



Technical Service Information

BMW 5L40-E (A5S 360R) **PRELIMINARY INFORMATION**

Beginning at the start of production for some 1999 models, BMW has introduced a new 5 speed automatic transmission that is designed and manufactured by General Motors Powertrain division in Strasbourg, France and is illustrated in Figure 1. This new transmission is designated as follows:

GM Designation - 5L40-E
BMW Designation - A5S 360R

Model year 1999 applications are as follows:

- 3 Series BMW, with 2.5L Gasoline Engine, Used in USA and Japan.*
- 3 Series BMW, with 2.8L Gasoline Engine, Used in USA and Japan.*
- 5 Series BMW, with 3.0L Diesel Engine, Used Worldwide.*

The 5L40-E transmission is a completely new design rear wheel drive unit and was designed to be a four or five speed transmission. The same case and components are used for both applications with the exclusion of the 2nd clutch and the 2nd sprag clutch, and the use of a smaller ravigneaux planetary carrier assembly in the 4 speed version.

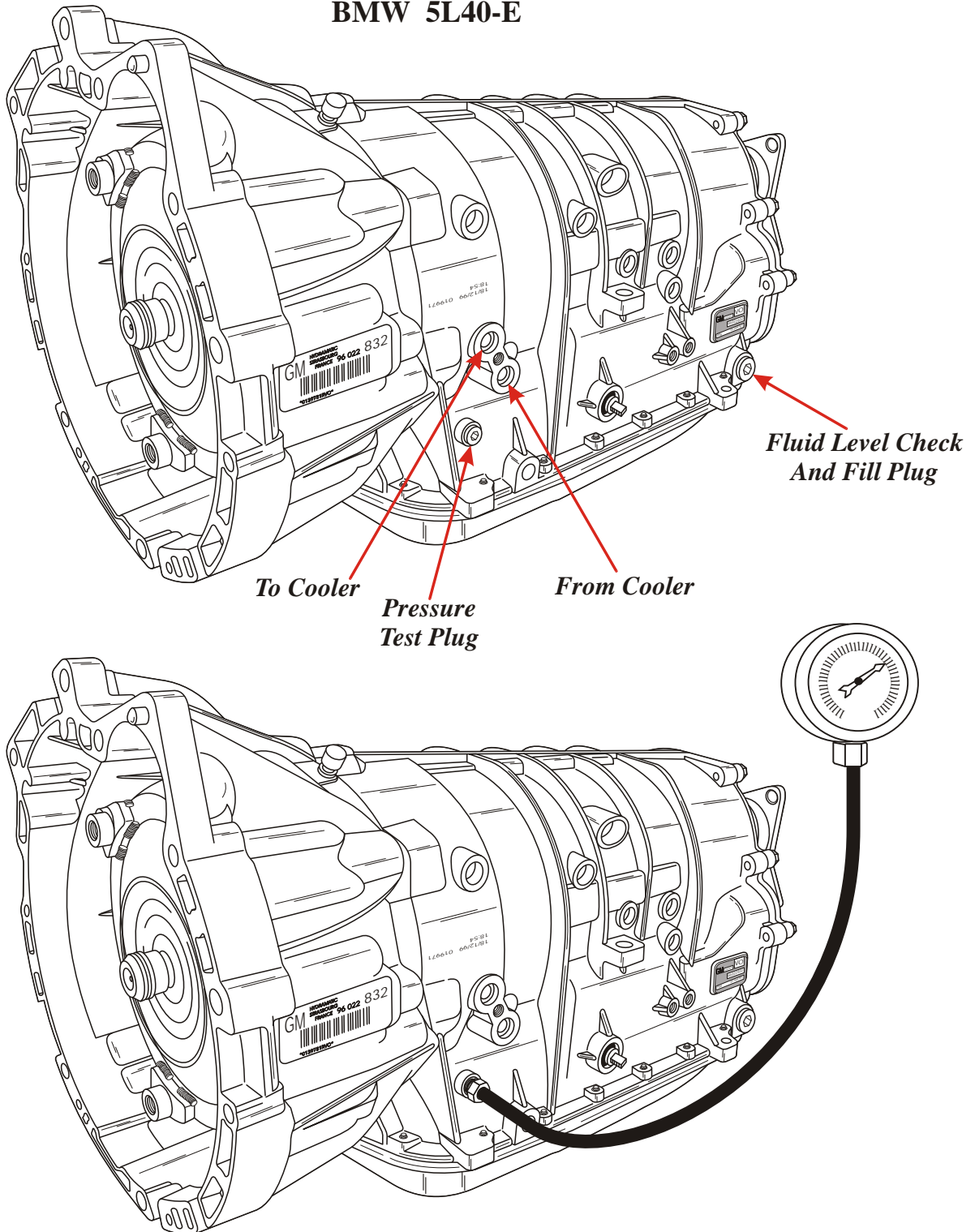
The Hydra-matic 5L40-E is a fully automatic, five forward speed, rear wheel drive, fully electronic controlled transmission, with a maximum torque rating of 360 Nm. It consists primarily of a four element (Lock-Up) torque converter, one ravigneaux planetary gear set, nine multiple-disc friction clutch packs, four mechanical sprag clutches and a hydraulic pressurization and control system. We have provided you with an illustration to identify the location of the nine different clutch packs, the four mechanical sprag clutches and a component application chart in Figure 2.

The ravigneaux planetary gear set provides the five forward speeds and reverse. Changing gear ratios is fully automatic and is accomplished through the use of a Transmission Control Module (TCM). The TCM receives and monitors various electronic sensor inputs and uses this information to shift the transmission at the optimum time, as illustrated in Figure 5.

The TCM commands three on/off Shift Solenoids to control shift timing. The TCM controls shift feel through the Pressure Control Solenoid. The TCM also controls the apply and release of the torque converter clutch through a TCC/PWM Solenoid. Refer to Figure 3 for the solenoid application chart for each gear, along with case connector pin identification and a resistance chart for the internal components. Refer to Figure 4 for the internal wiring schematic. Notice also in Figure 4 that this transmission uses an Internal Mode Switch (IMS). The IMS operation is illustrated and explained in Figure 6, and description of each gear range is explained in Figure 7.

The hydraulic system primarily consists of a 13 vane pump, two control valve bodies, two channel plates, converter housing and transmission case. The pump maintains the working pressures needed to stroke the clutch pistons that apply or release the friction components, and is illustrated in Figure 8. The two control valve bodies and two channel plates are illustrated in Figures 9, 10, and 11. Check ball locations for this transmission are illustrated in Figure 12.

BMW 5L40-E

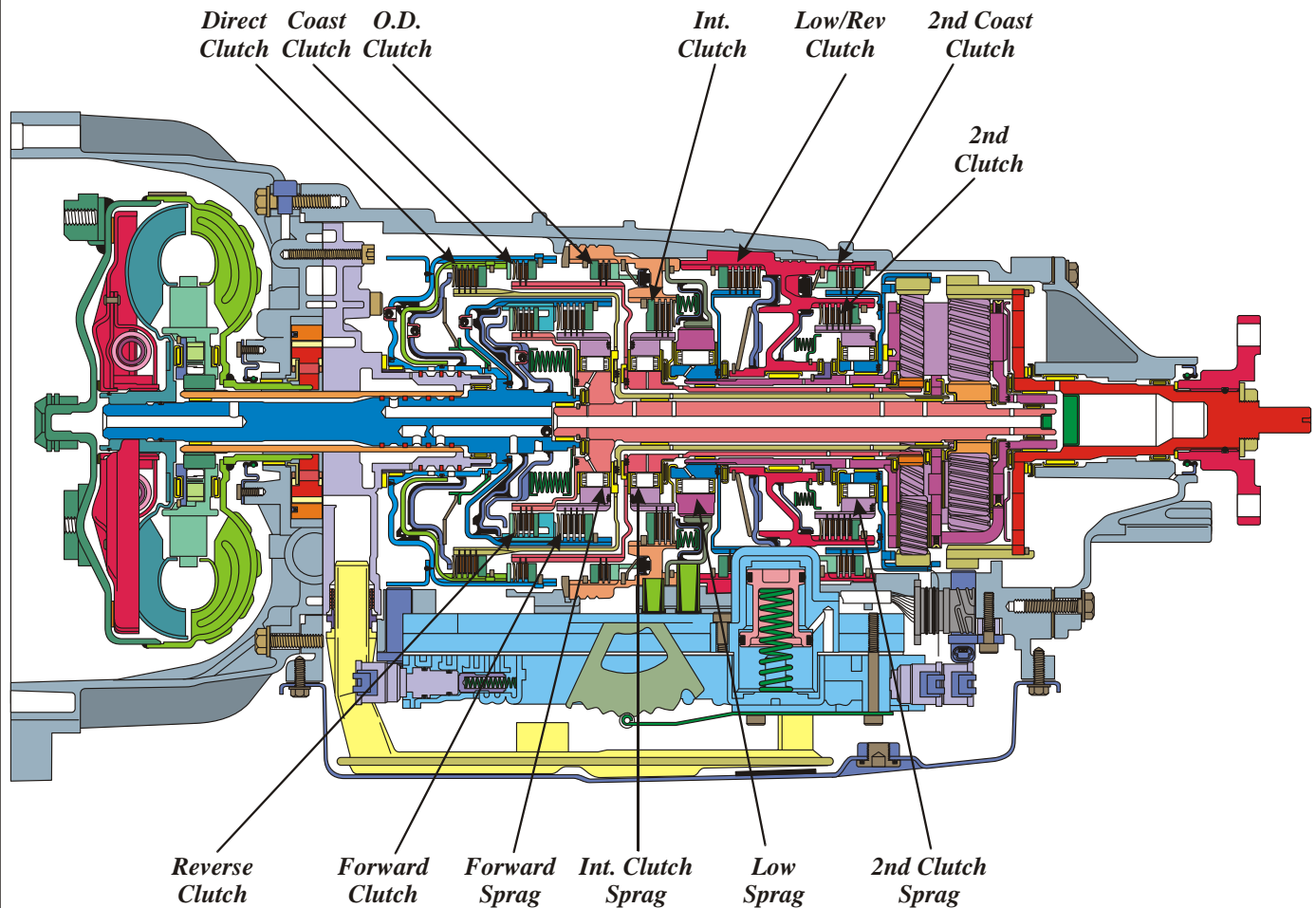


RANGE	LINE PRESSURE	
	Minimum	Maximum
P, N, D, M4, M3, M2	48 psi	180 psi
REVERSE	60 psi	232 psi

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Figure 1

5L40-E COMPONENT APPLICATION CHART



5L40-E COMPONENT APPLICATION CHART

RANGE	GEAR	Engine Braking	Direct Clutch	Coast Clutch	Reverse Clutch	Fwd. Clutch	2nd Clutch	Int. Clutch	O.D. Clutch	Low/Reverse Clutch	2nd Coast Clutch	Fwd. Clutch Sprag	Low Clutch Sprag	2nd Clutch Sprag	Int. Clutch Sprag	Gear Ratio
Park/Neutral																
Reverse	R	Yes			On					On						3.03
D, 4, 3, 2,	1st	No*		On		On						Hold	Hold			3.42
	1st	Yes		On		On				On		Hold	Hold			3.42
	2nd	No*		On		On	On					Hold		Hold		2.21
	2nd	Yes		On		On	On				On	Hold		Hold		2.21
	3rd	No*		On		On	On	On				Hold			Hold	1.60
	3rd	Yes		On		On	On	On	On			Hold			Hold	1.60
	4th	Yes	On	On		On	On	On				Hold				1.00
	5th	Yes	On			On	On	On	On							0.75

* Engine braking is electronically controlled by the TCM, and is available as calibrated for each model and application.
On = Clutch Applied.

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Figure 2

5L40-E SOLENOID APPLICATION CHART

RANGE	GEAR	Engine Braking	Direct Clutch	Coast Clutch	Reverse Clutch	Fwd. Clutch	2nd Clutch	Int. Clutch	O.D. Clutch	Low/ Reverse Clutch	2nd Coast Clutch	1-2 Shift Sol.	2-3 Shift Sol.	4-5 Shift Sol.	TCC Sol.	Gear Ratio
Park/Neutral												***	***	***	Off	
Reverse	R	Yes			On					On		On			Off	3.03
D, 4, 3, 2,	1st	No*		On		On						Off	On	Off	Off	3.42
	1st	Yes		On		On				On		Off	On	On	Off	3.42
	2nd	No*		On		On	On					On	On	Off	On**	2.21
	2nd	Yes		On		On	On				On	On	On	On	On**	2.21
	3rd	No*		On		On	On	On				On	Off	Off	On**	1.60
	3rd	Yes		On		On	On	On	On			On	Off	On	On**	1.60
	4th	Yes	On	On		On	On	On				Off	Off	On	On**	1.00
	5th	Yes	On			On	On	On	On			Off	Off	Off	On**	0.75

* Engine braking is electronically controlled by the TCM, and is available as calibrated for each model and application.

** Dependant upon various sensors including vehicle speed and throttle position.

*** Calibrated for particular model and application.

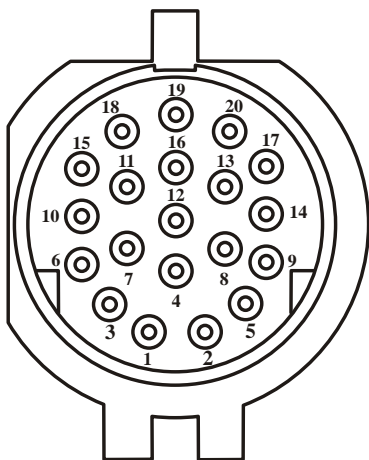
On = Clutch Applied.

On = Solenoid Energized.

Off = Solenoid De-Energized.

5L40-E COMPONENT RESISTANCE CHART

COMPONENT	CASE CONN TERMINALS	RESISTANCE @ 20°C (68°F)
1-2 Shift Solenoid "A" (On/Off - N/C)	14 And 17	15-17 Ohms
2-3 Shift Solenoid "B" (On/Off - N/C)	9 And 17	15-17 Ohms
4-5 Shift Solenoid "C" (On/Off - N/C)	5 And 17	15-17 Ohms
TCC Solenoid (PWM - N/C)	20 And 17	10.0-11.5 Ohms
Pressure Control Solenoid (PWM - N/C)	8 And 13	3.5-4.6 Ohms
Input Speed Sensor	18 And 15	325-485 Ohms
Output Speed Sensor	1 And 3	325-485 Ohms
Transmission Fluid Temperature Sensor	10 And 6	See Chart Below
Internal Mode Switch	See Wire Schematic	See Chart



View Looking Into Transmission Case Connector

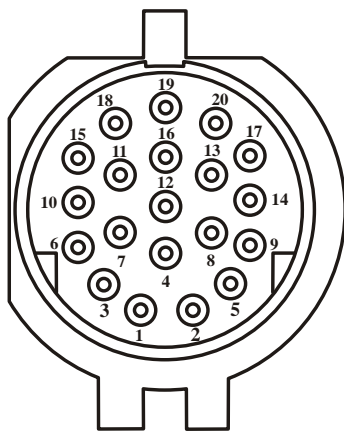
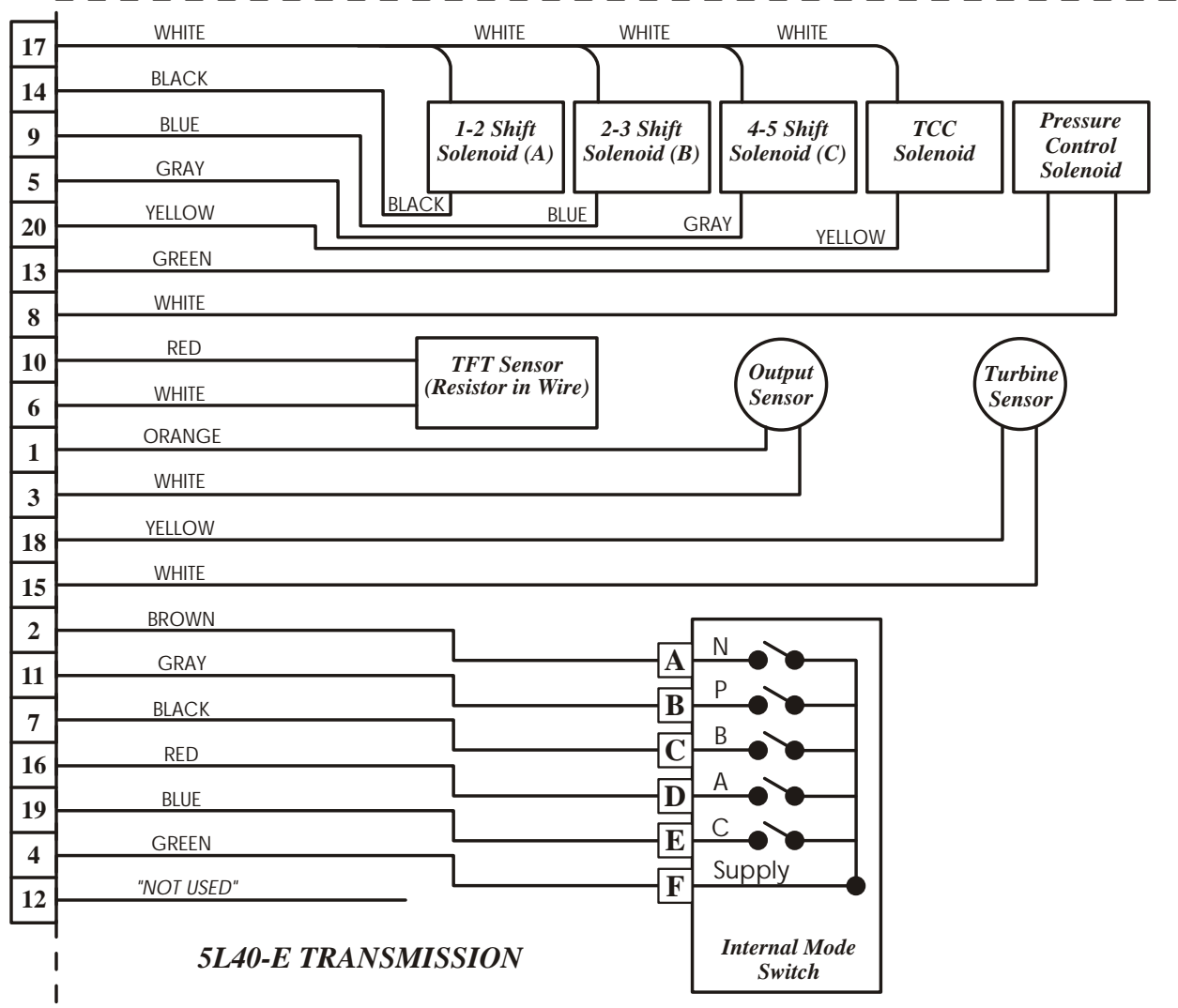
TFT Sensor Resistance Chart

Temperature C° (F°)	Resistance In Ohms		
	Minimum	Nominal	Maximum
-30C (-22F)	50264	52594	54924
-20C (-8F)	27439	28582	29725
-10C (14F)	15540	16120	16700
0C (32F)	9097	9399	9701
10C (50F)	5493	5658	5823
20C (68F)	3418	3511	3604
30C (86F)	2185	2240	2295
40C (104F)	1430	1465	1500
50C (122F)	958	980	1002
60C (140F)	656	671	686
70C (158F)	459	469	479
80C (176F)	327	334	341
90C (194F)	237	242	247
100C (212F)	174	178	182
110C (230F)	130	133	136
120C (248F)	98	101	104
130C (266F)	75	78	80

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Figure 3

BMW INTERNAL WIRE SCHEMATIC



View Looking Into
Trans Case Connector

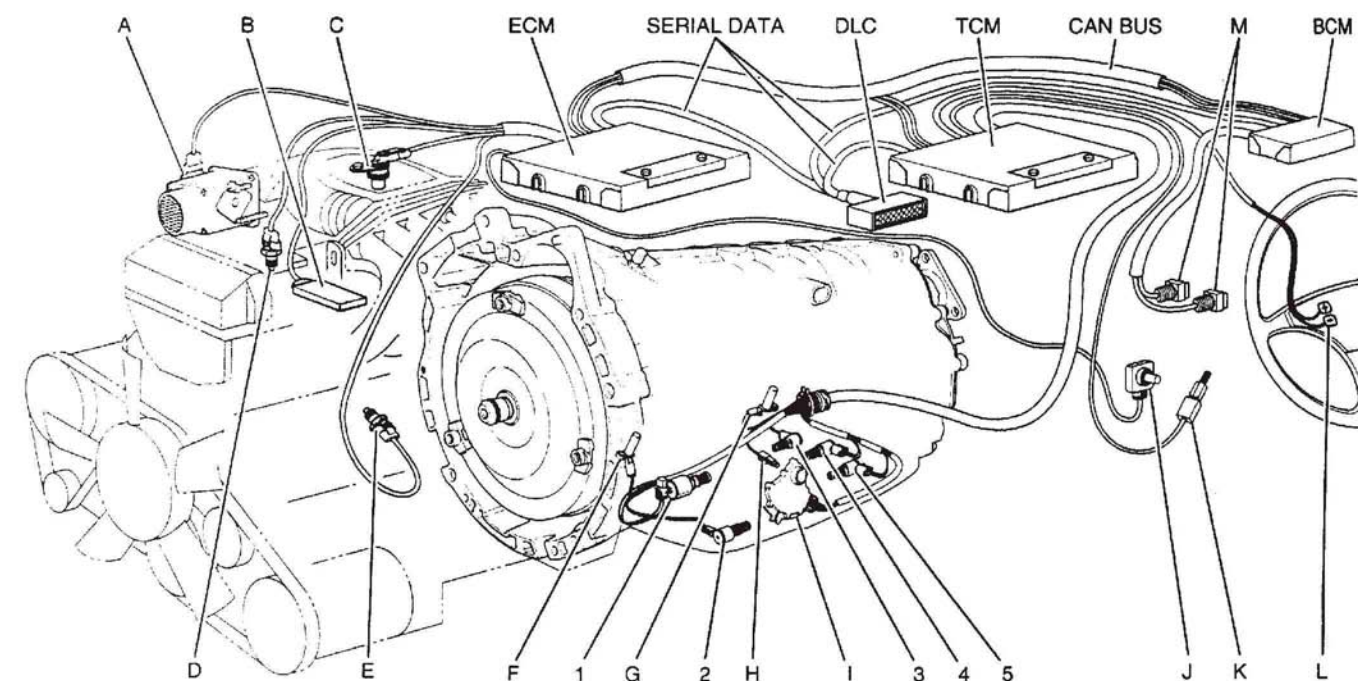
Case Connector Terminal Identification			
Pin No.	Description	Pin No.	Description
1	Output Speed Sensor (OSS)	11	Internal Mode Switch Signal "P"
2	Internal Mode Switch Signal "N"	12	"Not Used"
3	Output Speed Sensor (OSS)	13	Pressure Control Solenoid (+)
4	Internal Mode Switch Volts In	14	1-2 Shift Solenoid (A) Ground
5	4-5 Shift Solenoid (C) Ground	15	Input Speed Sensor (ISS)
6	Trans Fluid Temp (TFT) Sensor	16	Internal Mode Switch Signal "A"
7	Internal Mode Switch Signal "B"	17	Solenoid Power In
8	Pressure Control Solenoid (-)	18	Input Speed Sensor (ISS)
9	2-3 Shift Solenoid (B) Ground	19	Internal Mode Switch Signal "C"
10	Trans Fluid Temp (TFT) Sensor	20	TCC/PWM Solenoid Ground

ELECTRICAL COMPONENTS

Electrical signals from various sensors provide information to the TCM or PCM, about vehicle speed, throttle position, engine coolant temp, range selector position, engine speed and converter turbine speed. The TCM or PCM uses this information to determine upshift and downshift speeds, apply or release of the TCC and what fluid pressure is needed to apply the clutch packs. This type of control provides consistent shift points and shift quality based on the operating conditions of the vehicle.

If for any reason the entire electronic control system of the transmission becomes disabled, all three shift solenoids will be turned off. This "Safety Mode" operating state forces the transmission to operate in 5th gear when the range selector is any forward range. Also, the pressure control solenoid is turned off which will increase line pressure to the maximum.

Note: Some models use an Engine Control Module (ECM) and a Transmission Control Module (TCM) and some models use a Powertrain Control Module (PCM) for both engine and transmission management.



INFORMATION SENSORS

- A. THROTTLE POSITION SENSOR (TPS)
- B. MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
- C. ENGINE SPEED SENSOR
- D. MANIFOLD AIR TEMPERATURE (MAT) SENSOR
- E. ENGINE COOLANT TEMPERATURE (ECT) SENSOR
- F. INPUT SPEED SENSOR (ISS)
- G. OUTPUT SPEED SENSOR (OSS)
- H. TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR
- I. INTERNAL MODE SWITCH (IMS)
- J. ACCELERATOR PEDAL POSITION (APP) SENSOR
- K. TCC BRAKE SWITCH

ELECTRONIC CONTROLLERS

- * TRANSMISSION CONTROL MODULE (TCM) *SOME MODELS*
- * POWERTRAIN CONTROL MODULE (PCM)
- * ENGINE CONTROL MODULE (ECM) *SOME MODELS*
- * BODY CONTROL MODULE (BCM)
- * DIAGNOSTIC LINK CONNECTOR (DLC)

TRANSMISSION COMPONENTS

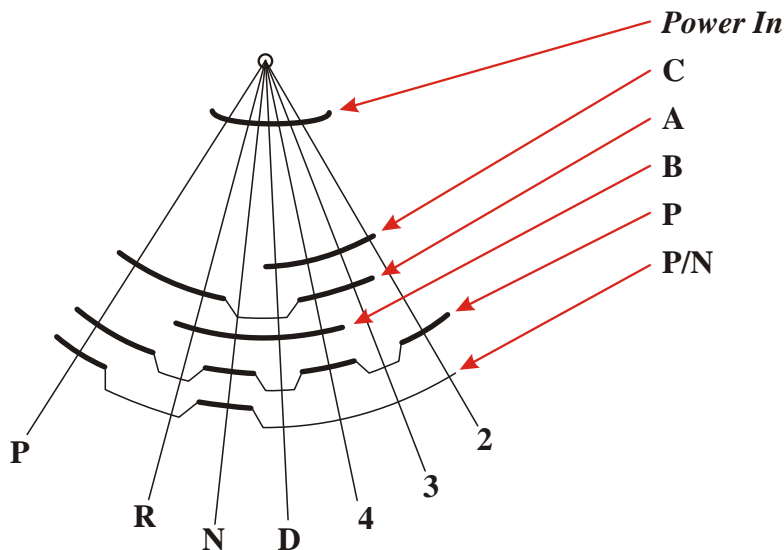
- 1. PRESSURE CONTROL SOLENOID
- 2. TCC/PWM SOLENOID
- 3. 1-2 SHIFT SOLENOID
- 4. 2-3 SHIFT SOLENOID
- 5. 4-5 SHIFT SOLENOID

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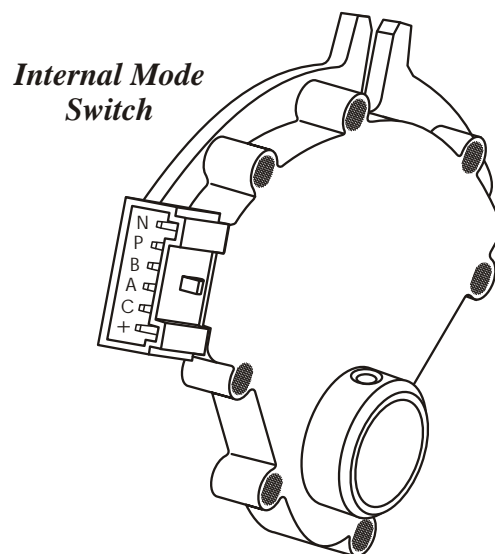
Figure 5

INTERNAL MODE SWITCH

The Internal Mode Switch supplies the Transmission Control Module or Powertrain Control Module with input regarding the selector lever position (P, R, N, D, 4, 3, 2). The selector position is indicated by the state of five different On/Off switches, as shown below. The mode switch is located inside the transmission, on the manual shaft and is fixed in rotation to the main case by the dentent lever spring and no adjustment is ever necessary.



RANGE SELECTED	CIRCUIT				
	A	B	C	P	P/N
Park	1	0	0	1	1
Reverse	1	1	0	0	0
Neutral	0	1	0	1	1
Overdrive	0	1	0	0	0
Manual 4	1	1	1	1	0
Manual 3	1	0	1	0	0
Manual 2	0	0	1	1	0
1 = Switch Closed 0 = Switch Open					



STANDARD SHIFT QUADRANT

With the "Standard" range indicator, as illustrated in Figure 5, the transmission may be operated in any one of the seven different positions shown on the shift quadrant as follows;

P - Park position enables the engine to be started while preventing the vehicle from rolling either forward or backward. Park position should not be selected until the vehicle has come to a complete stop. For safety reasons, the vehicles parking brake should always be used in addition to the "Park" position.

R - Reverse position enables the vehicle to be operated in a rearward direction.

N - Neutral position enables the engine to start and operate without driving the vehicle. If necessary, this position should be selected to restart the engine while the vehicle is moving.

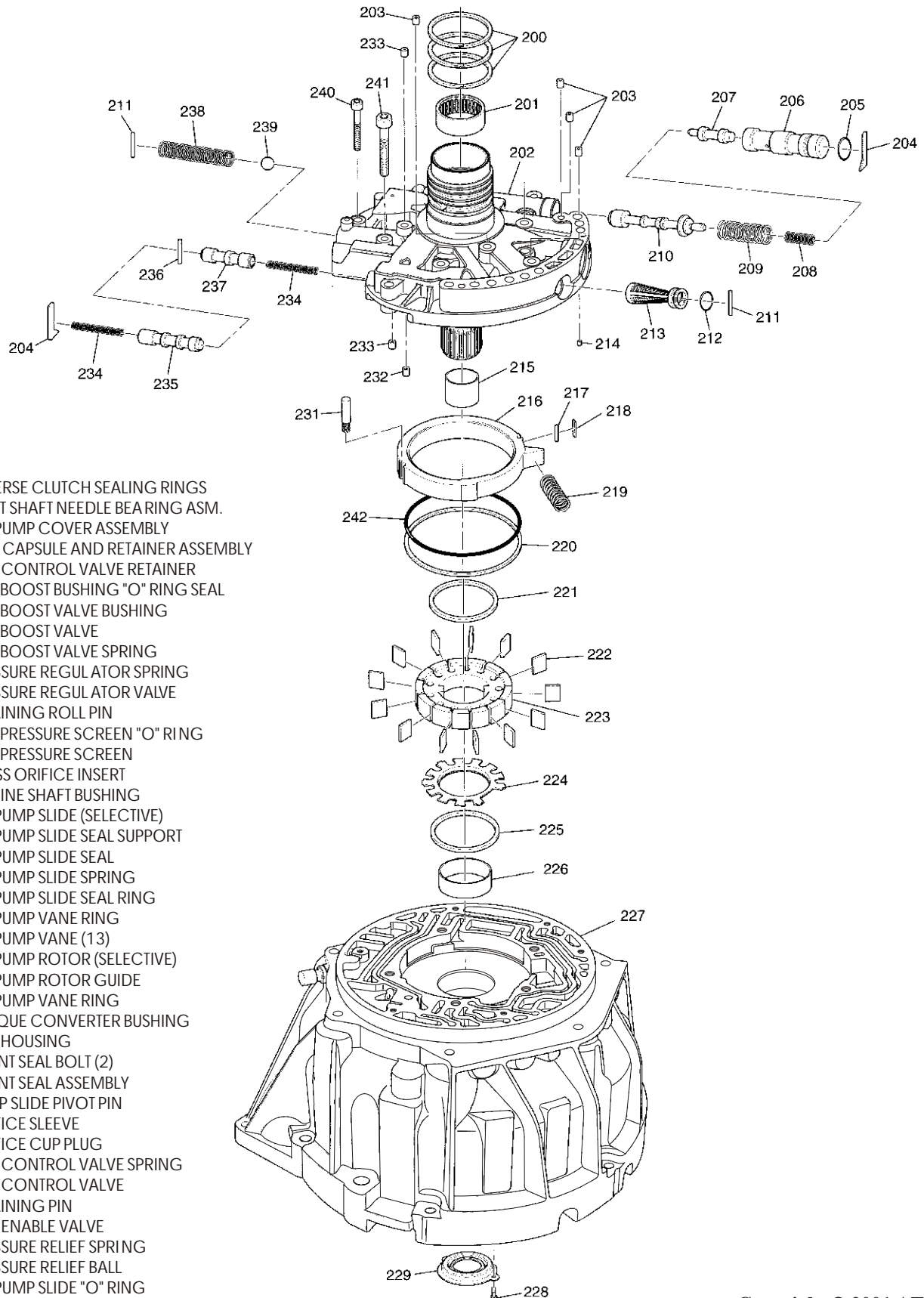
D - Overdrive range should be used for all normal driving conditions for maximum efficiency and fuel economy. Overdrive range allows the transmission to upshift automatically into each of the 5 forward gear ratios. Downshifts to a lower gear are possible for safe passing by depressing the accelerator, or by manually selecting a lower gear with the shift selector.

4 - Manual Fourth can be used for conditions where it may be desirable to use only 4 gear ratios, such as trailer towing or hilly terrain. This range is also helpful for engine braking when descending slight grades. Upshifts and downshifts all occur automatically, except 5th gear is prohibited. Manual Fourth can be selected at any vehicle speed but will downshift into 4th gear only if vehicle speed is low enough not to over-rev the engine. Manual downshifts are controlled by the TCM, not the manual valve location.

"STANDARD" RANGE INDICATOR



3 - Manual Fourth can be used for conditions where it may be desirable to use only 4 gear ratios, such as trailer towing or hilly terrain. This range is also helpful for engine braking when descending slight grades. Upshifts and downshifts all occur automatically, except 5th gear is prohibited. Manual Fourth can be selected at any vehicle speed but will downshift into 4th gear only if vehicle speed is low enough not to over-rev the engine. Manual downshifts are controlled by the TCM, not the manual valve location.



- 200 REVERSE CLUTCH SEALING RINGS
- 201 INPUT SHAFT NEEDLE BEARING ASM.
- 202 OIL PUMP COVER ASSEMBLY
- 203 BALL CAPSULE AND RETAINER ASSEMBLY
- 204 TCC CONTROL VALVE RETAINER
- 205 LINE BOOST BUSHING "O" RING SEAL
- 206 LINE BOOST VALVE BUSHING
- 207 LINE BOOST VALVE
- 208 LINE BOOST VALVE SPRING
- 209 PRESSURE REGULATOR SPRING
- 210 PRESSURE REGULATOR VALVE
- 211 RETAINING ROLL PIN
- 212 LINE PRESSURE SCREEN "O" RING
- 213 LINE PRESSURE SCREEN
- 214 BRASS ORIFICE INSERT
- 215 TURBINE SHAFT BUSHING
- 216 OIL PUMP SLIDE (SELECTIVE)
- 217 OIL PUMP SLIDE SEAL SUPPORT
- 218 OIL PUMP SLIDE SEAL
- 219 OIL PUMP SLIDE SPRING
- 220 OIL PUMP SLIDE SEAL RING
- 221 OIL PUMP VANE RING
- 222 OIL PUMP VANE (13)
- 223 OIL PUMP ROTOR (SELECTIVE)
- 224 OIL PUMP ROTOR GUIDE
- 225 OIL PUMP VANE RING
- 226 TORQUE CONVERTER BUSHING
- 227 BELL HOUSING
- 228 FRONT SEAL BOLT (2)
- 229 FRONT SEAL ASSEMBLY
- 231 PUMP SLIDE PIVOT PIN
- 232 ORIFICE SLEEVE
- 233 ORIFICE CUP PLUG
- 234 TCC CONTROL VALVE SPRING
- 235 TCC CONTROL VALVE
- 236 RETAINING PIN
- 237 TCC ENABLE VALVE
- 238 PRESSURE RELIEF SPRING
- 239 PRESSURE RELIEF BALL
- 242 OIL PUMP SLIDE "O" RING

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Figure 8

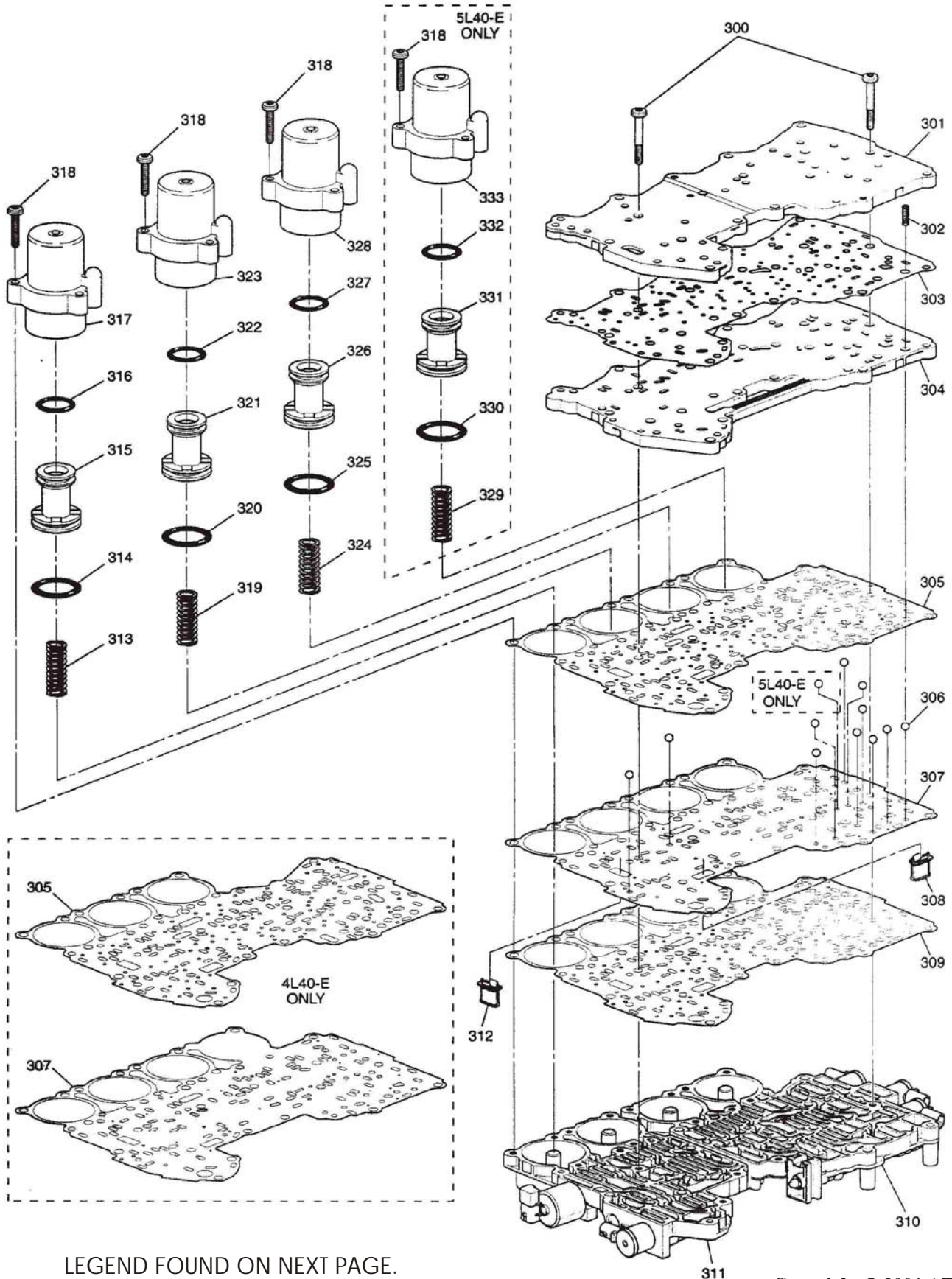


Figure 9



Technical Service Information

300 CONTROL VALVE BODY BOLT
301 CONTROL VALVE BODY "TOP" CHANNEL PLATE
302 NUMBER 7 CHECK BALL SPRING
303 CONTROL VALVE CHANNEL PLATE GASKET
304 CONTROL VALVE BODY "BOTTOM" CHANNEL PLATE
305 CONTROL VALVE BODY GASKET, UPPER
306 CHECK BALLS (12)
307 CONTROL VALVE BODY SPACER PLATE
308 TCC/PWM SOLENOID SCREEN
309 CONTROL VALVE BODY GASKET, LOWER
310 REAR CONTROL VALVE BODY ASSEMBLY
311 FRONT CONTROL VALVE BODY ASSEMBLY
312 PRESSURE CONTROL SOLENOID SCREEN
313 DIRECT CLUTCH ACCUMMULATOR SPRING
314 DIRECT CLUTCH ACCUMMULATOR PISTON LARGE SEAL RING
315 DIRECT CLUTCH ACCUMMULATOR PISTON
316 DIRECT CLUTCH ACCUMMULATOR PISTON SMALL SEAL RING
317 DIRECT CLUTCH ACCUMMULATOR HOUSING
318 ACCUMULATOR HOUSING BOLTS
319 O.D. CLUTCH ACCUMMULATOR SPRING
320 O.D. CLUTCH ACCUMMULATOR PISTON LARGE SEAL RING
321 O.D. CLUTCH ACCUMMULATOR PISTON
322 O.D. CLUTCH ACCUMMULATOR PISTON SMALL SEAL RING
323 O.D. CLUTCH ACCUMMULATOR HOUSING
324 INTERM. CLUTCH ACCUMMULATOR SPRING
325 INTERM. CLUTCH ACCUMMULATOR PISTON LARGE SEAL RING
326 INTERM. CLUTCH ACCUMMULATOR PISTON
327 INTERM. CLUTCH ACCUMMULATOR PISTON SMALL SEAL RING
328 INTERM. CLUTCH ACCUMMULATOR HOUSING
329 2ND CLUTCH ACCUMMULATOR SPRING
330 2ND CLUTCH ACCUMMULATOR PISTON LARGE SEAL RING
331 2ND CLUTCH ACCUMMULATOR PISTON
332 2ND CLUTCH ACCUMMULATOR PISTON SMALL SEAL RING
333 2ND CLUTCH ACCUMMULATOR HOUSING

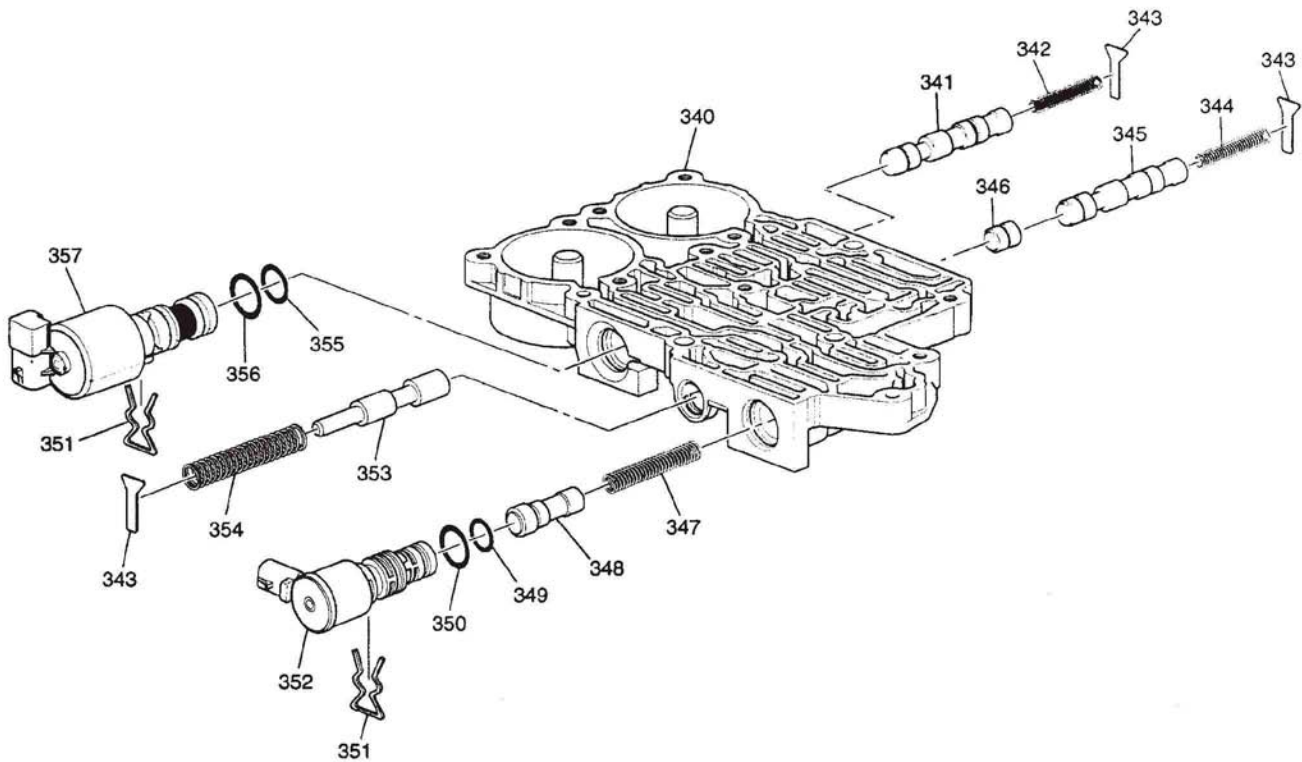
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Figure 9 LEGEND

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02-05
Page 11 of 14

FRONT CONTROL VALVE BODY EXPLODED VIEW

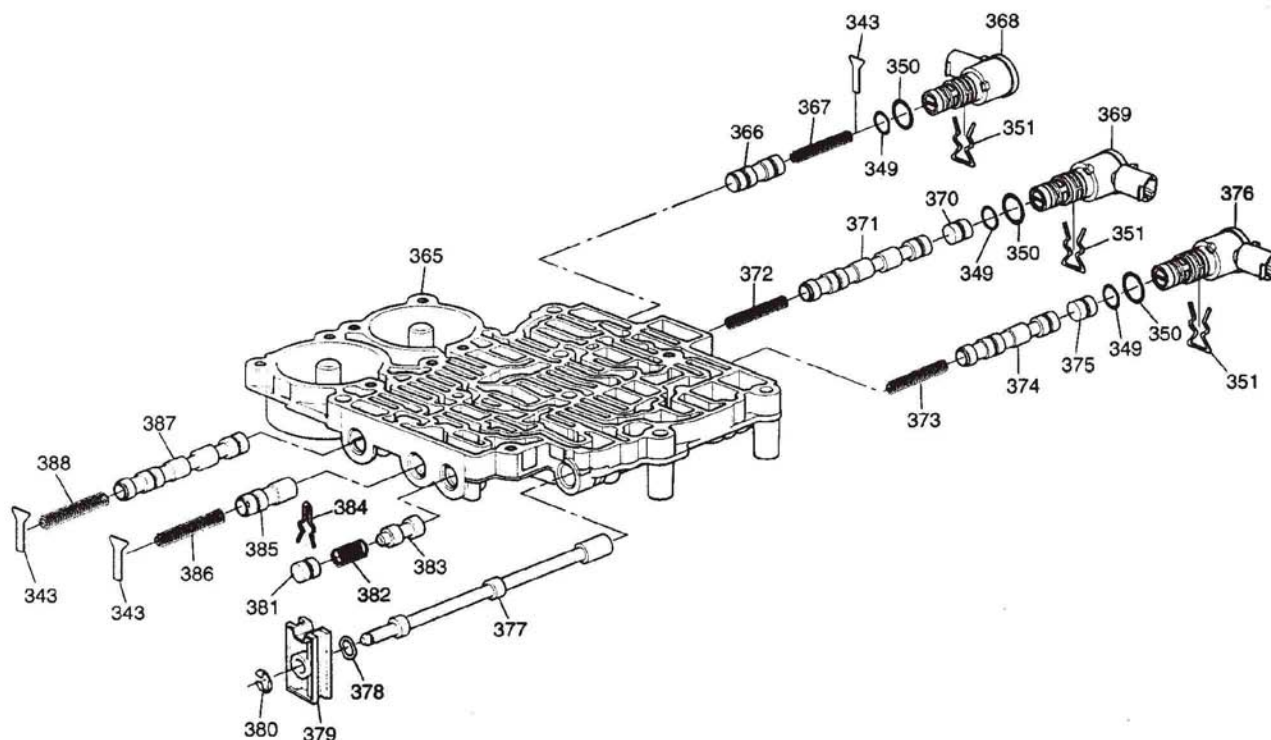


- 340 FRONT CONTROL VALVE BODY CASTING
- 341 SAFETY MODE VALVE
- 342 SAFETY MODE VALVE SPRING
- 343 VALVE SPRING RETAINER
- 344 3-4 SHIFT VALVE SPRING
- 345 3-4 SHIFT VALVE
- 346 3-4 SHIFT CONTROL VALVE
- 347 TCC REGULATOR APPLY VALVE SPRING
- 348 TCC REGULATOR APPLY VALVE
- 349 TCC/PWM SOLENOID SMALL "O" RING SEAL
- 350 TCC/PWM SOLENOID LARGE "O" RING SEAL
- 351 SOLENOID RETAINING CLIP
- 352 TCC/PWM SOLENOID ASSEMBLY
- 353 FEED LIMIT VALVE
- 354 FEED LIMIT VALVE SPRING
- 355 PRESSURE CONTROL SOLENOID SMALL "O" RING SEAL
- 356 PRESSURE CONTROL SOLENOID LARGE "O" RING SEAL
- 357 PRESSURE CONTROL SOLENOID ASSEMBLY

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Figure 10

REAR CONTROL VALVE BODY EXPLODED VIEW

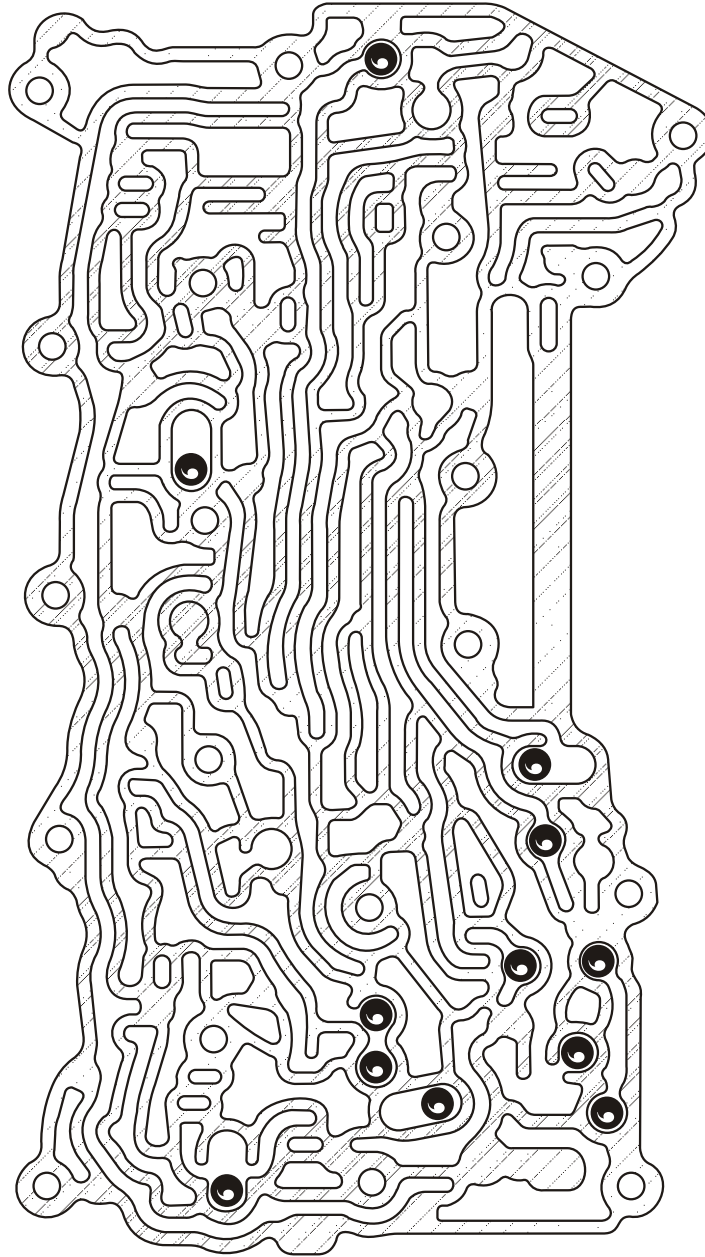


- 343 VALVE SPRING RETAINER
- 349 SHIFT SOLENOID SMALL "O" RING SEAL
- 350 SHIFT SOLENOID LARGE "O" RING SEAL
- 351 SHIFT SOLENOID RETAINER
- 365 REAR CONTROL VALVE BODY CASTING
- 366 1-2 SHIFT CONTROL VALVE
- 367 1-2 SHIFT CONTROL VALVE SPRING
- 368 1-2 (A) SHIFT SOLENOID ASSEMBLY
- 369 2-3 (B) SHIFT SOLENOID ASSEMBLY
- 370 2-3 SHIFT CONTROL VALVE
- 371 2-3 SHIFT VALVE
- 372 2-3 SHIFT VALVE SPRING
- 373 4-5 SHIFT VALVE SPRING
- 374 4-5 SHIFT VALVE
- 375 4-5 SHIFT CONTROL VALVE
- 376 4-5 (C) SHIFT SOLENOID ASSEMBLY
- 377 MANUAL VALVE
- 378 MANUAL VALVE LINK "WAVED" WASHER
- 379 MANUAL VALVE LINK
- 380 MANUAL VALVE LINK "E" CLIP RETAINER
- 381 LOW PRESSURE CONTROL VALVE PLUG
- 382 LOW PRESSURE CONTROL VALVE SPRING
- 383 LOW PRESSURE CONTROL VALVE
- 384 LOW PRESSURE CONTROL VALVE BORE PLUG RETAINER
- 385 REVERSE LOCK OUT VALVE
- 386 REVERSE LOCK OUT VALVE SPRING
- 387 1-2 SHIFT VALVE
- 388 1-2 SHIFT VALVE SPRING

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Figure 11

BOTTOM CHANNEL PLATE (Control Valve Body Side)



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Figure 12