GM POWERTRAIN

4/5L40-E

HYDRA-MATIC

CONTENTS

PREFACE

The Hydra-matic 4/5L40-E Technician's Guide is intended for automotive technicians that are familiar with the operation of an automatic transaxle or transmission. Technicians or other persons not having automatic transaxle or transmission know-how may find this publication somewhat technically complex if additional instruction is not provided. Since the intent of this book is to explain the fundamental mechanical, hydraulic and electrical operating principles, technical terms used herein are specific to the transmission industry. However, words commonly associated with the specific transaxle or transmission function have been defined in a Glossary rather than within the text of this book.

The Hydra-matic 4/5L40-E Technician's Guide is also intended to assist technicians during the service, diagnosis and repair of this transmission. However, this book is not intended to be a substitute for other General Motors service publications that are normally used on the job. Since there is a wide range of repair procedures and technical specifications specific to certain vehicles and transmission models, the proper service publication must be referred to when servicing the Hydra-matic 4/5L40-E transmission.

All information contained in this book is based on the latest data available at the time of publication approval. The right is reserved to make product or publication changes, at any time, without notice.

INTRODUCTION

The Hydra-matic 4/5L40-E Technician's Guide is another Powertrain publication from the Technician's Guide series of books. The purpose of this publication, as is the case with other Technician's Guides, is to provide complete information on the theoretical operating characteristics of this transmission. Operational theories of the mechanical, hydraulic and electrical components are presented in a sequential and functional order to better explain their operation as part of the system.

In the first section of this book entitled "Principles of Operation", detailed explanations of the major components and their functions are presented. In every situation possible, text describes component operation during the apply and release cycle as well as situations where it has no effect at all. The descriptive text is then supported by numerous graphic illustrations to further emphasize the operational theories presented.

The second major section entitled "Power Flow", blends the information presented in the "Principles of Operation" section into the complete transmission assembly. The transfer of torque from the engine through the transmission is graphically displayed on a full page while a narrative description is provided on a facing half page. The opposite side of the half page contains the narrative description of the hydraulic fluid as it applies components or shifts valves in the system. Facing this partial page is a hydraulic schematic that shows the position of valves, ball check valves, etc., as they function in a specific gear range.

The third major section of this book displays the "Complete Hydraulic Circuit" for specific gear ranges. Fold-out pages containing fluid flow schematics and two dimensional illustrations of major components graphically display hydraulic circuits. This information is extremely useful when tracing fluid circuits for learning or diagnosis purposes.

The "Appendix" section of this book provides additional transmission information regarding lubrication circuits, seal locations, illustrated parts lists and more. Although this information is available in current model year Service Manuals, its inclusion provides for a quick reference guide that is useful to the technician.

Production of the Hydra-matic 4/5L40-E Technician's Guide was made possible through the combined efforts of many staff areas within the General Motors Powertrain Division. As a result, the Hydra-matic 4/5L40-E Technician's Guide was written to provide the user with the most current, concise and usable information available regarding this product.

HOW TO USE THIS BOOK

First time users of this book may find the page layout a little unusual or perhaps confusing. However, with a minimal amount of exposure to this format its usefulness becomes more obvious. If you are unfamiliar with this publication, the following guidelines are helpful in understanding the functional intent for the various page layouts:

- Read the following section, "Understanding the Graphics" to know how the graphic illustrations are used, particularly as they relate to the mechanical power flow and hydraulic controls (see Understanding the Graphics page 6).

- Unfold the cutaway illustration of the Hydra-matic 4/5L40-E (page 8) and refer to it as you progress through each major section. This cutaway provides a quick reference of component location inside the transmission assembly and their relationship to other components.

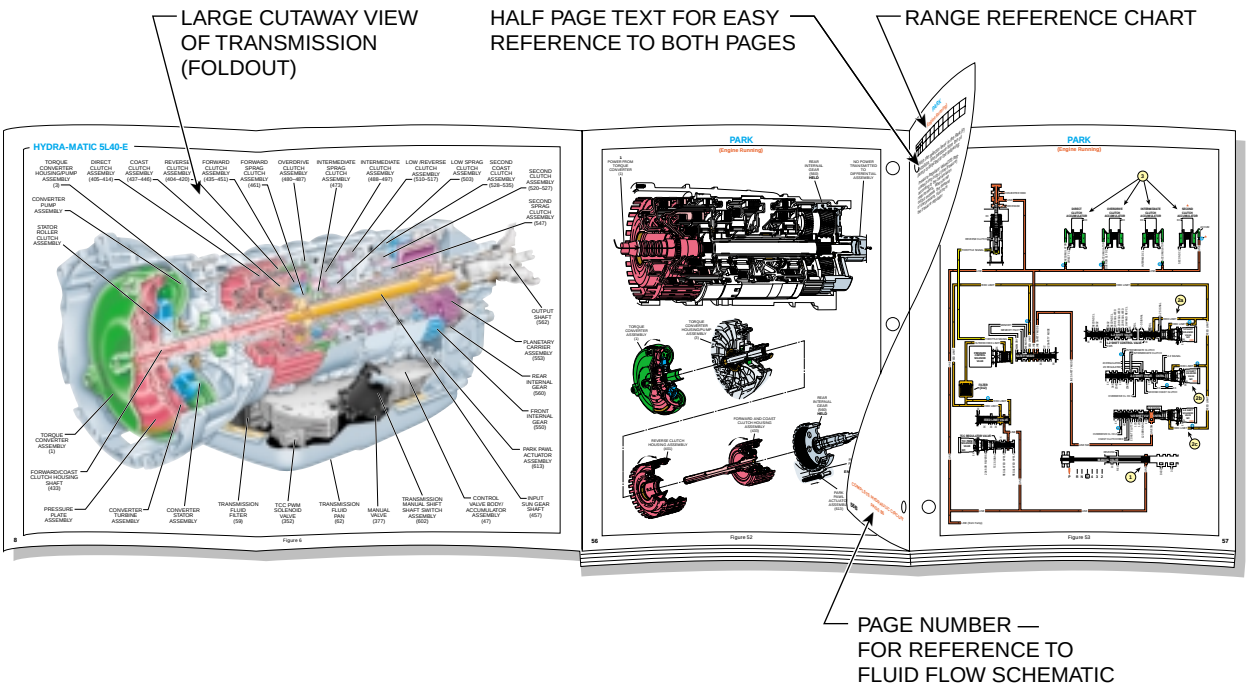
- The Principles of Operation section (beginning on page 9A) presents information regarding the major apply components and hydraulic control components used in this transmission. This section describes "how" specific components work and interfaces with the sections that follow.

- The Power Flow section (beginning on page 53) presents the mechanical and hydraulic functions corresponding to specific gear ranges. This section builds on the information presented in the Principles of Operation section by showing specific fluid circuits that enable the mechanical components to operate. The mechanical power flow is graphically displayed on a full size page and is followed by a half page of descriptive text. The opposite side of the half page contains the narrative description of the hydraulic fluid as it applies components or moves valves in the system. Facing this partial page is a hydraulic schematic which shows the position of valves, ball check valves, etc., as they function in a specific gear range. Also, located at the bottom of each half page is a reference to the Complete Hydraulic Circuit section that follows.

- The Complete Hydraulic Circuits section (beginning on page 85) details the entire hydraulic system. This is accomplished by using a fold-out circuit schematic with a facing page two dimensional fold-out drawing of each component. The circuit schematics and component drawings display only the fluid passages for that specific operating range.

- Finally, the Appendix section contains a schematic of the lubrication flow through the transmission, disassembled view parts lists and transmission specifications. This information has been included to provide the user with convenient reference information published in the appropriate vehicle Service Manuals. Since component parts lists and specifications may change over time, this information should be verified with Service Manual information.

HOW TO USE THIS BOOK



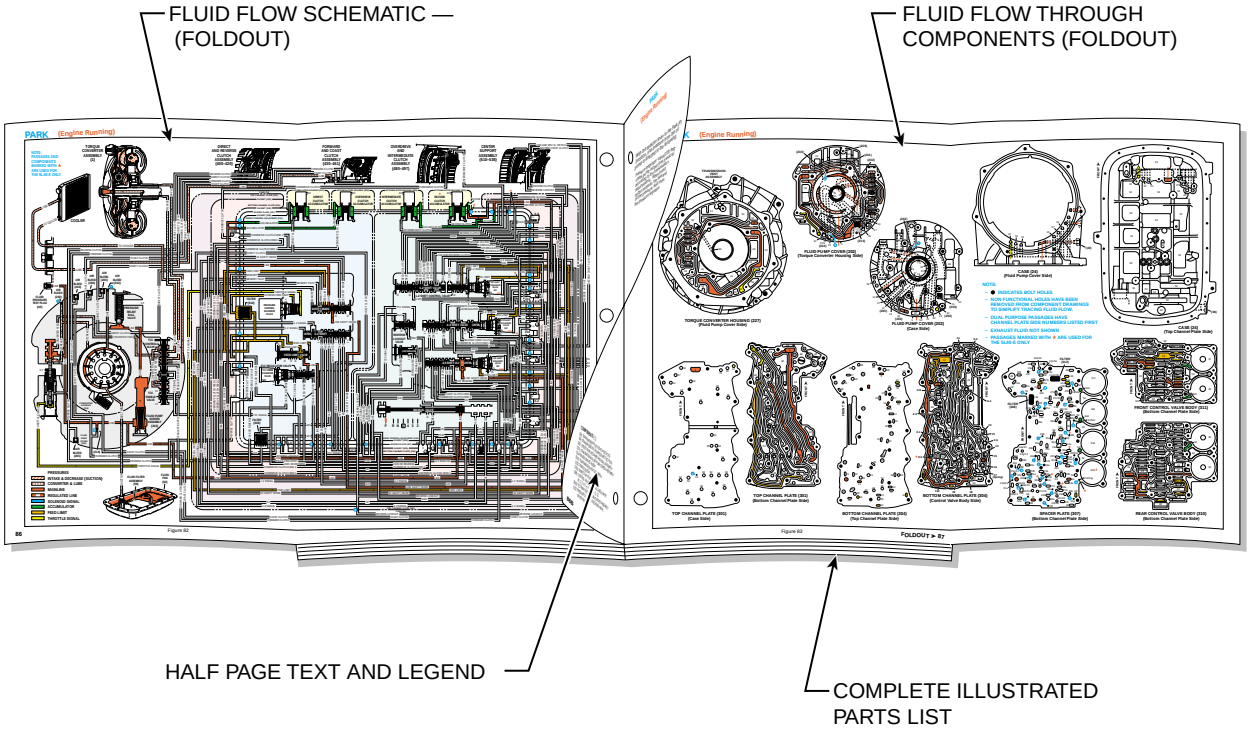


Figure 1

UNDERSTANDING THE GRAPHICS

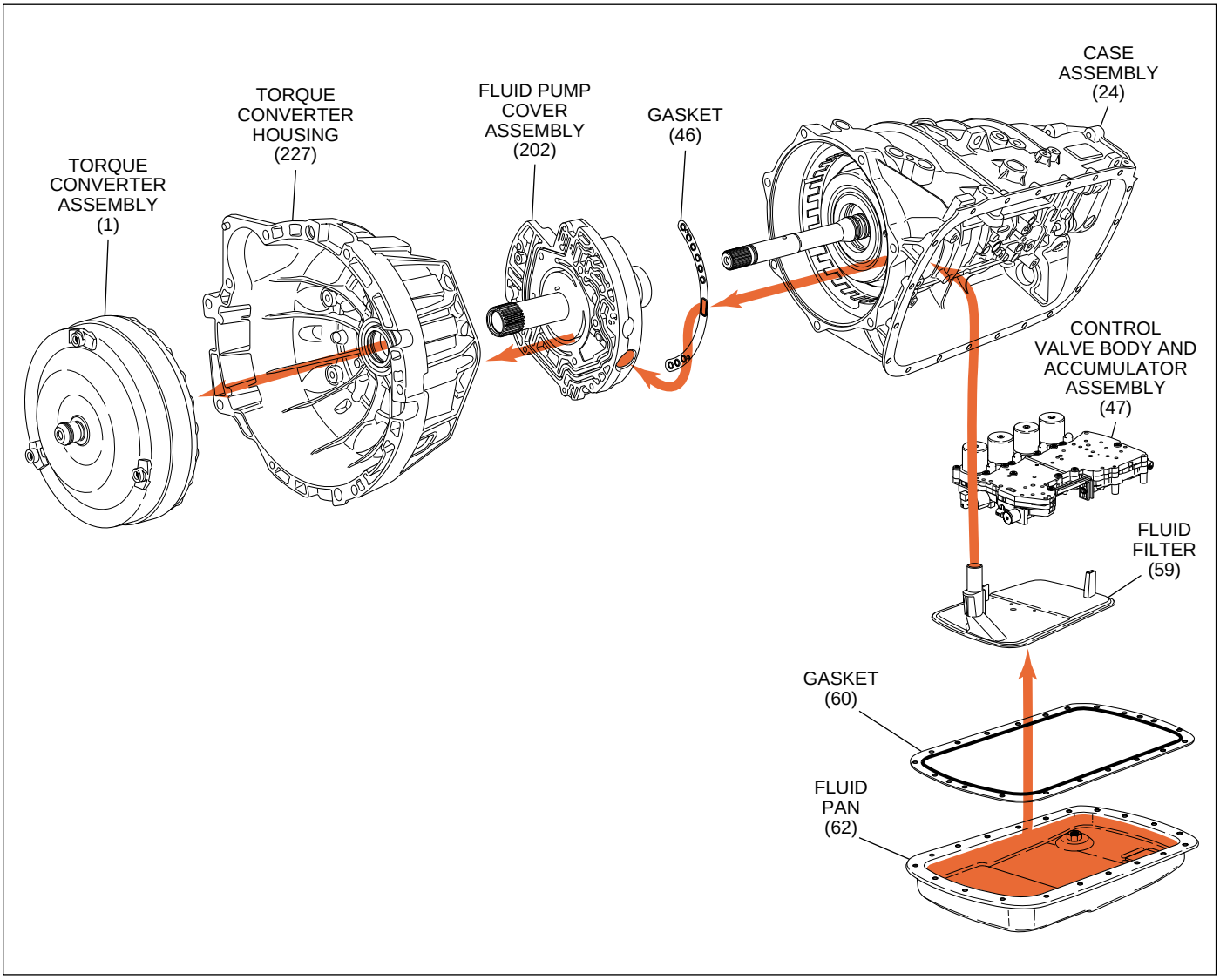


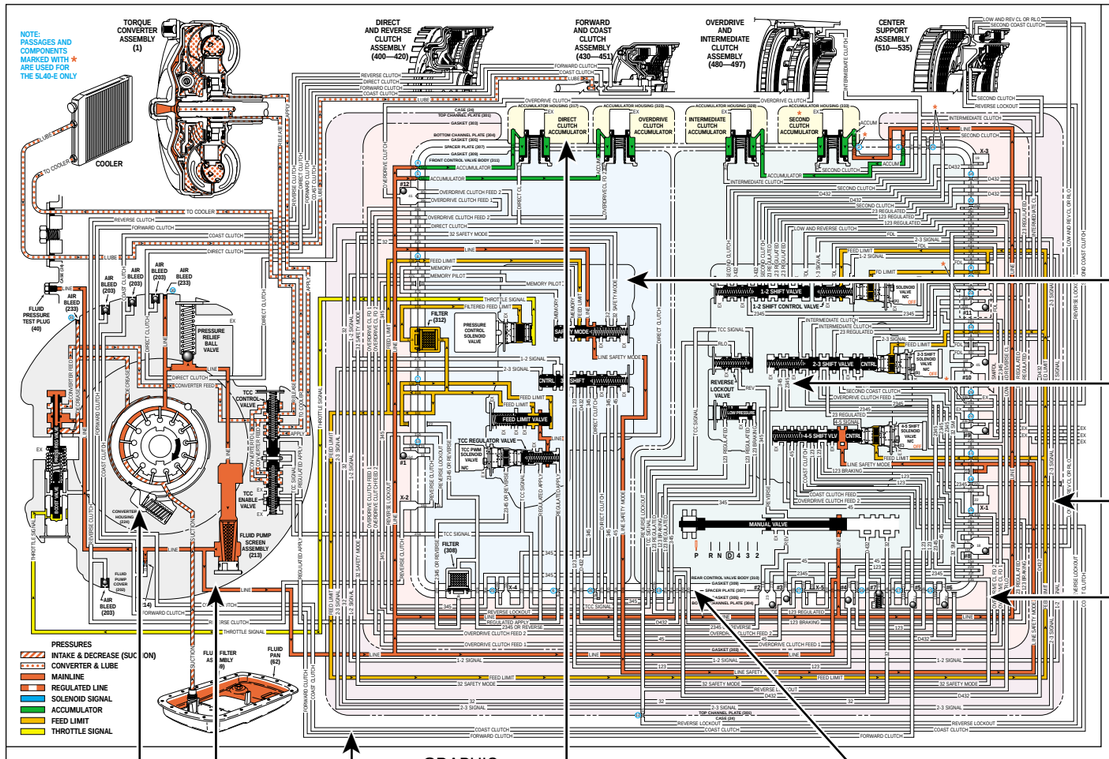
Figure 2

The flow of transmission fluid starts in the bottom pan and is drawn through the filter, case assembly and into the oil pump assembly. This is a basic concept of fluid flow that can be understood by reviewing the illustrations provided in Figure 2. However, fluid may pass between the control valve body, spacer plate, case and other components many times before reaching a valve or applying a clutch. For this reason, the graphics are designed to show the exact location where fluid passes through a component and into other passages for specific gear range operation.

To provide a better understanding of fluid flow in the Hydra-matic 4/5L40-E transmission, the components involved with hydraulic control and fluid flow are illustrated in three major formats. Figure 3 provides an example of these formats which are:

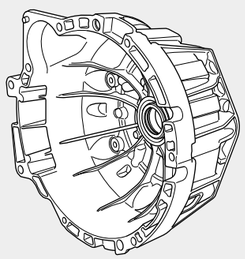
- A three dimensional line drawing of the component for easier part identification.
- A two dimensional line drawing of the component to indicate fluid passages and orifices.
- A graphic schematic representation that displays valves, ball check valves, orifices and so forth, required for the proper function of the transmission in a specific gear range. In the schematic drawings, fluid circuits are represented by straight lines and orifices are represented by indentations in a circuit. All circuits are labeled and color coded to provide reference points between the schematic drawing and the two dimensional line drawing of the components.
- Figure 4 (page 7B) provides an illustration of a typical valve, bushing and valve train components. A brief description of valve operation is also provided to support the illustration.
- Figure 5 (page 7B) provides a color coded chart that references different fluid pressures used to operate the hydraulic control systems. A brief description of how fluid pressures affect valve operation is also provided.

UNDERSTANDING THE GRAPHICS

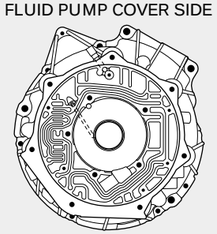


GRAPHIC SCHEMATIC REPRESENTATION

TORQUE CONVERTER HOUSING (227)

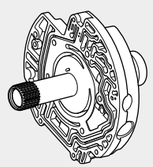


THREE DIMENSIONAL
FLUID PUMP COVER SIDE

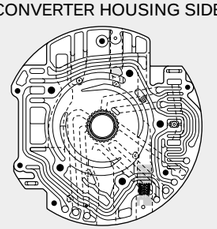


TWO DIMENSIONAL

FLUID PUMP COVER ASSEMBLY (202)

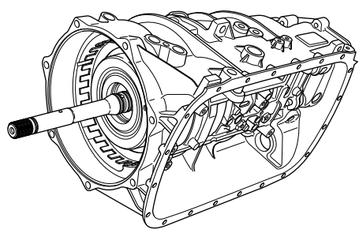


THREE DIMENSIONAL
CONVERTER HOUSING SIDE

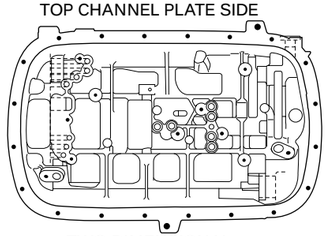


TWO DIMENSIONAL

CASE ASSEMBLY (24)

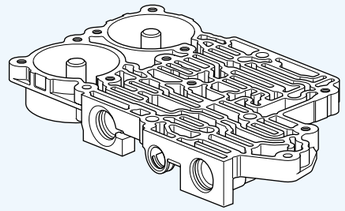


THREE DIMENSIONAL
TOP CHANNEL PLATE SIDE



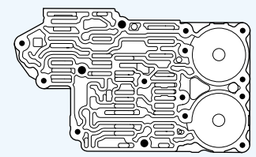
TWO DIMENSIONAL

FRONT CONTROL VALVE BODY ASSEMBLY (311)



THREE DIMENSIONAL

BOTTOM CHANNEL PLATE SIDE



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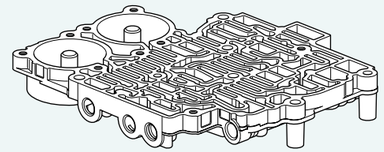
REAR CONTROL VALVE BODY (310)



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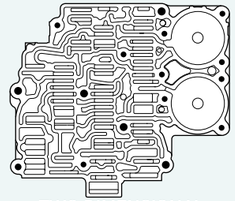
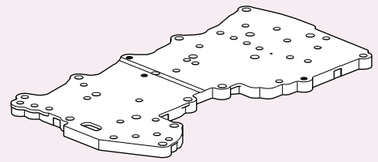
BOTTOM CHANNEL PLATE SIDE



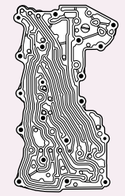
TWO DIMENSIONAL

TOP CHANNEL PLATE (301)



THREE DIMENSIONAL

BOTTOM CHANNEL PLATE SIDE



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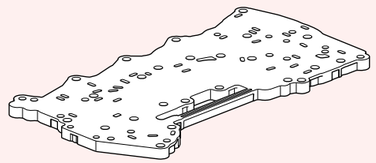
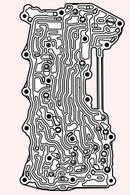
BOTTOM CHANNEL PLATE (304)



THREE DIMENSIONAL

CONTROL VALVE BODY SIDE



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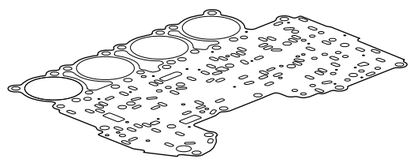
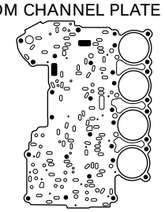
SPACER PLATE (307)



THREE DIMENSIONAL

BOTTOM CHANNEL PLATE SIDE



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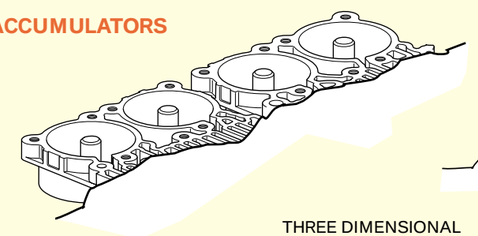
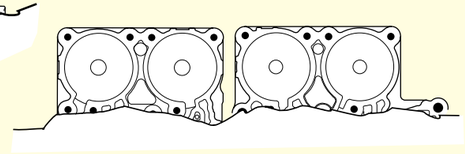
ACCUMULATORS



THREE DIMENSIONAL

CONTROL VALVE BODY SIDE



TWO DIMENSIONAL

Figure 3

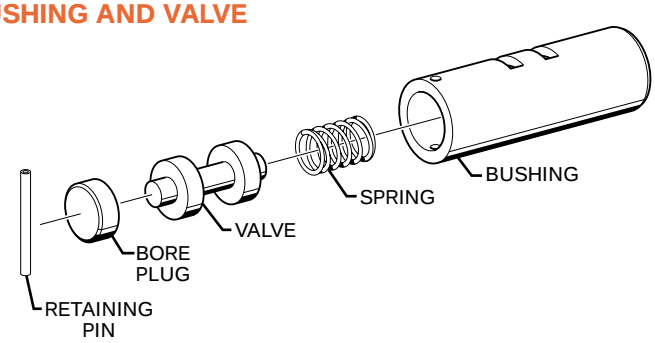
FOLDOUT ➤ 7

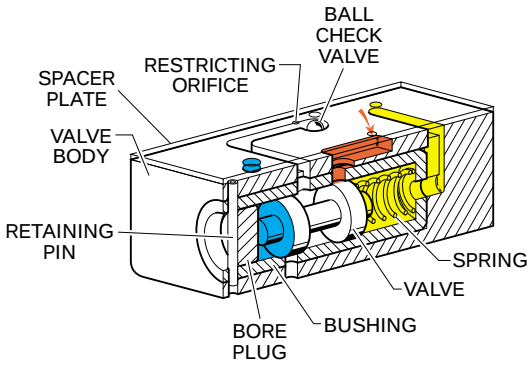
FOLDOUT ➤ 7A

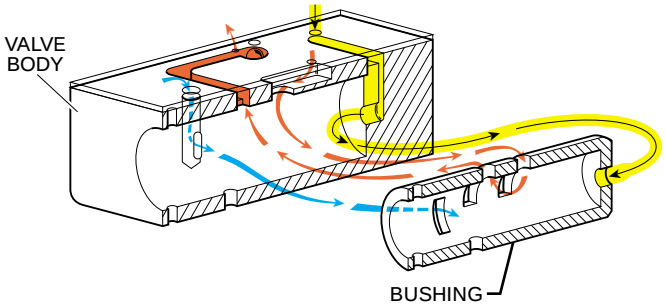
UNDERSTANDING THE GRAPHICS

TYPICAL BUSHING AND VALVE

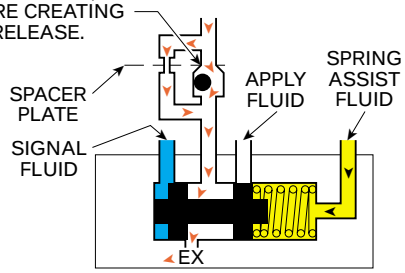
NOTE: NOT ALL VALVES ARE USED WITH A BUSHING







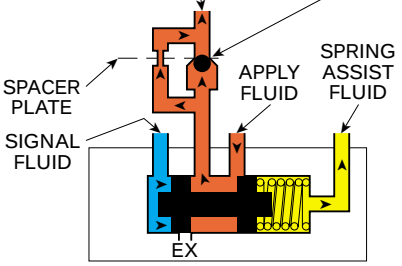
EXHAUST FROM THE APPLY COMPONENT UNSEATS THE BALL CHECK VALVE, THEREFORE CREATING A QUICK RELEASE.



WITH SIGNAL FLUID PRESSURE EQUAL TO OR LESS THAN SPRING AND SPRING ASSIST FLUID PRESSURE THE VALVE REMAINS IN CLOSED POSITION.

TO APPLY COMPONENT

APPLY FLUID SEATS THE BALL CHECK VALVE FORCING FLUID THROUGH AN ORIFICE IN THE SPACER PLATE, WHICH CREATES A SLOWER APPLY.

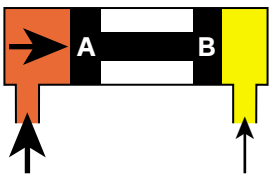


WITH SIGNAL FLUID PRESSURE GREATER THAN SPRING AND SPRING ASSIST FLUID PRESSURE THE VALVE MOVES OVER.

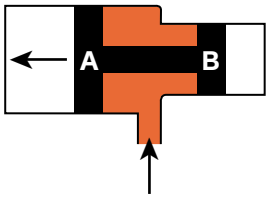
Figure 4

FLUID PRESSURES

- **INTAKE & INCREASE (SUCTION)**
- **CONVERTER & LUBE**
- **MAINLINE**
- **REGULATED LINE**
- **SOLENOID SIGNAL**
- **ACCUMULATOR**
- **FEED LIMIT**
- **THROTTLE SIGNAL**
- **EXHAUST**
- **DIRECTION OF FLOW**



WITH EQUAL SURFACE AREAS ON EACH END OF THE VALVE, BUT FLUID PRESSURE "A" BEING GREATER THAN FLUID PRESSURE "B", THE VALVE WILL MOVE TO THE RIGHT.



WITH THE SAME FLUID PRESSURE ACTING ON BOTH SURFACE "A" AND SURFACE "B" THE VALVE WILL MOVE TO THE LEFT. THIS IS DUE TO THE LARGER SURFACE AREA OF "A" THAN "B".

Figure 5

HYDRA-MATIC 5L40-E

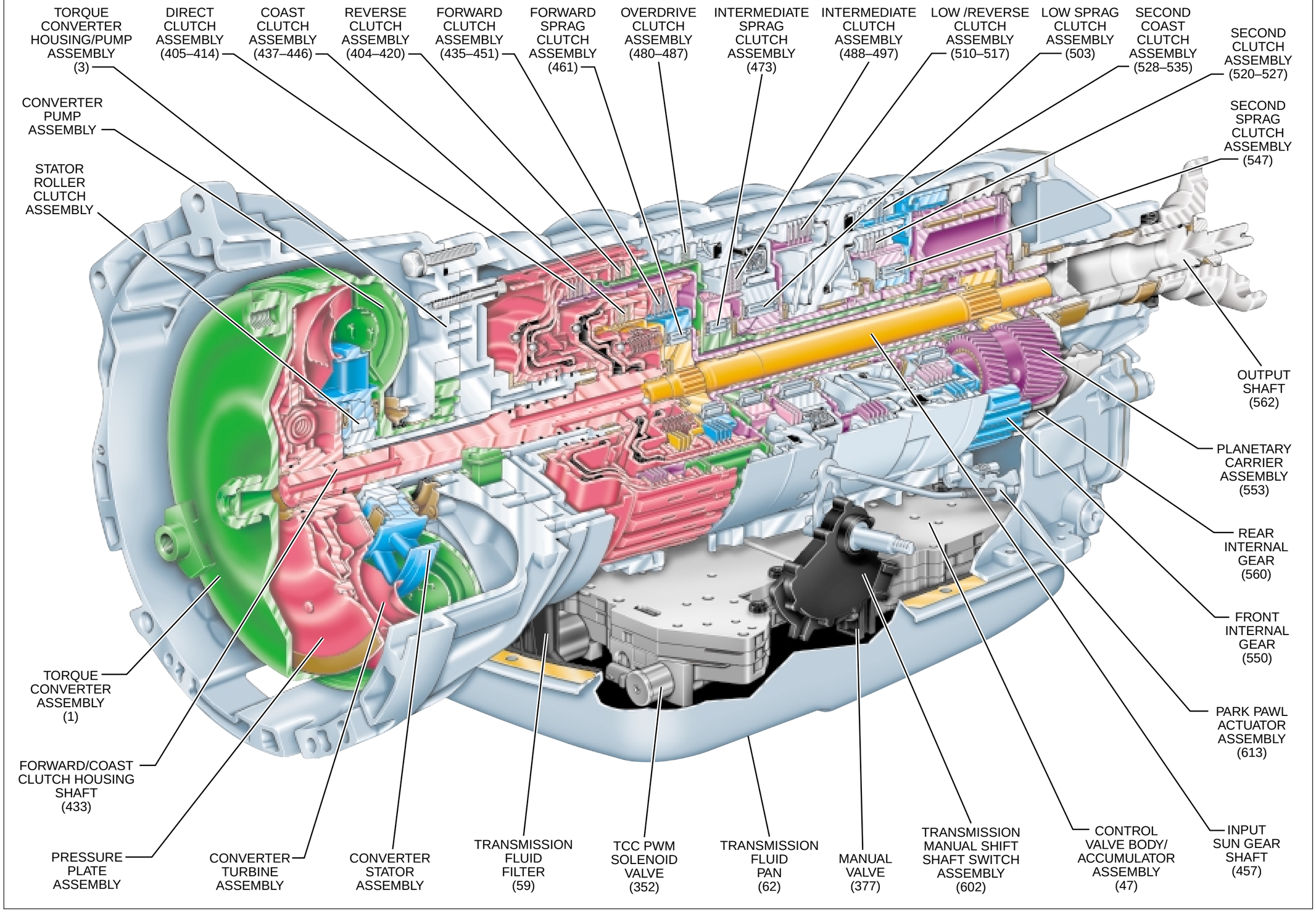


Figure 6

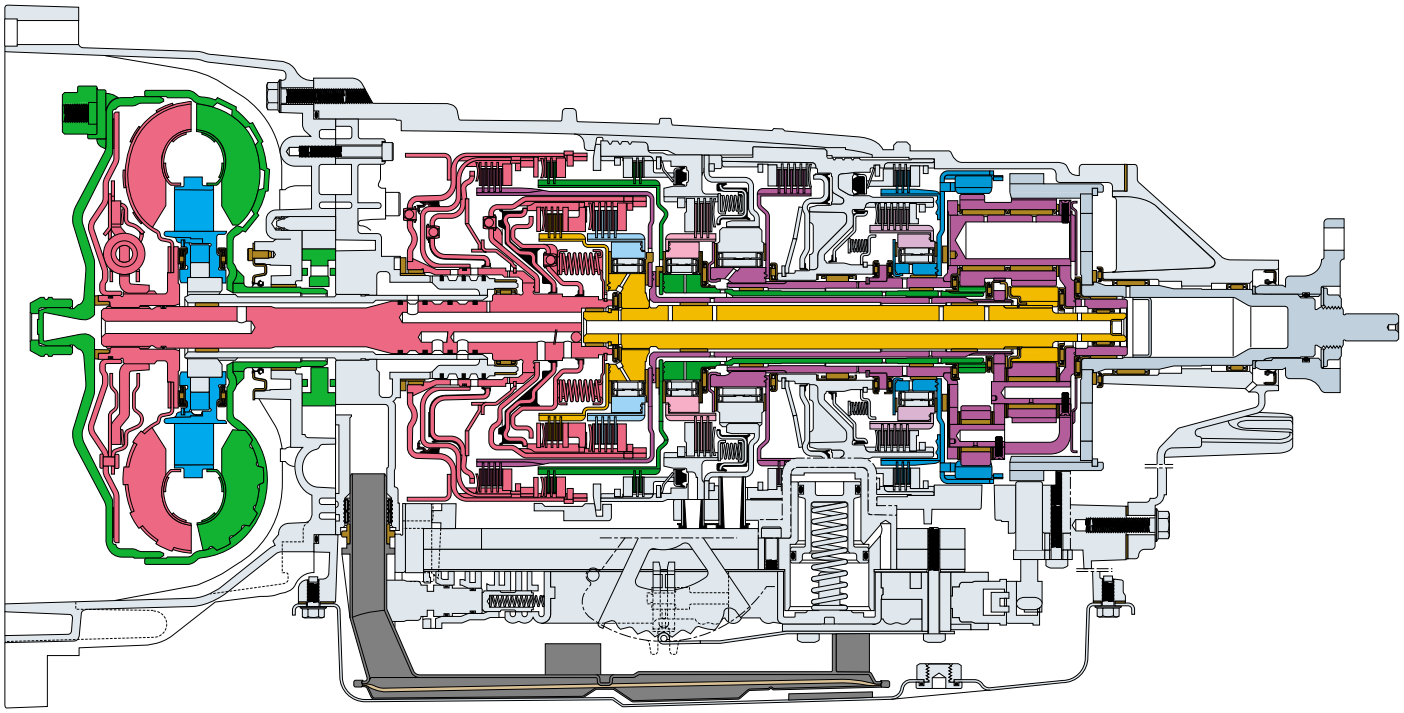


Figure 7

HYDRA-MATIC 4/5L40-E CROSS SECTIONAL DRAWING

A cross sectional line drawing is typically the standard method for illustrating either an individual mechanical component or a complete transmission assembly. However, unless a person is familiar with all the individual components of the transmission, distinguishing components may be difficult in this type of drawing. For this reason, a three dimensional perspective illustration (shown on page 8) is the primary drawing used throughout this book.

The purpose for this type of illustration is to provide a more detailed graphic representation of each component and to show their relationship to other components within the transmission assembly. It is also useful for understanding the cross sectional line drawing by comparing the same components from the three dimensional perspective illustration. In this regard it becomes an excellent teaching instrument.

Additionally, all the illustrations contained in this book use a color scheme that is consistent throughout this book. In other words, regardless of the type of illustration or drawing, all components have an assigned color and that color is used whenever that component is illustrated. This consistency not only helps to provide for easy component identification but it also enhances the graphic and color continuity between sections.

GENERAL DESCRIPTION

The 4/5L40-E 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 second clutch and the second sprag clutch, and the use of a smaller ravigneaux planetary carrier assembly in the four speed version. This book will describe the five speed model, however, the parts list will show the differences in components between the four and five speed. The function and operation of all components and systems is the same for both the four and five speed models, except that the four speed model uses third as second gear, fourth as third gear and fifth as fourth gear.

The Hydra-matic 5L40-E is a fully automatic, five speed, rear wheel drive, electronically controlled transmission. It consists primarily of a four-element torque converter, one planetary gear set, friction and mechanical clutches and a hydraulic pressurization and control system.

The four-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 set provides the five forward gear ratios 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.

The TCM commands shift solenoids, within the transmission, on and off 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 which allows the engine to deliver the maximum fuel efficiency without sacrificing vehicle performance.

The hydraulic system primarily consists of a vane type pump, two control valve bodies, two channel plates, converter housing 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 nine multiple disc clutches. The multiple disc clutches combine with four mechanical sprag clutches, to deliver six different gear ratios through the gear set. The gear set then transfers torque through the output shaft.

EXPLANATION OF GEAR RANGES

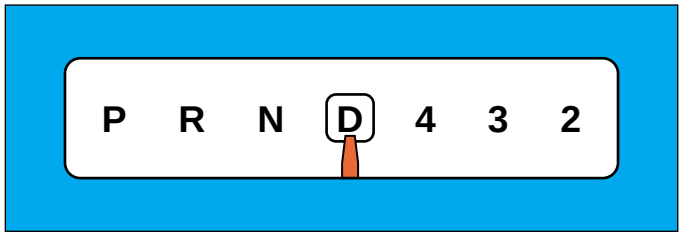


Figure 8

The transmission can be operated in any one of the seven different positions shown on the shift quadrant (Figure 8).

P – Park position enables the engine to be started while preventing the vehicle from rolling either forward or backward. For safety reasons, the vehicle's parking brake should be used in addition to the transmission "Park" position. Since the output shaft is mechanically locked to the case through the parking pawl and rear internal gear, Park position should not be selected until the vehicle has come to a complete stop.

R – Reverse 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 operate in each of the five 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 with the shift selector.

4 – Manual Fourth can be used for conditions where it may be desirable to use only four gear ratios. These conditions include towing a trailer and driving on hilly terrain as described above. This range is also helpful for engine braking when descending slight grades. Upshifts and downshifts are the same as in Overdrive range for first, second, third and fourth gears except that the transmission will not shift into fifth gear. Manual Fourth can be selected at any vehicle speed but will downshift into fourth gear only if vehicle speed is low enough not to overrev the engine (calibratable in TCM).

3 – Manual Third adds more performance for congested traffic and hilly terrain. It has the same starting ratio (first gear) as Manual Fourth but prevents the transmission from shifting above Third gear. Thus, Manual Third can be used to retain third gear for acceleration and engine braking as desired. Manual Third can be selected at any vehicle speed but will downshift into third gear only if vehicle speed is low enough not to overrev the engine (calibratable in TCM).

2 – Manual Second adds more performance for congested traffic and hilly terrain. It has the same starting ratio (first gear) as Manual Third but prevents the transmission from shifting above second gear. Thus, Manual Second can be used to retain second gear for acceleration and engine braking as desired. Manual Second can be selected at any vehicle speed but will downshift into second gear only if vehicle speed is low enough not to overrev the engine (calibratable in TCM).

When the vehicle speed slows down to a speed low enough not to overrev the engine (calibratable in TCM), the transmission will automatically shift into first gear. This is particularly beneficial for maintaining maximum engine braking when descending steep grades.

DRIVER SHIFT CONTROL GEAR RANGES

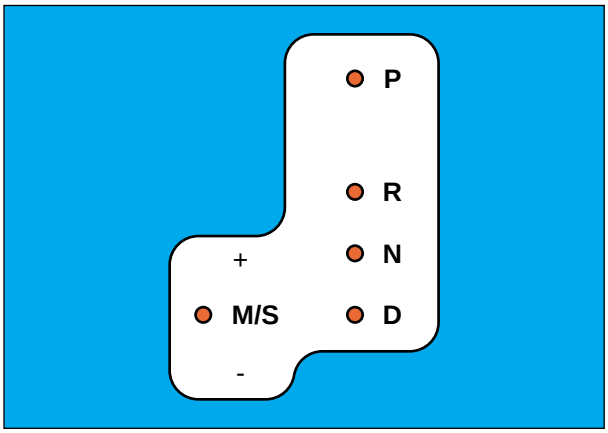


Figure 9

Some vehicles are equipped with a Driver Shift Control (DSC) version of the selector system (Figure 9). This configuration allows the driver to manually shift between Park (**P**), Reverse (**R**), Neutral (**N**) and Drive (**D**).

D – In the Drive position, the transmission will automatically upshift from first to fifth, and downshift from fifth to first, according to the Economy shift pattern programmed in the TCM.

M/S – In the M/S position, the transmission will either automatically upshift from first to fifth, and downshift from fifth to first, according to the Performance shift pattern programmed in the TCM or, the driver may activate the manual function by tapping the selector lever towards "+" or "-" to cause an upshift or downshift. The transmission will shift up or down depending on the request that is made by tapping the selector. The TCM will upshift automatically when maximum engine speed is achieved and will protect from any downshift which may overrev the engine.

PRINCIPLES OF OPERATION

An automatic transmission is the mechanical component of a vehicle that transfers power (torque) from the engine to the wheels. It accomplishes this task by providing a number of forward gear ratios that automatically change as the speed of the vehicle increases. The reason for changing forward gear ratios is to provide the performance and economy expected from vehicles manufactured today. On the performance end, a gear ratio that develops a lot of torque (through torque multiplication) is required in order to initially start a vehicle moving. Once the vehicle is in motion, less torque is required in order to maintain the vehicle at a certain speed. When the vehicle has reached a desired speed, economy becomes the important factor and the transmission will shift into overdrive. At this point output speed is greater than input speed, and, input torque is greater than output torque.

Another important function of the automatic transmission is to allow the engine to be started and run without transferring torque to the wheels. This situation occurs whenever Park (**P**) or Neutral (**N**) range has been selected. Also, operating the vehicle in a rearward direction is possible whenever Reverse (**R**) range has been selected (accomplished by the gear sets).

The variety of gear ranges in an automatic transmission are made possible through the interaction of numerous mechanically, hydraulically and electronically controlled components inside the transmission. At the appropriate time and sequence, these components are either applied or released and operate the gear set at a gear ratio consistent with the driver's needs. The following pages describe the theoretical operation of the mechanical, hydraulic and electrical components found in the Hydra-matic 4/5L40-E transmission. When an understanding of these operating principles has been attained, diagnosis of these transmission systems is made easier.

MAJOR MECHANICAL COMPONENTS

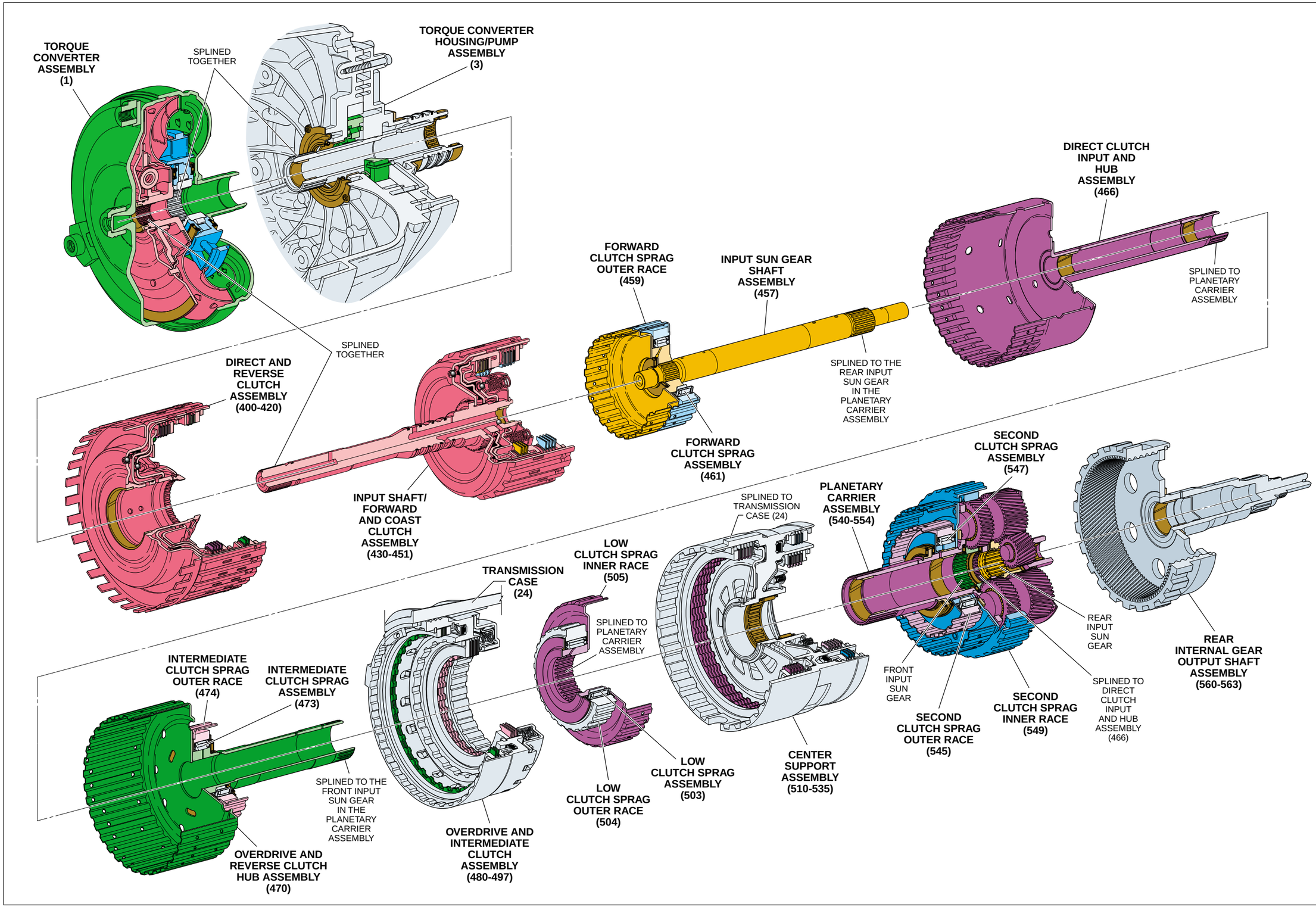


Figure 10

COLOR LEGEND

MAJOR MECHANICAL COMPONENTS

The foldout graphic on page 10 contains a disassembled drawing of the major components used in the Hydra-matic 4/5L40-E transmission. This drawing, along with the cross sectional illustrations on page 8 and 8A, show the major mechanical components and their relationship to each other as a complete assembly. Therefore, color has been used throughout this book to help identify parts that are splined together, rotating at engine speed, held stationary, and so forth. Color differentiation is particularly helpful when using the Power Flow section for understanding the transmission operation.

The color legend below provides the "general" guidelines that were followed in assigning specific colors to the major components. However, due to the complexity of this transmission, some colors (such as grey) were used for artistic purposes rather than based on the specific function or location of that component.

Components held stationary in the case or splined to the case. Examples: the Fluid Pump Cover Assembly (202), the Overdrive Clutch Housing (493), and the Center Support (518). Also includes the Clutch Sprag assemblies.

Components that rotate at engine speed. Examples: the Torque Converter Assembly (1), the Fluid Pump Rotor (223), and the Fluid Pump Vanes (222).

Components that rotate at turbine speed. Examples: the Converter Turbine, the Forward Clutch and Input Housing Assembly (433), and the Reverse Clutch and Input Housing Assembly (401).

Components such as the Stator in the Torque Converter Clutch Assembly (1).

Components such as the Input Sun Gear Shaft Assembly (457).

Components such as the Forward Clutch Sprag Outer Race (459).

Components such as the Direct Clutch Input and Hub Assembly (466), and the Input and Reaction Carrier Assembly (553).

Components such as the Overdrive and Reverse Clutch Hub Assembly (470).

Components such as the Intermediate Clutch Sprag Outer Race (474).

Components such as the Second Clutch Sprag Outer Race (545).

Components such as the Second Clutch Sprag Inner Race (549).

Components that rotate at transmission output speed. Examples: the Output Shaft Assembly (562) and the Input and Reaction Carrier Assembly (553).

Accumulators, Servos and Bands.

All bearings and bushings.

All seals

COLOR LEGEND

APPLY COMPONENTS

The Range Reference Chart on page 11, provides another valuable source of information for explaining the overall function of the Hydra-matic 4/5L40-E transmission. This chart highlights the major apply components that function in a selected gear range, and the specific gear operation within that gear range.

Included as part of this chart is the same color reference to each major component that was previously discussed. If a component is active in a specific gear range, a word describing its activity will be listed in the column below that component. The row where the activity occurs corresponds to the appropriate transmission range and gear operation. An abbreviated version of this chart can also be found at the top of the half page of text located in the Power Flow section. This provides for a quick reference when reviewing the mechanical power flow information contained in that section.

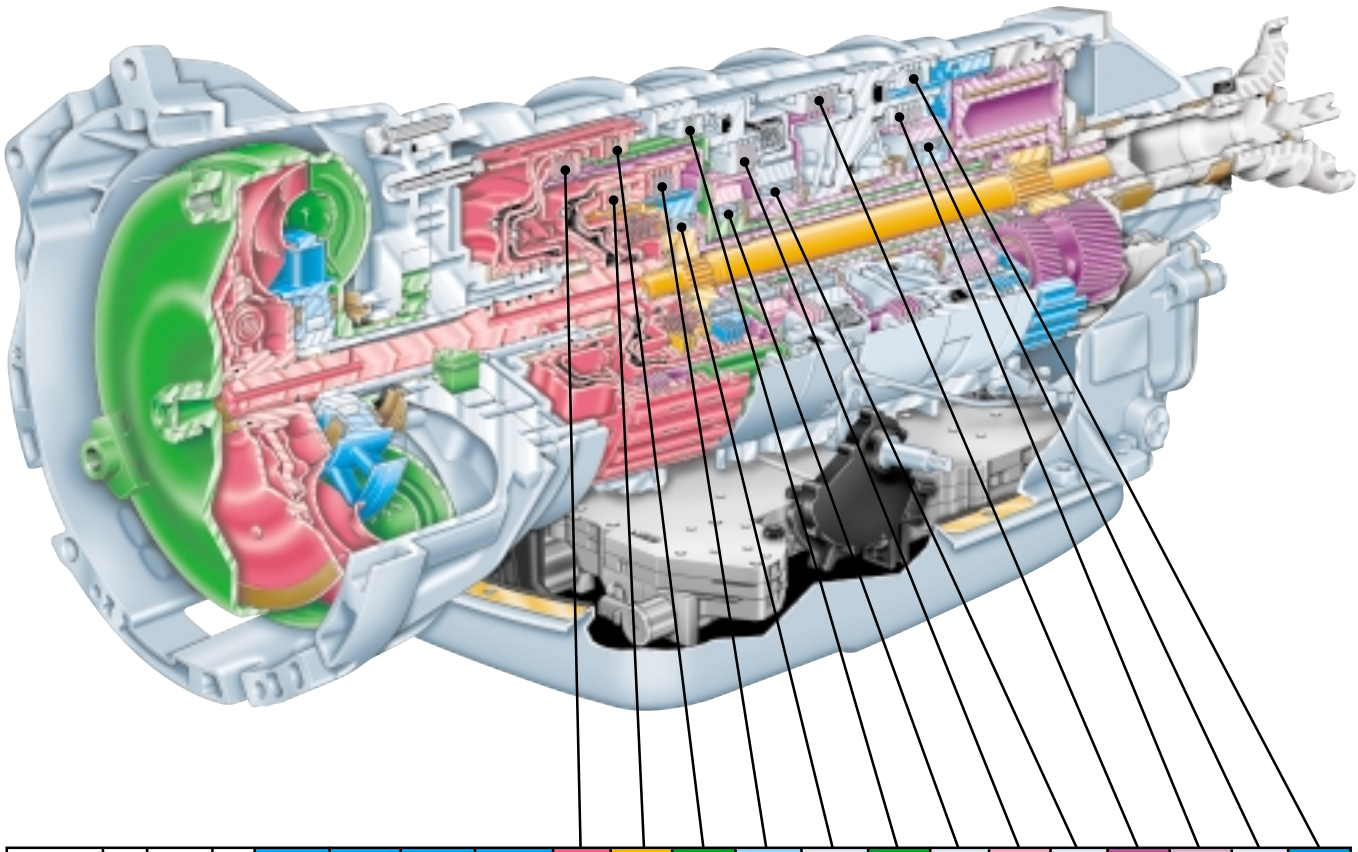
RANGE REFERENCE CHART

HYDRA-MATIC 4L40-E - GEAR RATIOS

FIRST	2.82	FOURTH	0.70
SECOND	1.54	REVERSE	2.38
THIRD	1.00		

HYDRA-MATIC 5L40-E - GEAR RATIOS

FIRST	3.42	FOURTH	1.00
SECOND	2.21	FIFTH	0.75
THIRD	1.60	REVERSE	3.03



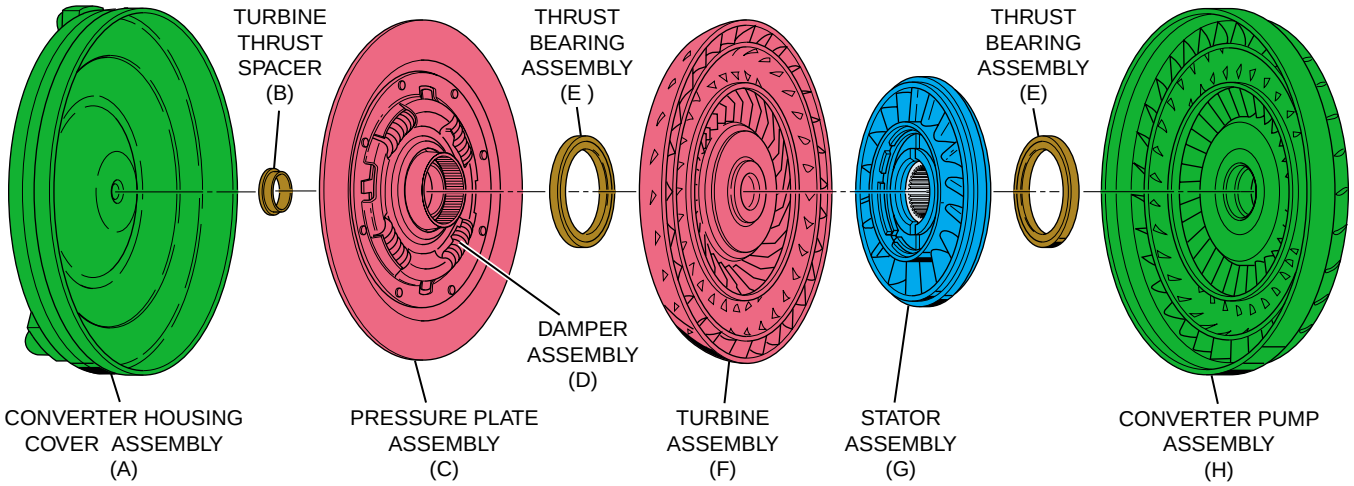
RANGE	GEAR	ENGINE BRAKING	RATIO	1-2 SHIFT SOLENOID VALVE	2-3 SHIFT SOLENOID VALVE	4-5 SHIFT SOLENOID VALVE	TCC SOLENOID VALVE	DIRECT CLUTCH	COAST CLUTCH	REVERSE CLUTCH	FORWARD CLUTCH	FORWARD CLUTCH SPRAG	OVER-DRIVE CLUTCH	INTERM. CLUTCH SPRAG	INTER-MEDIATE CLUTCH	LOW CLUTCH SPRAG	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND CLUTCH SPRAG	SECOND COAST CLUTCH
D432	1	*NO	3.42	OFF	ON	OFF	OFF		APPLIED		APPLIED	LD				LD				
	1	YES	3.42	OFF	ON	ON	OFF		APPLIED		APPLIED	LD				LD	APPLIED			
	2	*NO	2.21	ON	ON	OFF	ON/OFF @		APPLIED		APPLIED	LD						APPLIED	LD	
	2	YES	2.21	ON	ON	ON	ON/OFF @		APPLIED		APPLIED	LD						APPLIED	LD	APPLIED
	3	*NO	1.60	ON	OFF	OFF	ON/OFF @		APPLIED		APPLIED	LD		LD	APPLIED			APPLIED		
	3	YES	1.60	ON	OFF	ON	ON/OFF @		APPLIED		APPLIED	LD	APPLIED	LD	APPLIED			APPLIED		
	4	YES	1.00	OFF	OFF	ON	ON/OFF @	APPLIED	APPLIED		APPLIED	LD			APPLIED			APPLIED		
	5	YES	0.75	OFF	OFF	OFF	ON/OFF @	APPLIED			APPLIED		APPLIED		APPLIED			APPLIED		
NEUTRAL	–	–	–	@ ON/OFF	@ ON/OFF	@ ON/OFF														
REVERSE	R	YES	3.03	@ ON/OFF	@ ON/OFF	@ ON/OFF	OFF			APPLIED							APPLIED			
PARK	–	–	–	@ ON/OFF	@ ON/OFF	@ ON/OFF														

LD = LOCKED IN DRIVE
ON = SOLENOID ENERGIZED
OFF = SOLENOID DE-ENERGIZED

@ THE SOLENOID'S STATE FOLLOWS A SHIFT PATTERN WHICH DEPENDS UPON VEHICLE SPEED AND THROTTLE POSITION. IT DOES NOT DEPEND UPON THE SELECTED GEAR.
* ENGINE BRAKING IS ELECTRONICALLY CONTROLLED BY THE TCM, AND IS AVAILABLE AS CALIBRATED FOR EACH MODEL AND APPLICATION.

Figure 11

TORQUE CONVERTER



TORQUE CONVERTER:
The torque converter (1) is the primary component for transmittal of power between the engine and the transmission. It is bolted to the engine flywheel (also known as the flexplate) so that it will rotate at engine speed. Some of the major functions of the torque converter are:

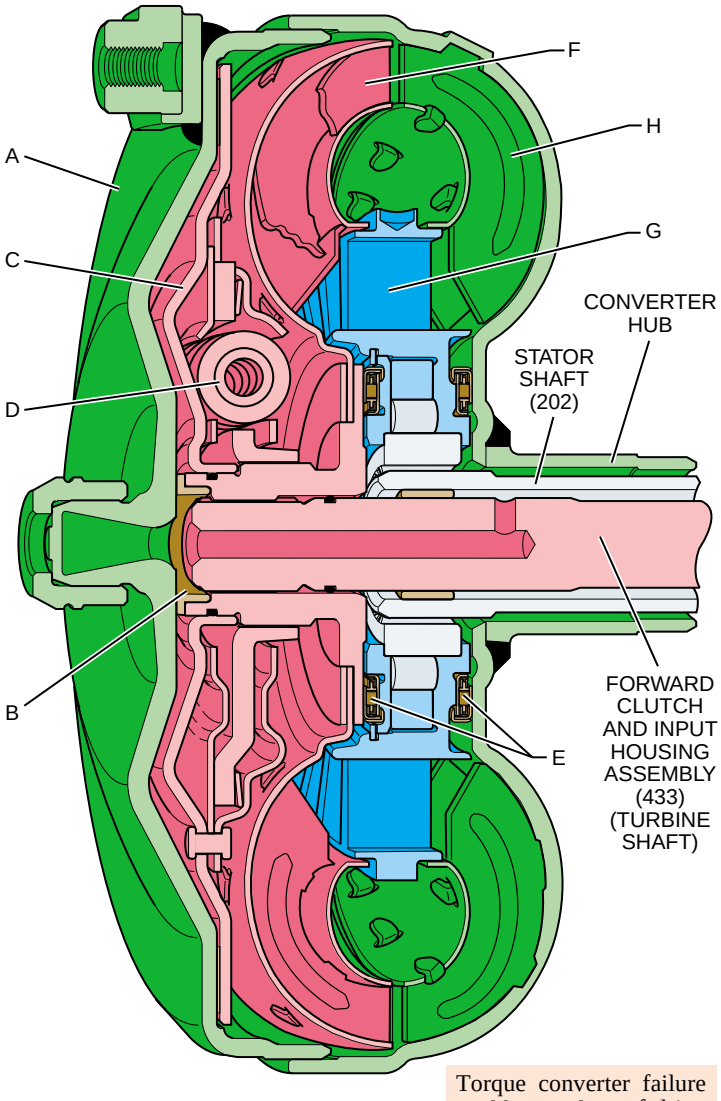
- to provide for a smooth conversion of torque from the engine to the mechanical components of the transmission.
- to multiply torque from the engine that enables the vehicle to achieve additional performance when required.
- to mechanically operate the transmission fluid pump (3) through the converter hub.
- to provide a mechanical link, or direct drive, from the engine to the transmission through the use of a torque converter clutch (TCC).

The torque converter assembly is made up of the following five main sub-assemblies:

- a converter housing cover assembly (A) which is welded to the converter pump assembly (H).
- a converter pump assembly (H) which is the driving member.
- a turbine assembly (F) which is the driven or output member.
- a stator assembly (G) which is the reaction member located between the converter pump and turbine assemblies.
- a pressure plate assembly (C) splined to the turbine assembly to enable direct mechanical drive when appropriate.

CONVERTER PUMP ASSEMBLY AND TURBINE ASSEMBLY
When the engine is running the converter pump assembly acts as a centrifugal pump by picking up fluid at its center and discharging it at its rim between the blades (see Figure 13). The force of this fluid then hits the turbine blades and causes the turbine to rotate. As the engine and converter pump increase in RPM, so does the turbine.

PRESSURE PLATE, DAMPER AND CONVERTER HOUSING ASSEMBLIES
The pressure plate is splined to the turbine hub and applies (engages) with the converter cover to provide a mechanical coupling of the engine to the transmission. When the pressure plate assembly is applied, the amount of slippage that occurs through a fluid coupling is reduced (but not necessarily eliminated), thereby providing a more efficient transfer of engine torque to the drive wheels.



Torque converter failure could cause loss of drive and or loss of power.

To reduce torsional shock during the apply of the pressure plate to the converter cover, a spring loaded damper assembly (D) is used. The pressure plate is attached to the pivoting mechanism of the damper assembly which allows the pressure plate to rotate independently of the damper assembly up to approximately 45 degrees. During engagement, the springs in the damper assembly cushion the pressure plate engagement and also reduce irregular torque pulses from the engine or road surface.

Figure 12

TORQUE CONVERTER

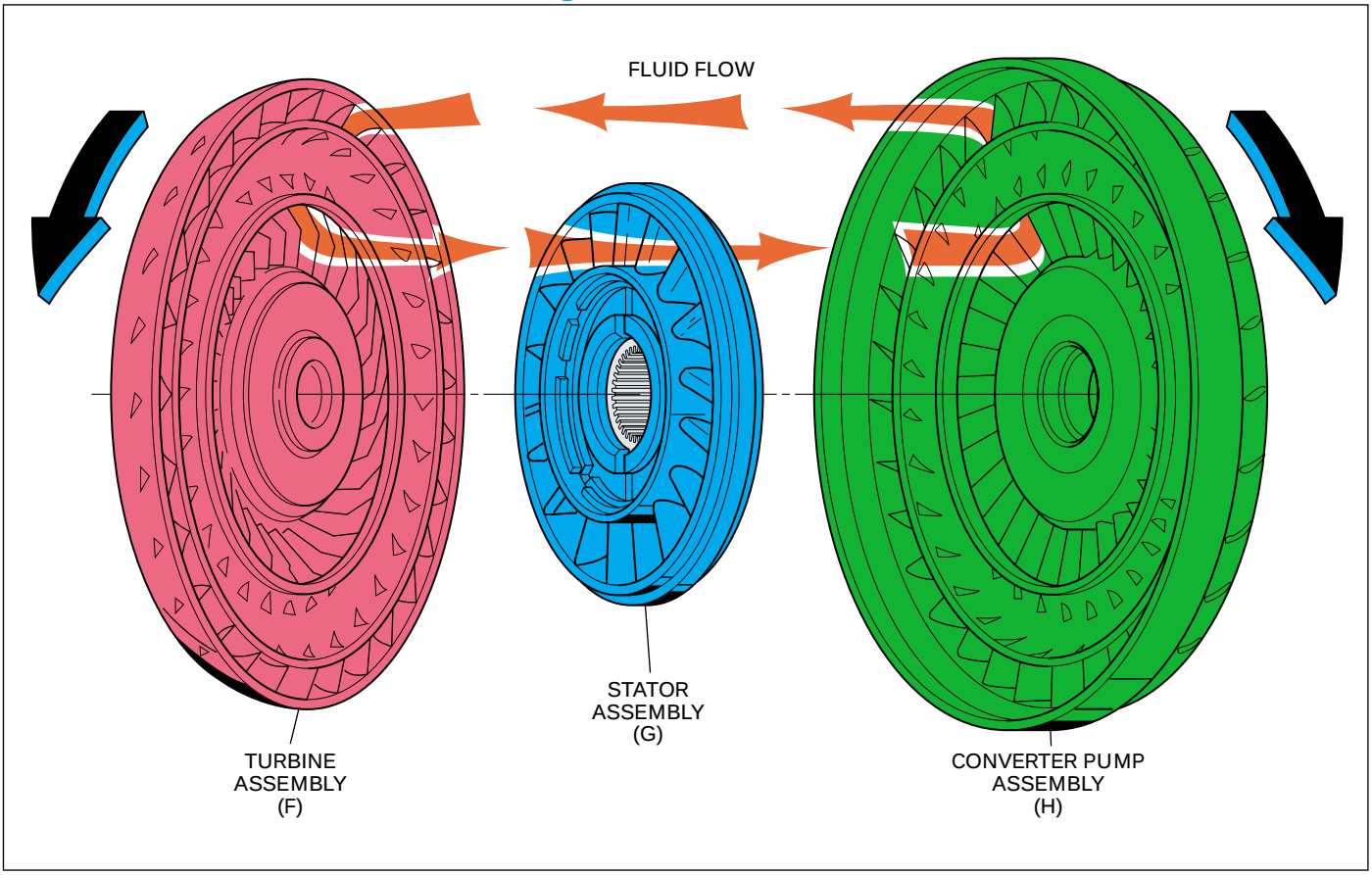


Figure 13

Stator roller clutch failure

- roller clutch freewheels in both directions can cause poor acceleration at low speed.
- roller clutch locks up in both directions can cause poor acceleration at high speed.
- Overheated fluid.

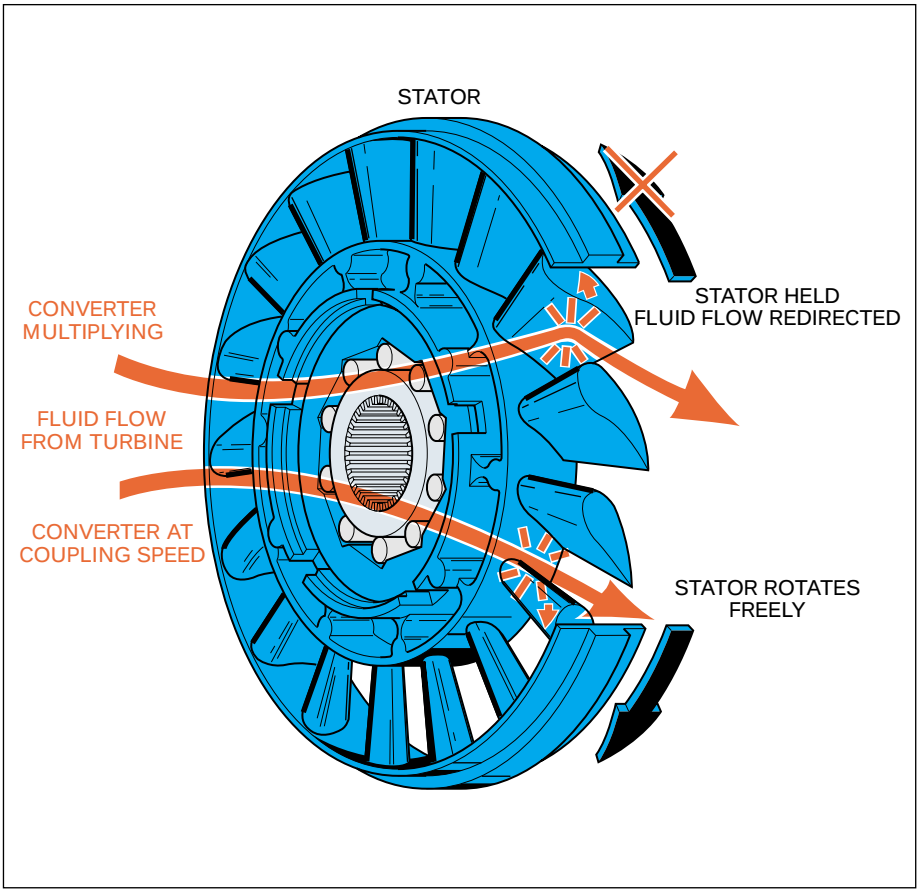


Figure 14

STATOR ASSEMBLY

The stator assembly is located between the pump assembly and turbine assembly, and is mounted on a one-way roller clutch. This one-way roller clutch allows the stator to rotate in one direction and prevents (holds) the stator from rotating in the other direction. The function of the stator is to redirect fluid returning from the turbine in order to assist the engine in turning the converter pump assembly.

At low vehicle speeds, when greater torque is needed, fluid from the turbine hits the front side of the stator blades (the converter is multiplying torque). At this time, the one-way roller clutch prevents the stator from rotating in the same direction as the fluid flow, thereby redirecting fluid to assist the engine in turning the converter pump. In this mode, fluid leaving the converter pump has more force to turn the turbine assembly and multiply engine torque.

As vehicle speed increases and less torque is required, centrifugal force acting on the fluid changes the direction of the fluid leaving the turbine such that it hits the back side of the stator blades (converter at coupling speed). When this occurs, the roller clutch overruns and allows the stator to rotate freely. Fluid is no longer being redirected to the converter pump and engine torque is not being multiplied.

TORQUE CONVERTER

RELEASE

When the torque converter clutch is released, fluid is fed into the torque converter by the pump into the release fluid passage. The release fluid passage is located between the stator shaft (202) and the turbine shaft (433). Fluid travels between the shafts and enters the release side of the pressure plate at the end of the turbine shaft. The pressure plate is forced away from the converter cover and allows the torque converter turbine to rotate at speeds other than engine speed.

The release fluid then flows between the friction element on the pressure plate and the converter cover to enter the apply side of the torque converter. The fluid then exits the torque converter through the apply passage, which is located between the torque converter clutch hub and the stator shaft (202), and enters the pump.

No TCC apply can be caused by:

- Electrical connectors, wiring harness or solenoid damaged
- Converter clutch valves stuck or assembled backwards
- Pump to case gasket mispositioned
- Solenoid O-ring seal cut or damaged
- Turbine shaft O-ring seal cut or damaged
- Control valve body TCC signal valve stuck
- Solenoid screen blocked
- TCC solenoid valve internal damage
- Turbine speed sensor internal damage

APPLY

When the TCM determines that the vehicle is at the proper speed for the torque converter clutch to apply it sends a signal to the TCC PWM solenoid valve. The TCC PWM solenoid valve then regulates line fluid from the pump into the regulated apply passage. The regulated apply fluid then feeds the apply fluid passage and applies the torque converter. The apply passage is located between the converter hub and the stator shaft. The fluid flows between the shafts, then passes into the torque converter on the apply side of the pressure plate assembly. Release fluid is then routed out of the torque converter between the turbine shaft and the stator shaft.

Apply fluid pressure forces the pressure plate against the torque converter cover to provide a mechanical link between the engine and the turbine.

The TCC apply may occur in second, third, fourth and fifth gear (depending on the shift pattern), and should not apply until the transmission fluid and engine coolant temperatures have reached a minimum value (calibratable in TCM).

For more information on TCC apply and release, see Overdrive Range – Fifth Gear TCC Released and Applied, pages 72–75.

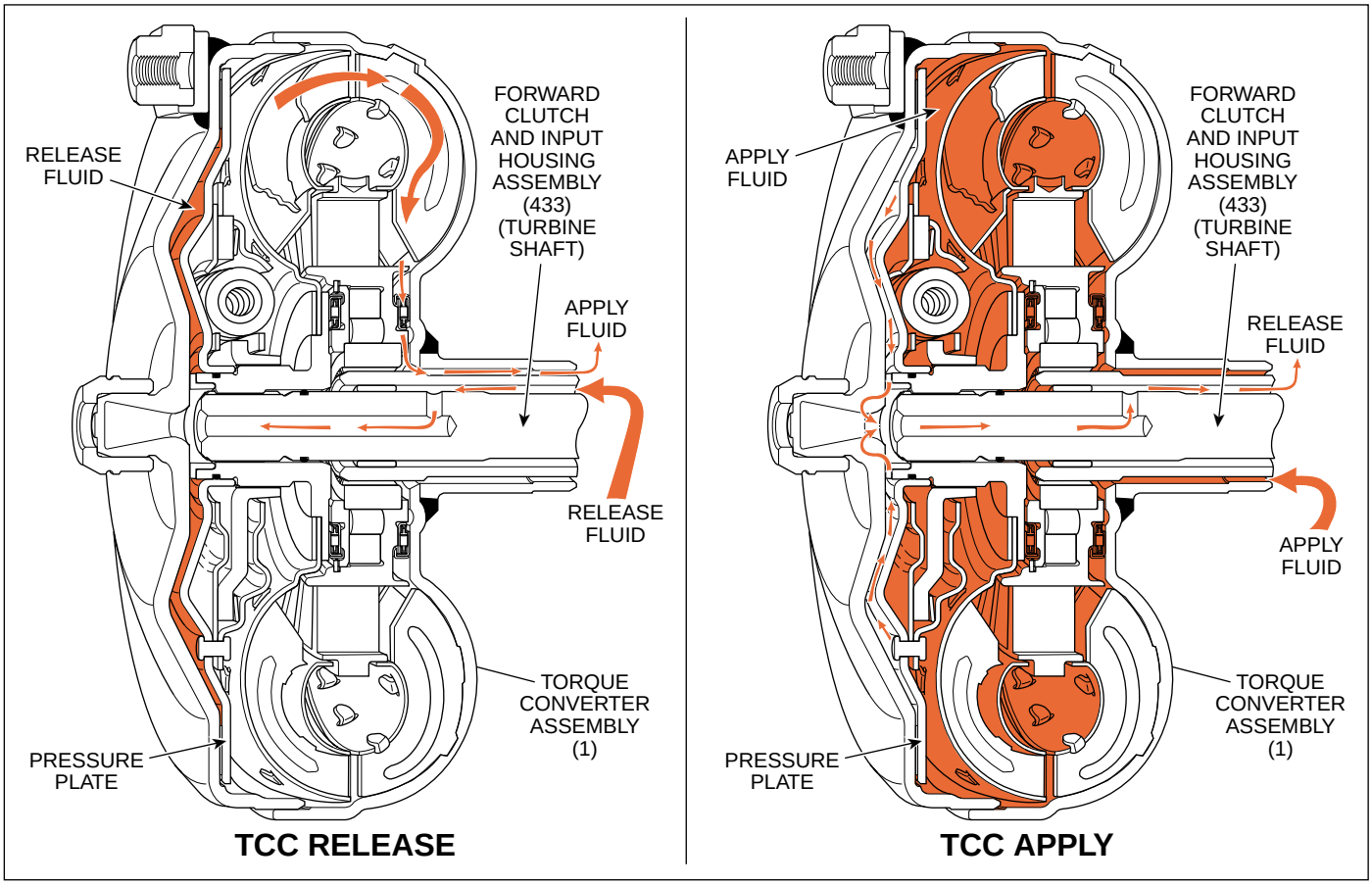


Figure 15

APPLY COMPONENTS

The Apply Components section is designed to explain the function of the hydraulic and mechanical holding devices used in the Hydra-matic 4/5L40-E transmission. Some of these apply components, such as clutches, are hydraulically “applied” and “released” in order to provide automatic gear range shifting. Other components, such as a sprag clutch, often react to a hydraulically “applied” component by mechanically “holding” or “releasing” another member of the transmission. This interaction between the hydraulically and mechanically applied components is then explained in detail and supported with a graphic illustration. In addition, this section shows the routing of fluid pressure to the individual components and their internal functions when it applies or releases.

The sequence in which the components in this section have been discussed coincides with their physical arrangement inside the transmission. This order closely parallels the disassembly sequence used in the Hydra-matic 4/5L40-E Unit Repair Section located in Section 7 of the appropriate Service Manual. It also correlates with the components shown on the Range Reference Charts that are used throughout the Power Flow section of this book. The correlation of information between the sections of this book helps the user more clearly understand the hydraulic and mechanical operating principles for this transmission.

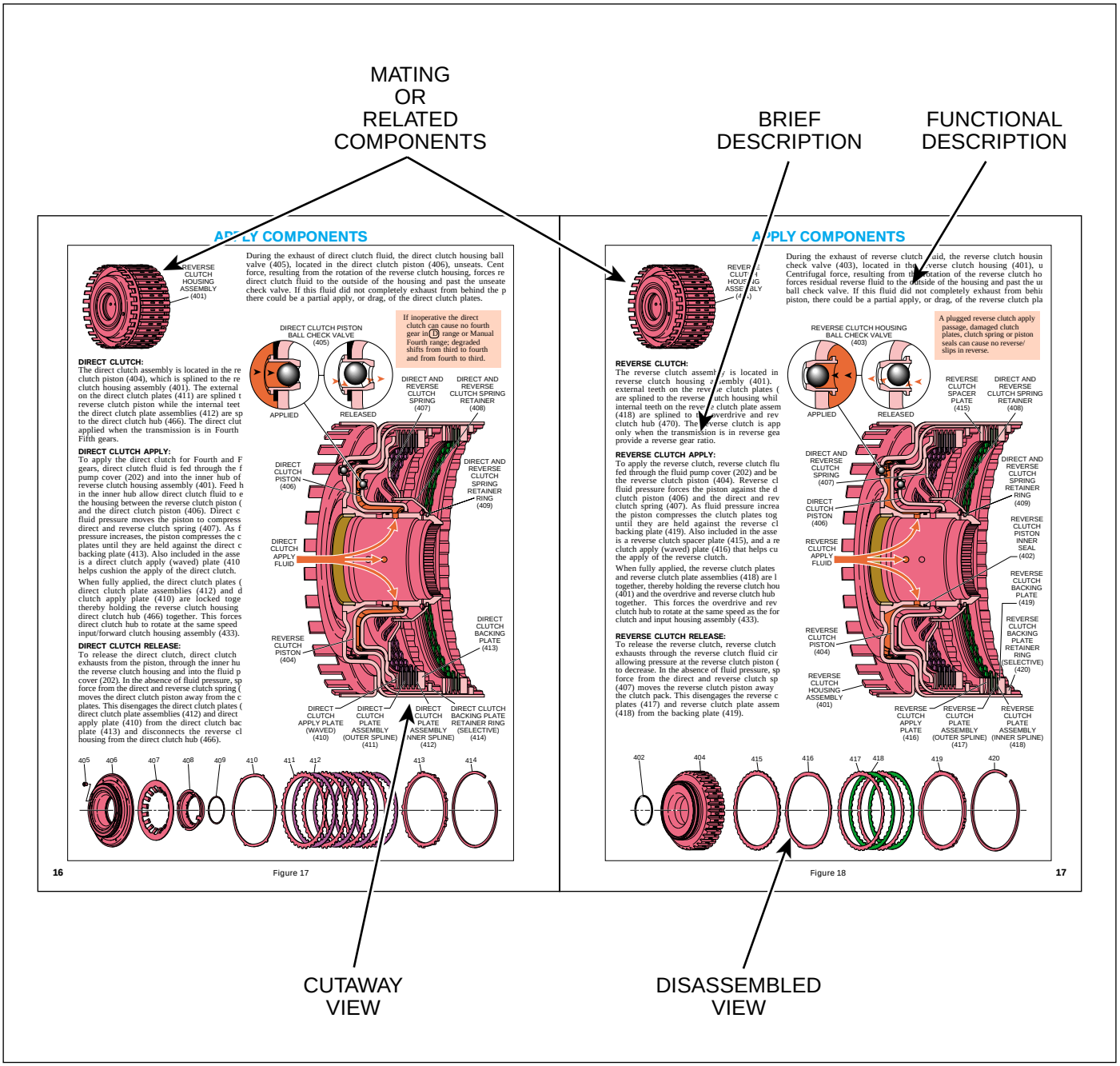
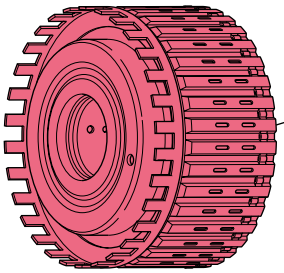


Figure 16

APPLY COMPONENTS



DIRECT CLUTCH:
The direct clutch assembly is located in the reverse clutch piston (404), which is splined to the reverse clutch housing assembly (401). The external teeth on the direct clutch plates (411) are splined to the reverse clutch piston while the internal teeth on the direct clutch plate assemblies (412) are splined to the direct clutch hub (466). The direct clutch is applied when the transmission is in Fourth and Fifth gears.

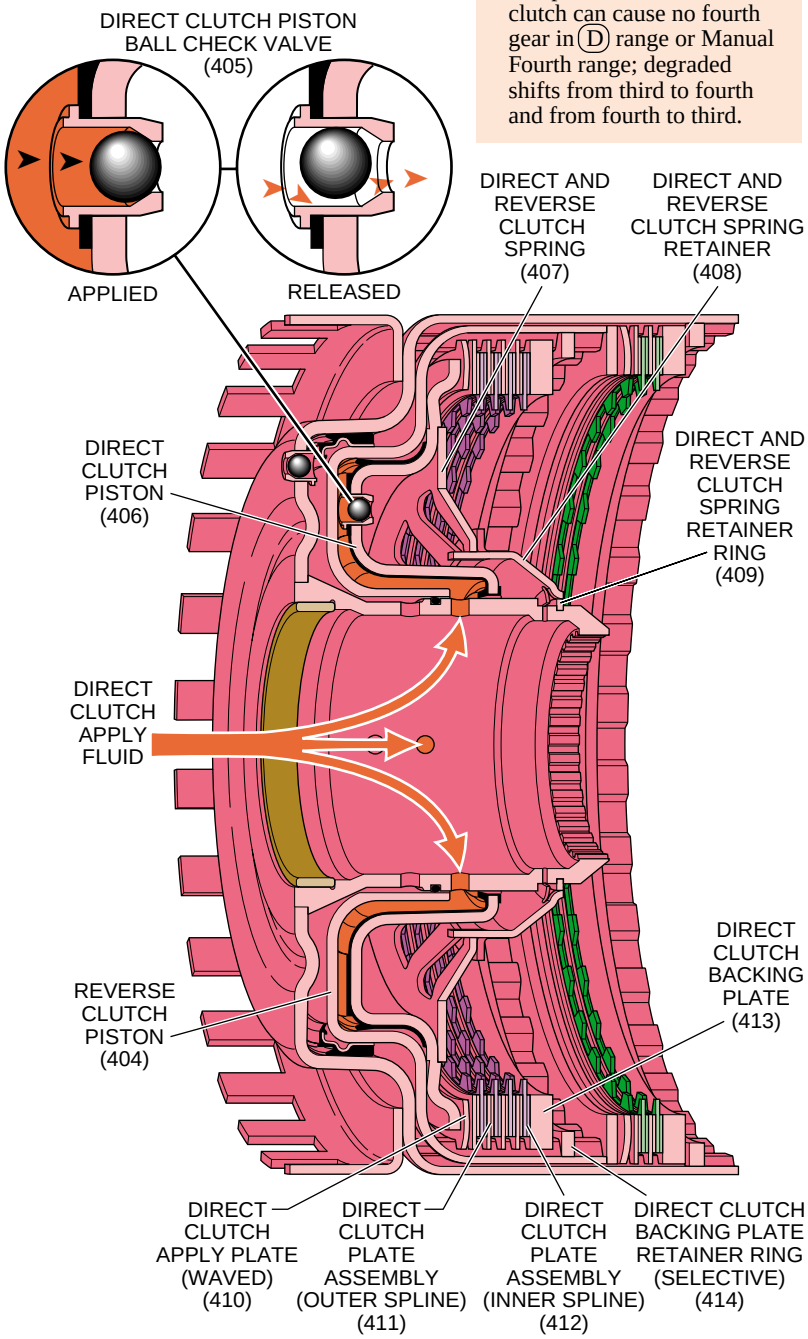
DIRECT CLUTCH APPLY:
To apply the direct clutch for Fourth and Fifth gears, direct clutch fluid is fed through the fluid pump cover (202) and into the inner hub of the reverse clutch housing assembly (401). Feed holes in the inner hub allow direct clutch fluid to enter the housing between the reverse clutch piston (404) and the direct clutch piston (406). Direct clutch fluid pressure moves the piston to compress the direct and reverse clutch spring (407). As fluid pressure increases, the piston compresses the clutch plates until they are held against the direct clutch backing plate (413). Also included in the assembly is a direct clutch apply (waved) plate (410) that helps cushion the apply of the direct clutch.

When fully applied, the direct clutch plates (411), direct clutch plate assemblies (412) and direct clutch apply plate (410) are locked together, thereby holding the reverse clutch housing and direct clutch hub (466) together. This forces the direct clutch hub to rotate at the same speed as the input/forward clutch housing assembly (433).

DIRECT CLUTCH RELEASE:
To release the direct clutch, direct clutch fluid exhausts from the piston, through the inner hub of the reverse clutch housing and into the fluid pump cover (202). In the absence of fluid pressure, spring force from the direct and reverse clutch spring (407) moves the direct clutch piston away from the clutch plates. This disengages the direct clutch plates (411), direct clutch plate assemblies (412) and direct clutch apply plate (410) from the direct clutch backing plate (413) and disconnects the reverse clutch housing from the direct clutch hub (466).

During the exhaust of direct clutch fluid, the direct clutch housing ball check valve (405), located in the direct clutch piston (406), unseats. Centrifugal force, resulting from the rotation of the reverse clutch housing, forces residual direct clutch fluid to the outside of the housing and past the unseated ball check valve. If this fluid did not completely exhaust from behind the piston, there could be a partial apply, or drag, of the direct clutch plates.

If inoperative the direct clutch can cause no fourth gear in (D) range or Manual Fourth range; degraded shifts from third to fourth and from fourth to third.



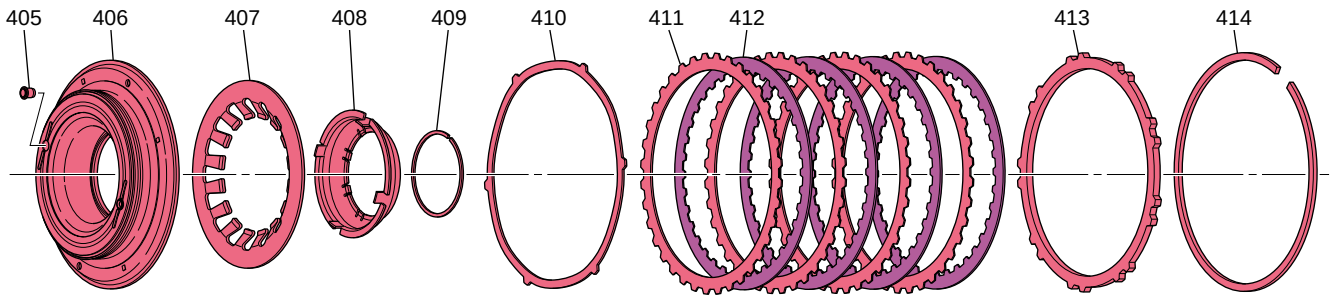
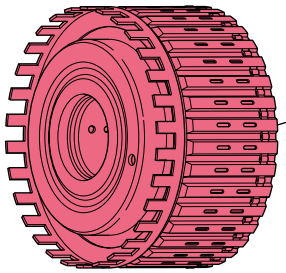


Figure 17

APPLY COMPONENTS



REVERSE CLUTCH:
The reverse clutch assembly is located in the reverse clutch housing assembly (401). The external teeth on the reverse clutch plates (417) are splined to the reverse clutch housing while the internal teeth on the reverse clutch plate assemblies (418) are splined to the overdrive and reverse clutch hub (470). The reverse clutch is applied only when the transmission is in reverse gear to provide a reverse gear ratio.

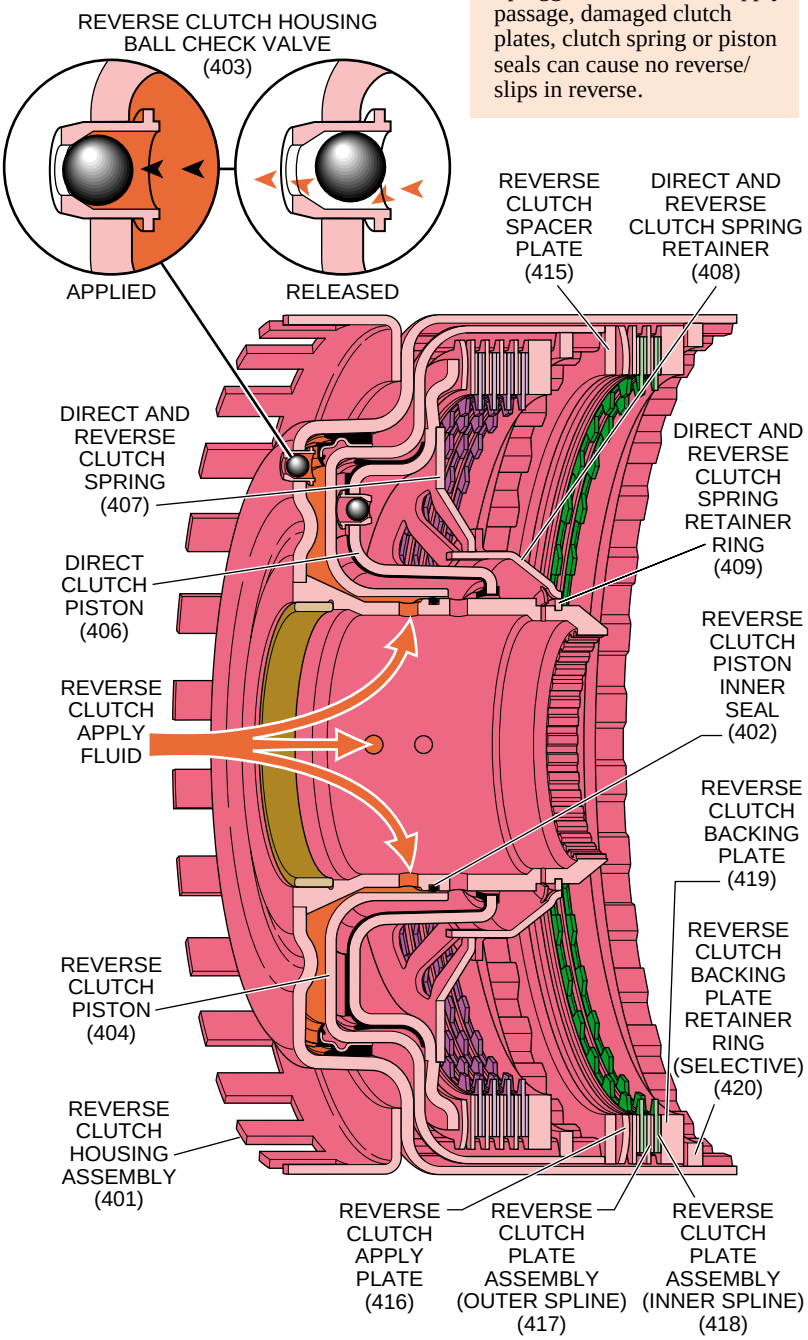
REVERSE CLUTCH APPLY:
To apply the reverse clutch, reverse clutch fluid is fed through the fluid pump cover (202) and behind the reverse clutch piston (404). Reverse clutch fluid pressure forces the piston against the direct clutch piston (406) and the direct and reverse clutch spring (407). As fluid pressure increases, the piston compresses the clutch plates together until they are held against the reverse clutch backing plate (419). Also included in the assembly is a reverse clutch spacer plate (415), and a reverse clutch apply (waved) plate (416) that helps cushion the apply of the reverse clutch.

When fully applied, the reverse clutch plates (417) and reverse clutch plate assemblies (418) are locked together, thereby holding the reverse clutch housing (401) and the overdrive and reverse clutch hub (470) together. This forces the overdrive and reverse clutch hub to rotate at the same speed as the forward clutch and input housing assembly (433).

REVERSE CLUTCH RELEASE:
To release the reverse clutch, reverse clutch fluid exhausts through the reverse clutch fluid circuit, allowing pressure at the reverse clutch piston (404) to decrease. In the absence of fluid pressure, spring force from the direct and reverse clutch spring (407) moves the reverse clutch piston away from the clutch pack. This disengages the reverse clutch plates (417) and reverse clutch plate assemblies (418) from the backing plate (419).

During the exhaust of reverse clutch fluid, the reverse clutch housing ball check valve (403), located in the reverse clutch housing (401), unseats. Centrifugal force, resulting from the rotation of the reverse clutch housing, forces residual reverse fluid to the outside of the housing and past the unseated ball check valve. If this fluid did not completely exhaust from behind the piston, there could be a partial apply, or drag, of the reverse clutch plates.

A plugged reverse clutch apply passage, damaged clutch plates, clutch spring or piston seals can cause no reverse/ slips in reverse.



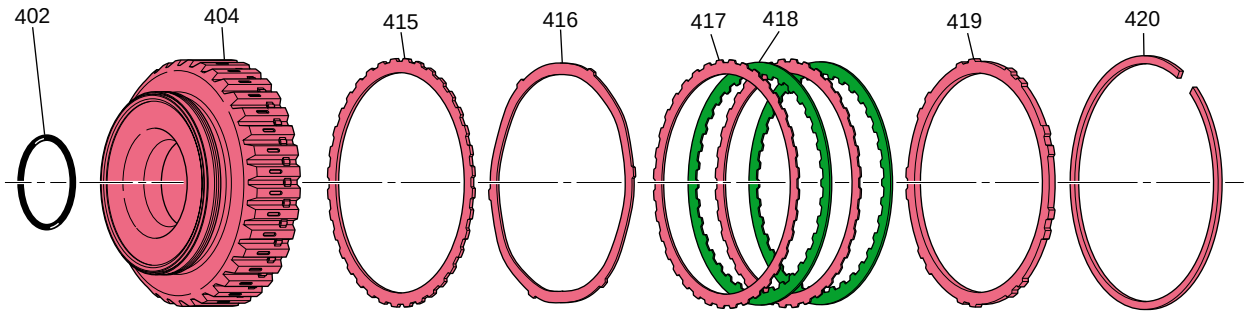
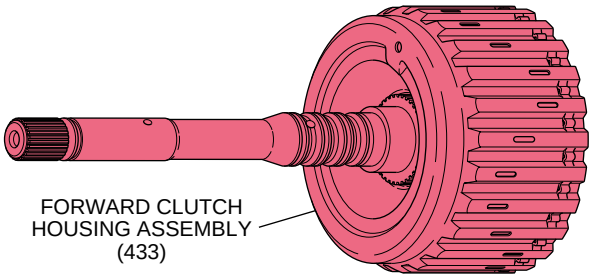


Figure 18

APPLY COMPONENTS



COAST CLUTCH:
The coast clutch assembly is located in the coast clutch housing (446), which is splined to the forward clutch housing assembly (433). The external teeth on the coast clutch plates (443) are splined to the coast clutch housing while the internal teeth on the coast clutch plate assemblies (444) are splined to the input sun gear shaft assembly (457). The coast clutch is applied when the transmission is in all forward gear ranges, except Fifth gear, to transfer engine coast torque to the input and reaction planetary gear set.

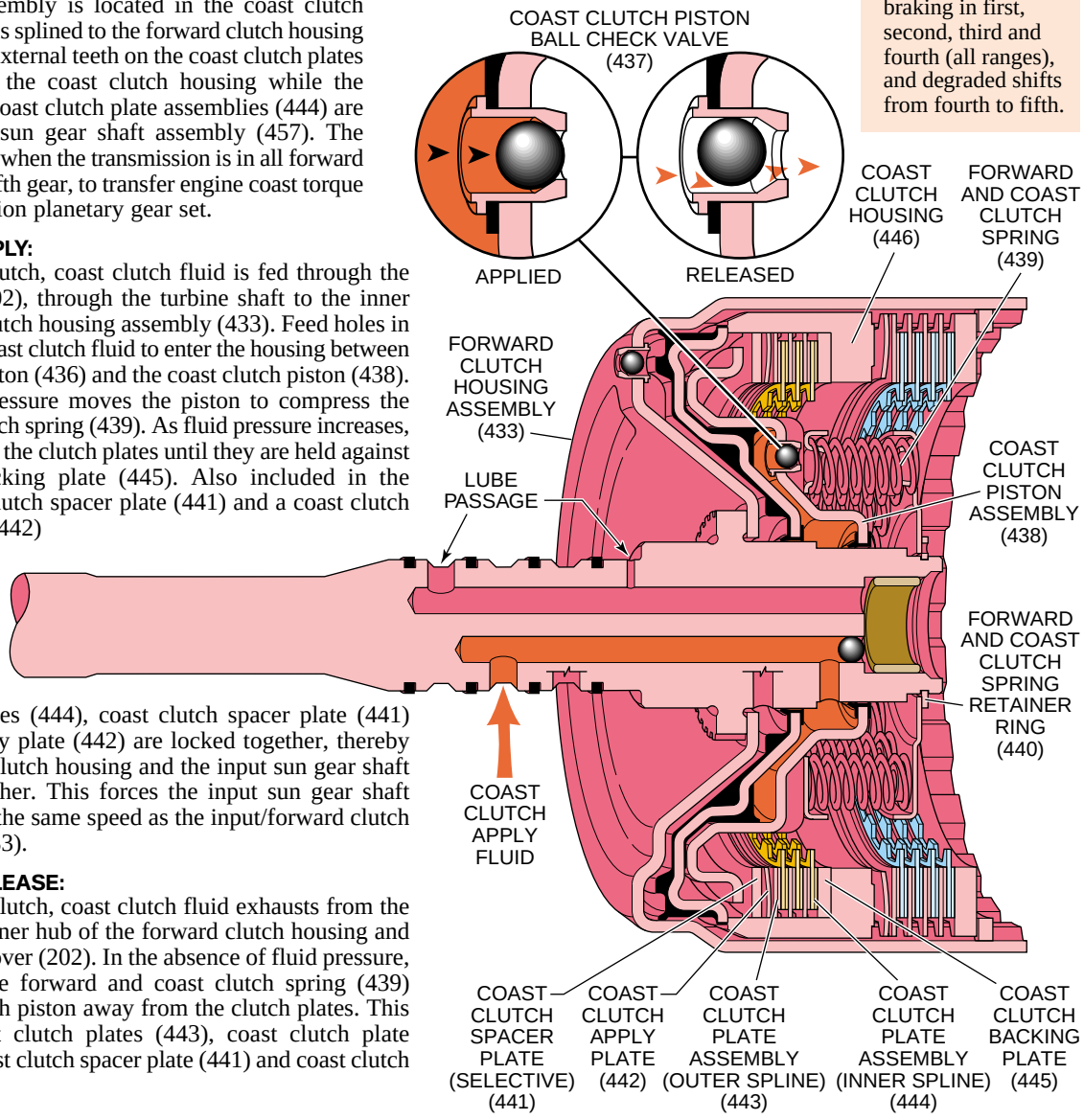
COAST CLUTCH APPLY:
To apply the coast clutch, coast clutch fluid is fed through the fluid pump cover (202), through the turbine shaft to the inner hub of the forward clutch housing assembly (433). Feed holes in the inner hub allow coast clutch fluid to enter the housing between the forward clutch piston (436) and the coast clutch piston (438). Coast clutch fluid pressure moves the piston to compress the forward and coast clutch spring (439). As fluid pressure increases, the piston compresses the clutch plates until they are held against the coast clutch backing plate (445). Also included in the assembly is a coast clutch spacer plate (441) and a coast clutch apply (waved) plate (442) that helps cushion the apply of the coast clutch.

When fully applied, the coast clutch plates (443), coast clutch plate assemblies (444), coast clutch spacer plate (441) and coast clutch apply plate (442) are locked together, thereby holding the forward clutch housing and the input sun gear shaft assembly (457) together. This forces the input sun gear shaft assembly to rotate at the same speed as the input/forward clutch housing assembly (433).

COAST CLUTCH RELEASE:
To release the coast clutch, coast clutch fluid exhausts from the piston, through the inner hub of the forward clutch housing and into the fluid pump cover (202). In the absence of fluid pressure, spring force from the forward and coast clutch spring (439) moves the coast clutch piston away from the clutch plates. This disengages the coast clutch plates (443), coast clutch plate assemblies (444), coast clutch spacer plate (441) and coast clutch apply plate (442) from the coast clutch backing plate (445) and disconnects the forward clutch housing from the input sun gear shaft assembly (457).

During the exhaust of coast clutch fluid, the coast clutch piston ball check valve (437), located in the coast clutch piston (438), unseats. Centrifugal force, resulting from the rotation of the forward/coast clutch housing, forces residual coast clutch fluid to the outside of the housing and past the unseated ball check valve. If this fluid did not completely exhaust from behind the piston, there could be a partial apply, or drag, of the coast clutch plates.

If inoperative the coast clutch can cause no engine braking in first, second, third and fourth (all ranges), and degraded shifts from fourth to fifth.



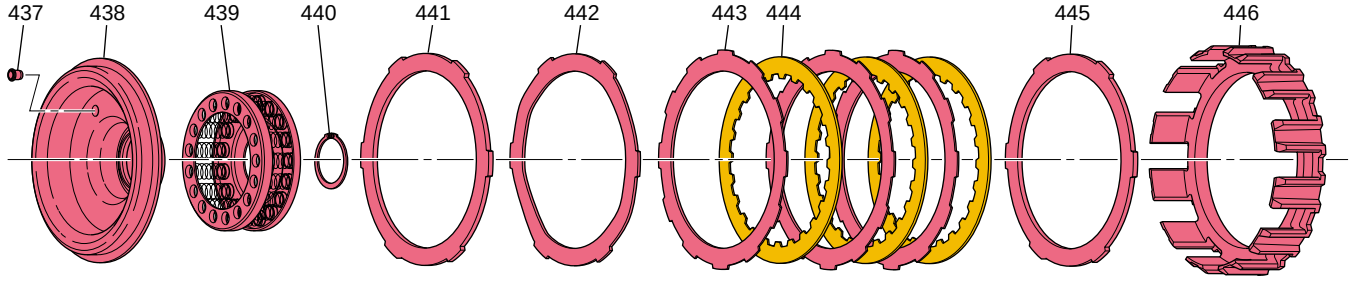
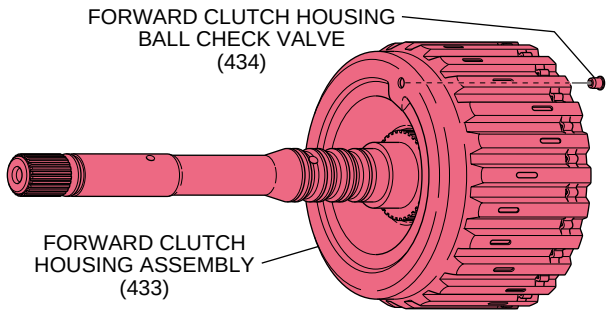


Figure 19

APPLY COMPONENTS



During the exhaust of forward clutch fluid, the forward clutch housing ball check valve, located in the forward clutch housing assembly (434), unseats. Centrifugal force, resulting from the rotation of the forward clutch housing assembly, forces residual forward clutch fluid to the outside of the housing and past the unseated ball check valve. If this fluid did not completely exhaust from behind the piston, there could be a partial apply, or drag, of the forward clutch plates.

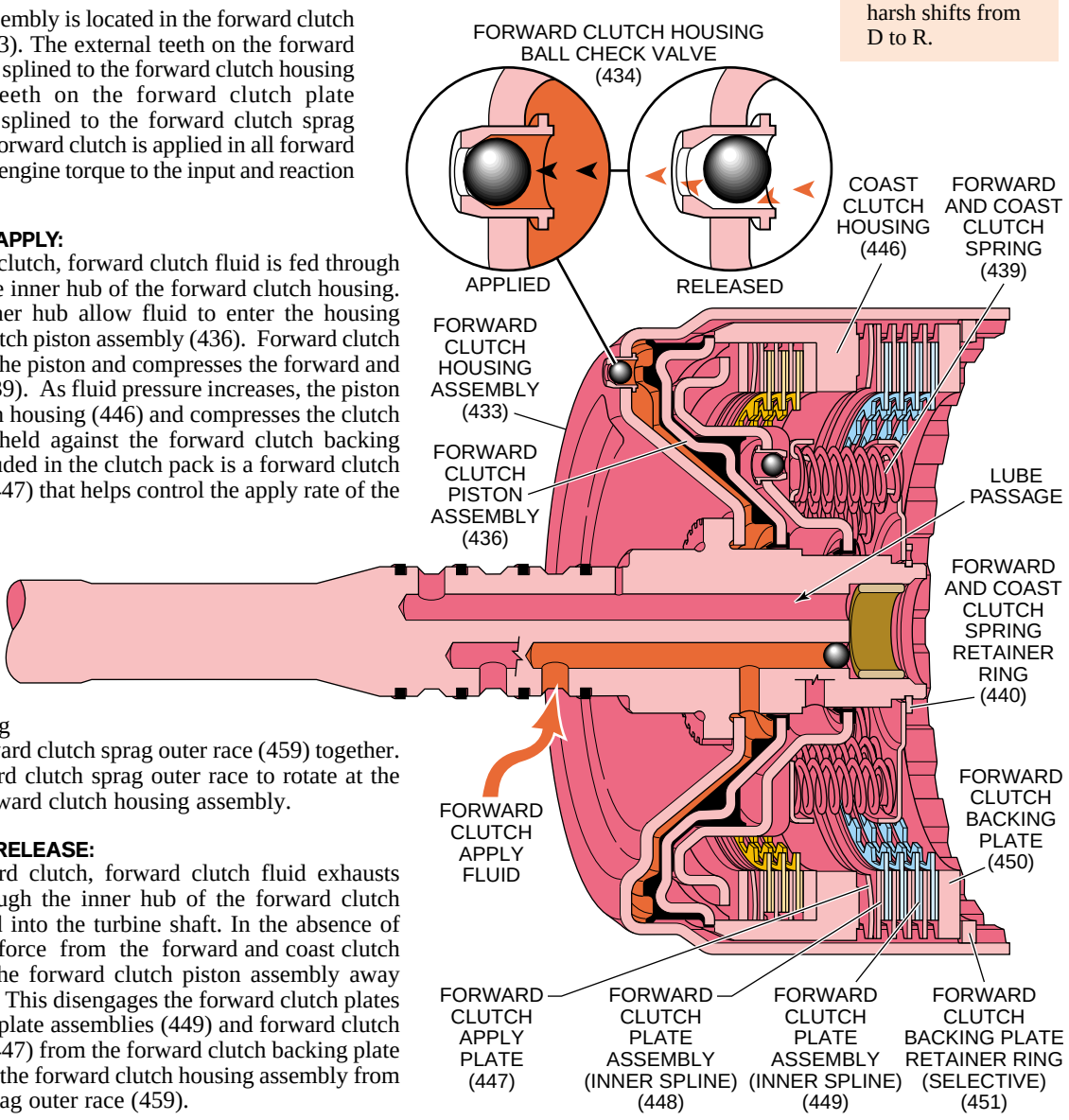
If inoperative the forward clutch can cause forward motion in Neutral, loss of drive, and harsh shifts from D to R.

FORWARD CLUTCH:
The forward clutch assembly is located in the forward clutch housing assembly (433). The external teeth on the forward clutch plates (448) are splined to the forward clutch housing while the internal teeth on the forward clutch plate assemblies (449) are splined to the forward clutch sprag outer race (459). The forward clutch is applied in all forward gear ranges to transfer engine torque to the input and reaction planetary gear set.

FORWARD CLUTCH APPLY:
To apply the forward clutch, forward clutch fluid is fed through the turbine shaft to the inner hub of the forward clutch housing. Feed holes in the inner hub allow fluid to enter the housing behind the forward clutch piston assembly (436). Forward clutch fluid pressure moves the piston and compresses the forward and coast clutch spring (439). As fluid pressure increases, the piston moves the coast clutch housing (446) and compresses the clutch plates until they are held against the forward clutch backing plate (450). Also included in the clutch pack is a forward clutch apply (waved) plate (447) that helps control the apply rate of the forward clutch.

When fully applied, the forward clutch plates (448) and forward clutch plate assemblies (449) are locked together, thereby holding the forward clutch housing assembly and the forward clutch sprag outer race (459) together. This forces the forward clutch sprag outer race to rotate at the same speed as the forward clutch housing assembly.

FORWARD CLUTCH RELEASE:
To release the forward clutch, forward clutch fluid exhausts from the piston, through the inner hub of the forward clutch housing assembly and into the turbine shaft. In the absence of fluid pressure, spring force from the forward and coast clutch spring (439) moves the forward clutch piston assembly away from the clutch plates. This disengages the forward clutch plates (448), forward clutch plate assemblies (449) and forward clutch apply (waved) plate (447) from the forward clutch backing plate (450) and disconnects the forward clutch housing assembly from the forward clutch sprag outer race (459).



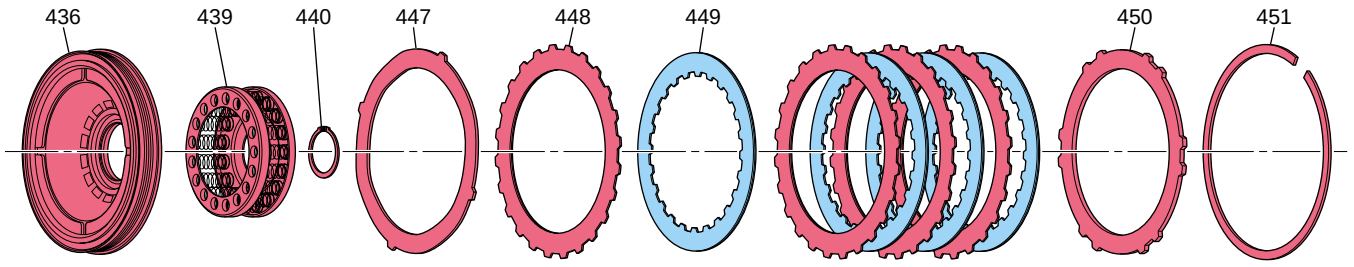
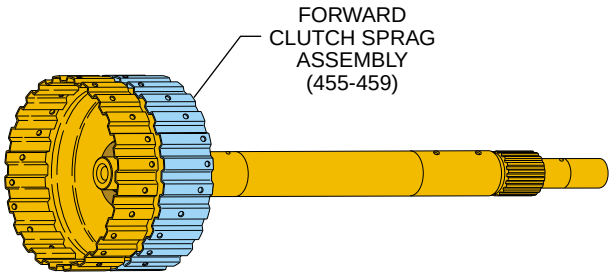


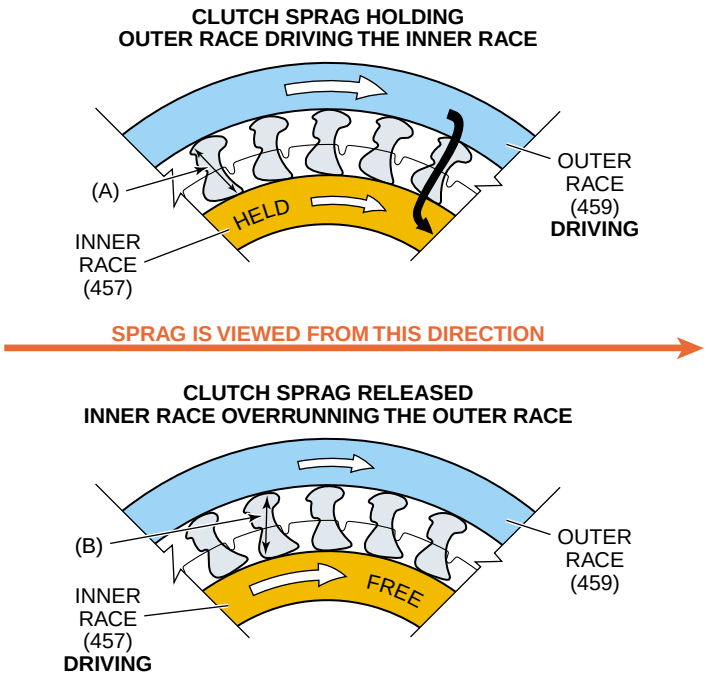
Figure 20

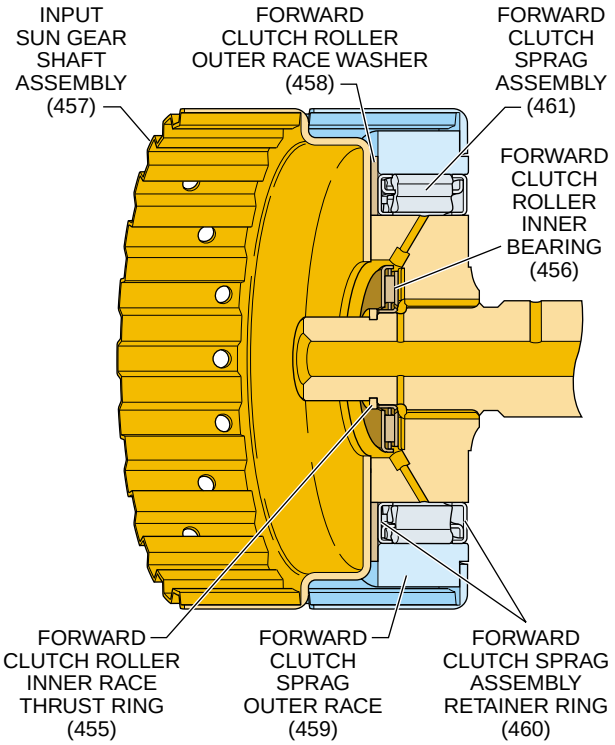


FORWARD CLUTCH SPRAG ASSEMBLY:
The forward clutch sprag assembly (461) is located between the forward clutch sprag outer race (459) and the input sun gear shaft assembly (457) (inner race). The input sun gear shaft assembly is splined to the input sun gear in the input and reaction carrier (553) while the forward clutch sprag outer race is splined to the forward clutch plates. The clutch sprag is a type of one-way clutch that transfers engine torque from the forward clutch to the input sun gear during acceleration in First, Second, Third and Fourth gears in all ranges.

FORWARD CLUTCH SPRAG RELEASED:
The clutch sprag releases when the sprags pivot toward their short diagonals. The length of the short diagonals (B) is less than the distance between the inner and outer sprag races. This occurs when power flow drives the input sun gear shaft assembly (457) faster than the forward clutch drives the forward clutch sprag outer race (459). During acceleration the clutch sprag is overrun only in Fifth gear.

COAST CLUTCH APPLIED:
The coast clutch is applied in first, second, third and fourth gear in all forward ranges. It holds the coast clutch housing (446) and the input sun gear shaft assembly (457) together. These components are then forced to rotate at the same speed as the forward clutch housing assembly (433). This prevents the input sun gear shaft assembly (457) from being driven faster than the forward clutch sprag outer race (459) and, also allows engine braking to occur in first, second, third or fourth gear if the proper braking clutch is applied (refer to the range reference chart on page 11), specific per customer application.





FORWARD CLUTCH SPRAG HOLDING:
When the forward clutch is applied, engine torque is transferred to the forward clutch sprag outer race (459). The rotation of the forward clutch sprag outer race pivots the sprags toward their long diagonals. The length of the long diagonal (distance A) is greater than the distance between the outer race and inner race (457). This causes the sprags to "lock" between the inner and outer races and transfer engine torque from the forward clutch sprag outer race to the input sun gear shaft assembly (457).

A damaged forward clutch sprag assembly can cause loss of drive, no first gear in overdrive and manual ranges.

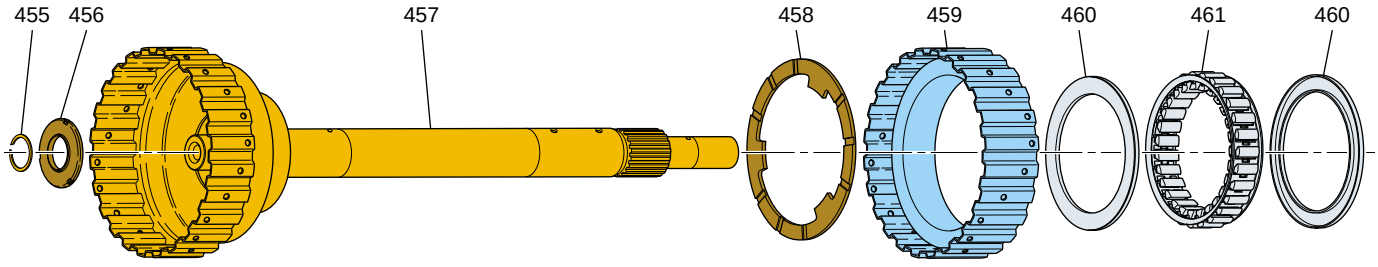
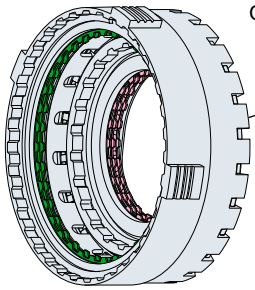


Figure 21

APPLY COMPONENTS



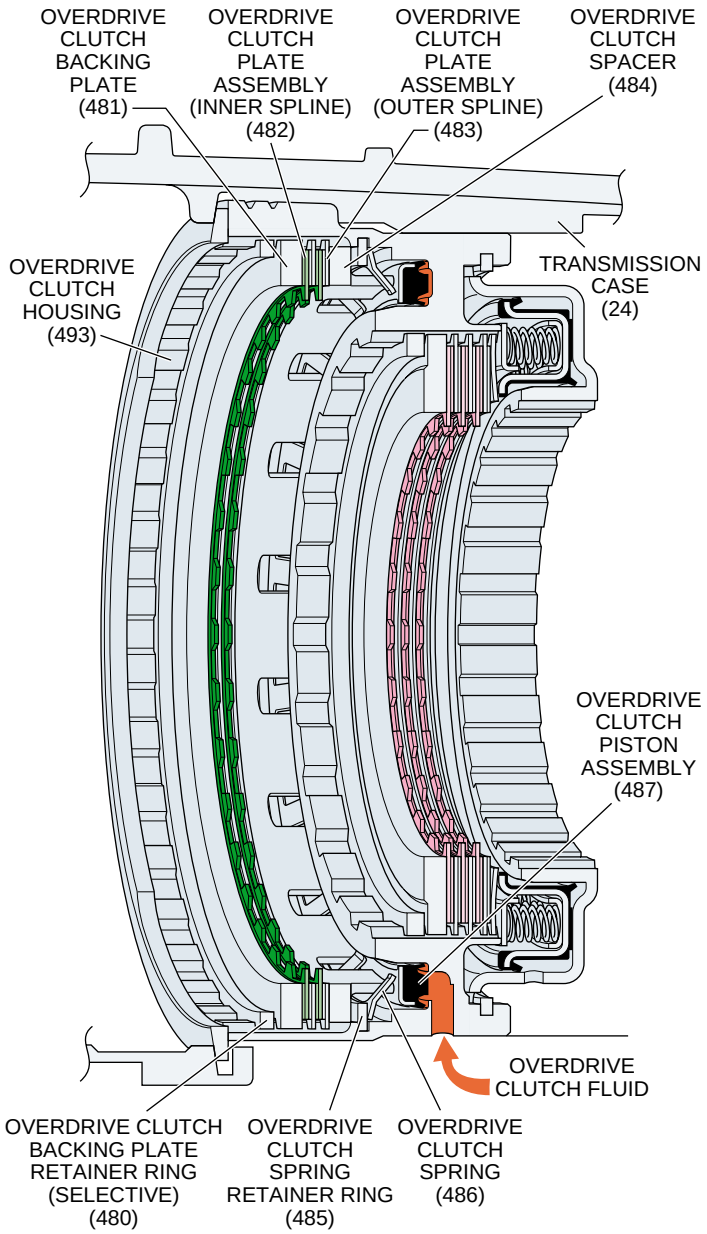
If inoperative the overdrive clutch can cause:
- No engine braking in third gear
- No fifth gear - (D)
- Degraded shifts from fourth to fifth and from fifth to fourth.

OVERDRIVE CLUTCH:
The overdrive clutch assembly is located in the overdrive clutch housing (493). The overdrive clutch housing is splined to the transmission case (24). The external teeth on the overdrive clutch plates (483) are splined to the overdrive clutch housing while the internal teeth on the overdrive clutch plate assemblies (482) are splined to the overdrive and reverse clutch hub assembly (470). The overdrive clutch is applied only when the transmission is in Overdrive range Fifth gear, or in Third gear in (D), manual fourth and manual third ranges when engine braking is commanded ON.

OVERDRIVE CLUTCH APPLY:
To apply the overdrive clutch, overdrive clutch fluid is fed through the transmission case (24) into the overdrive clutch housing (493). A feed hole in the overdrive clutch housing allows fluid to enter the housing behind the overdrive clutch piston assembly (487). Overdrive clutch fluid pressure moves the piston to compress the overdrive clutch spring (486). As fluid pressure increases, the overdrive clutch spacer plate (484) compresses the overdrive clutch plates together until they are held against the overdrive clutch backing plate (481).

When fully applied, the overdrive spacer (484), the overdrive clutch plates (483) and the overdrive clutch plate assemblies (482) are locked together, thereby holding the overdrive clutch housing (493) and the overdrive and reverse clutch hub assembly (470) together. This holds the overdrive and reverse clutch hub assembly stationary to the transmission case (24).

OVERDRIVE CLUTCH RELEASE:
To release the overdrive clutch, overdrive clutch fluid exhausts through the overdrive clutch housing and into the transmission case, allowing pressure at the overdrive clutch piston (487) to decrease. In the absence of fluid pressure, spring force from the overdrive clutch spring (486) moves the overdrive clutch piston (487) away from the clutch pack. This disengages the overdrive clutch plates (483) and the overdrive clutch plate assemblies (482) from the backing plate (481), thereby allowing the overdrive and reverse clutch hub assembly to rotate freely.



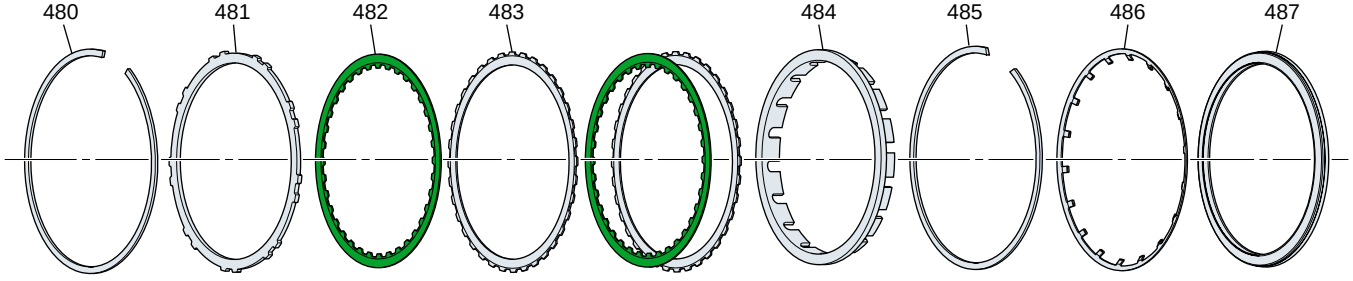
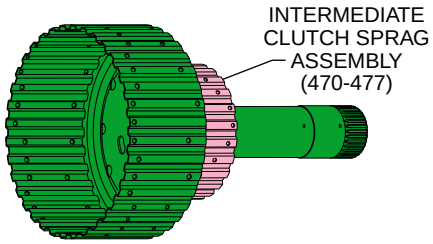
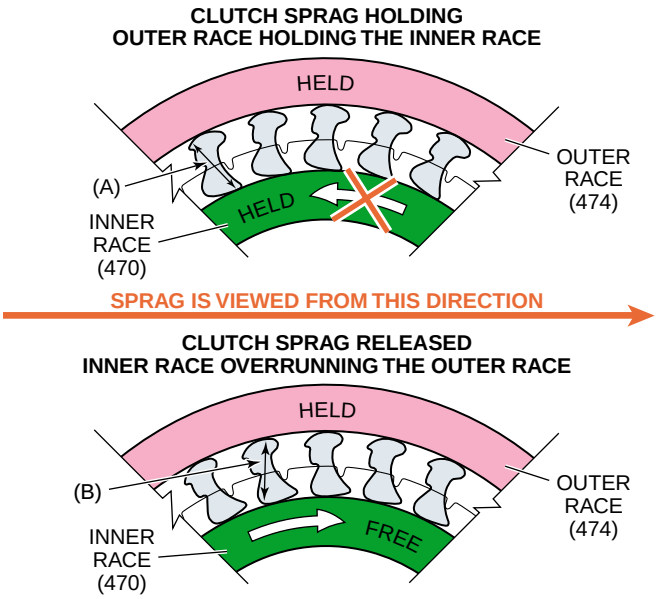


Figure 22



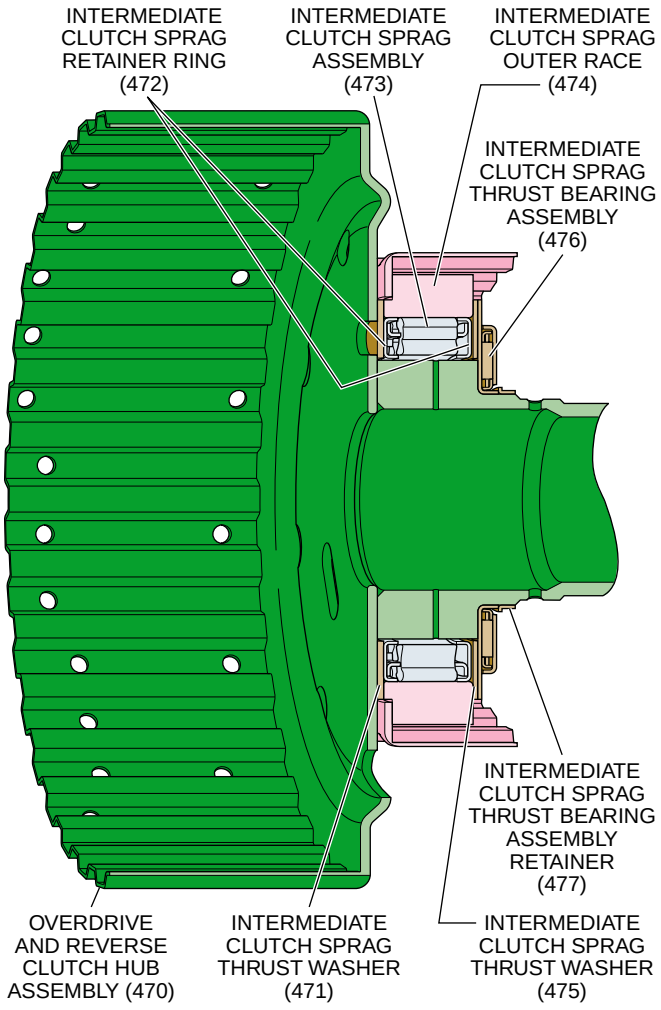
INTERMEDIATE CLUTCH SPRAG:
The intermediate clutch sprag assembly (473) is located between the intermediate clutch sprag outer race (474) and the overdrive and reverse clutch hub assembly (470) (inner race). The overdrive and reverse clutch hub assembly is splined to the overdrive and reverse sun gear in the input and reaction carrier (553) while the intermediate clutch plate assemblies are splined to the intermediate clutch sprag outer race (474). The intermediate clutch sprag is a type of one-way clutch that, when effective, prevents the overdrive and reverse clutch hub assembly from rotating in the direction opposite of engine rotation. The clutch sprag is holding, and effective, when the transmission is in Third Gear.



INTERMEDIATE CLUTCH SPRAG HOLDING:
In Third gear, power flow attempts to drive the overdrive and reverse clutch hub assembly in the direction opposite of engine rotation and pivots the sprags toward their long diagonals. The long diagonal (A) of the sprag is greater than the distance between the inner race and the outer race, causing the sprags to "lock" against the intermediate clutch sprag outer race (474). However, in Third gear the intermediate clutch is applied and the outer race is held stationary to the transmission case (24). Therefore, the sprag assembly, being "locked" between the outer race and overdrive and reverse clutch hub assembly (inner race), holds the overdrive and reverse clutch hub assembly (470) and the overdrive and reverse sun gear (553) stationary to obtain a Third gear ratio through the transmission gear set.

INTERMEDIATE CLUTCH SPRAG RELEASED:
The intermediate clutch sprag releases when the sprags pivot toward their short diagonals. The short diagonal (B) is smaller than the distance between the inner race and outer race and the outer race overruns the sprags. This action occurs in Fourth and Fifth gears when the intermediate clutch is applied and power flow drives the overdrive and reverse clutch hub assembly in the direction of engine rotation.

Depending on model and application, the inner race may also overrun the intermediate clutch sprag during coast conditions (throttle released) in (D), manual fourth and manual third ranges – Third Gear when vehicle speed is greater than engine speed (refer to the Range Reference Chart on page 11). This causes the transmission gear set to be driven by the vehicle drive shaft, and not the engine, which drives the overdrive and reverse clutch hub assembly in the direction of engine rotation, overrunning the sprags.



A damaged intermediate clutch sprag can cause no third gear or, no torque in third gear, in overdrive range, manual fourth, or manual third.

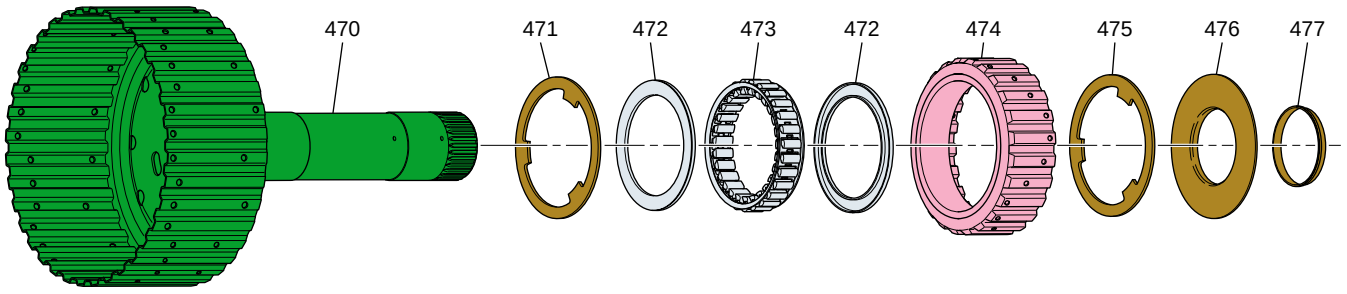
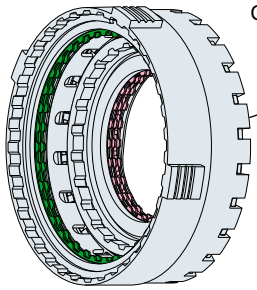


Figure 23



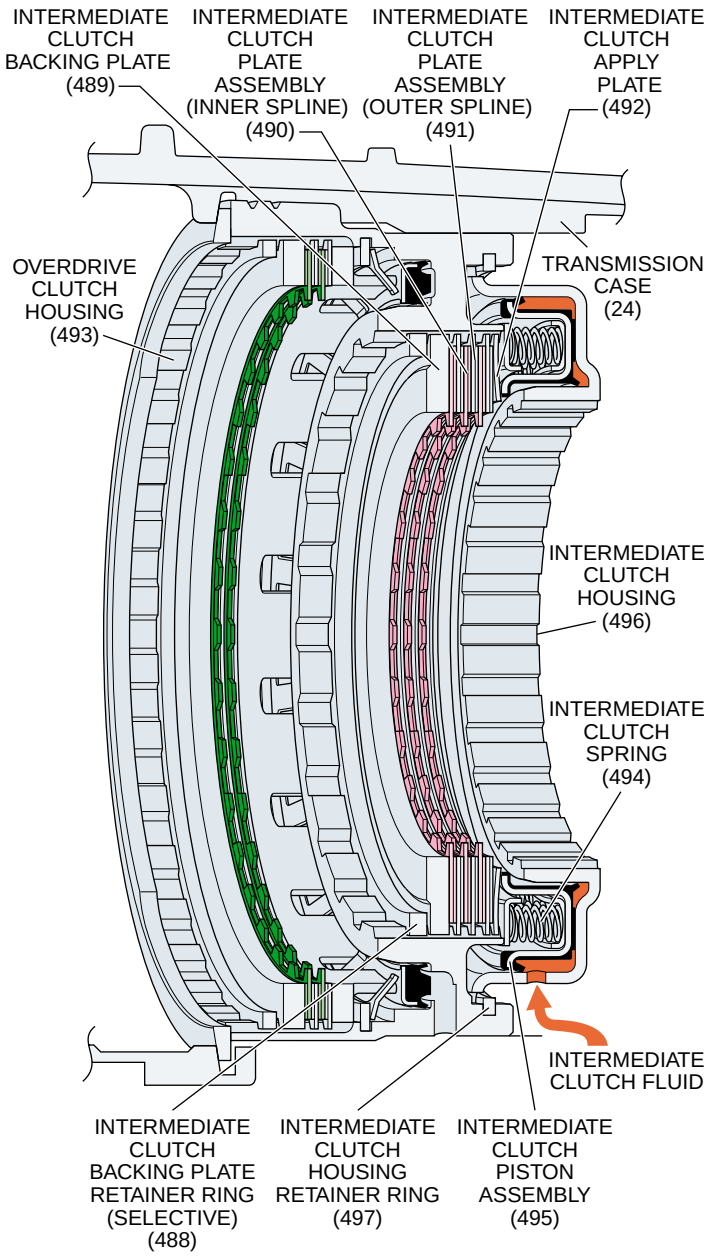
INTERMEDIATE CLUTCH:
The intermediate clutch assembly is located between the intermediate clutch housing (496) and the overdrive clutch housing (493). The overdrive clutch housing is splined to the transmission case (24). The external teeth on the intermediate clutch plates (491) are splined to the overdrive clutch housing (493) while the internal teeth on the intermediate clutch plate assemblies (490) are splined to the intermediate clutch sprag outer race (474). The intermediate clutch is applied when the transmission is in Third, Fourth, and Fifth gears.

INTERMEDIATE CLUTCH APPLY:
To apply the intermediate clutch, intermediate clutch apply fluid is fed from the transmission case (24) into the intermediate clutch housing (496). A feed hole in the intermediate clutch housing allows fluid to enter the housing behind the intermediate clutch piston assembly (495). Intermediate clutch fluid pressure moves the piston to compress the intermediate clutch spring (494). As fluid pressure increases, the piston compresses the intermediate clutch plates until they are held against the intermediate clutch backing plate (489). Also included in the intermediate clutch pack is an intermediate clutch apply (waved) plate (492) that helps control the apply rate of the intermediate clutch.

When fully applied, the intermediate clutch plates (491) and intermediate clutch plate assemblies (490) are locked together, thereby holding the intermediate clutch sprag outer race (474) stationary to the transmission case. This allows the intermediate clutch sprag (473) to become effective and hold when the overdrive and reverse clutch hub assembly (470) attempts to rotate in the direction opposite of engine rotation. Remember that the inner race of the intermediate clutch sprag is part of the overdrive and reverse clutch hub assembly (470).

INTERMEDIATE CLUTCH RELEASE:
To release the intermediate clutch, intermediate clutch fluid exhausts from the piston, through the intermediate clutch housing and into the transmission case. In the absence of fluid pressure, spring force from the intermediate clutch spring (494) moves the piston away from the clutch plates. This disengages the intermediate clutch plates (491) and intermediate clutch plate assemblies (490) from the intermediate clutch backing plate (489) and disconnects the intermediate clutch sprag outer race from the overdrive clutch housing/transmission case. Therefore, the intermediate clutch sprag is no longer effective – the outer race will rotate with the overdrive and reverse clutch hub assembly when the sprags engage.

If inoperative the intermediate clutch can cause:
- No third gear in overdrive range, manual fourth or manual third
- Degraded shifts from second to third and from third to second



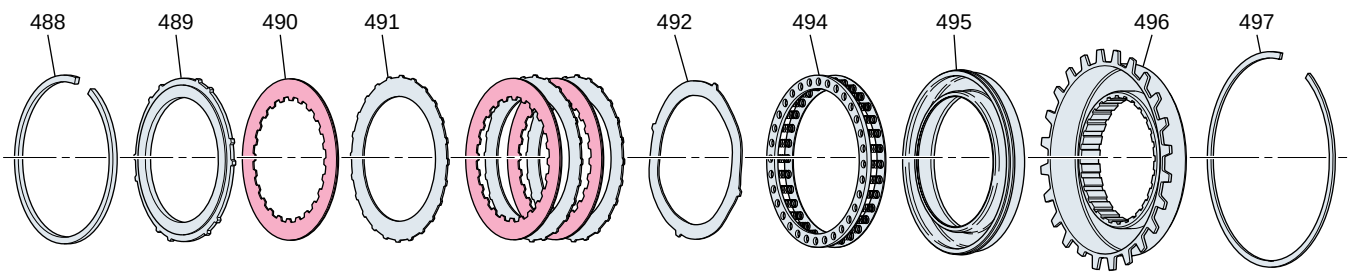
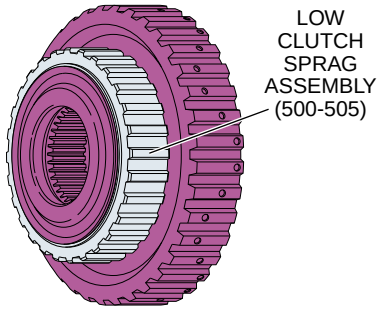
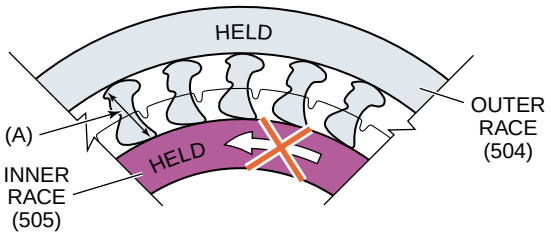


Figure 24



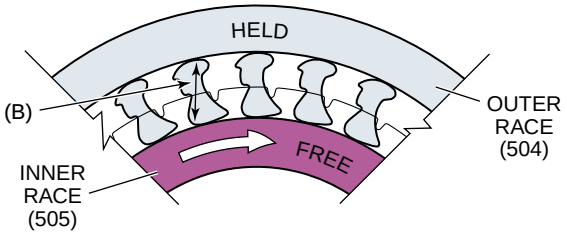
LOW CLUTCH SPRAG:
The low clutch sprag assembly (503) is located between the low clutch sprag outer race (504) and the low clutch sprag inner race (505). The low clutch sprag outer race is splined to the transmission case (24) through the intermediate clutch housing assembly (496) and the overdrive clutch housing (493). The low clutch sprag inner race is splined to the input and reaction carrier (553). The low clutch sprag assembly is a type of one-way clutch that prevents the input and reaction carrier from rotating in the direction opposite of engine rotation. The low clutch sprag is holding, and effective, when the vehicle is in First Gear.

CLUTCH SPRAG HOLDING
OUTER RACE HOLDING THE INNER RACE



SPRAG IS VIEWED FROM THIS DIRECTION

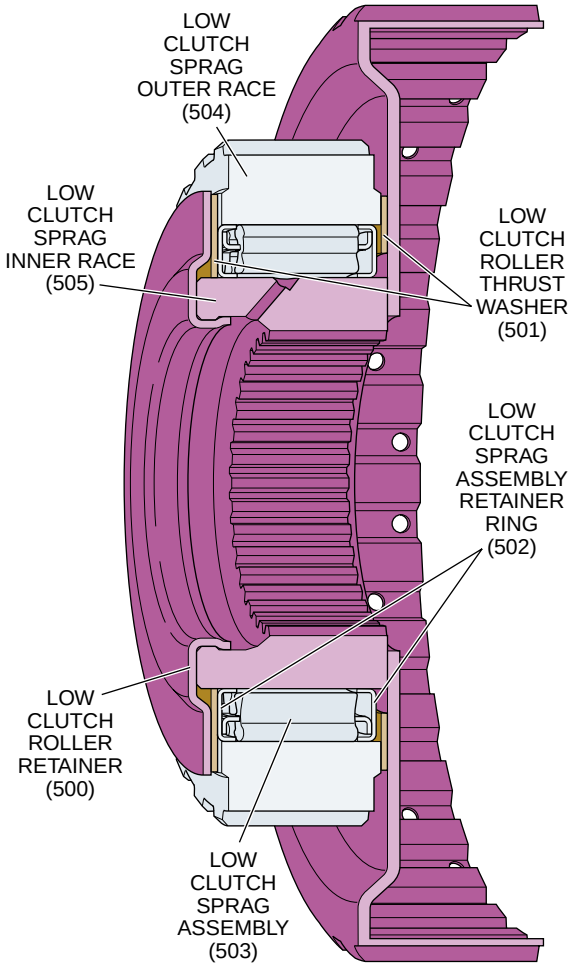
CLUTCH SPRAG RELEASED
INNER RACE OVERRUNNING THE OUTER RACE



LOW CLUTCH SPRAG HOLDING:
In First gear, power flow attempts to drive the input and reaction carrier in the direction opposite of engine rotation and pivots the sprags toward their long diagonals. The long diagonal (A) of the sprag is greater than the distance between the inner race and the outer race, causing the sprags to "lock" between the inner and outer races. This action holds the input and reaction carrier stationary to the transmission case (24) to obtain a First gear ratio through the transmission gear set.

LOW CLUTCH SPRAG RELEASED:
The low clutch sprag releases when the sprags pivot toward their short diagonals. The length of the short diagonals (B) is less than the distance between the inner race and the outer race. This causes the inner race to overrun the sprags. This action occurs in Second, Third, Fourth and Fifth gears when power flow drives the input and reaction carrier in the direction of engine rotation.

Depending on model and application, the input and reaction carrier may also overrun the low clutch sprag during coast conditions (throttle released) in (D), manual fourth, manual third and manual second ranges – First Gear when vehicle speed is greater than engine speed. This causes the transmission gear set to be driven by the vehicle drive shaft, and not the engine, which drives the input and reaction carrier in the direction of engine rotation, overrunning the sprags.



A damaged low clutch sprag can cause loss of drive/no first gear in overdrive range and all manual ranges.

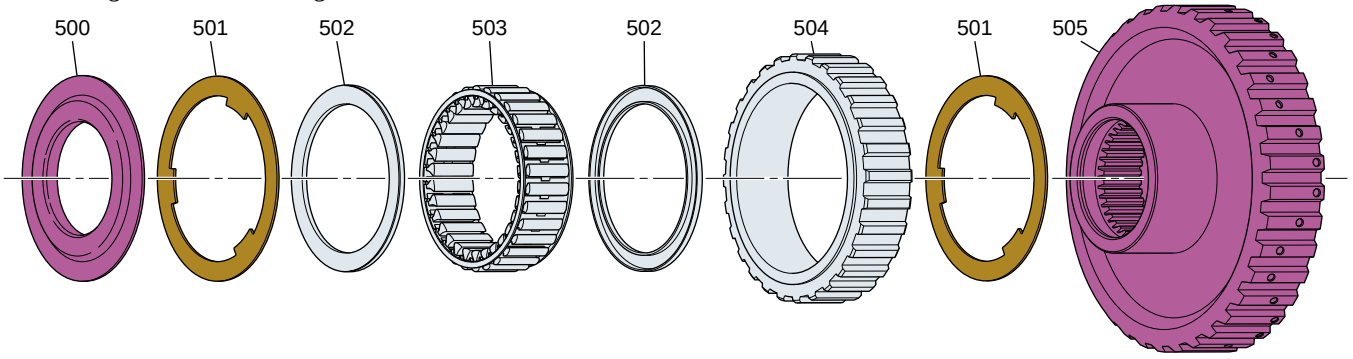
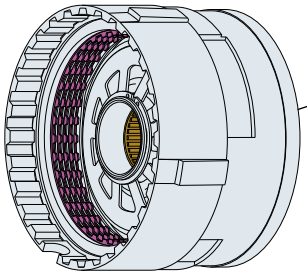


Figure 25

APPLY COMPONENTS



If inoperative the low and reverse clutch can cause:

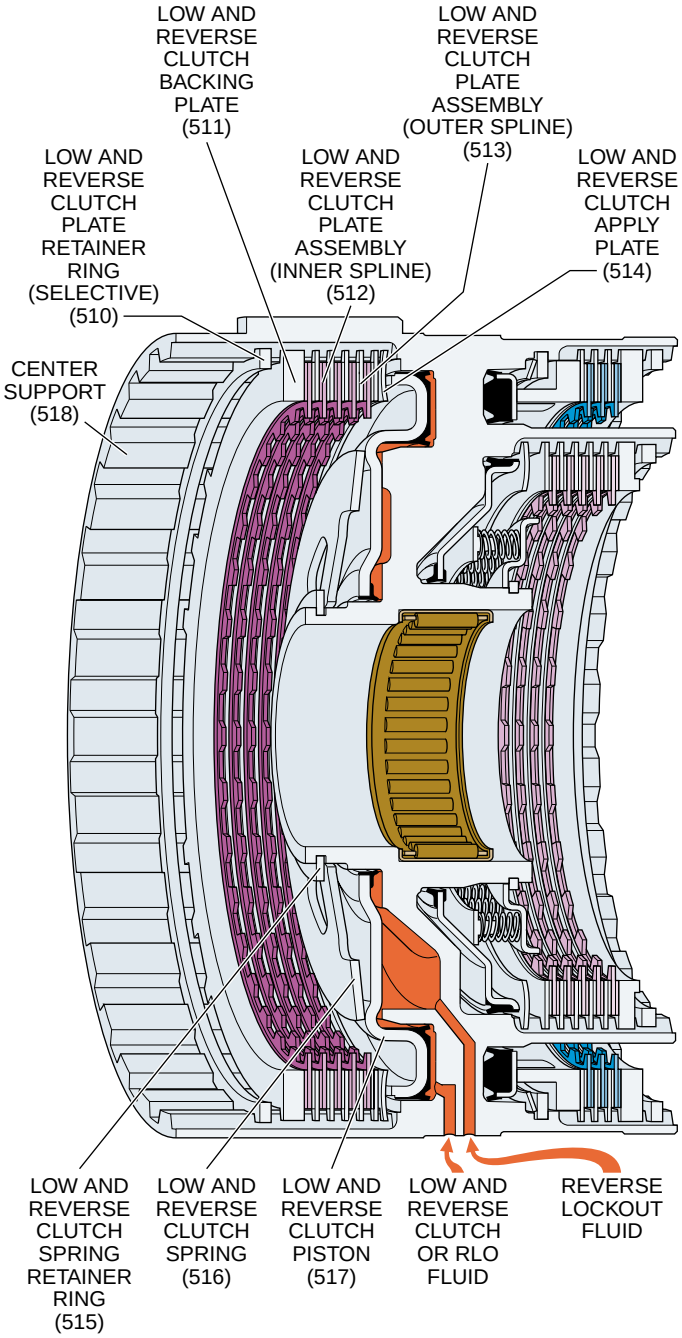
- No first gear engine braking in overdrive range, manual fourth, manual third, manual second, or manual first
- No reverse/slips in reverse

LOW AND REVERSE CLUTCH:
The low and reverse clutch assembly is located in the center support (518). The center support is splined to the transmission case (24). The external teeth on the low and reverse clutch plates (513) are splined to the center support (518) while the internal teeth on the low and reverse clutch plate assemblies (512) are splined to the low clutch sprag inner race (505). The low and reverse clutch is applied when the transmission is in First gear in all forward ranges when engine braking is commanded ON, and in Reverse.

LOW AND REVERSE CLUTCH APPLY:
To apply the low and reverse clutch, low and reverse clutch or reverse lockout (RLO) apply fluid is fed from the transmission case (24) into the center support (518). A feed hole in the center support allows fluid to enter behind the low and reverse clutch piston assembly (517). Low and reverse clutch or reverse lockout (RLO) fluid pressure moves the piston to compress the low and reverse clutch spring (516). As fluid pressure increases, the piston compresses the low and reverse clutch plates until they are held against the low and reverse clutch backing plate (511). Also included in the clutch pack is a low and reverse clutch apply (waved) plate (514) that helps control the apply rate of the low and reverse clutch.

When fully applied, the low and reverse clutch plates (513) and low and reverse clutch plate assemblies (512) are locked together, thereby holding the low clutch sprag inner race (505) stationary to the transmission case (24). The low clutch sprag inner race (505) is splined to the input and reaction carrier (553), causing the input and reaction carrier to be held stationary also.

LOW AND REVERSE CLUTCH RELEASE:
To release the low and reverse clutch, low and reverse clutch or reverse lockout (RLO) fluid exhausts from the piston, through the center support and into the transmission case. In the absence of fluid pressure, spring force from the low and reverse clutch spring (516) moves the piston away from the clutch plates. This disengages the low and reverse clutch plates (513) and low and reverse clutch plate assemblies (512) from the low and reverse clutch backing plate (511) and disconnects the low clutch sprag inner race from the center support/transmission case. Therefore, the low clutch sprag inner race (505) and the input and reaction carrier (553) are free to rotate in the direction of engine rotation.



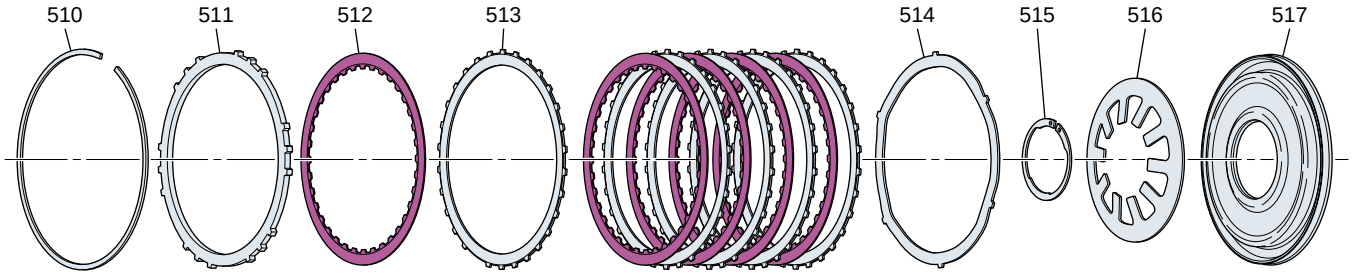
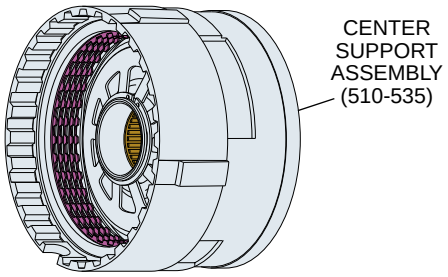


Figure 26

APPLY COMPONENTS



If inoperative the second clutch can cause:

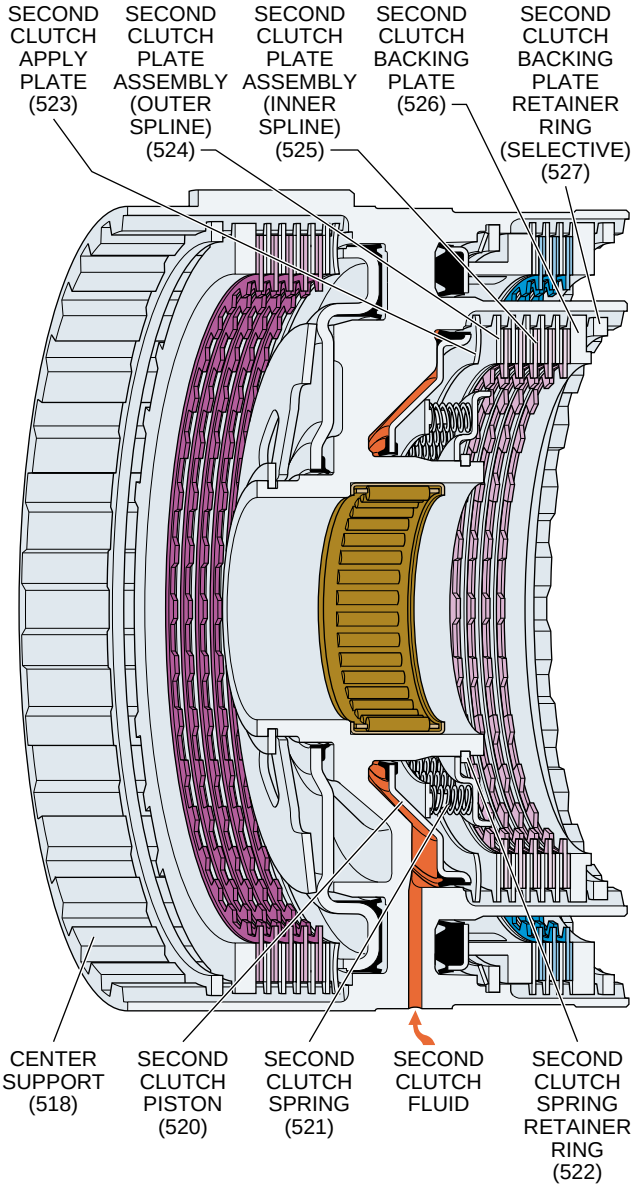
- No second gear in overdrive range, manual fourth, manual third, or manual second
- Degraded shifts from first to second and from second to first

SECOND CLUTCH:
The second clutch assembly is located in the center support (518). The center support is splined to the transmission case (24). The external teeth on the second clutch plates (524) are splined to the center support (518) while the internal teeth on the second clutch plate assemblies (525) are splined to the second clutch sprag outer race (545). The second clutch is applied when the transmission is in Second, Third, Fourth or Fifth gears.

SECOND CLUTCH APPLY:
To apply the second clutch, second clutch apply fluid is fed from the transmission case (24) into the center support (518). A feed hole in the center support allows fluid to enter behind the second clutch piston (520). Second clutch fluid pressure moves the piston to compress the second clutch spring (521) to cushion the apply. As fluid pressure increases, the piston compresses the second clutch plates until they are held against the second clutch backing plate (526). Also included in the clutch pack is a second clutch apply (waved) plate (523) that, in addition to the second clutch spring, helps control the apply rate of the second clutch.

When fully applied, the second clutch plates (524) and second clutch plate assemblies (525) are locked together, thereby holding the second clutch sprag outer race (545) stationary to the transmission case (24). This allows the second clutch sprag assembly (547) to become effective and hold when the second clutch sprag inner race (549) attempts to rotate in the direction opposite of engine rotation.

SECOND CLUTCH RELEASE:
To release the second clutch, second clutch fluid exhausts from the piston, through the center support and into the transmission case. In the absence of fluid pressure, spring force from the second clutch spring (521) moves the piston away from the clutch plates. This disengages the second clutch plates (524) and second clutch plate assemblies (525) from the second clutch backing plate (526) and disconnects the second clutch sprag outer race (545) from the second clutch sprag inner race (549). Therefore, the second clutch sprag is no longer effective – the inner race is free to rotate.



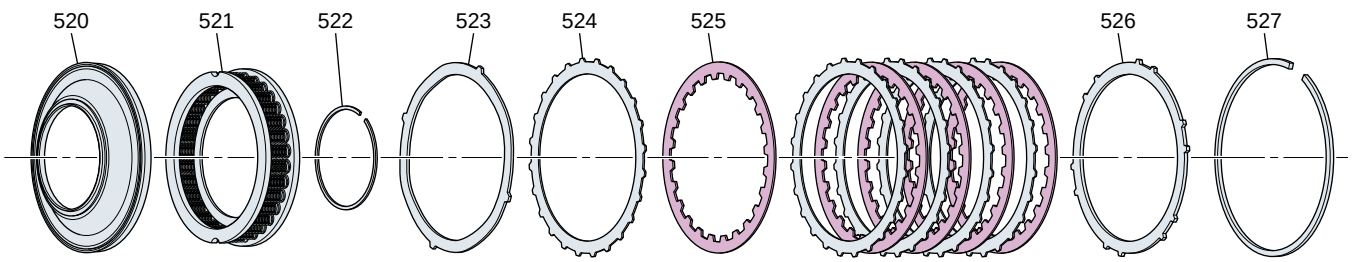
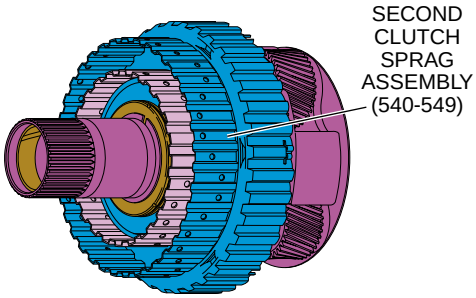
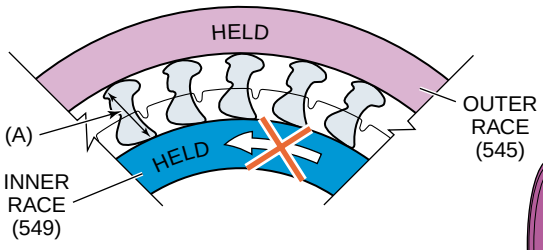


Figure 27



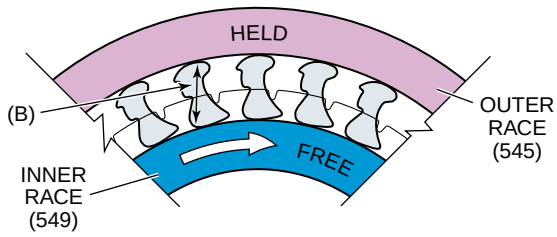
SECOND CLUTCH SPRAG:
The second clutch sprag assembly (547) is located between the second clutch sprag outer race (545) and the second clutch sprag inner race (549). The second clutch sprag outer race is splined to the second clutch plate assemblies (525). The second clutch sprag inner race is splined to the reaction internal gear (550). The second clutch sprag assembly is a type of one-way clutch that prevents the reaction internal gear (550) from rotating in the direction opposite of engine rotation and affects the output gear ratio of the input and reaction carrier (553). The second clutch sprag is holding, and effective, when the vehicle is in Second Gear.

CLUTCH SPRAG HOLDING
OUTER RACE HOLDING THE INNER RACE



SPRAG IS VIEWED FROM THIS DIRECTION

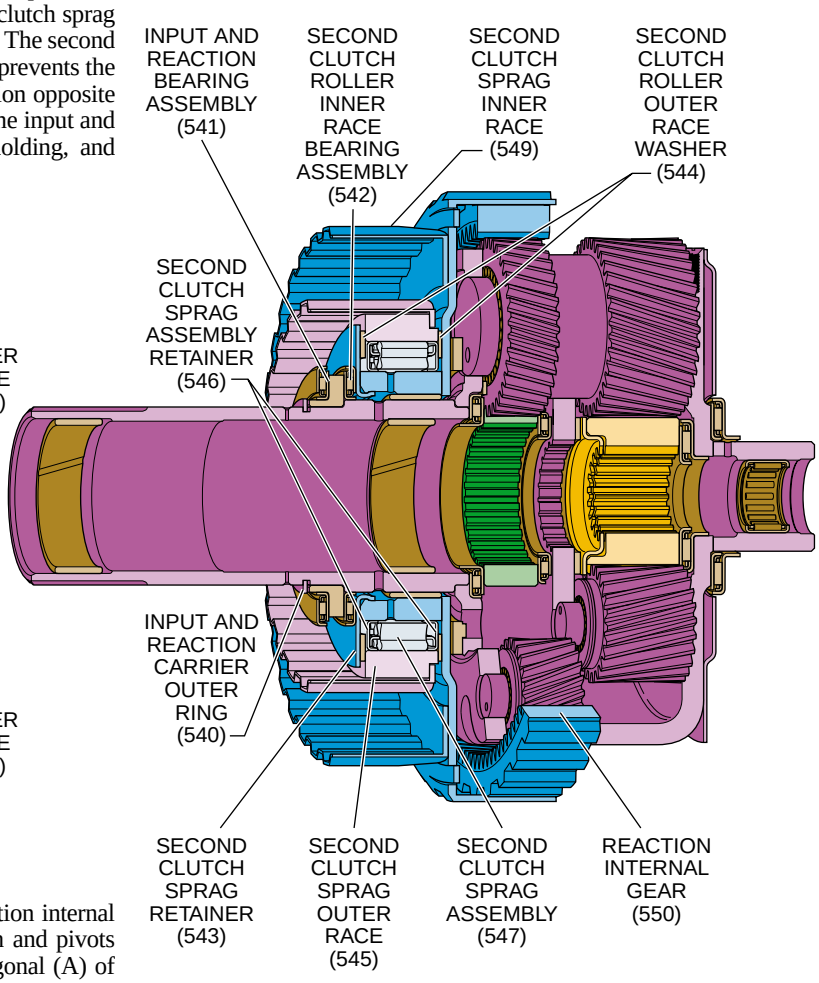
CLUTCH SPRAG RELEASED
INNER RACE OVERRUNNING THE OUTER RACE



SECOND CLUTCH SPRAG HOLDING:
In Second gear, power flow attempts to drive the reaction internal gear (550) in the direction opposite of engine rotation and pivots the sprags toward their long diagonals. The long diagonal (A) of the sprag is greater than the distance between the inner race and the outer race, causing the sprags to "lock" between the inner and outer races. Because the second clutch is also applied, this action holds the reaction internal gear (550) stationary to the transmission case (24) to obtain a Second gear ratio through the transmission gear set.

SECOND CLUTCH SPRAG RELEASED:
The second clutch sprag releases when the sprags pivot toward their short diagonals. The length of the short diagonals (B) is less than the distance between the inner race and the outer race. This causes the inner race to overrun the sprags. This action occurs in Third, Fourth and Fifth gears when power flow drives the reaction internal gear (550) in the direction of engine rotation.

Depending on model and application, the reaction internal gear (550) may also overrun the second clutch sprag during coast conditions (throttle released) in (D), manual fourth, manual third, and manual second ranges – Second Gear when vehicle speed is greater than engine speed (refer to the Range Reference Chart on page 11). This causes the transmission gear set to be driven by the vehicle drive shaft, and not the engine, which drives the reaction internal gear in the direction of engine rotation, overrunning the sprags.



A damaged second clutch sprag can cause no second gear in overdrive range, manual fourth, manual third and manual second.

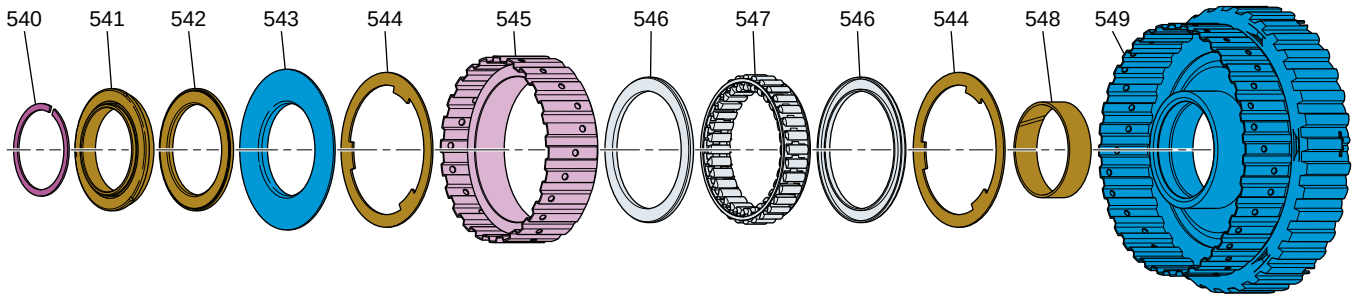
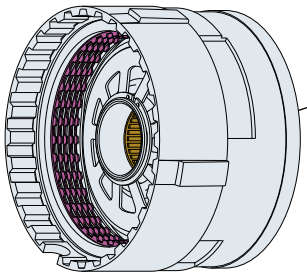


Figure 28



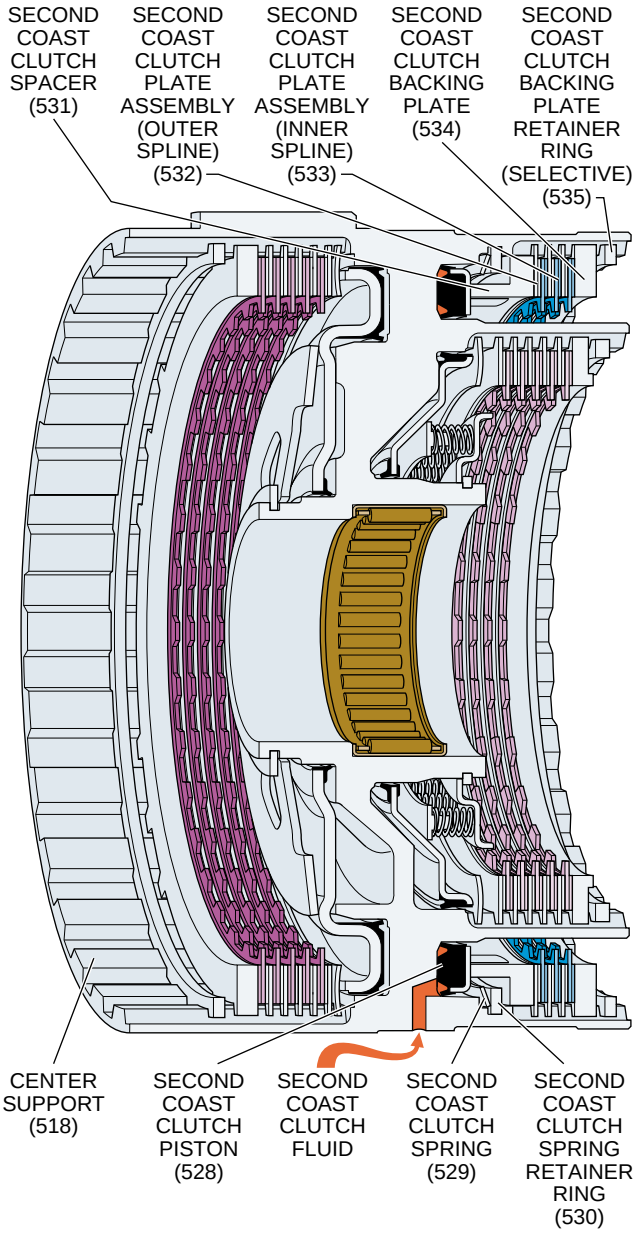
If inoperative the second coast clutch can cause:
- No second gear engine braking in overdrive range, manual fourth, manual third, or manual second

SECOND COAST CLUTCH:
The second coast clutch assembly is located in the center support (518). The center support is splined to the transmission case (24). The external teeth on the second coast clutch plates (532) are splined to the center support (518) while the internal teeth on the second coast clutch plate assemblies (533) are splined to the second clutch sprag inner race (549). The second coast clutch is applied when the transmission is in Second gear in all forward ranges when engine braking is commanded ON.

SECOND COAST CLUTCH APPLY:
To apply the second coast clutch, second coast clutch apply fluid is fed from the transmission case (24) into the center support (518). A feed hole in the center support allows fluid to enter behind the second coast clutch piston assembly (528). Second coast clutch fluid pressure moves the piston to compress the second coast clutch spring (529) to cushion the apply. As fluid pressure increases, the piston compresses the second coast clutch plates until they are held against the second coast clutch backing plate (534). Also included in the clutch pack is a second coast clutch spacer (531).

When fully applied, the second coast clutch plates (532) and second coast clutch plate assemblies (533) are locked together, thereby holding the second clutch sprag inner race (549) stationary to the transmission case (24). This allows the second clutch sprag assembly (547) to become effective and hold when the second clutch sprag inner race (549) attempts to rotate.

SECOND COAST CLUTCH RELEASE:
To release the second coast clutch, second coast clutch fluid exhausts from the piston, through the center support and into the transmission case. In the absence of fluid pressure, spring force from the second coast clutch spring (529) moves the piston away from the clutch plates. This disengages the second coast clutch plates (532) and second coast clutch plate assemblies (533) from the second coast clutch backing plate (534) and disconnects from the second clutch sprag inner race (549). Therefore, the second clutch sprag is no longer effective – the inner race is free to rotate.



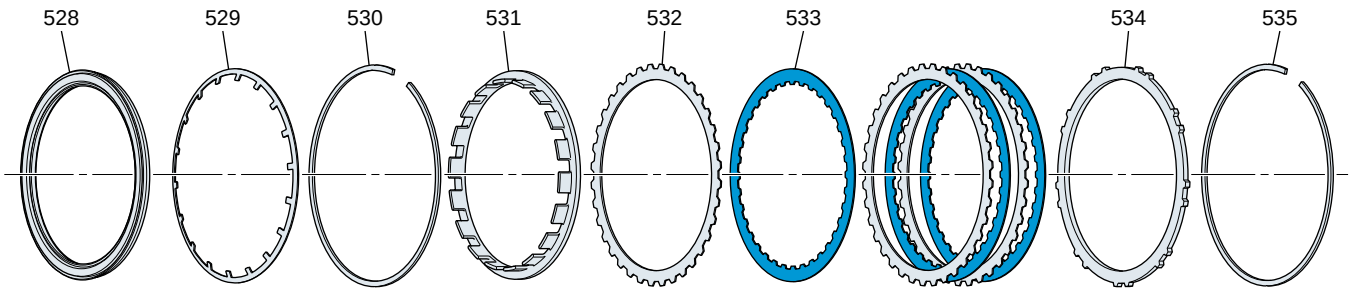


Figure 29

PLANETARY GEAR SETS

Planetary gear sets are commonly used in automatic transmissions as the primary method of multiplying the torque, or twisting force, of the engine (reduction). Planetary gear sets are also used to reverse the direction of rotation, function as a coupling for direct drive, and provide an overdrive gear ratio.

Planetary gear sets are so named because of their physical arrangement. All planetary gear sets contain at least three main components:

- a sun gear at the center of the gear set,
- a carrier assembly with planet pinion gears that rotate around the sun gear and,
- an internal (ring) gear that encompasses the entire gear set.

The gears are designed such that several gear teeth are always in contact, or mesh, at the same time. This design distributes the energy forces over several gear teeth for greater strength and eliminates potential clash that is a common occurrence in manual transmissions when gear teeth go in and out of mesh. Another benefit of planetary gear sets is that shafts are generally used for input and output components and can be arranged on the same axis, thus providing a very compact unit.

The Hydra-matic 4/5L40-E transmission uses one planetary gear set, the Ravigneaux gear set. Figures 30, 31 and 32 show this gear set and it's respective components. These figures also graphically explain how the planetary gear set is used to achieve each of the transmission's five forward gear ratios and Reverse.

Ravigneaux Planetary Gear Set

The Ravigneaux planetary gear set is unique in that it resembles a combination of two gear sets. This gear set consists of three sets of pinion gears (one long and two short) in one planetary carrier (553), two sun gears – front input and rear input, and two internal gears – reaction (550) and rear (560). The front input sun gear is in constant mesh with the long pinion gears. The rear input sun gear is in constant mesh with the rear short pinion gears. The long pinion gears are in constant mesh with both the front and the rear short pinion gears, and the rear internal gear (560). The front short pinion gears are in constant mesh with the reaction internal gear (550) in addition to the long pinion gears. Also, the output shaft (562) is splined to the rear internal gear (560) which acts as a part of the Ravigneaux planetary gear set.

Torque

When engine torque is transferred through a gear set the output torque from the gear set can either increase, decrease, or remain the same. The output torque achieved depends on:

- which member of the gear set provides the input torque,
- which member of the gear set (if any) is held stationary, and,
- which member of the gear set provides the output torque.

If output torque is greater than input torque the gear set is operating in reduction (First, Second, Third and Reverse gears). If output torque is less than input torque, then the gear set is operating in overdrive (Fifth gear). When output torque equals input torque the gear set is operating in direct drive (Fourth gear) and all gear set components are rotating at the same speed.

Torque vs. Speed

One transmission operating condition directly affected by input and output torque through a gear set is the relationship of torque with output speed. As the transmission shifts from First to Second to Third to Fourth to Fifth gear, the overall output torque to the wheels decreases as the speed of the vehicle increases (when input speed and input torque are held constant). Higher output torque is needed at low vehicle speed (First, Second and Third gears) to provide the power to move the vehicle from a standstill. However, once the vehicle is moving and the speed of the vehicle increases (Fourth and Fifth gears), less output torque is required to maintain that speed. This provides for a more efficient operation of the powertrain.

Gear set failure can cause noise and loss of drive.

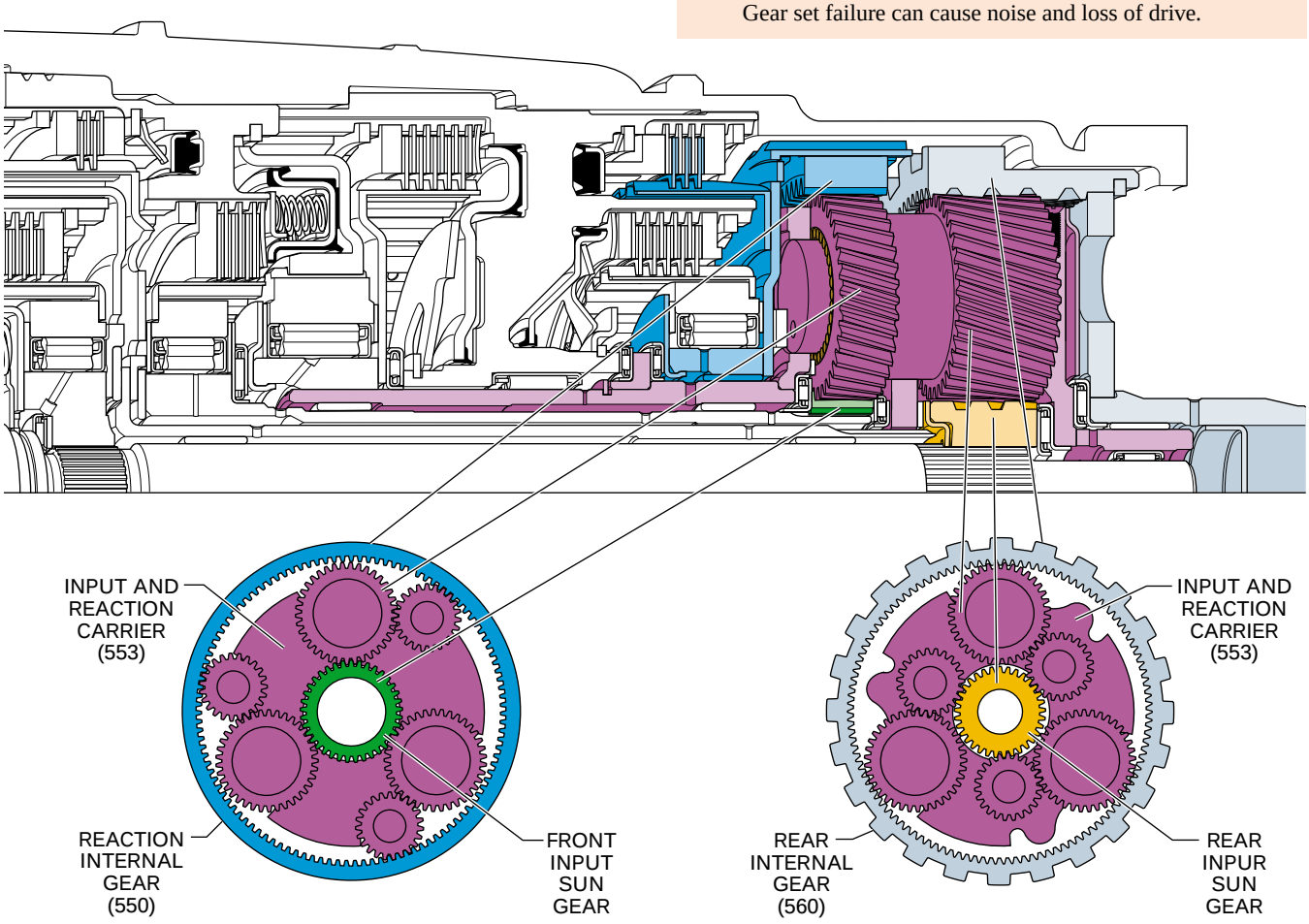


Figure 30

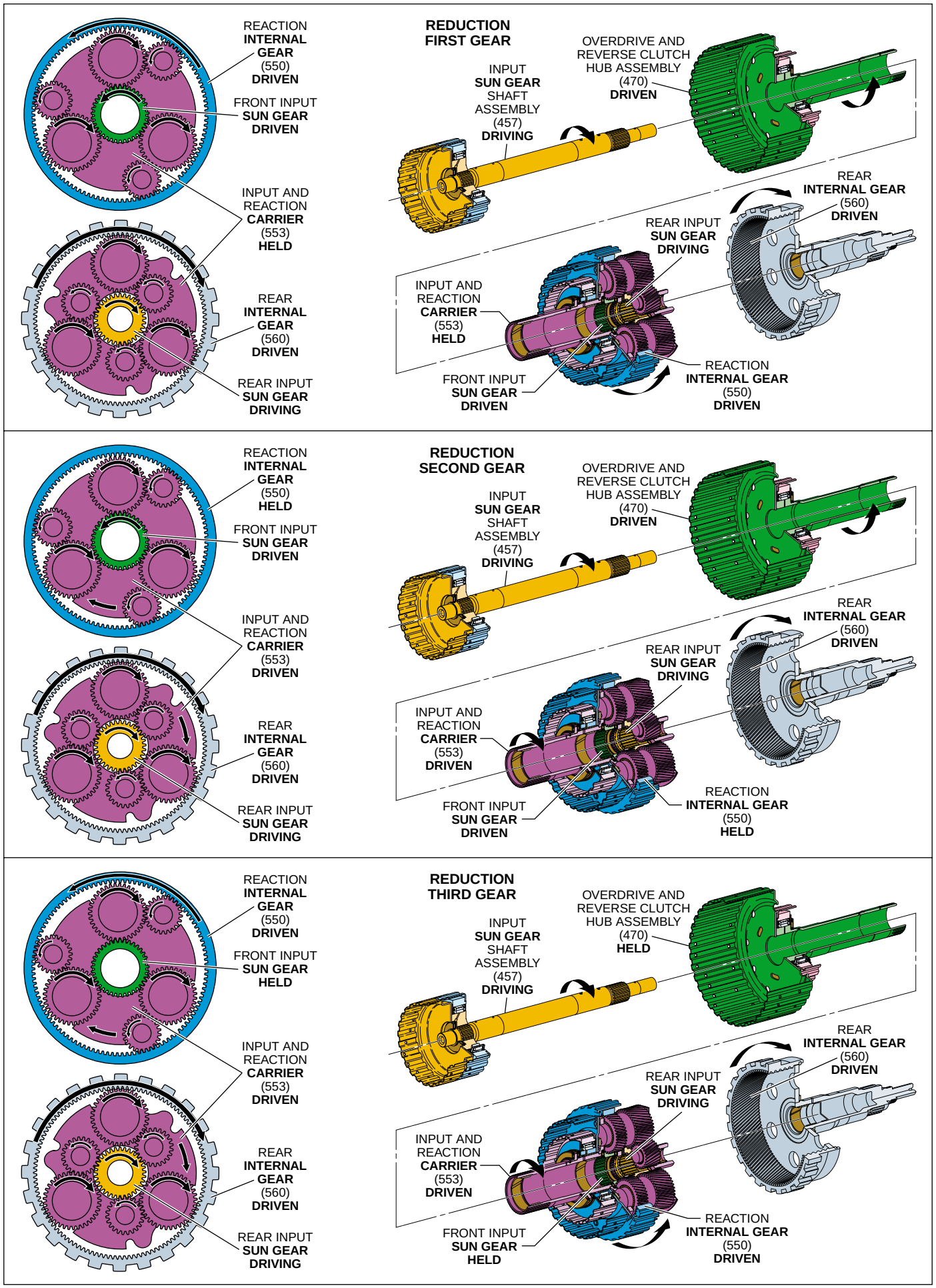


Figure 31

PLANETARY GEAR SETS

REDUCTION

Increasing the output torque is known as operating in reduction because there is a decrease in the speed of the output member proportional to the increase in output torque. Therefore, with a constant input speed, the output torque increases when the transmission is in a lower gear, or higher gear ratio. Reduction occurs in First, Second, Third and Reverse gears through the Ravigneaux gear set.

FIRST GEAR

In First gear, torque input to the Ravigneaux gear set is provided by the rear input sun gear in the direction of engine rotation. The rear input sun gear drives the rear short pinion gears in the direction opposite of engine rotation. The rear short pinion gears then drive the long pinion gears in the direction of engine rotation. The long pinion gears drive the front short pinion gears which in turn drive the reaction internal gear (550) in the direction opposite of engine rotation. The front short pinion gears also attempt to drive the input and reaction carrier (553) in the direction opposite of engine rotation but, the low clutch sprag prevents this from occurring and the carrier is held stationary. This action forces the long pinion gears to drive the rear internal gear (560) and output shaft assembly in an reduction gear ratio of approximately 3.42:1.

SECOND GEAR

In Second gear, the torque input to the Ravigneaux gear set is provided by the rear input sun gear in the direction of engine rotation. The rear input sun gear drives the rear short pinion gears in the direction opposite of engine rotation. The rear short pinion gears then drive the long pinion gears in the direction of engine rotation. The long pinion gears drive the front short pinion gears, and the front short pinion gears then attempt to drive the reaction internal gear (550) in the direction opposite of engine rotation but, because the second clutch is applied, the second clutch sprag prevents this from occurring and the rear internal gear is held stationary. The front short pinion gears are forced to walk around the stationary reaction internal gear and drive the input and reaction carrier (553) in the direction of engine rotation. This action forces the long pinion gears to drive the rear internal gear (560) and output shaft assembly in a reduction gear ratio of approximately 2.21:1.

THIRD GEAR

In Third gear, the torque input to the Ravigneaux gear set is provided by the rear input sun gear in the direction of engine rotation. The rear input sun gear drives the rear short pinion gears in the direction opposite of engine rotation. The rear short pinion gears then drive the long pinion gears in the direction of engine rotation. The long pinion gears drive the front short pinion gears, and the front short pinion gears then attempt to drive the front input sun gear in the direction opposite of engine rotation. However, the intermediate clutch is applied, holding the front input sun gear stationary and forcing the long pinion gears to walk around the stationary front input sun gear, driving the input and reaction carrier (553) in the direction of engine rotation. This action forces the long pinion gears to drive the rear internal gear (560) and output shaft assembly in a reduction gear ratio of approximately 1.60:1.

DIRECT DRIVE

Direct drive through a planetary gear set is obtained when any two members of the gear set rotate in the same direction at the same speed. This forces the third member of the gear set to rotate at the same speed. Therefore, in direct drive the output speed of the transmission is the same as the input speed from the converter turbine. Output speed will equal engine speed when the torque converter clutch is applied (see Torque Converter – pages 12-14).

FOURTH GEAR

Direct drive occurs in Fourth gear when input torque to the Ravigneaux gear set is provided by both the rear input sun gear and the direct clutch input and hub assembly (466). The direct clutch input and hub assembly (466) is splined directly to the input and reaction carrier (553) and drives the carrier in the direction of engine rotation at input speed. The rear input sun gear attempts to drive the long pinion gears in the direction of engine rotation at input speed through the rear short pinion gears but, because the carrier is rotating at the same speed, the long pinion gears are prevented from rotating on their pins and they force the rear internal gear (560) to rotate at the same speed. Therefore, the Ravigneaux carrier (553) and the output shaft assembly (562) are driven at the same speed for a direct drive 1:1 gear ratio.

OVERDRIVE

Operating the transmission in Overdrive allows the output speed of the transmission to be greater than the input speed from the engine. This mode of operation allows the vehicle to maintain a given road speed with reduced engine speed for increased fuel economy.

FIFTH GEAR

Overdrive is achieved through the Ravigneaux gear set and only occurs in Overdrive Range – Fifth Gear. The overdrive clutch holds the overdrive and reverse clutch hub (470) and the front input sun gear stationary to the transmission case. Therefore, when input torque drives the input and reaction carrier (553) in the direction of engine rotation, the long pinion gears walk in the direction of engine rotation around the stationary front input sun gear. These pinion gears then drive the rear internal gear (560) in the direction of engine rotation in an overdrive gear ratio of approximately 0.75:1.

REVERSE

The Ravigneaux planetary gear set reverses the direction of power flow rotation when the reverse clutch and the low and reverse clutch are applied. Input torque to the Ravigneaux gear set is provided through the reverse clutch to the front input sun gear in the direction of engine rotation, while the input and reaction carrier (553) is held stationary by the low and reverse clutch. The front input sun gear drives the long pinion gears in the direction opposite of engine rotation. With the input and reaction carrier (553) held, the long pinion gears drive the rear internal gear (560) and output shaft (562) assembly in the direction opposite of engine rotation (reverse), in a reduction gear ratio of approximately 3.03:1.

PLANETARY GEAR SETS

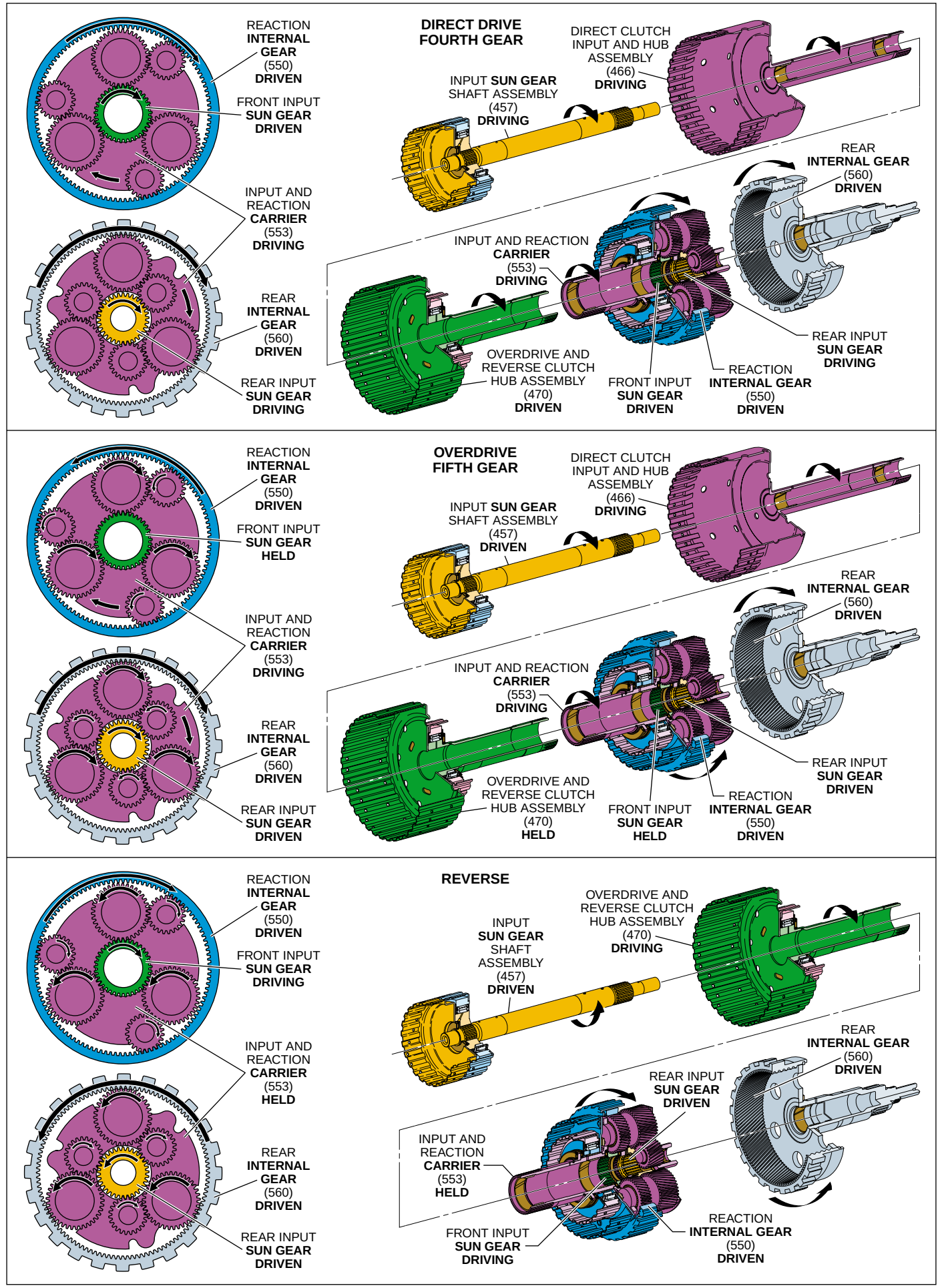


Figure 32

HYDRAULIC CONTROL COMPONENTS

The previous sections of this book were used to describe some of the mechanical component operations of the Hydra-matic 4/5L40-E. In the Hydraulic Control Components section a detailed description of individual components used in the hydraulic system will be presented. These hydraulic control components apply and release the clutch packs to provide automatic shifting of the transmission.

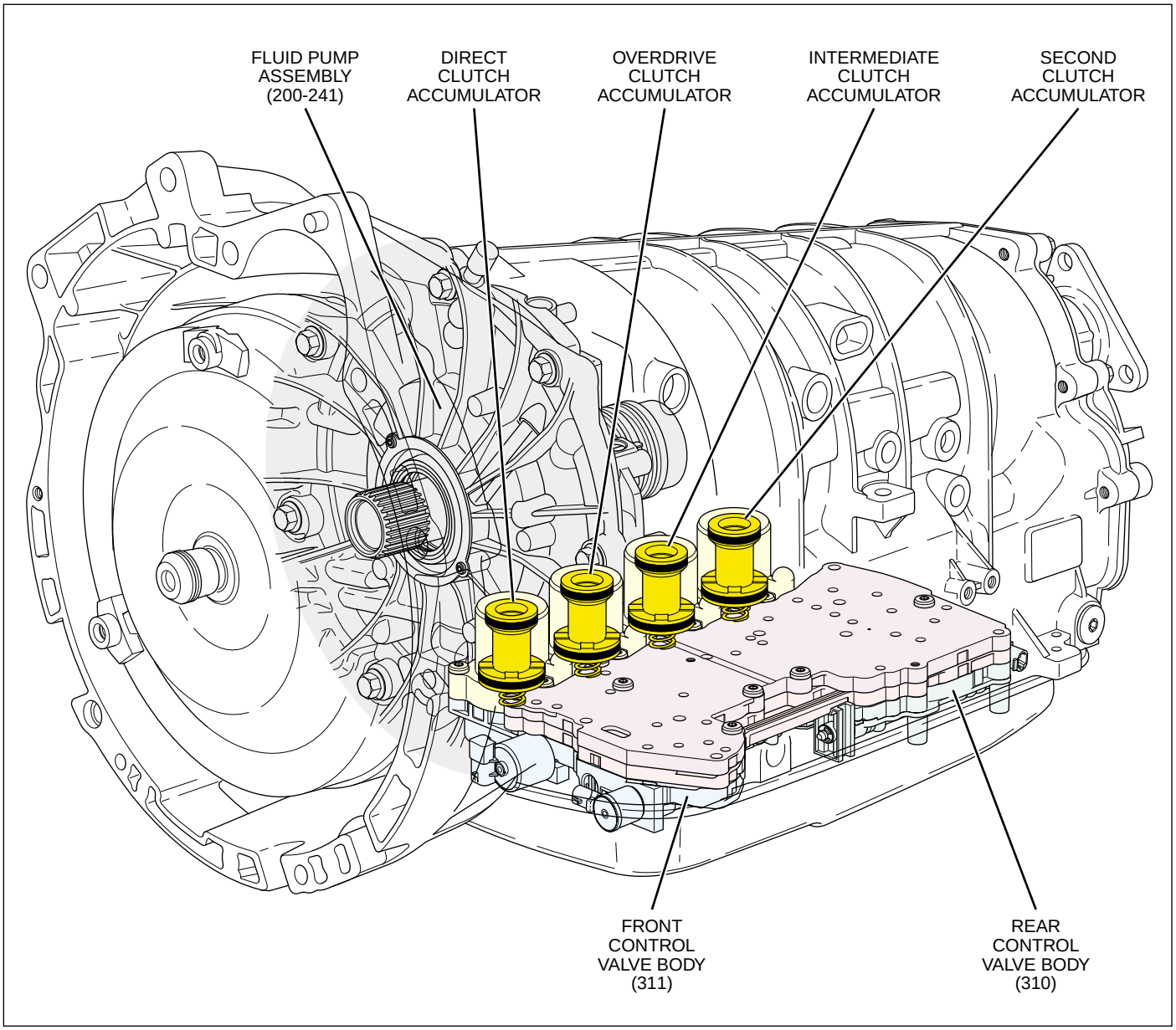
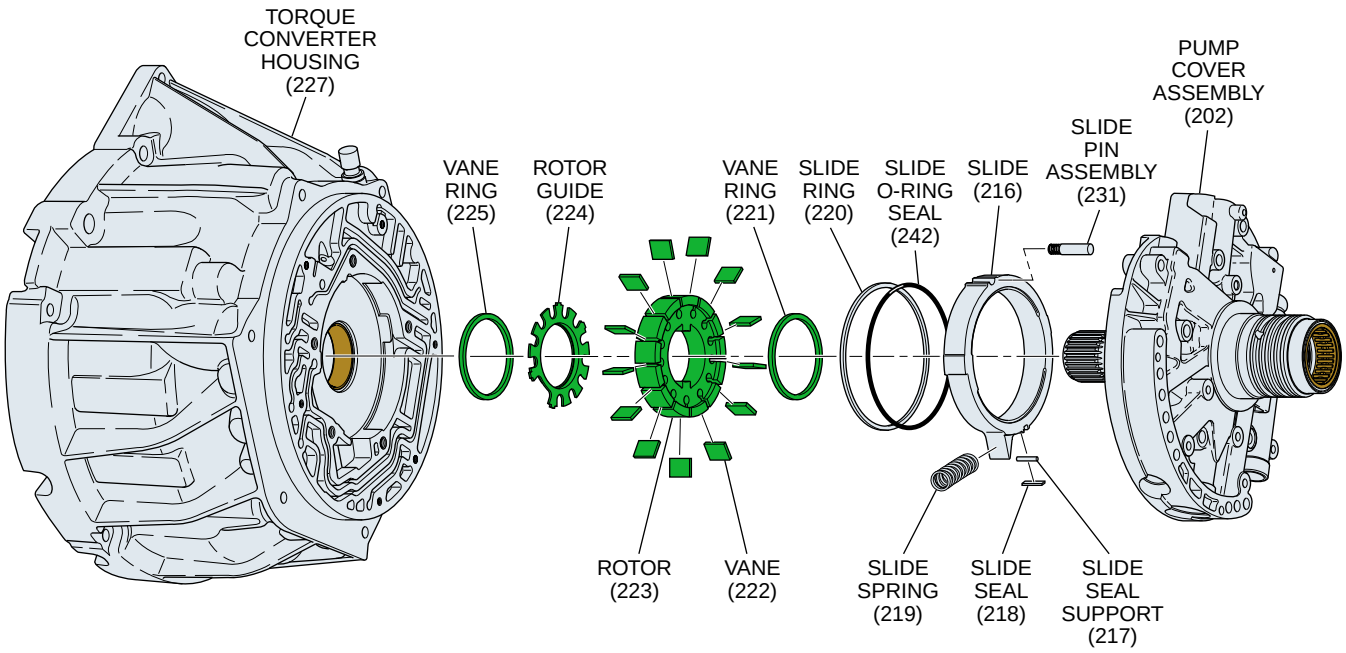
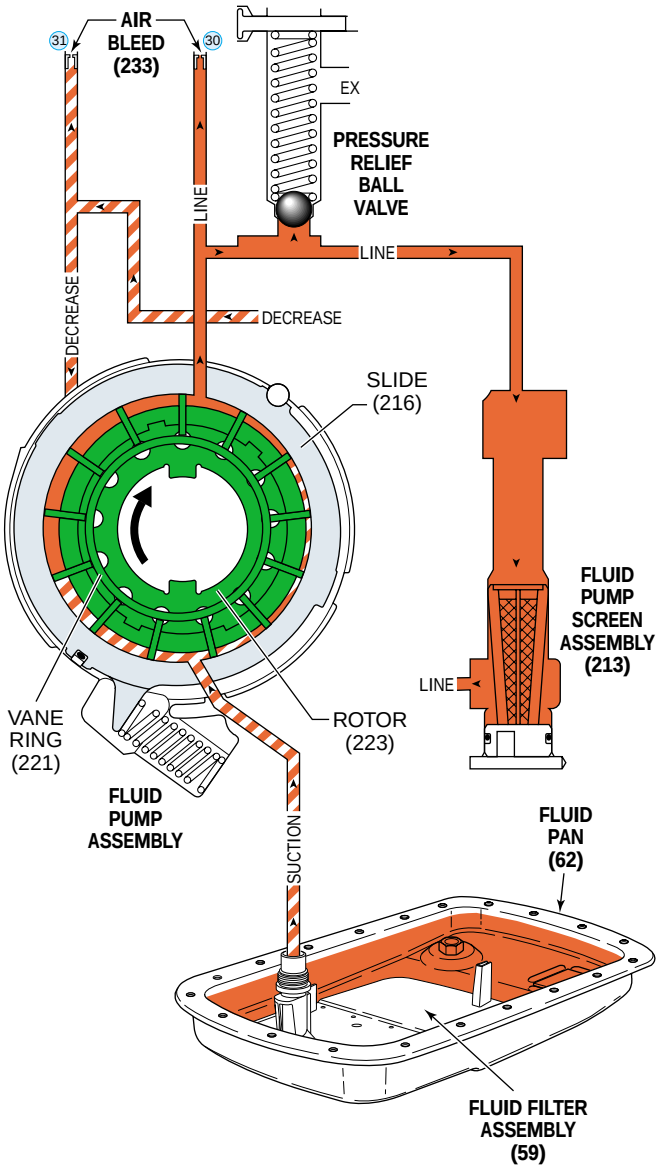


Figure 33

HYDRAULIC CONTROL COMPONENTS

FLUID PUMP ASSEMBLY





FLUID PUMP ASSEMBLY

The fluid pump assembly contains a variable displacement, vane type pump, located in the torque converter housing (227). When the engine is cranking, the torque converter pump hub, which is keyed to the fluid pump rotor (223), turns the rotor at cranking speed. As the fluid pump rotor and the fluid pump vanes (222) begin to rotate, the volume of fluid between the vanes is at its maximum, creating a vacuum at the pump intake port. The vacuum allows atmospheric pressure, acting on the fluid in the bottom pan, to prime the pump quickly and pressurize the hydraulic system when the engine is running.

Fluid from the transmission bottom pan (62) is drawn through the fluid filter assembly (59) and into the fluid pump intake (suction) fluid circuit. This fluid is then forced to rotate around the fluid pump slide (216) to the pump outlet port where the clearance between the fluid pump slide and the fluid pump rotor decreases. Decreasing the volume pressurizes the fluid and forces the fluid into the line pressure fluid circuit. This fluid is directed to the pressure regulator valve and becomes the main supply of fluid to the various components and hydraulic circuits in the transmission.

The events described above occur when the pump is operating at maximum output. Since most normal driving conditions do not require maximum output, the pressure regulator valve will move far enough against spring force to allow excess line pressure fluid to enter the decrease fluid circuit. Decrease pressure is applied to the backside of the fluid pump slide, and moves the slide against pump slide spring (219) pressure to lower the output of the pump. The result is a control of the pump's delivery rate of fluid to the hydraulic system.

Pump Related Diagnostic Tips

- Transmission Overheating
- Loss of drive
- High or low line pressure
- Slipping clutch or harsh apply

Figure 34

HYDRAULIC CONTROL COMPONENTS

PRESSURE REGULATION

The main components that control line pressure are the pressure control solenoid valve and the pressure regulator valve. The fluid pressure required to apply the clutches varies in relation to throttle position and engine torque. At the pressure regulator valve, line pressure is regulated in response to the following:

- throttle signal fluid pressure routed from the pressure control (PC) solenoid valve (this fluid pressure is proportional to engine torque – see page 51). Throttle signal fluid pressure moves the line boost valve (207) against the line boost valve spring (208) which acts against the pressure regulator valve.
- pressure regulator valve spring force.
- line pressure acting on the end of the pressure regulator valve.
- reverse clutch fluid pressure acting on the line boost valve in Reverse.

The pressure regulator valve routes line pressure into both the converter feed and the decrease fluid circuits. Converter feed fluid is routed through the TCC control valve to the torque converter apply and release, and the cooler fluid circuits. Decrease fluid pressure moves the fluid pump slide against the force of the pump slide spring (219).

Pressure Regulation

The PC solenoid valve regulates throttle signal fluid pressure as a function of engine torque (minimum signal pressure at low torque, maximum signal pressure at high torque). Line pressure, acting on the end of the pressure regulator valve, moves the valve against spring force and throttle signal fluid pressure to a point where line pressure enters both the converter feed and the decrease fluid circuits. Decrease fluid pressure moves the pump slide (216) against spring force and toward the center of the pump cavity, causing the slide to partially cover the pump intake port and increase the concentricity between the pump slide and the rotor which, as a consequence, decreases the pump output capacity. Decrease pressure and the position of the pump slide constantly varies depending on driving conditions and the amount of fluid pressure and volume needed to operate the transmission.

Pressure Regulator Related Diagnostic Tips

A stuck or damaged pressure regulator valve could cause:

- High or low line pressure
- Slipping clutches or harsh apply
- Transmission overheating
- Low or no cooler/lube flow

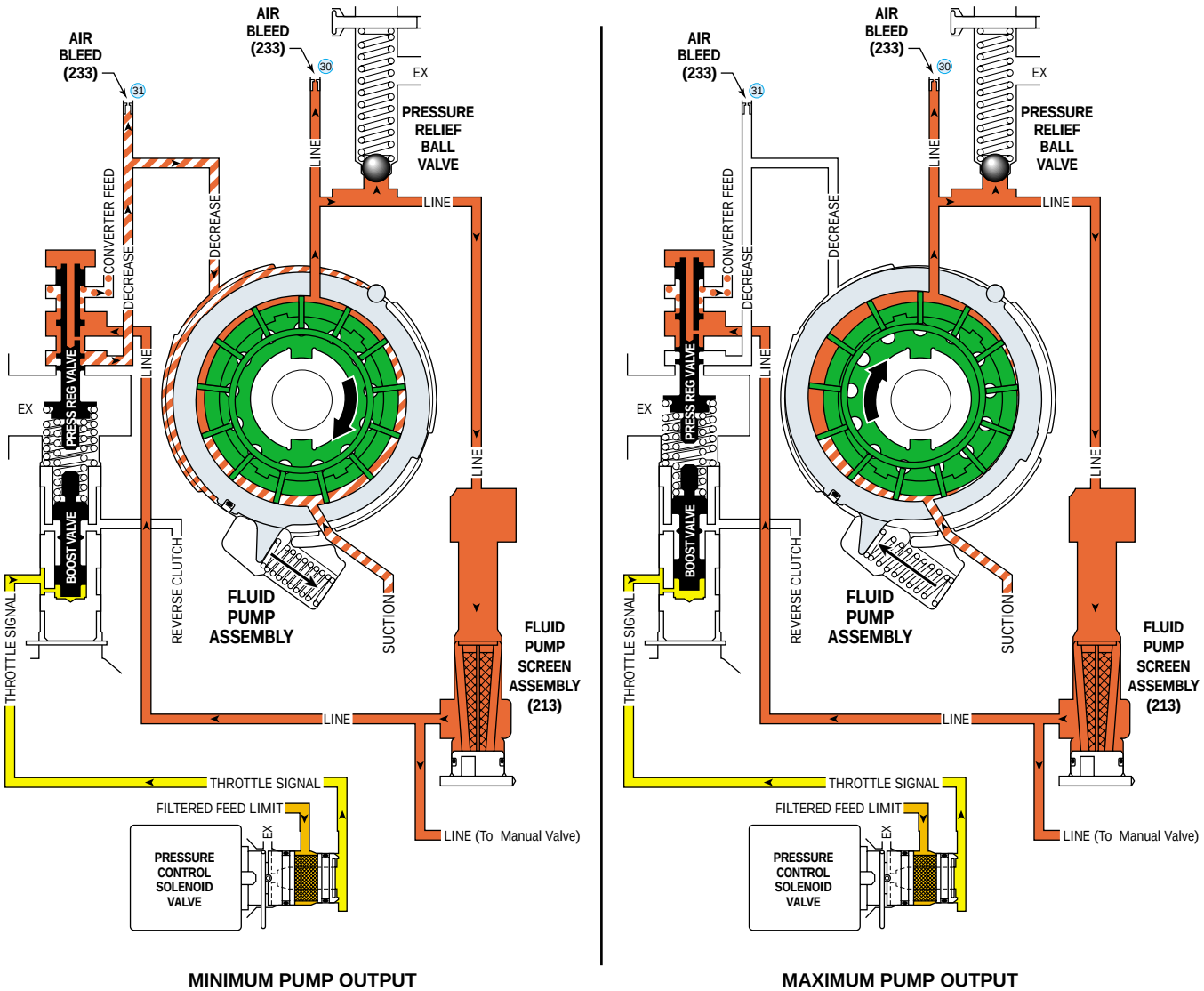


Figure 35

HYDRAULIC CONTROL COMPONENTS

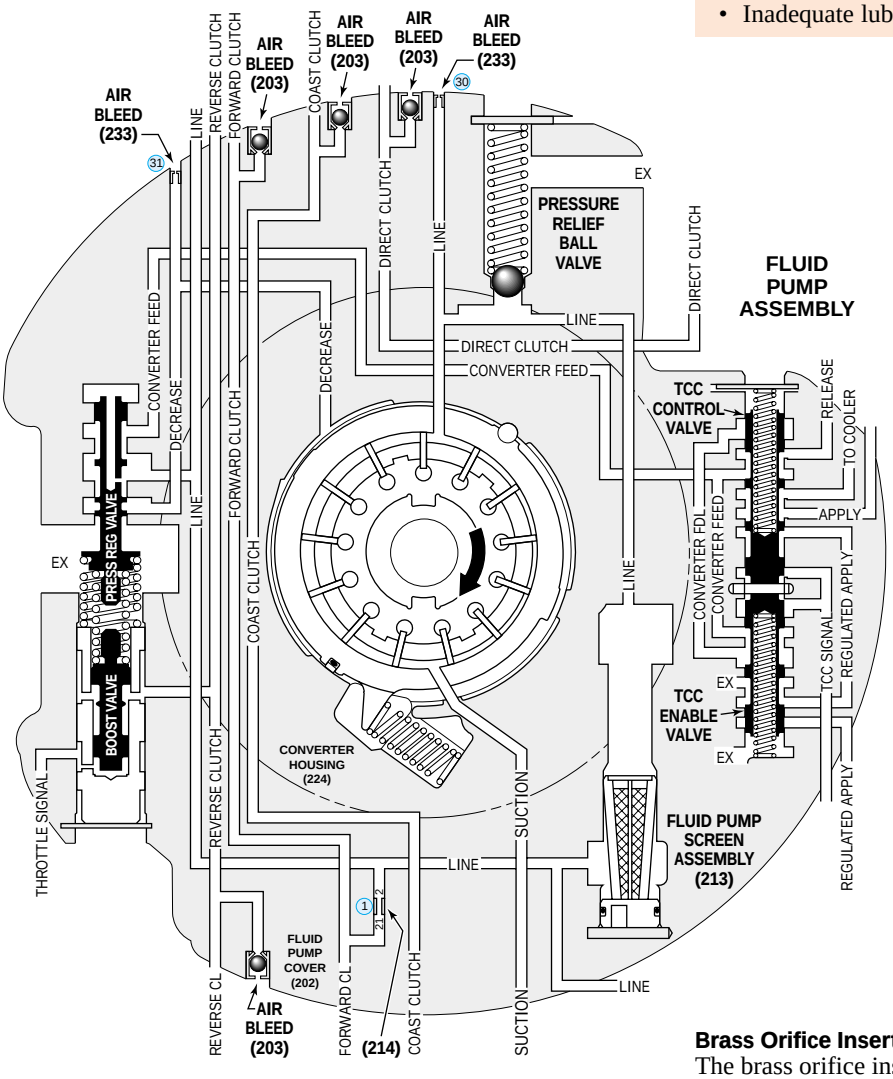
VALVES LOCATED IN THE FLUID PUMP COVER ASSEMBLY

PRESSURE REGULATOR VALVE TRAIN (204-210)

Pressure Regulator Valve (210)
Regulates line pressure in relation to vehicle operating conditions (see page 34 on Pressure Regulation). The pressure regulator valve is biased by throttle signal fluid pressure, pressure regulator spring (209) force, line pressure routed to the end of the valve, and reverse clutch fluid pressure acting on the line boost valve in Reverse. Line pressure is routed through the valve and into both the converter feed and decrease fluid circuits.

- A stuck pressure regulator valve could cause high or low fluid pressure.

Line Boost Valve (207)
Throttle signal fluid pressure moves the line boost valve against the line boost valve spring (208). The line boost valve spring then transfers the force from throttle signal fluid pressure to the pressure regulator valve. Therefore, line pressure increases as throttle position and engine torque increase. Also, reverse clutch fluid pressure acting on the line boost valve increases the operating range of line pressure when the transmission is in Reverse.



Check Valve Retainer and Ball Assemblies (203)
These four assemblies are located in the reverse clutch, forward clutch, direct clutch and coast clutch fluid circuits. When the clutch releases the ball unseats and allows air into the circuit to displace the exhausting fluid.

Pressure Relief Ball Valve (239)
The pressure relief ball valve and spring (238) prevent line pressure from exceeding approximately 2240 to 2520 kPa (320 to 360 psi). Above this pressure, line fluid pressure moves the ball against spring force and exhausts until line pressure decreases sufficiently.

- A pressure relief ball not seated or damaged could cause high or low fluid pressure.

Torque Converter Clutch (TCC) Control Valve (235)
Controlled by the TCC PWM solenoid valve state and TCC signal fluid pressure, it directs converter feed fluid pressure to the release side of the converter clutch and into the cooler fluid circuit. The TCC control valve also directs regulated apply fluid to the apply side of the converter clutch. The valve is held in the release position (as shown) by spring force when the TCC PWM solenoid valve is OFF. With the TCC PWM solenoid valve ON, TCC signal fluid pressure increases and moves the valve into the apply position against spring force.

If stuck, missing or binding, the TCC control valve or spring may cause:
- Incorrect TCC apply or release
- Inadequate lubrication

Torque Converter Clutch (TCC) Enable Valve (237):
When the TCC is released, converter feed fluid passes through the valve and enters the converter feed limit fluid circuit to go on stand by at the TCC control valve. If for any reason the TCC control valve is stuck ON when the TCC is commanded OFF, converter feed limit pressure will enter the release side of the converter preventing overheating of the TCC. When the TCC applies, TCC signal fluid moves the valve against spring force and allows regulated apply pressure to be directed to the TCC control valve and then to the apply side of the TCC.

- If stuck, missing or binding, the TCC enable valve or spring may cause incorrect TCC apply or release.

Brass Orifice Insert (214)
The brass orifice insert is located in the fluid pump cover (202). It is a restriction, between the line and forward clutch fluid circuits, that provides a constant feed to the forward clutch in order to reduce garage shift response time.

Orifice Cup Plugs (233)
Orifice cup plugs are located in the fluid pump cover (202). They allow air to escape from the fluid circuits and prevent pressure oscillations.

Figure 36

HYDRAULIC CONTROL COMPONENTS

VALVES LOCATED IN THE FRONT CONTROL VALVE BODY

Pressure Control (PC) Solenoid Valve Assembly (357):
Controlled by the TCM, it provides controlled throttle signal fluid pressure to the line boost valve (207). (See the Electrical Components Section for additional information.)

- A leaking/damaged o-ring or bad electrical connection can cause high or low line pressure.

Feed Limit Valve (353):
The PC solenoid valve and the shift solenoid valves can not support more than a given fluid pressure. In order not to overload these solenoids, the feed limit valve regulates line fluid pressure into feed limit fluid pressure given by the solenoid design. Force from the feed limit valve spring (354) and orificed feed limit fluid pressure acting on the end of the valve regulate line pressure as it passes through the valve and enters the feed limit circuit. Feed limit pressures will normally equal line pressure when line pressure is below the calibrated limiting values.

- If stuck in the exhaust position, the feed limit valve or spring could cause 5th gear only and low line pressure.

TCC REGULATOR VALVE TRAIN (347-352)

Torque Converter Clutch Pulse Width Modulated (TCC PWM) Solenoid Valve Assembly (352):
Voltage supply is through the ignition switch while the TCM provides the ground to energize the solenoid. The solenoid regulates 2345 or reverse fluid into TCC signal fluid pressure (according to TCC PWM duty cycle) that is routed to the TCC control valve (235), the TCC enable valve (237), the reverse lockout (RLO) valve (385), and to the TCC regulator apply valve (348). (See the Electrical Components Section for additional information.)

- Stuck on, exhaust plugged, would cause no TCC release in 2nd, 3rd, 4th or fifth gear, and no reverse.
- Stuck off, leaking o-ring, no voltage, would cause no TCC/ slip or soft apply.

Torque Converter Clutch (TCC) Regulator Apply Valve (348):
It is controlled by TCC signal fluid pressure on one side of the valve and spring force from the TCC regulator apply valve spring (347) and orificed regulated apply pressure at the other end. When the TCC PWM solenoid valve assembly is energized and TCC signal fluid pressure is present, it regulates line fluid pressure into the regulated apply fluid passage.

- Stuck in the release position would cause no TCC/slip or soft apply.
- Stuck in the maximum pressure position would cause harsh TCC apply.

3-4 SHIFT VALVE TRAIN (343-346)

3-4 Shift Valve (345):
Responds to 2-3 signal fluid pressure acting on the 3-4 shift control valve, 1-2 signal fluid pressure and force from the 3-4 shift valve spring (344). Depending on the transmission gear range operation and the shift solenoid valve states, the valve directs D432 fluid into the 123 fluid circuit to apply the coast clutch, or it directs 345 fluid into the direct clutch and the 45 fluid circuits to apply the direct and overdrive clutches. When in the released position, the valve opens 123 fluid to an exhaust.

- 3-4 shift valve stuck in the applied position could cause no 4th or slips in 4th gear, and no 5th or slips in 5th gear.
- 3-4 shift valve stuck in the released position could cause no engine braking in 1st, 2nd and 3rd gear.

3-4 Shift Control Valve (346):
Responds to 2-3 signal fluid pressure and force from the 3-4 shift valve spring (344). Depending on the transmission gear range operation and the 2-3 shift solenoid valve state, the valve allows D432 fluid to be directed into the 123 fluid circuit to apply the coast clutch. When in the released position, the valve allows 123 clutch fluid to exhaust.

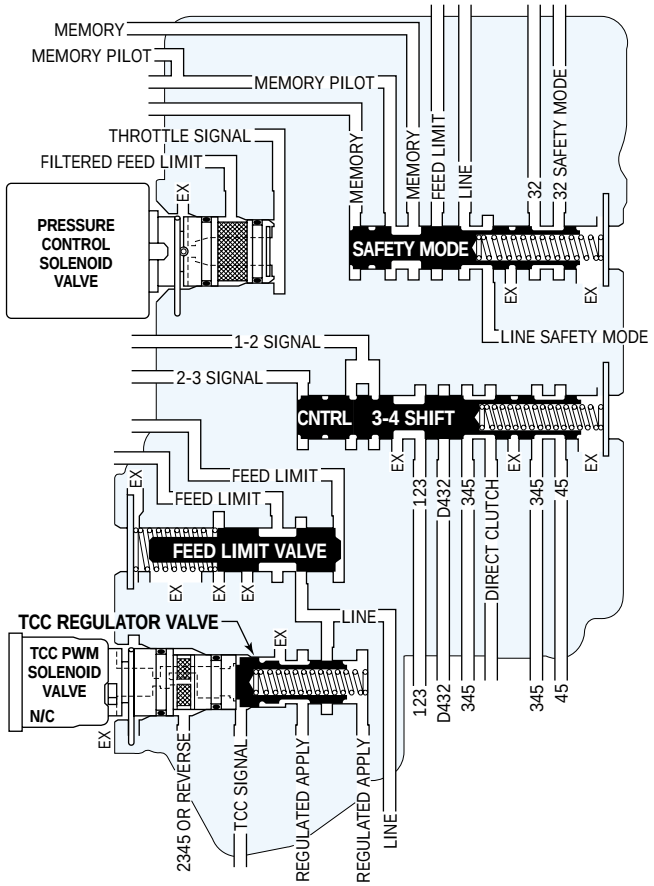
- 3-4 shift control valve stuck in the applied position could cause no 4th or slips in 4th gear, and no 5th or slips in 5th gear.
- 3-4 shift control valve stuck in the released position could cause no engine braking in 1st gear.

HYDRAULIC CONTROL COMPONENTS

VALVES LOCATED IN THE FRONT CONTROL VALVE BODY

Safety Mode Valve (341):
Responds to memory pilot (1-2 signal) fluid pressure and force from the safety mode valve spring (342). Under normal transmission operation, when the first 1-2 shift occurs, the valve is shifted to the applied position by memory pilot fluid. If there is no TCM signal to the shift solenoid valves, the transmission will operate in fifth gear. When the engine is switched off, the valve shifts to the released position and directs (when the engine is restarted) line pressure into the line safety mode fluid circuit allowing the transmission to operate in fourth gear.

- If stuck in the applied position, the transmission could be limited to fifth gear only in Safety Mode.



FRONT CONTROL VALVE BODY

Figure 37

HYDRAULIC CONTROL COMPONENTS

VALVES LOCATED IN THE REAR CONTROL VALVE BODY

Reverse Lockout (RLO) Valve (385):
Responds to TCC signal fluid pressure and force from the reverse lockout valve spring (386). In reverse gear the valve directs reverse fluid into the reverse lockout (RLO) fluid circuit to apply the reverse clutch and the low and reverse clutch. When the TCC PWM solenoid valve provides TCC signal fluid pressure, the RLO valve is applied to block reverse fluid from entering the reverse lockout fluid circuit, thereby preventing reverse clutch or low and reverse clutch apply while the vehicle is moving forward at a speed greater than a value calibratable in the TCM, even if the manual valve is in reverse position.

- Reverse lockout valve stuck in the applied position could cause no reverse gear.
- Reverse lockout valve stuck in the released position could allow the reverse clutch and the low and reverse clutch to apply, if reverse gear is selected while the vehicle is moving forward at any speed, causing transmission damage.

Low Pressure Control Valve (383):
In first, second and third gear coast conditions, when engine braking is desired, 123 braking fluid pressure is regulated through the valve into the 123 regulated fluid circuit by orificed 123 regulated fluid pressure and force from the low pressure control valve spring (382). Depending on the transmission gear and the shift solenoid valve operating states, 123 regulated fluid is directed to provide engine braking through a controlled apply of the low and reverse clutch, the second coast clutch or the overdrive clutch.

- A missing, stuck or incorrectly assembled low pressure control valve could cause harsh or no engine braking in 1st, 2nd, or third gear.

1-2 SHIFT VALVE TRAIN (343, 349-351, 366-368, 387-388)

1-2 Shift Solenoid (SS) Valve Assembly (368):
The 1-2 SS valve assembly is a normally closed, 3-port, ON/OFF type solenoid controlled by the TCM. When energized (ON) in Second and Third Gear, the 1-2 SS valve assembly fluid inlet port opens allowing feed limit fluid to pressurize the 1-2 signal fluid circuit. 1-2 signal fluid pressure acts on the 1-2 shift control valve and the 3-4 shift valve to control the shift valve positioning for the appropriate gear range. 1-2 signal (memory pilot) fluid pressure also acts on the safety mode valve to provide safe transmission operation if there is no TCM signal to the shift solenoid valves. When de-energized (OFF), the solenoid inlet port is closed and 1-2 signal fluid is exhausted through the solenoid exhaust port. (See the Electrical Components Section for more detail.)

- 1-2 SS valve stuck off or leaking could cause a 1st, 4th and 5th gear only condition.
- 1-2 SS valve stuck on could cause 2nd and 3rd gears only.

1-2 Shift Control Valve (366):
Responds to 1-2 signal fluid pressure, 2-3 signal fluid pressure, and force from the 1-2 shift control valve spring (367). Depending on the transmission gear range operation, 1-2 shift solenoid valve and 2-3 shift solenoid valve operating states, the valve directs feed limit fluid into the FDL fluid circuit in order to apply the 1-2 shift valve. When released, the valve opens FDL fluid to exhaust.

- 1-2 shift control valve stuck in the applied position could cause 1st gear only.
- 1-2 shift control valve stuck in the released position could cause no 1st gear.

1-2 Shift Valve (387):
Responds to FDL fluid pressure and force from the 1-2 shift valve spring (388). Depending on the transmission gear range operation, 1-2 shift solenoid valve and 2-3 shift solenoid valve operating states, the valve directs 123 regulated fluid into the low and reverse clutch fluid circuit in order to provide engine braking. When released, the valve directs D432 fluid into the 2345 fluid circuit and the second clutch fluid circuit.

- 1-2 shift valve stuck in the applied position could cause no 2nd, 3rd, 4th or 5th gear.
- 1-2 shift valve stuck in the released position could cause no 1st gear.

2-3 SHIFT VALVE TRAIN (349-351, 369-372)

2-3 Shift Solenoid (SS) Valve Assembly (369):
The 2-3 SS valve assembly is a normally closed, 3-port, ON/OFF type solenoid controlled by the TCM. When energized (ON) in First and Second Gear, the 2-3 SS valve assembly fluid inlet port opens allowing feed limit fluid to pressurize the 2-3 signal fluid circuit. 2-3 signal fluid pressure acts on the 2-3 shift control valve, the 1-2 shift control valve, and the 3-4 shift control valve to control the shift valve positioning for the appropriate gear range. When de-energized (OFF), the solenoid inlet port is closed and 2-3 signal fluid is exhausted through the solenoid exhaust port. (See the Electrical Components Section for more detail.)

- 2-3 SS valve stuck off or leaking could cause no 1st or 2nd gear.
- 2-3 SS valve stuck on could cause 1st and 2nd gears only.

2-3 Shift Control Valve (370) and 2-3 Shift Valve (371):
The 2-3 shift valve train responds to 2-3 signal fluid pressure and force from the 2-3 shift valve spring (372). Depending on the transmission gear range operation and the 2-3 shift solenoid valve state, the valve train controls the routing and exhausting of various fluids to obtain the appropriate gear range as determined by the TCM or gear selector lever.

- 2-3 shift valve stuck in the applied position could cause 1st or 2nd gear only.
- 2-3 shift valve stuck in the released position could cause no 3rd, 4th or 5th gears.

HYDRAULIC CONTROL COMPONENTS

VALVES LOCATED IN THE REAR CONTROL VALVE BODY

4-5 SHIFT VALVE TRAIN (349-351, 373-376)

4-5 Shift Solenoid (SS) Valve Assembly (376):
The 4-5 SS valve assembly is a normally closed, 3-port, ON/OFF type solenoid controlled by the TCM. When energized (ON) in Fourth Gear, the 4-5 SS valve assembly fluid inlet port opens allowing feed limit fluid to pressurize the 4-5 signal fluid circuit. 4-5 signal fluid pressure acts on the 4-5 shift control valve to help control the 4-5 shift valve positioning for the appropriate gear range. When de-energized (OFF), the solenoid inlet port is closed and 4-5 signal fluid is exhausted through the solenoid exhaust port. (See the Electrical Components Section for more detail.)

- 4-5 SS valve stuck off or leaking could cause no 4th gear and no engine braking in 1st, 2nd or 3rd gears.
- 4-5 SS valve stuck on could cause no 5th gear.

4-5 Shift Control Valve (375) and 4-5 Shift Valve (374):
The 4-5 shift valve train responds to 4-5 signal fluid pressure and force from the 4-5 shift valve spring (373). Depending on the transmission gear range operation and the 4-5 shift solenoid valve state, the valve train controls the routing and exhausting of various fluids to obtain the appropriate gear range as determined by the TCM or gear selector lever.

- 4-5 shift valve stuck in the applied position could cause no 5th gear.
- 4-5 shift valve stuck in the released position could cause no 4th gear and no engine braking in 1st, 2nd or 3rd gears.

Manual Valve (377):
The manual valve is fed by line pressure from the fluid pump assembly and is mechanically linked to the gear selector lever. When a gear range is selected, the manual valve directs line pressure into the various circuits by opening and closing feed passages. The circuits that are fed by the manual valve are: Reverse, D432, and 32.

Stuck, misaligned or damaged, the manual valve and linkage could cause:

- No Park
- No reverse or slips in reverse
- Drives in Neutral
- No Drive
- No gear selections
- Shift indicator indicates wrong gear selection

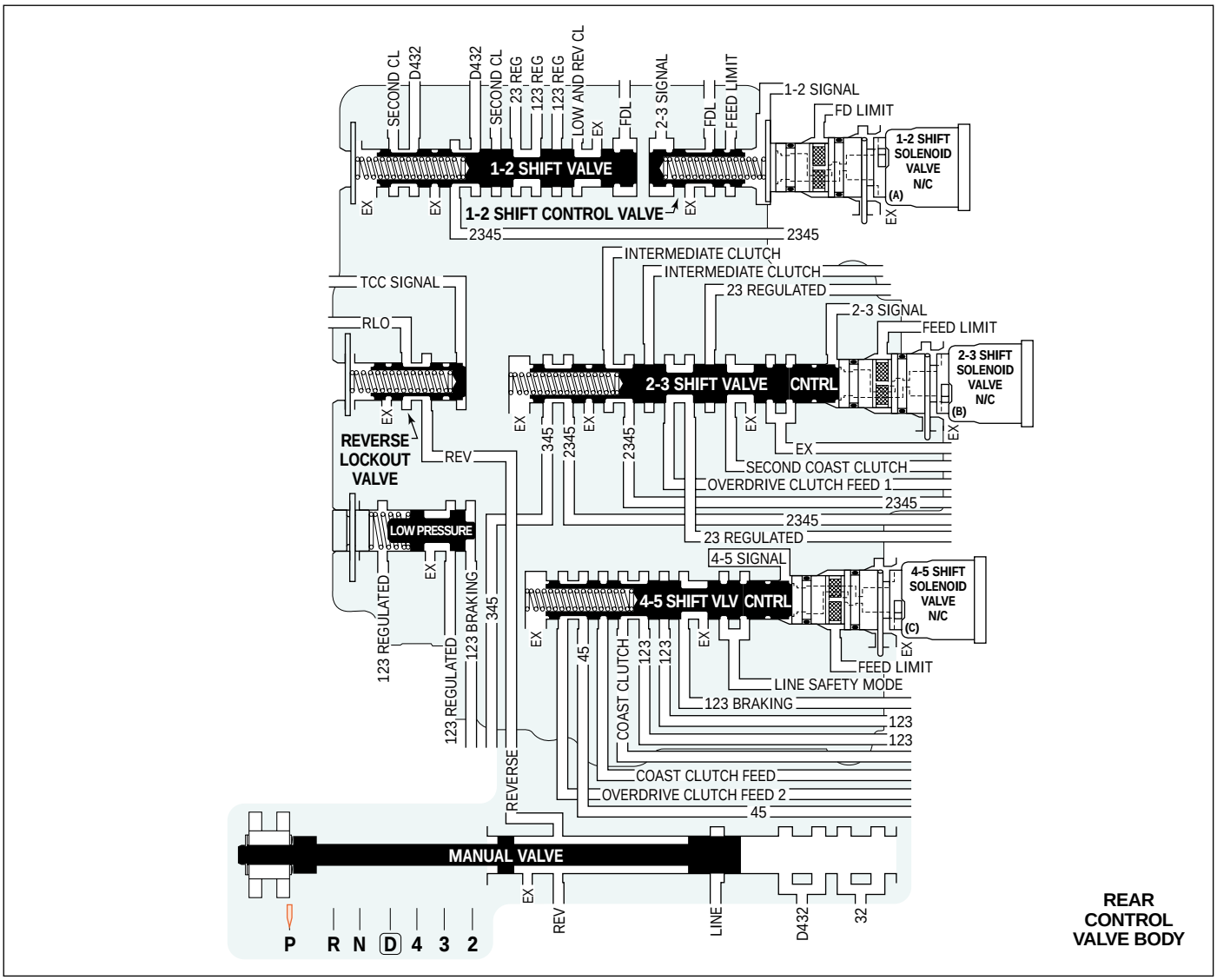
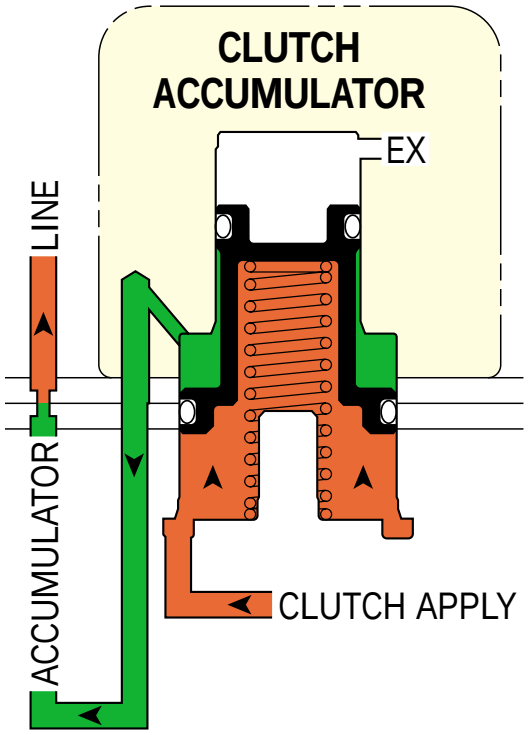
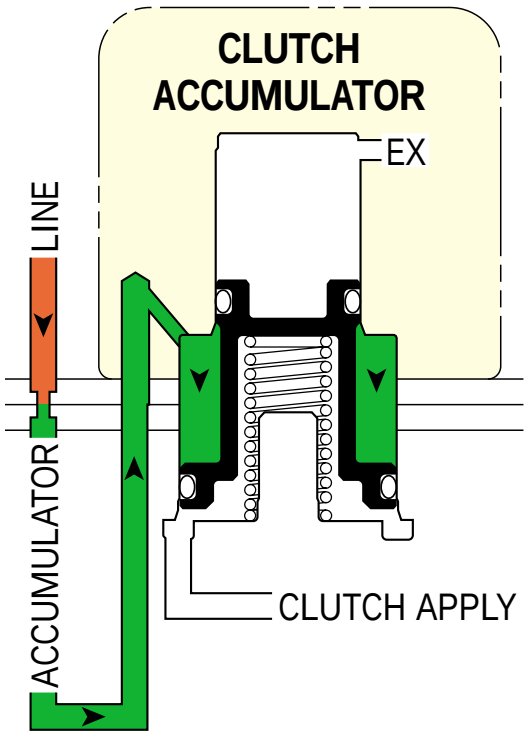


Figure 38

HYDRAULIC CONTROL COMPONENTS



UPSHIFT CONTROL
- **CLUTCH APPLIED**
- **ACCUMULATOR ABSORBS EXCESS APPLY PRESSURE**



DOWNSHIFT CONTROL
- **CLUTCH RELEASED**
- **ACCUMULATOR READY FOR UPSHIFT**

ACCUMULATORS

In the Hydra-matic 4/5L40-E, accumulators are used to control shift feel for the apply of the second clutch (2nd), the intermediate clutch (3rd), the direct clutch (4th), and the overdrive clutch (5th). All four of these accumulators function identically.

An accumulator is a fluid pressure operated component that absorbs a certain amount of clutch apply fluid pressure to cushion the clutch engagement.

Clutch apply fluid pressure, directed to an accumulator piston and helped by a spring force, opposes an accumulator fluid pressure to create an action similar to a shock absorber.

Upshift Control:

During the clutch apply, clutch apply fluid pressure moves the clutch piston against the clutch piston spring and clutch plates. After the clearance between the clutch plates is taken up by the clutch piston travel and the clutch plates begin to hold, fluid pressure in the circuit builds up rapidly. This clutch apply fluid pressure is also directed to an accumulator assembly. As clutch apply fluid pressure increases, the accumulator piston moves to an intermediate position determined by the equilibrium between accumulator fluid pressure and clutch apply fluid pressure, assisted by the accumulator spring force. The movement of the accumulator piston delays the pressure buildup in the circuit and allows for a more gradual clutch apply. Without an accumulator in the circuit, this rapid buildup of clutch apply fluid pressure would cause the clutch to grab very quickly and create a harsh shift.

The force of the accumulator fluid pressure controls the rate at which the clutch is applied. Because accumulator fluid pressure is supplied by line fluid pressure, it is affected by engine throttle position. At minimum or light throttle, engine torque is at a minimum and the clutch requires less apply force. At heavy throttle, the engine develops a large amount of torque which requires a greater apply pressure to hold the clutch. To accommodate these various conditions, the pressure regulator valve (210) regulates line fluid pressure, and therefore accumulator fluid pressure, in order to control shift feel in the transmission. At greater throttle positions, accumulator fluid pressure increases, thereby creating less cushion for the clutch apply fluid during an upshift. Remember that throttle signal fluid acting on the pressure regulator valve (210) is regulated according to engine torque by the pressure control (PC) solenoid valve (357).

Downshift Control:

During a downshift, the clutch apply fluid pressure is exhausted from the accumulator assembly by the shift valve. Accumulator fluid pressure, supplied by orificed line fluid pressure from the fluid pump, fills the accumulator with fluid and returns the piston to its initial position in preparation for another upshift. Orificing line fluid pressure helps control the rate at which accumulator fluid pressure fills the accumulator and the rate at which clutch apply fluid exhausts. If clutch apply fluid exhausts too quickly, pressure could build up in the clutch apply circuit. This would cause the clutch to release too slowly and possibly “drag” and damage the clutch.

Figure 39

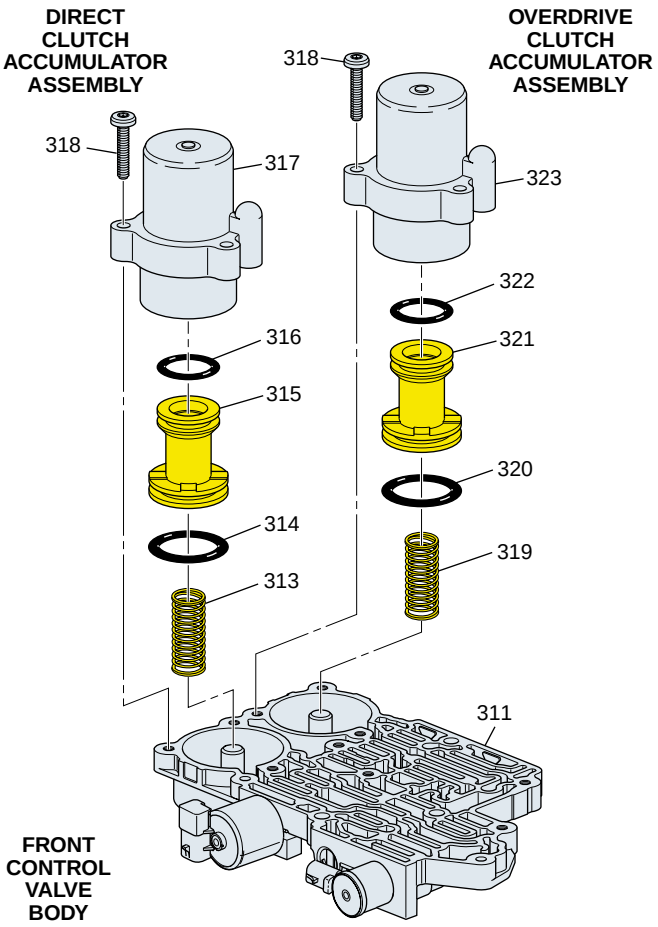
HYDRAULIC CONTROL COMPONENTS

DIRECT CLUTCH ACCUMULATOR ASSEMBLY:
The direct clutch accumulator assembly is located in an accumulator housing bolted to the front control valve body and consists of the direct clutch accumulator piston (315) and the direct clutch accumulator piston spring (313). The direct clutch accumulator assembly is the primary component for controlling the shift feel of a 3-4 shift.

- A leak at the accumulator piston seal or porosity in the accumulator housing could cause slipping during a 3-4 shift.
- A stuck accumulator piston would cause harsh 3-4 shifts.

OVERDRIVE CLUTCH ACCUMULATOR ASSEMBLY:
The overdrive clutch accumulator assembly is located in an accumulator housing bolted to the front control valve body and consists of the overdrive clutch accumulator piston (321) and the overdrive clutch accumulator piston spring (319). The overdrive clutch accumulator assembly is the primary component for controlling the shift feel of a 4-5 shift.

- A leak at the accumulator piston seal or porosity in the accumulator housing could cause slipping during a 4-5 shift.
- A stuck accumulator piston would cause harsh 4-5 shifts.



INTERMEDIATE CLUTCH ACCUMULATOR ASSEMBLY:
The intermediate clutch accumulator assembly is located in an accumulator housing bolted to the rear control valve body and consists of the intermediate clutch accumulator piston (326) and the intermediate clutch accumulator piston spring (324). The intermediate clutch accumulator assembly is the primary component for controlling the shift feel of a 2-3 shift.

- A leak at the accumulator piston seal or porosity in the accumulator housing could cause slipping during a 2-3 shift.
- A stuck accumulator piston would cause harsh 2-3 shifts.

SECOND CLUTCH ACCUMULATOR ASSEMBLY *:
The second clutch accumulator assembly is located in an accumulator housing bolted to the rear control valve body and consists of the second clutch accumulator piston (331) and the second clutch accumulator piston spring (329). The second clutch accumulator assembly is the primary component for controlling the shift feel of a 1-2 shift.

- A leak at the accumulator piston seal or porosity in the accumulator housing could cause slipping during a 1-2 shift.
- A stuck accumulator piston would cause harsh 1-2 shifts.

*Note: The second clutch accumulator assembly is used for the 5L40-E only.

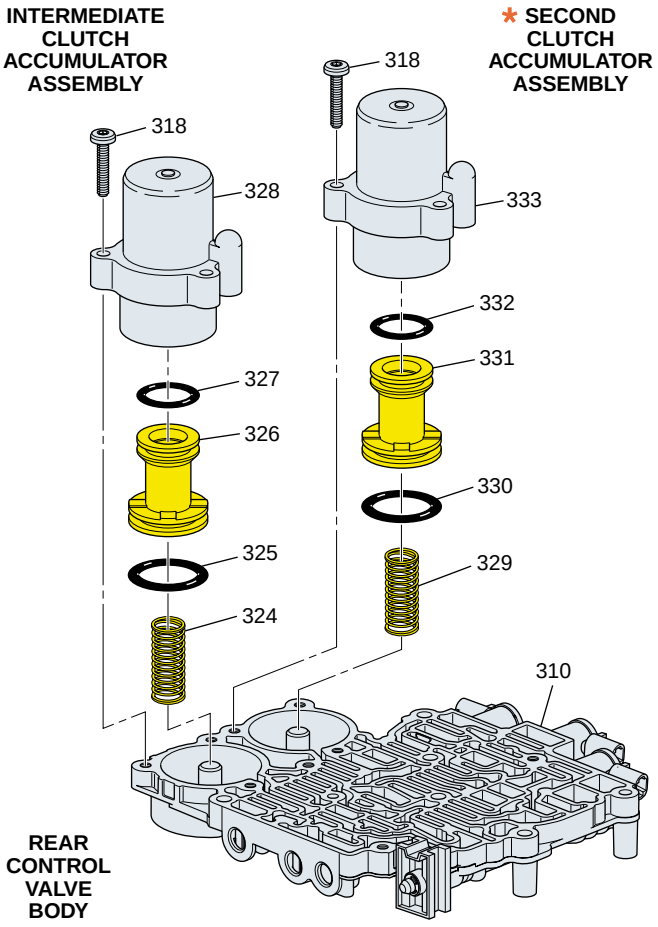


Figure 40

HYDRAULIC CONTROL COMPONENTS

BALL CHECK VALVES LOCATION AND FUNCTION

#1 REVERSE CLUTCH:
Located in the bottom channel plate, it seats to force reverse lockout fluid through orifice 13 on the spacer plate and into the reverse clutch fluid circuit. This helps control the apply rate of the reverse clutch. When the reverse clutch releases, exhausting reverse clutch fluid unseats, and flows past, the #1 ball check valve and into the reverse lockout fluid circuit. This allows for a faster exhaust of reverse clutch fluid and a quick release of the reverse clutch.

#2 REVERSE/2345:
Located in the bottom channel plate, it allows either reverse fluid (in Reverse) or 2345 fluid (in Second, Third, Fourth and Fifth) to enter the 2345 or reverse fluid circuit while blocking the other fluid circuit.

#3 45:
Located in the bottom channel plate, it seats to force 45 fluid through orifice 27 to help control the apply rate of the overdrive clutch. When the clutch releases, exhausting 45 fluid unseats, and flows past, the #3 ball check valve. This allows for a faster exhaust of 45 fluid and a quick release of the overdrive clutch assembly.

#4 123:
Located in the bottom channel plate, it seats to force 123 fluid through orifice 16 to help control the apply rate of the coast clutch. When the coast clutch releases, exhausting 123 fluid unseats, and flows past, the #4 ball check valve. This allows for a faster exhaust of 123 fluid and a quick release of the coast clutch.

#5 COAST CLUTCH:
Located in the bottom channel plate, it seats to force forward clutch fluid through orifice 17 before entering the coast clutch feed circuit. This helps control the apply rate of the coast clutch. When the coast clutch releases, exhausting coast clutch feed fluid unseats, and flows past, the #5 ball check valve. This allows for a faster exhaust of coast clutch feed fluid and a quick release of the coast clutch.

#6 D432/FORWARD CLUTCH:
Located in the bottom channel plate, it seats to force D432 fluid through orifice 15 before entering the forward clutch circuit. This helps control the apply rate of the forward clutch. When the forward clutch releases, exhausting D432 feed fluid unseats, and flows past, the #6 ball check valve. This allows for a faster exhaust of D432 fluid and a quick release of the forward clutch.

#7 FORWARD CLUTCH/COAST CLUTCH:
Located in the bottom channel plate, it is seated by a calibrated spring and provides extra D432 fluid flow into the forward clutch and coast clutch circuits to reduce garage shift response time.

#8 LOW AND REVERSE CLUTCH OR RLO:
Located in the bottom channel plate, it allows either low and reverse clutch fluid (in a First gear coast condition) or reverse lockout (RLO) fluid (in Reverse) to enter the low and reverse clutch or RLO fluid circuit while blocking the other fluid circuit. Low and reverse clutch or RLO fluid is used to apply the low and reverse clutch.

#9 23 REGULATED/OVERDRIVE CLUTCH FEED 1:
Located in the bottom channel plate, it seats to force 23 regulated fluid through orifice 22 before entering the overdrive clutch feed 1 circuit. This helps control the apply rate of the overdrive clutch in a Third gear coast condition. When the overdrive clutch releases, exhausting 23 regulated fluid unseats, and flows past, the #9 ball check valve. This allows for a faster exhaust of 23 regulated fluid and a quick release of the overdrive clutch.

#10 32 SAFETY MODE/FDL:
Located in the bottom channel plate, it allows either 32 safety mode fluid (in Safety Mode operation only) or FDL fluid (in First gear) to enter the 32 safety mode or FDL fluid circuit while blocking the other fluid circuit.

#11 23 REGULATED/SECOND COAST CLUTCH (Used Only On 5L40-E Models):
Located in the bottom channel plate, it seats to force 23 regulated fluid through orifice 23 before entering the second coast clutch circuit. This helps control the apply rate of the second coast clutch in a Second gear coast condition. When the second coast clutch releases, exhausting 23 regulated fluid unseats, and flows past, the #11 ball check valve. This allows for a faster exhaust of 23 regulated fluid and a quick release of the second coast clutch.

#12 OVERDRIVE CLUTCH FEED:
Located in the bottom channel plate, it allows either overdrive clutch feed 1 fluid (in a Third gear coast condition) or overdrive clutch feed 2 fluid (in Fifth gear) to enter the overdrive clutch fluid circuit while blocking the other fluid circuit. Overdrive clutch fluid is used to apply the overdrive clutch.

Ball Check Valves Related Diagnostic Tips

Understanding the design principle of each ball check valve will help in the diagnosis of hydraulic related conditions. For example:

- A harsh shift complaint could be caused by a stuck or missing ball check valve.
- Slow reverse or disengagement could be caused by a stuck #1 ball check valve.
- No engine compression braking in manual first could be caused by a missing or stuck #8 ball check valve.

HYDRAULIC CONTROL COMPONENTS

BALL CHECK VALVES LOCATION AND FUNCTION

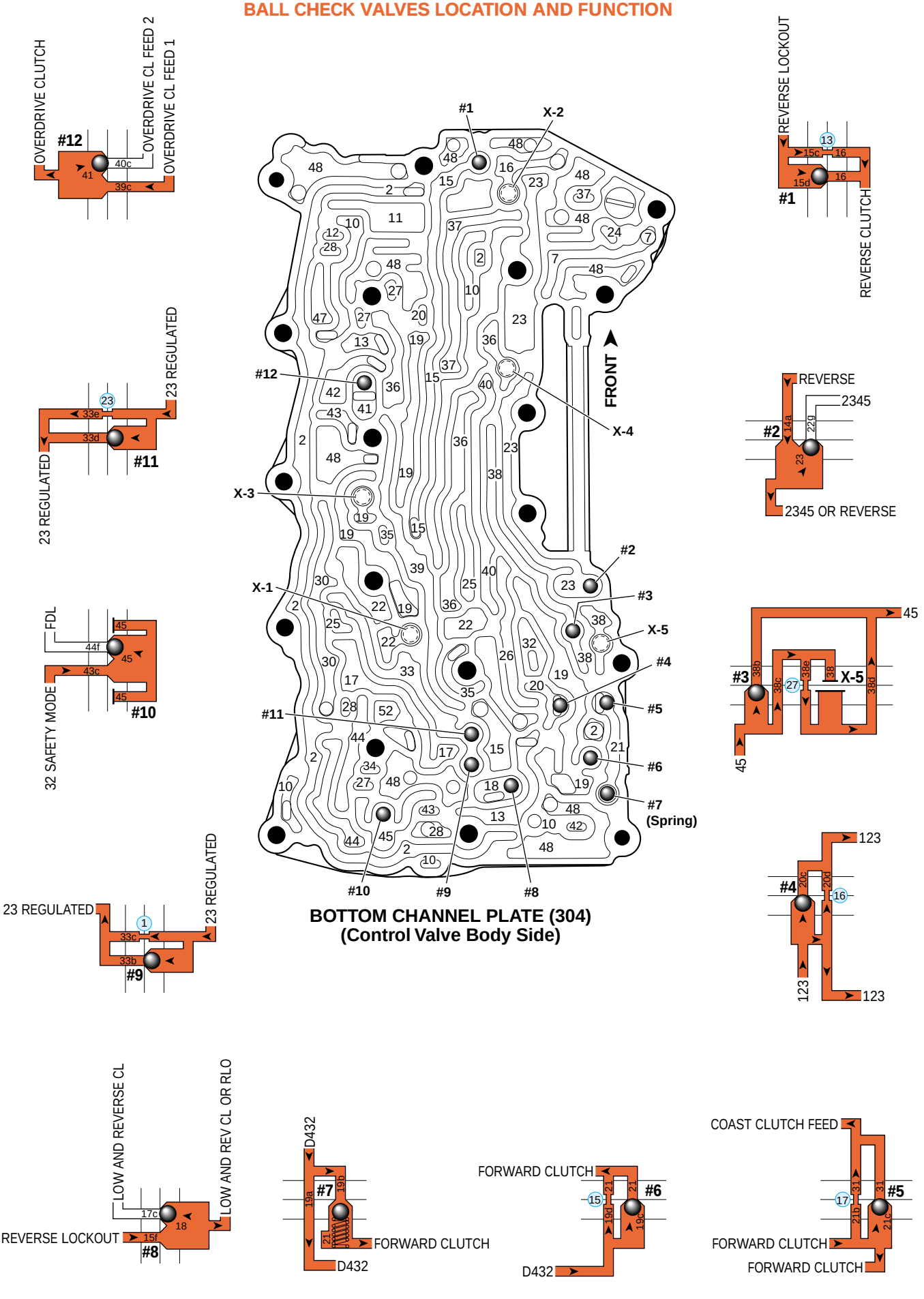


Figure 41

NOTES

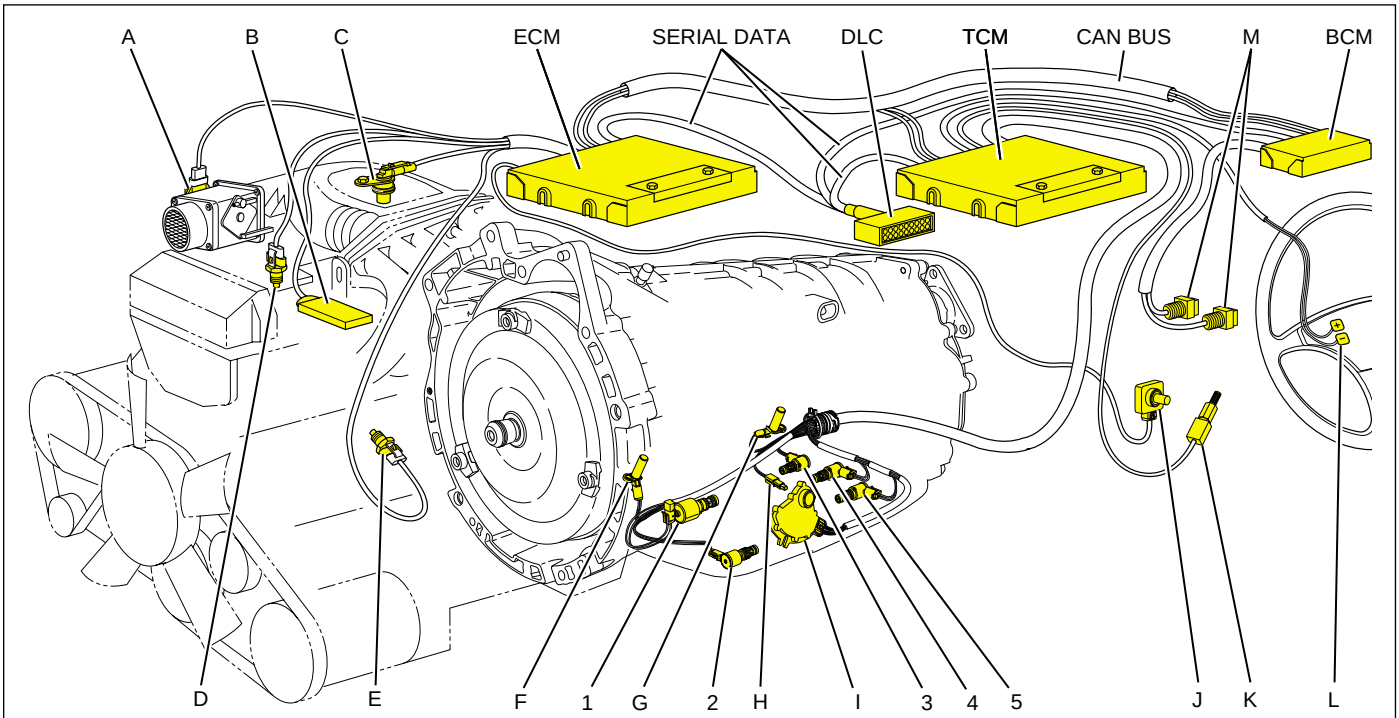
ELECTRICAL COMPONENTS

The Hydra-matic 4/5L40-E transmission incorporates electronic controls that utilize the transmission control module (TCM) (see Note below) to control shift points (through shift solenoid valves), torque converter clutch (TCC) apply and release [through the torque converter clutch pulse width modulated (TCC PWM) solenoid] and line pressure [through the pressure control (PC) solenoid valve]. Electrical signals from various sensors provide information to the TCM about vehicle speed, throttle position, engine coolant temperature, transmission fluid temperature, gear range selector position, engine speed, converter turbine speed, engine load braking and operating mode. The TCM uses this information to determine the precise moment to upshift or downshift, apply or release the TCC and what fluid pressure is needed to apply the clutches. This type of control provides consistent and precise 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 of the shift solenoid valves will be de-energized (turned OFF). This "Safety Mode" operating state of the solenoids forces the transmission to operate in Fifth gear regardless of other vehicle operating conditions when the gear selector is in a forward drive range. Also, in "Safety Mode" the PC solenoid valve is turned off which increases line pressure to a maximum and the TCC PWM solenoid valve cannot apply the TCC. This allows the vehicle to be operated safely, despite the disabled electronic controls, until the condition can be corrected.

Another feature of the Hydra-matic 4/5L40-E is the electronic control of engine braking. In Overdrive Range, Manual Fourth, Manual Third, and Manual Second, engine braking in first, second and third gear can be obtained if desired by activation of the 4-5 shift solenoid valve.

Note: Some models utilize a Powertrain Control Module (PCM) instead of a TCM. The PCM functions similar to the TCM but does incorporate some different controls. However, throughout this publication only the TCM is referenced for simplicity. Refer to the appropriate General Motors Service Manual for a description of PCM controls.



INPUTS

INFORMATION SENSORS

- A. THROTTLE POSITION (TP) SENSOR
- B. MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
- C. ENGINE SPEED SENSOR
- D. MANIFOLD AIR TEMPERATURE (MAT) SENSOR
- E. ENGINE COOLANT TEMPERATURE (ECT) SENSOR
- F. TRANSMISSION INPUT SPEED SENSOR (A/T ISS)
- G. TRANSMISSION OUTPUT SPEED SENSOR (A/T OSS)
- H. TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR
- I. TRANSMISSION MANUAL SHIFT SHAFT SWITCH ASSEMBLY
- J. ACCELERATOR PEDAL POSITION (APP) SENSOR
- K. TCC BRAKE SWITCH
- L. DRIVER SHIFT CONTROL (DSC) SWITCHES
- M. OPERATING MODE SELECTION SWITCHES

ELECTRONIC CONTROLLERS

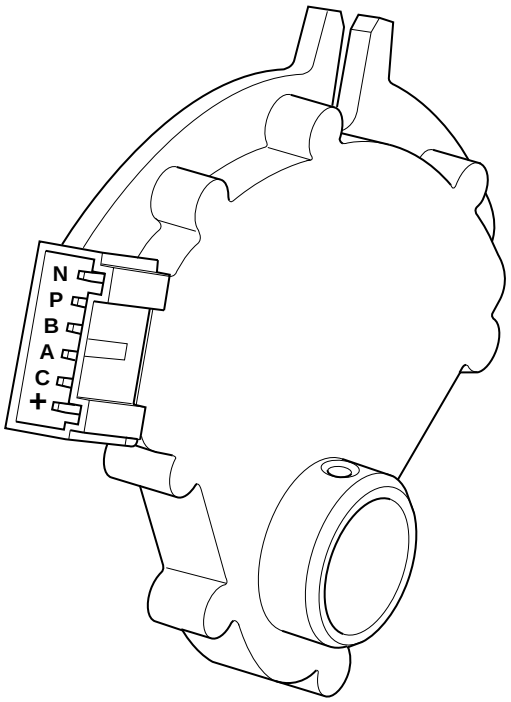
- TRANSMISSION CONTROL MODULE (TCM) OR POWERTRAIN CONTROL MODULE (PCM) (SEE NOTE ABOVE)
- ENGINE CONTROL MODULE (ECM)
- BODY CONTROL MODULE (BCM)
- ELECTRONIC BRAKE AND TRACTION CONTROL MODULE (EBTCM) (NOT SHOWN)
- DIAGNOSTIC LINK CONNECTOR (DLC)

OUTPUTS

ELECTRONICALLY CONTROLLED TRANSMISSION COMPONENTS

1. PRESSURE CONTROL (PC) SOLENOID VALVE
2. TORQUE CONVERTER CLUTCH PULSE WIDTH MODULATION (TCC PWM) SOLENOID
3. 1-2 SHIFT SOLENOID (SS) VALVE
4. 2-3 SHIFT SOLENOID (SS) VALVE
5. 4-5 SHIFT SOLENOID (SS) VALVE

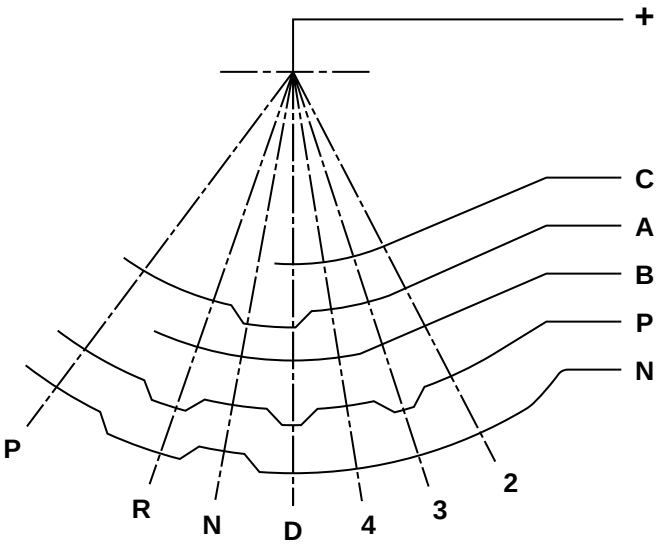
Figure 42



TRANSMISSION MANUAL SHIFT SHAFT SWITCH ASSEMBLY (602)

TRANSMISSION MANUAL SHIFT SHAFT SWITCH ASSEMBLY (602):

The transmission manual shift shaft switch assembly (602) is a sliding contact switch attached to the manual shift shaft inside the transmission case. The five inputs to the TCM from the transmission manual shift shaft switch assembly indicate which position is selected by the transmission selector lever. 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 Mode A, Mode B, Mode C, Mode P (Parity) and Mode N (P/N Start).



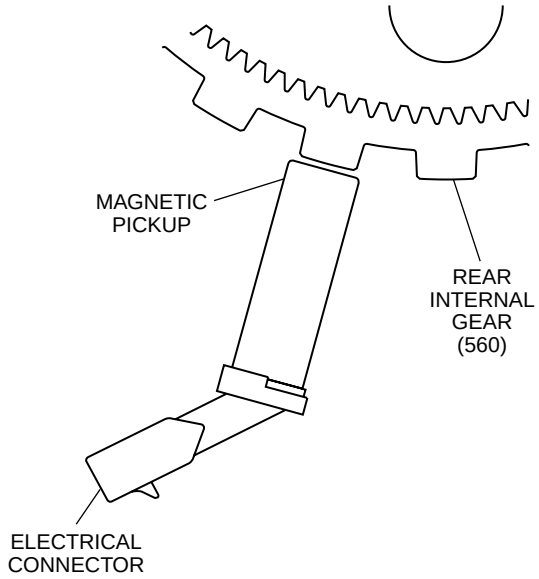
If the TCM detects an improper signal from the transmission manual shift shaft switch assembly, a DTC will be activated.

The DTC strategy may be different depending on the customer/application (refer to the appropriate Service Information).

RANGE INDICATOR	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	1	0	0
Manual Fourth	1	1	1	1	0
Manual Third	1	0	1	0	0
Manual Second	0	0	1	1	0

1 = Closed (Resistance <50 ohms)
0 = Open (Resistance >50k ohms)

Figure 43



OUTPUT SPEED SENSOR

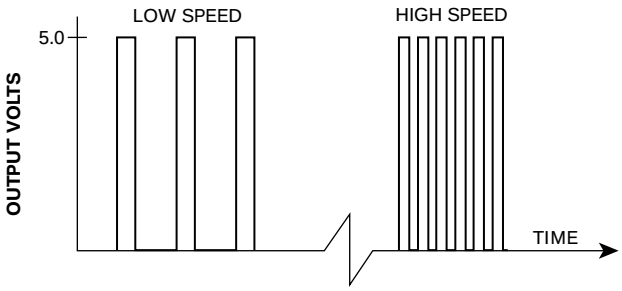
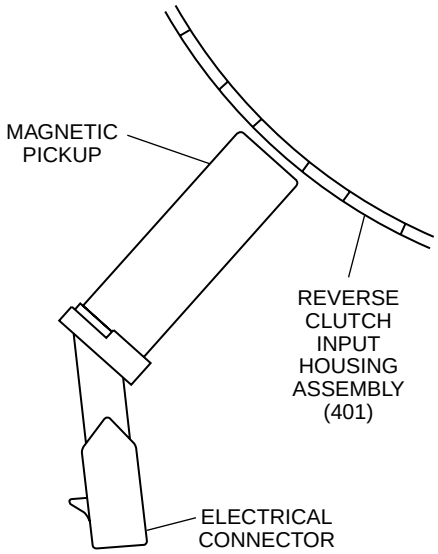


FIGURE A: CONDITIONED SIGNAL

Sensor resistance should measure between 325 and 485 ohms at 20°C (68°F). Output voltage will vary from a minimum of 0.5 V peak to peak at 100 RPM, to 600 V peak to peak at 8500 RPM.



INPUT SPEED SENSOR

TRANSMISSION SPEED SENSORS

Automatic Transmission Output (Shaft) Speed (A/T OSS) Sensor (42):
The A/T OSS sensor is a variable reluctance magnetic pickup located in the rear of the transmission case. This sensor is mounted in the case opposite the rear internal gear (560). The rear internal gear is splined to the output shaft assembly (562). The sensor consists of a permanent magnet surrounded by a coil of wire. As the output shaft and rear internal gear rotate, an alternating current (AC) is induced in the coil by the "teeth" on the rear internal gear as they pass by the magnetic pickup. Therefore, whenever the vehicle is moving, the A/T OSS sensor produces an AC voltage signal proportional to vehicle speed.

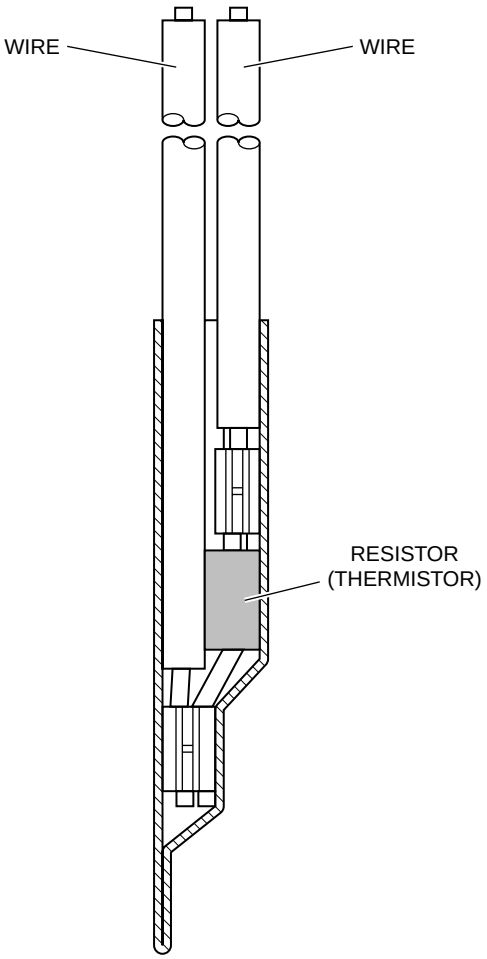
At the TCM, the AC signal is electronically conditioned to a 5 volt square wave form (see Figure A). The square wave form can then be interpreted as transmission output speed by the TCM through the frequency of square waves in a given time frame. The square waves can be thought of as a representation of the rear internal gear teeth. Therefore, the more teeth (or waves) that pass by the magnetic pickup in a given time frame, the faster the vehicle is moving. The square wave form is compared to a fixed clock signal within the TCM to determine transmission output speed.

If the TCM detects an improper signal from the transmission input or output speed sensors, a DTC will be activated.

The DTC strategy may be different depending on the customer/application (refer to the appropriate Service Information).

Automatic Transmission Input (Shaft) Speed (A/T ISS) Sensor (44):
The A/T ISS sensor operates identically to the A/T OSS sensor except that it uses the stamped teeth on the reverse clutch input housing assembly (401) as the rotor (reluctor). Remember that the reverse clutch input housing assembly is driven at converter turbine speed. The A/T ISS sensor square wave form is also compared to a fixed clock signal within the TCM to determine actual converter turbine speed. The TCM uses transmission input and output speeds to help determine line pressure, transmission shift patterns, TCC apply pressure, gear ratios, and TCC slippage for diagnostic purposes.

Figure 44



TRANSMISSION FLUID TEMPERATURE SENSOR

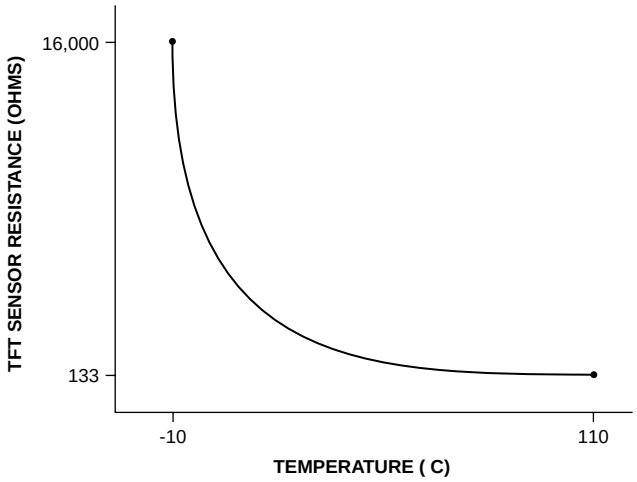
Automatic Transmission Fluid Temperature (TFT) Sensor:
The TFT sensor is part of the transmission wiring harness assembly (55). The TFT sensor is a resistor, or thermistor, which changes value based on temperature (see chart). The sensor has a negative-temperature coefficient. This means that as the temperature increases, the resistance decreases, and as the temperature decreases the resistance increases. The TCM supplies a 5-volt reference signal to the sensor and measures the voltage drop in the circuit. When the transmission fluid is cold the sensor resistance is high and the TCM detects high signal voltage. As the fluid temperature warms to a normal operating temperature, the resistance becomes less and the signal voltage decreases. The TCM uses this information to maintain shift quality and torque converter clutch apply quality over operating temperature range.

If transmission fluid temperatures become excessively high [above approximately 140°C (284°F) (calibratable in the TCM)], the TCM will disable ECCC function and command lock up mode. Applying the TCC serves to reduce transmission fluid temperatures created by the fluid coupling in the torque converter with the TCC released.

Above approximately 149°C (300°F) (calibratable in the TCM), the TCM will set a transmission fluid temperature code. This causes the TCM to use a fixed value of 135°C (275°F) (calibratable in the TCM) as the transmission fluid temperature input signal.

If the TCM detects an improper signal from the transmission fluid temperature sensor, a DTC will be activated.

The DTC strategy may be different depending on the customer/application (refer to the appropriate Service Information).



TFT SENSOR RESISTANCE VS. TEMPERATURE

Temperature	Resistance	R% (+/-)	+/-°C
-40	100000	10.5	1.51
-30	51400	9.69	1.52
-20	27610	9.02	1.49
-10	15450	8.35	1.49
0	8972	7.74	1.43
10	5391	7.16	1.42
20	3342	6.64	1.42
30	2132	6.19	1.41
40	1397	5.73	1.39
50	938	5.32	1.38
60	645	4.92	1.35
70	453	4.55	1.30
80	324	4.19	1.27
90	237	3.89	1.25
100	176	3.59	1.22
110	132	3.25	1.16
120	101	2.96	1.13
130	79	2.66	1.07
140	62	2.58	1.09
150	49	2.83	1.26

Figure 45

SHIFT SOLENOID VALVES

The Hydra-matic 4/5L40-E uses three electromagnetic shift solenoid valves (1-2, 2-3 and 4-5) to control upshifts and downshifts in all forward gear ranges. The shift solenoid valves are all identical, normally closed, 3-port, ON/OFF type solenoids controlled by the TCM. These shift solenoid valves work together in a combination of ON and OFF sequences to control the various shift valves. The TCM uses numerous inputs (as shown in Figure 42) to determine which solenoid state combination the transmission should be in. The following table shows the solenoid state combination required for each gear range:

RANGE	GEAR	ENGINE BRAKING	1-2 SS VALVE	2-3 SS VALVE	4-5 SS VALVE
D432	1	NO	OFF	ON	OFF
	1	YES	OFF	ON	ON
	2	NO	ON	ON	OFF
	2	YES	ON	ON	ON
	3	NO	ON	OFF	OFF
	3	YES	ON	OFF	ON
	4	YES	OFF	OFF	ON
	5	YES	OFF	OFF	OFF
Neutral	–	–	ON/OFF		
Reverse	R	YES			
Park	–	–			

When the TCM provides a path to ground for the electrical circuit to energize (turn ON) the solenoid, current flows through the coil assembly in the solenoid and creates a magnetic field. The magnetic field moves the plunger to the left (with respect to the illustration) and feed limit fluid seats the metering ball against the exhaust seat, thereby blocking the exhaust passage and creating signal fluid pressure.

The shift solenoid valves are de-energized (turned OFF) when the TCM opens the path to ground for the solenoid's electrical circuit. With the solenoid OFF, solenoid spring force moves the metering ball and plunger away from the exhaust seat. This blocks feed limit fluid from entering the signal fluid circuit and allows any existing signal fluid pressure to flow past the metering ball and exhaust out of the solenoid as shown in the illustration.

Shift solenoid valve resistance should measure between 15 and 17 ohms when measured at 20°C (68°F). The resistance should measure approximately 24 ohms at 150°C (302°F).

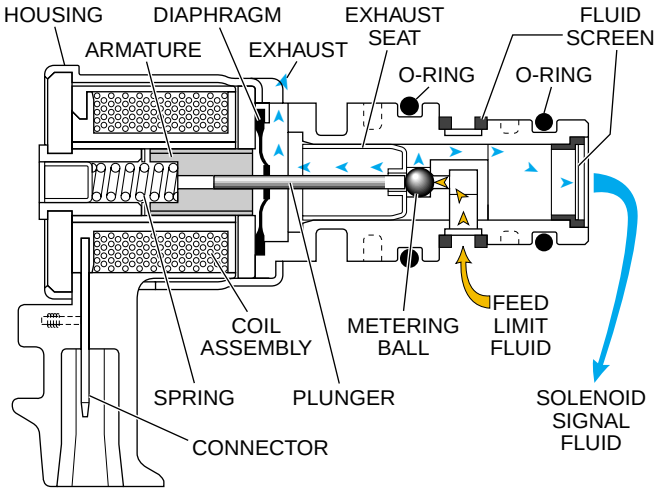
1-2 Shift Solenoid (SS) Valve (368):

Feed limit fluid feeds the 1-2 signal fluid circuit at the 1-2 shift control valve (366). When the 1-2 SS valve is energized (ON), feed limit fluid is allowed to pass through the solenoid, thereby creating 1-2 signal fluid pressure (see Second Gear Coast example below). 1-2 signal fluid pressure acts together with spring force on the 1-2 shift control valve (366) to keep it in the downshifted position when 2-3 signal fluid pressure is present. 1-2 signal fluid pressure also acts on the 3-4 shift valve (345) and the safety mode valve (341).

When the 1-2 SS valve is de-energized (OFF), feed limit fluid is blocked from feeding the 1-2 signal fluid circuit, and any existing 1-2 signal fluid pressure exhausts through the solenoid.

2-3 Shift Solenoid (SS) Valve (369):

The 2-3 SS valve functions similar to the 1-2 SS valve in that the TCM controls the path to ground for the electrical circuit to turn the solenoid ON or OFF. Feed limit fluid feeds the 2-3 signal fluid circuit at the 2-3 shift control valve (370). When the 2-3 SS valve is energized (ON), feed limit fluid is allowed to pass through the solenoid, thereby creating 2-3 signal fluid pressure (see Second Gear Coast example below). 2-3 signal fluid pressure acts on the 2-3 shift control valve (370) and the 2-3 shift valve (371) (against spring force) to move it into the upshifted position.



1-2, 2-3 OR 4-5 SHIFT SOLENOID VALVE

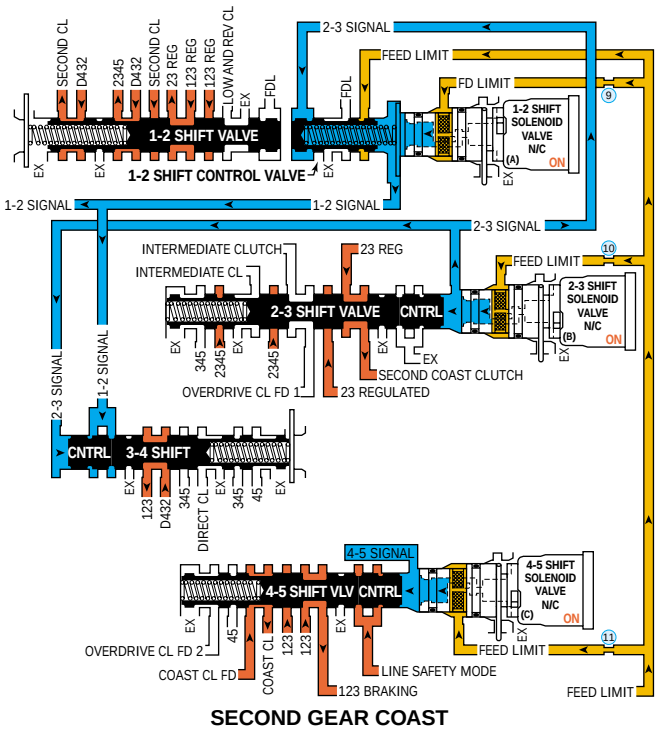
2-3 signal fluid pressure also acts on the 1-2 shift control valve (366) and the 3-4 shift control valve (346).

When the 2-3 SS valve is de-energized (OFF), feed limit fluid is blocked from feeding the 2-3 signal fluid circuit, and any existing 2-3 signal fluid pressure exhausts through the solenoid.

4-5 Shift Solenoid (SS) Valve (376):

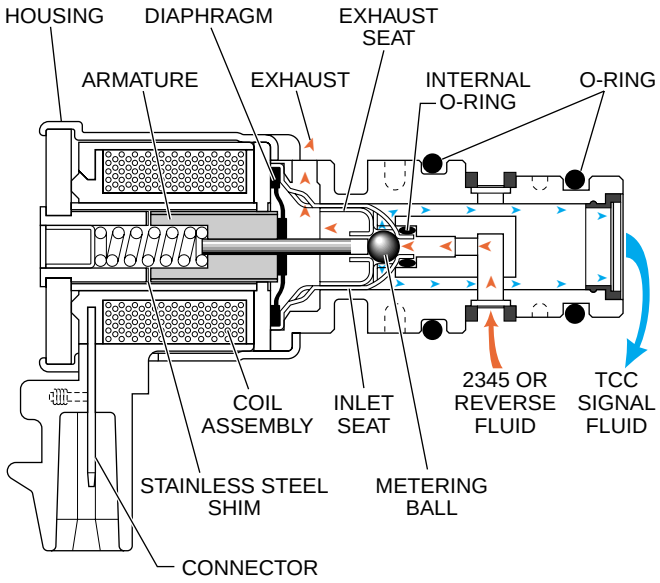
The 4-5 SS valve functions similar to the 1-2 SS valve and the 2-3 SS valve in that the TCM controls the path to ground for the electrical circuit to turn the solenoid ON or OFF. Feed limit fluid feeds the 4-5 signal fluid circuit at the 4-5 shift control valve (375). When the 4-5 SS valve is energized (ON), feed limit fluid is allowed to pass through the solenoid, thereby creating 4-5 signal fluid pressure (see Second Gear Coast example below). 4-5 signal fluid pressure acts on the 4-5 shift control valve (375) and the 4-5 shift valve (374) (against spring force) to move it into the upshifted position.

When the 4-5 SS valve is de-energized (OFF), feed limit fluid is blocked from feeding the 4-5 signal fluid circuit, and any existing 4-5 signal fluid exhausts through the solenoid.



SECOND GEAR COAST

Figure 46



TCC PWM SOLENOID VALVE

If the TCM detects that the TCC system is stuck ON or stuck OFF, a DTC will be activated.

The DTC strategy may be different depending on the customer/application (refer to the appropriate Service Information).

Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve (352):
The TCC PWM solenoid valve is a normally closed, pulse width modulated (PWM) solenoid used to control the apply and release of the converter clutch. The TCM operates the solenoid with a negative duty cycle, at a fixed frequency of 32 Hz, to control the rate of TCC apply/release. The solenoid's ability to "ramp" the TCC apply and release pressures results in a smoother TCC operation.

When vehicle operating conditions are appropriate to apply the TCC, the TCM increases the duty cycle to allow the TCC PWM solenoid valve to command TCC signal fluid pressure at a level sufficient to move the TCC enable valve and the TCC control valve to the apply position. Release pressure is directed to exhaust, and regulated apply fluid is directed to the apply side of the converter pressure plate/damper assembly. The TCM then increases the duty cycle to control a slippage of 20–80 RPM between the pressure plate/damper assembly and the converter cover. This provides for improved filtration of engine vibrations and allows the TCC to apply at low engine speeds in 2nd, 3rd, 4th and 5th gear. At high speed, lock up mode is set by activating the TCC PWM solenoid valve at maximum duty cycle.

Release of the TCC is achieved by decreasing the duty cycle to a level low enough to allow spring force to move the TCC enable valve and the TCC control valve to the release position. Apply fluid is directed to exhaust and converter feed fluid is directed into the release circuit to the release side of the pressure plate/damper assembly.

There are also some operating conditions that may prevent or enable TCC apply under various conditions (engine temperature, transmission temperature, brake switch activation) depending on vehicle application.

TCC PWM solenoid valve resistance should measure between 10.0 and 11.5 ohms when measured at 20°C (68°F). The resistance should measure approximately 16 ohms at 150°C (300°F).

Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve Operation:
The TCC PWM solenoid valve is the electronic control component of the TCC apply and release system. The other components are all hydraulic control or regulating valves. The illustration below shows all the valves and the TCC PWM solenoid valve that make up the TCC control system. (For more information on system operation see pages 74–75 in the Power Flow section).

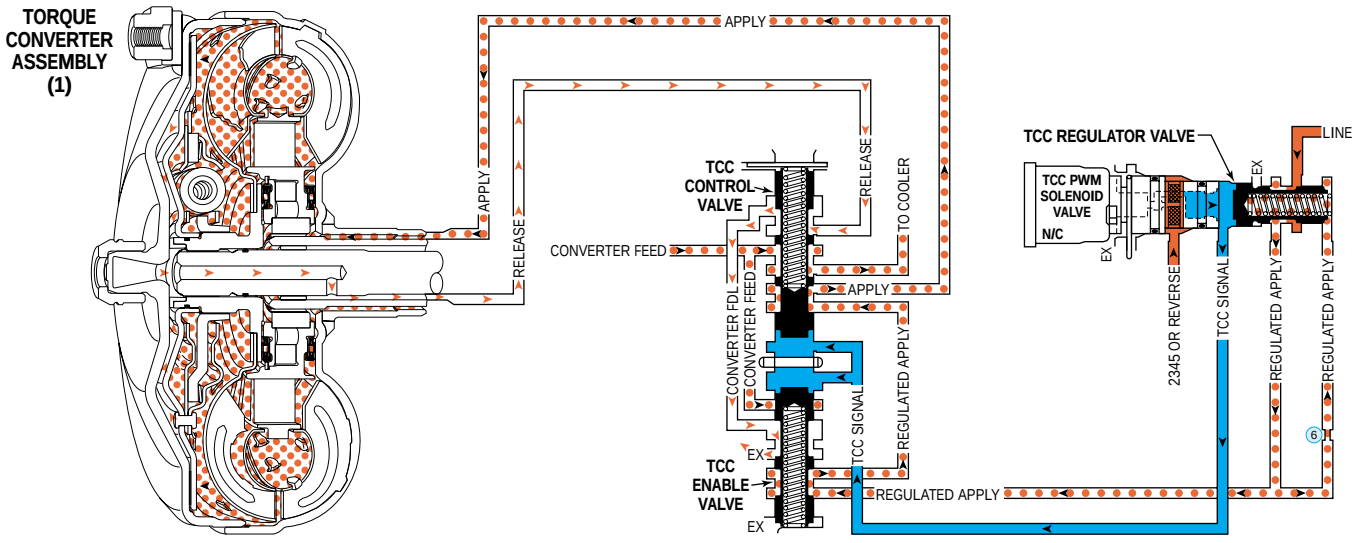


Figure 47

Pressure Control (PC) Solenoid Valve (357):
The pressure control (PC) solenoid valve is a precision electronic pressure regulator that controls transmission line pressure based on current flow through its coil windings. As current flow is increased, the magnetic field produced by the coil moves the solenoid's plunger further away from the exhaust port. Opening the exhaust port decreases the output fluid pressure regulated by the PC solenoid valve, which ultimately decreases line pressure. The TCM controls the PC solenoid valve based on various inputs including throttle position, transmission fluid temperature and gear state.

Duty Cycle, Frequency and Current Flow:
A "duty cycle" may be defined as the percentage of time current is flowing through a solenoid coil during each cycle. The number of cycles that occur within a specified amount of time, usually measured in seconds, is called "frequency". Typically, the operation of an electronically controlled pulse width modulated solenoid is explained in terms of duty cycle and frequency.

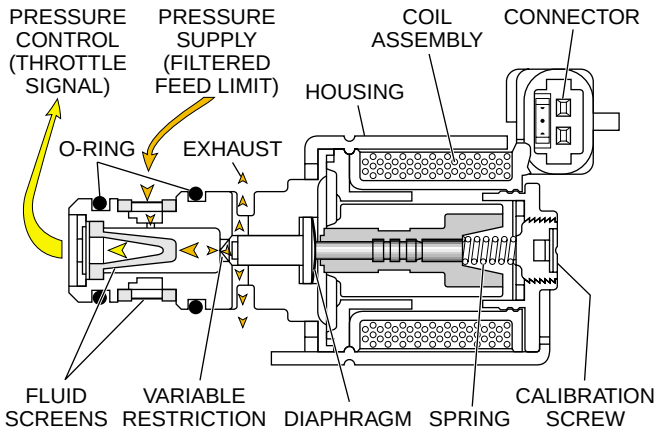
The TCM controls the PC solenoid valve on a positive duty cycle at a fixed frequency of 292.5 Hz (cycles per second). A higher duty cycle provides a greater current flow through the solenoid. The high (positive) side of the PC solenoid valve electrical circuit at the TCM controls the PC solenoid valve operation. The TCM provides a ground path for the circuit, monitors average current and continuously varies the PC solenoid valve duty cycle to maintain the correct average current flowing through the PC solenoid valve.

Duty Cycle	Current	Line Pressure
Minimum	0.1 Amps	Maximum
Maximum	1.1 Amps	Minimum

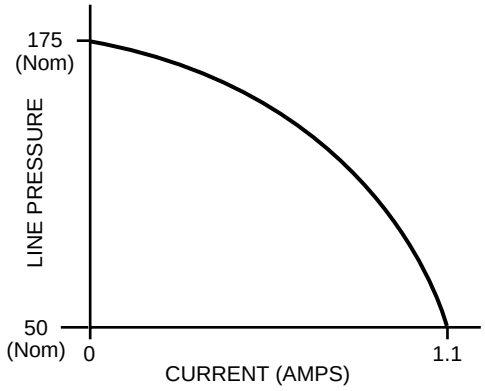
Pressure control solenoid valve resistance should measure between 3.5 and 4.6 ohms when measured at 20°C (68°F), and approximately 6 ohms at 150°C (302°F).

The duty cycle and current flow to the PC solenoid valve are mainly affected by throttle position (engine torque) and they are inversely proportional to throttle angle (engine torque). In other words, as the throttle angle (engine torque) increases, the duty cycle is decreased by the TCM which decreases current flow to the PC solenoid valve. Current flow to the PC solenoid valve creates a magnetic field that moves the solenoid armature against spring force.

Transmission Adapt Function:
Programming within the TCM also allows for automatic adjustments in shift pressure that are based on the changing characteristics of the transmission components. As the apply components within the transmission wear, shift time (the time required to apply a clutch) increases. In order to compensate for this wear, the TCM adjusts trim pressure by controlling the PC solenoid valve in order to maintain the originally calibrated shift timing. The automatic adjusting process is referred to as "adaptive learning" and it is used to assure consistent shift feel plus increase transmission durability. The TCM monitors the A/T ISS and the A/T OSS during commanded shifts to determine if a shift is occurring too fast (harsh) or too slow (soft) and adjusts the PC solenoid valve signal to maintain a set shift feel.



PRESSURE CONTROL SOLENOID VALVE



If the TCM detects a pressure control solenoid valve electrical malfunction, a DTC will be activated.

The DTC strategy may be different depending on the customer/application (refer to the appropriate Service Information).

Transmission adapts must be reset whenever the transmission is overhauled or replaced (see appropriate service manual).

Figure 48

ELECTRICAL COMPONENTS

COMPONENTS EXTERNAL TO THE TRANSMISSION

Throttle Position (TP) Sensor: The ECM monitors the variable voltage signal from the TP sensor to calculate throttle position (angle). These input signals are then transmitted over the CAN bus to the TCM, in addition to other vehicle and transmission sensor inputs, in order to determine the appropriate line pressure, shift pattern and TCC apply and release for the transmission. In general, with greater throttle angle, upshift speeds and line pressure both increase.

Engine Speed Sensor: Monitored by the ECM through the ignition module, information from this sensor is transmitted over the CAN bus to the TCM and used to help determine shift patterns and TCC apply and release.

Manifold Absolute Pressure (MAP) Sensor: The MAP sensor measures changes relative to intake manifold pressure which results from changes in engine load and speed. These changes are converted to a voltage output which is monitored by the ECM and transmitted over the CAN bus to the TCM in order to adjust line pressure and shift timing.

Engine Coolant Temperature (ECT) Sensor: The ECM monitors the variable resistance signal from this sensor to determine engine coolant temperature. When the engine is cold, resistance is high, and when the engine is hot, resistance through the sensor is low. The ECM then transmits this information over the CAN bus to the TCM where it is used to prevent the TCC from applying when engine temperature is below approximately 20°C (68°F) (calibratable).

Manifold Air Temperature (MAT) Sensor: The ECM monitors the variable resistance signal from the MAT sensor to determine manifold air temperature. When the air is cold, resistance is high, and when the air is hot, resistance through the sensor is low. The ECM then transmits this information over the CAN bus to the TCM where it is used to prevent the TCC from applying when manifold air temperature is below approximately 20°C (68°F) (calibratable).

Accelerator Pedal Position (APP) Sensor: The APP sensor is monitored by the ECM in order to determine accelerator pedal position. The ECM uses this signal to open and close the throttle in response to the driver's commands. It also signals the TCM when the accelerator pedal is fully depressed, allowing forced downshifts and maximum performance.

TCC Brake Switch: This switch causes the TCM to command TCC release. When the brake pedal is depressed, the TCM opens the path to ground for the TCC electrical circuit which releases the torque converter clutch.

Driver Shift Control (DSC) Switches: These switches are located either on the steering wheel or on a secondary gate within the console shift lever mechanism. The TCM uses the switch inputs to provide manual shift control to the driver. When a switch is depressed, the TCM opens a path to ground causing the transmission to shift up or down.

Operating Mode Selection Switches: Depending on the customer/ application, vehicles may be equipped with switches allowing the driver to select various automatic operating modes (Economy, Performance, Winter), or manual mode (Driver Shift Control) to allow manual shifting by bumping the selector lever up and down.

Diagnostic Link Connector (DLC): The DLC is a multi-terminal connector that is located under the vehicle dashboard. The DLC is connected by serial data wires to the various control modules located throughout the vehicle. The DLC can be used to diagnose conditions in the vehicle's electrical system, TCM or PCM, and various transmission components. Refer to the appropriate Service Manual for specific electrical diagnosis information.

Controller Area Network (CAN) Bus: The CAN bus consists of two wires that connect the various vehicle control modules together, allowing them to exchange information about vehicle conditions.

Note: These are typical inputs to the controllers. The combination and usage of these inputs may vary depending on model and application.

POWER FLOW

This section of the book describes how torque from the engine is transferred through the Hydra-matic 4/5L40-E transmission allowing the vehicle to move either in a forward or reverse direction. The information that follows details the specific mechanical operation, electrical, hydraulic and apply components that are required to achieve a gear operating range.

The full size, left hand pages throughout this section contain drawings of the mechanical components used in a specific range and gear. Facing this full page is a half page insert containing a color coded range reference chart at the top. This chart is one of the key items used to understand the mechanical operation of the transmission in each range and gear. The text below this chart provides a detailed explanation of what is occurring mechanically in that range and gear.

The full size, right hand pages contain a simplified version of the Complete Hydraulic Circuit that is involved for that range and gear. Facing this full page is a half page insert containing text and a detailed explanation of what is occurring hydraulically in that range and gear. A page number located at the bottom of the half page of text provides a ready reference to the complete Hydraulic Circuits section of this book if more detailed information is desired.

It is the intent of this section to provide an overall simplified explanation of the mechanical, hydraulic and electrical operation of the Hydra-matic 4/5L40-E transmission. If the operating principle of a clutch, or valve is unclear, refer to the previous sections of this book for individual component descriptions.

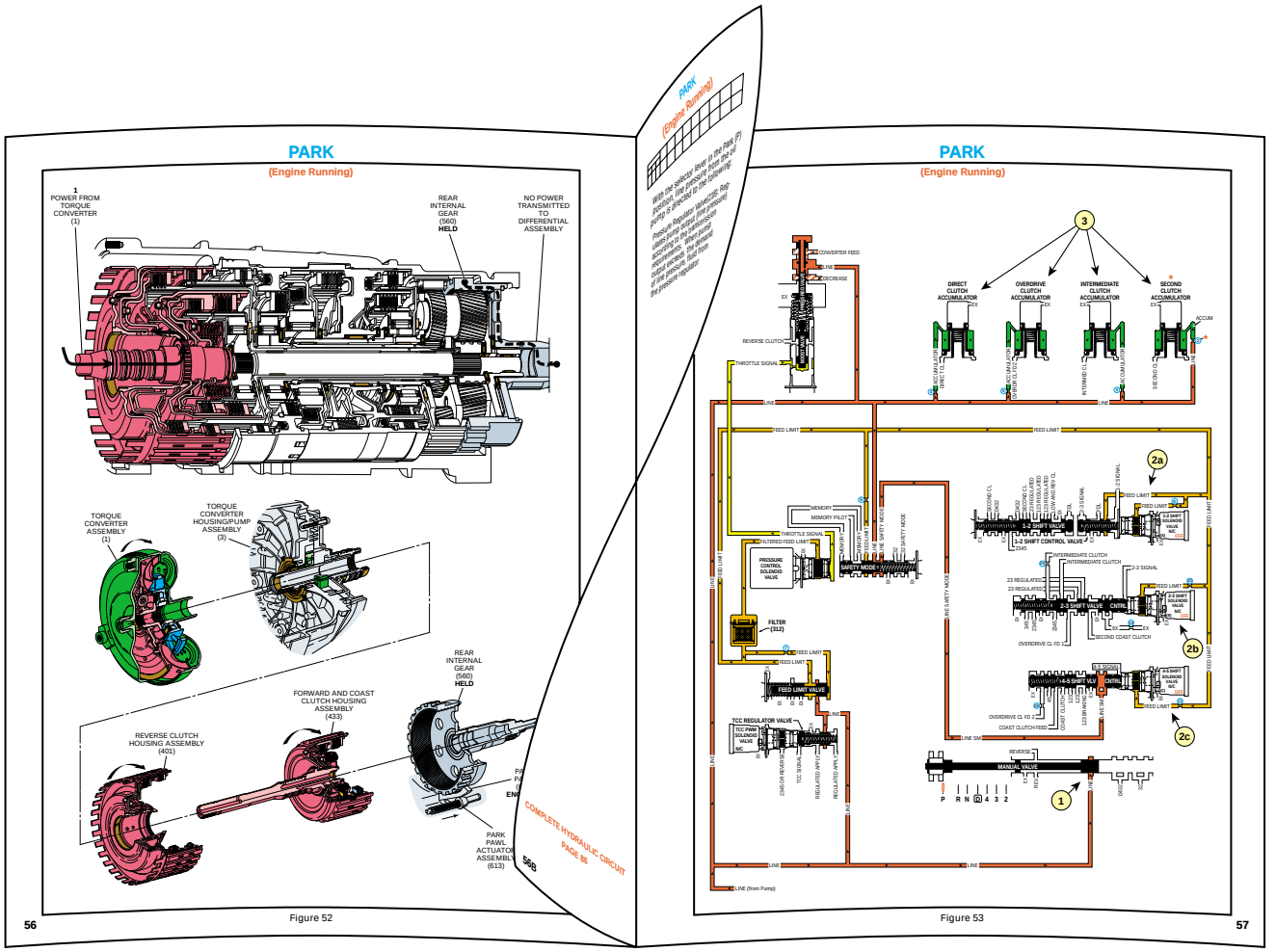


Figure 49

MECHANICAL POWERFLOW FROM THE TORQUE CONVERTER TO THE TURBINE SHAFT

(Engine Running)

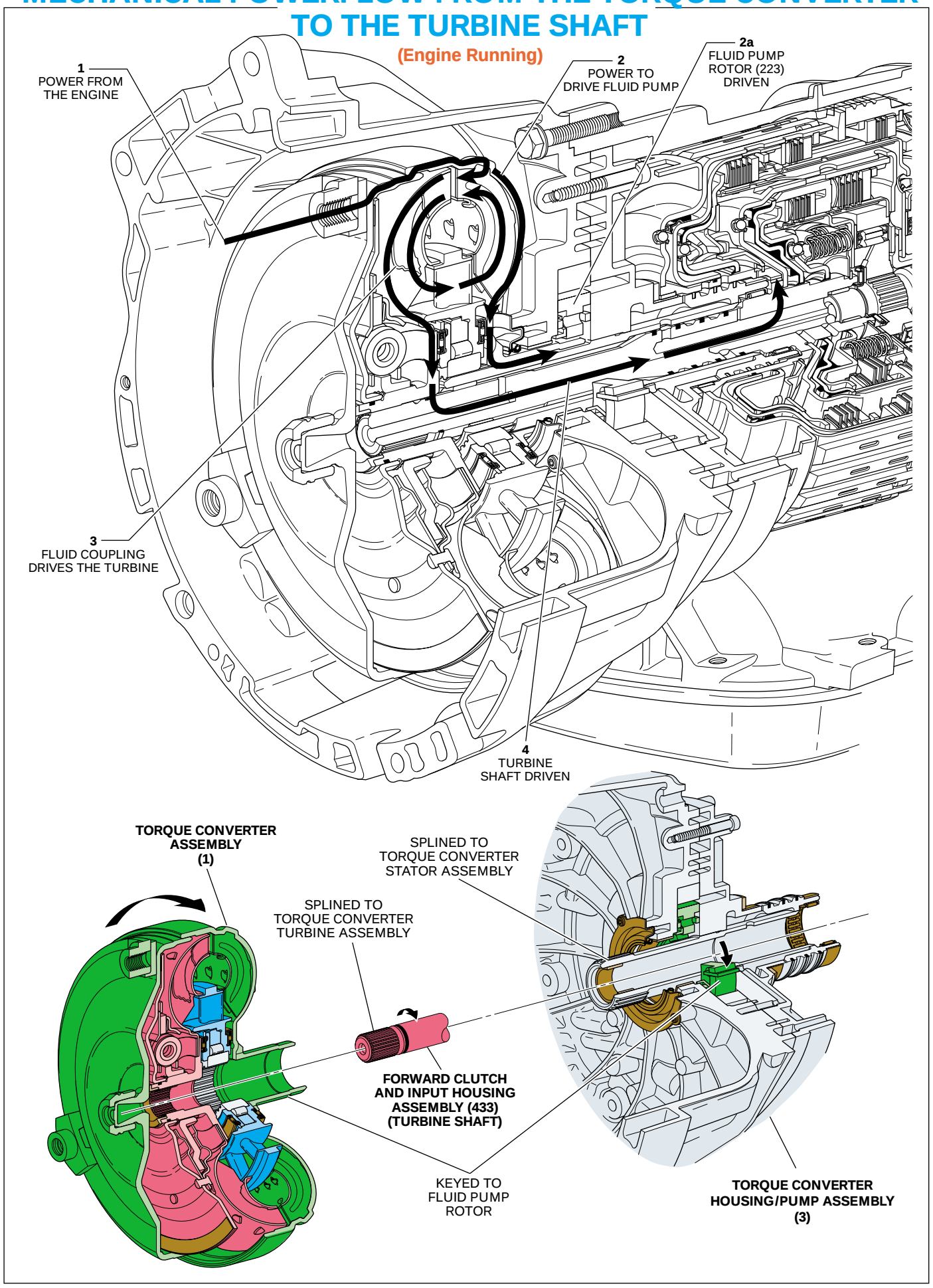


Figure 50

MECHANICAL POWERFLOW FROM THE TORQUE CONVERTER TO THE TURBINE SHAFT

(Engine Running)

The mechanical power flow in the Hydra-matic 4/5L40-E transmission begins at the point of connection between the torque converter and the engine flywheel. When the engine is running, the torque converter cover (pump) is forced to rotate at engine speed. As the torque converter rotates it multiplies engine torque and transmits it to the turbine shaft (433). The turbine shaft provides the primary link to the mechanical operation of the transmission.

The Hydra-matic 4/5L40-E automatic transmission requires a constant supply of pressurized fluid to cool and lubricate all of the components throughout the unit. It also requires a holding force to be applied to the clutches during the various gear range operations. The torque converter housing/pump assembly (3) and the control valve body accumulator assembly (47) provide for the pressurization and distribution of fluid throughout the transmission.

1 Power from the Engine
Torque from the engine is transferred to the transmission through the engine flywheel which is bolted to the engine crankshaft.

2 Power to Drive the Fluid Pump
The fluid pump rotor (223) is keyed to the torque converter hub. Therefore, the fluid pump rotor also rotates at engine speed.

3 Fluid Coupling Drives the Turbine
Transmission fluid inside the torque converter (1) creates a fluid coupling which in turn drives the torque converter turbine.

4 Turbine Shaft Driven
As the torque converter turbine rotates, the turbine shaft (433), which is splined to the torque converter turbine, is also forced to rotate at turbine speed.

NOTE: To minimize the amount of repetitive text, the remaining mechanical power flow descriptions will begin with the turbine shaft (433). The transfer of torque from the engine through the torque converter to the turbine shaft is identical in all gear ranges except when the torque converter clutch is applied (see pages 74A and 74B for complete explanation of torque converter apply.

HYDRAULIC POWERFLOW – COMMON FUNCTIONS FOR ALL RANGES

(Engine Running)

When the gear selector lever is in the Park (P) position and the engine is running, fluid is drawn into the oil pump and line pressure is directed to the pressure regulator valve.

1 PRESSURE REGULATION

1a Pressure Regulator Valve:
Regulates pump output (line pressure) in response to throttle signal fluid pressure acting on the line boost valve, spring force, and line pressure acting on the end of the valve. Line pressure is directed to the manual valve, the TCC regulator valve, feed limit valve, and the safety mode valve. Line pressure also feeds the converter feed circuit through the pressure regulator valve, and the accumulator fluid circuits.

1b Feed Limit Valve:
Line pressure is routed through the valve and into the feed limit fluid circuit. The valve limits feed limit fluid pressure to a maximum pressure. Feed limit fluid is routed to the pressure control solenoid valve, the safety mode valve, the 1-2 control valve, and also feeds the 1-2 signal, the 2-3 signal, and the 4-5 signal fluid circuits.

1c Pressure Control (PC) Solenoid Valve:
Controlled by the TCM, the PC solenoid valve regulates filtered feed limit fluid pressure into the throttle signal fluid circuit.

2 SHIFT ACCUMULATION

2a Direct, Overdrive, Intermediate, and Second Clutch Accumulator Assemblies:
Accumulator fluid is routed to each of the accumulator assemblies in preparation for upshifts and downshifts.

3 TORQUE CONVERTER (RELEASED POSITION ONLY)

3a Pressure Regulator Valve:
Line pressure is routed through the pressure regulator valve and into the converter feed fluid circuit. Converter feed fluid is routed to the TCC control valve and to the TCC enable valve.

3b TCC Regulator Valve:
Spring force holds the valve in the release position, thereby blocking line pressure from entering the regulated apply fluid circuit.

3c TCC Enable Valve:
Converter feed fluid is routed through the TCC enable valve and into the converter FDL circuit. Converter FDL fluid is routed to the TCC control valve.

3d TCC Control Valve:
Spring force holds the valve in the release position allowing converter feed fluid to enter the release circuit.

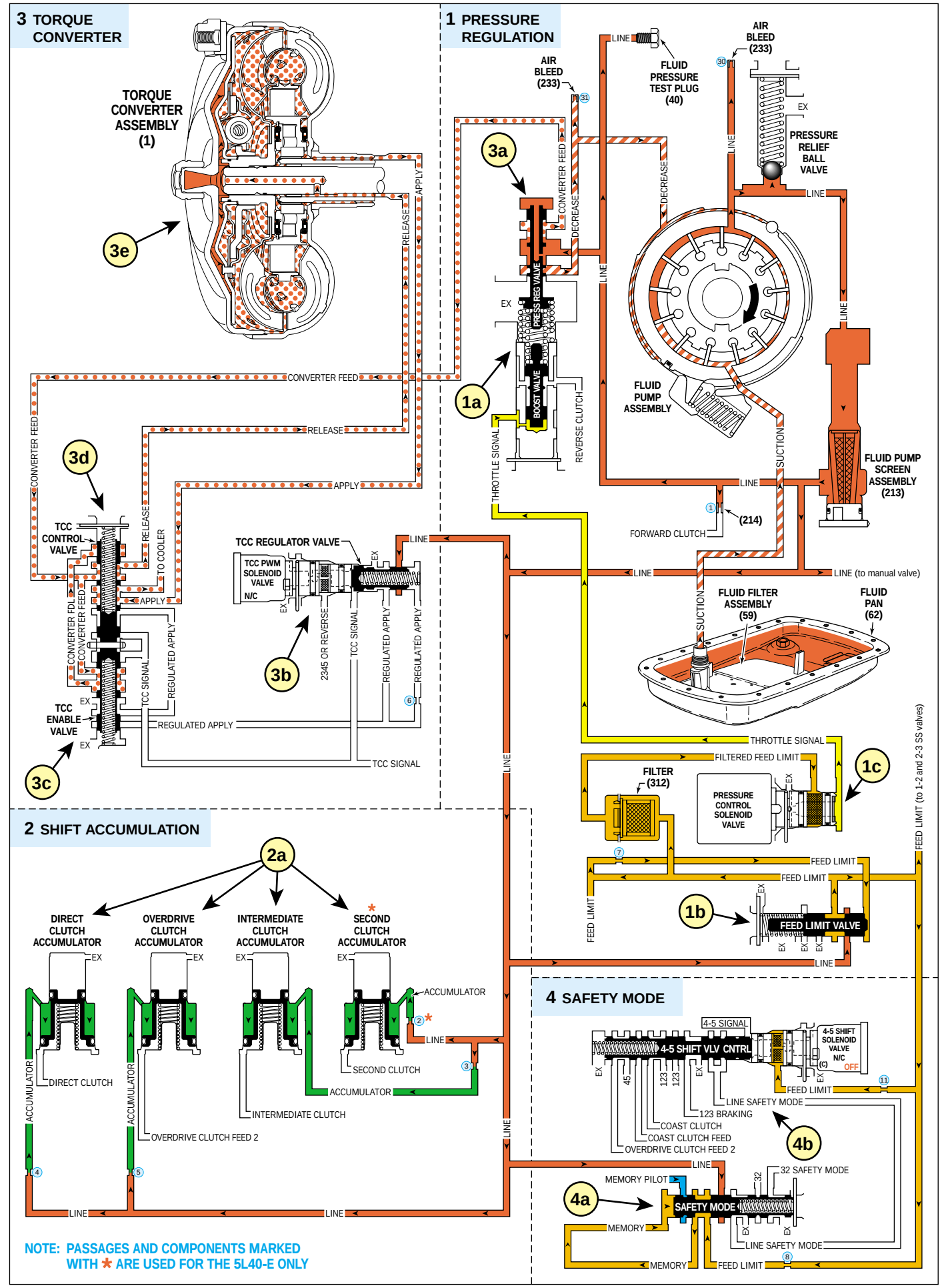
3e Torque Converter:
Release fluid pressure is routed to the torque converter to keep the TCC released. Fluid leaves the converter in the apply fluid circuit and returns to the cooler through the TCC control valve.

4 SAFETY MODE

4a Safety Mode Valve:
When the first 1-2 shift occurs, the safety mode valve shifts from the released position to the applied position and remains there until the engine is switched OFF. If safety mode occurs (no TCM signal to the shift solenoid valves), the transmission will shift to safety (fifth) gear. If the engine is then switched OFF and ON, still with no TCM signal, the safety mode valve will return to, and remain in, the released position. Line pressure fluid will pass through the safety mode valve into the line safety mode fluid circuit. Line safety mode fluid is routed to the 4-5 shift valve train.

4b 4-5 Shift Valve and 4-5 Shift Control Valve:
Line safety mode fluid forces the 4-5 shift valve to downshift to the fourth gear position allowing (after the engine has been switched OFF) a fourth gear start (instead of fifth) in the event of safety mode.

COMMON HYDRAULIC FUNCTIONS FOR ALL RANGES



NOTE: PASSAGES AND COMPONENTS MARKED WITH * ARE USED FOR THE 5L40-E ONLY

Figure 51

PARK

(Engine Running)

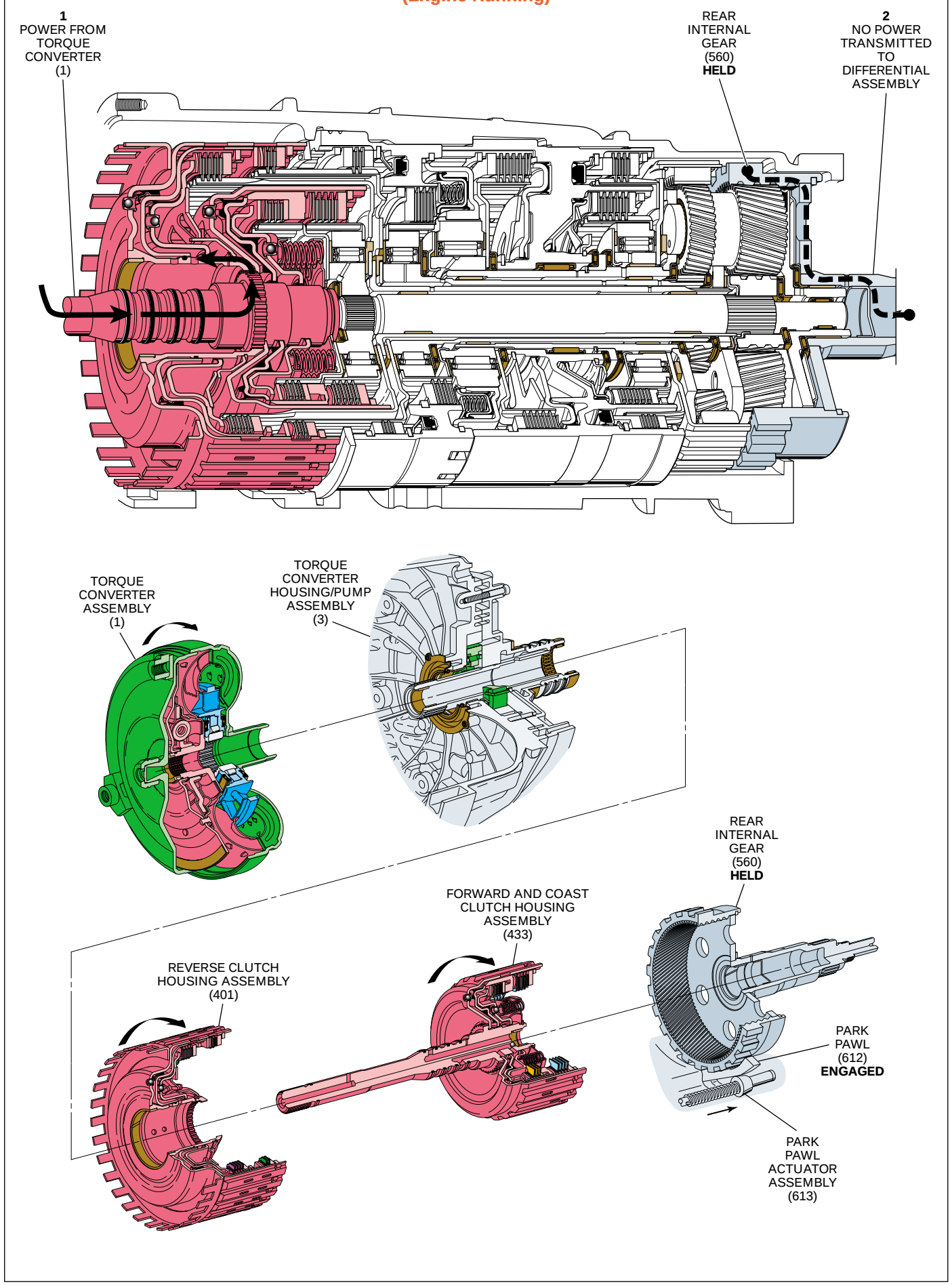


Figure 52

PARK

(Engine Running)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF													

LD = LOCKED IN DRIVE

- The manual shift shaft (606) and the manual valve (377) are in the Park position. The parking pawl actuator assembly (613) engages the parking pawl (612) with the lugs on the rear internal gear (560).
- The rear internal gear is held stationary by the parking pawl.
- The output shaft (562), which is splined to the rear internal gear is also held stationary preventing the vehicle from moving.

1 Power from Torque Converter
The input shaft forward and coast clutch assembly (433) and the reverse clutch housing assembly (401) are driven by the turbine shaft, which is splined to the converter turbine.

2 Power Flow Terminated
The input shaft forward and coast clutch assembly rotates freely without any clutches applied or sprag clutches holding and power flow is terminated.

Note: The vehicle should be completely stopped before selecting Park range or internal damage to the transmission could occur.

Also, the manual linkage must be adjusted properly so the indicator quadrants in the vehicle correspond with the manual shaft detent lever (600) in the transmission. If not adjusted properly, an internal leak between fluid passages at the manual valve may cause a clutch to slip or cause the transmission to not hold in park.

Refer to the appropriate General Motors Service Manual for the proper manual linkage adjustment procedures.

PARK

(Engine Running)

SOLENOID 1-2	SOLENOID 2-3	SOLENOID 4-5	DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
OFF	OFF	OFF													

LD = LOCKED IN DRIVE

FLUID PRESSURE DIRECTED IN PREPARATION FOR A SHIFT

1 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, D432 and 32 fluid circuits.

2a 1-2 Shift Solenoid (SS) Valve and 1-2 Shift Control Valve:
Feed limit fluid from the feed limit valve is routed to the 1-2 SS valve and to the 1-2 shift control valve in preparation for a shift.

2b 2-3 Shift Solenoid (SS) Valve:
Feed limit fluid from the feed limit valve is routed to the 2-3 SS valve in preparation for a shift.

2c 4-5 Shift Solenoid (SS) Valve:
Feed limit fluid from the feed limit valve is routed to the 4-5 SS valve in preparation for a shift.

Note: *Refer to Shift Solenoid Valves on page 49 for a description of solenoid and shift valve operation.*

3 Direct Clutch, Overdrive Clutch, Intermediate Clutch, and Second Clutch Accumulators:
Line fluid fills the accumulator circuits and accumulator assemblies in preparation for an upshift.

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PARK

(Engine Running)

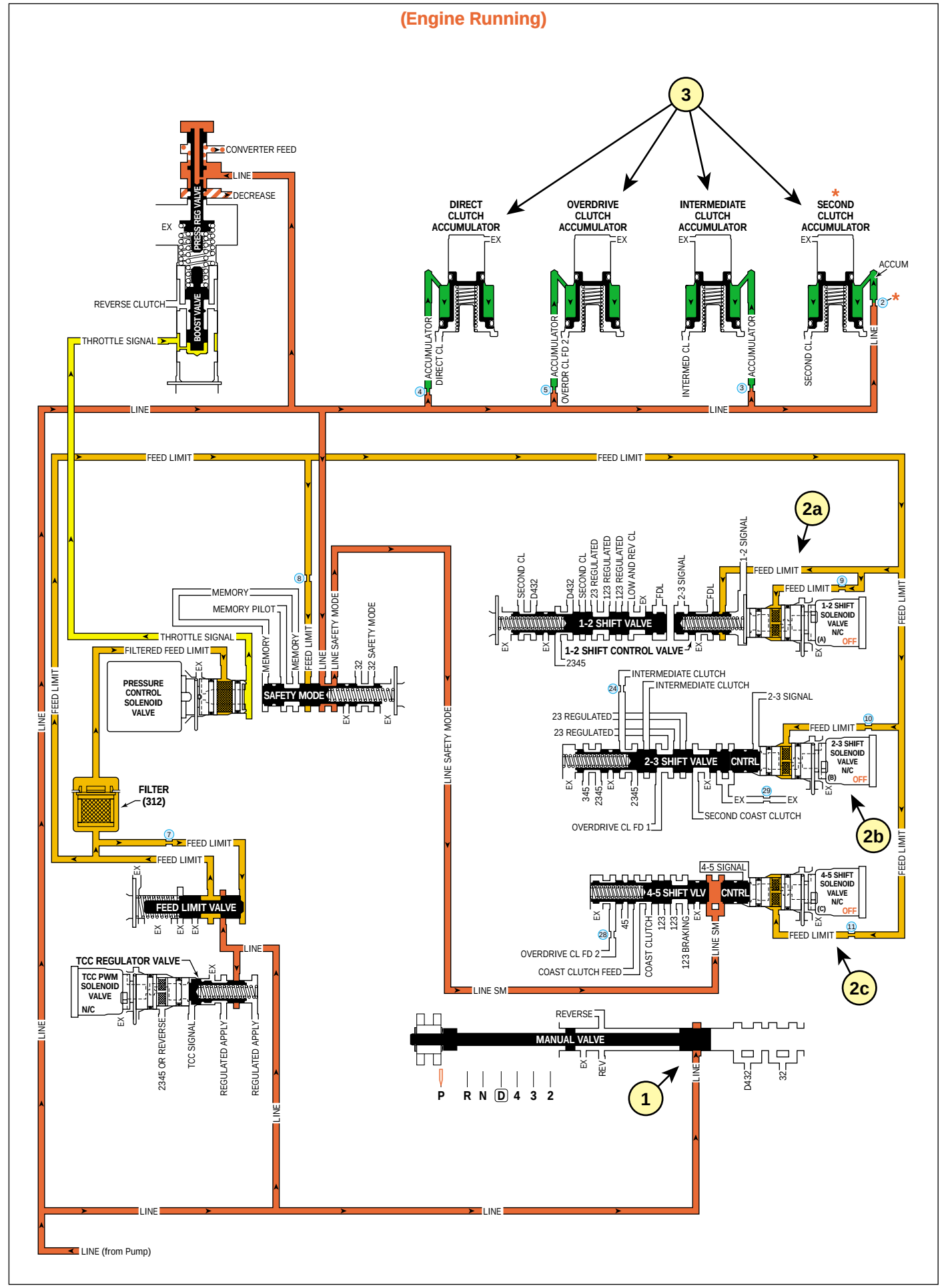

Figure 53

REVERSE

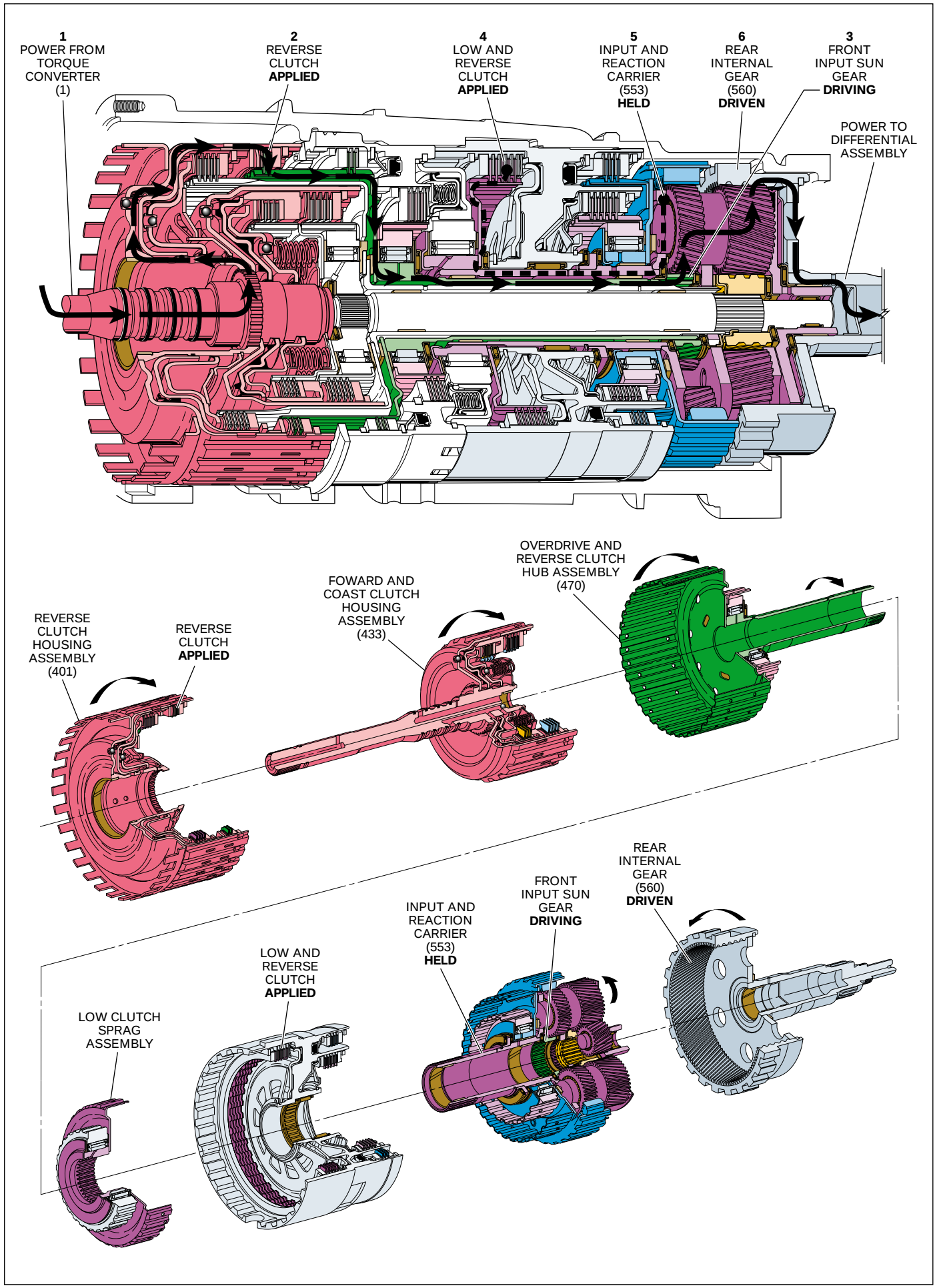

Figure 54

REVERSE

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF		APPLIED								APPLIED			

LD = LOCKED IN DRIVE

In Reverse (R), torque from the engine is multiplied through the torque converter and transmission gear set to the vehicle's drive shaft and rear axle. The planetary gear set operates in reduction and also reverses the direction of input torque for a reverse gear ratio of approximately 3.03:1.

- The manual shift shaft (606) and the manual valve (377) are in the Reverse position.

1 Power from Torque Converter
The input shaft forward and coast clutch assembly (433) is driven by the converter turbine.

2 Reverse Clutch Applied
The reverse clutch plates (415-419) are applied and allow the overdrive and reverse clutch hub assembly (470), to drive the front input sun gear.

3 Front Input Sun Gear Driving
Engine torque is transferred from the reverse clutch housing, through the front input sun gear and to the long pinion gears. The long pinion gears are in mesh with and drive the rear internal gear (560).

4 Low and Reverse Clutch Applied
The low and reverse clutch is applied and holds the low clutch sprag inner race which is splined to the input and reaction carrier.

5 Input and Reaction Carrier Assembly Held
With the low and reverse clutch holding the input and reaction carrier assembly, the reaction long pinion gears drive the rear internal gear (560) in a reverse direction.

6 Rear Internal Gear Driven
The rear internal gear (560) is splined to the output shaft assembly (562), thus the output shaft is also driven in a reverse direction.

When the throttle is released in Reverse, power from the vehicle (output shaft) drives through the reverse clutch to the input shaft faster than engine speed is driving the input shaft. The engine then works as a brake, slowing the transmission down to input speed. This is referred to as engine braking.

REVERSE

SOLENOID 1-2	SOLENOID 2-3	SOLENOID 4-5	DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
OFF	OFF	OFF		APPLIED								APPLIED			

LD = LOCKED IN DRIVE

When the gear selector lever is moved to the Reverse (R) position (from the Park position) the following changes occur in the transmission's hydraulic and electrical systems.

1 PRESSURE REGULATION

1a Manual Valve:
With the manual valve in the reverse position, line pressure is directed into the reverse fluid circuit.

1b Reverse Lockout Valve:
Reverse fluid is routed through the reverse lockout valve into the reverse lockout fluid circuit.

1c Pressure Regulator and Line Boost Valves:
Reverse clutch fluid at the line boost valve boosts line pressure for the additional torque requirements in Reverse. Throttle signal fluid pressure from the pressure control (PC) solenoid acting on the line boost valve also helps determine line pressure in Reverse depending on throttle position and other TCM input signals.

2 LOW AND REVERSE CLUTCH APPLIES

2a #8 Ball Check Valve and Orifice #12:
Located in the bottom channel plate, reverse lockout fluid seats the #8 ball check valve against the low and reverse clutch fluid passage and directs fluid into the low and reverse clutch or reverse lockout fluid passage. Reverse lockout fluid pressure is also orificed, through orifice #12, to provide a controlled apply of the low and reverse clutch.

2b Low and Reverse Clutch:
Low and reverse clutch or reverse lockout fluid pressure enters the outer area of the low and reverse clutch piston and moves the piston against spring force to apply the low and reverse clutch plates. In addition, reverse lockout fluid pressure is orificed into the inner area of the low and reverse clutch piston and provides additional force to apply the low and reverse clutch plates.

3 REVERSE CLUTCH APPLIES

3a #1 Ball Check Valve:
Located in the bottom channel plate, reverse lockout fluid seats the #1 ball check valve and is forced through orifice #13 in the control valve body spacer plate into the reverse clutch fluid passage.

Note: Remember that the function of an orifice is to control the flow rate of fluid and rate of apply or release of a clutch.

3b Reverse Clutch:
Reverse clutch fluid enters the reverse clutch housing and acts on the reverse clutch piston to apply the reverse clutch plates.

4 FLUID PRESSURE DIRECTED IN PREPARATION FOR TCC APPLY

4a #2 Ball Check Valve:
Located in the bottom channel plate, reverse fluid seats the #2 ball check valve against the 2345 fluid passage and directs fluid into the 2345 or reverse fluid passage.

4b Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve:
The TCC PWM solenoid valve remains de-energized (OFF). 2345 or reverse fluid is prevented from entering the TCC signal fluid circuit. Under normal circumstances the TCC PWM solenoid valve is not energized. In the event the TCC PWM solenoid valve is energized (when engaging Reverse while driving in Forward above a certain speed), TCC signal fluid will shift the reverse lockout valve to block reverse fluid from entering the reverse lockout circuit and the reverse clutch and the low and reverse clutch will release to prevent damage to the transmission.

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REVERSE

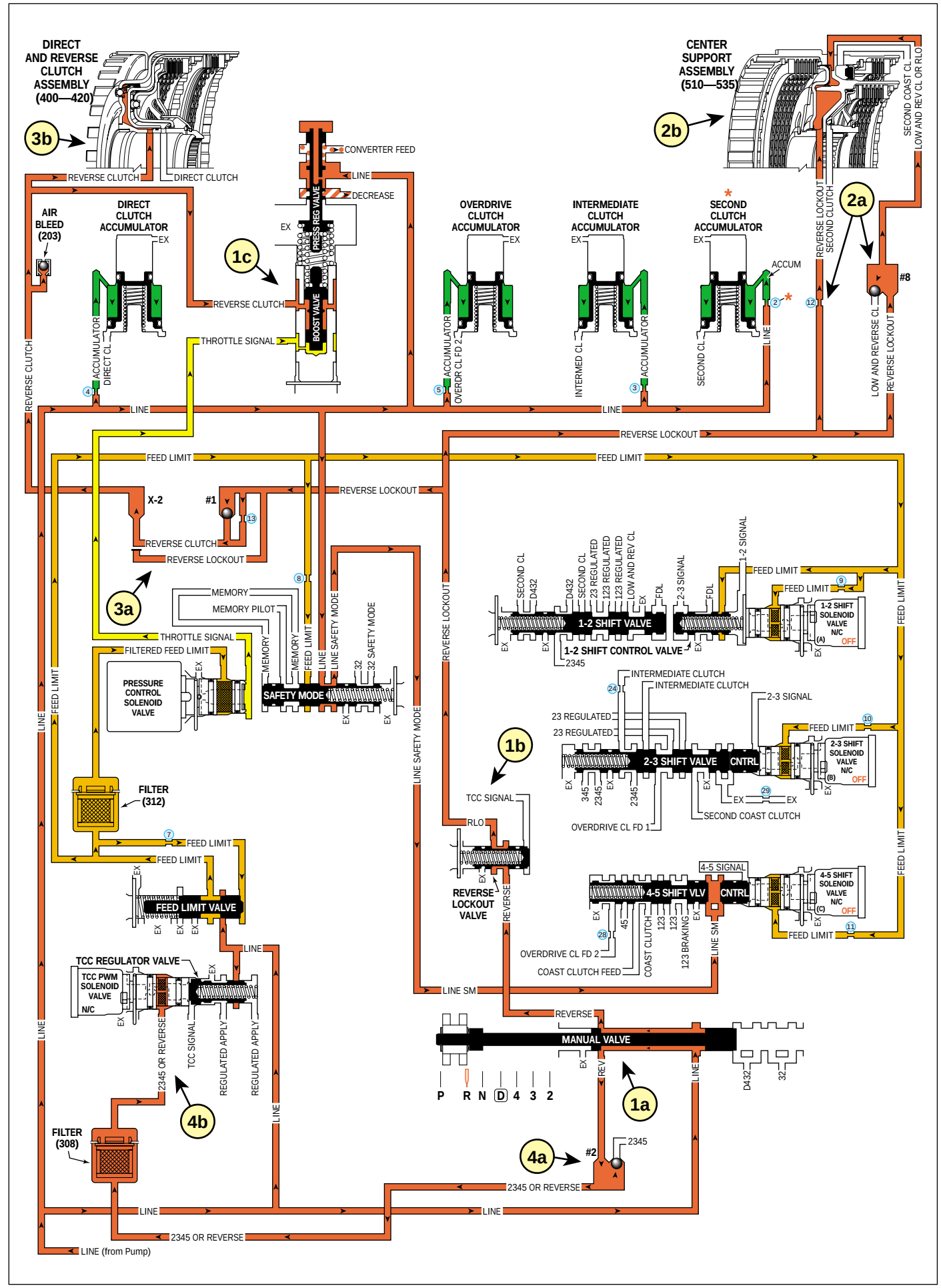
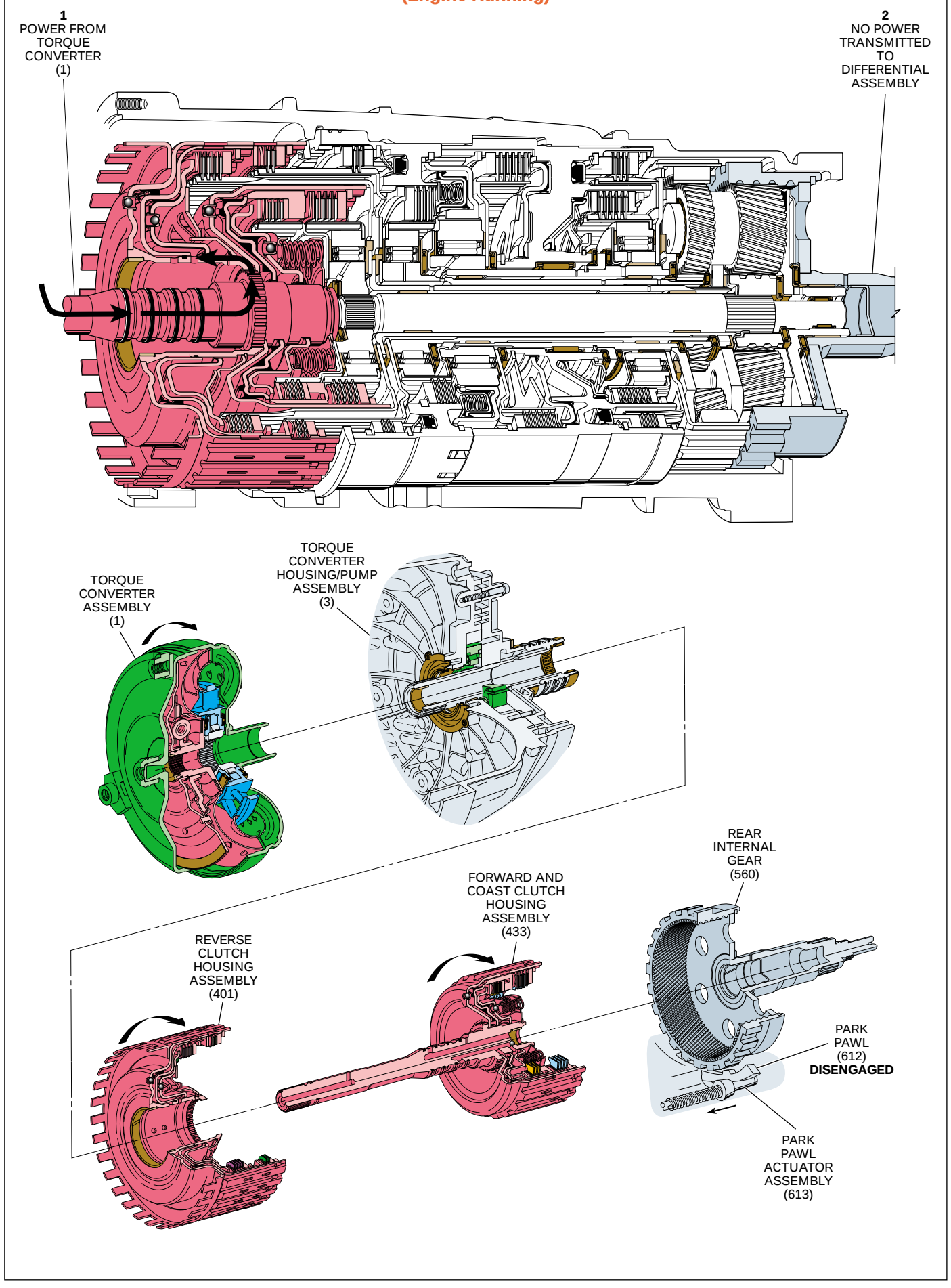


Figure 55

NEUTRAL

(Engine Running)



NEUTRAL

(Engine Running)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF													

LD = LOCKED IN DRIVE

When the gear selector lever is placed in the Neutral (N) position, mechanical power flow is identical to Park (P) range, except that the park lock actuator assembly (613) is disengaged. The park pawl spring (611) releases the park pawl (612) from the lugs on the rear internal gear (560). With the park pawl disengaged, the output shaft is free to rotate allowing the vehicle to roll.

- The manual shift shaft (606) and the manual valve (377) are in the Neutral position.

1 Power from Torque Converter
The input shaft forward and coast clutch housing assembly is splined to and driven by the converter turbine.

2 Powerflow Terminated
Without any clutches applied, or sprag clutches holding, the input shaft forward and coast clutch housing assembly rotates freely and power flow is terminated.

Neutral range may be selected for starting the engine when the vehicle is standing still or moving down the road.

Figure 56

NEUTRAL

(Engine Running)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF													

LD = LOCKED IN DRIVE

When the gear selector lever 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 following changes would occur in the hydraulic system:

1 REVERSE CLUTCH RELEASES

1a Manual Valve:
The manual valve is moved to the Neutral position and blocks line pressure from entering the reverse fluid circuit. The reverse fluid circuit is opened to an exhaust at the manual valve.

1b Reverse Clutch:
Reverse clutch fluid exhausts from the reverse clutch to the #1 ball check valve allowing the reverse clutch to release.

1c #1 Ball Check Valve:
Reverse clutch fluid unseats the #1 ball check valve and enters the reverse lockout fluid circuit. Reverse lockout fluid then flows to the reverse lockout valve where it enters the reverse fluid circuit.

1d Reverse Lockout Valve:
Reverse lockout fluid passes through the reverse lockout valve and into the reverse fluid circuit and on to the manual valve where it exhausts.

1e Line Boost Valve:
Reverse clutch fluid exhausts from the line boost valve, allowing line pressure to return to the normal operating range as in Park, Neutral and Overdrive gear ranges.

2 LOW AND REVERSE CLUTCH RELEASES

2a Low and Reverse Clutch:
Low and reverse clutch or reverse lockout fluid exhausts from the outer area of the low and reverse clutch piston to the #8 ball check valve. Reverse lockout fluid also exhausts from the inner area of the low and reverse clutch piston through orifice #12. The exhaust of these fluids allows the low and reverse clutch to release.

2b #8 Ball Check Valve:
Low and reverse clutch or reverse lockout fluid seats the #8 ball check valve against the low and reverse clutch fluid circuit and enters the reverse lockout fluid circuit where it exhausts along with reverse clutch fluid past the manual valve.

Note: *Allowing fluid to bypass an orifice when exhausting ensures a quick release of the clutch. This prevents the friction material from "dragging" and creating excess fluid temperatures or damaging the clutch.*

Note: *In Park, Reverse and Neutral the shift solenoid valves are shown de-energized. This is the normal operating state when the vehicle is stationary or at low vehicle speeds. However, the TCM will change the shift solenoid valve states depending on vehicle speed. For example, if Neutral range is selected when the vehicle is operating in Second gear, the shift solenoid valves will remain in a Second gear state. But with the manual valve in Neutral, line pressure is blocked, D432 fluid exhausts and the transmission will shift into Neutral.*

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NEUTRAL

(Engine Running)

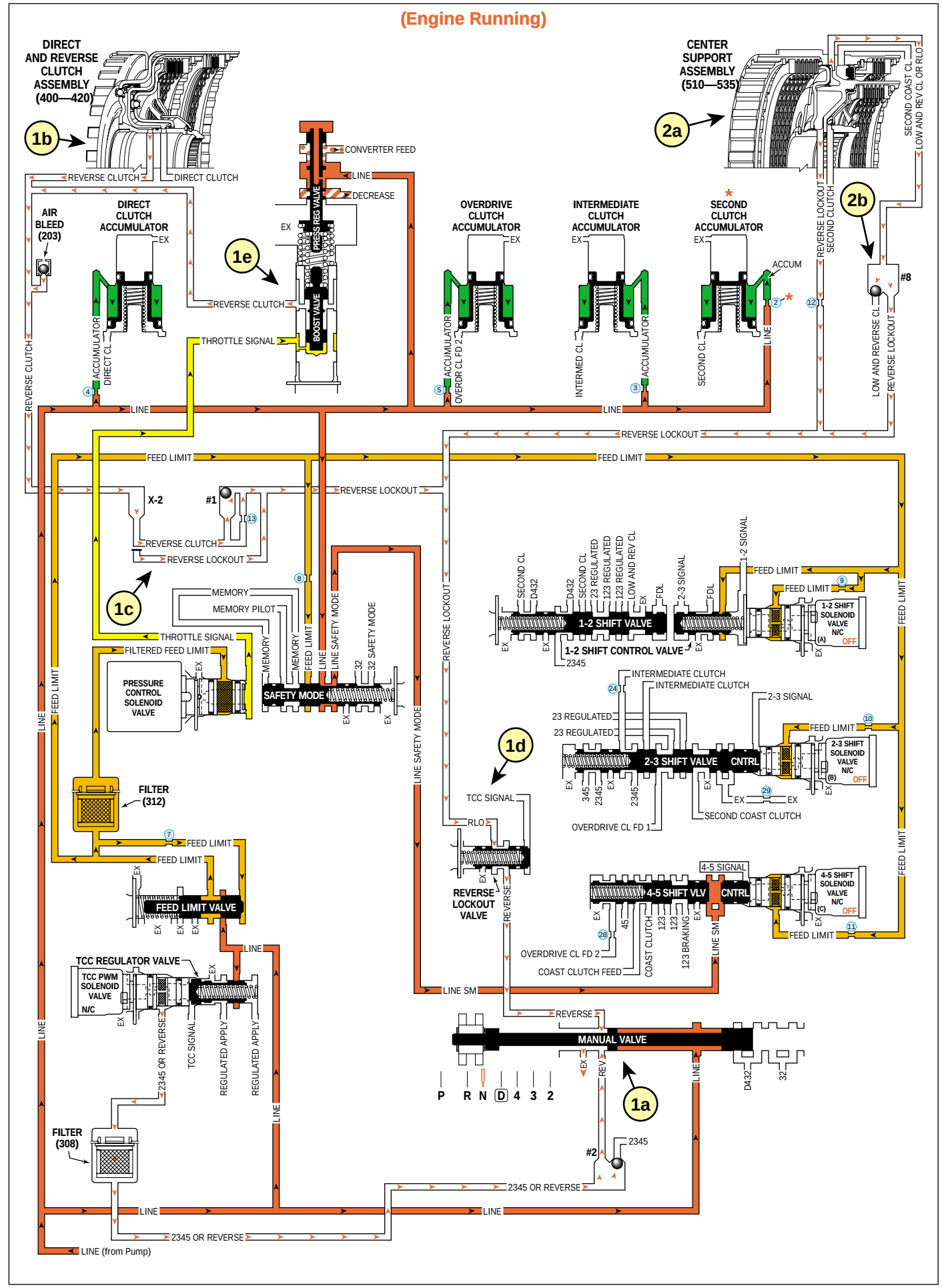

Figure 57

OVERDRIVE RANGE – FIRST GEAR

(before the first 1-2 shift has occurred)

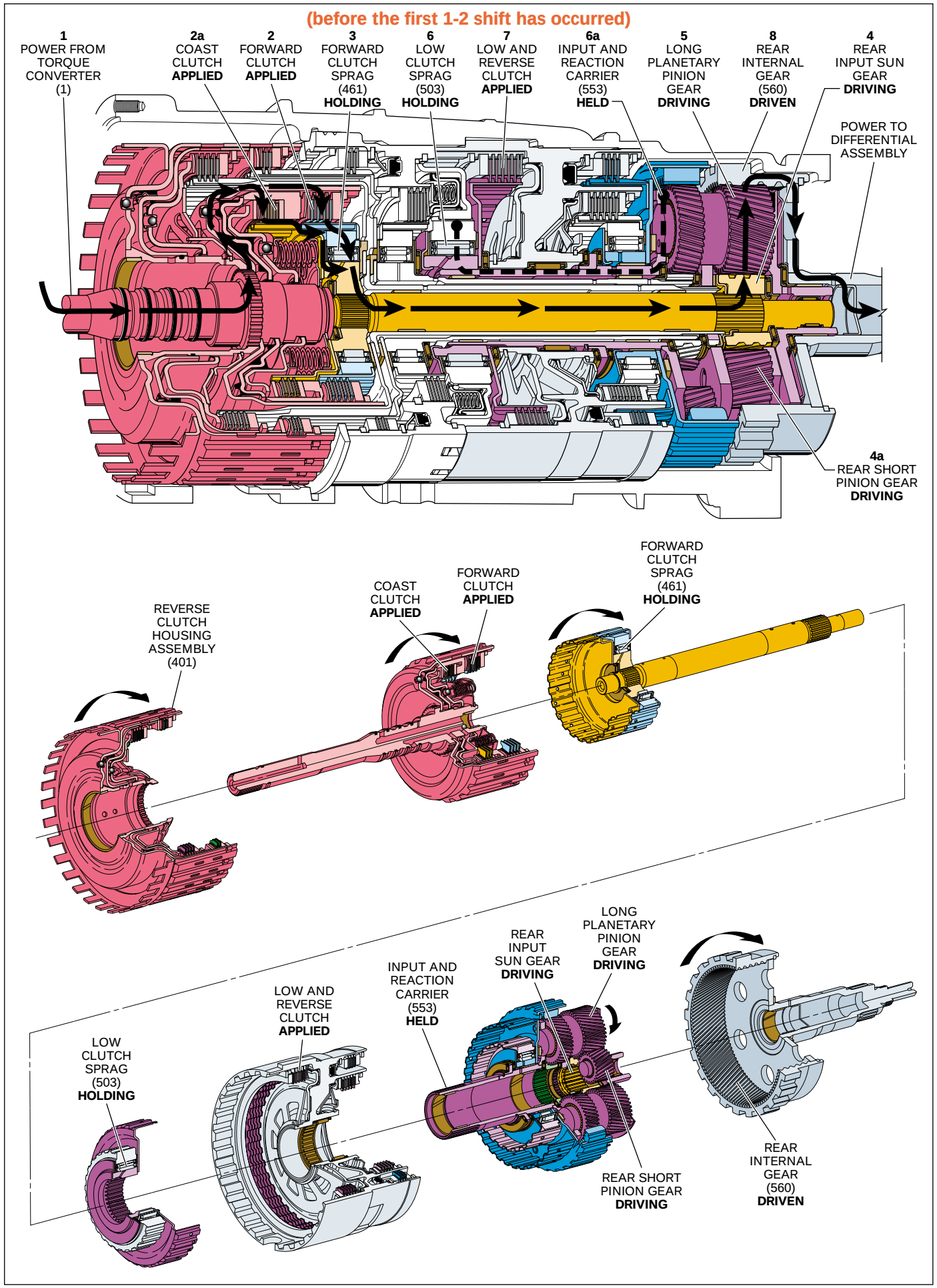

Figure 58

OVERDRIVE RANGE – FIRST GEAR

(before the first 1-2 shift has occurred)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	ON	OFF			APPLIED	APPLIED	LD				LD	APPLIED			

LD = LOCKED IN DRIVE

In Overdrive Range Ⓓ – First Gear, torque from the engine is multiplied through the torque converter and transmission gear set to the vehicle's drive shaft. The planetary gears operate in reduction to achieve a First gear starting ratio of approximately 3.42:1.

- The manual shift shaft (606) and the manual valve (377) are in the Overdrive Ⓓ position.

1 Power from Torque Converter
The input shaft forward and coast clutch housing assembly (433) is splined to and driven by the converter turbine.

2 Forward and Coast Clutches Applied
The forward clutch, which is located within the input shaft forward and coast clutch housing assembly (433), is applied and holds the forward clutch sprag outer race (459). The coast clutch is also located in the input shaft forward and coast clutch housing assembly (433) and is also applied.

3 Forward Clutch Sprag Holding
The forward clutch sprag (461) holds and power is transmitted to the input sun gear shaft assembly (457).

4 Rear Input Sun Gear Driving
The input sun gear shaft assembly (457) is splined to the rear input sun gear. The rear input sun gear drives the rear short planetary pinions.

5 Long Planetary Pinion Gears Driving
The rear short planetary pinions drive the long planetary pinions. The long pinions are in mesh with the front input sun gear, the front short pinions and the rear internal gear.

6 Low Clutch Sprag Holding
The power transferred to the input and reaction carrier (553) by the long planetary pinions attempts to rotate the carrier but, the carrier is held stationary by the low clutch sprag (503).

7 Low and Reverse Clutch Applied
The low and reverse clutch, which is located within the center support (518), is applied and holds the low clutch sprag inner race (505). This assists the low clutch sprag in holding the input and reaction carrier (553) stationary.

8 Rear Internal Gear Driven
With the input and reaction carrier (553) held, the long pinions drive the rear internal gear (560) to achieve the first gear starting ratio of approximately 3.42:1

- When the throttle is released in Overdrive Range – First Gear before the first 1-2 shift has occurred, power from the vehicle wheels attempts to drive the transmission components faster than engine torque is driving them. Because the low and reverse clutch is applied and holds the input and reaction carrier assembly stationary, the low clutch sprag (503) is prevented from overrunning and engine braking slows the vehicle.

As vehicle speed increases, less torque multiplication is needed for maximum efficiency. Therefore, it is desirable to shift the transmission to a lower gear ratio, or Second gear.

Note: the above description of mechanical power flow occurs before the first 1-2 shift has occurred.

OVERDRIVE RANGE – FIRST GEAR

(before the first 1-2 shift has occurred)

SOLENOID 1-2	SOLENOID 2-3	SOLENOID 4-5	DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
OFF	ON	OFF			APPLIED	APPLIED	LD				LD	APPLIED			

LD = LOCKED IN DRIVE

When the gear selector lever is moved to the Overdrive Range (D) position from the Neutral (N) position, before the first 1-2 shift has occurred, the following changes occur to shift the transmission into Overdrive Range – First Gear.

1 MANUAL VALVE

In the Overdrive position the manual valve routes line pressure into the D432 fluid circuit. D432 fluid is routed to the 1-2 shift valve and to the 3-4 shift valve.

2 FORWARD CLUTCH APPLIES

2a #6 and #7 Ball Check Valves:
D432 fluid seats the #6 ball check valve and passes through orifice #15 into the forward clutch fluid circuit. D432 fluid also passes by the spring loaded #7 ball check valve to feed the forward clutch circuit as necessary to help control forward clutch apply.

2b Forward Clutch Assembly:
Forward clutch fluid is routed to the forward clutch piston to apply the forward clutch plates.

3 COAST CLUTCH APPLIES

3a #5 Ball Check Valve:
Forward clutch fluid seats the #5 ball check valve and passes through orifice #17 into the coast clutch feed circuit. This orifice helps to control coast clutch apply.

3b Safety Mode Valve
Before the first 1-2 shift has occurred, the safety mode valve (341) remains in the released position, allowing line fluid pressure to enter the line safety mode fluid circuit.

3c 4-5 Shift Valve:
Line safety mode fluid applies the 4-5 shift valve (374) against 4-5 shift valve spring (373) force. This allows coast clutch feed fluid to enter the coast clutch fluid circuit.

3d Coast Clutch Assembly:
Coast clutch fluid is routed to the coast clutch piston to apply the coast clutch plates.

4 LOW AND REVERSE CLUTCH APPLIES

4a 2-3 Shift Solenoid (SS) Valve:
The 2-3 SS valve is energized, allowing feed limit fluid to enter the 2-3 signal fluid circuit. 2-3 signal fluid overcomes spring force and applies the 2-3 shift valve (371).

4b 3-4 Shift Control Valve and 3-4 Shift Valve:
2-3 signal fluid is routed to the 3-4 shift control valve (346) and applies the valve against spring force. This allows D432 fluid to enter the 123 fluid circuit.

4c #4 Ball Check Valve:
123 fluid seats the #4 ball check valve and passes through orifice #16. This orifice helps to control low and reverse clutch apply.

4d 4-5 Shift Valve:
Orificed 123 fluid is routed to the 4-5 shift valve (374) where it passes into the 123 braking fluid circuit.

4e Low Pressure Control Valve:
123 braking fluid is routed to the low pressure control valve (383). This valve regulates 123 braking fluid into the 123 regulated fluid circuit against spring force and orificed 123 regulated fluid pressure.

4f 1-2 Shift Control Valve and 1-2 Shift Valve:
2-3 signal fluid is also routed to the 1-2 shift control valve (366) and applies the valve against spring force. This allows feed limit fluid to enter the FDL fluid circuit. FDL fluid is routed to the 1-2 shift valve (387) and applies the valve against spring force. 123 regulated fluid is routed through orifice #20 to the 1-2 shift valve where it passes into the low and reverse clutch fluid circuit.

4g #8 Ball Check Valve:
Low and reverse clutch fluid seats the #8 ball check valve against the reverse lockout fluid passage and enters the low and reverse clutch or reverse lockout fluid passage.

4h Low and Reverse Clutch:
Low and reverse clutch or reverse lockout fluid pressure enters the outer area of the low and reverse clutch piston and moves the piston against spring force to apply the low and reverse clutch plates.

5 FLUID PRESSURE DIRECTED IN PREPARATION FOR A SHIFT TO SECOND GEAR

5a 1-2 Shift Valve:
D432 fluid is routed to the 1-2 shift valve (387) where it is blocked by the valve in preparation for an upshift to second gear.

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OVERDRIVE RANGE – FIRST GEAR

(before the first 1-2 shift has occurred)

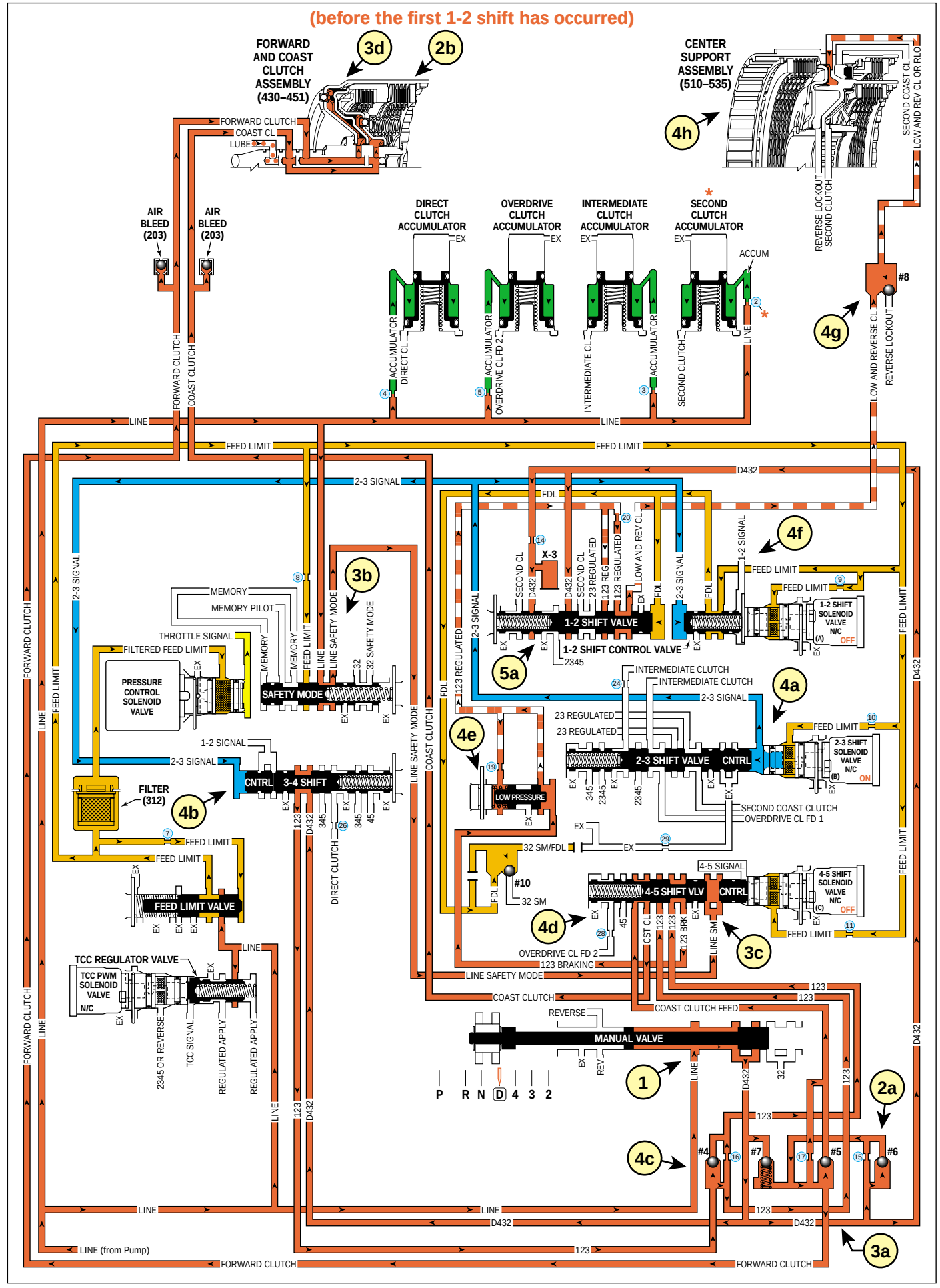

Figure 59

OVERDRIVE RANGE – FIRST GEAR

(after the first 1-2 shift has occurred)

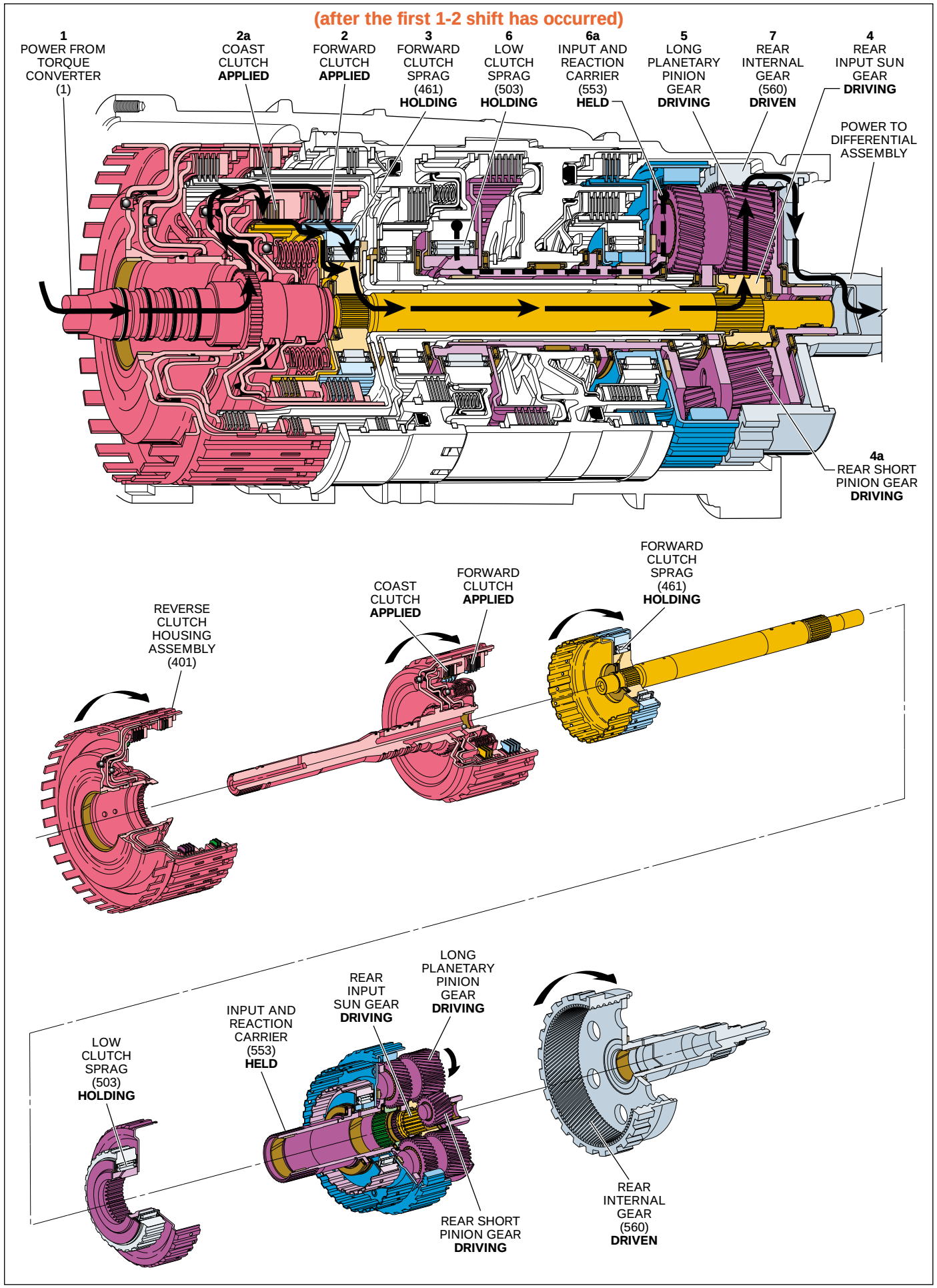

Figure 60

OVERDRIVE RANGE – FIRST GEAR

(after the first 1-2 shift has occurred)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	ON	OFF			APPLIED	APPLIED	LD				LD				

LD = LOCKED IN DRIVE

In Overdrive Range Ⓓ – First Gear, torque from the engine is multiplied through the torque converter and transmission gear set to the vehicle's drive shaft. The planetary gears operate in reduction to achieve a First gear starting ratio of approximately 3.42:1.

- The manual shift shaft (606) and the manual valve (377) are in the Overdrive Ⓓ position.

1 Power from Torque Converter
The input shaft forward and coast clutch housing assembly (433) is splined to and driven by the converter turbine.

2 Forward and Coast Clutches Applied
The forward clutch, which is located within the input shaft forward and coast clutch housing assembly (433), is applied and holds the forward clutch sprag outer race (459). The coast clutch is also located in the input shaft forward and coast clutch housing assembly (433) and is also applied.

3 Forward Clutch Sprag Holding
The forward clutch sprag (461) holds and power is transmitted to the input sun gear shaft assembly (457).

4 Rear Input Sun Gear Driving
The input sun gear shaft assembly (457) is splined to the rear input sun gear. The rear input sun gear drives the rear short planetary pinions.

5 Long Planetary Pinion Gears Driving
The rear short planetary pinions drive the long planetary pinions. The long pinions are in mesh with the front input sun gear, the front short pinions and the rear internal gear.

6 Low Clutch Sprag Holding
The power transferred to the input and reaction carrier (553) by the long planetary pinions attempts to rotate the carrier but, the carrier is held stationary by the low clutch sprag (503).

7 Rear Internal Gear Driven
With the input and reaction carrier (553) held, the long pinions drive the rear internal gear (560) to achieve the first gear starting ratio of approximately 3.42:1

- When the throttle is released in Overdrive Range – First Gear, power from the vehicle wheels drives the transmission components faster than engine torque is driving them. This causes the low clutch sprag (503) to overrun and allows the vehicle to coast freely without engine braking.

- In order to achieve engine braking, the low and reverse clutch can be applied to hold the input and reaction carrier assembly. See Manual Second – First Gear (page 82A) for a description of power flow during coast conditions.

As vehicle speed increases, less torque multiplication is needed for maximum efficiency. Therefore, it is desirable to shift the transmission to a lower gear ratio, or Second gear.

Note: the above description of mechanical power flow occurs after the first 1-2 shift has occurred.

OVERDRIVE RANGE – FIRST GEAR

(after the first 1-2 shift has occurred)

SOLENOID 1-2	SOLENOID 2-3	SOLENOID 4-5	DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
OFF	ON	OFF			APPLIED	APPLIED	LD				LD				

LD = LOCKED IN DRIVE

When the gear selector lever is moved to the Overdrive Range Ⓓ position from the Neutral (N) position, after the first 1-2 shift has occurred, the following changes occur to shift the transmission into Overdrive Range – First Gear.

1 MANUAL VALVE

In the Overdrive position the manual valve routes line pressure into the D432 fluid circuit. D432 fluid is routed to the 1-2 shift valve and to the 3-4 shift valve.

2 FORWARD CLUTCH APPLIES

2a #6 and #7 Ball Check Valves:
D432 fluid seats the #6 ball check valve and passes through orifice #15 into the forward clutch fluid circuit. D432 fluid also passes by the spring loaded #7 ball check valve to feed the forward clutch circuit as necessary to help control forward clutch apply.

2b #5 Ball Check Valve:
Forward clutch fluid seats the #5 ball check valve and passes through orifice #17 into the coast clutch feed circuit.

2c Forward Clutch Assembly:
Forward clutch fluid is routed to the forward clutch piston to apply the forward clutch plates.

3 COAST CLUTCH APPLIES

3a 2-3 Shift Solenoid (SS) Valve:
The 2-3 SS valve is energized, allowing feed limit fluid to enter the 2-3 signal fluid circuit. 2-3 signal fluid overcomes 2-3 shift valve spring (372) force and moves the 2-3 shift valve (371) to the applied position.

3b 1-2 Shift Control Valve and 1-2 Shift Valve:
2-3 signal fluid is routed to the 1-2 shift control valve (366) and moves the valve against 1-2 shift control valve spring (367) force to the applied position. This allows feed limit fluid to enter the FDL fluid circuit. FDL fluid is routed to the 1-2 shift valve (387) and moves the valve against 1-2 shift valve spring (388) force to the applied position to block D432 fluid at the valve.

3c 3-4 Shift Control Valve and 3-4 Shift Valve:
2-3 signal fluid is also routed to the 3-4 shift control valve (346) and moves the valve against 3-4 shift valve spring (344) force to the applied position. This allows D432 fluid to enter the 123 fluid circuit at the 3-4 shift valve (345).

3d #4 Ball Check Valve:
123 fluid seats the #4 ball check valve and passes through orifice #16. This orifice helps to control coast clutch apply.

3e 4-5 Shift Valve:
Orificed 123 fluid is routed to the 4-5 shift valve (374) where it passes into the coast clutch fluid circuit.

3f Coast Clutch Assembly:
Coast clutch fluid is routed to the coast clutch piston to apply the coast clutch plates.

4 FLUID PRESSURE DIRECTED IN PREPARATION FOR A SHIFT TO SECOND GEAR

4a 1-2 Shift Valve:
D432 fluid is routed to the 1-2 shift valve (387) where it is blocked by the valve in preparation for an upshift to second gear.

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OVERDRIVE RANGE – FIRST GEAR

(after the first 1-2 shift has occurred)

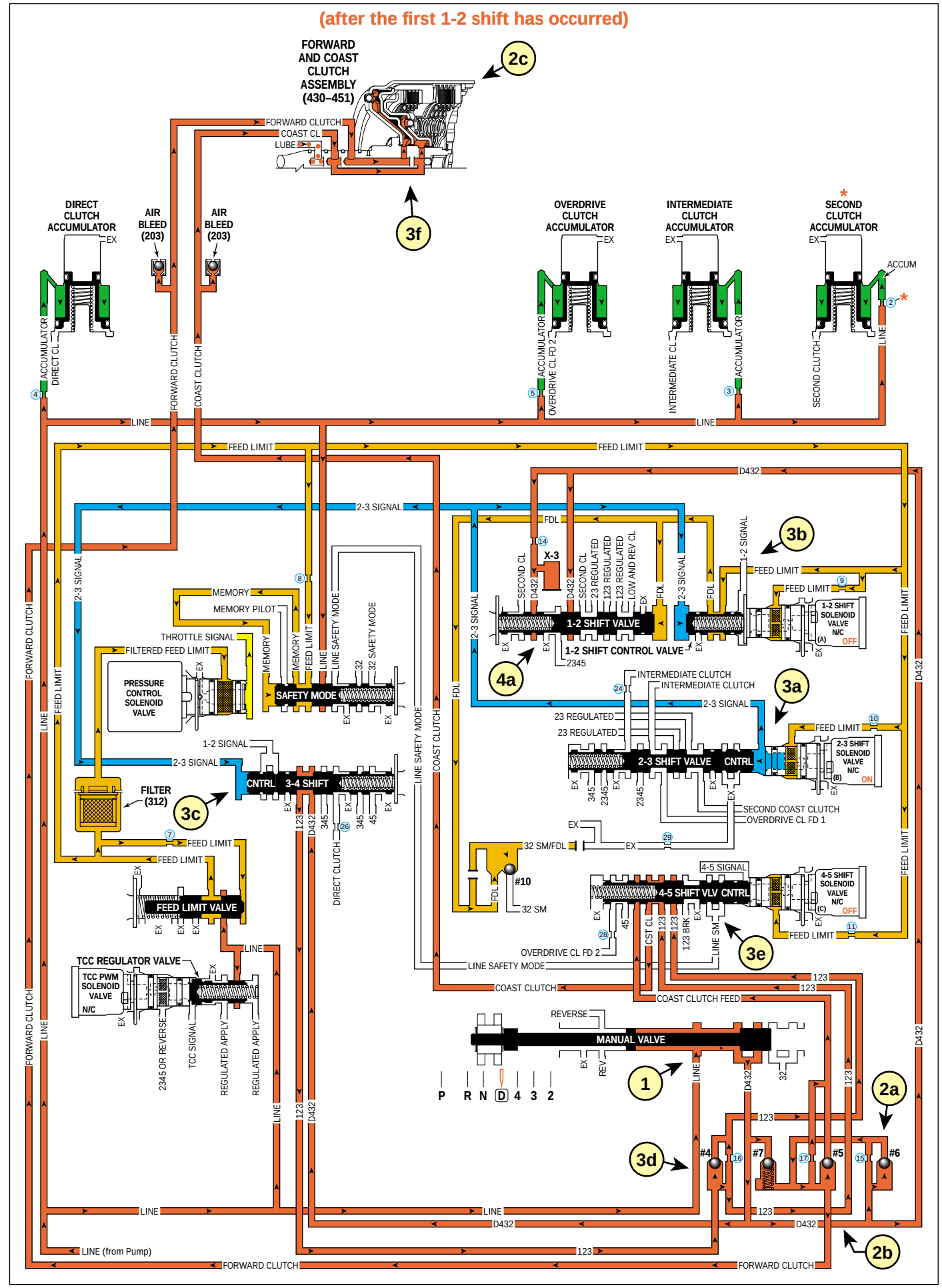

Figure 61

OVERDRIVE RANGE – SECOND GEAR

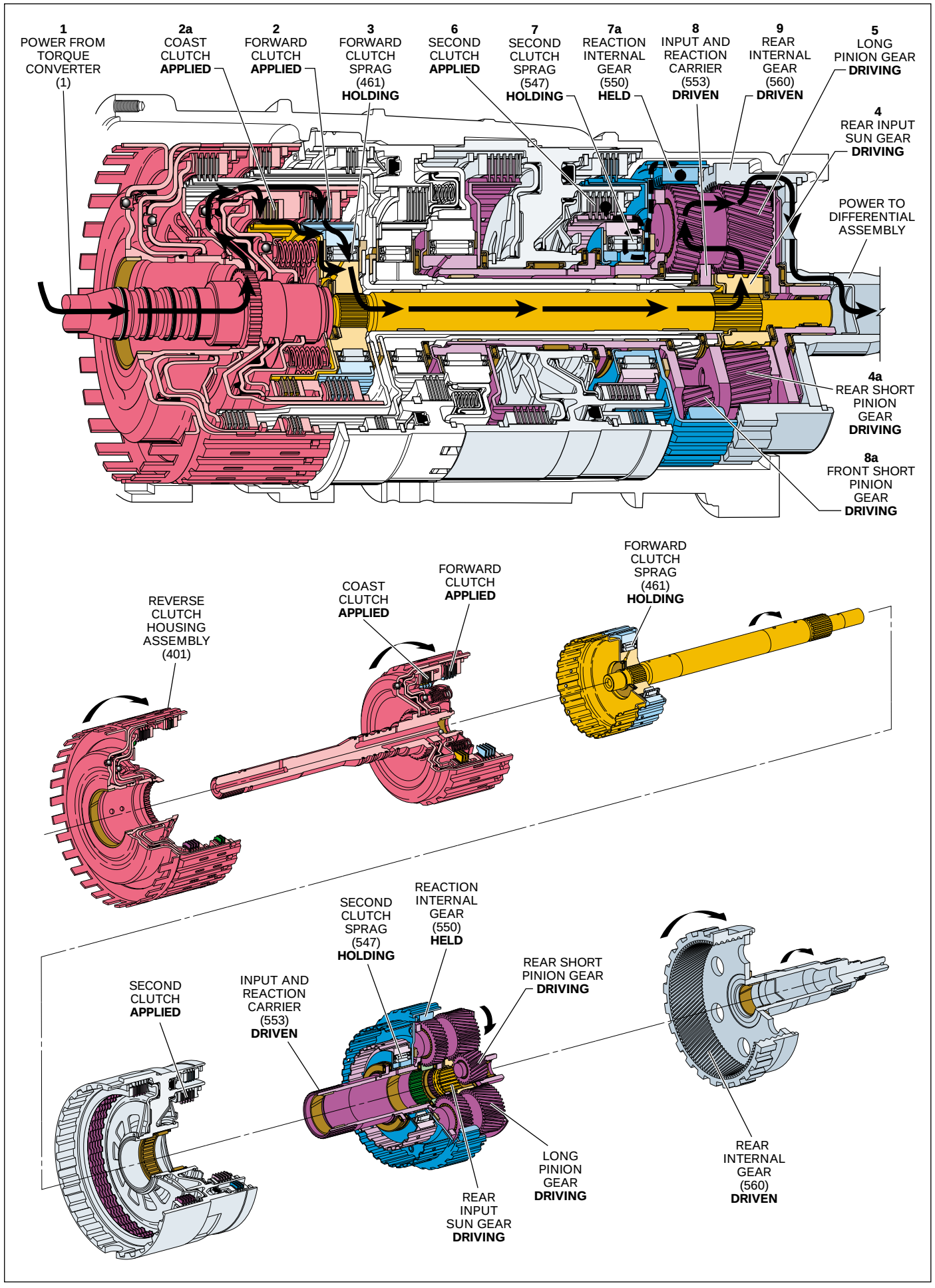

Figure 62

OVERDRIVE RANGE – SECOND GEAR

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
ON	ON	OFF			APPLIED	APPLIED	LD						APPLIED	LD	

LD = LOCKED IN DRIVE

As vehicle speed increases, input signals from the transmission speed sensors (input and output), throttle position (To) sensor, and other vehicle sensors are sent to the transmission control module (TCM). The TCM processes this information to determine the precise moment to shift the transmission. In Second gear, the planetary gear set continues to operate in reduction at a gear ratio of approximately 2.21:1.

1 Power from Torque Converter
The input shaft forward and coast clutch housing assembly (433) is splined to and driven by the converter turbine.

2 Forward and Coast Clutches Applied
The forward clutch, which is located within the input shaft forward and coast clutch housing assembly (433), is applied and holds the forward clutch sprag outer race (459). The coast clutch is also located in the input shaft forward and coast clutch housing assembly (433) and is also applied.

3 Forward Clutch Sprag Holding
The forward clutch sprag (461) holds and power is transmitted to the input sun gear shaft assembly (457).

4 Rear Input Sun Gear Driving
The input sun gear shaft assembly (457) is splined to the rear input sun gear. The rear input sun gear drives the rear short planetary pinions.

5 Long Planetary Pinion Gears Driving
The rear short planetary pinions drive the long planetary pinions. The long pinions are in mesh with the front input sun gear, the front short pinions and the rear internal gear.

6 Second Clutch Applied
The second clutch, which is located within the center support (518), is applied and holds the second clutch sprag outer race (545).

7 Second Clutch Sprag Holding
The power transferred to the front short pinions by the long planetary pinions attempts to rotate the reaction internal gear (550) but, the reaction internal gear is held stationary by the second clutch sprag (547).

8 Input and Reaction Carrier Driven
The front short pinions are driven around the stationary reaction internal gear (550), driving the input and reaction carrier (553).

9 Rear Internal Gear Driven
The long pinions drive the rear internal gear (560) to achieve the second gear ratio of approximately 2.21:1

- When the throttle is released in Overdrive Range – Second Gear, power from the vehicle wheels drives the transmission components faster than engine torque is driving them. This causes the second clutch sprag (547) to overrun and allows the vehicle to coast freely without engine braking.

- In order to achieve engine braking, the second coast clutch can be applied to hold the reaction internal gear. See Manual Second – Second Gear (page 80A) for a description of power flow during coast conditions.

As vehicle speed increases, less torque multiplication is needed to move the vehicle efficiently. Therefore, it is desirable to shift the transmission to a lower gear ratio, or Third gear.

OVERDRIVE RANGE – SECOND GEAR

SOLENOID 1-2	SOLENOID 2-3	SOLENOID 4-5	DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
ON	ON	OFF			APPLIED	APPLIED	LD						APPLIED	LD	

LD = LOCKED IN DRIVE

As vehicle speed increases, the transmission control module (TCM) receives input signals from both the input and output speed sensors, the throttle position (To) sensor and other vehicle sensors to determine the precise moment to energize or "turn ON" the 1-2 shift solenoid (SS) valve.

1 SECOND CLUTCH APPLIES

1a 1-2 Shift Solenoid (SS) Valve:
The 1-2 SS valve is energized, allowing feed limit fluid to enter the 1-2 signal fluid circuit. 1-2 signal fluid, together with 1-2 shift control valve spring (367) force, overcomes 2-3 signal fluid pressure and moves the 1-2 shift control valve (366) to the released position. This blocks feed limit fluid from entering the FDL fluid circuit.

1b 1-2 Shift Valve:
FDL fluid is exhausted from the 1-2 shift valve (387) and 1-2 shift valve spring (388) force moves the valve to the released position to allow D432 fluid to enter the second clutch and 2345 fluid circuits.

1c Second Clutch:
Second clutch fluid is directed to the second clutch piston to apply the second clutch plates and achieve Second gear.

2 SHIFT ACCUMULATION

2a Second Clutch Accumulator:
Second clutch fluid is also sent to the second clutch accumulator assembly. Second clutch fluid, together with accumulator spring force, moves the second clutch accumulator piston against accumulator fluid pressure to cushion the apply of the second clutch.

3 FLUID PRESSURE DIRECTED IN PREPARATION FOR A SHIFT TO THIRD GEAR

3a 2-3 Shift Valve:
2345 fluid is routed to the 2-3 shift valve (371) where it is blocked by the valve in preparation for an upshift to third gear.

4 TORQUE CONVERTER CLUTCH RELEASED

4a #2 Ball Check valve:
2345 fluid seats the ball check valve against the reverse passage and enters the 2345 or reverse fluid circuit.

4b TCC PWM Solenoid Valve:
2345 or reverse fluid is directed through the TCC PWM solenoid valve filter to the TCC PWM solenoid valve. However, depending on the shift pattern, the TCM keeps the pulse width modulated (PWM) solenoid de-energized blocking filtered 2345 or reverse fluid from entering the TCC signal fluid circuit, thereby keeping the torque converter clutch released.

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OVERDRIVE RANGE – SECOND GEAR

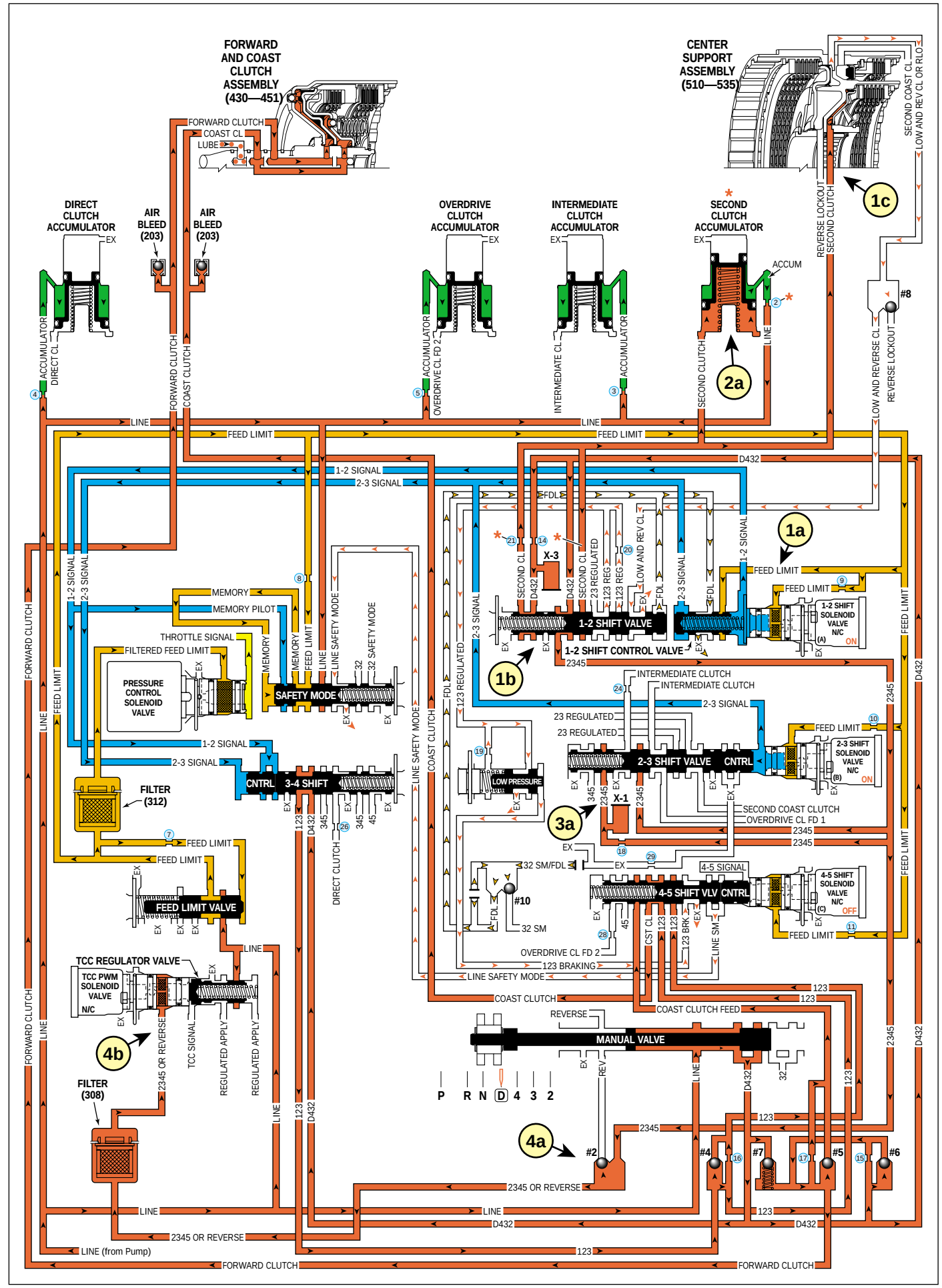

Figure 63

OVERDRIVE RANGE – THIRD GEAR

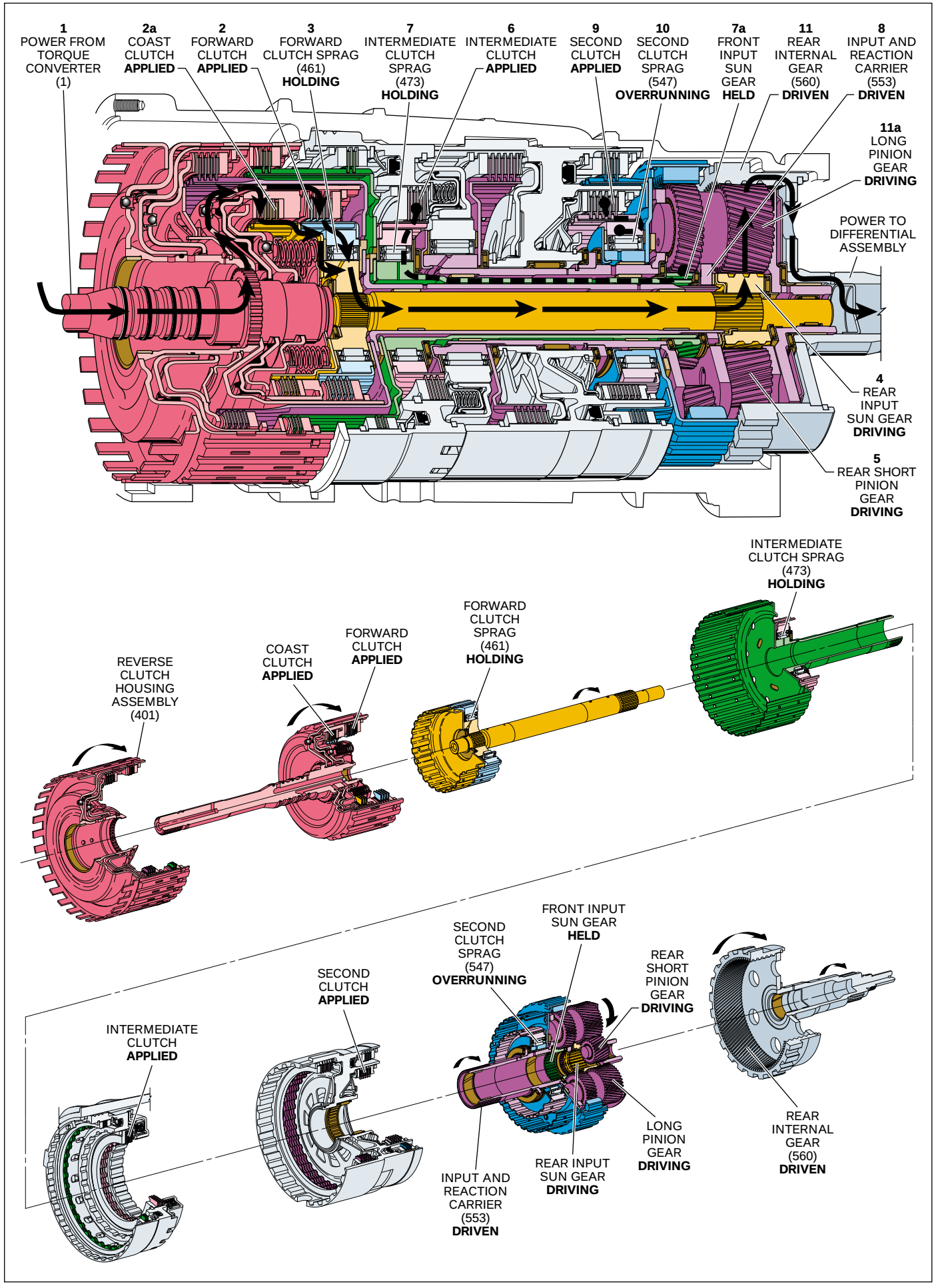

Figure 64

OVERDRIVE RANGE – THIRD GEAR

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
ON	OFF	OFF			APPLIED	APPLIED	LD		LD	APPLIED			APPLIED		

LD = LOCKED IN DRIVE

As vehicle speed continues to increase, input signals from the transmission speed sensors (input and output), throttle position (To) sensor, and other vehicle sensors are sent to the TCM. The TCM uses this information to determine the precise moment to shift the transmission into Third gear. In Third gear, the planetary gear set continues to operate in reduction at a gear ratio of approximately 1.60:1.

1 Power from Torque Converter
The input shaft forward and coast clutch housing assembly (433) is splined to and driven by the converter turbine.

2 Forward and Coast Clutches Applied
The forward clutch, which is located within the input shaft forward and coast clutch housing assembly (433), is applied and holds the forward clutch sprag outer race (459). The coast clutch is also located in the input shaft forward and coast clutch housing assembly (433) and is also applied.

3 Forward Clutch Sprag Holding
The forward clutch sprag (461) holds and power is transmitted to the input sun gear shaft assembly (457).

4 Rear Input Sun Gear Driving
The input sun gear shaft assembly (457) is splined to the rear input sun gear. The rear input sun gear drives the rear short planetary pinions.

5 Long Planetary Pinion Gears Driving
The rear short planetary pinions drive the long planetary pinions. The long pinions are in mesh with the front input sun gear, the front short pinions and the rear internal gear.

6 Intermediate Clutch Applied
The intermediate clutch, which is located within the overdrive and intermediate clutch assembly (15), is applied and holds the intermediate clutch sprag outer race (474).

7 Intermediate Clutch Sprag Holding
The power transferred to the front short pinions by the long planetary pinions attempts to drive the front input sun gear but, the front input sun gear is held stationary by the intermediate clutch sprag (473).

8 Input and Reaction Carrier Driven
The long planetary pinions are forced to walk around the stationary front input sun gear, driving the input and reaction carrier (553).

9 Second Clutch Applied
The second clutch, which is located within the center support (518), is applied and holds the second clutch sprag outer race (545).

10 Second Clutch Sprag Overrunning
The power transferred to the front short pinions by the long planetary pinions drives the reaction internal gear (550) in the opposite direction of the input and reaction carrier (553) and the second clutch sprag (547) overruns.

11 Rear Internal Gear Driven
The long pinions drive the rear internal gear (560) to achieve the second gear ratio of approximately 1.60:1

- When the throttle is released in Overdrive Range – Third Gear, power from the vehicle wheels drives the transmission components faster than engine torque is driving them. This causes the intermediate clutch sprag (473) to overrun and allows the vehicle to coast freely without engine braking.
- In order to achieve engine braking, the overdrive clutch can be applied to hold the front input sun gear. See Manual Third – Third Gear (page 78A) for a description of power flow during coast conditions.

As vehicle speed increases, less torque multiplication is required to move the vehicle efficiently. Therefore, it is desirable to shift the transmission to a lower gear ratio, or Fourth gear.

OVERDRIVE RANGE – THIRD GEAR

SOLENOID 1-2	SOLENOID 2-3	SOLENOID 4-5	DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
ON	OFF	OFF			APPLIED	APPLIED	LD		LD	APPLIED			APPLIED		

LD = LOCKED IN DRIVE

As vehicle speed increases, the TCM receives input signals from both speed sensors, the To sensor and other vehicle sensors to determine the precise moment to de-energize or “turn OFF” the 2-3 shift solenoid (SS) valve. The 2-3 solenoid is OFF when the TCM removes the path to ground for that electrical circuit. This allows 2-3 signal fluid to exhaust at the 2-3 SS valve.

1 INTERMEDIATE CLUTCH APPLIES

1a 2-3 Shift Solenoid (SS) Valve:
The 2-3 SS valve is de-energized, blocking feed limit fluid from entering the 2-3 signal fluid circuit. 2-3 signal fluid pressure exhausts through the 2-3 SS valve and 2-3 shift valve spring (372) force moves the 2-3 shift valve (371) to the released position.

1b 2-3 Shift Valve:
2345 fluid is routed through the 2-3 shift valve and enters the intermediate clutch circuit.

1c Intermediate Clutch:
Intermediate clutch fluid is directed to the intermediate clutch piston to apply the intermediate clutch plates and achieve Third gear.

2 SHIFT ACCUMULATION

2a Intermediate Clutch Accumulator:
Intermediate clutch fluid is also sent to the intermediate clutch accumulator assembly. Intermediate clutch fluid, together with accumulator spring force, moves the intermediate clutch accumulator piston against accumulator fluid pressure to cushion the apply of the intermediate clutch.

3 TORQUE CONVERTER CLUTCH RELEASED

3a TCC PWM Solenoid Valve:
Filtered 2345 or reverse fluid is still available at the TCC PWM solenoid valve. However, depending on the shift pattern, the TCM keeps the pulse width modulated (PWM) solenoid de-energized blocking filtered 2345 or reverse fluid from entering the TCC signal fluid circuit, thereby keeping the torque converter clutch released.

4 FLUID PRESSURE DIRECTED IN PREPARATION FOR A SHIFT TO FOURTH GEAR

4a 2-3 Shift Valve:
2345 fluid is routed through the 2-3 shift valve (371) into the 345 fluid circuit.

4b X-4 Ball Check Valve:
345 fluid is routed through the X-4 ball check valve pocket. In some transmission models there is a ball check valve present which would force 345 fluid through orifice #25.

4c 3-4 Shift Valve:
345 fluid is routed to the 3-4 shift valve (345) where it is blocked by the valve in preparation for an upshift to fourth gear.

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OVERDRIVE RANGE – THIRD GEAR

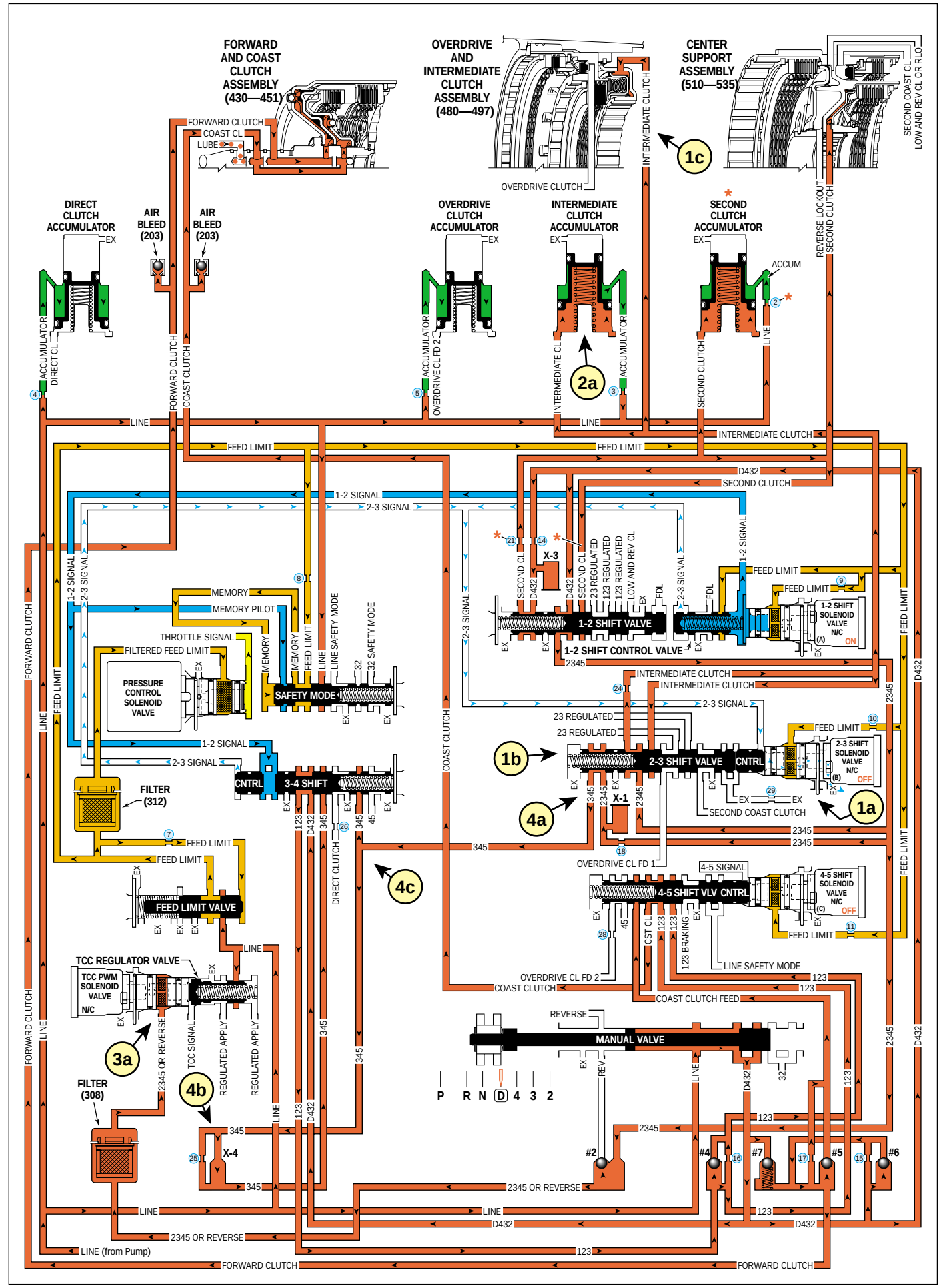

Figure 65

OVERDRIVE RANGE – FOURTH GEAR

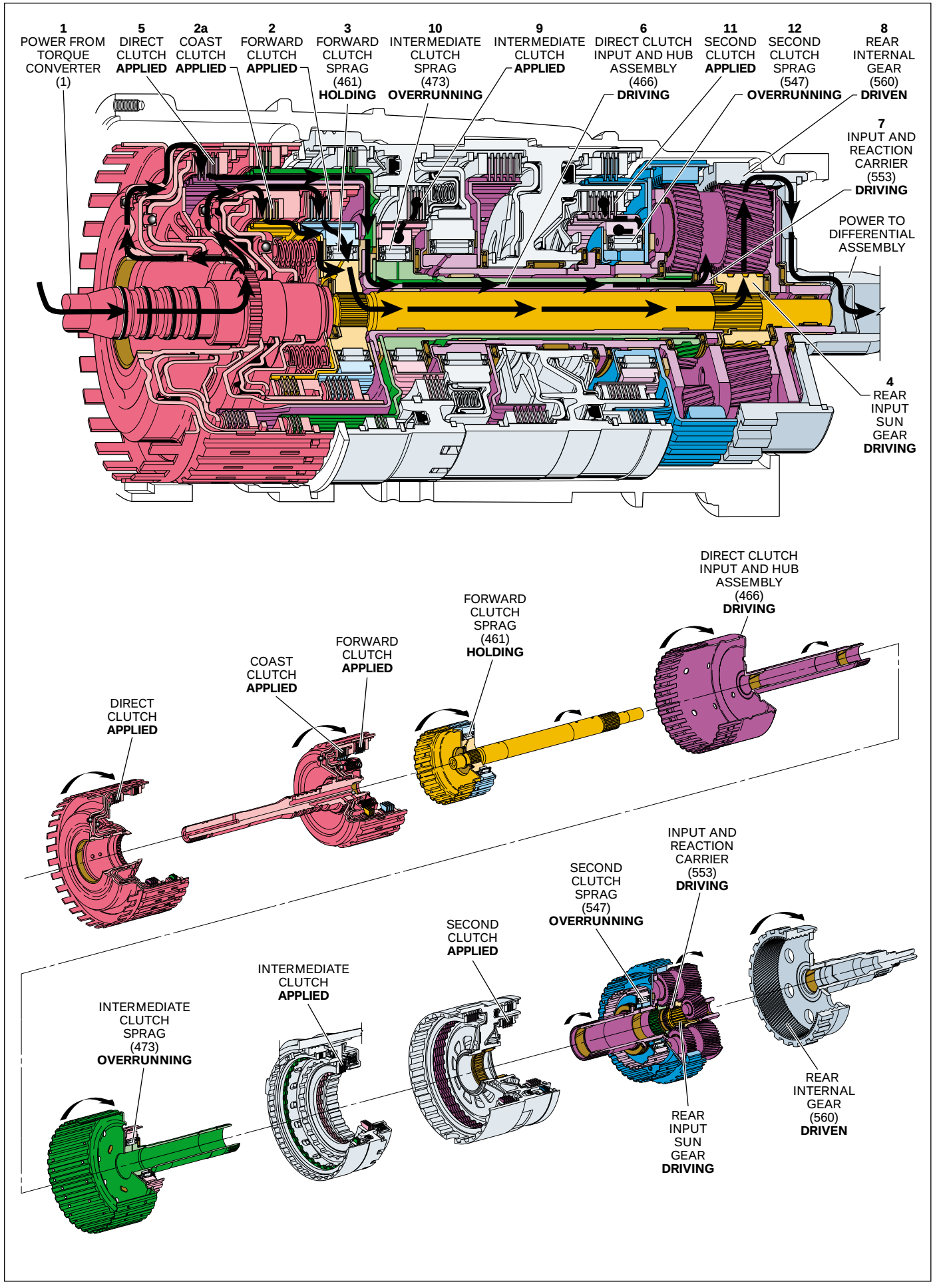

Figure 66

OVERDRIVE RANGE – FOURTH GEAR

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	ON	APPLIED		APPLIED	APPLIED	LD			APPLIED			APPLIED		

LD = LOCKED IN DRIVE

As vehicle speed increases further, input signals from both transmission speed sensors (input and output), throttle position (To) sensor, and other vehicle sensors are sent to the TCM. The TCM uses this information to determine the precise moment to shift the transmission into Fourth Gear. In Fourth gear, the planetary gear set rotates as a unit, providing a 1:1 direct drive gear ratio between the converter turbine and output shaft.

1 Power from Torque Converter
The input shaft forward and coast clutch housing assembly (433) is splined to and driven by the converter turbine.

2 Forward and Coast Clutches Applied
The forward clutch, which is located within the input shaft forward and coast clutch housing assembly (433), is applied and holds the forward clutch sprag outer race (459). The coast clutch is also located in the input shaft forward and coast clutch housing assembly (433) and is also applied.

3 Forward Clutch Sprag Holding
The forward clutch sprag (461) holds and power is transmitted to the input sun gear shaft assembly (457).

4 Rear Input Sun Gear Driving
The input sun gear shaft assembly (457) is splined to the rear input sun gear. The rear input sun gear attempts to drive the long planetary pinion gears through the rear short planetary pinions.

5 Direct Clutch Applied
The direct clutch, which is located within the reverse clutch housing assembly (401), is applied and engine torque is transferred to the direct clutch input and hub assembly (466).

6 Direct Clutch Input and Hub Assembly Driving
The direct clutch input and hub assembly (466) is splined to and drives the input and reaction carrier (553).

7 Input and Reaction Carrier Driving
With the rear input sun gear and the input and reaction carrier both turning at converter turbine speed, the carrier pinion gears are locked together as an assembly and drive the rear internal gear (560).

8 Rear Internal Gear Driven
The input and reaction carrier (553) drives the rear internal gear (560) at converter turbine speed to obtain a 1:1 direct drive gear ratio through the transmission gear set.

9 Intermediate Clutch Applied
The intermediate clutch, which is located within the overdrive and intermediate clutch assembly (15), is applied and holds the intermediate clutch sprag outer race (474).

10 Intermediate Clutch Sprag Overrunning
With the input and reaction carrier (553) locked together and driving as a unit, the intermediate clutch sprag (473) is overrunning.

11 Second Clutch Applied
The second clutch, which is located within the center support (518), is applied and holds the second clutch sprag outer race (545).

12 Second Clutch Sprag Overrunning
With the input and reaction carrier (553) locked together and driving as a unit, the second clutch sprag (547) is overrunning.

- When the throttle is released in Overdrive Range – Fourth Gear, the vehicle is allowed to coast brake. Because none of the sprag clutches are used in driving the vehicle during acceleration, there are no elements to overrun to allow the vehicle to coast freely in fourth gear. Therefore, engine compression slows the vehicle when the throttle is released. Refer to Manual Fourth – Fourth Gear (page 76A) a for description of power flow during coast conditions.

As vehicle speed increases, less torque multiplication is required to operate the engine efficiently. Therefore, it is desirable to shift to an overdrive gear ratio, or Fifth gear.

OVERDRIVE RANGE – FOURTH GEAR

SOLENOID 1-2	SOLENOID 2-3	SOLENOID 4-5	DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
OFF	OFF	ON	APPLIED		APPLIED	APPLIED	LD			APPLIED			APPLIED		

LD = LOCKED IN DRIVE

As vehicle speed increases, the TCM receives input signals from both speed sensors, the To sensor and other vehicle sensors to determine the precise moment to de-energize or "turn OFF" the 1-2 shift solenoid (SS) valve, and to energize or "turn ON" the 4-5 SS valve.

1 DIRECT CLUTCH APPLIED

1a 1-2 Shift Solenoid (SS) Valve:
The 1-2 SS valve is de-energized, blocking feed limit fluid from entering the 1-2 signal fluid circuit and 1-2 signal fluid pressure exhausts through the 1-2 SS valve.

1b 3-4 Shift Valve:
When 1-2 signal fluid pressure exhausts from the 3-4 shift valve (345), the 3-4 shift valve spring (344) moves the valve to the released position. 345 fluid from the 2-3 shift valve flows through the 3-4 shift valve and enters the direct clutch circuit.

1c Direct Clutch:
Direct clutch fluid is routed to the direct clutch piston to apply the direct clutch plates and obtain Fourth gear.

2 3-4 SHIFT ACCUMULATION

2a Direct Clutch Accumulator:
Direct clutch fluid is also sent to the direct clutch accumulator assembly. Direct clutch fluid, together with accumulator spring force, moves the direct clutch accumulator piston against accumulator fluid pressure to cushion the apply of the direct clutch.

3 COAST CLUTCH FEED

3a 4-5 Shift Solenoid (SS) Valve:
The 4-5 SS valve is energized, allowing feed limit fluid to enter the 4-5 signal fluid circuit. 4-5 signal fluid overcomes 4-5 shift valve spring (373) force and moves the 4-5 shift control valve (375) and the 4-5 shift valve (374) to the applied position.

3b 4-5 Shift Valve:
In first through third gears, the coast clutch has been fed by 123 fluid. In fourth gear the 4-5 shift valve (374) is applied in preparation for a shift to fifth gear. This causes the coast clutch fluid circuit to be supplied by coast clutch feed fluid, and 123 fluid to exhaust.

4 TORQUE CONVERTER CLUTCH RELEASED

4a TCC PWM Solenoid Valve:
Filtered 2345 or reverse fluid is still available at the TCC PWM solenoid valve. However, depending on the shift pattern, the TCM keeps the pulse width modulated (PWM) solenoid de-energized blocking filtered 2345 or reverse fluid from entering the TCC signal fluid circuit, thereby keeping the torque converter clutch released.

5 FLUID PRESSURE DIRECTED IN PREPARATION FOR A SHIFT TO FIFTH GEAR

5a 3-4 Shift Valve:
345 fluid is routed through the 3-4 shift valve (345) into the 45 fluid circuit.

5b #3 Ball Check Valve:
45 fluid seats the #3 ball check valve and passes through orifice #27. This orifice helps to control overdrive clutch apply in fifth gear.

5c 4-5 Shift Valve:
45 fluid is routed to the 4-5 shift valve (374) where it is blocked by the valve in preparation for an upshift to fifth gear.

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OVERDRIVE RANGE – FOURTH GEAR

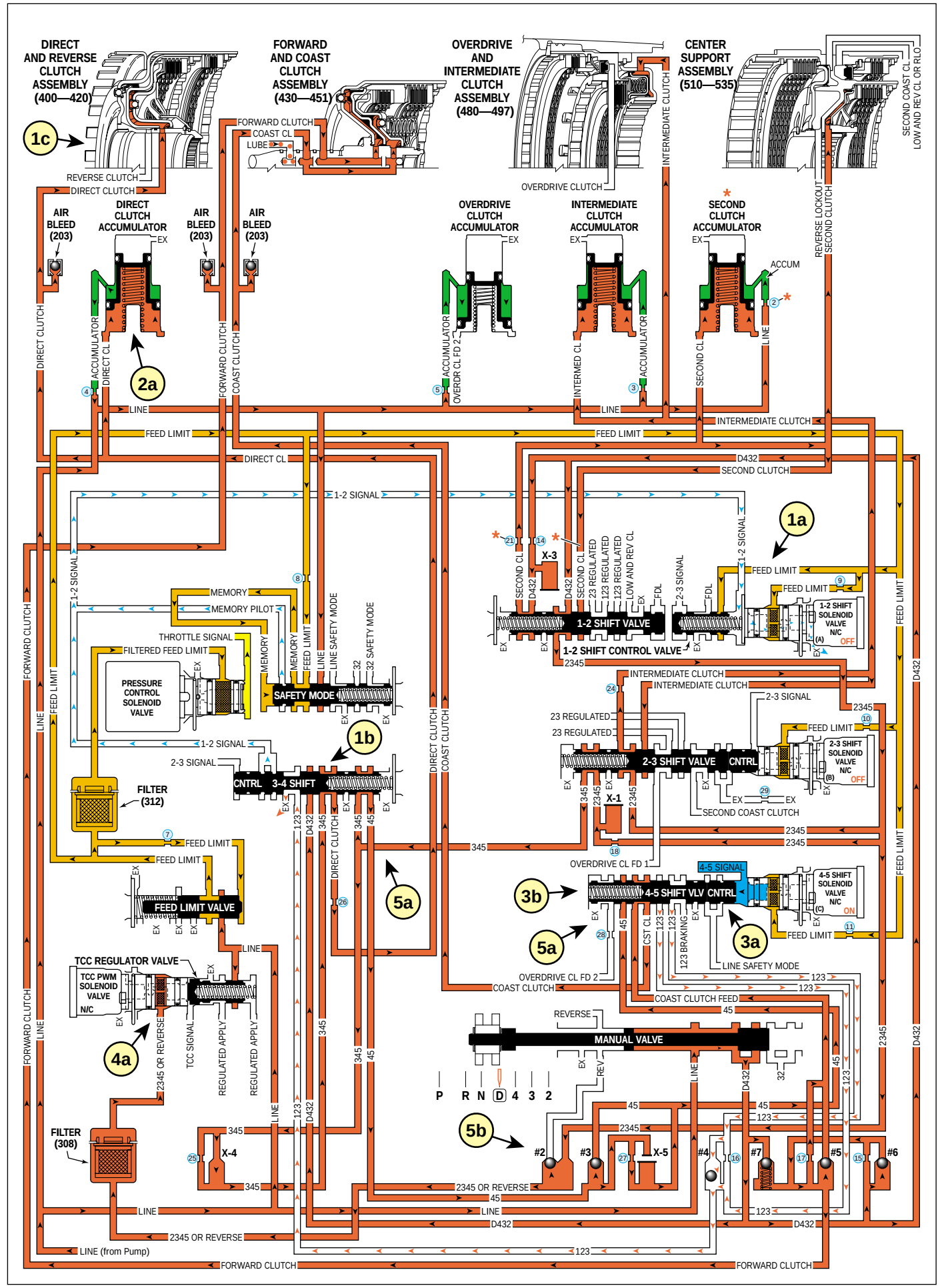

Figure 67

OVERDRIVE RANGE – FIFTH GEAR

(Torque Converter Clutch Released)

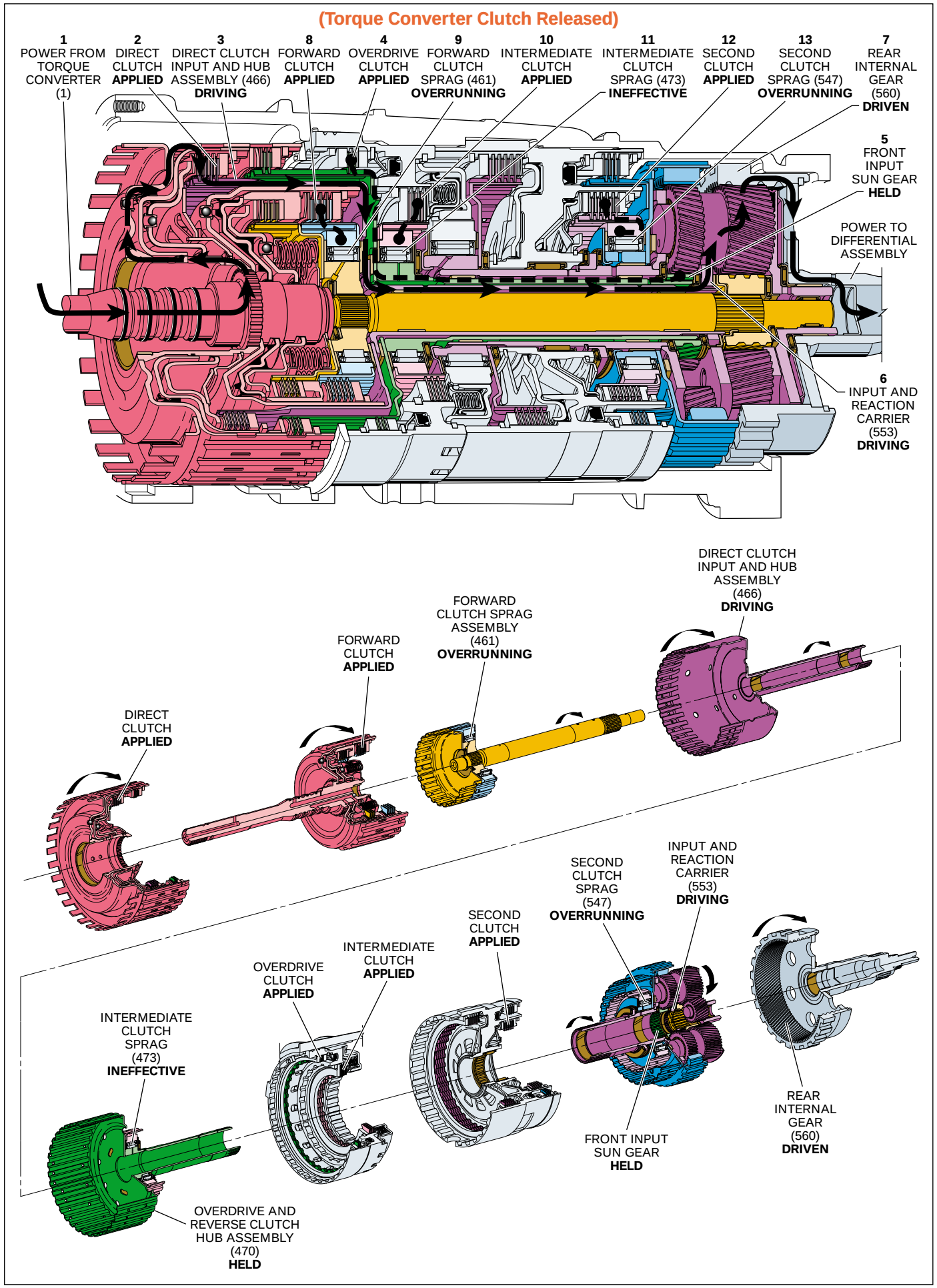

Figure 68

OVERDRIVE RANGE – FIFTH GEAR

(Torque Converter Clutch Released)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF	APPLIED			APPLIED		APPLIED		APPLIED			APPLIED		

LD = LOCKED IN DRIVE

To maximize engine performance and fuel economy, a Fifth gear (Overdrive) is used to achieve an approximate ratio of 0.75:1 through the transmission gear set to the vehicle drive shaft. This allows the vehicle to maintain a given road speed with less engine output speed.

1 Power from Torque Converter
The input shaft forward and coast clutch housing assembly (433) is splined to and driven by the converter turbine.

2 Direct Clutch Applied
The direct clutch, which is located within the reverse clutch housing assembly (401), is applied and engine torque is transferred to the direct clutch input and hub assembly (466).

3 Direct Clutch Input and Hub Assembly Driving
The direct clutch input and hub assembly (466) is splined to and drives the input and reaction carrier (553).

4 Overdrive Clutch Applied
The overdrive clutch, which is located within the overdrive clutch housing (493), is applied and holds the overdrive and reverse clutch hub assembly (470) stationary.

5 Front Input Sun Gear Held
The overdrive and reverse clutch hub assembly (470) is splined to the front input sun gear and holds it stationary.

6 Input and Reaction Carrier Driving
With the front input sun gear held, and the input and reaction carrier being driven by the direct clutch input and hub assembly (466), the long planetary pinion gears are forced to walk in the direction of engine rotation around the stationary front input sun gear and drive the rear internal gear (560).

7 Rear Internal Gear Driven
The input and reaction carrier long pinion gears drive the rear internal gear (560) faster than converter turbine speed to obtain a 0.75:1 overdrive drive gear ratio through the transmission gear set.

8 Forward Clutch Applied
The forward clutch is applied and holds the forward clutch sprag outer race (459).

9 Forward Clutch Sprag Overrunning
The input sun gear shaft assembly is splined to and driven by the rear input sun gear, causing the forward clutch sprag (461) to overrun.

10 Intermediate Clutch Applied
The intermediate clutch is applied and holds the intermediate clutch sprag outer race (474) stationary.

11 Intermediate Clutch Sprag Ineffective
With the intermediate clutch sprag outer race (474) and the overdrive and reverse clutch hub assembly (470) both held, the intermediate clutch sprag (473) has no effect in fifth gear.

12 Second Clutch Applied
The second clutch is applied and holds the second clutch sprag outer race (545) stationary.

13 Second Clutch Sprag Overrunning
The power transferred to the front short pinions by the long planetary pinions drives the reaction internal gear (550) causing the second clutch sprag (547) to overrun.

When the throttle is released in Overdrive Range – Fifth Gear, the vehicle is allowed to coast brake. Because none of the sprag clutches are used in driving the vehicle during acceleration, there are no elements to overrun to allow the vehicle to coast freely in Fifth gear. Therefore, engine compression slows the vehicle when the throttle is released until the transmission downshifts into Overdrive Range – Fourth Gear.

However, due to the gear ratio in Overdrive, engine compression braking is not as noticeable by the driver as it is in the Manual gear ranges.

OVERDRIVE RANGE – FIFTH GEAR

(Torque Converter Clutch Released)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF	APPLIED			APPLIED		APPLIED		APPLIED			APPLIED		

LD = LOCKED IN DRIVE

Overdrive Range – Fifth Gear is used to maximize engine efficiency and fuel economy under most normal driving conditions. In order to shift the transmission into Fifth gear, the TCM receives input signals from both speed sensors, the To sensor and other vehicle sensors to determine the precise moment to de-energize or "turn OFF" the 4-5 shift solenoid (SS) valve.

1 OVERDRIVE CLUTCH APPLIED

1a 4-5 Shift Solenoid (SS) Valve:
The 4-5 SS valve is de-energized, blocking feed limit fluid from entering the 4-5 signal fluid circuit. 4-5 signal fluid pressure exhausts through the 4-5 SS valve and 4-5 shift valve spring (373) force moves the 4-5 shift valve (374) and the 4-5 shift control valve (375) to the released position.

1b 4-5 Shift Valve:
45 fluid is routed through the 4-5 shift valve and enters the overdrive clutch feed 2 fluid circuit through orifice #28.

1c #12 Ball Check Valve:
Overdrive clutch feed 2 fluid seats the #12 ball check valve against the overdrive clutch feed 1 passage and enters the overdrive clutch fluid circuit.

1d Overdrive Clutch:
Overdrive clutch fluid is then directed to the overdrive clutch piston to apply the overdrive clutch plates and achieve Fifth gear.

2 4-5 SHIFT ACCUMULATION

2a Overdrive Clutch Accumulator:
Overdrive clutch fluid is also sent to the overdrive clutch accumulator assembly. Overdrive clutch fluid, together with accumulator spring force, moves the overdrive clutch accumulator piston against accumulator fluid pressure to cushion the apply of the overdrive clutch.

3 COAST CLUTCH RELEASES

3a Coast Clutch:
When the 4-5 shift valve is shifted to the released position, coast clutch feed fluid is blocked and coast clutch fluid exhausts through the valve allowing the coast clutch to release.

3b 4-5 Shift Valve:
Coast clutch fluid passes through the 4-5 shift valve and into the 123 circuit and on to the 3-4 shift valve where it exhausts.

4 TORQUE CONVERTER CLUTCH RELEASED

4a TCC PWM Solenoid Valve:
Filtered 2345 or reverse fluid is still available at the TCC PWM solenoid valve. However, depending on the shift pattern, the TCM keeps the pulse width modulated (PWM) solenoid de-energized blocking filtered 2345 or reverse fluid from entering the TCC signal fluid circuit, thereby keeping the torque converter clutch released.

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OVERDRIVE RANGE – FIFTH GEAR

(Torque Converter Clutch Released)

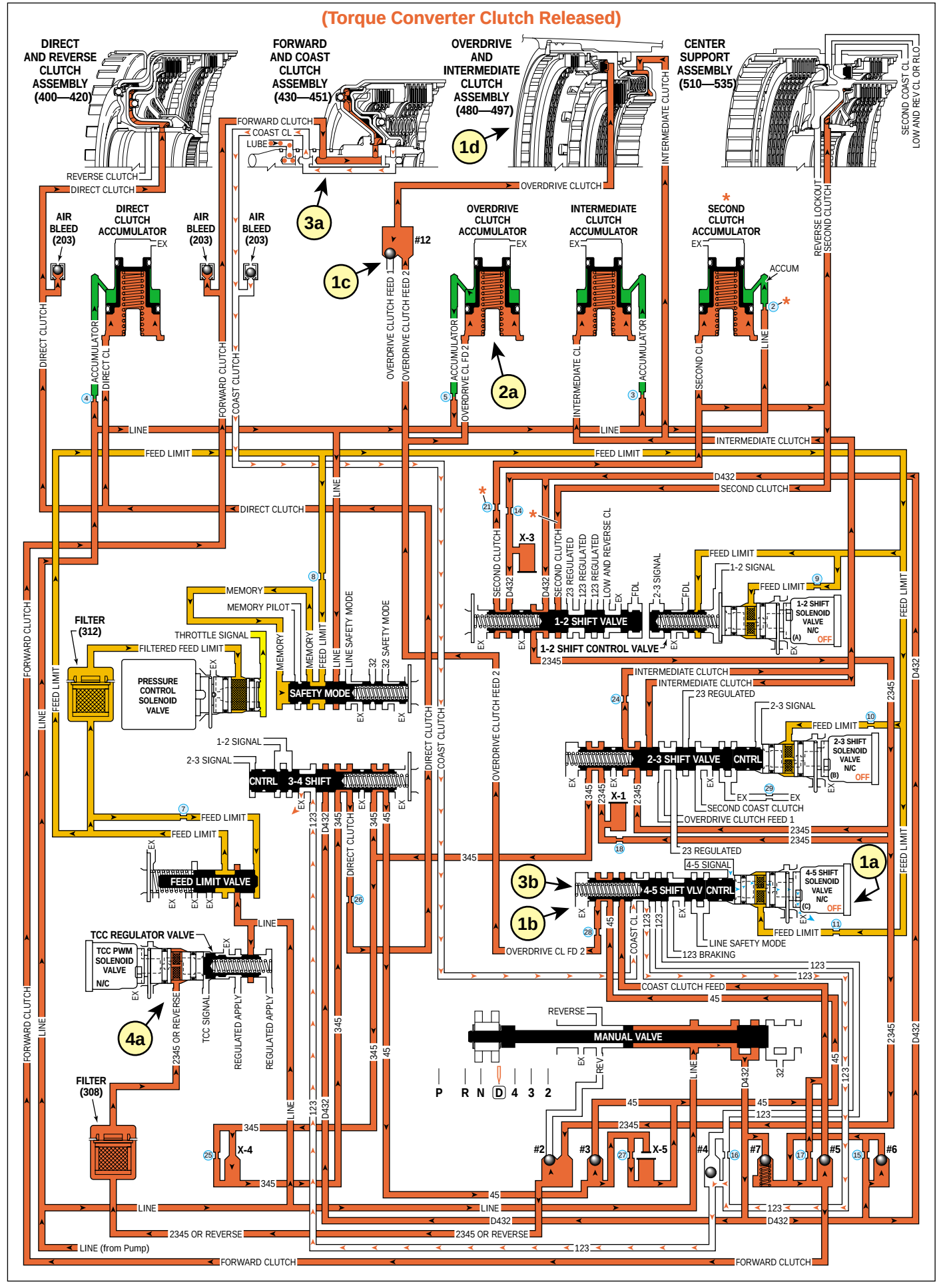
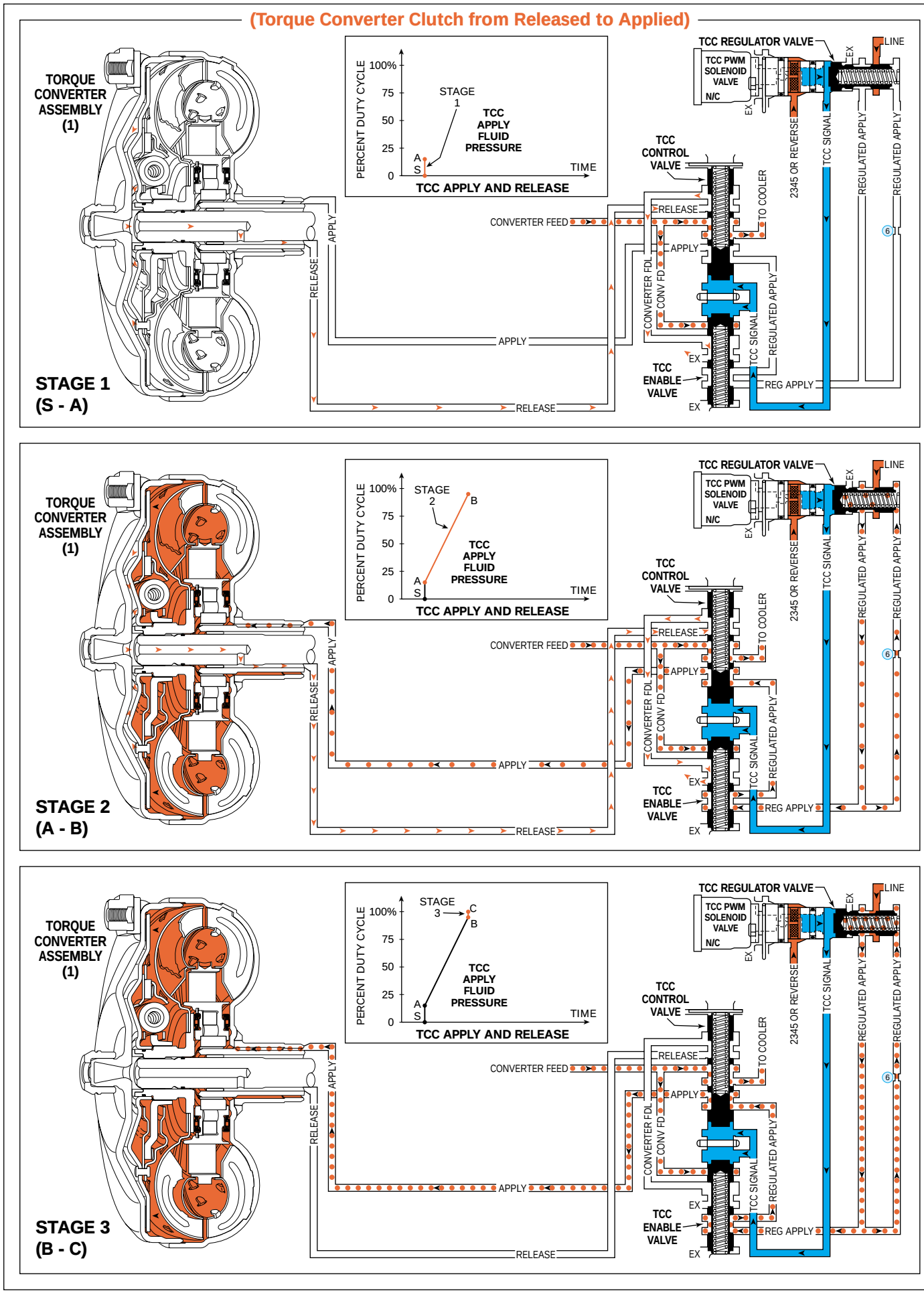


Figure 69

OVERDRIVE RANGE – FIFTH GEAR

(Torque Converter Clutch from Released to Applied)



OVERDRIVE RANGE – FIFTH GEAR

(Torque Converter Clutch from Released to Applied)

When the Transmission Control Module (TCM) determines that the engine and transmission are operating properly to engage the Torque Converter Clutch (TCC), the TCM energizes the TCC PWM solenoid valve. The following events occur in order to apply the torque converter clutch:

OFF **At this time the Torque Converter Clutch is considered to be disengaged (OFF).**

TCM decision to apply TCC (see page 50, in the Electrical Components section, for more information).

Stage 1 The TCM pulses the TCC PWM solenoid valve to approximately 15% duty cycle from point **S** to point **A**. 2345 or Reverse fluid at the TCC PWM solenoid valve is "pulsed" into the TCC Signal fluid circuit. The TCC Signal fluid pressure at point **A** is strong enough to move the TCC Control, and TCC Enable valves against spring force. The TCC Control valve moves and allows Release fluid to begin to exhaust from the torque converter and enter the Converter FDL fluid circuit. The TCC Enable valve moves and allows Release/Converter FDL fluid to exhaust into the sump. This stage is designed to move the TCC Control and TCC Enable valves from the released position toward the applied position; there is not enough pressure to apply the TCC.

Stage 2 The TCC PWM solenoid valve duty cycle is ramped up from point **A** to point **B**. TCC Signal fluid pressure is now strong enough to move the TCC Regulator valve against spring force. Line pressure from the pump enters the Regulated Apply circuit at the TCC Regulator valve. Regulated Apply fluid is routed through the TCC Enable valve and through the TCC Control valve into the Apply circuit. The pressure value in the Regulated Apply circuit is precisely controlled to maintain a small amount of slippage (20 to 80 RPM) between the engine and the turbine, reducing driveline torsional disturbances.

Stage 3 Now the Regulated Apply pressure is increased. This is caused by the TCC PWM solenoid valve duty cycle being increased from point **B** to point **C,** to maximum duty cycle. This extra pressure ensures that the apply force on the TCC pressure plate is not at the slip threshold, but in the condition of full lock up.

COMPLETE HYDRAULIC CIRCUIT
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Figure 70

OVERDRIVE RANGE – FIFTH GEAR

(Torque Converter Clutch from Applied to Released)

When the TCC pressure plate is applied, it is held against the torque converter cover. Since it is splined to the converter turbine hub, it provides a mechanical coupling (direct drive) of the engine to the transmission gear sets. This mechanical coupling eliminates the small amount of slippage that occurs in the fluid coupling of a torque converter, resulting in a more efficient transfer of engine torque through the transmission and to the drive wheels.

ON At this time the Torque Converter Clutch is considered to be engaged (ON).

TCM decision to release TCC (see page 50, in the Electrical Components section, for more information).

Stage 4 During this stage, the apply pressure from the TCC Regulator valve is decreased by the TCC PWM solenoid valve duty cycle dropping from point **D** to point **E**. Spring force pushes the valve back and reduces the Regulated Apply pressure. This reduces the apply force on the TCC pressure plate to the slip threshold. This gets the TCC pressure plate ready for a smooth release.

Stage 5 The TCC PWM solenoid valve duty cycle is ramped down from point **E** to point **F** through this stage. This action allows the Regulated Apply pressure to start at the slip threshold, and decrease to near "0" pressure over a very short time to point **F**. The Regulated Apply pressure value from the TCC Regulator valve at this duty cycle (point **F**) should fully release the TCC pressure plate. Slip speed should be at the maximum value.

Stage 6 The TCM pulses the TCC PWM solenoid valve to a value of "0". Now the TCC Control and TCC Enable valves return to their released positions (away from the spring). Release fluid is now directed back to the torque converter. This stage is designed to move the TCC Control and TCC Enable valves to the released position.

OFF At this time the Torque Converter Clutch is considered to be disengaged (OFF).

(Some TCM calibrations may allow stages 4 - 6 to happen very rapidly in almost a straight line down from point **D** to point **G**.)

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OVERDRIVE RANGE – FIFTH GEAR

(Torque Converter Clutch from Applied to Released)

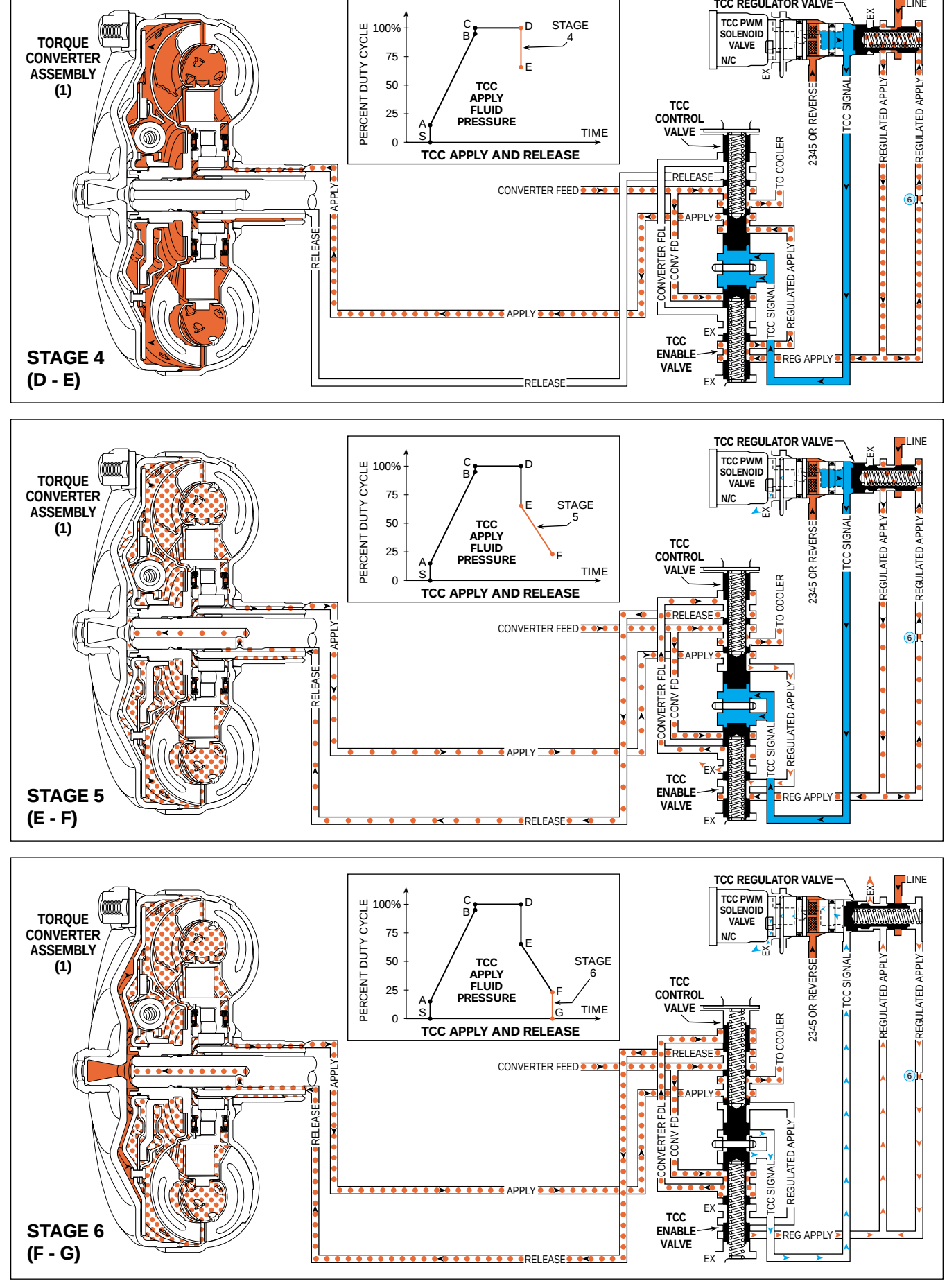

Figure 71

MANUAL FOURTH – FOURTH GEAR

(from Overdrive Range – Fifth Gear)

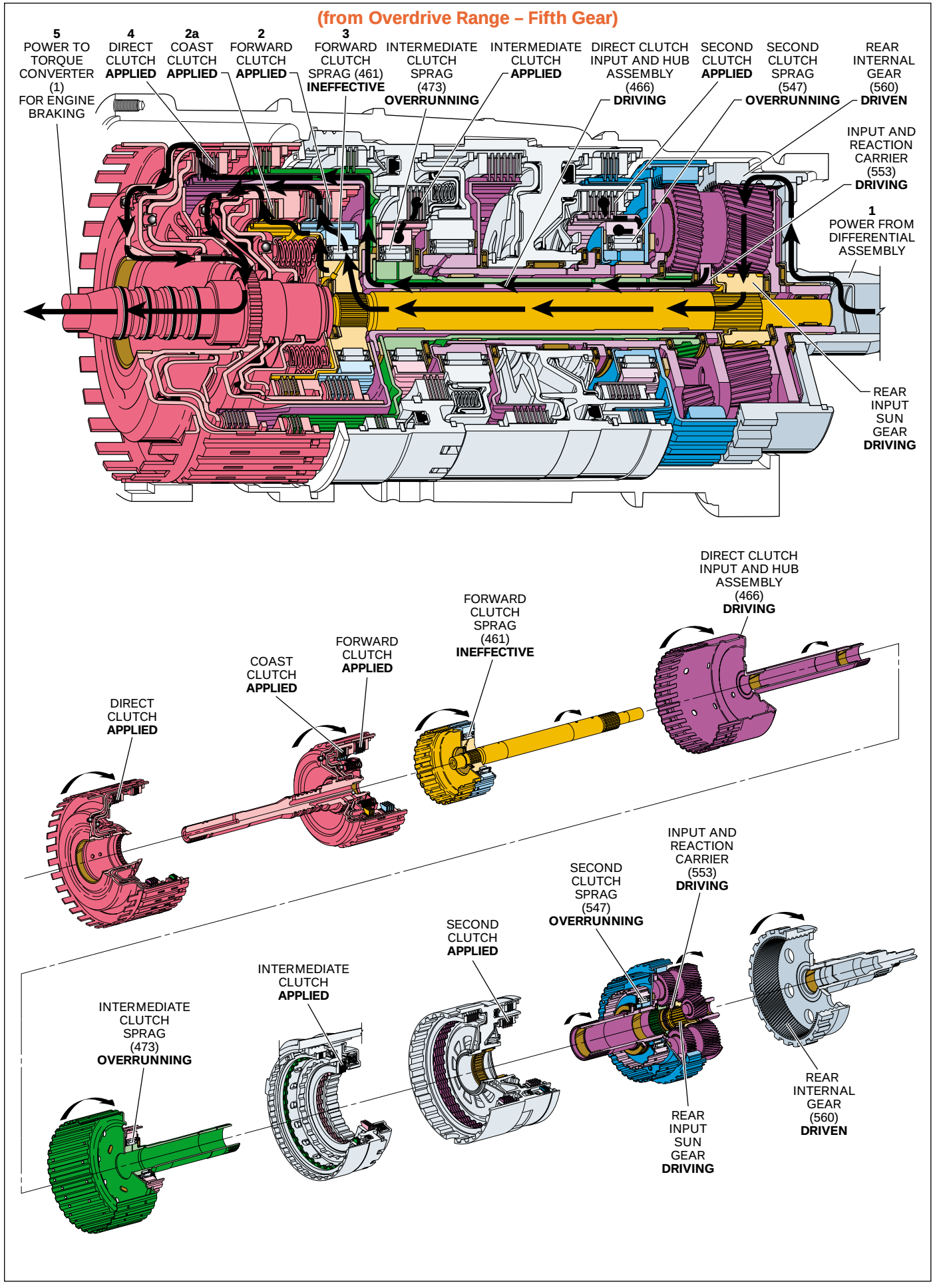

Figure 72

MANUAL FOURTH – FOURTH GEAR

(from Overdrive Range – Fifth Gear)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	ON	APPLIED		APPLIED	APPLIED	LD			APPLIED			APPLIED		

LD = LOCKED IN DRIVE

Manual Fourth – Fourth Gear (4) is available to the driver when vehicle operating conditions make it desirable to use only four gear ratios. These conditions include city driving [where speeds are generally below 72 km/h (45 mph)], towing a trailer, or driving in hilly terrain. Manual Fourth also provides for engine compression braking when descending slight grades and can be used to retain Fourth gear when ascending slight grades for additional engine performance. Manual Fourth is also referred to as Drive Range because it has a 1:1 direct drive gear ratio available through the transmission gear set.

In Manual Fourth, the transmission can upshift and downshift between First, Second, Third and Fourth gears in the same manner as Overdrive Range. However, the transmission is prevented from shifting into Fifth gear while operating in this gear selector position. If the transmission is in Overdrive Range – Fifth Gear when Manual Fourth is selected, the transmission will not shift into Fourth gear until vehicle speed is low enough not to overrev the engine (calibratable in the TCM).

Note: Transfer of engine torque during acceleration is identical to Overdrive Range – Fourth Gear (refer to page 70A). The power flow in Figure 72 and the following text describes conditions during deceleration (zero or minimum throttle conditions) and how engine compression braking is achieved.

Vehicle speed provides the torque input to the transmission through the drive shaft and transmission output shaft assembly (562). This is shown by the direction of the power flow arrows in the drawing at the top of Figure 72. Notice that this flow is identical to Overdrive Range – Fourth Gear except that the arrows are in the opposite direction.

1 Power From the Differential Assembly
Power flow is transferred back through the transmission from the output shaft to the input shaft forward and coast clutch housing assembly (433). Each of the component's function and rotation direction is the same as during acceleration (compare Figures 66 and 72).

2 Forward and Coast Clutches Applied
The forward clutch, which is located within the input shaft forward and coast clutch housing assembly (433), is applied and holds the forward clutch sprag outer race (459). The coast clutch is also located in the input shaft forward and coast clutch housing assembly (433) and is also applied.

3 Forward Clutch Sprag Ineffective
With the forward and coast clutches both applied, the forward clutch sprag (461) has no effect in Manual Fourth.

4 Direct Clutch Applied
The direct clutch is applied and input torque from the input and reaction carrier (553) is transferred through the direct clutch input and hub assembly (466) to the reverse clutch housing assembly (401).

5 Engine Compression Braking
The reverse clutch housing assembly (401) is splined to the input shaft forward and coast clutch housing assembly (433), creating a mechanical link between the output shaft and torque converter turbine. This creates a 1:1 direct drive gear ratio and allows engine compression to slow the vehicle when the throttle is released.

In Manual Fourth range, First, Second and Third gears operate the same as in Overdrive Range.

MANUAL FOURTH – FOURTH GEAR

(from Overdrive Range – Fifth Gear)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	ON	APPLIED		APPLIED	APPLIED	LD			APPLIED			APPLIED		

LD = LOCKED IN DRIVE

Manual Fourth – Fourth Gear (Drive Range) may be selected at any time while the vehicle is being operated in a forward gear range. However, TCM control prevents the transmission from shifting into Fifth gear. When the gear selector lever is moved to Drive Range (4) from Overdrive Range (D), the manual valve also moves. Changes to the hydraulic and electrical systems are as follows:

1 OVERDRIVE CLUTCH RELEASES

1a Manual Valve:
The manual valve moves only to activate the transmission manual shift shaft switch assembly. The transmission manual shift shaft switch assembly signals the TCM that the transmission is in Manual Fourth Range. There is no hydraulic difference between Overdrive Range and Manual Fourth Range at the manual valve.

1b 4-5 Shift Solenoid (SS) Valve:
The 4-5 SS valve is energized, allowing feed limit fluid to enter the 4-5 signal fluid circuit. 4-5 signal fluid overcomes 4-5 shift valve spring (373) force and moves the 4-5 shift control valve (375) and the 4-5 shift valve (374) to the applied position.

1c 4-5 Shift Valve:
4-5 fluid is blocked at the 4-5 shift valve (374) allowing overdrive clutch feed 2 fluid to exhaust.

1d Overdrive Clutch Assembly:
Overdrive clutch fluid exhausts from the overdrive clutch piston, allowing the overdrive clutch plates to disengage.

1e #12 Ball Check Valve:
Overdrive clutch fluid seats the #12 ball check valve against the overdrive clutch feed 1 passage and enters the overdrive clutch feed 2 fluid circuit where it exhausts at the 4-5 shift valve.

2 SHIFT ACCUMULATION

2a Overdrive Clutch Accumulator:
Overdrive clutch fluid also exhausts from the overdrive clutch accumulator assembly. Accumulator fluid moves the overdrive clutch accumulator piston against accumulator spring force in preparation for another application of the overdrive clutch.

3 COAST CLUTCH APPLIES

3a 4-5 Shift Valve:
Coast clutch feed fluid passes through the 4-5 shift valve (374) and into the coast clutch circuit.

3b Coast Clutch:
Coast clutch fluid is routed to the coast clutch piston to apply the coast clutch plates.

In Manual Fourth – Fourth Gear, the TCC will not release if Manual Fourth was selected while the vehicle was operating in Overdrive Range – Fifth Gear with the TCC applied. Under normal operating conditions, the converter clutch operates the same way in Manual Fourth – Fourth Gear as in Overdrive Range – Fourth Gear. Refer to pages 74A and 74B for descriptions of TCC release and apply.

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MANUAL FOURTH – FOURTH GEAR

(from Overdrive Range – Fifth Gear)

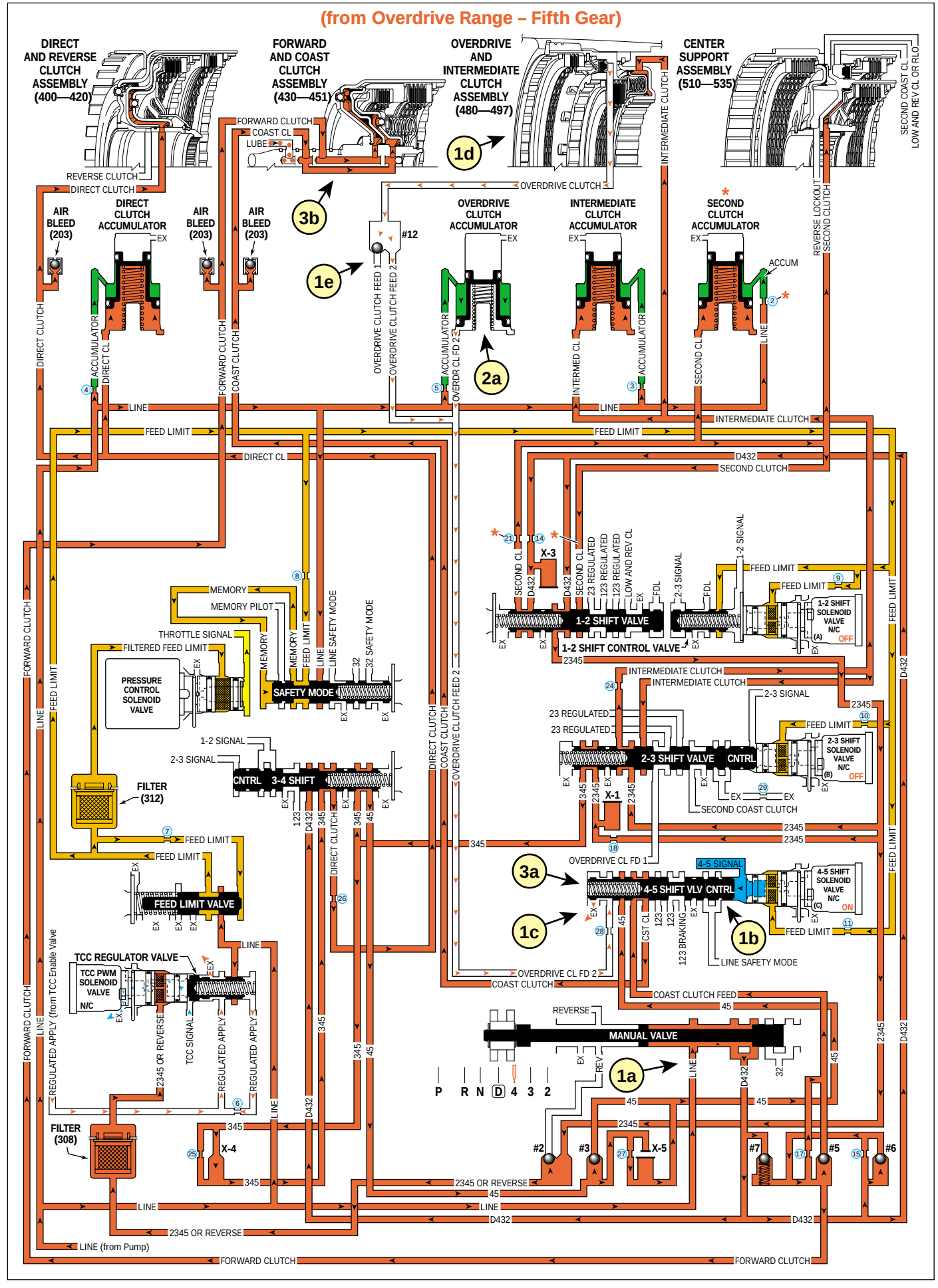

Figure 73

MANUAL THIRD – THIRD GEAR

(from Manual Fourth – Fourth Gear)

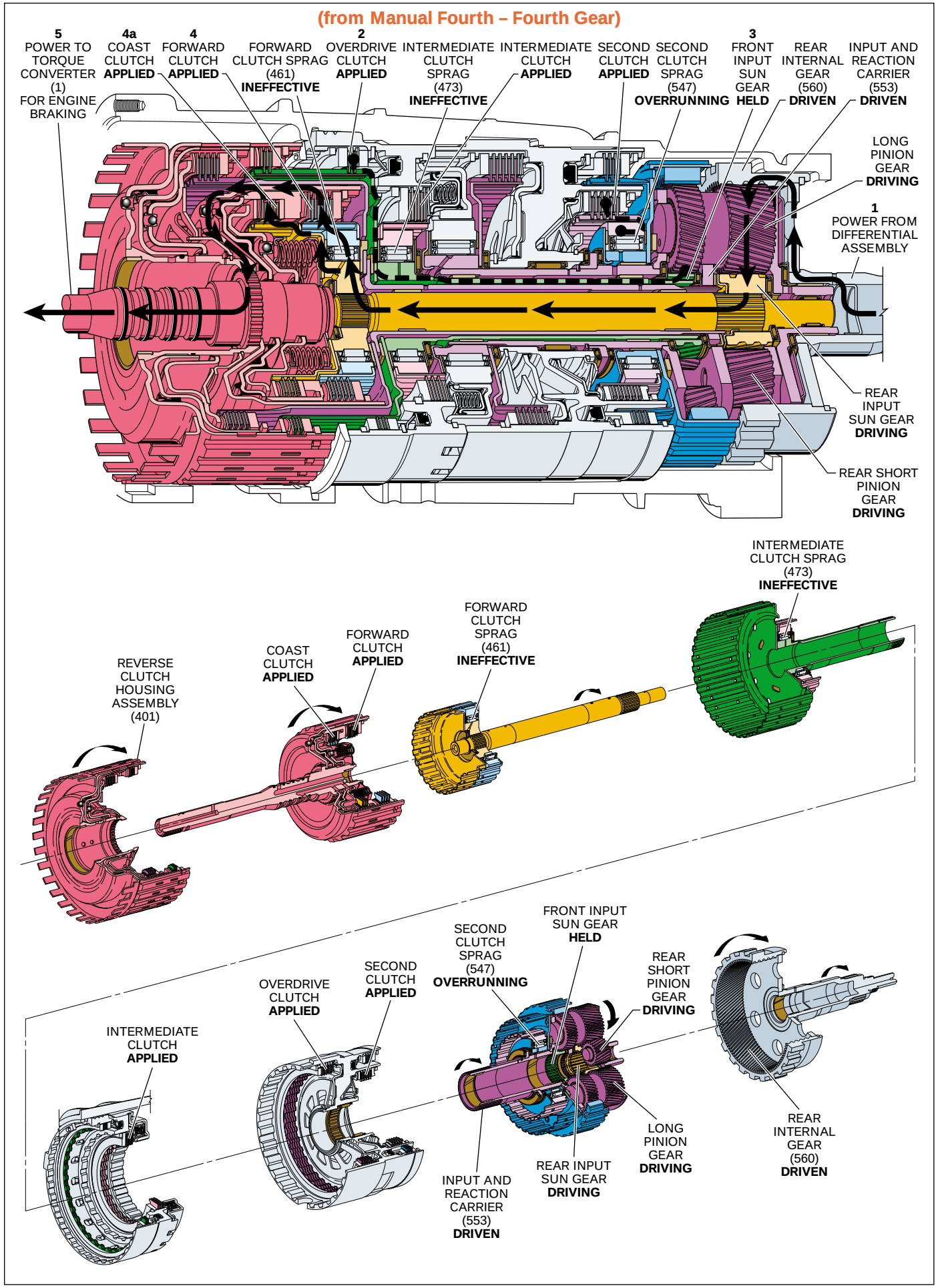

Figure 74

MANUAL THIRD – THIRD GEAR

(from Manual Fourth – Fourth Gear)

SOLENOID 1-2	SOLENOID 2-3	SOLENOID 4-5	DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
ON	OFF	ON			APPLIED	APPLIED	LD	APPLIED	LD	APPLIED			APPLIED		

LD = LOCKED IN DRIVE

Manual Third – Third Gear (3) is available to the driver when vehicle operating conditions make it desirable to use only three gear ratios. These conditions include descending a steep grade when engine compression braking is needed, or to retain third gear when ascending a steep grade for additional engine performance.

In Manual Third, the transmission can upshift and downshift between First, Second and Third gears in the same manner as Overdrive Range but is prevented from shifting into Fourth or Fifth gear while operating in this gear selector position. If the transmission is in Fourth or Fifth Gear when Manual Third is selected, the transmission will not shift into Third gear until vehicle speed is low enough not to overrev the engine (calibratable in the TCM).

Note: Transfer of engine torque during acceleration is identical to Overdrive Range – Third Gear (refer to page 68A) to obtain an approximate gear ratio reduction of 1.60:1 through the transmission gear set. The power flow in Figure 74 and the following text describes conditions during deceleration (zero or minimum throttle conditions) and how engine compression braking is achieved.

Vehicle speed provides the torque input to the transmission through the drive shaft and transmission output shaft assembly (562). This is shown by the direction of the power flow arrows in the drawing at the top of Figure 74. Notice that this flow is identical to Overdrive Range – Third Gear except that the arrows are in the opposite direction.

1 Power From the Differential Assembly
Power flow is transferred back through the transmission from the output shaft to the input shaft forward and coast clutch housing assembly (433). Each of the component's function and rotation direction is the same as during acceleration (compare Figures 64 and 74).

2 Overdrive Clutch Applied
The overdrive clutch, which is located within the overdrive clutch housing (493), is applied and holds the overdrive and reverse clutch hub assembly (470) stationary.

3 Front Input Sun Gear Held
The overdrive and reverse clutch hub assembly (470) is splined to the front input sun gear and holds it stationary.

4 Forward and Coast Clutches Applied
The forward clutch, which is located within the input shaft forward and coast clutch housing assembly (433), is applied and holds the forward clutch sprag outer race (459). The coast clutch is also located in the input shaft forward and coast clutch housing assembly (433) and is also applied. Input torque from the rear input sun gear of the input and reaction carrier (553) is transferred through the coast clutch to the input shaft forward and coast clutch housing assembly (433).

5 Engine Compression Braking
With the overdrive clutch applied, power flow is mechanically connected between the output shaft and torque converter turbine. This allows engine compression to slow the vehicle when the throttle is released.

In Manual Third range, First and Second gears operate the same as in Overdrive Range.

MANUAL THIRD – THIRD GEAR

(from Manual Fourth – Fourth Gear)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
ON	OFF	ON			APPLIED	APPLIED	LD	APPLIED	LD	APPLIED			APPLIED		

LD = LOCKED IN DRIVE

Manual Third – Third Gear may be selected at any time while the vehicle is being operated in a forward gear range. However, TCM control prevents the transmission from shifting above Third gear. When the gear selector lever is moved to Manual Third range (3) from Manual Fourth – Fourth Gear, the manual valve also moves. Changes to the hydraulic and electrical systems are as follows:

1 OVERDRIVE CLUTCH APPLIES

1a Manual Valve:
Line pressure enters the 32 fluid circuit at the manual valve. 32 fluid is routed to the safety mode valve.

1b 1-2 Shift Solenoid (SS) Valve:
The 1-2 SS valve is energized, allowing feed limit fluid to enter the 1-2 signal fluid circuit. 1-2 signal fluid is routed to the safety mode valve and to the 3-4 shift valve.

1c 3-4 Shift Valve:
1-2 signal fluid overcomes 3-4 shift valve spring force and moves the 3-4 shift valve to the applied position. This allows D432 fluid to enter the 123 fluid circuit, and allows direct clutch and 45 fluids to exhaust.

1d #4 Ball Check Valve:
123 fluid seats the #4 ball check valve and passes through orifice #16 on the way to the 4-5 shift valve.

1e 4-5 Shift Valve:
123 fluid passes through the 4-5 shift valve (333) into the 123 braking fluid circuit.

1f Low Pressure Control Valve:
123 braking fluid is regulated into the 123 regulated fluid circuit through the low pressure control valve (383).

1g 1-2 shift Valve:
123 regulated fluid passes through the 1-2 shift valve into the 23 regulated fluid circuit.

1h #9 and #11 Ball Check Valves:
23 regulated fluid seats the #9 and the #11 ball check valves and is forced through orifices #22 and #23.

1i 2-3 Shift Valve:
23 regulated fluid passes through the 2-3 shift valve into the overdrive clutch feed 1 fluid circuit.

1j #12 Ball Check Valve:
Overdrive clutch feed 1 fluid seats the #12 ball check valve against the overdrive clutch feed 2 passage and enters the overdrive clutch fluid circuit.

1k Overdrive Clutch:
Overdrive clutch fluid is then directed to the overdrive clutch piston to apply the overdrive clutch plates.

2 DIRECT CLUTCH RELEASES

2a Direct Clutch:
Direct clutch fluid is exhausts from the direct clutch piston to release the direct clutch plates.

2b 3-4 Shift Valve:
Direct clutch fluid flows through orifice #26 to the 3-4 shift valve where it exhausts.

3 SHIFT ACCUMULATION

3a Direct Clutch Accumulator:
Direct clutch fluid also exhausts from the direct clutch accumulator assembly. Accumulator fluid moves the direct clutch accumulator piston against accumulator spring force in preparation for another application of the direct clutch.

In Manual Third – Third Gear, the TCC will not release if Manual Third was selected while the vehicle was operating in Overdrive Range – Fifth Gear with the TCC applied. Under normal operating conditions, the converter clutch operates the same way in Manual Third – Third Gear as in Overdrive Range – Third Gear. Refer to pages 74A and 74B for descriptions of TCC release and apply.

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MANUAL THIRD – THIRD GEAR

(from Manual Fourth – Fourth Gear)

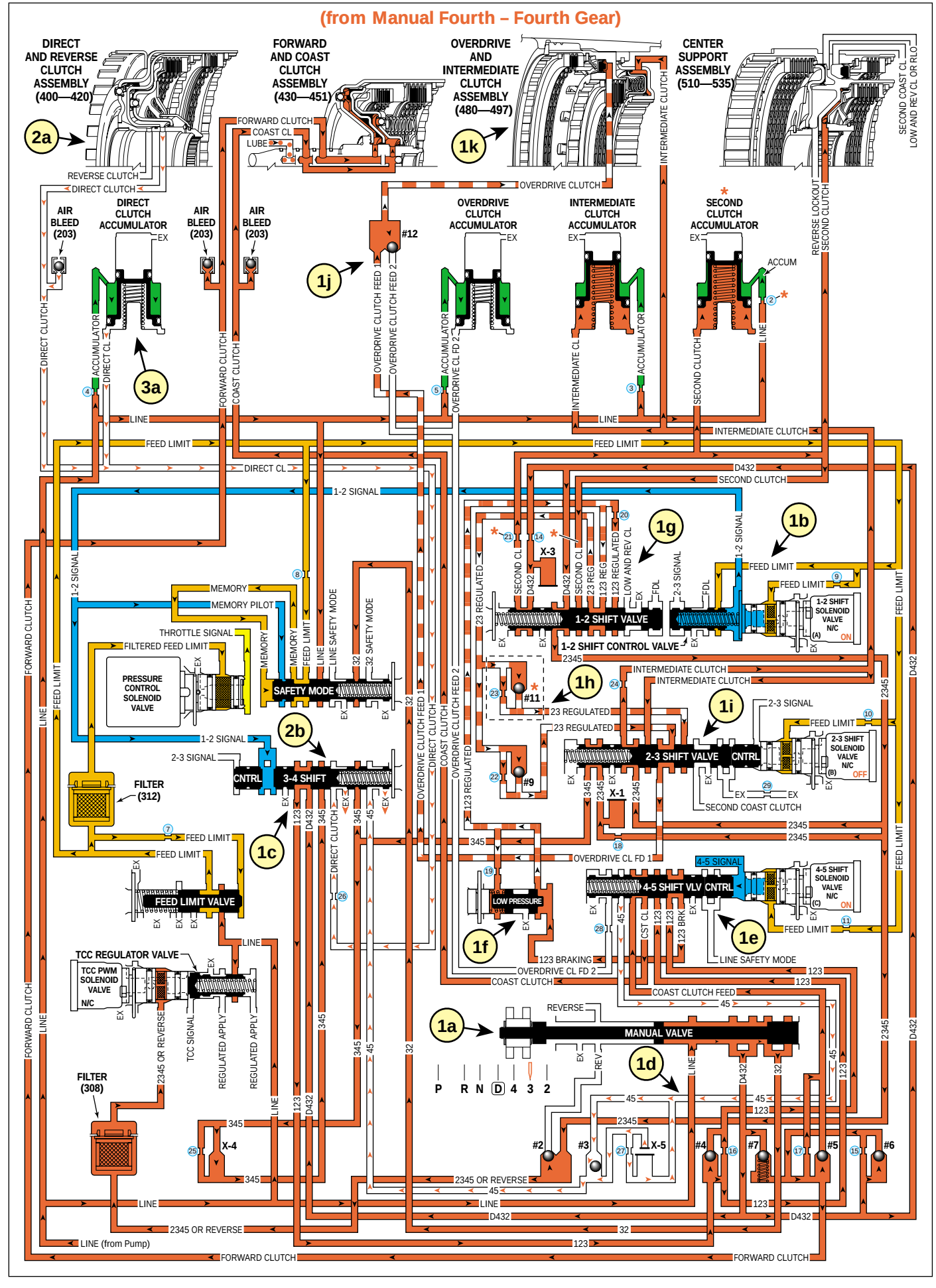

Figure 75

MANUAL SECOND – SECOND GEAR

(from Manual Third – Third Gear)

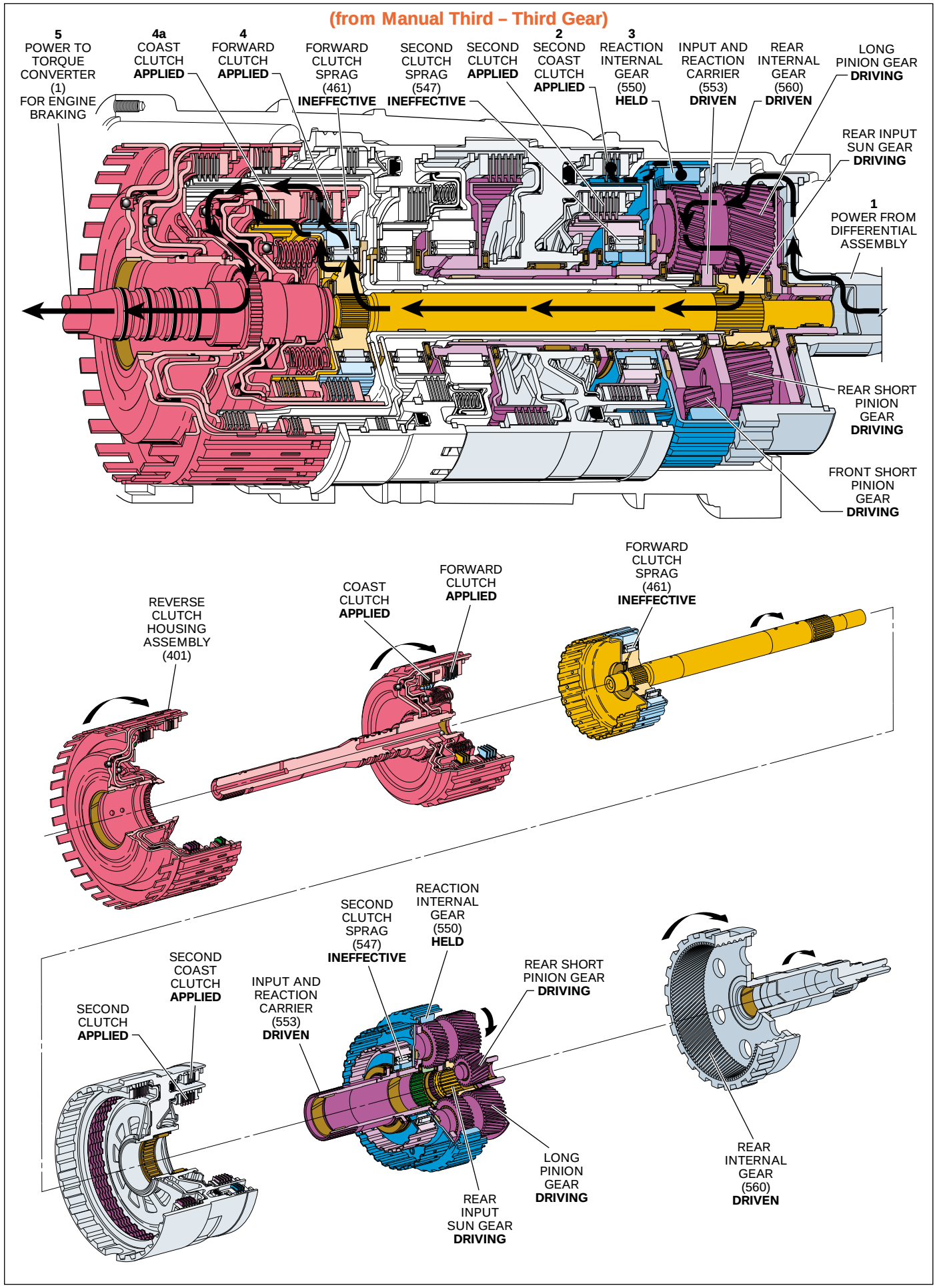

Figure 76

MANUAL SECOND – SECOND GEAR

(from Manual Third – Third Gear)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
ON	ON	ON			APPLIED	APPLIED	LD						APPLIED	LD	APPLIED

LD = LOCKED IN DRIVE

Manual Second (2) gear range is available to the driver when vehicle operating conditions require maximum engine compression braking for slowing the vehicle, or maximum engine torque transfer to the wheels. These conditions include descending a steep grade when maximum engine compression braking is needed, to retain second gear when ascending a steep grade, or pulling a heavy load for maximum engine power.

In Manual Second, the transmission can upshift and downshift between First and Second gear in the same manner as Overdrive Range but is prevented from shifting into Third, Fourth or Fifth gear while operating in this gear selector position. If the transmission is in any other forward gear range when Manual Second is selected, the transmission will not shift into Second gear until vehicle speed is low enough not to overrev the engine (calibratable in the TCM). Above this speed, the transmission will first shift into Third gear until vehicle speed slows sufficiently.

Note: Transfer of engine torque during acceleration is identical to Overdrive Range – Second Gear (refer to page 66A) to obtain an approximate gear ratio reduction of 2.21:1 through the transmission gear set. The power flow in Figure 76 and the following text describes conditions during deceleration (zero or minimum throttle) and how engine compression braking is achieved.

Vehicle speed provides the torque input to the transmission through the drive shaft and transmission output shaft assembly (562). This is shown by the direction of the power flow arrows in the drawing at the top of Figure 76. Notice that this flow is identical to Overdrive Range – Second Gear except that the arrows are in the opposite direction.

1 Power From the Differential Assembly
Power flow is transferred back through the transmission from the output shaft to the input shaft forward and coast clutch housing assembly (433). Each of the component's function and rotation direction is the same as during acceleration (compare Figures 62 and 76).

2 Second Coast Clutch Applied
The second coast clutch, which is located within the center support (518), is applied and holds the second clutch sprag inner race (549) stationary.

3 Reaction Internal Gear Held
The second clutch sprag inner race (549) is splined to the reaction internal gear (550) and holds it stationary.

4 Forward and Coast Clutches Applied
The forward clutch, which is located within the input shaft forward and coast clutch housing assembly (433), is applied and holds the forward clutch sprag outer race (459). The coast clutch is also located in the input shaft forward and coast clutch housing assembly (433) and is also applied. Input torque from the rear input sun gear of the input and reaction carrier (553) is transferred through the coast clutch to the input shaft forward and coast clutch housing assembly (433).

5 Engine Compression Braking
With the second coast clutch applied, power flow is mechanically connected between the output shaft and torque converter turbine. This allows engine compression to slow the vehicle when the throttle is released.

In Manual Second range, First gear operates the same as in Overdrive Range.

MANUAL SECOND – SECOND GEAR

(from Manual Third – Third Gear)

SOLENOID 1-2	SOLENOID 2-3	SOLENOID 4-5	DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
ON	ON	ON			APPLIED	APPLIED	LD						APPLIED	LD	APPLIED

LD = LOCKED IN DRIVE

Manual Second – Second Gear may be selected at any time while the vehicle is being operated in a forward gear range. However, TCM control prevents the transmission from upshifting above Second gear. When the gear selector lever is moved to Manual Second (2) from Manual Third – Third Gear, the manual valve also moves. Changes to the hydraulic and electrical systems are as follows:

1 SECOND COAST CLUTCH APPLIED

1a Manual Valve:
The volume of line pressure entering the 32 fluid circuit at the manual valve is increased to accommodate the added torque requirements for engine braking or increased engine load.

1b 2-3 Shift Solenoid (SS) Valve:
The 2-3 SS valve is energized, allowing feed limit fluid to enter the 2-3 signal fluid circuit. 2-3 signal fluid overcomes 2-3 shift valve spring (372) force and moves the 2-3 shift valve (371) to the applied position. This allows 23 regulated fluid to enter the second coast clutch fluid circuit and also opens the overdrive clutch feed 1, intermediate clutch and 345 fluid circuits to exhaust.

1c 3-4 Shift Control Valve:
2-3 signal fluid is also routed to the 3-4 shift control valve (346) and moves the valve against 1-2 signal fluid pressure to keep the 3-4 shift valve (345) in the applied position.

1d Second Coast Clutch:
Second coast clutch fluid is directed to the second coast clutch piston to apply the second coast clutch plates.

Note: Figure 77 is shown in Second gear with the 2-3 SS valve energized. However, if vehicle operating conditions are such that the TCM signals a Third, Fourth or Fifth gear state, the 2-3 solenoid will be de-energized. Thus a downshift will not occur until the vehicle speed is low enough not to overrev the engine (calibratable in the TCM).

2 OVERDRIVE CLUTCH RELEASES

2a Overdrive Clutch Assembly:
Overdrive clutch fluid exhausts from the overdrive clutch piston, allowing the overdrive clutch plates to disengage.

2b #12 Ball Check Valve:
Overdrive clutch fluid seats the #12 ball check valve against the overdrive clutch feed 2 passage and enters the overdrive clutch feed 1 fluid circuit.

2c 2-3 Shift Valve:
Exhausting overdrive clutch feed 2 fluid is routed through the 2-3 shift valve into the intermediate clutch fluid circuit.

3 INTERMEDIATE CLUTCH RELEASES

3a Intermediate Clutch Assembly:
Intermediate clutch fluid exhausts from the intermediate clutch piston, allowing the intermediate clutch plates to disengage.

3b 2-3 Shift Valve:
Intermediate clutch fluid is routed through orifice #24 to the 2-3 shift valve where it exhausts.

4 SHIFT ACCUMULATION

4a Intermediate Clutch Accumulator:
Intermediate clutch fluid also exhausts from the intermediate clutch accumulator assembly. Accumulator fluid moves the intermediate clutch accumulator piston against accumulator spring force in preparation for another application of the intermediate clutch.

If the converter clutch was applied when Manual Second was selected it will release during downshifting. Under normal operating conditions the converter clutch will not re-apply in Second gear.

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MANUAL SECOND – SECOND GEAR

(from Manual Third – Third Gear)

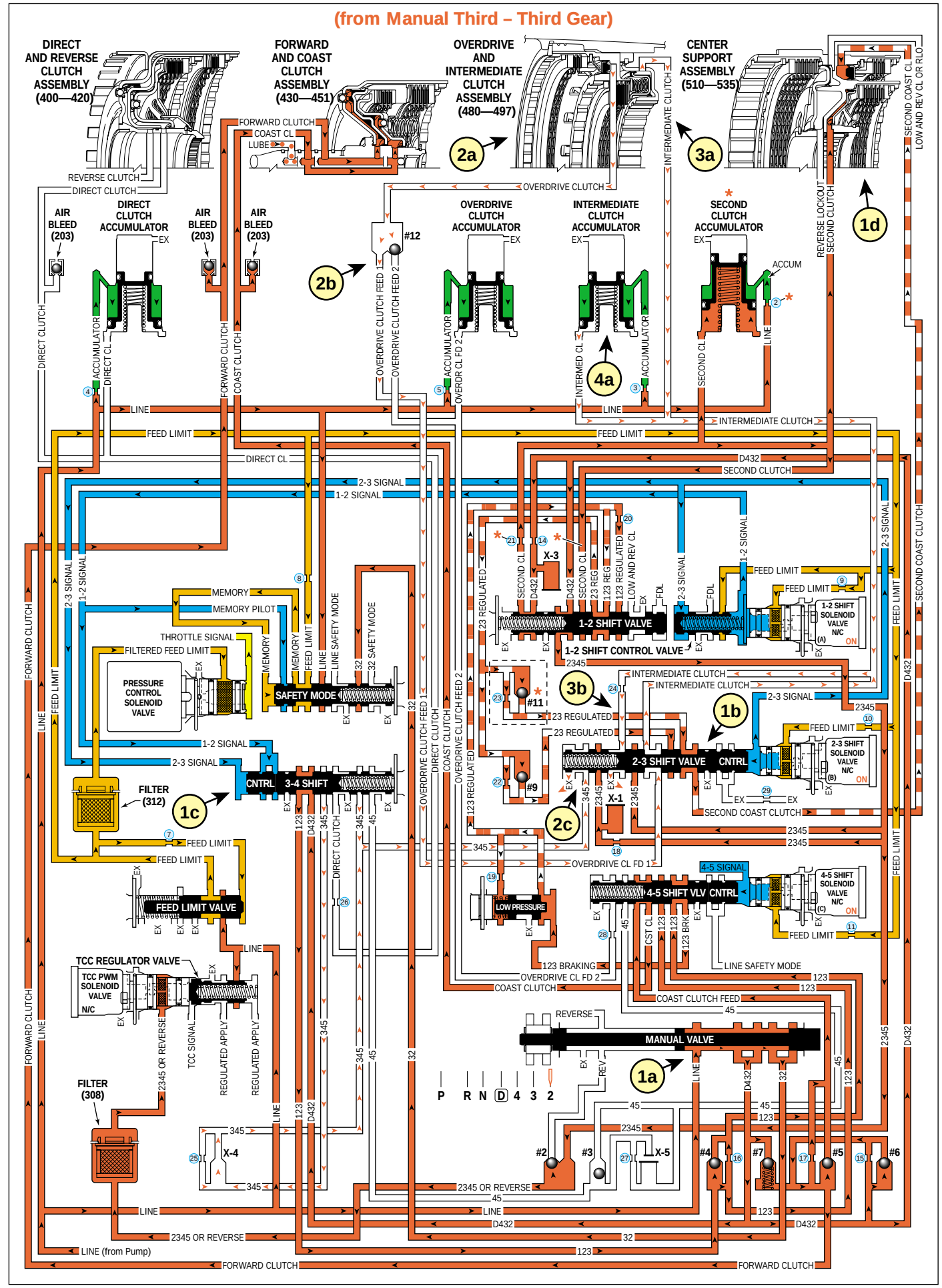


Figure 77

MANUAL SECOND – FIRST GEAR

(from Manual Second – Second Gear)

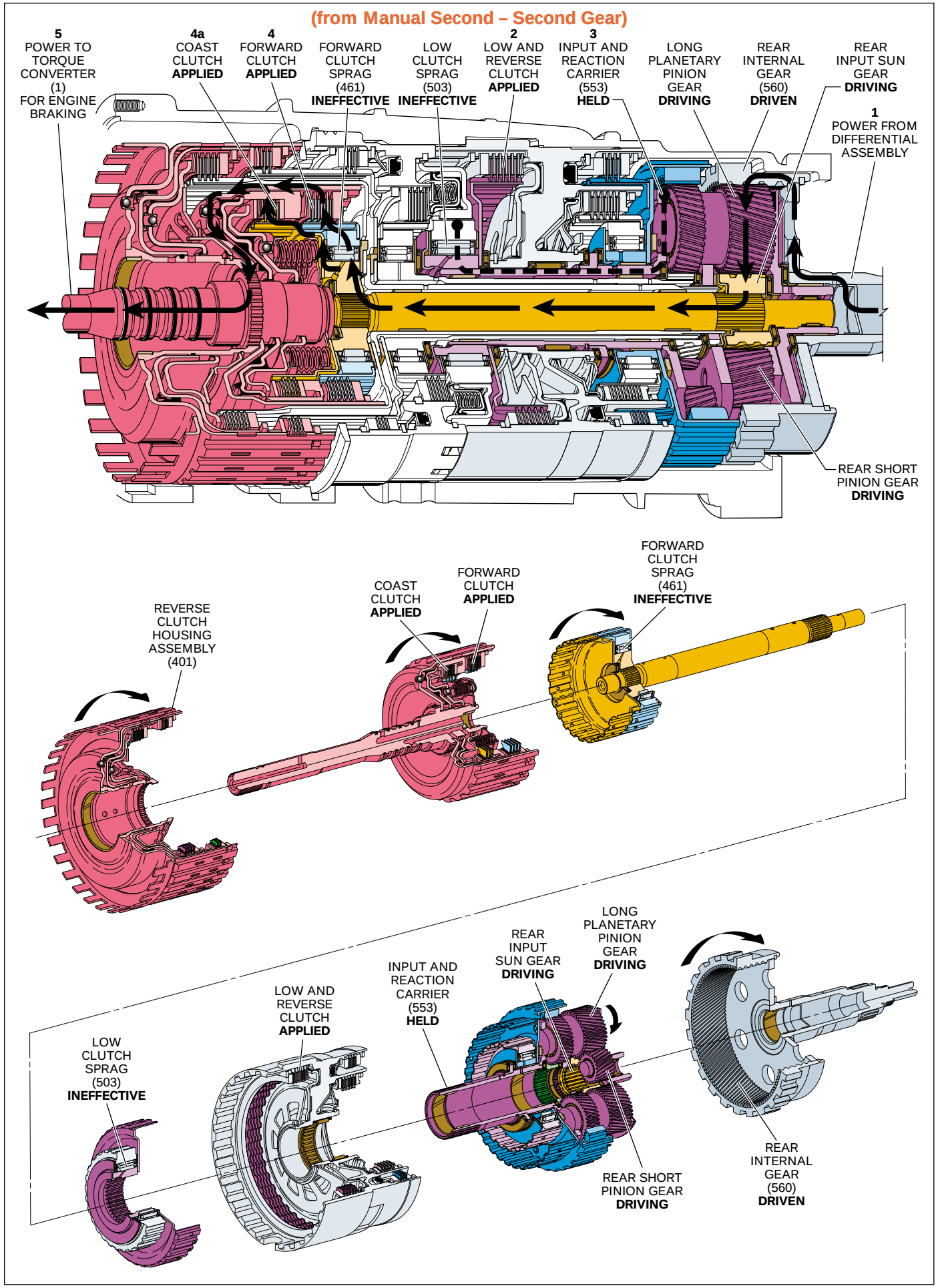


Figure 78

MANUAL SECOND – FIRST GEAR

(from Manual Second – Second Gear)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	ON	ON			APPLIED	APPLIED	LD				LD	APPLIED			

LD = LOCKED IN DRIVE

Manual Second – First Gear is commanded by the TCM when vehicle speed is low enough not to overrev the engine (calibratable in the TCM). Manual Second – First Gear is commanded in order to achieve maximum engine compression braking for slowing the vehicle.

Note: Transfer of engine torque during acceleration is identical to Overdrive Range – First Gear (refer to page 64A) to obtain an approximate gear ratio reduction of 3.42:1 through the transmission gear set. The power flow in Figure 78 and the following text describes conditions during deceleration (zero or minimum throttle) and how engine compression braking is achieved.

Vehicle speed provides the torque input to the transmission through the drive shaft and transmission output shaft assembly (562). This is shown by the direction of the power flow arrows in the drawing at the top of Figure 78. Notice that this flow is identical to Overdrive Range – First Gear except that the arrows are in the opposite direction.

1 Power From the Differential Assembly
Power flow is transferred back through the transmission from the output shaft to the input shaft forward and coast clutch housing assembly (433). Each of the component's function and rotation direction is the same as during acceleration (compare Figures 60 and 78).

2 Low and Reverse Clutch Applied
The low and reverse clutch, which is located within the center support (518), is applied and holds the low clutch sprag inner race (505) stationary.

3 Input and Reaction Carrier Held
The low clutch sprag inner race (505) is splined to the input and reaction carrier (553) and holds it stationary.

4 Forward and Coast Clutches Applied
The forward clutch, which is located within the input shaft forward and coast clutch housing assembly (433), is applied and holds the forward clutch sprag outer race (459). The coast clutch is also located in the input shaft forward and coast clutch housing assembly (433) and is also applied. Input torque from the rear input sun gear of the input and reaction carrier (553) is transferred through the coast clutch to the input shaft forward and coast clutch housing assembly (433).

5 Engine Compression Braking
With the low and reverse clutch applied, power flow is mechanically connected between the output shaft and torque converter turbine. This allows engine compression to slow the vehicle when the throttle is released.

MANUAL SECOND – FIRST GEAR

(from Manual Second – Second Gear)

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	ON	ON			APPLIED	APPLIED	LD				LD	APPLIED			

LD = LOCKED IN DRIVE

Manual Second – First Gear is commanded by the TCM, when vehicle speed is low enough not to overrev the engine (calibratable in the TCM), in order to achieve maximum engine braking. Changes to the hydraulic and electrical systems are as follows:

1 MANUAL VALVE

Manual Second – First Gear is commanded by the TCM only, there is no movement of the manual valve.

2 LOW AND REVERSE CLUTCH APPLIED

2a 1-2 Shift Solenoid (SS) Valve:
The 1-2 SS valve is de-energized, blocking feed limit fluid from entering the 1-2 signal fluid circuit and 1-2 signal fluid pressure exhausts through the 1-2 SS valve.

2b 1-2 Shift Control Valve:
With 1-2 signal fluid exhausted, 2-3 signal fluid is able to move the 1-2 shift control valve (366) against 1-2 shift control valve spring (367) force to the applied position. This allows feed limit fluid to enter the FDL fluid circuit.

2c 1-2 Shift Valve:
FDL fluid is routed to the 1-2 shift valve (387) and moves the valve against 1-2 shift valve spring (388) force to the applied position. This allows 123 regulated fluid to enter the low and reverse clutch fluid circuit.

2d #8 Ball Check Valve:
Low and reverse clutch fluid seats the #8 ball check valve against the reverse lockout fluid passage and enters the low and reverse clutch or reverse lockout fluid passage.

2e Low and Reverse Clutch:
Low and reverse clutch or reverse lockout fluid pressure enters the outer area of the low and reverse clutch piston and moves the piston against spring force to apply the low and reverse clutch plates.

3 SECOND CLUTCH AND SECOND COAST CLUTCH RELEASE

3a Second Clutch Assembly:
Second clutch fluid exhausts from the second clutch piston, allowing the second clutch plates to disengage.

3b Second Coast Clutch Assembly:
Second coast clutch fluid exhausts from the second coast clutch piston, allowing the second coast clutch plates to disengage.

3c 1-2 Shift Valve:
Second coast clutch fluid is routed through the 2-3 shift valve to the 1-2 shift valve where it enters the second clutch fluid circuit. Second clutch fluid is routed through orifice #21 to the 1-2 shift valve where it exhausts.

4 SHIFT ACCUMULATION

4a Second Clutch Accumulator:
Second clutch fluid also exhausts from the second clutch accumulator assembly. Accumulator fluid moves the second clutch accumulator piston against accumulator spring force in preparation for another application of the second clutch.

COMPLETE HYDRAULIC CIRCUIT
Page 110

MANUAL SECOND – FIRST GEAR

(from Manual Second – Second Gear)

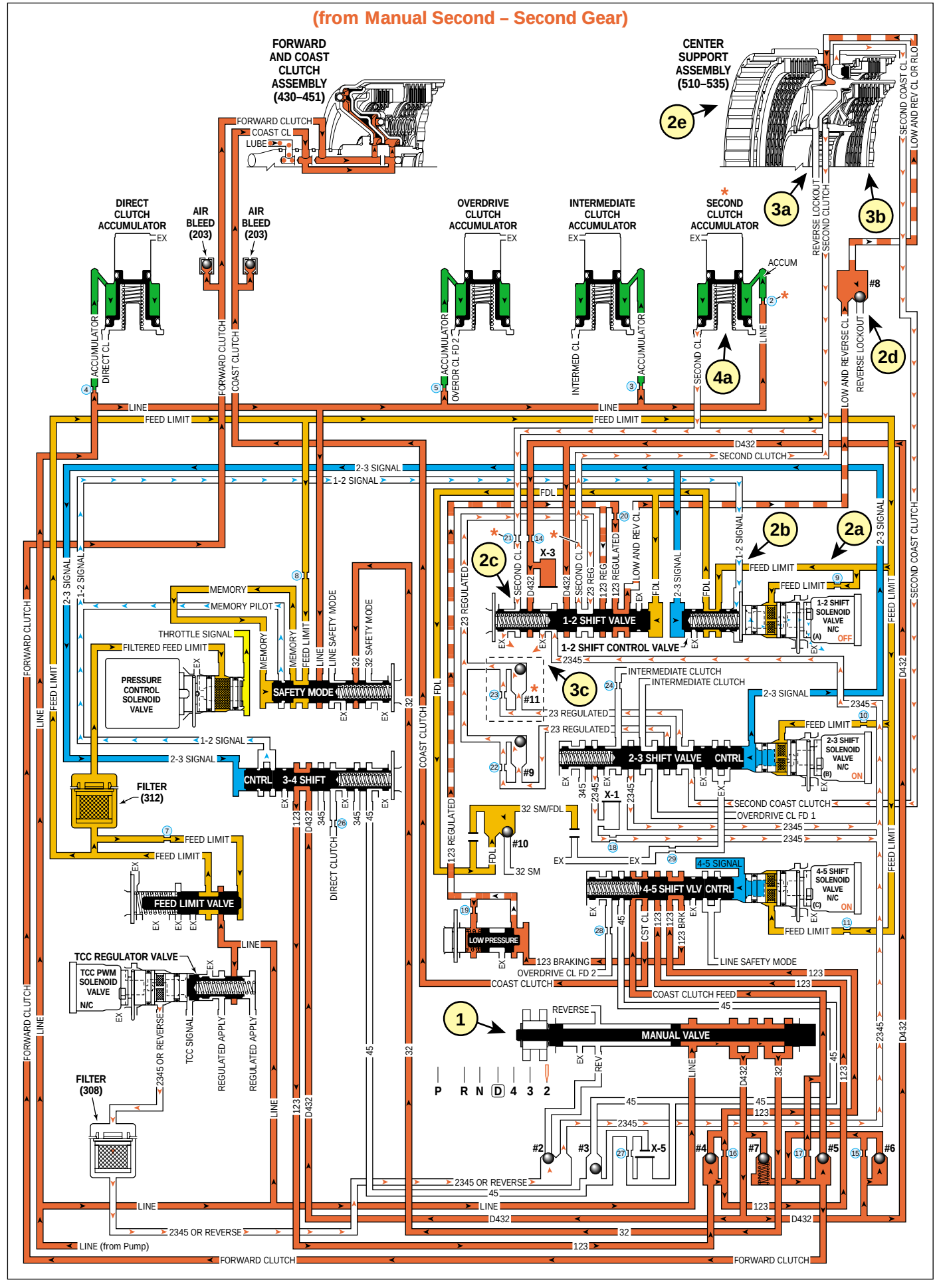


Figure 79

OPERATING CONDITIONS

RANGE REFERENCE CHART

RANGE	GEAR	ENGINE BRAKING	RATIO	1-2 SHIFT SOLENOID VALVE	2-3 SHIFT SOLENOID VALVE	4-5 SHIFT SOLENOID VALVE	TCC SOLENOID VALVE	1 DIRECT CLUTCH	2 COAST CLUTCH	3 REVERSE CLUTCH	4 FORWARD CLUTCH	5 FORWARD CLUTCH SPRAG	6 OVER-DRIVE CLUTCH	7 INTERM. CLUTCH SPRAG	8 INTER-MEDIATE CLUTCH	9 LOW CLUTCH SPRAG	10 LOW AND REVERSE CLUTCH	11 SECOND CLUTCH	12 SECOND CLUTCH SPRAG	13 SECOND COAST CLUTCH
D432	1	*NO	3.42	OFF	ON	OFF	OFF		APPLIED		APPLIED	LD				LD				
	1	YES	3.42	OFF	ON	ON	OFF		APPLIED		APPLIED	LD				LD	APPLIED			
	2	*NO	2.21	ON	ON	OFF	ON/OFF @		APPLIED		APPLIED	LD						APPLIED	LD	
	2	YES	2.21	ON	ON	ON	ON/OFF @		APPLIED		APPLIED	LD						APPLIED	LD	APPLIED
	3	*NO	1.60	ON	OFF	OFF	ON/OFF @		APPLIED		APPLIED	LD		LD	APPLIED			APPLIED		
	3	YES	1.60	ON	OFF	ON	ON/OFF @		APPLIED		APPLIED	LD	APPLIED	LD	APPLIED			APPLIED		
	4	YES	1.00	OFF	OFF	ON	ON/OFF @	APPLIED	APPLIED		APPLIED	LD			APPLIED			APPLIED		
	5	YES	0.75	OFF	OFF	OFF	ON/OFF @	APPLIED			APPLIED		APPLIED		APPLIED			APPLIED		
NEUTRAL	—	—	—	@ ON/OFF	@ ON/OFF	@ ON/OFF														
REVERSE	R	YES	3.03	@ ON/OFF	@ ON/OFF	@ ON/OFF	OFF			APPLIED							APPLIED			
†REVERSE LOCK OUT				@ ON/OFF	@ ON/OFF	@ ON/OFF	ON													
PARK	—	—	—	@ ON/OFF	@ ON/OFF	@ ON/OFF														

LD = LOCKED IN DRIVE
ON = SOLENOID ENERGIZED
OFF = SOLENOID DE-ENERGIZED

@ THE SOLENOID'S STATE FOLLOWS A SHIFT PATTERN WHICH DEPENDS UPON VEHICLE SPEED AND THROTTLE POSITION. IT DOES NOT DEPEND UPON THE SELECTED GEAR.

* ENGINE BRAKING IS ELECTRONICALLY CONTROLLED BY THE TCM, AND IS AVAILABLE AS CALIBRATED FOR EACH MODEL AND APPLICATION.

† REVERSE LOCK OUT IS A CONDITION THAT OCCURS WHEN TCC APPLY IS COMMANDED BY THE TCM. TCC SIGNAL FLUID FROM THE TCC PWM SOLENOID VALVE APPLIES THE REVERSE LOCKOUT VALVE TO PREVENT REVERSE CLUTCH OR LOW AND REVERSE CLUTCH APPLY EVEN IF THE MANUAL VALVE IS IN REVERSE POSITION.

NOTE: DESCRIPTIONS ABOVE EXPLAIN COMPONENT FUNCTION DURING ACCELERATION.

EXPECTED OPERATING CONDITION IF COMPONENT IN COLUMN NUMBER IS INOPERATIVE:

COLUMN #	CONDITION
1	NO 4TH OR FIFTH GEARS.
2	NO ENGINE BRAKING IN OVERDRIVE RANGE – FIRST, SECOND, THIRD AND FOURTH GEARS; OR IN MANUAL FOURTH, MANUAL THIRD AND MANUAL SECOND RANGES.
3	NO REVERSE.
4	NO FORWARD.
5	NO FORWARD.
6	NO FIFTH GEAR OR, NO ENGINE BRAKING IN THIRD GEAR – ALL FORWARD RANGES.
7	NO THIRD GEAR.
8	NO THIRD, FOURTH, OR FIFTH GEARS.
9	NO FIRST GEAR.
10	NO REVERSE, NO ENGINE BRAKING IN MANUAL FIRST.
11	NO SECOND, THIRD, FOURTH, OR FIFTH GEARS.
12	NO SECOND GEAR.
13	NO ENGINE BRAKING IN SECOND GEAR – ALL FORWARD RANGES.

Figure 80

COMPLETE HYDRAULIC CIRCUITS

The hydraulic circuitry of the Hydra-matic 4/5L40-E transmission is better understood when fluid flow can be related to the specific components in which the fluid travels. In the Power Flow section, a simplified hydraulic schematic was given to show what hydraulically occurs in a specific gear range. The purpose was to isolate the hydraulics used in each gear range in order to provide the user with a basic understanding of the hydraulic system.

In contrast, this section shows a complete hydraulic schematic with fluid passages active in the appropriate component for each gear range. This is accomplished using two opposing foldout pages that are separated by a half page of supporting information.

The left side foldout contains the complete color coded hydraulic circuit used in that gear range along with the relative location of valves, ball check valves and orifices within specific components. A broken line is also used to separate components such as the pump, control valve bodies, channel plates and case to assist the user when following the hydraulic circuits as they pass between them. The half page of information facing this foldout lists possible conditions and component diagnostic tips. Always refer to the appropriate vehicle platform service manual when diagnosing specific concerns.

The right side foldout shows a two-dimensional line drawing of the fluid passages within each component. The active fluid passages for each gear range are appropriately colored to correspond with the hydraulic schematic used for that range. The half page of information facing this foldout identifies the various fluid circuits with numbers that correspond to the circuit numbers used on the foldout page.

For a more complete understanding of the different hydraulic systems used in a specific gear range, refer to the Hydraulic Control Components section and/or Power Flow section.

PASSAGE A IS LOCATED IN THE FLUID PUMP BODY (LIGHT GREY AREA)
PASSAGE B IS LOCATED IN THE FRONT CONTROL VALVE BODY (LIGHT BLUE AREA)
PASSAGE C IS LOCATED IN THE REAR CONTROL VALVE BODY (LIGHT GREEN AREA)
PASSAGE D IS LOCATED ON THE SPACER PLATE (DASHED LINE)
PASSAGE E IS LOCATED IN THE BOTTOM CHANNEL PLATE (LIGHT RED AREA)
PASSAGE F IS LOCATED IN THE TOP CHANNEL PLATE (LIGHT PURPLE AREA)
PASSAGE G IS LOCATED IN THE ACCUMULATOR HOUSING (LIGHT YELLOW AREA)
PASSAGE H IS LOCATED IN THE CASE (WHITE AREA)

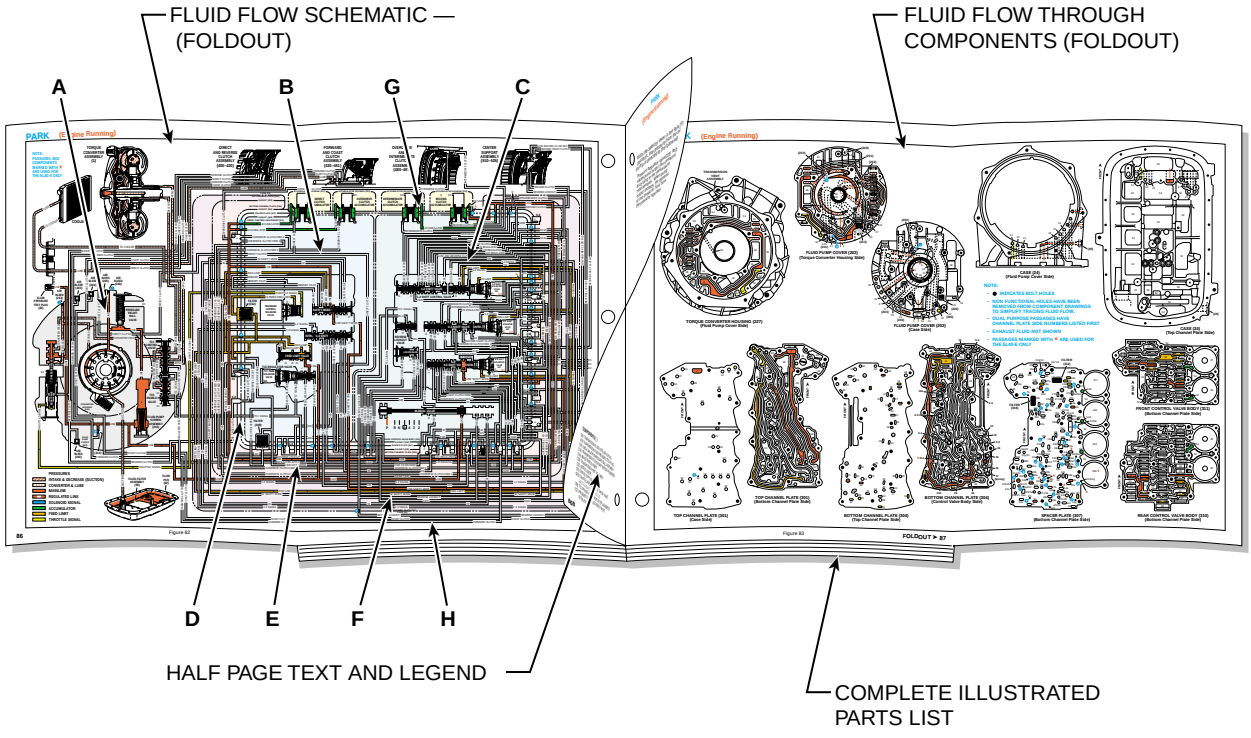


Figure 81

PARK (Engine Running)

NOTE: PASSAGES AND COMPONENTS MARKED WITH * ARE USED FOR THE 5L40-E ONLY

TORQUE CONVERTER ASSEMBLY (1)

DIRECT AND REVERSE CLUTCH ASSEMBLY (400–420)

FORWARD AND COAST CLUTCH ASSEMBLY (430–451)

OVERDRIVE AND INTERMEDIATE CLUTCH ASSEMBLY (480–497)

CENTER SUPPORT ASSEMBLY (510–535)

COOLER

LUBE

TO COOLER

RELEASE

APPLY

REVERSE CLUTCH

FORWARD CLUTCH

DIRECT CLUTCH

COAST CLUTCH

OVERDRIVE CLUTCH

INTERMEDIATE CLUTCH

LOW AND REV CL OR RLO

SECOND COAST CLUTCH

SECOND CLUTCH

REVERSE LOCKOUT

CASE (24)

TOP CHANNEL PLATE (301)

GASKET (303)

BOTTOM CHANNEL PLATE (304)

GASKET (305)

SPACER PLATE (307)

GASKET (309)

FRONT CONTROL VALVE BODY (311)

ACCUMULATOR HOUSING (317)

DIRECT CLUTCH ACCUMULATOR

ACCUMULATOR HOUSING (323)

OVERDRIVE CLUTCH ACCUMULATOR

ACCUMULATOR HOUSING (328)

INTERMEDIATE CLUTCH ACCUMULATOR

ACCUMULATOR HOUSING (333)

SECOND CLUTCH ACCUMULATOR

ACCUM

ACCUMULATOR

LINE

EX

AIR BLEED (203)

AIR BLEED (233)

FLUID PRESSURE TEST PLUG (40)

PRESSURE RELIEF BALL VALVE

CONVERTER FEED

DECREASE

TCC CONTROL VALVE

TCC ENABLE VALVE

CONVERTER HOUSING (224)

PRESS REG VALVE

BOOST VALVE

FLUID PUMP SCREEN ASSEMBLY (213)

FLUID PUMP COVER (202)

(214)

FLUID FILTER ASSEMBLY (59)

FLUID PAN (62)

#12

#1

#2

#3

#4

#5

#6

#7

#8

#9

#10

#11

X-1

X-2

X-3

X-4

X-5

FILTER (312)

PRESSURE CONTROL SOLENOID VALVE

FEED LIMIT VALVE

TCC REGULATOR VALVE

TCC PWM SOLENOID VALVE N/C

FILTER (308)

SAFETY MODE

CNTRL 3-4 SHIFT

1-2 SHIFT VALVE

1-2 SHIFT CONTROL VALVE

1-2 SHIFT SOLENOID VALVE N/C (A) OFF

2-3 SHIFT VALVE CNTRL

2-3 SHIFT SOLENOID VALVE N/C (B) OFF

4-5 SHIFT VLV CNTRL

4-5 SHIFT SOLENOID VALVE N/C (C) OFF

REVERSE LOCKOUT VALVE

LOW PRESSURE

MANUAL VALVE

P R N D 4 3 2

REAR CONTROL VALVE BODY (310)

GASKET (309)

SPACER PLATE (307)

GASKET (305)

BOTTOM CHANNEL PLATE (304)

GASKET (303)

TOP CHANNEL PLATE (301)

CASE (24)

THROTTLE SIGNAL

FEED LIMIT

MEMORY

MEMORY PILOT

FILTERED FEED LIMIT

1-2 SIGNAL

2-3 SIGNAL

32 SAFETY MODE

LINE SAFETY MODE

OVERDRIVE CLUTCH FEED 1

OVERDRIVE CLUTCH FEED 2

OVERDRIVE CL. FD 1

OVERDRIVE CL. FD 2

TCC SIGNAL

REGULATED APPLY

2345 OR REVERSE

123 REGULATED

123 BRAKING

D432

FDL

2-3 SIGNAL

FD LIMIT

1-2 SIGNAL

TCC SIGNAL

RLO

REV

ACCUM

SECOND CLUTCH

INTERMEDIATE CLUTCH

LOW AND REVERSE CLUTCH

2-3 SM/FDL

32 SM

PRESSURES

- INTAKE & DECREASE (SUCTION)
- CONVERTER & LUBE
- MAINLINE
- REGULATED LINE
- SOLENOID SIGNAL
- ACCUMULATOR
- FEED LIMIT
- THROTTLE SIGNAL

Figure 82

PARK
(Engine Running)

The following conditions and component problems could happen in any gear range, and are only some of the possibilities recommended to diagnose hydraulic problems. Always refer to the appropriate vehicle platform service manual when diagnosing specific concerns.

HIGH LINE PRESSURE

- Pressure Regulator Valve (210), or Line Boost Valve (207)
  - Stuck, damaged
- Pump Slide (216)
  - Stuck
- Pressure Control Solenoid Valve (357)
  - Loose connector
  - Valve has failed Off

LOW LINE PRESSURE

- Pressure Regulator Valve (210), Line Boost Valve (207), or Pressure Regulator Valve Spring (209)
  - Stuck, damaged, broken
- Fluid Pump Cover (202)
  - Cross channel leak, converter housing to cover or cover to case
- Fluid Pump Cover Gasket (46)
  - Damaged
- Pump Valve Bores
  - Excessive valve clearance due to wear
- Front Control Valve Body (340)
  - Cross channel leaks
  - Cross valve land leaks
- Rear Control Valve Body (365)
  - Cross channel leaks
  - Cross valve land leaks
- Gasket/Spacer Plate
  - Damaged
  - Missing
- Pressure Control Solenoid Valve (357)
  - Valve is stuck On
  - Broken clip causes leakage
- Pressure Control Solenoid Valve Filter (312)
  - Clogged or restricted
- Feed Limit Valve (353), Spring (354) or Retainer (343)
  - Stuck, damaged, broken

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF													

LD = LOCKED IN DRIVE

PARK
(Engine Running)

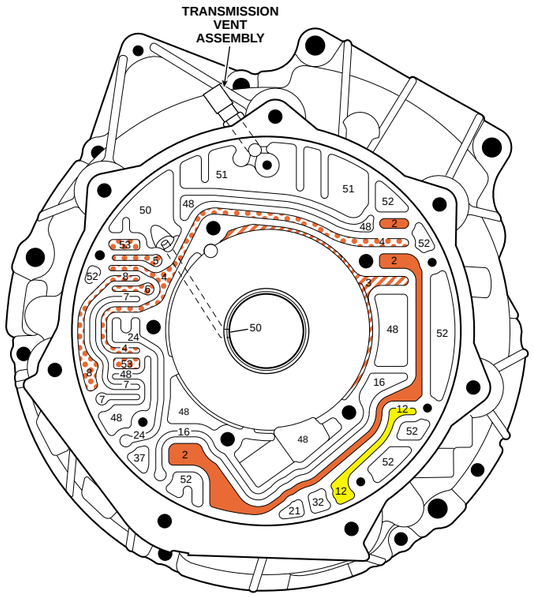
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

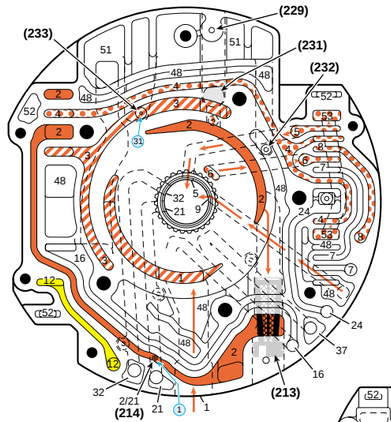
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

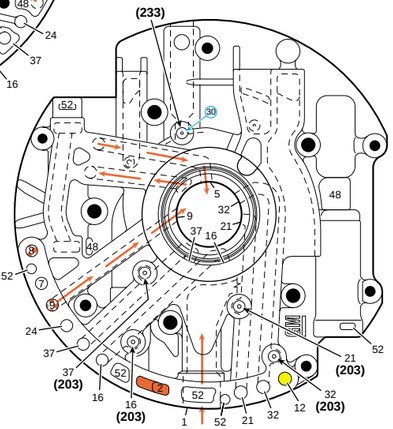
PARK (Engine Running)



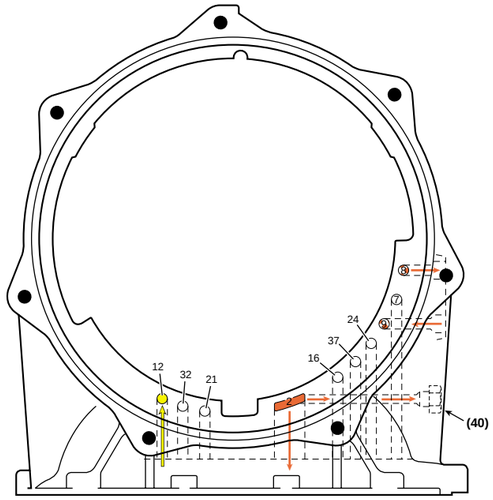
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



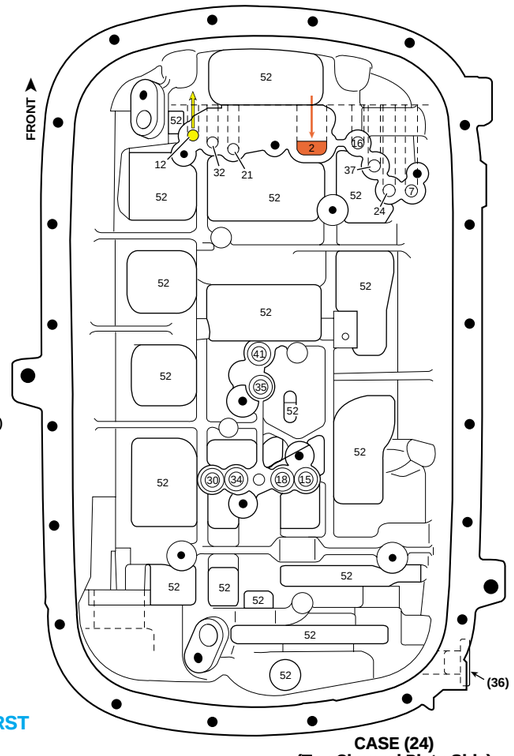
FLUID PUMP COVER (202)
(Case Side)



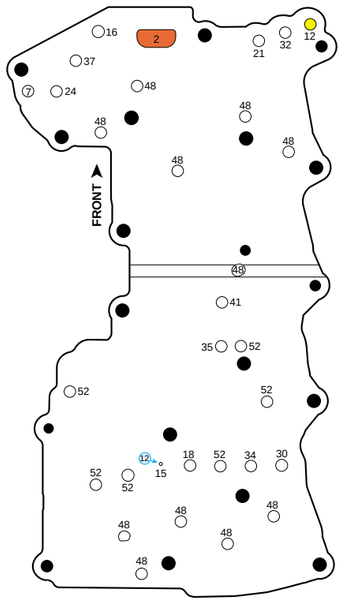
CASE (24)
(Fluid Pump Cover Side)

NOTE:

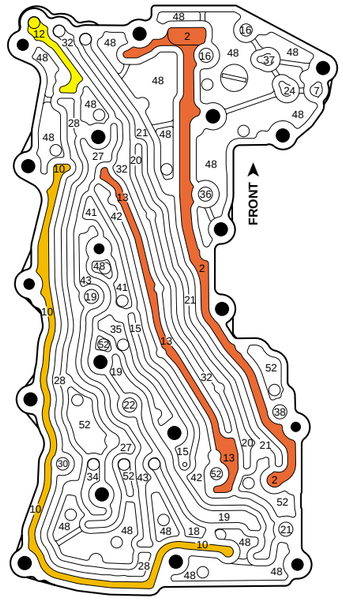
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



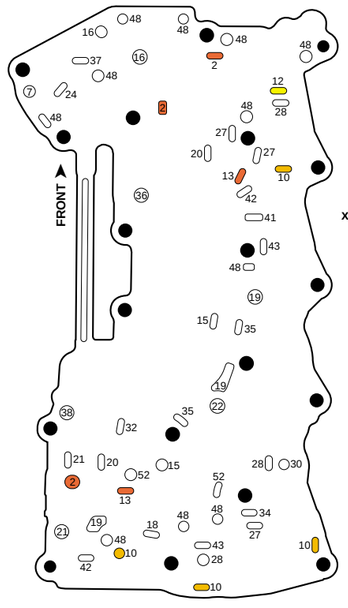
CASE (24)
(Top Channel Plate Side)



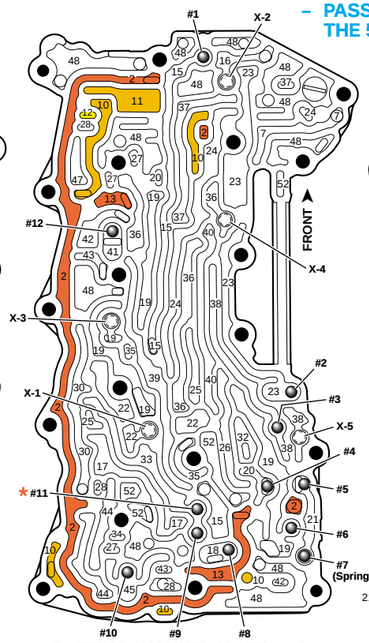
TOP CHANNEL PLATE (301)
(Case Side)



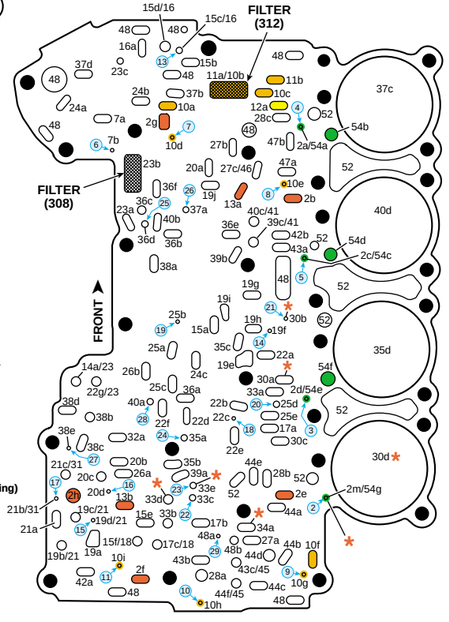
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



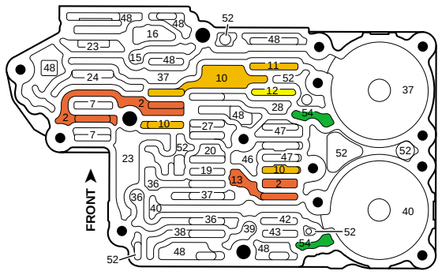
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



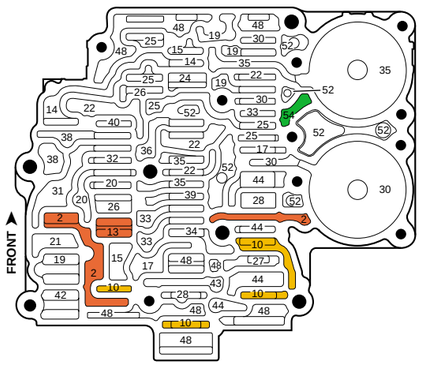
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 83

FOLDOUT ➤ 87

REVERSE

NOTE:
PASSAGES AND COMPONENTS MARKED WITH * ARE USED FOR THE 5L40-E ONLY

TORQUE CONVERTER ASSEMBLY (1)

DIRECT AND REVERSE CLUTCH ASSEMBLY (400–420)

FORWARD AND COAST CLUTCH ASSEMBLY (430–451)

OVERDRIVE AND INTERMEDIATE CLUTCH ASSEMBLY (480–497)

CENTER SUPPORT ASSEMBLY (510–535)

COOLER

LUBE

TO COOLER

REVERSE CLUTCH

FORWARD CLUTCH

COAST CLUTCH

DIRECT CLUTCH

OVERDRIVE CLUTCH

INTERMEDIATE CLUTCH

SECOND CLUTCH

REVERSE LOCKOUT

LOW AND REV CL OR RLO

SECOND COAST CLUTCH

CASE (24)

TOP CHANNEL PLATE (301)

GASKET (303)

BOTTOM CHANNEL PLATE (304)

GASKET (305)

SPACER PLATE (307)

GASKET (309)

FRONT CONTROL VALVE BODY (311)

ACCUMULATOR HOUSING (317)

DIRECT CLUTCH ACCUMULATOR

ACCUMULATOR HOUSING (323)

OVERDRIVE CLUTCH ACCUMULATOR

ACCUMULATOR HOUSING (328)

INTERMEDIATE CLUTCH ACCUMULATOR

ACCUMULATOR HOUSING (333)

SECOND CLUTCH ACCUMULATOR

ACCUM

ACCUMULATOR

APPLY

RELEASE

LINE

EX

AIR BLEED (203)

AIR BLEED (233)

FLUID PRESSURE TEST PLUG (40)

PRESSURE RELIEF BALL VALVE

CONVERTER FEED

DECREASE

TCC CONTROL VALVE

TCC ENABLE VALVE

PRESS REG VALVE

BOOST VALVE

CONVERTER HOUSING (224)

FLUID PUMP SCREEN ASSEMBLY (213)

FLUID PUMP COVER (202)

(214)

SUCTION

THROTTLE SIGNAL

FILTER (312)

PRESSURE CONTROL SOLENOID VALVE

MEMORY

MEMORY PILOT

FEED LIMIT

FILTERED FEED LIMIT

THROTTLE SIGNAL

SAFETY MODE

LINE SAFETY MODE

1-2 SIGNAL

2-3 SIGNAL

CNTRL 3-4 SHIFT

FEED LIMIT VALVE

TCC REGULATOR VALVE

TCC PWM SOLENOID VALVE N/C

FILTER (308)

32 SAFETY MODE

OVERDRIVE CLUTCH FEED 1

OVERDRIVE CLUTCH FEED 2

2345 OR REVERSE

REGULATED APPLY

TCC SIGNAL

1-2 SHIFT VALVE

1-2 SHIFT CONTROL VALVE

1-2 SHIFT SOLENOID VALVE N/C (A) OFF

FD LIMIT

2-3 SHIFT VALVE CNTRL

2-3 SHIFT SOLENOID VALVE N/C (B) OFF

4-5 SHIFT VLV CNTRL

4-5 SHIFT SOLENOID VALVE N/C (C) OFF

REVERSE LOCKOUT VALVE

LOW PRESSURE

MANUAL VALVE

P R N D 4 3 2

REAR CONTROL VALVE BODY (310)

GASKET (309)

SPACER PLATE (307)

GASKET (305)

BOTTOM CHANNEL PLATE (304)

GASKET (303)

TOP CHANNEL PLATE (301)

CASE (24)

FLUID FILTER ASSEMBLY (59)

FLUID PAN (62)

PRESSURES
- INTAKE & DECREASE (SUCTION)
- CONVERTER & LUBE
- MAINLINE
- REGULATED LINE
- SOLENOID SIGNAL
- ACCUMULATOR
- FEED LIMIT
- THROTTLE SIGNAL

Figure 84

REVERSE

NO REVERSE OR SLIPS IN REVERSE

- Center Support (518)
  - Broken
  - Leaking at case
- Fluid Passage Sleeve (38)
  - Leaking
- Low and Reverse Clutch Piston (517)
  - Leaking
  - Jammed or cracked
- Reverse Lockout Valve
  - Stuck
- #2 Ball Check Valve
  - Stuck
  - Missing
- #8 Ball Check Valve
  - Stuck
  - Missing
- Reverse Clutch Piston (404)
  - Leaking
  - Jammed or cracked
- Reverse Clutch Housing Ball Check Valve (403)
  - Leaking
- Reverse Clutch Housing Seal Ring (200)
  - Leaking
- TCC PWM Solenoid Valve (352)
  - Stuck On

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF		APPLIED								APPLIED			

LD = LOCKED IN DRIVE

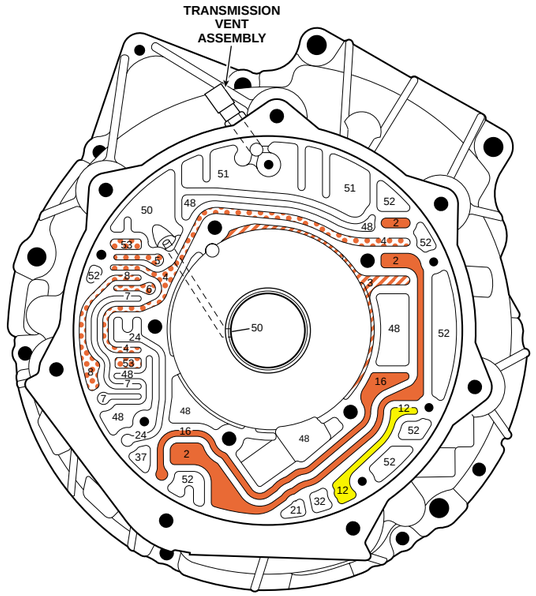
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

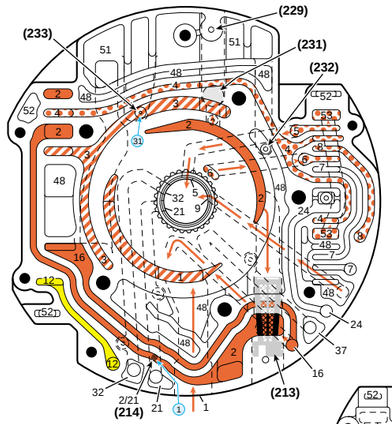
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

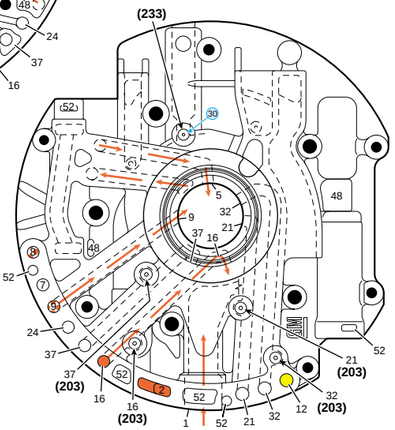
REVERSE



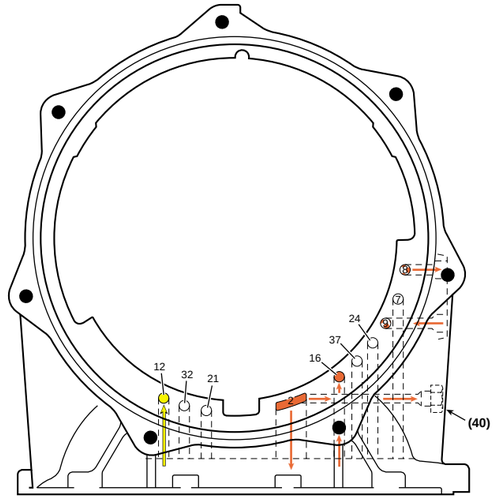
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



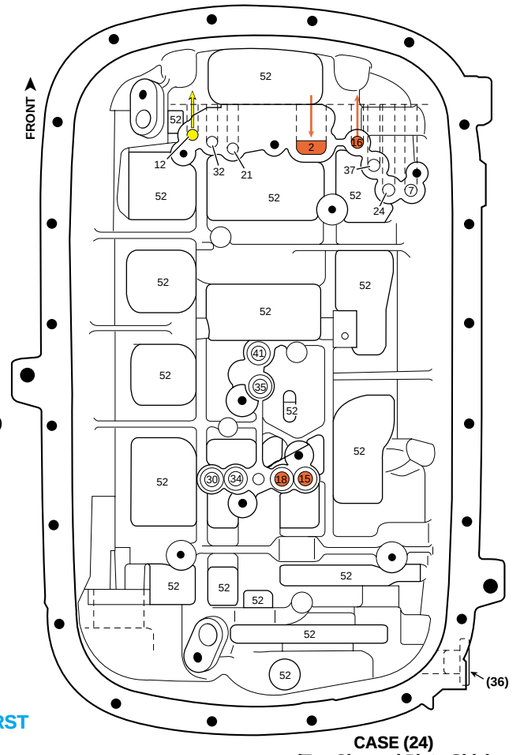
FLUID PUMP COVER (202)
(Case Side)



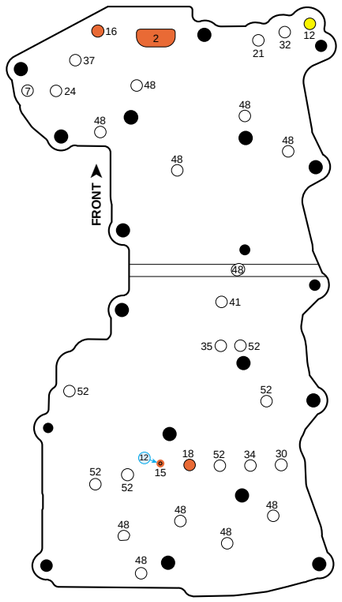
CASE (24)
(Fluid Pump Cover Side)

NOTE:

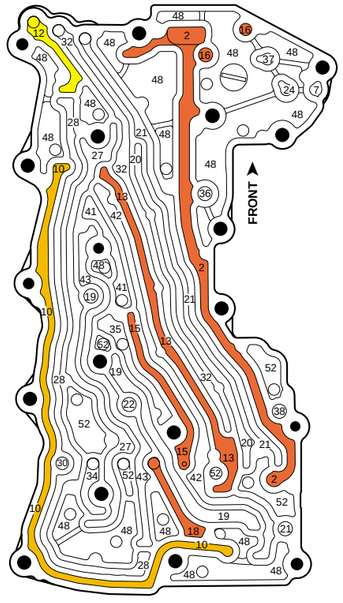
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



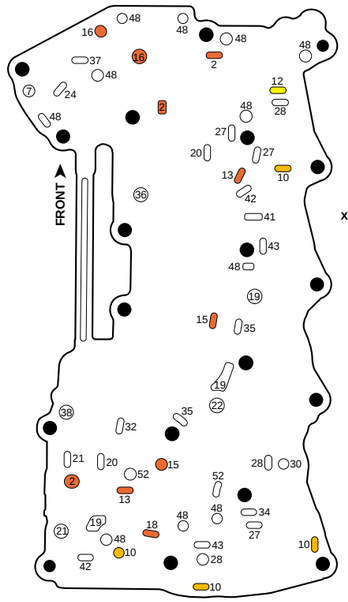
CASE (24)
(Top Channel Plate Side)



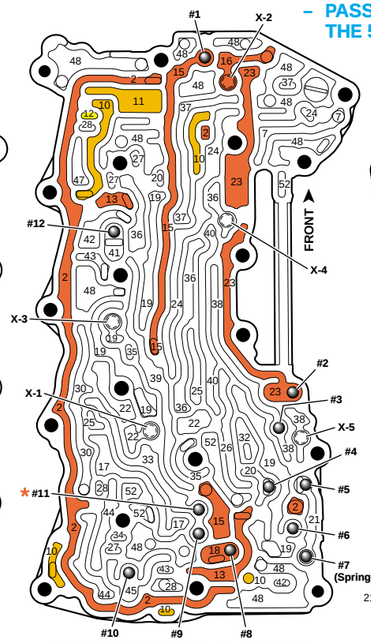
TOP CHANNEL PLATE (301)
(Case Side)



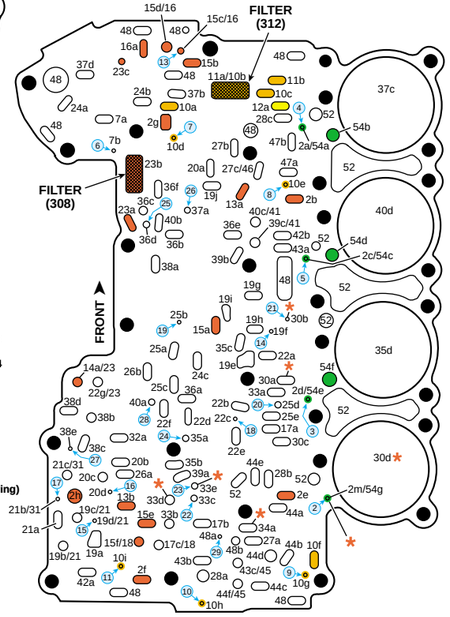
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



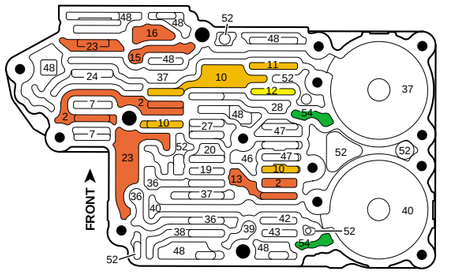
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



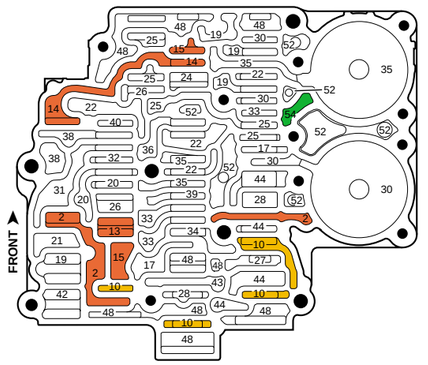
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 85

FOLDOUT ➤ 89

NEUTRAL (Engine Running)

NOTE: PASSAGES AND COMPONENTS MARKED WITH * ARE USED FOR THE 5L40-E ONLY

TORQUE CONVERTER ASSEMBLY (1)

DIRECT AND REVERSE CLUTCH ASSEMBLY (400–420)

FORWARD AND COAST CLUTCH ASSEMBLY (430–451)

OVERDRIVE AND INTERMEDIATE CLUTCH ASSEMBLY (480–497)

CENTER SUPPORT ASSEMBLY (510–535)

COOLER

FLUID PRESSURE TEST PLUG (40)

PRESSURE RELIEF BALL VALVE

TCC CONTROL VALVE

TCC ENABLE VALVE

BOOST VALVE

PRESS REG VALVE

CONVERTER HOUSING (224)

FLUID PUMP SCREEN ASSEMBLY (213)

FLUID PUMP COVER (202)

FILTER (312)

PRESSURE CONTROL SOLENOID VALVE

FEED LIMIT VALVE

TCC REGULATOR VALVE

TCC PWM SOLENOID VALVE N/C

FILTER (308)

ACCUMULATOR HOUSING (317)

DIRECT CLUTCH ACCUMULATOR

ACCUMULATOR HOUSING (323)

OVERDRIVE CLUTCH ACCUMULATOR

ACCUMULATOR HOUSING (328)

INTERMEDIATE CLUTCH ACCUMULATOR

ACCUMULATOR HOUSING (333)

SECOND CLUTCH ACCUMULATOR

1-2 SHIFT VALVE

1-2 SHIFT CONTROL VALVE

1-2 SHIFT SOLENOID VALVE N/C (A) OFF

2-3 SHIFT VALVE CNTRL

2-3 SHIFT SOLENOID VALVE N/C (B) OFF

3-4 SHIFT VALVE CNTRL

4-5 SHIFT VLV CNTRL

4-5 SHIFT SOLENOID VALVE N/C (C) OFF

REVERSE LOCKOUT VALVE

MANUAL VALVE

P R N D 4 3 2

CASE (24)
TOP CHANNEL PLATE (301)
GASKET (303)
BOTTOM CHANNEL PLATE (304)
GASKET (305)
SPACER PLATE (307)
GASKET (309)
FRONT CONTROL VALVE BODY (311)
REAR CONTROL VALVE BODY (310)

FLUID FILTER ASSEMBLY (59)

FLUID PAN (62)

PRESSURES
- INTAKE & DECREASE (SUCTION)
- CONVERTER & LUBE
- MAINLINE
- REGULATED LINE
- SOLENOID SIGNAL
- ACCUMULATOR
- FEED LIMIT
- THROTTLE SIGNAL

Figure 86

NEUTRAL
(Engine Running)

FORWARD MOTION IN NEUTRAL

- Manual Valve (377)
  - Mis-positioned
- Forward Clutch Piston (436)
  - Jammed
- Coast Clutch Piston (438)
  - Jammed
- Forward Clutch Input Housing (433)
  - Passage plugged

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF													

LD = LOCKED IN DRIVE

NEUTRAL
(Engine Running)

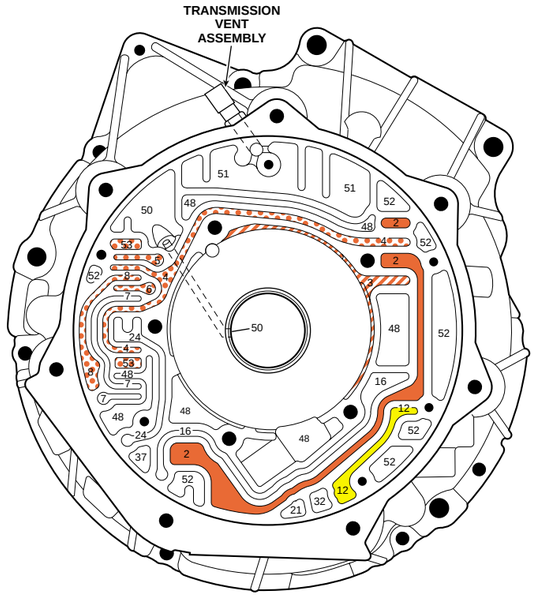
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

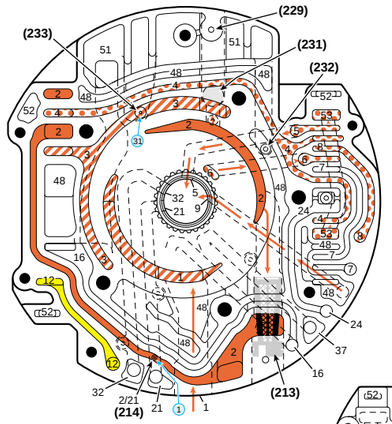
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

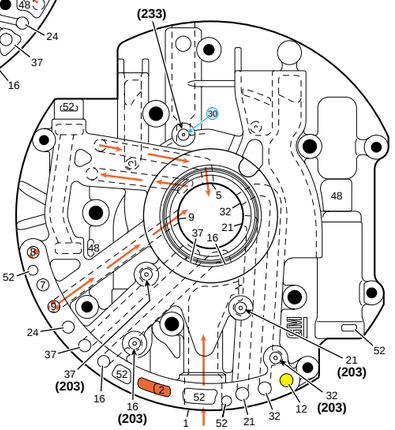
NEUTRAL (Engine Running)



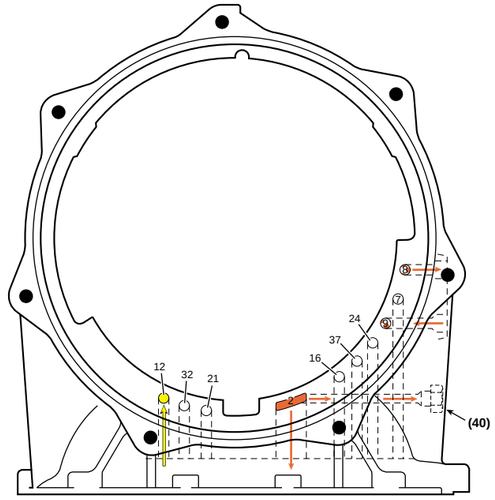
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



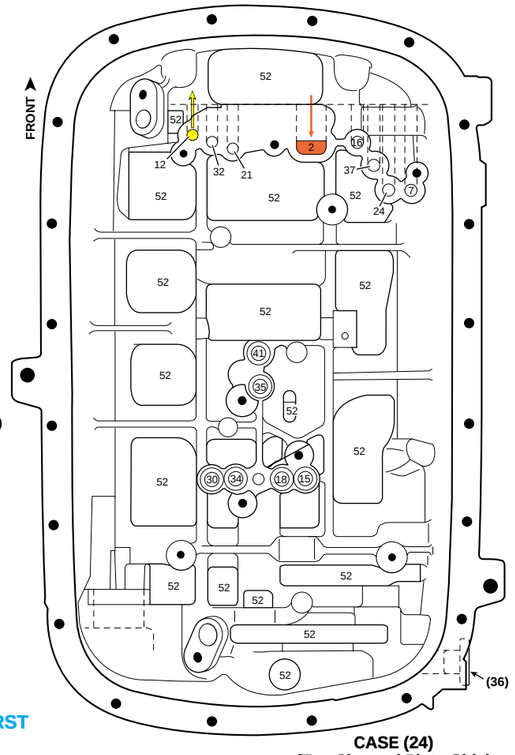
FLUID PUMP COVER (202)
(Case Side)



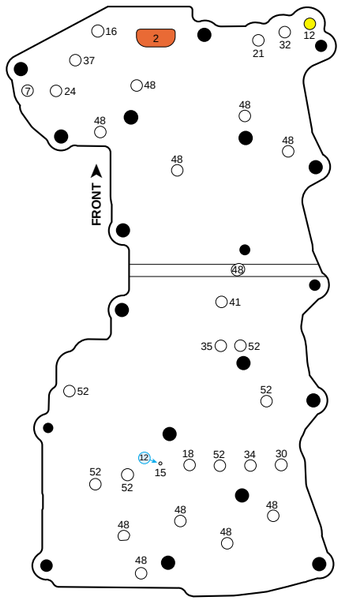
CASE (24)
(Fluid Pump Cover Side)

NOTE:

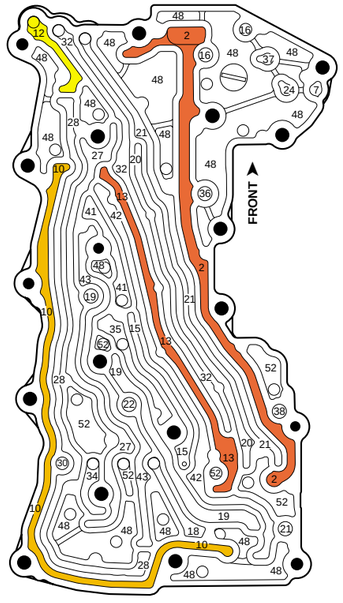
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



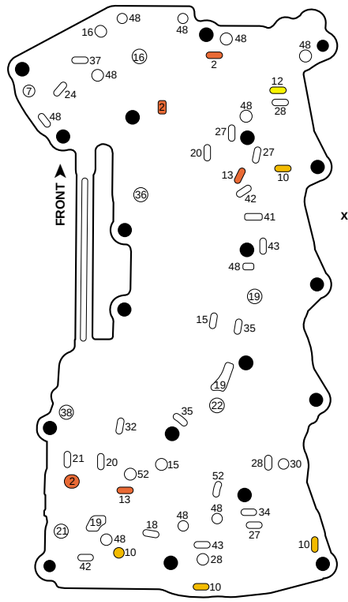
CASE (24)
(Top Channel Plate Side)



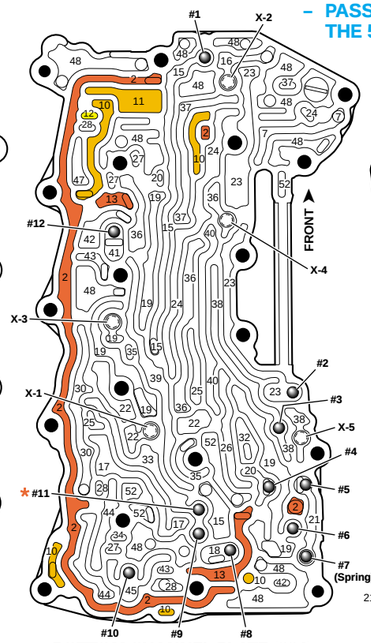
TOP CHANNEL PLATE (301)
(Case Side)



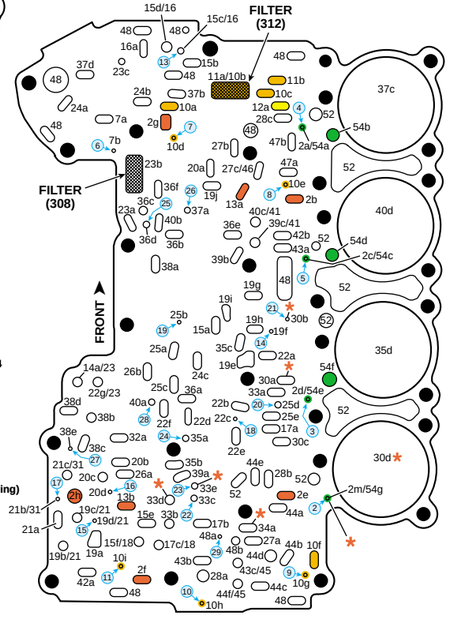
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



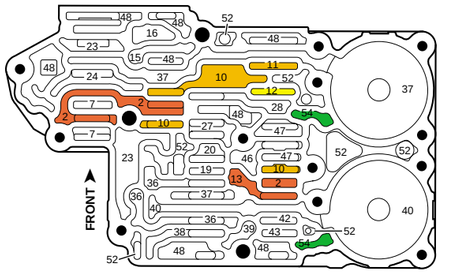
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



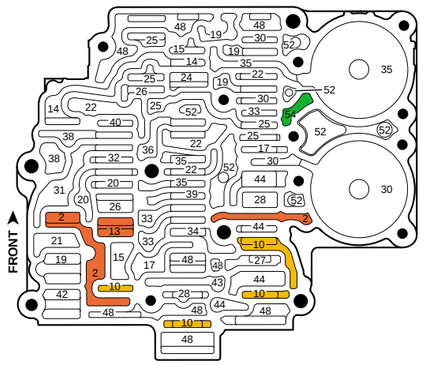
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 87

FOLDOUT ➤ 91

OVERDRIVE RANGE – FIRST GEAR

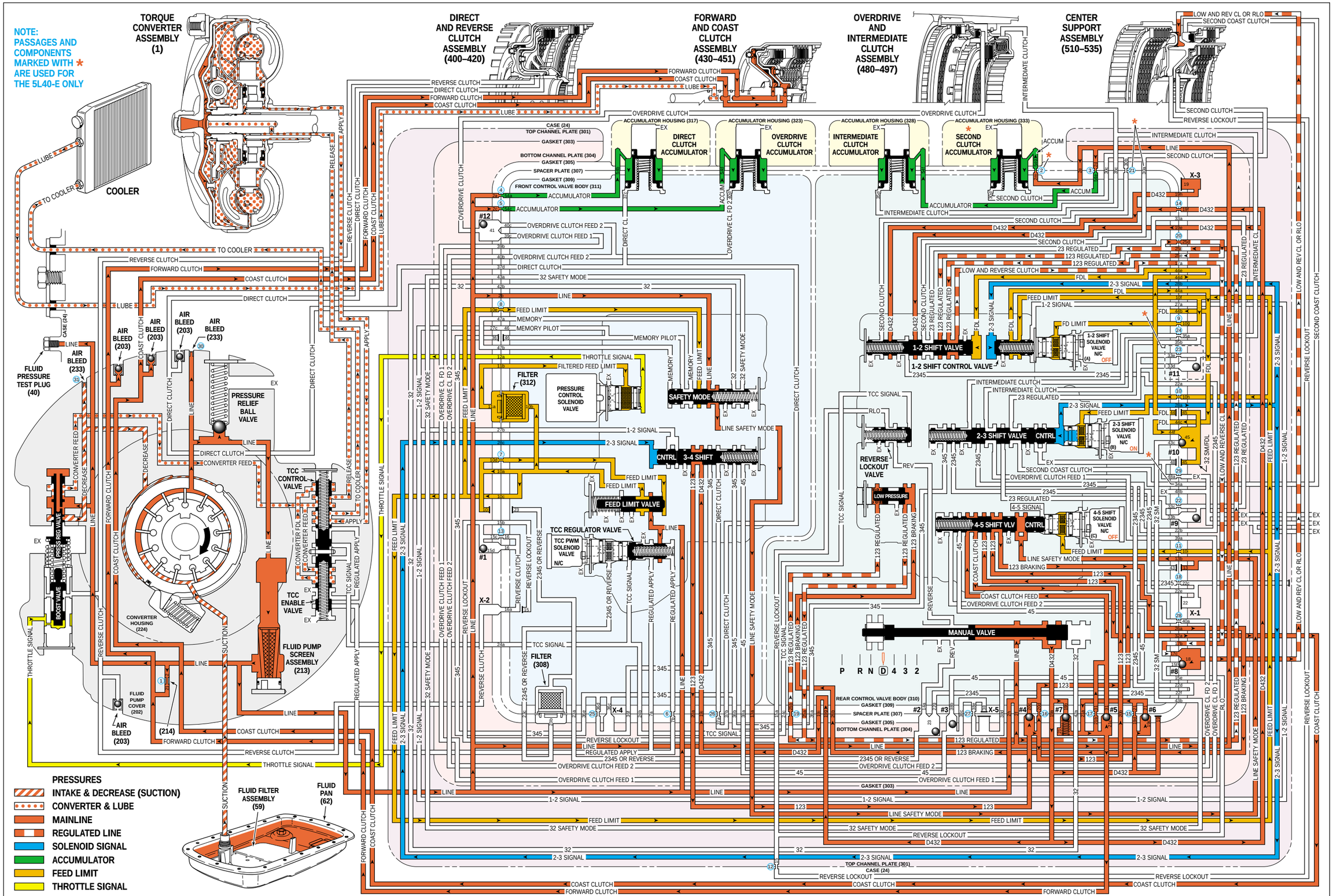


Figure 88

OVERDRIVE RANGE – FIRST GEAR

LOSS OF DRIVE

- Fluid Pump (202)
  - Seized
- Forward Clutch Piston (436)
  - Jammed or cracked
  - Leaking
- Forward Clutch Input Housing (433)
  - Passage plugged
- Forward Clutch Housing Ball Check Valve (434)
  - Leaking
- Forward Clutch Sprag (461)
  - Not Holding
- Input Shaft Fluid Seal (432)
  - Leaking

FIRST, FOURTH AND FIFTH GEAR ONLY

- 1-2 Shift Solenoid Valve (368)
  - Stuck Off
  - Loose connector
  - No voltage
  - Leaking
- 1-2 Shift Valve (387)
  - Stuck
- 1-2 Shift Control Valve (366)
  - Stuck

THIRD, FOURTH AND FIFTH GEAR ONLY

- 2-3 Shift Solenoid Valve (369)
  - Stuck Off
  - Loose connector
  - No voltage
  - Leaking
- 2-3 Shift Valve (371)
  - Stuck
- 2-3 Shift Control Valve (370)
  - Stuck

FIRST, SECOND, THIRD AND FIFTH GEAR ONLY

- 4-5 Shift Solenoid Valve (376)
  - Stuck Off
  - Loose connector
  - No voltage
  - Leaking
- 4-5 Shift Valve (374)
  - Stuck
- 4-5 Shift Control Valve (375)
  - Stuck

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	ON	OFF			APPLIED	APPLIED	LD				LD	★APPLIED			

LD = LOCKED IN DRIVE ★APPLIED BEFORE THE FIRST 1-2 SHIFT HAS OCCURRED

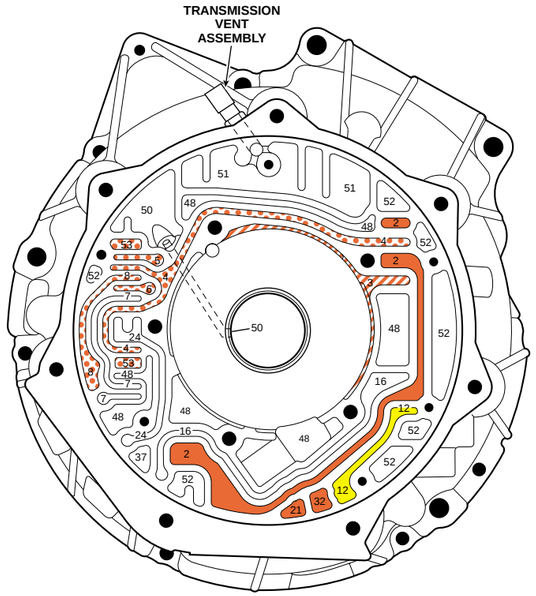
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

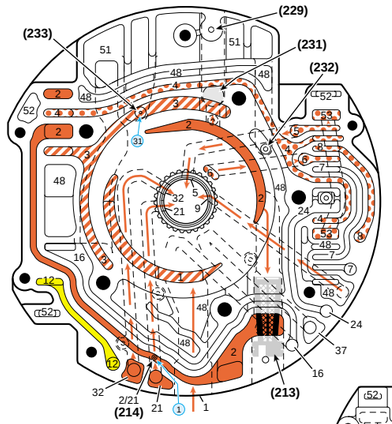
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

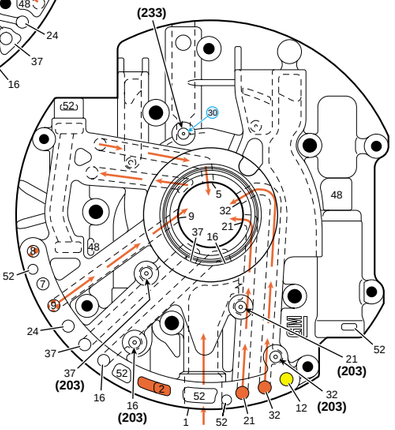
OVERDRIVE RANGE – FIRST GEAR



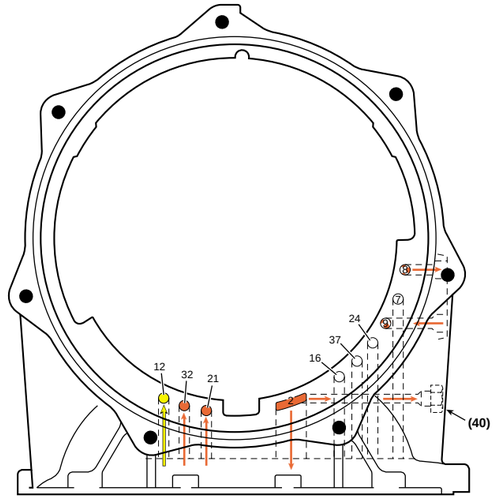
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



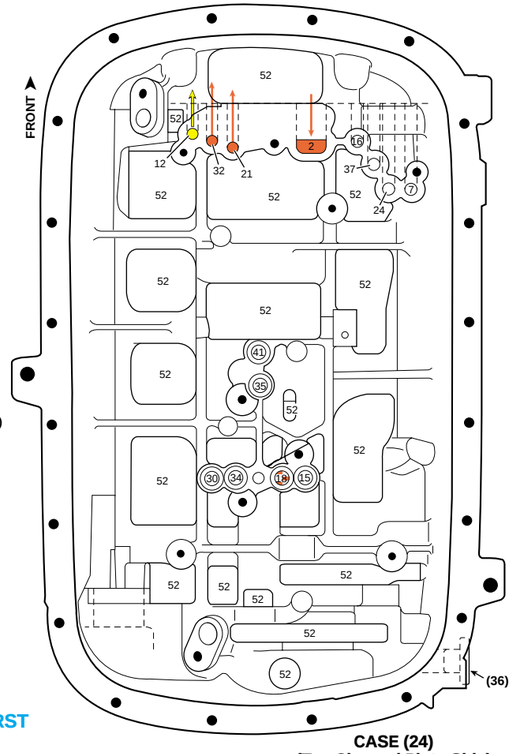
FLUID PUMP COVER (202)
(Case Side)



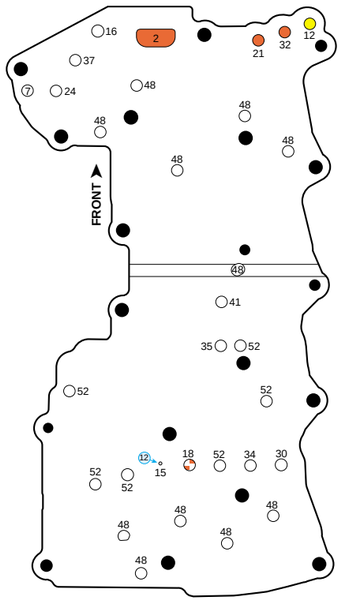
CASE (24)
(Fluid Pump Cover Side)

NOTE:

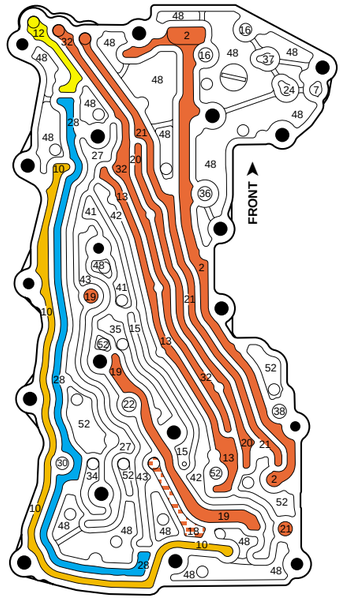
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



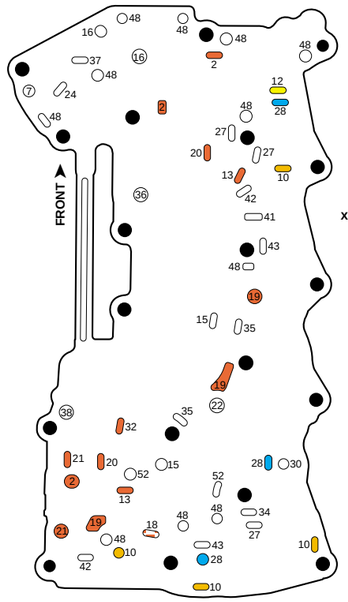
CASE (24)
(Top Channel Plate Side)



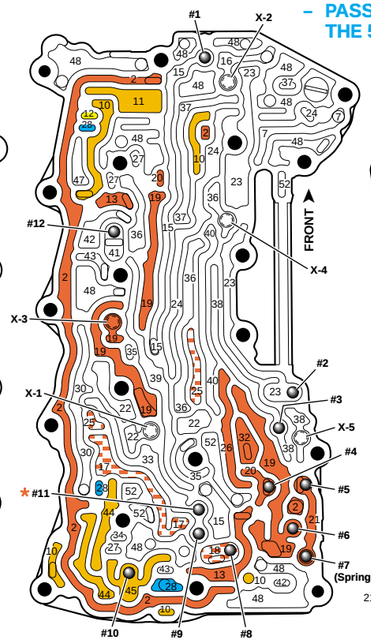
TOP CHANNEL PLATE (301)
(Case Side)



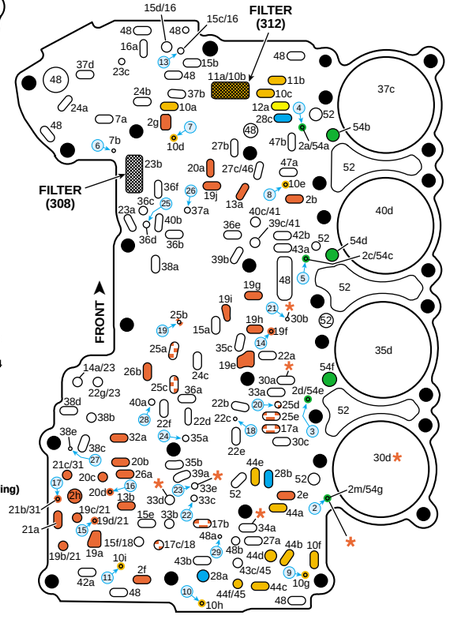
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



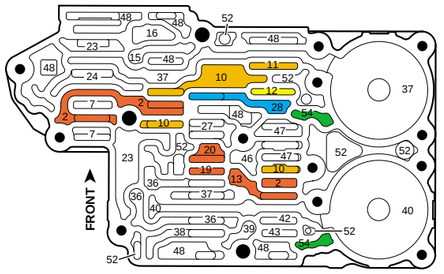
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



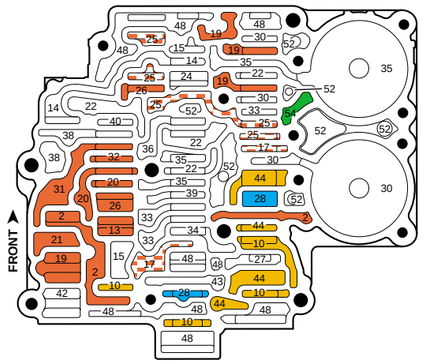
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 89

FOLDOUT ➤ 93

OVERDRIVE RANGE – SECOND GEAR

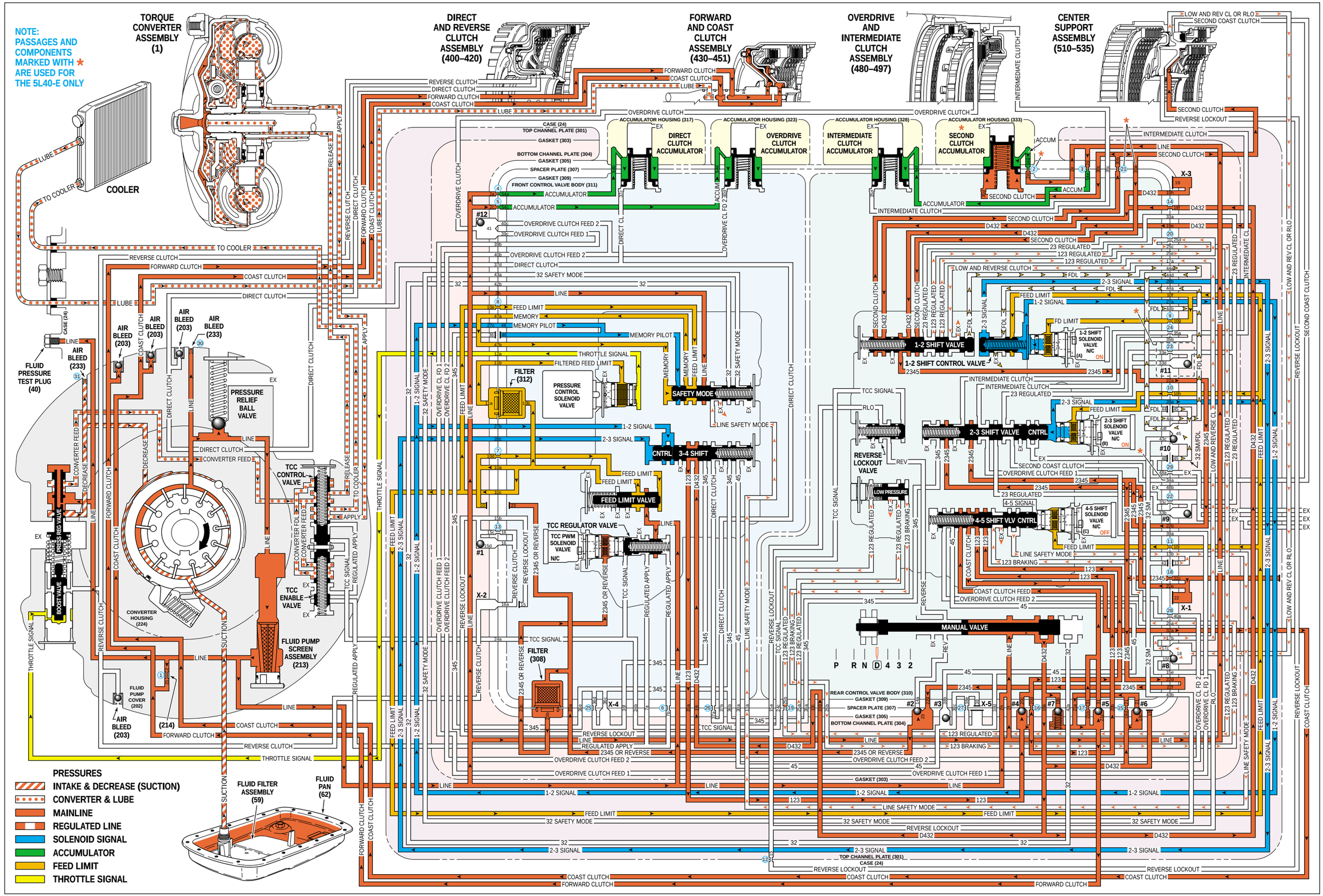


Figure 90

OVERDRIVE RANGE – SECOND GEAR

NO SECOND GEAR

- Center Support (518)
  - Cracked
  - Feed hole blocked
- Fluid Passage Sleeve (38)
  - Leaking
- Second Clutch Piston (520)
  - Cracked or jammed
  - Leaking seals
- Second Clutch Sprag (547)
  - Not holding
- 1-2 Shift Solenoid Valve (368)
  - Stuck Off
  - Leaking
  - No voltage supply
- 1-2 Shift Valve (387)
  - Stuck
- 1-2 Shift Control Valve (366)
  - Stuck
- Second Clutch Accumulator
  - Leaking

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
ON	ON	OFF			APPLIED	APPLIED	LD						APPLIED	LD	

LD = LOCKED IN DRIVE

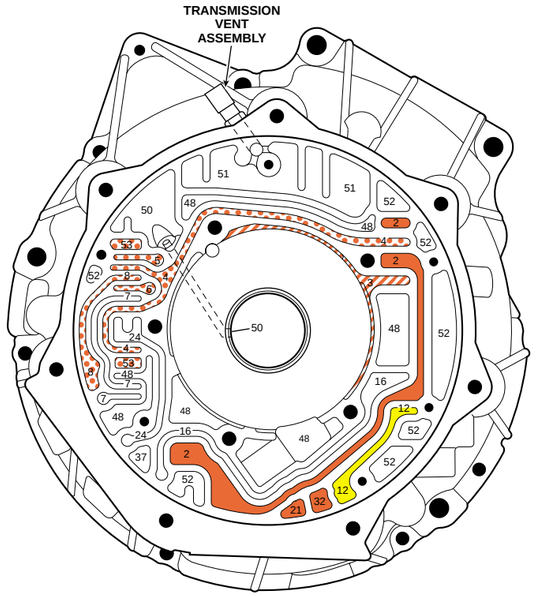
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

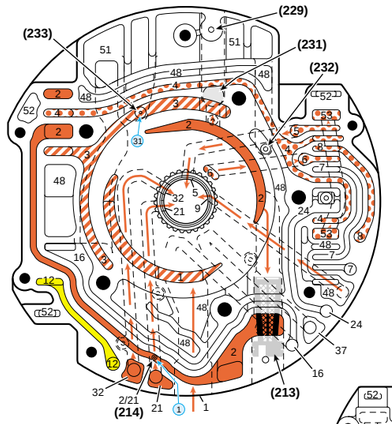
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

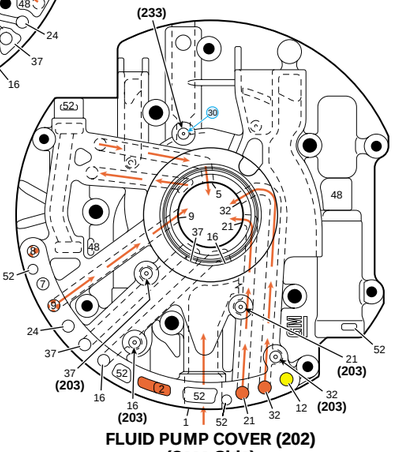
OVERDRIVE RANGE – SECOND GEAR



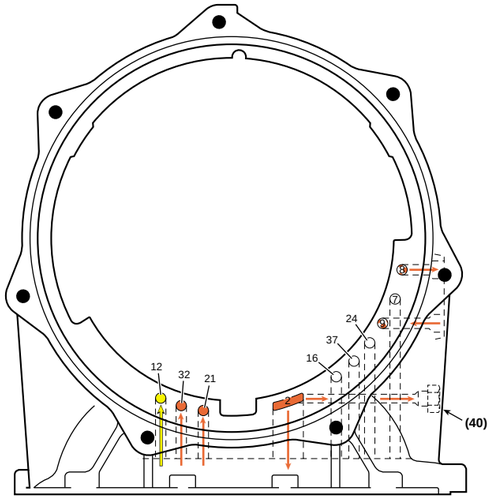
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



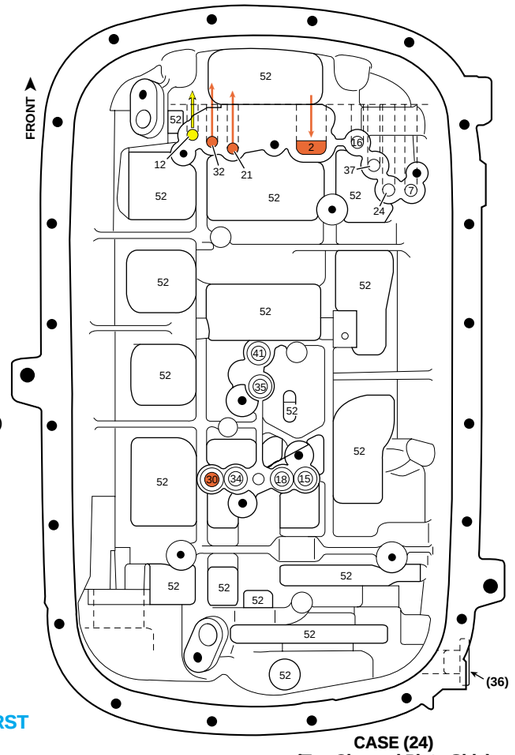
FLUID PUMP COVER (202)
(Case Side)



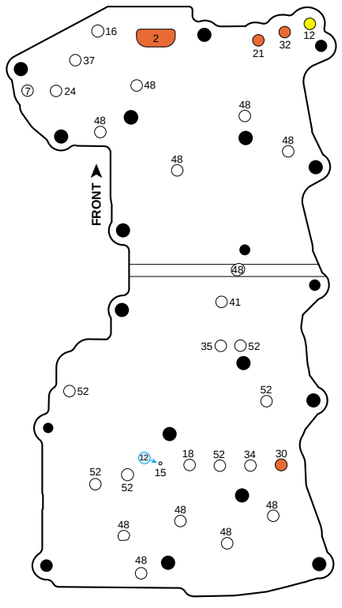
CASE (24)
(Fluid Pump Cover Side)

NOTE:

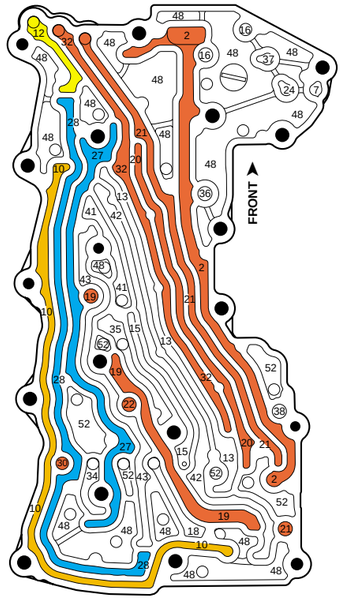
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



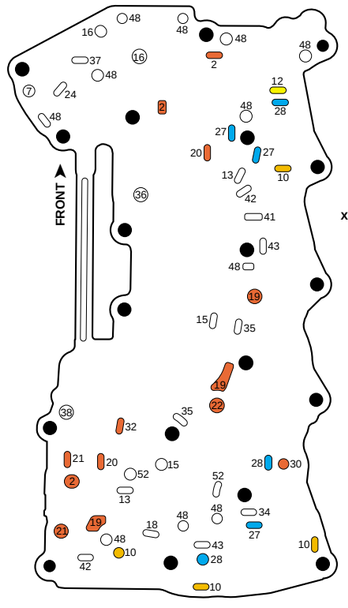
CASE (24)
(Top Channel Plate Side)



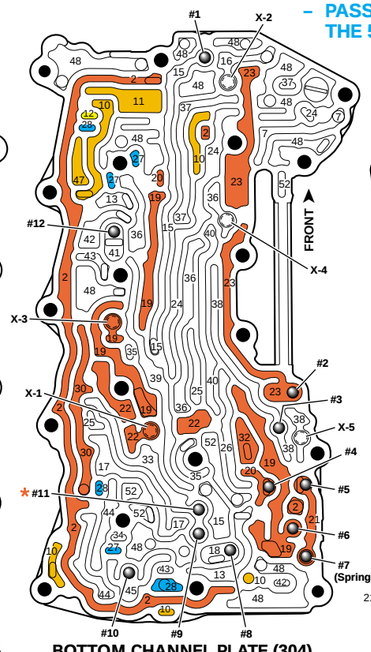
TOP CHANNEL PLATE (301)
(Case Side)



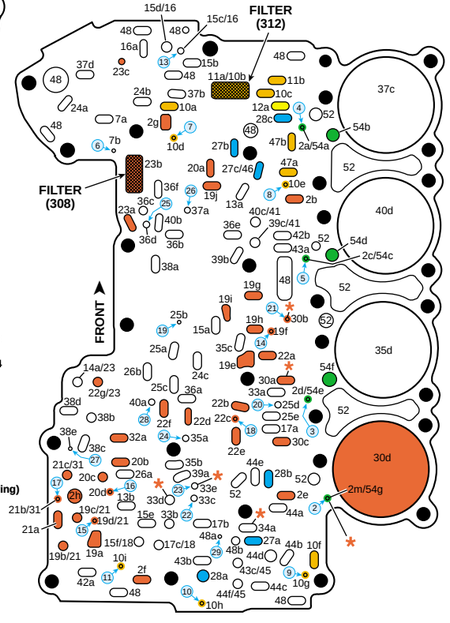
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



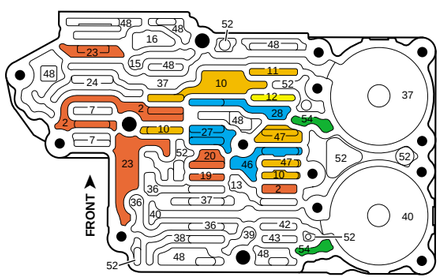
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



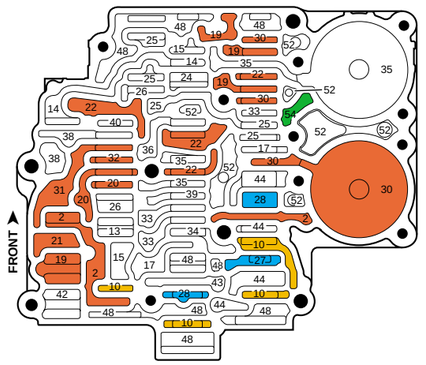
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 91

FOLDOUT ➤ 95

OVERDRIVE RANGE – THIRD GEAR

NOTE:
PASSAGES AND COMPONENTS MARKED WITH * ARE USED FOR THE 5L40-E ONLY

TORQUE CONVERTER ASSEMBLY (1)

DIRECT AND REVERSE CLUTCH ASSEMBLY (400–420)

FORWARD AND COAST CLUTCH ASSEMBLY (430–451)

OVERDRIVE AND INTERMEDIATE CLUTCH ASSEMBLY (480–497)

CENTER SUPPORT ASSEMBLY (510–535)

COOLER

FLUID PRESSURE TEST PLUG (40)

PRESSURE RELIEF BALL VALVE

TCC CONTROL VALVE

TCC ENABLE VALVE

BOOST VALVE

PRESS REG VALVE

CONVERTER HOUSING (224)

FLUID PUMP SCREEN ASSEMBLY (213)

FLUID PUMP COVER (202)

FILTER (312)

FILTER (308)

PRESSURE CONTROL SOLENOID VALVE

TCC REGULATOR VALVE

TCC PWM SOLENOID VALVE N/C

FEED LIMIT VALVE

CNTRL 3-4 SHIFT

DIRECT CLUTCH ACCUMULATOR

OVERDRIVE CLUTCH ACCUMULATOR

INTERMEDIATE CLUTCH ACCUMULATOR

SECOND CLUTCH ACCUMULATOR

1-2 SHIFT VALVE

1-2 SHIFT CONTROL VALVE

1-2 SHIFT SOLENOID VALVE N/C (A) ON

2-3 SHIFT VALVE CNTRL

2-3 SHIFT SOLENOID VALVE N/C (B) OFF

4-5 SHIFT VLV CNTRL

4-5 SHIFT SOLENOID VALVE N/C (C) OFF

REVERSE LOCKOUT VALVE

MANUAL VALVE

P R N D 4 3 2

FLUID FILTER ASSEMBLY (59)

FLUID PAN (62)

CASE (24)
TOP CHANNEL PLATE (301)
GASKET (303)
BOTTOM CHANNEL PLATE (304)
GASKET (305)
SPACER PLATE (307)
GASKET (309)
FRONT CONTROL VALVE BODY (311)
REAR CONTROL VALVE BODY (310)

PRESSURES
- INTAKE & DECREASE (SUCTION)
- CONVERTER & LUBE
- MAINLINE
- REGULATED LINE
- SOLENOID SIGNAL
- ACCUMULATOR
- FEED LIMIT
- THROTTLE SIGNAL

Figure 92

OVERDRIVE RANGE – THIRD GEAR

NO THIRD GEAR

- Overdrive Clutch Housing (493)
  - Cracked
  - Feed hole blocked
- Fluid Passage Sleeve (39)
  - Leaking
- Intermediate Clutch Piston (495)
  - Leaking
  - Cracked or jammed
- 2-3 Shift Solenoid Valve (369)
  - Stuck On
- 2-3 Shift Valve (371)
  - Stuck
- 2-3 Shift Control Valve (370)
  - Stuck
- Intermediate Clutch Accumulator
  - Leaking
- Intermediate Clutch Sprag (473)
  - Not holding

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
ON	OFF	OFF			APPLIED	APPLIED	LD		LD	APPLIED			APPLIED		

LD = LOCKED IN DRIVE

OVERDRIVE RANGE – THIRD GEAR

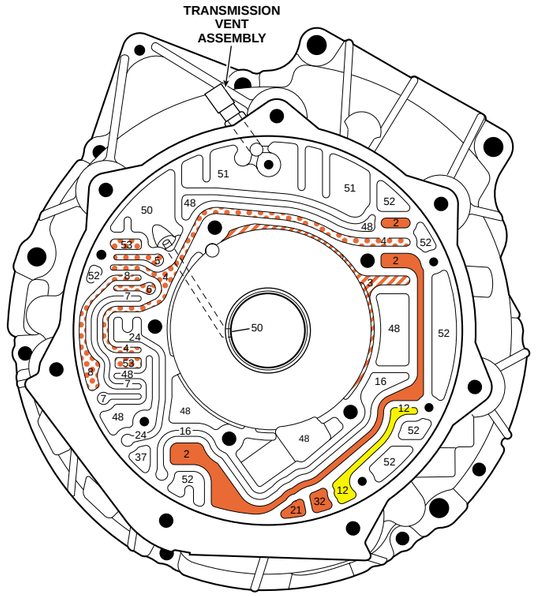
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

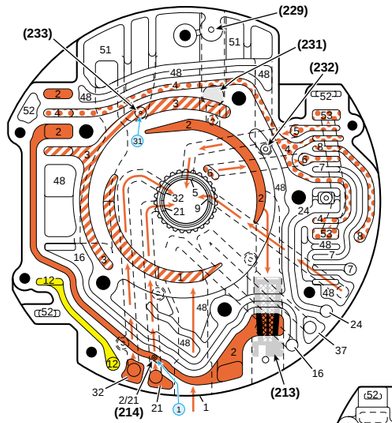
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

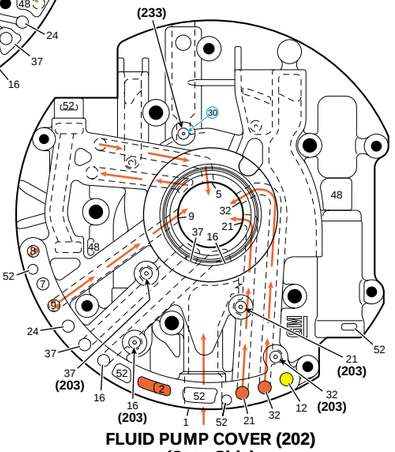
OVERDRIVE RANGE – THIRD GEAR



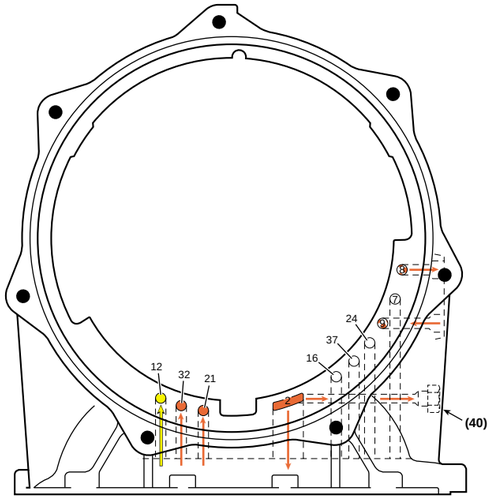
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



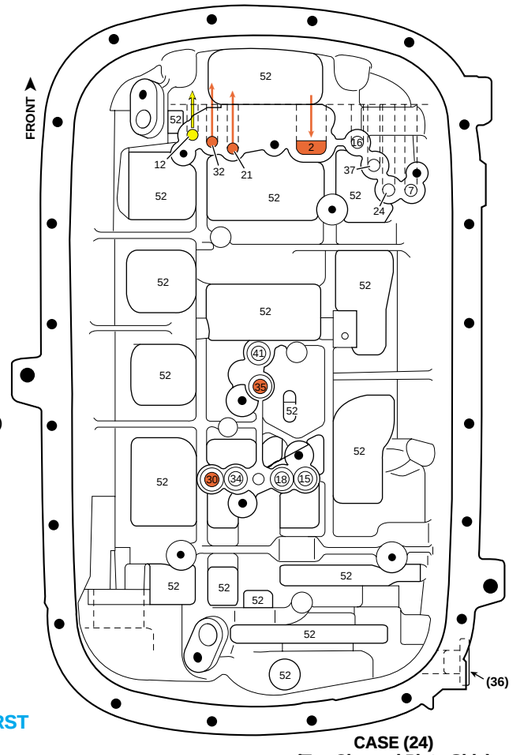
FLUID PUMP COVER (202)
(Case Side)



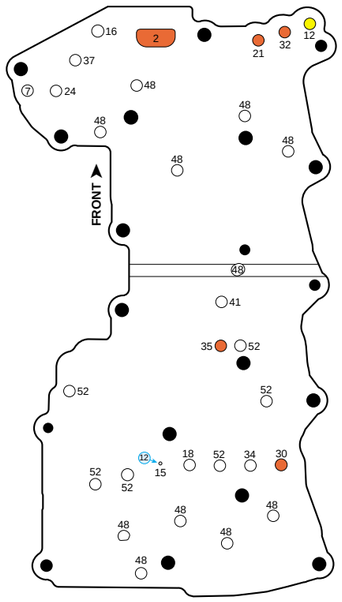
CASE (24)
(Fluid Pump Cover Side)

NOTE:

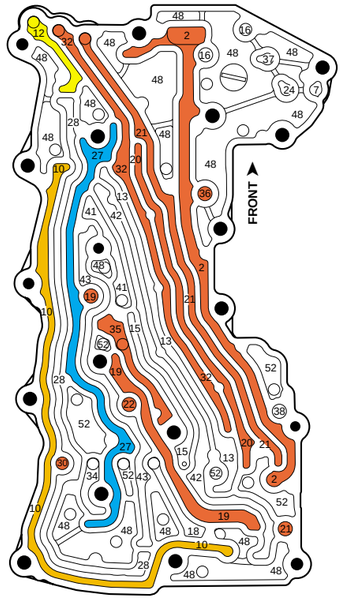
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



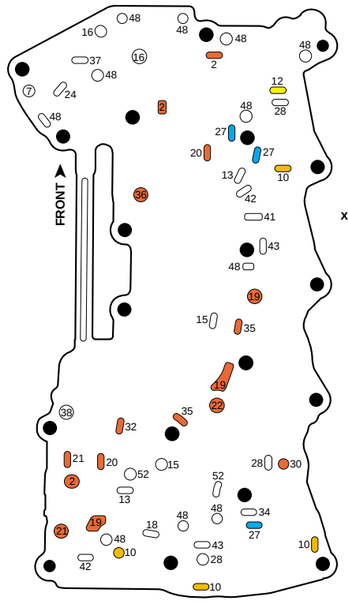
CASE (24)
(Top Channel Plate Side)



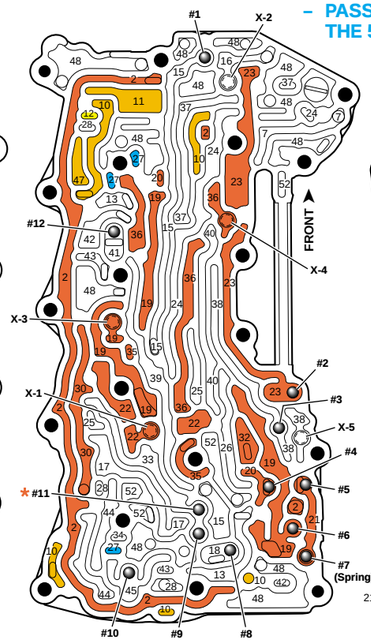
TOP CHANNEL PLATE (301)
(Case Side)



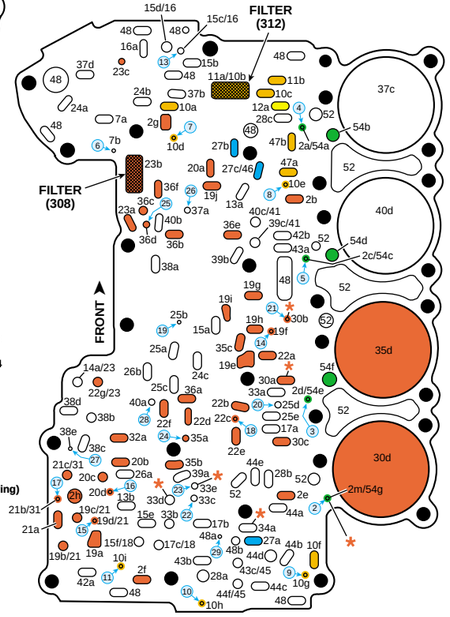
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



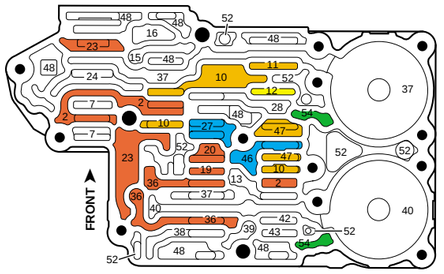
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



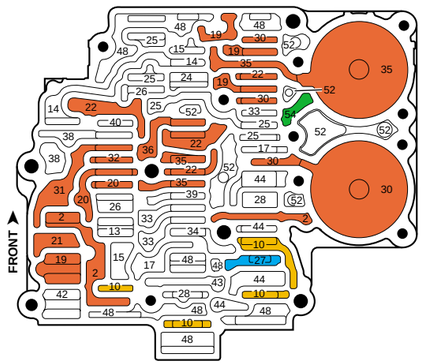
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 93

FOLDOUT ➤ 97

OVERDRIVE RANGE – FOURTH GEAR

NOTE:
PASSAGES AND COMPONENTS MARKED WITH * ARE USED FOR THE 5L40-E ONLY

TORQUE CONVERTER ASSEMBLY (1)

DIRECT AND REVERSE CLUTCH ASSEMBLY (400–420)

FORWARD AND COAST CLUTCH ASSEMBLY (430–451)

OVERDRIVE AND INTERMEDIATE CLUTCH ASSEMBLY (480–497)

CENTER SUPPORT ASSEMBLY (510–535)

COOLER

FLUID PRESSURE TEST PLUG (40)

PRESSURE RELIEF BALL VALVE

TCC CONTROL VALVE

TCC ENABLE VALVE

BOOST VALVE

PRESS REG VALVE

CONVERTER HOUSING (224)

FLUID PUMP SCREEN ASSEMBLY (213)

FLUID PUMP COVER (202)

FILTER (312)

FILTER (308)

PRESSURE CONTROL SOLENOID VALVE

TCC REGULATOR VALVE

TCC PWM SOLENOID VALVE N/C

FEED LIMIT VALVE

CNTRL 3-4 SHIFT

SAFETY MODE

DIRECT CLUTCH ACCUMULATOR

OVERDRIVE CLUTCH ACCUMULATOR

INTERMEDIATE CLUTCH ACCUMULATOR

SECOND CLUTCH ACCUMULATOR

1-2 SHIFT VALVE

1-2 SHIFT CONTROL VALVE

1-2 SHIFT SOLENOID VALVE N/C (A) OFF

2-3 SHIFT VALVE CNTRL

2-3 SHIFT SOLENOID VALVE N/C (B) OFF

4-5 SHIFT VLV CNTRL

4-5 SHIFT SOLENOID VALVE N/C (C) ON

REVERSE LOCKOUT VALVE

MANUAL VALVE

P R N D 4 3 2

FLUID FILTER ASSEMBLY (59)

FLUID PAN (62)

CASE (24)
TOP CHANNEL PLATE (301)
GASKET (303)
BOTTOM CHANNEL PLATE (304)
GASKET (305)
SPACER PLATE (307)
GASKET (309)
FRONT CONTROL VALVE BODY (311)
REAR CONTROL VALVE BODY (310)

PRESSURES
- INTAKE & DECREASE (SUCTION)
- CONVERTER & LUBE
- MAINLINE
- REGULATED LINE
- SOLENOID SIGNAL
- ACCUMULATOR
- FEED LIMIT
- THROTTLE SIGNAL

Figure 94

OVERDRIVE RANGE – FOURTH GEAR

NO FOURTH GEAR

- Direct Clutch Piston (406)
  - Leaking
  - Cracked or jammed
- Direct Clutch Housing Ball Check Valve (405)
  - Leaking
- Direct Clutch Accumulator
  - Leaking
- 1-2 Shift Solenoid Valve (368)
  - Stuck On
- 3-4 Shift Valve (345)
  - Stuck
- Reverse Clutch Housing Seal Ring (200)
  - Leaking

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	ON	APPLIED		APPLIED	APPLIED	LD			APPLIED			APPLIED		

LD = LOCKED IN DRIVE

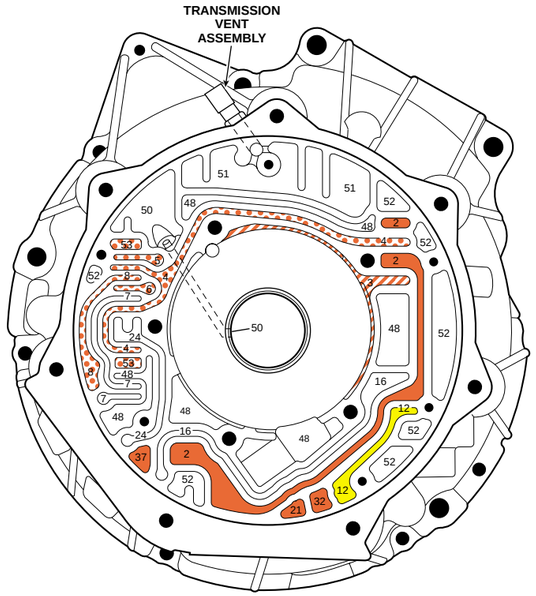
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

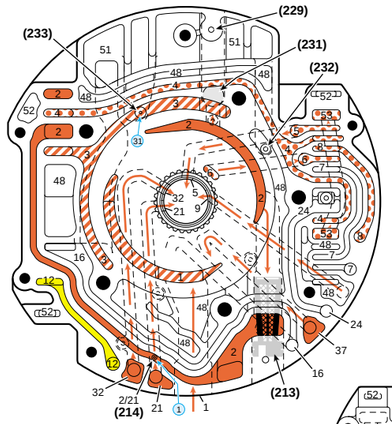
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

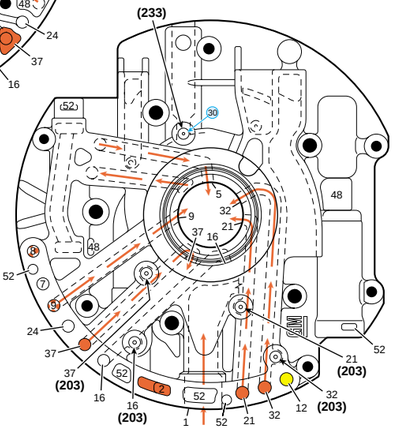
OVERDRIVE RANGE – FOURTH GEAR



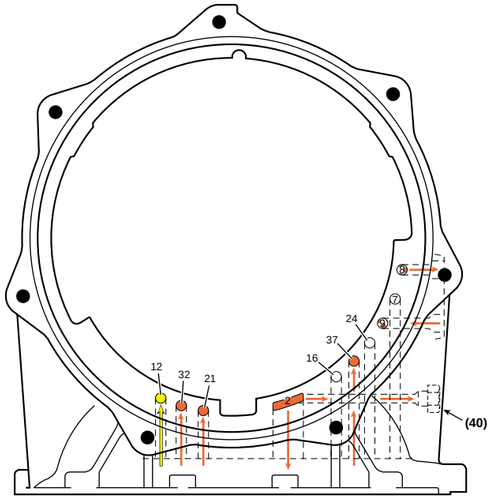
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



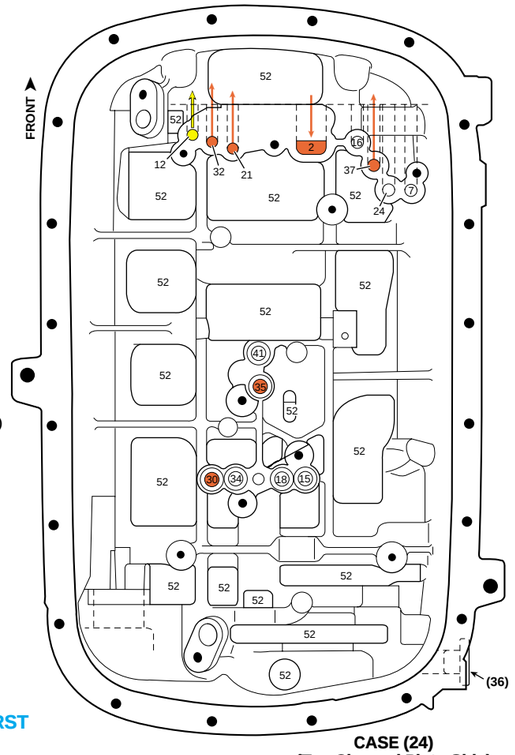
FLUID PUMP COVER (202)
(Case Side)



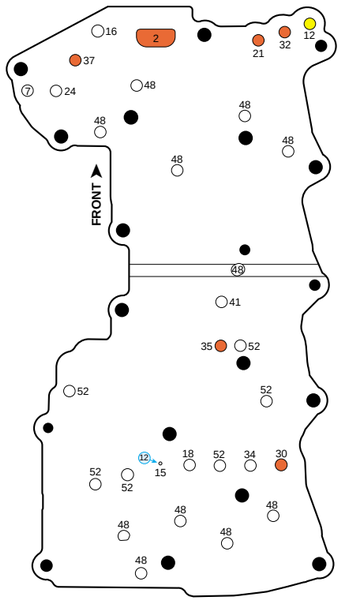
CASE (24)
(Fluid Pump Cover Side)

NOTE:

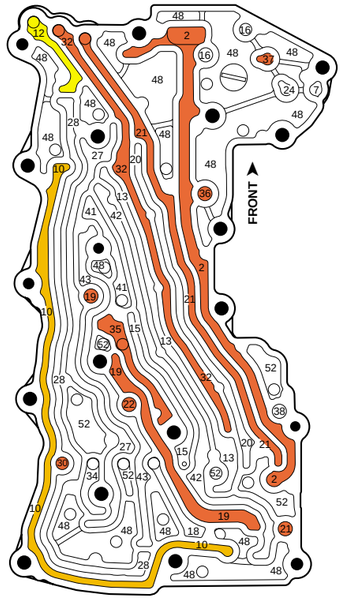
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



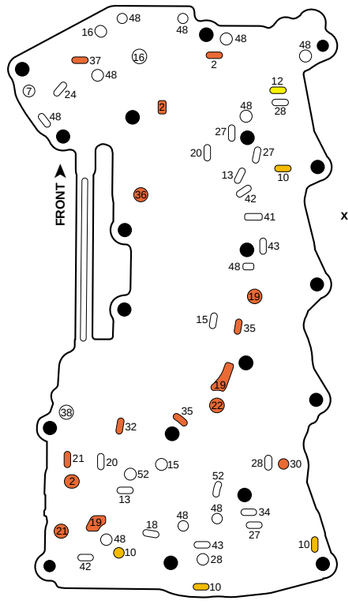
CASE (24)
(Top Channel Plate Side)



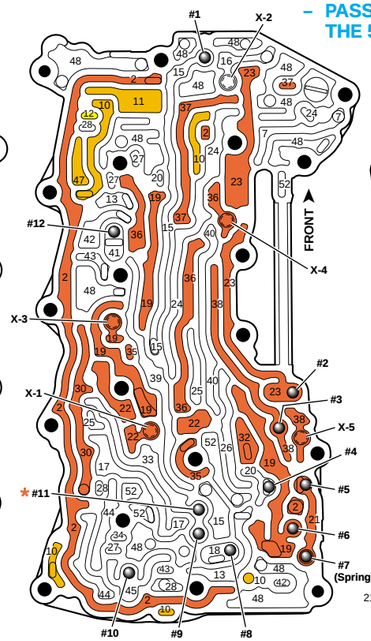
TOP CHANNEL PLATE (301)
(Case Side)



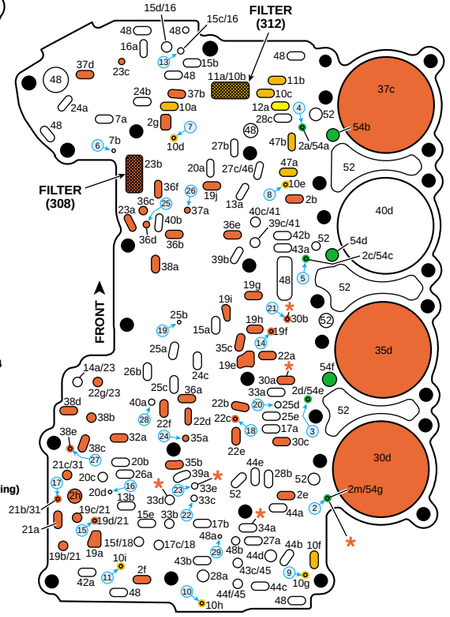
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



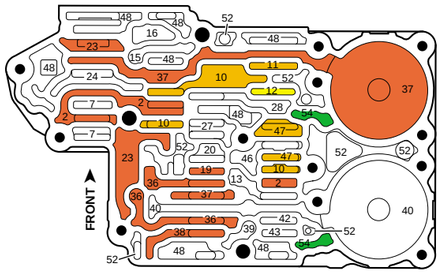
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



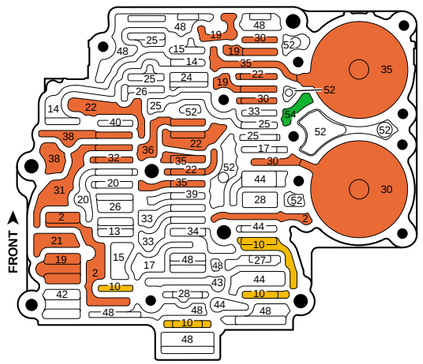
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 95

FOLDOUT ➤ 99

OVERDRIVE RANGE – FIFTH GEAR (Torque Converter Clutch Released)

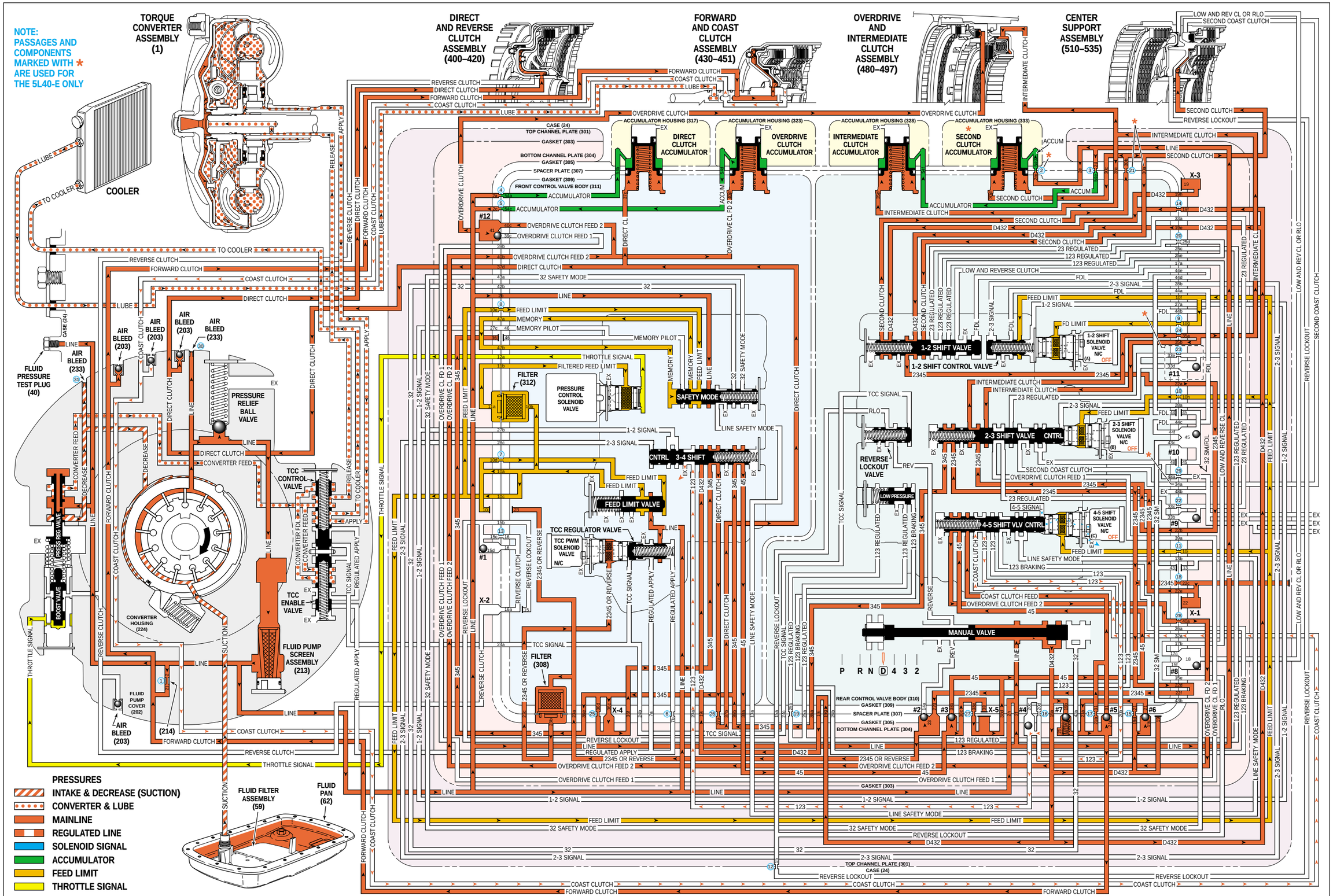


Figure 96

OVERDRIVE RANGE – FIFTH GEAR
(Torque Converter Clutch Released)

NO FIFTH GEAR

- Overdrive Clutch Piston (487)
  - Leaking
  - Cracked or jammed
- #12 Ball Check Valve
  - Stuck
  - Missing
- 4-5 Shift Solenoid Valve (376)
  - Stuck On
- 4-5 Shift Valve (374)
  - Stuck
- 4-5 Shift Control Valve (375)
  - Stuck
- Overdrive Accumulator
  - Leaking
- Fluid Passage Sleeve (39)
  - Leaking

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF	APPLIED			APPLIED		APPLIED		APPLIED			APPLIED		

LD = LOCKED IN DRIVE

OVERDRIVE RANGE – FIFTH GEAR
(Torque Converter Clutch Released)

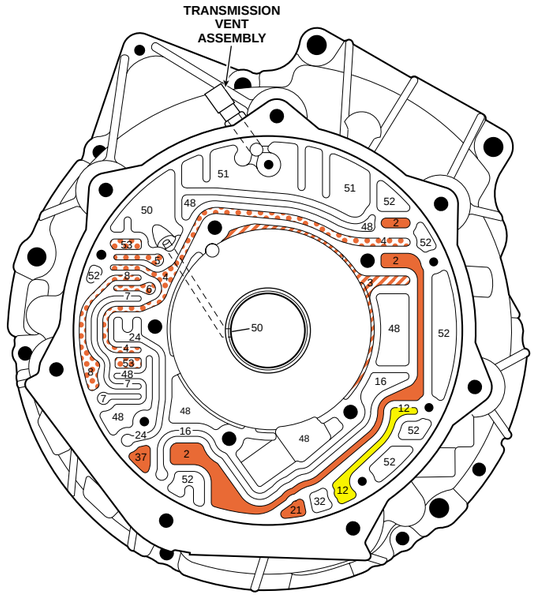
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

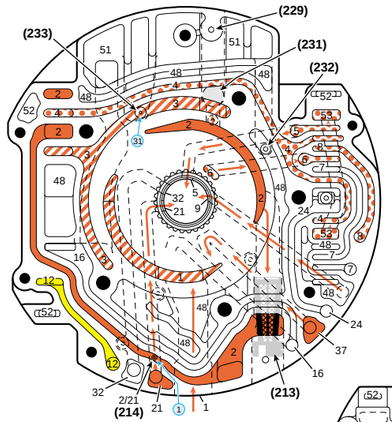
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

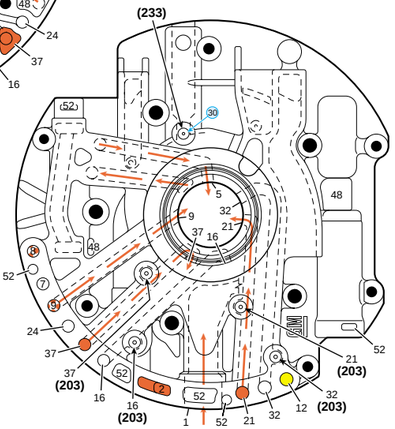
OVERDRIVE RANGE – FIFTH GEAR (Torque Converter Clutch Released)



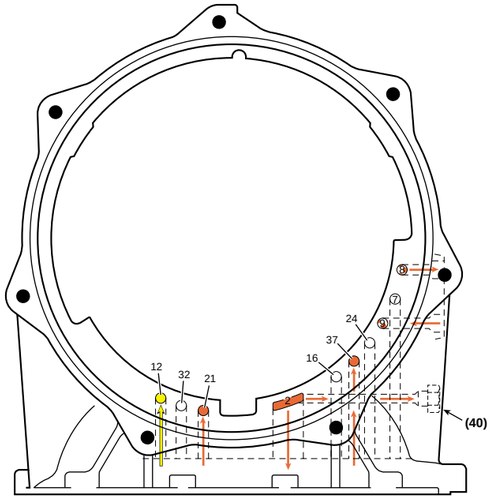
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



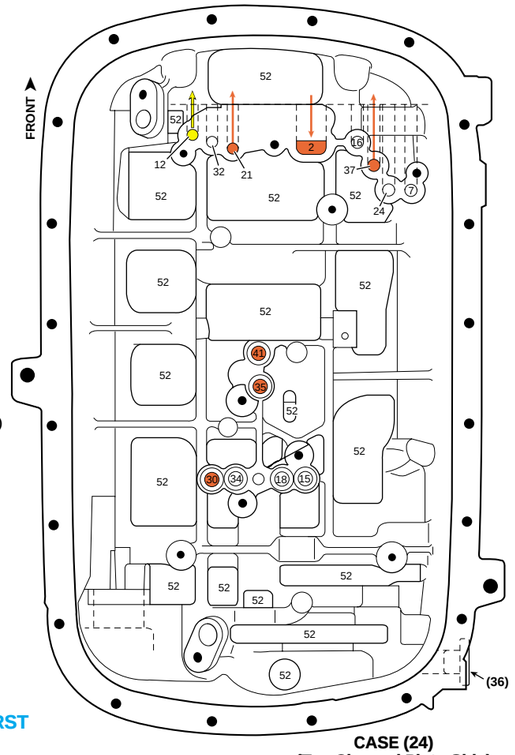
FLUID PUMP COVER (202)
(Case Side)



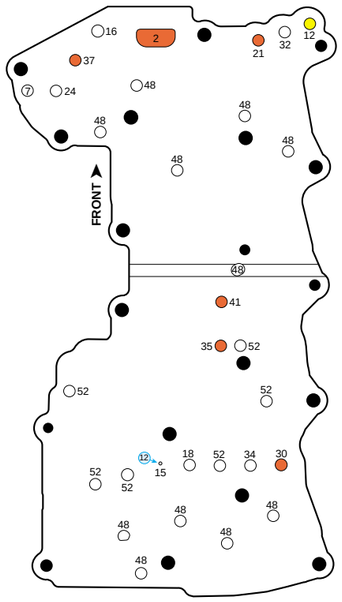
CASE (24)
(Fluid Pump Cover Side)

NOTE:

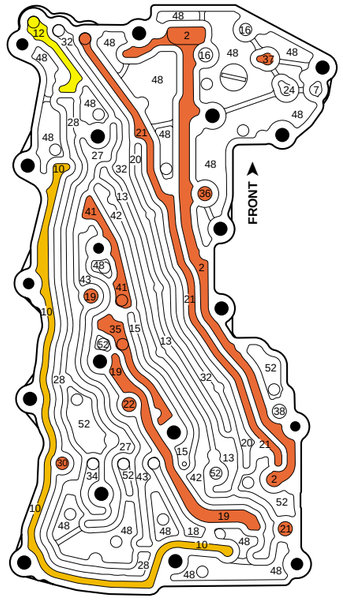
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



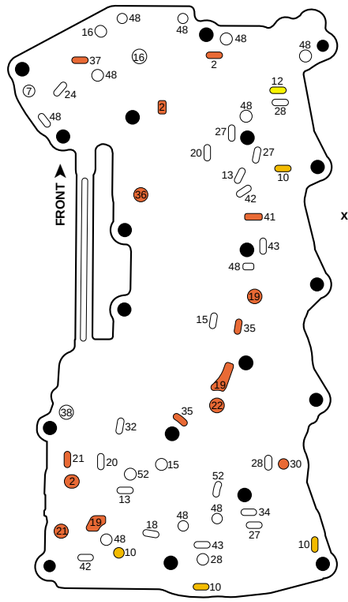
CASE (24)
(Top Channel Plate Side)



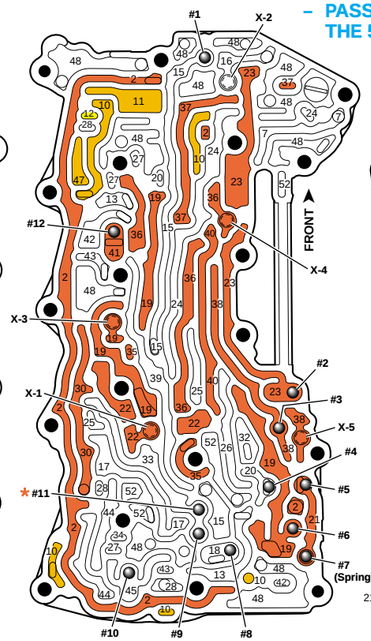
TOP CHANNEL PLATE (301)
(Case Side)



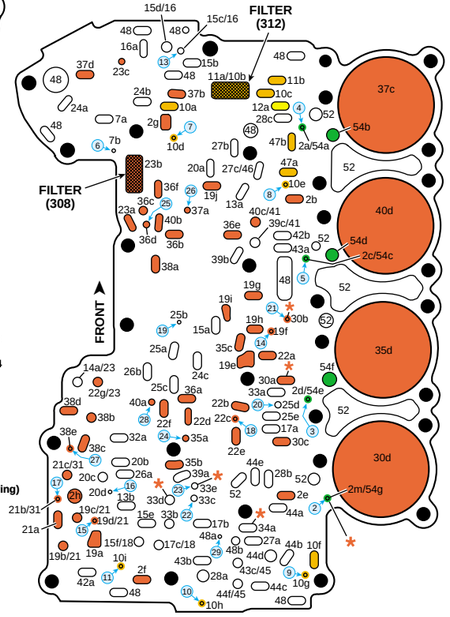
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



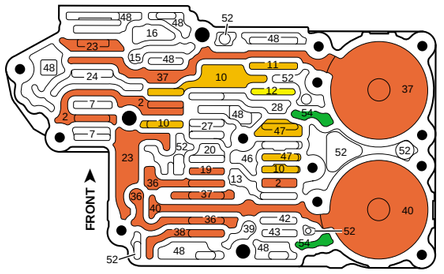
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



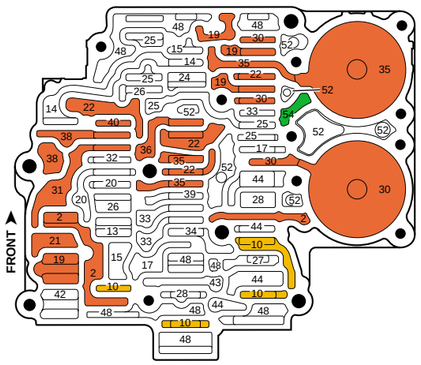
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 97

FOLDOUT ➤ 101

OVERDRIVE RANGE – FIFTH GEAR (Torque Converter Clutch Applied)

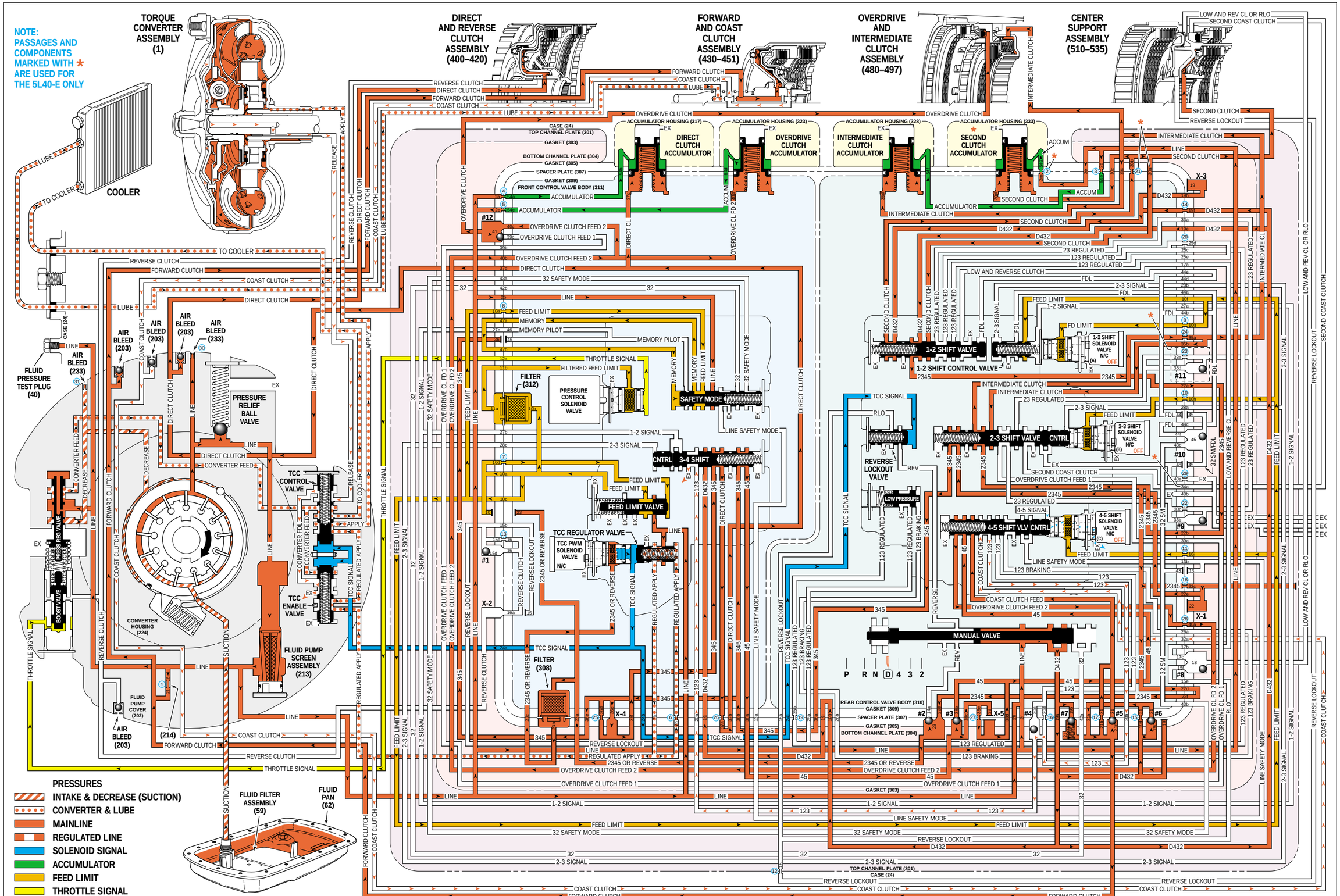


Figure 98

OVERDRIVE RANGE – FIFTH GEAR
(Torque Converter Clutch Applied)

The torque converter clutch (TCC) applies during Fifth gear operation when the transmission control module (TCM) receives the appropriate input signals to energize (turn ON) the Torque Converter Clutch Pulse Width Modulated (TCC PWM) solenoid valve.

NO TCC APPLY

- TCC PWM Solenoid Valve (352)
  - Stuck Off
  - Leaking
  - No voltage to the solenoid
  - Poor connection
- TCC Regulator Apply Valve (348)
  - Stuck
- Input Shaft Fluid Seal (432)
  - Leaking
- TCC Control Valve (235)
  - Stuck in Off position
- TCC Enable Valve (237)
  - Stuck in Off position
- #2 Ball Check Valve
  - Stuck
  - Missing

TCC STUCK ON

- TCC PWM Solenoid Valve (352)
  - Stuck On
- TCC Regulator Apply Valve (348)
  - Stuck

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	OFF	APPLIED			APPLIED		APPLIED		APPLIED			APPLIED		

LD = LOCKED IN DRIVE

OVERDRIVE RANGE – FIFTH GEAR
(Torque Converter Clutch Applied)

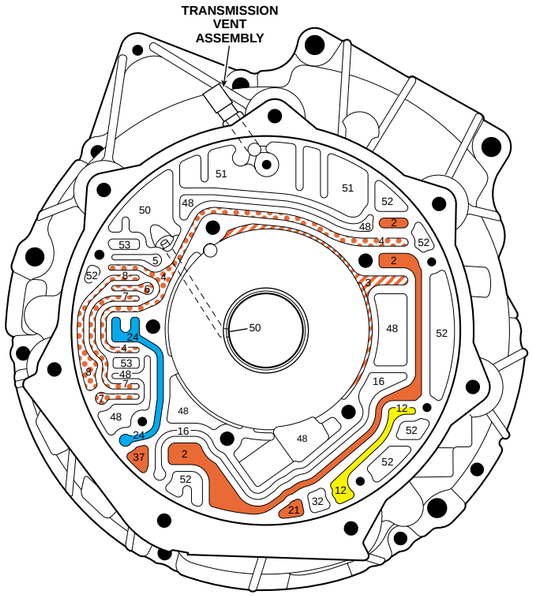
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

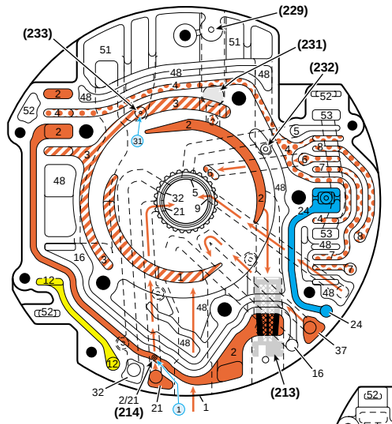
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

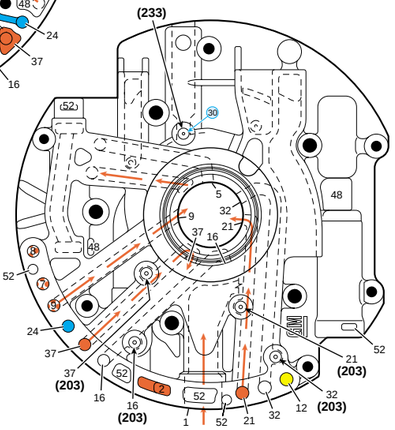
OVERDRIVE RANGE – FIFTH GEAR (Torque Converter Clutch Applied)



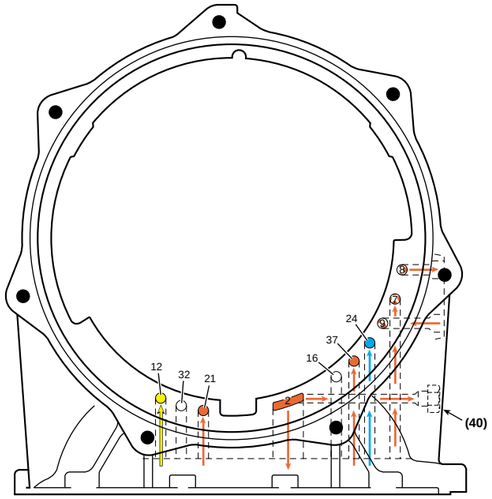
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



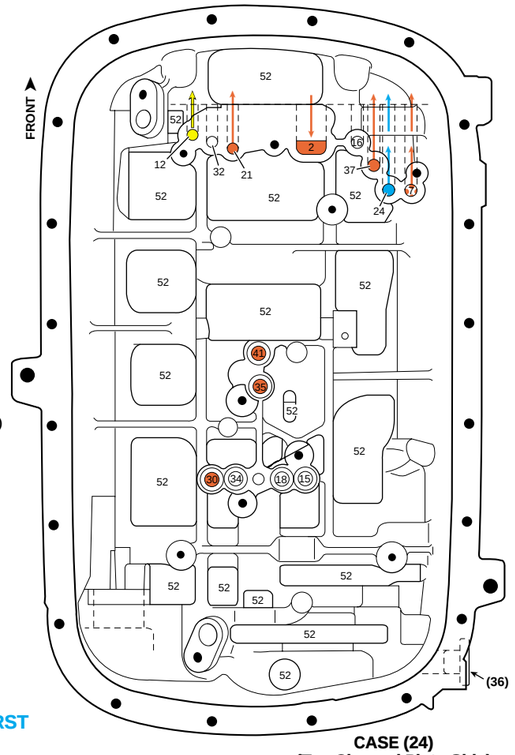
FLUID PUMP COVER (202)
(Case Side)



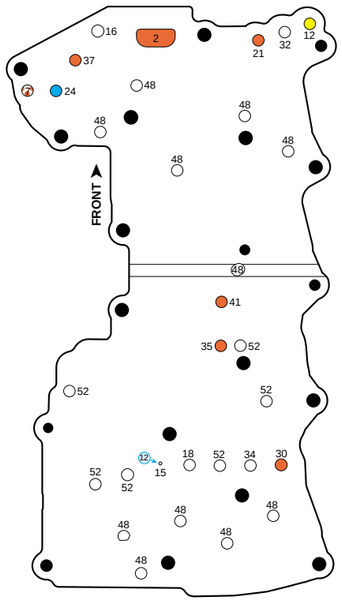
CASE (24)
(Fluid Pump Cover Side)

NOTE:

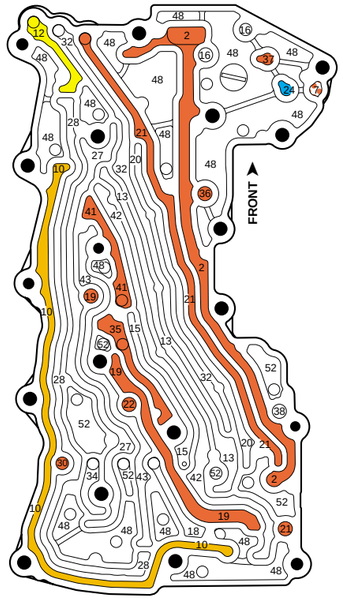
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



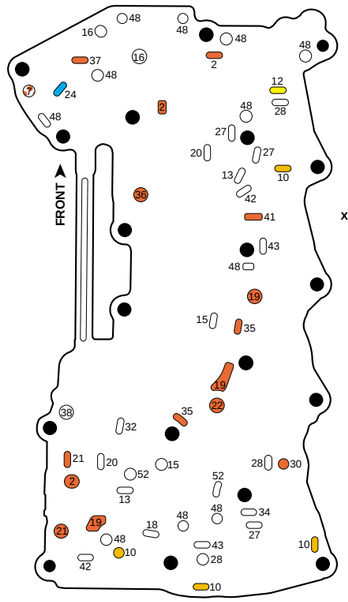
CASE (24)
(Top Channel Plate Side)



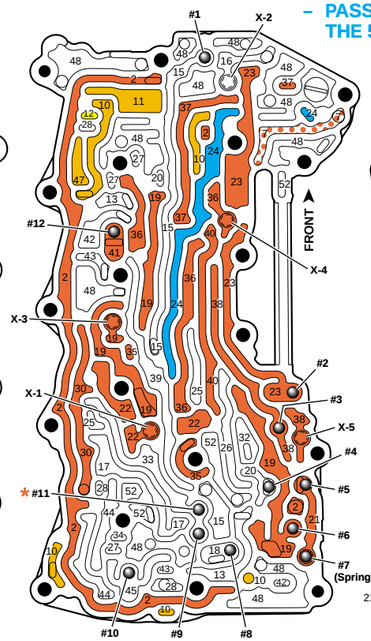
TOP CHANNEL PLATE (301)
(Case Side)



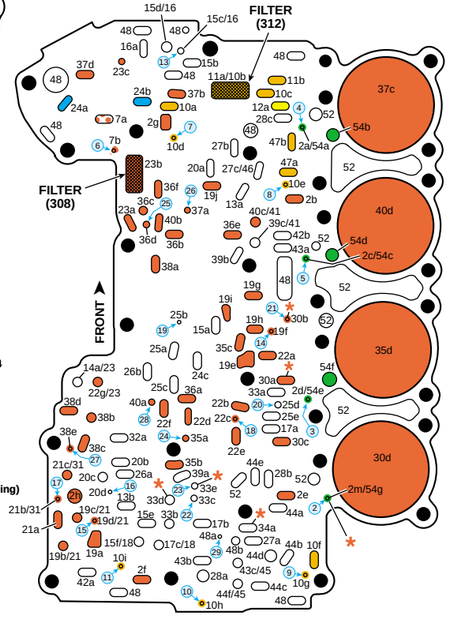
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



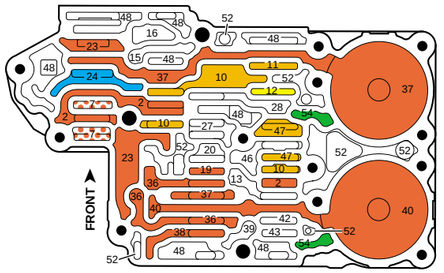
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



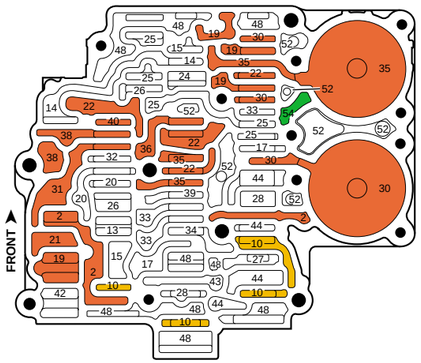
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 99

FOLDOUT ➤ 103

MANUAL FOURTH – FOURTH GEAR (from Overdrive Range – Fifth Gear)

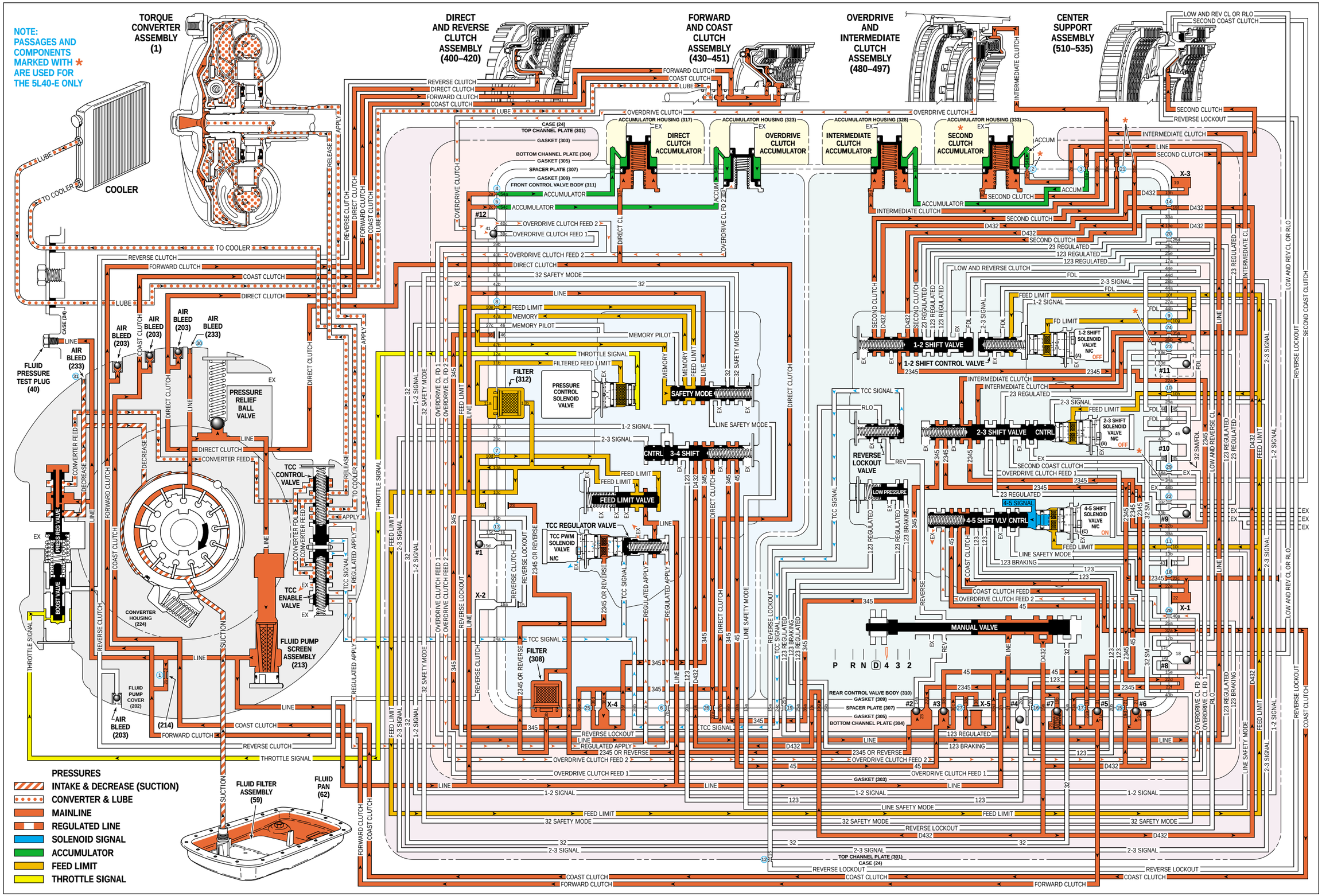


Figure 100

MANUAL FOURTH – FOURTH GEAR
(from Overdrive Range – Fifth Gear)

A manual 5-4 downshift can be accomplished by moving the gear selector lever into the Manual Fourth position (4) when the transmission is operating in Overdrive Range – Fifth Gear (D).

NO FOURTH GEAR

- 4-5 Shift Solenoid Valve (376)
  - Stuck Off
  - Leaking
  - No voltage to the solenoid
- 4-5 Shift Valve (374)
  - Stuck
- 4-5 Shift Control Valve (375)
  - Stuck
- Coast Clutch Piston (438)
  - Leaking
  - Cracked or jammed
- Coast Clutch Piston Ball Check Valve (437)
  - Leaking
- Input Shaft Fluid Seal Ring (432)
  - Leaking

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	OFF	ON	APPLIED		APPLIED	APPLIED	LD			APPLIED			APPLIED		

LD = LOCKED IN DRIVE

MANUAL FOURTH – FOURTH GEAR
(from Overdrive Range – Fifth Gear)

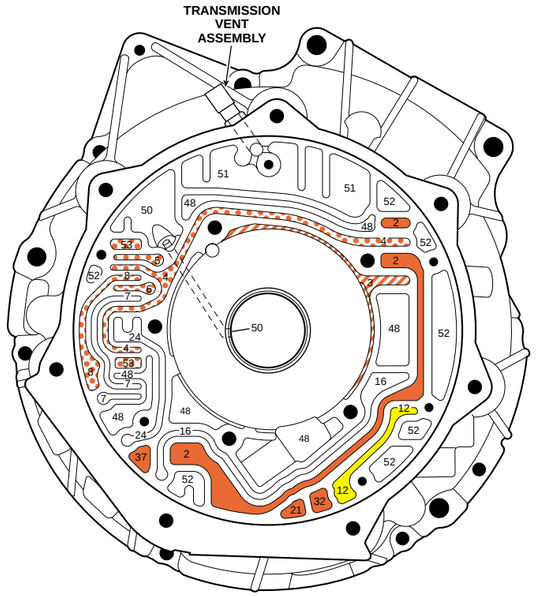
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

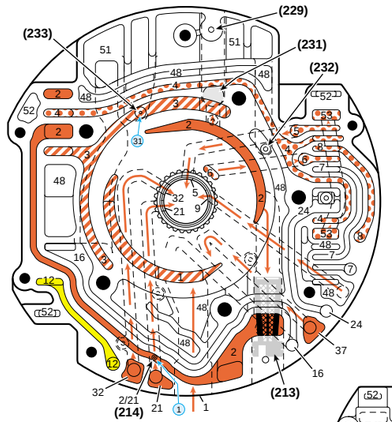
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

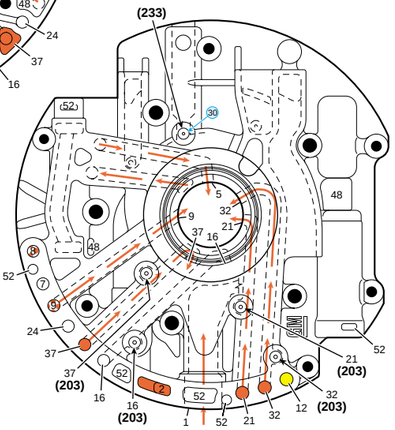
MANUAL FOURTH – FOURTH GEAR (from Overdrive Range – Fifth Gear)



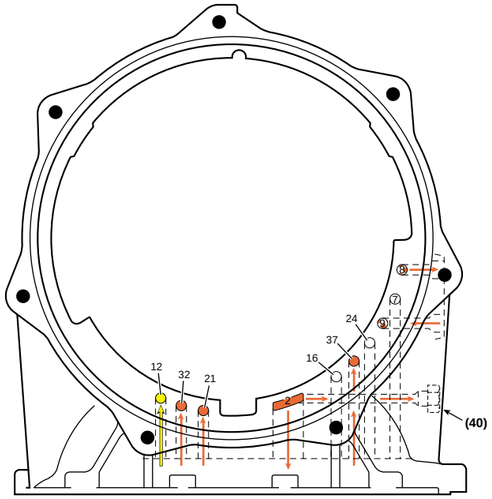
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



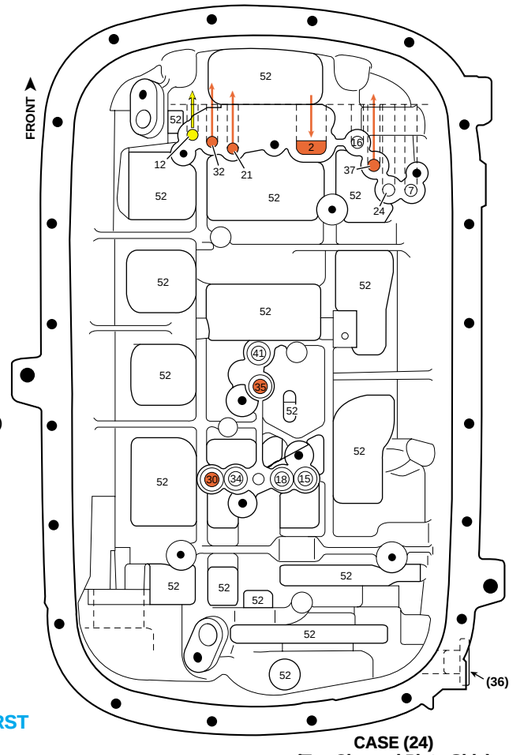
FLUID PUMP COVER (202)
(Case Side)



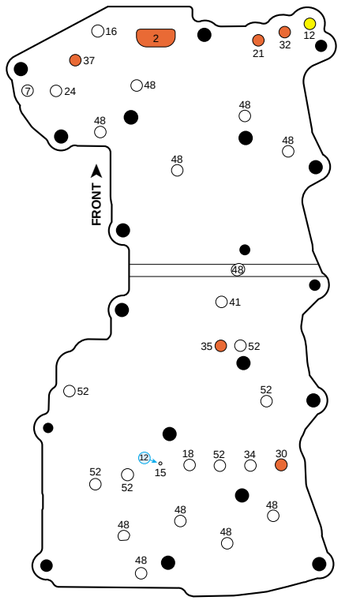
CASE (24)
(Fluid Pump Cover Side)

NOTE:

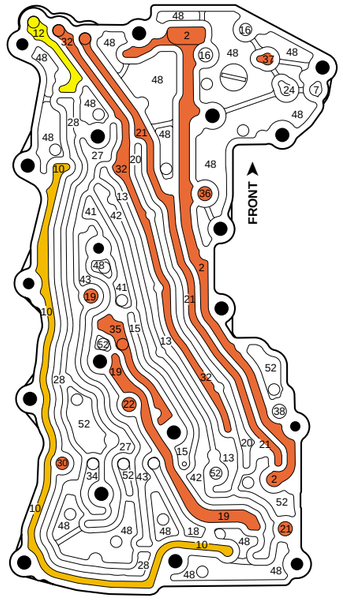
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



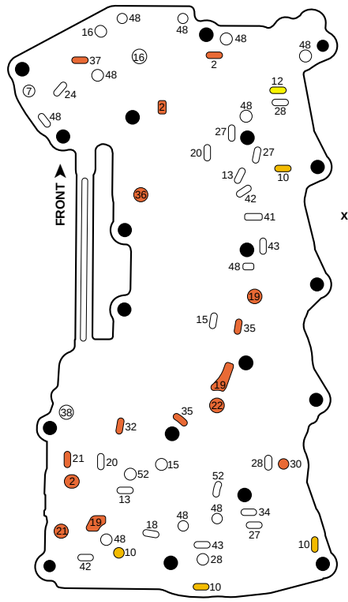
CASE (24)
(Top Channel Plate Side)



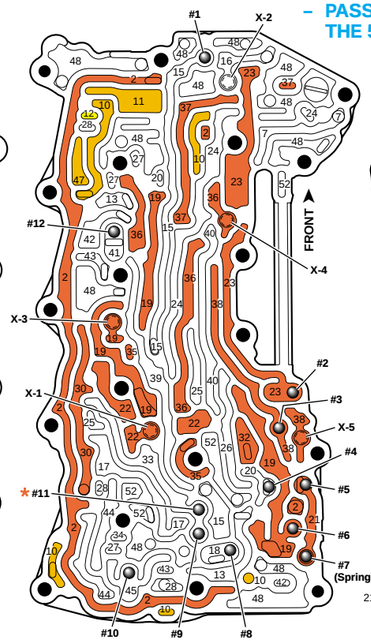
TOP CHANNEL PLATE (301)
(Case Side)



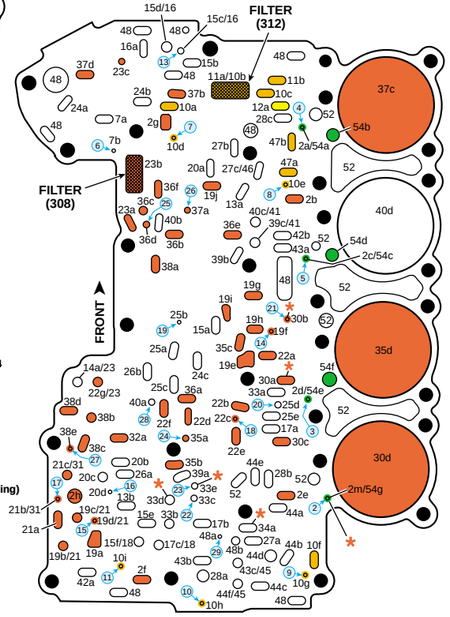
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



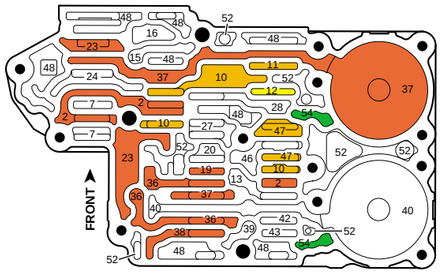
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



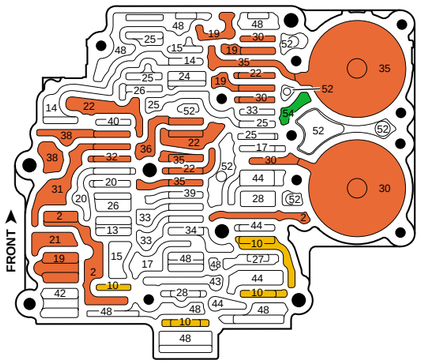
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 101

FOLDOUT ➤ 105

MANUAL THIRD – THIRD GEAR (from Manual Fourth – Fourth Gear)

NOTE:
PASSAGES AND COMPONENTS MARKED WITH * ARE USED FOR THE 5L40-E ONLY

TORQUE CONVERTER ASSEMBLY (1)

DIRECT AND REVERSE CLUTCH ASSEMBLY (400–420)

FORWARD AND COAST CLUTCH ASSEMBLY (430–451)

OVERDRIVE AND INTERMEDIATE CLUTCH ASSEMBLY (480–497)

CENTER SUPPORT ASSEMBLY (510–535)

COOLER

FLUID PRESSURE TEST PLUG (40)

PRESSURE RELIEF BALL VALVE

TCC CONTROL VALVE

TCC ENABLE VALVE

BOOST VALVE

PRESS REG VALVE

CONVERTER HOUSING (224)

FLUID PUMP SCREEN ASSEMBLY (213)

FLUID PUMP COVER (202)

FILTER (312)

PRESSURE CONTROL SOLENOID VALVE

FEED LIMIT VALVE

TCC REGULATOR VALVE

TCC PWM SOLENOID VALVE N/C

FILTER (308)

DIRECT CLUTCH ACCUMULATOR

OVERDRIVE CLUTCH ACCUMULATOR

INTERMEDIATE CLUTCH ACCUMULATOR

SECOND CLUTCH ACCUMULATOR

1-2 SHIFT VALVE

1-2 SHIFT CONTROL VALVE

1-2 SHIFT SOLENOID VALVE N/C (A) ON

2-3 SHIFT VALVE CNTRL

2-3 SHIFT SOLENOID VALVE N/C (B) OFF

3-4 SHIFT CNTRL

4-5 SHIFT VLV CNTRL

4-5 SHIFT SOLENOID VALVE N/C (C) ON

REVERSE LOCKOUT VALVE

LOW PRESSURE

MANUAL VALVE

P R N D 4 3 2

FLUID FILTER ASSEMBLY (59)

FLUID PAN (62)

CASE (24)
TOP CHANNEL PLATE (301)
GASKET (303)
BOTTOM CHANNEL PLATE (304)
GASKET (305)
SPACER PLATE (307)
GASKET (309)
FRONT CONTROL VALVE BODY (311)
REAR CONTROL VALVE BODY (310)

PRESSURES
- INTAKE & DECREASE (SUCTION)
- CONVERTER & LUBE
- MAINLINE
- REGULATED LINE
- SOLENOID SIGNAL
- ACCUMULATOR
- FEED LIMIT
- THROTTLE SIGNAL

Figure 102

MANUAL THIRD – THIRD GEAR
(from Manual Fourth – Fourth Gear)

A manual 4-3 downshift can be accomplished by moving the gear selector lever into the Manual Third (3) position when the transmission is operating in Fourth gear. This causes the transmission to shift into Third gear and prevents the transmission from upshifting to either Fourth or Fifth gears.

NO THIRD GEAR

- 1-2 Shift Solenoid Valve (368)
  - Stuck Off
  - Leaking
  - No voltage to solenoid
- 3-4 Shift Valve (345)
  - Stuck

NO ENGINE BRAKING

- 4-5 Shift Solenoid Valve (376)
  - Leaking
  - No voltage to solenoid
- Low Pressure Control Valve (383)
  - Stuck
- #12 Ball Check Valve
  - Stuck
  - Missing
- Fluid Passage Sleeve (39)
  - Leaking
- Overdrive Clutch Piston (487)
  - Leaking
  - Cracked or jammed

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
ON	OFF	ON			APPLIED	APPLIED	LD	APPLIED	LD	APPLIED			APPLIED		

LD = LOCKED IN DRIVE

MANUAL THIRD – THIRD GEAR
(from Manual Fourth – Fourth Gear)

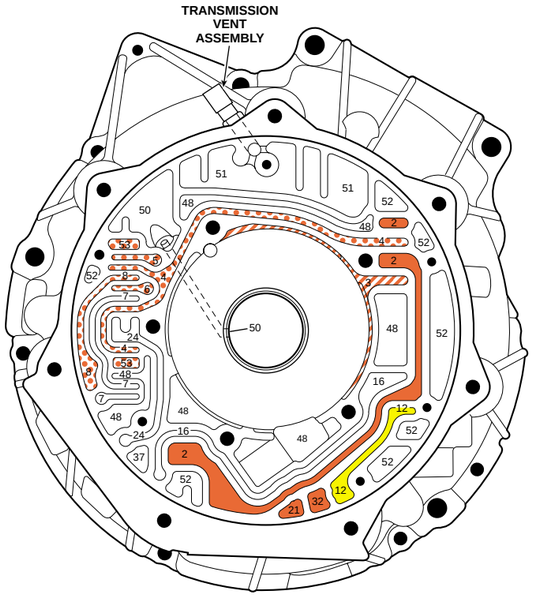
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

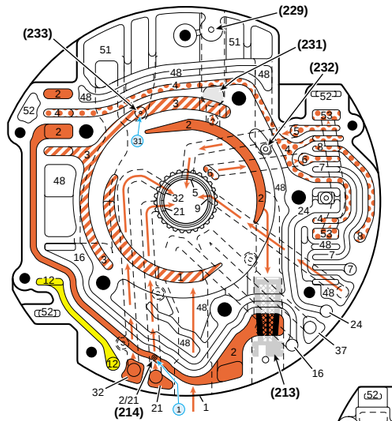
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

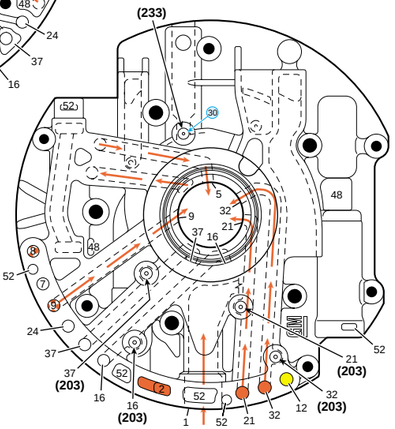
MANUAL THIRD – THIRD GEAR (from Manual Fourth – Fourth Gear)



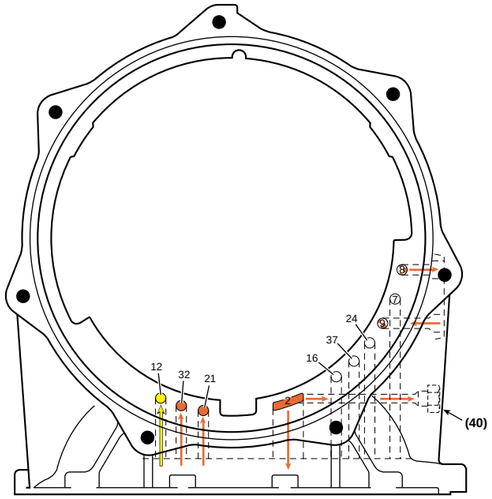
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



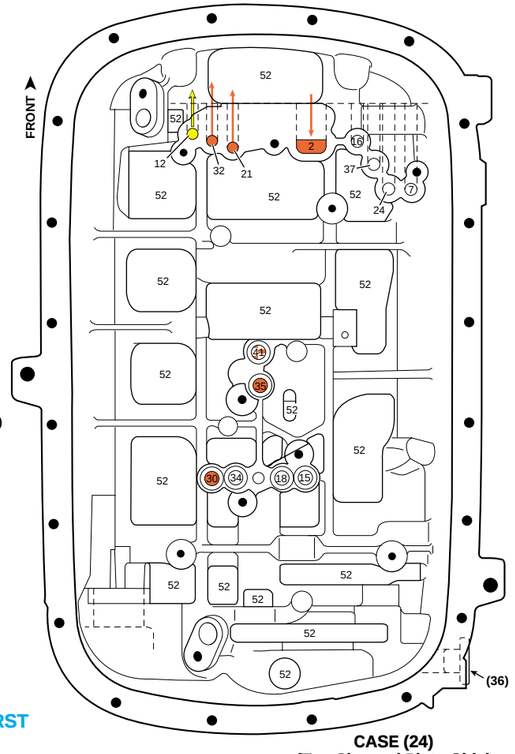
FLUID PUMP COVER (202)
(Case Side)



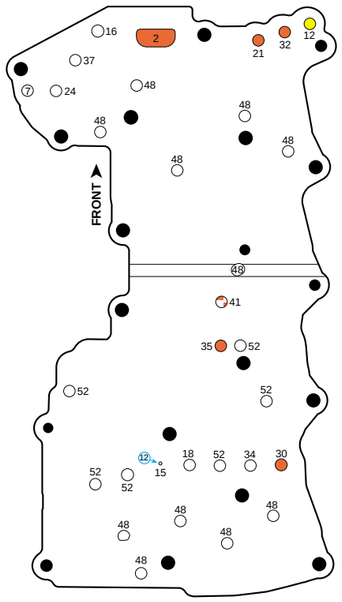
CASE (24)
(Fluid Pump Cover Side)

NOTE:

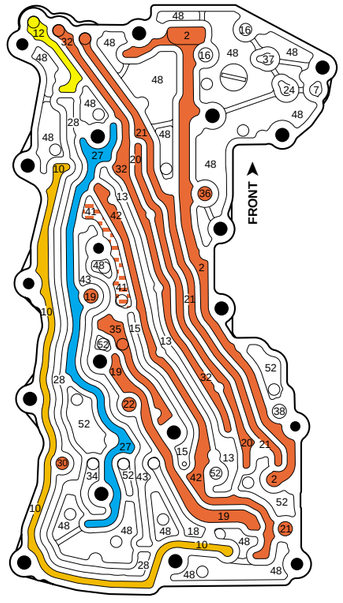
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



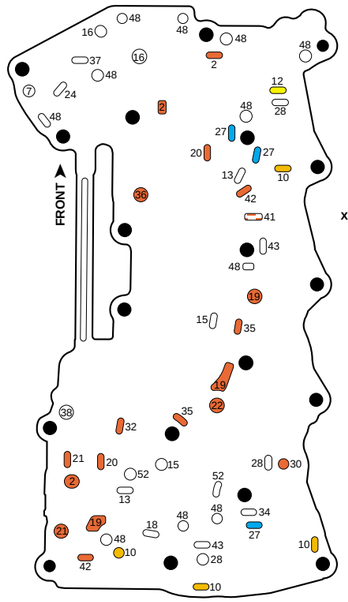
CASE (24)
(Top Channel Plate Side)



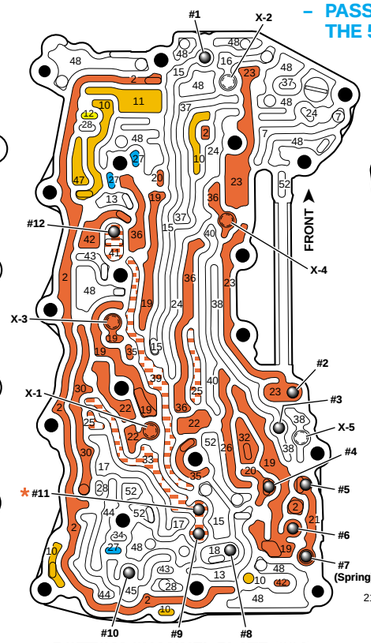
TOP CHANNEL PLATE (301)
(Case Side)



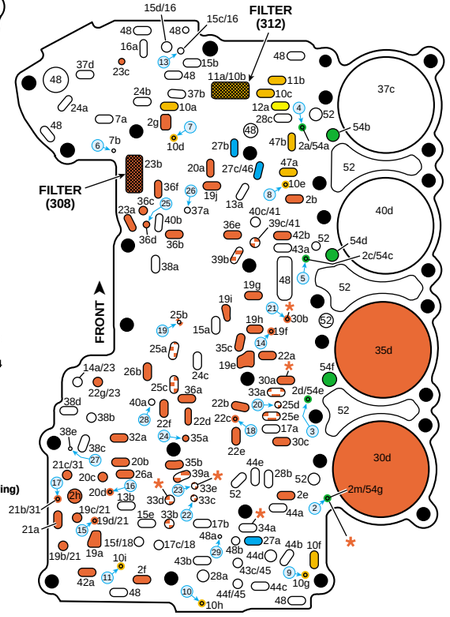
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



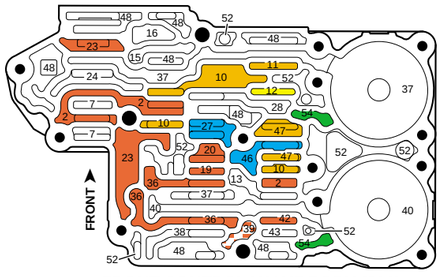
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



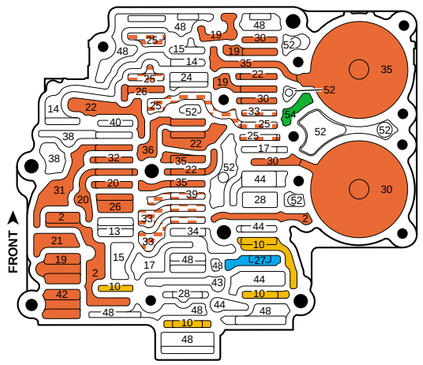
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 103

FOLDOUT ➤ 107

MANUAL SECOND – SECOND GEAR (from Manual Third – Third Gear)

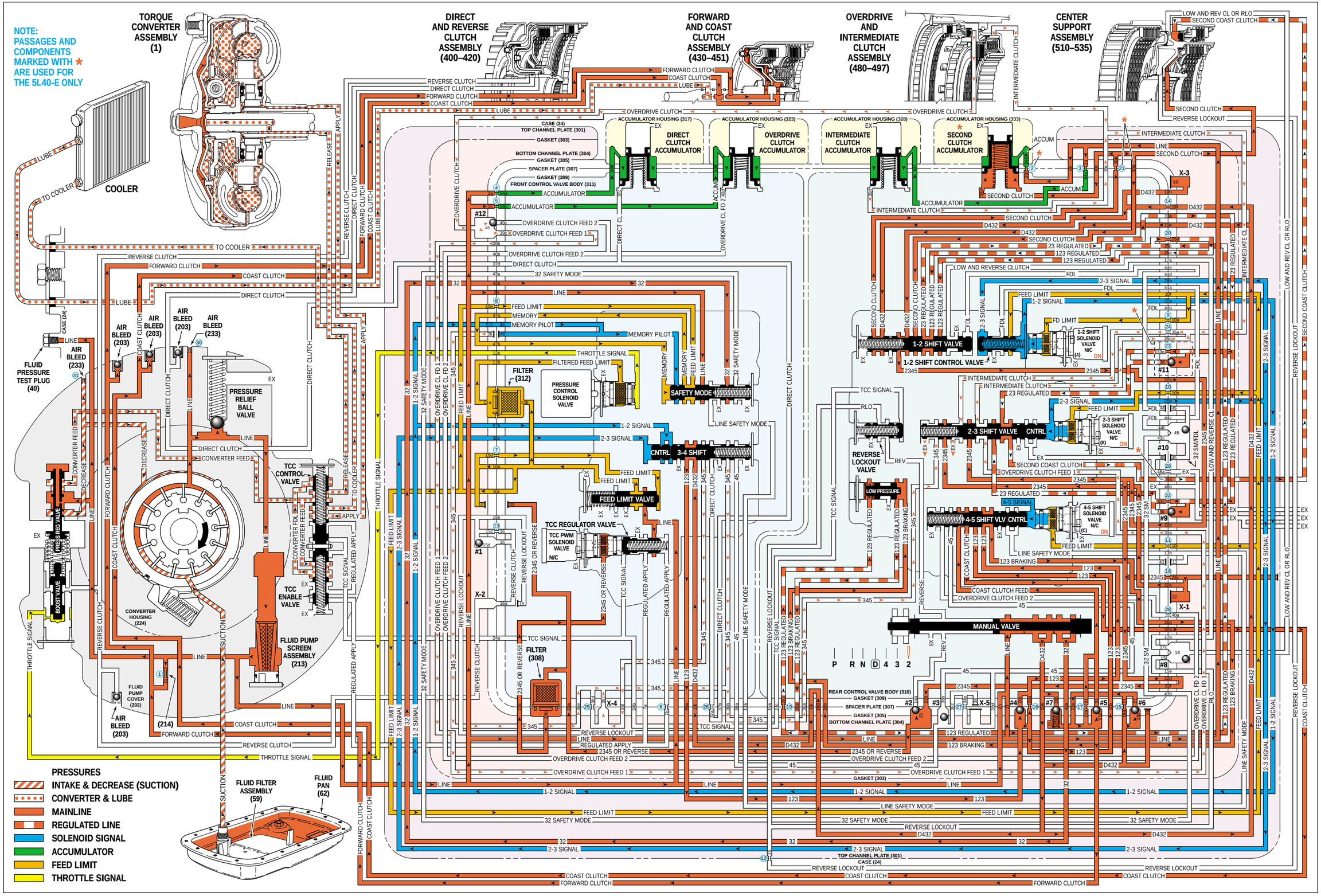


Figure 104

MANUAL SECOND – SECOND GEAR
(from Manual Third – Third Gear)

A manual 3-2 downshift can be accomplished by moving the gear selector lever into the Manual Second (2) position when the transmission is operating in Third gear. This causes the transmission to shift into Second gear and prevents the transmission from upshifting to Third, Fourth or Fifth gears.

NO SECOND GEAR

- 2-3 Shift Solenoid Valve (369)
  - Stuck Off
  - Leaking
  - No voltage to solenoid
- 2-3 Shift Valve (371)
  - Stuck
- 2-3 Shift Control Valve (370)
  - Stuck

NO ENGINE BRAKING

- Center Support (518)
  - Cracked
  - Feed hole blocked
- Fluid Passage Sleeve (38)
  - Leaking
- Second Coast Clutch Piston (528)
  - Cracked or jammed
  - Leaking seals
- 4-5 Shift Solenoid Valve (376)
  - Leaking
  - No voltage to solenoid
- Low Pressure Control Valve (383)
  - Stuck

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
ON	ON	ON			APPLIED	APPLIED	LD						APPLIED	LD	APPLIED

LD = LOCKED IN DRIVE

MANUAL SECOND – SECOND GEAR
(from Manual Third – Third Gear)

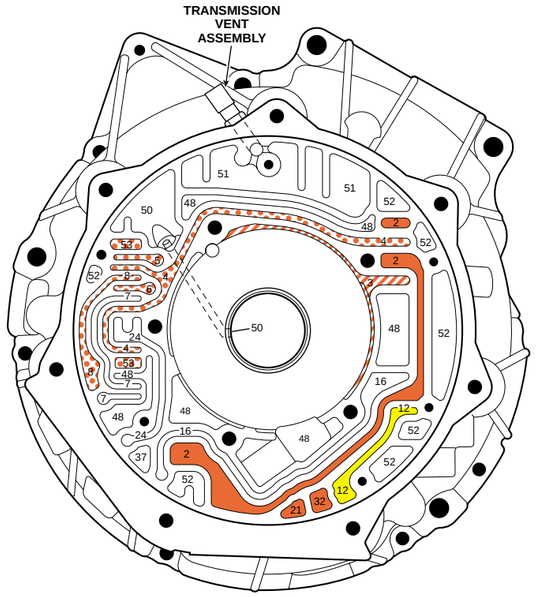
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

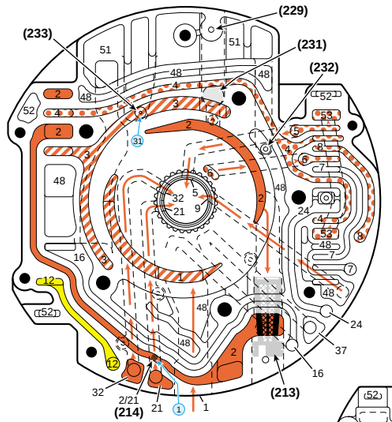
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

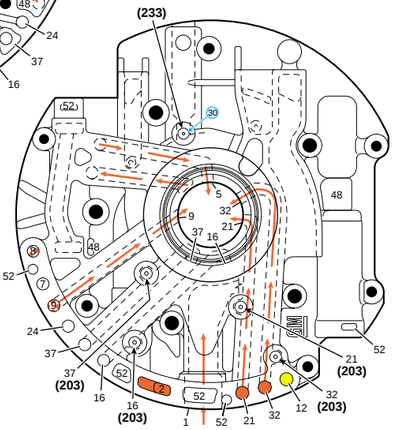
MANUAL SECOND – SECOND GEAR (from Manual Third – Third Gear)



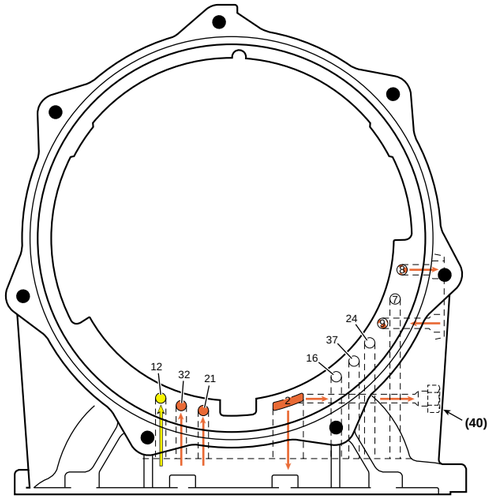
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



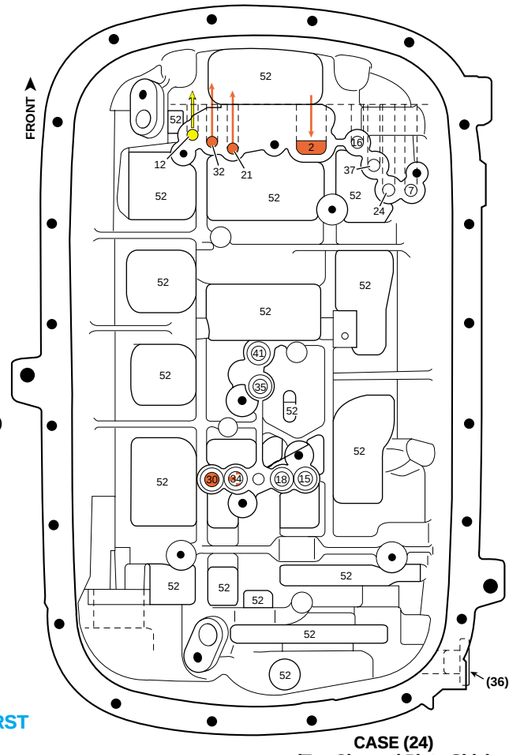
FLUID PUMP COVER (202)
(Case Side)



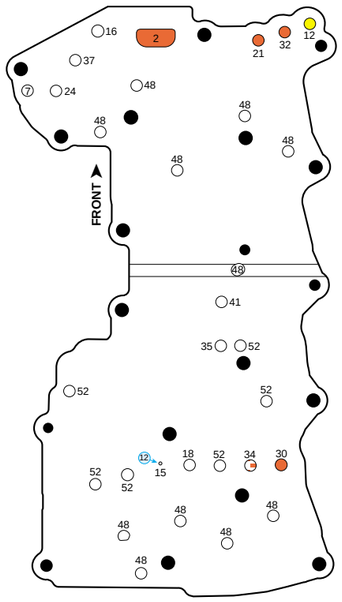
CASE (24)
(Fluid Pump Cover Side)

NOTE:

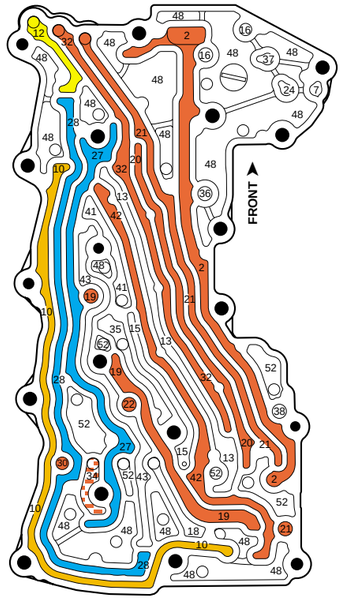
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



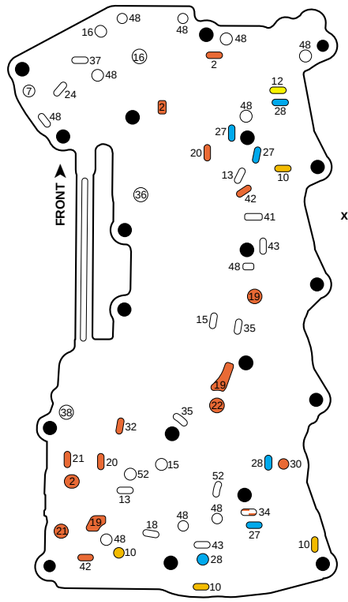
CASE (24)
(Top Channel Plate Side)



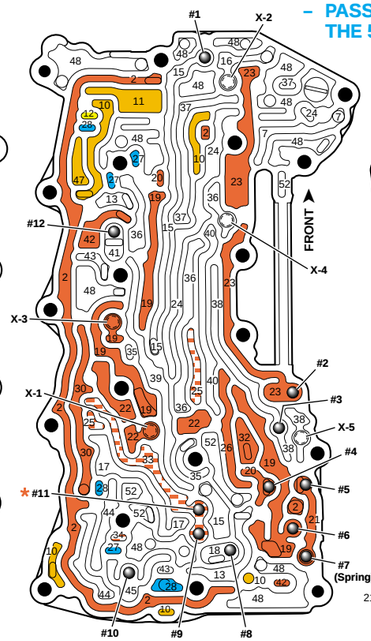
TOP CHANNEL PLATE (301)
(Case Side)



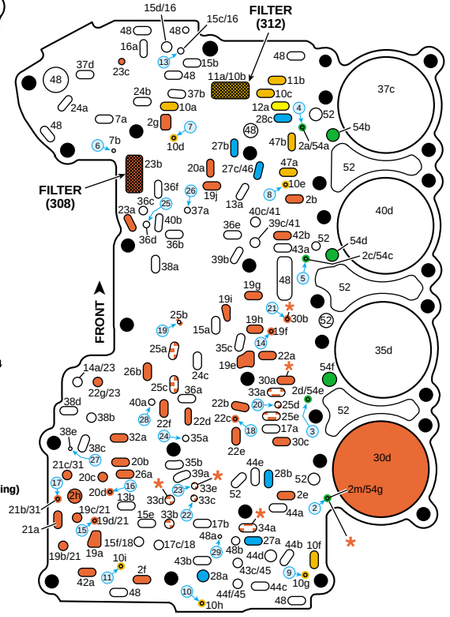
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



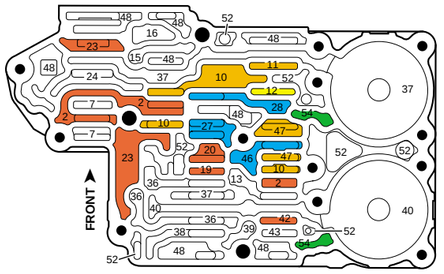
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



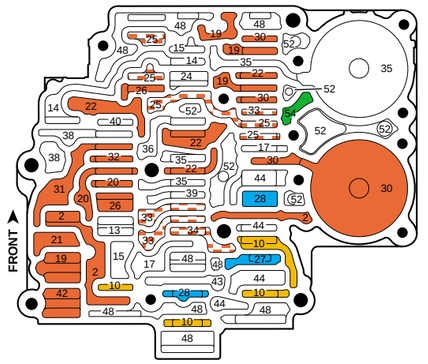
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 105

FOLDOUT ➤ 109

MANUAL SECOND – FIRST GEAR (from Manual Second – Second Gear)

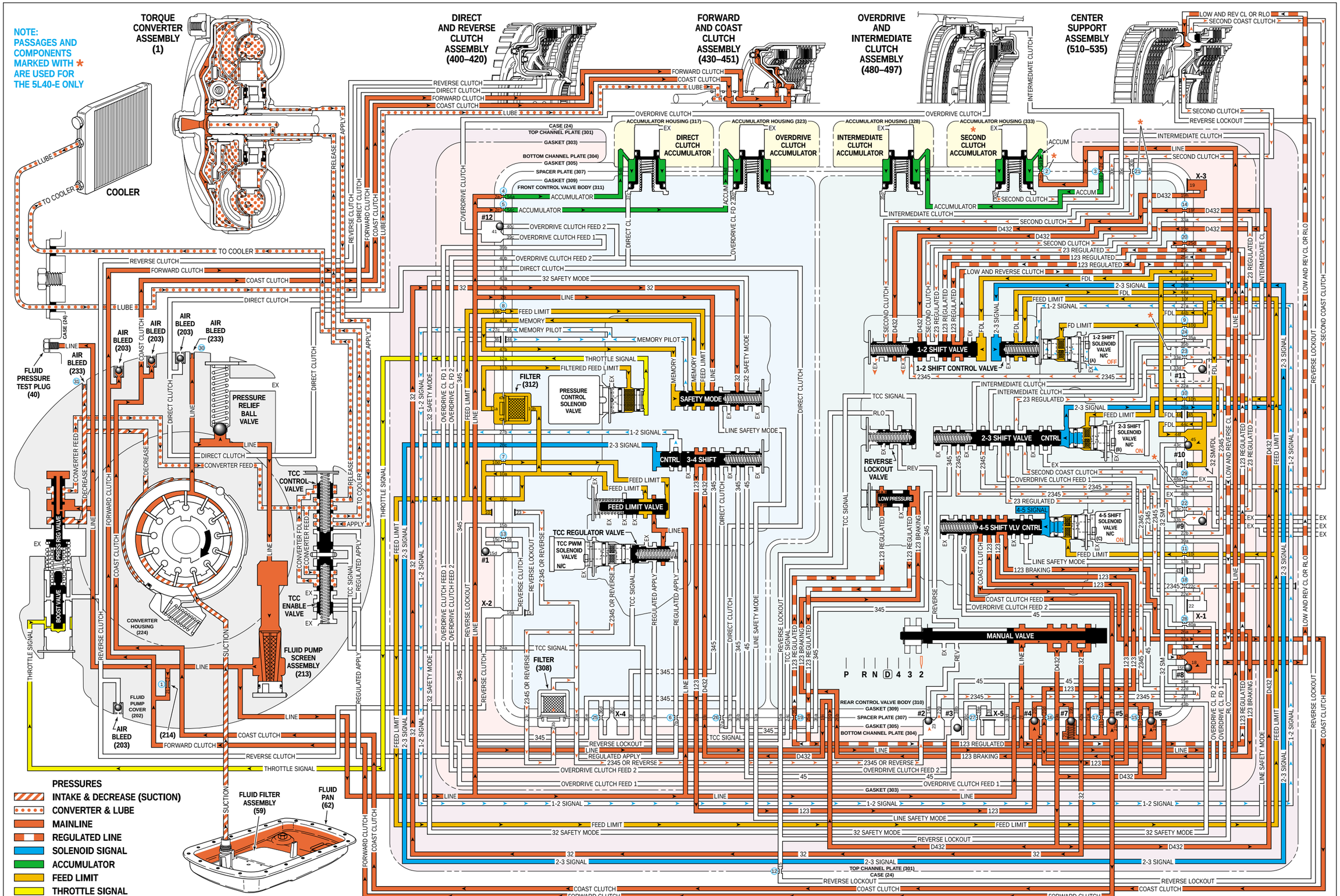


Figure 106

MANUAL SECOND – FIRST GEAR
(from Manual Second – Second Gear)

In Manual Second range, a 2-1 downshift can be commanded by the TCM, if the vehicle speed is low enough not to overrev the engine (calibratable in the TCM). Manual Second – First Gear is commanded in order to achieve maximum engine compression braking for slowing the vehicle.

NO FIRST GEAR

- 1-2 Shift Solenoid Valve (368)
  - Stuck On
- 1-2 Shift Control Valve (366)
  - Stuck
- 1-2 Shift Valve (387)
  - Stuck

NO ENGINE BRAKING

- #8 Ball Check Valve (518)
  - Stuck
  - Missing
- Fluid Passage Sleeve (38)
  - Leaking
- Low and Reverse Clutch Piston (517)
  - Leaking
  - Jammed or cracked
- Center Support (518)
  - Broken
  - Leaking
- 4-5 Shift Solenoid Valve (376)
  - Leaking
  - No voltage to solenoid
- Low Pressure Control Valve (383)
  - Stuck

SOLENOID			DIRECT CLUTCH	REVERSE CLUTCH	COAST CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CLUTCH	OVER-DRIVE CLUTCH	INTERM. SPRAG CLUTCH	INTER-MEDIATE CLUTCH	LOW SPRAG CLUTCH	LOW AND REVERSE CLUTCH	SECOND CLUTCH	SECOND SPRAG CLUTCH	SECOND COAST CLUTCH
1-2	2-3	4-5													
OFF	ON	ON			APPLIED	APPLIED	LD				LD	APPLIED			

LD = LOCKED IN DRIVE

MANUAL SECOND – FIRST GEAR
(from Manual Second – Second Gear)

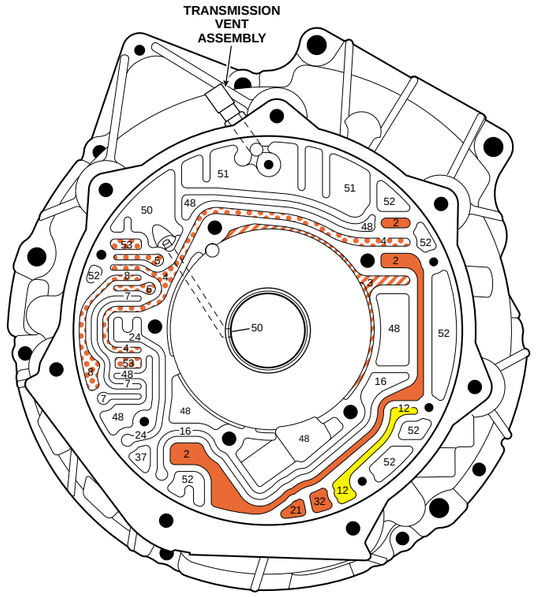
PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 RELEASE
6 APPLY
7 REGULATED APPLY
8 TO COOLER
9 LUBE
10 FEED LIMIT
11 FILTERED FEED LIMIT
12 THROTTLE SIGNAL
13 LINE SAFETY MODE
14 REVERSE
15 REVERSE LOCK OUT (RLO)
16 REVERSE CLUTCH
17 LOW AND REVERSE CLUTCH
18 LOW AND REVERSE CLUTCH OR RLO
19 D432
20 123
21 FORWARD CLUTCH
22 2345
23 2345 OR REVERSE
24 TCC SIGNAL
25 123 REGULATED
26 123 BRAKING
27 1-2 SIGNAL
28 2-3 SIGNAL
29 4-5 SIGNAL
30 SECOND CLUTCH
31 COAST CLUTCH FEED
32 COAST CLUTCH
33 23 REGULATED
34 SECOND COAST CLUTCH
35 INTERMEDIATE CLUTCH
36 345
37 DIRECT CLUTCH
38 45
39 OVERDRIVE CLUTCH FEED 1
40 OVERDRIVE CLUTCH FEED 2
41 OVERDRIVE CLUTCH
42 32
43 32 SAFETY MODE
44 FDL
45 32 SAFETY MODE/FDL
46 MEMORY PILOT
47 MEMORY
48 EXHAUST
49 OIL RESERVOIR
50 TORQUE CONVERTER SEAL DRAINBACK
51 VENT
52 VOID
53 CONVERTER FDL
54 ACCUMULATOR

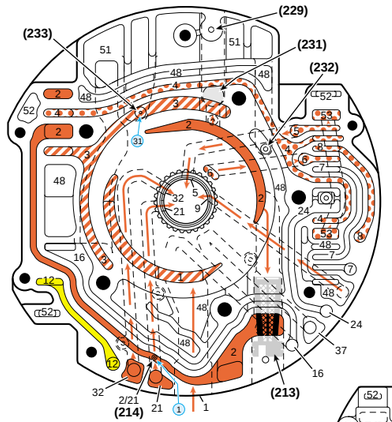
COMPONENTS ( )

(36) TRANSMISSION FLUID LEVEL HOLE PLUG
(40) TRANSMISSION FLUID PRESSURE TEST PLUG
(203) CHECK VALVE RETAINER AND BALL ASSEMBLY
(213) TRANSMISSION FLUID PUMP SCREEN ASSEMBLY
(214) BRASS ORIFICE INSERT
(232) ORIFICE SLEEVE
(233) ORIFICE CUP PLUG
(306) CONTROL VALVE BODY BALL CHECK VALVE (#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
(308) TCC PWM SOLENOID VALVE FILTER ASSEMBLY
(312) PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

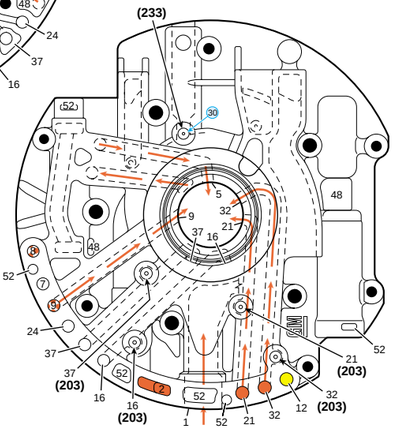
MANUAL SECOND – FIRST GEAR (from Manual Second – Second Gear)



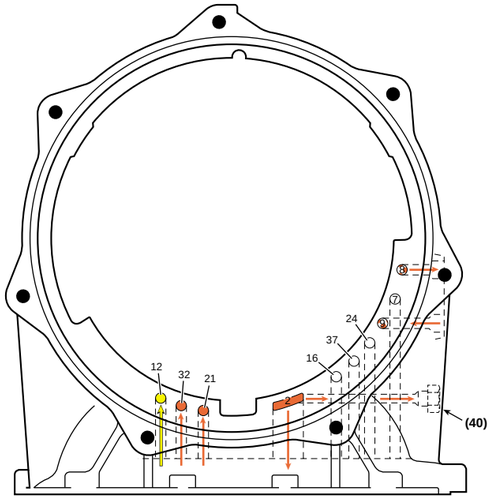
TORQUE CONVERTER HOUSING (227)
(Fluid Pump Cover Side)



FLUID PUMP COVER (202)
(Torque Converter Housing Side)



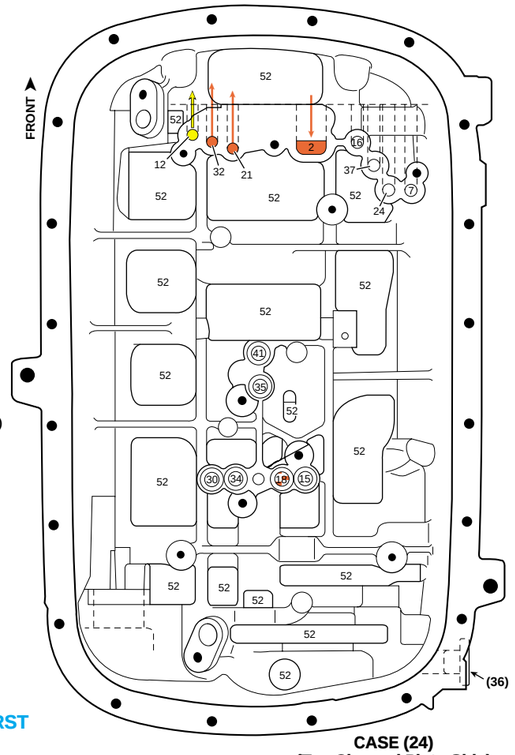
FLUID PUMP COVER (202)
(Case Side)



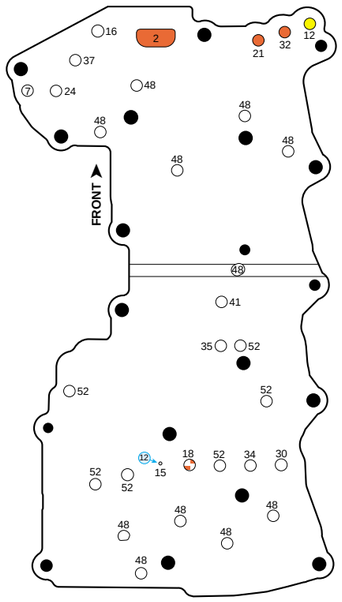
CASE (24)
(Fluid Pump Cover Side)

NOTE:

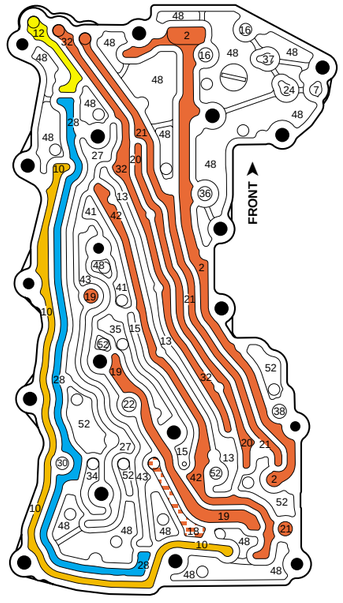
- ● INDICATES BOLT HOLES
- NON FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE NUMBERS LISTED FIRST
- EXHAUST FLUID NOT SHOWN
- PASSAGES MARKED WITH ✱ ARE USED FOR THE 5L40-E ONLY



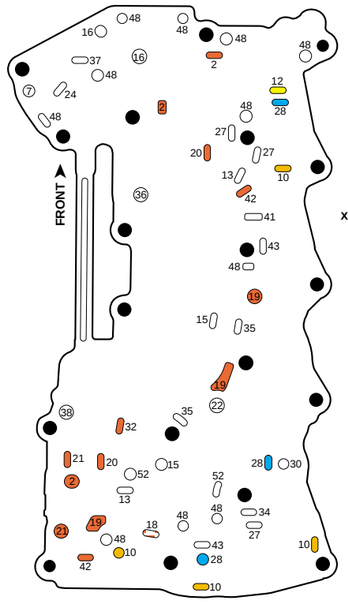
CASE (24)
(Top Channel Plate Side)



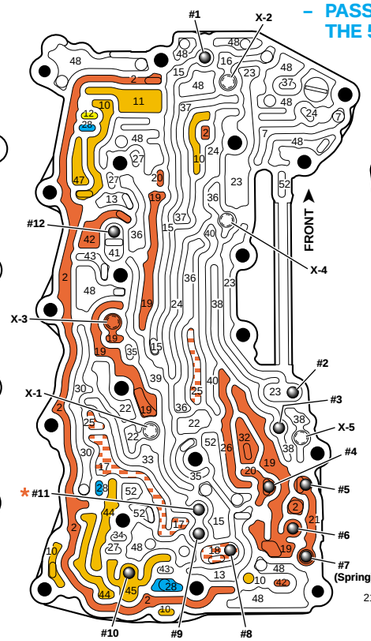
TOP CHANNEL PLATE (301)
(Case Side)



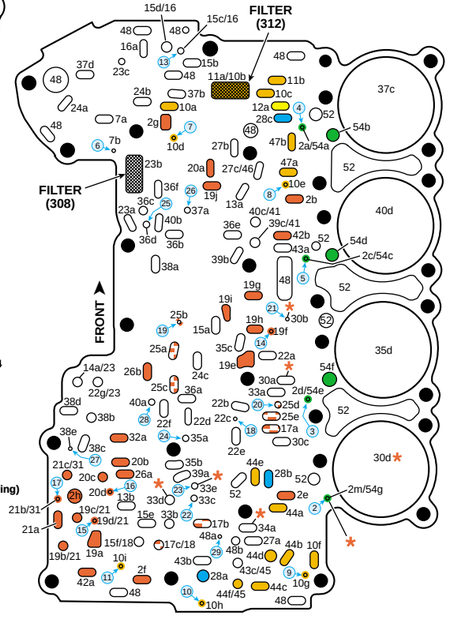
TOP CHANNEL PLATE (301)
(Bottom Channel Plate Side)



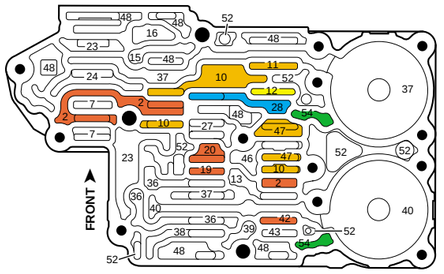
BOTTOM CHANNEL PLATE (304)
(Top Channel Plate Side)



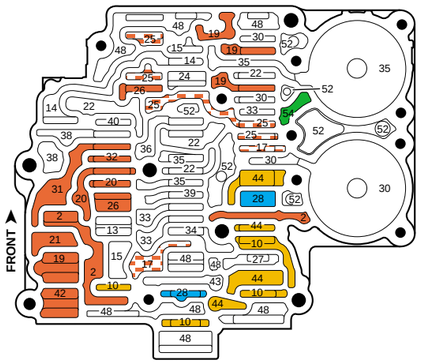
BOTTOM CHANNEL PLATE (304)
(Control Valve Body Side)



SPACER PLATE (307)
(Bottom Channel Plate Side)



FRONT CONTROL VALVE BODY (311)
(Bottom Channel Plate Side)



REAR CONTROL VALVE BODY (310)
(Bottom Channel Plate Side)

Figure 107

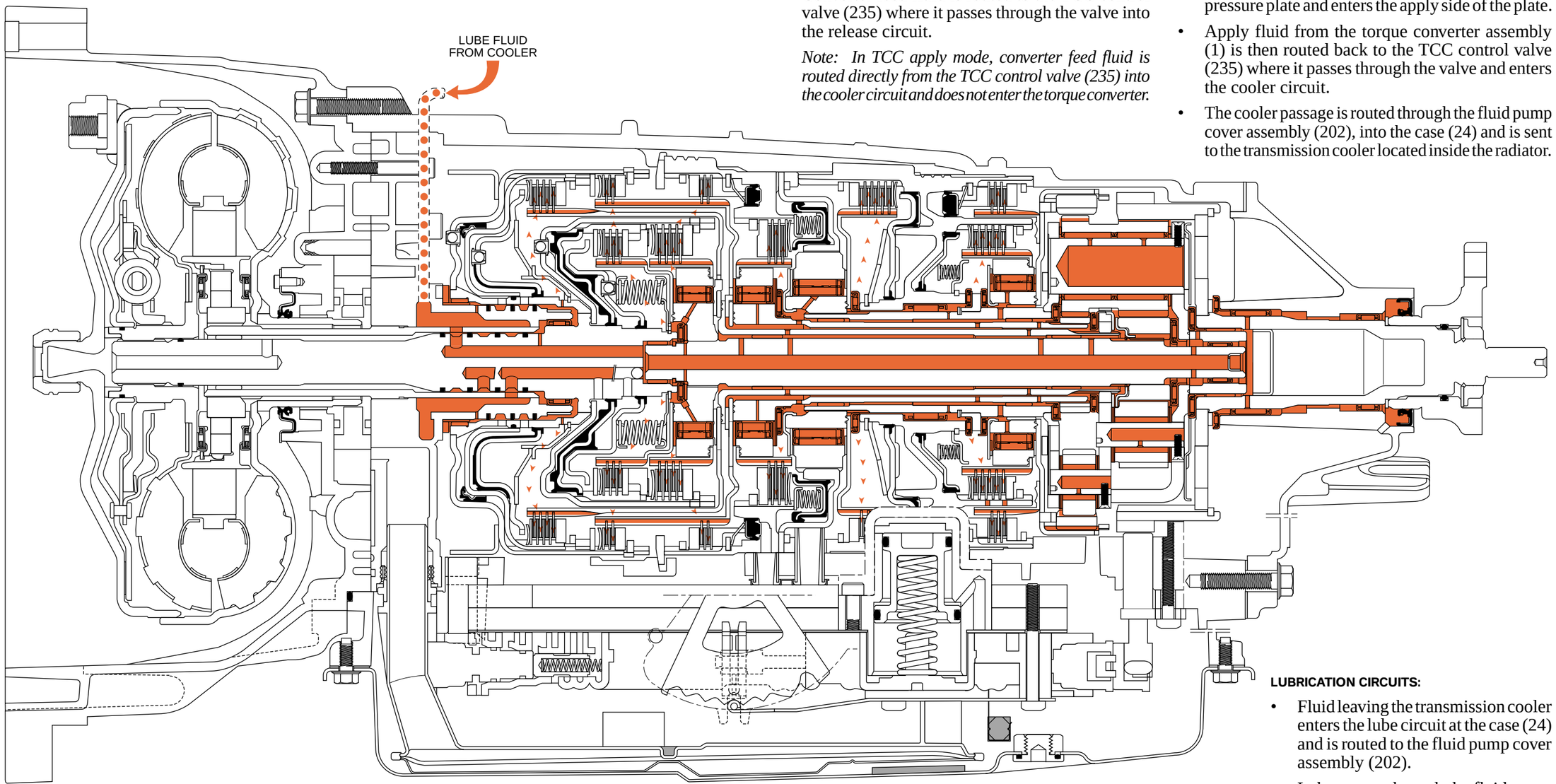
FOLDOUT ➤ 111

COOLER AND LUBRICATION CIRCUITS

COOLER CIRCUIT:

- Line pressure from the fluid pump assembly is directed to the pressure regulator valve (210) located in the fluid pump cover assembly (202).
- Line pressure passes through the pressure regulator valve (210) and enters the converter feed passage.
- Converter feed fluid is routed to the TCC control valve (235) where it passes through the valve into the release circuit.

  Note: In TCC apply mode, converter feed fluid is routed directly from the TCC control valve (235) into the cooler circuit and does not enter the torque converter.
- Release fluid passes through the fluid pump cover assembly (202) and flows between the stator shaft and the turbine shaft (433).
- Release fluid enters a passage in the turbine shaft (433) and flows to the release side of the torque converter clutch pressure plate, passes around the pressure plate and enters the apply side of the plate.
- Apply fluid from the torque converter assembly (1) is then routed back to the TCC control valve (235) where it passes through the valve and enters the cooler circuit.
- The cooler passage is routed through the fluid pump cover assembly (202), into the case (24) and is sent to the transmission cooler located inside the radiator.

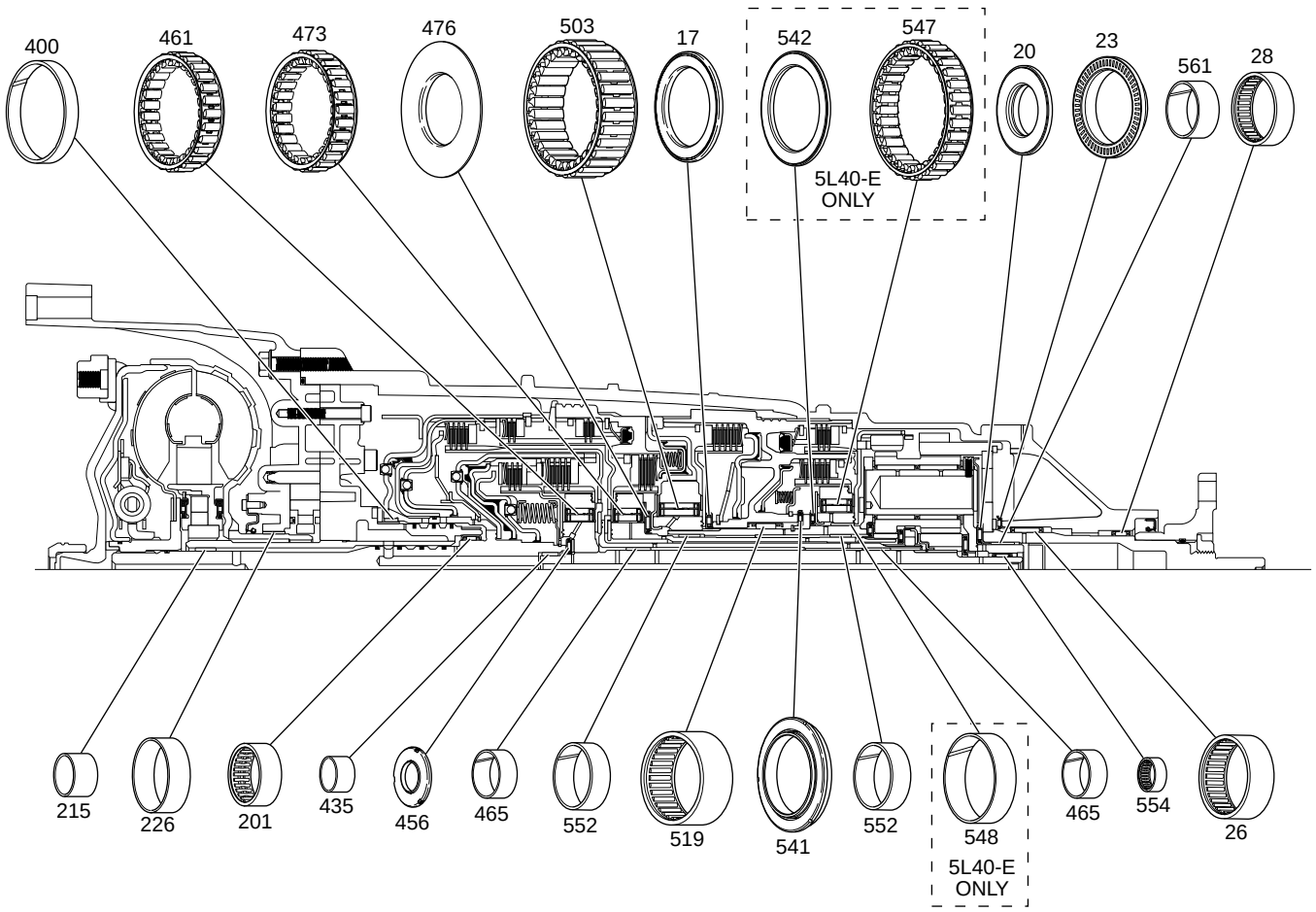


LUBRICATION CIRCUITS:

- Fluid leaving the transmission cooler enters the lube circuit at the case (24) and is routed to the fluid pump cover assembly (202).
- Lube passes through the fluid pump cover assembly (202) and enters the input shaft (433).
- Lube then passes through the input shaft (433) and flows throughout the transmission.

Figure 108

Bushing and Bearing Locations



17 LOW CLUTCH ROLLER THRUST BEARING

20 INPUT AND REACTION CARRIER THRUST BEARING

23 INPUT AND REACTION CARRIER THRUST BEARING

26 OUTPUT SHAFT BEARING

28 OUTPUT SHAFT BEARING

201 INPUT SHAFT BEARING ASSEMBLY

215 TURBINE SHAFT BUSHING

226 TORQUE CONVERTER BUSHING

400 REVERSE CLUTCH HOUSING BUSHING

435 FORWARD CLUTCH BUSHING

456 FORWARD CLUTCH ROLLER INNER BEARING

461 FORWARD CLUTCH SPRAG ASSEMBLY

465 INPUT AND REACTION CARRIER BUSHING ASSEMBLY

473 INTERMEDIATE CLUTCH SPRAG ASSEMBLY

476 INTERMEDIATE CLUTCH ROLLER THRUST BEARING ASSEMBLY

503 LOW CLUTCH SPRAG ASSEMBLY

519 INPUT AND REACTION BEARING ASSEMBLY

541 INPUT AND REACTION BEARING ASSEMBLY

542 2ND CLUTCH ROLLER INNER RACE BEARING ASSEMBLY

547 2ND CLUTCH SPRAG ASSEMBLY

548 INPUT AND REACTION CARRIER BUSHING

552 REACTION CARRIER BUSHING

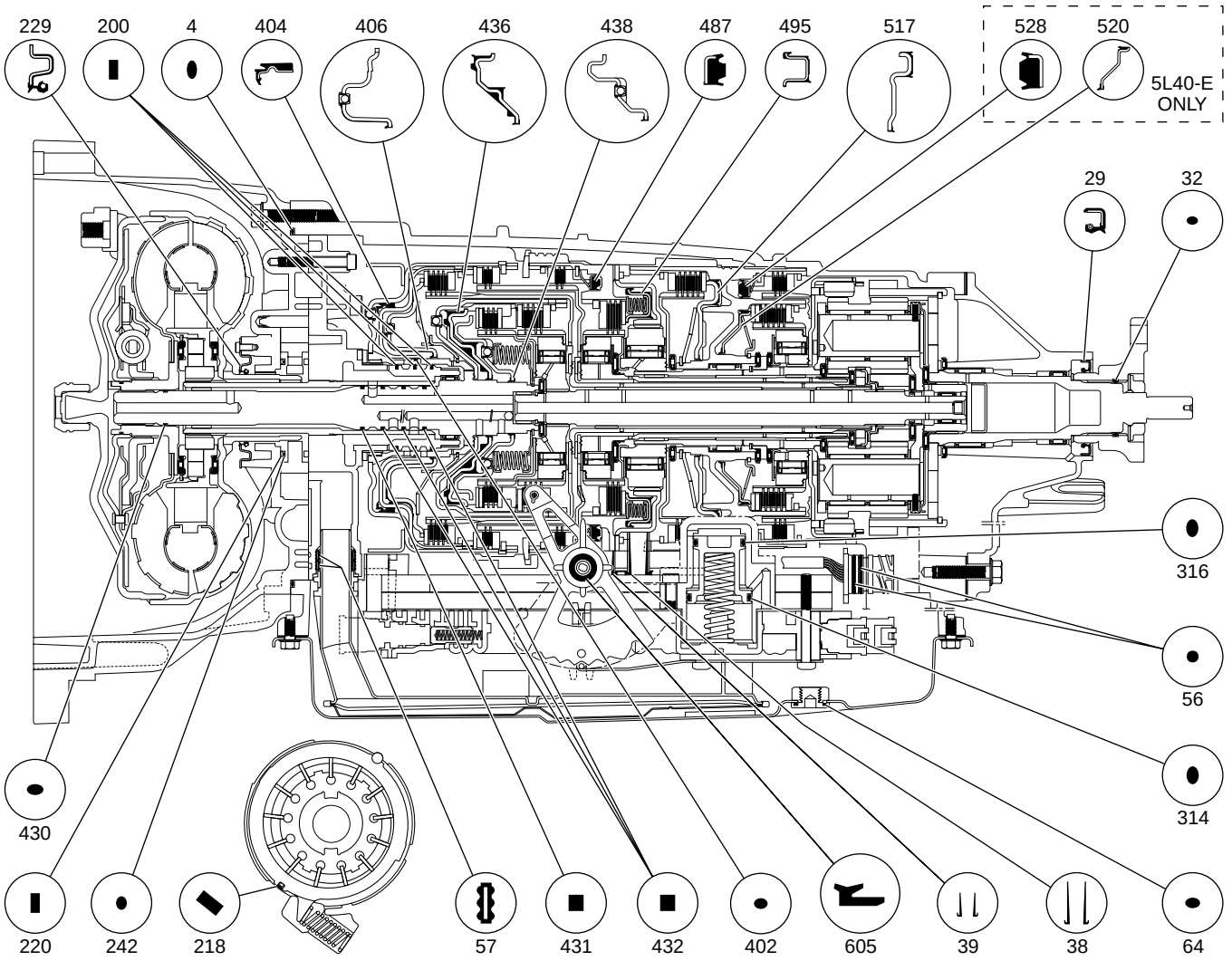
554 INPUT AND REACTION BEARING ASSEMBLY

561 INPUT AND REACTION CARRIER BUSHING

bushbrngloc

Figure 109

Seal Locations



4	TORQUE CONVERTER HOUSING FLUID SEAL ASSEMBLY
29	TRANSMISSION PROP SHAFT FLANGE SEAL
32	TRANSMISSION PROP SHAFT FLANGE (O-RING) SEAL
38	CENTER SUPPORT FLUID PASSAGE SLEEVE
39	OVERDRIVE CLUTCH FLUID PASSAGE SLEEVE
56	A/TRANSMISSION WIRING HARNESS (O-RING) SEAL (2)
57	TRANSMISSION FILTER SEAL (2)
64	A/TRANS FLUID PAN DRAIN PLUG SEAL
200	REVERSE CLUTCH HOUSING FLUID SEAL RING
218	A/TRANS FLUID PUMP SLIDE SEAL
220	A/TRANS FLUID PUMP SLIDE RING
229	TORQUE CONVERTER HOUSING SEAL
242	A/TRANS FLUID PUMP SLIDE O-RING SEAL
314	CLUTCH ACCUMULATOR PISTON FLUID SEAL RING
316	CLUTCH ACCUMULATOR PISTON FLUID SEAL RING
402	REVERSE CLUTCH PISTON INNER SEAL
404	REVERSE CLUTCH PISTON
406	DIRECT CLUTCH PISTON ASSEMBLY
430	INPUT SHAFT (O-RING) SEAL
431	INPUT SHAFT FLUID SEAL RING
432	INPUT SHAFT FLUID SEAL RING
436	FORWARD CLUTCH PISTON ASSEMBLY
438	COAST CLUTCH PISTON ASSEMBLY
487	OVERDRIVE CLUTCH PISTON ASSEMBLY
495	INTERMEDIATE CLUTCH PISTON ASSEMBLY
517	LOW AND REVERSE CLUTCH PISTON
520	2ND CLUTCH PISTON
528	2ND COAST CLUTCH PISTON ASSEMBLY
605	MANUAL SHIFT SHAFT SEAL

sealloc

Figure 110

ILLUSTRATED PARTS LIST

Case and Associated Parts

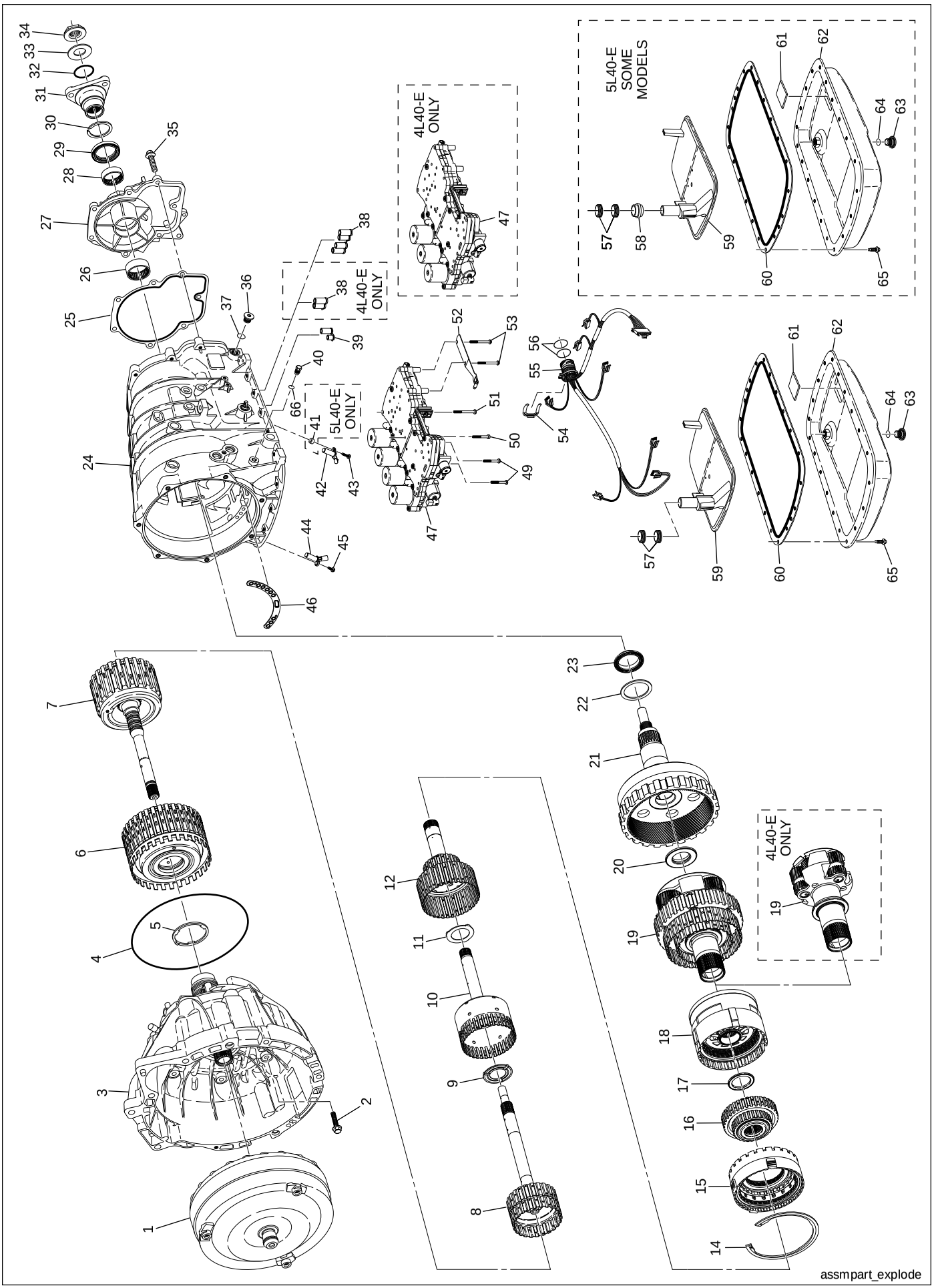


Figure 111

Case and Associated Parts Legend

1 TORQUE CONVERTER ASSEMBLY

2 TORQUE CONVERTER HOUSING TO MAIN CASE BOLT

3 TORQUE CONVERTER HOUSING ASSEMBLY

4 TORQUE CONVERTER HOUSING FLUID SEAL ASSEMBLY

5 REVERSE CLUTCH HOUSING THRUST WASHER (SELECTIVE)

6 DIRECT AND REVERSE CLUTCH ASSEMBLY

7 FORWARD AND COAST (W/CLUTCH ASSEMBLY)

8 INPUT SUN GEAR (W/FORWARD CLUTCH ROLLER INNER RACE) SHAFT

9 DIRECT CLUTCH HUB THRUST WASHER

10 DIRECT CLUTCH (W/INPUT AND REACTION CARRIER IN) HUB

11 INPUT AND REACTION CARRIER INNER SHAFT THRUST WASHER

12 INTERMEDIATE CLUTCH SPRAG ASSEMBLY

14 INTERMEDIATE AND OVERDRIVE CLUTCH HOUSING RETAINER RING (SELECTIVE)

15 OVERDRIVE CLUTCH HOUSING

16 LOW CLUTCH SPRAG

17 LOW CLUTCH ROLLER THRUST BEARING

18 CENTER SUPPORT

19 INPUT AND REACTION CARRIER

20 INPUT AND REACTION CARRIER THRUST BEARING

21 OUTPUT SHAFT ASSEMBLY (W/REAR INTERNAL GEAR)

22 INPUT AND REACTION CARRIER WASHER (SELECTIVE)

23 INPUT AND REACTION CARRIER THRUST BEARING

24 A/TRANSMISSION CASE

25 A/T CASE EXTENSION GASKET

26 OUTPUT SHAFT BEARING

27 TRANSMISSION CASE EXTENSION

28 OUTPUT SHAFT BEARING

29 TRANSMISSION PROP SHAFT FLANGE SEAL

30 OUTPUT SHAFT ASSEMBLY RETAINER

31 TRANSMISSION PROP SHAFT FLANGE

32 TRANSMISSION PROP SHAFT FLANGE (O-RING) SEAL

33 TRANSMISSION PROP SHAFT THRUST WASHER

34 PROP SHAFT FLANGE NUT

35 A/T CASE EXTENSION BOLT

36 TRANSMISSION LEVEL HOLE PLUG

37 TRANSMISSION FLUID LEVEL HOLE PLUG O-RING

38 CENTER SUPPORT FLUID PASSAGE SLEEVE

39 OVERDRIVE CLUTCH FLUID PASSAGE SLEEVE

40 TRANSMISSION PRESSURE TEST PLUG

41 OUTPUT SPEED SENSOR SPACER

42 OUTPUT SPEED SENSOR

43 OUTPUT SPEED SENSOR BOLT

44 INPUT SPEED SENSOR

45 INPUT SPEED SENSOR BOLT

46 TRANSMISSION FLUID PUMP COVER GASKET

47 CONTROL VALVE BODY AND ACCUMULATOR ASSEMBLY

49 CONTROL VALVE BODY BOLT

50 CONTROL VALVE BODY BOLT

51 CONTROL VALVE BODY BOLT

52 MANUAL SHAFT DETENT ASSEMBLY

53 CONTROL VALVE BODY BOLT

54 WIRING HARNESS CLIP

55 A/TRANSMISSION WIRING HARNESS

56 A/TRANSMISSION WIRING HARNESS (O-RING) SEAL (2)

57 TRANSMISSION FILTER SEAL (2)

58 TRANSMISSION FILTER SPACER

59 A/TRANSMISSION FLUID FILTER

60 A/TRANS FLUID PAN GASKET

61 A/TRANS FLUID PAN MAGNET

62 A/TRANS FLUID PAN ASSEMBLY

63 A/TRANS FLUID PAN DRAIN PLUG

64 A/TRANS FLUID PAN DRAIN PLUG SEAL

65 A/TRANS FLUID PAN BOLT

66 TRANSMISSION PRESSURE TEST PLUG O-RING SEAL

Fluid Pump Assembly

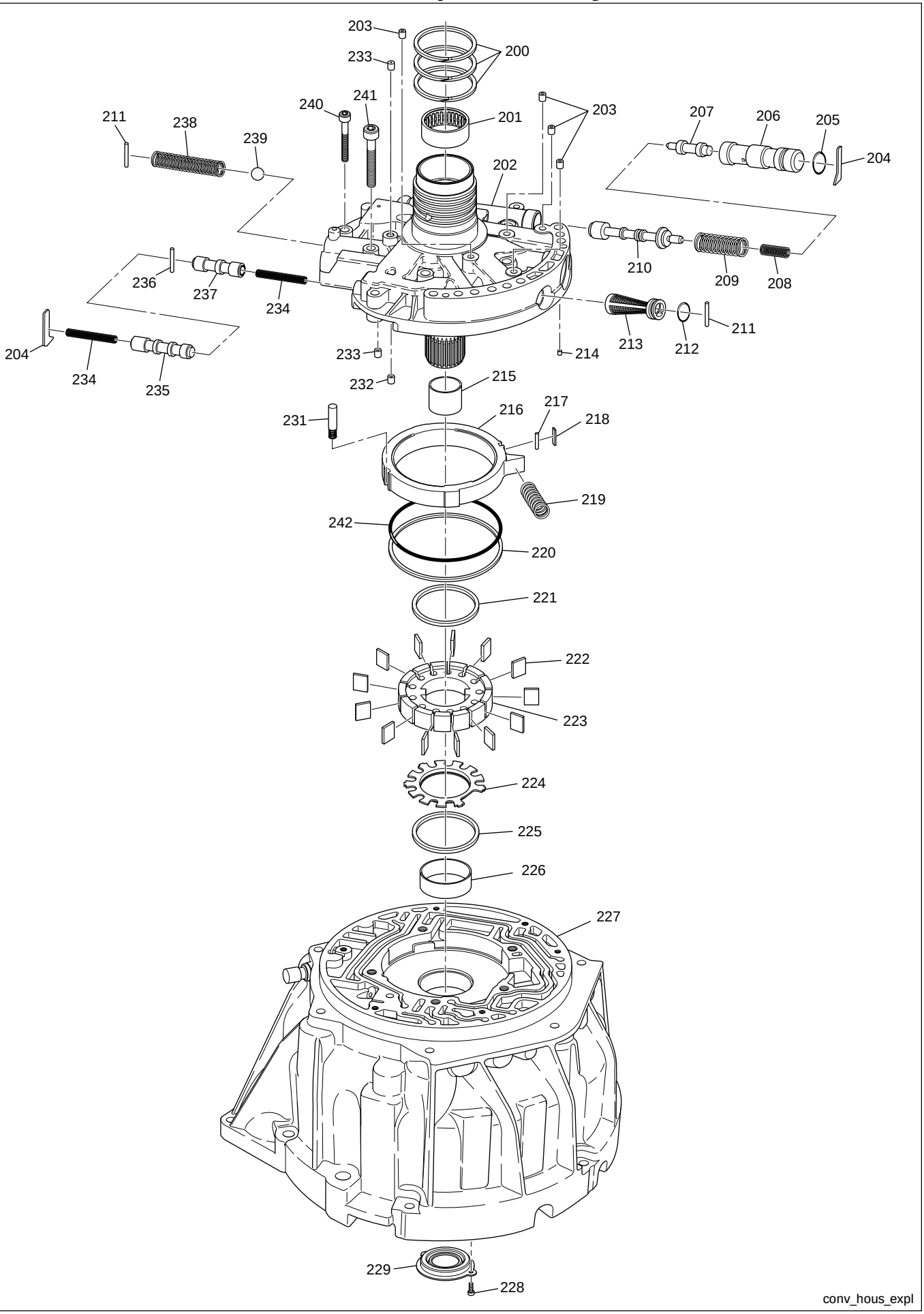


Figure 112

Fluid Pump Assembly Legend

200 REVERSE CLUTCH HOUSING FLUID SEAL RING

201 INPUT SHAFT BEARING ASSEMBLY

202 A/TRANS FLUID PUMP COVER ASSEMBLY

203 CHECK VALVE RETAINER AND BALL ASSEMBLY

204 VALVE BUSHING/SPRING RETAINER

205 LINE BOOST VALVE BUSHING SEAL

206 LINE BOOST VALVE BUSHING

207 LINE BOOST VALVE

208 LINE BOOST VALVE SPRING

209 PRESSURE REGULATOR VALVE SPRING

210 PRESSURE REGULATOR VALVE

211 A/TRANS FLUID PUMP RETAINER PIN

212 A/TRANS FLUID PUMP COVER SEAL

213 A/TRANS FLUID PUMP SCREEN ASSEMBLY

214 BRASS ORIFICE INSERT

215 TURBINE SHAFT BUSHING

216 A/TRANS FLUID PUMP SLIDE (SELECTIVE)

217 A/TRANS FLUID PUMP SLIDE SEAL SUPPORT

218 A/TRANS FLUID PUMP SLIDE SEAL

219 A/TRANS FLUID PUMP SLIDE SPRING

220 A/TRANS FLUID PUMP SLIDE RING

221 A/TRANS FLUID PUMP VANE RING

222 A/TRANS FLUID PUMP VANE

223 A/TRANS FLUID PUMP ROTOR (SELECTIVE)

224 A/TRANS FLUID PUMP ROTOR GUIDE

225 A/TRANS FLUID PUMP VANE RING

226 TORQUE CONVERTER BUSHING

227 TORQUE CONVERTER HOUSING

228 TORQUE CONVERTER HOUSING SEAL BOLT

229 TORQUE CONVERTER HOUSING SEAL

231 A/TRANS FLUID PUMP SLIDE PIN ASSEMBLY

232 ORIFICE SLEEVE

233 ORIFICE CUP PLUG

234 TCC CONTROL VALVE SPRING

235 TCC CONTROL VALVE

236 A/TRANS FLUID PUMP RETAINER PIN

237 TCC ENABLE VALVE

238 PRESSURE RELIEF BALL VALVE SPRING

239 PRESSURE RELIEF BALL VALVE

240 A/TRANS FLUID PUMP BOLT

241 A/TRANS FLUID PUMP BOLT

242 A/TRANS FLUID PUMP SLIDE O-RING SEAL

Control Valve Body and Accumulator Assembly

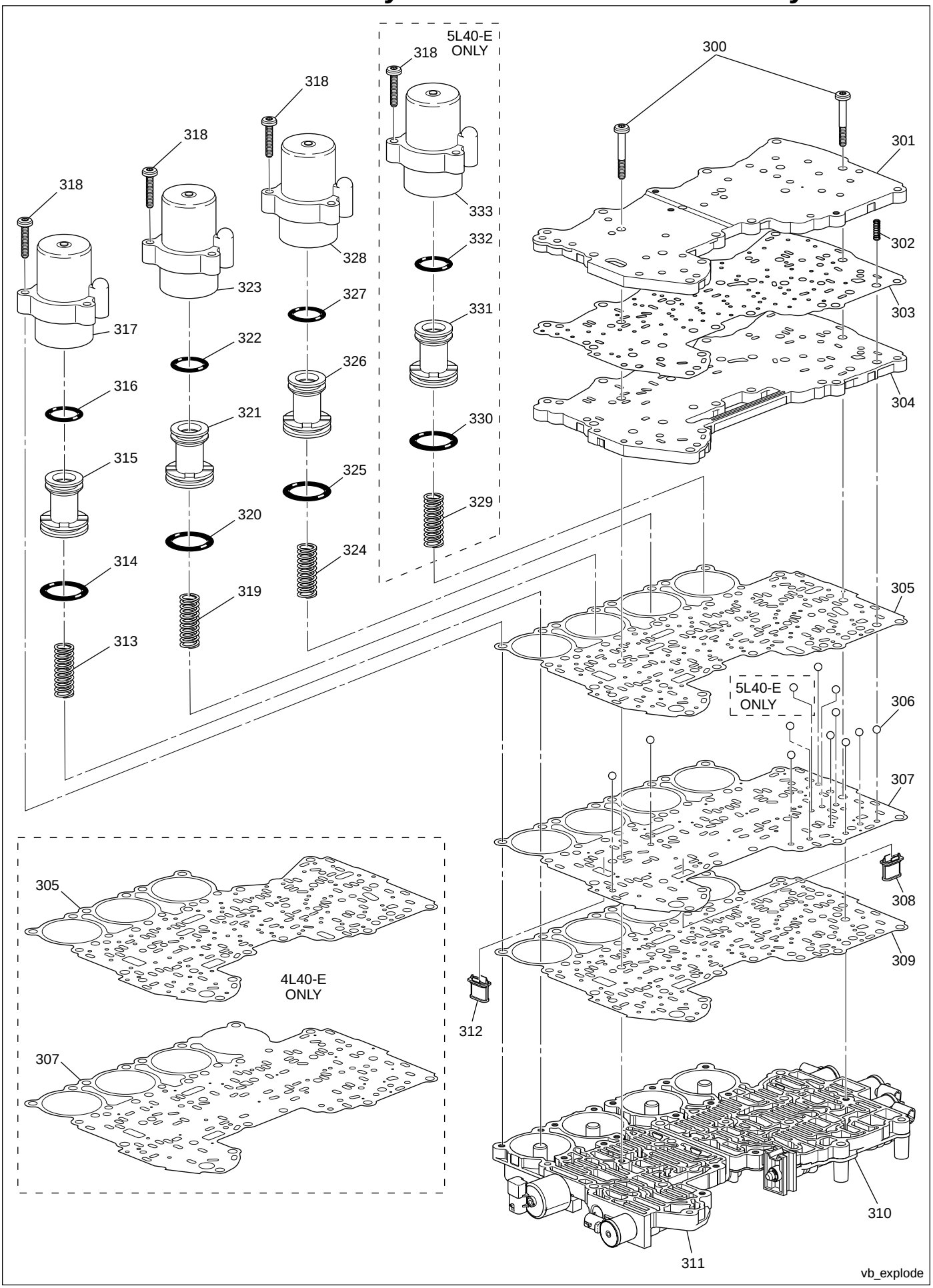


Figure 113

Control Valve Body and Accumulator Assembly Legend

300 CONTROL VALVE BODY BOLT

301 CONTROL VALVE TOP CHANNEL PLATE

302 CONTROL VALVE CHANNEL PLATE BALL CHECK SPRING

303 CONTROL VALVE CHANNEL PLATE GASKET

304 CONTROL VALVE BOTTOM CHANNEL PLATE

305 CONTROL VALVE BODY GASKET

306 CONTROL VALVE BODY BALL CHECK VALVE

307 CONTROL VALVE BODY SPACER PLATE

308 TCC PWM SOLENOID VALVE FILTER ASSEMBLY

309 CONTROL VALVE BODY SPACER PLATE GASKET

310 CONTROL VALVE REAR BODY

311 CONTROL VALVE FRONT BODY

312 PRESSURE CONTROL SOLENOID VALVE FILTER ASSEMBLY

313 DIRECT CLUTCH ACCUMULATOR PISTON SPRING

314 DIRECT CLUTCH ACCUMULATOR PISTON FLUID SEAL RING

315 DIRECT CLUTCH ACCUMULATOR PISTON

316 DIRECT CLUTCH ACCUMULATOR PISTON FLUID SEAL RING

317 DIRECT CLUTCH ACCUMULATOR HOUSING

318 ACCUMULATOR HOUSING BOLT

319 OVERDRIVE CLUTCH ACCUMULATOR PISTON SPRING

320 OVERDRIVE CLUTCH ACCUMULATOR PISTON FLUID SEAL RING

321 OVERDRIVE CLUTCH ACCUMULATOR PISTON

322 OVERDRIVE CLUTCH ACCUMULATOR PISTON FLUID SEAL RING

323 OVERDRIVE CLUTCH ACCUMULATOR HOUSING

324 INTERMEDIATE CLUTCH ACCUMULATOR PISTON SPRING

325 INTERMEDIATE CLUTCH ACCUMULATOR PISTON FLUID RING

326 INTERMEDIATE CLUTCH ACCUMULATOR PISTON

327 INTERMEDIATE CLUTCH ACCUMULATOR PISTON FLUID SEAL RING

328 INTERMEDIATE CLUTCH ACCUMULATOR HOUSING

329 2ND CLUTCH ACCUMULATOR PISTON SPRING

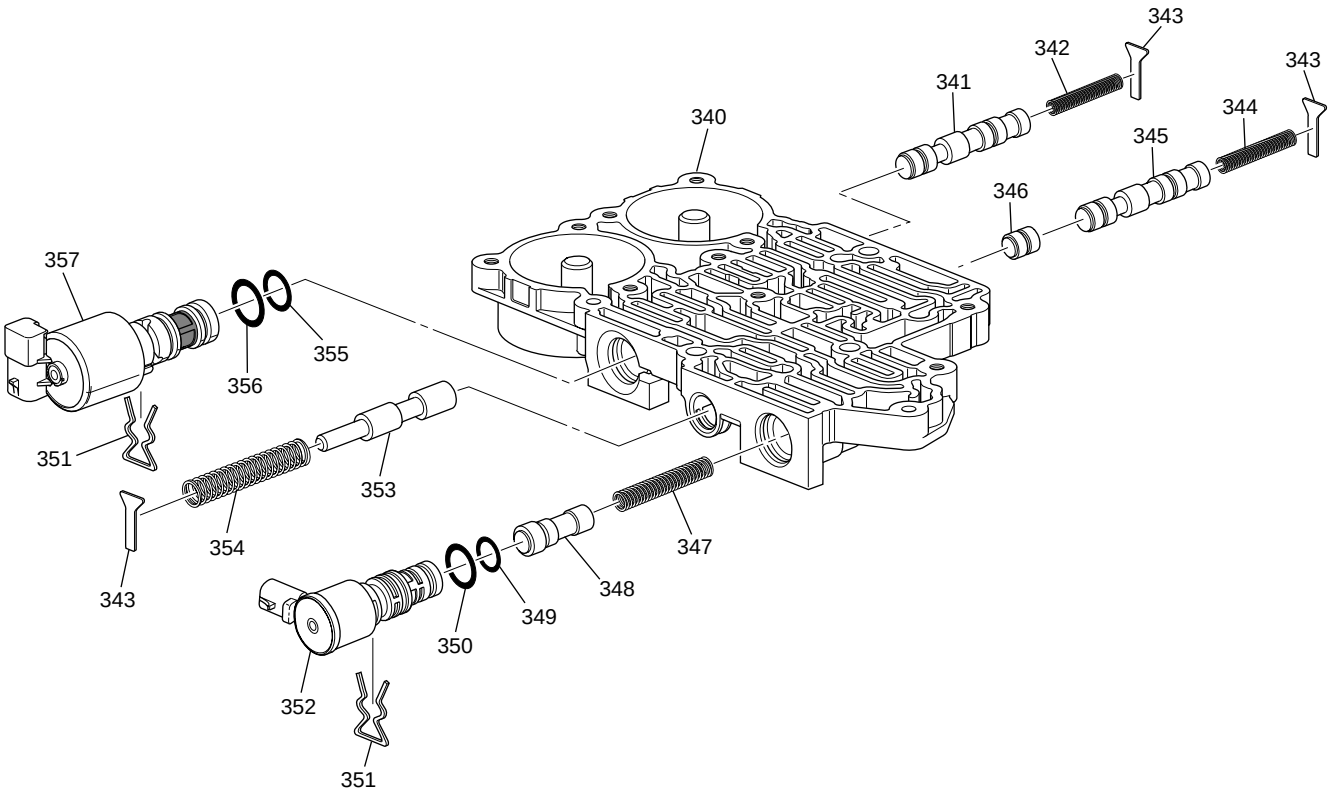
330 2ND CLUTCH ACCUMULATOR PISTON RING

331 2ND CLUTCH ACCUMULATOR PISTON

332 2ND CLUTCH ACCUMULATOR PISTON RING

333 2ND CLUTCH ACCUMULATOR HOUSING

Front Control Valve Body

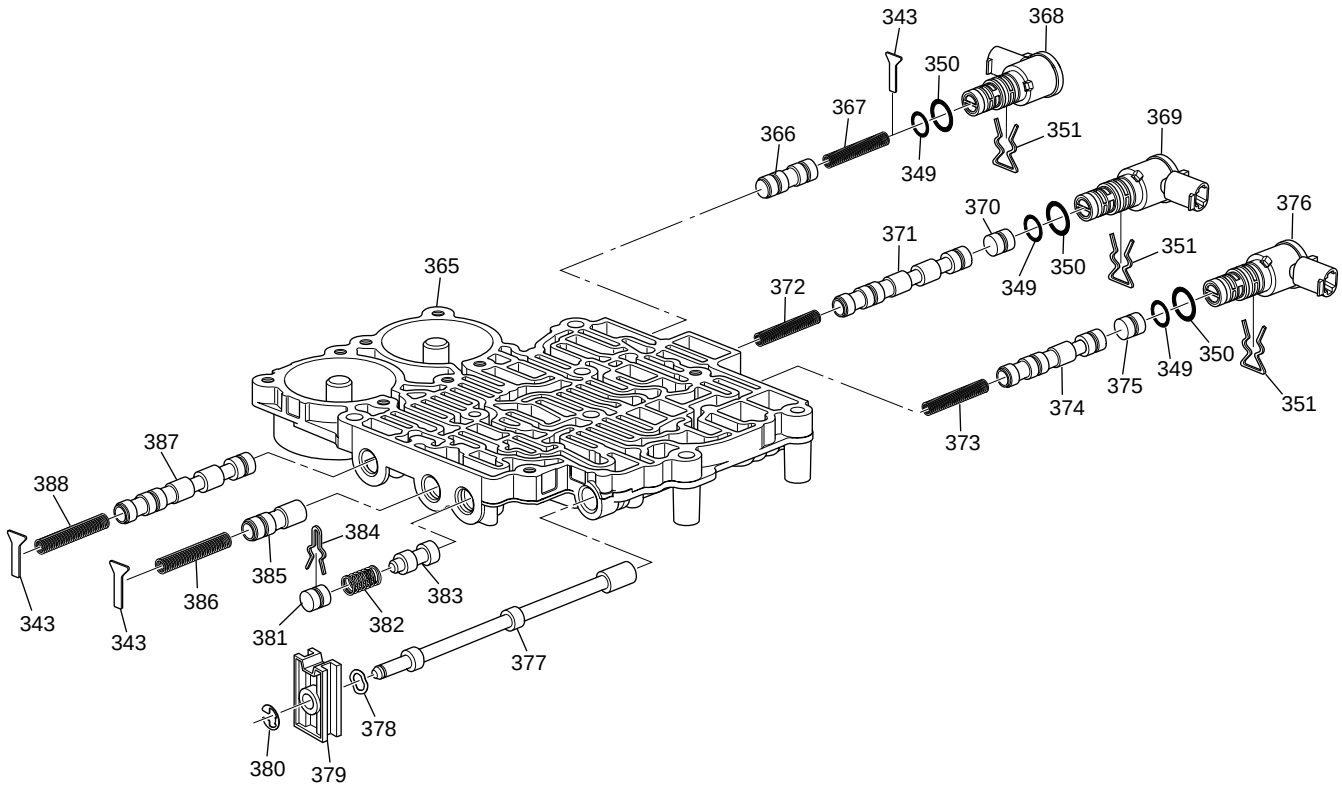


340	CONTROL VALVE FRONT BODY	349	SOLENOID VALVE (O-RING) SEAL
341	SAFETY MODE VALVE	350	SOLENOID VALVE (O-RING) SEAL
342	SAFETY MODE VALVE SPRING	351	SOLENOID VALVE RETAINER
343	VALVE SPRING RETAINER	352	TCC PWM SOLENOID VALVE
344	3-4 SHIFT VALVE SPRING	353	FEED LIMIT VALVE
345	3-4 SHIFT VALVE	354	FEED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

vb2_disassembly

Figure 114

Rear Control Valve Body

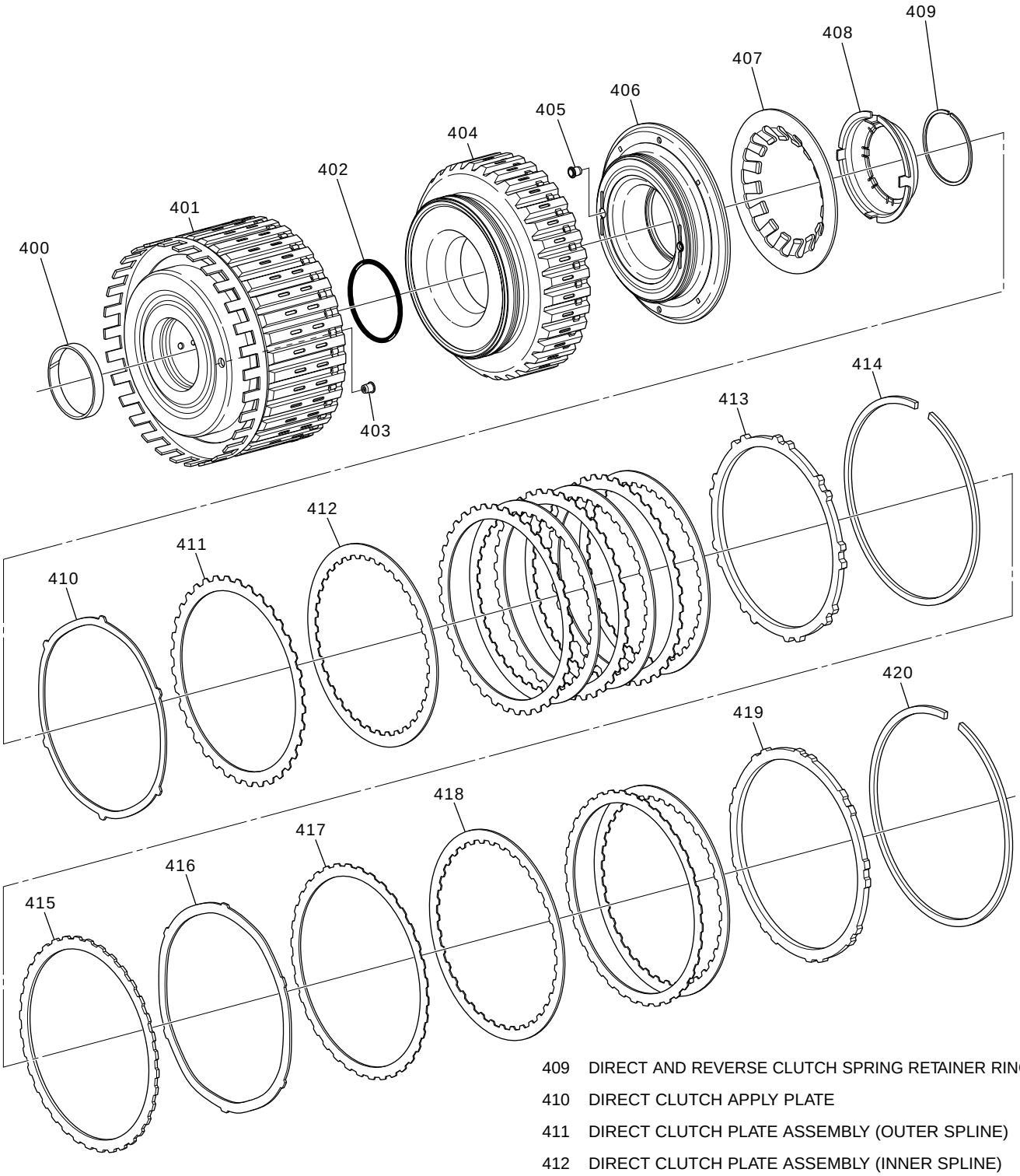


343	VALVE SPRING RETAINER
349	SOLENOID VALVE (O-RING) SEAL
350	SOLENOID VALVE (O-RING) SEAL
351	SOLENOID VALVE RETAINER
365	CONTROL VALVE REAR BODY
366	1-2 SHIFT CONTROL VALVE
367	1-2 SHIFT CONTROL VALVE SPRING
368	1-2 SHIFT SOLENOID VALVE ASSEMBLY
369	2-3 SHIFT SOLENOID VALVE ASSEMBLY
370	2-3 SHIFT 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 SHIFT SOLENOID VALVE ASSEMBLY
377	MANUAL VALVE
378	MANUAL VALVE LINK WASHER (WAVED)
379	MANUAL VALVE LINK
380	MANUAL VALVE LINK RETAINER
381	LOW PRESSURE CONTROL VALVE BORE PLUG
382	LOW PRESSURE CONTROL VALVE SPRING
383	LOW PRESSURE CONTROL VALVE
384	LOW PRESSURE CONTROL VALVE BORE RETAINER
385	REVERSE LOCKOUT VALVE
386	REVERSE LOCKOUT VALVE SPRING
387	1-2 SHIFT VALVE
388	1-2 SHIFT VALVE SPRING

vb1_disassembly

Figure 115

Direct and Reverse Clutch Assembly



400 REVERSE CLUTCH HOUSING BUSHING

401 REVERSE CLUTCH (W/INPUT HOUSING ASSEMBLY)

402 REVERSE CLUTCH PISTON INNER SEAL

403 REVERSE CLUTCH HOUSING BALL CHECK VALVE

404 REVERSE CLUTCH PISTON

405 DIRECT CLUTCH HOUSING BALL CHECK VALVE

406 DIRECT CLUTCH PISTON ASSEMBLY

407 DIRECT AND REVERSE CLUTCH SPRING

408 DIRECT AND REVERSE CLUTCH SPRING RETAINER

409 DIRECT AND REVERSE CLUTCH SPRING RETAINER RING

410 DIRECT CLUTCH APPLY PLATE

411 DIRECT CLUTCH PLATE ASSEMBLY (OUTER SPLINE)

412 DIRECT CLUTCH PLATE ASSEMBLY (INNER SPLINE)

413 DIRECT CLUTCH BACKING PLATE

414 DIRECT CLUTCH BACKING PLATE RETAINER RING (SELECTIVE)

415 REVERSE CLUTCH SPACER

416 REVERSE CLUTCH APPLY PLATE

417 REVERSE CLUTCH PLATE ASSEMBLY (OUTER SPLINE)

418 REVERSE CLUTCH PLATE ASSEMBLY (INNER SPLINE)

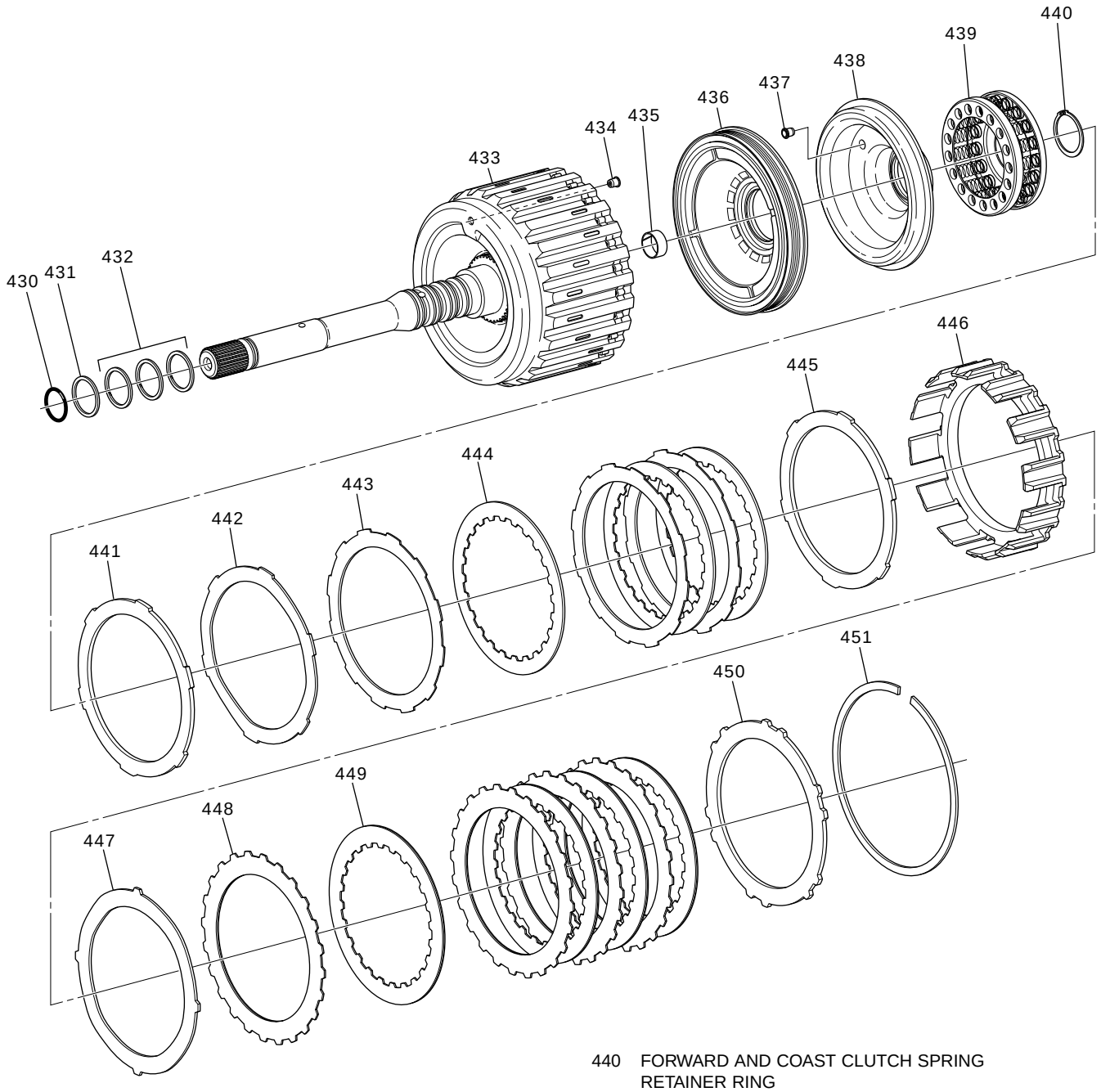
419 REVERSE CLUTCH BACKING PLATE

420 REVERSE CLUTCH BACKING PLATE RETAINER RING (SELECTIVE)

Partlist_A

Figure 116

Forward and Coast Clutch Assembly



430 INPUT SHAFT (O-RING) SEAL

431 INPUT SHAFT FLUID SEAL RING

432 INPUT SHAFT FLUID SEAL RING

433 FORWARD CLUTCH (W/INPUT HOUSING ASSEMBLY)

434 FORWARD CLUTCH HOUSING BALL CHECK VALVE ASSEMBLY

435 FORWARD CLUTCH BUSHING

436 FORWARD CLUTCH PISTON ASSEMBLY

437 COAST CLUTCH PISTON BALL CHECK VALVE ASSEMBLY

438 COAST CLUTCH PISTON ASSEMBLY

439 FORWARD AND COAST CLUTCH SPRING

440 FORWARD AND COAST CLUTCH SPRING RETAINER RING

441 COAST CLUTCH SPACER PLATE (SELECTIVE)

442 COAST CLUTCH APPLY PLATE

443 COAST CLUTCH PLATE ASSEMBLY (OUTER SPLINE)

444 COAST CLUTCH PLATE ASSEMBLY (INNER SPLINE)

445 COAST CLUTCH BACKING PLATE

446 COAST CLUTCH HOUSING

447 FORWARD CLUTCH APPLY PLATE

448 FORWARD CLUTCH PLATE ASSEMBLY (OUTER SPLINE)

449 FORWARD CLUTCH PLATE ASSEMBLY (INNER SPLINE)

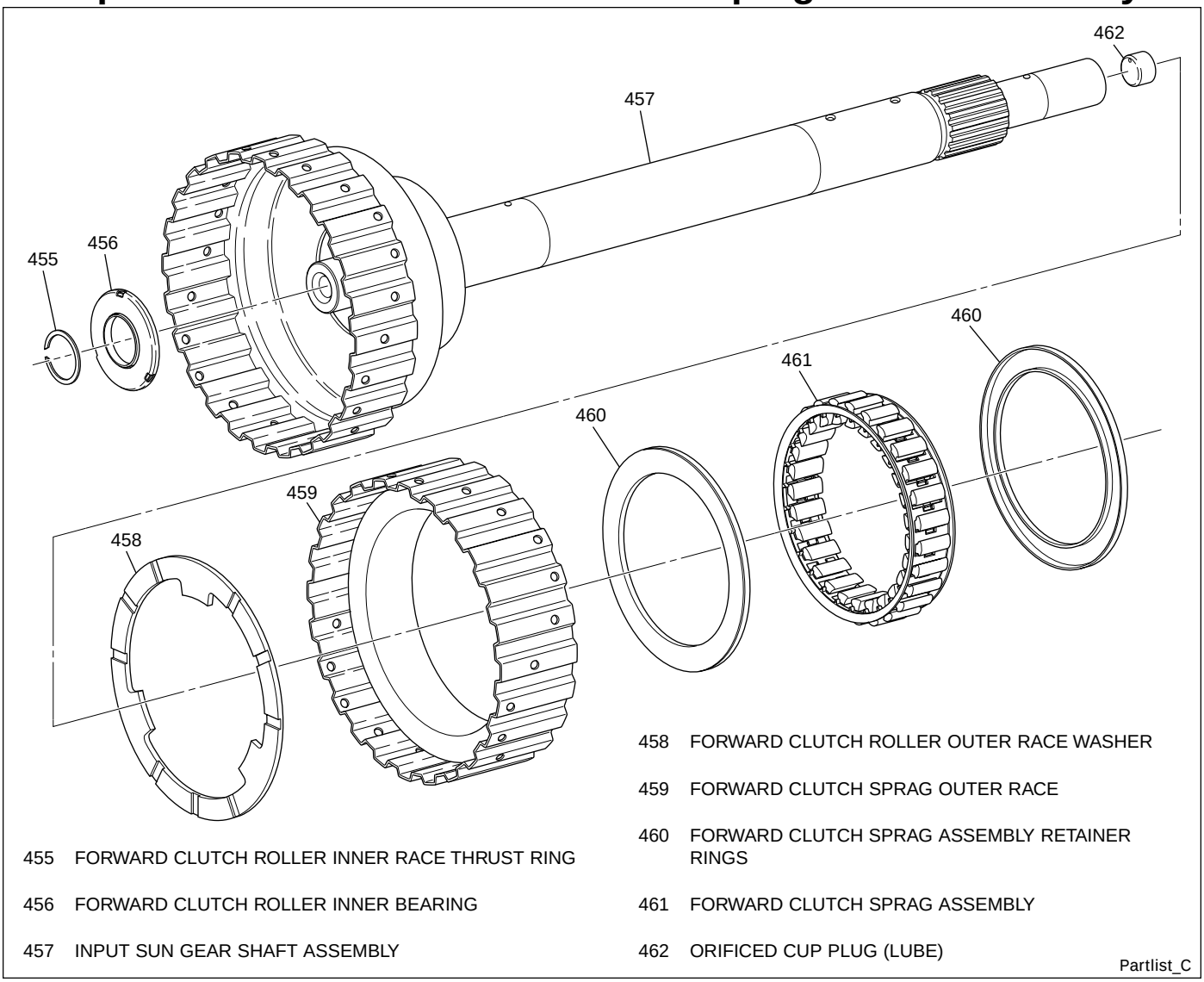
450 FORWARD CLUTCH BACKING PLATE

451 FORWARD CLUTCH BACKING PLATE RETAINER RING (SELECTIVE)

Partlist_B

Figure 117

Input Sun Gear Shaft and Forward Sprag Clutch Assembly



455 FORWARD CLUTCH ROLLER INNER RACE THRUST RING

456 FORWARD CLUTCH ROLLER INNER BEARING

457 INPUT SUN GEAR SHAFT ASSEMBLY

458 FORWARD CLUTCH ROLLER OUTER RACE WASHER

459 FORWARD CLUTCH SPRAG OUTER RACE

460 FORWARD CLUTCH SPRAG ASSEMBLY RETAINER RINGS

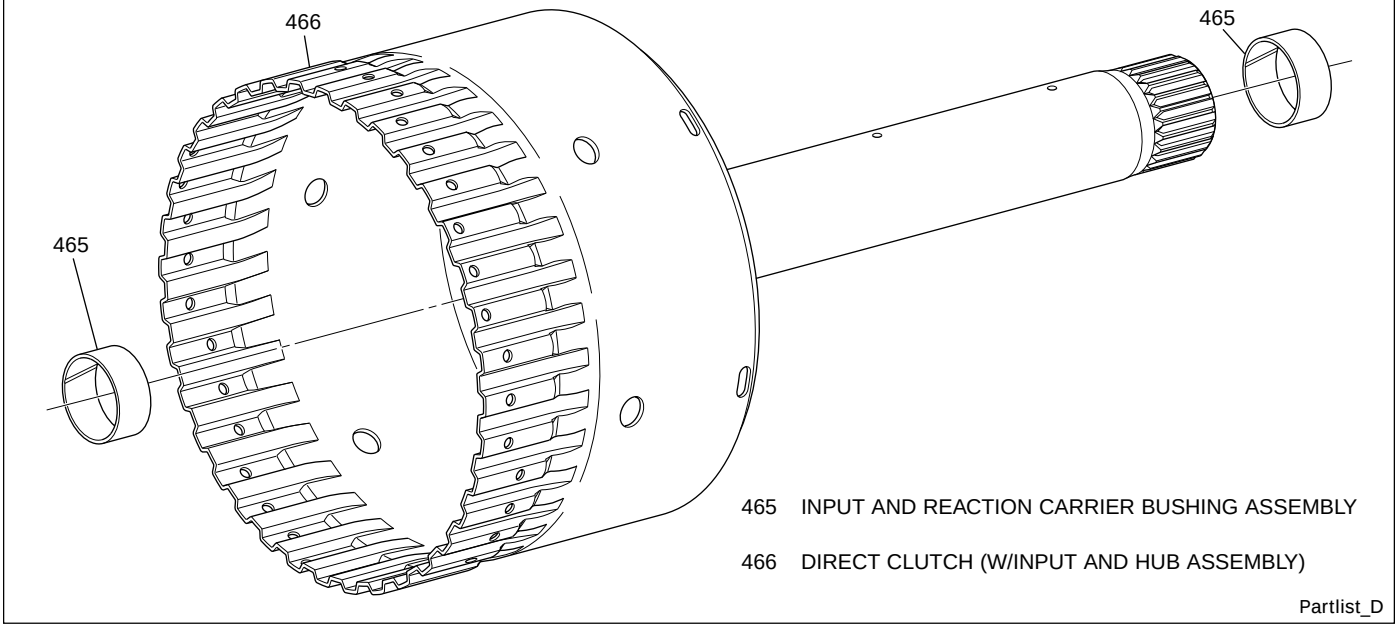
461 FORWARD CLUTCH SPRAG ASSEMBLY

462 ORIFICED CUP PLUG (LUBE)

Partlist_C

Figure 118

Direct Clutch Drum and Shaft Assembly



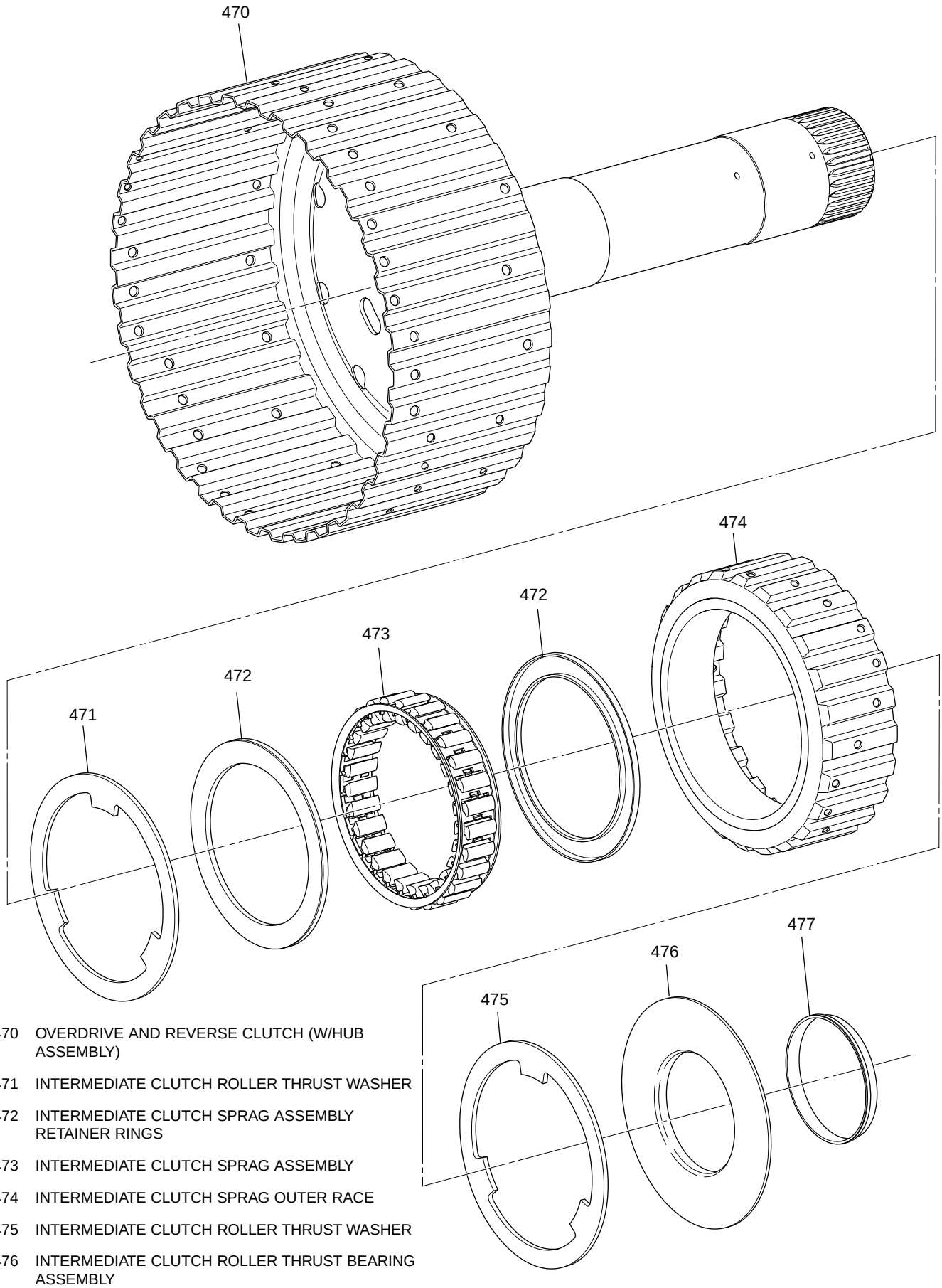
465 INPUT AND REACTION CARRIER BUSHING ASSEMBLY

466 DIRECT CLUTCH (W/INPUT AND HUB ASSEMBLY)

Partlist_D

Figure 119

Intermediate Sprag Clutch Assembly



470 OVERDRIVE AND REVERSE CLUTCH (W/HUB ASSEMBLY)

471 INTERMEDIATE CLUTCH ROLLER THRUST WASHER

472 INTERMEDIATE CLUTCH SPRAG ASSEMBLY RETAINER RINGS

473 INTERMEDIATE CLUTCH SPRAG ASSEMBLY

474 INTERMEDIATE CLUTCH SPRAG OUTER RACE

475 INTERMEDIATE CLUTCH ROLLER THRUST WASHER

476 INTERMEDIATE CLUTCH ROLLER THRUST BEARING ASSEMBLY

477 INTERMEDIATE CLUTCH ROLLER THRUST BEARING ASSEMBLY RETAINER

Partlist_E

Figure 120

Overdrive and Intermediate Clutch Assembly

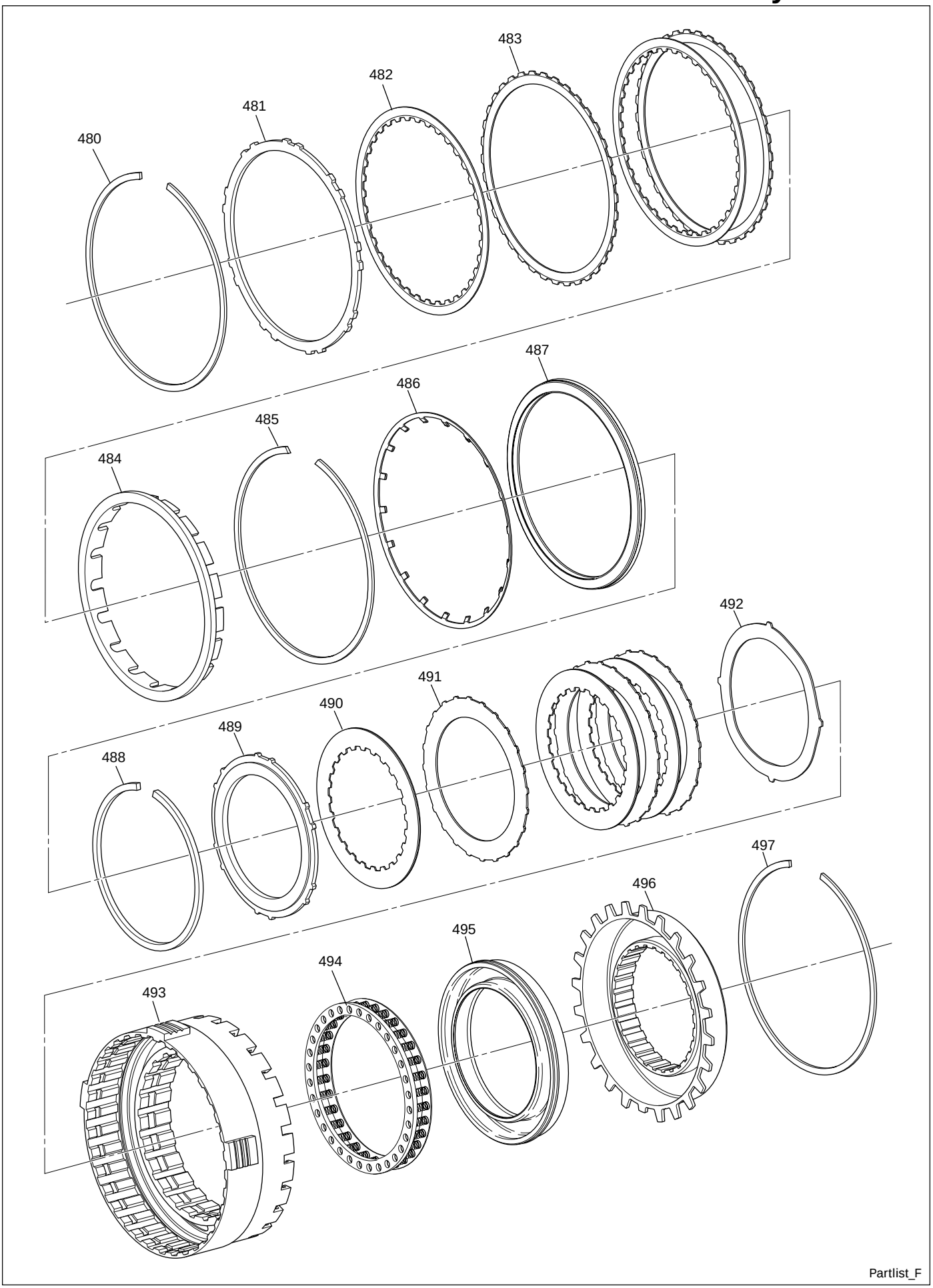


Figure 121

Overdrive and Intermediate Clutch Assembly Legend

480 OVERDRIVE CLUTCH BACKING PLATE RETAINER RING (SELECTIVE)

481 OVERDRIVE CLUTCH BACKING PLATE

482 OVERDRIVE CLUTCH PLATE ASSEMBLY (INNER SPLINE)

483 OVERDRIVE CLUTCH PLATE ASSEMBLY (OUTER SPLINE)

484 OVERDRIVE CLUTCH SPACER

485 OVERDRIVE CLUTCH SPRING RETAINER RING

486 OVERDRIVE CLUTCH SPRING

487 OVERDRIVE CLUTCH PISTON ASSEMBLY

488 INTERMEDIATE CLUTCH BACKING PLATE RETAINER RING (SELECTIVE)

489 INTERMEDIATE CLUTCH BACKING PLATE

490 INTERMEDIATE CLUTCH PLATE ASSEMBLY (INNER SPLINE)

491 INTERMEDIATE CLUTCH PLATE ASSEMBLY (OUTER SPLINE)

492 INTERMEDIATE CLUTCH APPLY PLATE

493 OVERDRIVE CLUTCH HOUSING

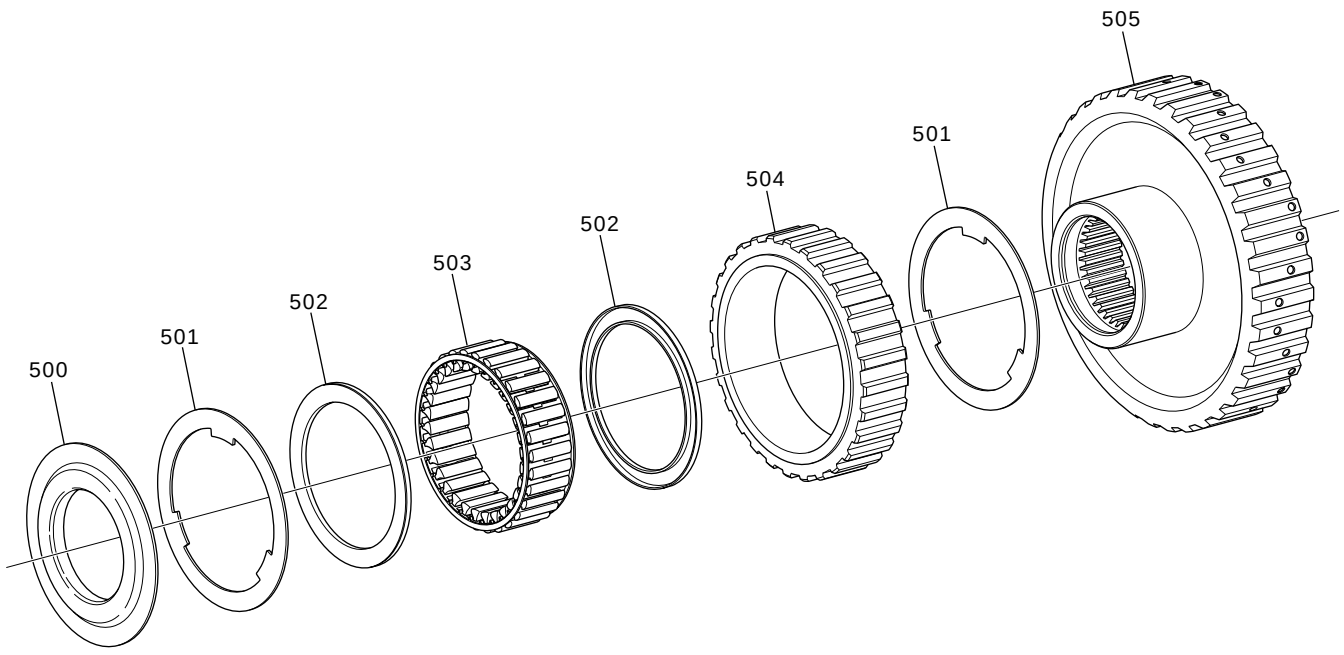
494 INTERMEDIATE CLUTCH SPRING

495 INTERMEDIATE CLUTCH PISTON ASSEMBLY

496 INTERMEDIATE CLUTCH (W/HOUSING ASSEMBLY)

497 INTERMEDIATE CLUTCH HOUSING RETAINER RING

Low Clutch Sprag Assembly



500 LOW CLUTCH ROLLER RETAINER

501 LOW CLUTCH ROLLER THRUST WASHER

502 LOW CLUTCH SPRAG ASSEMBLY RETAINER RINGS

503 LOW CLUTCH SPRAG ASSEMBLY

504 LOW CLUTCH SPRAG OUTER RACE

505 LOW CLUTCH SPRAG INNER RACE

Partlist_G

Figure 122

Center Support Assembly

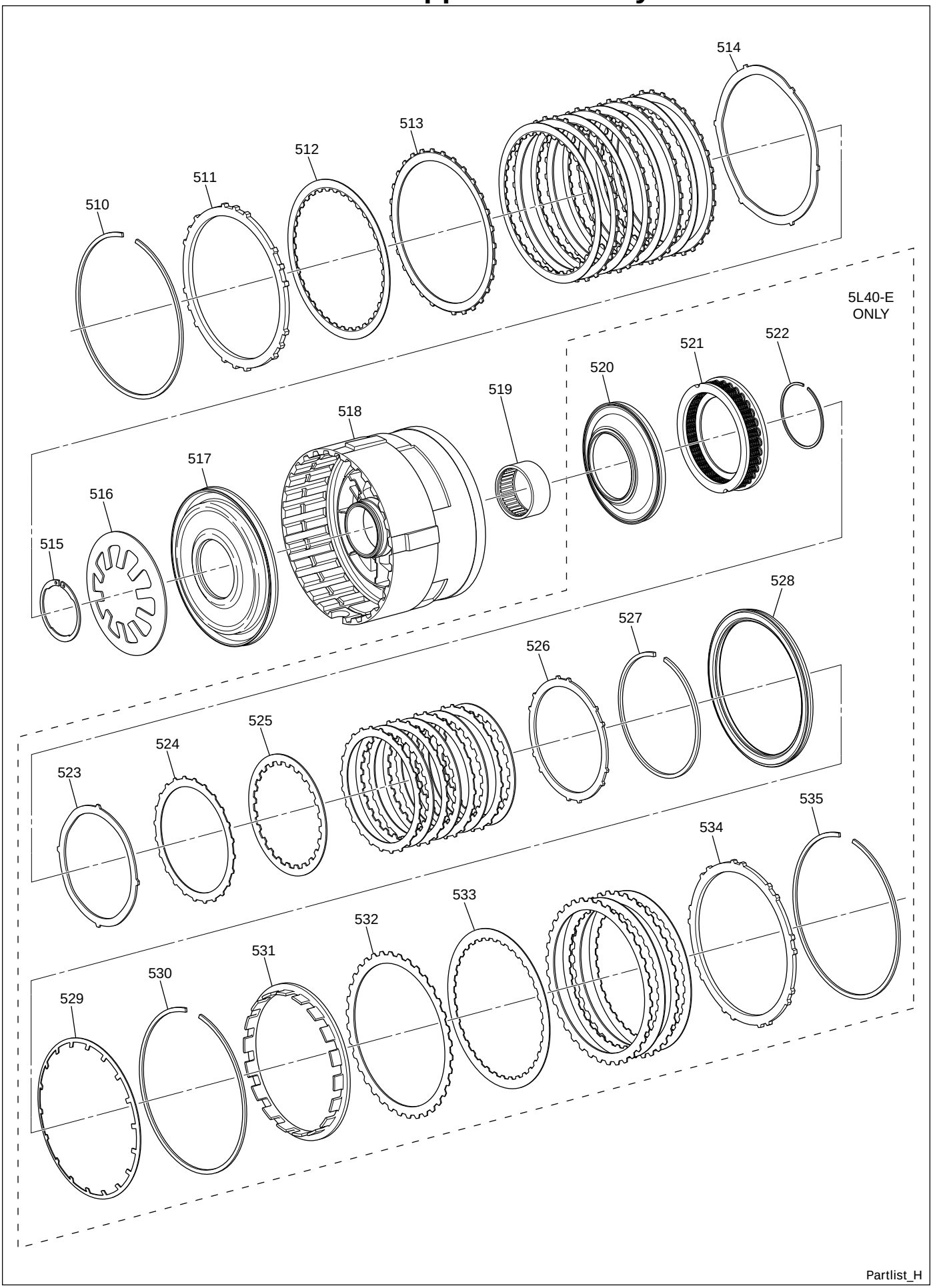


Figure 123

Center Support Assembly Legend

510 LOW AND REVERSE CLUTCH PLATE RETAINER RING (SELECTIVE)

511 LOW AND REVERSE CLUTCH BACKING PLATE

512 LOW AND REVERSE CLUTCH PLATE ASSEMBLY (INNER SPLINE)

513 LOW AND REVERSE CLUTCH PLATE ASSEMBLY (OUTER SPLINE)

514 LOW AND REVERSE CLUTCH APPLY PLATE

515 LOW AND REVERSE CLUTCH SPRING RETAINER RING

516 LOW AND REVERSE CLUTCH SPRING

517 LOW AND REVERSE CLUTCH PISTON

518 CENTER SUPPORT

519 INPUT AND REACTION BEARING ASSEMBLY

520 2ND CLUTCH PISTON

521 2ND CLUTCH SPRING

522 2ND CLUTCH SPRING RETAINER RING

523 2ND CLUTCH APPLY PLATE

524 2ND CLUTCH PLATE ASSEMBLY (OUTER SPLINE)

525 2ND CLUTCH PLATE ASSEMBLY (INNER SPLINE)

526 2ND CLUTCH BACKING PLATE

527 2ND CLUTCH BACKING PLATE RETAINER RING (SELECTIVE)

528 2ND COAST CLUTCH PISTON ASSEMBLY

529 2ND COAST CLUTCH SPRING

530 2ND COAST CLUTCH SPRING RETAINER RING

531 2ND COAST CLUTCH SPACER

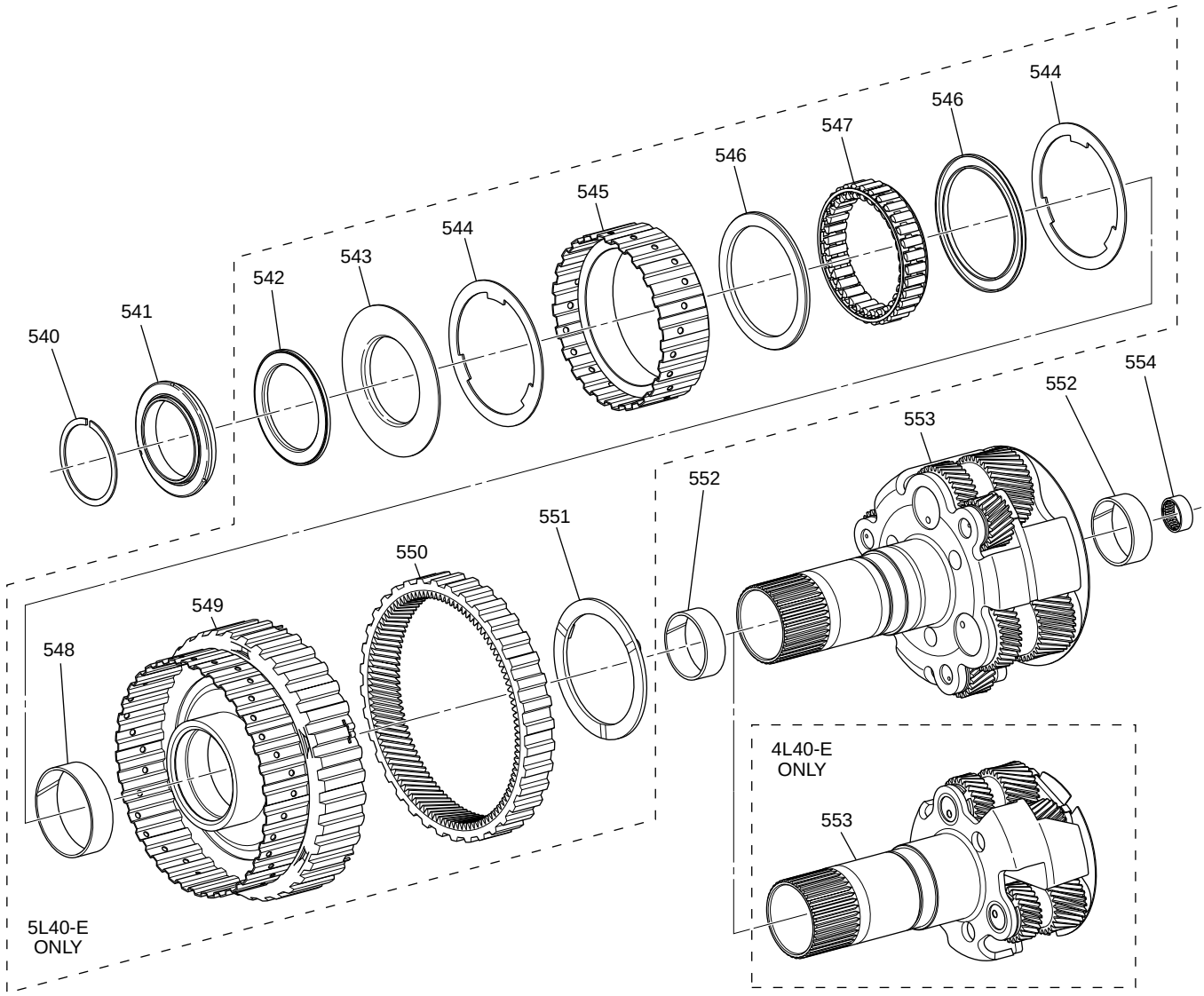
532 2ND COAST CLUTCH PLATE ASSEMBLY (OUTER SPLINE)

533 2ND COAST CLUTCH PLATE ASSEMBLY (INNER SPLINE)

534 2ND COAST CLUTCH BACKING PLATE

535 2ND COAST CLUTCH PLATE (BACKING PLATE) RETAINER RING (SELECTIVE)

Planetary Carrier Assembly



540 INPUT AND REACTION CARRIER OUTER RING

541 INPUT AND REACTION BEARING ASSEMBLY

542 2ND CLUTCH ROLLER INNER RACE BEARING ASSEMBLY

543 2ND CLUTCH SPRAG RETAINER

544 2ND CLUTCH ROLLER OUTER RACE WASHER

545 2ND CLUTCH SPRAG OUTER RACE

546 2ND CLUTCH SPRAG ASSEMBLY RETAINER

547 2ND CLUTCH SPRAG ASSEMBLY

548 INPUT AND REACTION CARRIER BUSHING

549 2ND CLUTCH SPRAG INNER (W/RACE)

550 REACTION INTERNAL GEAR

551 REACTION INTERNAL GEAR FLANGE WASHER

552 REACTION CARRIER BUSHING (2)

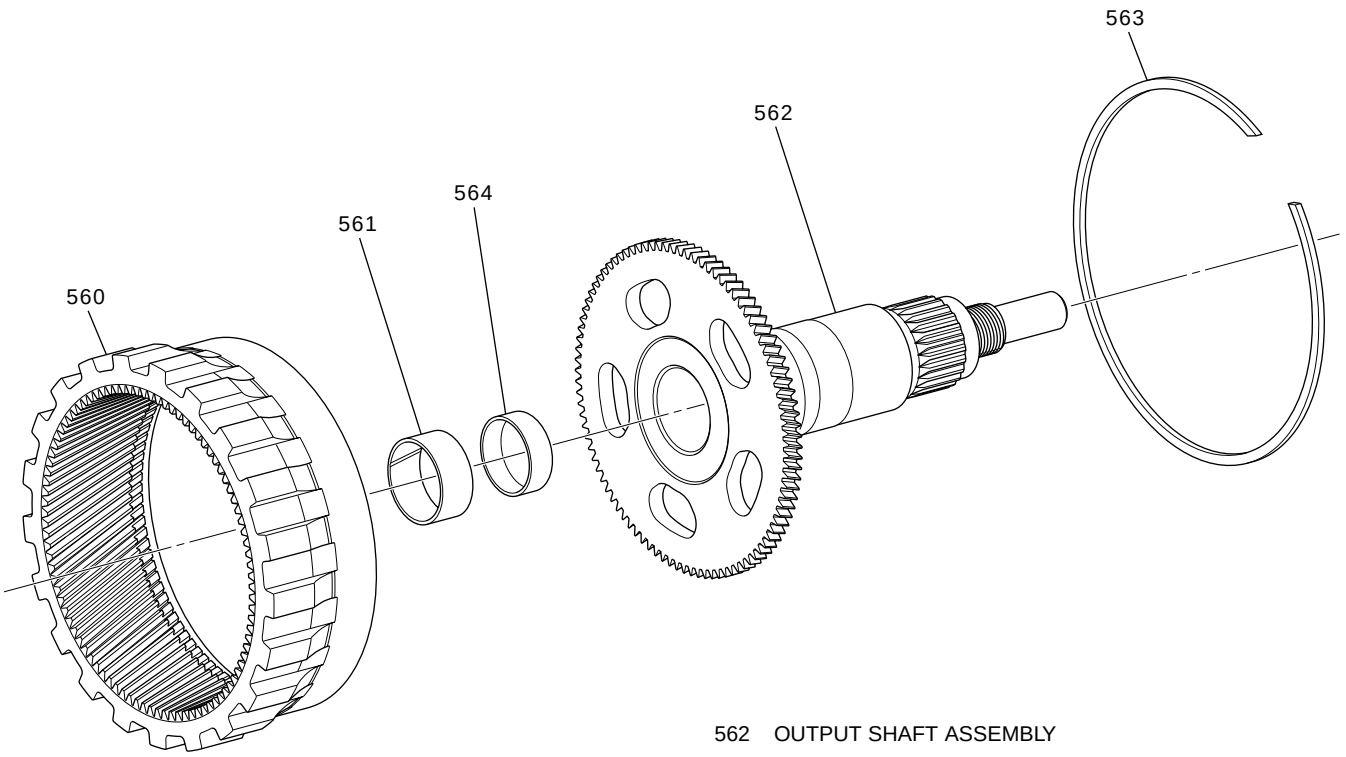
553 INPUT AND REACTION CARRIER

554 INPUT AND REACTION BEARING ASSEMBLY

Partlist_J

Figure 124

Rear Internal Gear Output Shaft Assembly (4L40-E)



560 REAR INTERNAL GEAR

561 INPUT AND REACTION CARRIER BUSHING

562 OUTPUT SHAFT ASSEMBLY

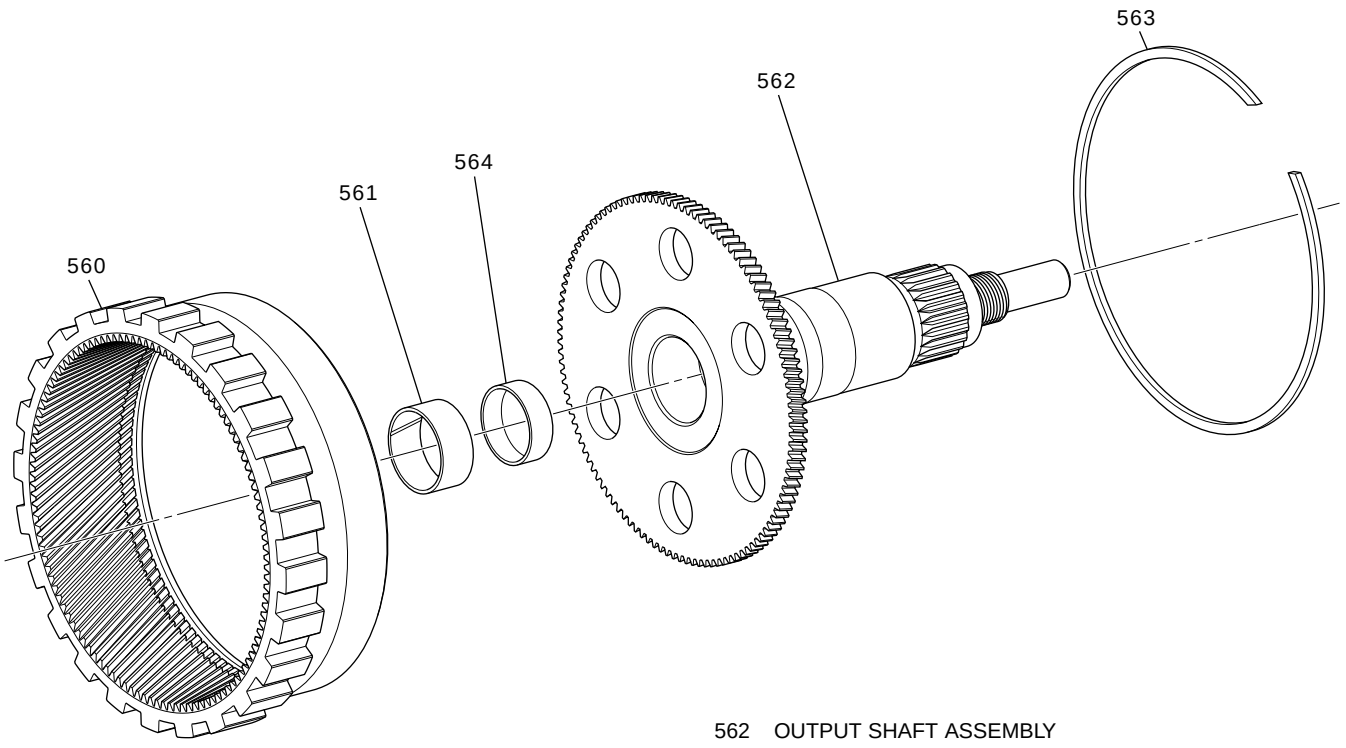
563 REAR INTERNAL RETAINER RING

564 CUP PLUG

Partlist_K4L40-E

Figure 125

Rear Internal Gear Output Shaft Assembly (5L40-E)



560 REAR INTERNAL GEAR

561 INPUT AND REACTION CARRIER BUSHING

562 OUTPUT SHAFT ASSEMBLY

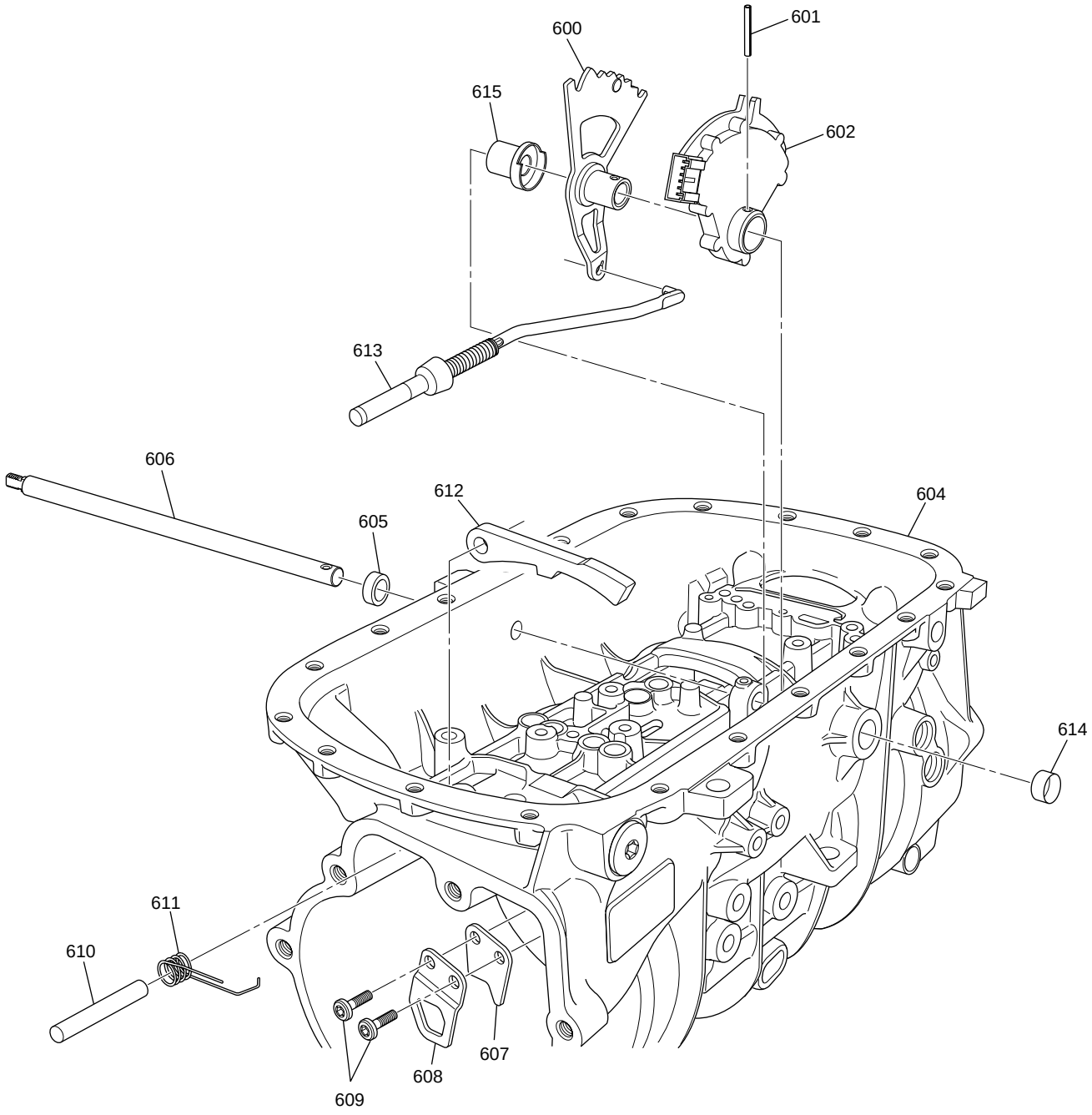
563 REAR INTERNAL RETAINER RING

564 CUP PLUG

Partlist_K

Figure 126

Park Pawl Assembly A



600 MANUAL SHAFT DETENT LEVER

601 MANUAL SHAFT DETENT LEVER PIN

602 TRANSMISSION MANUAL SHIFT SHAFT SWITCH ASSEMBLY

604 TRANSMISSION CASE ASSEMBLY

605 MANUAL SHIFT SHAFT SEAL

606 MANUAL SHIFT SHAFT

607 PARK PAWL ACTUATOR BRACKET

608 PARK PAWL ACTUATOR BRACKET

609 PARK PAWL ACTUATOR BRACKET BOLT

610 PARK PAWL SHAFT

611 PARK PAWL SPRING

612 PARK PAWL

613 PARK PAWL ACTUATOR ASSEMBLY

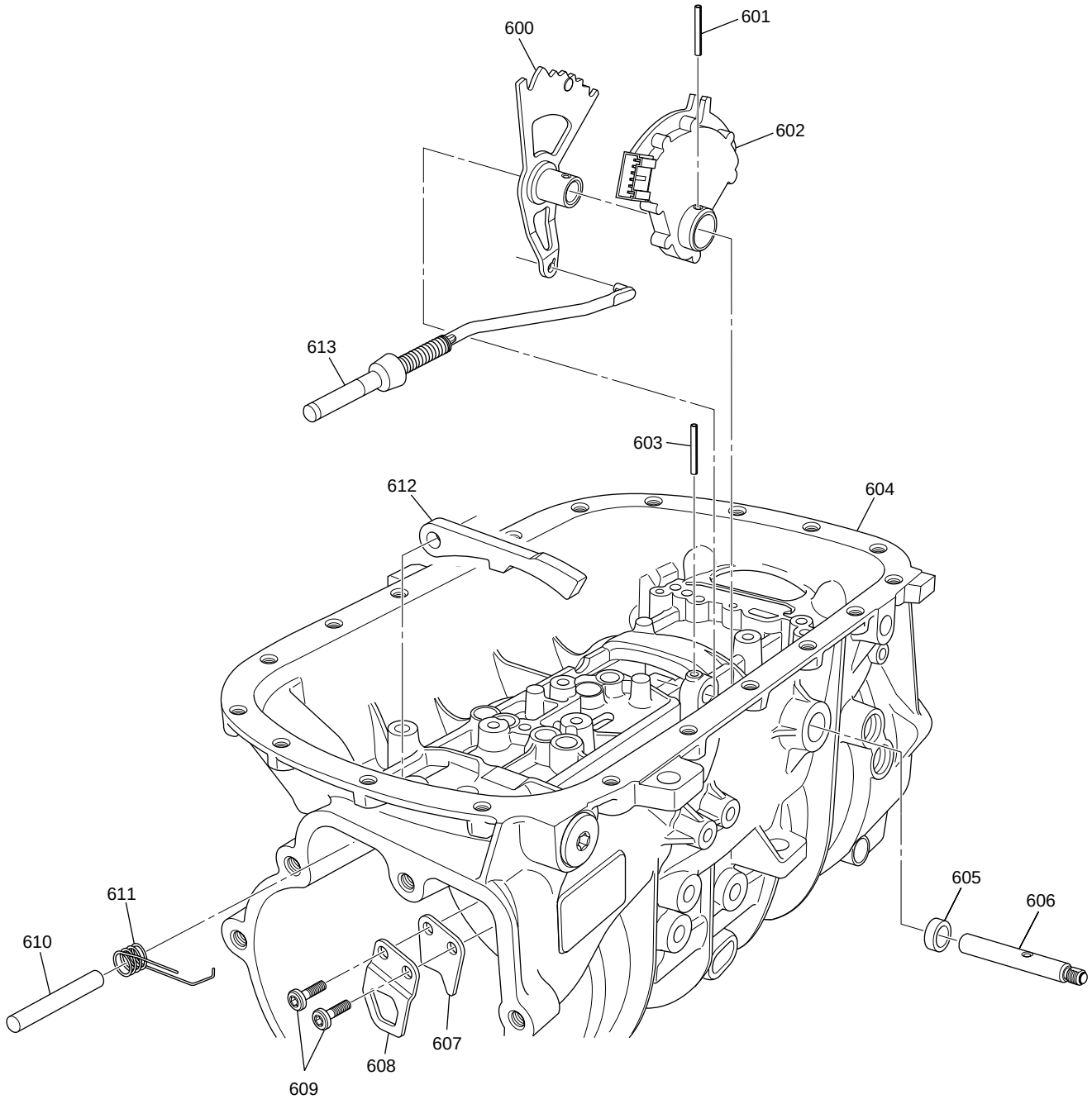
614 CUP PLUG

615 TRANSMISSION MANUAL SHIFT SHAFT ASSEMBLY SPACER

shift_assmA

Figure 127

Park Pawl Assembly B



600 MANUAL SHAFT DETENT LEVER

601 MANUAL SHAFT DETENT LEVER PIN

602 TRANSMISSION MANUAL SHIFT SHAFT SWITCH ASSEMBLY

603 MANUAL SHAFT DETENT LEVER PIN

604 TRANSMISSION CASE ASSEMBLY

605 MANUAL SHIFT SHAFT SEAL

606 MANUAL SHIFT SHAFT

607 PARK PAWL ACTUATOR BRACKET

608 PARK PAWL ACTUATOR BRACKET

609 PARK PAWL ACTUATOR BRACKET BOLT

610 PARK PAWL SHAFT

611 PARK PAWL SPRING

612 PARK PAWL

613 PARK PAWL ACTUATOR ASSEMBLY

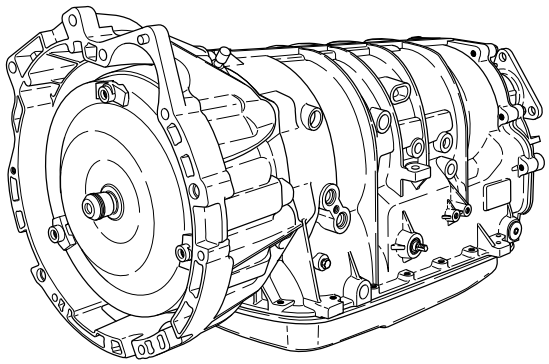
shift_assmB

Figure 128

BASIC SPECIFICATIONS

HYDRA-MATIC 4L40-E TRANSMISSION

Produced at: Strasbourg, France



HYDRA-MATIC 4L40-E (FOUR-SPEED)

Transmission Drive
Rear Wheel Drive
All Wheel Drive

Transmission Type
4L40-E = 4: Four Speed
L: Longitudinal Mount
40: Product Series
E: Electronically Controlled
Automatic Overdrive with a Torque Converter Clutch Assembly.

Current Engine Range
1.9 L Gasoline

Control Systems
Shift Pattern – (3) Two-way on/off solenoids
Shift Quality – Pressure Control Solenoid
Torque Converter Clutch – Pulse Width Modulated solenoid control

Gear Ratios

1st	2.82
2nd	1.54
3rd	1.00
4th	0.70
Rev	2.38

Maximum Engine Torque
180 N•m (133 lb ft)

Maximum Gearbox Torque
430 N•m (317 lb ft)

Maximum Shift Speed
Output: 8,500 RPM
Shift: 6,500 RPM

Maximum Gross Vehicle Weight
3,500 kg (7,716 lb)

Transmission Fluid Type
Dexron® III

Transmission Fluid Capacity (Approximate)
245 mm Converter (Dry): 8.5 L (9.0 qt)

Transmission Weight
245 mm Converter (Dry): 66.5 kg (146.6 lb)
(Wet): 74.0 kg (163.1 lb)

Converter Sizes Available
245 mm

Converter Bolt Circle Diameters
For 245 mm Converter – 228.0 mm to 247.7 mm

Converter Stall Torque Ratio Range
For 245 mm Converter – 1.60 to 2.70

Converter "K" Factor Range
For 245 mm Converter – 122 to 260
Not all "K" Factors are applicable across the range of Converter Stall Torque Ratios.

Transmission Packaging Information*
Overall Length
723.0 mm with 245 mm Converter
(2 Wheel Drive)
*All dimensions shown are nominal.

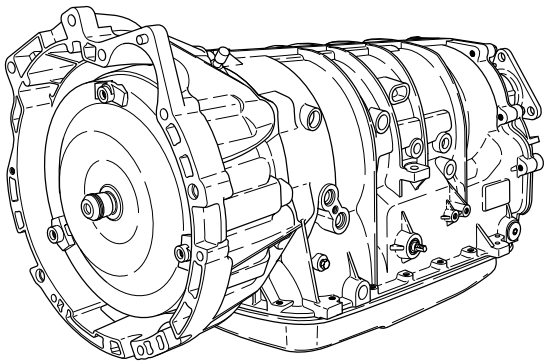
Driver Shift Control Only

Pressure Taps Available
Line Pressure

BASIC SPECIFICATIONS

HYDRA-MATIC 5L40-E TRANSMISSION

Produced at: Strasbourg, France



HYDRA-MATIC 5L40-E (FIVE-SPEED)

Transmission Drive
Rear Wheel Drive
All Wheel Drive

Transmission Type
5L40-E = 5: Five Speed
L: Longitudinal Mount
40: Product Series
E: Electronically Controlled
Automatic Overdrive with a Torque Converter Clutch Assembly.

Current Engine Range
2.2 L to 3.2 L Gasoline
2.0 L to 3.0 L Diesel

Control Systems
Shift Pattern – (3) Two-way on/off solenoids
Shift Quality – Pressure Control Solenoid
Torque Converter Clutch – Pulse Width Modulated solenoid control

Gear Ratios

1st	3.42
2nd	2.21
3rd	1.60
4th	1.00
5th	0.75
Rev	3.03

Maximum Engine Torque
390 N•m (288 lb ft)

Maximum Gearbox Torque
670 N•m (494 lb ft)

Maximum Shift Speed
Output: 8,500 RPM
Shift: 6,500 RPM

Maximum Gross Vehicle Weight
3,500 kg (7,716 lb)

Transmission Fluid Type
Dexron® III

Transmission Fluid Capacity (Approximate)
245 mm Converter (Dry): 8.5 L (9.0 qt)

Transmission Weight
245 mm Converter (Dry): 73.0 kg (161.0 lb)
(Wet): 80.5 kg (177.5 lb)

Converter Sizes Available
245 mm
245 mm Hybrid Converter (Option for applications above approximately 280 N•m (207 lb ft)
258 mm Converter (Option for applications above approximately 350 N•m (258 lb ft)

Converter Bolt Circle Diameters
For 245 mm Converter – 228.0 mm to 247.7 mm
For 245 mm Hybrid Converter – 234.0 mm (Reference)
For 258 mm Converter – 234.0 mm (Reference)

Converter Stall Torque Ratio Range
For 245 mm Converter – 1.60 to 2.70
For 245 mm Hybrid Converter – 2.0 (Reference)
For 258 mm Converter – 1.60 to 2.10

Converter "K" Factor Range
For 245 mm Converter – 122 to 260
For 245 mm Hybrid Converter – 140 (Reference)
For 258 mm Converter – 106 to 164
Not all "K" Factors are applicable across the range of Converter Stall Torque Ratios.

Transmission Packaging Information*
Overall Length
711.0 to 723.0 mm with 245 mm Converter (2 Wheel Drive)
728.0 mm with 258 mm Converter (2 Wheel Drive)
*All dimensions shown are nominal.

Seven Position Quadrant or Driver Shift Control
(P, R, N, (D), 4, 3, 2)

Pressure Taps Available
Line Pressure

Information may vary with application. All information, illustrations and specifications contained in this book are based on the latest product information available at the time of publication. The right is reserved to make changes at any time without notice.

HYDRA-MATIC PRODUCT DESIGNATION SYSTEM

The product designation system used for all Hydra-matic transaxles and transmissions consists of a series of numbers and letters that correspond with the special features incorporated in that product line. The first character is a number that designates the number of forward gear ranges available in that unit. For example: 4 = four forward gear ranges.

The second character is a letter that designates how the unit is mounted in the vehicle. When the letter "T" is used, it designates that the unit is transversely mounted and is used primarily for front wheel drive vehicles. The letter "L" designates that it is longitudinally mounted in the vehicle and it is used primarily for rear wheel drive vehicles. The letter "M" designates that the unit is a manual transaxle or transmission but not specific to a front or rear wheel drive vehicle application.

The third and fourth characters consists of a set of numbers, (i.e. "40"), that designate the transaxle or transmission "Series" number. This number signifies the relative torque capacity of the unit.

The fifth character designates the major features incorporated into this unit. For example, the letter "E" designates that the unit has electronic controls.

By using this method of classification, the HYDRA-MATIC 4L40-E is a 4-speed, longitudinally mounted, 40 series unit, with electronic controls.

HYDRA-MATIC 4L40-E

HYDRA-MATIC	4	L	40	E
	Number of Speeds: 3 4 5 V (CVT)	Type: T - Transverse L - Longitudinal M - Manual	Series: Based on Relative Torque Capacity	Major Features: E - Electronic Controls A - All Wheel Drive HD - Heavy Duty

HYDRA-MATIC PRODUCT DESIGNATION SYSTEM

The product designation system used for all Hydra-matic transaxles and transmissions consists of a series of numbers and letters that correspond with the special features incorporated in that product line. The first character is a number that designates the number of forward gear ranges available in that unit. For example: 5 = five forward gear ranges.

The second character is a letter that designates how the unit is mounted in the vehicle. When the letter "T" is used, it designates that the unit is transversely mounted and is used primarily for front wheel drive vehicles. The letter "L" designates that it is longitudinally mounted in the vehicle and it is used primarily for rear wheel drive vehicles. The letter "M" designates that the unit is a manual transaxle or transmission but not specific to a front or rear wheel drive vehicle application.

The third and fourth characters consists of a set of numbers, (i.e. "40"), that designate the transaxle or transmission "Series" number. This number signifies the relative torque capacity of the unit.

The fifth character designates the major features incorporated into this unit. For example, the letter "E" designates that the unit has electronic controls.

By using this method of classification, the HYDRA-MATIC 5L40-E is a 5-speed, longitudinally mounted, 40 series unit, with electronic controls.

HYDRA-MATIC 5L40-E

HYDRA-MATIC	5	L	40	E
	Number of Speeds: 3 4 5 V (CVT)	Type: T - Transverse L - Longitudinal M - Manual	Series: Based on Relative Torque Capacity	Major Features: E - Electronic Controls A - All Wheel Drive HD - Heavy Duty

GLOSSARY OF TECHNICAL TERMS

Accumulator: A component of the transmission that absorbs hydraulic pressure during the apply of clutch or band. Accumulators are designed to control the quality of a shift from one gear range to another.

Adaptive Learning: Programming within the TCM that automatically adjusts hydraulic pressures in order to compensate for changes in the transmission (i.e. component wear).

Applied: An apply component that is holding another component to which it is splined or assembled with. Also referred to as "engaged".

Apply Components: Hydraulically operated clutches, servos, bands, and mechanical one-way roller or sprag clutches that drive or hold members of a planetary gear set.

Apply Plate: A steel clutch plate in a clutch pack located next to the (apply) piston.

Backing Plate: A steel plate in a clutch pack that is usually the last plate in that clutch assembly (farthest from the clutch piston).

Ball Check Valve: A spherical hydraulically controlled component (usually made of steel) that either seals or opens fluid circuits. It is also referred to as a check valve or checkball.

Band: An apply component that consists of a flexible strip of steel and friction material that wraps around a drum. When applied, it tightens around the drum and prevents the drum from rotating.

Brake Switch: An electrical device that provides signals to the Transmission Control Module (TCM) based on the position of the brake pedal. The TCM uses this information to apply or release the torque converter clutch (TCC).

Centrifugal Force: A force that is imparted on an object (due to rotation) that increases as that object moves further away from a center/point of rotation.

Clutch Pack: An assembly of components generally consisting of clutch plates, an apply plate and a backing plate.

Clutch Plate: A hydraulically activated component that has two basic designs: (1) all steel, or (2) a steel core with friction material bonded to one or two sides of the plate.

Component: Any physical part of the transmission.

Control Valve Body: A machined metal casting that contains valve trains and other hydraulically controlled components that shift the transmission.

Coupling Speed: The speed at which a vehicle is traveling and no longer requires torque multiplication through the torque converter. At this point the stator free wheels to allow fluid leaving the turbine to flow directly to the pump. (See torque converter)

De-energize(d): To interrupt the electrical current that flows to an electronically controlled device making it electrically inoperable.

Direct Drive: A condition in a gear set where the input speed and input torque equals the output speed and torque. The gear ratio through the gear set is 1:1.

Downshift: A change in a gear ratio where input speed and torque increases.

Driver Shift Control: A selector system variant which is configured to be shifted only manually, and allows for engine braking in first, second, third and fourth gears.

Duty Cycle: In reference to an electronically controlled solenoid, it is the amount of time (expressed as a percentage) that current flows through the solenoid coil.

Engine Control Module (ECM): An electronic device that manages the electrical system of the engine.

Energize(d): To supply a current to an electronically controlled device enabling it to perform its designed function.

Engine Compression Braking: A condition where compression from the engine is used with the transmission to decrease vehicle speed. Braking (slowing of the vehicle) occurs when a lower gear ratio is manually selected by moving the gear selector lever.

Exhaust: The release of fluid pressure from a hydraulic circuit. (The words exhausts and exhausting are also used and have the same intended meaning.)

Fluid: Generally considered a liquid or gas. In this publication fluid refers primarily to "transmission fluid".

Fluid Pressure: A pressure (in this textbook usually transmission fluid) that is consistent throughout its circuit.

Force: A measurable effort that is exerted on an object (component).

Freewheeling: A condition where power is lost through a driving or holding device (i.e. roller or sprag clutches).

Friction Material: A heat and wear resistant fibrous material bonded to clutch plates and bands.

Gear: A round, toothed device that is used for transmitting torque through other components.

Gear Range: A specific speed to torque ratio at which the transmission is operating (i.e. 1st gear, 2nd gear etc.).

GLOSSARY OF TECHNICAL TERMS

Gear Ratio: Revolutions of an input gear as compared to the revolutions of an output gear. It can also be expressed as the number of teeth on a gear as compared to the number of teeth on a gear that it is in mesh with.

Hydraulic Circuit: A fluid passage which often includes the mechanical components in that circuit designed to perform a specific function.

Input: A starting point for torque, revolutions or energy into another component of the transmission.

Internal Gear: The outermost member of a gear set that has gear teeth in constant mesh with planetary pinion gears of the gear set.

Internal Leak: Loss of fluid pressure in a hydraulic circuit.

Land (Valve Land): The larger diameters of a spool valve that contact the valve bore or bushing.

Line Pressure: The main fluid pressure in a hydraulic system created by the pump and pressure regulator valve.

Manual Valve: A spool valve that distributes fluid to various hydraulic circuits and is mechanically linked to the gear selector lever.

Orifice: A restricting device (usually a hole in the spacer plate) for controlling pressure build up into another circuit.

Overdrive: An operating condition in the gear set allowing output speed to be higher than input speed and output torque to be lower than input torque.

Overrunning: The function of a one-way mechanical clutch that allows the clutch to freewheel during certain operating conditions of the transmission.

Pinion Gear: A small toothed gear that meshes with a larger gear.

Planet Pinion Gears: Pinion gears (housed in a carrier) that are in constant mesh with a circumferential internal gear and centralized sun gear.

Planetary Gear Set: An assembly of gears that consists of an internal gear, planet pinion gears with a carrier, and a sun gear.

Powertrain Control Module (PCM): An electronic device that manages most of the electrical systems throughout the vehicle.

Pressure: A measurable force that is exerted on an area and expressed as kilopascals (kPa) or pounds per square inch (psi).

Pulse Width Modulated (PWM): An electronic signal that continuously cycles the ON and OFF time of a device (such as a solenoid) while varying the amount of ON time.

Race (Inner or Outer): A highly polished steel surface that contacts bearings or sprag or roller elements.

Reduction (Gear Reduction): An operating condition in the gear set allowing output speed to be lower than input speed and output torque to be higher than input torque.

Residual Fluid Pressure: Excess pressure contained within an area after the supply pressure has been terminated.

Roller Clutch: A mechanical clutch (holding device) consisting of roller bearings assembled between inner and outer races.

Safety Mode: A condition whereby a component (i.e. engine or transmission) will partially function even if its electrical system is disabled.

Servo: A spring loaded device consisting of a piston in a bore that is operated (stroked) by hydraulic pressure to apply or release a band.

Solenoid Valve: An electronic device used to control transmission shift patterns or regulate fluid pressure.

Spool Valve: A cylindrical hydraulic control device having a variety of land and valley diameters, used to control fluid flow.

Sprag Clutch: A mechanical clutch (holding device) consisting of figure eight like elements assembled between inner and outer races.

Throttle Position: The travel of the throttle plate that is expressed in percentages and measured by the throttle position (TP) sensor.

Torque: A measurable twisting force expressed in terms of Newton-meters (N•m), pounds feet (lbs ft) or pounds inches (lbs in).

Torque Converter: A component of an automatic transmission, (attached to the engine flywheel) that transfers torque from the engine to the transmission through a fluid coupling.

Transmission Control Module (TCM): An electronic device that manages the electrical system of the transmission.

Variable Capacity Pump: The device that provides fluid for operating the hydraulic circuits in the transmission. The amount of fluid supplied varies depending on vehicle operating conditions.

ABBREVIATIONS

AC - Alternating Current
A/C - Air Conditioning
ACC or ACCUM - Accumulator
AFL - Actuator Feed Limit
ALDL - Assembly Line Diagnostic Link
AMP - Amperage
ASM - Assembly
AT - Automatic Transmission

°C - Degrees Celsius
CC - Converter Clutch
CL - Clutch
CONT - Control
CONV - Converter

DC - Direct Current
D.C. - Duty Cycle
DLC - Diagnostic Link Connector
DRAC - Digital Ratio Adaptor Converter
DSC - Driver Shift Control
DTC - Diagnostic Trouble Code
D2 - Drive 2 (circuit)
D3 - Drive 3 (circuit)
D4 - Drive 4 (circuit)
D432 - Drive 432 (circuit)

ECM - Engine Control Module
ECT - Engine Coolant Temperature
EX - Exhaust

°F - Degrees Fahrenheit
FD - Feed
FWD - Forward

Hz - Hertz

ISS - Input Speed Sensor

KM/H - Kilometers per Hour
kPa - KiloPascals

MAP - Manifold Absolute Pressure
MPH - Miles per Hour

N - Neutral
NC - Normally Closed
N·m - Newton Meters
NO - Normally Open

ORF - Orificed
ORUN - Overrun
OSS - Output Speed Sensor

P - Park
PCM - Powertrain Control Module
PC - Pressure Control (solenoid)
PR - Park Reverse (circuit)
PRESS REG - Pressure Regulator
PSI - Pounds per Square Inch
PWM - Pulse Width Modulated

R - Reverse
REV - Reverse
RPM - Revolutions per Minute

SEL - Selective
SIG - Signal
SOL - Solenoid
SS - Shift Solenoid

TCC - Torque Converter Clutch
TCM - Transmission Control Module
TFP - Transmission Fluid Pressure
TFT - Transmission Fluid Temperature
TP - Throttle Position (sensor)
TRANS - Transmission or Transaxle

V - Volts
VSS - Vehicle Speed Sensor

2WD - 2 Wheel Drive
4WD - 4 Wheel Drive

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NOTES