SECTION B: SYSTEM OPERATION
3000 AND 4000 PRODUCT FAMILIES

ALLISON 6TH GENERATION CONTROLS

APPLICABLE MODELS: **3000 Product Family**
4000 Product Family

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SECTION B: SYSTEM OPERATION – 3000 & 4000 PRODUCT FAMILIES

1.0 PURPOSE

The purpose of this section is to describe the function and operation of the transmission control system and components for the 3000 and 4000 Product Families. For 1000 and 2000 models, refer to *Section B: System Operation – 1000/2000 Product Family*.

2.0 REFERENCED DOCUMENTS

Unless otherwise noted, all documents referenced in this document may be found in the Allison HUB website at https://hub.allisontransmission.com/login. To locate the referenced documents look for Tech Data under the Engineering heading on the Allison HUB home page. In this document, these references are identified by italic font. Contact your Allison Transmission representative if you do not have access to the Allison HUB. A list of all items referenced in this document can be found at the end of this document.

3.0 STARTING THE ENGINE

No special procedure is required. The driver must simply verify that the brakes are applied and Neutral has been selected if the vehicle is equipped with a bump lever selector. The keypad and strip pushbutton selectors will automatically initialize in Neutral. When the ignition is turned on, the digital display will indicate N for Neutral for both **SELECT** and **MONITOR**. This indicates Neutral has been both selected and attained and that the engine may now be started.

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

4.0 TRANSMISSION SYSTEM OPERATION

4.1 BASIC OPERATION

With an Allison automatic transmission, the shift selector is used by the operator to select Neutral (N), Reverse gear (R), or a range of forward gears. When a forward gear 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. Appendix A shows typical shift sequences for each transmission type.

Selected 7-speed models in the 4000 Product Family offer an option for two reverse gears – the standard reverse gear ratio and an optional deeper reverse ratio. For detailed description of shift selector operation with 2nd Reverse, refer to *Technical Document (TD) 191, Application and Installation Requirements for the 2nd Reverse Feature with Allison 6th Generation Controls*.

During certain operating conditions the control system may inhibit transmission operation or range shifts. Refer to paragraph 4.10, Shift Inhibits, for additional details.

WARNING! If you leave the vehicle and the engine is running, the vehicle can move suddenly and you or others could be injured. If you must leave the engine running, do not leave the vehicle until you do all of the following:

- **Put the transmission in NEUTRAL, and**
- **Ensure that the engine is at low idle rpm (below 1000 rpm), and**
- **Apply the park brake and emergency brakes and make sure they are properly engaged, and**
- **Chock the wheels and take any other steps necessary to keep the vehicle from moving.**

WARNING! The vehicle service brakes, park brake, or emergency brake must be applied whenever NEUTRAL is selected to prevent unexpected vehicle movement. Selecting NEUTRAL does not apply the vehicle brakes unless an auxiliary system to apply the park brake is installed by the vehicle manufacturer.

4.2 KEYPAD PUSHBUTTON SHIFT SELECTOR OPERATION

This type of shift selector is available in four different styles (Figure B-1). The function of the keypad buttons are identical on all types.

Refer to Figure B-2, which illustrates the standard pushbutton shift selector, for items in the discussion which follows.

R – REVERSE: selects Reverse gear.

N – NEUTRAL: selects Neutral. The area around the N button is a raised ridge so the driver can identify the pushbuttons 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.

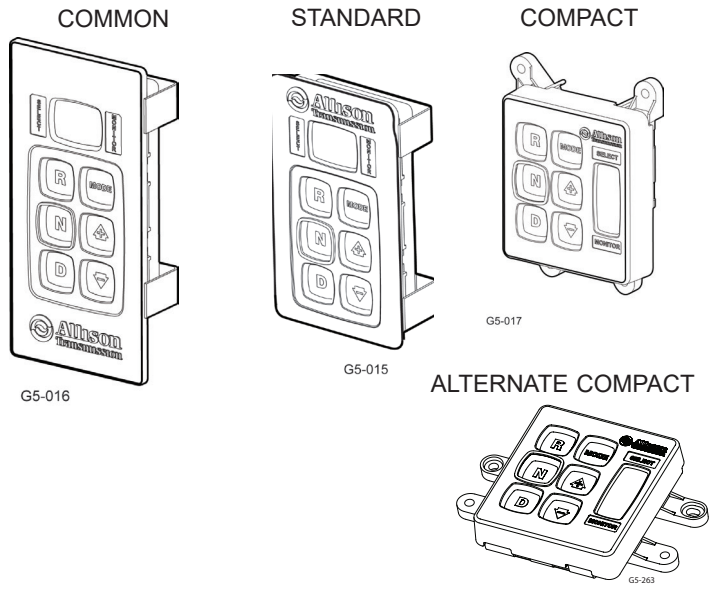


Figure B-1: Keypad Pushbutton Shift Selectors

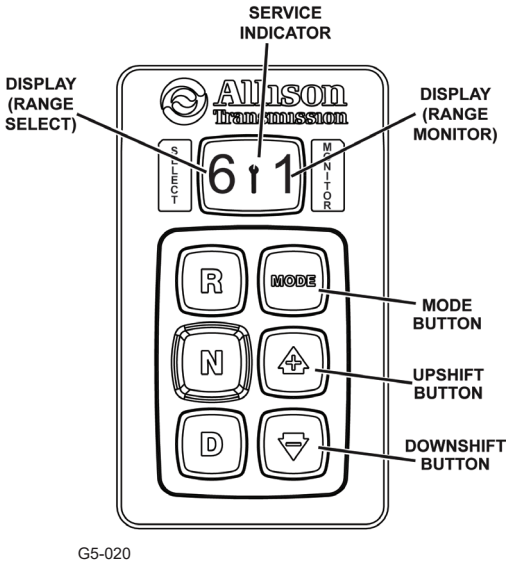


Figure B-2: Keypad Pushbutton Shift Selector Features

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 (Figure B-3). 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.

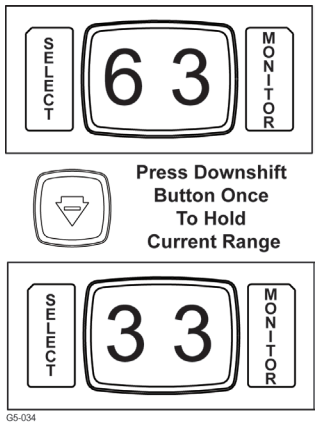


Figure B-3: Operation of Downshift Button

MODE Button: Pressing the **MODE** button invokes a secondary shift schedule or a special operating function. The function of the **MODE** button is determined when the Input/Output Package is selected during definition of the TCM calibration. See paragraph 4.6, Function of the MODE Button, for additional details.

Backlighting: Backlighting of keypads can be controlled using a J1939 message or can be configured to be hardwired. Refer to *Datalink Communications* Tech Data for J1939 control or to *Vehicle Electrical System Interface* Tech Data for the hardwire configuration.

Select and Monitor: During normal operation with **D** (Drive) selected, the **SELECT** section of the display shows the highest attainable forward range for the shift schedule in use. The **MONITOR** section displays the gear range that has been commanded in the transmission. Reverse **R** and Neutral **N** are likewise displayed when appropriately selected and in use. The display of any other character in the **SELECT** or **MONITOR** section denotes a nonstandard operating condition. See 4.5, Shift Selector Display.

Diagnostic Functions: Pressing the **UPSHIFT** and **DOWNSHIFT** buttons simultaneously with the transmission in Neutral invokes a service or diagnostic function. The function invoked depends upon whether the transmission is equipped with the Oil Level Sensor (OLS) and whether Prognostics is enabled in the TCM calibration, as shown in the table below:

OLS Equipped?	Prognostics Enabled?	Simultaneous Press of UPSHIFT & DOWNSHIFT Buttons				
		1st Press	2nd Press	3rd Press	4th Press	5th Press
Yes	Yes	OLS	Prognostics	Diagnostics	Hardware Level	Normal Range Display
Yes	No	OLS	Diagnostics	Hardware Level	Normal Range Display	
No	Yes	Prognostics	Diagnostics	Hardware Level	Normal Range Display	
No	No	Diagnostics	Hardware Level	Normal Range Display		

4.3 STRIP PUSHBUTTON SHIFT SELECTOR OPERATION

Function of these selectors is similar to the keypad pushbutton 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 depressed, a light in the upper right corner of the button indicates the selected range. Refer to Figure B-4.

Backlighting: All buttons are continually backlit during normal vehicle operation.

Display: The strip selectors do not have a display. If a display is desired in a vehicle equipped with a strip selector, the display must be supplied and installed by the vehicle builder.

MODE Button: The strip selectors do not have a **MODE** button. Therefore, access to a secondary mode shift schedule or activation of an alternative function requires use of an electrical switch. The switch and related circuitry are supplied and installed by the vehicle builder. Refer to the documentation for *Input / Output (I/O) Functions*.

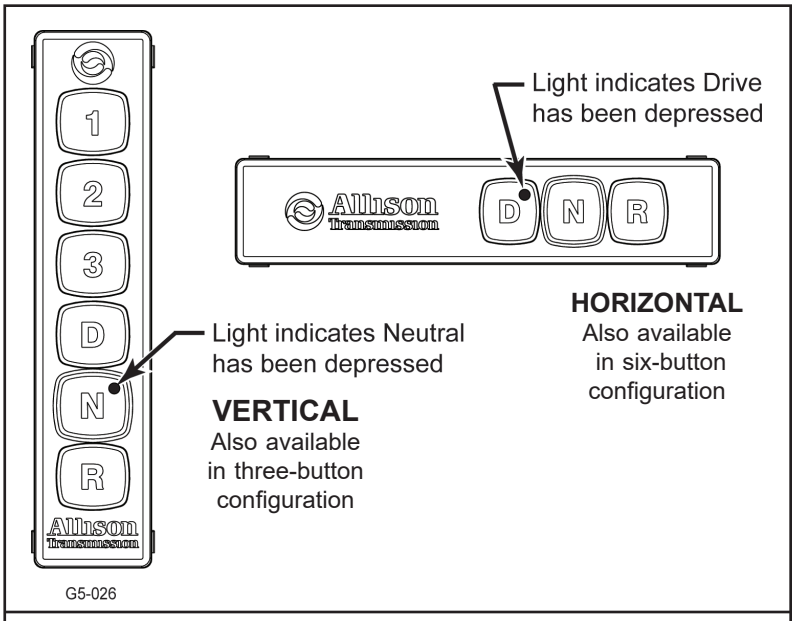


Figure B-4: Strip Shift Selectors Showing Range Indicator Light

4.4 BUMP LEVER SHIFT SELECTOR OPERATION

Refer to Figure B-5.

R – REVERSE: selects Reverse gear. Bumping the lever forward will select the alternate reverse gear range in select models. For more information on 2nd Reverse for the 4000 7-speed models, refer to *Technical Document (TD) 191, Application and Installation Requirements for 2nd Reverse with 6th Gen Controls*.

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 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.

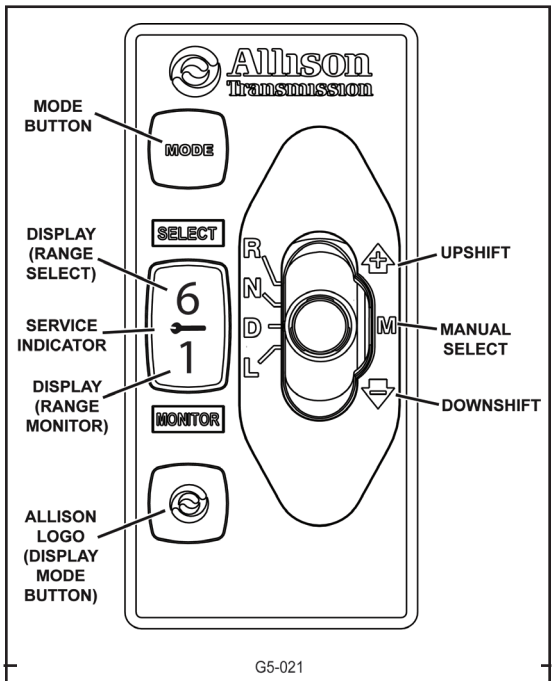


Figure B-5: Bump Lever Shift Selector *(Knob Removed for Clarity)*

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. 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 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 bump lever selector features a detent to prevent inadvertent shifting between **R**, **N**, **D,** and **L**. 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.

Select and Monitor: During normal operation with **D** (Drive) selected, the **SELECT** section of the display shows the highest attainable forward range for the shift schedule in use. The **MONITOR** section displays the gear range that has been commanded in the transmission. Reverse **R** and Neutral **N** are likewise displayed when appropriately selected and in use. The display of any other character in the **SELECT** or **MONITOR** section denotes a nonstandard operating condition. See 4.5, Shift Selector Display.

Backlighting: The **MODE** button and the display mode button with the Allison logo are continually backlit during normal vehicle operation.

Diagnostic Functions: Pressing the Allison logo button with the transmission in Neutral invokes a service or diagnostic function. The function invoked depends upon whether the transmission is equipped with the Oil Level Sensor (OLS) and whether Prognostics is enabled in the TCM calibration, as shown in the table below:

OLS Equipped?	Prognostics Enabled?	Press of the Allison Logo Button				
		1st Press	2nd Press	3rd Press	4th Press	5th Press
Yes	Yes	OLS	Prognostics	Diagnostics	Hardware Level	Normal Range Display
Yes	No	OLS	Diagnostics	Hardware Level	Normal Range Display	
No	Yes	Prognostics	Diagnostics	Hardware Level	Normal Range Display	
No	No	Diagnostics	Hardware Level	Normal Range Display		

4.5 SHIFT SELECTOR DISPLAY

4.5.1 DURING NORMAL OPERATING CONDITIONS

DISPLAY	DESCRIPTION
SELECT	During normal operation, this display indicates the gear range which has been selected by the operator.
MONITOR	During normal operation, this display indicates the actual gear in which the transmission is currently operating.
Service Indicator (Wrench icon)	This icon is functional only if Prognostics are enabled in the TCM calibration. Displayed at startup for a bulb check, this indicator will be turned off if no service conditions exist. Refer to 6.0, Control System Prognostics.

Note: During initilization / Power-up, "Allison" splash screen is displayed for approximately 2 seconds followed by a "FuelSense" splash screen for approximately 2 seconds (if so equipped). The Prognostics symbol will display after the splash screens if Prognostics is enabled in the calibration.

4.5.2 OPERATION DURING DIAGNOSTIC OR INHIBITED CONDITIONS

DISPLAY	DESCRIPTION
SELECT Blank	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** light will also be activated.
SELECT Flashing	The flashing of the **SELECT** 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.
Display of Service Indicator (Wrench icon)	This indicator will be displayed to alert the operator 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. It is functional only if Prognostics are enabled in the TCM controls calibration. Refer to paragraph 6.0, Control System Prognostics, for more details.
INIT FAULT	If the TCM does not complete initialization after the ignition switch is moved to the On position, INIT FAULT is displayed. A diagnostic code is associated with this condition.
Blank Display	This condition indicates either lack of power to the selector or the CAN (J1939) Link is failed. Continuous blank indicates loss of power to the selector. If the blank display changes to cat-eyes, other conditions exist. See cat-eye discussion below.
Double Cat-Eyes **(-\- -\-)**	This display indicates a failure of the CAN communication link and is always accompanied by a diagnostic code. The cat-eyes are illuminated in both the **SELECT** and **MONITOR** locations after approximately 12 seconds of blank display.

WARNING! Without the CAN link, the shift selector cannot display the transmission range. Vehicle operation will be affected. Refer to paragraph 4.11.

4.6 FUNCTION OF THE MODE BUTTON

Pressing the **MODE** button requests a function which is specified when the TCM calibration is defined. One of the most common uses of the **MODE** button is to select an alternative shift schedule, as described in 4.8, Transmission Shift Calibrations and Shift Schedules. The **MODE** button is located on the bezel face of lever and keypad pushbutton shift selectors. Refer to Figure B-2, Keypad Selector, and Figure B-5, Lever Selector. This feature is not available with strip pushbutton shift selectors.

When the **MODE** button is pressed, MODE will appear on the selector display as shown in Figure B-6. When the TCM calibration is defined, a more descriptive label may be specified. For example, if the **MODE** button selects an alternative shift schedule, ECONOMY or PERF (for performance) may be selected.

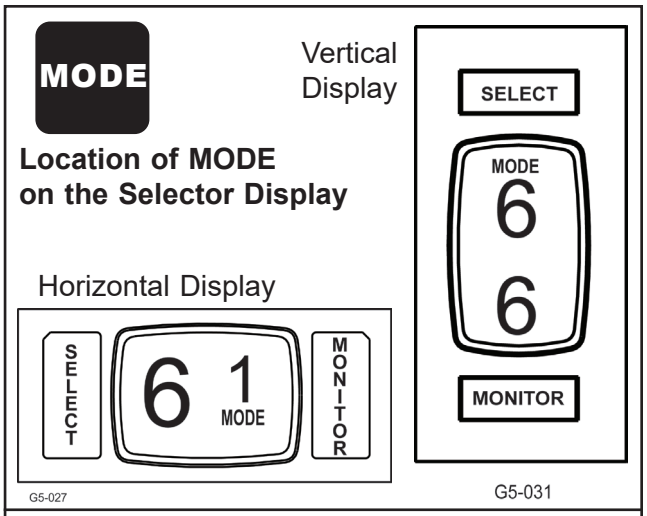


Figure B-6: MODE on the Selector Display

4.7 CONTROL OF THE TRANSMISSION WITH TWO SHIFT SELECTORS

The control system for these transmission families includes the capability to control the transmission from two separate operator stations with a separate selector dedicated to each of the locations. The control system will recognize operator input from only one selector at a time, which is determined by the position of a dash-mounted switch. Installation requirements, including those for the dash switch, are discussed in *Section C: Controls Component Installation* of this manual.

Active selector:
- Display is functional
- TCM responds to operator requests

Inactive selector:
- Display reads SELECTOR INACTIVE
- TCM ignores operator requests

4.8 TRANSMISSION SHIFT CALIBRATIONS AND SHIFT SCHEDULES

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. Available gear ranges and typical shift sequences for each transmission model, including availability of converter or lockup operation in each range, are tabulated in Appendix A-1 (3000 Product Family) and A-2 (4000 Product Family models).

The points at which transmission upshifts and downshifts occur, commonly called shift schedules, are dependent upon predetermined speeds and other operating conditions. The shift calibration which is programmed into each TCM includes several different shift schedules which govern transmission shifting during a variety of specific vehicle operating conditions. Although vehicle performance may be affected when shift schedules change, the actual transition between shift schedules will be transparent to the operator.

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

- Direct operator request via the **MODE** button or a dash switch. For example: performance based shift scheduling in Primary Mode and economy based shift scheduling in Secondary Mode.
- Automatically, as determined by vehicle load or acceleration conditions, if the Dynamic Shift Sensing option is selected when the TCM calibration is defined.
- Indirectly from activation of a non-transmission vehicle component or system which is interlocked with the transmission control system. For example, modified transmission downshift points when an engine brake is in use, which enhances engine brake performance.
- When the operator selects a forward drive gear that is not the highest available gear for the transmission. If the transmission is operating in a higher gear than the newly selected gear, downshifts to that gear will be at higher-than-normal speeds. These are commonly called preselect downshifts. Once the preselected gear has been reached, the upshift speed from that gear, commonly called the hold upshift speed, is increased in order to hold the transmission in that gear and inhibit upshifting.
- Commanded automatically for certain vehicle or transmission configurations when specific operating conditions are encountered. For example, the retarder downshift schedule is enabled when the transmission retarder option is in operation.

Each of the numerous shift schedule types, their typical use, and specialized characteristics are described in *Section A-2: Shift Calibration Familiarization* of this manual.

4.9 INPUT AND OUTPUT (I/O) FUNCTIONS

Each calibration includes the capability for additional functional control of the transmission or vehicle operations using Input, Output, and Interface functions.

An **Input Function** sends discrete vehicle data to the TCM, indicating an operator request or the operating state of another vehicle system. An input function can be activated by one or more of the following methods:

- Operator presses the **MODE** button on the keypad or bump lever selector. For example, pressing the **MODE** button selects secondary mode operation, typically an alternate shift schedule.
- Operator presses a switch. For example, in a dual selector installation, using a switch to select which selector the operator will use to control the transmission.
- Closing or opening a switch in a vehicle control system. For example, a pressure switch in the brake line closes when the service brakes are applied.
- A discrete signal from another controller on the vehicle. For example, the Anti-Lock Brake System (ABS) controller sends a signal when ABS is active.

An **Output Function** sends a discrete signal out of the TCM to indicate a particular operating state of the transmission. Some examples are:

- Indicating that the transmission is in a specific gear range, such as Neutral.
- Indicating that the transmission has attained a specific operating condition, such as exceeding the transmission sump temperature limit.

An **Interface Function** is a combination of Input and Output Functions. Typically, the TCM receives a request via an Input. If defined transmission operating parameters are satisfied, the TCM activates an Output indicating that the requested action can occur. For example, the TCM receives a request that engine brake operation is desired. If the transmission is in lockup and the engine is at closed throttle, the TCM will activate an output allowing engine brake operation.

Various combinations of these functions are assembled into I/O Packages. In many cases, multiple I/O packages have been created for vehicles used in specific vocations. More details on this subject are provided in *Section E: Using Input/Output (I/O) Functions and Packages*.

For detailed descriptions of all of the Input, Output and Interface Functions, refer to *Input and Output (I/O) Functions for 6th Generation Controls*.

Many of the Input, Output and Interface functions may be implemented using SAE J1939 messages. Refer to *Datalink Communications for 6th Generation Controls*.

4.10 SHIFT INHIBITS

When appropriate, the control system will invoke built-in logic to protect against certain types of abusive operation. For example:

- **Engine Speed Inhibit:** This standard feature inhibits neutral-to-range shifts when engine speed is greater than 900 rpm. The TCM indicates that a shift has been inhibited by flashing the range **SELECT** digit on the shift selector. 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 3.0 seconds, the inhibit will self-clear and the requested shift will be commanded. The same 3.0 second grace period is permitted for applications with an enabled Neutral Indicator for PTO output function.

  Neutral-to-Range Assist: In vehicles with Engine Management integration, the **Neutral-to-Range Assist** feature will attempt to reduce the engine speed when the engine speed is greater than the transmission's allowable limit and a shift from 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**: This standard feature inhibits forward / reverse directional changes if one of the following conditions is detected:
  - Appreciable output shaft speed of approximately 225 rpm or higher
  - Throttle position greater than approximately 40%

  The TCM will indicate that the shift is inhibited by flashing the range **SELECT** digit on the shift selector. Engine speed, including a high idle condition, is not considered when determining if a Drive-to-Reverse or Reverse-to-Drive shift should be inhibited.

  If the elevated output speed or throttle position drops below the inhibit threshold within a specified grace period of 3.0 seconds, the inhibit will self-clear and the requested shift will be commanded.

- **Inhibit Rolling Direction Changes**: This optional feature inhibits forward / reverse directional change shifts unless the output shaft speed is nearly stopped, approximately 40 rpm or lower. The TCM will indicate that the shift is inhibited by flashing the range **SELECT** digit on the shift selector. Engine speed, including a high idle condition, is not considered when determining if a Drive-to-Reverse or Reverse-to-Drive shift should be inhibited.

  If the elevated output speed or throttle position drops below the inhibit threshold within a specified grace period of 3.0 seconds, the inhibit will self-clear and the requested shift will be commanded.

  This feature is typically used in vehicles that are geared for relatively low road speed (high N/v ratio), such as street sweepers and dock spotters. This optional feature must be specified when defining the TCM calibration.

- **Transmission Diagnostic Active Inhibit**: During certain diagnostic events, the transmission will limit operation to appropriate operational states for the response action.

- **Transmission Cold Operation Inhibit**: Available transmission ranges may be temporarily limited in cold operating conditions until the transmission sump temperature increases.

These inhibits are designed to protect the transmission in the event of abusive operation. They should not be regarded as replacements for safety interlocks which restrict vehicle operation during the use of auxiliary equipment or other specialized vehicle functions. To create a positive inhibit that will prevent these shifts from occurring in these circumstances, *Input Function E: Auxiliary Function Range Inhibit*, must be used.

NOTE: Depending on the engine control logic, an operator request for a Neutral-to-Drive or Neutral-to-Reverse shift may cancel an engine high-idle condition via the J1939 ETC2 Transmission Selected Gear parameter. This is true whether the high idle was the result of an engine regen cycle, a PTO-cruise condition, or any other general high-idle operation. Refer to *Datalink Communications*.

4.11 OPERATION DURING A CAN LINK FAILURE

In the event of loss of the CAN communications link, limited communication between the TCM and Allison CAN-based shift selectors continues through the Direction Signal wire 134. This limited communication permits the operator to select the operating direction (Drive, Neutral, or Reverse) in order that the vehicle may be driven to a service location. Operator requests for range upshifts and downshifts will not be recognized. The shift selector will not display the transmission range due to the lack of CAN signal. Instead, the selector will display cat eyes (-\- -\-).

WARNING! Assuming proper installation of Direction Signal wire 134, Allison shift selectors may still be used to command transmission direction changes in these circumstances. Due to the failure of the CAN communication, however, the shift selector cannot display the transmission 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. The operator must be advised of this limitation in the vehicle operating instructions.

5.0 OIL LEVEL SENSOR (OLS)

Most transmission models are equipped with an electronic oil level sensor (OLS) as standard equipment. Refer to *Features and Options* for the *3000 Product Family* or the *4000 Product Family* to determine if the OLS is available with your transmission model. The OLS is designed to measure transmission oil level only when the vehicle is on a level surface. In addition, the following specific combination of operating conditions must be met:

- Engine must be at idle
- Neutral must be selected
- Output speed must be zero
- Transmission sump oil must be within an operating temperature band of 40º–104º C (104º–220º F)
- The transmission must meet all four conditions for 2 minutes to facilitate consistent oil drain back.

After the 2 minute waiting period has passed, oil level measurement and readout may be initiated.

For the keypad pushbutton and bump lever selectors oil level measurement is initiated as follows:

- Keypad pushbutton selectors: simultaneously press the **UPSHIFT** and **DOWNSHIFT** arrows on the selector
- Bump lever selectors: depress the button with the Allison logo

The display provision of the keypad pushbutton selector and the bump lever selector is used to indicate oil level status to the operator. For installations with strip pushbutton selectors the oil level status may be displayed in an auxiliary vehicle dash display using SAE J1939 messages broadcast by the TCM; refer to *Datalink Communications* for details.

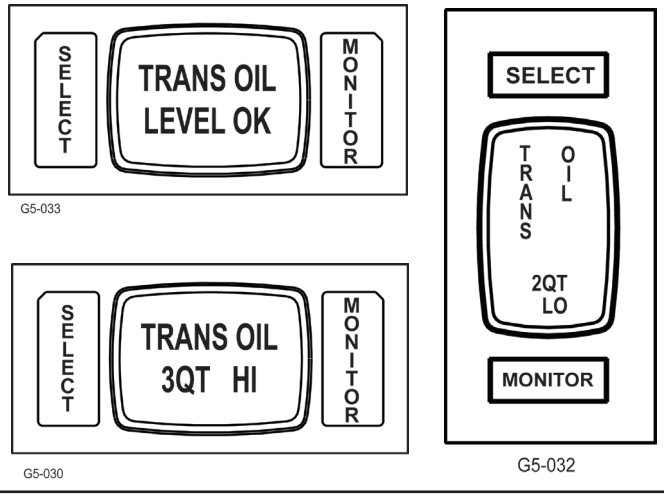


Figure B-7: Examples of Oil Level Display – Keypad and Bump Lever Selectors

The display indicates the oil level as follows:

- TRANS OIL LEVEL OK
- TRANS OIL [number of quarts] LO
- TRANS OIL [number of quarts] HI

Refer to Figure B-7 for examples.

If the fluid level check cannot be completed the display will indicate “READING OIL LEVEL”. After 2 seconds, one of the following oil level display faults will appear on the display:

- SETTLING [time remaining until settling is complete]
- ENG RPM TOO LO
- ENG RPM TOO HI
- MUST BE IN NEUTRAL
- OIL TEMP TOO LO
- OIL TEMP TOO HI
- VEH SPD TOO HI
- SENSOR ERROR (may be speed sensor, temperature sensor, oil level sensor or throttle sensor)

Refer to Figure B-8 for examples of the Oil Level Display Faults

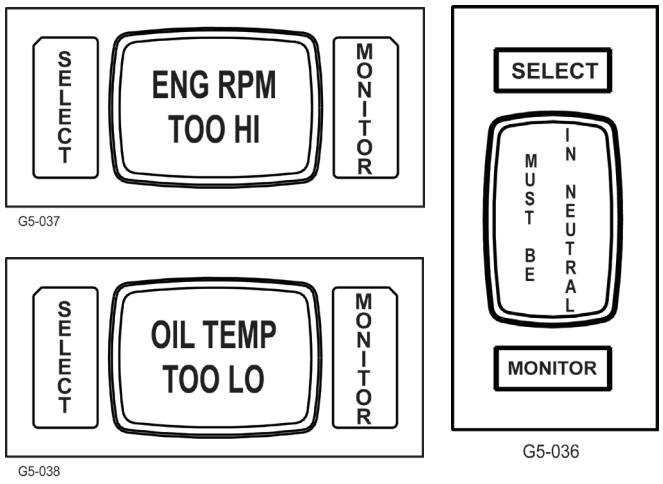


Figure B-8: Examples of OLS Display Faults – Keypad and Bump Lever Selectors

The following methods may be used to exit the oil level display mode and enter the transmission prognostics mode (paragraph 6.0) or diagnostic mode (paragraph 7.0):

- For keypad pushbutton selectors – simultaneously press the **UPSHIFT** and **DOWNSHIFT** arrows
- For bump lever selectors – press the Allison logo button

If D, N, R, or L (bump lever only), are selected on the shift selector, the OLS mode will abort and normal transmission operation will commence. Shifts are not inhibited.

6.0 CONTROL SYSTEM PROGNOSTICS

This feature of the transmission system provides a constant monitor of the following transmission operating parameters when available in the TCM calibration and enabled:

- Oil Life (paragraph 6.1)
- Fluid Filter Life (paragraph 6.2)
- Transmission Health (paragraph 6.3)

If Prognostics is available (Defaulted Off) in the TCM calibration, Prognostics can be enabled in one of the following ways:

- When the TCM calibration is defined
- With the *Allison DOC®* program
- With the shift selector if allowed in the calibration via Prognostic: Allow Enable/Disable via Shift Selector:
  - Set the vehicle brakes to prevent movement of the vehicle.
  - Move the shift selector through the following sequence of range positions:
    N-D-N-R-N-D-N-R-N-D-N-R-N *
  - Pause no more than three (3) seconds between consecutive shifts

*** 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 permitted only in the shift mode with the highest maximum allowable range.**

Additionally, individual Prognostics operating parameters have independent enable/disable options in the controls calibration – switch on or off as specified by the customer. All Prognostics operating parameters, Oil Life, Fluid Filter Life, and Transmission Health are defaulted to enabled when Prognostics is enabled.

If so desired, Prognostics may be disabled using Allison DOC® or the selector if allowed.

Once the Prognostics feature has been enabled, the transmission operating parameters can be monitored by the system.

- Oil Life Monitor — See paragraph 6.1.
- Filter Life Monitor — See paragraph 6.2.
- Transmission Health Monitor — See paragraph 6.3.

When a specified threshold is detected for any of the serviceable conditions, the **TRANS SERVICE** indicator is displayed to alert the operator. Refer to 6.4, Trans Service Indicator. The **TRANS SERVICE** indicator is integral to the display on the Allison keypad pushbutton and bump lever selectors. The **TRANS SERVICE** indication is also available for a J1939-based dash display.

NOTE: The strip pushbutton selectors do not have integral displays. Therefore, if the transmission Prognostics are functional, a J1939-based dash display is required for installations with a strip pushbutton selector.

The dash display and its interface to the J1939 communication network are supplied and installed by the vehicle builder.

NOTE: In the discussions which follow, the term TRANS SERVICE indicator refers to the icon in the shift selector display or the dash display, depending upon the vehicle configuration.

6.1 TRANSMISSION OIL LIFE MONITOR

The display message indicates the calculated remaining life of the transmission fluid. This value is based on the established life for the required baseline fluid. The value is continuously adjusted for cumulative effects of such operating parameters as operating time, retarder operation, output shaft revolutions, and shift frequency.

Display: The display shows the percentage of the fluid life which remains.
New fluid is displayed as: OIL LIFE 99%

TRANSMISSION SERVICE Condition: When the remaining fluid life reaches approximately 1–2%, the **TRANS SERVICE** indicator will be displayed, indicating that the transmission fluid must be changed. The indicator will be displayed upon each initialization of the TCM, and will remain steadily displayed for approximately 1–2 minutes after the initial selection of a drive range. The **TRANS SERVICE** indicator will continue to be displayed until service is performed and the indicator is reset.

Failure to perform maintenance and reset the **TRANS SERVICE** indicator within a defined period will result in the illumination of the **CHECK TRANS** light. Any time the **CHECK TRANS** has been illuminated, the TCM will register a diagnostic code. Diagnostic codes may be recalled using the *Allison DOC®* diagnostic program. Diagnostic codes are discussed further in 7.3, Diagnostic Codes, and tabulated in Appendix B.

Reset: The **TRANS SERVICE** indicator can be reset by one of the following methods:

- Using the *Allison DOC®* diagnostic program
- Depressing and holding the **MODE** button for ten (10) seconds if allowed in the calibration via Prognostics: Allow Reset via Shift Selector Mode Button.
- Selecting N-D-N-D-N-R-N * on the shift selector with the ignition on, the engine not running, and the brakes applied if allowed in the calibration via Prognostics: Allow Enable/Disable via Shift Selector Sequence. Pause less than 3 seconds between each selector movement.
- Sending a message over the SAE J1939 communication interface if allowed in the calibration via Prognostics: Allow Reset via J1939 Command. Refer to *Datalink Communications*.

*** NOTE: If the shift calibration permits a maximum allowable gear in primary mode that is different than the maximum allowable gear in secondary mode, resetting the TRANS SERVICE indicator is permitted only in the shift mode with the highest maximum allowable range.**

More details are provided in applicable Allison service literature for your specific transmission model.

History: A historical record of the last six resets, including mileage at the time of each reset, may be viewed using the *Allison DOC®* diagnostics program.

NOTE: Required calendar-based fluid change intervals are not monitored by this feature and remain applicable to all vehicle installations in addition to the above.

6.2 TRANSMISSION FILTER LIFE MONITOR

The display message indicates the operating status of the transmission main fluid filter. The feature is not functional at transmission sump temperatures below 40º C (105º F).

Display: An acceptable filter life status is displayed as FILTERS OK.
An unacceptable filter life status is displayed as REPLACE FILTERS.

TRANSMISSION SERVICE Condition: Once the filter has reached the end of its designed life, the transmission controls will record a diagnostic code. The **TRANS SERVICE** indicator will flash for approximately 1–2 minutes after the initial selection of a drive range, until service is performed and the indicator is reset.

For 6-speed models, the diagnostic code will be recorded when the maximum pressure drop across the filter has been reached. For 7-speed models, the diagnostic code is set based on time and mileage parameters.

After a calibration-defined number of warnings, failure to perform maintenance and to reset the monitor will result in the illumination of the **CHECK TRANS** light. The TCM will register an additional diagnostic code.
Diagnostic codes may be recalled using the *Allison DOC®* diagnostic program. Refer to 7.3, Diagnostic Codes, and Appendix B.

Reset: The **TRANS SERVICE** indicator can be reset by one of the following methods:
- Using the *Allison DOC®* diagnostic program
- Depressing and holding the **MODE** button for ten (10) seconds if allowed in the calibration via Prognostics: Allow Reset via Shift Selector Mode Button.
- Selecting N-R-N-R-N-D-N * on the shift selector with the ignition on, the engine not running, and the brakes applied if allowed in the calibration via Prognostics: Allow Enable/Disable via Shift Selector Sequence. Pause less than 3 seconds between each selector movement.
- Sending a message over the SAE J1939 communication interface if allowed in the calibration via Prognostics: Allow Reset via J1939 Command. Refer to *Datalink Communications.*

*** NOTE: If the shift calibration permits a maximum allowable gear in primary mode that is different than the maximum allowable gear in secondary mode, resetting the TRANS SERVICE indicator is permitted only in the shift mode with the highest maximum allowable range.**

More details are provided in applicable Allison service literature for your specific transmission model.

For 6-speed models, the feature will reset automatically if the control main fluid filter has been changed. After specified period of normal transmission operation, the controls detect that the pressure drop across the filter no longer exceeds the threshold value.

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

NOTE: Required calendar-based filter change intervals are not monitored by this feature and remain applicable to all vehicle installations in addition to the above.

6.3 TRANSMISSION HEALTH MONITOR

The display message indicates clutch life status, as determined by monitored changes and the calculated running clearance of the transmission clutches.

Display: An acceptable clutch life status is displayed as TRANS HEALTH OK
An unacceptable clutch life status is displayed as TRANS HEALTH LO
If transmission shifts have not adapted, the display reads TRANS HEALTH NA

TRANSMISSION SERVICE Condition: The **TRANS SERVICE** indicator will be displayed when the remaining clutch life reaches approximately 10%, or if the running clearance exceeds a maximum value due to a non-wear-related issue. The indicator will be displayed upon initialization of the TCM, and will remain steadily displayed at all times.

Reset: The feature can only be reset using the *Allison DOC®* diagnostics program.

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

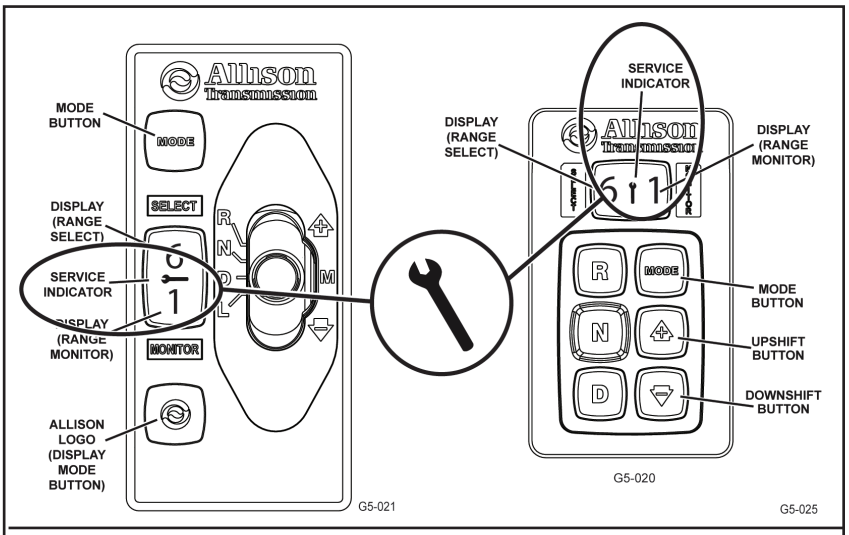
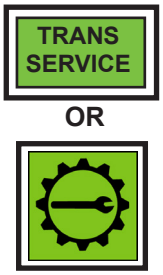


Figure B-9: TRANS SERVICE Indicator on Shift Selectors

6.4 TRANS SERVICE INDICATORS



The **TRANS SERVICE** indicator is displayed when a specified threshold has been reached for the transmission oil, filter or clutches. The purpose of the **TRANS SERVICE** indicator is to alert the vehicle operator that a transmission service condition exists. The **TRANS SERVICE** indicator is displayed differently for each of the three service conditions, as described above. Two types of indicators are possible, as noted in the following paragraphs.

6.4.1 TRANS SERVICE INDICATOR ON SHIFT SELECTORS

A wrench icon between the Select and Monitor displays on the face of the selector serves as the **TRANS SERVICE** indicator on the keypad pushbutton and bump lever shift selectors. Refer to Figure B-9.

This feature is not available with the Allison strip pushbutton selectors, which do not have a display. Therefore, vehicle installations which utilize the Prognostics features and are equipped with a strip pushbutton selector must be equipped with a separate dash-mounted indicator as described in paragraph 6.4.2.

6.4.2 TRANS SERVICE INDICATOR LIGHT

Vehicle installations with strip pushbutton selectors must be equipped with a separate **TRANS SERVICE** indicator light in order to use the Prognostics features.

If desired as a redundant operator alert, this indicator light may also be installed in vehicles equipped with the Allison bump lever or keypad pushbutton selectors. Refer to paragraph 6.4.1 for details regarding the selector-based service indicator.

When used, the separate **TRANS SERVICE** indicator is supplied and installed by the vehicle builder. The **TRANS SERVICE** indicator may be implemented in either of two ways:

- An SAE J1939-based vehicle controller activates a dedicated **TRANS SERVICE** dash light as directed by the SAE J1939 message broadcast by the TCM. Examples of recommended light configurations are illustrated at the right.

- SAE J1939 messages broadcast by the TCM are used for an informational text display in the dash. A standard red or amber SAE warning light may be used in conjunction with the text display, but is not required.

The J1939-based controller which physically actuates this light must perform a bulb check or functionality check at the beginning of each ignition (key switch) cycle. Refer to *Datalink Communications* documentation for additional information and requirements.

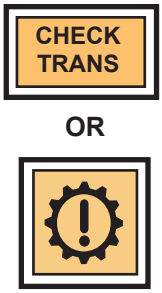
7.0 CONTROL SYSTEM DIAGNOSTICS

Diagnostic features are provided with the transmission control system to assist in troubleshooting of malfunctions and the monitoring of specific operating parameters. Features include a **CHECK TRANS** light at the operators station and the PC-based *Allison DOC®* diagnostic program. When a control system malfunction is detected, a series of diagnostic codes are used to identify and clarify the nature of the malfunction.

NOTE: Transmissions using Allison 6th Generation Controls typically are not compatible with industry On-Board Diagnostics II (OBDII) requirements. If your vehicle must satisfy these requirements, contact your Allison representative.

7.1 CHECK TRANS LIGHT

The **CHECK TRANS** light is usually located on the instrument panel and may be controlled either by hardwiring to the TCM (wire 129) or by messages over the vehicle communications datalink.



After start-up, illumination of the light indicates that a problem has been detected and that shifts may be restricted. Depending upon the severity of the problem, operation may continue in order to reach service assistance.

WARNING! When this light is illuminated, the TCM may not respond to shift selector requests, since operating limitations are being placed on the transmission. Direction changes may not occur.

Any time this light has been illuminated, the TCM will register a diagnostic code, which may subsequently be recalled using the *Allison DOC®* diagnostic program. Refer to *Section D: Vehicle Electrical System Interface* of this manual for details relating to installation of the **CHECK TRANS** light using the wire 129 interface. If wire 129 is used to illuminate this indicator light, the TCM will illuminate the light briefly as a bulb check at TCM power-up.

If illumination of the light is controlled by the vehicle communications datalink, the controller which physically actuates this light must perform a bulb check or functionality check at the beginning of each ignition key switch cycle. Refer to *Datalink Communications* documentation for additional information and requirements.

7.2 ALLISON DOC® DIAGNOSTIC PROGRAM

Control system diagnostics are provided with *Allison DOC®*, a Windows-based interface software program. *Allison DOC®* is available through Allison service tool sources. The purpose of the program is to assist in the installation checkout and the troubleshooting of malfunctions as detected by the TCM. It may also be used to modify certain customer-modifiable parameters, including the selected Input/Output Function package. Operating instructions are supplied with the software.

For source information, refer to *Section F: Controls Support Equipment* of this manual.

7.3 DIAGNOSTIC CODES

Illumination of the **CHECK TRANS** light at any time after the start-up bulb check indicates that the TCM has registered a diagnostic code. As many as five codes may be recorded in memory, listed in the order of newest to oldest. Diagnostic codes may be accessed through *Allison DOC®* or by displaying the codes on the display of the Alison keypad or bump lever selector. Codes may be displayed at any transmission output shaft speed. For a complete description of the diagnostics and a step-by-step procedure for the use of *Allison DOC®*, consult the Troubleshooting Manual.

The process for displaying diagnostic codes on the selector display depends upon the style of the shift selector:

- Keypad pushbutton selectors: simultaneously press the **UPSHIFT** and **DOWNSHIFT** arrows on the selector
- Bump lever selectors: depress the button with the Allison logo

Once the display mode has been initiated:

- If the transmission is equipped with an oil level sensor, the fluid level is displayed first.
- If Prognostics functions are enabled in the TCM controls calibration, the Prognostics readouts are displayed next.
- Diagnostics codes are then displayed. Each code remains on the display until the next code, if present, is accessed by depressing the **MODE** button. Active codes are displayed first, newest to oldest, followed by any inactive codes that are still in memory.
  - An active code is displayed as: P0730 ACTIVE
  - An inactive code is displayed as: P071D INACTIVE

Any of the following methods may be used to exit the diagnostic display mode:

- With keypad pushbutton shift selectors: Simultaneously depress the **UPSHIFT** and **DOWNSHIFT** arrows or press any range button, D, N, or R. If the shift is not inhibited by an active code, the TCM will command the transmission to shift to the selected range.
- With bump lever shift selectors: Momentarily press the Allison logo button or move the shift selector to any shift position other than the one selected when the diagnostic display mode was activated. If the shift is inhibited due to a service condition, the TCM will continue to command the current transmission range attained and the bump lever should be returned to its previous position.
- Wait until time-out, approximately ten minutes. The system will automatically return to the normal operating mode.
- Turn off the vehicle engine with the ignition switch, which turns off power to the TCM.

After a fixed number of ignition cycles, a diagnostic code will automatically disappear from memory if it has not reoccurred. Ignition cycle counts, which indicate the age of a stored code, and event counts, which indicate the frequency of code occurrence, are available for reference – but accessible only with *Allison DOC®*.

For a complete listing of 3000/4000 Family transmission diagnostic codes see the *Diagnostic Communication for OEM Use* section of the *Datalink Communications for Allison 6th Gen Controls* document.

8.0 OPERATION OF THE RETARDER

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 serves to extend the life of the service brakes and to enhance vehicle control.

When the retarder is On a special retarder mode shift schedule is activated as shown in Figure B-10. The retarder shift schedule incorporates raised closed throttle downshifts for additional cooling.

The actual amount of retardation is controlled by the operator and will depend on the type of retarder control used in the vehicle. Various hand, foot and automatic control techniques are used as described in *Technical Document 175 (TD-175), Guidelines for Selecting Retarder Controls*. This same document includes a guidelines regarding installation of the retarder enable switch.

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

As the vehicle approaches a stop, the retarder automatically disengages. The output shaft speed at which this disengagement occurs is shown in Figure B-10.

	Transmission Output Shaft Speed	
	Normal Conditions	**Sump Temperature Above 121° C (250° F)**
Speed that enables retarder shift schedule	375 rpm	475 rpm
Speed that disables retarder operation		
Close Ratio Models	215 rpm	450 rpm
Wide Ratio Models	165 rpm	450 rpm

Figure B-10: Retarder Shift Schedule and Disengagement Speeds

8.1 RETARDER CAPACITY REDUCTION AND PRESELECT DOWNSHIFTS

NOTE: In the event of excessively high temperatures in the transmission fluid or engine coolant during retarder operation, vehicle operation may be affected by the following:
- **The retarder preselect downshift schedule may be invoked**
- **The maximum available retarder capacity may be reduced**

The preselect downshift schedule will be invoked and/or retarder capacity will be reduced if the following temperatures exceed specified limits:
- Transmission retarder-out temperature - invokes preselect downshifts and capacity reduction
- Transmission sump temperature - invokes capacity reduction

In addition, the preselect downshifts can be invoked and retarder capacity reduced if the engine coolant temperature exceeds specified limits. The TCM can receive the engine coolant temperature input from two sources:
- A message broadcast over the SAE J1939 datalink
- An engine coolant temperature sensor which provides an analog input signal to the TCM on wire 135. This sensor is supplied and installed by the vehicle builder.

NOTE: The source of the engine coolant temperature must be specified when the TCM calibration is defined.

BASED ON RETARDER TEMPERATURE

Refer to Figure B-11. If the retarder temperature exceeds 143º C (290º F), the TCM will raise the closed throttle downshift points by invoking the preselect downshift schedule. Use of the preselect downshift schedule forces downshifts to occur at higher than normal road speeds, which increases engine speeds. Higher engine speeds increase the coolant flow through the transmission cooler and the engine radiator.

If the retarder temperature exceeds 152º C (305º F) or RETARDER: Retarder Temperature Based Reduction Threshold 1, retarder capacity will begin to be reduced. Capacity reduction will continue until it is reduced to approximately 596 Nm. For retarder performance curves, refer to the Transmission Data documents for the *3000* and *4000* Product Families.

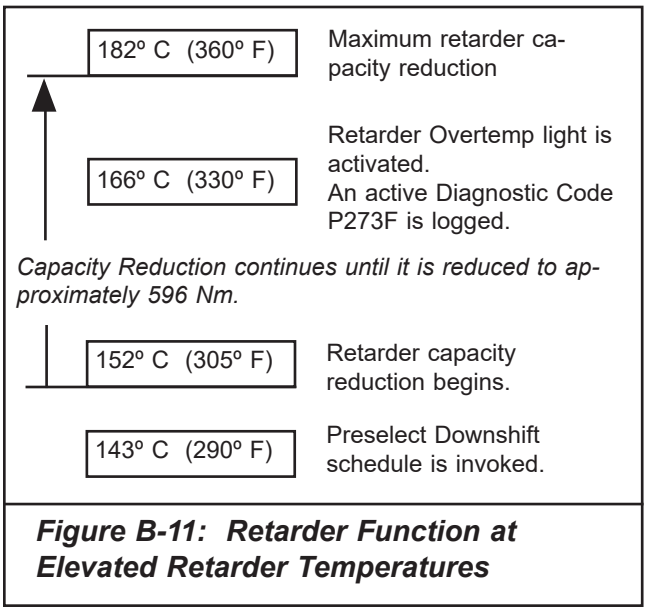


Figure B-11: Retarder Function at Elevated Retarder Temperatures

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

If the retarder temperature exceeds 166º C (330º F) or RETARDER: Retarder Temperature Based Reduction Threshold 2, the retarder temperature indicator output will be activated. This illuminates a retarder over-temperature light which alerts the operator of excessive retarder temperature. The retarder temperature light will be deactivated when the retarder temperature drops below 166º C (330º F) or RETARDER: Retarder Temperature Based Reduction Threshold 2.

If the retarder temperature remains above 166º C (330º F) or RETARDER: Retarder Temperature Based Reduction Threshold 2 for ten consecutive seconds, an active diagnostic code will be logged by the TCM. When the temperature drops and remains below 166º C (330º F) or RETARDER: Retarder Temperature Based Reduction Threshold 2 for ten consecutive seconds, the code will become inactive and will be stored in memory.

BASED ON TRANSMISSION SUMP TEMPERATURE

Independently of the retarder temperature, if the transmission sump temperature exceeds 117º C (240º F) or RETARDER: Retarder Temperature Based Reduction Threshold 1, retarder capacity will similarly be reduced as described above.

The over-temperature indicator is activated and the over-temp diagnostic code is logged if the sump temperature exceeds 121º C (250º F) or RETARDER: Retarder Temperature Based Reduction Threshold 2 for fifteen (15) minutes, exceeds 128º C (262º F) for more than one minute, or instantaneously reaches 132º C (270º F).

BASED ON ENGINE COOLANT TEMPERATURE

If optional engine coolant capacity reduction or preselect downshifts are used, similar responses occur based on excessive engine coolant temperature. Parameters which define the logic and characterization of the capacity reduction are shown in Figure B-12. These parameters may be specified when the TCM calibration is defined.

Allison DOC® (V5.0 or later) can be used to enable or disable the engine coolant temperature-based capacity reduction feature. It can also be used to set two of the parameters listed in Figure B-12:

- Engine coolant temperature threshold at which the retarder auto-preselect shift schedule is invoked
- Engine coolant temperature threshold at which retarder capacity reduction begins

However, the rate slope of retarder capacity reduction must be specified when the TCM calibration is defined. The slope of retarder capacity reduction cannot be modified with the *Allison DOC®* program. This parameter defines the amount of retarder capacity reduction, expressed as a percentage of its programmed maximum, as a function of the coolant temperature.

RETARDER PARAMETERS	UNITS
Engine Coolant Temperature-Based Capacity Reduction	On / Off
Engine Coolant Temperature-Based Capacity Slope	% torque/ºC
Engine Coolant Temperature-Based Capacity Threshold	ºC
Engine Coolant Temperature-Based Preselect Threshold	ºC

Figure B-12: Retarder Capacity Reduction Factors Based on Engine Water Temperature

Retarder capacity begins to be reduced from the maximum programmed capacity level when engine coolant reaches the selected coolant temperature limit. The capacity will be reduced at the rate slope specified in the TCM calibration. Retarder capacity will continue to be reduced at this rate until one of the following occurs:

- The retarder is operating at approximately 596 Nm. For retarder performance curves, refer to the Transmission Data documents for the *3000* and *4000* Product Families.
- The retarder is deactivated by the operator or by vehicle operating conditions which eliminate the need for retardation.
- Engine coolant temperature is returned to a level that does not invoke the capacity reduction.

Refer to Figure B-13 for graphical representations of the default values for both Standard and Low capacity reduction characterizations, plus an illustration of custom capacity reduction values.

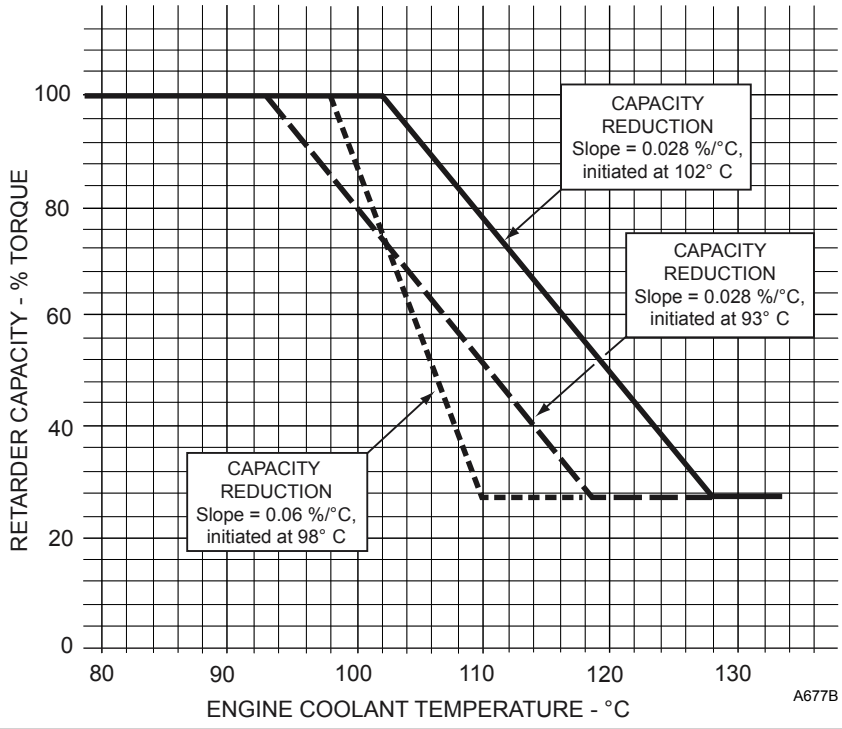


Figure B-13: Examples of Retarder Capacity Reduction Based on Engine Water Temperature

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

8.2 RETARDER / CRUISE CONTROL INTERACTIONS

Three optional control features affect retarder operation when the vehicle is equipped with cruise control:

Feature 1, RETARDER: Cancel Retarder when Cruise Control is Active

This feature applies only to electronic engines that communicate with the transmission on the SAE J1939 datalink. This feature must be specified On or Off when TCM calibration is defined. Feature 1 is not compatible with Feature 3. Feature 3 must be disabled when Feature 1 is used. If the feature is On in the calibration, the TCM prohibits retarder operation when cruise 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 when the throttle is closed.

If the feature is Off in the calibration or the engine is not electronic, the TCM will command 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 upon Rapid Modulation Request Increase

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 requested level of retardation is changed. This operation emulates the effect of applying the service brakes. Feature 2 is an optional feature that must be specified when the TCM calibration is defined.

Feature 3, RETARDER: Enhanced Speed Control
This feature applies only to electronic engines that communicate with the transmission controller over the SAE J1939 datalink. Feature 3 is not compatible with Feature 1. Feature 1 must be disabled when Feature 3 is used. This feature allows the retarder to be applied and modulated automatically when the vehicle is going down hill with cruise active and speed set, or Road Speed governor active, and the vehicle speed exceeds the limit of either of those features by a calibration amount. The retarder will operate based on thresholds defined in the TCM calibration. If the operator increases the retarder request more than a calibrated amount over the initially set RMR level, the Enhanced Speed Control will be deactivated and the retarder will increase to match the operator's request. Feature 3 is an optional feature that must be specified when the TCM calibration is defined.

NOTE: The vehicle OEM may have to decouple the service brake status and retarder active indicator as cruise control inputs. Activating the brake lights when the retarder is applied during Enhanced Speed Control operation is optional.

Assuming SAE J1939 EEC2 Engine Percent Load at Current Speed is present in cruise mode, the following describes additional information about the use of the above features:

Configuration A. If the retarder is activated by the brake pedal **without** auto apply, neither Feature 1 or Feature 2 is required.

Configuration B. If the retarder is activated by the brake pedal **with** auto apply:
- Feature 1 keeps the retarder Off during cruise operation when the engine percent load is zero.
- Feature 2 would have no effect because depressing the brake pedal will turn off cruise anyway. Therefore, it doesn't matter if Feature 2 is turned On or Off.

Configuration C. If the retarder is activated by a lever, it will auto apply at the appropriate level according to the retarder lever position when throttle reaches 0%.
- **Using Feature 1 and Feature 2** - Feature 1 will keep the retarder Off during cruise operation when the engine percent load goes to zero. If Feature 1 has already prevented the auto apply and the engine percent load is still at zero, Feature 2 will cause the retarder to come on and disable cruise if the lever is moved to increase retarder capacity during cruise operation.
- **Using Feature 1 without Feature 2** - Feature 1 will keep the retarder Off during cruise operation when the engine percent load goes to zero. Since Feature 2 is not used, the retarder will never come on when cruise is active.
- **Using Feature 2 without Feature 1** - Feature 2 can be used to cancel cruise control by increasing Retarder Modulation Request (RMR) when cruise is active and percent engine load (throttle) is **greater than** 0%.
- **Not Using Feature 1 or Feature 2** - If Feature 1 is not used, the retarder will apply anytime engine percent load goes to zero. This will also cancel cruise every time. Therefore Feature 2 is not required to cancel cruise control.

Configuration D. If the retarder is activated with a retarder pedal:
- There is no auto-On and therefore, Feature 1 is not required. Feature 2 is also not required because cruise will be cancelled anytime the retarder pedal is used. Refer to *Input Z: Retarder Enable*.

9.0 SPECIAL USES – COOLING TESTS

A transmission cooling test typically requires operation of the vehicle until the transmission and engine fluid temperatures stabilize. During this extended period of operation, the transmission must be in converter mode with lockup disabled. Due to the output torque transmitted during this type of operation, it is normally desirable to run the test in a higher gear range – in which converter operation is not normally used.

3000/4000 Family transmissions require a TCM with a special calibration for cooling tests. The special calibration starts the transmission in a higher gear in converter mode. By using the special calibration, the cooler flow in third and fourth converter will be less than the cooler flow shown in 3000/4000 Product Family Transmission Data.

APPENDIX A-1: TYPICAL SHIFT SEQUENCES – 3000 PRODUCT FAMILY

Shifter Position	Ranges Available	Usage
All Models except Seven-Speed Models		
R	Reverse Converter	Backing the vehicle.
N	Neutral	Starting engine and stationary operation.
D *	1C-2C-2L-3L-4L-5L-6L	Normal driving.
5 *	1C-2C-2L-3L-4L-5L	When road conditions, load, or traffic conditions make it desirable to restrict automatic shifting to a lower range. **
4 *	1C-2C-2L-3L-4L	
3 *	1C-2C-2L-3L	
2 *	1C-2C-2L	
1	1C-1L	Pulling through mud and snow and braking on very steep downgrades.
Seven-Speed Models		
R	Reverse Converter	Backing the vehicle.
N	Neutral	Starting engine and stationary operation.
D	2C-3C-3L-4L-5L-6L-7L	Normal driving.
6	2C-3C-3L-4L-5L-6L	When road conditions, load, or traffic conditions make it desirable to restrict automatic shifting to a lower range. **
5	2C-3C-3L-4L-5L	
4	2C-3C-3L-4L	
3	2C-3C-3L	
2	2C-2L	
1	1C-[1L] ***	Pulling through mud and snow and braking on very steep downgrades.

* If configured with the second gear start option, the transmission will start in second gear in these ranges. If configured with Optional 1st Lockup for Buses, available ranges will be 1C-1L-2C-2L... Availability is limited; refer to *Allison 6th Generation Controls Section A-2: Shift Calibration Familiarization*.

** Lower ranges provide greater engine braking for going down grades – the lower the range, the greater the breaking effect. Always select lower ranges when using the retarder or engine brake to descend grades.

*** Lockup is available only at wide open throttle.

APPENDIX A-2: TYPICAL SHIFT SEQUENCES – 4000 PRODUCT FAMILY

Shifter Position	Ranges Available	Usage
All Models except Seven-Speed Models		
R	Reverse Converter	Backing the vehicle.
N	Neutral	Starting engine and stationary operation.
D *	1C-2C-2L-3L-4L-5L-6L	Normal driving.
5 *	1C-2C-2L-3L-4L-5L	When road conditions, load, or traffic conditions make it desirable to restrict automatic shifting to a lower range. **
4 *	1C-2C-2L-3L-4L	
3 *	1C-2C-2L-3L	
2 *	1C-2C-2L	
1	1C-1L	Pulling through mud and snow and braking on very steep downgrades.
Seven-Speed Models		
R	Reverse Converter, [2nd Reverse***]	Backing the vehicle.
N	Neutral	Starting engine and stationary operation.
D	2C-3C-3L-4L-5L-6L-7L	Normal driving.
6	2C-3C-3L-4L-5L-6L	When road conditions, load, or traffic conditions make it desirable to restrict automatic shifting to a lower range. **
5	2C-3C-3L-4L-5L	
4	2C-3C-3L-4L	
3	2C-3C-3L	
2	2C-2L	
1	1C-[1L] ****	Pulling through mud and snow and braking on very steep downgrades.

* If configured with the second gear start option, the transmission will start in second gear in these ranges. If configured with Optional 1st Lockup for Buses, available ranges will be 1C-1L-2C-2L... Availability is limited; refer to *Allison 6th Generation Controls Section A-2: Shift Calibration Familiarization*.

** Lower ranges provide greater engine braking for going down grades – the lower the range, the greater the breaking effect. Always select lower ranges when using the retarder or engine brake to descend grades.

*** Availability of 2nd Reverse is limited. Refer to *TD191, Application and Installation Requirements for 2nd Reverse with Allison 6th Generation Controls*.

**** Lockup is available in standard shift calibrations. Calibrations without lockup in this range are available upon request.

APPENDIX B: CROSS-REFERENCE
WIRE NUMBER TO CONTROL FUNCTION

– 3000/4000 PRODUCT FAMILIES –

WIRE NO.	FUNCTION
101	Input Function (–)
102	Input Function (+)
103	Digital Signal Return
104	Output Function (–)
105	Output Function (–)
106	CAN2 High
107	CAN1 Termination
108	CAN1 Low
109	Battery Ground
110	Battery Power
111	PCS 4 & Mod Main Solenoid (+) (6-speed models)
111	PCS 4, PCS 6, & Mod Main Solenoids (+) (7-speed models)
112	Reference Voltage (+5 v)
113	Output Function (–)
114	Not used
115	Retarder Solenoid (PCSS) (–) (retarder models)
115	Differential Lock (PCSS) (–) (3000 7-speed models)
116	Oil Level
117	Input Function (–)
118	Filter Delta P (6-speed models)
118	not used (7-speed models)
119	Retarder Accumulator Solenoid (–) (6-speed models)
119	Shift Solenoid 2 (–) (7-speed models)
120	Turbine Speed (–)
121	ABS (–)
122	Input Function (–)
123	Input Function (+)
124	Output Function (–)
125	Speedometer (non zero crossing)
126	CAN2 Termination
127	CAN2 Low
128	CAN1 High
129	Check Trans (–)
130	Output Function (+)
131	TCC, Retarder & Retarder Accumulator Solenoids (+) (6-speed models)
131	TCC & Diff Lock Solenoids, Shift Solenoid 2 (+) (3000 7-speed models)
131	TCC & Retarder Solenoids, Shift Solenoid 2 (+) (4000 7-speed models)
132	CAN3 High
133	Pressure Control Solenoid 3 (–)
134	Direction Signal (Allison J1939 Shift Selectors Only)
135	Engine Water Temperature
136	Pressure Control Solenoid 1 (–)

WIRE NO.	FUNCTION
137	TCC Solenoid (–)
138	Not used
139	Engine Speed (–)
140	Output Speed (–)
141	Crank Enable (+)
142	Input Function (–)
143	Input Function (+)
144	PWM Throttle
145	Output Function (–)
146	CAN3 Shield
147	not used
148	CAN1 High
149	CAN1 Shield
150	Output Function (–)
151	Shift Solenoid 1 (–)
152	Pressure Control Solenoid 2 (–)
153	Not used
154	Sump Temperature
155	Pressure Control Solenoid 4 (–)
156	Retarder Modulation Request
157	Input Function (–)
158	Analog Return
159	Engine Speed (+)
160	Output Speed (+)
161	Input Function (–)
162	Input Function (–)
163	Ignition Power
164	Output Function (–)
165	Reverse Warning (–)
166	CAN2 High
167	CAN2 Shield
168	not used
169	Battery Ground
170	Battery Power
171	PCS 1, PCS 2, PCS 3, and Shift Solenoid 1 (+)
172	CAN3 Low
173	Not used
174	Modulated Main Solenoid (–)
175	Retarder Temperature
176	not used
177	Pressure Switch 1
178	not used (6-speed models)
178	Pressure Control Solenoid 6 (–) (7-speed models)
179	Input Function (–)
180	Turbine Speed (+)

Legend: PCS = Pressure Control Solenoid; TCC = Torque Converter Clutch

LIST OF REFERENCED DOCUMENTS

Allison 6th Generation Controls Manual

- *Section A-2: Shift Calibration Familiarization*
- *Section B: System Operation for 1000/2000 Product Family*
- *Section C: Controls Component Installation*
- *Section D: Vehicle Electrical System Interface*
- *Section F: Controls Support Equipment*
- *Input and Output Functions*
  - *Input AF: Differential Clutch Request*
  - *Input Z: Retarder Enable*

Transmission Features and Options

- *3000 Product Family*
- *4000 Product Family*

Transmission Data

- *3000 Product Family*
- *4000 Product Family*

- *Datalink Communications for Allison 6th Generation Controls*
- *Fluids Page at www.allisontransmission.com*
- *Allison DOC® for PC*

Technical Documents

- *TD-175: Guidelines for Selecting Retarder Controls*
- *TD-191: Application and Installation Guidelines for 2nd Reverse with Allison 6th Gen Controls*

REVISION HISTORY

October 18, 2022

- In 8.1, Retarder Temperature Based Reduction Threshold 1 and 2 were added as these temperature thresholds are now programmable.

July 21, 2022

- In 6.1, changed “100%” to “99%” as the shifter display only supports two digits not three digits, so 99% is what is displayed when the Oil Life Monitor is reset.

September 19, 2021

- Updated the tables in Sections 4.2 and 4.4 adding the hardware identification diagnostic mode.

July 13, 2020

- Created, Allison 6th Generation Controls - Controls Installation Manual - Section B: System Operation 3000/4000 Product Families