Troubleshooting Manual

2016 AUGUST

TS7870EN

Allison Transmission

Commercial Electronic Controls 5 (CEC5)

5000, 6000, 8000 and 9000 Product Families

Allison Transmission, Inc.
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Section 1—ESSENTIAL TOOLS FOR TROUBLESHOOTING AND CALIBRATION

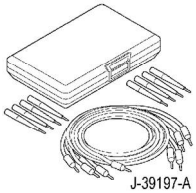
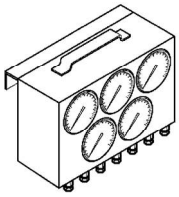
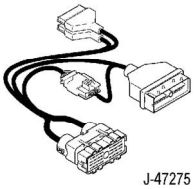
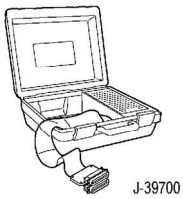
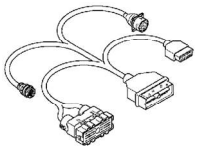
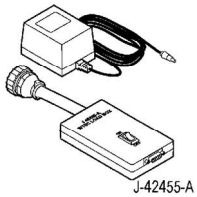
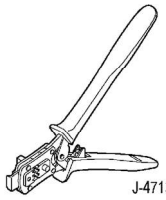
1–1. GENERAL TOOLS INFORMATION

All tools listed are essential for overhaul, maintenance, and/or recalibration of the Off Highway CEC5 electronic and electrical systems. The tools listed below are available for purchase from the Allison Web Store at *https://allison.noregon.com* and from:

Bosch Automotive Service Solutions
28635 Mound Rd.
Warren, Michigan 48092
1-800-821-3036
https://allison.service-solutions.com

1–2. ESSENTIAL TOOLS LIST

Table 1–1. Bosch Essential Tools

 J-39197-A	J-39197 Jumper Wire Kit or J-39197-A Jumper Wire Kit **NOTE:** J 47277 Terminal Probe is now included in the J-39197-A Jumper Kit.	 J-34520-A	J-46708 High Impedance Digital Multimeter or equivalent
 J-47943	J-47943-A DPA4 (Plus) USB Translator Device Kit or J-47943 DPA4 (Plus) USB Translator Device Kit		J-26417-A Pressure Gauge Set or equivalent
 J-47275	J-47275 TCM Breakout Harness Adapter **NOTE:** Used with J-39700 Universal Breakout Box.	 J-39700	J-39700 Universal Breakout Box
 J-47276	J-47276 “T” Breakout and TCM Reflashing Harness	 J-42455-A	J-42455-A Load Box
 J-38125-12A	Terminal Remover (80-way connector) GM P/N 12094429 J-38125-12A Terminal Remover (80-way connector)	 J-47139	J-47139 Former Crimper, 63811-6000 Current Crimper

NOTE: Seek approval from the OEM prior to installing a 3-button or 6-button strip style shift selector in any vehicle that is currently not equipped with this style shift selector. To comply with all Vehicle Safety Standards, there must be OEM installed external lighting or dimming functionality in applications with this style shift selector.

I. Dual Stations or Multiple Transmission Control.

The Off-Highway CEC5 transmission controls and calibrations are capable of operating in vehicles with selectors at two operator stations. Listed below are the requirements for installations with two shift selectors.

- Either Selector 1 or Selector 2 can be used for driving the vehicle or for the auxiliary operation.
- The TCM must distinguish between the selectors in order to associate the correct shift calibration with the appropriate selector. The installation of a jumper wire from pin 5 to pin 6 at the selector 2 connector is required to identify selector 2.
- Selector 2 must be a SAE J1939-based shift selector. Allison lever and keypad selectors, which communicate with the TCM over the SAE J1939 datalink and selector direction signal wire 134, are acceptable for use as Selector 2.
- Allison strip shift selectors are not SAE J1939-based, and therefore may not be used as Selector 2. All other combinations are compatible, as shown in Table 2–1.

Table 2–1. Acceptable Combinations of Shift Selectors in Two-Selector Installations

SELECTOR 1 MAY BE ANY OF THE FOLLOWING:	SELECTOR 2 MAY BE ANY OF THE FOLLOWING:
• Allison lever selector • Allison keypad pushbutton selector • Allison strip pushbutton selector • OEM-supplied, SAE J1939-based selector	• Allison lever selector • Allison keypad pushbutton selector • OEM-supplied, SAE J1939-based selector

2–4. THROTTLE POSITION SENSOR (TPS)

The TPS can be mounted to the engine, chassis, or transmission. The TPS (refer to Figure 2–7) contains a pull actuation cable and a potentiometer. One end of the cable is attached to the engine fuel lever and the other is attached to the TPS potentiometer inside a protective housing. 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.

2–8. VEHICLE INTERFACE MODULE (VIM)

The VIM provides relays, fuses, and connection points to interface with 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 parts catalog for the transmission assembly number that you are servicing for detailed parts information.

Some OEMs may provide their own equivalent for the VIM which performs the same functions as the VIM shown (refer to Figure 2–15).

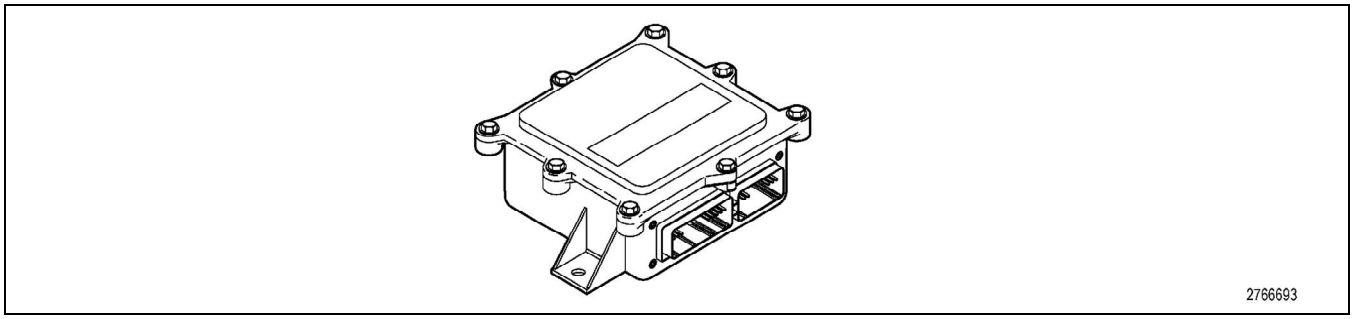


Figure 2–15. VEHICLE INTERFACE MODULE (VIM)

2–9. AUTODETECT FEATURE

Autodetect is active on the first 25 engine starts and may continue past 25 ignition cycles until a valid source is determined. Autodetect takes place within the first 30 seconds of each engine start monitored. Autodetect searches for the presence of the following transmission component or data inputs as listed:

- Oil Level Sensor (OLS)

Even after auotdetect 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 Universal Allison DOC®, select “RESET AUTODETECT” and search for both devices.

NOTE: The Universal Allison DOC® can also be used to override autodetect and manually enter the component or sensor to be recognized by the TCM by changing appropriate CMCs. The two 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 Guide GN7588EN for detailed instructions related to CEC5 controls, refer to A. Oil Level Sensor (OLS).

A. 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 112. 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.

(9.51 quarts) low from the full mark. The actual fluid volume to drain may be more than 6 liters (6.34 quarts) if the transmission is overfull by more than 6 liters (6.43 quarts).

Full Function Pushbutton or Lever Shift Selectors

NOTE: The full-function pushbutton and lever shift selectors can display two characters at one time. One character is displayed under the SELECT label and one under the MONITOR label.

1. Park the vehicle on a level surface and shift to **N** (Neutral). Apply the parking brake.
2. To enter oil level display mode:
   - Pushbutton shift selector—simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrow buttons once.
   - Lever shift selector—press the **DISPLAY MODE/DIAGNOSTIC** (DMD) pushbutton once.

NOTE: The TCM may delay the fluid level check until the following conditions are met:

- The fluid temperature is above 140 °F (60 °C) or below 220 °F (104 °C).
- The transmission is in **N** (Neutral).
- The vehicle has been stationary for approximately two minutes to allow the fluid to settle.
- The engine is at idle.

Indication of a delayed fluid level check for Allison CEC5 controls is a flashing display under SELECT label and a digit countdown from 8 to 1 under MONITOR label.

3. Correct fluid level is reported when “o L” is displayed (o L” indicates the Oil Level Check Mode), followed by “o K o K”. The “o K” display indicates the fluid level is within the correct fluid level zone. The sensor display and the transmission dipstick may not agree exactly because the oil level sensor compensates for fluid temperature. Example: “o L o K o K” indicates correct fluid level.
4. Low fluid level is reported when “o L” is displayed followed by “L o” and a number. “L o” indicates a low fluid level and the number indicates the number of quarts of fluid the transmission requires. Confirm a low fluid level condition by making a manual fluid level check. Example: “o L L o 0 2” indicates two additional quarts of fluid will bring the fluid level within the middle of the “O K” zone.
5. High fluid level (o L H I 0 #) is reported when “o L” is displayed, followed by “H I” and a number. “H I” indicates high fluid level and the number indicates the number of quarts the transmission is overfilled. Example: “O L H I 0 1” indicates one quart of fluid above the full level.

CAUTION: A low or high fluid level causes overheating and irregular shift patterns; if not corrected, transmission damage can occur.

6. To exit the oil level display mode:
   - Pushbutton shift selector—press any pushbutton once.
   - Lever shift selector—press the **MODE** button once or move the lever.

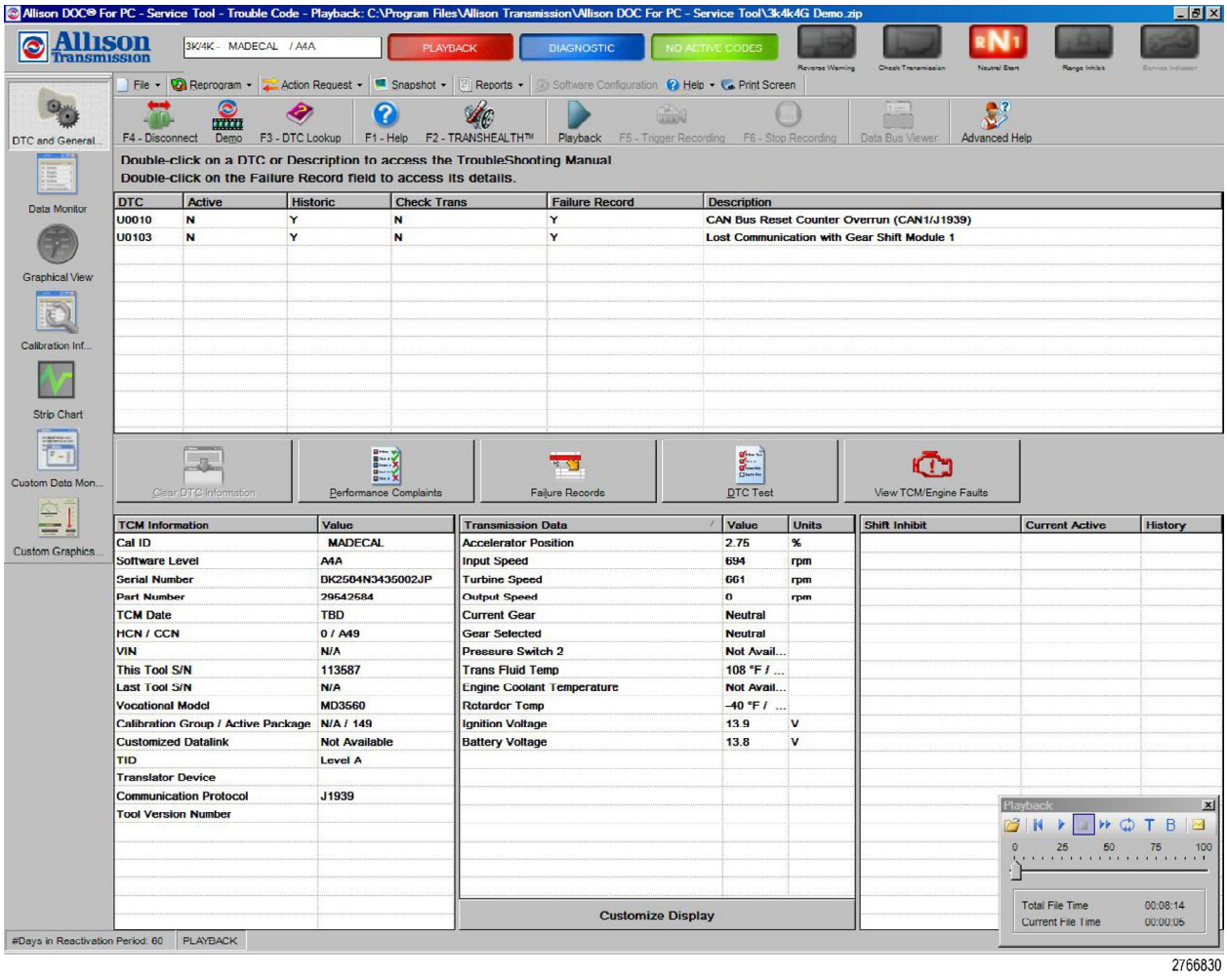


Figure 4–1. Universal Allison DOC® Home Screen

In the DTC and General Information window of Universal Allison DOC®, double-click the DTC number or DTC description to display troubleshooting steps. Adobe®Acrobat® Reader displays the Troubleshooting Manual page appropriate for the DTC.

B. Clearing DTCs.

1. In the DTC and General Information window, click the **Clear DTC Information** button.
2. A window appears displaying the message, “Clear DTC Information Request Completed Successfully!”
3. Click the **OK** button.

All DTCs and associated information are cleared from the DTC and General Information window. Shift Inhibits are also cleared with this command button. If the cause of the DTC is not corrected, the DTC may immediately reappear.

NOTE: To clear all DTCs, the vehicle must be stopped and in **N** (Neutral). If these conditions are not met, a message will display “Request Denied. Output Speed not less than maximum allowable value.” or “Neutral not attained.”

DTC GROUP 1 High Side Driver 1 and F, G, and B Solenoids *(cont'd)*

Active Indicator Clearing Procedure

- Power down
- Manual

NOTE: Before troubleshooting, review 4–2. BEGINNING THE TROUBLESHOOTING PROCESS, and refer to F–1. STANDARD WIRING CHECKS, G–1. ADVANCED TROUBLESHOOTING, and I–1. NON-APPROVED WIRE CHECKS.

Clutch Pressure Tap Locations

Refer to K–1. PRESSURE TAP LOCATIONS.

Clutches Engaged and Solenoids Energized per Gear

Refer to J–1. CLUTCHES AND SOLENOIDS.

Troubleshooting

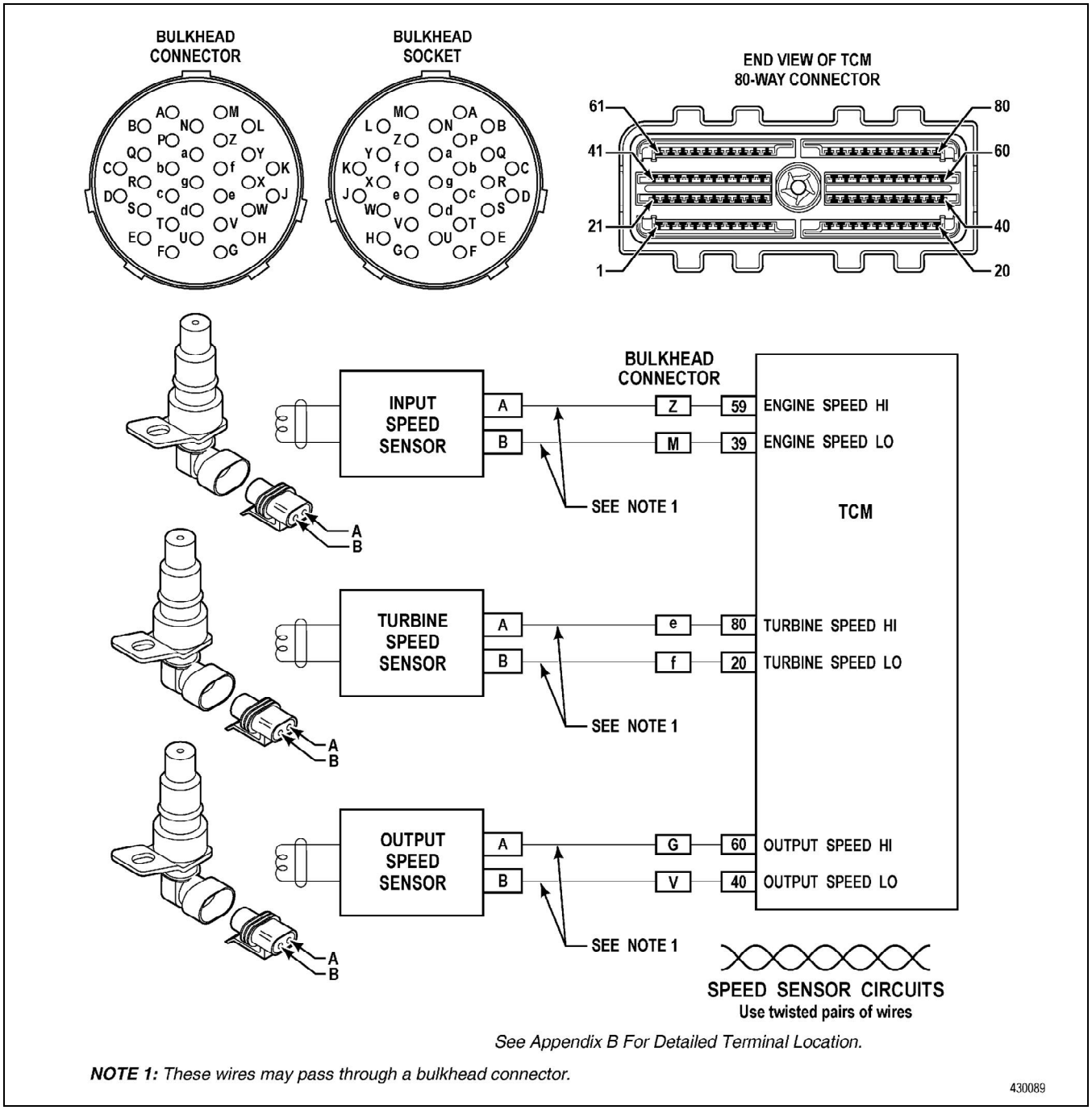
NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes. Measure battery and TCM input voltages.

1. Inspect the valve body connector and make sure it is tightly connected. Clean or replace as necessary.
2. If the connector is connected, clean, and not damaged, test the solenoid circuit in the valve body for opens or shorts. Refer to the wiring diagram at the beginning of this DTC Group to identify wires in the internal harness which are connected. If the open or short circuit is found, replace the faulty component (refer to the appropriate transmission service manual), and eliminate the problem. The fault may be in the solenoid itself.
3. If the condition persists, remove the solenoid cover and closely inspect the solenoid and internal harness for damage. Repair or replace as necessary (refer to the appropriate transmission service manual).
4. If the open or short is not found at the transmission connector, disconnect the transmission harness connector at the TCM and inspect the terminals in the connector and the TCM for damage or contamination. Clean or replace as necessary. If the terminals are satisfactory, test the wires of the solenoid circuit in the transmission harness for continuity. If the open or short is found in one of the wires, isolate and repair it.
5. If the condition persists, replace the TCM. If replacing the TCM corrects the problem, reinstall the original TCM to confirm that the problem is in the TCM. If the original TCM now works, inspect the TCM connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement TCM.
6. If the open or short is not found in the transmission harnesses or the TCM, the condition must be intermittent. Use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) for the solenoid circuit indicated by the diagnostic code. Refer to Appendix L. CONNECTOR, TERMINAL AND TOOL PART NUMBERS AND REPAIR INSTRUCTIONS for information on connector assembly/disassembly.

Diagnostic Aids

HSD1 Supply Voltage: HSD1 supplies power to the F, G, and B solenoids. Other codes related to these solenoids and solenoid circuits may need to be resolved if no cause is found for the active DTC P0657.

DTC GROUP 4 Speed Sensor/Circuitry Faults



Circuit Description

Speed sensors are variable reluctance devices that convert mechanical motion to an AC voltage. Each sensor consists of a wire coil wrapped around a pole piece that is adjacent to a permanent magnet. These elements are contained in a housing that is mounted adjacent to a rotating ferrous member. Two signal wires extend from one end of the housing and an exposed end of the pole piece is at the opposite end of the housing. The permanent magnet produces lines of flux around the pole piece. As a ferrous object (gear teeth) approaches and passes through the gap at the end of the pole piece, an AC voltage pulse is induced in the wire coil. The TCM calculates the frequency of these AC pulses and converts it to a speed value. The signal wires from the sensor are formed as twisted pairs to cancel magnetically induced fields. The cable is also

DTC GROUP 7 Incorrect Gear Ratio *(cont'd)*

DTCs In This Group Include:

DTC	Description	CHECK TRANS	Inhibited Operation Description
P0729	Incorrect 6th Gear Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P0730	Incorrect Reverse 2 Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P0731	Incorrect 1st Gear Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P0732	Incorrect 2nd Gear Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P0733	Incorrect 3rd Gear Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P0734	Incorrect 4th Gear Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P0735	Incorrect 5th Gear Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P0736	Incorrect Reverse 1 Gear Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P0737	Incorrect 7th Gear Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P0738	Incorrect 8th Gear Ratio	Yes	DNS – LIR for mobile, LTN for stationary
P1899	Lock in Range	Yes	DNS – LIR for mobile, LTN for stationary Cat-eyes is displayed on shifter

Conditions For Setting The DTCs

The following codes set during steady state conditions when:

- P0729 sets when the actual 6th gear ratio (based on turbine and output speeds) differs from the calculated 6th gear ratio.
- P0730 sets when the actual R2 gear ratio (based on turbine and output speeds) differs from the calculated R2 gear ratio.
- P0731 sets when the actual 1st gear ratio (based on turbine and output speeds) differs from the calculated 1st gear ratio.
- P0732 sets when the actual 2nd gear ratio (based on turbine and output speeds) differs from the calculated 2nd gear ratio.
- P0733 sets when the actual 3rd gear ratio (based on turbine and output speeds) differs from the calculated 3rd gear ratio.
- P0734 sets when the actual 4th gear ratio (based on turbine and output speeds) differs from the calculated 4th gear ratio.
- P0735 sets when the actual 5th gear ratio (based on turbine and output speeds) differs from the calculated 5th gear ratio.
- P0736 sets when the actual R1 gear ratio (based on turbine and output speeds) differs from the calculated R1 gear ratio.
- P0737 sets when the actual 7th gear ratio (based on turbine and output speeds) differs from the calculated 7th gear ratio.
- P0738 sets when the actual 8th gear ratio (based on turbine and output speeds) differs from the calculated 8th gear ratio.
- P1899 sets when a minimum turbine speed is not achieved after Neutral is commanded.

DTC GROUP 10 Pedal Position Sensor Circuit *(cont'd)*

links as accelerator pedal position and/or percent engine load. The TCM logs this code if it fails to detect a throttle source during auto-detect.

DTCs In This Group Include:

DTC	Description	CHECK TRANS	Inhibited Operation Description
P0122	Pedal Position Sensor–Low Voltage	Yes	Use default throttle values 92%
P0123	Pedal Position Sensor–High Voltage	Yes	Use default throttle values 92%
P063E	Auto Configuration Throttle Input Not Present	No	Use default throttle values 92%

Conditions For Setting The DTCs

DTCs P0122 and P0123 indicate the TCM has detected a signal voltage from the TPS either in the low error zone or the high error zone. These codes can be caused by:

- TPS out of adjustment.
- Faulty external wiring harness.
- Faulty connections to the TPS.
- Faulty internal wiring harness.
- A faulty TPS.
- A faulty TCM.

DTC P063E sets if the TCM fails to detect throttle position information for a specified time interval.

Active Indicator Clearing Procedure

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, review 4–2. BEGINNING THE TROUBLESHOOTING PROCESS, and refer to F–1. STANDARD WIRING CHECKS, G–1. ADVANCED TROUBLESHOOTING, and I–1. NON-APPROVED WIRE CHECKS.

Clutch Pressure Tap Locations

Refer to K–1. PRESSURE TAP LOCATIONS.

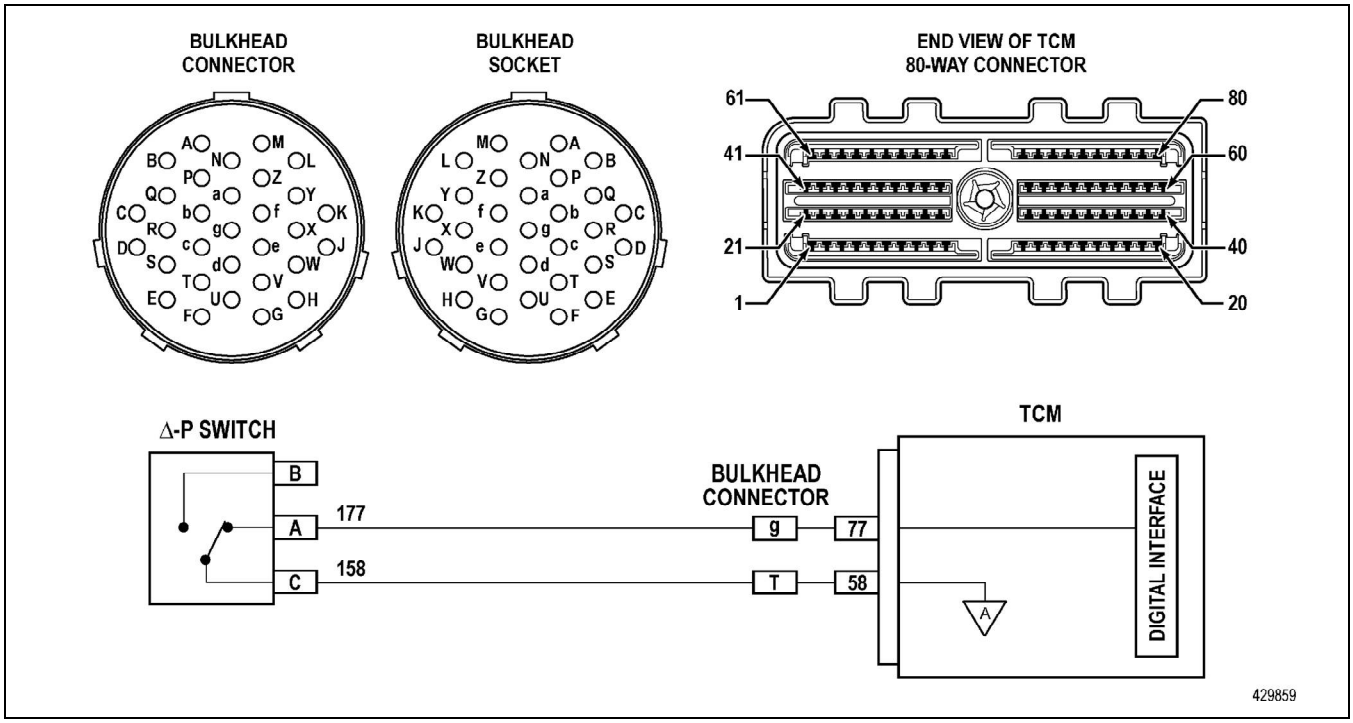
Clutches Engaged and Solenoids Energized per Gear

Refer to J–1. CLUTCHES AND SOLENOIDS.

DTC P0604 Control Module Random Access Memory (RAM) *(cont'd)*

Step	Action	Value(s)	Yes	No
3	After TCM initialization, does range selected and range attained windows show cat-eye symbols or does TCM snapshot data indicate erroneous DTCs present and/or erroneous prognostics data or prognostics DTCs?		*Replace TCM. Return vehicle to service.*	*System OK. Clear inactive DTCs and return vehicle to service.*

DTC P3702 Transmission Oil Filter Clogged



Circuit Description

A differential pressure switch is located on the transmission oil filter head. It detects the pressure difference across the filter element, indicating when the filter is clogged. The switch is closed under normal operation – differential pressure below 35 psi. The switch opens when differential pressure is 35 psi or greater.

DTC	Description	CHECK TRANS	Inhibited Operation Description
P3702	Transmission Oil filter Clogged	Yes	Normal downshift, hold override up shifts only

Conditions For Setting The DTC

- P3702 sets when the TCM detects an open condition in the differential pressure switch circuit.

Active Indicator Clearing Procedure

- Power down
- Manual

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

NOTE: Before troubleshooting, review 4–2. BEGINNING THE TROUBLESHOOTING PROCESS, and refer to F–1. STANDARD WIRING CHECKS, G–1. ADVANCED TROUBLESHOOTING, and I–1. NON-APPROVED WIRE CHECKS.

DTC U0103 Lost Communication With Gear Shift Module 1 (Shift Selector) *(cont'd)*

and produces 60 Ω resistance for the circuit. Vehicle OEMs may choose to install external termination resistors or use internal termination resistors built into many SAE J1939 electronic modules, including the TCM and shift selector. This DTC test verifies that there is SAE J1939 communication between the TCM and the primary SAE J1939 shift selector by monitoring a State Of Health (SOH) message. This DTC is active when the SOH message is lost.

Action Taken When the DTC Sets

When DTC U0103 is active, the following conditions occur:

- The DTC is stored in the TCM history.
- The TCM illuminates the **CHECK TRANS** light.
- The TCM upshifts and downshifts according to the PWM signal (W134) from shift selector.
- If the shift selector has lost communications with the TCM, the TCM commands the last valid selected gear, and any pre-select capability is disabled.
- When this DTC is active, the shift selector freezes the current display for about 1.5 seconds followed by 10.5 seconds of a blank display. If the shift selector still has power, then dual cat-eye symbols () appear in both displays to notify the operator that range monitor and range select data is unavailable to the shift selector.

Conditions for Clearing the DTC/CHECK TRANS Light

Use the Universal Allison DOC® to clear the DTC from the TCM history. The TCM automatically clears the DTC from the TCM history if the vehicle completes 40 warm-up cycles without the DTC recurring.

Diagnostic Aids

- DTC U0103 indicates a missing datalink message for the shift selector SOH message.

  This DTC may be caused by:

  – Miswired or mis-pinned shift selector harness.
  – Loss of ignition or battery power to primary shift selector.
  – Miswired or defective OEM controllers, OEM components, or OEM circuits attached to the datalink.
  – Electrical noise.
  – Bus-loading.
  – Short to power or short to another wire in datalink wiring.
  – High resistance or open in datalink wiring.
  – Poor vehicle grounds.
  – Unlocked connectors, expanded terminals, poor pin crimps or unlocked pins causing high resistance or open circuit.
  – Unlocked connectors, unlocked pins, causing shorts in connectors.
  – TCM ground is at different voltage potential than the ground of the OEM voltage source responsible for shift selector.
  – Defective TCM.
  – Defective shift selector.

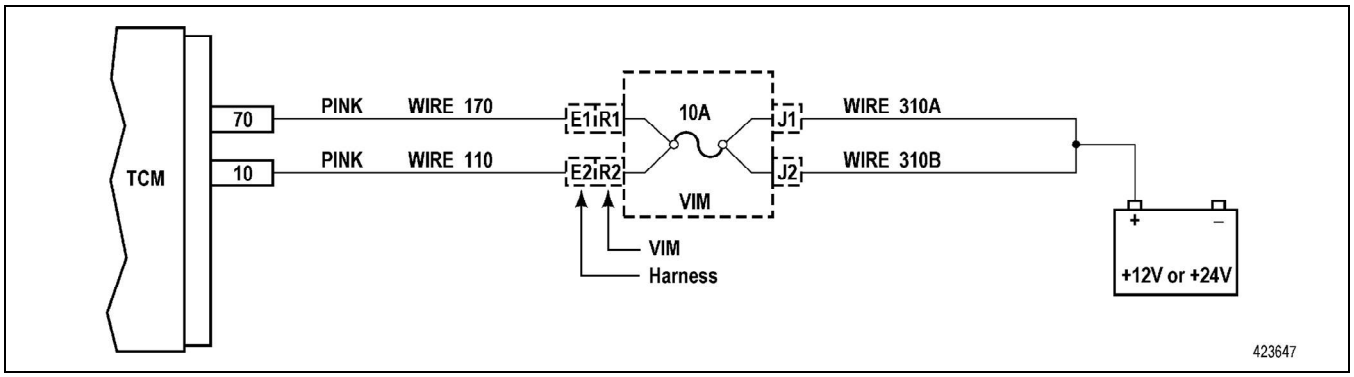
DTC U0291 Lost Communication With Gear Shift Module 2 (Shift Selector) *(cont'd)*

Step	Action	Value(s)	Yes	No
6	1. Turn ignition **OFF**. 2. Leave shift selector harness disconnected from shift selector. 3. Leave all OEM termination points for shift selector wires disconnected from their OEM source. 4. Check for high resistance or open through shift selector ignition power wire in shift selector terminal 12, shift selector battery power wire at terminal 13, and shift selector battery ground wire at terminal 5. Does circuit resistance measure 2 Ω or less through each of the wires in OEM shift selector harness that terminate at shift selector terminals 12, 13, and 5?	2 Ω or less	*Go to Step 7*	*Resolve shift selector wiring issue. Go to Step 11*
7	1. Leave ignition **OFF**. 2. Leave all OEM shift selector connectors disconnected. 3. Leave OEM TCM 80-way connector disconnected. 4. Locate where SAE J1939 CAN high and CAN low wires terminate in vehicle and disconnect from datalink. 5. Disconnect both external 120 Ω termination resistors or unplug the datalink connector from any controller responsible for an internal 120 Ω datalink termination point. 6. Check for shorts wire to wire and to chassis ground in SAE J1939 shift selector wires for CAN high to selector terminal 8 and CAN low to selector terminal 15. **NOTE:** A properly terminated datalink (e.g., both ends terminated with 120 Ω resistors) should measure 60 Ω with ignition **OFF**. If it measures 120 Ω, one termination resistor is missing and could cause this code. 7. Repeat task 6 for wires to TCM terminals 28 (CAN high), 8 (CAN low) and, if equipped, as pass-through TCM terminals 48 (CAN high) and 68 (CAN low). Do shift selector and TCM datalink wires for CAN high and CAN low measure more than 20 kΩ to all other wires in shift selector harness and to chassis ground?	20 kΩ or more	*Go to Step 8*	*Resolve datalink wiring issue with CAN high or CAN low. Go to Step 11*

DTC U0333 Gear Shift Module 2 Incompatible *(cont'd)*

Step	Action	Value(s)	Yes	No
5	**NOTE:** Parallel (wire) Data Link (PDL) selectors set as the secondary require special calibrations to ensure this DTC is not enabled. Is secondary shift selector an approved OEM selector or ATI genuine shift selector?		*Go to Step 6*	*Install an approved ATI shift selector. Go to Step 7*
6	Is there a history of battery power DTCs, such as P0880, or is the DTC more common after engine cranking or during incidents that include other battery related symptoms, such as engine will not start, alternator charging issues, etc.?		*Correct issue with batteries, battery cabling, or defective batteries. Go to Step 7*	*Go to DTC U0103 or DTC U0291*
7	To verify the repair: 1. Turn ignition **OFF**. 2. Install or reconnect all OEM and transmission components and connectors, if needed. 3. Use Universal Allison DOC® to clear inactive DTCs from history. 4. Acquire new Universal Allison DOC® snapshot while driving vehicle under same conditions, if possible, noted in failure records. Did DTC U0333 return?		*Review Diagnostic Aids for this DTC, then begin diagnosis again at Step 1.*	*System OK. Clear inactive DTCs and return vehicle to service.*

5–1. TCM POWER

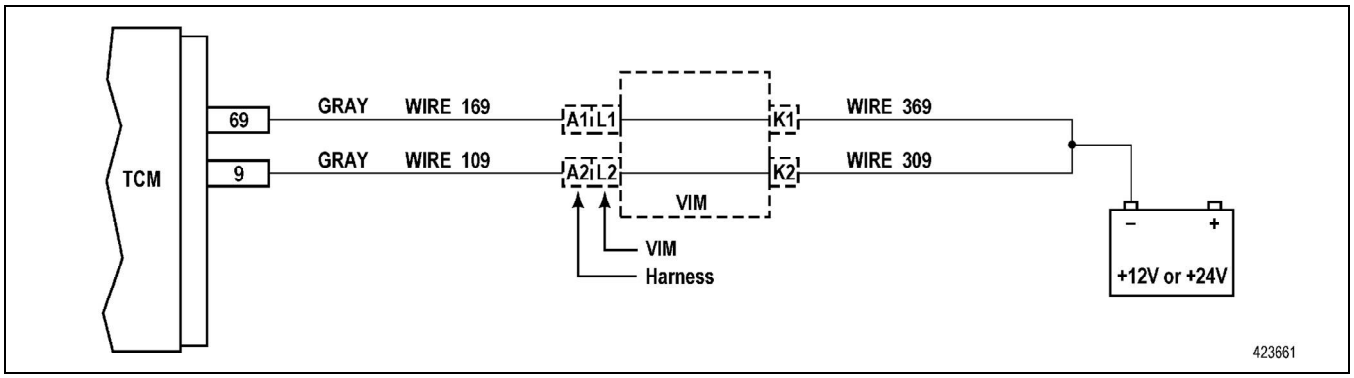


Positive battery voltage **must be** supplied directly to the TCM from the battery positive terminal or a dedicated “electronic” bus bar.

- Power is provided through a 10A or 15A fuse.
- Wires **must be** kept as short as possible.
- **No other loads** can be added to these wires.
- Minimize the number of electrical connections between the TCM and battery to reduce the potential for poor connections, corrosion, etc.
- Wires from the battery to the splice point before the VIM **must be** no smaller than 10 AWG. They may need to be larger, depending on length.
  - Wiring shall be sized to maintain a minimum of 10.5V at the TCM during max current draw conditions (9 amp).

NOTE: Always remove all connectors from the TCM whenever welding on the vehicle.

5–2. SYSTEM GROUNDS



Ground **must be** supplied directly to the TCM from the battery negative terminal or a dedicated “electronic” bus bar.

- Never use chassis grounds for these wires.
- If a power supply other than a battery is used, these wires **must be** connected directly to the negative side of the power supply.

Problem	Probable Cause	Suggested Remedy
INPUT SEAL LEAK	Input seal worn or damaged	Replace input seal
	Debris on seal	Clean input seal
OUTPUT OIL SEAL LEAK	Output seal worn or damaged	Replace output oil seal
	Output flange worn, grooved or damaged	Replace output flange and output oil seal
	Damaged or missing output retainer plate	Replace retainer plate. Run driveline report, inspect driveline and resolve any driveline issues found
ALL OTHER LEAK AREAS	Various, e.g., loose, missing or damaged bolts at transmission casting split-lines; damaged gaskets at split-lines; loose or damaged transmission cooler lines; loose or damaged fittings; loose or damaged plugs or O-rings; loose or damaged PTO line; cracked or porous casting	Identify cause for leak and correct. Refer to SIL 19-TR-03 for additional information on how to identify leaks
	Non-transmission leak misidentified as transmission fluid leak, engine output oil seal leak, oil pan leak, hydraulic fluid leak from fan drive, fluid leak from PTO, loose hydraulic fluid lines and fittings, leaking brake system component, leaking engine coolant, insufficiently filtered compressed air system leaking contaminants, water or oil	Identify non-transmission cause and resolve leak issue
	INHIBIT ISSUES	
TRANSMISSION STAYS IN **N** (Neutral) WHEN **D** (Drive) OR **R** (Reverse) SELECTED, THE SELECT CHARACTER OF THE SHIFT SELECTOR IS BLINKING, RANGE INHIBIT INDICATOR IS ALSO ON IN UNIVERSAL ALLISON DOC®	I/O inputs state causing a range inhibit	Use Universal Allison DOC® to snapshot issue. Review all inputs of enabled I/O functions. Refer to the Universal Allison DOC® Technician's Library for additional information.

APPENDICES

G. Vehicle Noise and Vibration Troubleshooting Skills.

Vehicle noise and vibration troubleshooting skills require:

- Ability to take accurate measurements using J-38792 EVA and J-38792–A EVA 2 Electronic Vibration Analyzer, or similar tool, to isolate noise or vibration sources.
- Working knowledge of Chassis Ear, or similar tool, to isolate source of noise.
- Ability to make vehicle driveline inspections, take measurements, and run reports.

H. Vehicle Operation Troubleshooting Skills.

Vehicle operation troubleshooting skills require:

- Complete familiarity with the appropriate Allison Transmission Operator's Manual (if applicable) for the model year and vocational model types. Operator's Manuals are available for free download from the Allison Transmission public website at *www.allisontransmission.com* or the Allison Transmission extranet site.
- Working knowledge of OEM publications and training related to vehicle or application operation.

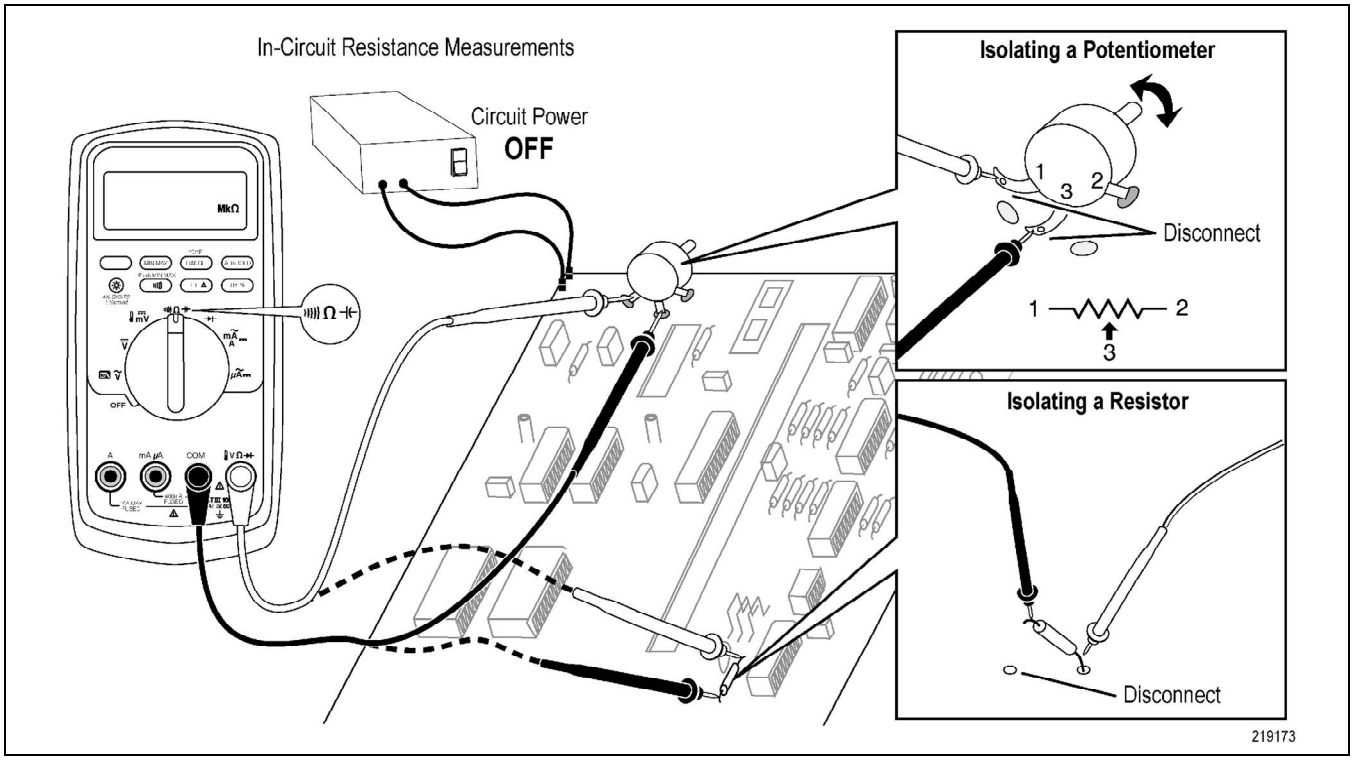


Figure D–1. Resistance Measuring

The following are some tips for measuring resistance:

- The resistance function can produce enough voltage to a forward-bias silicon diode or transistor junctions, causing them to conduct. If this is suspected, press the range button on the meter to apply a lower current in the next higher range. If the resistance value is higher, use the higher range value.
- The measured value of a resistor in a circuit is often different from the resistor's rated value. To avoid possible damage to the meter or the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before testing resistance.

B. Measuring AC and DC Voltage.

To measure AC or DC voltage, refer to Figure D–2. When measuring voltage, the meter acts approximately as a 10 MΩ (10,000,000 Ω) impedance in parallel with the circuit. This loading effect can cause measurement errors in high-impedance circuits. In most cases, the error is negligible (0.1% or less) if the circuit impedance is 10 KΩ (10,000 Ω) or less.

Appendix F—STANDARD WIRING CHECKS

F–1. STANDARD WIRING CHECKS

The vehicle/equipment may have to be driven/operated in order to experience the fault. Use the data from failure records to determine transmission range and/or certain vehicle operating variables such as temperature, run time, etc. This data can be useful in reproducing the failure mode when the DTC was set.

Inspect the wiring for poor electrical connections from the TCM to the component connector. Look for the following conditions:

- bent, backed-out, or damaged terminals
- poor terminal tension
- broken wire inside the insulation or chafed wires
- poor connections

Inspect OEM wiring harness routing and look for possible contact points where chafing could lead to an open or short circuit condition. Moving parts on the vehicle could be contacting the harness; this includes parking brake components, suspension components, etc.

When diagnosing for an intermittent short or open, massage the wiring harness while watching the test equipment for a change.

The following wiring and connector issues can cause transmission DTCs:

- Expanded female terminals in a connector. Use a mating pin or terminal to check for a light drag feel when the mating terminal or pin is inserted and then slowly removed. There should be some slight friction between the matching terminal and pin combination. Expanded terminals have no feel of drag when the matching pin or terminal is inserted and removed.
- Broken terminal locks allow the pins or terminals to push back into the connector, resulting in poor connection or pin-to-pin shorts in the connector. Inspect for broken locks and displaced terminals in connectors. Never use paper clips or other devices to back probe a connector while doing Allison service work.
- Poor pin crimps. Pin crimps should be pull-tested by the technician to verify that the crimp is secure to the wire. If the pin crimp is loose, the pin easily moves or can come off the wire with a slight tug on the terminal by the technician. This situation may not set an active DTC, but may indicate other symptoms like shift quality issues.
- Connector and pin corrosion caused by moisture in connectors. Empty wire locations in connectors must always have a plug to keep moisture from finding a path into the connector.
- Poor harness routing and improper strain relief may cause damage resulting in an electrical open and/or short circuits to wires and connector components.
- Butt splices and wire ties are not an ideal solution for any transmission repair. If butt splices are used, then always use heat-shrinkable butt splices. Never use wire ties inside the transmission to replace connector locks that hold connector components together. Also, never use wire ties to replace appropriate strain relief components and clips that are used to fasten harnesses to the vehicle and retain vehicle connectors, unless approved by the OEM for the location and component being repaired.

Appendix J—CLUTCHES AND SOLENOIDS

Table J–7. 9600 Series Solenoids Energized per Gear

Gear Selected	Splitter Lo	Splitter Hi	High	Intermediate	Low	Reverse	LIR Sol*
R2						B	A, G
R1	F					B	A
N	F						A
1	F				C		
2					C		G
3	F			D			
4				D			G
5	F		E				
6			E				G

Table J–8. 9800 Series Solenoids Energized per Gear

Gear Selected	Splitter Lo	Splitter Hi	High	Intermediate	Low	High Intermediate	LIR Sol*
N	F						A, I
1	F				H		
2					H		G
3	F			C			
4	F					D	A
5				C			G
6						D	A, G
7	F		E				
8			E				G

Appendix L—CONNECTOR, TERMINAL AND TOOL PART NUMBERS AND REPAIR INSTRUCTIONS

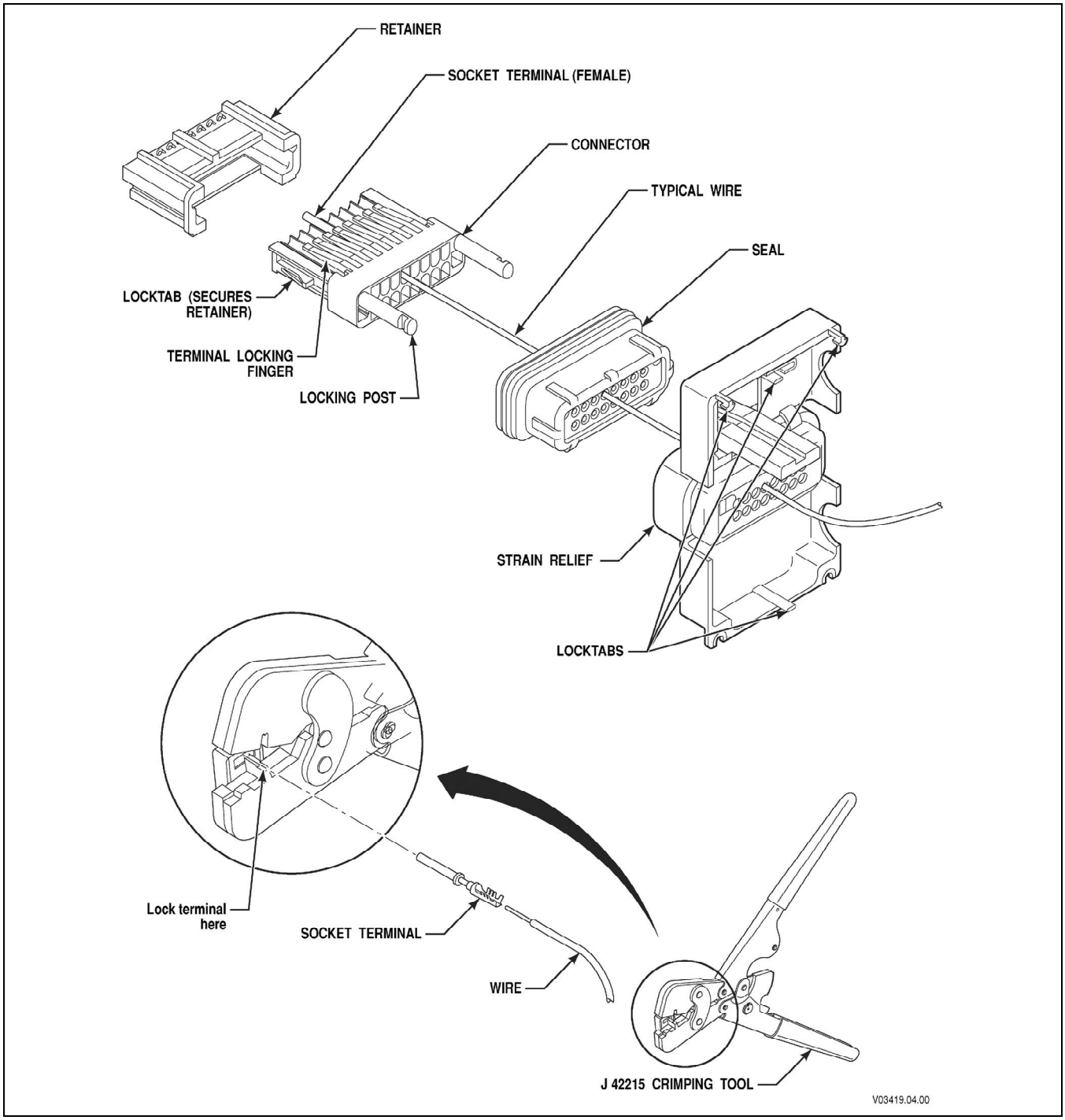


Figure L–5. Delphi-Packard Micro Pack 16-Way 90 Degree Connector

L–4. DELPHI-PACKARD METRI-PACK 150 SERIES CONNECTORS—PUSH-TO-SEAT (TURBINE SPEED SENSOR, 30-WAY AND 18-WAY VIM, RETARDER TEMPERATURE SENSOR, AND RETARDER ACCUMULATOR SOLENOID)

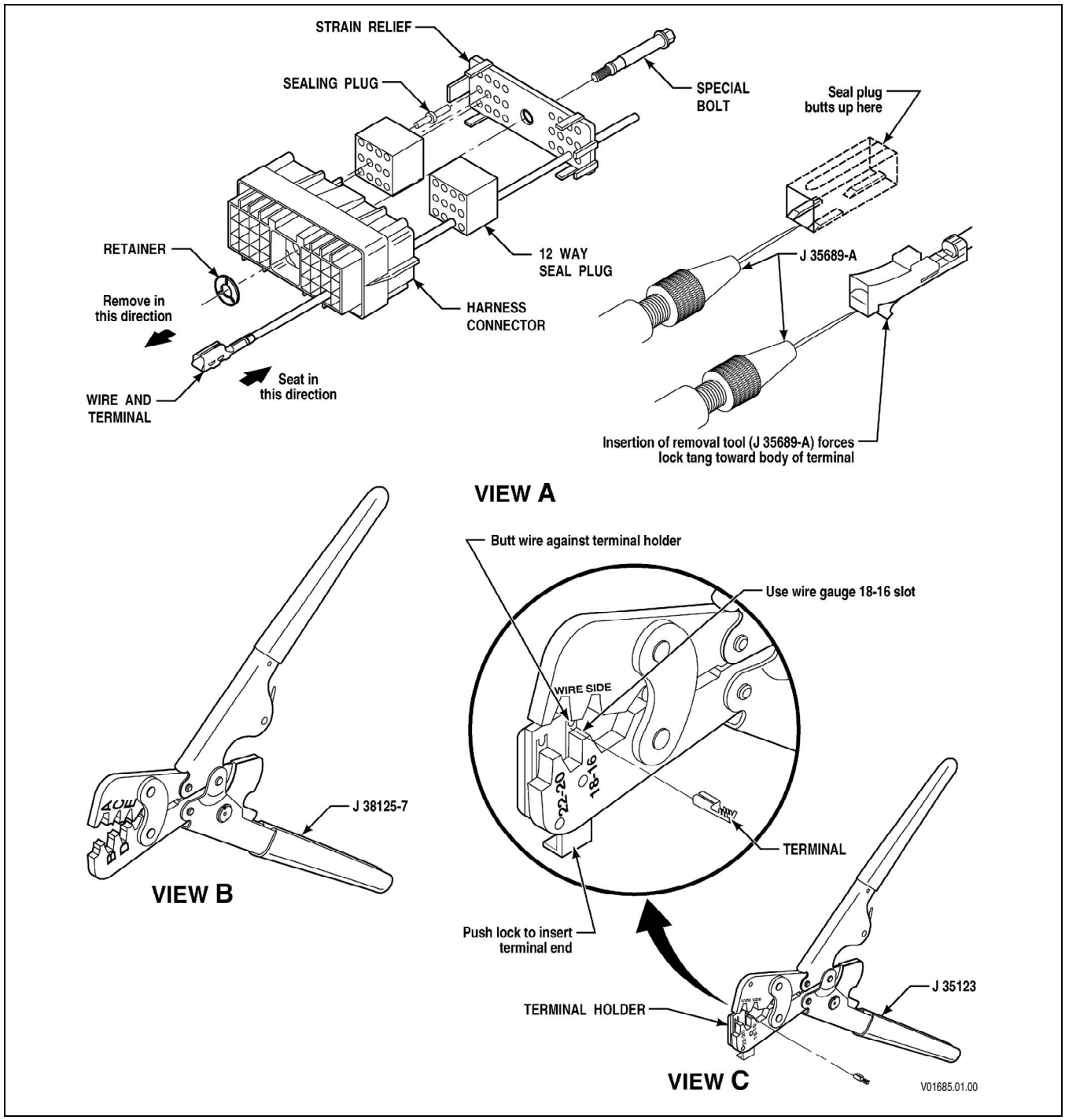


Figure L–9. Delphi-Packard Metri-Pack 150 Series connectors Pull-To-Seat (Turbine Speed Sensor, 30-Way and 18-Way VIM, Retarder Temperature Sensor, and Retarder Accumulator Solenoid)

Appendix L—CONNECTOR, TERMINAL AND TOOL PART NUMBERS AND REPAIR INSTRUCTIONS

A. Connector/Terminal Repairs.

Table L–1. Connector/Terminal Repairs (Figure L–12)

Required Tools	
Crimping Tool	J-38125-6
Wire Crimp	J-38125-6 Anvil “2”
Insulation Crimp	J-38125-6 Anvil “5”
Alternate Crimping Tool	J-35606 or J-38852
Removal Tool	J-38125-10

Use	**Description**	**Manufacturers P/N**
TPS	Connector	P/N 12015793
	Terminal	P/N 12089040
	Wire Seal	P/N 12089444
RMR Device	Connector	P/N 12015795
	Terminal	P/N 12089040
	Wire Seal	P/N 12089444
Retarder Temperature Sensor	Connector	P/N 12010973
	Terminal	P/N 12089188
	Wire Seal	P/N 12089444

B. Terminal Removal.

1. Unlatch and open the secondary lock on the connector (refer to Figure L–12, View A).
2. From the front of the connector, insert J-38125-10 Removal Tool over the terminal. Push the tool over the terminal and pull the terminal out the back of the connector (refer to Figure L–12, View B).
3. If a terminal is to be replaced, cut the terminal between the core and the insulation crimp to minimize wire loss.

NOTE: Two special tools are available for this operation: Tool J-38125-6 (Paragraph C); Tool J-35606 Figure L–13 or J-38852 (Paragraph D).

C. Terminal Crimping Using Crimping Tool J-38125-6.

1. Place the wire seal onto the wire before stripping the wire (refer to Figure L–12, View C).
2. Strip 6.0 ±0.25 mm (0.24 ±0.01 inch) of insulation from the end of the wire.
3. Place the terminal onto crimping tool J-38125-6 Crimping Tool (refer to Figure L–12, View E), Anvil “2.”
4. Slightly close the crimping tool to hold the terminal steady.
5. Insert the wire so that the stripped portion of the wire is in the core crimp area and the insulated portion of the wire is in the insulation crimping area (refer to Figure L–12, View C).
6. Crimp the stripped section of the wire.

Appendix M—THROTTLE POSITION SENSOR ADJUSTMENT

N–3. EXTERNALLY-GENERATED SPEED SENSOR SIGNALS

A. Testing for Externally-Generated Speed Sensor Signals.

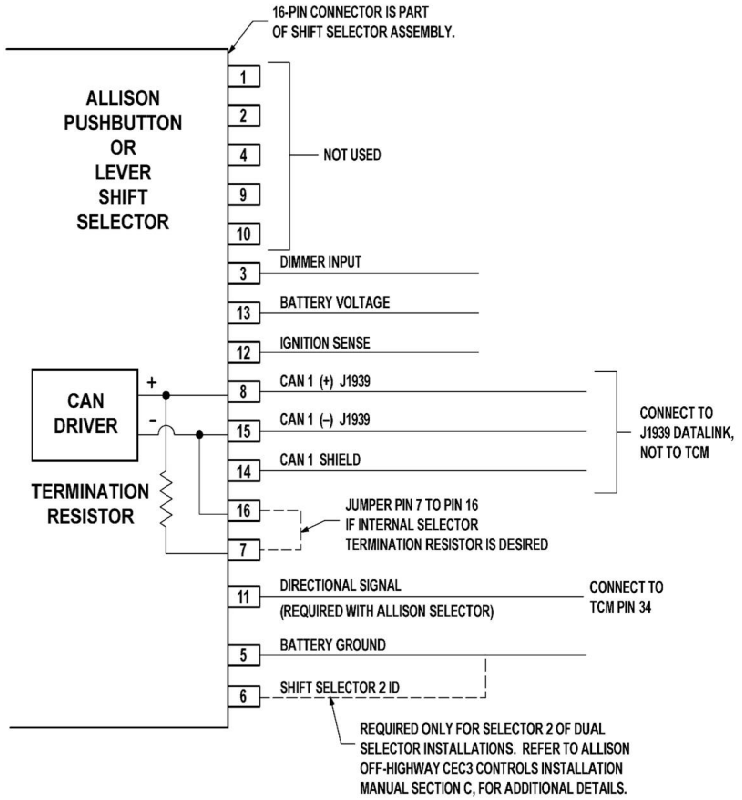
Use the following procedures to determine if speed sensor signals generated by a source external to the transmission or wiring harness are present:

1. Turn ignition ON.
2. Keep engine OFF.
3. If the TCM is ON (shift selector display remains illuminated), connect the Universal Allison DOC®.

NOTE: If false speed signals were present at the previous shutdown, the TCM might still be “on” even though the ignition is “OFF.”

4. Read speed sensor signals.
5. If a speed sensor signal is other than one (1), then there is a short to another circuit that is carrying an AC signal.
6. Measure the resistance of the sensor.
7. Test for shorts to other circuits within the harness or transmission connector.
8. Test to be sure there is no conductive material inside the connector.
9. Inspect to be sure speed sensor circuit wires are a twisted pair.
10. Test to be sure there is a properly grounded drain wire.
11. Test for the presence of a strong external AC signal.
12. Repair or replace parts as required.

ALLISON J1939-BASED SHIFT SELECTOR INTERFACES



STRIP SHIFT SELECTOR INSTALLATION

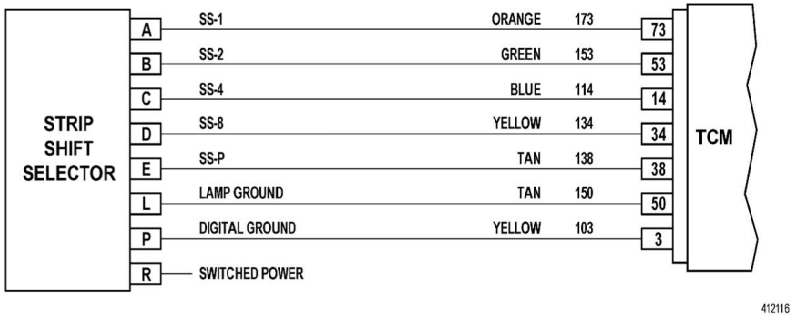


Figure O–4. SAE J1939–Based Shift Selector Interfaces