1877	Up and Down Shift Switch Performance	C *				C			
P2637	Transmission Torque Delivered Circuit	B							
P2761	TCC-PWM Solenoid Circuit						B *		
P2763	TCC-PWM Solenoid Circuit High Voltage			A		A	B *	B	B
P2764	TCC-PWM Solenoid Circuit Low Voltage			A		A	B *	B	B
P2769	TCC Enable solenoid Circuit Low Voltage			A			B *		
P2770	TCC Enable solenoid Circuit High Voltage			A			B *		
P2771	4WD Low Circuit						B *		
P2796	Auxiliary Pump Relay Circuit						B *		
DTC	DESCRIPTION	5L40/50E	AF23/33	HONDA	VT25E	4T40/45E	4L60E/65E/80/85E	4T65E	4T80E
P2797	Aux Pump Performance						B *		
U0100	Loss of Communication with The ECM	B							
U2139	Loss of Communication with The CIM	C							

Type A DTC'S- Emission's related MIL-ON DTC set during the 1ST Failure.

Type B DTC'S- Emission's related, DTC set on 1ST failure MIL-ON during the second consecutive failure

TYPE C DTC'S- Non-Emission related DTC set on 1ST failure no MIL-ON, although message may/may not be displayed on the driver information center (DIC) during the 1ST failure.

4L60E/4L80E/LCT1000/4T40E/ 4T65E/4T80E

Loss of power, Shift related concerns

When scanning the vehicle you may notice a P0171 and/or P0174 DTC's (Lean Codes) are set. These codes can be in conjunction with a loss-of-power complaint.

Many vehicles are being equipped with reusable air filters. Most companies selling this type of filter require a special oil to be used on the filter element.

Since most MAF sensors operate by measuring the amount of energy it takes to keep the sensing element a specified temperature (Usually 125°C) above the temperature of the incoming air, a film of oil on the sensing element will dramatically shift the grams per second value the sensor sends to the PCM. This leads to fuel and spark timing changes, which ultimately lead to the above concerns.

To correct the condition, clean the filter with the cleaning kit recommended by the filter manufacture and be careful not to over oil the filter element. In addition you will need to clean or replace the MAF sensor. If you choose to clean the element, electric circuit board cleaner is the best product to use, although some technicians use brake clean or other products. Be sure not to damage the sensing element or the deflector screen or the sensor will not operate properly. In addition, some filter manufactures recommend using "their" MAF sensor if you are installing their filter. Some of the aftermarket sensors contain burn off routines that are designed to clean the sensor element. Many of the aftermarket sensors require a grounding bracket kit to assure their sensor is grounded.

4T40E/4T45E

Updates

2004 Model Year Changes for the 4T40E and 4T45E Transmissions

The vehicles and models affected are 2004 Chevrolet Cavalier, Classic Malibu, Oldsmobile Alero, Pontiac Grand Am, and Sunfire. Some of the updated parts include:

1. New Spacer Plate for Electronic Range Selector Mode Models (Malibu)
2. New Hydrophobic Filter/Vent and Filler Cap with Case Baffle
3. Valve Body Assembly, TCC Control Valve
4. Decontented Transmission Fluid Pressure (TFP)
5. Two DTCs were also removed: P1815 Transmission Fluid Pressure (TFP) Valve Position Switch – Start in Wrong Range and P1817 Transmission Fluid Pressure (TFP) Valve Position Switch
6. New NSBU (Neutral Safety Backup) Switch

Electronic Range Selector Mode Models (Z body Malibu)
The electronic range selector mode has the following new DTCs:
P0815 – Upshift Switch Circuit
P0816 – Downshift Switch Circuit
P0826 – Up and Down Shift Switch Circuit
P0876 – Up and Down Shift Switch (Performance – Range Switch not in D3)
P1877 – Up and Down Shift Switch (Performance – Range Switch in D3)

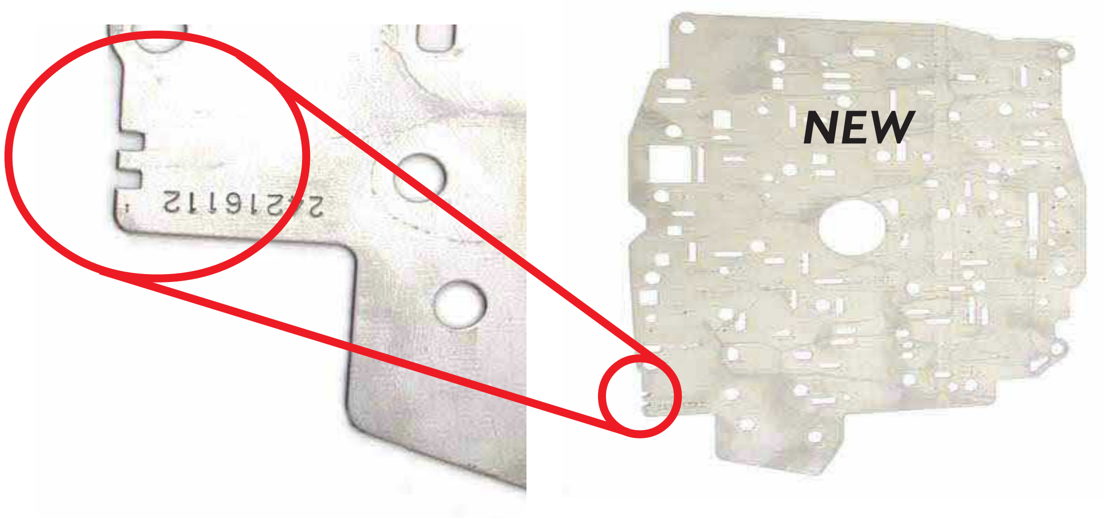
4T40E/4T45E

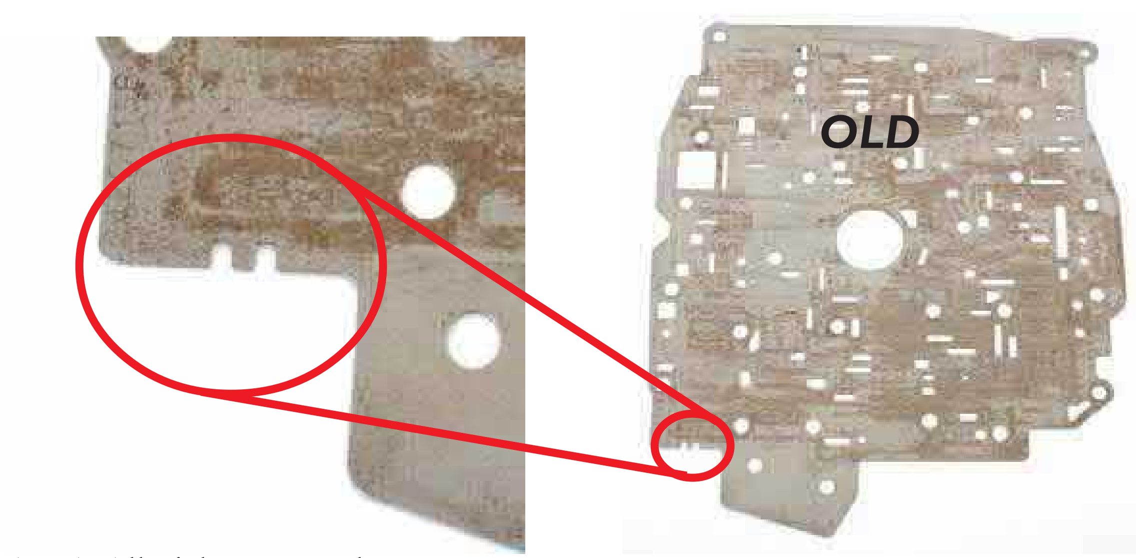
Updates (continued)

New Spacer Plate for Electronic Range Selector Mode Models (Z body Malibu classic)

The new spacer plate has one notch for TAP (Turbo Application) models and two notches for all other models.

New Seperator part# 24216112 (two notch)





4T40E/4T45E

Updates (continued)

Valve Body Assembly, TCC Control Valve

The new TCC control valve is larger in diameter and the step at the end of the valve is smaller by 4.4mm to prevent the valve from sticking in the end of the bore. The valve body bore was made larger in diameter when compared to the old one.

The previous design was sticking in the end of the bore leading to converter drain back issues. This was a huge issue as the unit would leave people stranded because the converter would not fill unless the valve was freed up.

This step reduced the valve diameter at the end of the valve by 4.4mm

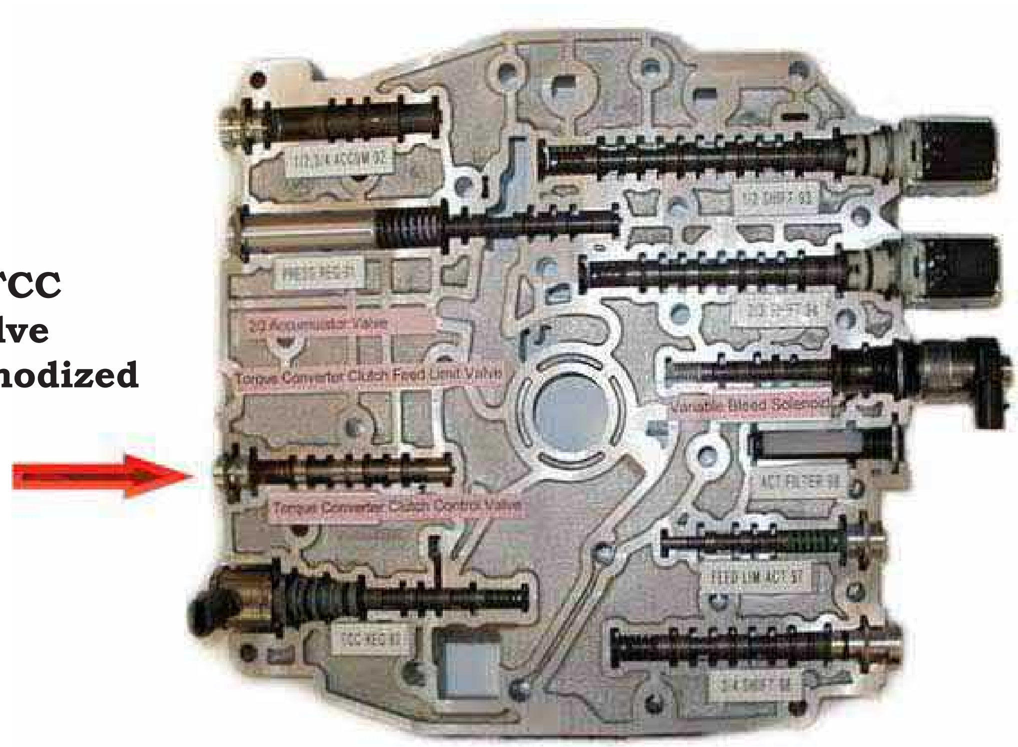
This is the measurement of the old style valve.

4T40E/4T45E

Updates *(continued)*

The valve body under went several changes for the ‘04 model year (in addition to the TCC control valve info on the previous page) including the TCC feed valve being eliminated. The valve body was machined to accept the decontented TFP. It needs to be noted that a major change also occurred in the channel plate when all the valve body changes occurred so it will <u>NOT</u> back service previous years.

The New TCC control valve made of anodized steel



4T40E/4T45E

Updates *(continued)*

New Hydrophobic Filter/Vent and Filler Cap with Case Baffle

A new hydrophobic filter/vent and filler cap with case baffle has been added to prevent water entering through the vent. The new caps are different colors, one red and the other black.

The Red cap is for 2003 and prior

The Black cap is for 2004.

4T40E/4T45E

Updates (continued)

Decontented Transmission Fluid Pressure (TFP)

Three pressure switches have been eliminated on 2004 models. The three switches that remain are: TCC release, drive and reverse. The color of the plastic has changed from black to gray. The additional functions are now done by the redesigned NSBU switch.

Two DTCs were also removed

P1815 Transmission Fluid Pressure (TFP) Valve Position Switch – Start in Wrong Range and P1817 Transmission Fluid Pressure (TFP) Valve Position Switch – Reverse with Drive Ratio.

This switch is only for 2003 and prior models with the black color base.

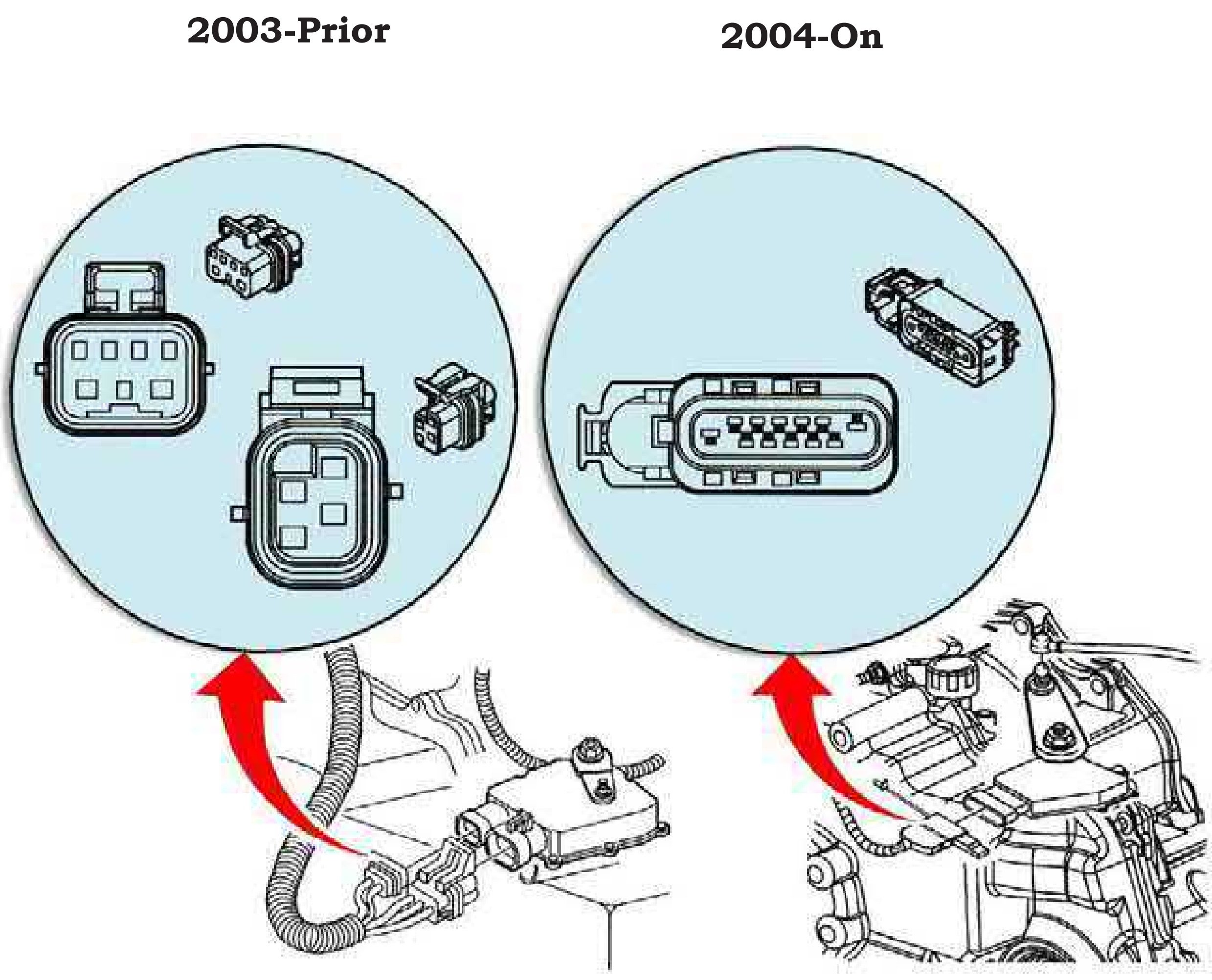
This switch is for 2004 and on models with a gray color base. Part# 24217544

4T40E/4T45E

Updates (continued)

New NSBU (Neutral Safety Back Up) Switch

A new NSBU switch with one large connector replaces the switch with two connectors. In the graphic, the two connectors are for 2003 and prior while the one large connector is for 2004.



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4T40E/4T45E

Updates (continued)

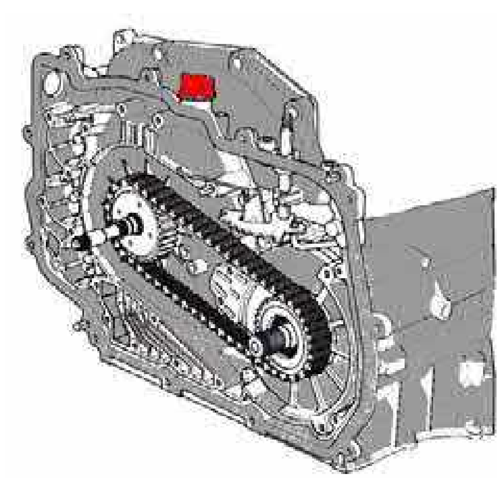
New PCS solenoid

A bosch PCS was implemented for all 4T40E/45E applications (same as the 4T65E we covered last year even the same part number) The updated PCS is in all 2004 4T40E/45E applications.

Part Number 10478146

New Drive Chain

In January 2004, the drive chain and sprockets were updated to a new " ZX design". The redesign uses an "inverted" tooth chain. The update was for durability. The new chain and sprockets are 5/8" wide and available in 35/35 or 32/37 sprocket tooth counts only. The old chains were 7/8 inch and 3/4 inch wide. The 33/37 sprocket tooth count applications are the previous design. The updated chain and sprockets can back service previous years although you will have to change the chain and sprockets as a set.



4T40E/4T45E

Updates (continued)

New Washers for the Input Carrier

Coated “Bat Wing” washers were implemented on the input carrier pinions. In addition, both the input and the reaction carrier pinion pin diameter was reduced and one more needle was added to each pinion gear/pin to improve the pinion life on higher torque applications. The Bearing that sits on the end of the reaction carrier was also updated adding another needle to it. The updates help prevent spalling. The updated parts will back service previous years. This was an update on all 4T45E applications for 2004.

4T40E/4T45E

Updates (continued)

New Pump needle bearing

The oil pump bearing was updated to improve the life of the pump. The cage was removed and one more needle was added to the bearing. This was an update on all 2004 models.

New 2004-On **2003-Proir**

4T40E/4T45E

Updates (continued)

New Axle Seal

The axle seal material was changed. The update is designed to improve seal life during cold temperature operation. The updated seal went into production on April 16, 2003 as a running change for late 2003 and all 2004 models

New Reverse Clutch Assembly

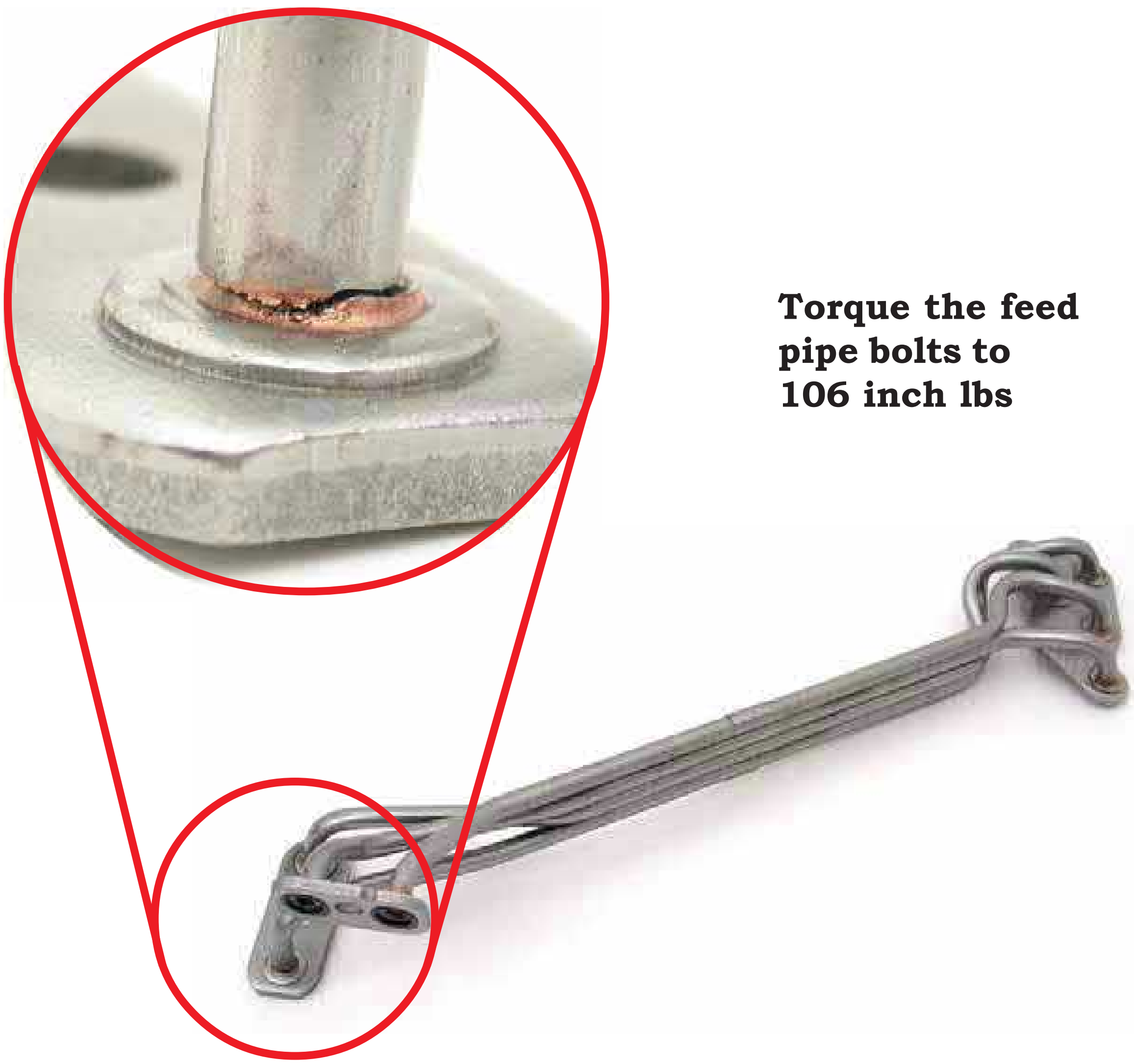
A running change for the 2003 model year was the reverse input clutch assembly. The bottom of the snap ring grove was moved down to make the groove wider. A new stiffer snap ring was implemented. The feed orifice for the center seal area was changed from 1.71mm on 1995-2003 models to 1.87mm on 2003-2005 models. The part number then changed for the drum kits, the 1995-2003 reverse input clutch kit number is 2420541 while the part number for the 2003-2005 application is 24223014. This change occurred on December 4th 2002 for the 2003 model year.

4T40E/4T45E

Slips in Forward

Cracked Oil Feed Tube

A cracked Oil Feed Tube may be the cause of a no forward or slips in forward condition. When installing the tube assembly to the case make sure there is no debris caught under the plate area before torquing the tube bolts. This may cause the tube assembly to crack. Make sure to check all tubes during disassembly and reassembly.



Torque the feed pipe bolts to 106 inch lbs

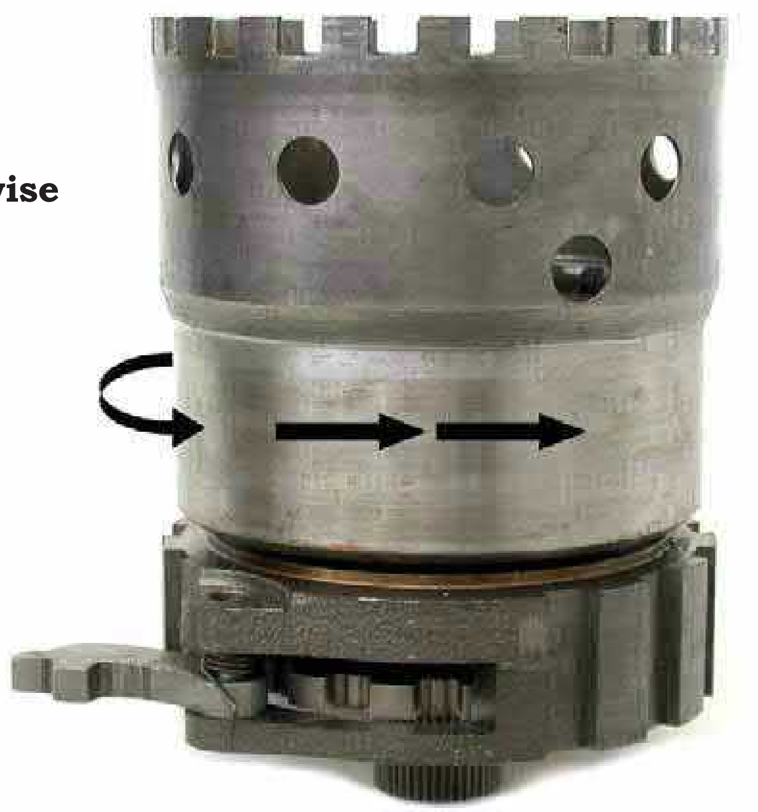
4T40E/4T45E

Low Roller Clutch Rotation

A failure to the Low Roller clutch assembly will result in a NO FORWARD condition in the O/D range.

NOTE: It will usually work on the lift

Rotates counter clockwise



4T40E/4T45E

2nd Roller Clutch Rotation

The outer race of the 2nd roller clutch rotates in a clockwise direction.

4T40E / 4T45E

Multiple Codes, Slips, Failsafe

DTCs P0753, P0758, P1860, C1223, C1224 or C1275

Other complaints: Transmission slips in 4th Gear, Stuck in 2nd Gear or SES/TCS light illuminated, DTCs:

P0753-1-2 Solenoid Circuit Failure
P0758-2-3 Solenoid Circuit Failure
P1860-TCC Solenoid Electrical Fault
C1223-2 Wheel Speed Sensor
C1224-2 Wheel Speed Sensor
C1275- ABS System Failure

This may be caused by the wiring being damaged or the Evap Emission Vent Solenoid failing. The models affected by this are 2002-2004 Chevrolet Cavalier and 2002-2004 Pontiac Sunfire with 2.2L Engine (VIN F – RPL L61)

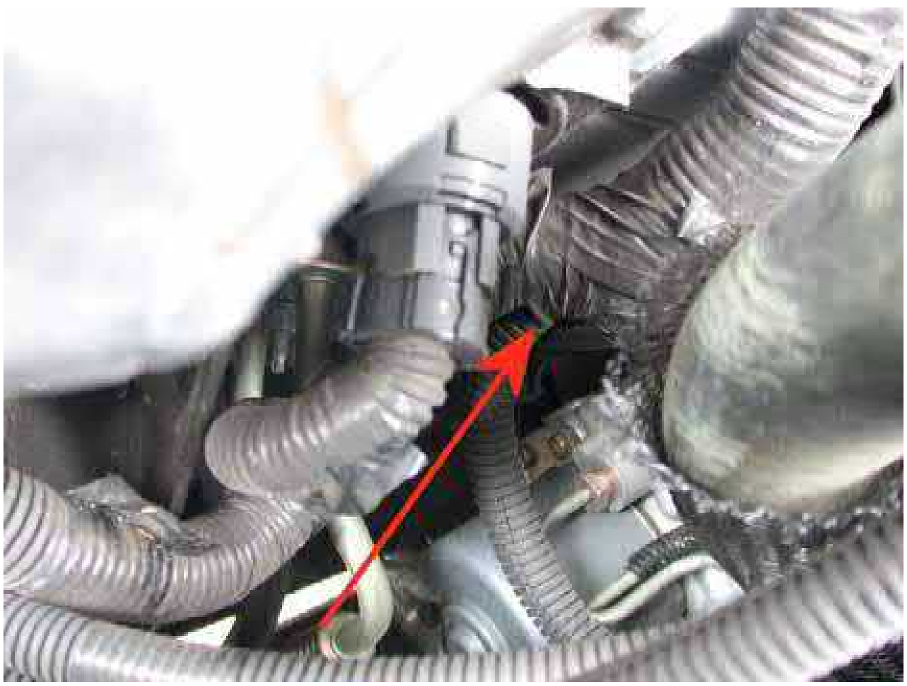
Both causes should be examined when a vehicle is brought in for the above concern.

4T40E / 4T45E

Multiple Codes, Slips, Failsafe

Wiring and Conduit Inspection (continued)

Cause #1:
Possible water intrusion at the transmission to the front end vehicle harness. This harness is located near the transmission breakout and is protected by plastic split tube type conduit and electrical tape. In some cases, the split may be facing upward which will increase the tendency of the conduit to hold water. Eventually, the #107 splice to the transmission may become corroded and become non-conductive.



Correction #1:
Locate the conduit for the transmission breakout directly above the transmission oil cooler lines. Remove the electrical tape wrap from the plastic conduit and peel the conduit open. With the conduit open, examine the splices inside for signs of corrosion. Splice #107 (part of circuit 439, PINK) is located approximately 13 in forward of the transmission breakout point. Examine the splice for signs of corrosion. If corrosion is found, repair the splice. Use only a GM Crimp and Seal splice. Strip back the wire until clean, non-corroded wire is available.

4T40E / 4T45E

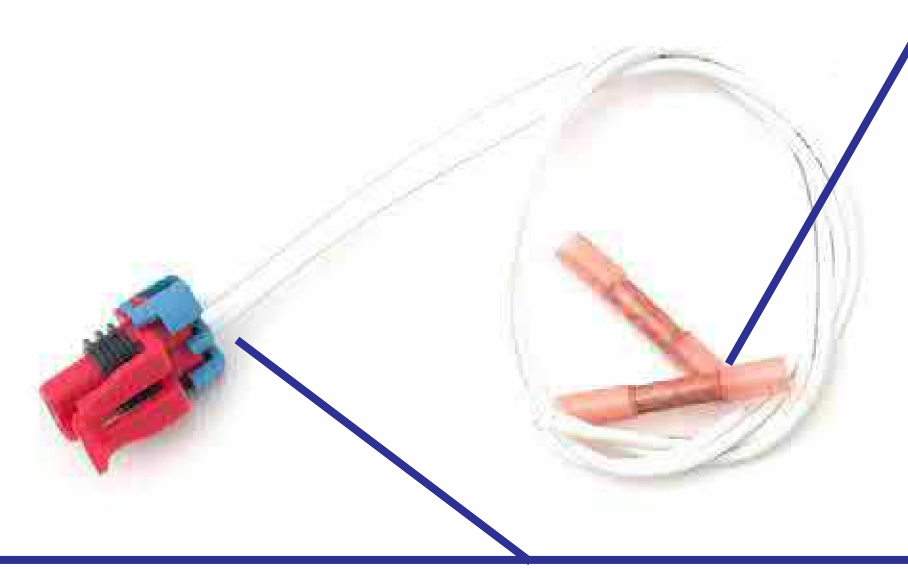
Multiple Codes, Slips, Failsafe (continued)

Evaporative Emissions Canister Vent Solenoid retainer

Cause #2 The Evaporative Emissions Canister Vent Solenoid retainer may have come loose, allowing the associated wire harness to contact the axle. Abrasion of the wire against the axle may rub through the insulation creating a short to ground.

1. The Evaporative Emissions Vent Solenoid is retained by a molded in, plastic extension. The retainer has molded in ridges that create an interference fit to the underbody. Under some instances, the retainer may have not been fully seated when installed.
2. Remove the jumper harness from the Evaporative Emissions Vent Solenoid and repair the harness as necessary.

Connector, GM Crimp n' Seal Butt End Part# 12089189



Connector, Body Harness Extension Part# 12101858

4T40E / 4T45E

Multiple Codes, Slips, Failsafe (continued)

The fastener style used to retain the Evap vent solenoid does not click when properly installed. This is normal, try to seat the fastener as deeply as possible without using excessive or damaging force.

Inspect the retainer for damage. Additionally, examine the solenoid body for any signs of damage. If the retainer and solenoid body appear in good condition, verify that the fastener holds properly by pulling on the solenoid body to check that it is retained. If the fastener will not retain properly or there are signs of damage, replace the Evap Vent Solenoid.
Discard and replace the jumper harness with P/N 12101858, lower the vehicle and clear all DTCs.

Part Number	Description
22622022	**Valve, Evap Canister Vent**

4T65E/4T45E

Tap Shifts

2004 Pontiac (W body) Grand Prix GTP equipped with the 4T65E and the 2004 Chevrolet (Z body) Malibu Classic equipped with the 4T40E/4T45E have a new feature referred to with the following terms ; “Tap Shifts”(Touch Activated Power), “Electronic Range Select Mode” (ERS) or as “DSC” (Driver Controlled Shifts) depending on the application and which literature you are referencing . Both applications give the customer the ability to upshift and downshift the transmission by moving a button. The button on the Malibu is located in the shift lever while the Grand Prix uses a set of paddles mounted on the spoke of the steering wheel.

Operation:
The addition of the TAP shift system led to several transmission changes including the valve body, spacer plate, channel plate and even the friction materials depending on the application. Several changes were also made to the vehicle wiring and to the PCM/BCM to make the TAP shift system function.

The system consists of the following:

- TAP switches- The tap switches are momentary contact type switches. In addition to the switch contacts, the switch assembly contains a series of dropping resistors (A voltage divider circuit).
- A fuse controls power to the switch assembly. On the W car application the “Cruise” fuse located in the IP fuse block controls the system while the Z car uses the “Run/Crank” fuse located in center console fuse block for operation.
- The shift lever position indicator is attached to the shift lever and is used to enable or disable TAP operation on the Malibu (Z body) application.
- The IMS is used to enable or disable TAP operation on Grand Prix (W body) applications.
- The PCM receives the input from the TAP switches and then commands the transmission to shift to the gear commanded by the customer. The voltage value received by the PCM from the switches varies based on whether the customer is commanding an upshift or a down shift.
- A BCM interface via the serial data line, is used on the Malibu to tell the PCM when the shifter has been moved into the proper position so the TAP shifts can be enabled.

4T65E/4T45E

Tap Shifts

Malibu Operation:

To operate the TAP system on the Malibu, the customer must first place the shift selector into the “Low” (L) position. If the shifter is in any other position, the PCM will inhibit the shift. The BCM monitors the shifter enable circuit via circuit 5525. When the shifter is place in L position, the voltage on circuit 5525 is pulled low by the shift lever indicator switch, enabling the Tap Shifts to function. When the voltage is pulled low the “Driver Shift Control” parameter on the scan tool will display “Active” as a value. When the Driver Shift Control parameter reads Active, the BCM will inform the PCM via serial data that the TAP shift function should be enabled. The PCM then looks at typical inputs such as VSS and Engine load to determine if the shifts should be allowed and if so, when the shift should occur. When the shifter is in the “L” position the transmission range sensor (PRNDL switch) will indicate D3 range as the manual valve is actually in D3 range. The PRNDL switch values for circuits A, B, C and P will display “LOW” for all of the switch circuits.

When the shifter is placed in any other range, the voltage on circuit 5525 will be high and the Tap Shift function will no longer operate. If the shifter is in any range other than L the scan tool parameter displayed as “Driver Shift Control” will read “Inactive”. When the Driver Shift Control parameter reads Inactive, the BCM will inform the PCM via serial data that the TAP shift function should be disabled. When the customer presses the upshift button, battery voltage is fed through a 4.42K resistor to the PCM via circuit 5526. The resulting voltage drop is then recognized as an upshift command. To command a downshift, the customer presses the button in the opposite direction. Battery voltage is fed through a 1.5K resistor to the PCM through circuit 5526.

4T65E/4T45E

Tap Shifts

Malibu Operation (continued):

The voltage level available at the PCM when the switch is moved to the downshift position is different than the value at the PCM when the driver commanded an upshift to occur. . The scan tool parameter that displays the shift switch voltage values is called out as “Shift Voltage Request”.

Typical TAP Shift switch values with the engine running are as follows:

No Button Pushed- .65 Volts

Upshift Button Pushed - 1.78 Volts

Downshift Button Pushed- 3.4 Volts

NOTE: It should be noted that the above values will vary with battery voltage. If the voltage is being monitored with the engine off, key on the voltage values will be lower than those shown above.

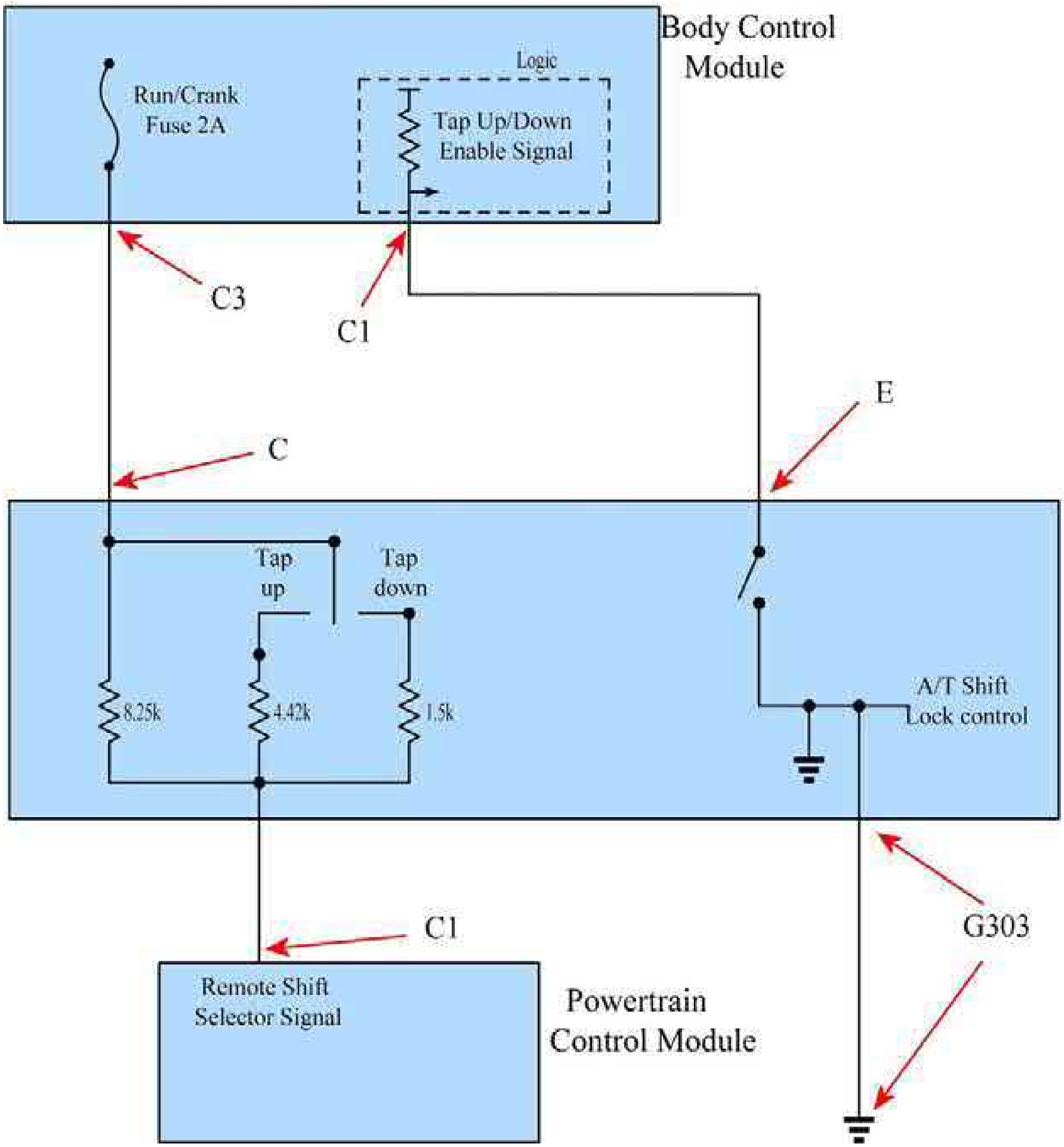
NOTE: On the Z body applications the BCM also communicates with the IPC regarding shifter position, as well as TAP command values. When the shifter is placed in the “L” position the PRNDL indicator in the dash will display L3 as a value. As the downshift TAP button is pressed the indicator will display L2 and then L1 if the button is pressed again. If a TAP upshift is commanded the PRNDL will display L2 and then L3 if the button is pressed again.

NOTE: It should be noted that the transmission cannot be TAP shifted if the vehicle is stationary. The indicator in the dash will change but the transmission will not shift. In addition, some TAP upshifts will be inhibited if the road speed is to low.

4T65E/4T45E

Tap Shifts

Z car TAP Shift



4T65E/4T45E

Tap Shifts

Pontiac Grand Prix GXP Super Charged Operation:

To enable the TAP Shift system on the Grand Prix the customer must have the shifter in the “M” position. If the shifter is in any other position, the TAP shift feature will not function. The shifter position on the W car is determined by the IMS, which is mounted inside the transmission. When the shifter is in the M position, the HUD (Heads Up Display) digits will decrease in size. In addition, the HUD will change from showing the PRNDL position to showing the commanded TAP gear.

NOTE: If the engine is not running the HUD will always read “3” in M range and the scan parameter will indicate only 3rd gear commanded even if you push or pull on the paddles commanding a shift to occur.

The scan tool parameter for the IMS will display “Drive 3” when the shifter is in the M position. IMS circuits A, B, C and P will all display a “LOW” value on the scan tool. In addition, the “Driver Shift Control” parameter will change to “ACTIVE” enabling TAP shifts to occur.

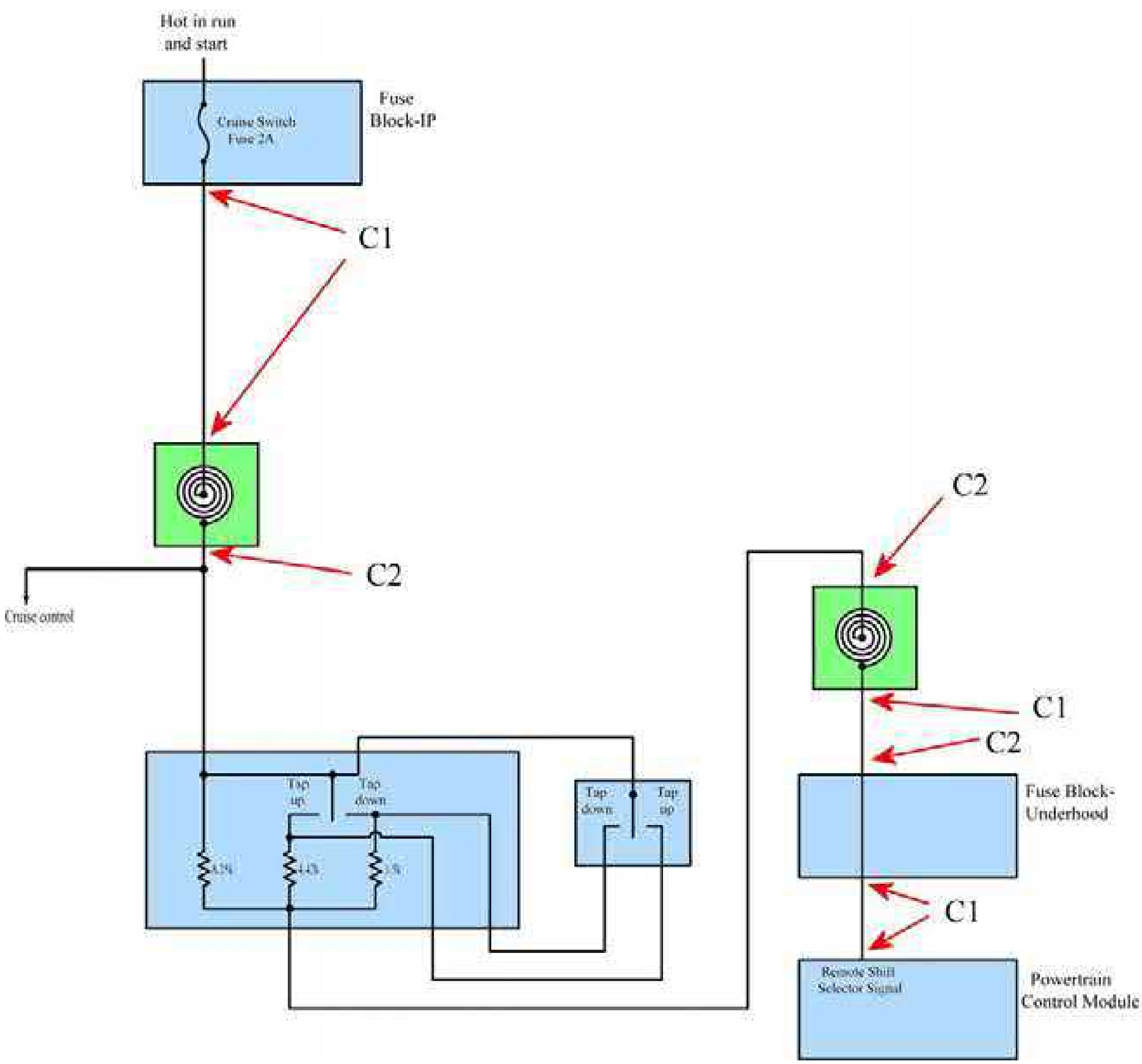
The W car uses two switches mounted on each side of the steering wheel center spoke. The left switch is the master, in which a series of resistors are housed. The right switch is simply a single pole double throw type switch.
If the driver pushes one of the switches an upshift will be commanded. If the driver pulls on one of the switches a downshift will occur. When an upshift is commanded, battery voltage will be fed through a 4.42K resistor to the PCM via circuit 1996. A downshift command will cause battery voltage to be fed through a 1.5K resistor to the PCM on circuit 1996.

Typical TAP Shift switch values with the <u>engine running</u> are as follows:
No Button Pushed- .65 Volts
Upshift Button Pushed - 1.70 Volts
Downshift Button Pushed- 3.35 Volts
NOTE: It should be noted that the above values will vary with battery voltage. If the voltage is being monitored with the engine off, key on the voltage values will be lower than those shown above.
NOTE: It should be noted that the transmission cannot be TAP shifted above 2nd gear if the vehicle is stationary. In addition, some TAP upshifts will be inhibited if the road speed is to low.

4T65E/4T45E

Tap Shifts

W car TAP Shift



4T65E/4T45E

Tap Shifts

Diagnostics:

Several new DTC's are available for the TAP system, they include: P0815, P0816, P0826, P1876 and P1877

P0815 will set if:

- P0826 is not set
- No PSM/PSA DTC's are set (Z body)
- No IMS DTC's (W body)
- The engine is running
- It has been at least 6 seconds since the shifter range had been changed
- The PCM detects the upshift signal for longer than 2 seconds in park or 5 minutes in D4 range

If a P0815 sets the PCM will

- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

P0816 will set if:

- P0826 is not set
- No PSM/PSA /Range DTC's are set (Z body)
- No IMS DTC's are set (W body)
- The engine is running
- It has been at least 6 seconds since the shifter range had been changed
- The PCM detects the downshift signal for longer than 2 seconds in park or 5 minutes in D4 range

If a P0816 sets the PCM will

- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

4T65E/4T45E

Tap Shifts

Diagnostics:

P0826 will set if:
- The engine is running
- The PCM detects an invalid voltage value on circuit 5526 (Z body) circuit 1996 (W body) for longer than 5 seconds

If a P0826 is set the PCM will:
- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

P1876 (Z body only) will set if:
- No TAP system DTC's are set
- No PSA/PSM/RANGE DTC's are set
- Engine is running
- The PCM detects the TAP enable circuit is "ACTIVE" and the transmission is in D4 range
- The condition lasts longer than 3 seconds

If a P1876 is set the PCM will:
- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

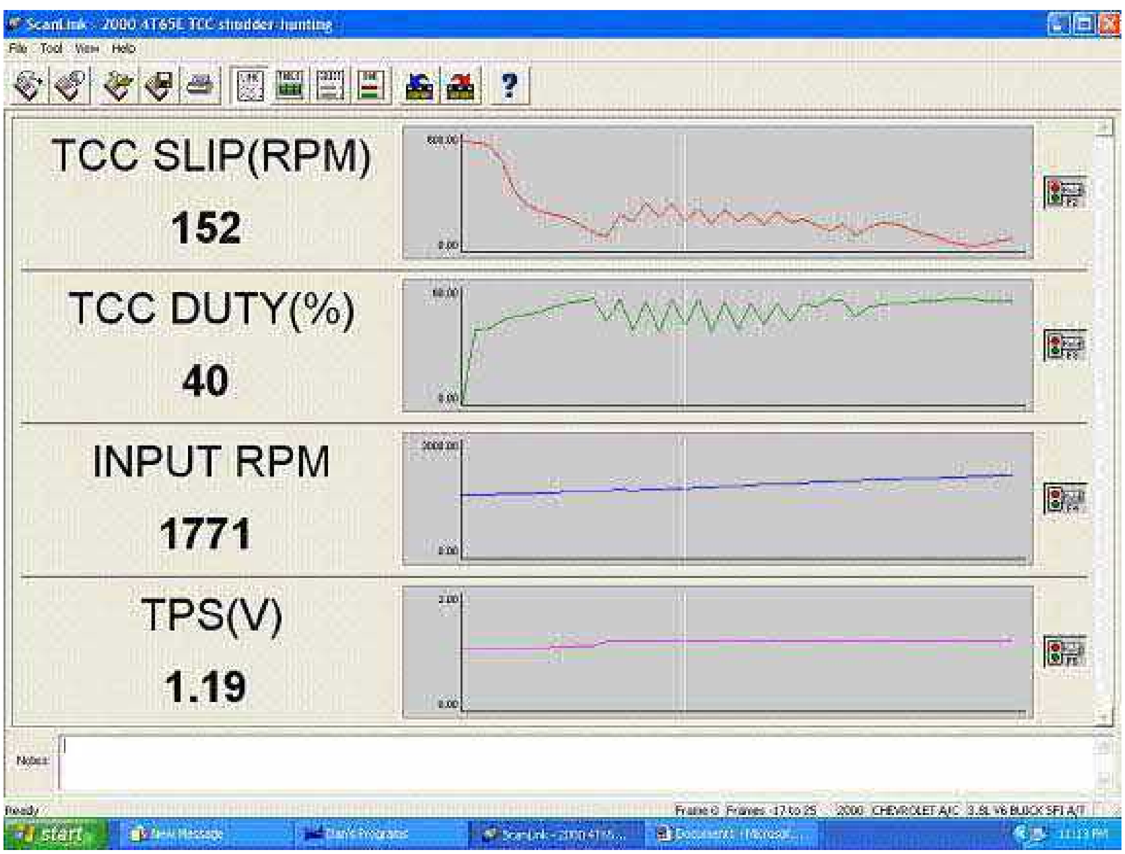
P1877 (Z body only) will set if:
- No TAP system DTC's are set
- No PSA/PSM/RANGE DTC's are set
- Engine is running
- The PCM detects the TAP enable circuit is "INACTIVE" and the transmission is in L range
- The condition lasts longer than 3 seconds

If a P1877 is set the PCM will:
- Disable the TAP shift function
- Default the shifter range to the D4 shift pattern

4T60E / 4T65E

TCC Slip

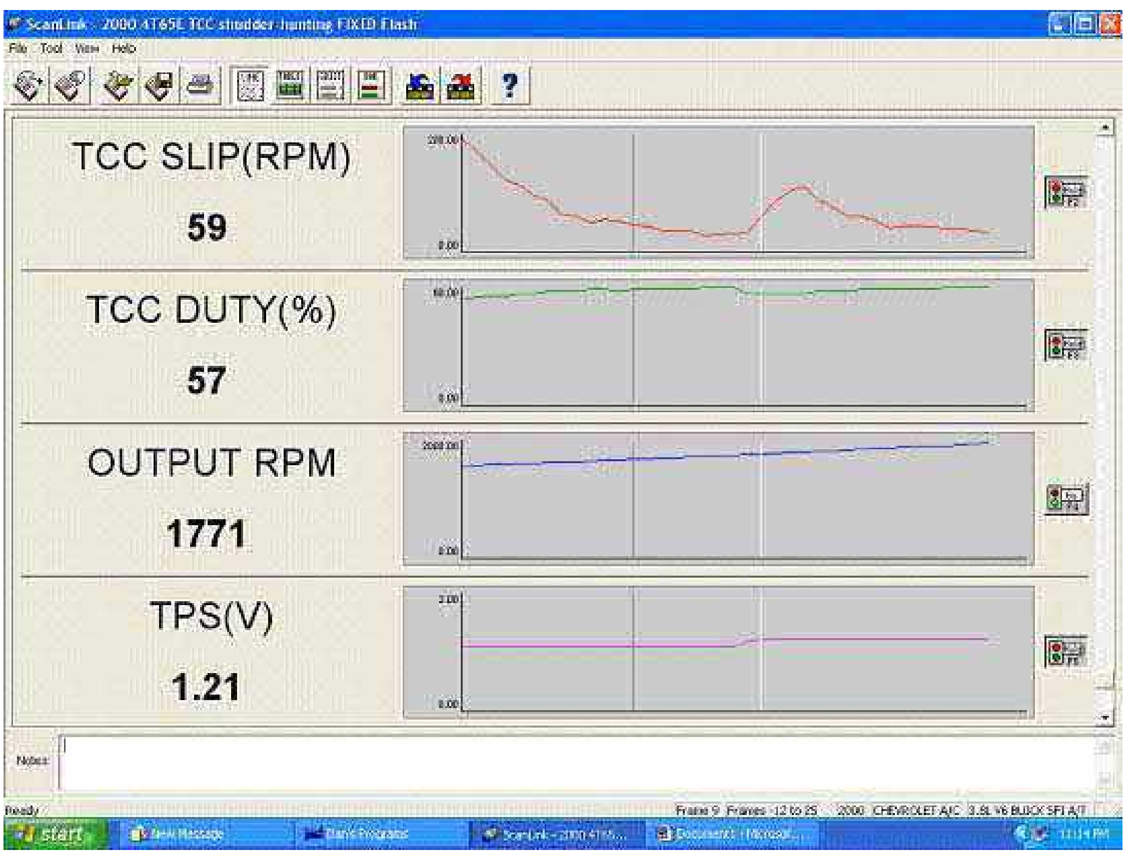
Many TCC related complaints are caused by computer programing problems. The chart below shows the TCC Slip speed is varying about 100 RPMs about every 1.5-2 seconds. This isolation feels a little like an engine misfire, but smoother. It is apparent the computer is commanding the TCC to be erratic. First determine if there is a input causing your problem. If all of your inputs are at their perspective specifications, try reprogramming the computer.



4T60E / 4T65E

TCC Slip (continued)

Here's the same vehicle after the processor was reprogramed. Notice the TCC duty cycle is steady, as well as the slip. The slight increase in the TCC slip is from a slight dip of the throttle. Trying to correct this problem mechanically might be impossible.



4T65E

Codes P0753/P0758/P1860

2000/2004 Pontiac H Cars Buick C/H Cars

Some 4T65E Pontiac Bonneville (H Body), Buick LeSabre (H Body) and Buick Park Avenue (C Body) applications may exhibit any combination of the following DTCs, P0753, P0758 or P1860. P0753 and P1860 seem to be the most common combination of DTCs that are setting. In addition, the default actions for those DTC's will be in effect if the DTCs are set. As with other conditions on today's vehicles, it is common for the above symptoms to be intermittent. To set the DTCs the following must occur:

P0753 will set if:
The PCM commands the 1-2 shift solenoid ON and the feedback voltage is HIGH for more than 5 seconds
OR
The PCM commands the 1-2 shift solenoid OFF and the feedback voltage is LOW for more than 5 seconds

If a P0753 is set the PCM will:
Turn on the MIL (SES light) on the second consecutive failure
Command Maximum line pressure
Inhibit 3-2 downshifts when VSS is greater than 30 MPH (48 km/h)
Freeze shift adapts

P0758 will set if:
The PCM commands the 2-3 shift solenoid ON and the feedback voltage is HIGH for more than 5 seconds
OR
The PCM commands the 2-3 shift solenoid OFF and the feedback voltage is LOW for more than 5 seconds

4T65E

Codes P0753/P0758/P1860 (continued)

2000/2004 Pontiac H Cars Buick C/H Cars

If a P0758 is set the PCM will:
Turn on the MIL (SES light) on the second consecutive failure
Command Maximum line pressure
Inhibit TCC
Command 2nd gear
Freeze shift adapts

P1860 will set if:
The PCM commands the TCC solenoid to 90% or greater duty cycle and the feedback voltage is HIGH for more than 5 seconds
OR
The PCM commands the TCC shift solenoid 10% or less duty cycle and the feedback voltage is LOW for more than 5 seconds

If a P1860 is set the PCM will:
Turn on the MIL (SES light) on the second consecutive failure
Inhibit TCC
Inhibit 4th gear if in hot mode
Freeze shift adapts

Several items may cause the conditions listed above. One of the common areas that seems to occur with great frequency, is a poor connection at the “under hood fuse block”. The pin and its location vary based on the vehicle model. On H-car applications inspect connector C-3 pin E7 for damage. On C- car applications inspect connector C-2 pin E4 for damage. In most instances you will find the terminal lock tab damaged. This will allow the terminal to back out, leading to the intermittent concern.

4T65E

Codes P0753/P0758/P1860 *(continued)*

2000/2004 Pontiac H Cars Buick C/H Cars

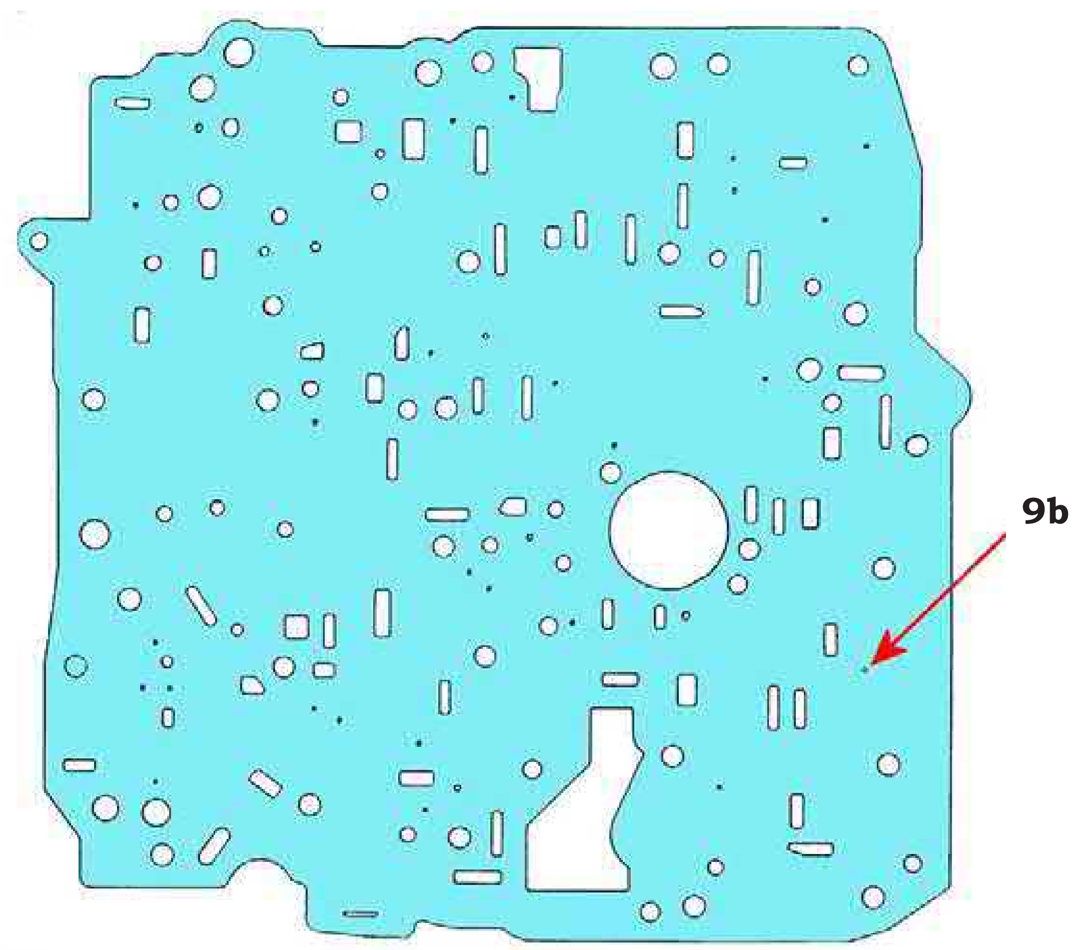
To inspect the pins, remove the under hood fuse block or under hood junction block and flip it upside down. On H cars, connector C-3 is the black 68 pin connector. On C cars, connector C2 is the brown 68 pin connector. On C car applications pin E4 is fed from the IGNFD 10A fuse while H cars feed pin E7 though the 10 A TRANS fuse.
To repair the condition, replace the terminal or repair the collapsed locking tab.

Remove the under hood fuse block or under hood junction block and flip it upside down.

4T65E

P0741, Excessive TCC Slip, No TCC Apply

Orifice 9b is too small, not allowing enough TCC Signal / PWM oil to the TCC Reg. Apply valve

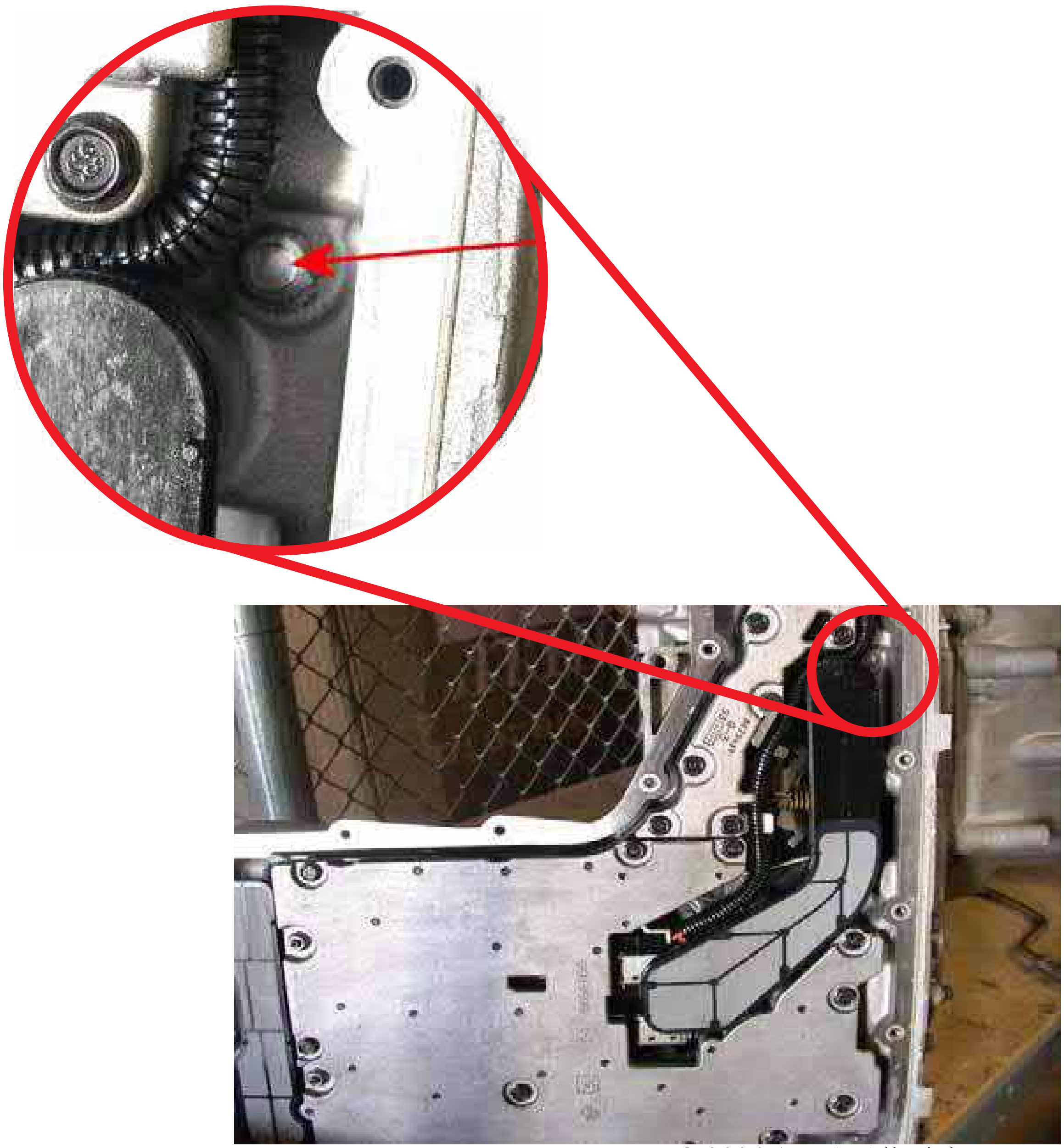


Enlarge orifice 9b with .020" to .030" drill

4T80E

Refill Procedures

When servicing a 4T80E transmission it is necessary to remove the plug from inside the case to drain the side cover of it's oil. This plug is located near the chain cover. Fluid level that is not correct may be caused by not reinstalling the plug.

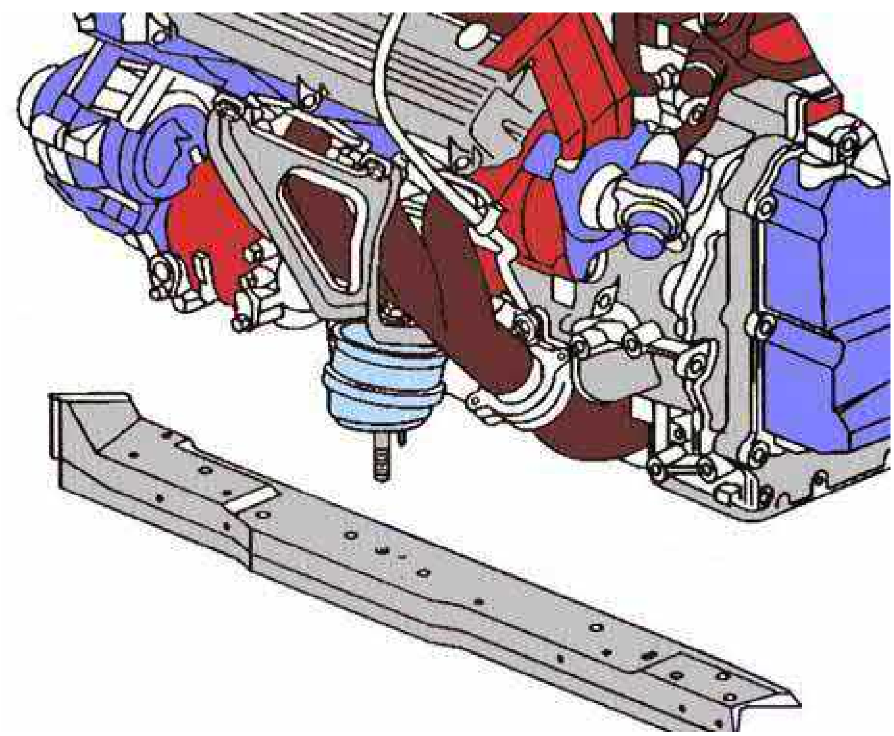


4T80E

"Clunk" During a Garage Shift and/or a "Thud" Noise When Accelerating

Many (K- Car) Northstar equipped 4T80E vehicles may have aggressive garage shifts. The condition may have gotten progressively worse or may have developed all at once. In addition a "Thud" noise when accelerating from a stop may also be felt. An oil leak from the motor mount may also be present on the garage floor or drive way.

This is a common issue on the Northstar applications and it is generally caused by a cracked front engine mount. The mount generally cracks in the area of the stud where it mounts to the frame.



4T80E

Erratic VSS Signal

4T80E Northstar applications may experience an erratic speedometer reading, as well as other conditions such as a TCS (Transmission Control Switch) light on, and a possible C1295 DTC. Some conditions may also lead to shift related concerns.

In some instances the customer may comment that the speedometer is reading high (up to 150 MPH) even though the car may not be moving. In some instances the speedometer may drop out while driving. Either of the above conditions may be intermittent or may have occurred only after the engine, transmission or alternator was replaced.

Typically one of the following is responsible for the conditions:

1. **A bad 3A ground wire typically located near the alternator**

2. **The Transmission harness is rubbing on the cooling hose clamps in the area of the coolant recovery jug.**

Repair the harness or ground connection

4T40E/4T45E

2003/2004 Ratio and Application chart

This year's seminar book includes an update to the charts contained within the 2002 seminar book. The 2002 seminar book contains listings for 1995-2002 4T40E/45E applications. The 4T45E/40E utilizes several different final drive, drive/driven sprocket and torque converter combinations. Installing the wrong transmission, drive/driven sprockets, final drive or toque converter can result in several different ratio error or slip DTC's . If a ratio error, maximum adapt or TCC slip DTC is present, and the unit has been previously repaired or replaced, the converter, final drive ratio and/or drive to driven sprocket ratio could possibly be incorrect for your application. Refer to our chart to determine what final drive and drive/driven sprocket ratios are available for your application. As with other GM vehicles the engine, transmission and final drive ratio information for your specific vehicle model is located on the regular production option label (RPO). The RPO label should be used exclusively to determine which transmission fits in which vehicle body style and application.

RPO codes for the 4T40E/45E applications

RPO CODE DESCRIPTION	RPO CODE DESCRIPTION
LG8-3.1L V-6 ENGINE	FY1- 3.05 FINAL DRIVE
L61- 2.2L 4 CYL ENGINE	FR9- 3.29 FINAL DRIVE
L42- 2.2L 4 CYL ENGINE	F83- 3.05 FINAL DRIVE
LA1- 3.4L V-6 ENGINE	FX2- 3.29 FINAL DRIVE
L81- 3.0L V-6 ENGINE	FR3- 3.29 HD FINAL DRIVE
LX9- 3.5L V-6 ENGINE	

NOTE: The effective ratio available at the transmission drive shafts will include the final drive ratio and the drive/driven sprocket ratio.

RPO	Effective ratio
FY1	3.63
FR9	3.29
F83	3.05
FR3	3.69
FX2	3.91

4T40E/4T45E

2003/2004 Ratio and Application chart

Application	Year	Model Codes	Drive/Driven	Final Drive	SRTA Part #
N-BODY CHEV LG8 MN4	2003	3WCR	35/35	3.05	24224355
N, ZJ & J BODY CHEV,PONT OLDS, SATURN L61, L42,MN4	2003	3PCR	32/38	3.29	24224356
N-BODY PONT,OLDS LA1 MN5	2003	3WXJ	35/35	3.05	24224358
N-BODY PONT LA1 MN5	2003	3MXJ	35/35	3.29	24224359
ZJ-BODY L300 SATURN L81 MN5	2003	3FDJ	33/37	3.29	24224360
N, ZJ & J BODY CHEV, PONT, OLDS, SATURN L61 L42 MN4	2004	4PCR	32/38	3.29	24227118
N-BODY PONT- OLDS LA1 MN5	2004	4WXJ	35/35	3.05	24227119
N-BODY PONT	2004	4MXJ	35/35	3.29	24224359
ZJ-BODY L300 SATURN L61 MN5	2004	4FDJ	33/37	3.29	
Z-BODY CHEV LX9 MN5	2004	4ERJ	35/35	3.05	24227122
Z-BODY EXTENDED CHEV LX9 MN5	2004	4ETJ	35/35	3.29	24224355
Z-BODY CHEV L61 MN5	2004	4EBJ	32/38	3.05	24227436

4T65E

2003/2004 Ratio and Application chart

This year's seminar book includes an update to the charts contained within the 2002 seminar book. The 2002 seminar book contains listings for 1997-2002 4T65E applications. The 4T65E utilizes several different final drive, drive/driven sprocket and torque converter combinations. Installing the wrong transmission, drive/driven sprockets, final drive or toque converter can result in several different ratio error or slip DTC's . If a ratio error, maximum adapt or TCC slip DTC is present, and the unit has been previously repaired or replaced, the converter, final drive ratio and/or drive to driven sprocket ratio could possibly be incorrect for your application. Refer to our chart to determine what final drive and drive/driven sprocket ratios are available for your application. As with other GM vehicles the engine, transmission and final drive ratio information for your specific vehicle model is located on the regular production option label (RPO). The RPO label should be used exclusively to determine which transmission fits in which vehicle body style and application.

RPO codes for the 4T65E applications

RPO CODE	DESCRIPTION	RPO CODE	DESCRIPTION
MN3-4T65E	Transmission	LB8	2.5L Engine
MN7-4T65E	HD Transmission	L46	3.0L Engine
M76-4T65E	AWD Transmission	LG8	3.1L Engine
M15-4T65E	Advanced Electronic Controls	LA1	3.4L Engine
		LQ1	3.4l DOHC Engine
FQ3	2.86 Final drive	LX5	3.5L DOHC Engine
FR2	3.29 Final drive	L36	3.8L Engine
F83	3.05 Final drive	L67	3.8L Engine Super charged
FR9	3.29 Final drive	L32	3.8L Engine
FV4	3.71 Final drive	LY7	3.6L Engine

Police/taxi special equipment options (SEO) 9C1, 9C3,9C6

NOTE: The effective ratio available at the transmission drive shafts will include the final drive ratio and the drive/driven sprocket ratio.

RPO	Effective ratio
FQ3	2.86
FR9	3.29
F83	3.05
FR2	2.93

4T65E

2003/2004 Ratio and Application chart

Application	Year	Model Codes	Drive/Driven	Final Drive	SRTA Part #
C-BODY L36 MN3	2003	3FFB	35/35	3.05	24224273
H-BODY L36 MN3	2003	3PAB	35/35	2.86	24224275
H-BODY L-36 MN3	2003	3PBB	35/35	3.05	24224276
C-BODY L67 MN7	2003	3FCB	37/33	3.29	24224280
H-BODY L67 MN7	2003	3CHB	37/33	3.29	24224281
W-BODY L67 MN7 PONT/BUICK	2003	3XAB	37/33	3.29	24224284
B&U BODY LA1 M15	2003	3BCB	35/35	3.29	24224288
W-BODY CHEV LA1 M15	2003	3RDB	35/35	2.86	24224290
W-BODY PONT/BUICK LG8 M15	2003	3RNB	35/35	3.05	24224291
W-BODY CHEV POLICE/TAXI L36 M15	2003	3LCB	35/35	3.29	24224292
W-BODY CHEV/BUICK L36 M15	2003	3LBB	35/35	3.05	24224293
W-BODY CHEV/PONT L36 M15	2003	3LDB	35/35	3.29	24224294
B&U BODY LA1 M76	2003	3CXB	35/35	3.29	24224295
C-BODY L36 MN3	2004	4FFB	35/35	3.05	24224282
H-BODY L36 MN3	2004	4PAB	35/35	2.86	24224312

4T65E

2003/2004 Ratio and Application chart

Application	Year	Model Codes	Drive/Driven	Final Drive	SRTA Part #
H-BODY L-36 MN3	2004	4PBB	35/35	3.05	24224289
C-BODY L67 MN7	2004	4FCB	37/33	3.29	24224283
W-BODY L32 OR L67 MN7 PONT/CHEV	2004	4CAB	37/33	3.29	24224300
W-BODY Pont L32 MN7	2004	4CBB	35/35	3.29	24224301
W-BODY BUICK L67 MN7	2004	4KNB	37/33	3.29	24227445
W-BODY PONT LG8 M15	2004	4RNB	35/35	3.05	24227449
W-BODY CHEV POLICE/TAXI L36 M15	2004	4LCB	35/35	3.29	24227446
W-BODY CHEV/BUICK PONT L36 M15	2004	4LBB	35/35	3.05	24224302
W-BODY CHEV L36 M15	2004	4LDB	35/35	3.29	24227447
W-BODY CHEV LA1 M15	2004	4RDB	35/35	3.29	24227448
B&U BODY LA1 M15	2004	4BCB	35/35	3.29	24227438
B&U BODY LA1 M76	2004	4CXB	35/35	3.29	24224309
B BODY BUICK LY7 M76	2004	4VCB	35/35	3.29	24224310

4T80E

2003/2004 Ratio and Application chart

This year's seminar book includes an update to the charts contained within the 2002 seminar book. The 2002 seminar book contains listings for 1992-2002 4T80E applications. The 4T80E utilizes several different final drive and torque converter combinations. Installing the wrong transmission, final drive or toque converter can result in several different ratio error or slip DTC's . If a ratio error, maximum adapt or TCC slip DTC is present, and the unit has been previously repaired or replaced, the converter or the final drive ratio could possibly be incorrect for your application. Refer to our chart to determine what final drive and drive/driven sprocket ratios are available for your application. As with other GM vehicles the engine, transmission and final drive ratio information for your specific vehicle model is located on the regular production option label (RPO). The RPO label should be used exclusively to determine which transmission fits in which vehicle body style and application.

RPO codes for the 4T80E applications:

RPO CODE DESCRIPTION

LD8- 4.6L NORTHSTAR ENGINE
L37- 4.6L NORTHSTAR ENGINE
L47- 4.0L NORTHSTAR ENGINE
FW2- 3.06 FINAL DRIVE
F13- 3.48 FINAL DRIVE
FV4- 3.71 FINAL DRIVE

RPO CODE DESCRIPTION

FP3- 2.73 FINAL DRIVE
F79- 2.97 FINAL DRIVE
F17- 2.84 FINAL DRIVE
FV3- 3.11 FINAL DRIVE
FR9- 3.29 FINAL DRIVE
MH1- 4T80E TRANSMISSION

NOTE: ALL 2003/2004 4T80E APPLICATIONS USE AN IMS

4T80E

2003/2004 Ratio and Application chart

APPLICATION	YEAR	MODEL CODE	CONVERTER	FINAL DRIVE	SRTA PART #
K-BODY LD8 MH1	2003	3AAN	VCC	3.11	24224454
K-BODY L37 MH1	2003	3AJN	TCC	3.71	24224453
K-BODY L37 MH1	2003	3MLN	VCC	3.71	24224455
G-BODY L47 MH1	2003	3MSN	VCC	3.71	24224456
K-BODY LD8 MH1	2004	4AAN	VCC	3.11	24224454
K-BODY L37 MH1	2004	4AJN	TCC	3.71	24224453
K-BODY L37 MH1	2004	4MLN	VCC	3.71	24224455

4L60E/65E

Low Power, Shudder

1999-2003 4.8L, 5.3L, 6.0L Engines

Some customers may comment that their vehicle appears to be losing power, usually intermittently. In addition, the customer may comment that the vehicle seems to shudder on acceleration when the condition is present.

The vehicle may be operating in “Low Power Mode”. This condition can be triggered by several conditions including a faulty PSM/PSA. If the switch indicates that the transmission has shifted to neutral when the vehicle is actually being driven at highway speeds, the PCM may command the system into low power mode. If you note that the PSM is changing state, check the switch and wiring and replace the switch if you cannot isolate a specific cause.

4L60E

Burned 3-4 Clutch, Slip DTC's Set

Condition: 4L60E applications setting slip DTC's may have problems with the 3-4 clutch. Upon inspection you may find the 3-4 clutches are burned.

4L60E

Burned 3-4 Clutch, Slip DTC's Set

Cause/Correction: Several items have been found as causes for 3-4 clutch damage. If 3-4 clutch damage is suspected or if the clutch is found to be damaged inspect the following:

1. 3-4 Piston seals damaged, cut
2. 3-4 Piston cracked
3. Housing cracked
4. Turbine shaft cracked (inspect the inside of the stator support sleeve for damage)
5. 3-4 feed hole restricted
6. Pump passages incorrectly drilled or cross leaks present
7. Turbine shaft seals damaged
8. 3-4 clutch check ball leaking (620)
9. 3-4 check ball plug in the end of the turb
ine shaft leaking
10. Bleed orifice leaking or missing
11. Turbine shaft leaking around splines that attach it to the drum
12. TCC inoperative
13. Engine modifications have been preformed that allow the engine to exceed the transmissions maximum torque capacity
14. PCS or its valving is sticking or faulty (Remember the quality spill on the PCS, Look at your build date)· Pump sleeve incorrectly positioned
15. Partially sticking 2-3 shift valve
16. Improper PCM calibration loaded
17. 3rd accumulator check ball #7, not sealing or servo orifice cup plug missing/damaged (2-4 band will be burned also)

18 Leaking servo seals (on 3rd piston) (2-4 band will be burned also)

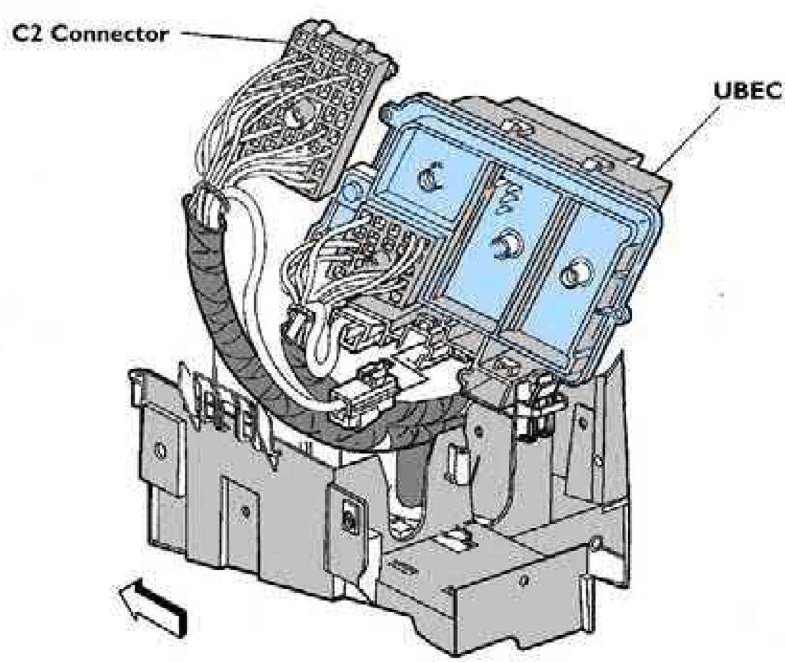
4L80E/85E and 4L60E/65E

Failsafe, 2nd or 3rd Gear Only

1999 and later C-K Truck applications may experience a condition that results in the transmission defaulting into 2nd gear (4L80E/85E) or 3rd gear (4L60E/65E) when the shifter is placed in the OD position. In addition, several DTCs may set, which relate to electrical faults in the solenoids or there circuits.

Although the ignition switch has been a common cause of this concern and a new updated ignition switch (As outlined in previous seminar manuals) has been released the problem may not be corrected by replacing the ignition switch.

Always check circuit 1020 at the UBEC (Under hood Electrical Center) Connector C-2, terminal F-2 for a poor crimp condition. In many instances the terminal is crimped over the top of some of the wiring insulation leading to a poor connection. In most instances this condition is intermittent. Wiggle the wires at connector C-2 while monitoring the voltage on circuit 1020. If a terminal crimp issue is present replace the terminal using the special crimping pliers designed for the GM terminals.



4L60E/65E, 4L80E/85E

Multiple Codes Set

4.8L, 5.3L, 6.0L Applications codes P1514, P1515,P1516, P1518

Some customers may comment that they have an SES light which is often accompanied by a lack of power condition (Vehicle operating in the reduced power mode and the reduced power light may have been on also). In many instances the customer mistakes the lack of power condition with a possible transmission problem as the transmission is no longer as responsive to throttle input as it was prior the condition occurring. In addition, you will generally find a P1516 set. To Set a P1516 the following conditions must occur:

1. The TAC (Throttle Actuator Control) module detects that the desired and the actual throttle positions are not within a calibrated range of each other. (Greater than a 2 degree error in the amount the throttle was commanded to move and the actual amount it moved)

2. Neither the PCM nor the TAC module can determine the actual throttle position.

3. Both of the TP sensor values are invalid (Both have DTCs set). The above conditions are met for more than 1 second.

4L60E/65E, 4L80E/85E

Multiple Codes Set (continued)

4.8L, 5.3L, 6.0L Applications codes P1514, P1515,P1516, P1518

In some instances you may find any/all of the following DTCs set:

P1514-TAC system Performance
P1515-TAC system Performance
P1516-TAC system Performance
P1518-TAC Module Serial Data Fault

As with all other DTCs, this concern is usually intermittent. Prior to replacing parts for this concern, make sure to check the vehicle's battery and charging system; Low battery voltage can result in the above DTCs setting. If battery and charging system operations are okay inspect the APP system connections.

Check the TAC module connectors and the PCM connectors for proper pin tension, proper terminal crimp and moisture intrusion into the connectors. In addition, the plastic connector tab (TPA) may be missing, allowing for an intermittent contact. If no problems are found, check the following grounds before replacing any parts.

On C/K trucks inspect ground wire G103 (PCM) and G104 (TAC Module) for corrosion and tightness. The G103 ground wire is located at the back of the passenger side cylinder head on the block just above the bellhousing. The G104 ground wire is located at the back of the drivers side cylinder head on the block just above the bellhousing. Some applications also utilize a G108 ground wire, which is located on the lower driver's side of the block.

4L60E

2002 Trailblazer/Envoy 4.2L applications shift concerns

Condition: Some T-truck applications may exhibit any or all of the following shift related concerns

- **Delayed downshifts**
- **1-2 shift quality**
- **Cold start shift quality**
- **Cooling fan noise**

Cause/Correction: An updated calibration has been released to address the above concerns. Several different calibrations have been released so be sure you have the latest transmission calibration installed prior to attempting to repair any of the concerns. The latest calibration addresses all of the issues in one calibration load. Use your scan tool to identify the vehicles current software level. Access the GM calibration web site (http://calid.gm.com) or (http://calid.gm.com/vci/) to find if your vehicle has an updated calibration available

4L60/65E

Updates

New 3/4 clutch plates

A running change is scheduled for the 3-4 clutches to improve clutch durability. The 6.0L C/K truck and the N truck (H2 Hummer) are scheduled to receive the updated design 7 plate packs for the 2004 model year. The updated clutch pack will fit into the current input housing. The updated design is scheduled to be implemented into other applications in 2005.

New parking pawl actuator

A running change was implemented on October 10^{th} 2003 for the 2004 model year. The update is a new design park pawl actuator rod. The updated design lessens the chance that the manual linkage (shifter) will get stuck in park.

New 5 pinion Corvette carrier

In 2004 all 5 pinion Corvette 4L65E carriers will receive two updates. The "bat wing" washers used on all Corvette reaction carriers will be coated with PTFE (Teflon) to increase the life of the carrier, when it is operated at high speeds. The updated carriers will no longer use the oil dam on the end of the reaction carrier. In addition, the carrier pins are no longer cross drilled.

New Reaction Sun Shell

An updated reaction sun shell went into production in December 2003 as a running change for the 2004 model year. The shell update is designed to address the spline strippage issue that has plagued the current design since the last update was made. The new shell is made of 1020 steel and then carbon treated for hardening. The updated shell can be identified by its dark color. The part number remains the same.

4L60/65E

Updates (continued)

New Pump

In an attempt to increase the pump output for high RPM operation, a major change was implemented for the 4L60E/65E pumps at SOP 2004. The high volume pump uses a redesigned pump body. The redesigned body contains an offset slide and a smaller rotor. The updated design parts can be identified by the dimples imprinted in the rotor and slide. The updated rotor will have two dimples, one at each converter drive lug location. The updated slide will have a dimple on the lug where the priming spring rides. The updated rotor and slide are not designed for use in the earlier design pump bodies as component interference may occur. Although, the complete updated pump body (with the rotor, slide and vanes) can be used for 1997 and later applications. The part number for the high volume pump body assembly (includes rotor, vanes and slide) is 24230110. The part numbers for the 5 different selective high volume rotor/vane kits are 24219538, 24219539, 24219540, 24219541 and 24219542. The pump cover part number remains the same for all 1997 and later pumps.

A major change has occurred to the pump, case and the pump outer seal as a running change in January 2004 for the 2004 model year. The pump outer seal groove has been moved in the pump cover on the interim design (It was moved 1.6mm). As the design is fully implemented, the seal groove in the pump cover will be eliminated. In addition, the chamfer in the front of the case has been changed. The revised lead in bore in the front of the case is required for the new seal design to operate correctly. The updated full circle compression style design will seal as the bellhousing is tightened. The installation process has also changed:

First the pump must be installed, followed by the seal and then the bellhousing. All parts must be torqued to specifications as the seal relies on the proper clamp load to function properly. There will be no back service for the updated seal, case or pump with the previous designs. The updated full circle seal part number is 24226315.

4L60/65E

Updates (continued)

New Pump (continued)

A running change implemented on December 15th 2003 for the 2004 model year updated the pump priming springs used on the 4L60E/65E applications. The two pump priming springs used on previous applications are being replaced by the single “conical” shaped priming spring. The spring is the same part number as the one used on the 5L40E application and can be used to back service pumps used on 1997 and later models.

New oil pan

A running change implemented on December 15th 2003 for the 2004 model year updated the oil pan used on the 4L60E/65E applications. The drain plug has been removed and an integral dipstick stop is molded into the pan design.. The updated pan will back service previous year applications.

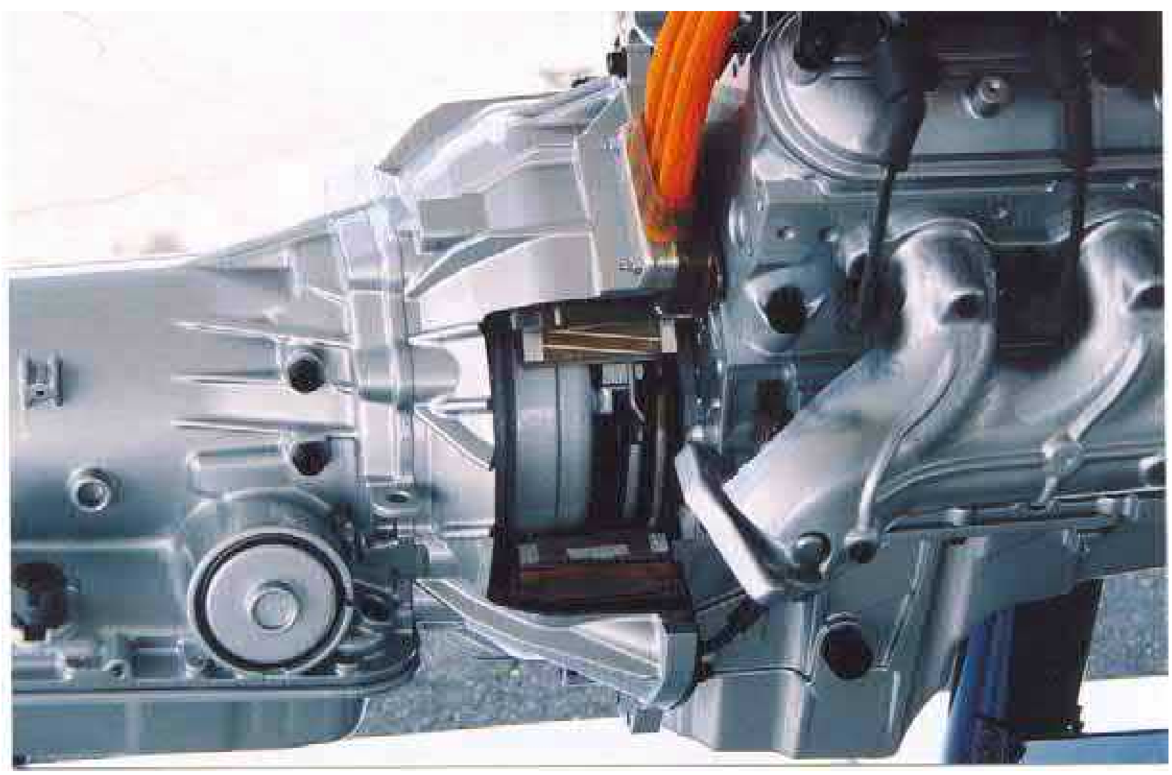
4L60/65E

Updates PHT

PHT (Parallel Hybrid Truck)

The PHT (Parallel Hybrid Truck) will be introduced in March of 2004. This vehicle operates on both gasoline and electric power. The new transmission will be a highly modified 4L60E PHT (RPO M33). Several changes have occurred with the M33 application, they include:

A new Bell housing - The updated bellhousing contains not only the torque converter but also the stator and rotor assembly. The Starter and the Alternator have been replaced by the stator and rotor assembly. The PHT design significantly improves fuel economy because the engine is shut off when the vehicle is stationary unless the A/C or Defrosters are on. As the customer steps on the accelerator pedal the vehicle will be driven by the electrical system until such time that the computer deems it necessary to restart the engine.



4L60/65E

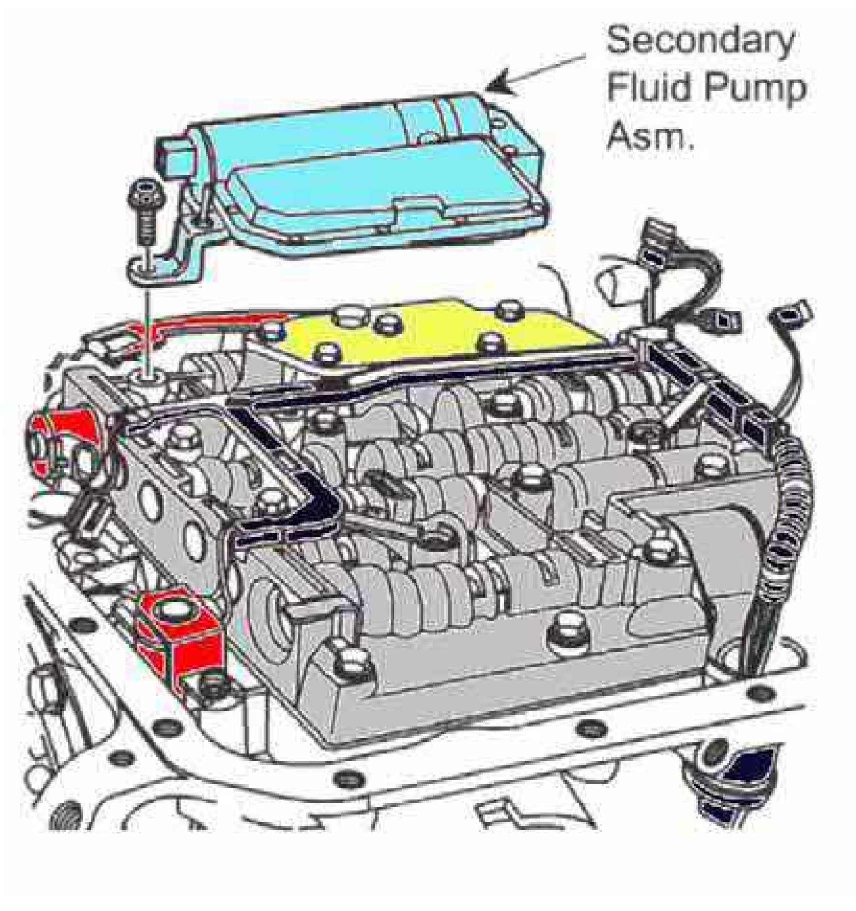
Updates PHT (continued)

Secondary Electric Fluid Pump

A secondary electric fluid pump is mounted to the valve body area and will keep the transmission operational even if the engine is not running. To diagnose the pump and its circuit two new DTCs have been developed: P2796 and P2797.

Updated wiring harness

An updated internal wiring harness includes a connector for the secondary fluid pump.



4L60/65E

UpdatesPHT (continued)

New TFP Switch

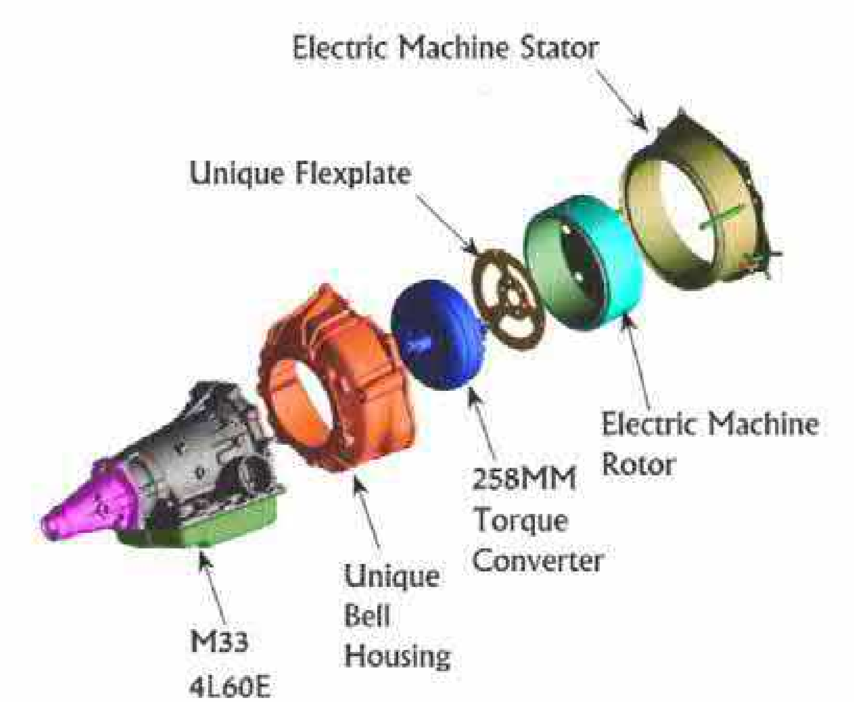
TFP switches operate at a different tension (For D2 switch) so the TFP switch assembly is a different part number. One of the new functions for the TFP is to determine if the secondary pump is running or not. The PHT TFP switch uses a different color connector (White) for identification compared to the standard TFP (Black)

New Checkball location

A check ball has been added to the valve body for secondary pump operation. The check ball will be called out as number 399 in the schematics.

New Input Shaft and Torque Converter

The input shaft and torque converter were updated to accommodate the PHT changes.



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H G M Auto Electronics AD

4L80E/85E/4L60E/65E/4T65E/4T40E

Miss, Surge, Chuggle, Possible DTC's

Condition: As you are well aware, an engine misfire is many times misconstrued by the customer as a transmission problem. In many cases you will see misfire DTC's stored which are specific to the cylinder in question on OBD II applications (IE; P0301=#1 cylinder, P0302=#2 cylinder) or a random misfire DTC such as P0300 may be set.

Starting with the 1984 model year many GM vehicle applications started to implement crank trigger ignition systems. Starting with the 1994 model year many of these systems made major software changes which led to additional service requirements such as crankshaft relearn procedures. In addition, GM software started to measure and display misfire counts so you could view misfire per cylinder on your scan tool. Starting with 1999 model year many GM engine applications started to implement a new design injector known as the "Multec II" or "peanut injector".

Cause/Correction: Two areas that are "commonly overlooked" when it comes to misfire concerns on today's vehicles are centered around the design of the Multec injector and crankshaft sensor relearning procedures.

To isolate a misfire on an OBD II application, monitor the "current and history" misfire accumulators with your scan tool. Typically you will see the misfire accumulators incrementing upward when the misfire is present. From that information you will generally be able to isolate it to a specific cylinder or cylinders. Two areas to check on crank triggered Multec design applications is the operation of the injector and the crank trigger circuit.

CRANK TRIGGER- Many times the problem with the misfire is not due to the sensor itself (exceptions are the 2001-04 8.1L truck engine and the Northstar 4.0L and 4.6L engines which commonly fail) but rather to the fact the sensor and its hardware need to be relearned. Relearning is <u>required</u> when any of the following occur:

PCM/ECM replaced/reprogrammed
Engine replaced
Sensor replaced
Front cover replaced (those that mount the sensor in the cover)
Crankshaft has been replaced

4L80E/85E/4L60E/65E/4T65E/ 4T40E

Miss, Surge, Chuggle, Possible DTC's

It is a good practice to relearn the sensor anytime you have an actual or false misfire condition. Many times the learned value seems to get "lost" and the misfire condition will simply go away after the relearn has been done.

Relearning a crankshaft sensor is really quite simple. First, your scan tool must be capable of conducting the relearn procedure. Secondly, simply follow the directions on your scan tool to relearn the sensor.

MULTEC- As with other injector designs the Multec injector can be come restricted and may require cleaning. To determine if the complaint is due to a restricted/dirty injector you can either run an injector balance test or simply clean the injectors. GM has always contended that the most effective cleaner on the market is "top engine cleaner" part # 12346535. Mix 10% top engine cleaner with gasoline and place it into your injector cleaning equipment. Disable the fuel pump and block the return line. Start the engine and allow it to operate on the cleaning solution. Once the injectors are clean you should recommend the customer run over the counter injector cleaner at regular intervals when he/she fills with gas. The most effective products seem to be those that contain "TecRon".

One other area to be aware of with the Multec design is the electrical connections at the injector. We have seen several cases where a condition know as fretting is starting to occur. Fretting is basically a tiny rubbing action (due to normal vehicle vibrations) that occurs between two electrical surfaces or pins. This action causes microscopic corrosion which leads to insulating oxidizing formations on the terminals. This has a drastic effect on the current flow through the injector leading to the misfire concern. You will not be able to see fretting with the naked eye. Fretting is a common cause of intermittent misfire complaints. Another source of concern with the Multec design is pin tension at the injector connector. Since the terminals are so small on this design connector the female pins tend to expand leading to a connection issue.

To address the injector issues check the terminal pin tension when ever a misfire concern is present. If the terminal is enlarged you will need to either resize it or replace the terminal. If fretting is suspected clean the terminals with "electric circuit board cleaner" (NAPA CRC 091843). Once the terminals are clean, coat the female terminals of <u>all</u> the injector connectors with dielectric compound (GM# 12377900 or NAPA 765-1190)

4L80E

Servo Updates

Reverse engagement upgrade

1997 and later 4L80Es received an upgrade to the reverse-2nd accumulator to improve the harsh reverse engagement concern. These parts may be interchanged in earlier units as long as the entire assembly is used.

Part numbers:

1:	**Bolt (M8X1.25X20)**		**8676000**
2:	**Rear Servo Cover**		**24202280**
3:	**Gasket**		**8675728**
4:	**Clip**		**18015044**
5:	**Rear Servo Piston**		**24202985**
6:	**Piston Seal**		**8623430**
7:	**Accumulator Assist Spring**		**24202987**
8:	**Outer Seal**		
9:	**Rear Accumulator Piston-(includes seals)**		**24205250**
10:	**Inner Seal**		
11:	**Spacer**		**24202986**
12:	**Rear Servo Spring**		**8623666**
13:	**Spring Retainer**		**862366414**
14:	**Rear Band Apply Pin**	**(3.303")**	**24202577**
		(3.331")	**24202580**
		(3.359")	**24202578**
		(3.387")	**24202581**
		(3.415")	**24202579**
		(3.443")	**24202582**
		(3.471")	**24202583**
15:	**Accumulator Spring**		**8655843**

4L80E

Servo Updates *(continued)*

New design supercedes all previous 4L80E servos

The new servo assembly has a beveled cover and requires assembly when purchased.

Beveled Cover and Piston

4L80E/80HD

No Upshift (continued)

6.5L Diesel No upshift at TP values greater than 50%

Some 1992 and later 6.5L diesel applications with a mechanical diesel injection pump (Engine VIN F) may exhibit some upshift related concerns. Typically, the vehicle will not upshift to 2nd gear when TP values are above 60% or to 3rd gear when TP values exceed 50%.

In addition, other concerns may be regarding the amount of power and RPM the engine can produce. In most instances, if the customer is questioned correctly prior to you working on the vehicle, the service advisor will discover recent repairs have been performed.

The basics need to be performed prior to replacing parts for this condition, these include:

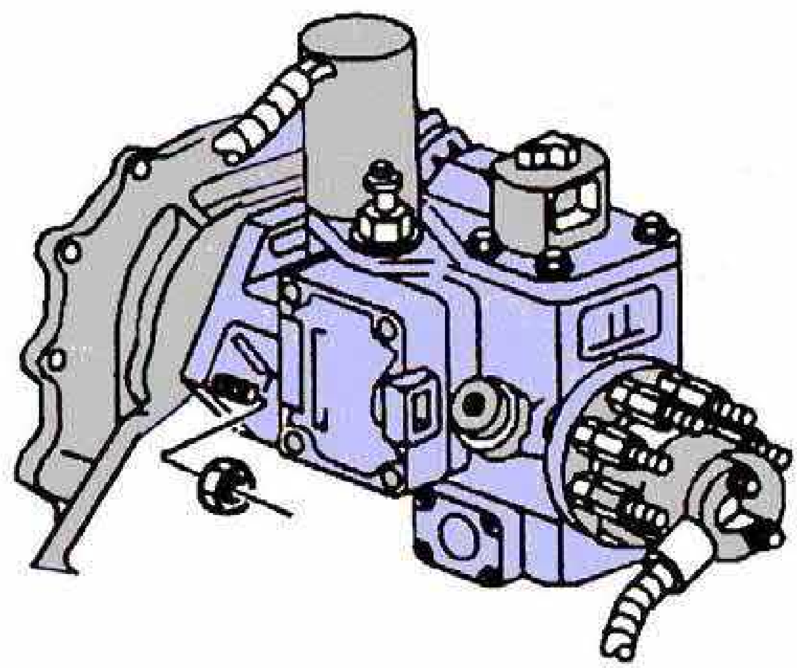
1. **Lift pump pressure (Spec 5-9 Psi)**
2. **Lift Pump Volume (Spec ½ pint in 15 seconds)**
3. **Check the fuel filter for water or restrictions**
4. **Check the air intake for restrictions**
5. **Check the Exhaust for restrictions**
6. **Compression (Spec 380 Psi minimum, and even between cylinders)**
7. **TP sensor operation and adjustment is correct**
8. **Turbo Operating correctly (2 PSI boost minimum during snap acceleration)**

4L80E/80HD

No Upshift (continued)

6.5L Diesel: No upshift at TP values greater than 50%

If all of the previous checks are okay or if the injector pump has been recently replaced, the most likely cause of the concern is that the wrong part number injector pump was installed, or the pump advance is too low. If the wrong pump was installed, its governor setting may limit the maximum engine rpm to something less than the vehicle was designed for. If this condition occurs the customer will increase the throttle opening in an attempt to increase acceleration. This action causes the upshifts to be delayed.
If the pump is determined to be the cause it will need to be replaced or repaired.



4L80E

Slip Codes

1999 and later 4L80E applications may exhibit excessive TCC slip and in many instances may have a slip related DTC set.

As with other applications several areas can cause the excessive slip condition. One of the most common causes on late model applications is cracks forming on the TCC apply plate. If the typical causes for the condition fail to address the root cause of the condition, replace the torque converter.

"Photo courtesy of Precision Torque Converters of New Hampton"

4L80E

Slips, Flares When Shifting Into 3rd Gear, Damaged Direct Clutches

Slips, flares, delayed shift into 3rd gear, or burned direct clutches. In many cases this condition is temperature related. The problem typically improves if line pressure is elevated. In most instances you will be able to see the extended shift time on the scan tool by noting the “shift time error” parameter. If you look at the shift adapt values you will typically see evidence that the PCM is trying to correct for the condition.

Several common areas should be looked at for this concern, they include:

1. Pinched rings on the center support. If this condition is present the ring will stick in the groove preventing it from sealing properly

2. Improper loading of the center support assembly during overhaul (not preloading the support correctly) or reusing the center support bolt

3. Direct clutch seals damaged

4. Distorted/undersized 3rd accumulator piston seals. (Usually the condition will be worse cold and improve as the transmission warms up)

4L80E

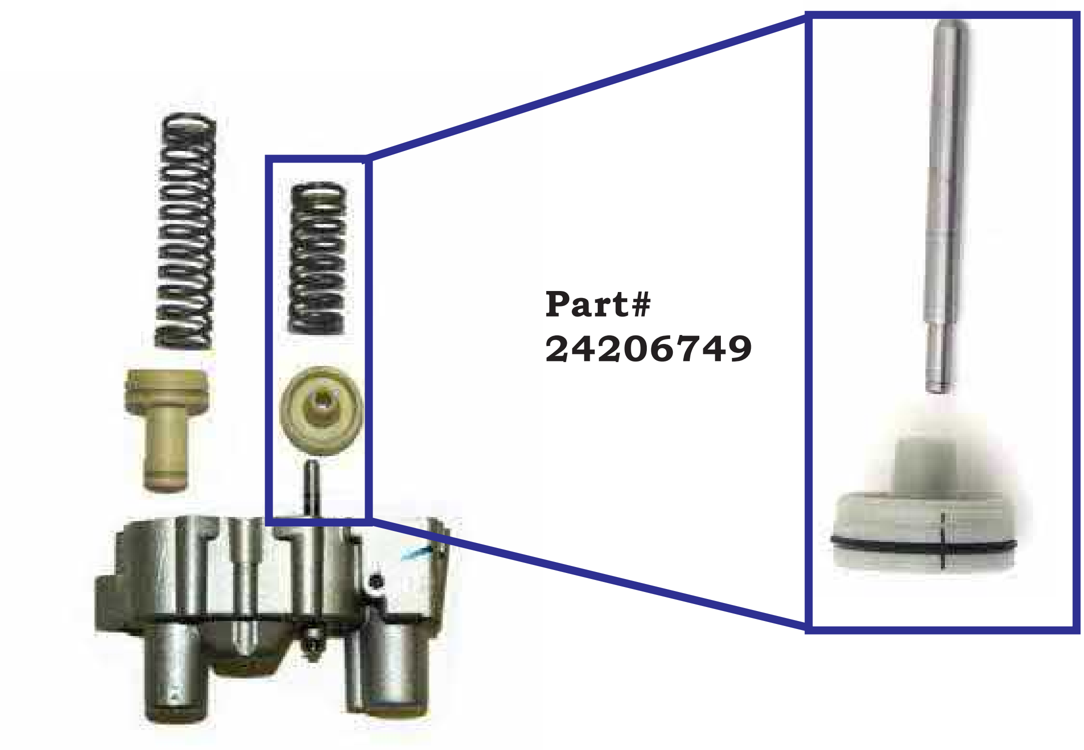
Slips, Flares When Shifting Into 3rd Gear, Damaged Direct Clutches (continued)

Updated seal/piston/pin design is available for the 3rd and 4th accumulators under the following part numbers:

1. Accumulator piston kit - This kit includes the seals for both pistons, piston seals and 4th accumulator pin and is sold under GM part number 24206749

2. The 3rd and 4th large seals are available separately under GM part number 08661647

3. The small seal for the 3rd accumulator (most common cause) is available under GM part number 08661639



4L80E/85E

Updates 2004

An updated PCS. As with the 4L60E/65E application all 2004 4L80E/85E transmissions will use the Borg Warner design PCS. This update was done for durability reasons. The updated PCS is not recommended for earlier applications as valve spring changes were also implemented to allow solenoid to be used. It should be noted that the connector for the solenoid will not plug into the previous design harness.

An updated magnet was introduced. The Borg Warner PCS is very sensitive to fine metal (Ferrous) debris. As a safe guard the updated pan magnet was installed. It is actually the older style round design magnet seen in GM applications for many years.

Part # 24224905

4L80E/85E

Updates 2004

An updated internal transmission harness. The harness was redesigned to accommodate the updated PCS. In addition as a running change the material the wire insulation is made of will change from a fluropolymer to a cross link polyester. The material change is designed to improve the durability of the harness as it is a more heat resistant material.

An oil pan update is planned for applications built after December 2003. The updated pan will eliminate the drain plug on most applications and it will include a dipstick stop. The updated pan can be used to back service previous model years.

4th clutch backing plate was updated.

The Forward clutch drum bushing material and machining process are scheduled as a running change for the 2004 model year. The updated bushing will be coated with PTFE to prevent galling. In addition, the machining process, finish and clearances for the bushing will also change. This update is planned because of durability concerns with the bushing.

5L40E

No Reverse

A No Reverse condition can be caused by the TCC solenoid not functioning correctly. Reverse oil flows through the TCC Solenoid. An internal fault can cause the solenoid to exhaust the reverse oil.
The vehicles affected are: 2003 Cadillac CTS built prior to May 2003 built prior to Transmission serial number 849522 (February 10, 2003)

1. Raise and support the vehicle.
2. Remove the transmission fluid drain plug.

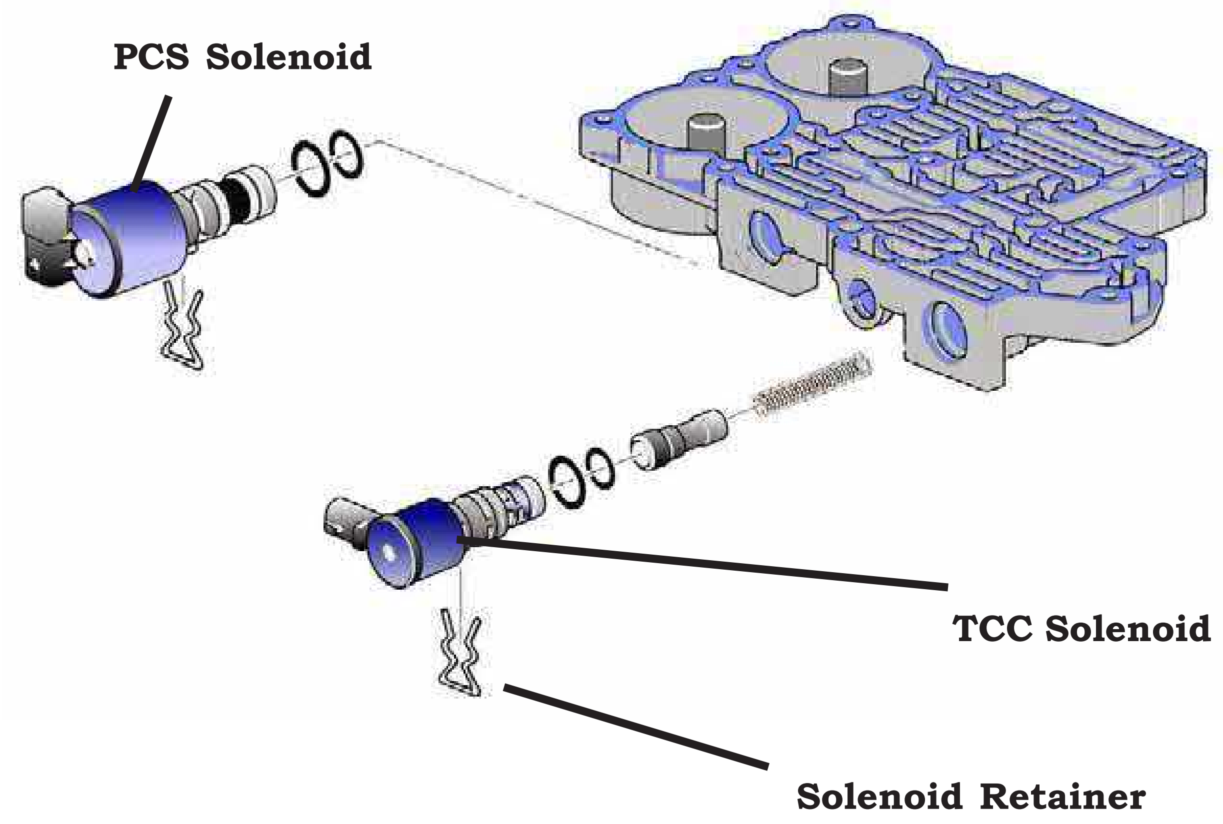
NOTE: If the transmission is already burnt, remove and repair transmission.

NOTE: If the transmission fluid is "normal" color and no burnt odor, continue with the next step of replacing the TCC solenoid.

5L40E

No Reverse *(continued)*

Remove and inspect the TCC solenoid from the transmission. The plastic connector may be labeled “2690”. The “2690” TCC PWM solenoid is the suspect solenoid and should NOT BE REUSED. The new TCC PWM solenoid, P/N 96042599, is labeled “7792” and should be the ONLY solenoid used.



Part Number
96042599 TCC PWM Solenoid

LCT 1000

PRNDL Flashes, Default Actions Present

CONDITION: As was covered in previous seminar manuals, an updated PRNDL switch is available for the LCT 1000. The updated switch is more resistant to moisture intrusion making it more reliable. A faulty PRNDL switch can set several DTC's. Many of the DTC's have default actions that can range in severity from turning on the MIL to preventing the vehicle from moving. One of the concerns with the 2001-02 design software is that it may leave the customer stranded when a PRNDL DTC is set even though the system could operate without a PRNDL switch.

CAUSE/CORRECTION: After the updated PRNDL switch has been installed you and your customer may want to consider updating the vehicle software. An updated calibration is now available that will prevent the default actions the TCM normally assigns for a PRNDL switch DTC from being implemented for up to 50 warm up cycles. In other words, when the updated software is installed, the switch would need to fail 50 times before most of the default actions would occur. One exception to this is the MIL which will still be illuminated when a PRNDL DTC is set. The updated software will allow the customer ample time to get the vehicle in for service.
Refer to (http://calid.gm.com) or (http://calid.gm.com/vci/) for calibration information on this issue.

LCT 1000

Known Wiring Concerns

CONDITION: Several areas have come to light that may cause multiple/various DTC's to set, default actions to occur, neutral only conditions, a flashing PRNDL display as well as several other symptoms.

CAUSE/CORRECTION: If you get an Allison LCT 1000 with any type of "strange" operation or you find electrical related DTC's inspect the following areas:

1. **Power Steering Return Line Clamp- Chaffs the TCM harness on the clamp in the reservoir area.**
2. **Body Pinch Weld- Chaffs the harness coming from the transmission in the bellhousing, body area.**
3. **Transmission Pass Thru Connector- Chaffs the harness on the exhaust hanger bracket. In addition this connector is very difficult to plug into the transmission so in many cases it is not fully seated. Make sure the plug in is fully seated.**
4. **TCM Cover- Chaffs the harness at the TCM connector area. Many times the wiring will be wedged under the cover.**
5. **Valve Body- Chaffs the harness on the valve body**
6. **TCM connectors not fully seated**
7. **Ground G103 (Gas) G105 and G105 (Diesel) and G110 may be loose or corroded.**
8. If a problem with the wiring is found, repair the concern and reposition the wiring if needed.

NOTE:
It should also be noted when you are looking for wiring problems or when you are checking voltage/resistance values on the wiring, circuit 1020 connector C1 terminal 2 and 4 made a change at the start of production for the 2003 model year. 2001/02 models had a wire in the terminal number 2 position. 2003/04 applications "DO NOT" have a wire in the number 2 cavity although it may be shown in the service manual wiring schematic.

LCT 1000

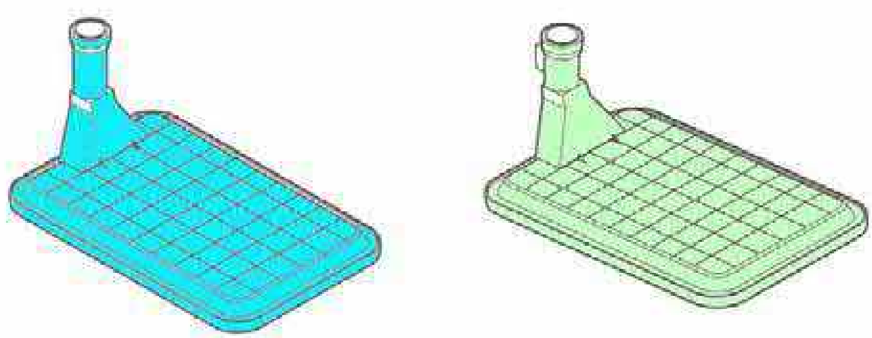
Pump Noise

Many Allison LCT 1000 owners comment regarding the amount of pump noise that is present with their Allison applications. It should be noted that some pump noise is considered “NORMAL” by Allison. Please make certain you and your customer have watched the “Video Tape” provided to the customer by GM. In addition, make sure you compare the complaint vehicle with other like vehicles prior to attempting to repair this condition. If the complaint vehicle is deemed “ABNORMAL” proceed with the repair.

Cause/Correction: Several items can lead to excessive pump noise, they include: Restricted filters - The LCT 1000 uses two filters, one is a spin-on design while the other is similar to other GM applications. Both filters have undergone updates. The spin-on filter seal material was changed to improve its elasticity in cold temperatures.

The suction filter was also updated by:

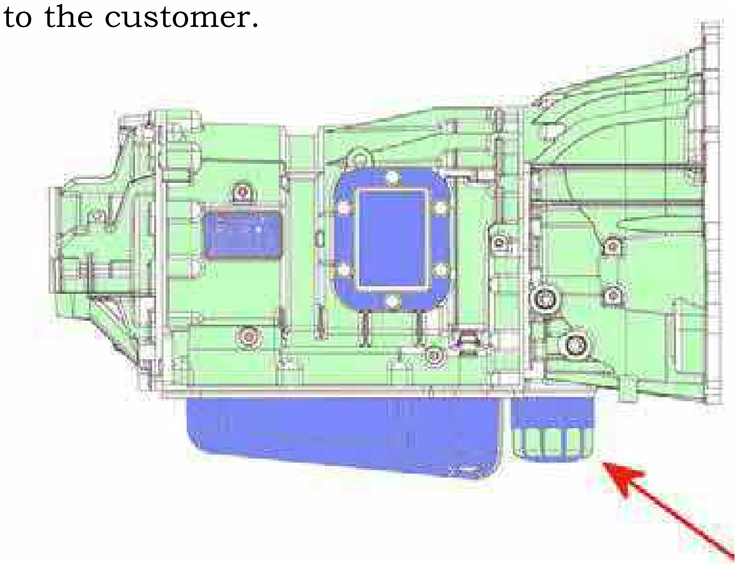
1. Making the body wider to increase the flow area.
2. The filter material was changed to improve the filtration rate while reducing the amount of contamination that the control main filter would need to control
3. A cold temperature bypass was added with a “screen over bypass” incorporated to prevent large debris from entering the pump during bypass operation



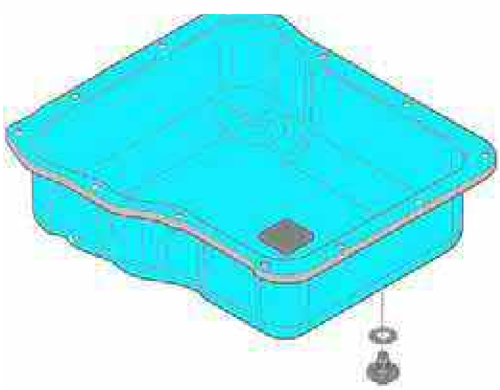
LCT 1000

Pump Noise (continued)

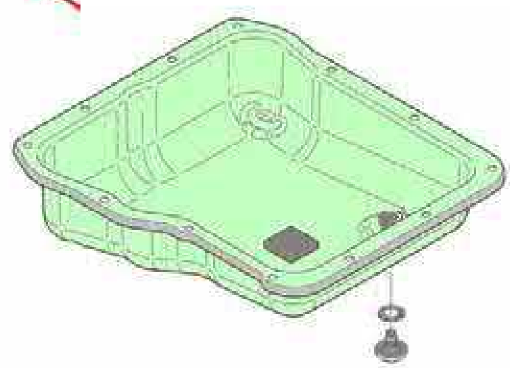
The updated filters went into production on 2002 models with build dates greater than 6310122178 (Indianapolis) and 6320028313 (Baltimore) The updated GM and Allison part numbers are 29537965 (Shallow pan) 29537966 (Deep pan) NOTE: It is common for DTC P0701(Transmission Control System Performance) to set during a fluid/filter service. If the DTC sets, clear the codes before returning it to the customer.



The updated GM and Allison part number is 29539579



29537966 (Deep pan)



29537965 (Shallow pan)

LCT 1000

Pump Noise *(continued)*

The pump may have excessive wear. Several pumps have been found to have opposite corner wear leading to very excessive pump noise (See Illustration) Visually inspect the pump, measure the pump for wear as outlined in the service manual. If the pump is worn replace the pump or the damaged parts. Several updates have been made to the pump, housing gasket and pump wear plate.

These updates were done to improve pump prime time, reduce low speed pump noise and improve idle cooling. The new parts were implemented from build dates 6310144856 (Indianapolis) 6320047965 (Baltimore) transmissions.

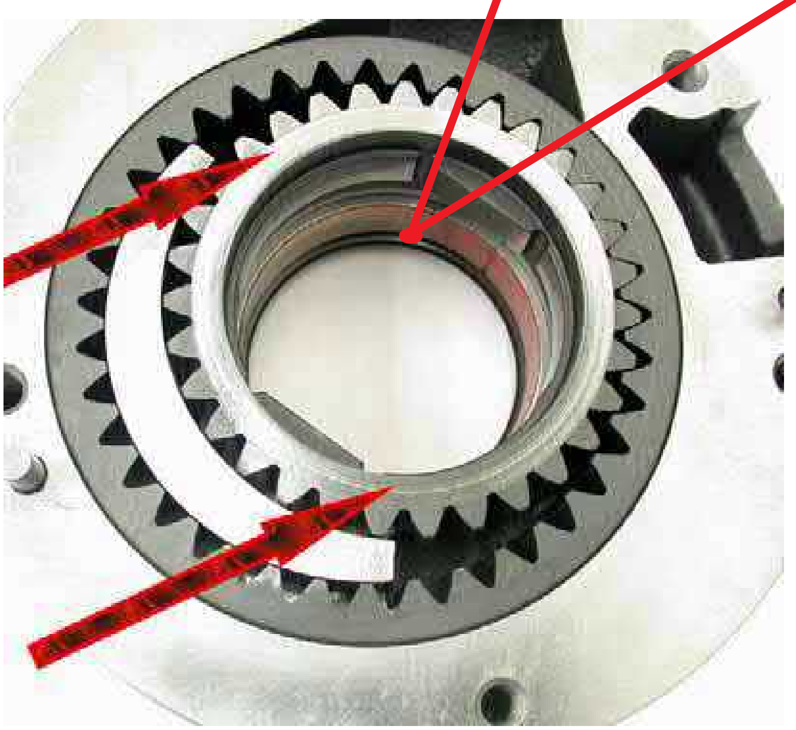
The updated pump is available under GM and Allison part number 29539580. The updated pump eliminated the two finger slots, cast into the body of the pump. In addition, the position of the crescent was also offset. It can be identified by the updated casting number 29539852 stamped into the body of the pump. The updated pump wear plate. Allison part number 29539616 added a metering groove in the pumping chamber area. The updated housing gasket (GM and Allison part number 29540130) eliminated two pressure slots in the pump area and strengthened the gasket by adding material to the gasket, in the pump area. The updated parts will back service the previous applications if used as a complete package.

NOTE: Always double check the part numbers before ordering. Numerous updates have occurred with many of the part numbers. GM is adding Allison part numbers as a common practice, so check the Allison part number with your local GM suppliers. You may find the part now available from your local GM source.

LCT 1000

Pump Noise (continued)

The converter bushing and the torque converter hub dimensions should be checked.



GM and Allison part number 29539580

LCT 1000

Delayed/Lack of Engagement Forward and Reverse

2001-03(RPO M74)

Several different scenarios may be described by the customer including:
MIL on delayed engagement forward/reverse after the vehicle has been left sitting for as little as 10 minutes (severe cases) to as much as several days before the condition will occur. The delayed engagement may last anywhere from a few seconds to several minutes. The customer may also comment that the transmission appears to be slipping after a cold start.

No engagement, forward or reverse, 0 psi line pressure, pump will not prime unless the engine speed is raised to at least 1400 RPM. As the engine speed is raised the line pressure will normalize and the engagement problem will no longer be present. This type of condition can occur after the vehicle has been left sitting for as little as 10 minutes with the engine off. Once the line pressure normalizes, the condition will not occur again unless the engine is shut off again.

Any combination of the following PSM DTCs:
P0701-Transmission Control System Performance
P0708-Transmssion Range Sensor Circuit High
P0840-Pressure Control Switch Solenoid C Circuit
P0841-Pressure Control Switch Solenoid C Circuit Stuck Open
P0843-Pressure Control Switch Solenoid C Circuit High
P0845-Pressure Control Switch Solenoid D Circuit
P0846-Pressure Control Switch Solenoid D Circuit Stuck Open
P0848-Pressure Control Switch Solenoid D Circuit High
P0870-Pressure Control Switch Solenoid E Circuit
P0871-Pressure Control Switch Solenoid E Circuit Stuck Open
P0875-Pressure Control Switch Solenoid E Circuit High
P1709-Pressure Control Switch Solenoid E Circuit
P1710-Pressure Control Switch Solenoid E Circuit Stuck Open
P1713-Pressure Control Switch Solenoid E Circuit High

When reviewing the freeze frame information, you will generally note that the DTCs were set within <u>30 seconds</u> of engine run time.

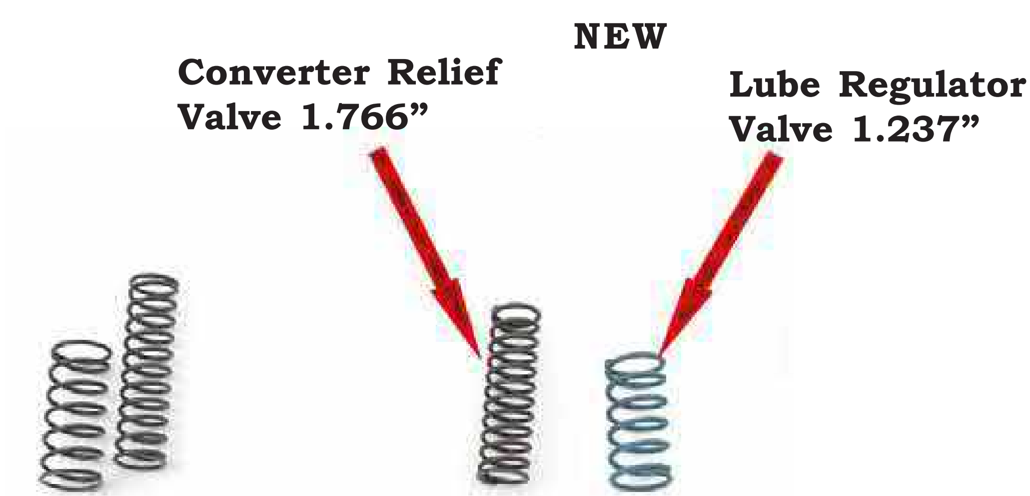
LCT 1000

Delayed/Lack of Engagement Forward and Reverse *(continued)*

2001-03(RPO M74)

The torque converter may be draining back. This allows air into the cooler circuit which then migrates to the suction side of the pump, leading to cavitation and loss of prime. The most common cause is the lube regulator valve or the torque converter relief valve is sticking. Both valves are located in the front support assembly. Make sure the valves are clean and free, then install the updated springs for both valves. The updated springs are designed to eliminate valve sticking as an issue. The updated lube regulator valve spring tension was increased to attain 40 Psi of lube pressure. This allows air to be purged through the lube circuit rather than though the pump suction circuit. The updated springs were implemented into production after transmission build date break points S/N 6310234829 (Indianapolis) S/N 6320154492 (Baltimore).
The springs are available under separate part numbers from GM and Allison. The part numbers are as follows:
Converter Relief Spring- #29541296
Lube Regulator Spring- #29540523
GM Kit- #88996718 major gasket and parts kit

NOTE: It should be noted that the lube regulator valve is available in two different designs. They are interchangeable. The change reduced the leading edge diameter of the valve land to lessen bore damage and sticking concerns



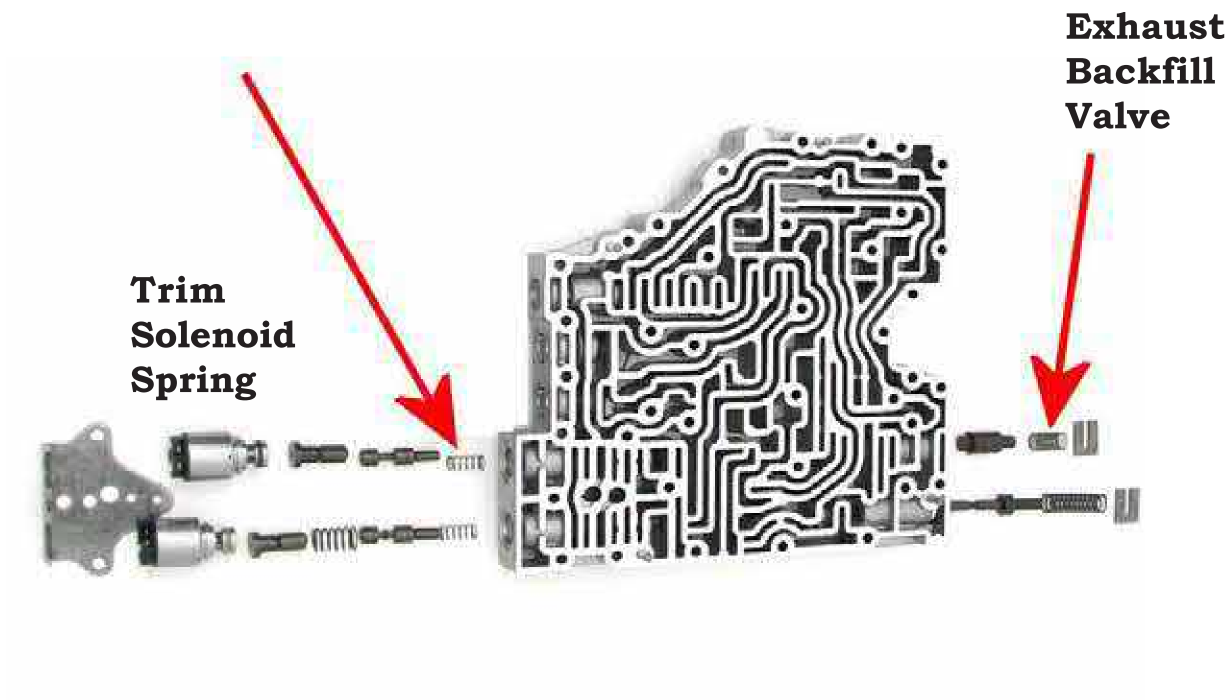
LCT 1000

Clutch Failure After repair

During repairs on the LCT 1000 it is common for technicians to clean and inspect the various valves and springs. One area that has been a concern with this unit is intermixing springs as they sometimes appear to be the same. Even though the springs may appear to be the same in size and shape they may not be. If the "exhaust backfill" spring is intermixed with the "Trim solenoid" gain spring clutch failure will occur as the back fill pressure will be high enough to keep the clutch partially applied.

CAUSE/CORRECTION: In an attempt to limit the chances of this type of failure from occurring in your shop always keep the springs separated and in the correct positions on your work bench as perform repairs on the hydraulic system. To help identify the exhaust back fill springs they have now been color coded. The color codes are as follows:

1. **NO COLOR- Introduced 6/99**
2. **Orange stripe- Introduced 7/00**
3. **Light green stripe- Introduced 7/01**
4. **Solid Green- Introduced 9/01**



LCT 1000

P0731 SET

Some Allison LCT 1000 applications may set an intermittent or hard DTC P0731. In addition the default actions for the DTC may be present even if the problem is not currently present. PO731 will set if:

1. Engine running
2. Output speed exceeds 200 RPM
3. Turbine speed is present
4. DTC's P0708, P0875, P0876, P0721, P0722, P0716, P0717 are not present
5. 1st gear is commanded by the TCM
6. The calculated gear ratio is higher/lower than 3.10
7. The above concern is present for longer than 20 seconds

If a P0731 is set the TCM will:

1. Default to 2nd or 5th gear
2. When the shifter is moved to reverse the transmission may lock into neutral and the PRNDL may flash
3. MIL ON
4. Shift adapts frozen
5. TCC inhibited

Cause/Correction: Several different areas may cause this DTC to set, they include:

1. Incorrect TCM software calibration
2. Hydraulic or mechanical problems with the C1 or C5 Clutch (Do a clutch test) (C1 clutch has had apply issues on 01-03 models)
3. Solenoid failure (Trim A)
4. Trim Valve sticking
5. Poor connection at the Transmission pass through connector (Common)
6. Erratic VSS or Turbine sensor values (a common cause is terminal 15, connector C2, circuit 821 not seated properly at the TCM connector)

LCT 1000

P0731 SET

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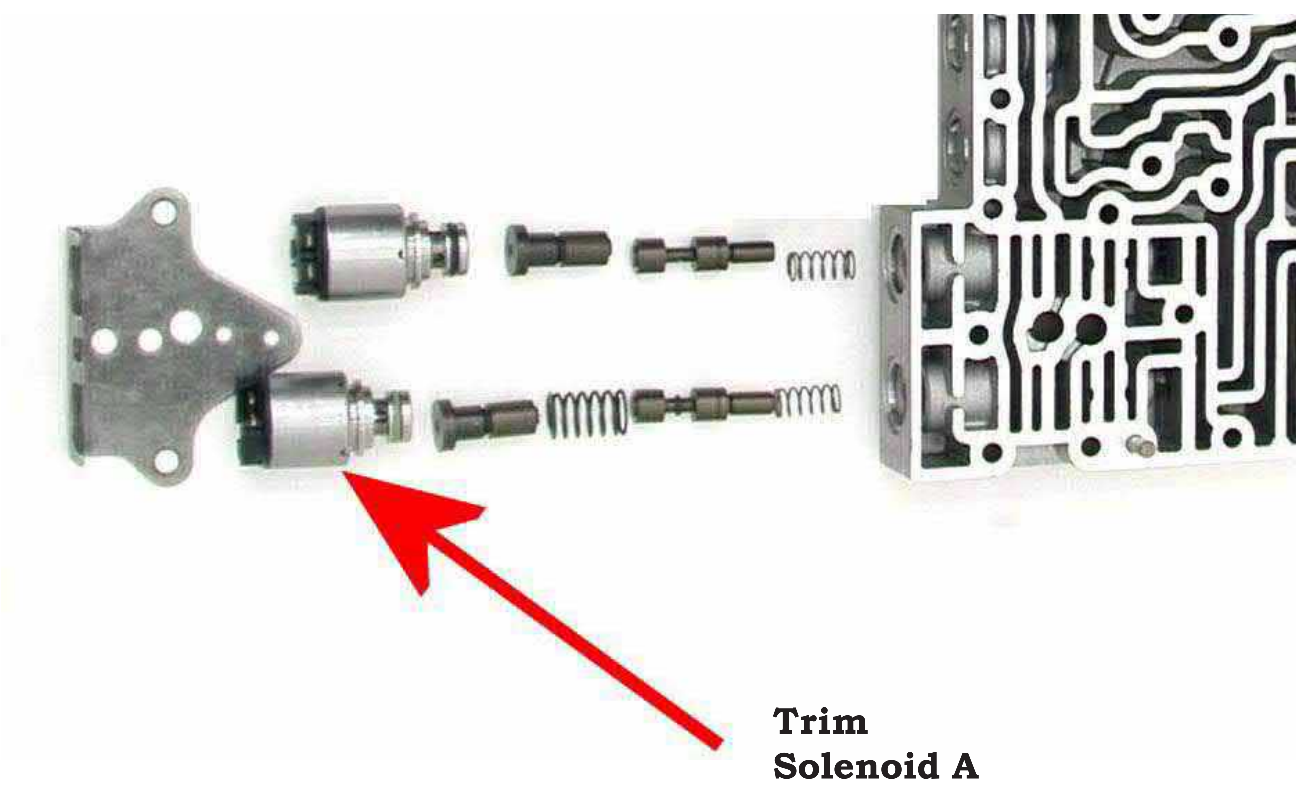


LCT 1000

Shift Concerns, Possible DTC's Set

Some 2001-2002 Allison LCT 1000 transmissions may exhibit any/all of the following concerns:

- Excessively hard shifts when cold (Firm shifts are normal)
- Delayed 2-1 downshifts when coming to a stop
- Shift busyness
- Flare/bump during low speed coast down conditions when the throttle is reapplied

In addition the technician may find one or more of the following DTC's set:

- P0708
- P0847
- P0872
- P0875
- P1711
- P1713

Cause/Correction: A recalibration is available to address the above concerns. Visit the GM calibration web site to see if it is available for you particular application. (http://calid.gm.com) or (http://calid.gm.com/vci/)

LCT 1000

Lack Of Scan Tool Communication

Applications equipped with the LCT 1000 transmission may experience any or all of the following conditions:

1. **Your scan tool is unable to communicate with the TCM**
2. **TCCM DTCs may be set**
3. **ABS failure, erraitc operation**
4. **The Transmission may not operate properly (failsafe)**

The condition may be caused by a bad ground. Check the G110 Ground wire which is located on the driver's side front body mount frame bracket. Clean the frame contact area, the ground wire, and install a star washer before tightening the ground.

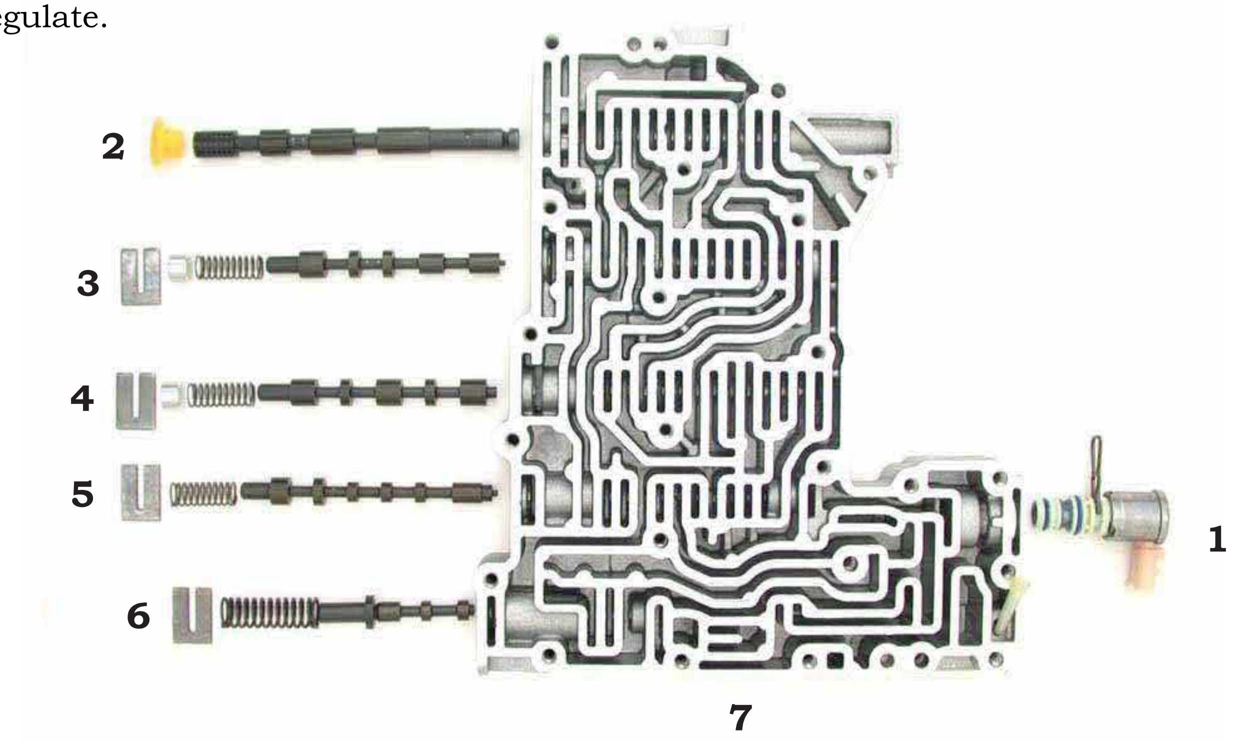
If the condition is still present, check and clean the G102 ground wire (6.6 L-Duramax) which is located on the lower RH passenger side corner of the engine block. On 8.1 L gas applications check/clean the G103 ground wire which is located on the passenger side cylinder head at the back corner.

LCT 1000

Valve Body Identification

Shift Valve Body Assembly

The LCT 1000 valve body does not have as much wear as you may expect due to the nature of the unit. The valves are only used to switch the fluid and not used to regulate.

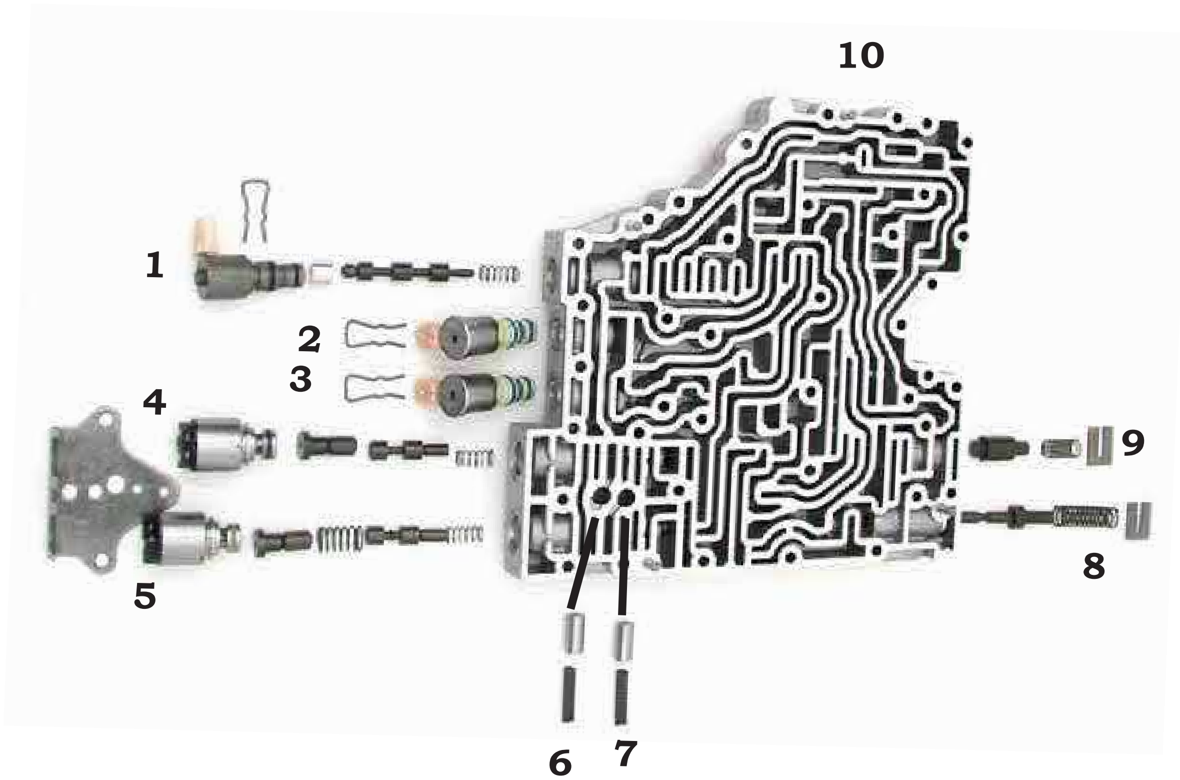


ID	Description
1	SSC ON/OFF
2	Manual Valve
3	D Shift Valve and Spring
4	E Shift Valve and Spring
5	C Shift Valve and Spring
6	Control Main Valve
7	Shift Valve Body

LCT 1000

Valve Body Identification (continued)

Main Valve Body Assembly

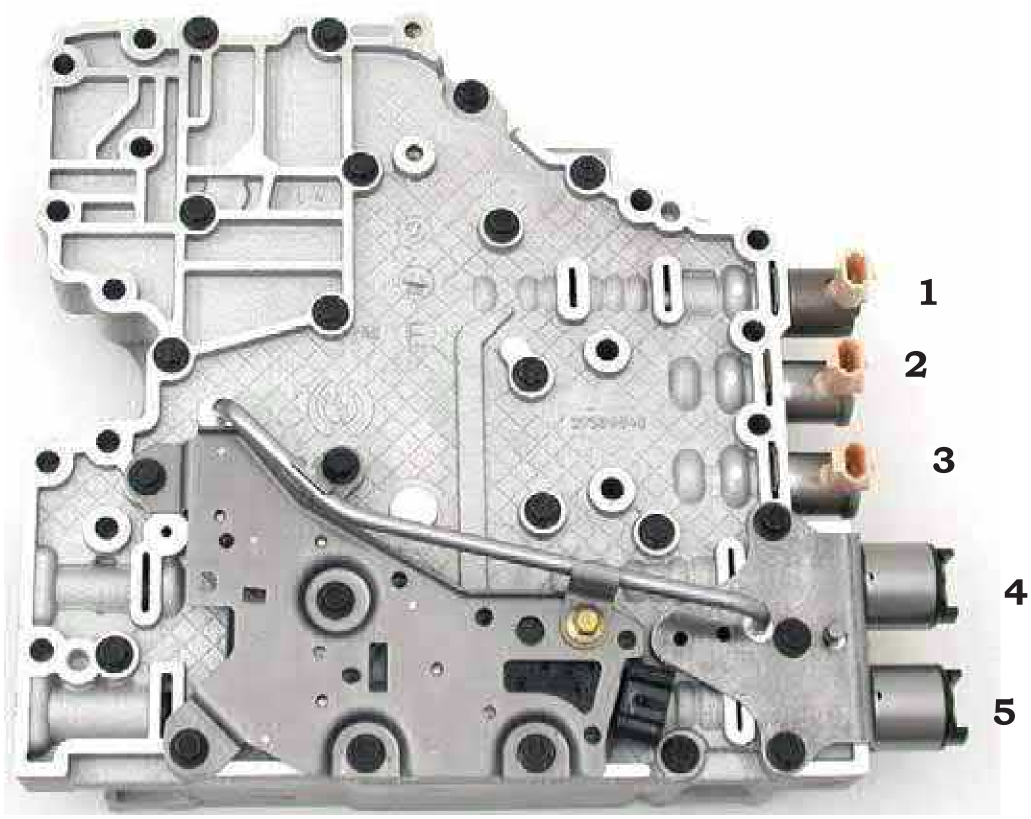


ID	Decription
1	F Trim Solenoid PWM
2	D Solenoid ON/OFF
3	E Solenoid ON/OFF
4	B Trim Solenoid PWM
5	A Trim Solenoid PWM
6	Accumulator Plug and Spring for Trim Solenoid B
7	Accumulator Plug and Spring for Trim Solenoid A
8	Control Relief Valve
9	Exhaust Backfill Valve
10	Main Valve Body

LCT 1000

Valve Body Identification (continued)

Main Valve Body Assembly

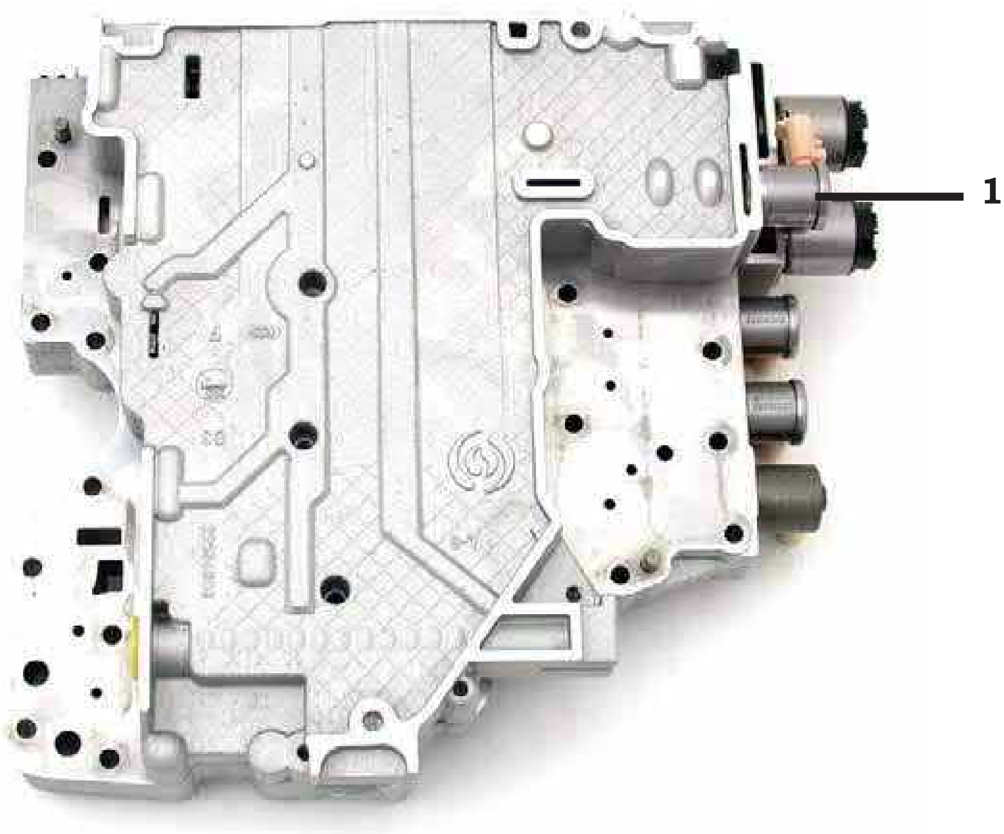


ID	Description	Resistance
1	F Trim Solenoid PWM	11.0 ohms
2	D Shift Solenoid ON/OFF	22.0 ohms
3	E Shift Solenoid ON/OFF	22.0 ohms
4	B Trim Solenoid PWM	5.9 ohms
5	A Trim Solenoid PWM	5.9 ohms

LCT 1000

Valve Body Identification (continued)

Shift Valve Body Assembly



ID	Description	Resistance
1	C Shift Solenoid ON/OFF	22.0 ohms

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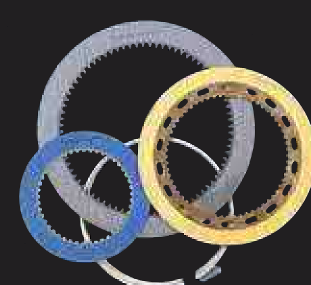

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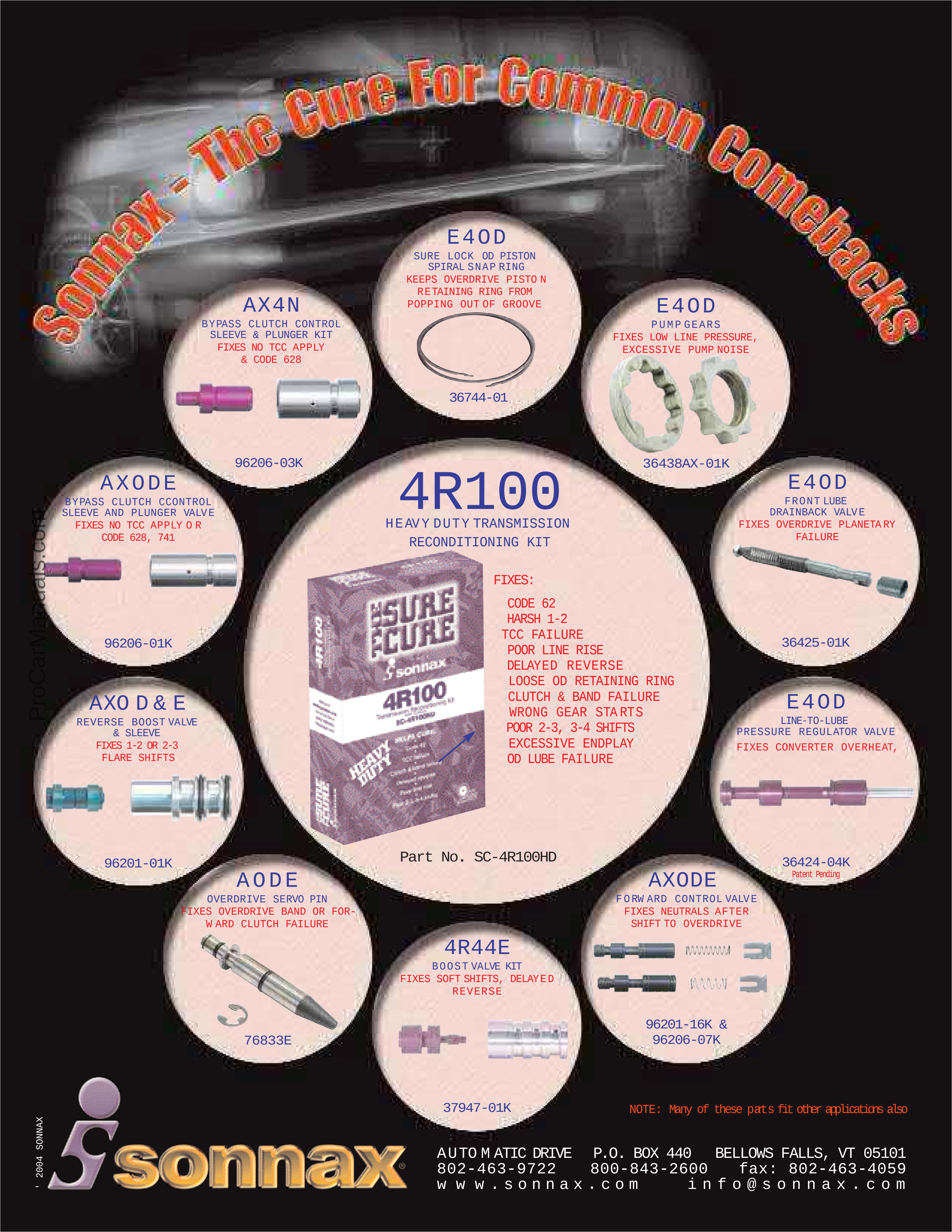
Sonnax - The Cure For Common Comebacks
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KEEPS OVERDRIVE PISTON RETAINING RING FROM POPPING OUT OF GROOVE
36744-01
AX4N
BYPASS CLUTCH CONTROL SLEEVE & PLUNGER KIT
FIXES NO TCC APPLY & CODE 628
96206-03K
E40D
PUMP GEARS
FIXES LOW LINE PRESSURE, EXCESSIVE PUMP NOISE
36438AX-01K
AXODE
BYPASS CLUTCH CCONTROL SLEEVE AND PLUNGER VALVE
FIXES NO TCC APPLY OR CODE 628, 741
96206-01K
4R100
HEAVY DUTY TRANSMISSION RECONDITIONING KIT
FIXES:
CODE 62
HARSH 1-2
TCC FAILURE
POOR LINE RISE
DELAYED REVERSE
LOOSE OD RETAINING RING
CLUTCH & BAND FAILURE
WRONG GEAR STARTS
POOR 2-3, 3-4 SHIFTS
EXCESSIVE ENDPLAY
OD LUBE FAILURE
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E40D
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36425-01K
AXOD & E
REVERSE BOOST VALVE & SLEEVE
FIXES 1-2 OR 2-3 FLARE SHIFTS
96201-01K
E40D
LINE-TO-LUBE PRESSURE REGULATOR VALVE
FIXES CONVERTER OVERHEAT,
36424-04K
Patent Pending
AODE
OVERDRIVE SERVO PIN
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A & P Transmission Parts

All

Flexplate Failures

Diagnosing Flexplate Failures

Flexplate cracking on various, engine applications are common. The cracking on these flexplates can be seen either around the crankshaft or torque convert bolt hole patterns. In severe situations, the outer portion is completely separated from the mounting areas.

The following causes for cracked flexplate failures:

1) Out of balance engine or torque converter.

2) Bad starter drive can cause teeth or ring gear to wear rapidly or break off. Teeth can also break when engine is running and starter is engaged.

3) Failure to torque the flexplate bolts to proper specifications and in proper sequence.

4) Some applications may require starter shims to be used. If these shims are not used when the starter is installed, improper alignment could occur and damage to the flywheel will result.

5) Poor quality parts.

6) Missing Dowel pins.

GM & Ford Transmissions

Electronic Pressure Controlled

1) Connect a 0-400 psi gauge to the main line test port.
2) Set the parking brake firmly.
3) Start the vehicle and place the selector in the overdrive position and record the pressure reading at idle.
4) Place your left foot firmly on the brake pedal and with your right foot press accelerator pedal fully and record the pressure.
5) Follow steps 3 & 4 in reverse position.

Compare your results to the chart below if your readings are not within specs. You will need to correct the problem before the vehicle is put into service.

Caution – Do not exceed more than 3 seconds on stall test!

Ford

Trans	In OD at Idle	In OD at Stall	In R at Idle	In R at Stall
AXODE/AX4N	45-85	175-220	50-80	260-320
AODE/4R70W	50-80	160-210	80-120	260-320
E4OD/4R100	50-70	160-190	80-110	240-310
4R55E	65-100	190-250	110-165	235-350
CD4E	45-70	160-185	65-80	250-300

General Motors

Trans	In OD at Idle	In OD at Stall	In R at Idle	In R at Stall
4L30E	45-55	145-170	55-70	185-215
4L60E	50-65	160-190	55-70	290-340
4L80E	50-70	150-190	55-75	260-300
4T65E	55-75	190-220	70-85	240-300
4T80E	50-70	230-250	80-95	270-310

These are approximate specifications.

Ford

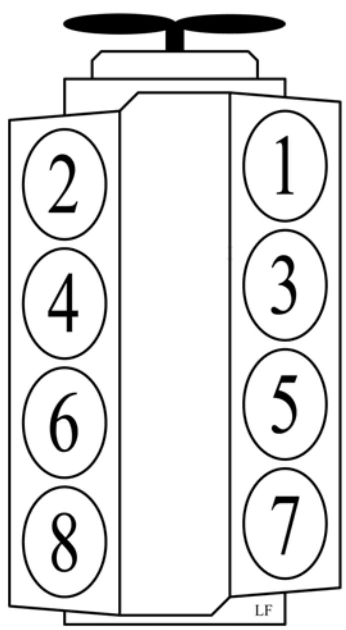
Cylinder Contribution Test

7.3L Diesel Cylinder Contribution Self Test

The Cylinder Contribution Self Test is a functional test of the PCM performed Ondemand with the engine running, A/C off and engine oil temperature above 70°F.

This test will determine if all cylinders are contributing equally to engine performance. The PCM will test all 8 cylinders continuously during the test: The test checks for cylinder-to-cylinder changes in engine rpm, and sets a code if the rpm change is not within a pre-calibrated range.

This test checks for weak injectors or low compression cylinders. A fault must be present at the time of testing for the KOER Cylinder Contribution Self Test to detect a fault, so the engine operating condition at which the idle is the worst will produce the best test results. For automatic transmission vehicles, the best results are reached with the parking brake set and the transmission in DRIVE. If a fault is detected, a Diagnostic Trouble Code (DTC) will be output on the data link at the end of the test when requested by a scan tool. Only a hard fault code (DTC) will be displayed.



Ford

Injector Test

7.3L Diesel Injector Electrical Self Test

Injector Electrical Self Test is a functional test of the PCM performed on demand with the key on and the engine off.

This test determines if the injector circuits and solenoids are electrically operating without fault. All injectors will first buzz (audible feedback of the injector solenoids energizing the injector valves) together for approximately 2 seconds, then each injector will buzz for approximately 1 second in numerical order (1 through 8).

The IDM (Injector Driver Module) stores all historical IDM fault codes; to ensure that the DTC is a hard fault, you must first clear continuous DTCs (be sure to record all IDM fault codes before clearing). After clearing, re-run self test; a fault must be present at the time of testing for the KOEO Injector Electrical Self Test to detect the fault. If a fault is detected, a Diagnostic Trouble Code (DTC) will be the output on the data link at the end of the test when requested by a scan tool. Only a hard fault code (DTC) will be displayed.

Ford

Parameter Identifications and Description

Parameter Identification (PID) List		
Acronym	**Description**	**Measurement Units**
4x4L	4x4 Low Switch	ON/OFF
ACCS	Air Conditioning Clutch Status	ON/OFF
AP	Accel Pedal Position Sensor	Volts
ARPMDES	Ancillary Engine Speed Desired	RPM
BARO	Barometric Pressure Sensor	PSI
BARO V	Barometric Pressure Sensor Actual	Volts
BPP_BOO	Brake ON/OFF Switch	ON/OFF
BPA/SW	Brake Pressure Applied	ON/OFF
CCS	Coast Clutch Solenoid	ON/OFF
CCSF	Coast Clutch Solenoid Fault	ON/OFF
CCP/PNP	Clutch Pedal Position/Park Neutral Position Switch	ON/OFF
CPP/TCS	Clutch Pedal Position/TCS	ON/OFF
CRUISE	Cruise Control Mode (Driving)	ON/STNDBY/TAPUP/TAPDN
DTC CNT	Diagnostic Trouble Code Count	DTC No.
EBP	Exhaust Back Pressure	PSI (Absolute)
EBP V	Exhaust Back Pressure Actual	Volts
EOT	Engine Oil Temperature	Degrees C (F)
EOT_V	Engine Oil Temperature Voltage	Volts
EPC*	Electronic Pressure Control	PSI
EPC V	Electronic Pressure Control Actual	Volts
EPR	Exhaust Pressure Regulator	Percent
FLI	Fuel Level Input	Percent
FLI V	Fuel Level Input Actual (Voltage)	Volts
FP	Fuel Pump Control	Duty Cycle (100% = On)
FUEL PW	Fuel Pulse Width	Milliseconds
GEAR	Transmission Gear 4R100 Only (Driving)	Trans. Gear

Ford

Parameter Identifications and Description

(continued)

GPC	Glow Plug Control Duty Cycle	Percent
GPC TM	Glow Plug Control Time	Seconds
GPL TM	Glow Plug Lamp Time	Seconds
GPML	Glow Plug Monitoring Left Bank	Amp
GPMR	Glow Plug Monitoring Right Bank	Amp
IAT*	Intake Air Temperature	Degrees
IAT V	Intake Air Temperature Actual	Volts
ICP	Injector Control Pressure Sensor	PSI
ICP V	Injection Control Pressure Actual	Volts
IPR	Injector Control Pressure Regulator	Percent
IVS	Idle Validation Switch	ON/OFF
MAP	Manifold Absolute Pressure Sensor	PSI (Absolute)
MAP_Hz	Manifold Absolute Pressure Frequency	Hertz
MAP_V	Manifold Absolute Pressure Actual	Volts
MAT	Manifold Air Temperature	Degrees
MAT V	Manifold Air Temperature Actual (Voltage)	Volts
MFDES	Mass Fuel Desired	Milligrams
MGP	Manifold Gauge Pressure	PSI
MIL	Malfunction Indicator Light	ON/OFF
OSS	Transmission Output Shaft Speed	RPM
PBA	Parking Brake Applied	ON/OFF
PERDEL 1	Percent Delta Cylinder #1 (Misfire Data)	Percent
PERDEL 2	Percent Delta Cylinder #2 (Misfire Data)	Percent
PERDEL 3	Percent Delta Cylinder #3 (Misfire Data)	Percent
PERDEL 4	Percent Delta Cylinder #4 (Misfire Data)	Percent
PERDEL 5	Percent Delta Cylinder #5 (Misfire Data)	Percent
PERDEL 6	Percent Delta Cylinder #6 (Misfire Data)	Percent
PERDEL 7	Percent Delta Cylinder #7 (Misfire Data)	Percent
PERDEL 8	Percent Delta Cylinder #8 (Misfire Data)	Percent
RPM	Engine Speed	RPM
SCCS	Speed Control Command Switch	Volts
SCCS M	Speed Control Command Switch Mode	Mode

Ford

Parameter Identifications and Description

(continued)

SS1	Shift Solenoid No. 1 — 4R100 Only	ON/OFF
SS2	Shift Solenoid No. 2 — 4R100 Only	ON/OFF
SS1F	Shift Solenoid #1 Output Fault	ON/OFF
SS2F	Shift Solenoid #2 Output Fault	ON/OFF
SS3	Shift Solenoid #3 Commanded ON	ON/OFF
SS3F	Shift Solenoid #3 Output Fault	ON/OFF
TCC	Torque Converter Clutch	ON/OFF/Percent
TCCA	Torque Converter Clutch Primary Circuit Monitor	ON/OFF
TCCF	Torque Converter Clutch Output Fault Detected	ON/OFF
TCCMACT	Torque Converter Modulator Actual	ON/OFF
TCCMCMD	Torque Converter Modulator Commanded	ON/OFF
TCIL	Transmission Control Indicator Lamp	ON/OFF
TCILF	Transmission Control Indicator Lamp Out Fault	ON/OFF
TFT	Transmission Fluid Temperature	Degrees
TFT V*	Transmission Fluid Temperature Sensor Actual	Volts
TRANRAT	Transmission Ratio	Ratio
TORQUE	Engine Torque	Lb/Ft
TPREL	Low Idle Throttle Position	V
TR	Transmission Range Sensor Position	PARK, REV, NTRL, OD, DRIVE,
TR D	Transmission Range Sensor Digital Signal	O's/1's
TR V	Transmission Ranger Sensor Actual	Volts
TSS/ISS	Transmission Turbine Input Speed Sensor	RPM
VFDES	Volume Fuel Desired	Cubic Millimeters
VPWR	Vehicle Power Supply	Volts
VREF	Vehicle Reference Voltage	Volts
VS SET	Vehicle Speed Setting	MPH
VSS	Vehicle Speed Sensor	MPH
WGC	Wastegate Control	Duty Cycle

Ford 4X4

(ESOF) Electronic Shift On the Fly *(continued)*

Stuck in 4X4, Erratic 4X4 Operation

Vehicles bewtween the years of 1995-1999 exhibiting inadvertent 4X4 Hi or Low shift events, 4X4 and/or Low Range indicator flashing or solid or vehicle stuck in 4L after uncommanded shift may be caused by the 4X4 shift motor.

Install a YL1Z-7G360-AA shift motor on vehicles built before 12/99. The YL1Z-7G360-AA shift motor with a grey contact plate cover replaces the prior design F75Z-7G360-AA motor with a blue contact plate cover. Grey-cover shift motors contain improved sense plate material and shift motor terminal upgrades. For vehicles already equipped with the latest style shift motor, refer to the following service procedure for details.

Uncommanded Shift to 4L

Parking Maneuvers/Gear Lever Transitions: Symptoms noted during a lower speed uncommanded shift to 4L event include:

1. Front end binding or hopping while turning
2. Bind feel in drivetrain when backing up and/or turning
3. Audible clunking or grinding noises, and/or
4. Amber low range light illuminated

If the Generic Electronic Module (GEM) receives a false mode switch input during or shortly after the Digital Transmission Range Sensor (DTR) indicates a Neutral range, an uncommanded shift is possible if remaining 4L pre-conditions are met. The pre-conditions (besides transmission in neutral range) include: service brake depressed, and vehicle speed less than 3 mph. A false switch input may also set a P1812 (4-wheel drive mode select circuit failure) or P1815 (4-wheel drive mode select short circuit to ground) DTC in the GEM.

Check mode switch circuits 682 (dark blue) for short to power and 780 (dark blue wire) for ground short, loose connections at inline connectors, and chafes.

Monitor the mode switch “Parameter Identification Display” (PID) 4WD_SW for false readings while slightly pushing in and wiggling the mode switch knob.

Ford 4X4

(ESOF) Electronic Shift On the Fly *(continued)*

Uncommanded Shift to 4X4 High (continued)

Replace the mode switch if it fails testing, or repair wiring on circuits 682 or 780 if fault indicated. If the tests pass, inspect the build date stamped on the GEM and replace the GEM if the GEM is built prior to 9/98.
Test drive the vehicle for proper 4X4 operation in all modes. Include parking lot maneuvers and transmission gear range lever transitions. Check for DTCs in the GEM. Clear any codes present and cycle ignition.

Road Speed: Reported symptoms for a higher speed uncommanded shift to 4L event include:

1. Rapid deceleration
2. High engine reving possibly accompanied by a P1270 DTC in the PCM
3. Clunk/grind noise
4. Speedometer may spike higher than actual speed.
5. After the initial event, the vehicle may exhibit restricted vehicle top speed without 4X4 indicators illuminated but possible MIL (Malfunction Indictor Lamp) on.

Monitor contact plate A,B,C,D PIDS. (sequentially read starting with plate A then B, then C, finally D). With Mode Switch in;
1. A4WD, plate PIDS should read "OCOO"
2. 4H PIDS should read "COOC"
3. 4L PIDS should read "COCO"

If contact plate PIDS DO NOT correspond to the set 4WD position, check for continuity/shorts/moisture/corrosion in the vehicle side of the transfer case shift motor connector (toward the GEM). Visually inspect all terminals, pins, crimps, and connectors closely. Repair any wiring conditions in the contact plate circuits as necessary.

Road test at speeds above 10 mph with mode switch in both A4WD and 4H to see if the condition returns. Clear DTCs from GEM (even if no DTCs exist) and cycle the ignition. Clear DTCs from the PCM if a P1270 (engine RPM or vehicle speed limiter reached) code was initially present.

Ford 4X4

(ESOF) Electronic Shift On the Fly *(continued)*

Uncommanded Shift to 4X4 High (continued)

1. Autolock Strategy (Expedition/Navigator Vehicles Only):

Uncommanded 4H shifts with red 4X4 light on "solid" while driving in Automatic Mode may be a vehicle characteristic if driven off-road or under slippery conditions.
The GEM Autolock strategy commands the transfer case clutch to minimum duty cycle and engages 4H (with mode switch still set to A4WD) to prevent continuous cycling from prematurely wearing the clutch. This is design intent. Excessive tire circumference variations or axles with unmatched gear ratios can result in unexpected Autolock function as well. For more detail check the speed sensor section below.
Once the condition that caused the Autolock strategy to activate is no longer present, the system stays in 4H until the operator cycles the ignition key or sets the mode switch to 4H then back to A4WD.

2.Transfer Case Speed Sensors (Expedition/Navigator Vehicles Only):

If an uncommanded shift to 4H occurs on hi-traction surfaces, check the TRA_FSP (T-case front speed sensor) and TRA_RSP (T-case rear speed sensor) PIDS for excessive speed sensor variation between the front and rear transfer case speed sensors.
If the PIDS show sensor inputs are not within 1-2 mph of each other during steady-state driving with possible DTCs P1836 (T-Case front speed sensor) /P1837 (T-Case rear speed sensor), first verify tire pressures, sizes, circumference within 1/4" among all four tires, and front and rear axle gear ratios for matching.

If the ratios match and tire sizes are okay, check associated circuits and replace the speed sensor(s) or repair the wiring as necessary.
After any repairs, road test while comparing scanner GEM PIDS TRA_FSP and TRA_RSP to PCM VSS signal. Verify all three PIDS match each other within 1-2 mph.

Ford 4X4

(ESOF) Electronic Shift On the Fly (continued)

Uncommanded Shift to 4X4 High (continued)

A false mode switch input on circuits 682 and/or 780 (dark blue wire) could be interpreted by the GEM as operator requesting a 4H shift. Under this condition, the GEM will command shift motor movements to match the false switch input. The red 4X4 indicator light will illuminate just as if the operator moved the switch. If the condition became intermittent, the 4X4 range and also the indicators could switch back and forth between A4WD/2H and 4H.

Check the mode switch circuits between the GEM and dash for chafing, shorts, crimps, and continuity. Repair the wiring if faults found. If the wiring is okay, replace the mode switch itself. After any repair, pull DTCs from the GEM,even if there are no DTCs available. Always go thru the ritual of clearing codes.

Stuck in 4X4 Low at all Times

Customers describing an uncommanded shift to 4L shortly after start-up and then unable to shift the transfer case. Associated symptoms could include valid GEM DTCs being erased and false DTCs such as C1107 (4WABS module failure) present. If the transfer case is stuck in 4X4, re-establishing normal shift motor operation is possible by putting the mode switch in 4L with the trans gear lever in neutral, service brake depressed, and vehicle stationary.
A new GEM program has been updated to address this concern, if the GEM needs to be replaced, the new program is already installed in the new GEM.

Ford 4X4

(ESOF) Electronic Shift On the Fly (continued)

Old Number
F75Z-7G360-AA

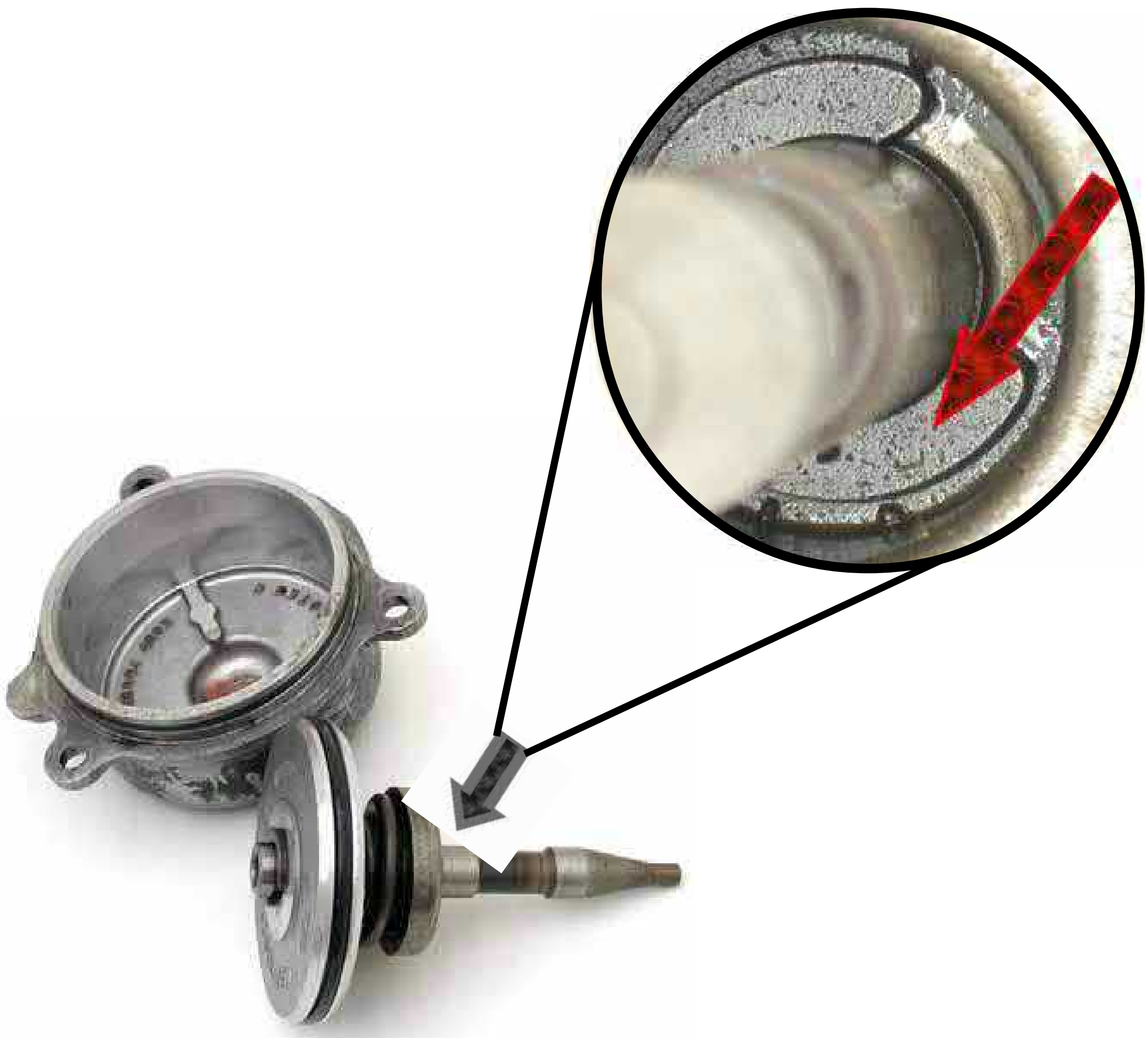
New Part Number
w/ gray connector
YL1Z-7G360-AA

Transgo AD

AX4S

No Movement

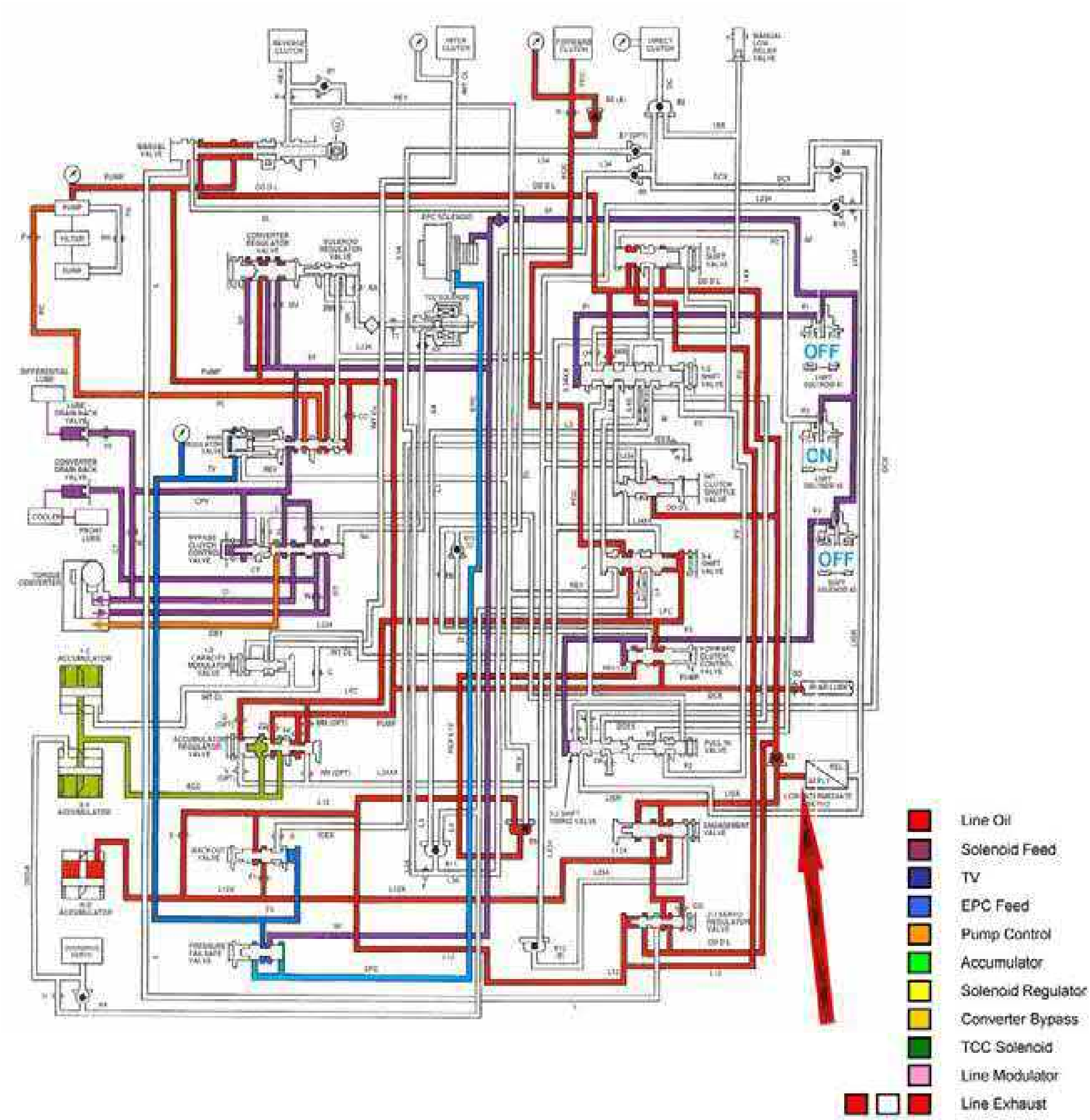
A no movement condition can be caused by the front clip breaking in the Low/ Intermediate servo assembly.



AX4S

No Movement *(continued)*

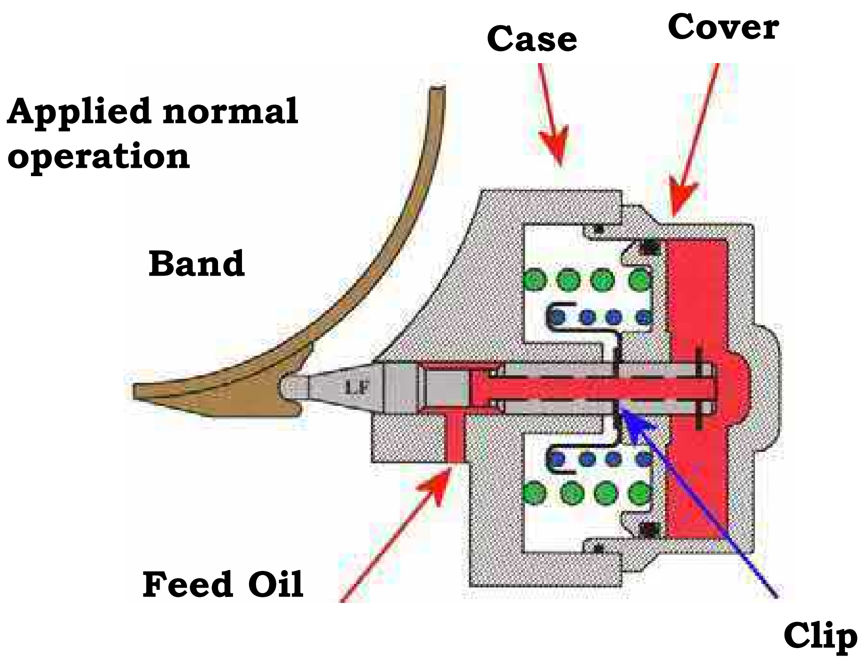
The Low-Intermediate servo is applied in 1st and 2nd drive gear, and is released in 3rd. The hydraulic diagram shows a typical AX4S 1st gear application.

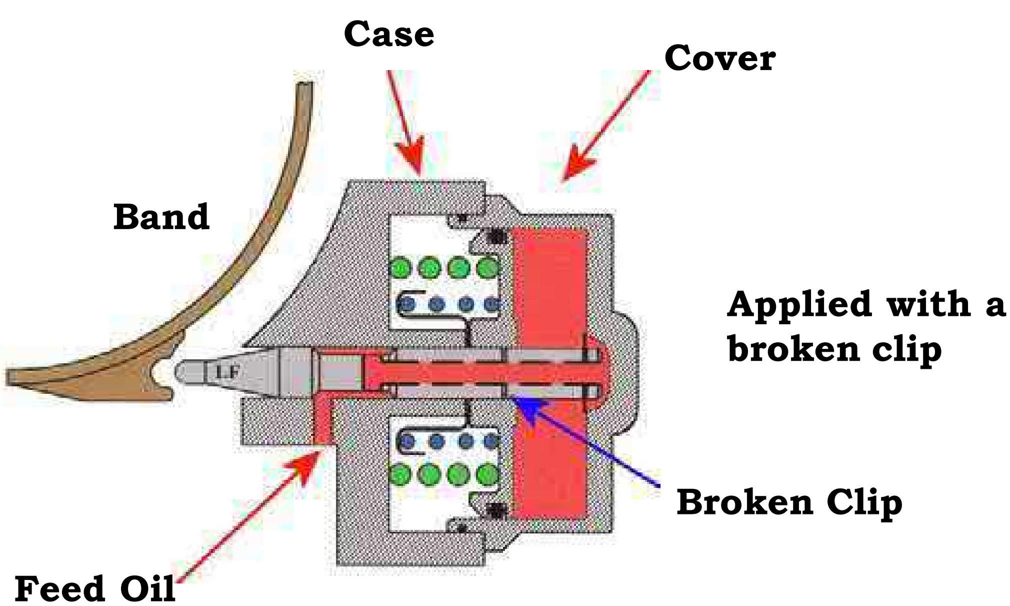


AX4S

No Movement *(continued)*

Oil enters the servo through the case and is directed to the top of the servo piston. If the clip is broken the piston will bottom out and the servo apply rod will be stationary and not apply the band.

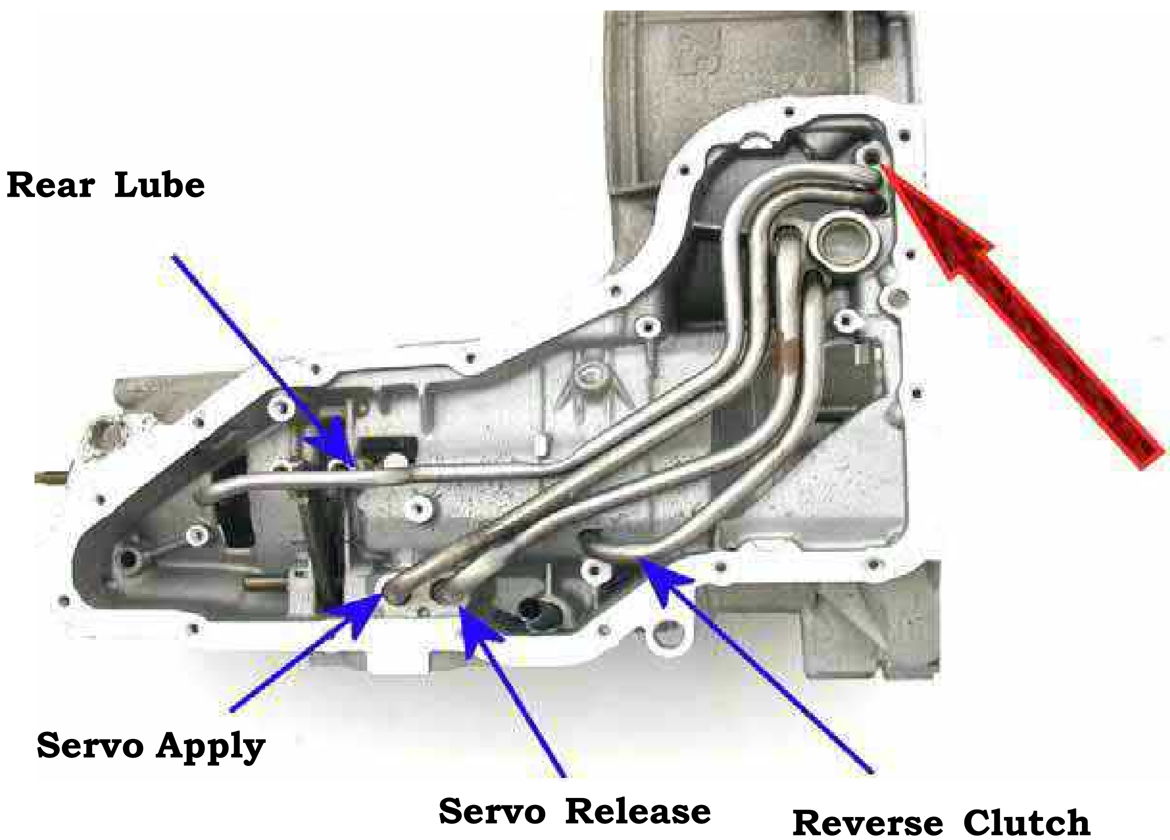




AX4S

No Rear Lube Tube

All 1999 and newer AX4S transmissions have only four tubes in the bottom of the transmission. A new tube now incorporates the differential speedometer lube transfer tube that was deleted from production.



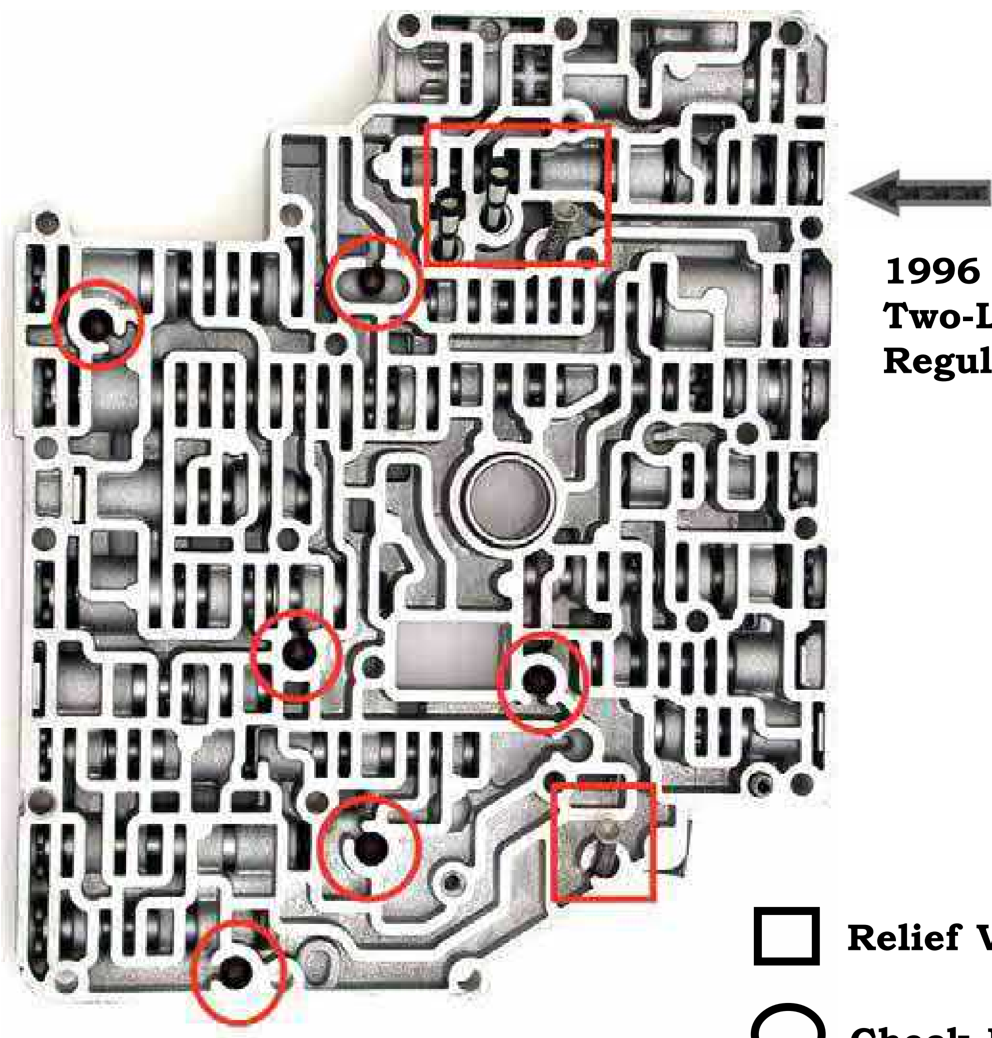
Transtar

AX4S

Valve Body Interchange

1996-1998 Valve Body Assembly

From 1996-1998 all AX4S valve bodies are interchangeable. These valve bodies have six Checkballs and two relief valves.



1996 and later Two-Land Converter Regulator Valve

Relief Valves

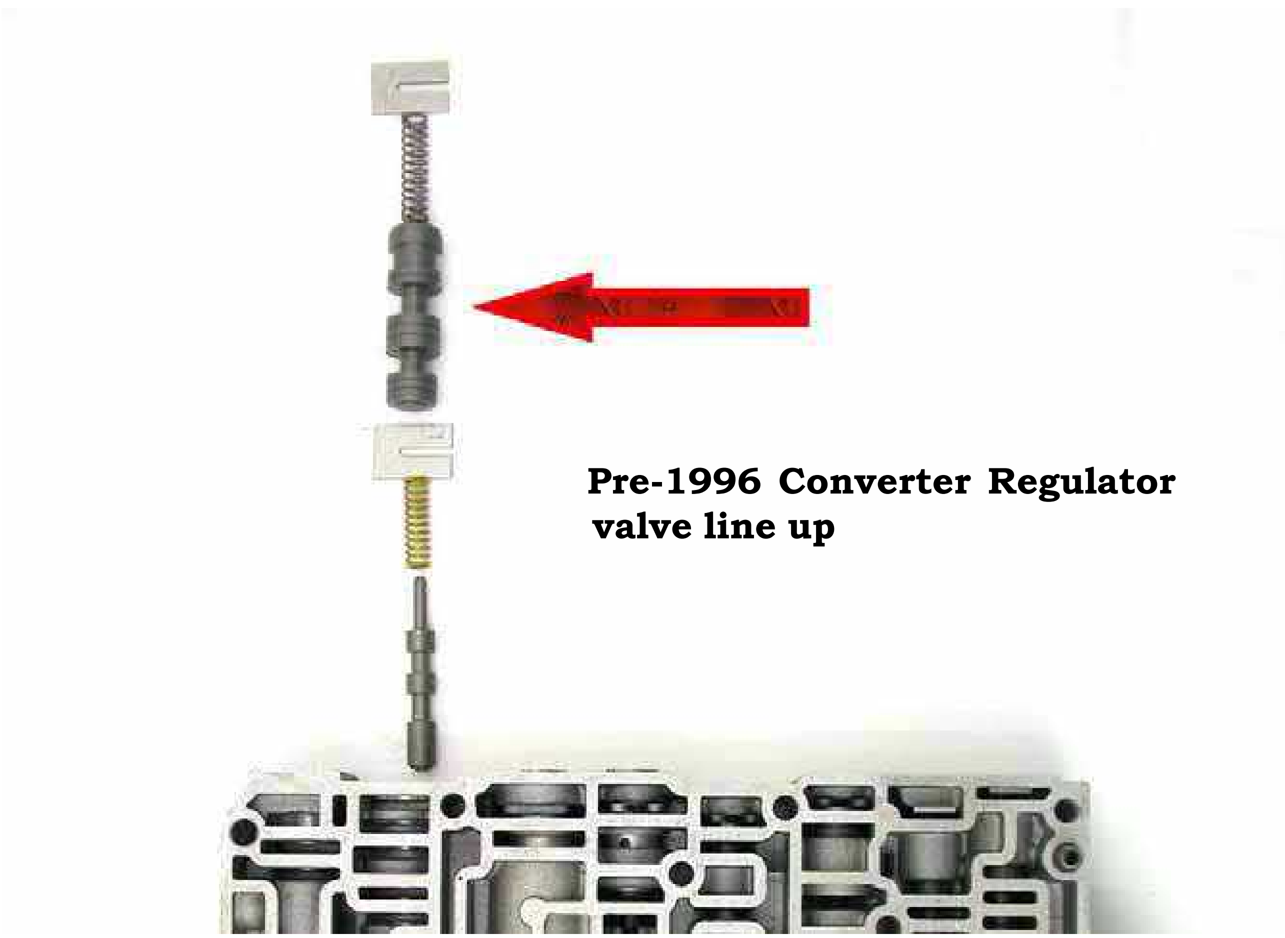
Check Balls

AX4S

Valve Body Interchange *(continued)*

Pre-1996 Converter Regulator Valve Assembly

The Pre-1996 Converter regulator valve has four lands and is not interchangeable with later valve bodies.

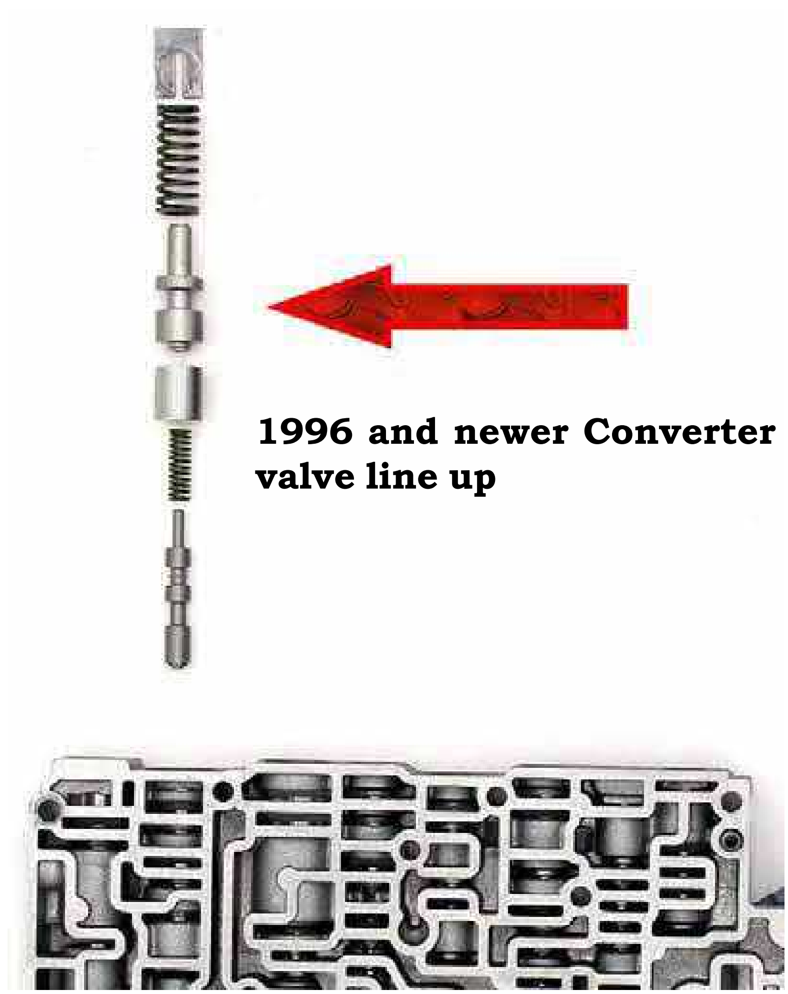


AX4S

Valve Body Interchange *(continued)*

1996 and Newer Converter Regulator Valve

The 1996-1998 Converter regulator valve has two lands and is not interchangable with later models



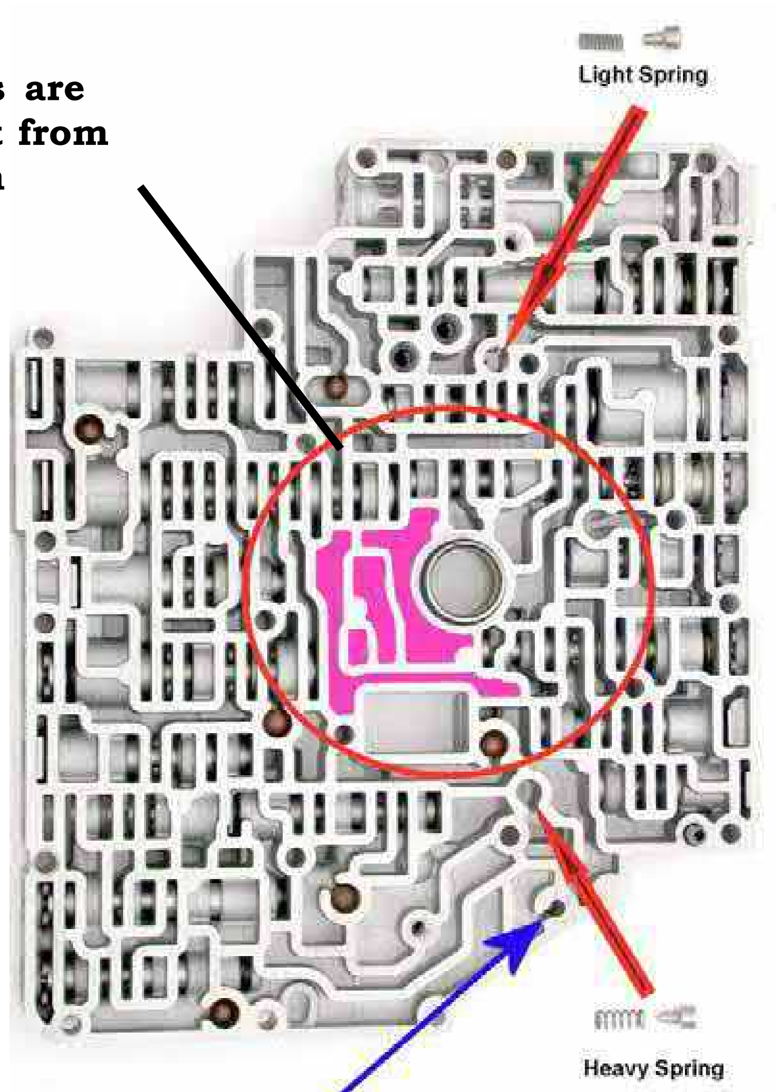
1996 and newer Converter Regulator valve line up

AX4S

Valve Body Interchange (continued)

1999 and Newer Valve Body Assembly

Passages are different from 1999-On



No Pull-In valve (Empty Bore)

Location of the Relief Valve Changed

No relief Valve located here may be the best ID

AX4S

Valve Body Interchange *(continued)*

Seperator Plate Codes

Beginning April 19, 1994, the AX4S transaxles contain bonded main control separator plate gaskets. AX4S applications, both the valve body and pump body contain separator plates bonded with gaskets.

If service is required on a main control assembly containing a separator plate with a bonded gasket, service the separator plate with the correct application from the following charts.

AX4S Pump Separator Plate Application Chart		
#ID	Vehicle	Part Number
#AH	1994-95 3.0L and 3.8L Taurus/Sable	F5DZ-7R167-A
#AH	1994 3.8L Continental	F5DZ-7R167-A
#AH	1994-95 3.2L Taurus SHO	F5DZ-7R167-A
#AH	1995 3.8L Windstar	F5DZ-7R167-A
#51	1995 3.0L Windstar	F58Z-7R167-A
#51	96-97 All Engine Sizes- Taurus, Sable, Windstar	F58Z-7R167-A
#66	1999-UP 3.0L Windstar	XF2Z-7R167-AA

AX4S Valve Body Separator Plate Application Chart		
ID #	Vehicle	Part Number
#58	1995 3.8L Windstar	F58Z-7Z490-A
#43	1995 3.0L Windstar	F58Z-7Z490-B
#31	1994-95 3.2L Taurus SHO	F5DZ-7Z490-B
#40	1994-95 3.0L Taurus/Sable	F5DZ-7Z490-C
#41	1994-95 3.8L Taurus/Sable	F5DZ-7Z490-D
#41	1994 Continental	F5DZ-7Z490-D
#42	1996-97 3.0L Windstar, Taurus, Sable Replaces #63 & #97	F6DZ-7Z490-FB
#47	1996-97 3.8L Windstar	F68Z-7Z490-A
#98	98-Up 3.0L Taurus, 3.0/3.8L Windstar	F88Z-7Z490-AA

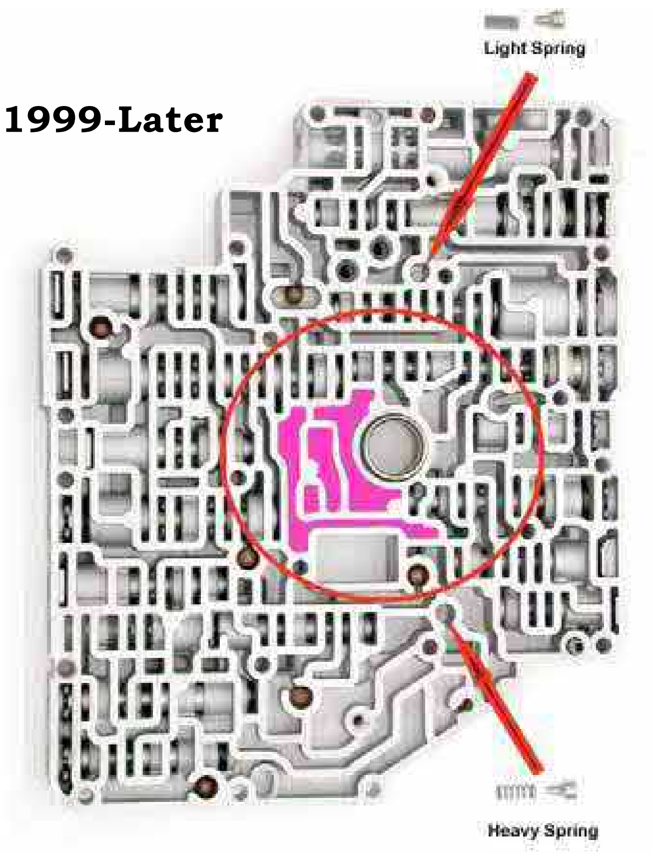
VBX AX4S interchange

AX4S

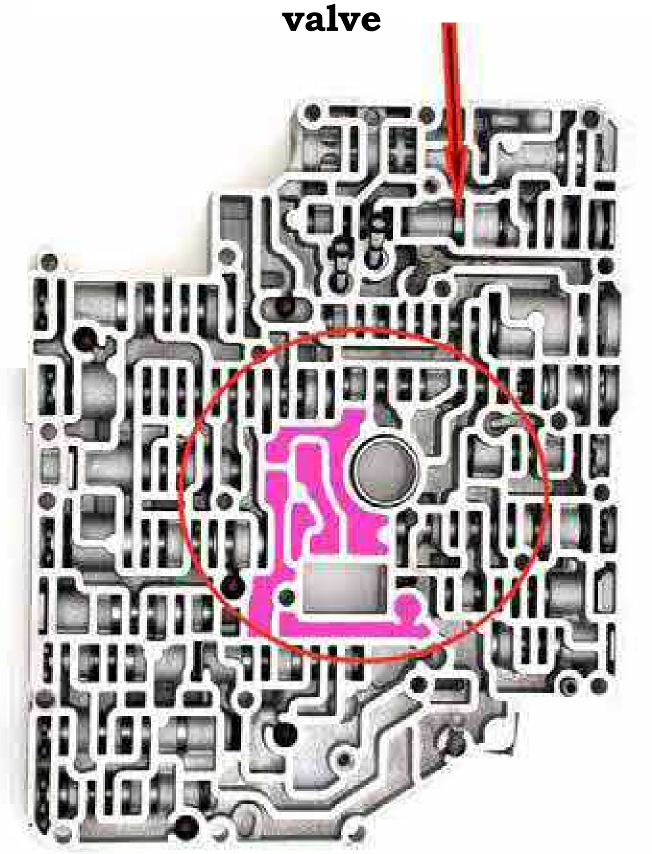
Valve Body Interchange *(continued)*

Areas of difference

1999-Later



1996-1998 two land valve

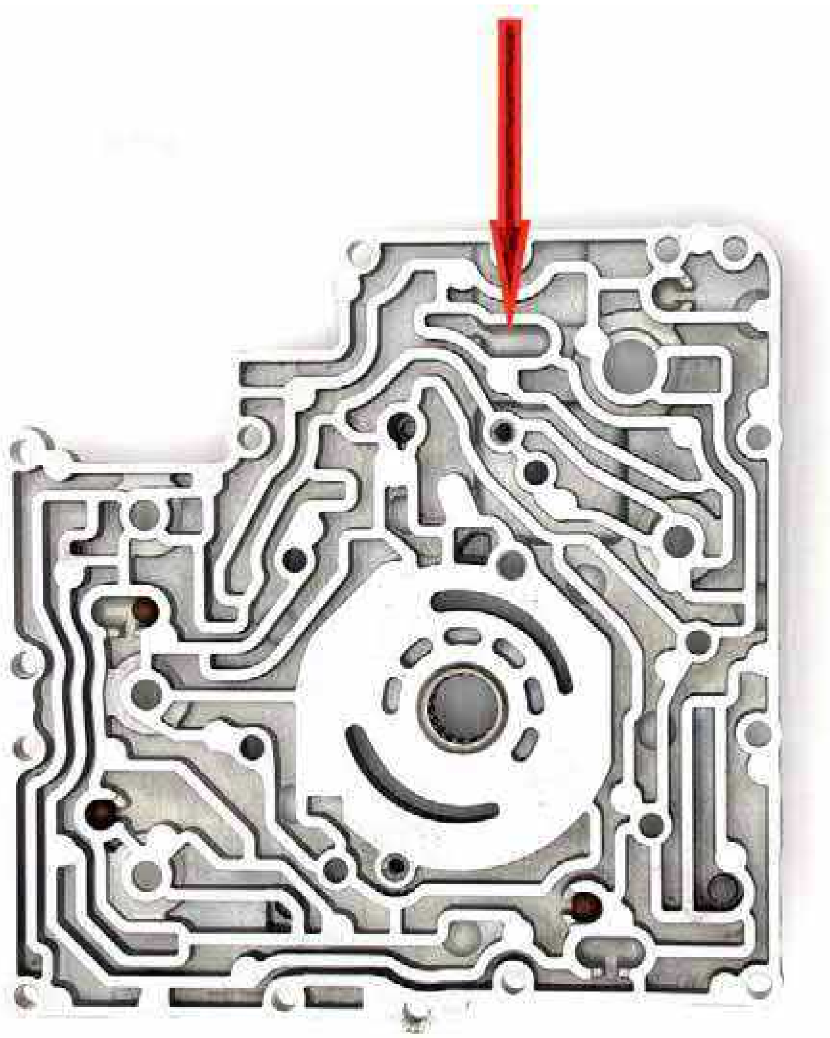


AX4S

Valve Body Interchange (continued)

1999 -On Pump Body Assembly

1999 - On AX4S pump bodies do not have a CB “5” checkball. One easy way to determine if your plate and valve body are correct is the number of holes over the CB “5” checkball bathtube. One hole means no check ball, two holes means a check ball is required.



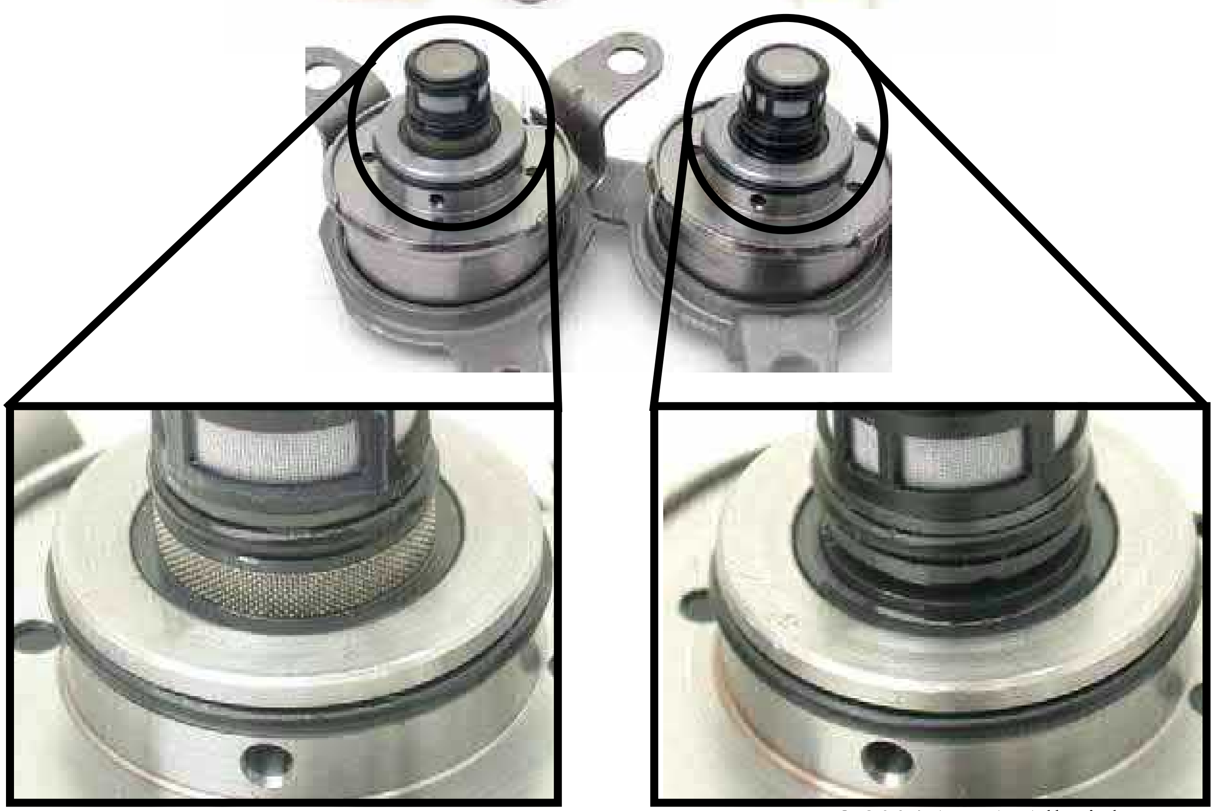
AX4S and AX4N

EPC Solenoids

The AX4S and AX4N EPC solenoids are interchangeable, they have the same resistance, and connector. The only difference is the bracket, which is removable and can be swapped if necessary. The cost is about $10 less then the AX4N solenoid.

New part # AX4S
F8DZ-7G383-BB

New part # AX4N
F8DZ-7G383-AB



AX4N

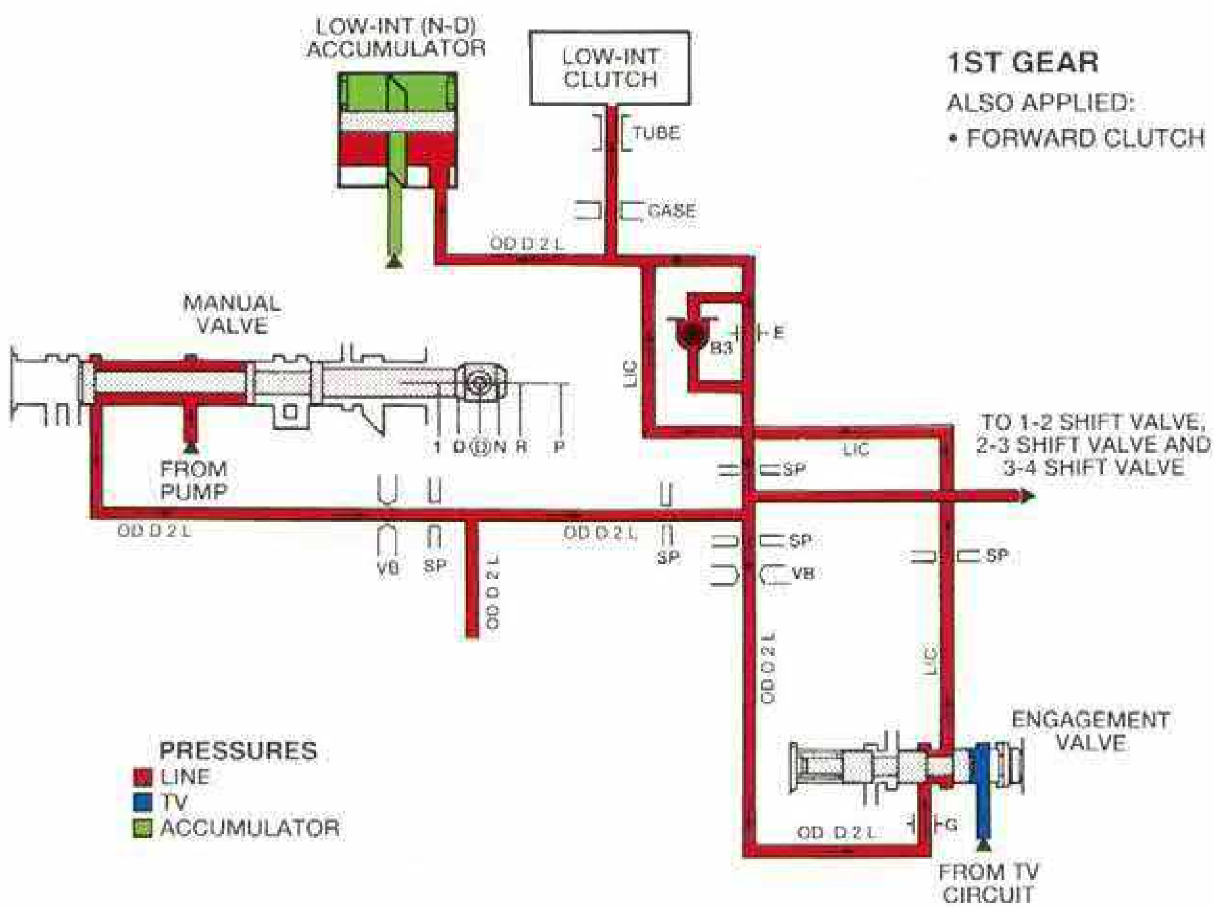
Delayed Engagement

A delayed engagement may be caused by a worn or damaged neutral drive accumulator pin. The pin seals the oil between the accumulator and the forward clutch. When the pin is worn or damaged the forward clutch oil pressure is lost.

AX4N

Delayed Engagement (continued)

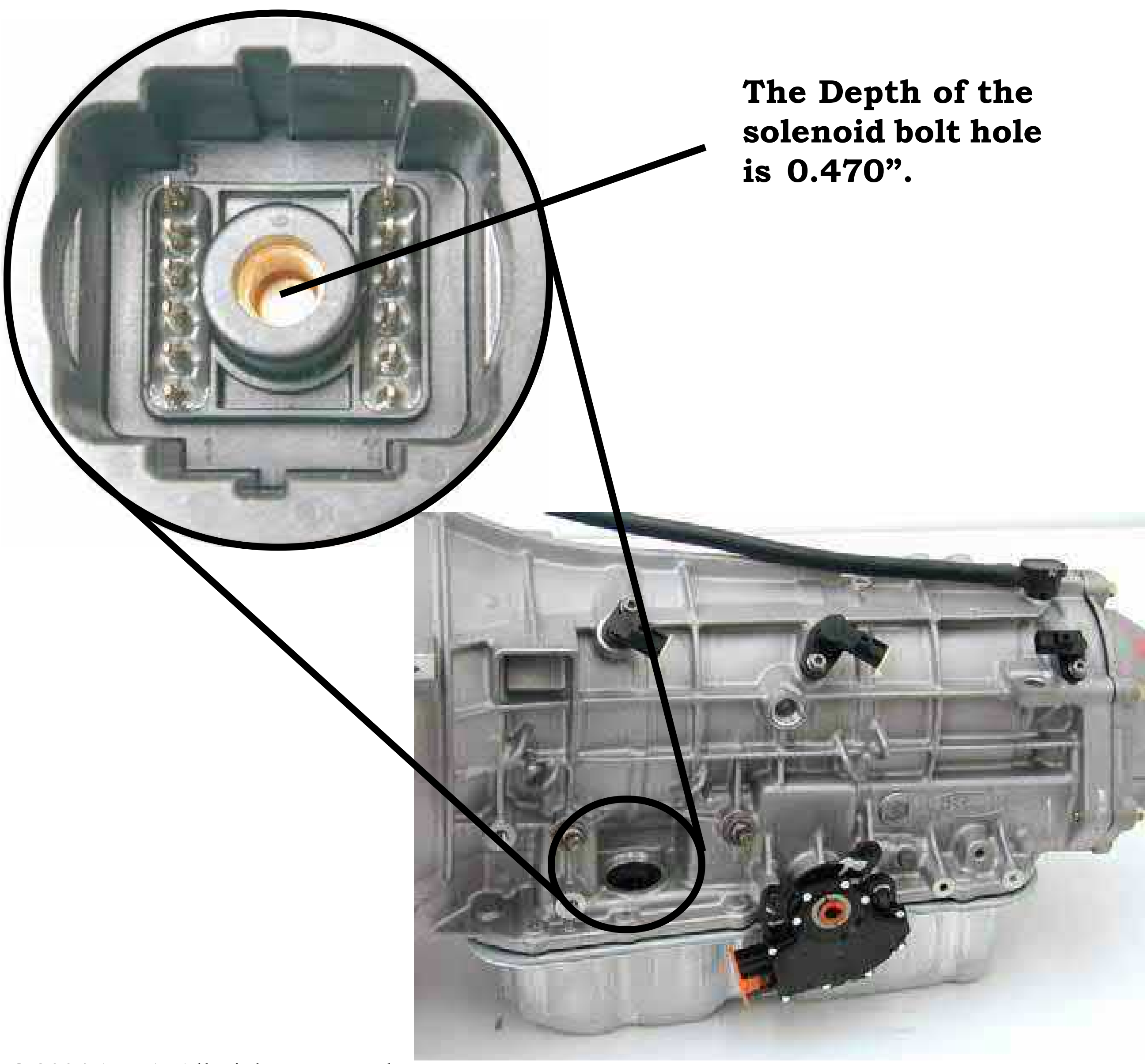
The green oil is modulated pressure from the line modulator valve. It enters the accumulator through the accumulator pin. The Red oil is line oil that comes from the 1-2 shift vale and applies the forward clutch while using the N-D accumulator to cushion the application. If the pin becomes worn it allows the line oil to enter the accumulator regulaotr circuit.



5R55N/W/S

Multiple Solenoid Codes

Multiple codes that won't clear may be caused by a bad or loose connection at the solenoid connector. This concern is especially found after overhaul and during the installation. The bolt on the connector has to bottom out on the solenoid block.

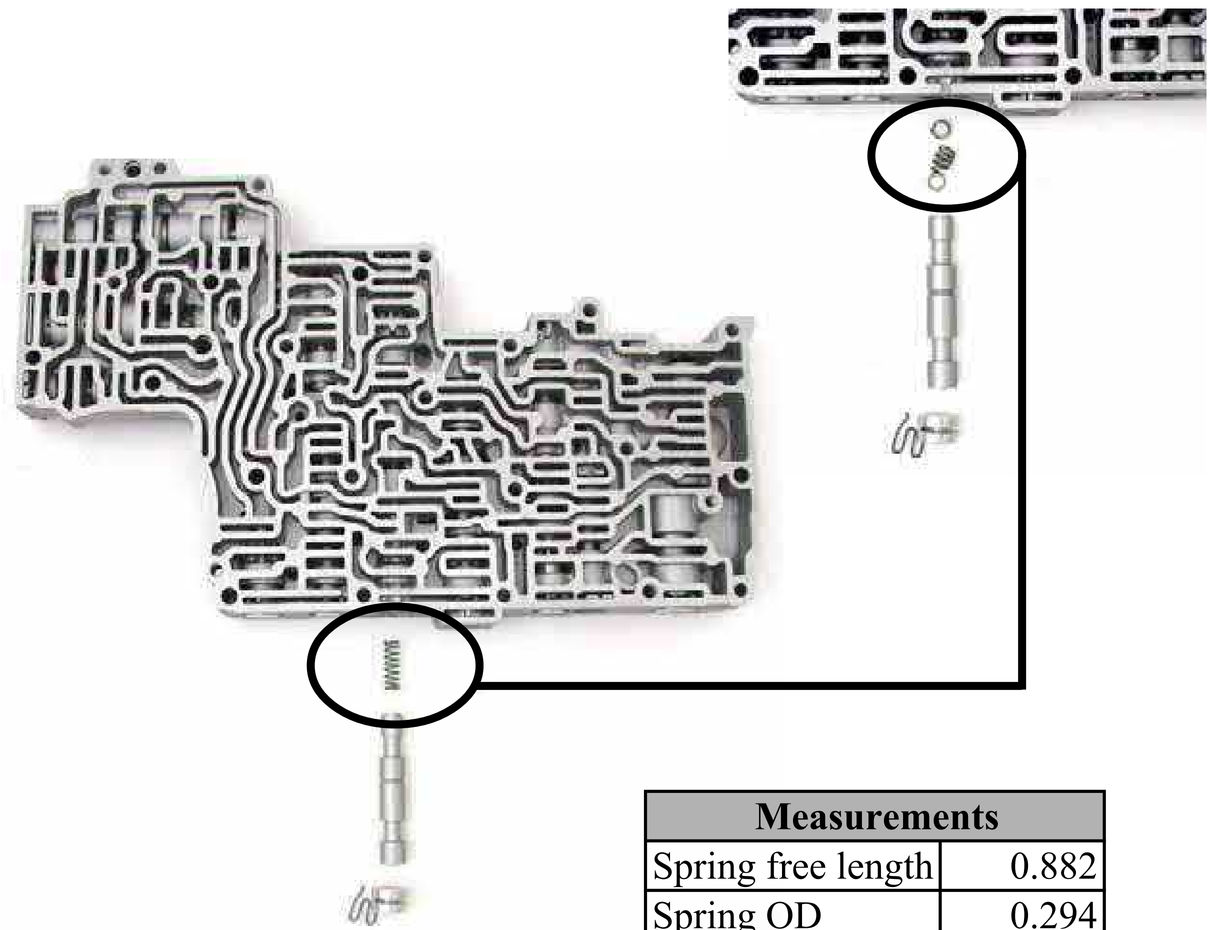


The Depth of the solenoid bolt hole is 0.470".

5R55N only

No 4th and No 5th

The 4-3 pre-stroke intermediate band control valve spring may break due to the spring being machined incorrectly. Also, a code P0795 (Pressure Control Solenoid C circuit failure or shorted) may be present.

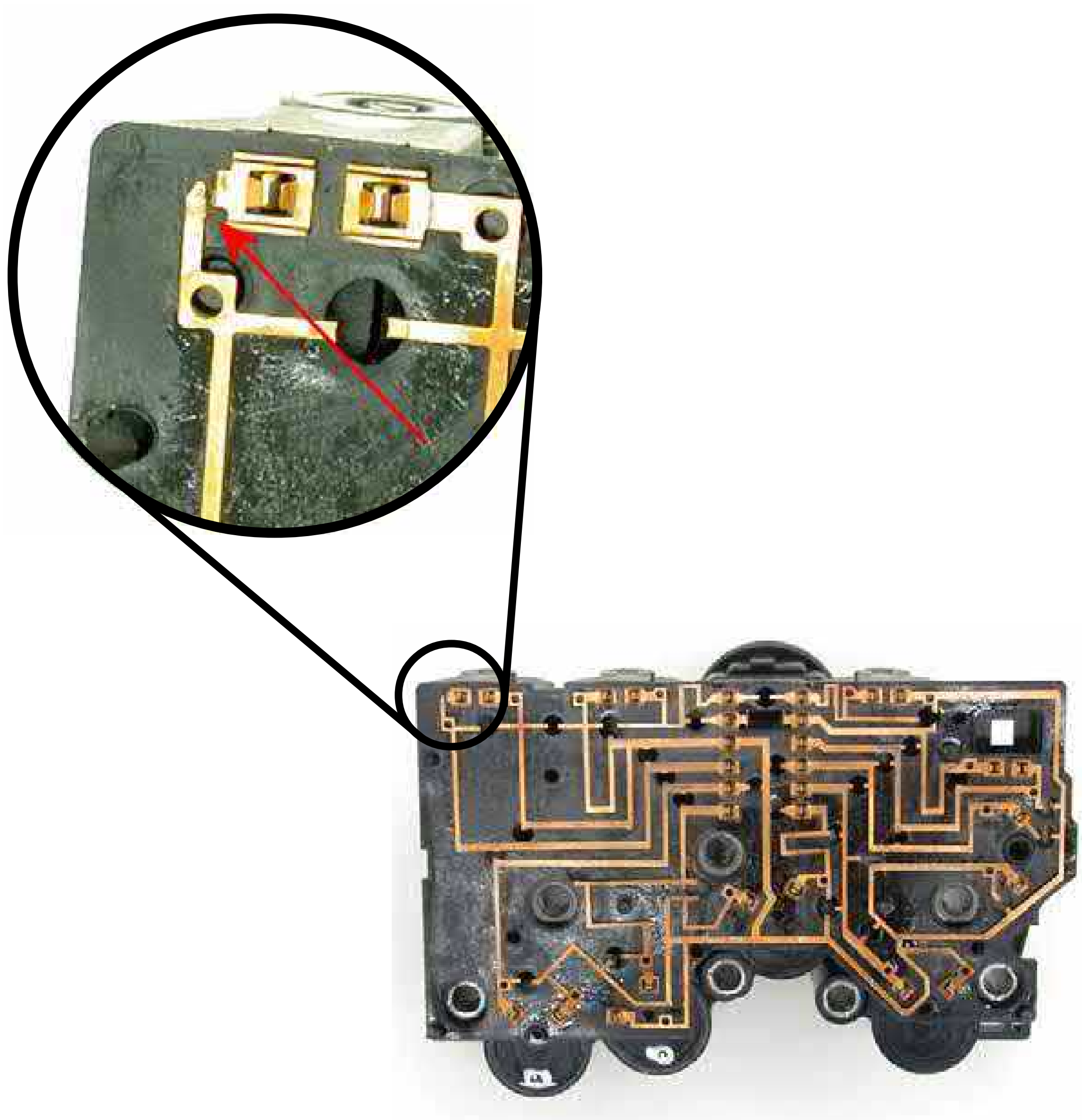


Measurements	
Spring free length	0.882
Spring OD	0.294
Spring wire size	0.034

5R55N/W/S

Solenoid Failure

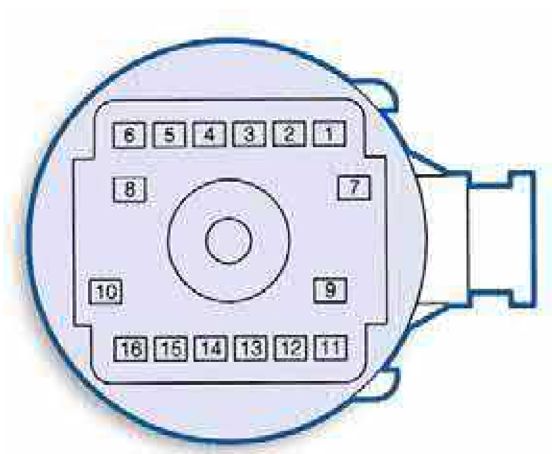
Multiple codes, with gears missing may be caused by a broken solenoid block circuit. This can be caused by the plastic housing rubbing on the circuit board.

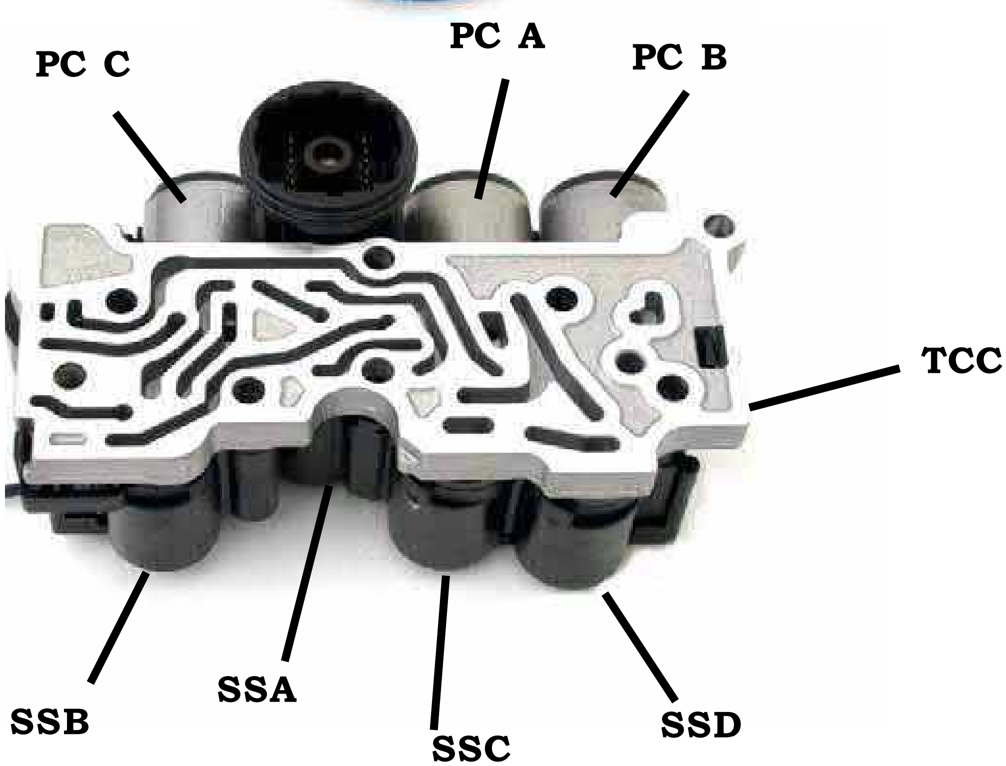


5R55N/W/S

Solenoid ID

When testing the solenoids on the bench, you'll need to use the harness connector illustration on this page.





5R55N/W/S

Solenoid ID (continued)

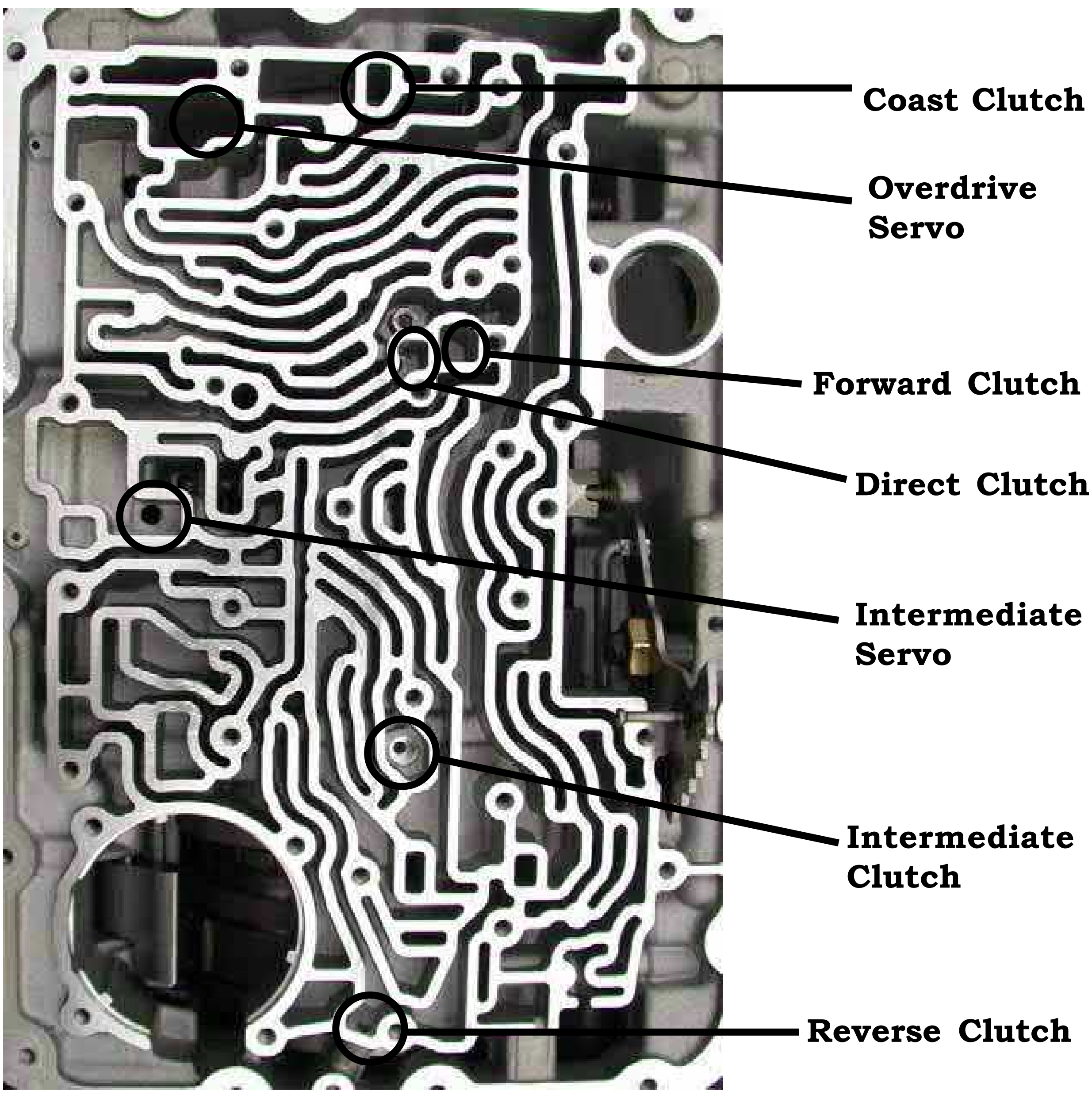
ID	Resistance
PC A	3.3-7.5 ohms
PC B	3.3-7.5 ohms
PC C	3.3-7.5 ohms

ID	Resistance
SSA	16-45 ohms
SSB	16-45 ohms
SSC	16-45 ohms
SSD	16-45 ohms
TCC	9-16 ohms

Pin#	5R55W/S	5R55N
1	PC B	PC A
2	TFT sensor	TFT sensor
3	SS +	SS +
4	PC C	PC B
5	SSD	SSD
6	SSC	SSC
7	N/A	N/A
8	N/A	N/A
9	N/A	N/A
10	N/A	N/A
11	PC A	PC C
12	Sig Return	Sig Return
13	N/A	RP Switch
14	TCC	TCC
15	SSB	SSB
16	SSA	SSA

5R55N

Air Checks



5R55N

Delayed Engagements

Vehicles built prior to 10/17/2000 with the 5R55N transmission may exhibit delayed reverse or drive engagements, harsh upshifts or downshifts, erratic upshifts, or delayed downshifts near 20 mph. This may be caused by the calibration of the Powertrain Control Module (PCM).

If the condition is valid, first repair all Diagnostic Trouble Codes (DTCs) that may be present. If the condition is still present or returns after repair, the PCM must be reprogrammed.

Refer to the following PCM calibration information chart. After reprogramming has been completed, the transmission adaptive strategy for pressure control on engagements must be updated.

1. Install your scanner and monitor the Transmission Fluid Temperature (TFT). Warm the transmission fluid to at least 54°C (130°F) as indicated by the TFT.

2. Perform five (5) engagements from park to reverse. Each engagement must be 5 seconds apart.

3. Perform five (5) engagements from drive to reverse. Each engagement must be 5 seconds apart. Perform five (5) engagements from reverse to drive.

4. Perform five (5) engagements from neutral to drive. Each engagement must be 5 seconds apart.

Calibration Chart

PCM CALIBRATION INFORMATION						
Application	Old Part Number (-12A650-)	Tear Tag	New Part Number (-12A650-)	Old Calibration	New Calibration	NGS/WDS Qualifier
LS - 3.0L, 5R55N	XW4F-JJ	VAV0	XU7Z-TA	9LDA-AAH	9LDA-AAH	WDS B14.3 Release
LS - 3.0L, 5R55N w/SST	XW4F-KH	DYZ0	XU7Z-SA	9LDA-ACG	9LDA-ACG	WDS B14.3 Release
LS - 3.0L, 5R55N	1U7A-JA	MSU1	1U7Z-JB	1LQ16B0507	1LQ16B0507	WDS B14.3 Release
LS - 3.0L, 5R55N w/SST	1U7A-KA	DJY1	1U7Z-KB	1LQ16S0507	1LQ16S0507	WDS B14.3 Release
LS - 3.9L, 5R55N w/SST	1U7A-HA	MFF1	1U7Z-HB	1LQ19S0506	1LQ19S0506	WDS B14.3 Release
LS - 3.9L, 5R55N w/3.31 axle	1U7A-DA	KQI1	1U7Z-DB	1LQ18B0506	1LQ18B0506	WDS B14.3 Release
LS - 3.9L, 5R55N w/3.58 axle	1U7A-GA	KSF1	1U7Z-GB	1LQ19B0506	1LQ19B0506	WDS B14.3 Release
LS - 3.9L, 5R55N 50 States w/SST	1U7A-FA	FMS1	1U7Z-FB	1LQ18S0506	1LQ18S0506	WDS B14.3 Release

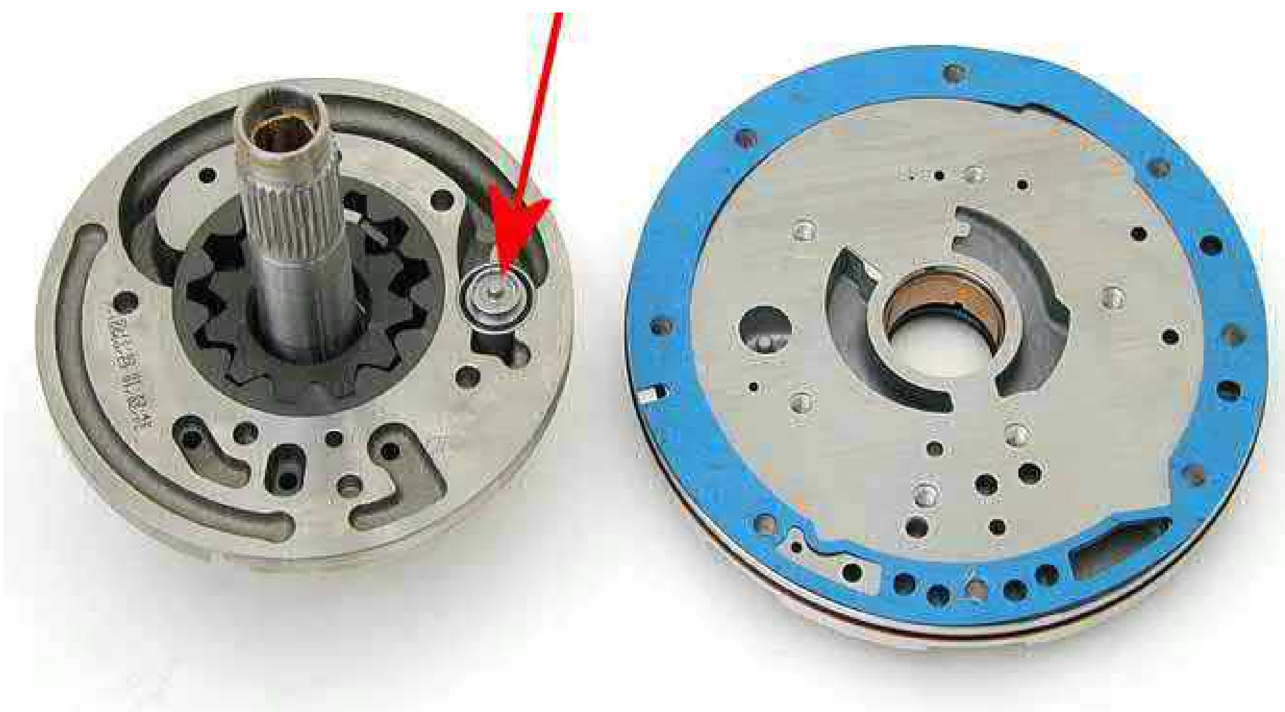
5R55N/W/S

No and/or Slow Engagement

5R55N/W/S Flow Control Valve

A Delayed engagement after sitting when hot or cold may be caused by the flow control valve o-ring missing, destroyed, or the control valve is stuck in the OPEN possition.
The flow control valve is used to help control the volume output of the pump.

Control valve and O-Ring

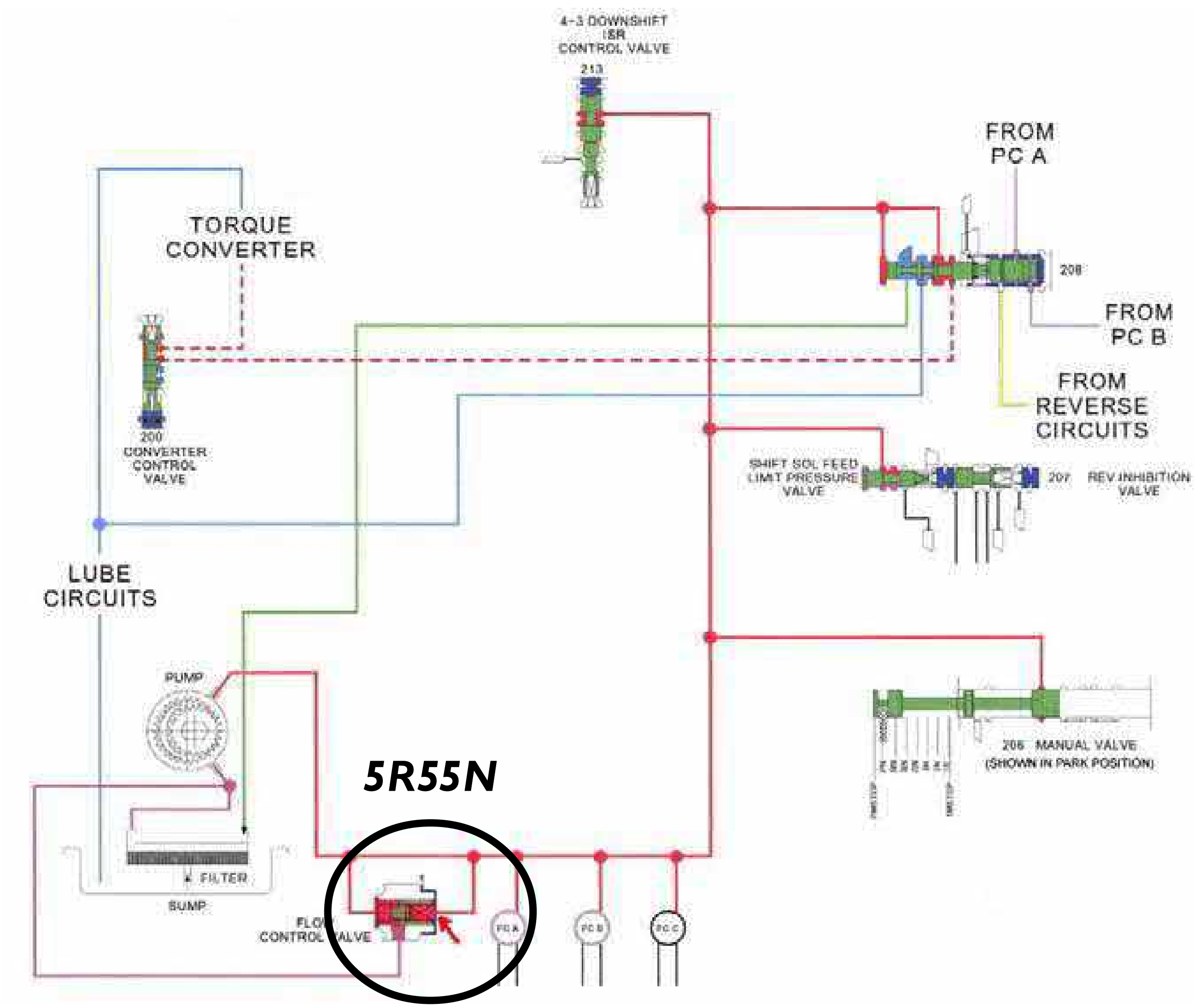


5R55N/W/S

No and/or Slow Engagement (continued)

5R55N/W/S Flow Control Valve

The flow control valve works like a high pressure blow off valve. As main line oil is distributed the flow control valve is used to make sure pressure does not become excessive. If the pressure exceeds the maximum limit, the valve simply opens and allows the oil to drain back into the pump intake.

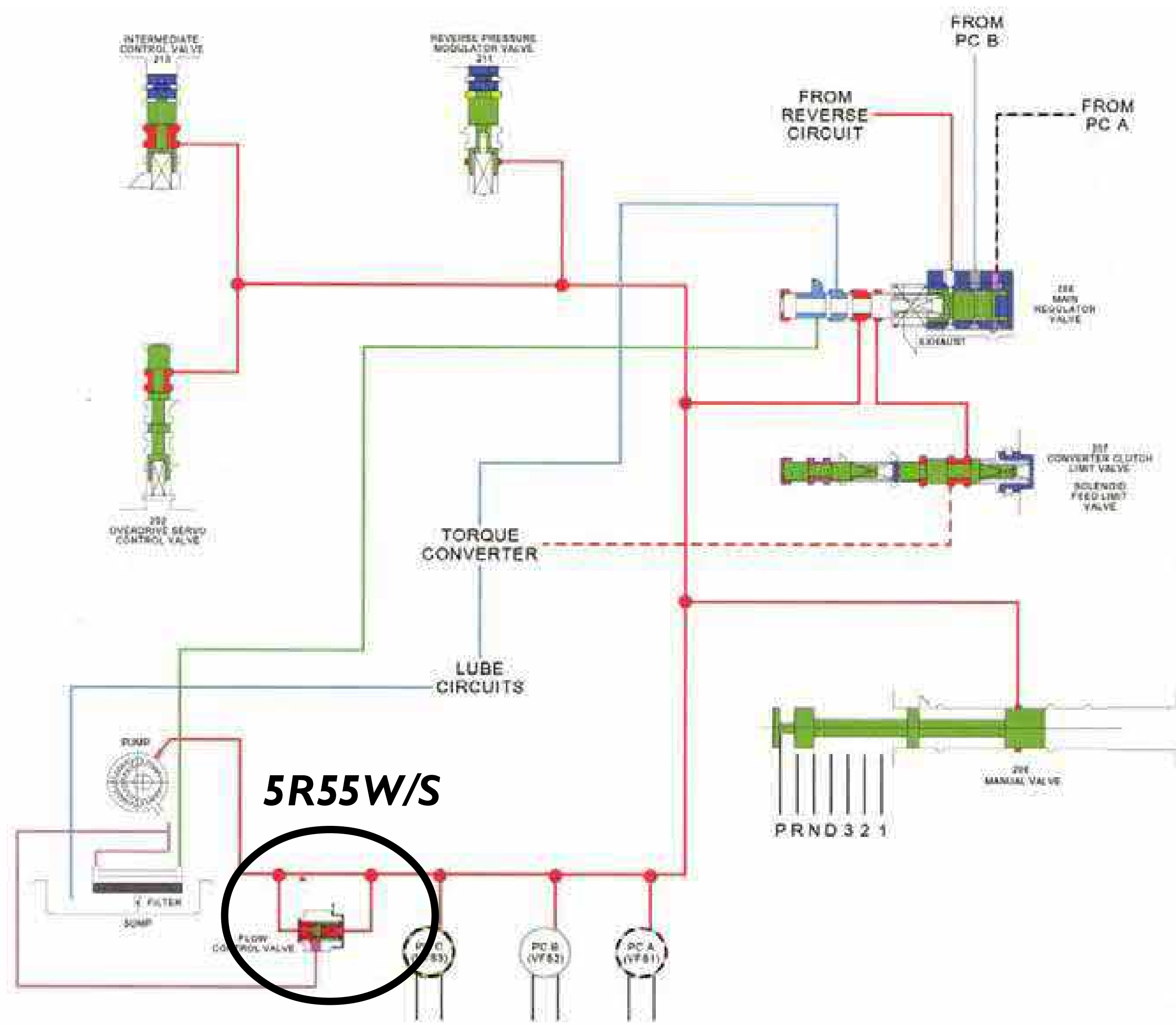


5R55N/W/S

No and/or Slow Engagement *(continued)*

5R55W/S Flow Control Valve

The flow control valve works like a high pressure blow off valve. As main line oil is distributed, the flow control valve makes sure pressure does not become excessive. If the pressure exceeds the maximum limit, the valve simply opens and allows the oil to drain back into the pump intake.



5R55N/W/S

No and/or Slow Engagement (continued)

Make sure during reassembly that the oil seal is attached to the valve assembly.

E4OD

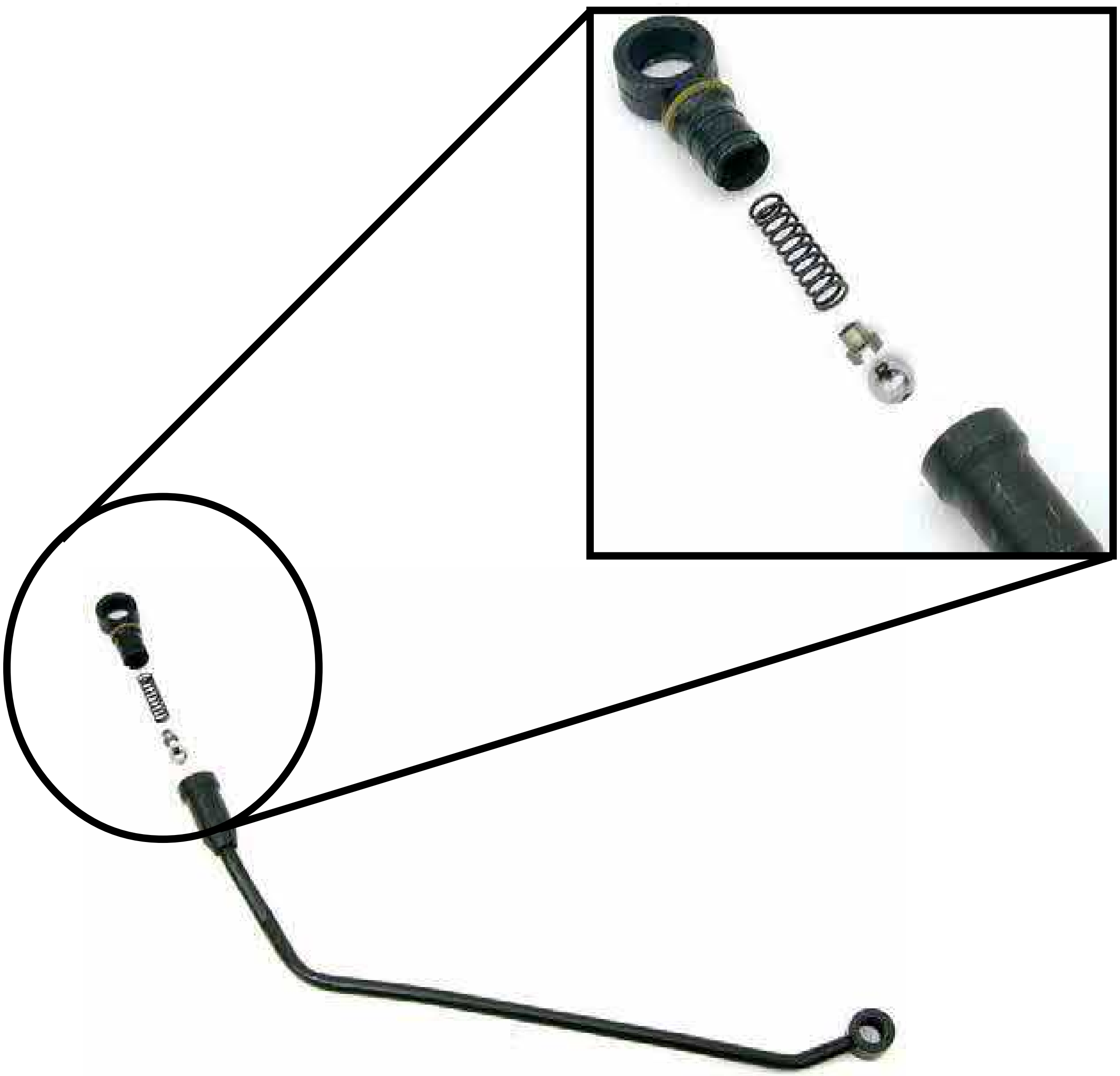
Failsafe with No Codes

When diagnosing an E4OD in failsafe with no codes, attempt to create a code by disconnecting a solenoid or sensor I.E.: MAF, TPS, MLP, MAP.
Any one of these inputs should cause the check engine light or TCS light to illuminate. If the check engine light or TCS light fails to illuminate suspect a failed PCM. Always go through the normal procedures of checking the PCM powers and grounds before attempting to reprogram the PCM before replacing it.

4R100

Bypass Tube

Dissassembly and re-Assembly of the bypass tube may be necessary due to heavy contamination. Simply pull the top off the cooler fitting adapter while holding the tube, and the sealed fitting will release from the tube assembly.



TorqShift

Lack of Power, Slow Reverse, or Lurching at a Stop

Reprogramming the PCM

A lack of power condition, slow reverse after cold soak, lurching at a stop (zero mph) may be caused by a reprogramming fault. If a complaint of this nature comes in to your shop, monitor the Acelerator Pedal Position sensor and RPM.

The Transmission may think it is getting a false signal from the APP sensor. In some cases the APP sensor is bad causing this false reading. This fault in the programing of the computer is causing the engine to ramp up as if the accelerator were pushed down. This may surprise the customer sitting at a stop and severe damage may occur.

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FIXES HARSH SHIFTS & HIGH LINE PRESSURE
74846-05
41TE
CONVERTER REGULATOR VALVE KIT
FIXES CONVERTER SHUDDER & FAILURE
92835-03K
Patent Pending
KM175
ENDPLAY SHIM & WASHER KIT
FIXES FLARE 2-3 OR 3-2 SHIFT
42000-01K
CHRYSLER
RWD 78 & UP
MANUAL VALVE, LUBE REGULATED PR VALVE & 4 SPOOLED SWITCH VALVE
FIXES DELAYED ENGAGEMENT, LUBE FAILURE, LOCKUP SHUDDER & OVERHEATED CONVERTER
Part Nos. 22771-09*, 22771A-02K* & 22771A-01
*Patent Pending
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92834-03K & -05K
ZF
OVERSIZED PRESSURE REGULATOR VALVE
FIXES HIGH LINE PRESSURE
85991-01
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INTERMEDIATE SHAFT PILOT & END PLUG KIT
FIXES POOR LUBE OIL CONTROL
22171A-02K
A4RA
96- 99 HONDA CIVIC CPC VALVE SPRING
FIXES HARSH UPSHIFTS & DOWNSHIFTS
88894
4L30-E
BOOST VALVE & SLEEVE KITS
FIXES LOW LINE PRESSURE
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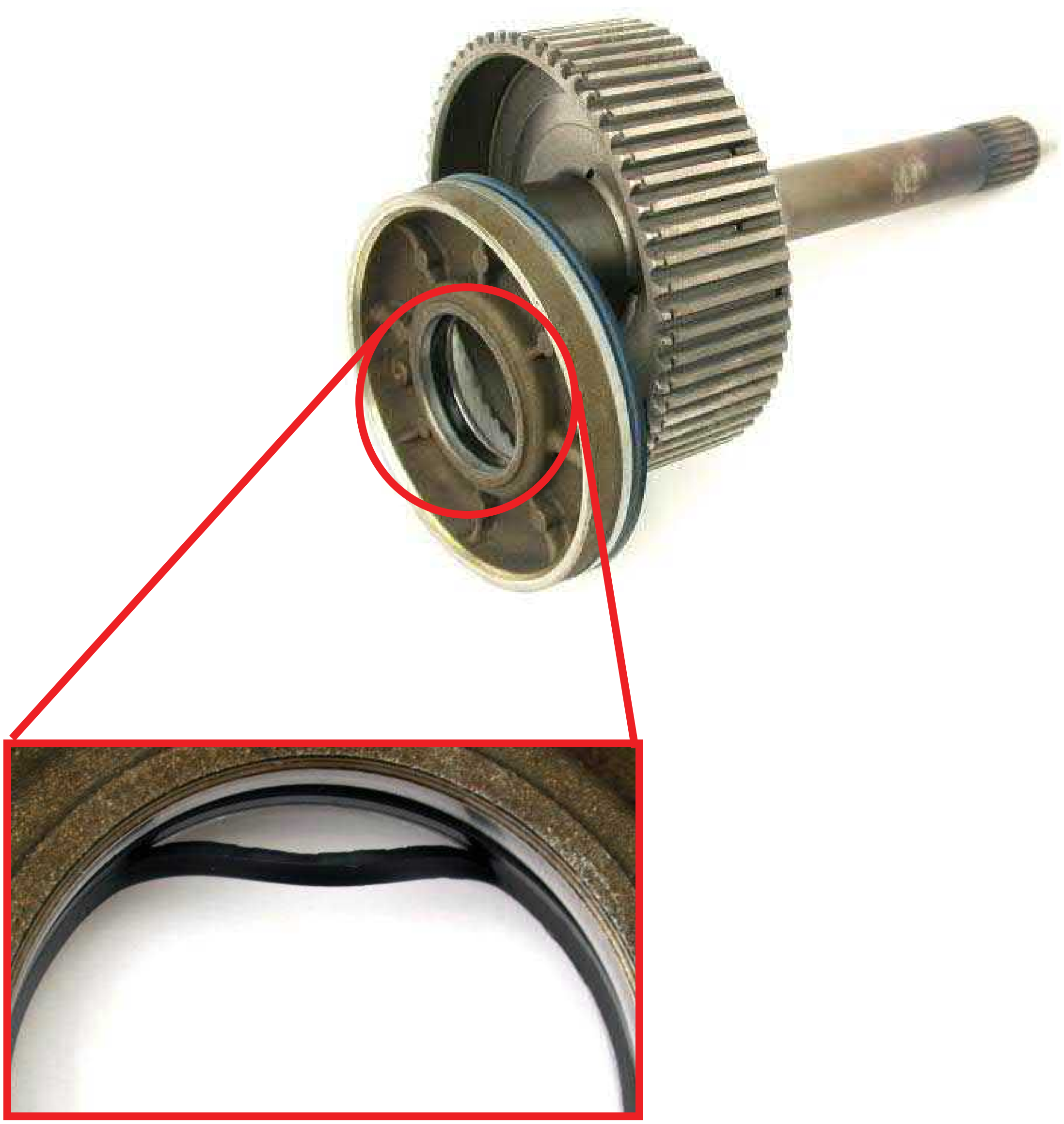
Chrysler Contents

46RE
No Forward

A no movement concern first thing in the morning may be present, but the reverse engagement is good. The transmission may also fall out of gear while driving hot or cold weather. This concern may be caused by the inner lip seal of the Forward drum having shrank or being torn/ripped.
In some extreme cases during the winter months this seal can shrink and never apply.



42/44RE
Updated Parts

Chrysler has released a new direct clutch outer seal for the 42RE and 44RE transmissions. The drum, piston and outer seal have all been revised for the 2000 and up models. The outer piston is located in the drum rather than the piston. The inner cluth seal is located in the same place and carries the original OEM part number.

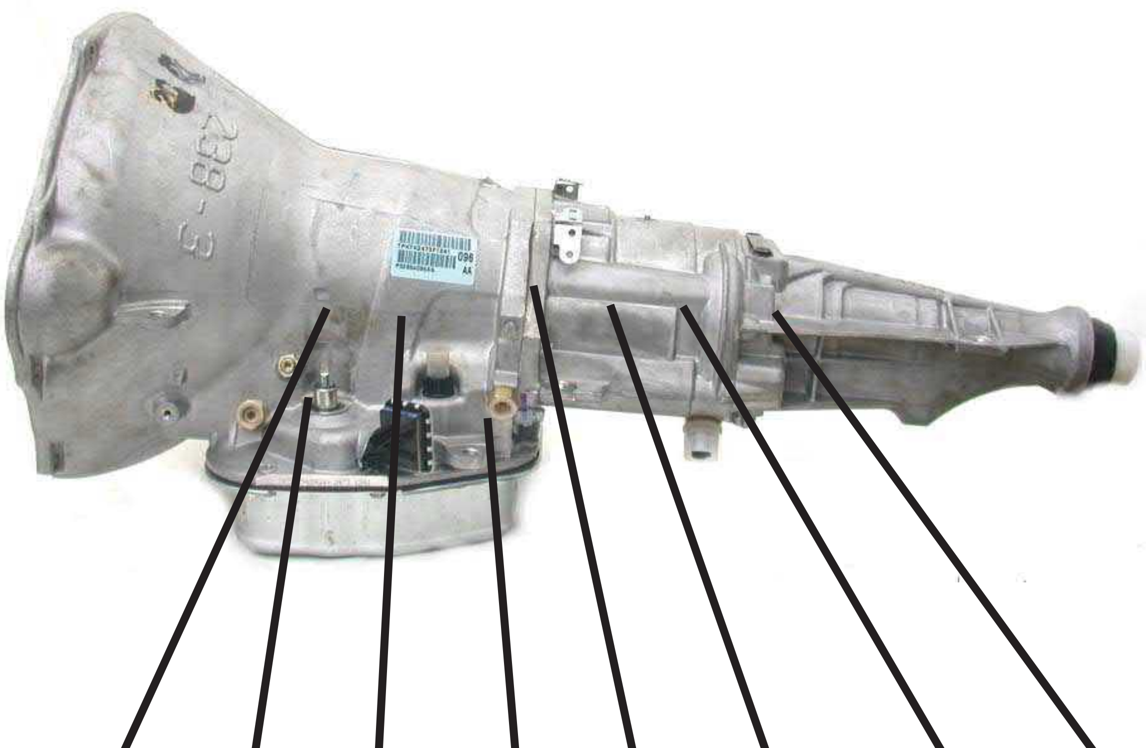
Part Number
4058487 AB

ALL RE Series
TCC Shuttle

Reflashing the ECM can correct this problem. It can also make the shift feel better and firmer. An added bonus is the program will make the doors lock when the vehicle starts to move.

48RE

New Transmission



SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVER-RUNNING CLUTCH	OVER-DRIVE CLUTCH	DIRECT CLUTCH	OVER-RUNNING CLUITCH
REVERSE	X			X			X	
DRIVE-FIRST			X		X		X	X
DRIVE-SECOND		X	X				X	X
DRIVE-THIRD	X		X				X	X
DRIVE-FOURTH	X		X			X		
MANUAL SECOND		X	X				X	X
MANUAL FIRST			X	X	X		X	X

48RE

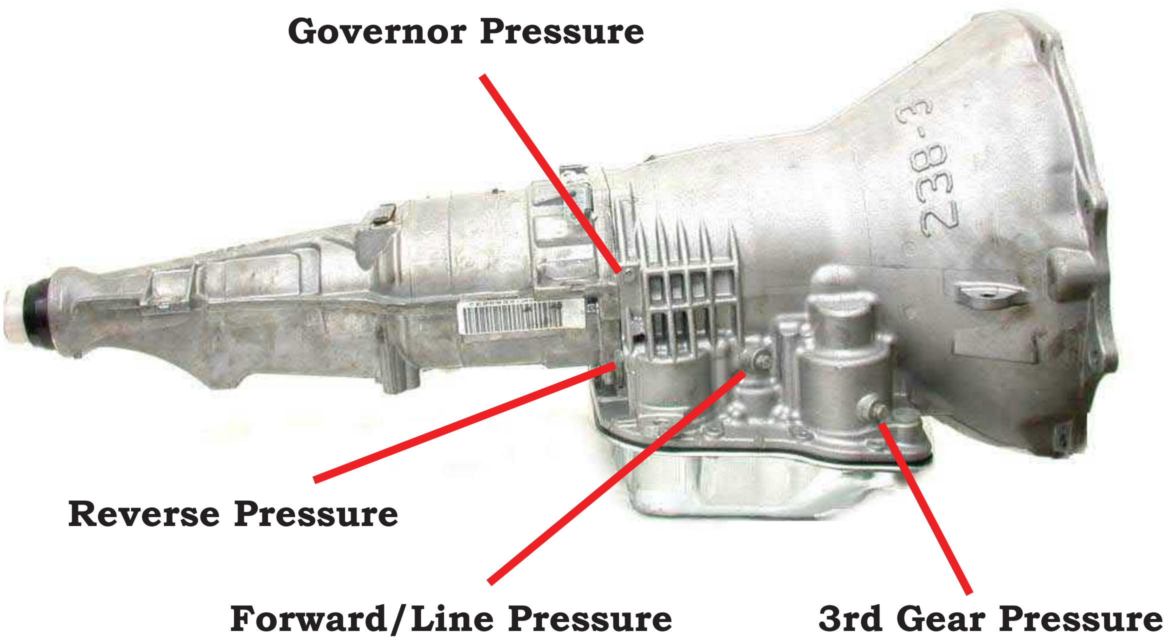
Pressure Tap Locations

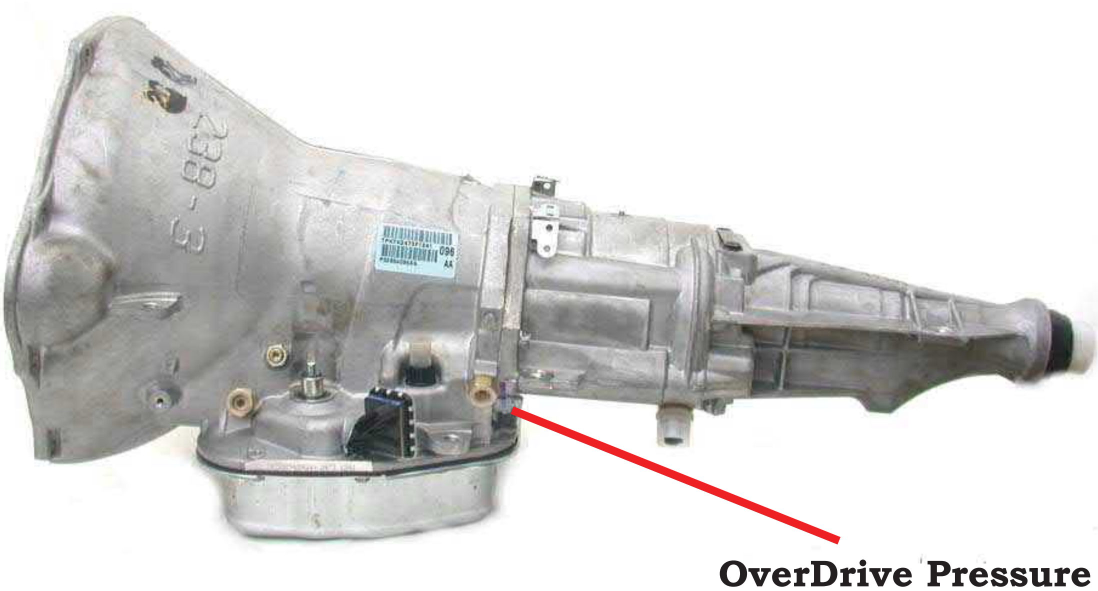
The 48RE transmission has several different pressure ports to choose from. In many cases, it's a good idea to have two pressure gauges. Keep in mind that in reverse the pressure can exceed 280 PSI, so always use a 0-300 or 0-400 PSI gauge when testing reverse pressure. Despite the number of pressure taps, there is no mainline pressure tap. Use the chart below to compare your results to the factory specifications.

RANGE	ACCUMULATOR		FRONT SERVO		REAR SERVO		OD CLUTCH		GOVERNOR PRESSURE
	IDLE	WOT	IDLE	WOT	IDLE	WOT	IDLE	WOT	
P/N	0	0	0	0	0	0	0	0	0
R	0	0	145-175	230-280	145-175	230-280	0	0	0
Drive 1st	55-60	90-100	0	0	0	0	0	0	Pressure should be zero at a stop and increase about 1 PSI per MPH
Drive 2nd	55-60	90-100	0	0	0	0	0	0	
Drive 3rd	55-60	90-100	55-60	90-100	0	0	0	0	
Drive 4th	55-60	90-100	55-60	90-100	0	0	55-60	90-100	
MANUAL 2	55-60	90-100	0	0	0	0	0	0	
MANUAL 1	55-60	90-100	0	0	55-60	55-60	0	0	

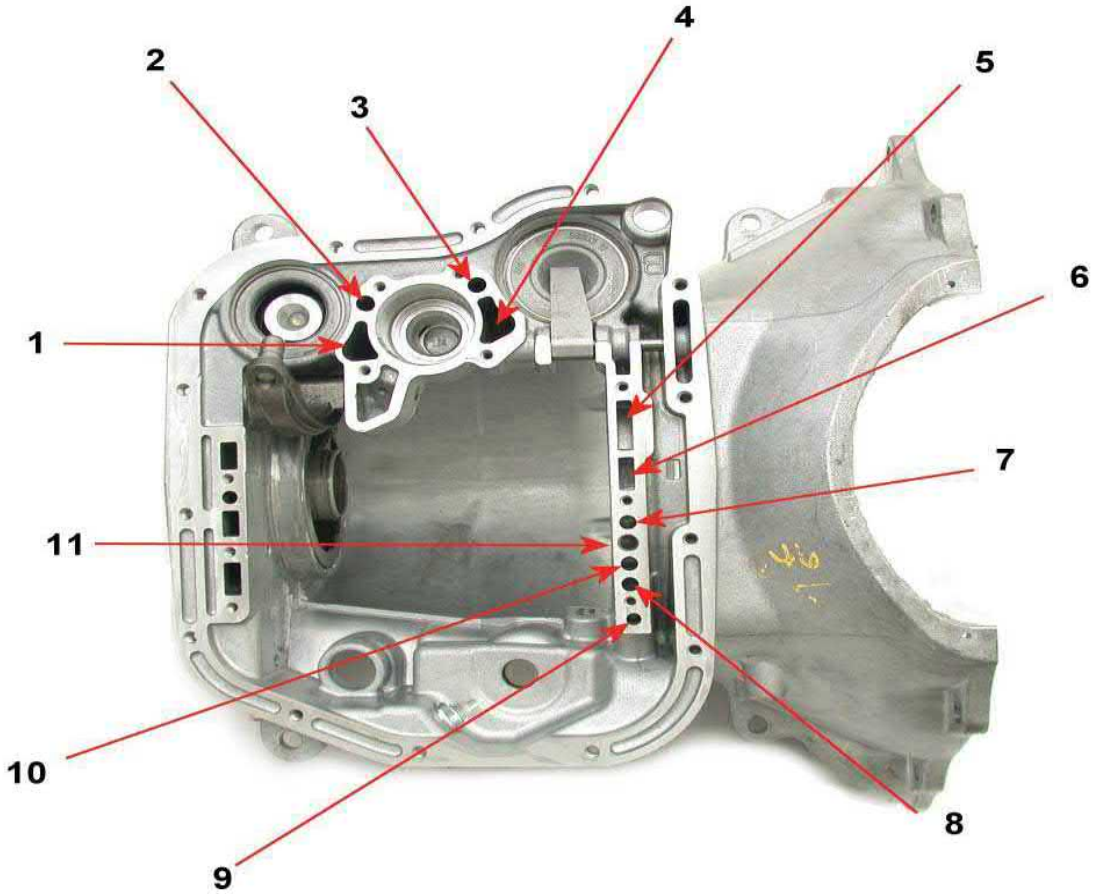
48RE

Pressure Tap Locations (continued)





48RE
Air Test



Location	Air Pressure Test Passage
1	Line Pressure to Accumulator
2	Rear Servo Apply
3	Front Servo Apply
4	Front Servo Release
5	Pump Suction
6	Pump Pressure
7	Front Clutch apply
8	From Torque Converter
9	To Cooler
10	To Torque Converter
11	Rear Clutch Apply

48RE

Six Pinion Planets

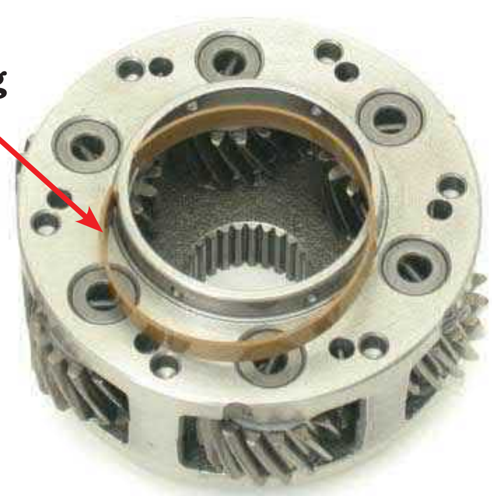
The rear planetary assembly has changed to a steel-housed six pinion carrier. This change also caused a change to be made in the washer design between the ring gear and planetary.

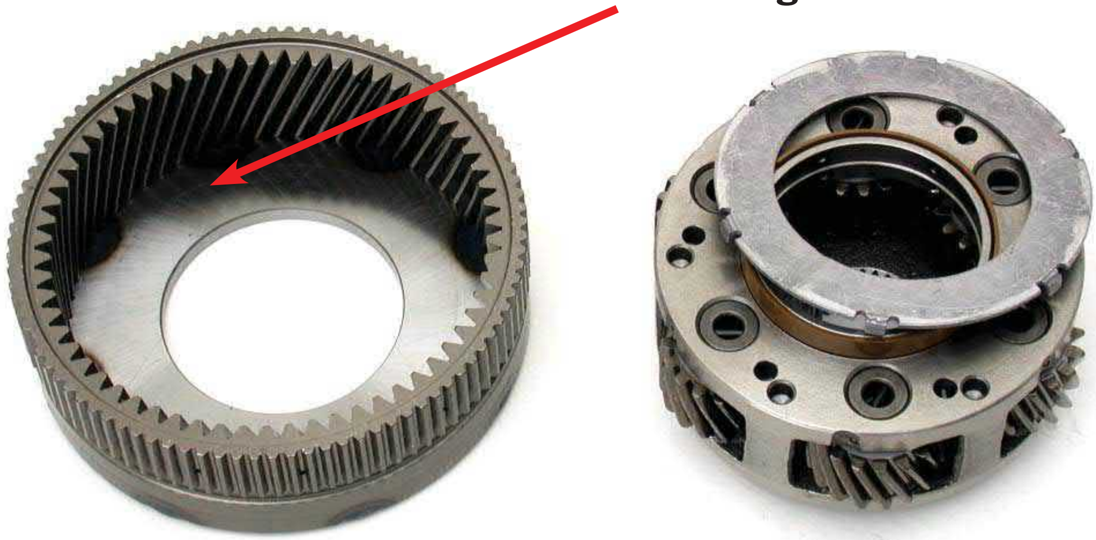
The rear ring gear has also changed to have a larger lube reserve area and increase in welds to hold the hub to the ring area. The back of this annulus is also machined to allow for the changes in the reverse drum. This is NOT interchangeable with earlier 46RE or 47RE transmissions.

48RE

Six Pinion Planet *(continued)*

The front planet changed to a six pinion steel carrier. A damper ring is added to calm down vibrations during reduction speeds of the planet. The front annulus gear is also machined with a larger lube oil reserve groove at the bottom of the ring gear for extra cooling. With the change in the planetary.





48RE
Rear Clutch Drum

Not many noticeable changes have been made to this drum and input shaft. The splined area of the input shaft has changed to have deeper radius grooves for strength.

Deeper radius grooves for strength.

48RE
Pump Assembly

Changes to the pump include directional gears, and the addition of a new Teflon ring housed on the stator support shaft. The change to the reaction shaft makes the torque converter not serviceable to the 46RE or 47RE. The 48RE converter is a beefier design, able to be used on the 48RE transmission only.

48RE
O/D Direct Clutch

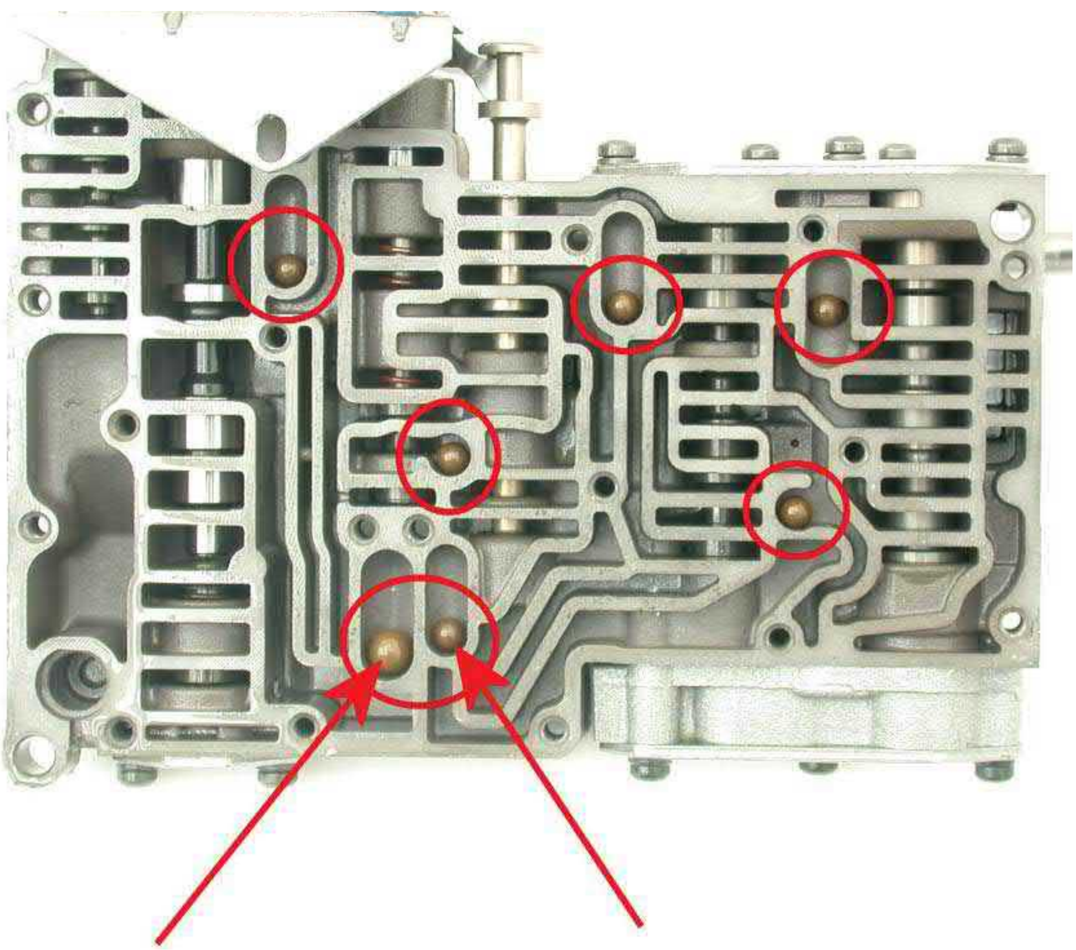
Major changes have occurred in the OD direct clutch stackup. There are now 23 single-sided clutches. The pressure plate is still the second-design plate measuring out at 0.085” on the lug ears.

48RE

Reverse Servo and Apply Lever

The Low/Reverse servo has changed to allow for greater holding strength and torque load. The apply lever is changed to a new ratio to increase clamping force onto the redesigned Low/Reverse band.

48RE
Checkball Locations

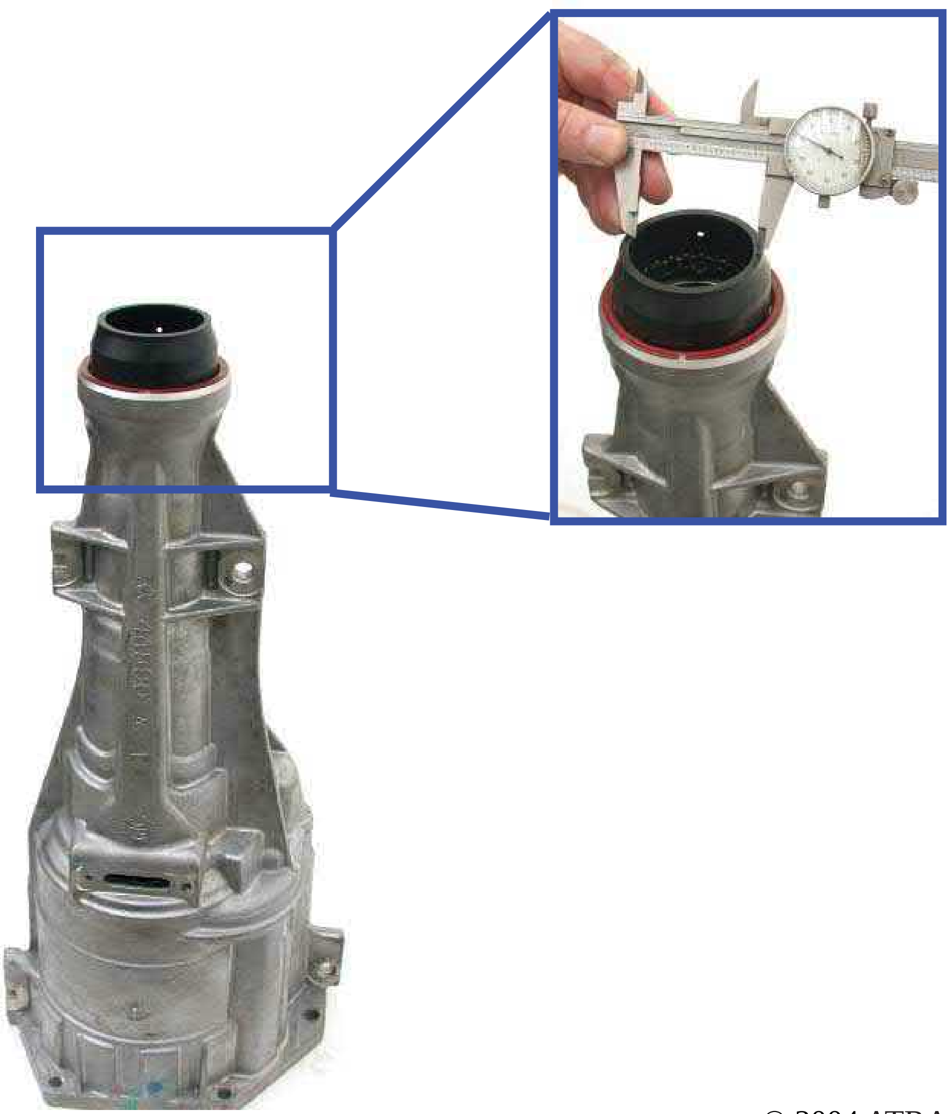


Different size checkballs

48RE

Extension Housing Seal

The output shaft bushing and seal have changed. The new seal and bushing are much larger than the earlier 46RE and 47RE. This change means there is a new housing that can not be interchanged. It is used on the 48RE only.



48RE

Sun Gear

The sun gear shell has increased in thickness by 0.055” for strength. The sun gear has also undergone some changes that allow for more lube oil flow to the planetaries.

Hardparts

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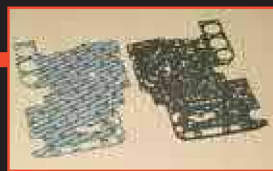
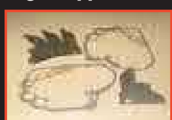


Gaskets:

Paper gaskets included in TransTec kits are manufactured by our Freudenberg-NOK Necedah plant (formerly known as Farnam). This QS-certified plant also supplies virtually all domestic OEMs with many of their paper gasket requirements used in automotive transmission and engine applications. Look for the TransTec name on these paper gaskets. It's your assurance of quality.



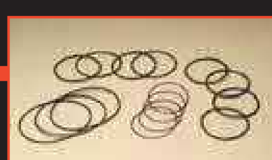
For applications using bonded valve body plates, we supply bonded gaskets with metal cores. You get the same OE-quality gaskets in TransTec overhaul kits that we supply to OEMs.

The manufacturing process used for our silicone beaded gaskets utilizes leading-edge technology to provide superior sealing.

Pan gaskets made of cork and rubber are high quality and manufactured by OE suppliers. Duraprene® fibrous material pan gaskets are also offered as an alternative for installer preference. Our molded rubber pan gaskets are formed around a plastic core for more stability; a proprietary process which Freudenberg-NOK developed for its current OEM customers. These gaskets feature torque-limiting inserts to help avoid over-torquing.

Bonded Pistons:

Bonded pistons are manufactured using a very precise molding process to create smooth, exacting rubber sealing surfaces bonded to metal pistons. Freudenberg was a pioneer in molding bonded pistons for European applications. NOK is the dominant supplier for Asian applications, and Freudenberg-NOK is an OE supplier of these domestically. The sealing surface of these pistons performs the same function as previous separate-seal designs, so bonded pistons should always be replaced during a rebuild.



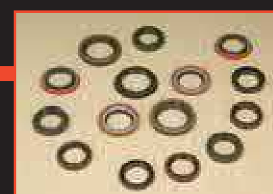
Lip Seals:

The majority of lip seals contained in TransTec kits are manufactured by Freudenberg-NOK plants and exclusive to our kits. We have supplied lip seals via the IPC group to automotive manufacturers for over 40 years. TransTec kits for import applications contain original NOK lip seals, a claim no other kit maker can make.

Teflon® and Vespel® are registered trademarks of E.I. du Pont de Nemours & Company. TransTec®, Corteco® and Duraprene® are registered trademarks of Freudenberg-NOK. PEEK™ is a trademark of Victrex PLC.

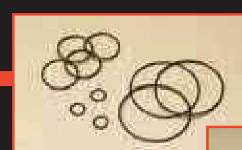
Sealing Rings:

TransTec kits use Freudenberg-NOK manufactured PTFE (Teflon®) rings. The QS-certified manufacturing plant is a pioneer in PTFE machined ring design. A machined ring involves a more exacting manufacturing process that results in components that seal better. With over 28 different compounds to choose from, complex formulas are used to ensure superior sealing in a broad range of sealing applications. In addition, TransTec is the aftermarket leader using state-of-the-art materials including Vespel®, PEEK™ and other synthetics. For applications requiring metal, we use only OEM-quality rings.



Metal Clad Seals:

Globally, Freudenberg-NOK manufactures more precision-molded radial shaft seals than all other manufacturers *combined*. TransTec alone has sold over 3 million NOK seals for *domestic* applications since they were first introduced in 1999. NOK brand oil seals are used exclusively in TransTec kits – no other transmission kits have them.



O-rings & D-rings:

The Freudenberg and NOK group companies manufacture O-rings and D-rings for automotive applications on a worldwide basis, an advantage we use to incorporate the OEM design, materials and resources of these seals into our kits.

It's What's Inside That Counts!

We're so confident in our world-class seals that we mold our initials into them. Look for these RMA (Rubber Manufacturers Association) codes on our seals.

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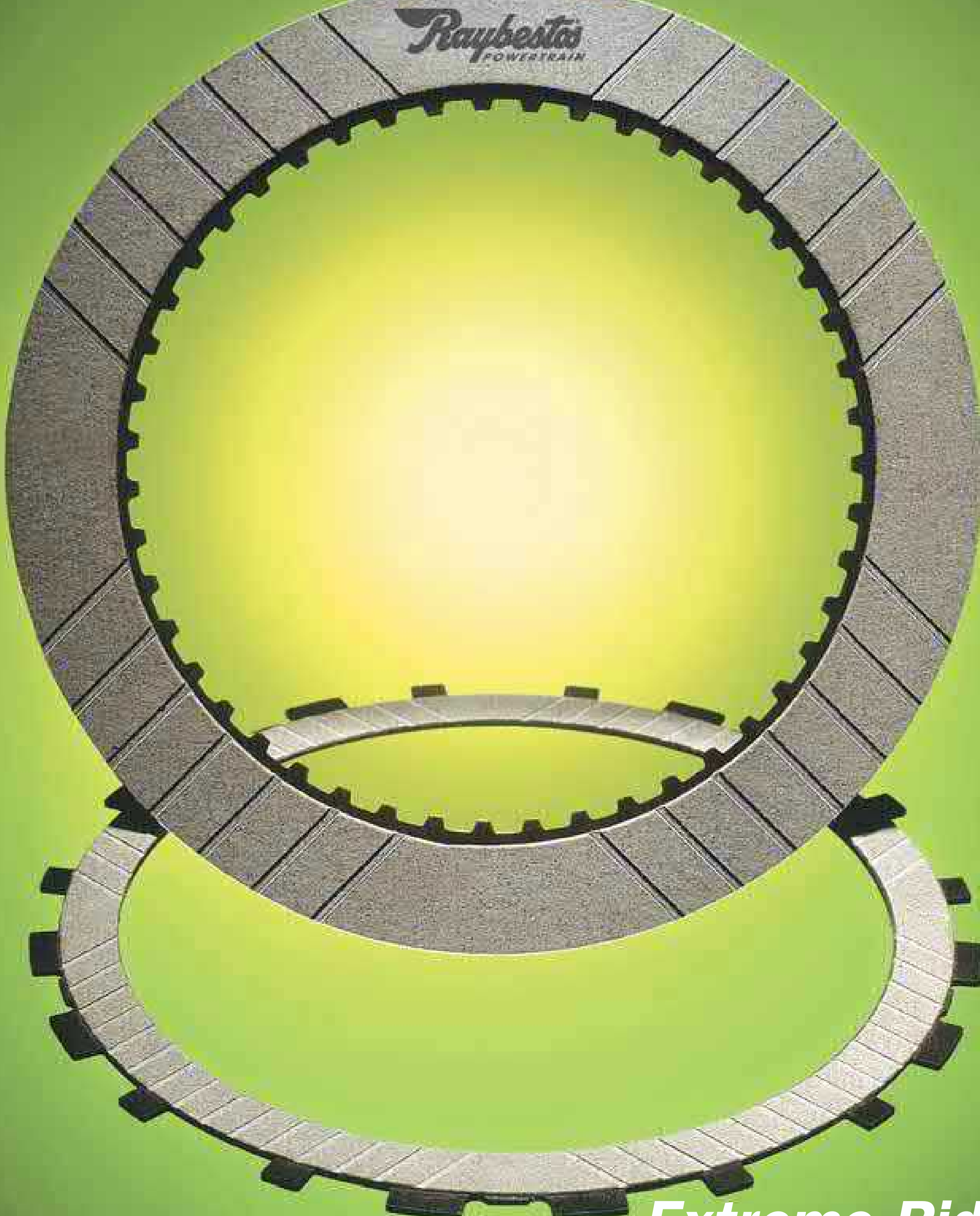
Raybestos
POWERTRAIN

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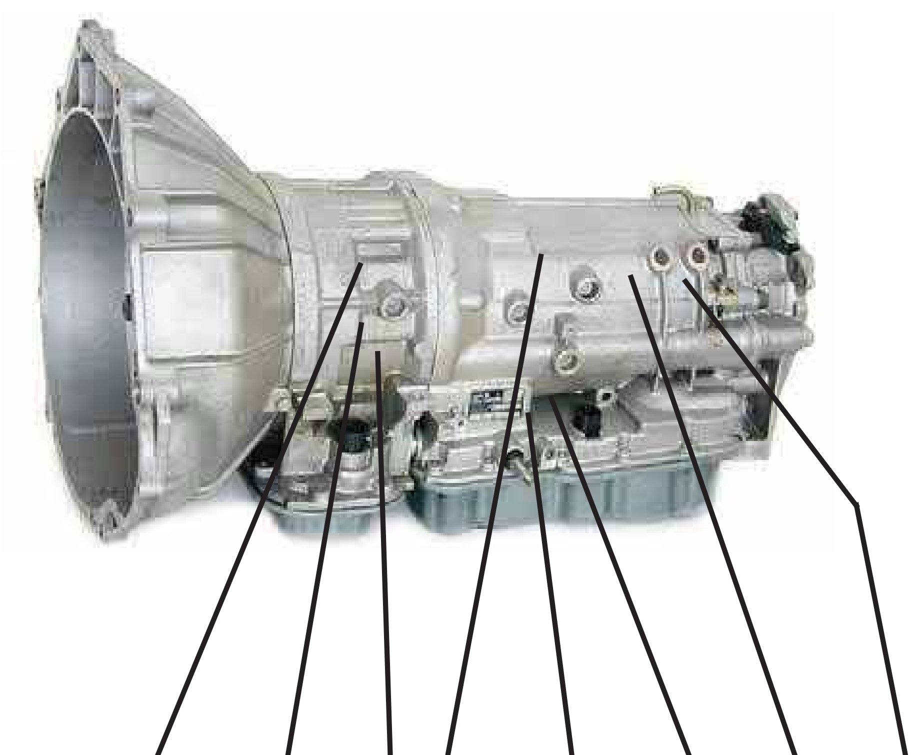
ATRA AD

4L30E Table Of Contents

4L30E

Clutch and Band Application Chart



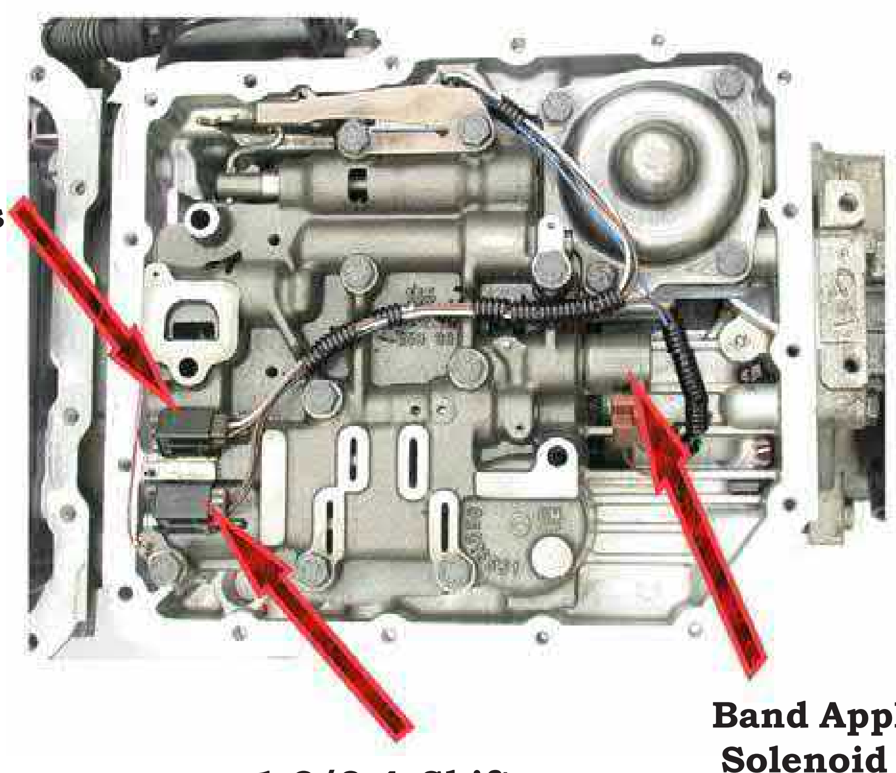
RANGE	GEAR	1-2/3-4 SOL. N.C.	2-3 SOL N.O.	OVERDRIVE ROLLER CLUTCH	OVERRUN CLUTCH	FOURTH CLUTCH	THIRD CLUTCH	REVERSE CLUTCH	SECOND CLUTCH	PRINCIPLE SPRAG ASSEMBLY	BAND ASSEMBLY	ENGINE BRAKING
P-N		OFF	ON		APPLIED							NO
R	REVERSE	OFF	ON	LD	APPLIED			APPLIED		LD		NO
D	1st	OFF	ON	LD	APPLIED					LD	APPLIED	NO
	2nd	ON	ON	LD	APPLIED				APPLIED	FW	APPLIED	YES
	3rd	ON	OFF	LD	APPLIED		APPLIED		APPLIED	NE		YES
	4th	OFF	OFF	FW		APPLIED	APPLIED		APPLIED	NE		YES
3	1st	OFF	ON	LD	APPLIED					LD	APPLIED	NO
	2nd	ON	ON	LD	APPLIED				APPLIED	FW	APPLIED	YES
	3rd	ON	OFF	LD	APPLIED		APPLIED		APPLIED	NE		YES
2	1st	OFF	ON	LD	APPLIED		APPLIED			LD	APPLIED	YES
	2nd	ON	ON	LD	APPLIED				APPLIED	FW	APPLIED	YES
1	1st	OFF	ON	LD	APPLIED		APPLIED			LD	APPLIED	YES

LD = LOCKED IN DRIVE	FW = FREEWHEELING	NE = NOT EFFECTIVE

4L30E

Solenoid Identification

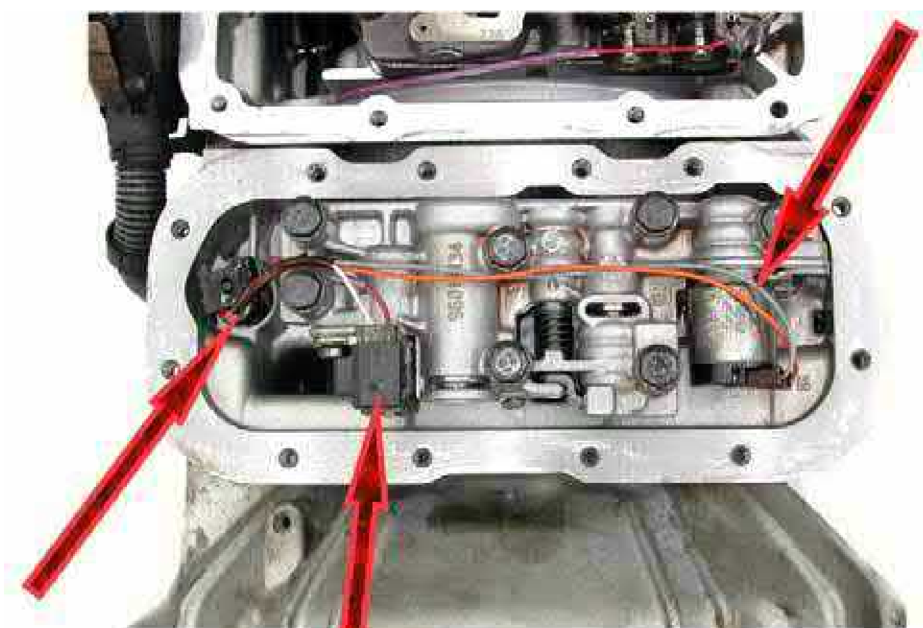
Always check the resistance of the solenoids and visually check the wire harness for damage. Keep in mind, the 2-3 shift solenoid is “normally open” and the 1-2/3-4 shift solenoid is “normally closed”.



4L30E

Solenoid Identification (continued)

Always check the resistance of the solenoids and visually check the wire harness for damage.



4L30E

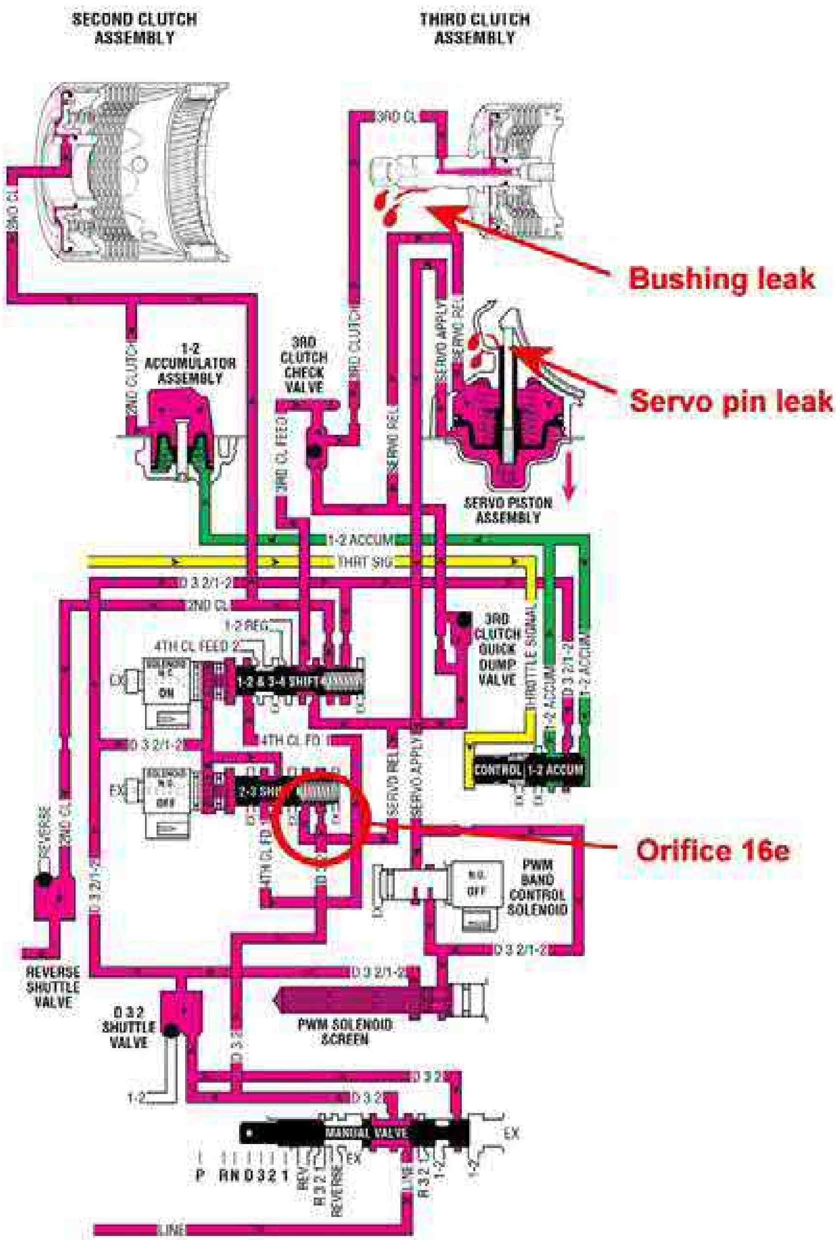
Band Failure, Binds In 3rd or 4th, Dragging Sensation

A common cause for the Band failure is the band being partially applied and dragging in 3rd or 4th gear. This is usually caused by insufficient servo release pressure, which can be the result of leaks in the 2nd clutch and/or 3rd clutch circuits. In this section we are going to review the servo release and related oil circuits, as well as what you need to check on every overhaul to prevent band failure.

4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation *(continued)*

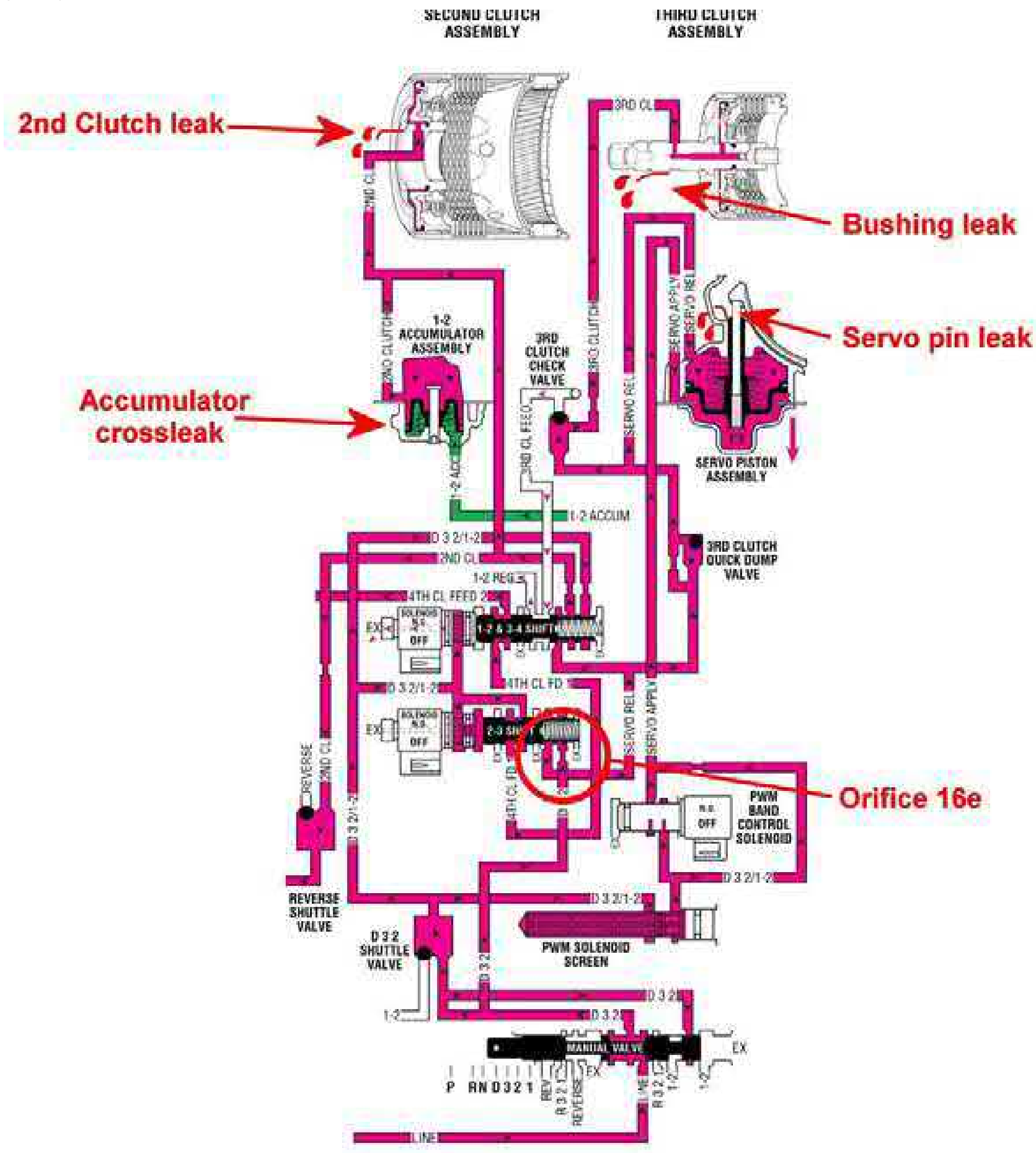
In third gear, the servo release and 3rd clutch are being fed through the #16e orifice.



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation *(continued)*

In fourth gear the 2nd clutch, is also fed through the #16e orifice. A leak in the second clutch circuit will cause a loss of servo release oil, resulting in a dragging band



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

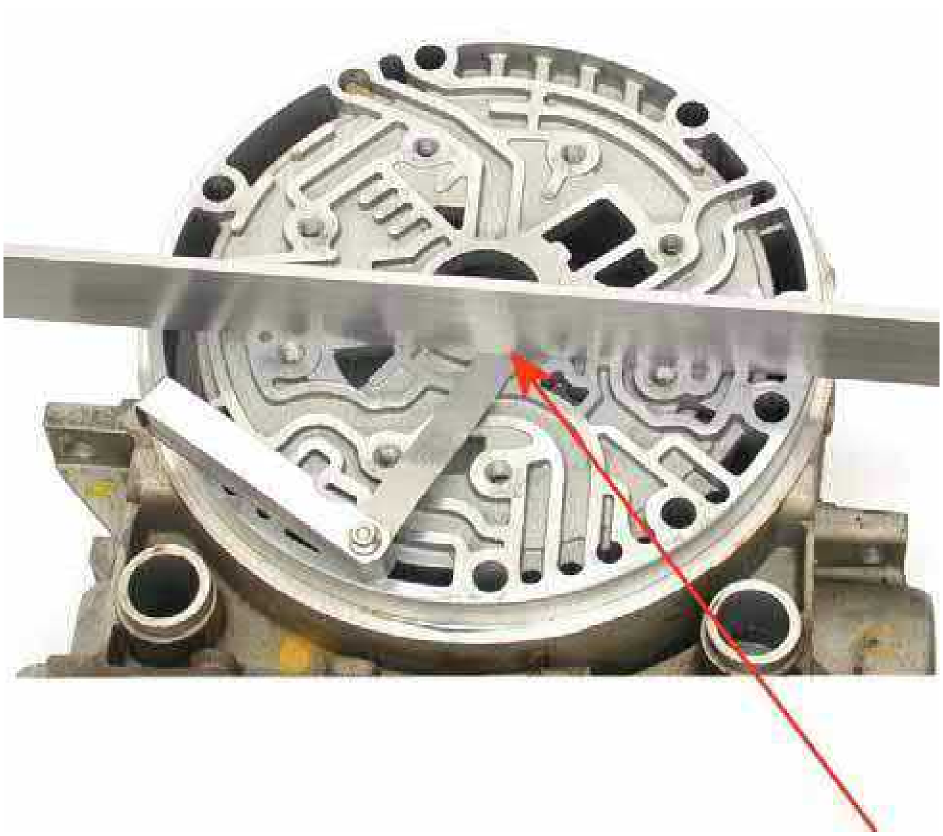
The 2nd clutch drum is a common failure. Closely inspect the drum for cracks in the ring bore chamfer.

Check here for cracks

4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation *(continued)*

Always use a straight edge and a feeler gauge across the adapter case in several places to check it for possible warpage. The bolt holes are usually the high spots. You should not be able to fit a 0.0015” feeler gauge under the straight edge surface. If you can, your adapter case is warped.

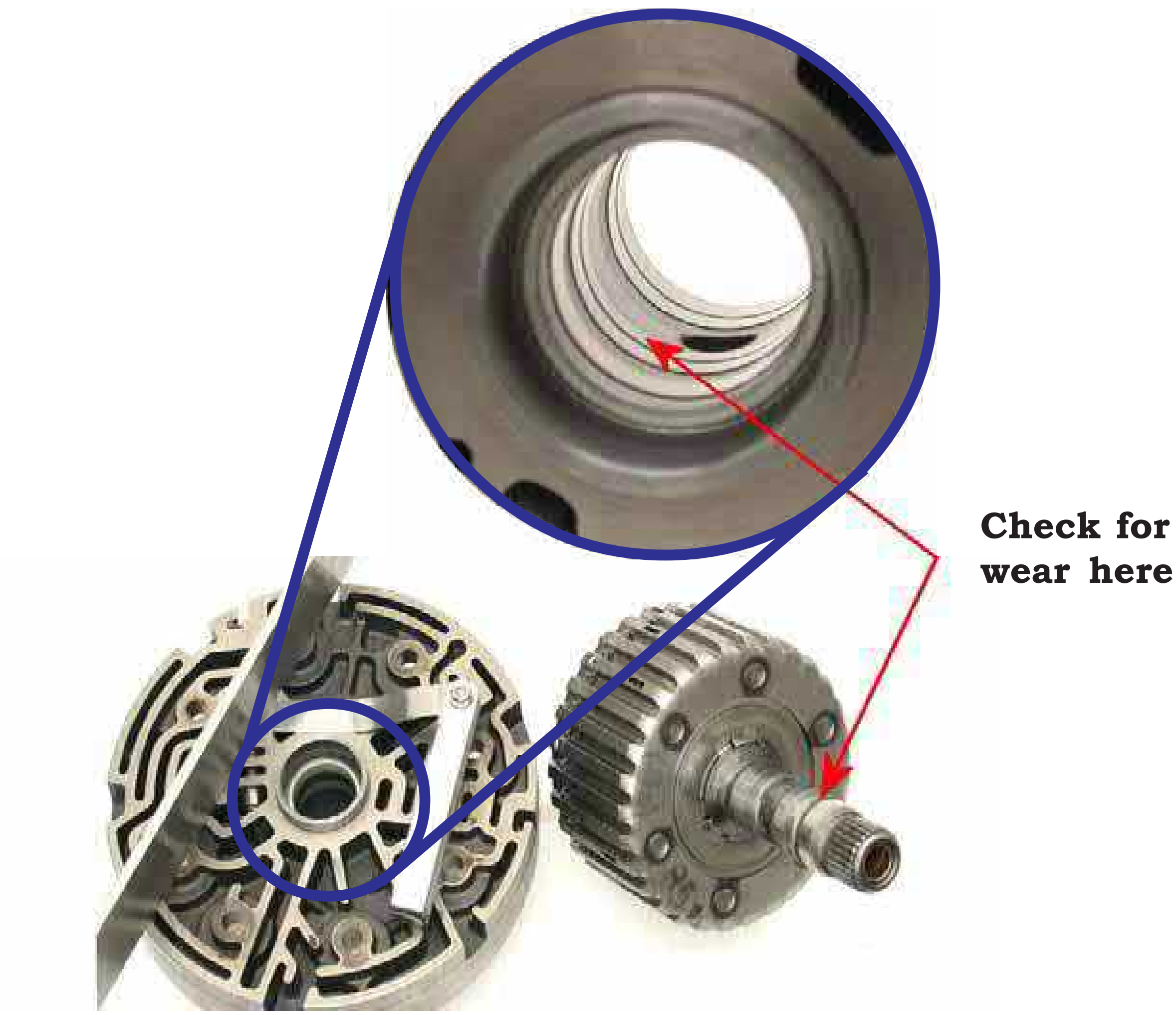


Any gap under the straight edge should not exceed 0.0015”

4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation (continued)

When checking the center support for warpage, use the same technique as the adapter case. Center support warpage should not exceed 0.0015”. Check the 3rd clutch drum shaft and center support bushing for wear or scoring. Keep in mind, the bushing seals the apply circuit; there are no sealing rings in this location.



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation *(continued)*

After removing the servo from the bore, check the inside area for wear.

Check for wear in these locations

4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation *(continued)*

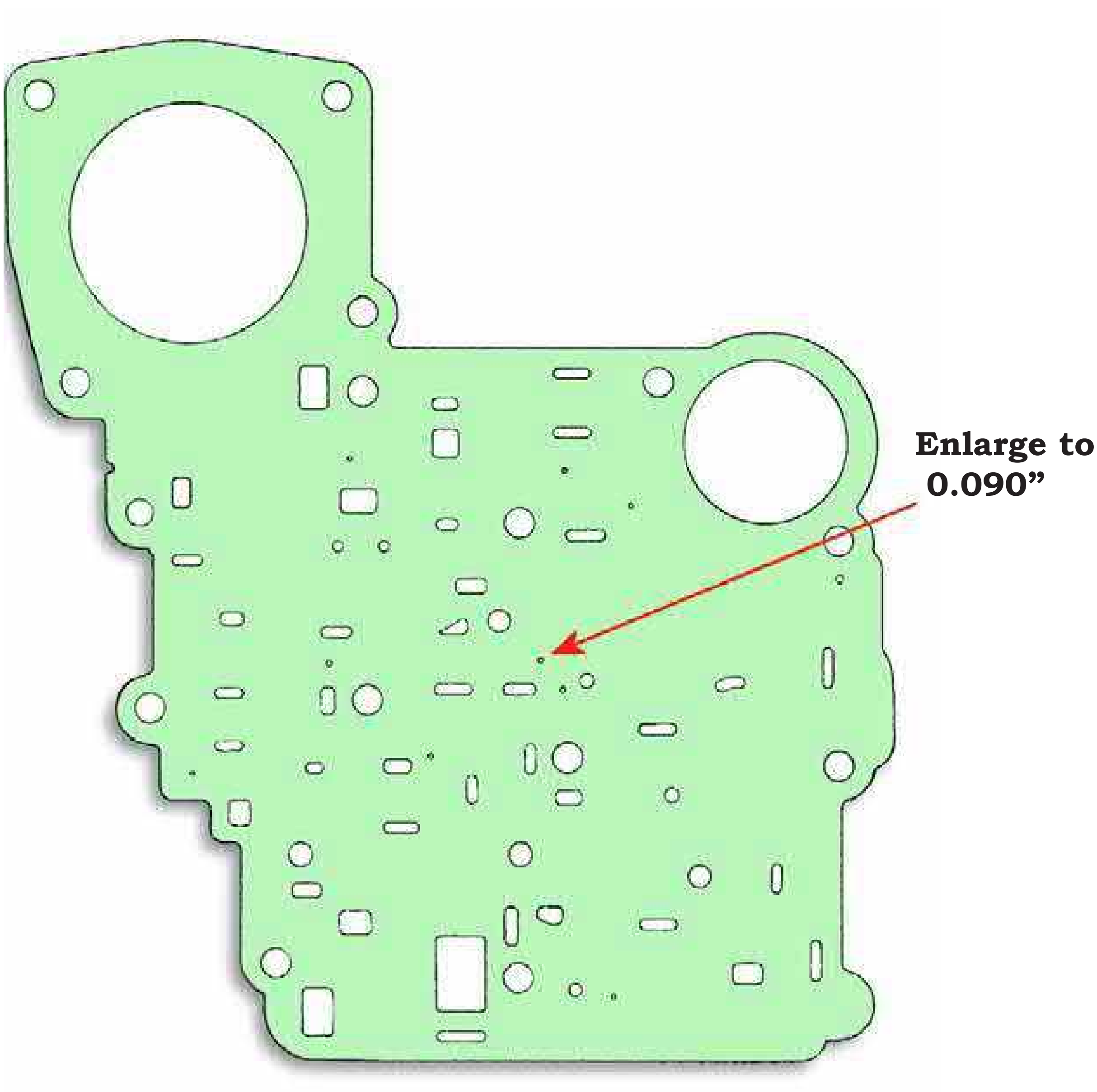
The servo release pressure port should always be drilled and tapped in the location shown below. Servo release pressure should be checked after every rebuild. There should be no more then 10 psi difference between the servo release pressure and main line pressure in 3rd and 4th gear.

Drill and Tap the hole with an 1/8” pipe tap

4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation *(continued)*

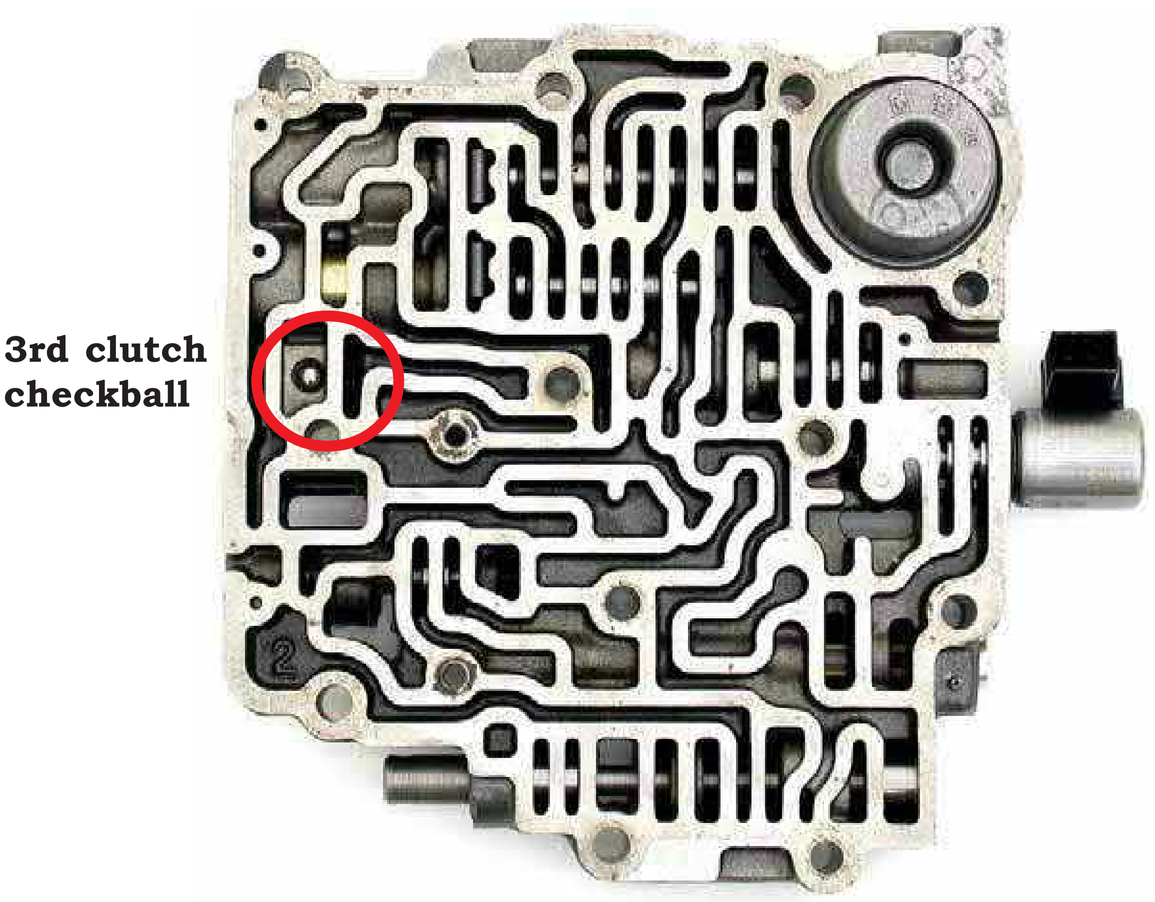
As a preventitive measure you can enlarge the feed orifice hole #16e to 0.090”.



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation *(continued)*

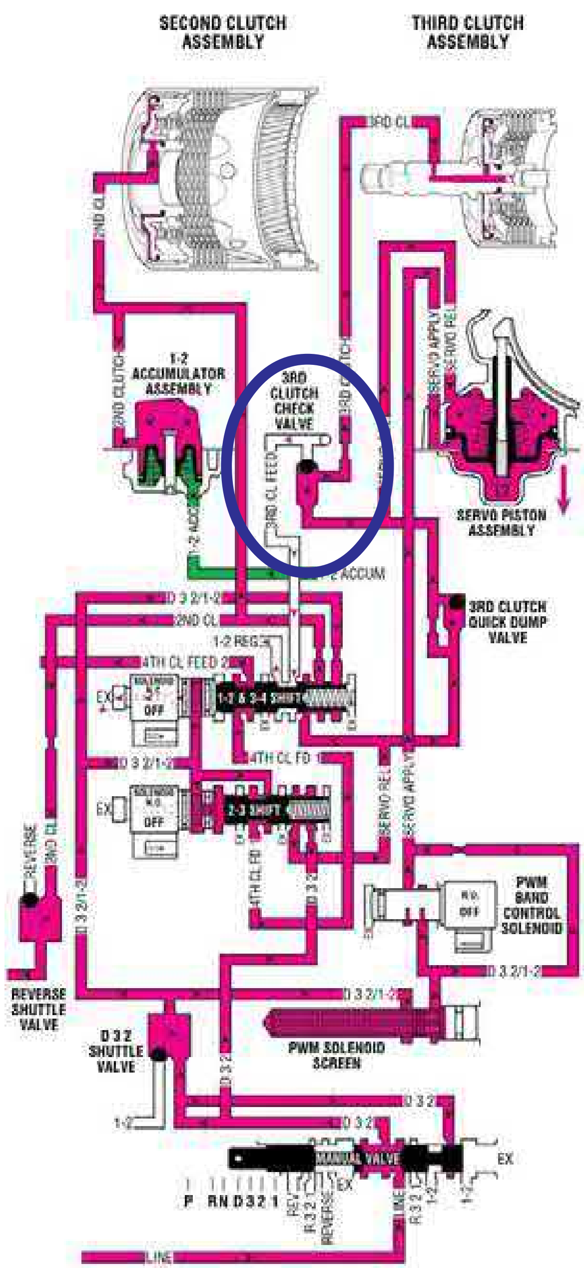
A bindup condition in 4th gear may be caused by a missing or leaking 3rd clutch checkball. When this checkball is missing, 1-2 servo release pressure can leak in 4th gear causing the 1-2 band to apply.



4L30E

Band Failure, Binds In 3rd or 4th, Dragging Sensation *(continued)*

A missing or leaking 3rd clutch checkball can cause the 1-2 servo release pressure to leak in 4th gear causing the 1-2 band to apply.



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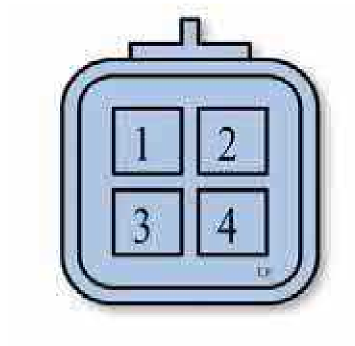
Case Connector ID

4 Pin Main Case Connector

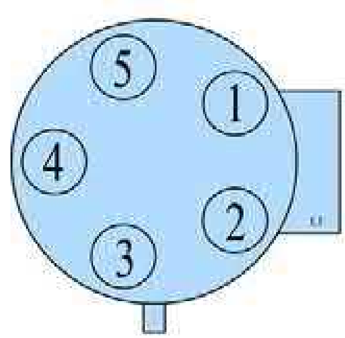
Pin	Function
1	2-3 Shift solenoid
2	Band apply solenoid
3	1-2/3-4 Shift solenoid
4	Ground from computer (Type 1 only)
	B+ from computer (All others)



Solenoid	Pins	Resistance
2-3 Shift solenoid	1 and 4	17-24ohms
Band apply solenoid	2 and 4	9-14 ohms
1-2/3-4 Shift solenoid	3 and 4	17-24 ohms

5 Pin Adapter Case Connector

Pin	Function
1	Fluid temperature sensor
2	TCC solenoid
3	Force motor (+)
4	Force motor (-)
5	Fluid temperature sensor



Solenoid	Pins	Resistance	
Force motor	3 and 4	3-6 ohms	
TCC solenoid	2 and ground	17-24 ohms	
Fluid temperature sensor	1 and 5	-40°F (-40°C)	672K ohms
		32°F (0°C)	65K ohms
		68°F (20°C)	25K ohms
		176°F (80°C)	2.5K ohms
		248°F (120°C)	780 ohms
		302°F (150°C)	370 ohms

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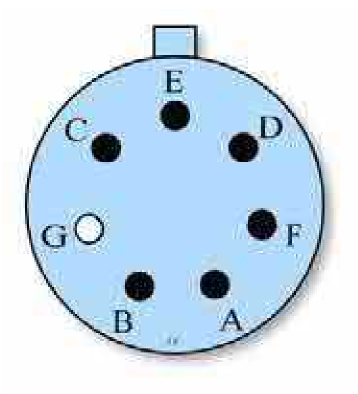
Case Connector ID (continued)

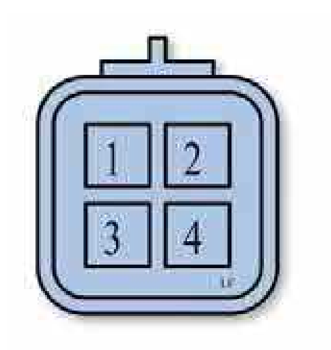
7Pin Main Case Connector



Pin	Function
A	2-3 Shift solenoid
B	Band apply solenoid
C	1-2/3-4 shift solenoid
D	B+ from computer
E	Fluid temperature sensor (-)
F	Fluid temperature sensor (+)
G	Not used

Solenoid	Pins	Resistance	
2-3 Shift solenoid	D and A	17-24 ohms	
Band apply solenoid	D and B	9-14 ohms	
1-2/3-4 Shift solenoid	D and C	17-24 ohms	
Fluid temperature sensor	E and F	-40°F (-40°C)	672K ohms
		32°F (0°C)	65K ohms
		68°F (20°C)	25K ohms
		176°F (80°C)	2.5K ohms
		248°F (120°C)	780 ohms
		302°F (150°C)	370 ohms

Solenoid	Pins	Resistance
Force motor	2 and 4	3-6 ohms
PWM TCC	1 and 3	9-14 ohms



Pin	Function
1	PWM TCC (+)
2	Force motor (+)
3	PWM TCC (-)
4	Force motor (-)

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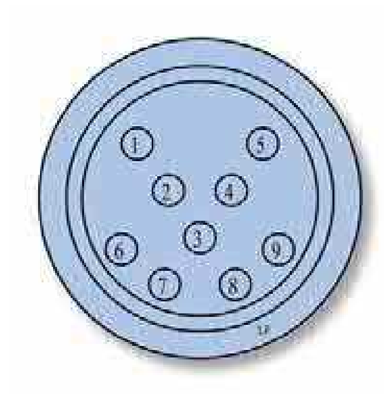
Case Connector ID (continued)

9 Pin Main Case Connector (BMW)

Pin	Function
1	Force motor
2	Fluid temperature sensor
3	Force motor
4	Fluid temperature sensor
5	2-3 Shift solenoid
6	B+ from computer
7	TCC solenoid
8	Band apply solenoid
9	1-2/3-4 Shift solenoid



Solenoid	Pins	Resistance	
2-3 Shift solenoid	6 and 5	17-24 ohms	
Band apply solenoid	6 and 8	9-14 ohms	
1-2/3-4 Shift solenoid	6 and 9	17-24 ohms	
Force motor	1 and 3	3-6 ohms	
TCC solenoid	6 and 7	17-24 ohms	
Fluid temperature sensor	2 and 4	-40°F (-40°C)	672K ohms
		32°F (0°C)	65K ohms
		68°F (20°C)	25K ohms
		176°F (80°C)	2.5K ohms
		248°F (120°C)	780 ohms
		302°F (150°C)	370 ohms

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Computer Types

Asian models

Type 1

1990-1993 Isuzu Rodeo and Trooper

Type 2

1994-1995 Isuzu Rodeo, Trooper, Amigo and Honda Passport

Type 3

1996-1999 Isuzu Rodeo, Trooper, Amigo, Vehicross, Honda Passport and Acura SLX

German models

Type 5

1997-1998 Cadillac Catera

Type 6

1996-2001 BMW
1999-2001 Cadillac Catera

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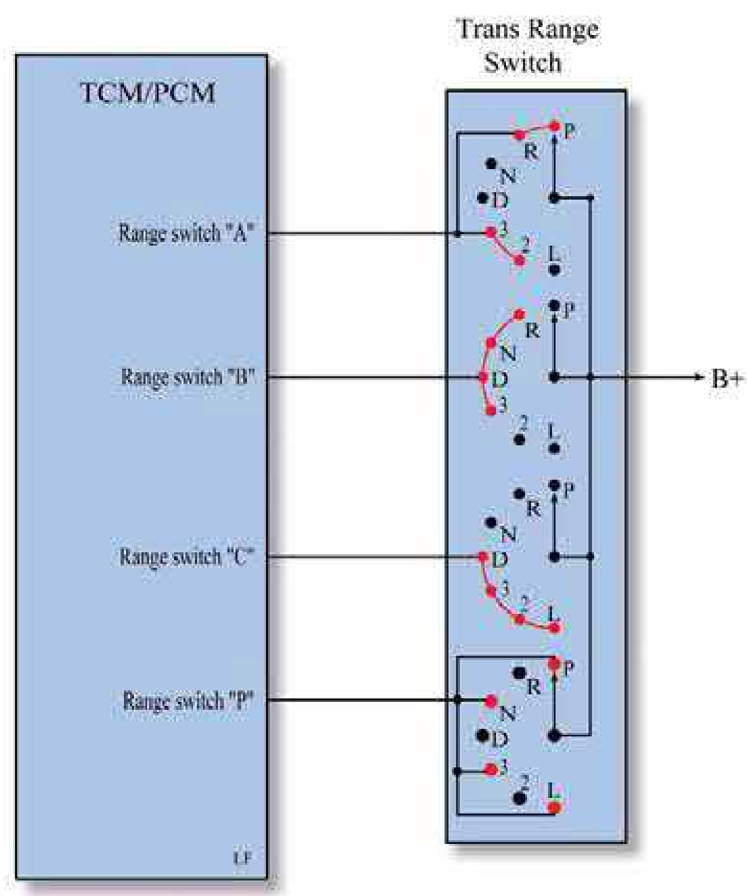
Range Switch All (except BMW)



Range switch voltages (all except BMW)							
	P	R	N	D	3	2	L
Switch “A”	B+	B+	0v	0v	B+	B+	0v
Switch “B”	0v	B+	B+	B+	B+	0v	0v
Switch “C”	0v	0v	0v	B+	B+	B+	B+
Switch “P”	B+	0v	B+	0v	B+	0v	B+

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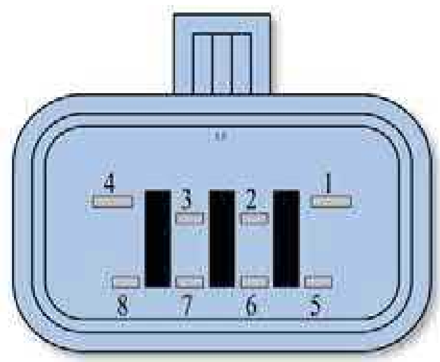
Range Switch All (except BMW) (continued)



Range switch continuity (all except BMW)							
	P	R	N	D	3	2	L
Pins 5 to 8	•	•			•	•	
Pins 5 to 7		•	•	•	•		
Pins 5 to 6				•	•	•	•
Pins 5 to 3	•		•		•		•

Note: . =continuity

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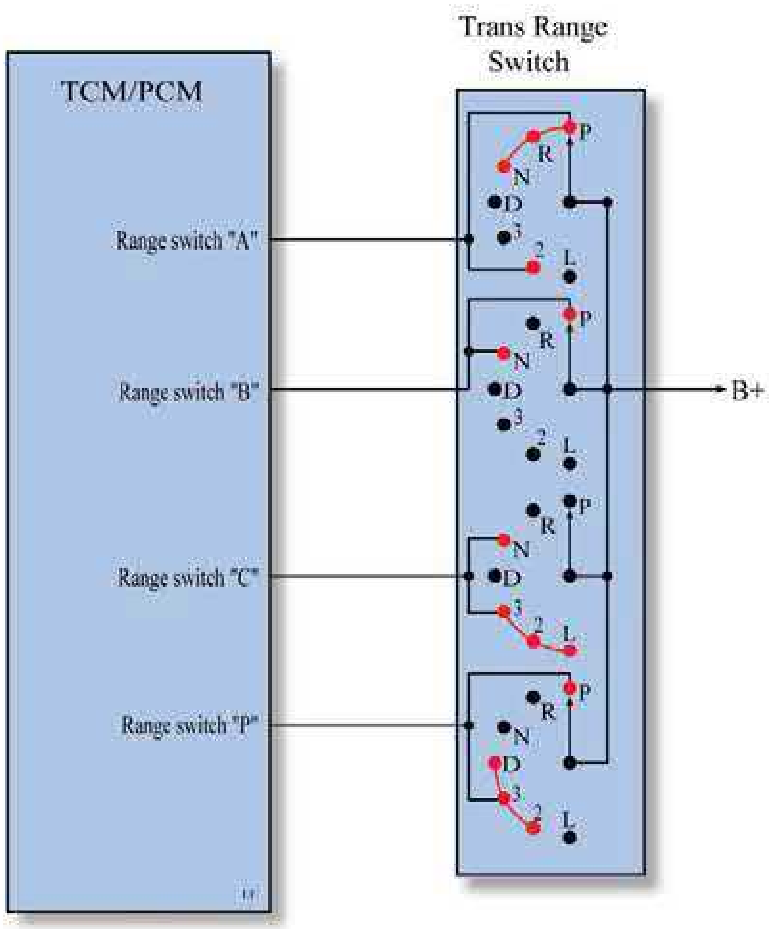
Range Switch BMW (only)



Range switch voltages (BMW)							
	P	R	N	D	3	2	L
Switch "A"	B+	B+	B+	0v	0v	B+	0v
Switch "B"	B+	0v	B+	0v	0v	0v	0v
Switch "C"	0v	0v	B+	0v	B+	B+	B+
Switch "P"	B+	0v	0v	B+	B+	B+	0v

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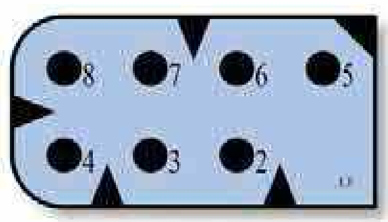
Range Switch BMW (only) (continued)



Range switch continuity (BMW)							
	P	R	N	D	3	2	L
Pins 5 to 4	•	•	•			•	
Pins 5 to 7	•		•				
Pins 5 to 6			•		•	•	•
Pins 5 to 8	•			•	•	•	

Note: . =continuity

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VSS (Pulse Generator)

The VSS voltage output is 1-30 volts AC when the output shaft is spinning. The resistance is 2.8-3.0K ohms.

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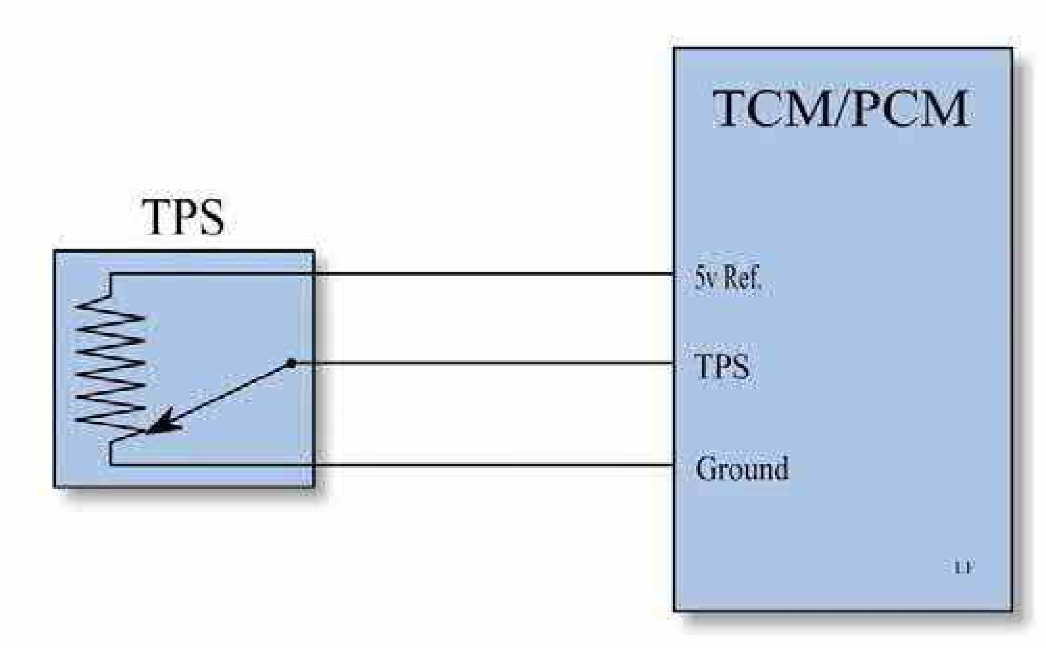
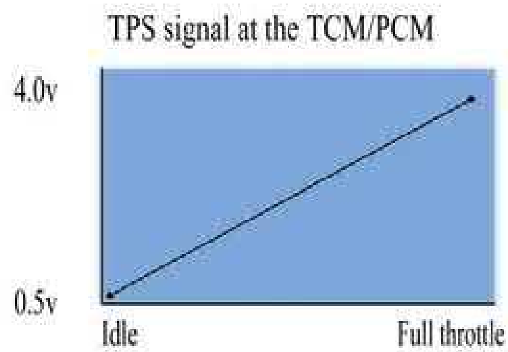
TPS Circuit Types 1-3

When working on vehicles with either type 1, 2, or 3 computer system, the TPS voltage can be monitored at the TPS and/or the TCM/PCM.





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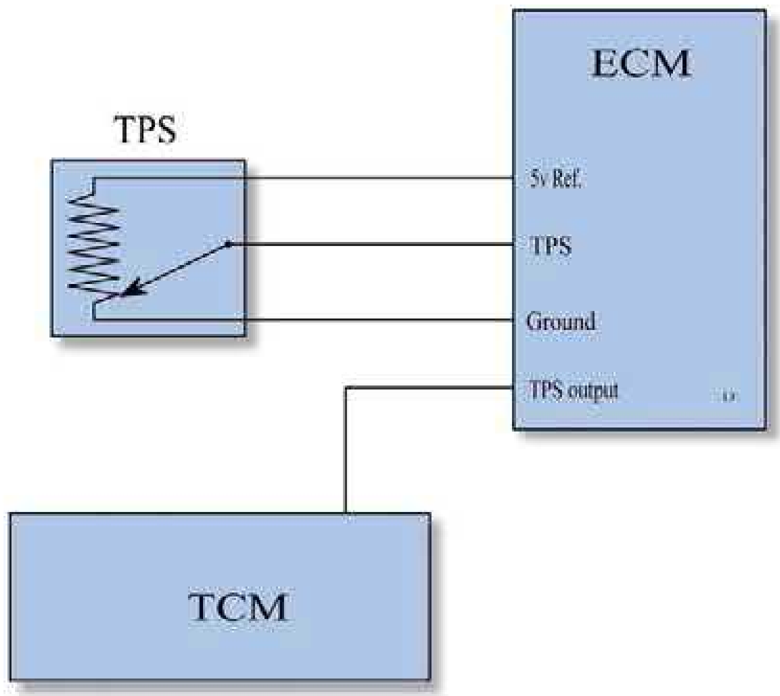
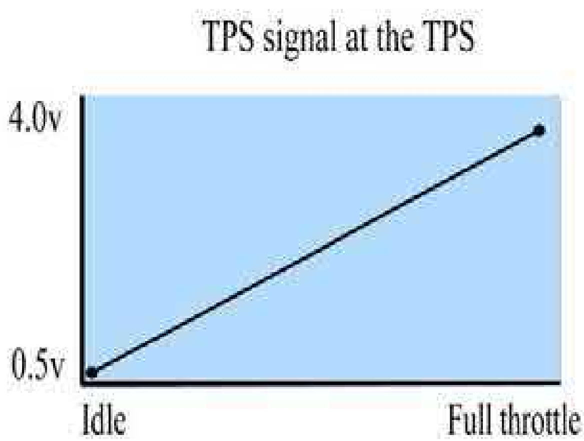
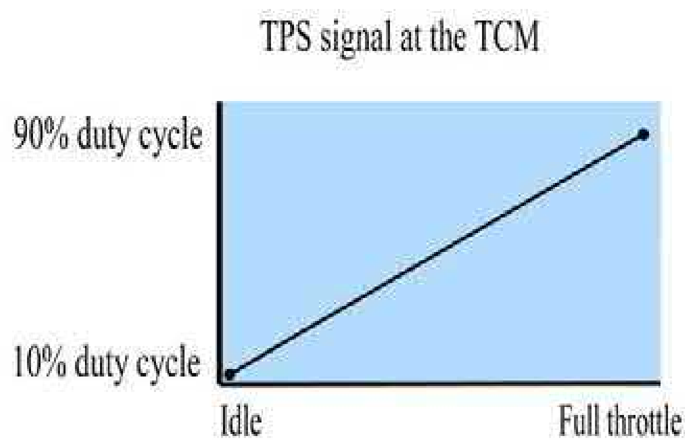
TPS Circuit Type 5

When working on a vehicle with a type 5 computer, the TPS voltage can be monitored at the TPS only. The ECM converts the TPS signal to a varying duty cycle and sends this signal to the TCM. Therefore, when monitoring the TPS signal at the TCM, you must set your voltmeter to read duty cycle.







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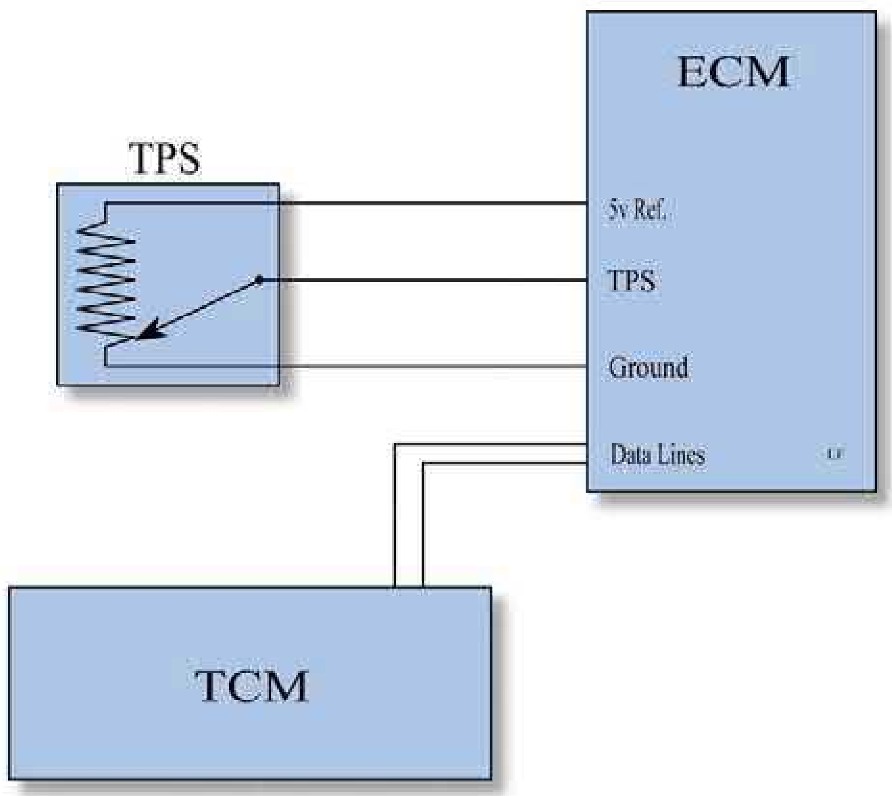
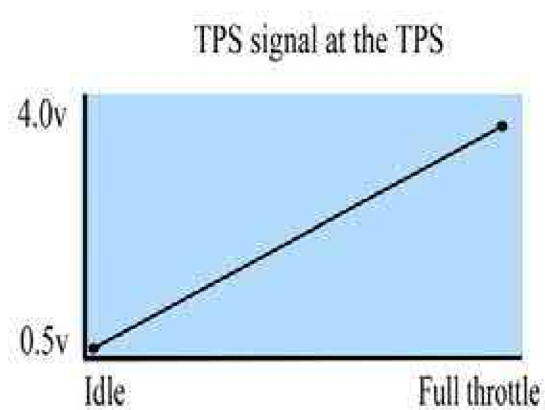
TPS Circuit Type 6

When working on a vehicle with a type 6 computer, the TPS voltage can be monitored at the TPS only. The ECM transmits the TPS signal to the TCM through the data lines and CAN NOT be monitored at the TCM with a voltmeter.





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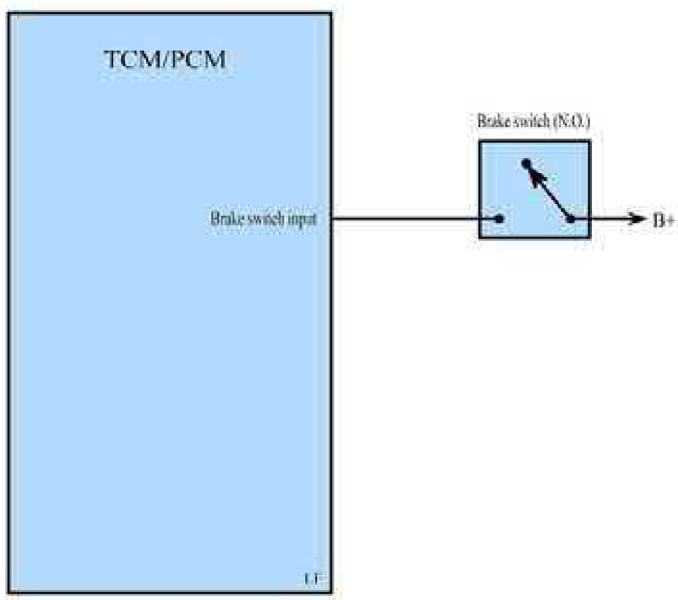
Brake Switch Circuit All (except Type 1)

With the exception of the type 1 computer system, the brake switch simply sends a signal to the TCM/PCM when the brake pedal is depressed. The computer uses this input to decide whether or not to command lockup.



Brake released = 0 volts

Brake depressed = B+

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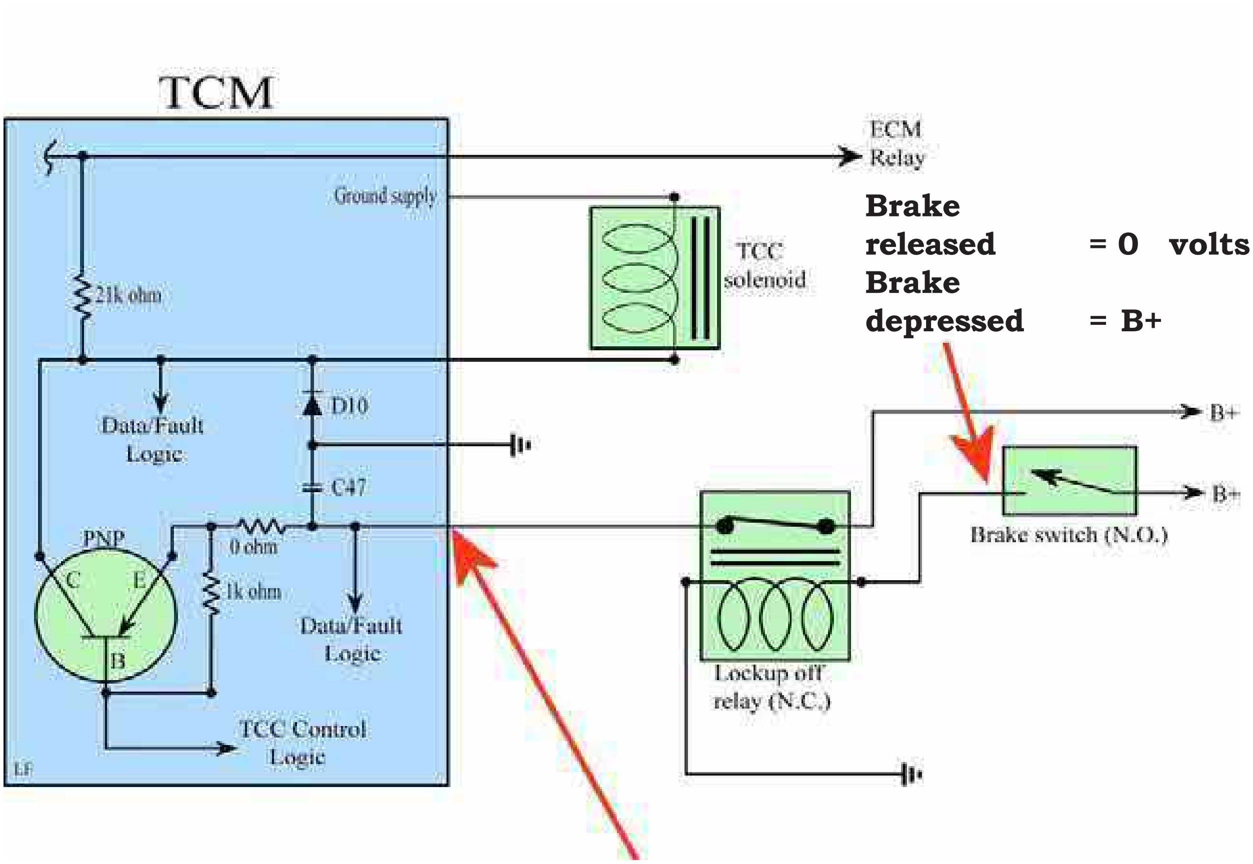
Brake Switch Circuit Type 1

Although the computer decides whether or not to command lockup, the type 1 computer actually uses the voltage from the lockup off relay to turn the TCC solenoid on. A bad brake switch or a bad lockup off relay can cause a “no TCC apply” without setting any trouble codes.



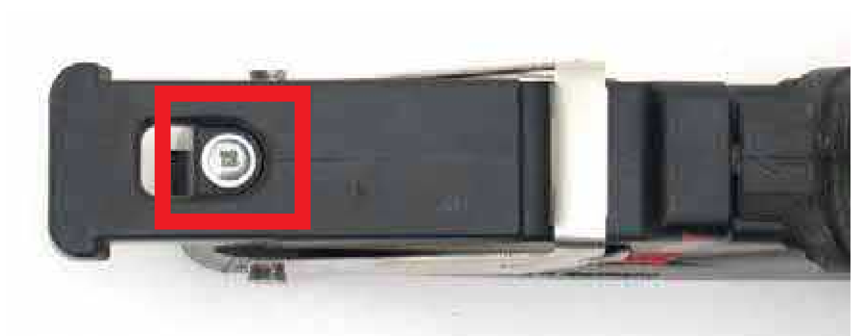
Brake released = B+
Brake depressed = 0 volts

4L30E

Diagnosing at the TCM

Removing the shield from the TCM (type 1, 5 and 6 connectors)

Remove the screw from the connector shield.



Remove the tape and/or tie from the harness.

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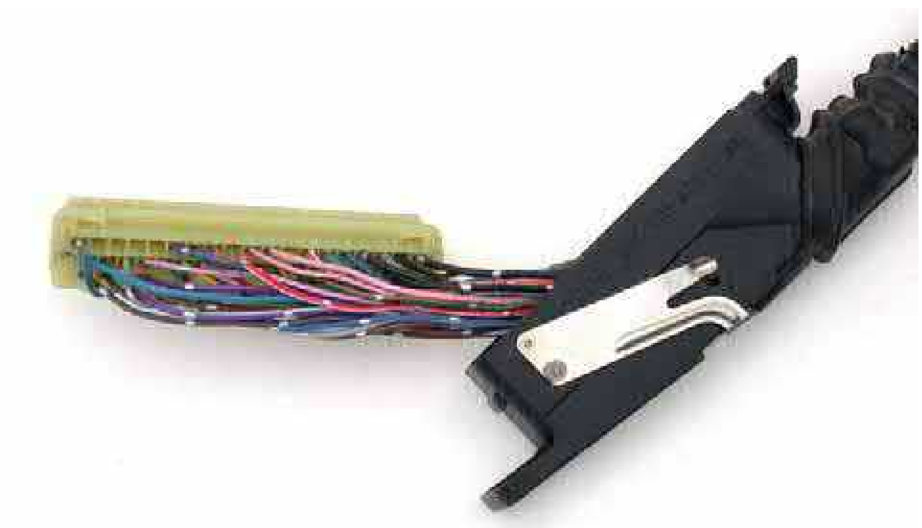
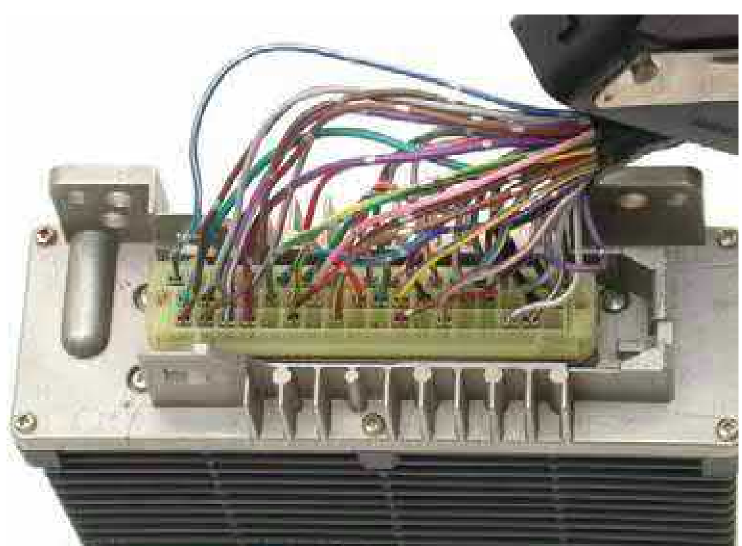
Diagnosing at the TCM (continued)

Removing the shield from the TCM (type 1, 5 and 6 connectors)



Slide the shield up the harness and away from the connector

Reconnect the computer connector



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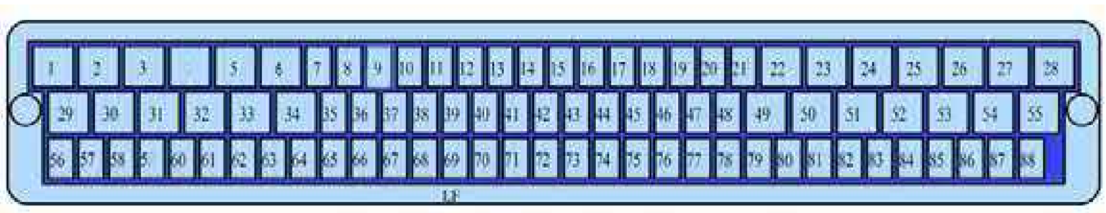
TCM Pin Charts (Type 1)



Pin	Function	Condition	Signal
1	A/C request	Compressor off	< 1v
		Compressor on	B+
2	Cruise control		
3	N/A	-	-
4	N/A	-	-
5	N/A	-	-
6	TPS (varying voltage)	Idle	0.5 v
		Full throttle	4.0 v
7	Power mode indicator	Light off	B+
		Light on	< 0.1v
8	Range selector pin C	Manual D, 3, 2 & L	B+
		All others	0v
9	N/A	-	-
10	Winter mode indicator	Light off	B+
		Light on	< 0.1v
11	Engine RPM (some models)	Engine running	DC frequency
12	N/A	-	-
13	Diagnostic	-	-
14	VSS ground	Always	< 0.1v
15	Kickdown switch	Full throttle	< 0.1v
		All others	B+
16	Ground	Always	< 0.1v
17	Ground	Always	< 0.1v
18	Ground	Always	< 0.1v

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TCM Pin Charts (Type 1) (continued)

Pin	Function	Condition	Signal
19	Ground	Always	< 0.1v
20	VSS signal	Vehicle stopped	0v AC
		Vehicle moving	Above 1v AC
21	A/C cut relay		
22	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms
23	Range selector pin A	Manual P, R, 3, 2	B+
		All others	0v
24	5 V reference voltage	Key off	0v
		Key on	5v
25	Diagnostic enable	Normal	B+
		During code retrieval	0v
26	Range selector pin B	Manual R, N, D, 3	B+
		All others	0v
27	N/A	-	-
28	Keep alive power	Always	B+
29	Check trans indicator	Light off	B+
		Light on	< 0.1v
30	Coolant temp	Engine temp cold	5v
		Engine temp warm	< 0.1v
31	Winter mode switch	Switch released	B+
		Switch depressed	< 0.1v
32	N/A	-	-
33	Range selector pin P	Manual P, N, 3 & L	B+
		All others	0v
34	Power mode switch	Switch released	B+
		Switch depressed	< 0.1v
35	N/A	-	-
36	Ground	Always	< 0.1v
37	Ignition	Key off	0v
		Key on	B+

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TCM Pin Charts (Type 1) (continued)

Pin	Function	Condition	Signal
38	TCC Solenoid	Lockup off	0v
		Lockup on	B+
39	Brake switch	Brake released	B+
		Brake depressed	< 0.1v
40	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
41	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
42	N/A	-	-
43	2-3 solenoid	Solenoid off	0v
		Solenoid on	B+
44	N/A	-	-
45	Band apply solenoid	During drive engagement	Approx. 75% duty cycle
		After engagement	0% Duty cycle (sol off)
		During a 3-2 or 3-1 kickdown & 3-2 coast down	25%-75% Duty cycle
46	N/A	-	-
47	N/A	-	-
48	1-2 / 3-4 solenoid	Solenoid Off	0v
		Solenoid On	B+
49	N/A	-	-
50	Barometric sensor (some models)		
51	N/A	-	-
52	N/A	-	-
53	Reference voltage	Key off	0v
		Key on	5v
54	Solenoid ground	Normal operation	< 0.1v
		W/solenoid codes	B+
55	Engine RPM (some models)	Engine running	DC frequency

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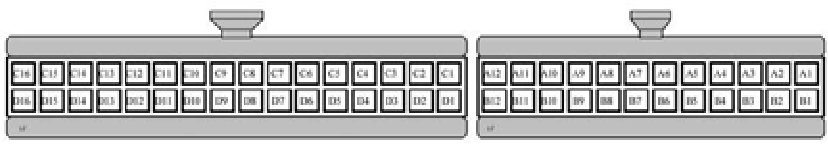
TCM Pin Charts (Type 2)



Pin	Function	Condition	Signal
A1	N/A	-	-
A2	1-2/3-4 Solenoid	Sol on	< 1v
		Sol off	B+
A3	2-3 Solenoid	Sol on	< 1v
		Sol off	B+
A4	Keep alive power	Always	B+
A5	N/A	-	-
A6	N/A	-	-
A7	Power from ECM main Relay	Key off	0v
		Key on	B+
A8	Power from ECM main Relay	Key off	0v
		Key on	B+
A9	Band apply solenoid	During drive engagement	Approx. 75% Duty cycle
		After engagement	0% Duty cycle (sol off)
		During a 3-2 or 3-1 kickdown & 3-2 coast down	25%-75% Duty cycle
A10	A/T fluid temp light	Light off	B+
		Light on	< 0.1v
A11	Winter mode indicator light	Light off	B+
		Light on	< 0.1v
A12	Output speed sensor	Wheels stopped	0V
		Wheels spinning	Above 1v AC
B1	N/A	-	-
B2	N/A	-	-
B3	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms

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TCM Pin Charts (Type 2) (continued)

Pin	Function	Condition	Signal
B4	Cruise control	Button depressed	< 1v
		Button released	B+
B5	Kickdown switch	Full throttle	< 0.1v
		All others	B+
B6	Winter mode switch	Button released	B+
		Button depressed	< 0.1v
B7	N/A	-	-
B8	Power switch	Button released	B+
		Button depressed	< 0.1v
B9	Power indicator light	Light off	B+
		Light on	< 0.1v
B10	R&L output to antilock brake system (some models)	-	-
B11	VSS shield ground	Always	< 0.1v
B12	VSS signal ground	Always	< 0.1v
C1	Ground	Always	< 0.1v
C2	N/A	-	-
C3	Sensor ground (some vehicles)	Always	< 0.1v
C4	N/A	-	-
C5	TPS (varying voltage)	Idle	0.5v
		Full throttle	4.0v
C6	Ground	Always	< 0.1v
C7	TCC solenoid	Sol off	0v
		Sol on	B+
C8	Data link	Key off	0v
		Key on	5v
C9	N/A	-	-
C10	Check trans indicator light	Light off	B+
		Light on	< 0.1v
C11	N/A	-	-
C12	Power relay output to main case solenoid	Key off	0v
		Key on	B+
C13	N/A	-	-

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TCM Pin Charts (Type 2) (continued)

Pin	Function	Condition	Signal
C14	Fluid temp sensor ground	Always	< 0.1v
C15	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
C16	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
D1	Ground	Always	< 0.1v
D2	BARO sensor		
D3	5 volt reference (some vehicles)	Key off	0v
		Key on	5v
D4	Trans range position "P"	P, N, 3, L	B+
		All others	0v
D5	Trans range position "C"	D, 3, 2, L	B+
		All others	0v
D6	Trans range position "B"	R, N, D, 3	B+
		All others	0v
D7	Trans range position "A"	P, R, 3, 2	B+
		All others	0v
D8	A/C on input	Compressor off	< 1v
		Compressor on	B+
D9	Brake input	Brake released	0v
		Brake depressed	B+
D10	N/A	-	-
D11	N/A	-	-
D12	Engine RPM signal	Engine running	DC frequency
D13	N/A	-	-
D14	Coolant temp switch from ECM	Cold	5v
		Warm	< 0.1v
D15	N/A	-	-
D16	Diagnostic input	During diagnostics	0v
		All others	5v

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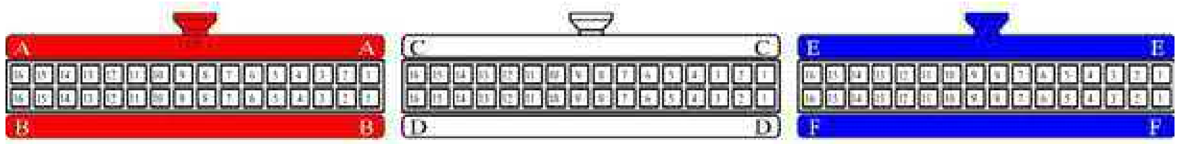
TCM Pin Charts (Type 3)



Pin	Function	Condition	Signal
A1	5v reference to TPS	Key off	0v
		Key on	5v
A2	Knock sensor		
A3			
A4	Keep alive power	Always	B+
A5	Idle air control valve		
A6	Idle air control valve		
A7	Idle air control valve		
A8	Idle air control valve		
A9	Fluid temp light	Light off	B+
		Light on	< 0.1v
A10	Winter mode indicator light	Light off	B+
		Light on	< 0.1v
A11	Power mode indicator light	Light off	B+
		Light on	< 0.1v
A12	EHCU		
A13	Malfunction indicator lamp		
A14	Check trans indicator light	Light off	B+
		Light on	< 0.1v
A15	VSV duty solenoid		
A16	Band apply solenoid	During drive engagement	Approx.50-75% Duty cycle
		After engagement	0% Duty cycle (sol off)
		During a 3-2 or 3-1 Kickdown & 3-2 coast down	25%-75% (-) Duty cycle
B1			
B2	Ignition coil #4		
B3	Ignition coil #2		

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TCM Pin Charts (Type 3) (continued)

Pin	Function	Condition	Signal
B4	Ignition coil #6		
B5	Fuel tank sensor		
B6	Vapor sensor		
B7	EGR		
B8	Intake air temperature sensor		
B9			
B10	Power steering pressure switch		
B11			
B12	Tail relay		
B13	Class 2 data		
B14	A/C compressor relay		
B15	Low fuel warning light		
B16	Fuel gauge		
C1	Injector #4		
C2	2-3 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
C3	Injector #6		
C4	Ignition coil #1		
C5	Crank position sensor		
C6			
C7	Ground	Always	< 0.1v
C8	Ground	Always	< 0.1v
C9	Ground	Always	< 0.1v
C10	Tachometer		
C11	VSV intake air		
C12	AC generator		
C13	Canister purge		
C14	O2 B		
C15	O2 B		
C16	O2 D		
D1	Injector #2		
D2	TCC solenoid	Solenoid off	< 1v
		Solenoid on	B+
D3	Injector #1		

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TCM Pin Charts (Type 3) (continued)

Pin	Function	Condition	Signal
D4	Serial data	Key on	5v
D5	Ignition coil #5		
D6	Ignition coil #3		
D7	VSS (meter)	Wheels turning	DC freqency
D8	Ground	Always	< 0.1v
D9	Ground	Always	< 0.1v
D10	Mass air flow		
D11	Cam position sensor		
D12	O2 C		
D13	O2 C		
D14	O2 A		
D15	O2 A		
D16	O2 D		
E1	VSS (+)	Wheels stopped	0V
		Wheels spinning	Above 1v AC
E2	VSS (-)	Always	< 0.1v
E3	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
E4	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
E5	Ignition	Key off	0v
		Key on	B+
E6	EGR		
E7	Trans range position "B"	R, N, D, 3	B+
		All others	0v
E8	TPS	Idle	0.5v
		Full throttle	4.0-4.3v
E9	Coolant temperature	Operating temp	Approx 2.0-2.5 v
E10			
E11			
E12	Trans range position "A"	P, R, 3, 2	B+
		All others	0v
E13	To fuel pump relay		

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TCM Pin Charts (Type 3) (continued)

Pin	Function	Condition	Signal
E14	Power relay output ok to excep TCC Solenoid	Key off	0v
		Engine running	B+
E15	A/C thermo relay		
E16	Power from PCM main relay	Key off	1.0-2.0v
		Key on	B+
F1			
F2	Trans range position "C"	D, 3, 2, L	B+
		All others	0v
F3	Trans range position "P"	P, N, 3, L	B+
		All others	0v
F4	Brake switch	Brake released	0v
		Brake applied	B+
F5	Power switch	Switch released	B+
		Switch depressed	< 0.1v
F6	Winter mode switch	Switch released	B+
		Switch depressed	< 0.1v
F7	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms
F8	MAP sensor	Idle	1.0-1.4 v
		Full stall	4.5-4.9v
F9			
F10	Cruise control	Off	B+
		On	< 1v
F11	Kickdown switch	Full throttle	< 0.1v
		All other	B+
F12	Serial data		
F13	Injector #3		
F14	1-2/3-4 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
F15	Injector #5		
F16	Power from PCM main relay	Key off	1.0-2.0v
		Key on	B+

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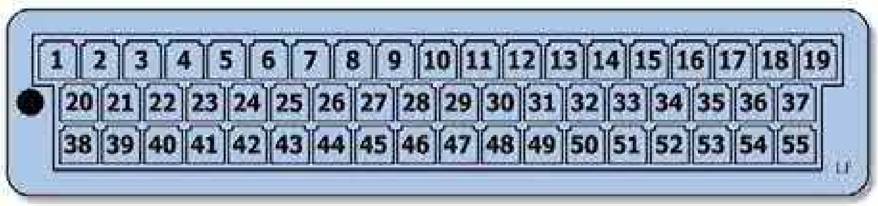
TCM Pin Charts (Type 5) *(continued)*



Pin	Function	Condition	Signal
1	P/N out	In Park or neutral	< 0.1v
		All other ranges	9.0-13.5v
2	N/A	-	-
3	VSS (+) (between pin 3 &5)	Wheels spinning	Above 1v AC
4	Torque control output to ECM	During upshift	Varies duty cycle 3-4 pulses
5	VSS (-) (between pin 3 &5)	Wheels spinning	Above 1v AC
6	N/A	-	-
7	Sport mode indicator	Light off	B+
		Light on	< 0.1v
8	Trans range position "C"	D, 3, 2, L	B+
		All others	0v
9	Traction control torque reduction request input (always 100 Hz)	Normal	80-90% duty
		Active	30-40% duty
10	N/A	-	-
11	Engine RPM signal	Engine running	DC frequency
12	Winter mode indicator light	Light off	B+
		Light on	< 0.1v
13	Serial data		
14	N/A	-	-
15	Kickdown switch (some models)	Full throttle	< 0.1v
		All other	B+
16	Fluid temp sensor ground	Always	< 0.1v
17	N/A	-	-
18	VSS shield ground	Always	< 0.1v
19	Ground	Always	< 0.1v
20	N/A	-	-

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TCM Pin Charts (Type 5) (continued)

Pin	Function	Condition	Signal
21	A/C request input	Compressor off	< 1v
		Compressor on	B+
22	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms
23	Trans range position "A"	P, R, 3, 2	B+
		All others	0v
24	N/A	-	-
25	N/A	-	-
26	Trans range position "B"	R, N, D, 3	B+
		All others	0v
27	N/A	-	-
28	Keep alive power	Always	B+
29	Check trans indicator light	Light off	B+
		Light on	< 1v
30	N/A	-	-
31	Winter mode switch	Switch released	B+
		Switch depressed	< 0.1v
32	Data output to ECM		
33	Trans range position "P"	P, N, 3, L	B+
		All others	0v
34	Sport mode switch	Switch released	B+
		Switch depressed	< 0.1v
35	Ground	Always	< 0.1v
36	N/A	-	-
37	Ignition	Key off	0v
		Key on	B+
38	TCC solenoid	Solenoid off	B+
		Solenoid on	< 1v

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TCM Pin Charts (Type 5) (continued)

Pin	Function	Condition	Signal
39	Brake switch	Brake released	< 1v
		Brake depressed	B+
40	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
41	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
42	N/A	-	-
43	2-3 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
44	Torque reduction signal	Varies with TPS	25-60%
45	Band apply solenoid	During drive engagement	Approx. 75% Duty cycle
		After engagement	0% Duty cycle (sol off)
		During a 3-2 or 3-1 Kickdown & 3-2 coast down	25%-75% Duty cycle
46	N/A	-	-
47	N/A	-	-
48	1-2/3-4 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
49	N/A	-	-
50	N/A	-	-
51	N/A	-	-
52	N/A	-	-
53	N/A	-	-
54	Power relay output to 1-2/3-4, 2-3, band apply and TCC solenoids	Key off	0v
		Key on	B+
		W/solenoid codes	0v
55	TPS signal from ECM (always 100 Hz)	Idle	9-10 % duty
		Full throttle	88-90% duty

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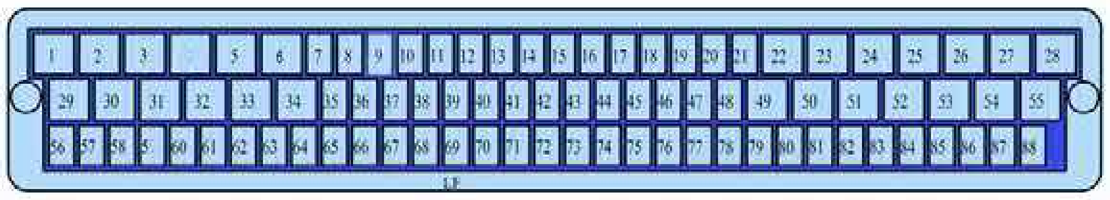
TCM Pin Charts (Type 6)



Pin	Function	Condition	Signal
1	N/A	-	-
2	Shifter lock solenoid (some models)	Solenoid off	B+
		Solenoid on	< 1v
3	N/A	-	-
4	Band apply solenoid	During drive engagement	Approx. 75% Duty cycle
		Above 8-10 MPH	0% Duty cycle (sol off)
		During a 3-2 or 3-1 kickdown & 3-2 coast down	25%-75% Duty cycle
5	Force motor (-)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
6	Ground	Always	< 0.1v
7	N/A	-	-
8	Trans range position "B"	(Catera) R, N, D, 3	B+
		(BMW) P, N	B+
		All others	0v
9	Trans range position "P"	(Catera) P, N, 3, L	B+
		(BMW) P, D, 3 ,2	B+
		All others	0v
10	Brake switch (some models)	Brake released	0v
		Brake depressed	B+
11	N/A	-	-
12	Sport mode switch (some models)	Sport mode off	B+
		Sport mode on	0v
13	Manual (winter) mode switch	Manual mode off	B+
		Manual mode on	0v
14	VSS (-) (between pin 14 & 42)	Wheels spinning	Above 1v AC

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TCM Pin Charts (Type 6) (continued)

Pin	Function	Condition	Signal
15	VSS shield ground	Always	< 0.1v
16	N/A	-	-
17	Sport mode indicator light (some models)	Light off	B+
		Light on	< 1v
18	Kickdown switch (some models)	Full throttle	0 v
		All other	B+
19	ABS/ASC signal (some models)		
20	Auto mode switch (some models)	Auto mode off	B+
		Auto mode on	0v
21	Fluid temp ground	Always	< 0.1v
22	Fluid temp	32° F (0° C)	65K ohms
		68° F (20° C)	25K ohms
		176° F (80° C)	2.5K ohms
		248° F (120° C)	780 ohms
23	N/A	-	-
24	N/A	-	-
25	Check trans indicator (some models)	Light off	B+
		Light on	< 1v
26	Keep alive power	Always	B+
27	Manual (winter) mode indicator	Light off	B+
		Light on	< 1v
28	Ground	Always	< 0.1v
29	N/A	-	-
30	1-2/3-4 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
31	N/A	-	-
32	TCC solenoid	Solenoid off	B+
		Solenoid on	< 1v
33	2-3 shift solenoid	Solenoid off	B+
		Solenoid on	< 1v
34	Ground	Always	< 0.1v
35	N/A	-	-
36	Trans range position “A”	(Catera) P, R, 3, 2	B+
		(BMW) P, R, N, 2	B+
		All others	0v

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TCM Pin Charts (Type 6) (continued)

Pin	Function	Condition	Signal
37	Trans range position "C"	(Catera) D, 3, 2, L	B+
		(BMW) N, 3, 2, L	B+
		All others	0v
38	N/A	-	-
39	N/A	-	-
40	Engine RPM signal (some models)	Engine running	DC frequency
41	N/A	-	-
42	VSS (+) (between pin 14 & 42)	Wheels spinning	Above 1v AC
43	N/A	-	-
44	N/A	-	-
45	Auto mode indicator	Light off	B+
		Light on	< 1v
46	A/C compressor on signal (some models)	Compressor off	B+
		Compressor on	0v
47	N/A	-	-
48	Brake switch test signal (some models)	Brake released	B+
		Brake depressed	0v
49	CAN LOW (some models)		2.5v
50	CAN HIGH (some models)		2.5v
51	Serial data (some models)		
52	Force motor (+)	Idle	0.7-0.9 Amps
		Full throttle	0.1-0.2 Amps
53	Power relay output to 1-2/3-4, 2-3, band apply and TCC solenoids	Key off	0v
		Key on	B+
		W/solenoid codes	0v
54	Ignition	Key off	0v
		Key on	B+
55	Ignition (some models)	Key off	0v
		Key on	B+
56	N/A	-	-
57	Cruise control signal (some models)		
58	N/A	-	-
59	N/A	-	-
60	Program voltage from data link (some models)		
61	N/A	-	-

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TCM Pin Charts (Type 6) *(continued)*

Pin	Function	Condition	Signal
62	N/A	-	-
63	N/A	-	-
64	N/A	-	-
65	N/A	-	-
66	N/A	-	-
67	N/A	-	-
68	N/A	-	-
69	N/A	-	-
70	N/A	-	-
71	N/A	-	-
72	N/A	-	-
73	N/A	-	-
74	N/A	-	-
75	N/A	-	-
76	N/A	-	-
77	N/A	-	-
78	N/A	-	-
79	N/A	-	-
80	N/A	-	-
81	N/A	-	-
82	Connected to pin 83 (some models)		
83	Connected to pin 82 (some models)		
84	N/A	-	-
85	CAN LOW (some models)		2.5v
86	CAN HIGH (some models)		2.5v
87	RXD Data Link (some models)		B+
88	TXT Data link (some models)		B+

NOTES:

ATEC Import

450-43LE Contents

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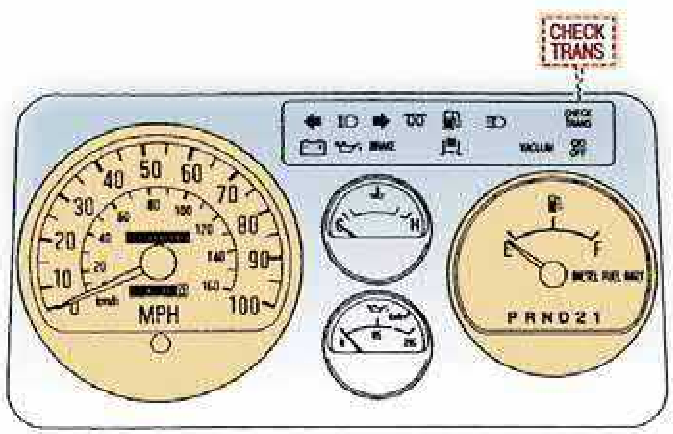
Self-Diagnostic Information

NPR, FUSO

There are only 13 components that will cause the “Check Trans” light to illuminate.

1. Vehicle Speed Sensor #1
2. Engine Speed Sensor
3. Transmission fluid sensor
4. Inhibitor Switch
5. Throttle Position Sensor
6. Vehicle Speed Sensor#2
7. SS#1
8. SS#2
9. Timing Solenoid
10. TCC Solenoid
11. EPC Solenoid
12. Exhaust Brake Solenoid
13. Engine Warming sensor



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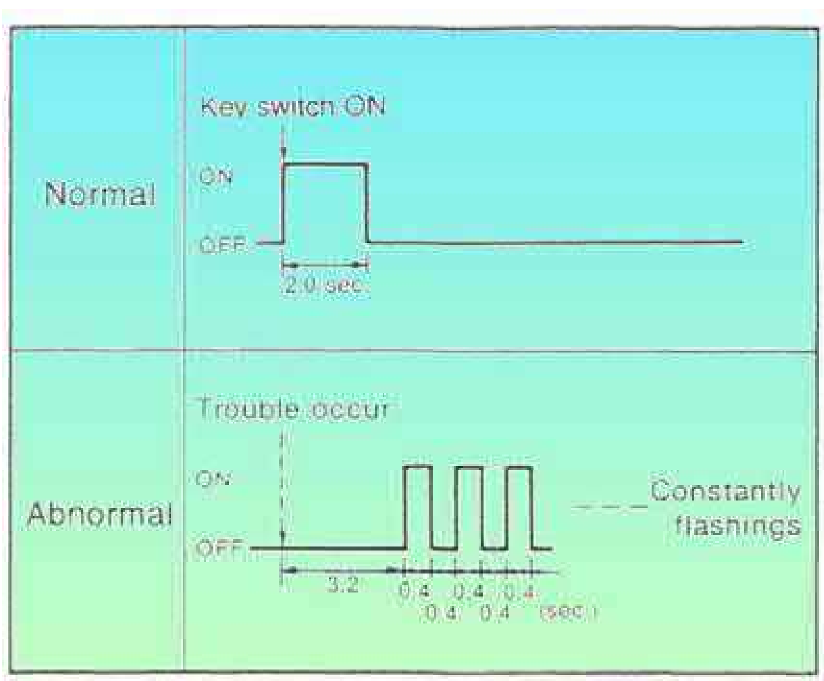
Checking for Codes

As a pretest procedure, the “Check Trans” light will come ON when the ignition key is turned to the ON position. This tests the operation of the light bulb and connection from the TCM to the check engine light.

When the Throttle Position Sensor, Vehicle Speed Sensor, Solenoids, or any one of the 13 components start to malfunction when the vehicle is running, the “Check Trans” light will start to blink to warn the driver.

The “Check Trans” light begins to blink as soon as a problem occurs during driving conditions and keeps blinking until it is corrected.



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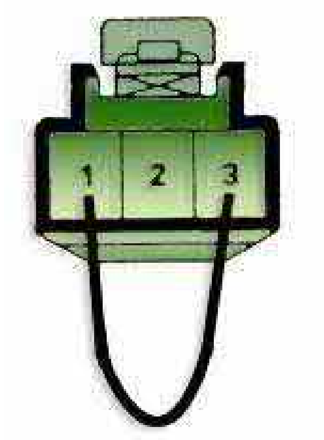
Self- Diagnostic Results

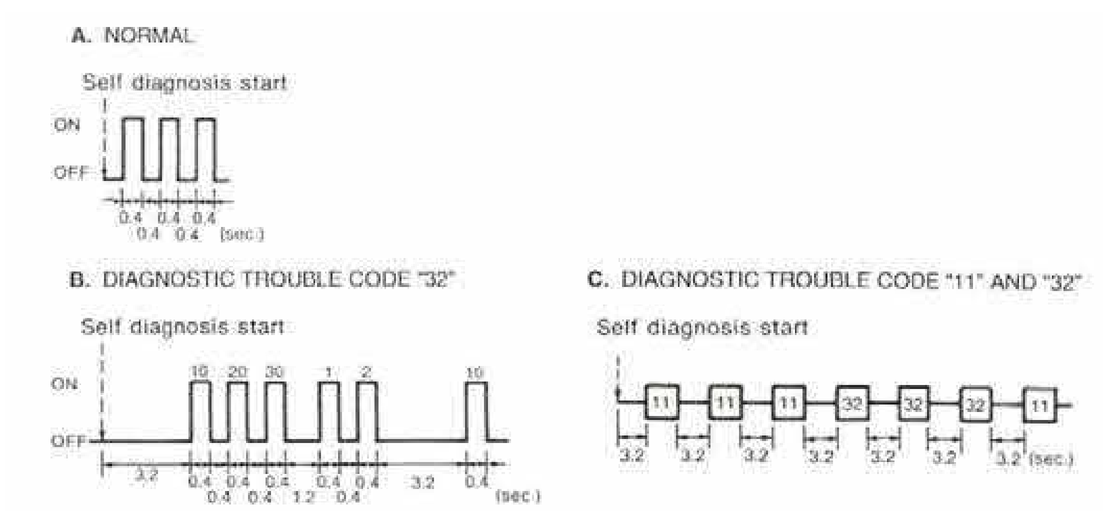
The DLC (Data Link Conector) is a Green three-pin connector and it is tied to the support bracket located under the brake and clutch fluid tank.

A DTC can be retrieved by jumping a wire from terminal 1 (Black/White) and terminal 3 (Black) located at both ends of the Data Link Connector.



Green Three Pin Connector

When no problem exists, the display flashes “1” repeatedly. When a malfuntion exists, the DTC is displayed three times repeatedly. When two or more DTCs are generated, they are all displayed three times repeatedly, one at a time, starting with the lowest code number first.



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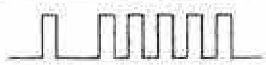
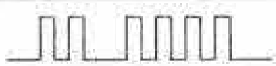
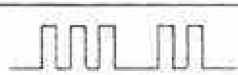
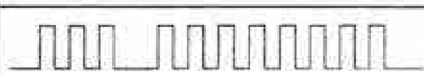
Codes

DTC No.	DISPLAY PATTERN	DIAGNOSED CONTENT
11	ON OFF 	Vehicle speed sensor 1 circuit open or shorted (Fitted to transmission)
13		Engine speed sensor circuit open or shorted
15		Automatic transmission fluid thermosensor circuit open
17		Inhibitor switch circuit open or shorted
21		Throttle position sensor circuit open or shorted
24		Vehicle speed sensor 2 circuit open or shorted (Built into speedometer)
31		No.1 shift solenoid (S1) circuit open or shorted
32		No.2 shift solenoid (S2) circuit open or shorted
33		Timing solenoid (ST) circuit open or shorted
34		Lock-up solenoid circuit open or shorted
35		Line pressure solenoid circuit open or shorted
37		Exhaust brake cut system circuit open or shorted
38		Engine warming up cut system circuit open or shorted

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Clearing Codes

You can use the factory scan tool (Tech 2 or Mastertech), to clear the codes. However, if a Factory scan tool is unavailable, perform the following operation.

1. Turn the key switch to the ON position, but DO NOT start the engine. (=No Engine RPM/No vehicle speed)

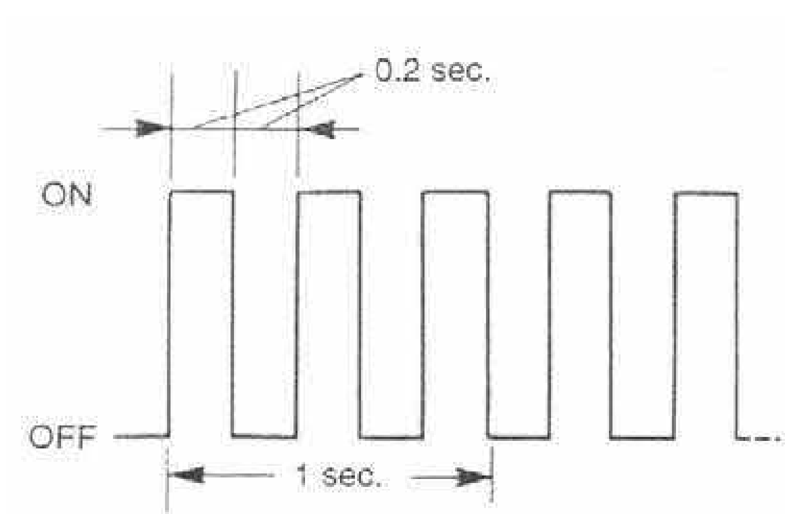
2. Connect a jumper terminal to pins 1 and 3 of the DLC. (=Self-diagnostic is started)

3. Select “N” (Neutral) Range (=”N” range signal is sent)

4. Depress brake pedal fully (=Brake switch is ON)

5. Depress accelerator pedal fully. (=Kick-down switch is ON)

6. The Check Trans light will flash rapidly (“ON”-0.2 sec, “OFF”-0.2 sec) for ten seconds if the clear memory operation is successful.



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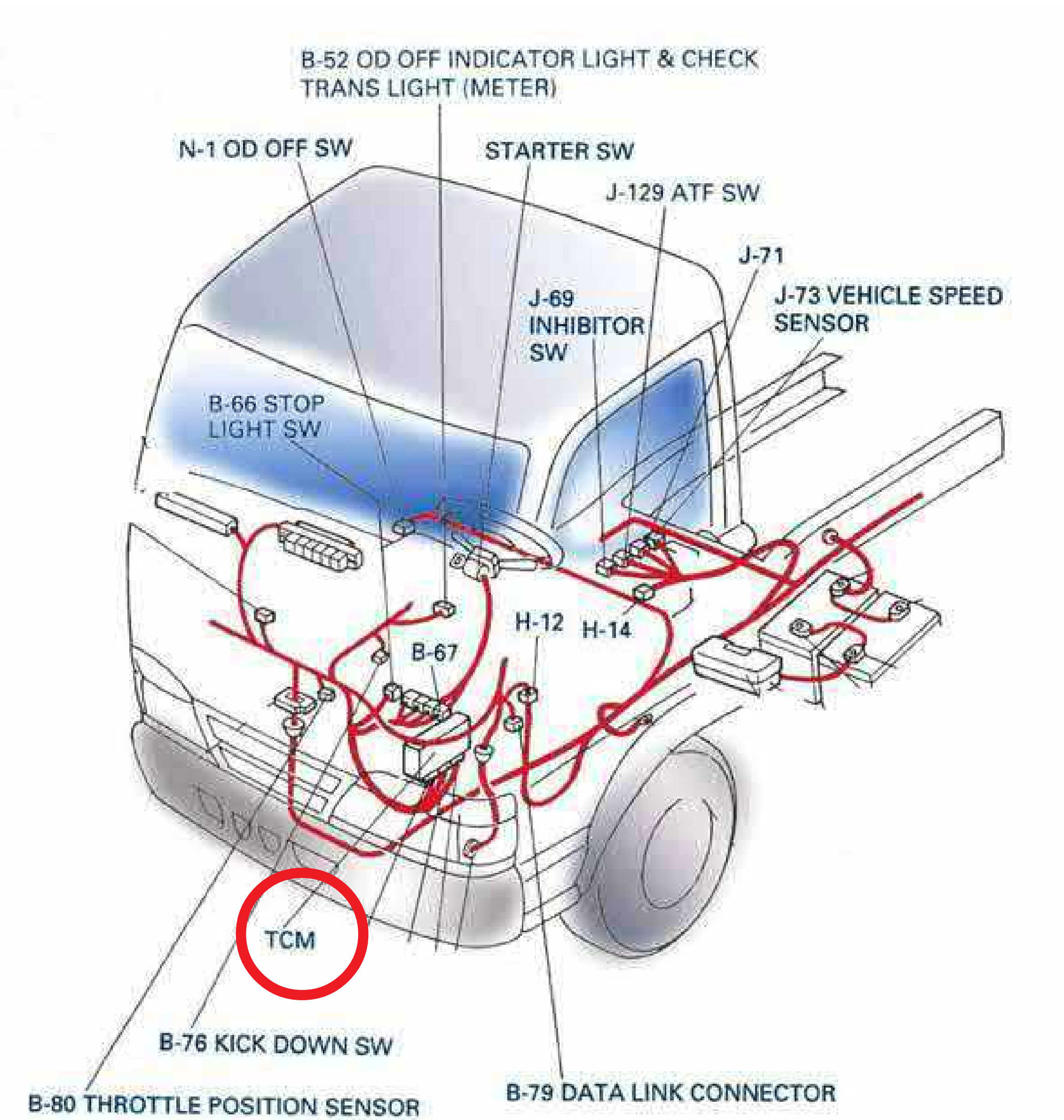
Component Locations



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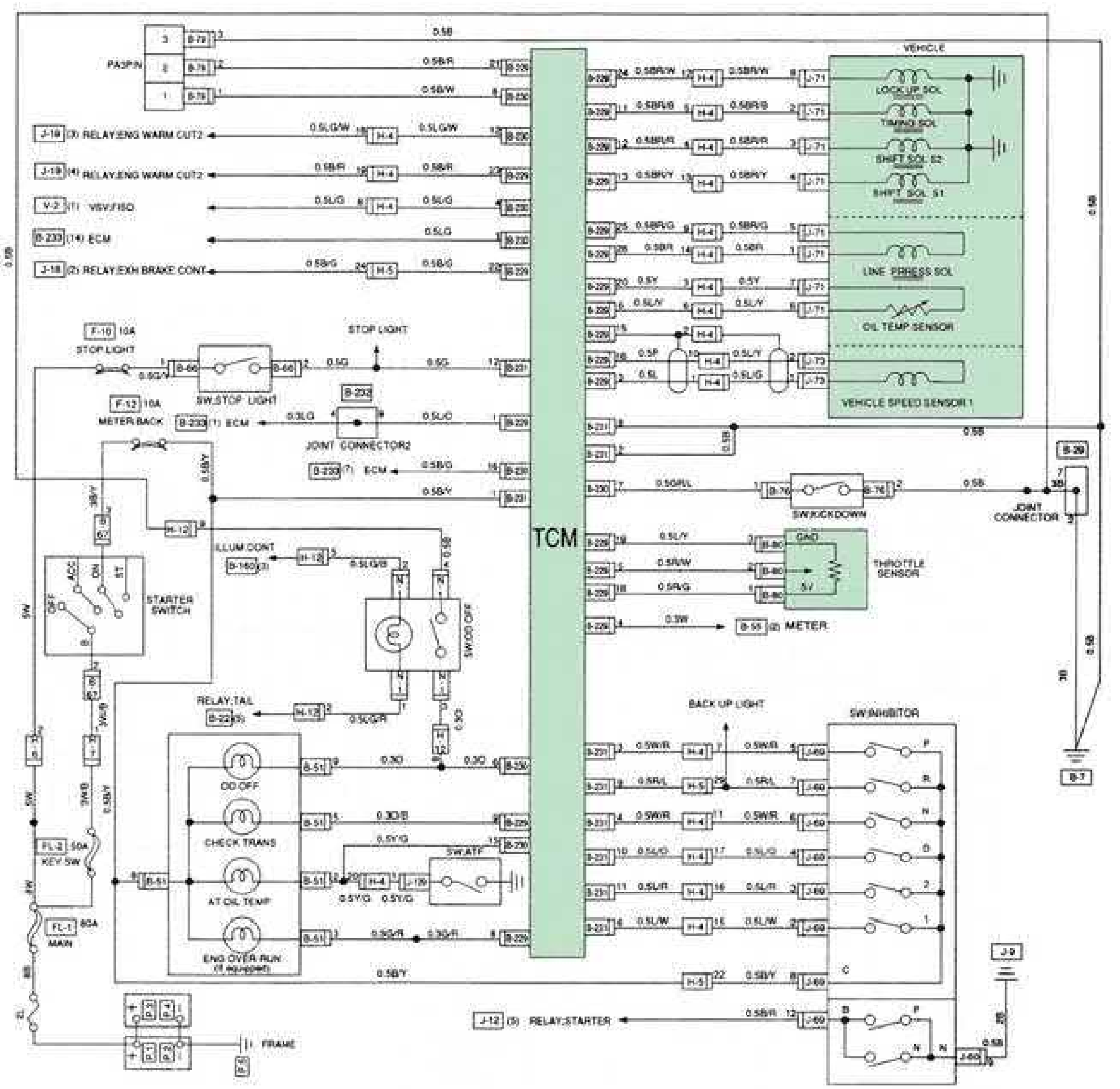
Wiring Diagram

Color Abbreviations:

L-Blue **G-Green** **B-Black**
W-White **P-Purple** **Y-Yellow**
R-Red **O-Orange**



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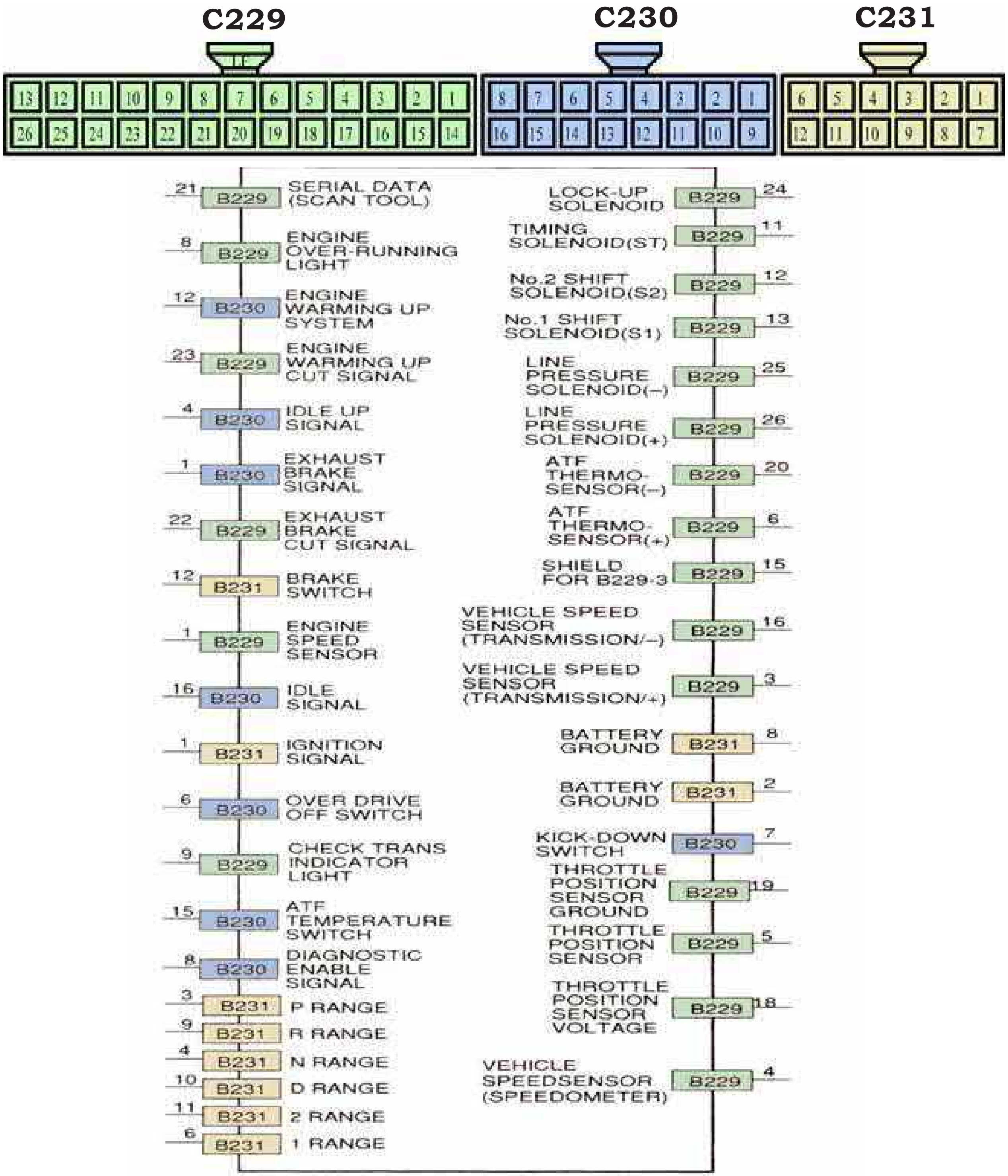
TCM Pin Location



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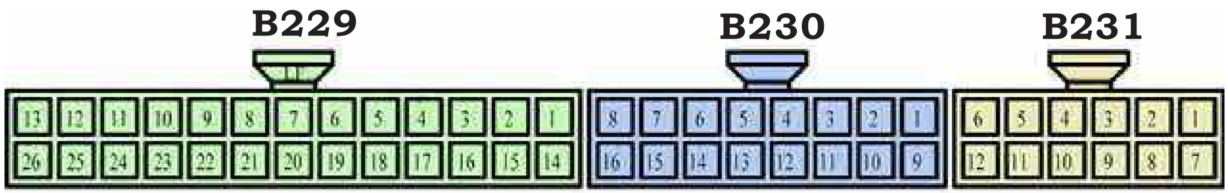
TCM Specifications



TCM Terminal No. (Wire Color) Tester (–)	Tester (+)	Standard Voltage	Inspection Condition	Signal Type	Circuit
B231-2 (B) or B231-8 (B)	B229-1 (L/O)	More than 1.0 (Intermittent AC)	At an engine speed of approx. 1,000 RPM	Input	Engine speed sensor
	B229-2	Not used	—	—	—
B229-16 (P)	B229-3 (L)	More than 0.35 (AC)	Vehicle speed 24 km/h (15 mph) (Voltage increases in proportion to the speed)	Input	Vehicle speed sensor (Transmission)
		0	Vehicle stopped		
B231-2 (B) or B231-8 (B)	B229-4 (L/G)	0–5	Vehicle moved at slowest possible speed at least 1 meter	Input	Vehicle speed sensor (SPEEDOMETER)
B229-19 (L/Y)	B229-5 (R/W)	3.8–4.5	Accelerator pedal fully closed	Input	Throttle position sensor
		0.5–1.8	Accelerator pedal fully opened		
B229-20 (Y)	B229-6 (L/Y)	0.9	ATF temp. approx. 10 °C (50 °F)	Input	ATF thermosensor
		0.3	ATF temp. approx. 40 °C (104 °F)		
B231-2 (B) or B231-8 (B)	B229-7	Not used	—	—	—
	B229-8 (B/W)	10–16	Engine speed more than 3,800 RPM	Output	Engine overrunning light (If equipped)
		Less than 1.0	Engine speed less than 3,700 RPM		
	B229-9 (O/B)	10–16	Normally state	Output	Check trans light
		Less than 3.0	In order to 2 seconds when after the key switch "ON"		
	B229-10	Not used	—	—	—
	B229-11 (R/B)	10–16	Shift up to 2nd or 3rd kick down to 1st	Output	Timing solenoid (ST)
		Less than 1.0	Normally state		
	B229-12 (BR/R)	10–16	Driving at "D2" and "D3" (No.2 shift solenoid (S2) "ON")	Output	No.2 shift solenoid (S2)
		Less than 1.0	Driving at "D1" and "D4" (No.2 shift solenoid (S2) "OFF")		

AC: Alternating Current ATF: Automatic Transmission Fluid TCM: Transmission Control Module

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TCM Specifications (continued)

TCM Terminal No. (Wire Color) Tester (–)	Tester (+)	Standard Voltage	Inspection Condition	Signal Type	Circuit
B231-2 (B) or B231-8 (B)	B230-4 (L/G)	10–16	Air conditioner copmressor "ON"	Input	Engine idle up
		Less than 1.0	Air conditioner copmressor "OFF"		
	B230-5	Not used	—	—	—
	B230-6 (O)	10–16	O/D OFF switch "OFF"	Input	O/D OFF switch
		Less than 1.0	O/D OFF switch "ON"		
	B230-7 (GR/L)	10–16	Accelerator pedal "released"	Input	Kick down switch
		Less than 1.0	Accelerator pedal "depressed"		
	B230-8 (B/W)	10–16	Self diagnosis "OFF"	Input	Data link connector
		Less than 1.0	Self diagnosis "ON"		
	B230-9	Not used	—	—	—
	B230-10	Not used	—	—	—
	B230-11	Not used	—	—	—
	B230-12 (LG/W)	10–16	QWS switch "ON"	Input	Engine warming up
		Less than 1.0	QWS switch "OFF"		
	B230-13	Not used	—	—	—
	B230-14	Not used	—	—	—
	B230-15 (Y/G)	10–16	Normally state	Input	ATF thermo switch
		Less than 1.0	ATF temperature more than 147 °C		
	B230-16 (B/G)	10–16	Engine speed more than 880 RPM	Input	Idle signal
		Less than 1.0	Accelerator pedal full closed. Engine speed 400-880 RPM		

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TCM Specifications (continued)

TCM Terminal No. (Wire Color) Tester (–)	Tester (+)	Standard Voltage	Inspection Condition	Signal Type	Circuit
B231-2 (B) or B231-8 (B)	B231-1 (BY)	10–16	Key switch "ON"	Source	Battery voltage
	B231-3 (W/R)	10–16	Selector "P" range	Input	"P" range switch
		Less than 1.0	Selector other than except "P" range		
	B231-4 (W/R)	10–16	Selector "N" range	Input	"N" range switch
		Less than 1.0	Selector other than except "N" range		
	B231-5	Not used	—	—	—
	B231-6 (L/W)	10–16	Selector "1" range	Input	"1" range switch
		Less than 1.0	Selector other than except "1" range		
	B231-7	Not used	—	—	—
	B231-9 (R/L)	10–16	Selector "R" range	Input	"R" range switch
		Less than 1.0	Selector other than except "R" range		
	B231-10 (L/O)	10–16	Selector "D" range	Input	"D" range switch
		Less than 1.0	Selector other than except "D" range		
	B231-11 (L/R)	10–16	Selector "2" range	Input	"2" range switch
		Less than 1.0	Selector other than except "2" range		
	B231-12 (G)	10–16	Stop light "ON"	Input	Stop light
		Less than 1.0	Stop light "OFF"		

450-43LE

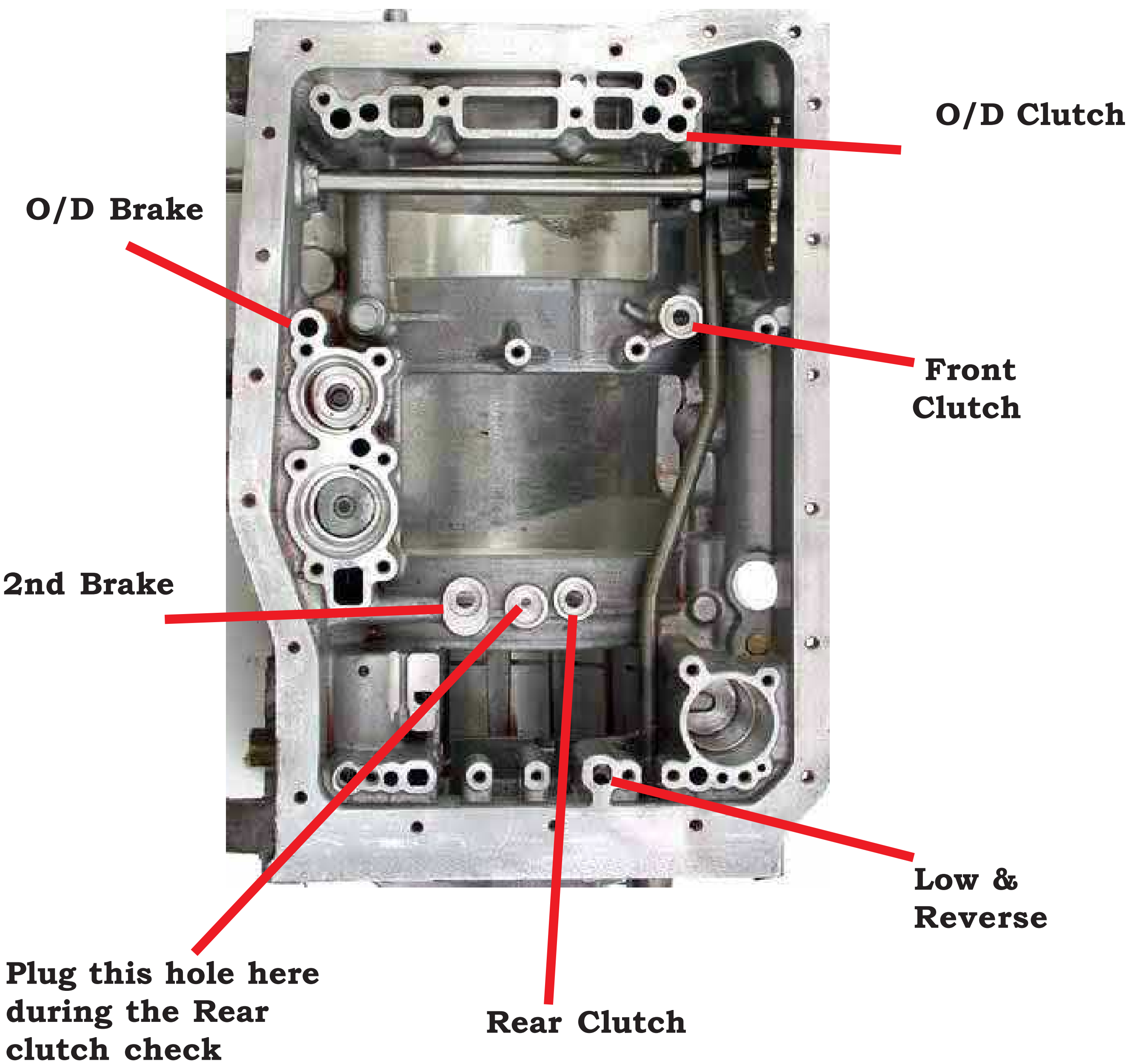
Sprag Rotation

Low One-way Clutch

The Low one-way clutch is connected to the case and the Planetary rotates clockwise.

450-43LE

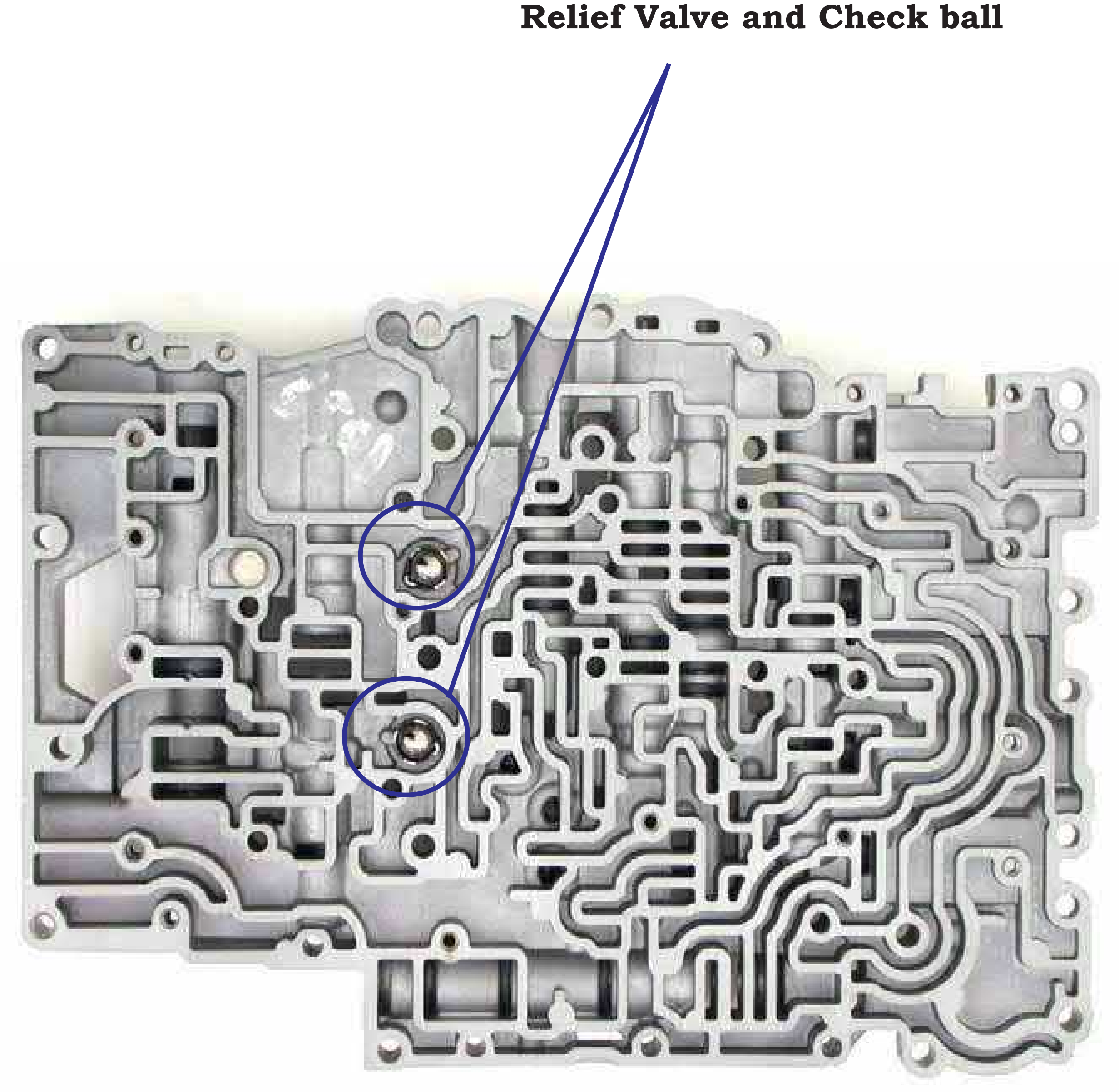
Air Checking



450-43LE

Checkball Location

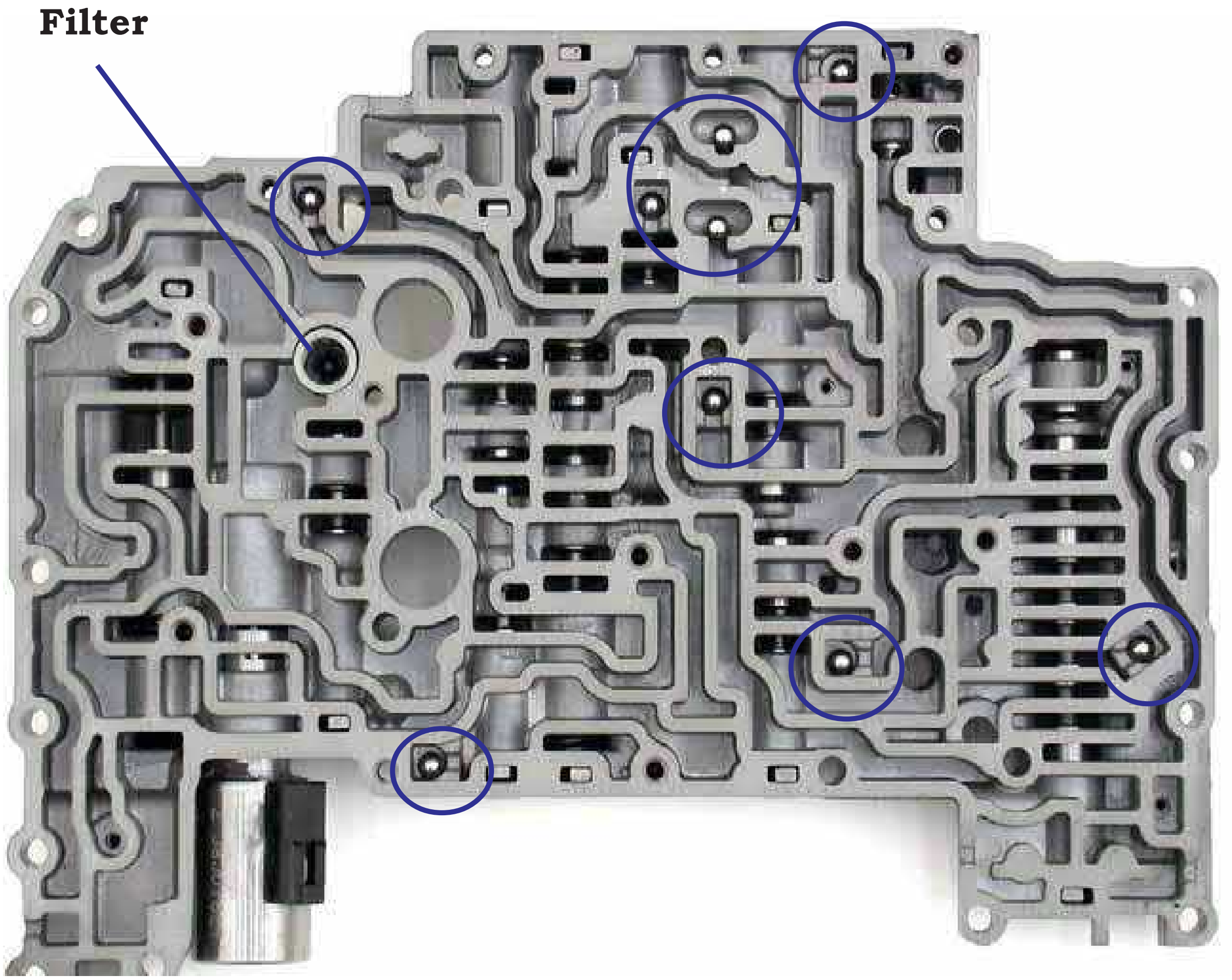
Lower Valve body



450-43LE

Checkball Location (continued)

Upper Valve Body

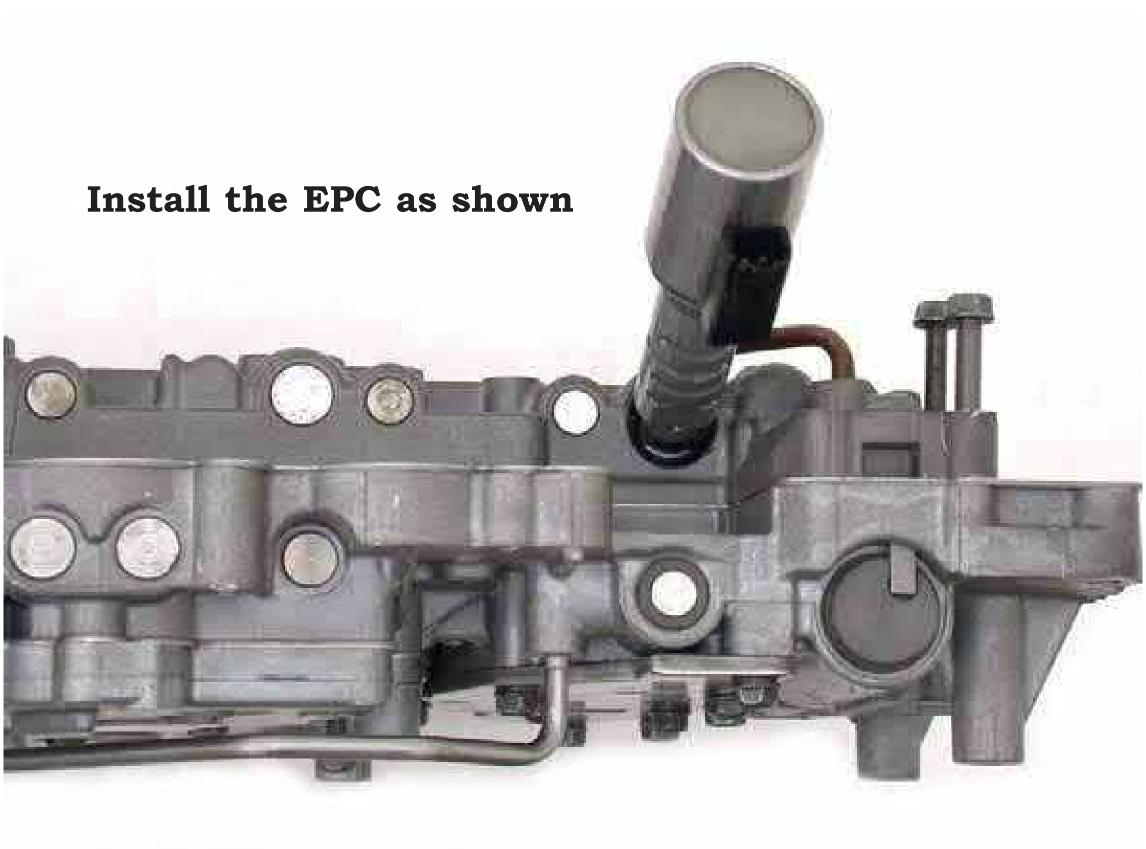


450-43LE

EPC Location

The EPC solenoid can be installed upside down. Be sure when reinstalling the EPC solenoid that the slots are pointing toward the worm tracks on the upper valvebody.

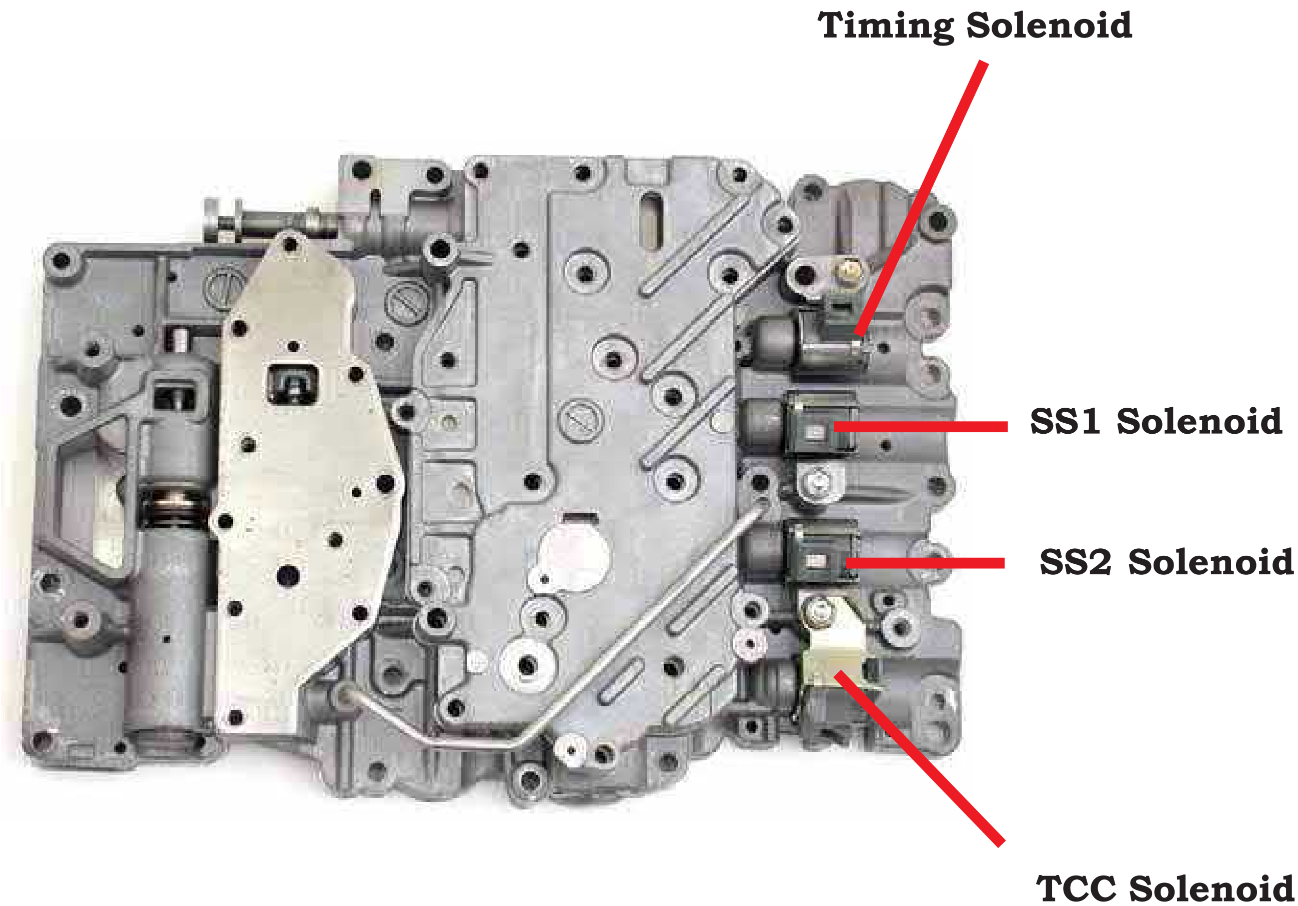
Description	Resistance
EPC	3.5-5.5 ohms



450-43LE

Solenoid Location

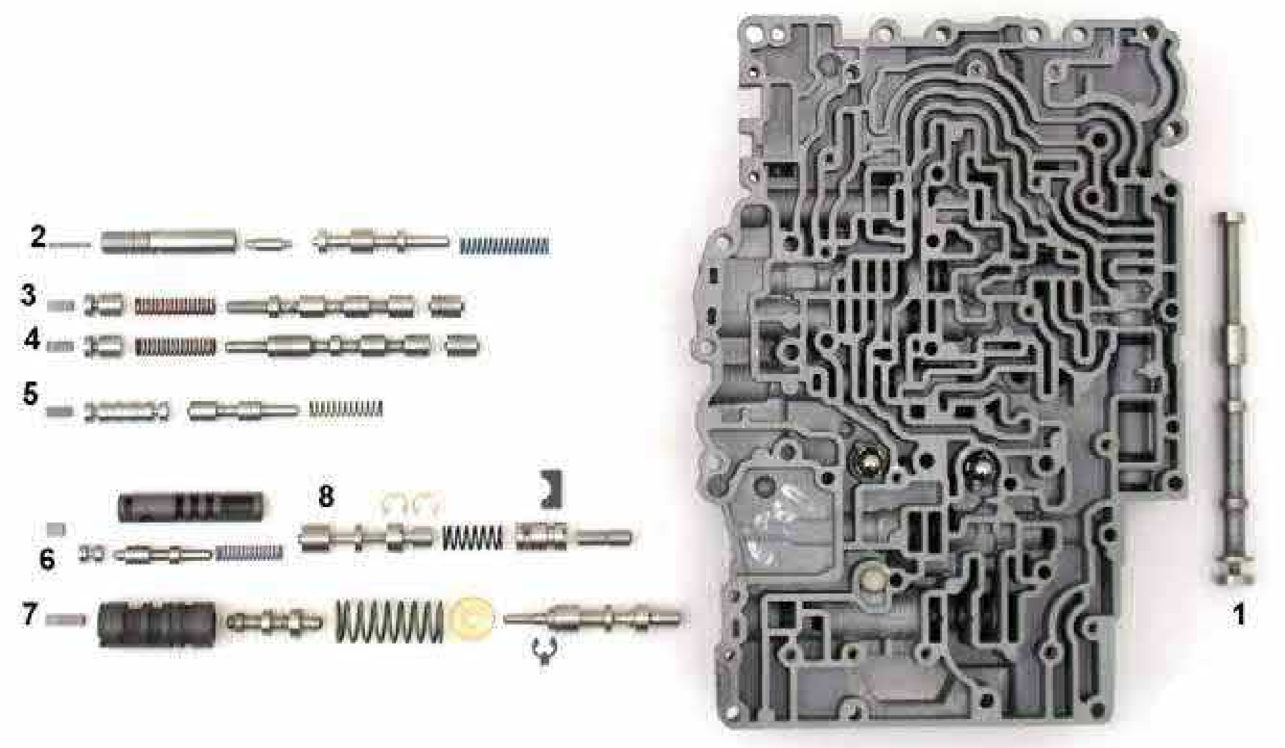
Description	Resistance
SS1	10-20 ohms
SS2	10-20 ohms
TCC	10-20 ohms
Timing	10-20 ohms



450-43LE

Valve Body Exploded View

Lower Valve Body

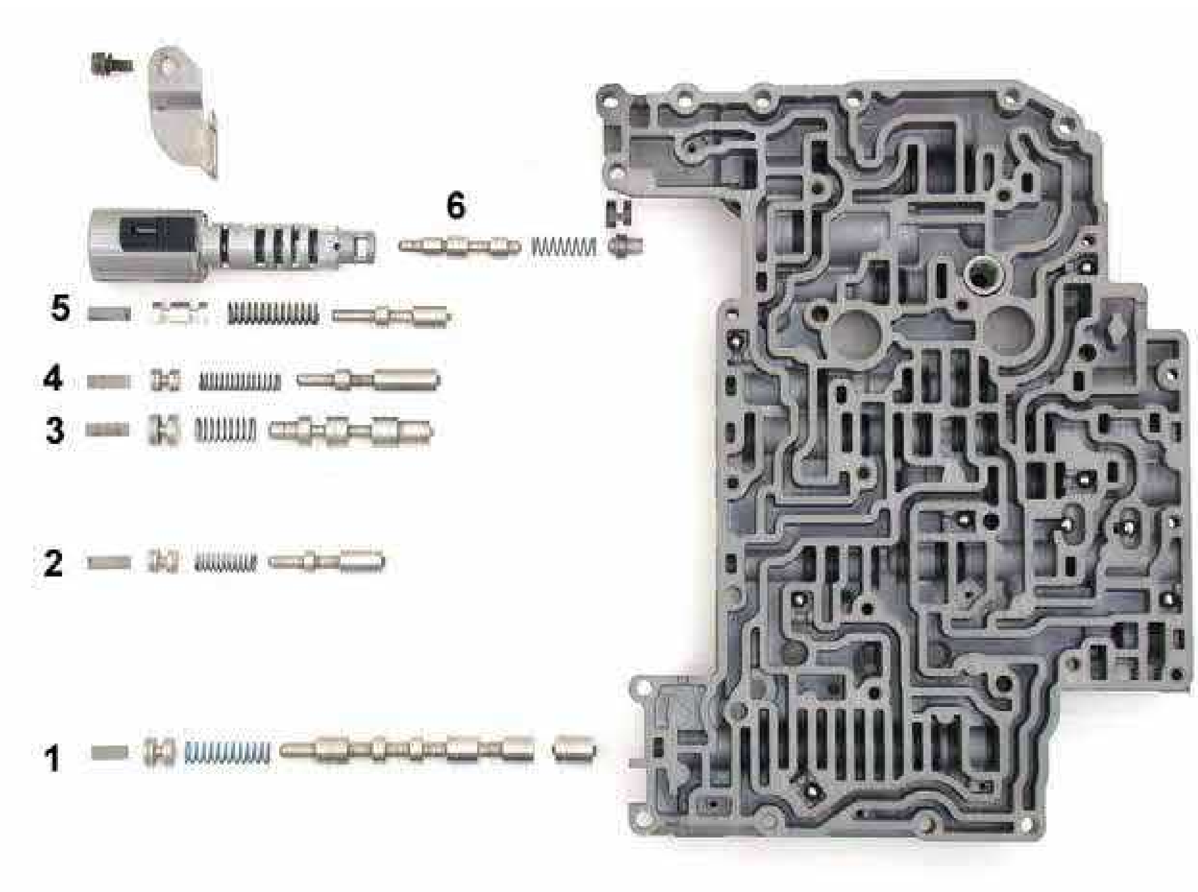


ID	Description
1	Manual Valve
2	2-3 Timing Valve
3	1-2 Shift Valve
4	3-4 Shift Valve
5	CO Exhaust Valve
6	Cut-Back Valve
7	Pressure Relief Valve
8	Lock-Up Control Valve

450-43LE

Valve Body Exploded View (continued)

Upper Valve Body

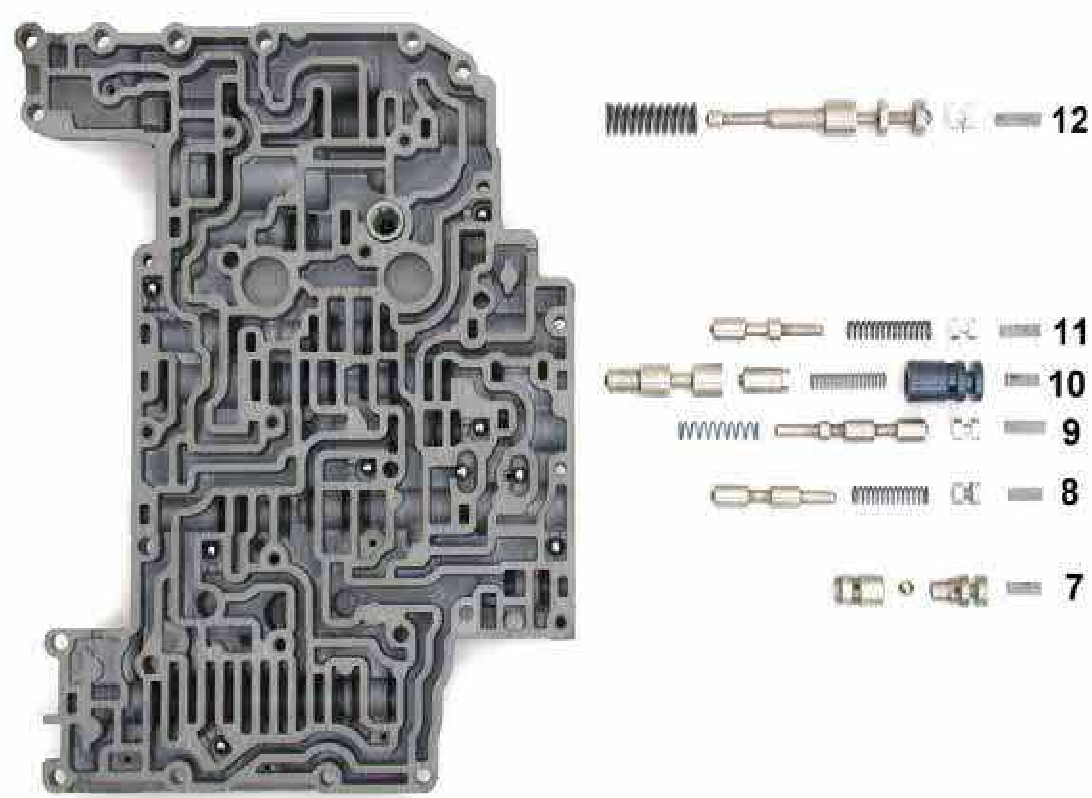


ID	Description
1	2-3 Shift Valve
2	Orifice control Valve
3	Accumulator Control Valve
4	Lock-Up Signal Valve
5	Reducing Valve
6	Throttle Valve

450-43LE

Valve Body Exploded View (continued)

Upper Valve Body (continued)



ID	Description
7	Check Valve
8	Low Inhibitor Valve
9	Low coast Modulator Valve
10	Reverse Inhibitor Valve
11	Modulator Valve
12	Secondary Regulator Valve

450-43LE

Erratic TCC Operation

Missing Lock-Up control valve clip

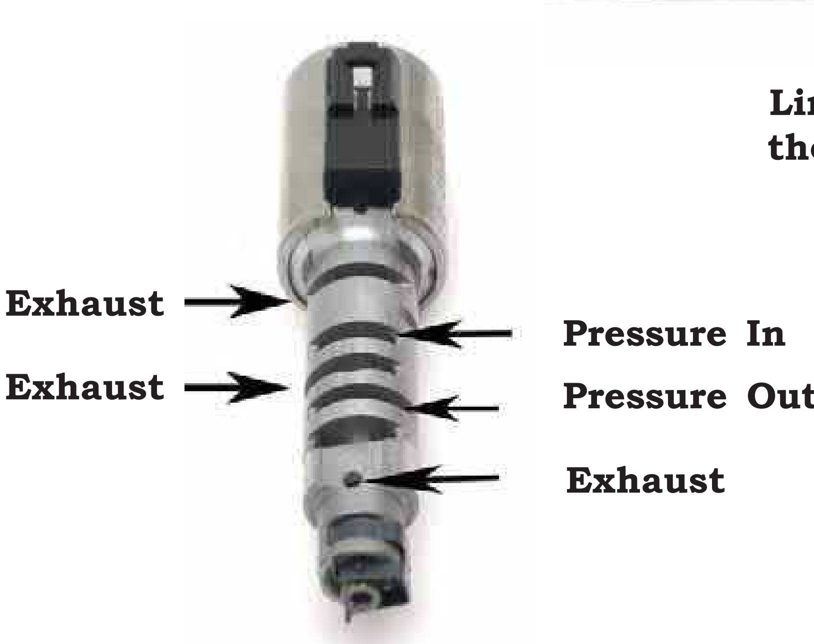
The Lock-Up control valve clip may fall out during the disassembly of the valve body. Take extra measures during the reassembly to ensure the clip is installed correctly

Correct location and installation

450-43LE

Low Line Pressure

The correct installation of the EPC solenoid is critical. The EPC should be facing the Lower valve body. If you're not sure about the location or installation, look inside the valve body bore. The lands will help you locate the correct position.



NOTES:

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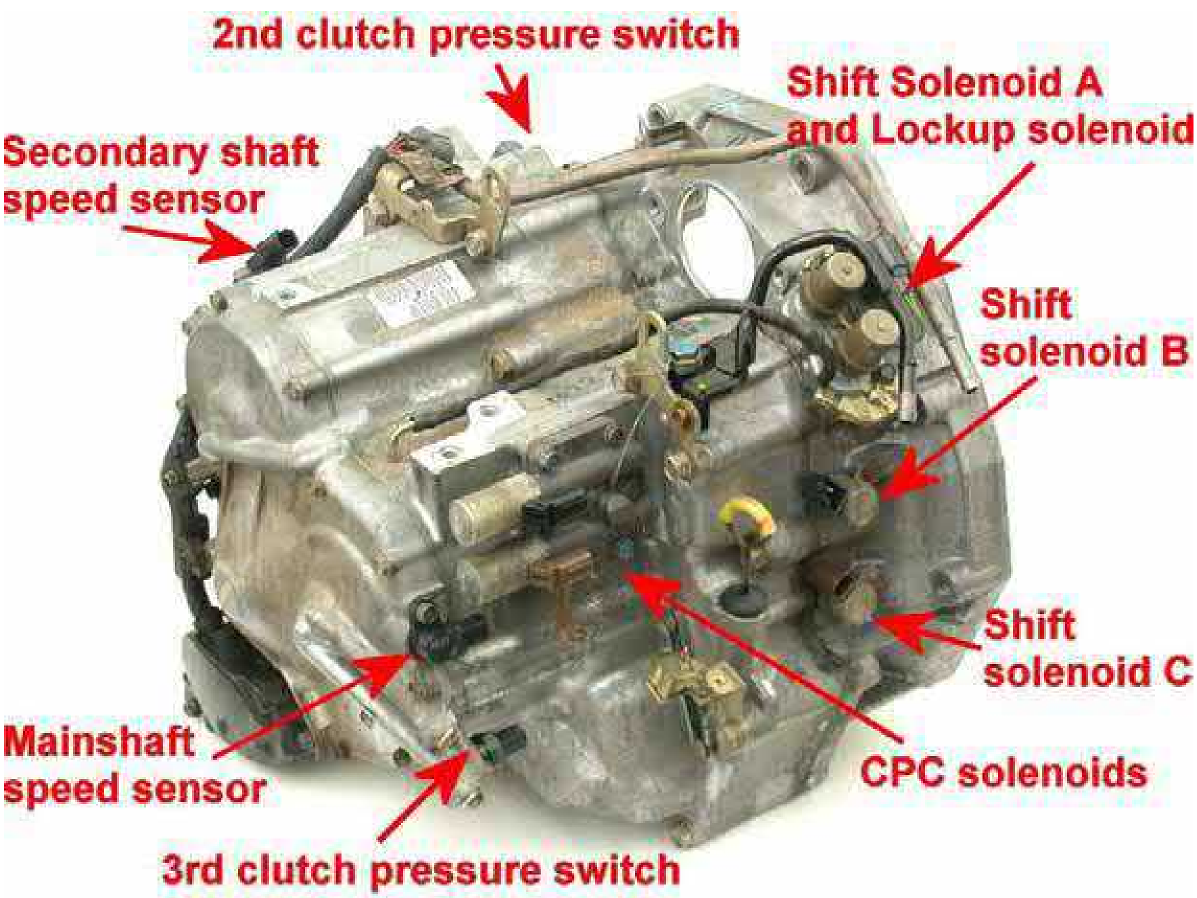
Honda
Table Of Contents

BAXA, MAXA, B7XA

4 Cylinder Unit

Component Identification

Below is an illustration showing various electrical components used in the BAXA, MAXA, and B7XA family transaxles used on 4 cylinder vehicles.

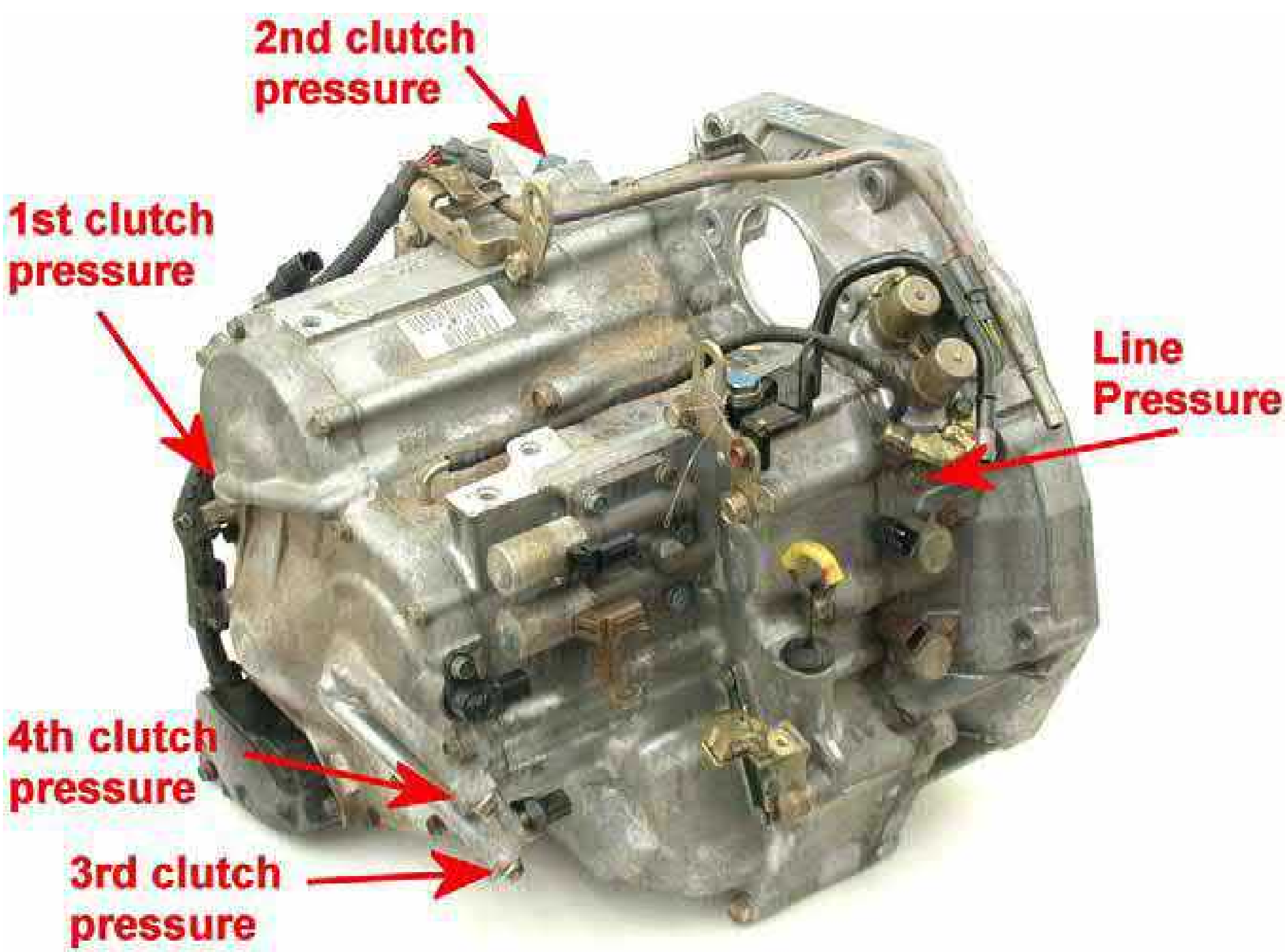


BAXA, MAXA, B7XA (continued)

4 Cylinder Unit

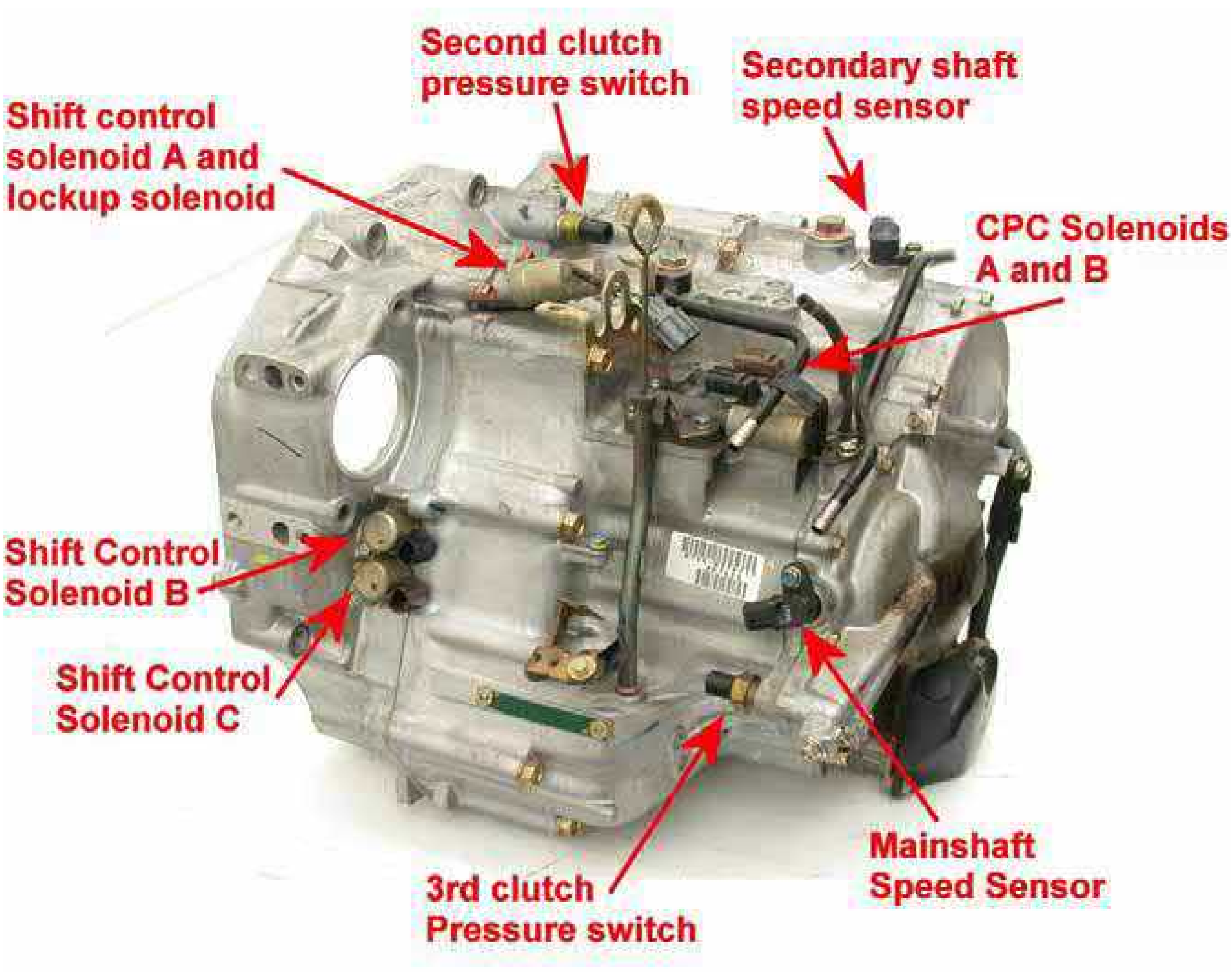
Pressure Taps

Pressure specifications are 120-130 psi. Line pressure will boost to approximately 300 psi at full throttle.



BAXA, MAXA, B7XA (continued)
V6 Unit
Component Identification

Below is an illustration showing various electrical components used in the BAXA, MAXA, and B7XA family transaxles used on V6 vehicles.

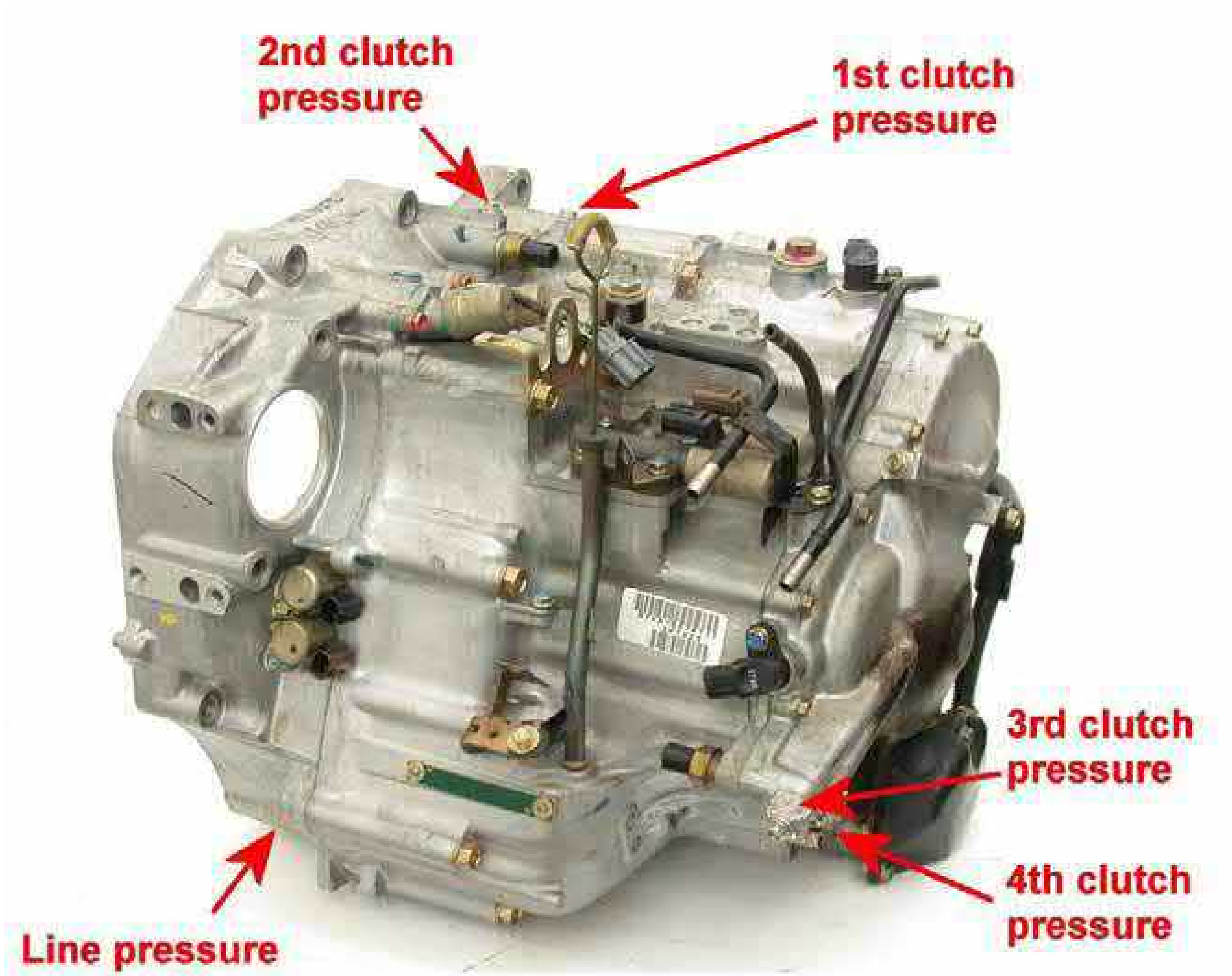


BAXA, MAXA, B7XA (continued)

V6 Unit

Pressure Taps

Pressure specifications are 120-130 psi. Line pressure will boost to approximately 300psi at full throttle.



BAXA, MAXA, B7XA (continued)

Erratic Shifts/Quality

Contamination CPC/Linear Solenoids

Many shift quality complaints including flares, harsh shifts, soft shifts, and engagement feel problems can be caused by contaminated CPC (Clutch Pressure Control) or Linear solenoids. Symptoms may be present only when cold. Normal flushing and cleaning of contaminated solenoids is usually not successful.

BAXA, MAXA, B7XA *(continued)*

Poor Shift Quality After Overhaul

The following can have a major effect on shift quality:
Fluid type, steel plate finish, and clutch material

Engine performance Adaptive learn: Make sure there are no DTC's , including engine codes.

Relearn Procedure

1. Start the engine and bring the transmission fluid temperature up to normal operating temperature of at least 104F°.

2. Turn the engine off and clear the codes.

3. Disconnect the battery. With both battery cables disconnected, touch them together, then turn on the headlights and press the brake pedal. Turn off lights, release the brake pedal, and reconnect battery.

4. Start the vehicle and let it idle until the cooling fan comes on.

5. As soon as the fan turns off let it idle in Park for one minute with the brake applied and all electrical accessories off.

6. Move the gear selector to the Drive position and let it idle for one minute with the brake applied and all electrical accessories off.

7. Road test the vehicle (do not drive with the wheels off of the ground). Accelerate lightly to 37 mph without exceeding 2400 rpm, then let it coast for five seconds (lift throttle).

8. Drive the vehicle at light throttle, automatically upshifting 1-2, 2-3, 3-4 and let it coast to a stop. Repeat this procedure four times.

9. Drive above 37 mph for five minutes.

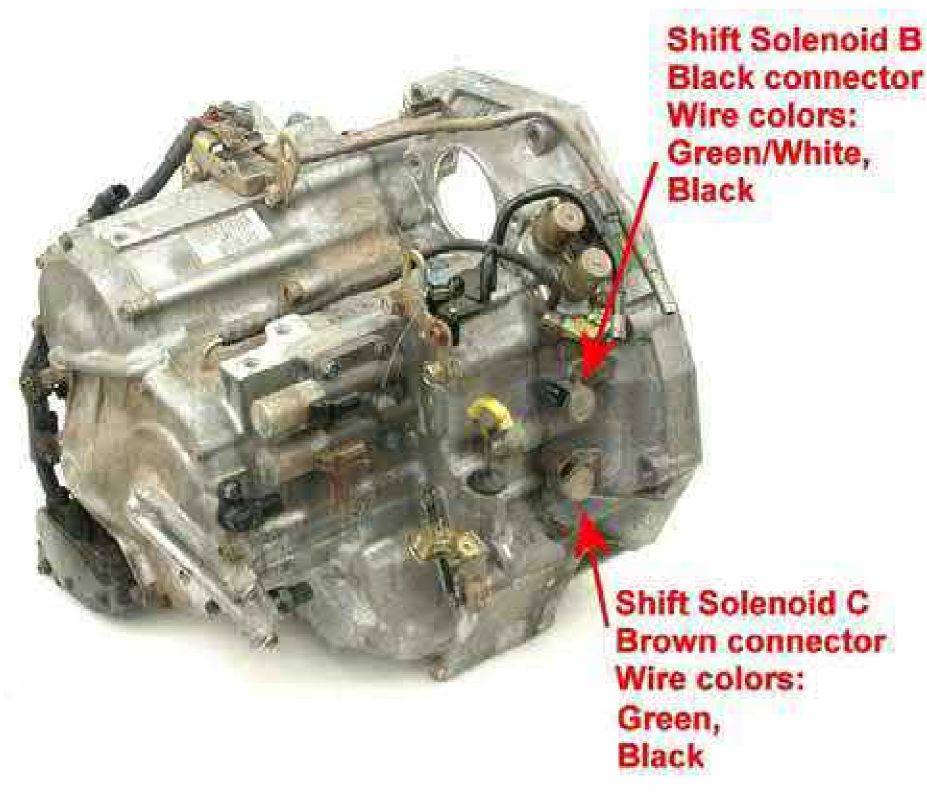
10. Check for codes.

BAXA, MAXA, B7XA

Bindups, erratic shifting, lugs engine

A Bindup, Erratic shift and/or engine lugging may be caused by SSB and SSC harness connectors switched with CPC solenoid A and B harness connectors. Use wire colors to identify the correct harness connectors.

These wires may not be so easy to cross on a V6 unit, however you can cross the SSB and SSC solenoid wires; these connectors are the same.



4 cyl. model shown here

BAXA, MAXA, B7XA

Long or Delayed 1-2 Upshift

A Long/Delayed 1-2 upshift may be caused by a 2nd clutch pressure switch failure. This Switch is sensitive to moisture contamination, especially when it is unplugged. During disassembly of the transmission, do not expose this switches to water or moisture. Meaning, don't put it in the parts washer!

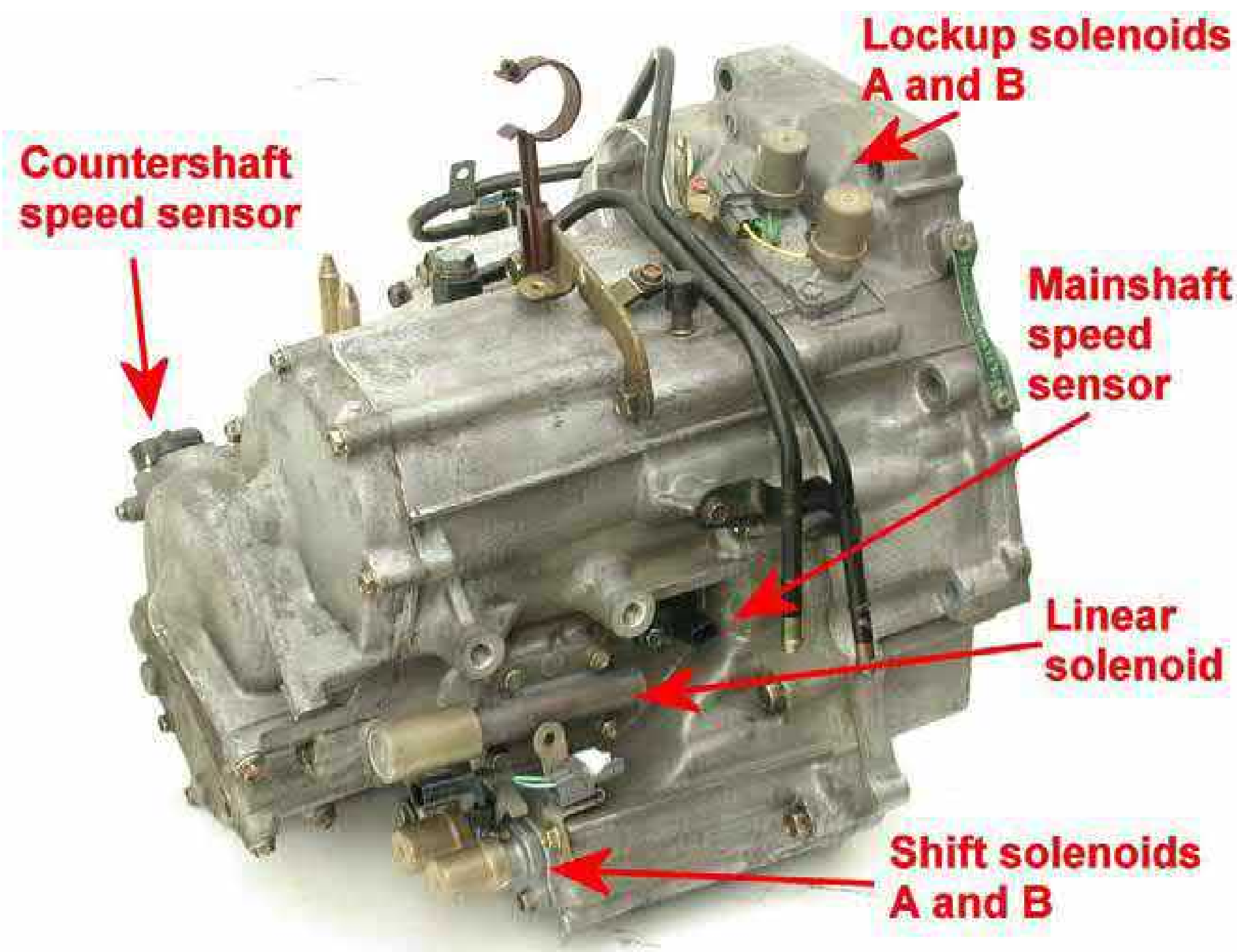
When testing the pressure switches, connect a digital volt/ohm meter to the switch leads. The readings will be either 0 ohms or open (infinite ohms). 0 ohms equals pressure below 36 psi, when the pressure rises above 36-40 psi the switch will open. It is very important that the switch opens and closes every time at the same pressure, if it does not, replace the switch.

0 ohms = closed
Infinite ohms = open

A4RA, B4RA, M4RA

Identification

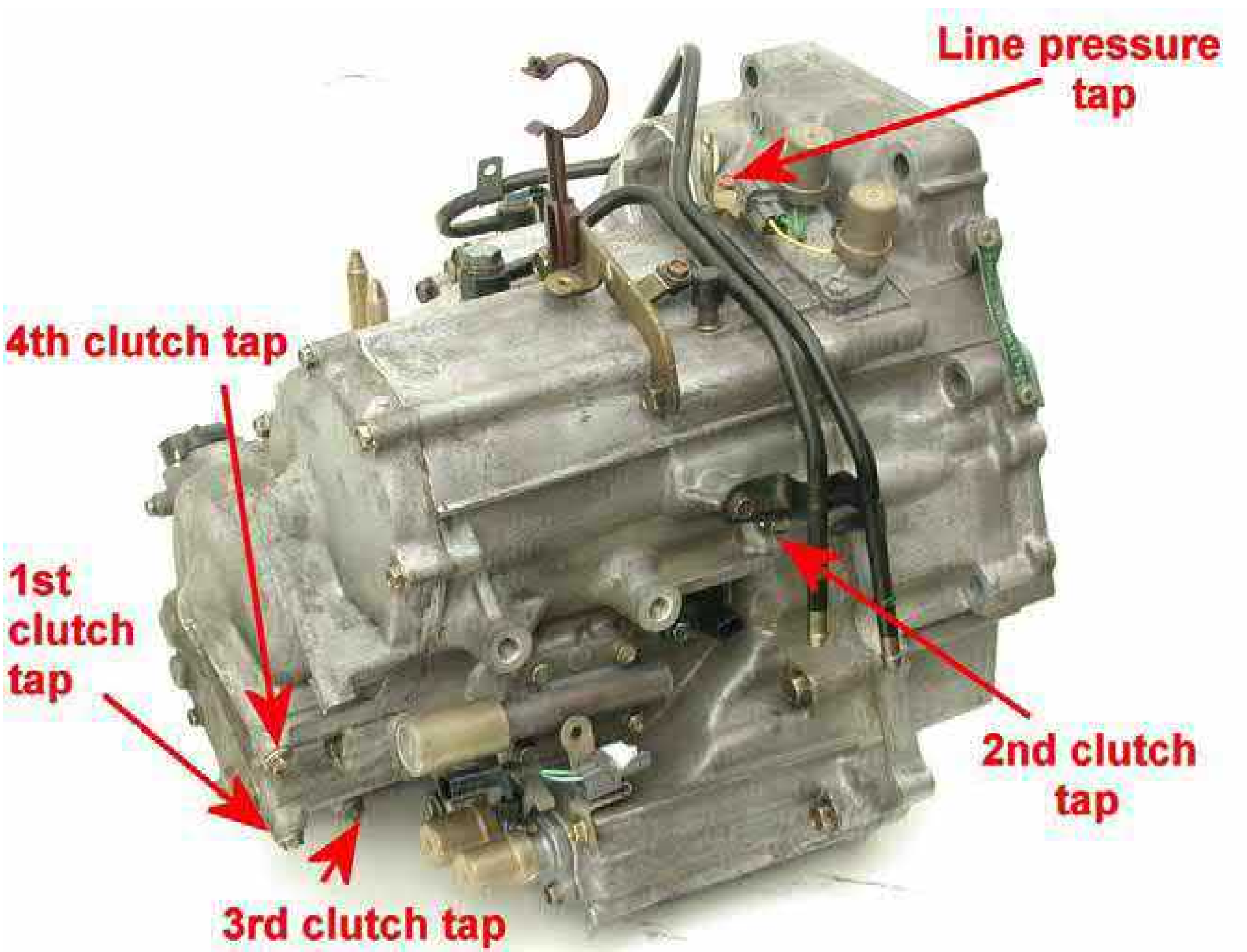
Identifying Honda transmission solenoids and switches can be difficult. Use the following pages to correctly identify them.



A4RA, B4RA, M4RA

Pressure Taps

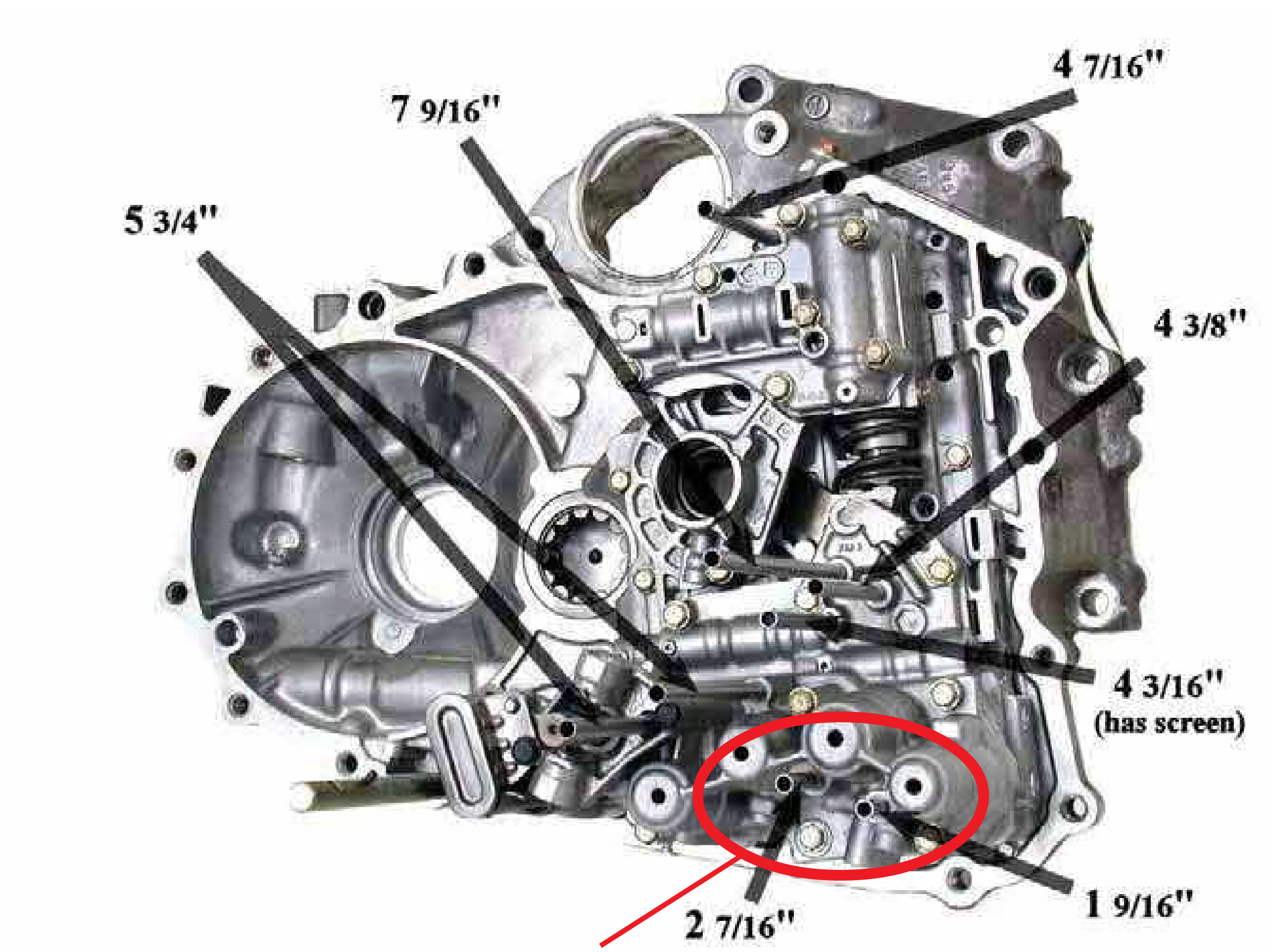
Pressure specifications are 120-130 psi. Line pressure will boost to approximatly 300 psi at full throttle.



A4RA, B4RA, M4RA

Wrong gear starts with 2nd and 3rd gear only, mainshaft speed sensor code (P0715)

Shift solenoid feed pipes incorrectly installed may cause a number of shift concerns including; wrong gear starts or no first no fourth. Use the diagram below for correct length and location of the feed pipes.



Shift solenoid feed pipes

A4RA, B4RA, M4RA

Cracked 1st clutch drum

A cracked 1st clutch drum can cause a number of different concerns. These concerns may be: Slipping in D on takeoff, OK after 1-2 shift, falls out of gear at a stop, no forward engagement, 1st clutch failure. These symptoms usually get worse as the transmission warms up.

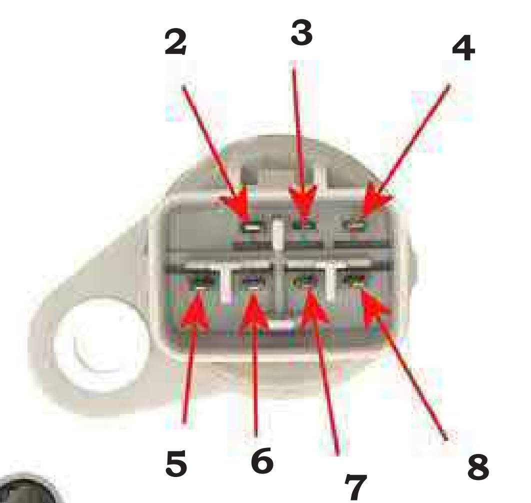
Carefully inspect the drum on every one of these units. Many times a crack can be difficult to see.

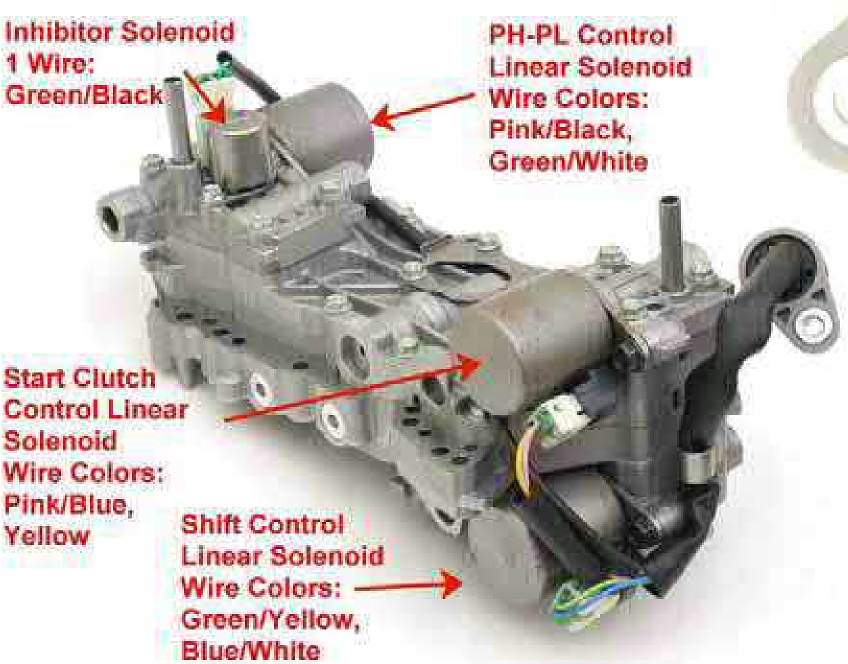
Most common area of the cracks will be seen here.

Civic CVT
Valve Body and Solenoids

Solenoid identification and wire colors.

Solenoid:	Measure between:	Resistance spec:
Shift Control Linear Solenoid	Terminals 3 and 7	3.8 to 6.8 ohms
PH-PL Linear Solenoid	Terminals 2 and 6	3.8 to 6.8 ohms
Start Clutch Control Linear Solenoid	Terminals 4 and 8	3.8 to 6.8 ohms
Inhibitor Solenoid	Terminal 5 and the valve body	11.7 to 21.0 ohms





NOTES:

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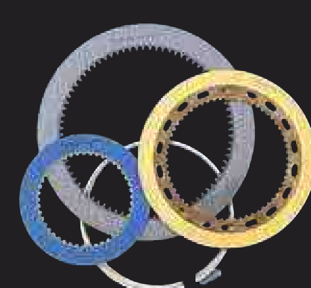

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ZF5HP19FL Table Of Contents

ZF5HP19FL

ZF5HP19FL
Transmission Identification

Identifying the ZF transmission tag is easy. The tag refers directly to the model of the transmission. It will also give you a part number to referances.

This transmission is from an Audi

ZF5HP19FL
Application and General Information

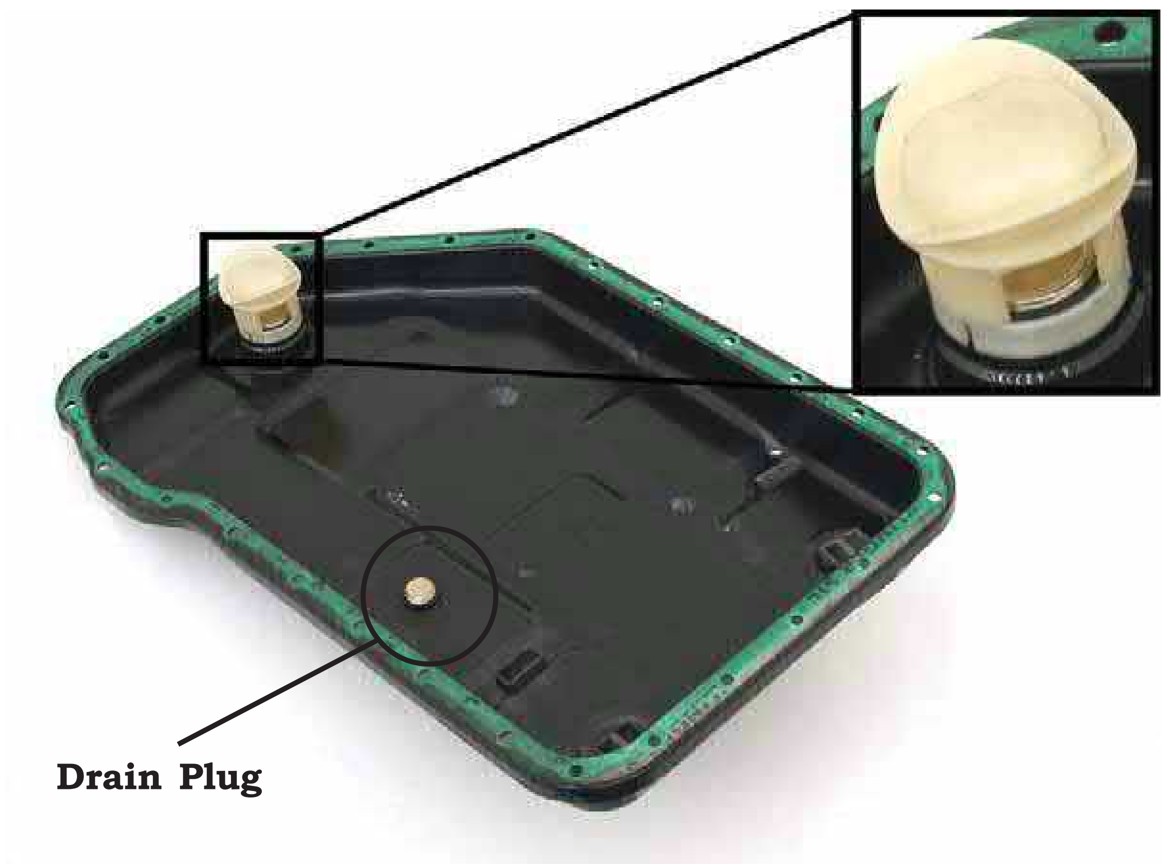
01V Transmissions				
Trans Code Letters		DRD	DSS	EBD
Date Manufactured		Apr-97	May-97	01/99-08/00
Vehicle		98-up Passat		
Engine		2.8L	2.8L	1.8L
Converter codes		F31	F31	M28
Transmission Ratios	1st	3.665:1		
	2nd	1.999:1		
	3rd	1.407:1		
	4th	1.000:1		
	5th	0.742:1		
	Reverse	4.096:1		
Intermediate Drive Teeth & Ratios	Input	29	29	29
	Output	35	29	35
	Ratio	1.207:1	1.000:1	1.207:1
Final Drive Teeth & Ratios	Pinion	11	11	11
	Ring	30	34	30
	Ratio	2.727:1	3.091:1	2.727:1
Bus Data		Yes	Yes	No
Hydraulic Control		E17	E17	E18/2

*** VW models only**

ZF5HP19FL

Oil Pan and Fill Hole

The ZF5HP19FL unit is a Fill for Life fluid. The pan holds 2.7-3.2 quarts of oil and a complete refill will hold 9.5 quarts of oil. Fill the transmission with the engine idling and the transmission in park. The oil temperature must be between 95 °F and 115 °F.



ZF5HP19FL

Clutch and Band Application Chart

E17 Models

Position/Gear	Solenoid Valves							Clutches				Brakes			Freewheel
	N88	N89	N90	N91	N92	N93	N94	A	B	E	F	C	D	G	1ST Gear
Reverse	X			X		X			X				X	X	
Neutral	X	X		X		X					X			X	
D/1st	X	X		X		X		X						X	X
D/2nd	X	X		X	X	X		X				X		X	
D/3rd		X	X	X	X			X			X	X			
D/4th			X	X				X		X	X				
D/5th	X		X	X	X					X	X	X			
2/1st	X			X		X		X					X	X	X
D/5th-4th	X		X	X	X		X	(X)		X	X	(X)			

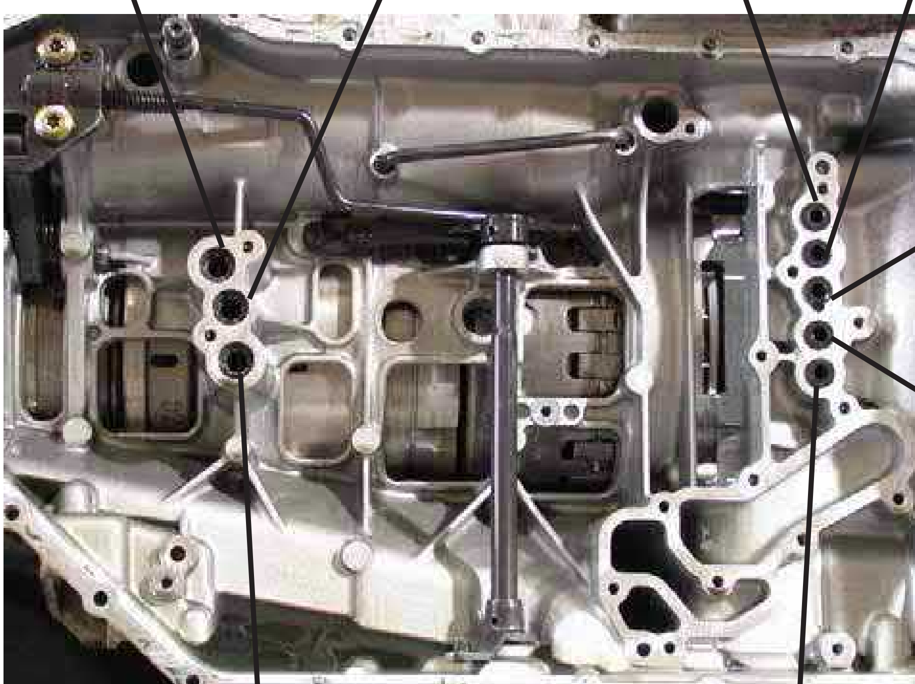
E18 Models

Position/Gear	Solenoids							Clutches							
	Solenoid Valves			Pressure Regulating				Clutches				Brakes			Freewheel
	N88	N89	N90	N215	N216	N217	N218	A	B	E	F	C	D	G	1ST Gear
Reverse	X			X		X			X				X	X	
	X	X		X		X					X			X	
D/1st	X	X		X		X		X						X	X
D/2nd	X	X		X	X	X		X				X		X	
D/3rd		X	X	X	X			X			X	X			
D/4th			X	X				X		X	X				
D/5th	X		X	X	X					X	X	X			
2/1st	X			X		X		X					X	X	X
D/5th-4th	X		X	X	X		X	(X)		X	X	(X)			

ZF5HP19FL

Air Checking the Case

When air checking a case to clutch application, use regulated air pressure at approximately 30 psi.



ZF5HP19FL

Front Seal and Oil Deflector

When dissassembling the pump assembly, you can choose to remove the oil deflector or simply stake it in to place. In some cases the oil deflector becomes loose and can cause the pump bushing to jar loose and spin in the housing. This can cause severe damage to the hub and seal.

Remove oil deflector or stake it in place

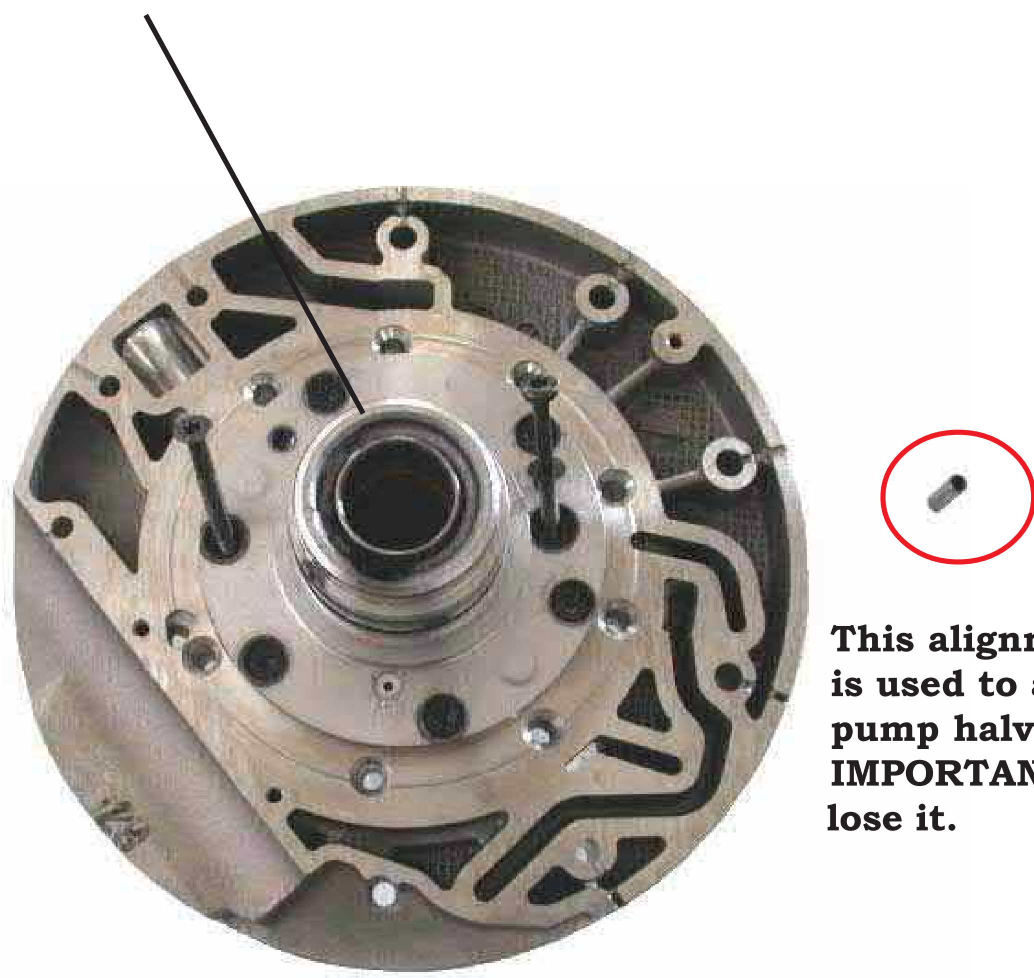
Front Bushing Wear

Possible front seal leak due to the oil deflector becoming loose and damaging the seal

ZF5HP19FL

Pump Disassembly

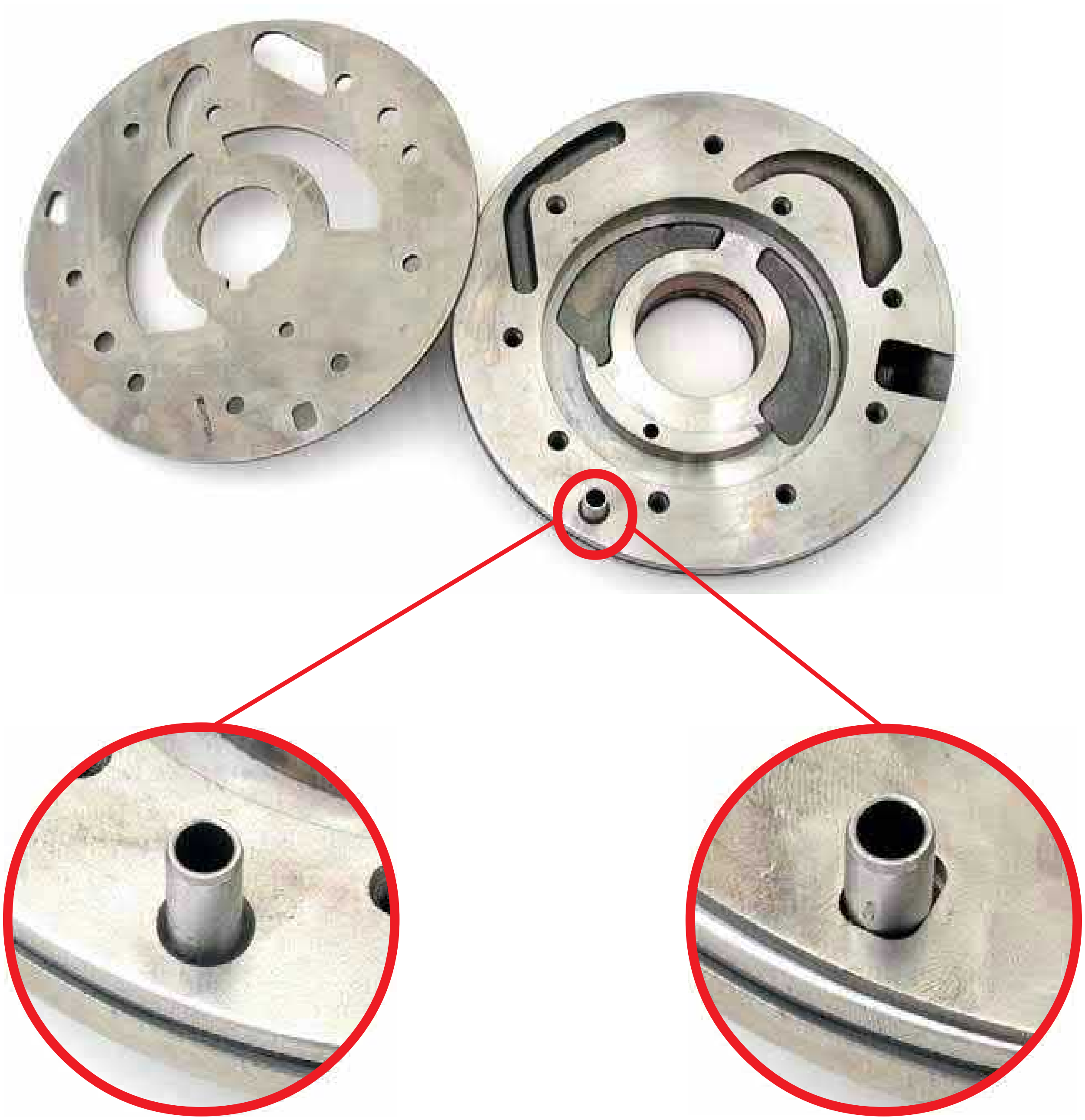
Look here for bushing wear.



This alignment dowel is used to align the pump halves. VERY IMPORTANT not to lose it.

ZF5HP19FL

Pump Disassembly *(continued)*

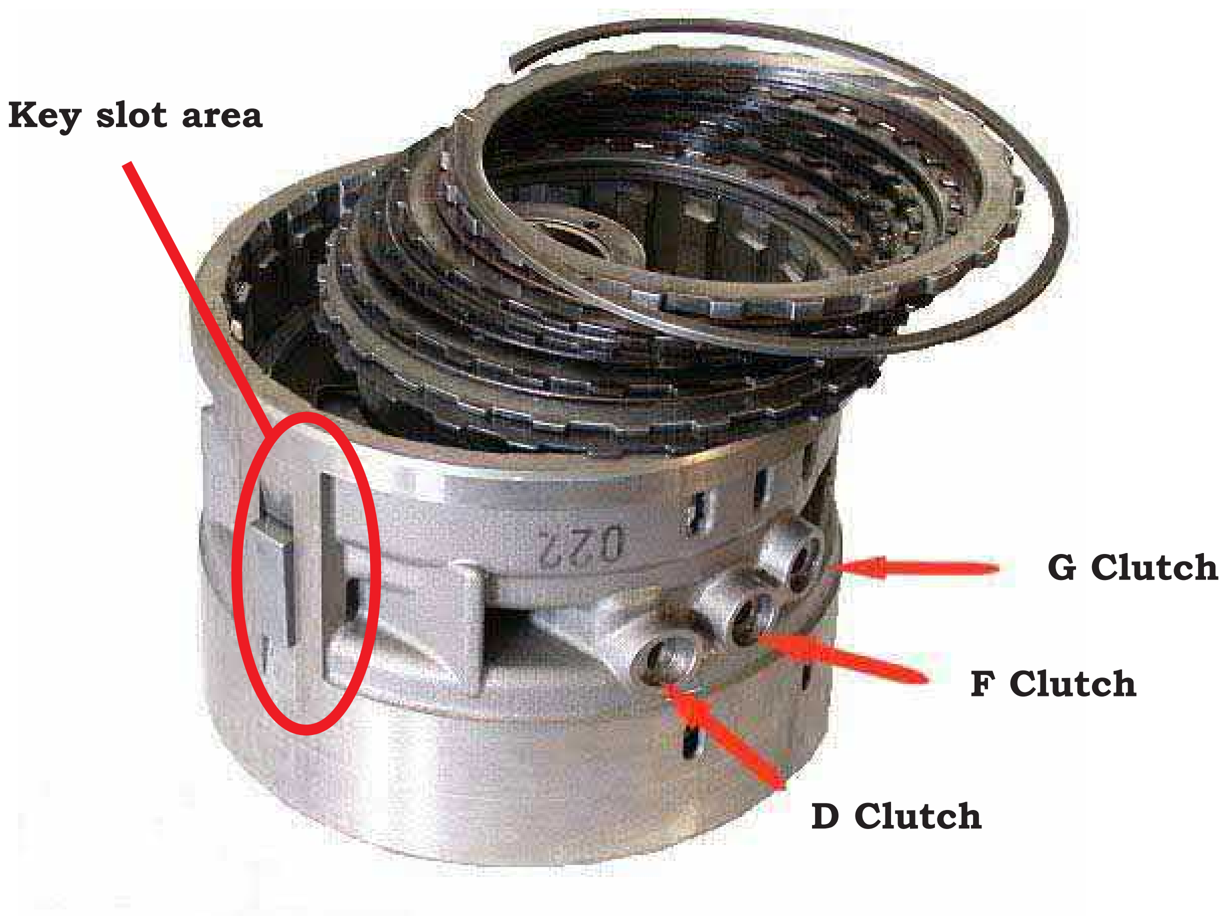


ZF5HP19FL

D Clutch Failure, No Reverse

The rear clutch support housing can become damaged at the key slot area. During disassembly pay close attention to the key slot area. It may be necessary to replace the drum assembly.

Note: Also check the case for slot wear.



ZF5HP19FL

Sprag Rotation

The sprag is viewed from the front of the case.

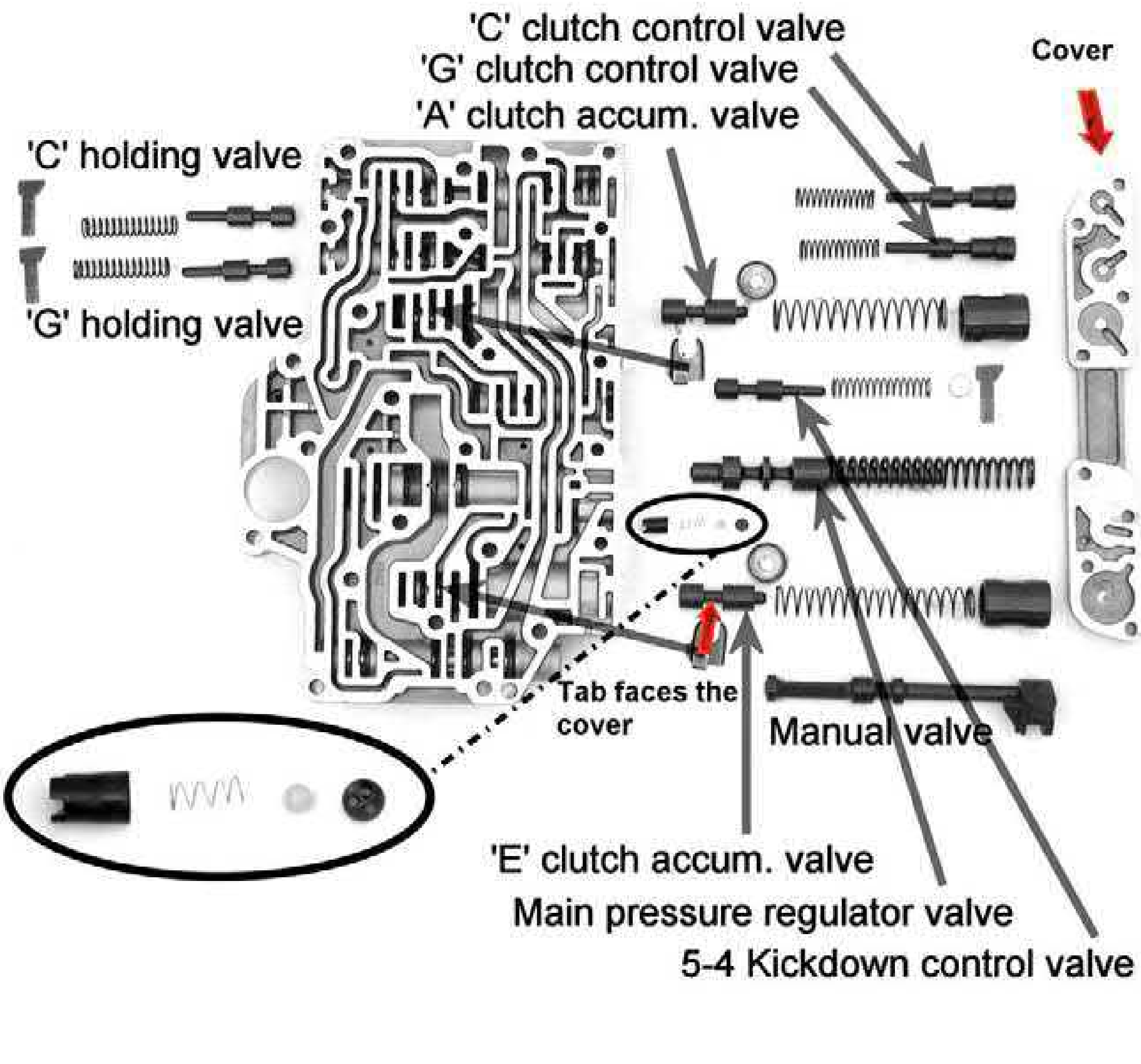
Race for the outer portion of the sprag and D clutch

Rear Clutch support

The support locks into the case using the outer key of the drum.

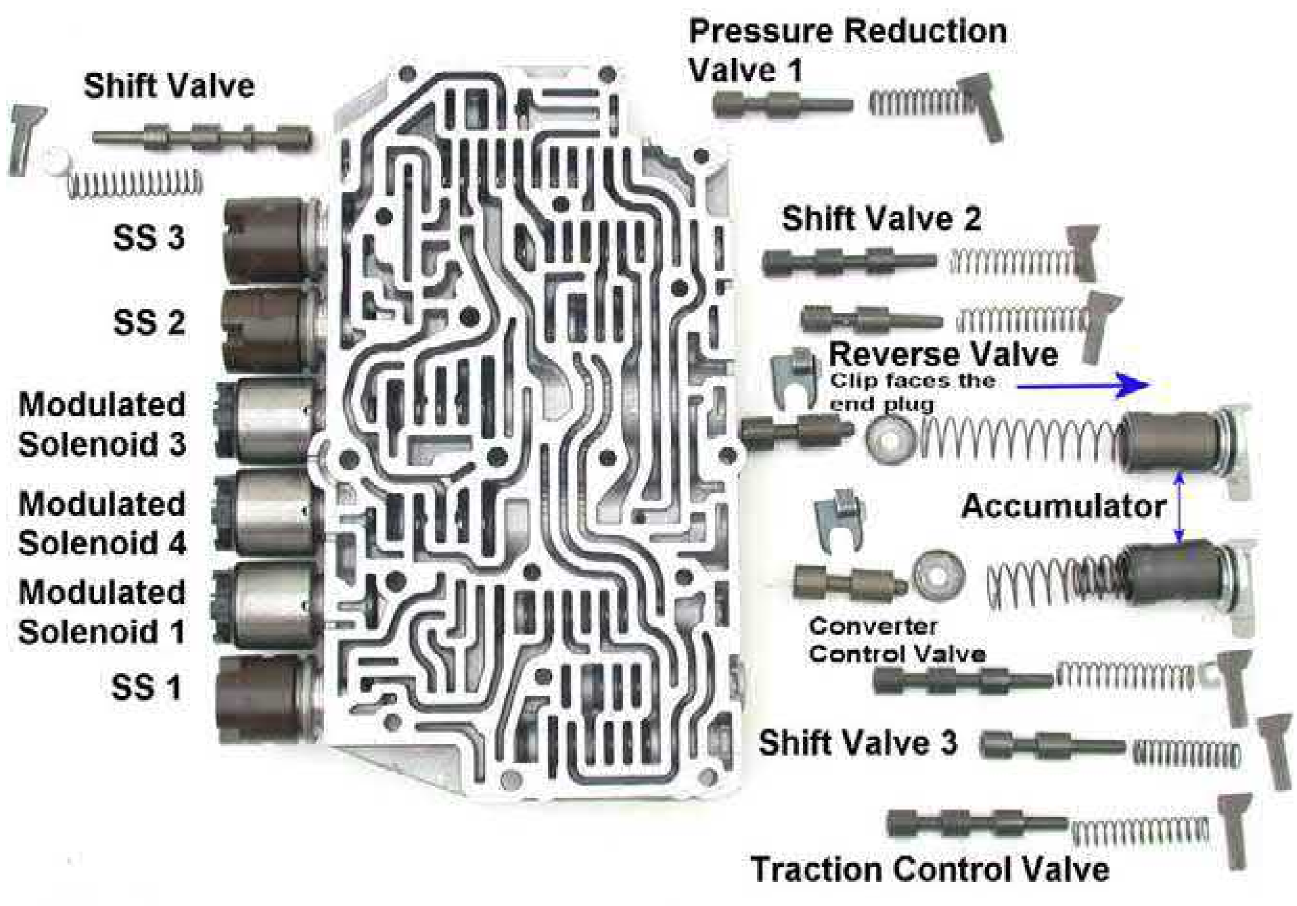
ZF5HP19FL

Main Valve Body Housing



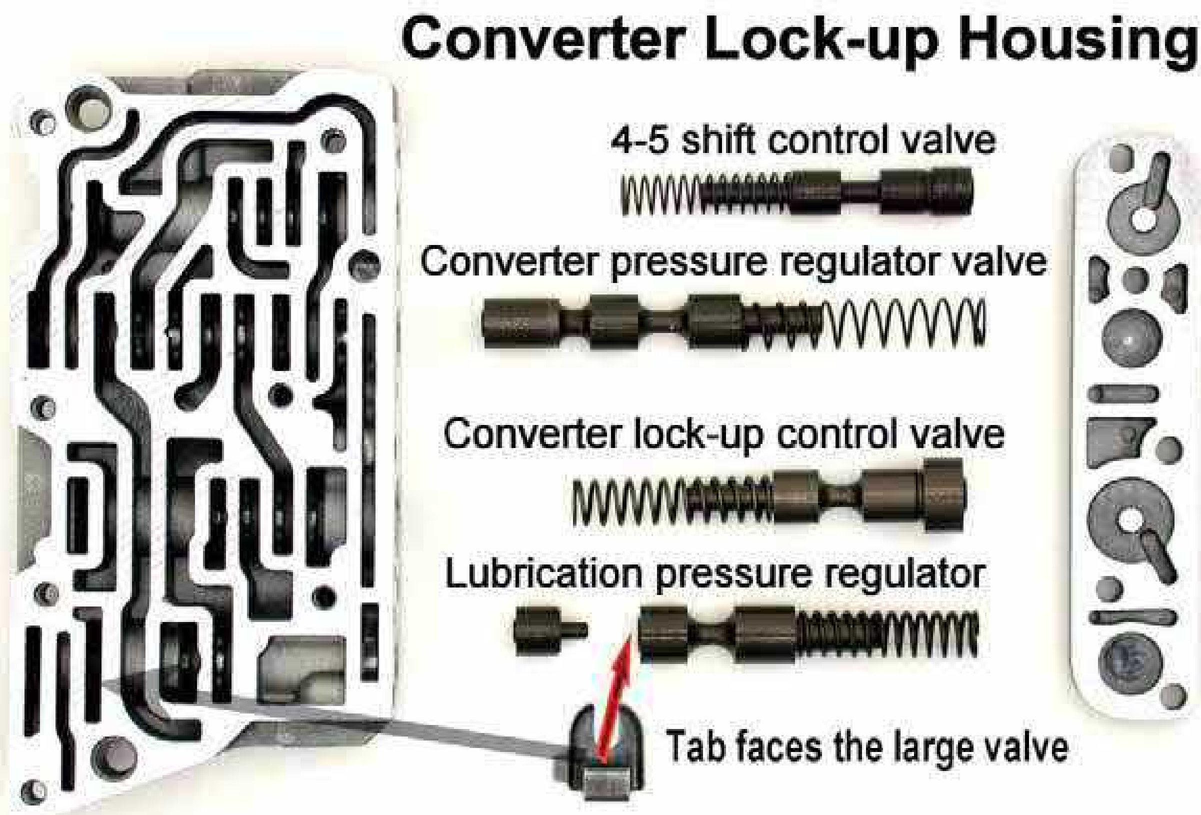
ZF5HP19FL

Main Valve Body Housing (continued)



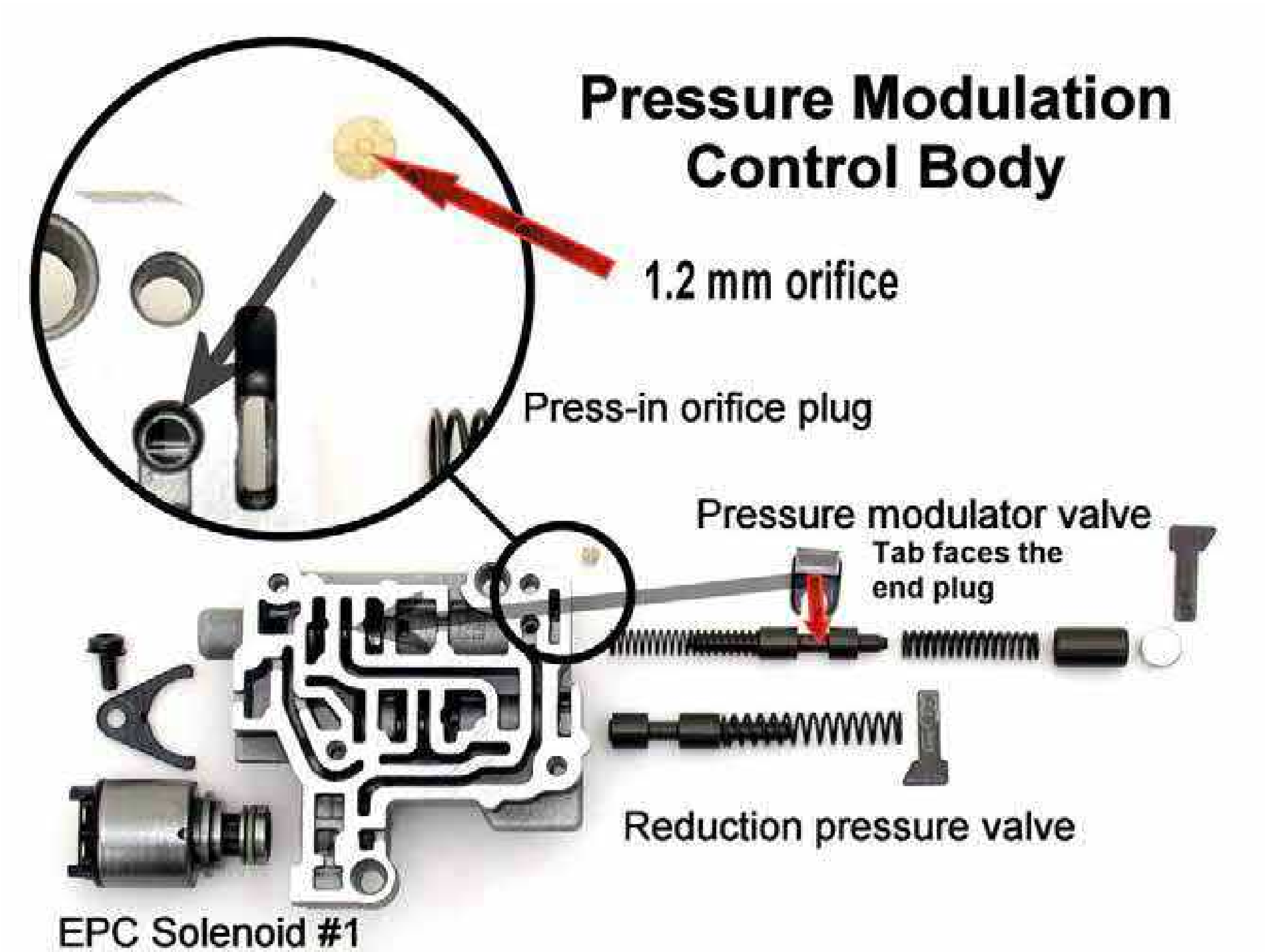
ZF5HP19FL

Converter Lock-up Housing



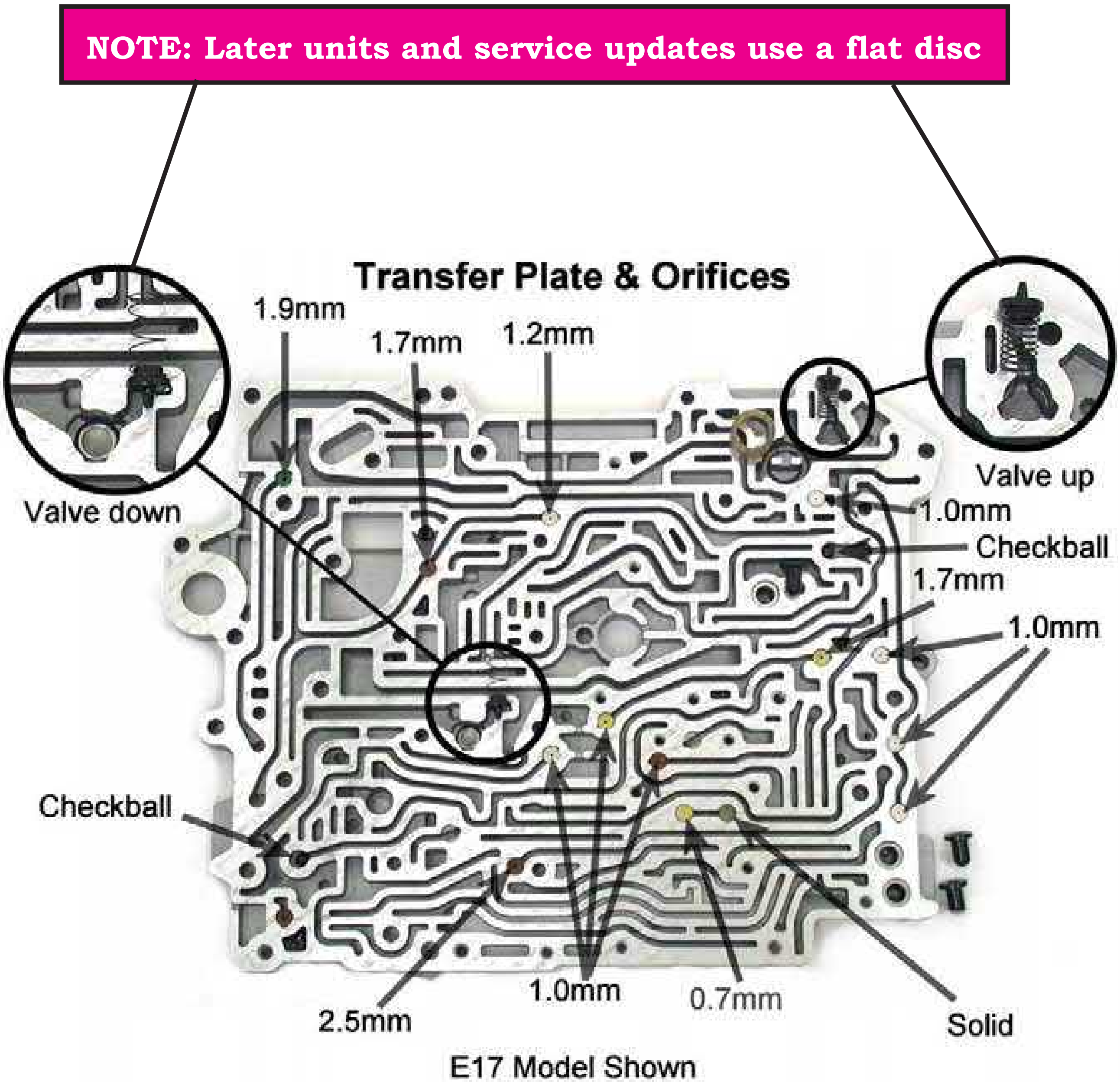
ZF5HP19FL

Pressure Modulation Control Body



ZF5HP19FL

Transfer Plate and Orifices



Reference Contents

Conversion Tables

Area

Multiply	By	To Obtain
In^2	645.2	mm^2
In^2	6.452	cm^2
In^2	0.0069	Ft^2
Ft^2	0.0929	m^2
Ft^2	144.0	In^2
m^2	10.764	Ft^2
cm^2	0.155	In^2
mm^2	0.00155	In^2

area of a circle = πr^2
area of a cylinder = $\pi r^2 h$

π = 3.14 r = Radius h = Height

Distance

Multiply	By	To Obtain
in	25.4	mm
in	2.54	cm
mm	0.0394	in
cm	0.3937	in
ft	0.3048	meter
ft	5280.0	miles
meter	3.2808	ft
mile	1.6093	km
km	0.6214	mile

Temperature

(F° – 32) x 5 ÷ 9 = C°

(C° x 9 ÷ 5) + 32 = F°

Pressure

Multiply	By	To Obtain
PSI	0.0703	kg/cm^2
PSI	0.0689	bar
PSI	6.8948	kPa
kPa	0.14503	PSI
bar	14.503	PSI
kg/cm^2	14.2233	PSI
Hg	34.0136	mbar
mbar	0.0294	Hg

Continued...

Conversion Tables (continued)

Torque		
Multiply	By	To Obtain
in-lbs	0.0833	ft-lbs
in-lbs	0.113	Nm
in-lbs	1.152	kg-cm
ft-lbs	12.0	in-lbs
ft-lbs	1.3558	Nm
ft-lbs	0.138	kg-m
Nm	0.73756	ft-lbs
Nm	8.8507	in-lbs
kg-cm	0.8679	in-lbs
kg-m	7.233	ft-lbs

Weight		
Multiply	**By**	**To Obtain**
Grams	0.03527	Ounces
Ounces	28.3495	Grams
Ounces	0.0625	Pounds
Pounds	16.0	Ounces
Pounds	0.0005	Tons
Pounds	0.4536	Kilograms
Tons	2000.0	Pounds
Tons	907.18	Kilograms
Kilograms	2.20462	Pounds
Kilograms	0.001102	Tons

Volume (Cubic Measure)		
Multiply	By	To Obtain
Cubic in. (in^3)	0.01639	Liters
Cubic in. (in^3)	16.387	Cubic cm (cm^3)
Cubic in. (in^3)	16387.0	Cubic mm (mm^3)
Liters	61.025	Cubic in. (in^3)
Cubic cm (cm^3)	0.06103	Cubic in. (in^3)
Cubic mm (mm^3)	0.000061	Cubic in. (in^3)

Volume (Liquid Measure)		
Multiply	**By**	**To Obtain**
Quarts	0.94633	Liters
Pints	0.4732	Liters
Ounces	0.02957	Liters
LIters	1.05672	Quarts
LIters	2.11344	Pints
Liters	33.81497	Ounces

Conversion Tables (continued)

Duty Cycle/Dwell/Voltage					
Duty Cycle (%)		Degrees Dwell			
Feed Controlled	Ground Controlled	4-Cyl Scale	6-Cyl Scale	8-Cyl Scale	Voltage*
100	0	90.0	60	45.00	14.0
95	5	85.5	57	42.75	13.3
90	10	81.0	54	40.50	12.6
85	15	76.5	51	38.25	11.9
80	20	72.0	48	36.00	11.2
75	25	67.5	45	33.75	10.5
70	30	63.0	42	31.50	9.8
65	35	58.8	39	29.25	9.1
60	40	54.0	36	27.00	8.4
55	45	49.5	33	24.75	7.7
50	50	45.0	30	22.50	7.0
45	55	40.5	27	20.25	6.3
40	60	36.0	24	18.00	5.6
35	65	31.5	21	15.75	4.9
30	70	27.0	18	13.50	4.2
25	75	22.5	15	11.25	3.5
20	80	18.0	12	9.00	2.8
15	85	13.5	9	6.75	2.1
10	90	9.0	6	4.50	1.4
5	95	4.5	3	2.25	0.7
0	100	0.0	0	0.00	0.0

* *The voltage values are based on a 14-volt system voltage. Variations from this level will affect all of the voltage readings.*

Resistor Values

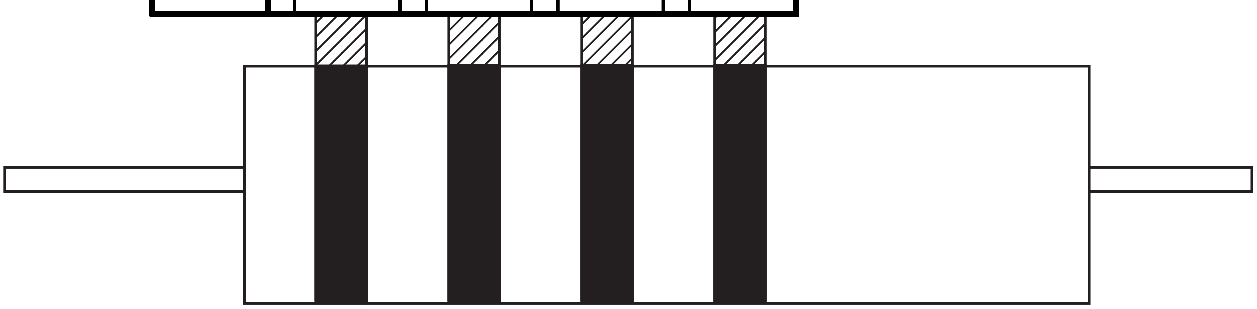
If you can read the bands on a ceramic resistor, you can determine its resistance value and its tolerance:

- The first two bands indicate the first two digits of its resistance value.
- The third band indicates the number of zeros to add.
- The fourth band indicates the tolerance.

Resistance Values

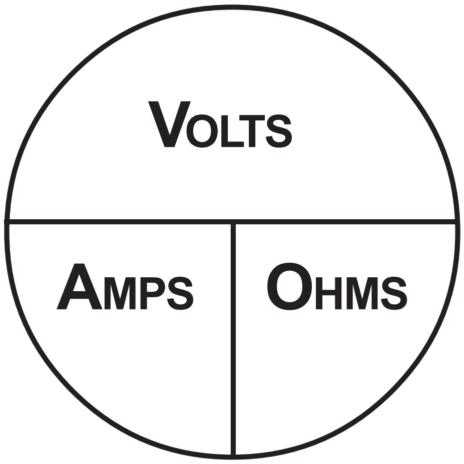
Color	1st Band	2nd Band	3rd Band	4th Band
Black	0	0	0	—
Brown	1	1	1	—
Red	2	2	2	—
Orange	3	3	3	—
Yellow	4	4	4	—
Green	5	5	5	—
Blue	6	6	6	—
Violet	7	7	7	—
Gray	8	8	8	—
White	9	9	—	—
Brown	—	—	—	1%
Gold	—	—	—	5%
Silver	—	—	—	10%
Plain	—	—	—	20%

Brown
1%



So if the bands are:					**The resistor value is:**
Blue	Green	Yellow	Silver		
6	5	0,000	±10%	=	650 kΩ, ±10%
Red	Violet	Brown	Gold		
2	7	0	±5%	=	270 Ω, ±5%
White	Orange	Violet	Plain		
9	3	0,000,000	±20%	=	930 MΩ, ±20%

Ohm's Law



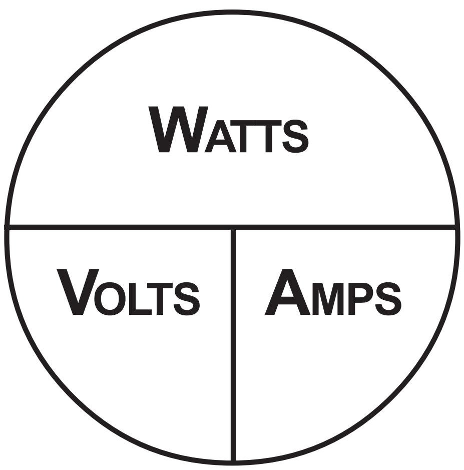
With Ohm's Law, as long as you have any two circuit values, you can easily calculate the third:

Volts ÷ Amps = Ohms

Volts ÷ Ohms = Amps

Amps x Ohms = Volts

Electrical Power



A measurement of power developed in an electrical circuit.

Just like with Ohm's Law, whenever you have two measurements, you can calculate the third.

Watts ÷ Volts = Amps

Watts ÷ Amps = Volts

Volts x Amps = Watts

Electrical Formulas

Resistors in a Series Circuit

$$R_{Total} = R_1 + R_2 + R_3 \ldots$$

Two Resistors in a Parallel Circuit

$$R_{Total} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Multiple Resistors in a Parallel Circuit

$$R_{Total} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots}$$

Two Capacitors in a Series Circuit

$$C_{Total} = \frac{C_1 \times C_2}{C_1 + C_2}$$

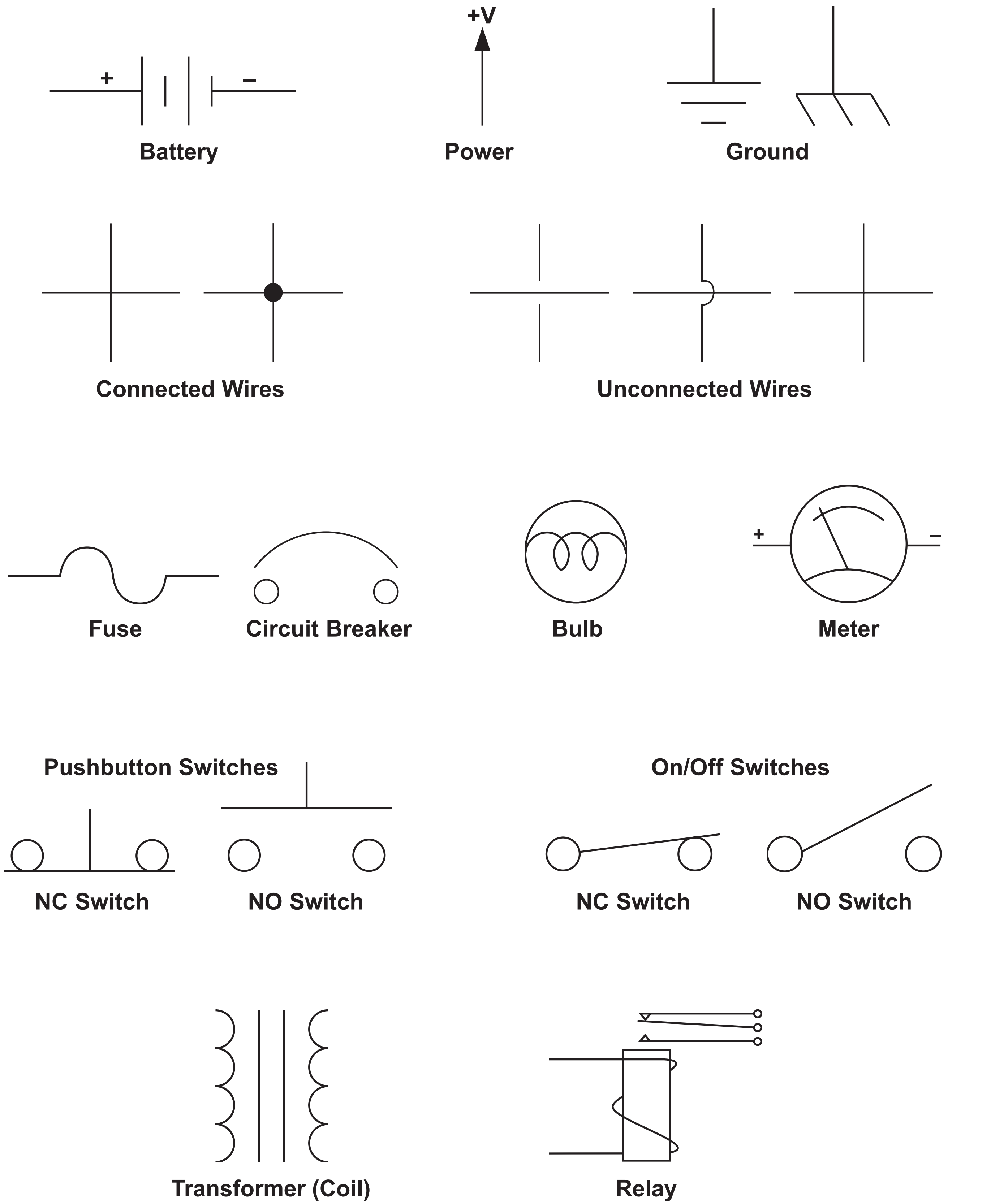
Multiple Capacitors in a Series Circuit

$$C_{Total} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \ldots}$$

Capacitors in a Parallel Circuit

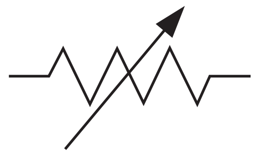
$$C_{Total} = C_1 + C_2 + C_3 \ldots$$

Schematic Symbols

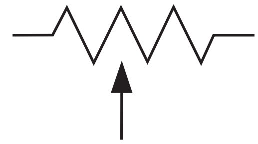


Schematic Symbols (continued)

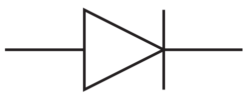
Fixed Resistor



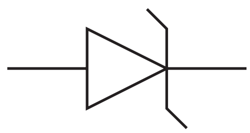
Variable Resistor



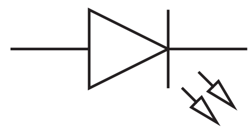
Potentiometer



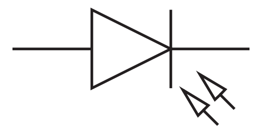
Diode



Zener Diode

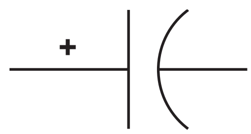


LED

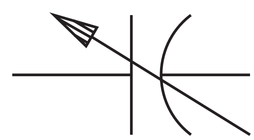


Photodiode

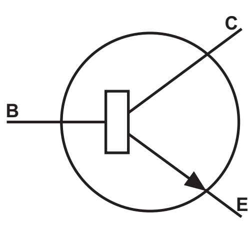
Fixed Capacitor



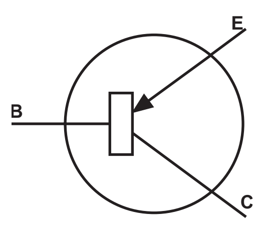
Fixed Capacitor (Polarized)



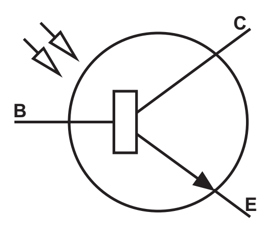
Variable Capacitor



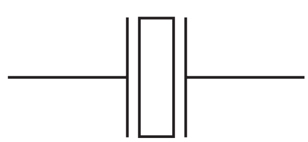
NPN Transistor



PNP Transistor



Phototransistor



Crystal

Glossary of Electrical Terms

Ammeter — Electrical test device that measures current flow in a circuit. Displays measurement in amperes, or amps.

Amperage — Measurement of current flow in a circuit.

Amperes; Amps — Unit of measurement for reading current flow. Amperage is actually a reading of how many electrons are moving through a circuit at any given moment. One amp is the amount of current that one volt will push through one ohm of resistance.

Analog Meter — Measurement device that provides readings using a needle, instead of a digital output. Analog meters measure constantly, so the reading you see is the value taking place right now. But analog meters tend to be less accurate than digital meters, and the reading only updates as quickly as the needle can move.

B+ — Battery power.

Closed Circuit — A complete electrical path that provides the means for electricity to perform work. A closed circuit allows current to flow from its source, through the resistances, and back to its source.

Computer — Also controller; microprocessor. Device that provides the commands necessary to operate the engine or transmission, based on inputs from a series of sensors and switches.

Controller — See Computer.

Conventional Electrical Theory — Electrical circuit model which indicates that electrical flow is from positive to negative. More recent studies show that electrons actually flow from negative to positive, but most texts still prefer to use the conventional model.

Current — Electron flow through a circuit, current is measured in amps.

De-energize — To turn off, or shut down a circuit or component.

Digital — On/off signal. A series of pulses that are either on or off, which provide information by varying frequency, or which control a circuit by varying frequency, duty cycle or on-time.

Digital Multimeter — Also DMM; DVOM; Digital Volt-Ohmmeter. Electrical device that provides measurements of electrical circuits, using a digital display. Digital meters and oscilloscopes read a circuit through sampling; how accurate your measurement is depends on how many samples the meter takes per second.

Digital Volt-Ohmmeter — See Digital Multimeter.

Distributorless Ignition System — Also Electronic Ignition. A type of ignition that doesn't use a distributor to provide spark to the cylinders. These systems usually provide spark through a process known as "wastespark"; a process which provides spark to two cylinders at once. One cylinder fires; the other receives spark on its exhaust stroke — that cylinder's spark is "wasted." Ford uses this term to identify one of its electronic ignition system.

Continued...

Glossary of Electrical Terms (cont)

Diode — An electrical one-way shutoff valve. A diode is a semiconductor, designed to allow current flow in one direction, but not in the other direction. These devices are commonly used to control the spark that develops when an electromagnetic coil de-energizes, and the magnetic field collapses.

Duty Cycle — A signal that varies its relationship between on-time and off-time. Duty cycle signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes.

Electrostatic Discharge — Electrical potential that releases suddenly; the “shock” you feel when you touch a doorknob on a dry day is electrostatic discharge. That “shock” can damage or destroy electronic components. That’s why it’s important to take precautions — wear a static strap, never touch the terminals, etc. — when working with electronic devices.

Energize — To turn on a circuit or component; provide with power and ground, to enable an electrical device to operate.

Engine Control Module — Also ECM. SAE J-1930 term for a device that controls only engine operation. See also PCM, TCM, Computer.

Frequency — The number of complete oscillations, or cycles, that occur each second. Measured in Hertz.

Ground — The return side of an electrical circuit, as defined by the conventional electrical theory. More recent studies show that electrons actually flow in the opposite direction of that shown by conventional theory, but it’s still the most common model for electrical circuits.

Grounded Circuit — An electrical circuit failure that keeps the circuit energized all the time, regardless of switch or relay position. Also known as a short-to-ground.

Hertz — Also Hz. Unit of measurement for frequency; the number of complete cycles that take place in one second. A signal that repeats itself 20 times every second has a frequency of 20 Hertz.

High Impedance — Having high resistance to electrical flow. Usually used to describe electrical meters. When used to test an electronic circuit, a low impedance meter would affect the characteristics of the circuit. The higher the meter’s impedance, the less effect it will have on the circuit, so the less change it will make to the circuit operation when connected.

Intermittent — Taking place in an irregular or unpredictable cycle. An intermittent problem or failure may happen one moment, then not be there the next. That’s why intermittent failures are often difficult to isolate.

Light-Emitting Diode — Also LED. A semiconductor that lights when energized, much like a light bulb. But, unlike a light bulb, an LED requires very little current, and that current flow must be in a specific

Continued...

Glossary of Electrical Terms (cont)

direction, or the LED won't light.

Microprocessor — See Computer.

Ohm — Unit of resistance measurement. It takes one volt to push one amp of current through one ohm resistance.

Ohmmeter — Electrical device for measuring resistance in a circuit or component.

Ohm's Law — Principle that defines the relationship between pressure (voltage), flow (amperage) and resistance (ohms). Ohms x Amps = Volts; Volts ÷ Ohms = Amps; Volts ÷ Amps = Ohms.

Open Circuit — An incomplete electrical path that won't provide the means for electricity to perform work. An open circuit prevents current flow, so the circuit won't operate.

Oscilloscope — An electrical test device that maps voltage changes in a circuit over a specific amount of time. An oscilloscope displays the voltage signal as a picture, to show how voltage changes through the component's operating cycle.

Parallel Circuit — An electrical circuit designed with multiple paths through the circuit, so that not all of the current must pass through all of the loads in the circuit. If one leg of a parallel circuit opens, it won't prevent the other legs from operating.

Potentiometer — A three-wire sensor that modifies a voltage signal based on movement or position. Potentiometers receive a regulated voltage signal to one end of a resistor, and ground to the other; a wiper slides along the resistor, and picks up the voltage signal, based on its position along the resistor.

Powertrain Control Module — Also PCM. SAE J-1930 term for a computer that controls engine and transmission operation. A PCM may also control other systems, including cruise control, A/C system, antilock brakes, etc., but it must control engine and transmission to be called a PCM. See also ECM, TCM.

Pulse Generator — An AC generator that develops a frequency signal that varies with the rotational speed of an internal transmission component, such as a sun shell, turbine shaft or output ring gear. The computer uses this signal to measure the component's RPM. From this, the computer can determine when to shift, when a shift is complete, or if a clutch is slipping.

Pulse Width Modulated — Also PWM. A signal that varies its relationship between on-time and off-time. Pulse width modulated signals usually control a computer output device, such as an electronic pressure control solenoid: The longer the signal on-time, the longer the solenoid remains open, so the lower mainline pressure becomes. See Duty Cycle.

Relay — An electrical device that allows a low current circuit to control a high current circuit. Energizing a relay energizes an electromagnet, which opens or closes a set of contacts, to provide power or ground to a circuit that would normally require too much current for the device control-

Continued...

Glossary of Electrical Terms (cont)

ling the circuit.

Resistance — The ability of a circuit or device to reduce or limit current flow.

Resistor — A device that limits or reduces current flow in a circuit.

Sensor — A device that provides signals to the computer, based on engine or transmission operating conditions. The computer uses these signals to control engine operation more precisely.

Serial Data — A digital signal from the computer, to communication information with other computers or scan tools. Scan tools can provide the actual sensor readings the computer sees, and outputs from the computer, by interpreting serial data signals.

Series Circuit — An electrical circuit in which all of the loads are wired end to end, in such a way that forces all of the current passing through the circuit to travel through all of the loads. If one load in a series circuit opens, it will prevent the other loads from operating.

Short Circuit — An electrical circuit without the resistance necessary to operate properly. Because of this lost resistance, these circuits will often burn up, unless protected by a fuse or circuit breaker. Not to be confused with a grounded circuit.

Shrink Tubing — An insulating material that shrinks to seal a connection when you apply heat.

Solenoid — An electrical device that turns electrical signals into movement or work. Solenoids can control lever movement, such as throttle kickers, or can control vacuum or hydraulic flow. The solenoids you'll most likely

Abbreviations

Abbr.	Description
A	Ammeter
AC	Alternating current
B, b	Base electrode, units with single base
°C	Degrees Celsius or centigrade
C	Capacitance, capacitor
C, c	Collector electrode
cm	Centimeter
cu	Cubic
db	Decibels
DC	Direct current
dm	Decimeter
DPDT	Double-pole, double-throw switch
DPST	Double-pole, single-throw switch
E, e	Emitter electrode
E, e	Voltage
mf	Microfarad
°F	Degrees Fahrenheit
F, f	Frequency
flu	Fluid
FM	Frequency modulation
g	Gram
gnd, grd	Ground
Hg	Mercury
Hz	Hertz
I	Current
I_B	Base current (DC)
I_C	Collector current (DC)
I_E	Emitter current (DC)
k	x1000
kg	Kilograms
kHz	Kilohertz

Abbr.	Description
kV	Kilovolt
kW	Kilowatt
kWH	Kilowatt hour
lb	Pound
M	Mega; x1,000,000
m	Milli; one-one thousanth; 1/1000; 0.001
mf, mfd	Microfarad
MHz	Megahertz
mm	Millimeter
NC	Normally closed
Nm	Newton-meter
NO	Normally open
R	Resistance; resistor
SPDT	Single-pole, double-throw switch
SPST	Single-pole, single-throw switch
t	Time
T	Temperature
V, v	Volt; voltmeter
V_{BB}	Base supply voltage (DC)
V_{BC}	Base-to-collector voltage (DC)
V_{BE}	Base-to-emitter voltage (DC)
V_{CB}	Collector-to-base voltage (DC)
V_{CC}	Collector supply voltage (DC)
V_{CE}	Collector-to-emitter voltage (DC)
V_{EB}	Emitter-to-base voltage (DC)
V_{EC}	Emitter-to-collector voltage (DC)
v_{ee}	Emitter supply voltage (DC)
v_F	Forward voltage (DC)
W	Watt; work
w	Watt
wh, whr	Watt-hour

Numeric Equivalents

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.0078	1/128	0.1981		
0.0135		0.3429	80	
0.0145		0.3683	79	
0.0156	1/16	0.3962		
0.0160		0.4064	78	
0.0180		0.4572	77	
0.0200		0.5080	76	
0.0210		0.5334	75	
0.0225		0.5715	74	
0.0234	3/128	0.5944		
0.0240		0.6096	73	
0.0250		0.6350	72	
0.0260		0.6604	71	
0.0280		0.7112	70	
0.0292		0.7417	69	
0.0310		0.7874	68	
0.0312	1/32	0.7925		
0.0320		0.8128	67	
0.0330		0.8382	66	
0.0350		0.8890	65	
0.0360		0.9144	64	
0.0370		0.9398	63	
0.0380		0.9652	62	
0.0390	5/128	0.9906	61	
0.0400		1.0160	60	
0.0410		1.0414	59	
0.0420		1.0668	58	
0.0430		1.0922	57	
0.0465		1.1811	56	
0.0469	3/64	1.1913		0-80 NF
0.0520		1.3208	55	
0.0547	7/128	1.3894		
0.0550		1.3970	54	
0.0595		1.5113	53	1-64 NC
				1-72NF
0.0625	1/16	1.5875		
0.0635		1.6129	52	
0.0670		1.7018	51	
0.0700	9/128	1.7780	50	2-56 NC
				2-64 NF
0.0730		1.8542	49	
0.0760		1.9304	48	
0.0781	5/64	1.9837		
0.0785		1.9939	47	3-48 NC
0.0810		2.0574	46	
0.0820		2.0828	45	3-56 NF
0.0860	11/128	2.1844	44	4-36 NS
0.0890		2.2606	43	4-40 NC
0.0935		2.3749	42	4-48 NF
0.0938	3/32	2.3825		1/8-32 NC
0.0960		2.4384	41	
0.0980		2.4892	40	3mm - 0.50
0.0995		2.5273	39	
0.1015		2.5781	38	1/8-40NF
				5-40NC
0.1016	13/128	2.5806		
0.1040		2.6416	37	5-44 NF
0.1065		2.7051	36	6-32 NC
0.1094	7/64	2.7788		
0.1100		2.7940	35	
0.1110		2.8194	34	6-36 NS

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.1130		2.8702	33	6-40 NF
0.1160		2.9464	32	
0.1172	15/128	2.9769		
0.1200		3.0480	31	6-48 NS
0.1250	1/8	3.1750		
0.1285		3.2639	30	
0.1328	17/128	3.3731		
0.1340		3.4036		4mm - 0.70
				4mm - 0.75
0.1360		3.4544	29	8-32 NC
				8-36 NF
0.1405		3.5687	28	8-40 NS
0.1406	9/64	3.5712		
0.1440		3.6576	27	
0.1470		3.7338	26	3/16-24 NC
0.1476		3.7500		4.5mm - 0.75
0.1484	19/128	3.7694		
0.1495		3.7973	25	10-24 NC
0.1520		3.8608	24	
0.1540		3.9116	23	
0.1563	5/32	3.9700		
0.1570		3.9878	22	3/16-32 NF
0.1590		4.0386	21	10-32 NF
0.1610		4.0894	20	
0.1641	21/128	4.1681		
0.1650		4.1910		5mm - 0.90
0.1660		4.2164	19	
0.1690		4.2926		5mm - 0.80
0.1695		4.3053	18	
0.1719	11/64	4.3663		
0.1730		4.3942	17	
0.1770		4.4958	16	12-24 NC
0.1797	23/128	4.5644		
0.1800		4.5720	15	
0.1653		4.2000		5.5mm - 0.80
0.1820		4.6228	14	12-28 NF
0.1850		4.6990	13	12-32 NEF
0.1875	3/16	4.7625		
0.1890		4.8006	12	
0.1910		4.8514	11	
0.1935		4.9149	10	14-20 NS
0.1953	25/128	4.9606		
0.1960		4.9784	9	
0.1990		5.0546	8	
0.2010		5.1054	7	1/4-20 NC
				14-24 NS
0.2031	13/64	5.1587		
0.2040		5.1816	6	
0.2050		5.2070		6mm - 1.00
0.2055		5.2197	5	
0.2090		5.3086	4	1/4-24 NS
0.2109	27/128	5.3569		
0.2130		5.4102	3	1/4-28 NF
0.2188	7/32	5.5575		1/4-32 NEF
0.2210		5.6134	2	
0.2266	29/128	5.7556		
0.2280		5.7912	1	1/4-40 NS
0.2340		5.9436	A	
0.2344	15/64	5.9538		
0.2380		6.0452	B	
0.2400		6.0960		7mm - 1.00

Numeric Equivalents (continued)

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.2420		6.1468	C	
0.2422	31/128	6.1519		
0.2460		6.2484	D	
0.2500	1/4	6.3500	E	
0.2570		6.5278	F	5/16-18 NC
0.2578	33/128	6.5481		
0.2610		6.6294	G	
0.2656	17/64	6.7462		
0.2660		6.7564	H	
0.2720		6.9088	I	8mm - 1.25
				5/16-24 NF
0.2734	35/128	6.9444		
0.2770		7.0358	J	
0.2800		7.1120		8mm - 1.00
0.2810		7.1374	K	
0.2813	9/32	7.1450		5/16-32 NEF
0.2891	37/128	7.3431		
0.2900		7.3660	L	
0.2950		7.4930	M	
0.2969	19/64	7.5413		
0.3020		7.6708	N	
0.3047	39/128	7.7394		
0.3110		7.8994		9mm - 1.25
0.3125	5/16	7.9375		3/8-16 NC
0.3160		8.0264	O	
0.3190		8.1026		9mm - 1.00
0.3203	41/128	8.1356		
0.3230		8.2042	P	
0.3270		8.3058		9mm - 0.75
0.3281	21/64	8.3337		
0.3320		8.4328	Q	3/8-24 NF
0.3359	43/128	8.5319		
0.3390		8.6106	R	**1/8-27 NPT**
0.3430		8.7122		10mm - 1.50
0.3438	11/32	8.7325		
0.3480		8.8392	S	
0.3500		8.8900		10mm - 1.25
0.3516	45/128	8.9306		
0.3580		9.0932	T	10mm - 1.0
0.3594	23/64	9.1288		
0.3672	47/128	9.3269		
0.3680		9.3472	U	7/16-14 NC
0.3750	3/8	9.5250		
0.3770		9.5758	V	
0.3820		9.7028		11mm - 1.50
0.3828	49/128	9.7231		
0.3860		9.8044	W	
0.3906	25/64	9.9212		7/16-20 NF
0.3970		10.0838	X	
0.3984	51/128	10.1194		
0.4040		10.2616	Y	
0.4063	13/32	10.3200		
0.4130		10.4902	Z	12mm - 1.75
0.4141	53/128	10.5181		
0.4210		10.6934		12mm - 1.50
0.4219	27/64	10.7163		1/2-13 NC
0.4290		10.8966		12mm - 1.25
0.4297	55/128	10.9144		
0.4375	7/16	11.1125		**1/4-18NPT**
0.4453	57/128	11.3106		

Decimal Inches	Fraction Inches	Millimeters	Drill Size	Tap Size
0.4531	29/64	11.5087		1/2-20 NF
				1/2-24 NS
0.4609	59/128	11.7069		
0.4688	15/32	11.9075		
0.4766	61/128	12.1056		
0.4800		12.1920		14mm - 2.00
0.4844	31/64	12.3038		9/16-12 NC
0.4922	63/128	12.5019		
0.5000	1/2	12.7000		14mm - 1.50
0.5039		12.8000		14mm - 1.25
0.5156	33/64	13.0962		9/16-18 NF
0.5312	17/32	13.0962		5/8-11 NC
0.5469	35/64	13.8913		
0.5590		14.2000		16mm - 2.00
0.5625	9/16	14.2875		
0.5781	37/64	14.6837		5/8-18NF
				3/8-18NPT
0.5787		14.7000		16mm - 1.50
0.5938	19/32	15.0825		11/16-11 NS
0.6094	39/64	15.4788		
0.6220		15.8000		18mm - 2.50
0.6250	5/8	15.8750		11/16-16 NS
0.6406	41/64	16.2712		
0.6562	21/32	16.6675		3/4-10 NC
0.6614		16.8000		18mm - 1.50
0.6719	43/64	17.0663		
0.6875	11/16	17.4625		3/4-16NF
0.7008		17.8000		20mm - 2.50
0.7031	45/64			**1/2-14 NPT**
0.7187	23/32			
0.7344	47/64			
0.7500	3/4			
0.7656	49/64			7/8-9 NC
0.7812	25/32			
0.7969	51/64			
0.8125	13/16			7/8-14 NF
0.8228		20.9000		22mm - 1.50
0.8281	53/64			7/8-18 NS
0.8425		21.4000		24mm - 3.00
0.8437	27/32			
0.8594	55/64			
0.8750	7/8			1-8 NC
0.8779		22.3000		24mm - 2.00
0.8906	57/64			
0.9062	29/32			
0.9219	59/64			1-12 NF
				3/4-14 NPT
0.9375	15/16			1-14 NS
0.9531	61/64			
0.9687	31/32			
0.9844	63/64			
1.0000	1			

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(805) 604-2000 • Fax (805) 604-2003
www.ATRAonline.com • www.atra.com

Membership Application

"Applicant understands and agrees that resignation from membership in the association together with the applicant's continuing obligation to pay monthly membership fees shall only take effect and cease at the end of the last month during under which all advertisements and promotional materials identifying the applicant as a member of the association (including but not limited to the display of the ATRA logo) ceases to be displayed at the applicant's place of business, in any local telephone directories, business cards, brochures and/or any other type or kind of promotional communication, material, means or device."

(Please Print or Type) *Please complete and return this form to the ATRA business office by mail or fax*

Business Legal Name		Business Operating Name (If different than legal name)	
Business MAILING Address	Suite #		Phone Number
City	State	Zip	Fax Number
Business STREET Address (if different from above)	Suite #		Phone Number
City	State	Zip	Fax Number
Email Address			Business Tax Identification Number
Website Address http://			State License Number

ENTITY INFORMATION

Applicant is a: ❑ Sole Proprietorship ❑ Partnership ❑ Corporation ❑ Limited Liability Company

Applicant is a: ❑ One-shop operation ❑ Multi-shop operation

(If a multi-shop operation, a rebuilder membership application is required and must be submitted for each shop.

OWNERSHIP Name(s) of Owner, Shareholder(s), Partner(s) or Member(s)

Name		Social Security Number
Residence Address	Suite #	Phone Number
City	State	Zip

Name		Social Security Number
Residence Address	Suite #	Phone Number
City	State	Zip

Name		Social Security Number
Residence Address	Suite #	Phone Number
City	State	Zip

Seminar Questionnaire

Location of the seminar ___________________________________

Please give us a rating from 1 - 5.
(1 = unacceptable, 2 = needs work, 3 = Good, 4 = Very Good, 5 = Excellent:

1. Type of material covered	0	1	2	3	4	5
2. Presentation of material	0	1	2	3	4	5
3. Speaker #1 knowledge of subject	0	1	2	3	4	5
4. Speaker #2 knowledge of subject	0	1	2	3	4	5
5. Ability of speaker #1 to communicate	0	1	2	3	4	5
6. Ability of speaker #2 to communicate	0	1	2	3	4	5

Are you a

❏ ATRA Rebuilder Member ❏ Supplier Member ❏ ATRA Technical Subscriber

❏ Proctor ❏ Student

❏ Non-Member-Would you like information on becoming a member? ___

Please provide us some information: Your Name_____________________________________

Company Name and Address ____

Email Address____

Are you a shop

❏ Owner ❏ Manager ❏ Technician

How many miles did you travel to attend today's ATRA Seminar?

❏ Less than 50 ❏ 50 – 149 ❏ 150 – 249 ❏ Over 250

Who paid your seminar registration fee?

❏ Myself ❏ My employer

Hotel accommodations	1	2	3	4	5
Meeting room accommodations	1	2	3	4	5
Quality of luncheon	1	2	3	4	5

COMMENTS

____

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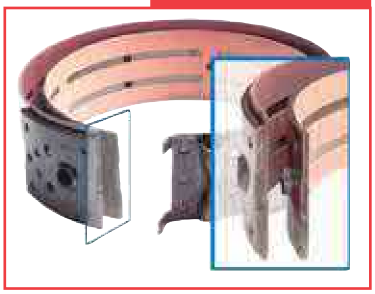
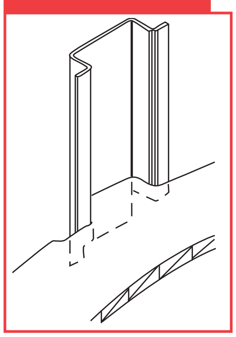
Not All Parts are OE Quality;

Some are Just a Little Better...

If the OEM part is just not good enough, request Alto Original Equipment Improvement (OEI™)parts. Alto has pioneered OEI™ replacement parts for over 20 years. Our innovative designs and aggressive research and development have produced more improvements and enhancements in clutch technology than all the competition combined.

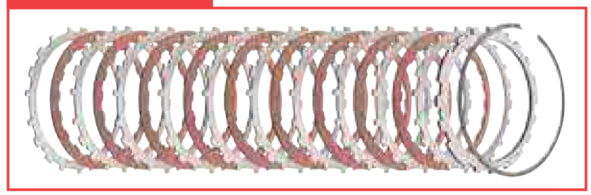


PowerBands® are the latest innovation to come out of the relentless Alto technical department. PowerBands® enhance torque load and improve shift quality. They are designed wider than the original band to increase stopping capacity of up to 25%. Anchors have been increased in thickness and heat treated when required to eliminate premature failures.



In certain applications steel plates can scar the case. Indentations produced by these steels cause the plates to stick and allow metal to enter in the valve body. This plate hang-up causes delayed engagement. Alto's patented CaseSaver™ gives the steel plate a smooth surface to interact with; eliminating clutch hang-up and preventing extraneous metal from reaching the valve body.

Innovations and enhancements make Alto the serious racers' choice. Alto is the leader in Hi-Performance technology with Kolene® Steels, Turbulator Steels, Anti-Drag™ Steels and Red Eagle® Frictions.



Beginning with the first introduction of the TH700R4 extra capacity kit, Alto has been developing PowerPack® innovations for 20 years. Alto PowerPacks® have become the industry standard in hi-performance and heavy-duty applications. PowerPacks® are specially engineered clutch packs designed with additional clutches to increase friction plate capacity. This capacity increase enables torque load to spread over more friction area, resulting in a clutch pack that can handle higher torque load with reduced heat generation.

DrumSavers™ prevent the replacement of expensive drums by installing Alto components that will prevent further damage to the existing drum, and allow the drum to perform as designed. DrumSavers contain direct replacement parts for the OE stack-up of the damaged drum, and requires no machining.

Alto Products, an ISO 9002 Manufacturer, is the oldest and largest independently owned manufacturer of friction discs and steel separators in the world. For almost 50 years, Alto has supplied over a half a billion clutches specializing in product improvements and enhancement in clutch plate technology.

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