

# Medium Duty 4-Speed EV Transmission TRTS2150 EN-US

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EMA-12N0304C



*Powering Business Worldwide*

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SUPPORT



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## Warnings and Cautions

**The alert symbols, signal words (DANGER, WARNING and CAUTION) and statements throughout this manual indicate the potential severity of a situation. Ensure to read, understand and follow each statement to avoid vehicle damage, component damage, personal injury, severe injury and/or death.**

 **DANGER:** Indicates an immediate hazard. Failure to follow the indicated procedures will cause major vehicle component damage, severe injury or death.

 **WARNING:** Indicates an immediate hazard. Failure to follow the indicated procedures may result in major vehicle component damage, severe injury or death.


 **CAUTION:** Indicates a potential hazard. Failure to follow the indicated procedures could result in minor or moderate component damage and/or personal injury.


The NOTICE and Note statements throughout this manual provide additional details required to avoid damaging a component or incorrectly completing a repair. Ensure to read, understand and follow each statement to properly complete a repair.


**NOTICE:** Indicates component or property damage could result if you do not follow the indicated procedure.


**Note:** Indicates additional detail that will aid in the repair of a component.


### While working on a vehicle:


 **WARNING:** Do not modify transmission components or systems. Modification (altering, substituting, relocating) of transmission components may result in major vehicle component damage, severe injury or death.

 **WARNING:** Do not modify transmission service tools. Modification (altering, substituting, relocating) of transmission service tools may result in major vehicle component damage, severe injury or death.

 **WARNING:** Read, understand and follow each statement regarding cap screw installation and torque specification requirements. Failure to install and torque cap screws to specification may result in major vehicle component damage, severe injury or death.

 **WARNING:** When working on vehicle components, keep body parts clear of sharp objects and pinch points. Failure to keep clear of sharp objects and pinch points may result in severe injury or death.

 **WARNING:** Use appropriate lifting devices and equipment when working with heavy vehicle components. Failure to do so may result in major vehicle component damage, severe injury or death.


 **CAUTION:** Do not work on the vehicle immediately after operation. Working on a hot vehicle component could result in personal injury.

### Before starting a vehicle:

- Sit in the driver's seat.
- Confirm vehicle parking brake is applied.
- Confirm Neutral is selected on the driver interface device.
- Follow vehicle manufacturer instructions prior to operating vehicle.

### When parking the vehicle or leaving the cab:

1. Safely come to a complete stop.
2. Continue to depress and hold service brake.
3. Select Neutral on the driver interface device.
4. Apply vehicle parking brake.

 **WARNING:** Apply vehicle parking brake and follow vehicle manufacturer parking instructions. Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, severe injury or death.

5. Turn ignition key Off and allow the vehicle powertrain system to power down.

### Before working on a vehicle or leaving the cab with engine running:

1. Safely come to a complete stop.
2. Continue to depress and hold service brake.
3. Select Neutral on the driver interface device.
4. Apply vehicle parking brake.



**WARNING:** Apply vehicle parking brake and follow vehicle manufacture parking instructions. Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, severe injury or death.

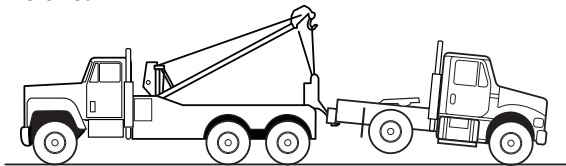
5. Chock wheels.

### To avoid damage to the transmission during towing:

When towing a vehicle equipped with the EV MD 4 Speed Transmission, do not allow the output shaft of the transmission to rotate. If the vehicle is towed with the drive wheels still in contact with the road surface, the vehicle axle shafts or driveline must be removed or disconnected prior to towing vehicle.

**NOTICE:** Internal transmission damage can result from improper vehicle towing.

#### Preferred



#### Must remove vehicle axle shafts or driveline prior to towing



After completing a transmission service procedure, ensure to complete Transmission Service Routines when directed.

### Transmission Service Routines

Perform Transmission Service Routine - Grade Sensor Calibration after completing the following procedures:

- Transmission removal and installation
- TECU removal and installation

**NOTICE:** Failure to perform the Transmission Service Routines results in degraded transmission performance.

## Required Tools

### Diagnostic Tools

- Pin Out Adapter Jumper Kit - RR1009HY

Available at [www.klineind.com](http://www.klineind.com) or contact K-Line at 1-800-824-5546

### Volt/Ohm Meter

- Digital Volt/Ohm Meter (DVOM)

### PC-Based Service Tool

- ServiceRanger
- Approved Communication Adapter
- 9-Pin Deutsch Diagnostic Adapter

### Service Publications

Publication	Title
TRSM2150	EV MD 4 Speed Transmission Service Manual
TCMT0072	ServiceRanger™ User's Guide
TCMT0073	ServiceRanger™ Quick Start Guide
TCMT0020	Eaton Approved Lubricant Suppliers
TCMT0021	Roadranger Lubricant Products Manual
TRIG2150	EV MD 4 Speed Installation Guide

# Transmission Lamp and Gear Display Descriptions

## Overview

All Medium Duty 4-Speed EV Transmission systems utilize a service lamp that can be illuminated when certain system failures are detected. The service lamp may be part of the Shift Device or may be a separate light in the vehicle dash.

Additionally, Medium Duty 4-Speed EV Transmission systems utilize a gear display that indicates the current state of the transmission. The gear display may be an integral part of the vehicle dash, or may be a separate dash mounted display.

This procedure describes the possible states of the service lamp and gear display.

## Lamp Descriptions

### Transmission Service Lamp

The Transmission Service Lamp is usually a red light that reads "Service". However, on some chassis an amber transmission icon or "Check Trans" light may be substituted for the red Service Lamp. It may be located on the Push Button Shift Control, Shift Lever, or in the vehicle dash. The Transmission Service Lamp is commanded on and off by the Transmission Electronic Control Unit (TECU) via a direct wire, J1939, or the High Integrity Link (HIL).

- Under normal conditions, the Service Lamp lights momentarily at key-on as part of the TECU self-test.
- A continuously flashing Service Lamp indicates a currently Active fault code. However, not all fault codes will turn on the Service Lamp.
- A Service Lamp that is continuously illuminated indicates a failure of the TECU.

## Gear Display Descriptions

### Solid "N" in Gear Display



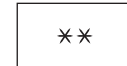
Indicates that the transmission is currently in Neutral.

### Flashing "F" in Gear Display



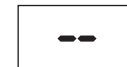
Indicates that the transmission has detected an Active fault code. This fault code can be accessed with the ServiceRanger diagnostic software. See *Fault Code Isolation Procedure Index* on page 14.

### Double Stars "\*" "\*" in Gear Display



Indicates that the gear display is receiving no communication over the data link. The gear display may communicate over the J1939 data link depending upon the specific display type. See *Diagnostic Procedure* on page 11. If no problem is found, troubleshoot the gear display connection to the J1939 data link per OEM guidelines.

### Double Dashes "- -" in Gear Display



Indicates that the gear display has lost communication with the TECU over the data link. The gear display may communicate over the J1939 data link depending upon the specific display type. See *Diagnostic Procedure* on page 11. If no problem is found, troubleshoot the gear display connection to the J1939 data link per OEM guidelines.

## Blank Gear Display



Indicates that the gear display has lost power or has lost communication with the TECU over the data link. See *Diagnostic Procedure* on page 11. If no problem is found, troubleshoot the gear display power and ground supply per OEM guidelines.

## “PD” in Gear Display



Indicates that the transmission is in Product Diagnostic (PD) Mode. See *Product Diagnostic (PD) Mode* on page 6.

## “AN” in Gear Display



Indicates that the transmission is currently in Auto Neutral.

## “ST” in Gear Display



Indicates that the driver has recorded a Driver Triggered Snapshot. Snapshot is a diagnostic tool used to capture specific data at the time an event is happening. This data should be collected and reviewed at the direction of Eaton.

To collect a Driver Triggered Snapshot:

1. Drive or operate vehicle and attempt to duplicate the shift complaint.

**NOTICE:** The purpose of this test is to duplicate the complaint and set a fault code or capture a driver triggered snapshot of the event happening.

2. If the shift complaint is duplicated, capture a Driver Triggered Snapshot of the event by performing the procedure below:
  - Place the transmission shift device into Low (L) mode and quickly depress the upshift button twice.

**NOTICE:** Capturing the driver triggered snapshot is time sensitive; for the best results, perform this sequence immediately after the symptom occurs.

3. The transmission will set a tone and the letters “ST” will appear in the display if the Snapshot is captured.
4. If the Snapshot was initiated while driving, return the transmission shift device to the mode that was selected prior to initiating the Snapshot.

**Note:** The Driver Triggered Snapshot data can be retrieved with ServiceRanger and sent to Eaton for review.

1. Key off and allow the transmission to perform a complete power down.
2. Key on with motor off.
3. Connect ServiceRanger.
4. Retrieve Snapshot and VPA data by creating a Service Activity Report and select “Send to Eaton”.
5. Contact Eaton at (800) 826-4357 for review.

## Product Diagnostic (PD) Mode

PD Mode is used to diagnose Inactive fault codes that may have set during normal operation. This diagnostic mode increases the fault sensing capability of the transmission system, making it more likely to detect intermittent electrical or wiring issues. The PD Mode procedure tests loose, degraded and intermittent connections.

When troubleshooting an Inactive fault code, use the Fault Isolation Procedures to guide you to the wiring and connectors associated with that fault. Once PD Mode is activated, flex the wiring harness and connectors to attempt to recreate the fault.

This procedure may be used prior to performing any troubleshooting or as directed by a Fault Isolation Procedure. PD Mode may be used to troubleshoot intermittent electrical fault issues when there are no Active fault codes present.

**NOTICE:** The vehicle will not operate in PD Mode. You must turn vehicle key off, and allow the transmission to fully power down to exit PD Mode before the vehicle will operate.

### PD Mode Inactive Fault Codes

The following is a list of fault codes that work with PD Mode:

13, 14, 15, 16, 17, 33, 34, 35, 51, 52, 56, 58, 61, 63, and 99.

### Entering PD Mode

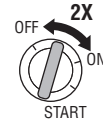
**Note:** Vehicle must have no Active fault codes.

**Note:** Vehicle must be stationary, motor off with vehicle parking brake set.

1. Turn the ignition on and allow the transmission to fully power up. Verify the transmission is in Neutral.



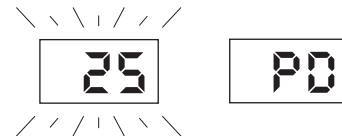
2. Perform two key cycles of the ignition switch starting in the on position and ending in the on position.



**Note:** The gear display may flash a “88” at key on, which is a normal power-up test of the display.



- The gear display will flash a “25.” Then a solid “PD” to indicate that the transmission has entered PD Mode.



### Exiting PD Mode

- Turn the ignition key off. Allow the transmission to completely power down.

**Note:** The transmission must exit PD Mode before the motor can operate again. The transmission will no longer show “PD” in the gear display when it has exited PD Mode.

## Troubleshooting Using PD Mode

- Flex the wiring harness and connector bodies appropriate for the intermittent fault condition while the transmission is in PD Mode.
- “PD” will remain in gear display until an Active fault code has been set during the PD Mode fault isolation procedure.
- If an Active fault code is set during PD Mode, the gear display will display the Active fault code(s). A warning tone will sound when the fault code is Active. The fault code will continue to be shown in the gear display, even if Inactive, until the transmission has powered down.
- Fault codes that occur in PD Mode will not be stored in the TECU as Inactive fault codes.

## Identifying a Problem in PD Mode

- Identify any areas of wear or damage to wiring harnesses or connectors.
- If a fault occurs while flexing a connector, exit PD Mode. Disconnect the connector and inspect both sides for damage, corrosion and spread or loose pins.
- Refer to the *Fault Code Isolation Procedure Index* on page 14 for the troubleshooting procedures for a specific fault code.

# Driver Questionnaire Overview

## Overview

The Driver Questionnaire is used to document vehicle symptoms that may be critical to the diagnosis or repair of the transmission system.

The questionnaire should be completed by a driver that experienced the specific vehicle symptoms pertaining to this repair. The Driver Questionnaire can be printed from this Troubleshooting Guide.

**Note:** A first hand account of the symptoms may offer specific details that are critical to the repair.

## Driver Questionnaire

Fleet: \_\_\_\_\_

Fleet Unit # \_\_\_\_\_

Date: \_\_\_\_\_

Dealer: \_\_\_\_\_

RO # \_\_\_\_\_

Email to [auto.rtw@eaton.com](mailto:auto.rtw@eaton.com)

1. Describe what happened (report any observations not captured below):				
2. If problem happens when first turning the key, on skip to question #8.				
3. Does motor RPM rev up and down a few times in an effort to make a shift?	Yes	No	Don't Know	NA
If Yes: a. What gears is the transmission trying to shift? Circle any that apply or describe.  1-2   3-4				
b. Does the transmission eventually make the shift?	Yes	No	Don't Know	NA
c. Does the transmission shift back into the gear it is trying to shift out of?	Yes	No	Don't Know	NA
If No: a. What gears does the transmission stick in? Circle one or more below.  1   2   3   4				
b. Are you able to go to Manual mode and make the transmission shift?	Yes	No	Don't Know	NA
4. Do you have to stop the vehicle when the problem happens?	Yes	No	Don't Know	NA
5. Does the transmission find neutral?	Yes	No	Don't Know	NA
6. Do you have to shut the vehicle off in gear?	Yes	No	Don't Know	NA
7. Does the transmission find neutral after turning the key back on?	Yes	No	Don't Know	NA

8. Does the motor operate when the key is cycled to the "Start" position?	Yes	No	Don't Know	NA
9. What is in the display when the problem happens? Circle one or more below. "-" Single dash    "- -" Double dash    Flashing gear number    Solid gear number    flashing "F"    Blank display				
10. Does the transmission service or other malfunction light come on when the problem happens?	Trans Service Red / Amber	Other	None	
11. Does the problem happen when the transmission is cold, hot or both?	Cold	Hot	Both	NA
12. Does the problem happen when operating in wet weather, dry weather or both?	Wet	Dry	Both	NA
13. How many times a day, week or month does the problem happen? Number of times _____	Day	Week	Month	NA
14. How long has the vehicle had the problem?	First Time	Past 2 weeks	Past Month	Several Months
15. How long have you been driving this vehicle?	Days	Weeks	Months	Years
16. List any known problems the vehicle has had in the past: Circle one or more below or describe known problem. OEM electrical    Accident    Flood damage    Lightning strike				
17. How long has it been since any known problems listed above happened?	First Time	Past 2 weeks	Past Month	Several Months

---

## Symptom-Driven Diagnostics Index

### Example Below

<b>Isolation Procedures</b>	<b>Symptom</b>	<b>Page #</b>
Start Enable Relay Contact Test	Engine cranking issues without any fault codes	
Brake Switch Functionality Test	Transmission does not engage a gear from Neutral (N)	
Transmission Shift Complaint Test	Shift complaint exists without any fault codes	
J1939 Vehicle Data Link Test	No J1939 communication	

## Diagnostic Procedure

**A** *Purpose: Document the vehicle symptom and check for Active or Inactive fault codes.*

1. Document the vehicle symptoms.
2. Set vehicle parking brake and chock wheels.
3. Key on with motor off.
4. Connect ServiceRanger.
5. Retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton".
6. Update transmission software to latest available level.

**Note:** To avoid damaging the TECU, use an Eaton-approved communications adapter and ensure all satellite systems are disabled before updating software.

7. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
  - If a vehicle/motor fault code(s) is Active, contact OEM for further diagnostic instructions.
  - If a transmission fault code(s) is Active, go to **Step F**.
  - If a transmission fault code(s) is Inactive or not set, go to **Step B**.
  - If ServiceRanger does not connect to the Transmission Electronic Control Unit (TECU), go to the *Power-Up Sequence* on page 23.

**B** *Purpose: Verify the motor operates.*

1. Key on with motor operating.
  - If the motor operates, go to **Step C**.
  - If the display indicates "F", retrieve fault code(s) with ServiceRanger. Go to **Step F**.
  - If the motor does not operate and the display indicates "N", refer to OEM guidelines for repair or replacement of the vehicle motor system.

**C** *Purpose: Verify the transmission engages a gear from neutral.*

1. Key on with motor operating.
2. Depress and hold the service brake.
3. Select a forward and reverse mode from neutral.
  - If the transmission engages a gear, re-select neutral mode. Go to **Step D**.
  - If the display indicates "F" during the mode selection and/or engagement of a gear, re-select neutral mode. Retrieve fault code(s) with ServiceRanger, go to **Step F**.
  - If the transmission does not engage a gear and the display indicates "N", re-select neutral mode and contact the OEM for instructions on how to test Brake Switch functionality.

**D**

**Purpose:** Operate vehicle (road test) and attempt to duplicate the vehicle symptom.

1. Drive or operate the vehicle (road test), attempt to duplicate the vehicle symptom and set a fault code under the conditions reported in the Driver Questionnaire.
    - If the symptom was duplicated and/or the display indicated “F”, go to **Step E**.
    - If the symptom was not duplicated, no problem was found, test complete. Contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions.
- 

**E**

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
  2. Key off and allow the TECU to perform a complete power down.
  3. Key on.
  4. Connect ServiceRanger.
  5. Retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton Cummins Automated Transmission Technologies”.
    - If a vehicle/motor fault code(s) set during the road test, contact OEM for further diagnostic instructions.
    - If a transmission fault code(s) set during the road test, go to **Step F**.
    - If a fault code did not set during the road test and the symptom was duplicated, contact Eaton at 1-800-826-HELP (4357) for further diagnostic instructions.
-

**F****Purpose:** Prioritize fault codes for troubleshooting.

1. Determine the fault code to troubleshoot first by using the priority index below (with 1 highest priority and 4 least priority).
    - **Priority 1:** 11, 12, 22, 30, 31, 32, 33, 34, 37, 38, 39, 40, 81, 84, 85, 99
    - **Priority 2:** 15, 16, 21, 23, 26, 27, 28, 35, 56, 58, 61, 63
    - **Priority 3:** 13, 51, 52, 68
    - **Priority 4:** 71, 72, 73
  2. Go to the *Fault Code Isolation Procedure Index* on page 14 and troubleshoot the fault code with the highest priority level.
    - If more than one fault code within a level applies, troubleshoot Active fault codes before Inactive fault codes.
    - If only Inactive fault codes are present, troubleshoot the fault code that has the highest occurrence count or most recent timestamp.
    - If no fault codes are found, test complete.
-

## Fault Code Isolation Procedure Index

Fault Code	SPN	FMI	Description	Page Number
11	629	12	No TECU Operation	page 44
12	629	13, 14	Improper TECU Configuration	page 47
13	751	8, 9	J1939 Shift Control Device	page 50
15	751	9	HIL Shift Device Communication	page 62
16	625	2, 9	High Integrity Link	page 72
21	70	14	Park Brake Switch	page 81
22	563	2, 9	J1939 ABS Message	page 84
23	521	2	Brake Pedal Position	page 87
26	84	2, 9	J1939 Cruise Control Vehicle Speed (CCVS) Message	page 89
27	91	2, 9	J1939 Accelerator Pedal Position (EEC2) Message	page 92
28	703	2, 9	J1939 Auxiliary Input/Output Message	page 95
30	520260	2, 7, 9	Motor A Feedback Message	page 98
31	520261	2, 9	Motor B Feedback Message	page 106
32	158	2	Loss of Switch Ignition Voltage	page 113
33	168	4	Low Battery Voltage Supply	page 116
34	168	14	Weak Battery Voltage Supply	page 123
35	639	2, 9	J1939 Communication Link	page 130
37	627	5	TECU Power Supply	page 139
38	520262	2, 9	EV System Status Communication	page 145
39	520263	2, 9	Motor Configuration Message	page 152
40	767	7	EV Motor Direction	page 159
51	60	2, 3, 4, 10	Rail Position Sensor	page 163
52	59	2, 3, 4, 7, 10	Gear Position Sensor	page 173
56	161	2, 3, 4, 5, 10	Input Shaft Speed Sensor	page 183
58	191	2, 3, 4, 5, 8, 10	Output Shaft Speed Sensor	page 191
61	772	1, 5, 6, 12	Rail Motor Circuit	page 199
63	773	1, 5, 6, 12	Gear Motor Circuit	page 210
68	520321	13, 14	Grade Sensor	page 221
71	560	7	Unable to Disengage Gear	page 225
72	782	7	Failed to Select Rail	page 234
73	781	7, 11	Failed to Engage Gear	page 243
81	780	7	XY Shift Actuator Finger Position	page 253
84	751	13	Shift Device Not Configured	page 262
85	751	12	Shift Control Device Incompatible	page 266
99	781	12, 13	Direction Mismatch	page 269



# Wiring Inspection and Troubleshooting Procedure

## Overview

This is a set of recommendations for how to troubleshoot potential wiring issues in the vehicle. These issues may be resident in the Transmission Harness, Vehicle Harness, Power Supply Harnesses or other ancillary wiring, depending upon the fault code or condition that is taking place. When troubleshooting wiring, consider that wiring failures can be continuous, intermittent or there may be no failure of the wiring at all.

This procedure describes a visual inspection of wiring and connectors and how to use a volt/ohm meter to inspect for open circuits, short circuits to other wires, and short circuits to ground. Product Diagnostic (PD) Mode is a wiggle-wire test that can be used to detect intermittent open circuit and short circuit conditions that exist while a wire is being moved or flexed. Instructions for PD Mode are included on page 6.

## Possible Causes

- Various Wires
  - Wiring Shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Missing or failed connector seals
  - Wiring damaged, pinched or rubbed through

### Visual Inspection

1. Make sure all connectors are clean and tight.
2. Inspect the length of the wiring between connections and look for signs of pinched or chafed wiring.
3. When taking a volt/ohm meter reading, inspect for loose terminals, corrosion and bent or spread pins.

**Note:** If damage is found to the Transmission Harness, it is recommended that the harness be replaced. Inspect the mating connector for damage and replace, if appropriate. If damage is found to OEM wiring, refer to OEM guide-lines for replacement of wiring and connectors.

4. Inspect connectors for debris and contamination. If needed, clean connector and contacts only with an Eaton approved contact and connector fluid.
5. When reconnecting, Eaton recommends the use of NyoGel 760G on electrical contacts. Make sure all connectors are clean and tight.

**NOTICE:** To avoid damaging the TECU, use an Eaton-approved communications adapter and ensure all satellite systems are disabled before updating software.

### Use PD Mode for Intermittent Issues

1. If there are no Active fault codes, use Product Diagnostic (PD) Mode to diagnose intermittent wiring or connection issues.
2. PD Mode allows the user to test loose, degraded or intermittent connection issues using a wiggle wire test.
3. See *Product Diagnostic (PD) Mode* on page 6 for instructions for using PD Mode.

### Recommendations for Using a Volt/Ohm Meter

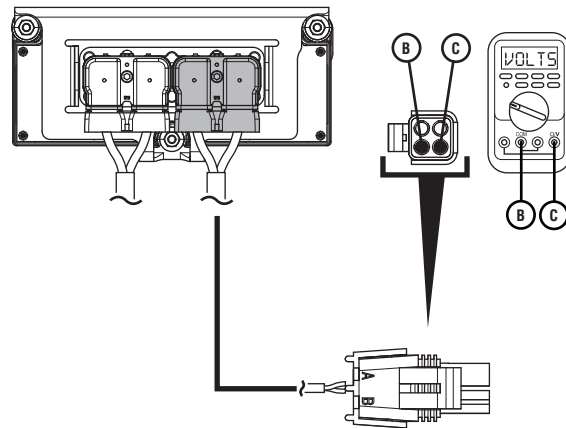
1. Use a quality digital auto-ranging volt/ohm meter.
2. When using a volt/ohm meter without auto-ranging capabilities, use the correct range setting for the reading.
3. Verify that the battery and fuse are in good working order.
4. Some volt/ohm meters have multiple sockets for test leads. Use the correct socket for the type of reading you need.

5. Reset the volt/ohm meter to zero before testing by holding the leads together and verifying that the scale shows zero ohms.
6. Use the correct pin test adapter for the connector(s) that are being tested. Incorrect test lead sizes may cause permanent damage to connector pins.
7. When measuring resistance, be sure that the ignition is off and the circuit is completely powered down.

### Example Voltage Readings

#### Voltage Reading

Verify the voltage measurement is within range. Low voltage readings may be a sign of poor voltage supply or excessive in-line resistance. Pay close attention to whether the reading requires a key-on or key-off condition.

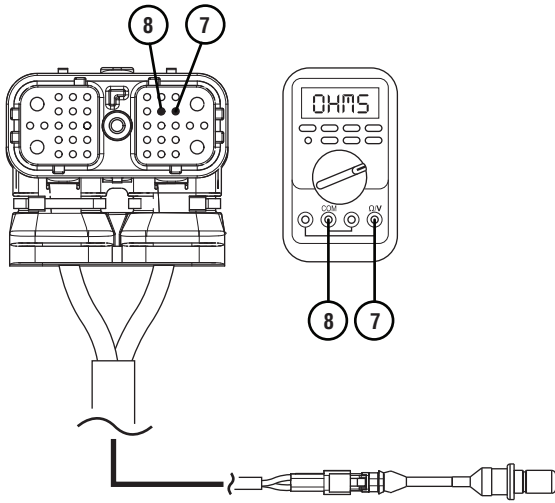


Pins	Range	Reading(s)
B to C	Within 0.6 V of Battery Voltage	12.5 V

## Example Circuit Continuity Readings

### Circuit has Continuity

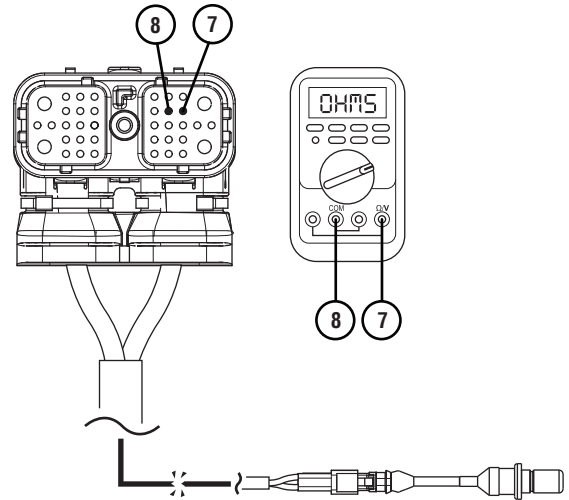
The circuit is complete when the resistance reading is within range. A circuit reading infinite resistance or Open Lead (OL) does not have continuity.



Pins	Range	Reading(s)
7 to 8	2.0k – 4.5k ohms	<b>3.2k ohms</b>

### Open Circuit

The circuit is incomplete when the resistance reading is infinite or Open Lead (OL). In cases where resistance readings are greater than 10k ohms, the circuit has some continuity, but is not making good contact. These can generally be treated as an open circuit.

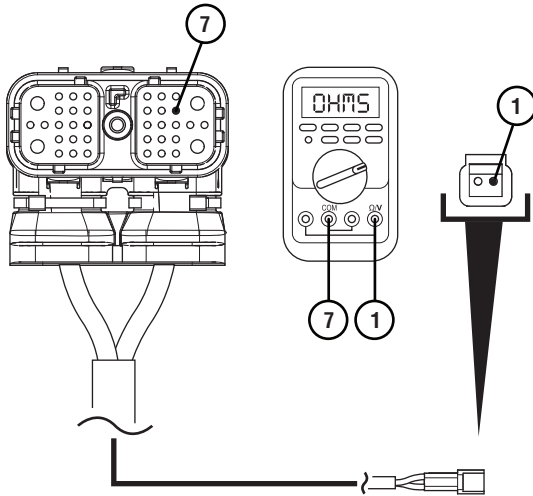


Pins	Range	Reading(s)
7 to 8	2.0k – 4.5k ohms	<b>OL</b>

### Example End to End Resistance

#### End to End Resistance is Within Range

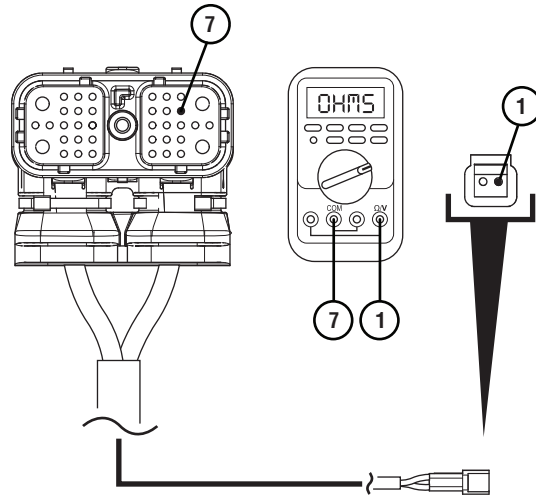
The wire has continuity when the resistance reading is within range. A wire reading infinite resistance or Open Lead (OL) does not have continuity.



Pins	Range	Reading(s)
7 to 1	0.0 – 0.3 ohms	<b>0.2 ohms</b>

#### End to End Resistance is Too High

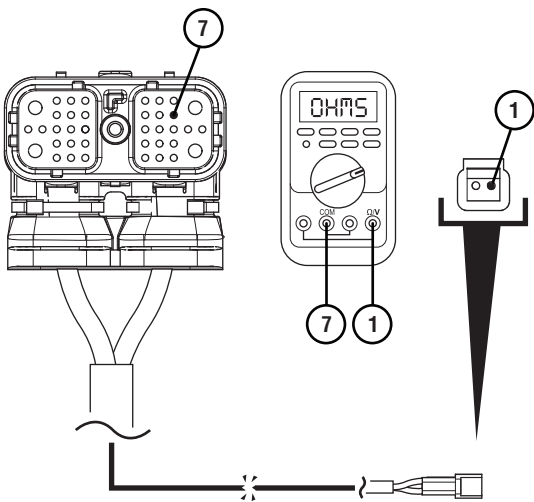
When the resistance is higher than the acceptable range there is additional resistance in this wire. Check for corrosion, loose or spread pins or damage to the harness.



Pins	Range	Reading(s)
7 to 1	0.0 – 0.3 ohms	<b>2.0 ohms</b>

### Open Circuit

The circuit is incomplete when the resistance reading is infinite or Open Lead (OL). Check for wire abrasions, cuts, loose or spread pins and unseated connectors.

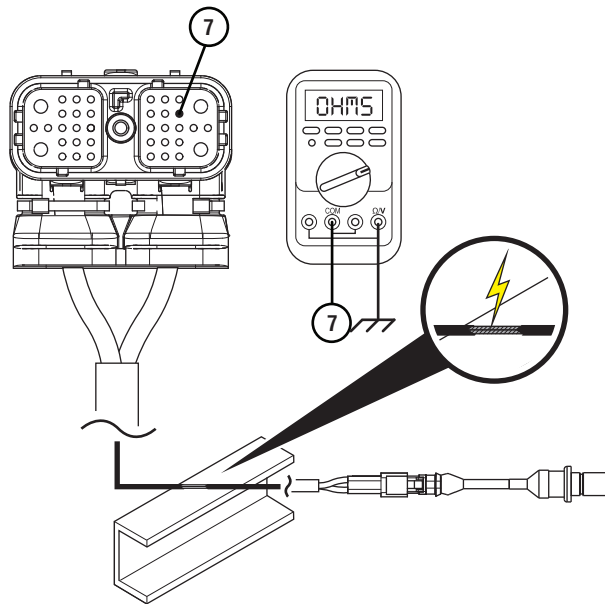


Pins	Range	Reading(s)
7 to 1	0.0 – 0.3 ohms	<b>OL</b>

### Short Circuit to Chassis Ground

#### Short to Ground

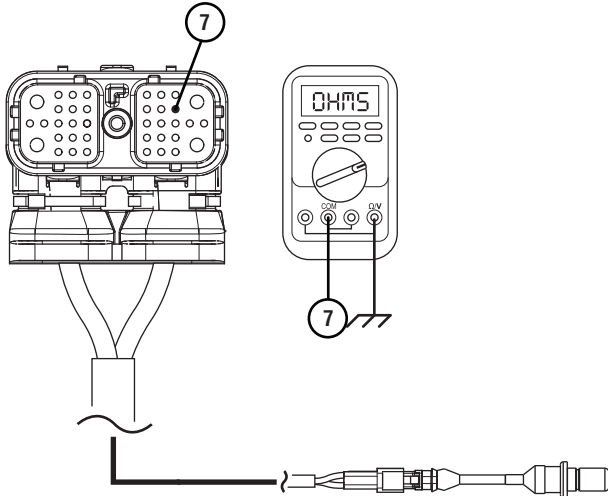
A wire is shorted to ground when the resistance between a non-ground wire and chassis ground shows continuity. Low resistance values (near 0 ohms) indicate a direct short to ground. Higher resistance values may indicate a partial-short.



Pins	Range	Reading(s)
7 to Ground	Open Circuit (OL)	<b>2.0 ohms</b>

### No Short to Ground

The wire is not shorted to ground when the resistance between a non-ground wire and chassis ground is infinite or Open Lead (OL). This wire has no continuity to chassis ground.

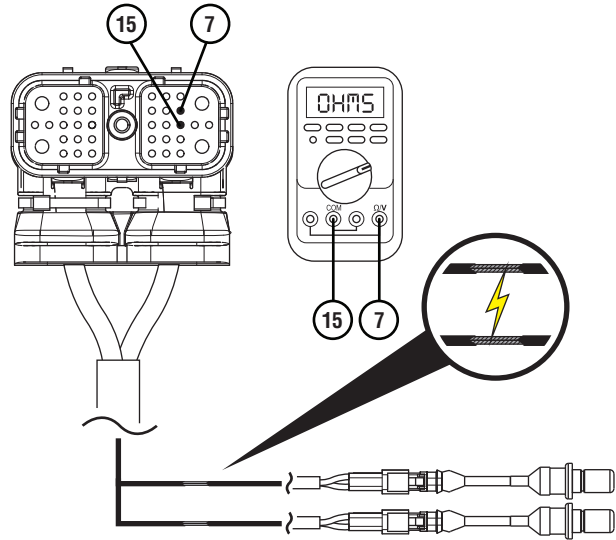


Pins	Range	Reading(s)
7 to Ground	Open Circuit (OL)	<b>OL</b>

### Short to Another Circuit

#### Two Circuits Shorted Together

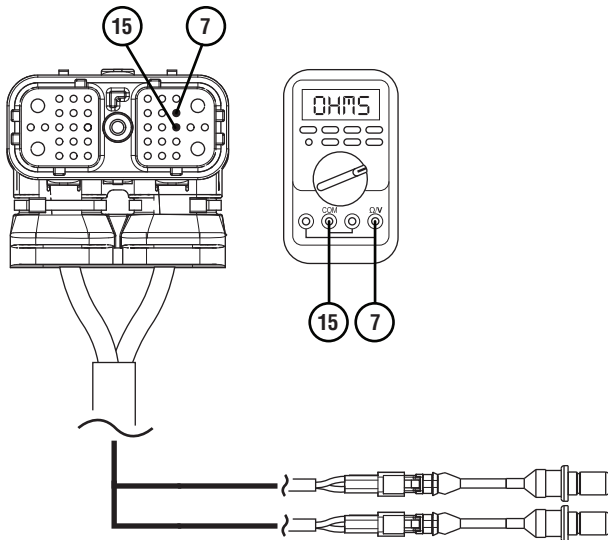
When wires from two unrelated circuits show continuity (low resistance) to one another, these circuits are shorted together.



Pins	Range	Reading(s)
7 to 15	Open Circuit (OL)	<b>2.0 ohms</b>

## Two Circuits Not Shorted Together

When wires from the two unrelated circuits show an infinite resistance or Open Lead (OL) between one another, these wires are not shorted together.



Pins	Range	Reading(s)
7 to 15	Open Circuit (OL)	<b><i>OL</i></b>

## Power-Up Sequence

### Overview

This symptom-driven test is performed if the transmission system fails to fully power up at ignition on.

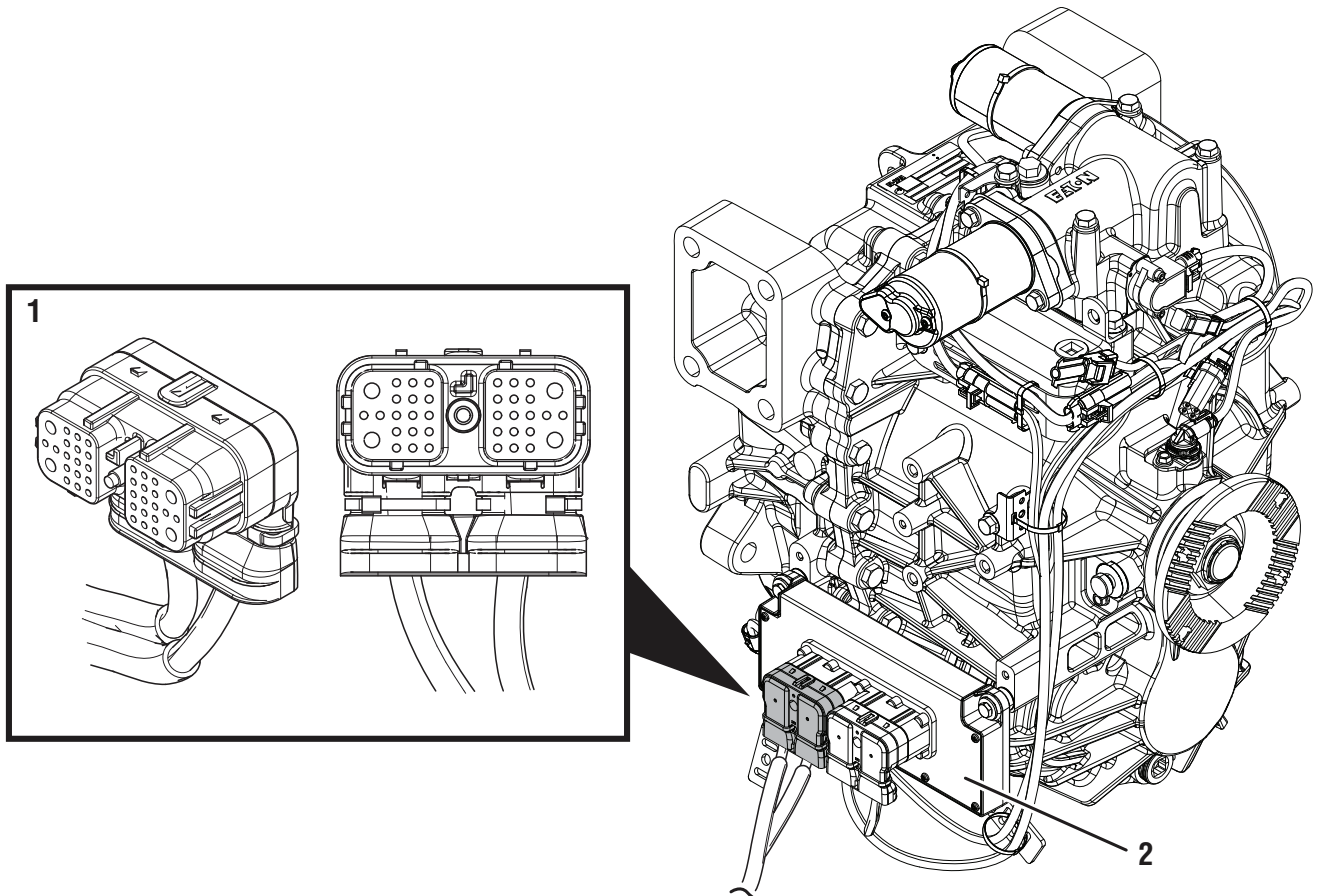
### Detection

- Gear Display may be blank.
- Gear Display may show double dashes “- -”.
- Gear Display may show double stars “\* \*”.
- Motor may not operate.
- Transmission will not engage a gear from neutral.

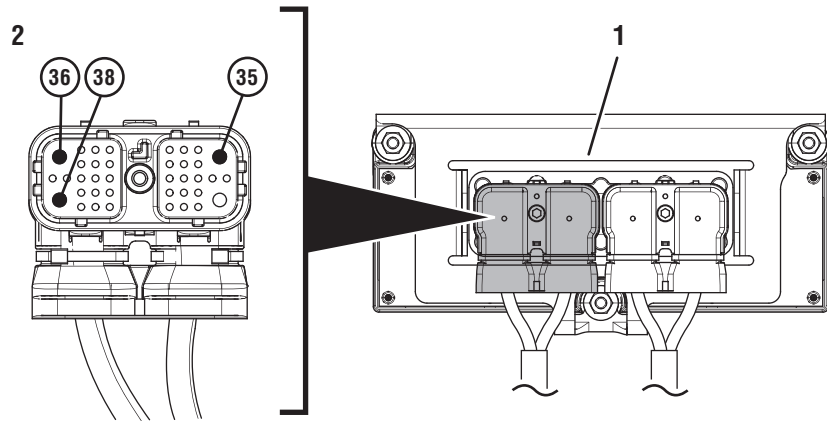
### Possible Causes

- Vehicle Power Supply Wiring
  - Poor power or ground supply to TECU
  - Bent, spread, corroded or loose terminals
  - Wires grounded, open or shorted
- Vehicle Batteries
  - Internal failure
- TECU
  - Internal Failure

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)



- 1. Transmission Electronic Control Unit (TECU)
- 2. 38-Way Vehicle Harness Connector

## Power-Up Sequence

**A** **Purpose:** Inspect the batteries, in-line fuse and power and ground supplies to the TECU.

1. Key off.
2. Measure voltage across all batteries. Record reading(s) in table.
3. Inspect battery terminals and transmission 30-amp In-line Fuse Holder Connections for corrosion, loose terminals and bent or spread pins.
4. Visually inspect Vehicle Harness between the power supply and the TECU for signs of rubbing or chafing to the wiring.

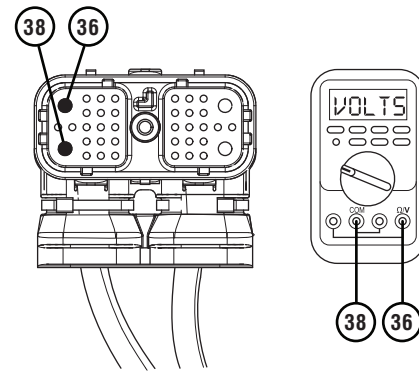
**Note:** Some chassis use a power and ground distribution block separate from the battery. Be sure to clean and inspect connections at this location and at the battery.

5. Verify that the battery voltage meets specifications for battery voltage.
  - If damage is found, repair or replace wiring per OEM guidelines. Go to **Step V.**
  - If no damage is found and the battery voltage is out of range, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**
  - If no damage is found and the battery voltage is in range, go to **Step B.**

Battery Voltage

**B** **Purpose:** Verify battery voltage at the TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect connector body for corrosion, damage and loose, spread or bent terminals.
4. Measure voltage between 38-Way Connector Pin 38 (Battery Positive) and Pin 36 (Battery Negative). Record reading(s) in table.

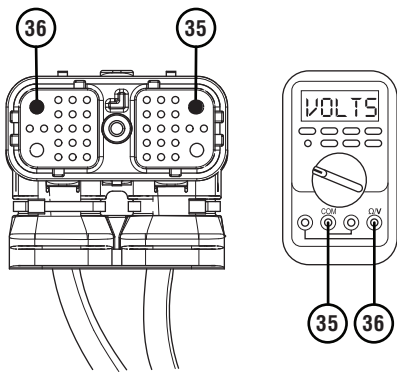


5. Compare reading(s) in table.
  - If readings are in range, go to **Step C.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of power and ground wiring between the batteries and 38-Way Vehicle Harness Connector at the TECU. Go to **Step V.**

Pins	Range	Reading(s)
38 to 36	Within 0.6 V of Battery Voltage	

**C****Purpose:** Verify ignition voltage at the TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect Connector body for damage and bent, spread, corroded or loose terminals.
4. Key on with motor off.
5. Measure voltage between 38-Way Connector Pin 35 (Ignition Positive) and Pin 36 (Battery Negative). Record reading(s) in table.



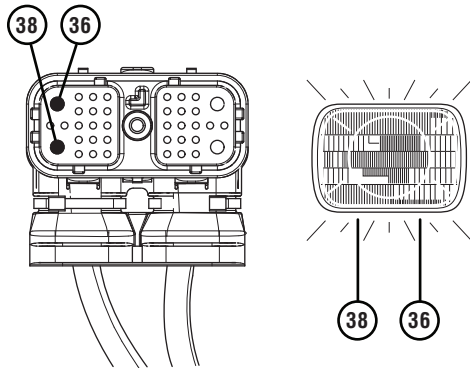
6. Compare reading(s) in table.
  - If readings are in range, go to **Step D.**
  - If readings are out of range, refer to OEM guidelines for repair of ignition voltage supply to TECU. Go to **Step V.**

Pins	Range	Reading(s)
35 to 36	Within 1.2 V of Battery Voltage	

**D**

**Purpose:** Load Test the vehicle power supply to the TECU.

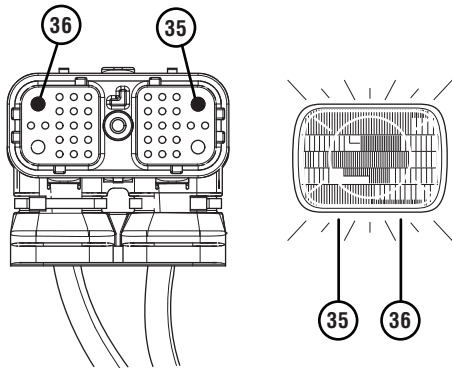
1. Key off.
2. Verify TECU battery power and ground supply from the Vehicle Harness is connected properly and not corroded, damaged or loose.
3. Disconnect 38-Way Vehicle Harness Connector from TECU.
4. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
5. Load test the Vehicle Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin 38 (power) and Pin 36 (ground). Load Test for 5 minutes to verify the harness will carry a load with the 30-amp fuse installed.



6. Wiggle the harness during the Load Test from vehicle batteries to TECU.
  - If issues are found with the power supply or connectors, refer to OEM guidelines for repair or replacement of OEM wiring. Go to **Step V.**
  - If the power supply does not carry a load, refer to OEM guidelines for repair or replacement of OEM wiring. Go to **Step V.**
  - If no issues are found with the power supply or connectors and the power supply carries a load, go to **Step E.**

**E** **Purpose:** *Purpose: Load Test the vehicle ignition supply to the TECU.*

1. Key off.
2. Verify TECU ignition supply from the Vehicle Harness is connected properly and not corroded, damaged or loose.
3. Disconnect 38-Way Vehicle Harness Connector from TECU.
4. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
5. Key on with motor off.
6. Load test the Vehicle Ignition Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin 35 (ignition) and Pin 36 (ground). Load Test for 5 minutes to verify the harness will carry a load with the 10-amp fuse installed.



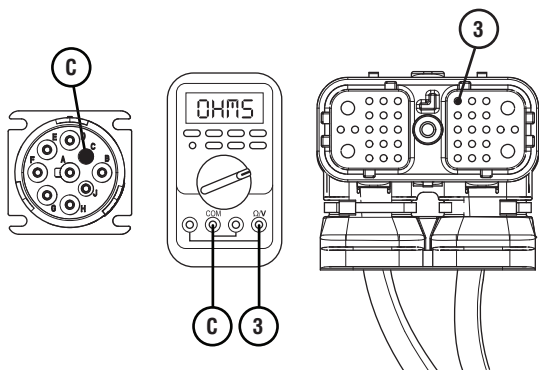
7. Wiggle the harness during the Load Test from vehicle ignition to TECU.
  - If issues are found with the ignition supply or connectors, refer to OEM guidelines for repair or replacement of OEM wiring. Go to **Step V**.
  - If the ignition supply does not carry a load, refer to OEM guidelines for repair or replacement of OEM wiring. Go to **Step V**.
  - If no issues are found with the ignition supply or connectors and the ignition supply carries a load, go to **Step F**.

**F** **Purpose:** *Verify TECU location on the vehicle J1939 Data Link.*

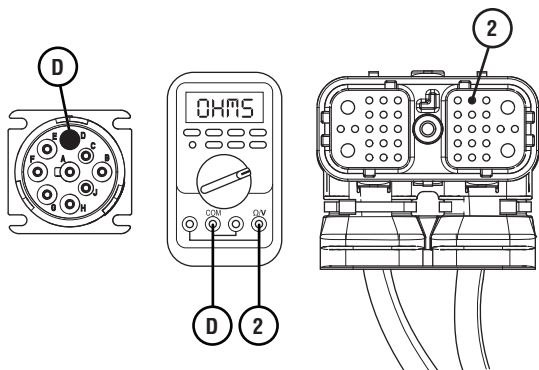
1. Key off.
2. Refer to the OEM and identify the TECU location on the vehicle J1939 Data Link at the 9-Way Diagnostic Connector.
  - If Black 9-Way Diagnostic Connector, Go to **Step G**.
  - If Green 9-Way Diagnostic Connector on Pin C and Pin D, go to **Step G**.

**G** **Purpose:** Verify J1939 positive and negative connections to TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Measure resistance between 9-Way Diagnostic Connector Pin C and 38-Way Vehicle Harness Connector Pin 3. Record reading(s) in table.



4. Measure resistance between 9-Way Diagnostic Connector Pin D and 38-Way Vehicle Harness Connector Pin 2. Record reading(s) in table.



5. Compare reading(s) in table.
  - If readings are in range, replace the TECU. Go to **Step V**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle J1939 Data Link. Go to **Step V**.

Pins	Range	Reading(s)
C to 3	0.0–0.3 ohms	
D to 2	0.0–0.3 ohms	

**V** **Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active during the test drive and vehicle operates properly, test complete.
  - If a fault code is set Active during the test drive, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
  - If no fault codes set Active and the vehicle complaint is duplicated, contact Eaton at (800) 826-4357 for further diagnostics.

## Transmission Service Light Status Test

### Overview

This symptom-driven test is performed to identify transmission service light issues.

### Detection

- Transmission Service Light is on constantly.
- Transmission Service Light never illuminates.

### Possible Causes

- Vehicle Shift Device Wiring
  - Bent, spread, corroded or loose terminals
  - Wires grounded, open or shorted
- Vehicle Shift Device
  - Internal failure
- TECU
  - Internal Failure

## Transmission Service Light Status Test

**A** **Purpose:** Communicate with the TECU using ServiceRanger.

1. Key on with motor off.
  2. Connect ServiceRanger.
    - If ServiceRanger is unable to communicate with the TECU, go to *Power-Up Sequence* on page 23
    - If ServiceRanger can communicate with the TECU go to **Step B**.
- 

**B** **Purpose:** Check for Active or Inactive fault codes.

1. Key on with motor off.
  2. Connect ServiceRanger.
  3. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
    - If Fault Code(s) 13, 14, 15, 84 and/or 85 are Active or Inactive, troubleshoot the fault code(s) per the *Fault Code Isolation Procedure Index* on page 14.
    - If Fault Code(s) 13, 14, 15, 84 and/or 85 are not set, go to **Step C**.
- 

**C** **Purpose:** Purpose: Identify type of shift device.

1. Identify if the shift device is an OEM-built device or an Eaton built device.
    - If the vehicle is equipped with an Eaton built shift device, go to **Step D**.
    - If the vehicle is equipped with an OEM shift device, go to **Step G**.
-

**D** **Purpose:** Observe the Service Light during the key-on power up.

1. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

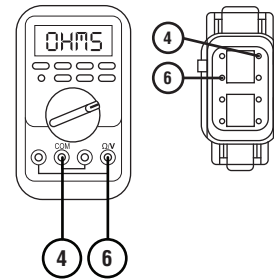
2. Key on with motor off.
3. Observe Service Light during the key on sequence.
  - If the Service Light illuminates for 1 second, then turns off, test complete. Go to **Step V.**
  - If the Service Light never illuminates and the vehicle is equipped with an Eaton Push Button Shift Control Device, pull fault codes with ServiceRanger and troubleshoot the Active fault code per the *Fault Code Isolation Procedure Index* on page 14.
  - If the Service Light never illuminates and the vehicle is equipped with an Eaton built Shift Lever, go to **Step F.**
  - If the Service Light is on constantly and the vehicle is equipped with an Eaton built Shift Lever, go to **Step E.**
  - If the Service Light is on constantly and the vehicle is equipped with an Eaton Push Button Shift Control Device, replace the TECU. Go to **Step V.**
  - If the Service Light flashes, pull fault codes with ServiceRanger and troubleshoot the Active fault code per the *Fault Code Isolation Procedure Index* on page 14.

**E** **Purpose:** Verify the Service Light is not shorted to power.

1. Key off.

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Disconnect the 8-Way Shift Lever Connector.
4. Measure resistance between 8-Way Shift Lever Harness Connector Pin 4 and Pin 6. Record reading(s) in table.

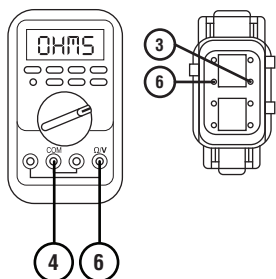


5. Compare reading(s) in table.
  - If readings are in range, replace Eaton built Shift Lever. Go to **Step V.**
  - If readings are out of range, repair or replace wiring between the TECU and Shift Lever per OEM guidelines. Go to **Step V.**

Pins	Range	Reading(s)
4 to 6	Open Circuit (OL)	

**F** **Purpose:** Measure the Service Light voltage supply at the Shift Lever.

1. Key off.  
**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Disconnect the 8-Way Shift Lever Connector.
3. Key on with motor off.
4. Measure voltage between 8-Way Shift Lever Harness Connector Pin 6 and Pin 3 while turning the key on. Record reading(s) in table.



5. Compare reading(s) in table.
  - If readings are in range, replace Eaton built Shift Lever. Go to **Step V.**
  - If readings are out of range, repair or replace wiring between the TECU and Shift Lever per OEM guidelines. go to **Step V.**

Pins	Range	Reading(s)
6 to 3 (first second after key on)	Within 2.0 V of Battery Voltage	
6 to 3 (after 1 second)	Less than 1.5 V	

**G** **Purpose:** Purpose: Verify continuity of Service Light wiring between TECU and Service Lamp.

1. Key off.  
**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.  
**Note:** See OEM wiring diagram and connector views to identify the Service Light Power and Ground Pins at the Service Lamp in the dash.
3. Inspect wiring between the TECU and Service Lamp for signs of rubbing or chafing to the wiring.
4. Inspect connector bodies for corrosion, damage and loose, spread or bent terminals.
5. Contact the OEM to perform the following tests:

**Note:** The transmission sends a voltage to the 38-Way Vehicle Harness Pin 23 to light the Service Lamp. The OEM is responsible for supplying the Service Lamp ground.

**Note:** Some OEM chassis use a switched ground to control the Service Lamp, rather than the switched voltage that the TECU is sending. Those chassis may use a relay, or another technique, to replace the TECU Service Lamp output voltage with a ground signal.

- Verify that the wiring between the TECU and the Service Lamp is wired per OEM specifications.
- Verify the wiring is not open or shorted to ground.
- Verify a proper ground path is supplied to the Service Lamp.
- Refer to OEM guidelines for repair or replacement of vehicle wiring and or transmission service light. Go to **Step V.**

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active during the test drive and vehicle operates properly, test complete.
    - If a fault code is set Active during the test drive, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
    - If no fault codes set Active and the vehicle complaint is duplicated, contact Eaton at (800) 826-4357 for further diagnostics.
-

# Electrical Pretest

## Overview

This procedure provides a basic test of the vehicle electrical system. A well-functioning electrical supply is required for proper operation of the Medium Duty 4-Speed EV Transmission.

This test verifies the vehicle batteries are fully charged, proper battery and ignition voltage are being supplied to the transmission components, and the electrical system can supply proper voltage and current when under load.

Fault codes that set for a specific transmission give additional information about performance issues detected on that vehicle. If a unit has an Active fault code, or repeated occurrences of an Inactive fault code, refer to the troubleshooting procedure for that fault code. Certain fault code troubleshooting procedures require completion of the Troubleshooting Pretest. Some electrical system failures may cause performance problems without setting a fault code.

## Detection

None

## Conditions to Set Fault Code Active

None

## Fallback

None

## Conditions to Set Fault Code Inactive

None

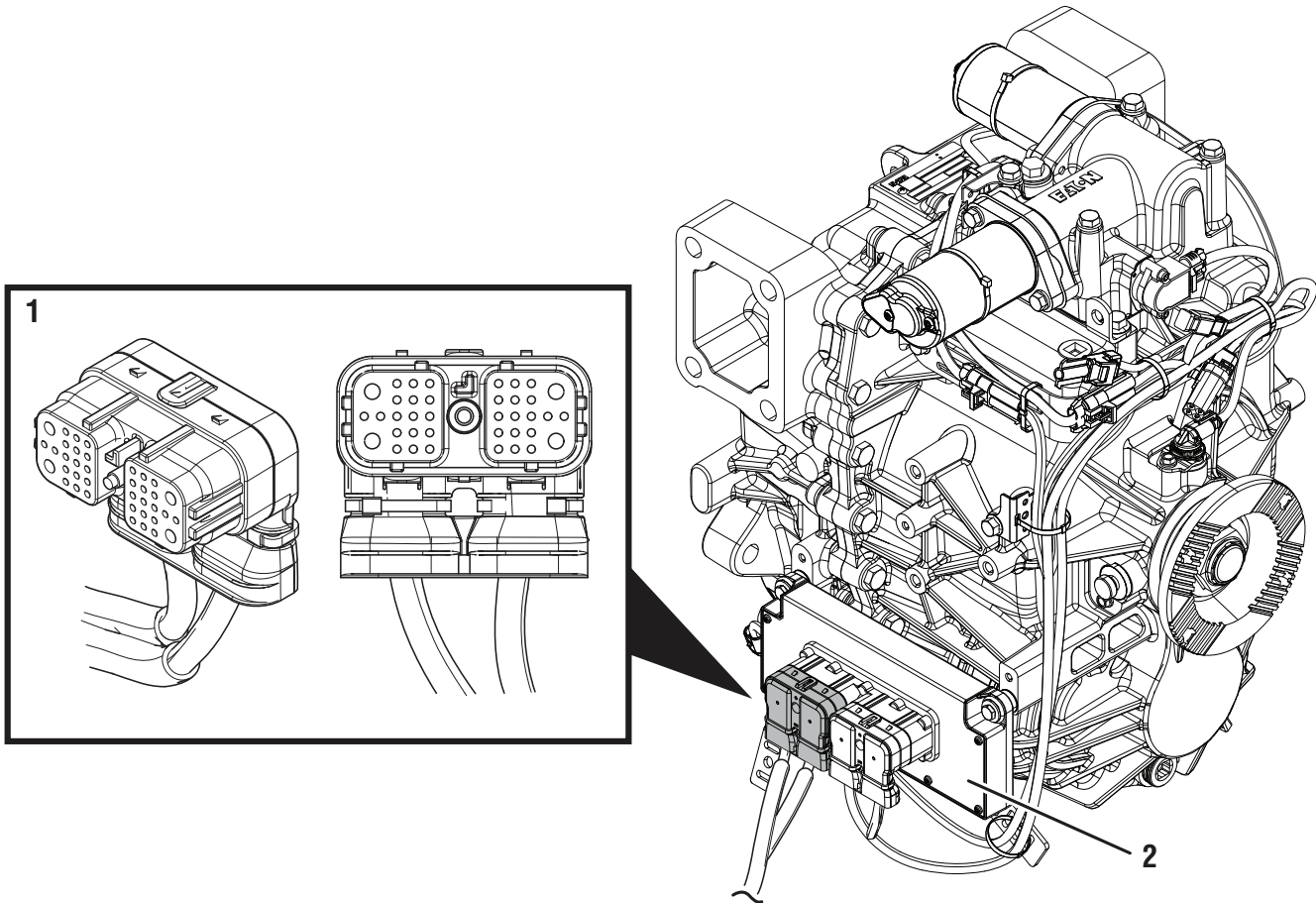
## Possible Causes

- Vehicle Batteries
  - Internal failure
- Vehicle Charging System
  - Charging system failed
- Vehicle Harness
  - Poor power or ground supply to Transmission Electronic Control Unit (TECU)
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Improperly seated or missing 30-amp fuse
- Transmission Harness
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals

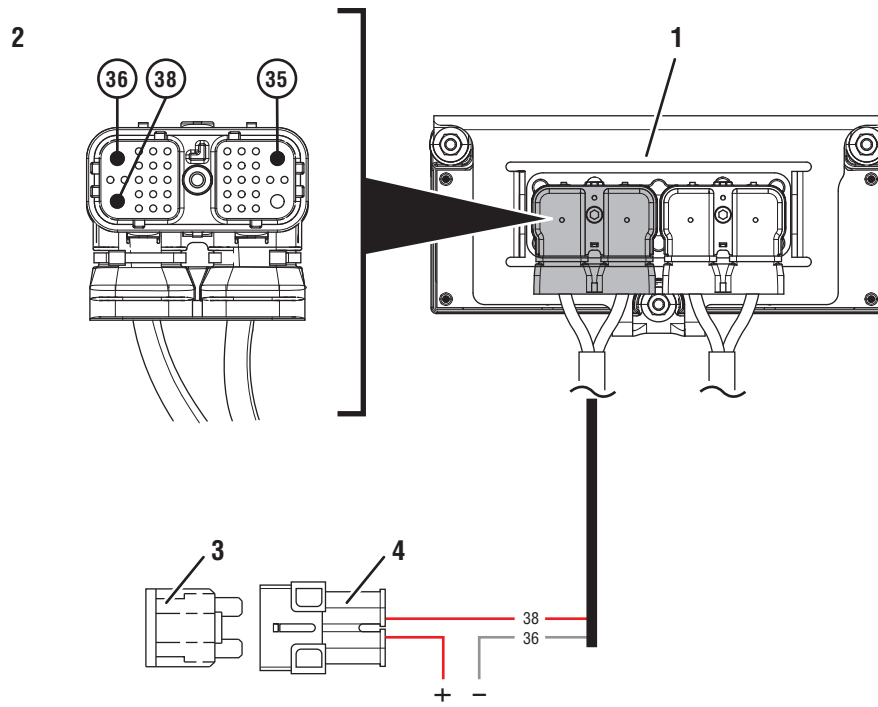
## Additional Tools

Battery load testing equipment (see OEM for specific recommendations)

## Component Identification



- 1. 38-Way Vehicle Harness Connector
- 2. Transmission Electronic Control Unit (TECU)



- 1. Transmission Electronic Control Unit (TECU)
- 2. 38-Way Vehicle Harness Connector
- 3. 30-amp Fuse
- 4. In-line Fuse Holder



## Electrical Pretest

**A** **Purpose:** Inspect the batteries, in-line fuse and power and ground supplies to the TECU.

1. Key off.
2. Measure voltage across all batteries. Record reading(s) in table.
3. Inspect battery terminals and transmission 30-amp in-line fuse holder connections for damage and bent, spread, corroded or loose terminals.
4. Visually inspect Vehicle Harness between the power supply and the TECU for signs of rubbing or chafing to the wiring.

**Note:** Some chassis use a power and ground distribution block separate from the battery. Be sure to clean and inspect connections at this location and at the battery.

- If damage is found, repair or replace wiring per OEM guidelines, go to **Step B.**
- If no damage is found, go to **Step B.**

Battery Voltage

**B** **Purpose:** Perform a Load Test on each vehicle battery.

1. Key off.
 

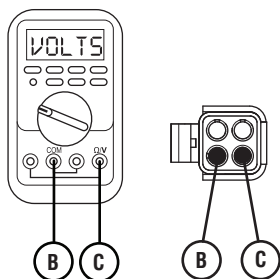
**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Load test each vehicle battery per OEM specifications. Record reading(s).
  - If all batteries pass the Load Test, go to **Step C.**
  - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step C.**

Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

**C** **Purpose:** Verify voltage supply to the TECU through the 4-Way Diagnostic Connector.

1. Reconnect all harnesses and connectors.
2. Key on with motor off.
3. Remove connector cover of 4-Way Diagnostic Connector on the Transmission Harness.
4. Measure voltage between Pin B (Service Battery positive) and Pin C (Service Battery negative). Record reading(s).

**WARNING:** Do not Load Test the power supply through this connection.

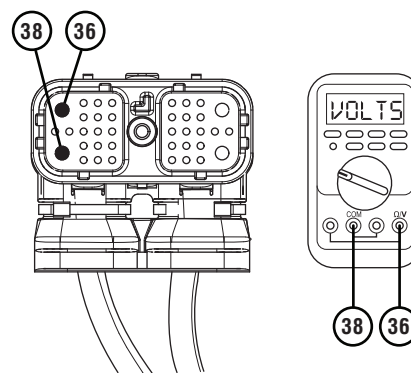


5. Compare reading(s) in table.
  - If readings are in range, go to **Step F.**
  - If readings are out of range, Go to **Step D.**

Pins	Range	Reading(s)
B to C	Within 1.2 V of Battery Voltage	

**D** **Purpose:** Verify battery voltage at the TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect connector body for damage and bent, spread, corroded or loose terminals.
4. Measure voltage between 38-Way Connector Pin 38 (Battery positive) and Pin 36 (Battery negative). Record reading(s).



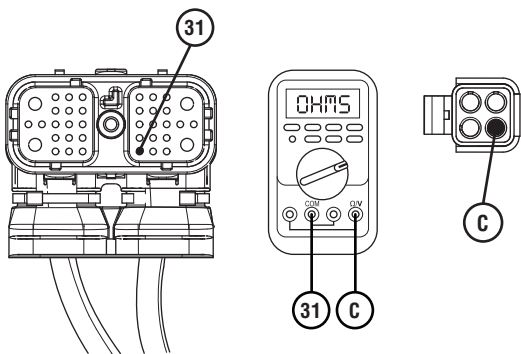
5. Compare reading(s) in table.
  - If readings are in range, go to **Step E.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of battery power and ground supply to TECU. Go to **Step V.**

Pins	Range	Reading(s)
38 to 36	Within 1.2 V of Battery Voltage	

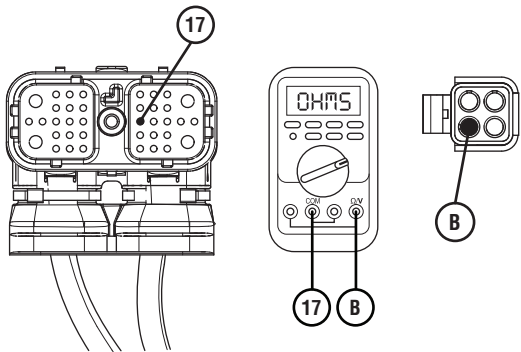
**E**

**Purpose:** Verify continuity and check for short to ground of service battery voltage circuits between the TECU and 4-Way Diagnostic Connector.

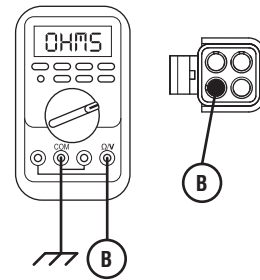
1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from TECU.
3. Inspect connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between Pin 31 and Pin C. Record reading(s) in table.



5. Measure resistance between Pin 17 and Pin B. Record reading(s) in table.



6. Measure resistance between Pin B and ground. Record reading(s) in table.



7. Compare reading(s) in table.

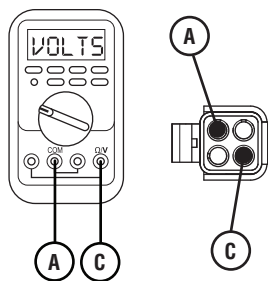
- If readings are out of range, replace **Transmission Harness**. Go to **Step V**.
- If readings are in range, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.

Pins	Range	Reading(s)
31 to C	0.0–0.3 Ohms	
17 to B	0.0–0.3 Ohms	
B to Ground	Open Circuit (OL)	

**F** **Purpose:** Verify ignition voltage to the TECU through the 4-Way Diagnostic Connector.

1. Key off.
2. Reconnect all harnesses and connectors.
3. Key on with motor off.
4. Remove connector cover of 4-Way Diagnostic Connector on the Transmission Harness.
5. Measure voltage between Pin A (Service Ignition positive) and Pin C (Service Battery negative). Record reading(s).

**WARNING:** Do not Load Test the power supply through this connection.

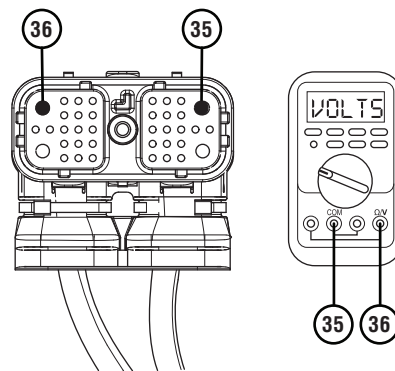


6. Compare reading(s) in table.
  - If readings are in range, go to **Step V.**
  - If readings are out of range, go to **Step G.**

Pins	Range	Reading(s)
A to C	Within 1.2 V of Battery Voltage	

**G** **Purpose:** Verify ignition voltage at the TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Verify connector is free from any corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Key on with motor off.
5. Measure voltage between 38-Way Connector Pin 35 (Ignition positive) and Pin 36 (Battery negative). Record reading(s) in table.



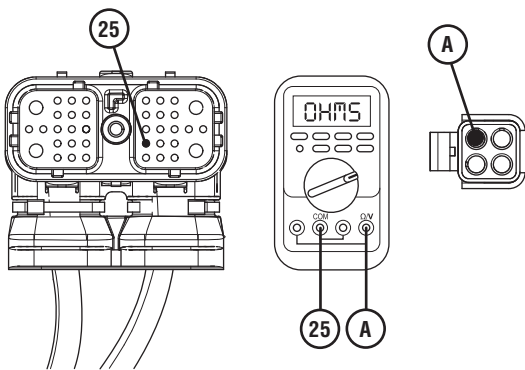
6. Compare reading(s) in table.
  - If readings are in range, go to **Step H.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of ignition voltage supply. Go to **Step V.**

Pins	Range	Reading(s)
35 to 36	Within 1.2 V of Battery Voltage	

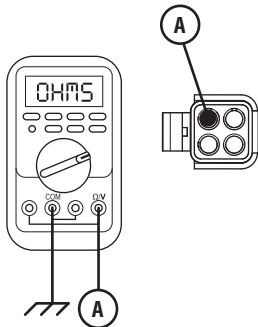
**H**

**Purpose:** Verify continuity and check for short to ground of service ignition circuit between the TECU and 4-Way Diagnostic Connector.

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from TECU.
3. Inspect connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between Pin 25 and Pin A. Record reading(s) in table.



5. Measure resistance between Pin A and ground. Record reading(s) in table.



6. Compare reading(s) in table.
  - If readings are out of range, replace **Transmission Harness**. Go to **Step V**.
  - If readings are in range, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.

Pins	Range	Reading(s)
25 to A	0.0–0.3 Ohms	
A to Ground	Open Circuit (OL)	

**V**

**Purpose:** Verify Electrical Pretest.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active, test complete.
  - If a fault code sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 11: No TECU Operation

**J1939: SA 3      SPN 629      FMI 12**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with a Transmission Electronic Control Unit (TECU). The TECU performs a variety of functions including receiving inputs from sensors, sending outputs to control devices, operating X-Y Shifter motors and actuators and making shift decisions. Fault Code 11 indicates an internal failure of the TECU.

### Detection

The TECU performs a self-check during power up, any failure detected sets this fault.

### Conditions to Set Fault Code Active

**FMI 12 – Bad Intelligent Device:** TECU detects an internal failure.

### Fallback

#### FMI 12

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Motor may not operate.
- Transmission may not attempt to shift.
- Transmission may not confirm neutral.
- Motor may have to be shut down with transmission still in gear.

### Conditions to Set Fault Code Inactive

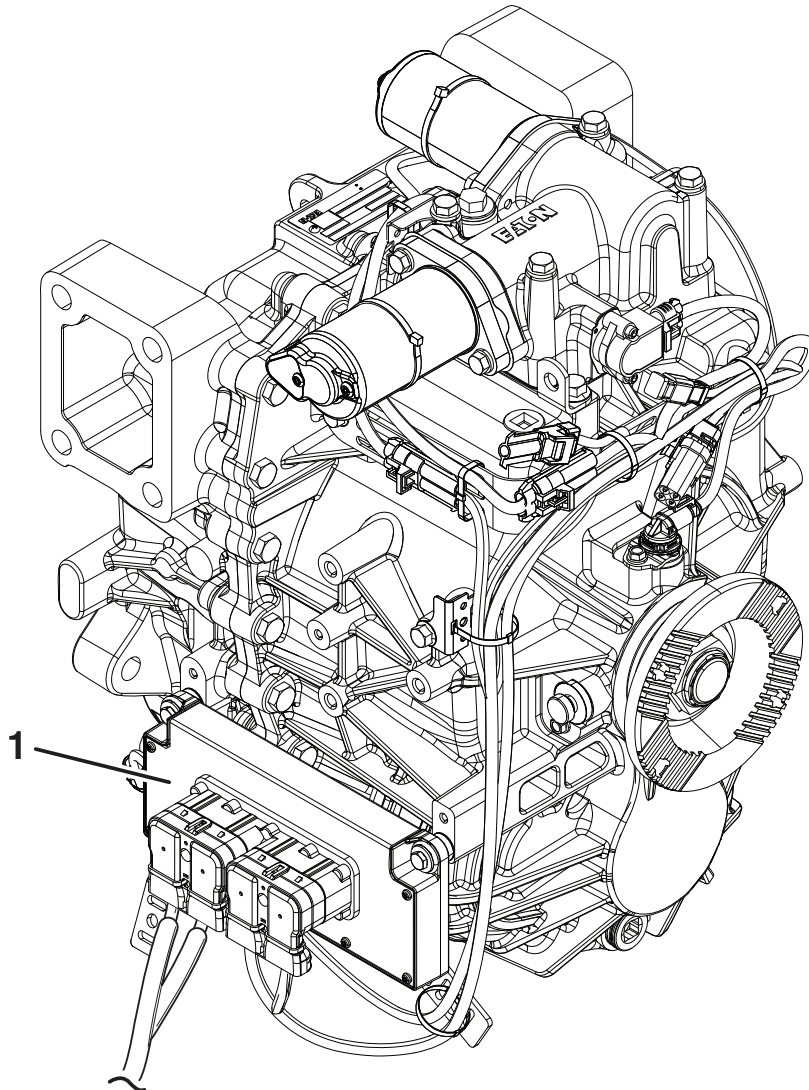
**FMI 12:** Transmission powers up and the failure is no longer detected by the TECU.

### Possible Causes

#### FMI 12

- TECU
  - Internal failure

## Component Identification



1. Transmission Electronic Control Unit (TECU)

## Fault Code 11 Troubleshooting

**A**

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
  - If Fault Code 11 sets Active or Inactive, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.

**V**

**Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 11 sets Active during the test drive, contact Eaton at (800) 826-4357 for further diagnostics.
  - If a fault code other than 11 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

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## Fault Code 12: Improper TECU Configuration

**J1939: SA 3      SPN 629      FMI 13, 14**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with a Transmission Electronic Control Unit (TECU). The TECU performs a variety of functions including receiving inputs from sensors, sending outputs to control devices, operating X-Y Shifter motors and actuators and making shift decisions. Fault Code 12 indicates an internal failure of the TECU.

### Detection

The TECU performs a self-check during power up. If the TECU does not detect valid memory, or if there are missing or corrupt transmission configuration files, this fault sets Active.

### Conditions to Set Fault Code Active

**FMI 13 – Out of Calibration:** TECU is unable to determine the proper transmission configuration.

**FMI 14 – Special Instructions:** TECU is unable to complete writing of memory files during power down.

### Fallback

#### FMI 13

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Motor may not operate.
- Transmission may not engage a gear.
- Transmission may not make up shifts or down shifts.
- Motor may have to be shut down with transmission still in gear.

#### FMI 14

- None

### Conditions to Set Fault Code Inactive

**FMI 13:** TECU has detected a proper configuration for the transmission.

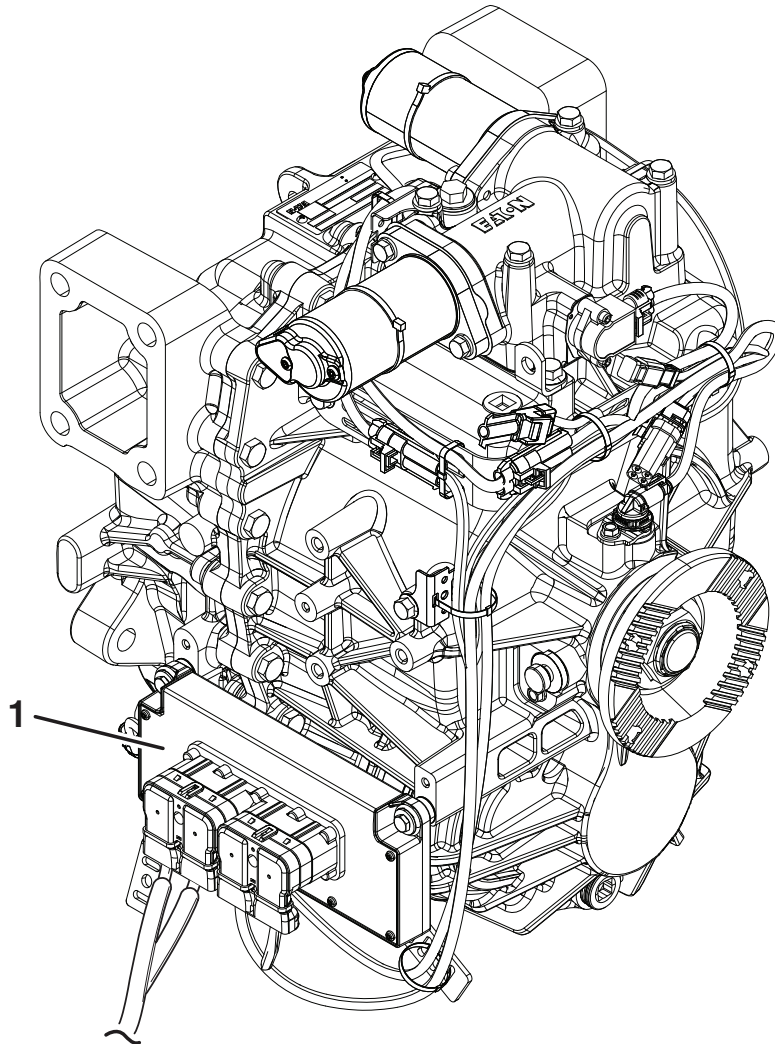
**FMI 14:** TECU has detected a successful writing of memory files during power down.

### Possible Causes

#### All FMIs

- TECU
  - Internal failure

## Component Identification



1. Transmission Electronic Control Unit (TECU)

## Fault Code 12 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 12, FMI 13 is Active or Inactive, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.
  - If Fault Code 12, FMI 14 is Active, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.
  - If Fault Code 12, FMI 14 is Inactive, test complete. Go to **Step V**.

### V

**Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 12 sets Active during the test drive, contact Eaton at (800) 826-4357 for further diagnostics.
  - If a fault code other than 12 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 13: J1939 Shift Control Device

**J1939: SA 3      SPN 751      FMI 8, 9**

### Overview

The Medium Duty 4-Speed EV Transmission may be equipped with a J1939 Shift Control Device. This version of the Shift Control Device uses the J1939 Data Link to broadcast the driver's shift request to the Transmission Electronic Control Unit (TECU). The system includes redundant neutral request and neutral confirmation signals hard-wired between the Shift Control Device and TECU. These redundant signals allow the transmission to achieve neutral if the J1939 Data Link fails.

Fault Code 13 indicates that either the TECU lost J1939 Data Link communications with the Shift Control Device or that the neutral request status received over J1939 and the neutral request status received through the hard-wired signal do not match.

### Detection

The ignition key is on and the TECU has not detected any low battery system faults.

### Conditions to Set Fault Code Active

**FMI 8 – Abnormal Frequency:** TECU compares the J1939 Data Link message from the Shift Control Device to the hard-wired neutral signal request. When 10 consecutive messages do not match, the fault code sets Active.

**FMI 9 – Abnormal Update Rate:** TECU has lost communication with the J1939 Shift Control Device but can communicate with other devices on the J1939 Data Link. When no J1939 messages have been received for 5 seconds, the fault code sets Active.

### Fallback

#### FMI 8

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Motor may not operate.
- Transmission may not engage a gear from neutral.

#### FMI 9

- Transmission may not attempt to shift.
- Until the fault becomes Inactive, driver may have to shut off motor with transmission in gear.

### Conditions to Set Fault Code Inactive

**All FMIs:** TECU receives a valid message over the J1939 Data Link.

### Possible Causes

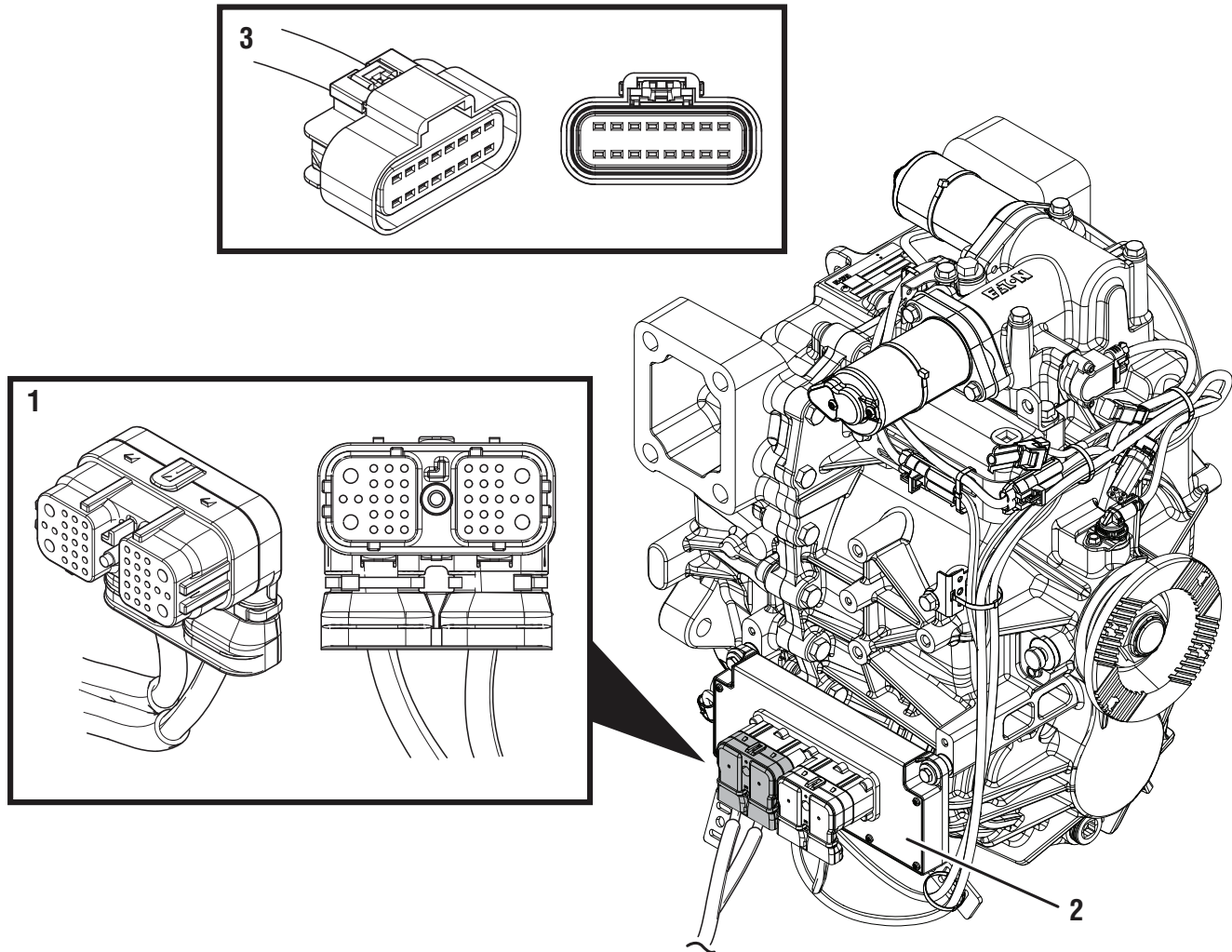
#### FMI 8

- Vehicle Harness
  - Bent, spread or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Shift Control Device
  - Internal failure

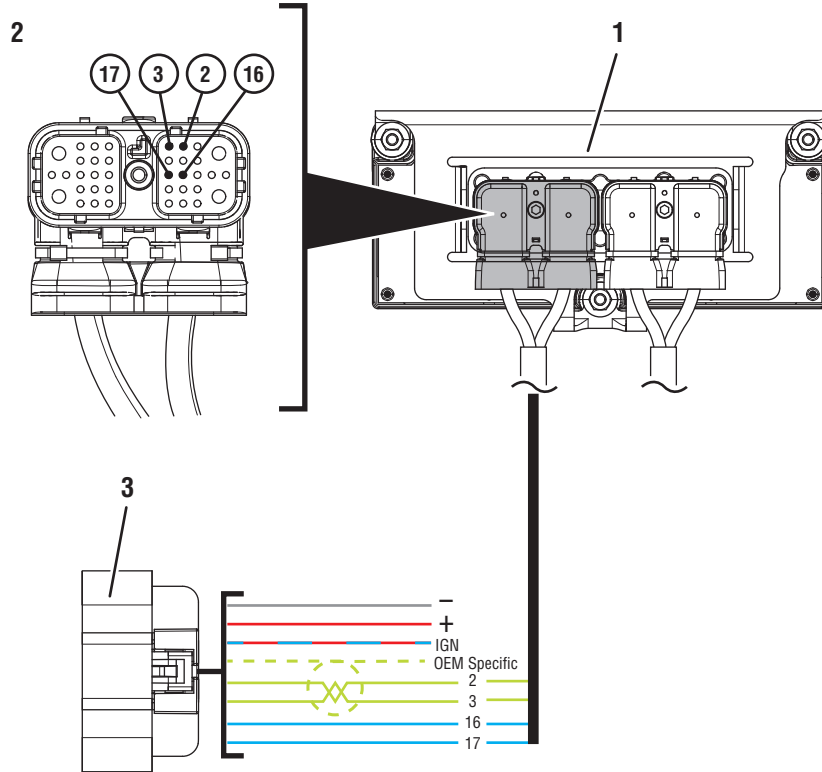
#### FMI 9

- Data Link
  - Bent, spread, or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Vehicle Harness
  - Bent, spread or loose terminals
- Shift Control Device Power Supply
  - Loss of supply battery voltage
  - Loss of supply ignition voltage
  - Loss of supply ground connection
- Shift Control Device
  - Internal failure

## Component Identification



- 1. 38-Way Vehicle Harness Connector
- 2. Transmission Electronic Control Unit (TECU)
- 3. OEM J1939 Shift Control Connector (in cab)



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. OEM J1939 Shift Control Connector



## Fault Code 13 Troubleshooting

**A**

**Purpose:** Check for Active or Inactive fault codes related to J1939 Data Link.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If non-transmission fault codes related to the J1939 Data Link are present, troubleshoot per OEM guidelines.
  - If transmission Fault Code 35 is present, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
  - If no J1939 Data Link fault codes are present, go to **Step B.**

**B**

**Purpose:** Verify which FMI set.

1. Determine which FMI set for Fault Code 13.
  - If Fault Code 13 FMI 9 is Active, go to **Step D.**
  - If Fault Code 13 FMI 8 is Active or Inactive, go to **Step J.**
  - If Fault Code 13 FMI 9 is Inactive, go to **Step C.**

**C** **Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



3. Wiggle J1939 Data Link Wiring. Look for signs of rubbing, chafing or corrosion on the wires.
4. Wiggle the power and ground supply to the Shift Control Device. Look for signs of rubbing, chafing or corrosion on the wires.
5. Exit PD Mode by powering down.

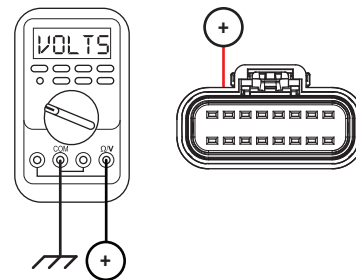
**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault code became Active while wiggling the power or ground supply to the Shift Control Device, refer to OEM guidelines for repair or replacement of the power and ground supply to the Shift Control Device. Go to **Step V.**
- If any fault code became Active while wiggling J1939 Data Link Wiring refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**
- If no fault codes became Active while wiggling either harness, go to **Step D.**

**D** **Purpose:** Verify battery voltage at the OEM Shift Control Device.

1. Key off.
 

**Note:** See OEM wiring diagram and connector views to identify the corresponding pin at the Shift Control Device Connector.
2. Disconnect OEM J1939 Shift Control Connector.
3. Inspect OEM J1939 Shift Control Connector body for damage and bent, spread, corroded or loose terminals.
4. Key on with motor off.
5. Measure voltage between Battery Positive (+) Pin on OEM J1939 Shift Control Connector and ground. Record reading(s) in table.



6. Compare reading(s) in the table.
  - If readings are in range, go to **Step E.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of wiring between the Shift Control Device Connector and Battery Positive (+). Go to **Step V.**

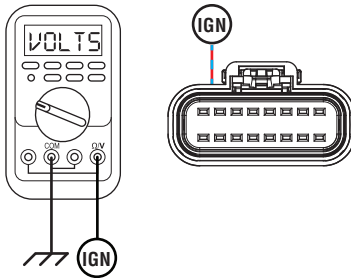
Pins	Range	Reading(s)
Battery Positive (+) at OEM J1939 Shift Control Connector to Ground	Within 1.2 V of battery voltage	

**E** **Purpose:** Verify Ignition Voltage to the Shift Control Device.

1. Key on with motor off.

**Note:** See OEM wiring diagram and connector views to identify the corresponding pin at the Shift Control Device Connector.

2. Measure voltage between Ignition Pin on OEM J1939 Shift Control Connector and ground.



- If readings are in range, go to **Step F.**
- If readings are out of range, refer to OEM guidelines for repair or replacement of ignition wiring to the Shift Control Device. Go to **Step V.**

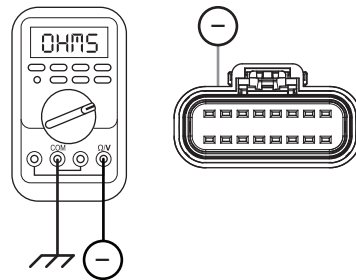
Pins	Range	Reading(s)
Switched Ignition at OEM J1939 Shift Control Connector to Ground	Within 1.2 V of battery voltage	

**F** **Purpose:** Verify ground supply to the Shift Control Device.

1. Key off.

**Note:** See OEM wiring diagram and connector views to identify the corresponding pin at the OEM J1939 Shift Control Connector.

2. Measure resistance from Ground Supply Pin on OEM J1939 Shift Control Connector to ground. Record reading(s) in table.



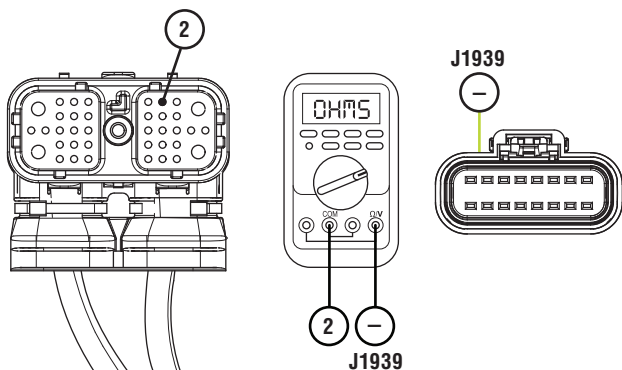
3. Compare reading(s) in table.
  - If readings are in range, go to **Step G.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of wiring between Ground Supply Pin on OEM J1939 Shift Control Connector and vehicle ground. Go to **Step V.**

Pins	Range	Reading(s)
Ground Supply at OEM J1939 Shift Control Connector Pin to Ground	0.0–0.3 ohms	

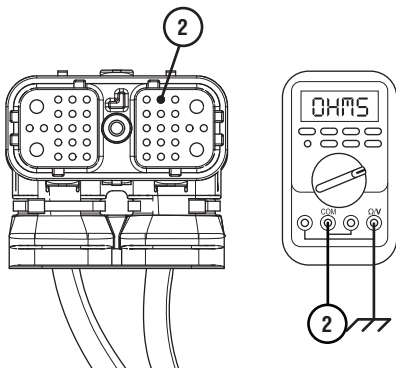
**G Purpose:** Verify continuity across J1939 Negative (-) between the TECU and Shift Control Device.

1. Key off.
 

**Note:** See OEM wiring diagram and connector views to identify the corresponding pin at the OEM J1939 Shift Control Connector.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 2 and the corresponding J1939 Negative (-) Pin on the OEM J1939 Shift Control Connector. Record reading(s) in table.



5. Measure resistance between 38-Way Vehicle Harness Connector Pin 2 and ground. Record reading(s) in table.



6. Compare reading(s) in table.
  - If readings are in range, go to **Step H.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link wiring between TECU and the Shift Control Device. Go to **Step V.**

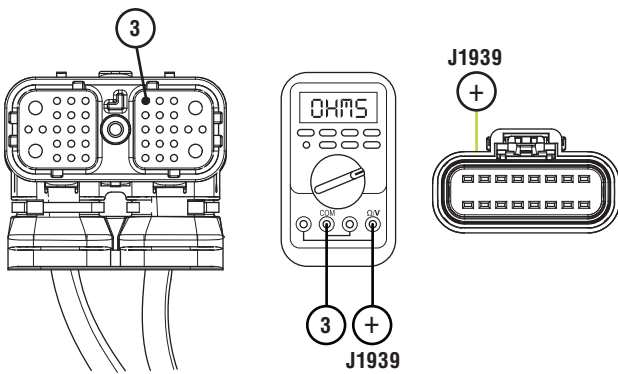
Pins	Range	Reading(s)
2 to J1939 Negative (-) Shift OEM J1939 Shift Control Connector Pin	0.0–0.6 ohms	
2 to Ground	Open Circuit (OL)	

**H** **Purpose:** Verify continuity across J1939 Positive (+) between the TECU and Shift Control Device.

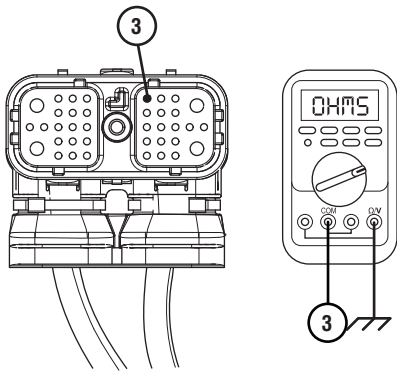
1. Key off.

**Note:** See OEM wiring diagram and connector views to identify the corresponding pin at the OEM J1939 Shift Control Connector.

2. Measure resistance between 38-Way Vehicle Harness Connector Pin 3 and the corresponding J1939 Positive (+) Pin on the OEM J1939 Shift Control Connector. Record reading(s) in table.



3. Measure resistance between 38-Way Vehicle Harness Connector Pin 3 and ground. Record reading(s) in table.



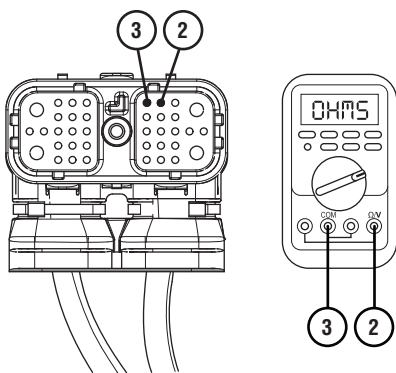
4. Compare reading(s) in table.

- If readings are in range, go to **Step I.**
- If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link Wiring between TECU and Shift Control Device. Go to **Step V.**

Pins	Range	Reading(s)
3 to J1939 Positive (+) OEM J1939 Shift Control Connector	0.0–0.6 ohms	
3 to Ground	Open Circuit (OL)	

**Purpose:** Verify proper resistance across the J1939 Data Link, including terminating resistors.

1. Key off.  
**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Reconnect OEM J1939 Shift Control Connector.
3. Measure resistance between 38-Way Vehicle Harness Connector Pin 2 and Pin 3. Record reading(s) in table.



4. Compare reading(s) in table.
  - If readings are in range, refer to OEM guidelines for repair or replacement of Shift Control Device. Go to **Step V.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**

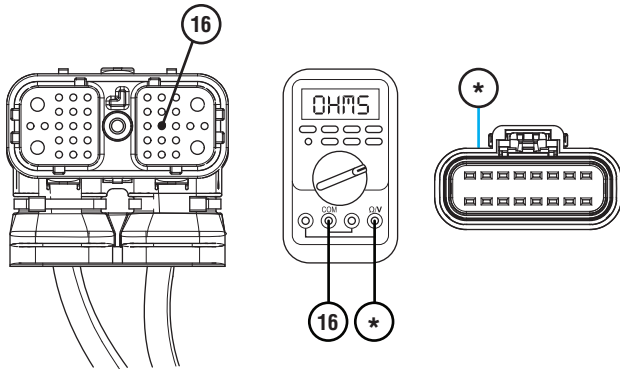
Pins	Range	Reading(s)
2 to 3	50–70 ohms	

**J** **Purpose:** Verify continuity between Neutral Request Signal Pin and Shift Control Device.

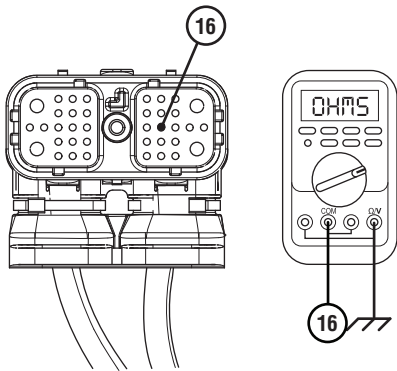
1. Key off.

**Note:** See OEM wiring diagram and connector views to identify the corresponding pin at the OEM J1939 Shift Control Connector.

2. Disconnect OEM J1939 Shift Control Connector.
3. Inspect Connector body for damage and bent, spread, corroded or loose terminals
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 16 and corresponding neutral request signal pin on the OEM J1939 Shift Control Connector. Record reading(s) in table.



5. Measure resistance between 38-Way Vehicle Harness Connector Pin 16 and ground. Record reading(s) in table.



6. Compare reading(s) in table.

- If readings are in range, go to **Step K**.
- If readings are out of range, refer to OEM guidelines for repair or replacement of wiring between 38-Way Vehicle Harness Connector Pin 16 and corresponding pin at the OEM J1939 Shift Control Connector. Go to **Step V**.

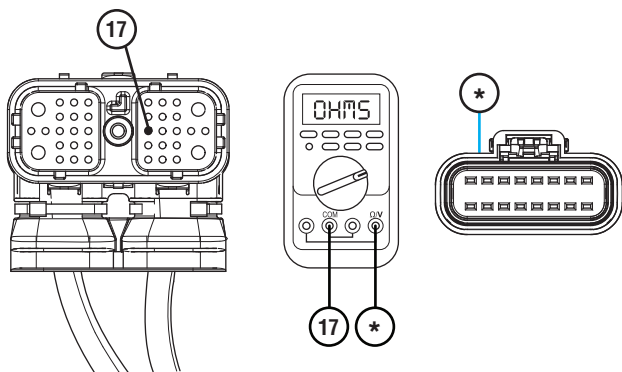
Pins	Range	Reading(s)
16 to OEM J1939 Shift Control Connector Neutral Request Signal	0.0–0.6 ohms	
16 to Ground	Open Circuit (OL)	

**K** **Purpose:** Verify continuity between Neutral Request Return Pin and Shift Control Device.

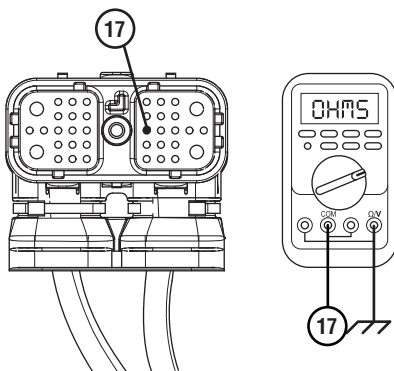
1. Key off.

**Note:** See OEM wiring diagram and connector views to identify the corresponding pin at the OEM J1939 Shift Control Connector.

2. Measure resistance between 38-Way Vehicle Harness Connector Pin 17 and corresponding neutral request return pin at the OEM J1939 Shift Control Connector. Record reading(s) in table.



3. Measure resistance between 38-Way Vehicle Harness Connector Pin 17 and ground. Record reading(s) in table.



4. Compare reading(s) in table.

- If readings are in range, go to **Step L**.
- If readings are out of range, refer to OEM guidelines for repair or replacement of wiring between 38-Way Vehicle Harness Connector Pin 17 and corresponding pin at the OEM J1939 Shift Control Connector. Go to **Step V**.

Pins	Range	Reading(s)
17 to OEM J1939 Shift Control Connector Neutral Request Return Pin	0–0.6 ohms	
17 to Ground	Open Circuit (OL)	

**L**

**Purpose:** Check for Active or Inactive fault code status.

1. Key off.
2. Reconnect all electrical connections.
3. Key on with motor off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
  - If Fault Code 13 FMI 8 is Active, repair or replace Shift Control Device per OEM guidelines. Go to **Step V**.
  - If Fault Code 13 FMI 8 is Inactive, refer to OEM guidelines for repair or replacement of wiring between 38-way Vehicle Harness Connector Pin 16 and corresponding pin at the OEM J1939 Shift Control Connector. Also repair or replace wiring between 38-Way Vehicle Harness Connector Pin 17 and corresponding pin at the OEM J1939 Shift Control Connector. Go to **Step V**.

**V**

**Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set and vehicle operates properly, test complete.
  - If Fault Code 13 sets Active during the test drive, go to **Step A**.
  - If a fault code other than 13 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 15: Shift Device Communication

**J1939: SA 3      SPN 751      FMI 9**

### Overview

Vehicles equipped with an Medium Duty 4-Speed EV Transmission may have an Eaton Push Button Shift Control Device (PBSC). The PBSC broadcasts driver shift requests to the Transmission Electronic Control Unit (TECU) through a high speed proprietary data link called the High Integrity Link (HIL). The portion of the HIL that connects the TECU to the PBSC is contained within the 38-Way Vehicle Harness. Fault Code 15 indicates a loss of communication between the TECU and PBSC.

### Detection

The TECU monitors communication with the PBSC over the HIL. If the TECU loses communication with the PBSC, Fault Code 15 sets Active.

### Conditions to Set Fault Code Active

**FMI 9 – Abnormal Update Rate:** TECU loses communication with the PBSC for 5 seconds or longer.

### Fallback

**FMI 9**

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Transmission may not engage a gear from neutral.
- Transmission is limited to down shifts only.
- Once the transmission re-engages the start gear, the transmission will not shift until the fault becomes Inactive.
- Once the vehicle stops, the transmission will not engage a start gear until the fault becomes Inactive.

### Conditions to Set Fault Code Inactive

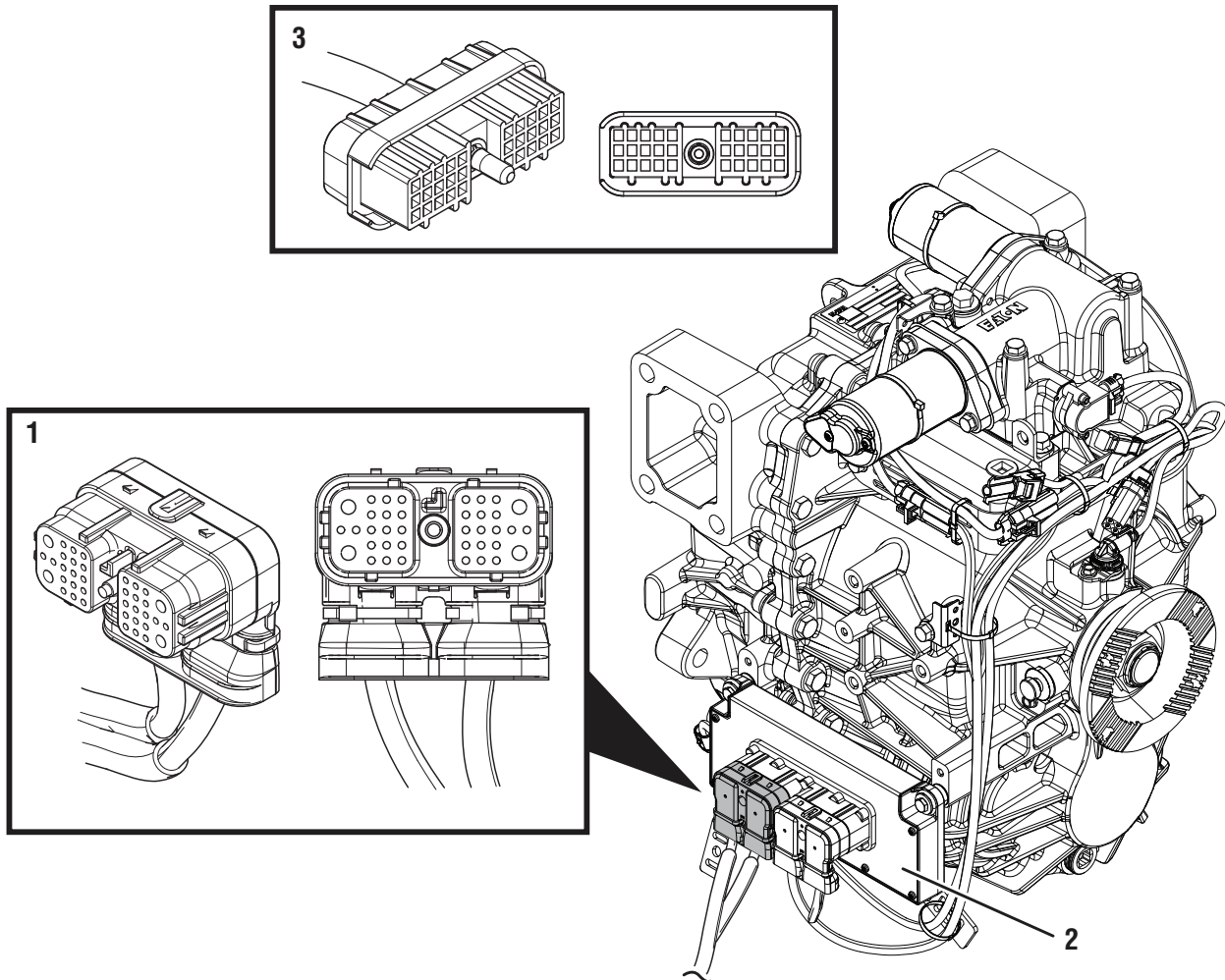
**FMI 9:** The TECU establishes communication with the PBSC for 10 seconds.

### Possible Causes

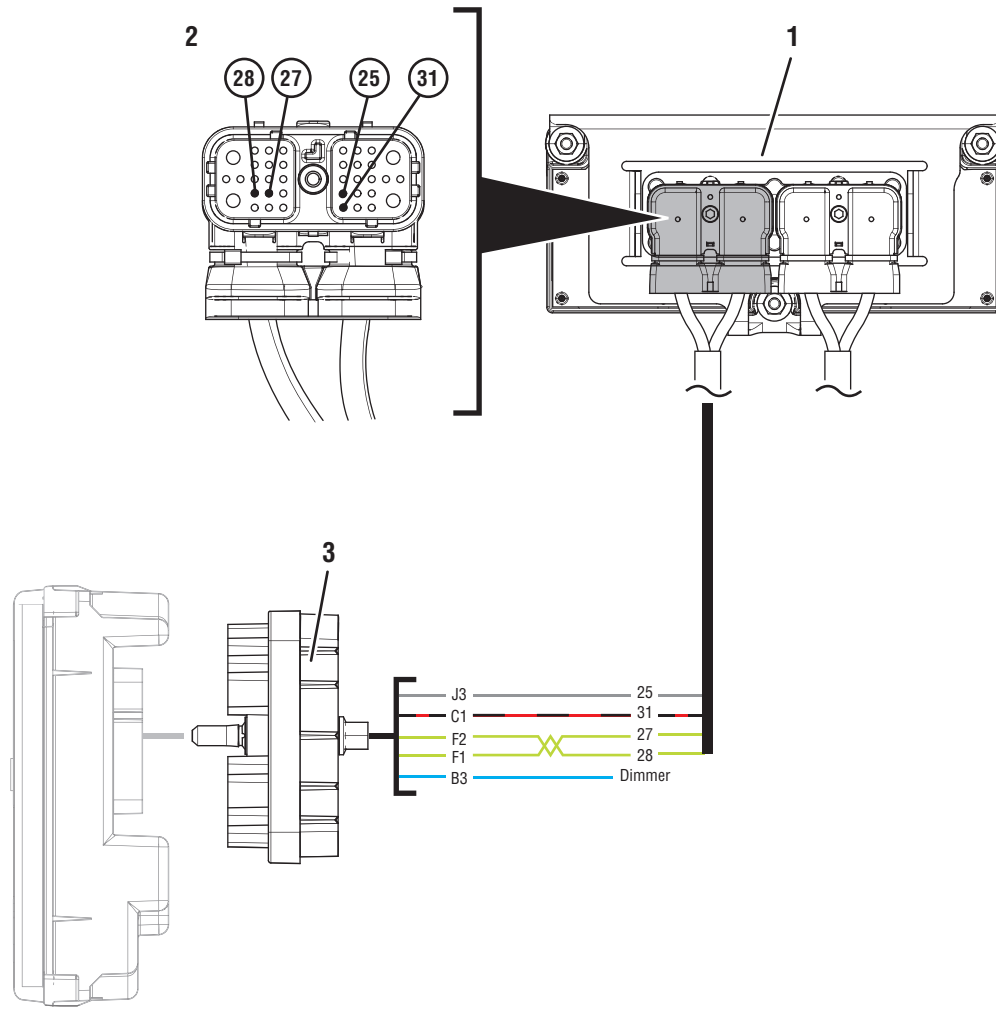
**FMI 9**

- High Integrity Link (HIL)
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Missing or additional terminating resistors
- 38-Way Vehicle Harness Connector
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
- Vehicle Power and Ground Supply to PBSC
  - Poor power or ground supply to PBSC
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- TECU
  - Internal failure
- PBSC
  - Internal failure

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 30-Way Push Button Shift Control Device (PBSC) Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 30-Way Eaton Push Button Shift Control Device (PBSC) Connector



## Fault Code 15 Troubleshooting

**A** *Purpose: Check for Active or Inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
  2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If Fault Code 16 is Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
    - If Fault Code 15 is Active, go to **Step D**.
    - If Fault Code 15 is Inactive and Fault Code 16 is not set, go to **Step B**.
- 

**B** *Purpose: Verify integrity of vehicle Bulkhead Connection (if equipped).*

1. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
  2. If vehicle is equipped with a Bulkhead Connection, disconnect Bulkhead Connector. Inspect connector for corrosion, loose terminals and bent or spread pins.
  3. Wiggle wiring connections to the Bulkhead Connector to verify the pins are not loose and are secure within the connector.
  4. Reconnect Bulkhead Connector.
    - If no Bulkhead Connection is present, go to **Step C**.
    - If damage or looseness is found, refer to OEM guidelines for repair or replacement of Bulkhead Connection. Go to **Step V**.
    - If no damage is found, go to **Step C**.
-

**C**

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



3. Wiggle wiring and connections from the Push Button Shift Controller (PBSC) to the batteries. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Wiggle wiring and connections of the High Integrity Link (HIL) between the 30-Way PBSC Connector and the 38-Way Vehicle Harness Connector at the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
5. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault code became Active while wiggling the PBSC power supply, refer to OEM guidelines for repair or replacement of the PBSC power supply harness. Go to **Step V**.
- If any fault code became Active while wiggling the HIL, refer to OEM guidelines for repair or replacement of the HIL wiring. Go to **Step V**.
- If no fault codes became Active, Go to **Step D**.

**D**

**Purpose:** Verify integrity of vehicle Bulkhead Connection (if equipped).

1. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

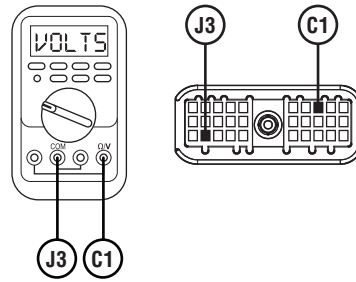
2. If vehicle is equipped with a Bulkhead Connection, disconnect Bulkhead Connector. Inspect connector for corrosion, loose terminals and bent or spread pins.
3. Wiggle wiring connections to the Bulkhead Connector to verify the pins are not loose and are secure within the connector.
4. Reconnect Bulkhead Connector.
  - If no Bulkhead Connection is present, go to **Step E**.
  - If damage or looseness is found, refer to OEM guidelines for repair or replacement of Bulkhead Connection. Go to **Step V**.
  - If no damage is found, go to **Step E**.

**E** **Purpose:** Verify integrity of 30-Way PBSC Connector.

1. Key off.
2. Disconnect 30-Way PBSC Connector.
3. Inspect 30-Way for loose terminals, corrosion and bent or spread pins.
  - If damage is found, refer to OEM guidelines for repair or replacement of 30-Way Connector and harness. Go to **Step V.**
  - If no damage is found, go to **Step F.**

**F** **Purpose:** Verify voltage supply to PBSC.

1. Key on with motor off.
2. Measure voltage between 30-Way Pin C1 and Pin J3. Record reading(s) in table.

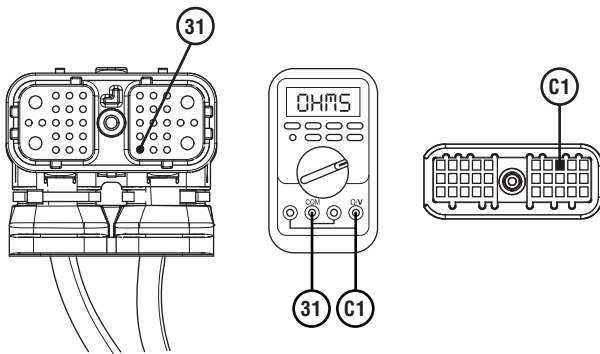


3. Compare reading(s) in table.
  - If readings are in range, go to **Step I.**
  - If readings are out of range, go to **Step G.**

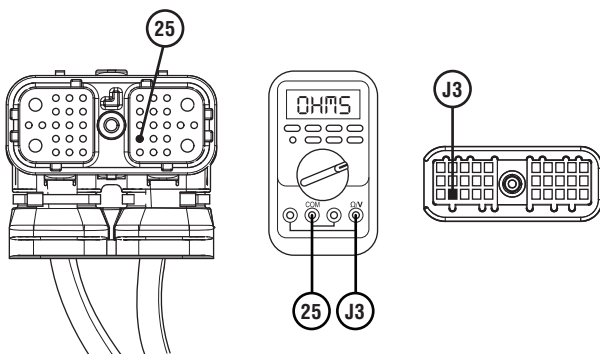
Pins	Range	Reading(s)
C1 to J3	Within 0.6 V of battery voltage	

**G** **Purpose:** Verify continuity of PBSC power supply wiring.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect 38-Way for loose terminals, corrosion and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 31 and 30-Way PBSC Connector Pin C1. Record reading(s) in table.



5. Measure resistance between 38-Way Vehicle Harness Connector Pin 25 and 30-Way PBSC Connector Pin J3. Record reading(s) in table.

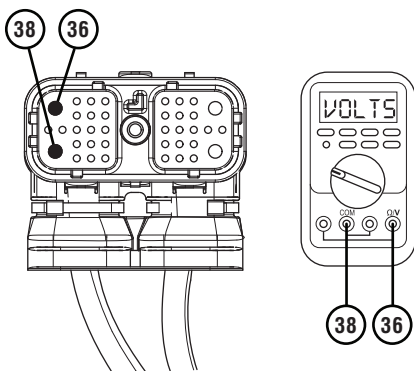


6. Compare reading(s) in table.
  - If readings are in range, go to **Step H**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of harness between TECU and PBSC. Go to **Step V**.

Pins	Range	Reading(s)
31 to C1	0.0–0.3 ohms	
25 to J3	0.0–0.3 ohms	

**H** **Purpose:** Verify battery voltage supply to the TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect connector body for corrosion, damage, loose, spread or bent terminals.
4. Measure voltage between 38-Way Connector Pin 38 and Pin 36. Record reading.



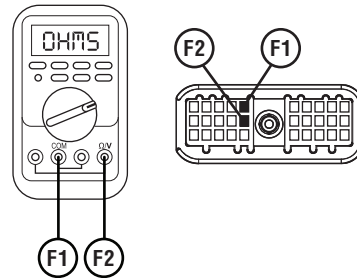
5. Compare voltage to specified range in table.
  - If readings are in range, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of Vehicle Power Supply Harness. Go to **Step V**.

Pins	Range	Reading(s)
38 to 36	Within 1.2 V of Battery Voltage (Step A)	

**I** **Purpose:** Verify HIL circuit resistance.

1. Key off.
 

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Measure resistance between 30-Way Connector Pin F1 and Pin F2. Record reading(s) in table.



3. Compare reading(s) in table.
  - If readings are in range, go to **Step J**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of High Integrity Link (HIL) between the PBSC and TECU. Go to **Step V**.

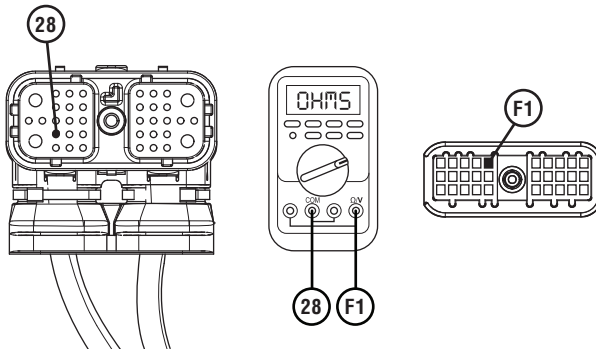
Pins	Range	Reading(s)
F1 to F2	50–70 ohms	

**J** **Purpose:** Verify integrity of 38-Way Vehicle Harness Connector.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect 38-Way for loose terminals, corrosion and bent or spread pins.
  - If damage is found, refer to OEM guidelines for repair or replacement of 38-Way Connector and harness. Go to **Step V.**
  - If no damage is found and the connector is not loose, go to **Step K.**

**K** **Purpose:** Verify HIL Positive (+) continuity between PBSC and TECU.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 28 and 30-Way PBSC Connector Pin F1. Record reading(s) in table.

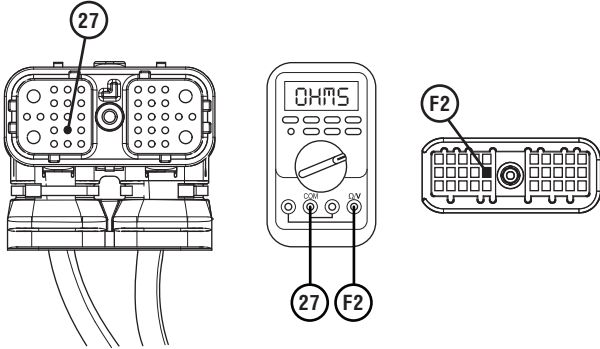


3. Compare reading(s) in table.
  - If readings are in range, go to **Step L.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of High Integrity Link (HIL) between the PBSC and TECU. Go to **Step V.**

Pins	Range	Reading(s)
28 to F1	0.0–0.6 ohms	

**L** **Purpose:** Verify HIL Negative (-) continuity between PBSC and TECU.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 27 and 30-Way PBSC Connector Pin F2. Record reading(s) in table.



3. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of High Integrity Link (HIL) between the PBSC and TECU. Go to **Step V**.
  - If readings are in range, replace PBSC. Go to **Step V**.

Pins	Range	Reading(s)
27 to F2	0.0–0.6 ohms	

**V** **Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 15 sets Active during test drive, contact Eaton at (800) 826-4357 for further diagnostics.
  - If a fault code other than 15 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 16: High Integrity Link

**J1939: SA 3      SPN 625      FMI 2, 9**

### Overview

The High Integrity Link (HIL) is a Controller Area Network (CAN) high-speed proprietary data link that communicates data between the Transmission Electronic Control Unit (TECU), and Eaton Push Button Shift Control (PBSC). Fault Code 16 indicates a loss of communication of the HIL.

### Detection

The TECU monitors communication with the Shift Control Device over the HIL Link. If the TECU is unable to receive any messages from the other components on the HIL, Fault Code 16 sets Active.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU does not receive any messages over the HIL for more than .03 seconds.

**FMI 9 – Abnormal Update Rate:** TECU does not receive any messages over the HIL for more than .30 seconds.

### Fallback

#### All FMIs

- Transmission may not engage a gear from neutral.
- Once the transmission down shifts to the start gear, no up shifts occur as long as the fault code is Active.
- If equipped with an Eaton PBSC:
  - “F” flashes in gear display.
  - Service light flashes (if equipped).
- If equipped with an Eaton Cobra Shift Lever or OEM J1939 Shift Controller:
  - “F” does not flash in gear display.
  - Service lamp does not flash.

### Conditions to Set Fault Code Inactive

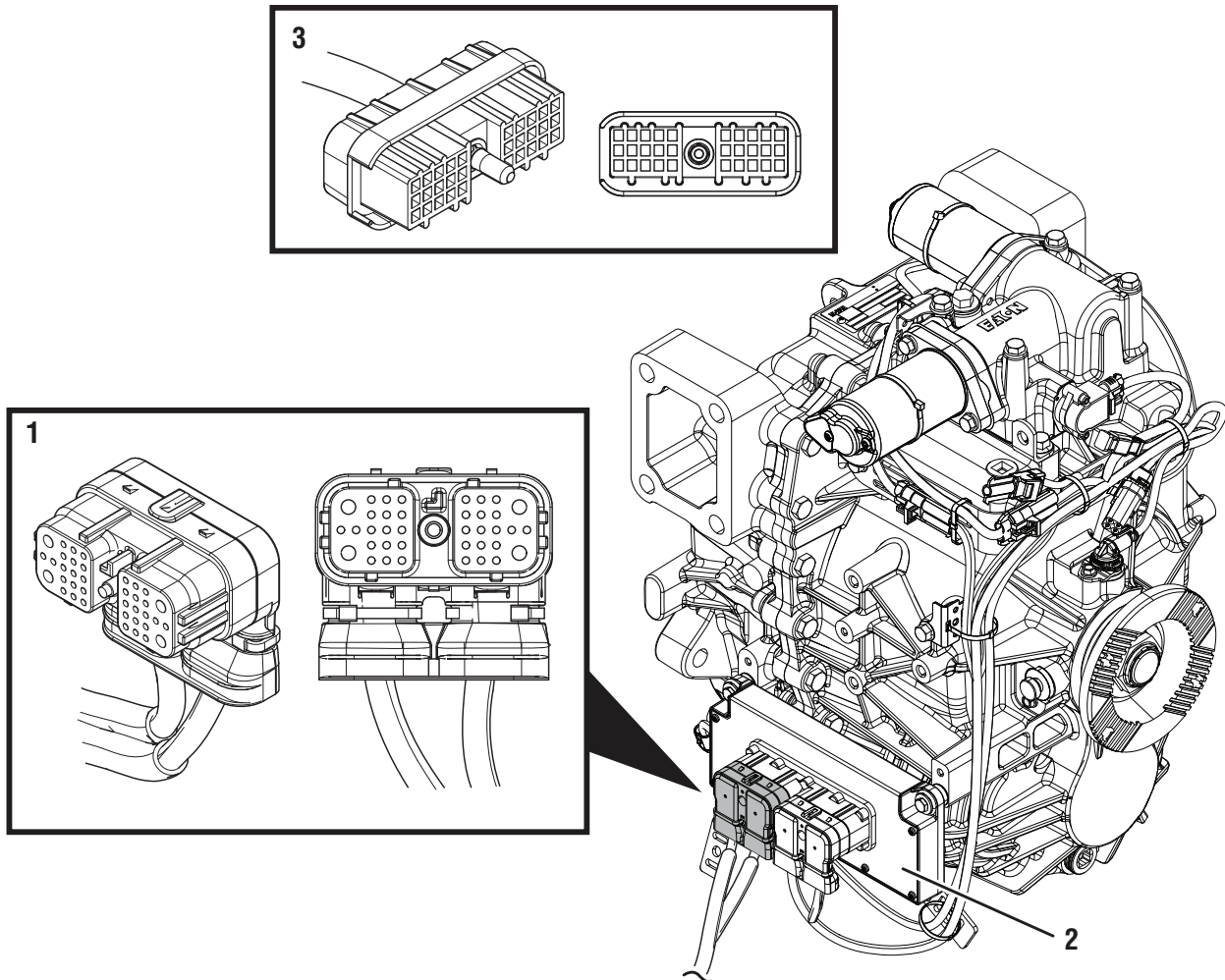
**All FMIs:** Communication between components is restored for 1 second.

### Possible Causes

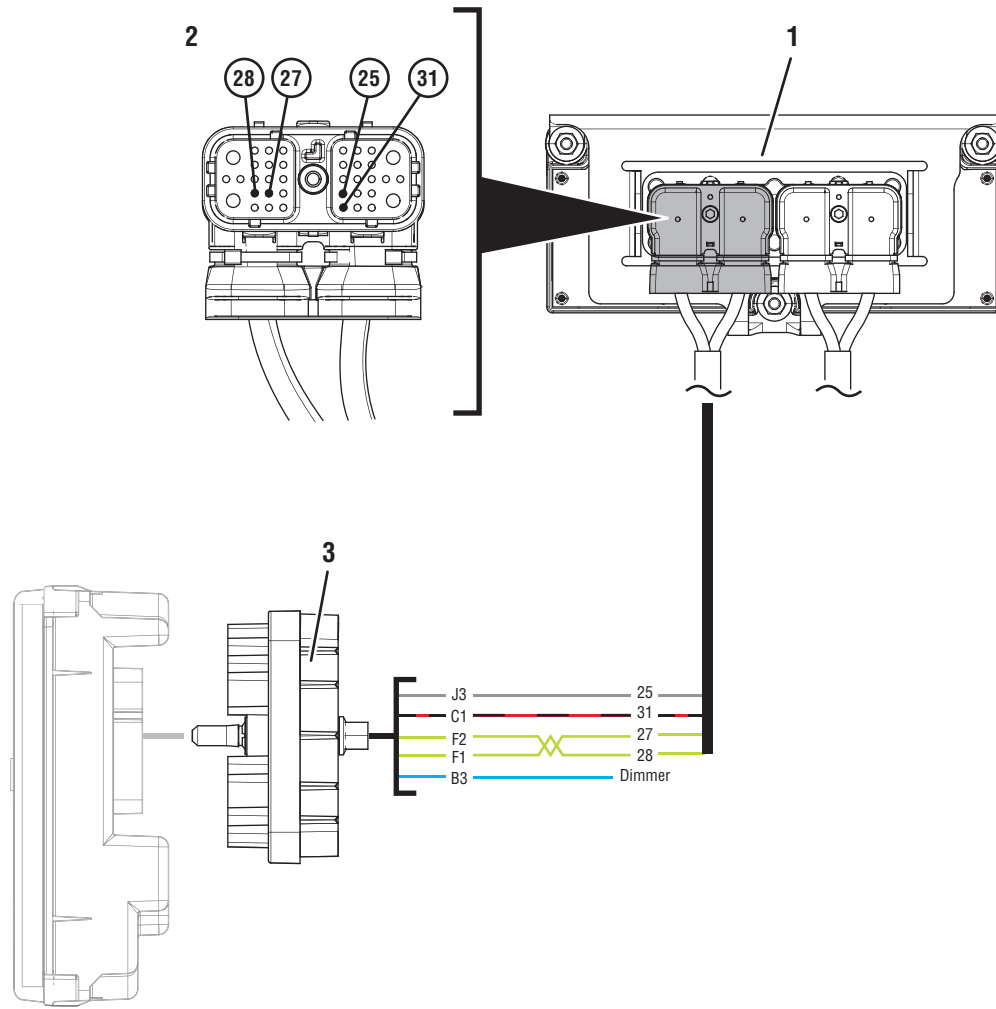
#### All FMIs:

- HIL
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Missing terminating resistor
- Vehicle Batteries
  - Internal failure
- Vehicle Power and Ground Supply to TECU
  - Corroded or loose power supply connections to TECU
- TECU
  - Internal failure
- PBSC (if equipped)
  - Internal failure

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 30-Way Push Button Shift Control Device (PBSC) Connector



- 1. Transmission Electronic Control Unit (TECU)
- 2. 38-Way Vehicle Harness Connector
- 3. 30-Way Eaton Push Button Shift Control Device (PBSC) Connector

 Battery Voltage	 Switched Battery from TECU	 Ground	 Communication	 Signal
 Ignition Voltage	 Switched 5V from TECU	 Switched Ground	 Relay/Solenoid Driver	

## Fault Code 16 Troubleshooting

**A** **Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 16 is Active, go to **Step D.**
  - If Fault Code 16 is Inactive and Fault Code 16 is not set, go to **Step B.**

**B** **Purpose:** Verify integrity of vehicle Bulkhead Connection (if equipped).

1. Key off.
 

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. If vehicle is equipped with a Bulkhead Connection, disconnect Bulkhead Connector. Inspect connector for corrosion, loose terminals and bent or spread pins.
3. Wiggle wiring connections to the Bulkhead Connector to verify the pins are not loose and are secure within the connector.
4. Reconnect Bulkhead Connector.
  - If no Bulkhead Connection is present, go to **Step C.**
  - If damage or looseness is found, refer to OEM guidelines for repair or replacement of Bulkhead Connection. Go to **Step V.**
  - If no damage is found, go to **Step C.**

**C** **Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



3. Wiggle wiring and connections from the Push Button Shift Controller (PBSC) to the batteries. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Wiggle wiring and connections of the High Integrity Link (HIL) between the 30-Way PBSC Connector and the 38-Way Vehicle Harness Connector at the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
5. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault code became Active while wiggling the PBSC power supply, refer to OEM guidelines for repair or replacement of the PBSC power supply harness. Go to **Step V.**
- If any fault code became Active while wiggling the HIL, refer to OEM guidelines for repair or replacement of the HIL wiring. Go to **Step V.**
- If no fault codes became Active, Go to **Step D.**

**D** **Purpose:** Verify integrity of vehicle Bulkhead Connection (if equipped).

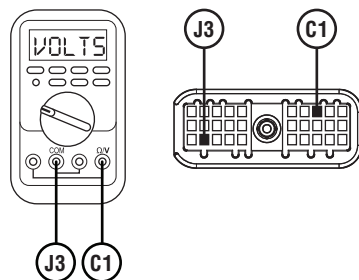
1. Key off.  
**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. If vehicle is equipped with a Bulkhead Connection, disconnect Bulkhead Connector. Inspect connector for corrosion, loose terminals and bent or spread pins.
3. Wiggle wiring connections to the Bulkhead Connector to verify the pins are not loose and are secure within the connector.
4. Reconnect Bulkhead Connector.
  - If no Bulkhead Connection is present, go to **Step E.**
  - If damage or looseness is found, refer to OEM guidelines for repair or replacement of Bulkhead Connection. Go to **Step V.**
  - If no damage is found, go to **Step E.**

**E** **Purpose:** Verify integrity of 30-Way PBSC Connector.

1. Key off.
2. Disconnect 30-Way PBSC Connector.
3. Inspect 30-Way for loose terminals, corrosion and bent or spread pins.
  - If damage is found, refer to OEM guidelines for repair or replacement of 30-Way Connector and harness. Go to **Step V.**
  - If no damage is found, go to **Step F.**

**F** **Purpose:** Verify voltage supply to PBSC.

1. Key on with motor off.
2. Measure voltage between 30-Way Pin C1 and Pin J3. Record reading(s) in table.



3. Compare reading(s) in table.
  - If readings are in range, go to **Step I.**
  - If readings are out of range, go to **Step G.**

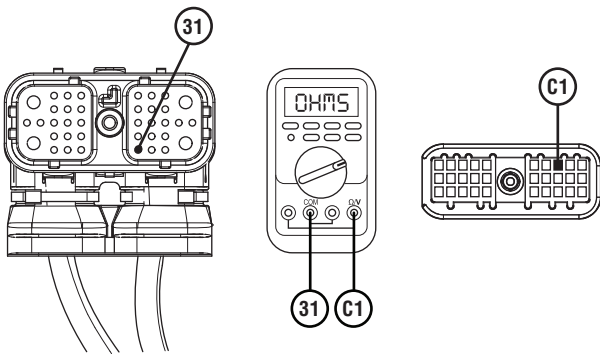
Pins	Range	Reading(s)
C1 to J3	Within 0.6 V of battery voltage	

**G Purpose:** Verify continuity of PBSC power supply wiring.

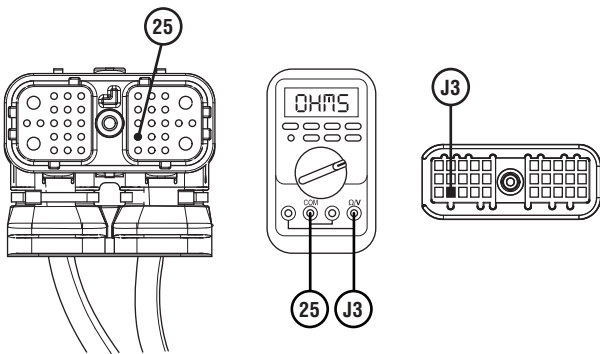
1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect 38-Way for loose terminals, corrosion and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 31 and 30-Way PBSC Connector Pin C1. Record reading(s) in table.

6. Compare reading(s) in table.
  - If readings are in range, go to **Step H**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of harness between TECU and PBSC. Go to **Step V**.

Pins	Range	Reading(s)
31 to C1	0.0–0.3 ohms	
25 to J3	0.0–0.3 ohms	

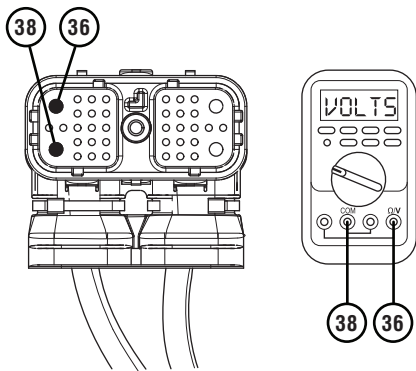


5. Measure resistance between 38-Way Vehicle Harness Connector Pin 25 and 30-Way PBSC Connector Pin J3. Record reading(s) in table.



**H** **Purpose:** Verify battery voltage supply to the TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect connector body for corrosion, damage, loose, spread or bent terminals.
4. Measure voltage between 38-Way Connector Pin 38 and Pin 36. Record reading.



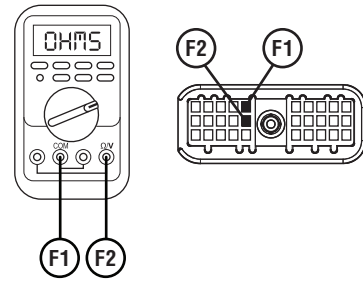
5. Compare voltage to specified range in table.
  - If readings are in range, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of Vehicle Power Supply Harness. Go to **Step V**.

Pins	Range	Reading(s)
38 to 36	Within 1.2 V of Battery Voltage (Step A)	

**I** **Purpose:** Verify HIL circuit resistance.

1. Key off.
 

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Measure resistance between 30-Way Connector Pin F1 and Pin F2. Record reading(s) in table.



3. Compare reading(s) in table.
  - If readings are in range, go to **Step J**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of High Integrity Link (HIL) between the PBSC and TECU. Go to **Step V**.

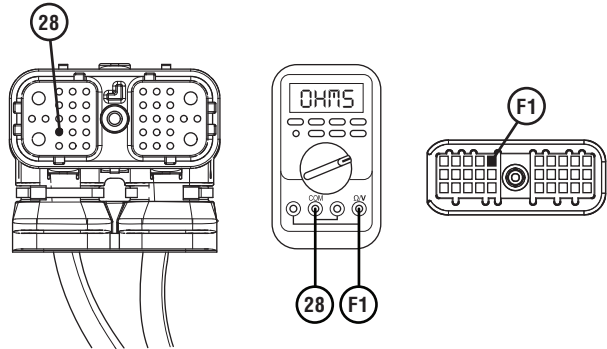
Pins	Range	Reading(s)
F1 to F2	50–70 ohms	

**J** **Purpose:** Verify integrity of 38-Way Vehicle Harness Connector.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect 38-Way for loose terminals, corrosion and bent or spread pins.
  - If damage is found, refer to OEM guidelines for repair or replacement of 38-Way Connector and harness. Go to **Step V**.
  - If no damage is found and the connector is not loose, go to **Step K**.

**K** **Purpose:** Verify HIL Positive (+) continuity between PBSC and TECU.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 28 and 30-Way PBSC Connector Pin F1. Record reading(s) in table.

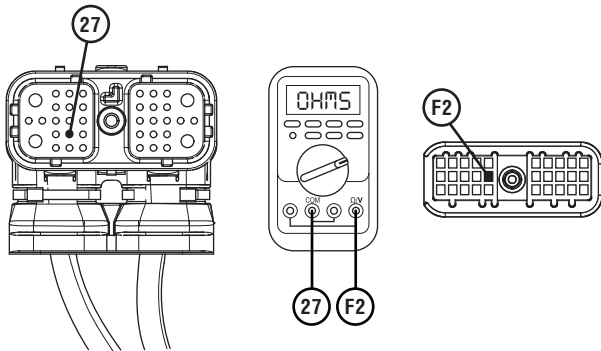


3. Compare reading(s) in table.
  - If readings are in range, go to **Step L**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of High Integrity Link (HIL) between the PBSC and TECU. Go to **Step V**.

Pins	Range	Reading(s)
28 to F1	0.0–0.6 ohms	

**L** **Purpose:** Verify HIL Negative (-) continuity between PBSC and TECU.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 27 and 30-Way PBSC Connector Pin F2. Record reading(s) in table.



3. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of High Integrity Link (HIL) between the PBSC and TECU. Go to **Step V**.
  - If readings are in range, replace PBSC. Go to **Step V**.

Pins	Range	Reading(s)
27 to F2	0.0–0.6 ohms	

**V** **Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 16 sets Active during test drive, contact Eaton at (800) 826-4357 for further diagnostics.
  - If a fault code other than 16 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 21: Park Brake Switch

**J1939: SA 3      SPN 70      FMI 14**

### Overview

The Transmission Electronic Control Unit (TECU) receives the vehicle's Park Brake Switch status message from a Vehicle Electronic Control Unit (ECU) over the J1939 Data Link. This information is used by the TECU to determine the vehicle state.

### Detection

The TECU monitors the Park Brake Switch message. If the message is invalid, the fault is set active.

### Conditions to Set Fault Code Active

**FMI 14 – Special Instructions:** Park Brake Switch message indicates the vehicle parking brake is set and vehicle is moving for 5 seconds.

### Fallback

**FMI 14:** Refer to OEM for troubleshooting a failed system. Brake system fallback modes may vary.

- Amber warning lamp on

### Conditions to Set Fault Code Inactive

**FMI 14:** Park Brake Switch message indicates parking brake is released for 1 second.

### Possible Causes

All FMIs:

- Vehicle Components
  - Park Brake Switch and/or Wiring
  - Other Vehicle ECU(s)
  - J1939 Data Link

**Note:** Refer to OEM for troubleshooting a failed system.

## Fault Code 21 Troubleshooting

**A**

*Purpose: Check for Active or Inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
  2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If Fault Code 21 FMI 14 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
    - If Fault Code 21 FMI 14 is Active or Inactive and there are no other Active fault codes, go to **Step B.**
-

**B** *Purpose: Monitor vehicle Parking Brake Switch signal message.*

1. Key on with engine running.
2. Allow air pressure to build to governor cut off.
3. Key off.
4. Key on with engine off.
5. Connect ServiceRanger.
6. Go To “Data Monitor”.
7. Select “Status”.
8. Select “Parking brake switch status”.
9. Select all of the “- 70” SPN sources.  
**Note:** Not all sources will indicate a value.
10. Monitor 70 - Parking brake switch status value. Record reading in table.
11. Depress and hold service brake.
12. Release vehicle parking brake.
13. Monitor 70 - Parking brake switch status value. Record reading in table.
14. Set vehicle parking brake.
15. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of the Park Brake Switch signal message. Go to **Step V.**
  - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Park Brake Switch signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

**V** *Purpose: Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
  - If no fault codes set and the vehicle operates properly, test complete.
  - If Fault Code 21 sets Active, go to **Step A.**
  - If a fault code other than 21 sets Active, troubleshoot per See “Fault Code Isolation Procedure Index” on page 14.

Parking Brake State	Parameter	Range	Reading(s)
Set	70-Parking brake switch status	Set	
Released	70-Parking brake switch status	Not set	

## Fault Code 22: J1939 ABS Message

**J1939: SA 3      SPN 563      FMI 2, 9**

### Overview

The Transmission Electronic Control Unit (TECU) receives the vehicle's Anti-Lock Brake System (ABS) message (EBC1 brake pedal position) over the J1939 Data Link. This information is used to determine transmission operation.

### Detection

The TECU monitors the ABS message. If the message is not received the fault is set Active.

### Conditions to Set Fault Code Active

#### FMI 2 - Data Erratic:

- ABS message not received for 10 seconds while vehicle is stationary
- or
- ABS message not received after 30 consecutive messages while driving

### Fallback

#### FMI 9, 13, 19:

- Amber warning lamp on
- Hill Start Aid feature prohibited

### Conditions to Set Fault Code Inactive

**FMI 2, 9:** ABS message is received.

### Possible Causes

#### FMI 2, 9:

- Vehicle Components
  - Vehicle ECU(s)
  - J1939 Data Link

### Additional Tools

- None

## Fault Code 22 Troubleshooting

**A** **Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 22 FMI 9 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V**.
  - If Fault Code 22 FMI 9 is Inactive, go to **Step B**.
  - If Fault Code 152 FMI 13 is Inactive, go to **Step V**.
  - If Fault Code 22 FMI 9 is Active, refer to OEM guidelines regarding ABS message repair or replacement. Go to **Step V**.

**B** **Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. Reference *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.

**Note:** The vehicle J1939 Data Link and connectors between the vehicle ABS ECU and TECU is OEM proprietary. Refer to OEM wiring diagrams, harness routing, connector view and pin locations.
3. Wiggle the J1939 Data Link and connections between vehicle ABS ECU and 38-Way TECU Vehicle Harness Connector. Look for signs of rubbing or chafing.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

  - If Fault Code 22 FMI 2 became Active while wiggling the J1939 Data Link, refer to OEM guidelines for repair or replacement of harness. Go to **Step V**.
  - If Fault Code 22 is Inactive, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the J1939 Data Link between the 38-Way TECU Vehicle Harness Connector and vehicle ABS ECU Connector. Refer to OEM guidelines for repair or replacement of the J1939 Data Link. Go to **Step V**.

**V****Purpose:** *Verify Repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
  - If no fault codes set and the vehicle operates properly, test complete.
  - If Fault Code 22 sets Active, go to **Step A**.
  - If a fault code other than 22 sets Active, troubleshoot per See “Fault Code Isolation Procedure Index” on page 14.

---

## Fault Code 23: Brake Pedal Position

**J1939: SA 3      SPN 521      FMI 2**

### Overview

The Transmission Electronic Control Unit (TECU) receives the vehicle's Brake Pedal Position message and Brake Switch message from other Vehicle Electronic Control Units (ECUs) over the J1939 Data Link. This information is used to determine transmission operation.

### Detection

The TECU monitors the Brake Pedal Position message and Brake Switch message. If the messages do not correlate the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 2 - Data Erratic:** Brake Pedal Position and Brake Switch message do not match for 1 second.

### Fallback

**FMI 2:**

- Amber warning lamp on
- No downshifts if accelerator pedal is not pressed

### Conditions to Set Fault Code Inactive

**FMI 2:** Brake Pedal Position and Brake Switch messages match.

### Possible Causes

**FMI 2:**

- Vehicle Components
  - Vehicle ECU(s)
  - Brake Pedal Position
  - Brake Switch
  - J1939 Data Link

### Additional Tools

- None

## Fault Code 23 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 23 FMI 2 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V**.
  - If Fault Code 23 FMI 2 is Active, refer to OEM guidelines for repair or replacement of the Brake Pedal Position message and/or Brake Switch message. Go to **Step V**.
  - If Fault Code 23 FMI 13 is Inactive, go to **Step V**.
  - If Fault Code 23 FMI 2 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Brake Pedal Position message and/or Brake Switch message and/or J1939 Data Link. Refer to OEM guidelines for repair or replacement of the Brake Pedal Position message and/or Brake Switch message. Go to **Step V**.

### V

**Purpose:** Verify Repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
  - If no fault codes set and the vehicle operates properly, test complete.
  - If Fault Code 23 sets Active during operation, go to **Step A**.
  - If a fault code other than 23 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 26: J1939 Brake Pedal Position (CCVS) Message

**J1939: SA 3      SPN 84      FMI 2, 9**

### Overview

The Transmission Electronic Control Unit (TECU) receives the Brake Pedal Position (CCVS) message over the J1939 Data Link. This information is used to determine transmission operation.

### Detection

The TECU monitors the CCVS message. If the message is not received the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 2 - Data Erratic:** CCVS message not received and Product Diagnostic Mode is Active.

**FMI 9 - Abnormal Update Rate:** CCVS message not received for 3 seconds.

### Fallback

**FMI 2, 9:**

- Amber warning lamp on

### Conditions to Set Fault Code Inactive

**FMI 2, 9:** CCVS message is received.

### Possible Causes

**FMI 2, 9:**

- Vehicle Components
  - Vehicle ECU(s)
  - J1939 Data Link

### Additional Tools

- None

## Fault Code 26 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 26 FMI 9 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V**.
  - If Fault Code 26 FMI 9 is Inactive, go to **Step B**.
  - If Fault Code 26 FMI 9 is Active, refer to OEM guidelines regarding CCVS message repair or replacement. Go to **Step V**.

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. Reference *Identifying a Problem in PD Mode* on page 7.
 

**Note:** Transmission does not enter PD Mode when Active fault codes exist.

**Note:** The vehicle J1939 Data Link and connectors between the vehicle CCVS message ECU and TECU is OEM proprietary. Refer to OEM wiring diagrams, harness routing, connector view and pin locations.
3. Wiggle the J1939 Data Link and connections between vehicle CCVS message ECU and 38-Way TECU Vehicle Harness Connector. Look for signs of rubbing or chafing.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If Fault Code 26 FMI 2 became Active while wiggling the J1939 Data Link, refer to OEM guidelines for repair or replacement of harness. Go to **Step V**.
- If Fault Code 26 is Inactive, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the J1939 Data Link between the 38-Way TECU Vehicle Harness Connector and vehicle CCVS message ECU Connector. Refer to OEM guidelines for repair or replacement of the J1939 Data Link. Go to **Step V**.

**V****Purpose:** Verify Repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with engine off.
  4. Connect ServiceRanger.
  5. Go to “Fault Codes”.
  6. Select “Clear All Faults”.
  7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
  8. Check for fault codes using ServiceRanger.
    - If no fault codes set and the vehicle operates properly, test complete.
    - If Fault Code 26 sets Active, go to **Step A**.
    - If a fault code other than 26 sets Active, troubleshoot per See “Fault Code Isolation Procedure Index” on page 14.
-

## Fault Code 27: J1939 Accelerator Pedal (EEC2) Message

**J1939: SA 3      SPN 91      FMI 2, 9**

### Overview

The Transmission Electronic Control Unit (TECU) receives the vehicle's Accelerator Pedal message (EEC2) over the J1939 Data Link. This information is used to determine transmission operation.

### Detection

The TECU monitors the EEC2 message. If the message is not received the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 2 - Data Erratic:** EEC2 message not received and Product Diagnostic Mode is Active.

**FMI 9 - Abnormal Update Rate:** EEC2 message not received for 1.5 seconds.

### Fallback

**FMI 2, 9:**

- Amber warning lamp on

### Conditions to Set Fault Code Inactive

**FMI 2, 9:** EEC2 message is received.

### Possible Causes

**FMI 2, 9:**

- Vehicle Components
  - Vehicle ECU(s)
  - J1939 Data Link

### Additional Tools

- None

## Fault Code 27 Troubleshooting

**A** **Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 27 FMI 9 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V**.
  - If Fault Code 27 FMI 9 is Inactive, go to **Step B**.
  - If Fault Code 27 FMI 9 is Active, refer to OEM guidelines regarding EEC2 message repair or replacement. Go to **Step V**.

**B** **Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. Reference *Identifying a Problem in PD Mode* on page 7.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.

**Note:** The vehicle J1939 Data Link and connectors between the vehicle EEC2 message ECU and TECU is OEM proprietary. Refer to OEM wiring diagrams, harness routing, connector view and pin locations.

3. Wiggle the J1939 Data Link and connections between vehicle EEC2 message ECU and 38-Way TECU Vehicle Harness Connector. Look for signs of rubbing or chafing.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If Fault Code 27 FMI 2 became Active while wiggling the J1939 Data Link, refer to OEM guidelines for repair or replacement of harness. Go to **Step V**.
- If Fault Code 27 is Inactive, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the J1939 Data Link between the 38-Way TECU Vehicle Harness Connector and vehicle EEC2 message ECU Connector. Refer to OEM guidelines for repair or replacement of the J1939 Data Link. Go to **Step V**.

**V****Purpose:** *Verify Repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
  - If no fault codes set and the vehicle operates properly, test complete.
  - If Fault Code 27 sets Active, go to **Step A**.
  - If a fault code other than 27 sets Active, troubleshoot per See “Fault Code Isolation Procedure Index” on page 14.

## Fault Code 28: J1939 Auxiliary I/O Message

**J1939: SA 3      SPN 703      FMI 2, 9**

### Overview

The Transmission Electronic Control Unit (TECU) receives the Auxiliary Input/Output (I/O) message over the J1939 Data Link. This information is used to determine transmission operation.

### Detection

The TECU monitors the Auxiliary I/O message. If the message is not received the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 2 - Data Erratic:** Auxiliary I/O message not received and Product Diagnostic Mode is Active.

**FMI 9 - Abnormal Update Rate:** Auxiliary I/O message not received.

### Fallback

**FMI 2, 9:**

- Amber warning lamp on

### Conditions to Set Fault Code Inactive

**FMI 2, 9:** Auxiliary I/O message is received.

### Possible Causes

**FMI 2, 9:**

- Vehicle Components
  - Vehicle ECU(s)
  - J1939 Data Link

### Additional Tools

- None

## Fault Code 28 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 28 FMI 9 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
  - If Fault Code 28 FMI 9 is Inactive, go to **Step B.**
  - If Fault Code 28 FMI 9 is Active, refer to OEM guidelines regarding Auxiliary I/O message repair or replacement. Go to **Step V.**

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. Reference *Identifying a Problem in PD Mode* on page 7.
 

**Note:** Transmission does not enter PD Mode when Active fault codes exist.

**Note:** The vehicle J1939 Data Link and connectors between the vehicle Auxiliary I/O message ECU and TECU is OEM proprietary. Refer to OEM wiring diagrams, harness routing, connector view and pin locations.
3. Wiggle the J1939 Data Link and connections between vehicle Auxiliary I/O message ECU and 38-Way TECU Vehicle Harness Connector. Look for signs of rubbing or chafing.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If Fault Code 28 FMI 2 became Active while wiggling the J1939 Data Link, refer to OEM guidelines for repair or replacement of harness. Go to **Step V.**
- If Fault Code 28 is Inactive, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the J1939 Data Link between the 38-Way TECU Vehicle Harness Connector and vehicle Auxiliary I/O message ECU Connector. Refer to OEM guidelines for repair or replacement of the J1939 Data Link. Go to **Step V.**

**V****Purpose:** Verify Repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with engine off.
  4. Connect ServiceRanger.
  5. Go to “Fault Codes”.
  6. Select “Clear All Faults”.
  7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
  8. Check for fault codes using ServiceRanger.
    - If no fault codes set and the vehicle operates properly, test complete.
    - If Fault Code 28 sets Active, go to **Step A**.
    - If a fault code other than 28 sets Active, troubleshoot per See “Fault Code Isolation Procedure Index” on page 14.
-

## Fault Code 30: Motor A Feedback Message

**J1939: SA 3      SPN 520260      FMI 2, 7, 9**

### Overview

The J1939 Data Link is a Controller Area Network (CAN) communication bus. The Medium Duty 4-Speed EV Transmission uses the J1939 Data Link to communicate with other ECUs (Inverter, Body Controller, etc.). The Transmission Electronic Control Unit (TECU) sends and receives messages from other ECUs on the data link to determine when to initiate a shift, hold shifts, command motor speed to make shifts, as well as other functions. Proper operation of the J1939 Data Link is critical for shift performance. Fault Code 30 indicates the TECU can communicate with other ECUs on the J1939 Data Link but has lost Motor A Feedback Message.

### Detection

TECU has either lost communication or received erratic signals from Motor A Feedback over the J1939 Data Link and the TECU has not detected any low or weak battery system fault codes.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU has not received 3 consecutive messages from Motor A Feedback.

**FMI 7 – Mechanical System Not Responding:** Motor RPM did not change when requested by TECU, to support synchronization of a transmission gear change, for 2 seconds.

**FMI 9 – Abnormal Update Rate:** TECU has not received 30 consecutive messages from Motor A Feedback.

### Fallback

#### FMI 2, 9:

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If fault occurs during power up, the transmission requires the driver to manually synchronize shifts with the throttle.
- If fault occurs while driving, transmission remains in its current gear until the vehicle stops. Transmission then requires the driver to manually synchronize shifts with the throttle.

#### FMI 7:

- “F” flashes in gear display.
- Red service light flashes (if equipped).
- Transmission may not complete shift, may require driver to manually synchronize shifts with the throttle.

### Conditions to Set Fault Code Inactive

**FMI 2, 9:** TECU receives messages across the data link for at least 1 second.

**FMI 7:** Requested gear change completes or key cycle.

## Possible Causes

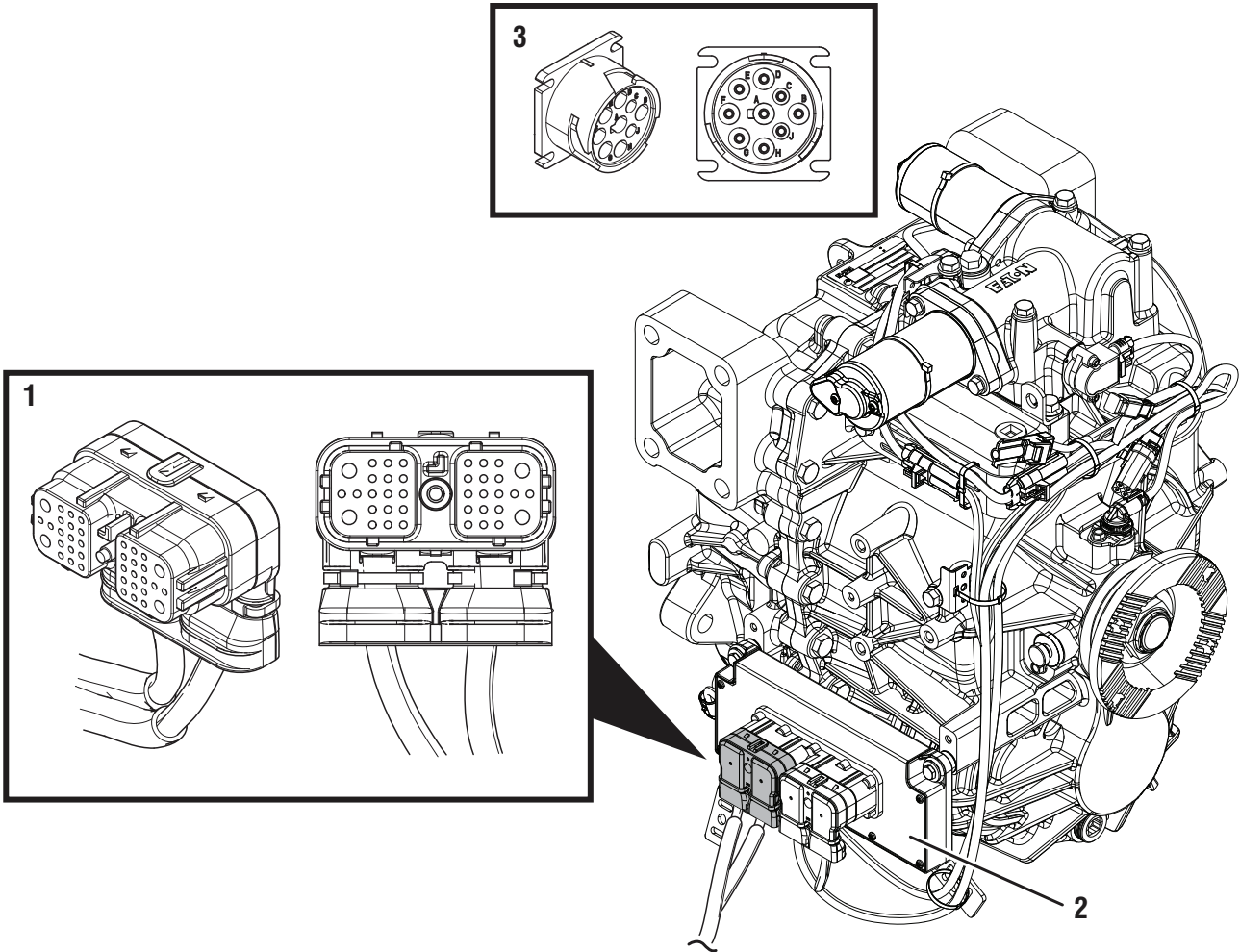
### FMI 2,9

- J1939 Data Link
  - Wiring shorted to ground, shorted to power or open
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Inverter
  - Internal failure
- Vehicle Harness
  - Wiring shorted to ground, shorted to power or open
- Inverter Harness
  - Wiring shorted to ground, shorted to power or open

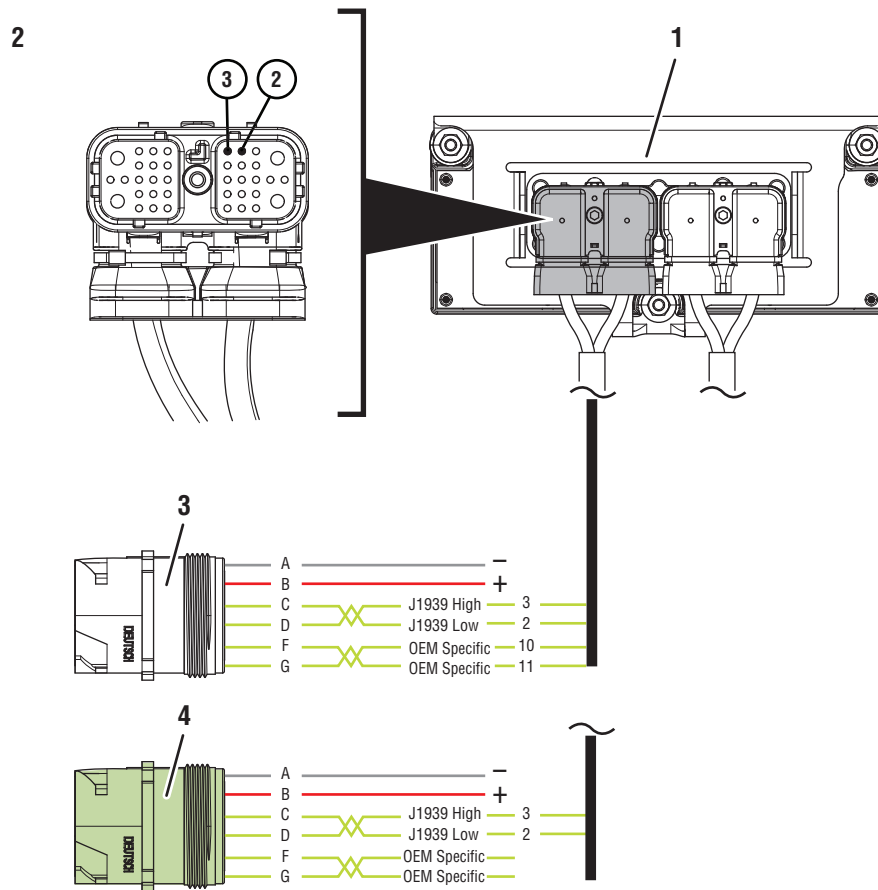
### FMI 7

- Inverter
  - Internal failure

## Component Identification



- 1. 38-Way Vehicle Harness Connector
- 2. Transmission Electronic Control Unit (TECU)
- 3. 9-Way Diagnostic Connector (in cab)



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 9-Way Diagnostic Connector (Black) - OEM Specific CD (in cab)
4. 9-way Diagnostic Connector (Green) - OEM Specific CD (in cab)



## Fault Code 30 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

**Note:** Fault Code 30 indicates an issue with communication over the J1939 data link between Motor A Feedback and the Transmission TECU. All wiring and pin outs for connectors are OEM proprietary. Refer to OEM guidelines for proper documentation.

- If Fault Code 30 FMI 7, or 9 are Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V**.
- If Fault Code 30 FMI 9 is Active, go to **Step C**.
- If Fault Code 30 FMI 9 is Inactive, go to **Step B**.
- If Fault Code 30 FMI 7 is Inactive or Active, refer to OEM guidelines and verify motor operation. Go to **Step V**.

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when there are Active fault codes.



3. Wiggle J1939 Data Link wiring and Vehicle Harness wiring throughout the vehicle. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If Fault Code 35 or Fault Code 30 became Active while wiggling the J1939 Data Link or the Vehicle Harness, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.
- If no fault codes became Active, go to **Step C**.

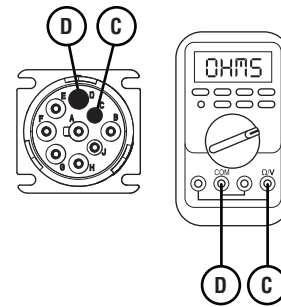
**C** **Purpose:** Verify TECU location on the vehicle J1939 Data Link.

1. Key off.
2. Refer to the OEM and identify the TECU location on the vehicle J1939 Data Link at the 9-Way Diagnostic Connector.
  - If Black 9-Way Diagnostic Connector, go to **Step D.**
  - If Green 9-Way Diagnostic Connector on Pin C and Pin D, go to **Step D.**

**D** **Purpose:** Verify proper resistance exists on the J1939 Data Link.

1. Key off.
 

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Measure resistance between 9-Way Diagnostic Connector Pin C and Pin D. Record reading(s) in table.



3. Compare reading(s) in table.
  - If readings are in range, go to **Step E.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of terminating resistors, ECUs or J1939 data link wiring. Go to **Step V.**

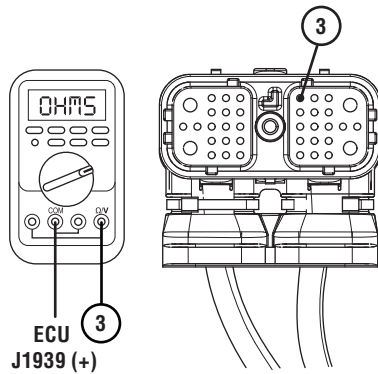
Pins	Range	Reading(s)
C to D	50–70 ohms	

**E** **Purpose:** Verify connection across J1939 Positive Pin (+) between Motor A Feedback and the TECU.

1. Key off.  
**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Disconnect 38-Way Vehicle Harness Connector from TECU. Inspect connector for loose terminals, corrosion, and bent or spread pins.
3. Disconnect Motor A Feedback Harness Connector from Motor A Feedback. Inspect connector for loose terminals, corrosion, and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 3 and J1939 Positive Pin (+) on Motor A Feedback Connector. Record reading(s) in table.

5. Compare reading(s) in table.
  - If readings are in range, go to **Step F.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**

Pins	Range	Reading(s)
3 to Motor A Feedback J1939 Positive (+)	0.0–0.3 ohms	

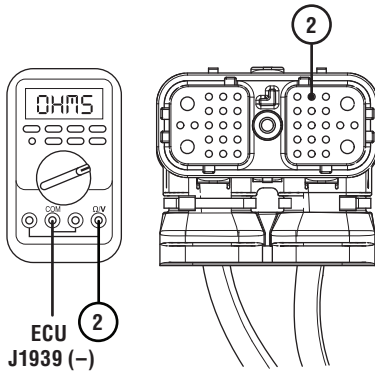


**Note:** Refer to OEM guidelines for location of Motor A Feedback J1939 Positive Pin (+).

**F**

**Purpose:** Verify connection across J1939 Negative Pin (-) between Motor A Feedback and the TECU.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 2 and J1939 Negative Pin (-) on Motor A Feedback Connector. Record reading(s) in table.



**Note:** Refer to OEM guidelines for location of Motor A Feedback J1939 Negative Pin (-).

3. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.
  - If readings are in range, an intermittent wiring issue exists within the J1939 Data Link, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.

Pins	Range	Reading(s)
2 to Motor A Feedback J1939 Negative (-)	0.0–0.3 ohms	

**V**

**Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 30 sets Active during the test drive, go to **Step A**.
  - If a fault code other than Fault Code 30 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

# Fault Code 31: Motor B Feedback Message

**J1939: SA 3      SPN 520261      FMI 2, 9**

## Overview

The J1939 Data Link is a Controller Area Network (CAN) communication bus. The Medium Duty 4-Speed EV Transmission uses the J1939 Data Link to communicate with other ECUs (Inverter, Body Controller, etc.). The Transmission Electronic Control Unit (TECU) sends and receives messages from other ECUs on the data link to determine when to initiate a shift, hold shifts, command motor speed to make shifts, as well as other functions. Proper operation of the J1939 Data Link is critical for shift performance. Fault Code 31 indicates the TECU can communicate with other ECUs on the J1939 Data Link but has lost Motor B Feedback Message.

## Detection

TECU has either lost communication or received erratic signals from Motor B Feedback over the J1939 Data Link and the TECU has not detected any low or weak battery system fault codes.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU has not received 3 consecutive messages from Motor B Feedback.

**FMI 9 – Abnormal Update Rate:** TECU has not received 30 consecutive messages from Motor B Feedback.

## Fallback

### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If fault occurs during power up, the transmission requires the driver to manually synchronize shifts with the throttle.
- If fault occurs while driving, transmission remains in its current gear until the vehicle stops. Transmission then requires the driver to manually synchronize shifts with the throttle.

## Conditions to Set Fault Code Inactive

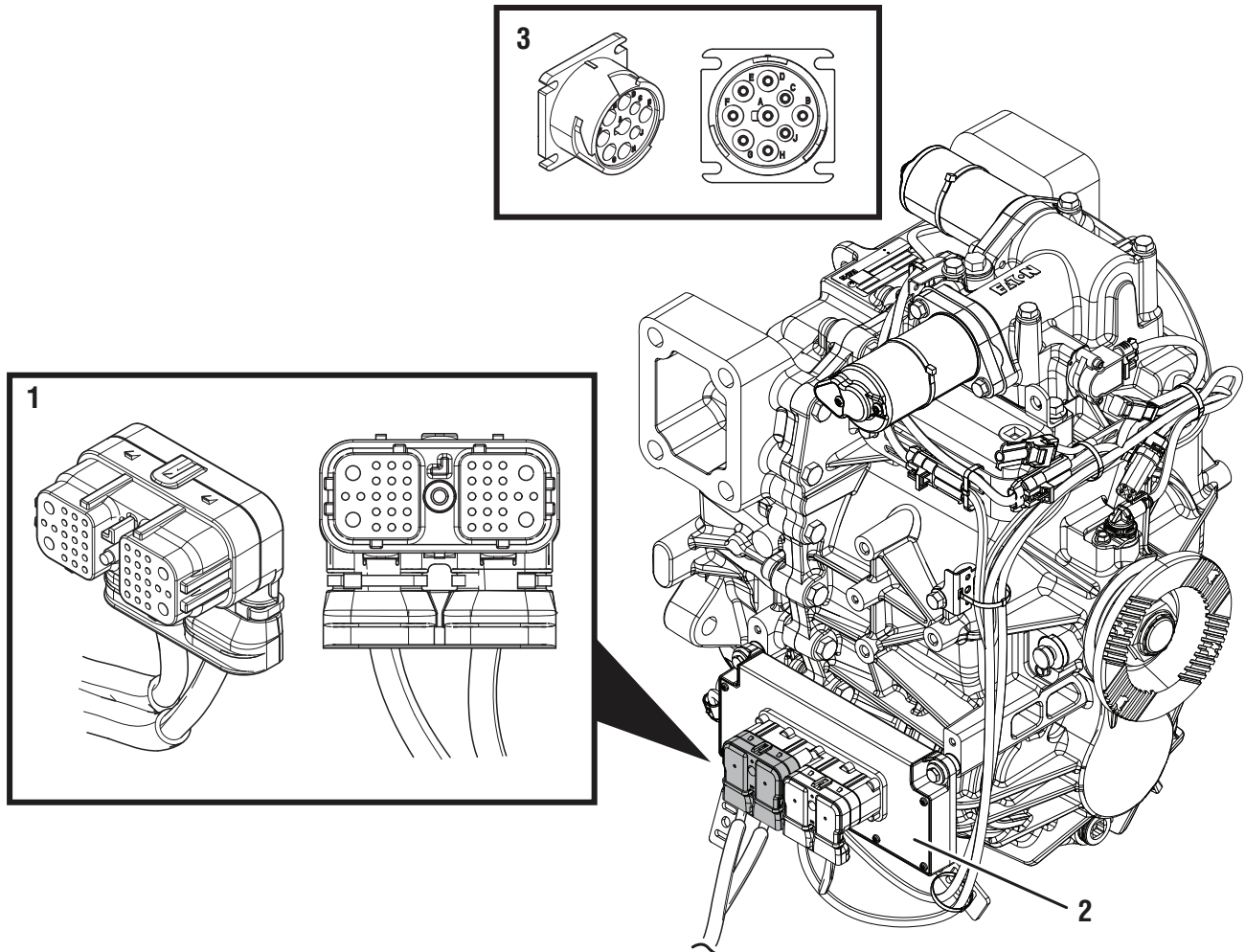
**All FMIs:** TECU receives messages across the data link for at least 1 second.

## Possible Causes

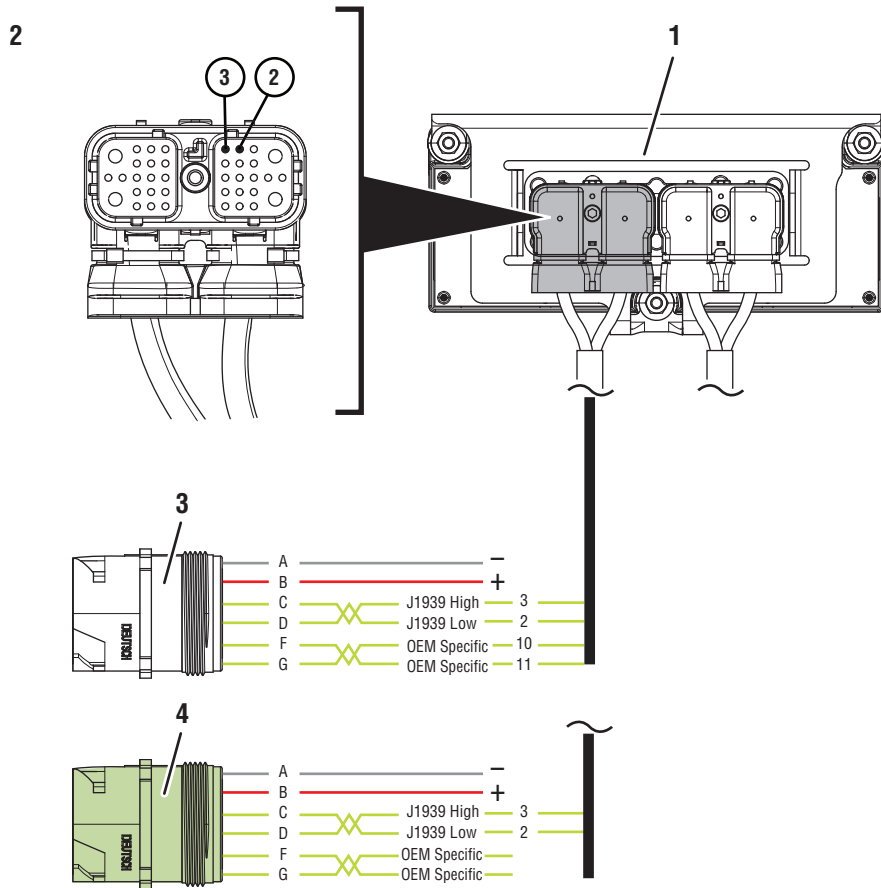
### All FMIs

- J1939 Data Link
  - Wiring shorted to ground, shorted to power or open
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Inverter
  - Internal failure
- Vehicle Harness
  - Wiring shorted to ground, shorted to power or open
- Inverter Harness
  - Wiring shorted to ground, shorted to power or open

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 9-Way Diagnostic Connector (in cab)



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 9-Way Diagnostic Connector (Black) - OEM Specific CD (in cab)
4. 9-Way Diagnostic Connector (Green) - OEM Specific CD (in cab)



## Fault Code 31 Troubleshooting

**A** **Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

**Note:** Fault Code 31 indicates an issue with communication over the J1939 data link between Motor B Feedback and the Transmission TECU. All wiring and pin outs for connectors are OEM proprietary. Refer to OEM guidelines for proper documentation.

- If Fault Code 31 is Active, go to **Step C.**
- If Fault Code 31 is Inactive, and there are other Active fault codes, troubleshoot all other Active fault codes first per *Fault Code Isolation Procedure Index* on page 14.
- If Fault Code 31 is Inactive, and there are no other Active fault codes, go to **Step B.**

**B** **Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when there are Active fault codes.



3. Wiggle J1939 Data Link wiring and Vehicle Harness wiring throughout the vehicle. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If Fault Code 35 or Fault Code 31 became Active while wiggling the J1939 Data Link or the Vehicle Harness, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**
- If no fault codes became Active, go to **Step C.**

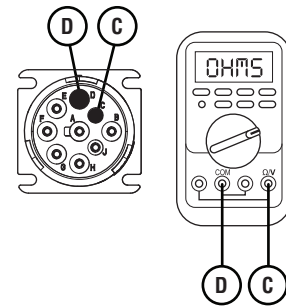
**C** **Purpose:** Verify TECU location on the vehicle J1939 Data Link.

1. Key off.
2. Refer to the OEM and identify the TECU location on the vehicle J1939 Data Link at the 9-Way Diagnostic Connector.
  - If Black 9-Way Diagnostic Connector, go to **Step D.**
  - If Green 9-Way Diagnostic Connector on Pin C and Pin D, go to **Step D.**

**D** **Purpose:** Verify proper resistance exists on the J1939 Data Link.

1. Key off.
 

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Measure resistance between 9-Way Diagnostic Connector Pin C and Pin D. Record reading(s) in table.



3. Compare reading(s) in table.
  - If readings are in range, go to **Step E.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of terminating resistors, ECUs or J1939 data link wiring. Go to **Step V.**

Pins	Range	Reading(s)
C to D	50–70 ohms	

**E**

**Purpose:** Verify connection across J1939 Positive Pin (+) between Motor B Feedback and the TECU.

1. Key off.

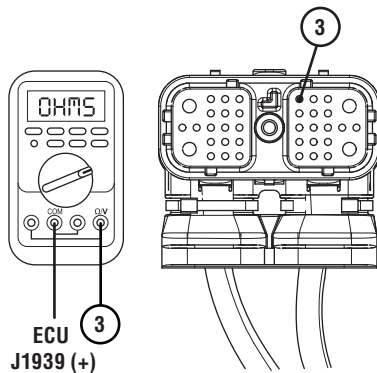
**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Disconnect 38-Way Vehicle Harness Connector from TECU. Inspect connector for loose terminals, corrosion, and bent or spread pins.
3. Disconnect Motor B Feedback Harness Connector from Motor B Feedback. Inspect connector for loose terminals, corrosion, and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 3 and J1939 Positive Pin (+) on Motor B Feedback Connector. Record reading(s) in table.

5. Compare reading(s) in table.

- If readings are in range, go to **Step F.**
- If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**

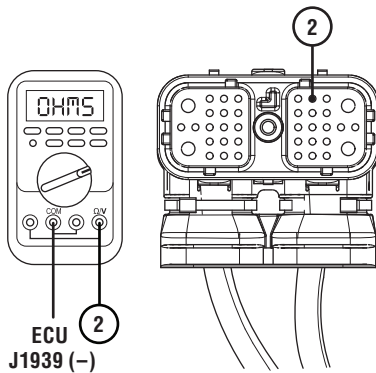
Pins	Range	Reading(s)
3 to Motor B Feedback J1939 Positive (+)	0.0–0.3 ohms	



**Note:** Refer to OEM guidelines for location of Motor B Feedback J1939 Positive Pin (+).

**F** **Purpose:** Verify connection across J1939 Negative Pin (-) between Motor B Feedback and the TECU.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 2 and J1939 Negative Pin (-) on Motor B Feedback Connector. Record reading(s) in table.



**Note:** Refer to OEM guidelines for location of Motor B Feedback J1939 Negative Pin (-).

3. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.
  - If readings are in range, an intermittent wiring issue exists within the J1939 Data Link, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.

Pins	Range	Reading(s)
2 to Motor B Feedback J1939 Negative (-)	0.0–0.3 ohms	

**V** **Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 31 sets Active during the test drive, go to **Step A**.
  - If a fault code other than 31 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 32: Loss of Switched Ignition Voltage

**J1939: SA 3      SPN 158      FMI 2**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with a Transmission Electronic Control Unit (TECU) and requires a key on battery voltage ignition supply. The ignition voltage initiates TECU operation at and during key on. The ignition voltage circuit is contained within the 38-Way TECU Vehicle Harness Connector. This fault code indicates a loss of Switched Ignition Power to the TECU.

### Detection

The TECU monitors Ignition Power during normal operation. If Ignition power is lost to the TECU during operation a fault is logged.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU has lost ignition voltage for 2 seconds or longer. J1939 devices are still communicating with the TECU.

### Fallback

#### FMI 2

- Service light flashes (if equipped).
- Motor may not operate.
- Transmission may not engage a gear from neutral.
- Transmission may not attempt to shift.
- Until the fault becomes inactive, driver may have to shut off motor with transmission gear.

### Conditions to Set Fault Code Inactive

**FMI 2:** TECU detects ignition voltage for 2 seconds more.

### Possible Causes

#### All FMIs

- Ignition switch keyed off during operation
- Ignition switch failure
- Vehicle Harness
  - Wiring shorted to ground or open
  - Terminals bent, spread, corroded or loose

## Fault Code 32 Troubleshooting

### **A** Purpose: Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Report created during the Diagnostic Procedure.

**Note:** If vehicle comes to a stop, TECU will shut down and Fault Code 32 will be inactive.

**Note:** If Fault Code 32 is Inactive and there are other Active faults, troubleshoot all Active faults first.

- If Fault Code 32 FMI 2 is Inactive, go to **Step B.**

### **B** Purpose: Verify battery voltage ignition supply.

1. Key on with motor off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From the “Default Parameter Files” tab, select “J1939 Transmission Actuators and Power”.
5. Monitor 158 - Battery voltage - switched value. Record reading in table.
6. Compare reading(s) in table.
  - If readings are within range:
    - Driver may have cycled key off while the vehicle was moving.
    - The intermittent nature of the fault makes it likely that the problem is between the vehicle’s ignition voltage supply and the 38-way TECU Vehicle Harness Connector Pin 35. Refer to OEM guidelines for repair or replacement of the Ignition Voltage supply circuit. Go to **Step V.**

Parameter	Range	Reading
“Battery Voltage - switched value”	Within 1.2 V of Battery Voltage	

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes and vehicle operates properly, Test Complete.
    - If Fault Code 32 sets Active during the test drive, go to **Step A.**
    - If a fault code other than 32 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 33: Low Battery Voltage Supply

**J19s9: SA 3****SPN 168****FMI 4**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with a Transmission Electronic Control Unit (TECU) and requires battery voltage to operate. Fault Code 33 sets Active if battery voltage to the TECU falls below 7 volts for more than 1 second.

### Detection

The Transmission Electronic Control Unit (TECU) monitors the battery voltage supplied to the TECU after completing power up. Fault Code 33 sets Active if battery voltage to the TECU falls below 7 volts for more than 1 second. Fault Code 33 represents a more severe drop in battery voltage than Fault Code 34, *Weak Battery Voltage Supply*, which sets Active below 9 volts.

### Conditions to Set Fault Code Active

**FMI 4 – Voltage Below Normal or Shorted Low:** TECU monitors battery voltage of the vehicle. If the voltage falls below 7 volts for more than 1 second, the fault sets Active.

### Fallback

**FMI 4**

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Motor may not operate.
- Transmission may not engage a gear from neutral.
- Transmission may not attempt to shift.
- Until the fault becomes Inactive, driver may have to shut off motor with transmission in gear.

### Conditions to Set Fault Code Inactive

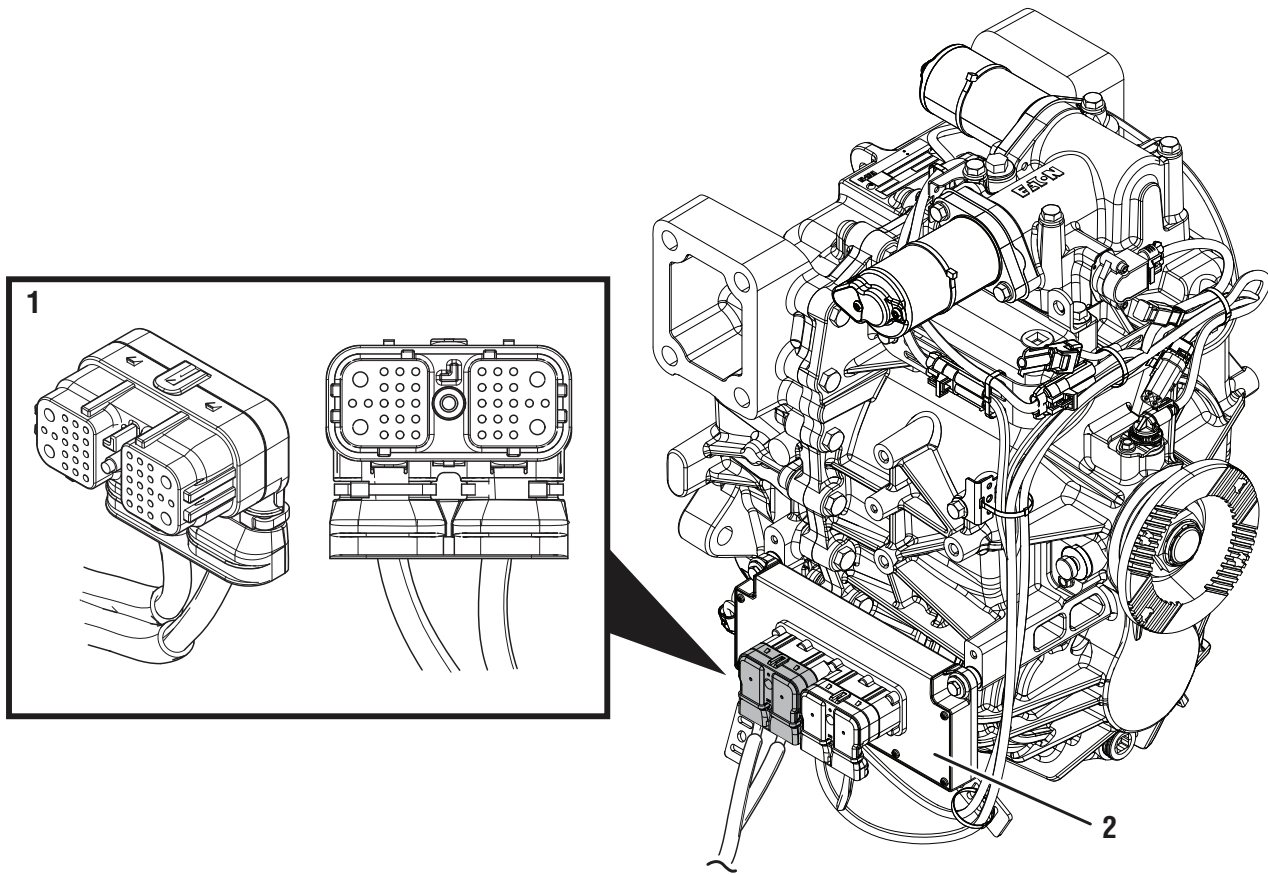
**FMI 4:** Battery voltage stays at 7 volts or greater for more than 1 second.

### Possible Causes

**FMI 4**

- Vehicle Power Supply
  - Wiring shorted to ground, shorted to power or open
  - Terminals bent, spread, corroded or loose
  - In-line fuse corrosion, loose connection or blown fuse
- Vehicle Batteries
  - Internal failure
- Vehicle Charging System
  - Charging system failed
- TECU
  - Internal failure

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)

## Fault Code 33 Troubleshooting

**A** **Purpose:** Inspect the batteries, in-line fuse and power and ground supplies to the TECU.

1. Key off.  
**NOTICE:** Allow TECU to perform a complete power-down sequence before proceeding.
2. Measure voltage across all batteries. Record voltage in table.
3. Inspect battery terminals and transmission 30-amp In-line Fuse Holder Connections for corrosion, loose terminals and bent or spread pins.
  - If any issues are found with connectors, refer to OEM guidelines for repair or replacement of Vehicle Harness wiring. Go to **Step V.**
  - If corrosion or other damage is visible at the battery terminals, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**
  - If no issues are found, go to **Step B.**

Battery Voltage

**B** **Purpose:** Load test each vehicle battery.

1. Key off.
2. Load test each vehicle battery per OEM specifications. Record reading(s) in table.
  - If all batteries pass the Load Test, go to **Step C.**
  - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**

Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

**C Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 33 is Active, go to **Step F**.
  - If Fault Code 33 is Inactive, go to **Step D**.

**D Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



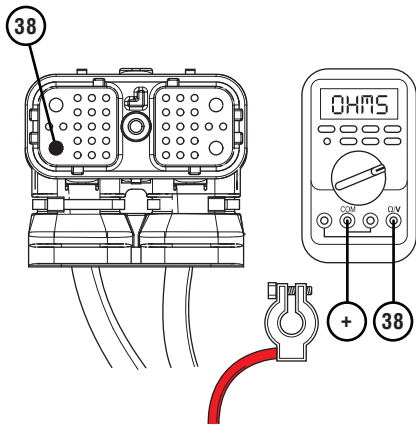
3. Wiggle wiring and connections of the Vehicle Harness from the batteries to the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

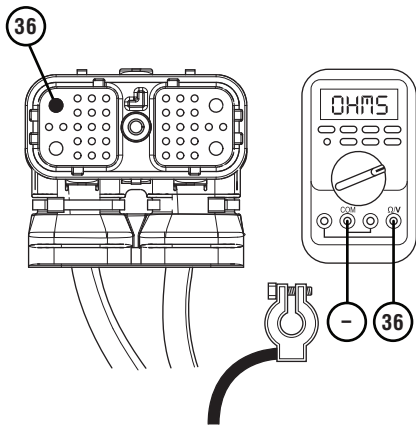
- If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of Vehicle Harness wiring. Go to **Step V**.
- If no fault codes set Active, go to **Step E**.

**E Purpose:** Verify continuity of battery supply and TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect connector body for corrosion and damage, and loose, spread or bent terminals.
4. Disconnect Battery Positive (+) and Negative (-) connections.
5. Measure resistance between 38-Way Connector Pin 38 and Battery Positive (+) connection. Record reading(s) in table.



6. Measure resistance between 38-Way Connector Pin 36 and Battery Negative (-) connection. Record reading(s) in table.



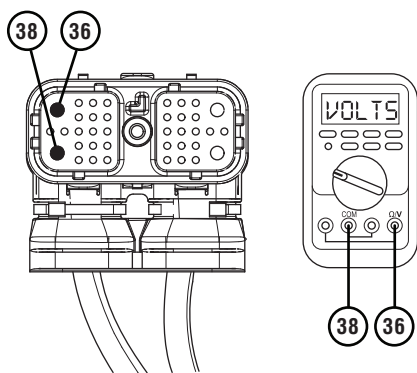
7. Compare reading(s) in table.

- If readings are in range, no problem was identified. Test complete. If additional troubleshooting is required, contact the OEM for additional diagnosis of the Vehicle Power Supply Harness. Go to **Step V**.
- If readings are out of range, repair or replace damaged wiring per OEM guidelines. Go to **Step V**.

Pins	Range	Reading(s)
38 to Battery Positive (+)	0.0–0.3 ohms	
36 to Battery Negative (-)	0.0–0.3 ohms	

**F Purpose:** Verify battery voltage at the TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect connector body for corrosion, damage, loose, spread or bent terminals.
4. Key on with motor off.
5. Measure voltage between 38-Way Connector Pin 38 and Pin 36. Record reading(s) in table.



6. Compare reading(s) in table.
  - If readings are in range, go to **Step G**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of 38-Way Vehicle Harness. Go to **Step V**.

Pins	Range	Reading(s)
38 to 36	Within 1.2 V of Battery Voltage (Step A)	

**G Purpose:** Verify fault code status.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Connect ServiceRanger and check fault codes.
  - If Fault Code 33 remains Active with all connections re-established, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.
  - If Fault Code 33 is now Inactive with all connections re-established, refer to OEM guidelines for repair or replacement of Vehicle Harness wiring. Go to **Step V**.

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Codes 33 or 34 sets Active during the test drive, go to **Step A**.
    - If a fault code other than 33 or 34 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 34: Weak Battery Voltage Supply

**J1939: SA 3      SPN 168      FMI 14**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with a Transmission Electronic Control Unit (TECU) and requires battery voltage to operate. Fault Code 34 sets Active if battery voltage to the TECU falls below 9 volts for more than 10 seconds.

### Detection

The TECU monitors the battery voltage supplied to the TECU after completing the power-up sequence. Fault Code 34 sets Active if battery voltage to the TECU falls below 9 volts for more than 10 seconds. Fault Code 33, *Low Battery Voltage Supply*, represents a more severe drop in battery voltage than Fault Code 34.

### Conditions to Set Fault Code Active

**FMI 14 – Special Instructions:** TECU monitors the battery voltage of the vehicle. If the voltage falls below 9 volts for more than 10 seconds, the fault sets Active.

### Fallback

#### FMI 14

- Motor may not operate.
- Transmission may not engage a gear from neutral.
- Transmission may not attempt to shift.
- Until the fault becomes Inactive, driver may have to shut off motor with transmission in gear.

### Conditions to Set Fault Code Inactive

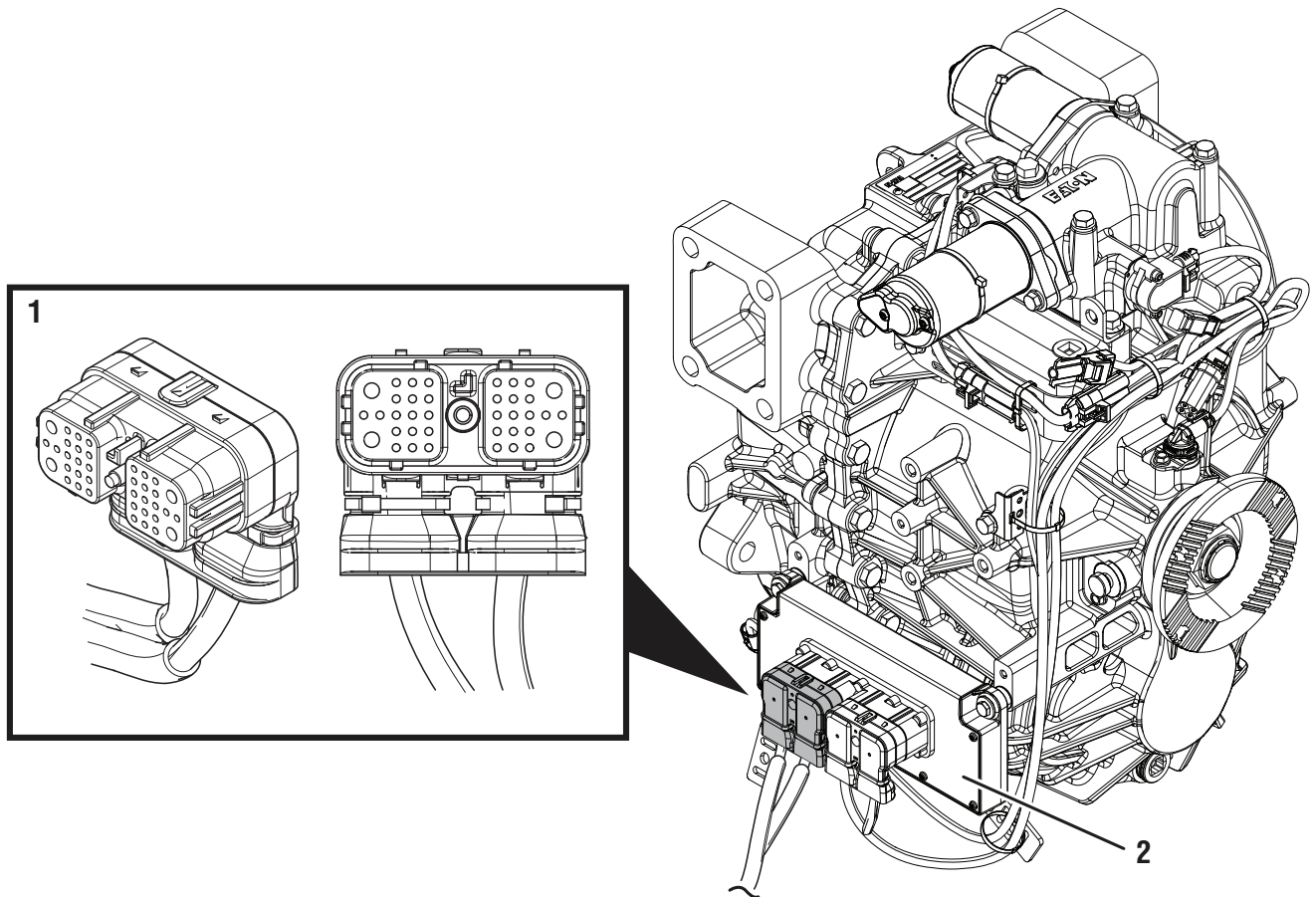
**FMI 14:** Battery voltage stays at 9 volts or greater for at least 20 seconds.

### Possible Causes

#### FMI 14

- Vehicle Power Supply
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - In-line fuse corrosion, loose connection or blown fuse
- Vehicle Batteries
  - Internal failure
- Vehicle Charging System
  - Charging system failed
- TECU
  - Internal failure

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)

## Fault Code 34: Troubleshooting

**A** *Purpose: Inspect the batteries, in-line fuse and power and ground supplies to the TECU.*

1. Key off.

**NOTICE:** Allow TECU to perform a complete power-down sequence before proceeding.

2. Measure voltage across all batteries. Record voltage in the table.
3. Inspect battery terminals and transmission 30-amp In-line Fuse Holder Connections for corrosion, loose terminals and bent or spread pins.
  - If any issue is found with connectors, refer to OEM guidelines for repair or replacement of Vehicle Harness wiring. Go to **Step V.**
  - If corrosion or other damage is visible at the battery terminals, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**
  - If no issues are found, go to **Step B.**

Battery Voltage

**B** *Purpose: Load test each vehicle battery.*

1. Key off.
2. Load test each vehicle battery per OEM specifications. Record reading(s) in table.
  - If all batteries pass the Load Test, go to **Step C.**
  - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**

Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

**C**

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
  2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If Fault Code 34 is Active, go to **Step F.**
    - If Fault Code 34 is Inactive, go to **Step D.**
- 

**D**

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



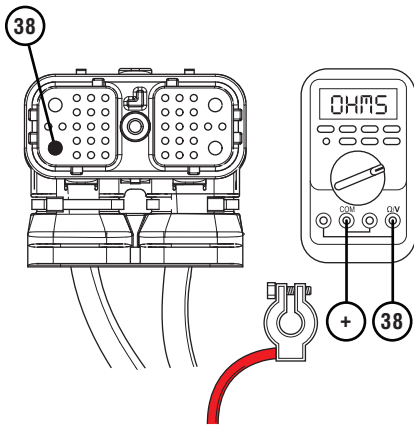
3. Wiggle wiring and connectors of the Vehicle Harness from the batteries to the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

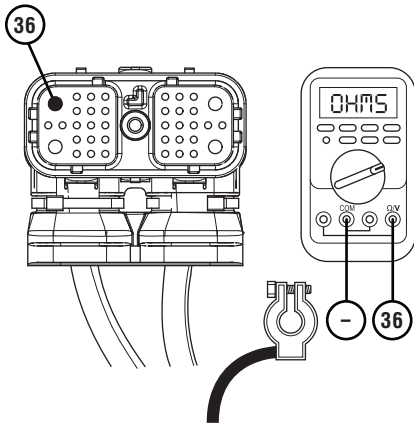
- If any fault sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of Vehicle Harness wiring. Go to **Step V.**
  - If no fault codes set Active, go to **Step E.**
-

**E** **Purpose:** Verify continuity of battery supply to TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect connector body for corrosion, damage, loose, spread or bent terminals.
4. Disconnect Battery Positive (+) and Negative (-) connections.
5. Measure resistance between 38-Way Connector Pin 38 and Battery Positive (+) connection. Record reading(s) in table.



6. Measure resistance between 38-Way Connector Pin 36 and Battery Negative (-) connection. Record reading(s) in table.



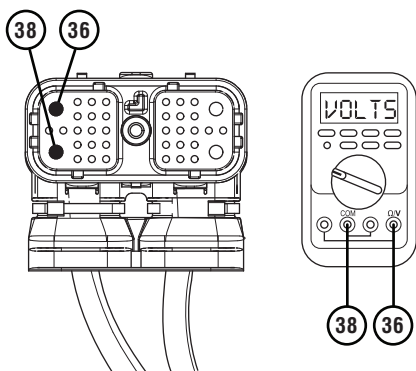
7. Compare reading(s) in table.

- If readings are in range, no problem was identified. Test complete. If additional troubleshooting is required, contact the OEM for additional diagnosis of the Vehicle Power Supply Harness. Go to **Step V**.
- If readings are out of range, repair or replace damaged wiring per OEM guidelines. Go to **Step V**.

Pins	Resistance Range	Resistance
38 to Battery Positive (+)	0.0–0.3 ohms	
36 to Battery Negative (-)	0.0–0.3 ohms	

**F** **Purpose:** Verify battery voltage at the TECU.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect connector body for corrosion, damage, loose, spread or bent terminals.
4. Key on with motor off.
5. Measure voltage between 38-Way Connector Pin 38 and Pin 36. Record reading(s) in table.



6. Compare reading(s) in table.
  - If readings are in range, go to **Step G.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of 38-Way Vehicle Harness. Go to **Step V.**

Pins	Voltage Range	Voltage
38 to 36	Within 1.2 V of Battery Voltage (Step A)	

**G** **Purpose:** Verify fault code status.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Connect ServiceRanger and check fault codes.
  - If Fault Code 34 remains Active with all connections re-established, replace **Transmission Electronic Control Unit (TECU).** Go to **Step V.**
  - If Fault Code 34 is now Inactive with all connections re-established, refer to OEM guidelines for repair or replacement of Vehicle Harness wiring. Go to **Step V.**

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 33 or 34 set Active during the test drive, go to **Step A**.
    - If a fault code other than 33 or 34 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 35: J1939 Communication Link

**J1939: SA 3      SPN 639      FMI 2, 9**

### Overview

The J1939 Data Link is a Controller Area Network (CAN) communication bus. The Medium Duty 4-Speed EV Transmission uses the J1939 Data Link to communicate with other ECUs (Motor, Body Controller, etc.). The Transmission Electronic Control Unit (TECU) sends and receives messages from other ECUs on the data link to determine when to initiate a shift, hold shifts, command motor speed to make shifts, as well as other functions. Proper operation of the J1939 Data Link is critical for shift performance. Fault Code 35 indicates an issue with communication across the J1939 Data Link.

### Detection

TECU has either lost communication or received erratic signals over the J1939 Data Link and the TECU has not detected any low battery system fault codes.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU has lost communication or has received erratic signals over the J1939 Data Link for 0.3 seconds or longer.

**FMI 9 – Data Erratic:** TECU has lost communication or has received erratic signals over the J1939 Data Link for 3 seconds or longer.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If fault occurs during power up, the transmission requires the driver to manually synchronize shifts with the throttle.
- If fault occurs while driving, transmission remains in its current gear until the vehicle stops. Transmission then requires the driver to manually synchronize shifts with the throttle.

### Conditions to Set Fault Code Inactive

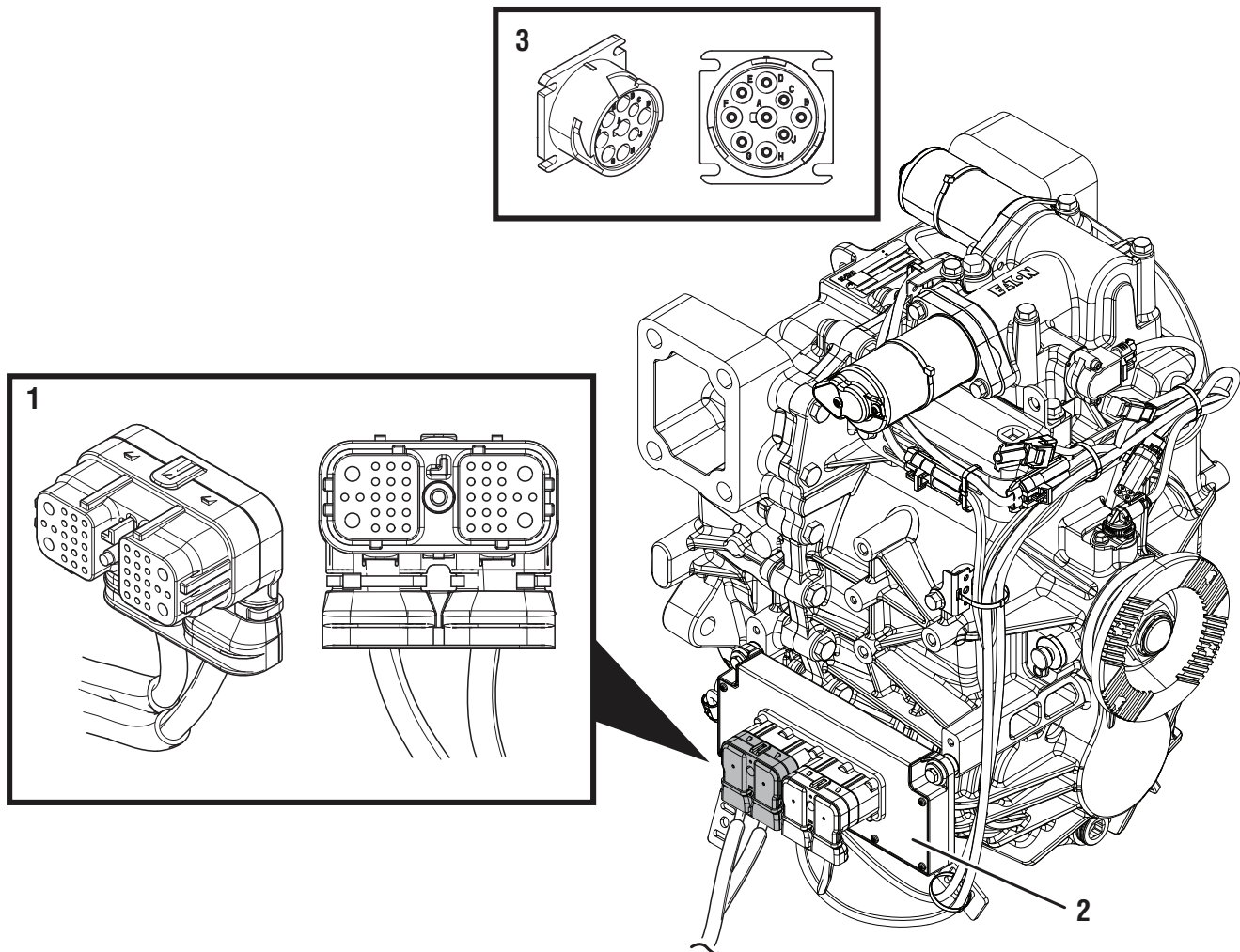
**All FMIs:** TECU receives messages across the data link for at least 10 seconds.

### Possible Causes

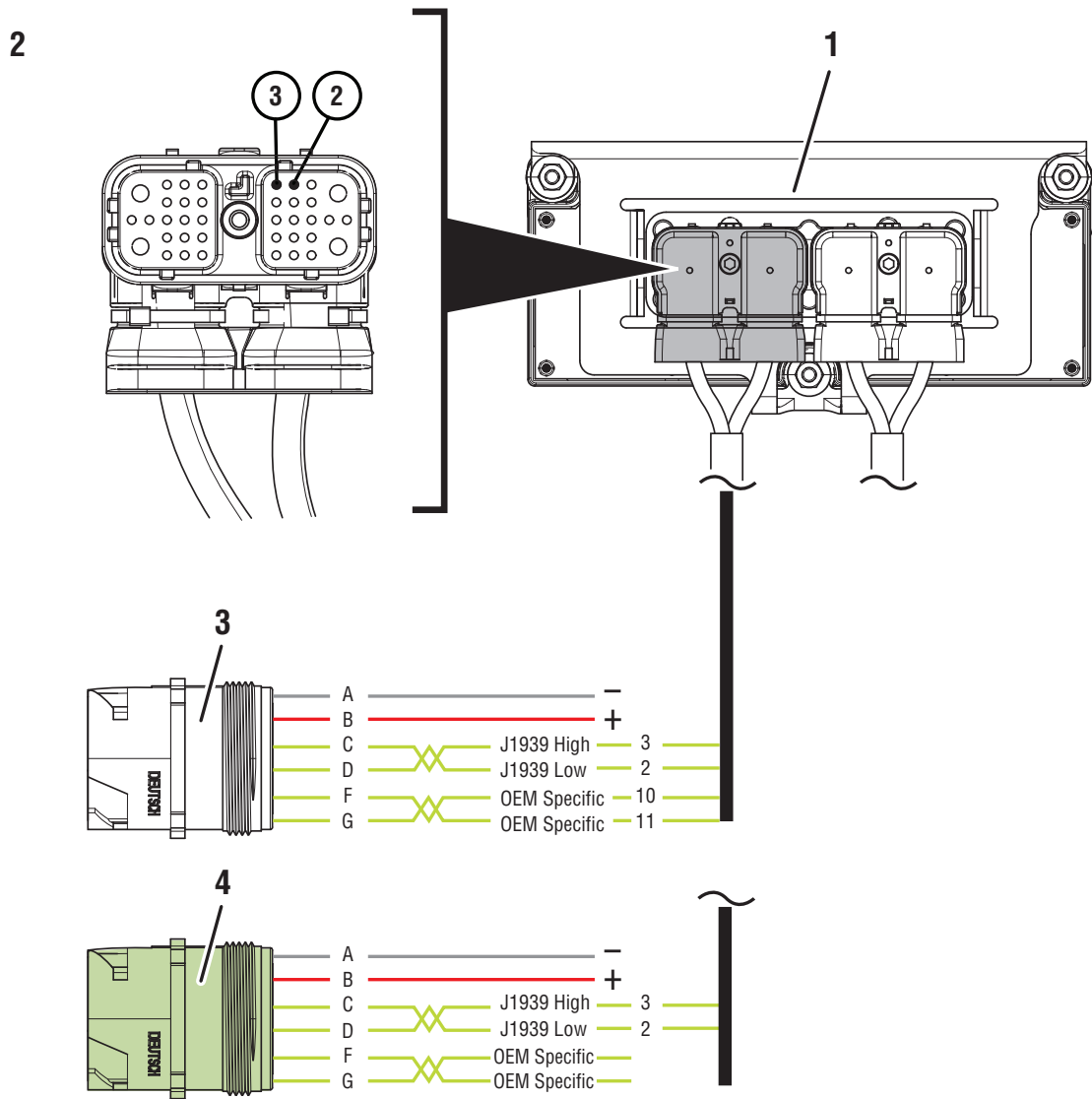
#### All FMIs

- 38-Way Vehicle Harness Connector
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, or loose terminals
- Other ECUs
  - Internal failure
- J1939 Data Link
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, or loose terminals
  - Excessive electrical noise
  - Missing or additional terminating resistors
- TECU
  - Internal failure

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 9-Way Diagnostic Connector (in cab)



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 9-Way Diagnostic Connector (Black) - OEM Specific CD (in cab)
4. 9-Way Diagnostic Connector (Green) - OEM Specific CD (in cab)



## Fault Code 35 Troubleshooting

**A** **Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 35 is Active, go to **Step C**.
  - If Fault Code 35 is Inactive, and there are other Active fault codes, troubleshoot all Active fault codes first per *Fault Code Isolation Procedure Index* on page 14.
  - If Fault Code 35 is Inactive, and there are no other Active fault codes, go to **Step B**.

**B** **Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



3. Wiggle J1939 Data Link wiring and Vehicle Harness wiring throughout the vehicle. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If Fault Code 35 or Fault Code 36 became Active while wiggling the J1939 Data Link or the Vehicle Harness, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.
- If no fault codes became Active, go to **Step C**.

**C**

**Purpose:** Verify TECU location on the vehicle J1939 Data Link.

1. Key off.
  2. Refer to the OEM and identify the TECU location on the vehicle J1939 Data Link at the 9-Way Diagnostic Connector.
    - If Black 9-Way Diagnostic Connector, go to **Step D.**
    - If Green 9-Way Diagnostic Connector on Pin C and Pin D, go to **Step D.**
- 

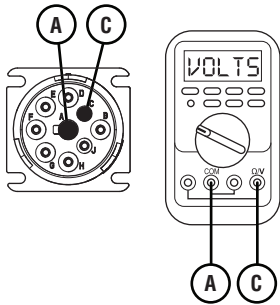
**D**

**Purpose:** Verify integrity of vehicle Bulkhead Connection (if equipped).

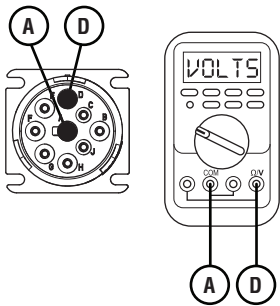
1. Key off.
  2. If vehicle is equipped with a Bulkhead Connection, inspect Bulkhead Connector for corrosion, loose terminals, and bent or spread pins.
  3. Wiggle wiring connections to the Bulkhead Connector to verify the pins are not loose and are secure within the connector.
    - If no Bulkhead Connection is present, go to **Step E.**
    - If no damage is found and the connector is not loose, go to **Step E.**
    - If damage or looseness is found, refer to OEM guidelines for repair or replacement of Bulkhead Connection. Go to **Step V.**
-

**E** **Purpose:** Verify proper signal voltage on J1939 Data Link.

1. Key on with motor off.
2. Measure voltage between 9-Way Diagnostic Connector Pin C and Pin A. Record reading(s) in table.



3. Measure voltage between 9-Way Diagnostic Connector Pin D and Pin A. Record reading(s) in table.



4. Record the total voltage in table by adding together the voltage readings recorded earlier in this step.
5. Compare reading(s) in table.
  - If readings are in range, go to **Step F.**
  - If readings are out of range, an issue is present on the vehicle J1939 Data Link. Refer to OEM guidelines for repair or replacement of the vehicle data link. Go to **Step V.**

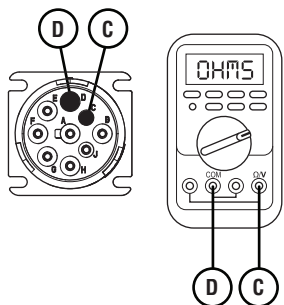
Pins	Range	Reading(s)
C to A	N/A	
D to A	N/A	+
Total Voltage	4.5–5.5 V	=

**F** **Purpose:** Verify proper resistance on the vehicle J1939 Data Link.

1. Key off.

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Measure resistance between 9-Way Diagnostic Connector Pin C and Pin D. Record reading(s) in table.

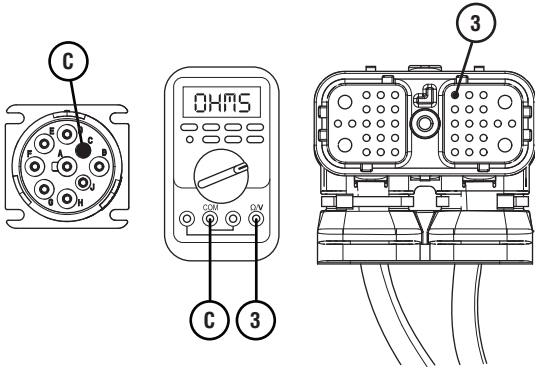


3. Compare reading(s) in table.
  - If readings are in range, go to **Step G.**
  - If readings are out of range, an issue is present on the vehicle J1939 Data Link. Refer to OEM guidelines for repair or replacement of terminating resistors, ECUs or data link wiring. Go to **Step V.**

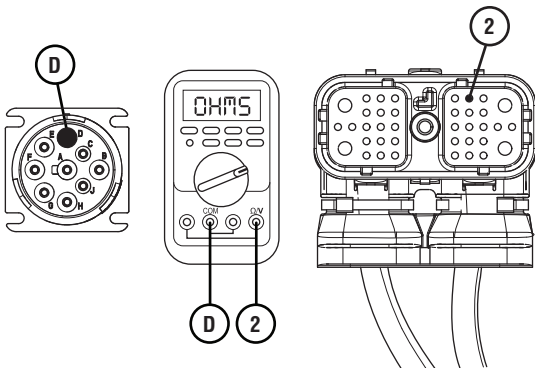
Pins	Range	Reading(s)
C to D	50–70 ohms	

**G** *Purpose: Verify J1939 positive and negative connections to TECU.*

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Measure resistance between 9-Way Diagnostic Connector Pin C and 38-Way Vehicle Harness Connector Pin 3. Record reading(s) in table.



4. Measure resistance between 9-Way Diagnostic Connector Pin D and 38-Way Vehicle Harness Connector Pin 2. Record reading(s) in table.



5. Compare reading(s) in table.
  - If readings are in range, go to **Step H.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle J1939 Data Link. Go to **Step V.**

Pins	Range	Reading(s)
C to 3	0.0–0.3 ohms	
D to 2	0.0–0.3 ohms	

**H** *Purpose: Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Connect ServiceRanger
4. Key on with motor off.
5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
  - If Fault Code 35 is Inactive, an intermittent wiring issues exists within the vehicle J1939 Data Link, refer to OEM guidelines for repair or replacement of the data link. Go to **Step V.**
  - If Fault Code 35 is Active, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V.**

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 35 sets Active during the test drive, go to **Step A**.
    - If a fault code other than 35 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 37: TECU Power Supply

**J1939: SA 3      SPN 627      FMI 5**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with electronic components that require high current to operate. It is critical that the OEM power supply be able to deliver the proper voltage and current in these high-load situations for smooth and efficient shifting. Additional resistance introduced into the system can cause the supplied voltage to drop low enough to cause performance issues. Fault Code 37 indicates an excessive resistance between the power supply source (battery) and the Transmission Electronic Control Unit (TECU).

### Detection

The TECU monitors the OEM power supply circuit for excessive resistance by measuring the voltage drop during high current demands, such as a shift request, and calculates a resistance value based on those demands. Fault Code 37 sets Active when the calculated resistance during high-load conditions exceeds 0.4 ohms and the TECU has not detected any low or weak battery system faults.

### Conditions to Set Fault Code Active

**FMI 5 – Current Below Normal or Open Circuit:** TECU calculates a resistance value based on high current demands and sets the fault code Active when that resistance exceeds 0.4 ohms.

### Fallback

No fallback mode is associated with this fault; however, transmission performance issues may be presented.

### Conditions to Set Fault Code Inactive

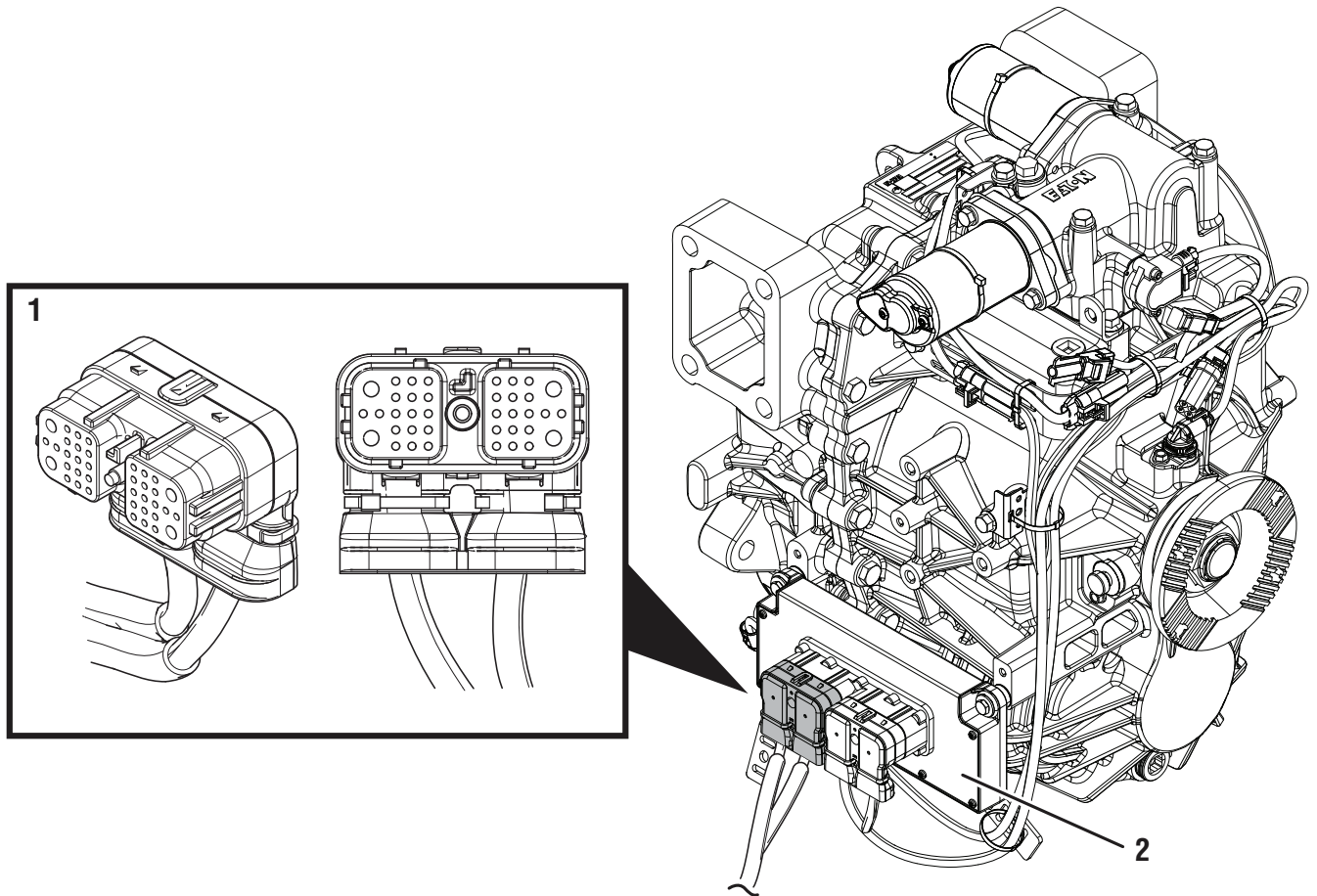
TECU calculates a resistance value below 0.4 ohms.

### Possible Causes

#### FMI 5

- Vehicle Power Supply
  - In-line fuse corrosion or loose connection
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
- Vehicle Batteries
  - Internal failure or high resistance

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)

## Fault Code 37 Troubleshooting

**A** *Purpose: Check for Active or Inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

**NOTICE:** Fault Code 37 indicates there is high resistance in the vehicle power supply to the TECU. Consult OEM diagnostics for more detailed troubleshooting.

- If Fault Code 37 is Inactive and there are Active vehicle faults, refer to OEM for additional diagnostic instructions.
- If Fault Code 37 is Inactive and there are Active transmission faults, troubleshoot all Active fault codes per *Fault Code Isolation Procedure Index* on page 14.
- If Fault Code 37 is Active or Inactive, and there are no Active vehicle or transmission faults, go to **Step B.**

**B** *Purpose: Inspect the batteries, in-line fuse, and power and ground supplies to the TECU.*

1. Key off.
2. Measure voltage across all batteries. Record reading(s) in table.
3. Inspect battery terminals and transmission 30-amp in-line fuse holder connections for damage and bent, spread, corroded or loose terminals.
4. Visually inspect Vehicle Harness between the power supply and the TECU for signs of rubbing or chafing to the wiring.

**Note:** Some chassis use a power and ground distribution block separate from the battery. Be sure to clean and inspect connections at this location and at the battery.

- If damage is found, refer to OEM guidelines for repair or replacement of the vehicle power supply to the TECU. Go to **Step V.**
- If no damage is found, go to **Step C.**

Battery Voltage

**C** **Purpose:** Perform a Load Test on each vehicle battery.

1. Key off.

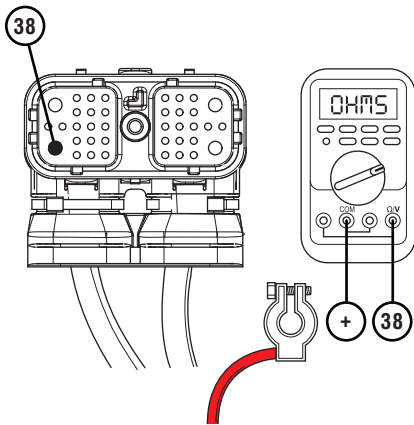
**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Load Test each vehicle battery per OEM specifications. Record reading(s) in table.
  - If all batteries pass the Load Test, go to **Step D.**
  - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**

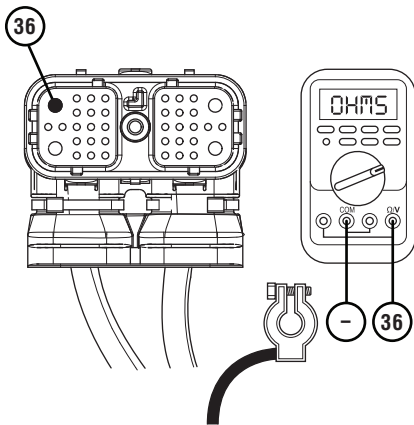
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

**D** **Purpose:** Verify continuity of Vehicle power and ground wiring.

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect connector body for damage, and bent, spread, corroded or loose terminals.
4. Disconnect Battery Positive (+) and Battery Negative (-) connections.
5. Measure resistance between 38-Way Connector Pin 38 and Battery Positive (+) connection. Record reading(s) in table.



6. Measure resistance between 38-Way Connector Pin 36 and Battery Negative (-) connection. Record reading(s) in table.



7. Compare reading(s) in table.

- If readings are in range, an intermittent issue exists with the vehicle power supply. Refer to OEM guidelines for repair or replacement of the vehicle power supply to the TECU. Go to **Step V.**
- If readings are out of range, refer to OEM guidelines for repair or replacement of the vehicle power supply to the TECU. Go to **Step V.**

Pins	Range	Reading(s)
38 to Battery Positive (+)	0.0–0.3 ohms	
36 to Battery Negative (-)	0.0–0.3 ohms	

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 37 sets Active during the test drive, go to **Step A**.
    - If a fault code other than 37 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 38: EV System Status Communication

**J1939: SA 3      SPN 520262    FMI 2, 9**

### Overview

The J1939 Data Link is a Controller Area Network (CAN) communication bus. The Medium Duty 4-Speed EV Transmission uses the J1939 Data Link to communicate with other ECUs (Inverter, Body Controller, etc.). The Transmission Electronic Control Unit (TECU) sends and receives messages from other ECUs on the data link to determine when to initiate a shift, hold shifts, command motor speed to make shifts, as well as other functions. Proper operation of the J1939 Data Link is critical for shift performance. Fault Code 38 indicates the TECU can communicate with other ECUs on the J1939 Data Link but has lost EV System Status communication from the Supervisory Control Module (SCM).

### Detection

TECU has either lost communication or received erratic EV System Status signals over the J1939 Data Link and the TECU has not detected any low or weak battery system fault codes.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU has not received 3 consecutive EV System Status messages from the SCM.

**FMI 9 – Abnormal Update Rate:** TECU has not received 30 consecutive EV System Status messages from the SCM.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If fault occurs during power up, the transmission requires the driver to manually synchronize shifts with the throttle.
- If fault occurs while driving, transmission remains in its current gear until the vehicle stops. Transmission then requires the driver to manually synchronize shifts with the throttle.

### Conditions to Set Fault Code Inactive

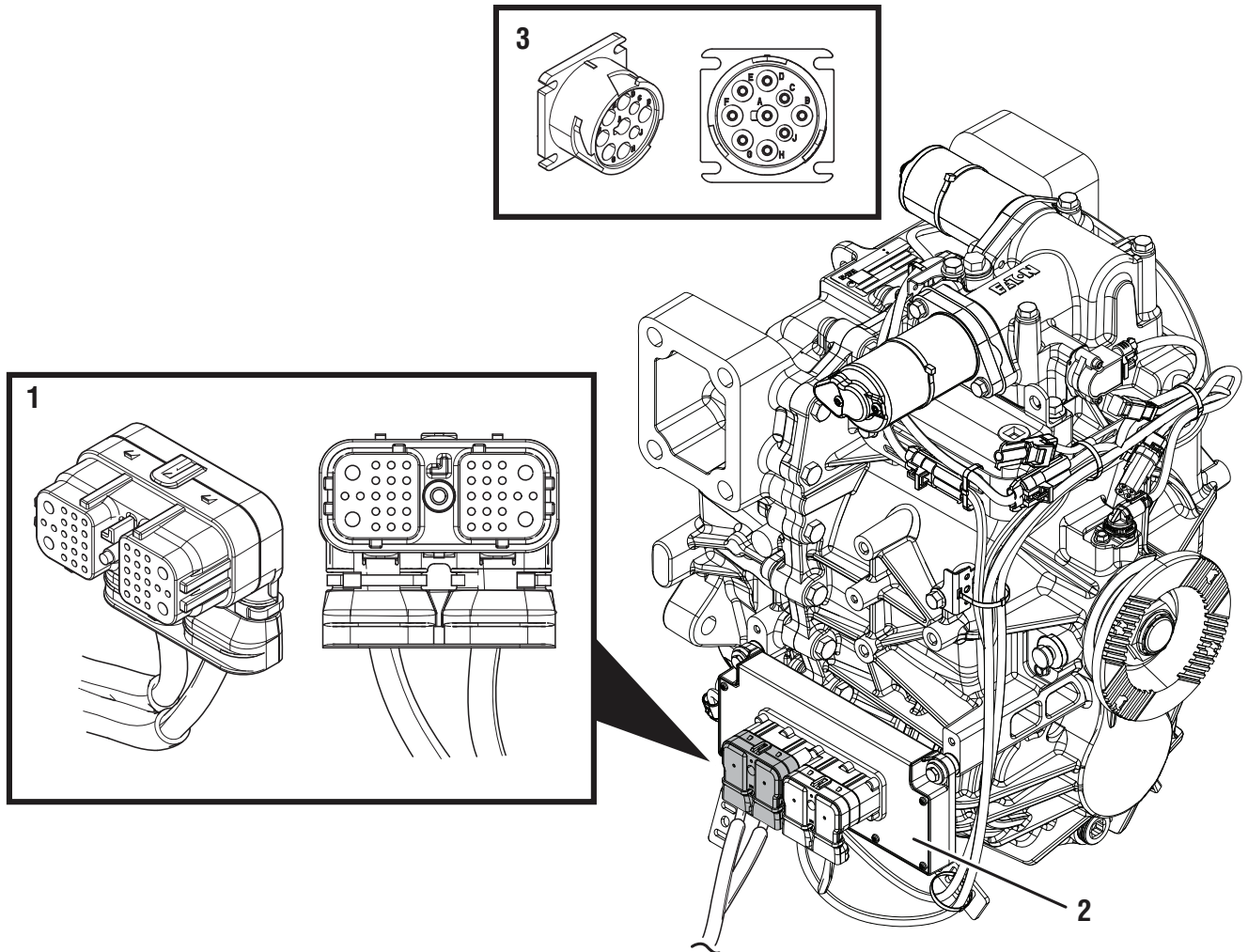
**All FMIs:** TECU receives messages across the data link for at least 1 second.

### Possible Causes

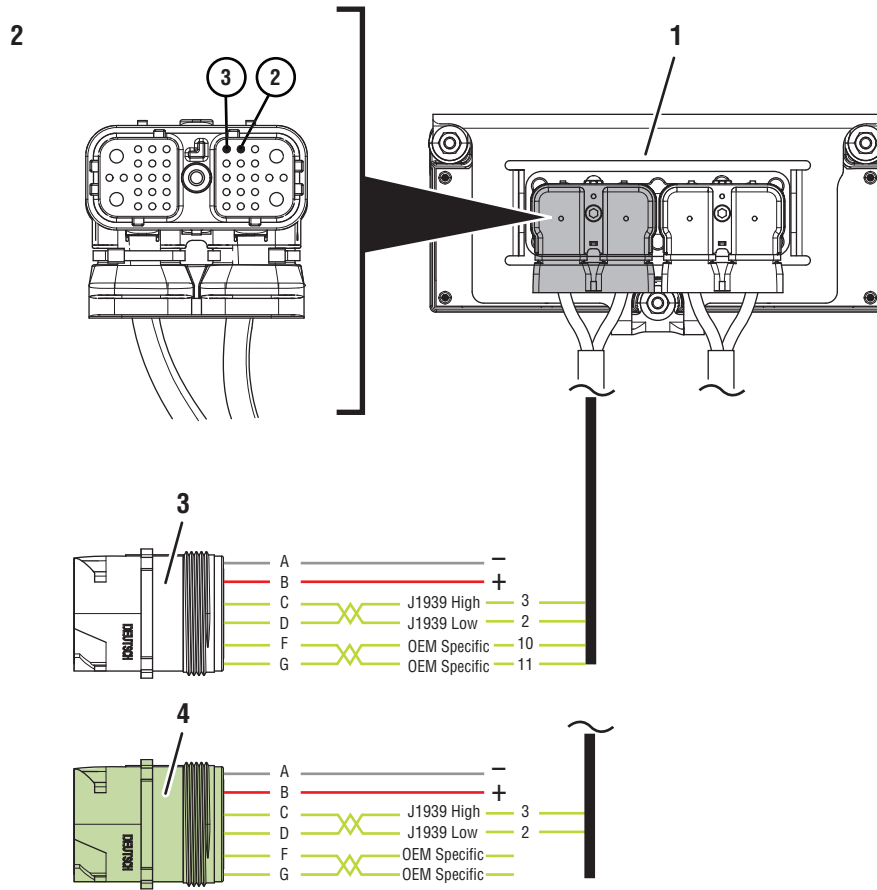
#### All FMIs

- J1939 Data Link
  - Wiring shorted to ground, shorted to power or open
  - Excessive electrical noise
  - Missing or additional terminating resistors
- SCM
  - Internal failure
- Vehicle Harness
  - Wiring shorted to ground, shorted to power or open
- SCM Harness
  - Wiring shorted to ground, shorted to power or open

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 9-Way Diagnostic Connector (in cab)



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 9-Way Diagnostic Connector (Black) - OEM Specific CD (in cab)
4. 9-way Diagnostic Connector (Green) - OEM Specific CD (in cab)



## Fault Code 38 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

**Note:** Fault Code 38 indicates an issue with communication over the J1939 data link between the SCM and the Transmission TECU. All wiring and pin outs for connectors are OEM proprietary. Refer to OEM guidelines for proper documentation.

- If Fault Code 38 is Active, go to **Step C.**
- If Fault Code 38 is Inactive, and there are other Active fault codes, troubleshoot all other Active fault codes first per *Fault Code Isolation Procedure Index* on page 14.
- If Fault Code 38 is Inactive, and there are no other Active fault codes, go to **Step B.**

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when there are Active fault codes.



3. Wiggle J1939 Data Link wiring and Vehicle Harness wiring throughout the vehicle. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If Fault Code 35 or Fault Code 38 became Active while wiggling the J1939 Data Link or the Vehicle Harness, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**
- If no fault codes became Active, go to **Step C.**

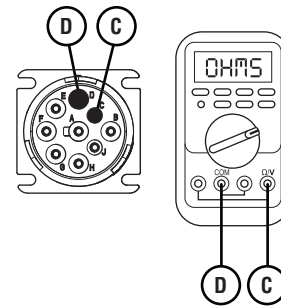
**C** **Purpose:** Verify TECU location on the vehicle J1939 Data Link.

1. Key off.
2. Refer to the OEM and identify the TECU location on the vehicle J1939 Data Link at the 9-Way Diagnostic Connector.
  - If Black 9-Way Diagnostic Connector, go to **Step D.**
  - If Green 9-Way Diagnostic Connector on Pin C and Pin D, go to **Step D.**

**D** **Purpose:** Verify proper resistance exists on the J1939 Data Link.

1. Key off.
 

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Measure resistance between 9-Way Diagnostic Connector Pin C and Pin D. Record reading(s) in table.



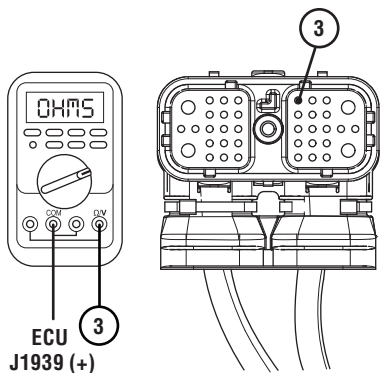
3. Compare reading(s) in table.
  - If readings are in range, go to **Step E.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of terminating resistors, ECUs or J1939 data link wiring. Go to **Step V.**

Pins	Range	Reading(s)
C to D	50–70 ohms	

**E** **Purpose:** Verify connection across J1939 Positive Pin (+) between SCM and the TECU.

1. Key off.
 

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Disconnect 38-Way Vehicle Harness Connector from TECU. Inspect connector for loose terminals, corrosion, and bent or spread pins.
3. Disconnect SCM Harness Connector from SCM. Inspect connector for loose terminals, corrosion, and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 3 and J1939 Positive Pin (+) on SCM Connector. Record reading(s) in table.



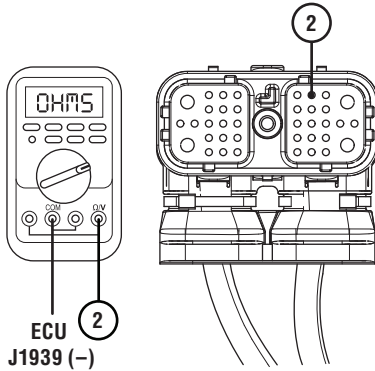
**Note:** Refer to OEM guidelines for location of SCM J1939 Positive Pin (+).

5. Compare reading(s) in table.
  - If readings are in range, go to **Step F**.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.

Pins	Range	Reading(s)
3 to SCM J1939 Positive (+)	0.0–0.3 ohms	

**F** **Purpose:** Verify connection across J1939 Negative Pin (-) between SCM and the TECU.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 2 and J1939 Negative Pin (-) on SCM Connector. Record reading(s) in table.



**Note:** Refer to OEM guidelines for location of SCM J1939 Negative Pin (-).

3. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.
  - If readings are in range, an intermittent wiring issue exists within the J1939 Data Link, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.

Pins	Range	Reading(s)
2 to SCM J1939 Negative (-)	0.0–0.3 ohms	

**V** **Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 38 sets Active during the test drive, go to **Step A**.
  - If a fault code other than 38 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 39: Motor Configuration Message

**J1939: SA 3      SPN 520263      FMI 2, 9**

### Overview

The J1939 Data Link is a Controller Area Network (CAN) communication bus. The Medium Duty 4-Speed EV Transmission uses the J1939 Data Link to communicate with other ECUs (Inverter, Body Controller, etc.). The Transmission Electronic Control Unit (TECU) sends and receives messages from other ECUs on the data link to determine when to initiate a shift, hold shifts, command motor speed to make shifts, as well as other functions. Proper operation of the J1939 Data Link is critical for shift performance. Fault Code 39 indicates the TECU can communicate with other ECUs on the J1939 Data Link but has lost the Motor Configuration Message from the Supervisory Control Module (SCM).

### Detection

TECU has either lost communication or received erratic Motor Configuration messages over the J1939 Data Link and the TECU has not detected any low or weak battery system fault codes.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU has not received 3 consecutive Motor Configuration messages from the SCM.

**FMI 9 – Abnormal Update Rate:** TECU has not received 10 consecutive Motor Configuration messages from the SCM.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If fault occurs during power up, the transmission requires the driver to manually synchronize shifts with the throttle.
- If fault occurs while driving, transmission remains in its current gear until the vehicle stops. Transmission then requires the driver to manually synchronize shifts with the throttle.

### Conditions to Set Fault Code Inactive

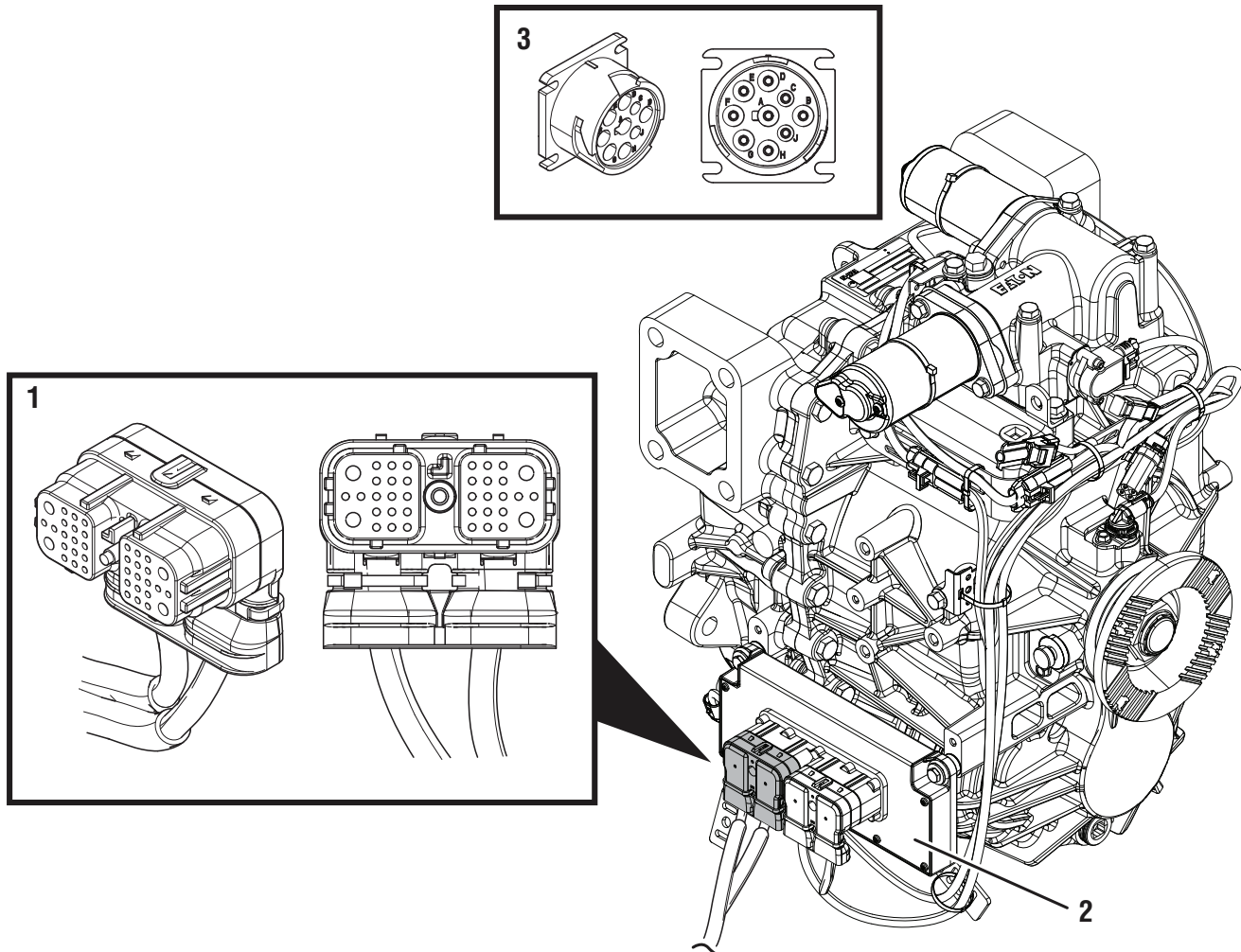
**All FMIs:** TECU receives messages across the data link for at least 1 second.

### Possible Causes

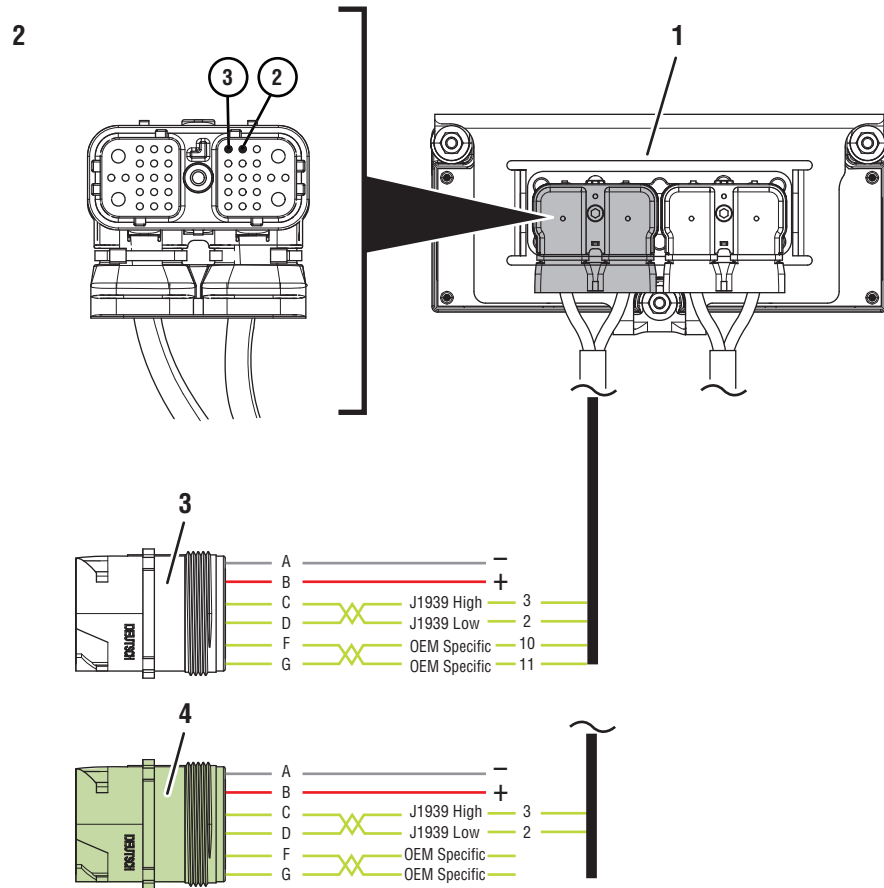
#### All FMIs

- J1939 Data Link
  - Wiring shorted to ground, shorted to power or open
  - Excessive electrical noise
  - Missing or additional terminating resistors
- SCM
  - Internal failure
- Vehicle Harness
  - Wiring shorted to ground, shorted to power or open
- SCM Harness
  - Wiring shorted to ground, shorted to power or open

## Component Identification



- 1. 38-Way Vehicle Harness Connector
- 2. Transmission Electronic Control Unit (TECU)
- 3. 9-Way Diagnostic Connector (in cab)



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 9-Way Diagnostic Connector (Black) - OEM Specific CD (in cab)
4. 9-way Diagnostic Connector (Green) - OEM Specific CD (in cab)



## Fault Code 39 Troubleshooting

**A** **Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

**Note:** Fault Code 39 indicates an issue with communication over the J1939 data link between the SCM and the Transmission TECU. All wiring and pin outs for connectors are OEM proprietary. Refer to OEM guidelines for proper documentation.

- If Fault Code 39 is Active, go to **Step C.**
- If Fault Code 39 is Inactive, and there are other Active fault codes, troubleshoot all other Active fault codes first per *Fault Code Isolation Procedure Index* on page 14.
- If Fault Code 39 is Inactive, and there are no other Active fault codes, go to **Step B.**

**B** **Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when there are Active fault codes.



3. Wiggle J1939 Data Link wiring and Vehicle Harness wiring throughout the vehicle. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.

4. Exit PD Mode by powering down.

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If Fault Code 35 or Fault Code 39 became Active while wiggling the J1939 Data Link or the Vehicle Harness, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**
- If no fault codes became Active, go to **Step C.**

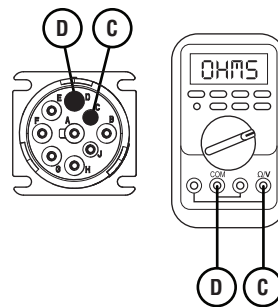
**C** **Purpose:** Verify TECU location on the vehicle J1939 Data Link.

1. Key off.
2. Refer to the OEM and identify the TECU location on the vehicle J1939 Data Link at the 9-Way Diagnostic Connector.
  - If Black 9-Way Diagnostic Connector, go to **Step D.**
  - If Green 9-Way Diagnostic Connector on Pin C and Pin D, go to **Step D.**

**D** **Purpose:** Verify proper resistance exists on the J1939 Data Link.

1. Key off.
 

**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Measure resistance between 9-Way Diagnostic Connector Pin C and Pin D. Record reading(s) in table.

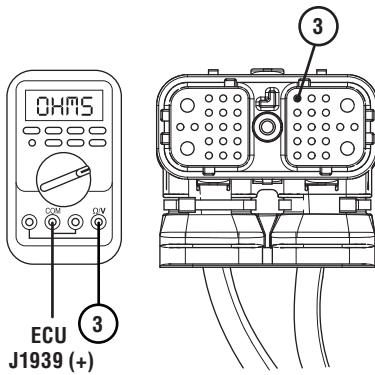


3. Compare reading(s) in table.
  - If readings are in range, go to **Step E.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of terminating resistors, ECUs or J1939 data link wiring. Go to **Step V.**

Pins	Range	Reading(s)
C to D	50–70 ohms	

**E** **Purpose:** Verify connection across J1939 Positive Pin (+) between SCM and the TECU.

1. Key off.  
**Note:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Disconnect 38-Way Vehicle Harness Connector from TECU. Inspect connector for loose terminals, corrosion, and bent or spread pins.
3. Disconnect SCM Harness Connector from SCM. Inspect connector for loose terminals, corrosion, and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 3 and J1939 Positive Pin (+) on SCM Connector. Record reading(s) in table.



**Note:** Refer to OEM guidelines for location of SCM J1939 Positive Pin (+).

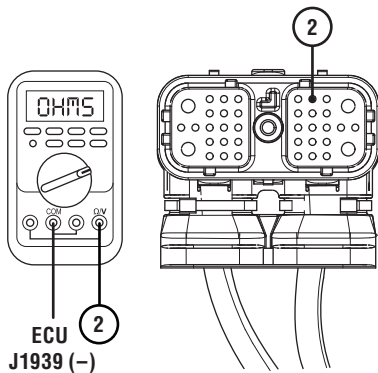
5. Compare reading(s) in table.
  - If readings are in range, go to **Step F.**
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**

Pins	Range	Reading(s)
3 to SCM J1939 Positive (+)	0.0–0.3 ohms	

**F**

**Purpose:** Verify connection across J1939 Negative Pin (-) between SCM and the TECU.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 2 and J1939 Negative Pin (-) on SCM Connector. Record reading(s) in table.



**Note:** Refer to OEM guidelines for location of SCM J1939 Negative Pin (-).

3. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.
  - If readings are in range, an intermittent wiring issue exists within the J1939 Data Link, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V**.

Pins	Range	Reading(s)
2 to SCM J1939 Negative (-)	0.0–0.3 ohms	

**V**

**Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 39 sets Active during the test drive, go to **Step A**.
  - If a fault code other than 39 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 40: EV Motor Direction

**J1939: SA 3      SPN 767      FMI 7**

### Overview

The Medium Duty 4-Speed EV Transmission Electronic Control Unit (TECU) monitors directional rotation of the Motor and Input Shaft and compares this to the requested transmission mode.

Fault Code 40 indicates the TECU has detected a directional mismatch between the Motor and the requested transmission mode.

### Detection

TECU compares directional rotation of the Motor to the transmission requested mode. If there is a mismatch in the values, Fault Code 40 sets Active.

### Conditions to Set Fault Code Active

**FMI 7 - Mechanical System Not Responding:** TECU compares directional rotation of the Motor to the transmission requested mode. If the value does not match the transmission requested mode for more than 0.5 seconds, the fault sets Active.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Motor may not operate.
- Transmission may not engage a gear from neutral.
- Transmission does not shift while vehicle is moving.
- Until fault becomes Inactive, driver may have to shut off motor with transmission in gear.

### Conditions to Set Fault Code Inactive

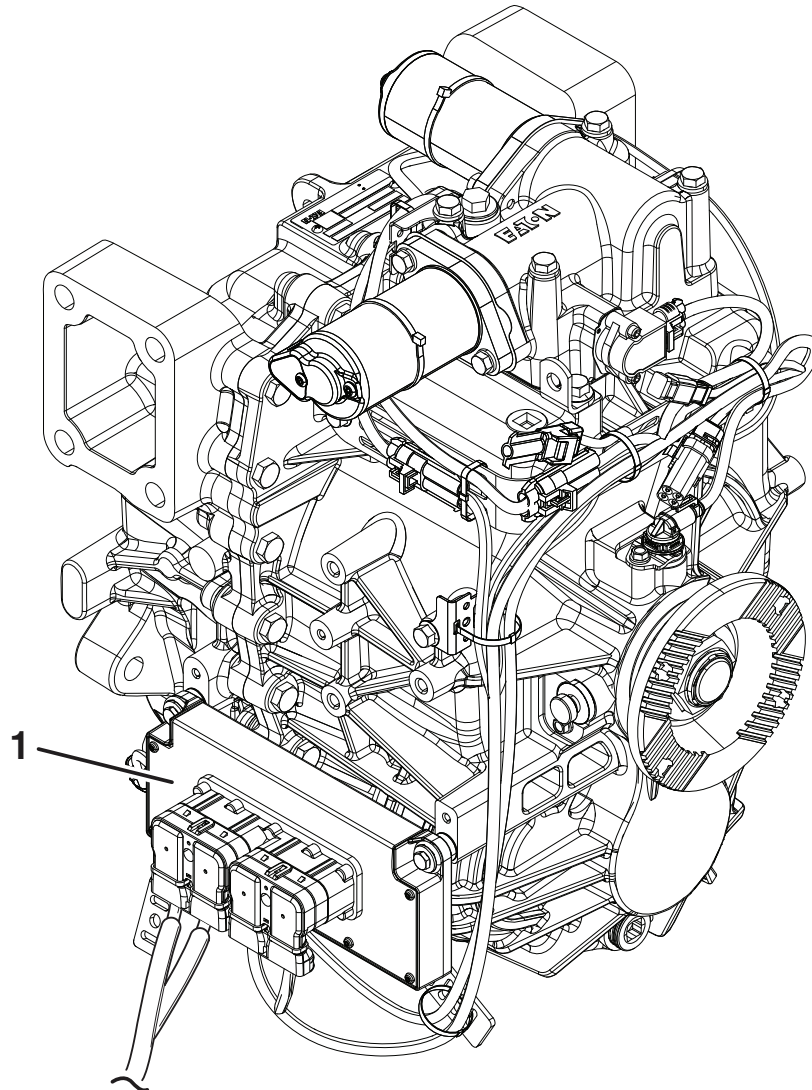
**All FMIs:** Directional rotation of the Motor matches transmission requested mode for greater than 1 second or Neutral mode is selected and achieved.

### Possible Causes

#### FMI 7:

- OEM/Vehicle Faults Preventing the Transmission from Selecting Modes
- TECU
  - Transmission Configuration Value

## Component Identification



1. Transmission Electronic Control Unit (TECU)

## Fault Code 40 Troubleshooting

**A**

**Purpose:** Check for Active or Inactive fault codes.

1. Record the transmission and OEM/Vehicle fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If other transmission and/or OEM/Vehicle Fault Codes are Active or Inactive, resolve all other Fault Codes. Go to **Step V.**
    - If no other Fault Codes are present, go to **Step B.**
- 

**B**

**Purpose:** Verify OEM Configuration Setting.

1. Key on.
  2. Connect ServiceRanger.
  3. Go To Configuration.
  4. Select Vehicle.
  5. Record OEM Configuration Current Value.
    - If the Current Value does not match the OEM of the vehicle, from the "New Value" drop down select the appropriate OEM value and follow on-screen prompts. Go to **Step V.**
    - If the Current Value matches the OEM of the vehicle, test complete. Go to **Step V.**
-

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 40 sets Active during the test drive, go to **Step A**.
    - If a fault code other than 40 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 51: Rail Position Sensor

**J1939: SA 3      SPN 60      FMI 2, 3, 4, 10**

### Overview

The Medium Duty 4-Speed EV Transmission X-Y Shifter is equipped with a Rail Position Sensor. The X-Y Rail Position Sensor reports lateral movement of the Shift Finger to the Transmission Electronic Control Unit (TECU) as a voltage signal. The X-Y Rail Position Sensor is connected to the TECU via the Transmission Harness.

The TECU performs continuous diagnostics on the circuit to detect a shorted circuit, open circuit or incorrect position reading. Fault Code 51 is set when the TECU has detected either an electrical failure of the X-Y Rail Position Sensor circuit or a mechanical failure within the X-Y Shifter.

### Detection

The TECU monitors both the 5-volt X-Y Rail Position Sensor supply and the return voltage signal from the X-Y Rail Position Sensor. If the system detects that either the supply voltage or return voltage is out of range, the fault code is set Active.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU detects the X-Y Rail Position Sensor return voltage signal is outside of the 0.5–4.5-volt range for 1 second or longer.

**FMI 3 – Voltage Above Normal or Shorted High:** TECU detects the X-Y Rail Position Sensor supply voltage has exceeded 5.25 volts for 1 second or longer.

**FMI 4 – Voltage Below Normal or Shorted Low:** TECU detects the X-Y Rail Position Sensor supply voltage is below 4.75 volts for 1 second or longer.

**FMI 10 – Abnormal Rate of Change:** The reported X-Y Rail Position Sensor return voltage signal changed by more than  $\pm 0.2$  volts, or finger position moved by more than  $\pm 0.093$  inches, while the transmission is engaged in gear.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Transmission remains in current gear.
- Until the fault becomes Inactive, driver may have to shut off motor with transmission in gear.

### Conditions to Set Fault Code Inactive

**FMI 2:** X-Y Rail Position Sensor return voltage signal stays within the 0.5–4.5-volt range for 1 second.

**FMI 3, 4:** Supply voltage stays within the 4.75–5.25 volt range for 1 second.

**FMI 10:** X-Y Rail Position Sensor return voltage signal remains consistent (within  $\pm 0.2$  volts) while the transmission is in gear.

### Possible Causes

#### FMI 2, 4, 10

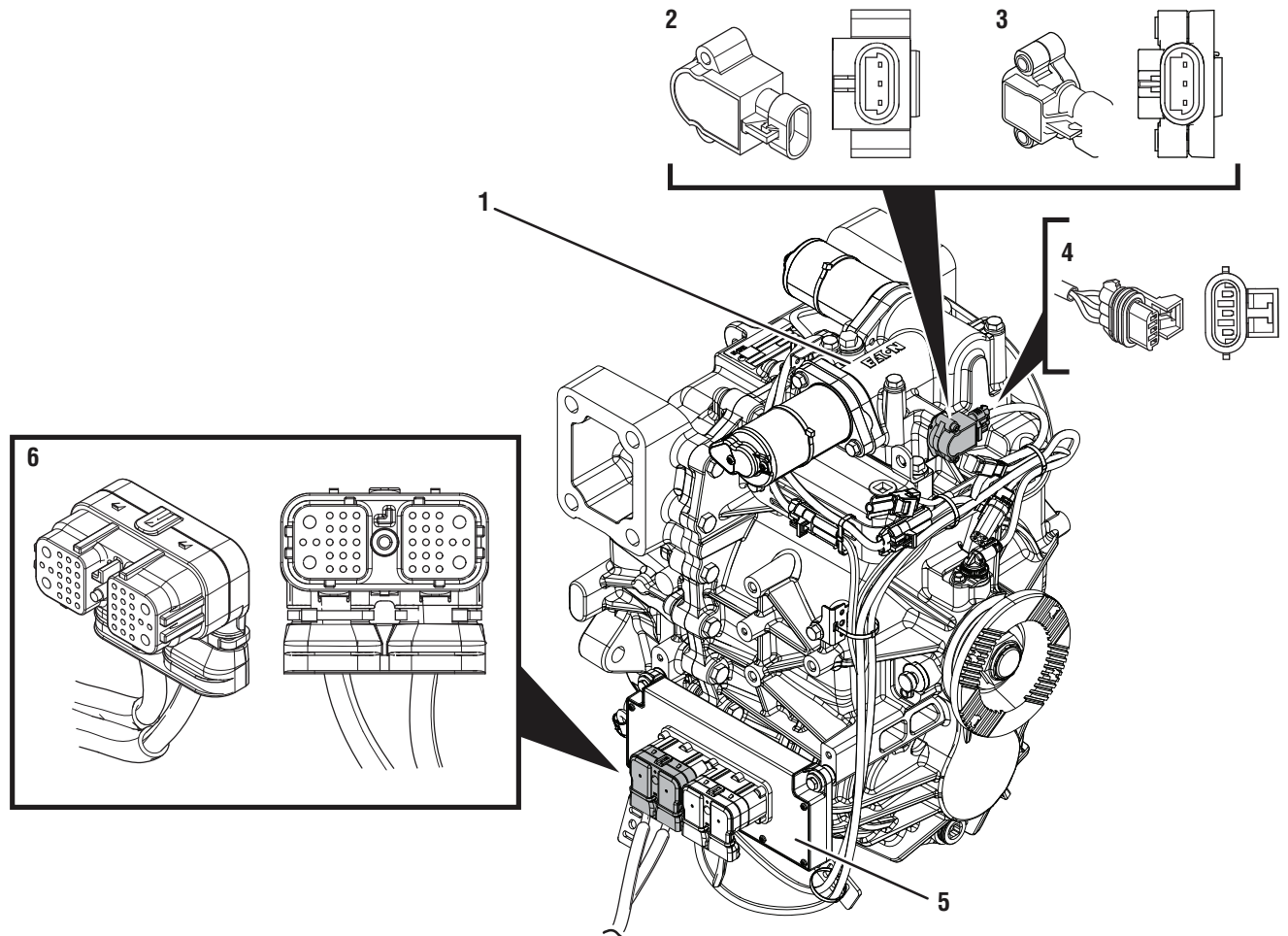
- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- X-Y Shifter
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Rail Position Sensor damaged

- TECU
  - Internal failure

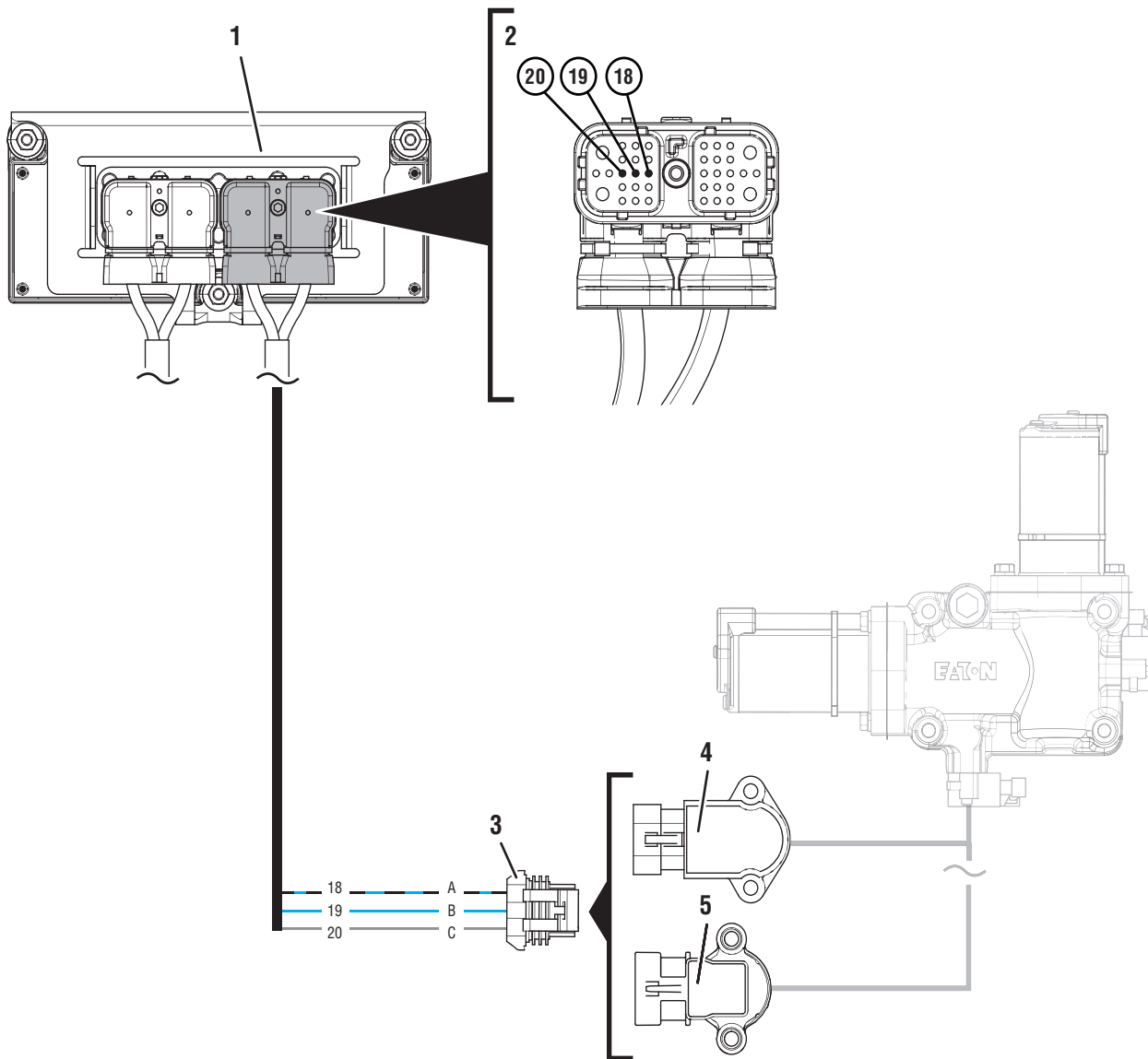
#### FMI 3

- TECU
  - Internal failure
- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to power

## Component Identification



1. X-Y Shifter
2. 3-Way Rail Position Sensor (A)
3. 3-Way Rail Position Sensor (B)
4. 3-Way Rail Position Sensor Connector
5. 38-Way Transmission Harness Connector
6. Transmission Electronic Control Unit (TECU)



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 3-Way Rail Position Sensor Connector
4. 3-Way Rail Position Sensor (A)
5. 3-Way Rail Position Sensor (B)



## Fault Code 51 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 51 FMI 3, 4, 10 is Active, go to **Step C.**
  - If Fault Code 51 FMI 3, 4, 10 is Inactive, go to **Step B.**
  - If Fault Code 51 FMI 2 is Active or Inactive, go to **Step D.**

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



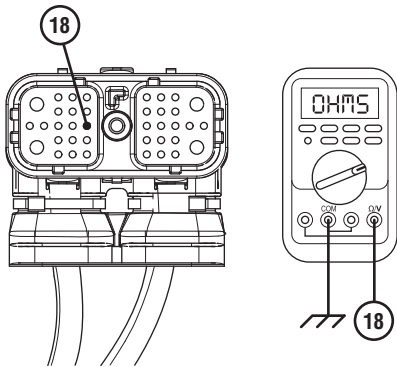
3. Wiggle wiring and connections of the Transmission Harness between the Rail Position Sensor and the TECU.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault codes set Active while wiggling the Transmission Harness, replace **Transmission Harness**. Go to **Step V.**
- If no fault codes set Active while wiggling the Transmission Harness, go to **Step C.**

**C** **Purpose:** Check for short to ground in Rail Position circuit.

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 38-Way Transmission Harness Connector Pin 18 and ground. Record reading(s) in table.



5. Compare reading(s) in table.
  - If connector is damaged, replace **Transmission Harness**. Go to **Step V**.
  - If readings are in range, go to **Step E**.
  - If readings are out of range, replace **Transmission Harness**. Go to **Step V**.

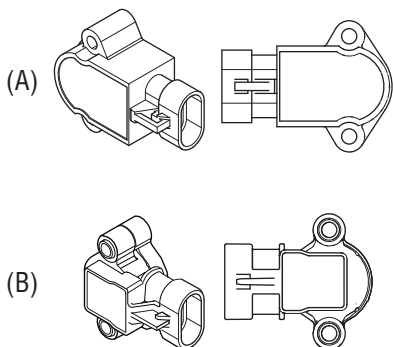
Pins	Range	Reading(s)
18 to Ground	Open Circuit (OL)	

**D** **Purpose:** Verify the condition of the 38-Way Transmission Harness Connector.

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TECU side of the 38-Way Transmission Harness Connector for contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
  - If no contamination or damage is found, Go to **Step E**.
  - If contamination or damage is found, replace the **Transmission Harness**. Go to **Step V**.

**E** *Purpose: Identify 3-Way Rail Position Sensor installed on transmission.*

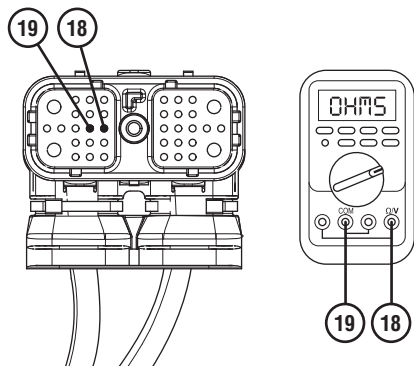
1. Inspect 3-Way Rail Position Sensor, reference image below.



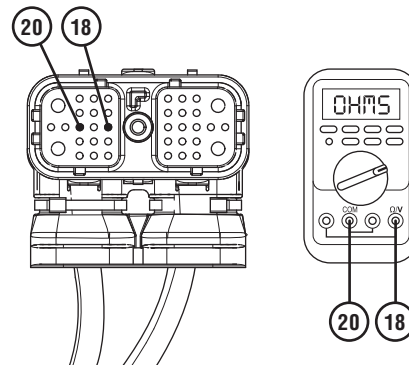
- If equipped with a 3-Way Rail Position Sensor (A), go to **Step F.**
- If equipped with a 3-Way Rail Position Sensor (B), go to **Step J.**

**F** *Purpose: Verify the proper resistance of the Rail Position Sensor circuit.*

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 18 and Pin 19. Record reading(s) in table.



3. Measure resistance between 38-Way Transmission Harness Connector Pin 18 and Pin 20. Record reading(s) in table.



4. Compare reading(s) in table.
  - If all readings are in range, go to **Step G.**
  - If either reading is out of range, go to **Step H.**

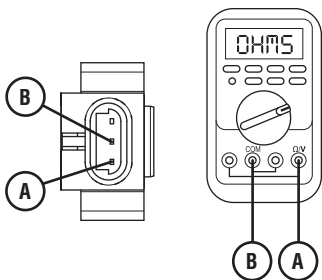
Pins	Range	Reading(s)
18 to 19	150 – 200 ohms	
18 to 20	5.5k – 6.5k ohms	

**G** *Purpose: Verify which FMI set.*

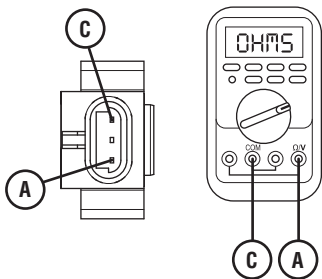
1. Determine which FMI set for Fault Code 51.
  - If FMI 2 or 10 set, replace **Transmission Harness.** Go to **Step V.**
  - If FMI 3 or 4 set, replace **Transmission Electronic Control Unit (TECU)** and **Transmission Harness.** Go to **Step V.**

**H** **Purpose:** Measure the resistance of the Rail Position Sensor (A).

1. Key off.
2. Disconnect 3-Way Transmission Harness Connector from 3-Way Rail Position Sensor (A).
3. Inspect 3-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 3-Way Rail Position Sensor (A) Body Pin A and Pin B. Record reading(s) in table.



5. Measure resistance between 3-Way Rail Position Sensor (A) Body Pin A and Pin C. Record reading(s) in table.



6. Compare reading(s) in table.
  - If the connector is damaged, replace **Transmission Harness**. Go to **Step V**.
  - If all readings are in range, go to **Step I**.
  - If either reading is out of range, replace **X-Y Shift Actuator**. Go to **Step V**.

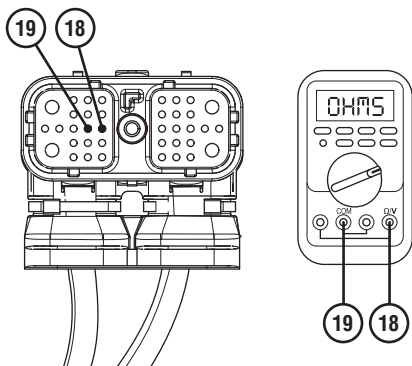
Pins	Range	Reading(s)
A to B	150 – 200 ohms	
A to C	5.5k – 6.5k ohms	

**I** **Purpose:** Verify which FMI set.

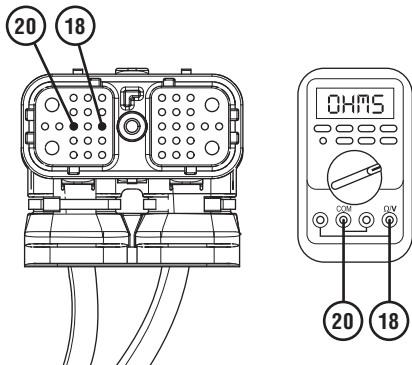
1. Determine which FMI set for Fault Code 51.
  - If FMI 2 or 10 set, replace **Transmission Harness**. Go to **Step V**.
  - If FMI 3 or 4 set, replace **Transmission Electronic Control Unit (TECU)** and **Transmission Harness**. Go to **Step V**.

**J** **Purpose:** Verify the proper resistance of the Rail Position Sensor circuit.

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 18 and Pin 19. Record reading(s) in table.



3. Measure resistance between 38-Way Transmission Harness Connector Pin 18 and Pin 20. Record reading(s) in table.



4. Compare reading(s) in table.
  - If all readings are in range, go to **Step K**.
  - If either reading is out of range, go to **Step L**.

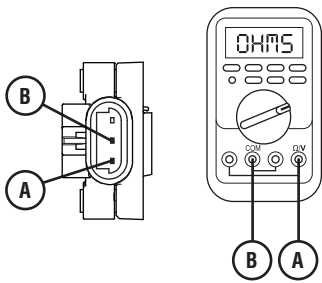
Pins	Range	Reading(s)
18 to 19	150 – 200 ohms	
18 to 20	180 – 230 ohms	

**K** **Purpose:** Verify which FMI set.

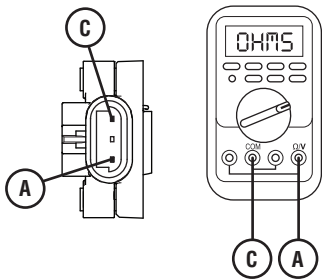
1. Determine which FMI set for Fault Code 51.
  - If FMI 2 or 10 set, replace **Transmission Harness**. Go to **Step V**.
  - If FMI 3 or 4 set, replace **Transmission Electronic Control Unit (TECU)** and **Transmission Harness**. Go to **Step V**.

**L** **Purpose:** Measure the resistance of the Rail Position Sensor (B).

1. Key off.
2. Disconnect 3-Way Transmission Harness Connector from 3-Way Rail Position Sensor (B).
3. Inspect 3-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 3-Way Rail Position Sensor (B) Body Pin A and Pin B. Record reading(s) in table.



5. Measure resistance between 3-Way Rail Position Sensor (B) Body Pin A and Pin C. Record reading(s) in table.



6. Compare reading(s) in table.
  - If the connector is damaged, replace **Transmission Harness**. Go to **Step V**.
  - If all readings are in range, go to **Step M**.
  - If either reading is out of range, replace **X-Y Shift Actuator**. Go to **Step V**.

Pins	Range	Reading(s)
A to B	150 – 200 ohms	
A to C	180 – 230 ohms	

**M** **Purpose:** Verify which FMI set.

1. Determine which FMI set for Fault Code 51.
  - If FMI 2 or 10 set, replace **Transmission Harness**. Go to **Step V**.
  - If FMI 3 or 4 set, replace **Transmission Electronic Control Unit (TECU)** and **Transmission Harness**. Go to **Step V**.

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and the vehicle operates properly, test complete.
    - If Fault Code 51 sets Active during the test drive, go to **Step A**.
    - If a fault code other than 51 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 52: Gear Position Sensor

**J1939: SA 3      SPN 59      FMI 2, 3, 4, 7, 10**

### Overview

The Medium Duty 4-Speed EV Transmission X-Y Shifter is equipped with a Gear Position Sensor. The X-Y Gear Position Sensor reports fore-and-aft movement of the Shift Finger to the Transmission Electronic Control Unit (TECU) as a voltage signal. The X-Y Gear Position Sensor is connected to the TECU via the Transmission Harness.

The TECU performs continuous diagnostics on the circuit to detect a shorted circuit, open circuit or incorrect position reading. Fault Code 52 is set when TECU has detected either an electrical failure of the X-Y Gear Position Sensor circuit or a mechanical failure within the X-Y Shifter.

### Detection

The TECU monitors both the 5-volt X-Y Gear Position Sensor supply and the return voltage signal from the X-Y Gear Position Sensor. If the system detects that either the supply voltage or return voltage is out of range, the fault code is set Active.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU detects the X-Y Gear Position Sensor return voltage signal is outside of the 0.5–4.5-volt range for 1 second or longer.

**FMI 3 – Voltage Above Normal or Shorted High:** TECU detects the X-Y Gear Position Sensor supply voltage has exceeded 5.25 volts for 1 second or longer.

**FMI 4 – Voltage Below Normal or Shorted Low:** TECU detects the X-Y Gear Position Sensor supply voltage is below 4.75 volts for 1 second or longer.

**FMI 7 – Mechanical System Not Responding:** The reported X-Y Gear Position Sensor return voltage signal is outside of the operating range physically allowed for 1 second or longer.

**FMI 10 – Abnormal Rate of Change:** The reported X-Y Gear Position Sensor return voltage signal changed by more than  $\pm 0.2$  volts, or finger position moved by more than  $\pm 0.093$  inches, while the transmission is engaged in gear.

### Fallback

#### All FMIs:

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Transmission remains in current gear.
- Until the fault becomes Inactive, driver may have to shut off motor with transmission in gear.

### Conditions to Set Fault Code Inactive

**FMI 2:** X-Y Gear Position Sensor return voltage signal stays within the 0.5–4.5-volt range for 1 second.

**FMI 3, 4:** Supply voltage stays within the 4.75–5.25-volt range for 1 second.

**FMI 7:** X-Y Gear Position Sensor return voltage signal returns within the physical operating range of the Shift Detent Block Assembly.

**FMI 10:** X-Y Gear Position Sensor return voltage signal remains consistent (within  $\pm 0.2$  volts) while the transmission is in gear.

### Possible Causes

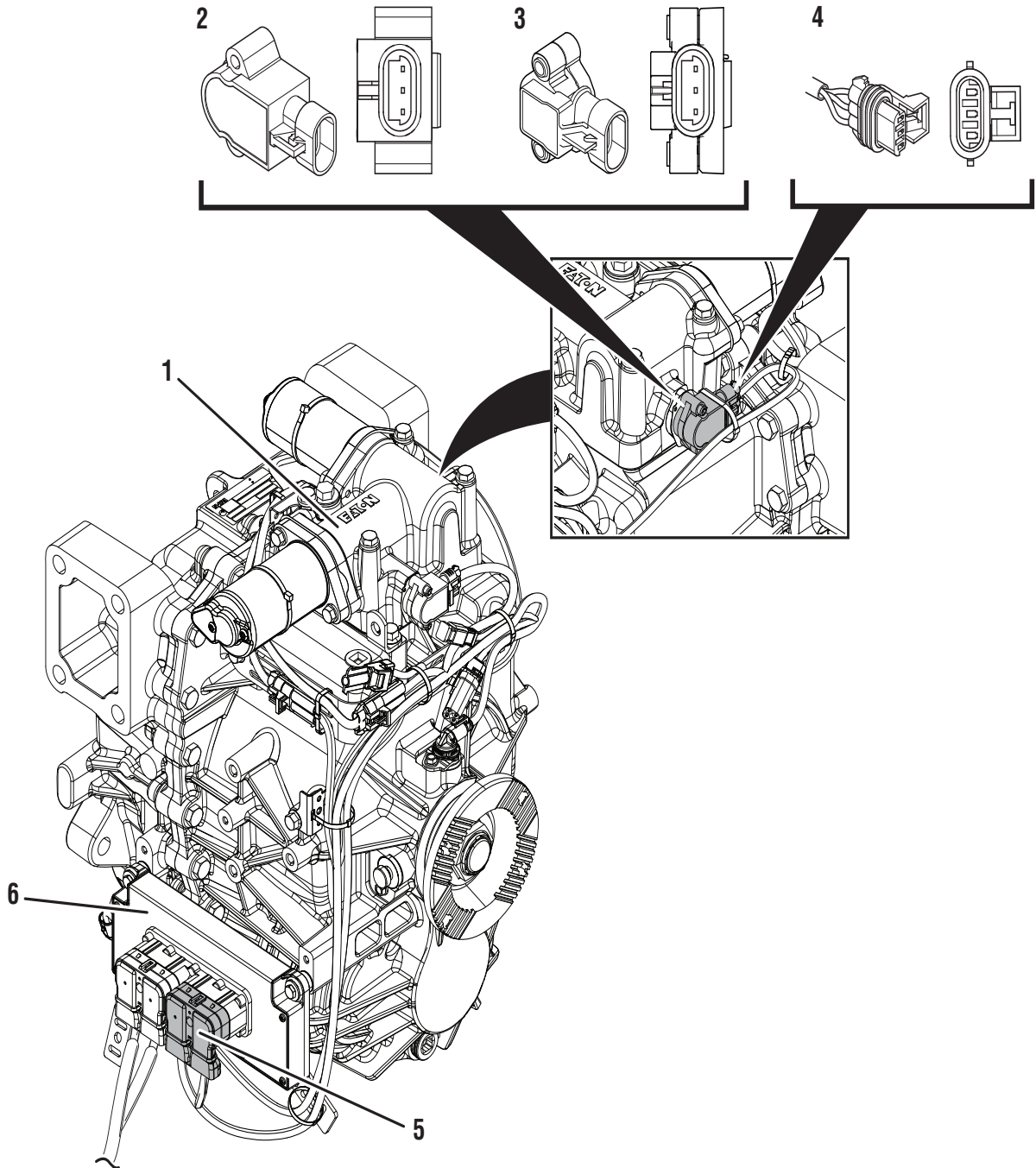
#### 2, 4, 7, 10:

- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- X-Y Shifter
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Gear Position Sensor damaged
- TECU
  - Internal failure

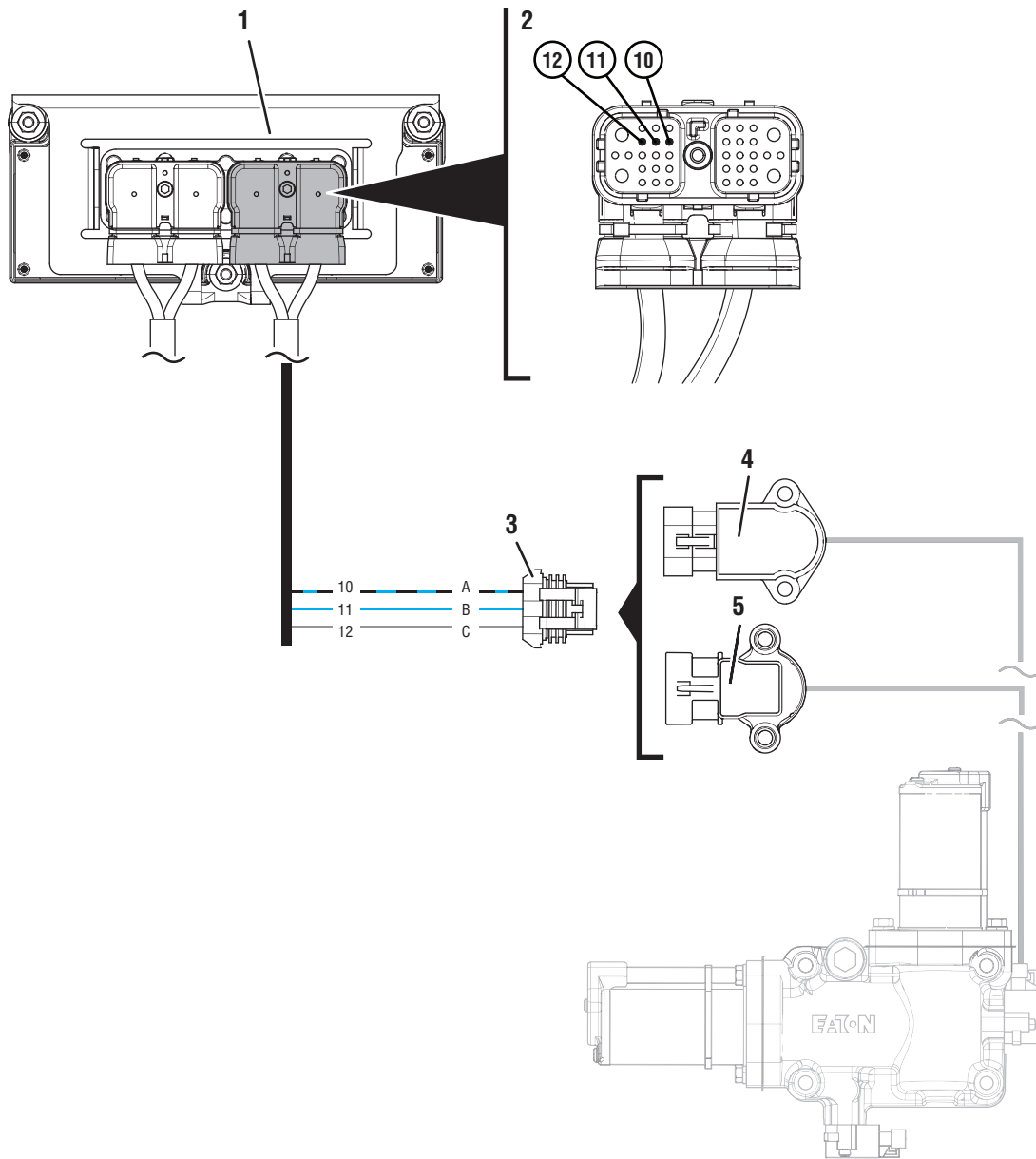
#### FMI 3:

- TECU
  - Internal failure
- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to power

### Component Identification



- 1. X-Y Shifter
- 2. 3-Way Gear Position Sensor (A)
- 3. 3-Way Gear Position Sensor (B)
- 4. 3-Way Gear Position Sensor Connector
- 5. Transmission Electronic Control Unit (TECU)
- 6. 38-Way Transmission Harness Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 3-Way Gear Position Sensor Connector
4. 3-Way Gear Position Sensor (A)
5. 3-Way Gear Position Sensor (B)



## Fault Code 52 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
  2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If Fault Code 52 FMI 3, 4, 7, 10 is Active, go to **Step C.**
    - If Fault Code 52 FMI 3, 4, 7, 10 is Inactive, go to **Step B.**
    - If Fault Code 52 FMI 2 is Active or Inactive, go to **Step I.**
- 

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



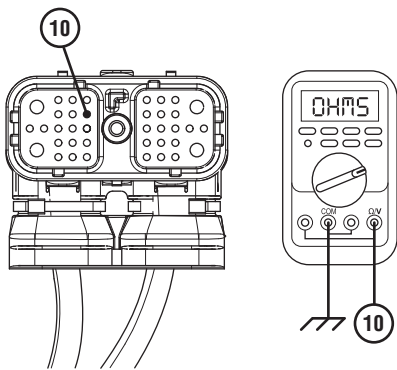
3. Wiggle wiring and connections of the Transmission Harness between the Gear Position Sensor and the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault codes set Active while wiggling the Transmission Harness, replace **Transmission Harness.** Go to **Step V.**
  - If no fault codes set Active while wiggling the Transmission Harness, go to **Step C.**
-

**C** *Purpose: Check for short to ground in Gear Position circuit.*

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 38-Way Transmission Harness Connector Pin 10 and ground. Record reading(s) in table.



5. Compare reading(s) in table.
  - If connector is damaged, replace **Transmission Harness**. Go to **Step V**.
  - If readings are in range, go to **Step E**.
  - If readings are out of range, replace **Transmission Harness**. Go to **Step V**.

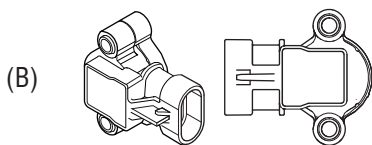
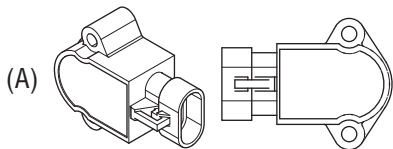
Pins	Range	Reading(s)
10 to Ground	Open Circuit (OL)	

**D** *Purpose: Verify the condition of the 38-Way Transmission Harness Connector.*

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TECU side of the 38-Way Transmission Harness Connector for contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
  - If no contamination or damage is found, go to **Step E**.
  - If contamination or damage is found, replace the **Transmission Harness**. Go to **Step V**.

**E** **Purpose:** Identify 3-Way Gear Position Sensor installed on transmission.

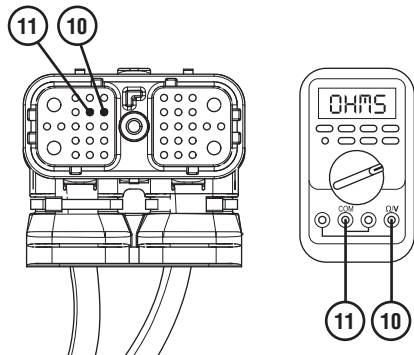
1. Inspect 3-Way Gear Position Sensor, reference image below.



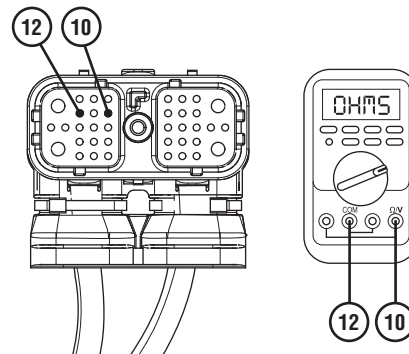
- If equipped with a 3-Way Gear Position Sensor (A), go to **Step F**.
- If equipped with a 3-Way Gear Position Sensor (B), go to **Step J**.

**F** **Purpose:** Verify the proper resistance of the Gear Position Sensor circuit.

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 10 and Pin 11. Record reading(s) in table.



3. Measure resistance between 38-Way Transmission Harness Connector Pin 10 and Pin 12. Record reading(s) in table.



4. Compare reading(s) in table.
  - If all readings are in range, go to **Step G**.
  - If either reading is out of range, go to **Step H**.

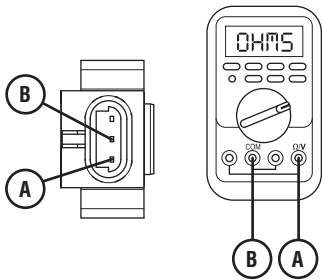
Pins	Range	Reading(s)
10 to 11	150 – 200 ohms	
10 to 12	5.5k – 6.5k ohms	

**G** **Purpose:** Verify which FMI set.

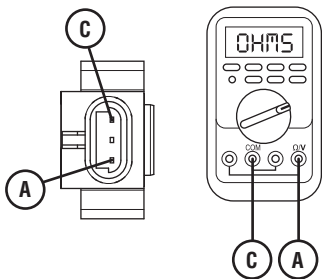
1. Determine which FMI set for Fault Code 52.
  - If FMI 2, 7 or 10 set, replace **Transmission Harness**. Go to **Step V**.
  - If FMI 3 or 4 set, replace **Transmission Electronic Control Unit (TECU)** and **Transmission Harness**. Go to **Step V**.

**H** **Purpose:** Measure the resistance of the Gear Position Sensor.

1. Key off.
2. Disconnect 3-Way Transmission Harness Connector from the 3-Way Gear Position Sensor.
3. Inspect 3-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 3-Way Gear Position Sensor Body Pin A and Pin B. Record reading(s) in table.



5. Measure resistance between 3-Way Gear Position Sensor Body Pin A and Pin C. Record reading(s) in table.



6. Compare reading(s) in table.

- If the connector is damaged, replace **Transmission Harness**. Go to **Step V**.
- If all readings are in range, go to **Step I**.
- If either reading is out of range, replace the **X-Y Shift Actuator**. Go to **Step V**.

Pins	Range	Reading(s)
A to B	150 – 200 ohms	
A to C	5.5k – 6.5k ohms	

**I** *Purpose: Verify which FMI set.*

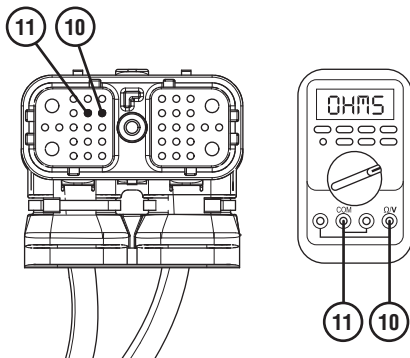
- Determine which FMI set for Fault Code 52.
  - If FMI 2, 7, or 10 set, replace **Transmission Harness**. Go to **Step V**.
  - If FMI 3 or 4 set, replace **Transmission Electronic Control Unit (TECU)** and **Transmission Harness**. Go to **Step V**.

- Compare reading(s) in table.
  - If all readings are in range, go to **Step K**.
  - If either reading is out of range, go to **Step L**.

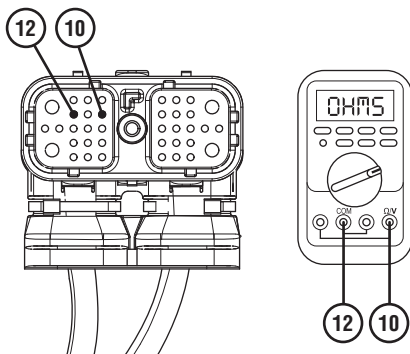
Pins	Range	Reading(s)
10 to 11	150 – 200 ohms	
10 to 12	180 – 230 ohms	

**J** *Purpose: Verify the proper resistance of the Gear Position Sensor circuit.*

- Key off.
- Measure resistance between 38-Way Transmission Harness Connector Pin 10 and Pin 11. Record reading(s) in table.



- Measure resistance between 38-Way Transmission Harness Connector Pin 10 and Pin 12. Record reading(s) in table.

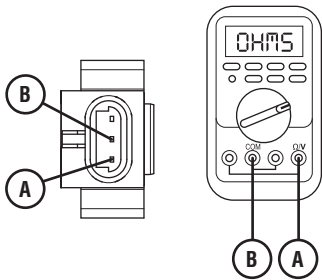


**K** *Purpose: Verify which FMI set.*

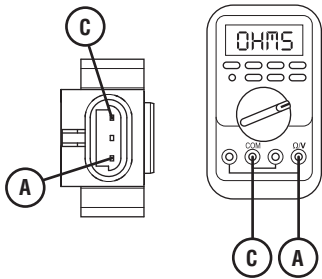
- Determine which FMI set for Fault Code 52.
  - If FMI 2, 7, or 10 set, replace **Transmission Harness**. Go to **Step V**.
  - If FMI 3 or 4 set, replace **Transmission Electronic Control Unit (TECU)** and **Transmission Harness**. Go to **Step V**.

**L** **Purpose:** Measure the resistance of the Gear Position Sensor.

1. Key off.
2. Disconnect 3-Way Transmission Harness Connector from the 3-Way Gear Position Sensor.
3. Inspect 3-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 3-Way Gear Position Sensor Body Pin A and Pin B. Record reading(s) in table.



5. Measure resistance between 3-Way Gear Position Sensor Body Pin A and Pin C. Record reading(s) in table.



6. Compare reading(s) in table.
  - If the connector is damaged, replace **Transmission Harness**. Go to **Step V**.
  - If all readings are in range, go to **Step M**.
  - If either reading is out of range, replace the **X-Y Shift Actuator**. Go to **Step V**.

Pins	Range	Reading(s)
A to B	150 – 200 ohms	
A to C	180 – 230 ohms	

**M** **Purpose:** Verify which FMI set.

1. Determine which FMI set for Fault Code 52.
  - If FMI 2, 7 or 10 set, replace **Transmission Harness**. Go to **Step V**.
  - If FMI 3 or 4 set, replace **Transmission Electronic Control Unit (TECU)** and **Transmission Harness**. Go to **Step V**.

**V****Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 52 sets Active during the test drive, go to **Step A**.
  - If a fault code other than 52 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 56: Input Shaft Speed Sensor

**J1939 SA 3****SPN 161****FMI 2, 3, 4, 5, 10**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with electronic speed sensors. The Input Shaft and Output Shaft Speed Sensors are used to calculate gear ratios within the transmission. The Input Shaft Speed Sensor measures the rotational speed of the Input Shaft, taken from the countershaft drive gear.

The Input Shaft Speed Sensor transmits a voltage signal to the TECU based on the rotational speed of the Input Shaft entering the transmission. The TECU compares Input Shaft Speed to Output Shaft Speed to confirm the overall transmission gear ratio.

Fault Code 56 indicates an electrical fault within the Input Shaft Speed Sensor circuit or a speed value that is inconsistent with the calculated gear ratios.

### Detection

The TECU monitors the Input Shaft Speed Sensor signal and compares the sensor readings with the Output Shaft Speed Sensor to determine sensor validity. The TECU also monitors the Input Shaft Speed Sensor electrical circuit for any shorts to power, ground or open circuits.

### Conditions to Set Fault Code Active

The system can detect Input Shaft Speed Sensor faults when one of the following conditions is present for 1 second or longer:

**FMI 2 – Data Erratic:** TECU detects data being reported from the Input Shaft Speed Sensor does not match the current gear ratio in comparison with other sensors.

**FMI 3 – Voltage Above Normal or Shorted High:** TECU detects a short to power in the circuit.

**FMI 4 – Voltage Below Normal or Shorted Low:** TECU detects a short to ground in the circuit.

**FMI 5 – Current Below Normal or Open Circuit:** TECU detects an open circuit or the Input Shaft Speed Sensor has high resistance.

**FMI 10 – Abnormal Rate of Change:** Input Shaft Speed changed faster than expected compared to other sensors.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Transmission will not engage a gear from neutral.
- Transmission may be limited to down shifts only.
- Transmission operates as normal until neutral gear selection is attained. Once in neutral, the transmission will not engage a start gear.

### Conditions to Set Fault Code Inactive

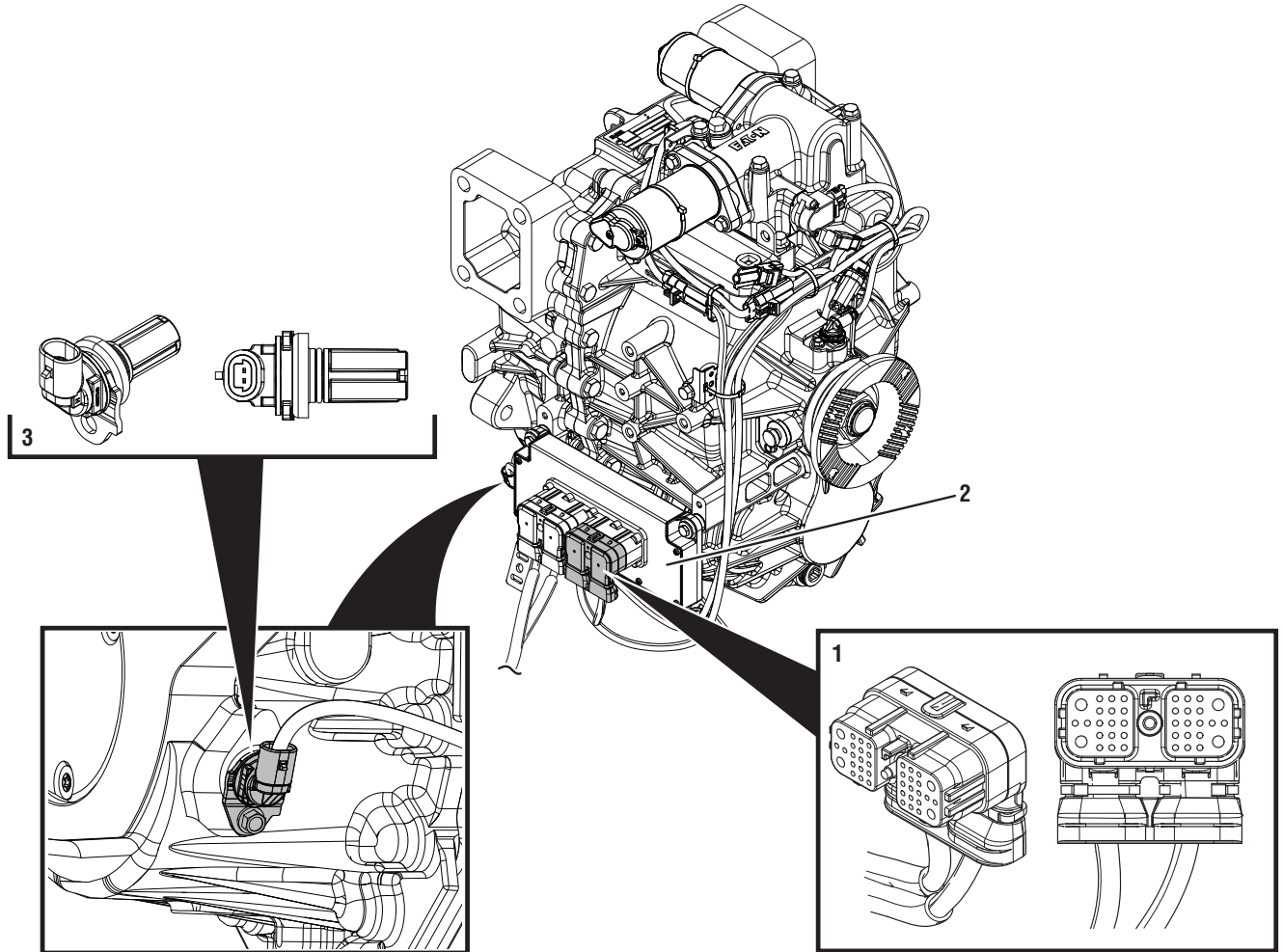
**All FMIs:** TECU receives a valid signal from the Input Shaft Speed Sensor and detects no electrical open or short circuits for 2 seconds.

### Possible Causes

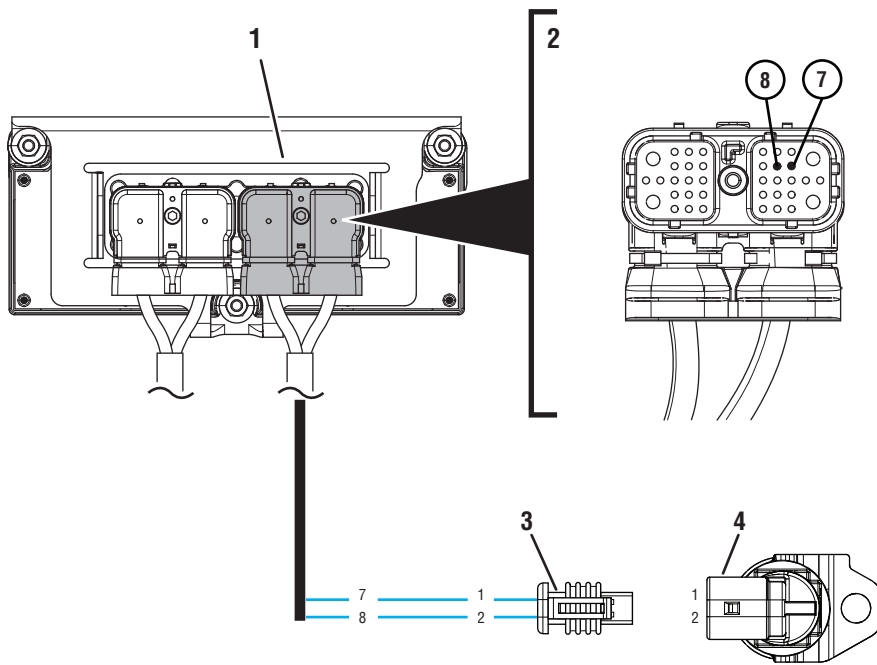
#### All FMIs

- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Input Shaft Speed Sensor
  - Internal failure
  - Physical damage
- Mechanical Transmission
  - Internal transmission wear or damage

## Component Identification



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 2-Way Input Shaft Speed Sensor



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 2-Way Input Shaft Speed Sensor Connector
4. 2-Way Input Shaft Speed Sensor



## Fault Code 56 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 56 is Active with FMI 3, 4, or 5, go to **Step C.**
  - If Fault Code 56 is Active or Inactive with FMI 2 or 10, go to **Step F.**
  - If Fault Code 56 is Inactive with FMI 3, 4, or 5, go to **Step B.**

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



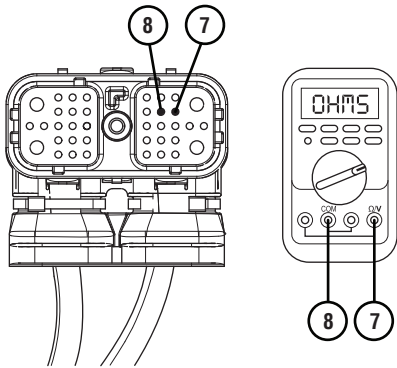
3. Wiggle wiring and connections of the Transmission Harness from the Input Shaft Speed Sensor to the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Verify Input Shaft Speed Sensor is properly installed and secured, not damaged or corroded within the Front Housing.
5. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault became Active while wiggling the Transmission Harness, replace **Transmission Harness**. Go to **Step V.**
- If any fault became Active while wiggling the Input Shaft Speed Sensor, replace **Input Shaft Speed Sensor**. Go to **Step V.**
- If no fault is found, replace **Transmission Harness** and **Input Shaft Speed Sensor**. Go to **Step V.**

**C** **Purpose:** Verify continuity of Input Shaft Speed Sensor circuit and no continuity to ground.

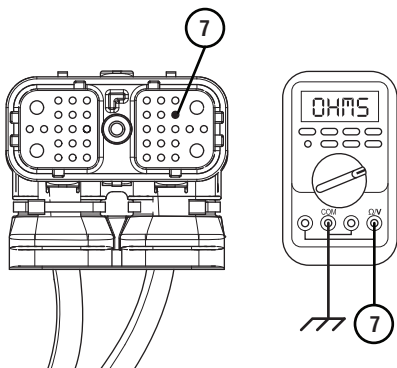
1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 38-Way Transmission Harness Connector Pin 7 and Pin 8. Record reading(s) in table.



6. After reading is taken, reconnect 38-Way Transmission Harness Connector at the TECU.
7. Compare reading(s) in table.
  - If readings are in range, go to **Step D**.
  - If readings are out of range, go to **Step E**.

Pins	Range	Reading(s)
7 to 8	2.0k–4.5k ohms	
7 to Ground	Open Circuit (OL)	

5. Measure resistance between 38-Way Transmission Harness Connector Pin 7 and ground. Record reading(s) in table.

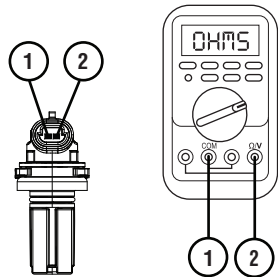


**D** **Purpose:** Verify fault code status.

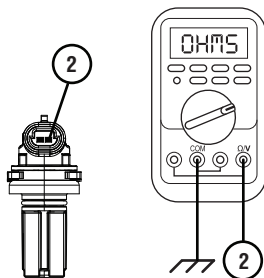
1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Connect ServiceRanger.
4. Key on with motor off.
5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
  - If Fault Code 56 is Inactive, replace **Transmission Harness** and **Input Shaft Speed Sensor**. Go to **Step V**.
  - If Fault Code 56 is Active, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.

**E** **Purpose:** Verify continuity across Input Shaft Speed Sensor and no continuity to ground.

1. Key off.
2. Disconnect the 2-Way Input Shaft Speed Sensor Connector.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals. Also, check sensor body for cracks or visual damage.
4. Measure resistance between 2-Way Input Shaft Speed Sensor Pin 1 and Pin 2 Record reading(s) in table.



5. Measure resistance between 2-Way Input Shaft Speed Sensor Pin 2 and ground. Record reading(s) in table.

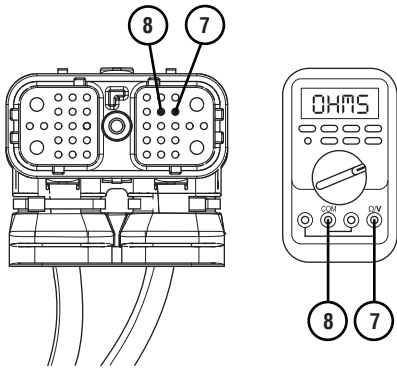


6. Reconnect 2-Way Input Shaft Speed Sensor to the Transmission Harness.
7. Compare reading(s) in table.
  - If readings are in range, replace **Transmission Harness**. Go to **Step V**.
  - If readings are out of range, replace **Input Shaft Speed Sensor**. Go to **Step V**.

Pins	Range	Reading(s)
1 to 2	2.0k–4.5k ohms	
2 to Ground	Open Circuit (OL)	

**F** *Purpose: Verify continuity of Input Shaft Speed Sensor circuit.*

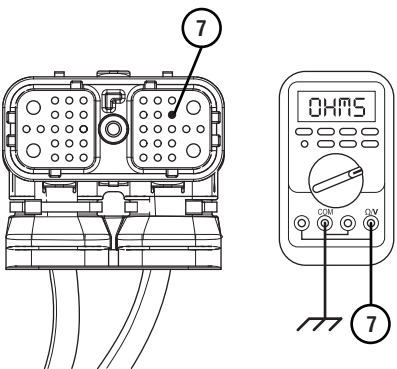
1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 38-Way Transmission Harness Connector Pin 7 and Pin 8. Record reading(s) in table.



6. After reading is taken, reconnect 38-Way Transmission Harness Connector at the TECU.
7. Compare reading(s) in table.
  - If readings are in range, go to **Step G.**
  - If readings are out of range, go to **Step H.**

Pins	Range	Reading(s)
7 to 8	2.0k–4.5k ohms	
7 to Ground	Open Circuit (OL)	

5. Measure resistance between 38-Way Transmission Harness Connector Pin 7 and ground. Record reading(s) in table.

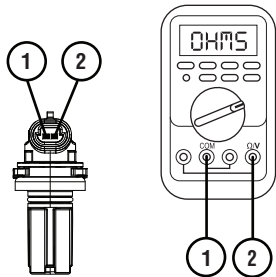


**G** *Purpose: Inspect Transmission for internal damage.*

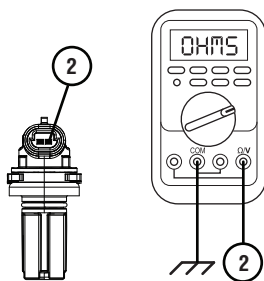
1. Key off.
2. Disconnect the 2-Way Input Shaft Speed Sensor Connector.
3. Drain transmission of lubricant into a clean pan for re-use. Note how much lubricant comes out and if significant metal fragments appear in the oil.
4. Remove the 2-Way Input Shaft Speed Sensor.
5. Inspect gearing through Input Shaft Speed Sensor mounting location for signs of damage.
  - If damage is found or there are significant metal fragments in the oil, replace damaged, worn or failed transmission components. Go to **Step V.**
  - If no damage is found, replace **Input Shaft Speed Sensor** and **Transmission Harness**. Go to **Step V.**

**H** **Purpose:** Verify continuity across Input Shaft Speed Sensor and no continuity to ground.

1. Key off.
2. Disconnect the 2-Way Input Shaft Speed Sensor Connector.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals. Also, check sensor body for cracks or visual damage.
4. Measure resistance between 2-Way Input Shaft Speed Sensor Pin A and Pin B. Record reading(s) in table.



5. Measure resistance between 2-Way Input Shaft Speed Sensor Pin A and ground. Record reading(s) in table.



6. Reconnect 2-Way Input Shaft Speed Sensor to the Transmission Harness.
7. Compare reading(s) in table.
  - If readings are in range, replace **Transmission Harness**. Go to **Step V**.
  - If readings are out of range, replace the **Input Shaft Speed Sensor**. Go to **Step V**.

Pins	Range	Reading(s)
1 to 2	2.0k–4.5k ohms	
2 to Ground	Open Circuit (OL)	

**V** **Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 56 sets Active during the test drive, contact Eaton at (800) 826-4357 for further diagnostics.
  - If a fault code other than 56 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 58: Output Shaft Speed Sensor

**J1939: SA 3      SPN 191      FMI 2, 3, 4, 5, 8, 10**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with electronic speed sensors. The Input Shaft and Output Shaft Speed Sensors are used to calculate gear ratios within the transmission. The Output Shaft Speed Sensor measures the rotational speed of the output shaft, taken from the Output Flange.

Fault Code 58 indicates an electrical fault within the Output Shaft Speed Sensor circuit or a speed value that is inconsistent with the calculated gear ratios

### Detection

The TECU compares the values of the two speed sensors to determine sensor validity. The TECU also monitors the Output Shaft Speed Sensor circuit for any shorts to power, shorts to ground or open circuits.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** TECU compares Output Shaft to Input Shaft speed and it produces an inconsistent reading for 1 second or greater.

**FMI 3 – Voltage Above Normal or Shorted High:** TECU detects a short to power in the circuit.

**FMI 4 – Voltage Below Normal or Shorted Low:** TECU detects a short to ground in the circuit.

**FMI 5 – Current Below Normal or Open Circuit:** TECU detects an open circuit or the Output Shaft Speed Sensor has high resistance.

**FMI 8 – Abnormal Frequency:** Output Shaft Speed direction does not match Input Shaft Speed direction.

**FMI 10 – Abnormal Rate of Change:** Output Shaft Speed changed faster than expected compared to other sensors.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Transmission may be limited to start gear only.

### Conditions to Set Fault Code Inactive

**All FMIs:** TECU receives a valid signal from the Output Shaft Speed Sensor and detects no electrical open or short circuits for 2 seconds.

### Possible Causes

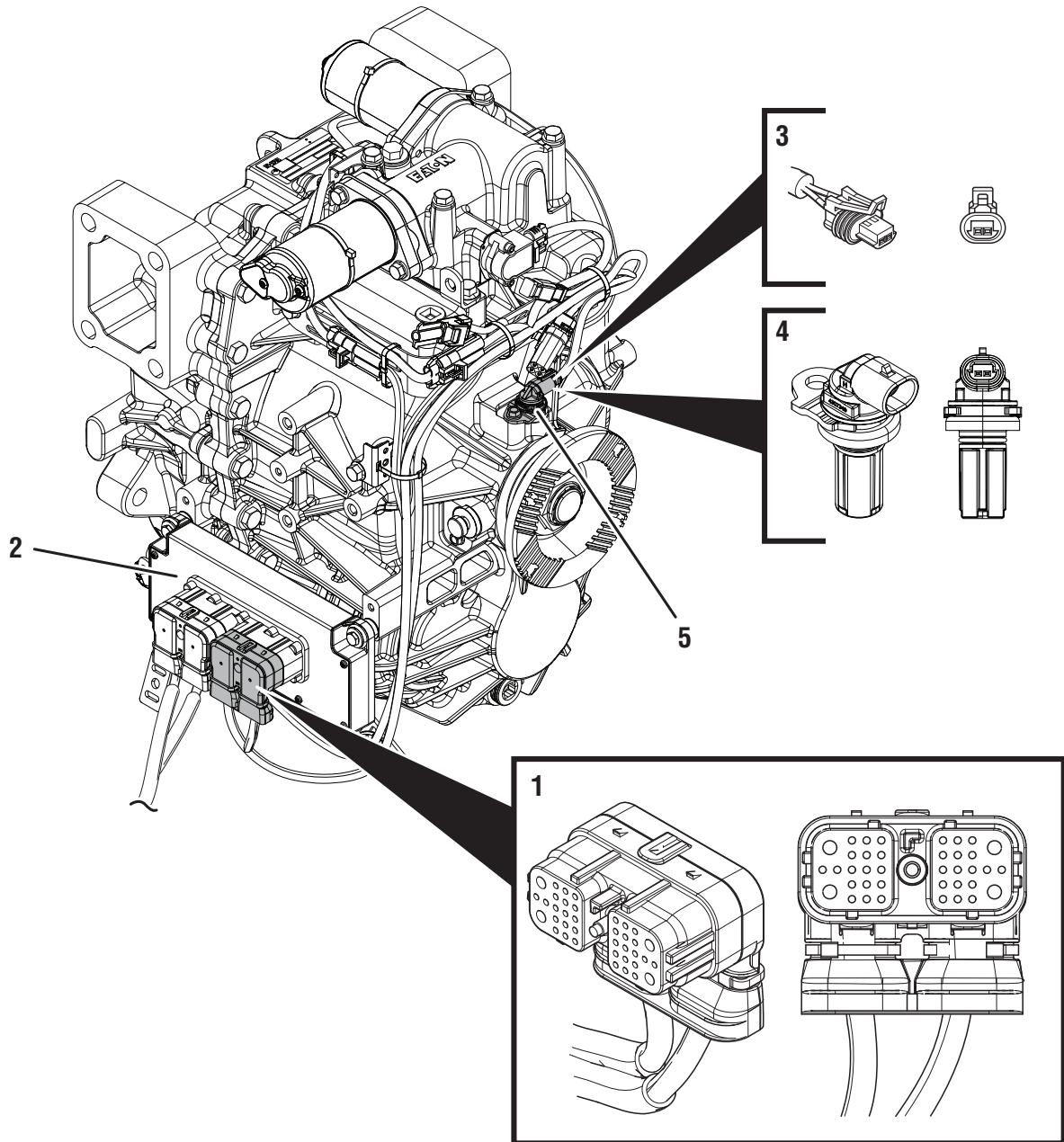
#### FMI 2, 8, 10

- Output Shaft Speed Sensor
  - Internal failure
  - Physical damage
- Mechanical Transmission
  - Internal failure in transmission
  - Damaged Output Flange
  - Debris on Output Flange

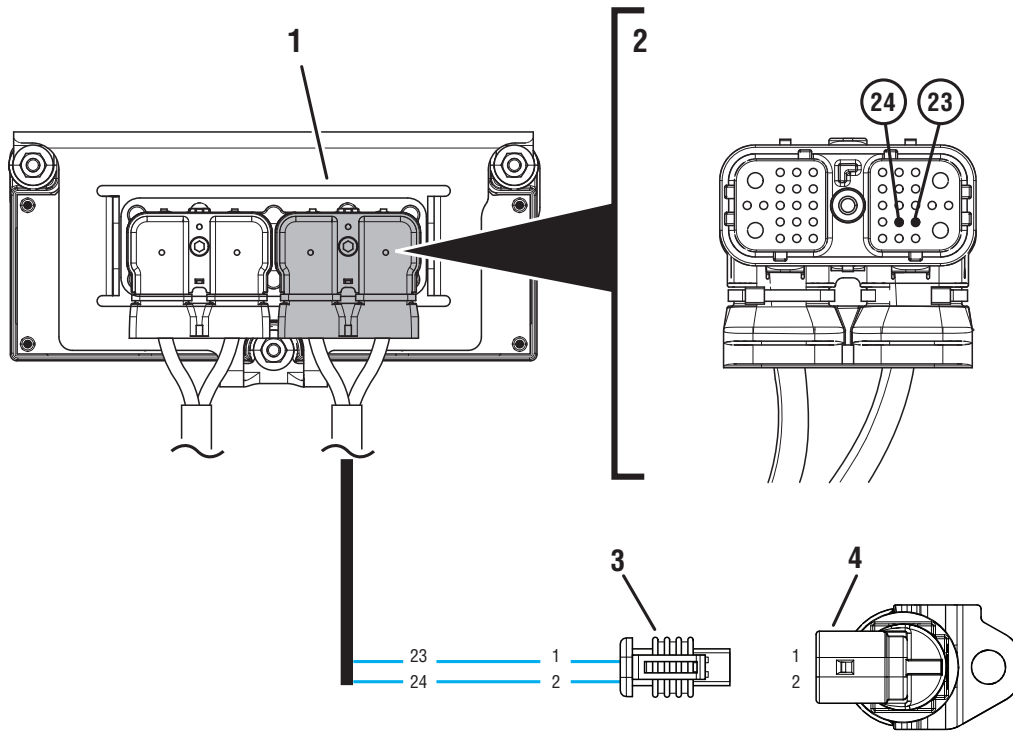
#### FMI 3, 4, 5

- Output Shaft Speed Sensor
  - Internal failure
  - Physical damage or failure
- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open

## Component Identification



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 2-Way Output Shaft Speed Sensor Connector Body
4. 2-Way Output Shaft Speed Sensor Connector
5. 2-Way Output Shaft Speed Sensor



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 2-Way Output Shaft Speed Sensor Connector
4. 2-Way Output Shaft Speed Sensor



## Fault Code 58 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set parking brake and chock wheels.
  2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If Fault Code 58 FMI 3, 4 or 5 is Inactive, go to **Step B.**
    - If Fault Code 58 FMI 3, 4 or 5 is Active, go to **Step F.**
    - If Fault Code 58 FMI 2, 8, or 10 is Active or Inactive, go to **Step I.**
- 

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



3. Wiggle wiring and connections of the Transmission Harness from the Output Shaft Speed Sensor to the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault code set Active while wiggling the Transmission Harness, replace **Transmission Harness.** Go to **Step V.**
  - If no fault codes set Active, go to **Step C.**
-

**C** *Purpose: Inspect the transmission Output Flange.*

1. Key off.
2. Set parking brake and chock wheels.
3. Inspect the Output Flange at the rear of the transmission.
4. Attempt to move the Output Flange both vertically and horizontally, checking for excessive movement.
  - If the Output Flange has excessive movement, go to **Step E**.
  - If the Output Flange does not have movement, go to **Step D**.

**D** *Purpose: Inspect Output Speed Sensor and Tone Wheel.*

1. Key off.
2. Remove the Output Shaft Speed Sensor and inspect for damage (cracks, broken pickup, etc.).
3. Inspect the Tone Wheel for damage on the Output Flange, verify the Tone Wheel is clean and free of debris.
  - If the Output Speed Sensor and Tone Wheel are not damaged and free of debris, go to **Step E**.
  - If the Output Speed Sensor is damaged, replace the **Output Shaft Speed Sensor**. Go to **Step V**.
  - If the Tone Wheel is damaged and/or debris is present, repair the Tone Wheel as needed. Go to **Step V**.

**E** *Purpose: Inspect transmission for damage.*

1. Key off.
2. Perform Oil Drain Procedure.
 

**NOTICE:** Place a clean suitable container under the Oil Drain Plug, oil may be re-used if no debris or contamination is found.

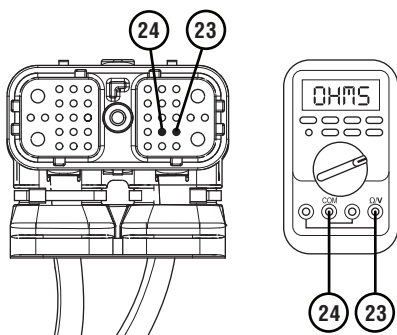
**Note:** Reference *EV-4 Speed Automated Transmission Service Manual TRSM2150, Oil Drain Procedure*.
3. Record residual oil volume in table.
4. Inspect oil for contamination and debris.
5. Refer to OEM guidelines for transmission removal.
6. Perform Front Housing Service Procedure.
 

**Note:** Reference *EV-4 Speed Automated Transmission Service Manual TRSM2150, Front Housing Service Procedure*.
7. Inspect internal transmission for damage.
  - If contamination or debris, or damage is found, repair as necessary. Go to **Step V**.
  - If no contamination or debris, or damage is found, replace the Output Bearing assembly. Go to **Step V**.

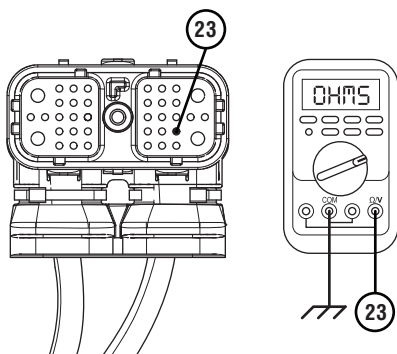
Residual Oil Volume

**F** **Purpose:** Verify continuity of Output Shaft Speed Sensor circuit and no continuity to ground.

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between the 38-Way Transmission Harness Connector Pin 23 and Pin 24. Record reading(s) in table.



5. Measure resistance between the 38-Way Transmission Harness Connector Pin 23 and ground. Record reading(s) in table.



6. After reading is taken, reconnect 38-Way Transmission Harness Connector at the TECU.
7. Compare reading(s) in table.
  - If readings are in range, go to **Step G**.
  - If readings are out of range, go to **Step H**.

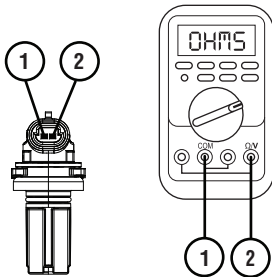
Pins	Range	Reading(s)
23 to 24	2.0k–4.5k Ohms	
23 to Ground	Open Circuit (OL)	

**G** **Purpose:** Verify fault code status

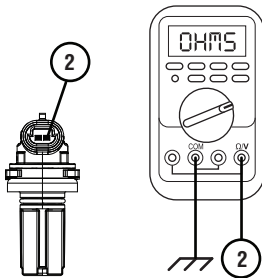
1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Connect ServiceRanger.
4. Key on with motor off.
5. Retrieve and record the transmission fault codes and FMIs and their occurrences and timestamps.
  - If Fault Code 58 is Inactive, replace **Transmission Harness** and **Output Shaft Speed Sensor**. Go to **Step V**.
  - If Fault Code 58 is Active, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.

**H** *Purpose: Verify continuity of Output Shaft Speed Sensor and no continuity to ground.*

1. Key off.
2. Disconnect 2-Way Output Shaft Speed Sensor Connector.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals. Also, check sensor body for cracks or visual damage.
4. Measure resistance between 2-Way Output Shaft Speed Sensor Pin 1 and Pin 2. Record reading(s) in table.



5. Measure resistance between 2-Way Output Shaft Speed Sensor Pin 2 and ground. Record reading(s) in table.



6. Reconnect 2-Way Output Shaft Speed Sensor to the Transmission Harness.
7. Compare reading(s) in table.
  - If readings are in range, replace **Transmission Harness**. Go to **Step V**.
  - If readings are out of range, replace the **Output Shaft Speed Sensor**. Go to **Step V**.

Pins	Range	Reading(s)
1 to 2	2.0–4.5 Ohms	
2 to Ground	Open Circuit (OL)	

**I** *Purpose: Inspect the transmission Output Flange.*

1. Key off.
2. Set parking brake and chock wheels.
3. Inspect the Output Flange at the rear of the transmission.
4. Attempt to move the Output Flange both vertically and horizontally, checking for excessive movement.
  - If the Output Flange has excessive movement, go to **Step E**.
  - If the Output Flange does not have movement, Go to **Step J**.

**J**

**Purpose:** Inspect Output Speed Sensor and Tone Wheel.

1. Key off.
2. Remove the Output Shaft Speed Sensor and inspect for damage (cracks, broken pickup, etc.).
3. Inspect the Tone Wheel for damage, verify the Tone Wheel is clean and free of debris.
  - If the Output Speed Sensor and Tone Wheel are not damaged and free of debris, replace the **Output Shaft Speed Sensor**, go to **Step V**.
  - If the Output Speed Sensor is damaged, replace the **Output Shaft Speed Sensor**. Go to **Step V**.
  - If the Tone Wheel is damaged and/or debris is present, repair the Tone Wheel as needed. Go to **Step V**.

**V**

**Purpose:** Validate repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to "Fault Codes".
6. Select "Clear All Faults".
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
  - If no fault codes set and vehicle operates properly, test complete.
  - If Fault Code 58 sets Active during the test drive, go to **Step A**.
  - If a fault code other than 58 sets, go to *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 61: Rail Motor Circuit

**J1939: SA 3      SPN 772      FMI 1, 5, 6, 12**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with an X-Y Shifter that selects a transmission gear. The X-Y Shifter motors are controlled with electrical current supplied by the TECU to move the Shift Finger either side-to-side (rail selection) or fore-and-aft (gear engagement and disengagement). Fault Code 61 indicates a failure with the circuit controlling the Rail Motor and the side-to-side movement of the X-Y Shift Finger.

### Detection

The system can identify an issue with the X-Y Shifter Rail Motor circuit, the TECU rail motor controller or the power and ground connections to the TECU under the following conditions:

- FMI 1, 5 and 12 can be detected when the X-Y Rail Motor is energized.
- FMI 6 can be detected when the X-Y Rail Motor is not energized.

### Conditions to Set Fault Code Active

**FMI 1 – Data Valid but Below Normal:** Transmission fails to complete a shift and the measured current draw of the Rail Motor is below expected values, but no short to ground or open circuit condition is detected.

#### **FMI 5 – Current Below Normal or Open Circuit:**

Transmission fails to complete a shift, the measured current draw of the Rail Motor is below expected values and an open circuit or short to ground condition is detected for 0.5 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** TECU detects a short to power on the Rail Motor circuit for 0.5 seconds at power up or prior to a shift.

**FMI 12 – Bad Intelligent Device:** Transmission fails to complete a shift and the TECU detects intermittent fluctuations in supply voltage due to poor connections, shorted Rail Motor circuit or a hardware failure of the TECU.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Motor may not operate.
- Transmission may not engage a gear from neutral.
- Transmission does not shift while vehicle is moving.
- Until fault becomes Inactive, driver may have to shut off motor with transmission in gear.

### Conditions to Set Fault Code Inactive

**FMI 1, 5, 12:** Set Inactive when the shift is completed.

**FMI 6:** An electrical short or open circuit is not detected for 0.5 seconds.

### Possible Causes

#### FMI 1, 5

- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground or open
- X-Y Shifter Rail Motor
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground or open
  - Rail Motor shorted to ground, partial short to ground, or open
  - Rail Motor internal failure

- TECU
  - Internal failure

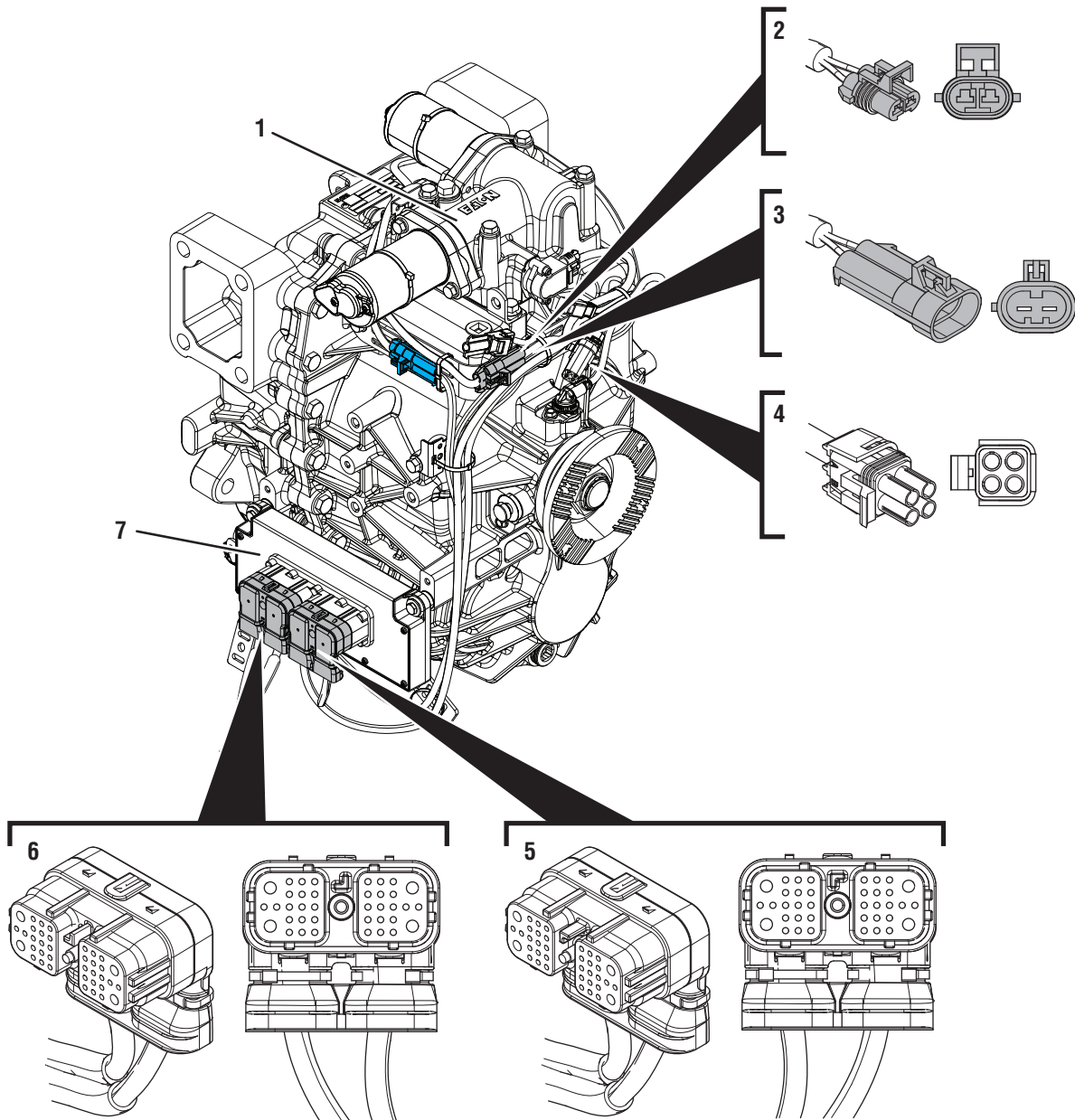
#### FMI 6

- Transmission Harness
  - Wiring shorted to power
- TECU
  - Internal failure

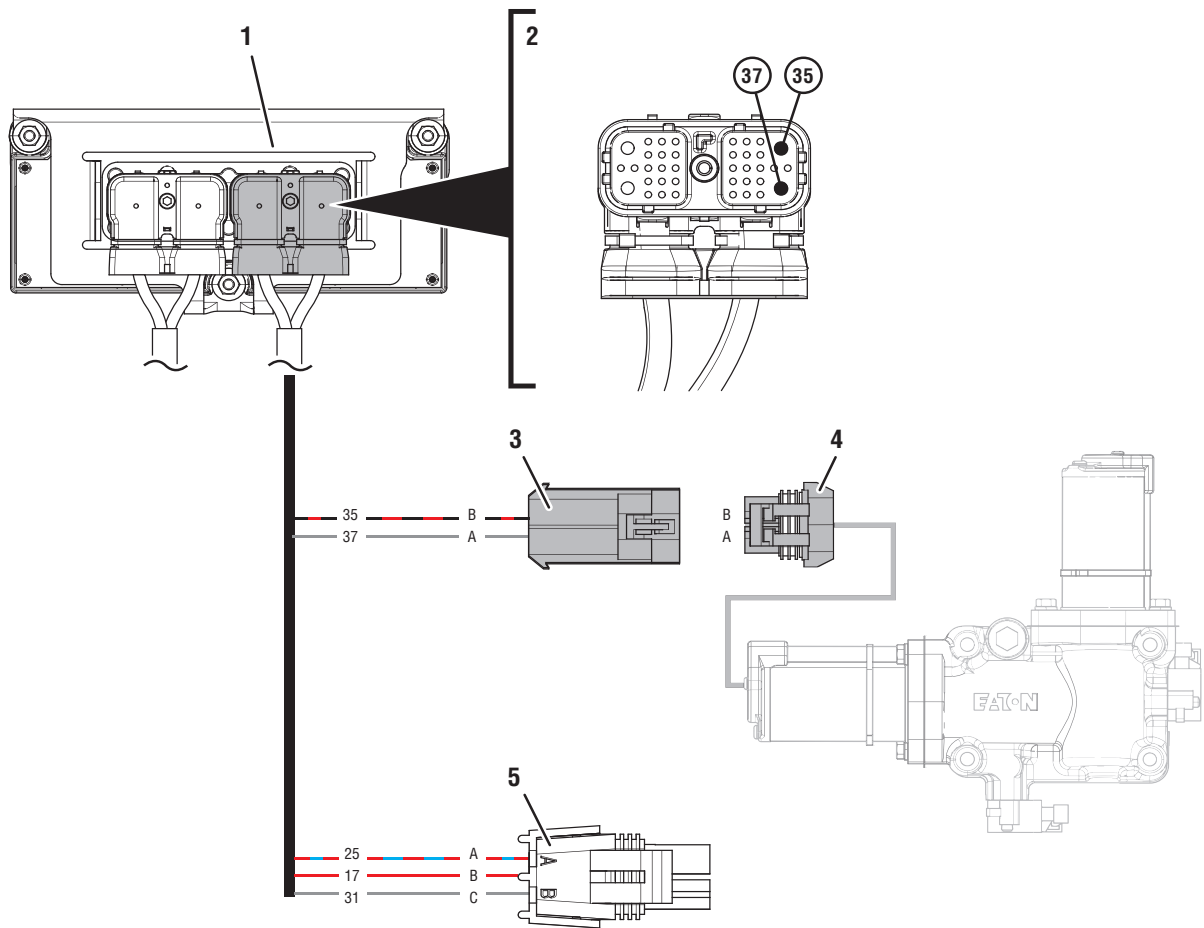
**FMI 12**

- Vehicle Power Supply
  - Poor power or ground supply to TECU (may be in conjunction with Fault Codes 33 or 34)
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Vehicle Batteries
  - Internal failure
- Vehicle 30-amp Battery Fuse
  - Bent, spread, corroded or loose terminals
  - Fuse missing or improperly seated
- TECU
  - Internal failure

## Component Identification



1. X-Y Shifter
2. 2-Way Rail Motor Connector (black)
3. 2-Way Rail Motor Connector Body (black)
4. 4-Way Diagnostic Connector
5. 38-Way Transmission Harness Connector
6. 38-Way Vehicle Harness Connector
7. Transmission Electronic Control Unit (TECU)



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 2-Way Rail Motor Connector Body (black)
4. 2-Way Rail Motor Connector (black)
5. 4-Way Diagnostic Connector



## Fault Code 61 Troubleshooting

**A** *Purpose: Check for Active or Inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If either Fault Codes 33 or 34 are Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
  - If Fault Code 61 is Active and Fault Codes 33 or 34 are Inactive or not set, go to **Step D.**
  - If Fault Code 61 is Inactive and Fault Codes 33 or 34 are Inactive or not set, go to **Step B.**

**B** *Purpose: Verify condition of power and ground supply.*

1. Key off.
2. Set parking brake and chock wheels.
3. Load test each vehicle battery per OEM specifications. Record reading(s).
  - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**
  - If all batteries pass the Load Test, go to **Step C.**

Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

**C**

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



3. Wiggle wiring and connections between 38-Way Vehicle Harness Connector at the TECU and vehicle battery supply. Look for signs of rubbing or chafing.
4. Wiggle wiring and connections between 38-Way Transmission Harness Connector at the TECU and the black (X-Rail Motor) 2-Way Transmission Harness Connector.
5. Wiggle wiring and connections between 38-Way Connector at the TECU and the blue (Y-Gear Motor) 2-Way Transmission Harness Connector.
6. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If Fault Code 61 or 63 set Active immediately and continuously after entering PD Mode, go to **Step D.**
- If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of the OEM wiring. Go to **Step V.**
- If any fault code sets Active while wiggling the Transmission Harness, replace **Transmission Harness.** Go to **Step V.**
- If no fault code sets Active while wiggling either harness, go to **Step D.**

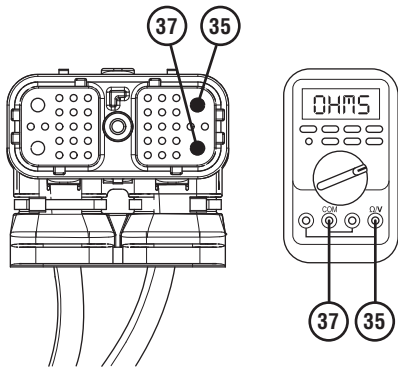
**D**

**Purpose:** Verify which FMI set.

1. Determine which FMI set for Fault Code 61.
  - If FMI 1, 5 or 12 set, go to **Step E.**
  - If FMI 6 set, replace **Transmission Electronic Control Unit (TECU).** Go to **Step V.**

**E** *Purpose: Verify proper resistance through the Transmission Harness and Rail Motor.*

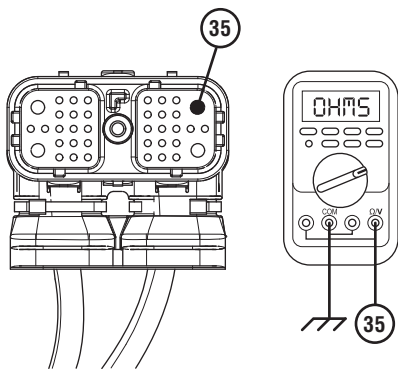
1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 38-Way Connector Pin 35 and Pin 37. Record reading(s) in table.



6. Compare reading(s) in table.
  - If readings are in range, go to **Step F.**
  - If any reading is out of range, go to **Step H.**

Pins	Range	Reading(s)
35 to 37	10 ohms or less	
35 to Ground	Greater than 5K ohms or Open Circuit (OL)	

5. Measure resistance between 38-Way Connector Pin 35 and ground. Record reading(s) in table.

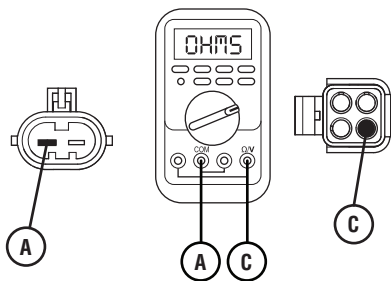


**F** *Purpose: Verify which FMI set.*

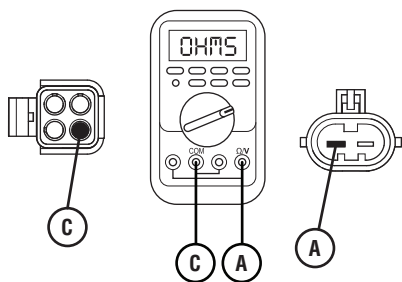
1. Determine which FMI set for Fault Code 61.
  - If FMI 1 or 12 set, go to **Step I.**
  - If FMI 5 set, go to **Step G.**

**G** **Purpose:** Verify internal circuit resistance of the TECU.

1. Reconnect 38-Way Transmission Harness to the TECU.
2. Disconnect black 2-Way Rail Motor Connector from Transmission Harness.
3. Remove cover of the 4-Way Diagnostic Connector.
4. Measure resistance between 2-Way Connector Body Pin A and the 4-Way Connector Pin C. Record reading(s) in table.



5. Reverse meter leads and take the same resistance measurement between the 2-Way Connector Body Pin A and the 4-Way Connector Pin C. Record reading(s) in table.

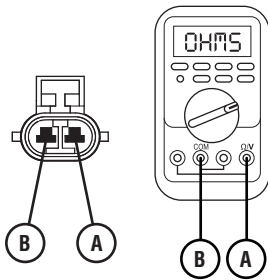


6. Compare reading(s) in table.
  - If readings are in range, replace **X-Y Shift Actuator**. Go to **Step V**.
  - If any reading is out of range, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.

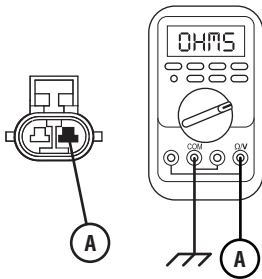
Pins	Range	Reading(s)
A to C	15k ohms or greater	
C to A	15k ohms or greater	

**H** **Purpose:** Verify the resistance of the X-Y Rail Motor and verify motor is not shorted to ground.

1. Key off.
2. Disconnect black 2-Way Rail Motor Connector from Transmission Harness.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between the black 2-Way Connector Pin A and Pin B. Record reading(s) in table.



5. Measure resistance between 2-Way Connector Pin A and ground. Record reading(s) in table.



6. Compare reading(s) in table.

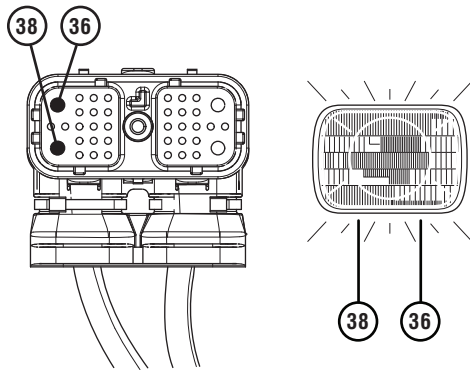
- If readings are in range, replace **Transmission Harness**. Go to **Step V**.

If any reading is out of range, replace the **X-Y Shift Actuator**. Go to **Step V**.

Pins	Range	Reading(s)
A to B	10 ohms or less	
A to Ground	Greater than 5K ohms or Open Circuit (OL)	

**I** **Purpose:** Load Test the vehicle power supply to the TECU.

1. Key off.
2. Verify TECU battery power and ground supply from the OEM Vehicle Harness is connected properly and not corroded, damaged or loose.
3. Disconnect 38-Way Vehicle Harness Connector from TECU.
4. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
5. Load test the Vehicle Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin 38 (power) and Pin 36 (ground). Load Test for 5 minutes to verify the harness will carry a load with the 30-amp fuse installed.



6. Wiggle the harness during the Load Test from the vehicle batteries to TECU.
  - If issues are found with the power supply or connectors, refer to OEM guidelines for repair or replacement of OEM wiring and continue Load Test.
  - If the power supply does not carry a load, refer to OEM guidelines for repair or replacement of OEM wiring. Go to **Step V**.
  - If no issues are found with the power supply or connectors and the power supply carries a load, go to **Step J**.

**J** **Purpose:** Verify which FMI set.

1. Determine which FMI set for Fault Code 61.
  - If FMI 1 set, contact Eaton at (800) 826-4357 for repair strategy.
  - If FMI 12 set, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set and vehicle operates properly, test complete.
    - If Fault Code 61 sets Active during the test drive, go to **Step A**.
    - If a fault code other than 61 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 63: Gear Motor Circuit

**J1939: SA 3      SPN 773      FMI 1, 5, 6, 12**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with an X-Y Shifter that selects a transmission gear. The X-Y Shifter motors are controlled with electrical current supplied by the TECU to move the Shift Finger either side-to-side (rail selection) or fore-and-aft (gear engagement and disengagement). Fault Code 63 indicates a failure of the circuit controlling the Gear Motor and the fore-and-aft movement of the X-Y Shift Finger.

### Detection

The system can identify an issue with the X-Y Shifter Gear Motor circuit, the TECU gear motor controller or the power and ground connections to the TECU under the following conditions:

- FMI 1, 5 and 12 can be detected when the X-Y Gear Motor is energized.
- FMI 6 can be detected when the X-Y Gear Motor is not energized.

### Conditions to Set Fault Code Active

**FMI 1 – Data Valid but Below Normal:** Transmission fails to complete a shift and the measured current draw of the Gear Motor is below expected values, but no short to ground or open circuit condition is detected.

#### **FMI 5 – Current Below Normal or Open Circuit:**

Transmission fails to complete a shift, the measured current draw of the Gear Motor is below expected values and an open circuit or short to ground condition is detected for 0.5 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** TECU detects a short to power on the Gear Motor circuit for 0.5 seconds at power up or prior to a shift.

**FMI 12 – Bad Intelligent Device:** Transmission fails to complete a shift and the TECU detects intermittent fluctuations in supply voltage due to poor connections, shorted Gear Motor circuit or a hardware failure of the TECU.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Motor may not operate.
- Transmission may not engage a gear from neutral.
- Transmission does not shift while the vehicle is moving.
- Until the fault becomes Inactive, driver may have to shut off motor with transmission in gear.

### Conditions to Set Fault Code Inactive

**FMI 1, 5, 12:** Set Inactive when the shift is completed.

**FMI 6:** An electrical short or open circuit is not detected for 0.5 seconds.

### Possible Causes

#### FMI 1, 5

- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground or open
- X-Y Shifter Gear Motor
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground or open
  - Gear Motor shorted to ground, partial short to ground, or open
  - Gear Motor internal failure
- TECU
  - Internal failure

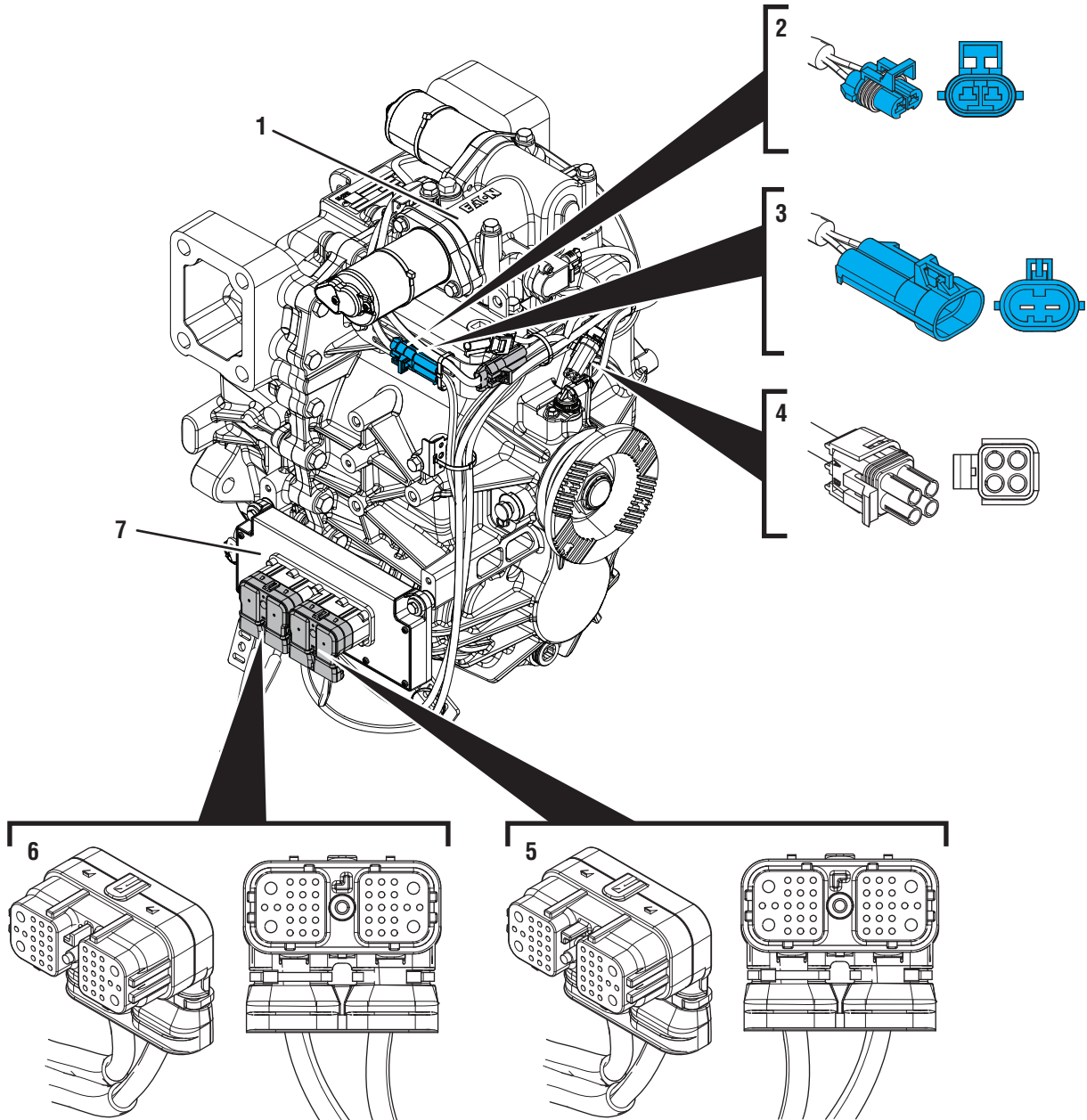
#### FMI 6

- Transmission Harness
  - Wiring shorted to power
- TECU
  - Internal failure

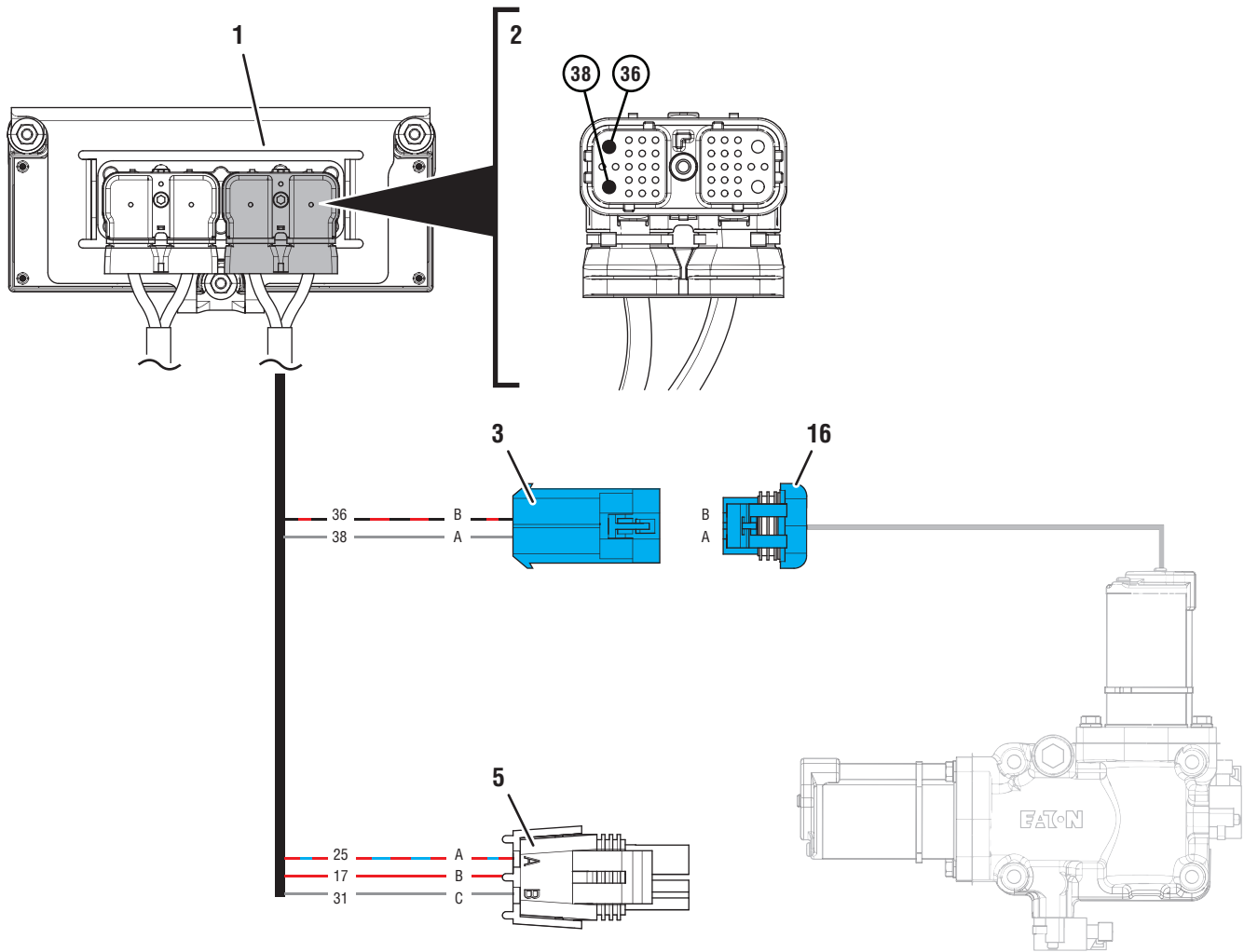
## **FMI 12**

- Vehicle Power Supply
  - Poor power or ground supply to TECU (may be in conjunction with Fault Codes 33 or 34)
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Vehicle Batteries
  - Internal failure
- Vehicle 30-amp Battery Fuse
  - Bent, spread, corroded or loose terminals
  - Fuse missing or improperly seated
- TECU
  - Internal failure

## Component Identification



- 1. X-Y Shifter
- 2. 2-Way Gear Motor Connector (blue)
- 3. 2-Way Gear Motor Connector Body (blue)
- 4. 4-Way Diagnostic Connector
- 5. 38-Way Transmission Harness Connector
- 6. 38-Way Vehicle Harness Connector
- 7. Transmission Electronic Control Unit (TECU)



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 2-Way Gear Motor Connector Body (blue)
4. 2-Way Gear Motor Connector (blue)
5. 4-Way Diagnostic Connector



## Fault Code 63 Troubleshooting

### **A** *Purpose: Check for Active or Inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
  2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If either Fault Code 33 or 34 are Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
    - If Fault Code 63 is Active and Fault Code 33 or 34 are Inactive or not set, go to **Step D.**
    - If Fault Code 63 is Inactive and Fault Code 33 or 34 are Inactive or not set, go to **Step B.**
- 

### **B** *Purpose: Verify condition of power and ground supply.*

1. Key off.
2. Set parking brake and chock wheels.
3. Load test each vehicle battery per OEM specifications. Record reading(s).
  - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**
  - If all batteries pass the Load Test, go to **Step C.**

Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

---

**C** **Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



3. Wiggle wiring and connections between 38-Way Vehicle Harness Connector at the TECU and vehicle battery supply. Look for signs of rubbing or chafing.
4. Wiggle wiring and connections between 38-Way Transmission Harness Connector at the TECU and the black (X-Rail Motor) 2-Way Transmission Harness Connector.
5. Wiggle wiring and connections between 38-Way Connector at the TECU and the blue (Y-Gear Motor) 2-Way Transmission Harness Connector.
6. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

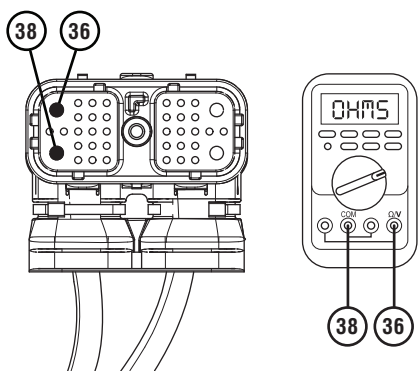
- If Fault Code 61 or 63 set Active immediately and continuously after entering PD Mode, go to **Step D.**
- If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of the OEM wiring. Go to **Step V.**
- If any fault code sets Active while wiggling the Transmission Harness, replace **Transmission Harness.** Go to **Step V.**
- If no fault code set Active while wiggling either harness, go to **Step D.**

**D** **Purpose:** Verify which FMI set.

1. Determine which FMI set for Fault Code 63.
  - If FMI 1, 5 or 12 set, go to **Step E.**
  - If FMI 6 set, replace **Transmission Electronic Control Unit (TECU).** Go to **Step V.**

**E** **Purpose:** Verify proper resistance through the Transmission Harness and Gear Motor.

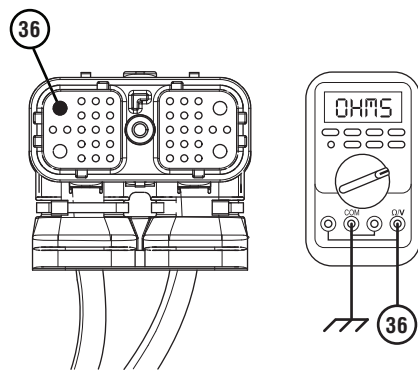
1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 38-Way Connector Pin 36 and Pin 38. Record reading(s) in table.



6. Compare reading(s) in table.
  - If readings are in range, go to **Step F.**
  - If any reading is out of range, go to **Step H.**

Pins	Range	Reading(s)
36 to 38	10 ohms or less	
36 to Ground	Greater than 5k ohms or Open Circuit (OL)	

5. Measure resistance between 38-Way Connector Pin 36 and ground. Record reading(s) in table.

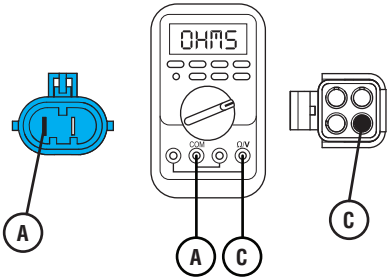


**F** **Purpose:** Verify which FMI set.

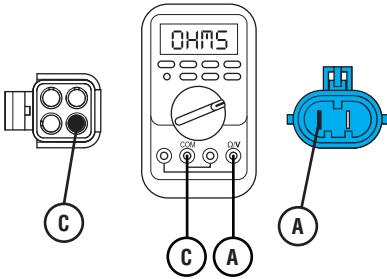
1. Determine which FMI set for Fault Code 63.
  - If FMI 1 or 12 set, go to **Step I.**
  - If FMI 5 set, go to **Step G.**

**G** **Purpose:** Verify internal circuit resistance of the TECU.

1. Reconnect 38-Way Transmission Harness to the TECU.
2. Disconnect blue 2-Way Gear Motor Connector from the Transmission Harness.
3. Remove connector cover of the 4-Way Diagnostic Connector.
4. Measure resistance between 2-Way Connector Body Pin A and 4-Way Connector Pin C. Record reading(s) in table.



5. Reverse meter leads and take the same resistance measurement between the 2-Way Connector Body Pin A and the 4-Way Connector Pin C. Record reading(s) in table.

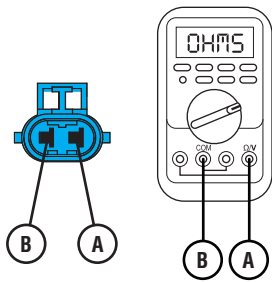


6. Compare reading(s) in table.
  - If readings are in range, replace **X-Y Shift Actuator**. Go to **Step V**.
  - If any reading is out of range, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.

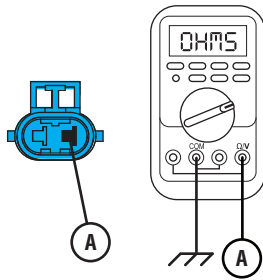
Pins	Range	Reading(s)
A to C	15k ohms or greater	
C to A	15k ohms or greater	

**H** **Purpose:** Verify the resistance of the X-Y Gear Motor and verify motor is not shorted to ground.

1. Key off.
2. Disconnect blue 2-Way Gear Motor Connector from the Transmission Harness.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between the blue 2-Way Connector Pin A and Pin B. Record reading(s) in table.



5. Measure resistance between 2-Way Connector Pin A and ground. Record reading(s) in table.



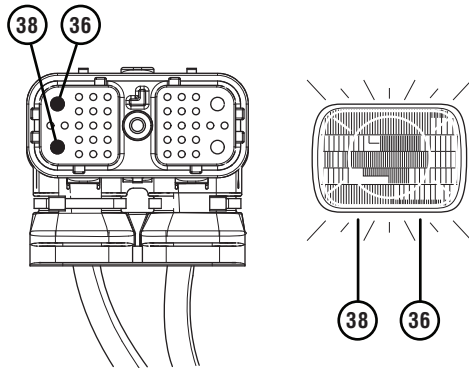
6. Compare reading(s) in table.

- If readings are in range, replace **Transmission Harness**. Go to **Step V**.
- If any reading is out of range, replace the **X-Y Shift Actuator**. Go to **Step V**.

Pins	Range	Reading(s)
A to B	10 ohms or less	
A to Ground	Greater than 5k ohms or Open Circuit (OL)	

**I** **Purpose:** Load Test the vehicle power supply to the TECU.

1. Key off.
2. Verify TECU battery power and ground supply from the Vehicle Harness is connected properly and not corroded, damaged or loose.
3. Disconnect 38-Way Vehicle Harness Connector from TECU.
4. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
5. Load test the Vehicle Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin 38 (power) and Pin 36 (ground). Load Test for 5 minutes to verify the harness will carry a load with the 30-amp fuse installed.



6. Wiggle the harness during the Load Test from vehicle batteries to TECU.
  - If issues are found with the power supply or connectors, refer to OEM guidelines for repair or replacement of OEM wiring and continue Load Test.
  - If the power supply does not carry a load, refer to OEM guidelines for repair or replacement of OEM wiring. Go to **Step V**.
  - If no issues are found with the power supply or connectors and the power supply carries a load, go to **Step J**.

**J** **Purpose:** Verify which FMI set.

1. Determine which FMI set for Fault Code 63.
  - If FMI 1 set, contact Eaton at (800) 826-4357 for repair strategy.
  - If FMI 12 set, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step V**.

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set and vehicle operates properly, test complete.
    - If Fault Code 63 sets Active during the test drive, go to **Step A**.
    - If a fault code other than 63 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 68: Grade Sensor

**J1939: SA 3      SPN 520321      FMI 13, 14**

### Overview

The Medium Duty 4-Speed EV Transmission is equipped with a Grade Sensor which calculates vehicle incline. The grade position provides information to assist in vehicle launch and shifting. The Grade Sensor is internal to the Transmission Electronic Control Unit (TECU). Fault Code 68 indicates an issue with either the Grade Sensor or the Grade Sensor calibration.

**Note:** Initial calibration of the Grade Sensor must be completed at the OEM assembly plant or anytime the TECU is replaced.

### Detection

Starting at key on, the TECU verifies the Grade Sensor is calibrated and current grade position is within range. If the sensor is not calibrated or grade position is out of range, Fault Code 68 sets Active.

### Conditions to Set Fault Code Active

**FMI 13 – Out of Calibration:** Grade Sensor has not been calibrated.

**FMI 14 – Special Instructions:** Grade Sensor is reporting an unrealistic vehicle incline.

### Fallback

#### All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).

### Conditions to Set Fault Code Inactive

**All FMIs:** Grade position is within range or the Grade Sensor has been calibrated.

### Possible Causes

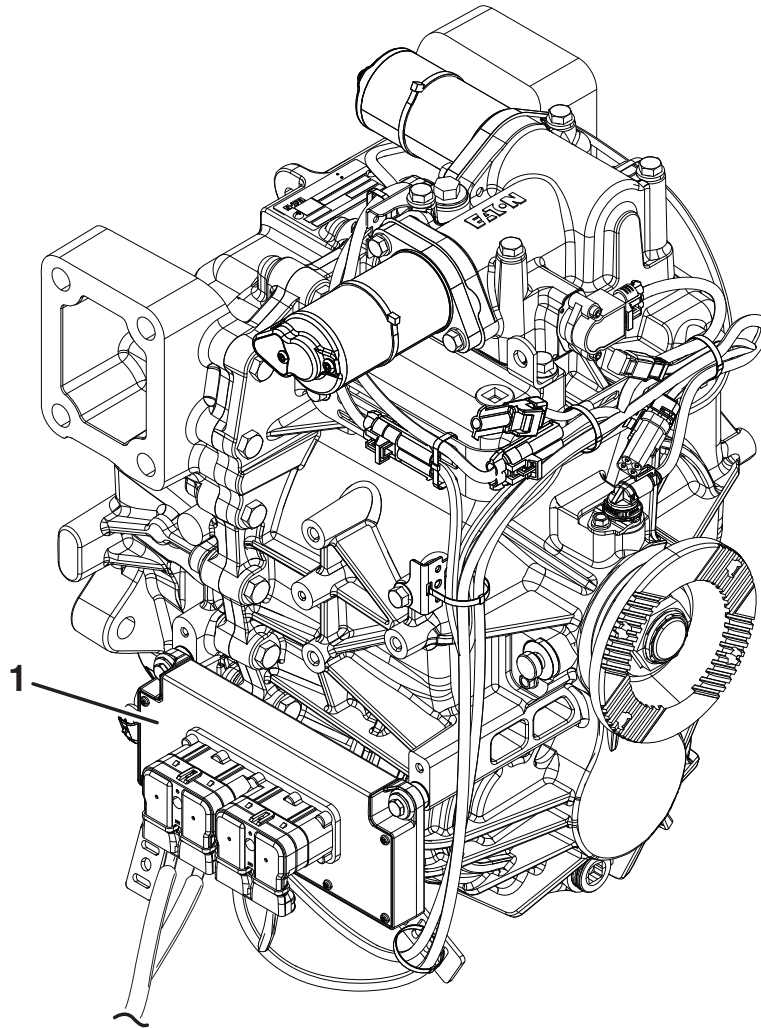
#### FMI 13

- Grade Sensor
  - Incorrect or uncompleted calibration
- TECU
  - Grade Sensor incorrect or incomplete calibration
  - Not securely mounted
  - Internal failure

#### FMI 14

- TECU
  - Not securely mounted
  - Internal failure

## Component Identification



1. Transmission Electronic Control Unit (TECU)

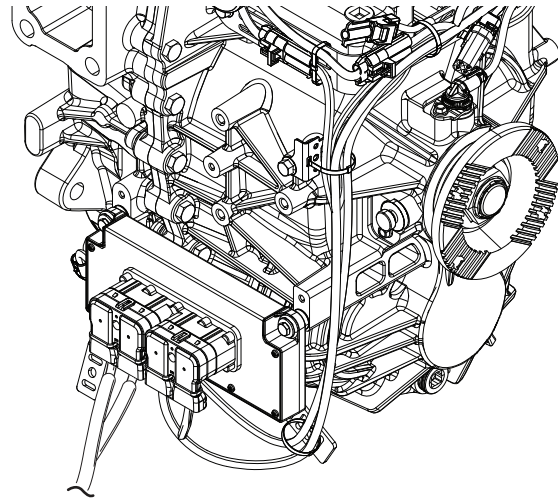
## Fault Code 68 Troubleshooting

**A** *Purpose: Check for Active or Inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
  2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If Fault Code 68 is Active, go to **Step B**.
    - If Fault Code 68 is Inactive, test complete. Go to **Step V**.
- 

**B** *Purpose: Verify TECU is properly mounted.*

1. Key off.
2. Set parking brake and chock wheels.
3. Verify TECU is properly secured and mounted on the transmission.



- If TECU is improperly mounted or not secure, mount or secure TECU properly. Go to **Step C**.
  - If TECU is properly mounted and secured, go to **Step C**.
-

**C**

**Purpose:** Perform Grade Sensor calibration procedure.

1. Key on with motor off.
2. Connect ServiceRanger.
3. In ServiceRanger, go to “Service Routines”.
4. Select “Grade Sensor Calibration”.

**NOTICE:** Verify vehicle is parked on level ground and the suspension is fully aired (if equipped) and set to proper ride height.

5. Run Grade Sensor Calibration.
6. If procedure fails, contact Eaton at (800) 826-4357 for repair strategy.
7. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

8. Key on with motor off.
9. Connect ServiceRanger.
10. Retrieve and record the transmission fault codes.
  - If Fault Code 68 is Inactive, go to **Step V**.
  - If Fault Code 68 is Active, replace **Transmission Electronic Control Unit (TECU)**. Perform Grade Sensor Calibration procedure with ServiceRanger. Go to **Step V**.

**V**

**Purpose:** Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
  - If no fault codes set Active and vehicle operates properly, test complete.
  - If Fault Code 68 sets Active during the test drive, go to **Step A**.
  - If a fault code other than 68 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.

## Fault Code 71: Unable to Disengage Gear

**J1939: SA 3****SPN 560****FMI 7**

### Overview

The Medium Duty 4-Speed EV Transmission uses the X-Y Shifter to engage and disengage a gear based on the driver's selected mode of operation. Gear disengagement is achieved by activating the X-Y Shifter Gear Motor, which controls the fore-and-aft movement of the Shift Finger. Pushing the Shift Finger against one of the Shift Detent Block Assembly Shift Blocks guides the Shift Yoke to disengage the Sliding Clutch from a gear. The position of the X-Y Shift Finger is monitored by the Transmission Electronic Control Unit (TECU) by way of the X-Y Gear Position Sensor and Rail Position Sensor.

Fault Code 71 is set when the X-Y Shift Finger attempts to pull out of gear, but the X-Y Gear Position Sensor indicates that the transmission was unable to disengage that gear. The TECU detected a system failure, but was unable to detect the specific root cause.

### Detection

This fault can only be detected when there are no failures of the TECU, X-Y Gear or Rail Motors, X-Y Position Sensors or Battery Supply voltage. This fault code is set when the system is unable to pull the transmission out of gear.

### Conditions to Set Fault Code Active

**FMI 7 – Mechanical System Not Responding:** After the first failed attempt to pull to neutral, the system commands the motor to break torque and attempts to pull to neutral again. If the system is unable to achieve neutral after three consecutive attempts, the fault code sets Active.

### Fallback

**FMI 7**

- Transmission may not be able to complete a shift to neutral.
- Transmission will attempt to move the Shift Finger to neutral.
- Motor may not operate.
- Gear display may flash current or destination gear.
- Until the fault becomes Inactive, driver may have to shut off motor with transmission in gear.

### Conditions to Set Fault Code Inactive

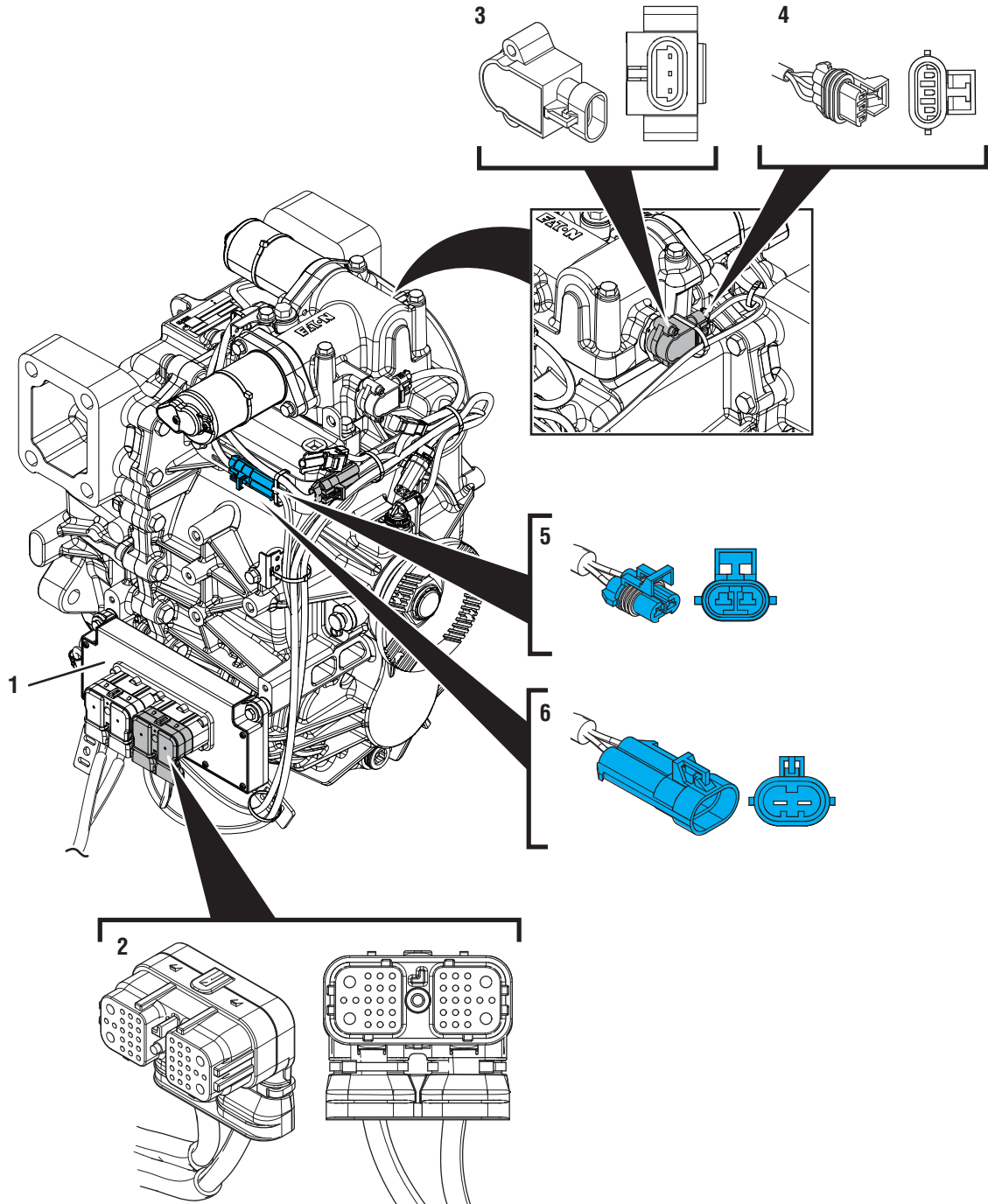
**FMI 7:** The system successfully completes a shift into Neutral.

### Possible Causes

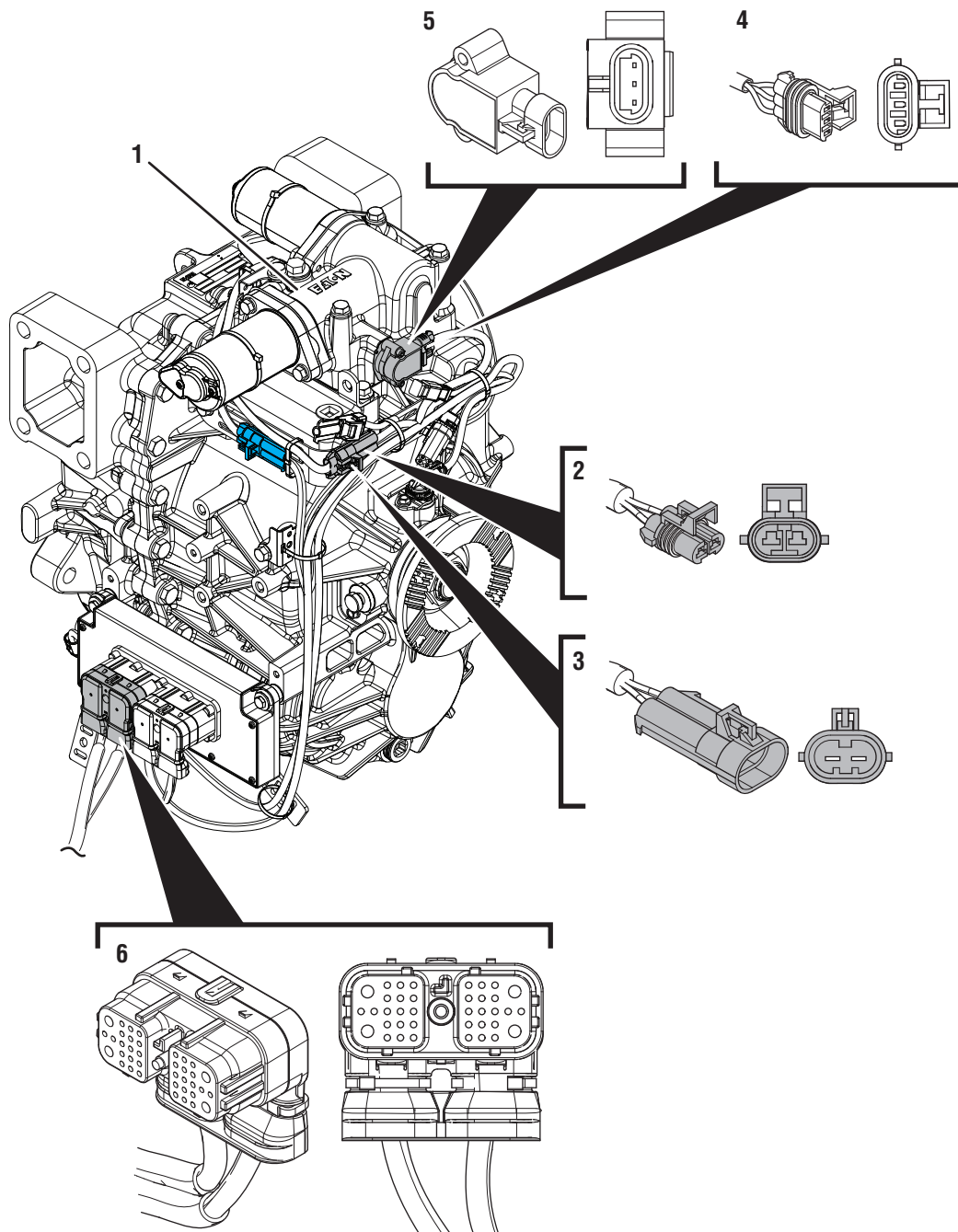
**FMI 7**

- Vehicle Power Supply
  - Poor power or ground supply to TECU
  - Bent, spread, corroded or loose terminals
- Vehicle Batteries
  - Internal failure
- Transmission Harness
  - Damaged wiring between the TECU and X-Y Shifter
  - Bent, spread, corroded or loose terminals
- X-Y Shifter
  - Worn or damaged X-Y Shifter ball screw, center shaft bushing, or other internal components
  - Contamination of X-Y Shifter ball screw due to coolant leak or oil contamination
  - Bent, spread, corroded or loose terminals
- Mechanical Transmission
  - Worn or damaged Shift Detent Block Assembly
  - Worn or damaged Sliding Clutch slot width
  - Worn or damaged Shift Yokes
  - Worn or damaged internal transmission components

## Component Identification



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. Gear Position Sensor
4. 3-Way Gear Position Sensor Connector
5. 2-Way Gear Motor Connector (blue)
6. 2-Way Gear Motor Connector Body (blue)



- 1. X-Y Shifter
- 2. 2-Way Rail Motor Connector (black)
- 3. 2-Way Rail Motor Connector Body (black)
- 4. 3-Way Rail Position Sensor Connector
- 5. Rail Position Sensor
- 6. 38-Way Vehicle Harness Connector

## Fault Code 71 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

**Note:** If Fault Code 71 FMI 7 is Inactive and there are other Active fault codes, troubleshoot all Active fault codes first.

- If Fault Code 71 FMI 7 is Active or Inactive and/or Fault Codes 33, 34, 51, 52, 61 or 63 are Active or Inactive, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
- If Fault Code 71 is Inactive, go to **Step B**.
- If Fault Code 71 is Active, go to **Step C**.

3. Wiggle wiring and connections of the Transmission Harness from the X-Y Shifter to the TECU.
4. Wiggle wiring and connections of the Vehicle Power Supply Harness from the batteries to the TECU.
5. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault sets Active while wiggling the Transmission Harness, replace **Transmission Harness**. Go to **Step V**.
- If any fault sets Active while wiggling the Power Supply harness, refer to OEM guidelines for repair or replacement of Power Supply wiring. Go to **Step V**.
- If no fault codes set Active, go to **Step C**.

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Fault Code 71 does not set Active during PD Mode. Other fault codes may set Active during PD Mode that could indicate an issue with the wiring.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



**C Purpose:** Inspect the batteries, in-line fuse and power and ground supplies to the TECU.

1. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Inspect battery terminals and transmission 30-amp In-line Fuse Holder Connections for corrosion, loose terminals and bent or spread pins.
3. Inspect Battery Positive (+) and Negative (-) wires from the batteries to the TECU including all connections. Ensure a clean ground connection on the chassis. Verify no damage or corrosion to connectors.
  - If damage is found, repair or replace Power Supply Harness per OEM guidelines. Go to **Step V.**
  - If no damage is found, go to **Step D.**

**D Purpose:** Perform a Load Test on each vehicle battery.

1. Key off.
2. Set parking brake and chock wheels.
3. Load test each vehicle battery per OEM specifications. Record reading(s).
  - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**
  - If all batteries pass the Load Test, go to **Step E.**

Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

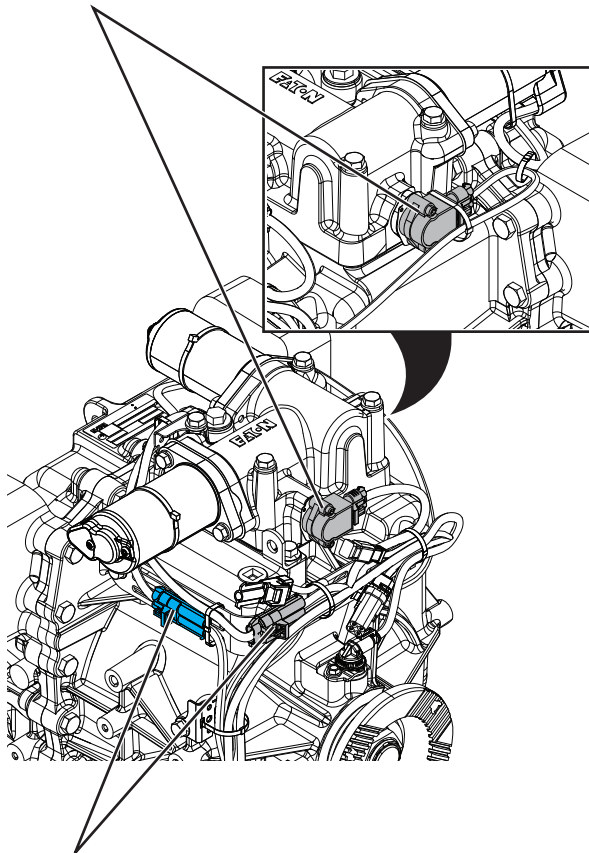
**E**

**Purpose:** Inspect X-Y Shifter and Transmission Harness for physical damage.

1. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Inspect the physical condition of X-Y Shifter and all connections.
3. Inspect Transmission Harness for any pinched, chafed, corroded or shorted wiring.
4. Disconnect both 2-Way X-Y Gear and Rail Position Sensor Connectors.

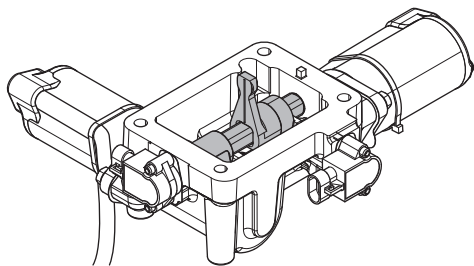


5. Disconnect both 2-Way X-Y Motor Connectors to the Transmission Harness.

6. Inspect connectors for corrosion, loose terminals, bent or spread pin or damage to the connector bodies.
  - If damage to the X-Y Shifter or X-Y Shifter wiring is found, replace **X-Y Shift Actuator**. Go to **Step V**.
  - If damage to the Transmission Harness is found, replace **Transmission Harness**. Go to **Step V**.
  - If no damage is found, go to **Step F**.

**F Purpose:** Inspect condition of X-Y Shifter internal components.

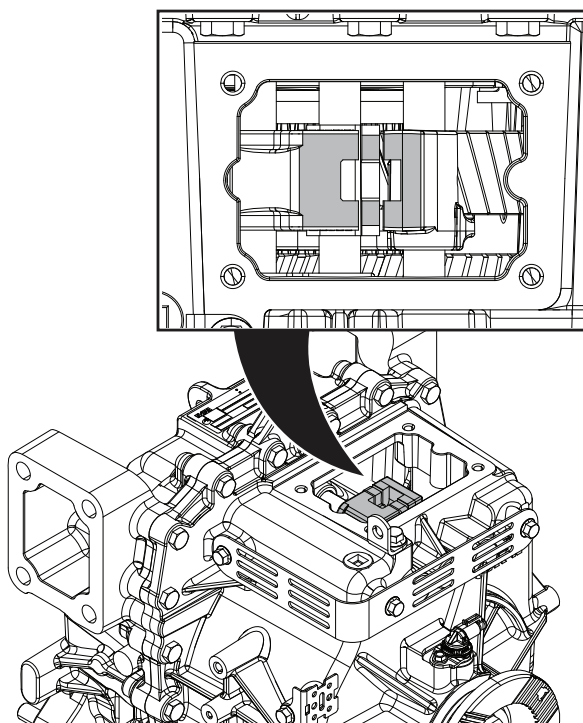
1. Key off.
2. Remove the X-Y Shifter.
3. Inspect condition of the X-Y Shift Finger and Cross Shaft for damage or wear.



4. Inspect the X-Y Shifter ball screw for signs of contamination.
  - If contamination is found, determine and repair the source of contamination, flush the transmission using Dexron automatic transmission fluid and replace the X-Y Shifter. Go to **Step V.**
  - If damage to the X-Y Shifter is found, replace **X-Y Shift Actuator**. Go to **Step V.**
  - If no damage is found, go to **Step G.**

**G Purpose:** Inspect condition of Shift Detent Block Assembly.

1. Key off.
2. Inspect condition of the Shift Detent Block Assembly Shift Blocks. Look for uneven gaps between the Shift Blocks or excessive wear to the block faces.
3. Verify Shift Blocks are tight to the rails and there are no other mechanical issues with the Shift Detent Block Assembly.



4. Verify transmission shifts fully in and out of each gear.
5. Test the Shift Interlock to verify that the transmission will not engage two gears at once.
  - If damage to the Shift Detent Block Assembly is found, replace Shift Detent Block Assembly. Go to **Step V.**
  - If no damage is found, go to **Step I.**

**H**

**Purpose:** Inspect condition of the transmission lubricant.

1. Key off.
  2. Drain transmission lubricant into a clean pan for re-use. Note how much lubricant comes out and if significant metal fragments appear in the oil.
    - If there are significant metal fragments in the oil. Go to **Step I**.
    - If metal fragments do not appear in oil, replace **X-Y Shift Actuator** and **Transmission Har-ness**. Go to **Step V**.
- 

**I**

**Purpose:** Inspect condition of the internal transmission components.

1. Key off.
2. Drain and save the transmission oil.
3. Remove the transmission.
4. Remove the front housing.
5. Inspect transmission gearing for damage or excessive movement.
6. Inspect Shift Yokes and Sliding Clutches for damage or excessive wear.
  - If damage is found or there are significant metal fragments in the oil, replace damaged, worn or failed transmission components. Go to **Step V**.
  - If no damage is found within the transmission main case, contact Eaton at (800) 826-4357 for further diagnostics

**Note:** If unsure whether damage or wear is significant, take pictures of the transmission gearing. Ensure these pictures are clear and the components are easily visible. Email these pictures to [auto.rtw@eaton.com](mailto:auto.rtw@eaton.com) and contact Eaton at (800) 826-4357.

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**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors, verify that all components are properly installed and refill the transmission with lubricant if necessary.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 71 sets Active, contact Eaton at (800) 826-4357 for further diagnostics.
    - If a fault code other than 71 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 72: Failed to Select Rail

**J1939: SA 3****SPN 782****FMI 7**

### Overview

The Medium Duty 4-Speed EV Transmission uses the X-Y Shifter to engage and disengage a gear based on the driver's selected mode of operation. Rail selection is achieved by activating the X-Y Shifter Rail Motor, which controls the lateral movement of the X-Y Shift Finger within the Shift Detent Block Assembly. Certain shifts require the transmission to engage a different rail on the Shift Detent Block Assembly. These rail shifts require the X-Y Shifter to move to Neutral prior to selecting another rail and allowing the next gear engagement. The Shift Detent Block Assembly Interlock physically prevents the engagement of two gears at the same time.

Fault Code 72 sets when the X-Y Shift Finger attempts to move to a different rail position, but the X-Y Rail Position Sensor indicates that the transmission was unable to select the next rail position. Transmission Electronic Control Unit (TECU) detected a system failure, but was unable to detect the specific root cause.

### Detection

This fault can only be detected when there are no failures of the TECU, X-Y Gear or Rail Motors, X-Y Position Sensors or Battery Supply voltage. This fault code is set when the system is unable to move to a different rail position and the transmission is not engaged in a gear.

### Conditions to Set Fault Code Active

**FMI 7 – Mechanical System Not Responding:** After being unable to select a rail position for 2 seconds, the fault code sets Active.

### Fallback

**FMI 7:**

- Transmission may not be able to complete a shift to the proper rail.
- Transmission will attempt to move the Shift Finger to the proper rail.
- Gear display may flash current or destination gear.

### Conditions to Set Fault Code Inactive

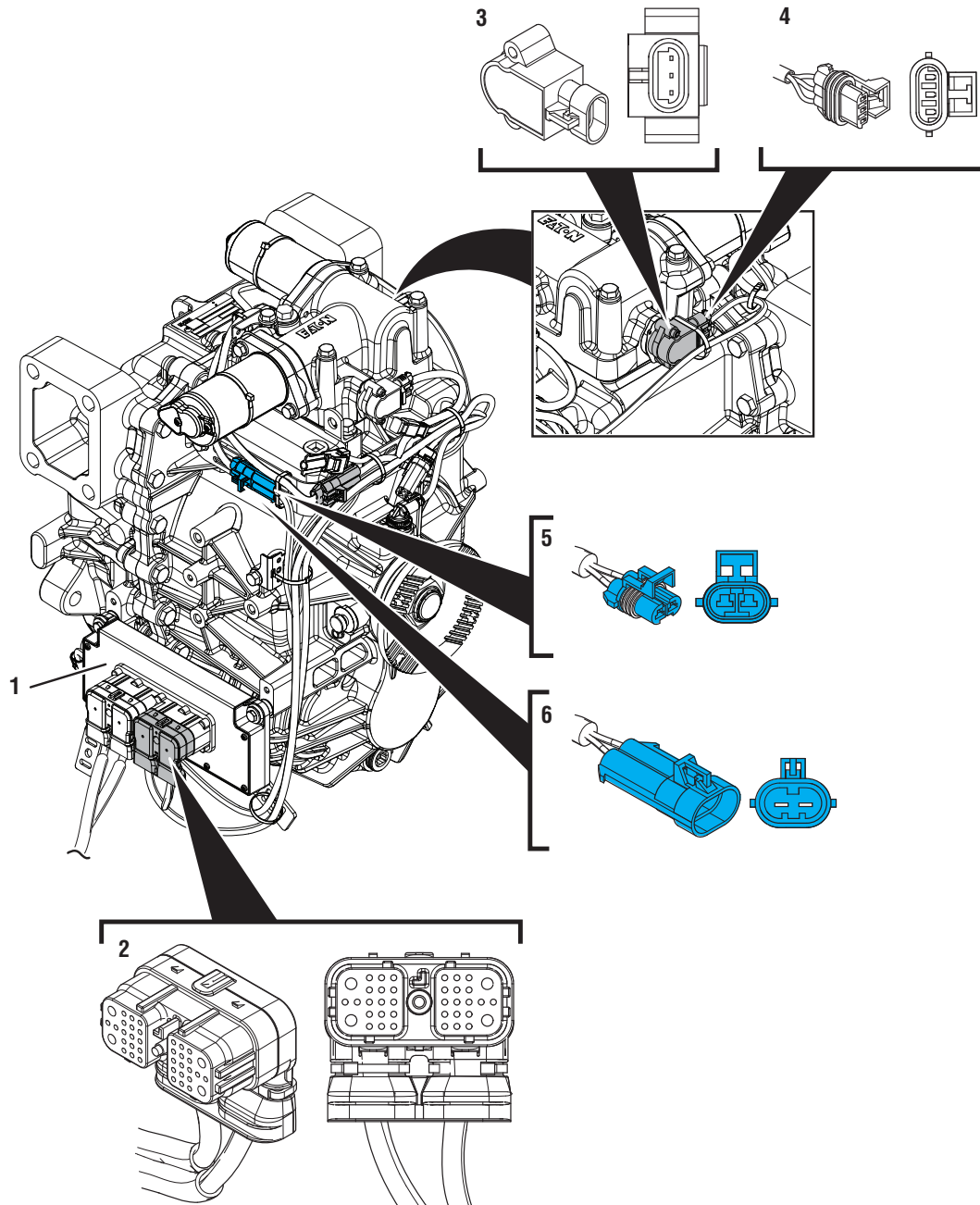
**FMI 7:** The system successfully positions the Shift Finger on the proper rail.

### Possible Causes

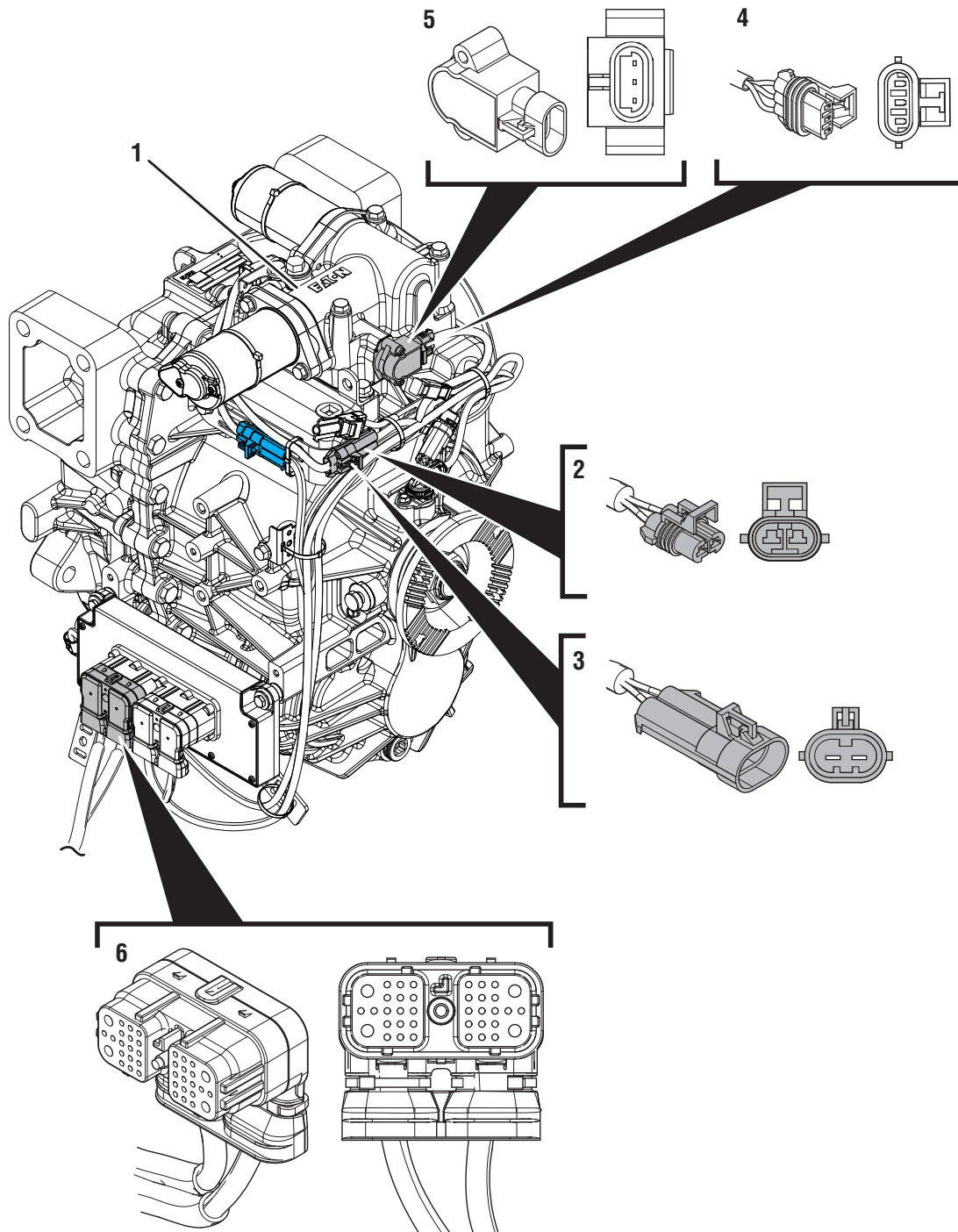
**FMI 7:**

- Vehicle Power Supply
  - Poor power or ground supply to TECU
  - Bent, spread, corroded or loose terminals
- Vehicle Batteries
  - Internal failure
- Transmission Harness
  - Damaged wiring between the TECU and X-Y Shifter
  - Bent, spread, corroded or loose terminals
- X-Y Shifter
  - Worn or damaged X-Y Shifter ball screw, center shaft bushing, or other internal components
  - Contaminated X-Y Shifter ball screw due to coolant leak or oil contamination
  - Bent, spread, corroded or loose terminals
- Mechanical Transmission
  - Worn or damaged Shift Detent Block Assembly
  - Worn Sliding Clutch slot width
  - Worn or damaged Shift Yokes
  - Worn or damaged internal transmission components

## Component Identification



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. Gear Position Sensor
4. 3-Way Gear Position Sensor Connector
5. 2-Way Gear Motor Connector (blue)
6. 2-Way Gear Motor Connector Body (blue)



1. X-Y Shifter
2. 2-Way Rail Motor Connector (black)
3. 2-Way Rail Motor Connector Body (black)
4. 3-Way Rail Position Sensor Connector
5. Rail Position Sensor
6. 38-Way Vehicle Harness Connector

## Fault Code 72 Troubleshooting

**A** **Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

**Note:** If Fault Code 72 is Inactive and there are other Active fault codes, troubleshoot all Active fault codes first.

- If Fault Codes 33, 34, 51, 52, 61, or 63 are Active or Inactive, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
- If Fault Code 72 is Inactive, go to **Step B**.
- If Fault Code 72 is Active, go to **Step C**.

**B** **Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Fault Code 72 does not set Active during PD Mode. Other fault codes may set Active during PD Mode that could indicate an issue with the wiring.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.



3. Wiggle wiring and connections of the Transmission Harness from the X-Y Shifter to the TECU.
4. Wiggle wiring and connections of the Vehicle Power Supply Harness from the batteries to the TECU.
5. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault code sets Active while wiggling the Transmission Harness, replace **Transmission Harness**. Go to **Step V**.
- If any fault code sets Active while wiggling the Power Supply Harness, refer to OEM guidelines for repair or replacement of power supply wiring. Go to **Step V**.
- If no fault codes set Active, go to **Step C**.

**C** **Purpose:** *Inspect the batteries, in-line fuse and power and ground supplies to the TECU.*

1. Key off.  
**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Inspect battery terminals and transmission 30-amp In-line Fuse Holder Connections for corrosion, loose terminals and bent or spread pins.
3. Inspect Battery Positive (+) and Negative (-) wires from the batteries to the TECU including all connections. Ensure a clean ground connection on the chassis. Verify no damage or corrosion to connectors.
  - If damage is found, repair or replace Power Supply Harness per OEM guidelines. Go to **Step V.**
  - If no damage is found, go to **Step D.**

**D** **Purpose:** *Perform a Load Test on each vehicle battery.*

1. Key off.
2. Set parking brake and chock wheels.
3. Load test each vehicle battery per OEM specifications. Record reading(s).
  - If any battery(s) does not pass the Load Test, refer to OEM guidelines for repair or replacement of battery(s). Go to **Step V.**
  - If all batteries pass the Load Test, go to **Step E.**

Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

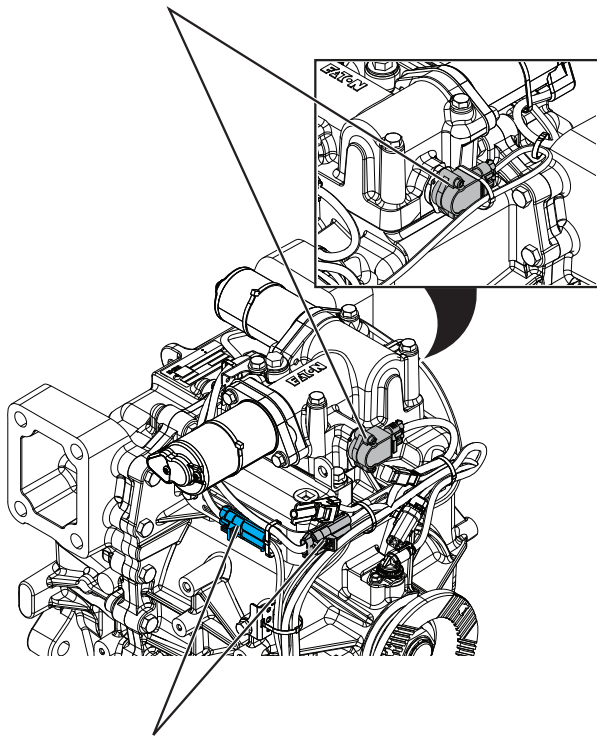
**E**

**Purpose:** Inspect X-Y Shifter and Transmission Harness for physical damage.

1. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Inspect the physical condition of X-Y Shifter and all connections.
3. Inspect Transmission Harness for any pinched, chafed, corroded or shorted wiring.
4. Disconnect both 2-Way X-Y Gear and Rail Position Sensor Connectors.



5. Disconnect both 2-Way X-Y Motor Connectors to the Transmission Harness.

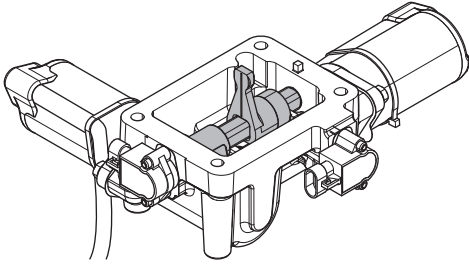
6. Inspect connectors for corrosion, loose terminals, bent or spread pin or damage to the connector bodies.

- If damage to the X-Y Shifter or X-Y Shifter wiring is found, replace **X-Y Shift Actuator**. Go to **Step V**.
- If damage to the Transmission Harness is found, replace **Transmission Harness**. Go to **Step V**.
- If no damage is found, go to **Step F**.

**F**

**Purpose:** Inspect condition of X-Y Shifter internal components.

1. Key off.
2. Remove the X-Y Shifter.
3. Inspect condition of the X-Y Shift Finger and Cross Shaft for damage or wear.

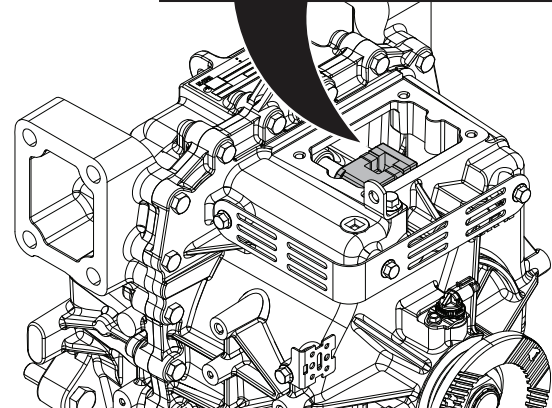
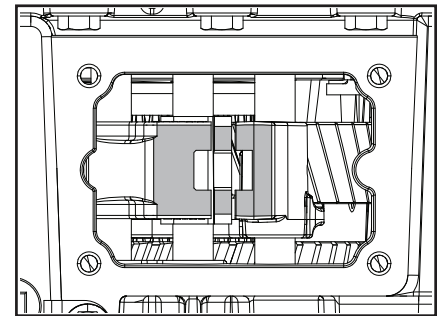


4. Inspect the X-Y Shifter ball screw for signs of contamination.
  - If contamination is found, determine and repair the source of contamination, flush the transmission using Dexron automatic transmission fluid and replace the X-Y Shifter. Go to **Step V.**
  - If damage to the X-Y Shifter is found, replace **X-Y Shift Actuator**. Go to **Step V.**
  - If no damage is found, go to **Step G.**

**G**

**Purpose:** Inspect condition of Shift Detent Block Assembly.

1. Key off.
2. Inspect condition of the Shift Detent Block Assembly Shift Blocks. Look for uneven gaps between the Shift Blocks or excessive wear to the block faces.
3. Verify Shift Blocks are tight to the rails and there are no other mechanical issues with the Shift Detent Block Assembly.



4. Verify transmission shifts fully in and out of each gear.
5. Test the Shift Interlock to verify that the transmission will not engage two gears at once.
  - If damage to the Shift Detent Block Assembly is found, replace Shift Detent Block Assembly. Go to **Step V.**
  - If no damage is found, go to **Step H.**

**H**

**Purpose:** Inspect condition of the transmission lubricant.

1. Key off.
  2. Drain transmission lubricant into a clean pan for re-use. Note how much lubricant comes out and if significant metal fragments appear in the oil.
    - If there are significant metal fragments in the oil. Go to **Step I**.
    - If metal fragments do not appear in oil, replace **X-Y Shift Actuator** and **Transmission Har-ness**. Go to **Step V**.
- 

**I**

**Purpose:** Inspect condition of the internal transmission components.

1. Key off.
2. Drain and save the transmission oil.
3. Remove the transmission.
4. Remove the front housing.
5. Inspect transmission gearing for damage or excessive movement.
6. Inspect Shift Yokes and Sliding Clutches for damage or excessive wear.
  - If damage is found or there are significant metal fragments in the oil, replace damaged, worn or failed transmission components. Go to **Step V**.
  - If no damage is found within the transmission main case, contact Eaton at (800) 826-4357 for further diagnostics.

**Note:** If unsure whether damage or wear is significant, take pictures of the transmission gearing. Ensure these pictures are clear and the components are easily visible. Email these pictures to [auto.rtw@eaton.com](mailto:auto.rtw@eaton.com) and contact Eaton at (800) 826-4357.

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**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors, verify that all components are properly installed, and refill the transmission with lubricant if necessary.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 72 sets Active, contact Eaton at (800) 826-4357 for further diagnostics.
    - If a fault code other than 72 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 73: Failed to Engage Gear

**J1939: SA 3      SPN 781      FMI 7, 11**

### Overview

The Medium Duty 4-Speed EV Transmission uses the XY Shift Actuator to engage and disengage a gear based on the driver's selected mode of operation. Gear engagement is achieved by activating the XY Shift Actuator Gear Motor, which controls the fore-and-aft movement of the Shift Finger. Pushing the Shift Finger against one of the Shift Detent Block Assembly Shift Blocks guides the Shift Yoke to engage the Sliding Clutch into a gear. The position of the XY Shift Actuator Finger is monitored by the Transmission Electronic Control Unit (TECU) by way of the XY Shift Actuator Gear Position and Rail Position Sensors.

Fault Code 73 is set when the XY Shift Actuator Finger attempts to engage a gear, but the XY Gear Position Sensor indicates that the transmission was unable to engage that gear. The TECU detected a system failure, but was unable to detect the specific root cause.

### Detection

This fault is detected when there are no failures evident with the vehicle battery supply voltage, TECU, XY Shift Actuator Position Sensors, Gear and Rail Motors. This fault sets when the system is unable to engage a gear.

### Conditions to Set Fault Code Active

**FMI 7 – Mechanical System Not Responding:** The transmission was unable to achieve the minimum gear engagement after 4 consecutive attempts.

**FMI 11 – Root Cause Unknown:** The transmission was unable to achieve minimum gear engagement 6 seconds after the shift request.

### Fallback

#### FMI 7

- Transmission may not be able to complete a shift into gear.
- Transmission will attempt to move the Shift Finger to the destination gear.
- Motor may not operate.
- Gear display may flash current or destination gear.

### Conditions to Set Fault Code Inactive

**FMI 7:** The system successfully engages the desired gear.

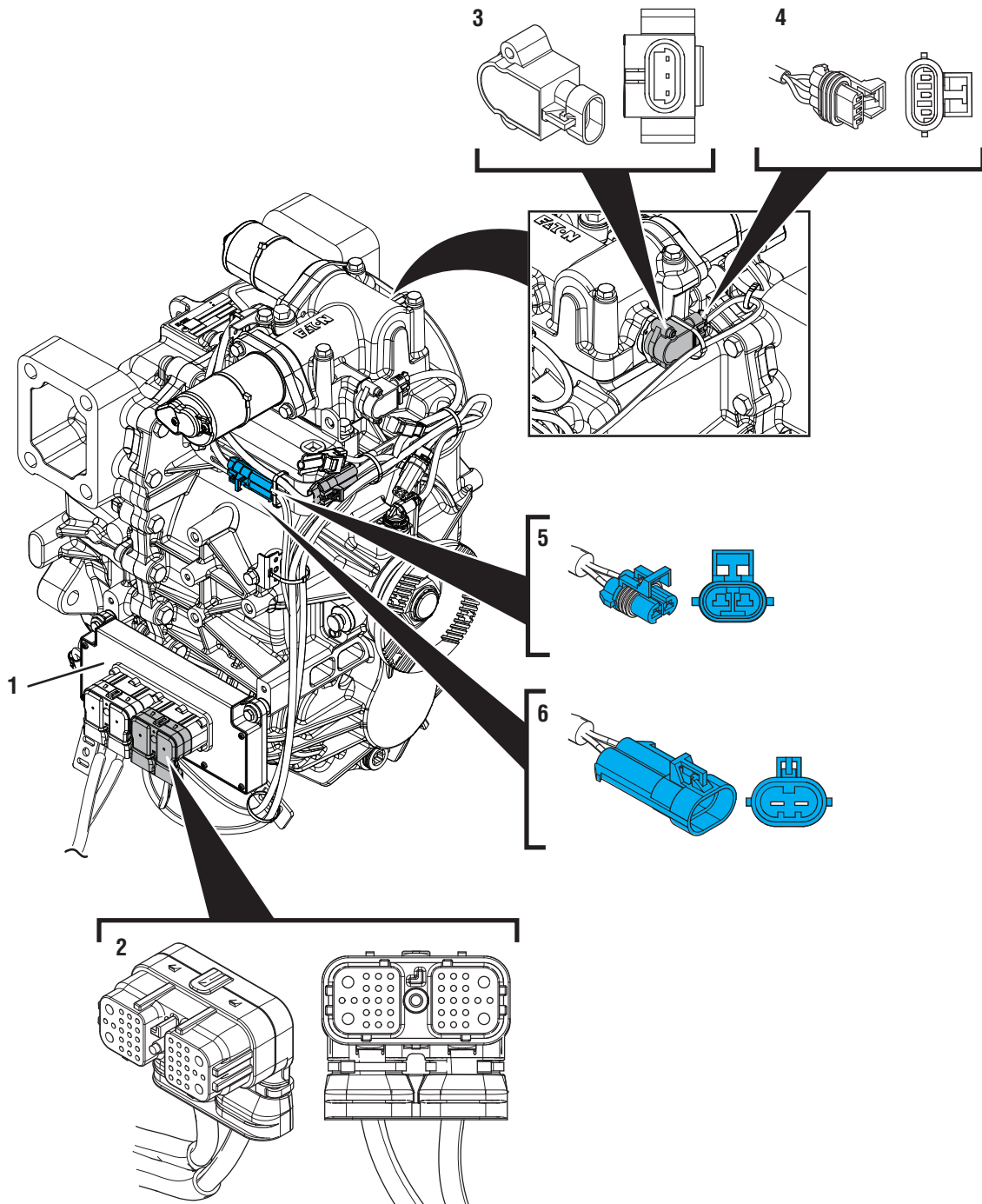
**FMI 11:** The system successfully engages the desired gear or a key cycle.

### Possible Causes

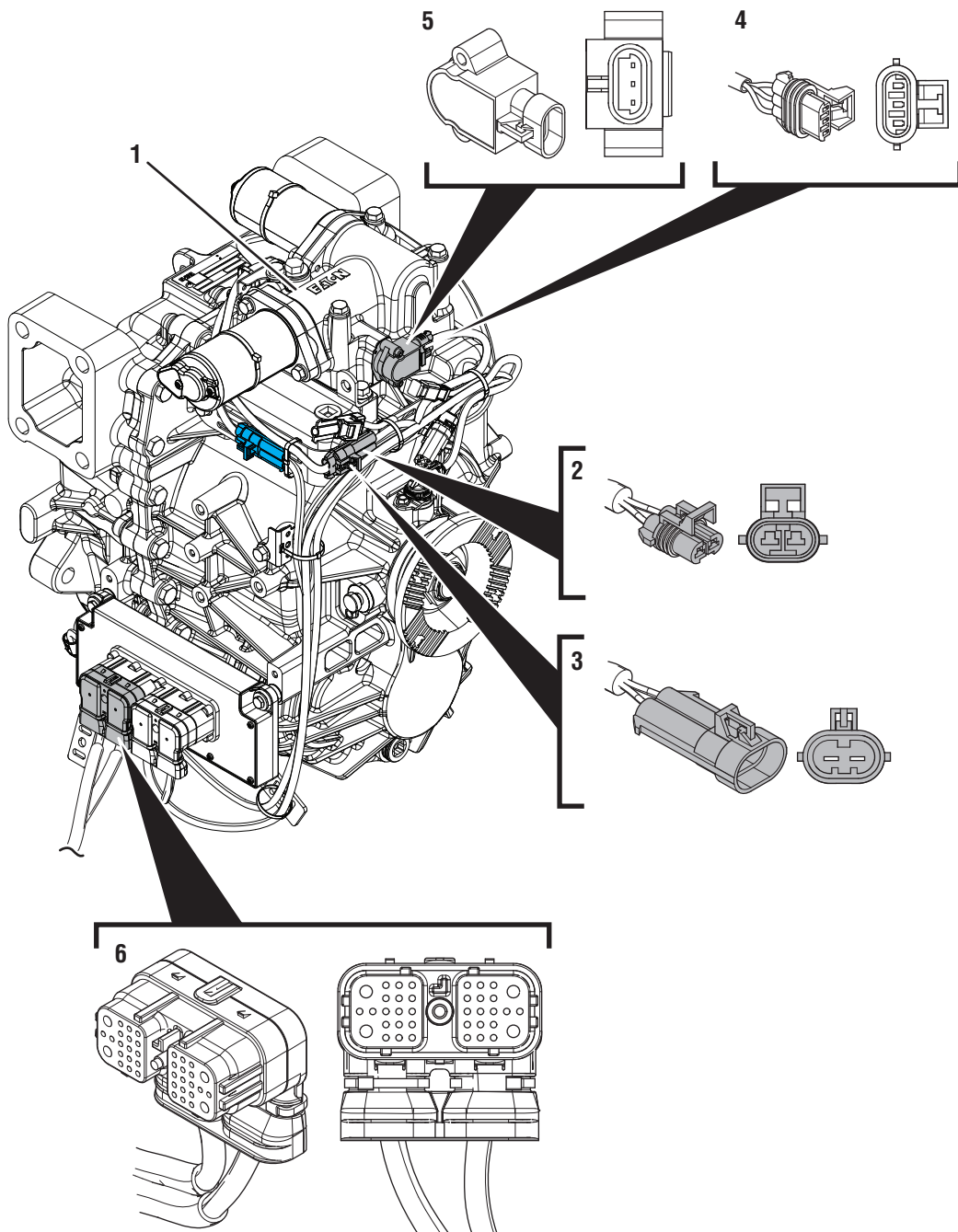
#### FMI 7, 11

- Vehicle Power Supply
  - Poor power or ground supply to TECU
  - Bent, spread, corroded or loose terminals
- Vehicle Batteries
  - Internal failure
- Transmission Harness
  - Damaged wiring between the TECU and XY Shift Actuator
  - Bent, spread, corroded or loose terminals
- XY Shift Actuator
  - Worn or damaged ball screw, center shaft bushing, or other internal components
  - Contaminated ball screw due to coolant leak or oil contamination
  - Bent, spread, corroded or loose terminals
- Mechanical Transmission
  - Worn or damaged Shift Detent Block Assembly
  - Worn Sliding Clutch slot width
  - Worn or damaged Shift Yokes
  - Worn or damaged internal transmission components

## Component Identification



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. Gear Position Sensor
4. 3-Way Gear Position Sensor Connector
5. 2-Way Gear Motor Connector (blue)
6. 2-Way Gear Motor Connector Body (blue)



- 1. XY Shift Actuator
- 2. 2-Way Rail Motor Connector (black)
- 3. 2-Way Rail Motor Connector Body (black)
- 4. 3-Way Rail Position Sensor Connector
- 5. Rail Position Sensor
- 6. 38-Way Vehicle Harness Connector

## Fault Code 73 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Code 73 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
  - If Fault Code 73 FMI 7, 11 is Inactive, go to **Step B.**
  - If Fault Code 73 FMI 7, 11 is Active, go to **Step C.**

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. Refer to *Product Diagnostic (PD) Mode* on page 6.

**Note:** The transmission does not enter PD Mode if Active transmission fault codes are present.

**Note:** Fault Code 73 does not set Active during PD Mode. Vehicle power supply to the TECU (fault codes 33, 34), XY Shift Actuator position sensors (fault codes 51, 52), and motors (fault codes 61, 63) may set Active during PD Mode.



3. Wiggle the Transmission Harness and connections between the TECU and the XY Shift Actuator including position sensors and motors.

4. Wiggle the vehicle power supply harness and connections between the batteries and TECU.
5. Key off, to exit PD Mode.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

6. Key on with engine off.
7. Connect ServiceRanger.
8. Go To “Fault Codes”.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault set Active while wiggling the Transmission Harness, replace the **Transmission Harness**. Go to **Step V.**
- If any fault set Active while wiggling the vehicle power supply wiring, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If no fault codes set Active, go to **Step C.**

**C** **Purpose:** *Inspect the batteries, in-line fuse and power and ground supplies to the TECU.*

1. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Inspect battery terminals and transmission 30-amp In-line Fuse Holder Connections for corrosion, loose terminals and bent or spread pins.
3. Inspect Battery Positive (+) and Negative (-) wires from the batteries to the TECU including all connections. Ensure a clean ground connection on the chassis. Verify no damage or corrosion to connectors.
  - If contamination or damage is found, refer to OEM guidelines for repair or replacement of the vehicle power supply harness to the 38-Way TECU Vehicle Harness Connector. Go to **Step V.**
  - If no contamination or damage is found, go to **Step D.**

**D** **Purpose:** *Perform a Load Test on each vehicle battery.*

1. Key off.
2. Set vehicle parking brake and chock wheels.
3. Load test each vehicle battery per OEM specifications. Record reading(s).
  - If any battery(s) does not pass the Load Test, refer to OEM guidelines for repair or replacement of battery(s). Go to **Step V.**
  - If all batteries pass the Load Test, go to **Step E.**

Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

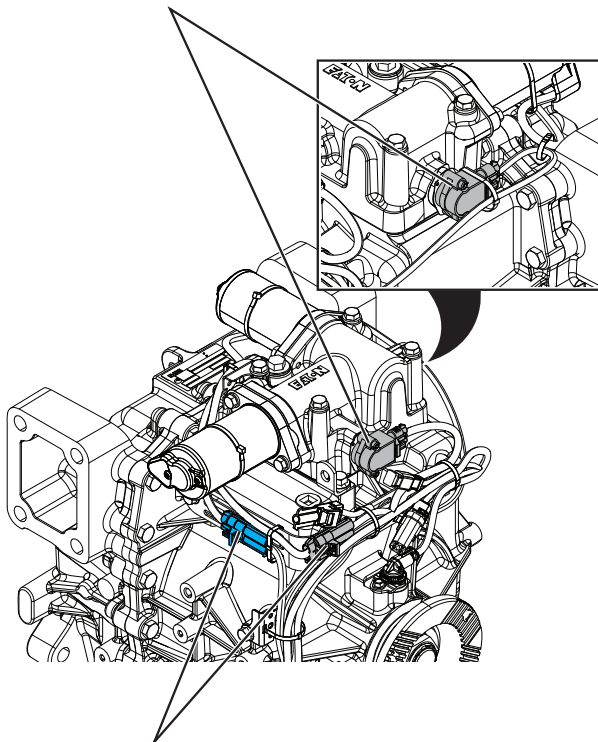
**E**

**Purpose:** Inspect XY Shifter and Transmission Harness for physical damage.

1. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Inspect the physical condition of XY Shift Actuator and all connections.
3. Inspect Transmission Harness for any pinched, chafed, corroded or shorted wiring.
4. Disconnect both 2-Way XY Shift Actuator Gear and Rail Position Sensor Connectors.

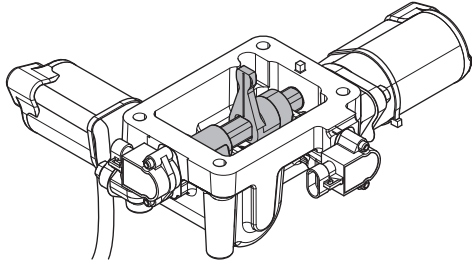


5. Disconnect both 2-Way XY Shift Actuator Motor Connectors to the Transmission Harness.

6. Inspect connectors for corrosion, loose terminals, bent or spread pin or damage to the connector bodies.
  - If damage is found with the XY Shift Actuator or related connectors or wiring, replace **X-Y Shift Actuator**. Go to **Step V**.
  - If damage to the Transmission Harness is found, replace **Transmission Harness**. Go to **Step V**.
  - If no damage is found, go to **Step F**.

## F **Purpose:** Inspect condition of XY Shifter internal components.

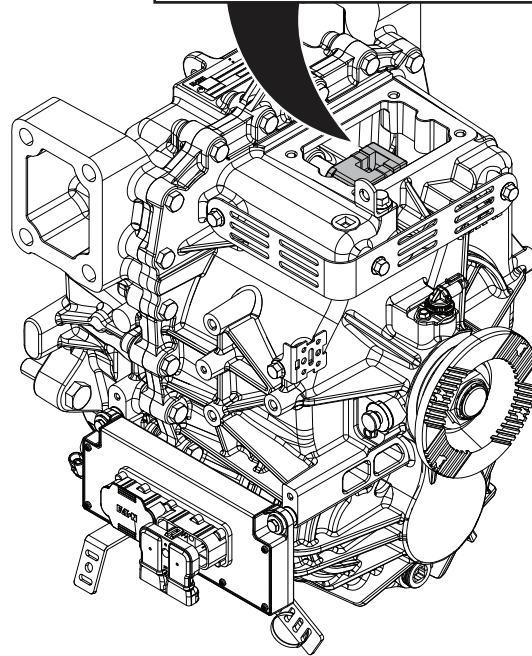
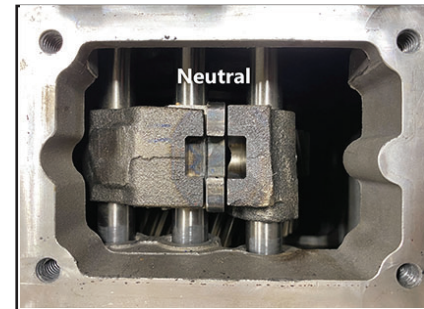
1. Key off.
2. Remove the XY Shift Actuator.
3. Inspect condition of the XY Shift Actuator Finger and Cross Shaft for damage or wear.



4. Inspect the XY Shift Actuator ball screw for signs of contamination.
  - If contamination is found, determine and repair the source of contamination, flush the transmission using Dexron automatic transmission fluid and replace the **X-Y Shift Actuator**. Go to **Step V**.
  - If damage is found to the XY Shift Actuator, replace **X-Y Shift Actuator**. Go to **Step V**.
  - If no damage is found, go to **Step G**.

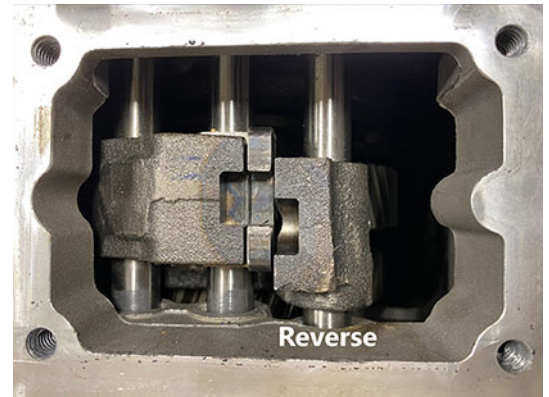
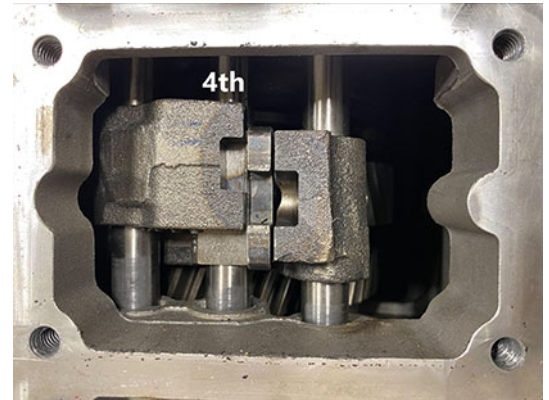
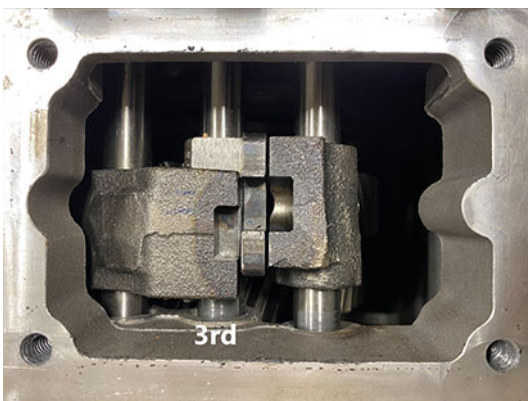
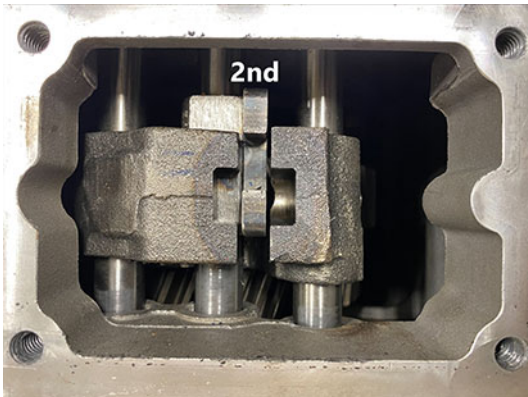
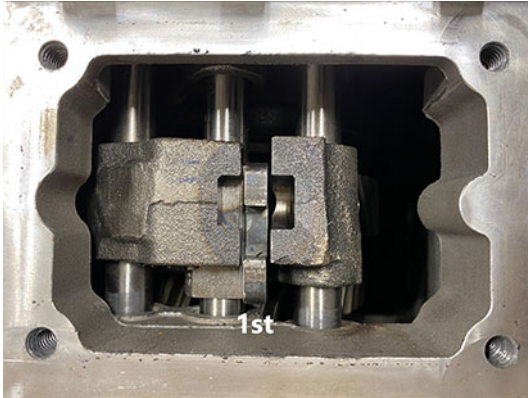
## G **Purpose:** Inspect Condition of Shift Detent Block Assembly.

1. Key off.
2. Inspect condition of the Shift Detent Block Assembly. Look for uneven gaps between the Shift Blocks or excessive wear to the block faces.
3. Verify Shift Blocks are tight to the rails and there are no other mechanical issues with the Shift Detent Block Assembly.



- Verify transmission shifts fully in and out of each gear.

**Note:** If the shift rail will not engage a gear easily, rotate the output shaft until the shift block can engage a gear position.



- Test the Shift Interlock to verify that the transmission will not engage two gears at the same time.
- Shift the transmission to the Neutral position.
  - If damage is found to the Shift Detent Block Assembly or the transmission does not shift fully into all gears, Go to **Step I**.
  - If no damage is found and the transmission shifts fully into all gears, go to **Step H**.

**H** **Purpose:** Inspect condition of the transmission lubricant.

1. Key off.
2. Perform Oil Drain Procedure.

**NOTICE:** Place a clean suitable container under the Oil Drain Plug, oil may be re-used if no debris or contamination is found.

**Note:** Reference *EV-4 Speed Automated Transmission Service Manual TRSM2150, Oil Drain Procedure*.

3. Record residual oil volume in table.
4. Inspect oil for debris and contamination.
  - If contamination or debris is evident, Go to **Step I**.
  - If no contamination or debris is evident, replace the **X-Y Shift Actuator** and **Transmission Harness**. Go to **Step V**.

Residual Oil Volume

**I** **Purpose:** Inspect condition of the internal transmission components.

1. Key off.
2. Refer to OEM guidelines for transmission removal.
3. Perform Front Housing Service Procedure.

**Note:** Reference *EV-4 Speed Automated Transmission Service Manual TRSM2150, Front Housing Service Procedure*.

4. Inspect internal transmission for contamination, debris and damage.
5. Inspect transmission gearing for damage or excessive movement.
6. Inspect Shift Yokes and Sliding Clutches for damage or excessive wear.
  - If contamination, debris or damage is found, repair as needed. Go to **Step V**.
  - If no contamination, debris or damage is found, replace the **X-Y Shift Actuator** and **Transmission Harness**. Go to **Step V**.

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed and refill the transmission with lubricant if necessary.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Inspect Shift Yokes and Sliding Clutches for damage or excessive wear.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 73 sets Active, contact Eaton at (800) 826-4357 for further diagnostics.
    - If a fault code other than 73 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

# Fault Code 81: XY Shift Actuator Finger Position

**J1939: SA 3****SPN 780****FMI 7**

## Overview

The Medium Duty 4-Speed EV Transmission uses the X-Y Shifter to engage and disengage gears based on the driver's selected mode of operation. Gear engagement and disengagement is achieved by activating the X-Y Shifter Gear Motor, which controls the fore-and-aft movement of the Shift Finger. Pushing the Shift Finger against one of the Shift Detent Block Assembly Shift Blocks guides the Shift Yoke to engage or disengage the Sliding Clutch into or out of a gear. The position of the X-Y Shift Finger is controlled and monitored by the Transmission Electronic Control Unit (TECU) by way of the X-Y Gear Position and Rail Position Sensors. The TECU uses the Transmission Speed Sensors to verify gear engagement or disengagement, and to confirm that the current transmission gear ratio is appropriate for the selected gear.

Fault Code 81 is set when the X-Y Gear Position Sensor and Rail Position Sensor indicate that the Shift Finger is in a neutral position, but other indicators do not confirm that the transmission is in Neutral.

## Detection

This fault can only be detected when there are no failures of the TECU, X-Y Position Sensors or Transmission Speed Sensors. This fault code is set when the Transmission Speed Sensor values are not consistent with the X-Y Gear Position and Rail Position values.

## Conditions to Set Fault Code Active

### FMI 7 – Mechanical System Not Responding:

- Both the X-Y Gear Position Sensor and Rail Position Sensor indicate the Shift Finger is in a neutral position. However, the Transmission Speed Sensors indicate that the transmission is in gear. If the overall transmission gear ratio indicates the transmission is not in neutral after two unsuccessful attempts to pull the Shift Finger to neutral, the fault sets Active.

## Fallback

### FMI 7

- "F" flashes in gear display.
- Service light flashes (if equipped).
- Transmission may remain in current gear.
- Motor may have to be shut down with transmission still in gear.

## Conditions to Set Fault Code Inactive

**FMI 7:** This fault code sets Inactive in one of two ways:

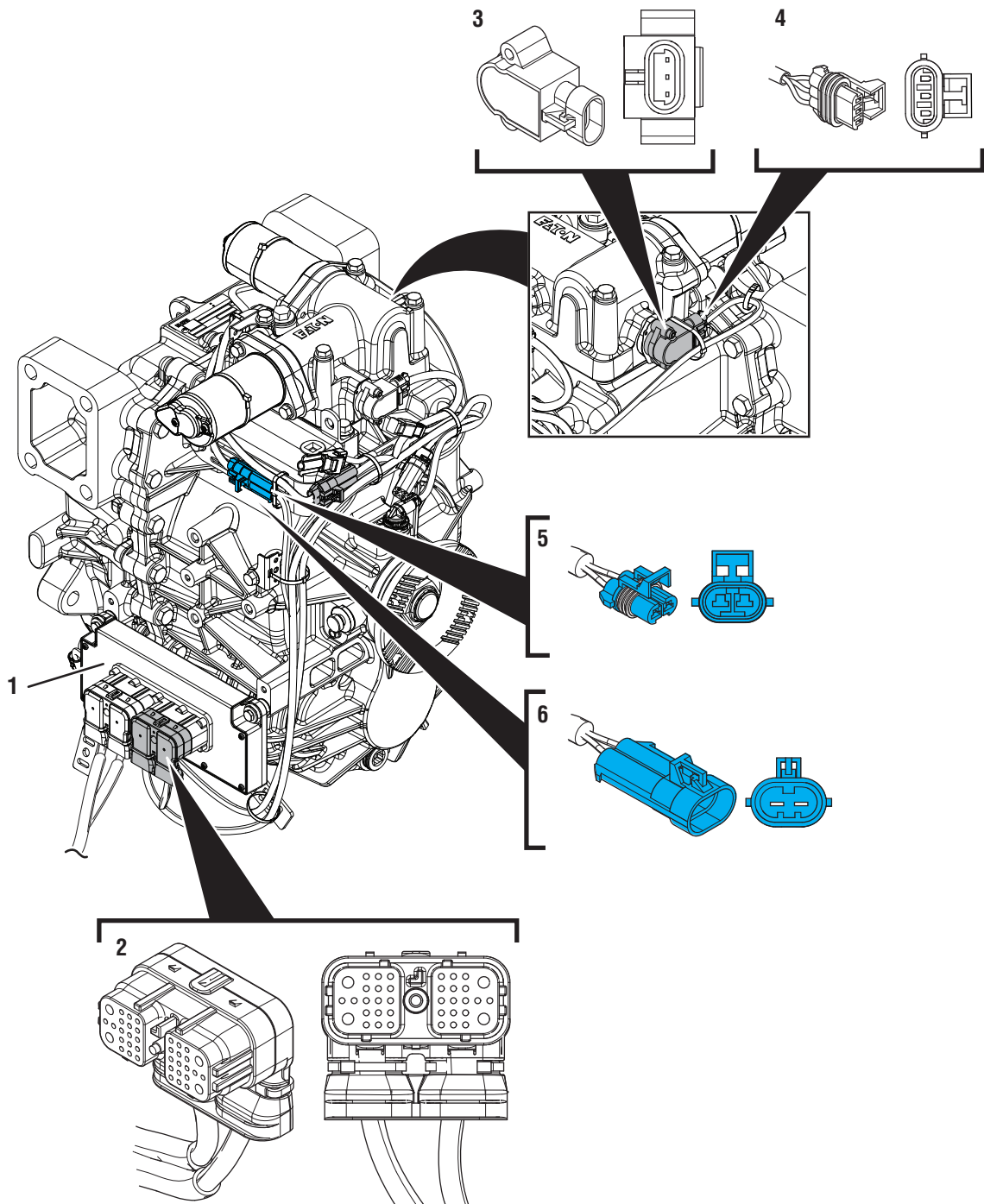
- Ignition key is turned off and TECU is powered down.
- The system successfully engages the desired gear.

## Possible Causes

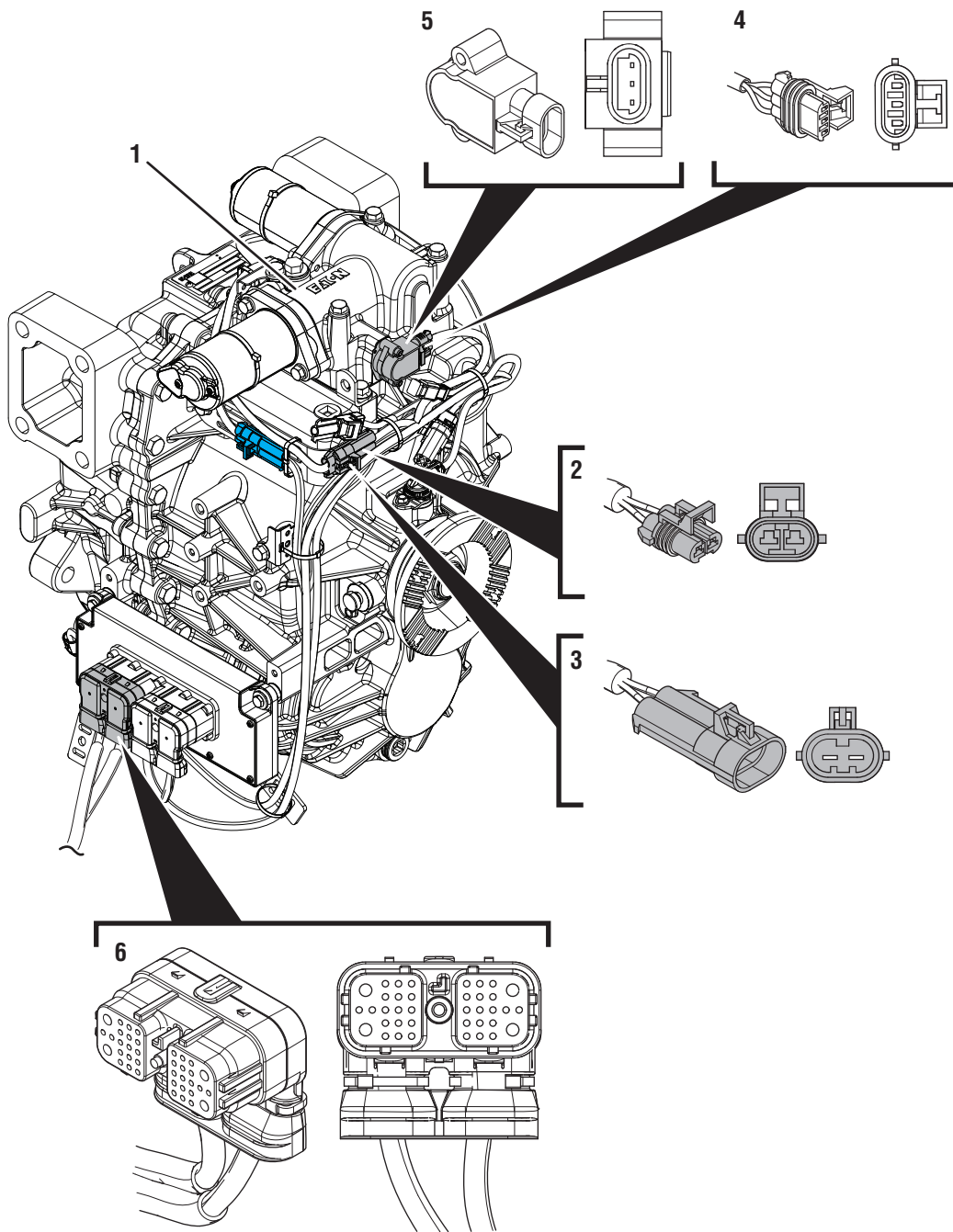
### FMI 7

- X-Y Shifter
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Gear Position Sensor damaged
  - Worn or damaged X-Y Shifter ball screw, center shaft bushing, or other internal components
- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Mechanical Transmission
  - Worn or damaged Shift Detent Block Assembly
  - Worn Sliding Clutch slot width
  - Worn or damaged Shift Yokes
  - Worn or damaged internal transmission components

## Component Identification



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 3-Way Gear Position Sensor
4. 3-Way Gear Position Sensor Connector
5. 2-Way Gear Motor Connector (blue)
6. 2-Way Gear Motor Connector Body (blue)



- 1. X-Y Shifter
- 2. 2-Way Rail Motor Connector (black)
- 3. 2-Way Rail Motor Connector Body (black)
- 4. 3-Way Rail Position Sensor Connector
- 5. 3-Way Rail Position Sensor
- 6. 38-Way Vehicle Harness Connector

## Fault Code 81 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
  - If Fault Codes 51 or 52 are Active or Inactive, troubleshoot per *Fault Code Isolation Procedure Index* on page 14 prior to troubleshooting Fault Code 81.
  - If Fault Code 81 is Inactive, go to **Step B.**
  - If Fault Code 81 is Active, go to **Step C.**

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.

**Note:** Fault Code 81 does not set Active during PD Mode. Other fault codes may set during PD Mode that could indicate an issue with the wiring being inspected.



3. Wiggle wiring and connections of the Transmission Harness between the TECU and the X-Y Shifter. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- If any fault codes set Active while wiggling the Transmission Harness, replace **Transmission Harness.** Go to **Step V.**
- If no fault codes set Active, go to **Step C.**

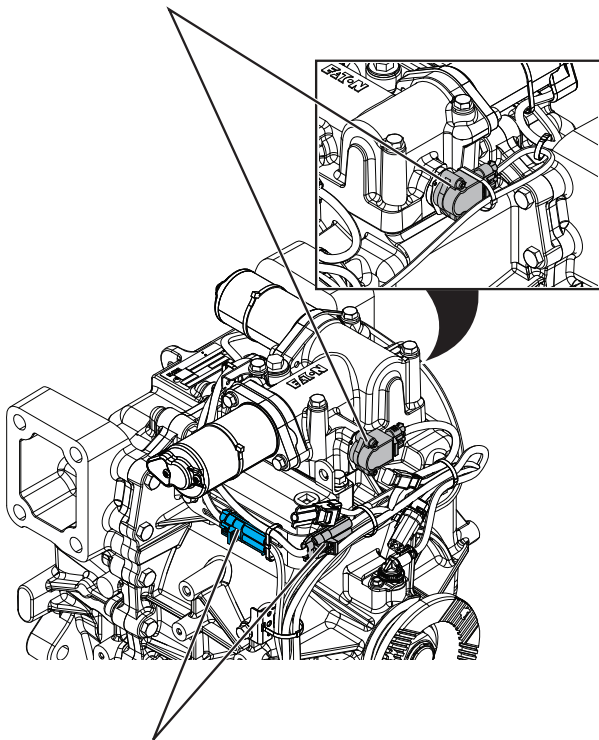
**C**

**Purpose:** Inspect X-Y Shifter and Transmission Harness for physical damage.

1. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Inspect the physical condition of X-Y Shifter and all connections to X-Y Shifter.
3. Inspect Transmission Harness for any pinched, chafed, corroded or shorted wiring.
4. Disconnect both 2-Way X-Y Gear and Rail Position Sensor Connectors.



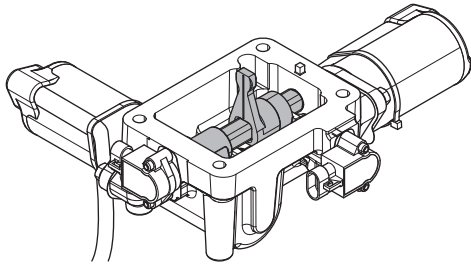
5. Disconnect both 2-Way X-Y Motor Connectors to the Transmission Harness.

6. Inspect connectors for corrosion, loose terminals, bent or spread pin or damage to the connector bodies.

- If damage to the X-Y Shifter or X-Y Shifter wiring is found, replace **X-Y Shift Actuator**. Go to **Step V**.
- If damage to the Transmission Harness is found, replace **Transmission Harness**. Go to **Step V**.
- If no damage is found, go to **Step D**.

**D** **Purpose:** *Inspect condition of X-Y Shifter internal components.*

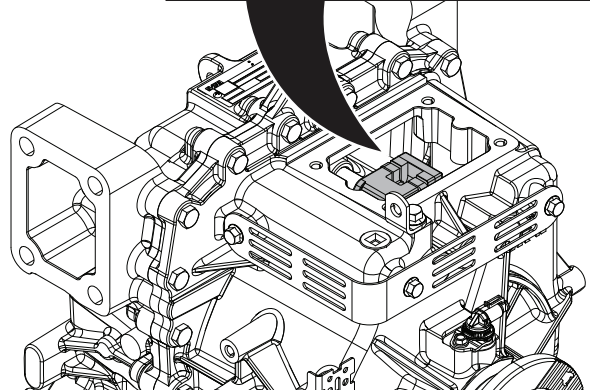
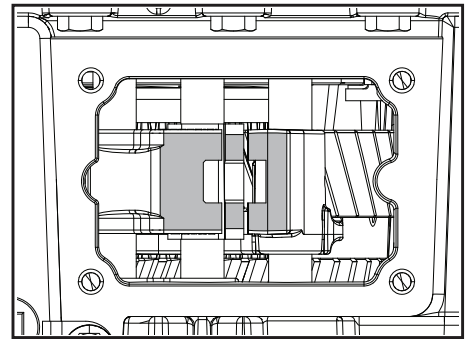
1. Key off.
2. Remove the X-Y Shifter.
3. Inspect condition of the X-Y Shift Finger and Cross Shaft for damage or wear.



4. Inspect the X-Y Shifter ball screw for signs of contamination.
  - If contamination is found, determine and repair the source of contamination, flush the transmission using Dexron automatic transmission fluid and replace the X-Y Shifter. Go to **Step V.**
  - If damage to the X-Y Shifter is found, replace **X-Y Shift Actuator**. Go to **Step V.**
  - If no damage is found, go to **Step E.**

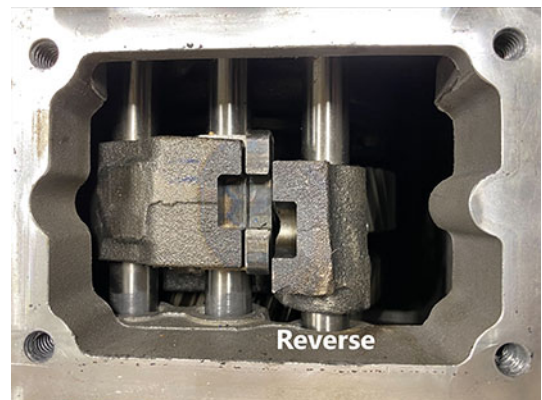
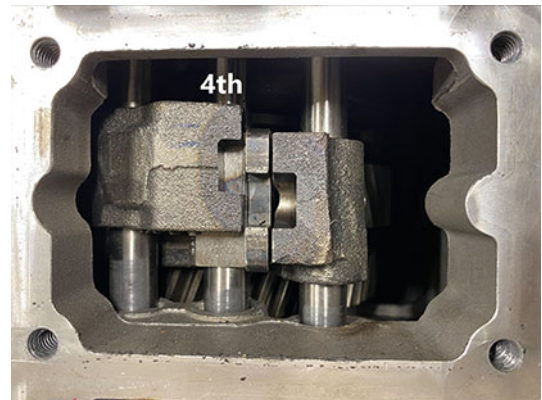
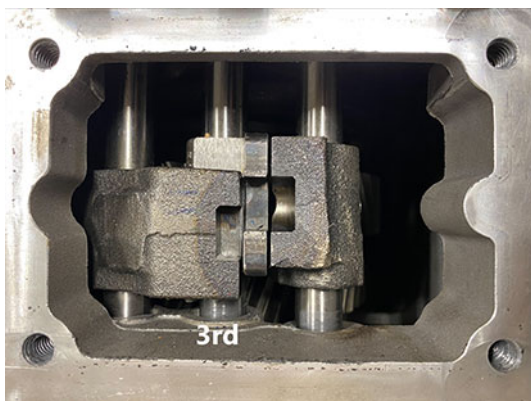
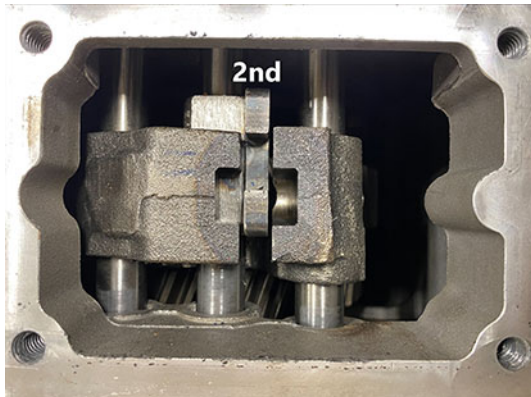
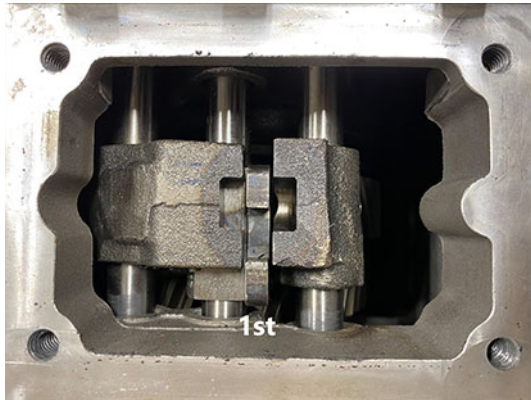
**E** **Purpose:** *Inspect condition of Shift Detent Block Assembly.*

1. Key off.
2. Inspect condition of the Shift Detent Block Assembly Shift Blocks. Look for uneven gaps between the Shift Blocks or excessive wear to the block faces.
3. Verify Shift Blocks are tight to the rails and there are no other mechanical issues with the Shift Detent Block Assembly.



- Verify transmission shifts fully in and out of each gear.

**Note:** If the shift rail will not engage a gear easily, rotate the output shaft until the shift block can engage a gear position.



- Test the Shift Interlock to verify that the transmission will not engage two gears at the same time.
- Shift the transmission to the Neutral position.
  - If damage is found to the Shift Detent Block Assembly or the transmission does not shift fully into all gears, go to **Step G**.
  - If no damage is found and the transmission shifts fully into all gears, go to **Step F**.

**F**

**Purpose:** *Inspect condition of the transmission lubricant.*

1. Key off.
2. Perform Oil Drain Procedure.

**NOTICE:** Place a clean suitable container under the Oil Drain Plug, oil may be reused if no debris or contamination is found.

**Note:** Reference *EV-4 Speed Automated Transmission Service Manual TRSM2150, Oil Drain Procedure.*

3. Record residual oil volume in table.
4. Inspect oil for debris and contamination.
  - If contamination or debris is evident, go to **Step G.**
  - If no contamination or debris is evident, replace the **X-Y Shift Actuator** and **Transmission Harness**. Go to **Step V.**

**G**

**Purpose:** *Inspect condition of the internal transmission components.*

1. Key off.
2. Refer to OEM guidelines for transmission removal.
3. Perform Front Housing Service Procedure.

**Note:** Reference *EV-4 Speed Automated Transmission Service Manual TRSM2150, Front Housing Service Procedure.*

4. Inspect internal transmission for contamination, debris, and damage.
5. Inspect transmission gearing for damage or excessive movement.
6. Inspect Shift Yokes and Sliding Clutches for damage or excessive wear.
  - If contamination, debris, or damage is found, repair as needed. Go to **Step V.**
  - If no contamination, debris, or damage is found, replace the **X-Y Shift Actuator**.

**V****Purpose:** *Verify repair.*

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed and refill the transmission with lubricant if necessary.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 81 sets Active during the test drive, contact Eaton at (800) 826-4357.
    - If a fault code other than 81 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 84: Shift Device Not Configured

**J1939: SA 3      SPN 751      FMI 13**

### Overview

The Medium Duty 4-Speed EV Transmission may be equipped with an analog Shift Control Device. The Transmission Electronic Control Unit (TECU) supplies the analog Shift Control Device a 5-volt reference through OEM wiring. This voltage is reduced by resistive ladder circuitry in the Shift Device, based on the position the driver selects. The return voltage to the TECU indicates the position of the Shift Lever. Fault Code 84 indicates that the TECU detected an incorrect Driver Interface Type configuration.

### Detection

The TECU determines the type of Shift Control Device the vehicle is equipped with during the initial power up. Fault Code 84 sets Active when the stored Driver Interface Type configuration in the TECU does not match the Shift Device on the vehicle, provided there are no low battery system fault codes set.

### Conditions to Set Fault Code Active

**FMI 13 – Out of Calibration:** The stored Driver Interface Type configuration file does not match the Shift Device on the vehicle.

### Fallback

#### FMI 13

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Motor may not operate.
- Transmission will not engage a gear from neutral.

### Conditions to Set Fault Code Inactive

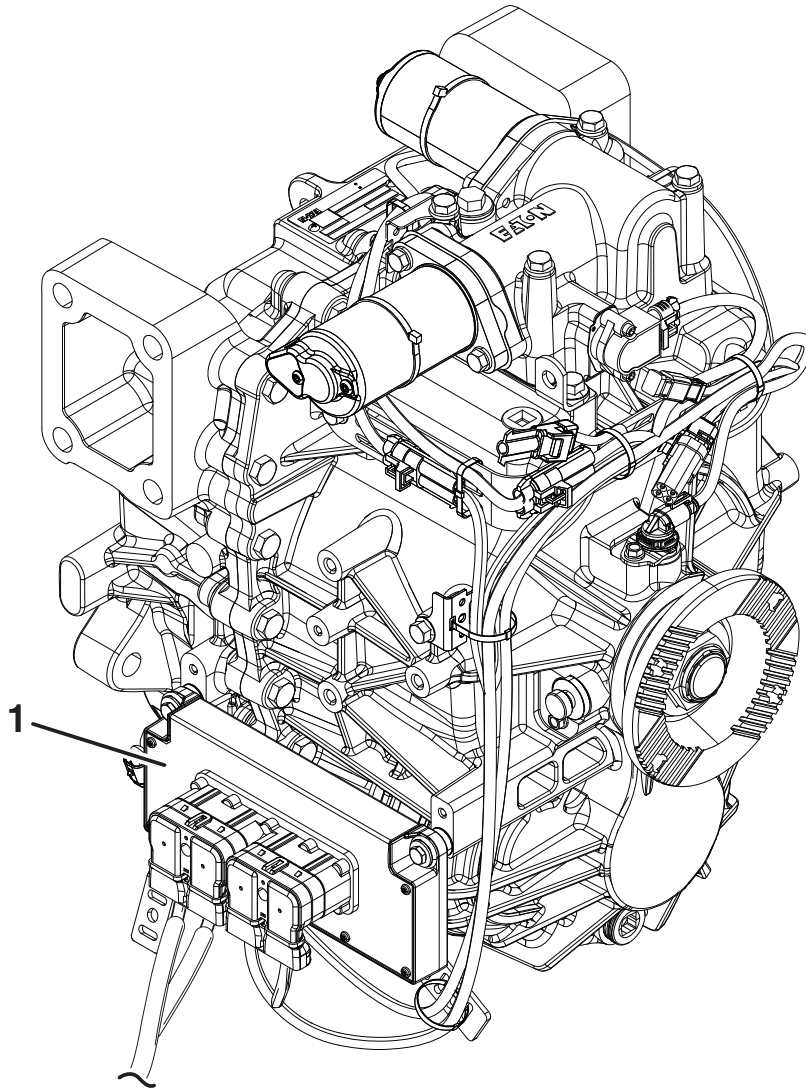
**FMI 13:** This fault code is never set Inactive. Fault Code 84 only sets in an Active state.

### Possible Causes

#### FMI 13

- TECU
  - Driver Interface Type configuration incorrect or unknown

## Component Identification



1. Transmission Electronic Control Unit (TECU)

## Fault Code 84 Troubleshooting

### A

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
  2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If Fault Code 84 is Active, go to **Step B**.
    - If Fault Code 84 is Inactive, test complete. go to **Step V**.
- 

### B

**Purpose:** Perform Driver Interface reset procedure.

1. Key on with motor off.
  2. Connect ServiceRanger.
  3. In ServiceRanger, go to “Service Routines”.
  4. Select “Driver Interface Reset Utility”.
  5. Select and perform “Transmission Driver Interface Type Reset”.
  6. Key off.

**NOTICE:** Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
  7. Key on with motor off.
  8. Connect ServiceRanger.
  9. Retrieve and record the transmission fault codes.
    - If Driver Interface Device is now calibrated and Fault Code 84 is Inactive, go to **Step V**.
    - If Driver Interface Device could not be calibrated and Fault Code 84 remains Active, replace **Transmission Electronic Control Unit (TECU)**. Go to **Step A**.
-

**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 84 sets Active during the test drive, go to **Step A**.
    - If a fault code other than 84 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 85: Shift Control Device Incompatible

**J1939: SA 3      SPN 751      FMI 12**

### Overview

The Medium Duty 4-Speed EV Transmission may be equipped with an Eaton Push Button Shift Control Device (PBSC) or J1939 Shift Control Device. At key on, the Transmission Electronic Control Unit (TECU) establishes communication with the Shift Control Device in preparation for vehicle operation. Fault Code 85 sets when the TECU receives a message from an incompatible Shift Control Device.

### Detection

The TECU determines the type of Shift Control Device the vehicle is equipped with during the initial power up. If the TECU determines the Shift Control Device is incorrect and there are no low battery system faults, this fault code sets Active.

### Conditions to Set Fault Code Active

**FMI 12 – Bad Intelligent Device:** TECU detects an incompatible Shift Control Device for 10 seconds.

### Fallback

**FMI 12**

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Transmission will not engage a gear from neutral.
- Transmission will not attempt to shift out of current gear.

### Conditions to Set Fault Code Inactive

**FMI 12:** TECU recognizes a valid Shift Control Device.

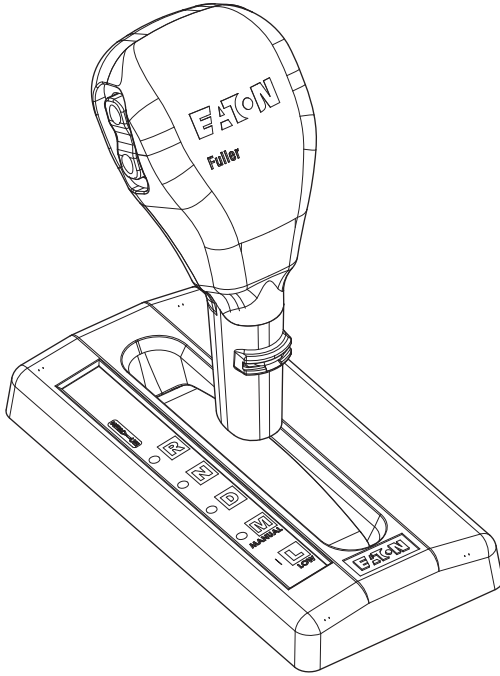
### Possible Causes

**FMI 12**

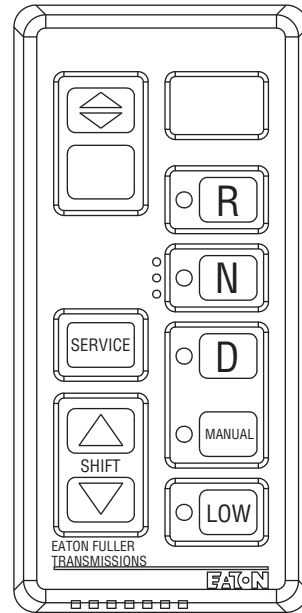
- Shift Control Device
  - Improper Shift Control Device installed on vehicle

## Component Identification

1



2



1. Eaton Cobra Lever
2. Eaton Push Button Shift Controller (PBSC)

---

## Fault Code 85 Troubleshooting

**A**

**Purpose:** Check for Active or Inactive fault codes.

1. Set vehicle parking brake and chock wheels.
  2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If Fault Code 85 is Active, install correct Shift Control Device type. Go to **Step V.**
    - If Fault Code 85 is Inactive, test complete. Go to **Step V.**
- 

**V**

**Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Check for fault codes using ServiceRanger.
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 85 sets Active during the test, go to **Step A.**
    - If a fault code other than 85 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Fault Code 99: Direction Mismatch

**J1939: SA 3      SPN 781      FMI 12, 13**

### Overview

The Medium Duty 4-Speed EV Transmission uses the X-Y Shifter to select the proper rail and engage or disengage a gear based on the driver's selected mode of operation. The position of the X-Y Shift Finger is controlled and monitored by the Transmission Electronic Control Unit (TECU) by way of the X-Y Gear Position and Rail Position Sensors.

Fault Code 99 is set when the TECU commands the X-Y Shifter to move to a specific position and the reported Shift Finger position achieved does not match the desired position.

### Detection

This fault can only be detected when there are no failures of the TECU or X-Y Position Sensors. This fault code is set when the X-Y Gear Position and Rail Position values are valid, but do not match the requested positions requested by the TECU.

### Conditions to Set Fault Code Active

**FMI 12 – Bad Intelligent Device:** The XY Shift Actuator Gear Position reports the Gear Motor is moving in the opposite direction of the selected mode.

**FMI 13 – Out of Calibration:** The XY Shift Actuator Gear Position reports Reverse Gear is engaged when not selected.

### Fallback

#### FMI 14:

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Transmission remains in current gear.
- May not engage a start gear from neutral.
- Motor may have to be shut down with the transmission still in gear.
- Audible warning tone sounds.

### Conditions to Set Fault Code Inactive

**All FMIs:** Neutral mode is selected and the system confirms Neutral.

### Possible Causes

#### FMI 12:

- TECU
  - Internal failure
- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- X-Y Shifter
  - Bent, spread, corroded or loose terminals
  - Gear Position Sensor damaged
  - Rail Position Sensor damaged

#### FMI 13:

- TECU
  - Internal failure
  - Transmission Configuration Value
- X-Y Shifter
  - Bent, spread, corroded or loose terminals
  - Gear Position Sensor damaged
  - Rail Position Sensor damaged

### Component Identification

None

---

## Fault Code 99 Troubleshooting

**A****Purpose:** Check for Active or Inactive fault codes.

1. Document the vehicle symptoms.
  2. Set vehicle parking brake and chock wheels.
  3. Key on with motor off.
  4. Connect ServiceRanger.
  5. Retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton".
  6. Retrieve and record the transmission fault codes and FMI, and their occurrences and timestamps.
    - Contact Eaton at (800) 826-4357 for further diagnostic instructions.
-

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## J1939 Vehicle Data Link Test

### Overview

This symptom driven test is performed if the J1939 Vehicle Data Link is failing to function in some way without setting transmission Fault Code 35. Proper operation of the J1939 Vehicle Data Link is critical for proper transmission operation.

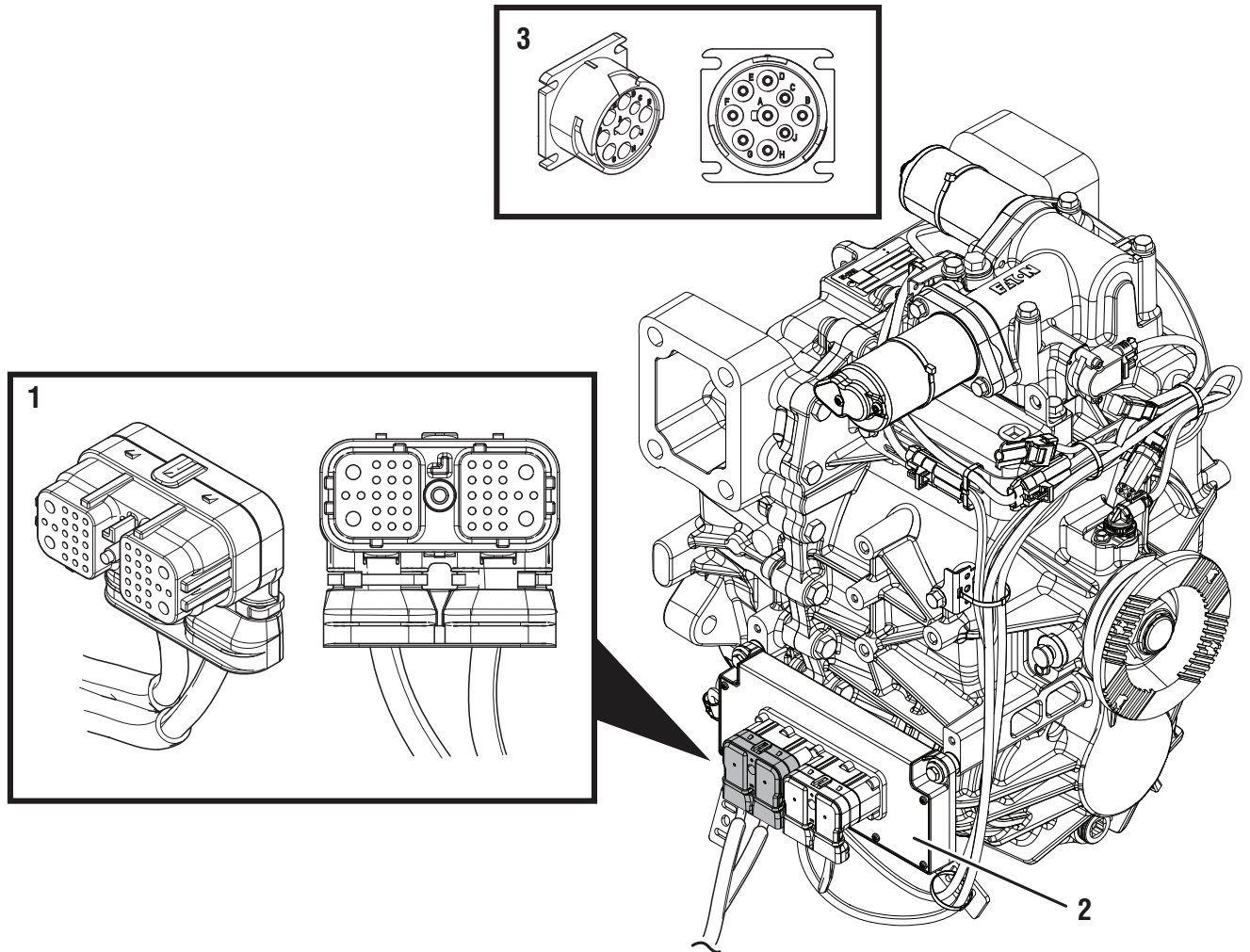
### Detection

- Various communication problems between vehicle ECUs.
- ServiceRanger or other diagnostic software may not be able to communicate with TECU or vehicle ECUs.

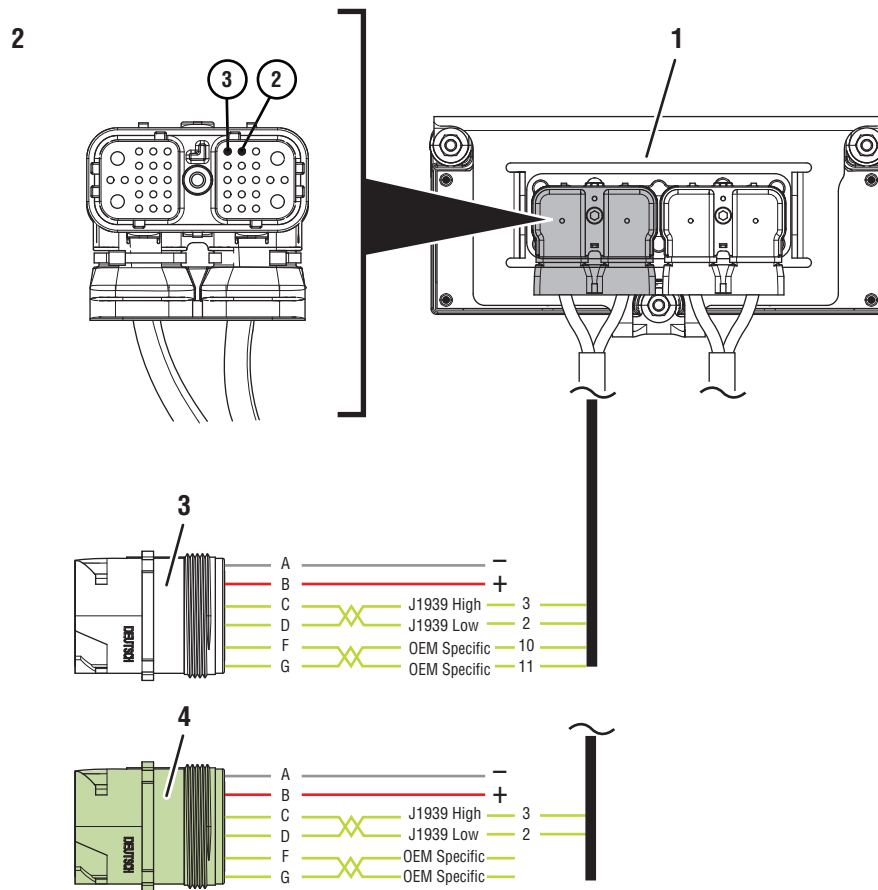
### Possible Causes

- J1939 Vehicle Data Link
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Various Vehicle ECUs
  - Internal Failure
  - Loss of Power Supply to ECU
  - Poor connection to J1939 Vehicle Data Link
  - Wiring shorted to ground, shorted to power or open

## Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 9-Way Diagnostic Connector (in cab)



- 1. Transmission Electronic Control Unit (TECU)
- 2. 38-Way Vehicle Harness Connector
- 3. 9-Way Diagnostic Connector (Black) - OEM Specific CD (in cab)
- 4. 9-way Diagnostic Connector (Green) - OEM Specific CD (in cab)



## J1939 Vehicle Data Link Test

### A

**Purpose:** Check for active or inactive fault codes.

1. Set parking brake and chock wheels.
2. Key on with motor off.
3. Connect ServiceRanger.
4. Update transmission software to latest available level.

**Note:** To avoid damaging the TECU, use an approved communications adapter and ensure all satellite systems are disabled before updating software.

5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
  - If Fault Code 35 is Active or Inactive, troubleshoot per Fault Code Isolation Procedure Index on page 13.
  - If another Fault Code is Active, troubleshoot per Fault Code Isolation Procedure Index on page 13.
  - If Fault Codes 35 is not present and there are no other Active fault codes, go to **Step B**.
  - If ServiceRanger does not connect, go to **Step C**.

### B

**Purpose:** Use Product Diagnostic (PD) Mode to locate intermittent failures.

1. Set parking brake and chock wheels.
2. Place transmission in PD Mode. See more about *Product Diagnostic (PD) Mode* on page 6.

**Note:** Transmission does not enter PD Mode when Active fault codes exist.

**Note:** Solid "PD" in display when test is active.



3. Wiggle wiring and connections through out the entire J1939 Vehicle Data Link up to the 38-Way TECU Vehicle Harness. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM for specific wire routing locations.
4. Exit PD Mode.
  - If the ServiceRanger connection to the vehicle was lost or Fault Code 35 became Active while wiggling the J1939 Vehicle Data Link, refer to OEM guidelines for repair or replacement of J1939 Vehicle Data Link. Go to **Step V**.
  - If no fault code set active, go to **Step C**.

**C** *Purpose: Identify TECU location on J1939 Vehicle Data Link.*

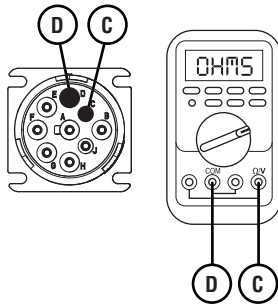
1. Key off.
2. Refer to the OEM and identify the TECU location on the J1939 Vehicle Data Link at the 9-Way Diagnostic Connector.
  - If Black 9-Way Diagnostic Connector, go to **Step D.**
  - If Green 9-Way Diagnostic Connector on Pin C and Pin D, go to **Step D.**

3. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Vehicle Data Link. Go to **Step V.**
  - If readings are in range, go to **Step E.**

Pins	Range	Reading(s)
C to D	50–70 Ohms	

**D** *Purpose: Verify resistance of J1939 Vehicle Data Link at 9-Way Diagnostic Connector (CD).*

1. Key off.
2. Measure resistance between 9-Way Diagnostic Connector Pin C and Pin D. Record reading in table.



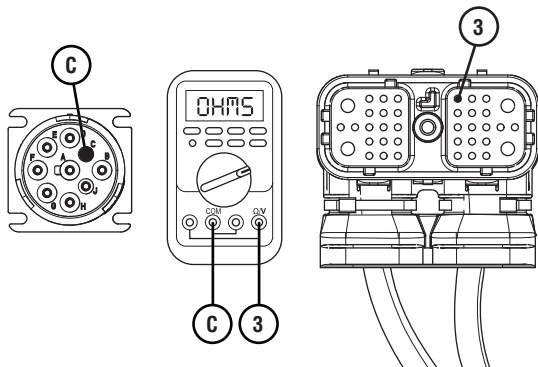
**E** *Purpose: Verify 38-Way TECU Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect the 38-Way TECU Vehicle Harness Connector.
3. Inspect the 38-Way TECU Vehicle Harness Connector for contamination, corrosion, damage, loose, bent or spread terminals.
4. Inspect the TECU side of the 38-Way TECU Vehicle Harness Connector for contamination, corrosion, damage, loose, bent or spread terminals.
  - If any contamination or damage is found, refer to OEM guidelines for repair or replacement of the 38-Way TECU Vehicle Harness Connector.
  - If no contamination or damage is found, go to **Step F.**

**F**

**Purpose:** Verify TECU connection across J1939 Vehicle Data Link Positive (+/High) to 9-Way Diagnostic Connector.

1. Key off.
2. Measure resistance between 38-Way TECU Vehicle Harness Connector Pin 3 and 9-Way Diagnostic Connector Pin C. Record reading in table.



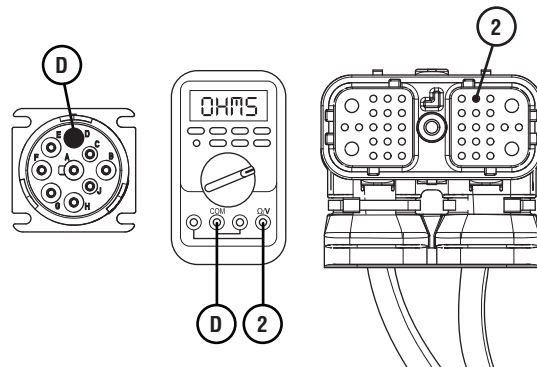
3. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Vehicle Data Link. Go to **Step V**.
  - If readings are in range, go to **Step G**.

Pins	Range	Reading(s)
3 to C	0–0.3 Ohms	

**G**

**Purpose:** Verify TECU connection across J1939 Vehicle Data Link Negative (-/Low) to 9-Way Diagnostic Connector.

1. Key off.
2. Measure resistance between 38-Way TECU Vehicle Harness Connector Pin 2 and 9-Way Diagnostic Connector Pin D. Record reading in table.



3. Compare reading(s) in table.
  - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Vehicle Data Link. Go to **Step V**.
  - If readings are in range, go to **Step H**.

Pins	Range	Reading(s)
2 to D	0–0.3 Ohms	

**H**

**Purpose:** Use ServiceRanger to monitor ECUs communication on the J1939 Vehicle Data Link.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with motor off.
4. Connect ServiceRanger.
5. Go To “Data Monitor”.
6. Select “Components” tab.
7. Monitor the roster of vehicle ECUs currently communicating on the J1939 Vehicle Data Link.
8. Compare this list to the roster of vehicle ECUs that should be communicating on the J1939 Vehicle Data Link.

**Note:** Contact the OEM for information about which vehicle ECUs should be on the J1939 Vehicle Data Link.

- If no vehicle ECUs are present on the ServiceRanger roster, go to **Step I**.
- If all vehicle ECUs are present on the ServiceRanger roster, no problem was found during testing. Test complete. Contact the OEM if further diagnostics are required.
- If any vehicle ECU is missing from the ServiceRanger roster, investigate that device to verify that it is properly powered and wired to the J1939 Vehicle Data Link. Repair or replace any component or wiring per OEM requirements. Go to **Step V**.

**I**

**Purpose:** Remove vehicle devices from the J1939 Vehicle Data Link.

1. Key on with motor off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. Select “Components” tab.
5. Monitor the roster of vehicle ECUs currently communicating on the J1939 Vehicle Data Link.
6. Individually remove each vehicle ECU from the J1939 Vehicle Data Link.
7. After removing each device, monitor the ServiceRanger ECU roster.
8. If the removal of an ECU from the J1939 Vehicle Data Link allows other ECUs to appear in the ServiceRanger ECU roster, the removed ECU may have been shorting out the J1939 Data Link or otherwise preventing communication.
  - If a problem is found, repair or replace the wiring or component per OEM requirements. Go to **Step V**.
  - If no problems are found, contact the OEM for further diagnostics.

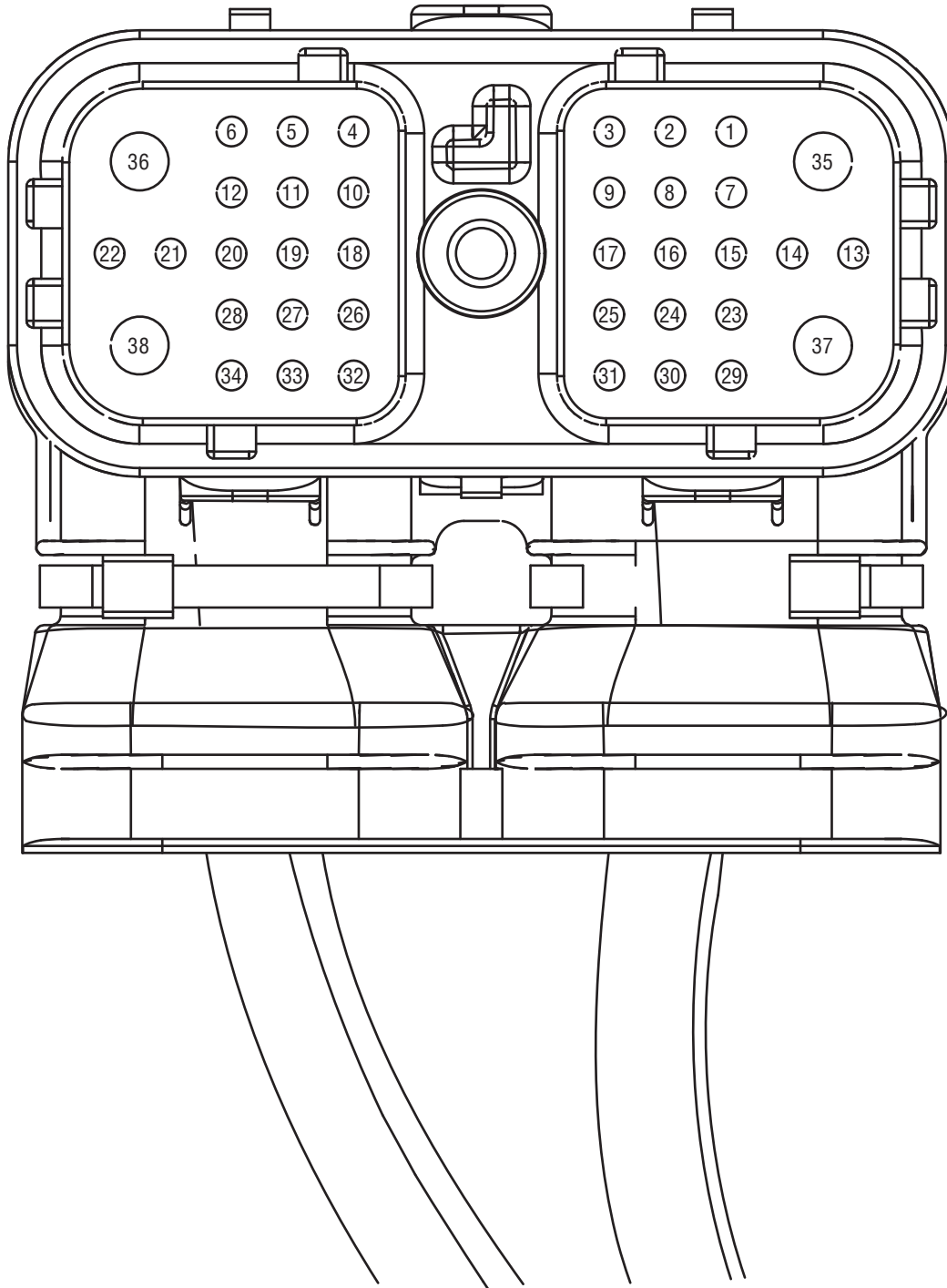
**V****Purpose:** Verify repair.

1. Key off.
  2. Reconnect all connectors and verify that all components are properly installed.
  3. Key on with motor off.
  4. Clear fault codes using ServiceRanger.
  5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
  6. Check for fault codes using ServiceRanger:
    - If no fault codes set and vehicle operates properly, test complete.
    - If Fault Code 35 sets Active during the test drive, go to **Step A**.
    - If a fault code other than 35 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 14.
-

## Connector Pin Descriptions

**Note:** This section is intended as a quick reference. For specific instructions, see the Medium Duty 4-Speed EV Transmission Installation Guide TRIG2150.

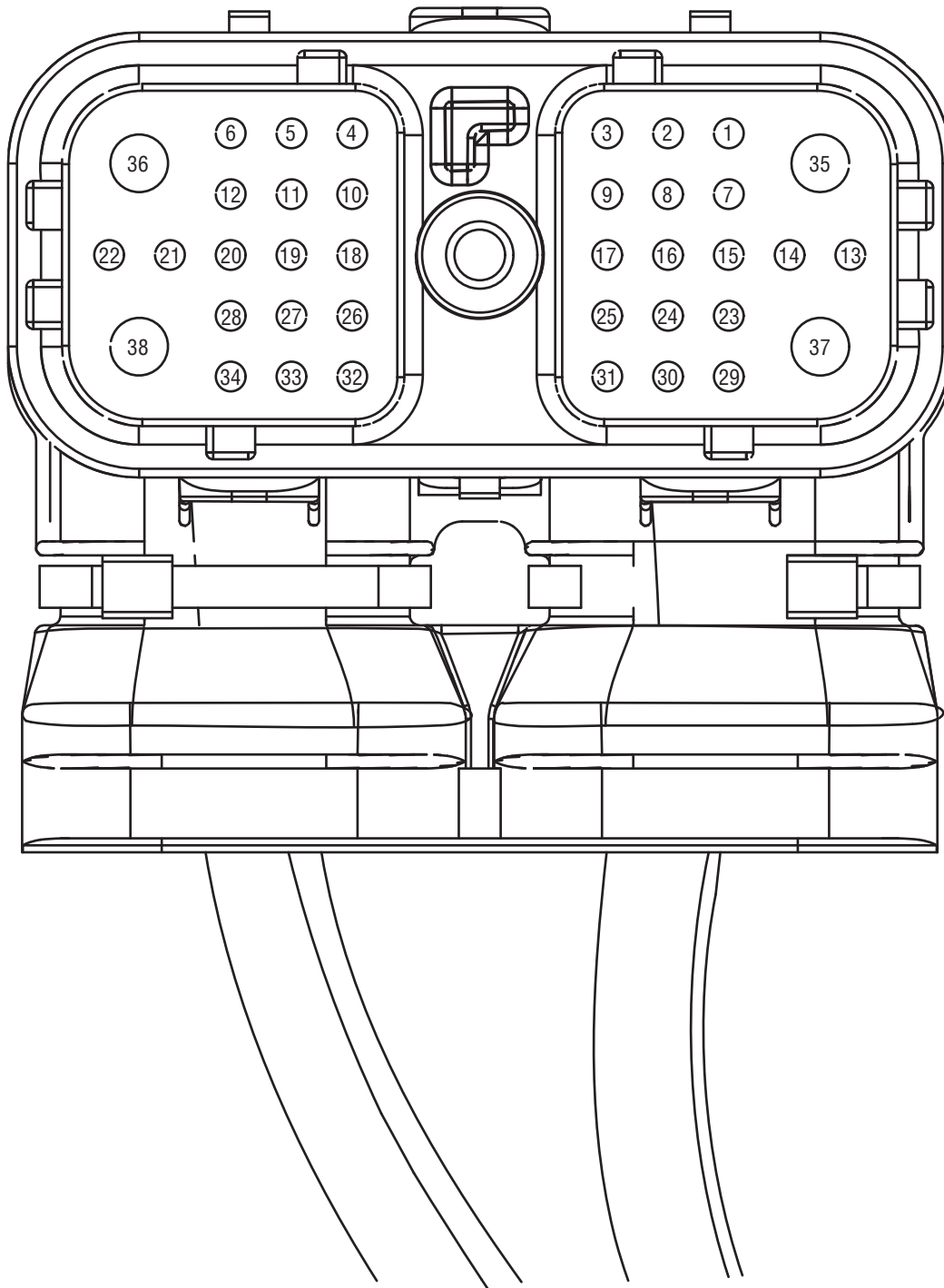
### 38-Way Vehicle Harness Connector



38-Way Pin	Description	Wire
1	Not Used	Plug
2	J1939 Low (-)	18 TXL
3	J1939 High (+)	18 TXL
4	Not Used	Plug
5	Not Used	Plug
6	Not Used	Plug
7	Not Used	Plug
8	Not Used	Plug
9	Not Used	Plug
10	Not Used	Plug
11	Not Used	Plug
12	Not Used	Plug
13	Not Used	Plug
14	Shift Control Input Common 2 (-)	18 TXL
15	Shift Control Input Auto Mode Signal (+)	18 TXL
16	Shift Control Input Manual Mode Signal (+)	18 TXL
17	Shift Control Input Common 1 (-)	18 TXL
18	Not Used	Plug
19	Not Used	Plug

38-Way	Description	Wire
20	Not Used	Plug
21	Not Used	Plug
22	Not Used	Plug
23	Service Light Supply	18 TXL
24	Not Used	Plug
25	Shift Control Protected Battery Negative (-)	18 TXL
26	Not Used	Plug
27	HIL Low (-)	18 TXL
28	HIL High (+)	18 TXL
29	Not Used	Plug
30	Not Used	Plug
31	Shift Control Protected Battery Positive (+)	18 TXL
32	Not Used	Plug
33	Not Used	Plug
34	Not Used	Plug
35	Ignition	12 GXL or 14SXL
36	Battery Negative (-)	12 GXL
37	Not Used	Plug
38	Battery Positive (+)	12 GXL

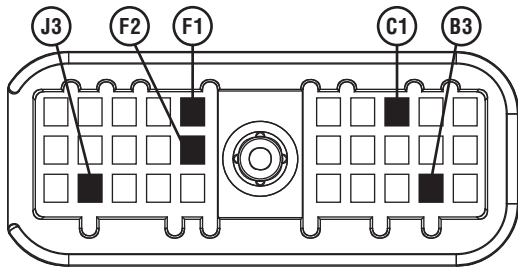
### 38-Way Heavy-Duty Transmission Harness Connector



38-Way Pin	Description	Wire
1	Not Used	Plug
2	Not Used	Plug
3	Not Used	Plug
4	Not Used	Plug
5	Not Used	Plug
6	Not Used	Plug
7	Input Shaft Speed Signal High (+)	18 GXL
8	Input Shaft Speed Signal Low (-)	18 GXL
9	Not Used	Plug
10	X-Y Gear Position Sensor Power Source (5V)	18 GXL
11	X-Y Gear Position Sensor Signal Return	18 GXL
12	X-Y Gear Position Sensor Ground	18 GXL
13	Not Used	Plug
14	Not Used	Plug
15	Not Used	Plug
16	Not Used	Plug
17	Service Battery Positive (+)	18 GXL
18	X-Y Rail Position Sensor Power Source (5V)	18 GXL
19	X-Y Rail Position Sensor Signal Return	18 GXL

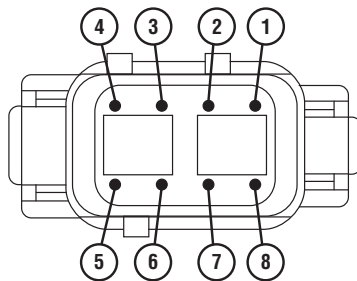
38-Way	Description	Wire
20	X-Y Rail Position Sensor Ground	18 GXL
21	Not Used	Plug
22	Not Used	Plug
23	Output Shaft Speed Signal High (+)	18 GXL
24	Output Shaft Speed Signal Low (-)	18 GXL
25	Service Ignition	18 GXL
26	Not Used	Plug
27	Not Used	Plug
28	Not Used	Plug
29	HIL Low (-)	18 GXL
30	HIL High (+)	18 GXL
31	Service Battery Negative (-)	18 GXL
32	Not Used	Plug
33	Not Used	Plug
34	Not Used	Plug
35	X-Y Rail Motor Positive (+)	14SXL
36	X-Y Gear Motor Positive (+)	14SXL
37	X-Y Rail Motor Negative (-)	14SXL
38	X-Y Gear Motor Negative (-)	14SXL

## 30-Way Push Button Shift Control Device (PBSC) Connector



30-Way Pin	Description	Wire	38-Way Vehicle Harness Connector Pin
C1	Shift Control Protected Battery Positive (+)	16 TXL	31
B3	Dimmer Control	16 TXL	N/A
F1	HIL High (+)	16 TXL	28
F2	HIL Low (-)	16 TXL	27
J3	Shift Control Protected Battery Negative (-)	16 TXL	25

## 8-Way Vehicle Harness Shift Lever Connector



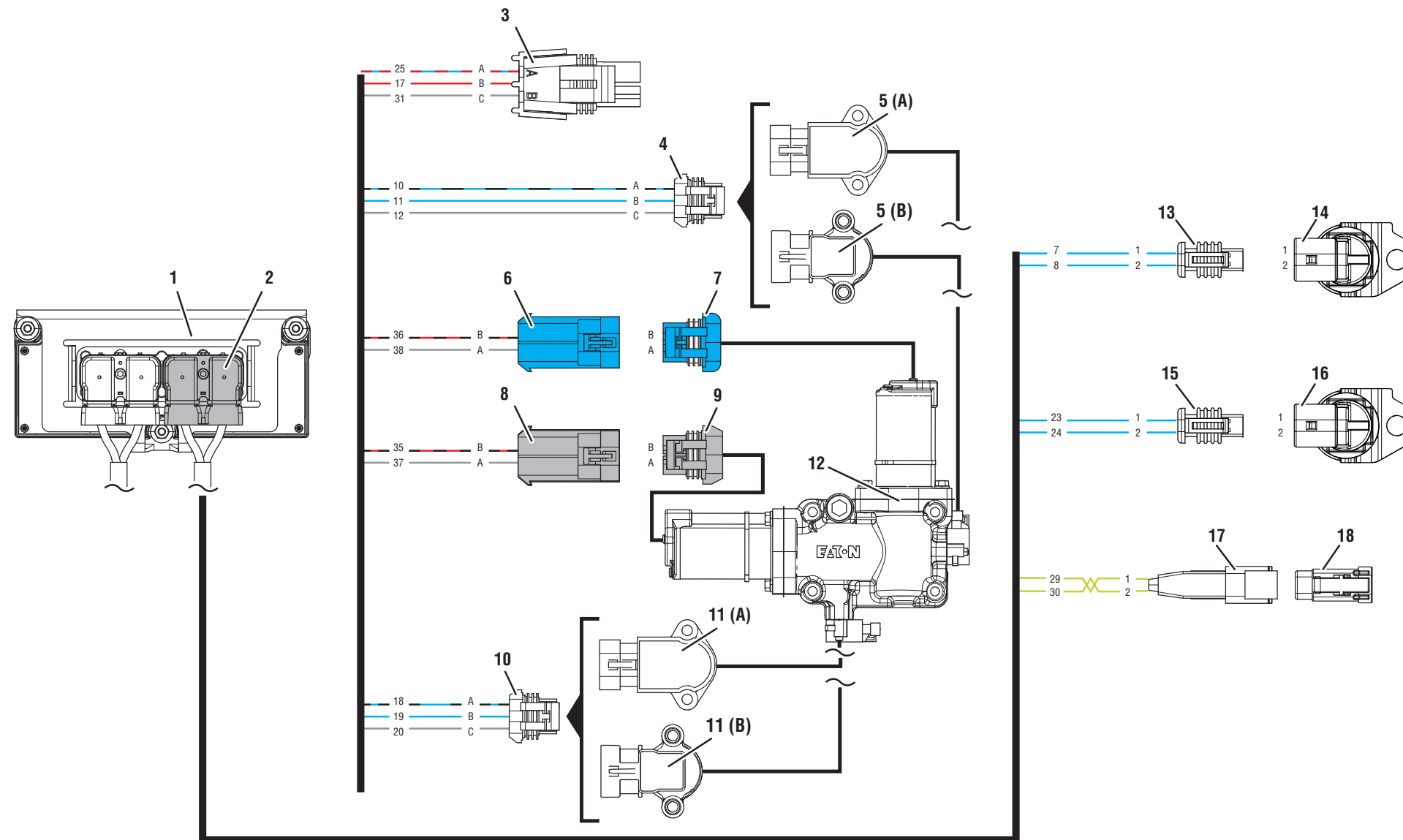
8-Way Pin	Description	Wire	38-Way Vehicle Harness Connector Pin
1	Auto Mode Signal (+)	16 TXL	15
2	Shift Control Common 1 (-)	16 TXL	17
3	Shift Control Protected Battery Negative (-) 1	16 TXL	25
4	Shift Control Protected Battery Positive (+)	16 TXL	31
5	Dash Lights	16 TXL	N/A
6	Service Light Supply	16 TXL	23
7	Shift Control Protected Battery Negative (-) 2	16 TXL	14
8	Shift Control Manual Mode Signal (+)	16 TXL	16

### 3-Way OEM Analog Shift Lever Connector

3-Way Pin	Description	Wire	38-Way Vehicle Harness Connector Pin
A	Shift Control Manual Mode Signal (+)	16 TXL	16
B	Auto Mode Signal (+)	16 TXL	15
C	Shift Control Common 1 (-)	16 TXL	17
	Service Lamp	16 TXL	23

# Wiring Diagrams

## Transmission Harness Connections



- 1. Transmission Electronic Control Unit (TECU)
- 2. 38-Way Transmission Harness Connector
- 3. 4-Way Diagnostic Connector
- 4. 3-Way Gear Position Sensor Connector
- 5. 3-Way Gear Position Sensor

- 6. 2-Way Gear Motor Connector Body (blue)
- 7. 2-Way Gear Motor Connector (blue)
- 8. 2-Way Rail Motor Connector Body (black)
- 9. 2-Way Rail Motor Connector (black)
- 10. 3-Way Rail Position Sensor Connector

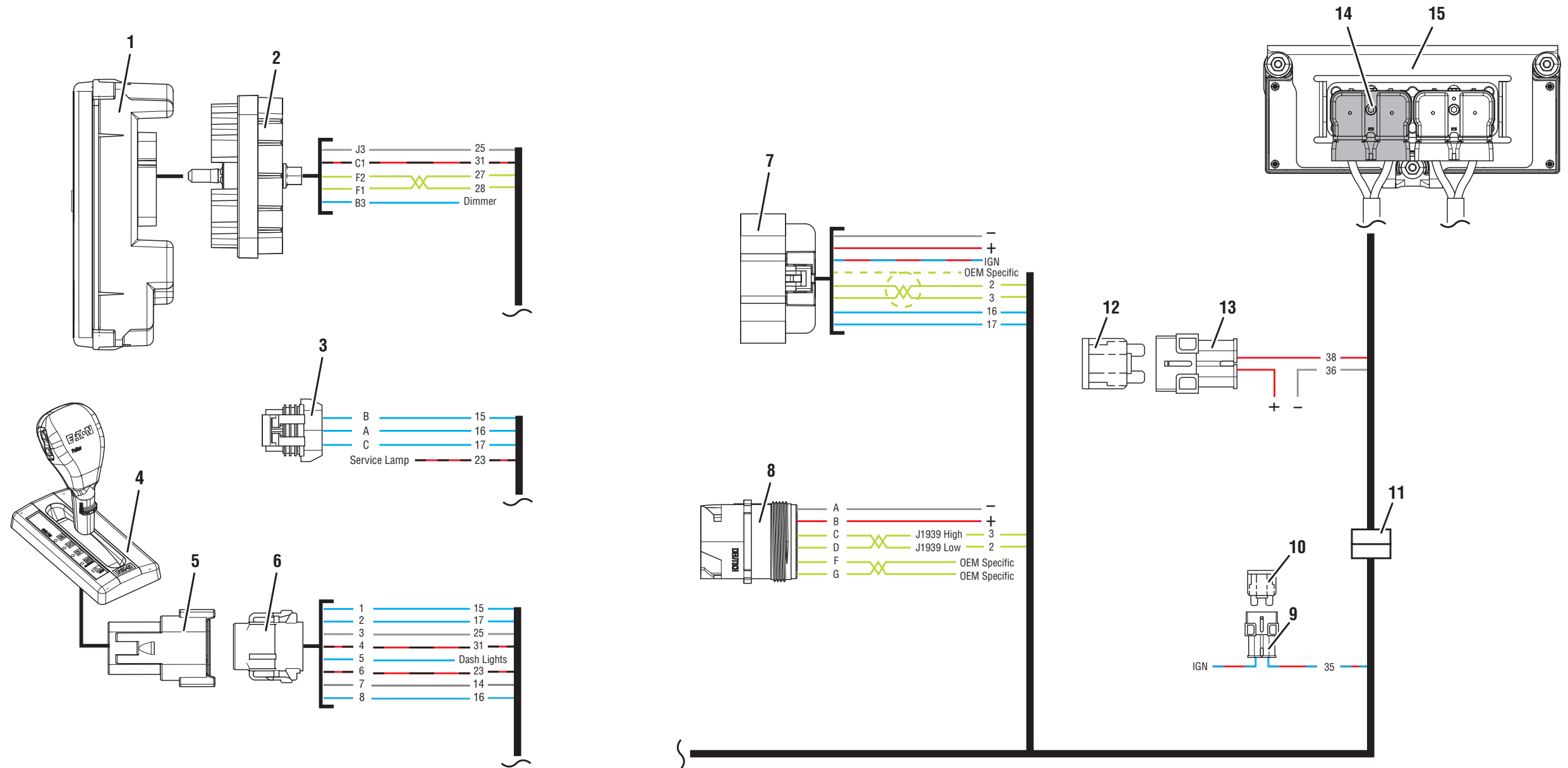
- 11. 3-Way Rail Position Sensor
- 12. X-Y Shifter
- 13. 2-Way Input Shaft Speed Sensor Connector Body
- 14. 2-Way Input Shaft Speed Sensor
- 15. 2-Way Output Shaft Speed Sensor Connector

- 16. 2-Way Output Shaft Speed Sensor
- 17. 2-Way Terminating Resistor Connector Body
- 18. 2-Way High Integrity Link (HIL) Terminating Resistor



### Vehicle Harness Connections

**Note:** Refer to OEM guidelines for wiring details.



- 1. Eaton Push Button Shift Control Device (PBSC)
- 2. 30-Way Push Button Shift Control Device (PBSC) Connector
- 3. 3-Way OEM Analog Shift Lever Connector
- 4. Cobra Shift Lever

- 5. 8-Way Cobra Shift Lever Connector
- 6. 8-Way Vehicle Harness Shift Lever Connector
- 7. OEM J1939 Shift Control Connector
- 8. 9-Way Diagnostic Connector (in cab)

- 9. In-line Fuse Holder
- 10. 10-amp Fuse
- 11. Bulkhead Connector
- 12. 30-amp Fuse

- 13. In-line Fuse Holder
- 14. 38-Way Vehicle Harness Connector
- 15. Transmission Electronic Control Unit (TECU)







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## Change Log

Date	Description
September 2024	Links added on PIL



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