Troubleshooting Manual

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TS3989EN

Allison Transmission

Open front screen

VOCATIONAL MODELS

3000 VOCATIONAL MODELS

3000 HS	3500 RDS		B 300(P)(R)
3000 RDS	3500 EVS		B 400(P)(R)
3000 EVS			T 200
3000 MH			T 300
3000 PTS			
3000 TRV			
3200 SP	3500 SP	3700 SP	
3200 TRV			

4000 VOCATIONAL MODELS

4000 EVS	4500 EVS	4700 EVS	4800 EVS	B 500
4000 HS	4500 HS	4700 RDS		B 500P
4000 MH	4500 RDS	4700 OFS		B 500R
4000 RDS	4500 SP			B 500PR
4000 TRV	4500 TRV			T 425
				T 450

Allison Transmission

Allison Transmission, Inc.
P.O. Box 894 Indianapolis, Indiana 46206-0894
www.allisontransmission.com

Printed in USA

FOREWORD — How to Use This Manual

This manual provides troubleshooting information for the 3000 and 4000 Product Families Transmissions. Service Manuals SM4013EN and SM4014EN, plus Parts Catalogs PC2150EN and PC2456EN may be used in conjunction with this manual.

This manual includes:

- Description of the 3000 and 4000 Product Families Allison 4TH Generation Electronic Control system.
- Description of the electronic control system components.
- Description of diagnostic codes, system responses to faults, and troubleshooting.
- Wire, terminal, and connector repair information.

Specific instructions for using many of the available or required service tools and equipment are not included in this manual. The service tool manufacturer will furnish instructions for using the tools or equipment.

Additional information may be published from time to time in Service Information Letters (SIL) and will be included in future revisions of this and other manuals. Please use these SILs to obtain up-to-date information concerning Allison Transmission products.

This publication is revised periodically to include improvements, new models, special tools, and procedures. A revision is indicated by a new date on the title page and in the lower left corner of the rear cover. Check with your Allison Transmission service outlet for the currently applicable publication. Additional copies of this publication may be purchased from authorized Allison Transmission service outlets. Look in your telephone directory under the heading of Transmissions — Truck, Tractor, etc.

Take time to review the Table of Contents and the manual. Reviewing the Table of Contents will aid you in quickly locating information.

NOTE: ***Allison Transmission is providing for service of wiring harnesses and wiring harness components as follows:***

- ***Repair parts for the internal wiring harness and for wiring harness components attached to the shift selector will be available through the Allison Transmission Parts Distribution Center (PDC). Use the P/N from your appropriate parts catalog or from Appendix E in this manual. Allison Transmission (AT) is responsible for warranty on these parts.***
- ***Repair parts for the external harnesses and external harness components must be obtained from St. Clair Technologies Inc. (SCTI). SCTI provides parts to any Allison customer or OEM and is responsible for warranty on these parts. SCTI recognizes AT, manufacturers, and SCTI part numbers. SCTI provides a technical HELPLINE at 519-627-1673 (Wallaceburg). SCTI will have parts catalogs available. The SCTI addresses and phone numbers for parts outlets are:***

St. Clair Technologies, Inc.
920 Old Glass Road
Wallaceburg, Ontario, N8A 4L8
Phone: 519-627-1673
Fax: 519-627-4227

St. Clair Technologies, Inc.
Calle Damanti S/N Col
Guadalupe—Guaymas
Sonora, Mexico 85440
Phone: 011-526-2222-43834
Fax: 011-526 2222-43553

IMPORTANT SAFETY NOTICE

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

Also, be sure to review and observe WARNINGS, CAUTIONS, and NOTES provided by the vehicle manufacturer and/or body builder before servicing the Allison transmission in that vehicle.

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

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

WARNINGS, CAUTIONS, AND NOTES

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

WARNING!	**Is used when an operating procedure, practice, etc., which, if not correctly followed, could result in injury or loss of life.**

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

NOTE: Is used when an operating procedure, practice, etc., is essential to highlight.

TRADEMARKS USED IN THIS MANUAL

The following trademarks are the property of the companies indicated:

- Allison DOC™ is a trademark of General Motors Corporation.
- DEXRON® is a registered trademark of General Motors Corporation.
- LPS® Cleaner is a registered trademark of LPS Laboratories.
- Loctite® is a registered trademark of the Loctite Corporation.
- MagiKey® is a registered trademark of NEXIQ Technologies, Inc.
- Teflon® is a registered trademark of the DuPont Corporation.
- TranSynd™ is a trademark of Castrol Ltd.

SHIFT SELECTOR TERMS AND DISPLAY INDICATIONS

Shift selector terms and displays are represented in this manual as follows:

- Button Names — ↑, ↓, "display mode", **MODE**, etc.
- Transmission Ranges — **D** (Drive), **N** (Neutral), **R** (Reverse), **1** (First), **2** (Second), etc.
- Displays — "**o**, **L**"; "**o**, **K**", etc. (Display occurs one character at a time.)

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APPENDICES

NOTES

SECTION 1—GENERAL DESCRIPTION

1–1. TRANSMISSION

The Allison 4th Generation Controls feature closed-loop clutch control to provide superior shift quality over a wide range of operating conditions. The 3000 and 4000 Product Families transmissions configurations can be programmed to have up to six forward ranges, neutral, and one reverse range. The 3700 SP, 4700 RDS, 4700/4800 EVS, 4700/4800 SP, and 4700 OFS have up to seven forward ranges and one reverse.

Figure 1–1 is a block diagram of the basic system inputs and outputs.

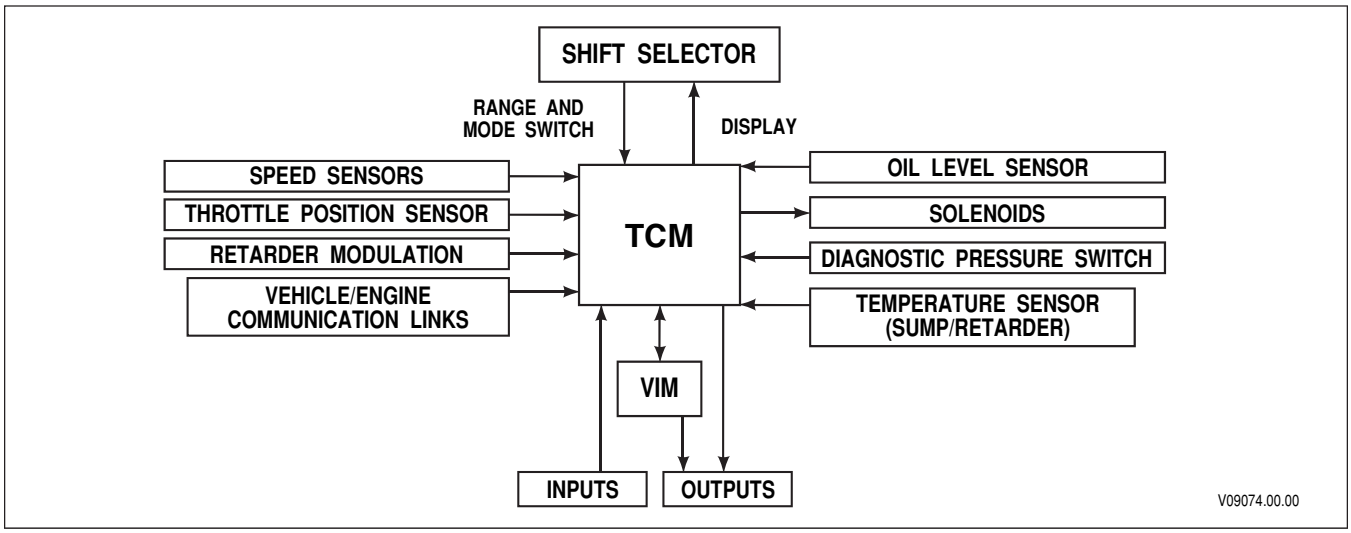

Figure 1–1. Transmission Control Module

Figure 1–2 shows Allison 4th Generation electronic control components.

Allison 4th Generation Controls consist of the following elements:

- Remote 12V or 12/24V Max Feature Sealed Transmission Control Module (TCM)
- Remote Pushbutton or Lever Shift Selector
- Optional Secondary Shift Selector
- Throttle Position Sensor (TPS) (or electronic engine throttle data or PWM signal)
- Engine, Turbine, and Output Speed Sensors
- Control Module (Electro-Hydraulic Valve Body)
- Wiring Harnesses
- Vehicle Interface Module (VIM)
- Autodetect Feature
- TransID Feature
- Optional Retarder Controls
- Optional Engine Coolant Temperature Input.

NOTE: • ***All external harnesses are OEM supplied.***

• ***The VIM is an OEM option.***

GENERAL DESCRIPTION

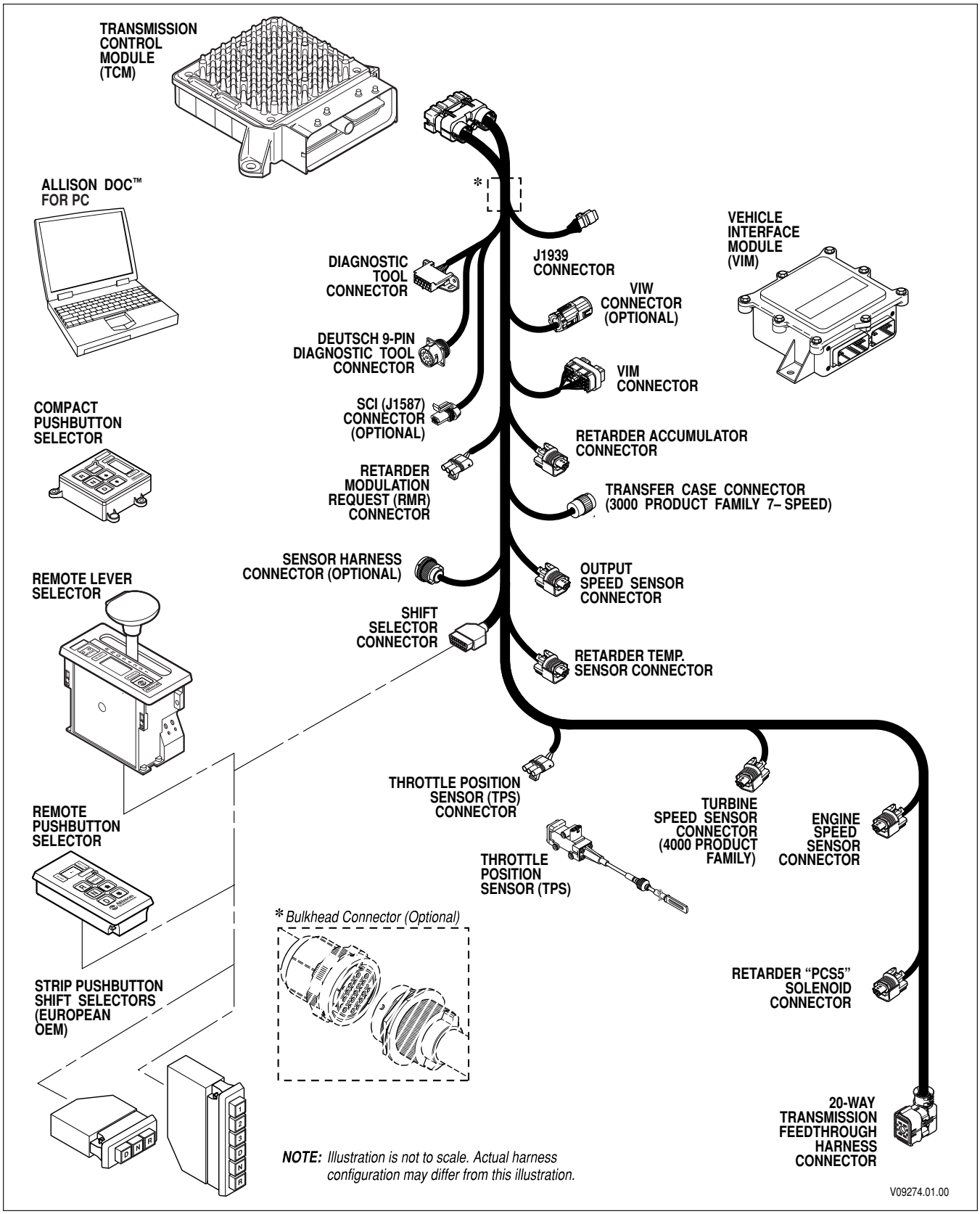

Figure 1–2. Typical Allison 4th Generation Control Components

GENERAL DESCRIPTION

1–2. TRANSMISSION CONTROL MODULE (TCM)

The electronic control of the transmission is performed by a microcomputer. The microcomputer is an independent controller and is referred to as a Transmission Control Module (TCM). TCMs are available in both 12V and 12/24V configurations to match the configuration of the vehicle electrical system.

The TCM (Figure 1–3) contains the microcomputer which is the brain of the control system. The TCM receives and processes information defining:

- Shift selector
- Throttle position
- Sump/retarder temperature
- Pressure switch state
- Engine speed
- Turbine speed
- Transmission output speed.

The TCM uses the information to:

- Control transmission solenoids
- Supply system status
- Provide diagnostic information.

Each TCM has a date code laser etched on the outer case of the TCM. This is the date when the TCM passed final testing. This date is commonly used to denote the change configuration level of the TCM. It is normal for the TCM date displayed electronically to be a few days prior to the date shown on the label.

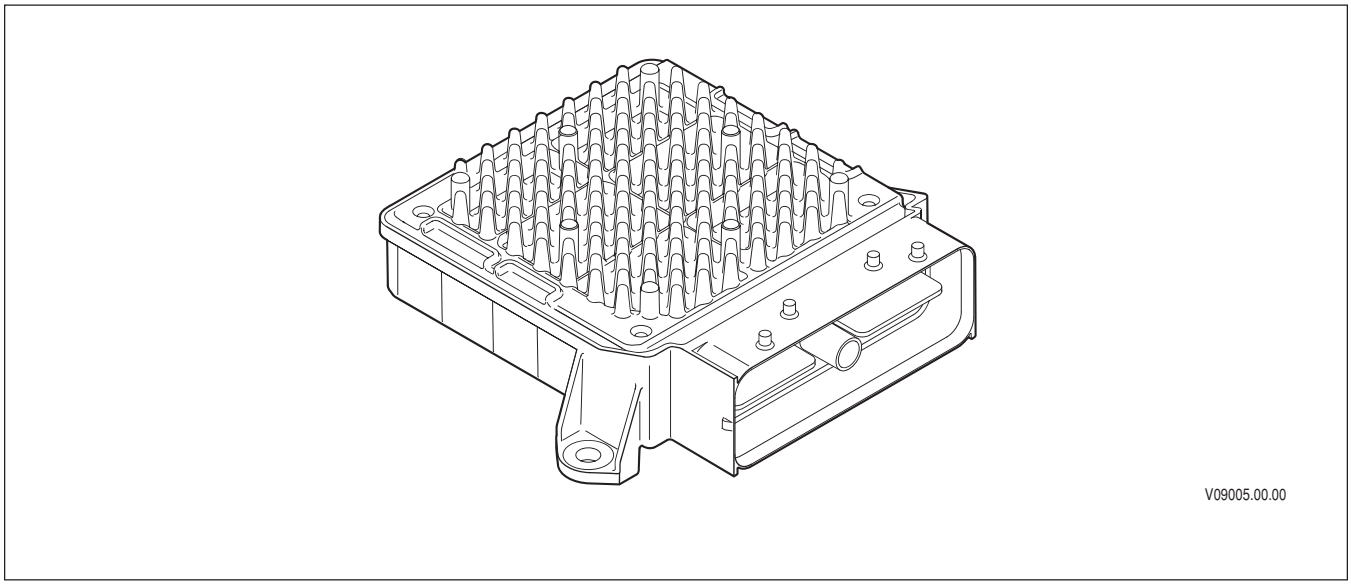

Figure 1–3. Transmission Control Module (TCM)

GENERAL DESCRIPTION

1–3. SHIFT SELECTOR

Pushbutton and lever shift selectors for the Allison 4th Generation Series are remote mounted from the TCM and communicate to the TCM via the J1939 communications data link. All shift selectors except the strip-type pushbutton have a dual digit vacuum fluorescent (VF) display and a mode indicator (LED). During normal transmission operation, illumination of the LED indicator shows that a secondary or special operating condition has been selected by pressing the **MODE** button. During diagnostic display mode, illumination of the LED indicator shows that the displayed diagnostic code is active. Display brightness is regulated by the same vehicle potentiometer that controls dash light display brightness. More information on both types of shift selectors is continued below.

A. Pushbutton Shift Selector *(Figure 1–4)*

There are three full-function pushbutton shift selectors and a strip pushbutton shift selector. Strip pushbutton shift selectors are used primarily by non-North American OEMs. A full-function shift selector has a **MODE** button and diagnostic display capability through the dual digit vacuum fluorescent (VF) display. The strip pushbutton shift selector does not have a **MODE** button, diagnostic capability, or adjustable illumination. The full-function pushbutton shift selector has six (6) pushbuttons which are **R** (Reverse), **N** (Neutral), **D** (Drive), ↓ (Down), ↑ (Up), and **MODE**. Manual forward range downshifts and upshifts are made by pressing the ↓ (Down) or ↑ (Up) arrow buttons after selecting **D** (Drive). The **N** (Neutral) button has a raised lip to aid in finding it by touch. The **MODE** button is pressed to select a secondary or special operating condition, such as ECONOMY shift schedule. Diagnostic information is obtained by pressing the ↑ (Up) and ↓ (Down) arrow buttons at the same time.

The strip pushbutton shift selector has either three or six range selection positions as shown in Figure 1–4. When a strip pushbutton shift selector is used, diagnostic information must be obtained by using the Allison DOC™ For PC–Service Tool, or a customer-furnished remote display.

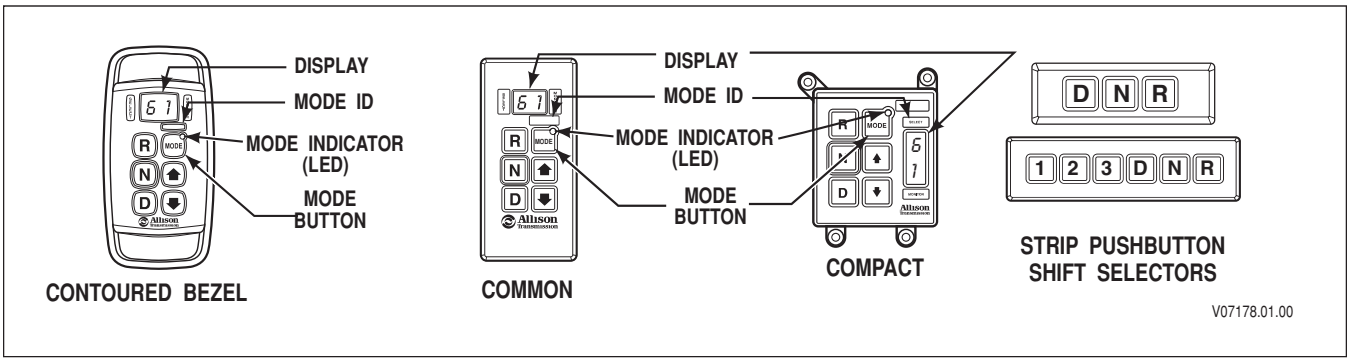

Figure 1–4. Typical Pushbutton Shift Selectors

GENERAL DESCRIPTION

B. Lever Shift Selector *(Figure 1–5)*

The lever shift selector can have as many as six forward range positions (seven for the 7-speed models), as well as **R** (Reverse) and **N** (Neutral). There is a hold override button which **must be pressed** and held in order to move between certain selector positions. The hold override button **must be pressed** when shifting between **R**, **N,** and **D**. The hold override button is released when the desired selector position is reached. The selector lever can be moved freely between **D** and the numbered forward ranges without pressing the hold override button. The lever selector can be chosen with the lever on the left side or on the right side and with the **R** (Reverse) position toward the front or toward the rear of the selector. Diagnostic and oil level (if sensor is present) information is obtained from the LED display by pressing the "display mode" button.

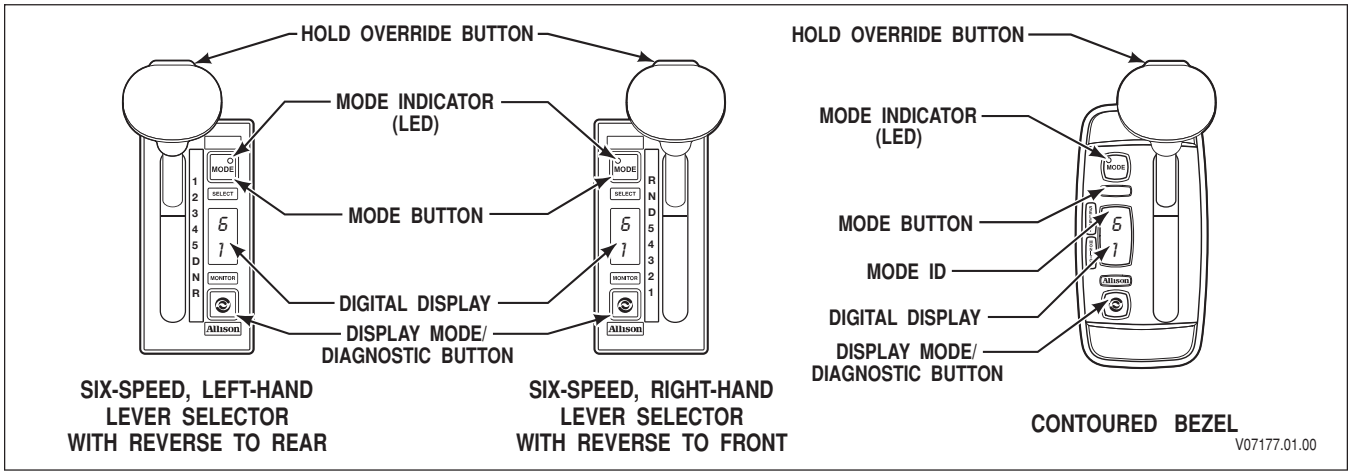

Figure 1–5. Typical Lever Shift Selector

1–4. THROTTLE POSITION SENSOR *(Figure 1–6)*

The Throttle Position Sensor (TPS) can be mounted to the engine, chassis, or transmission. The TPS contains a pull actuation cable and a potentiometer. One end of the cable is attached to the engine fuel lever and the other, inside a protective housing, to the TPS potentiometer. Output voltage from the TPS is directed to the TCM through the external harness. The voltage signal indicates the throttle position and, in combination with other input data, determines shift timing.

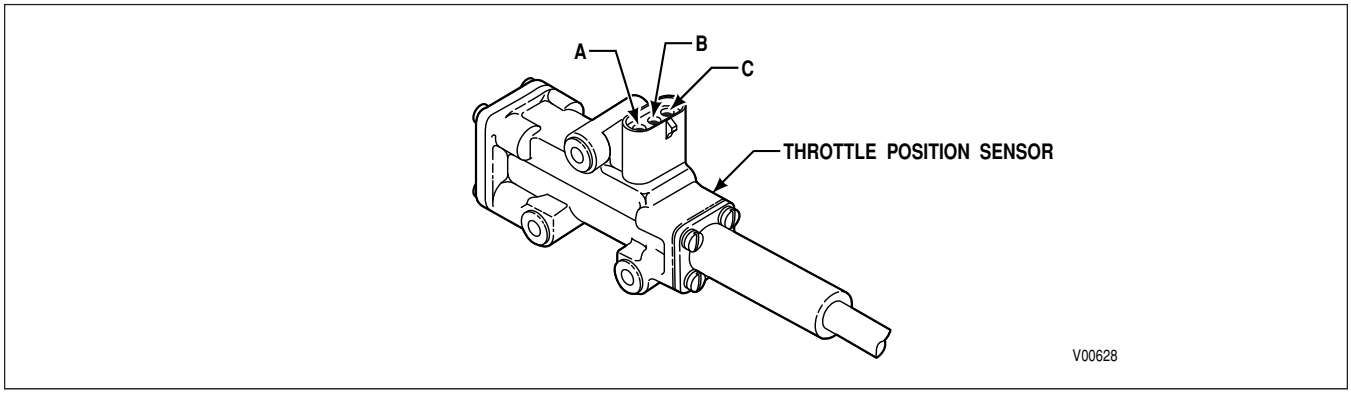

Figure 1–6. Throttle Position Sensor (Without Mounting Brackets)

GENERAL DESCRIPTION

1–5. SPEED SENSORS *(Figure 1–7)*

Three speed sensors—engine speed, turbine speed, and output speed—provide information to the TCM. The engine speed signal is generated by ribs on the shell of the torque converter pump. The turbine speed signal is generated by the rotating-clutch housing spline contours. The output speed signal is generated by a toothed member attached to the output shaft (except for the 3000 Product Family 7-speed models, where the toothed member is the transfer case idler gear). The speed ratios between the various speed sensors allow the TCM to determine if the transmission is in the selected range. Speed sensor information is also used to control the timing of clutch apply pressures, resulting in the smoothest shifts possible. Hydraulic problems are detected by comparing the speed sensor information for the current range to that range's speed sensor information stored in the TCM memory.

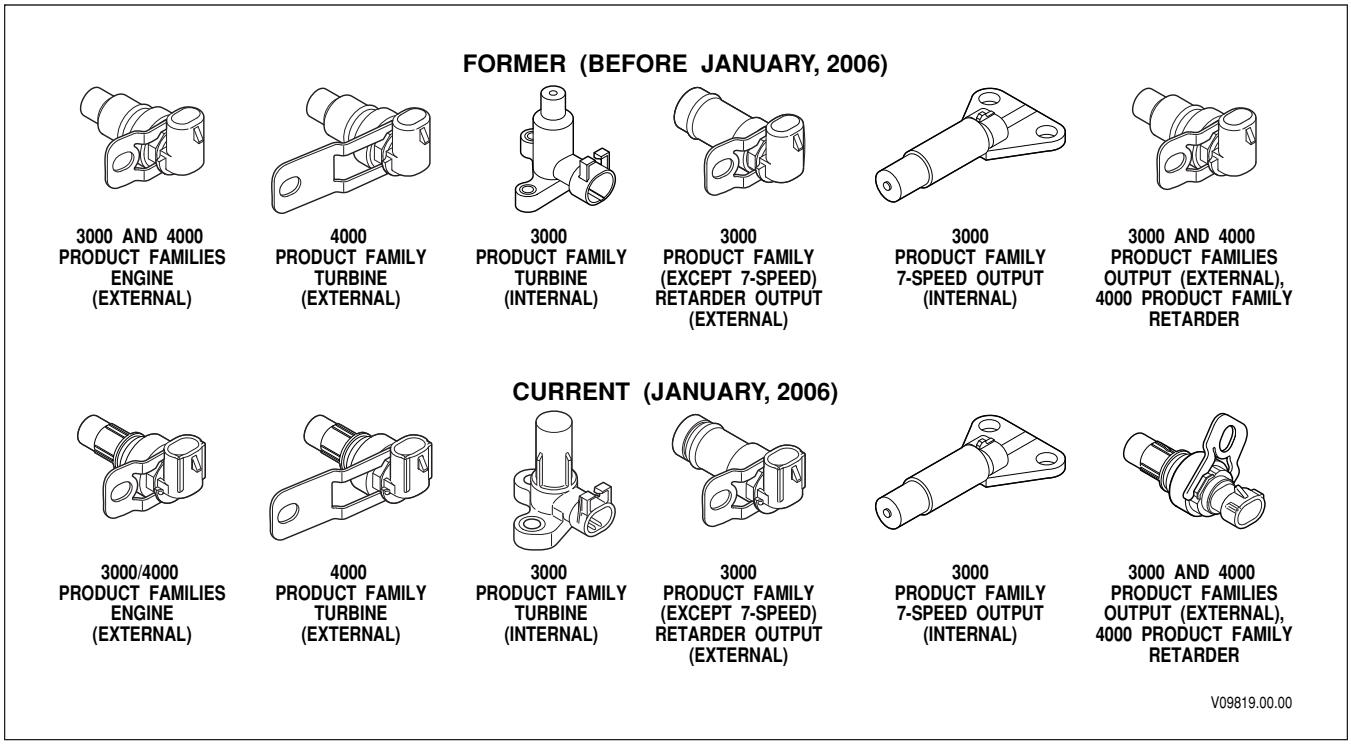

Figure 1–7. Speed Sensors

GENERAL DESCRIPTION

1–6. CONTROL MODULE *(Figure 1–8)*

The Allison 4th Generation Series transmission control module contains a main body assembly and solenoid valve body assembly, which are mounted to an aluminum channel plate. The TCM issues commands to various solenoids in the two valve bodies to govern fluid flow to the clutches (including torque converter clutch). The solenoids produce an output pressure that is proportional to current from the TCM. Hence, the solenoids are referred to as pressure control solenoids (PCS).

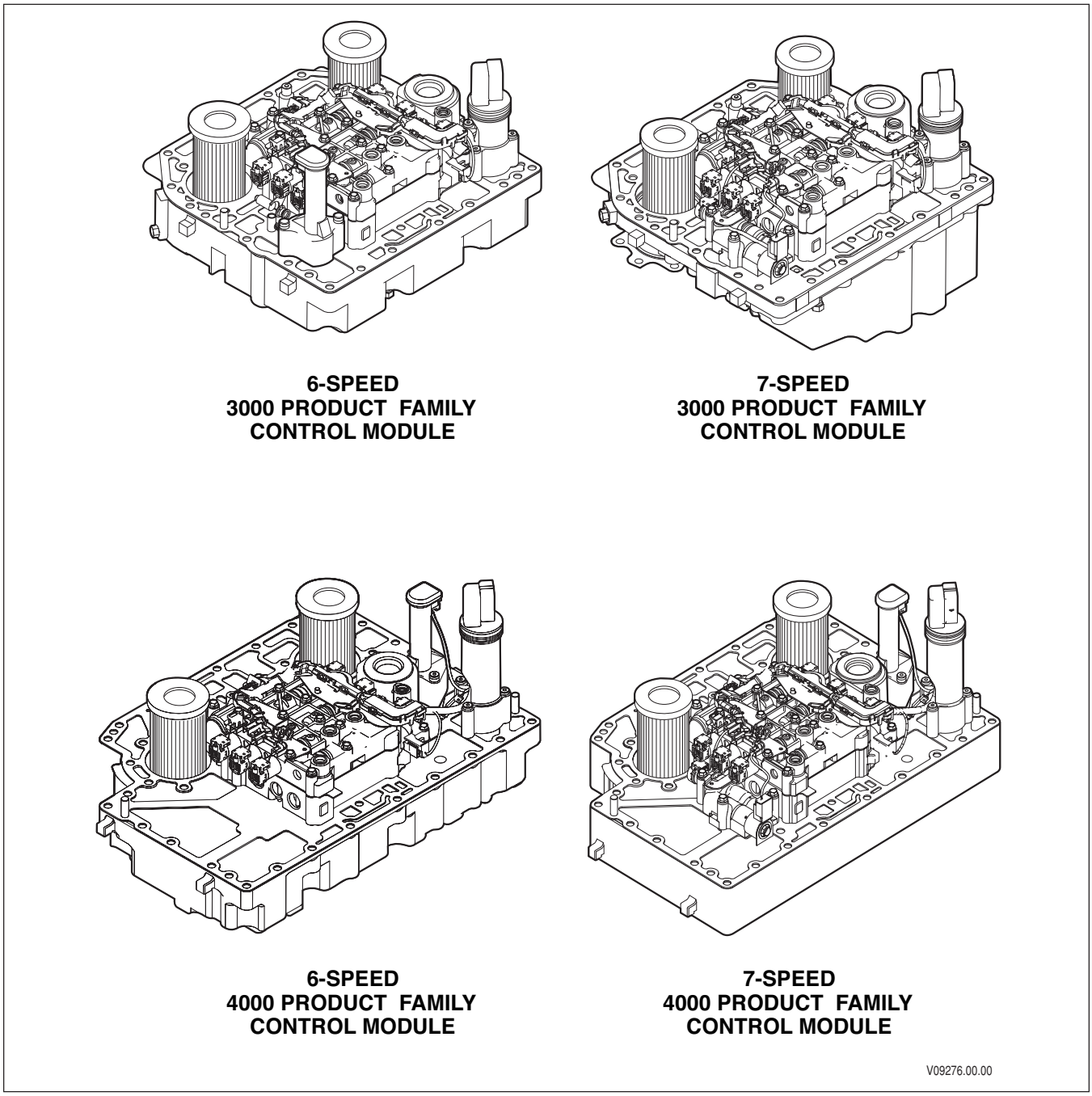

Figure 1–8. Allison 4th Generation Control Modules

GENERAL DESCRIPTION

The main valve body assembly contains the following:

- Main pressure regulator valve
- Control main regulator valve
- Converter flow valve
- Lube regulator valve
- Converter regulator valve
- Exhaust backfill valve
- Two latching logic valves
- On/Off solenoid SS1.

The solenoid valve body assembly contains the following:

- Pressure control solenoid MAIN MOD
- PCS1 (A trim)
- PCS2 (B trim)
- PCS3 (C trim)
- PCS4 (D trim)
- TCC (lockup)
- Diagnostic pressure switch PS1
- Five solenoid regulator valves
- One diagnostic valve.

The low valve body assembly (in 3000 and 4000 Product Families 7-speed models) contains solenoid PCS6 (C6) and one ON/OFF solenoid SS2 (C6 enable). Refer to the appropriate service manual for valve locations.

The Allison 4th Generation controls system includes a main modulation solenoid. Modulated main pressure results in improved cooler flow and reduced pump losses when throttle position and output speed is low. The Allison 4th Generation Controls TCM commands the main mod solenoid ON when all of the following conditions are simultaneously met:

- Sump temperature is greater than 30ºC (86ºF) and less than 150ºC (302ºF) [greater than –5ºC (23ºF) and less than 225ºC (437ºF) for 4700 and 4800 model transmissions].
- Engine speed less than 1200 rpm in all ranges except neutral. There are no restrictions on engine speed in neutral.
- Throttle percentage less than 15 percent in reverse, low (7-speed), first, or second range. Main mod may be commanded ON in neutral at any throttle position.
- Output speed is less than 250 rpm in neutral, reverse, low (7-speed), first, or second range.
- The PTO input to the TCM indicates the PTO is OFF.
- Shift not in progress.

The TCM may activate the main mod solenoid for improved clutch control and transmission response during other unusual operating situations.

A temperature sensor (thermistor) is located in the internal wiring harness. Changes in sump fluid temperature are indicated by changes in sensor resistance, which changes the signal sent to the TCM. Refer to the chart in Appendix Q.

The oil level sensor (OLS) is a float type device mounted on the control module channel plate. The OLS senses transmission fluid level by electronically measuring the buoyancy forces on the float. The sensor operates on 5VDC supplied by the TCM. The oil level sensor is available on any 3000 and 4000 Product Families transmissions except the 3000 7-speed transmissions.

GENERAL DESCRIPTION

The diagnostic pressure switch PS1 is mounted on the solenoid valve body assembly and performs the following two functions:

- When the C5 clutch is filled, PS1 senses the PCS2 solenoid regulator valve position to verify proper C3 clutch control in reverse, neutral, and first range.
- When the C5 clutch is exhausted, as in second through sixth ranges, PS1 verifies the position of the C1 and C2 latch valves.

The turbine speed sensor is mounted on the control module for the 3000 Product Family transmissions. The turbine speed sensor is directed at the rotating-clutch housing. The turbine speed sensor on the 4000 Product Family transmission is located on the outside of the main housing.

1–7. WIRING HARNESSES

A. External Wiring Harness *(Figure 1–9)*

The TCM uses a single 80-way connector, which is used to receive input from the following:

Transmission	TPS	Diagnostic tool connector
Engine	Vehicle interface module (VIM)	Retarder
Turbine	Retarder control module	Retarder temperature sensor
Output speed sensor	Shift selector	Accumulator

Many harnesses will include a bulkhead fitting to separate cab and chassis components. Also, many different styles and materials for harnesses are likely to be encountered.

NOTE: Allison Transmission is providing for service of wiring harnesses and wiring harness components as follows:

- ***Repair parts for the internal wiring harness and for wiring harness components attached to the shift selector will be available through the Allison Transmission Parts Distribution Center (PDC). Use the P/N from your appropriate parts catalog or from Appendix E in this manual. Allison Transmission is responsible for warranty on these parts.***
- ***Repair parts for the external harnesses and external harness components must be obtained from St. Clair Technologies Inc. (SCTI). SCTI provides parts to any Allison customer or OEM and is responsible for warranty on these parts. SCTI recognizes Allison Transmission, manufacturers, and SCTI part numbers. SCTI provides a technical HELPLINE at 519-627-1673 (Wallaceburg). SCTI will have parts catalogs available. The SCTI addresses and phone numbers for parts outlets are:***

St. Clair Technologies, Inc.
920 Old Glass Road
Wallaceburg, Ontario, Canada N8A 4L8
Phone: 519-627-1673
Fax: 519-627-4227

St. Clair Technologies, Inc.
Calle Damanti S/N Col
Guadalupe—Guaymas
Sonora, Mexico 85440
Phone: 011-526 2222-43834
Fax: 011-526-2222-43553

- ***SCTI is the source for external harness repair parts.***

GENERAL DESCRIPTION

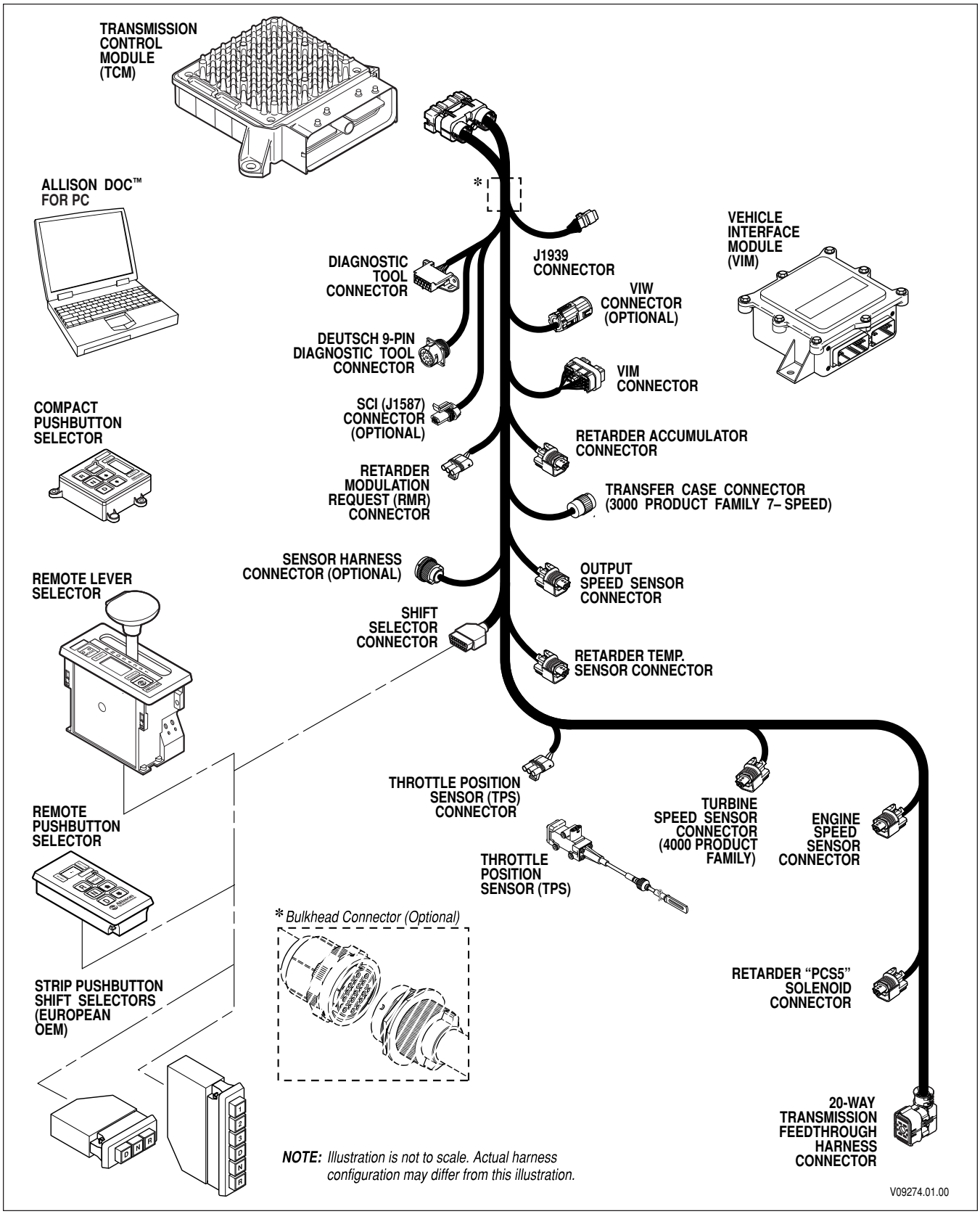

Figure 1–9. Typical 4th Generation Electronic Controls External Wiring Harnesses

GENERAL DESCRIPTION

B. Internal Wiring Harness *(Figure 1–10)*

The internal wiring harness provides connection between the following:

- External harness
- Pressure control and shift solenoids
- Oil level sensor
- Diagnostic pressure switch
- Temperature sensor
- Turbine speed sensor.

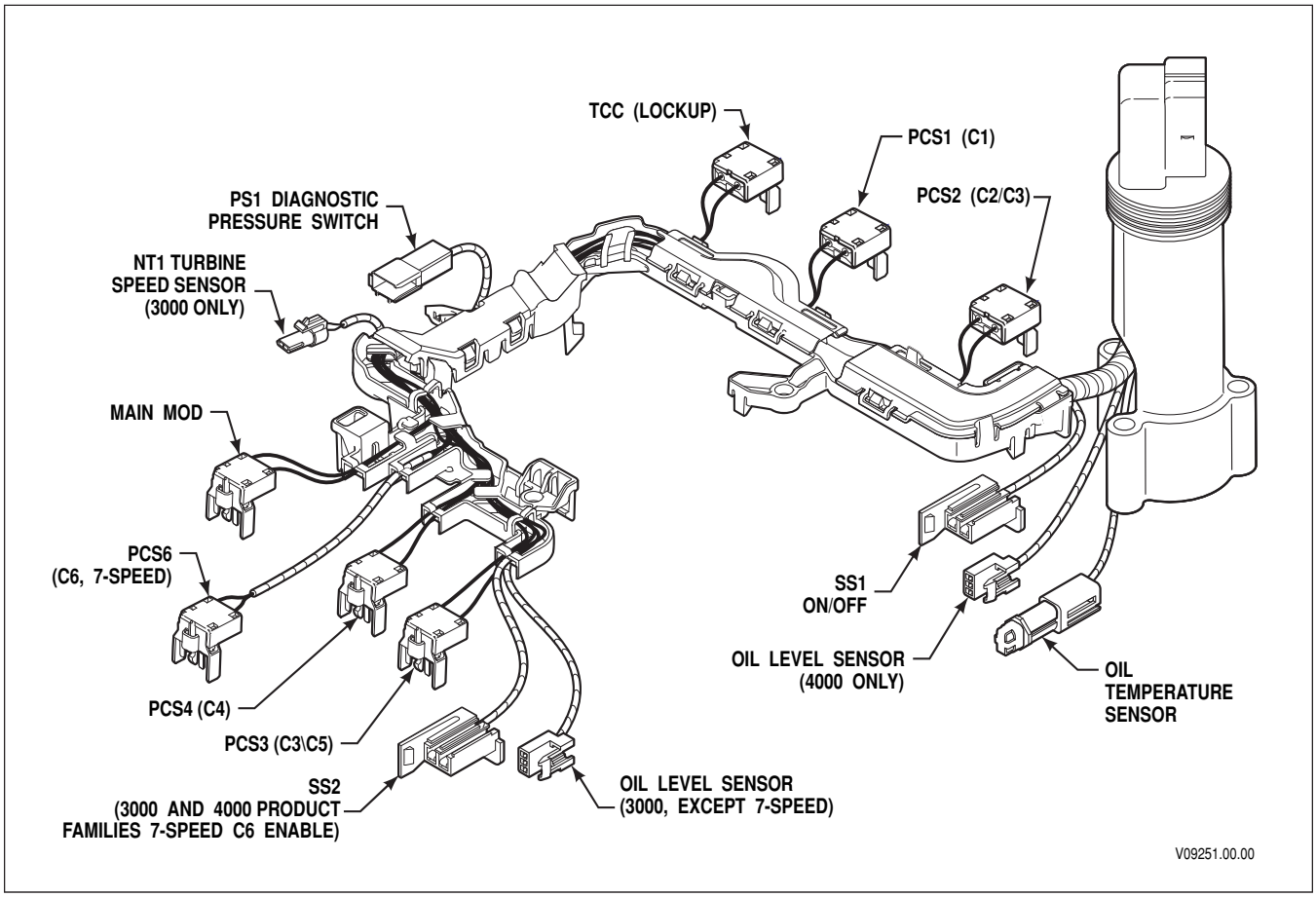

Figure 1–10. Allison 4th Generation Internal Wiring Harness

GENERAL DESCRIPTION

1–8. VEHICLE INTERFACE MODULE *(Figure 1–11)*

The vehicle interface module (VIM) provides relays, fuses, and connection points for interface with the output side of the vehicle electrical system. VIMs are available for both 12V and 24V electrical systems. The VIM for 12V systems uses all 12V relays. The VIM for 24V systems has all 24V relays. Refer to the appropriate parts catalog for the transmission assembly number that you are servicing for detailed parts information. Refer to Pages D–15 and D–16 for VIM wire number and terminal information.

Some OEMs may provide their own equivalent for the VIM which performs the same functions as the VIM shown in Figure 1–11.

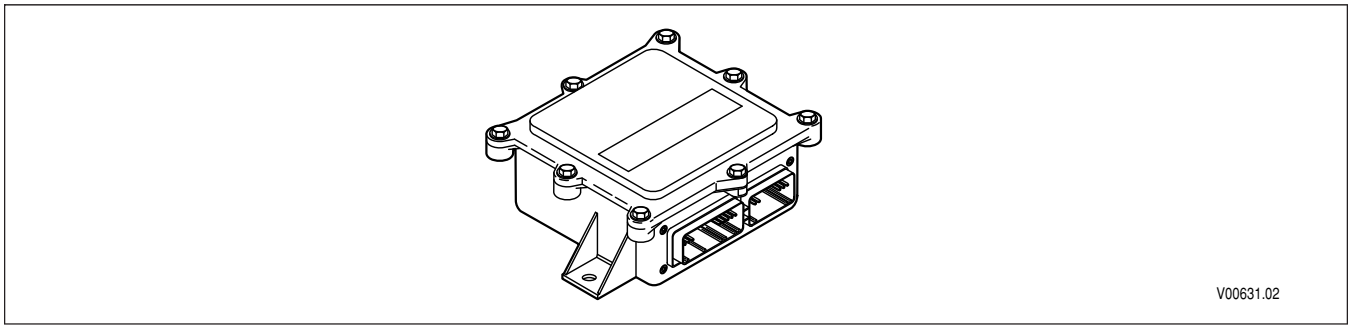

Figure 1–11. Vehicle Interface Module (VIM)

1–9. AUTODETECT FEATURE

Autodetect is active on the first 25 engine starts and, in the case of throttle source detection logic, may continue past 25 ignition cycles until a valid source is determined (details follow in A through D below). Autodetect takes place within the first 30 seconds of each engine start monitored. Autodetect searches for the presence of the following transmission components or data inputs in the priority listed:

Retarder	Present, Not Present
Oil Lever Sensor (OLS)	Present, Not Present
Throttle	TPS, J1587, J1939
Engine Coolant Temperature	Sensor, J1939, J1587

Even after autodetect has been completed, it can be reset to monitor an additional group of engine starts. Reset may be necessary if a device known to be present is not detected or if an autodetectable component or sensor was added after the initial vehicle build. Reset is accomplished by using Allison DOC™ For PC–Service Tool. To use the Allison DOC™ For PC–Service Tool, select “RESET AUTODETECT” to search for all four devices. Select “RESET AUTODETECT RETARDER” to search for a retarder only. Selecting “RESET ADAPTIVE SHIFT PARAMETERS” **will not reset** autodetect logic.

The Allison DOC™ For PC–Service Tool can also be used to override autodetect and manually enter the component or sensor to be recognized by the TCM by changing appropriate “customer modifiable constants” (CMC). The four items above are the only CMCs that are autodetectable. Other CMCs can be changed at any time and are not related to autodetect. Consult the Allison DOC™ User’s Guide, GN3433EN, for, detailed instructions related to Allison 4th Generation Controls CMC. Additional details for each of the four autodetectable features are given below.

GENERAL DESCRIPTION

A. Retarder

Autodetect searches for the presence of pressure control solenoid 5 (PCS5) to the retarder during the first 35 engine ignition cycles. Retarder autodetect will countdown for a maximum of 35 ignition cycles while recording detections of a retarder. A retarder will be identified as present and the retarder autodetect logic will stop once it is detected for three consecutive ignition cycles. If the ignition cycle counter completes the 35 cycles before there are three consecutive detections of a retarder, the software will log that there is no retarder and the retarder autodetect logic will stop. If the autodetect logic is not satisfied during the first 35 engine starts, the retarder is not detected and will not function on subsequent engine starts.

WARNING: **If a retarder is present but is not detected by autodetect, the retarder will not function. Be sure to determine that the retarder is functioning properly immediately after the 35th engine start. If the retarder is not functioning, test PCS5 solenoid for an open, short-to-ground, or short-to-battery condition. Use the Allison DOC™ For PC–Service Tool to reset retarder autodetect or to manually select the presence of the retarder after the PCS5 circuit is repaired.**

B. Oil Level Sensor (OLS)

NOTE: ***If an OLS is known to be present, but has not been detected, a possible cause is that the transmission fluid level is too low. Determine the fluid level before beginning the OLS troubleshooting.***

Oil level sensor autodetect will countdown for a maximum of 25 engine starts while recording detections of an OLS. The TCM monitors the OLS input voltage on wire 116. OLS input voltage **must exceed** a predetermined level for the TCM to record a detection. Additionally, OLS detection **must occur** within 12.5 seconds on any given engine start. An OLS will be identified as present and the OLS autodetect logic will stop once it is detected during any single engine start.

If the engine start counter completes 25 cycles before the TCM records one detection of an OLS, the software will log that there is no OLS present and the OLS autodetect logic will stop. Then the TCM concludes that no OLS is present.

No OLS diagnostics take place until the OLS is detected. Frequently test for the presence of oil level diagnostics if the transmission is known to contain an OLS. If an OLS is known to be present, but has not been detected, troubleshooting the OLS circuit is required. After the OLS circuit is repaired, reset autodetect or manually select the OLS function using the Allison DOC™ For PC–Service Tool.

C. Throttle Source

Throttle autodetect will increment a counter for a throttle source on each engine start during which the possible throttle source is detected. When the counter for any of the sources indicates five consecutive detections, the software will set a “confidence flag” to indicate that this is an available throttle source. Multiple throttle sources can be detected on a single engine start and multiple confidence flags can be set. There is no limit to the number of engine starts for autodetection of the throttle source until a confidence flag is set for a source. Once a confidence flag is set for any one of the sources, a counter begins to countdown for 15 additional engine starts. During the entire autodetect period, the software will use the highest priority source as the throttle source if multiple sources are detected before any confidence flags are set. Once a confidence flag is set, that source is

used as the source for the throttle signal. When the countdown period is complete, the software will use the highest priority throttle source having a confidence flag set and the autodetect logic will stop.

D. Engine Coolant Temperature

Engine coolant temperature sensor autodetect will countdown for a total of 25 engine starts while recording detections of engine coolant temperature sources. A "confidence flag" will be set once a source is detected for five consecutive engine starts. Multiple sources detected before a confidence flag is set or multiple confidence flags will result in the highest priority source being used as the engine coolant temperature source. Multiple sources can be detected on a single engine start cycle.

1–10. TRANSID (TID)

The TransID feature enables the TCM to recognize various transmission hardware configurations and select an appropriate software calibration. However, if a matching calibration does not exist in memory, the TCM registers a diagnostic code. Furthermore, TID only works when the controller and transmission have the same generation controls. Thus, TID will not allow an Allison 4th Generation TCM to recognize a transmission with WTEC III controls, nor will TID allow a WTEC III ECU to recognize a transmission with Allison 4th Generation Controls.

The TCM senses the transmission configuration using TID wire 176. In initial versions of Allison 4th Generation Controls, wire 176 is connected to high side driver 1 (HSD1), wire 111, in the internal wiring harness. HSD1 supplies power to PCS6 and MAIN MOD solenoids. This wiring configuration is designated TID A.

Whenever a TID level change is to be made, the new TID level calibration will be added to the PROM Calibration Configurator System (PCCS) before the change (s) is (are) made in production to the transmissions. All TCMs programmed and sold after that date will be loaded with the new TID calibration. These TCMs will contain calibrations for the new level transmission and all previous TID levels and will automatically load the correct calibration for the transmission based on the TID signal sensed by Autodetect during the first 25 engine starts.

SECTION 2—DEFINITIONS AND ABBREVIATIONS

2–1. CHECK TRANS LIGHT

When the TCM detects a serious fault, the **CHECK TRANS** light (usually located on the vehicle instrument panel) illuminates and action is automatically taken to protect operator, vehicle, and the transmission. A diagnostic trouble code (DTC) will nearly always be registered when the **CHECK TRANS** light is on; however, not all diagnostic codes will turn on the **CHECK TRANS** light. Codes related to the **CHECK TRANS** light are detailed in the diagnostic trouble code chart (refer to Section 6).

Illumination of the **CHECK TRANS** light indicates that a condition was detected that requires service attention. Operation may or may not be restricted. Even when operation is restricted, the vehicle can be operated to reach a service assistance location. Depending upon the cause for the **CHECK TRANS** light illumination, the TCM may or may not respond to shift selector requests. The transmission may be locked in a range. That range will be shown on the shift selector display. Both upshifts and downshifts may be restricted when the **CHECK TRANS** light is illuminated. Seek service assistance as soon as possible.

Each time the engine is started, the **CHECK TRANS** light illuminates briefly and then goes off. This momentary lighting shows the light circuit is working properly. If the light does not come on during engine start, request service immediately.

2–2. ALLISON TRANSMISSION DIAGNOSTIC TOOL

Allison DOC™ (Diagnostic Optimized Connection) For PC–Service Tool is a PC-based diagnostic tool for use with 3000 and 4000 Product Families transmissions. The Allison DOC™ For PC–Service Tool is a full-feature diagnostic software application supporting the Allison 4th Generation Control System. When installed on the user's own PC, it will allow the technician to acquire data from the transmission's control system and through the use of embedded troubleshooting manuals, conduct systematic troubleshooting of transmission complaints.

Basic Features

Allison DOC™ For PC–Service Tool uses a Windows® style graphical user interface (GUI) and includes:

- User selected views of multiple transmission parameters
- Active and historical diagnostic trouble codes (DTCs)
- Graphical instrument panel view of transmission parameters
- Strip chart function
- User configurable Snapshot function
- User configurable Print function
- Code driven links to embedded Allison 4th Generation Control System Troubleshooting Manuals
- Reprogramming capability (available after satisfying Allison Transmission training certification requirements)
- Demo Mode which allows the user to practice the program without being connected to a vehicle
- New animated screen by screen help support (found in Help, Video-based training materials, Allison DOC™ For PC–Service Tool Training Videos)
- Application Configuration—This menu function serves as the platform for three different features:
  (1) General tab, which allows the user to select language (English only at this time), and unit of measure.
  (2) TCM Reprogramming tab, used to enable the reprogramming capability of the Allison DOC™ For PC–Service Tool.
  (3) Update Application tab, will access a web URL that will contain minor updates for the diagnostic tool to support changes in the various transmission control systems.
- Data Bus Viewer allows the user to capture (see and save) the raw data transmitted on the various vehicle data buses supported by Allison DOC™ For PC–Service Tool (J1939, and J1850)

DEFINITIONS AND ABBREVIATIONS

- Printed user's manual and laminated Job Aid Card
- Adobe® Acrobat® 5.0 bundled on the CD for reading the Troubleshooting Manual
- Microsoft® Media Player® 6.4 and 7.0 bundled on the CD for displaying various and updated training videos (available from the application Help menu).

PC Platform Definition

Allison DOC™ For PC–Service Tool has been tested with and is known to operate on PCs with the following configurations*:

- Microsoft® Windows® XP® Professional and Window® 2000 (SP4 or later)
- 600 MB free hard drive space required to install the program (sufficient free hard disk space will be required by the operating system after the software installation to run the program)
- 128 MB of RAM (256 MB or greater recommended)
- Pentium® III Processor—800MHz (Pentium® IV, 2.0GHz or greater recommended)
- Internet connection capability (Internet Explorer 5.0.1 or greater). (A broadband Internet connection is highly recommended for receiving updates and file downloads.)
- One available USB port—USB 1.1 (USB 2.0 recommended)
- 16x CD-ROM (48x or greater recommended)
- Full administrative privileges are required to install, update, and run Allison DOC™ and Allison TCM Reflash
- A PCMCIA slot might be required depending on the type of Softing CAN product being used as a translator device (if any)

NOTE:

- Error messages, sudden disconnections, and poor performance are some of the results users will experience if Allison DOC™ For PC-Service Tool V6.0.0 is installed on PCs that do not meet one or more of the above specifications.
- For the latest requirements, please refer to ***www.allisontransmission.com/Service/Electronic (Diagnostic) Tools/Requirements*** or the latest revision of Service Information Letter 25-TR-06.

NOTE: Additional information available in Appendix N.

DEFINITIONS AND ABBREVIATIONS

2–3. ABBREVIATIONS

A/N	Assembly Number
ABS	Anti-lock Brake System—OEM-provided means to detect and prevent wheel stoppage to enhance vehicle handling. Retarder and engine brakes will not apply when ABS is active.
Amp	Unit of electrical current
API	Application Program Interface
AT	Allison Transmission
C1...C6	Clutch 1....Clutch 6
CAN	Controller Area Network—A network for all SAE J1939 communications in a vehicle (engine, transmission, ABS, etc.)
CIN	Calibration Identification Number
CMC	Customer Modified Constant
CPA	Connector Position Assurance
CT	Closed Throttle
DMM	Digital Multimeter
DNA	Does Not Adapt—Adaptive shift control is disabled
DNS	DO NOT SHIFT—Refers to the DO NOT SHIFT diagnostic response during which the CHECK TRANS light is illuminated and the transmission will not shift and will not respond to the Shift Selector
DOC	Diagnostic Optimized Connection
DPA	Dearborn Protocol Adapter
DTC	Diagnostic Trouble Code
DVOM	Digital Volt/Ohmmeter
ECM	Engine Control Module
EMI	ElectroMagnetic Interference
FBO	Feature Based Ordering
FCC	Federal Communications Commission
GPI	General Purpose Input—Input signal to the TCM to request a special operating mode or condition
GPO	General Purpose Output—Output signal from the TCM to control vehicle components (such as PTOs, backup lights, etc.) or allow a special operating mode or condition
GUI	Graphical User Interface
HSD	High Side Driver
J1587	Engine/transmission serial data communications link
J1939	High-speed vehicle serial data communications link
LED	Light-Emitting Diode—Electronic device used for illumination
LRTP	Low Range Torque Protection

DEFINITIONS AND ABBREVIATIONS

2–3. ABBREVIATIONS *(cont'd)*

LSD	Low Side Driver
MB	Mega Byte
NNC	Neutral No Clutches—Neutral commanded with no clutches applied
NVL	Neutral Very Low—The TCM has sensed turbine speed below 150 rpm when output speed is below 100 rpm and engine speed is above 400 rpm when N (Neutral) was selected. This is usually caused by a dragging C1 or C3 clutch or a failed turbine speed sensor. NVL is attained by turning D solenoid "ON" (in addition to E solenoid) and the C4 and C5 clutches are applied to lock the transmission output.
OEM	Original Equipment Manufacturer—Maker of vehicle or equipment
Ohm	Unit of electrical resistance
OL	Over Limit or Oil Level—For Over Limit see "∞". Indicates Oil Level is being displayed on a shift selector
OLS	Oil Level Sensor—Electronic device (optional) on control module for indicating transmission fluid level
PC	Personal Computer
PCCS	PROM Calibration Configurator System
PCS	Pressure Control Solenoid
PLR	Primary Lock Reinforcement (Connector)
P/N	Part Number
PROM	Programmable Read Only Memory
PSS	Primary Shift Selector—Main shift selector in a two-selector control system.
PTO	Power Takeoff
PWM	Pulse Width Modulation
RELS	Reduced Engine Load at Stop
RFI	Radio Frequency Interference
RMR	Retarder Modulation Request—Signal from a retarder control device
RPR	Return to Previous Range—Diagnostic response in which the transmission is commanded to return to previously commanded range
RTDR	Retarder
SCI	Serial Communication Interface—Used to transmit data and messages between the diagnostic tool and the TCM and other systems such as electronically-controlled engines.
SCTI	St. Clair Technologies, Inc.
SEM	Shift Energy Management
S/N	Serial Number
SOH	State Of Health
SOL OFF	All SOLenoids OFF

DEFINITIONS AND ABBREVIATIONS

2–3. ABBREVIATIONS *(cont'd)*

SPI	Serial Peripheral Interface—The means of communication between the microprocessor and the interface circuits
SS	Shift Solenoid
SSS	Secondary Shift Selector—Alternate shift selector in a two-selector control system
TCC	Torque Converter Clutch
TCM	Transmission Control Module
TFT	Transmission Fluid Temperature
TID	TransID—A feature which allows the TCM to know the transmission configuration and provide the corresponding calibration required
TPA	Terminal Position Assurance
TPS	Throttle Position Sensor—Potentiometer for signaling the position of the engine fuel control lever
V	Version—Abbreviation used in describing TCM software levels
VDC	Volts Direct Current (DC)
VF	Vacuum Fluorescent
VIM	Vehicle Interface Module—A watertight box containing relays and fuses—interfaces the transmission electronic control system with components on the vehicle
VIW	Vehicle Interface Wiring—Interfaces TCM programmed input and output functions with the vehicle wiring
Volt	Unit of electrical force
WOT	Wide Open Throttle
∞	Infinity—Condition of a circuit with higher resistance than can be measured, effectively an open circuit

DEFINITIONS AND ABBREVIATIONS

NOTES

SECTION 3—BASIC KNOWLEDGE

3–1. BASIC KNOWLEDGE REQUIRED

To service Allison 4th Generation Controls, the technician must understand basic electrical concepts. Most troubleshooting tests consist of determining resistance, continuity, and testing for shorts between wires and to ground. Technicians need to know how to use a digital volt/ohmmeter (DVOM) to make resistance and continuity tests. The technician should be able to use jumper wires and breakout harnesses and connectors. Technicians unsure of making the required tests should ask questions of experienced personnel or find instruction.

The technician should also have the mechanical aptitude required to connect pressure gauges or transducers to identified pressure ports used in the troubleshooting process. Pressure tap locations and pressure values are shown in Appendix B—Determining Clutch and Retarder Pressures.

Input power, ground, neutral start circuitry, etc., can cause problems with electronic controls or vehicle functioning and may not generate a diagnostic code. A working knowledge of the Allison 4th Generation Controls vehicle installation is necessary in troubleshooting installation-related problems.

Refer to Section 8 for information concerning performance complaints (non-code) troubleshooting. A complete wiring schematic is shown in Appendix J. Refer to the Allison 4th Generation Controls and General Information Sales Tech Data Book for information concerning electronic controls installation and the Installation Checklist. Reliable transmission operation and performance depend upon a correctly installed transmission. Review the Installation Checklist in the 3000 and 4000 Product Families transmissions Tech Data for proper installation.

NOTE: ***Allison Transmission is providing for service of wiring harnesses and wiring harness components as follows:***

- ***Repair parts for the internal wiring harness and for wiring harness components attached to the shift selector will be available through the Allison Transmission Parts Distribution Center (PDC). Use the P/N from your appropriate parts catalog or from Appendix E in this manual. Allison Transmission is responsible for warranty on these parts.***
- ***Repair parts for the external harnesses and external harness components must be obtained from St. Clair Technologies Inc. (SCTI). SCTI provides parts to any Allison customer or OEM and is responsible for warranty on these parts. SCTI recognizes Allison Transmission, manufacturers, and SCTI part numbers. SCTI provides a technical HELPLINE at 519-627-1673 (Wallaceburg). SCTI will have parts catalogs available. The SCTI addresses and phone numbers for parts outlets are:***

St. Clair Technologies, Inc.
920 Old Glass Road
Wallaceburg, Ontario, Canada N8A 4L8
Phone: 519-627-1673
Fax: 519-627-4227

St. Clair Technologies, Inc.
Calle Damanti S/N Col
Guadalupe—Guaymas
Sonora, Mexico 85440
Phone: 011-526 2222-43834
Fax: 011-526-2222-43553

3–2. USING THE TROUBLESHOOTING MANUAL

Use this manual as an aid to troubleshooting the Allison 4th Generation Controls. Every possible problem and its solution cannot be encompassed by any manual. However, this manual does provide a starting point from which most problems can be resolved.

Once a problem solution is discovered in the manual do not look further for other solutions. It is necessary to determine *why* a problem occurred. The root cause of a problem as well as the symptom **must be** corrected to be sure of trouble-free operation. For example, taping a wire that has been rubbing on a frame rail will not correct the problem unless the rubbing contact is eliminated.

BASIC KNOWLEDGE

3–3. SYSTEM OVERVIEW

Allison 4th Generation Control functions are controlled by the TCM. The TCM reads the following to determine when to command a shift:

- Shift selector range selection
- Output speed
- Throttle position.

In order to control the oncoming and off-going clutches during a shift, the TCM monitors:

- Turbine speed
- Output speed
- Throttle position.

When the TCM detects an electrical fault, it logs a diagnostic code indicating the faulty circuit and may alter the transmission operation to prevent or reduce damage.

When the TCM detects a non-electrical problem while trying to make a shift, the TCM may try that shift a second or third time before setting a diagnostic code. Once that shift has been retried, and a fault is still detected, the TCM sets a diagnostic code and holds the transmission in a fail-to-range mode of operation.

3–4. IMPORTANT INFORMATION IN THE TROUBLESHOOTING PROCESS

A. Before Beginning Troubleshooting

Before beginning the troubleshooting process, read and understand the following:

- Allison Transmission recommended wire numbers (i.e. 158) all use a “1” for the first digit and the pin-out information at the TCM for the second and third digits.
- Shut off the engine and ignition before any harness connectors are disconnected or connected.
- Remember to do the following when testing for shorts and opens:
  - — Minimize movement of wiring harnesses when looking for shorts. Shorts involve wire-to-wire or wire-to-ground contacts and moving the harnesses may eliminate the problem.
  - — Wiggle connectors, harnesses, and splices when looking for opens. This simulates vehicle movements which occur during actual operation.
- When disconnecting a harness connector, be sure the pulling force is applied to the connector itself and **not the wires** extending from the connector.
- Resistance tests involving wiring between the TCM connector and other components adds about one Ohm of resistance to the component resistance shown.
- Inspect all connector terminals for damage. Terminals may have been bent or lost the necessary tension to maintain firm contact.
- Clean dirty terminals or connectors with isopropyl alcohol and a cotton swab, or a good quality, non-residue, non-lubricating, cleaning solvent such as LPS Electro Contact Cleaner® or LPS NoFlash Electro Contact Cleaner®.