SECTION A-1:
CONTROLS SYSTEM FAMILIARIZATION

ALLISON 6TH GENERATION CONTROLS

APPLICABLE MODELS: **1000/2000 Product Family**
2900 Product Family
3000 Product Family
4000 Product Family

Contents:

SECTION A-1: ALLISON 6TH GENERATION CONTROLS SYSTEM FAMILIARIZATION

1.0 PURPOSE

The purpose of this section is to describe Allison 6th Generation Controls (6th Gen) system features and components. For a description of Allison 6th Generation Controls Shift Calibrations, refer to *Section A-2: Shift Calibration Familiarization for Allison 6th Generation Controls*.

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.

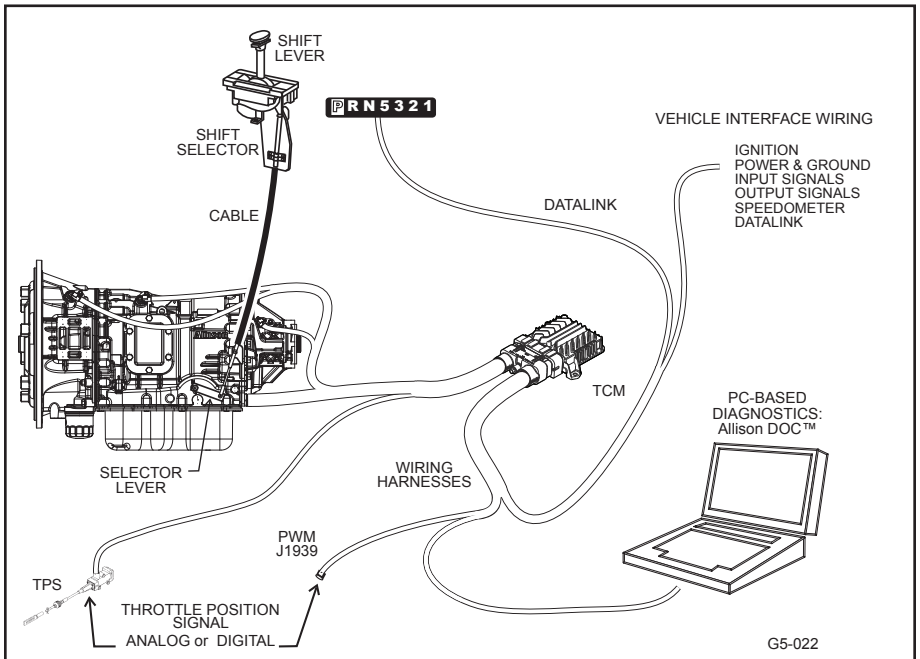

Figure A1-1: Transmission Control System Components for the 1000/2000 Product Family

3.0 CONTROLS SYSTEM OVERVIEW

The Allison 6th Generation Controls system provides the functional control for Allison transmissions. The transmission control system consists of the components shown in Figure A1-1 for the 1000/2000 Product Family. Figure A1-2 shows the control system components for the 3000 and 4000 Product Families.

NOTE: Consult your Allison Representative regarding the availability of the 6th Gen Controls features. Some options discussed in this document are for future release.

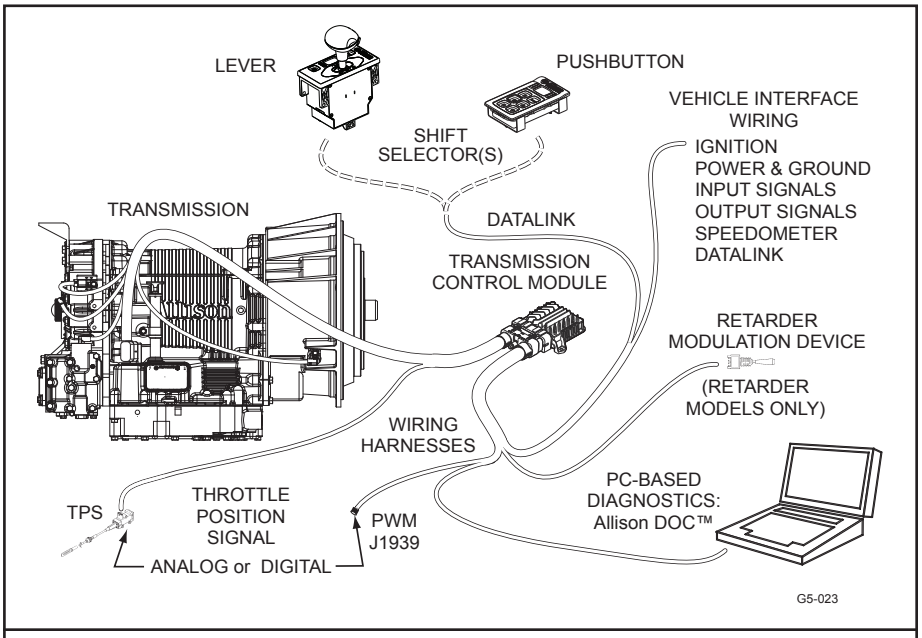

Figure A1-2: Transmission Control System Components for the 3000 and 4000 Product Families (Shown with Optional Retarder)

4.0 TRANSMISSION CONTROL MODULE (TCM)

The Transmission Control Module (TCM), shown in Figure A1-3, provides functional control of the transmission. Three TCM configurations are available, providing various levels of feature content, as shown in Figure A1-4. The external features of the three TCM configurations are identical; all differences are internal to the TCM. All TCM configurations are compatible with 12-volt vehicle electrical systems. The C73M and Max-Feature TCMs are also compatible with 24-volt vehicle electrical systems. These TCMs can auto-detect the CAN1 default boot baud rate. CAN1, CAN 2, and CAN 3 baud rate can be programmed.

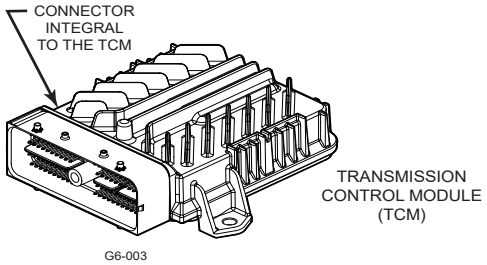

Figure A1-3: Transmission Control Module (TCM)

Refer to the *TCM Installation Drawing, AS07-612*, for dimensions and mounting information.

Allison 6th Gen TCM Model	Chassis-Mounted	12-Volt Compatible	24-Volt Compatible	SAE J1939 / ISO 11898	6-Speed 1000/2000 Models 3000 & 4000 Models	7-Speed 4000 Models	Retarder 3000 & 4000 Models	9-Speed 2900 Models
C71M Basic	X	X		X	X			
C72M Expanded	X	X		X	X	X	X	X
C73M Max-Feature	X	X	X	X	X	X	X	X

Figure A1-4: Allison 6th Generation TCM Configurations

4.1 FUNCTIONAL OVERVIEW

The TCM provides functional control of the transmission by integrating information from two primary sources:

- The TCM **program** includes the basic logic and algorithms which command all of the various elements of transmission operation. The program is an integral element of the TCM structure and is defined as having a specific software level.
- The TCM **calibration** includes all variables which are required for the program to tailor the transmission operation to the specific vehicle in which it is installed. Each calibration is based on input from the vehicle manufacturer. Once defined, the calibration must be downloaded into the TCM to make the TCM fully operational.

Functional control of the transmission results from integration of the **calibration** data sets with the elements of the software **program**, including the following:

- Automatic detection of transmission components (Autodetect). Refer to paragraph 4.2.
- Adaptive controls. Refer to paragraph 4.3.
- Transmission and controls diagnostics. Refer to paragraph 4.4.
- Transmission prognostics. Refer to paragraph 4.5.
- Communication via vehicle datalinks. Refer to paragraph 4.6.

- Shift inhibits. Refer to paragraph 4.7.
- Continuous re-calibration of the throttle position sensor (AutoCal). Refer to paragraph 7.3.
- Control of the retarder (3000/4000 Product Families only). Refer to paragraph 9.0

In addition, the control system for each transmission contains built-in logic to protect against certain types of abusive operation. For more details, see the following sections of this manual:
- *Section B: System Operation for the 1000/2000 Product Family*
- *Section B: System Operation for the 2900 Product Family*
- *Section B: System Operation for the 3000/4000 Product Families*

4.2 VEPS END OF LINE PROGRAMMING

Allison 6th Generation Controls support VEPS (Vehicle Electronics Programming Station) programming of the TCM. Customers who choose to utilize VEPS will be able to program the TCM using a process that is common to other major truck components using the SAE standard implementation of VEPS. Use of VEPS to program the TCM reduces the number of TCM calibration part numbers ordered from Allison and increases production flexibility.

Allison offers the following three VEPS implementation options:
- Full VEPS implementation – vehicle builder fully integrates the Allison VEPS tools into their business and assembly processes. This option is typical for larger OEMs that already use VEPS for other vehicle components.
- VEPS via Allison PDC (Parts Distribution Center) or local Customization Center – PDC or the Customization Center ships the vehicle builder a fully programmed TCM. This option is used by OEMs that do not utilize VEPS to program other component controllers.
- VEPS via Allison Distributor – Allison Distributor provides the vehicle builder with a fully programmed TCM. This option is used by OEMs who purchase Allison transmissions from an Allison Distributor.

4.2.1 FULL VEPS IMPLEMENTATION

For OEMs who choose to fully implement Allison VEPS, Allison will provide Allison's Vendor Component Program (VCP) for use in the OEM VEPS station.

Each TCM shipped to the OEM will be pre-programmed with software and a base Vocational Model Calibration (VMC). The VMC will be determined by the transmission's vocational model or vocational usage – for example EVS or Fire/Emergency Service, RDS or On/Off-Highway use.

The pre-programmed TCM has a Factory Mobility Mode (FMM) feature. This feature allows the vehicle to be moved when the TCM is in VEPS-ready mode. Drive, Neutral and Reverse can be selected on the shift selector. In order for Factory Mobility Mode to work, certain minimum installation requirements must be met. Refer to *Section C: Controls Component Installation* of this Manual

Based on the customer order, the OEM will create a Parameter (PAR) file for each vehicle/transmission combination. The PAR file will be used to "trim" the TCM calibration settings, including the following:
- Transmission shift schedules
- Transmission shift speeds
- Input and Output functions
- Throttle source
- Retarder or non-retarder
- Activation of optional J1939 messages
- FuelSense® features

After VEPS has successfully programmed the TCM a Verification (VER) file is created and transmitted to Allison for use by the Allison Service Network.

4.2.2 VEPS VIA ALLISON PDC OR CUSTOMIZATION CENTER

OEMs may choose to order fully programmed TCMs from the Allison PDC (Parts Distribution Center) or their regional Customization Center. The OEM uses the Allison Calibration Configuration Tool (ACCT) to generate a Parameter (PAR) file. ACCT is available to authorized users on the Allison Extranet under Engineering. The PAR files will be automatically registered and stored within the Cal Delivery System.

The OEM identifies the PAR file and the transmission vocational model, or vocational usage, when ordering the TCM from PDC or the Customization Center. PDC or the Customization Center uses VEPS to load the PAR file into the appropriate TCM prior to shipment.

4.2.3 VEPS VIA ALLISON DISTRIBUTOR

For OEMs that purchase transmissions from an Allison Distributor, the Distributor provides fully programmed TCMs. The Distributor uses the Allison Calibration Configuration Tool (ACCT) to generate a Parameter (PAR) file based on input from the OEM. Prior to shipping the TCM to the OEM, the Distributor programs the TCM with the appropriate Vocational Model Calibration (VMC) and PAR file using TCM Reflash.

4.3 AUTODETECT (3000/4000 PRODUCT FAMILIES ONLY)

The Autodetect software feature automatically detects the presence of the following transmission components:

- Oil Level Sensor
- Retarder

Diagnostic functions relating to each of these items are executed if the feature is detected and used. Autodetect permits the use of different features with a common TCM. TCM calibration proliferation can be reduced as a result.

NOTE: If the engine is started before all transmission-related components and connectors are properly installed, the Autodetect feature of the TCM may not function as designed. For further details, refer to *Section C: Controls Component Installation* of this manual.

If a TCM is moved from one vehicle to another, Autodetect must be reset with the *Allison DOC®* diagnostics program in order for the TCM to determine proper settings for the new installation.

4.4 ADAPTIVE CONTROLS

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. The TCM makes continuous adjustments as required to 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. In order to optimize each type of shift for normal driving, a drive-in period under varied driving conditions is required. In general, shift quality will begin to converge to the adapted level after five shifts of a particular shift type.

4.5 SHIFT INHIBITS

When appropriate, the control system will automatically invoke an inhibit to protect against certain types of abusive operation.

For more detail, refer to Section B: System Operation for the *1000/2000*, *2900*, or *3000/4000* Product Families.

4.6 TRANSMISSION AND CONTROLS DIAGNOSTICS

This feature of the transmission control system assists in troubleshooting transmission malfunctions. The feature requires use of the following:

- A dash-mounted **CHECK TRANS** light to alert the operator when a diagnostic condition exists
- *Allison DOC® for PC*, a diagnostics program which interfaces with the TCM to provide readout of the condition of the control system.

Refer to *Section B: System Operation for the 1000/2000 Product Family*, *Section B: System Operation for the 2900 Product Family*, or *Section B: System Operation for the 3000/4000 Product Families* for more information.

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

4.7 COMMUNICATION VIA VEHICLE DATALINKS

All TCMs are capable of communicating with engine controls, and other vehicle systems, over the SAE J1939 datalink. For additional information on datalink communication, refer to *Allison 6th Generation Controls Section D: Vehicle Electrical System Interface* and to *Datalink Communications*.

4.8 FUNCTIONAL SAFETY (ISO 26262) CAPABILITY

The Allison controls system provides on “off-the-shelf” system that can be integrated without any vehicle manufacturer’s specific ISO 26262 Functional Safety requirements or objectives up to an ASIL D capable framework that dependent on vehicle level integration can support the most stringent vehicle level requirements.

For more detail, refer to *FUSA link TBD*

5.0 CUSTOMIZING THE CONTROLS FUNCTIONALITY TO YOUR VEHICLE

Numerous provisions are available to customize the function of the controls system to the expected use and operation of the vehicle. The following paragraphs are dedicated to discussing the significant selectable controls features which are programmed into each TCM. This information is general in nature, and some topics or options may not be applicable to all installations.

5.1 TRANSMISSION SHIFT CALIBRATIONS

A transmission shift calibration includes multiple sets of shift points which may be used to control transmission operation at various times. The shift points affect the timing of shifts which are being commanded. The most commonly used shift calibrations, including DynActive™ Shifting, are described in *Section A-2: Shift Calibration Familiarization*. For additional information on DynActive Shifting availability through FuelSense 2.0 Packages, reference paragraph 5.4.2.

The shift points have no effect on the number of gears that may be commanded, which may vary depending upon the transmission model and the selected range position of the shift selector. Typical shift sequences for each transmission model, including available gear ranges and availability of lockup operation in each range, are discussed separately in *Section B: System Operation* for the *1000/2000*, *2900*, or the *3000/4000* Product Families.

5.2 INPUT AND OUTPUT (I/O) FUNCTIONS

Each transmission control system includes the capability for additional functional control of transmission or vehicle operations which are tailored to the expected duty of the vehicle.

Input Functions send discrete signals **to the TCM** indicating the operating state of other vehicle systems. Specific transmission operation or function may thus be coordinated with the indicated state of the vehicle.

Output Functions send discrete signals **out of the TCM** for use in controlling the operation of other non-transmission components. The output functions may be turned on and off based on the state of related input function signals or the operating state of the transmission.

Interface Functions use a combination of both Input Functions and Output Functions to interface with the operation of vehicle components.

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*. Many I/O functions can be implemented using SAE J1939 datalink messages. Refer to *Datalink Communications* for detailed information.

5.3 TRANSMISSION PROGNOSTICS

This feature of the transmission system provides a constant monitor of the following transmission operating parameters:

- Oil Life
- Fluid Filter
- Transmission Health (not yet available for the 2900 Product Family)

The feature requires a **TRANS SERVICE** indicator to alert the operator when a service condition relating to any of these items exists. If the serviceable condition is ignored for a defined period, the **CHECK TRANS** light is illuminated, indicating the increased probability that the service condition will develop into a more serious condition. See *Section B: System Operation* for the *1000/2000 Product Family*, *2900 Product Family*, or for the *3000/4000 Product Families* for more details.

For the Prognostics feature to be functional, the following two conditions must be satisfied:

- Prognostics must be **available** in the TCM controls calibration – specified when the TCM calibration is defined.
- Prognostics must be **enabled** in the controls calibration – switched on or off as specified by the customer.
  - 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.
- Prognostics Transmission Fluid is not set to Other

See Figure A1-5 for further explanation.

One of five combinations must be specified by customer when defining the TCM calibration			
Prognostics available in calibration?	Prognostics enabled in calibration?*	Prognostics reset by Service Tool only?	Prognostics functioning at startup?
No	—	—	No. Available only by re-calibrating TCM
Yes	Defaulted ON	No	Yes. Prognostics enable/disable toggle and reset of transmission monitors may be done with Allison DOC®, J1939 request, or shift selector *
Yes	Defaulted ON	Yes	Yes. Prognostics enable/disable toggle and reset of transmission monitors may be done only with Allison DOC®
Yes	Defaulted OFF	No	No. Prognostics enable/disable toggle and reset of transmission monitors may be done with Allison DOC®, J1939 request, or shift selector *
Yes	Defaulted OFF	Yes	No. Prognostics enable/disable toggle and reset of transmission monitors may be done only with Allison DOC®
* Refers only to overall Prognostics enable, individual Prognostics operating can be individually enabled/disabled ** For instructions to toggle Prognostics between enable/disable, or to reset Oil Life and Filter Life monitors using the shift selector, see *Section B: System Operation* for *1000/2000* or *3000/4000* Product Families.			
Figure A1-5: Allison 6th Generation TCM Prognostic Configurations			

The Prognostics feature is only available with transmissions using one of the following fluids:
- TES 668 licensed fluid
- TranSynd™ or an equivalent TES 295 licensed fluid
- A Schedule One TES 389 licensed fluid

For lists of acceptable TES 668, TES 295 and TES 389 fluids, refer to the *Fluids Page* under Service at *www.allisontransmission.com*. During the process of defining the TCM calibration, the type of fluid must be specified when prognostics is selected.

NOTE: The type of fluid must be specified when the TCM calibration is defined.

5.4 FUELSENSE® FEATURE PACKAGES

FuelSense® is a set of Allison fuel economy calibrations/features. FuelSense® 2.0 features are discussed below.

5.4.1 AVAILABLE FUELSENSE® 2.0 FEATURES:

- **Dynactive™ Shifting** - an innovative new method of shift scheduling that uses an algorithm to choose the most efficient shift point based on environmental and vehicle parameters. This continuously variable shift program will meet drivers' power demands more efficiently and intelligently than table based shift scheduling with fixed shift points. See the *6th Generation Controls Manual Section A-2, Shift Calibration Familiarization*.

- **EcoCal** - calibration that implements lower speed table based shift schedules designed to optimize the engine operating speed and to shift the transmission from converter mode to lock-up mode as early as possible. EcoCal is designed to provide necessary performance while avoiding shift cycling. For further information, reference the *6th Generation Controls Manual Section A-2, Shift Calibration Familiarization*.

- **Dynamic Shift Sensing (DSS)** - shift strategy feature combines the advantages of both performance and economy shift strategies by automatically selecting between the two strategies based on conditions. When enabled, the controls will automatically select the Economy shift schedule when an unloaded state of the vehicle is detected, based on capability of the vehicle to accelerate quickly. The controls will automatically switch to the Performance shift schedule when the vehicle is loaded and its ability to accelerate is reduced.

- **Neutral at Stop** - feature that reduces or eliminates the load on the engine while the vehicle is stopped, reducing fuel usage and emissions.

  Available levels:
  - Standard: Provides partial neutral at stop with locked output to improve return-to-range shift quality.
  - Premium: Provides full neutral at stop with locked output to improve return-to-range shift quality. Neutral at Stop – Premium will be disabled on grades greater than 4% nose down (< -4%) and greater than 6% nose up (> 6%).

- **Neutral at Stop with Coast Mode** - feature that will activate at very low speeds as the vehicle comes to a stop with the service brake pedal applied and acknowledged, and will remain active until the service brake pedal is released and acknowledged. This reduces the load on the engine when the service brake pedal is applied and the vehicle is moving at low speeds or stopped. The output lock will engage when the vehicle is stopped and the service brake is applied and acknowledged. This feature is only available when Neutral at Stop Premium is selected in the calibration.

  In order to use Neutral at a Stop Standard, or Neutral at a Stop Premium w/optional Coast Mode, with a 1000/2000 Series transmission, the Neutral at Stop valve body is required.

  For further information, refer to *Neutral at Stop Function Input AS* in the Allison 6th Generation Controls Manual.

• **Acceleration Rate Management** - feature that mitigates aggressive driving practices by automatically controlling engine torque to control the vehicle's rate of acceleration. The amount of engine torque control is influenced by the vehicle's weight and the grade on which it's operating. There are five pre-determined acceleration rate limits as well as an option for custom acceleration rate definition. The custom option allows tailoring of the shape of the ARM curves by specifying the Low Speed Breakpoint & Acceleration Limit and the High Speed Breakpoint & Acceleration Limit when defining the calibration.

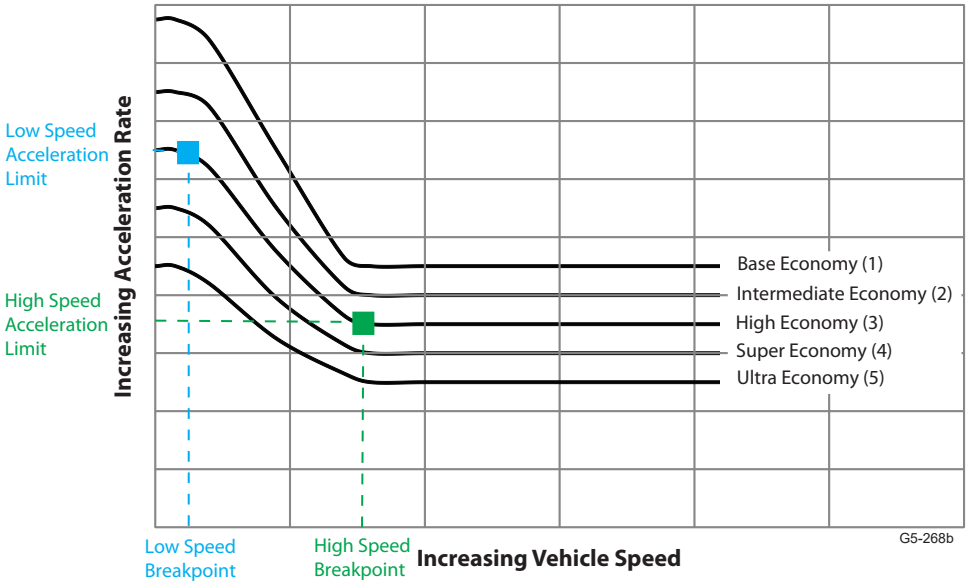

Figure A1-8: Enhanced Acceleration Rate Management

FuelSense® 2.0 features are available on all vocational models, but some may be limited for the Emergency Vehicle Series (EVS) and Oil Field Series (OFS) models. All 3000 xFE™ models must have Dynactive™ Shifting and First Lockup specified in the calibration. All 1000/2000 xFE™ models must have Dynactive™ Shifting.

5.4.2 FUELSENSE® AND XFE TRANSMISSION HARDWARE:

- All 1000/2000 xFE™ models come standard with FuelSense® 2.0.
- All 3000 xFE™ models come standard with FuelSense® 2.0.
- The 3414 RHS model comes standard with FuelSense® 2.0.

Additional Information:

- All 1000/2000 xFE™ models and the T3270 xFE™ model come equipped with a special Low Rate Damper Torque Converter.
- For 1000/2000 xFE™ models, Neutral at Stop valve body is standard.
- For 1000/2000 non-xFE™ models, Neutral at Stop valve body is optional, but is if the Neutral at Stop option is desired.
- 1st lockup is available on close ratio xFE™ models and must be specified in calibration
- 2nd lockup is available on close & wide ratio xFE™ models and must be specified in calibration

5.5 OUTPUT TORQUE LIMITING

Output Torque Limiting is an engine management function where the TCM manages engine torque in order to keep the transmission output torque below OEM-specified limits. Use of Output Torque Limiting requires Allison Customer Integration Engineering review.

Output Torque Limiting requires Engine Management (SEM/LRTP or LRTP-Only) integration between the engine and transmission controls. Feature is currently intended for use with diesel engine applications. Non-diesel engine applications may require additional validation prior to use. Refer to *TD161-1* if using a non-diesel engine for validation status.

The following parameters must be specified when the TCM calibration is defined:

- Output Torque Limiting – Enable or Disable (default)
- Output Torque Limiting: Default Turbine Torque with Loss of Comm – sets the value used to calculate the engine torque limit that the engine should use if datalink communication with the TCM is lost.
- Output Torque Limiting: General Output Torque Limit – Sets the limit invoked by the TCM for all operations except those limited to a lower limit by T-Case Low Output Torque Limit or by Reverse Output Torque Limit.
- Output Torque Limiting: Reverse Output Torque Limit – Sets the limit invoked by the TCM if the transmission is in reverse gear. In reverse, the TCM will use the minimum of the General Output Torque Limit or the Reverse Output Torque Limit.
- Output Torque Limiting: T-Case Low Output Torque Limit – Sets the limit invoked by the TCM if the T-Case is in low gear. In T-Case low, the TCM will use the minimum of the General Output Torque Limit or the T-Case Low Output Torque Limit.

Refer to the *Allison Calibration Configuration Tool (ACCT)* found on the Allison HUB, or contact your Allison Transmission representative if you do not have access to ACCT.

5.6 HILL HOLD INTERFACE

Allison 6th Generation Controls support Hill Hold Systems by providing messaging to communicate the transmission is ready for service brake release or not ready for service brake release . *Transmission Ready for Brake Release* message is generated when the torque is available at the transmission output shaft to release the service brakes without a risk of unintentional vehicle movement in the opposite direction. This is determined by comparing estimated available output torque to the estimated output torque required to hold the vehicle stationary. *Transmission Not Ready for Brake Release* message is generated when the torque is not available at the transmission output shaft to hold the vehicle and thus the Hill Hold System keeping the service brakes applied. The TCM always reports ready for brake release when near level ground or output speed is high. Refer to *Datalink Communications for Allison 6th Generation Controls* for integration information and installation checklist.

Note: The Hill Hold System controls the service brakes not the transmission controls.

5.7 CUSTOMER MODIFIABLE CONSTANTS (CMC)

The explicit operating conditions related to certain functions, such as some I/O functions and Acceleration Rate Management, may be specified. The term "Customer Modifiable Constant" (CMC) is used when referring to the variables associated with these selections. This capability to customize functionality of some controls features to a specific vehicle further enhances the benefit of many of the I/O functions. For example, the request to engage a transmission-mounted PTO is limited to a specific range of engine speeds. Both the minimum and maximum limits of this speed range are CMCs. The specific speeds, or the default values, must be specified when the TCM calibration is defined. CMCs may subsequently be modified with the *Allison DOC® for PC* program — but only within allowable limits.

5.8 GREENHOUSE GAS PARAMETER RESTRICTIONS

Allison Transmission offers calibration lockdown options to help facilitate vehicle EPA emission compliance. These calibration options have associated lockdown features to ensure ongoing compliance. The available calibration lockdowns are configured in the initial VEPS PAR file configuration and result in prevention of changes to the relevant associated VEPS parameters, based on the configuration after the vehicle is in service.

- **Emission Credit Vehicle**: Neutral at Stop – Premium - This parameter indicates that Neutral at Stop was activated in a particular vehicle by the OEM to facilitate vehicle EPA emission compliance. Usage of this parameter will prevent changes to the vehicle's Neutral at Stop configuration.

- **Emission Credit Vehicle:** Transmission File used in GEM Simulation - This parameter indicates that features in the Transmission input data file for the Greenhouse Gas Emissions Model (GEM) simulation were used by the OEM to facilitate EPA emission compliance. Usage of this parameter will prevent changes to any parameter impacting the maximum gear available, lockup scheduling, and the vehicle's Neutral at Stop configuration.

- **Emission Credit Vehicle:** Powertrain Certified Calibration - This parameter indicates that the vehicle was certified for EPA emission compliance using powertrain data input for the engine and transmission. Usage of this parameter will prevent changes to any parameter impacting shift scheduling including features, maximum gear available, and engine configuration.

6.0 SHIFT SELECTORS

The shift selector is used by the operator to select Neutral (N), Reverse (R), or a forward gear range. On most selectors, the highest available forward gear range is labeled D (Drive). When a forward range is selected, the transmission will start in the lowest gear of the range and, as conditions warrant, will automatically upshift until the highest gear of the selected range is attained. For example, if the TCM is programmed with a 1-5 shift schedule and the operator selects 4th gear at the selector, the transmission will start in 1st and automatically upshift through 2nd, 3rd and into 4th gear. Normally, the TCM will not command the transmission to shift into 5th gear until the driver selects 5th gear on the selector. For a possible exception see the Caution note relating to "Hold Schedule for Upshifts", in *6th Gen Controls Manual Section A-2, Shift Calibration Familiarization*.

6.1 SHIFT SELECTORS - 1000/2000 PRODUCT FAMILY

6.1.1 OVERVIEW

Transmissions of the 1000/2000 Product Family and 2900 (Shift-by-Cable) Product Family commonly use a mechanical selector as shown in Figure A1-8. In this configuration, the operator's gear range selection is communicated from the shift selector to the shift selector shaft in the transmission via a mechanical cable and shift lever. For shift selector and system installation requirements, refer to the Shift Selector Requirements Installation Drawing, *AS64-410* for the 1000/2000 Product Family or *AS64-910* for the 2900 Product Family. The transmission shift selector shaft is part of the transmission assembly. All other selector and cable components are supplied and installed by the vehicle manufacturer.

Some selector manufacturers offer electronic/electric or air/hydraulic shift control systems for the 1000/2000 and 2900 transmission. Refer to *Section F: Controls Support Equipment* of this manual for information on selector manufacturers.

Allison allows the use of an Allison pushbutton selector with transmissions in the 1000/2000 and 2900 (Shift-by-Cable) Product Families. The vehicle must be equipped with a shift actuator system that is sourced and installed by the vehicle builder. The actuator system must be capable of receiving J1939 selector commands and physically rotating the selector shaft on the transmission. The TCM will send the range, mode, prognostic and diagnostic data to the selector for display. However, the Allison keypad pushbutton selectors, which include a display, are not allowed with 1000/2000 and 2900 models equipped with a Park Pawl. Refer to *Datalink Communications for Allison 6th Generation Controls* for additional information.

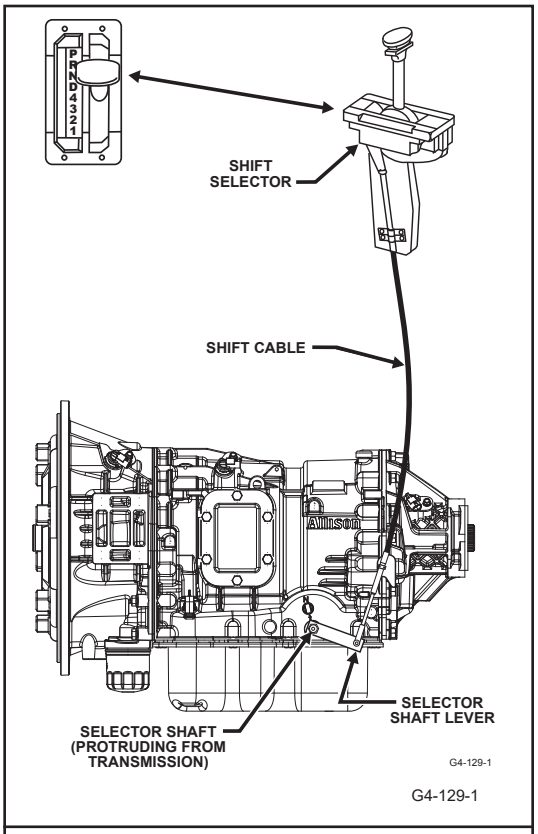

Figure A1-8: Typical 1000/2000 Lever Shift Selector

6.1.2 MECHANICAL SHIFT SELECTOR CONFIGURATIONS

Several shift selector configurations are commercially available. The combination of shift selector design and a variety of programmed controls features provide for a very flexible design of the controls system for these transmission models.

Details are discussed in the paragraphs which follow. 1000/2000 shift selectors typically include the following as the minimum gear selection provisions:

- **R – Reverse**
- **N – Neutral:** Position may be used for starting the engine
- **6 – Sixth:** Designates highest available forward range, overdrive. Transmission shifts to first gear for starting, and will automatically upshift through the gears until sixth (6) gear is attained.
- **4, 2, 1 – forward range selection:** Transmission starts in first gear. The gear selected on the shift selector is the highest gear which will be attained during automatic shifting.

1000/2000 shift selection systems may include one or more of the following provisions in order to further enhance transmission and vehicle operation:

- **P – Park:** Engages the transmission park pawl, if available. This provision is not available with all transmission models, nor is it available on all shift selectors. The Park position may be used for starting the engine.
- **PB – Park Brake:** Automatically engages a transmission-mounted park brake with selection of this position on the shift selector. This position may be used for starting the engine. The Park Brake position is not available on all shift selectors, nor is it available with transmissions which are equipped with a park pawl.

NOTE: Only one of the following three features may be installed in a vehicle at any time. DO NOT attempt to mix these features in any combination — doing so may result in unpredictable transmission and vehicle operation.

- **Tap Up / Tap Down:** This feature uses the SAE J1939 vehicle communications to alert the TCM of an operator request to raise or lower the selected forward gear range, one range at a time. A typical Tap Up/Tap Down input device might be an UP/DOWN momentary rocker switch on the steering wheel, bump positions on the shift selector, or momentary pushbuttons.
- **3-Position Hold Switch:** Used with six-speed transmission models only, this OEM-installed non-momentary switch permits the operator to select 6, 5, or 4 as the highest available range during transmission operation.
- **OverDrive Disable input function/switch:** When used with five- or six-speed transmission models, closing the switch enables this input function to set 4th as the highest available range during transmission operation.

  For six-speed transmission models, the selected range of the enabled function may be set in the shift calibration to select either 5th or 4th as the highest available range during transmission operation. When set to 4th, this function effectively becomes a **Double OverDrive Disable** feature.

Available combinations of the various features described above are tabulated in the Appendix.

Several reference documents are available to assist in determining which of the items in the Appendix are available with your transmission model and control system configuration:
- Whether or not the transmission has a park pawl – Refer to the *1000/2000 Product Family Transmission Features and Options*.
- The shift pattern programmed into the control system – Refer to *Allison 6th Generation Controls Manual Section B: System Operation for the 1000/2000 Product Family*.
- Whether or not the vehicle park brake is applied by the shift selector – Refer to *1000/2000 Product Family Park Brake Provisions – System Design*.

A transmission equipped with the park pawl **requires** a shift selector with a position P for Park. A vehicle equipped with a selector-applied park brake **requires** a shift selector with a position PB for Park Brake. Refer to the *Section C: Controls Component Installation* of this manual for more information.

Design requirements for shift selectors and cable apply systems are discussed in *Technical Document 177 (TD-177): Requirements for Shift Selector and Cable System*. Refer to *Section C: Controls Component Installation* of this manual for shift selector and cable apply system installation requirements.

Details are discussed in the paragraphs which follow. 2900 (Shift-by-Cable) shift selectors typically include the following as the minimum gear selection provisions:

- **R – Reverse**
- **N – Neutral:** Position may be used for starting the engine
- **9 – Ninth:** Designates highest available forward range, overdrive. Transmission shifts to first gear for starting, and will automatically upshift through the gears until ninth (9) gear is attained.
- **9, 1 – forward range selection:** Transmission starts in first gear. The gear selected on the shift selector is the highest gear which will be attained during automatic shifting.

2900 shift selection systems may include one or more of the following provisions in order to further enhance transmission and vehicle operation:

- **P – Park:** Engages the transmission park pawl, if available. This provision is not available with all transmission models, nor is it available on all shift selectors. The Park position may be used for starting the engine.
- **PB – Park Brake:** Automatically engages a transmission-mounted park brake with selection of this position on the shift selector. This position may be used for starting the engine. The Park Brake position is not available on all shift selectors, nor is it available with transmissions which are equipped with a park pawl.

NOTE: Only one of the following three features may be installed in a vehicle at any time. DO NOT attempt to mix these features in any combination — doing so may result in unpredictable transmission and vehicle operation.

- **Tap Up / Tap Down:** This feature uses the SAE J1939 vehicle communications to alert the TCM of an operator request to raise or lower the selected forward gear range, one range at a time. A typical Tap Up/Tap Down input device might be an UP/DOWN momentary rocker switch on the steering wheel, bump positions on the shift selector, or momentary pushbuttons.
- **OverDrive Disable input function/switch:** When used with 2900 transmission models, closing the switch enables this input function to set 6th as the highest available range during transmission operation.

Available combinations of the various features described above are tabulated in the Appendix.

Several reference documents are available to assist in determining which of the items in the Appendix are available with your transmission model and control system configuration:

- Whether or not the transmission has a park pawl – Refer to the *2900 Product Family Transmission Features and Options*.
- The shift pattern programmed into the control system – Refer to *Allison 6th Generation Controls Manual Section B: System Operation for the 2900 Product Family*.
- Whether or not the vehicle park brake is applied by the shift selector – Refer to *1000/2000 and 2900 Product Family Park Brake Provisions – System Design*.

A transmission equipped with the park pawl **requires** a shift selector with a position P for Park. A vehicle equipped with a selector-applied park brake **requires** a shift selector with a position PB for Park Brake. Refer to the *Section C: Controls Component Installation* of this manual for more information.

Design requirements for shift selectors and cable apply systems are discussed in *Technical Document 177 (TD-177): Requirements for Shift Selector and Cable System*. Refer to *Section C: Controls Component Installation* of this manual for shift selector and cable apply system installation requirements.

6.2 SHIFT SELECTORS – 3000 & 4000 AND 2900 PRODUCT FAMILIES

Allison Transmission offers three types of shift selectors for the 2900 (Shift-by-Wire), 3000 and 4000 Product Families:

- Keypad Pushbutton
- Bump Lever
- Strip Pushbutton (3000 and 4000 only)

The various shift selectors are illustrated in Figure A1-9. Dimensional information is available on *Installation Drawing AS07-617, 6th Generation Shift Selectors*.

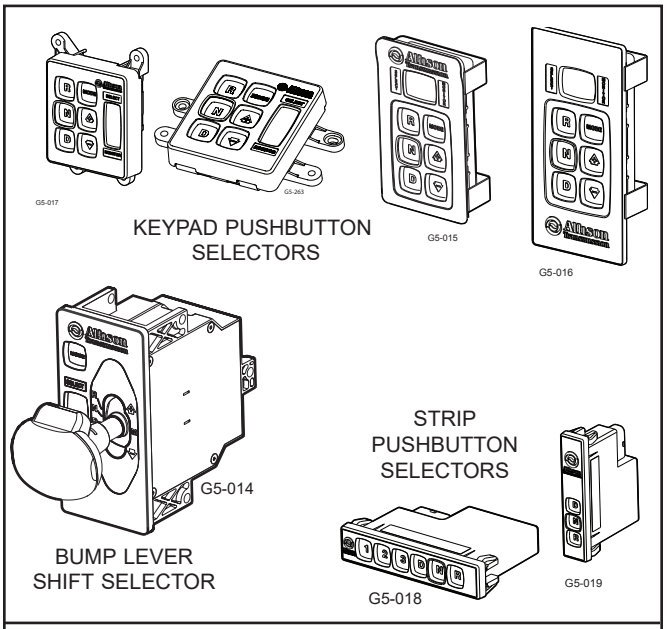

Figure A1-9: 2900 (Shift-by-Wire) and 3000/4000 Shift Selector Types

All Allison selectors communicate with the TCM via the SAE J1939 datalink and a selector direction signal wire. Refer to *Section C: Controls Component Installation* of this manual for more information.

The keypad pushbutton selector is available in several configurations. The choices for this component represent a variety of physical sizes and shapes to accommodate differing requirements for installed space claim. Each of these selectors includes three primary buttons for the selection of R (Reverse), N (Neutral) and D (Drive). Selection of forward gear ranges lower than Drive are attained through separate upshift or downshift buttons which are used to request a change from the currently selected gear range.

The bump lever selector has a bump-shift feature to allow for unlimited forward and reverse range capability. The bump lever shift 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)

All configurations of the lever selector have identical external dimensions.

The lever selector and keypad selectors are equipped with a **MODE** button. The **MODE** button is used to change the shift characteristics of the transmission or to enable an operator-requested input function. In most installations the **MODE** button is used to transition between a performance shift schedule and an economy shift schedule (refer to *6th Generation Controls Manual Section A-2: Shift Calibration Familiarization*). To determine which input functions may be enabled by the **MODE** button, refer to *Input/Output Functions* for the 2900, 3000, and 4000 Product Families.

The bump lever and the keypad pushbutton selectors have a graphic vacuum florescent display (VFD) as shown in Figure A1-10. Significant features of the display are as follows:

- During typical vehicle operation, the side of the display window labeled **SELECT** shows the range selected by the operator. The side of the display window labeled **MONITOR** shows the current transmission range.
- A wrench icon is displayed between Range Selected and Range Monitor when certain types of prognostic transmission services are needed.
- MODE appears on the display when the operator depresses the **MODE** button. Another appropriate label for the Mode operation, such as ECON for economy shift schedule, can be specified when the TCM calibration is defined.
- System information is displayed when the control system is in diagnostic or prognostic mode. Refer to *Section B: System Operation for the 3000/4000 Product Families* or *Section B: System Operation for the 2900 Product Families* of this manual for information regarding system prognostics and diagnostics.

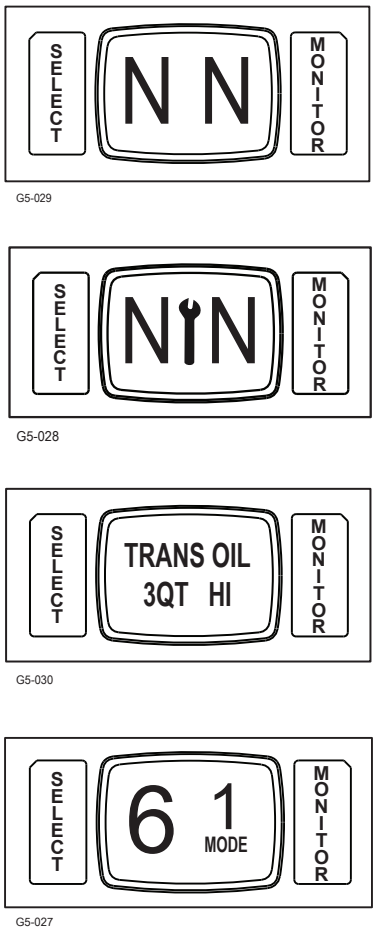

Figure A1-10: Examples of Bump Lever and Keypad Selector Displays – Keypad Selector Horizontal Display Shown

Illumination lamps in the keypad selectors and bump lever selector provide the following backlighting:

- Display Window - bump lever and keypad selectors
- **MODE** Button - bump lever and keypad selectors
- Range Buttons - keypad selectors only

The backlighting may be dimmed using the dash dimmer control. Refer to *Section D: Vehicle Electrical System Interface* of this manual for more information regarding dimming.

For the keypad pushbutton and bump lever selectors, five pins on the connector are reserved for future use with Input and Output functions. Consult your Allison Representative regarding availability of the Input and Output functions at the shift selector.

The strip pushbutton selector is available in four configurations for the 3000 and 4000 Product Families:

- 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

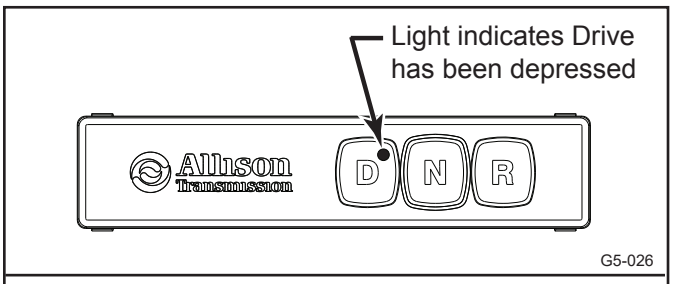

Figure A1-11: Strip Selector Indicator Light – 3-Button Horizontal Selector Shown

The strip pushbutton selectors do not include an informational display. These installations therefore require installation of a separate J1939-compatible display in order to alert the operator of conditions monitored by the system prognostics feature. Refer to Section 11.0, Remote Display.

All of the range buttons on the strip pushbutton selectors have backlighting. When a button is depressed by the operator, a light in the upper right corner of the button is illuminated. See Figure A1-11. The indicator light remains illuminated until a different button is pressed or the vehicle's key switch is turned off. The backlighting and indicator light may be dimmed using the dash dimmer

control. Refer to *Section D: Vehicle Electrical System Interface* of this manual for more information regarding dimming.

If the vehicle has two operator's stations, two selectors may be used to control the single transmission. Examples include a dual-station refuse packer and a fire truck pumper with a split-shaft PTO that is controlled from a remote control panel. This feature is not available with the 2900 Product Family. Refer to *Section C: Controls Component Installation* of this manual for more information.

A single shift selector may be used to control multiple transmissions in installations where multiple selectors are not an option. Examples include oil field pumping operations where multiple powerpacks are driving a large pump and “road-train” trucks with two or three powertrains and one driver. This feature is not available with the 2900 Product Family. For more information, contact your Allison representative and request *Engineering Memorandum (EM) 78, Using a Single Selector to Control Multiple Transmissions – 3000/4000 Product Families*.

Allison controls support non-Allison, OEM-supplied shift selectors. An OEM-supplied selector must communicate with the TCM using the SAE J1939 standard interface

NOTE: An extension of Functional Safety (ISO 26262) capability with an Allison shift selector requires usage of the keypad pushbutton selector. Contact Allison Customer Integration Engineering for details.

7.0 THROTTLE POSITION INPUT SIGNAL

The TCM must receive throttle position information from one of the following sources:

- From the controls of an electronically-controlled engine over an electronic communication link
- As a pulse-width-modulated (PWM) signal from an electronically-controlled engine.
- From an Allison-supplied throttle position sensor (TPS)

NOTE: The source of the throttle signal must be specified when the TCM calibration is defined.

The transmission wiring harness includes provisions to accommodate connections to the vehicle communication link or throttle sensor. Refer to *Installation Drawings in the AS07-6xx* series for system schematics and connector information to support these requirements.

7.1 ELECTRONIC ENGINE COMMUNICATION

If the engine is controlled electronically, throttle position data may be communicated from the engine controls to the TCM over the SAE 1939 datalink.

Consultation with Allison Application Engineering may be needed to define the communication details for a particular engine. Refer to *Datalink Communications* for other related information.

7.2 ELECTRONIC ENGINE CONTROLS - PULSE WIDTH MODULATED (PWM) SIGNAL

When used with electronically-controlled engines which do not communicate over the SAE J1939 datalink, the TCM can receive throttle information as a PWM signal from the engine ECM. Signals used in this manner must conform to SAE J1843. Certain compatibility issues must be reviewed to assure adequate transmission operation when using this configuration. Contact Allison Customer Integration Engineering for details.

7.3 NON-ELECTRONIC ENGINES — THROTTLE POSITION SENSOR (TPS)

For engines without electronic controls, Allison provides a resistive-type throttle position sensor. The sensor includes a mechanical cable that attaches to the engine fuel control and translates the motion of the fuel control into a regulated voltage signal indicating throttle position. The output voltage signal of the TPS is communicated to the TCM through the controls wiring harness. AutoCal, a basic software feature of the TCM, provides automatic compensation for linkage wear and for gradual changes in the TPS adjustment over time, resulting in more consistent shifting over the life of the vehicle.

The TPS is available with several cable lengths. In addition, brackets are available from Allison Parts Distribution Center with vibration isolation properties which permit the TPS to be mounted to engines and to some Allison transmission models. For details regarding the TPS and its features, refer to *Technical Document 178 (TD-178), Throttle Position Sensor (TPS) for Use with Allison Transmissions* and to *Installation Drawing AS07-551, Throttle Position Sensor*.

8.0 WIRING HARNESSES

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

- The TCM
- The main connector on the transmission
- Engine speed sensor on the transmission
- Turbine speed sensor on the transmission (1000/2000, 2900, and 4000 Product Families)
- Transmission output speed sensor on the transmission
- Serial communication datalink
- The shift selector (2900 Shift-by-Wire, 3000 & 4000 Product Families)
- Diagnostic connector
- Retarder controls (3000 & 4000 Product Families)
- Vehicle interface wiring
- Throttle position sensor (only with mechanically-controlled engines)
- The optional Vehicle Interface Module (VIM)

All wiring harnesses and connectors which mate to the connectors on Allison components are 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.

Harness design information can be found in the following documents:

- *Technical Document 173 (TD-173), Wiring Harnesses for Allison Transmissions with Allison 4th, 5th, and 6th Generation Controls* contains detail wiring harness design requirements.
- *Installation Drawing AS07-605, Connector Information*, illustrates the electrical connectors located on the transmission and on Allison-supplied control components.
- *Allison 6th Generation Controls System Data* contains electrical requirements for the control system such as voltage, current, and loads.

9.0 RETARDER CONTROLS – 3000 & 4000 PRODUCT FAMILIES ONLY

9.1 OPERATOR CONTROLS

Various types of retarder operator controls and vehicle interface controls are available for use with the 3000 and 4000 Product Families' retarder. Some of the available operator controls include:

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

The retarder apply system does not actuate the retarder directly. The driver uses the retarder operator controls to request a desired level of retardation. 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.

An in-depth discussion of the types and combinations of controls, their respective applications, and installation recommendations are discussed in *Technical Document 175 (TD-175), Guidelines for Selection of Allison Retarder Controls*.

The retarder can also be controlled via an SAE J1939 message. For details, refer to *Datalink Communications*.

9.2 RETARDER CAPACITY

A choice of maximum retarder capacities are available for each transmission model. The retarder capacity must be specified when the TCM calibration is defined. For a definition of the available retarder capacities, refer to *Transmission Data* for the *3000* or the *4000 Product Family*.

The actual amount of retarder torque applied to the vehicle driveline will be equal to or less than the maximum available retarder capacity, depending upon the type of operator control and the operator's request.

For more details on retarder operation, refer to the retarder discussion in *Section B: System Operation for the 3000 & 4000 Product Families* of this manual.

10.0 VEHICLE INTERFACE MODULE (VIM)

The optional VIM may simplify the controls installation. 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. Details regarding the VIM are included on *Installation Drawing AS07-552*.

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

11.0 REMOTE DISPLAY

The vehicle manufacturer may chose to integrate transmission status information into a vehicle dash display, or to supply and install a remote display. Transmission status information may include the transmission range selected, transmission range attained, sump temperature indicator, prognostic information, and diagnostic codes. The transmission control system supports SAE J1939, which transmits transmission operational data in an industry standard format. J1939 is applicable to all transmission models, and is required to display system prognostic data.

Design and interface requirements for a remote display should be consistent with data stream protocol, format, and speed as defined by the SAE J1939. For detailed information, refer to *Datalink Communications* for Allison 6th Generation Controls.

LIST OF REFERENCED DOCUMENTS

Allison 6th Generation Controls Manual

- *Section A-2: Shift Calibration Familiarization*
- *Section B: System Operation*
  - *for the 1000/2000 Product Family*
  - *for the 2900 Product Family*
  - *for the 3000/4000 Product Families*
- *Section C: Controls Component Installation*
- *Section D: Vehicle Electrical System Interface*
- *Section E: Using Input/Output (I/O) Functions, Groups and Packages*
- *Section F: Controls Support Equipment*

- *Allison 6th Generation Controls System Data*
- *Input/Output (I/O) Functions*

- *1000/2000 and 2900 Product Families Park Brake Provisions – System Design*
- *1000/2000 Product Family Transmission Features and Options*
- *2900 Product Family Transmission Features and Options*

- *Datalink Communications for 6th Gen Controls*
- *Allison Calibration Configuration Tool (ACCT)*
- *Allison DOC®*

- *Fluids Page* under Service at *www.allisontransmission.com*

- *Transmission Data* for the *3000 Product Family* or the *4000 Product Family*

1000/2000 Product Family Installation Drawings

- *AS64-410, Shift Selector Requirements*

2900 Product Family Installation Drawings

- *AS64-910, Shift Selector Requirements*

Allison 6th Generation Controls Installation Drawings

- *AS07-505, Connector Information*
- *AS07-612, Transmission Control Module (TCM)*
- *AS07-617, Allison Selectors for the 3000/4000 Product Families*
- *AS07-551, Throttle Position Sensor*
- *AS07-552, Vehicle Interface Module (VIM)*

Technical Documents (TD's)

- *TD161-1, Communication Requirements for Various Combinations of Engine and Transmission Controls (General)*
- *TD-173, Wiring Harnesses for Allison Transmissions Equipped with Allison 4th & 5th Generation Controls*
- *TD-175, Guidelines for Selecting Retarder Controls for Allison 4th & 5th Generation Controls*
- *TD-177, Requirements for Shift Selector and Cable System*
- *TD-178, Throttle Position Sensor (TPS) for Use with Allison Transmissions*

Engineering Memorandums (EM's)

- *EM-78, Using a Single Shift Selector to Control Multiple Transmissions – 3000/4000 Product Families*

REVISION HISTORY

MAY 5, 2022

- Added the 2900 Product Family

SEPTEMBER 18, 2021

- In 5.4, remove references to Basic, Plus, and Max FuelSense® packages.
- In 5.4.1, replace, "help prevent vehicle roll back" with, "improve return-to-range shift quality".

SEPTEMBER 8, 2021

- In 5.4.2, add, "For 1000/2000 models with a Neutral at Stop valvebody, wires 131 & 137 **MUST** be present between the TCM and transmission".

JULY 1, 2020

- Created, Allison 6th Generation Controls - Controls Installation Manual - Section A-1: Controls System Familiarization