

## **SECTION A: CONTROLS FAMILIARIZATION**

### **ALLISON 4TH GENERATION CONTROLS**

Items discussed in the CONTROLS FAMILIARIZATION section are:

#### **1.0 General**

#### **2.0 Controls System Overview**

#### **3.0 Transmission Control Module (TCM)**

- 3.1 Adaptive Controls
- 3.2 Trans ID
- 3.3 Autodetect
- 3.4 Auto Cal (Automatic Throttle Position Calibration)

#### **4.0 Shift Selectors**

- 4.1 Shift Selectors – 1000 & 2000 Product Families
- 4.2 Shift Selectors – 3000 & 4000 Product Families

#### **5.0 Throttle Position Input Signal**

- 5.1 Electronic Engine Communication – 3000 & 4000 Product Families
- 5.2 Non-Electronic Engines, Throttle Position Sensor (TPS)
- 5.3 Electronic Engine Controls, Pulse-Width-Modulated Throttle Signal

#### **6.0 Wiring Harness**

#### **7.0 Retarder Control**

- 7.1 Retarder Controls
- 7.2 Retarder Capacity

#### **8.0 Vehicle Interface Module (VIM) – 3000 & 4000 Product Families**

#### **9.0 Remote Display**

#### **Revision History**

# SECTION A: ALLISON 4TH GENERATION CONTROLS FAMILIARIZATION

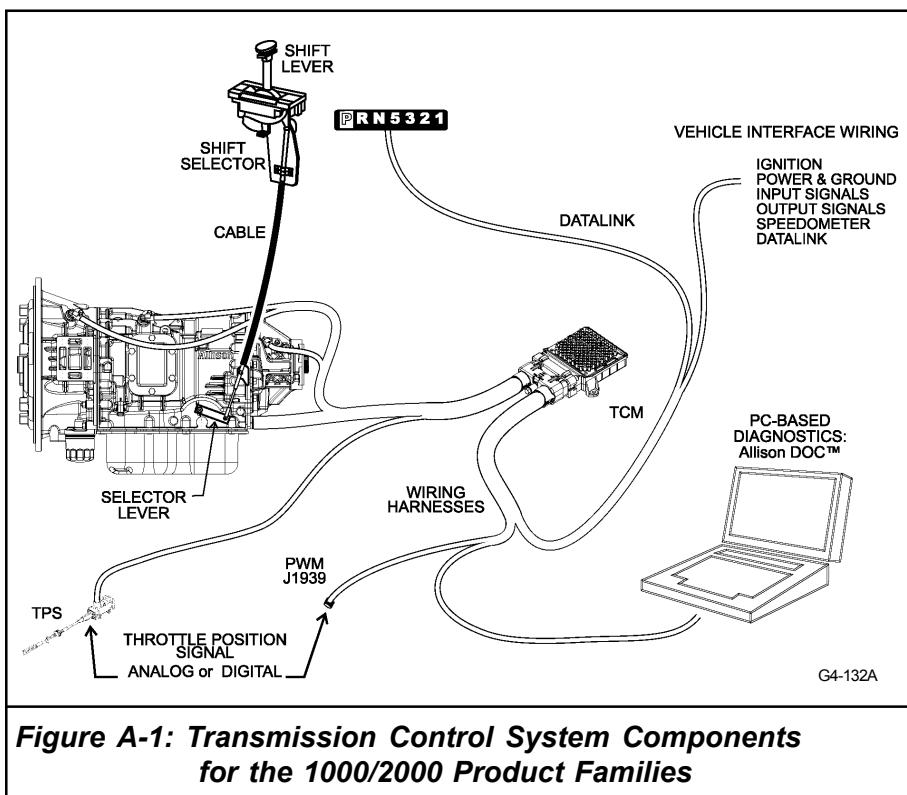
## 1.0 GENERAL

The purpose of this section is to describe Allison 4th Generation Controls features and components.

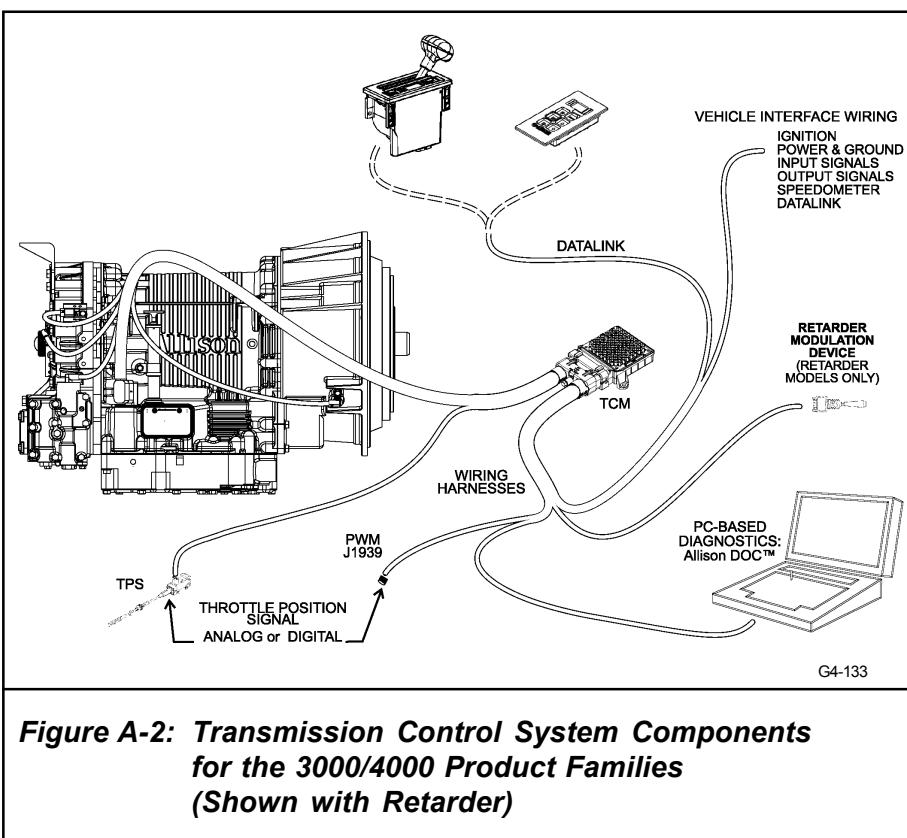
Unless otherwise noted, all documents referred to in this document may be found in the Tech Data section of the Extranet on the Allison Transmission website at [www.allison-transmission.com](http://www.allison-transmission.com). Contact your Allison representative if you do not have access to the Allison Transmission Extranet.

## 2.0 CONTROLS SYSTEM OVERVIEW

The Allison 4th Generation Controls system provides the functional control for Allison transmissions. The transmission control system consists of the components shown in Figure A-1 for the 1000 and 2000 Product Family. Figure A-2 shows the control system components for the 3000 and 4000 Product Families.



**Figure A-1: Transmission Control System Components for the 1000/2000 Product Families**



**Figure A-2: Transmission Control System Components for the 3000/4000 Product Families (Shown with Retarder)**

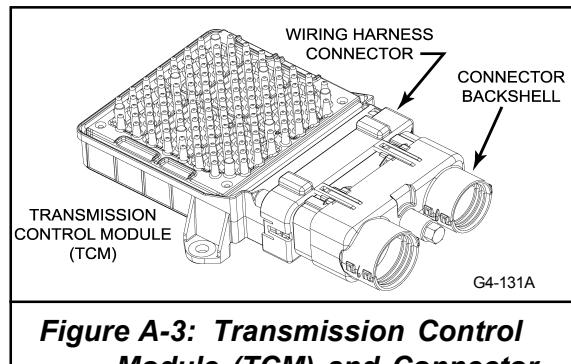
### 3.0 TRANSMISSION CONTROL MODULE (TCM)

The TCM (Figure A-3) provides functional control of the transmission, including:

- Transmission Shifting - the TCM commands the transmission to make shifts requested by the operator and to make automatic upshifts and downshifts. The transmission shift schedules are based on the desired number of gear ranges and the shift speed, typically based on the engine governed speed. Both performance and economy shift schedules are available. The vehicle builder specifies the shift schedule using the Customer Specification Sheet (CSS) on the Allison Transmission Extranet. Refer to *Section B, System Operation*, for more information on transmission shifting and shift schedules.
- Adaptive Controls - optimize shift quality. See Section 3.1.
- Diagnostics - assist in troubleshooting transmission malfunctions and monitor specific operating parameters. Refer to *Section B: System Operation* of this manual for more information.
- Trans ID - assists in matching TCM software to transmission hardware. See Section 3.2.
- Retarder Control (3000/4000 Product Families only) - if the transmission includes a retarder, the TCM controls the retarder operation based on operator input. Refer to section 7.0 and to *Technical Document 175, Guidelines for Selecting Retarder Controls for Allison 4th Generation Controls*.

The TCM also provides the interface with vehicle functions such as:

- Neutral Start - prevents engine from starting when transmission is in a range other than neutral. Refer to *Section D, Vehicle Electrical System Interface*.
- Reverse Warning - signals when transmission is in reverse. Refer to *Section D, Vehicle Electrical System Interface*.
- Vehicle Datalink Communications - The TCM can communicate with other vehicle systems over the SAE J1939 datalink, the SAE J1587 datalink or the ISO-9141 communication link. SAE J1587 and ISO-9141 communications are not available in all of the TCM models. Refer to Figure A-4 for datalink availability by TCM model. Refer to *Datalink Communications* on the Extranet for detailed information.



**Figure A-3: Transmission Control Module (TCM) and Connector**

Allison 4th Generation TCM Model	Voltage	Installed Ambient Temperature Limits	Dual Full Feature CAN J1939 & J2284 / ISO 11898	Neutral Start Output	Retarder – 3000 and 4000 Product Families	7-Speed – 3000 and 4000 Product Families	J1708/J1587 Communication 3000 and 4000 Product Families	ISO-9141 (Type 5) and SSF 14230-3 Communication
<b>A41</b> Basic	12		X	X				
<b>A42</b> Expanded	12	Refer to Controls Specifications Section	X	X	X	X	X	
<b>A43</b> Max-Feature	24 or 12		X	X	X	X	X	X

**Figure A-4: Allison 4th Generation TCM Configurations**

- Input and Output Functions - interface the transmission controls with numerous vehicle functions such as PTO operation and transmission shift inhibits. Refer to *Section E: Input and Output Functions* of this manual for detailed information regarding the available functions for your model.
- Autodetect - automatically determines the presence of various features. Refer to Section 3.3.
- Auto Cal - automatic throttle position calibration. Refer to Section 3.4.

Allison offers three different TCM configurations as shown in Figure A-4. The three TCM configurations are externally the same; all of the differences are internal to the TCM. All of the TCM configurations are compatible with 12-volt vehicle electrical systems. The A43 Max-Feature TCM is also compatible with 24-volt vehicle electrical systems.

Refer to the TCM Installation Drawing, AS67-412, for dimensions and mounting information.

### 3.1 ADAPTIVE CONTROLS

"Adaptive shifting" is a basic design feature of the shift controls for these transmission models. Adaptive shifting optimizes shift quality by monitoring critical characteristics of clutch engagement and making continuous adjustments to improve subsequent shifts.

The transmission shift calibration is based on several different types of shifts, e.g. full throttle, part throttle, closed throttle – upshifts, downshifts, etc. Each shift is associated with specific speed and throttle position parameters. In order to optimize each type of shift for normal driving, it is therefore necessary for the shift controls to have experienced operation and shifting in a wide variety of operating conditions. A drive-in period under varied driving conditions is required before the Adaptive Controls can be expected to optimize each and every shift. In general, shift quality will begin to converge to their adapted level after five shifts of a particular shift type.

### 3.2 TRANS ID

The TCM is programmed such that it can identify the configuration of the transmission and select a calibration which is appropriate for that level of hardware. Configuration information is sent from the transmission to the TCM on wire 176. This permits use of a recently-released TCM to support both current and earlier transmission hardware configurations. If a calibration for the identified level of transmission hardware does not exist in the TCM, a diagnostic code is registered. Trans ID works only when the controller and the transmission have the same generation controls. Trans ID will not permit an Allison 4th Generation TCM to control a transmission configured for WTEC-III controls; nor can a WTEC-III ECU be used to control a transmission configured for Allison 4th Generation Controls.

### 3.3 AUTODETECT

Autodetect automatically detects the presence of the transmission components or input signals shown in Figure A-5, thus permitting the use of different features or input signals with a common TCM and reducing calibration proliferation. Autodetect checks for the presence of an input according to the priority shown in Figure A-5. Diagnostic functions relating to each of these items are executed if the feature is detected and used.

Autodetect Priority			
Feature	1st	2nd	3rd
Throttle	TPS	J1587	J1939
Engine Water Temp.	Sensor	J1939	J1587
Oil Level Sensor	Present	Not Present	
Retarder	Present	Not Present	

**Figure A-5: Autodetect Features and Priorities**

**NOTE: SAE J-1587 communication is available only with transmissions in the 3000 and 4000 Product Families using the A42 or A43 TCM models. Refer to Figure A-4.**

**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.**

Similarly, if the TCM is moved from one vehicle to another, Autodetect must be reset with the Allison diagnostic tool in order for the TCM to determine proper settings for the new installation.

### 3.4 AUTO CAL (AUTOMATIC THROTTLE POSITION CALIBRATION)

Auto Cal is another basic feature for installations using the Allison throttle position sensor (TPS) to generate the throttle input signal for the transmission control system. This feature provides automatic compensation for linkage wear and TPS adjustment changes over time, resulting in more consistent shifting over the life of the vehicle. For details regarding the TPS and its features, refer to *Technical Document 178 (TD-178), Throttle Position Sensor (TPS) for Use with Allison Transmissions*.

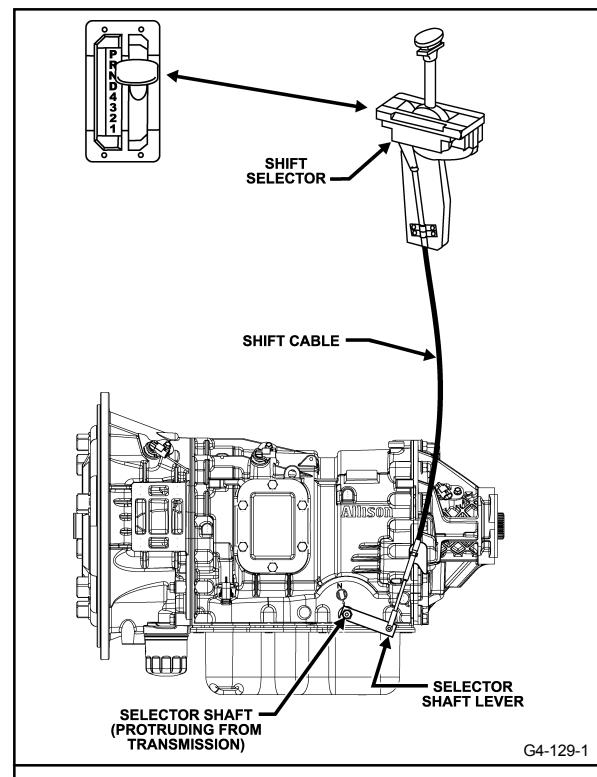
## 4.0 SHIFT SELECTOR

The shift selector is used by the operator to select Neutral (N), Reverse (R), or a forward gear range. 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. The TCM will not command the transmission to shift into 5th gear until the driver selects 5th gear on the selector. On some selectors, the highest available forward gear range is labeled D (Drive).

### 4.1 SHIFT SELECTOR - 1000 & 2000

#### PRODUCT FAMILIES

Transmissions of the 1000/2000 Product Families typically use a mechanical selector as shown in Figure A-6. 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. The transmission shift selector shaft is part of the transmission assembly; all other selector and cable components are customer furnished. Some selector manufacturers offer electronic/electric or air/hydraulic shift control systems for the 1000/2000 transmission. Refer to *Section F: Support Equipment* of this manual for information on selector manufacturers.



**Figure A-6: Typical 1000/2000 Lever Shift Selector**

The typical 1000/2000 shift selector will include provisions to make the following gear selections:

- **P – Park:** Transmission park pawl, if available, is engaged. This position may be used for starting the engine. The Park position is not available on all shift selectors.
- **R – Reverse**
- **N – Neutral:** position may be used for starting the engine
- **5 – Fifth:** highest forward range, overdrive. Transmission shifts to first gear for starting, and will automatically upshift through the gears until fifth (5) gear is attained.
- **4, 2, 1 – forward range selection:** transmission shifts to first gear for starting. The gear selected on the shift selector is the highest gear which will be attained during automatic shifting.

Shift selector manufacturers offer several different shift selector configurations. The appropriate selector configuration for a vehicle depends upon the following:

- whether or not the transmission has a park pawl Refer to the Transmission Configuration Matrix in *1000/2000 Installation Manual Section A: Transmission Familiarization*.
- the shift pattern programmed into the control system. Refer to *Section B: System Operation* of this manual.
- whether or not the vehicle park brake is applied by the shift selector. Refer to *1000/2000 Installation Manual Section G: Park Provisions*.

Transmissions equipped with the park pawl or vehicles with selector-applied park brakes require a shift selector with a position P for Park or 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): Specifications 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.

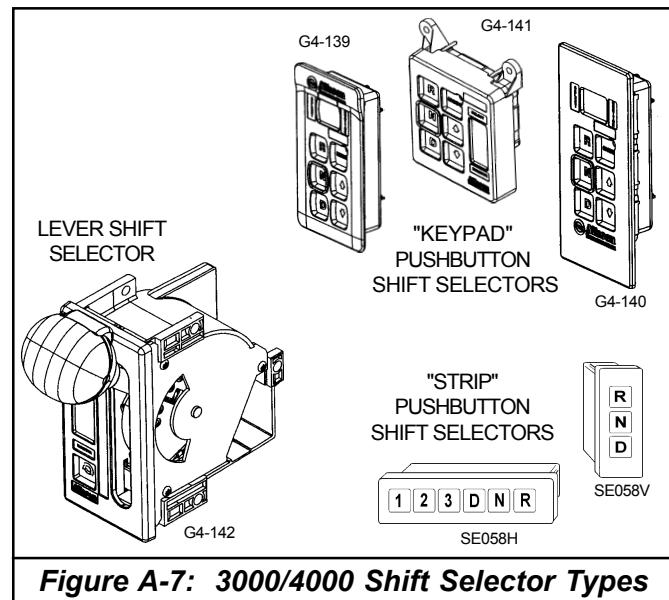
## 4.2 SHIFT SELECTORS – 3000 & 4000 PRODUCT FAMILIES

Allison Transmission offers three types of shift selectors for the 3000 and 4000 Product Families:

- lever
- keypad pushbutton
- strip pushbutton

The various types of shift selectors are illustrated in Figure A-7. Detailed information for each is available on installation drawing AS07-417.

The lever selector is available in several configurations reflecting the variety of gear ranges which are available with these transmission models, including automatic 2–7 with selectable 1st gear, and automatic models 1–6, 1–5, and 1–4. All configurations of the lever selector have identical external dimensions.



**Figure A-7: 3000/4000 Shift Selector Types**

The keypad pushbutton selector is also 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.

All lever selectors and keypad pushbutton 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. All of these components also have a two-digit, vacuum fluorescent display. The display window labeled Select shows the range selected by the operator. The display window labeled Monitor shows the current transmission range. The display window shows transmission diagnostic codes when in the diagnostic mode. Refer to *Section B: System Operation* of this manual.

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 calibration and an economy shift calibration. To determine which input functions may be enabled by the MODE button, refer to *Input/Output Packages* for your model under Allison 4th Generation Controls on the Extranet.

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

- Range Select and Range Monitor displays - lever and keypad selectors
- MODE Button - lever and keypad selectors
- Range Buttons - keypad selectors only

These illumination lamps may be dimmed using the dash dimmer control. Refer to *Section D: Vehicle Electrical System Interface* of this manual for more information.

The strip pushbutton selector is available in four configurations:

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

The strip pushbutton selectors are not J1939 compatible, nor do they include the two-digit display that is integral to the other types of selectors. The strip pushbutton selectors also have only one level of backlighting for the depressed button, and will not meet some Vehicle Safety Standards without customer-supplied external lighting for dimming.

If the vehicle has two operator's stations, two shifters may be used to control the single transmission. Examples include a dual-station refuse packer or a fire truck with remote controls for operating a split shaft PTO. Refer to *Section C: Controls Component Installation* of this manual for more information.

## 5.0 THROTTLE POSITION INPUT SIGNAL

The TCM can receive throttle position information from one of three sources:

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

The TCM uses Autodetect (see Section 3.3) to determine the source of throttle position information.

**NOTE: Autodetect cannot properly identify a Pulse Width Modulated (PWM) throttle signal. Therefore, the use of a PWM throttle signal must be specified when ordering a TCM calibration.**

## 5.1 ELECTRONIC ENGINE COMMUNICATION - 3000 & 4000 PRODUCT FAMILIES

If the engine is electronically controlled, throttle position data may be communicated from the engine controls to the transmission controls over either the SAE J1587 or SAE J1939 Serial Communication Interface (SCI) data link. Use of the SAE J1587 datalink requires the A42 or A43 TCM. See Figure A-4.

Consultation with Allison Application Engineering may be needed to define the communication details for a particular engine. Refer to *Datalink Communications* in the Tech Data channel of the Extranet.

The transmission wiring harness includes optional provisions to accommodate the connections to the engine or vehicle communication link which provides this data.

## **5.2 NONELECTRONIC 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. The TPS 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 a connection to the controls wiring harness. 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 the TPS installation drawing.

## **5.3 ELECTRONIC ENGINE CONTROLS — PULSE-WIDTH-MODULATED (PWM) SIGNAL**

When used with certain electronically-controlled engines which do not provide a J-1939 data link, the TCM can receive throttle information as a pwm signal from the engine ECM. Signals used in this manner must conform to SAE J-1843. Certain compatibility issues must be reviewed to assure adequate transmission operation when using this configuration. Contact Allison Application Engineering for details.

## **6.0 WIRING HARNESS**

The transmission controls require the use of wiring harnesses to connect the various 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 and 4000 Product Families)
- transmission output speed sensor on the transmission
- serial communication datalink
- the shift selector (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 VIM (3000 & 4000 Product Families)

Harnesses may consist of a single piece, or may be divided into multiple segments joined by bulk-head connectors.

Electrical connectors located on the transmission or Allison-supplied control components are illustrated and described on the Connector and Harness Attachment Information installation drawing. All wiring harnesses and connectors which mate to Allison connectors / components are customer supplied. For wiring harness specification details, refer to *Technical Document 173 (TD-173), Wiring Harnesses for Allison Transmissions Equipped with Allison 4th Generation Controls*. Refer to *Allison 4th Generation Controls Specifications* for electrical requirements for the control system such as voltage, current, and loads.

## 7.0 RETARDER CONTROL – 3000 & 4000 PRODUCT FAMILIES ONLY

### 7.1 RETARDER 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 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 — ranging from none, up to the maximum available from the specific retarder / transmission configuration in use. The TCM processes the request in conjunction with other input data which defines the current operating status of the transmission and vehicle. The TCM turns the retarder on at the requested level when conditions are appropriate for retarder operation.

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 4th Generation Retarder Controls*.

### 7.2 RETARDER CAPACITY

A choice of maximum retarder capacities are available for each transmission model. Low, medium or high retarder capacity must be specified when ordering the TCM. Refer to the Transmission Specifications section for your transmission model for a definition of the available retarder capacities.

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* of this manual.

## 8.0 VEHICLE INTERFACE MODULE (VIM) - 3000 & 4000 PRODUCT FAMILIES

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. Refer to AS07-452, the VIM installation drawing.

In some cases, the OEM or Body Builder may choose not to use the Allison VIM. In these cases, the vehicle manufacturer specifies and installs components which interface with the transmission control system.

## 9.0 REMOTE DISPLAY

A customer-furnished, remote display may be used to display transmission status information and service information as broadcast over the vehicle datalink. Such information may include the transmission range selected, transmission range attained, check transmission indicator, sump temperature indicator, and diagnostic codes. The transmission control system supports two serial communication links which transmit transmission operational data in industry standard format, Society of Automotive Engineers (SAE) standards J1587 and J1939. J1939 is applicable to all transmission

models. J1587 capability is available only with 3000 and 4000 Product Family transmission models using A42 and A43 TCM models.

Design and interface requirements for a customer-supplied remote display should be consistent with data stream protocol, format, speed, etc. as defined by the appropriate SAE recommended practice. For detailed information, refer to the appropriate document under *Datalink Communications*.

## REVISION HISTORY

### **MARCH 9, 2005**

In paragraph 3.3, added note to complete controls installation before initial engine startup.

### **DECEMBER 1, 2004**

Revised description of PWM signal, paragraph 5.3.

### **OCTOBER 25, 2004**

Clarified availability of J1587, paragraphs 3.3 and 9.0.

### **OCTOBER 15, 2004**

A43 TCM renamed from "Universal" to "Max-Feature". Added TD-178 references for TPS. Added descriptive detail for shift selectors, paragraph 4.2.

### **JUNE 3, 2004**

Created new *Section A: Familiarization & Component Selection* for Allison 4th Generation Controls.