

2013 TRANSMISSION

Automatic Transmission - 6T70 (M7W) - Description and Operation - Malibu

DESCRIPTION AND OPERATION

DEFINITIONS AND ABBREVIATIONS

Throttle Positions

Engine Braking

A condition where the engine is used to slow the vehicle by manually downshifting during a zero throttle coastdown.

Full Throttle Downshift

A quick apply of the accelerator pedal to its full travel, forcing a downshift.

Heavy Throttle

Approximately 3/4 of accelerator pedal travel, 75 percent throttle position.

Light Throttle

Approximately 1/4 of accelerator pedal travel, 25 percent throttle position.

Medium Throttle

Approximately 1/2 of accelerator pedal travel, 50 percent throttle position.

Minimum Throttle

The least amount of throttle opening required for an upshift.

Wide Open Throttle (WOT)

Full travel of the accelerator pedal, 100 percent throttle position.

Zero Throttle Coastdown

A full release of the accelerator pedal while the vehicle is in motion and in drive range.

Shift Condition Definitions

Bump

A sudden and forceful apply of a clutch or a band.

Chuggle

A bucking or jerking. This condition may be most noticeable when the converter clutch is engaged. It is similar to the feel of towing a trailer.

Delayed

A condition where a shift is expected but does not occur for a period of time. This could be described as a clutch or band engagement that does not occur as quickly as expected during a part throttle or wide open throttle apply of the accelerator, or during manual downshifting to a lower range. This term is also defined as LATE or EXTENDED.

Double Bump - Double Feel

Two sudden and forceful applies of a clutch or a band.

Early

A condition where the shift occurs before the car has reached proper speed. This condition tends to labor the engine after the upshift.

End Bump

A firmer feel at the end of a shift than at the start of the shift. This is also defined as END FEEL or SLIP BUMP.

Firm

A noticeably quick apply of a clutch or band that is considered normal with a medium to heavy throttle. This apply should not be confused with HARSH or ROUGH.

Flare

A quick increase in engine RPM along with a momentary loss of torque. This most generally occurs during a shift. This condition is also defined as SLIPPING.

Harsh - Rough

A more noticeable apply of a clutch or band than FIRM. This condition is considered undesirable at any throttle position.

Hunting

A repeating quick series of upshifts and downshifts that causes a noticeable change in engine RPM, such as a 4-3-4 shift pattern. This condition is also defined as BUSYNESS.

Initial Feel

A distinctly firmer feel at the start of a shift than at the finish of the shift.

Late

A shift that occurs when the engine RPM is higher than normal for a given amount of throttle.

Shudder

A repeating jerking condition similar to CHUGGLE but more severe and rapid. This condition may be most noticeable during certain ranges of vehicle speed.

Slipping

A noticeable increase in engine RPM without a vehicle speed increase. A slip usually occurs during or after initial clutch or band apply.

Soft

A slow, almost unnoticeable clutch or band apply with very little shift feel.

Surge

A repeating engine related condition of acceleration and deceleration that is less intense than CHUGGLE.

Tie-Up

A condition where two opposing clutch and/or bands are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine RPM.

Noise Conditions

Drive Link Noise

A whine or growl that increases or fades with vehicle speed, and is most noticeable under a light throttle acceleration. It may also be noticeable in PARK or NEUTRAL operating ranges with the vehicle stationary.

Final Drive Noise

A hum related to vehicle speed which is most noticeable under a light throttle acceleration.

Planetary Gear Noise

A whine related to vehicle speed, which is most noticeable in FIRST gear, SECOND gear, FOURTH gear or REVERSE. The condition may become less noticeable, or go away, after an upshift.

Pump Noise

A high pitched whine that increases in intensity with engine RPM. This condition may also be noticeable in all operating ranges with the vehicle stationary or moving.

Torque Converter Noise

A whine usually noticed when a vehicle is stopped, and the transmission is in DRIVE or REVERSE. The noise will increase with engine RPM.

Driver Shift Control

Driver shift control (DSC) allows the driver to change gears similar to a manual transmission. Refer to the vehicle owner's manual for specific DSC operating instructions.

Transmission Abbreviations

A/C

Air Conditioning

AC

Alternating Current

AT

Automatic Transmission

CCDIC

Climate Control Driver Information Center

DC

Direct Current

DIC

Driver Information Center

DLC

Diagnostic Link Connector

DMM

Digital Multimeter

DSC

Driver Shift Control

DTC

Diagnostic Trouble Code

EBTCM

Electronic Brake/Traction Control Module

ECCC

Electronically-Controlled Capacity Clutch

ECT

Engine Coolant Temperature

EMI

Electromagnetic Interference

IAT

Intake Air Temperature

IGN

Ignition

IMS

Internal Mode Switch

ISS

Input Speed Sensor

MAP

Manifold Absolute Pressure

MIL

Malfunction Indicator Lamp

NC

Normally Closed

NO

Normally Open

OBD

On Board Diagnostic

OSS

Output Speed Sensor

PC

Pressure Control

PCM

Powertrain Control Module

PCS

Pressure Control Solenoid

PS

Pressure Switch

PWM

Pulse Width Modulation

RPM

Revolutions Per Minute

SS

Shift Solenoid

STL

Service Transmission Lamp

TAP

Transmission Adaptive Pressure

TCC

Torque Converter Clutch

TFP

Transmission Fluid Pressure

TFT

Transmission Fluid Temperature

TP

Throttle Position

VSS

Vehicle Speed Sensor

WOT

Wide Open Throttle

TRANSMISSION IDENTIFICATION INFORMATION



Fig. 1: Transmission Identification Label
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Code for Automatic Transmission
2	Model Year
3	Model for Transmission
4	Transmission Family
5	Source Code for Plant
6	Calendar Year
7	Julian Date
8	Shift/Line (A/B)
9	Numeric sequence starting at 0001 @ 12:01 AM each day
10	Model Code
11	Machine Readable Matrix
12	Sequential Serial Number
13	Broadcast Code
14	Transmission Assembly Number

Source Code for Plant

- 4 - Ramos Arizpe, Mexico
- J - Windsor, Ontario
- S - Strasbourg, France

- W - Warren, Michigan
- Y - Toledo, Ohio
- R - Boryeong, Korea
- M - N.man Tai, Shan Dong, China
- P - San Luis Potosi, Mexico
- S - Silao, Mexico

TRANSMISSION GENERAL DESCRIPTION

The Hydra-matic 6T70/75 is a fully automatic, 6-speed, front-wheel drive, electronic-controlled transmission. It consists primarily of a 4-element torque converter, a compound planetary gear set, friction and mechanical clutch assemblies, and a hydraulic pressurization and control system. There are 2 variants of the transmission, based on torque capacity. Architecture is common between the variants, and component differences are primarily related to size.

The 4-element torque converter contains a pump, a turbine, a pressure plate splined to the turbine, and a stator assembly. The torque converter acts as a fluid coupling to smoothly transmit power from the engine to the transmission. It also hydraulically provides additional torque multiplication when required. The pressure plate, when applied, provides a mechanical direct drive coupling of the engine to the transmission.

The planetary gear sets provide the 6 forward gear ratios and reverse. Changing gear ratios is fully automatic and is accomplished through the use of a transmission control module (TCM) located inside the transmission. The TCM receives and monitors various electronic sensor inputs and uses this information to shift the transmission at the optimum time.

The TCM commands shift solenoids and variable bleed pressure control solenoids to control shift timing and feel. The TCM also controls the apply and release of the torque converter clutch which allows the engine to deliver the maximum fuel efficiency without sacrificing vehicle performance. All the solenoids, including the TCM, are packaged into a self-contained control solenoid valve assembly.

The hydraulic system primarily consists of a vane-type pump, 2 control valve body assemblies, transfer drive gear support assembly and case. The pump maintains the working pressures needed to stroke the clutch pistons that apply or release the friction components. These friction components, when applied or released, support the automatic shifting qualities of the transmission.

The friction components used in this transmission consist of 5 multiple disc clutches. The multiple disc clutches combine with one way clutch to deliver 7 different gear ratios, 6 forward and one reverse, through the gear sets. The gear sets then transfer torque through the transfer drive gear, transfer driven gear and differential assembly.

The transmission may be operated in any of the following gear ranges:

PARK (P)

This position locks the front wheels and prevents the vehicle from rolling either forward or backward. PARK is the best position to use when starting the vehicle. Because the transmission utilizes a shift lock control system, it is necessary to fully depress the brake pedal before shifting out of PARK. For safety

reasons, use the parking brake in addition to the PARK position.

REVERSE (R)

This position allows the vehicle to be operated in a rearward direction.

NEUTRAL (N)

This position allows the engine to be started and operated while driving the vehicle. If necessary, you may select this position in order to restart the engine with the vehicle moving. This position should also be used when towing the vehicle.

DRIVE (D)

Drive range should be used for all normal driving conditions for maximum efficiency and fuel economy. Drive range allows the transmission to operate in each of the 6 forward gear ratios. Downshifts to a lower gear, or higher gear ratio, are available for safe passing by depressing the accelerator or by manually selecting a lower gear in the manual mode range.

Driver Shift Control (DSC) or Electronic Range Selection (ERS)

This position (M-Manual / L-Low) allows the driver to utilize the DSC/ERS system. When the shift selector lever is moved to this position, the driver may select upshifts or downshifts by using the paddle switches located on the steering wheel/shifter. An upshift is requested by pushing either + button. Refer to the vehicle owner's manual for more specific DSC/ERS information.

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTION

The mechanical components of the 6T70/75 are as follows:

- A torque converter with an electronically controlled capacity clutch (ECCC)
- Off axis chain driven vane-type fluid pump assembly
- Input sun gear and carrier assembly
- 4-5-6 and 3-5 reverse clutch assembly with turbine shaft
- Low and reverse clutch (one way clutch) assembly
- Control valve body assembly
- Front differential transfer drive gear support assembly
- Front differential transfer drive gear assembly
- Front differential carrier assembly
- Case cover assembly

The electrical components of the 6T70/75 are as follows:

- Output speed sensor assembly
- Input speed sensor assembly

- Manual shift shaft with internal mode switch
- Control solenoid valve assembly, which contains the following components:
 - Transmission control module (TCM)
 - 5 variable bleed line pressure control (PC) solenoids
 - Torque converter clutch (TCC) pressure control solenoid
 - 2 shift solenoids
 - Transmission fluid temperature sensor

For more information, refer to **Electronic Component Description**.

TOW/HAUL MODE DESCRIPTION AND OPERATION

Tow/haul mode is a function within the vehicle's software/calibration that optimizes transmission gear selection for operation during towing or with heavy loads. This optimization includes improving acceleration performance during launches, reducing shift busyness, assisting brake performance and speed control during engine braking situations, and improving vehicle speed control while requiring less throttle pedal activity.

In general, tow/haul mode maintains lower gears longer and increases shift pressures. It is designed to be most effective when the vehicle and trailer combined weight is at least 75% of the vehicle's Gross Combined Weight Rating (GCWR). Operation of tow/haul in a lightly loaded or non-loaded vehicle will not cause damage. However, there is no benefit to the selection of tow/haul when the vehicle is unloaded, and use of tow/haul mode during unloaded driving conditions will decrease fuel economy and may generate shift feel concerns.

TRANSMISSION ADAPTIVE FUNCTIONS

The 6T70/75 transmission utilizes a line pressure control system during upshifts to compensate for the normal wear of transmission components. As the apply components within the transmission wear or change over time, shift time (the time required to apply a clutch) increase or decreases. In order to compensate for these changes, the transmission control module (TCM) adjusts the pressure commands to the various PC solenoids, to maintain the originally calibrated shift timing. The automatic adjusting process is referred to as "adaptive learning" and it is used to ensure consistent shift feel plus increase transmission durability. The TCM monitors the A/T input speed sensor (ISS) and the A/T output speed sensor (OSS) during commanded shifts to determine if a shift is occurring too fast (harsh) or too slow (soft) and adjusts the corresponding pressure control (PC) solenoid signal to maintain the set shift feel.

The purpose of the adapt function is to automatically compensate the shift quality for the various vehicle shift control systems. The adapt function is a continuous process that will help to maintain optimal shift quality throughout the life of the vehicle.

TRANSMISSION INDICATORS AND MESSAGES

The following transmission-related indicators and messages may be displayed on the Instrument Panel Cluster (IPC). For a complete listing and description of all vehicle indicators and messages, refer to **Indicator/Warning Message Description and Operation**.

"TRANSMISSION HOT IDLE ENGINE"

This message is displayed when the TCM detects a transmission fluid temperature (TFT) equal to or greater than 132°C (270°F) for 5 seconds.

"SERVICE TRANSMISSION"

This message displays when there is a problem with the transmission.

ELECTRONIC COMPONENT DESCRIPTION

Control Solenoid (W/Body and TCM) Valve Assembly

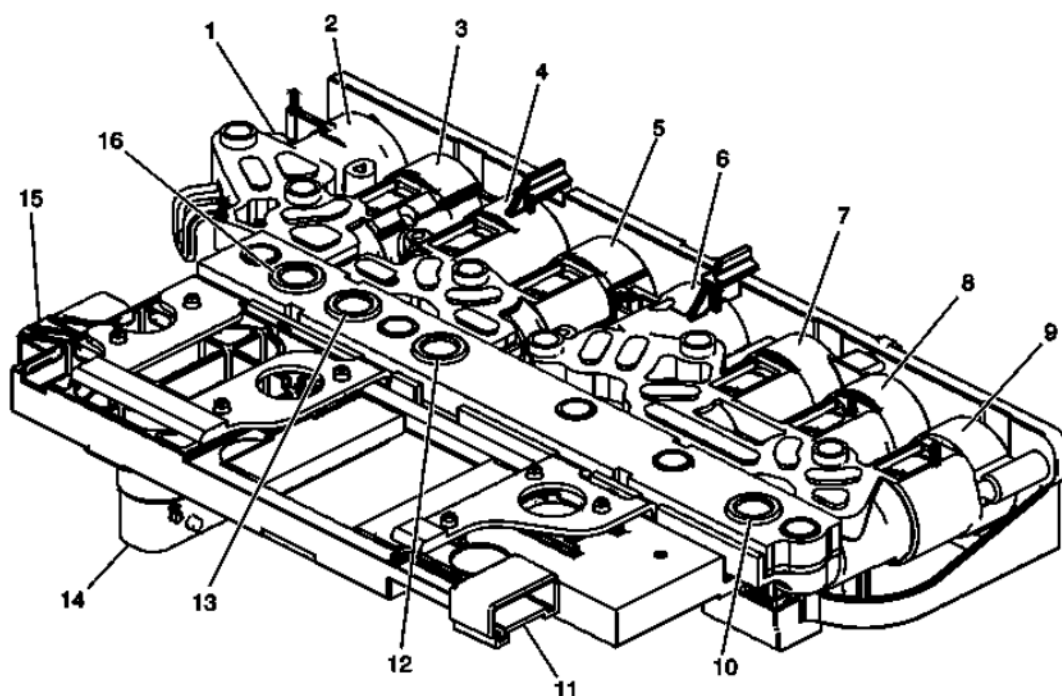


Fig. 2: Identifying Control Solenoid (W/Body & TCM) Valve Assembly Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Control Solenoid Valve Assembly X3 (ISS)
2	Shift Solenoid 1
3	Pressure Control Solenoid 3 (R1/456)
4	Pressure Control Solenoid 5 (1234)
5	Torque Converter Clutch (TCC) Pressure Control Solenoid
6	Shift Solenoid 2
7	Pressure Control Solenoid 2 (35R)
8	Pressure Control Solenoid 4 (26)
9	Line Pressure Control Solenoid
10	Transmission Fluid Pressure (TFP) Switch 5 (35R)

11	Control Solenoid Valve Assembly X2 (IMS)
12	Transmission Fluid Pressure (TFP) Switch 3 (26)
13	Transmission Fluid Pressure (TFP) Switch 4 (456/R1)
14	Control Solenoid Valve Assembly X1
15	Control Solenoid Valve Assembly X4 (OSS)
16	Transmission Fluid Pressure (TFP) Switch 5 (35R)

The control solenoid (w/body and TCM) valve assembly contains the following components:

- Transmission control module (TCM)
- Clutch pressure control solenoids (Clutch PC Sol)
- Shift solenoids (SS)
- Line pressure control solenoid (Line PC Sol)
- Torque converter clutch pressure control solenoid (TCC PC Sol)
- Transmission fluid temperature sensor (TFT Sensor)
- TCM temperature sensor
- Power-up temperature sensor
- Transmission fluid pressure switches (TFP Sw)

These components are not serviced separately. The control solenoid (w/body and TCM) valve assembly utilizes a lead-frame system to connect these components electrically to the TCM. No wires are used for these components. The control solenoid (w/body and TCM) valve assembly bolts directly to the lower and upper valve body assemblies inside the transmission. The control solenoid (w/body and TCM) valve assembly connects to the engine harness 20-way connector.

Manual Shift Detent Lever with Shaft Position Switch Assembly (IMS)

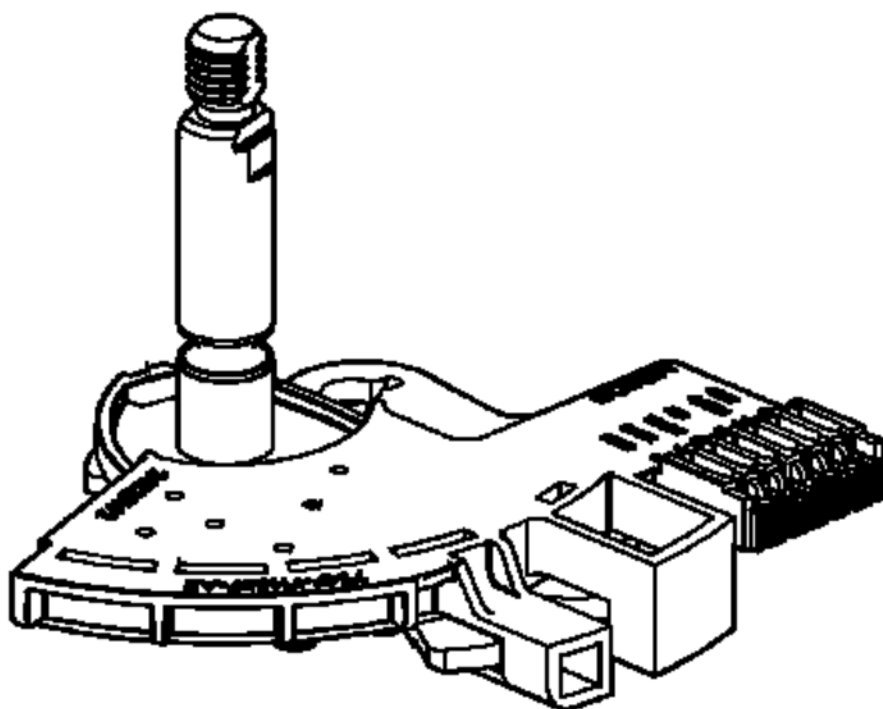


Fig. 3: Identifying Manual Shift Detent Lever with Shaft Position Switch
Courtesy of GENERAL MOTORS COMPANY

The transmission shaft position switch assembly is a sliding contact switch attached to the manual shaft detent lever assembly inside the transmission case. The five inputs to the TCM from the transmission manual shift shaft switch assembly indicate the transmission gear selector lever position. This information is used for engine controls as well as determining the transmission shift patterns. The state of each input is available for display on the scan tool. The five input parameters represented are Signal A, Signal B, Signal C, Signal P (Parity) and Signal N (P/N Start). The transmission shaft position switch assembly is connected to the Control Solenoid (W/Body and TCM) Valve Assembly via the Control Solenoid Valve Assembly X2 (IMS) connector.

Input Speed Sensor (ISS)

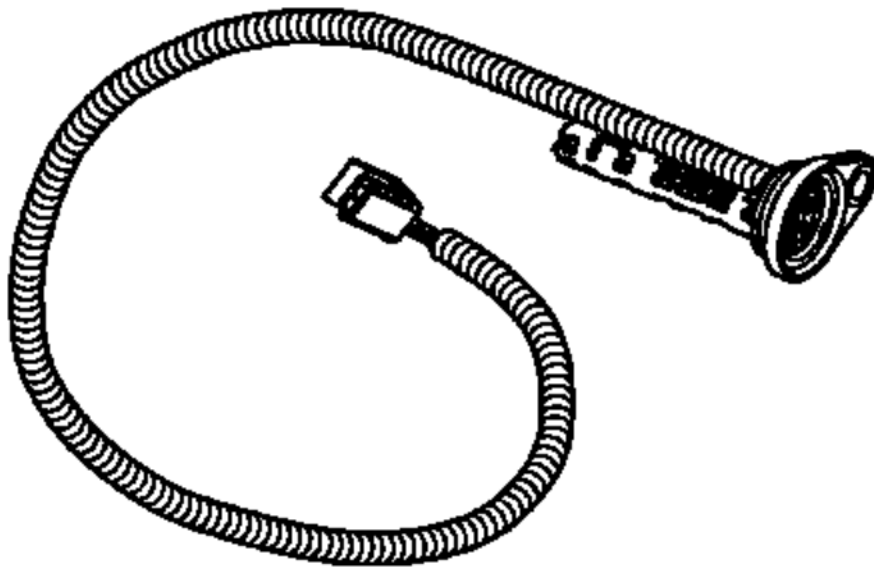


Fig. 4: Identifying Input Speed Sensor (ISS)
Courtesy of GENERAL MOTORS COMPANY

The input speed sensor (ISS) is a hall-effect type sensor. The ISS mounts to the transmission case cover assembly and connects to the control solenoid (w/body and TCM) valve assembly through a wire harness and connector. The sensor faces the 3-5-R clutch piston housing machined teeth surface. The sensor receives 8.3-9.3 volts on the ISS/OSS Supply Voltage circuit from the TCM. As the 3-5-R/4-5-6 clutch piston housing rotates, the sensor produces a signal frequency based on the machined surface of the 3-5-R/4-5-6 clutch piston housing. This signal is transmitted through the ISS signal circuit to the control solenoid (w/body and TCM) valve assembly. The TCM uses the ISS signal to determine line pressure, transmission shift patterns, torque converter clutch (TCC) slip speed and gear ratio. The input speed sensor (ISS) is connected to the Control Solenoid (W/Body and TCM) Valve Assembly via the Control Solenoid Valve Assembly X3 (ISS) connector.

Output Speed Sensor (OSS)

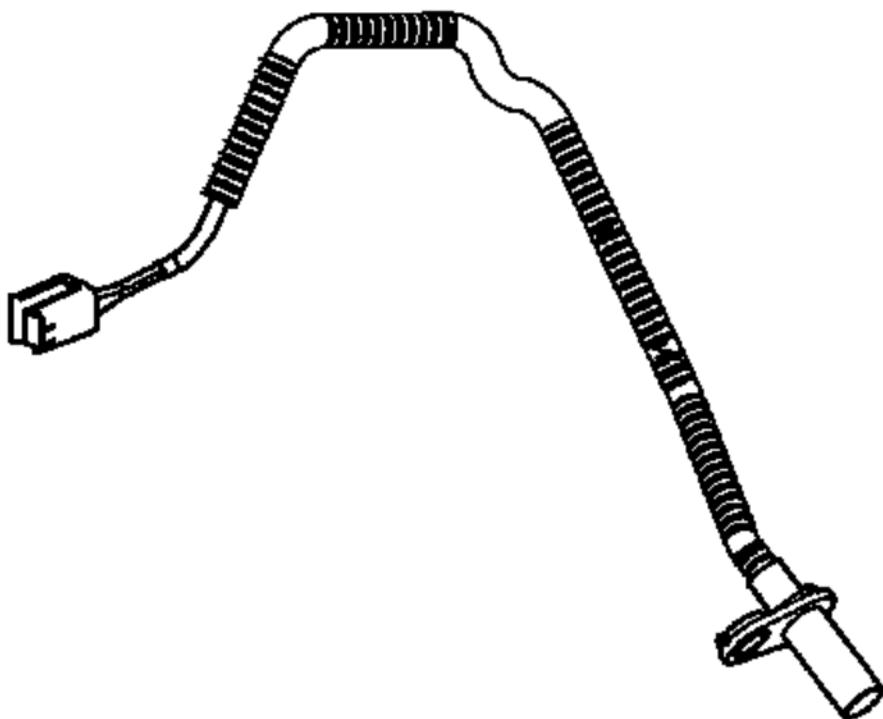


Fig. 5: Identifying Output Speed Sensor (OSS)
Courtesy of GENERAL MOTORS COMPANY

The output speed sensor (OSS) is a hall-effect type sensor. The OSS mounts to the transmission case below the control valve body assembly and connects to the control solenoid (w/body and TCM) valve assembly through a wire harness and connector. The sensor faces the Park gear machined teeth surface. The sensor receives 8.3-9.3 volts on the ISS/OSS supply voltage circuit from the TCM. As the front differential transfer drive gear assembly rotates, the sensor produces a signal frequency based on the machined surface of the Park gear. This signal is transmitted through the OSS signal circuit to the TCM. The TCM uses the OSS signal to determine line pressure, transmission shift patterns, torque converter clutch (TCC) slip speed and gear ratio. The output speed sensor (OSS) is connected to the Control Solenoid (W/Body and TCM) Valve Assembly via the Control Solenoid Valve Assembly X4 (OSS) connector.

AUTOMATIC TRANSMISSION INLINE 20-WAY CONNECTOR DESCRIPTION

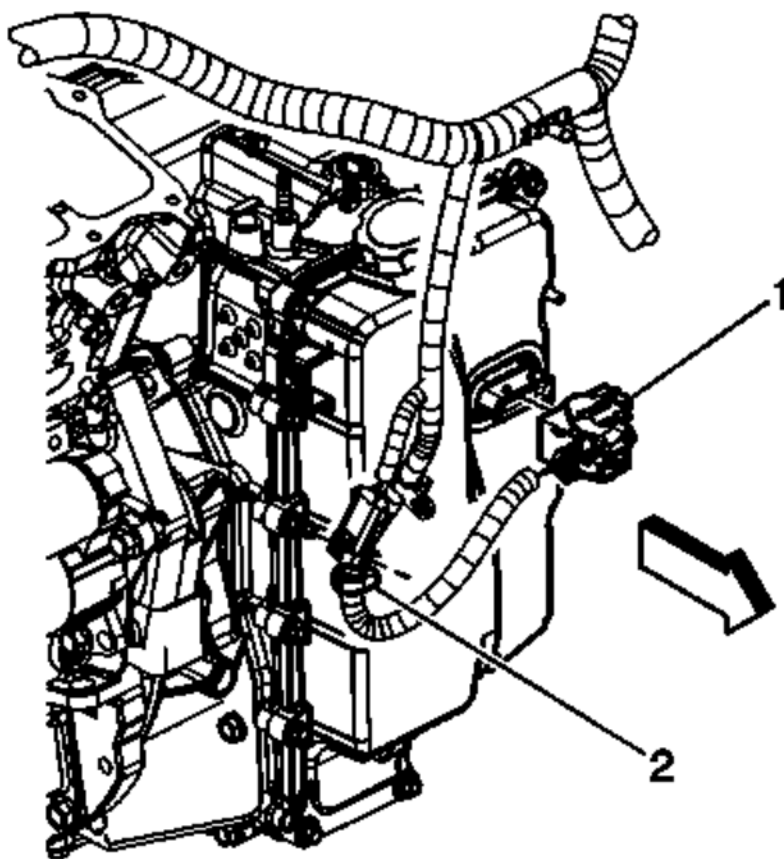


Fig. 6: Identifying Wire Harness Retainer & TCM Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

The transmission electrical connector is an important part of the transmission operating system. Any interference with the electrical connection can cause the transmission to set diagnostic trouble codes or affect proper operation. The following items can affect the electrical connection:

- Bent pins in the connector from rough handling during connection and disconnection
- Wires backing away from the pins or coming uncrimped, in the external wiring harness
- Dirt contamination entering the connector when disconnected
- Transmission fluid leaking into the connector, wicking up into the external wiring harness and degrading the wire insulation
- Moisture intrusion in the connector
- Low pin retention in the external connector from excessive connection and disconnection of the wiring connector assembly
- Pin corrosion from contamination
- Damaged connector assembly

Remember the following points:

- Limit twisting or wiggling the connector during removal. Bent pins can occur.
- Do not pry the connector off with a screwdriver or other tool.
- Whenever the transmission external wiring connector is disconnected from the internal harness and the engine is operating, DTCs will set. Clear these DTCs after reconnecting the external connector.

NON-SHIFTING CLUTCH FUNCTION VERIFICATION DESCRIPTION

The 6T70/75 transmission uses a pressure control system to apply and release clutches during shifts. The transmission control module (TCM) controls pressure commands to the pressure control solenoids.

As normal wear of the transmission clutches occur, the TCM performs a clutch function verification. The TCM momentarily commands a clutch on at a low pressure. The clutch function verification is conducted on smooth roads when the transmission is not shifting and engine torque is consistent and positive.

When a clutch function verification is occurring, a slight bump or drag may be detected momentarily. The clutch function verification will occur a few times over several minutes and will not repeat again for a thousand or more miles. This is a normal condition and no repair attempts should be performed.

The clutch function verification will be performed sooner for a particular clutch if the TCM detects it is producing frequent poor shift control.

AUTOMATIC TRANSMISSION HYDRAULIC DIAGRAMS

Park - Engine Running

When the gear selector lever is in the Park (P) position, fluid is drawn into the pump through the transmission fluid filter assembly. Line pressure is then directed to the following valves:

Fluid Pressure Directed in Preparation for a Shift

Manual Valve

Mechanically controlled by the gear selector lever, the manual valve is in the Park (P) position and prevents line pressure from the pressure regulator valve from entering the reverse and drive circuits.

R1/456 Pressure Control (PC) Solenoid 3

The R1/456 pressure control solenoid (PCS) is energized (HIGH) allowing actuator feed limit fluid to enter the PCS R1/456 CL fluid circuit. PCS R1/456 CL fluid is then routed through orifice #22 to the 4-5-6 clutch boost valve and through orifice #21 to the R1/ 456 clutch regulator valve.

R1/456 Clutch Regulator Valve

PCS R1/456 CL fluid at the R1/4-5-6 clutch regulator valve moves the valve against R1/4-5-6 clutch regulator spring force and R1/FDBK fluid. This allows line pressure to pass through the valve and enter the R1/456CL FD circuit. R1/456CL FD is then routed to clutch select valve 2.

Shift Solenoid 1

Shift solenoid 1 is energized (ON) allowing actuator feed limit fluid to enter the solenoid 1 circuit. Solenoid 1 fluid is routed to the #2 ball check valve and through orifice #10 to the torque converter clutch (TCC) regulator valve and shuttle valve (SHTL).

TCC Regulator Valve and Shuttle Valve

Solenoid 1 fluid is routed to the TCC regulator valve and shuttle valve and moves the valve against TCC regulator valve spring force.

#2 Ball Check Valve

Solenoid 1 fluid seats the #2 ball check valve against the reverse fluid passage and fluid is forced through orifice #15 into the CSV2 enable fluid circuit.

Clutch Select Valve 2

CSV2 enable fluid is routed to the clutch select valve 2 and moves the valve against clutch select valve 2 spring force. This allows R1/456 CL FD fluid to pass through the valve and enter the R1 supply circuit. R1 Supply fluid is then routed into the R1 fluid circuit and, through orifice #18. R1 fluid is then routed to the low & reverse clutch assembly in preparation for a shift into low or reverse gear.

Shift Solenoid 2

Shift solenoid 2 is energized (ON) allowing actuator feed limit fluid to enter the solenoid 2 fluid circuit and is then routed to the #3 ball check valve and through orifice #13 to the clutch select valve #3.

3-5 Reverse Clutch Regulator Valve

Actuator feed limit fluid is routed through the valve and into the PS2 fluid passage. PS2 fluid is then sent to the normally closed #2 pressure switch and opens the switch.

#3 Ball Check Valve

Solenoid 2 fluid seats the #3 ball check valve against 456 CL fluid passage and fluid is forced through orifice #13 into the CSV3 enable fluid circuit. CSV3 enable fluid is then routed to the clutch select valve 3.

Clutch Select Valve #3

CSV3 enable fluid moves the clutch select valve 3 against clutch select valve 3 spring force.

Compensator Blow Off

Line pressure is routed through orifice #17 to the compensator feed circuit. Compensator feed fluid enters the compensator blow off circuit and fills the 4-5-6 dam piston area.

Park- Engine Running

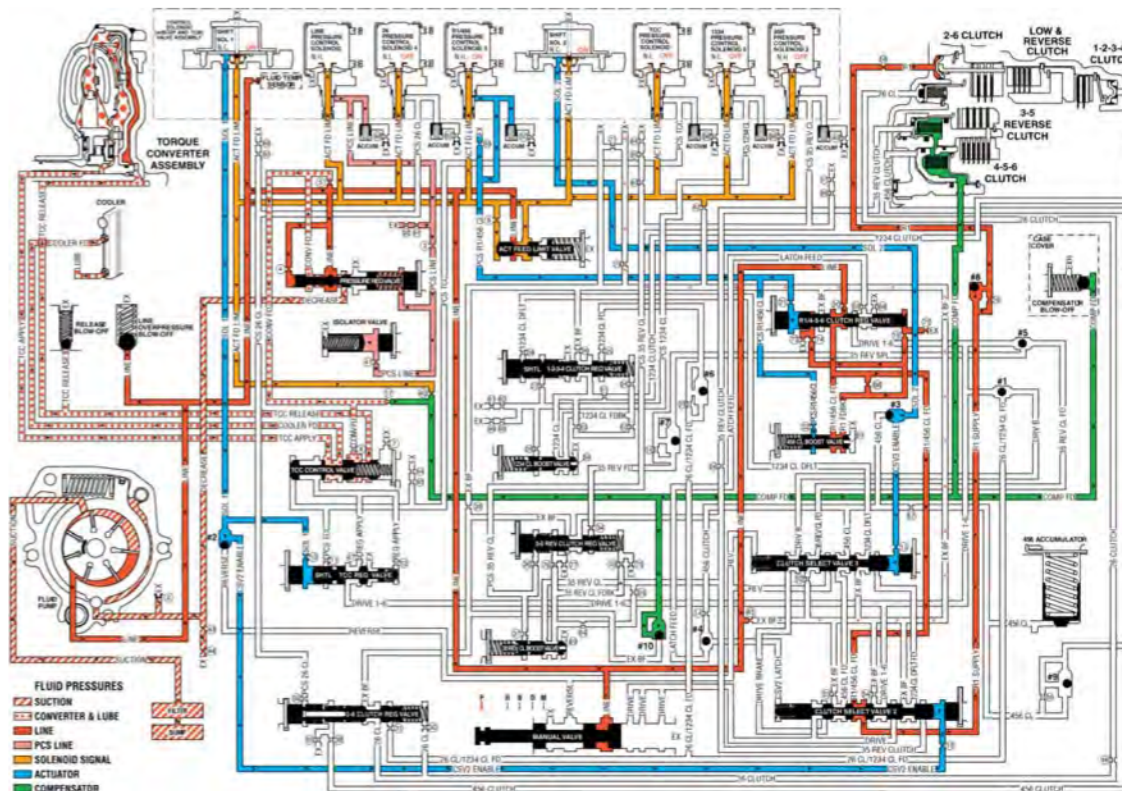


Fig. 7: Fluid Flow Diagram - Park - Engine Running
Courtesy of GENERAL MOTORS COMPANY

Reverse

When the gear selector lever is moved to the Reverse (R) position (from the Park position) the normally high 35R pressure control solenoid 2 is commanded ON and the following changes occur in the transmission's hydraulic and electrical systems:

Fluid Pressure Directed in Preparation for a Shift

Manual Valve

With the manual valve in the reverse position, line pressure is directed into the reverse fluid circuit to the #2 ball check valve and clutch select valve 3.

#2 Ball Check Valve

Reverse fluid seats the #2 ball check valve against the solenoid 1 fluid passage and fluid is forced through orifice #15 into the CSV2 enable circuit.

Clutch Select Valve 2

CSV2 enable fluid, present at the valve from Park position, continues to hold the clutch select valve 2 against

clutch select valve 2 spring force.

Low & Reverse Clutch Applies

Clutch Select Valve 3

Reverse fluid from the manual valve is routed to clutch select valve 3 to combine with clutch select valve 3 spring force to keep the valve in the off position. This allows reverse fluid to pass through the valve and enter the 3-5 clutch reverse feed circuit. The 3-5 clutch reverse feed fluid from the clutch select valve 3 is also routed to #5 ball check valve.

Low & Reverse Clutch

R1 supply fluid passes through orifice #18 and unseats check ball #8. R1 supply fluid enters the low & reverse clutch piston circuit and moves the piston against the spring force to apply the low & reverse clutch plates.

#5 Ball Check Valve

The 3-5 clutch reverse feed fluid seats #5 ball check valve against the drive 1-6 circuit allowing 3-5 clutch reverse feed fluid to enter the 3-5 reverse supply circuit. The 3-5 reverse supply fluid is then routed to #7 ball check valve and through orifice #16 where it enters the 3-5 reverse feed circuit. The 3-5 reverse feed passes through orifice #34 and then is routed to the 3-5 reverse clutch regulator valve.

3-5 Reverse Clutch Applies

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is energized (HIGH) allowing actuator feed limit fluid to enter the PCS 3-5 reverse clutch circuit. PCS 3-5 reverse clutch fluid is then routed through orifice #36 to the 3-5 reverse clutch regulator valve and through orifice #37 to the 3-5 reverse boost valve.

3-5 Reverse Clutch Regulator Valve

PCS 3-5 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 3-5 reverse clutch feedback fluid. This allows 3-5 reverse feed to pass through the valve and enter the 3-5 reverse clutch circuit. The 3-5 reverse clutch fluid is then routed to the 3-5 reverse clutch and the 3-5 reverse boost valve. PS2 fluid from pressure switch 2 exhausts through the valve allowing the switch to close.

3-5 Reverse Boost Valve

PCS 3-5 reverse clutch fluid pressure acts on a differential area moving the 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 3-5 reverse clutch fluid passes through the valve and enters the 3-5 reverse clutch feedback circuit. As PCS 3-5 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 3-5 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 3-5 clutch reverse feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch

The 3-5 reverse clutch fluid enters the 3-5R/456 clutch housing to move the piston against spring force and compensator feed fluid to apply the 3-5 reverse clutch plates.

Reverse

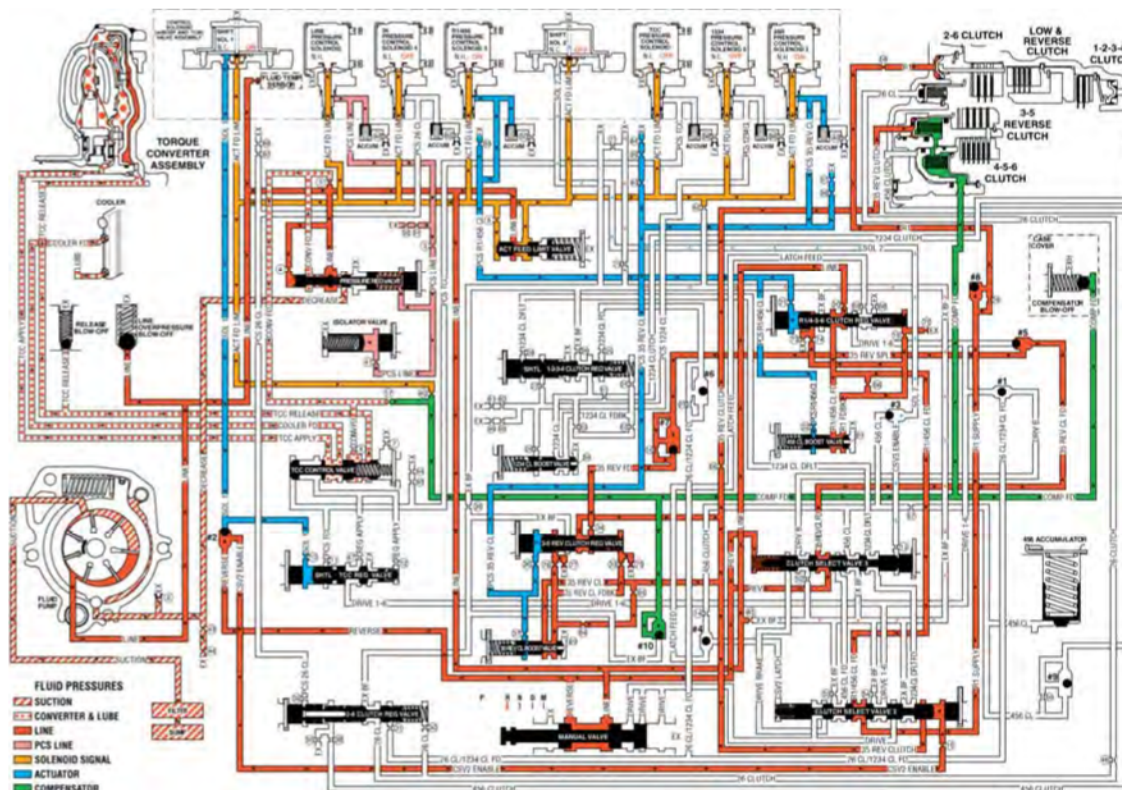


Fig. 8: Fluid Flow Diagram - Reverse
Courtesy of GENERAL MOTORS COMPANY

Neutral - Engine Running

When the gear selector is moved to the Neutral (N) position, the hydraulic and electrical system operation is identical to Park (P) range. However, if Neutral is selected after the vehicle was operating in Reverse (R), the normally high 35R pressure control solenoid 2 is commanded OFF and the following changes would occur in the hydraulic system:

3-5 Reverse Clutch Releases

Manual Valve

The manual valve is moved to the Neutral position and blocks line pressure from entering the reverse and drive fluid circuits. The reverse fluid from the #2 ball check valve and clutch select valve 3 is opened to an exhaust passage at the manual valve.

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded OFF allowing PCS 3-5 reverse clutch fluid from the 3-5 reverse clutch boost valve and 3-5 reverse clutch regulator valve to exhaust.

3-5 Reverse Clutch Boost Valve

The 3-5 reverse boost valve spring force moves the valve to allow 3-5 reverse clutch feedback fluid from the 3-5 reverse clutch regulator valve to enter the 3-5 reverse clutch circuit and exhaust.

3-5 Reverse Clutch Regulator Valve

The 3-5 reverse clutch regulator valve spring force moves the valve to allow 3-5 reverse clutch fluid from the 3-5 reverse clutch and clutch select valve 2 to pass through the valve and enter the 35 reverse clutch feed circuit through orifice #16 past check ball #5 to clutch select valve 3 to exhaust back fill circuit to exhaust.

3-5 Reverse Clutch

The 3-5 reverse clutch spring force moves the 3-5 reverse clutch piston to release the 3-5 reverse clutch plates and force 3-5 reverse clutch fluid to exhaust from the 3-5/4-5-6 reverse clutch housing. The 3-5 reverse clutch fluid is then routed to the 3-5 reverse clutch regulator valve allowing the 3-5 reverse clutch to release.

Clutch Select Valve 3

When reverse fluid exhausts through the manual valve, CSV3 enable fluid moves the valve against clutch select valve 3 spring force. The 3-5 reverse feed fluid is routed into the exhaust back fill circuit and exhausts.

Neutral- Engine Running

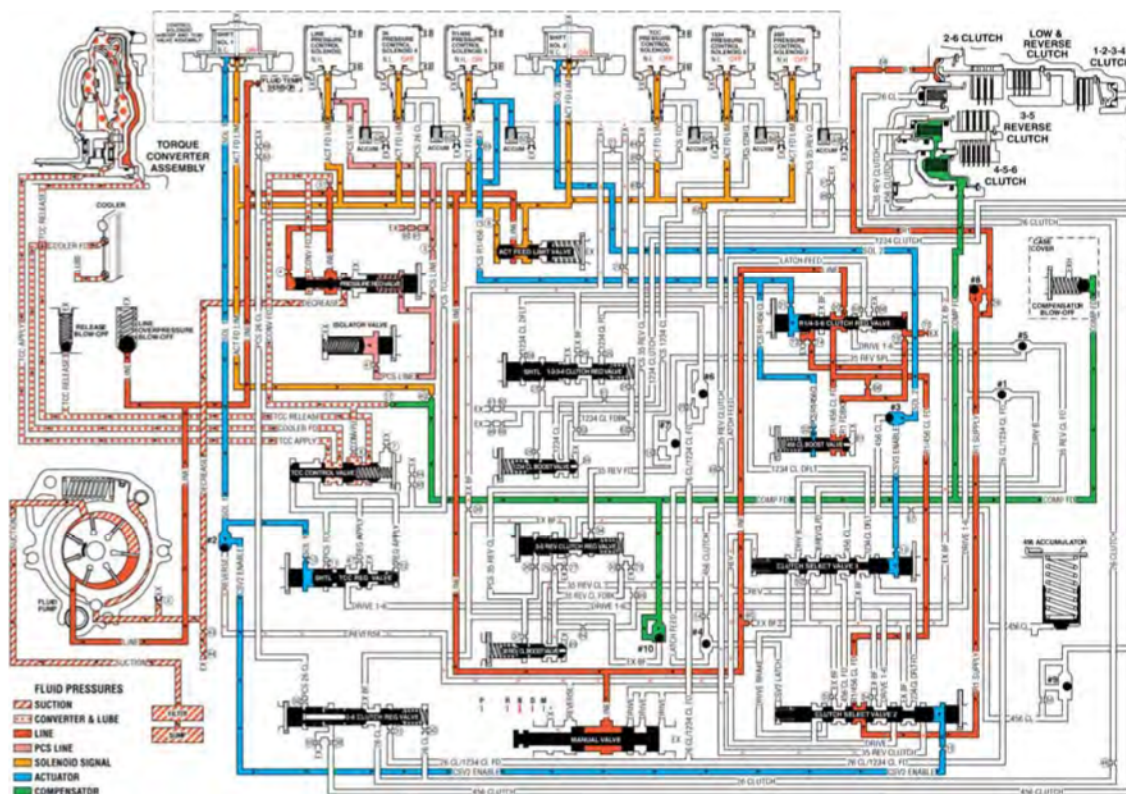


Fig. 9: Fluid Flow Diagram - Neutral - Engine Running
 Courtesy of GENERAL MOTORS COMPANY

Drive Range, First Gear Engine Braking

When the gear selector lever is moved to the Drive (D) range from the Neutral (N) position, the transmission will provide engine braking. In this operating range, the normally-low 1234 pressure control solenoid 5 is commanded ON and in the engine braking mode the following changes occur within the hydraulic circuits:

Fluid Pressure is Directed to the 1-2-3-4 Clutch and the Low & Reverse Clutch to Provide Engine Braking

Manual Valve

The manual valve is moved to the Drive (D) position and allows line fluid pressure to enter the drive fluid circuit. Drive fluid is then routed to the clutch select valve 2.

Clutch Select Valve 2

Drive fluid at the clutch select valve 2 passes through the valve and enters the drive brake circuit. Drive brake fluid is then routed to the clutch select valve 3.

Clutch Select Valve 3

Drive brake fluid at the clutch select valve 3 passes through the valve and enters the Drive B fluid circuit. Drive B fluid is then routed to #1 ball check valve.

#1 Ball Check Valve

Drive B fluid seats the #1 ball check valve against drive 1-6 fluid to force drive B fluid into the 26/1234 feed passage. The 26/ 1234 feed fluid is routed through orifice #31 and, to the 2-6 clutch regulator valve. The 26/1234 feed fluid passes through the 2-6 clutch regulator valve and enters the pressure switch 3 (PS3) fluid circuit. PS3 fluid is then routed to the normally closed pressure switch 3 and opens the switch.

#6 Ball Check Valve

26/1234 feed fluid unseats the #6 ball check valve allowing 26/1234 feed fluid to enter the 1234 clutch feed circuit. The 1234 clutch feed fluid is routed through orifice #25 and then to the 1-2-3-4 clutch regulator valve.

1-2-3-4 Clutch Applies

1234 Pressure Control Solenoid 5

The 1234 pressure control solenoid 5 is commanded ON allowing actuator feed limit to enter the PCS 1234 clutch fluid circuit. PCS 1234 clutch fluid is then routed through orifice #27 to the 1-2-3-4 clutch regulator valve. PCS1234 clutch fluid is also routed through orifice #29 and then to the 1-2-3-4 clutch boost valve.

1-2-3-4 Clutch Regulator Valve

PCS1234 clutch fluid moves the 1-2-3-4 clutch regulator valve against 1-2-3-4 clutch regulator valve spring force to allow 1234 clutch feed fluid to pass through the valve and enter the 1234 clutch fluid circuit. The 1234 clutch fluid is then routed to the 1234 clutch boost valve and the 1-2-3-4 clutch.

1-2-3-4 Clutch Boost Valve

PCS1234 clutch fluid pressure acts on a differential area moving the 1234 clutch boost valve against the 1234 clutch boost valve spring. The 1234 clutch fluid passes through the valve and enters the 1234 clutch feedback circuit. As PCS 1234 clutch fluid pressure is increased to a given value, the 1234 clutch boost valve opens the 1234 clutch feedback circuit to exhaust. This results in the 1234 clutch regulator valve moving to the full feed position sending full 26 CL/1234 CL feed pressure (full line pressure) to the clutch.

1-2-3-4 Clutch

The 1234 clutch fluid enters the 1234 clutch to move the piston against spring force to apply the 1-2-3-4 clutch plates.

Drive Range, First Gear Engine Braking

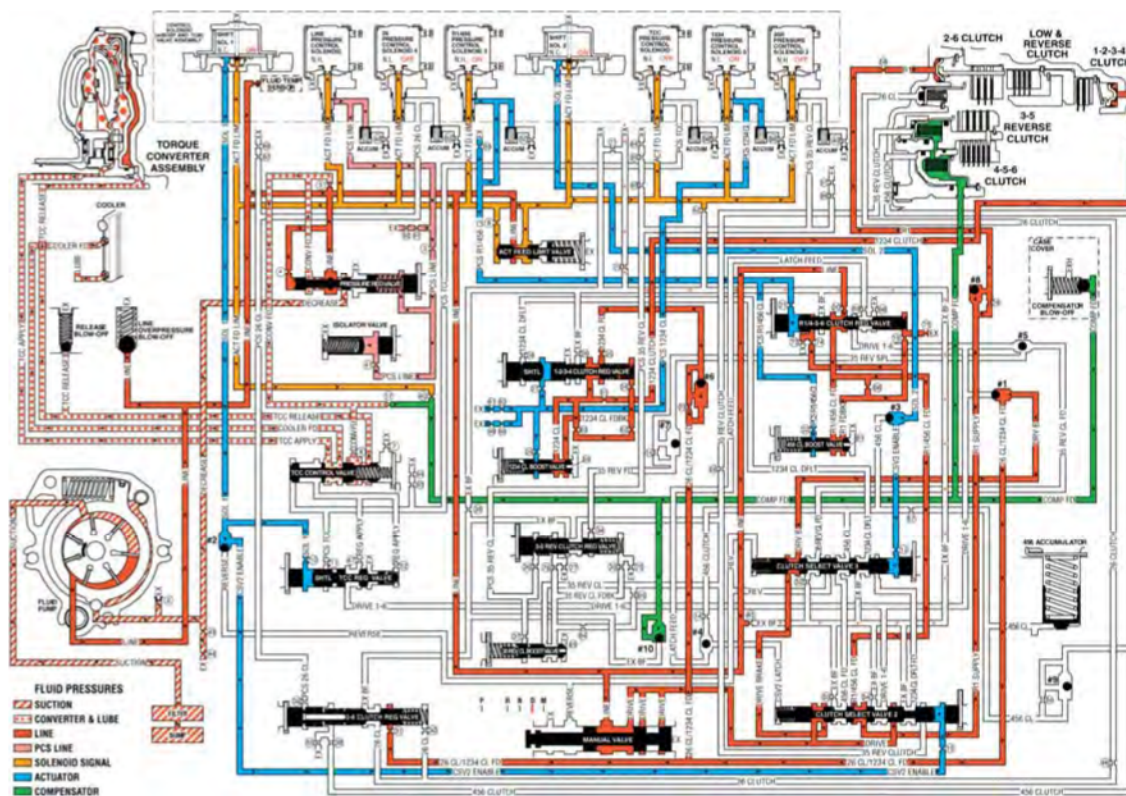


Fig. 10: Fluid Flow Diagram - Drive Range, First Gear Engine Braking
Courtesy of GENERAL MOTORS COMPANY

Drive Range, First Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, throttle position sensor and other vehicle sensors to determine the precise moment to deenergize or "turn off" shift solenoid 1 and command OFF the normally-high R1/456 pressure control solenoid 3.

Low & Reverse Clutch Releases

Shift Solenoid 1

When shift solenoid 1 is "turned OFF", CSV2 enable fluid from the clutch select valve 2 passes by the #2 ball check valve and enters the solenoid 1 fluid circuit. Solenoid 1 fluid from the #2 ball check valve and TCC regulator valve is then routed to the solenoid where it exhausts.

Clutch Select Valve 2

Clutch select valve 2 (CSV2) enable fluid is exhausted from the clutch select valve 2 and clutch select valve 2 spring force moves the valve to the released position. With clutch select valve 2 in the released position, drive fluid from the manual valve passes through the valve and enters the drive 1-6 fluid circuit. Drive 1-6 fluid then feeds the R1/456 and 35 reverse clutch regulator valves and the TCC regulator valve.

R1/456 Pressure Control Solenoid 3

The R1/456 pressure control solenoid 3 is commanded OFF allowing PCS R1/456 fluid from the R1/456 clutch regulator valve and 456 clutch boost valve to exhaust.

R1/456 Clutch Regulator Valve

R1/456 clutch regulator valve spring force moves the valve to exhaust the R1/456 clutch feed circuit and allow drive 1-6 fluid to enter the PS4 fluid circuit. PS4 fluid is then routed to the normally-closed pressure switch 4 and opens the switch. PS4 fluid is also routed to the #4 ball check valve and flows into the CSV2 latch fluid circuit.

#4 Ball Check Valve

PS4 fluid pressure seats the #4 ball check valve against the 456 clutch fluid circuit. PS4 fluid is then directed into the CSV2 latch fluid circuit and routed to the clutch select valve 2. CSV2 latch fluid combines with clutch select valve 2 spring force and holds the valve in this position during all 6 forward gear ranges.

#5 Ball Check Valve

Drive 1-6 fluid pressure seats the #5 ball check valve against the 35 reverse clutch feed fluid passage. Drive 1-6 fluid is then directed into the 35R supply fluid circuit which is routed to the #7 ball check valve and orifice #16.

#7 Ball Check Valve

The 35R supply fluid seats the #7 ball check valve against the 35R feed fluid passage to force 35R supply fluid through orifice #16 before entering the 35R feed circuit. The 35R feed fluid is then routed to the 3-5 reverse clutch regulator valve.

Low and Reverse Clutch

Low and reverse clutch spring force moves the low and reverse clutch piston which forces R1 fluid out. R1 fluid is routed to the clutch select valve 2 where it enters the exhaust backfill circuit. The low and reverse clutch is in the released position.

Drive Range, First Gear

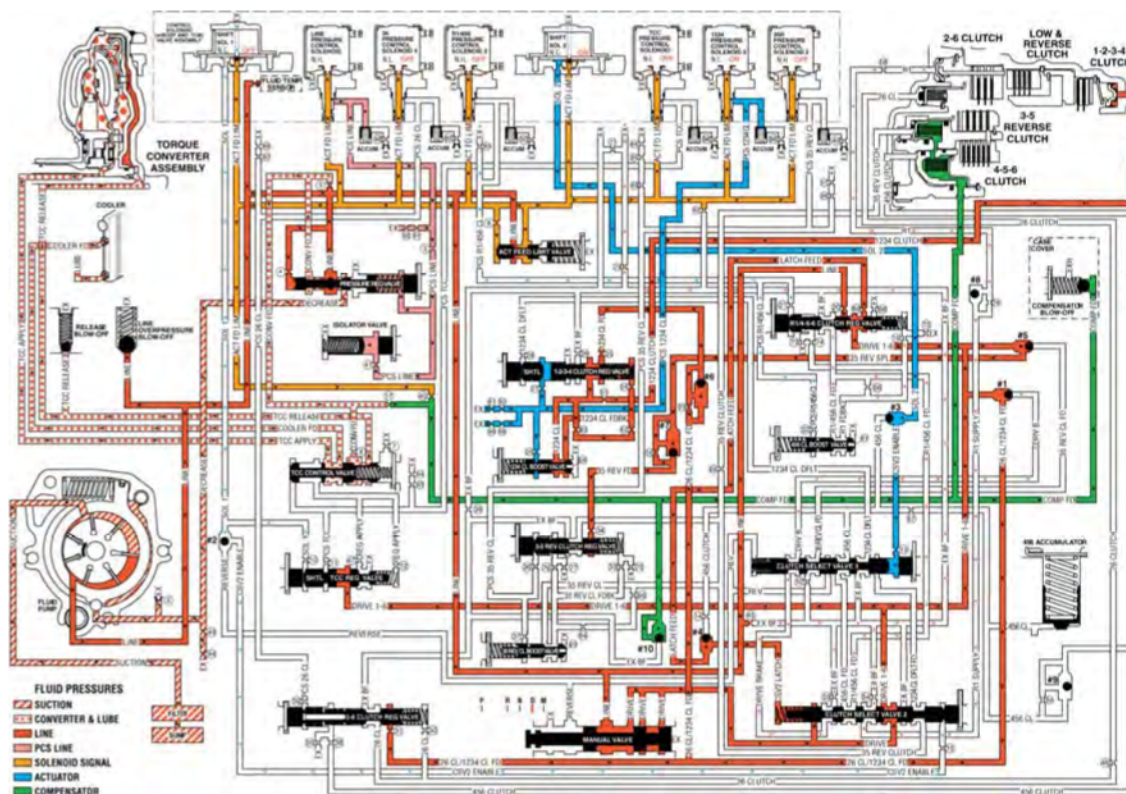


Fig. 11: Fluid Flow Diagram - Drive Range, First Gear
 Courtesy of GENERAL MOTORS COMPANY

Drive Range, Second Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command ON the normally-low pressure control solenoid 4.

Second Clutch Applies

26 Pressure Control Solenoid 4

The 26 pressure control solenoid 4 is commanded ON, allowing actuator feed limit fluid to enter the pressure control solenoid (PCS) 26 clutch fluid circuit. PCS 26 clutch fluid is then routed through orifice #32 to the 2-6 clutch regulator valve.

2-6 Clutch Regulator Valve

PCS 26 clutch fluid moves the 2-6 clutch regulator valve assembly against the 2-6 clutch regulator valve spring force to allow 26 clutch/1234 clutch feed fluid to pass through the valve. The 26 clutch/1234 clutch feed fluid is routed into the 26 clutch fluid circuit where it passes through orifice #46 and then to the spring end of the 2-6 clutch regulator valve, and to the 2-6 clutch within the case cover.

2-6 Clutch

The 26 clutch fluid from the 2-6 clutch regulator valve is routed through the case cover and to the 2-6 clutch piston assembly. The 26 clutch fluid pressure moves the piston against 2-6 clutch spring force to apply the 2-6 clutch plates.

Drive Range, Second Gear

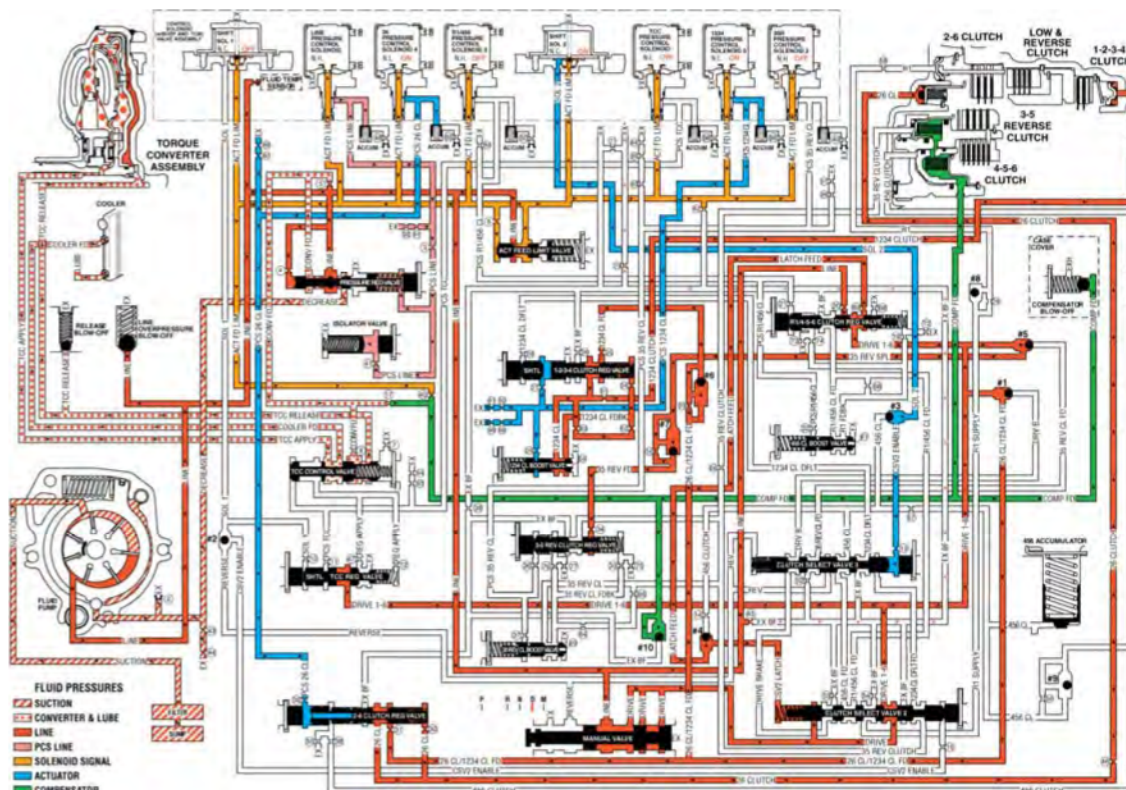


Fig. 12: Fluid Flow Diagram - Drive Range, First Gear
Courtesy of GENERAL MOTORS COMPANY

Drive Range, Third Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command OFF the normally-low 26 pressure control solenoid 4. At the same time the 35R pressure control solenoid 2 is also commanded ON to regulate 3-5 clutch apply.

3-5 Reverse Clutch Applies

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded ON allowing actuator feed fluid to enter the pressure control solenoid (PCS) 35 reverse clutch fluid circuit. PCS 35 reverse clutch fluid is routed through orifice #36 and then to the 3-5 reverse clutch regulator valve. PCS 35 reverse clutch fluid is also routed through orifice #37 and then to the 3-5 reverse clutch boost valve.

3-5 Reverse Clutch Boost Valve

PCS 35 reverse clutch fluid pressure acts on a differential area moving the 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 35 reverse clutch fluid passes through the valve and enters the 35 reverse clutch feedback circuit. As PCS 35 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 35 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 35 reverse clutch feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch Regulator Valve

PCS 35 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 35 reverse clutch feedback fluid. This allows 35 reverse feed to pass through the valve and enter the 35 reverse clutch circuit. The 35 reverse clutch fluid is then routed to the 3-5 reverse clutch, the 3-5 reverse boost valve and the clutch select valve 2. When the 3-5 reverse clutch regulator valve is in this position, PS2 fluid from the pressure switch 2 exhausts through the valve allowing the switch to close.

3-5 Reverse Clutch

The 35 reverse clutch fluid enters the 3-5 reverse/4-5-6 clutch housing to move the piston against spring force to apply the 3-5 reverse clutch plates.

2-6 Clutch Releases

26 Pressure Control Solenoid 4

The 26 pressure control solenoid 4 is commanded OFF allowing PCS 26 clutch fluid from the 2-6 clutch regulator valve to exhaust. The 26 clutch/1234 clutch feed fluid at the 2-6 clutch regulator valve passes through the valve and enters the PS3 fluid circuit. PS3 fluid is then routed to pressure switch 3 and opens the normally-closed switch.

2-6 Clutch Regulator Valve

The 2-6 clutch regulator valve spring force moves the valve to allow 26 clutch fluid from the 2-6 clutch to pass through the valve and enter the exhaust backfill fluid circuit.

2-6 Clutch

The 2-6 clutch spring force moves the 2-6 clutch piston to release the 2-6 clutch plates and forces 26 clutch fluid to exhaust. The 26 clutch fluid is routed through the 2-6 clutch regulator valve where it enters the exhaust backfill fluid circuit and is exhausted.

Drive Range, Third Gear

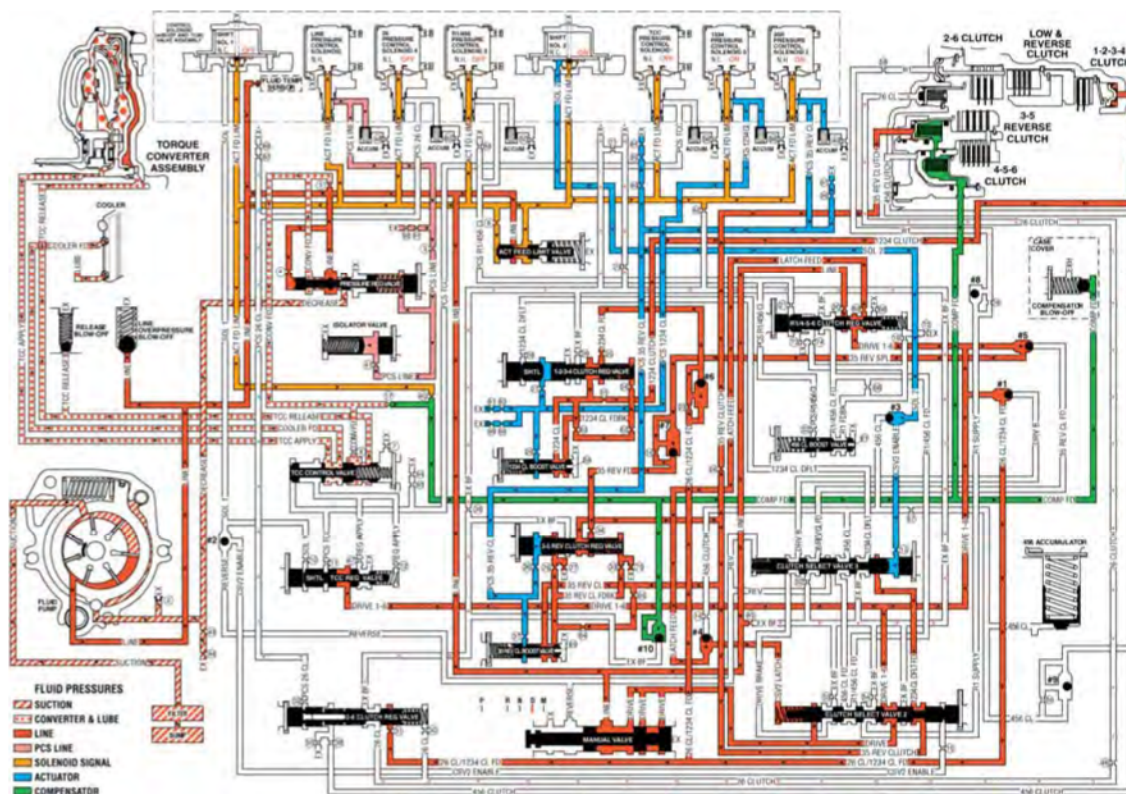


Fig. 13: Fluid Flow Diagram - Drive Range, Third Gear
 Courtesy of GENERAL MOTORS COMPANY

Drive Range, Third Gear Default

If the transmission is in 1st, 2nd or 3rd gear during a transmission electrical component failure, the transmission will default to 3rd gear. All solenoids will default to their normal state. If the torque converter clutch was applied, it will release. This default action will enable the vehicle to be safely driven to a service center.

1-2-3-4 Clutch Stays Applied

Shift Solenoid 2

Shift solenoid 2 defaults to it's normally-closed state (OFF), and SOL 2 fluid exhausts through the solenoid.

Clutch Select Valve 3

Solenoid 2 fluid pressure no longer holds the clutch select valve 3 open. When the valve moves back to the closed position, it opens the 1234 clutch default fluid circuit, and 1234 default fluid is routed to the 1-2-3-4 clutch regulator valve.

1-2-3-4 Clutch Regulator Valve

With the absence of PCS 1234 clutch fluid, due to the default state of the 1234 pressure control solenoid 5, the 1-2-3-4 regulator valve would close from spring force. However, the 1234 clutch default fluid enters behind the 1-2-3-4 regulator shuttle valve and keeps the valve in the open position.

1-2-3-4 Clutch

With the 1-2-3-4 clutch regulator valve still held in the open position, the 1-2-3-4 clutch will stay applied.

3-5 Reverse Clutch Applied or Applies

35R Pressure Control Solenoid 2

The normal state for the 35R pressure control solenoid 2 is ON, therefore PSC 35 reverse clutch fluid will still be routed to the 3-5 reverse clutch regulator valve and the 3-5 reverse clutch boost valve.

3-5 Reverse Clutch Regulator Valve

PCS 3-5 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 3-5 reverse clutch feedback fluid. This allows 3-5 reverse feed to pass through the valve and enter the 3-5 reverse clutch circuit. 3-5 reverse clutch fluid is then routed to the 3-5 reverse clutch, the 3-5 reverse boost valve and the clutch select valve 2. When the 3-5 reverse clutch regulator valve is in this position, PS2 fluid from the pressure switch 2 exhausts through the valve, allowing the switch to close.

3-5 Reverse Clutch Boost Valve

PCS 3-5 reverse clutch fluid pressure acts on a differential area moving the 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 3-5 reverse clutch fluid passes through the valve and enters the 3-5 reverse clutch feedback circuit. As PCS 3-5 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 3-5 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 3-5 reverse clutch feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch

The 3-5 reverse clutch fluid enters the 3-5 reverse/456 clutch housing to move the piston against spring force to apply the 3-5 reverse clutch plates.

Drive Range, Third Gear Default

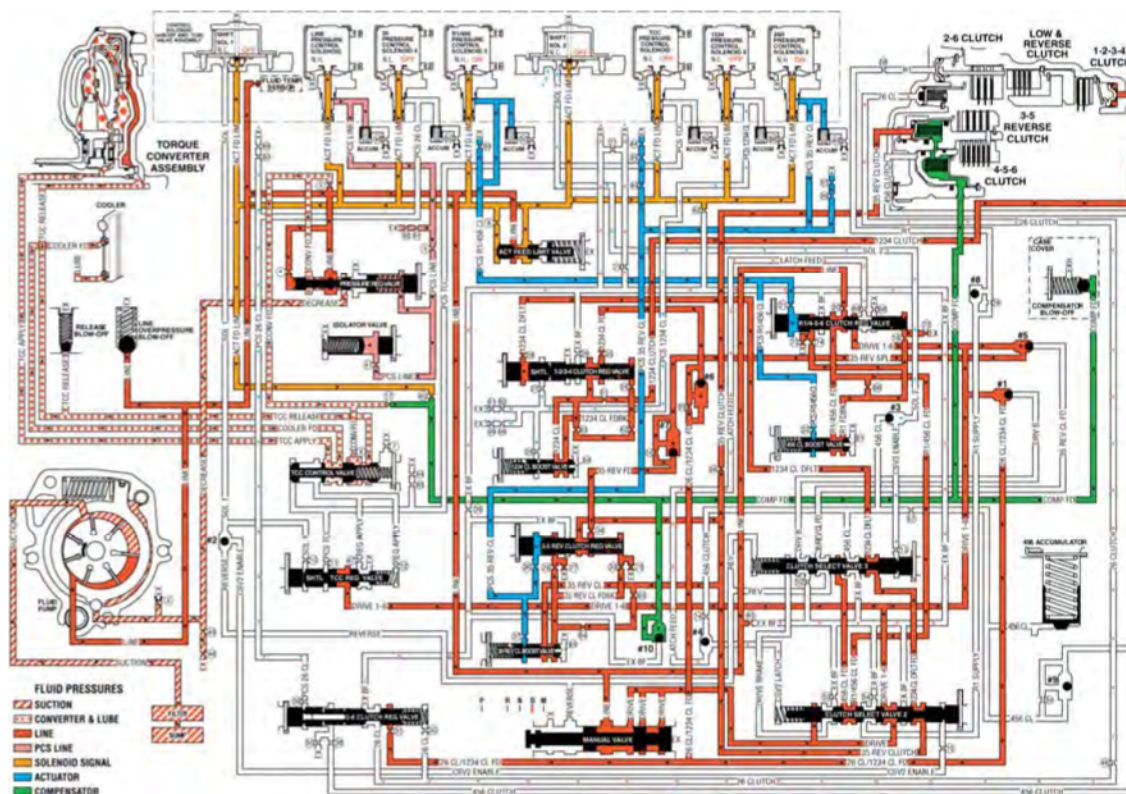


Fig. 14: Fluid Flow Diagram - Drive Range, Third Gear
Courtesy of GENERAL MOTORS COMPANY

Drive Range - Fourth Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command OFF the normally-high 35R pressure control solenoid 2. At the same time the normally-low R1/456 pressure control solenoid 3 is commanded ON to regulate 4-5-6 clutch apply.

4-5-6 Clutch Applies

R1/456 Pressure Control Solenoid 3

The R1/456 pressure control solenoid 3 (PCS) is commanded ON allowing actuator feed fluid to enter the PCS R1/456 clutch fluid circuit. PCS R1/456 clutch fluid is routed through orifice #21 to the R1/456 clutch regulator valve and, through orifice #22 to the R1/456 clutch boost valve.

R1/456 Clutch Regulator Valve

PCS R1/456 clutch fluid moves the R1/456 clutch regulator valve against R1/456 clutch regulator valve spring force to allow line fluid to pass through the valve and enter the R1/456 clutch feed circuit. R1/456 clutch feed is then routed to the 4-5-6 clutch boost valve and clutch select valve 2.

4-5-6 Clutch Boost Valve

PCS R1/456 clutch fluid pressure acts on a differential area moving the R1/456 clutch boost valve against the R1/456 clutch boost valve spring. R1/456 clutch fluid passes through the valve and enters the R1/456 clutch feedback circuit. As PCS R1/456 clutch fluid pressure is increased to a given value, the R1/456 clutch boost valve opens the R1/456 clutch feedback circuit to exhaust. This results in the R1/456 clutch regulator valve moving to the full feed position, sending full line pressure to the clutch.

Clutch Select Valve 2

R1/456 clutch feed fluid passes through the clutch select valve 2 and enters the 456 clutch feed circuit. The 456 clutch feed fluid is routed to the clutch select valve 3 where it passes through the valve and enters the 456 clutch fluid circuit. The 456 clutch fluid is routed to the 4-5-6 clutch, the 4-5-6 accumulator, #9 ball check valve and to the #4 ball check valve. The 456 clutch fluid seats the #9 ball check valve and routes fluid through orifice #39. The 456 clutch fluid passes through orifice #14, seats #4 ball check valve against the PS4 fluid circuit and routes fluid to the CSV2 latch circuit.

4-5-6 Clutch

The 456 clutch fluid enters the 4-5-6 clutch housing to move the piston against spring force, combined with force from the compensator to apply the 4-5-6 clutch plates.

3-5 Reverse Clutch Releases

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded OFF, allowing PCS 35 reverse clutch fluid from the 3-5 reverse clutch boost valve and the 3-5 reverse clutch regulator valve to exhaust through the solenoid.

3-5 Reverse Clutch Boost Valve

The 3-5 reverse boost valve spring force moves the valve to allow 35 reverse clutch feedback fluid from the 3-5 reverse clutch regulator valve to enter the 35 reverse clutch fluid circuit and exhaust.

#9 Ball Check Valve

The 456 clutch fluid pressure seats #9 ball check valve to force fluid through orifice #39 and applies the 456 clutch.

3-5 Reverse Clutch Regulator Valve

The 3-5 reverse clutch regulator valve spring force moves the valve to allow 35 reverse clutch fluid from the 3-5 reverse clutch to pass through the valve and enter the exhaust backfill fluid circuit. The 35 reverse clutch fluid then enters the exhaust backfill fluid circuit and is routed through orifice #30 to the exhaust backfill pressure relief valve where excess pressure is exhausted.

3-5 Reverse Clutch

The 3-5 reverse clutch spring force combined with force from the compensator move the 3-5 reverse clutch piston to release the 3-5 clutch plates and forces 35 reverse clutch fluid to exhaust from 3-5 reverse/456 clutch

housing. The 35 reverse clutch fluid is then routed to the 3-5 reverse clutch regulator valve and exhausted.

#4 Ball Check Valve

The 456 clutch fluid pressure passes through orifice #14 to seat #4 ball check valve against PS4 fluid passage. The 456 clutch fluid is then directed into the CSV2 latch circuit.

456 Accumulator

The 456 clutch fluid enters the 456 accumulator to move the piston against spring force to cushion the 456 clutch piston apply.

Drive Range, Fourth Gear

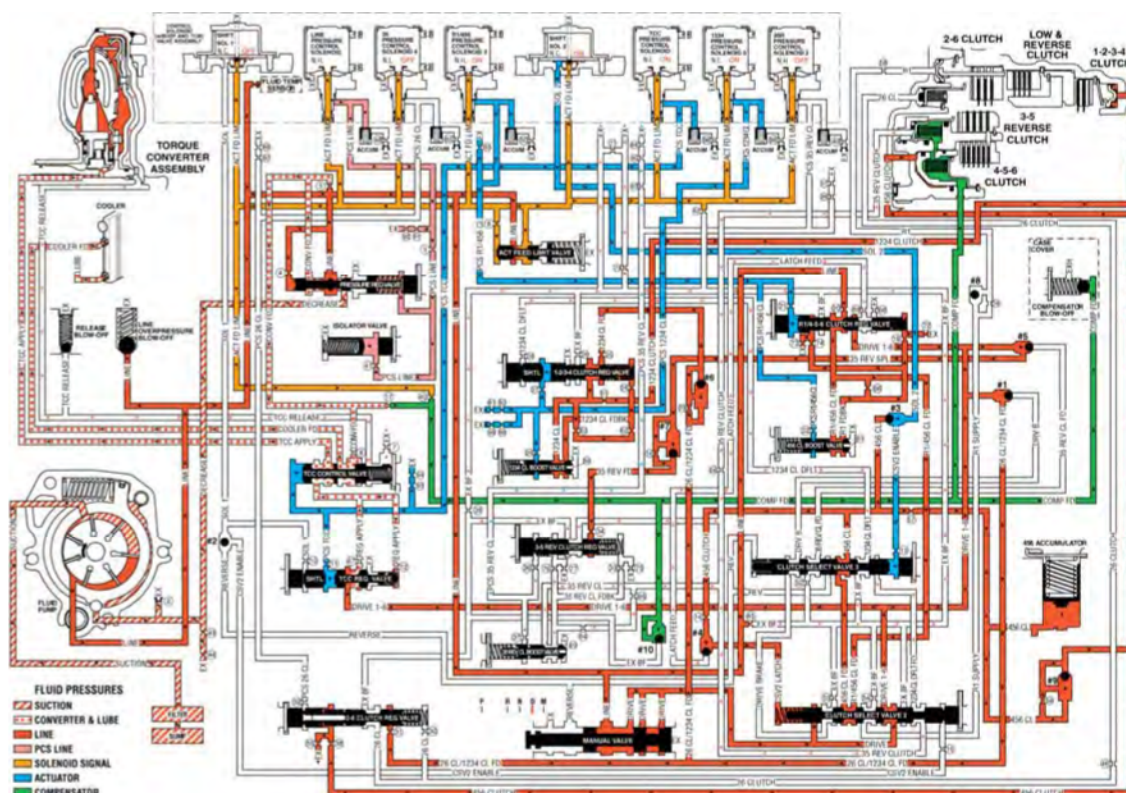


Fig. 15: Fluid Flow Diagram - Drive Range, Fourth Gear
Courtesy of GENERAL MOTORS COMPANY

Drive Range, Fifth Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command ON the normally-high 35R pressure control solenoid 2. At the same time the normally-low 1234 pressure control solenoid 5 is commanded OFF.

3-5 Reverse Clutch Applies

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded ON, allowing actuator feed fluid to enter the PCS 35 reverse clutch fluid circuit. PCS 35 reverse clutch fluid is routed through orifice #36 and then to the 3-5 reverse clutch regulator valve. PCS 35 reverse clutch fluid is also routed through orifice #37 and then to the 3-5 reverse clutch boost valve.

3-5 Reverse Clutch Boost Valve

PCS 35 reverse clutch fluid pressure acts on a differential area moving the PCS 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 35 reverse clutch fluid passes through the valve and enters the 35 reverse clutch feedback circuit. As PCS 35 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 35 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 35 reverse clutch feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch Regulator Valve

PCS 35 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 35 reverse clutch feedback fluid. This allows 35 reverse feed to pass through the valve and enter the 35 reverse clutch circuit. The 35 reverse clutch fluid is then routed to the 3-5 reverse clutch, the 3-5 reverse boost valve and the clutch select valve 2. When the 3-5 reverse clutch regulator valve is in this position, PS2 fluid from the pressure switch 2 exhausts through the valve allowing the switch to close.

Clutch Select Valve 2

The 35 reverse clutch fluid passes through the clutch select valve 2 and enters the 1234 clutch default feed fluid circuit. The 1234 clutch default feed fluid is then routed to the clutch select valve 3.

3-5 Reverse Clutch

The 35 reverse clutch fluid enters the 3-5 reverse/456 clutch housing to move the piston against spring force combined with force from the compensator to apply the 3-5 reverse clutch plates.

1-2-3-4 Clutch Releases

1234 Pressure Control Solenoid 5

The 1234 pressure control solenoid 5 is commanded OFF, allowing PCS 1234 clutch fluid from the 1-2-3-4 clutch regulator valve and 1-2-3-4 clutch boost valve to exhaust.

1-2-3-4 Clutch Regulator Valve

The 1-2-3-4 clutch regulator valve spring force moves the valve to allow 1234 clutch feed fluid from the 1-2-3-4 clutch to pass through the valve and enter the exhaust backfill fluid circuit. The 1234 clutch fluid enters the exhaust backfill fluid circuit and is routed through orifice #26 where excess pressure is exhausted. Also, 1234 clutch regulator valve spring force moves the valve to allow 1234 clutch feed fluid to pass through the valve and enter the PS1 fluid circuit. PS1 fluid is then routed to pressure switch 1 and opens the normally-

closed switch.

1-2-3-4 Clutch Boost Valve

The 1-2-3-4 clutch boost valve spring force moves the valve to allow 1234 clutch feedback fluid from the 1-2-3-4 clutch regulator valve to enter the 1234 clutch circuit and exhaust.

1-2-3-4 Clutch

The 1-2-3-4 clutch spring force moves the 1-2-3-4 clutch piston to release the clutch plates and force 1234 clutch fluid from the 1-2-3-4 clutch. The 1234 clutch fluid is routed through the 1-2-3-4 clutch regulator valve where it enters the exhaust backfill fluid circuit.

Drive Range, Fifth Gear

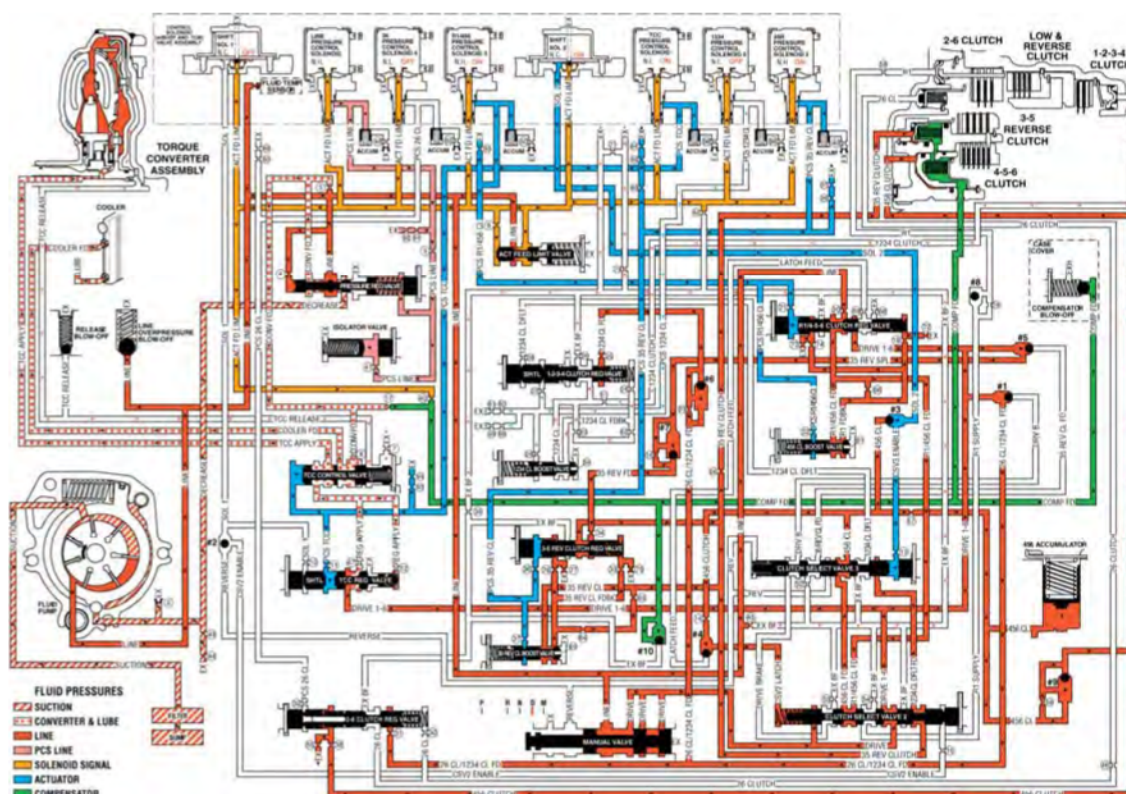


Fig. 16: Fluid Flow Diagram - Drive Range, Fifth Gear
Courtesy of GENERAL MOTORS COMPANY

Drive Range, Fifth Gear Default

If the transmission is in 4th, 5th or 6th gear during a transmission electrical component failure, the transmission will default to 5th gear. All solenoids will default to their normal state. If the torque converter clutch was applied, it will release. The transmission will stay in 5th gear default range until the ignition has been turned off or transmission shifted to reverse. When the vehicle is restarted, and shifted back into drive, the transmission will then operate in the 3rd gear default range. This default action will enable the vehicle to be safely driven to a service center.

3-5 Reverse Clutch Applies

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 defaults to ON, allowing actuator feed fluid to enter the pressure control solenoid (PCS) 35 reverse clutch fluid circuit. PCS 35 reverse clutch fluid is routed through orifice #36 and then to the 3-5 reverse clutch regulator valve. PCS 35 reverse clutch fluid is also routed through orifice #37 and then to the 3-5 reverse clutch boost valve.

3-5 Reverse Clutch Boost Valve

PCS 3-5 reverse clutch fluid pressure acts on a differential area moving the PCS 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 3-5 reverse clutch fluid passes through the valve and enters the 3-5 reverse clutch feedback circuit. As PCS 3-5 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 3-5 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 3-5 reverse clutch feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch Regulator Valve

PCS 3-5 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 3-5 reverse clutch feedback fluid. This allows 3-5 reverse feed to pass through the valve and enter the 3-5 reverse clutch circuit. The 3-5 reverse clutch fluid is then routed to the 3-5 reverse clutch, the 3-5 reverse boost valve and the clutch select valve 2. When the 3-5 reverse clutch regulator valve is in this position, PS2 fluid from the pressure switch 2 exhausts through the valve, allowing the switch to close.

3-5 Reverse Clutch

The 3-5 reverse clutch fluid enters the 3-5 reverse/456 clutch housing to move the piston against spring force to apply the 3-5 reverse clutch plates.

Clutch Select Valve 3

Once the clutch select valve 3 is moved to the ON position in 4th gear, it will remain in this position throughout the 5th gear default range, until the ignition has been turned OFF. When the ignition is OFF, fluid will exhaust from the valve, thus when the vehicle is restarted, the transmission will then be in the 3rd gear default range.

1-2-3-4 Clutch Releases or 2-6 Clutch Releases

1234 Pressure Control Solenoid 5

If the transmission was in 4th gear when an electrical condition commands a protection mode, the 1234 pressure control solenoid 5 defaults to the OFF position, allowing PCS 1234 clutch fluid from the 1-2-3-4 clutch, the 1-2-3-4 clutch regulator valve and 1-2-3-4 clutch boost valve to exhaust.

2-6 26 Pressure Control Solenoid 4

If the transmission was in 6th gear when an electrical condition commands a protection mode, the 26 pressure

control solenoid 4 defaults to the OFF position, allowing PCS 26 clutch fluid from the 2-6 clutch regulator valve, and the 2-6 clutch to exhaust.

Torque Converter Clutch Releases

TCC Pressure Control Solenoid

The torque converter clutch (TCC) pressure control solenoid will default to it's normal state, OFF. PCS TCC fluid will exhaust from the TCC control valve, and spring force will shuttle the valve to the off position. TCC apply fluid will then be routed to the cooler, and TCC release fluid will be routed to the torque converter for complete TCC release.

1234 Clutch Regulator Valve

The 1234 clutch regulator valve spring force moves the valve to allow 1234 clutch feed fluid to enter the PS1 fluid circuit which opens PS1 switch. The 1234 clutch fluid passes through orifice #51 to the 1234 clutch regulator valve, through orifice #26 and enters the exhaust backfill circuit.

Drive Range, Fifth Gear Default

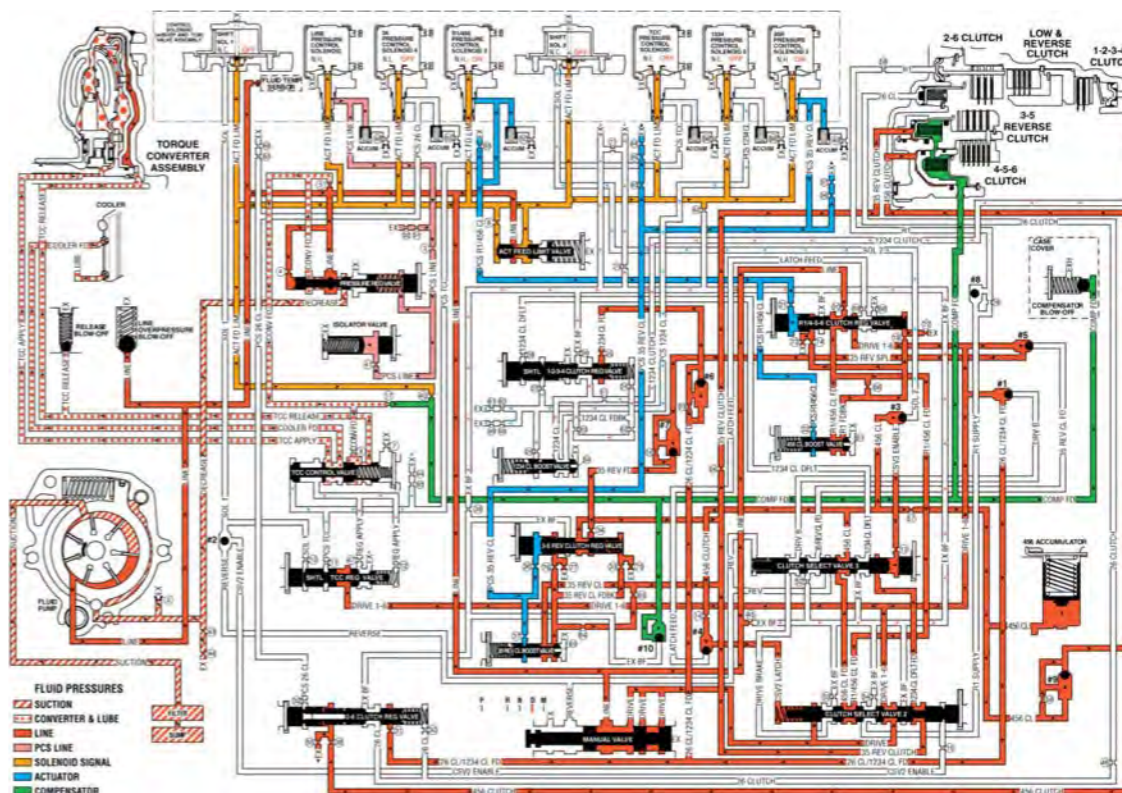


Fig. 17: Fluid Flow Diagram - Drive Range, Fifth Gear Default
Courtesy of GENERAL MOTORS COMPANY

Drive Range, Sixth Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the

automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command ON the normally-low 26 pressure control solenoid 4 (PCS). At the same time the normally-high 35R pressure control solenoid 2 is commanded OFF.

2-6 Clutch Applies

26 Pressure Control Solenoid 4

The 26 pressure control solenoid 4 is commanded ON, allowing actuator feed fluid to enter the PCS 26 clutch fluid circuit. PCS 26 fluid is routed through orifice #32 and then to the 2-6 clutch regulator valve.

2-6 Clutch Regulator Valve

PCS 26 clutch fluid moves the 2-6 clutch regulator valve assembly against the 2-6 clutch regulator valve spring force to allow 26 clutch/1234 clutch feed fluid to pass through the valve. The 26 clutch/1234 clutch feed fluid is routed into the 26 clutch fluid circuit where it passes through orifice #46 and then to the spring end of the 2-6 clutch regulator valve, and to the 2-6 clutch.

2-6 Clutch

The 26 clutch fluid from the 2-6 clutch regulator valve is routed to the 2-6 clutch piston assembly. The 26 clutch fluid pressure moves the piston against 2-6 clutch spring force to apply the 2-6 clutch plates.

3-5 Clutch Releases

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded OFF, allowing PCS 35 reverse clutch fluid from the 3-5 reverse clutch boost valve and the 3-5 reverse clutch regulator valve to exhaust through the solenoid.

3-5 Reverse Clutch Boost Valve

The 3-5 reverse boost valve spring force moves the valve to allow 35 reverse clutch feedback fluid from the 3-5 reverse clutch regulator valve to enter the 35 reverse clutch circuit and exhaust.

3-5 Reverse Clutch Regulator Valve

The 3-5 reverse clutch regulator valve spring force moves the valve to allow actuator feed limit fluid to pass through the valve and enter the PS2 fluid circuit which opens PS2. The 35 reverse clutch fluid then enters the exhaust backfill fluid circuit and is routed through orifice #30 to the exhaust backfill pressure relief valve where excess pressure is exhausted.

3-5 Reverse Clutch

The 3-5 reverse clutch spring force moves the 3-5 reverse clutch piston to release the 3-5 clutch plates and forces 35 reverse clutch fluid to exhaust from 3-5 reverse/456 clutch housing. The 35 reverse clutch fluid is then routed to the 3-5 reverse clutch regulator valve where it exhaust excess pressure.

Drive Range, Sixth Gear

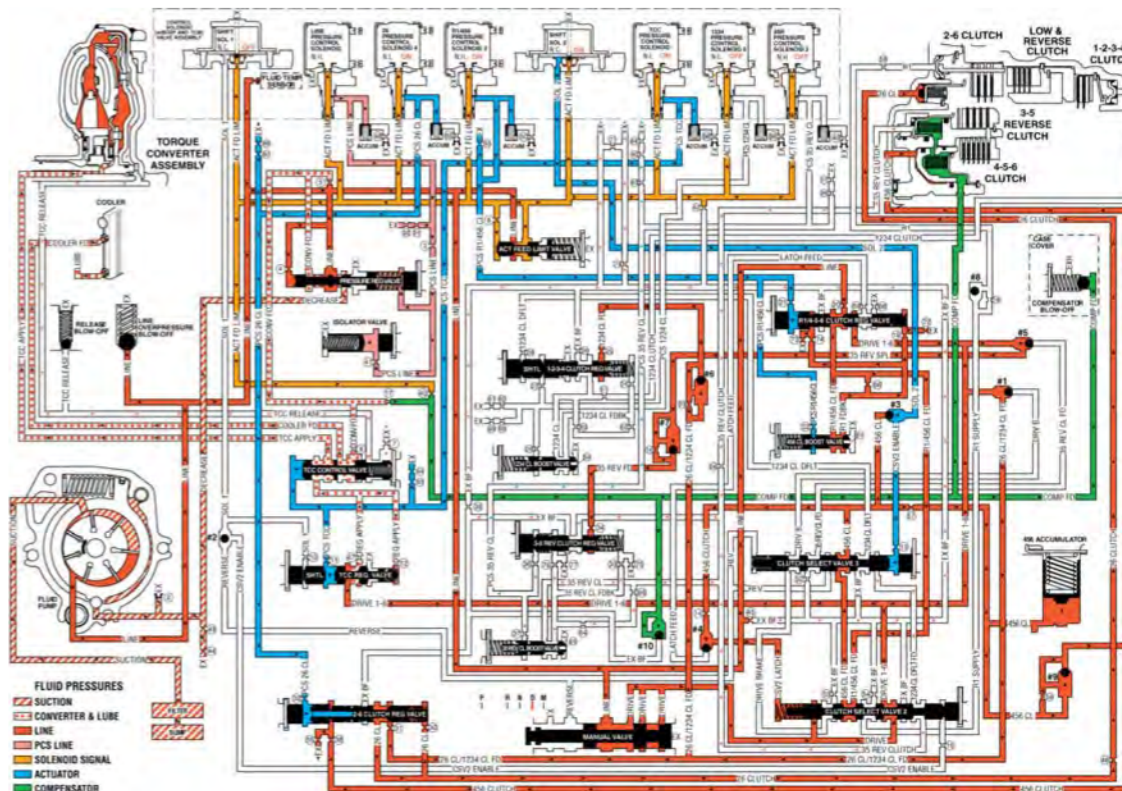


Fig. 18: Fluid Flow Diagram - Drive Range, Sixth Gear
Courtesy of GENERAL MOTORS COMPANY

FLUID PASSAGES

Control Solenoid (w/Body and TCM) Valve Assembly

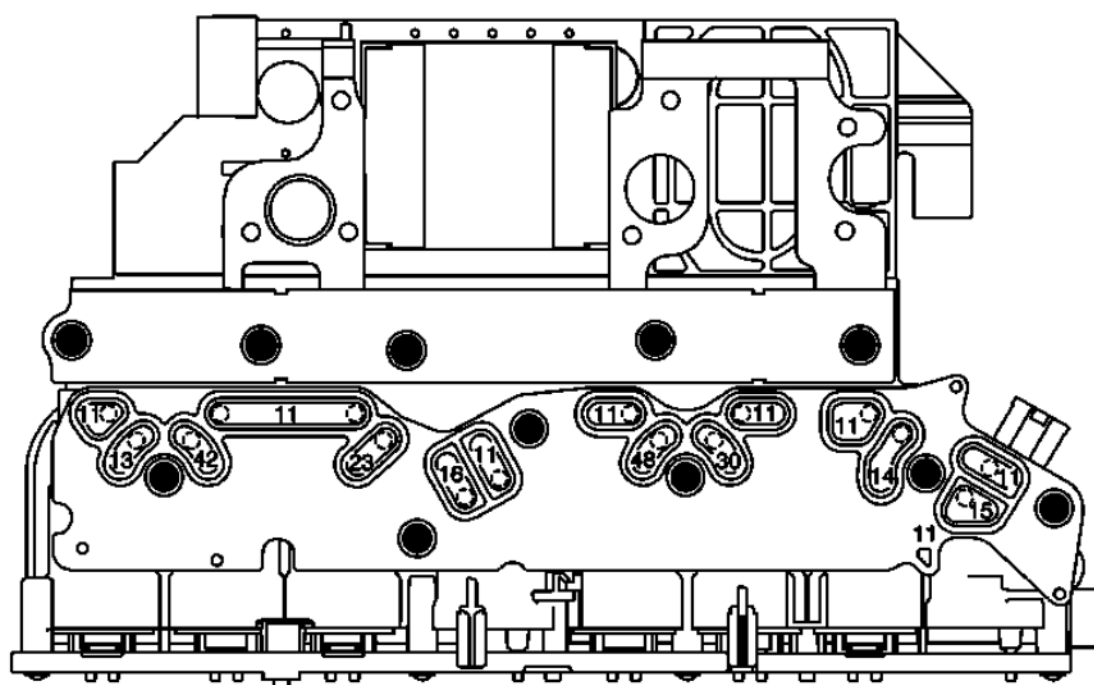


Fig. 19: Control Solenoid (w/Body and TCM) Valve Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
11	Actuator Feed Limit
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1
16	Solenoid 2
23	PCS 35 Reverse Clutch
30	PCS 1234 Clutch
42	PCS 26 Clutch
48	PCS TCC

Control Valve Channel Upper Plate Assembly

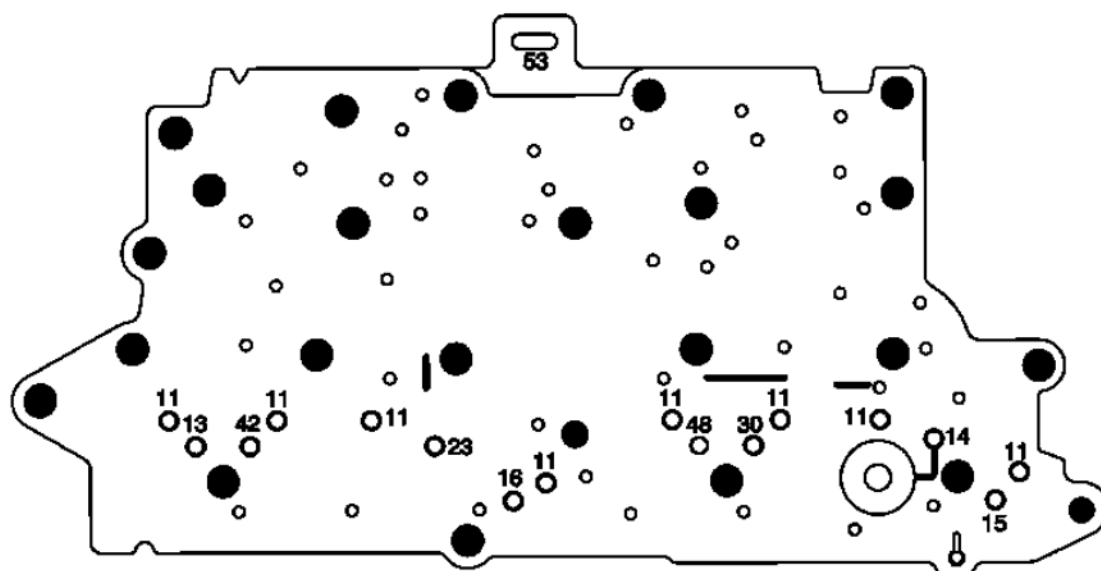


Fig. 20: Control Valve Channel Upper Plate Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
11	Actuator Feed Limit
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1
16	Solenoid 2
23	PCS 35 Reverse Clutch
30	PCS 1234 Clutch
42	PCS 26 Clutch
48	PCS TCC
53	Void

Control Valve Channel Plate- Upper Plate Side

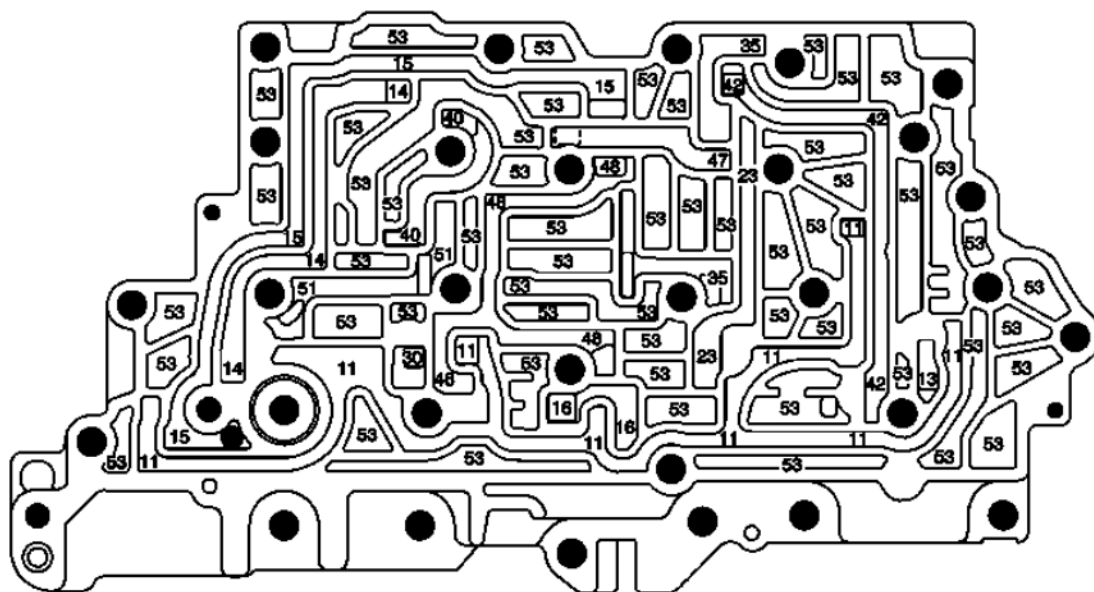


Fig. 21: Control Valve Channel Plate-- Upper Plate Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
11	Actuator Feed Limit
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1
16	Solenoid 2
23	PCS 35 Reverse Clutch
30	PCS 1234 Clutch
35	Exhaust
40	Latch Feed
42	PCS 26 Clutch
47	456 Clutch
48	PCS TCC
51	Exhaust
53	Void

Control Valve Channel Plate- Upper Body Spacer Plate Side

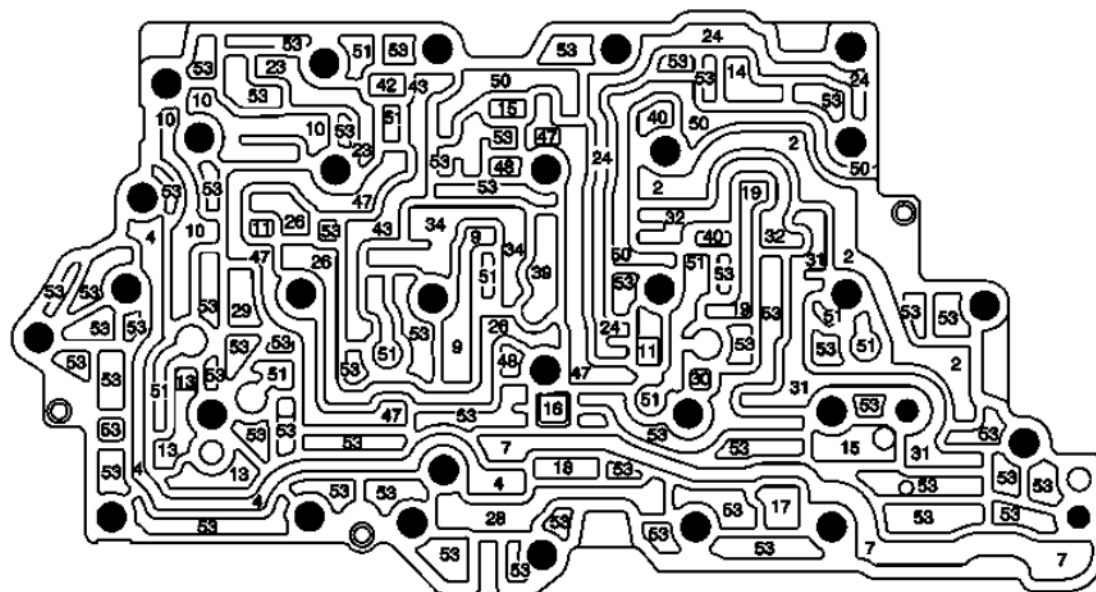


Fig. 22: Control Valve Channel Plate-- Upper Body Spacer Plate Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
4	Converter Feed
7	Cooler Feed
9	Regulated Apply
10	Compensator Feed
11	Actuator Feed Limit
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1
16	Solenoid 2
17	CSV2 Enable
18	CSV3 Enable
19	R1/456 Clutch Feed
23	PCS 35 Reverse Clutch
24	Reverse
26	35 Reverse Supply
28	35 Reverse Clutch
29	35 Reverse Clutch Feedback
30	PCS 1234 Clutch

31	Drive
32	Drive Brake
34	26 Clutch/1234 Clutch Feed
39	Drive 1-6
40	Latch Feed
42	PCS 26 Clutch
43	26 Clutch
47	456 Clutch
48	PCS TCC
50	Exhaust Backfill
51	Exhaust
53	Void

Control Valve Upper Body Spacer Plate Assembly

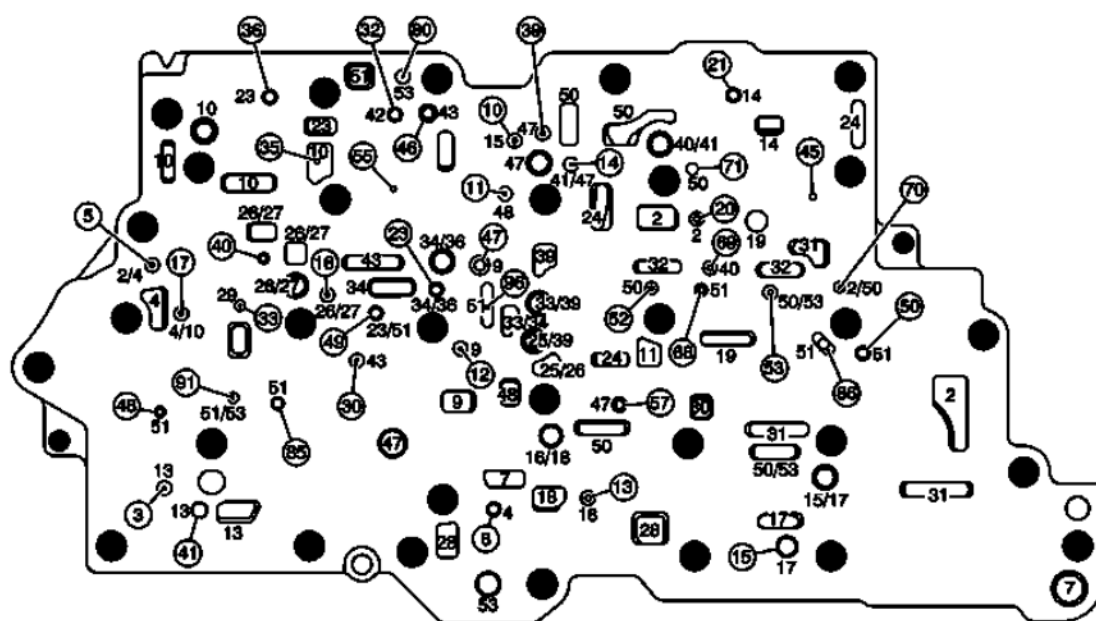


Fig. 23: Control Valve Upper Body Spacer Plate Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
3	Decrease
4	Converter Feed
5	TCC Release
7	Cooler Feed

8	Lube
9	Regulated Apply
10	Compensator Feed
11	Actuator Feed Limit
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1
16	Solenoid 2
17	CSV2 Enable
18	CSV3 Enable
19	R1/456 Clutch Feed
20	R1 Feedback
21	R1 Supply
23	PCS 35 Reverse Clutch
24	Reverse
25	35 Reverse Clutch Feed
26	35 Reverse Supply
27	35 Reverse Feed
28	35 Reverse Clutch
29	C35 Reverse Feedback
30	PCS 1234 Clutch
31	Drive
32	Drive Brake
33	Drive B
34	26 Clutch/1234 Clutch Feed
36	1234 Clutch Feed
39	Drive 1-6
40	Latch Feed
41	CSV2 Latch
42	PCS 26 Clutch
43	26 Clutch Feedback
45	1234 Clutch Default
46	456 Clutch Feed
47	456 Clutch
48	PCS TCC
50	Exhaust Backfill
51	Exhaust

Control Valve Upper Body Assembly- Upper Body Spacer Plate Side

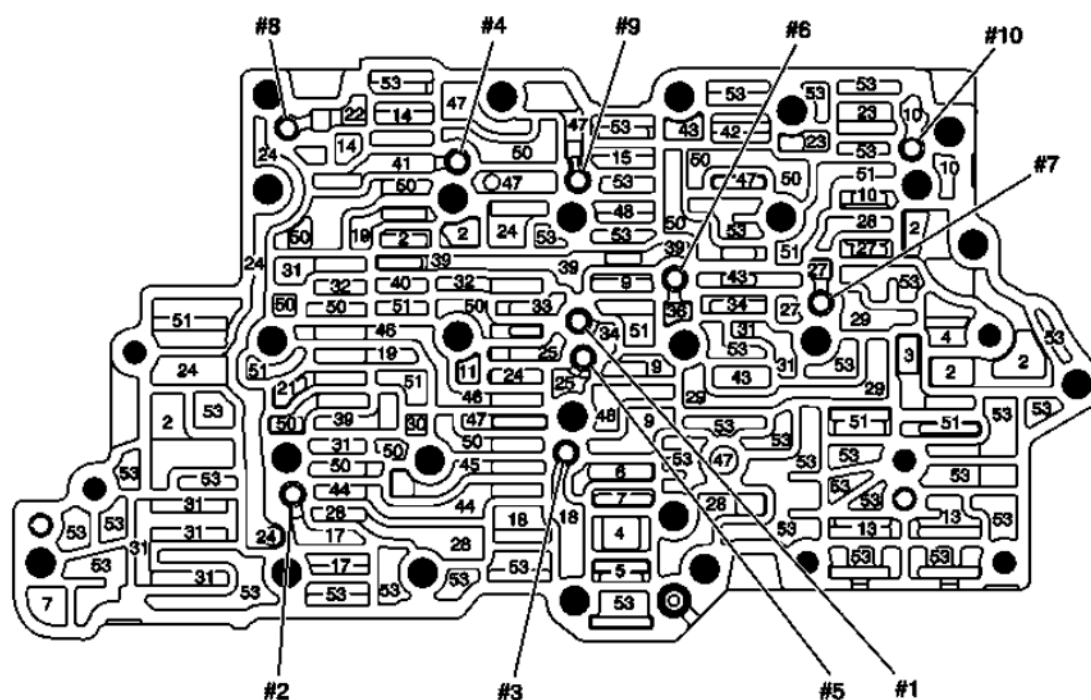


Fig. 24: Control Valve Upper Body Assembly-- Upper Body Spacer Plate Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
3	Decrease
4	Converter Feed
5	TCC Release
6	TCC Apply
7	Cooler Feed
9	Regulated Apply
10	Compensator Feed
11	Actuator Feed Limit
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1
17	CSV2 Enable
18	CSV3 Enable
19	R1/456 Clutch Feed
21	R1 Supply
22	R1
23	PCS 35 Reverse Clutch
24	Reverse

25	35 Reverse Clutch Feed
27	35 Reverse Feed
28	35 Reverse Clutch
29	35 Reverse Clutch Feedback
30	PCS 1234 Clutch
31	Drive
32	Drive Brake
33	Drive B
34	26 Clutch/1234 Clutch Feed
36	1234 Clutch Feed
39	Drive 1-6
40	Latch Feed
41	CSV2 Latch
42	PCS 26 Clutch
43	26 Clutch
44	1234 Clutch Default Feed
45	1234 Clutch Default
46	456 Clutch Feed
47	456 Clutch
48	PCS TCC
50	Exhaust Backfill
51	Exhaust
53	Void

Control Valve Upper Body Assembly- Lower Body Spacer Plate Side

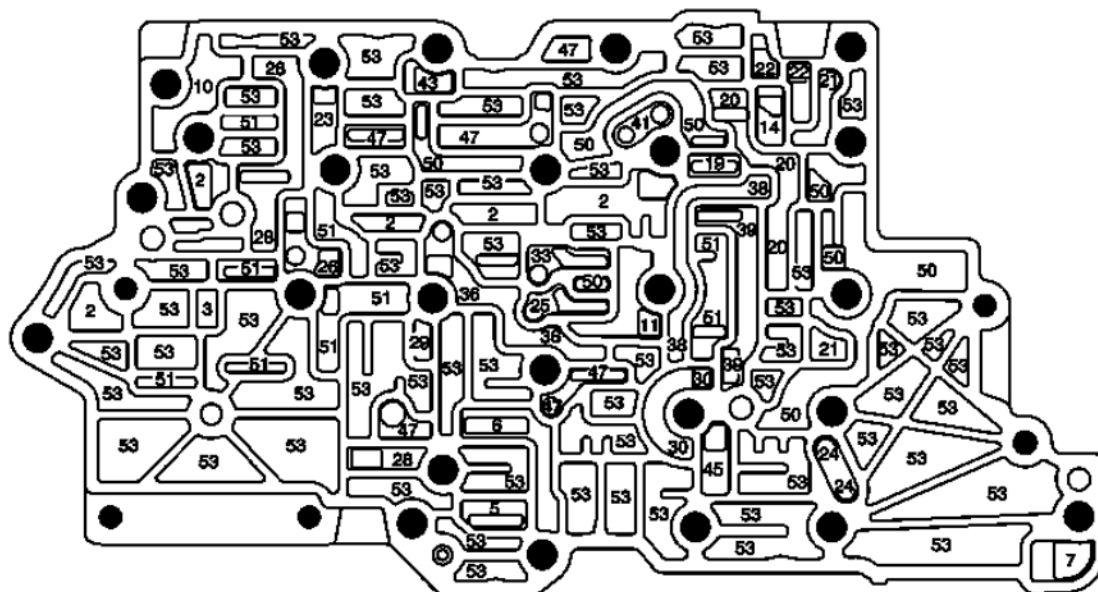


Fig. 25: Control Valve Upper Body Assembly-- Lower Body Spacer Plate Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
3	Decrease
5	TCC Release
6	TCC Apply
7	Cooler Feed
10	Compensator Feed
11	Actuator Feed Limit
14	PCS R1/456 Clutch
19	R1/456 Clutch Feed
20	R1/456 Feedback
21	R1 Supply
22	R1
23	PCS 35 Reverse Clutch
24	Reverse
25	35 Reverse Clutch Feed
26	35 Reverse Supply
28	35 Reverse Clutch
29	35 Reverse Clutch Feedback
30	PCS 1234 Clutch

33	Drive B
36	1234 Clutch Feed
38	1234 Clutch Feedback
39	Drive 1-6
41	CSV2 Latch
43	26 Clutch
45	1234 Clutch Default
47	456 Clutch
50	Exhaust Backfill
51	Exhaust
53	Void

Control Valve Lower Body Spacer Plate Assembly

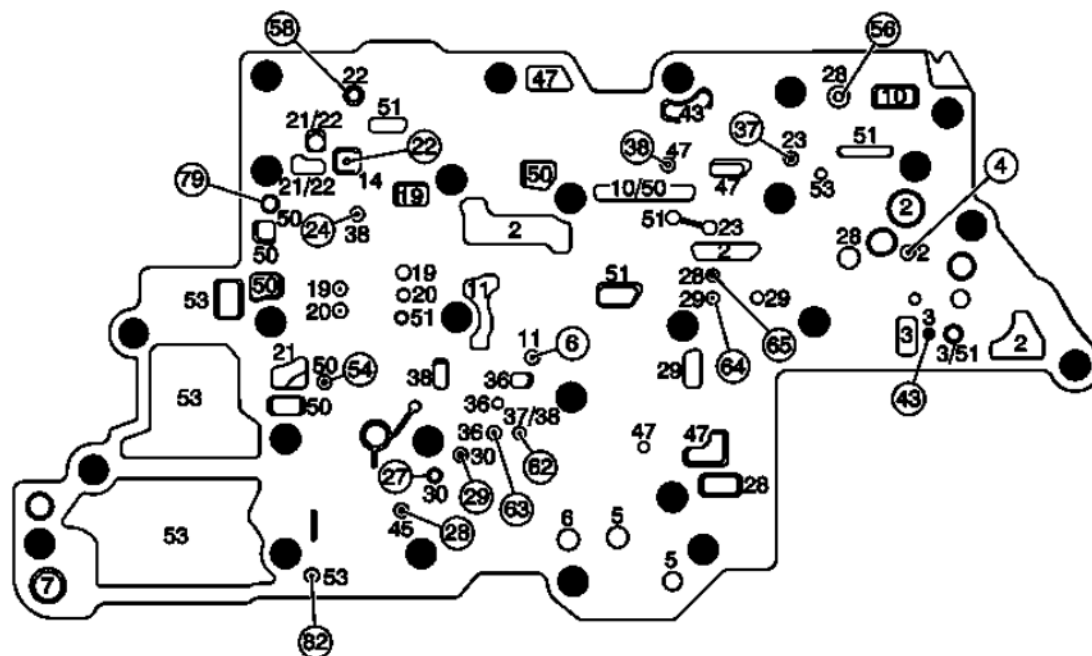


Fig. 26: Control Valve Lower Body Spacer Plate Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
3	Decrease
5	TCC Release
6	TCC Apply
10	Compensator Feed
11	Actuator Feed Limit

14	PCS R1/456 Clutch
19	R1/456 Clutch Feed
20	R1 Feedback
21	R1 Supply
22	R1
23	PCS 35 Reverse Clutch
27	35 Reverse Feed
28	35 Reverse Clutch
29	35 Reverse Clutch Feedback
30	PCS 1234 Clutch
36	1234 Clutch Feed
37	1234 Clutch
38	1234 Clutch Feedback
43	26 Clutch Feedback
45	1234 Clutch Default
47	456 Clutch
50	Exhaust Backfill
51	Exhaust
53	Void

Control Valve Lower Body

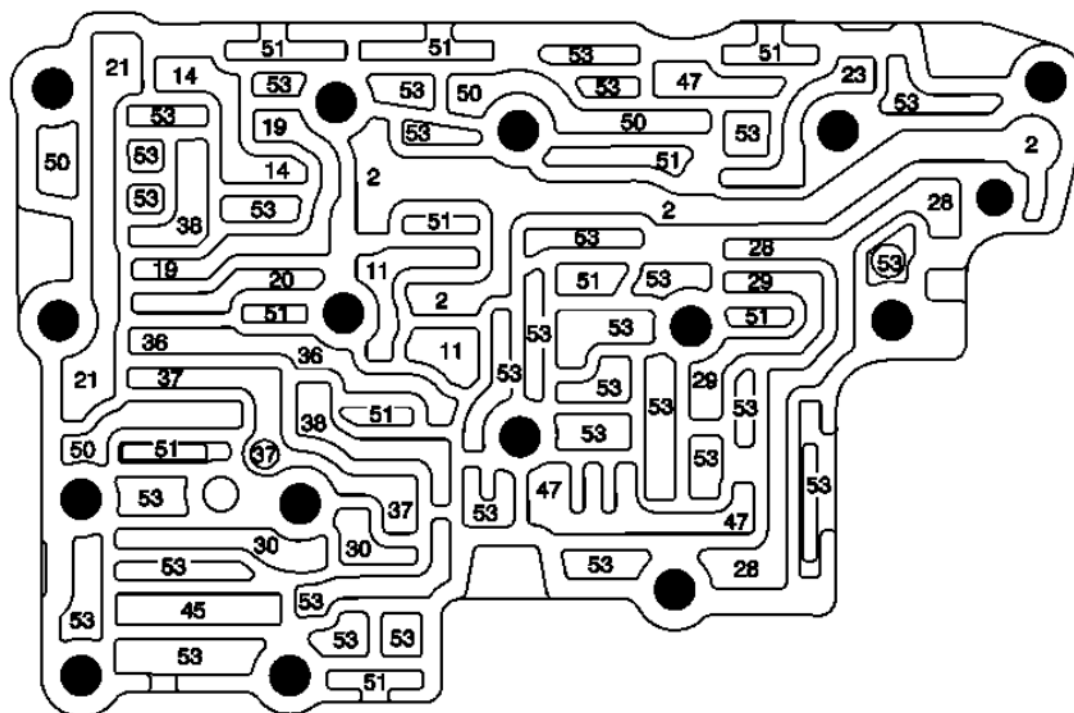


Fig. 27: Control Valve Lower Body
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
11	Actuator Feed Limit
14	PCS R1/456 Clutch
19	R1/456 Clutch Feed
20	R1 Feedback
21	R1 Supply
23	PCS 35 Reverse Clutch
28	35 Reverse Clutch
29	35 Reverse Clutch Feedback
30	PCS 1234 Clutch
36	1234 Clutch Feed
37	1234 Clutch
38	1234 Clutch Feedback
45	1234 Clutch Default
47	456 Clutch
50	Exhaust Backfill
51	Exhaust
53	Void

A/Trans Case Assembly- Control Valve Body Side

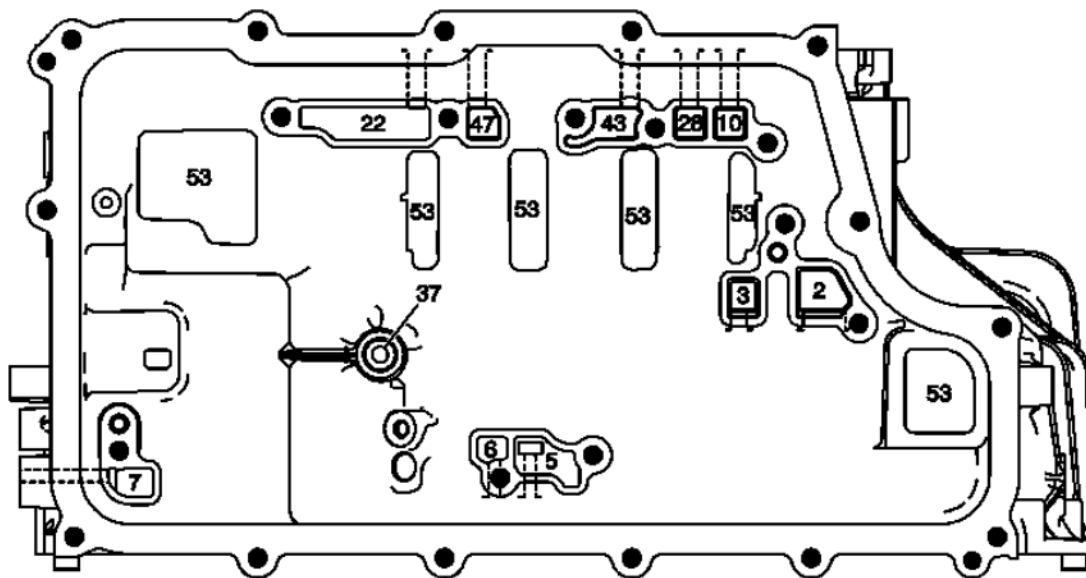


Fig. 28: A/Trans Case Assembly-- Control Valve Body Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
3	Decrease
5	TCC Release
6	TCC Apply
7	Cooler Feed
10	Compensator Feed
22	R1
28	35 Reverse Clutch
37	1234 Clutch
43	26 Clutch
47	456 Clutch
53	Void

A/Trans Case Assembly- Torque Converter and Differential Housing Side

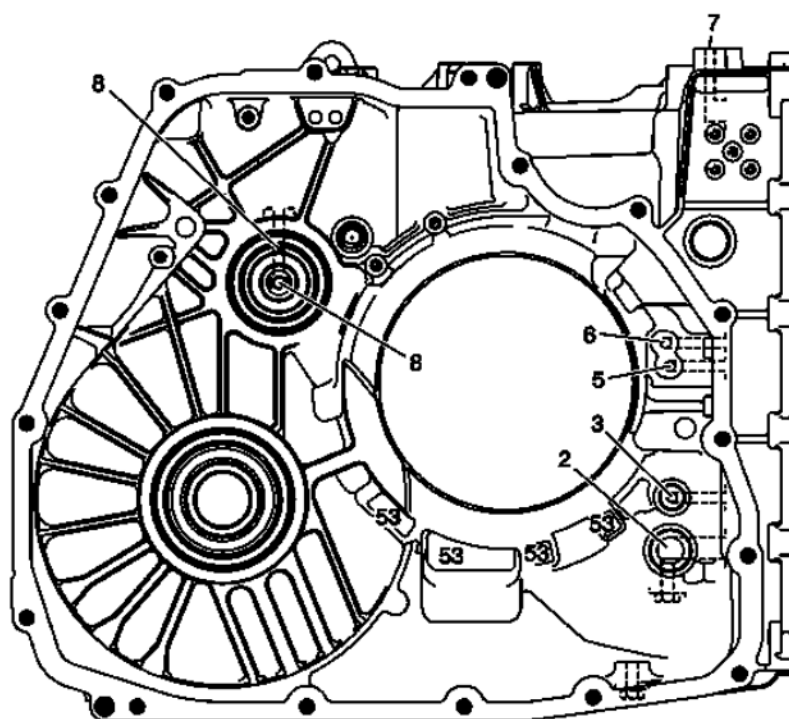


Fig. 29: A/Trans Case Assembly-- Torque Converter and Differential Housing Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
3	Decrease
5	TCC Release
6	TCC Apply

7	Cooler Feed
8	Lube
53	Void

A/Trans Case Assembly Case Cover Side

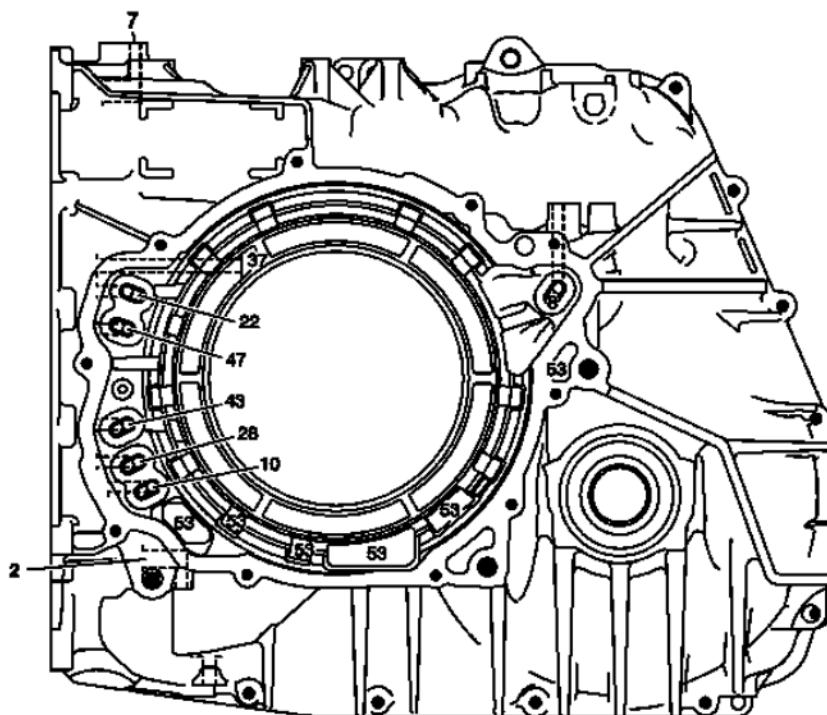


Fig. 30: A/Trans Case Assembly Case Cover Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line (to valve body)
7	Cooler Feed
8	Lube
10	Compensator Feed
22	R1
28	35 Reverse Clutch
37	1234 Clutch
43	26 Clutch
47	456 Clutch
53	Void

A/Trans Case Cover Assembly

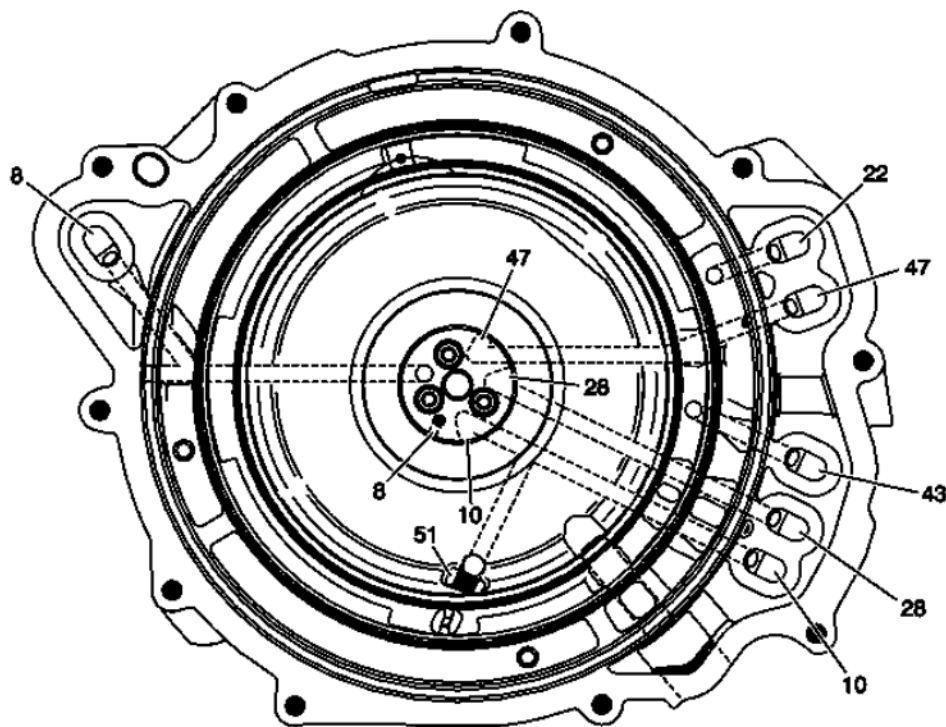


Fig. 31: A/Trans Case Cover Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
8	Lube
10	Compensator Feed
22	R1
28	35 Reverse Clutch
43	26 Clutch
47	456 Clutch
51	Compensator Feed Exhaust

Front Differential Transfer Drive Gear Support- Case Side

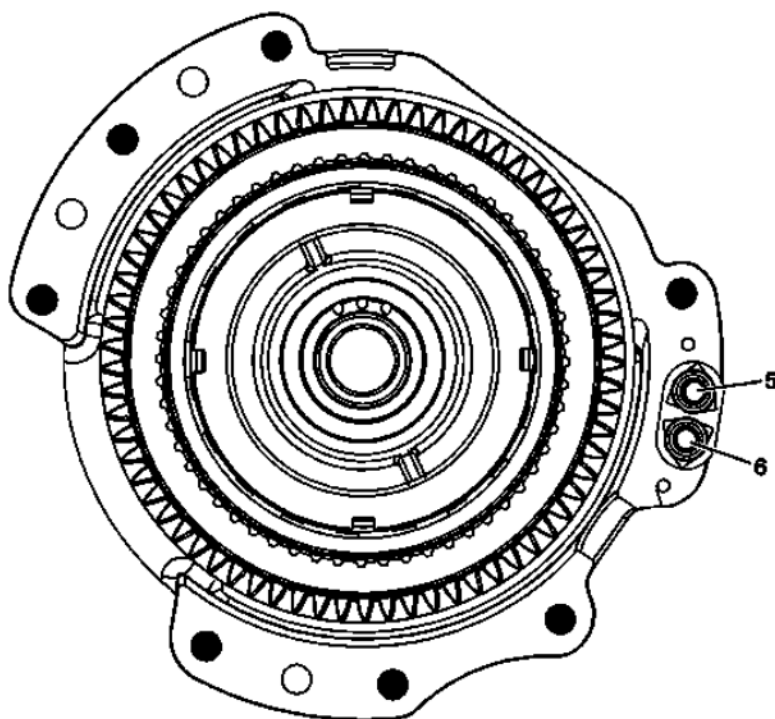


Fig. 32: Identifying Front Differential Transfer Drive Gear Support Fluid Passages - Case Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
5	TCC Release
6	TCC Apply

Front Differential Transfer Drive Gear Support- Torque Converter and Differential Housing Side

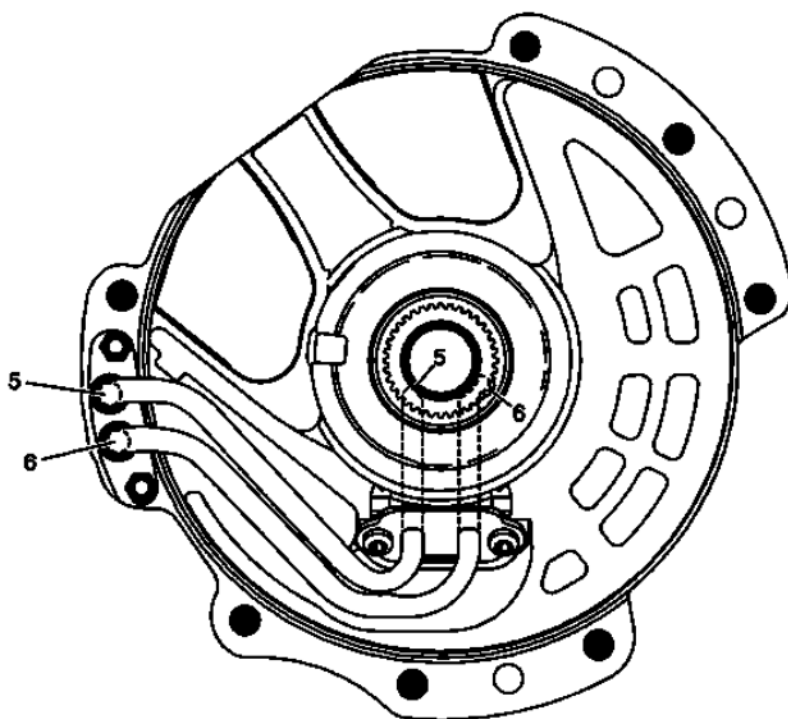


Fig. 33: Identifying Front Differential Transfer Drive Gear Support Fluid Passages - Torque Converter & Differential Housing Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
5	TCC Release
6	TCC Apply