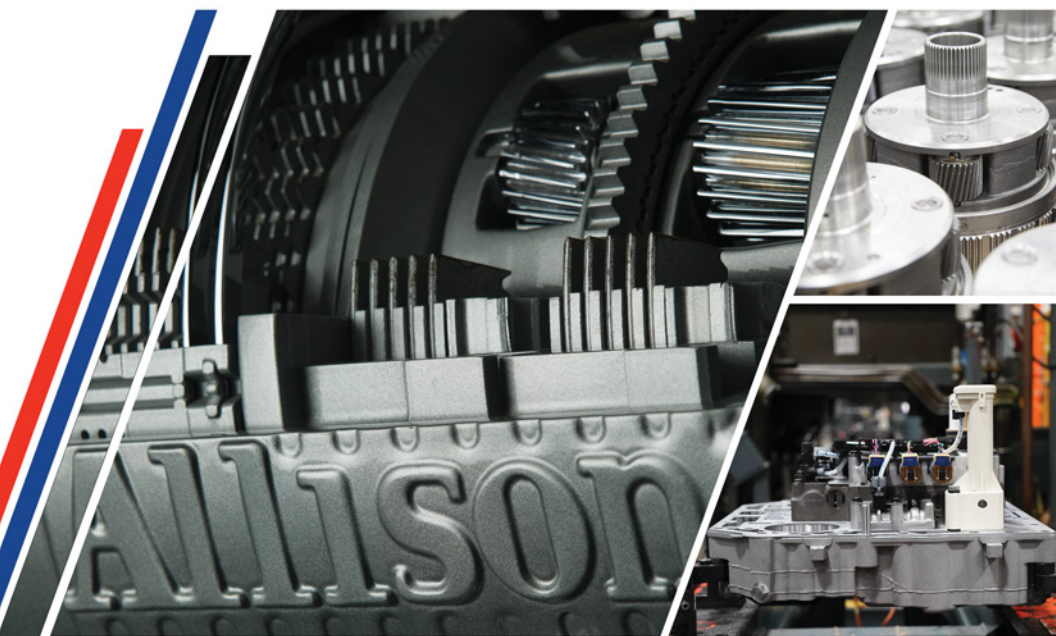


# 3000 and 4000 Series

Allison 5th and 6th Generation Controls



## OPERATOR'S MANUAL

# Operator's Manual

2023 JUNE

OM8491EN

## Allison Transmission

3000 Series™ and 4000 Series™

3000	3500 SP	4500 ORS	4800 ORS	B 295
3000 EVS	3700	4500 RDS	4800 SP	B 300
3000 HS	3700 SP	4500 SP	4850 EVS	B 400
3000 MH	4000	4600 ORS	4870	B 500
3000 ORS	4000 EVS	4650 OFS	4870 EVS	B3400 xFE™
3000 PTS	4000 HS	4700	4870 ORS*	T 260
3000 RDS	4000 MH	4700 EVS	4870 RDS	T 270
3000 SP	4000 ORS	4700 OFS	4870 SP*	T 280
3000 TRV	4000 RDS	4700 ORS	4900	T 310
3200	4000 SP	4700 RDS	4900 EVS	T 325
3200 MH	4000 TRV	4700 SP	4900 OFS	T 350
3200 ORS	4200 ORS	4750 OFS	4900 ORS	T 375
3200 SP	4430 OFS	4770	4900 RDS	T 390
3200 TRV	4430 ORS	4770 EVS	4900 SP	T 425
3500	4430 SP	4770 ORS*	4970	T 450
3500 EVS	4500	4770 RDS	4970 EVS	T 525
3500 OFS	4500 EVS	4770 SP*	4970 ORS*	T3280 xFE™
3500 ORS	4500 HS	4800	4970 RDS	T3325 xFE™
3500 RDS	4500 OFS	4800 EVS	4970 SP*	T3375 xFE™

\* These models are part of the Allison TerraTran™ family of products.



Allison Transmission, Inc.  
P.O. Box 894 Indianapolis, Indiana 46206-0894  
[allisontransmission.com](http://allisontransmission.com)



## IMPORTANT SAFETY INFORMATION

**IT IS YOUR RESPONSIBILITY** to be completely familiar with the warnings and cautions in this manual. These warnings and cautions advise of specific methods or actions that can result in personal injury, equipment damage or cause the equipment to become unsafe. These warnings and cautions are not exhaustive. Allison Transmission could not possibly know, evaluate or advise the service trade of all conceivable procedures by which service might be performed or of the possible hazardous consequences of each procedure. Accordingly, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ALLISON TRANSMISSION MUST first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service methods used.

Vehicle or equipment manufacturers (collectively hereinafter "manufacturer(s)") integrate Allison transmissions into vehicles or equipment used for a variety of vocations and services. The manufacturer is responsible for identifying the specific operating conditions to which the vehicle or equipment will be subjected and to communicate the appropriate means for preventing unintended vehicle or equipment movement within those conditions, in order to ensure vehicle or equipment safety and operator safety. The vehicle or equipment owner and operator should be aware of and follow the manufacturer's operating instructions and warnings related to parking and preventing unintended vehicle or equipment movement.

Proper service and repair is important to the safe and reliable operation of the equipment. The service procedures recommended by Allison Transmission (or the manufacturer) and described in this manual are effective methods for performing service and diagnostic operations. Some procedures require using specially designed tools. Use special tools when and in the manner recommended.

The WARNINGS, CAUTIONS and NOTES in this manual apply only to the Allison transmission and not to other vehicle or equipment systems which may interact with the transmission. Be sure to review and observe any vehicle or equipment system information provided by the manufacturer and/or body builder at all times the Allison transmission is being serviced.

### WARNINGS, CAUTIONS, NOTES

**Three types of headings are used in this manual to attract your attention:**



**WARNING:** A warning is used when an operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.



**CAUTION:** A caution is used when an operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.



**NOTE:** A note is used when an operating procedure, practice, etc., is essential to highlight.

## ABBREVIATIONS AND ACRONYMS

• ABMS	Acceleration Based Mode Switch
• ABP	Acceleration Based Pattern
• ABS	Anti-lock Brake System
• ACCT	Allison Calibration Configuration Tool
• ARM	Acceleration Rate Management
• ATI	Allison Transmission, Inc.
• BUS	Bus Series Vocational Model
• C1	Clutch 1
• C5	Clutch 5
• C6	Clutch 6
• C7	Clutch 7
• CAN	Controller Area Network
• CMC	Customer Modifiable Constant
• DMD	Display Mode/Diagnostic
• DNA	Do Not Adapt
• DNS	Do Not Shift
• DOC	Diagnostic Optimized Connection
• DSS	Dynamic Shift Sensing
• DTC	Diagnostic Trouble Code
• DTCs	Diagnostic Trouble Codes
• ECLR	Enhanced Converter Load Release
• ECM	Engine Control Module
• EMI	Electromagnetic Interference
• ES-S	Engine Stop-Start
• EVS	Emergency Vehicle Series
• FCC	Federal Communications Commission
• FLGS	Full Load Governed Speed
• FLI	Filter Life Indicator
• FM	Filter Life Monitor
• HS	Highway Series
• HSD1	High Side Driver 1
• HSD2	High Side Driver 2
• HSD3	High Side Driver 3

• I/O	Input/Output
• INT	International Series
• LBSS	Load-Based Shift Scheduling
• LIR	Lock in Range
• LRTP	Low Range Torque Protection
• LU	Lockup
• MH	Motorhome Series
• OEM	Original Equipment Manufacturer
• OFS	Oil Field Series
• OLS	Oil Level Sensor
• OM	Oil Life Monitor
• ORS	Off Road Series
• PCS	Pressure Control Solenoid
• PCS1	Pressure Control Solenoid 1
• PCS2	Pressure Control Solenoid 2
• PCS5	Pressure Control Solenoid 5
• PS1	Pressure Switch 1
• PTO	Power Takeoff
• PTS	Pupil Transport/Shuttle Series
• PWM	Pulse-Width Modulation
• RAM	Random Access Memory
• RDS	Rugged Duty Series
• RELS	Reduced Engine Load at Stop
• RFI	Radio Frequency Interference
• RMR	Retarder Modulation Request
• rpm	Revolutions Per Minute
• SAE	Society of Automotive Engineers
• SEM	Shift Energy Management
• SESS	Super Economy Shift Schedule
• SIL	Service Information Letter
• SP	Specialty Series
• SPI	Serial Peripheral Interface
• TAN	Total Acid Number
• TCC	Torque Converter Clutch

• TCM	Transmission Control Module
• TCMs	Transmission Control Modules
• TID	Transmission Identification Number
• TM	Transmission Health Monitor
• TPS	Throttle Position Sensor
• TRV	Truck RV Series
• TSC1	Torque Speed Control 1
• VAC	Vehicle Acceleration Control
• VEPS	Vehicle Electronic Programming Stations
• VF	Vacuum Fluorescent
• VFD	Vacuum Fluorescent Display
• VIM	Vehicle Interface Module
• VIW	Vehicle Interface Wiring
• WOT	Wide Open Throttle

## **TRADEMARK USAGE**

The following trademarks are the property of the companies indicated:

- 3000 Series™ is a Trademark of Allison Transmission, Inc.
- 4000 Series™ is a Trademark of Allison Transmission, Inc.
- Allison DOC® is a Registered Trademark of Allison Transmission, Inc.
- FuelSense® is a Registered Trademark of Allison Transmission, Inc.
- TES 295® is a Registered Trademark of Allison Transmission, Inc.
- TES 668® is a Registered Trademark of Allison Transmission, Inc.
- TES 389® is a Registered Trademark of Allison Transmission, Inc.



## **SUPERSESIONS**

This manual supersedes the following Operators Manuals:

OM3349; OM3654; OM3656; OM3749; OM3750; OM3751; OM3752;  
OM3753; OM4119; OM5821; OM5822; OM5823; OM5824; OM5825;  
OM5826; OM5827; OM5828; OM5829; OM5839; OM7152; OM7153;  
OM7154; OM7155; OM7156; OM7157; OM7158; OM7159; OM7160;  
OM7161; OM7707

## **ISO 14000**

As a responsible corporate citizen, Allison Transmission, Inc. is dedicated to protecting human health, natural resources and the global environment. End-users and service personnel are responsible for understanding and complying with all applicable environmental laws, safety regulations and Allison Transmission's policies and standards. The following recommendations concern the treatment and disposal of hazardous materials resulting from servicing an Allison Transmission product.

1. All lubricants/fluids used in the operation or storage of a transmission are to be treated as hazardous waste. These fluids are to be separated and discarded per current local statutes/regulations for the purpose of recycling, treatment, storage and/or disposal.
2. Oil soaked components (e.g., filters, seals, clutch packs, etc.) are to be treated as hazardous waste and are to be handled and discarded per current local statutes/regulations.
3. Exhausted electronic components (e.g., transmission control modules (TCM), pressure switches, speed sensors, etc.) are to be treated as electronic waste and are to be handled and discarded per current local statutes/regulations.

## LIST OF WARNINGS

This manual contains the following warnings—

**IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.**



**WARNING:** This product can expose you to chemicals including lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm.

For more information go to [www.p65Warnings.ca.gov/product](http://www.p65Warnings.ca.gov/product).

- **When starting the engine, make sure the service brakes are applied. Failure to apply service brakes may result in unexpected vehicle movement.**
- **If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. If you must leave the engine running, DO NOT LEAVE the vehicle until you have completed all of the following procedures:**
  - **Put the transmission in N (Neutral).**
  - **Be sure the engine is at low idle (500–800 rpm).**
  - **Apply the parking and emergency brakes and make sure they are properly engaged.**
  - **Chock the wheels and take other steps necessary to keep the vehicle from moving.**
- **The vehicle service brakes, parking brake, or emergency brake must be applied whenever N (Neutral) is selected to prevent unexpected vehicle movement. Selecting N (Neutral) does not apply the vehicle brakes unless an auxiliary system to apply the parking brake is installed by the OEM.**
- **Using the retarder on wet or slippery roads may cause loss of traction on the drive wheels—your vehicle may slide out of control. To help avoid injury or property damage, turn the retarder enable to OFF when driving on wet or slippery roads.**

## LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

**IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.**

- To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from N (Neutral) to D (Drive) or R (Reverse) when the engine is above low idle rpm. The vehicle may lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from N (Neutral) to a forward range or R (Reverse) only when the throttle is closed and the service brakes are applied.
- To help avoid unexpected vehicle movement that might cause death, serious injury, or property damage, always have your foot on the brake, the throttle released, and the engine at idle before making a N (Neutral) to D (Drive); N (Neutral) to R (Reverse); D (Drive) to R (Reverse); or R (Reverse) to D (Drive) selection.
- R (Reverse), R1 (Low Reverse) or R2 (Standard Reverse) may not be attained due to an active inhibitor. Always apply the service brakes when selecting R (Reverse), R1 (Low Reverse) or R2 (Standard Reverse) to prevent unexpected vehicle movement and because a service brake inhibit may be present. When R, R1 or R2 is flashing, it indicates the shift to R (Reverse), R1 (Low Reverse) or R2 (Standard Reverse) is inhibited. Determine if diagnostic codes are active if R (Reverse), R1 (Low Reverse) or R2 (Standard Reverse) is not attained. Refer to **7.5 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DIAGNOSTIC TROUBLE CODES (DTCs) AND INHIBITS**
- When starting the engine, make sure the service brakes are applied. Failure to apply the service brakes can result in unexpected vehicle movement.
- If you let the vehicle coast in N (Neutral), there is no engine braking and you could lose control. Coasting can also cause severe transmission damage. To help avoid injury and property damage, do not allow the vehicle to coast in N (Neutral).

## LIST OF WARNINGS (cont'd)

**This manual contains the following warnings—  
IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.**

- **D (Drive) may not be attained due to an active inhibitor. Always apply the service brakes when selecting D (Drive) to prevent unexpected vehicle movement and because a service inhibit may be present. When the selected range is flashing, it indicates the shift to D (Drive) is inhibited. Determine if diagnostic codes are active if D (Drive) is not attained. Refer to [7.5 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DIAGNOSTIC TROUBLE CODES \(DTCs\) AND INHIBITS](#).**
- **To avoid loss of control, use a combination of downshifting, braking, and other retarding devices. Downshifting to a lower transmission range increases engine braking and can help you maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if engine governed speed is exceeded in the lower range, the transmission will upshift to the next higher range to prevent engine damage. This will reduce engine braking and could cause a loss of control. Apply the vehicle brakes or other retarding device to prevent exceeding engine governed speed in the lower range selected.**

## **LIST OF WARNINGS (cont'd)**

**This manual contains the following warnings—**

**IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.**

- **This input function involves the use of complex algorithms in the control logic. If the function is enabled in the calibration but the control circuit for the function is not installed, there is a potential risk for one or more system failure modes which could result in undesirable transmission operation. Therefore, the activation circuit for this function **MUST BE** properly integrated in the vehicle in which it is installed. If the function will not be used in the final vehicle, it **MUST NOT** be ordered in the calibration. For specific installations, the vehicle may be operated prior to full integration of the function into the vehicle wiring. For example, a bare chassis transported to a body builder where the function will be wired into the completed vehicle. In these cases, if the function is activated in the calibration, the specific wires related to the function must be electrically isolated, completely and individually. Until properly integrated into the final vehicle wiring, the chassis builder must protect the wires such that they do not make electrical contact with the following:**
  - **each other, if the function involves more than one wire**
  - **any other transmission wiring**
  - **any other vehicle wires**
  - **any part of the vehicle or chassis**
- **This schematic shows the intended use of the specified controls feature which has been validated in the configuration shown. Any miswiring or use of this feature which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. Allison Transmission is not liable for the consequences associated with miswiring or unintended use of these features.**

## **LIST OF WARNINGS (cont'd)**

**This manual contains the following warnings—  
IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.**

- **DO NOT USE THE RETARDER DURING INCLEMENT WEATHER OR WHEN ROAD SURFACES ARE SLIPPERY.**

Use of the hydraulic retarder during inclement weather or when road surfaces are slippery could result in death, serious injury, or property damage. On vehicles which have a primary retarder control based upon closed throttle position, brake pedal position, or brake apply pressure, always manually disable the retarder controls during inclement weather or slippery road conditions, using the OEM provided retarder enable switch if present.

If the transmission retarder does not apply, death, serious injury, or property damage may occur. Operator should be prepared to apply vehicle brakes or other retarder device if the transmission retarder does not apply.

If the transmission retarder does not function, death, serious injury, or property damage may occur. Be sure to test for proper retarder function periodically. If a retarder is present but is not detected by “autodetect,” the retarder will not function. Whenever the retarder does not apply, seek service help immediately.

- **Avoid contact with the hot fluid or the sump when draining transmission fluid. Direct contact with the hot fluid or the hot sump may result in bodily injury.**
- **Without the SAE J1939 communication datalink, the shift selector cannot display the selected transmission range. Vehicle operation will be affected.**

## **LIST OF WARNINGS (cont'd)**

**This manual contains the following warnings—**

**IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.**

- **Assuming proper installation of direction signal wire 134, most Allison shift selectors may still be used to command transmission direction changes in these circumstances. Due to the failure of the SAE J1939 datalink communication, however, the shift selector cannot display the selected range. When this condition exists, it is advisable to slowly and carefully apply the throttle each time a change of direction has been selected in order to verify the direction of operation before accelerating the vehicle.**

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# 1.0 SCOPE OF MANUAL

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## 1.1 SCOPE OF MANUAL

This Operator's Manual contains a variety of information about the Allison 3000 and 4000 Series Transmission, and its Allison 5th Generation and 6th Generation Controls features. Refer to the Table of Contents to locate information by subject in this publication.

Additional information about your transmission is available at [allisontransmission.com](http://allisontransmission.com) using the publications links shown on the home page. Refer to the Sales and Service Locator at [allisontransmission.com](http://allisontransmission.com) to find contact and location information for Allison Transmission distributors and dealers.

If you need to contact an Allison Transmission representative, refer to the Customer Service section at the end of this publication for contact information.

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## 2.0 INTRODUCTION

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### 2.1 KEEPING THAT ALLISON ADVANTAGE

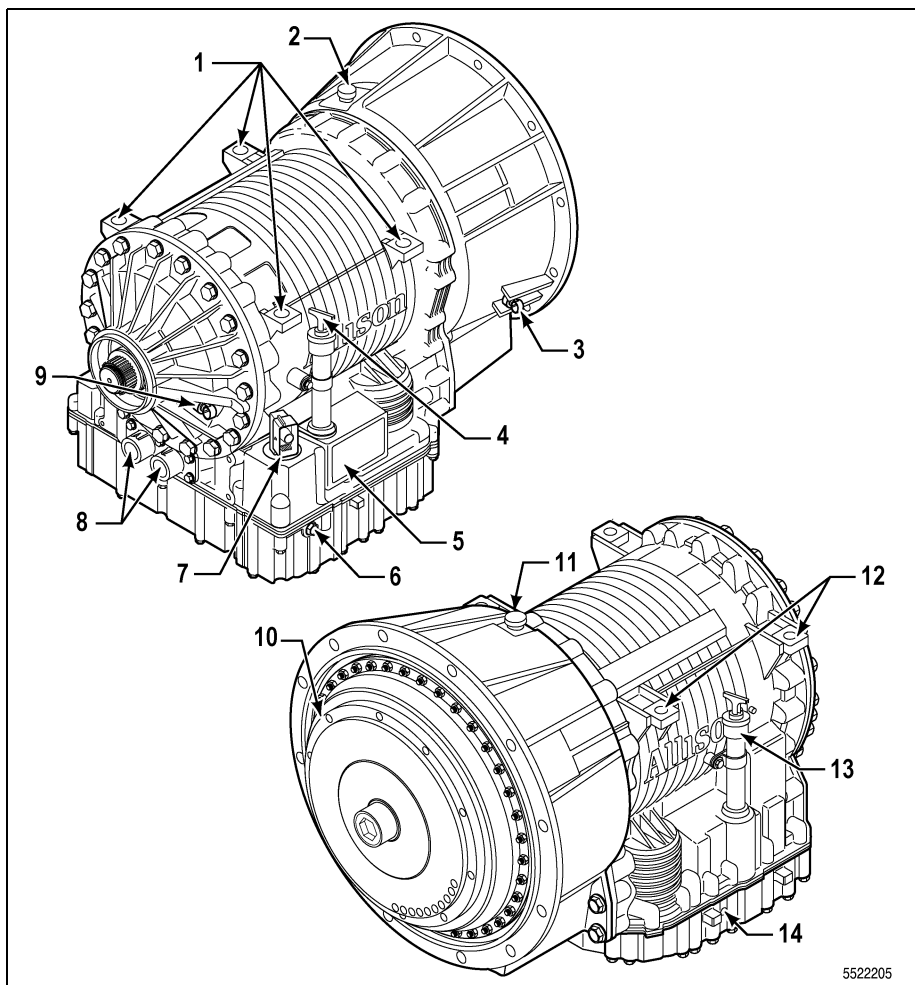


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Allison transmissions provide many advantages for the driver who must “stop and go” or change speeds frequently. Driving is easier, safer and more efficient.

Each transmission series (INT, MH, OFS, PTS, RDS, SP, HS, EVS, T-Series, ORS, BUS and TRV) contains features which have been designed for specific vocational needs.

The transmissions are rugged and designed to provide long, trouble-free service. This manual will help you gain maximum benefits from your Allison-equipped vehicle. Refer to [Figure 2-1](#) and [Figure 2-2](#) for non-PTO applications and [Figure 2-3](#), [Figure 2-4](#) and [Figure 2-5](#) for PTO applications. Refer to [Figure 2-6](#) for 4700/4800/4770/4870/4970 transmissions.

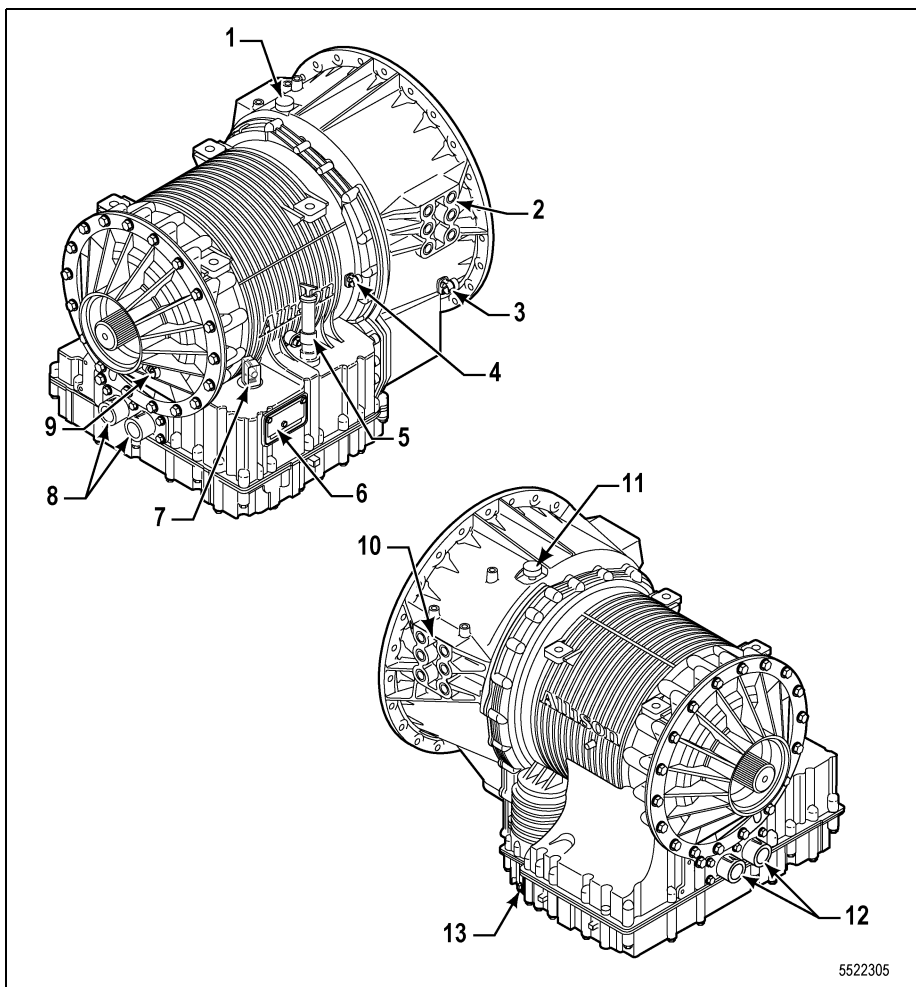


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- |  |   |
|--|---|
| (1) – Assembly Pads                                    | (8) – Cooler Ports  |
| (2) – Breather   | (9) – Output Speed Sensor                                       |
| (3) – Input Speed Sensor                               | (10) – Torque Converter with Lockup Clutch and Torsional Damper |
| (4) – Fill Tube and Dipstick (Available on Both Sides) | (11) – Breather   |
| (5) – Nameplate  | (12) – Assembly Pads (Both Sides)                               |
| (6) – Main-Pressure Tap                                | (13) – Fill Tube and Dipstick (Available on Both Sides)         |
| (7) – Feedthrough Harness Connector                    | (14) – Main-Pressure Tap  |

**Figure 2–1. 3000/3200/3500 Series**

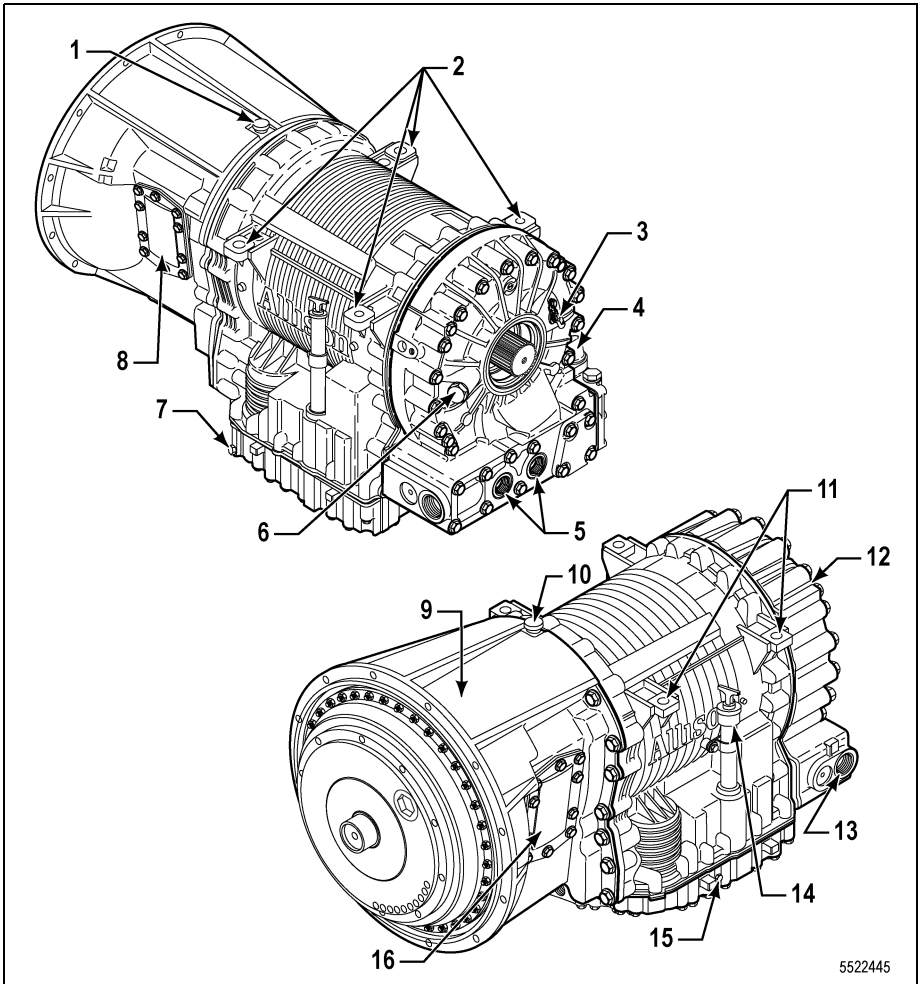




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- |                                     |                                  |
|-------------------------------------|----------------------------------|
| (1) – Breather                      | (8) – Cooler Ports               |
| (2) – Mounting Pad                  | (9) – Output Speed Sensor        |
| (3) – Input Speed Sensor            | (10) – Mounting Pad (Both Sides) |
| (4) – Turbine Speed Sensor          | (11) – Breather                  |
| (5) – Fill Tube and Dipstick        | (12) – Cooler Ports              |
| (6) – Nameplate                     | (13) – Main-Pressure Tap         |
| (7) – Feedthrough Harness Connector |                                  |

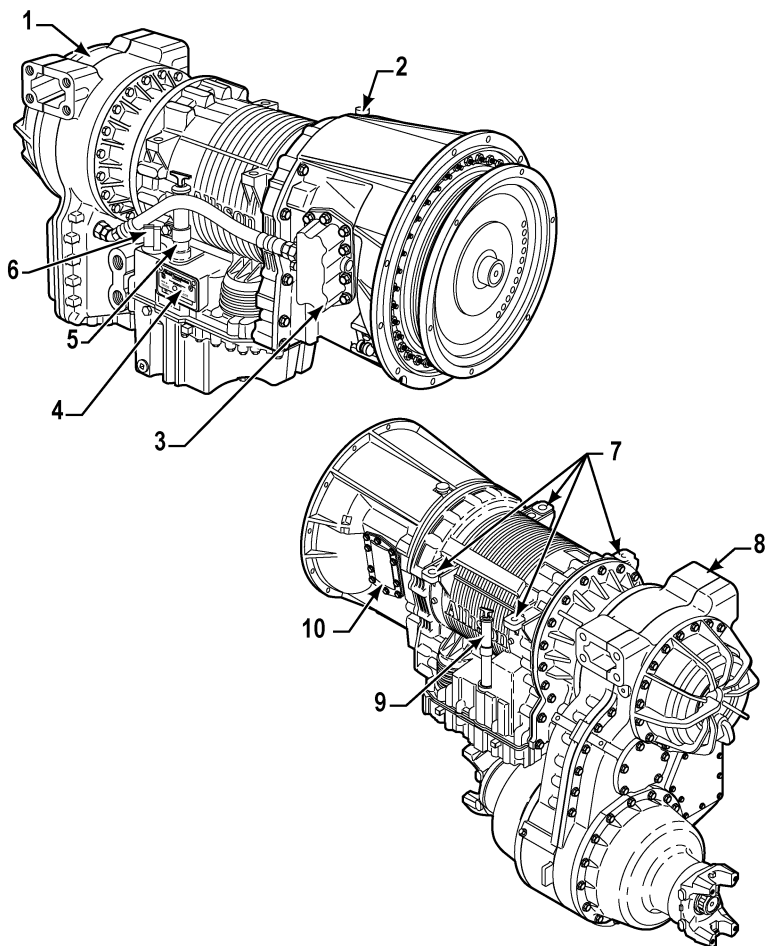
**Figure 2–2. 4000/4200/4430/4440/4500/4600 Series**



5522445

- |   |  |
|---|--|
| (1) - Breather  | (10) - Breather  |
| (2) - Assembly Pads   | (11) - Assembly Pads (Both Sides)                              |
| (3) - Output Speed Sensor   | (12) - Output Retarder   |
| (4) - Retarder Valve Body Connector                               | (13) - To Retarder Accumulator                                 |
| (5) - Cooler Ports  | (14) - Oil Fill Tube and Dipstick<br>(Available on Both Sides) |
| (6) - Tachograph Provision  | (15) - Main-Pressure Tap                                       |
| (7) - Main-Pressure Tap   | (16) - PTO Provision   |
| (8) - PTO Provision   |  |
| (9) - Torque Converter with Lockup<br>Clutch and Torsional Damper |  |

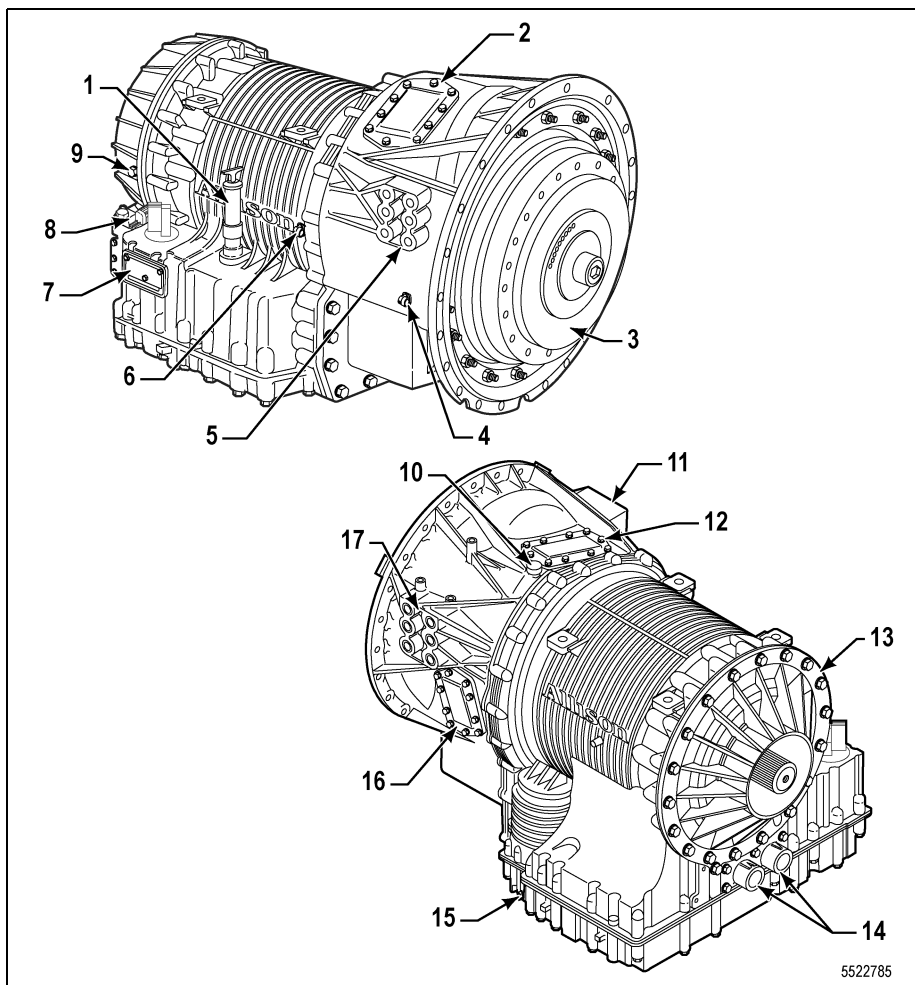
**Figure 2-3. 3000/3200/3500 Series with PTO and Retarder**



5522585

- |   |                                     |
|---|-------------------------------------|
| (1) – Transfer Case   | (6) – Feedthrough Harness Connector |
| (2) – Breather  | (7) – Assembly Pads (Both Sides)    |
| (3) – Scavenge Pump   | (8) – Transfer Case                 |
| (4) – Nameplate   | (9) – Oil Fill Tube and Dipstick    |
| (5) – Oil Fill Tube and Dipstick<br>(Available on Both Sides) | (10) – PTO Provision                |

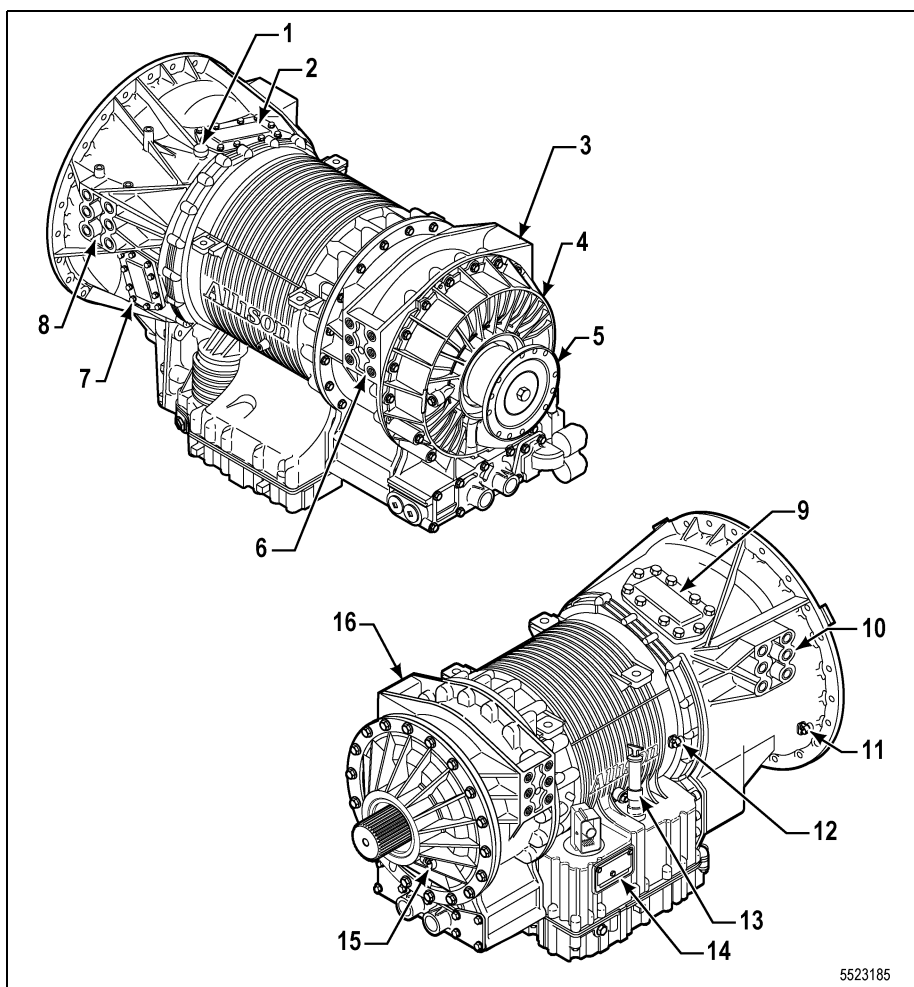
**Figure 2–4. 3700 SP with Transfer Case**



5522785

- |  |                                      |
|--|--------------------------------------|
| (1) - Fill Tube                          | (9) - Retarder Temperature Connector |
| (2) - PTO Provision (Top Right Position) | (10) - Breather                      |
| (3) - Torque Converter Module            | (11) - Mounting Pads (Both Sides)    |
| (4) - Engine-Speed Sensor                | (12) - PTO Provision                 |
| (5) - Mounting Pad                       | (13) - Standard Rear Cover           |
| (6) - Turbine-Speed Sensor               | (14) - Cooler Ports                  |
| (7) - Nameplate                          | (15) - Main-Pressure Tap             |
| (8) - Solenoid Connector                 | (16) - PTO Provision                 |

**Figure 2-5. 4000/4200/4430/4440/4500/4600 with PTO and Retarder (Right-Front View) with PTO and without Retarder (Left-Rear View)**



5523185

- |  |                             |
|--|-----------------------------|
| (1) – Breather                           | (10) – Mounting Pad         |
| (2) – PTO Provision                      | (11) – Input Speed Sensor   |
| (3) – C6 Adapter Housing                 | (12) – Turbine Speed Sensor |
| (4) – Retarder                           | (13) – Fill Tube            |
| (5) – Output Flange                      | (14) – Nameplate            |
| (6) – Mounting Pad                       | (15) – Output Speed Sensor  |
| (7) – PTO Provision                      | (16) – C6 Adapter Housing   |
| (8) – Mounting Pad                       |                             |
| (9) – PTO Provision (Top Right Position) |                             |

**Figure 2–6. 4700/4800/4770/4870/4970 Series with PTO and Retarder (Left-Rear View) with PTO and without Retarder (Right-Rear View)**

Typical vocations for these models include:

***Model 3000***

- General
- Refuse, Concrete Mixer
- Fire Truck, Emergency

***Model 3000 SP***

- Specialty/Military

***Model 3200***

- General
- Refuse, Concrete Mixer
- Fire Truck, Emergency

***Model 3200 ORS***

- Articulated Dump
- Rigid Dump

***Model 3200 SP***

- Specialty/Military

***Model 3500***

- General
- Refuse, Concrete Mixer
- Fire Truck, Emergency

***Model 3500 ORS***

- Articulated Dump
- Rigid Dump

***Model 3500 SP***

- Specialty/Military

***Model 4000***

- General
- Refuse, Concrete Mixer
- Fire Truck, Emergency
- Heavy Equipment Transporter

**Model 4000 ORS**

- Articulated Dump
- Rigid Dump

**Model 4000 SP**

- Specialty/Military

**Model 4200 ORS**

- Articulated Dump

**Model 4430**

- General
- Highway, Fire Truck, Emergency, Airport Rescue and Fire Fighting Vehicle (ARFF), Heavy Equipment Transport
- Refuse Vehicles
- AG Spreader, Sprayer, Blower, Feedlot Truck

**Model 4430 ORS**

- Articulated Dump, Rigid Rear Dump
- Off-road

**Model 4440**

- General
- Highway, Fire Truck, Emergency, ARFF, Heavy Equipment Transport
- Refuse Vehicles
- AG Spreader, Sprayer, Blower, Feedlot Truck

**Model 4500**

- General Construction
- Highway
- Refuse
- Fire Truck, Emergency, ARFF, Heavy Equipment Transport

**Model 4500 ORS**

- Articulated Dump
- Rigid Dump

**Model 4500 OFS**

- Oil Field Series

***Model 4500 SP***

- Specialty/Military

***Model 4600 ORS***

- Articulated Dump

***Model 4700***

- General, Construction
- Refuse
- ARFF
- Heavy Equipment Transporter

***Model 4700 OFS***

- Oil Field Series

***Model 4700 SP***

- Specialty/Military

***Model 4770 ORS***

- Off Road Series

***Model 4770 SP***

- Specialty/Military

***Model 4800***

- ARFF

***Model 4800 SP***

- Specialty/Military

***Model 4870 ORS***

- Off Road Series

***Model 4870 SP***

- Specialty/Military

***Model 4970 ORS***

- Off Road Series

***Model 4970 SP***

- Specialty/Military



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## 3.0 DRIVING TIPS

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### 3.1 THE AUTOMATIC EXPERIENCE

Smooth automatic upshifts and downshifts, without interruption of power to the wheels, occur in your Allison automatic transmission based on engine rpm, throttle position, vehicle load, road speed, and driver or feature request, such as manually preselecting ranges.

Allison automatic transmissions, along with a vehicle specification appropriate for the particular duty cycle, can provide superior fuel efficiency and optimum fuel economy. In vehicles with a manual or automated manual transmission, the power interrupts that occur during shifts reduce the engine's inertia energy, resulting in lower average wheel horsepower. Because the engine is not working efficiently, it cannot run at full load. With an Allison automatic transmission, there is no power interrupt during shift changes. The inertia energy built up by the engine is maintained, equating to higher wheel horsepower. As a result, not as much engine horsepower is needed to get the job done. Allison automatic transmissions provide smooth, seamless shifts at all points of the power curve, there is no jarring power interrupts to jostle the driver. Allison automatic transmission equipped vehicles are more nimble in traffic and easier to maneuver on congested routes. Vehicles equipped with Allison fully automatic transmissions will keep you on schedule with maximum operating economies and improved vehicle performance.

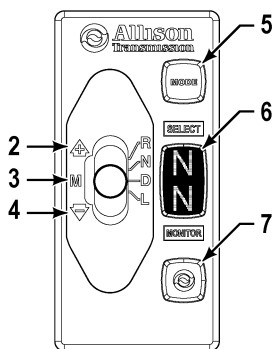
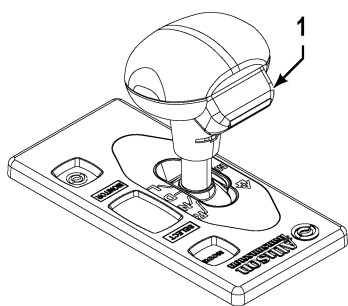
### 3.2 STARTING THE ENGINE



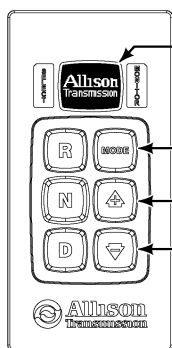
**WARNING:** When starting the engine, make sure the service brakes are applied. Failure to apply service brakes may result in unexpected vehicle movement.

No special procedure is required. If the vehicle is equipped with a bump-shift lever selector, the driver must simply verify that the brakes are applied and **N** (Neutral) has been selected. The keypad and strip push button selectors will automatically initialize in **N** (Neutral) when the ignition is turned on. For keypad push button and bump-shift lever selectors, the Vacuum Fluorescent Display (VFD) will display "N N" for Neutral between the **SELECT** and **MONITOR**

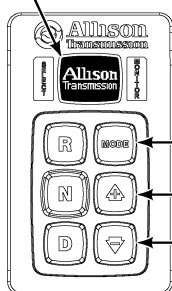
labels. This indicates that **N** (Neutral) has been selected and attained, and the engine may now be started. Strip push button selectors illuminate a lamp in the corner of the N button since they do not have a VFD. Refer to [7.0 SHIFT SELECTORS COMPONENTS AND FUNCTIONS](#), [Figure 3–1](#), [Figure 3–2](#) and [Table 4–1](#) for additional information.



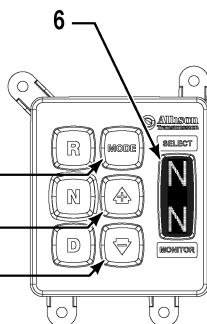
**A**



**B1**

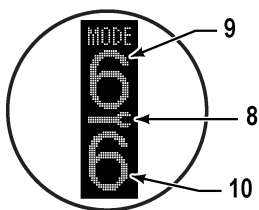
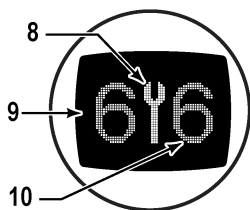


**B2**



**B3**

**B**



**C**

5523645

### **A: Shift Selectors**

- |                            |                                      |
|----------------------------|--------------------------------------|
| (1) – Hold Override Button | (5) – Mode Button                    |
| (2) – Upshift              | (6) – Digital Display                |
| (3) – Manual Select        | (7) – Display Mode/Diagnostic Button |
| (4) – Downshift            |                                      |

### **B: Push Button Selectors**

- |                 |                |
|-----------------|----------------|
| (B1) – Common   | (B3) – Compact |
| (B2) – Standard |                |

### **C: Location of Service Icon On Vertical and Horizontal Digital Display**

- |                      |                        |
|----------------------|------------------------|
| (8) – Service Icon   | (10) – Monitor Display |
| (9) – Select Display |                        |

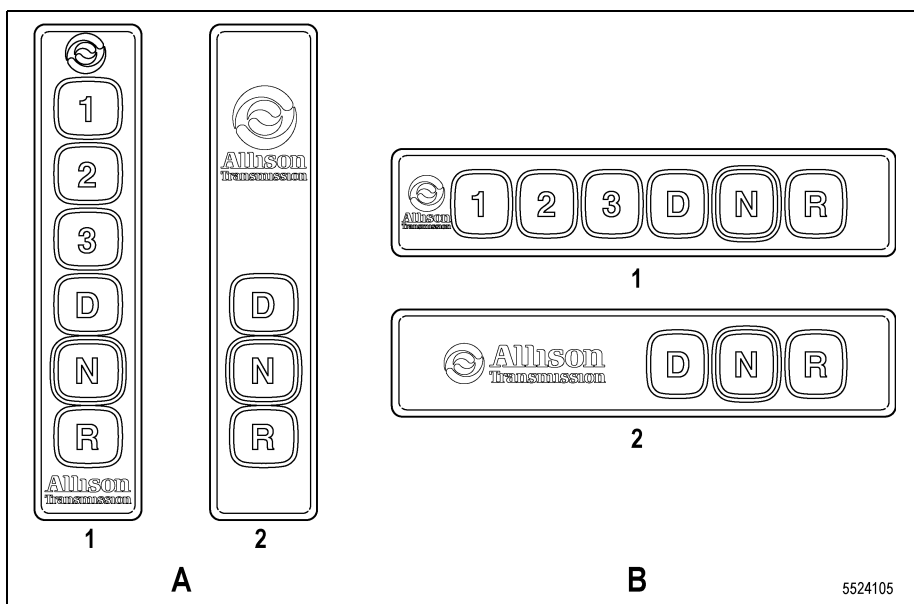
**Figure 3–1. Typical Allison Shift Selectors**



**NOTE:** The first number displayed in the digital display is the highest forward range available and the second number is range attained in selected position.

Visually confirm that the range selected was attained. If display is flashing, shift is inhibited.

---



(A) – Vertical  
(B) – Horizontal

(1) – 6 Position  
(2) – 3 Position

**Figure 3–2. Typical Allison Strip Push Button Shift Selectors**

### 3.3 COLD WEATHER STARTS

If a vehicle is started in cold ambient conditions below  $-5^{\circ}\text{C}$  ( $23^{\circ}\text{F}$ ), the transmission will be limited to **2** (Second Range), **N** (Neutral), and **R** (Reverse) operation (**3** (Third Range) for the 4700/4800/4770/4870/4970 transmission) until the sump temperature exceeds  $-1^{\circ}\text{C}$  ( $30^{\circ}\text{F}$ ). Once the sump temperature reaches this threshold, normal operation will resume for the transmission.

If the transmission fluid temperature is below  $10^{\circ}\text{C}$  ( $50^{\circ}\text{F}$ ) follow these procedures when making directional shift changes:

- To shift from forward to reverse, select **N** (Neutral) and then **R** (Reverse).
- To shift from reverse to forward, select **N** (Neutral) and then **D** (Drive) or other forward range.



**NOTE:** During cold fluid conditions, always place the transmission in **N** (Neutral) prior to any direction changes.



**NOTE:** Failure to follow these procedures during cold fluid conditions, may cause the **CHECK TRANS** light to illuminate and the transmission to be restricted to **N** (Neutral).

Transmission operation at extremely cold ambient temperatures may require preheating or the use of a TES 295® or TES 668® transmission fluid. Refer to [3.3.1 Preheating Requirement](#).

### 3.3.1 Preheating Requirement.



**NOTE:** For 3000 Series models, the combination of a retarder and a shallow (2 inch) sump can cause a truck to exhibit a delay when launching in cold ambient conditions with cold transmission fluid. To improve vehicle launch in conditions below 0°C (32°F):

- Make sure the transmission oil level is full (at the Hot Full mark with the transmission at its normal operating temperature).
- Recommend the vehicle to undergo a warm-up period when starting under the described cold ambient conditions.
- If a warm-up period is not possible, elevate the engine speed to 1300-1500 rpm after **D** (Drive) is selected for vehicle movement.

These recommendations will significantly improve vehicle launch when operating the vehicle in cold ambient conditions.

If ambient temperatures drop below the specified minimum levels for the fluid type, preheat the transmission fluid before beginning transmission operation. The minimum fluid temperatures at which the transmission may be safely operated without preheating are shown in [Table 3–1](#).

**Table 3–1. Fluid Type Specifications for Minimum Temperature**

Fluid Type	Minimum Temperature	
	Celsius	Fahrenheit
TES 295® and TES 668®	–35	–31
TES 389®	–25	–13

Preheat the transmission fluid using one of the following methods:

- Use an auxiliary heat source such as a sump heater.
- Operate the transmission in **N** (Neutral) with the engine running at idle for a minimum of 20 minutes before attempting range operation.



**CAUTION:** Transmission malfunction or damage may occur if you operate the transmission with the fluid temperature below the minimum fluid temperature specification limit.

### 3.4 HIGH FLUID TEMPERATURE

The transmission is considered to be overheated when any of the following temperatures are exceeded:

Sump fluid	121°C (250°F)
Fluid to cooler	149°C (300°F)
Retarder out fluid	165°C (330°F)

Typical continuous sump temperature is 93°C (200°F).

If the transmission overheats during normal operation, make sure the transmission fluid level is correct. Refer to [5.8 PERIODIC FLUID LEVEL CHECKS](#).



**CAUTION:** The engine should never be operated for more than 10 seconds at full throttle with the transmission in range and the output stalled. Prolonged operation of this type will cause the transmission fluid temperature to become excessively high and will cause severe overheat damage to the transmission.

If the engine temperature gauge indicates a high temperature, the transmission is probably overheated. Stop the vehicle and check the cooling system. If it appears to be functioning properly, run the engine at 1200–1500 rpm with the transmission in **N** (Neutral). This should reduce the transmission and engine temperatures to normal operating levels in 2 or 3 minutes.

If the transmission and engine temperatures do not decrease, reduce the engine rpm. If the engine temperature indicates a high temperature, an engine or radiator problem is indicated. If high temperature in either the engine or transmission persists, stop the engine and have the overheating condition investigated by maintenance personnel.



**NOTE:** Some shift schedules may be inhibited as a result of operating conditions, such as engine or transmission fluid temperature.

### 3.5 TURNING OFF THE VEHICLE

Always select **N** (Neutral) before turning the vehicle off.

### 3.6 PARKING BRAKE



**WARNING:** If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. If you must leave the engine running, **DO NOT LEAVE** the vehicle until you have completed all of the following procedures:

- Put the transmission in **N** (Neutral).
- Be sure the engine is at low idle (500–800 rpm).
- Apply the parking and emergency brakes and make sure they are properly engaged.
- Chock the wheels and take other steps necessary to keep the vehicle from moving.

The parking brake is only intended to secure an unattended vehicle with the ignition off. Always maintain the vehicle parking brake system according to the manufacturer's specifications. The parking brake may not have sufficient capacity to restrain a vehicle with the engine running and the transmission in a forward or reverse range. When the vehicle is unattended and the engine is running, the transmission **must be in N** (Neutral) with the **brakes fully applied** and the **wheels chocked**.



**WARNING:** The vehicle service brakes, parking brake, or emergency brake must be applied whenever **N** (Neutral) is selected to prevent unexpected vehicle movement. Selecting **N** (Neutral) does not apply the vehicle brakes unless an auxiliary system to apply the parking brake is installed by the OEM.

### 3.7 ENGINE-DRIVEN POWER TAKEOFF (PTO ALL MODELS EXCEPT HS AND PTS)



**CAUTION:** Do not exceed the engagement and operational speed limits imposed on the driven equipment during the operation of the PTO. Exceeding the speed limits produces high hydraulic pressure in the PTO that can damage the PTO components. Consult the vehicle manufacturer's literature for these speed limits.



If a PTO is present, it is normally mounted on either the left or right side of the 3000 Series transmission. On the 4000 Series transmission, the PTO is located on the left side or on the top of the transmission. The PTO drive gear is engine-driven and therefore provides direct engine power. The PTO can be operated when the vehicle is either moving or stopped.

The PTO gear is in constant mesh with the drive gear in the converter housing. However, the PTO may either be constant-drive (output always powered) or clutch-driven. When the PTO is clutch-driven, the clutch is part of the PTO, not the transmission. A clutch-driven PTO is powered only when the PTO clutch is engaged.

All Allison Transmission-equipped vehicles with PTO enabled have engagement and operational speed limits programmed into the Transmission Control Module (TCM) to help protect PTO equipment. Be sure the limits for PTO engagement and operational speeds are not exceeded. Consult the vehicle manufacturer's literature for these speed limits. Some speed limits have default values which are programmed out of the operating range and need to be set for your particular PTO duty cycle. Consult your vehicle manufacturer to see if your transmission has been programmed and what operational limits have been established.

When the programmed engagement speed is exceeded, the PTO will not engage. The PTO engagement must be retried after the speed has been reduced. When operational speeds (either engine or transmission output) are exceeded, the PTO deactivates and the PTO engagement process must be repeated.

### 3.8 DRIVING ON SNOW OR ICE



**WARNING:** Using the retarder on wet or slippery roads may cause loss of traction on the drive wheels—your vehicle may slide out of control. To help avoid injury or property damage, turn the retarder enable to OFF when driving on wet or slippery roads.



**NOTE:** The retarder is disabled automatically whenever the vehicle ABS is active. However, in the event the ABS malfunctions, it is recommended that the retarder enable switch, if equipped, be disabled.

If possible, reduce vehicle speed and select a lower range before losing traction. Select the range that will not exceed the speed expected to be maintained.

Accelerate or decelerate very gradually to prevent the loss of traction. It is very important to decelerate gradually when a lower range is selected. It is important that you reach the selected lower range before attempting to accelerate. This avoids an unexpected downshift during acceleration.

### 3.9 ROCKING OUT



**WARNING:** To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from **N** (Neutral) to **D** (Drive) or **R** (Reverse) when the engine is above low idle rpm. The vehicle may lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from **N** (Neutral) to a forward range or **R** (Reverse) only when the throttle is closed and the service brakes are applied.



**CAUTION:** DO NOT make **N** (Neutral) to **D** (Drive) or directional shift changes when the engine is above low idle rpm. Also, if the wheels are stuck and not turning, do not apply full power for more than 10 seconds in either **D** (Drive) or **R** (Reverse). Full power for more than 10 seconds under these conditions can cause the transmission to overheat. If the transmission overheats, shift to **N** (Neutral) and operate the engine at 1200–1500 rpm until it cools (2–3 minutes).

If the vehicle is stuck in deep sand, snow, or mud, it may be possible to rock it out using the following procedure:

1. Shift to **D** (Drive) and apply a steady, light throttle (never full throttle).
2. When the vehicle has rocked forward as far as it will go, apply and hold the vehicle service brakes.
3. When engine has returned to idle, select **R** (Reverse).
4. Release the vehicle service brakes and apply a steady, light throttle (never full throttle) allowing the vehicle to rock in **R** (Reverse) as far as it will go.
5. Apply and hold the vehicle service brakes and allow the engine to return to idle.

This procedure may be repeated in **D** (Drive) and **R** (Reverse) if each directional shift continues to move the vehicle a greater distance.

## 3.10 TOWING OR PUSHING



**CAUTION:** Failure to lift the drive wheels off the road, disconnect the driveline or remove the axle shafts before towing or pushing can cause serious transmission damage.



**NOTE:** The engine cannot be started by pushing or towing.



**NOTE:** When the axle shafts are removed, make sure the wheel openings are covered to prevent loss of lubricant and entry of dust and dirt.

Before pushing or towing a vehicle with a 3700 SP Model, do one of the following:

- Make sure all wheels are on the ground and drivelines are connected, or
- Lift one axle off the ground and disconnect the driveline to the axle contacting the ground.
- Lift the drive wheels off the road.

Before pushing or towing a vehicle with a 3000 or 4000 Series transmission (unless equipped with 3700 SP), do one of the following:

- Lift the drive wheels off the road.
- Disconnect the driveline, or
- Remove the axle shafts.

An auxiliary air supply is usually required to actuate the vehicle brake system.

3.11 OPERATING DOWN STEEP GRADES (REAR-DISCHARGE MIXER)



**CAUTION:** With this transmission, the service brakes must be used when backing a loaded rear-discharge mixer down a grade. But too much brake application, particularly on an unpaved surface, can lock the front brakes and reduce steering control. A crash could then occur. To help prevent injury or property damage:

- 1. Drive forward down the grade and then exit by backing up the grade when you can do so.
- 2. If equipped, use the trailer brake when backing the mixer down a grade. Do not use the trailer brake as a parking brake once the vehicle is at the bottom of the grade.
- 3. If a trailer brake is not available, back the mixer down the grade by modulating the service brakes to control and maintain a safe, steady vehicle speed. Avoid abrupt stops and starts.

3.12 4000 SERIES TRANSMISSIONS WITH TWO REVERSE RANGE CAPABILITY (4700/4800/4770/4870/4970 ONLY)

Certain 4000 Series transmissions have the capability of two separate reverse ranges. The range designation on the shift selector for lower and higher gear ratios is the same for all affected models. **R1** designates the lower gear ratio and **R2** the higher gear ratio.

Affected models fall into two categories:

- 1. 4700/4800 models without automatic range shift while in reverse range
- 2. 4770/4870/4970 models with automatic range shift capability while in reverse range

Reverse Range Ratios:

Select/Monitor Display	4700/4800 Range Ratios	4770/4870/4970 Range Ratios
R2	4.80:1	2.42:1
R1	17.12:1	5.55:1

3.12.1 USING R1 LOW REVERSE (4700/4800 ONLY).

Selected calibrations for the 4700/4800 models offer an option for two Reverse ranges – a standard Reverse gear ratio of 4.80:1 (shown as **R2** in the selector display) and an optional lower Reverse ratio of 17.12:1 (shown

as **R1** in the selector display). These models will not automatically shift from **R1** to **R2** or **R2** to **R1** with the vehicle in motion. Range selection must be made manually using the shift selector with the vehicle stationary and the service brake applied.



**NOTE:** Applying the parking brake with **R1** range attained will result in the transmission shifting from **R1** to **N** (Neutral) automatically. The transmission will not return to **R1** range automatically when the parking brake is released.

---

The Allison Low Reverse feature offers these operational benefits:

- Greater control and engine braking during operation on steep grades
- More maneuverability when operating in confined spaces
- Slow creep capability with high engine speeds

Refer to [4.1 SELECTING RANGE](#) and [7.0 SHIFT SELECTORS COMPONENTS AND FUNCTIONS](#) for additional information.

### **3.12.2 USING AUTOMATIC REVERSE RANGE SHIFT (4770/4870/4970 ONLY).**

Selected calibrations for the 4770/4870/4970 models offer an option for two automatic reverse ranges – a lower starting reverse ratio of 5.55:1 (shown as **R1** in the selector display) and a second higher reverse ratio of 2.42:1 (shown as **R2** in the selector display).

In certain calibrations programmed to employ both reverse ranges, when **R** is selected from the shift selector, the transmission will start in the lower **R1** range, and as vehicle speed increases in reverse, the transmission will automatically upshift to the higher **R2** range. The transmission will also automatically downshift as vehicle speed decreases.

The Allison Automatic Range Shift Reverse function offers these operational benefits:

- Greater range of speed and torque multiplication available to operator
- Increased vehicle productivity

Refer to [4.1 SELECTING RANGE](#) and [7.0 SHIFT SELECTORS COMPONENTS AND FUNCTIONS](#) for additional information.

## **3.13 ENGINE STOP-START OPERATION**

The Engine Stop-Start system checks for many conditions during normal road operation where an idle opportunity would be possible, i.e. the vehicle

coming to a stop. If any of the conditions are not met, the ES-S system will not engage. This not only prevents damage to the engine, transmission and other vehicle system components, but also prevents an engine shut down when movement is desired by the user.

Once the vehicle is completely stopped by brake input while in a forward range, without accelerator pedal input, the engine requests permission from the TCM to shut down. The TCM ensures that there are no inhibits or interlocks currently in the system. After all conditions are met, there is a system check to ensure that the vehicle's system is capable of an engine restart, validating that the engine would physically be able to start again, and that the transmission is at proper operating temperature, 40°C to 110°C (104°F to 230°F). Once all parameters are met, the engine shuts down and the ES-S pump engages to provide pressure to the transmission. This allows the transmission to remain in **1** (First Range) and provide torque immediately after engine restart.

Once the operator releases the brake pedal, the engine restarts, the ES-S pump disengages and the vehicle is ready for forward movement in **1** (First Range).

While the engine is shut down during ES-S operation, the system continues to check for inputs from the driver that would suggest desired movements from the accelerator, such as shift selector inputs to a forward or reverse range or releasing the parking brake. Any of these actions will cause the system to start the engine. If the engine is off for more than three minutes with ES-S engaged, the system will command an engine start to maintain proper operating temperature of the transmission. If the vehicle system or diagnostics believe that the engine needs to be started to resolve a recognized issue, the engine will automatically start back up.

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## 4.0 SELECTING RANGE AND SHIFT SCHEDULES

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### 4.1 SELECTING RANGE



**NOTE:** See the vehicle Original Equipment Manufacturer (OEM) for information about non ATI shift selectors (OFS Models).

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**WARNING:** To help avoid unexpected vehicle movement that might cause death, serious injury, or property damage, always have your foot on the brake, the throttle released, and the engine at idle before making a **N** (Neutral) to **D** (Drive); **N** (Neutral) to **R** (Reverse); **D** (Drive) to **R** (Reverse); or **R** (Reverse) to **D** (Drive) selection.



**NOTE:** Conditions responsible for illuminating the **CHECK TRANS** indicator will not allow any shift selector changes until the DTC related to the condition goes inactive. The MONITOR display shows the range the transmission has locked in because of an active DTC. The SELECT display goes blank when the **CHECK TRANS** indicator is on. Move the vehicle to a safe location before turning off the vehicle and seek qualified assistance if needed. Even if the transmission is not in **N** (Neutral), the operator will be able to view DTCs by simultaneously pressing the ↑ (Upshift) and ↓ (Downshift) arrows, if equipped with the keypad push button shift selector, or by pressing the **DISPLAY MODE/DIAGNOSTIC** (DMD) button, if equipped with the bump-shift lever selector.

---

With an Allison Transmission, the shift selector is used by the operator to select **N** (Neutral), **R** (Reverse) or a range of forward gears. When a forward range has been selected, the transmission starts in the lowest gear of the range and, as conditions permit, automatically upshifts to the highest gear in the selected range. Selected 7-speed models in the 4000 Series offer an option for two reverse gears – the standard reverse gear ratio and an optional

lower reverse ratio. During certain operating conditions the control system may inhibit transmission operation or range shifts.

#### 4.1.1 USING KEYPAD PUSH BUTTON SHIFT SELECTOR TO SELECT RANGE. Refer to [Figure 4–1](#).

- **R – REVERSE**: selects **R** (Reverse) gear.
- **N – NEUTRAL**: selects **N** (Neutral). The area around the N button is a raised ridge so the driver can identify the push buttons by touch, without looking at the display. It is not necessary to press this button prior to starting the vehicle.
- **D – DRIVE**: selects the highest available forward range. The transmission shifts to the starting gear and will automatically upshift through the gears, as operating conditions permit, until the highest available gear is attained.
- **D – DRIVE (Primary (ROAD) Mode OFS Models)**: selects the highest available forward range. The transmission shifts to the starting gear and will automatically upshift through the gears, as operating conditions permit, until the highest available gear is attained.
- **D – DRIVE (Secondary (RIG) Mode OFS Model)**: goes to the range set in the calibration set for stationary mode.

##### 4.1.1.1 USING UPSHIFT AND DOWNSHIFT ARROW BUTTONS

The ↑ (Upshift) and ↓ (Downshift) arrows are used to change the range selected to a higher or lower forward range:

- One press of the ↓ (Downshift) arrow sets range **SELECT** to the same forward range as the current forward range attained shown in the **MONITOR** position on the display. This type of preselect is called an Express Preselect.
- Each subsequent press of the ↓ (Downshift) arrow decreases the range selected by one range.
- One press of the ↑ (Upshift) arrow increases the range selected by one range.
- If the ↑ (Upshift) or ↓ (Downshift) arrow is held continuously, the selected range will continue to change up or down until the button is released or until the highest or lowest possible range of gears is selected.



**NOTE:** Pressing the ↓ (Downshift) arrow while in **R2** (Standard Reverse) will select **R1** (Low Reverse) in select 4700/4800 model calibrations when the vehicle is stopped and the service brake is applied.

---



#### 4.1.2 USING BUMP-SHIFT LEVER SELECTOR TO SELECT RANGE.

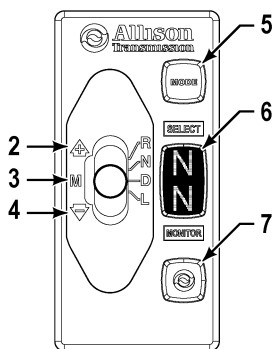
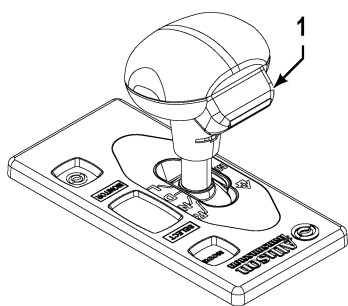
Refer to [Figure 4-1](#).

- **R – REVERSE:** selects **R** (Reverse) gear. Bumping the lever toward R will select the alternate reverse gear range in select 4700/4800 model calibrations.
- **N – NEUTRAL:** must be selected prior to starting the engine.
- **D – DRIVE:** selects the highest available forward range. Transmission shifts to starting gear and will automatically upshift through the gears, as operating conditions permit, until the highest available gear is attained.
- **D – DRIVE (Primary (ROAD) Mode OFS Model):** selects the highest available forward range. Transmission shifts to starting gear and will automatically upshift through the gears, as operating conditions permit, until the highest available gear is attained.
- **D – DRIVE (Secondary (RIG) Mode OFS Model):** goes to the range set in the calibration set for stationary mode.
- **L – LOW RANGE:** selects the lowest available forward range. The transmission will automatically downshift to the lowest range using the preselect downshift schedule. Once attained, the transmission will hold the low range until another range is selected.
- **M – MANUAL SELECT:** moving the lever from the Drive position into the Manual Select position allows the operator to select a lower or higher forward gear range.
- Initially moving the lever to M sets the Range Selected to the same forward range as the current Range Attained, shown in the **MONITOR** position on the display, also referred to as an Express Preselect.
- Each DOWNSHIFT (-) bump decreases the Range Selected by one forward range.
- Each UPSHIFT (+) bump increases the Range Selected by one forward gear range.
- These are momentary bump positions – when the operator releases the lever, the lever returns to the Drive position.
- The Manual Select position is accessible only from the Drive position and affects only forward gear ranges.

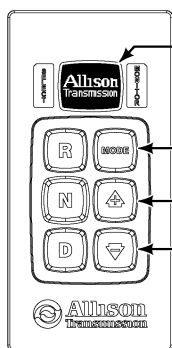
**Detent:** The lever selector features a detent to prevent inadvertent shifting between **R** (Reverse), **N** (Neutral), **D** (Drive) and **L** (Low). To release the lever from any of these positions, the detent must first be unlocked by depressing the finger release button on the shifter handle.

The bump-shift lever selector is available in the following configurations:

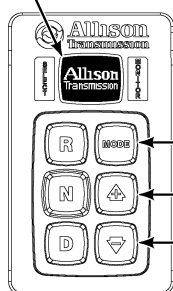
- Lever Right-hand, Reverse to Front (LRRF)
- Lever Right-hand, Reverse to Rear (LRRR)
- Lever Left-hand, Reverse to Front (LLRF)
- Lever Left-hand, Reverse to Rear (LRRR)



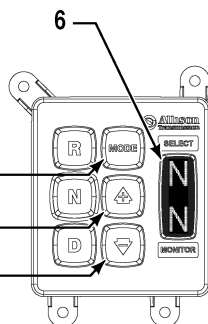
**A**



**B1**

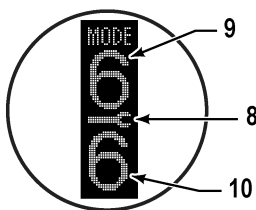
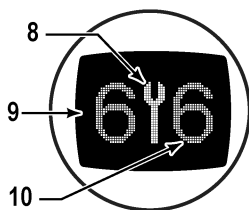


**B2**



**B3**

**B**



**C**

5523645

### A: Shift Selectors

- |                            |                                      |
|----------------------------|--------------------------------------|
| (1) – Hold Override Button | (5) – Mode Button                    |
| (2) – Upshift              | (6) – Digital Display                |
| (3) – Manual Select        | (7) – Display Mode/Diagnostic Button |
| (4) – Downshift            |                                      |

### B: Push Button Selectors

- |                 |                |
|-----------------|----------------|
| (B1) – Common   | (B3) – Compact |
| (B2) – Standard |                |

### C: Location of Service Icon On Vertical and Horizontal Digital Display

- |                      |                        |
|----------------------|------------------------|
| (8) – Service Icon   | (10) – Monitor Display |
| (9) – Select Display |                        |

**Figure 4–1. Typical Allison Shift Selectors**



**NOTE:** 5th Generation push button shift selectors are not forwards compatible with 6th Generation TCMs and 6th Generation push button shift selectors are not backwards compatible with 5th Generation TCMs.

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**NOTE:** The first number displayed in the digital display is the highest forward range available and the second number is range attained in selected position.

Visually confirm that the range selected was attained. If display is flashing, shift is inhibited.

---

#### 4.1.2.1 USING STRIP PUSH BUTTON SELECTOR TO SELECT RANGE

Refer to [Figure 4–2](#).



**NOTE:** The strip push button selectors do not include a Vacuum Fluorescent Display (VFD). These installations require the installation of a separate SAE J1939-compatible displays to alert the operator of conditions monitored by the optional prognostics feature.

---

- **R – REVERSE:** selects **R** (Reverse) gear.
- **N – NEUTRAL:** it is not necessary to press this button prior to starting the vehicle.
- **D – DRIVE:** selects the highest available forward range. Transmission shifts to the starting gear and will automatically upshift through the gears, as operating conditions permit, until the highest available gear is attained.

- **D – DRIVE (Primary (ROAD) Mode OFS Model):** selects the highest available forward range. Transmission shifts to starting gear and will automatically upshift through the gears, as operating conditions permit, until the highest available gear is attained.
- **D – DRIVE (Secondary (RIG) Mode OFS Model):** goes to the range set in the calibration set for stationary mode.

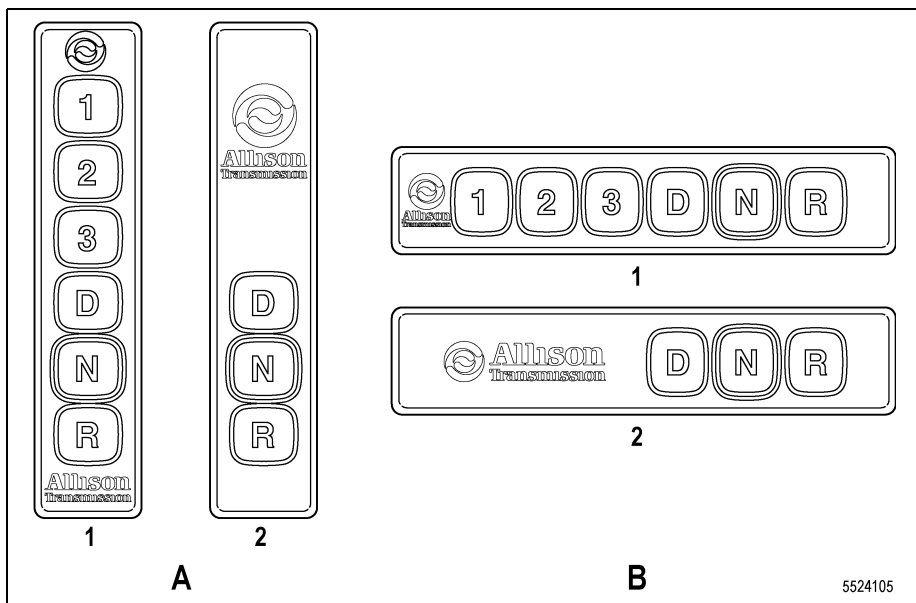


**NOTE:** When a button is pressed by the operator, a light in the upper right corner of the button is illuminated. Pushing buttons labeled 1, 2 or 3 selects those ranges.

---

The strip push button selector is available in four configurations:

- Three horizontal buttons – R,N,D
- Three vertical buttons – R,N,D
- Six horizontal buttons – R,N,D,3,2,1
- Six vertical buttons – R,N,D,3,2,1



(A) – Vertical  
(B) – Horizontal

(1) – 6 Position  
(2) – 3 Position

**Figure 4–2. Typical Allison Strip Push Button Shift Selectors**

**4.1.3 SELECTOR DISPLAY FLASHING (INHIBITS).** When appropriate, the transmission control system automatically invokes an inhibit to protect against certain types of abusive operation, such as:

- **Engine speed inhibit:** prevents shift from neutral to either a forward range or reverse if the engine speed is above 900 rpm. This feature is disabled in emergency vehicles and some other types of specialized equipment.

If the engine speed drops below the inhibit speed within a specified grace period of 3-seconds, the inhibit will self-clear and the requested shift will be commanded. The same 3-second grace period is permitted for applications with an enabled Neutral Indicator for PTO output function.

- **Neutral-to-Range Assist:** in vehicles with optional Neutral-to-Range Assist feature. Engine management commands are sent from the transmission controller which will attempt to reduce the engine speed when the engine speed is greater than the transmission's allowable limit and a shift from **N** (Neutral) to forward or reverse has been requested with the shift selector. The operator must have the service brakes applied. This feature must be specified when the TCM calibration is defined.

- **Direction change inhibit:** prevents shifting the transmission from forward-to-reverse or from reverse-to-forward if transmission output speed or throttle percentage is present. Rocking out by shifting from **D** (Drive) to **R** (Reverse) and **R** (Reverse) to **D** (Drive) is still available to the operator provided these parameters are below the limit allowed for rocking out the vehicle.



**NOTE:** If the elevated output speed or throttle position drops below the inhibit threshold within a specified grace period of 3 seconds, the inhibit will self-clear and the requested shift will be commanded.

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**NOTE:** The flashing of the SELECT range indicates a requested shift is either temporarily or permanently inhibited. The inhibit may clear if the cause of the inhibit clears within 3 seconds of the shift request. Otherwise, the operator must re-select the desired range.

---

**Inhibit Rolling Direction Changes:** This optional feature inhibits forward/reverse directional change shifts unless the output shaft speed is nearly stopped. The TCM will indicate that the shift is inhibited by flashing the range SELECT digit on the shift selector. If the elevated output speed or throttle position drops below the inhibit threshold within a specified grace period of 3 seconds, the inhibit will self-clear and the requested shift will be commanded.



**NOTE:** This feature is typically used in vehicles that are geared for relatively low road speed, such as street sweepers and dock spotters. This optional feature must be specified when defining the TCM calibration.

---





Shifts from **N** (Neutral) to **D** (Drive) or **N** (Neutral) to **R** (Reverse) are also inhibited when the TCM has been programmed (by input/output function) to detect that auxiliary equipment is in operation and the shift should not be allowed.



**NOTE:** If the controls have set a diagnostic code that holds the transmission in the current range, the **SELECT** display on the shift selector will be blank. The **MONITOR** display will indicate the range in which the transmission is locked. The **CHECK TRANS** indicator will also be activated.




---

**Table 4–1. DESCRIPTION OF AVAILABLE RANGES**




Description of Available Ranges (refer to <a href="#">Figure 4–1</a> )	
	<p><b>WARNING:</b> If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. If you must leave the engine running, <b>DO NOT LEAVE</b> the vehicle until you have completed all of the following procedures:</p> <ul style="list-style-type: none"> <li>• Put the transmission in <b>N</b> (Neutral).</li> <li>• Be sure the engine is at low idle (500–800 rpm).</li> <li>• Apply the parking and emergency brakes and make sure they are properly engaged.</li> <li>• Chock the wheels and take other steps necessary to keep the vehicle from moving.</li> </ul>
	<p><b>WARNING:</b> <b>R</b> (Reverse), <b>R1</b> (Low Reverse) or <b>R2</b> (Standard Reverse) may not be attained due to an active inhibitor. Always apply the service brakes when selecting <b>R</b> (Reverse), <b>R1</b> (Low Reverse) or <b>R2</b> (Standard Reverse) to prevent unexpected vehicle movement and because a service brake inhibit may be present. When <b>R</b>, <b>R1</b> or <b>R2</b> is flashing, it indicates the shift to <b>R</b> (Reverse), <b>R1</b> (Low Reverse) or <b>R2</b> (Standard Reverse) is inhibited. Determine if diagnostic codes are active if <b>R</b> (Reverse), <b>R1</b> (Low Reverse) or <b>R2</b> (Standard Reverse) is not attained. Refer to <a href="#">7.5 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DIAGNOSTIC TROUBLE CODES (DTCs) AND INHIBITS</a></p>
	<p><b>CAUTION:</b> Do not idle in <b>R</b> (Reverse), <b>R1</b> (Low Reverse) or <b>R2</b> (Standard Reverse) for more than five minutes. Extended idling in these ranges can cause transmission overheating and damage. Always select <b>N</b> (Neutral) whenever time at idle exceeds five minutes.</p>
	<p><b>NOTE:</b> Check the shift selector to verify the selected range whenever a button is pushed or the lever is moved to be sure the range selected is indicated. A flashing range select character in the VFD indicates the range selected was not attained due to an active inhibit. Refer to <a href="#">4.1.3 SELECTOR DISPLAY FLASHING (INHIBITS)</a> for additional information.</p>
<b>R (Reverse) to forward range or forward range to R (Reverse)</b>	<p>Completely stop the vehicle and let the engine return to idle before shifting from a forward range to any Reverse range (<b>R</b>, <b>R1</b> or <b>R2</b>) or from any Reverse range (<b>R</b>, <b>R1</b> or <b>R2</b>) to a forward range.</p>




**Table 4–1. DESCRIPTION OF AVAILABLE RANGES (cont'd)**

Description of Available Ranges (refer to <a href="#">Figure 4–1</a> )	
<b>R1 (4700/4800 Models)</b>	This optional feature for 4700/4800, and OFS models provides a low reverse gear (17.12:1 ratio). Refer to <a href="#">3.12.1 USING R1 LOW REVERSE (4700/4800 ONLY)</a> for additional information.
<b>R2 (4700/4800 Models)</b>	This optional feature for 4700/4800, and OFS models provides a standard reverse gear (4.80:1 ratio). Refer to <a href="#">3.12.1 USING R1 LOW REVERSE (4700/4800 ONLY)</a> for additional information.
<b>R1 (4770/4870/4970 Models)</b>	This optional feature for 4770/4870/4970, and ORS models provides a low reverse gear (5.55:1 ratio). Refer to <a href="#">3.12.2 USING AUTOMATIC REVERSE RANGE SHIFT (4770/4870/4970 ONLY)</a> for additional information.
<b>R2 (4770/4870/4970 Models)</b>	This optional feature for 4770/4870/4970, and ORS models provides a standard reverse gear (2.42:1 ratio). Refer to <a href="#">3.12.2 USING AUTOMATIC REVERSE RANGE SHIFT (4770/4870/4970 ONLY)</a> for additional information.
<b>Allison Strip Push Button Shift Selectors</b>	Allison strip push button shift selectors illuminate a light in the upper right corner of the <b>R</b> button after <b>R</b> (Reverse) is selected.
	<b>WARNING:</b> When starting the engine, make sure the service brakes are applied. Failure to apply the service brakes can result in unexpected vehicle movement.
	<b>WARNING:</b> The vehicle service brakes, parking brake, or emergency brake must be applied whenever <b>N</b> (Neutral) is selected to prevent unexpected vehicle movement. Selecting <b>N</b> (Neutral) does not apply the vehicle brakes unless an auxiliary system to apply the parking brake is installed by the OEM.
	<b>WARNING:</b> If you let the vehicle coast in <b>N</b> (Neutral), there is no engine braking and you could lose control. Coasting can also cause severe transmission damage. To help avoid injury and property damage, do not allow the vehicle to coast in <b>N</b> (Neutral).

**Table 4–1. DESCRIPTION OF AVAILABLE RANGES (cont'd)**

Description of Available Ranges (refer to <a href="#">Figure 4–1</a> )	
<b>N</b>	Use <b>N</b> (Neutral) when starting the engine to check vehicle accessories and for extended periods of engine idle operation (longer than five minutes). For vehicles equipped with the keypad push button or strip push button selector, <b>N</b> (Neutral) is selected by the TCM during start-up. For vehicles equipped with the bump-shift lever selector, the vehicle will not start unless <b>N</b> (Neutral) has been selected. If the vehicle starts in any range other than <b>N</b> (Neutral), seek service immediately. <b>N</b> (Neutral) may also be used during stationary operation of the Power Takeoff (PTO) (if the vehicle is equipped with a PTO). The digital display shows <b>N</b> when <b>N</b> (Neutral) is selected. Always select <b>N</b> (Neutral) before turning off the vehicle engine.
	<b>WARNING:</b> <b>D</b> (Drive) may not be attained due to an active inhibitor. Always apply the service brakes when selecting <b>D</b> (Drive) to prevent unexpected vehicle movement and because a service inhibit may be present. When the selected range is flashing, it indicates the shift to <b>D</b> (Drive) is inhibited. Determine if diagnostic codes are active if <b>D</b> (Drive) is not attained. Refer to <a href="#">7.5 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DIAGNOSTIC TROUBLE CODES (DTCs) AND INHIBITS</a> .
	<b>CAUTION:</b> Do not idle in <b>D</b> (Drive) for more than five minutes. Extended idling in <b>D</b> (Drive) may cause transmission overheating and damage. Always select <b>N</b> (Neutral) if time at idle exceeds five minutes.
	<b>NOTE:</b> If equipped with a HIGH IDLE switch, turn the HIGH IDLE switch off before shifting from <b>N</b> (Neutral) to <b>D</b> (Drive) or <b>R</b> (Reverse). <b>D</b> (Drive) or <b>R</b> (Reverse) may not be attained unless the shift is made with the engine at idle. Also, be aware of other interlocks that would prevent attaining <b>D</b> (Drive) or <b>R</b> (Reverse). Example: “service brakes not applied” (service brake interlock present).
<b>D</b>	The transmission initially attains its lowest programmed range when <b>D</b> (Drive) is selected. As vehicle speed increases, the transmission upshifts automatically through each range. As the vehicle or equipment slows down, the transmission automatically downshifts to the correct range. The keypad push button and bump-shift lever display shows the highest range available in <b>D</b> (Drive). The strip push button illuminates the upper right corner of the <b>D</b> button when pushed.

**Table 4–1. DESCRIPTION OF AVAILABLE RANGES (cont'd)**

Description of Available Ranges (refer to <a href="#">Figure 4–1</a> )	
<b>D (Primary (ROAD) Mode OFS Models)</b>	The transmission initially attains its lowest programmed range when <b>D</b> (Drive) is selected. As vehicle speed increases, the transmission upshifts automatically through each range. As the vehicle or equipment slows down, the transmission automatically downshifts to the correct range. The keypad push button and bump-shift lever display shows the highest range available in <b>D</b> (Drive). The strip push button illuminates the upper right corner of the <b>D</b> button when pushed.
<b>D (Secondary (RIG) Mode OFS Models)</b>	Goes to the range set in the calibration set for stationary mode.
	<b>WARNING:</b> To avoid loss of control, use a combination of downshifting, braking, and other retarding devices. Downshifting to a lower transmission range increases engine braking and can help you maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if engine governed speed is exceeded in the lower range, the transmission will upshift to the next higher range to prevent engine damage. This will reduce engine braking and could cause a loss of control. Apply the vehicle brakes or other retarding device to prevent exceeding engine governed speed in the lower range selected.
<b>7**</b> <b>6***</b> <b>5***</b> <b>4***</b> <b>3</b> <b>2</b>	Selecting lower ranges provide greater engine braking for going downgrades (the lowest range delivers the greatest braking effect). Occasionally, it may be desirable to restrict automatic shifting to a lower range because of: <ul style="list-style-type: none"> <li>• Road conditions</li> <li>• Load</li> <li>• Traffic conditions, etc.</li> </ul>
<b>1</b>	First Range provides the vehicle with its maximum driving torque and engine braking effect. Use First Range when: <ul style="list-style-type: none"> <li>• Pulling through mud and deep snow.</li> <li>• Maneuvering in tight spaces.</li> <li>• Driving up or down steep grades.</li> </ul>

**Table 4–1. DESCRIPTION OF AVAILABLE RANGES (cont'd)**

Description of Available Ranges (refer to <a href="#">Figure 4–1</a> )	
<b>Stationary (RIG) Mode OFS Models Shift Schedules = Powershift Shift Schedules</b>	444*, 555*, 666*, 777* and various Automatic Shift Schedules.
<p>** Only available in 3700/4700/4800/4770/4870/4970 models</p> <p>*** Actual ranges available depend on programming by vehicle manufacturer.</p> <p>* Indicates Max Attainable Range</p>	

#### **4.1.3.1 SHIFT SELECTOR TRANSITION AND OIL FIELD PUMPING (INPUT FUNCTION BZ: WIRE 142) (OFS Models)**



**WARNING:** This input function involves the use of complex algorithms in the control logic. If the function is enabled in the calibration but the control circuit for the function is not installed, there is a potential risk for one or more system failure modes which could result in undesirable transmission operation. Therefore, the activation circuit for this function **MUST BE** properly integrated in the vehicle in which it is installed. If the function will not be used in the final vehicle, it **MUST NOT** be ordered in the calibration. For specific installations, the vehicle may be operated prior to full integration of the function into the vehicle wiring. For example, a bare chassis transported to a body builder where the function will be wired into the completed vehicle. In these cases, if the function is activated in the calibration, the specific wires related to the function must be electrically isolated, completely and individually. Until properly integrated into the final vehicle wiring, the chassis builder must protect the wires such that they do not make electrical contact with the following:

- each other, if the function involves more than one wire
- any other transmission wiring
- any other vehicle wires
- any part of the vehicle or chassis

**Description:** This function combines the features of Secondary Shift Schedule (Input A) and Shift Selector Transition (Input D) into one switched input and is intended for use **ONLY** in dual-mode applications of OFS transmissions. The function is enabled when the transfer-case activated switch is closed to complete the circuit between wire 142 and ground. The

transition is permitted only when **N** (Neutral) is selected and attained in the transmission, and when transmission output speed is below 60 rpm.

When the function is disabled, the transmission operates according to the primary shift schedule programmed in the TCM and operator selections on shift selector 1. Shift selector 1 must be located in the vehicle cab. Primary (ROAD) Mode must be used **ONLY** for vehicle propulsion.

When the function is enabled, the transmission operates according to the secondary shift schedule and control of the transmission transitions to shift selector 2 (which must be located outside the vehicle cab). Secondary (RIG) Mode, which is programmed with special calibration characteristics and diagnostics for this application, must be used **ONLY** for stationary operation such as pumping, swabbing or winching.

When the function is disabled, operation in primary mode resumes, controlled by shift selector 1.

**USES:** For oil field dual-mode vehicles which are driven on-road in primary mode, then use secondary mode for stationary oil field operations such as pumping, swabbing or winching.

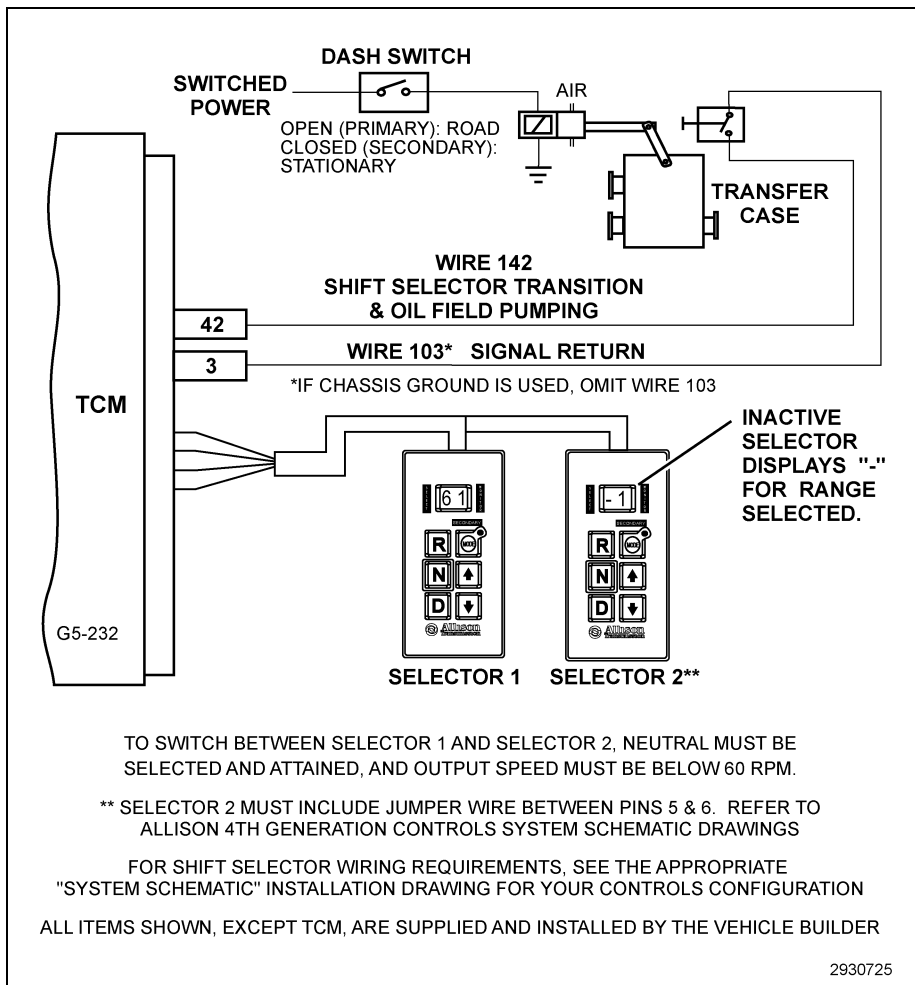
**CUSTOMER MODIFIABLE CONSTANTS:** None

**VOCATIONS:** Oil field pumper, cementer, winch

**FUNCTION RESPONSE TO TCM POWER INTERRUPTION (power-off, followed by power restored):**

Power off: No change

Power restored: No change



**Figure 4-3. Shift Selector Transition and Oil Field Pumping  
(Input Function BZ: Wire 142)**



**WARNING:** This schematic shows the intended use of the specified controls feature which has been validated in the configuration shown. Any miswiring or use of this feature which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. **Allison Transmission is not liable for the consequences associated with miswiring or unintended use of these features.**

## 4.2 SHIFT SCHEDULES AND AUTOMATIC RANGE SHIFTS

Each transmission shift calibration includes multiple shift schedules which are used to control transmission shifts in various operating conditions. The shift schedules affect the timing of shifts between gears. The actual number of forward gears is determined based on the transmission model and the selected range position of the shift selector.

Vehicle performance may be affected when shift schedules change. The transition between shift schedules can be initiated by several different actions.

The transmission initially attains first range when **D** (Drive) is selected (except for those units programmed to start in **2** (Second Range)). As vehicle speed increases, the transmission automatically upshifts through each range. As the vehicle or equipment slows down, the transmission automatically downshifts to the correct range. The SELECT display shows the highest range available in **D** (Drive).



**NOTE:** The vehicle OEM or bodybuilder is responsible for evaluating the driveability of shift schedules in the intended vehicle and duty cycle. For additional details regarding these shift schedules and/or other options for primary and secondary shift schedules, contact a qualified Allison Transmission service outlet for further information.

---

**4.2.1 UPSHIFTING.** As long as the TCM calculates that there is enough vehicle power and vehicle acceleration available to grant and keep the next upshift, then there are no other limitations imposed on upshifting until the vehicle attains its top range displayed in the SELECT display on the selector. Vehicle power and acceleration characteristics are monitored by the transmission controls to attempt to eliminate shift cycling. Shift cycling is an upshift followed closely by a downshift, which is then followed by another upshift, and so on.



**NOTE:** If shift cycling is noted, use the alternate shift schedule by pressing the **MODE** button. The operator can also manually select the next lower range (using the shift selector) to hold that lower range until conditions are met to grant the upshift point again without shift cycling.

---

### 4.2.1.1 HOLD SCHEDULE FOR UPSHIFTS

As a standard feature of each shift calibration, the transmission controls incorporate a **"hold upshift"** shift schedule, which the operator may select if the transmission is not operating in its highest range. When this schedule is

active, the shift points for upshifts are raised in order to hold the transmission in its current gear and inhibit upshifting beyond the current range. Holds are activated by selecting the current range or a lower range on the shift selector.



**CAUTION:** A typical use of the "hold" feature is to maximize engine braking when operating downhill. However, in order to prevent over-speeding the engine, the hold function is not infinite. It will permit shifts from the hold range to the next higher range at some speed above the shift calibration speed.

**4.2.2 DOWNSHIFTING.** Downshifts are allowed to occur as long as transmission output speed is low enough to keep from over-speeding the engine after completing the downshift. When a range downshift is manually selected by the operator, but the transmission output speed is determined to be above the limits, the transmission remains in the range even though a lower range was requested by the operator. A shift to a lower range can occur when the operator applies the vehicle service brakes or a retarding device, such as an exhaust brake, engine brake, or retarder. This action reduces the transmission output speed which in turn lowers the vehicle speed, allowing the transmission to shift to the lower range.

#### **4.2.2.1 PRESELECT SCHEDULE FOR DOWNSHIFTS**

The preselect downshift schedule is similar to the hold feature. The operator may initiate the preselect downshift shift schedule by selecting any forward gear on the shift selector that is lower than the gear currently in use. When a range has been "preselected" in this manner, shifts to and from gears above the preselected gear range occur at higher than normal engine speeds. Shifts below the preselected range are not affected.

Preselect downshifting is beneficial in maintaining higher engine speed, resulting in increased engine braking or engine brake performance during downhill operation or vehicle deceleration cycles. However, preselect shifts are permitted only if an engine over-speed condition will not occur after completion of the downshift.



**NOTE:** Preselecting during normal operation may result in reduced fuel economy.

#### **4.2.2.2 NON-ENGINE BRAKE OPERATION**

Two choices of preselect shift schedules are available for governing preselected downshifts during normal transmission operation. One of the



following choices is selected when the TCM is programmed by the vehicle OEM:

- **Standard Preselects** – downshifts occur so the engine speed after the shift is approximately 300 rpm above the engine governed speed
- **Low Preselects** – downshifts occur so the engine speed after the shift is approximately 150 rpm above the engine governed speed

#### 4.2.2.3 ENGINE BRAKE OR EXHAUST BRAKE OPERATION

When the TCM detects the engine brake is enabled, it commands use of a preselect shift schedule in order to enhance engine brake performance. The default speeds for these shifts are known as the Alternate Engine Brake Preselects.

- **Alternate Engine Brake Preselects** – downshifts occur at engine speeds approximately midway between 1000 rpm and the Standard Preselects for your transmission model

As an option, the preselect shift points during engine brake operation can be specified to be the same schedule selected when the TCM is programmed by the vehicle OEM for non-engine brake operation:

- **Standard Preselects** – downshifts occur so the engine speed after the shift is approximately 300 rpm above the engine governed speed
- **Low Preselects** – downshifts occur so the engine speed after the shift is approximately 150 rpm above the engine governed speed



**NOTE:** Specify Standard or Low Preselects when the TCM is programmed.

---

The preselect schedule chosen above will be activated for downshifts that occur while the engine brake is active and until operation in a specified gear is reached. This specified gear is the Engine Brake Preselect Range CMC that is programmable using Allison DOC®. If this CMC is set to a value higher than **2** (Second Range), then downshifts from the Engine Brake Preselect Range to **2** (Second Range) will be made as standard (non-engine brake) closed throttle downshifts. Additionally, if the TCM is programmed to make engine brake preselect downshifts at Standard Preselects or Low Preselect speeds, downshifts between the Engine Brake Preselected Range to an even lower gear can be specified to use the Alternate Engine Brake Preselect downshift speeds. The lowest gear to use this downshift schedule is also a CMC (Alternate Engine Brake Preselect Range). If this option is specified and the Alternate Engine Brake Preselect Range CMC is higher than **2** (Second

Range), downshifts from the Alternate Engine Brake Preselect Range to **2** (Second Range) uses normal (non-preselect) closed throttle shift speeds.



**NOTE:** If an exhaust brake or engine compression brake is installed on the engine, then they must be integrated to the transmission controls. Shift quality issues will arise if not properly integrated to the transmission controls.

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#### **4.2.2.4 RETARDER MODE SHIFT SCHEDULE**

The retarder mode shift schedule is automatically activated when the retarder is switched on in order to raise closed throttle downshifts for additional cooling during retarder operation. Retarder closed throttle downshifts occur at speeds approximately halfway between the normal closed throttle downshift and the preselect downshift for each range. Refer to [4.3 USING THE HYDRAULIC RETARDER](#).

**4.2.3 ACCELERATOR CONTROL.** The position of the accelerator pedal influences when automatic shifting occurs. An electronic throttle position signal tells the TCM how much the operator has pressed the pedal. When the pedal is fully pressed, upshifts occur automatically at higher engine speeds. A partially pressed position of the pedal causes upshifts to occur at lower engine speeds.

#### **4.2.3.1 KICKDOWN SHIFT SCHEDULE (N/A for OFS Models)**

Kickdown is an optional shift schedule which is activated when the kickdown input function is enabled. If shift schedule S2, S3, or S4 is in use and kickdown is active, all shifts revert to schedule S1, Wide Open Throttle (WOT) shift points. Similarly, if shift schedule S6, S7, or S8 is in use and kickdown is active, all shifts revert to schedule S5, WOT shift points.

**4.2.4 PRIMARY AND SECONDARY SHIFT SCHEDULES (N/A for OFS Models).** The primary shift schedule is normally used each time the vehicle is started and is specified in such a way to accommodate normal vehicle operation.

The secondary shift schedule is an alternate shift schedule that the TCM only uses upon request. The request for this schedule can be a dedicated request from the operator or it can be interlocked with the operation of another vehicle system.

Primary and secondary shift schedules may be changed using the **MODE** button, but some applications may use a dash-mounted switch. The MODE display illuminates while in secondary shift schedule. The vehicle might

also have a dash-mounted light that illuminates when the secondary mode schedule is active.

Frequently, either performance or economy shift points are selected for the primary shift schedule (reflecting the most commonly used state of the vehicle), and the other set of shift points are selected for the secondary shift schedule.

The primary and secondary shift schedules must be specified when the TCM is programmed. The vehicle OEM determines which primary/secondary shift schedule combination they would like the transmission to have when the vehicle is built.

**4.2.5 PERFORMANCE/ECONOMY SHIFT SCHEDULES (N/A for OFS Models).** Currently, Allison Transmission offers the following commonly available shift schedules to the OEM(s):

- **S1 & S5** - Performance: WOT upshifts near Full Load Governed Speed (FLGS)
- **S2 & S6** - Performance: WOT upshifts at a fixed (less than 100) percent of FLGS
- **S3 & S7** - Economy: Upshifts at speeds which pull engine down to a fixed rpm after the shift
- **S4 & S8** - Economy: Upshifts at speeds which pull engine down to a fixed rpm (and less than S3) after the shift
- **S9** - Economy: Upshifts and downshifts occur at speeds that are even lower than the S4 shift strategy
- **SA** - Economy: WOT upshifts are similar to S1 & S5. The SA part-throttle upshifts and downshifts occur at significantly lower speeds than the S5 part-throttle shifts.
- **SB** - Economy: WOT upshifts and downshifts similar to SA. The SB part-throttle upshifts occur at slightly higher speeds than the SA part-throttle upshifts.
- **SC** - Economy: WOT upshifts are similar to S3 & S7. The SC part-throttle and closed-throttle upshifts and downshifts are similar to the SA part-throttle and closed-throttle shifts.
- **SD** - Economy: WOT upshifts and downshifts similar to S3 & S7. The SD part-throttle and closed-throttle upshifts and downshifts are similar to the SB part-throttle and closed-throttle shifts.

Schedules S1 through S4 are typically used with engines using variable speed or all-speed governors. The differences between the schedules is typically close to full throttle. Schedules S5 through S8 are designed to provide the

same WOT upshifts as the corresponding S1 through S4 schedules. However, the S5 through S8 part throttle shift schedules have been modified.

#### 4.2.6 DYNAMIC SHIFT SENSING (DSS) (N/A for OFS Models).



**NOTE:** DSS was known as Load-Based Shift Scheduling (LBSS) prior to July 2014.

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The DSS shifting strategy option combines the advantages of both performance and economy shift schedules. The controls automatically select the economy shift schedule when an unloaded state of the vehicle is detected (based on capability of the vehicle to accelerate quickly), then automatically switch to performance shift points when the vehicle is loaded and its ability to accelerate is reduced. The resulting operation can continuously modify transmission shifting to keep the engine near its more efficient speeds, which can produce improved overall vehicle fuel economy while still enabling high productivity during loaded conditions. DSS is available for all transmission models, except the OFS. DSS requires that the Primary and Secondary shift schedules have the same number of forward gear ranges.

DSS is implemented two different ways depending on whether the vehicle has Engine Management Integration between the engine and transmission controls the DSS is implemented two different ways:

- **Torque-Based DSS:** In vehicles where the engine and transmission have Engine Management integration, the DSS algorithm will use the SAE J1939 engine torque messages to estimate the vehicle load. Torque-based DSS includes an additional shift mode which is a more aggressive economy shift schedule. The Super Economy Shift Schedule (SESS) works in the background of the selected Economy and Performance shift schedules. SESS allows the vehicle to cruise at the lowest possible engine speed without lugging the engine. DSS will shift based on the SESS when the vehicle meets the following conditions:
  - Constant throttle position
  - Very low tractive effort
  - Steady cruise operationAny sudden change in throttle position or tractive effort will cause the TCM to exit SESS and return to the basic Economy and Performance shift schedules. SESS is standard in all torque-based DSS-active calibrations.
- **Acceleration-Based DSS:** In vehicles without Engine Management Integration between the engine and transmission, the DSS algorithm uses throttle position and output acceleration to estimate the vehicle

load. SESS is not available with acceleration-based DSS. In addition, DSS uses an inclinometer/accelerometer in the TCM to refine the selection of the appropriate shift schedule based on vehicle operating requirements.

The TCM will initialize in the same mode, Economy or Performance, that it was in when last shutdown. The vehicle load is re-estimated during the first high throttle acceleration and the appropriate mode is commanded. The mode is also reset to Performance when one of the following is detected:

- An engine de-rate condition
- The loss of torque data from the engine

In addition to providing the capability to automatically switch between performance and economy schedules, the availability of economy mode in DSS is selectable as a CMC with Allison DOC<sup>®</sup> within the shift calibration as follows:

**Table 4–2. DSS ECONOMY MODE**

<b>CMC Setting</b>	<b>Selection</b>	<b>Description</b>
1	Reserved 1	Reserved for future use
2	Reserved 2	Reserved for future use
3	Low	This setting keeps the vehicle in economy mode when lightly loaded or on low upgrades. The vehicle will always be in performance mode if carrying a load or when negotiating moderate grades.
4	Medium	This is the default value. This setting keeps the vehicle in economy mode more than the default setting. When the vehicle is empty, even on moderate grades, economy mode is normally in use. Likewise, economy mode also is used on nearly-level grades with moderate loads. Performance mode will be commanded when heavily loaded or with moderate loads on larger grades.
5	High	This setting keeps the vehicle in economy mode in most circumstances. Performance will typically be commanded only when negotiating severe when heavily loaded. This setting permits higher powered vehicles to be in economy mode for most operations except during the most demanding operating conditions.

**4.2.7 OVER-TEMPERATURE SHIFT SCHEDULE (N/A for OFS Models).**

Regardless of operator request, the TCM automatically limits transmission operation to **4** (Fourth Range) or below during oil over-temperature conditions. If the transmission is above **4** (Fourth Range) when over-temperature occurs, the preselect shift schedule is used for all downshifts until **4** (Fourth Range) is reached.

**4.2.8 CRUISE MODE SHIFT SCHEDULE.** This shift schedule is activated when a SAE J1939 datalink message is received to indicate that cruise control is active. Shift points for this operation are modified in order to reduce the frequency of upshifts and downshifts during cruise operation. This shift schedule is a standard feature of each shift calibration.

The vehicle cruise control features interact with retarder activation/deactivation and are determined by calibration and CMC(s). Refer to [4.3.2 RETARDER/CRUISE CONTROL INTERACTIONS](#).

#### **4.2.9 ACCELERATION-BASED PATTERN (ABP).**

All calibrations include the ABP feature. ABP raises the full throttle upshift and downshift points under the following conditions:

- The throttle position is at or near 100%.
- The vehicle is not accelerating. An example of these conditions is a loaded vehicle climbing a grade. ABP will downshift the transmission at higher output shaft speeds than the standard full throttle downshifts. Downshifting the transmission increases the output torque and allows the vehicle to maintain road speed.

#### **4.2.10 ACCELERATION RATE MANAGEMENT (ARM) (N/A for OFS Models).**



**NOTE:** ARM was known as Vehicle Acceleration Control (VAC) prior to July 2014.

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ARM is an engine management function where the TCM manages engine torque to limit vehicle acceleration to a calibrated rate. This function will allow full torque from the engine if the vehicle is unable to reach the calibrated acceleration rate, such as on steep grades or when the vehicle is heavy. This function may be used for the following:

- To improve fuel efficiency.
- To reduce tire wear.
- To reduce acceleration aggressiveness.
- To provide for consistent acceleration in loaded and unloaded conditions.

ARM may be used in conjunction with DSS.

ARM offers the levels of acceleration control shown in [Table 4–3](#). The acceleration control setting is a CMC.

**Table 4–3. ARM Level Description Acceleration Rate Comments**

Setting	Selection	Description
5	Ultra Economy	Provides the slowest acceleration rate. Offers the highest potential for fuel savings
4	Super Economy	
3	High Economy	
2	Intermediate Economy	
1	Base Economy	Provides acceleration closest to normal vehicle acceleration. Offers the lowest potential for fuel savings
9	Off	Default Setting

**4.2.11 LOW SPEED GRADE ASSIST.**

When the engine is being sluggish during full throttle operation, Low Speed Grade Assist allows a quicker transition into first lockup from second converter in 6-speed transmissions, and a quicker transition into second lockup from third converter in 7-speed models. Low Speed Grade Assist is available in 3000 and 4000 Series applications that have Engine Management Integration between the transmission controls and the engine controls. This feature must be specified when the TCM calibration is defined.

**4.2.12 ALLISON TRANSMISSION FUELSENSE® 2.0 (N/A for OFS Models).**

Vehicles equipped with an Allison Transmission and a FuelSense® 2.0 package will save fuel when compared to vehicles without the package, depending on the duty cycle.

FuelSense® 2.0 is an initiative that groups software and calibration fuel economy features into packages that can be easily selected when specifying a TCM calibration in the Allison Calibration Configuration Tool (ACCT).

With the introduction of FuelSense® 2.0 packages, more descriptive feature designations have been created. Refer to [Table 4–4](#) for FuelSense® 2.0 features and package designations.



**Table 4–4. 5th Generation FuelSense® 2.0 Features and Package Designations**

Former Terminology	FuelSense® 2.0 Terminology	FuelSense® 2.0	FuelSense® 2.0 Plus	FuelSense® 2.0 Max
Low Speed Shift Calibrations	EcoCal	X	X	X
Load-Based Shift Scheduling (LBSS)	Dynamic Shift Sensing (DSS)	X	X	X
Acceleration Based Mode Switch (ABMS)				
Super Economy Shift Schedule (SESS)				
Reduced Engine Load at Stop (RELS) or Enhanced Converter Load Release (ECLR)	Neutral at Stop Standard or Neutral at Stop Premium		X	X
Vehicle Acceleration Control (VAC)	ARM			X

**Table 4–5. 6th Generation FuelSense® 2.0 School Bus and Truck Features**

Features	FuelSense® 2.0	Neutral at Stop
DynActive®	X	
Dynamic Shift Sensing	X	
Neutral at Stop		X
Acceleration Rate Management	X	



**NOTE:** Applicable to North America only. 6th Generation Controls outside North America will continue to use 5th Generation packages.



**NOTE:** For school bus and truck vocations, Neutral at Stop and FuelSense® 2.0 are purchased separately.

**Table 4–6. 6th Generation FuelSense® 2.0 Transit and Coach Bus Features**

Features	FuelSense® 2.0
DynActive®	X
Dynamic Shift Sensing	X
Neutral at Stop	X
Acceleration Rate Management	X



**NOTE:** Applicable to North America only. 6th Generation Controls outside North America will continue to use 5th Generation packages.

#### **4.2.12.1 FUELSENSE® 2.0 Terminology Descriptions**

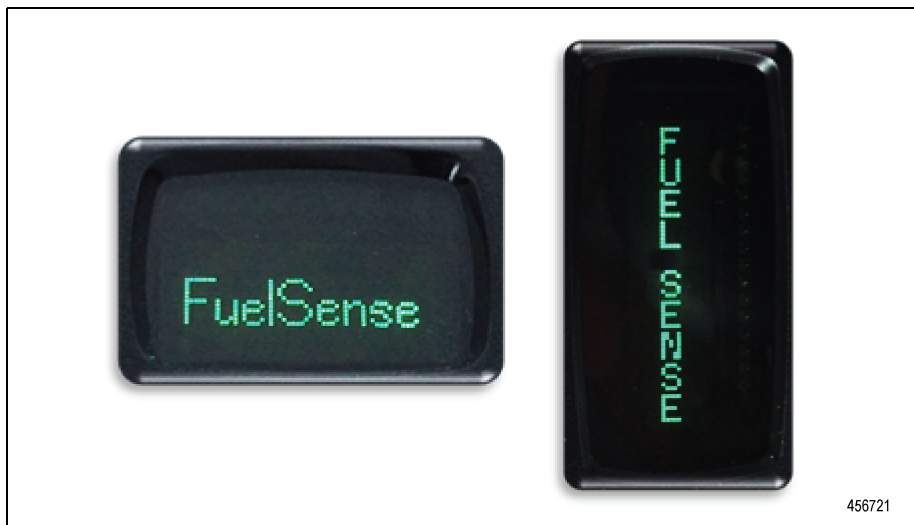
- **EcoCal:** EcoCal describes lower engine speed shift schedules designed to match the engine and duty cycle, maintain optimum engine speed, perform torque converter lockup as soon as possible, and provide necessary performance without shift cycling.
- **Dynamic Shift Sensing (DSS):** DSS is a feature that automatically selects between EcoCal and higher speed shift schedules based on the vehicle's actual payload and the grade on which it's operating.
- **Neutral at Stop:** Neutral at Stop is a feature that reduces or eliminates the load on the engine while the vehicle is stopped, thus reducing fuel usage and emissions.
- **Acceleration Rate Management (ARM):** ARM is a feature that alleviates aggressive driving practices by controlling engine torque based on the vehicle's grade and load.

#### **4.2.12.2 FUELSENSE® 2.0 Driver Indicator (with FuelSense® 2.0 Package (N/A for OFS Models))**



**NOTE:** The TCM software must be configured to enable FuelSense® 2.0 in order for the FuelSense® 2.0 driver indicator initialization screen to appear. A New Parameter Option is provided in ACCT/Vehicle Electronic Programming Stations (VEPS) Programming Guides that must be answered in order to configure FuelSense® 2.0.

Vehicles equipped with a FuelSense® 2.0 package will include a display of the FuelSense® 2.0 logo. At the discretion of the OEM, vehicles not equipped with an Allison shift selector display can provide the FuelSense® message on a dash display. The Allison shift selector will display the “Allison Transmission” initialization screen followed by a “FuelSense® 2.0” screen upon vehicle startup (refer to [Figure 4–4](#)).



**Figure 4–4. FuelSense® 2.0 Display**

### **4.3 USING THE HYDRAULIC RETARDER**

A hydraulic retarder is optional on most models covered in this manual. The purpose of the retarder is to assist in stopping the vehicle during stop-and-go driving and to control the downhill speed of the vehicle on a grade. For both of these uses, the retarder extends the life of the service brakes and enhances vehicle control. The retarder automatically disengages when the vehicle approaches a stop.

When the retarder enable switch is turned on to enable the retarder system, a special retarder mode shift schedule is activated. This shift schedule allows downshifts at higher than the normal road speeds. Increased coolant flow through the transmission cooler and engine radiator occurs due to the raised downshift points. Refer to [4.3.1 RETARDER CAPACITY REDUCTION](#).



**NOTE:** The transmission retarder is configured as either a low, medium or high capacity retarder by TCM calibration. Allison Transmission requires written vehicle OEM approval before a service outlet increases the retarder capacity at a customer's request. Existing vehicle drivelines, differentials, axles and the cooling system must be designed for the additional retarder torque generated if a higher capacity retarder calibration is installed. The cost to modify retarder capacity is the responsibility of the customer.

---

The amount of Retarder Modulation Request (RMR) is controlled by the operator and depends on the type of retarder control used in the vehicle. Various hand, foot and automatic control techniques are used. Refer to [Table 4–7](#). Beginning with Allison 5th Generation Controls, the TCM also activates or limits retarder operation in response to torque speed control or electronic retarder control messages received on the vehicle's SAE J1939 Datalink. Contact your OEM to understand how the retarder controls have been integrated into your vehicle.

The presence of a retarder must be autodetected beginning with Allison 5th Generation Controls.



**NOTE:** The retarder enable switch is used to turn the retarder off for slippery road conditions.

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**WARNING:** DO NOT USE THE RETARDER DURING INCLEMENT WEATHER OR WHEN ROAD SURFACES ARE SLIPPERY.

Use of the hydraulic retarder during inclement weather or when road surfaces are slippery could result in death, serious injury, or property damage. On vehicles which have a primary retarder control based upon closed throttle position, brake pedal position, or brake apply pressure, always manually disable the retarder controls during inclement weather or slippery road conditions, using the OEM provided retarder enable switch if present.

If the transmission retarder does not apply, death, serious injury, or property damage may occur. Operator should be prepared to apply vehicle brakes or other retarder device if the transmission retarder does not apply.

If the transmission retarder does not function, death, serious injury, or property damage may occur. Be sure to test for proper retarder function periodically. If a retarder is present but is not detected by “autodetect,” the retarder will not function. Whenever the retarder does not apply, seek service help immediately.

Regardless of the type of Allison retarder controls on your vehicle (refer to [Table 4–7](#)), the following safety features are common to each configuration:

- The retarder can be disabled when inclement weather or slippery road conditions are present.
- Vehicle brake lights should always be on when the retarder is applied (periodically verify they are working).
- Anti-lock Brake System (ABS) sends a signal to the TCM to indicate the brake system is activated.



**NOTE:** The retarder is automatically disabled and the lockup clutch is disengaged whenever the ABS is active. If the ABS malfunctions, it is recommended the retarder enable switch be disabled, if equipped.



**NOTE:** If your transmission has a retarder but it is not functioning, it may not have been autodetected during vehicle manufacture. Consult the nearest Allison Transmission service outlet to have autodetect reset or the retarder enabled using the Allison DOC®.



**NOTE:** A common cause for retarder performance complaints is incorrect transmission fluid level. Fluid level must be set correctly for maximum retarder effectiveness. As little as 2 liters (2 quarts) too high or too low can reduce retarder effectiveness and increase transmission temperature. Refer to [5.8 PERIODIC FLUID LEVEL CHECKS](#).

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**NOTE:** The retarder requires about two seconds to reach full capacity. Be sure to anticipate this delay when using the retarder to prevent unnecessary service brake applications during non-emergency stops.

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**NOTE:** When the transmission fluid or engine water temperature (an OEM option) exceeds programmed limits, retarder capacity automatically reduces gradually to minimize or avoid system overheating.

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**CAUTION:** Observe the following cautions when driving a vehicle equipped with a retarder:

- THE RETARDER WORKS ONLY WHEN THE ENGINE IS AT CLOSED THROTTLE.
- OBSERVE TRANSMISSION AND ENGINE TEMPERATURE LIMITS AT ALL TIMES. Select the lowest possible transmission range to increase the cooling system capacity and total retardation available.
- In the event of OVERHEATING, DECREASE THE USE OF THE RETARDER; USE THE SERVICE BRAKES TO SLOW THE VEHICLE.
- OBSERVE THE RETARDER/SUMP “OVERTEMP” LIGHT to be sure it responds properly to retarder temperature.

**Table 4–7. Types of Retarder Control**

Type	Description	Amount of Application
Manual	Separate apply pedal	Zero to Full apply
	Hand lever*	Six levels based on lever position
Automatic	Auto “Full On”	“Full On” when closed throttle sensed
Brake Pressure Apply**	Single pressure switch	Off or “Full On” (based on brake pressure)
	Three pressure switches	1/3, 2/3, or “Full On” (based on brake pressure)
Pedal Position**	Special brake pedal	1/3, 2/3, or “Full On” (based on brake pressure)
SAE J1939 Data Link	Digital message from engine controller	Zero to Full Apply
Combinations of the above systems**	Auto “half-on” plus pressure switch*	Half capacity at closed throttle or “Full On” with brake pressure
	Auto “1/3 on” plus two pressure switches*	1/3 capacity at closed throttle or 2/3 and “Full On” with brake pressure
	Hand lever plus pressure switch*	6 levels of modulation with lever, or “Full On” with brake pressure
	Foot pedal plus pressure switch	Full modulation with separate pedal, or “Full On” with brake pressure
	Hand lever plus interface for special pedal*	6 levels of modulation with lever, or 3 levels of modulation based on pedal position

\* These control systems may apply the retarder at high speed on grades when the vehicle has road speed limiting and the retarder is enabled.

\*\* For retarder apply systems integrated with the service brake system, the retarder is most effective when applied with light brake pedal pressure for 1–2 seconds to allow the retarder to fully charge. Added pedal pressure can be applied when more aggressive braking is desired.

### 4.3.1 RETARDER CAPACITY REDUCTION.



**NOTE:** In the event of excessively high temperatures in the transmission fluid and/or engine coolant during retarder operation, the maximum available retarder capacity may be reduced, affecting vehicle operation.

Retarder capacity is reduced if the transmission retarder-out or transmission sump temperature exceeds specified limits, as detected by temperature sensors which are integral to the transmission. In addition, retarder capacity is reduced in the event of elevated engine water temperature based on:

- engine water temperature as communicated to the TCM with an engine coolant sensor or via an SAE J1939 datalink, or
- detection by an engine water temperature sensor which provides an analog input signal to the TCM. This sensor is supplied and installed by the vehicle builder.

#### **4.3.1.1 BASED ON RETARDER TEMPERATURE**

If the retarder temperature exceeds 143°C (290°F), the TCM raises the closed throttle downshift points by activating the preselect downshift schedule. Use of the preselect downshift schedule forces downshifts to occur at higher than normal road speeds, increasing coolant flow through the transmission cooler and engine radiator.

If the retarder temperature exceeds 149°C (300°F), retarder capacity begins to reduce. Capacity reduction continues until it is reduced to approximately 27% of the maximum available retarder capacity.



**NOTE:** If the output speed increases 300 rpm above the speed at which capacity reduction starts, full retardation is restored.

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If the retarder temperature exceeds 166°C (330°F), the retarder temperature indicator output activates. This illuminates a retarder over-temperature light that alerts the operator of excessive retarder temperature. The retarder temperature light deactivates when the retarder temperature drops below 159°C (318°F). If the retarder temperature remains above 166°C (330°F) for ten consecutive seconds, an active DTC P273F (Retarder Oil Temperature Sensor Over Temperature Condition) is logged by the TCM. When the temperature drops and remains below 166°C (330°F) for ten consecutive seconds, the DTC becomes inactive and is stored in memory.

#### **4.3.1.2 BASED ON TRANSMISSION SUMP TEMPERATURE**

Independent of the retarder temperature, if the transmission sump temperature exceeds 117°C (240°F), retarder capacity will similarly be reduced as described above. The over-temperature indicator is activated and the over-temp DTC is logged if the sump temperature exceeds 121°C (250°F) for fifteen minutes, exceeds 128°C (262°F) for more than one minute, or instantaneously reaches 132°C (270°F).



### 4.3.1.3 BASED ON ENGINE WATER TEMPERATURE

If optional engine water capacity reduction and/or preselect downshifts are used, similar responses occur based on excessive engine water temperature. The capacity is reduced at the rate/slope programmed into the calibration and may continue to be reduced at this rate until:

- The retarder is operating at approximately 27.5% of its maximum capacity.
- The retarder is deactivated by the operator or by vehicle operating conditions which eliminate the need for retardation.
- Engine water temperature is returned to a level that does not invoke the capacity reduction.



**NOTE:** Full retardation is restored if the output speed increases 300 rpm above the speed at which water capacity reduction starts.

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**4.3.2 RETARDER/CRUISE CONTROL INTERACTIONS.** Two control features affect retarder operation when the vehicle is equipped with cruise control:

- Feature 1: Cruise Control Retarder Auto On Disable

This feature only applies to electronic engines that communicate with the transmission on the SAE J1939. The TCM calibration must specify this feature to be either on or off. If the feature is on in the calibration, the TCM prohibits retarder operation when cruise control is active but the throttle is closed, which implies downhill coasting operation. This feature is highly recommended if the retarder apply system automatically applies the retarder at high levels at closed throttle.

If the feature is off in the calibration or the engine is not electronic, the TCM commands retarder operation whenever the cruise control goes to zero throttle. This mode of operation is only acceptable if the subsequent level of retarder apply is less than 25%.

- Feature 2: Retarder Cancel Cruise Control

This feature provides for a short flash of the retarder indicator output whenever the requested retarder level is increased. The retarder indicator output must be wired to the engine cruise control to turn off cruise control when the level of retardation requested is changed. This operation emulates the effect of applying the service brakes. Feature 2 is an optional feature that must be specified for the controls calibration.

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## 5.0 CARE AND MAINTENANCE

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### 5.1 PERIODIC INSPECTIONS

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**NOTE:** The terms fluid and oil are used interchangeably in this publication. Both terms refer to the fluid or oil in the transmission and nowhere else.

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**CAUTION:** Do not spray steam, water or cleaning solution directly at electrical connectors or the breather. Fluids forced into electrical connectors can cause false codes and cross-talk. Steam, water or cleaning solution forced into the breather will contaminate the transmission fluid. Seal all openings, the breather and electrical connections before spraying steam, water or cleaning solution on the transmission.

It is very important to continually monitor the fluid level and connections for the electronic and hydraulic circuits. Clean and inspect the exterior of the transmission at regular intervals. Severity of service and operating conditions determine the frequency of these inspections. Make regular periodic inspections for:

- Proper transmission fluid fill. Refer to [5.8 PERIODIC FLUID LEVEL CHECKS](#).
- Transmission fluid that is discolored, has a strong odor or exceeded oil analysis limits.
- Presence of engine coolant in the transmission fluid.



**NOTE:** Transmission overhaul is required when the transmission has been contaminated with engine coolant. Allison Transmission recommends all clutch friction plates, lockup clutch, solenoids and rusted/damaged parts be replaced during the rebuild.

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- Presence of transmission fluid in the engine cooling system.
- Leaking fluid around fittings or hydraulic lines.

- Dripping oil from the transmission or output seal area.
- Debris that is blocking the breather located on top of the torque converter housing.
- Loose bolts securing transmission to engine or vehicle components attached to the transmission.
- Loose engine and transmission mounts.
- Harnesses interfacing with transmission controls and vehicle function are still in good condition.

Report any abnormal condition to service management. Immediately correct any problems found during this inspection to prevent further vehicle and/or transmission damage.

## 5.2 PREVENT MAJOR PROBLEMS

You can help keep minor problems from becoming major problems by contacting an Allison Transmission distributor or dealer when one of these conditions occur:

- A shift quality issue
- A driveability issue such as a vibration
- Transmission, hydraulic line or fitting is leaking fluid



**NOTE:** Dampness around the breather and output seal is normal. If there is a drip associated with the dampness at the breather, output seal, or elsewhere on the transmission then repair the cause of the leak.

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- **CHECK TRANS** light illuminates

## 5.3 IMPORTANCE OF TRANSMISSION FLUIDS

Proper transmission fluid selection is important to transmission performance, reliability, and durability. The fluid used in the transmission does the following:

- Provides the working medium for the torque converter, controls, and clutch application
- Transfers heat from the transmission to the cooler
- Lubricates gears and bearings
- Carries rust inhibiting chemicals throughout the transmission
- Achieves optimum coefficient of friction for the clutch application
- Maintains clutch engagement

- Carries contaminants to the filters

## 5.4 RECOMMENDED AUTOMATIC TRANSMISSION FLUIDS

Only use fluids meeting Allison Transmission specification TES 295, TES 668 or TES 389 in your transmission. For a list of currently approved transmission fluids, go to the Allison Transmission web site at: [allisontransmission.com](http://allisontransmission.com), select SERVICE, Fluids.

Allison Transmission recommends you take the following into consideration when selecting the appropriate fluid type for your transmission:


- Fluids meeting specification TES 295 or TES 668 are preferred over TES 389 fluids for use in all 3000 and 4000 Series transmission applications.
- TES 295 and TES 668 fluids are fully qualified for Severe Duty and Extended Drain intervals.
- A TES 295 and TES 668 fluid allows you to operate at a lower ambient temperature than a TES 389 type fluid. Refer to [Table 5–1](#).
- A TES 389 fluid is the minimum fluid requirement approved for use in 3000 and 4000 Series transmissions.
- To extend the TES 389 fluid drain intervals beyond the recommended mileage or hours change interval, use a fluid analysis program. Refer to [5.6 FLUID ANALYSIS](#).

When choosing a fluid type to use, consider what the minimum fluid operating temperature of the fluid will be based on the ambient temperatures reached in the geographical location for the vehicle. Refer to [3.3.1 Preheating Requirement](#).

**Table 5–1. Transmission Fluid Minimum Operating Temperature Requirements**

Fluid Type	Minimum Operating Conditions	
	Celsius	Fahrenheit
TES 295 or TES 668	–35	–31
TES 389	–25	–13

## 5.5 KEEPING FLUID CLEAN



**CAUTION:** Containers or fillers that have had antifreeze solution or engine coolant in them must NEVER be used to hold transmission fluid. Antifreeze and coolant solutions contain ethylene glycol and water which, if put into the transmission, can cause damage.

Make sure that transmission fluid is clean, free of chemical contaminants, and within fluid specification limits. Refer to [Table 5–2](#).

Handle transmission fluid in clean, residue-free containers and fillers to prevent any foreign material or chemical contamination of the transmission fluid.

## 5.6 FLUID ANALYSIS


Transmissions used in high cycle rate applications should use fluid analysis to make sure fluid is changed as soon as needed. Transmission protection and fluid change intervals may be optimized by monitoring fluid oxidation according to the tests and limits. Refer to [Table 5–2](#). Use only one fluid analysis firm to ensure consistent and accurate fluid analysis. Refer to Technician’s Guide for Automatic Transmission Fluid, GN2055EN, or SIL 17-TR-96 for additional information.

**Table 5–2. Fluid Oxidation Measurement Limits**

Test	Limit
Viscosity	±25 change from new fluid
Total Acid Number (TAN)	+3.0*change from new fluid
Solids	2 percent by volume
* mg of potassium hydroxide (KOH) to neutralize a gram of fluid.	

## 5.7 TRANSMISSION FLUID REFILL

The fluid refill volume will be less than the volume listed for the initial fill due to some fluid remaining in the external circuits as well as in various transmission component cavities. After refill, verify the fluid level is correct (refer to [5.8 PERIODIC FLUID LEVEL CHECKS](#)).



**NOTE:** Quantities listed in [Table 5–3](#) are approximate and do not include external lines and cooler hoses.

**Table 5–3. Transmission Fluid Capacity**

Transmission	Sump	Initial Refill		Refill	
		Liters	Quarts	Liters	Quarts
3000 Series	4 inch	27	29	18	19
	2 inch	25	26	16	17
4000 Series*	4 inch	48	51	40	42
	2 inch	41	43	33	35
* Subtract 2.8 Liters (3 Quarts) for transmissions without PTO.					

## 5.8 PERIODIC FLUID LEVEL CHECKS

Even though transmission fluid is not consumed during transmission operation as engine oil might be, periodic fluid level checks should be made prior to placing the vehicle in service or just after returning from service. Periodic fluid level checks help prevent mechanical failure of a vehicle or transmission component. Periodic checks also help to detect fluid leaks, cooler failure (contaminating the transmission fluid), fluid overfill, fluid underfill or the wrong kind of fluid used the last time the transmission was serviced.

Check the transmission fluid level by one of the following methods:

- Dipstick
- Using Allison 5th Generation or 6th Generation shift selector to electronically check the Oil Level Sensor (OLS) located in the transmission control valve module
- Using Allison DOC to check the level with the OLS



**NOTE:** OLS is not available in the 3700 SP or the 4700/4800/4770/4870/4970 transmission equipped with the retarder option.

The dipstick is marked with temperature bands for a COLD and HOT fluid level check. The fluid check marked COLD is designed to allow the fluid level to be checked from 16°C (61°F) to 60°C (140°F).



**NOTE:** Only use this check to confirm adequate fluid volume for a cold start-up and not to set fluid levels for continued operation.

The OLS is designed to automatically compensate for fluid temperature fluctuations (thermal expansion) within its operating band parameters for

fluid temperature. Allison Transmission recommends using the Allison 5th Generation controls shift selector to check the OLS. This method is more accurate than the dipstick method.

Use the dipstick method if any of the following situations exist:

- If transmission fluid temperature is below the temperature to check it electronically, conduct a COLD CHECK to determine whether there is enough fluid to start and move the vehicle.
- If the vehicle does not have an Allison 5th Generation shift selector or the OEM has not integrated the electronic messages regarding oil level into their selector.
- If the OLS or vehicle wiring is defective or the OLS was not auto detected, preventing electronic access to fluid level.

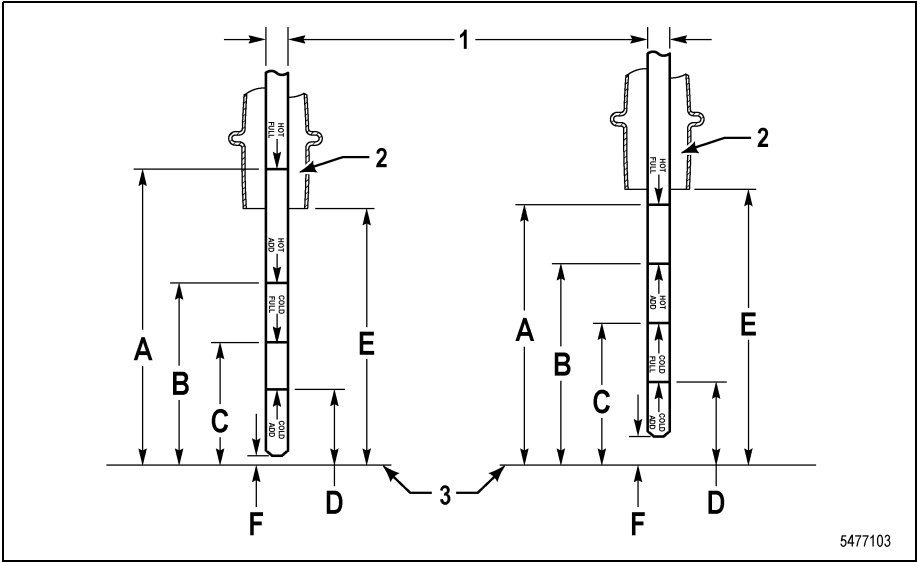
### 5.8.1 FLUID CHECK USING DIPSTICK.

There are two temperature bands marked on the dipstick to allow for transmission fluid expansion when the temperature increases. The lower band, referred to as COLD CHECK, is used when the transmission fluid is below operating temperature. The upper band, referred to as HOT CHECK, is used when the transmission fluid is at normal operating temperature. The OEM may refer to these as COLD FULL/COLD ADD (COLD CHECK) and HOT FULL/HOT ADD (HOT CHECK). Refer to [Figure 5-1](#) for further information on dipstick markings.



**NOTE:** For the location of the fill tube and dipstick, refer to [Figure 2-1](#) and [Figure 2-2](#) for non-PTO applications and [Figure 2-3](#), [Figure 2-4](#) and [Figure 2-5](#) for PTO applications. For 4700/4800/4770/4870/4970 Models, refer to [Figure 2-6](#) for the location of the fill tube and dipstick.

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- (1) - 6.35 mm (0.250 in.)  
REFERENCE. Blade can be as narrow as 4.76 mm (0.187 in.).
- (2) - Fill Tube
- (3) - Transmission Control Module Split Line
- (NOTE) - 3000 Series shown on left. 4000 Series shown on right.

**Figure 5-1. Standard Transmission Dipstick Markings**

OIL SUMP	TRANSMISSION/ SUMP DESCRIPTION	DIM A	DIM B	DIM C	DIM D	DIM E	DIM F**
2.00 in. and 4.00 in.	4000 Series	106.7 mm (4.20 in.)	76.2 mm (3.00 in.)	66.0 mm (2.60 in.)	*	132.6 mm (5.22 in.)	13.8 mm (0.54 in.)
2.00 in.	3000 Series	101.6 mm (4.00 in.)	73.7 mm (2.90 in.)	50.8 mm (2.00 in.)	*	86.6 mm (3.41 in.)	5.9 mm (0.23 in.)
4.00 in.	3000 Series	101.6 mm (4.00 in.)	63.5 mm (2.50 in.)	45.7 mm (1.80 in.)	*	86.6 mm (3.41 in.)	5.9 mm (0.23 in.)

\*\*Reference dimension only. Actual dimension to be determined by installation.

\*Dimension determined by installation.





**NOTE:** Calibrate level marking locations with respect to transmission control module split line and fill tube.

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**COLD CHECK:** The COLD CHECK band verifies the transmission has adequate fluid for start-up and operation until it can be checked at the operating (hot) temperature. Only use this check to confirm adequate fluid level for a cold start-up and not to set fluid levels for continued operation. Typically, the check is most accurate with fluid temperatures of 16-49°C (61-120°F).



**NOTE:** With engine off, the fluid level should reach the hot run band or higher on the dipstick even at cold ambient temperatures. The cold check band is calibrated on the stick for the fluid level attained while the transmission is running and in **N** (Neutral). Do not move the vehicle until the fluid level reaches the cold full mark with engine running and transmission in **N** (Neutral).

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**HOT CHECK:** The HOT CHECK band checks the fluid level at the normal operating temperature, 71-93°C (160-200°F). Fluid level checks at operating temperature offer the best assurance of maintaining the correct fluid level. Typically, the transmission is at operating temperature at the end of the shift or at the end of the day.

The fluid must be maintained above the COLD CHECK mark to assure the fluid is above the charging pump suction port inside the transmission. This prevents charging pump cavitation which causes aeration of the fluid and erratic operation of the transmission. If the fluid is above the HOT CHECK mark, it may contact the rotating parts of the transmission causing fluid aeration which results in erratic transmission operation and may cause overheating and power loss.



**CAUTION:** Transmission damage can result from extended operation at low fluid level conditions.



**NOTE:** Do not overfill the transmission. Overheating, oil foaming out of the breather and power loss may occur if driven while transmission is overfilled.

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### 5.8.1.1 COLD CHECK PROCEDURE



**NOTE:** The correct fluid level cannot be determined unless the transmission is in a level position.



**CAUTION:** DO NOT start the engine until the presence of sufficient transmission fluid has been confirmed. Remove the transmission fluid dipstick and be sure the static fluid level is near the HOT FULL mark.



**WARNING:** If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. If you must leave the engine running, **DO NOT LEAVE** the vehicle until you have completed all of the following procedures:

- Put the transmission in **N** (Neutral).
- Be sure the engine is at low idle (500–800 rpm).
- Apply the parking and emergency brakes and make sure they are properly engaged.
- Chock the wheels and take other steps necessary to keep the vehicle from moving.

A COLD CHECK determines if the transmission has enough fluid to be operated safely until a HOT CHECK can be made. Complete a COLD CHECK after the presence of transmission fluid has been confirmed with the engine off. The transmission fluid temperature should be between 16-49°C (61-120°F).



**NOTE:** Always check fluid level with the dipstick in the unscrewed or loose position.

Complete a COLD CHECK procedure using the dipstick as follows:

1. Move the vehicle to a level surface, put the transmission in **N** (Neutral) and set the parking brake.
2. With the engine idling (500–800 rpm), shift to **D** (Drive) and then to **R** (Reverse) to clear air from the hydraulic circuits.
3. Run the engine at idle (500–800 rpm) in **N** (Neutral) for about one minute.
4. Clean debris from around the end of the fill tube before removing the dipstick.
5. Remove the dipstick and wipe it clean.

6. Insert the dipstick into the fill tube, pushing down until it stops, but still in its loose or unscrewed position.
7. Remove the dipstick and observe the fluid level. If the fluid on the dipstick is within the COLD CHECK band (refer to [Figure 5-1](#)), the level is satisfactory. If the fluid level is not within this band, add or drain (refer to [5.7 TRANSMISSION FLUID REFILL](#)) as necessary to bring the level within the COLD CHECK band.
8. Perform a HOT CHECK at the first opportunity after normal operating temperature (71-93°C (160-199°F)) is reached.



**CAUTION: DO NOT** operate the transmission for extended periods of time until a HOT CHECK has verified proper fluid level. Transmission damage can result from extended operation at improper fluid level conditions.



**CAUTION:** The fluid level rises as fluid temperature rises. DO NOT fill the transmission above the COLD CHECK band if the transmission fluid is below normal operating temperatures. During operation, an overfull transmission can become overheated, leading to transmission damage.



**CAUTION:** Obtain an accurate fluid level by imposing the following conditions:

- Engine is idling (500–800 rpm) in **N** (Neutral)
- Transmission fluid is at the normal operating temperature
- The vehicle is on a level surface
- Apply the parking brake and chock the wheels

### 5.8.1.2 HOT CHECK PROCEDURE



**NOTE:** Always check fluid level with the dipstick in the unscrewed or loose position.

To complete a HOT CHECK procedure using the dipstick, do the following:

1. Be sure fluid has reached normal operating temperature of 71-93°C (160-200°F). If a transmission temperature gauge is not present, measure fluid level when the engine water temperature gauge has stabilized.

2. Park the vehicle on a level surface and shift to **N** (Neutral).
3. Apply the parking brake and allow the engine to idle (500–800 rpm).
4. Clean debris from around the end of the fill tube before removing the dipstick.
5. Remove the dipstick and wipe it clean.
6. Insert the dipstick into the fill tube, pushing down until it stops, but still in its loose or unscrewed position.
7. Remove the dipstick and observe the fluid level. The safe operating level is anywhere within the HOT RUN band on the dipstick. Refer to [Figure 5–1](#).
8. If the level is not within the HOT RUN band, add or drain fluid as necessary to bring the level within the HOT RUN band. Refer to [5.7 TRANSMISSION FLUID REFILL](#).
9. Measure fluid level more than once. Be sure fluid level measurements are consistent. If readings are not consistent, be sure the transmission breather is clean and not clogged.
10. If readings are still not consistent, contact your nearest Allison distributor or dealer.

### **5.8.1.3 TRANSMISSION DIPSTICK MARKINGS ILLUSTRATION**

Refer to [Figure 5–1](#).

## **5.8.2 FLUID LEVEL CHECKS USING ALLISON 5TH GENERATION OR NEWER SHIFT SELECTORS.**

The OLS is standard in all models except the 3700 SP and 4700/4800/4770/4870/4970 models equipped with a retarder. With the OLS and an Allison 5th Generation or newer shift selector, you can get a more accurate electronic fluid level check than with a dipstick.

### **5.8.2.1 ELECTRONIC FLUID LEVEL CHECK PREREQUISITES**

- OLS is functional and is auto-detected by the TCM.
- Vehicle has an Allison 5th Generation or newer shift selector with VFD.



**NOTE:** The strip button selector cannot display oil level.

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### 5.8.2.2 ELECTRONIC FLUID LEVEL CHECK PROCEDURE

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**NOTE:** The TCM delays the fluid level check until the following conditions are met:

- The fluid temperature is above 40°C (104°F) or below 104°C (220°F).
  - The transmission is in **N** (Neutral).
  - The vehicle has been stationary for approximately two minutes to allow the fluid to settle.
  - The engine is at idle.
  - When fluid level check is delayed by the TCM, a countdown timer in minutes and seconds appears in the selector graphics display.
- 

The OLS is designed to measure transmission fluid level. To check the fluid level electronically from the shift selector, do the following:

1. Park the vehicle on a level surface and shift to **N** (Neutral).
2. Apply the parking brake and allow the engine to idle (500–800 rpm).
3. Make sure vehicle is stopped with transmission output shaft speed at 0 rpm.
4. Allow a settling period of two minutes to facilitate oil drain back time. The TCM communicates status once fluid level request is initiated.
5. Fluid level measurement and readout may be initiated by pressing once on:
  - Bump-Shift Lever selector— press the **DISPLAY MODE/DIAGNOSTIC** (DMD) button once. Refer to [Figure 4–1](#).
  - Keypad Push button shift selector— simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows once. Refer to [Figure 4–1](#).
6. Correct fluid level is displayed as shown in [Figure 5–2](#).



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**Figure 5-2. Correct Fluid Level Display**

7. Low fluid level is displayed and the number indicates the number of quarts of fluid the transmission requires (refer to [Figure 5-3](#)).



**NOTE:** Confirm a low fluid level condition by making a manual fluid level check.



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**Figure 5-3. Low Fluid Level Display**

8. High fluid level is displayed followed by a number and the number indicates the number of quarts the transmission is overfilled (refer to [Figure 5-4](#)).



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**Figure 5-4. High Fluid Level Display**

9. To exit the fluid level display mode, press any range button on the push button shift selector or press the **DISPLAY MODE/DIAGNOSTIC** (DMD) button twice on the bump-shift lever selector.

### 5.8.2.3 FLUID RANGE DETECTED FOR OIL LEVEL SENSOR (OLS)

The OLS has a detection range of LO 4 to HI 3 that can display on the selectors. The actual oil level to add may be greater than 4 liters (4.22 quarts) if the transmission is more than 4 liters (4.22 quarts) low from the full mark. The actual fluid volume to drain may be more than 3 liters (3.17 quarts) if the transmission is overfilled by more than 3 liters (3.17 quarts).

### 5.8.2.4 INVALID FOR DISPLAY CODES

Invalid for Display is activated when conditions do not allow the fluid level to be determined. Refer to [Table 5–4](#) to review the codes and conditions and correct as necessary. If these conditions cannot be corrected, contact the nearest distributor or dealer in your area (look in the telephone directory for the Allison Transmission service outlet nearest you).

**Table 5–4. Invalid for Display Codes**

Code	Cause of Code
SETTLING / OK	Settling time too short
ENG RPM / TOO LOW	Engine rpm too low
ENG RPM TOO HIGH	Engine rpm too high
MUST BE / IN NEU	<b>N</b> (Neutral) must be selected
OIL TEMP / TOO LOW	Sump fluid temperature too low
OIL TEMP / TOO HIGH	Sump fluid temperature too high
VEH SPD / TOO HI	Output shaft speed
SENSOR FAILED	Sensor failure

## 5.9 PROGNOSTICS FEATURES

The Prognostics package contains functions that maximize fluid and filter use, as well as a feature which provides an indication of when the clutch system wear is significant enough to warrant transmission repair. You can then schedule the repair at your convenience. Refer to [Table 5–5](#) for Prognostics Function Description.

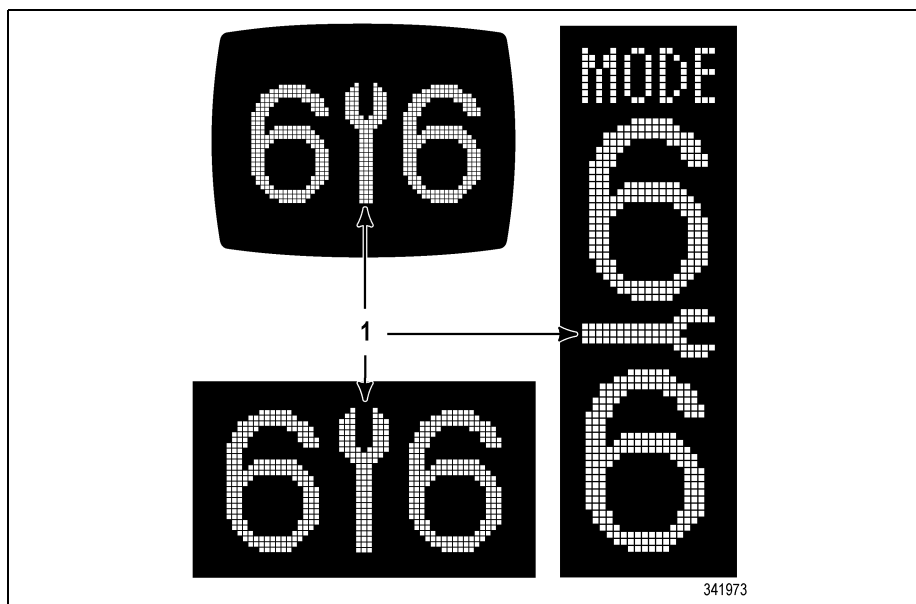
**Table 5–5. Prognostics Function Description**

Prognostics Function Name	Description
Oil Life Monitor (OM)	Displays the percentage of fluid life remaining
Filter Life Monitor (FM)	Notifies that main and lube filters need changing
Transmission Health Monitor (TM)	Notifies that one or more clutches, C1-C5, needs replacement

Allison transmissions with 5th Generation or 6th Generation Controls with Allison Prognostics enabled utilize a wrench icon (**TRANS SERVICE** indicator) located on the shift selector display (refer to [Figure 5–5](#)). The OEM may choose to use their own selector but provide the **TRANS SERVICE** indicator for Prognostics as a lamp or a message on a display unit.



**NOTE:** A wrench icon display on the face of the selector serves as the **TRANS SERVICE** indicator on the keypad push button and bump-shift lever selectors.



(1) – Wrench Icon

**Figure 5–5. Typical Allison Trans Service Indicator**



When a specified threshold is detected for any of the serviceable conditions, the **TRANS SERVICE** indicator is illuminated to alert the operator. Failure to attend to the service condition and reset the **TRANS SERVICE** indicator within a defined operating period results in illumination of the **CHECK TRANS** light, indicating the increased probability that the service condition will develop into a more serious condition. Refer to [6.2.1 CHECK TRANS LIGHT](#).

**5.9.1 PROGNOSTICS PREREQUISITES.** The following requirements must be met to use the Prognostics features and functions:

- Vehicle harness has a wire for the filter life indicator switch (wire 118).
- The OEM has ordered your calibration from Allison Transmission with Prognostics enabled.



**NOTE:** It is important to note that if Prognostics is **disabled**, it is not available in the calibration. This is different than the OEM ordering a calibration with Prognostics off. Defaulting Prognostics off means it could be enabled in the future without recalibrating to a different calibration, provided the other conditions are met to use Prognostics.

- 
- Using a TES 295, TES 668 or TES 389 transmission fluid
  - Using Allison Transmission High Capacity Main and Lube Filters



**NOTE:** Allison Transmission may approve some OEM selectors for Prognostics, provided the **TRANS SERVICE** indicator or message display is integrated by the OEM. At the time of this publication there are no capable OEM selectors for Prognostics.

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**5.9.2 PROGNOSTICS FEATURES AVAILABILITY.** The vehicle manufacturer specifies whether they want Allison Prognostics Feature Package to be made available in the calibration and in what configuration; for example, defaulted on or off. The OM, FM and TM are the individual functions included in the Allison Prognostics Feature Package. These individual functions cannot be turned on or off separately within the Allison Prognostics Feature Package.

The transmission calibration can be made for the vehicle manufacturer (or the customer) so the Prognostics Feature is in one of the following states:

- Available and the Prognostics Features are defaulted on and therefore monitoring OM, FM and TM presently.
- Available and the function is defaulted off and therefore available but not monitoring OM, FM and TM presently.
- Disabled and therefore not available within this Transmission Control Module (TCM) calibration.

Methods to turn the Prognostics Package Features on or off (provided all other requirements are met), include the following:

- Through the shift selector (if allowed by TCM programming). Refer to [5.9.3 PROCEDURE TO TURN PROGNOSTICS ON AND OFF](#).
- Using the Allison DOC, Customer Modifiable Constant (CMC) can be toggled to enabled or disabled for the Allison Prognostics Feature Package, provided the OEM ordered a calibration that has the Allison Prognostics Feature Package as a programmable feature.
- Recalibrate the TCM, provided wire 118 is in the harness. This can be done at an authorized Allison distributor or dealer.



**NOTE:** Prognostics should not be turned on after recalibration of the TCM until all other requirements for the fluid filters, selector and harness are met. If wire 118 is not in the vehicle harness, DTC P0848, Transmission Fluid Pressure Switch 2 Circuit High, will be active. Verify prognostics setting for fluid type, displayed in Allison DOC, matches type of fluid in the transmission. Refer to [5.9.5 SETTING FLUID TYPE FOR PROGNOSTICS](#) for additional information.

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The OEM initially specifies how they want the calibration configured for operator access regarding reset for Prognostics functions through the selector. The vehicle owner may then have the CMC toggled to either enabled or disabled to allow or disallow the Prognostics Package reset from the shift selector via programming features in Allison DOC®.

Reset methods for the Prognostics Package and reset of individual features in the package include the following: (Refer to [5.9.3 PROCEDURE TO TURN PROGNOSTICS ON AND OFF](#)).

- OM and FM may be reset through the selector by different shift pattern sequences.
- OM and FM may be reset by SAE J1939 datalink messages.
- OM, FM and TM may be reset individually with Allison DOC.
- TM is always manually reset with Allison DOC and cannot be manually reset through the selector. Individual clutch reset is allowed with Allison DOC.
- The Prognostics CMC can be set to restrict Prognostic Package resets to the Allison DOC only. Individual functions, such as the OM, FM and TM may not be restricted individually for reset by the service tool. Restriction to reset by the service tool only affects the whole Prognostics Package, which is handled by a single Prognostics CMC.

- FM and TM automatically reset themselves if monitored conditions allow.



**NOTE:** An Allison service outlet can assist with programming and recalibration to enable Prognostics, at customer expense, as long as all Allison Transmission requirements are met prior to the enabled feature being turned on.



**NOTE:** The three Prognostics functions, OM, FM and TM, are enabled or disabled as a group and cannot be enabled or disabled individually.



**CAUTION: Prognostics requires the use of Allison approved TES 295, TES 668 or TES 389 fluids and Allison High Capacity Filters if turned ON.** If any other fluids or filters are used, the Prognostics feature **MUST BE** turned OFF. Prognostics information will not be accurate with any other transmission fluids and could result in missed maintenance activities resulting in transmission damage. If Prognostics functions are not programmed or are turned OFF, refer to [5.0 CARE AND MAINTENANCE](#) and review the miles/hours/months fluid and filter change interval charts or visit [allisontransmission.com](http://allisontransmission.com), click Service, Fluid/Filter Change Interval, then Fluids, and read the current revision of Service Tips 1099 for details.

### 5.9.3 PROCEDURE TO TURN PROGNOSTICS ON AND OFF.



**WARNING:** To help avoid unexpected vehicle movement that might cause death, serious injury, or property damage, always have your foot on the brake, the throttle released, and the engine at idle before making a **N** (Neutral) to **D** (Drive); **N** (Neutral) to **R** (Reverse); **D** (Drive) to **R** (Reverse); or **R** (Reverse) to **D** (Drive) selection.

The Prognostics feature can be turned on with the Allison DOC or, if the specific calibration allows it, the operator can do the following:

1. Set the vehicle brakes to prevent movement of the vehicle.
2. With engine off, turn the ignition on (do not start the engine). Wait for initialization to complete (wait for N N to display in the selector).
3. Move the bump-shift lever selector or press the keypad (push button) through the following sequence of range positions, pausing

no more than three (3) seconds between consecutive shifts:  
**N-D-N-R-N-D-N-R-N-D-N-R-N.**

4. Watch for the **TRANS SERVICE** indicator located in the shift selector display to illuminate and then turn off. This indicates that the operator has successfully enabled the Allison Prognostics Feature Package, consisting of the OM, FM and TM.

If another **TRANS SERVICE** indicator is installed in the dash or incorporated in an OEM message display, it should also briefly illuminate in similar fashion as the **TRANS SERVICE** indicator.

Disabling the Prognostics feature can be done with Allison DOC or, if the specific calibration allows it, the operator can do the following:

1. Set the vehicle brakes to prevent movement of the vehicle.
2. With engine off, turn the ignition on (do not start the engine). Wait for initialization to complete (wait for N N to display in the selector).
3. Move the bump-shift lever selector or press the keypad (push button) through the following sequence of range positions, pausing no more than three (3) seconds between consecutive shifts:  
**N-D-N-R-N-D-N-R-N-D-N-R-N.**
4. Watch for the **TRANS SERVICE** indicator located in the shift selector display to illuminate and then turn off. This indicates that the operator has successfully enabled the Allison Prognostics Feature Package, consisting of the OM, FM and TM.

If another **TRANS SERVICE** indicator is installed in the dash or incorporated in an OEM message display, it should also briefly illuminate in similar fashion as the **TRANS SERVICE** indicator.

**5.9.4 NORMAL PROGNOSTICS INDICATION AT ENGINE START.** Once Prognostics is monitoring the system, normal operation at engine start is as follows:

1. A system bulb check illuminates the **TRANS SERVICE** indicator located in the shift selector display for approximately 0.5 seconds.
2. If Prognostics features are enabled, the **TRANS SERVICE** indicator illuminates again for 3 seconds after the bulb check.
  - If Prognostics features are disabled, the **TRANS SERVICE** indicator does not illuminate again after the bulb check.



**NOTE:** If the shift calibration permits a maximum allowable gear in primary mode that is different than the maximum allowable gear in secondary mode, Prognostics enabling/disabling is only permitted in the shift mode with the highest maximum allowable range. If you have a higher range set of gears in secondary mode than in primary mode to enable Prognostics, push the **MODE** button so **MODE** appears on the selector display first.

---



**NOTE:** The three Prognostics functions, OM, FM and TM, are enabled or disabled as a package and cannot be enabled or disabled individually.

---

**5.9.5 SETTING FLUID TYPE FOR PROGNOSTICS.** The fluid type can be programmed with the Allison DOC or, if the specific calibration allows it, the operator can do the following:

- With the engine off and ignition on, perform the following sequence on the selector, **N-R-N-D-N-R-N-D-N-R-N-D-N**.



**NOTE:** Verify prognostics fluid type setting matches transmission fluid type in transmission. OM notifications will be inaccurate when mismatched. This could result in transmission damage from running a TES 389 fluid too long or cause shortened TES 295 or TES 668 fluid changes to occur.

After recalibration of a TCM always verify prognostics fluid type setting is correct using Allison DOC. Change the fluid type setting using Allison DOC if incorrect.

---

The **TRANS SERVICE** indicator flashes if TES 389 is the current setting and illuminates solidly if TES 295 or TES 668 is the current setting. To change the transmission fluid type, wait 5 seconds after entering transmission fluid type mode and perform one of the following sequences to select the proper transmission fluid type:

- **N** (Neutral) **R** (Reverse) **N** (Neutral) to select TES 295 or TES 668 (the **TRANS SERVICE** indicator illuminates solidly showing TES 295 or TES 668 has been selected).
- **N** (Neutral) **D** (Drive) **N** (Neutral) to select TES 389 (the **TRANS SERVICE** indicator begins to flash showing TES 389 has been selected).

The selector exits 30 seconds after entering transmission fluid type mode or the ignition may be turned off to exit earlier. Only one transmission fluid type selection may be made after entering transmission fluid type mode. All other attempts will be ignored. Transmission fluid type mode needs to be entered again if the wrong type of transmission fluid is selected.

**5.9.6 OIL LIFE MONITOR (OM).** Based on the vehicle's duty cycle, this feature determines fluid life and alerts you when a fluid change is required. Not only does it help you get maximum fluid life while providing the maximum protection for the transmission, the OM also saves you money by preventing unnecessary fluid changes.

Oil life is calculated based on hours of engine and transmission operation. Miles are approximated from the hours and calibrated information. The number of shifts per mile (shift density) determines the duty cycle of the transmission and the oil life limits are based on the observed duty cycle. Hours are accumulated when the engine is running, including when the vehicle is stationary for Power Takeoff (PTO) operation or for extended idle time.



**NOTE:** Oil life is continuously calculated on the following cumulative effects:

- Operating hours
- Output revolutions
- Shift density (shifts per mile)
- Retarder accumulator applies (if equipped)

---

#### 5.9.6.1 FLUID CHANGE NOTIFICATION

The **TRANS SERVICE** indicator illuminates when remaining fluid life reaches 1%. Afterwards, every time the vehicle is started and **D** (Drive) is selected, the **TRANS SERVICE** indicator illuminates again and stays on for two minutes to remind the operator a fluid change is needed. This occurs until service is performed and the OM is reset.



**NOTE:** If the OM mode has been accessed via the shift selector, a number between 0 and 99 is displayed indicating the percentage of fluid life remaining before a change is required.

---

Calendar based fluid requirements still apply with OM (refer to [5.0 CARE AND MAINTENANCE](#)). If the OM has not indicated the need for a fluid change before 60 months for TES 295 or TES 668 fluid, or 24 months for TES 389 fluid, it is necessary to change the fluid and filters per calendar requirements

and then reset the OM. Calendar requirements are not required if a fluid analysis program is in place. Refer to [5.6 FLUID ANALYSIS](#).

### 5.9.6.2 READ AND RESET OIL LIFE MONITOR (OM) FROM SELECTOR

**READ OM.** With engine off and ignition on, push the **DISPLAY MODE/DIAGNOSTIC** (DMD) button twice on the bump-shift lever selector to enter OM mode. With engine off and ignition on, push the ↑ (Upshift) and ↓ (Downshift) arrows simultaneously twice on the keypad push button selector to enter OM mode. The oil life left is displayed as a percentage between 0 and 99 in the shift selector display window.

**RESET OM.** The OM may be reset back to 99% through the selector (if allowed in the calibration) by either of these methods:

- Display the OM information and press and hold the **MODE** button for 10 seconds.
- With ignition on and the engine off, shift between **N-D-N-D-N-R-N** to reset the value displayed to 99 pausing no more than 3 seconds between consecutive shifts.

The **TRANS SERVICE** indicator illuminates briefly following a reset to acknowledge the reset was successful.

**RESET** with Allison DOC. If the value displayed remains unchanged, then it is possible the reset may be restricted to Allison DOC only.

**HISTORY.** Allison DOC may also be used to review reset history and the mileage recorded at the time of reset. Fluid life remaining will be displayed from 100% down to -100% when viewing records in the service tool. A negative % indicates how far an oil change is past due. A historical record of the last six resets, including mileage at the time of each reset, may also be viewed using the Allison DOC Diagnostics Program.

**DTC P0897.** If transmission maintenance continues to be unattended, the **CHECK TRANS** light illuminates and DTC P0897, Transmission Fluid Deteriorated, sets.



**CAUTION:** Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes may be necessary than recommended in the general guidelines due to operating conditions and duty cycle.

For the appropriate recommended change interval guidelines for your specific transmission configuration, refer to [Table 5-6](#).

**5.9.7 FILTER LIFE MONITOR (FM).** This feature provides an alert when the transmission's fluid filters need to be replaced. It helps extend filter change intervals to reduce routine maintenance downtime and saves you money in the long run, all while providing maximum protection for the transmission. The FLI pressure switch signals the TCM when fluid exiting the main filter drops below a predetermined pressure. Both the main and lube filters **must be changed** when the **TRANS SERVICE** indicator in the selector display indicates that the main filter should be changed. The differential pressure limit is verified for a period of time to be sure there is no false indication of the need to change filters.



**NOTE:** The 3700/4700/4800/4770/4870/4970 models do not have the FLI pressure switch and valve body. FM is based on transmission duty cycle and other measured transmission parameters, instead of an FLI pressure switch.

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#### **5.9.7.1 FILTER CHANGE NOTIFICATION**

The **TRANS SERVICE** indicator flashes on and off for 2 minutes after **D** (Drive) is selected. Once the FM mode has been accessed via the shift selector, the "OIL FILTER OK" or "REPLACE FILTERS" message is displayed in the selector display window. An acceptable filter life status is displayed as "OIL FILTER OK". An unacceptable filter life status is displayed as "REPLACE FILTERS".

DTC P088A, Transmission Filter Maintenance Alert, sets along with the **TRANS SERVICE** indicator illuminating for filter restriction, but this DTC does not illuminate the **CHECK TRANS** light.

DTC P088B, Transmission Filter Maintenance Required, illuminates the **CHECK TRANS** light if filter service is not performed within a certain period of time of the **TRANS SERVICE** indicator illuminating.

#### **5.9.7.2 READ AND RESET FILTER LIFE MONITOR (FM) FROM SELECTOR**

**Read FM.** With engine off and ignition on, push the **DISPLAY MODE/DIAGNOSTIC** (DMD) button three times on the bump-shift lever selector to enter FM mode. With engine off and ignition on, push the ↑ (Upshift) and ↓ (Downshift) arrows simultaneously three times on the keypad push button selector to enter FM mode.

The message "**FILTERS OK**" or "**REPLACE FILTERS**" is displayed in the selector display window. An acceptable filter life status is displayed as "**FILTERS OK**". An unacceptable filter life status is displayed as "**REPLACE FILTERS**".



**Reset FM.** The FM automatically resets once the new filters have been installed and the FLI pressure switch no longer detects low pressure at the filter.

The FM can also be reset manually through the selector (if allowed in the calibration) by either of these methods:

- Press and hold the **MODE** button for 10 seconds while in FM mode.
- With ignition on and engine off, shift between **N-R-N-R-N-D-N** to reset the FM, pausing no more than 3 seconds between consecutive shifts.

The **TRANS SERVICE** indicator illuminates briefly following a reset to acknowledge the reset was successful.

If the value displayed remains unchanged, it is possible the reset may be restricted to Allison DOC only. The FM still resets automatically even if restricted from manual reset through the selector.

**History.** Allison DOC Diagnostics Program may be used to display the amount of transmission operation from the initial service indication until the filter reset occurred.



**CAUTION:** Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes may be necessary than recommended in the general guidelines due to operating conditions and duty cycle.

For the appropriate recommended change interval guidelines for your specific transmission configuration, refer to [Table 5–6](#).

**5.9.8 TRANSMISSION HEALTH MONITOR (TM).** This prognostic feature determines clutch life status of the transmission's clutches and alerts you when clutch maintenance is required. It helps avoid costly repairs and downtime by taking the guesswork out of scheduling routine transmission maintenance, and it ensures your transmission is operating at its maximum performance level. The clutch life status is determined by monitoring the cumulative changes and the calculated running clearance of the transmission clutches.

#### **5.9.8.1 CLUTCH MAINTENANCE NOTIFICATION**

The TM feature determines when clutch maintenance is needed. If any of the clutches (except lockup) reaches a remaining life of approximately 10% or if any of the clutch running clearances (except lockup) exceeds a maximum value, then the **TRANS SERVICE** indicator in the shift selector is steadily illuminated from just after ignition on until ignition is turned off. If TM mode has been accessed via the shift selector, a **“TRANS HEALTH OK”** or **“TRANS**

**HEALTH LO**” is displayed. An acceptable clutch life status is displayed as **“TRANS HEALTH OK”**. An unacceptable clutch life status is displayed as **“TRANS HEALTH LO”**.

DTC P2789, Transmission Clutch Life Expired (Clutch Adaptive Learning at Limit), sets if multiple warnings have occurred due to the TM actively detecting issues with the clutch system and illuminating the **CHECK TRANS** light.

### 5.9.8.2 READ AND RESET TM FROM SELECTOR

**Read TM.** With engine off and ignition on, push the **DISPLAY MODE/DIAGNOSTIC** (DMD) button four times on the bump-shift lever selector to enter TM mode. With engine off and ignition on, push the ↑ (Upshift) and ↓ (Downshift) arrows simultaneously four times on the keypad push button selector to enter TM mode.

The message **“TRANS HEALTH OK”** or **“TRANS HEALTH LO”** is displayed in the selector display window. An acceptable clutch life status is displayed as **“TRANS HEALTH OK”**. An unacceptable clutch life status is displayed as **“TRANS HEALTH LO”**.

**Reset.** The TM feature automatically resets when appropriate conditions are detected. TM can only be manually reset using Allison DOC. When resetting TM with the service tool, individual clutches or all clutches can be reset. Operator reset through the shift selector is not allowed.

**History.** The Allison DOC may be used to display the amount of transmission operation from the initial service indication until the service reset.

### 5.9.9 FLUID AND FILTER CHANGE INTERVAL RECOMMENDATIONS.



**CAUTION:** Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes may be necessary than recommended in the general guidelines due to operating conditions and duty cycle.

For the appropriate recommended change interval guidelines for your specific transmission configuration, refer to [Table 5–6](#).



**CAUTION:** Transmission fluid and filters **must be changed** whenever there is evidence of dirt or high temperature conditions. A high temperature condition is indicated when the transmission fluid is discolored, has a strong odor or has exceeded oil analysis limits.



**NOTE:** Refer to [Figure 5–6](#) for Drain Plug Locations and Filter Locations.

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**NOTE:** Local conditions, severity of operation or duty cycle may require more or less frequent fluid change intervals that differ from the published recommended fluid change intervals of Allison Transmission. Allison Transmission recommends that customers use fluid analysis as the primary method for determining fluid change intervals. In the absence of a fluid analysis program the fluid change intervals listed in the charts should be used.

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There are three methods recommended by Allison Transmission to help you determine when to change the fluid and filters in your Allison Transmission. The methods are as follows:

- When a Prognostics indicator becomes active (shown by illuminating the **TRANS SERVICE** indicator in the selector VF display).



**NOTE:** The strip push button selector has no display and is not prognostics capable.

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- When recommendations listed in the Fluid and Filter Change Interval Tables are met. Refer to [Table 5–6](#).
- When a fluid analysis program indicates a fluid change is necessary. Filter changes must still occur based on either of the events occurring above.



**NOTE:** Calendar-based change intervals must still be adhered to for both fluid and filter changes even if Prognostics has not indicated the need for either fluid or filter maintenance, unless fluid analysis is used. If maintenance is done because the fluid or filters reached the calendar-based change interval, the OM and FM should be manually reset at that time. Refer to [5.9.6 OIL LIFE MONITOR \(OM\)](#) and [5.9.7 FILTER LIFE MONITOR \(FM\)](#).

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**NOTE:** Allison Transmission High Capacity filters are required in order to use FM feature with Prognostics on maintenance schedule.

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**NOTE:** Either TES 295, TES 668 or TES 389 fluid types are required to use the OM feature with Prognostics on. A mixture of TES 389 and TES 295 or TES 668 fluid must continue to use the TES 389 fluid change intervals until two fluid changes with only TES 295 or TES 668 fluid have occurred, at which time the TES 295 and TES 668 schedule may be used.

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**NOTE:** Look at OM % left and/or fluid condition at the time of filter change to determine if it is in the best interest of the customer to change the fluid.

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**CAUTION:** Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes may be necessary than recommended in the general guidelines due to operating conditions and duty cycle.

For the appropriate recommended change interval guidelines for your specific transmission configuration, refer to [Table 5–6](#).

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**NOTE:** Change fluid/filters at or before recommended mileage, months or hours have elapsed, whichever occurs first. For vehicles that average less than 40 km/h (25 mph), operating hours represent a more reliable measure of fluid life; therefore, fluid change intervals should not be based on mileage only.

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**Table 5–6. Recommended Filter Change/Fluid Change Intervals**

3000/4000 Series Fluid And Filter Change Interval Recommendations					
		Prognostics Turned Off or Not Calibrated in TCM		Prognostics Turned On	
	Duty Cycle	Allison Approved TES 668 and/or TES 295 Fluid	Allison Approved TES 389 Fluid	Allison Approved TES 668 and/or TES 295 Fluid	Allison Approved TES 389 Fluid
Fluid	General*	300,000 Miles (480,000 km) 6,000 Hours 48 Months	25,000 Miles (40,000 km) 1,000 Hours 12 Months	When indicated by controller or 60 months, whichever occurs first	When indicated by controller or 24 months, whichever occurs first
	Severe**	150,000 Miles (240,000 km) 6,000 Hours 48 Months	12,000 Miles (20,000 km) 500 Hours 6 Months		
* General Vocation: All vocations not classified as Severe ** Severe Vocation: On/Off Highway, Refuse, City Transit, Shuttle Transit					
Main Filter	General*	75,000 Miles (120,000 km) 3,000 Hours 36 Months	25,000 Miles (40,000 km) 1,000 Hours 12 Months	When indicated by controller or 60 months, whichever occurs first	When indicated by controller or 24 months, whichever occurs first
	Severe**	75,000 Miles (120,000 km) 3,000 Hours 36 Months	12,000 Miles (20,000 km) 500 Hours 6 Months		
Internal Filter	All	Overhaul	Overhaul	Overhaul	Overhaul

**Table 5–6. Recommended Filter Change/Fluid Change Intervals (cont'd)**

3000/4000 Series Fluid And Filter Change Interval Recommendations					
		Prognostics Turned Off or Not Calibrated in TCM		Prognostics Turned On	
	Duty Cycle	Allison Approved TES 668 and/or TES 295 Fluid	Allison Approved TES 389 Fluid	Allison Approved TES 668 and/or TES 295 Fluid	Allison Approved TES 389 Fluid
Lube/ Auxiliary Filter	General*	75,000 Miles (120,000 km) 3,000 Hours 36 Months	25,000 Miles (40,000 km) 1,000 Hours 12 Months	When indicated by controller or 60 months, whichever occurs first	When indicated by controller or 24 months, whichever occurs first
	Severe**	75,000 Miles (120,000 km) 3,000 Hours 36 Months	12,000 Miles (20,000 km) 500 Hours 6 Months		
<b>NOTE:</b> TES 389 cannot be used in MY09.					
<b>NOTE:</b> Anything less than 100 percent concentration of TES 668 and/or TES 295 Allison approved fluids is considered a mixture and should utilize Schedule One TES 389 change intervals. Also, mixtures shall not be used with Prognostics.					
* General Vocation: All vocations not classified as Severe					
** Severe Vocation: On/Off Highway, Refuse, City Transit, Shuttle Transit					

### 5.9.9.1 FLUID AND FILTER CHANGE PROCEDURE



**NOTE:** Do not drain the transmission fluid if only filters are being replaced.



**WARNING:** Avoid contact with the hot fluid or the sump when draining transmission fluid. Direct contact with the hot fluid or the hot sump may result in bodily injury.

#### Drain Fluid

1. Drain the fluid when the transmission is at operating temperature of 71–93°C (160–200°F). Hot fluid flows quicker and drains more completely.

2. Remove the drain plug from the control module and allow the fluid to drain into a suitable container.
3. Examine the fluid for contamination.



**NOTE:** At each fluid change, examine the drained fluid for evidence of dirt or water. A normal amount of condensation appears in the fluid during operation.

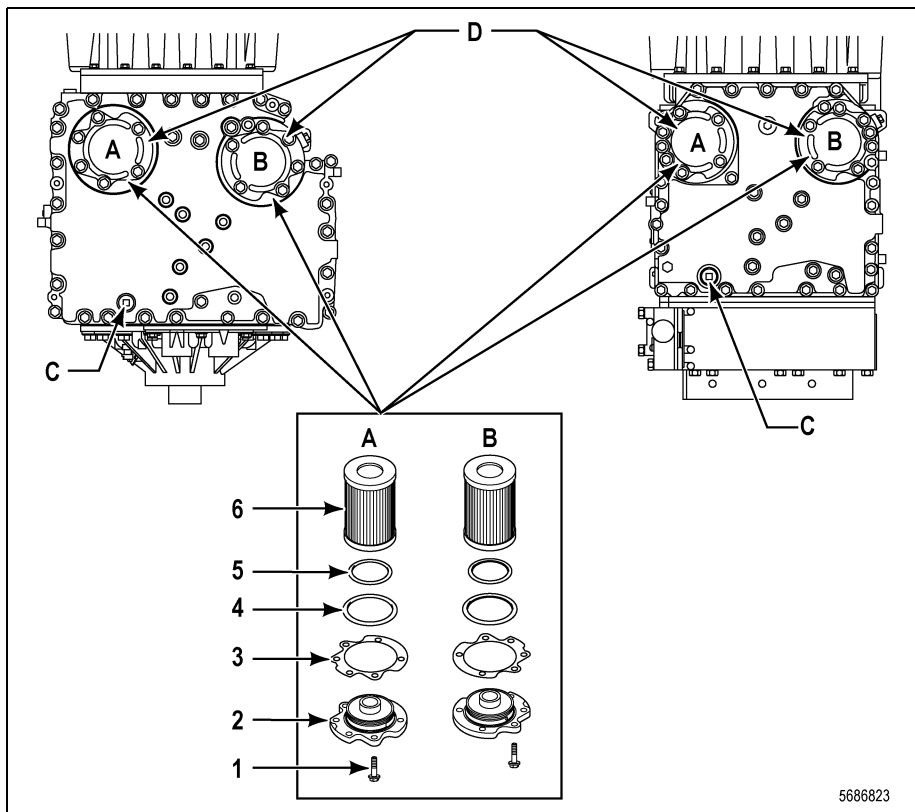
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**Replace Filters (Refer to [Figure 5-6](#)).**

1. Remove 12 bolts (1), two filter covers (2), two gaskets (3), two O-rings (4), two O-rings (5) and two filters (6) from the bottom of the control module.
2. When reinstalling parts, lubricate and install new O-rings (4) and (5) on each cover (2). Lubricate O-ring inside filter (6) and push filter onto cover (2). Install new gaskets (3) on cover (2) and align holes in gaskets with holes in cover.



**CAUTION:** Do not use the bolts to draw the filter covers to the control module. Do not use an impact wrench to tighten the bolts. Using an impact wrench to tighten the bolts may cause stripped threads and expensive parts replacement. Use a torque wrench to tighten the bolts.



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### 3000 Series (Shown on Right) and 4000 Series (Shown on Left)

- (A) – Lube
- (B) – Main

- (C) – Drain Plug
- (D) – Filter Cover

### A and B

- (1) – Bolt
- (2) – Filter Cover
- (3) – Gasket

- (4) – O-Ring
- (5) – O-Ring
- (6) – Filter

**Figure 5–6. Location of Filters for Service**

3. Install filter and cover assemblies into the filter compartment. Align each filter/cover assembly with the holes in the channel plate/sump. Push the cover assemblies in by hand to seat the seals.
4. Install 12 bolts into cover and tighten to 51–61 N•m (38–45 lb ft).
5. Replace the drain plug O-ring. Install the plug and tighten to 25–32 N•m (18–24 lb ft).

## 5.9.9.2 REFILL TRANSMISSION

Refer to [5.7 TRANSMISSION FLUID REFILL](#).



## **5.10 ENGINE STOP-START ELECTRIC PUMP FILTER CHANGE**

Certain 4000 Series transmissions may utilize an Engine-Stop Start Electric Pump. The ES-S electric pump has an internal suction filter that does not follow a filter change interval. The ES-S filter should be changed when substantial debris is found within the transmission filters. The ES-S electric pump shares a fluid circuit with the transmission where debris can flow from the transmission through the ES-S electric pump. Refer to Service Manual, SM4014EN, for filter change procedures.

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## 6.0 DIAGNOSTICS

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### 6.1 OVERVIEW

Diagnostic features are provided with the transmission control system to assist in troubleshooting of malfunctions and/or the monitoring of specific operating parameters. When a control system malfunction is detected, a series of Diagnostic Trouble Codes (DTCs) are used to identify and clarify the nature of the malfunction. These DTCs are each named by a 5 character alphanumeric string that refers to a diagnostic algorithm running pass/fail tests to help identify a malfunction in the transmission or vehicle operation. Most DTCs have some kind of diagnostic response that the operator notices, such as an illuminated **CHECK TRANS** light, selector display change, lock in range, or inhibit shifts condition.

DTCs are logged in the Transmission Control Module (TCM) memory by severity and by their active/inactive status with the most severe and active codes listed first. A maximum of five DTCs (numbered d1–d5) from most recent to oldest may be read from the shift selector. As DTCs are added, the oldest inactive DTC (historic) is dropped from the list. If all DTCs are active, the DTC with the lowest priority is dropped from the list.

An active code is any code that is current in the TCM decision-making process and has failed the DTC test(s) associated with that specific diagnostic algorithm. Historical codes, which are by definition inactive, are codes that are no longer failing their algorithm but are retained in the TCM in order to help the technician analyze possible causes and provide them direction if the vehicle is brought in before they are cleared from the queue.

DTCs can be cleared manually by the operator or they clear automatically from last (d5) to first (d1) in the queue after a number of engine starts, without becoming active again.

### 6.2 DIAGNOSTIC TROUBLE CODE RESPONSE

The electronic control system is programmed to inform the operator of a problem with the transmission system via the **CHECK TRANS** light and shift selector display while it automatically takes action to protect the operator, vehicle, and transmission. When the Transmission Control Module (TCM)

flags a Diagnostic Trouble Code (DTC) as active, the TCM may take a combination of diagnostic responses as listed in the table below. Refer to [Table 6–1](#).

**Table 6–1. DTC Response**

Category of Response	Actions Taken
Do Not Shift (DNS)	Release lockup (LU) clutch and inhibit LU operation
	Inhibit shifts from the current attained range
	Turn on the <b>CHECK TRANS</b> light
	Display the current attained range in the MONITOR window of the shift selector
	Blank the SELECT window of the shift selector
	Disable ability for shift selectors to respond to any range change request from the operator using the shift selector(s).
Solenoids OFF (SOL OFF)	All solenoids are commanded off resulting in hydraulic default operation of the transmission - PCS1 and PCS2 are on hydraulically when off electrically.
Return to Previous Range (RPR)	When speed sensor ratio or PS1 tests do not pass, the TCM commands the same range as commanded before the shift.
Neutral No Clutches (NNC)	When certain speed sensor ratio or PS1 tests do not pass, the TCM commands a neutral condition with no clutches applied.
Do Not Adapt (DNA)	The TCM stops adaptive shift control while the code is active.

**6.2.1 CHECK TRANS LIGHT.** Each time the engine is started, the **CHECK TRANS** light illuminates briefly for a bulb check. After a few seconds it should turn off. If the **CHECK TRANS** light does not illuminate briefly after the ignition is turned on, or if the **CHECK TRANS** light remains steadily on after ignition and engine start, have the vehicle and transmission system checked by a qualified Allison Transmission technician.

If the **CHECK TRANS** light is steadily illuminated due to an active DTC, the shift selector blanks the SELECT and only shows a range the transmission has locked into in the MONITOR window of the selector, seek immediate attention from a qualified Allison Transmission technician. Perform service as soon as possible in order to minimize the potential for damage to the transmission or vehicle. The transmission can be operated for a short time in the current attained range in order to get the vehicle to a safe location

for service assistance. If the vehicle engine is turned off, prepare for the possibility that at engine restart the transmission may be locked in **N** (Neutral) and will not accept operator requests to change range if a DTC that causes a **CHECK TRANS** light is active at time of engine restart.



**NOTE:** Some DTCs may be logged without the TCM activating the **CHECK TRANS** light. Contact your Allison Transmission authorized service outlet whenever there is a transmission-related concern. They have the equipment to access and troubleshoot DTCs.

### 6.3 USING SHIFT SELECTOR FOR ACCESSING DIAGNOSTICS INFORMATION

DTCs can be displayed on the display portion of the shift selector. A DTC is either active or historic. An active DTC is a DTC that is current in the TCM decision-making process. Historic DTCs are retained in the TCM memory and do not necessarily affect the TCM decision-making process.

#### 6.3.1 DISPLAY SEQUENCE.

Up to five DTCs may be displayed one at a time from the selector once the diagnostic display mode has been initiated by the operator. Each DTC is 5 characters in length. The DTC status active or inactive is shown below the DTC (refer to [Figure 6-1](#)).



**Figure 6-1. DTC Display**

The operator presses the **MODE** button to read the next DTC in the queue (if any) or requests to exit diagnostics mode. The diagnostics mode times out and returns the selector to normal operating mode after approximately 10 minutes of operator inactivity.

## 6.3.2 READ/CLEAR DTCs WITH KEYPAD PUSH BUTTON SELECTOR.

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**NOTE:** The strip button shift selector has no display or diagnostic capabilities.

---

### 6.3.2.1 READING DTCs WITH PROGNOSTICS PACKAGE ON

To read DTCs with prognostics on using the keypad push button shift selector:

- Simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows five times to enter diagnostic mode.
  - Press the **MODE** button to read the next code in the queue, if any.
- 



**NOTE:** For 3700 SP and 4700/4800/4770/4870/4970 transmissions equipped with a retarder, press the **MODE** button once.

---

### 6.3.2.2 READING DTCs WITH PROGNOSTICS PACKAGE OFF

To read DTCs with prognostics off using the keypad push button shift selector:

- Simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows two times to enter diagnostic mode.
  - Press the **MODE** button to read the next code in the queue, if any.
- 



**NOTE:** For 3700 SP and 4700/4800/4770/4870/4970 transmissions equipped with a retarder, press the **MODE** button once.

---

### 6.3.2.3 CLEARING DTCs

While in diagnostic mode, clear all active codes by pressing and holding the **MODE** button for approximately three seconds until the MODE message flashes. Release the **MODE** button. The MODE message should not remain illuminated if the active DTC shown in the display has cleared.

To clear all stored DTCs, press and hold the **MODE** button for ten seconds. The MODE message flashes a second time indicating all codes are cleared from the queue.

---



**NOTE:** Any codes that cause the **CHECK TRANS** light are considered severe enough to warrant immediate attention from a qualified repair facility. Schedule repair as soon as possible.

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**NOTE:** If an active indicator is cleared while the transmission is locked in range because of the diagnostic response to an active DTC, the transmission remains in that locked range even after clearing the active indicator. **N** (Neutral) must be manually selected or the ignition must be cycled.

---



**NOTE:** Some codes will self-clear once the conditions that caused the active code are not present. These codes are stored as inactive in the DTC queue. Some DTCs require an ignition cycle before they can be cleared from active status.

---



**NOTE:** If the condition(s) that caused the active code are still present, the code becomes active again.

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#### 6.3.2.4 EXITING DIAGNOSTIC MODE

Exit the diagnostic mode by one of the following methods:

- Momentarily press the ↑ (Upshift) and ↓ (Downshift) arrows once.
- Press any range button, **D** (Drive), **N** (Neutral), **R** (Reverse).
- After approximately 10 minutes of inactivity at the push button shift selector, the diagnostic mode automatically exits and returns to normal operating mode.

#### 6.3.3 READ/CLEAR DTCs WITH BUMP-SHIFT LEVER SELECTOR.

##### 6.3.3.1 READING DTCs WITH PROGNOSTICS PACKAGE ON

To read DTCs with prognostics on using the bump-shift lever selector:

- Press the **DISPLAY MODE/DIAGNOSTIC** (DMD) five times to enter diagnostic mode.
- Press the **MODE** button to read the next code in the queue, if any.



**NOTE:** For 3700 SP and 4700/4800/4770/4870/4970 transmissions equipped with a retarder, press the **MODE** button four times.

---

##### 6.3.3.2 READING DTCs WITH PROGNOSTICS PACKAGE OFF

To read DTCs with prognostics off using the bump-shift lever selector:

- Press the **DISPLAY MODE/DIAGNOSTIC** (DMD) two times to enter diagnostic mode.

- Press the **MODE** button to read the next code in the queue, if any.



**NOTE:** For 3700 SP and 4700/4800/4770/4870/4970 transmissions equipped with a retarder, press the **MODE** button once.

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### 6.3.3.3 CLEARING DTCs

While in diagnostic mode, clear all active codes by pressing and holding the **MODE** button for approximately three seconds until the MODE message flashes. Release the **MODE** button. The MODE message should not remain illuminated if the active DTC shown in the display has cleared.

To clear all stored DTCs, press and hold the **MODE** button for ten seconds. The MODE message flashes a second time indicating all codes are cleared from the queue.



**NOTE:** Any codes that cause the **CHECK TRANS** light are considered severe enough to warrant immediate attention from a qualified repair facility. Schedule repair as soon as possible.

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**NOTE:** If an active DTC is cleared while the transmission is locked in range because of the diagnostic response to an active DTC, the transmission remains in that locked range even after clearing the active DTC. **N** (Neutral) must be manually selected or the ignition must be cycled.

---



**NOTE:** Some codes will self-clear once the conditions that caused the active code are not present. These codes will be stored as inactive in the DTC queue. Some DTCs require an ignition cycle before they can be cleared from active status.

---



**NOTE:** If the condition(s) that caused the active code are still present, the code becomes active again.

---

### 6.3.3.4 EXITING DIAGNOSTIC MODE

Exit the diagnostic mode by one of the following methods:

- Momentarily press the **MODE** button once.
- Move the bump-shift lever selector to any range.

- After approximately 10 minutes of inactivity at the bump-shift lever selector, the diagnostic mode automatically exits and returns to normal operating mode.

### 6.3.3.5 DTC LIST AND DESCRIPTION

**Table 6–2. DTC List and Descriptions**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
C1312	Retarder Request Sensor Circuit Low	No	May inhibit retarder operation if not using J1939 datalink
C1313	Retarder Request Sensor Circuit High	No	May inhibit retarder operation if not using J1939 datalink
P0122	Pedal Position Sensor Circuit Low Voltage	Yes	Use default throttle values. Freezes shift adapts.
P0123	Pedal Position Sensor Circuit High Voltage	Yes	Use default throttle values. Freezes shift adapts.
P0218	Transmission Fluid Over Temperature Condition	No	Use default sump temp
P0562	System Voltage Low	Yes	Inhibit TCC Operation, DNA
P060C	Internal Control Module Main Processor Performance	Yes	TCM returns to the boot program, Transmission operates in hydraulic default: <b>N</b> (Neutral), <b>3</b> (Third Range), <b>4</b> (Fourth Range) and <b>5</b> (Fifth Range)
P0600	Solenoid Controller Serial Peripheral Interface (SPI) Communication Bus Off	Yes	Transmission operates in hydraulic default: <b>N</b> (Neutral), <b>3</b> (Third Range), <b>4</b> (Fourth Range) and <b>5</b> (Fifth Range)
P0602	TCM Not Programmed	Yes	Lock in Neutral
P0603	Internal Control Module Keep Alive Memory Error	No	Lock in Neutral



**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P0604	Control Module Random Access Memory (RAM)	No	TCM returns to the boot program, Transmission operates in hydraulic default: <b>N</b> (Neutral), <b>3</b> (Third Range), <b>4</b> (Fourth Range) and <b>5</b> (Fifth Range)
P0607	Control Module Performance	No	Use alternate DSS data
P0610*	Transmission Control Hardware Incompatible	Yes	No Range Inhibit Use Learned TID Level
P0614	Torque Control Data Mismatch—ECM/TCM	Yes	Allows operation only in reverse and second range
P0634	TCM Internal Temperature Too High	Yes	SOL OFF (hydraulic default)
P0642	Sensor Reference Voltage “A” Circuit Fault	Yes	Default sensor data used
P0652	Sensor Reference Voltage “B” Circuit Fault	Yes	None
P0657	Actuator Supply Circuit Voltage 1 Open (HSD1)	Yes	SOL OFF, DNA, Inhibit TCC operation, Inhibit main modulation
P0658	Actuator Supply Circuit Voltage 1 Low (HSD1)	Yes	DNS, SOL OFF (hydraulic default)
P0659	Actuator Supply Circuit Voltage 1 High (HSD1)	Yes	DNS, SOL OFF (hydraulic default)
P0702*	Transmission Control Hardware Not Determined	Yes	No Range Inhibit Use Current Key-Cycle TID Level
P0703	Brake Switch Circuit	No	No Neutral to Drive shifts for refuse packer. TCM inhibits retarder operation if a TPS code is also active.

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P0708	Transmission Range Sensor Circuit High	Yes	Ignore defective strip selector inputs
P070C	Transmission Fluid Level Sensor Circuit Low	No	None
P070D	Transmission Fluid Level Sensor Circuit High	No	None
P0711	Transmission Fluid Temperature Sensor Circuit Performance	Yes	Use default sump temp
P0712	Transmission Fluid Temperature Sensor Circuit Low	Yes	Use default sump temp
P0713	Transmission Fluid Temperature Sensor Circuit High	Yes	Use default sump temp
P0715	Turbine Shaft Speed Sensor Circuit	Yes	DNS, Lock in current range
P0716	Turbine Shaft Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0717	Turbine Shaft Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P071A	Neutral at Stop Input	No	Inhibit Neutral at Stop operation
P071D	General Purpose Input Fault	No	None
P0720	Output Shaft Speed Sensor Circuit	Yes	Shift not in process, LIR Shift in process, complete shift then LIR. TCM forces VMMS off. TCM inhibits TCC engagement. TCM freezes shift adapts.
P0721	Output Shaft Speed Sensor Circuit Performance	Yes	TCM freezes shift adapts. TCM inhibits TCC engagement.

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P0722	Output Shaft Speed Sensor Circuit No Signal	Yes	TCM freezes shift adapts. TCM inhibits TCC engagement. DNS, Lock in current range
P0725	Engine Speed Sensor Circuit	No	Default to turbine speed
P0726	Engine Speed Sensor Circuit Performance	No	Default to turbine speed
P0727	Engine Speed Sensor Circuit No Signal	No	Default to turbine speed
P0729	Incorrect 6 <sup>th</sup> Gear Ratio	Yes	DNS, Attempt 5 <sup>th</sup> , then 3 <sup>rd</sup>
P0731	Incorrect 1 <sup>st</sup> Gear Ratio	Yes	DNS, Attempt 2 <sup>nd</sup> , then 5 <sup>th</sup>
P0732	Incorrect 2 <sup>nd</sup> Gear Ratio	Yes	DNS, Attempt 3 <sup>rd</sup> , then 5 <sup>th</sup>
P0733	Incorrect 3 <sup>rd</sup> Gear Ratio	Yes	DNS, Attempt 4 <sup>th</sup> , then 6 <sup>th</sup>
P0734	Incorrect 4 <sup>th</sup> Gear Ratio	Yes	DNS, Attempt 5 <sup>th</sup> , then 3 <sup>rd</sup>
P0735	Incorrect 5 <sup>th</sup> Gear Ratio	Yes	DNS, Attempt 6 <sup>th</sup> , then 3 <sup>rd</sup> , then 2 <sup>nd</sup>
P0736	Incorrect Reverse Ratio	Yes	DNS, Lock in Neutral
P0741	Torque Converter Clutch (TCC) System Stuck Off	Yes	None
P0752	Shift Solenoid 1 Valve Performance–Stuck On	Yes	DNS
P076F	Incorrect 7 <sup>th</sup> Gear Ratio	Yes	DNS, Attempt 6 <sup>th</sup> Range
P0776	Pressure Control Solenoid (PCS) 2 Stuck Off	Yes	DNS
P0777	Pressure Control Solenoid (PCS) 2 Stuck On	Yes	DNS, RPR

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P077F	Incorrect Reverse 2 Ratio	Yes	DNS, Lock in Neutral
P07CE	Neutral At Stop Not Functioning	No	TCM inhibits Neutral at Stop operation
P0796	Pressure Control Solenoid (PCS) 3 Stuck Off	Yes	DNS, RPR
P0797	Pressure Control Solenoid (PCS) 3 Stuck On	Yes	DNS, RPR
P0842	Transmission Fluid Pressure Switch 1 Circuit Low	Yes	DNS, Lock in current range
P0843	Transmission Fluid Pressure Switch 1 Circuit High	Yes	DNS, Lock in current range
P0847	Transmission Fluid Pressure Switch 2 Circuit Low	Yes	None
P0848	Transmission Fluid Pressure Switch 2 Circuit High	Yes	None
P085D	Requested Direction Mismatch with Gear Shift Module 1	Yes	Lock in Neutral
P085E	Requested Direction Mismatch with Gear Shift Module 2	Yes	Lock in Neutral
P0880	TCM Power Input Signal	No	None
P0881	TCM Power Input Signal Performance	No	None
P0882	TCM Power Input Signal Low	Yes	DNS, SOL OFF (hydraulic default)
P0883	TCM Power Input Signal High	Yes	None

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P088A	Transmission Filter Maintenance Alert	No	None
P088B	Transmission Filter Maintenance Required	No	None
P0894	Unexpected Mechanical Gear Disengagement	Yes	DNS, Lock in first
P0897	Transmission Fluid Deteriorated	Yes	None
P0960	Main Pressure Modulation Solenoid Control Circuit Open	Yes	Full Main Pressure Commanded
P0961	Main Pressure Modulation Solenoid System Performance	No	Full Main Pressure is Commanded
P0962	Main Pressure Modulation Solenoid Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0963	Main Pressure Modulation Solenoid Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0964	Pressure Control Solenoid (PCS) 2 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0965	Pressure Control Solenoid (PCS) 2 System Performance	Yes	TCM forces VMM off, TCM inhibits TCC engagement. Hydraulic default: <b>N</b> (Neutral), <b>3</b> (Third Range), <b>4</b> (Fourth Range) and <b>5</b> (Fifth Range)
P0966	Pressure Control Solenoid (PCS) 2 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0967	Pressure Control Solenoid (PCS) 2 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P0968	Pressure Control Solenoid (PCS) 3 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0969	Pressure Control Solenoid (PCS) 3 System Performance	Yes	TCM forces VMM off, TCM inhibits TCC engagement.
P0970	Pressure Control Solenoid (PCS) 3 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0971	Pressure Control Solenoid (PCS) 3 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0973	Shift Solenoid 1 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0974	Shift Solenoid 1 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0976	Shift Solenoid 2 Control Circuit Low	Yes	7-speed: Allow 2 through 6, N, R. Inhibit TCC operation
P0977	Shift Solenoid 2 Control Circuit High	Yes	7-speed: Allow 2 through 6, N, R
P097A	Shift Solenoid 1 Control Circuit Open	Yes	Lock in range
P097B	Shift Solenoid 2 Control Circuit Open	Yes	7-speed: Allow 2 through 6, N, R
P0989	Retarder Pressure Sensor Circuit Low	No	None
P0990	Retarder Pressure Sensor Circuit High	No	None
P0C2B	Electric Pump Feedback Signal	Yes	**Engine Stop-Start operation is disabled
P1739	Incorrect Low Gear Ratio	Yes	Command 2nd and allow shifts 2 through 6, N, R

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P1790	Gear Shift Module 1 Calibration Invalid	Yes	Shift selector language or units incorrect
P1791	Gear Shift Module 2 Calibration Invalid	Yes	Shift selector language or units incorrect
P1891	Throttle Position Sensor PWM Signal Low	No	Use default throttle values
P1892	Throttle Position Sensor PWM Signal High	No	Use default throttle values
P2184	Engine Coolant Temperature Sensor 2 Circuit Low	No	Use default engine coolant values
P2185	Engine Coolant Temperature Sensor 2 Circuit High	No	Use default engine coolant values
P2637	Torque Management Feedback Signal A	Yes	Inhibit SEM
P2641	Torque Management Feedback Signal B	Yes	Inhibit LRTP
P2669	Actuator Supply Circuit Voltage 2 Open (HSD2)	Yes	SOL OFF, Inhibit TCC operation, Inhibit Main modulation, DNA
P2670	Actuator Supply Circuit Voltage Low (HSD2)	Yes	DNS, SOL OFF (hydraulic default)
P2671	Actuator Supply Circuit Voltage 2 High (HSD2)	Yes	DNS, SOL OFF (hydraulic default)
P2684	Actuator Supply Circuit Voltage 3 Open (HSD3)	Yes	SOL OFF, Inhibit TCC operation, Inhibit Main modulation, DNA
P2685	Actuator Supply Circuit Voltage 3 Low (HSD3)	Yes	DNS, SOL OFF (hydraulic default)
P2686	Actuator Supply Circuit Voltage 3 High (HSD3)	Yes	DNS, SOL OFF (hydraulic default)

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P27B2	Internal Control Module Transmission Range Control Performance	Yes	Hydraulic default. Transmission is restricted to <b>N</b> (Neutral), <b>3</b> (Third Range), <b>4</b> (Fourth Range) and <b>5</b> (Fifth Range)
P27B4	Output Shaft Direction Plausibility	Yes	Shift not in process, LIR Shift in process, complete shift then LIR. TCM forces VMMS off. TCM inhibits TCC engagement. TCM freezes shift adapts.
P27B6	Internal Control Module Transmission Speed Sensor Performance	Yes	Shift not in process, LIR Shift in process, complete shift then LIR. TCM forces VMMS off. TCM inhibits TCC engagement. TCM freezes shift adapts.
P2714	Pressure Control Solenoid (PCS) 4 Stuck Off	Yes	DNS, RPR
P2715	Pressure Control Solenoid (PCS) 4 Stuck On	Yes	DNS, SOL OFF (hydraulic default)
P2718	Pressure Control Solenoid (PCS) 4 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2719	Pressure Control Solenoid (PCS) 4 System Performance	Yes	TCM forces VMM off, TCM inhibits TCC engagement
P2720	Pressure Control Solenoid (PCS) 4 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2721	Pressure Control Solenoid (PCS) 4 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)



**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P2723	Pressure Control Solenoid (PCS) 1 Stuck Off	Yes	DNS, RPR
P2724	Pressure Control Solenoid (PCS) 1 Stuck On	Yes	DNS, RPR
P2727	Pressure Control Solenoid (PCS) 1 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2728	Pressure Control Solenoid (PCS) 1 System Performance	Yes	TCM forces VMM off, TCM inhibits TCC engagement. Hydraulic default: <b>N</b> (Neutral), <b>3</b> (Third Range), <b>4</b> (Fourth Range) and <b>5</b> (Fifth Range)
P2729	Pressure Control Solenoid (PCS) 1 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2730	Pressure Control Solenoid (PCS) 1 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2736	Pressure Control Solenoid (PCS) 5 Control Circuit Open	Yes	Inhibit retarder operation
P2738	Pressure Control Solenoid (PCS) 5 Control Circuit Low	Yes	Allow 2 through 6, N, R. Inhibit retarder and TCC operation
P2739	Pressure Control Solenoid (PCS) 5 Control Circuit High	Yes	Inhibit retarder operation
P273F	Retarder Oil Temperature Sensor Over Temperature Condition	No	None
P2742	Retarder Oil Temperature Sensor Circuit Low	No	Use default retarder temp values

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P2743	Retarder Oil Temperature Sensor Circuit High	No	Use default retarder temp values
P2761	Torque Converter Clutch (TCC) Pressure Control Solenoid (PCS) Control Circuit Open	Yes	Inhibit TCC operation
P2762	Torque Converter Clutch (TCC) Pressure Control Solenoid (PCS) Control Circuit Range/Performance	Yes	TCM forces VMM off, TCM inhibits TCC engagement. Hydraulic default: <b>N</b> (Neutral), <b>3</b> (Third Range), <b>4</b> (Fourth Range) and <b>5</b> (Fifth Range)
P2763	Torque Converter Clutch (TCC) Pressure Control Solenoid (PCS) Control Circuit High	Yes	Inhibit TCC operation
P2764	Torque Converter Clutch (TCC) Pressure Control Solenoid (PCS) Control Circuit Low	Yes	7-speed: allow 2 through 6, N, R. Inhibit TCC operation
P2789	Transmission Clutch Life Expired (Clutch Adaptive Learning at Limit)	Yes	None
P2793	Gear Shift Direction Circuit	Yes	*Ignores PWM input from shift selector **Depending on OEM configuration, may or may not allow direction changes during faults
P2797	Engine Stop-Start System Pressure Loss	Yes	**Engine Stop-Start operation is disabled
P2808	Pressure Control Solenoid (PCS) 6 Stuck Off	Yes	DNS, RPR
P2809	Pressure Control Solenoid (PCS) 6 Stuck On	Yes	DNS, RPR

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
P2812	Pressure Control Solenoid (PCS) 6 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2813	Pressure Control Solenoid (PCS) 6 System Performance	Yes	TCM forces VMM off, TCM inhibits TCC engagement
P2814	Pressure Control Solenoid (PCS) 6 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2815	Pressure Control Solenoid (PCS) 6 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
U0073	CAN Communication Bus 1 Off	Yes	Use default values
U0074	CAN Communication Bus 2 Off	No	Use default values
U0100	Lost Communications with ECM A	Yes	Use default values
U0103	Lost Communication With Gear Shift Module 1	Yes	*Maintain range selected, observe gear shift direction circuit **Depending on OEM configuration, may or may not allow direction changes during faults
U0287	Lost Communication with Electric Pump	Yes	**Engine Stop-Start operation is disabled
U0291	Lost Communication With Gear Shift Module 2	Yes	*Maintain range selected, observe gear shift direction circuit **Depending on OEM configuration, may or may not allow direction changes during faults
U0304	Gear Shift Module 1 Incompatible	Yes	Ignore shift selector inputs

**Table 6–2. DTC List and Descriptions (cont'd)**

<b>DTC</b>	<b>Description</b>	<b>CHECK TRANS Light</b>	<b>Inhibited Operation Description</b>
U0333	Gear Shift Module 2 Incompatible	Yes	Ignore shift selector inputs
U0400	Invalid CAN Communications Error	Yes	None
U0404	Gear Shift Module 1 Invalid Data	Yes	*Maintain range selected, observe gear shift direction circuit **Depending on OEM configuration, may or may not allow direction changes during faults
U0592	Gear Shift Module 2 Invalid Data	Yes	*Maintain range selected, observe gear shift direction circuit **Depending on OEM configuration, may or may not allow direction changes during faults
U1401	J1939 TSC1 Engine Message Impostor Detected		None
U1402	J1939 TSC1 Compression Brake Message Impostor Detected		None
U1403	J1939 TSC1 Exhaust Brake Message Imposter Detected		None
*5th Generation only **6th Generation only			

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## 7.0 SHIFT SELECTORS COMPONENTS AND FUNCTIONS

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### 7.1 SELECT/MONITOR DISPLAY

A two-character vacuum fluorescent blue-green display is included on the face of each bump-shift lever and keypad push button shift selector. The strip push button selector does not have a Vacuum Fluorescent Display (VFD). The left character, called the SELECT display appropriately designates **N** (Neutral), **R** (Reverse), or the highest gear available of the selected forward range. The right character of the display, called the MONITOR display, designates the actual gear being commanded by the TCM. The display of any other character in the SELECT or MONITOR display denotes a non-standard operating condition.

### 7.2 BACKLIGHTING

During normal vehicle operation, backlighting is provided for all keypad buttons of the push button shift selector, and buttons on the strip push button selector.

The **MODE** button and the **DISPLAY MODE DIAGNOSTIC** (DMD) button with the Allison logo are continually backlit during normal vehicle operation.

### 7.3 MODE BUTTON



**NOTE:** There is no **MODE** button located on the strip button selector.

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The **MODE** button is located on the bezel face of the bump-shift lever selector or keypad push button shift selector. The **MODE** button can be pressed any time after engine start to activate the alternate shift schedule or special function.

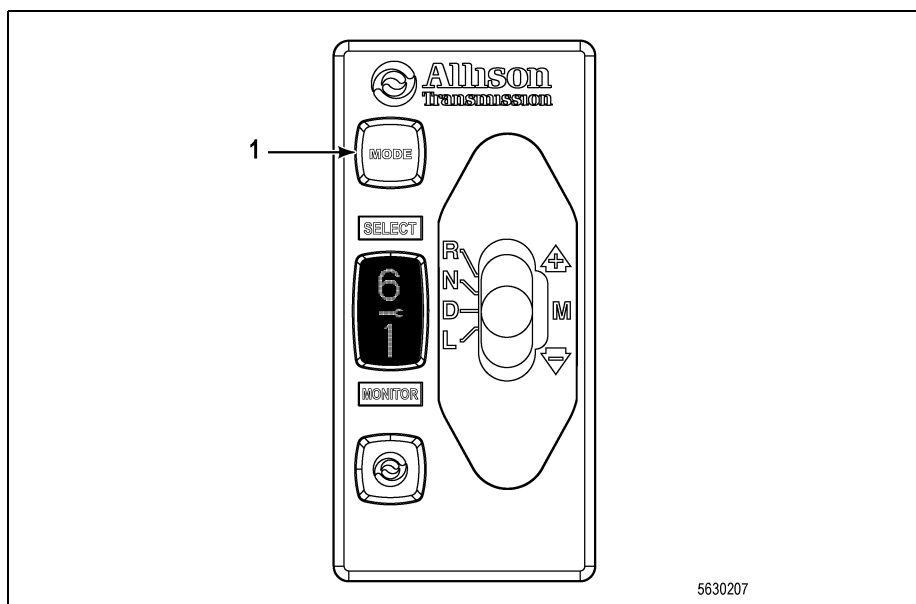
The **MODE** button performs the following functions:

- Activates a special function programmed into the TCM, which is typically an alternate ECONOMY or PERFORMANCE shift schedule.
- Toggles to the next DTC while in DTC display mode.
- Clears (erases) active and inactive DTCs from TCM memory.



**NOTE:** DTCs cannot be cleared individually. All active DTCs clear first, followed by the inactive (historic) DTCs, provided the **MODE** button is pressed long enough while in the DTC display mode. Refer to [6.0 DIAGNOSTICS](#) for information and the procedure on reading and clearing (erasing) DTCs.

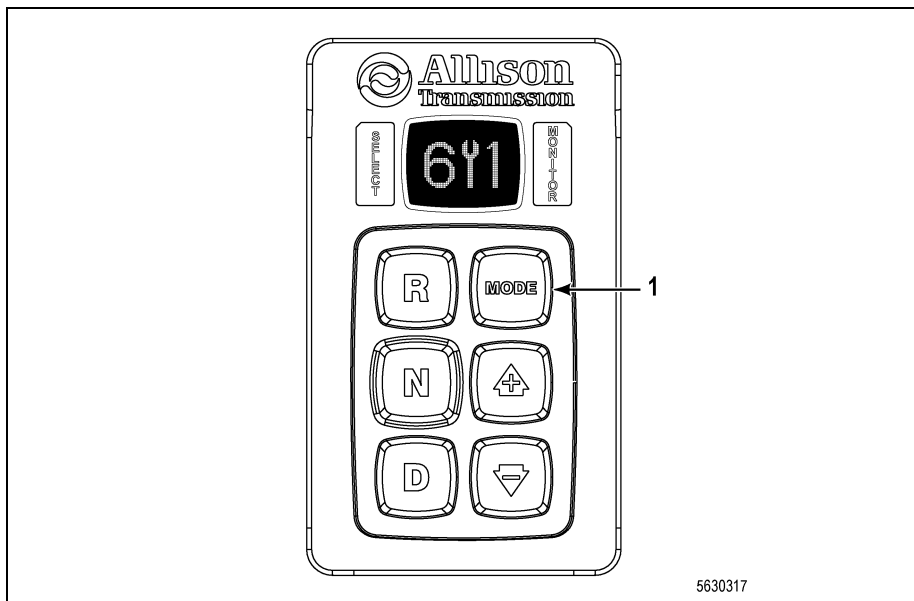
A MODE display is located near the **MODE** button to identify the purpose associated with the **MODE** button selection. Refer to [Figure 7-1](#) for the location of the **MODE** button and MODE display on a bump-shift lever selector. Refer to [Figure 7-2](#) for the location of the **MODE** button and MODE display on a push button shift selector.



5630207

(1) – MODE Button

**Figure 7-1. MODE Button and Display On a Bump-Shift Lever Selector**

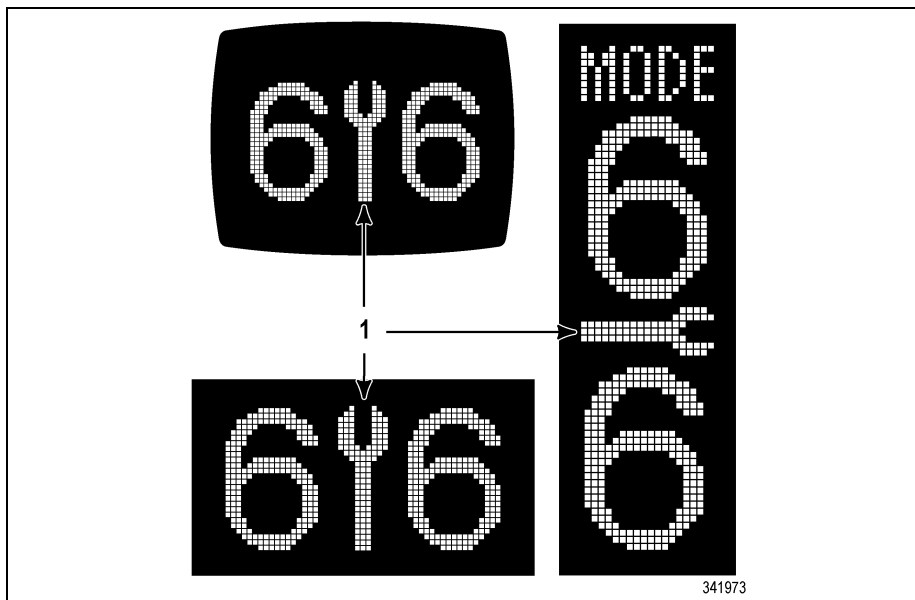


(1) – MODE Button

**Figure 7–2. MODE Button and Display on a Push Button Shift Selector**

## 7.4 TRANS SERVICE INDICATOR (WRENCH ICON)

The **TRANS SERVICE** (wrench icon) indicator illuminates in the event a service condition relating to a transmission clutch, fluid or filter life occurs. The **TRANS SERVICE** indicator is located on the shift selector display (refer to [Figure 7–3](#)).



(1) – Wrench Icon

**Figure 7-3. Typical Allison Trans Service Indicator**

For additional information regarding these conditions, refer to [5.9.6 OIL LIFE MONITOR \(OM\)](#), [5.9.7 FILTER LIFE MONITOR \(FM\)](#) or [5.9.8 TRANSMISSION HEALTH MONITOR \(TM\)](#).

## 7.5 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DIAGNOSTIC TROUBLE CODES (DTCs) AND INHIBITS


**RANGE SELECT Blank:** With an active DTC, the SELECT display on the shift selector is blank. The MONITOR display indicates the range in which the transmission is locked. The **CHECK TRANS** light is also activated. Refer to [6.0 DIAGNOSTICS](#).

**RANGE SELECT Flashing:** The flashing display indicates a requested shift is either temporarily or permanently inhibited. The inhibit may clear if the cause of the inhibit clears within 3 seconds of the shift request. Otherwise, the operator must re-select the desired range. Refer to [4.1.3 SELECTOR DISPLAY FLASHING \(INHIBITS\)](#).


**Wrench Icon (TRANS SERVICE) Illuminated:** This indicator is only functional if prognostics are enabled in the TCM controls calibration. This indicator is illuminated upon the detection of a service issue relating to clutch, filter or fluid life. The appearance of the indicator (lit steadily or flashing)



varies for each of the conditions monitored by the system (refer to [7.4 TRANS SERVICE INDICATOR \(WRENCH ICON\)](#)).

 **All Segments Illuminated:** If all segments of the display are on for more than 12 seconds, the TCM has not completed initialization. A DTC is associated with this condition. It is normal for all segments to illuminate for a brief time during initialization of the selector and controls.

**SELECT/MONITOR BOTH BLANK:** This condition indicates either a lack of power to the selector or the SAE J1939 communication datalink has failed. Continuous blank indicates loss of power to the selector. If the blank display changes to a double cat-eye display, other conditions exist. Refer to double cat-eye discussion below.

 **Double Cat-Eyes:** This display indicates a failure of the SAE J1939 communication link and may be accompanied by a DTC. The cat-eyes are illuminated in both the SELECT and MONITOR locations after approximately 12 seconds of blank display.



**WARNING:** Without the SAE J1939 communication datalink, the shift selector cannot display the selected transmission range. Vehicle operation will be affected.

## 7.6 SELECTOR DISPLAY IS INOPERATIVE

In the event communication with the SAE J1939 datalink is lost, limited communication between the TCM and the Allison keypad push button and lever shift selectors continues through direction signal wire 134. This limited communication allows the operator to select **D** (Drive), **N** (Neutral), or **R** (Reverse) in order to get the vehicle to a service location. Operator requests for range upshifts and downshifts will not be recognized, and the shift selector display will not display the selected transmission range due to the lack of a SAE J1939 datalink signal, but displays double cat-eyes.



**WARNING:** Assuming proper installation of direction signal wire 134, most Allison shift selectors may still be used to command transmission direction changes in these circumstances. Due to the failure of the SAE J1939 datalink communication, however, the shift selector cannot display the selected range. When this condition exists, it is advisable to slowly and carefully apply the throttle each time a change of direction has been selected in order to verify the direction of operation before accelerating the vehicle.

## 7.7 BUMP-SHIFT LEVER SELECTOR

The Allison Bump-Shift Lever selector is an electromechanical control that has locked positions to prevent accidentally selecting **R** (Reverse), **N** (Neutral) or **D** (Drive).

Bump-Shift Lever selector positions are:

- **R** (Reverse): selects reverse gear. Bumping the lever forward will select the alternate reverse gear range in select models.
- **N** (Neutral): must be selected prior to starting the engine.
- **D** (Drive): selects the highest available forward range. Transmission shifts to starting gear and will automatically upshift through the gears, as operating conditions permit, until the highest available gear is attained.
- **L (Low)**: selects the lowest available forward range. The transmission will automatically downshift to the lowest range using the preselect downshift schedule. Once attained, the transmission will hold the low range until another range is selected.
- **M (Manual)**: moving the bump-shift lever from the Drive position into the Manual Select position allows the operator to select a lower or higher forward gear range.
  - Initially moving the bump-shift lever to **M** (Manual) sets the Range Selected to the same forward range as the current Range Attained, shown in the MONITOR position on the display. Referred to as Express Preselect.
  - Each DOWNSHIFT (-) bump decreases the Range Selected by one forward range.
  - Each UPSHIFT (+) bump increases the Range Selected by one forward gear range.
  - These are momentary bump positions – when the operator releases the bump-shift lever, the bump-shift lever returns to the Drive position.
  - The **M** (Manual) position is accessible only from the Drive position and affects only forward gear ranges.

In addition to the features listed in [7.0 SHIFT SELECTORS COMPONENTS AND FUNCTIONS](#), the bump-shift lever selector also includes the following features:

- **HOLD OVERRIDE BUTTON**: The **HOLD OVERRIDE** button is a finger-controlled button integrated into the top and front side of the bump-shift lever selector knob. This button uses a detent feature with locked positions to prevent accidental range selection. Press the **HOLD**

**OVERRIDE** button to release the detent and move the bump-shift lever from any of these locked positions.

- **DISPLAY MODE/DIAGNOSTIC (DMD)**: The DMD button, when pressed, allows access to fluid level information, prognostics information and DTC information, depending on how many times it was pressed.

## 7.8 KEYPAD PUSH BUTTON SHIFT SELECTOR

The Allison keypad push button shift selector has six buttons on the keypad that cause the following transmission operations to occur:

- **R**: Press to select reverse
- **N**: Press to select neutral
- **D**: Press to select drive
- **Upshift and Downshift Arrow Buttons**

These buttons are used to change the Range Selected to a higher or lower forward range:

- One press of the **DOWNSHIFT** button sets range **SELECT** to the same range as the current range attained, shown in the **MONITOR** position on the display. Referred to as Express Preselect.
  - Each subsequent press of the **DOWNSHIFT** button decreases the range selected by one range.
  - One press of the **UPSHIFT** button increases the range selected by one range.
  - If the **UPSHIFT** or **DOWNSHIFT** button is held continuously, the selected range will continue to change up or down until the button is released or until the highest or lowest possible range of gears is selected.
- **MODE**: Multi-functional use (refer to [7.3 MODE BUTTON](#)).

Except for some 4700 models with a 2<sup>nd</sup> Reverse feature, the ↑ (Upshift) and ↓ (Downshift) arrows are only functional while in a forward range, and not in **N** (Neutral) or **R** (Reverse).

Pressing both the ↑ (Upshift) and ↓ (Downshift) arrows simultaneously when the transmission is in Neutral invokes requests for reading oil level, prognostics information or DTCs (refer to [7.0 SHIFT SELECTORS COMPONENTS AND FUNCTIONS](#)). If the transmission is locked in range due to an active DTC, the system still allows the operator to review the DTC in the selector with simultaneous button presses on the ↑ (Upshift) and ↓ (Downshift) arrows even though the transmission is not in **N** (Neutral).

Conditions which illuminate the **CHECK TRANS** indicator disable the shift selector. The SELECT display is blank and the MONITOR display shows the range actually attained. For a detailed explanation, refer to [6.2.1 CHECK TRANS LIGHT](#).

## 7.9 STRIP PUSH BUTTON SHIFT SELECTOR

Function of these selectors is similar to the keypad push button selectors. Buttons on the strip selectors, however, are arranged in a single horizontal row or a single vertical column. When one of the buttons is pressed, a light in the upper right corner of the button indicates the selected range. These selectors do not have a **MODE** button to select a secondary shift schedule. These selectors have no VFD and cannot display prognostic, fluid fill, or diagnostic information.

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## 8.0 CUSTOMIZING CONTROLS AND TCM PROGRAMMING

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### 8.1 VEHICLE AND TRANSMISSION SIGNAL INTERFACE OVERVIEW

This section describes the vehicle interface connections to the transmission controls and transmission signals. The vehicle interfaces discussed in this section may be provided through a SAE J1939 vehicle communications interface and include:

- **CHECK TRANS** indicator
- Wrench Icon. Used for Prognostics features for needed scheduled transmission maintenance
- **RANGE INHIBITED** or **RANGE INHIBIT** indicator
- Neutral Start
- Speedometer signal
- Reverse Warning
- Anti-Lock Brake System (ABS) status
- Service Brake status
- Retarder Modulation signals (if equipped)
- Engine Water Temperature signal
- Range Request signals
- Other miscellaneous Transmission Input/Output (I/O) signals that control Auxiliary Vehicle functions by using either discrete electrical signals, SAE J1939 messages, or a combination of both

### 8.2 INPUT AND OUTPUT FUNCTIONS OVERVIEW

**Input and Output (I/O) functions** are built into each transmission control system to allow additional functional controls of specialized transmissions and/or auxiliary vehicle operations that are tailored for the expected vocation of the vehicle.

Control signals are generally needed by each I/O function to work. These control signals, known as inputs, may be a combination of the following:

- Discrete analog switched signal voltages or switched-to-ground signals that control the on/off state of the needed input(s) that in turn allow the enabled I/O function to switch to on or off. Each input(s) must be wired to the correct vehicle circuits and the correct TCM pins through the correct OEM supplied switches, relays, connectors, and other components as needed.
- Various vehicle controller datalink messages from various controllers on the vehicle communications datalink such as SAE J1939.
- Use of monitored vehicle and/or transmission data such as, temperatures, various speeds, and specific range attained that are then compared with program limits and CMC parameters within the TCM to turn the I/O function on and off.

Various combinations of these I/O functions are assembled into I/O packages. The I/O package is contained in your TCM as part of its calibration and software for the exact vocation of your vehicle. This strategy allows the vehicle OEM(s) maximum flexibility for choosing which I/O functions and discrete input circuits, labeled by wire number and TCM pin assignments, they want to control the I/O functions on your vehicle. To provide flexibility to the OEM(s) and customer, specific discrete input circuits to specific TCM pins vary between vocations and I/O packages.

The calibration of each TCM, which also contains the programming of how your I/O is configured by the package, was selected for your vehicle by your vehicle OEM. To fit a customer's exact I/O requirement for their vehicle it may be necessary for the TCM to have individual I/O functions or packages re-programmed, or possibly recalibrate the TCM, for a different I/O package. You will have to take your vehicle to a qualified technician if you need to determine what I/O has been enabled or disabled by your OEM, body builder, or service location. A qualified Allison or OEM technician can download and review your calibration information within the "I/O Wires Report" Section that is part of "Diagnostic Reports" contained in the Allison DOC®. Your vehicle I/O or body builder should be consulted as well for information such as wiring diagrams, regarding how individual I/O functions were integrated in your vehicle.



**NOTE:** At the customer's request, and usually at the customer's expense, an Allison Service Outlet can:

- Run a report showing the present vehicle I/O configuration
- Enable/disable different I/O features and set the related CMC(s)
- Calibrate the TCM in order to get a different I/O packages

Proper chassis wiring and connectors, switches, relays, lamps, indicators, datalink messages, and CMC(s) must all be integrated into the vehicle and verified to be working properly before a newly programmed I/O feature or function works. If components for I/O functions are not integrated correctly in the vehicle, some of the enabled I/O features can inhibit the transmission from going to range or cause active DTCs.

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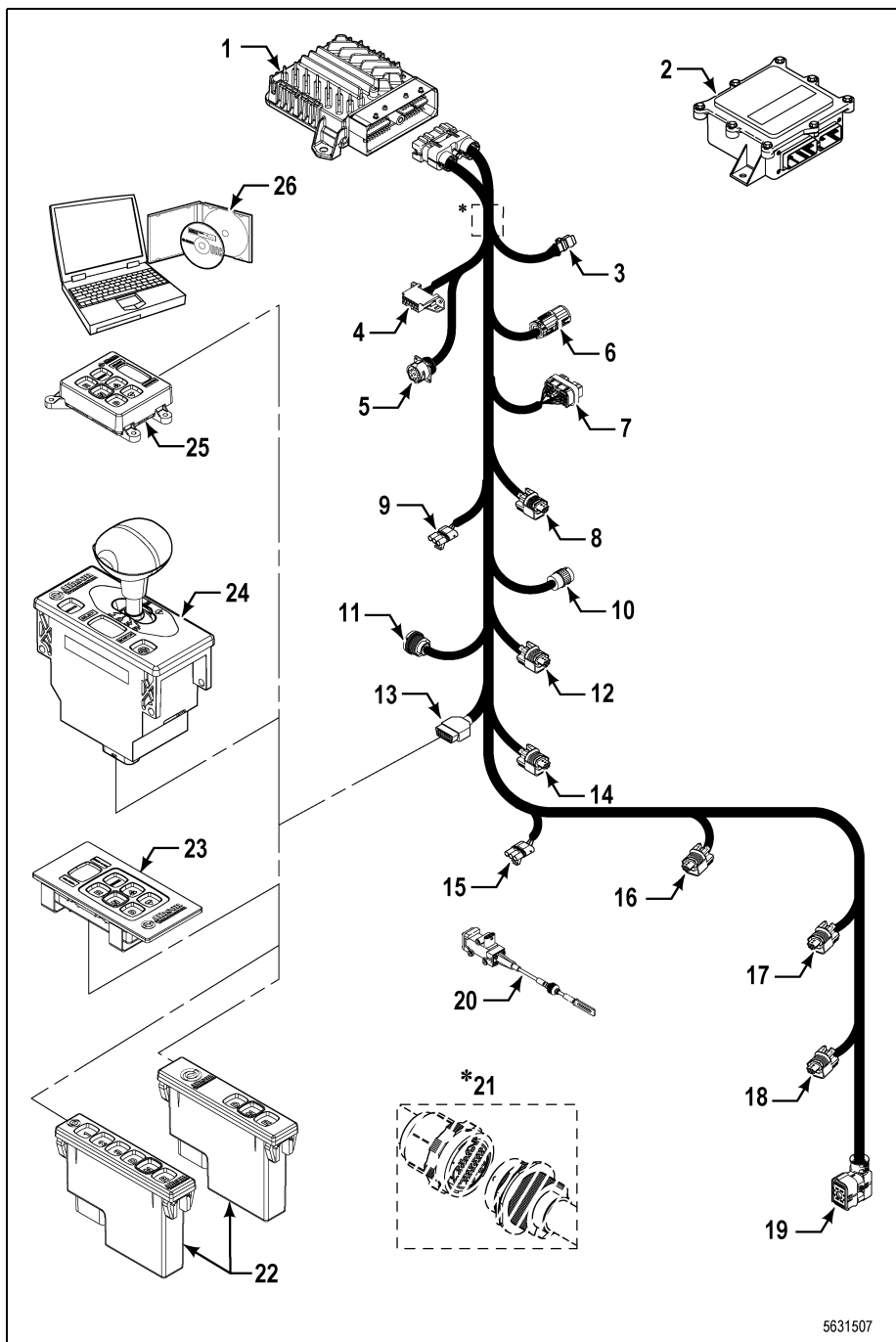


**NOTE:** All feature-related components must be integrated in the vehicle build prior to enabling the I/O feature. Features listed as “Not Enabled” must be enabled by Allison reprogramming-certified personnel.

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## 8.3 CONTROLS SYSTEM OVERVIEW

The Allison Controls system provides the functional control for Allison transmissions. The transmission control system consists of the components shown in [Figure 8–1](#) for the 3000 and 4000 Series.



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- |  |  |
|--|--|
| (1) – Transmission Control Module (TCM)*             | (13) – Shift Selector Connector                            |
| (2) – Vehicle Interface Module (VIM) (Optional)      | (14) – Retarder Temp Sensor Connector                      |
| (3) – J1939 Connector                                | (15) – Throttle Position Sensor (TPS) Connector (Optional) |
| (4) – SAE J1962 Diagnostic Tool Connector            | (16) – Turbine Speed Sensor Connector (4000 Series)        |
| (5) – Deutsch 9–Pin Diagnostic Tool Connector        | (17) – Engine Speed Sensor Connector                       |
| (6) – VIW Connector (Optional)                       | (18) – Retarder “PCS5” Solenoid Connector (Optional)       |
| (7) – VIM Connector (Optional)                       | (19) – 20–Way Transmission Feedthrough Harness Connector   |
| (8) – Retarder Accumulator Connector (Optional)      | (20) – Throttle Position Sensor (TPS)                      |
| (9) – Retarder Modulation Request (RMR) Connector    | (21) – Bulkhead Connector (Optional)                       |
| (10) – Transfer Case Connector (3000 Series 7–Speed) | (22) – Strip Push Button Shift Selectors (J1939)           |
| (11) – Sensor Harness Connector (Optional)           | (23) – Remote Push Button Selector                         |
| (12) – Output Speed Sensor Connector                 | (24) – Remote Level Selector                               |
|  | (25) – Compact Push Button Selectors                       |
|  | (26) – Allison DOC®  |

\* 5th Generation shown

**Figure 8–1. Typical Allison 5th Generation and 6th Generation Controls Components**

## 8.4 TRANSMISSION CONTROL MODULE (TCM) HARDWARE DESCRIPTION

**Harness Connector-** the TCM interfaces to your vehicle harness with one connector and uses an 80–pin connector interfaced to the vehicle harness. Refer to [Figure 8–1](#).

**TCM Power Requirements-** 5th Generation TCM models A61, A62 and A63 are offered to the OEM(s) for the 3000 and 4000 Series transmissions. All A61, A62 and A63 TCM configurations are compatible with 12-volt vehicle electrical systems. The A63 Max-Feature TCM is also compatible with a 24-volt vehicle electrical systems.

6th Generation TCM models C71M, C72M and C73M are offered to the OEM(s) for the 3000 and 4000 Series transmissions. All C71M, C72M and C73M TCM configurations are compatible with 12–volt vehicle electrical systems. The C73M Max-Feature TCM is also compatible with 24–volt vehicle electrical systems.

See your vehicle dealer if you need assistance in determining which TCM is installed in your vehicle.



**NOTE:** Allison electronic controls are designed and manufactured to comply with all FCC and other guidelines regarding Radio Frequency Interference/Electromagnetic Interference (RFI/EMI) for transportation electronics. Manufacturers, assemblers, and installers of radio-telephone or two-way communication radios have the sole responsibility to correctly install and integrate those devices into Allison Transmission-equipped vehicles to the customer's satisfaction.

## 8.5 AUTODETECT

The Autodetect software feature automatically detects the presence of transmission components or input signals, thus permitting the use of different features or input signals with a common TCM. Autodetect checks for the presence of a valid input signal denoting the presence of each of the features listed. Diagnostic functions relating to each of these items are executed if the feature is detected and used. Refer to [Table 8–1](#) for the presence of the following transmission components or data inputs.

**Table 8–1. Autodetect Features**

Output Retarder Presence	Autodetect
Oil Level Sensor (OLS) Presence	Autodetect

## 8.6 ADAPTIVE SHIFTING

Adaptive shifting is a basic design feature of the shift controls which optimizes shift quality. This is accomplished by frequent monitoring of critical characteristics in the clutch engagement process and making continuous adjustments to certain characteristics which improve subsequent shifts.

The transmission shift calibration is based on several different types of shifts, such as full throttle, part throttle, closed throttle, upshifts, and downshifts. Each shift is associated with specific speed and throttle position parameters. To optimize each type of shift for normal driving, it is necessary for the shift controls to have experienced operation and shifting in a wide variety of operating conditions. A drive-in period under various driving conditions is required before the adaptive controls can be expected to optimize each and every shift. You should begin to see shift quality converge to the adapted level after five shifts of a particular shift type.

## 8.7 COMMUNICATION THROUGH VEHICLE DATALINKS

The Communication Interface combined with the SAE Datalink Protocols enables various body, transmission, brake system, and engine controllers of a vehicle system to exchange information between these modules in the vehicle. Use of a network, or datalink, for on-vehicle communication can greatly reduce the amount of wiring in a vehicle and provide access to a wider range of information for many different components and subsystems.

Check with your vehicle OEM or Allison Transmission distributor or dealer for the capabilities of the TCM in your vehicle, or if you need assistance in determining the datalink types available for your vehicle.

## 8.8 INFORMATION DISPLAYS

The OEM may supply and install a remote display for use in displaying transmission status and service information broadcast over the vehicle datalink. This information may include the transmission range selected, transmission range attained, sump temperature indicator, prognostic information and DTCs (refer to [7.5 SELECTOR DISPLAY DESCRIPTIONS FOR ACTIVE DIAGNOSTIC TROUBLE CODES \(DTCs\) AND INHIBITS](#) for additional information).

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## 9.0 EXTERNAL WIRE HARNESSSES, VEHICLE INTERFACE MODULE, AND RETARDER CONTROLS

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### 9.1 WIRE HARNESSSES

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**NOTE:** The external harness connecting transmission controls is part of the vehicle chassis harness and typically will not have an Allison Transmission part number. The harness parts are usually only available through the vehicle manufacturer and their vendors. Check with the OEM or dealer first to determine their wire harness service parts availability. Any Allison distributor or dealer can assist with determining serviceability of the external harness as well. The internal transmission harness inside the transmission is an Allison part and only available from an Allison distributor or dealer.

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The transmission controls require the use of wiring harnesses to connect the various system components, including:

- Transmission Control Module (TCM)
- Main connector on the transmission
- Engine speed sensor
- Turbine shaft speed sensor (4000 Series)
- Output shaft speed sensor
- Serial communication datalink
- Shift selector
- Diagnostic connector
- Retarder controls (if equipped)
- Vehicle interface wiring
- Throttle Position Sensor (TPS) (only with mechanically controlled engines)
- Optional Vehicle Interface Module (VIM)

All wiring harnesses and connectors which mate to Allison connectors/components are typically supplied and installed by the vehicle manufacturer. Harnesses may consist of a single piece, or may be divided into multiple segments joined by bulkhead connectors.

## 9.2 VEHICLE INTERFACE MODULE (VIM)

The VIM contains relays and fuses necessary to interface the transmission controls with the vehicle wiring system. When ordering the VIM, specify 12 or 24 volts to properly match the vehicle electrical system.

In some cases, the OEM or body builder may choose not to use the Allison VIM. In these cases, the OEM must specify and install components which provide a proper interface between vehicle wiring and the transmission control system.

## 9.3 RETARDER CONTROLS

In order to meet the needs of operators in a wide variety of applications, vocations, and vehicle configurations, several retarder apply systems are offered for transmission models in the Allison Transmission 3000 and 4000 Series.

Certain types of apply systems may not be recommended for specific vocations. For example, factors such as retarder performance that may not be appropriate for the class or vehicle type or difficulty in installation. However, there are typically two or more apply types available for most vehicles.

In addition to the standard analog controls approach, the possible integration of the retarder with numerous other vehicle systems through a common SAE J1939-based vehicle controller creates additional design flexibility when determining methods of potential operator control of the transmission retarder.

The Transmission Control Module (TCM) must be calibrated to the proper method to ensure desired retarder operation. Operator controls of the retarder can be accomplished by either of the following methods:

- **Both Analog and J1939.** Input is based on a Retarder Enable switch for activation, plus one or more Allison Retarder Modulation Request (RMR) components to select the desired level of retardation. In addition, retardation is requested or limited based on messages from an SAE J1939-based vehicle controller.
- **J1939 Only.** Retardation is requested or limited based on messages from an SAE J1939-based vehicle controller.

The analog components that can be used with the 3000 and 4000 Series retarder are available from Allison Transmission. These components provide

control over retarder operation and include various types of retarder operator and vehicle interface controls. Some of the available operator controls, known also as Retarder Modulation Request (RMR) devices include:

- Foot pedal
- Hand lever
- Automatic apply at closed throttle
- Apply integrated with service brakes
- One-step, two-step or three-step applies

Refer to [Table 4–7](#) for the various types of retarder controls available.

The retarder apply system does not actuate the retarder directly. The driver uses the retarder operator controls to request a desired level of retardation, ranging from none, up to the maximum available from the specific retarder/transmission configuration in use. The TCM processes the request in conjunction with other input data which defines the current operating status of the transmission and vehicle. The TCM turns the retarder on at the requested level when conditions are appropriate for retarder operation.

Refer to [4.3 USING THE HYDRAULIC RETARDER](#) for additional information about the retarder controls, retarder performance, and retarder usage.

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# 10.0 TRANSMISSION COMPONENTS

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## 10.1 TORQUE CONVERTER

The torque converter multiplies engine torque and transfers smooth, uninterrupted power to the wheels quickly. The torque converter consists of these four components:

- Pump—input element driven directly by the engine
- Turbine—output element hydraulically driven by the pump
- Stator—reaction (torque multiplying) element
- Lockup Clutch—mechanically couples the pump and turbine when commanded by the Transmission Control Module (TCM).

When the pump turns faster than the turbine and the stator is stationary, the torque converter is multiplying torque. When the turbine approaches the speed of the pump, the stator starts to rotate with the pump and turbine. When this occurs, torque multiplication stops and the torque converter functions as a fluid coupling. The lockup clutch is located inside the torque converter and consists of the following components:

- Piston and backplate—driven by the engine
- Clutch plate/damper (located between the piston and the backplate)—splined to the converter turbine

The lockup clutch/torsional damper is engaged and released in response to electronic signals from the TCM. Lockup clutch engagement provides a direct drive from the engine to the transmission input. This eliminates converter slippage and maximizes fuel economy and vehicle speed. The lockup clutch releases at lower speeds or when the TCM detects conditions requiring it to be released.

The torsional damper tries to absorb engine torsional vibration in an attempt to prevent transmitting engine torsional vibration on through to transmission components (clutches, etc), or items bolted to the transmission.

## 10.2 PLANETARY GEARS AND CLUTCHES

A series of three helical, constant mesh planetary gear sets and shafts provides the mechanical gear ratios and direction of travel for the vehicle. The planetary gear sets are controlled by five multi-plate clutches that work in pairs to produce up to six forward speeds and one reverse speed. The clutches are applied and released hydraulically in response to electronic signals from the Transmission Control Module (TCM) to the appropriate solenoids.

## 10.3 COOLER CIRCUIT

The transmission fluid is cooled by an integral (transmission-mounted) or remote-mounted oil cooler. Connections to the cooling circuit are located at the front or rear of the transmission to facilitate installation of remote cooler lines. On retarder models, only the rear cooler ports may be used. The integral cooler is mounted on the lower rear portion of the transmission, replacing the remote cooler manifold. Integral cooler oil ports are internal requiring coolant to be routed to and from the cooler.

## 10.4 RETARDER

The self-contained retarder is at the output of the transmission and consists of a vaned rotor which rotates in a vaned cavity. The rotor is splined to and driven by the output shaft. When the retarder is activated, the fluid in the accumulator is displaced into the retarder cavity. The pressurized fluid in the cavity acting against the rotating and stationary vanes causes the retarder rotor and output shaft to reduce speed, slowing the vehicle or limiting speed on a downhill grade (refer to [4.3 USING THE HYDRAULIC RETARDER](#)) for additional information. When the retarder is deactivated, the retarder cavity is evacuated and the accumulator is recharged with fluid.

The retarder housing also allows the addition of either a remote or integral cooler for transmission sump fluid in addition to retarder out fluid. A bypass cover is placed over the sump cooling ports when the provision is not used. The sump cooler ports are located on the lower right rear face of the retarder housing. Refer to [Figure 2-1](#), [Figure 2-2](#), [Figure 2-5](#) and [Figure 2-6](#).

## 10.5 CONTROL VALVE MODULE

The 3000 and 4000 Series Transmission control valve module is bolted to the transmission main housing, and contain the main and lube filters. The control valve module also contains a main valve body assembly and solenoid valve body assembly. The Transmission Control Module (TCM) issues commands that actuate the range clutch solenoids to govern fluid flow to the commanded range clutches and lockup clutch contained in the torque converter.



The control valve module contains the following components:

- Various valves and valve bodies controlling and routing hydraulic pressure to the rest of the transmission
- Range clutch and lockup clutch solenoids
- Diagnostic valve, valve body, and diagnostic pressure switch
- Main filter life indicator valve, valve body, and filter life pressure switch
- Turbine speed sensor (3000 Series only)
- Sump temperature sensor

## 10.6 TRANSMISSION SPEED SENSORS

Three speed sensors are integral to the transmission assembly. The speed sensors provide input speed, converter turbine speed and transmission output speed signals to the TCM. For the specific location of speed sensors, refer to [Figure 2–1](#) and [Figure 2–2](#) for non-PTO applications. Refer to [Figure 2–3](#) and [Figure 2–5](#) for PTO applications. Refer to [Figure 2–6](#) for the 4700/4800/4770/4870/4970 transmissions.

The transmission input speed sensor is located on the converter housing. The transmission output speed sensor is located on the output housing (except for the 3700 SP where it is located inside the transfer case). Both speed sensors require a connection to the wiring harness.

The mounting provision for the turbine speed sensor differs between the transmission model families:

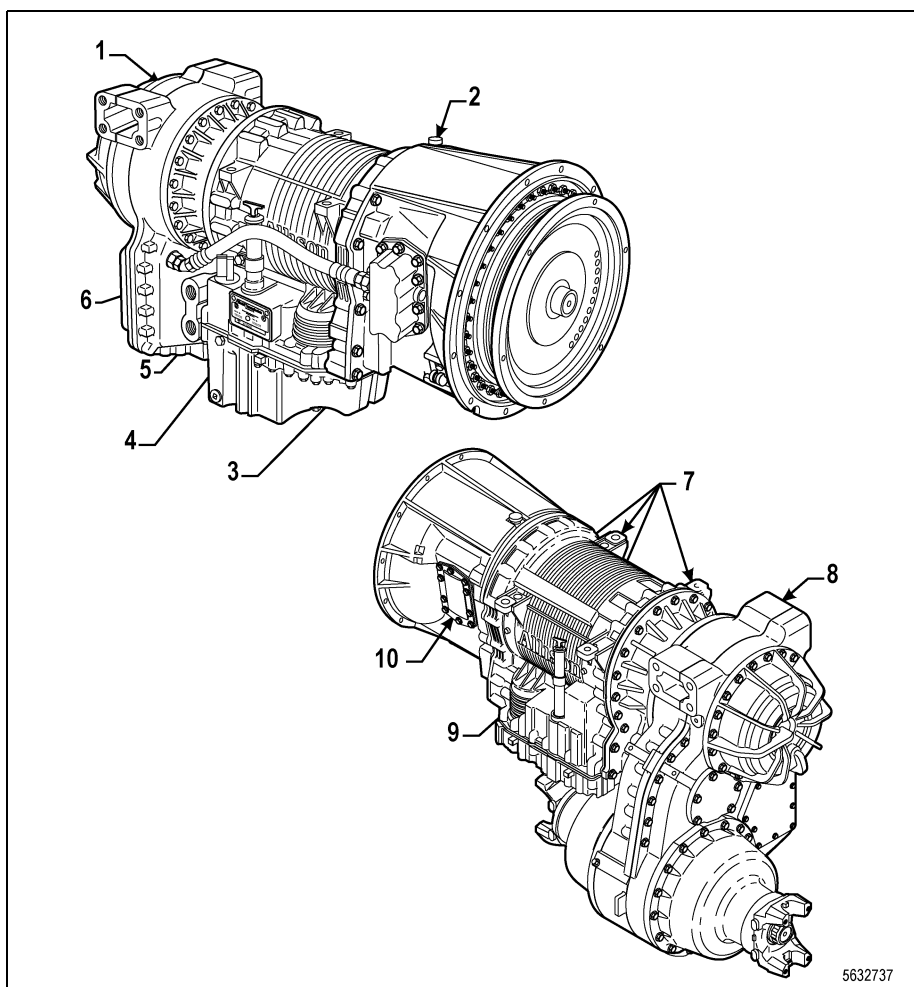
- For transmission models in the 3000 Series, the turbine speed sensor is internal to the transmission and does not require an external connection.
- For transmission models in the 4000 Series, the turbine speed sensor is external to the transmission and requires a connection to the wiring harness.

## 10.7 TRANSFER CASE (DROPBOX) 3700 SP TRANSMISSION (5TH GENERATION CONTROLS ONLY)

A transfer case (dropbox) module is provided for 3700 SP-vehicles where front and rear wheel drive is desired. The transfer case (refer to [Figure 10–1](#)) is merged with a six-speed close ratio gear train to produce a 7-speed configuration. One of the two Power Takeoff (PTO) drive provisions actuate a scavenge pump for the transfer case. A remote-mounted cooler is required for a dropbox unit.

Transfer case design features include helical transfer gears and a self-contained lubrication oil pump. The transfer gears provide a ratio of 1.2:1. The lubrication oil pump is driven directly by the output to the drive axles. Since lubrication is present whenever the drive axle is turning, it is not necessary to disconnect the drivelines or axle shafts when the vehicle is towed or pushed. A torque proportioning differential gives a front/rear torque split of 30/70 when the multi-plate differential (C7) is not engaged. When the multi-plate differential C7 is engaged, the torque split becomes 50/50. The multi-plate differential C7 is engaged in difficult traction situations.

The seventh forward speed in this transmission is the lowest numerical gear ratio provided and is intended for use in off-road conditions. This range is obtained when a multi-plate C6 in the transfer case is applied.

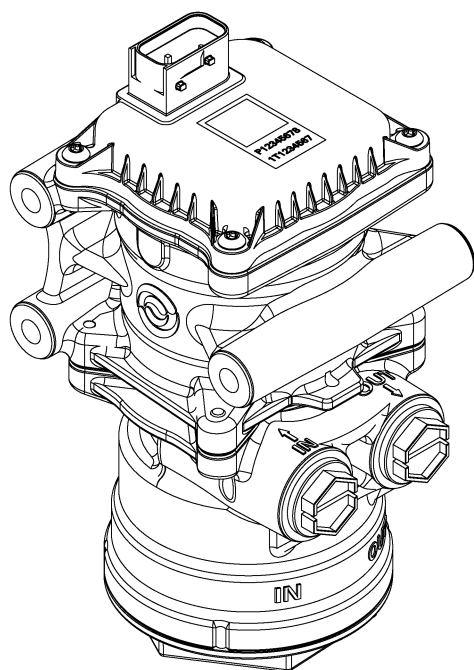


- |   |                                     |
|---|-------------------------------------|
| (1) – Transfer Case   | (6) – Feedthrough Harness Connector |
| (2) – Breather  | (7) – Assembly Pads (Both Sides)    |
| (3) – Scavenge Pump   | (8) – Transfer Case                 |
| (4) – Nameplate   | (9) – Oil Fill Tube and Dipstick    |
| (5) – Oil Fill Tube and Dipstick<br>(Available On Both Sides) | (10) – PTO Provision                |

**Figure 10–1. 3700 SP with PTO**

## 10.8 ENGINE STOP-START ELECTRIC PUMP

Certain 4000 Series transmissions may utilize a remote Engine Stop-Start electric pump. The ES-S electric pump allows the engine to shut down at idle opportunities where the pump is used to keep the transmission pressurized and first clutch engaged.



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**Figure 10–2. ES-S Pump**

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## 11.0 GENERAL GUIDELINES

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### 11.1 WELDING ON VEHICLE

Observe the following precautions when welding on the vehicle:

- Disconnect the wiring harnesses from the TCM.
- Disconnect the TCM power and ground circuits from the battery, and any electronic control ground wires connected to the frame or chassis.
- Do not connect welding cables to electronic control components.
- Do not weld on electronic control components.
- Cover electronic control components and wiring to protect them from hot sparks, heat, etc.

### 11.2 PAINTING ON VEHICLE

**11.2.1 Electrostatic Painting.** If the vehicle chassis or body is painted using an electrostatic painting process, electrical voltage must not be discharged through the TCM. To prevent this possibility, Allison recommends installing the TCM after the electrostatic paint process is complete. If the TCM is installed prior to electrostatic painting, make sure:

- the TCM is not painted.
- the elements being painted are properly and continuously grounded during the entire painting process.



**NOTE:** Allison Transmission is not responsible for TCM damage resulting from improper grounding during electrostatic painting of the vehicle.

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During electrostatic painting, the paint droplets receive an electrostatic charge attracting them to the grounded surfaces. Voltages at the spray gun can exceed several thousand volts. The charge which builds up on an improperly grounded chassis or body can be discharged through the TCM, resulting in damage to the TCM.

**11.2.2 Painting of Transmission Control Components.** While it may be desirable to paint chassis-mounted components to enhance the overall vehicle appearance and/or provide corrosion protection, the transmission control components **must not** be painted. Painting transmission control components can:

- compromise the integrity of connectors and connector seals.
- reduce thermal conductivity from inside the TCM to ambient air.
- cover labels or other identification, hindering the process to service these components.

## **11.3 ENVIRONMENT**

Allison Transmission designed the Allison controls and components to operate in normal vehicle cab and chassis environments. The Allison controls and components can withstand moisture, direct light, heat, and shock loads. The Transmission Control Module (TCM), Allison shift selectors and their connectors are sealed, but are not considered immersible. Installation of the Allison controls and components must meet the environmental requirements in Allison 5th Generation and 6th Generation Controls Data. In addition, mount the Allison controls and components away from direct exposure to road hazards and weather. In order to meet the temperature limits listed in Allison 5th Generation and 6th Generation Controls Data, allow for free air movement around each component. The air movement dissipates heat away from the components. Exceeding the temperature limits reduces the life of the components.

## **11.4 COMPONENT ACCESS REQUIREMENTS**

Access to service the controls and components is necessary throughout the life of the vehicle. Consider service access to transmission components when installing auxiliary vehicle controls and components, including the effort required to remove covers, body parts, or chassis members to gain access to the transmission component(s) being serviced.

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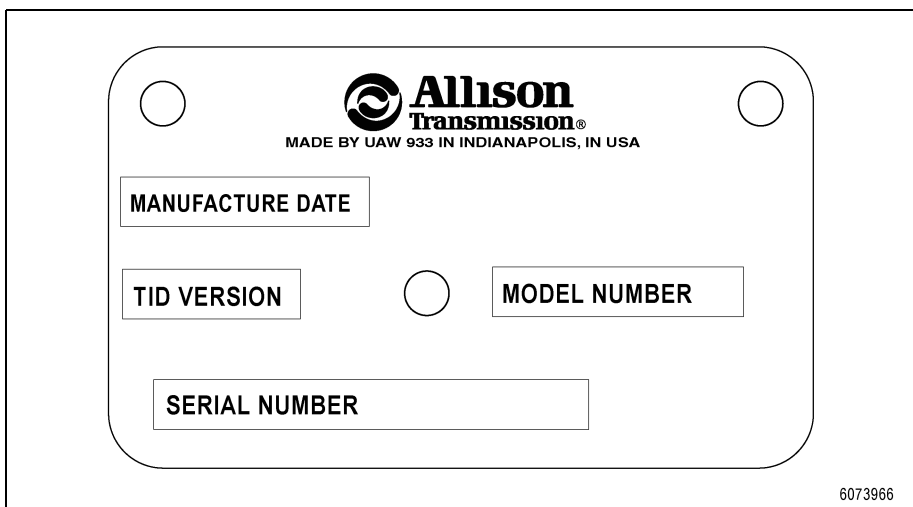
## 12.0 CUSTOMER SERVICE

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### 12.1 ORDERING PARTS

#### 12.1.1 TRANSMISSION NAMEPLATE.

The coded manufacture date, TransID version, model number and serial number are stamped into the transmission nameplate (refer to [Figure 12–1](#)). These numbers describe the transmission and all of its components. Use the serial number when ordering replacement parts or requesting service information. Location on the nameplate varies with the particular transmission.



**Figure 12–1. Transmission Nameplate**

**12.1.2 GENUINE PARTS.** Allison Transmission recommends that only genuine Allison parts be used in an Allison Transmission. Order all replacement parts from an authorized distributor or dealer. Service outlets can be located on the Allison Transmission website at [allisontransmission.com](http://allisontransmission.com).

## 12.2 OWNER ASSISTANCE

The satisfaction and goodwill of the owners of Allison transmissions are of primary concern to Allison Transmission, its distributors and their dealers.

As an owner of an Allison transmission, you have service locations throughout the world that are eager to meet your parts and service needs with:

- Expert service by trained personnel.
- Emergency service 24 hours a day in many areas.
- Complete parts support.
- Sales teams to help determine your transmission requirements.
- Product information and literature.

Normally, any situation that arises in connection with the sale, operation or service of your transmission will be handled by the distributor or dealer in your area. Check the telephone directory for the Allison Transmission service outlet nearest you or use Allison Transmission's Sales and Service Locator tool on the Allison Transmission website at [allisontransmission.com](http://allisontransmission.com).

We recognize, however, that despite the best intentions of everyone concerned, misunderstandings may occur. To further assure your complete satisfaction, we have developed the following three-step procedure to be followed in the event a problem has not been handled satisfactorily.

**Step One—Discuss your problem with a member of management from the distributorship or dealership.** Frequently, complaints are the result of a breakdown in communication and can be resolved quickly by a member of management. If you have already discussed the problem with the Sales or Service Manager, contact the General Manager. All Allison Transmission, Inc. dealers are associated with an Allison Transmission, Inc. distributor. If the problem originates with a dealer, explain the matter to a management member of the distributorship with whom the dealer has a service agreement. The dealer will provide the Allison Transmission distributor's name, address and telephone number on request.

**Step Two—**When it appears the problem cannot be readily resolved at the distributor level without additional assistance, **contact the Allison Technical Assistance Center at 800-252-5283.** They will place you in contact with the Regional Customer Support Manager for your area.

For prompt assistance, please have the following information available:

- Name and location of Allison Authorized Distributor or Dealer.
- Type and make of vehicle/equipment.



- Transmission model number, serial number and assembly number (if equipped with electronic controls, also provide the TCM assembly number).
- Transmission delivery date and accumulated miles and/or hours of operation.
- Nature of problem.
- Chronological summary of your transmission's history.

**Step Three**—If you are still not satisfied after contacting the Regional Customer Support Manager, **present the entire matter to the Home Office by writing to the following address:**

Allison Transmission  
Attn: Manager, Warranty Administration  
PO Box 894, Mail Code PF9  
Indianapolis, IN 46206-0894

The inclusion of all pertinent information will assist the Home Office in expediting the matter.

When contacting the Home Office, please keep in mind that ultimately the problem will likely be resolved at the distributorship or dealership using their facilities, equipment and personnel. Therefore, it is suggested that **Step One** be followed when experiencing a problem.

Your purchase of an Allison Transmission product is greatly appreciated and it is our sincere desire to assure complete satisfaction.

## 12.3 SERVICE LITERATURE

Allison service literature provides fully illustrated instructions for operation, maintenance, troubleshooting, service, overhaul and parts support for your transmission. For maximum performance and service life from your unit, you may order additional publications via phone, email or web.

Electronic versions of the publications can be found on the Allison HUB under *Publications* ⇒ *Allison ePubs*.

TOLL FREE: 844-829-3595  
INTERNATIONAL: 613-271-3842  
allisontransmission@gilmore.ca  
[allisontransmissionpublications.com](http://allisontransmissionpublications.com)

For more information about Allison products please visit  
[allisontransmission.com](http://allisontransmission.com).

## 12.4 ALLISON TRANSMISSION DISTRIBUTORS

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**NOTE:** Go to [allisontransmission.com/sales-service-locator](https://allisontransmission.com/sales-service-locator) for a complete and up-to-date listing of Allison Transmission Service Centers.

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## REVISION HISTORY

This revision history includes a summary of changes made to the following topics between 2022/07 and 2023/06.

### **3-13. ENGINE STOP-START OPERATION**

2022/07 New section to include information about the Engine Stop-Start operation

### **5-10. ENGINE STOP-START ELECTRIC PUMP FILTER CHANGE**

2022/07 New information for the ES-S Electric Pump filter

### **6-3. USING SHIFT SELECTOR FOR ACCESSING DIAGNOSTICS INFORMATION**

2023/05 Revised DTC Descriptions to match the Allison DOC Descriptions

2022/07 Added DTCs P0C2B, P2797 and U0287 to list

### **10-8. ENGINE STOP-START ELECTRIC PUMP**

2022/07 Added section about function of the Engine Stop-Start Electric Pump

## NOTES

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*One Allison Way  
Indianapolis, Indiana USA 46222-3271*

*OM8491EN (202306)*

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