Troubleshooting Guide

UltraShift PLUS Automated Transmissions

TRTS0940 EN-US

August 2019

UltraShift® *PLUS* Linehaul Active Shifting (LAS)
UltraShift® *PLUS* Linehaul Small Step Efficiency (LSE)
UltraShift® *PLUS* Multipurpose Extreme Performance (MXP)
UltraShift® *PLUS* Multipurpose High Performance (MHP)
UltraShift® *PLUS* Vocational Active Shifting (VAS)
UltraShift® *PLUS* Vocational Construction Series (VCS)
UltraShift® *PLUS* Vocational High Performance (VHP)
UltraShift® *PLUS* Vocational Multipurpose Series (VMS)
UltraShift® *PLUS* Vocational Extreme Performance (VXP)
UltraShift® *PLUS* Passenger Vehicle (PV)

AUTOMATED TRANSMISSION™
TECHNOLOGIES

BACKED BY
Roadranger
SUPPORT

Model:

F-14E316B-LSE	FOM-15E310C-LAS	FO-10E309ALL-VMS	FO-22E318B-MXP
F-15E316B-LSE	FOM-16E310C-LAS	FO-11E309ALL-VMS	FO-18E318A-VXP
F-17E316B-LSE	FOM-14E310C-VAS	FO-12E309ALL-VMS	FO-20E318A-VXP
FM-14E310B-LAS	FOM-15E310C-VAS	FO-14E309ALL-VMS	FO-22E318A-VXP
FM-15E310B-LAS	FOM-16E310C-VAS	FO-16E309ALL-VMS	FO-14E318B-VXP
FM-15E316B-LSE	FO-10E308LL-VCS	FO-17E309ALL-VMS	FO-16E318B-VXP
FO-10E310C-VAS	FO-11E308LL-VCS	FO-14E313B-MHP	FO-18E318B-VXP
FO-12E310C-VAS	FO-12E308LL-VCS	FO-16E313B-MHP	FO-20E318B-VXP
FO-14E310C-VAS	FO-14E308LL-VCS	FO-18E313B-MHP	FO-22E318B-VXP
FO-16E310C-VAS	FO-16E308LL-VCS	FO-20E313B-MHP	EO-11E406B-PVER
FO-14E310C-LAS	FO-17E308LL-VCS	FO-14E318B-MXP	EO-11E406B-PVHR
FO-16E310C-LAS	FO-16E313A-VHP	FO-16E318B-MXP	EO-11E406B-PV
FO-18E310C-LAS	FO-18E313A-VHP	FO-18E318B-MXP	
FOM-14E310C-LAS	FO-20E313A-VHP	FO-20E318B-MXP	

Table of Contents

Fault Isolation Procedures Continued

Symptom Isolation Procedures

Appendix

Warnings and Cautions

Warning: Failure to follow indicated procedures creates a high risk of personal injury to the servicing technician.

Caution: Failure to follow indicated procedures may cause component damage or malfunction.

Important: Highly recommended procedures for proper service of this unit.

Note: Additional service information not covered in the service procedure.

Before starting a vehicle:

- Ensure adequate fuel level.
- Sit in the driver's seat.
- Place shift lever in neutral.
- Set the parking brake.
- Do not operate the vehicle if Alternator light is lit or if gauges indicate low voltage.

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

- Ensure ignition is off while hands are within the clutch housing area.
- Place shift lever in neutral.
- Set the parking brake.
- Chock wheels.

When parking the vehicle or leaving the cab:

- Place shift lever in neutral.
- Set the parking brake.

Caution: Do not release the parking brake or attempt to select a gear until the air pressure is at the correct level.

To avoid damage to the transmission during towing:

1. Place shift lever in neutral.
2. Lift the drive wheels off of the ground or disconnect the driveline.

Suggested Tools

Air Gauges

- 2 (0–100) PSI Air Gauges
- 1 (0–150) PSI Air Gauges

Eaton Test Adapter Kit

- Roadranger Pin Out Adapter Jumper Kit
- P/N RR1009HY

Volt/Ohm Meter

- Digital Auto-Ranging Volt/Ohm Meter

PC-Based Service Tool

- ServiceRanger
- Contact Eaton: 1 (800) 826-4357

6-Pin Deutsch Diagnostic Adapter

- SPX / Kent-Moore 1 (800) 328-6657
- P/N J-38500-60A

9-Pin Deutsch Diagnostic Adapter

- SPX / Kent-Moore 1 (800) 328-6657
- P/N J-44012

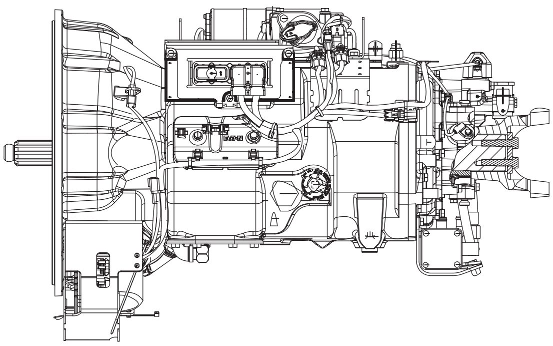
Service Publications

Publication	**Title**
TRSM0940	UltraShift *PLUS* Transmission Service Manual
TRDR1110	UltraShift *PLUS* Transmission Driver Instructions
TCMT0072	ServiceRanger™ 4 User's Guide
TCMT0073	ServiceRanger™ 4 Quick Start Guide
TCMT0020	Eaton Approved Lubricant Suppliers
TCWY0900	Eaton Warranty Guide
CLSM0200	Heavy-Duty Clutch Service Manual

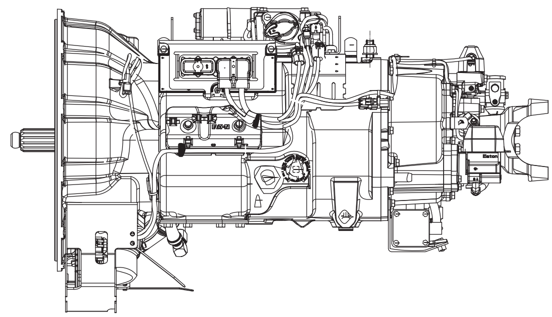
For more information, call 1 (800) 826-HELP (4357).

K-Line: 1 (800) 824-5546

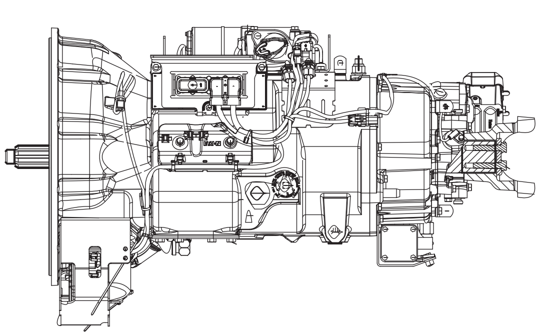
Transmission Models



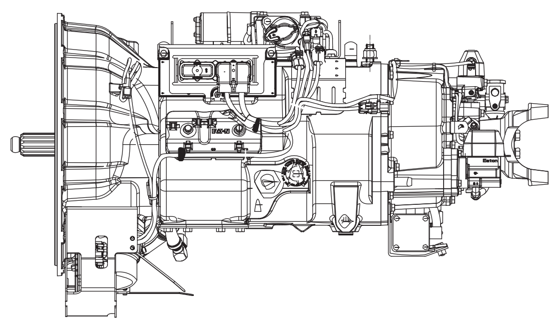
F(O)(M)-1XE310-LAS/VAS



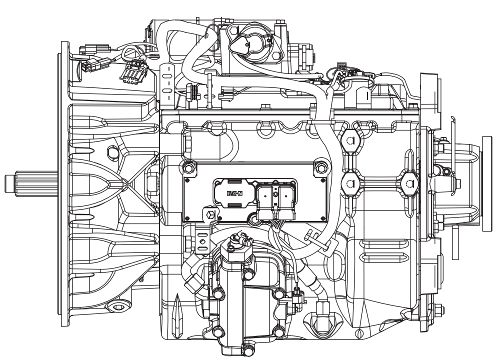
FO-1XE318-VXP/MXP, FO-1XE313-MHP/VHP



FO-1XE309LL-VMS, FO-1XE308LL-VCS



F(M)-1XE316-LSE



EO-11E406B-PV(ER)(HR)

Transmission Lamp and Gear Display Descriptions

Overview

All UltraShift *PLUS* 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, UltraShift *PLUS* 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.

Hill Start Aid (HSA) Lamp

The Hill Start Aid (HSA) lamp flashes when the Hill Start Aid is turned off. The Hill Start Aid (HSA) defaults to the “On” position. In Heavy-Duty UltraShift *PLUS* models, HSA can be turned “Off” by pressing and releasing the HSA Switch. Medium-Duty UltraShift *PLUS* models do not have a HSA override switch.

Gear Display Descriptions

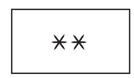
Solid “N” in Gear Display

Indicates that the transmission is currently in Neutral.

Flashing “F” in Gear Display

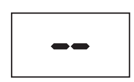
Indicates that the transmission has detected an Active fault code. This fault code can be accessed with the ServiceRanger diagnostic software. See *Fault Code Isolation Procedure Index* on page 13.

Double Stars “* *” in Gear Display



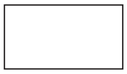
Indicates that the gear display is receiving no communication over the data link. The gear display may communicate over the J1939 or J1587 data link depending upon the specific display type. See *Diagnostic Procedure* on page 11. If no problem is found, troubleshoot the gear display connection to the J1939 or J1587 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 or J1587 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 or J1587 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.

"CA" in Gear Display

Indicates that a clutch abuse event is occurring.

"AN" in Gear Display

Indicates that the transmission is currently in Auto Neutral.

"GI" in Gear Display

Indicates that the clutch released bearing will need to be greased soon. See the *Heavy-Duty Clutch Service Manual* (CLSM0200).

"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.

Important: 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.

Important: 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 engine 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.

Important: The vehicle will not start 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 start.

PD Mode Inactive Fault Codes

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

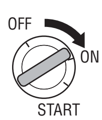
13, 14, 15, 16 (86), 17, 19 (89), 22, 29, 33, 34, 35, 36, 43, 44, 46, 51, 52, 56, 57, 58, 61, 63, 65 (95), 66 (96), 67 (97) and 99.

Entering PD Mode

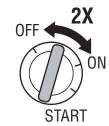
Note: Vehicle must have no Active fault codes.

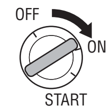
Note: Vehicle must be stationary, engine off with vehicle parking brake set.

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

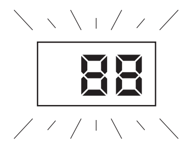


2. Perform two key cycles of the ignition switch starting in the on position and ending in the on position.

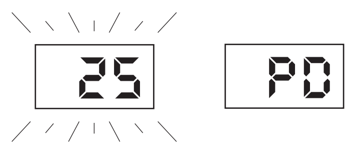




Note: The gear display may flash a "88" at key on, which is a normal power-up test of the display.



- 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 engine can be started 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 13 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 or is available as document RRCC0015 on roadranger.com.

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

Driver Questionnaire

Fleet: ______________________ Fleet Unit # ______________ Date: ______________

Dealer: ______________________ RO # ______________

Fax to 269-746-6965
Email to 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 engine 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 4-5 5-6 6-7 9-10 10-11 11-12 17-18				
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 5 6 7 8 9 10 11 12 13 14 15 16 17 18				
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 truck 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 truck 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 engine start with the key?	Yes	No	Don’t Know	NA
9. What is in the gear display when the problem happens? Circle one or more below. - Single dash - - Double dash Flashing gear number Solid gear number flashing F Down arrows Up arrows Flashing CA Blank display				
10. Does the transmission service, check engine or anti-lock brake light come on when the problem happens?	Trans Service	Check Engine	ABS	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 truck had the problem?	First Time	Past 2 weeks	Past Month	Several Months
15. How long have you been driving this truck?	Days	Weeks	Months	Years
16. List any known problems the truck has had in the past: Circle one or more below or describe known problem. Engine Transmission Cooling system OEM electrical ABS (truck) ABS (trailer) 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

Diagnostic Procedure

A

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

1. Document the vehicle symptoms by completing the *Driver Questionnaire* on page 9.
2. Set vehicle parking brake and chock wheels.
3. Key on with engine 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/engine 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 engine cranks.*

1. Key on with engine running.
   - If the engine cranks and runs, go to **Step C.**
   - If the display indicates "F" during the engine crank or while the engine is running, retrieve fault code(s) with ServiceRanger. Go to **Step F.**
   - If the engine does not crank and the display indicates "N", refer to OEM guidelines for repair or replacement of the vehicle starting/charging/battery system.

C

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

1. Key on with engine running.
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 go to the *Brake Switch Functionality Test* on page 524

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 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”.
   - If a vehicle/engine 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, go to the *Transmission Shift Complaint Test* on page 550.

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, 81, 84, 85, 99
   - **Priority 2:** 15, 16, 19, 26, 27, 33, 34, 35, 36, 37, 61, 63, 66, 67, 74, 76
   - **Priority 3:** 13, 14, 17, 21, 22, 29, 43, 44, 46, 51, 52, 56, 57, 58, 64, 65, 68, 83
   - **Priority 4:** 41, 42, 45, 71, 72, 73
2. Go to the *Fault Code Isolation Procedure Index* on page 13 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, match the vehicle symptom to the appropriate item in the *Symptom-Driven Diagnostics Index* on page 10

Fault Code Isolation Procedure Index

Fault Code	SPN	PID	SID	FMI	Description	Page Number
45	787		54	7	Inertia Brake performance	page 280
46	770		37	3, 4, 5, 6, 8, 12, 18	Splitter Direct Solenoid Valve	page 284
46	771		38	3, 4, 5, 6, 8, 12, 18	Splitter Indirect Solenoid Valve	page 284
51	60	60		2, 3, 4, 10, 11	Rail Position Sensor	page 296
52	59	59		2, 3, 4, 7, 10, 11	Gear Position Sensor	page 306
56	161	161		2, 3, 4, 5	Input Shaft Speed Sensor	page 317
57	160	160		2, 3, 4, 5	Main Shaft Speed Sensor	page 325
58	191	191		2, 5, 6, 8, 10, 11	Output Shaft Speed Sensor	page 333
61	772		39	1, 5, 6, 12	Rail Motor Circuit	page 342
63	773		40	1, 5, 6, 12	Gear Motor Circuit	page 353
64	788	34		2, 7, 12	Gen1 Electronic Clutch Actuator (ECA)	page 364
64	788	34		2, 7, 12	Gen2 Electronic Clutch Actuator	page 373
65	5052	190		2, 5	Gen1 ECA Speed Sensor	page 382
65	5052	190		2, 3, 4, 5	Gen2 ECA Speed Sensor	page 391
66	520271	34		3, 4	Gen1 ECA Battery Voltage	page 403
66	520271	34		3, 4	Gen2 ECA Battery Voltage	page 411
67	520274	158		3, 4	Gen1 ECA Ignition Voltage	page 420
67	520274	158		3, 4	Gen2 ECA Ignition Voltage	page 427
68	520321		227	13, 14	Grade Sensor	page 434
71	560		60	7, 11	Unable to Disengage Gear	page 438
72	772		59	7	Failed to select rail	page 447
73	781		58	7	Failed to Engage Gear	page 455
74	518	93		7	Engine Torque Response	page 463
74	898	190		7	Engine Speed Response	page 463
75	560		60	14	Power Down in Gear	page 467
76	639			11, 31	Neutral Coast Mode	page 469
81	780		47	7	Gear Engagement Detected	page 474
83	751		18	14	Invalid Shift Lever Position	page 482
84	751		18	13	Shift Device Not Configured	page 486
85	751		18	12	Shift Control Device Incompatible	page 489
99	781		58	12, 14	Direction mismatch	page 492

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.

Important: 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.

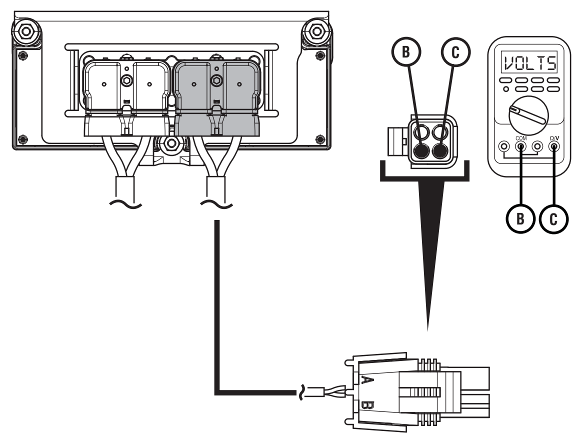
Recommendations for Using a Volt/Ohm Meter

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.

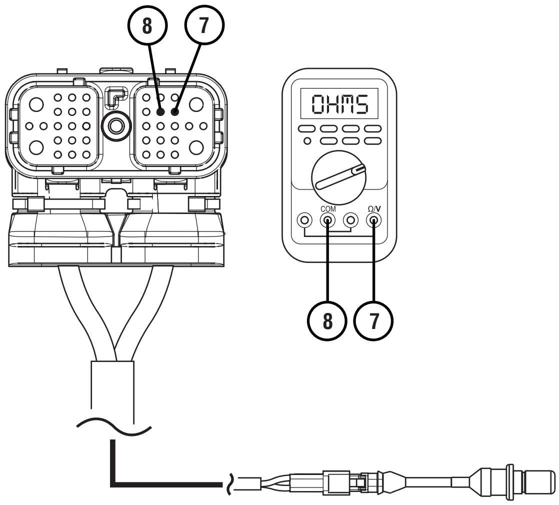


Pins	Range	Reading(s)
B to C	Within 0.6 V of Battery Voltage	***12.5 V***

Example Circuit Continuity Readings

Circuit has Continuity

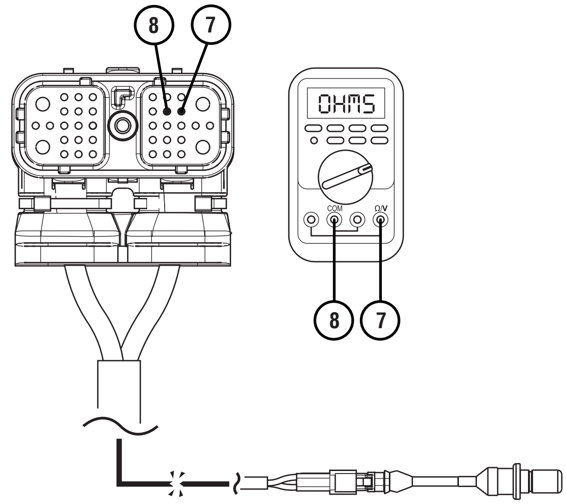
The circuit is complete when the resistance reading is within range. A circuit reading infinite resistance or Open Lead (OL) does not have continuity.



Pins	Range	Reading(s)
7 to 8	2.0k – 4.5k ohms	***3.2k ohms***

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.

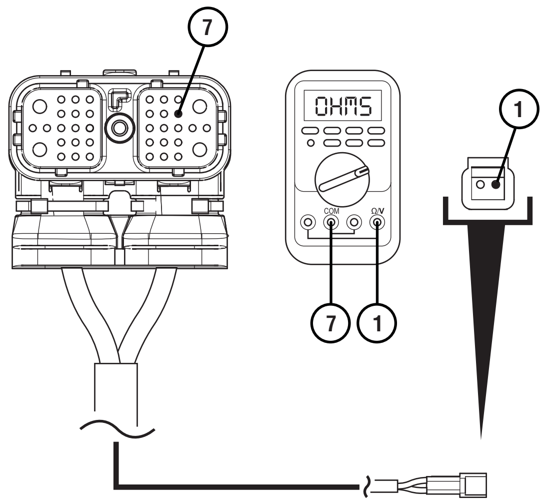


Pins	Range	Reading(s)
7 to 8	2.0k – 4.5k ohms	***OL***

Example End to End Resistance

End to End Resistance is Within Range

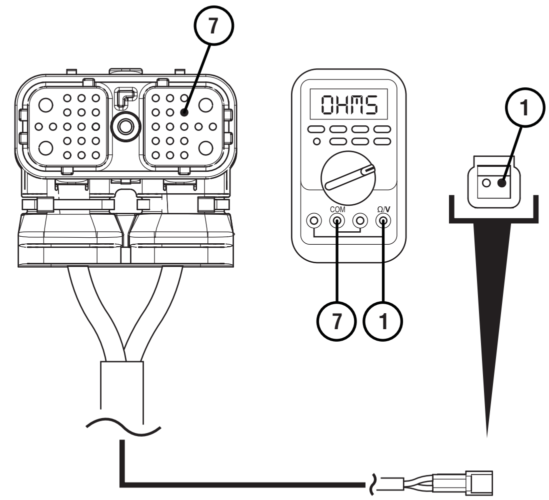
The wire has continuity when the resistance reading is within range. A wire reading infinite resistance or Open Lead (OL) does not have continuity.



Pins	Range	Reading(s)
7 to 1	0.0 – 0.3 ohms	***0.2 ohms***

End to End Resistance is Too High

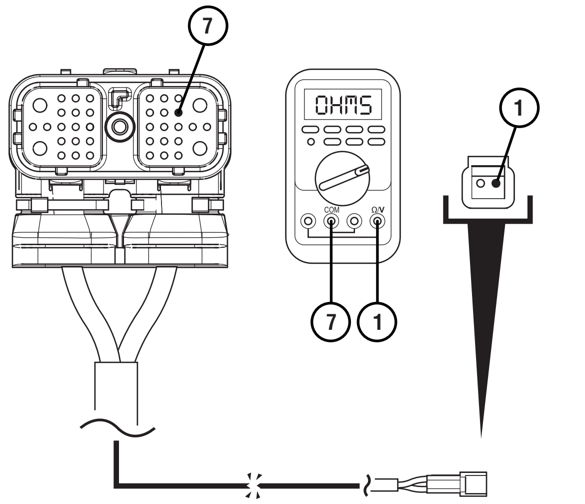
When the resistance is higher than the acceptable range there is additional resistance in this wire. Check for corrosion, loose or spread pins or damage to the harness.



Pins	Range	Reading(s)
7 to 1	0.0 – 0.3 ohms	***2.0 ohms***

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.

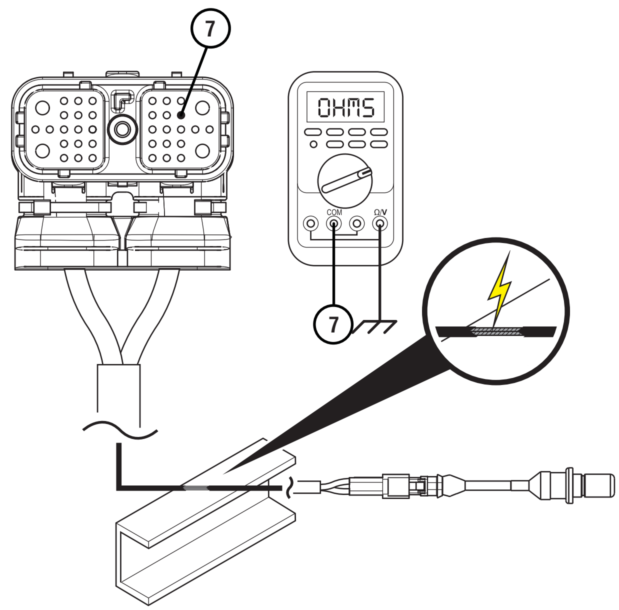


Pins	Range	Reading(s)
7 to 1	0.0 – 0.3 ohms	***OL***

Short Circuit to Chassis Ground

Short to Ground

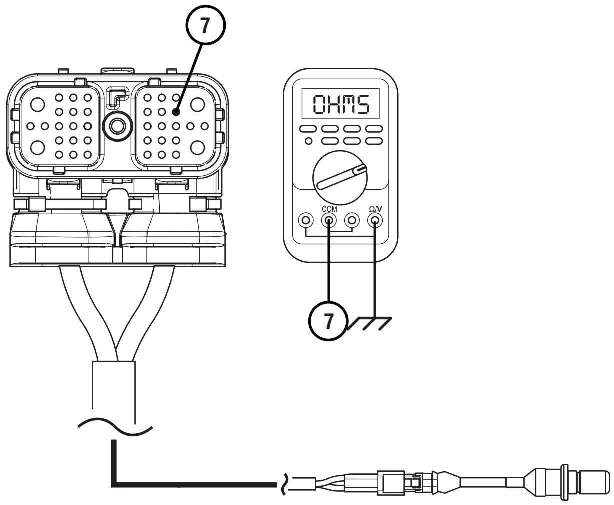
A wire is shorted to ground when the resistance between a non-ground wire and chassis ground shows continuity. Low resistance values (near 0 ohms) indicate a direct short to ground. Higher resistance values may indicate a partial-short.



Pins	Range	Reading(s)
7 to Ground	Open Circuit (OL)	***2.0 ohms***

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.

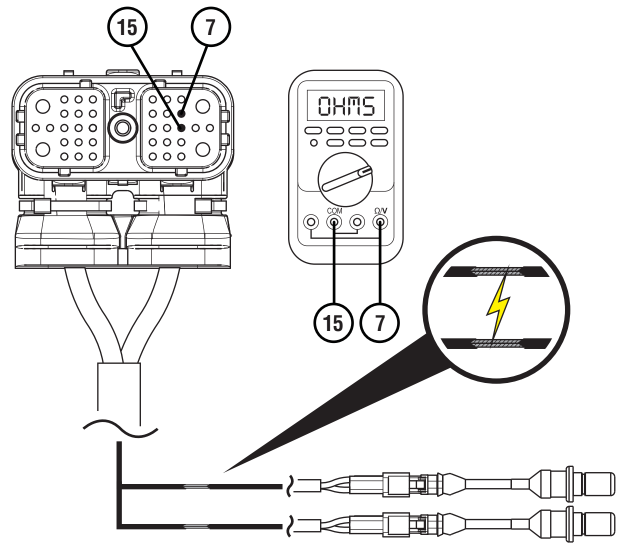


Pins	Range	Reading(s)
7 to Ground	Open Circuit (OL)	***OL***

Short to Another Circuit

Two Circuits Shorted Together

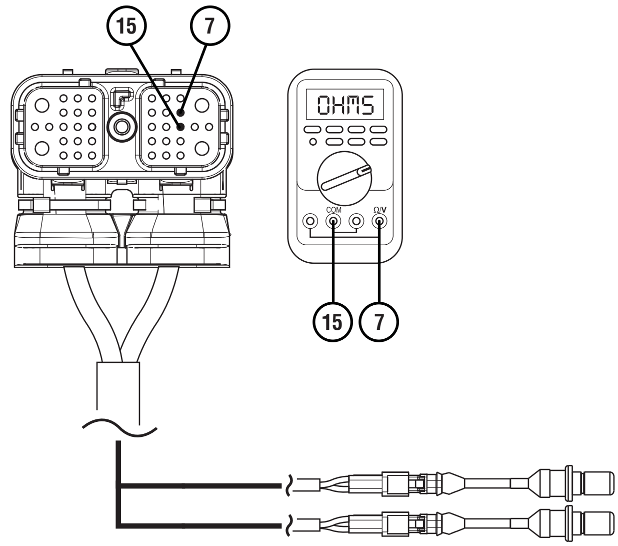
When wires from two unrelated circuits show continuity (low resistance) to one another, these circuits are shorted together.



Pins	Range	Reading(s)
7 to 15	Open Circuit (OL)	***2.0 ohms***

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.



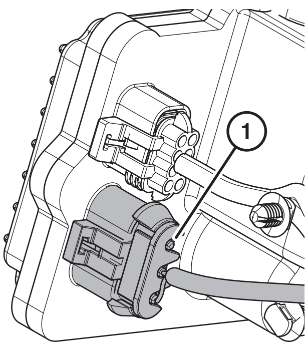
Pins	Range	Reading(s)
7 to 15	Open Circuit (OL)	***OL***

Electronic Clutch Actuator (ECA) Identification Overview

Electrical Pretest Identification

Check ECA OEM Power Supply Connector to determine if vehicle is equipped with a Gen1 or Gen2 ECA.

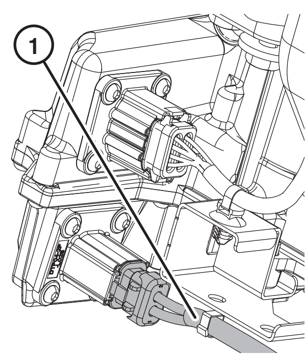
Gen1 ECA



1. *3-Way ECA Connector*

If equipped with a Gen1 ECA, reference the *Electrical Pretest Gen1 ECA* on page 37.

Gen2 ECA



1. *2-Way ECA Connector*

If equipped with a 2-Way ECA connector, reference the *Electrical Pretest Gen2 ECA* on page 50

Power-Up Sequence

Overview

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

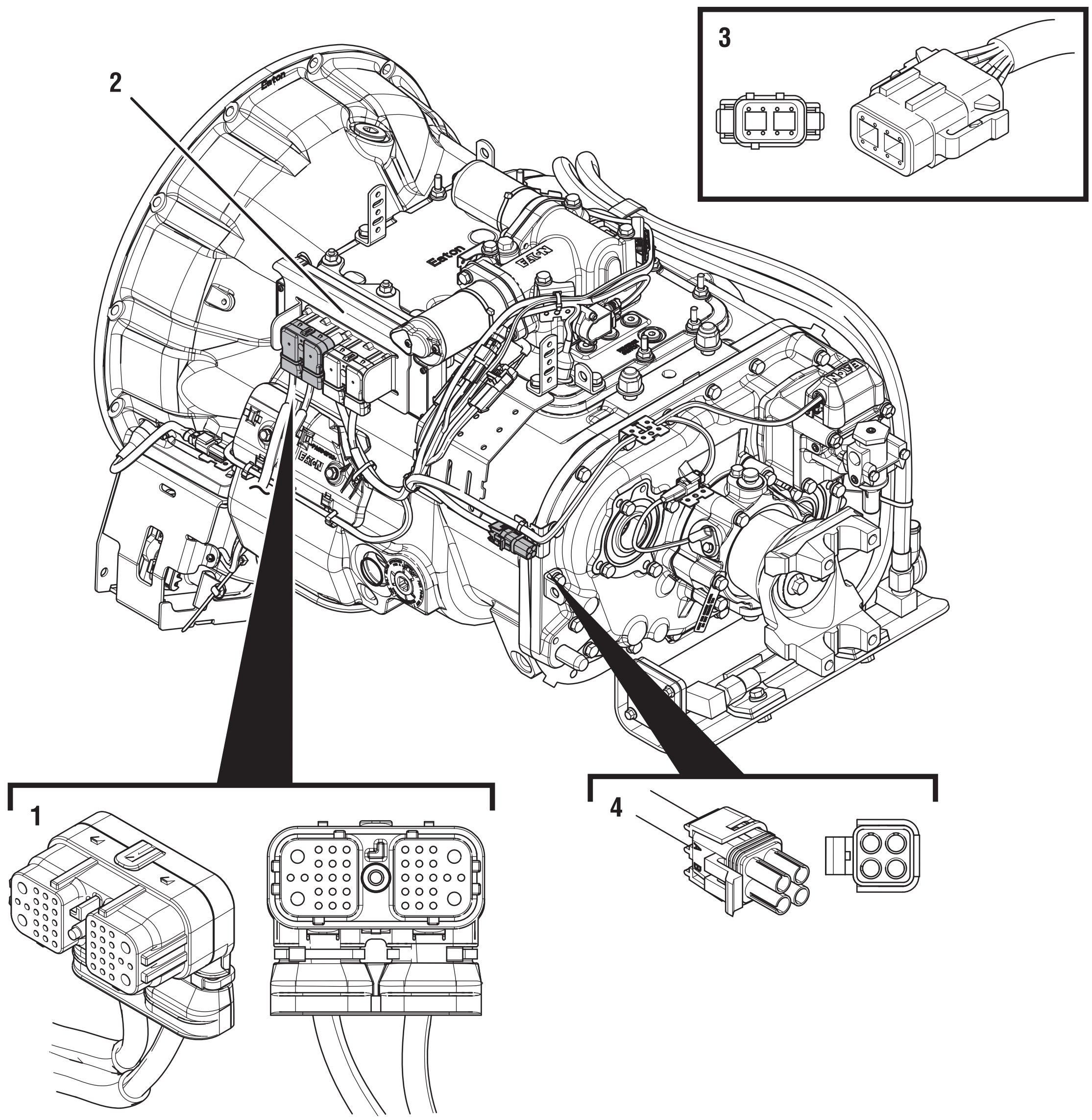
Detection

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

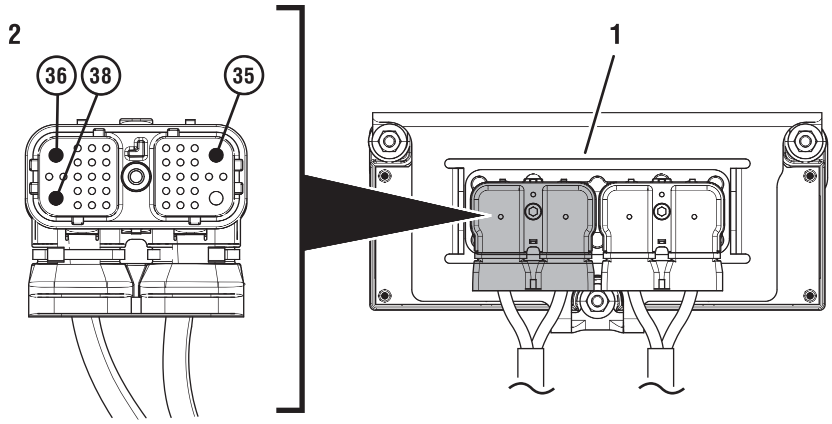
Possible Causes

- 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 starter, 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.

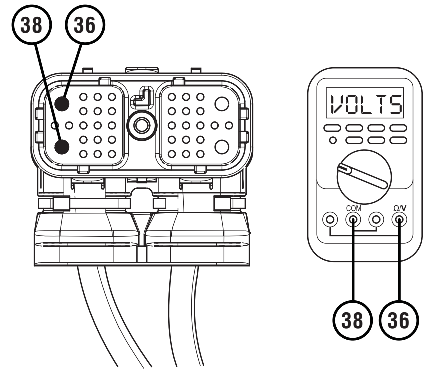
   Note: Some chassis use a power and ground distribution block separate from the battery or may route power and ground to the starter. Be sure to clean and inspect connections at this location and at the battery.
5. Verify that the battery voltage meets specifications for battery voltage.
   - If damage 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.

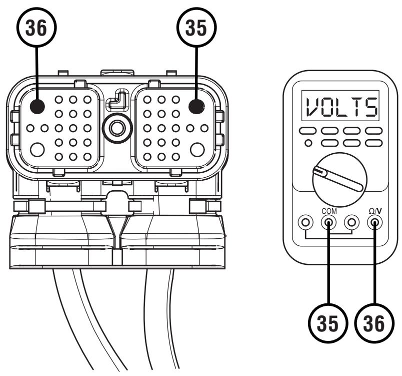


5. Compare reading(s) in table.
   - If readings are in range, go to **Step C.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of power and ground wring between the batteries and 38-Way Vehicle Harness Connector at the TECU. Go to **Step V.**

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 engine off.
5. Measure voltage between 38-Way Connector Pin 35 (Ignition Positive) and Pin 36 (Battery Negative). Record reading(s) in table.

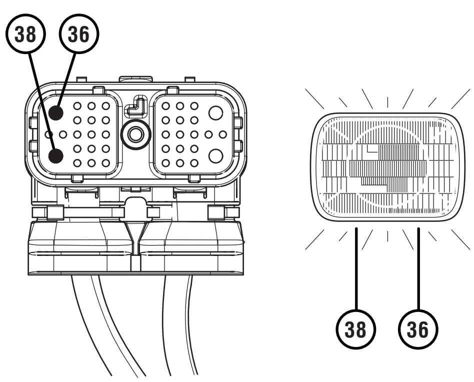


6. Compare reading(s) in table.
   - If readings are in range, go to **Step D.**
   - If readings are out of range, refer to OEM guidelines for repair of ignition voltage supply to TECU. Go to **Step V.**

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.

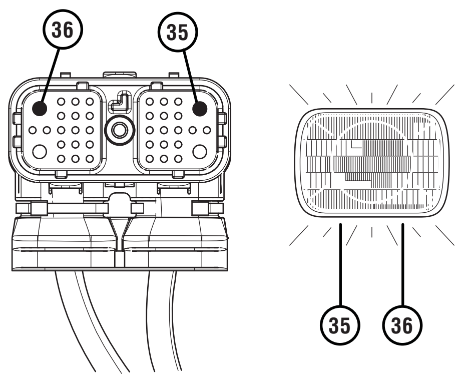


6. Wiggle the harness during the Load Test from vehicle batteries to TECU.
   - If issues are found with the power supply or connectors, refer to OEM guidelines for repair or replacement of OEM wiring. Go to **Step V.**.
   - If the power supply does not carry a load, refer to OEM guidelines for repair 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 engine 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.**

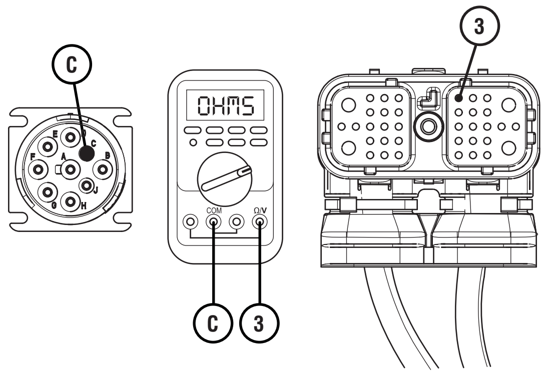
F

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

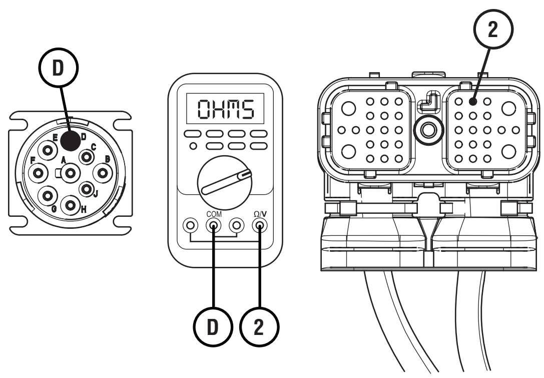
1. Key off.
2. Refer to the OEM and identify the TECU location on the vehicle J1939 Data Link at the 9-Way Diagnostic Connector.
   - If Black 9-Way Diagnostic Connector, Go to **Step G.**
   - If Green 9-Way Diagnostic Connector on Pin C and Pin D, go to **Step G.**
   - If Green 9-Way Diagnostic Connector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

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.



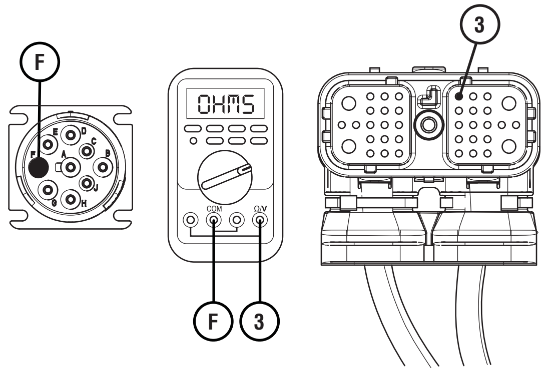
5. Compare reading(s) in table.
   - If readings are in range, replace the TECU. Go to **Step V.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle J1939 Data Link. Go to **Step V.**

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

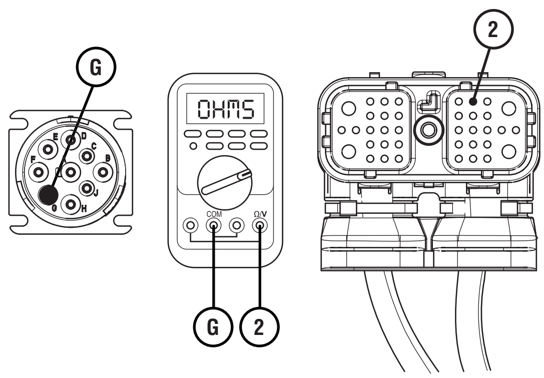
H

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 F and 38-Way Vehicle Harness Connector Pin 3. Record reading(s) in table.



4. Measure resistance between 9-Way Diagnostic Connector Pin G 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)
F to 3	0.0–0.3 ohms	
G 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 engine 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 13.
   - 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 engine 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 engine 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 13.
   - 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.

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

2. Key on with engine 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 13.
   - 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 13.

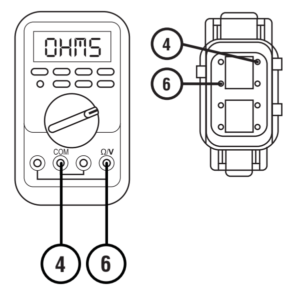
E

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)	

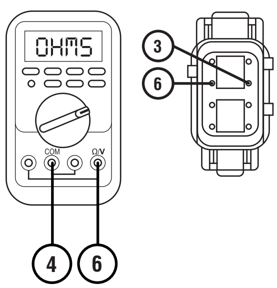
F

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

1. Key off.

Important: 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 engine 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.

Important: 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 engine 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 13.
   - If no fault codes set Active and the vehicle complaint is duplicated, contact Eaton at (800) 826-4357 for further diagnostics.

Electrical Pretest Gen1 ECA

Overview

This procedure provides a basic test of the vehicle electrical system. A well-functioning electrical supply is required for proper operation of the UltraShift *PLUS* 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

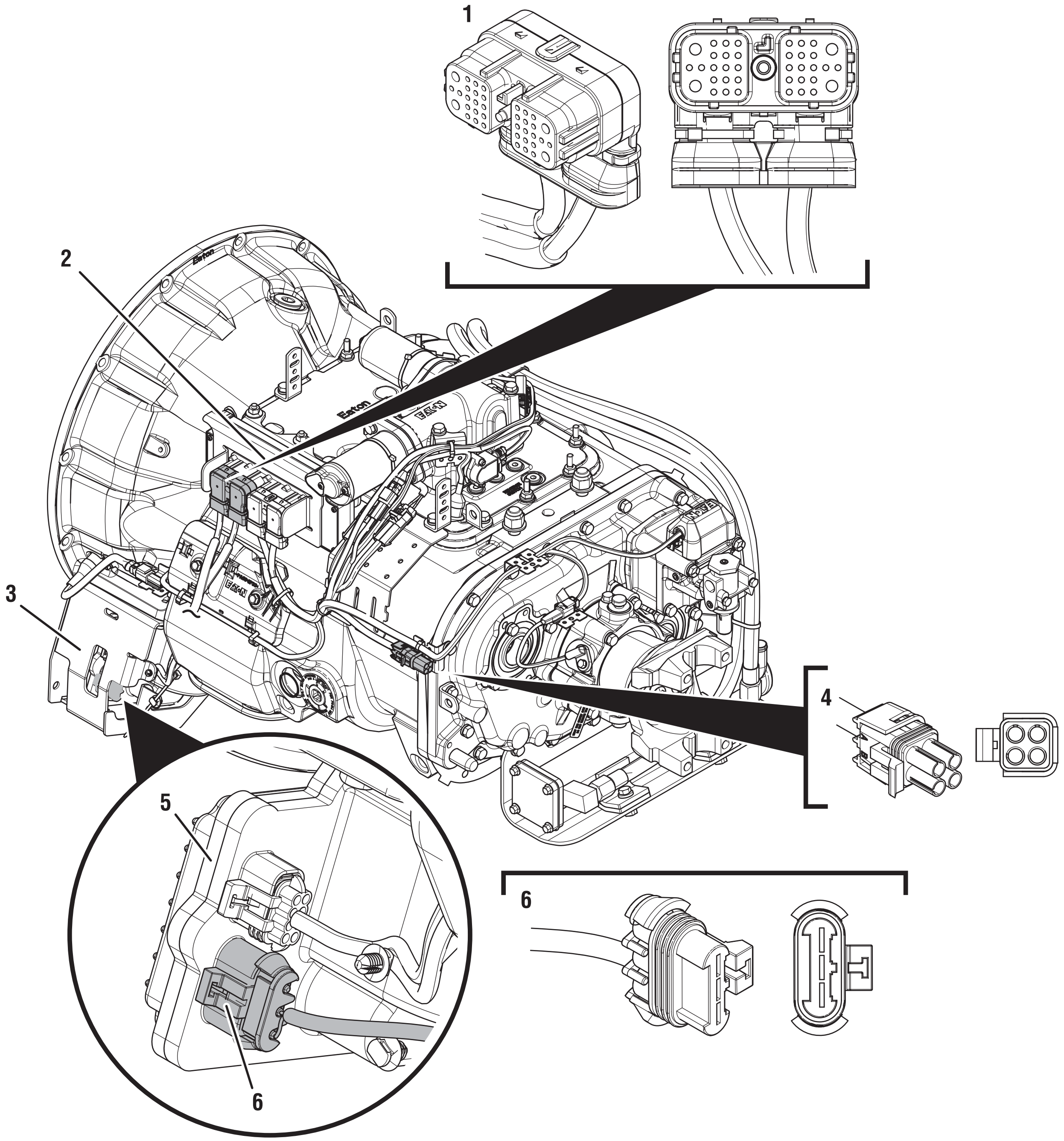
Possible Causes

- Vehicle Batteries
  - Internal failure
- Vehicle Charging System
  - Charging system failed
  - Alternator-Generator 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
- Vehicle Power and Ground Supply to ECA
  - Poor power or ground supply to ECA
  - Wiring shorted to ground, shorted to power or open
  - Improperly seated or missing 40-amp fuse
  - Bent, spread, corroded or loose terminals
- Transmission Harness
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals

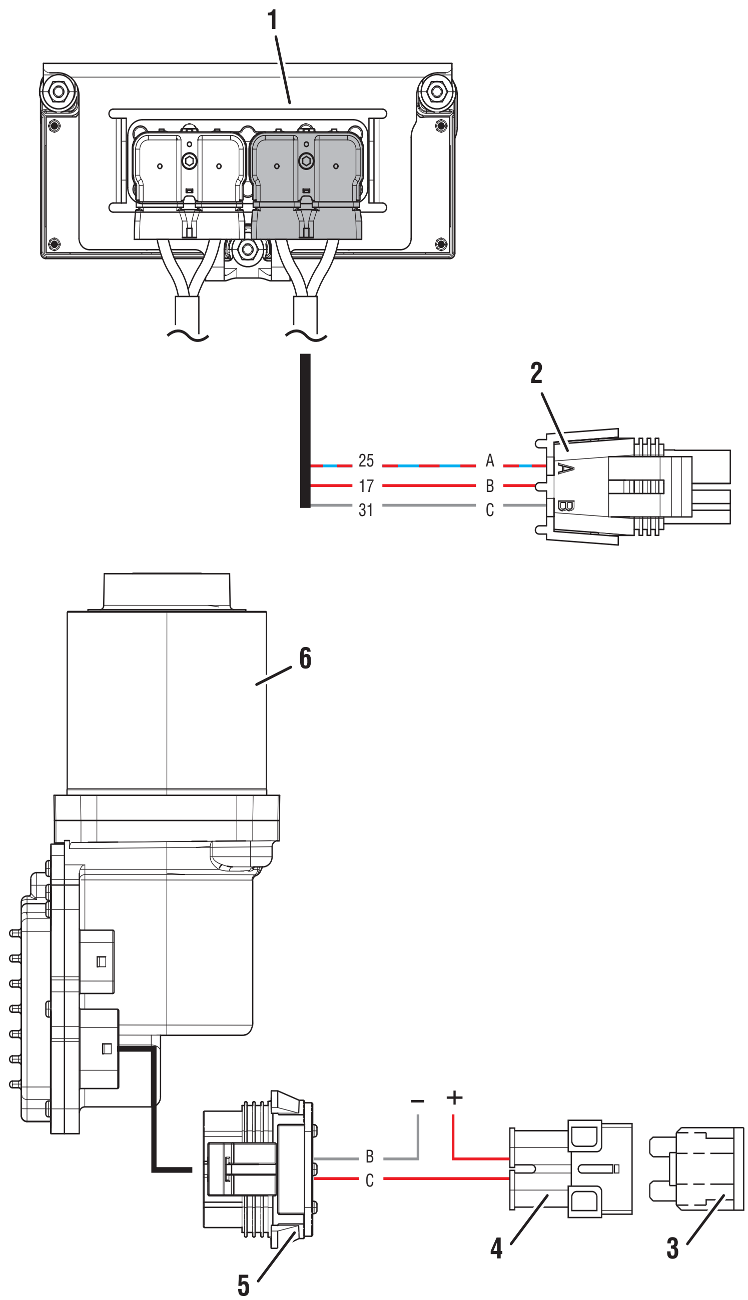
Additional Tools

Battery load testing equipment (see OEM for specific recommendations)

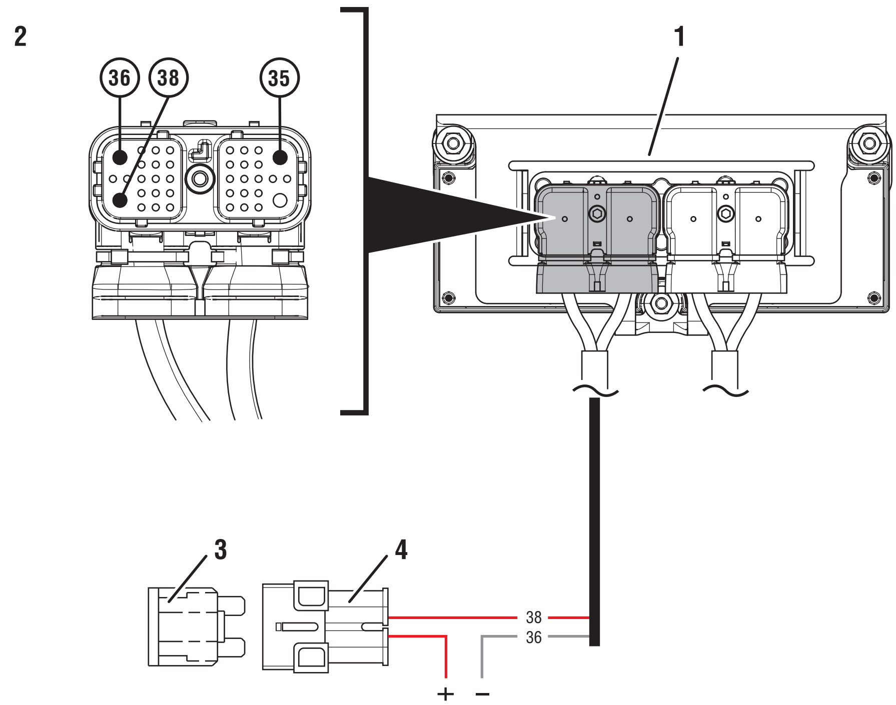
Component Identification



1. *38-Way Vehicle Harness Connector*
2. *Transmission Electronic Control Unit (TECU)*
3. *ECA Shield*
4. *4-Way Diagnostic Connector*
5. *Electronic Clutch Actuator (ECA)*
6. *3-Way ECA Connector*



1. Transmission Electronic Control Unit (TECU)
2. 4-Way Diagnostic Connector
3. 40-amp Fuse
4. In-line Fuse Holder
5. 3-Way ECA Connector
6. Electronic Clutch Actuator (ECA)



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

Electrical Pretest Gen1 ECA

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 starter, 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 or may route power and ground to the starter. Be sure to clean and inspect connections at this location and at the battery.

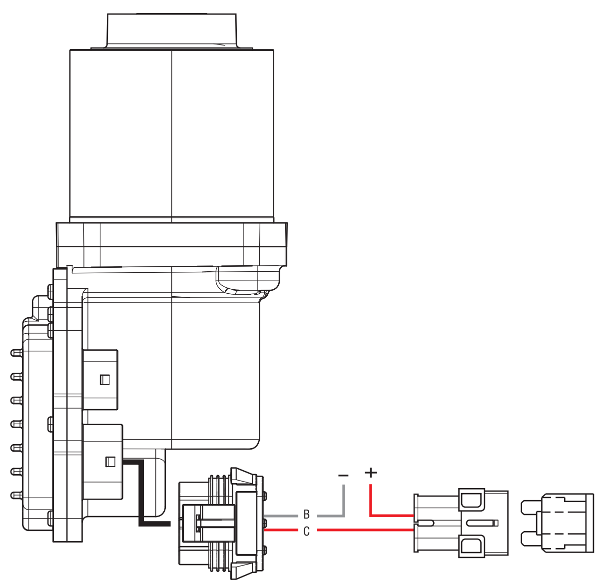
   - If damage is found, repair or replace wiring per OEM guidelines, go to **Step B.**
   - If no damage is found, go to **Step B.**

Battery Voltage

B ***Purpose:*** *Verify power and ground supply to the ECA.*

1. Key off.
2. Inspect the ECA 40-amp In-line Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.
3. Visually inspect ECA Power Supply Harness between the power supply and the ECA for signs of rubbing or chafing to the wiring.

   Note: Some chassis use a power and ground distribution block separate from the battery or may route power and ground to the starter. 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 battery power and ground supply to ECA, Go to **Step V.**
- If no damage is found, go to **Step C.**

C

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

1. Key off.

Important: 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 D.**
   - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step D.**

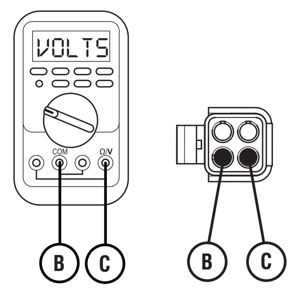
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

D

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

1. Reconnect all harnesses and connectors.
2. Key on with engine 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.



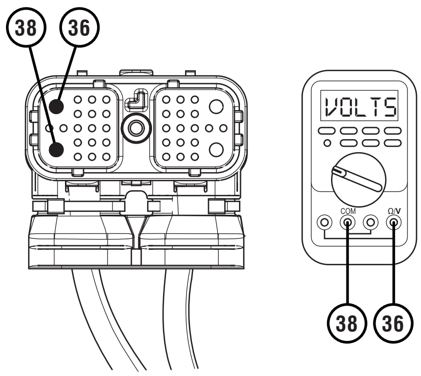
5. Compare reading(s) in table.
   - If readings are in range, go to **Step G.**
   - If readings are out of range, go to **Step E.**

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

E

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).



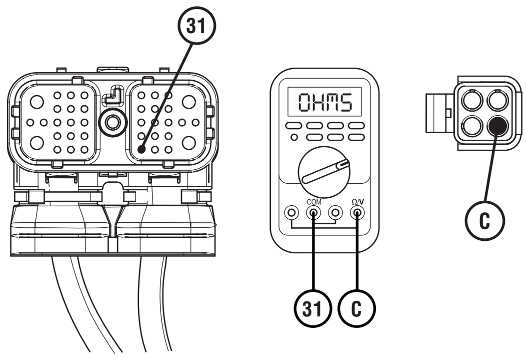
5. Compare reading(s) in table.
   - If readings are in range, go to **Step F.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of battery power and ground supply to TECU. Go to **Step V.**

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

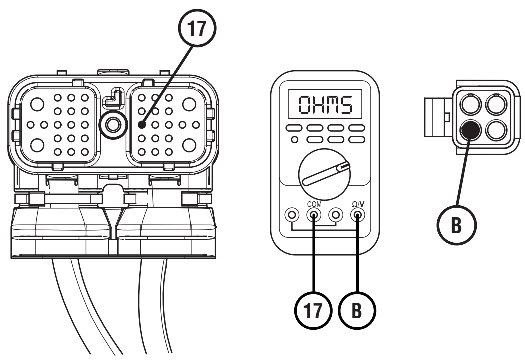
F

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

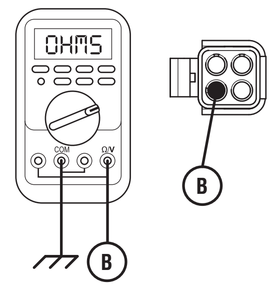
1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from TECU.
3. Inspect connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between Pin 31 and Pin C. Record reading(s) in table.



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 TECU. Go to **Step V.**

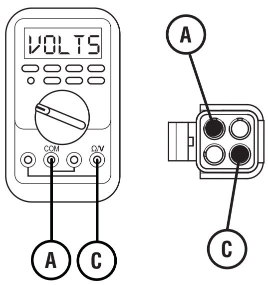
Pins	Range	Reading(s)
31 to C	0.0–0.3 Ohms	
17 to B	0.0–0.3 Ohms	
B to Ground	Open Circuit (OL)	

G

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 engine 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.



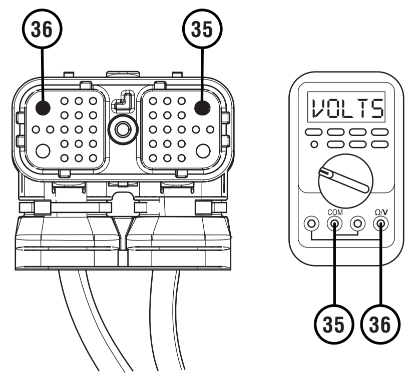
6. Compare reading(s) in table.
   - If readings are in range, go to **Step J.**
   - If readings are out of range, go to **Step H.**

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

H

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 engine off.
5. Measure voltage between 38-Way Connector Pin 35 (Ignition positive) and Pin 36 (Battery negative). Record reading(s) in table.



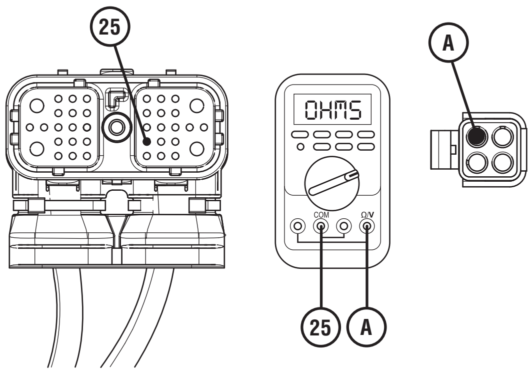
6. Compare reading(s) in table.
   - If readings are in range, go to **Step I.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of ignition voltage supply. Go to **Step V.**.

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

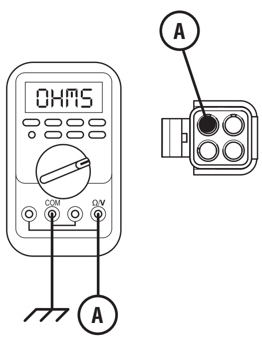
I

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.

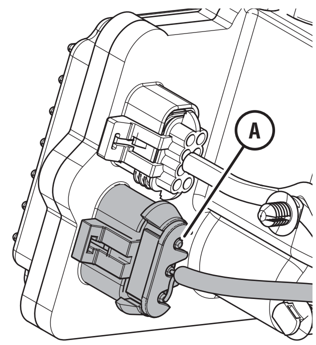


6. Compare reading(s) in table.
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**
   - If readings are in range, replace TECU. Go to **Step V.**

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

J ***Purpose:*** *Verify condition of 3-Way ECA Connector.*

1. Key off.
2. Disconnect 3-Way ECA Connector.
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. Confirm the 3-Way Connector has a seal plug in Cavity A.

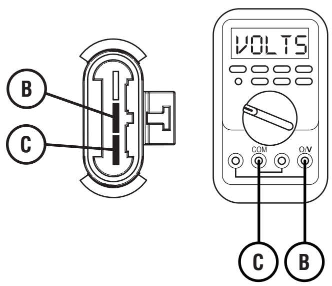


- If damage is found to the ECA Power Harness, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Go to **Step V.**
- If damage is found to the ECA side of the 3-Way ECA Connector, replace ECA. Go to **Step V.**.
- If no damage is found, go to **Step K.**

K

Purpose: *Verify battery voltage at ECA.*

1. Key off.
2. Measure voltage between 3-Way ECA Connector Pin C (Battery positive) and Pin B (Battery negative). Record reading(s) in table.



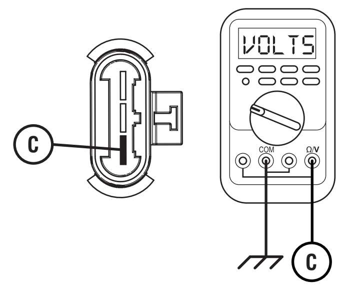
3. Compare reading(s) in table.
   - If readings are in range, go to **Step L.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Go to **Step V.**

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

L

Purpose: *Verify polarity of battery voltage at ECA.*

1. Key off.
2. Measure voltage between 3-Way ECA Connector Pin C (Battery positive) and ground. Record reading(s) in table.



3. Compare reading(s) in table.
   - If sent here from a Fault or Symptom Isolation Procedure and readings are in range, Electrical Pretest complete. Return to the Fault or Symptom Isolation Procedure for further diagnostic instructions.
   - If readings are in range, go to **Step V.**

Pins	Range	Reading(s)
C to Ground	Within 1.2 V of Battery Positive (+)	

V ***Purpose:*** *Verify Electrical Pretest.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine 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 13.

Electrical Pretest Gen2 ECA

Overview

This procedure provides a basic test of the vehicle electrical system. A well-functioning electrical supply is required for proper operation of the UltraShift *PLUS* 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

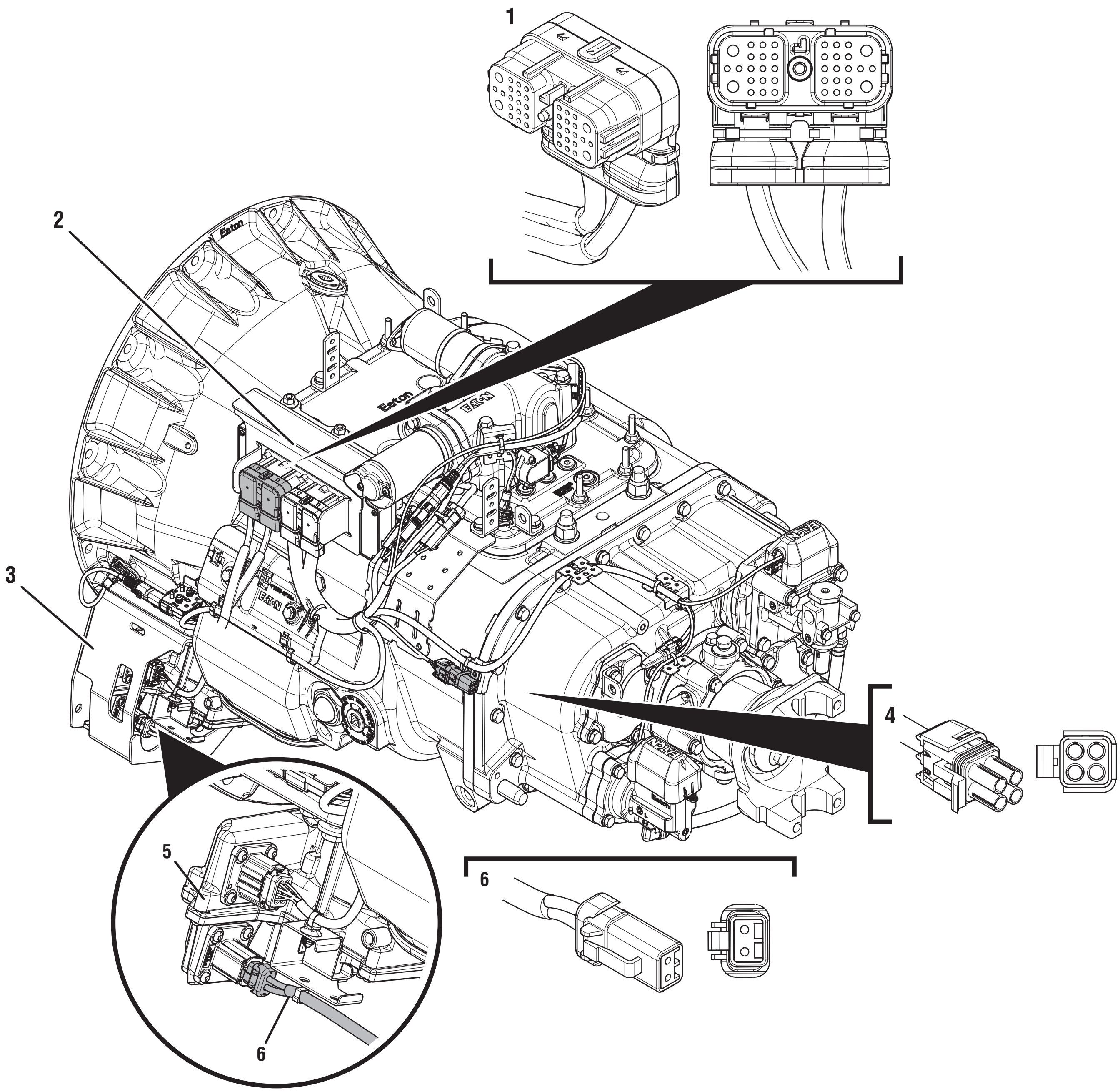
Possible Causes

- Vehicle Batteries
  - Internal failure
- Vehicle Charging System
  - Charging system failed
  - Alternator-Generator 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
- Vehicle Power and Ground Supply to ECA
  - Poor power or ground supply to ECA
  - Wiring shorted to ground, shorted to power or open
  - Improperly seated or missing 40-amp fuse
  - Bent, spread, corroded or loose terminals
- Transmission Harness
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals

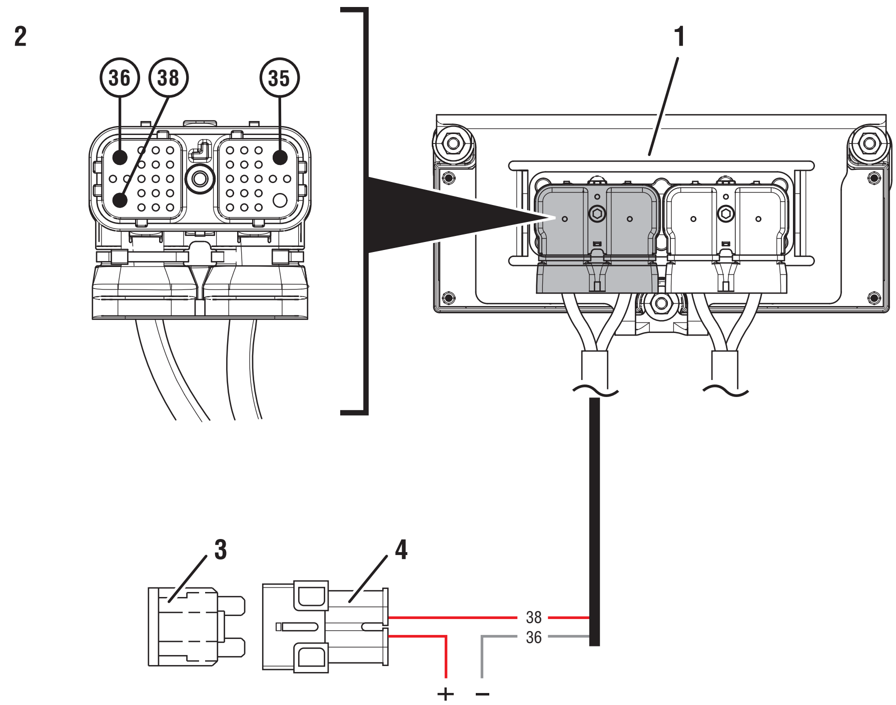
Additional Tools

Battery load testing equipment (see OEM for specific recommendations)

Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. ECA Shield
4. 4-Way Diagnostic Connector
5. Electronic Clutch Actuator (ECA)
6. 2-Way ECA Connector



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

Electrical Pretest Gen2 ECA

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 starter, 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 or may route power and ground to the starter. 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.**

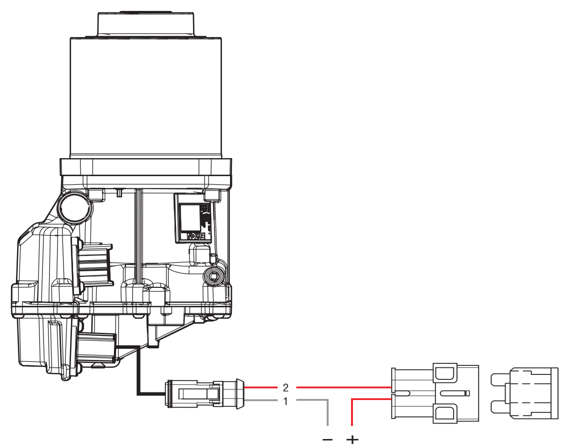
Battery Voltage

B

Purpose: *Verify power and ground supply to the ECA.*

1. Key off.
2. Inspect the ECA 40-amp In-line Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.
3. Visually inspect ECA Power Supply Harness between the power supply and the ECA for signs of rubbing or chafing to the wiring.

   Note: Some chassis use a power and ground distribution block separate from the battery or may route power and ground to the starter. 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. Repeat test.
- If no damage is found, go to **Step C.**

C

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

1. Key off.

Important: 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 D.**
   - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step D.**

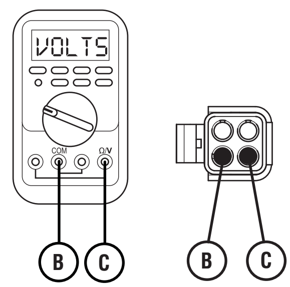
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

D

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

1. Reconnect all harnesses and connectors.
2. Key on with engine 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.

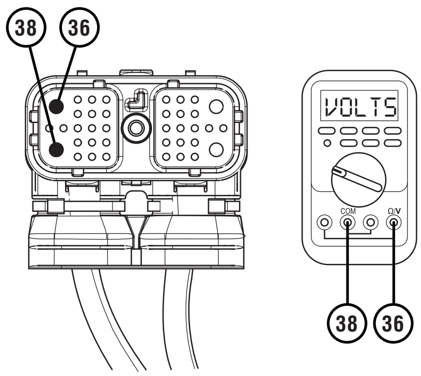


5. Compare reading(s) in table.
   - If readings are in range, go to **Step G.**
   - If readings are out of range, go to **Step E.**

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

E ***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).



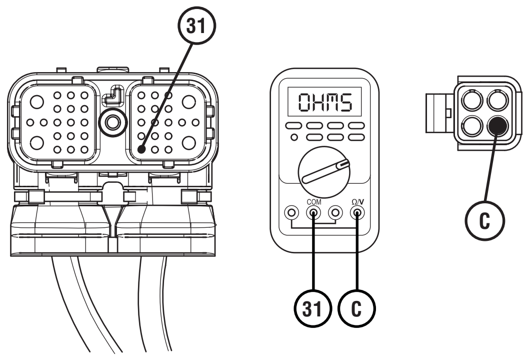
5. Compare reading(s) in table.
   - If readings are in range, go to **Step F.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of battery power and ground supply to TECU. Repeat Electrical Pretest.

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

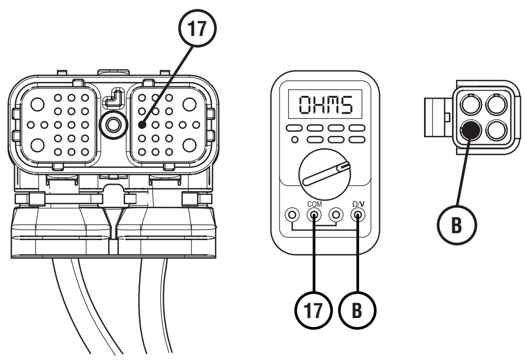
F

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

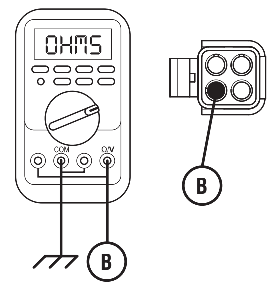
1. Key off.
2. Disconnect 38-Way Transmission Harness Connector from TECU.
3. Inspect connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between Pin 31 and Pin C. Record reading(s) in table.



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. Repeat Electrical Pretest.
   - If readings are in range, replace TECU. Repeat Electrical Pretest.

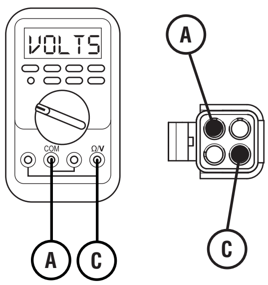
Pins	Range	Reading(s)
31 to C	0.0–0.3 Ohms	
17 to B	0.0–0.3 Ohms	
B to Ground	Open Circuit (OL)	

G

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 engine 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.



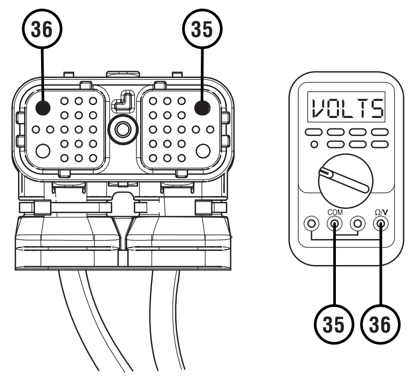
6. Compare reading(s) in table.
   - If readings are in range, go to **Step J.**
   - If readings are out of range, go to **Step H.**

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

H

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 engine off.
5. Measure voltage between 38-Way Connector Pin 35 (Ignition positive) and Pin 36 (Battery negative). Record reading(s) in table.



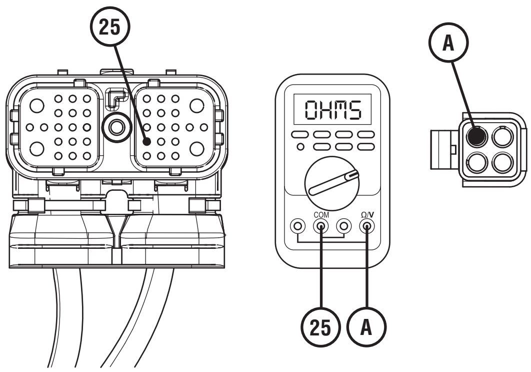
6. Compare reading(s) in table.
   - If readings are in range, go to **Step I.**
   - If readings are out of range, refer to OEM guidelines for repair of ignition voltage supply. Repeat Electrical Pretest.

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

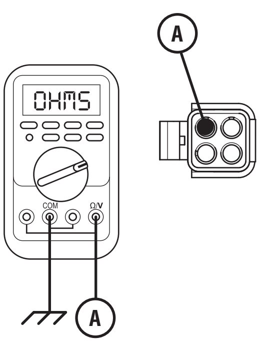
I

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.

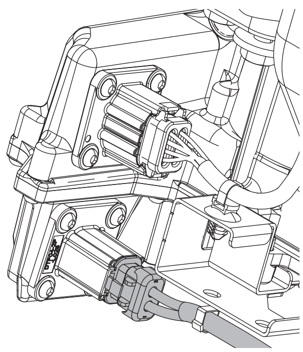


6. Compare reading(s) in table.
   - If readings are out of range, replace Transmission Harness. Repeat Electrical Pretest.
   - If readings are in range, replace TECU. Repeat Electrical Pretest.

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

J	***Purpose:*** *Verify condition of 2-Way ECA Connector.*

1. Key off.
2. Disconnect 2-Way ECA Connector.
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.

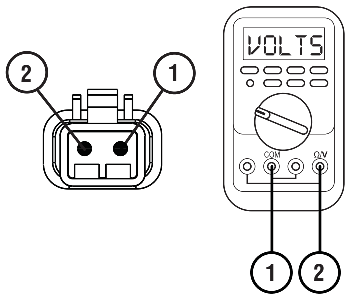


- If damage is found to the ECA Power Harness, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Repeat Electrical Pretest.
- If damage to the ECA is found, replace ECA. Repeat Electrical Pretest.
- If no damage is found, go to **Step K.**

K

Purpose: *Verify battery voltage at ECA.*

1. Key off.
2. Measure voltage between 2-Way ECA Connector Pin 2 (Battery positive) and Pin 1 (Battery negative). Record reading(s) in table.



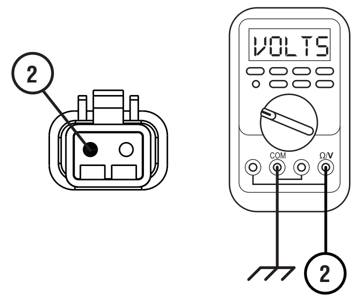
3. Compare reading(s) in table.
   - If readings are in range, no issue is found, go to **Step L.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Repeat Electrical Pretest.

Pins	Range	Reading(s)
1 to 2	Within 1.2 V of Battery Positive (+)	

L

Purpose: *Verify polarity of battery voltage at ECA.*

1. Key off.
2. Measure voltage between 2-Way ECA Connector Pin 2 (Battery positive) and ground. Record reading(s) in table.



3. Compare reading(s) in table.
   - If readings are in range, Electrical Pretest Complete.
   - If readings are out of range, the Battery positive and Battery negative wires are incorrectly pinned in the ECA 2-Way Connector. Refer to OEM requirements for repair or replacement of the ECA Power Harness. Repeat Electrical Pretest.

Pins	Range	Reading(s)
2 to Ground	Within 1.2 V of Battery Positive (+)	

Fault Code 11: No TECU Operation

J1587: MID 130 SID 254 FMI 12
J1939: SA 3 SPN 629 FMI 12

Overview

The UltraShift *PLUS* 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).
- Engine may not crank.
- Transmission may not attempt to shift.
- Transmission may not confirm neutral.
- Engine may have to be shut down with transmission still in gear.

Conditions to Set Fault Code Inactive

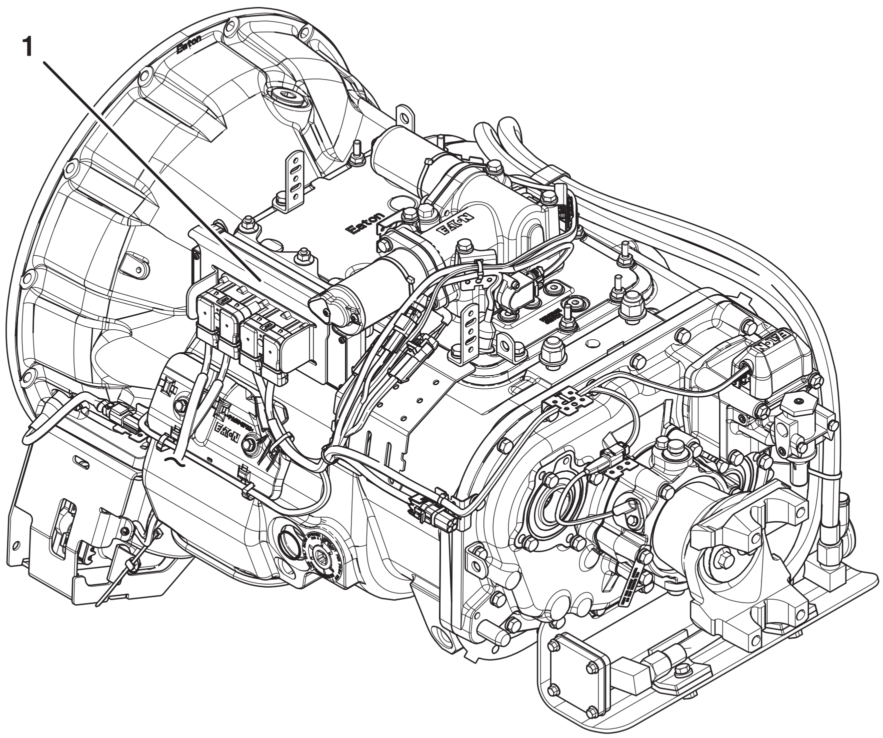
FMI 12: Transmission powers up and the failure is no longer detected by the TECU.

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. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the *Diagnostic Procedure* on page 11.
   - If Fault Code 11 sets Active or Inactive, replace 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 engine 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 13.

Fault Code 12: Improper TECU Configuration

J1587: MID 130 SID 254 FMI 13
J1939: SA 3 SPN 629 FMI 13

Overview

The UltraShift *PLUS* 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.

Fallback

FMI 13

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

Conditions to Set Fault Code Inactive

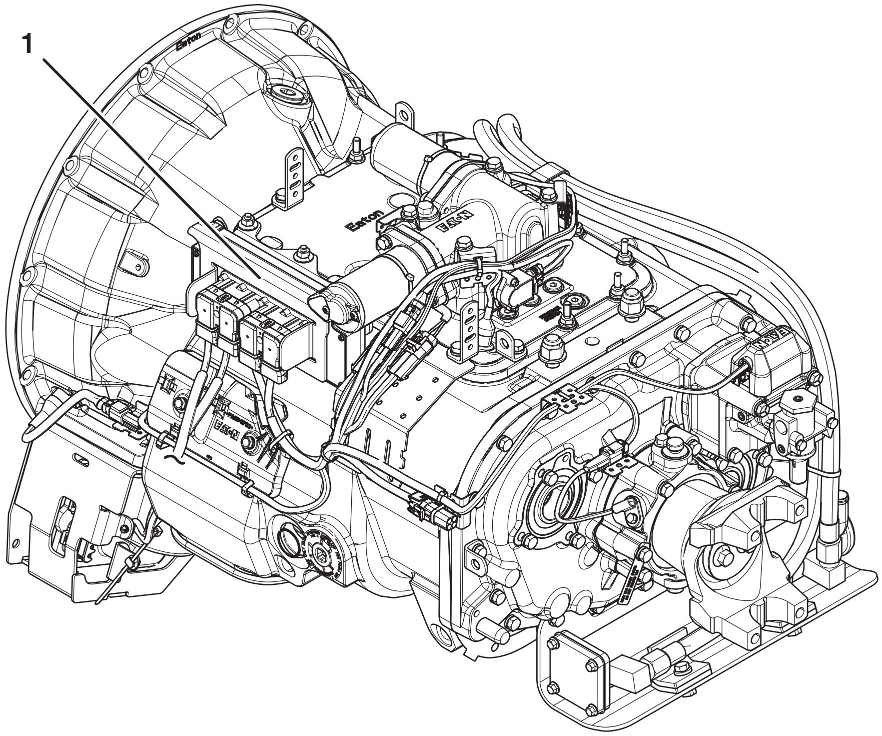
FMI 13: TECU has detected a proper configuration for the transmission.

Possible Causes

FMI 13

- 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. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 12 is Active or Inactive, replace 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 engine 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 13.

Fault Code 13: J1939 Shift Control Device

J1587: MID 130 SID 231 FMI 8, 11
J1939: SA 3 SPN 751 FMI 8, 11

Overview

The UltraShift *PLUS* 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 11 – FMI Unknown: 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).
- Engine may not crank.
- Transmission may not engage a gear from neutral.

FMI 11

- “F” does not flash in gear display.
- Service light does not flash (if equipped).
- Transmission may not attempt to shift.
- Until the fault becomes Inactive, driver may have to shut off engine with transmission in gear.

Conditions to Set Fault Code Inactive

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

Possible Causes

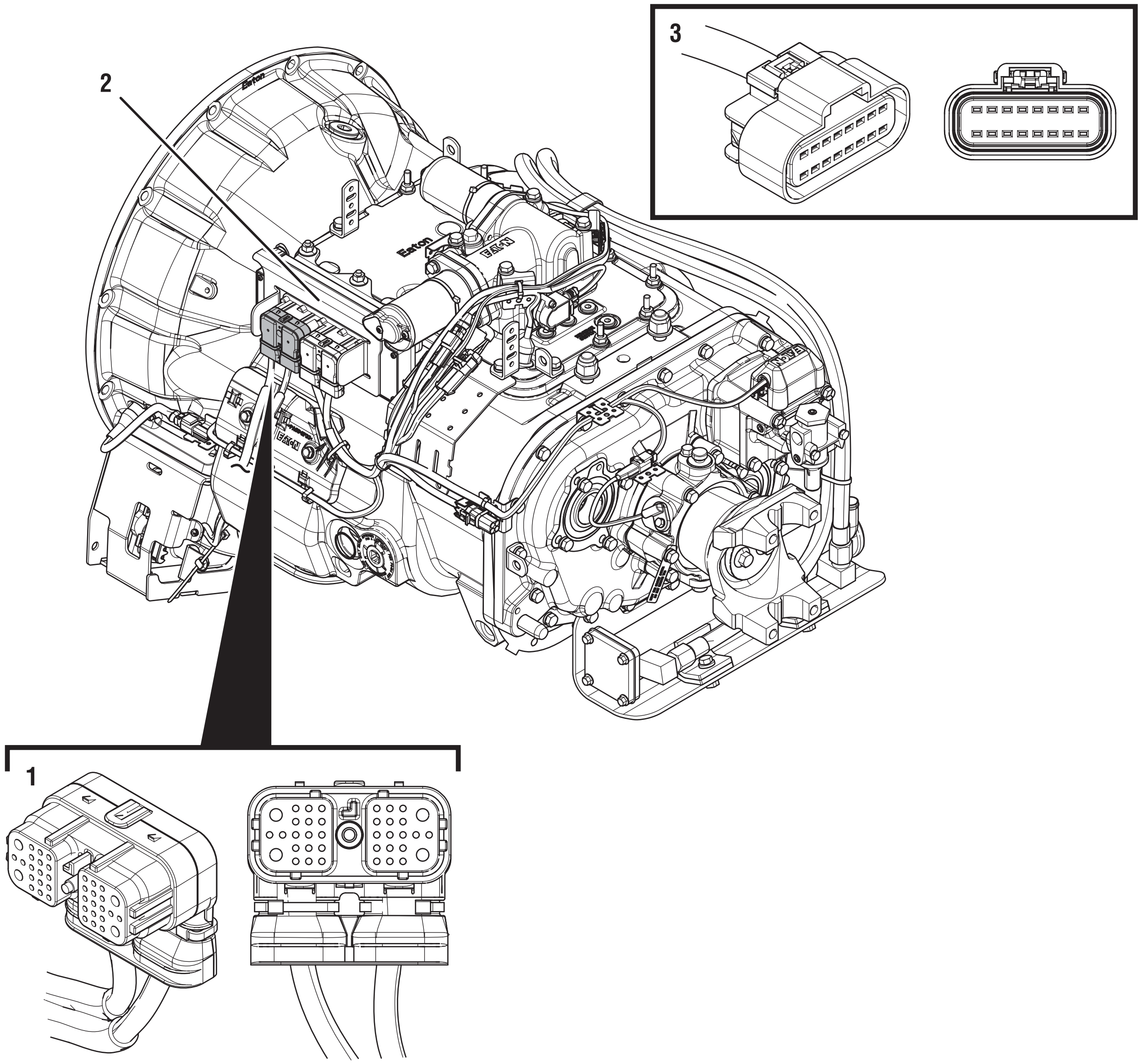
FMI 8

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

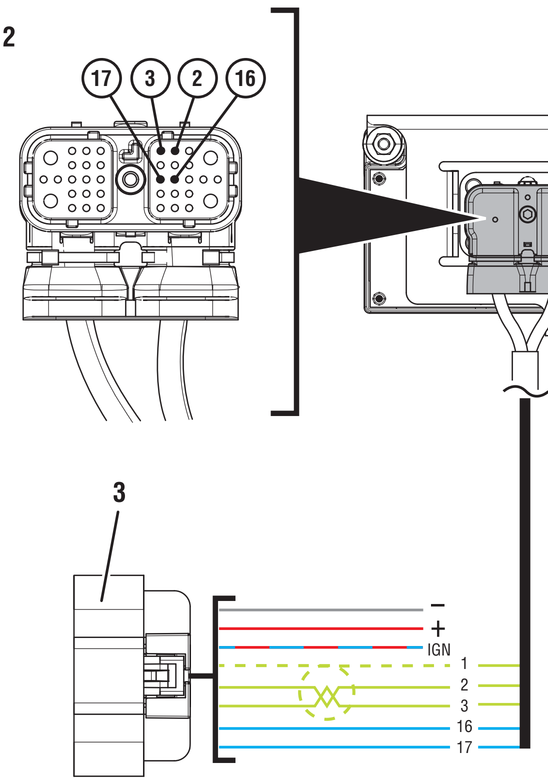
FMI 11

- 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 vehicle J1939 Data Link fault codes are set, refer to OEM guidelines for repair or replacement of the vehicle J1939 Data link. Go to **Step V.**
   - If transmission Fault Code 35 is set, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If vehicle J1939 Data Link fault codes and Fault Code 35 are **NOT** set, go to **Step B.**

B

Purpose: *Verify FMI set and vehicle OEM.*

1. Record FMI set for Fault Code 13 and vehicle OEM in table.
   - If Fault Code 13 FMI 8 is Active or Inactive and the vehicle OEM is Freightliner, go to **Step M.**
   - If Fault Code 13 FMI 8 is Active or Inactive and the vehicle OEM is **NOT** Freightliner, go to **Step J.**
   - If Fault Code 13 FMI 11 is Active (All OEMs), go to **Step D.**
   - If Fault Code 13 FMI 11 is Inactive (All OEMs), go to **Step C.**

FMI	OEM

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.

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

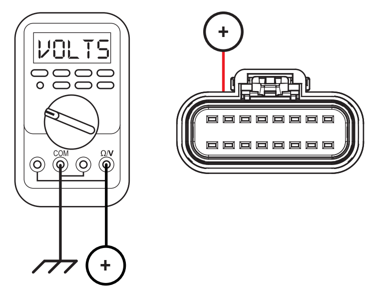
- If any fault code became Active while wiggling the power or ground supply to the Shift Control Device, refer to OEM guidelines for repair or replacement of the power and ground supply to the Shift Control Device. Go to **Step V.**
- If any fault code became Active while wiggling J1939 Data Link Wiring 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 engine 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.**

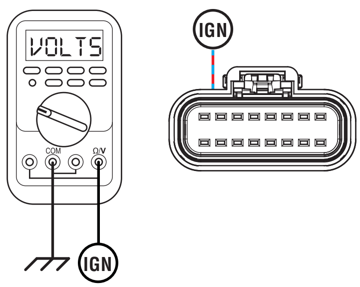
Pins	Range	Reading(s)
Battery Positive (+) at OEM J1939 Shift Control Connector to Ground	Within 1.2 V of battery voltage	

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

1. Key on with engine 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.**

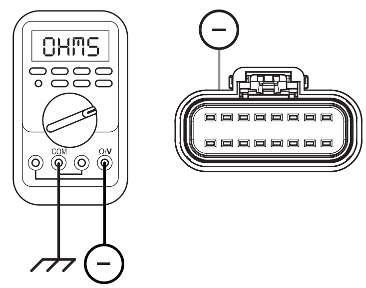
Pins	Range	Reading(s)
Switched Ignition at OEM J1939 Shift Control Connector to Ground	Within 1.2 V of battery voltage	

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

1. Key on with engine 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.**

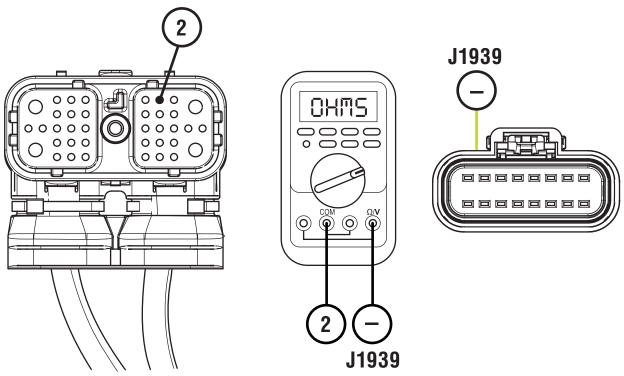
Pins	Range	Reading(s)
Ground Supply at OEM J1939 Shift Control Connector Pin to Ground	0.0–0.3 ohms	

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

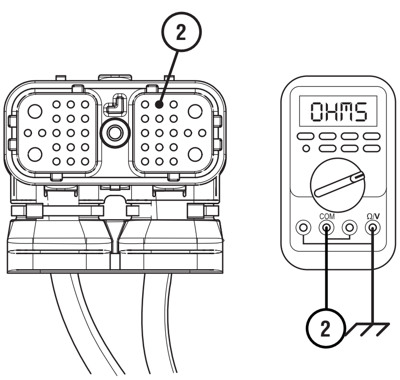
1. Key off.

   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.**

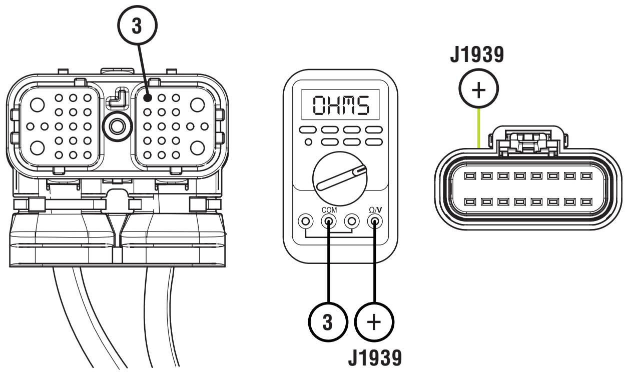
Pins	Range	Reading(s)
2 to J1939 Negative (-) Shift OEM J1939 Shift Control Connector Pin	0.0–0.6 ohms	
2 to Ground	Open Circuit (OL)	

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

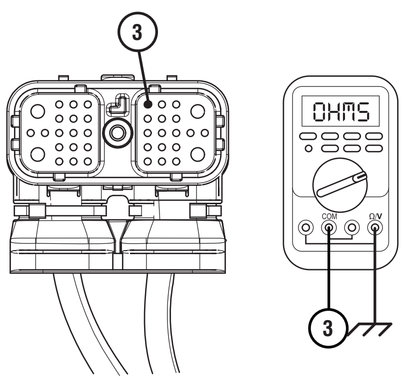
1. Key off.

   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.**

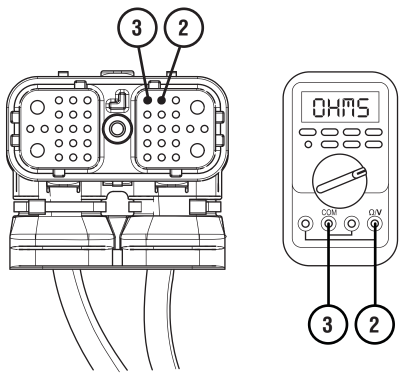
Pins	Range	Reading(s)
3 to J1939 Positive (+) OEM J1939 Shift Control Connector	0.0–0.6 ohms	
3 to Ground	Open Circuit (OL)	

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

1. Key off.

Important: 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.**

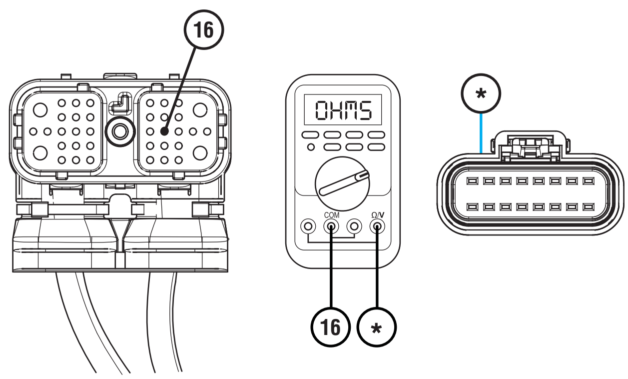
Pins	Range	Reading(s)
2 to 3	50–70 ohms	

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

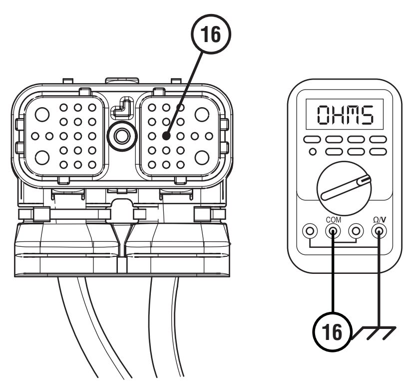
1. Key off.

   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.**

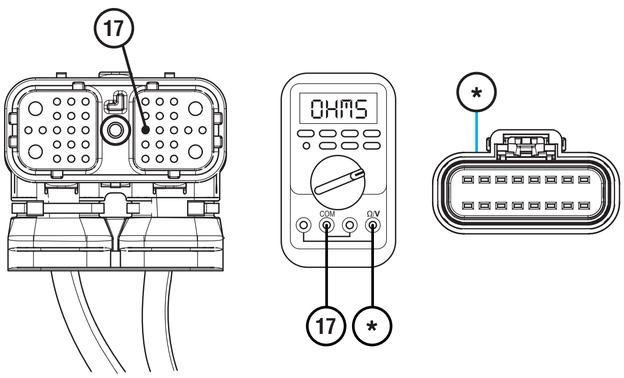
Pins	Range	Reading(s)
16 to OEM J1939 Shift Control Connector Neutral Request Signal	0.0–0.6 ohms	
16 to Ground	Open Circuit (OL)	

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

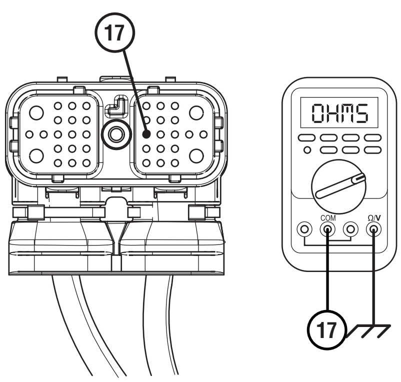
1. Key off.

   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 engine 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.**

M

Purpose: *Verify Transmission Driver Interface Device type.*

1. Record the vehicle transmission driver interface device type in table.
   - If Fault Code 13 FMI 8 is Active or Inactive and the vehicle is equipped with an Eaton Push Button, go to **Step J.**
   - If Fault Code 13 FMI 8 is Active and the vehicle is equipped with a Freightliner shift stalk, go to **Step N.**
   - If Fault Code 13 FMI 8 is Inactive and the vehicle is equipped with a Freightliner shift stalk, TECU is properly configured. Go to **Step V.**

Transmission Driver Interface Device Type

N

Purpose: *Update the Regional Calibration configuration setting with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Options”.
5. From the “Regional Calibration” configuration “New Value” drop down select “DTNA 2017 Cascadia 5573603”.
6. Select “Apply” and follow on-screen prompts.
   - 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. 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 13.

Fault Code 14: Invalid Shift Lever Voltage

J1587:	**MID 130**	**SID 18**	**FMI 2, 4, 5**
	MID 130	**SID 19**	**FMI 2, 4, 5, 14**
J1939:	**SA 3**	**SPN 751**	**FMI 2, 4, 5**
	SA 3	**SPN 752**	**FMI 2, 4, 5, 14**

Overview

The UltraShift *PLUS* transmission may be equipped with an analog Shift Control Device. The Transmission Electronic Control Unit (TECU) supplies the analog Shift Control Device with 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 14 indicates the TECU has detected an electrical fault in either the OEM-supplied wiring or Shift Control Device.

Detection

TECU monitors the voltage from the analog Shift Control Device. Fault Code 14 sets when the reported voltage for a selected mode does not match the actual value for that lever position.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: TECU receives erratic gear position information from the Shift Lever.

FMI 4 – Voltage Below Normal or Shorted Low: Short to ground is detected, or the voltage value is not defined.

FMI 5 – Current Below Normal or Open Circuit: An open circuit is present on the circuit, or the circuit is shorted high.

FMI 14 – Special Instructions: The TECU has detected an abnormally long up or down button request.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Engine may not crank.
- Transmission is limited to down shifts only.
- Transmission may not engage a gear from neutral.
- If a fault occurs with the manual mode up or down buttons, manual mode can not be used. The transmission will shift as normal in auto mode.

Conditions to Set Fault Code Inactive

All FMIs: Signal voltage enters a valid range for 0.2 seconds.

Possible Causes

FMI 2

- Vehicle Harness
  - Excessive resistance in shifter wiring
  - Bent, spread, corroded or loose terminals
- Analog Shift Lever
  - Internal failure

FMI 4

- Vehicle Harness
  - Wires between analog Shift Lever and TECU shorted to ground

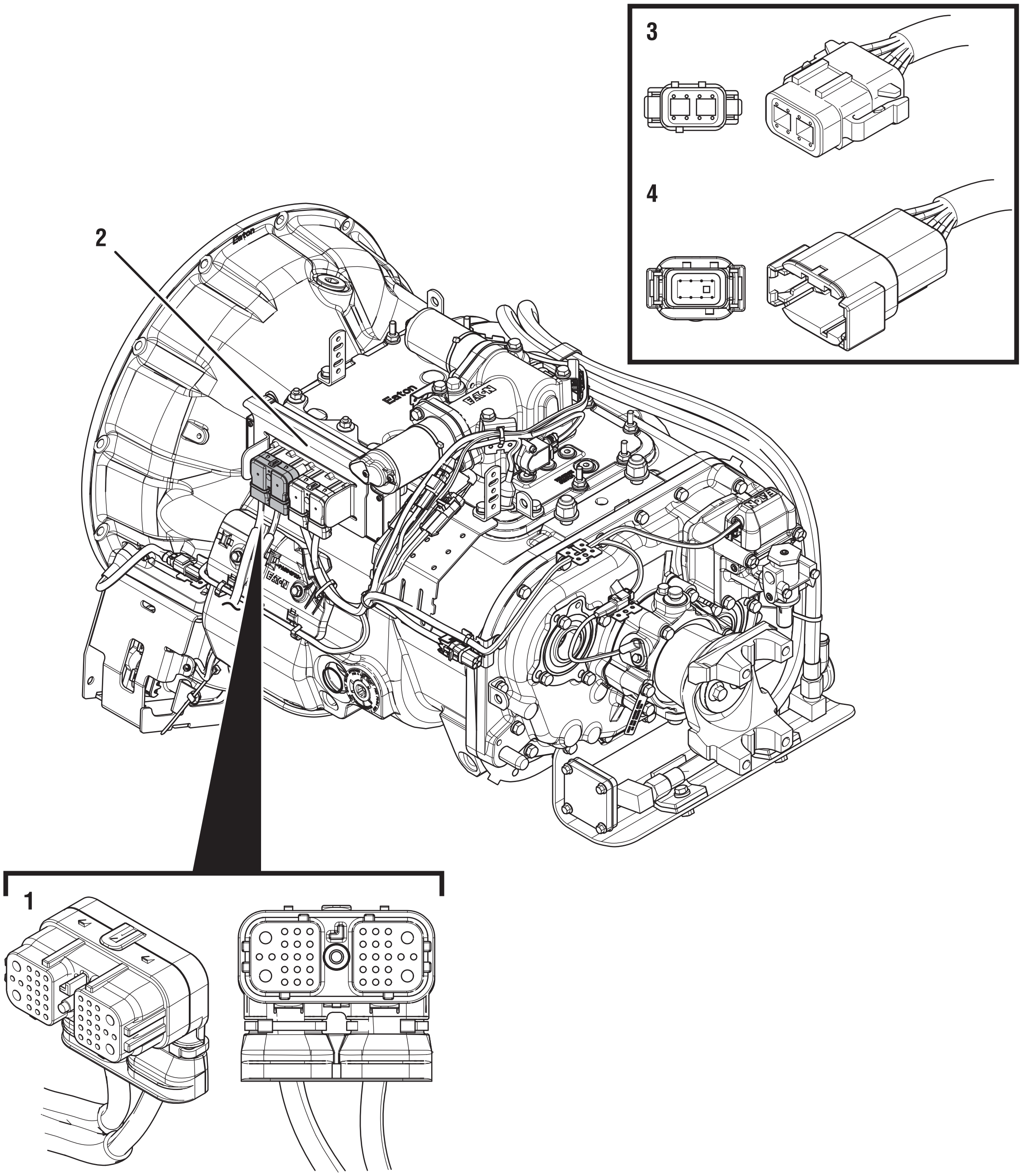
FMI 5

- Vehicle Harness
  - Wires between analog Shift Lever and TECU may be open or shorted to power
- Analog Shift Lever
  - Internal failure

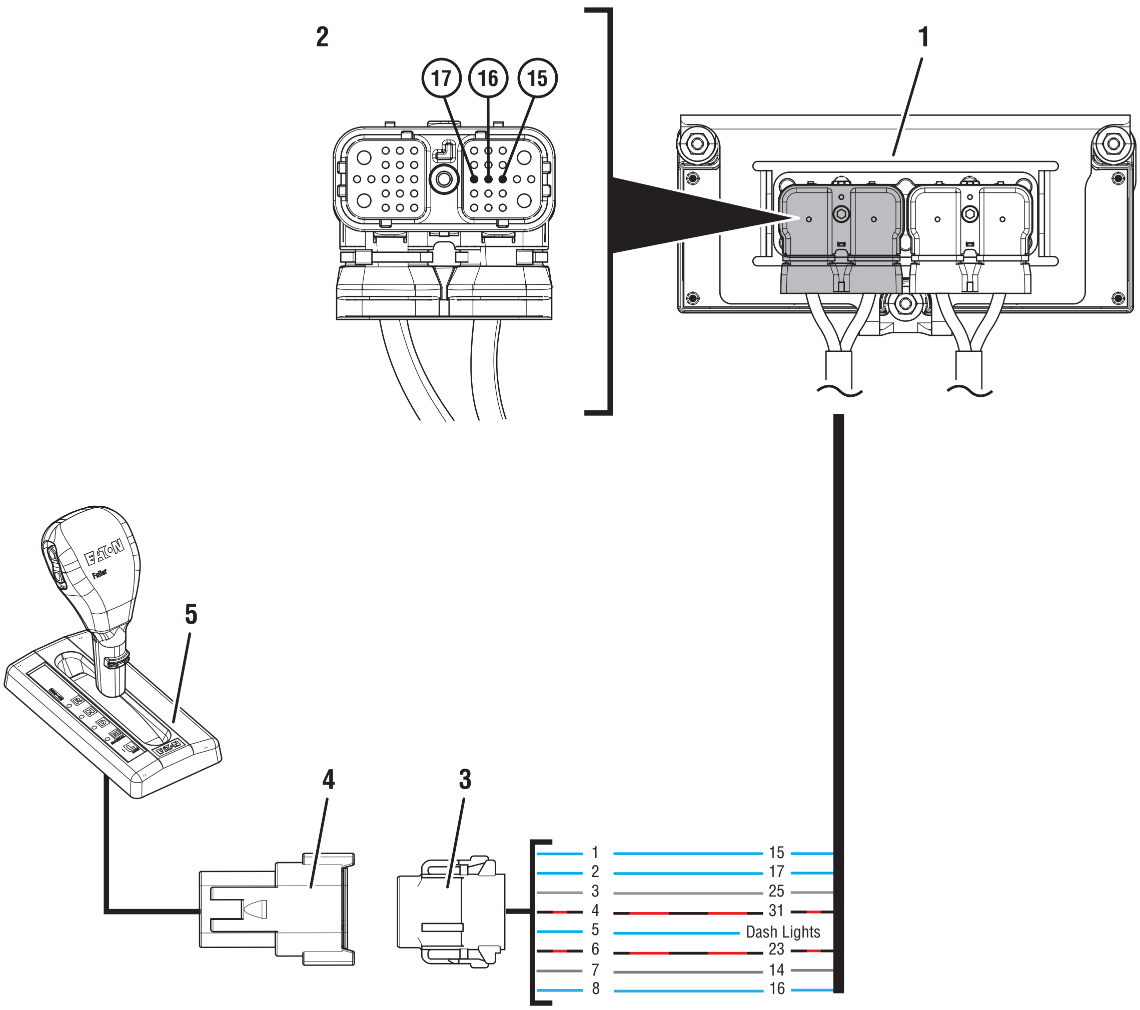
FMI 14

- Analog Shift Lever
  - Internal failure
- Driver Behavior
  - Up or Down button held excessively long

Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 8-Way Vehicle Harness Shift Lever Connector
4. 8-Way Cobra Shift Lever Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 8-Way Vehicle Harness Shift Lever Connector
4. 8-Way Cobra Shift Lever Connector
5. Cobra Shift Lever

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

Fault Code 14 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

   Note: Vehicles can be equipped with either an Eaton-supplied analog Shift Lever or an OEM analog Shift Lever. This troubleshooting guide is intended for use only with Eaton-supplied analog Shift Levers. If your vehicle has Fault Code 14 and is equipped with an OEM analog Shift Lever, consult the OEM for proper troubleshooting procedures.

   - If Fault Code 14 is Active, go to **Step D.**
   - If Fault Code 14 is Inactive, go to **Step B.**

B

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

1. Set parking brake and chock wheels.

   Note: Wiring between the TECU and analog Shift Lever is OEM proprietary. Refer to OEM wiring diagrams, harness routing, connector view and pin locations to ensure complete inspection of the analog Shift Device wiring harness.

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 and analog Shift Lever Connector. Look for signs of rubbing or chafing.
4. Exit PD Mode by powering down.

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

- If any fault became Active while wiggling the 38-Way Vehicle Harness, refer to OEM guidelines for repair or replacement of harness. Go to **Step V.**
- If no fault codes became Active, go to **Step C.**

C ***Purpose:*** *Inspect Vehicle Harness and connections.*

1. Key off.
2. Disconnect 8-Way Vehicle Harness Connector at analog Shift Lever.
3. Inspect 8-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Inspect Vehicle Harness at all points of connection, verifying no corrosion, bent pins or other issues are present.
5. Disconnect 38-Way Vehicle Harness Connector from TECU.
6. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
   - If damage is found during inspection, refer to OEM guidelines for repair or replacement of wiring between TECU and analog Shift Lever. Go to **Step V.**
   - If no damage is found during inspection, go to **Step D.**

D

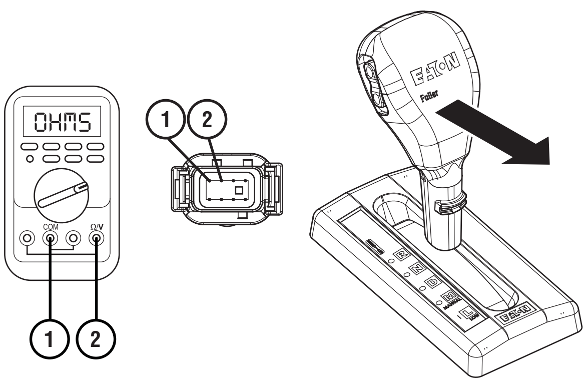
Purpose: *Verify proper operation of analog Shift Lever.*

1. Key off.

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

Note: If the vehicle is equipped with an OEM analog Shift Lever, consult the OEM schematics for proper connection pin out.

2. Disconnect 8-Way analog Shift Lever Connector.
3. Inspect 8-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure the resistance between 8-Way Shift Lever Connector Pin 1 and Pin 2. Take a resistance reading with the Analog Shift Lever in each position (R, N, D, M, L). Record reading(s) in table.



5. Compare reading(s) in table.
   - If all readings are in range, go to **Step E.**
   - If any readings are out of range, replace the analog Shift Lever. Go to **Step V.**

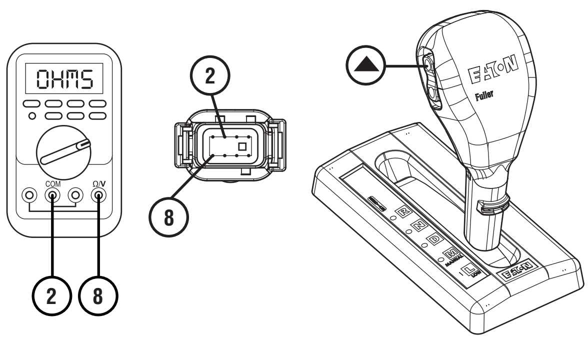
Pins	Lever Position	Range	Reading(s)
1 to 2	R	2917–3097 ohms	
1 to 2	N	343–364 ohms	
1 to 2	D	599–636 ohms	
1 to 2	M	993–1054 ohms	
1 to 2	L	1636–1737 ohms	

E ***Purpose:*** *Verify proper resistance values from Analog Shift Lever Up and Down positions.*

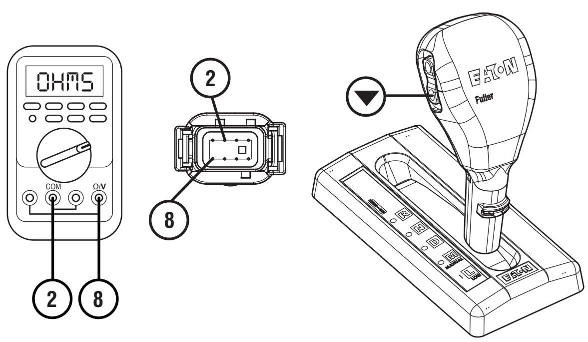
1. Key off.

   Note: If the vehicle is equipped with an OEM analog Shift Lever, consult the OEM schematics for proper connection pin out.

2. Place the analog Shift Lever in manual mode (M).
3. Measure resistance between 8-Way Shift Lever Connector Pin 2 and Pin 8 while holding the up-shift request button. Record reading(s) in table.



4. Measure resistance between 8-Way Shift Lever Connector Pin 2 and Pin 8 while holding the down-shift request button. Record reading(s) in table.



5. Compare reading(s) in table.
   - If all readings are in range, go to **Step F.**
   - If any readings are out of range, replace the analog Shift Lever. Go to **Step V.**

Pins	Lever Position	Range	Reading(s)
2 to 8	M + Up Button	609–647 ohms	
2 to 8	M + Down Button	1624–1724 ohms	

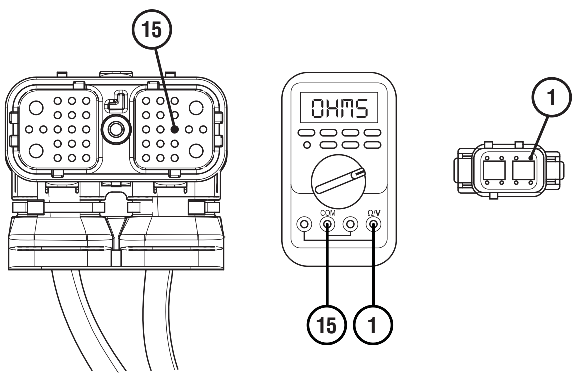
F

Purpose: *Verify continuity of auto mode input wire.*

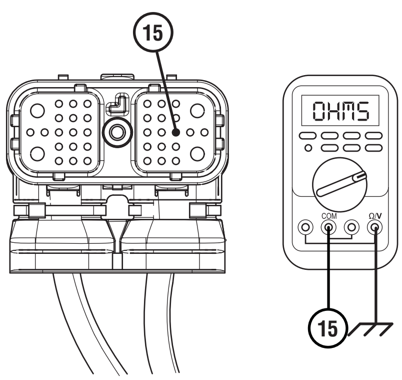
1. Key off.

   Note: If the vehicle is equipped with an OEM analog Shift Lever, please consult with the OEM schematics for proper connector pin out.

2. Disconnect 38-Way Vehicle Harness and 8-Way analog Shift Lever Connector.
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 15 and 8-Way Shift Lever Harness Connector Pin 1. Record reading(s) in table.



5. Measure resistance between 38-Way Vehicle Harness Connector Pin 15 and ground. Record reading(s) in table.



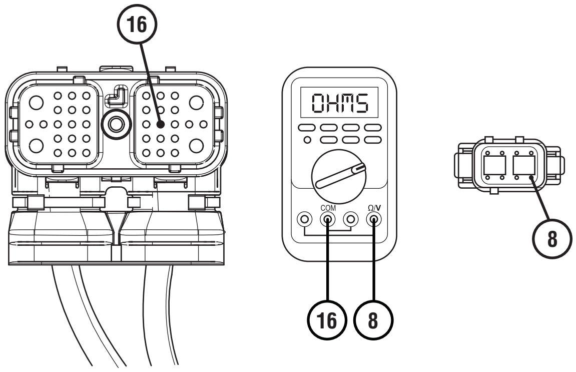
6. Compare reading(s) in table.
   - If readings are in range, go to **Step G.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of wiring between TECU and analog Shift Lever. Go to **Step V.**

Pins	Range	Reading(s)
15 to 1	0.0–0.3 ohms	
15 to Ground	Open Circuit (OL)	

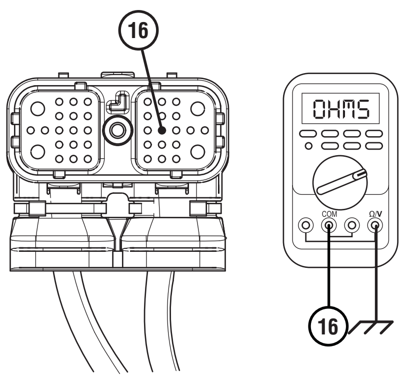
G ***Purpose:*** *Verify continuity of manual mode input wire.*

1. Measure resistance between 38-Way Vehicle Harness Connector Pin 16 and 8-Way Shift Lever Harness Connector Pin 8. Record reading(s) in table.

   Note: If the vehicle is equipped with an OEM analog Shift Device, please consult with the OEM for proper connector pin out.



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



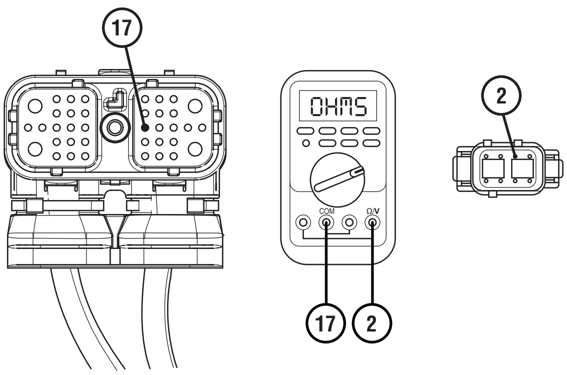
3. Compare reading(s) in table.
   - If readings are in range, go to **Step H.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of OEM wiring. Go to **Step V.**

Pins	Range	Reading(s)
16 to 8	0.0–0.3 ohms	
16 to Ground	Open Circuit (OL)	

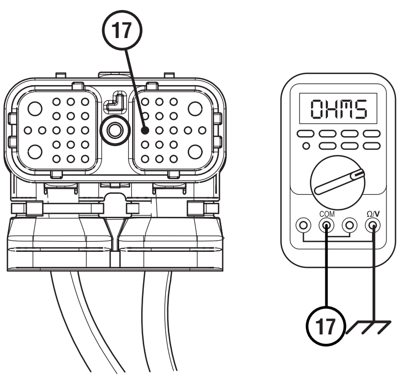
H ***Purpose:*** *Verify continuity of common ground wire.*

1. Measure resistance between 38-Way Vehicle Harness Connector Pin 17 and 8-Way Shift Lever Harness Connector Pin 2. Record reading(s) in table.

   Note: If the vehicle is equipped with an OEM analog Shift Device, please consult with the OEM for proper connector pin out.



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



3. Compare reading(s) in table.
4. Reconnect 38-Way Vehicle Harness Connector and analog 8-Way Shift Lever Connector. Ensure all connections are tight and secure.
   - If readings are in range, go to **Step I.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of wiring between TECU and analog Shift Lever. Go to **Step V.**

Pins	Range	Reading(s)
17 to 2	0.0–0.3 ohms	
17 to Ground	Open Circuit (OL)	

I

Purpose: *Verify integrity of OEM Bulkhead Connections.*

1. Key off.
2. Disconnect OEM Bulkhead Connector.
3. Inspect Bulkhead Connector body for damage and bent, spread, corroded or loose terminals.
   - If any issues are found with Bulkhead Connector, refer to OEM guidelines for proper repair or replacement of OEM wiring. Go to **Step V.**
   - If no issues are found in connector, go to **Step J.**

J

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

1. Key off.
2. Reconnect all electrical connections.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
   - If Fault Code 14 is still Active, replace analog Shift Lever. Go to **Step V.**
   - If Fault Code 14 is Inactive, refer to OEM guidelines for repair or replacement of wiring between TECU and analog Shift Lever. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key on with engine off.
2. Clear fault codes using ServiceRanger.
3. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
4. Check for fault codes using ServiceRanger.
   - If no fault codes set Active and vehicle operates properly, test complete.
   - If Fault Code 14 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 14 sets Active, troubleshoot per *Product Diagnostic (PD) Mode* on page 6.

Fault Code 15: HIL Shift Device Communication

J1587: MID 130 SID 18 FMI 9
J1939: SA 3 SPN 751 FMI 9

Overview

Vehicles equipped with an UltraShift *PLUS* transmission may also 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. The Electronic Clutch Actuator (ECA) communicates to the TECU through a portion of the HIL contained in the Transmission 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, but can still communicate with the ECA.

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

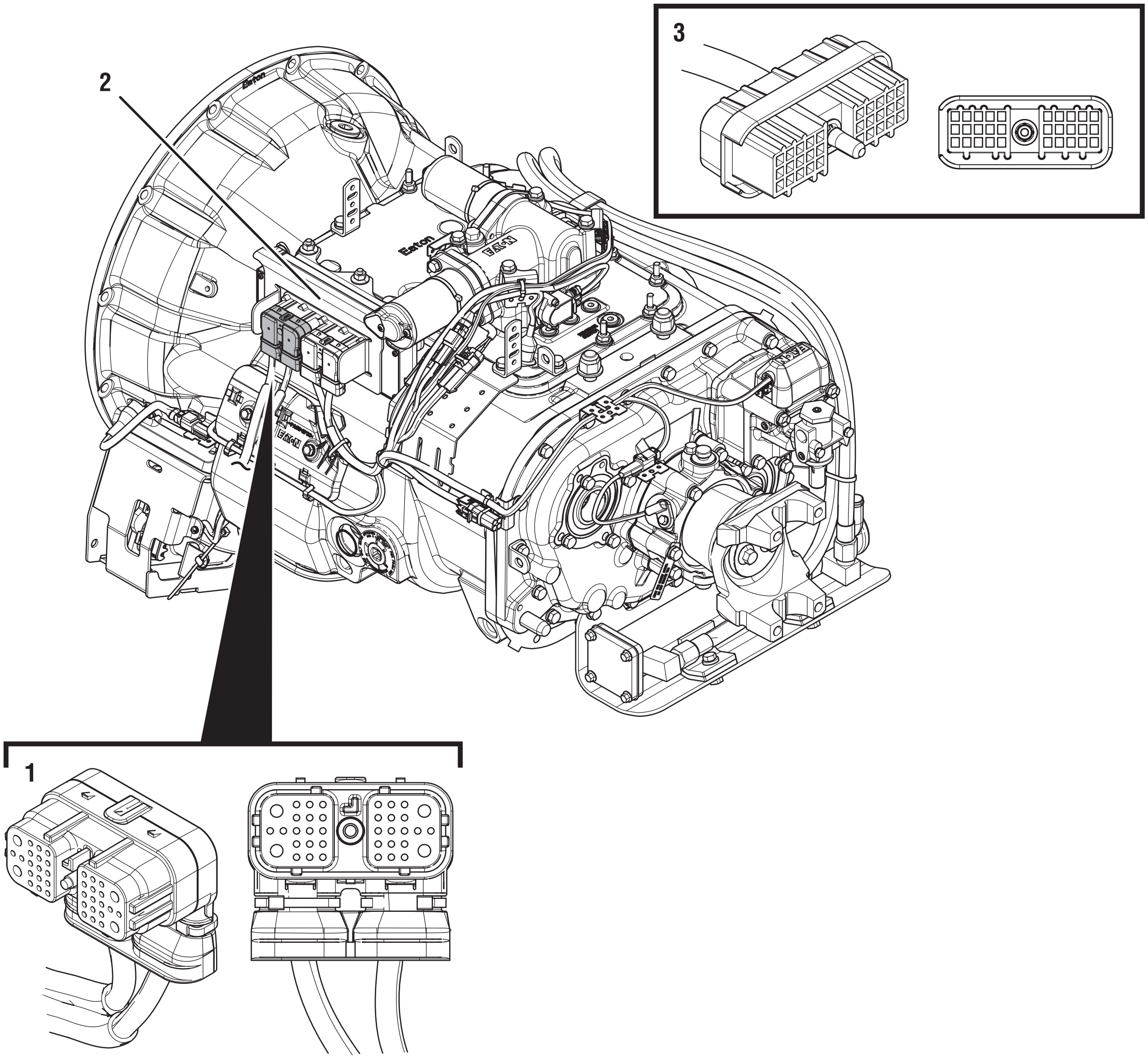
FMI 9: The TECU establishes communication with the PBSC for 10 seconds.

Possible Causes

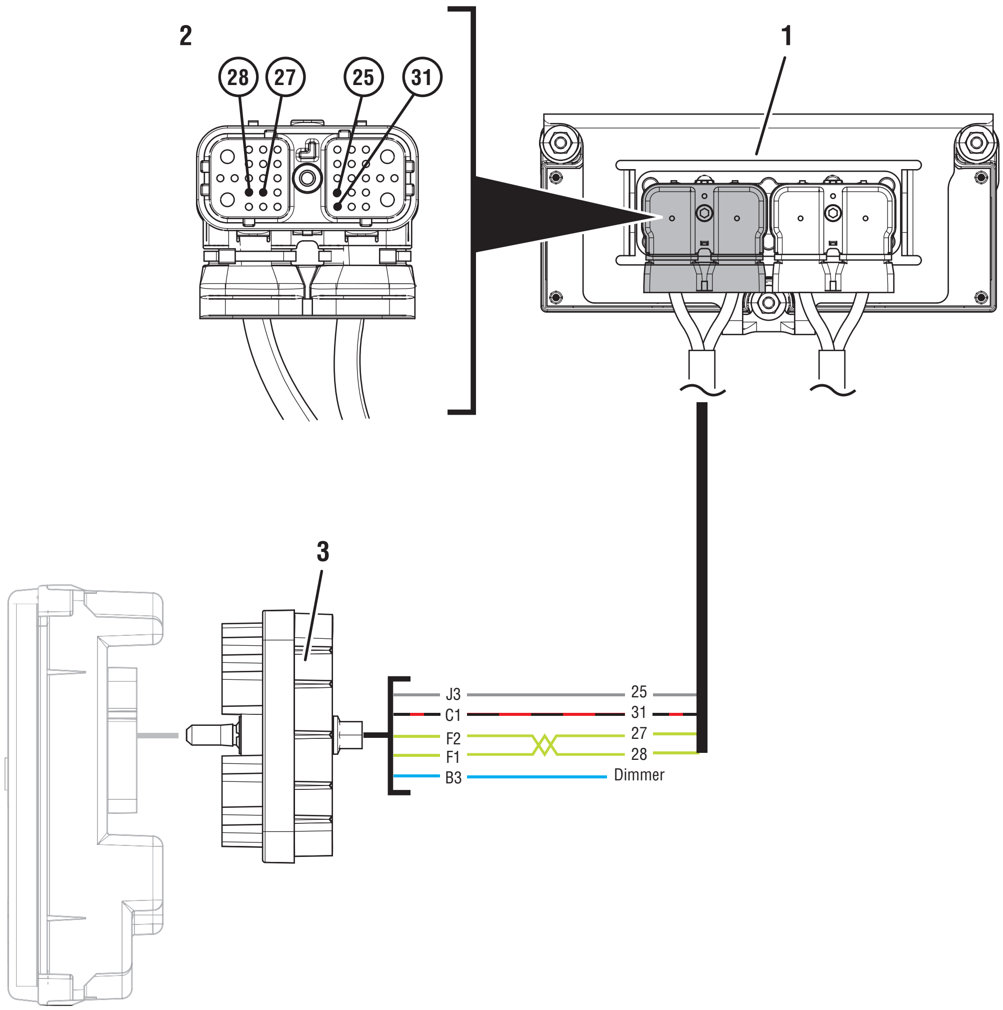
FMI 9

- 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
- PBSC
  - Internal failure
- TECU
  - 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. 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 13.
   - If Fault Code 15 is Active, go to **Step D.**
   - If Fault Codes 16 or 19 are Inactive and Fault Code 15 sets Inactive, troubleshoot Fault Code 16 per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 15 is Inactive and neither Fault Code 16 nor 19 is set, go to **Step B.**

B

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

1. Key off.

   ⚠ **Important:** 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.

Important: 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, refer to OEM guidelines for repair or replacement of HIL wiring between the PBSC and TECU. Go to **Step V.**

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

1. Key off.

Important: 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

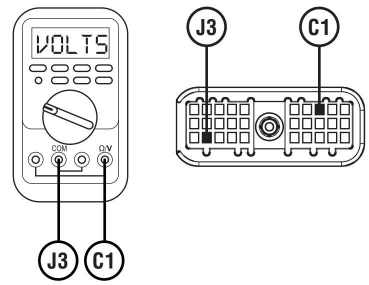
Purpose: *Verify integrity of 30-Way PBSC Connector.*

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.
   - If no damage is found, go to **Step F.**

F

Purpose: *Verify voltage supply to PBSC.*

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



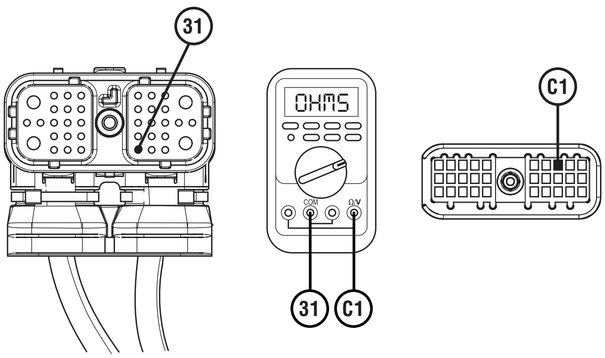
3. Compare reading(s) in table.
   - If readings are in range, go to **Step I.**
   - If readings are out of range, go to **Step G.**

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

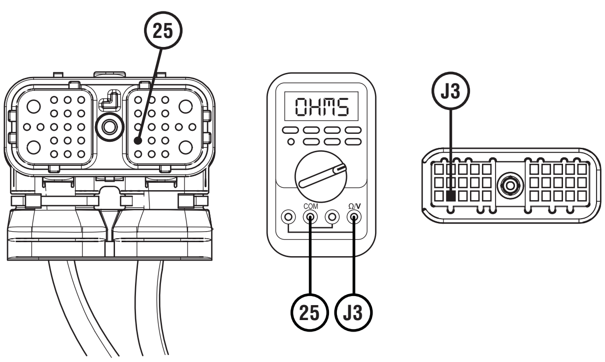
G

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.



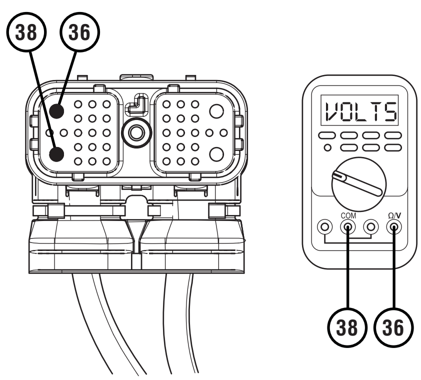
6. Compare reading(s) in table.
   - If readings are in range, go to **Step H.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of harness between TECU and PBSC. Go to **Step V.**

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 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)	

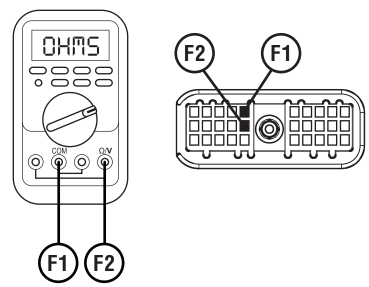
I

Purpose: *Verify HIL circuit resistance.*

1. Key off.

Important: 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

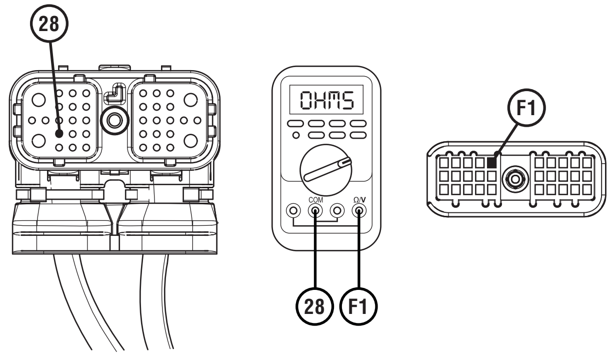
Purpose: *Verify integrity of 38-Way Vehicle Harness Connector.*

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.



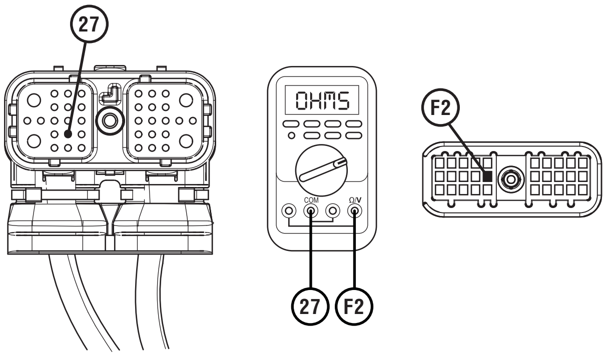
3. Compare reading(s) in table.
   - If readings are in range, go to **Step L.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of High Integrity Link (HIL) between the PBSC and TECU. Go to **Step V.**

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 engine 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 13.

Fault Code 16: High Integrity Link Gen1 ECA

J1587: MID 130 SID 248 FMI 2
J1939: SA 3 SPN 625 FMI 2

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), Electronic Clutch Actuator (ECA), and if equipped, Eaton Push Button Shift Control (PBSC). The portion of the HIL that connects the TECU to the ECA is contained within the Transmission Harness. The portion of the HIL that connects the TECU to the PBSC is contained within the Vehicle Harness. Fault Code 16 indicates a loss of communication of the HIL.

Detection

The TECU monitors communication with the Shift Control Device (if equipped) and the ECA 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 5 seconds.

Fallback

FMI 2

- 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

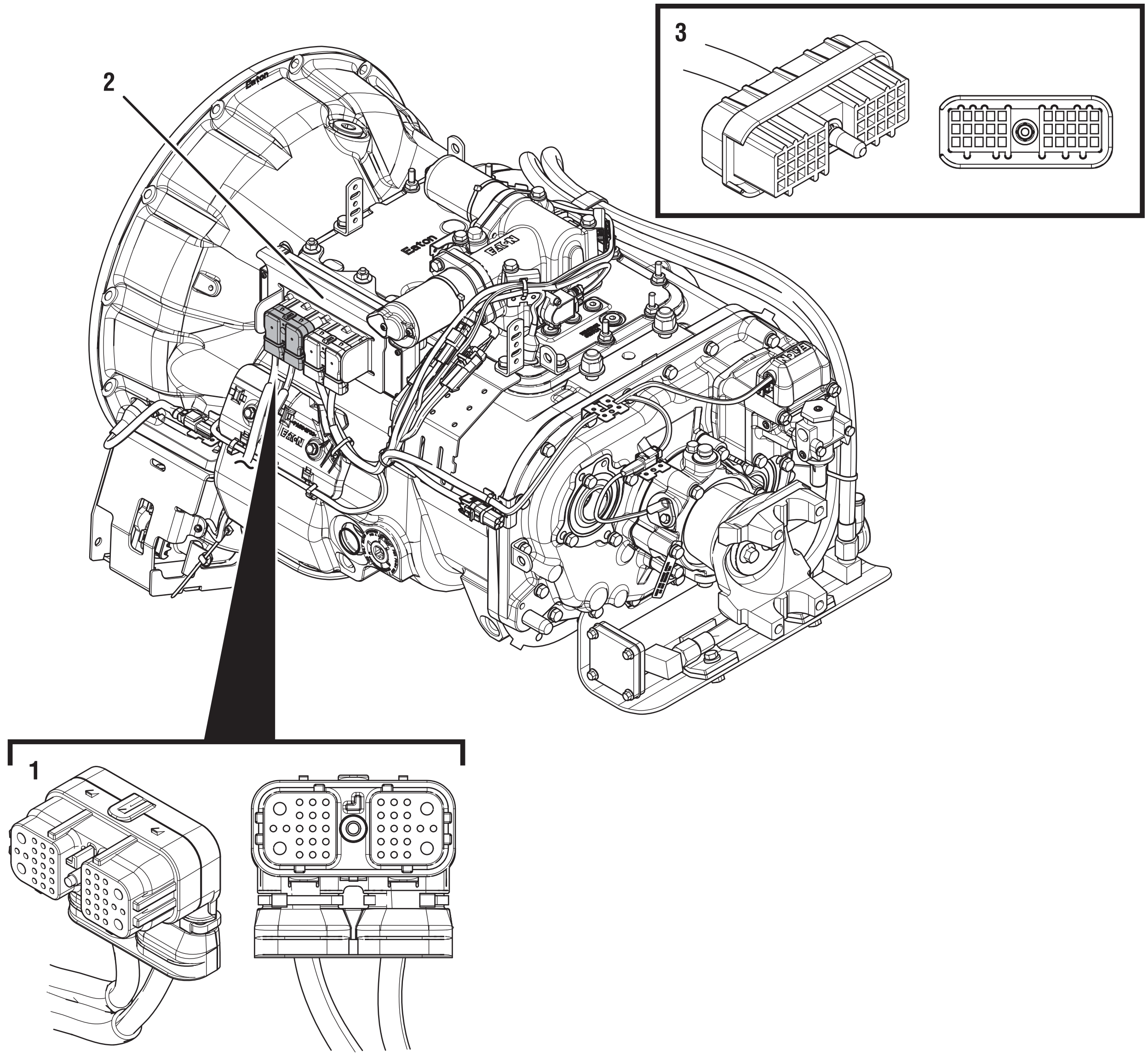
FMI 2: Communication between components is restored for 5 seconds.

Possible Causes

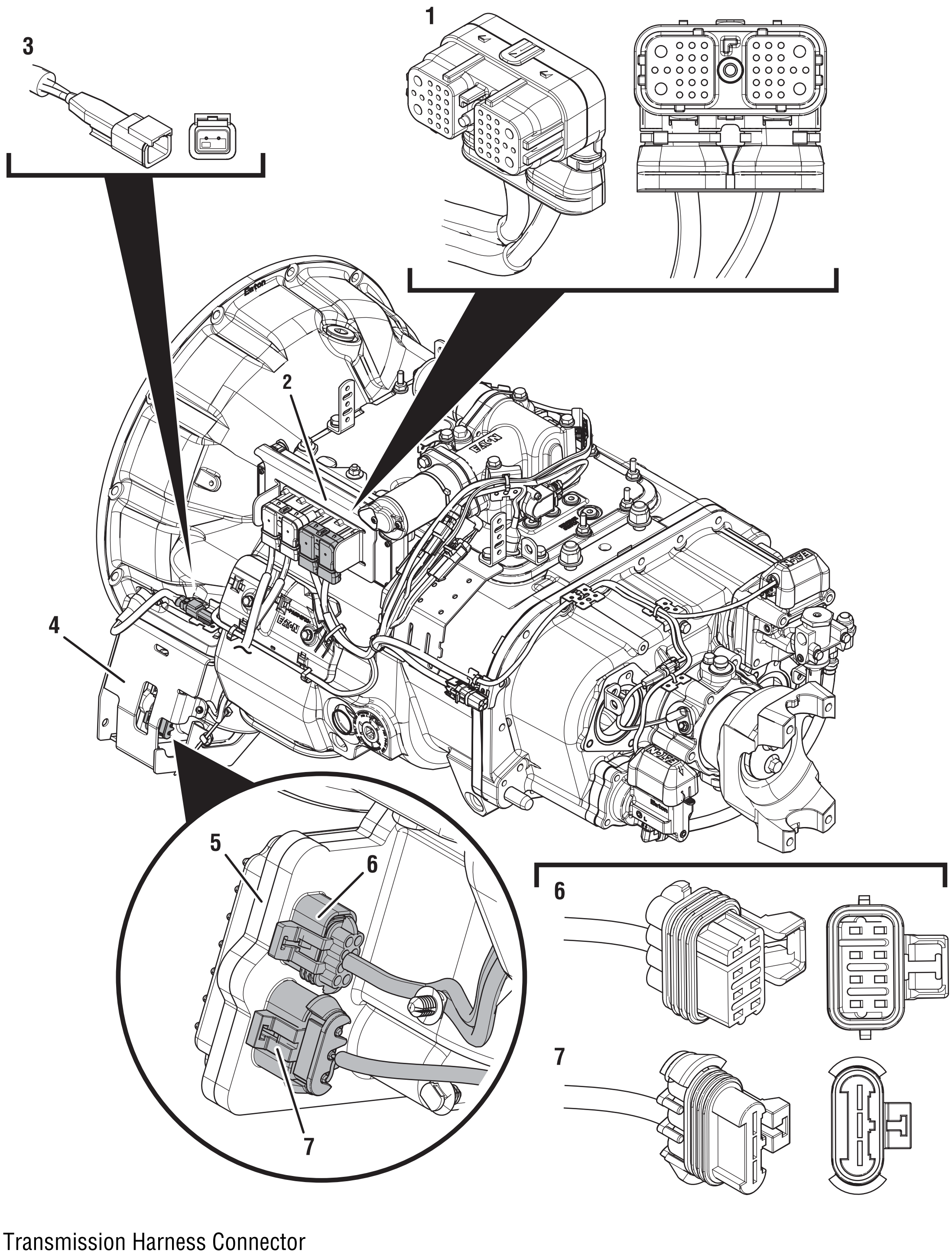
FMI 2

- HIL
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Missing terminating resistor
- Transmission Harness
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Seal failure in 8-Way ECA Connector
  - Loss of ignition voltage to ECA before power up
- ECA
  - Failed ECA software download
  - Bent, spread, corroded or loose terminals
  - Contamination in 3-Way ECA Connector
  - Contamination in 8-Way ECA Connector
  - Internal failure
- Vehicle Batteries
  - Internal failure
- Vehicle Power and Ground Supply to ECA
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Seal failure on 3-Way ECA Connector
  - Disconnected 3-Way ECA Connector
- Vehicle Power and Ground Supply to TECU
  - Corroded or loose power supply connections to TECU
- TECU
  - Internal failure
- PBSC
  - Internal failure

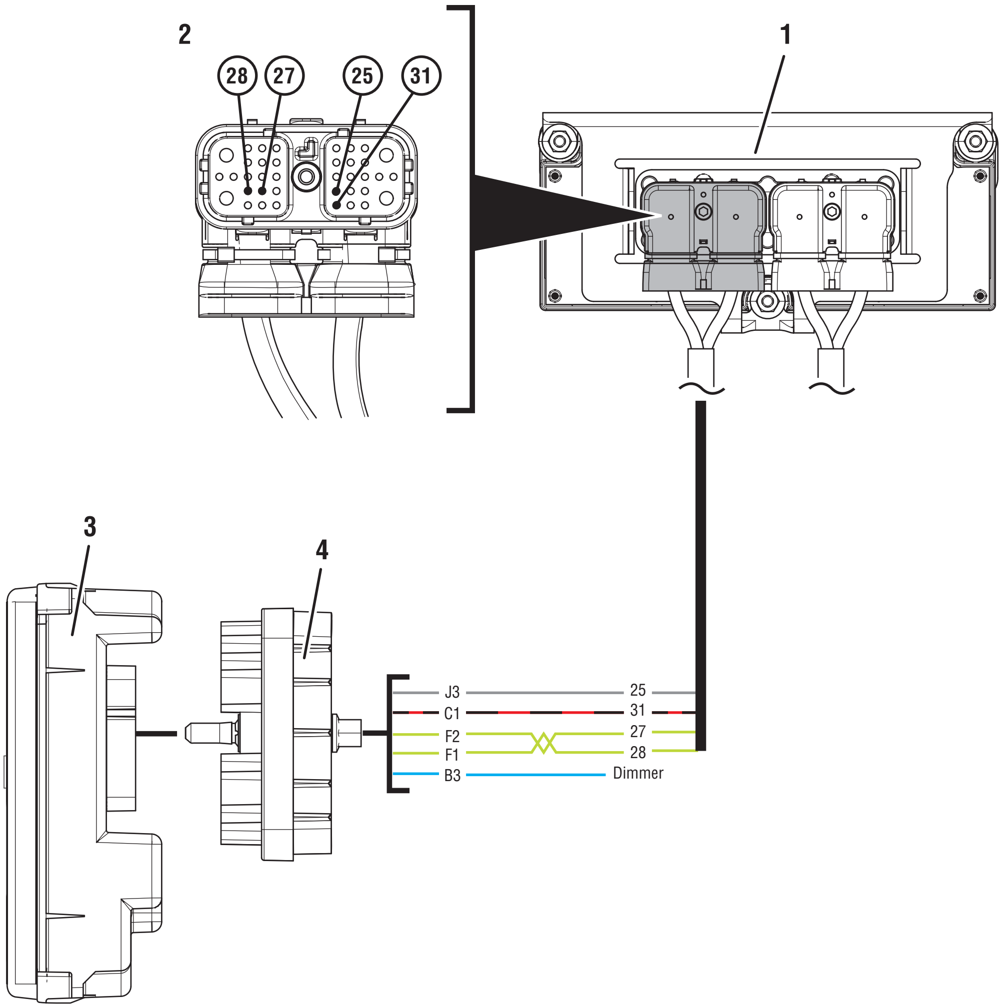
Component Identification



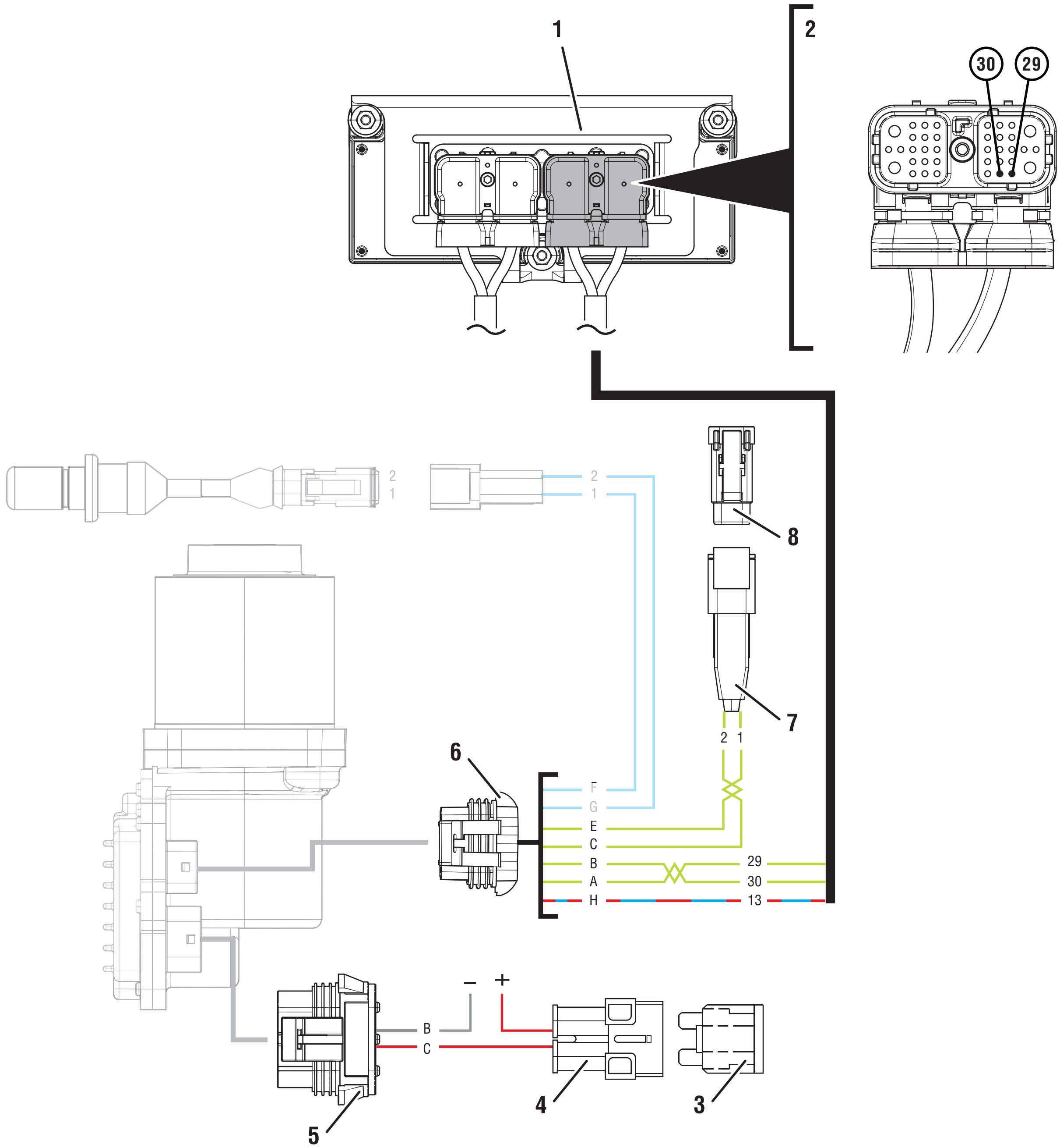
1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 30-Way Push Button Shift Control Device (PBSC) Connector



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 2-Way Terminating Resistor Connector Body
4. Gen1 ECA Shield
5. Gen1 Electronic Clutch Actuator (ECA)
6. 8-Way Gen1 ECA Connector
7. 3-Way Gen1 ECA Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. Eaton Push Button Shift Control Device (PBSC)
4. 30-Way PBSC Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 40-amp Fuse
4. In-line Fuse Holder
5. 3-Way Gen1 ECA Connector
6. 8-Way Gen1 ECA Connector
7. 2-Way Terminating Resistor Connector Body
8. 2-Way High Integrity Link (HIL) Terminating Resistor

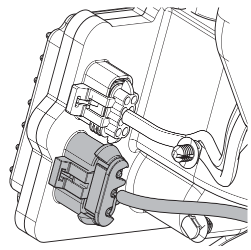
Battery Voltage	Switched Battery from TECU	Ground	Communication	Signal
Ignition Voltage	Switched 5V from TECU	Switched Ground	Relay/Solenoid Driver	

Fault Code 16 Troubleshooting Gen1 ECA

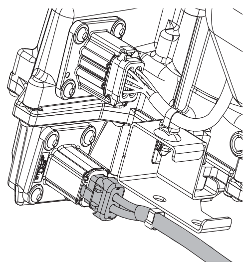
A

Purpose: Identify ECA installed on transmission.

1. Set parking brake and chock wheels.
2. Inspect ECA OEM Power Supply Connector, reference image below.



Gen1 ECA



Gen2 ECA

- If equipped with a Gen1 ECA, go to **Step B.**
- If equipped with a Gen2 ECA, go to *Fault Code 16: High Integrity Link Gen2 ECA* on page 120.

B

Purpose: Determine if ECA software was recently updated.

1. Determine if an ECA software download was performed immediately before Fault Code 16 set Active.
   - If an ECA software download was not recently performed, go to **Step D.**
   - If Fault Code 16 became Active immediately following an ECA software download, download may have failed. Go to **Step C.**

C

Purpose: Recover ECA software.

1. Key off.

   Note: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Use ServiceRanger to program or recover the TECU and ECA software to latest available levels.
   - If software does not download correctly, contact Eaton at (800) 826-4357.
   - If software downloads correctly and Fault Code 16 becomes Inactive, test complete. Go to **Step V.**
   - If software downloads correctly, but Fault Code 16 remains Active, go to **Step D.**

D

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

1. Key off.

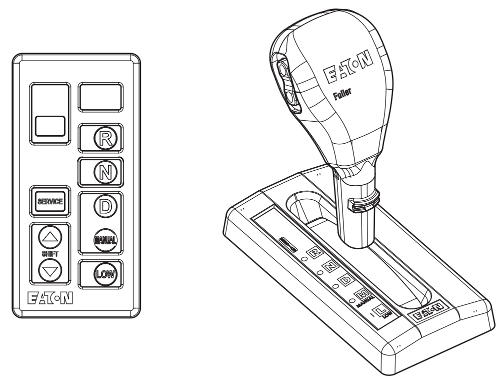
   Note: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. If vehicle is equipped with a Bulkhead Connection, disconnect Bulkhead Connector. Inspect connector for loose terminals, corrosion 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 Shift Control Device type.

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Check vehicle cab to determine the type of shift control device installed on the vehicle.



- If equipped with an Eaton PBSC, go to **Step F.**
- If equipped with any other shift device, including Eaton Cobra Lever or an OEM Shift Device, go to **Step M.**

F

Purpose: Check for Active or Inactive fault Codes for vehicles equipped with an Eaton PBSC.

1. Retrieve fault code information from the Service Activity Report.
   - If Fault Code 16 is Active, go to **Step H.**
   - If Fault Code 16 is Inactive, go to **Step G.**

G

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 batteries to the 3-Way Connector at the ECA. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Wiggle wiring and connections of the Transmission Harness from the 8-Way Gen1 ECA Connector to 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. Wiggle wiring and connections between the 30-Way PBSC Connector to the 38-Way Vehicle Harness Connector at the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
6. Exit PD Mode by powering down.

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

   - If any fault set Active while wiggling the ECA Power Harness, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Go to **Step V.**
   - If any fault set Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step V.**
   - If any fault set Active while wiggling the wiring between the PBSC and TECU, refer to OEM guidelines for repair or replacement of the OEM wiring. Go to **Step V.**
   - If no fault codes set Active, go to **Step H.**

H

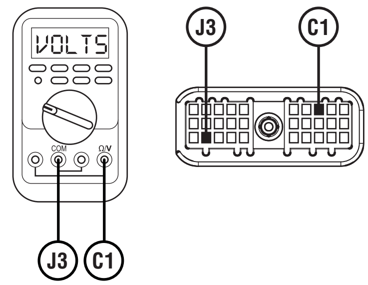
Purpose: Verify integrity of 30-Way PBSC Connector.

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 I.**

I

Purpose: Verify voltage supply to PBSC.

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

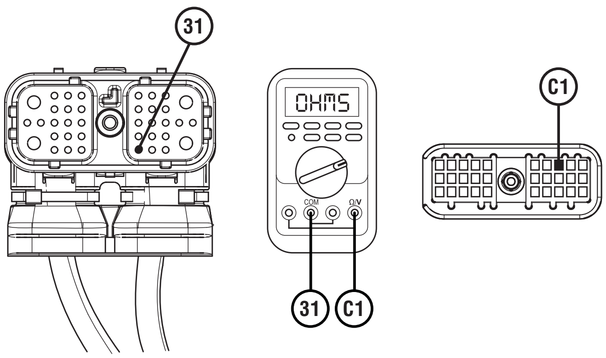


3. Compare reading(s) in table.
   - If readings are in range, go to **Step K.**
   - If readings are out of range, go to **Step J.**

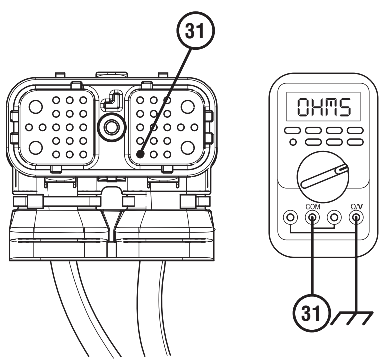
Pins	Range	Reading(s)
C1 to J3	Within 1.2 V of Battery Voltage	

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

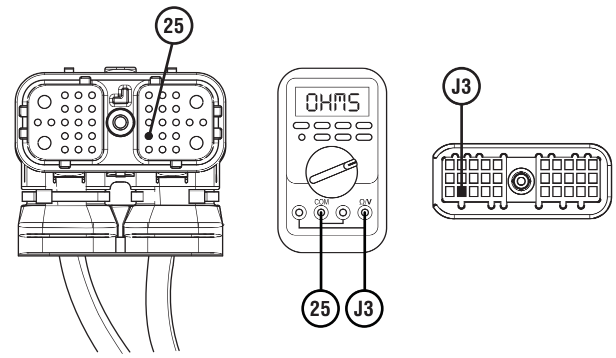
1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect 38-Way for loose terminals, corrosion and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 31 and 30-Way PBSC Connector Pin C1. Record reading in table.



5. Measure resistance between 38-Way Vehicle Harness Connector Pin 31 and ground. Record reading in table.



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

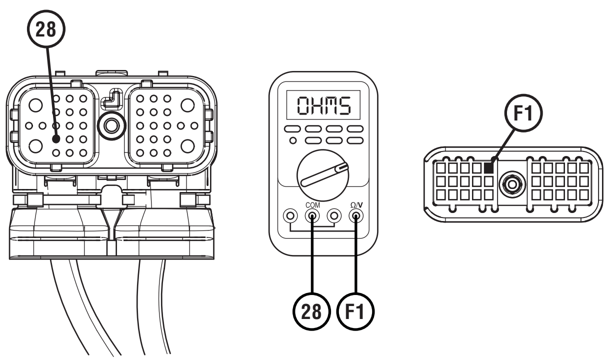


7. Compare reading(s) in table.
   - If readings are in range, replace TECU. Go to **Step V.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle harness between TECU and PBSC. Go to **Step V.**

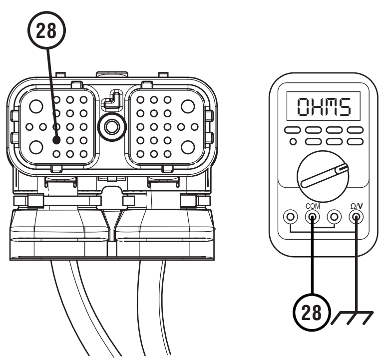
Pins	Range	Reading(s)
31 to C1	0.0–0.3 ohms	
31 to Ground	Open Circuit (OL)	
25 to J3	0.0–0.3 ohms	

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

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect 38-Way TECU Vehicle Harness Connector for loose terminals, corrosion and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 28 and 30-Way PBSC Connector Pin F1. Record reading in table.



5. Measure resistance between 38-Way Vehicle Harness Connector Pin 28 and Ground. Record reading in table.

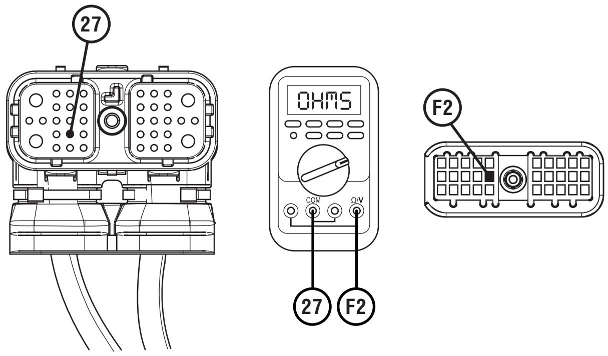


6. Compare reading(s) in table.
   - If readings are in range, go to **Step L.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of High Integrity Link (HIL) between the PBSC and TECU. Go to **Step V.**

Pins	Range	Reading(s)
28 to F1	0.0–0.6 ohms	
28 to Ground	Open Circuit (OL)	

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 in table.



3. Compare reading(s) in table.
   - If readings are in range, go to **Step O.**
   - 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)
27 to F2	0.0–0.6 ohms	

M **Purpose:** Check for Active or Inactive fault codes for vehicles not equipped with an Eaton PBSC.

1. Retrieve fault code information from the Service Activity Report.
   - If Fault Code 16 is Active, go to **Step O.**
   - If Fault Code 16 is Inactive, go to **Step N.**

N

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 exists.

3. Wiggle wiring and connections from the batteries to the 3-Way Connector at the ECA. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Wiggle wiring and connections of the Transmission Harness from the 8-Way Gen1 ECA Connector to 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.

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

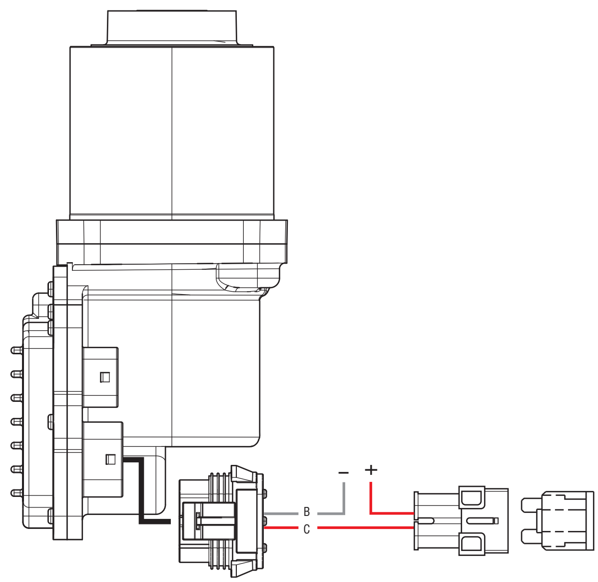
   - If any fault codes set Active while wiggling the ECA Power Harness, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Go to **Step V.**
   - If no fault codes set Active, go to **Step O.**

O

Purpose: Inspect power and ground supply to the ECA.

1. Key off.
2. Inspect the ECA Power Supply Harness between the batteries and the ECA for signs of rubbing or chafing to the wiring.
3. Inspect the ECA 40-amp In-line Fusible Link or Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.

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

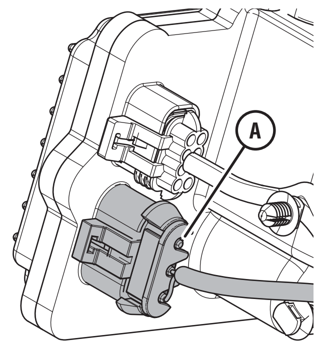


- If damage to the ECA Power Supply Harness is found, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If no damage is found, go to **Step P.**

P

Purpose: Verify condition of 3-Way ECA Connector.

1. Key off.
2. Disconnect 3-Way ECA Connector.
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. Confirm the 3-Way Gen1 ECA Connector has a seal plug in Cavity A.
5. Inspect ECA side of 3-Way ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.

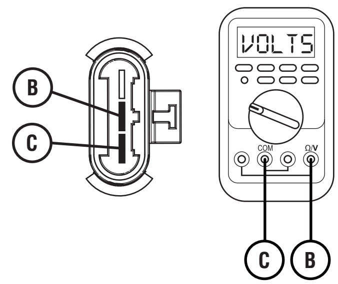


- If damage to the 3-Way Gen1 ECA Connector is found and/or missing seal plug in Cavity A, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If damage to the ECA side of 3-Way Gen1 ECA Connector is found, replace ECA. Go to **Step V.**
- If no damage is found, go to **Step Q.**

Q

Purpose: Verify battery voltage at ECA.

1. Key off.
2. Measure voltage between 3-Way Gen1 ECA Connector Pin C (Battery positive) and Pin B (Battery negative). Record reading in table.



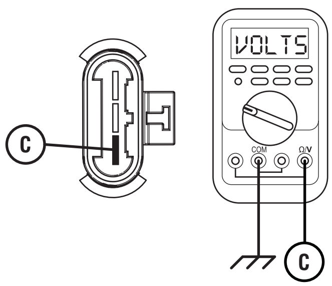
3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
   - If readings are in range, go to **Step R.**

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

R

Purpose: Verify polarity of battery voltage at ECA.

1. Key off.
2. Measure voltage between 3-Way Gen1 ECA Connector Pin C (Battery positive) and ground. Record reading in table.



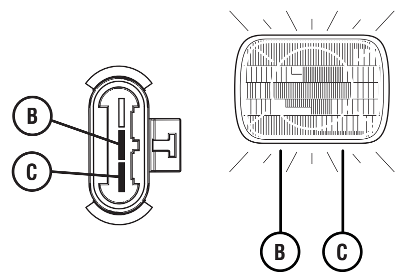
3. Compare reading(s) in table.
   - If readings are out of range, Pin C (Battery positive) and Pin B (Battery negative) wires are incorrectly pinned in the ECA 3-Way Connector. Refer to OEM requirements for repair or replacement. Go to **Step V.**
   - If readings are in range, go to **Step S.**

Pins	Range	Reading(s)
C to Ground	Within 1.2 V of Battery Positive (+)	

S

Purpose: Load Test the vehicle power and ground supply to the ECA.

1. Key off.
2. Load test the 3-Way Gen1 ECA Connector and ECA Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin C (Battery positive) and Pin B (Battery negative). Load Test for 5 minutes to verify the harness will carry a load with the 40-amp fuse or fusible link installed.



3. Wiggle the ECA Power Supply Harness during the Load Test from the vehicle batteries to ECA.
   - If the ECA Power Supply Harness does not carry a load, refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If the ECA Power Supply Harness carries a load, go to **Step T.**

T

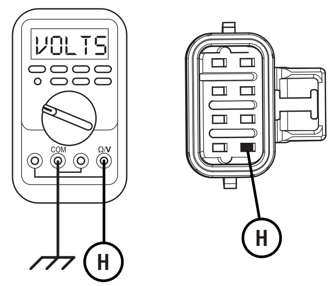
Purpose: Verify condition of 8-Way ECA Connector.

1. Key off.
2. Disconnect 8-Way ECA Connector.
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. Inspect ECA side of 8-Way ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.
5. Inspect the Transmission Harness from the TECU to the 8-Way ECA Connector. Look for signs of rubbed or chafed wiring.
    - If damage is found to the 8-Way ECA Connector, replace Transmission Harness. Go to **Step V.**
    - If damage is found to the ECA side of 8-Way ECA Connector, replace ECA. Go to **Step V.**
    - If no damage is found, go to **Step U.**

U

Purpose: Verify Ignition Voltage to ECA.

1. Key on with engine off.
2. Measure voltage between 8-Way ECA Pin H and ground. Record reading in table.

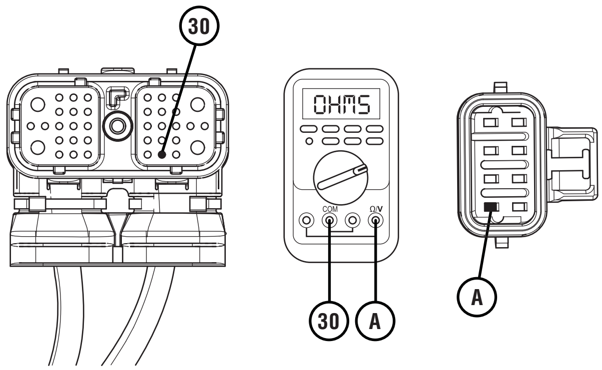


3. Compare reading(s) in table.
    - If readings are in range, go to **Step W.**
    - If readings are out of range, replace Transmission Harness. Go to **Step V.**

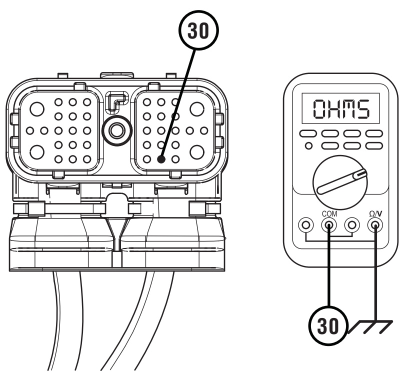
Pins	Range	Reading(s)
H to Ground	Within 1.2 V of Battery Voltage	

W **Purpose:** Verify HIL Positive (+) continuity between ECA and TECU.

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector.
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. Measure resistance between 38-Way Transmission Harness Connector Pin 30 and 8-Way Gen1 ECA Connector Pin A. Record reading in table.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 30 and ground. Record reading in table.

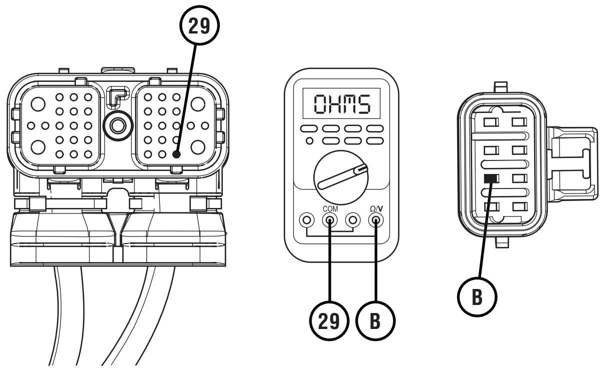


6. Compare reading(s) in table.
   - If readings are in range, go to **Step X.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

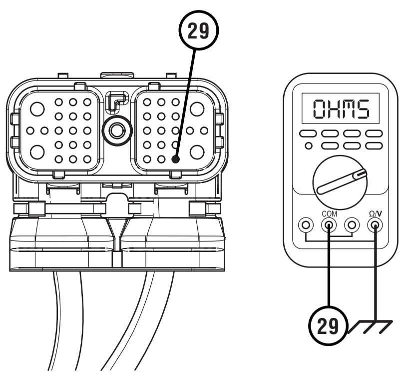
Pins	Range	Reading(s)
30 to A	0.0–0.6 ohms	
30 to Ground	Open Circuit (OL)	

X **Purpose:** Verify HIL Negative (-) continuity between ECA and TECU.

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 29 and 8-Way Gen1 ECA Connector Pin B. Record reading in table.



3. Measure resistance between 38-Way Transmission Harness Connector Pin 29 and ground. Record reading in table.



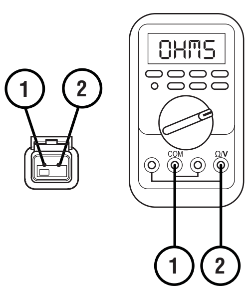
4. Compare reading(s) in table.
   - If readings are in range, go to **Step Y.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
29 to B	0.0–0.6 ohms	
29 to Ground	Open Circuit (OL)	

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

1. Key off.
2. Reconnect 3-Way ECA Connector.
3. Reconnect 8-Way ECA Connector.
4. Reconnect 38-Way Transmission Harness Connector.
5. Locate and remove the 2-Way HIL Terminating Resistor from the 2-Way Terminating Resistor Connector Body wired into the 8-Way Gen1 ECA Connector (Transmission Harness).

   Note: Reference the Component Identification section.
6. Inspect the 2-Way Terminating Resistor Connector Body for damage and bent, spread, corroded or loose terminals.
7. Measure resistance at the 2-Way Terminating Resistor Connector Body wired into the 8-Way Gen1 ECA Connector (Transmission Harness) between Pin 1 and Pin 2. Record reading in table.



   Note: The resistance of the HIL varies based on the transmission shift device equipped in the vehicle.
8. Reinstall the 2-Way HIL Terminating Resistor into the 2-Way Terminating Resistor Connector Body.
9. Compare reading(s) in table.
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**
   - If readings are in range, replace ECA. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2 (with Eaton PBSC)	50–70 ohms	
1 to 2 (without Eaton PBSC)	110–130 ohms	

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. 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, 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 13.

Fault Code 16: High Integrity Link Gen2 ECA

J1587: MID 130 SID 248 FMI 2
J1939: SA 3 SPN 625 FMI 2

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), Electronic Clutch Actuator (ECA), and if equipped, Eaton Push Button Shift Control (PBSC). The portion of the HIL that connects the TECU to the ECA is contained within the Transmission Harness. The portion of the HIL that connects the TECU to the PBSC is contained within the Vehicle Harness. Fault Code 86 indicates a loss of communication of the HIL, but is specific to systems that use a Gen2 ECA. Troubleshooting for this procedure is specific to the Gen2 ECA and associated harnesses.

Note: The troubleshooting procedure for Fault Code 16 may direct users to use this troubleshooting procedure if the vehicle is equipped with a Gen2 ECA, even if Fault Code 86 was not set by the transmission. This is because some transmission software versions do not set Fault Code 86.

Detection

The TECU monitors communication with the Shift Control Device (if equipped) and the ECA over the HIL Link. If the TECU is unable to receive any messages from the other components on the HIL, Fault Code 86 sets Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: TECU does not receive any messages over the HIL for more than 5 seconds.

Fallback

FMI 2

- 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

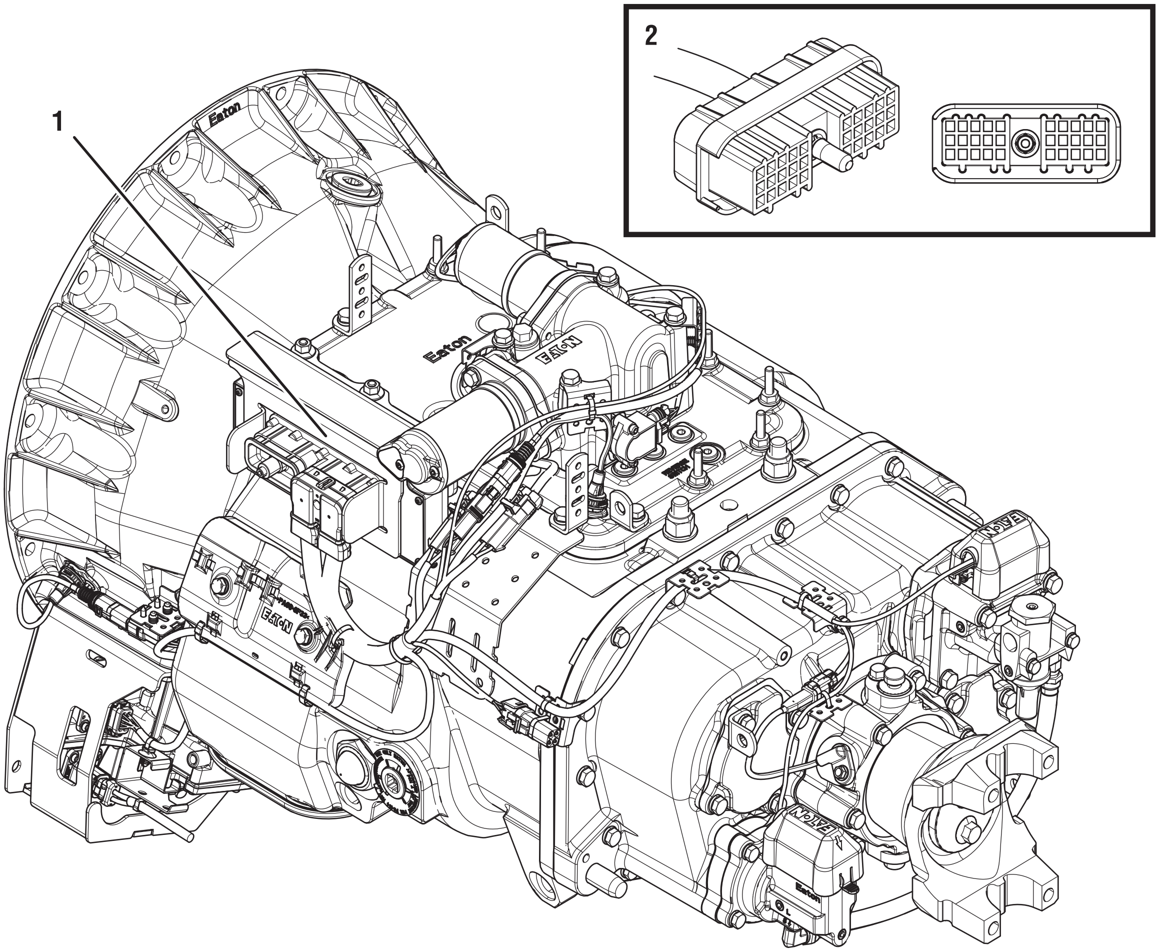
FMI 2: Communication between components is restored for 5 seconds.

Possible Causes

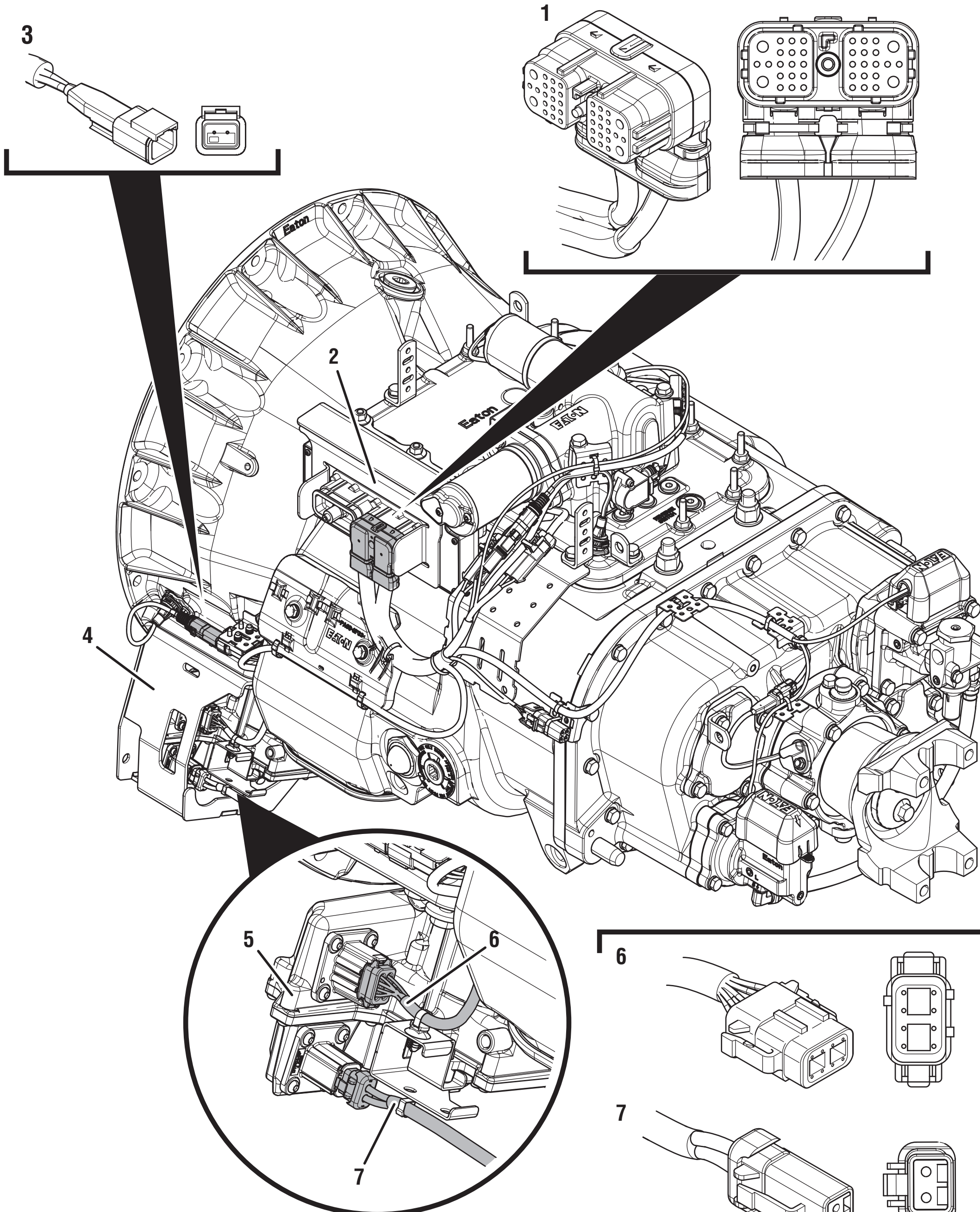
FMI 2

- HIL
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Missing terminating resistor
- Transmission Harness
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Seal failure in 8-Way ECA Connector
  - Loss of ignition voltage to ECA before power up
- ECA
  - Bent, spread, corroded or loose terminals
  - Contamination in 2-Way ECA Connector
  - Contamination in 8-Way ECA Connector
  - Internal failure
- Vehicle Batteries
  - Internal failure
- Vehicle Power and Ground Supply to ECA
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Seal failure on 2-Way ECA Connector
  - Disconnected 2-Way ECA Connector
- Vehicle Power and Ground Supply to TECU
  - Corroded or loose power supply connections to TECU
- TECU
  - Internal failure
- PBSC (if equipped)
  - Internal failure

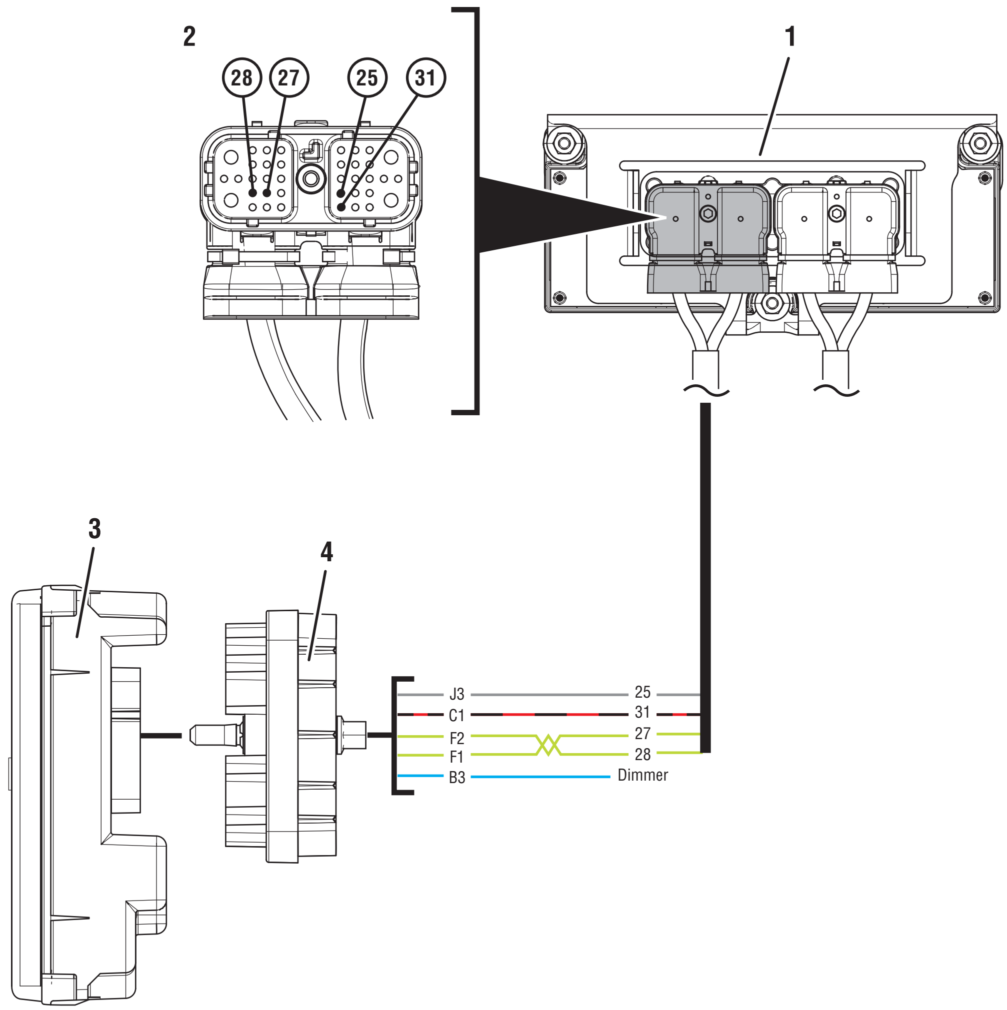
Component Identification



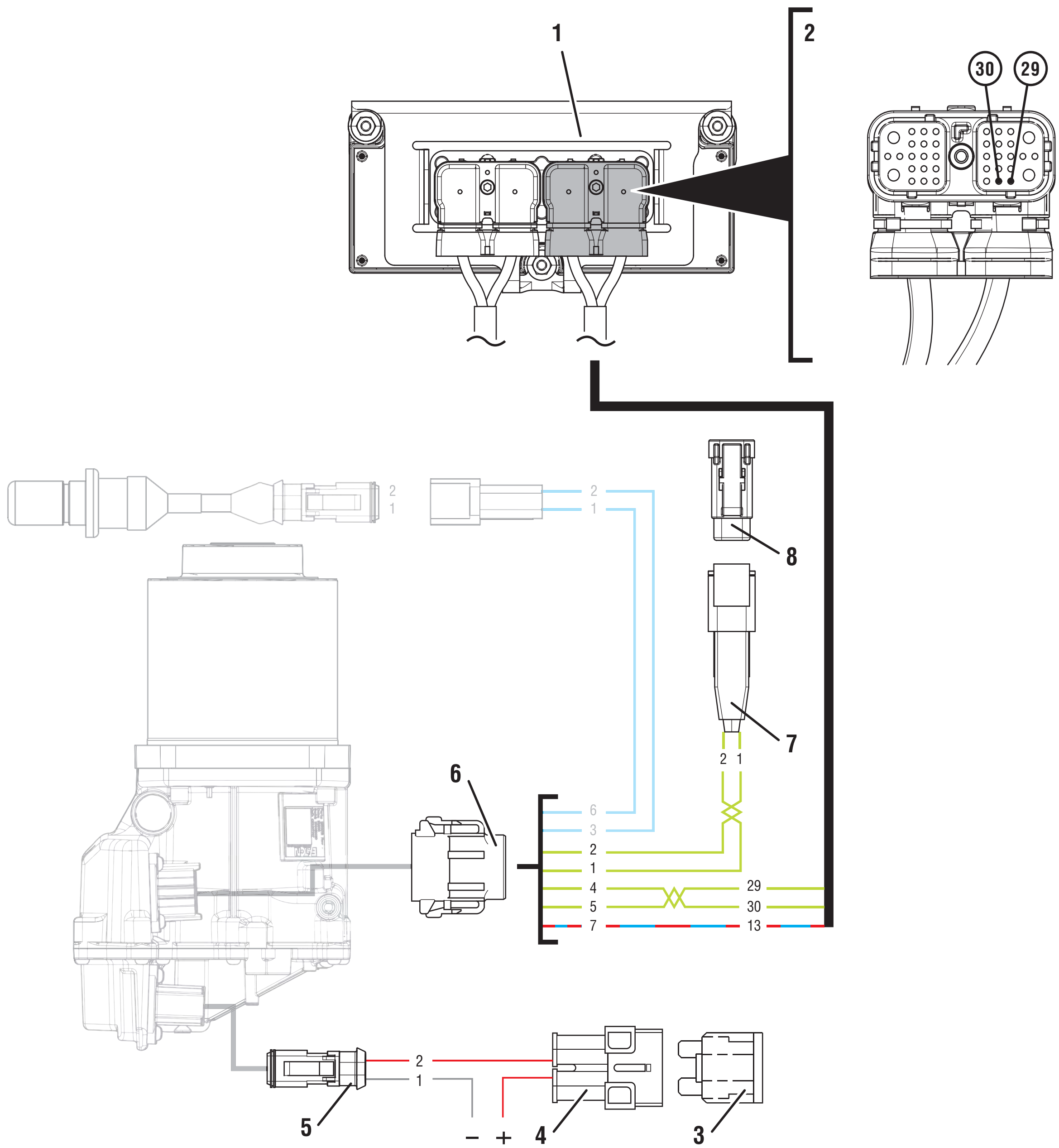
1. Transmission Electronic Control Unit (TECU)
2. 30-Way Push Button Shift Control Device (PBSC) Connector



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 2-Way Terminating Resistor Connector Body
4. Gen2 ECA Shield
5. Gen2 Electronic Clutch Actuator (ECA)
6. 8-Way Gen2 ECA Connector
7. 2-Way Gen2 ECA Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. Eaton Push Button Shift Control Device (PBSC)
4. 30-Way PBSC Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 40-amp Fuse
4. In-line Fuse Holder
5. 2-Way Gen2 ECA Connector
6. 8-Way Gen2 ECA Connector
7. 2-Way Terminating Resistor Connector Body
8. 2-Way High Integrity Link (HIL) Terminating Resistor

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

Fault Code 16 Troubleshooting Gen2 ECA

A

Purpose: Determine if ECA software was recently updated.

1. Determine if an ECA software download was performed immediately before Fault Code 16 set Active.
   - If an ECA software download was not recently performed, go to **Step C.**
   - If Fault Code or 16 became Active immediately following an ECA software download, download may have failed. Go to **Step B.**

B

Purpose: Recover ECA software.

1. Key off.

   Note: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Use ServiceRanger to program or recover the TECU and ECA software to latest available levels.
   - If software does not download correctly, contact Eaton at (800) 826-4357.
   - If software downloads correctly and Fault Code 16 becomes Inactive, test complete. Go to **Step V.**
   - If software downloads correctly, but Fault Code or 16 remains Active, go to **Step C.**

C

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

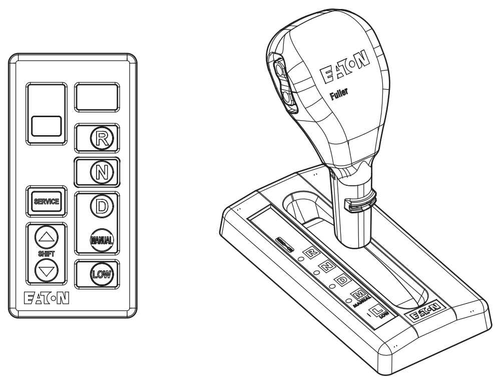
1. Set parking brake and chock wheels.
2. Key off.

   Note: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
3. If vehicle is equipped with a Bulkhead Connection, disconnect Bulkhead Connector. Inspect connector for loose terminals, corrosion and bent or spread pins.
4. Wiggle wiring connections to the Bulkhead Connector to verify the pins are not loose and are secure within the connector.
5. Reconnect Bulkhead Connector.
   - If no Bulkhead Connection is present, go to **Step D.**
   - 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 D.**

D

Purpose: Check for Active or Inactive fault codes and verify Shift Control Device type.

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Check vehicle cab to determine the type of shift control device installed on the vehicle.



- If equipped with an Eaton PBSC, go to **Step E.**
- If equipped with any other shift device, including Eaton Cobra Lever or an OEM Shift Device, go to **Step K.**

E

Purpose: Check for Active or Inactive fault Codes for vehicles equipped with an Eaton PBSC.

1. Retrieve fault code information from the Service Activity Report.
   - If Fault Code 16 is Active, go to **Step G.**
   - If Fault Code 16 is Inactive, go to **Step F.**

F **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.

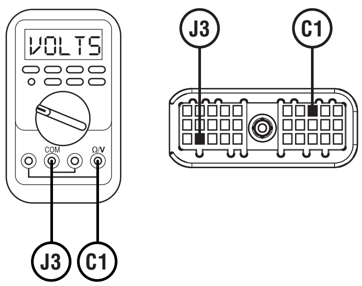
3. Wiggle wiring and connections from the batteries to the 2-Way Connector at the ECA. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Wiggle wiring and connections of the Transmission Harness from the 8-Way Gen2 ECA Connector to the 38-Way Vehicle Harness Connector at the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
5. Wiggle wiring and connections between the 30-Way PBSC Connector to the 38-Way Vehicle Harness Connector at the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
6. Exit PD Mode by powering down.

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

   - If any fault set Active while wiggling the ECA Power Harness, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Go to **Step V.**
   - If any fault set Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step V.**
   - If any fault set Active while wiggling the wiring between the PBSC and TECU, refer to OEM guidelines for repair or replacement of the OEM wiring. Go to **Step V.**
   - If no fault codes set Active, go to **Step G.**

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

1. Key off.
2. Disconnect 30-Way PBSC Connector.
3. Inspect 30-Way for loose terminals, corrosion and bent or spread pins.
4. Key on with engine off.
5. Measure voltage between 30-Way Pin C1 and Pin J3. Record reading in table.

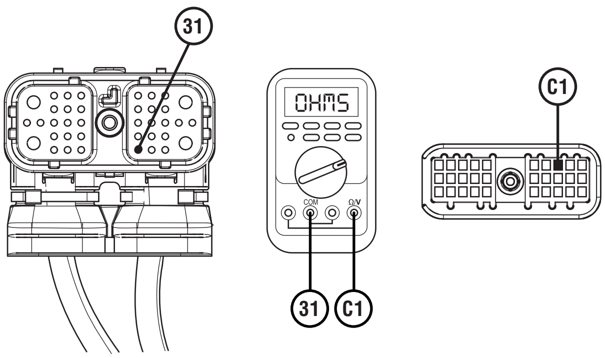


6. Compare reading(s) in table.
   - If readings are in range, go to **Step I.**
   - If readings are out of range, go to **Step H.**

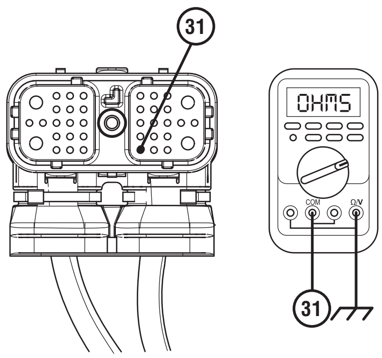
Pins	Range	Reading(s)
C1 to J3	Within 1.2 V of Battery Voltage	

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

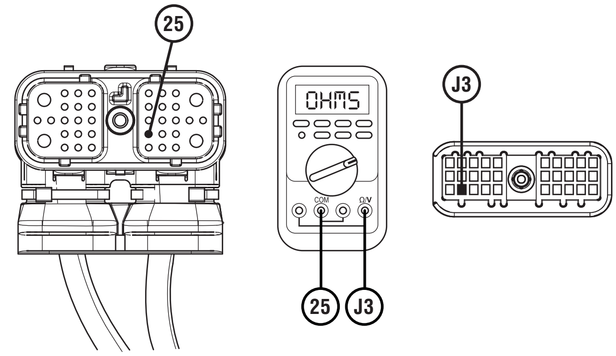
1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect 38-Way for loose terminals, corrosion and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 31 and 30-Way PBSC Connector Pin C1. Record reading in table.



5. Measure resistance between 38-Way Vehicle Harness Connector Pin 31 and ground. Record reading in table.



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

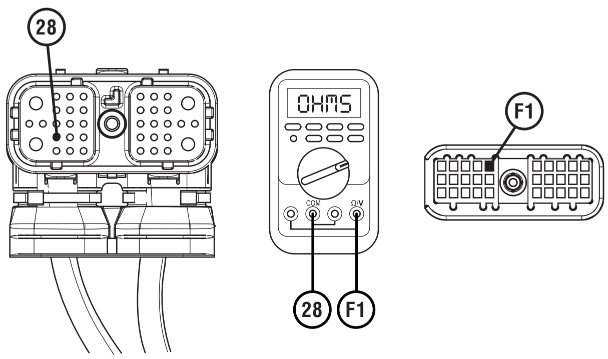


7. Compare reading(s) in table.
   - If readings are in range, replace TECU. Go to **Step V.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of harness between TECU and PBSC. Go to **Step V.**

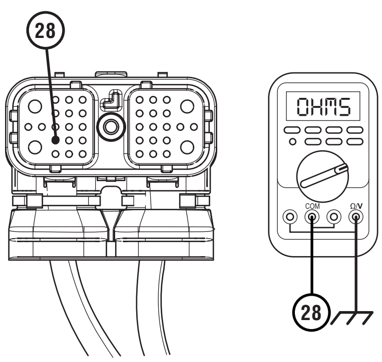
Pins	Range	Reading(s)
31 to C1	0.0–0.3 ohms	
31 to Ground	Open Circuit (OL)	
25 to J3	0.0–0.3 ohms	

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

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Inspect 38-Way TECU Vehicle Harness Connector for loose terminals, corrosion and bent or spread pins.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 28 and 30-Way PBSC Connector Pin F1. Record reading in table.



5. Measure resistance between 38-Way Vehicle Harness Connector Pin 28 and ground. Record reading in table.



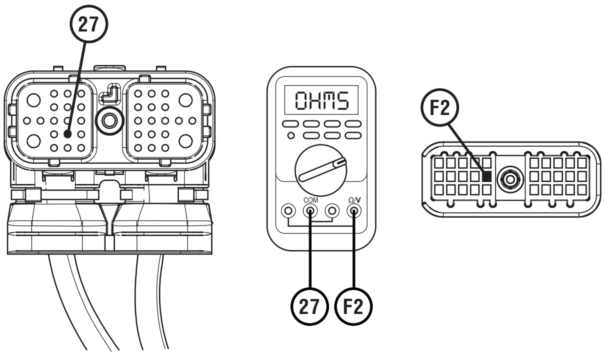
6. Compare reading(s) in table.
   - If readings are in range, go to **Step J.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of High Integrity Link (HIL) between the PBSC and TECU. Go to **Step V.**

Pins	Range	Reading(s)
28 to F1	0.0–0.6 ohms	
28 to Ground	Open Circuit (OL)	

J

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 in table.



3. Compare reading(s) in table.
   - If readings are in range, go to **Step M.**
   - 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)
27 to F2	0.0–0.6 ohms	

K

Purpose: Check for Active or Inactive fault codes for vehicles not equipped with an Eaton PBSC.

1. Retrieve fault code information from the Service Activity Report.
   - If Fault Code 16 is Active, go to **Step M.**
   - If Fault Code 16 is Inactive, go to **Step L.**

L

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 exists.

3. Wiggle wiring and connections from the batteries to the 2-Way Connector at the ECA. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Wiggle wiring and connections of the Transmission Harness from the 8-Way Gen2 ECA Connector to 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.

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

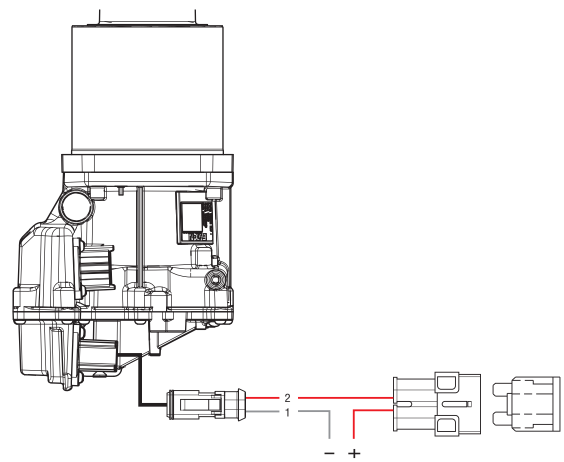
   - If any fault codes set Active while wiggling the ECA Power Harness, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Go to **Step V.**
   - If any fault codes set Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step V.**
   - If no fault codes set Active, go to **Step M.**

M

Purpose: Inspect power and ground supply to the ECA.

1. Key off.
2. Inspect the ECA Power Supply Harness between the batteries and the ECA for signs of rubbing or chafing to the wiring.
3. Inspect the ECA 40-amp In-line Fusible Link or Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.

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

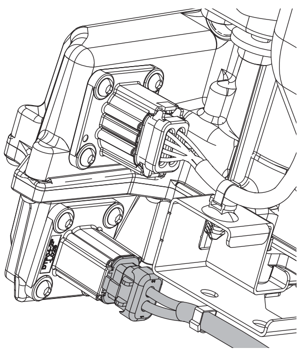


- If damage is found, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
- If no damage is found, go to **Step N.**

N

Purpose: Verify condition of 2-Way ECA Connector.

1. Key off.
2. Disconnect 2-Way ECA Connector.
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. Inspect ECA side of 2-Way ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.

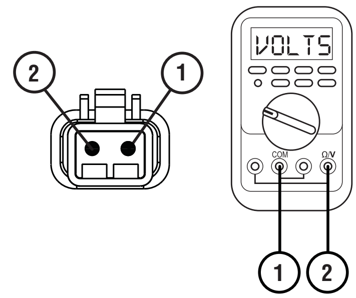


- If damage is found to the 2-Way ECA Connector, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If damage to the ECA side of 2-Way Gen2 ECA Connector is found, replace ECA. Go to **Step V.**
- If no damage is found, go to **Step O.**

O

Purpose: Verify battery voltage at ECA.

1. Key off.
2. Measure voltage between 2-Way Gen2 ECA Connector Pin 2 (Battery positive) and Pin 1 (Battery negative). Record reading in table.



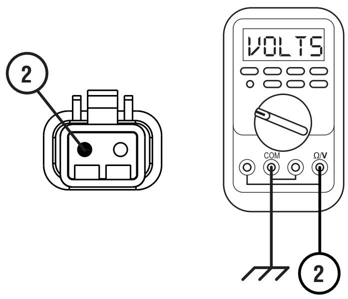
3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
   - If readings are in range, go to **Step P.**

Pins	Range	Reading(s)
1 to 2	Within 1.2 V of Battery Positive (+)	

P

Purpose: Verify polarity of battery voltage at ECA.

1. Key off.
2. Measure voltage between 2-Way Gen2 ECA Connector Pin 2 (Battery positive) and ground. Record reading in table.



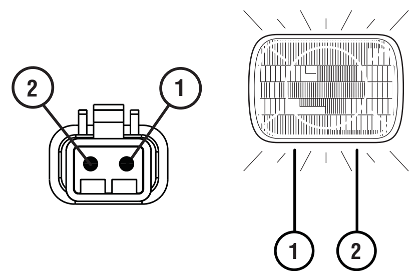
3. Compare reading(s) in table.
   - If readings are out of range, Pin 2 (Battery positive) and Pin 1 (Battery negative) wires are incorrectly pinned in the 2-Way ECA Connector. Refer to OEM requirements for repair or replacement. Go to **Step V.**
   - If readings are in range, go to **Step Q.**

Pins	Range	Reading(s)
2 to Ground	Within 1.2 V of Battery Positive (+)	

Q

Purpose: Load Test the vehicle power and ground supply to the ECA.

1. Key off.
2. Load test the 2-Way Gen2 ECA Connector and ECA Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin 2 (Battery positive) and Pin 1 (Battery negative). Load Test for 5 minutes to verify the harness will carry a load with the 40-amp fuse or fusible link installed.
3. Wiggle the ECA Power Supply Harness during the Load Test from the vehicle batteries to ECA.



- If the ECA Power Supply Harness does not carry a load, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If the ECA Power Supply Harness carries a load, go to **Step R.**

R

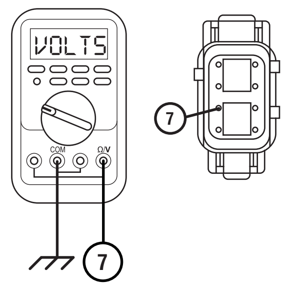
Purpose: Verify condition of 8-Way ECA Connector.

1. Key off.
2. Disconnect 8-Way ECA Connector.
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. Inspect the Transmission Harness from the TECU to the 8-Way ECA Connector. Look for signs of rubbed or chafed wiring.
5. Inspect ECA side of 8-Way ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.
   - If damage is found to the 8-Way Gen2 ECA Connector or Transmission Harness, replace Transmission Harness. Go to **Step V.**
   - If damage to the ECA side of 8-Way Gen2 ECA Connector is found, replace ECA. Go to **Step V.**
   - If no damage is found, go to **Step S.**

S

Purpose: Verify Ignition Voltage to ECA.

1. Key on with engine off.
2. Measure voltage between 8-Way ECA Pin 7 and ground. Record reading in table.

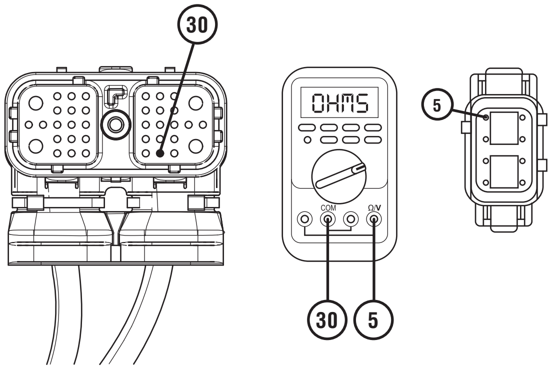


3. Compare reading(s) in table.
   - If readings are in range, go to **Step T.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

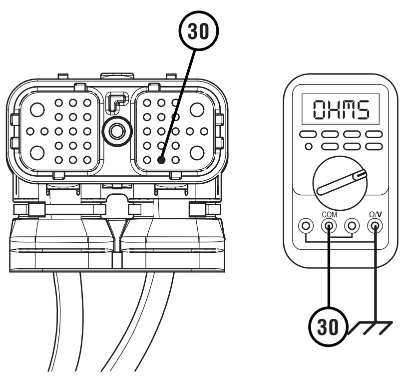
Pins	Range	Reading(s)
7 to Ground	Within 1.2 V of Battery Voltage	

T **Purpose:** Verify HIL Positive (+) continuity between ECA and TECU.

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector.
3. Verify 38-Way Transmission Harness Connector is free from any corrosion; the terminals are not bent, spread or loose, and there is no damage to the connector body.
4. Measure resistance between 38-Way Transmission Harness Connector Pin 30 and 8-Way Gen2 ECA Connector Pin 5. Record reading in table.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 30 and ground. Record reading in table.

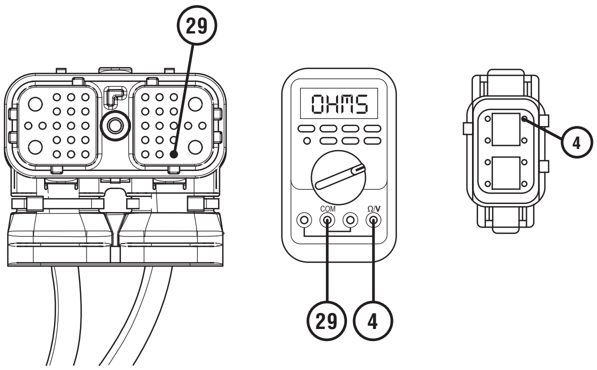


6. Compare reading(s) in table.
   - If readings are in range, go to **Step U.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

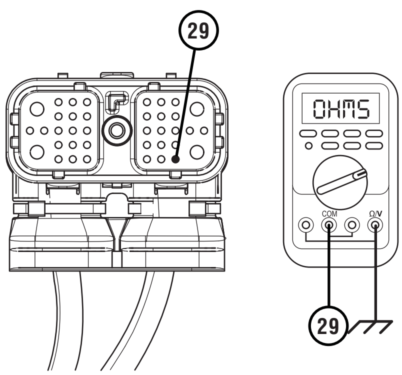
Pins	Range	Reading(s)
30 to 5	0.0–0.6 ohms	
30 to Ground	Open Circuit (OL)	

U **Purpose:** Verify HIL Negative (-) continuity between ECA and TECU.

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 29 and 8-Way Gen2 ECA Connector Pin 4. Record reading in table.



3. Measure resistance between 38-Way Transmission Harness Connector Pin 29 and ground. Record reading in table.



4. Compare reading(s) in table.
   - If readings are in range, go to **Step W.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
29 to 4	0.0–0.6 ohms	
29 to Ground	Open Circuit (OL)	

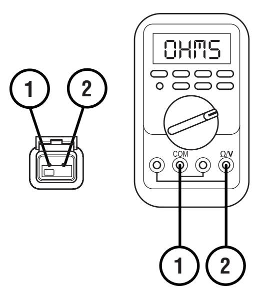
W

Purpose: Verify HIL circuit resistance.

1. Key off.
2. Reconnect 3-Way ECA Connector.
3. Reconnect 8-Way ECA Connector.
4. Reconnect 38-Way Transmission Harness Connector.
5. Locate and remove the 2-Way HIL Terminating Resistor from the 2-Way Terminating Resistor Connector Body wired into the 8-Way Gen2 ECA Connector (Transmission Harness).

   Note: Reference the Component Identification section.

6. Inspect the 2-Way Terminating Resistor Connector Body for damage and bent, spread, corroded or loose terminals.
7. Measure resistance at the 2-Way Terminating Resistor Connector Body wired into the 8-Way Gen2 ECA Connector (Transmission Harness) between Pin 1 and Pin 2. Record reading in table.



   Note: The resistance of the HIL varies based on the transmission shift device equipped in the vehicle.

8. Reinstall the 2-Way HIL Terminating Resistor into the 2-Way Terminating Resistor Connector Body.
9. Compare reading(s) in table.
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**
   - If readings are in range, replace ECA. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2 (with Eaton PBSC)	50–70 ohms	
1 to 2 (without Eaton PBSC)	110–130 ohms	

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. 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, 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 13.

Fault Code 17: Start Enable Relay

J1587: MID 130 SID 237 FMI 3, 4, 14
J1939: SA 3 SPN 1321 FMI 3, 4, 14

Overview

Vehicles with an UltraShift *PLUS* transmission are required to disable engine cranking when the transmission is in a non-neutral gear position. Some vehicles prevent non-neutral engine cranking through the use of a normally open Start Enable Relay actuated by the Transmission Electronic Control Unit (TECU) to interrupt power to the Starter. Other vehicles require the TECU to send a transmission engine crank enable message over the J1939 Data Link before the engine ECU will allow cranking. The Start Enable Relay circuit is supplied and wired by the OEM.

For vehicles equipped with a physical Start Enable Relay circuit, the relay will only latch when the following three conditions exist:

- Driver Interface Device is in the neutral position.
- Transmission has confirmed that it is physically in neutral.
- Engine is not running.

Under these conditions the TECU supplies a voltage source and a ground path to the Start Enable Relay coil, latching the relay. The latched relay allows Engine-Starter engagement when the ignition key is turned to the crank position. If these conditions are not met, the TECU removes the voltage source and ground path to the Start Enable Relay, opening the relay and preventing engagement of the Starter.

Fault Code 17 indicates that an electrical failure in the Start-Enable Relay circuit was detected. The fault will not set on vehicles that use J1939 messaging to enable engine cranking.

Detection

This fault can only be detected on transmission systems that are configured for Start Enable Relay. When the ignition key is on, the engine is not running, and the Start Enable Relay coil is not latched, this fault can be detected.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: TECU detects a short to voltage or an open circuit for at least 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: TECU detects a short to ground for at least 1 second.

FMI 14 – Special Instructions: TECU detects an engine start when the Start Enable Relay was not intentionally latched. This is typically an indication that the Start Enable Relay circuit is incorrectly wired or bypassed (jumped).

Fallback

FMI 3, 4:

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Engine will not crank.

FMI 14:

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If the Start Enable Relay circuit is incorrectly wired or bypassed (jumped), the TECU may not be able to prevent the engine from cranking when the transmission is in a non-neutral position.

Conditions to Set Fault Code Inactive

FMI 3, 4: An electrical short or open circuit is not detected for 2 seconds.

FMI 14: Start Enable Relay wiring issue is corrected and Start Enable Relay fault code is unlatched.

Possible Causes

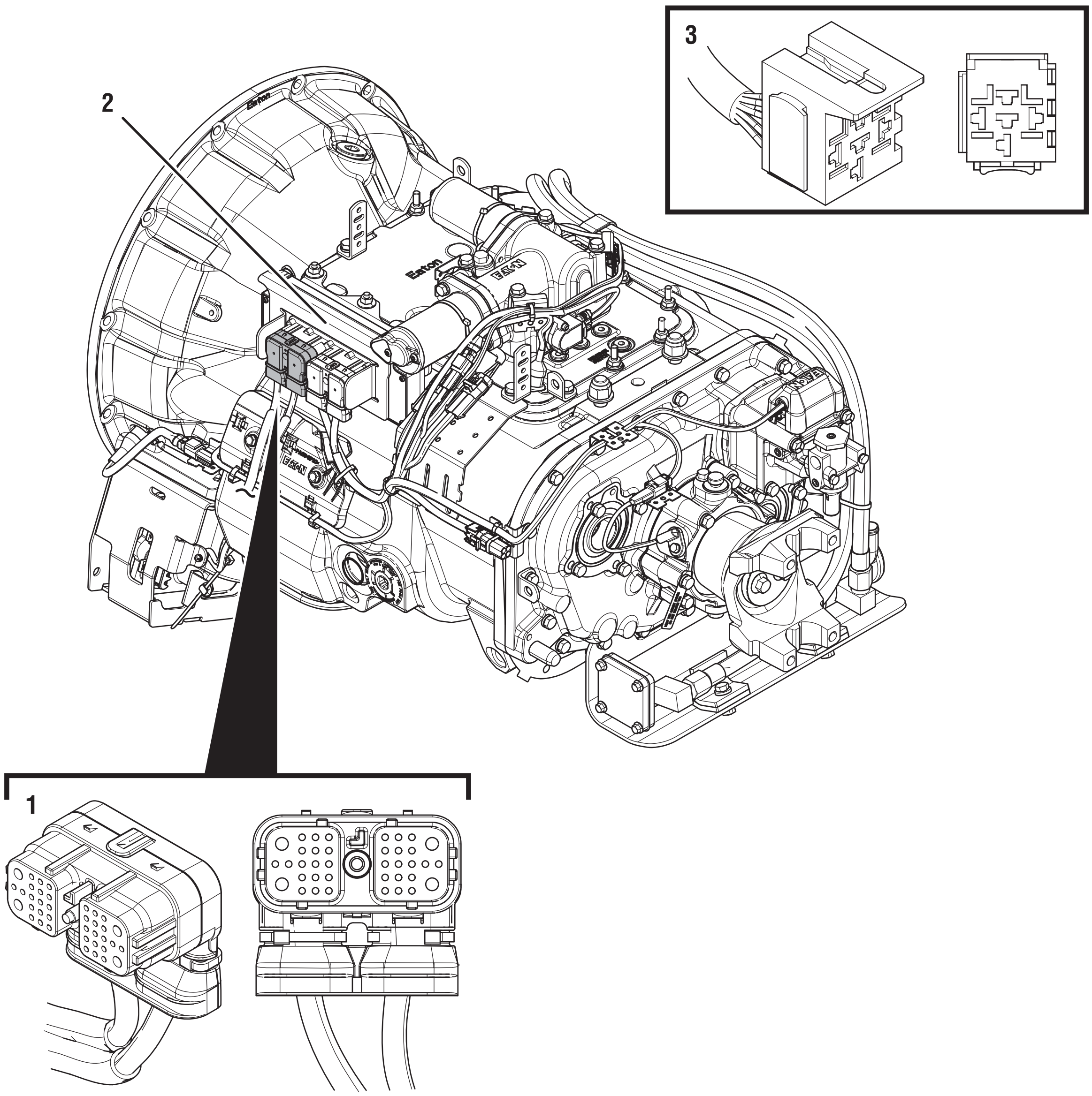
FMI 3, 4:

- Start Enable Relay
  - Internal Failure
- Start Enable Relay Wiring
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- TECU
  - Internal Failure

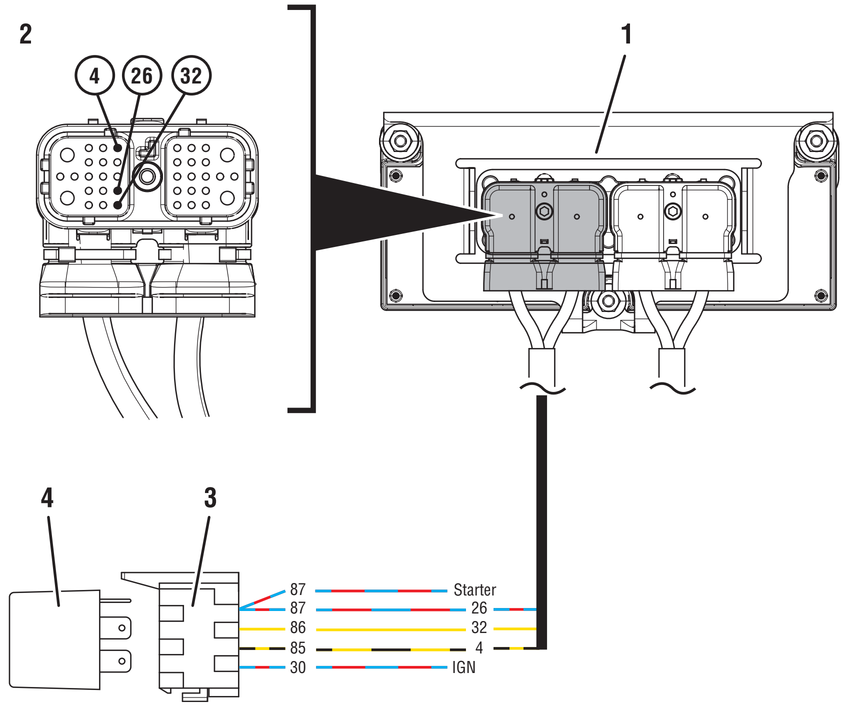
FMI 14:

- Start Enable Relay
  - Internal Failure
- Start Enable Relay Wiring
  - Incorrectly wired
  - Bypassed (jumped) Start Enable Relay circuit

Component Identification

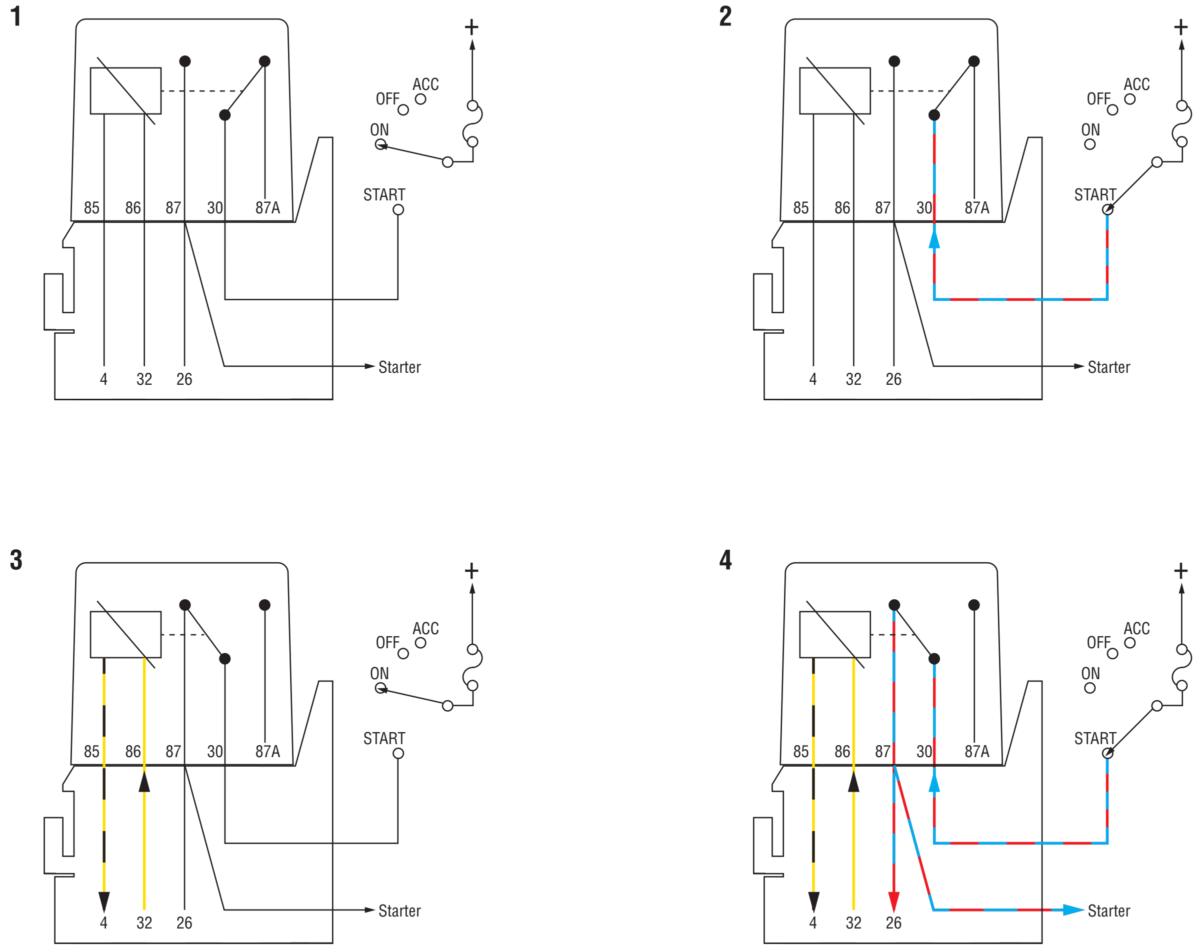


1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 5-Way Start Enable Relay Socket



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 5-Way Start Enable Relay Socket
4. 5-Way Start Enable Relay

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



Start Enable Relay Circuit States (Normally Open)

1. Open Relay - Key On and Transmission is Unable to Confirm Neutral
2. Open Relay - Key Start and Transmission is Unable to Confirm Neutral
3. Closed Relay - Key On and Transmission Confirmed in Neutral
4. Closed Relay - Key Start and Transmission Confirmed in Neutral

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

Fault Code 17 Troubleshooting

A

Purpose: Check for active or inactive fault codes.

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

   Note: If Fault Code 17 is Inactive and engine cranks, but does not run, troubleshoot vehicle engine system per OEM recommendations.

   Note: Some OEMs and chassis may use an alternate wiring pattern, which may include the use of a second relay for other vehicle systems. Please consult chassis specific OEM wiring schematics and verify which relay is in place for the Eaton automated transmission.

   - If Fault Code 17 FMI 14 is Active, go to **Step B.**
   - If Fault Code 17 FMI 14 is Inactive, Start Enable Relay may have been incorrectly wired and repaired or bypassed (jumped). Test complete, go to **Step V.**
   - If Fault Code 17 FMI 3 or 4 is Active, go to **Step D.**
   - If Fault Code 17 FMI 3 or 4 is Inactive, go to **Step C.**

B

Purpose: Procedure to set FMI 14 Inactive.

1. Set parking brake and chock wheels.
2. Key off.
3. Verify the Start Enable Relay circuit is correctly connected and wired per the wiring diagram. Consult OEM for specific wire routing locations. Correct wire routing if necessary.
4. Key on with engine off.
5. Wait for Neutral (N) to appear in the gear display

6. Turn and hold the key in the crank position for 5 seconds. A momentary crank should occur, but will be interrupted after 0.5 second. This test verifies the transmission can interrupt the Start Enable Relay circuit. The system does not allow engine cranking until the next power-up cycle.
7. Key off.

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

8. Key on with engine off.
9. Connect ServiceRanger.
10. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
    - If Fault Code 17 FMI 14 is now Inactive and the engine will now crank, Start Enable Relay may have been incorrectly wired and repaired or bypassed (jumped). Test complete, go to **Step V.**
    - If Fault Code 17 FMI 14 is Active or engine will not crank, go to **Step F.**

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

3. Wiggle Start Enable Relay wiring from the 38-Way Vehicle Harness Connector to the Start Enable Relay. Look for signs of rubbing or chafing. Consult OEM for specific wire routing locations.
4. Exit PD Mode by powering down.

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

- If Fault Code 17 became Active during wiggle wire test, repair or replace the Start Enable Relay wiring per OEM requirements. go to **Step V.**
- If Fault Code 17 remains Inactive, go to **Step E.**

D

Purpose: Verify Start Enable Type (Relay or J1939) configured in the TECU and installed on the vehicle.

1. Key off.

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

2. Key on with engine off.
3. Connect ServiceRanger.
4. Select “Configuration”.
5. Select “Vehicle”.
6. Record the “Current Value” for the “Start Enable Type”.
7. Record the “Start Enable Type” installed on the vehicle.

   Note: The vehicle's “Start Enable Type” (hardwired relay or J1939 controlled), is determined by the OEM. Refer to the OEM regarding “Start Enable Type” installed on the vehicle.

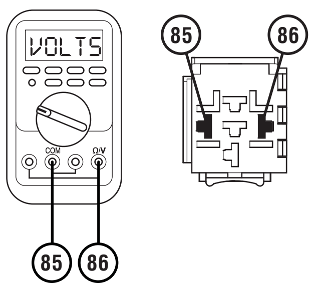
8. Compare reading(s) in table.
   - If “Start Enable Type” is configured correctly, go to **Step E.**
   - If “Start Enable Type” is not configured correctly, select the correct configuration from the “New Value” drop down, select “Apply” and follow on screen prompt. Go to **Step V.**

Location	Start Enable Type
TECU (ServiceRanger)	
Vehicle	

E **Purpose:** Verify proper voltage is supplied to the Start Enable Relay.

1. Key off.
2. Remove Start Enable Relay
3. Inspect Relay Connector body for damage and bent, spread, corroded or loose terminals.
4. Key on with engine off.
5. Wait for Neutral (N) to appear in the gear display.

   Note: Flashing "F" may appear in the gear display.
6. Measure voltage between Start Enable Relay socket Pin 86 (power) and Pin 85 (ground). Record reading(s) in table.



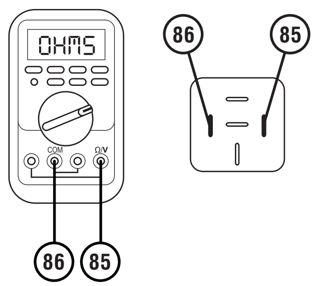
7. Compare reading(s) in table.
   - If all readings are in range, go to **Step F.**
   - If any readings are out of range, go to **Step G.**

Pins	Range	Reading(s)
85 to 86	Within 1.5 V of Battery Voltage	

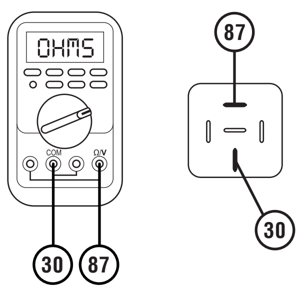
F **Purpose:** Verify the proper resistance of the Start Enable Relay.

1. Key off.
2. Determine if vehicle uses a 12-volt or a 24-volt electrical system.
3. Measure the resistance across relay Pin 85 and Pin 86. Record reading(s) in table.

   Note: The allowable relay resistance range is different for 12-volt and 24-volt systems.



4. Measure the resistance across relay Pin 30 and Pin 87. Record reading(s) in table.

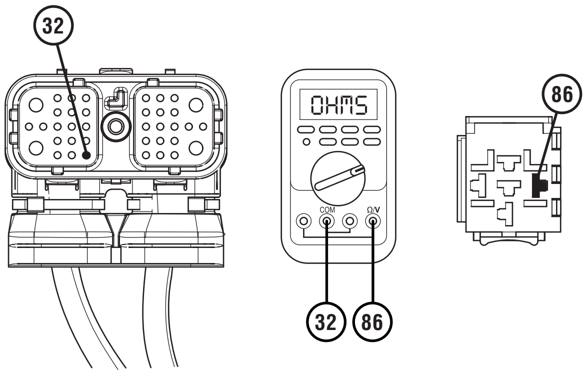


5. Compare reading(s) in table.
   - If readings are in range, go to **Step G.**
   - If readings are out of range, replace Start Enable Relay. Go to **Step V.**

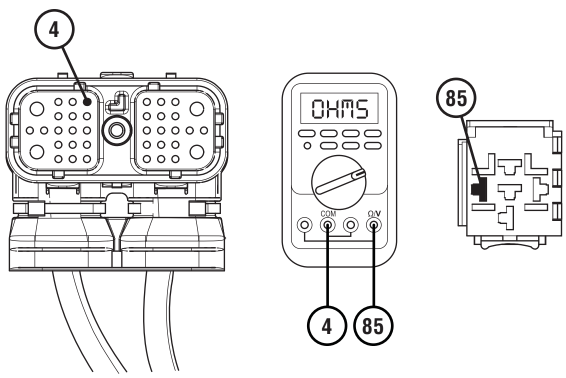
Pins	Range	Reading(s)
85 to 86	**12 V System** 40–200 Ohms	
	24 V System 40–500 Ohms	
30 to 87	Open Circuit (OL)	

G **Purpose:** Verify connection across the Start Enable Relay circuit wiring.

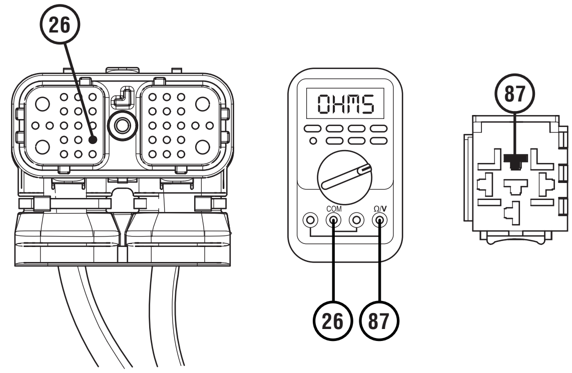
1. Key off.
2. Disconnect the 38-Way Vehicle Harness Connector at the TECU.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Remove the Start Enable Relay.
5. Measure resistance between 38-Way Vehicle Harness Connector Pin 32 and Start Enable Relay socket Pin 86. Record reading(s) in table.



6. Measure resistance between 38-Way Vehicle Harness Connector Pin 4 and Start Enable Relay socket Pin 85. Record reading(s) in table.



7. Measure resistance between 38-Way Vehicle Harness Connector Pin 26 and Start Enable Relay Socket Pin 87. Record reading(s) in table.

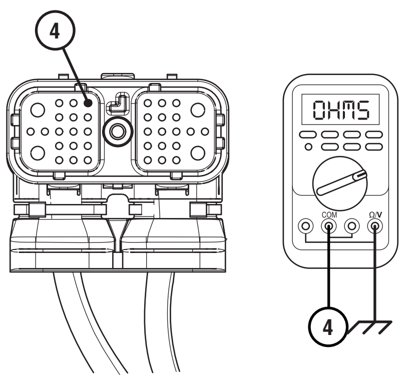


8. Compare reading(s) in table.
   - If all readings are in range, go to **Step H.**
   - If readings are out of range, repair or replace the Start Enable Relay wiring per OEM guidelines. Go to **Step V.**

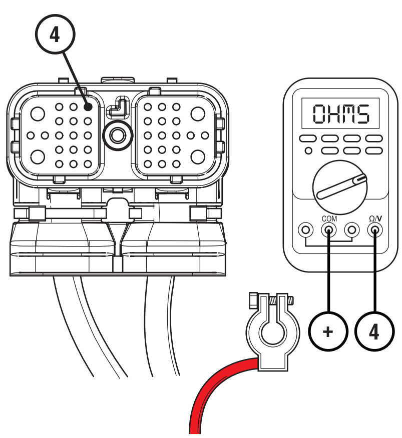
Pins	Range	Reading(s)
VH 32 to SER 86	0.0–0.3 Ohms	
VH 4 to SER 85	0.0–0.3 Ohms	
VH 26 to SER 87	0.0–0.3 Ohms	

H **Purpose:** Measure Start Enable Relay wiring (-) for indications of a short to ground or short to power.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 4 and ground. Record reading(s) in table.



3. Measure resistance between 38-Way Connector Pin 4 and Battery Positive (+). Record reading(s) in table.

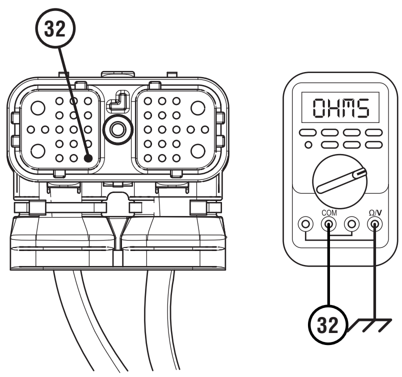


4. Compare reading(s) in table.
   - If all readings are in range, go to **Step I.**
   - If readings are out of range, repair or replace the Vehicle Harness per OEM guidelines. Go to **Step V.**

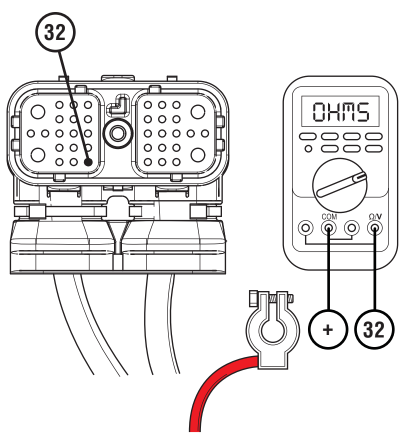
Pins	Range	Reading(s)
4 to Ground	Open Circuit (OL)	
4 to Battery Positive (+)	Open Circuit (OL)	

I **Purpose:** Measure Start Enable Relay wiring (+) for indications of a short to ground or short to power.

1. Key off.
2. Measure resistance between 38-Way Vehicle Harness Connector Pin 32 and ground. Record reading(s) in table.



3. Measure resistance between 38-Way Vehicle Harness Connector Pin 32 and Battery Positive (+). Record reading(s) in table.



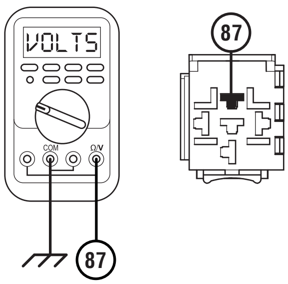
4. Compare reading(s) in table.
   - If all readings are in range, go to **Step J.**
   - If readings are out of range, repair or replace the Vehicle Harness per OEM guidelines. Go to **Step V.**

Pins	Range	Reading(s)
32 to Ground	Open Circuit (OL)	
32 to Battery Positive (+)	Open Circuit (OL)	

J

Purpose: Test the latch side of the Start Enable Relay circuit for a short to power.

1. Key off.
2. Measure voltage between Start Enable Relay socket Pin 87 and ground. Record reading(s) in table.



3. Compare reading(s) in table.
   - If all readings are in range, go to **Step K.**
   - If readings are out of range, repair or replace the Start Enable Relay Latch wire per OEM guidelines. Go to **Step V.**

Pins	Range	Reading(s)
87 to Ground	Less than 0.5 volt	

K

Purpose: Determine which FMI was set in Step A.

1. Verify which FMI was set for Fault Code 17 in Step A.
   - If Fault Code 17 FMI 3 or 4 was set, go to **Step L.**
   - If Fault Code 17 FMI 14 was set, go to **Step M.**

L

Purpose: Verify wiring and test Start Enable Relay Circuit.

1. Set parking brake and chock wheels.
2. Key off.
3. Verify the Start Enable Relay circuit is correctly connected and wired per the wiring diagram. Consult OEM for specific wire routing locations. Correct wire routing if necessary.
4. Key on with engine off.
5. Wait for Neutral (N) to appear in the gear display.

6. Attempt to crank the engine.
   - If Fault Code 17 FMI 3 or 4 is now Inactive and the engine will now crank, no problem was found. The intermittent nature of the fault makes it likely that the problem is in the Start Enable Relay wiring. Contact OEM for further help troubleshooting the wiring. Go to **Step V.**
   - If Fault Code 17 FMI 3 or 4 is Active, replace TECU. Go to **Step V.**

M

Purpose: Procedure to set FMI 14 Inactive.

1. Set parking brake and chock wheels.
2. Key off.
3. Verify the Start Enable Relay circuit is correctly connected and wired per the wiring diagram. Consult OEM for specific wire routing locations. Correct wire routing if necessary.
4. Key on with engine off.
5. Wait for Neutral (N) to appear in the gear display.

6. Turn and hold the key in the crank position for 5 seconds. A momentary crank should occur, but will be interrupted after 0.5 second. This test verifies the transmission can interrupt the Start Enable Relay circuit. The system does not allow engine cranking until the next power-up cycle.
7. Key off.

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

8. Key on with engine off.
9. Connect ServiceRanger.
10. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
    - If Fault Code 17 FMI 14 is now Inactive and the engine will now crank, no problem was found. Test complete, go to **Step V.**
    - If Fault Code 17 FMI 14 is Active, replace 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.
4. Clear fault codes using ServiceRanger.
5. Test the Start Enable Relay system by attempting to crank the Starter multiple times. Verify that the starting system operates properly.
6. Check for fault codes using ServiceRanger:
    - If no fault codes set Active and vehicle operates properly, test complete.
    - If Fault Code 17 sets Active during the test drive, go to **Step A.**
    - If a fault code other than 17 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 19: CAN Gen1 ECA Message

J1587: MID 130	**SID 248**	**FMI 9**
J1939: SA 3	**SPN 520273**	**FMI 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), Electronic Clutch Actuator (ECA), and if equipped, Eaton Push Button Shift Control (PBSC). The portion of the HIL that connects the TECU to the ECA is contained within the Transmission Harness. The portion of the HIL that connects the TECU to the PBSC is contained within the Vehicle Harness. Fault Code 19 indicates a loss of communication between the TECU and ECA.

Detection

The TECU monitors communication with the ECA over the HIL. If the TECU loses communication with the ECA, Fault Code 19 sets Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: TECU loses communication with the ECA for 2 seconds or longer.

Fallback

FMI 9

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Engine cranks and starts.
- Transmission may not engage a gear from neutral.
- ECA may maintain the current clutch position using the clutch holding device.
- ECA may move the clutch to the last position commanded by the TECU.

Conditions to Set Fault Code Inactive

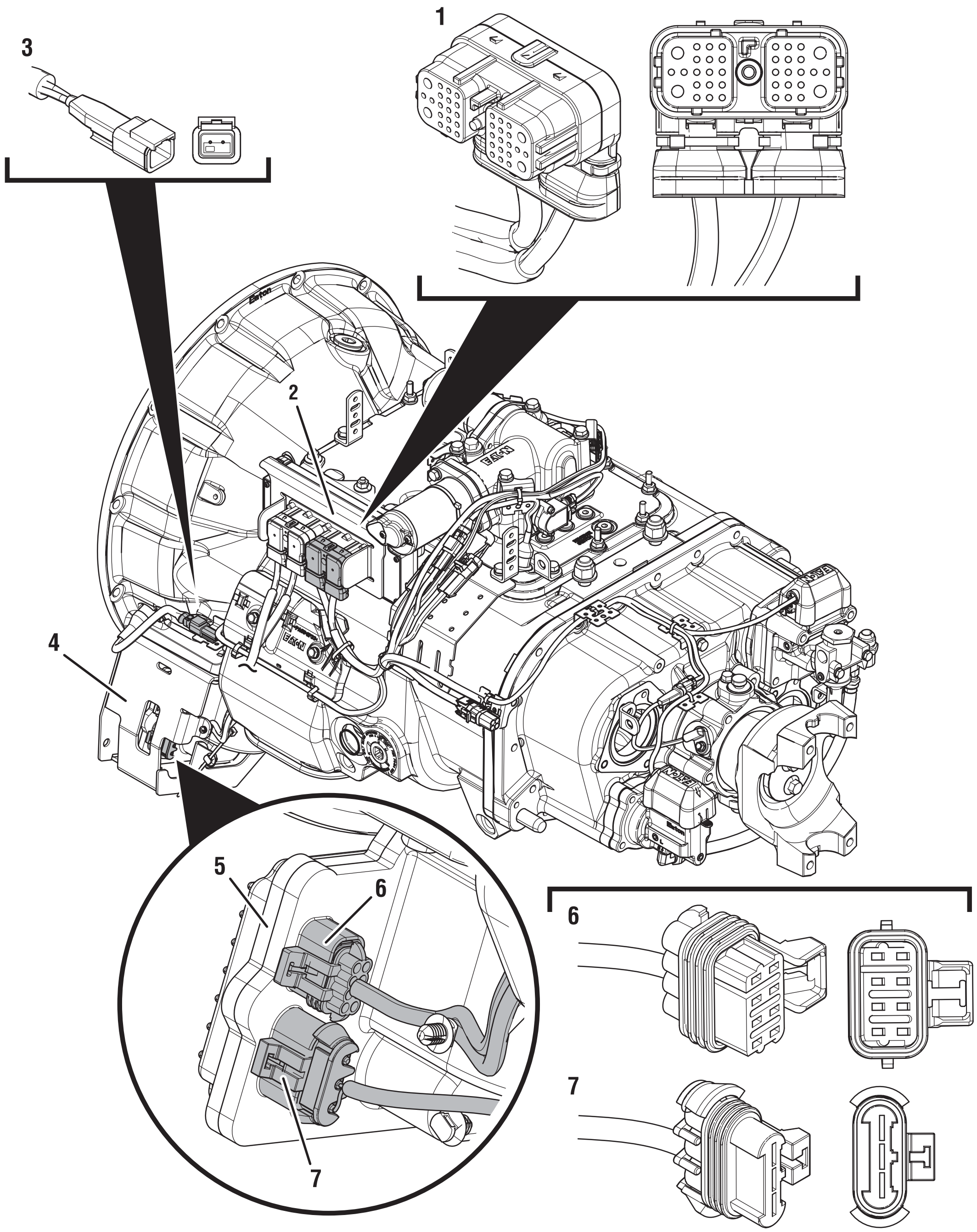
FMI 9: TECU establishes communication with the ECA for 4 seconds.

Possible Causes

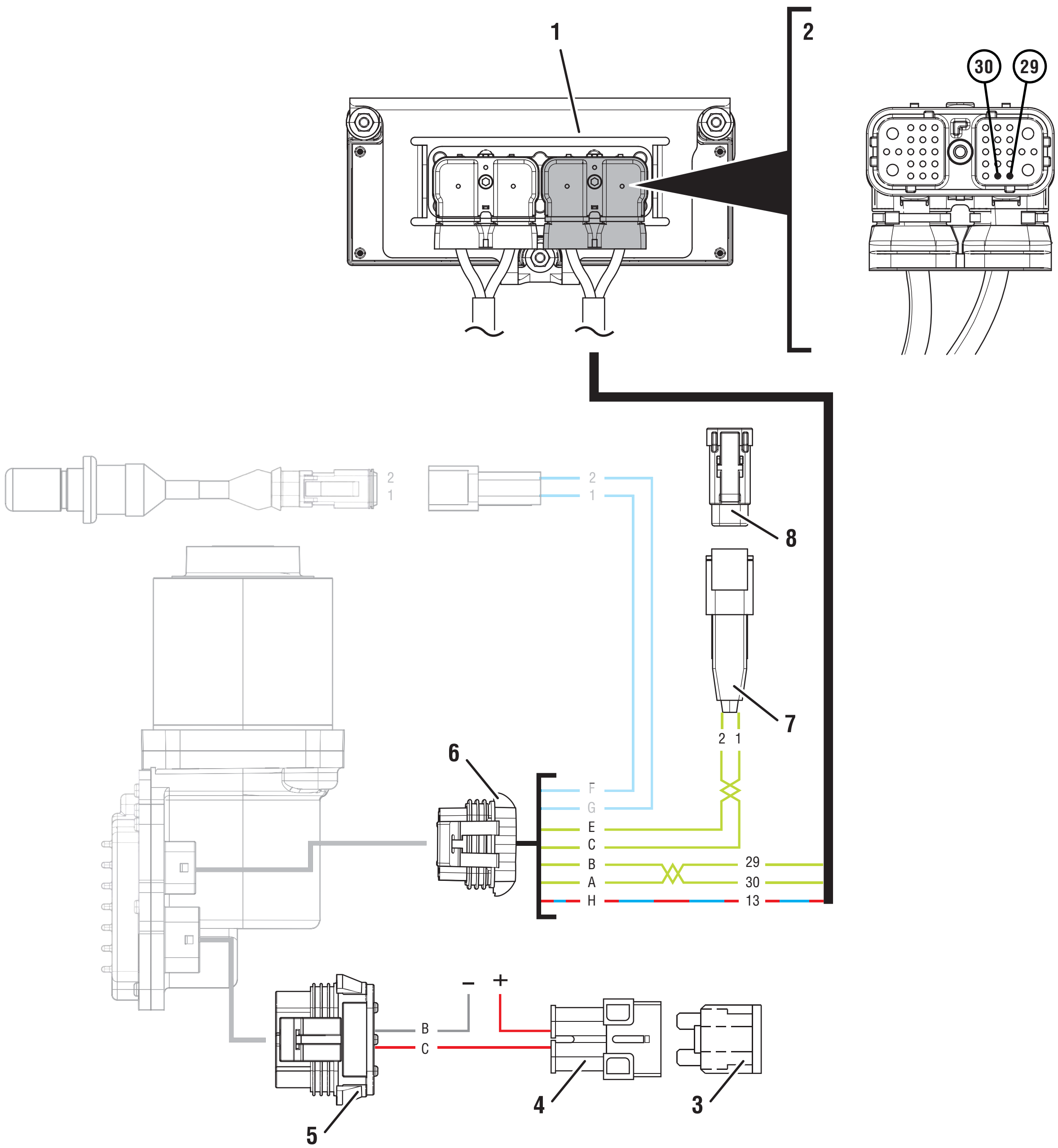
FMI 9

- Vehicle Power and Ground Supply to ECA
  - Poor power or ground supply
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Seal failure on 3-Way Gen1 ECA Connector
  - Disconnected 3-Way Gen1 ECA Connector
- Vehicle Batteries
  - Internal failure
- Transmission Harness
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Seal failure in 8-Way Gen1 ECA Connector
  - Loss of ignition voltage to ECA before power up
- ECA
  - Failed ECA software download
  - Bent, spread, corroded or loose terminals
  - Contamination in 3-Way Gen1 ECA Connector
  - Contamination in 8-Way Gen1 ECA Connector
  - Internal failure

Component Identification



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 2-Way Terminating Resistor Connector Body
4. Gen1 ECA Shield
5. Gen1 Electronic Clutch Actuator (ECA)
6. 8-Way Gen1 ECA Connector
7. 3-Way Gen1 ECA Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 40-amp Fuse
4. In-line Fuse Holder
5. 3-Way Gen1 ECA Connector
6. 8-Way Gen1 ECA Connector
7. 2-Way Terminating Resistor Connector Body
8. 2-Way High Integrity Link (HIL) Terminating Resistor

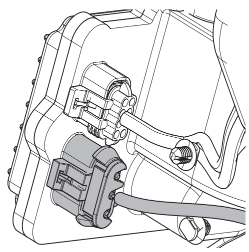
Battery Voltage	Switched Battery from TECU	Ground	Communication	Signal
Ignition Voltage	Switched 5V from TECU	Switched Ground	Relay/Solenoid Driver	

Fault Code 19 Troubleshooting Gen1 ECA

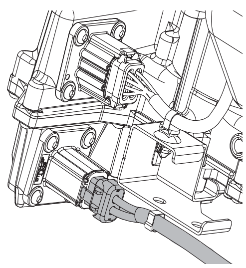
A

Purpose: *Identify ECA installed on transmission.*

1. Set parking brake and chock wheels.
2. Inspect ECA OEM Power Supply Connector, reference image below.



Gen1 ECA



Gen2 ECA

- If equipped with a Gen1 ECA, go to **Step B.**
- If equipped with a Gen2 ECA, go to *Fault Code 19: CAN Gen2 ECA Message* on page 165.

B

Purpose: *Determine if ECA software was recently updated.*

1. Determine if an ECA software download was performed immediately before Fault Code 19 set Active.

   Note: If an ECA software download fails to complete, the transmission will set Fault Code 19 and may also set Fault Code 16.

   - If an ECA software download was not recently performed, go to **Step D.**
   - If Fault Code 19 became Active immediately following an ECA software download, download may have failed. go to **Step C.**

C

Purpose: *Recover ECA software.*

1. Key off.

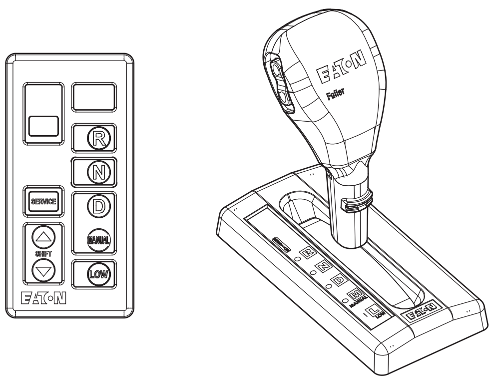
   Note: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Key on with engine off.
3. Connect ServiceRanger.
4. Use ServiceRanger to program or recover the TECU and ECA software to latest available levels.
   - If software does not download correctly, contact Eaton at (800) 826-4357.
   - If software downloads correctly and Fault Code 19 becomes Inactive, test complete. Go to **Step V.**
   - If software downloads correctly, but Fault Code 19 remains Active, go to **Step D.**

D

Purpose: *Verify Shift Control Device type.*

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Check vehicle cab to determine the type of Shift Control Device installed on the vehicle.



- If equipped with an Eaton PBSC, go to **Step E.**
- If equipped with any other shift device, including an Eaton Cobra Lever or an OEM Shift Device, go to **Step F.**

E

Purpose: *Check for Active or Inactive fault codes for vehicles equipped with an Eaton PBSC.*

1. Retrieve fault code information from the Service Activity Report.
   - If Fault Code 16 is Active, troubleshoot per *Fault Code Isolation Procedure*.
   - If Fault Code 19 is Active and Fault Code 16 is Inactive or not set, go to **Step H.**
   - If Fault Code 19 is Inactive, go to **Step G.**

F

Purpose: *Check for Active or Inactive fault codes for vehicles equipped with an Eaton Shift Lever or an OEM Shift Device.*

1. Retrieve fault code information from the Service Activity Report.
   - If Fault Code 19 is Active, go to **Step H.**
   - If Fault Code 19 is Inactive, go to **Step G.**

G

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 batteries to the 3-Way Connector at the ECA. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Wiggle wiring and connections of the Transmission Harness from the 8-Way Gen1 ECA Connector to the 38-Way Vehicle Harness Connector at the TECU.
5. Exit PD Mode by powering down.

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

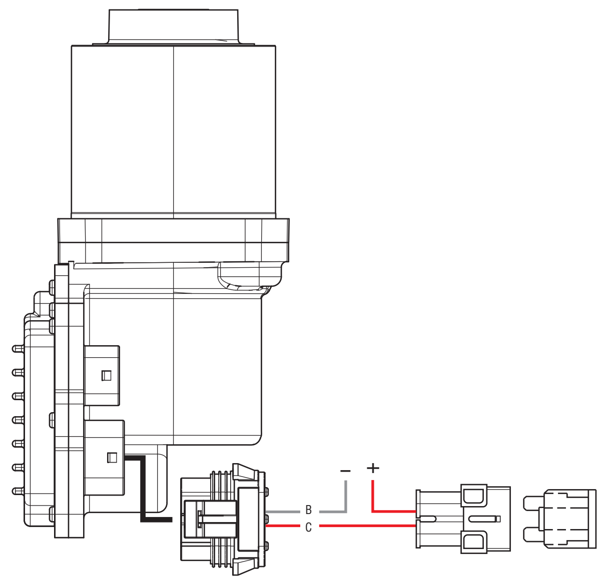
   - If any fault became Active while wiggling the 3-Way Connector to the ECA, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Go to **Step V.**
   - If any fault became Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step V.**
   - If no fault codes set Active, go to **Step H.**

H

Purpose: *Inspect power and ground supply to the ECA.*

1. Key off.
2. Inspect the ECA Power Supply Harness between the batteries and the ECA for signs of rubbing or chafing to the wiring.
3. Inspect the ECA 40-amp In-line Fusible Link or Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.

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

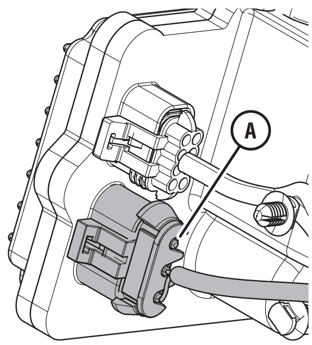


- If damage to the ECA Power Supply Harness is found, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If no damage is found, go to **Step I.**

I

Purpose: *Verify condition of 3-Way Gen1 ECA Connector.*

1. Key off.
2. Disconnect 3-Way Gen1 ECA Connector.
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. Confirm the 3-Way Gen1 ECA Connector has a seal plug in Cavity A.
5. Inspect ECA side of 3-Way Gen1 ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.

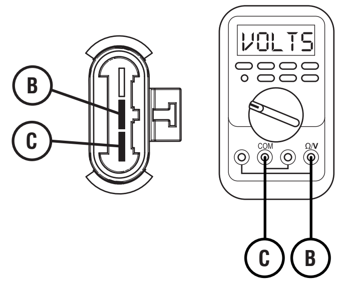


- If damage to the 3-Way Gen1 ECA Connector is found and/or missing seal plug in Cavity A, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If damage to the ECA side of 3-Way Gen1 ECA Connector is found, replace ECA. Go to **Step V.**
- If no damage is found, go to **Step J.**

J

Purpose: *Verify battery voltage at ECA.*

1. Key off.
2. Measure voltage between 3-Way Gen1 ECA Connector Pin C (Battery positive) and Pin B (Battery negative). Record reading in table.



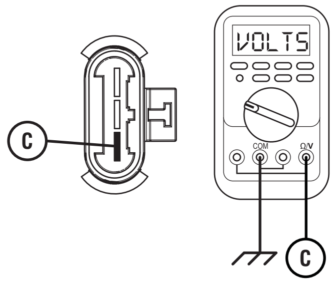
3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
   - If readings are in range, go to **Step K.**

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

K

Purpose: *Verify polarity of battery voltage at ECA.*

1. Key off.
2. Measure voltage between 3-Way Gen1 ECA Connector Pin C (Battery positive) and ground. Record reading(s) in table.



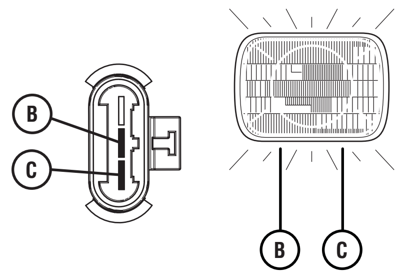
3. Compare reading in table.
   - If readings are out of range, Pin C (Battery positive) and Pin B (Battery negative) wires are incorrectly pinned in the ECA 3-Way Connector. Refer to OEM requirements for repair or replacement. Go to **Step V.**
   - If readings are in range, go to **Step L.**

Pins	Range	Reading(s)
C to Ground	Within 1.2 V of Battery Positive (+)	

L

Purpose: *Load Test the vehicle power and ground supply to the ECA.*

1. Key off.
2. Load test the 3-Way Gen1 ECA Connector and ECA Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin C (Battery positive) and Pin B (Battery negative). Load Test for 5 minutes to verify the harness will carry a load with the 40-amp fuse or fusible link installed.



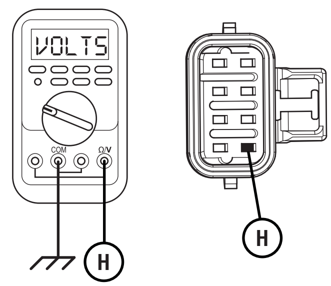
3. Wiggle the ECA Power Supply Harness during the Load Test from the vehicle batteries to ECA.
   - If the ECA Power Supply Harness does not carry a load, refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If the ECA Power Supply Harness carries a load, go to **Step M.**

M ***Purpose:*** *Verify condition of 8-Way Gen1 ECA Connector.*

1. Key off.
2. Disconnect 8-Way Gen1 ECA Connector.
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. Inspect the Transmission Harness from the TECU to the 8-Way Gen1 ECA Connector. Look for signs of rubbed or chafed wiring.
5. Inspect ECA side of 8-Way Gen1 ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.
   - If damage is found to the 8-Way Gen1 ECA Connector, replace Transmission Harness. Go to **Step V.**
   - If damage is found to the ECA side of 8-Way Gen1 ECA Connector, replace ECA. Go to **Step V.**
   - If no damage is found, go to **Step N.**

N ***Purpose:*** *Verify ignition voltage to ECA.*

1. Key on with engine off.
2. Measure voltage between 8-Way Gen1 ECA Pin H and ground. Record reading in table.

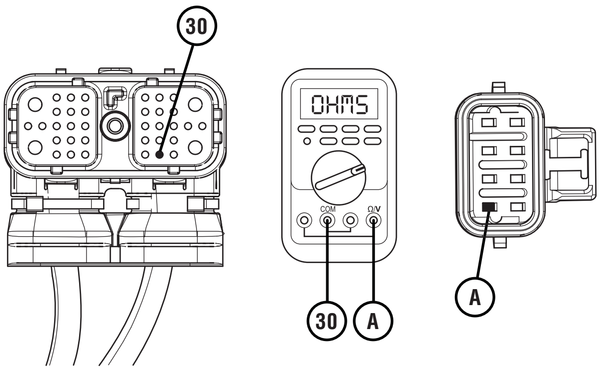


3. Compare reading(s) in table.
   - If readings are in range, go to **Step O.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

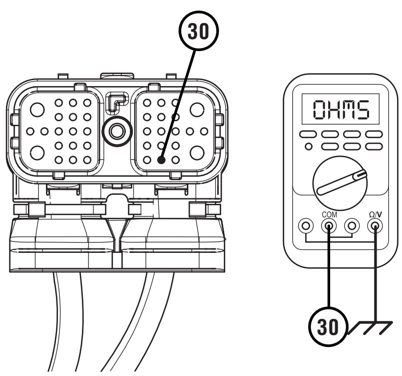
Pins	Range	Reading(s)
H to Ground	Within 1.2 V of Battery Voltage	

O ***Purpose:*** *Verify HIL positive (+) continuity between ECA and TECU.*

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector.
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. Measure resistance between 38-Way Transmission Harness Connector Pin 30 and 8-Way Gen1 ECA Connector Pin A. Record reading in table.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 30 and ground. Record reading in table.

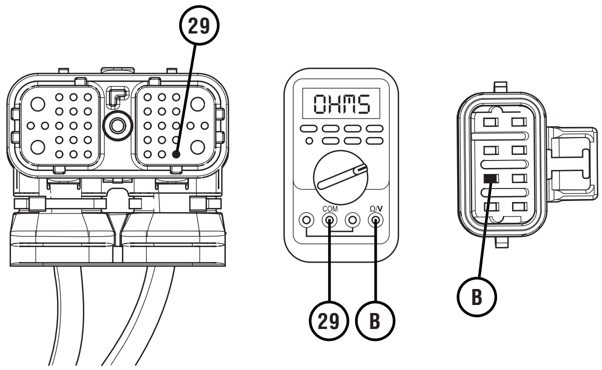


6. Compare reading(s) in table.
   - If readings are in range, go to **Step P.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

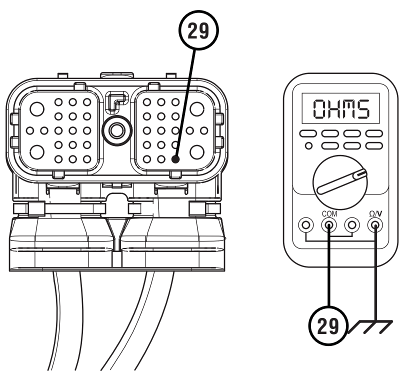
Pins	Range	Reading(s)
30 to A	0.0–0.6 ohms	
30 to Ground	Open Circuit (OL)	

P ***Purpose:*** *Verify HIL negative (-) continuity between ECA and TECU.*

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 29 and 8-Way Gen1 ECA Connector Pin B. Record reading in table.



3. Measure resistance between 38-Way Transmission Harness Connector Pin 29 and ground. Record reading in table.



4. Compare reading(s) in table.
   - If readings are in range, go to **Step Q.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

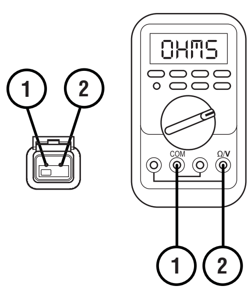
Pins	Range	Reading(s)
29 to B	0.0–0.6 ohms	
29 to Ground	Open Circuit (OL)	

Q

Purpose: *Verify HIL circuit resistance.*

1. Key off.
2. Reconnect 3-Way Gen1 ECA Connector.
3. Reconnect 8-Way Gen1 ECA Connector.
4. Reconnect 38-Way Transmission Harness Connector.
5. Locate and remove the 2-Way HIL Terminating Resistor from the 2-Way Terminating Resistor Connector Body wired into the 8-Way Gen1 ECA Connector (Transmission Harness).

   Note: Reference the Component Identification section.
6. Inspect the 2-Way Terminating Resistor Connector Body for damage and bent, spread, corroded or loose terminals.
7. Measure resistance at the 2-Way Terminating Resistor Connector Body wired into the 8-Way Gen1 ECA Connector (Transmission Harness) between Pin 1 and Pin 2. Record reading in table.



   Note: The resistance of the HIL varies based on the transmission shift device equipped in the vehicle.
8. Reinstall the 2-Way HIL Terminating Resistor into the 2-Way Terminating Resistor Connector Body.
9. Compare reading(s) in table.
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**
   - If readings are in range, replace ECA.Go to **Step V.**

Pins	Range	Reading(s)
1 to 2 (with Eaton PBSC)	50–70 ohms	
1 to 2 (without Eaton PBSC)	110–130 ohms	

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. 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 codes set Active and vehicle operates properly, test complete.
   - If Fault Code 19 sets Active contact Eaton at 1-800-826-4357 for further diagnostics.
   - If a fault code other than 19 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 19: CAN Gen2 ECA Message

J1587: MID 130 SID 248 FMI 9
J1939: SA 3 SPN 520273 FMI 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), Electronic Clutch Actuator (ECA), and if equipped, Eaton Push Button Shift Control (PBSC). The portion of the HIL that connects the TECU to the ECA is contained within the Transmission Harness. The portion of the HIL that connects the TECU to the PBSC is contained within the Vehicle Harness. Fault Code 89 indicates a loss of communication between the TECU and ECA, but is specific to systems that use a Gen2 ECA. Troubleshooting for this procedure is specific to the Gen2 ECA and associated harnesses.

Note: The troubleshooting procedure for Fault Code 19 may direct users to use this troubleshooting procedure if the vehicle is equipped with a Gen2 ECA, even if Fault Code 89 was not set by the transmission. This is because some transmission software versions do not set Fault Code 89.

Detection

The TECU monitors communication with the ECA over the HIL. If the TECU loses communication with the ECA, Fault Code 89 sets Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: TECU loses communication with the ECA for 2 seconds or longer.

Fallback

FMI 9

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Engine cranks and starts.
- Transmission may not engage a gear from neutral.
- ECA may maintain the current clutch position using the clutch holding device.
- ECA may move the clutch to the last position commanded by the TECU.

Conditions to Set Fault Code Inactive

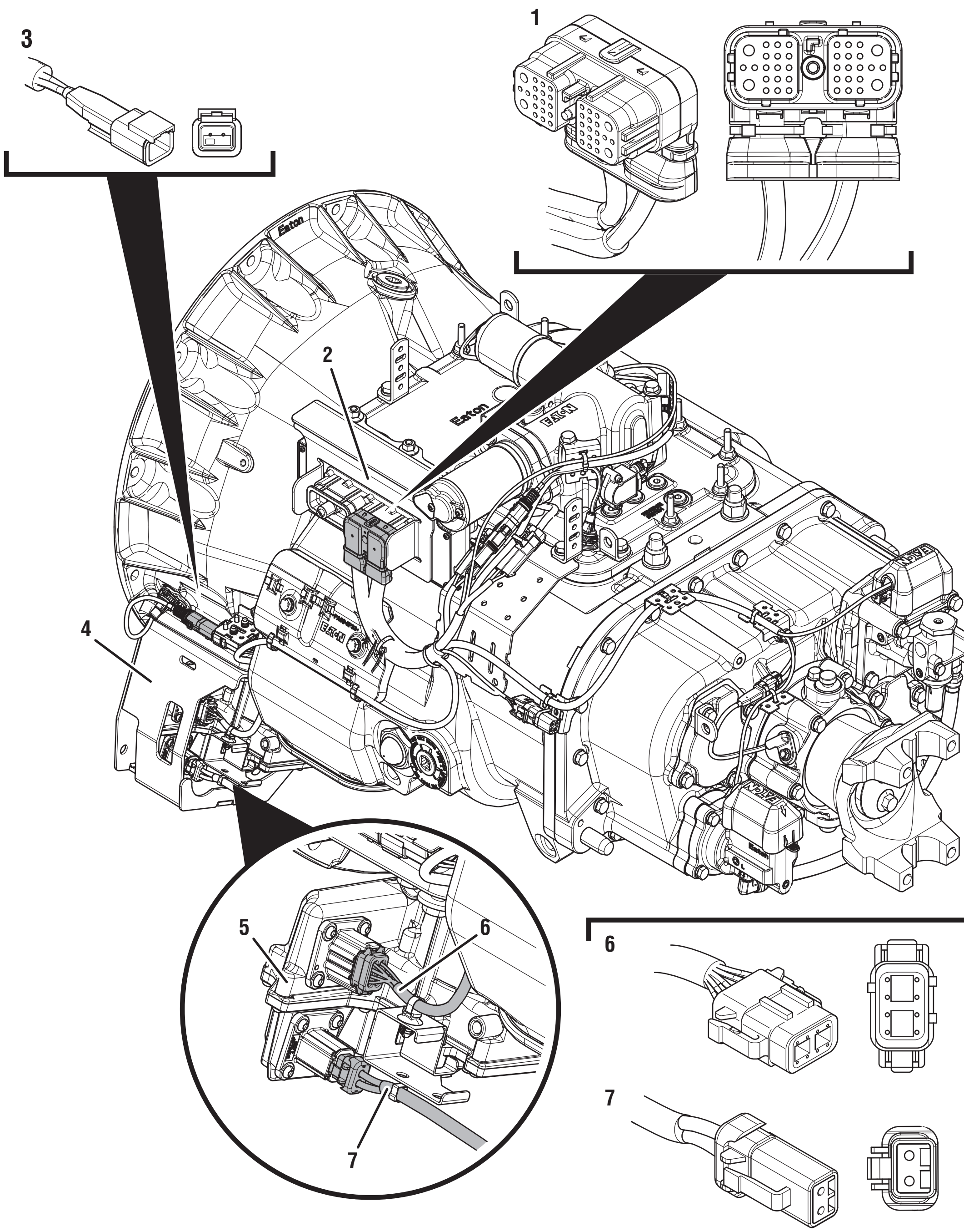
FMI 9: TECU establishes communication with the ECA for 4 seconds.

Possible Causes

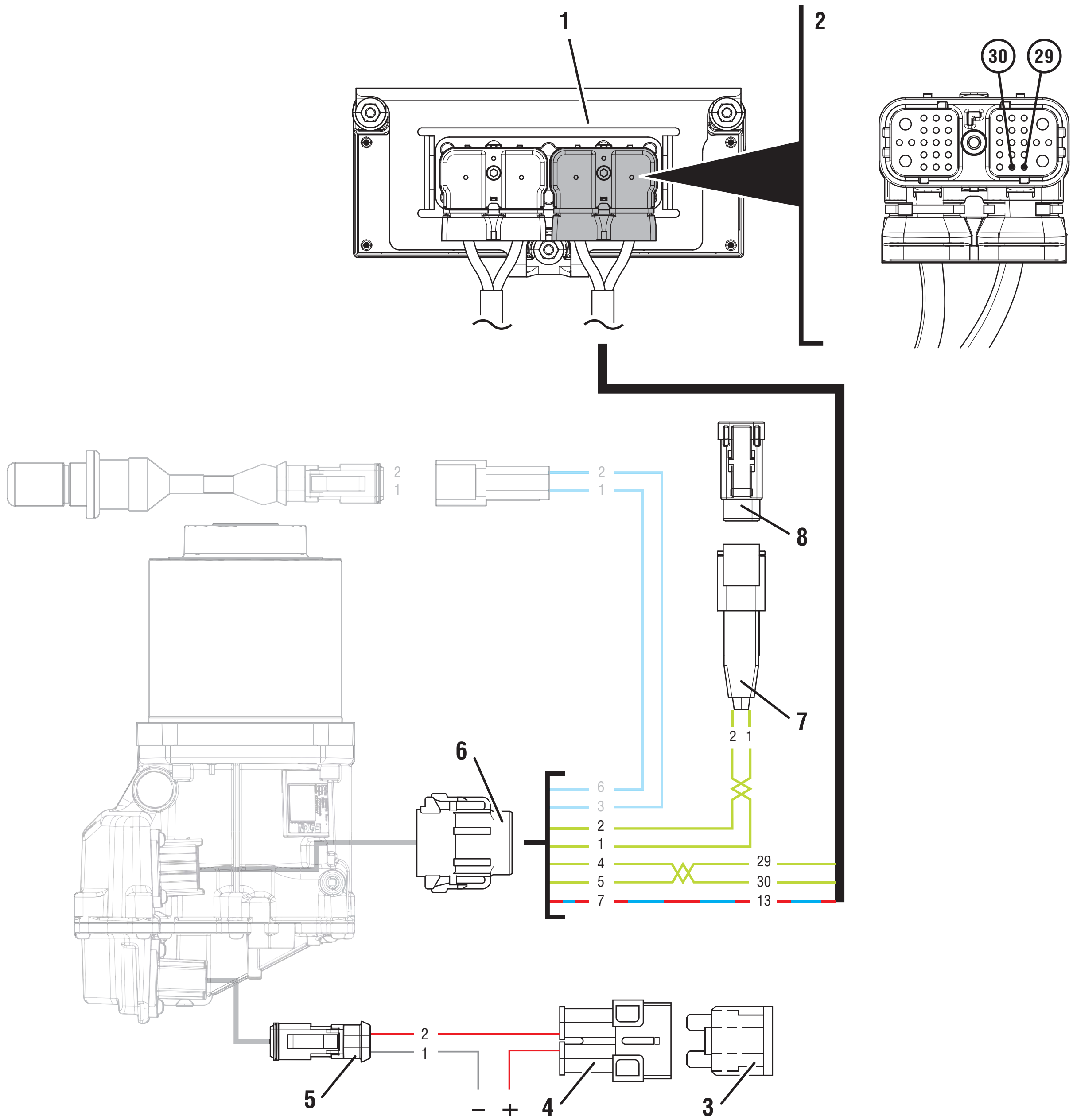
FMI 9

- Vehicle Power and Ground Supply to ECA
  - Poor power or ground supply
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Seal failure on 2-Way Gen2 ECA Connector
  - Disconnected 2-Way Gen2 ECA Connector
- Vehicle Batteries
  - Internal failure
- Transmission Harness
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
  - Seal failure in 8-Way Gen2 ECA Connector
  - Loss of ignition voltage to ECA before power up
- ECA
  - Bent, spread, corroded or loose terminals
  - Contamination in 2-Way Gen2 ECA Connector
  - Contamination in 8-Way Gen2 ECA Connector
  - Internal failure

Component Identification



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 2-Way Terminating Resistor Connector Body
4. ECA Shield
5. Electronic Clutch Actuator (ECA)
6. 8-Way ECA Connector
7. 2-Way ECA Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 40-amp Fuse
4. In-line Fuse Holder
5. 2-Way Gen2 ECA Connector
6. 8-Way Gen2 ECA Connector
7. 2-Way Terminating Resistor Connector Body
8. 2-Way High Integrity Link (HIL) Terminating Resistor

Fault Code 19 Troubleshooting Gen2 ECA

A

Purpose: *Determine if ECA software was recently updated.*

1. Determine if an ECA software download was performed immediately before Fault Code 19 set Active.

   Note: If an ECA software download fails to complete, the transmission will set Fault Code 19 and may also set Fault Code 16.

   - If an ECA software download was not recently performed, go to **Step C.**
   - If Fault Code 19 became Active immediately following an ECA software download, download may have failed. Go to **Step B.**

B

Purpose: *Recover ECA software.*

1. Key off.

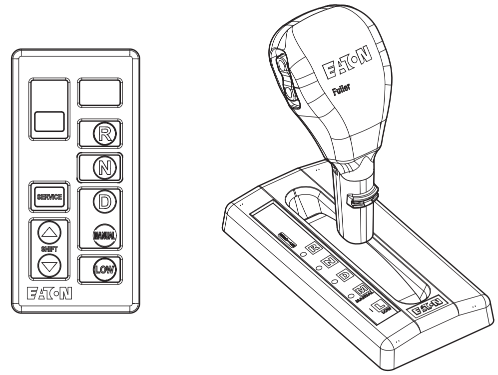
   Note: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

2. Key on with engine off.
3. Connect ServiceRanger.
4. Use ServiceRanger to program or recover the TECU and ECA software to latest available levels.
   - If software does not download correctly, contact Eaton at (800) 826-4357.
   - If software downloads correctly and Fault Code 19 becomes Inactive, test complete. Go to **Step V.**
   - If software downloads correctly, but Fault Code 19 remains Active, go to **Step C.**

C

Purpose: *Check for Active or Inactive fault codes and verify Shift Control Device type.*

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Check vehicle cab to determine the type of Shift Control Device installed on the vehicle.



- If equipped with an Eaton PBSC, go to **Step D.**
- If equipped with any other shift device, including an Eaton Cobra Lever or an OEM Shift Device, go to **Step E.**

D

Purpose: *Check for Active or Inactive fault codes for vehicles equipped with an Eaton PBSC.*

1. Retrieve fault code information from the Service Activity Report.
   - If Fault Code 16 is Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13
   - If Fault Code 19 is Active and Fault Code 16 is Inactive or not set, go to **Step H.**
   - If Fault Code 19 is Inactive, go to **Step G.**

E

Purpose: *Check for Active or Inactive fault codes for vehicles equipped with an Eaton Shift Lever or an OEM Shift Device.*

1. Retrieve fault code information from the Service Activity Report.
   - If Fault Code 19 is Active, go to **Step H.**
   - If Fault Code 19 is Inactive, go to **Step F.**

F

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 batteries to the 2-Way Connector at the ECA. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Wiggle wiring and connections of the Transmission Harness from the 8-Way Gen2 ECA Connector to the 38-Way Vehicle Harness Connector at the TECU.
5. Exit PD Mode by powering down.

   Note: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
   - If any fault became Active while wiggling the 2-Way Connector to the ECA, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Go to **Step V.**
   - If any fault became Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step V.**
   - If no fault codes set Active, go to **Step H.**

G ***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 batteries to the 2-Way Connector at the ECA. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Wiggle wiring and connections of the Transmission Harness from the 8-Way Gen2 ECA Connector to 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. Wiggle wiring and connections between the 30-Way PBSC Connector to the 38-Way Vehicle Harness Connector at the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
6. Exit PD Mode by powering down.

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

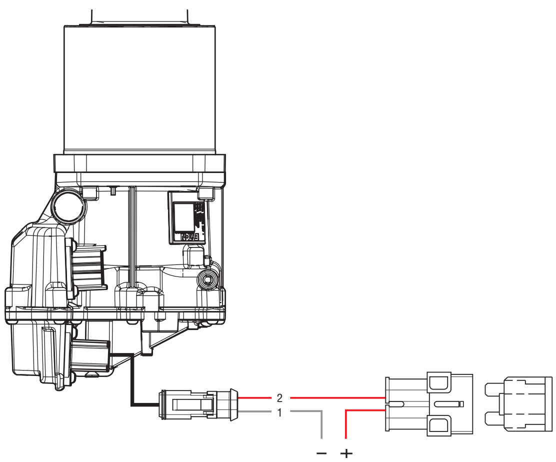
   - If any fault set Active while wiggling the ECA Power Harness, refer to OEM guidelines for repair or replacement of the ECA Power Harness. Go to **Step V.**
   - If any fault set Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step V.**
   - If any fault set Active while wiggling the wiring between the PBSC and TECU, refer to OEM guidelines for repair or replacement of the OEM wiring. Go to **Step V.**
   - If no fault codes set Active, go to **Step H.**

H

Purpose: *Inspect power and ground supply to the ECA.*

1. Key off.
2. Inspect the ECA Power Supply Harness between the batteries and the ECA for signs of rubbing or chafing to the wiring.
3. Inspect the ECA 40-amp In-line Fusible Link or Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.

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

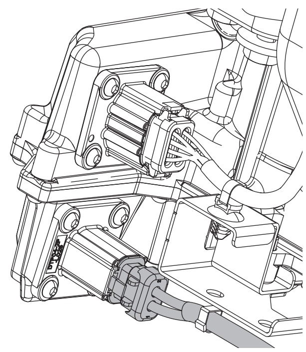


- If damage is found, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
- If no damage is found, go to **Step I.**

I

Purpose: *Verify condition of 2-Way* Gen2 *ECA Connector.*

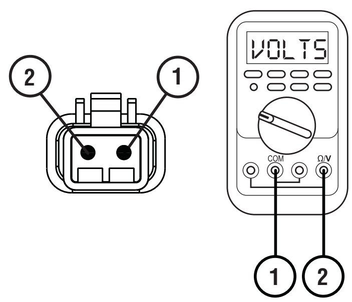
1. Key off.
2. Disconnect 2-Way Gen2 ECA Connector.
3. Verify connector is free from any corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect ECA side of 2-Way Gen2 ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.



- If damage is found to the 2-Way Gen2 ECA Connector, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If damage to the ECA side of 2-Way Gen2 ECA Connector is found, replace ECA. Go to **Step V.**
- If no damage is found, go to **Step J.**

J **Purpose:** *Verify battery voltage at ECA.*

1. Key off.
2. Measure voltage between 2-Way Gen2 ECA Connector Pin 2 (Battery positive) and Pin 1 (Battery negative). Record reading in table.

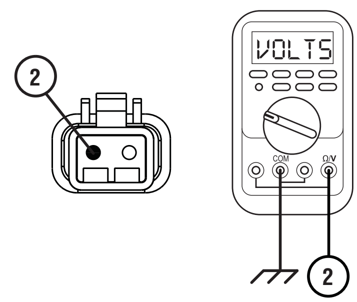


3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
   - If readings are in range, go to **Step K.**

Pins	Range	Reading(s)
1 to 2	Within 1.2 V of Battery Positive (+)	

K **Purpose:** *Verify polarity of battery voltage at ECA.*

1. Key off.
2. Measure voltage between 2-Way Gen2 ECA Connector Pin 2 (Battery positive) and ground. Record reading in table.



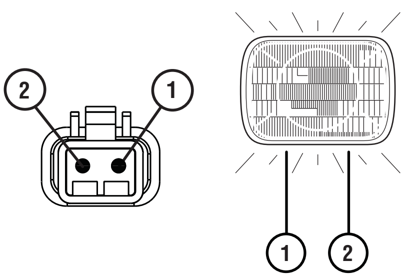
3. Compare reading(s) in table.
   - If readings are out of range, Pin 2 (Battery positive) and Pin 1 (Battery negative) wires are incorrectly pinned in the 2-Way Gen2 ECA Connector. Refer to OEM requirements for repair or replacement. Go to **Step V.**
   - If readings are in range, go to **Step L.**

Pins	Range	Reading(s)
2 to Ground	Within 1.2 V of Battery Positive (+)	

L

Purpose: *Load Test the vehicle power and ground supply to the ECA.*

1. Key off.
2. Load test the 2-Way Gen2 ECA Connector and ECA Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin 2 (Battery positive) and Pin 1 (Battery negative). Load Test for 5 minutes to verify the harness will carry a load with the 40-amp fuse or fusible link installed.
3. Wiggle the ECA Power Supply Harness during the Load Test from the vehicle batteries to ECA.



- If the ECA Power Supply Harness does not carry a load, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If the ECA Power Supply Harness carries a load, go to **Step M.**

M

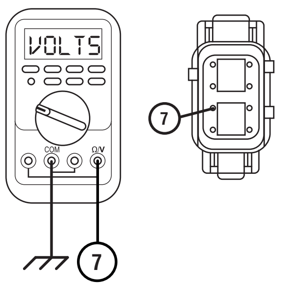
Purpose: *Verify condition of 8-Way* Gen2 *ECA Connector.*

1. Key off.
2. Disconnect 8-Way Gen2 ECA Connector.
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. Inspect the Transmission Harness from the TECU to the 8-Way Gen2 ECA Connector. Look for signs of rubbed or chafed wiring.
5. Inspect ECA side of 8-Way Gen2 ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.
   - If damage is found to the 8-way Gen2 ECA Connector or Transmission Harness, replace Transmission Harness. Go to **Step V.**
   - If damage to the ECA side of 8-Way Gen2 ECA Connector is found, replace ECA. Go to **Step V.**
   - If no damage is found, go to **Step N.**

N

Purpose: *Verify Ignition Voltage to ECA.*

1. Key on with engine off.
2. Measure voltage between 8-Way Gen2 ECA Pin 7 and ground. Record reading in table.



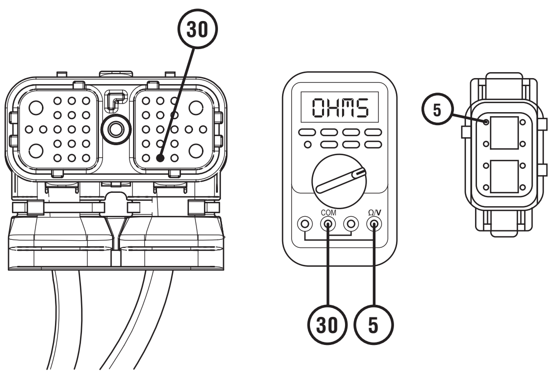
3. Compare reading(s) in table.
   - If readings are in range, go to **Step O.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
7 to Ground	Within 1.2 V of Battery Voltage	

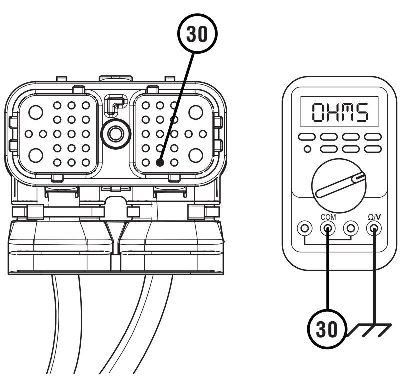
O

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

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector.
3. Verify 38-Way Transmission Harness Connector is free from any corrosion; the terminals are not bent, spread or loose, and there is no damage to the connector body.
4. Measure resistance between 38-Way Transmission Harness Connector Pin 30 and 8-Way Gen2 ECA Connector Pin 5. Record reading in table.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 30 and ground. Record reading in table.



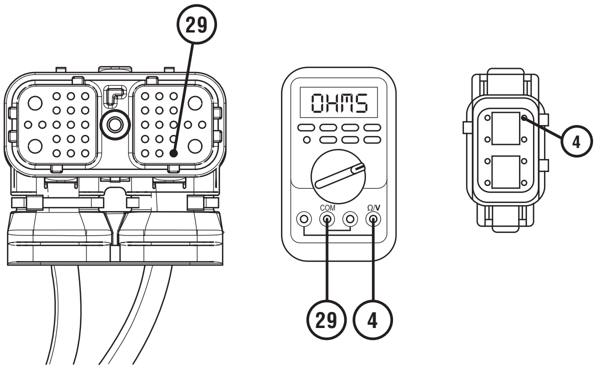
6. Compare reading(s) in table.
   - If readings are in range, go to **Step P.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
30 to 5	0.0–0.6 ohms	
30 to Ground	Open Circuit (OL)	

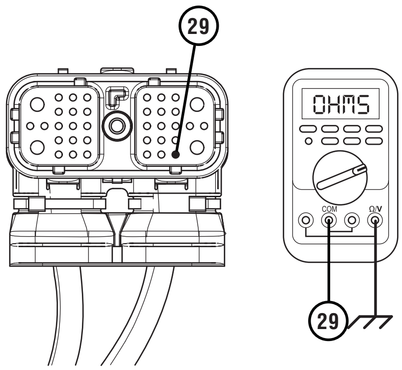
P

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

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 29 and 8-Way Gen2 ECA Connector Pin 4. Record reading in table.



3. Measure resistance between 38-Way Transmission Harness Connector Pin 29 and ground. Record reading in table.



4. Compare reading(s) in table.
   - If readings are in range, go to **Step Q.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
29 to 4	0.0–0.6 ohms	
29 to Ground	Open Circuit (OL)	

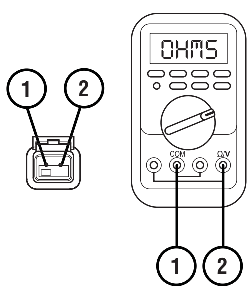
Q

Purpose: *Verify HIL circuit resistance.*

1. Key off.
2. Reconnect 2-Way Gen2 ECA Connector.
3. Reconnect 8-Way Gen2 ECA Connector.
4. Reconnect 38-Way Transmission Harness Connector.
5. Locate and remove the 2-Way HIL Terminating Resistor from the 2-Way Terminating Resistor Connector Body wired into the 8-Way Gen2 ECA Connector (Transmission Harness).

   Note: Reference the Component Identification section.

6. Inspect the 2-Way Terminating Resistor Connector Body for damage and bent, spread, corroded or loose terminals.
7. Measure resistance at the 2-Way Terminating Resistor Connector Body wired into the 8-way Gen2 ECA Connector (Transmission Harness) between Pin 1 and Pin 2. Record reading in table.



   Note: The resistance of the HIL varies based on the transmission shift device equipped in the vehicle.

8. Reinstall the 2-Way HIL Terminating Resistor into the 2-Way Terminating Resistor Connector Body.
9. Compare reading(s) in table.
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**
   - If readings are in range, replace ECA. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2 (with Eaton PBSC)	50–70 ohms	
1 to 2 (without Eaton PBSC)	110–130 ohms	

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. 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 codes set Active and vehicle operates properly, test complete.
   - If Fault Code 19 sets Active contact Eaton at 1-800-826-4357 for further diagnostics.
   - If a fault code other than 19 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 21: Auto-Neutral Park Brake Switch

J1587: MID 130	**PID 70**	**FMI 14**
J1939: SA 3	**SPN 70**	**FMI 14**

Overview

The UltraShift *PLUS* transmission is equipped with an auto-neutral function. This function shifts the transmission to neutral when the vehicle is brought to a complete stop while the transmission is in gear and the park brake is set. Fault Code 21 indicates a problem with the Auto-Neutral Park Brake Switch circuit.

Detection

The TECU has two options that can be configured depending on component setup. For a TECU configured for a Hard-Wired Park Brake Switch, this fault can be detected anytime the ignition key is on. For a TECU configured for a J1939 Park Brake Switch input, the fault can be detected anytime the J1939 communicates to the TECU from a chassis module (e.g., Cab Controller, Engine, etc).

Conditions to Set Fault Code Active

FMI 14 – Special Instructions: Park Brake Switch is set and one of the following are true:

- Vehicle is moving 11 MPH or greater for more than 9 seconds.
- Hard-wired Park Brake Switch and J1939 Park Brake Switch values do not match for more than 3 seconds.

Note: The fault can also set anytime the Park Brake Switch status remains released for five consecutive power-up and power-down cycles.

Fallback

FMI 14

- Remote Throttle and Split Shaft PTO (if equipped) may be inoperative if the TECU cannot determine if the park brake is set.

Conditions to Set Fault Code Inactive

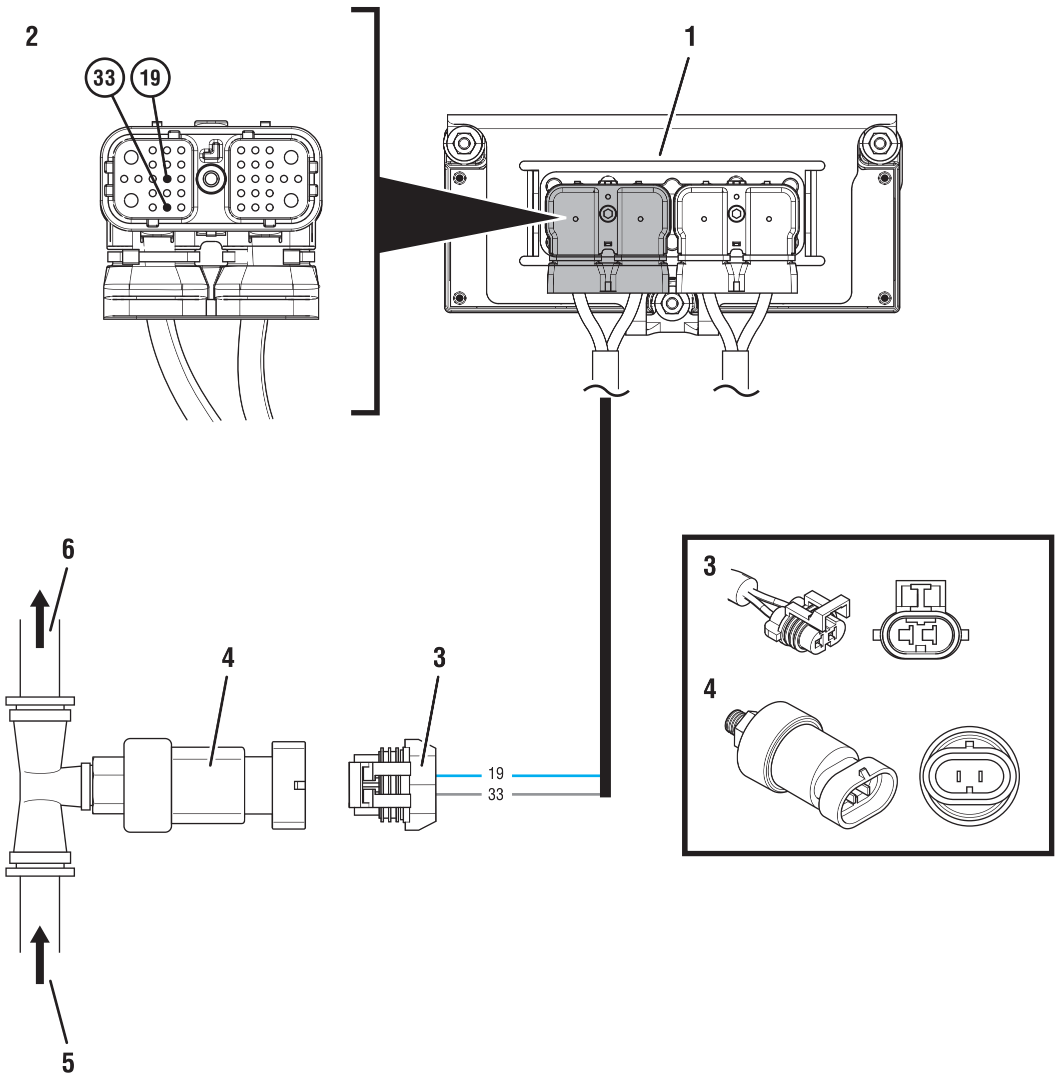
FMI 14: Park Brake Switch circuit operates normally for 6 seconds or after a power cycle.

Possible Causes

FMI 14

- Park Brake Switch
  - Normally open park brake switch installed on chassis (Normally closed is required)
  - Internal failure
- Park Brake Switch Configuration
  - Incorrect configuration setting
- Vehicle Harness
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
- J1939 Data Link
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, corroded or loose terminals
- Operator Influence
  - Not setting Park Brake Switch

Component Identification



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 2-Way Park Brake Switch Connector
4. 2-Way Park Brake Switch
5. Air Supply
3. To Park Brake System

Fault Code 21 Troubleshooting

A

Purpose: Verify if a physical Park Brake Switch is installed on the chassis.

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Inspect the vehicle to determine if the Park Brake Switch is physically hard-wired to the TECU or broadcast over the J1939 Data Link.

   Note: If Fault Code 21 is Inactive and there are other Active fault codes, troubleshoot all other Active fault codes first.

   - If the Park Brake Switch is directly hard-wired to the TECU, Go to **Step B.**
   - If the Park Brake Switch is broadcast over the J1939 Data Link, go to **Step D.**

B

Purpose: Determine if the Hard-Wired Park Brake Switch configuration matches the Hard-Wired Brake Switch installation.

1. Key on with engine off.
2. Connect ServiceRanger.
3. In ServiceRanger, go to Configuration.
4. Record current value of the Hard-Wired Park Brake Switch.

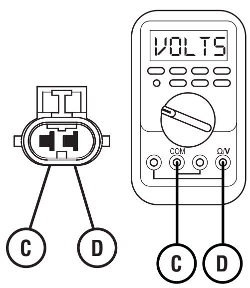
   Note: Reference the *ServiceRanger User Guide* (TCMT0072) for more information about the use of ServiceRanger.

   - If the current value is “Installed”, go to **Step C.**
   - If the current value is “Not Installed”, change value to “Installed”. Go to **Step V.**

C

Purpose: Confirm operation of the TECU Hard-Wired Park Brake Switch.

1. Key off.
2. Disconnect 2-Way Park Brake Switch Connector at the Park Brake Switch.
3. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Key on with engine off.
5. Measure voltage across 2-Way Vehicle Harness Connector Pin C and Pin D. Record reading(s) in table.



6. Compare reading(s) in table.
   - If readings are in range, refer to OEM guidelines for repair or replacement of Park Brake Wiring and Switch. Go to **Step V.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of Vehicle Harness between TECU and Park Brake Switch. Go to **Step V.**

Pins	Range	Reading(s)
C to D	4.0–5.0 V	

D

Purpose: Determine if the Park Brake Switch configuration matches the J1939 Brake Switch installation.

1. Key on with engine off.
2. Connect ServiceRanger.
3. In ServiceRanger, go to Configuration.
4. Record current value of the Hard-Wired Park Brake Switch.

   Note: Reference the *ServiceRanger User Guide* (TCMT0072) for more information about the use of ServiceRanger.

   - If the current value is "Not Installed," refer to OEM guidelines for diagnosing the J1939 Park Brake Switch.
   - If the current value is "Installed," change the value to "Not Installed." 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. Clear fault codes using ServiceRanger.
5. Operate 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 21 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 21 sets Active during the test, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 22: ABS CAN Message

J1587: MID 130 PID 49 FMI 9, 14
J1939: SA 3 SPN 563 FMI 9, 14

Overview

The UltraShift *PLUS* transmission is equipped with Hill Start Aid (HSA) which prevents roll-back and roll-forward while launching on grades that are 1% and greater. The HSA holds for 3 seconds using vehicle foundation wheel brakes. The Transmission Electronic Control Unit (TECU) and ABS Module communicate over the J1939 Data Link and control the HSA function. Fault Code 22 sets if the TECU loses communication with the ABS or the ABS communicates that the HSA is not available.

Detection

The TECU communicates with the ABS module over the J1939 Data Link. If communication is lost with the ABS module or the ABS module broadcasts a message indicating HSA is not available, this fault sets Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: TECU detects a loss of communication with the ABS Module over the J1939 Data Link for 5 seconds while other J1939 devices are still communicating with the TECU.

FMI 14 – Special Instructions: TECU receives a message from the ABS Module, over the J1939 Data Link, that the HSA function is not available.

Fallback

All FMIs

- Hill Start Aid is inoperative.

Conditions to Set Fault Code Inactive

All FMIs: TECU establishes communication with the ABS module and the ABS module communicates that HSA is available.

Possible Causes

FMI 9

- J1939 Data Link
  - J1939 Data Link damage between TECU and ABS module
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open

FMI 14

- ABS System
  - ABS component or system fault code
  - ABS module does not support or is not configured for HSA
  - ABS module internal failure
- HSA Disable Switch
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Internal failure

Component Identification

Refer to OEM guidelines for proper documentation.

Fault Code 22 Troubleshooting

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

1. Key on with engine off.

   Note: Fault Code 22 indicates an issue with communication between the transmission and ABS module over the J1939 Data Link or an issue with the HSA Disable Switch. All wiring and pin outs for connectors are OEM proprietary. Refer to OEM guidelines for proper documentation.

2. Retrieve and record ABS fault codes using an OEM-approved diagnostic tool.
   - If the ABS diagnostic tool can not communicate with the ABS system, troubleshoot the ABS issue per OEM guidelines. Go to **Step V.**
   - If no ABS fault codes are set, inspect HSA Disable Switch for proper operation per OEM guidelines. Go to **Step V.**

     Note: If there are no ABS, J1939 communication or HSA Disable Switch issues, refer to OEM guidelines for troubleshooting intermittent ABS, J1939 communication or HSA Disable Switch issues.

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. 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 set and vehicle operates properly, test complete.
   - If Fault Code 22 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 22 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 23: Urge to Move Brake Switch Signal

J1939 SA 3	**SPN 116**	**FMI 9, 13**
	SPN 521	**FMI 9, 13**
	SPN 597	**FMI 9, 13**
	SPN 1121	**FMI 9, 13**
	SPN 8484	**FMI 9, 13**
	SPN 520215	**FMI 14**
	SPN 520216	**FMI 31**

Overview
The UltraShift *PLUS* transmission may be configured with the Urge to Move (UTM) feature. If enabled and the transmission is in gear, UTM allows the vehicle to start moving after the vehicle service brake is released without having to depress the accelerator pedal. The UTM feature requires a primary on/off brake switch signal and one of two secondary brake signal messages to function. The brake signal messages are broadcast via J1939 to the Transmission Electronic Control Unit (TECU).

Detection
The TECU communicates with the vehicle over the J1939 Data Link. If the vehicle secondary brake signal messages are not received, the fault sets active.

Conditions to Set Fault Code Active
FMI 9 – Abnormal Update Rate: Brake Input Signal message not received for 5 seconds.

FMI 13 – Out of Calibration: Brake Input Signal message received in error or is out of range.

FMI 14 – Special Instructions: UTM is enabled and the TECU has never received the Brake Pedal Position or Brake Application Pressure signal messages in 5 seconds.

FMI 31 – Condition Exists: Primary Brake Input Signal and Secondary Brake Input Signal are configured to the same value.

Fallback
All FMIs:

- Urge to Move is inoperative.

Conditions to Set Fault Code Inactive
All FMIs:

- Key off, TECU powered down, key on and one of the two secondary brake signal messages are available.

Possible Causes
FMI 9, 13:

- Brake or Vehicle Controller (OEM determined)
  - Component and/or system fault
- J1939 Data Link
  - J1939 Data Link damage between TECU and Brake or Vehicle Controller
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open

FMI 14:

- Brake Input Signal message never received.

FMI 31:

- TECU
  - Configuration

Fault Code 23 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 22, 35 or 36 is Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 23, SPN 521, FMI 9 or 13 is Active, go to **Step B.**
   - If Fault Code 23, SPN 520216, FMI 31 is Active, go to **Step C.**
   - If Fault Code 23, SPN 520216, FMI 31 is Inactive, Brake Input Signals are configured correctly, go to **Step V.**
   - If Fault Code 23, SPN 520215, FMI 14 is Active or Inactive, go to **Step D.**
   - If Fault Code 23, SPN 597, FMI 9 or 13 is Active or Inactive,go to **Step E.**
   - If Fault Code 23, SPN 116, FMI 9 or 13 is Active or Inactive, go to **Step F.**
   - If Fault Code 23, SPN 1121, FMI 9 or 13 is Active or Inactive, go to **Step G.**
   - If Fault Code 23, SPN 8484, FMI 9 or 13 is Active or Inactive, go to **Step H.**

B ***Purpose:*** *Monitor Brake Pedal Position.*

1. Key off.
2. Set vehicle parking brake and chock wheels.
3. Key on with engine running.
4. Allow air pressure to build to governor cut off.
5. Key off.
6. Key on, engine off.
7. Connect ServiceRanger.
8. Select “Data Monitor”.
9. Select “Position”.
10. Select “Brake pedal position”.
11. Select all of the SPN 521 sources.
12. Service brake released, monitor ServiceRanger and record “Brake pedal position” value in table.
13. Depress and hold service brake, monitor ServiceRanger, and record “Brake pedal position” value (reading) in table.

Important: The “Brake pedal position” value may not be indicated in all the sources selected. Only one valid “Brake pedal position” value is required to support UTM.

14. Compare reading(s) in table.
    - If reading(s) are in range, no problem was found. The intermittent nature of the fault makes it likely that the problem is in the Brake Pedal Position signal. Contact the OEM for further help troubleshooting the issue.
    - If reading(s) is out of range, refer to OEM guidelines for repair or replacement of the Brake Pedal Position signal. Go to **Step V.**

Service Brake State	Range	Reading(s)
Released	0%	
Depressed	1% - 100%	

C ***Purpose:*** *Compare Primary and Secondary Brake Input Signal Values.*

1. Key on, engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Locate “Primary Brake Input Signal” and record value in table.
6. Locate “Secondary Brake Input Signal” and record value in table.
7. Compare reading(s) in table.
    - If Primary and Secondary Brake Input Signals are configured to the same value:
        - From the Primary Brake Input Signal New Value drop down select “Default”.
        - From the Secondary Brake Input Signal New Value drop down select “Default”.
        - Select “Apply” and follow the on-screen prompts. Go to **Step V.**
    - If Primary and Secondary Brake Input Signals are not configured to the same value, contact Eaton at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

Brake Input Signal	Reading(s)
Primary Brake Input Signal	
Secondary Brake Input Signal	

D ***Purpose:*** Contact OEM regarding brake signal messages availability.

1. Contact OEM regarding availability of “Brake Pedal Position” – SPN 521, “Brake Switch” – SPN 597 or “Brake Application Pressure” – SPN 116 signals on the vehicle.

Important: If UTM was just enabled the vehicle may not be equipped with the required secondary brake signal messages to support the feature.

- If one or both brake signals are available, configure vehicle per OEM guidelines and perform a TECU power down. Go to **Step V.**
- If both secondary brake signal messages are not available, the vehicle does not support UTM. Disable UTM, Go to **Step V.**

E ***Purpose:*** *Monitor Brake Switch Status.*

1. Key off.
2. Set vehicle parking brake and chock wheels.
3. Key on with engine running.
4. Allow air pressure to build to governor cut off.
5. Key off.
6. Key on, engine off.
7. Connect ServiceRanger.
8. Select “Data Monitor”.
9. Select “Status”.
10. Select “Brake switch”.
11. Select all of the SPN 597 sources.
12. Service brake released, monitor ServiceRanger and record “Brake switch” value (reading) in table.
13. Depress and hold service brake, monitor ServiceRanger, and record “Brake switch” value (reading) in table.

Important: The “Brake switch” value may not be indicated in all the sources selected. Only one valid “Brake switch” value is required to support UTM.

14. Compare reading(s) in table.
    - If reading(s) are in range, no problem was found. The intermittent nature of the fault makes it likely that the problem is in the Brake switch signal. Contact the OEM for further help troubleshooting the issue.
    - If reading(s) is out of range, refer to OEM guidelines for repair or replacement of the Brake switch signal. Go to **Step V.**

Service Brake State	Range	Reading(s)
Released	Released	
Depressed	Depressed	

F ***Purpose:*** *Monitor Brake Application Pressure.*

1. Key off.
2. Set vehicle parking brake and chock wheels.
3. Key on with engine running.
4. Allow air pressure to build to governor cut off.
5. Key off.
6. Key on, engine off.
7. Connect ServiceRanger.
8. Select “Data Monitor”.
9. Select “Pressure”.
10. Select “Brake application pressure”.
11. Select all of the SPN 116 sources.
12. Service brake released, monitor ServiceRanger and record “Brake application pressure” value (reading) in table.
13. Depress and hold service brake, monitor ServiceRanger, and record “Brake application pressure” value (reading) in table.

Important: The “Brake application pressure” value may not be indicated in all the sources selected. Only one valid “Brake application pressure” value is required to support UTM.

14. Compare reading(s) in table.
    - If reading(s) are in range, no problem was found. The intermittent nature of the fault makes it likely that the problem is in the Brake Application Pressure signal. Contact the OEM for further help troubleshooting the issue.
    - If reading(s) is out of range, refer to OEM guidelines for repair or replacement of the Brake Application Pressure signal. Go to **Step V.**

Service Brake State	Range	Reading(s)
Released	0 PSI	
Depressed	1 PSI - 145 PSI	

G ***Purpose:*** *Monitor EBS Brake Switch Status.*

1. Key off.
2. Set vehicle parking brake and chock wheels.
3. Key on with engine running.
4. Allow air pressure to build to governor cut off.
5. Key off.
6. Key on, engine off.
7. Connect ServiceRanger.
8. Select “Data Monitor”.
9. Select “Status”.
10. Select “EBS brake switch”.
11. Select all of the SPN 1121 sources.
12. Service brake released, monitor ServiceRanger and record “EBS brake switch” value (reading) in table.
13. Depress and hold service brake, monitor ServiceRanger, and record “EBS brake switch” value (reading) in table.

Important: The “EBS brake switch” value may not be indicated in all the sources selected. Only one valid “EBS brake switch” value is required to support UTM.

14. Compare reading(s) in table.
    - If reading(s) are in range, no problem was found. The intermittent nature of the fault makes it likely that the problem is in the EBS brake switch signal. Contact the OEM for further help troubleshooting the issue.
    - If reading(s) is out of range, refer to OEM guidelines for repair or replacement of the EBS brake switch signal. Go to **Step V.**

Service Brake State	Range	Reading(s)
Released	Brake pedal is not being pressed	
Depressed	Brake pedal is being pressed	

H ***Purpose:*** *Monitor Demanded Brake Pressure.*

1. Key off.
2. Set vehicle parking brake and chock wheels.
3. Key on with engine running.
4. Allow air pressure to build to governor cut off.
5. Key off.
6. Key on, engine off.
7. Connect ServiceRanger.
8. Select “Data Monitor”.
9. Select “Pressure”.
10. Select “Demanded brake pressure”.
11. Select all of the SPN 8484 sources.
12. Service brake released, monitor ServiceRanger and record “Demanded brake pressure” value (reading) in table.
13. Depress and hold service brake, monitor ServiceRanger, and record “Demanded brake pressure” value (reading) in table.

Important: The “Demanded brake pressure” value may not be indicated in all the sources selected. Only one valid “Demanded brake pressure” value is required to support UTM.

14. Compare reading(s) in table.
    - If reading(s) are in range, no problem was found. The intermittent nature of the fault makes it likely that the problem is in the Demanded brake pressure signal. Contact the OEM for further help troubleshooting the issue.
    - If reading(s) is out of range, refer to OEM guidelines for repair or replacement of the Demanded brake pressure. Go to **Step V.**

Service Brake State	Range	Reading(s)
Released	0 PSI	
Depressed	1 PSI - 932 PSI	

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. Clear fault codes using ServiceRanger.
5. Key on with engine idling.
6. Check for fault codes using ServiceRanger:
    - If no codes set and the vehicle operates properly, test complete.
    - If Fault Code 23 sets active during the test drive, go to **Step A.**
    - If a fault code other than 23 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 25: No Faults Found

J1587: MID 130 SID 254 FMI 1
J1939: SA 3 SPN 629 FMI 1

Overview

Fault Code 25 indicates the TECU has determined that all transmission functions are operating normally and the transmission currently has no logged fault codes.

Detection

Fault Code 25 is a TECU self-check and should be present when no other fault codes have been logged. This condition is normal and means that there are no failed circuits or components. Fault Code 25 will not display when verifying fault codes with ServiceRanger, but may appear when using the key-clicks method to verify fault codes.

Conditions to Set Fault Code Active

FMI 1 – Data Valid But Below Normal: All systems report no fault codes.

Fallback

FMI 1

- No fallback mode is associated with this fault.

Conditions to Set Fault Code Inactive

FMI 1: This fault code is never set Inactive.

Possible Causes

FMI 1

- None

Component Identification

None

Fault Code 25 Troubleshooting

A

Purpose: Check for Active or Inactive fault codes.

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

   Note: Fault code 25 is a TECU self-check and is present only when using the key-clicks method of retrieving fault codes and when no other fault codes have been logged. This condition is normal and means that there are no failed circuits or components.

   - If fault codes are present in ServiceRanger, use the *Diagnostic Procedure* on page 11 to match transmission fault codes to vehicle symptoms for troubleshooting.
   - If no fault codes are present, test complete.

Fault Code 26: Clutch Slip

J1587: MID 130 SID 55 FMI 10
J1939: SA 3 SPN 522 FMI 10

Overview

The UltraShift *PLUS* Transmission is equipped with a Heavy Duty Electronic Clutch Actuator (ECA) Clutch. The Transmission Electronic Control Unit (TECU) monitors engine speed and Input Shaft Speed Sensor values to calculate clutch slip. Fault Code 26 indicates that a clutch slip event has occurred.

Detection

The TECU calculates a significant variance between the engine speed and Input Shaft Speed Sensor values.

Conditions to Set Fault Code Active

FMI 10 – Abnormal Rate of Change: The TECU monitors and compares both Input Shaft Speed and engine speed. If the TECU calculates that engine speed is greater than Input Shaft Speed by over 150 RPM and remains at 50 RPM or higher for 1.3 seconds.

Fallback

FMI 10

- “F” flashes in gear display.
- Service light flashes (if equipped).
- During a slip event the engine torque will be decreased.

Conditions to Set Fault Code Inactive

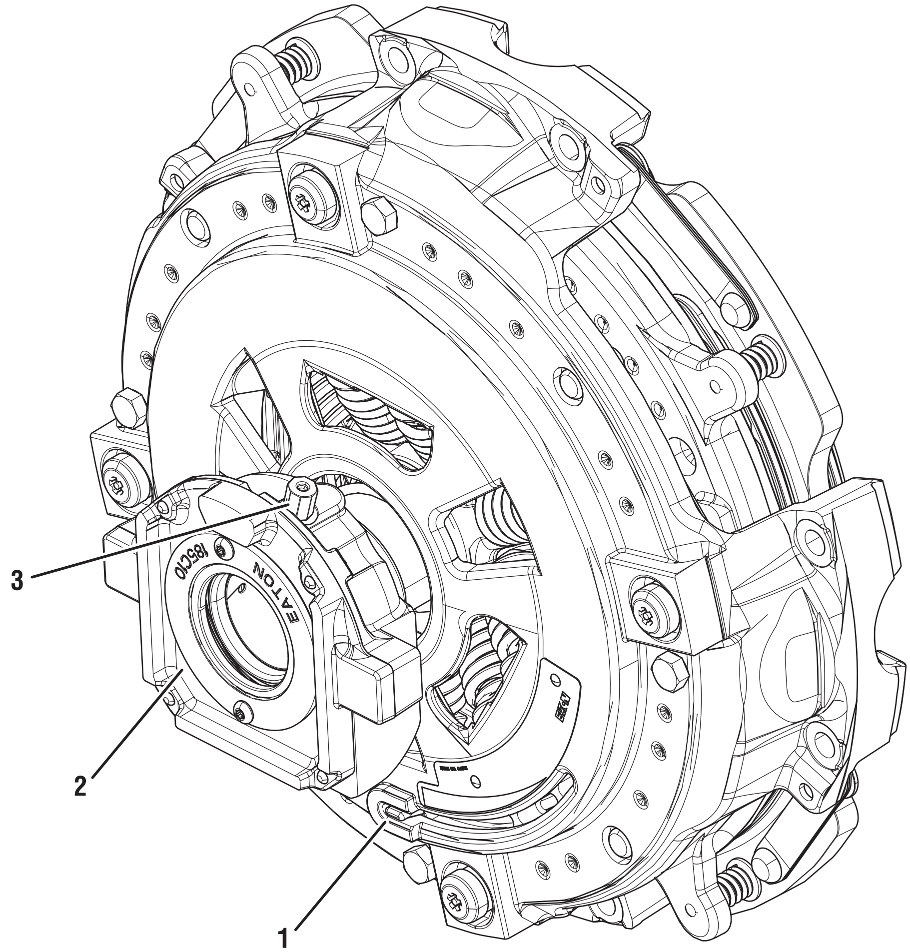
FMI 10: Ignition key is turned off and TECU is powered down.

Possible Causes

FMI 10

- Clutch
  - Excessive release bearing greasing
  - Contamination from oil leaks
  - Wear or damage
  - Damage due to excessive abuse
  - Clutch adjustment mechanism not functioning properly.
  - Clutch worn out
- OEM Engine
  - Intermittent loss of engine speed over the J1939 data link

Component Identification



Eaton ECA Clutch
1. Clutch Wear Tab
2. Release Bearing
3. Release Bearing Grease Zerk

Fault Code 26 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Set parking brake and chock wheels.
3. Key on with engine running. Run engine for 2 minutes.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes and FMIs and their occurrences and timestamps.
6. Retrieve and record fault codes from the engine, ABS, and other vehicle systems using the OEM-specific diagnostic scan tool.

Important: If an issue with the J1939 Data Link is present this fault can be set falsely.

- If non-transmission fault codes related to the J1939 Data Link are present, troubleshoot per OEM guidelines.
- If transmission Fault Code 35, Fault Code 36 or Fault Code 64 are present, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
- If Fault Code 26 is Active or Inactive, go to **Step B.**

B

Purpose: *Verify Inertia Brake Touch Point Delta (IBkTp Delta).*

1. Key on with engine off.
2. With ServiceRanger connected, select "Vehicle Data Monitor."
3. Select "J1939 Clutch Actuator" and review figure under "Clutch Inertia Brake TP Delta." Record this figure in table.
   - If readings are greater than 27°, go to **Step D.**
   - If readings are 27° or less, go to **Step C.**

Parameter	Range	Reading(s)
Clutch Inertia TP Delta	27°	

C Purpose: *Inspect condition of the clutch.*

1. Key off.

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

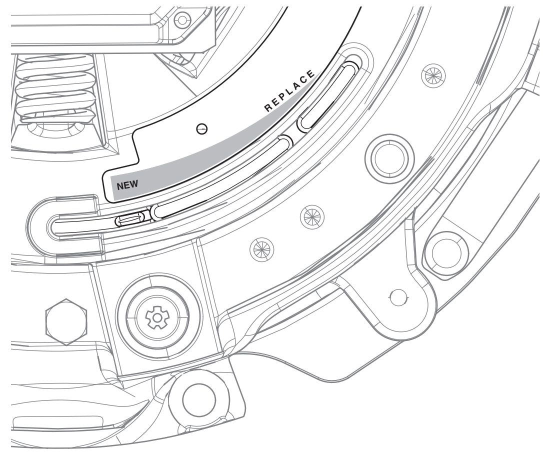
2. Remove single bolt for clutch housing access cover.
3. Inspect inside clutch housing for signs of oil or grease contamination.

Important: If the Release Bearing is over-greased, this could cause grease to purge out of the front of the Release Bearing and be drawn into the clutch causing a slipping complaint. Refer to CLSM0200 for proper lubrication procedures.

4. Inspect for broken clutch or spring material and other signs of a clutch failure.
5. Document any damage or failures with pictures.
   - If physical signs of a clutch failure are present, replace Heavy-Duty ECA Clutch. Go to **Step V.**
   - If grease contamination is found, road test truck to remove grease build up. Go to **Step V.**
   - If oil contamination is found, locate and correct cause of oil leak. Go to **Step V.**
   - If no issues are found in clutch housing, go to **Step D.**

D Purpose: *Verify wear tab position on the Heavy Duty ECA Clutch.*

1. Key off.
2. Check the position of the Wear Tab located on the clutch cover assembly.



- If Wear Tab is in the “Replace” position, replace Heavy Duty ECA Clutch. Go to **Step V.**
- If Wear Tab is not in the “Replace” position, go to **Step E.**

E ***Purpose:*** *Reset Heavy Duty ECA Clutch.*

1. Key on with engine on.

Caution: Keep hands and fingers clear of clutch housing when engine is running.

2. Ensure the park brake is set and ServiceRanger is connected.
3. Connect ServiceRanger.
4. In ServiceRanger, select “Service Routines”.
5. Start “Clutch Service Utility”.

Important: If ServiceRanger is unsuccessful in resetting the HD ECA Clutch, retry Step E again to attempt a successful reset.

6. Select “Clutch Adjustment” tab.
7. Perform clutch reset by selecting “Request Clutch Adjustment”.
8. Perform multiple vehicle launches to complete clutch adjustment procedure.
   - If clutch was successfully adjusted, test complete. Go to **Step V.**
   - If clutch was unsuccessfully adjusted after multiple attempts, replace HD ECA Clutch. 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. 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 codes set and vehicle operates properly, test complete.
   - If Fault Code 26 sets Active during the test drive, contact Eaton at (800) 826-4357 for further diagnostics.
   - If a fault code other than 26 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 27: Clutch Disengagement

J1587: MID 130 SID 55 FMI 7, 13
J1939: SA 3 SPN 522 FMI 7, 13

Overview

The UltraShift *PLUS* Transmission receives torque input through the clutch. The amount of torque being transferred through the clutch is controlled by the Electronic Clutch Actuator (ECA), which moves the Clutch Yoke, thereby opening and closing the clutch.

The Transmission Electronic Control Unit (TECU) monitors engine speed and Input Shaft speed to determine proper clutch operation. The TECU sends requests to the ECA to open or close the clutch during vehicle operation. If the ECA position is below the required value or the Input Shaft speed indicates a lack of separation from engine speed with the clutch commanded open, the system sets Fault Code 27.

Detection

The system can detect clutch disengagement faults under the following conditions:

- TECU indicates the ECA is open but the Input Shaft speed has not separated from engine speed.
- Inertia Brake Touch Point Delta (IBkTp Delta) value is below the required value.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: TECU detects clutch disengagement fault when one of the following conditions occurs:

- The transmission detects the Low Capacity Inertia Brake (LCIB) has not slowed the Input Shaft when applied. This is defined as Input Shaft speed within 50 RPM of engine speed for 1 second while the LCIB is applied.
- The transmission detects torque and Input Shaft speed when the clutch is being held open. This is defined as calculated engine torque greater than 400 Nm (295 ft-lbs) and Input Shaft speed within 50 RPM of engine speed for 1 second.
- Inertia Brake Touch Point Delta (IBkTp Delta) value is less than the default of 16° (as seen in ServiceRanger “Data Monitor”).

FMI 13 – Out of Calibration: A Clutch Calibration is required.

Fallback

All FMIs

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

Conditions to Set Fault Code Inactive

FMI 7: The system sets the fault code Inactive under the following conditions:

- Input Shaft speed and engine speed differ by greater than 50 RPM for 1 second.
- Inertia Brake Touch Point Delta (IBkTp Delta) goes above 16°.
- Inertia Brake Touch Point Delta (IBkTp Delta) goes above 16°.

FMI 13:

- A Clutch Calibration has been performed after a new TECU installation.

Possible Causes

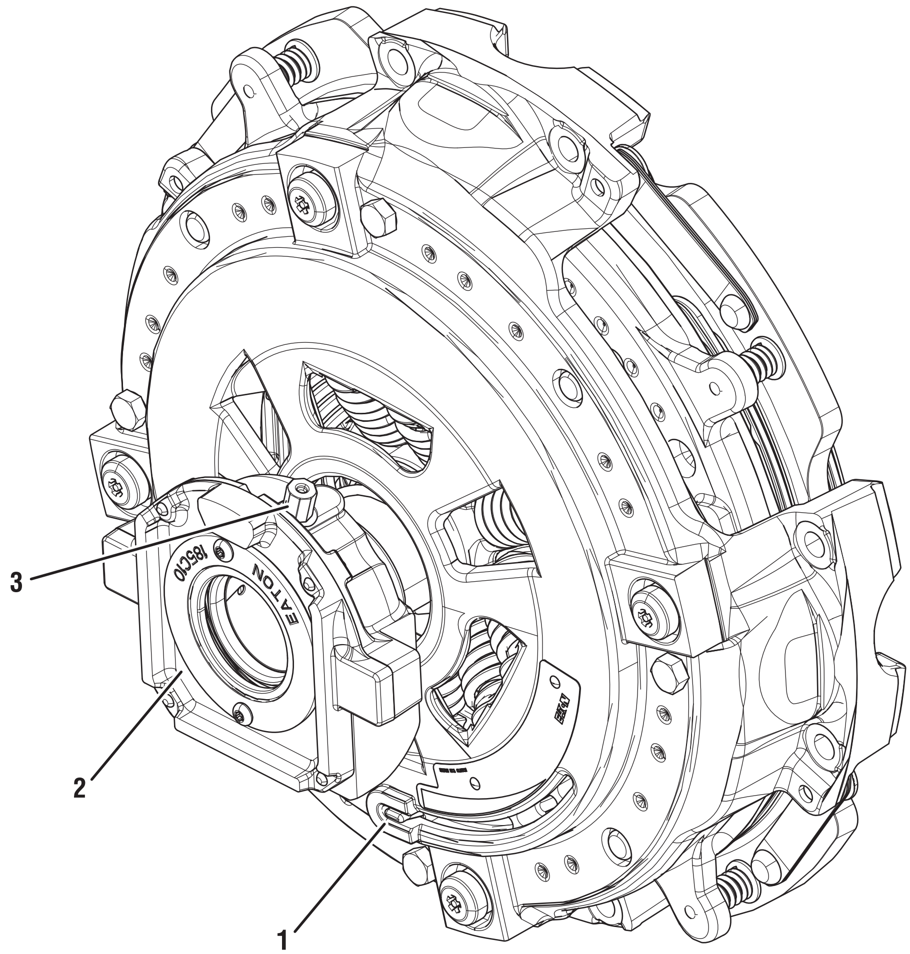
FMI 7

- Engine
  - Excessive Crankshaft play
- Clutch
  - Over-adjustment
  - Excessive abuse or damage
  - Release Bearing failure
  - Lack of lubricant in Release Bearing or Cross Shaft Assembly
  - Improper removal or installation
  - Shipping bolts not removed during installation
- Input Shaft
  - Excessive wear or damage
  - Pilot Bearing failure
- ECA
  - Internal failure

FMI 13

- A Clutch Calibration was not completed after a new TECU was installed

Component Identification



Eaton ECA Clutch
1. Clutch Wear Tab
2. Release Bearing
3. Release Bearing Grease Zerk

Fault Code 27 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.

   Note: The Adjust Clutch (Clutch Calibration) Service Routine is only required after completing an In-Vehicle Reset Procedure, replacing the Heavy-Duty ECA Clutch or installing a new TECU.

   - If Fault Code 27 FMI 7 is set and a new TECU was just installed, go to **Step F.**
   - If Fault Code 64, 66 or 67 is Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 27 FMI 7 is set and a new TECU was not just installed, go to **Step B.**
   - If Fault Code 27 FMI 13 is Active, go to **Step F.**
   - If Fault Code 27 FMI 13 is Inactive, a Clutch Calibration has been performed. Clear fault codes using ServiceRanger, test complete.

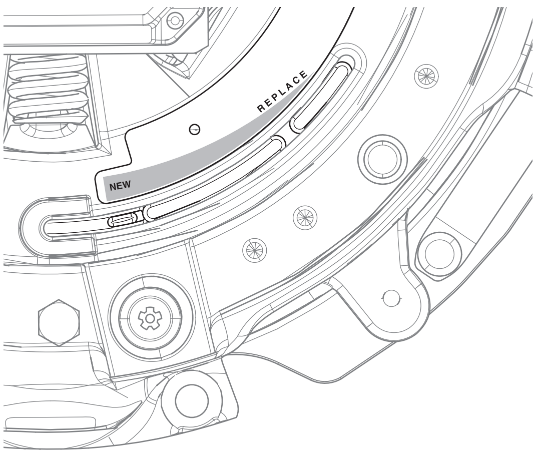
B

Purpose: *Inspect condition of clutch.*

1. Key off.
2. Remove single bolt for clutch housing access cover.
3. Inspect for excessive clutch dust, broken clutch or spring material, or other signs of clutch failure.
4. Ensure Release Bearing and Cross Shaft are properly greased per *Heavy-Duty Clutch Service Manual* (CLSM0200).
   - If no issues are found and properly greased, go to **Step C.**
   - If physical signs of a clutch failure are present, replace Heavy-Duty ECA Clutch. Go to **Step V.**

C ***Purpose:*** *Check wear tab position on the Heavy-Duty ECA Clutch.*

1. Key off.
2. Check the Wear Tab position located on the clutch cover assembly.



Caution: The Heavy-Duty ECA Clutch must always be caged (shipping bolts installed) while installing or removing the clutch. If clutch is not caged properly, permanent damage will occur. Replacement will be required. See the *Heavy-Duty Clutch Service Manual* (CLSM0200) for proper removal and installation procedures.

Important: Issues such as Pilot Bearing failures, excessive torsional vibration, excessive Flywheel run-out or clutch abuse can cause premature clutch failures. It is recommended that the Pilot Bearing and LCIB be replaced whenever the clutch is replaced. Refer to the *Eaton UltraShift® PLUS Transmission Installation Guide* (TRIG1110) for a list of recommended Pilot Bearings.

- If Wear Tab is in the “Replace” position, replace Heavy-Duty ECA Clutch. Go to **Step V.**
- If Wear Tab is not in the “Replace” position, go to **Step D.**

D ***Purpose:*** *Verify Clutch Inertia Brake Touch Point Delta using ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From the “Default Parameter Files” tab, select “J1939 Clutch Actuator”.
5. Monitor 520214 - Clutch inertia brake TP delta. Record reading in table.

Important: Engine crankshaft end play above the manufacturer's specification can affect Clutch Inertia Brake TP Delta Value. Ensure the engine is not experiencing symptoms that indicate excessive crankshaft end play.

6. Compare reading(s) in table.
   - If Clutch Inertia Brake TP Delta Value is less than 16.5° (degrees), retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger and select “Send to Eaton”. Go to **Step E.**
   - If Clutch Inertia Brake TP Delta Value is equal to or greater than 16.5° (degrees), retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger and select “Send to Eaton”. Replace the ECA, go to **Step V.**

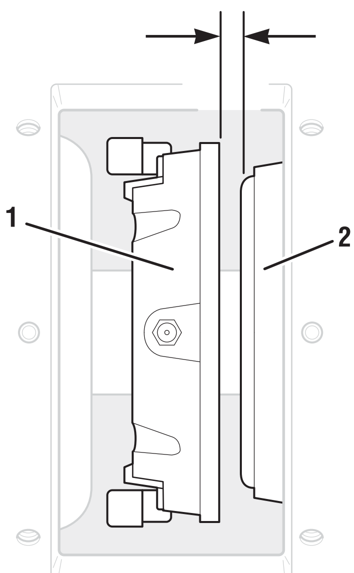
Parameter	Range	Reading(s)
520214-Clutch inertia brake TP delta	16.5°	

E ***Purpose:*** *Measure release bearing and Low Capacity Inertia Brake distance.*

1. Through the clutch housing access cover, compress and hold the Low Capacity Inertia Brake (LCIB) with a pry bar.

   Note: The LCIB is required to be compressed while measuring the distance between the release bearing and LCIB.

2. Measure the distance between the release bearing (1) and LCIB (2). Record measurement in table.



3. Compare reading(s) in table.
   - If reading is less than 0.490 inches (12.45 mm), replace the Heavy-Duty ECA Clutch, go to **Step V.**
   - If reading is equal to or greater than 0.490 inches (12.45 mm), replace the ECA, go to **Step V.**

Release Bearing and LCIB Distance	Measurement
0.490” (12.45 mm)	

F ***Purpose:*** *Perform Adjust Clutch (Clutch Calibration) Service Routine with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Service Routines”.
4. Select “Start” Adjust Clutch and follow on-screen prompts.
5. Key off.

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

6. Key on.
7. Connect ServiceRanger.
8. Retrieve and record the transmission fault codes and FMIs and their occurrences and timestamps.
   - If Fault Code 27 is Inactive, Clutch Calibration is complete. Clear fault codes using ServiceRanger, test complete.
   - If Fault Code 27 FMI 7 is Active, go to **Step B.**

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. 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 27 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 27 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 29: Remote Throttle Enable

J1587: MID 130 SID 372 FMI 4, 5
J1939: SA 3 SPN 969 FMI 4, 5

Overview

The UltraShift *PLUS* transmission is equipped with a relay circuit that allows the throttle of the engine to be located in a remote location. The relay and associated wiring are installed by the OEM. Fault Code 29 sets when the Transmission Electronic Control Unit (TECU) detects an open or a shorted condition in the wiring between the TECU and the relay.

Detection

The TECU monitors the remote throttle enable circuit for opens or shorts. If either condition is present for 1 second or greater, the fault is set Active.

Conditions to Set Fault Code Active

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 excessive resistance in the circuit.

Fallback

Remote throttle will not function.

Conditions to Set Fault Code Inactive

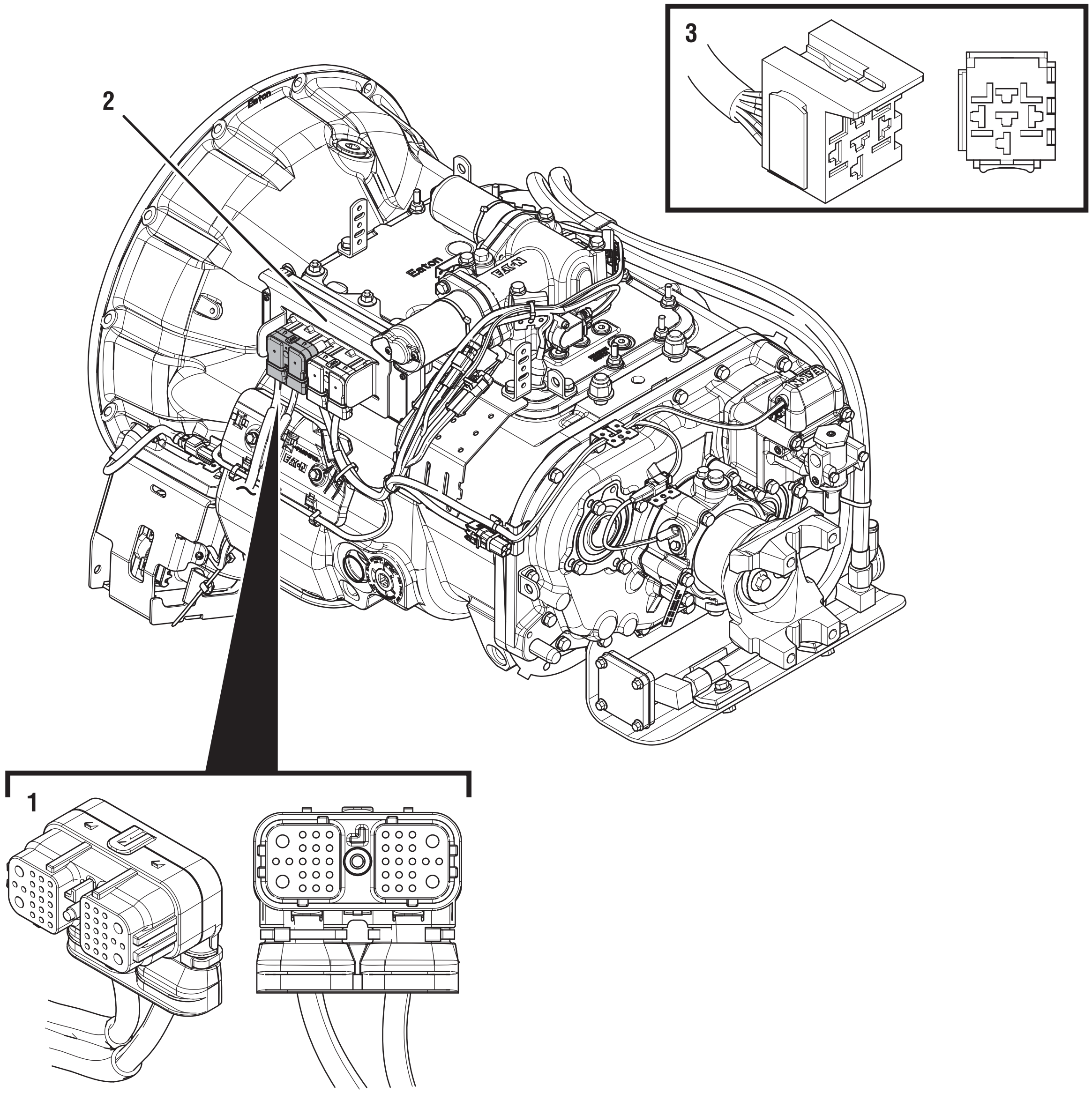
All FMIs: Short or open condition is not detected by the TECU for 2 seconds.

Possible Causes

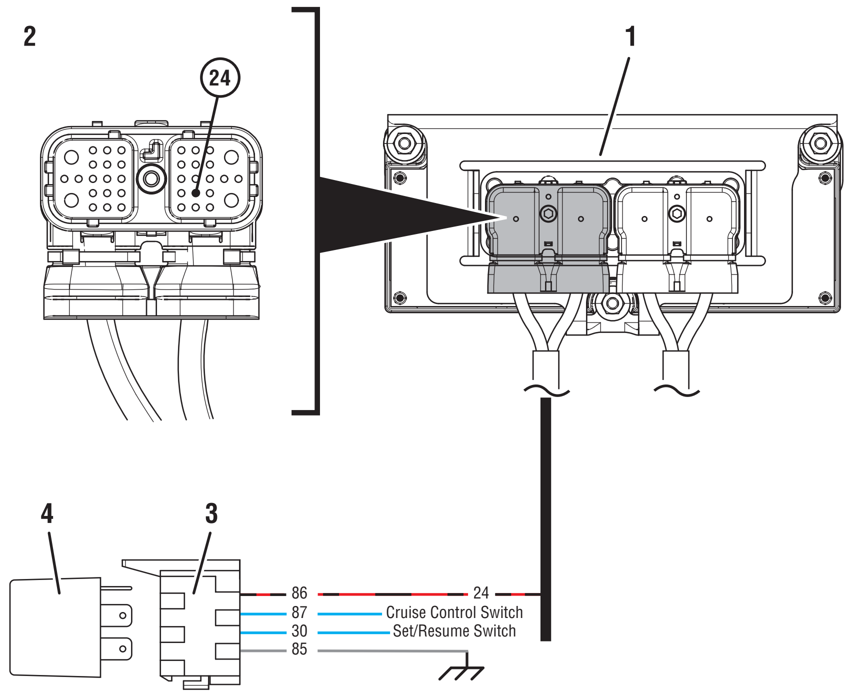
FMI 4, 5

- Vehicle Harness
  - Bent, spread, loose or corroded terminals
  - Wiring shorted to ground or open
- Remote Throttle Relay
  - Internal failure
- TECU
  - Internal failure

Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 5-Way Start Enable Relay Socket



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 5-Way Remote Throttle Enable Relay Socket
4. 5-Way Remote Throttle Enable Relay

Fault Code 29 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 29 is Active, go to **Step C.**
   - If Fault Code 29 is Inactive and there are other Active fault codes, troubleshoot all Active fault codes first.
   - If Fault Code 29 is Inactive, 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 Vehicle Harness wiring and connections between TECU and Remote Throttle Relay.

   Note: Wiring from the Remote Throttle Relay to TECU is OEM proprietary. Refer to OEM guidelines for proper repair or replacement procedures and proper wiring schematics and pin out locations.
4. Exit PD Mode by powering down.

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

- If any fault became Active while wiggling wires in the system, refer to OEM guidelines for repair or replacement of wiring between TECU and Remote Throttle Relay. Go to **Step V.**
- If no fault codes became Active, go to **Step C.**

C

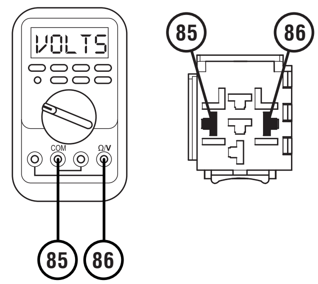
Purpose: *Inspect relay wiring and socket condition.*

1. Key off.
2. Remove Remote Throttle Relay from socket.
3. Inspect Remote Throttle Relay Socket and wiring for damage or bent, spread, corroded or loose terminals.
   - If no issues are found, go to **Step D.**
   - If any issues are present, refer to OEM guidelines for repair or replacement of wiring of Remote Throttle Enable Relay circuit. Go to **Step V.**

D

Purpose: *Verify power supply to relay.*

1. Key on with engine off.
2. Measure voltage between Remote Throttle Relay socket Pin 86 (power) and Pin 85 (ground). Record reading(s) in table.

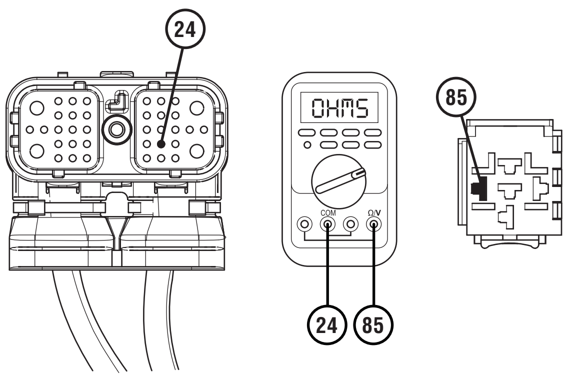


3. Compare reading(s) in table.
   - If readings are out of range, go to **Step E.**
   - If readings are in range, refer to OEM guidelines for replacement of the Remote Throttle Relay. Go to **Step V.**

Pins	Range	Reading(s)
86 to 85	Within 1.5 V of Battery Voltage	

E ***Purpose:*** *Verify continuity of Remote Throttle Relay Circuit wiring between TECU and the relay.*

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Disconnect Remote Throttle Relay from socket.
4. Measure resistance between 38-Way Connector Pin 24 and Relay Socket Pin 85. Record reading(s) in table.



5. Compare reading(s) in table.
   - If readings are in range, replace TECU. Go to **Step V.**
   - If readings are out of range, repair or replace wiring between the 38-Way Vehicle Harness Connector and Remote Throttle Relay per OEM guidelines. Go to **Step V.**

Pins	Range	Reading(s)
24 to 85	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 engine 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 29 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 29 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 33: Low Battery Voltage Supply

J1587: MID 130 PID 168 FMI 4
J1939: SA 3 SPN 168 FMI 4

Overview

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).
- Engine may not crank.
- 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 engine with transmission in gear.

Conditions to Set Fault Code Inactive

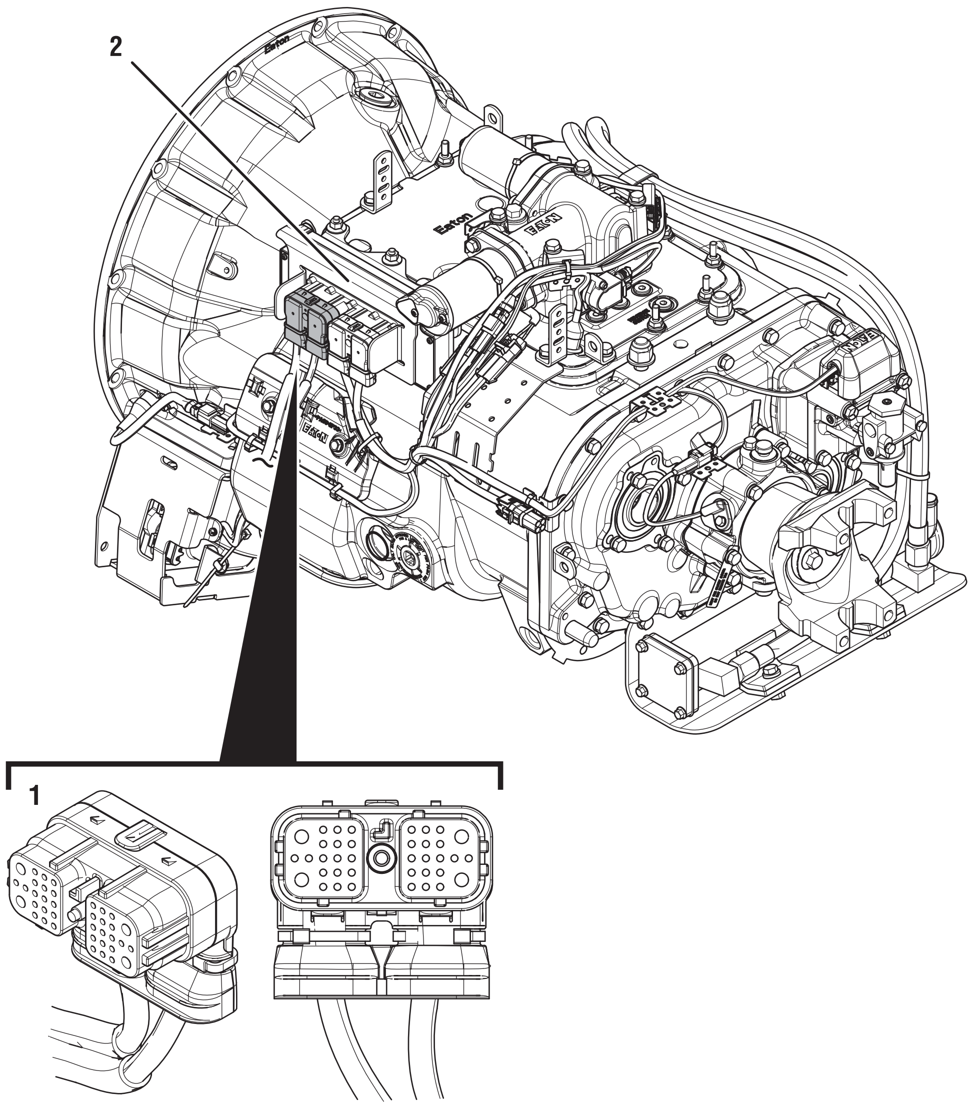
FMI 4: Battery voltage stays at 7 volts or greater for more than 1 second.

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.

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

2. Measure voltage across all batteries. Record voltage in table.
3. Inspect Starter, 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. 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.

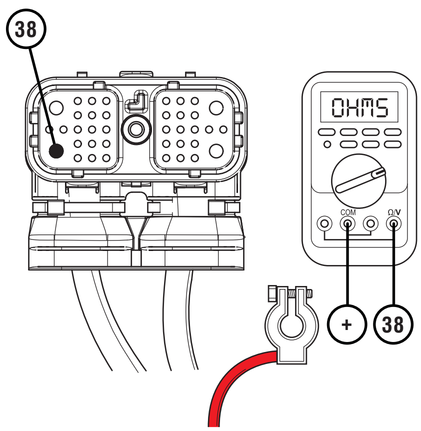
3. Wiggle wiring and connections of the Vehicle Harness from the batteries to the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

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

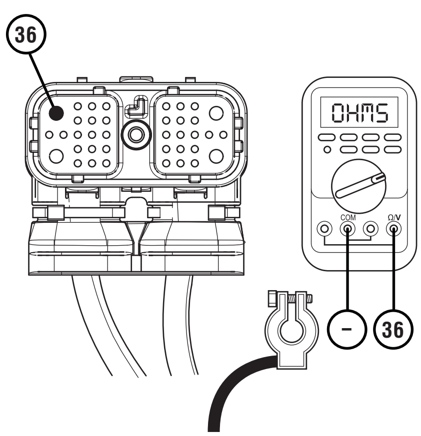
- If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of Vehicle Harness wiring. Go to **Step V.**
- If no fault codes set Active, go to **Step E.**

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.



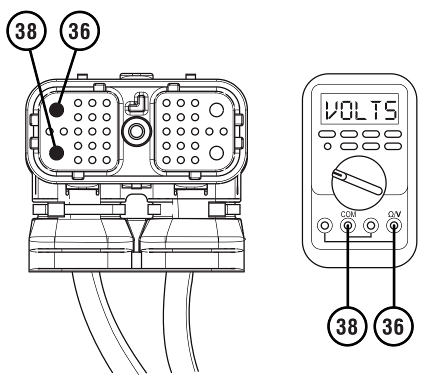
7. Compare reading(s) in table.
   - If readings are in range, no problem was identified. Test complete. If additional troubleshooting is required, contact the OEM for additional diagnosis of the Vehicle Power Supply Harness. Go to **Step V.**
   - If readings are out of range, repair or replace damaged 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 engine 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 engine off.
4. Connect ServiceRanger and check fault codes.
   - If Fault Code 33 remains Active with all connections re-established, replace 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 engine 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 13.

Fault Code 34: Weak Battery Voltage Supply

J1587: MID 130 PID 168 FMI 14
J1939: SA 3 SPN 168 FMI 14

Overview

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

- Engine may not crank.
- 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 engine with transmission in gear.

Conditions to Set Fault Code Inactive

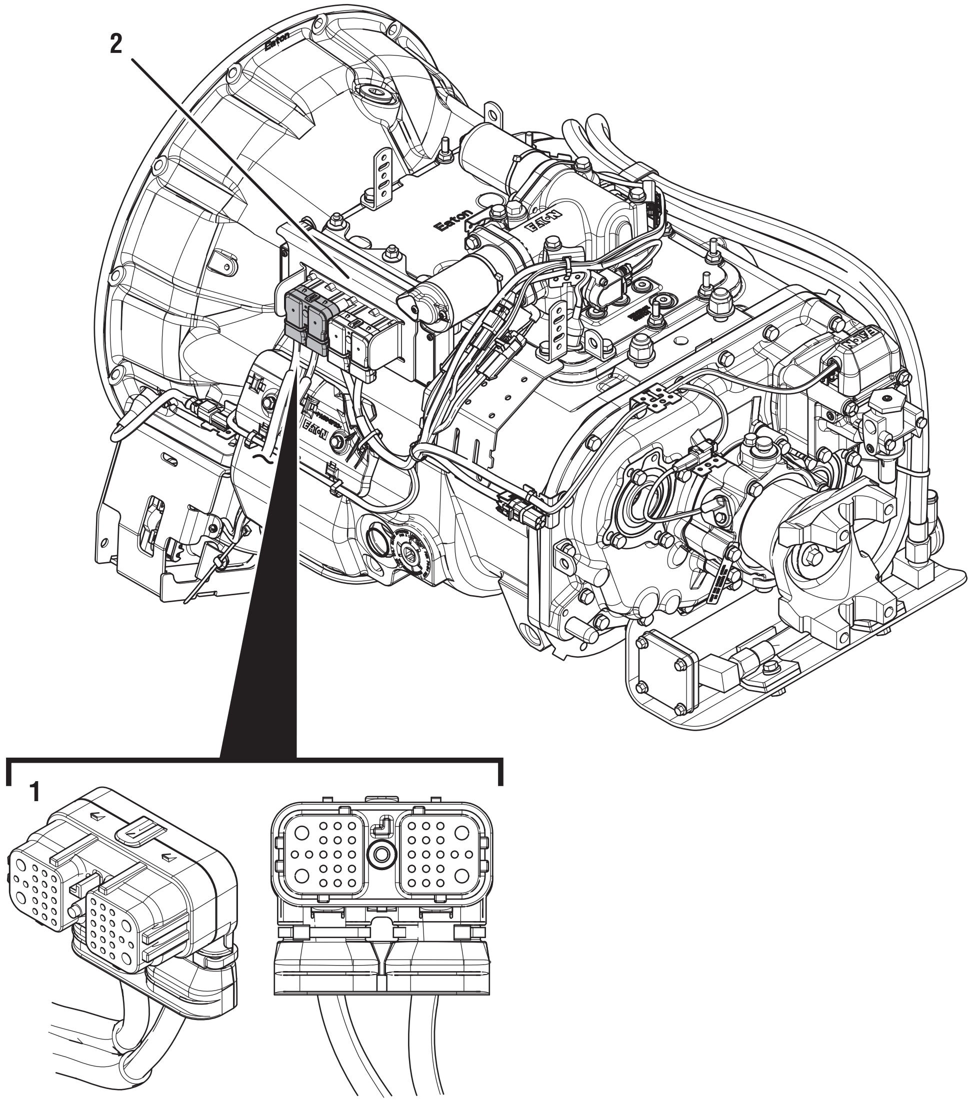
FMI 14: Battery voltage stays at 9 volts or greater for at least 20 seconds.

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.

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

2. Measure voltage across all batteries. Record voltage in the table.
3. Inspect Starter, 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. 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.

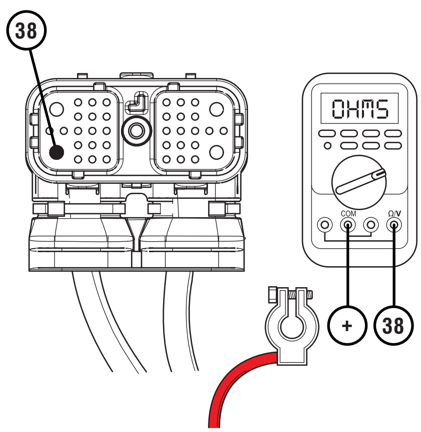
3. Wiggle wiring and connectors of the Vehicle Harness from the batteries to the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

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

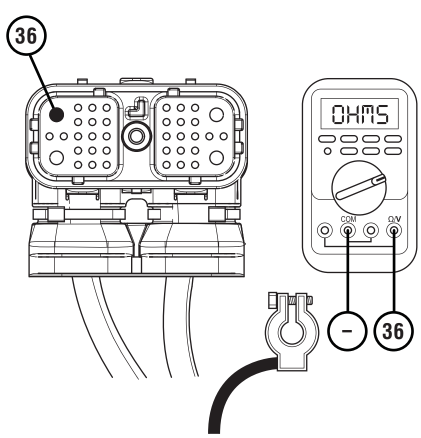
- If any fault sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of Vehicle Harness wiring. Go to **Step V.**
- If no fault codes set Active, go to **Step E.**

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.

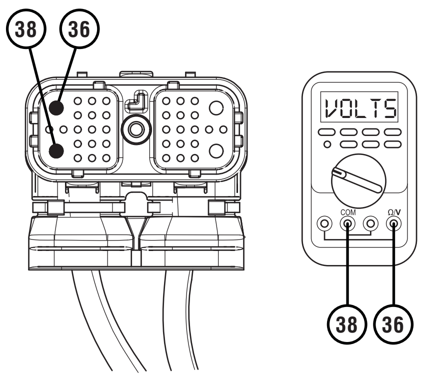


7. Compare reading(s) in table.
   - If readings are in range, no problem was identified. Test complete. If additional troubleshooting is required, contact the OEM for additional diagnosis of the Vehicle Power Supply Harness. Go to **Step V.**
   - If readings are out of range, repair or replace damaged 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 engine 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 engine off.
4. Connect ServiceRanger and check fault codes.
   - If Fault Code 34 remains Active with all connections re-established, replace 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 engine 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 13.

Fault Code 35: J1939 Communication Link

J1587: MID 130	**SID 231**	**FMI 2**
J1939: SA 3	**SPN 639**	**FMI 2**

Overview

The J1939 Data Link is a Controller Area Network (CAN) communication bus. The UltraShift *PLUS* transmission uses the J1939 Data Link to communicate with other ECUs (ABS, Engine, 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 engine torque 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 5 seconds or longer.

Fallback

FMI 2

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If vehicle is configured for the J1939 Start Enable feature the engine does not crank.
- 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

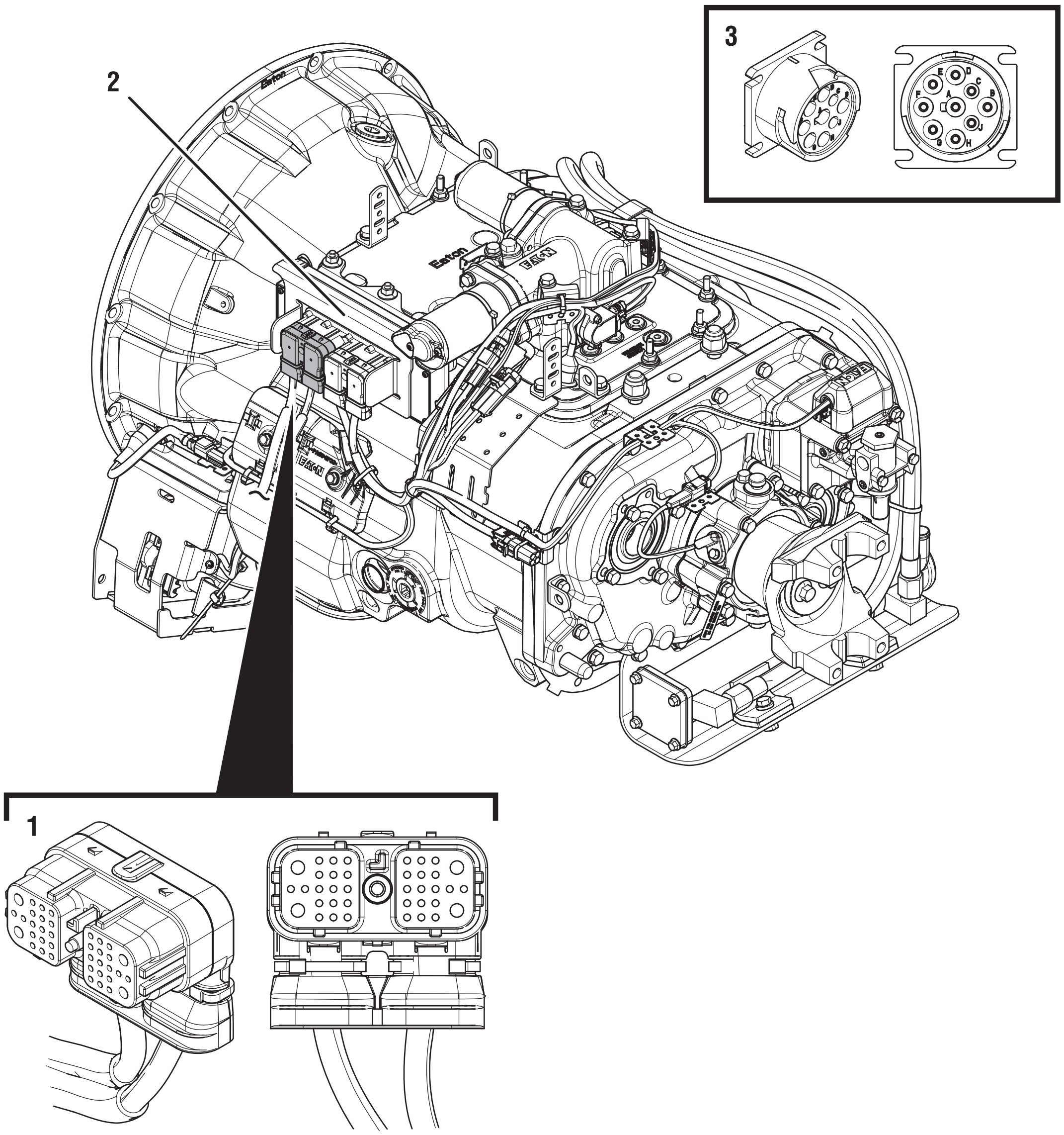
FMI 2: TECU receives messages across the data link for at least 10 seconds.

Possible Causes

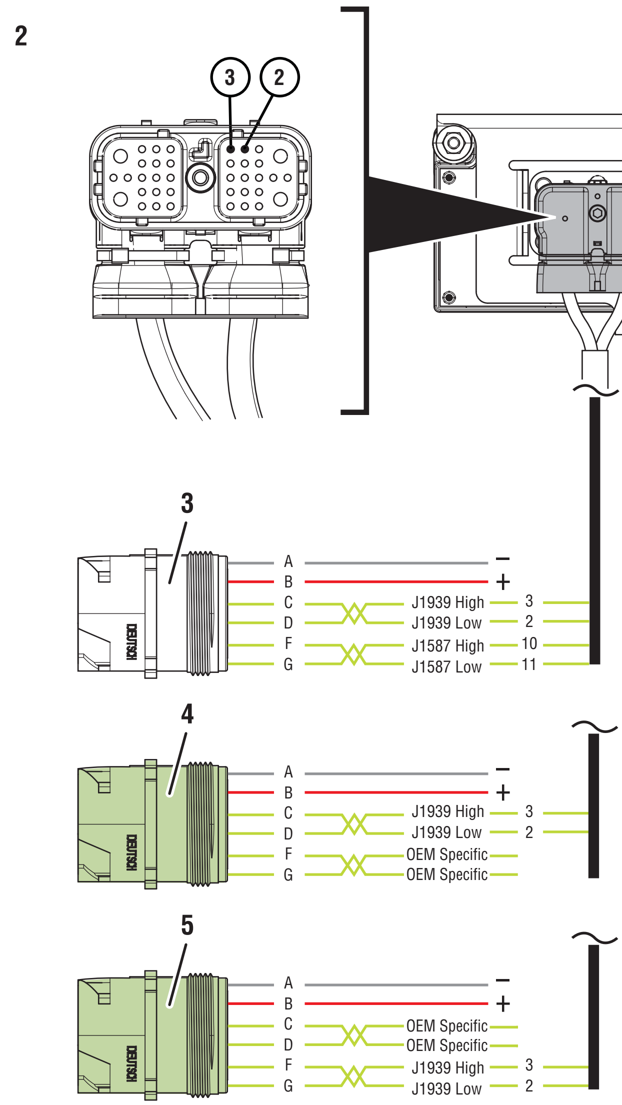
FMI 2

- 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)
5. 9-way Diagnostic Connector (Green) - OEM Specific FG (in cab)

Fault Code 35 Troubleshooting

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

1. 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 13.
   - 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.**
   - If Green 9-Way Diagnostic Connector on Pin F and Pin G, go to **Step H.**

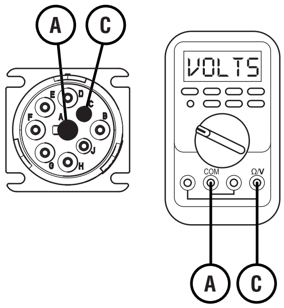
D

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

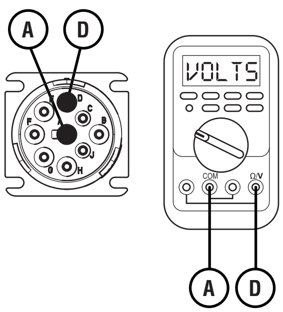
1. Key off.
2. If vehicle is equipped with a Bulkhead Connection, inspect Bulkhead Connector for corrosion, loose terminals, and bent or spread pins.
3. Wiggle wiring connections to the Bulkhead Connector to verify the pins are not loose and are secure within the connector.
   - If no Bulkhead Connection 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 engine 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.**

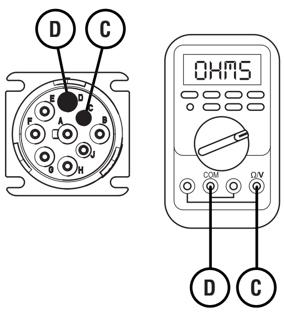
Pins	Range	Reading(s)
C to A	N/A	
D to A	N/A	+
Total Voltage	4.5–5.5 V	=

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.



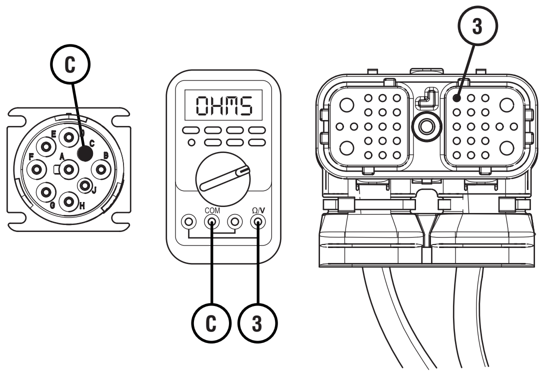
3. Compare reading(s) in table.
   - If readings are in range, go to **Step G.**
   - If readings are out of range, an issue is present on the vehicle J1939 Data Link. Refer to OEM guidelines for repair or replacement of terminating resistors, ECUs or data link wiring. Go to **Step V.**

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

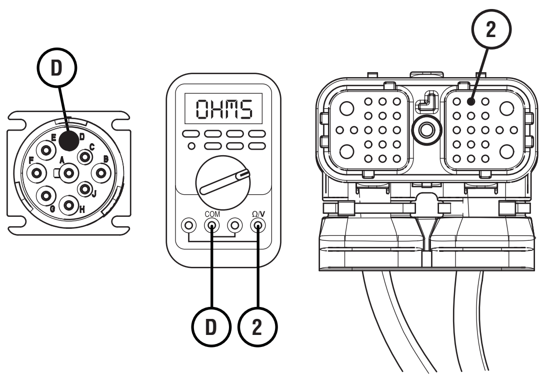
G

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 L.**
   - 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	

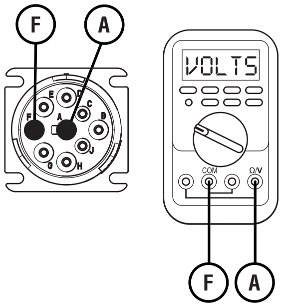
H

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

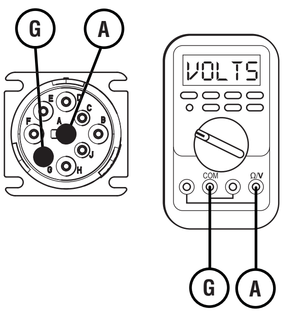
1. Key off.
2. If vehicle is equipped with a Bulkhead Connection, inspect Bulkhead Connector for corrosion, loose terminals, and bent or spread pins.
3. Wiggle wiring connections to the Bulkhead Connector to verify the pins are not loose and are secure within the connector.
   - If no Bulkhead Connection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

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

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



3. Measure voltage between 9-Way Diagnostic Connector Pin G 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 J.**
   - 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.**

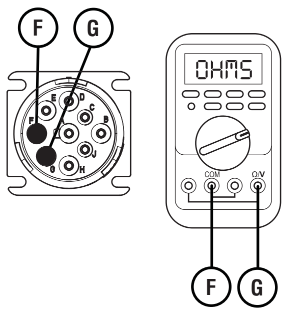
Pins	Range	Reading(s)
F to A	N/A	
G to A	N/A	+
Total Voltage	4.5–5.5 V	=

J ***Purpose:*** *Verify proper resistance 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 F and Pin G. Record reading(s) in table.



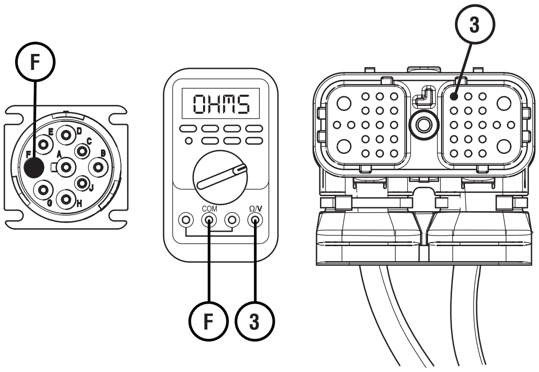
3. Compare reading(s) in table.
   - If readings are in range, go to **Step K.**
   - If readings are out of range, an issue is present on the J1939 Data Link. Refer to OEM guidelines for repair or replacement of terminating resistors, ECUs or data link wiring. Go to **Step V.**

Pins	Range	Reading(s)
F to G	50–70 ohms	

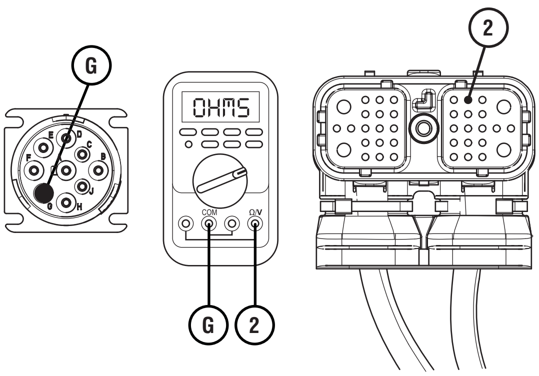
K

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 F and 38-Way Vehicle Harness Connector Pin 3. Record reading(s) in table.



4. Measure resistance between 9-Way Diagnostic Connector Pin G 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 L.**
   - 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)
F to 3	0.0–0.3 ohms	
G to 2	0.0–0.3 ohms	

L

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 engine 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 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 engine 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 13.

Fault Code 36: J1939 Engine Message

J1587: MID 130 SID 231 FMI 14
J1939: SA 3 SPN 639 FMI 14

Overview

The J1939 Data Link is a Controller Area Network (CAN) communication bus. The UltraShift *PLUS* transmission uses the J1939 Data Link to communicate with other ECUs (ABS, Engine, 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 engine torque to make shifts, as well as other functions. Proper operation of the J1939 Data Link is critical for shift performance. Fault Code 36 indicates the TECU can communicate with other ECUs on the J1939 Data Link but has lost communication with the Engine ECU.

Detection

TECU has either lost communication or received erratic signals from the Engine ECU 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 14 – Special Instructions: TECU has either lost communication or has received erratic signals from the Engine ECU over the J1939 Data Link for 5 seconds or longer.

Fallback

FMI 14

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If vehicle is configured for the J1939 Start Enable feature the engine does not crank.
- 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

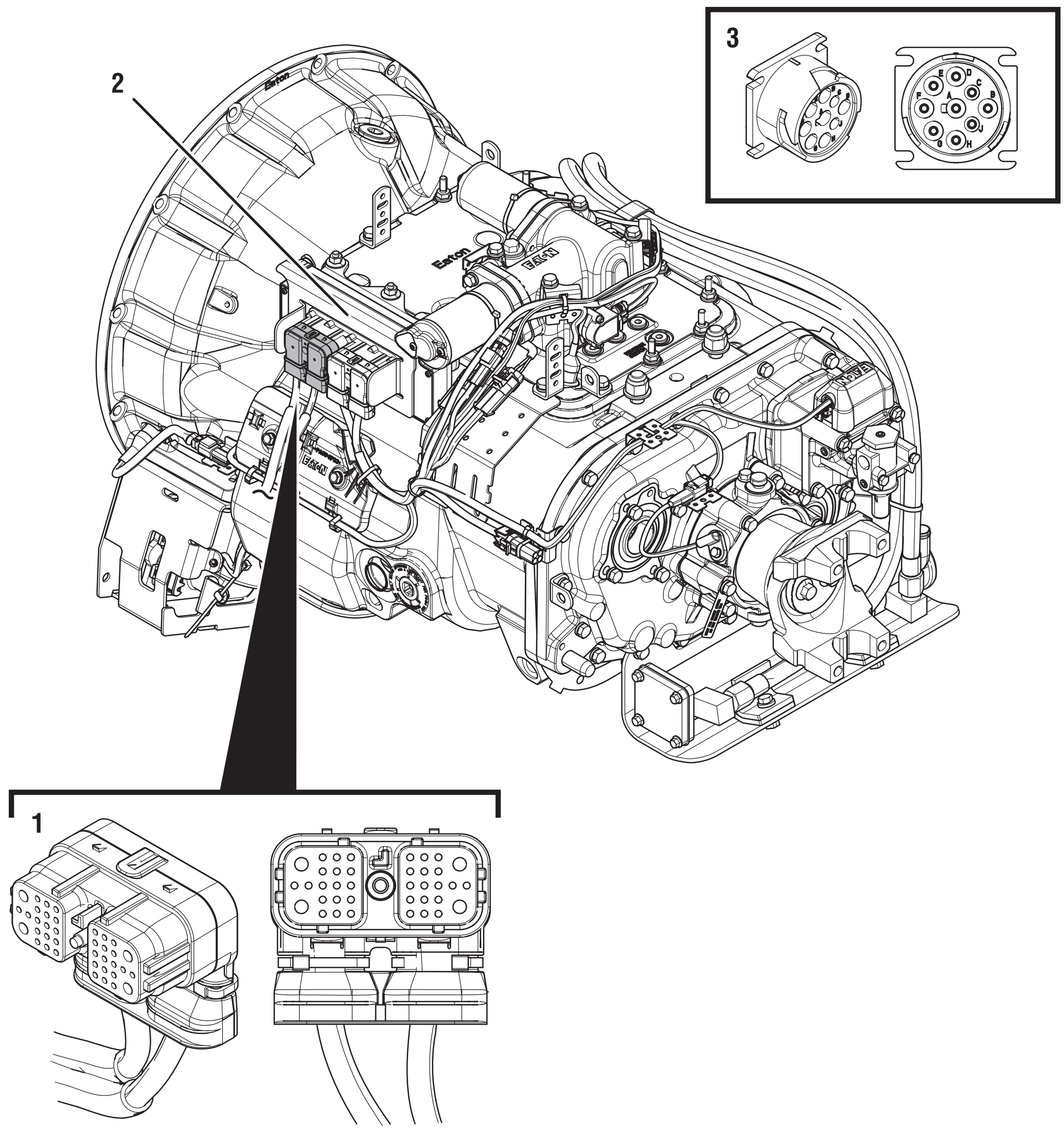
FMI 14: TECU receives messages across the data link for at least 10 seconds.

Possible Causes

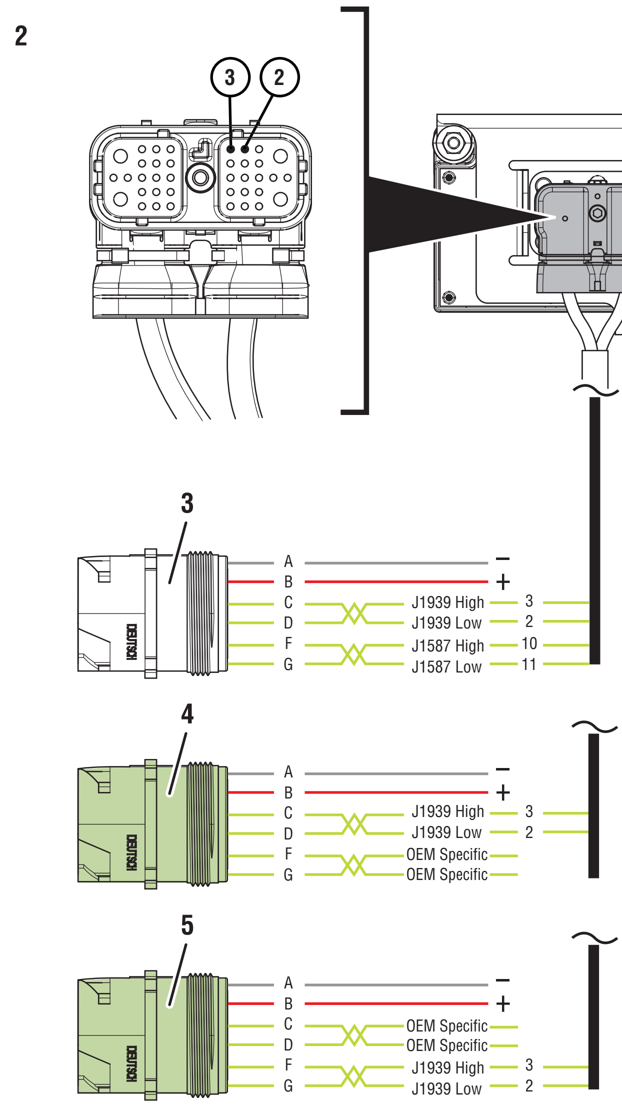
FMI 14

- J1939 Data Link
  - Wiring shorted to ground, shorted to power or open
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Engine ECU
  - Internal failure
- Vehicle Harness
  - Wiring shorted to ground, shorted to power or open
- Engine 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)
5. 9-way Diagnostic Connector (Green) - OEM Specific FG (in cab)

Fault Code 36 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

   Note: Fault Code 36 indicates an issue with communication over the J1939 data link between the Engine ECU and the Transmission TECU. All wiring and pin outs for connectors are OEM proprietary. Refer to OEM guidelines for proper documentation.

   - If Fault Code 36 is Active, go to **Step C.**
   - If Fault Code 36 is Inactive, and there are other Active fault codes, troubleshoot all other Active fault codes first per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 36 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 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.**
   - If Green 9-Way Diagnostic Connector on Pin F and Pin G, refer to OEM guidelines for diagnosing a communication issue between the Engine ECU and TECU.

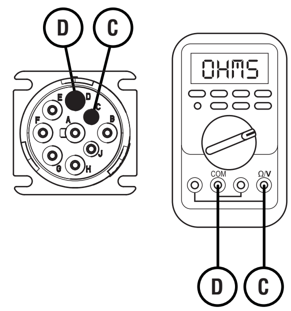
D

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.**

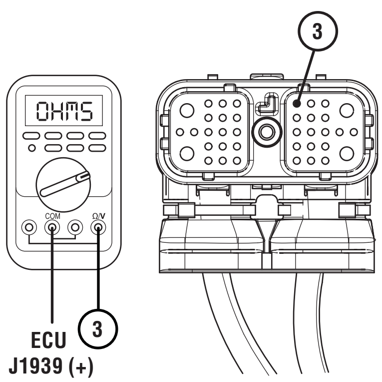
Pins	Range	Reading(s)
C to D	50–70 ohms	

E ***Purpose:*** *Verify connection across J1939 Positive Pin (+) between Engine ECU and 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 Engine ECU Harness Connector from the Engine ECU. 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 Engine ECU Connector. Record reading(s) in table.



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

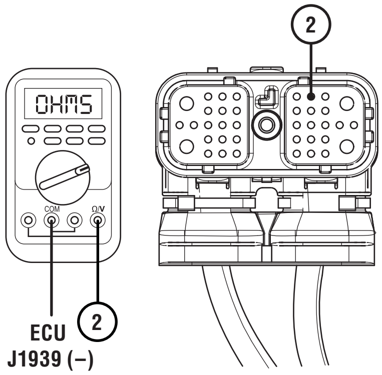
5. Compare reading(s) in table.
   - If readings are in range, go to **Step F.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**

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

F

Purpose: *Verify connection across J1939 Negative Pin (-) between Engine ECU and TECU.*

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



Note: Refer to OEM guidelines for location of Engine ECU 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 Engine 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 engine 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 36 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 36 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 37: Power Connect

J1587: MID 130	**SID 251**	**FMI 5**
J1939: SA 3	**SPN 627**	**FMI 5**

Overview

The UltraShift *PLUS* transmission is equipped with electronic components that require a high current. 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 or starter) 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

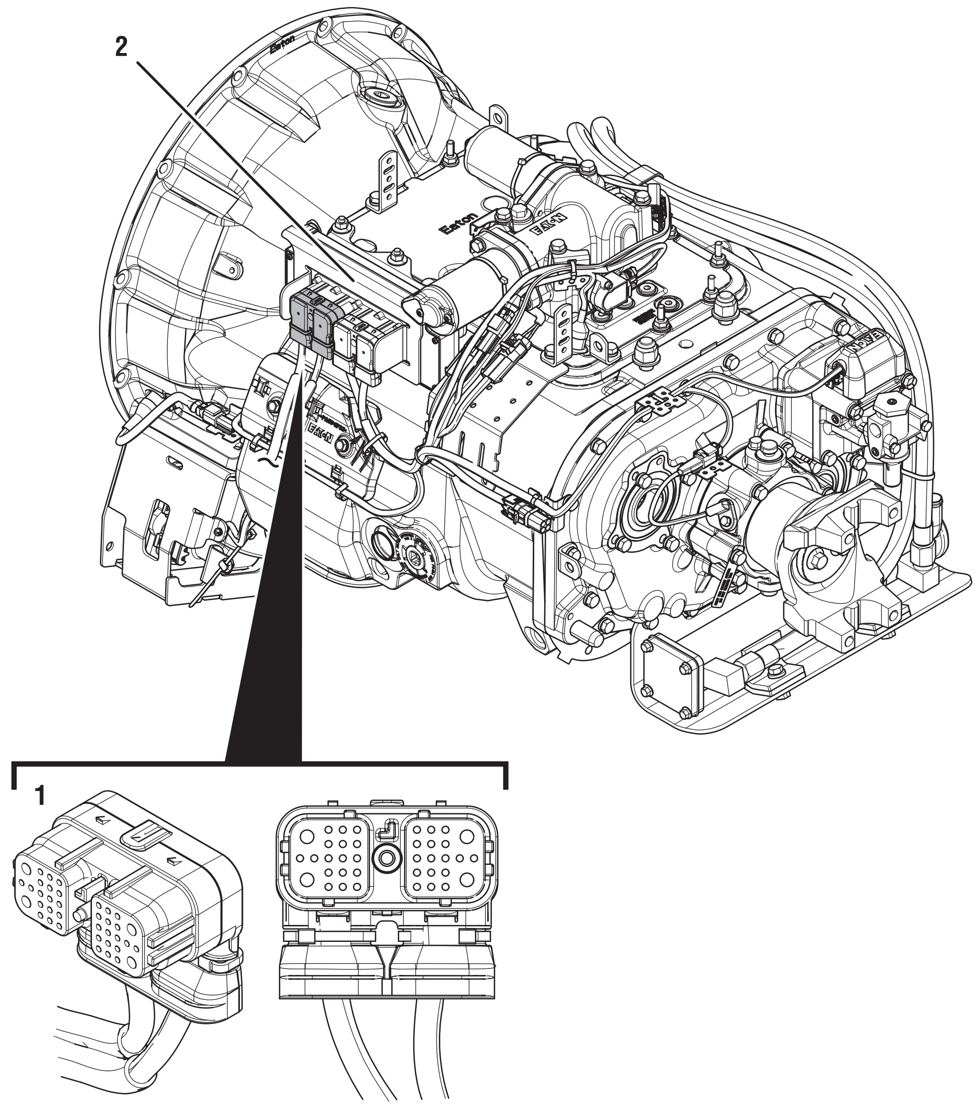
TECU calculates a resistance value below 0.4 ohms.

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.

Important: 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 13.
- 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 starter, 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 or may route power and ground to the starter. 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.

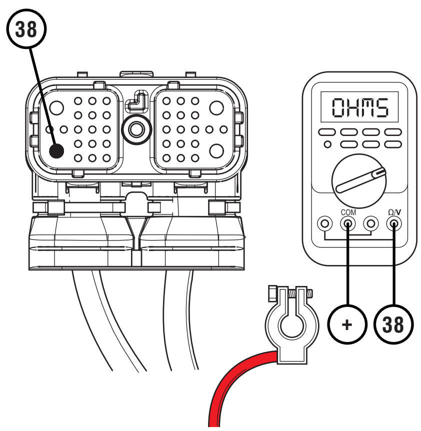
Important: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

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.**

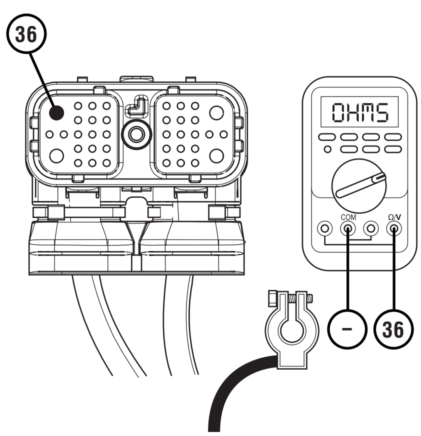
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

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 engine 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 13.

Fault Code 41: Range Failed to Engage

J1587:	**MID 130**	**SID 35**	**FMI 7**
	MID 130	**SID 36**	**FMI 7**
J1939:	**SA 3**	**SPN 768**	**FMI 7**
	SA 3	**SPN 769**	**FMI 7**

Overview

Most Heavy-Duty UltraShift *PLUS* Transmission models are equipped with a 2-speed range system in the auxiliary case. The ability to select an auxiliary range gear independently from a main case gear allows the transmission twice the number of overall gear ratios. Main case gearing can be used once in auxiliary low range and again in auxiliary high range.

The range system is equipped with a Range Solenoid Valve. The Range Solenoid Valve is an electric-over-air solenoid that is controlled by the Transmission Electronic Control Unit (TECU), replacing the Shift Knob-Slave Valve system found on Eaton Fuller manual transmissions.

During operation, the solenoid directs air pressure to either port in the Range Cylinder based on the need to activate the auxiliary low range or high range gearing. The applied air pressure directs the fore-and-aft movement of the Range Piston within the Range Cylinder, facilitating the mechanical engagement of the Range Synchronizer into either low or high range. Fault Code 41 indicates the transmission is unable to complete a range shift.

Detection

When toggling the Range Solenoid Valve, the TECU verifies the new range position by calculating the overall transmission gear ratio, using the Main Shaft and Output Shaft Speed Sensor signals. If the calculated ratio does not match the expected ratio for the new range position, the auxiliary case gearing did not change as expected and the TECU sets the fault code Active.

The TECU detected a range system failure, but was unable to detect the specific root cause.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding:
Transmission is either stuck in its current range position or it cannot engage the desired range position after five consecutive attempts.

Fallback

FMI 7

- Transmission remains in the range where the failure occurred.
- Transmission may attempt to shift into low range when the vehicle comes to a stop.
- Until the fault becomes Inactive, driver may have to shut off engine with transmission in gear.

Conditions to Set Fault Code Inactive

FMI 7: Transmission successfully attains the requested range for 2 seconds.

Possible Causes

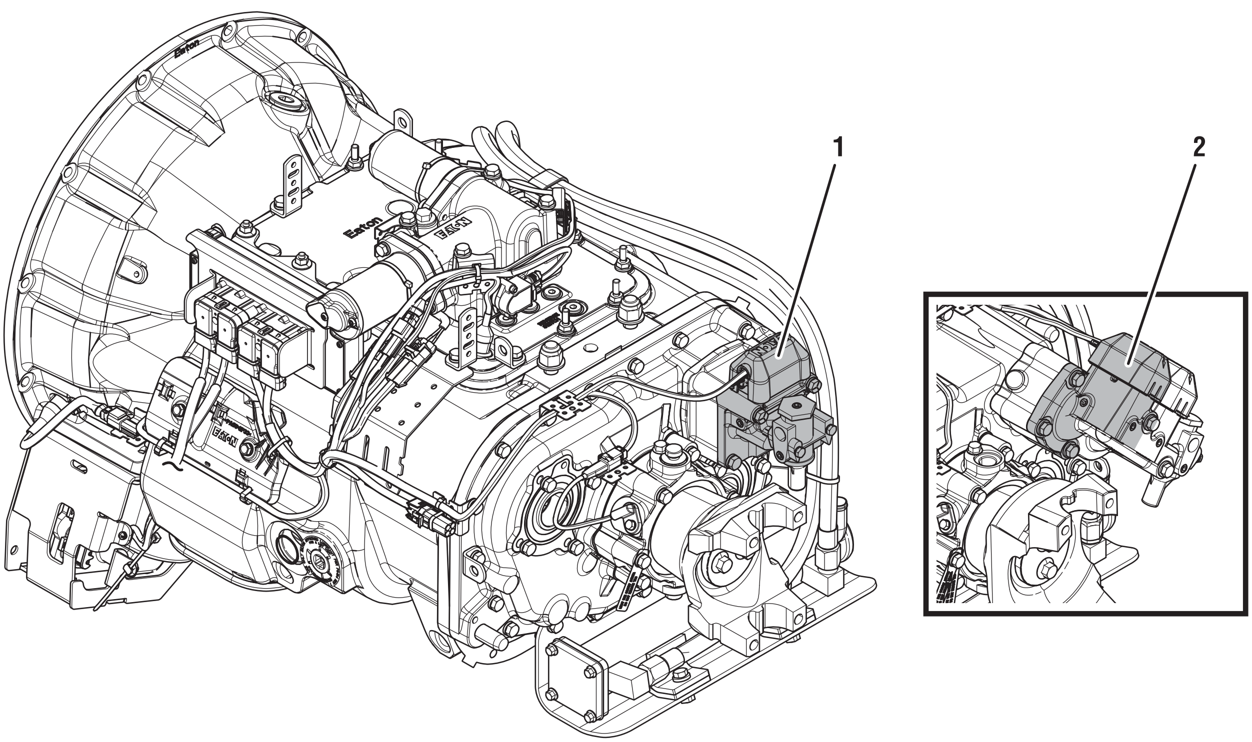
FMI 7

- Vehicle Air System
  - Low vehicle air pressure
  - Contamination in air supply
  - Air leaks
  - Filter-Regulator failure
- Range Solenoid Valve
  - Mechanical failure
- Mechanical Transmission
  - Range Synchronizer failure
  - Range Cylinder, Piston or Yoke wear or damage
  - Range Cover Gasket failure
  - Tone Wheel damage
  - Failed auxiliary case components
- Main Shaft Speed Sensor
  - Internal failure
- Output Shaft Sensor
  - Internal failure

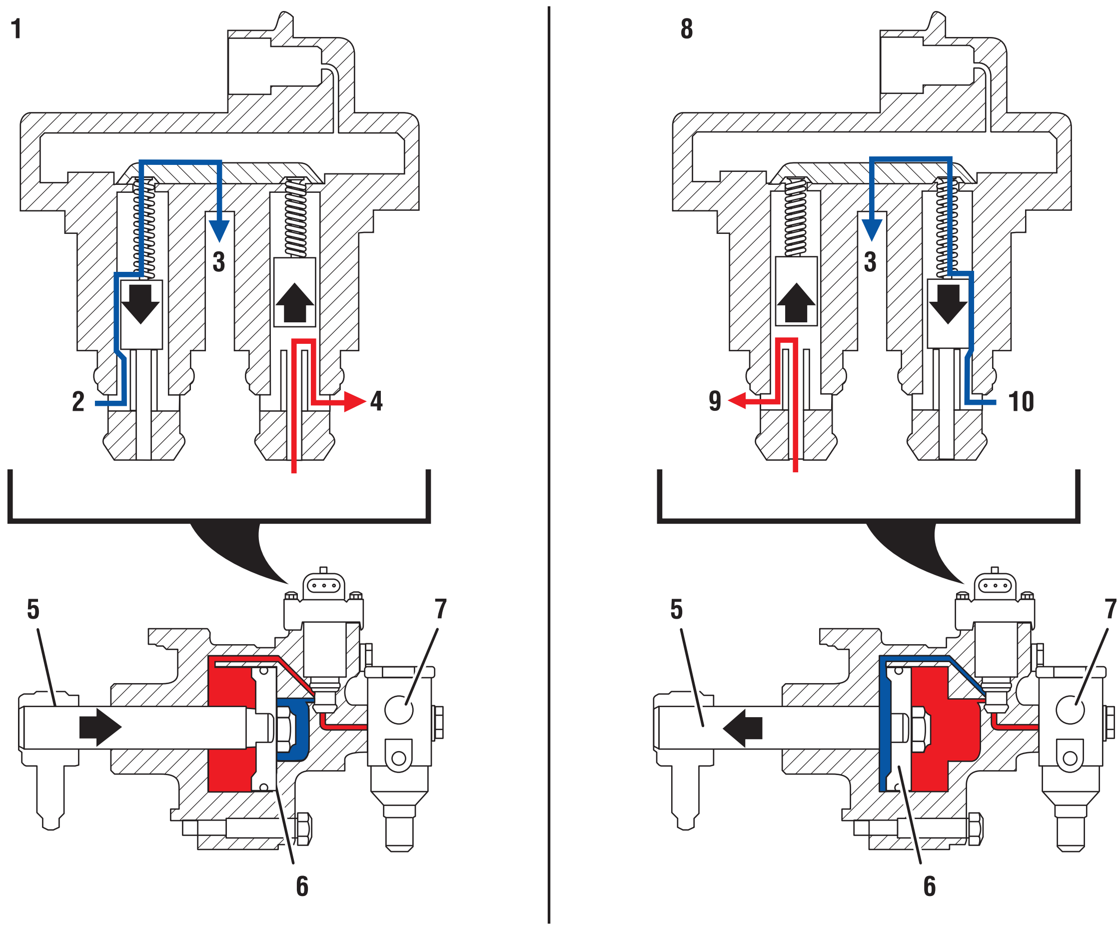
Additional Tools

- Two 0–100 PSI Air Pressure Gauges
- 0–150 PSI Air Pressure Gauge

Component Identification



1. Range Solenoid Valve (LAS / VAS / MHP / VHP / MXP / LSE / VXP)
2. Range Solenoid Valve (VCS / VMS)



LO HI

1. Range Solenoid Valve (LO)
2. Cylinder Port (Exhaust)
3. Exhaust Port
4. Regulated Port (Air)
5. Shift Yoke
6. Piston
7. Filter-Regulator
8. Range Solenoid Valve (HI)
9. Regulated Port (Air)
10. Cylinder Port (Exhaust)

Fault Code 41 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Codes 43, 57 or 58 are Active or Inactive, troubleshoot first per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 41 is Active or Inactive and Fault Codes 43, 57 or 58 are not set, go to **Step B.**

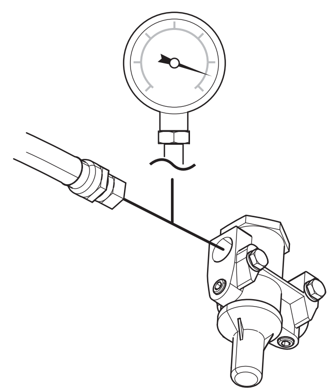
B

Purpose: *Verify vehicle air supply pressure.*

1. Key off.
2. Set parking brake and chock wheels.
3. Vent vehicle air supply tanks.

Caution: Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

4. Install a 0–150 PSI air pressure gauge between the supply line and the air Filter-Regulator located at the back of the transmission.



5. Key on with engine running.
6. Allow air pressure to build to governor cut off.
7. Key off.
8. Monitor air pressure at gauge on supply line for 1 minute. Record reading(s) in table.
9. Compare reading(s) in table.
   - If readings are in range and the vehicle is able to maintain pressure, go to **Step C.**
   - If readings are out of range, or the vehicle can not hold pressure, repair vehicle air system per OEM guidelines. Go to **Step V.**

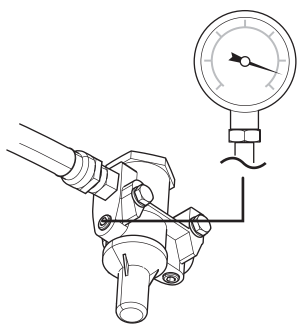
Model	Pressure	Reading(s)
All Models	90–120 PSI	

C ***Purpose:*** *Verify Air Filter-Regulator operation.*

1. Key off.
2. Vent vehicle air supply tanks.

Caution: Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

3. Reconnect the supply line to the Air Filter-Regulator.
4. Install a 0–100 PSI air pressure gauge into a regulator test port of the Air Filter-Regulator.



5. Key on with engine running.
6. Allow air pressure to build to governor cut off.
7. Key off.
8. Monitor air pressure and record reading(s) in table.
9. Compare reading(s) in table.
   - If air pressure is in range, go to **Step D.**
   - If air pressure is out of range, replace Air Filter-Regulator. Go to **Step V.**

Model	Pressure	Reading(s)
LAS/VAS	75–85 PSI	
All Other Models	55–65 PSI	

D

Purpose: *Verify Range operation.*

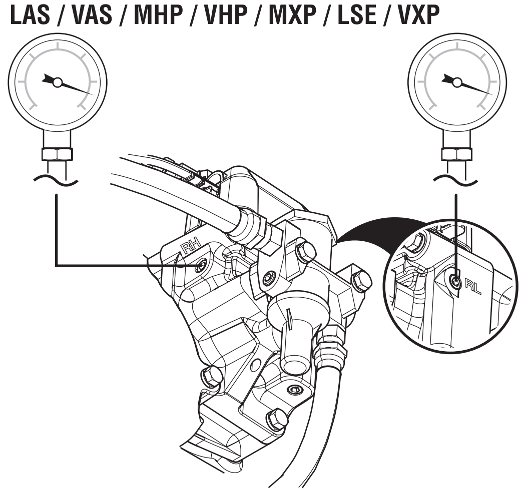
1. Key off.
2. Vent vehicle air supply tanks.

Caution: Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

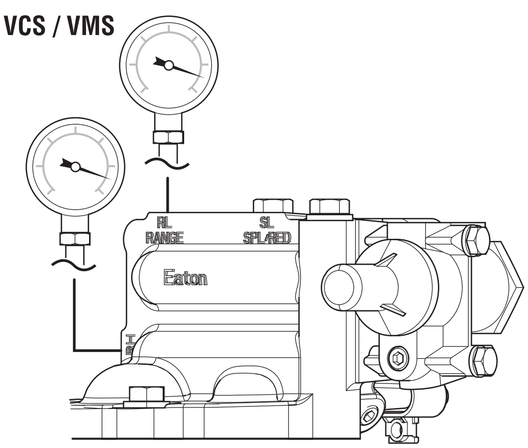
3. Install a 0–100 PSI air pressure gauge into each of the range cover diagnostic ports (L and H).

Caution: Use care when removing the test port pipe plugs. If air pressure is present, the plug can become a projectile during removal. When removing the L diagnostic port plug or H diagnostic port plug, pressure can be shut off by selecting the opposite range mode. If removing the F plug, exhaust the air to the module inlet.

LAS / VAS / MHP / VHP / MXP / LSE / VXP



VCS / VMS



4. Key on with engine running.
5. Allow air pressure to build to governor cut off.
6. Key on with engine off.

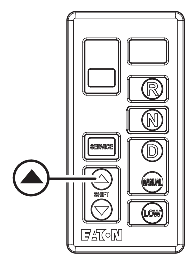
Caution: Verify engine is off before continuing.

7. Depress the Service Brake pedal and use the shift device to engage Reverse gear. Record air pressure reading of low-range pressure gauge in the table.

   Note: For MHP/VHP and LAS/VAS models, depress the Service Brake pedal and engage Reverse 1 (R1).

   Note: For VCS/VMS and MXP/LSE/VXP models, depress the Service Brake pedal and engage Reverse 2 (R2).

8. Depress the Service Brake pedal and use the shift device Upshift Button to engage the next Reverse gear. Record air pressure reading of high-range pressure gauge in table.



   Note: Pressure change should be immediately reflected on the gauge.

9. Depress the Service Brake pedal and use the shift device to select Neutral. Verify that the transmission finds Neutral using the gear display.
10. Monitor air pressure and record reading(s) in table.
11. Compare reading(s) in table.
    - If air pressures are in range, go to **Step F.**
    - If air pressures are out of range or pressure is slow to change, go to **Step E.**

Model	Pressure	Reading(s)
LAS/VAS Low Range	75–85 PSI	
LAS/VAS High Range	75–85 PSI	
All Other Models Low Range	55–65 PSI	
All Other Models High Range	55–65 PSI	

E

Purpose: *Verify mechanical condition of Range Cylinder Cover.*

1. Key off.
2. Vent vehicle air supply tanks.

Caution: Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

3. Remove Range Cylinder Cover.
4. Verify Range Cylinder Cover air ports are not obstructed or contaminated. Test for obstructions using shop air to ensure proper air flow.
   - If ports are obstructed or contaminated, replace Range Cylinder Cover, Range Solenoid Valve and overhaul Range Cylinder. Go to **Step G.**
   - If ports are not obstructed or contaminated, replace Range Solenoid Valve and overhaul Range Cylinder. Go to **Step G.**

F

Purpose: *Verify condition of internal range system components.*

1. Key off.
2. Vent vehicle air supply tanks.

Caution: Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

3. Disassemble Range Cylinder and components.
4. Inspect components for damage or contamination, specifically the Piston o-rings and Range Solenoid Valve.
5. Inspect Range Cylinder and ensure cylinder has a light coating of lube and is free from rust, corrosion or oil.
   - If components are in proper condition, go to **Step G.**
   - If components show signs of rust, corrosion or oil, or damage is found, overhaul Range Cylinder, replace Range Solenoid Valve and resolve contamination issues with vehicle air system. Go to **Step G.**

     Note: Rust and moisture may cause premature failure in air system components.

G

Purpose: *Verify operation of range system.*

1. Test drive vehicle and ensure that range system works as intended. Operate the vehicle in scenarios that require range shifts to be made.
   - If the vehicle does not properly complete range shifts, go to **Step H.**
   - If the vehicle completes range shifts without issues, go to **Step V.**

H

Purpose: *Verify condition of auxiliary section components.*

1. Inspect the Transmission Tone Wheel for damaged or missing gear teeth.
2. Drain transmission oil, looking for signs of significant metal fragments in the lubricant. Look for signs of internal damage to the transmission.
3. Remove auxiliary case from transmission.
4. Inspect auxiliary case Yoke Bar and Shift Yoke for any signs of damage.
5. Inspect Range Synchronizer for signs of worn friction material or broken Synchronizer Pins.
6. Ensure that auxiliary case Output Shaft Bearing and Auxiliary Countershaft Bearings are not damaged or worn.
   - If no damage is found, and the oil level is correct with no significant metal fragments, replace Range Solenoid Valve. Go to **Step V.**
   - If damage is found, repair or replace auxiliary case components as necessary. Go to **Step V.**

     Note: If the transmission is found to be low on oil, make sure to inspect the main case for damage due to the low lubricant condition.

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. 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 41 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 41 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 42: Splitter Failed to Engage

J1587:	**MID 130**	**SID 37**	**FMI 7**
	MID 130	**SID 38**	**FMI 7**
J1939:	**SA 3**	**SPN 770**	**FMI 7**
	SA 3	**SPN 771**	**FMI 7**

Overview

The UltraShift *PLUS* LSE, MHP, MXP, VCS, VHP, VMS and VXP series transmissions are equipped with a 2-speed splitter system in the auxiliary case. The splitter system uses a reduction gear to increase the total number of gear ratios available to the transmission. It also reduces the gear ratio step-sizes between shifts by using the main case gearing once in auxiliary low split and then again in auxiliary high split. The system can use the reduction gear to allow the transmission to operate at very low speeds (or creep) applications.

The splitter system is equipped with a Splitter Solenoid Valve. The Splitter Solenoid Valve is an electric-over-air solenoid that is controlled by the Transmission Electronic Control Unit (TECU), replacing the Shift Knob-Splitter Button system found on Eaton Fuller manual transmissions

During operation, the solenoid directs air pressure to either port in the Splitter Cover based on the need to activate the auxiliary low split or high split gearing. The applied air pressure directs the fore-and-aft movement of the Splitter Piston within the Splitter Cylinder, facilitating the mechanical engagement of either low or high split position. Fault Code 42 indicates that the transmission is unable to complete a split shift.

Detection

When toggling the Splitter Solenoid Valve, the TECU verifies the new splitter position by calculating the overall transmission gear ratio, using the Main Shaft and Output Shaft Speed Sensor signals. If the calculated ratio does not match the expected ratio for the new splitter position, the auxiliary case gearing did not change as expected, and the TECU sets the fault Active.

The TECU detected a system failure, but was unable to detect the specific root cause.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: The transmission is either stuck in its current splitter position or it cannot engage the desired splitter position after five consecutive attempts.

Fallback

FMI 7

- Transmission remains in the splitter state where the failure occurred.
- Transmission may attempt to shift into low split when the vehicle comes to a stop.
- Until the fault becomes Inactive, driver may have to shut off engine with transmission in gear.

Conditions to Set Fault Code Inactive

FMI 7: Transmission successfully attains the requested splitter position for 2 seconds.

Possible Causes

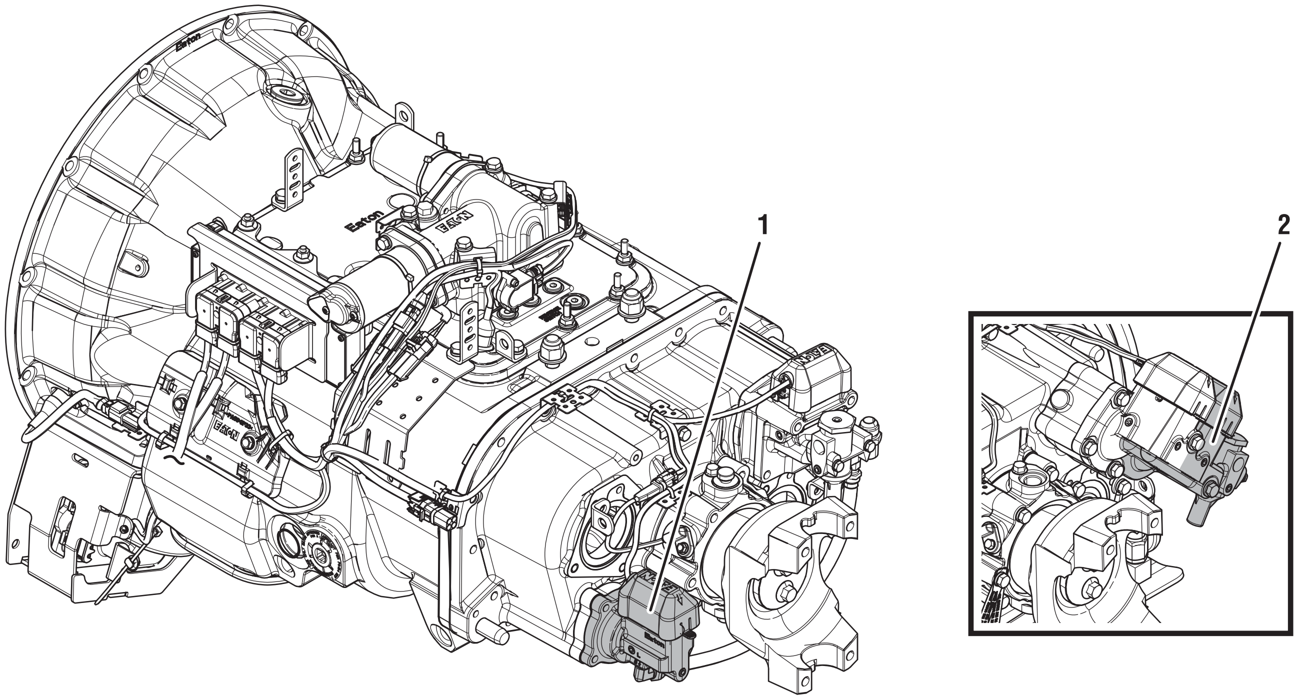
FMI 7

- Vehicle Air System
  - Low vehicle air pressure
  - Contamination in air supply
  - Air leaks
  - Filter-Regulator failure
- Splitter Solenoid Valve
  - Mechanical failure
- Mechanical Transmission
  - Splitter Cylinder, Piston, or Yoke wear or damage
  - Splitter Cover Gasket failure
  - Tone Wheel damage
  - Failed auxiliary case components
- Main Shaft Speed Sensor
  - Internal failure
- Output Shaft Sensor
  - Internal failure

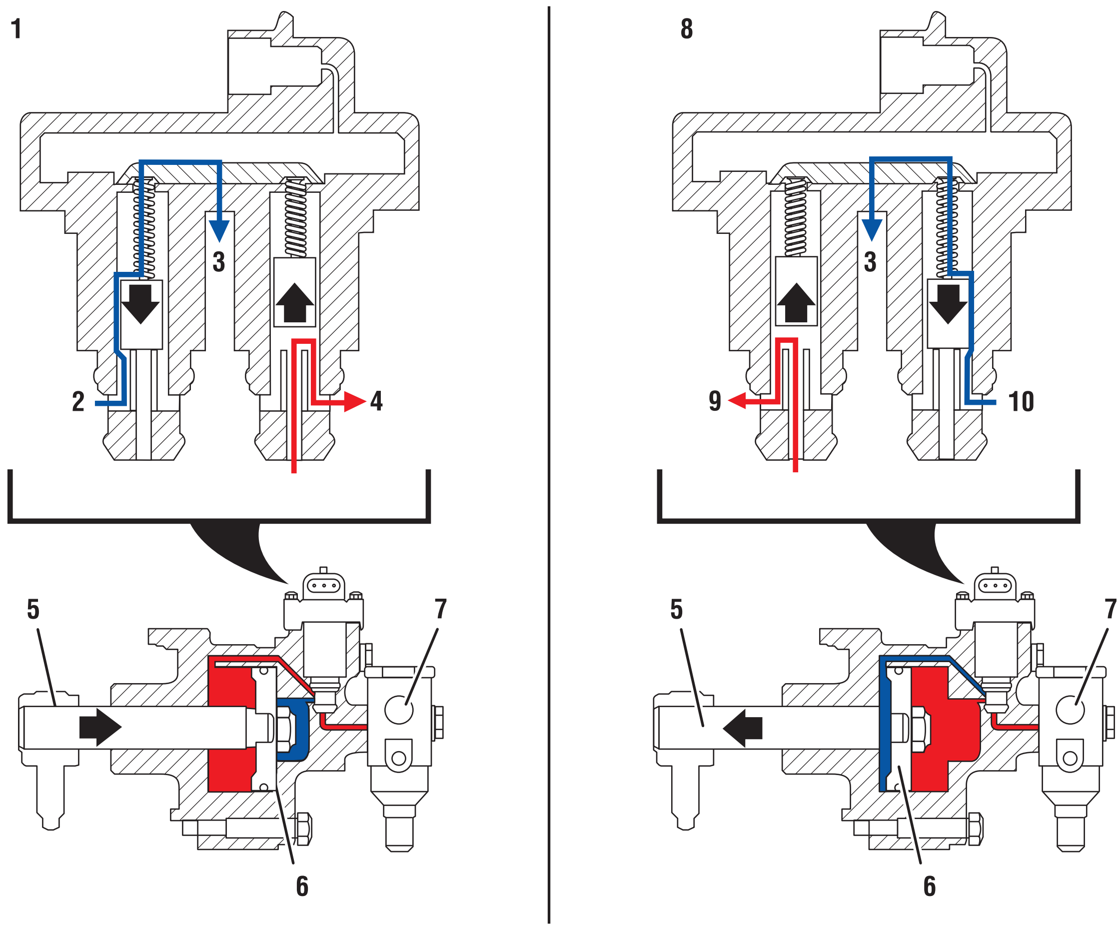
Additional Tools

- Two 0–100 PSI Air Pressure Gauges
- 0–150 PSI Air Pressure Gauge

Component Identification



1. Splitter Solenoid Valve (MHP / VHP / MXP / LSE / VXP)
2. Splitter Solenoid Valve (VCS / VMS)



LO HI

1. Splitter Solenoid Valve (LO)
2. Cylinder Port (Exhaust)
3. Exhaust Port
4. Regulated Port (Air)
5. Shift Yoke
6. Piston
7. Filter-Regulator
8. Splitter Solenoid Valve (HI)
9. Regulated Port (Air)
10. Cylinder Port (Exhaust)

Fault Code 42 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Codes 46, 57 or 58 are Active or Inactive, troubleshoot first per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 42 is Active or Inactive and Fault Codes 46, 57 or 58 are not set, go to **Step B.**

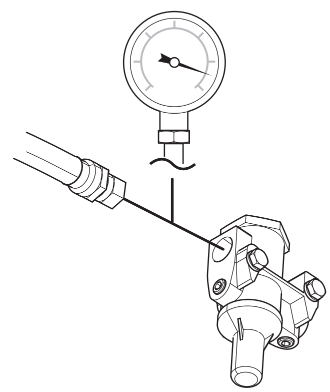
B

Purpose: *Verify vehicle air supply pressure.*

1. Key off.
2. Set parking brake and chock wheels.
3. Vent vehicle air supply tanks.

Caution: Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

4. Install a 0–150 PSI air pressure gauge between the supply line and the Air Filter-Regulator located at the back of the transmission.



5. Key on, engine running.
6. Allow air pressure to rise to governor cut off.
7. Key off.
8. Monitor air pressure at gauge on supply line for 1 minute. Record reading(s) in table.
   - If readings are in range and the vehicle is able to maintain pressure, go to **Step C.**
   - If readings are out of range or the vehicle can not hold pressure, repair vehicle air system per OEM guidelines. Go to **Step V.**

Model	Pressure	Reading(s)
All Models	90–120 PSI	

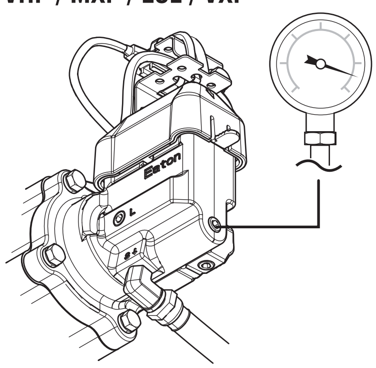
C	***Purpose:*** *Verify Air Filter-Regulator operation.*

1. Key off.
2. Vent vehicle air supply tanks.

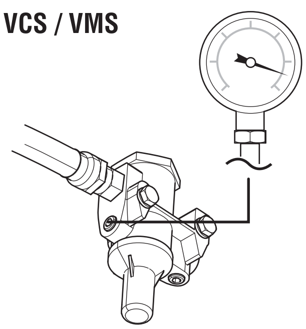
Caution: Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

3. Install a 0–100 PSI air pressure gauge into a regulator test port of the Air Filter-Regulator.

MHP / VHP / MXP / LSE / VXP



VCS / VMS



4. Key on with engine running.
5. Allow air pressure to build to governor cut off.
6. Key off.
7. Monitor air pressure and record reading(s) in table.
8. Compare reading(s) in table.
   - If air pressure is in range, go to **Step D.**
   - If air pressure is out of range, replace Air Filter-Regulator. Go to **Step V.**

Model	Pressure	Reading(s)
All Models	55–65 PSI	

D ***Purpose:*** *Verify Splitter operation.*

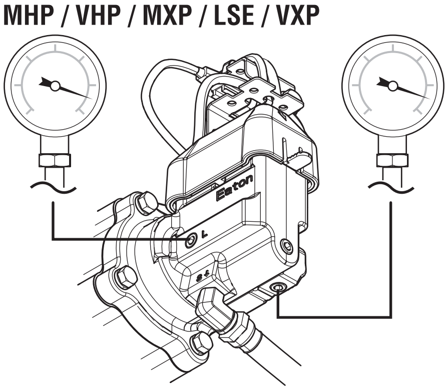
1. Key off.
2. Vent vehicle air supply tanks.

⚠ **Caution:** Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

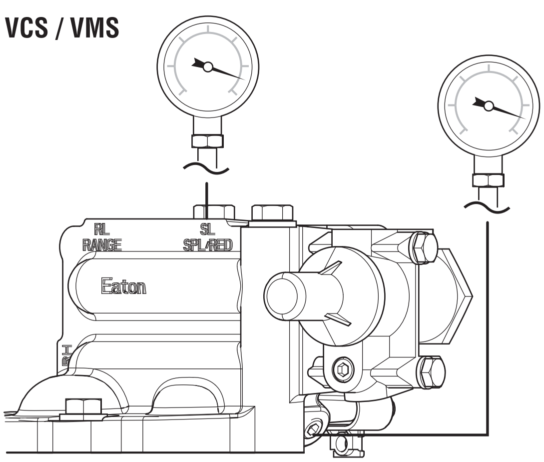
3. Install a 0–100 PSI air pressure gauge into each of the splitter cover diagnostic ports (L and H).

⚠ **Caution:** Use care when removing the test port pipe plugs. If air pressure is present, the plug can become a projectile during removal. When removing the L diagnostic port plug or H diagnostic port plug, pressure can be shut off by selecting the opposite splitter mode. If removing the F plug, exhaust the air to the module inlet.

MHP / VHP / MXP / LSE / VXP



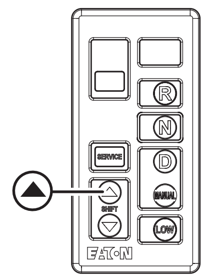
VCS / VMS



4. Key on with engine running.
5. Allow air pressure to build to governor cut off.
6. Key on with engine off.

⚠ **Caution:** Verify engine is off before continuing.

7. Depress the Service Brake pedal and using the shift device, engage Reverse 1 (R1). Record air pressure reading of low-split pressure gauge in the table.
8. Depress the Service Brake pedal and using the shift device, button up shift to Reverse 2 (R2). Record air pressure reading of high-split pressure gauge in table.



Note: Pressure changes should be immediately reflected on the gauge.

9. Depress the Service Brake pedal and use the shift device to select Neutral. Verify that the transmission finds Neutral using the gear display.
10. Monitor air pressure and record reading in table.
11. Compare reading(s) in table.
   - If air pressures are in range, go to **Step F.**
   - If air pressures are out of range or pressure is slow to change, go to **Step E.**

VCS/VMS, MHP/VHP/ MXP/LSE/ VXP	Pressure	Reading(s)
Low Split	55–65 PSI	
High Split	55–65 PSI	

E

Purpose: *Verify mechanical condition of Splitter Cylinder Cover.*

1. Key off.
2. Vent vehicle air supply tanks.

Caution: Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

3. Remove Splitter Cylinder Cover.
4. Verify Splitter Cylinder Cover air ports are not obstructed or contaminated. Test for obstructions using shop air to ensure proper air flow.
   - If ports are obstructed or contaminated, replace Splitter Cover, Splitter Solenoid Valve and overhaul Splitter Cylinder. Go to **Step G.**
   - If ports are not obstructed or contaminated, replace Splitter Solenoid Valve and overhaul Splitter Cylinder. Go to **Step G.**

F

Purpose: *Verify condition of internal splitter system components.*

1. Key off.
2. Vent vehicle air supply tanks.

Caution: Vehicle air tanks may have air stored at pressures in excess of 100 PSI. Failure to vent air tanks may cause personal injury.

3. Disassemble Splitter Cylinder and components.
4. Inspect components for damage or contamination, specifically Piston o-rings and Splitter Solenoid Valve.
5. Inspect Splitter Cylinder and ensure cylinder has a light coating of lube and is free from rust, corrosion or oil.
   - If components are in proper condition, go to **Step G.**
   - If components show signs of rust, corrosion or oil, or damage is found, overhaul Splitter Cylinder, replace Splitter Solenoid Valve and resolve contamination issues with vehicle air system. Go to **Step G.**

   Note: Rust and moisture may cause premature failure in air system components.

G

Purpose: *Verify operation of splitter system.*

1. Test drive vehicle and ensure that splitter system works as intended. Operate the vehicle in scenarios that require split shifts to be made.
   - If the vehicle does not properly complete a split shift, go to **Step H.**
   - If the vehicle completes split shifts without issues, go to **Step V.**

H

Purpose: *Verify condition of auxiliary section components.*

1. Inspect the transmission Tone Wheel for damaged or missing gear teeth.
2. Drain transmission oil, looking for signs of significant metal fragments in the lubricant. Look for signs of internal damage to the transmission.
3. Remove auxiliary case from transmission.
4. Inspect auxiliary case Yoke Bar and Shift Yoke for any signs of damage.
5. Inspect splitter system components for signs of wear or damage.
6. Ensure that auxiliary case Output Shaft Bearing and Auxiliary Countershaft Bearings are not damaged or worn.
   - If no damage is found and the oil level is correct with no significant metal fragments, replace Splitter Solenoid Valve. Go to **Step V.**
   - If damage is found, repair or replace Auxiliary Case components as necessary. Go to **Step V.**

     Note: If the transmission is found to be low on oil, make sure to inspect the main case for damage due to the low lubricant condition.

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. 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 42 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 42 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 43: Range Solenoid Valve

J1587:	**MID 130**	**SID 35**	**FMI 3, 4, 5, 6, 8, 12, 18**
	MID 130	**SID 36**	**FMI 3, 4, 5, 6, 8, 12, 18**
J1939:	**SA 3**	**SPN 768**	**FMI 3, 4, 5, 6, 8, 12, 18**
	SA 3	**SPN 769**	**FMI 3, 4, 5, 6, 8, 12, 18**

Overview

Most UltraShift *PLUS* Transmission models are equipped with a 2-speed range system in the auxiliary case. The ability to select an auxiliary range gear independently from a main case gear allows the transmission twice the number of overall gear ratios by using the main case gearing once in auxiliary low range and again in auxiliary high range.

The range system is equipped with a Range Solenoid Valve. The Range Solenoid Valve is an electric-over-air solenoid that is controlled by the Transmission Electronic Control Unit (TECU), replacing the Shift Knob-Slave Valve system found on Eaton Fuller manual transmissions.

During operation, the solenoid directs air pressure to either port in the Range Cylinder based on the need to activate the auxiliary low range or high range gearing. The applied air pressure directs the fore-and-aft movement of the Range Piston within the Range Cylinder, facilitating the mechanical engagement of the Range Synchronizer into either low or high range. Auxiliary case gear changes are physically engaged and disengaged to the transmission main case through the Range Synchronizer.

Fault Code 43 indicates an electrical fault within the Range Solenoid Valve circuit.

Detection

The TECU can detect an open circuit or a short to ground when the Range Solenoid Valve is on. The TECU can detect a short to power when the Range Solenoid Valve is off.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: With the solenoid off, the TECU detects high voltage in the Range Solenoid Valve high side driver circuit for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: With the solenoid on, the TECU detects low voltage in the Range Solenoid Valve low side driver circuit for 1 second.

FMI 5 – Current Below Normal or Open Circuit: With the solenoid on, the TECU detects an open in the Range Solenoid Valve circuit for 1 second.

FMI 6 – Current Above Normal or Shorted Circuit: TECU detects a short to power on the Range Solenoid Valve circuit.

FMI 8 – Abnormal Frequency: Range Solenoid Valve out of normal operating frequency.

FMI 12 – Bad Intelligent Device: Range Solenoid Valve driver internal failure.

FMI 18 – Data Valid But Below Normal (Moderately Severe): Range Solenoid Valve circuit current low and battery voltage below 9.2V when the solenoid is on.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Engine cranks and starts.
- High side coil failure (SID 35/SPN 768).
  - If the failure occurs in high range, the transmission shifts through all high range gears and shifts to low range when vehicle speed is appropriate; however, the transmission is then restricted to shifting in all low range gears only.
  - If the failure occurs in low range, the transmission shifts through all low range gears but will not shift to high range.
- Low side coil failure (SID 36/SPN 769).
  - If the failure occurs in high range, the transmission shifts through all high range gears but will not shift into low range.
  - If the failure occurs in low range, the transmission shifts through all low range gears but will not shift to high range.

Conditions to Set Fault Code Inactive

FMI 3, 4, 5, 6: Splitter Solenoid Valve circuit in range for 2 seconds.

FMI 8, 12, 18: Condition no longer exists.

Possible Causes

FMI 3

- Transmission Harness
  - Wiring shorted to power
- TECU
  - Internal short to power

FMI 4

- Transmission Harness
  - Wiring shorted to ground
- Range Solenoid Valve
  - Internal short to ground
- TECU
  - Internal short to ground

FMI 5

- Transmission Harness
  - Open circuit
  - Bent, spread, corroded or loose terminals
- Range Solenoid Valve
  - Internal solenoid coil failure
- TECU
  - Internal open circuit

FMI 6

- TECU

FMI 8

- 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

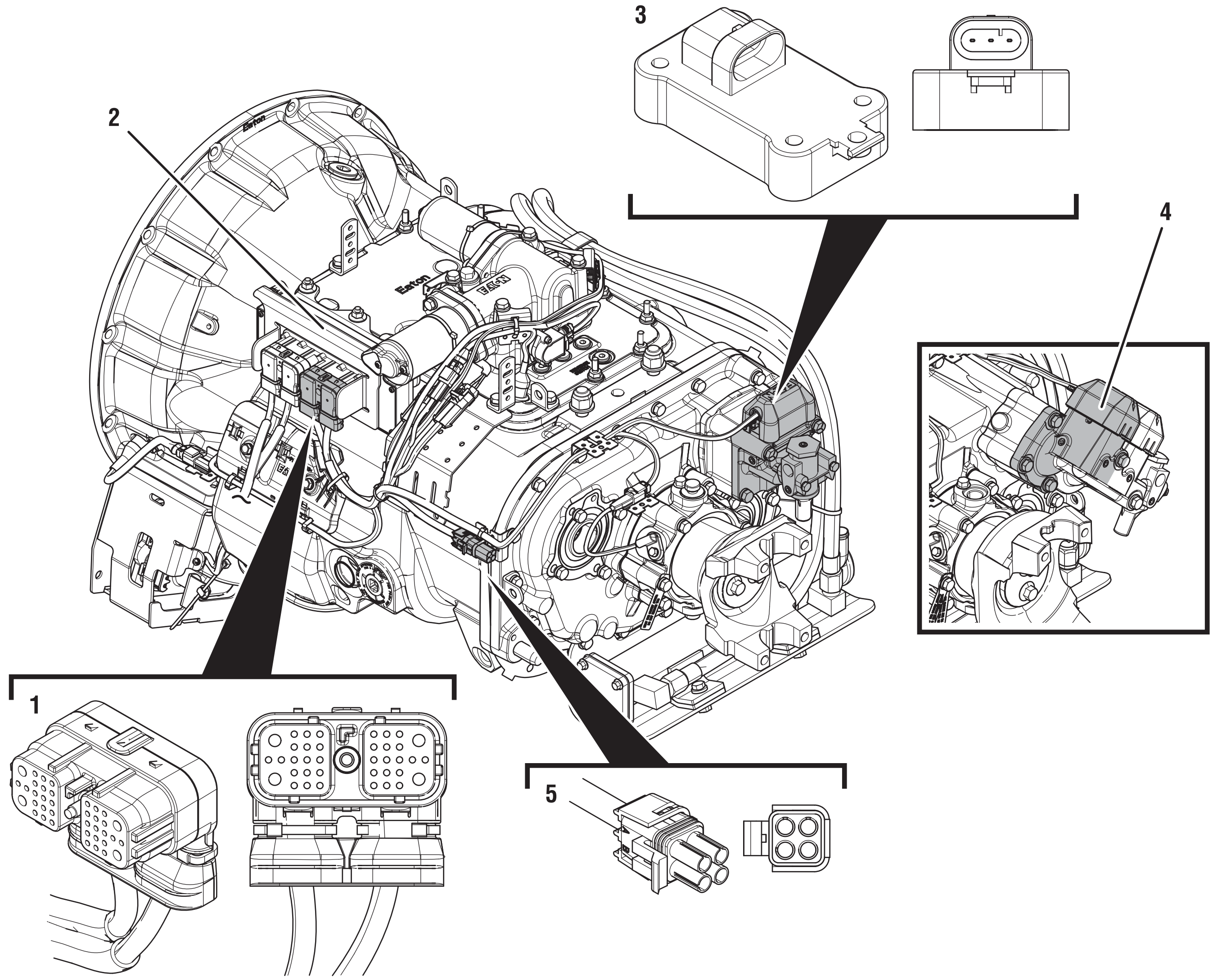
FMI 12

- Driver Behavior
  - Driver induced ignition key cycles not allowing TECU to fully power down
- TECU

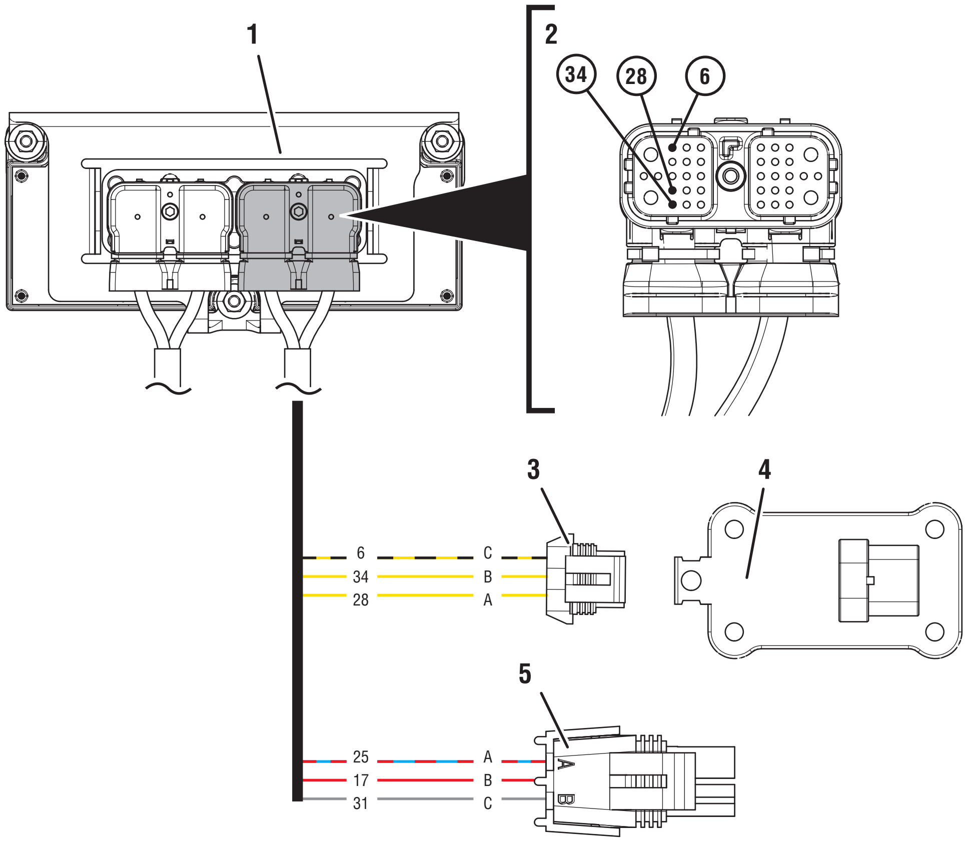
FMI 18

- 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

Component Identification



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. Range Solenoid Valve (LAS / VAS / MHP / VHP / MXP / LSE / VXP)
4. Range Solenoid Valve (VCS / VMS)
5. 4-Way Diagnostic Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 3-Way Range Solenoid Valve Connector
4. 3-Way Range Solenoid Valve
5. 4-Way Diagnostic Connector

Fault Code 43 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

   Note: If Fault Code 43 is Inactive and there are other Active fault codes, troubleshoot all Active fault codes first.

   - If Fault Code 43 FMI 3, 4 or 5 is Active, go to **Step C.**
   - If Fault Code 43 FMI 3, 4 or 5 is Inactive, go to **Step B.**
   - If Fault Code 43 FMI 6 is Active or Inactive, replace TECU. Go to **Step V.**
   - If Fault Code 43 FMI 12 is Active, go to **Step K.**
   - If Fault Code 43 FMI 12 is Inactive, test complete. Go to **Step V.**
   - If Fault Code 43 FMI 8 or 18 is Active or Inactive, go to **Step H.**

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 wiring and connections. Be sure to include Transmission Harness from the Range Solenoid Valve to the TECU.
4. Exit PD Mode by powering down.

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

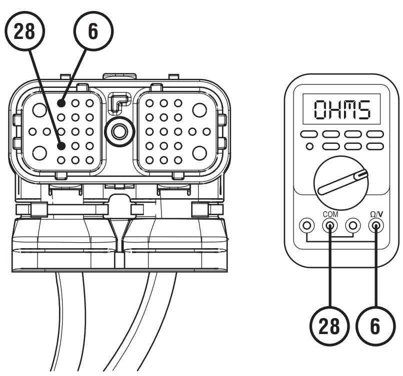
- If Fault Code 43 or any other fault code set Active while wiggling the Transmission Harness, replace the Transmission Harness. Go to **Step V.**
- If no fault codes became Active while wiggling the Transmission Harness, go to **Step C.**

C ***Purpose:*** *Verify continuity of Range Solenoid Circuit at the TECU.*

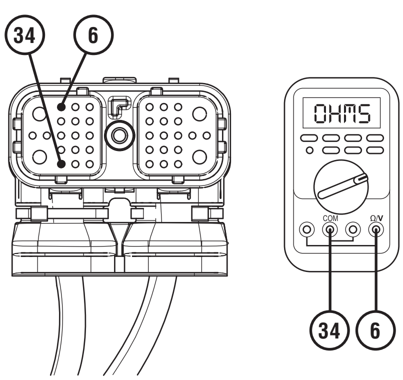
1. Key off.

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

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 28 and Pin 6. Record reading(s) in table.



5. Measure resistance between 38-Way Connector Pin 34 and Pin 6. Record reading(s) in table.

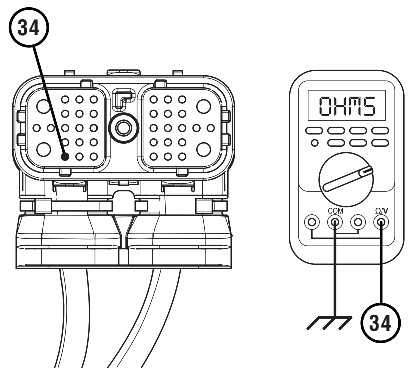


6. Compare reading(s) in table.
   - If both readings are in range, go to **Step D.**
   - If either reading is out of range, go to **Step F.**

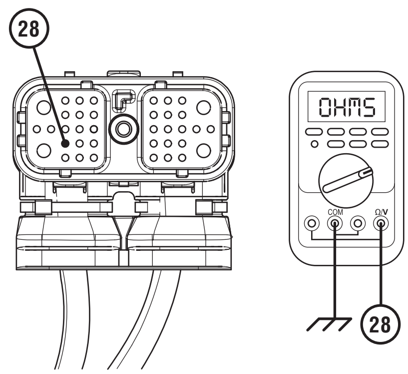
Pins	Range	Reading(s)
28 to 6	9–16 ohms	
34 to 6	9–16 ohms	

D ***Purpose:*** *Check for short to ground in Range Solenoid Valve circuit.*

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 34 and ground. Record reading(s) in table.



3. Measure resistance between 38-Way Connector Pin 28 and ground. Record reading(s) in table.



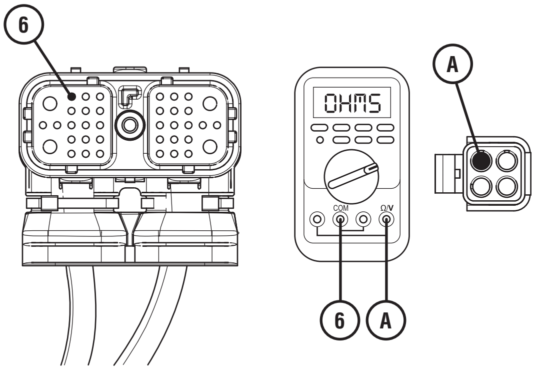
4. Disconnect 3-Way Range Solenoid Valve Connector.
5. Inspect 3-Way Connector body for damage and bent, spread, corroded or loose terminals.
6. Compare reading(s) in table.
   - If any reading is out of range, replace Transmission Harness. Go to **Step V.**
   - If all readings are in range and FMIs 4 or 5 are set, go to **Step G.**
   - If all readings are in range and FMI 3 is set, go to **Step E.**

Pins	Range	Reading(s)
34 to Ground	Open Circuit (OL)	
28 to Ground	Open Circuit (OL)	

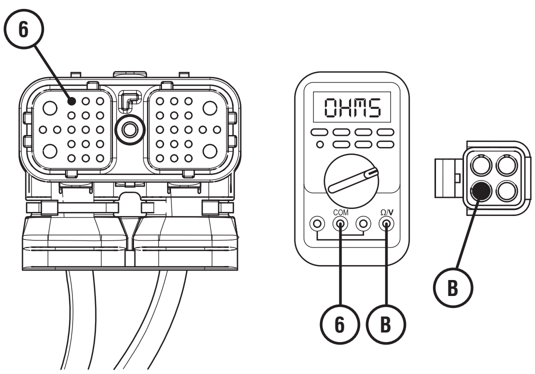
E

Purpose: *Check for short to power in Range Solenoid Valve circuit.*

1. Key off.
2. Remove cover of 4-Way Diagnostic Connector.
3. Inspect 4-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 38-Way Transmission Harness Connector Pin 6 and 4-Way Diagnostic Connector Pin A. Record reading(s) in table.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 6 and 4-Way Diagnostic Connector Pin B. Record reading(s) in table.

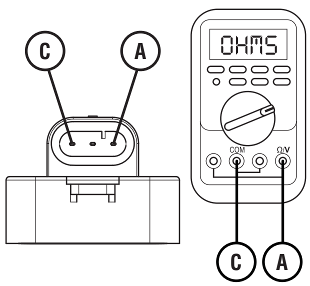


6. Compare reading(s) in table.
   - If any reading is out of range, replace Transmission Harness. Go to **Step V.**
   - If all readings are in range, replace TECU. Go to **Step V.**

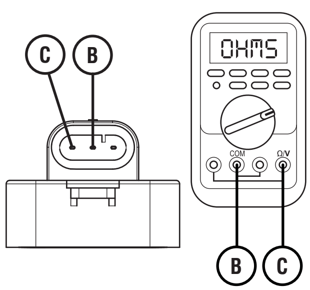
Pins	Range	Reading(s)
6 to A	Open Circuit (OL)	
6 to B	Open Circuit (OL)	

F ***Purpose:*** *Verify continuity of Range Solenoid Valve High and Low Circuits.*

1. Key off.
2. Disconnect 3-Way Range Solenoid Valve Connector.
3. Measure resistance between 3-Way Range Solenoid Valve Pin A and Pin C on the valve body. Record reading(s) in table.



4. Measure resistance between 3-Way Range Solenoid Valve Pin B and Pin C on the valve body. Record reading(s) in table.



5. Compare reading(s) in table.
   - If all readings are in range, replace Transmission Harness. Go to **Step V.**
   - If any reading is out of range, replace the Range Solenoid Valve. Go to **Step V.**

Pins	Range	Reading(s)
A to C	9–16 ohms	
B to C	9–16 ohms	

G

Purpose: *Verify fault code status.*

1. **1.** Key off.
2. **2.** Reconnect all connectors and verify that all components are properly installed.
3. **3.** Connect ServiceRanger.
4. **4.** Key on with engine off.
5. **5.** Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
   - If Fault Code 43 is now Inactive, replace Transmission Harness and Range Solenoid Valve. Go to **Step V.**
   - If Fault Code 43 is now Active, replace TECU. Go to **Step V.**

H

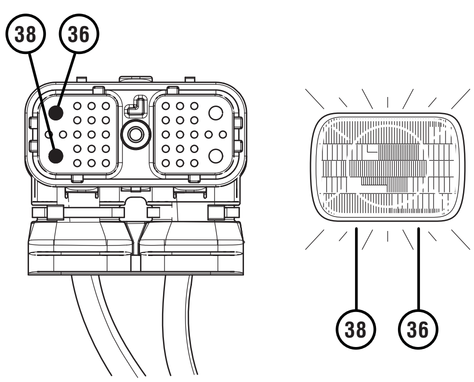
Purpose: *Verify condition of power and ground supply.*

1. **1.** Key off.
2. **2.** Set parking brake and chock wheels.
3. **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 I.**

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

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 fault code status.*

1. Determine which FMI set for Fault Code 43.
   - If FMI 8 set, replace TECU. Go to **Step V.**
   - If FMI 18 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is in TECU Power Supply Harness and/or battery/charging system. Contact OEM for further help troubleshooting the wiring and/or battery/charging system. Go to **Step V.**

K

Purpose: *Perform compete TECU Power Down.*

1. Key on with engine off.
2. Key off and allow the TECU to perform a complete power down.

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

   - 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. 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 43 FMI 3, 4, 5, 6, 8 or 18 sets Active during the test drive, go to **Step A.**
   - If Fault Code 43 FMI 12 sets Active during the test drive, replace the TECU.
   - If a fault code other than 43 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 45: Inertia Brake Performance

J1587: MID 130 SID 54 FMI 7
J1939: SA 3 SPN 787 FMI 7

Overview

The UltraShift *PLUS* transmission is equipped with a Low Capacity Inertia Brake (LCIB) to slow Input Shaft speed for more efficient gear engagement. As the Electronic Clutch Actuator (ECA) pulls the Heavy-Duty ECA Clutch Release Bearing back against the LCIB, the friction plates contained within the LCIB make contact with the outer plates and slow the Input Shaft down to allow smoother gear engagement. Fault Code 45 indicates the LCIB failed to reduce Input Shaft speed.

Detection

The Transmission Electronic Control Unit (TECU) commands the ECA to open the clutch and contact the LCIB. If the TECU does not see a significant enough drop in Input Shaft speed, the fault code is set Active.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: During LCIB engagement Input Shaft speed deceleration is less than 1000 RPM/sec for 0.15 seconds with significant current applied to the ECA and the transmission in a non-neutral mode.

Fallback

FMI 7

- No fallback mode associated with this fault; however, slow-to-shift or difficulty engaging start gear complaints may be presented.

Conditions to Set Fault Code Inactive

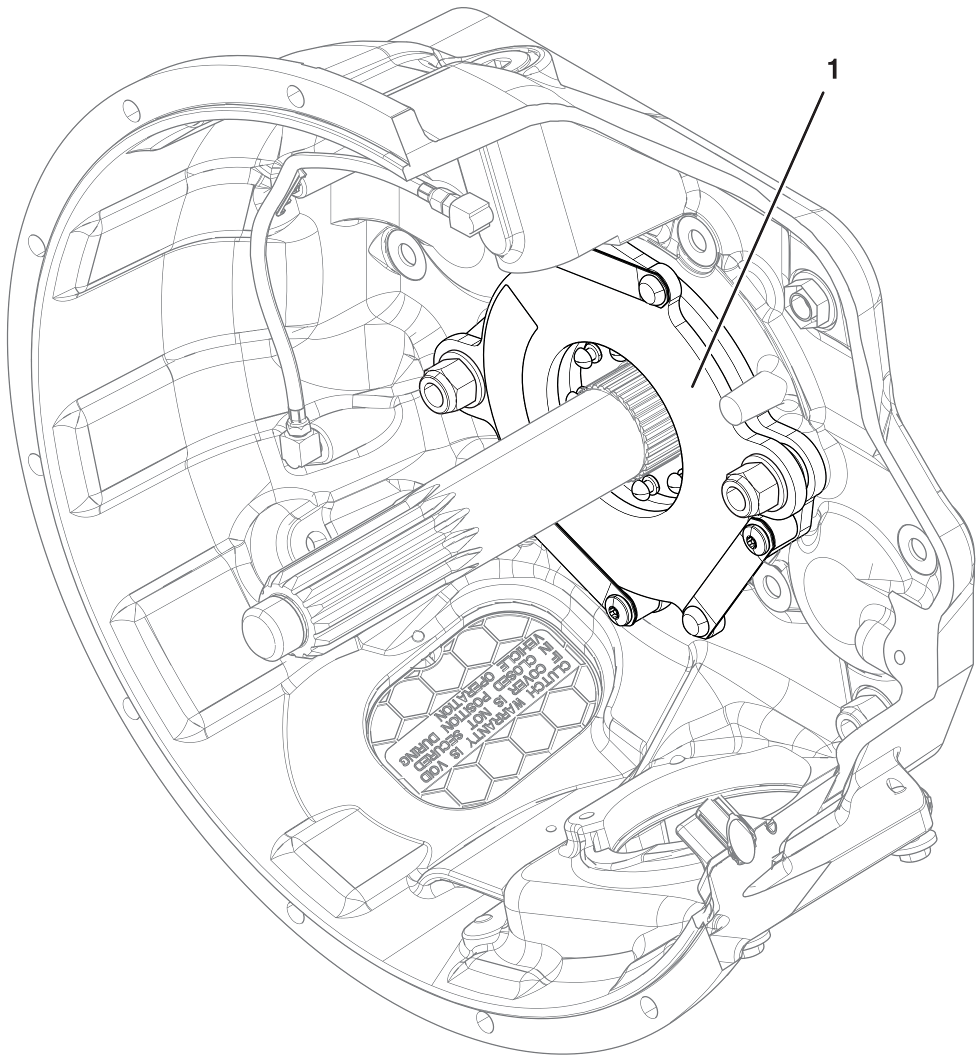
FMI 7: Input Shaft Speed deceleration is above 1000 RPM/sec.

Possible Causes

FMI 7

- LCIB
  - Oil leak contamination
  - Excessive release bearing greasing
  - Internal wear or damage
- ECA
  - Internal failure
- ECA Clutch
  - Excessive clutch drag
- Engine
  - Failed pilot bearing

Component Identification



1. Low Capacity Inertia Brake (LCIB)

Fault Code 45 Troubleshooting

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Codes 27, 64, 65, 66, or 67 are Active or Inactive, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 45 is Active or Inactive, go to **Step B.**

B ***Purpose:*** *Perform LCIB Deceleration Test in ServiceRanger.*

1. Set parking brake and chock wheels.
2. Key on with engine running.
3. Connect ServiceRanger.
4. Go To “Service Routines”.
5. Select “Start” Low Capacity Inertia Brake Test and follow on screen prompts.
   - If test passes, go to **Step C.**
   - If test fails, replace LCIB. Go to **Step V.**

C

Purpose: *Inspect physical condition of LCIB and ECA Clutch.*

1. Key off.
2. Remove single retaining bolt securing Clutch Housing cover.
3. Through the Clutch Housing cover opening, inspect LCIB for grease contamination or blue heat discoloration.
4. Inspect inside Clutch Housing for signs of LCIB friction material or other signs of LCIB failure.
5. Inspect clutch for any sign of a failure including corrosion, excessive clutch dust or related driver's complaint of a clutch failure.

   Note: Reference *Heavy-Duty Clutch Service Manual* (CLSM0200) for full LCIB inspection procedures.

   - If signs of a clutch failure are found, replace ECA Clutch and LCIB. Go to **Step V.**
   - If signs of an LCIB failure are found, replace LCIB. Go to **Step V.**
   - If no issues are found, replace ECA. Go to **Step V.**

     Note: A clutch that is dragging or binding can cause the LCIB to fail prematurely.

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. 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 codes set and vehicle operates properly, test complete.
   - If Fault Code 45 sets Active during the test drive, contact Eaton at (800) 826-4357 for further diagnostics.
   - If a fault code other than 45 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 46: Splitter Solenoid Valve

J1587:	**MID 130**	**SID 37**	**FMI 3, 4, 5, 6, 8, 12, 18**
	MID 130	**SID 38**	**FMI 3, 4, 5, 6, 8, 12, 18**
J1939:	**SA 3**	**SPN 770**	**FMI 3, 4, 5, 6, 8, 12, 18**
	SA 3	**SPN 771**	**FMI 3, 4, 5, 6, 8, 12, 18**

Overview

The UltraShift *PLUS* LSE, MHP, MXP, VCS, VHP, VMS and VXP series transmissions are equipped with a 2-speed splitter system in the auxiliary case. The splitter system uses a reduction gear to increase the total number of gear ratios available to the transmission. It also reduces the gear ratio step-sizes between shifts by using the main case gearing once in auxiliary low split and then again in auxiliary high split. The system can use the reduction gear to allow the transmission to operate at very low speeds (or creep) applications.

The splitter system is equipped with a Splitter Solenoid Valve. The Splitter Solenoid Valve is an electric-over-air solenoid that is controlled by the Transmission Electronic Control Unit (TECU), replacing the Shift Knob-Splitter Button system found on Eaton Fuller manual transmissions.

During operation, the solenoid directs air pressure to either port in the Splitter Cover based on the need to activate the auxiliary low split or high split gearing. The applied air pressure directs the fore-and-aft movement of the Splitter Piston within the Splitter Cylinder, facilitating the mechanical engagement of either low or high split position. Fault Code 46 indicates an electrical fault within the Splitter Solenoid Valve circuit.

Detection

The TECU can detect an open circuit or a short to ground when the Splitter Solenoid Valve is on. The TECU can detect a short to power when the Splitter Solenoid Valve is off.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: With the solenoid off, the TECU detects high voltage in the Splitter Solenoid Valve high side driver circuit for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: With the solenoid on, the TECU detects low voltage in the Splitter Solenoid Valve low side driver circuit for 1 second.

FMI 5 – Current Below Normal or Open Circuit: With the solenoid on, the TECU detects an open in the Splitter Solenoid Valve circuit for 1 second.

FMI 6 – Current Above Normal or Shorted Circuit: TECU detects a short to power on the Splitter Solenoid Valve circuit.

FMI 8 – Abnormal Frequency: Splitter Solenoid Valve out of normal operating frequency.

FMI 12 – Bad Intelligent Device: Splitter Solenoid Valve driver internal failure.

FMI 18 – Data Valid But Below Normal (Moderately Severe): Splitter Solenoid Valve circuit current low and battery voltage below 9.2V when the solenoid is on.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Engine cranks and starts.
- High side coil failure (SID 37/SPN 770).
  - If the failure occurs in high split, the transmission shifts through all high-split gears and shifts to low split when vehicle speed is appropriate; however, the transmission is then restricted to shifting in all low split gears only.
  - If the failure occurs in low split, the transmission shifts through all low split gears but does not shift to high split.
- Low side coil failure (SID 38/SPN 771).
  - If the failure occurs in high split, the transmission shifts through all high split gears but will not shift into low split.
  - If the failure occurs in low split, the transmission shifts through all low split gears but once it shifts to high split, the transmission will not engage any low split gears.

Conditions to Set Fault Code Inactive

FMI 3, 4, 5, 6: Splitter Solenoid Valve circuit in range for 2 seconds.

FMI 8, 12, 18: Condition no longer exists.

Possible Causes

FMI 3

- Transmission Harness
  - Wiring shorted to power
- TECU
  - Internal short to power

FMI 4

- Transmission Harness
  - Wiring shorted to ground
- Splitter Solenoid Valve
  - Internal short to ground
- TECU
  - Internal short to ground

FMI 5

- Transmission Harness
  - Open circuit
  - Bent, spread, corroded or loose terminals.
- Splitter Solenoid Valve
  - Internal solenoid coil failure
- TECU
  - Internal open circuit

FMI 6

- TECU

FMI 8

- 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

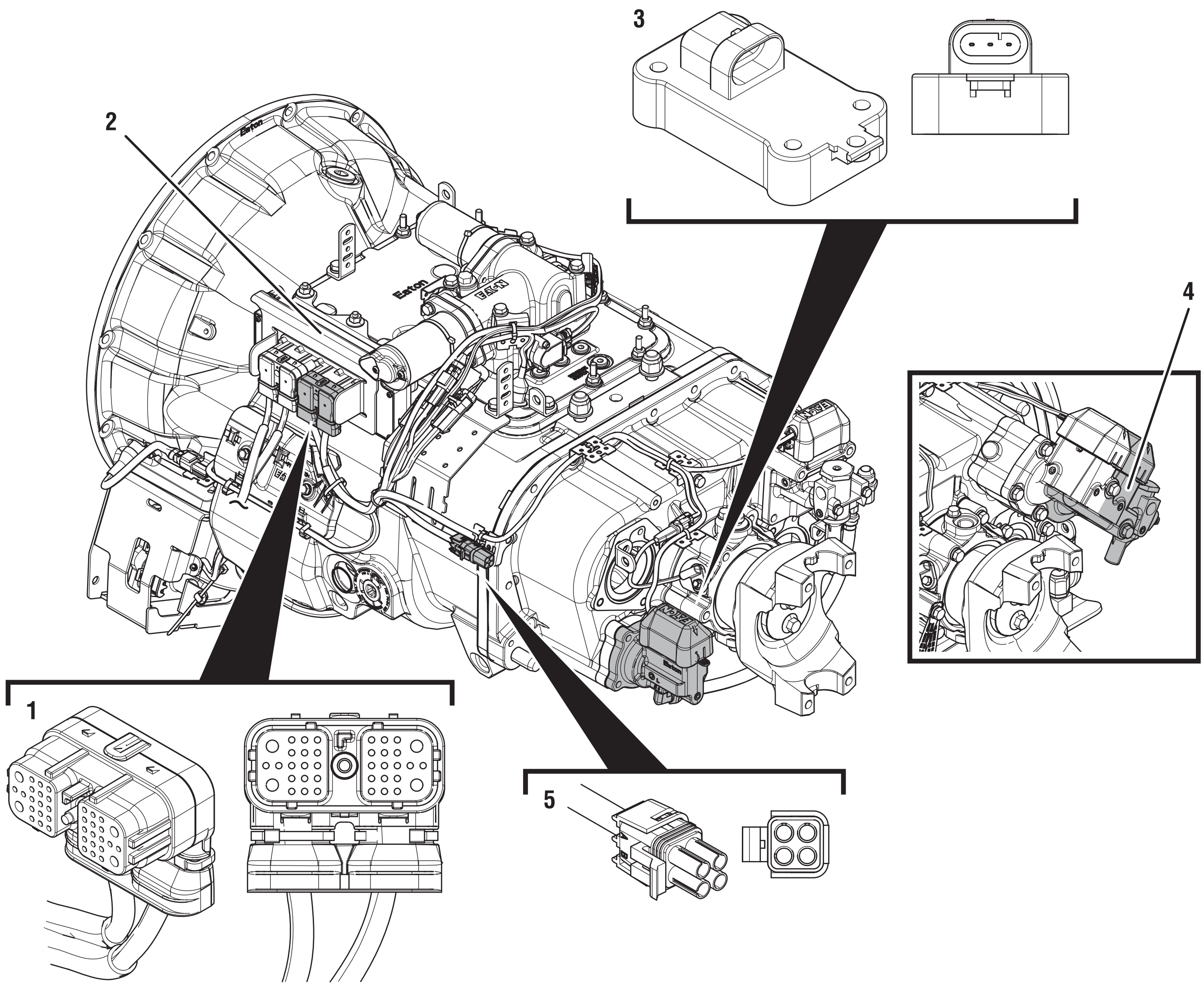
FMI 12

- Driver Behavior
  - Driver induced ignition key cycles not allowing TECU to fully power down
- TECU

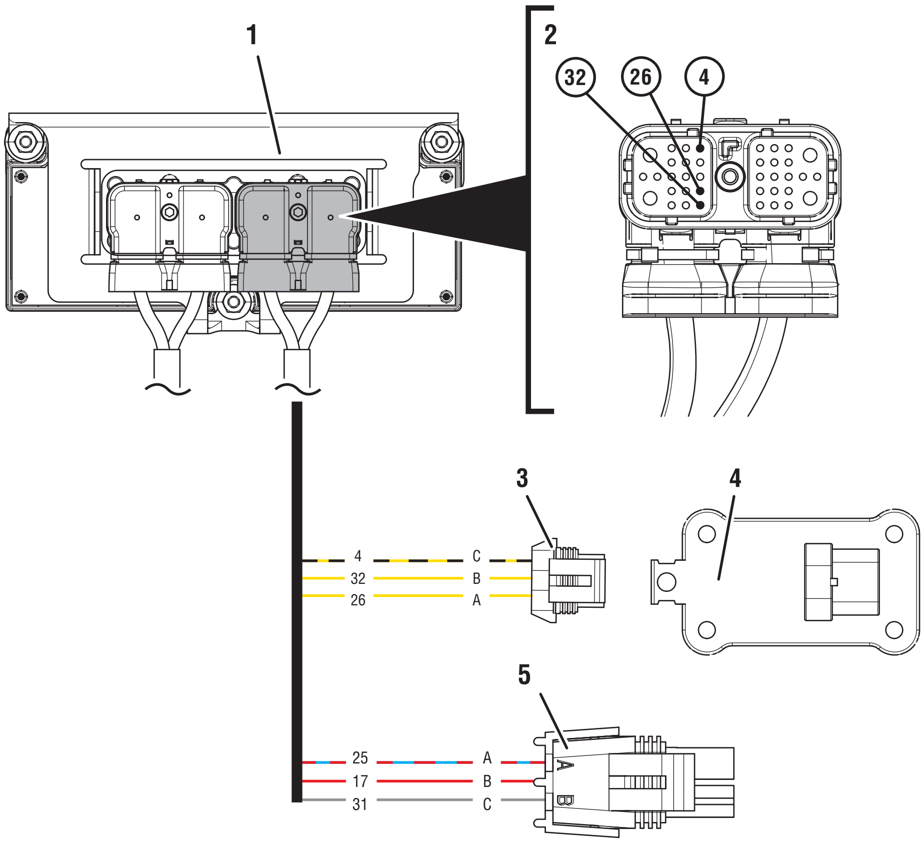
FMI 18

- 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

Component Identification



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. Splitter Solenoid Valve (MHP / VHP / MXP / LSE / VXP)
4. Splitter Solenoid Valve (VCS / VMS)
5. 4-Way Diagnostic Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 3-Way Splitter Solenoid Valve Connector
4. 3-Way Splitter Solenoid Valve
5. 4-Way Diagnostic Connector

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

Fault Code 46 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

   Note: If Fault Code 46 is Inactive, and there are other Active fault codes, troubleshoot all Active fault codes first.

   - If Fault Code 46 FMI 3, 4 or 5 is Active, go to **Step C.**
   - If Fault Code 46 FMI 3, 4 or 5 is Inactive, go to **Step B.**
   - If Fault Code 46 FMI 6 is Active or Inactive, replace TECU. Go to **Step V.**
   - If Fault Code 46 FMI 12 is Active, go to **Step K.**
   - If Fault Code 46 FMI 12 is Inactive, test complete. Go to **Step V.**
   - If Fault Code 46 FMI 8 or 18 is Active or Inactive, go to **Step H.**

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 wiring and connections of the Transmission Harness between the Splitter Solenoid Valve 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.

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

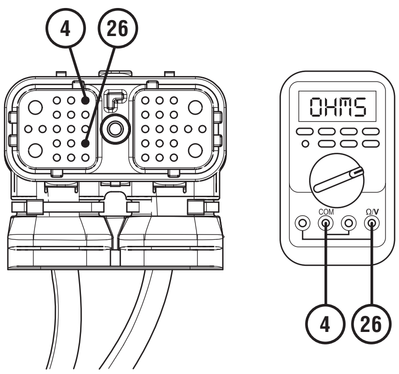
- If Fault Code 46 or any other fault became Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step V.**
- If no fault codes became Active while wiggling the Transmission Harness, go to **Step C.**

C *Purpose:* *Verify continuity of Splitter Solenoid Circuit at the TECU.*

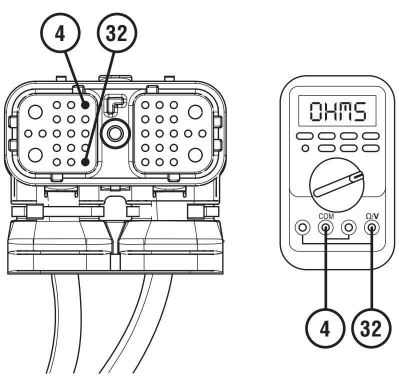
1. Key off.

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

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 26 and Pin 4. Record reading(s) in table.



5. Measure resistance between 38-Way Connector Pin 32 and Pin 4. Record reading(s) in table.

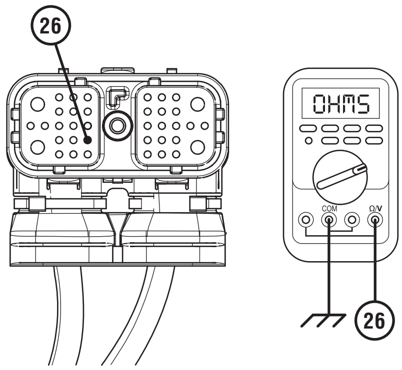


6. Compare reading(s) in table.
   - If readings are in range, go to **Step D.**
   - If readings are out of range, go to **Step F.**

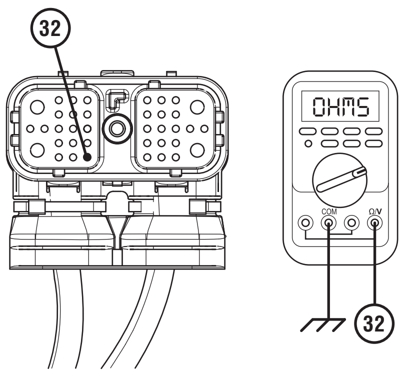
Pins	Range	Reading(s)
26 to 4	9–16 ohms	
32 to 4	9–16 ohms	

D ***Purpose:*** *Check for short to ground in Splitter Solenoid Valve circuit.*

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 26 and ground. Record reading(s) in table.



3. Measure resistance between 38-Way Connector Pin 32 and ground. Record reading(s) in table.

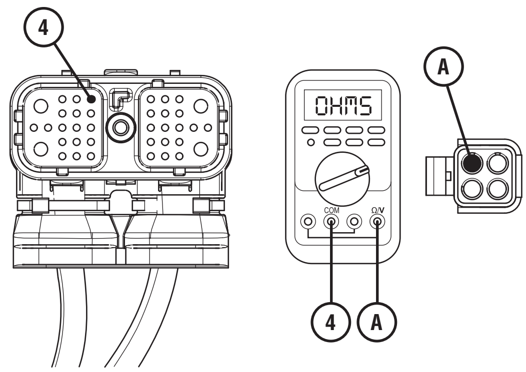


4. Disconnect 3-Way Splitter Solenoid Valve Connector.
5. Inspect 3-Way Connector body for damage and bent, spread, corroded or loose terminals.
6. Compare reading(s) in table.
   - If any reading is out of range, replace Transmission Harness. Go to **Step V.**
   - If all readings are in range and FMI 4 or 5 is set, go to **Step G.**
   - If all readings are in range and FMI 3 is set, go to **Step E.**

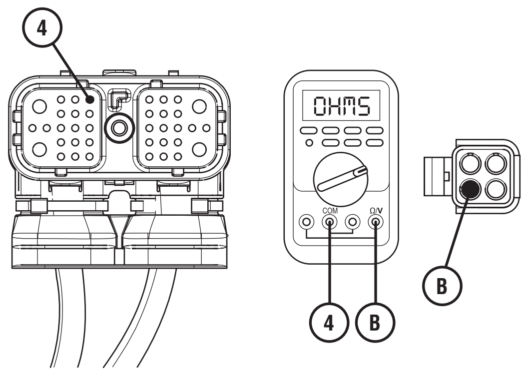
Pins	Range	Reading(s)
26 to Ground	Open Circuit (OL)	
32 to Ground	Open Circuit (OL)	

E ***Purpose:*** *Check for short to power in Splitter Solenoid Valve circuit.*

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



5. Measure resistance between 38-Way Transmission Harness Connector Pin 4 and 4-Way Connector Pin B. Record reading(s) in table.

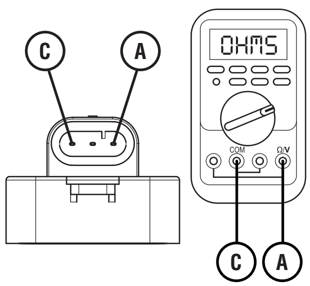


6. Compare reading(s) in table.
   - If any reading is out of range, replace Transmission Harness. Go to **Step V.**
   - If all readings are in range, replace TECU. Go to **Step V.**

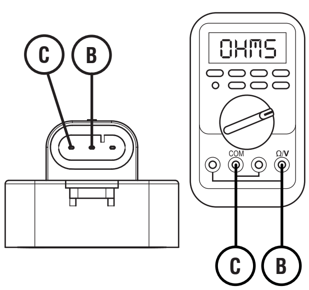
Pins	Range	Reading(s)
4 to A	Open Circuit (OL)	
4 to B	Open Circuit (OL)	

F ***Purpose:*** *Verify continuity of Splitter Solenoid Valve High and Low Circuits.*

1. Key off.
2. Disconnect 3-Way Splitter Solenoid Valve Connector.
3. Measure resistance between 3-Way Splitter Solenoid Valve Pin A and Pin C on the valve body. Record reading(s) in table.



4. Measure resistance between 3-Way Splitter Solenoid Valve Pin B and Pin C on the valve body. Record reading(s) in table.



5. Compare reading(s) in table.
   - If all readings are in range, replace Transmission Harness. Go to **Step V.**
   - If any reading is out of range, replace the Splitter Solenoid Valve. Go to **Step V.**

Pins	Resistance Range	Resistance
A to C	9–16 ohms	
B to C	9–16 ohms	

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 engine off.
5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
   - If Fault Code 46 is now Inactive, replace Transmission Harness and Splitter Solenoid Valve. Go to **Step V.**
   - If Fault Code 46 is now Active, replace TECU. Go to **Step V.**

H

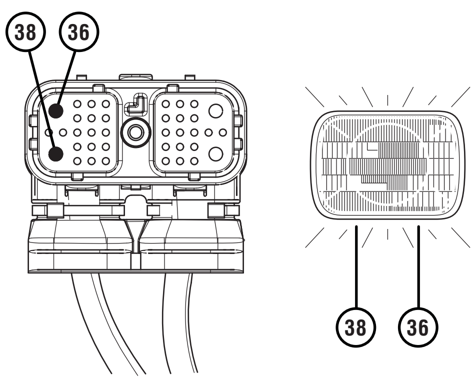
Purpose: *Verify condition of power and ground supply.*

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 I.**

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

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 fault code status.*

1. Determine which FMI set for Fault Code 46.
   - If FMI 8 set, replace TECU. Go to **Step V.**
   - If FMI 18 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is in TECU Power Supply Harness and/or battery/charging system. Contact OEM for further help troubleshooting the wiring and/or battery/charging system. Go to **Step V.**

K ***Purpose:*** *Perform compete TECU Power Down.*

1. Key on with engine off.
2. Key off and allow the TECU to perform a complete power down.

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

   - 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. 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 46 FMI 3, 4, 5, 6, 8 or 18 sets Active during the test drive, go to **Step A.**
   - If Fault Code 46 FMI 12 sets Active during the test drive, replace the TECU.
   - If a fault code other than 46 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 51: Rail Position Sensor

J1587: MID 130 PID 60 FMI 2, 3, 4, 10 , 11
J1939: SA 3 SPN 60 FMI 2, 3, 4, 10 , 11

Overview

The UltraShift *PLUS* 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 ±0.2 volts, or finger position moved by more than ±0.093 inches, while the transmission is engaged in gear.

FMI 11 – Root Cause Unknown: The X-Y Rail Position Sensor voltage is out of range.

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 engine 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 ±0.2 volts) while the transmission is in gear.

FMI 11: X-Y Rail Position Sensor voltage in range.

Possible Causes

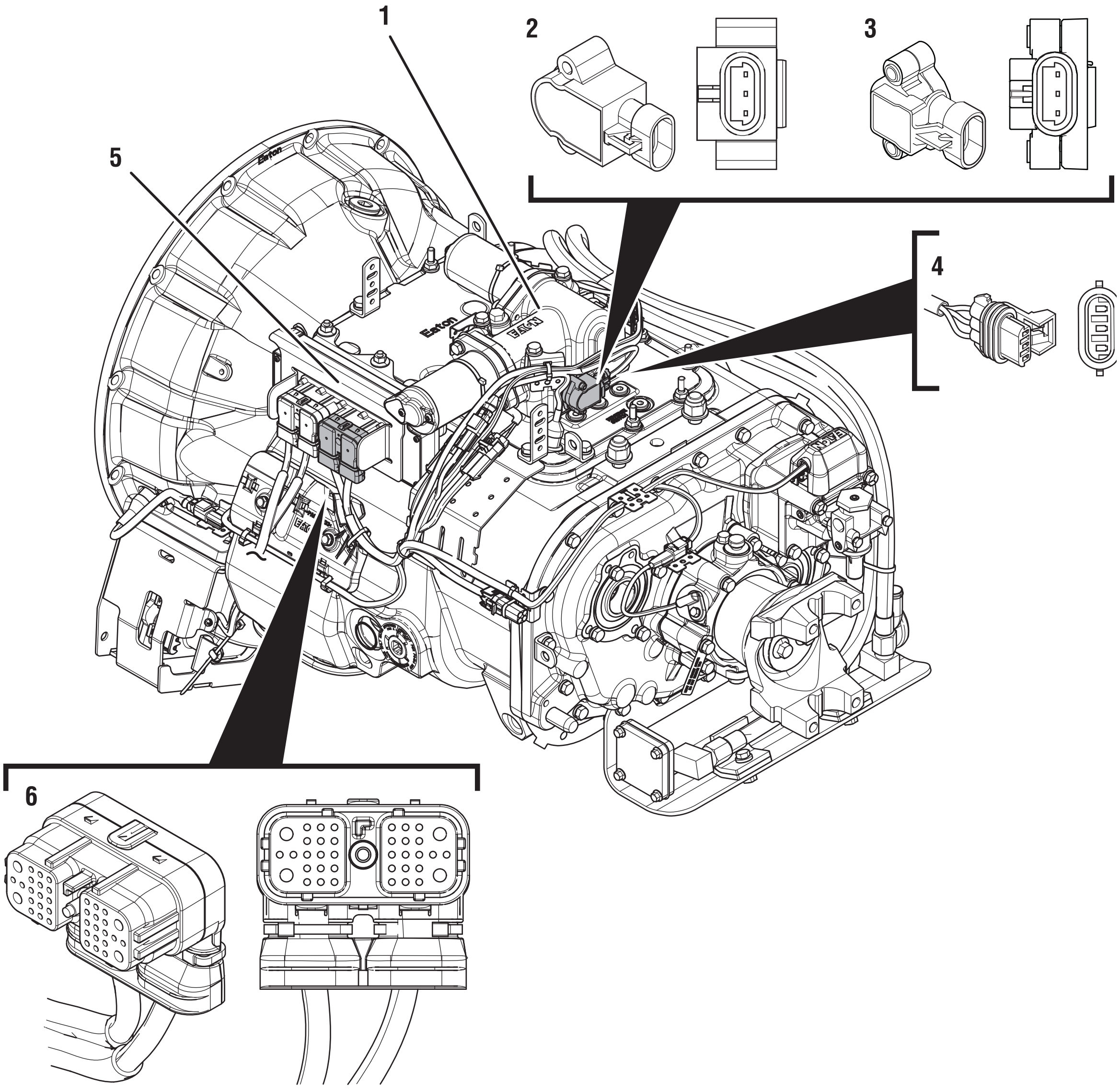
FMI 2, 4, 10, 11

- 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

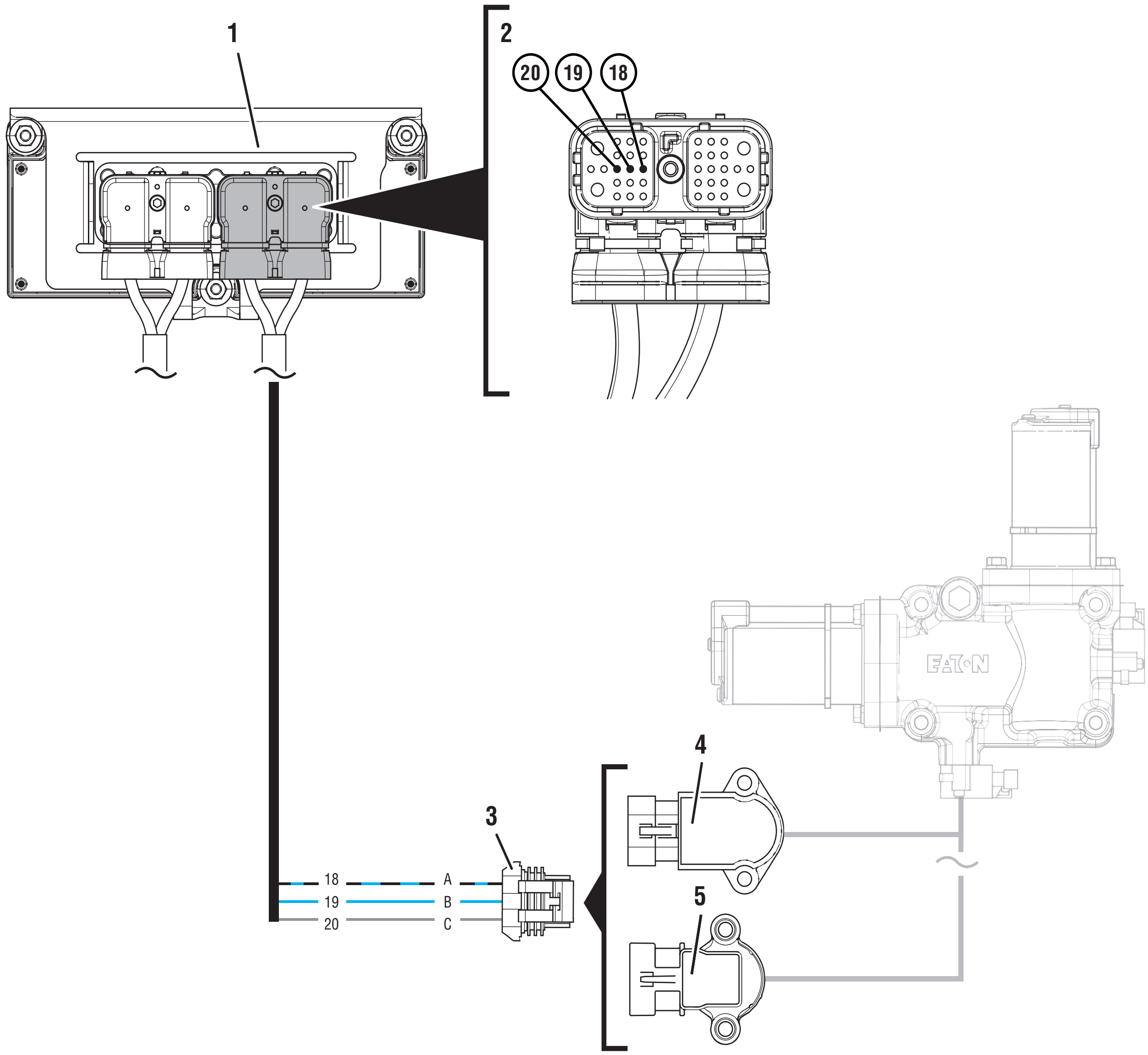
FMI 3

- 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. 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, 11 is Active, go to **Step C.**
   - If Fault Code 51 FMI 3, 4, 10, 11 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.

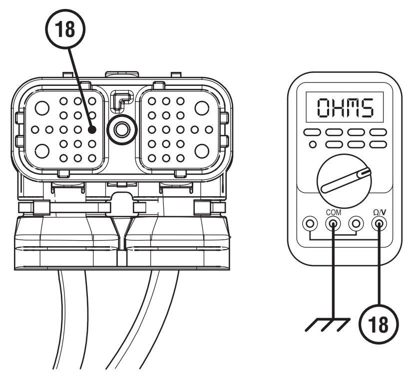
Important: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

   - 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 F.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
18 to Ground	Open Circuit (OL)	

D

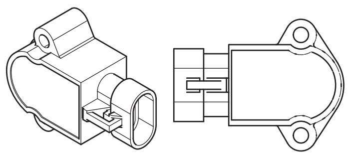
Purpose: *Verify the condition of the 38-Way Transmission Harness Connector.*

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 F.**
   - If contamination or damage is found, replace the Transmission Harness. Go to **Step V.**

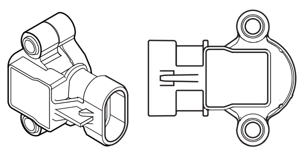
E ***Purpose:*** *Identify 3-Way Rail Position Sensor installed on transmission.*

1. Inspect 3-Way Rail Position Sensor, reference image below.

(A)



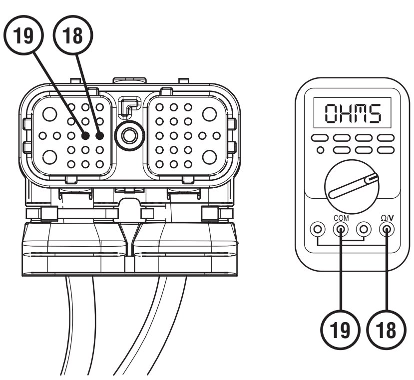
(B)



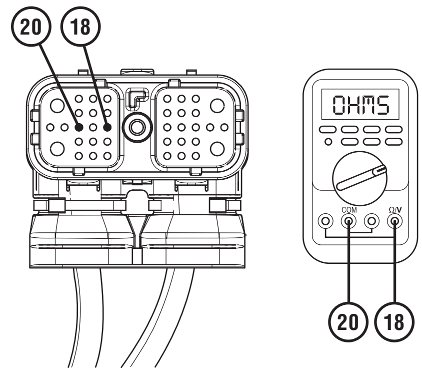
- If equipped with a 3-Way Rail Position Sensor (A), go to **Step F.**
- If equipped with a 3-Way Rail Position Sensor (B), go to **Step J.**

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	

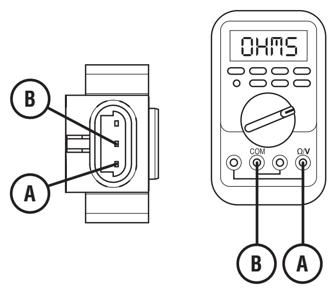
G ***Purpose:*** *Verify which FMI set.*

1. Determine which FMI set for Fault Code 51.
   - If FMI 2, 10 or 11 set, replace Transmission Harness. Go to **Step V.**
   - If FMI 3 or 4 set, replace TECU and Transmission Harness. Go to **Step V.**

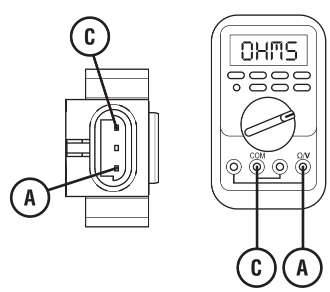
H

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 Shifter. Go to **Step V.**

Pins	Range	Reading(s)
A to B	150 – 200 ohms	
A to C	5.5k – 6.5k ohms	

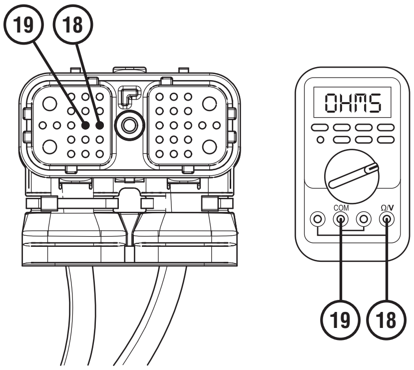
I

Purpose: *Verify which FMI set.*

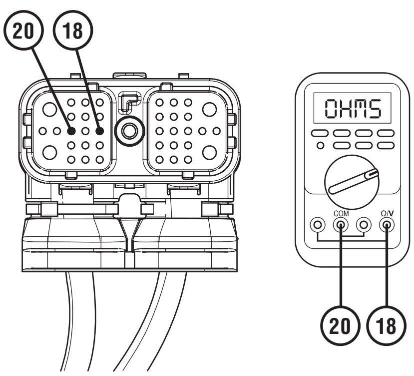
1. Determine which FMI set for Fault Code 51.
   - If FMI 2,10 or 11 set, replace Transmission Harness. Go to **Step V.**
   - If FMI 3 or 4 set, replace TECU and Transmission Harness. Go to **Step V.**

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	

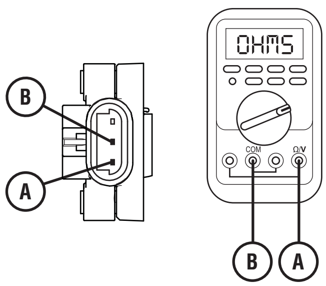
K *__Purpose:__ Verify which FMI set.*

1. Determine which FMI set for Fault Code 51.
   - If FMI 2, 10 or 11 set, replace Transmission Harness. Go to **Step V.**
   - If FMI 3 or 4 set, replace TECU and Transmission Harness. Go to **Step V.**

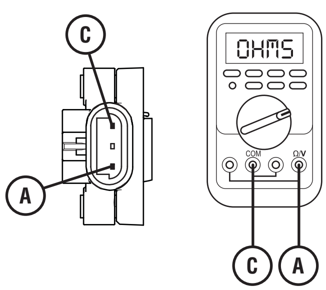
L

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 Shifter. 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 2,10 or 11 set, replace Transmission Harness. Go to **Step V.**
   - If FMI 3 or 4 set, replace 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 engine 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 13.

Fault Code 52: Gear Position Sensor

J1587: MID 130 PID 59 FMI 2, 3, 4, 7, 10, 11
J1939: SA 3 SPN 59 FMI 2, 3, 4, 7, 10, 11

Overview

The UltraShift *PLUS* 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 ±0.2 volts, or finger position moved by more than ±0.093 inches, while the transmission is engaged in gear.

FMI 11 – Mechanical System Not Responding: The X-Y Gear Position Sensor voltage is out of range.

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 engine 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 Bar Housing.

FMI 10: X-Y Rail Position Sensor return voltage signal remains consistent (within ±0.2 volts) while the transmission is in gear.

FMI 11: X-Y Rail Position Sensor voltage in range.

Possible Causes

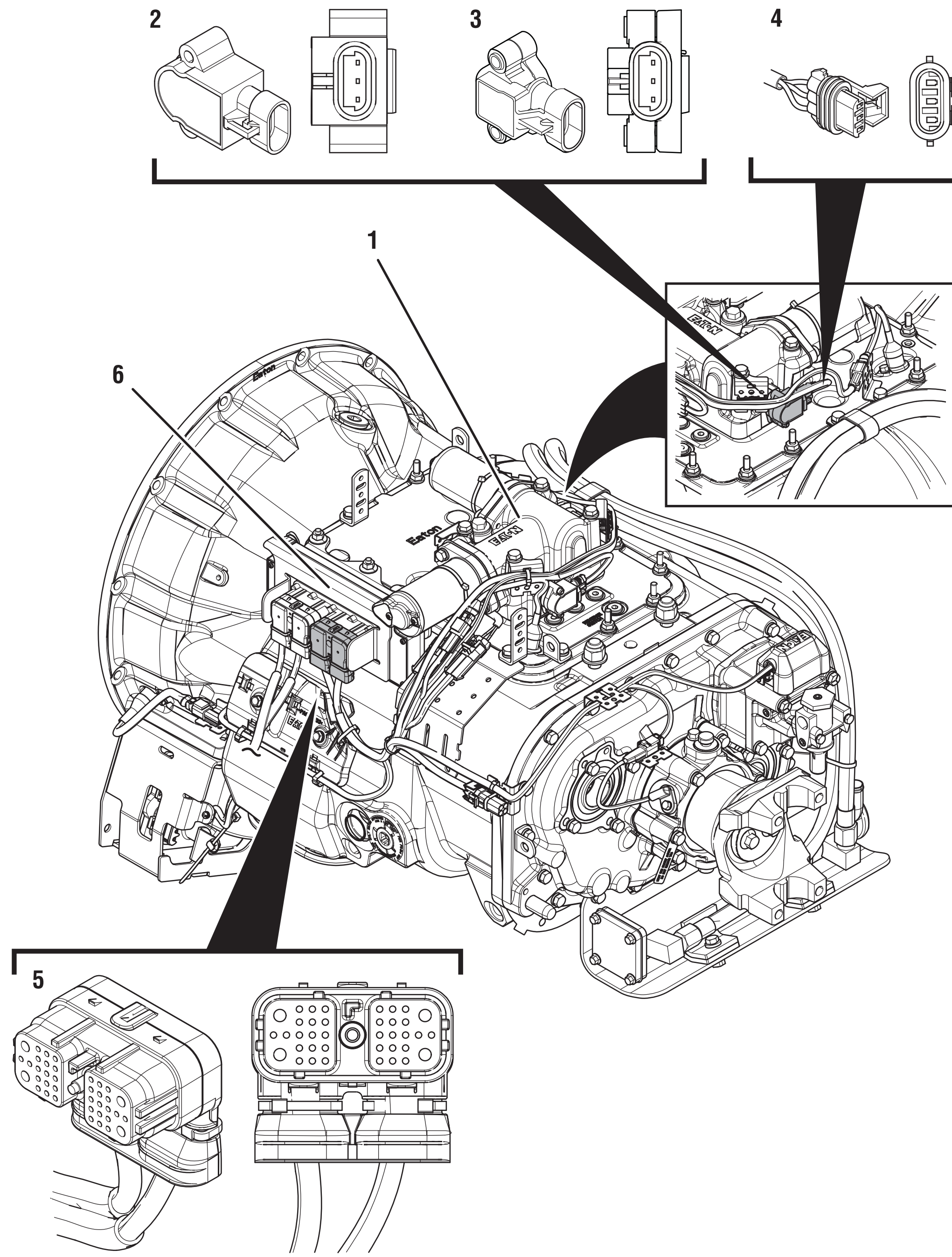
2, 4, 7, 10, 11:

- 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

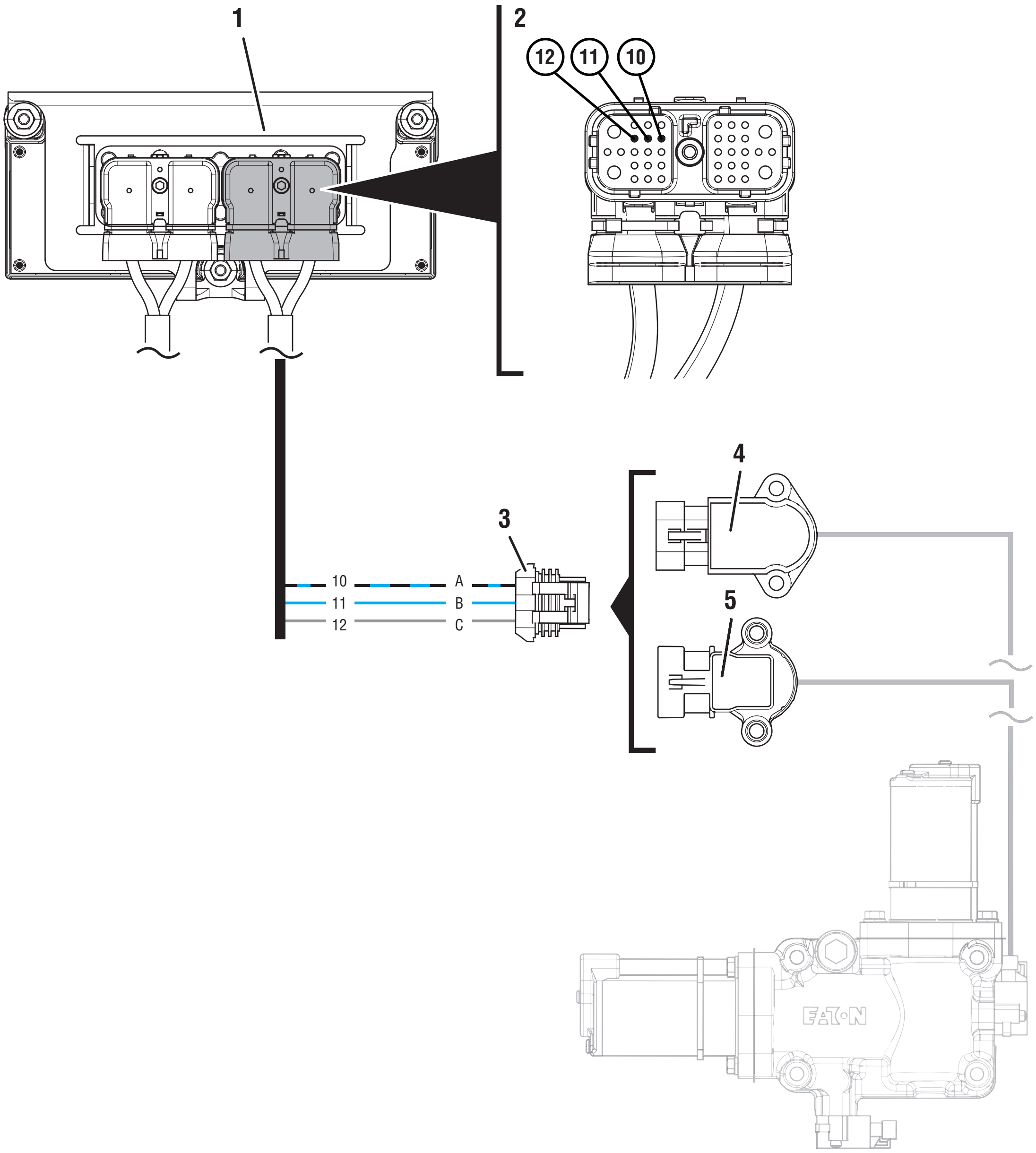
FMI 3:

- 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)

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

Fault Code 52 Troubleshooting

A

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

1. 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, 11 is Active, go to **Step C.**
   - If Fault Code 52 FMI 3, 4, 7, 10, 11 is Inactive, go to **Step B.**
   - If Fault Code 52 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 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.

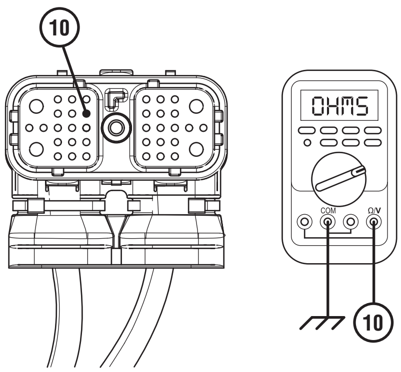
Important: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- 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 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 F.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
10 to Ground	Open Circuit (OL)	

D

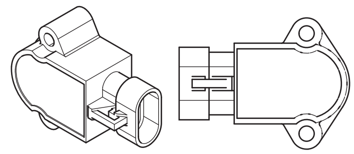
Purpose: *Verify the condition of the 38-Way Transmission Harness Connector.*

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 F.**
   - If contamination or damage is found, replace the Transmission Harness. Go to **Step V.**

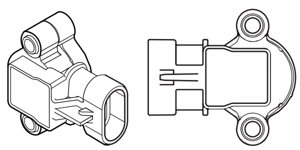
E ***Purpose:*** *Identify 3-Way Gear Position Sensor installed on transmission.*

1. Inspect 3-Way Gear Position Sensor, reference image below.

(A)



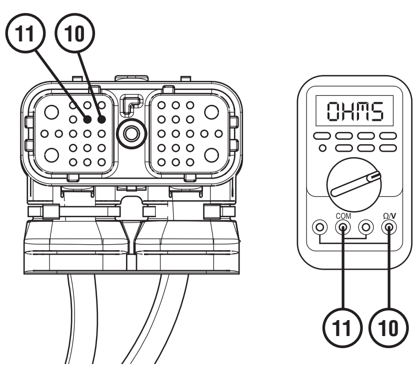
(B)



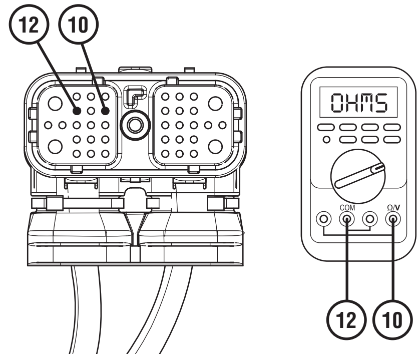
- If equipped with a 3-Way Gear Position Sensor (A), go to **Step F.**
- If equipped with a 3-Way Gear Position Sensor (B), go to **Step J.**

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.**

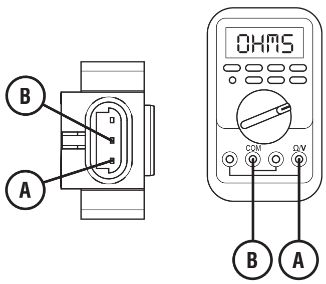
Pins	Range	Reading(s)
10 to 11	150 – 200 ohms	
10 to 12	5.5k – 6.5k ohms	

G ***Purpose:*** *Verify which FMI set.*

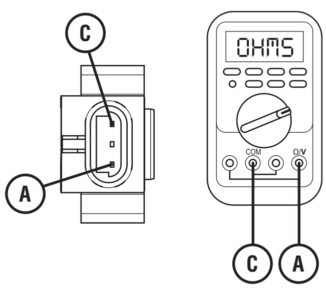
1. Determine which FMI set for Fault Code 52.
   - If FMI 2, 7, 10 or 11 set, replace Transmission Harness. Go to **Step V.**
   - If FMI 3 or 4 set, replace TECU and Transmission Harness. Go to **Step V.**

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 Shifter. Go to **Step V.**

Pins	Range	Reading(s)
A to B	150 – 200 ohms	
A to C	5.5k – 6.5k ohms	

I

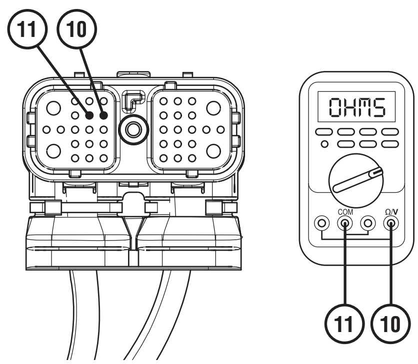
Purpose: *Verify which FMI set.*

1. Determine which FMI set for Fault Code 52.
   - If FMI 2, 7, 10 or 11 set, replace Transmission Harness. Go to **Step V.**
   - If FMI 3 or 4 set, replace TECU and Transmission Harness. Go to **Step V.**

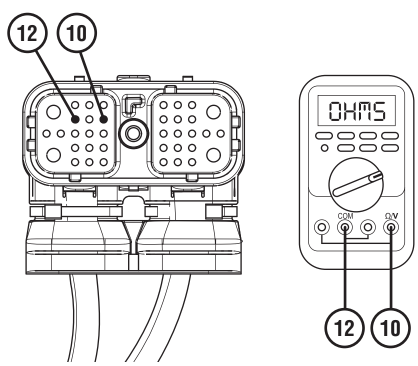
J

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 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	

K

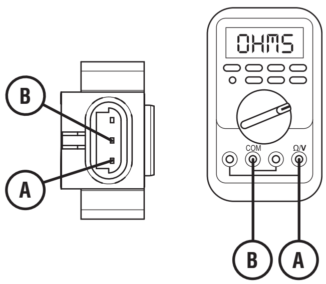
Purpose: *Verify which FMI set.*

1. Determine which FMI set for Fault Code 52.
   - If FMI 2, 7, 10 or 11 set, replace Transmission Harness. Go to **Step V.**
   - If FMI 3 or 4 set, replace TECU and Transmission Harness. Go to **Step V.**

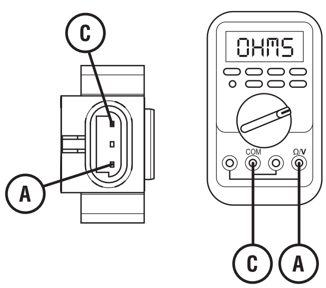
L

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 Shifter. 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, 10 or 11 set, replace Transmission Harness. Go to **Step V.**
   - If FMI 3 or 4 set, replace 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 engine 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 13.

Fault Code 56: Input Shaft Speed Sensor

J1587 MID 130 PID 161 FMI 2, 3, 4, 5
J1939 SA 3 SPN 161 FMI 2, 3, 4, 5

Overview

The UltraShift *PLUS* transmission is equipped with electronic speed sensors. The Input Shaft, Main 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 upper countershaft drive gear. The Main Shaft Speed Sensor measures the rotational speed of the transmission gearing exiting the main case, taken from the auxiliary upper countershaft gear. The Output Shaft Speed Sensor measures the rotational speed of the output shaft taken from the Output Shaft Tone Wheel. The Transmission Electronic Control Unit (TECU) compares these speeds to calculate the gear ratios of the main case, auxiliary case and overall transmission.

The Input Shaft Speed Sensor transmits a voltage signal to the TECU based on the rotational speed of the Input Shaft entering the transmission main case. The TECU compares Input Shaft Speed to Main Shaft Speed to confirm the gear ratio of the main case and 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 Main Shaft Speed Sensor and 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.

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

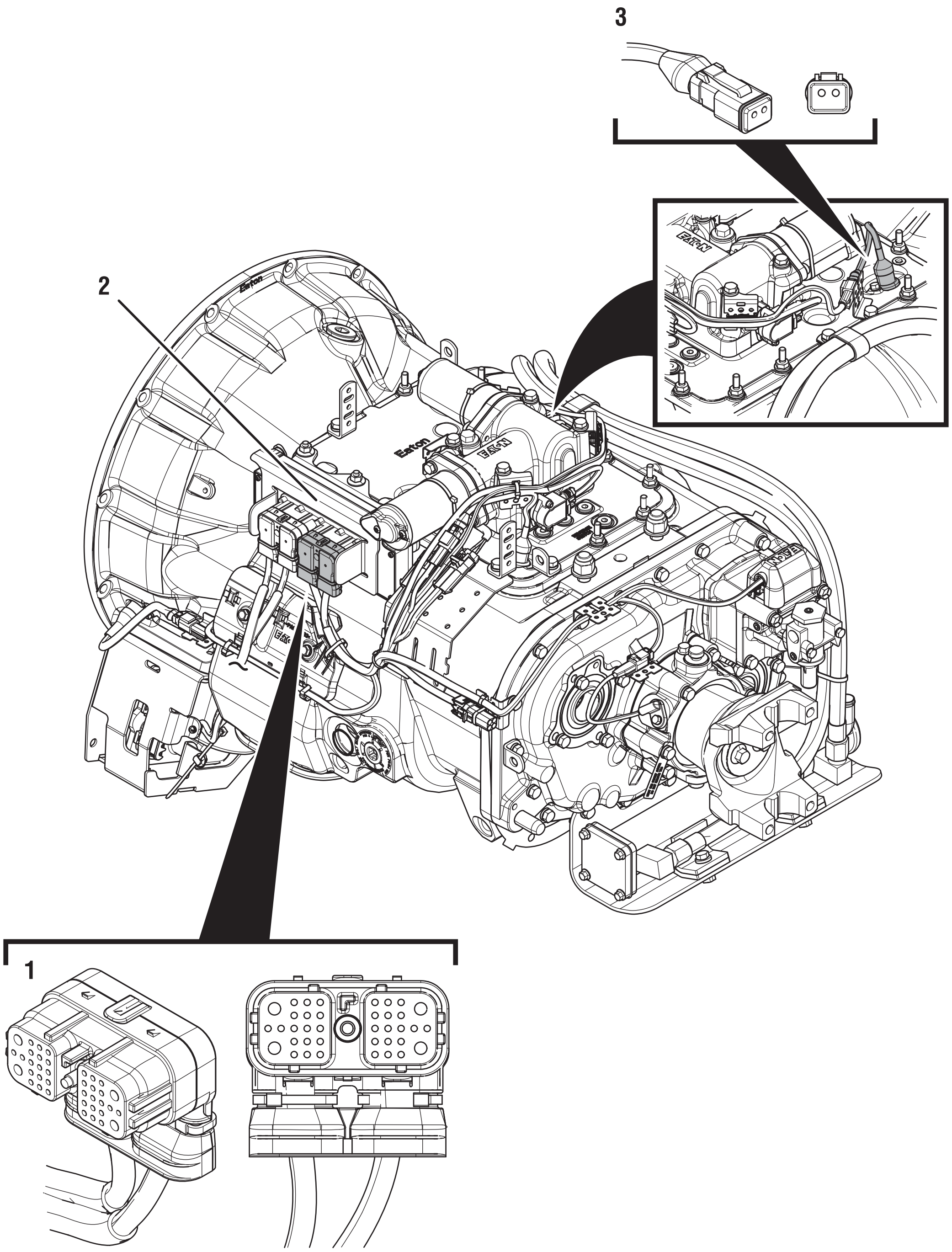
All FMIs: TECU receives a valid signal from the Input Shaft Speed Sensor and detects no electrical open or short circuits for 2 seconds.

Possible Causes

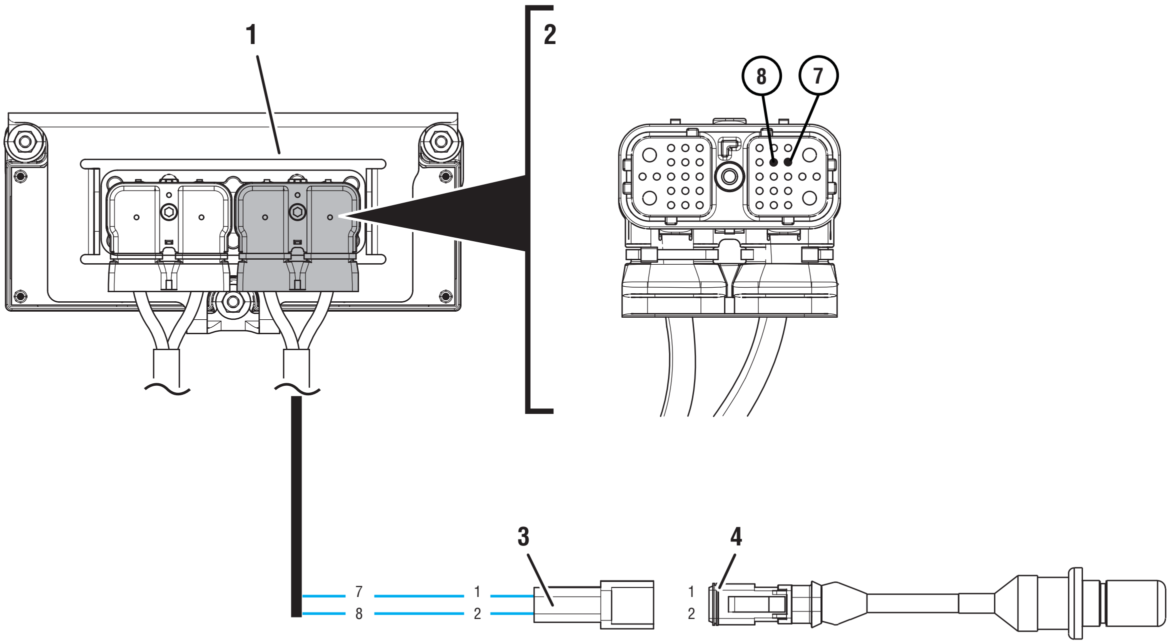
All FMIs

- 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. 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, 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 Shift Bar Housing.
5. Exit PD Mode by powering down.

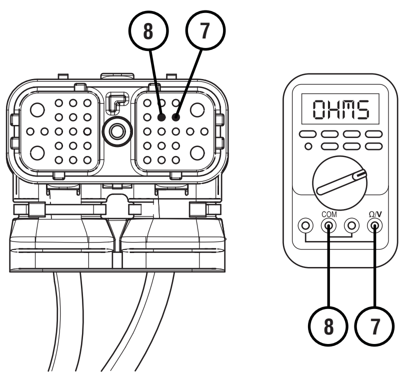
Important: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- 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.**

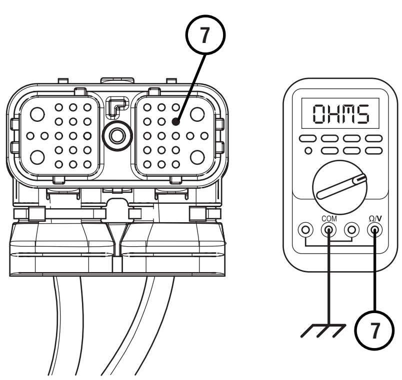
C

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.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 7 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 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)	

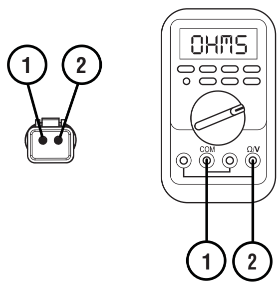
D

Purpose: *Verify fault code status.*

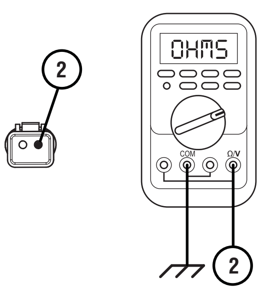
1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Connect ServiceRanger.
4. Key on with engine off.
5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
   - If Fault Code 56 is Inactive, replace Transmission Harness and Input Shaft Speed Sensor. Go to **Step V.**
   - If Fault Code 56 is Active, replace 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.

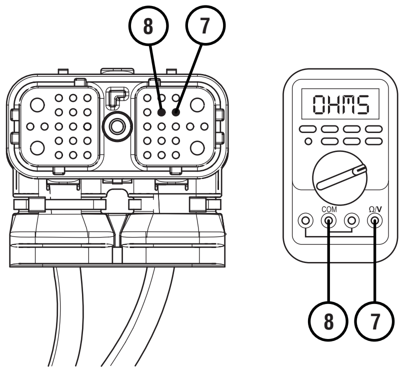


6. Reconnect 2-Way Input Shaft Speed Sensor to the Transmission Harness.
7. Compare reading(s) in table.
   - If readings are in range, replace Transmission Harness. Go to **Step V.**
   - If readings are out of range, replace Input Shaft Speed Sensor. Go to **Step V.**

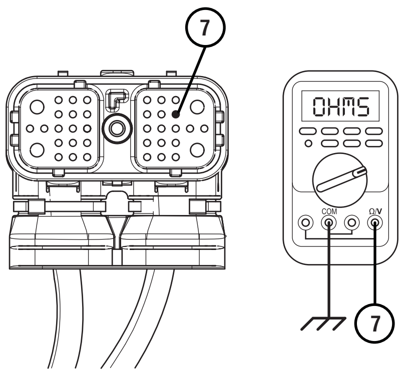
Pins	Range	Reading(s)
1 to 2	2.0k–4.5k ohms	
2 to Ground	Open Circuit (OL)	

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.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 7 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.**

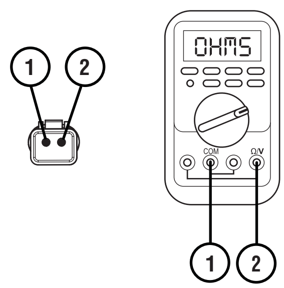
Pins	Range	Reading(s)
7 to 8	2.0k–4.5k ohms	
7 to Ground	Open Circuit (OL)	

G ***Purpose:*** *Inspect Transmission Main Case for internal damage.*

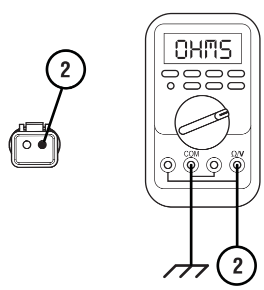
1. Key off.
2. Drain transmission of lubricant into a clean pan for re-use. Note how much lubricant comes out and if significant metal fragments appear in the oil.
3. Remove the 8-bolt PTO Cover.
4. Inspect Main Case components for any signs of damage, specifically to the main drive gear and its mating upper countershaft gear.
   - 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 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 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 engine 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 13.

Fault Code 57: Main Shaft Speed Sensor

J1587: MID 130 PID 160 FMI 2, 3, 4, 5
J1939: SA 3 SPN 160 FMI 2, 3, 4, 5

Overview

The UltraShift *PLUS* transmission is equipped with four electronic speed sensors. The Input Shaft, Main 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 upper countershaft drive gear. The Main Shaft Speed Sensor measures the rotational speed of the transmission gearing exiting the main case, taken from the auxiliary upper countershaft gear. The Output Shaft Speed Sensor measures the rotational speed of the output shaft taken from the Output Shaft Tone Wheel. The Transmission Electronic Control Unit (TECU) compares these speeds to calculate the gear ratios of the main case, auxiliary case and overall transmission.

The Main Shaft Speed Sensor transmits a voltage signal to the TECU based on the rotational speed of the gearing exiting the transmission main case. The TECU compares Main Shaft Speed to Input Shaft Speed to confirm the gear ratio of the main case and compares Main Shaft Speed to Output Shaft Speed to confirm the gear ratio of the auxiliary case.

Fault Code 57 indicates an electrical fault within the Main Shaft Speed Sensor circuit or a speed value that is inconsistent with the calculated gear ratios.

Detection

The TECU compares the values of these three speed sensors to determine sensor validity. The TECU also monitors the Main Shaft Speed Sensor electrical circuit for any shorts to power, ground or open circuits.

Conditions to Set Fault Code Active

The system can detect Main 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 Main Shaft Speed Sensor has high resistance.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If fault occurs in low range, transmission will not complete a high range shift.
- If fault occurs in high range, transmission will down shift into low range, but will not shift back into high range.

Conditions to Set Fault Code Inactive

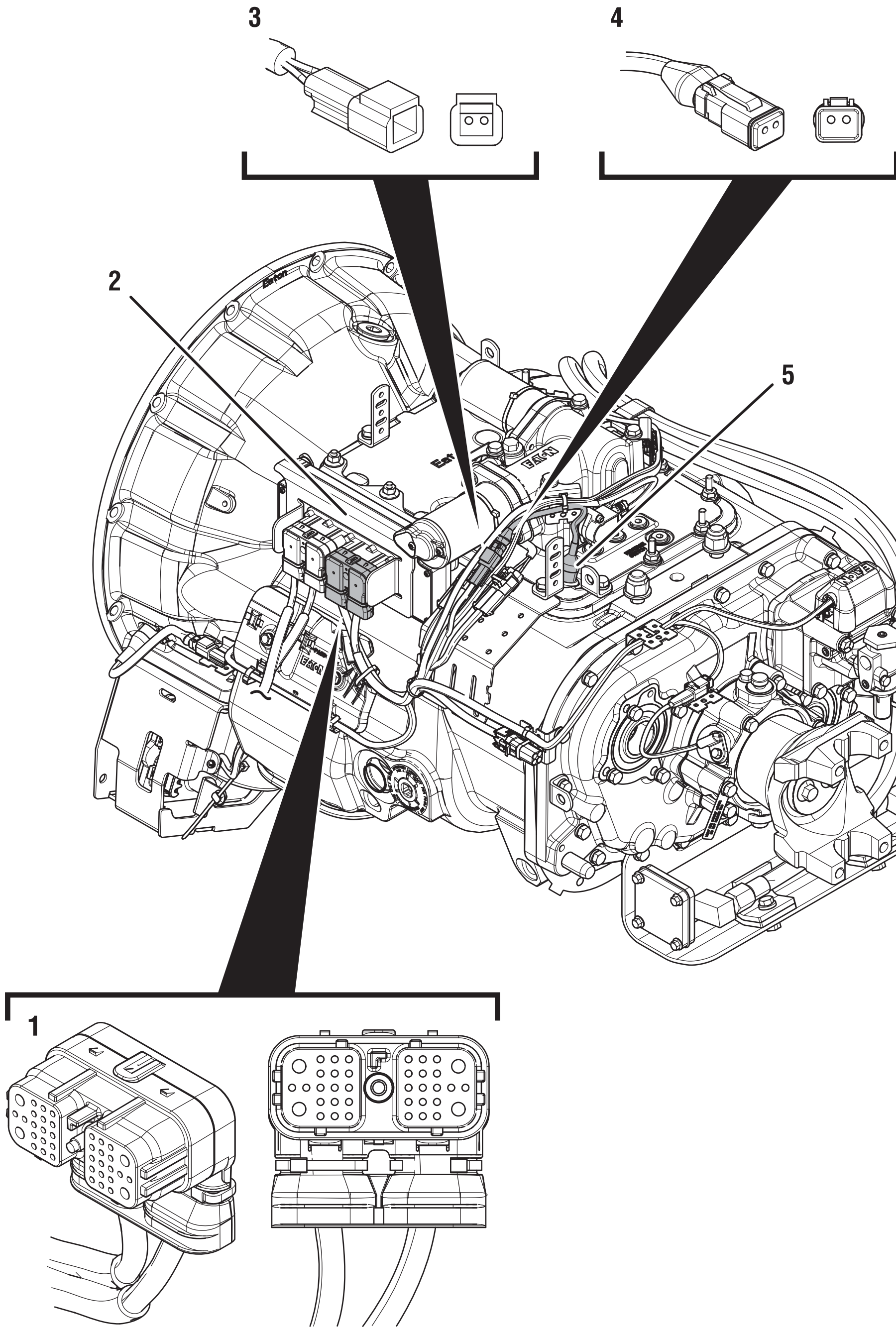
All FMIs: TECU receives a valid signal from the Main Shaft Speed Sensor and detects no electrical open or short circuits for 2 seconds.

Possible Causes

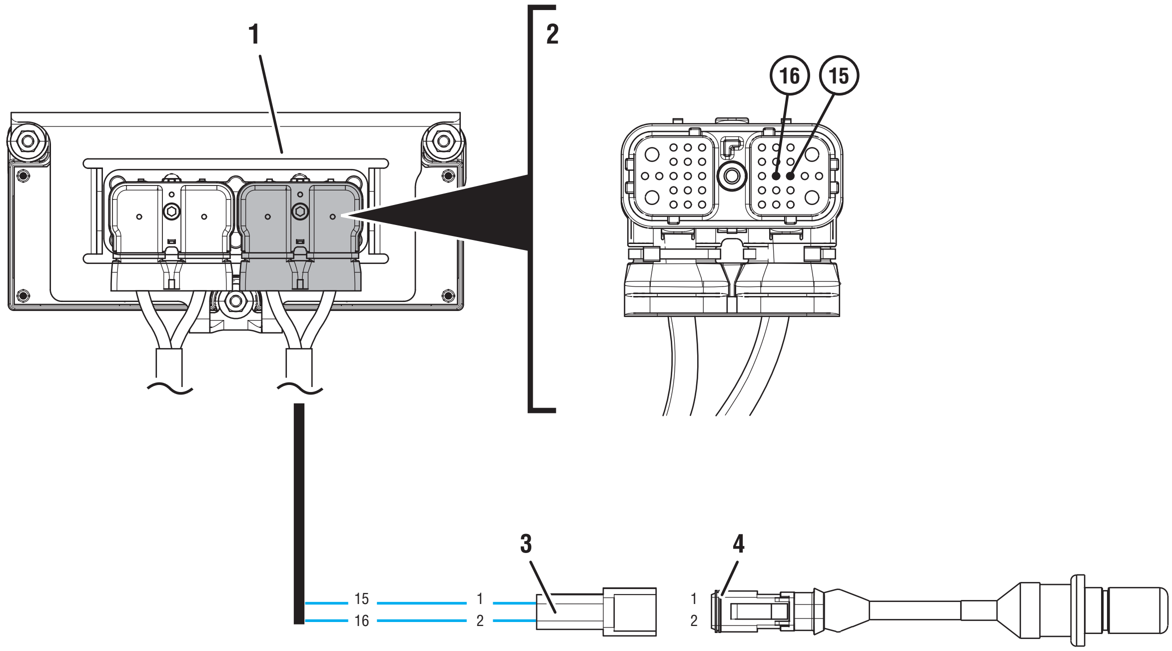
All FMIs

- Transmission Harness
  - Bent, spread, loose or corroded terminals
  - Wiring shorted to ground, shorted to power or open
- Main Shaft Speed Sensor
  - Internal failure
  - Physical damage
- Mechanical Transmission
  - Auxiliary Drive Gear damage or failure
  - Auxiliary Countershaft gear damage or failure

Component Identification



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. 2-Way Main Shaft Speed Sensor Connector Body
4. 2-Way Main Shaft Speed Sensor
5. Main Shaft Speed Sensor



1. *Transmission Electronic Control Unit (TECU)*
2. *38-Way Transmission Harness Connector*
3. *2-Way Main Shaft Speed Sensor Connector Body*
4. *2-Way Main Shaft Speed Sensor*

Fault Code 57 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
    - If Fault Code 57 is Active with FMI 3, 4 or 5, go to **Step C.**
    - If Fault Code 57 is Active or Inactive with FMI 2, go to **Step F.**
    - If Fault Code 57 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 Main Shaft Speed Sensor to the TECU. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Verify Main Shaft Speed Sensor is properly installed and secured, not damaged or corroded within the Shift Bar Housing.
5. Exit PD Mode by powering down.

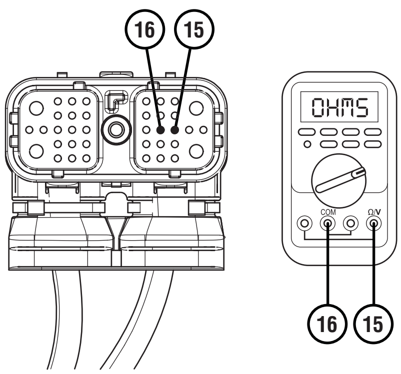
Important: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.

- 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 Main Shaft Speed Sensor, replace Main Shaft Speed Sensor. Go to **Step V.**
- If no fault is found, replace Transmission Harness and Main Shaft Speed Sensor. Go to **Step V.**

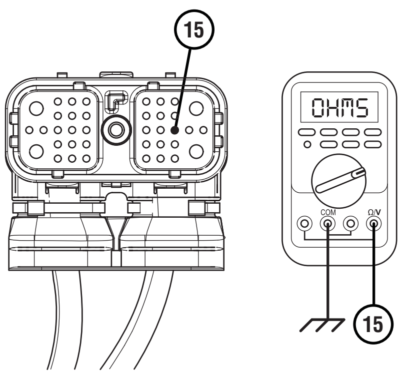
C

Purpose: *Verify continuity of Main 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 15 and Pin 16. Record reading(s) in table.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 15 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 D.**
   - If readings are out range, go to **Step E.**

Pins	Range	Reading(s)
15 to 16	2.0k–4.5k ohms	
15 to Ground	Open Circuit (OL)	

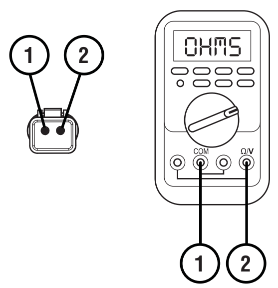
D

Purpose: *Verify fault code status.*

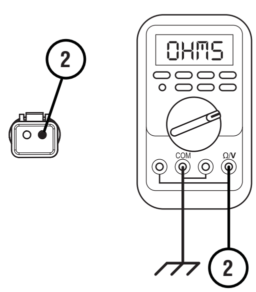
1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Connect ServiceRanger.
4. Key on with engine off.
5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
   - If Fault Code 57 is Inactive, replace Transmission Harness and Main Shaft Speed Sensor. Go to **Step V.**
   - If Fault Code 57 is Active, replace TECU. Go to **Step V.**

E ***Purpose:*** *Verify continuity across Main Shaft Speed Sensor and no continuity to ground.*

1. Key off.
2. Disconnect the 2-Way Main 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 Main Shaft Speed Sensor Pin 1 and Pin 2. Record reading(s) in table.



5. Measure resistance between 2-Way Main Shaft Speed Sensor Pin 2 and ground. Record reading(s) in table.



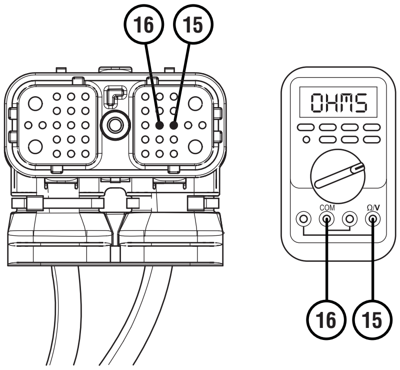
6. Reconnect 2-Way Main Shaft Speed Sensor to the Transmission Harness.
7. Compare reading(s) in table.
   - If readings are in range, replace Transmission Harness. Go to **Step V.**
   - If readings are out of range, replace Main Shaft Speed Sensor. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	2.0k–4.5k ohms	
2 to Ground	Open Circuit (OL)	

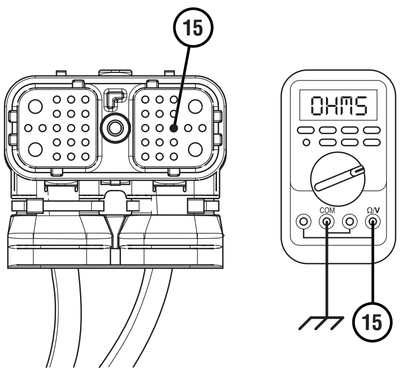
F

Purpose: *Verify continuity of Main 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 Pin 15 and Pin 16. Record reading(s) in table.



5. Measure resistance between 38-Way Transmission Harness Pin 15 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)
15 to 16	2.0k–4.5k ohms	
15 to Ground	Open Circuit (OL)	

G

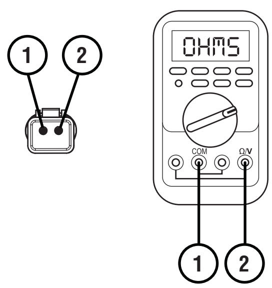
Purpose: *Inspect Transmission Main Case for internal damage.*

1. Key off.
2. 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.
3. Remove the 8-bolt PTO Cover.
4. Inspect Main Case components for any signs of damage, specifically to the main drive gear and its mating upper countershaft gear.
   - 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 Main Shaft Speed Sensor and Transmission Harness. Go to **Step V.**

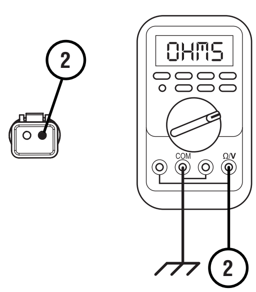
H

Purpose: *Verify continuity across Main Shaft Speed Sensor and no continuity to ground.*

1. Key off.
2. Disconnect the 2-Way Main 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 Main Shaft Speed Sensor Pin 1 and Pin 2. Record reading(s) in table.



5. Measure resistance between 2-Way Main Shaft Speed Sensor Pin 2 and ground. Record reading(s) in table.



6. Reconnect 2-Way Main 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 Main 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 engine 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 57 sets Active during the test drive, contact Eaton at (800) 826-4357 for further diagnostics.
   - If a fault code other than 57 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 58: Output Shaft Speed Sensor

J1587: MID 130 PID 191 FMI 2, 5, 6, 8, 10, 11
J1939: SA 3 SPN 191 FMI 2, 5, 6, 8, 10, 11

Overview

The UltraShift *PLUS* transmission is equipped with electronic speed sensors. The Input Shaft, Main 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 upper countershaft drive gear. The Main Shaft Speed Sensor measures the rotational speed of the transmission gearing exiting the main case, taken from the auxiliary upper countershaft gear. The Output Shaft Speed Sensor measures the rotational speed and direction of the output shaft, taken from the Tone Wheel. The Transmission Electronic Control Unit (TECU) compares these speeds to calculate the gear ratios of the main case, auxiliary case and overall transmission.

The Output Shaft Speed Sensor transmits a digital signal to the TECU based on the rotational speed of the Output Shaft Tone Wheel. The TECU compares Main Shaft Speed to Output Shaft Speed to confirm the gear ratio of the auxiliary case and compares Input Shaft Speed to Output Shaft Speed to confirm the overall transmission gear ratio.

Fault Code 58 indicates an electrical fault within the Output Shaft Speed Sensor circuit or a speed value or rotational direction that is inconsistent with the calculated gear ratios.

Detection

The TECU compares the values of the three speed sensors to determine sensor validity. The TECU also monitors the Output Shaft Speed Sensor circuit for any shorts to power, shorts to ground, open circuits or incorrect rotational direction of the Output Shaft.

Conditions to Set Fault Code Active

The system can detect Output Shaft Speed Sensor faults when one of the following conditions is present for 1 second or longer:

FMI 2 – Data Erratic: TECU detects data from the Output Shaft Speed Sensor does not match the current gear ratio.

FMI 5 – Current Below Normal or Open Circuit: TECU detects an open circuit or the Output Shaft Speed Sensor has high resistance.

FMI 6 – Current Above Normal or Grounded Circuit: TECU detects a short to power in the circuit.

FMI 8 – Abnormal Frequency: TECU detects an incorrect rotational direction from the Output Shaft Speed Sensor.

FMI 10 – Abnormal Rate of Change: TECU detects an excessive rate change.

FMI 11 – Root Cause Unknown: TECU detects a speed sensor error.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If fault occurs in low range, transmission still shifts up and down within low range, but will not complete the shift to high range.
- If fault occurs while in high range, the transmission still shifts up and down within high range. Once low range is reached, the transmission will not complete the shift back to high range.

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

- Output Shaft Speed Sensor
  - Internal failure
  - Physical damage
- Mechanical Transmission
  - Internal failure in auxiliary case
  - Loose or broken Tone Wheel

FMI 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

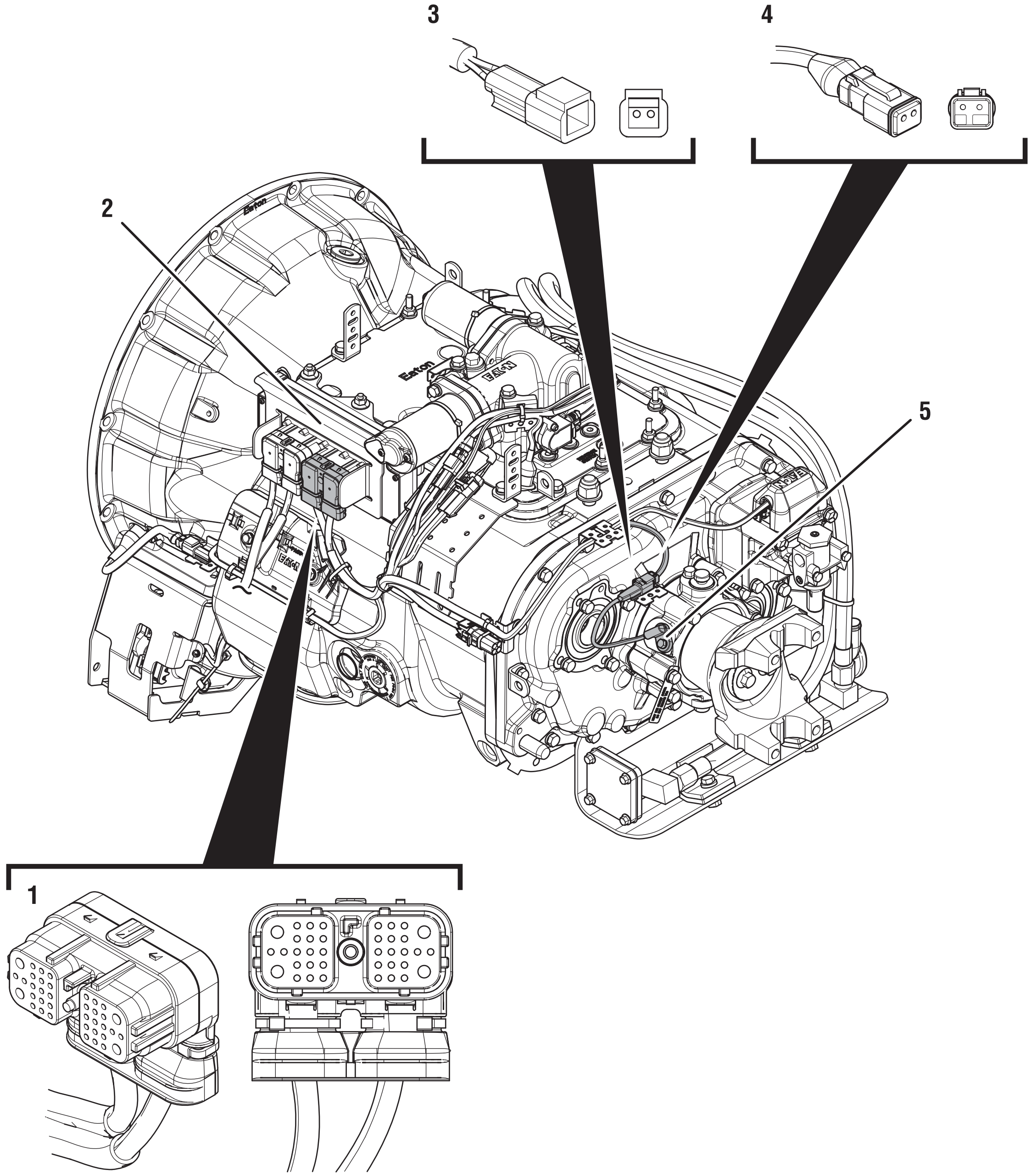
FMI 6, 8, 11

- Output Shaft Speed Sensor
  - Internal failure
  - Physical damage or failure

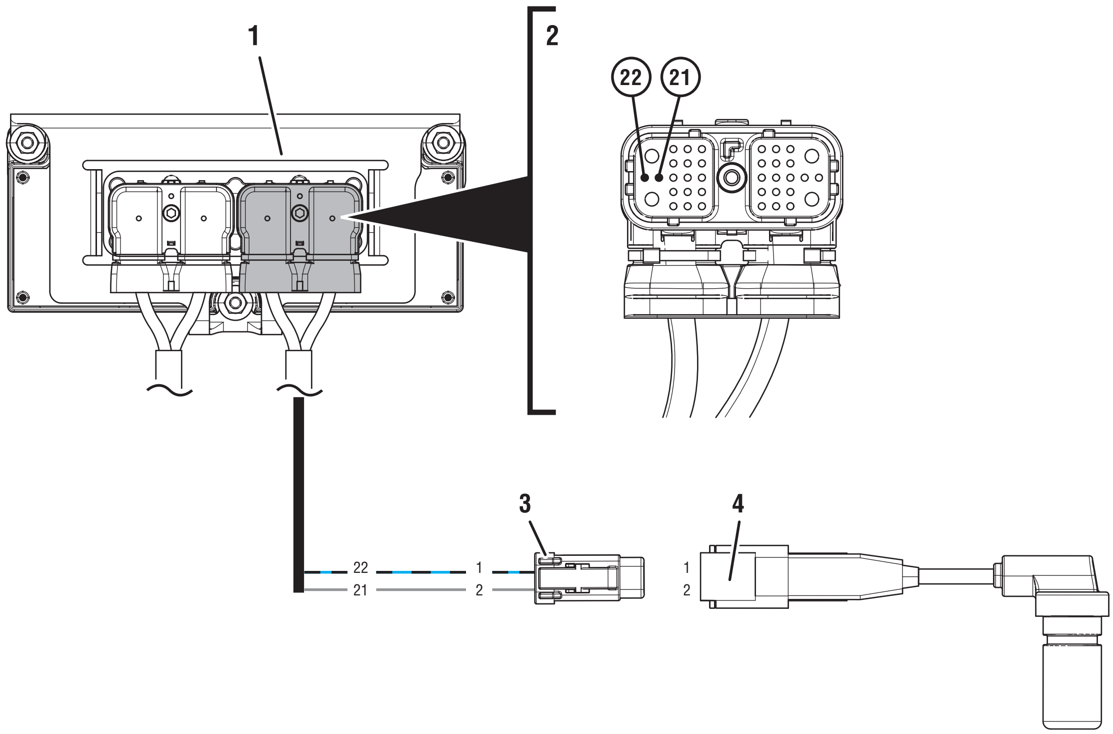
FMI 10

- Output Shaft Speed Sensor
  - Internal failure
  - Physical damage or failure
- Transmission Harness
  - Bent, spread, loose or corroded terminals
  - Wiring shorted to ground, shorted to power or open
- TECU
  - Internal failure
- Mechanical Transmission
  - Auxiliary Case: internal failure
  - Tone Wheel loose or broken

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. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 58 FMI 5, 6 or 10 is Inactive, go to **Step B.**
   - If Fault Code 58 FMI 5, 6, 10 is Active, go to **Step F.**
   - If Fault Code 58 FMI 2 is Active or Inactive, go to **Step D.**
   - If Fault Code 58 FMI 8, 11 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.

Important: 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: *Check tightness of Output Shaft End Yoke.*

1. Key off.
2. Set parking brake and chock wheels.
3. Attempt to move the Output Yoke at the rear of the transmission both vertically and horizontally. Look and feel for any play.
4. Verify that Tone Wheel is clean, free of debris or damage and does not spin freely by hand.
5. Remove Output Shaft Speed Sensor and inspect for any damage or signs of wear (cracks, broken pickup, etc.).
   - If play is present in Output Shaft End Yoke, go to **Step E.**
   - If Output Shaft Speed Sensor is damaged, replace Output Shaft Speed Sensor. Go to **Step V.**
   - If no play is present and no damage found, go to **Step F.**

D

Purpose: *Check tightness of Output Shaft End Yoke.*

1. Key off.
2. Set parking brake and chock wheels.
3. Attempt to move the Output Yoke at the rear of the transmission both vertically and horizontally. Look and feel for any play.
4. Verify that Tone Wheel is clean, free of debris or damage and does not spin freely by hand.
5. Remove Output Shaft Speed Sensor and inspect for any damage or signs of wear (cracks, broken pickup, etc.).
   - If play is present in Output Shaft End Yoke, go to **Step E.**
   - If no play is present, replace Output Shaft Speed Sensor. Go to **Step V.**

E

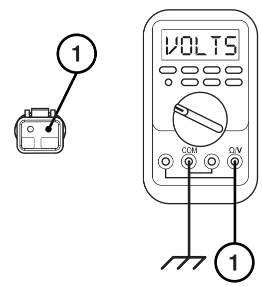
Purpose: *Inspect auxiliary case of transmission.*

1. 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.
2. Remove the auxiliary case of the transmission and inspect for signs of damage, specifically inspecting the Auxiliary Output Bearing for signs of failure.
3. Inspect Output Shaft Bearing for any damage or wear.
   - If metal fragments are found, or if damage is found in the auxiliary case, repair or replace auxiliary case components as necessary. Go to **Step V.**
   - If no metal fragments are found, replace Auxiliary Output Bearing and reinstall auxiliary case. Go to **Step V.**

F

Purpose: *Verify 5-volt reference at Output Shaft Speed Sensor.*

1. Key on with engine off.
2. Disconnect 2-Way Output Shaft Speed Sensor.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Inspect 2-Way Connector and Transmission Harness for any signs of cut, chafed or damaged wiring.
5. Measure voltage between the 2-Way Output Shaft Speed Sensor Connector Pin 1 and ground.



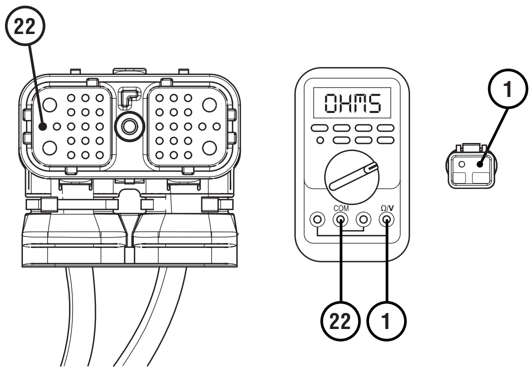
6. Compare reading(s) in table.
   - If readings are in range, go to **Step H.**
   - If readings are out of range, go to **Step G.**

Pins	Range	Reading(s)
1 to Ground	4.5–6.0 V	

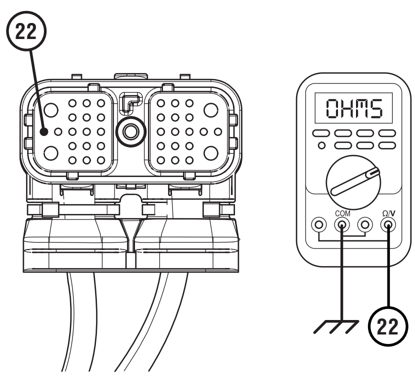
G

Purpose: *Verify continuity of Output 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 22 and 2-Way Output Shaft Speed Sensor Connector Pin 1. Record reading(s) in table.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 22 and ground. Record reading(s) in table.



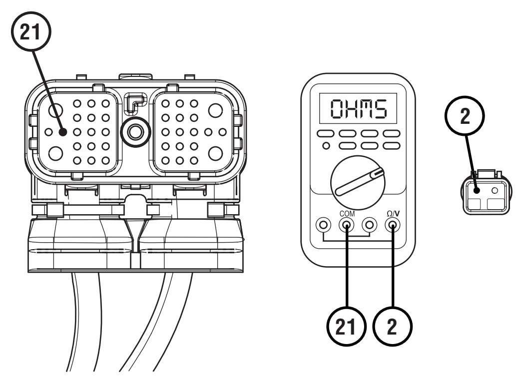
6. Compare reading(s) in table.
   - If readings are in range, replace Output Shaft Speed Sensor and Transmission Harness. Go to **Step V.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
22 to 1	0.0–0.3 Ohms	
22 to Ground	Open Circuit (OL)	

H

Purpose: *Verify continuity of Output Shaft Speed Sensor ground circuit.*

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector at 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 21 and 2-Way Output Shaft Speed Sensor Connector Pin 2.



5. Compare reading(s) in table.
   - If readings are in range, replace Output Shaft Speed Sensor. Go to **Step V.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
21 to 2	0.0–0.3 ohms	

I

Purpose: *Verify condition of Output Shaft Speed Sensor connector.*

1. Set parking brake and chock wheels.
2. Key off.
3. Disconnect the 2-Way Output Speed Sensor.
4. Inspect the 2-Way Output Speed Sensor Connector, 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.
5. Inspect the Transmission Harness side of the 2-Way Output Speed Sensor Connector, 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.
   - If no contamination and damage is found, replace the Output Speed Sensor. Go to **Step V.**
   - If contamination or damage is found, replace the Output Speed Sensor 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 engine 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 58 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 58 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 61: Rail Motor Circuit

J1587: MID 130 SID 39 FMI 1, 5, 6, 12
J1939: SA 3 SPN 772 FMI 1, 5, 6, 12

Overview

The UltraShift *PLUS* 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).
- Engine may not crank.
- 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 engine 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

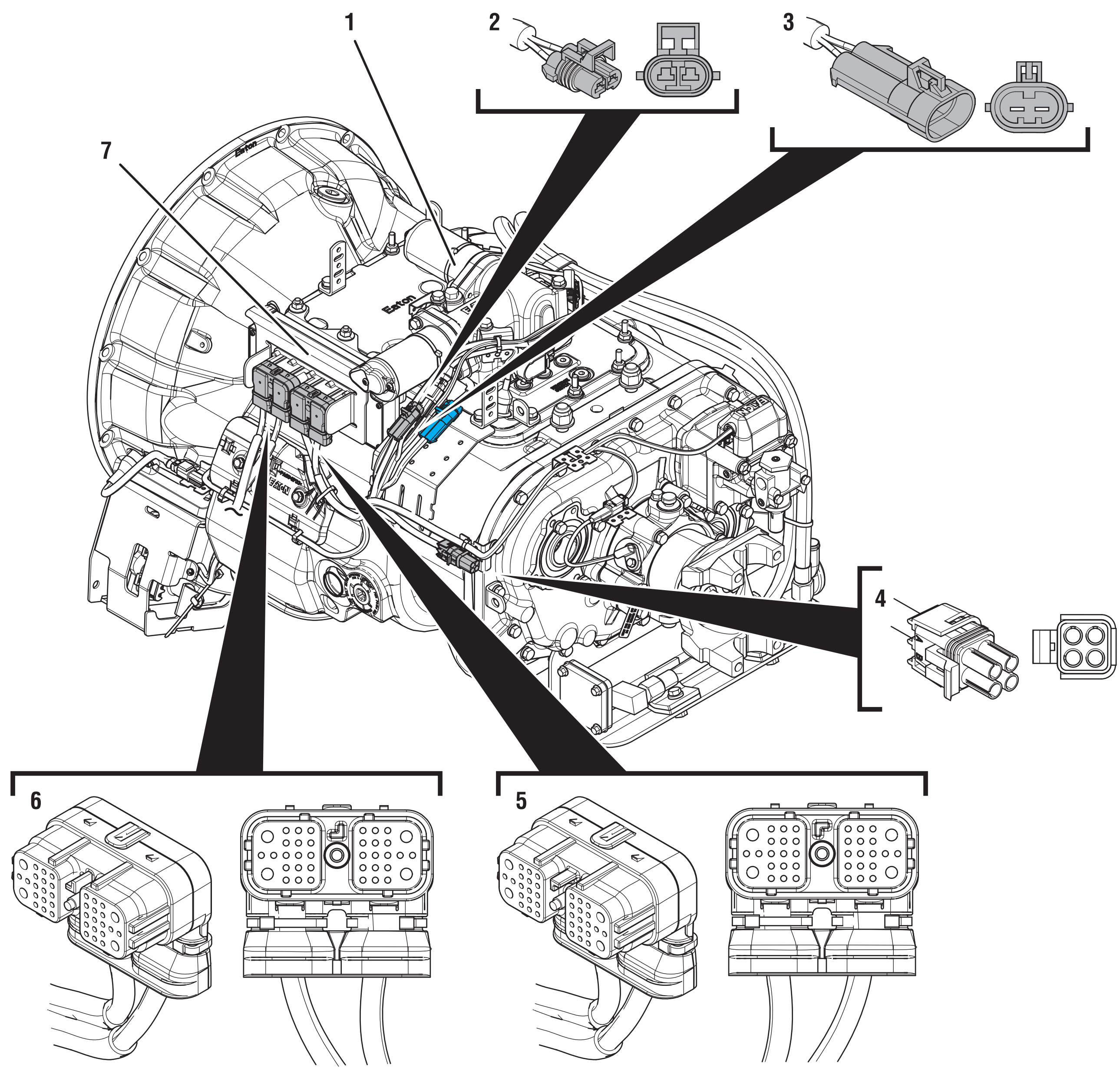
FMI 6

- Transmission Harness
  - Wiring shorted to power
- TECU
  - Internal failure

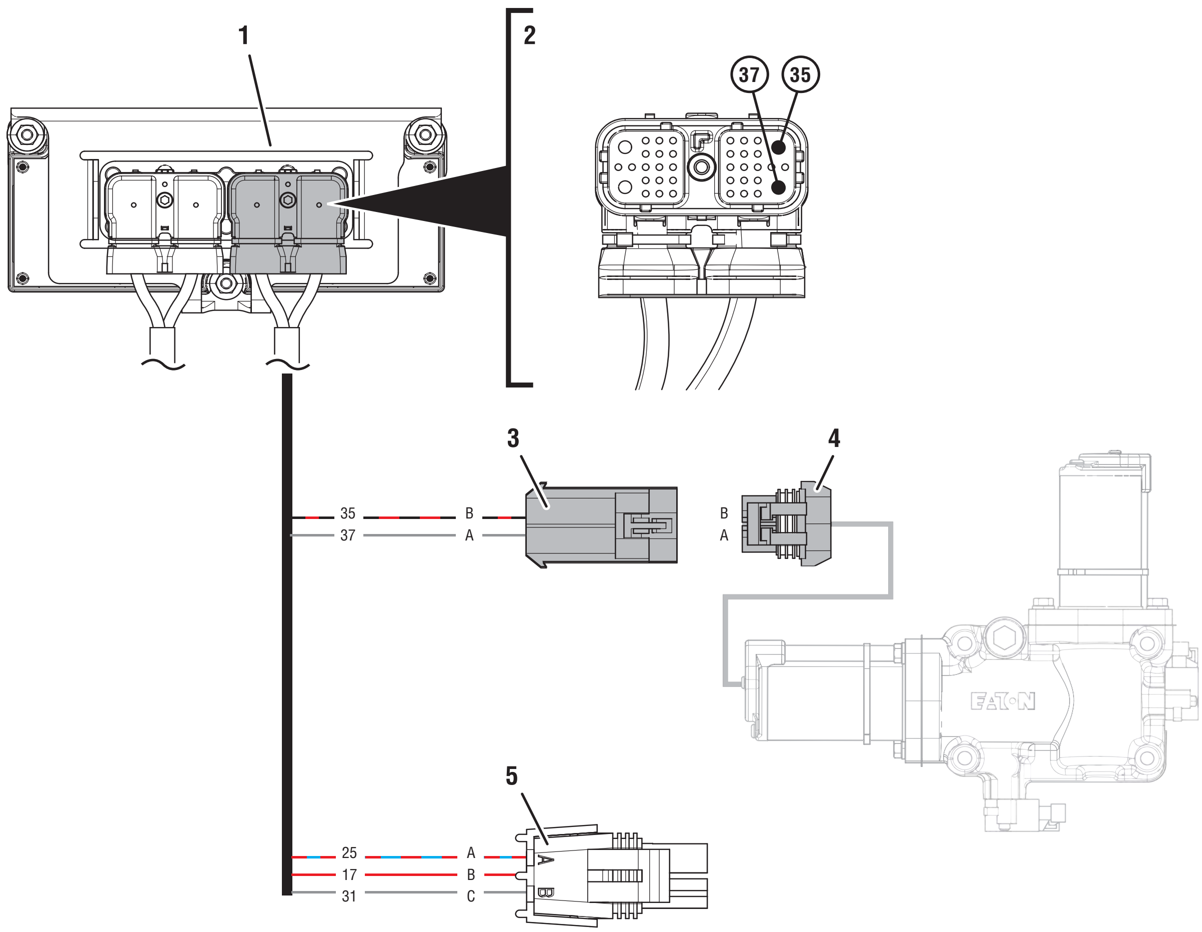
FMI 12

- 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

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

Fault Code 61 Troubleshooting

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

1. 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 13.
   - 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.

Important: 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.**

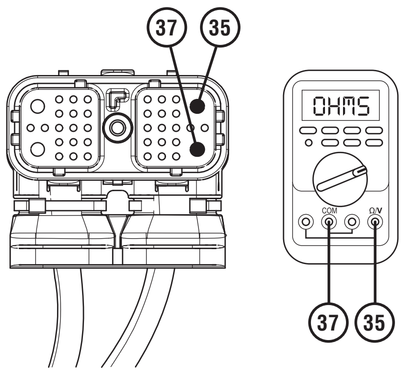
D ***Purpose:*** *Verify which FMI set.*

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 TECU. Go to **Step V.**

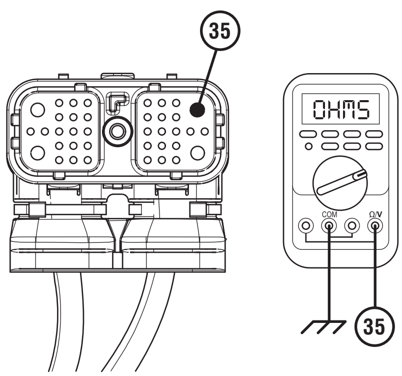
E

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.



5. Measure resistance between 38-Way Connector Pin 35 and ground. 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)	

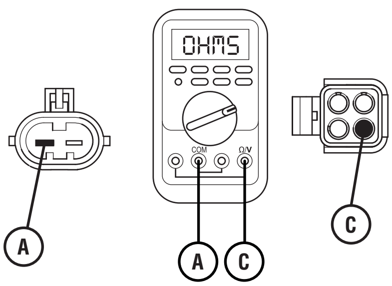
F

Purpose: *Verify which FMI set.*

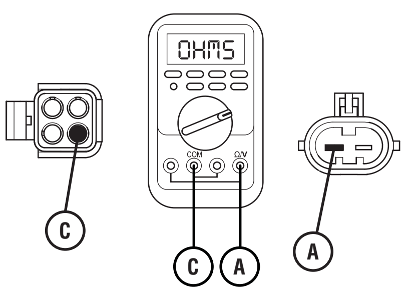
1. Determine which FMI set for Fault Code 61.
   - If FMI 1 or 12 set, go to **Step I.**
   - If FMI 5 set, go to **Step G.**

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.

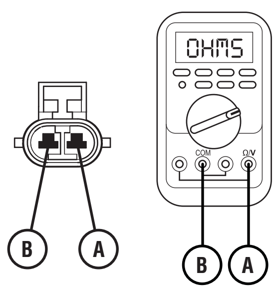


6. Compare reading(s) in table.
   - If readings are in range, replace XY Shifter. Go to **Step V.**
   - If any reading is out of range, replace TECU. Go to **Step V.**

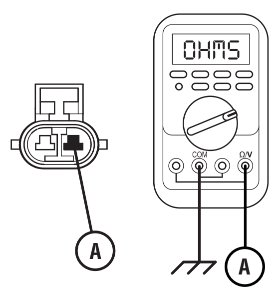
Pins	Range	Reading(s)
A to C	15k ohms or greater	
C to A	15k ohms or greater	

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.**

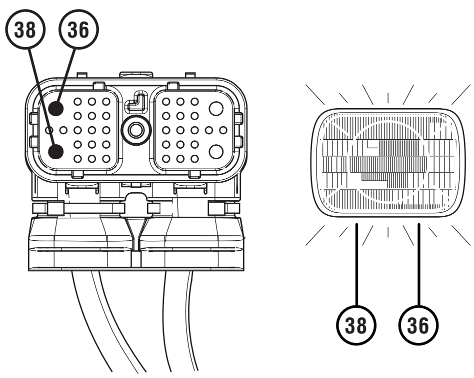
     If any reading is out of range, replace the XY Shifter. Go to **Step V.**

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 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 engine 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 13.

Fault Code 63: Gear Motor Circuit

J1587: MID 130 SID 40 FMI 1, 5, 6, 12
J1939: SA 3 SPN 773 FMI 1, 5, 6, 12

Overview

The UltraShift *PLUS* 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).
- Engine may not crank.
- 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 engine 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

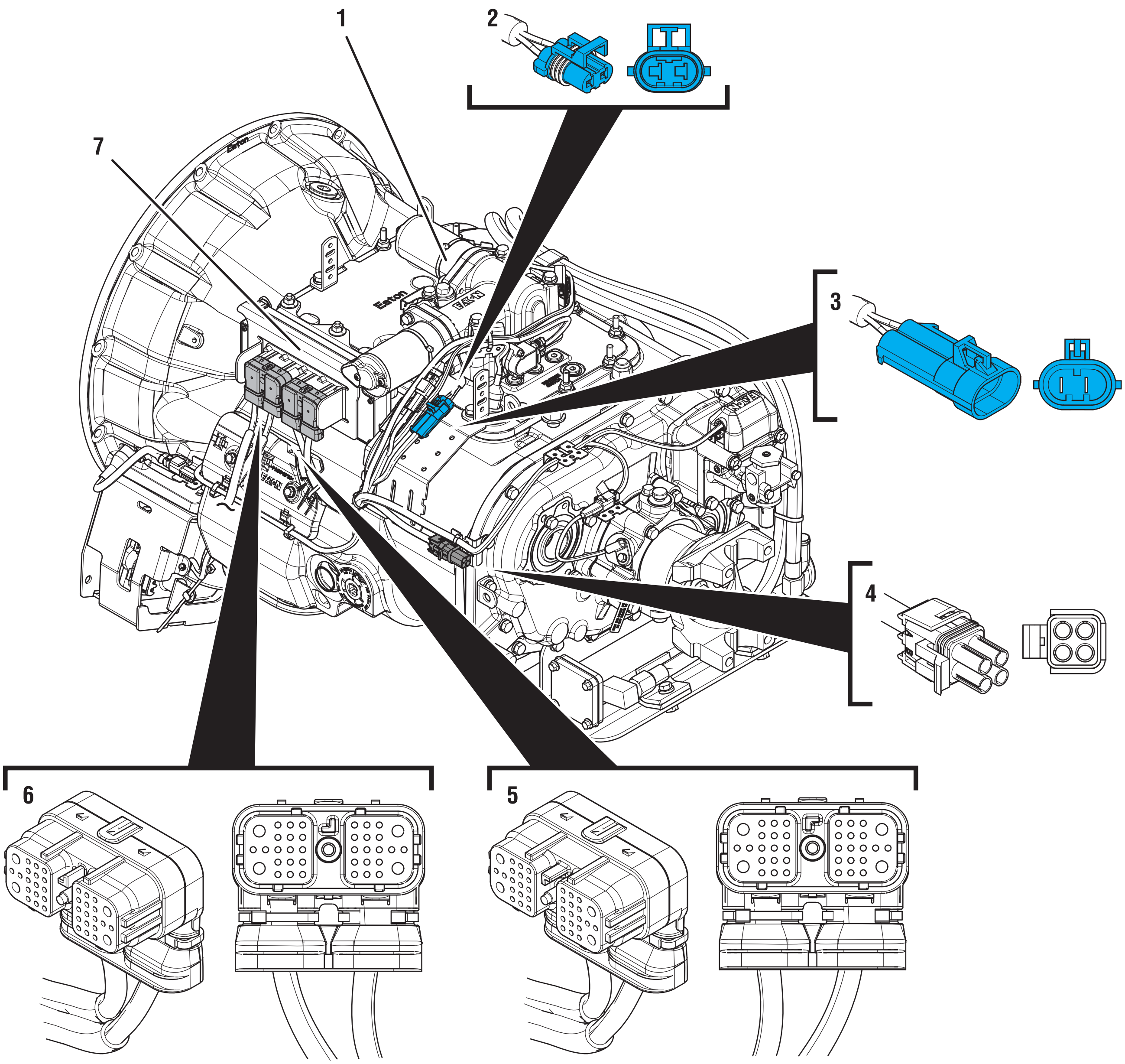
FMI 6

- Transmission Harness
  - Wiring shorted to power
- TECU
  - Internal failure

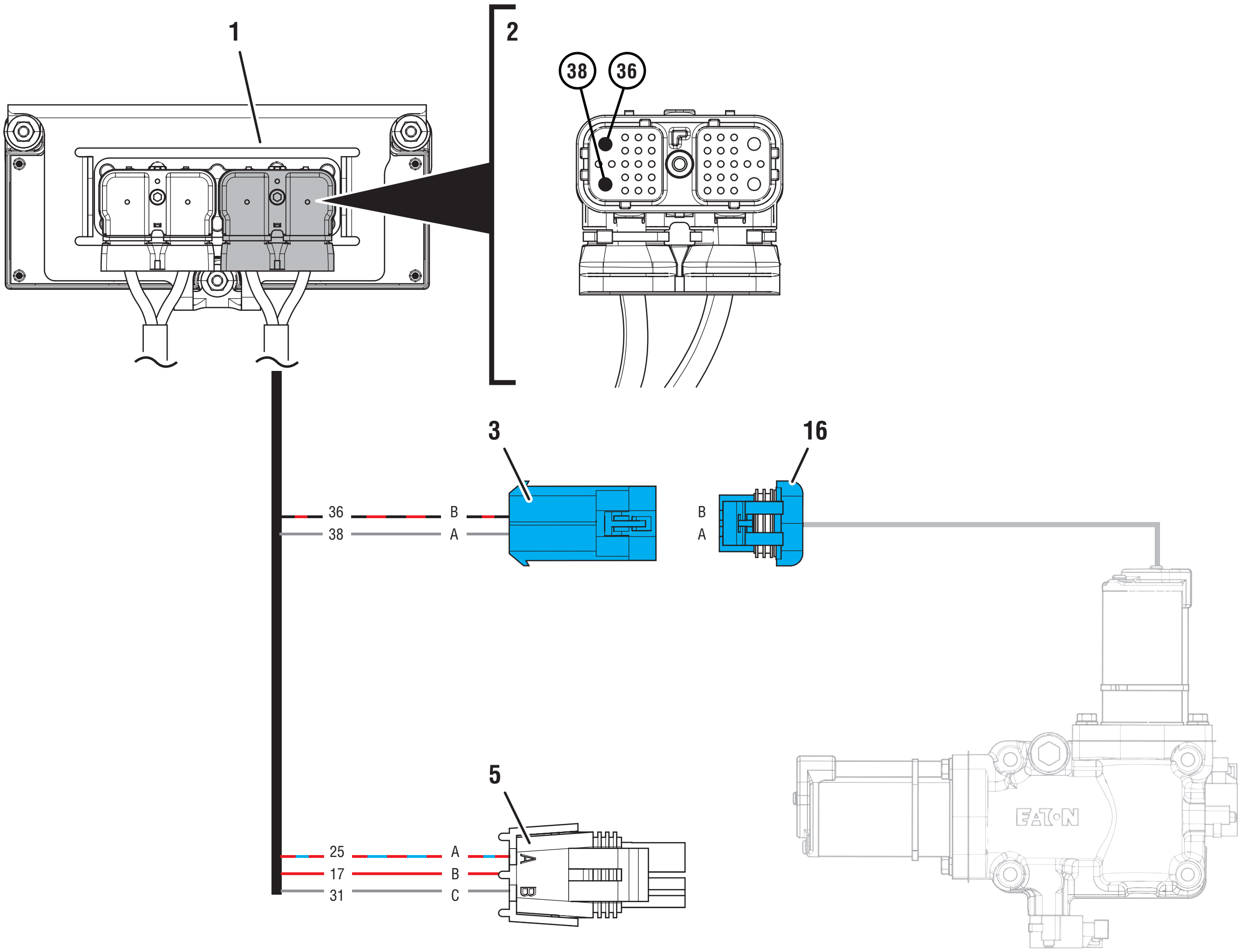
FMI 12

- 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

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

Fault Code 63 Troubleshooting

A

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

1. 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 13.
   - 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.

Important: 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

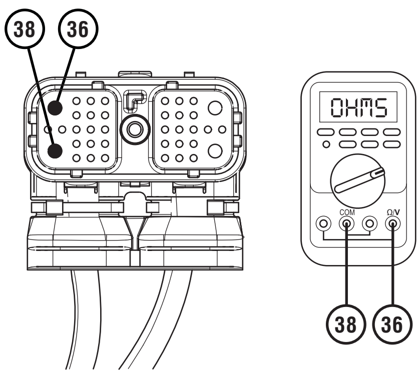
Purpose: *Verify which FMI set.*

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 TECU. Go to **Step V.**

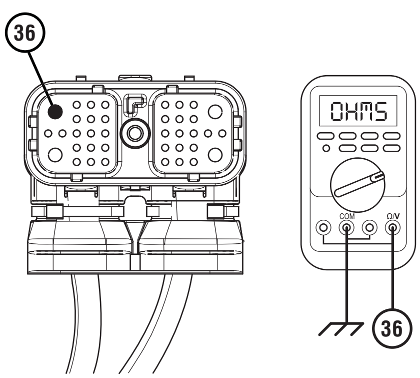
E

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.



5. Measure resistance between 38-Way Connector Pin 36 and ground. 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)	

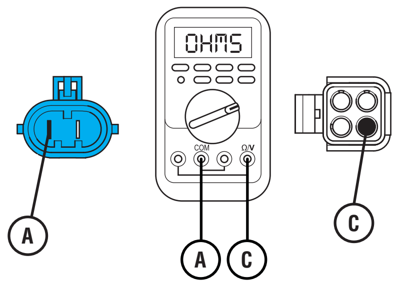
F

Purpose: *Verify which FMI set.*

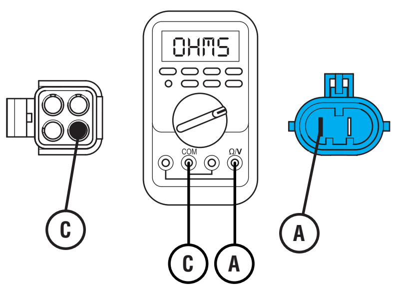
1. Determine which FMI set for Fault Code 63.
   - If FMI 1 or 12 set, go to **Step I.**
   - If FMI 5 set, go to **Step G.**

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.

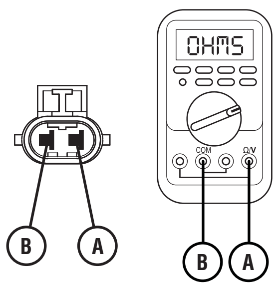


6. Compare reading(s) in table.
   - If readings are in range, replace X-Y Shifter. Go to **Step V.**
   - If any reading is out of range, replace TECU. Go to **Step V.**

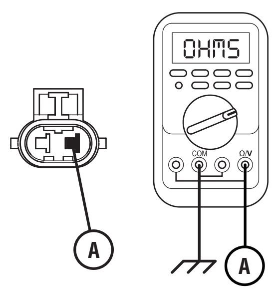
Pins	Range	Reading(s)
A to C	15k ohms or greater	
C to A	15k ohms or greater	

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.

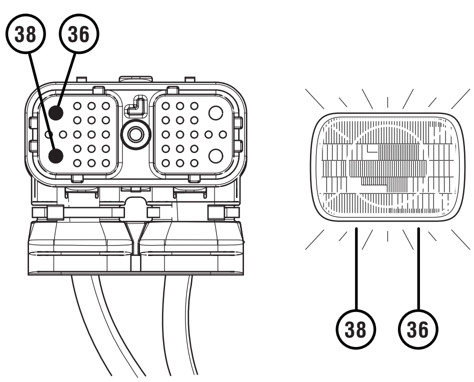


6. Compare reading(s) in table.
   - If readings are in range, replace Transmission Harness. Go to **Step V.**
   - If any reading is out of range, replace the XY Shifter. Go to **Step V.**

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 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 engine 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 13.

Fault Code 64: Gen1 Electronic Clutch Actuator (ECA)

J1587: MID 130 PID 34 FMI 2, 7, 12
J1939: SA 3 SPN 788 FMI 2, 7, 12

Overview

The UltraShift *PLUS* transmission is equipped with an Electronic Clutch Actuator (ECA) that controls the position of the clutch assembly. Power and ground to the ECA are OEM-supplied through a 3-Way Gen1 ECA Connector directly connected to the vehicle batteries. The ECA is connected to the TECU by an 8-Way Gen1 ECA Connector that is part of the transmission harness. The ECA communicates with the TECU over the High Integrity Link (HIL) to change position, show faults or include other operation information.

Detection

The TECU monitors the ECA for excessive motor current, excessive motor temperature, incorrect motor position, improper battery or ignition voltage to the ECA, or various internal ECA malfunctions.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: ECA detects a loss of battery and/or ground for 1 second or longer.

FMI 7 – Mechanical System Not Responding: ECA detects excessive motor current or ECA detects incorrect clutch position during a clutch position change for 1 second or longer.

FMI 12 – Bad Intelligent Device: ECA detects an internal failure for 1 second or longer.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If the fault occurs at power up, engine cranks and starts, but TECU will not engage a gear.
- If the fault occurs while driving, ECA maintains current clutch position or moves to the last position commanded by the TECU. Transmission may continue to shift until vehicle is stopped.

Conditions to Set Fault Code Inactive

FMI 2: No loss of battery and ground is detected for 2 seconds.

FMI 7: Normal motor current is detected and ECA position is correct for 2 seconds.

FMI 12: No internal ECA failures are detected for 2 seconds.

Possible Causes

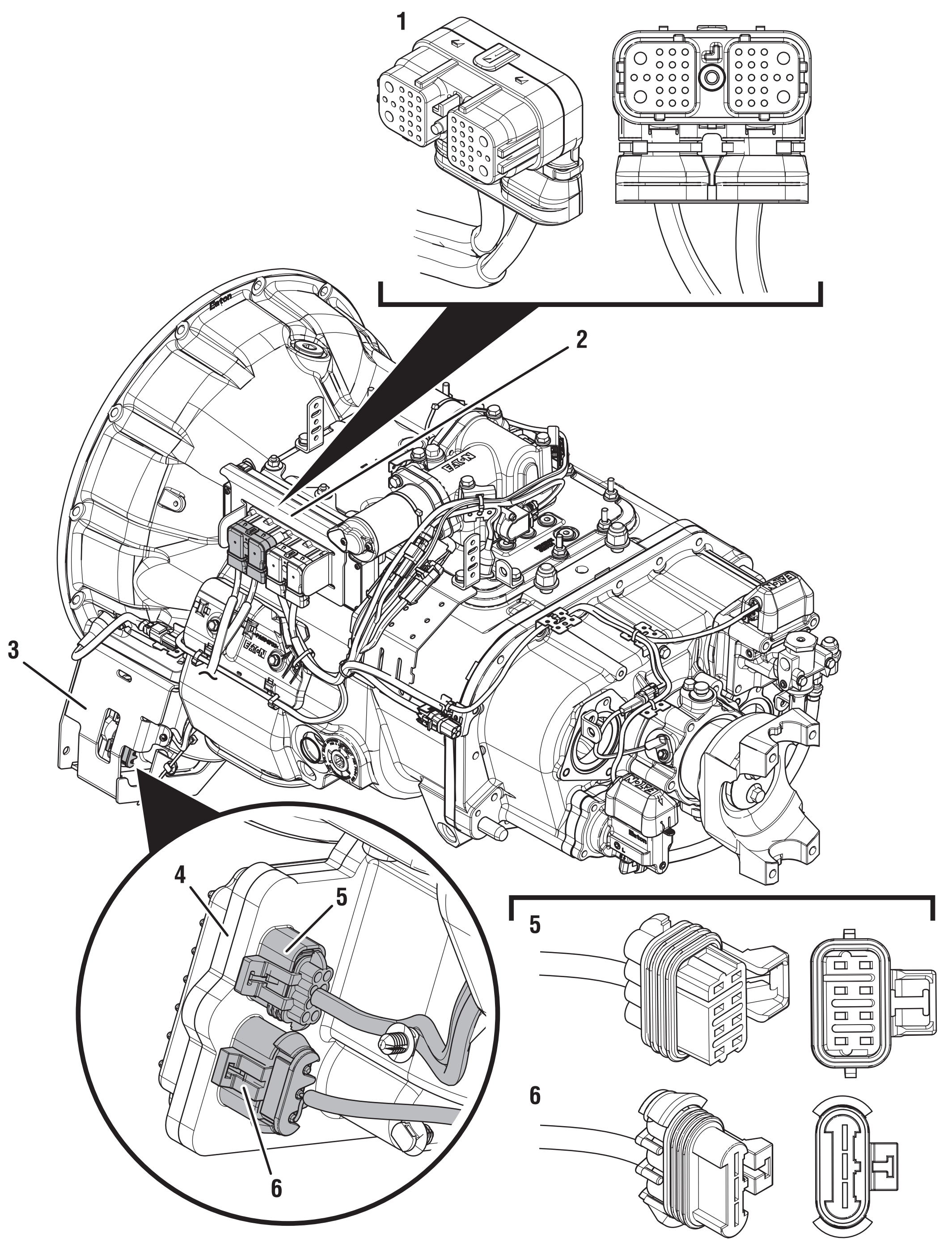
FMI 2, 12

- ECA Power Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- ECA
  - Internal failure

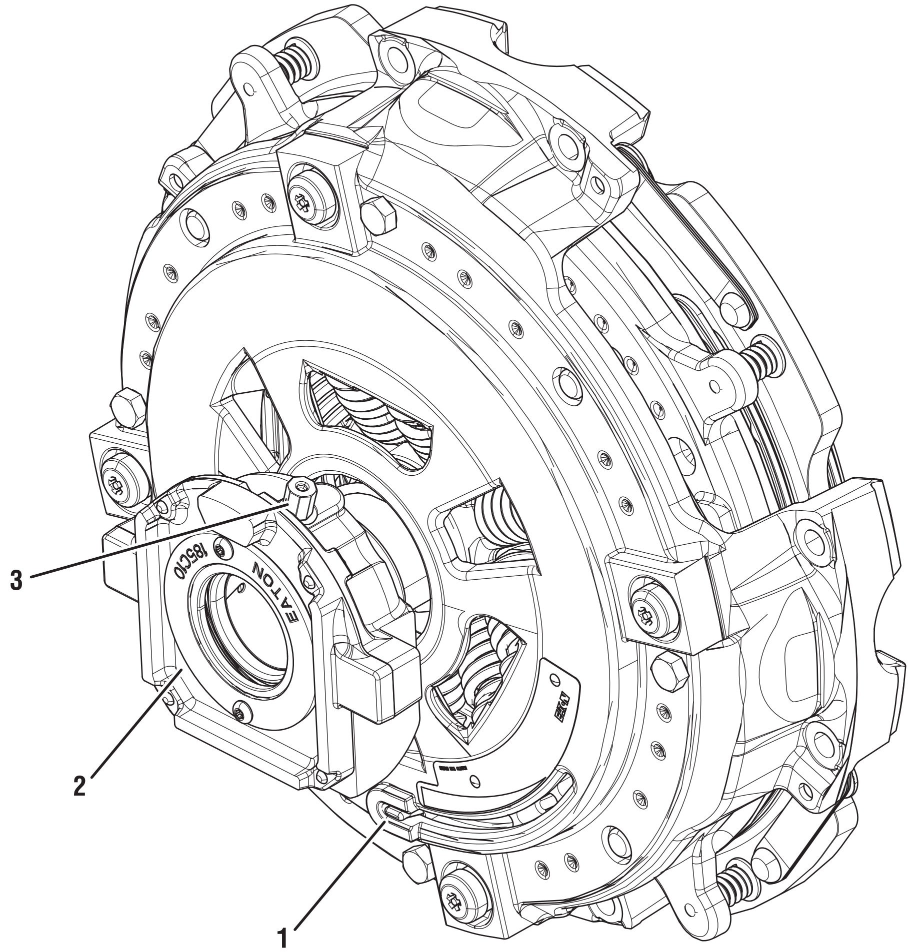
FMI 7

- ECA Power Harness
  - Bent, spread corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Mechanical Clutch System
  - Lack of lubrication of clutch release shaft/bushings
  - Lack of lubrication of clutch
  - Damage to clutch release yoke or cross shaft
  - Internal failure
- ECA
  - Internal failure

Component Identification



1. 38-Way Vehicle Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. ECA Shield
4. Electronic Clutch Actuator (ECA)
5. 8-Way ECA Connector
6. 3-Way ECA Power Supply Connector

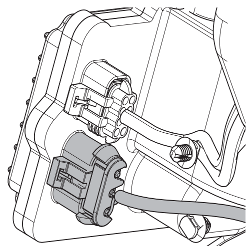


Eaton ECA Clutch
1. Clutch Wear Tab
2. Release Bearing
3. Release Bearing Grease Zerk

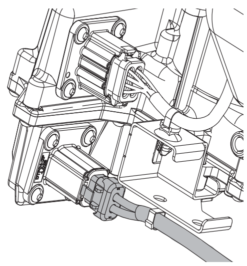
Fault Code 64 Troubleshooting Gen1 ECA

A ***Purpose:*** *Identify ECA installed on transmission.*

1. Inspect ECA OEM Power Supply Connector, reference image below.



Gen1 ECA



Gen2 ECA

- If equipped with a Gen1 ECA, go to **Step B.**
- If equipped with a Gen2 ECA, go to *Fault Code 64: Gen2 Electronic Clutch Actuator (ECA)* on page 373.

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 64 is Inactive and there are other Active fault codes, troubleshoot all Active fault codes per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Codes 15, 16 or 19 is Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 64 is set, go to **Step C.**

C

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 D.**

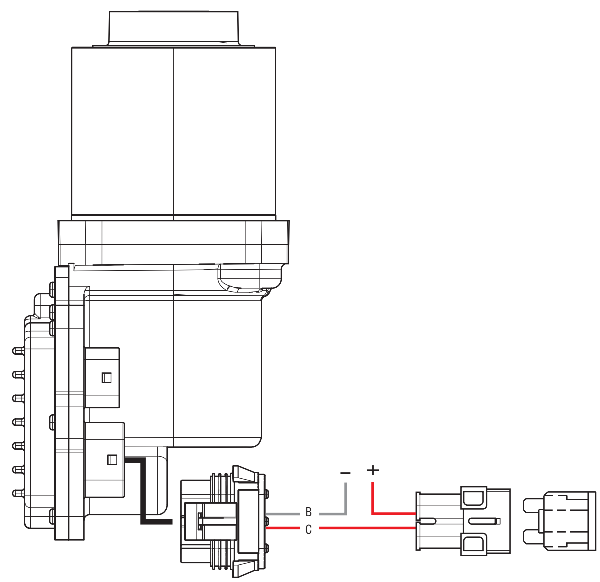
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

D

Purpose: *Inspect power and ground supply to the ECA.*

1. Key off.
2. Inspect the ECA Power Supply Harness between the batteries and the ECA for signs of rubbing or chafing to the wiring.
3. Inspect the ECA 40-amp In-line Fusible Link or Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.

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

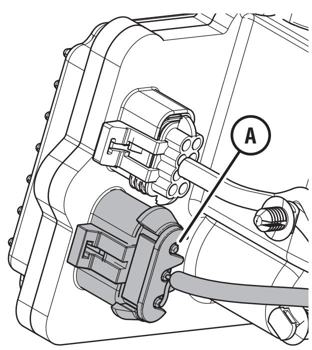


- If damage to the ECA Power Supply Harness is found, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If no damage is found, go to **Step E.**

E

Purpose: *Verify condition of 3-Way Gen1 ECA Connector.*

1. Key off.
2. Disconnect 3-Way Gen1 ECA Connector.
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. Confirm the 3-Way Gen1 ECA Connector has a seal plug in Cavity A.
5. Inspect ECA side of 3-Way Gen1 ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.

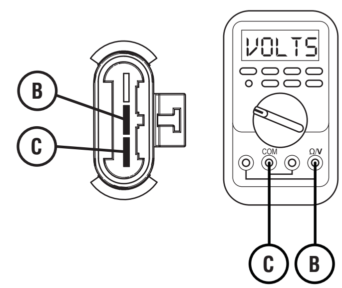


- If damage to the 3-Way Gen1 ECA Connector is found and/or missing seal plug in Cavity A, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If damage to the ECA side of 3-Way Gen1 ECA Connector is found, replace ECA. Go to **Step V.**
- If no damage is found, go to **Step F.**

F

Purpose: *Verify battery voltage at ECA.*

1. Key off.
2. Measure voltage between 3-Way Gen1 ECA Connector Pin C (Battery positive) and Pin B (Battery negative). Record reading(s) in table.

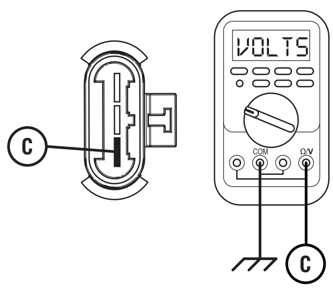


3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
   - If readings are in range, go to **Step G.**

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

G ***Purpose:*** *Verify polarity of battery voltage at ECA.*

1. Key off.
2. Measure voltage between 3-Way Gen1 ECA Connector Pin C (Battery positive) and ground. Record reading(s) in table.

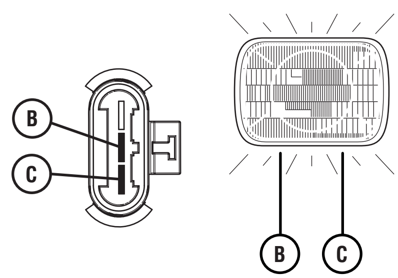


3. Compare reading(s) in table.
   - If readings are out of range, Pin C (Battery positive) and Pin B (Battery negative) wires are incorrectly pinned in the 3-Way Gen1 ECA Connector. Refer to OEM requirements for repair or replacement. Go to **Step V.**
   - If readings are in range, go to **Step H.**

Pins	Range	Reading(s)
C to Ground	Within 1.2 V of Battery Positive (+)	

H ***Purpose:*** *Load Test the vehicle power and ground supply to the ECA.*

1. Key off.
2. Load test the 3-Way Gen1 ECA Connector and ECA Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin C (Battery positive) and Pin B (Battery negative). Load Test for 5 minutes to verify the harness will carry a load with the 40-amp fuse or fusible link installed.



3. Wiggle the ECA Power Supply Harness during the Load Test from the vehicle batteries to ECA.
   - If the ECA Power Supply Harness does not carry a load, refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If the ECA Power Supply Harness carries a load, go to **Step I.**

I

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

1. Determine which FMI set for Fault Code 64, as noted in Step B.
   - If FMI 2 or 12 set and no fault was found with the ECA Power Supply Harness or battery/charging system, replace the ECA. Go to **Step V.**
   - If FMI 7 set, go to **Step J.**

J

Purpose: *Inspect for proper lubrication of Clutch Release Bearing and Cross Shaft.*

1. Key off.

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

2. Set parking brake and chock wheels.
3. Remove single bolt for clutch housing access cover.
4. Inspect for excessive clutch dust, broken clutch or spring material or other signs of clutch failure.
5. Ensure Release Bearing and Cross Shaft are adequately greased per the Heavy-Duty Clutch Service Manual (CLSM0200).
   - If physical signs of a failure are present, replace Heavy-Duty ECA Clutch and Cross Shaft. Go to **Step V.**
   - If no issues found and properly greased, go to **Step K.**

K

Purpose: *Verify Clutch Release Yoke and Cross Shaft rotation.*

1. Key off.
2. Remove ECA.
3. Inspect Clutch Release Yoke for excessive wear.
4. Rotate Clutch Release Yoke and Cross Shaft. Verify that they rotate freely without binding.
   - If the Clutch Release Yoke shows excessive wear, replace Clutch Release Yoke. Go to **Step V.**
   - If the Clutch Release Yoke and Cross Shaft bind when rotated, replace Cross Shaft. Go to **Step V.**
   - If no issues are found with the Clutch Release Yoke and Cross Shaft rotates freely without binding, and no fault was found with the ECA Power Supply Harness or battery/charging system, replace the ECA. 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.
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 codes set and the vehicle operates properly, test complete.
   - If Fault Code 64 sets active during the test drive, go to **Step A.**
   - If a fault code other than 64 sets, *Fault Code Isolation Procedure Index* on page 13.

Fault Code 64: Gen2 Electronic Clutch Actuator (ECA)

J1587: MID 130	**PID 34**	**FMI 2, 7, 12**
J1939: SA 3	**SPN 788**	**FMI 2, 7, 12**

Overview

The UltraShift *PLUS* transmission equipped with an Electronic Clutch Actuator (ECA) that controls the position of the clutch assembly. Power and ground to the ECA are OEM-supplied through a 2-Way Gen2 ECA Connector directly connected to the vehicle batteries. The ECA is connected to the TECU by an 8-Way Gen2 ECA Connector that is part of the transmission harness. The ECA communicates with the TECU over the High Integrity Link (HIL) to change position, show faults or include other operation information. Fault Code 94 indicates that a failure has been detected by the ECA, but is specific to systems that use a Gen2 ECA. Troubleshooting for this procedure is specific to the Gen2 ECA and associated harnesses.

Note: The troubleshooting procedure for Fault Code 64 may direct users to use this troubleshooting procedure if the vehicle is equipped with a Gen2 ECA, even if Fault Code 94 was not set by the transmission. This is because some transmission software versions do not set Fault Code 94.

Detection

The TECU monitors the ECA for excessive motor current, excessive motor temperature, incorrect motor position, improper battery or ignition voltage to the ECA, or various internal ECA malfunctions.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: ECA detects a loss of battery and/or ground for 1 second or longer.

FMI 7 – Mechanical System Not Responding: ECA detects excessive motor current or ECA detects incorrect clutch position during a clutch position change for 1 second or longer.

FMI 12 – Bad Intelligent Device: ECA detects an internal failure for 1 second or longer.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- If the fault occurs at power up, engine cranks and starts, but TECU will not engage a gear.
- If the fault occurs while driving, ECA maintains current clutch position or moves to the last position commanded by the TECU. Transmission may continue to shift until vehicle is stopped.

Conditions to Set Fault Code Inactive

FMI 2: No loss of battery and ground is detected for 2 seconds.

FMI 7: Normal motor current is detected and ECA position is correct for 2 seconds.

FMI 12: No internal ECA failures are detected for 2 seconds.

Possible Causes

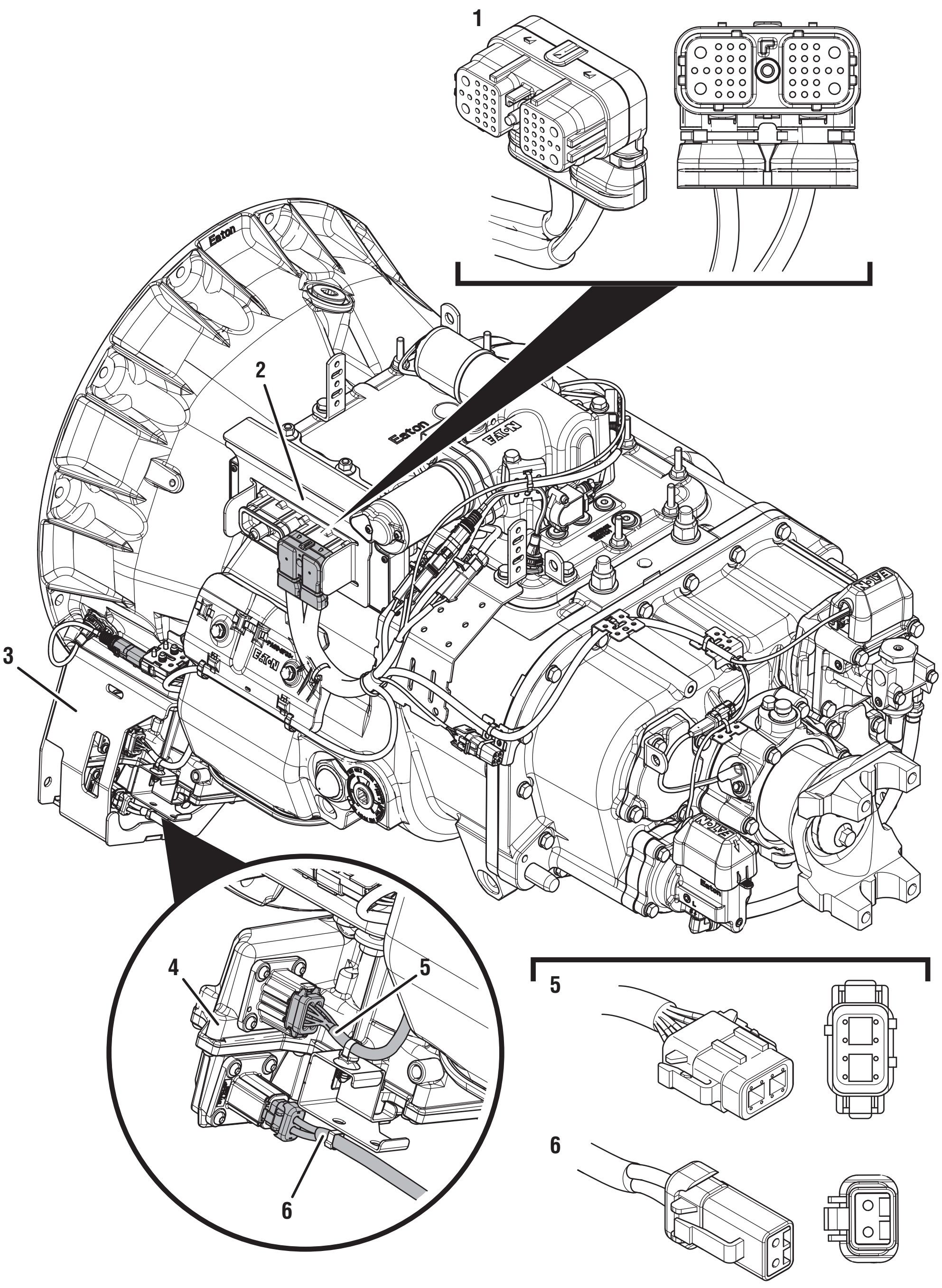
FMI 2, 12

- ECA Power Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- ECA
  - Internal failure

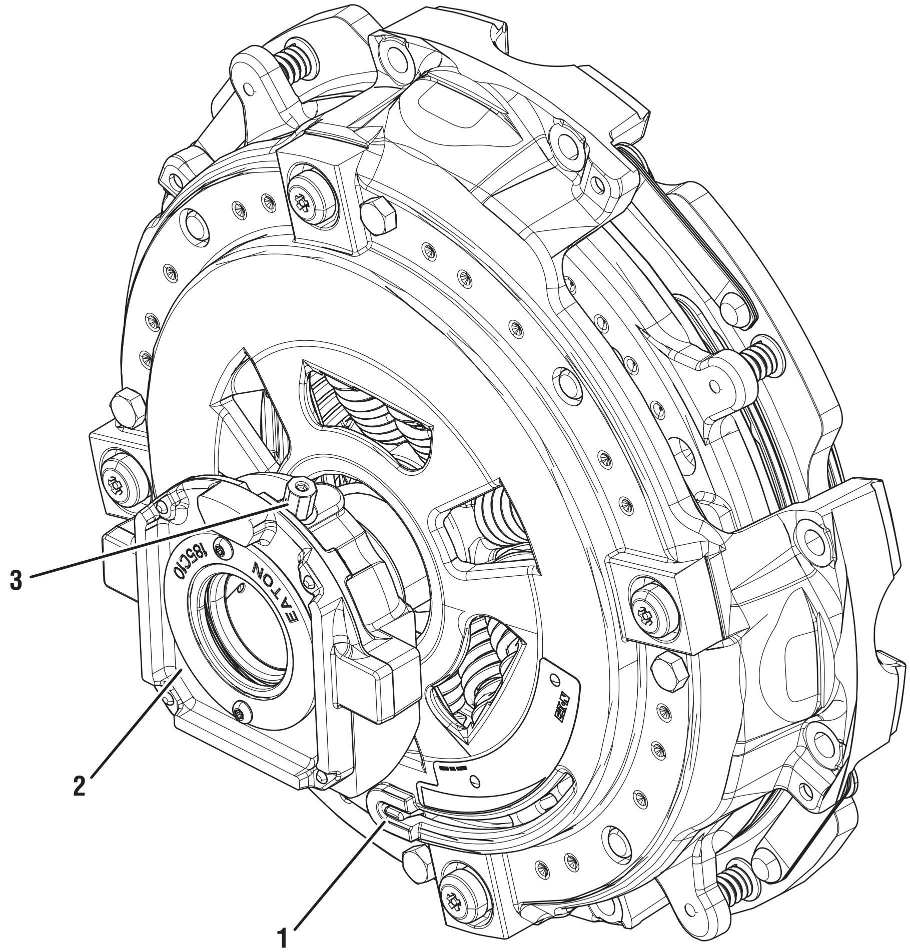
FMI 7

- ECA Power Harness
  - Bent, spread corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Mechanical Clutch System
  - Lack of lubrication of clutch release shaft/bushings
  - Lack of lubrication of clutch
  - Damage to clutch release yoke or cross shaft
  - Internal failure
- ECA
  - Internal failure

Component Identification



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. ECA Shield
4. Electronic Clutch Actuator (ECA)
5. 8-Way ECA Connector
6. 2-Way ECA Connector



Eaton ECA Clutch
1. Clutch Wear Tab
2. Release Bearing
3. Release Bearing Grease Zerk

Fault Code 64 Troubleshooting Gen2 ECA

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Update transmission and ECA software to latest available level, if not completed during the Diagnostic Procedure.

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

- If Fault Code 64 is Inactive and there are other Active fault codes, troubleshoot all Active fault codes per *Fault Code Isolation Procedure Index* on page 13.
- If Fault Codes 15, 16 or 19 are Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13
- If Fault Code 64 is set, go to **Step B.**

B

***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 C.**

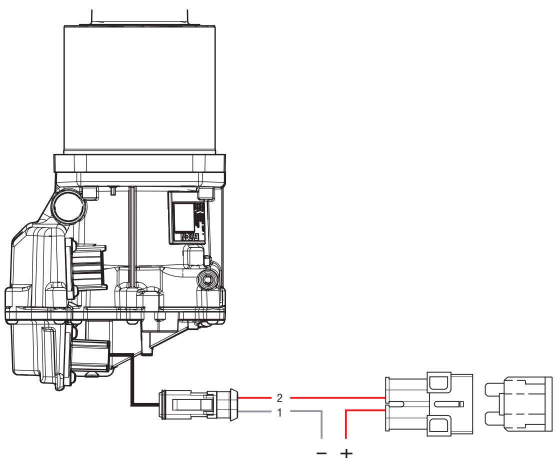
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

C

Purpose: *Inspect power and ground supply to the ECA.*

1. Key off.
2. Inspect the ECA Power Supply Harness between the batteries and the ECA for signs of rubbing or chafing to the wiring.
3. Inspect the ECA 40-amp In-line Fusible Link or Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.

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

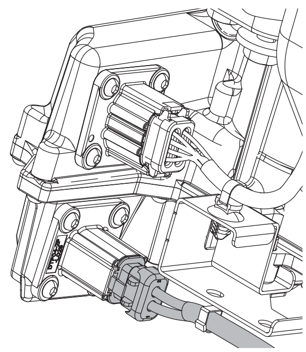


- If damage is found, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
- If no damage is found, go to **Step D.**

D

Purpose: *Verify condition of 2-Way ECA Connector.*

1. Key off.
2. Disconnect 2-Way Gen2 ECA Connector.
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. Inspect ECA side of 2-Way Gen2 ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.

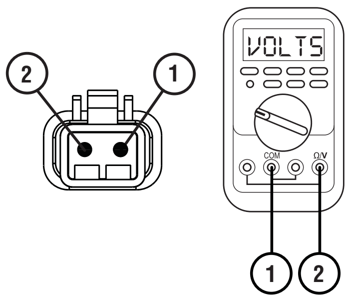


- If damage is found to the 2-Way Gen2 ECA Connector, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If damage to the ECA side of 2-Way Gen2 ECA Connector is found, replace ECA. Go to **Step V.**
- If no damage is found, go to **Step E.**

E

Purpose: *Verify battery voltage at ECA.*

1. Key off.
2. Measure voltage between 2-Way Gen2 ECA Connector Pin 2 (Battery positive) and Pin 1 (Battery negative). Record reading(s) in table.



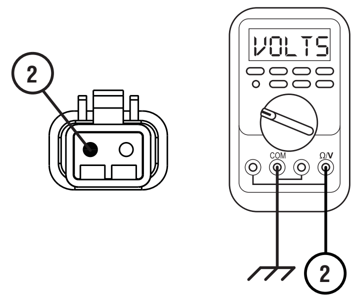
3. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
    - If readings are in range, go to **Step F.**

Pins	Range	Reading(s)
1 to 2	Within 1.2 V of Battery Positive (+)	

F

Purpose: *Verify polarity of battery voltage at ECA.*

1. Key off.
2. Measure voltage between 2-Way Gen2 ECA Connector Pin 2 (Battery positive) and ground. Record reading(s) in table.



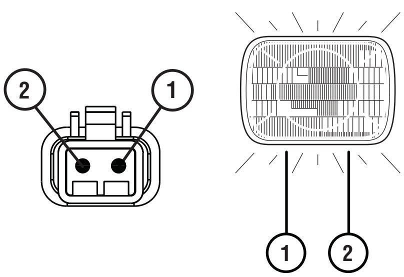
3. Compare reading(s) in table.
    - If readings are out of range, Pin 2 (Battery positive) and Pin 1 (Battery negative) wires are incorrectly pinned in the 2-Way Gen2 ECA Connector. Refer to OEM requirements for repair or replacement. Go to **Step V.**
    - If readings are in range, go to **Step G.**

Pins	Range	Reading(s)
2 to Ground	Within 1.2 V of Battery Positive (+)	

G

Purpose: *Load Test the vehicle power and ground supply to the ECA.*

1. Key off.
2. Load test the 2-Way Gen2 ECA Connector and ECA Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin 2 (Battery positive) and Pin 1 (Battery negative). Load Test for 5 minutes to verify the harness will carry a load with the 40-amp fuse or fusible link installed.
3. Wiggle the ECA Power Supply Harness during the Load Test from the vehicle batteries to ECA.



- If the ECA Power Supply Harness does not carry a load, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If the ECA Power Supply Harness carries a load, go to **Step H.**

H

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

1. Determine which FMI set for Fault Code 64 as noted in Step A.
   - If FMI 2 or 12 set, go to **Step I.**
   - If FMI 7 set, go to **Step J.**

I

Purpose: *Actuate the ECA and Check for Active or Inactive fault codes.*

1. Key off.

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

2. Set parking brake and chock wheels.
3. Reconnect all connectors and verify that all components are properly installed.
4. Key on with engine running.
5. Connect ServiceRanger.
6. Depress and hold service brake.
7. Select Drive Mode with the Driver Interface Device and wait 10 seconds.
8. After waiting 10 seconds, select Neutral Mode with the Driver Interface Device.
9. Ensure the parking brake is applied.
10. Key on with engine off.
11. Release service brake.
12. Go To “Fault Codes”.
13. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
    - If ECA and TECU software were updated to the latest available levels during the Diagnostic Procedure or Step A and Fault Code 64 FMI 2 or 12 is Inactive, test complete. Go to **Step V.**
    - If ECA and TECU software were at the latest available levels and Fault Code 64 FMI 2 or 12 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is in the ECA Power Supply Harness and/or battery/charging system. Refer to OEM guidelines for troubleshooting intermittent wiring and/or battery/charging system issues. Go to **Step V.**
    - If ECA and TECU software are at the latest available levels and Fault Code 64 FMI 2 or 12 is Active and no fault was found with the ECA Power Supply Harness or battery/charging system, replace the ECA. Go to **Step V.**

J

Purpose: *Inspect for proper lubrication of Clutch Release Bearing and Cross Shaft.*

1. Key off.

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

2. Set parking brake and chock wheels.
3. Remove single bolt for clutch housing access cover.
4. Inspect for excessive clutch dust, broken clutch or spring material or other signs of clutch failure.
5. Ensure Release Bearing and Cross Shaft are adequately greased per the Heavy-Duty Clutch Service Manual (CLSM0200).
   - If physical signs of a failure are found, replace Heavy-Duty ECA Clutch and Cross Shaft. Go to **Step V.**
   - If no issues found and properly greased, go to **Step K.**

K

Purpose: *Verify Clutch Release Yoke and Cross Shaft rotation.*

1. Key off.
2. Remove ECA.
3. Inspect Clutch Release Yoke for excessive wear.
4. Rotate Clutch Release Yoke and Cross Shaft. Verify that they rotate freely without binding.
   - If the Clutch Release Yoke shows excessive wear, replace Clutch Release Yoke. Go to **Step V.**
   - If Clutch Release Yoke and Cross Shaft bind when rotated, replace Cross Shaft. Go to **Step V.**
   - If no issues are found with the Clutch Release Yoke and the Cross Shaft rotates freely without binding, and no fault was found with the ECA Power Supply Harness or battery/charging system, replace the ECA. 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. 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 64 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 64 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 65: Gen1 ECA Speed Sensor

J1587: MID 130 PID 190 FMI 2, 5
J1939: SA 3 SPN 5052 FMI 2, 5

Overview

The UltraShift *PLUS* transmission is equipped with an Electronic Clutch Actuator (ECA) Speed Sensor that provides a secondary engine speed signal to the Transmission Electronic Control Unit (TECU). The ECA Speed Sensor is installed in the clutch housing. The ECA broadcasts the ECA Speed Sensor signal to the TECU through the High Integrity Link (HIL) contained within the transmission harness.

The TECU uses the ECA Speed Sensor signal to determine engine speed when the J1939 engine speed signal is not available. Early models have a thread-in ECA Speed Sensor installed in the flywheel housing. Fault Code 65 indicates either a loss of the signal or an electrical issue with the ECA Speed Sensor.

Detection

The TECU monitors the ECA Speed Sensor signal and compares the sensor reading with the J1939 Engine Speed signal to determine sensor validity. The TECU also monitors the ECA Speed Sensor electrical circuit for any shorts to ground or open circuits.

Conditions to Set Fault Code Active

The system can detect ECA Speed Sensor faults when one of the following conditions is present for 1 second or longer:

FMI 2 – Data Erratic: TECU detects engine speed over J1939 at idle, but does not detect ECA engine speed or transmission Input Shaft speed.

FMI 5 – Current Below Normal or Open Circuit: ECA detects an open on the ECA Speed Sensor signal circuit at key on.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- No fallback mode is associated with this fault. TECU uses the vehicle engine speed signal, broadcast over J1939, to operate the transmission.

Conditions to Set Fault Code Inactive

All FMIs: TECU detects the ECA Speed Sensor signal for 2 seconds.

Possible Causes

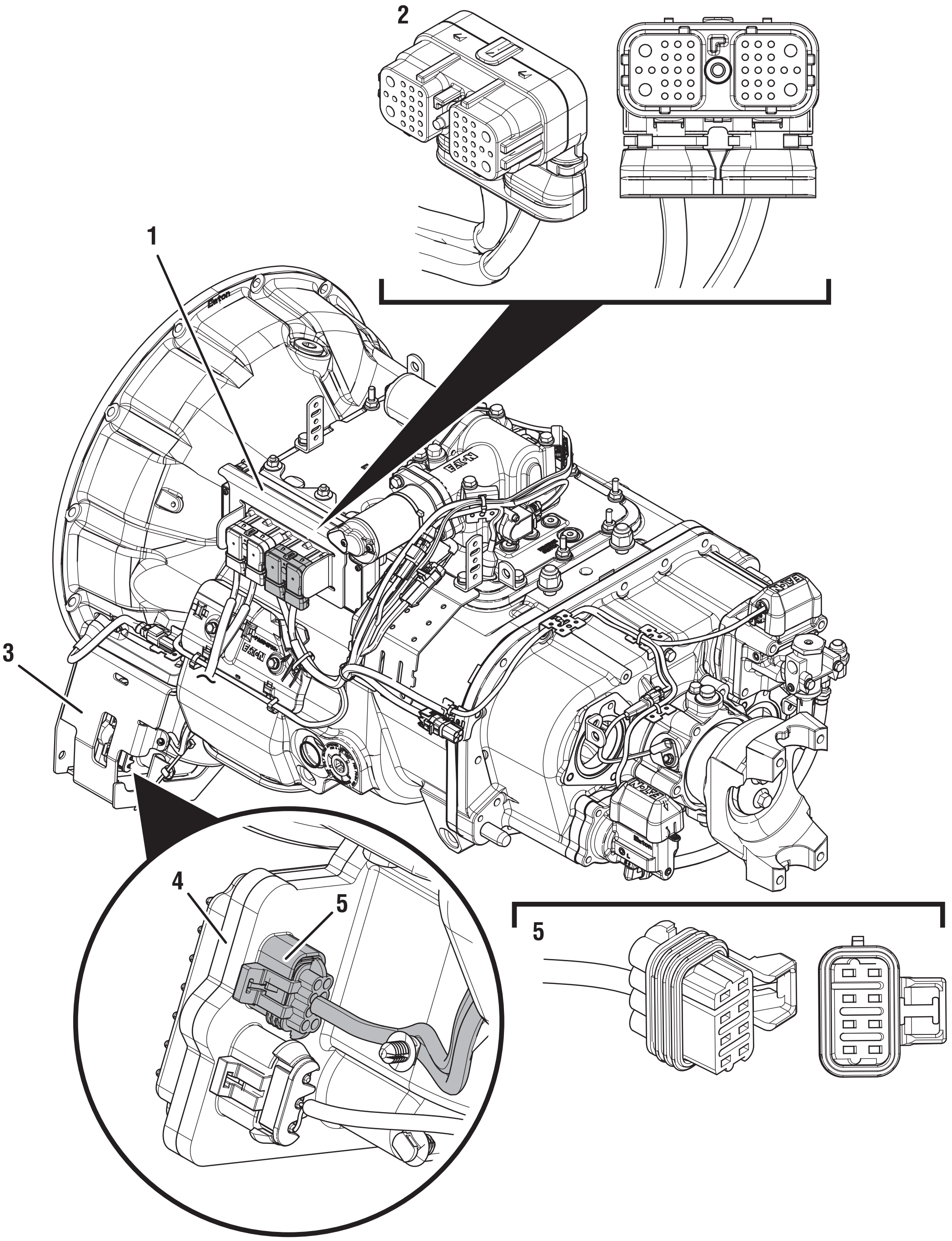
FMI 2

- ECA Speed Sensor
  - Debris build-up on ECA Speed Sensor
  - Mis-adjusted Thread-In ECA Speed Sensor
  - Contaminated, worn, broken or missing flywheel ring gear teeth (thread-in ECA Speed Sensor)
  - Broken or missing or Clutch Cover lugs (push-in ECA Speed Sensor)
- ECA
  - Internal failure

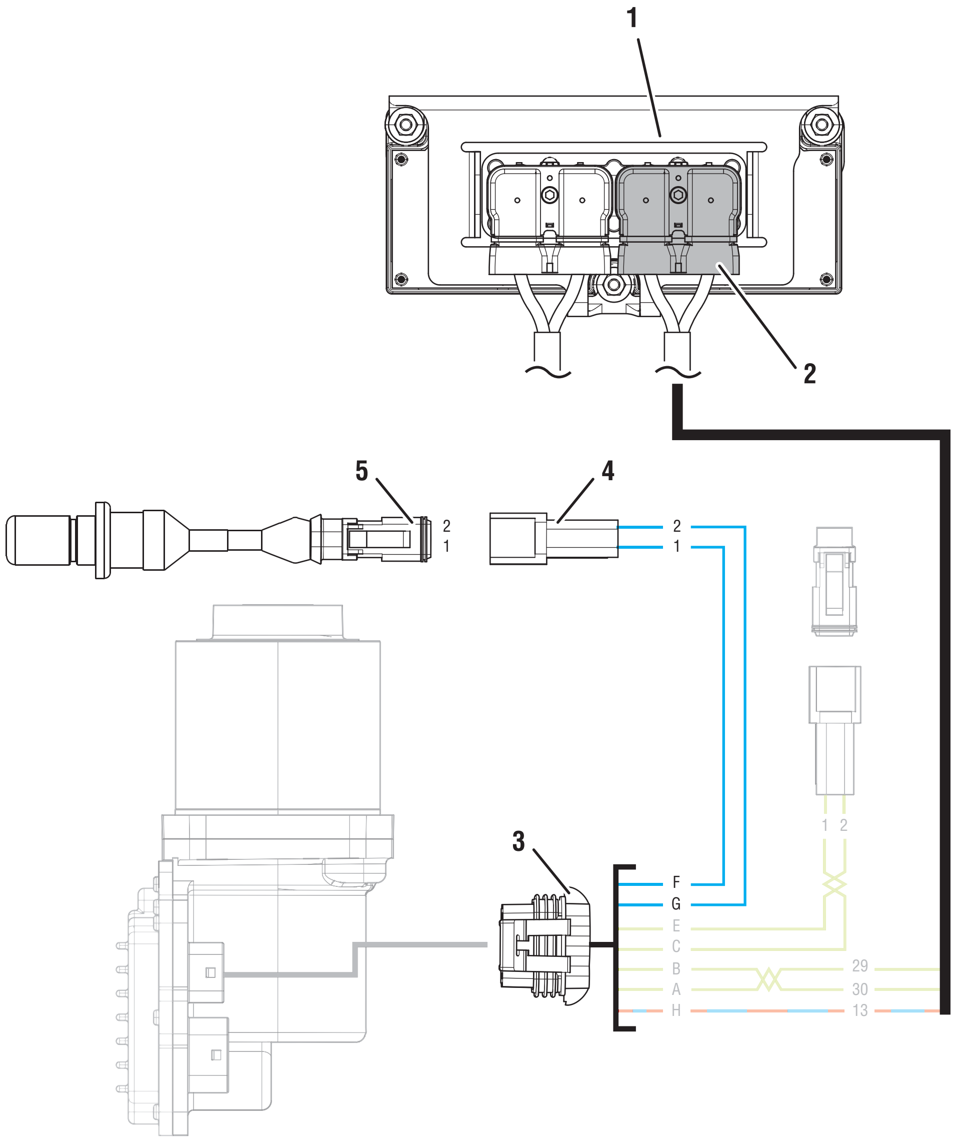
FMI 5

- ECA Speed Sensor
  - Open wiring
- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- ECA
  - Internal failure

Component Identification



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. Gen1 ECA Shield
4. Gen1 Electronic Clutch Actuator (ECA)
5. 8-Way Gen1 ECA Connector



1. *Transmission Electronic Control Unit (TECU)*
2. *38-Way Transmission Harness Connector*
3. *8-Way Gen1 ECA Connector*
4. *2-Way Gen1 ECA Speed Sensor Connector Body*
5. *2-Way Gen1 ECA Speed Sensor*

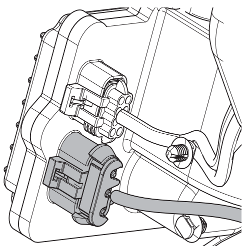
Battery Voltage	Switched Battery from TECU	Ground	Communication	Signal
Ignition Voltage	Switched 5V from TECU	Switched Ground	Relay/Solenoid Driver	

Fault Code 65 Troubleshooting Gen1 ECA

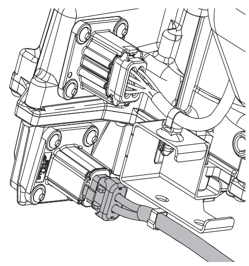
A

Purpose: *Identify ECA installed on transmission.*

1. Inspect ECA OEM Power Supply Connector, reference image below.



Gen1 ECA



Gen2 ECA

- If equipped with a Gen1 ECA, go to **Step B.**
- If equipped with a Gen2 ECA, go to *Fault Code 65: Gen2 ECA Speed Sensor* on page 391.

B

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

- If Fault Code 56 with FMI 2 is Active, go to *Fault Code Isolation Procedure Index* on page 13.
- If Fault Code 65 with FMI 2 or 5 is Active or Inactive, go to **Step C.**

C

Purpose: *Compare J1939 engine speed RPM and transmission clutch input speed RPM.*

1. Set vehicle parking brake and chock wheels.
2. Key on with engine on at idle.
3. Connect ServiceRanger.
4. Select "Data Monitor".
5. Select "Speed".
6. Select "Engine speed" and add parameter "Engine-190".
7. Select "Transmission clutch input speed" and add parameter "Transmission - 5052".
8. Monitor vehicle tachometer and record engine RPM value in table.
9. Monitor ServiceRanger and record "Engine speed" RPM value in table.
10. Monitor ServiceRanger and record "Transmission clutch input speed" RPM value in table.

Important: Do not depress the service brake when recording RPM readings.

11. Compare reading(s) in table.
    - If reading(s) are out of range, go to **Step D.**
    - If reading(s) are in range, go to **Step E.**

Engine Speed Signal Source	Range	Reading(s)
Vehicle Tachometer	Idle RPM	
Parameter "Engine-190"	Within 150 RPM of Engine Idle RPM	
Parameter "Transmission-5052"	Within 150 RPM of Engine Idle RPM	

D

Purpose: *Identify engine speed signal that is out of range.*

1. Compare reading(s) recorded in Step B table.
    - If Parameter "Engine - 190" RPM is out of range of Vehicle Tachometer Idle RPM, refer to OEM guidelines for repair or replacement of OEM Engine Speed Sensor signal. Go to **Step V.**
    - If Parameter "Transmission - 5052" RPM is out of range of Vehicle Tachometer Idle RPM, go to **Step E.**

E

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

1. Retrieve fault code(s) recorded in Step A.
    - If Fault Code 65 with FMI 2 or 5 is Inactive, go to **Step F.**
    - If Fault Code 65 with FMI 2 or 5 is Active, go to **Step G.**

F ***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.

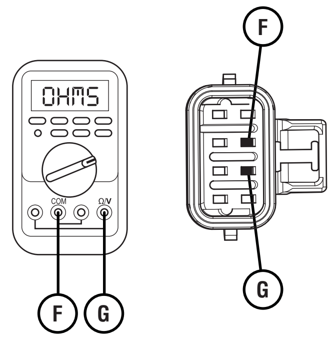
3. Wiggle wiring and connections of the Transmission Harness from the 2-Way Gen1 ECA Speed Sensor to the 8-Way Gen1 ECA Connector. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

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

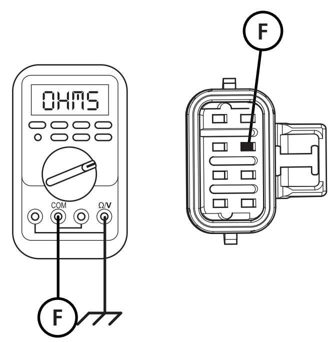
- If any fault code sets Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step V.**
- If any fault code sets Active while wiggling the ECA Speed Sensor wiring, replace ECA Speed Sensor. Go to **Step V.**
- If no fault code sets Active, go to **Step G.**

G ***Purpose:*** *Verify resistance of Transmission Harness and ECA Speed Sensor circuit and not shorted to ground.*

1. Key off.
2. Disconnect 8-Way Gen1 ECA Connector.
3. Inspect 8-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 8-Way Connector Pin F and Pin G. Record reading(s) in table based on configuration.



5. Measure resistance between 8-Way Gen1 ECA Connector Pin F to ground. Record reading(s) in table.



6. Compare reading(s) in table.

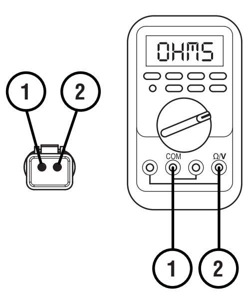
- If readings are out of range, go to **Step H.**
- If readings are in range, go to **Step I.**

ECA Speed Sensor Config	Pins	Range	Reading(s)
Transmission Clutch Housing	F to G	2.0k–4.5k Ohms	
Engine Flywheel Housing	F to G	140–180 Ohms	
Both	F to ground	Open Circuit (OL)	

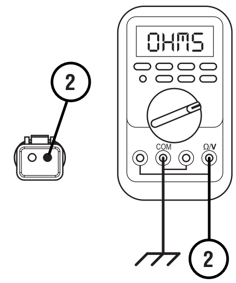
H

Purpose: *Verify resistance of ECA Speed Sensor circuit and not shorted to ground.*

1. Key off.
2. Disconnect 2-Way Gen1 ECA Speed Sensor Connector.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 2-Way Gen1 ECA Speed Sensor Connector Pin 1 and Pin 2. Record reading(s) in table.



5. Measure resistance between 2-Way Gen1 ECA Speed Sensor Connector Pin 2 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 readings are out of range, replace ECA Speed Sensor. Go to **Step V.**

ECA Speed Sensor Config	Pins	Range	Reading(s)
Transmission Clutch Housing	1 to 2	2.0k–4.5k Ohms	
Engine Flywheel Housing	1 to 2	140–180 Ohms	
Both	2 to ground	Open Circuit (OL)	

I

Purpose: *Verify type of ECA Speed Sensor.*

1. Inspect ECA Speed Sensor.
   - If equipped with Push-In Clutch Housing ECA Speed Sensor, go to **Step J.**
   - If equipped with Thread-In Flywheel Housing ECA Speed Sensor, go to **Step L.**

J

Purpose: *Inspect Push-In Clutch Housing ECA Speed Sensor.*

1. Key off.
2. Verify the Push-In ECA Speed Sensor is properly seated and installed in the Transmission Clutch Housing.
3. Remove ECA Speed Sensor. Inspect for signs of damage or debris build-up.
   - If no debris build-up or damage is present, go to **Step K.**
   - If sensor debris build-up or damage is found, inspect for cause of debris build-up or damage. Replace ECA Speed Sensor. Go to **Step V.**

K

Purpose: *Inspect Clutch Cover lugs.*

1. Key off.
2. Remove single bolt for clutch housing access cover.
3. Inspect Clutch Cover for any damaged or missing lugs.
   - If any damage is found or lugs are missing, replace the ECA Clutch. Go to **Step V.**
   - If the Clutch Cover is not damaged and all lugs are present, replace ECA. Go to **Step V.**

L

Purpose: *Inspect Flywheel Housing Thread-In ECA Speed Sensor and adjustment.*

1. Key off.
2. Verify the Thread-In ECA Speed Sensor is properly installed and adjusted in the Engine Flywheel Housing.

   Note: Reference TRSM0930, Thread-In ECA Speed Sensor, Service Procedures.
3. Remove ECA Speed Sensor. Inspect for signs of debris build-up or damage.
   - If ECA Speed Sensor is properly installed and adjusted with no damage or debris build-up, go to **Step M.**
   - If ECA Speed Sensor is out of adjustment, perform Thread-In ECA Speed Sensor adjustment. Go to **Step V.**
   - If ECA Speed Sensor is damaged or debris build-up is evident, inspect for cause of damage or debris build-up. Replace ECA Speed Sensor. Go to **Step V.**

M ***Purpose:*** *Inspect flywheel for damage.*

1. Key off.
2. Inspect Engine Flywheel Ring Gear for debris, wear or damage.
   - If flywheel damage is found, refer to OEM guidelines for repair or replacement of Engine Flywheel. Go to **Step V.**
   - If no flywheel damage is found, replace ECA. 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. 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 65 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 65 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 65: Gen2 ECA Speed Sensor

J1587: MID 130	**PID 190**	**FMI 2, 3, 4, 5**
J1939: SA 3	**SPN 5052**	**FMI 2, 3, 4, 5**

Overview

The UltraShift *PLUS* transmission is equipped with an Electronic Clutch Actuator (ECA) Speed Sensor that provides a secondary engine speed signal to the Transmission Electronic Control Unit (TECU). The ECA Speed Sensor is installed in the clutch housing. The ECA broadcasts the ECA Speed Sensor signal to the TECU through the High Integrity Link (HIL) contained within the Transmission Harness.

The TECU uses the ECA Speed Sensor signal to determine engine speed when the J1939 engine speed signal is not available. Early models have a thread-in ECA Speed Sensor installed in the flywheel housing. Fault Code 95 indicates either a loss of the signal or an electrical issue with the ECA Speed Sensor, but is specific to systems that use a Gen2 ECA. Troubleshooting for this procedure is specific to the Gen2 ECA and associated harnesses.

Note: The troubleshooting procedure for Fault Code 65 may direct users to use this troubleshooting procedure if the vehicle is equipped with a Gen2 ECA, even if Fault Code 95 was not set by the transmission. This is because some transmission software versions do not set Fault Code 95.

Detection

The TECU monitors the ECA Speed Sensor signal and compares the sensor reading with the J1939 Engine Speed signal to determine sensor validity. The TECU also monitors the ECA Speed Sensor electrical circuit for any short or open circuits.

Conditions to Set Fault Code Active

The system can detect ECA Speed Sensor faults when one of the following conditions is present for 1 second or longer:

FMI 2 – Data Erratic: TECU detects Engine speed over J1939 at idle, but does not detect Transmission clutch input speed or the TECU detects Transmission clutch input speed at idle, but does not detect Engine speed over J1939.

FMI 3 – Voltage Above Normal or Shorted High: ECA detects a short to power in the ECA Speed Sensor signal circuit.

FMI 4– Voltage Below Normal or Shorted Low: ECA detects a short to ground in the ECA Speed Sensor signal circuit.

FMI 5– Current Below Normal or Open Circuit: ECA detects an open on the ECA Speed Sensor signal circuit.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- No fallback mode is associated with this fault. TECU uses the vehicle engine speed signal, broadcast over J1939, to operate the transmission.

Conditions to Set Fault Code Inactive

All FMIs: TECU detects the ECA Speed Sensor signal for 2 seconds.

Possible Causes

FMI 2:

- Engine Speed Sensor
  - Missing or inconsistent engine speed signal to the TECU
- Clutch
  - Broken or missing or Clutch Cover lugs (Push-In ECA Speed Sensor)
- Engine Flywheel
  - Contaminated, worn, broken or missing flywheel ring gear teeth (Thread-In ECA Speed Sensor)
- ECA Speed Sensor
  - Debris build-up on ECA Speed Sensor
  - Mis-adjusted Thread-In ECA Speed Sensor
  - Physical Damage
  - Internal Failure
- Transmission Harness
  - Bent, spread, corroded or loose terminals
- ECA
  - Internal Failure

FMI 3:

- Transmission Harness
  - Wiring shorted to power
- ECA
  - Internal Failure

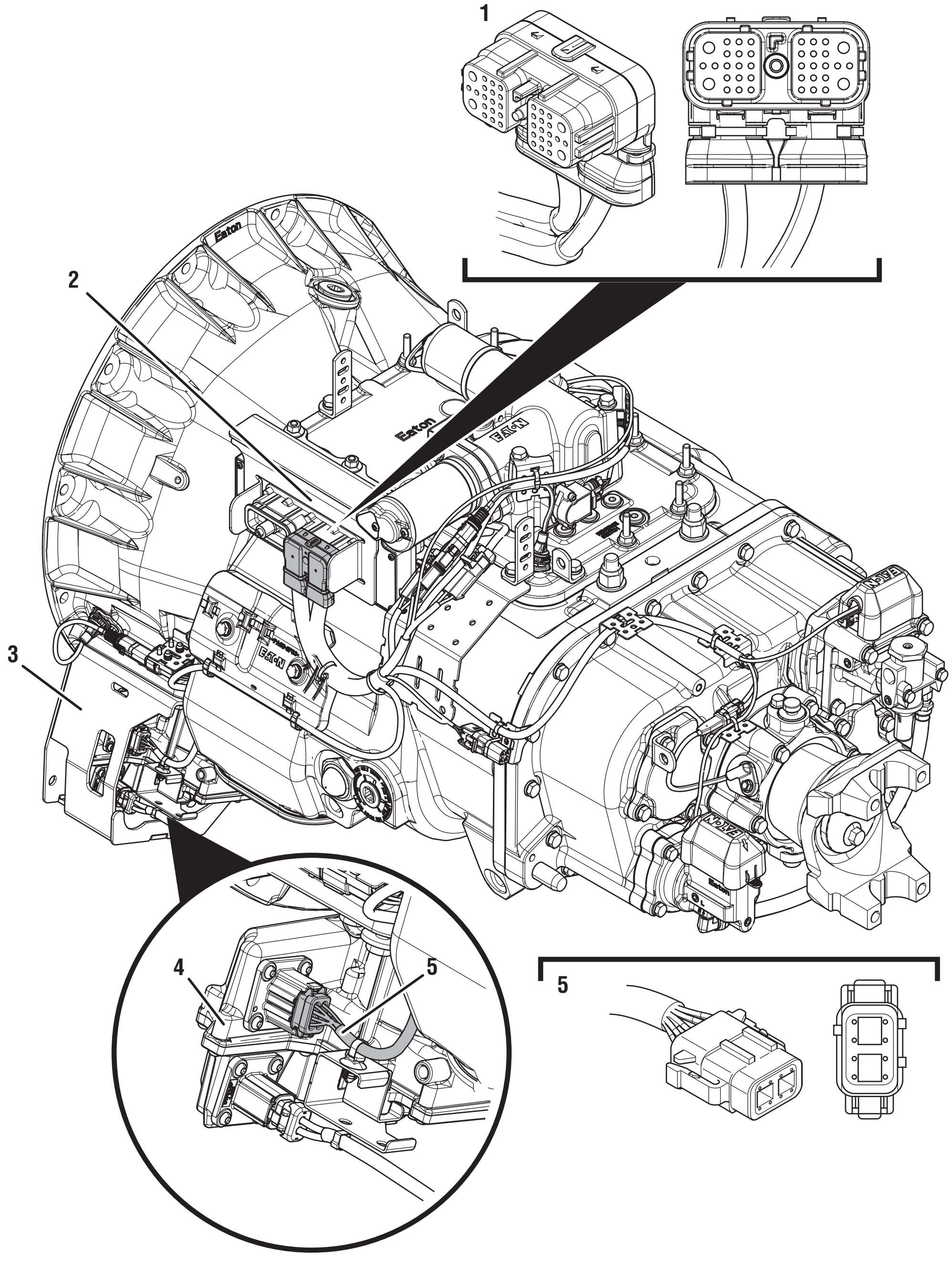
FMI 4:

- ECA Speed Sensor
  - Physical Damage
  - Internal Failure
- Transmission Harness
  - Wiring shorted to ground
- ECA
  - Internal Failure

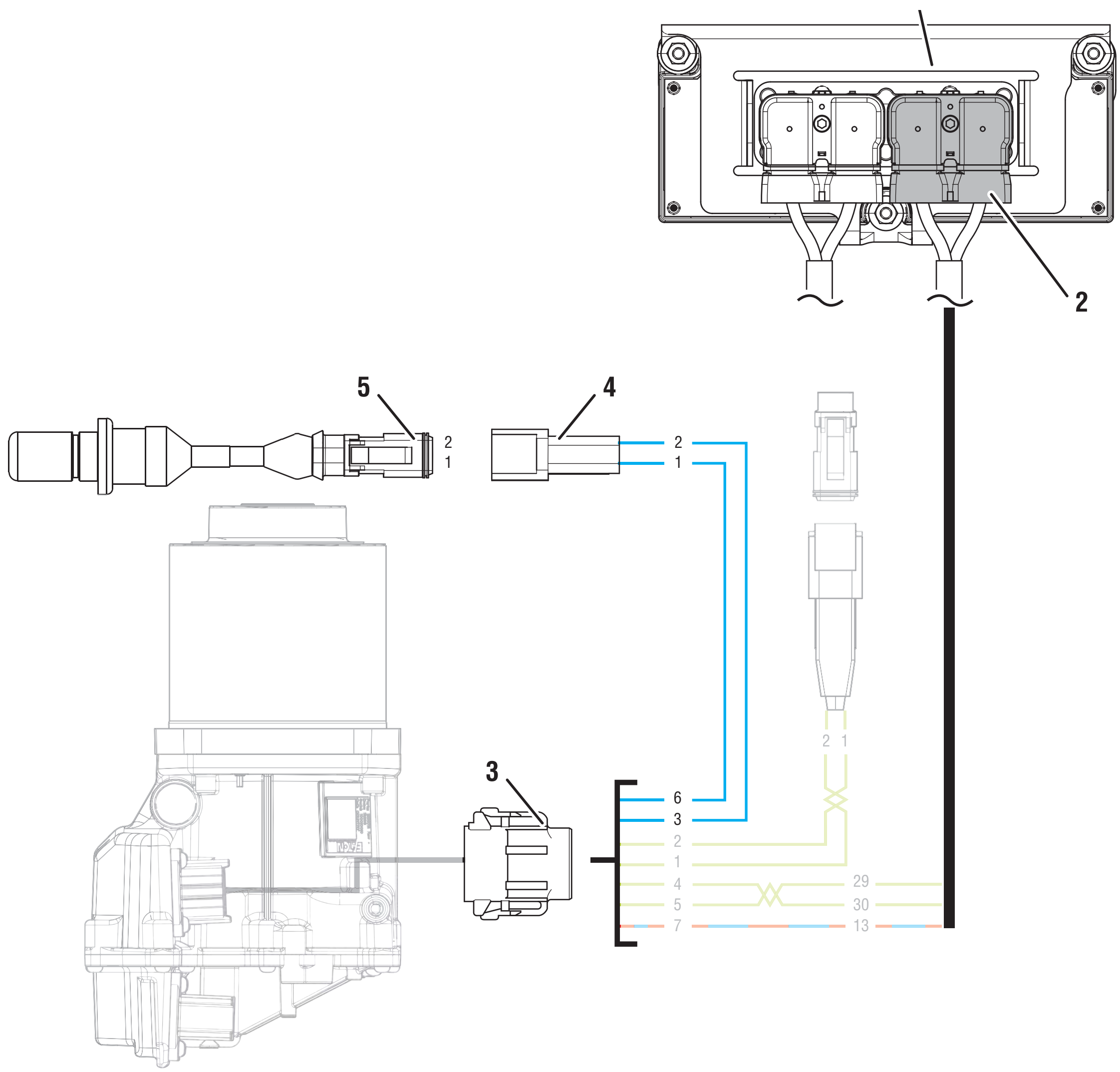
FMI 5:

- ECA Speed Sensor
  - Physical Damage
  - Internal Failure
- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring open
- ECA
  - Internal Failure

Component Identification



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. ECA Shield
4. Electronic Clutch Actuator (ECA)
5. 8-Way ECA Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 8-Way Gen2 ECA Connector
4. 2-Way Gen2 ECA Speed Sensor Connector Body
5. 2-Way Gen2 ECA Speed Sensor

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

Fault Code 65 Troubleshooting Gen2 ECA

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

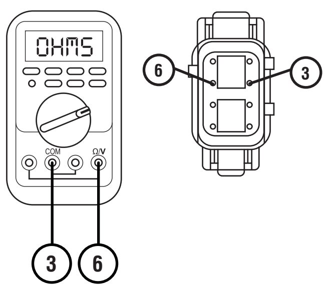
1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Update transmission and ECA software to latest available level, if not completed during the Diagnostic Procedure.

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

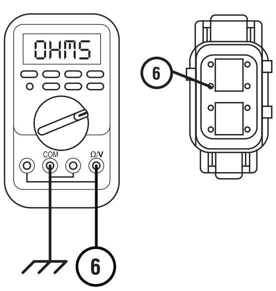
- If Fault Code 56 with FMI 2 is Active, go to *Fault Code Isolation Procedure Index* on page 13.
- If Fault Code 65 with FMI 3 is Active or Inactive, go to **Step B.**
- If Fault Code 65 with FMI 2, 4 or 5 is Active or Inactive, go to **Step D.**

B *Purpose:* *Verify resistance of Transmission Harness and ECA Speed Sensor circuit and not shorted to ground.*

1. Key off.
2. Disconnect 8-Way Gen2 ECA Connector.
3. Inspect 8-Way Gen2 ECA Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 8-Way Gen2 ECA Connector Pin 3 and Pin 6. Record reading(s) in table based on configuration.



5. Measure resistance between 8-Way Gen2 ECA Connector Pin 6 and ground. Record reading(s) in table.

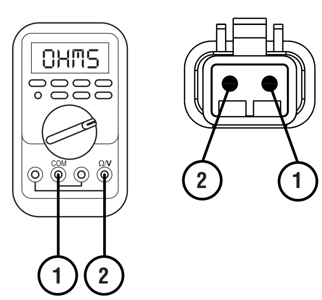


6. Compare reading(s) in table.
   - If readings are out of range, go to **Step C.**
   - If readings are in range, replace ECA. Go to **Step V.**

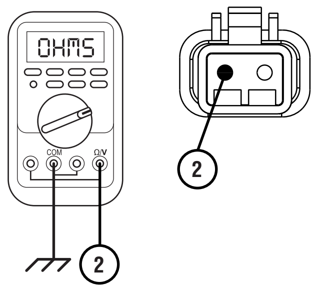
ECA Speed Sensor Configuration	Pins	Range	Reading(s)
Transmission Clutch Housing	3 to 6	2.0k–4.5k Ohms	
Engine Flywheel Housing	3 to 6	140–180 Ohms	
Both	6 to ground	Open Circuit (OL)	

C *Purpose:* *Verify resistance of ECA Speed Sensor circuit and not shorted to ground.*

1. Key off.
2. Disconnect 2-Way Gen2 ECA Speed Sensor Connector.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 2-Way Gen2 ECA Speed Sensor Connector Pin 1 and Pin 2. Record reading(s) in table based on configuration.



5. Measure resistance between 2-Way Gen2 ECA Speed Sensor Connector Pin 2 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 readings are out of range, replace ECA Speed Sensor. Go to **Step V.**

ECA Speed Sensor Configuration	Pins	Range	Reading(s)
Transmission Clutch Housing	1 to 2	2.0k–4.5k Ohms	
Engine Flywheel Housing	1 to 2	140–180 Ohms	
Both	2 to ground	Open Circuit (OL)	

D

Purpose: *Compare J1939 engine speed RPM and transmission clutch input speed RPM.*

1. Set vehicle parking brake and chock wheels.

2. Key on with engine on at idle.

3. Connect ServiceRanger.

4. Select “Data Monitor”.

5. Select “Speed”.

6. Select “Engine speed” and add parameter “Engine -190”.

7. Select “Transmission clutch input speed” and add parameter “Transmission - 5052”.

8. Monitor vehicle tachometer and record engine RPM value in table.

9. Monitor ServiceRanger and record “Engine speed” RPM value in table.

10. Monitor ServiceRanger and record “Transmission clutch input speed” RPM value in table.

Important: Do not depress the service brake when recording RPM readings.

11. Compare reading(s) in table.

- If readings are out of range, go to **Step E.**
- If readings are in range, go to **Step F.**

Engine Speed Signal Source	Range	Reading(s)
Vehicle Tachometer	Idle RPM	
Parameter “Engine-190”	Within 150 RPM of Engine Idle RPM	
Parameter “Transmission-5052”	Within 150 RPM of Engine Idle RPM	

E

Purpose: *Identify engine speed signal that is out of range.*

1. Compare reading(s) recorded in Step D table.
   - If parameter "Engine - 190" RPM is out of range of Vehicle Tachometer Idle RPM, refer to OEM guidelines for repair or replacement of OEM Engine Speed Sensor signal. Go to **Step V.**
   - If parameter "Transmission - 5052" RPM is out of range of Vehicle Tachometer Idle RPM, go to **Step H.**

F

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

1. Retrieve fault code(s) recorded in Step A.
   - If Fault Code 65 with FMI 2, 4 or 5 is Inactive, go to **Step G.**
   - If Fault Code 65 with FMI 2, 4 or 5 is Active, go to **Step H.**

G

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.

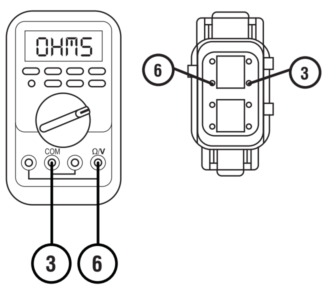
3. Wiggle wiring and connections of the Transmission Harness from the 2-Way Gen2 ECA Speed Sensor to the 8-Way Gen2 ECA Connector. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

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

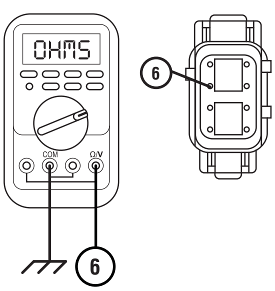
   - If any fault code sets Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step V.**
   - If any fault code sets Active while wiggling the ECA Speed Sensor wiring, replace ECA Speed Sensor. Go to **Step V.**
   - If no fault code sets Active, go to **Step H.**

H ***Purpose:*** *Verify resistance of Transmission Harness and ECA Speed Sensor circuit and not shorted to ground.*

1. Key off.
2. Disconnect 8-Way Gen2 ECA Connector.
3. Inspect 8-Way Gen2 ECA Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 8-Way Gen2 ECA Connector Pin 3 and Pin 6. Record reading(s) in table based on configuration.



5. Measure resistance between 8-Way Gen2 ECA Connector Pin 6 and ground. Record reading(s) in table.



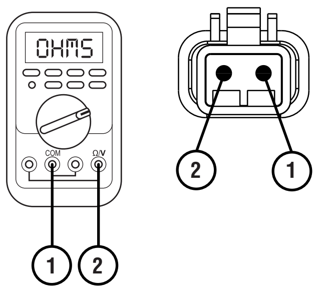
6. Compare reading(s) in table.
   - If readings are out of range, go to **Step I.**
   - If readings are in range, go to **Step J.**

ECA Speed Sensor Configuration	Pins	Range	Reading(s)
Transmission Clutch Housing	3 to 6	2.0k–4.5k Ohms	
Engine Flywheel Housing	3 to 6	140–180 Ohms	
Both	6 to ground	Open Circuit (OL)	

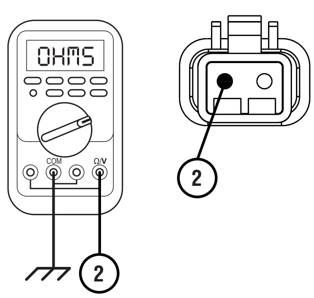
I

Purpose: *Verify resistance of ECA Speed Sensor circuit and not shorted to ground.*

1. Key off.
2. Disconnect 2-Way Gen2 ECA Speed Sensor Connector.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 2-Way Gen2 ECA Speed Sensor Connector Pin 1 and Pin 2. Record reading(s) in table based on configuration.



5. Measure resistance between 2-Way Gen2 ECA Speed Sensor Connector Pin 2 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 readings are out of range, replace ECA Speed Sensor. Go to **Step V.**

ECA Speed Sensor Configuration	Pins	Range	Reading(s)
Transmission Clutch Housing	1 to 2	2.0k–4.5k Ohms	
Engine Flywheel Housing	1 to 2	140–180 Ohms	
Both	2 to ground	Open Circuit (OL)	

J

Purpose: *Verify type of ECA Speed Sensor.*

1. Inspect ECA Speed Sensor.
   - If equipped with Clutch Housing Push-In ECA Speed Sensor, go to **Step K.**
   - If equipped with Flywheel Housing Thread-In ECA Speed Sensor, go to **Step M.**

K

Purpose: *Inspect Push-In Clutch Housing ECA Speed Sensor.*

1. Key off.
2. Verify the Push-In ECA Speed Sensor is properly seated and installed in the Transmission Clutch Housing.
3. Remove ECA Speed Sensor. Inspect for signs of damage or debris build-up.
   - If no debris build-up or damage is present, go to **Step L.**
   - If sensor debris build-up or damage is found, inspect for cause of debris build-up or damage. Replace ECA Speed Sensor. Go to **Step V.**

L

Purpose: *Inspect Clutch Cover lugs.*

1. Key off.
2. Remove single bolt for clutch housing access cover.
3. Inspect Clutch Cover for any damaged or missing lugs.
   - If any damage is found or lugs are missing, replace the ECA Clutch. Go to **Step V.**
   - If the Clutch Cover is not damaged and all lugs are present, replace ECA. Go to **Step V.**

M

Purpose: *Inspect Flywheel Housing Thread-In ECA Speed Sensor and adjustment.*

1. Key off.
2. Verify the Thread-In ECA Speed Sensor is properly installed and adjusted in the Engine Flywheel Housing.

   Note: Reference TRSM0930, Thread-In ECA Speed Sensor, Service Procedures.
3. Remove ECA Speed Sensor. Inspect for signs of debris build-up or damage.
   - If ECA Speed Sensor is properly installed and adjusted with no damage or debris build-up, go to **Step N.**
   - If ECA Speed Sensor is out of adjustment, perform thread-in ECA Speed Sensor adjustment. Go to **Step V.**
   - If ECA Speed Sensor is damaged or debris build-up is evident, inspect for cause of damage or debris build-up. Replace ECA Speed Sensor. Go to **Step V.**

N

Purpose: *Inspect flywheel for damage.*

1. Key off.
2. Inspect Engine Flywheel Ring Gear for debris, wear or damage.
   - If flywheel damage is found, refer to OEM guidelines for repair or replacement of Engine Flywheel. Go to **Step V.**
   - If no flywheel damage is found, replace ECA. 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. 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 65 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 65 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 66: Gen1 ECA Battery Voltage

J1587: MID 130	**PID 34**	**FMI 3, 4**
J1939: SA 3	**SPN 520271**	**FMI 3, 4**

Overview

The UltraShift *PLUS* transmission is equipped with an Electric Clutch Actuator (ECA) that controls the position of the clutch assembly. The ECA operates on a non-switched battery power supply. Fault Code 66 indicates battery power to the ECA is outside of the acceptable ECA operating range.

Detection

ECA monitors the battery voltage supply it receives. If the supplied voltage falls below operating range or spikes significantly above operating range, the ECA will broadcast a fault condition to the TECU, which sets the fault code Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: ECA battery voltage rises above 34 volts for 2 seconds or longer.

FMI 4 – Voltage Below Normal or Shorted Low: ECA battery voltage falls below 8.5 volts for 2 seconds or longer and the TECU has not detected low or weak battery voltage.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Engine does crank and/or start.
- Transmission does not engage a gear from neutral.
- When the transmission is in gear, it will not allow up shifts.
- ECA may maintain the current clutch position using the clutch holding device.
- ECA may move the clutch to the closed position (clutch engaged against engine flywheel).

Conditions to Set Fault Code Inactive

FMI 3: ECA battery voltage drops below 32 volts for 6 seconds.

FMI 4: ECA battery voltage rises above 9 volts on 12-volt chassis or above 18 volts on 24-volt chassis for 6 seconds.

Possible Causes

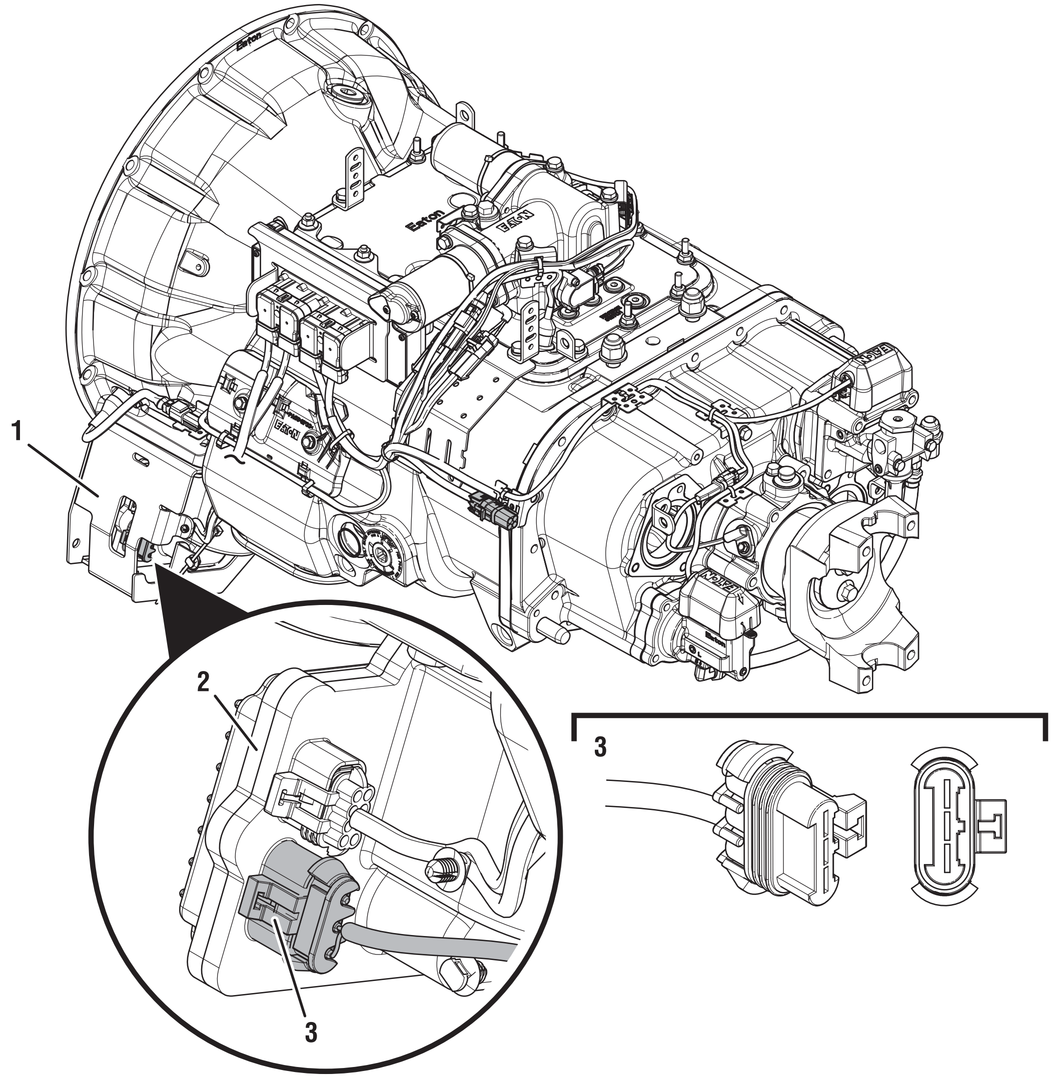
FMI 3

- Starting/Charging System
  - Alternator/Generator failure
  - Improper vehicle jump-start

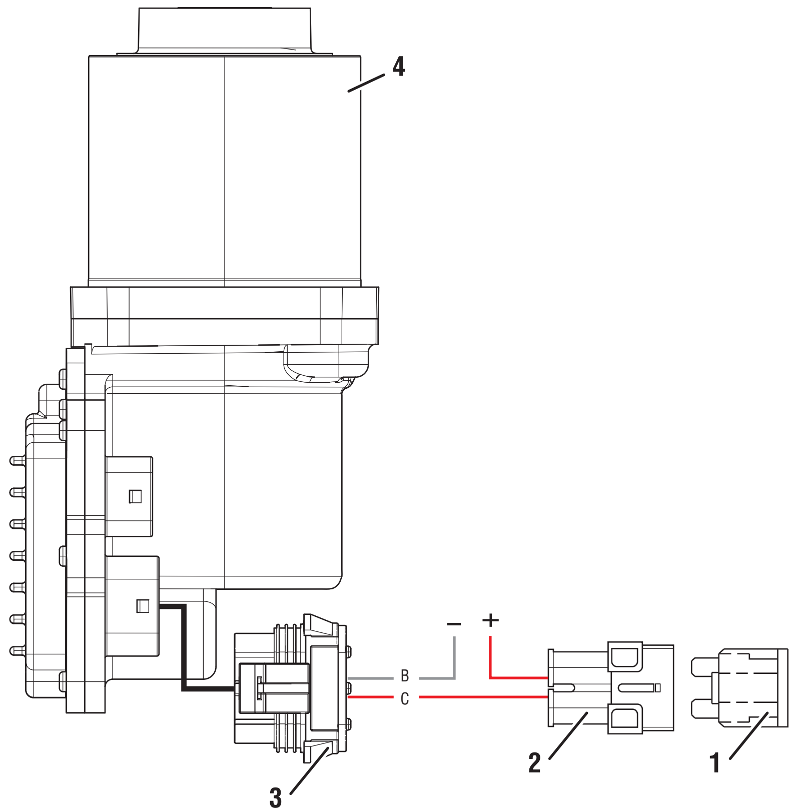
FMI 4

- ECA Vehicle Harness
  - Damaged wiring between the vehicle batteries and 3-Way ECA Connector
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- ECA 40-amp Fuse
  - Bent, spread, corroded or loose fuse terminals
  - Fuse not properly seated or connected
- Vehicle Batteries
  - Internal failure
- Starting/Charging System
  - Alternator/Generator failure
- ECA
  - Internal failure

Component Identification



1. Gen1 ECA Shield
2. Gen1 Electronic Clutch Actuator (ECA)
3. 3-Way Gen1 ECA Connector



1. 40-amp Fuse
2. In-line Fuse Holder
3. 3-Way Gen1 ECA Connector
4. Gen1 Electronic Clutch Actuator (ECA)

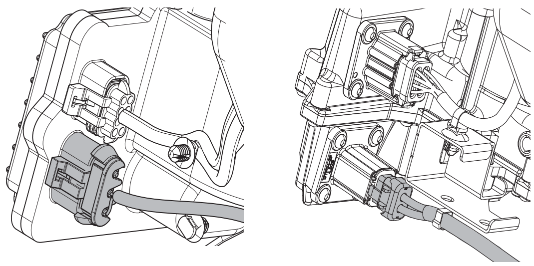
Battery Voltage	Switched Battery from TECU	Ground	Communication	Signal
Ignition Voltage	Switched 5V from TECU	Switched Ground	Relay/Solenoid Driver	

Fault Code 66 Troubleshooting Gen1 ECA

A

Purpose: *Identify ECA installed on transmission.*

1. Inspect ECA OEM Power Supply Connector, reference image below.



Gen1 ECA Gen2 ECA

- If equipped with a Gen1 ECA, go to **Step B.**
- If equipped with a Gen2 ECA, go to *Fault Code 66: Gen2 ECA Battery Voltage* on page 411.

B

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 66 is Inactive and there are other Active fault codes, troubleshoot all Active fault codes.
   - If Fault Code 66 is Active, go to **Step C.**
   - If Fault Code 66 is Inactive, go to **Step D.**

C

Purpose: *Investigate conditions of Active fault code.*

1. Key off.

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

2. Set parking brake and chock wheels.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.

   Note: Low battery voltage or jump starting the vehicle can induce Fault Code 66.

   - If Fault Code 66 remains Active, go to **Step E.**
   - If Fault Code 66 changed to 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 ECA Power Supply Harness between batteries and 3-Way ECA Connector. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

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

- If any fault sets Active while wiggling the ECA Power Supply Harness, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If no fault sets Active while wiggling the ECA Power Supply Harness, go to **Step E.**

E

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

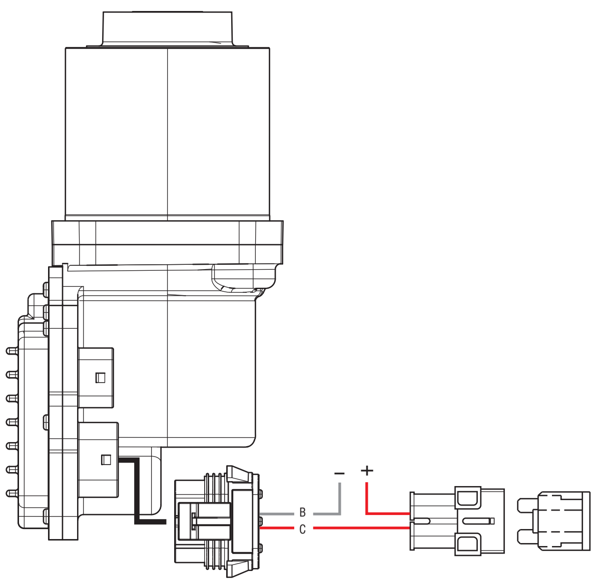
1. Key off.
2. Load test each vehicle battery per OEM specifications. Record reading(s).
   - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**
   - If all batteries pass the Load Test, go to **Step F.**

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

F *__Purpose:__ Inspect power and ground supply to the ECA.*

1. Key off.
2. Inspect the ECA Power Supply Harness between the batteries and the ECA for signs of rubbing or chafing to the wiring.
3. Inspect the ECA 40-amp In-line Fusible Link or Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.

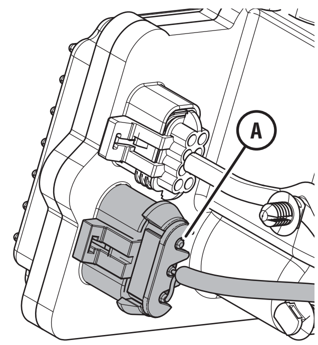
   Note: Some chassis use a power and ground distribution block separate from the battery or may route power and ground to the starter. Be sure to clean and inspect connections at this location and at the battery.



- If damage to the ECA Power Supply Harness is found, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If no damage is found, go to **Step G.**

G *__Purpose:__ Verify condition of 3-Way ECA Connector.*

1. Key off.
2. Disconnect 3-Way ECA Connector.
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. Confirm the 3-Way ECA Connector has a seal plug in Cavity A.

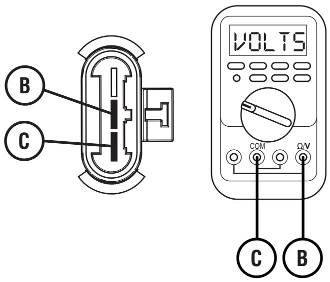


5. Inspect ECA side of 3-Way ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.
   - If damage to the 3-Way ECA Connector is found and/or missing seal plug in Cavity A, refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If damage to the ECA side of 3-Way ECA Connector is found, replace ECA. Go to **Step V.**
   - If no damage is found, go to **Step H.**

H

Purpose: *Verify battery voltage at ECA.*

1. Key off.
2. Measure voltage between 3-Way ECA Connector Pin C (Battery positive) and Pin B (Battery negative). Record reading(s) in table.



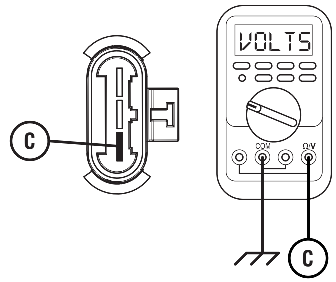
3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
   - If readings are in range, go to **Step I.**

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

I

Purpose: *Verify polarity of battery voltage at ECA.*

1. Key off.
2. Measure voltage between 3-Way ECA Connector Pin C (Battery positive) and ground. Record reading(s) in table.

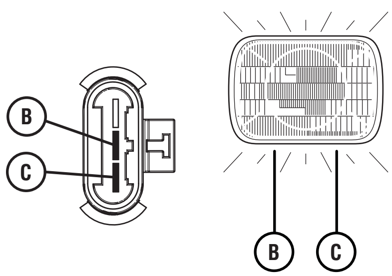


3. Compare reading(s) in table.
   - If readings are out of range, Pin C (Battery positive) and Pin B (Battery negative) wires are incorrectly pinned in the ECA 3-Way Connector. Refer to OEM requirements for repair or replacement. Go to **Step V.**
   - If readings are in range, go to **Step J.**

Pins	Range	Reading(s)
C to Ground	Within 1.2 V of Battery Positive (+)	

J ***Purpose:*** *Load Test the vehicle power and ground supply to the ECA.*

1. Key off.
2. Load test the 3-Way ECA Connector and ECA Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin C (Battery positive) and Pin B (Battery negative). Load Test for 5 minutes to verify the harness will carry a load with the 40-amp fuse or fusible link installed.



3. Wiggle the ECA Power Supply Harness during the Load Test from the vehicle batteries to ECA.
   - If the ECA Power Supply Harness does not carry a load, refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If the ECA Power Supply Harness carries a load and no fault was found with the ECA Power Supply Harness or battery/charging system, replace the ECA. 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. 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 the vehicle operates properly, test complete.
   - If Fault Code 66 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 66 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 66: Gen2 ECA Battery Voltage

J1587: MID 130 PID 34 FMI 3, 4
J1939: SA 3 SPN 520271 FMI 3, 4

Overview

The UltraShift *PLUS* transmission is equipped with an Electric Clutch Actuator (ECA) that controls the position of the clutch assembly. The ECA operates on a non-switched battery power supply.Fault Code 96 indicates battery power to the ECA is outside of the acceptable ECA operating range, but is specific to systems that use a Gen2 ECA. Troubleshooting for this procedure is specific to the Gen2 ECA and associated harnesses.

Note: The troubleshooting procedure for Fault Code 66 may direct users to use this troubleshooting procedure if the vehicle is equipped with a Gen2 ECA, even if Fault Code 96 was not set by the transmission. This is because some transmission software versions do not set Fault Code 96.

Detection

ECA monitors the battery voltage supply it receives. If the supplied voltage falls below operating range or spikes significantly above operating range, the ECA will broadcast a fault condition to the TECU, which sets the fault code Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: ECA battery voltage rises above 34 volts for 2 seconds or longer.

FMI 4 – Voltage Below Normal or Shorted Low: ECA battery voltage falls below 8.5 volts for 2 seconds or longer and the TECU has not detected low or weak battery voltage.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Engine does crank and/or start.
- Transmission does not engage a gear from neutral.
- When the transmission is in gear, it will not allow up shifts.
- ECA may maintain the current clutch position using the clutch holding device.
- ECA may move the clutch to the closed position (clutch engaged against engine flywheel).

Conditions to Set Fault Code Inactive

FMI 3: ECA battery voltage drops below 32 volts for 6 seconds.

FMI 4: ECA battery voltage rises above 9 volts on 12-volt chassis or above 18 volts on 24-volt chassis for 6 seconds.

Possible Causes

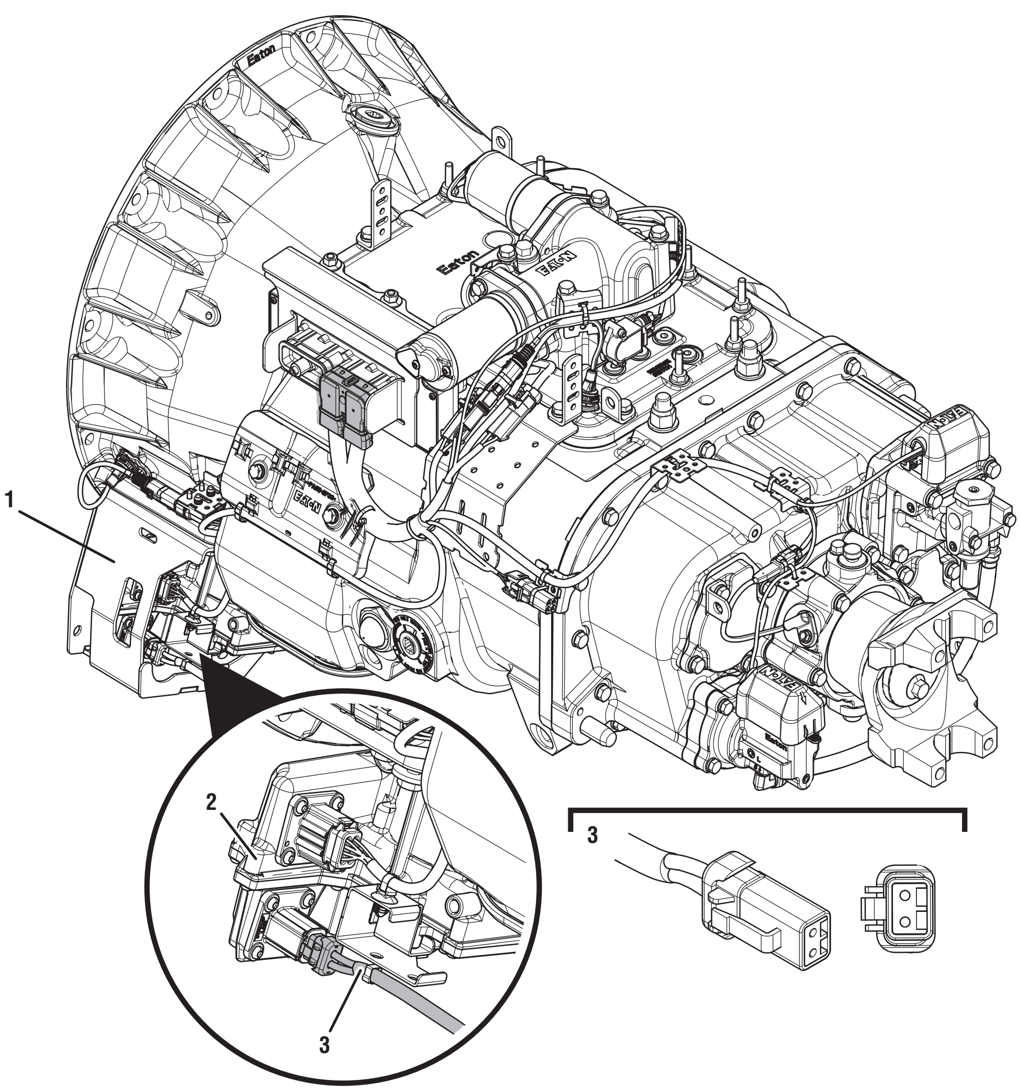
FMI 3

- Starting/Charging System
  - Alternator/Generator failure
  - Improper vehicle jump-start

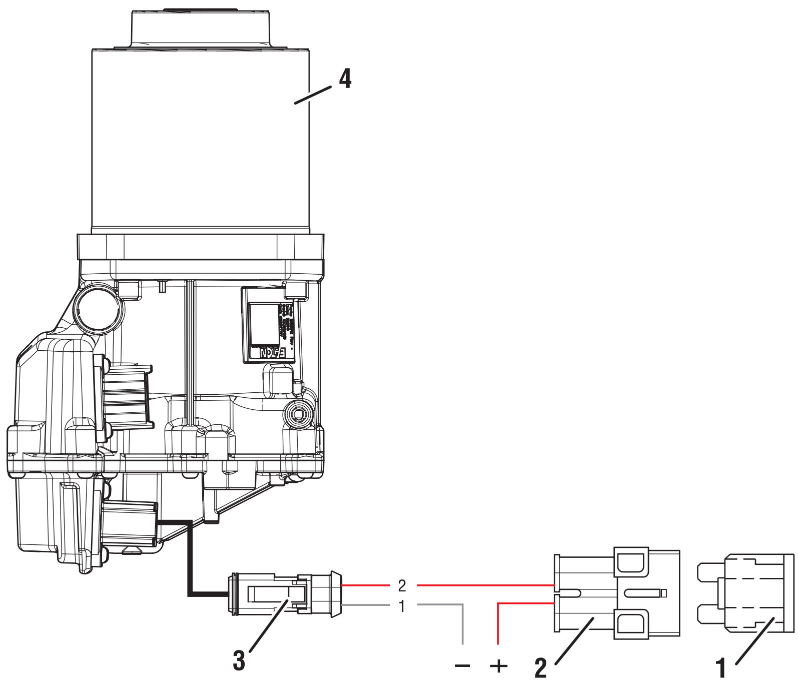
FMI 4

- ECA Power Harness
  - Damaged wiring between the vehicle batteries and 2-Way Gen2 ECA Connector
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
  - Damaged in-line connectors between the vehicle batteries and 2-Way Gen2 ECA Connector, if equipped
- ECA 40-amp Fuse
  - Bent, spread, corroded or loose fuse terminals
  - Fuse not properly seated or connected
- Vehicle Batteries
  - Internal failure
- Starting/Charging System
  - Alternator/Generator failure
- ECA
  - Internal failure

Component Identification



1. ECA Shield
2. Electronic Clutch Actuator (ECA)
3. 3-Way ECA Connector



1. 40-amp Fuse
2. In-line Fuse Holder
3. 2-Way Gen2 ECA Connector
4. Gen2 Electronic Clutch Actuator (ECA)

Fault Code 66 Troubleshooting Gen2 ECA

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Update transmission and ECA software to latest available level, if not completed during the Diagnostic Procedure.

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

- If Fault Code 66 is Inactive and there are other fault codes, troubleshoot all Active fault codes.
- If Fault Code 66 is Active, go to **Step B.**
- If Fault Code 66 is Inactive, go to **Step C.**

B

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

1. Key off.

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

2. Key on with engine off.
3. Connect ServiceRanger.
4. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.

Note: Low batteries or jump starting the vehicle can induce Fault Code 66.

- If Fault Code 66 stays Active, go to **Step D.**
- If Fault Code 66 changed to 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 wiring and connections of ECA Power Supply Harness between batteries and 2-Way Gen2 ECA Connector. Look for signs of pinched or chafed wiring. Verify all connections are clean and tight.
4. Exit PD Mode by powering down.

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

- If any fault sets Active during PD Mode, refer to OEM guidelines for repair or replacement of ECA Power Supply Harness. Go to **Step V.**
- If no fault sets Active while wiggling the ECA Power Supply Harness, go to **Step D.**

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

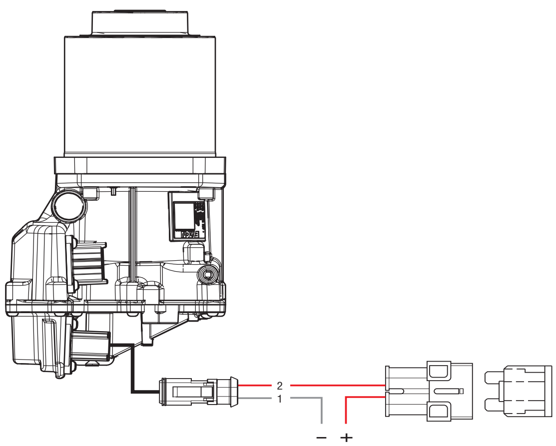
1. Key off.
2. Set parking brake and chock wheels
3. Load test each vehicle battery per OEM specifications. Record reading(s).
   - If any battery does not pass the Load Test, refer to OEM guidelines for repair or replacement of batteries. Go to **Step V.**
   - If all batteries pass the Load Test, go to **Step E.**

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

E ***Purpose:*** *Inspect power and ground supply to the ECA.*

1. Key off.
2. Inspect the ECA Power Supply Harness between the batteries and the ECA for signs of rubbing or chafing to the wiring.
3. Inspect the ECA 40-amp In-line Fusible Link or Fuse Holder Connections for damage and bent, spread, corroded or loose terminals.

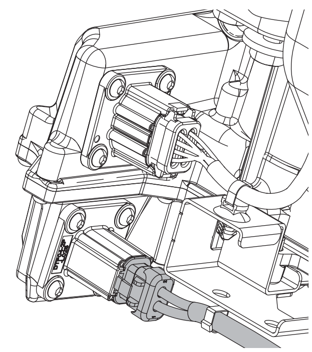
   Note: Some chassis use a power and ground distribution block separate from the battery or may route power and ground to the starter. Be sure to clean and inspect connections at this location and at the battery.



- If damage to the ECA Power Supply Harness is found, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If no damage is found, go to **Step F.**

F ***Purpose:*** *Verify condition of 2-Way Gen2 ECA Connector.*

1. Key off.
2. Disconnect 2-Way Gen2 ECA Connector.
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. Inspect ECA side of 2-Way Gen2 ECA Connector, verify connector is free from any corrosion, the terminals are not bent, spread or loose; and there is no damage to the connector body.

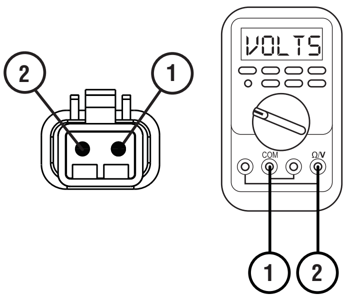


- If damage is found to the 2-Way Gen2 ECA Connector, refer to OEM guidelines for repair or replacement. Go to **Step V.**
- If damage to the ECA side of 2-Way Gen2 ECA Connector is found, replace ECA. Go to **Step V.**
- If no damage is found, go to **Step G.**

G

Purpose: *Verify battery voltage at ECA.*

1. Key off.
2. Measure voltage between 2-Way Gen2 ECA Connector Pin 2 (Battery positive) and Pin 1 (Battery negative). Record reading(s) in table.



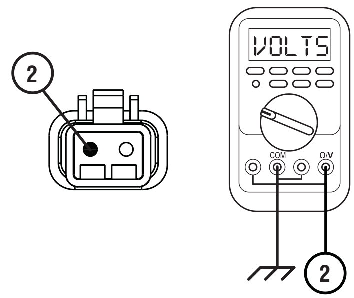
3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the ECA Power Supply Harness. Go to **Step V.**
   - If readings are in range, go to **Step H.**

Pins	Range	Reading(s)
1 to 2	Within 1.2 V of Battery Positive (+)	

H

Purpose: *Verify polarity of battery voltage at ECA.*

1. Key off.
2. Measure voltage between 2-Way Gen2 ECA Connector Pin 2 (Battery positive) and ground. Record reading(s) in table.



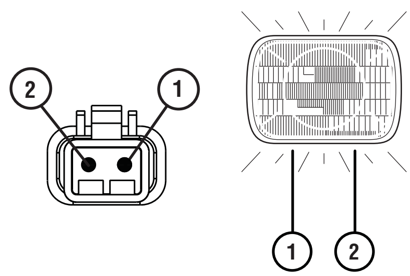
3. Compare reading(s) in table.
   - If readings are out of range, Pin 2 (Battery positive) and Pin 1 (Battery negative) wires are incorrectly pinned in the 2-Way Gen2 ECA Connector. Refer to OEM requirements for repair or replacement. Go to **Step V.**
   - If readings are in range, go to **Step I.**

Pins	Range	Reading(s)
2 to Ground	Within 1.2 V of Battery Positive (+)	

I

Purpose: *Load Test the vehicle power and ground supply to the ECA.*

1. Key off.
2. Load test the 2-Way Gen2 ECA Connector and ECA Power Supply Harness with an external load source. Use a sealed beam headlamp or blower motor attached to Pin 2 (Battery positive) and Pin 1 (Battery negative). Load Test for 5 minutes to verify the harness will carry a load with the 40-amp fuse or fusible link installed.



3. Wiggle the ECA Power Supply Harness during the Load Test from the vehicle batteries to ECA.
   - If the ECA Power Supply Harness does not carry a load, refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If the ECA Power Supply Harness carries a load, go to **Step J.**

J

Purpose: Check for Active or Inactive fault codes.

1. Key off.

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

2. Set parking brake and chock wheels.
3. Reconnect all connectors and verify that all components are properly installed.
4. Key on with engine running.
5. Connect ServiceRanger.
6. Depress and hold service brake for 15 seconds.
7. Release service brake.
8. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
   - If Fault Code 66 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is in ECA Power Supply Harness and/or battery/charging system. Contact OEM for further help troubleshooting the wiring and/or battery/charging system. Go to **Step V.**
   - If Fault Code 66 is Active and no fault was found with the ECA Power Supply Harness or battery/charging system, replace the ECA. 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. 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 the vehicle operates properly, test complete.
   - If Fault Code 66 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 66 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 67: Gen1 ECA Ignition Voltage

J1587: MID 130 PID 158 FMI 3, 4
J1939: SA 3 SPN 520274 FMI 3, 4

Overview

The UltraShift *PLUS* transmission is equipped with an Electronic Clutch Actuator (ECA) that controls the position of the clutch assembly. The ECA requires a 12-volt ignition supply from the Transmission Electronic Control Unit (TECU) via the Transmission Harness to initiate ECA operation when the key is on. Fault Code 67 indicates an issue with the ignition supply voltage to the ECA.

Detection

After power up, the ECA monitors the ignition voltage from the TECU. If the ECA loses ignition voltage, but maintains battery voltage and High Integrity Link (HIL) communication, that information is broadcast to the TECU and the fault code sets Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: ECA ignition voltage is shorted high for 2 seconds during key on operation.

FMI 4 – Voltage Below Normal or Shorted Low: ECA ignition voltage is shorted to ground or open for 2 seconds or longer during key on operation.

Fallback

All FMIs:

- "F" flashes in gear display.
- Service light flashes (if equipped).
- Engine does crank but the transmission cannot engage a start gear from neutral.
- If failure occurs during operation transmission shift quality is not affected by the fault until the vehicle ignition switch is turned off and TECU powers down.

Conditions to Set Fault Code Inactive

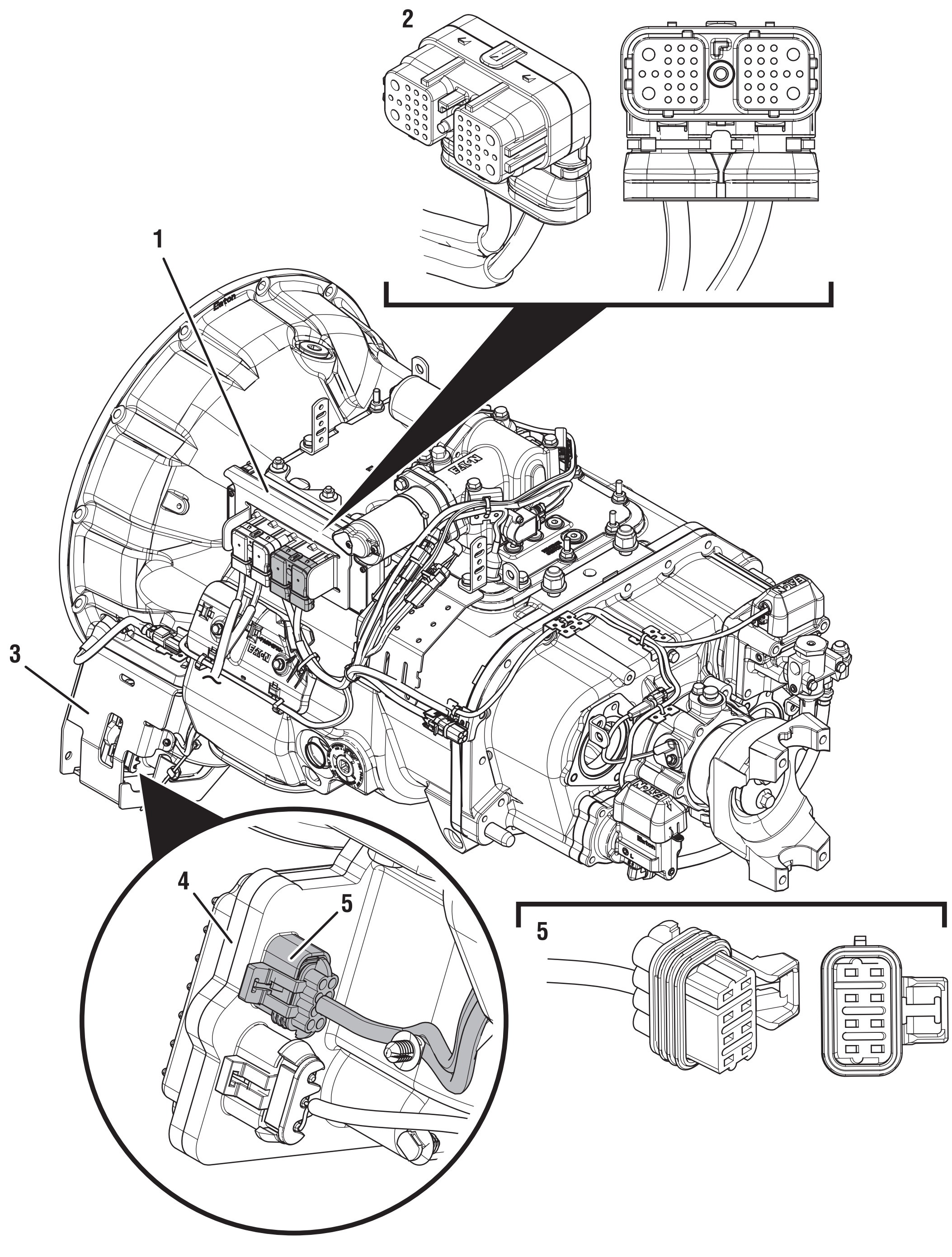
All FMIs: Ignition voltage signal is within range for 6 seconds.

Possible Causes

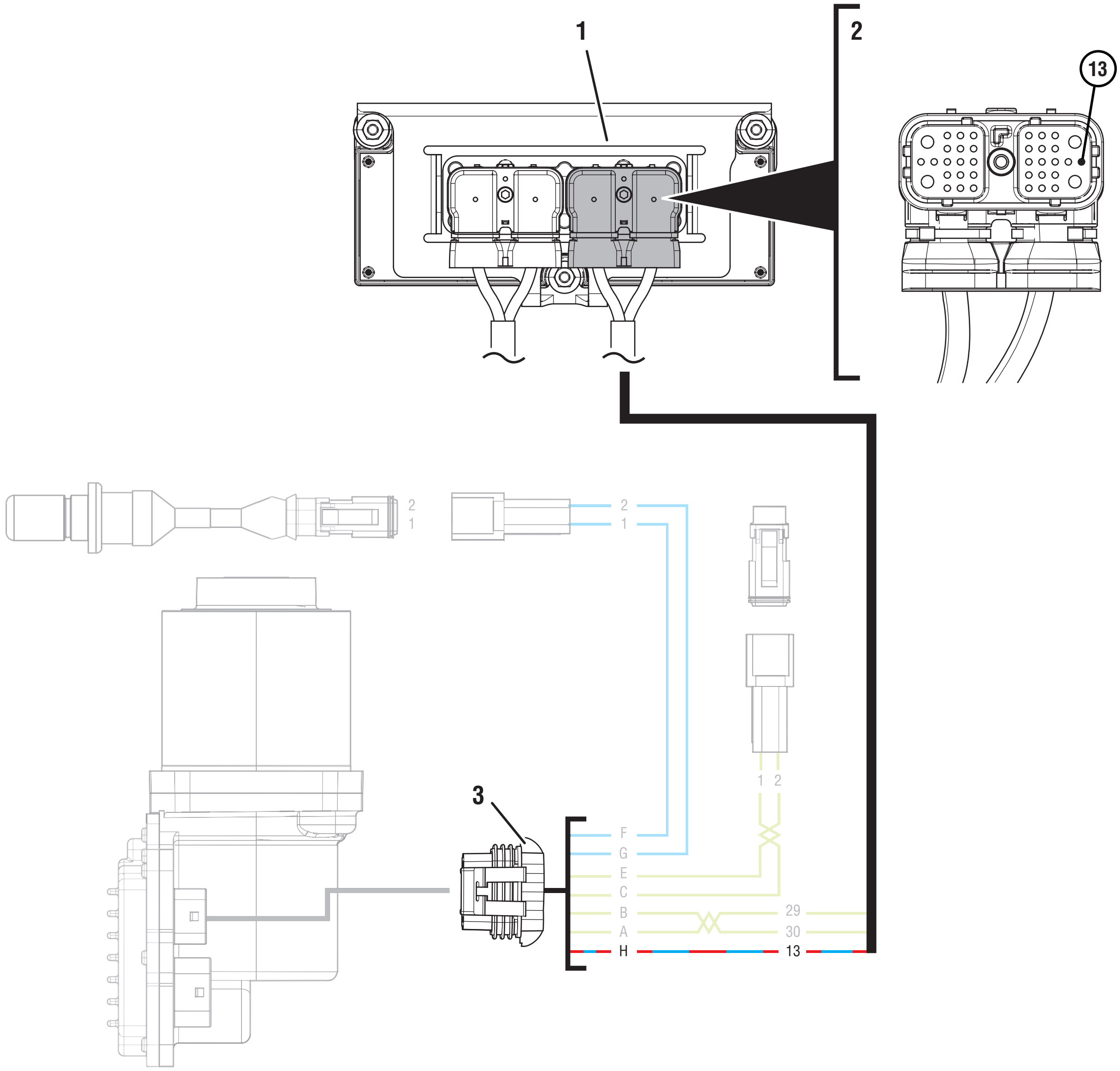
ALL FMIs:

- Transmission Harness
  - Damage to wiring between the TECU and ECA
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground or open
- ECA
  - Internal failure
- TECU
  - Internal failure

Component Identification



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. Gen1 ECA Shield
4. Gen1 Electronic Clutch Actuator (ECA)
5. 8-Way Gen1 ECA Connector



1. *Transmission Electronic Control Unit (TECU)*
2. *38-Way Transmission Harness Connector*
3. *8-Way Gen1 ECA Connector*

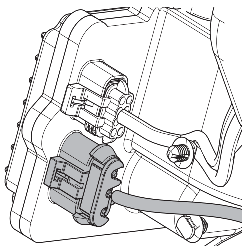
Battery Voltage
Ignition Voltage
Switched Battery from TECU
Switched 5V from TECU
Ground
Switched Ground
Communication
Relay/Solenoid Driver
Signal

Fault Code 67 Troubleshooting Gen1 ECA

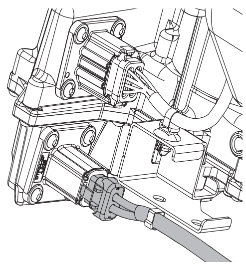
A

Purpose: *Identify ECA installed on transmission.*

1. Inspect ECA OEM Power Supply Connector, reference image below.



Gen1 ECA



Gen2 ECA

- If equipped with a Gen1 ECA, go to **Step B.**
- If equipped with a Gen2 ECA, go to *Fault Code 67: Gen2 ECA Ignition Voltage* on page 427.

B

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 67 is Active, go to **Step C.**
   - If Fault Code 67 is Inactive, replace the Transmission Harness. Go to **Step V.**

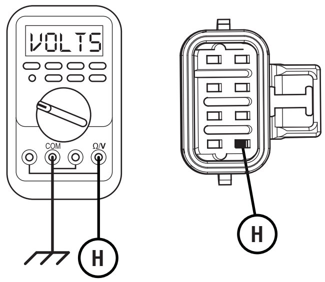
C

Purpose: *Verify condition of 8-Way Gen1 ECA Connector.*

1. Set parking brake and chock wheels.
2. Key off.
3. Disconnect the 8-Way Gen1 ECA Connector.
4. 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.
5. Inspect the ECA side of the 8-Way Gen1 ECA Connector, 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.
   - If no contamination and damage is found, go to **Step D.**
   - If contamination or damage is found, replace the ECA and Transmission Harness. Go to **Step V.**

D ***Purpose:*** *Verify ignition voltage signal at the ECA from the TECU.*

1. Key on.
2. Measure voltage between 8-Way Gen1 ECA Connector Pin H and ground. Record reading(s) in table.



3. Compare reading(s) in table.

   Note: If ECA is replaced, perform clutch adjustment through ServiceRanger prior to vehicle operation.

   - If readings are in range, go to **Step E.**
   - If readings are out of range, go to **Step F.**

Pins	Range	Reading(s)
H to Ground	Within 1.2 V of Battery Voltage	

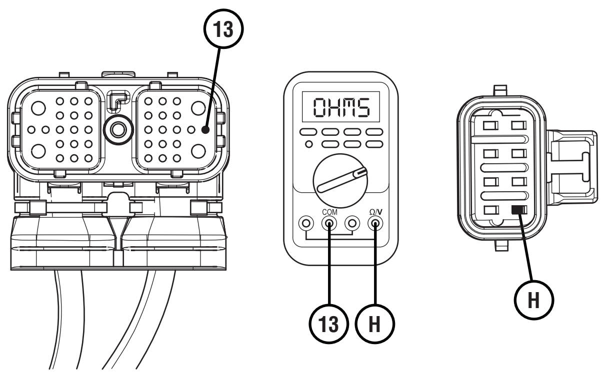
E ***Purpose:*** *Check for Active or Inactive fault codes.*

1. Key off.
2. Reconnect the 8-Way Gen1 ECA Connector and verify that all components are properly installed.
3. Key on.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes and FMIs and their occurrences and timestamps.
   - If Fault Code 67 is Active, replace the ECA. Go to **Step V.**
   - If Fault Code 67 is Inactive, replace the Transmission Harness. Go to **Step V.**

F

Purpose: *Verify ignition voltage signal circuit continuity between ECA and TECU.*

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector.
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. Measure resistance between 38-Way Transmission Harness Connector Pin 13 and 8-Way Gen1 ECA Connector Pin H. Record reading(s) in table.



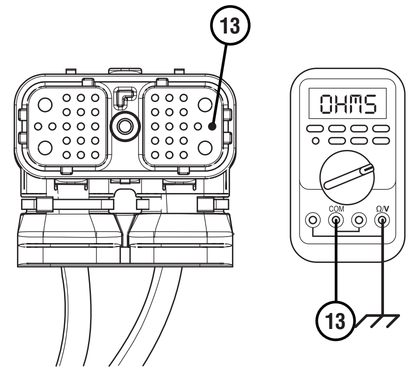
5. Compare reading(s) in table.
   - If readings are in range, go to **Step G.**
   - If readings are out of range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
13 to H	0.0–0.5 ohms	

G

Purpose: *Verify ECA ignition voltage circuit is not shorted to ground.*

1. Key off.
2. Measure resistance between 38-Way Transmission Harness Connector Pin 13 and ground. Record reading(s) in table.



3. Compare reading(s) in table.
   - If readings are out of range, replace the Transmission Harness. Go to **Step V.**
   - If readings are in range, go to **Step H.**

Pins	Range	Reading(s)
13 to Ground	Open Circuit (OL)	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes and FMIs and their occurrences and timestamps.
   - If Fault Code 67 is Active, replace the TECU. Go to **Step V.**
   - If Fault Code 67 is Inactive, replace the 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 engine 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 67 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 67 sets Active, see the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 67: Gen2 ECA Ignition Voltage

J1587: MID 130 PID 158 FMI 3, 4
J1939: SA 3 SPN 520274 FMI 3, 4

Overview

The UltraShift *PLUS* transmission is equipped with an Electronic Clutch Actuator (ECA) that controls the position of the clutch assembly. The ECA requires a 12-volt ignition supply from the Transmission Electronic Control Unit (TECU) via the Transmission Harness to initiate ECA operation when the key is on. Fault Code 97 indicates an issue with the ignition supply voltage to the ECA, but is specific to systems that use a Gen2 ECA. Troubleshooting for this procedure is specific to the Gen2 ECA and associated harnesses.

Note: The troubleshooting procedure for Fault Code 67 may direct users to use this troubleshooting procedure if the vehicle is equipped with a Gen2 ECA, even if Fault Code 97 was not set by the transmission. This is because some transmission software versions do not set Fault Code 97.

Detection

After power up, the ECA monitors the ignition voltage from the TECU. If the ECA loses ignition voltage, but maintains battery voltage and High Integrity Link (HIL) communication, that information is broadcast to the TECU and the fault code sets Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: ECA ignition voltage is shorted high for 2 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: ECA ignition voltage is shorted to ground or open for 2 seconds.

Fallback

All FMIs

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Engine does crank but the transmission cannot engage a start gear from neutral.
- If failure occurs during operation transmission shift quality is not affected by the fault until the vehicle ignition switch is turned off and TECU powers down.

Conditions to Set Fault Code Inactive

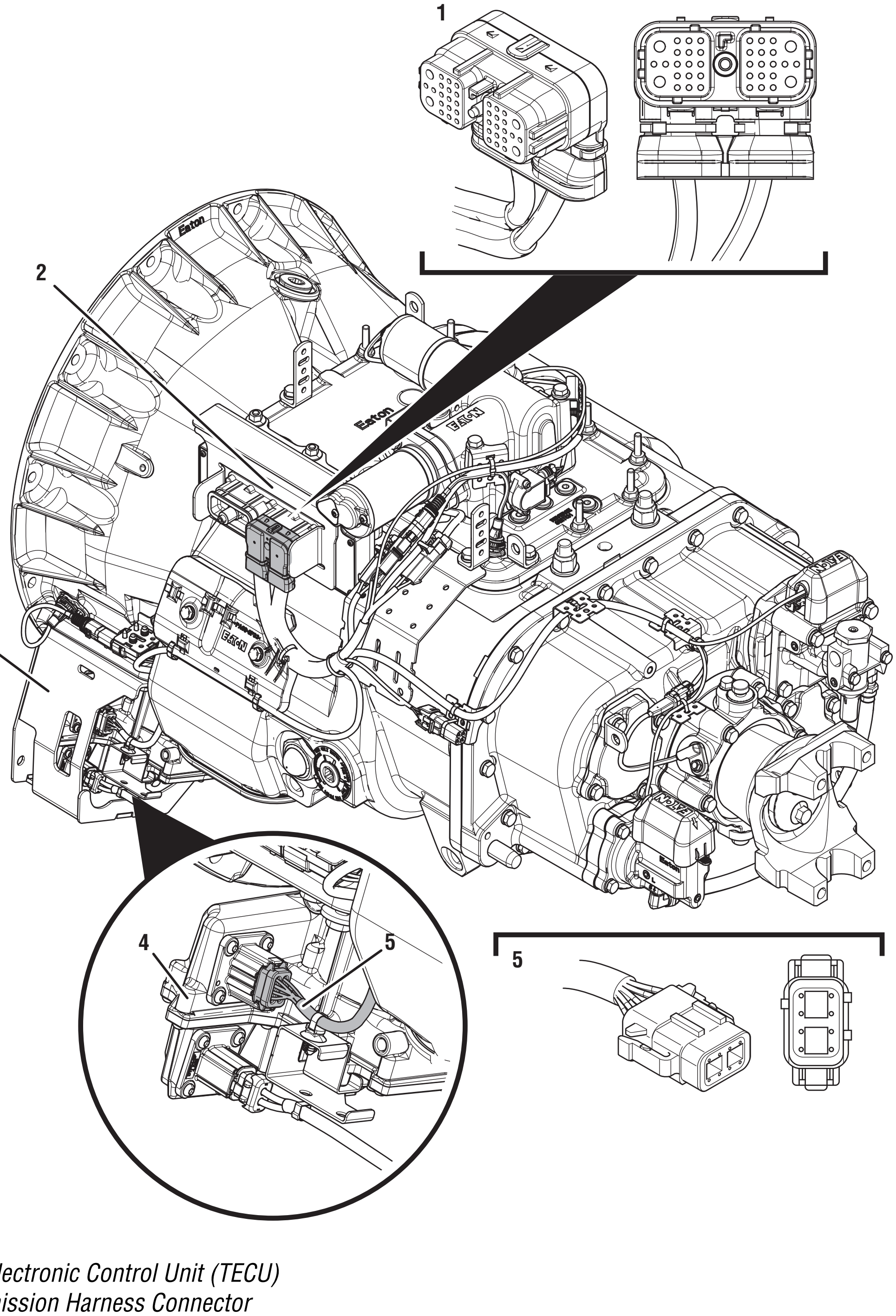
ALL FMIs: Ignition voltage signal is within range for 6 seconds.

Possible Causes

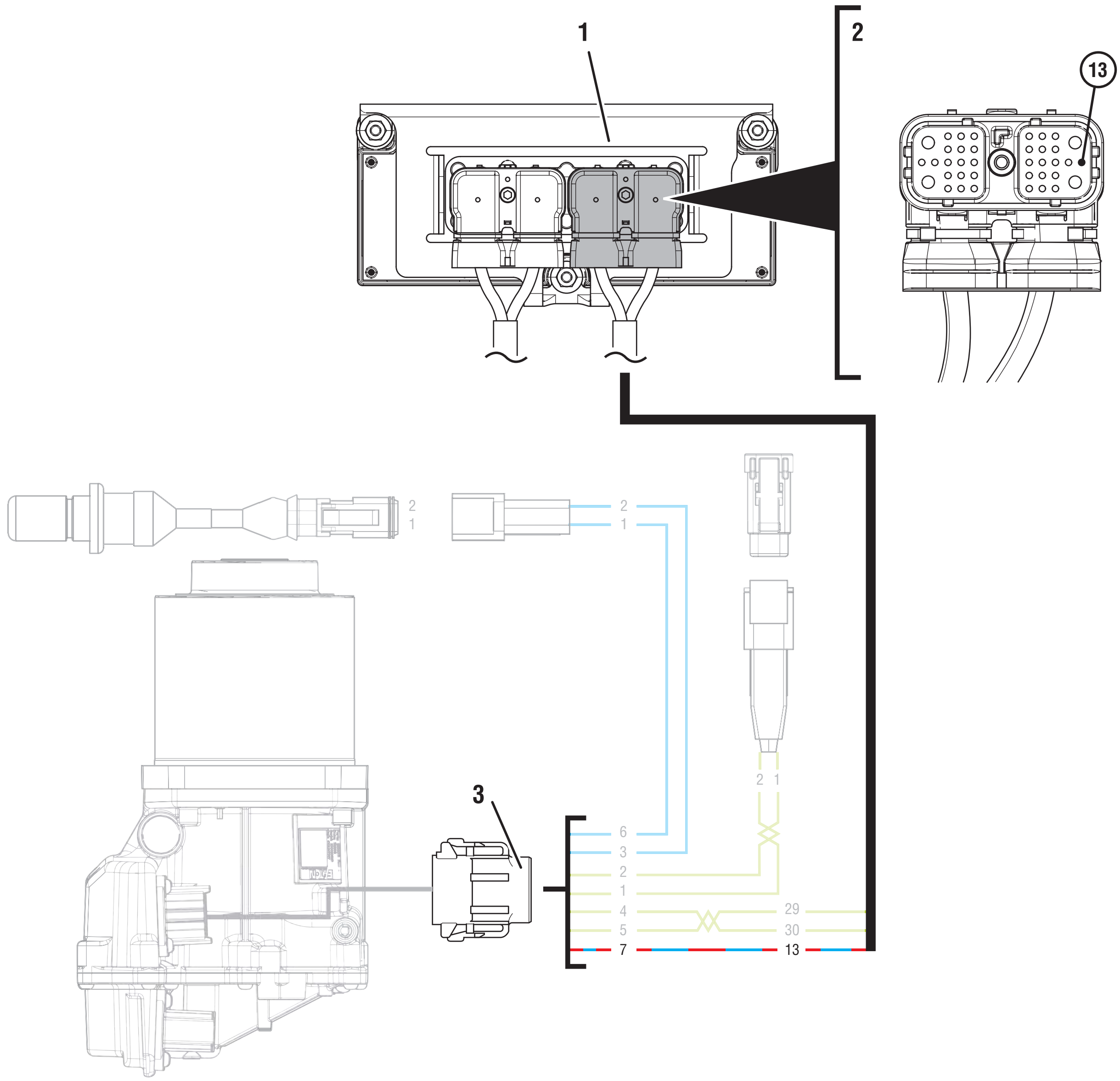
ALL FMIs:

- Transmission Harness
  - Damage to wiring between the TECU and ECA
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground or open
- ECA
  - Internal Failure
- TECU
  - Internal Failure

Component Identification



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. ECA Shield
4. Electronic Clutch Actuator (ECA)
5. 8-Way ECA Connector



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 8-Way Gen2 ECA Connector

Fault Code 67 Troubleshooting Gen2 ECA

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Update transmission and ECA software to latest available level, if not completed during the Diagnostic Procedure.

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

   - If Fault Code 67 is Active, go to **Step C.**
   - If Fault Code 67 is Inactive, go to **Step B.**

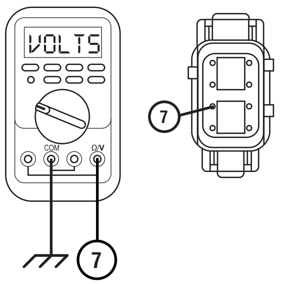
B

Purpose: *Verify condition of 8-Way Gen2 ECA Connector.*

1. Set parking brake and chock wheels.
2. Key off.
3. Disconnect the 8-Way Gen2 ECA Connector.
4. 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.
5. Inspect the ECA side of the 8-Way Gen2 ECA Connector, 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.
   - If no contamination and damage is found, go to **Step C.**
   - If contamination or damage is found, replace the ECA and Transmission Harness. Go to **Step V.**

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

1. Key on.
2. Measure voltage between 8-Way Transmission Harness Connector Pin 7 and ground. Record reading(s) in table.



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

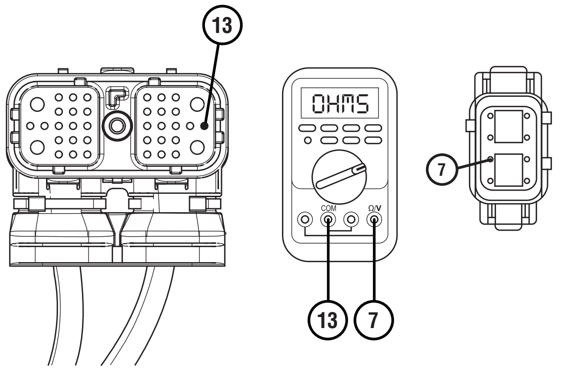
Pins	Range	Reading(s)
7 to ground	Within 1.2 V of Battery Voltage	

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

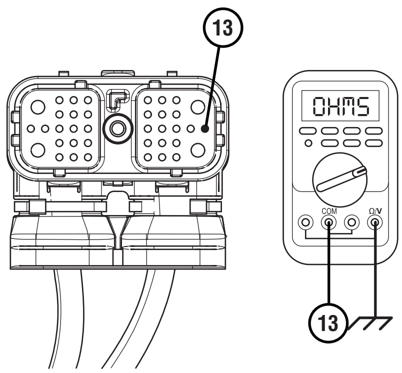
1. Key off.
2. Reconnect the 8-Way Gen2 ECA Connector and verify that all components are properly installed.
3. Key on.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes and FMIs and their occurrences and timestamps.
   - If Fault Code 67 is Active, replace the ECA. Go to **Step V.**
   - If Fault Code 67 is Inactive, replace the Transmission Harness. Go to **Step V.**

E	***Purpose:*** *Verify resistance of ignition voltage circuit and not shorted to ground between ECA and TECU.*

1. Key off.
2. Disconnect 38-Way Transmission Harness Connector.
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 13 and 8-Way Gen2 ECA Connector Pin 7. Record reading(s) in table.



5. Measure resistance between 38-Way Transmission Harness Connector Pin 13 and ground.



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

Pins	Range	Reading(s)
13 to 7	0.0–0.5 ohms	
13 to Ground	Open Circuit (OL)	

F

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes and FMIs and their occurrences and timestamps.
   - If Fault Code 67 is Active, replace the TECU. Go to **Step V.**
   - If Fault Code 67 is Inactive, replace the 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 engine 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 67 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 67 sets Active, see the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 68: Grade Sensor

J1587: MID 130 SID 227 FMI 13, 14
J1939: SA 3 SPN 520321 FMI 13, 14

Overview

The UltraShift *PLUS* is equipped with a Grade Sensor which calculates vehicle incline. The grade position is used for the Hill Start Aid (HSA) feature and 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 in the field. See Grade Sensor Calibration procedure in TRSM0940.

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).
- Hill Start Aid activates regardless of grade.

Conditions to Set Fault Code Inactive

All FMIs: Grade position is within range or the Grade Sensor has been calibrated.

Possible Causes

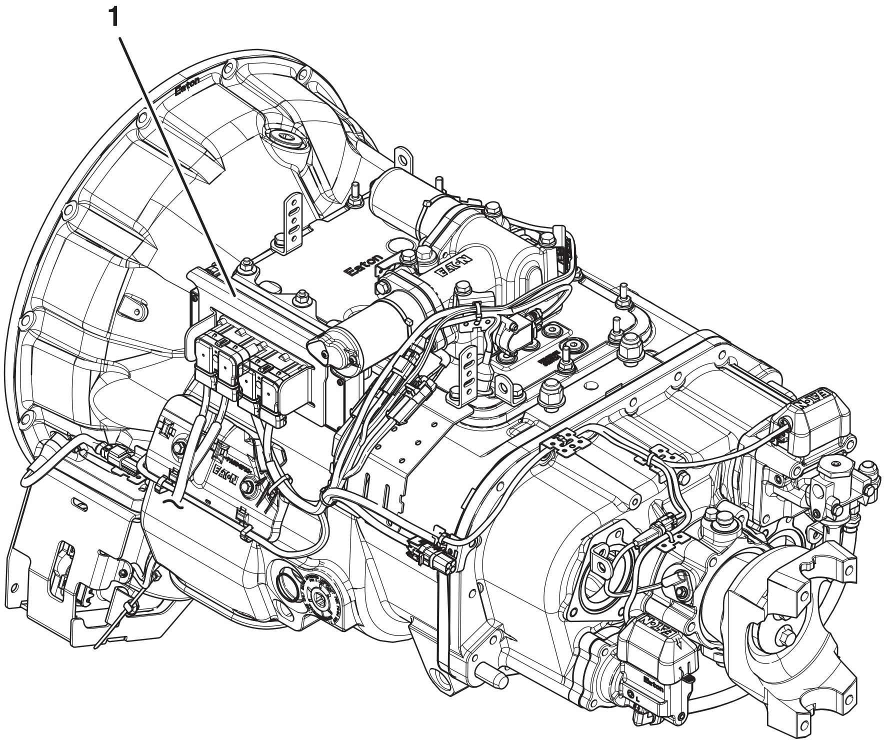
FMI 13

- 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

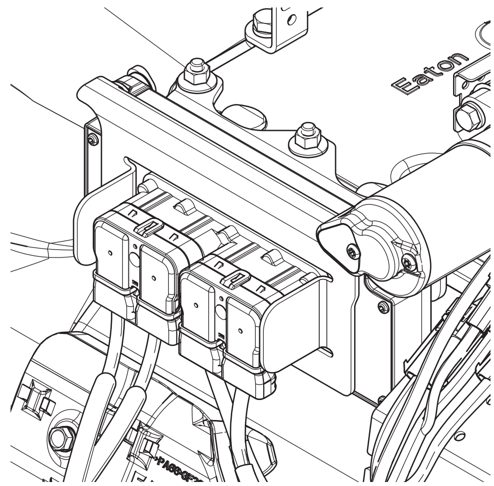
Purpose: *Check for Active or Inactive fault codes.*

1. 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 engine off.
2. Connect ServiceRanger.
3. In ServiceRanger, go to “Service Routines”.
4. Select “Grade Sensor Calibration”.

Important: 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, perform Operator Triggered Grade Sensor Calibration Procedure per *Eaton UltraShift PLUS Service Manual* TRSM0940.
7. Key off.

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

8. Key on with engine 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 TECU. Perform Grade Sensor Calibration procedure with ServiceRanger or Operator Triggered Procedure contained within TRSM0940. 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. 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 13.

Fault Code 71: Unable to Disengage Gear

J1587: MID 130 SID 60 FMI 7, 11
J1939: SA 3 SPN 560 FMI 7, 11

Overview

The UltraShift *PLUS* 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 Bar Housing 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 opens the clutch 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.

FMI 11 – Root Cause Unknown: When the engine is running and the vehicle comes to a complete stop, the system opens the clutch. If neutral is requested or commanded, the system attempts to shift to neutral. If the system is unable to achieve neutral after 4 seconds, the fault code sets Active. The system will continue to attempt to pull to neutral for 2 seconds. If the system is unable to obtain neutral, the system requests the engine to shut down.

Fallback

FMI 7

- Transmission may not be able to complete a shift to neutral.
- Transmission will attempt to move the Shift Finger to neutral.
- Engine may not crank.
- Gear display may flash current or destination gear.
- Until the fault becomes Inactive, driver may have to shut off engine with transmission in gear.

FMI 11

- "F" flashes in gear display.
- Service light flashes (if equipped).
- Engine may shut down (if engine shutdown message is supported by the Engine).
- Engine may be shut down with transmission in gear.
- If neutral was achieved, Low range gears are available (if engine shutdown message is not supported by the Engine).
- Engine may not crank if the transmission cannot shift to neutral.

Conditions to Set Fault Code Inactive

FMI 7: The system successfully completes a shift into Neutral.

FMI 11: Go to Service Bulletin CLIB0035.

Possible Causes

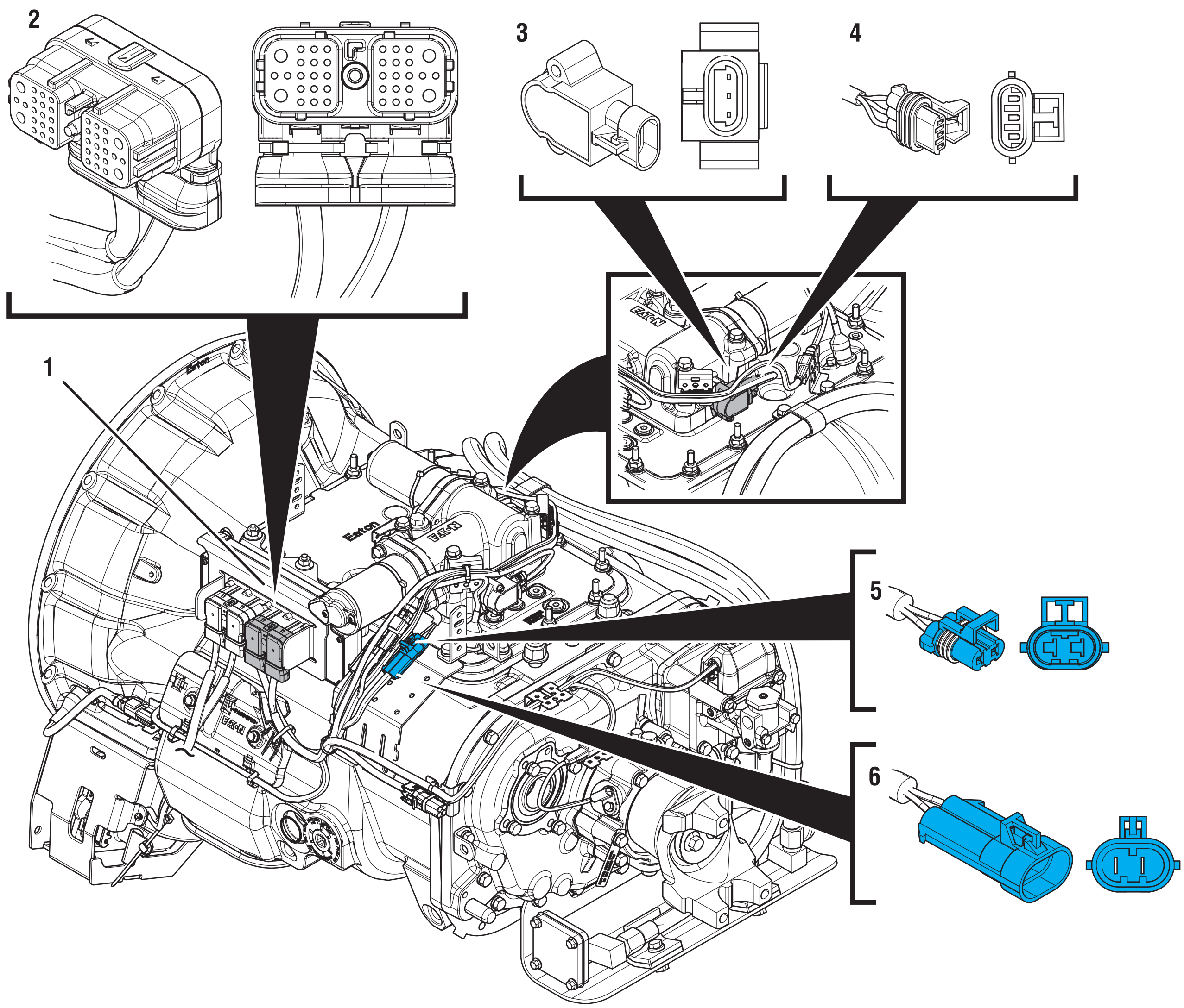
FMI 7

- 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 Bar Housing
  - Worn or damaged Sliding Clutch slot width
  - Worn or damaged Shift Yokes
  - Worn or damaged internal transmission components
- Clutch
  - Not properly disengaging (clutch drag)

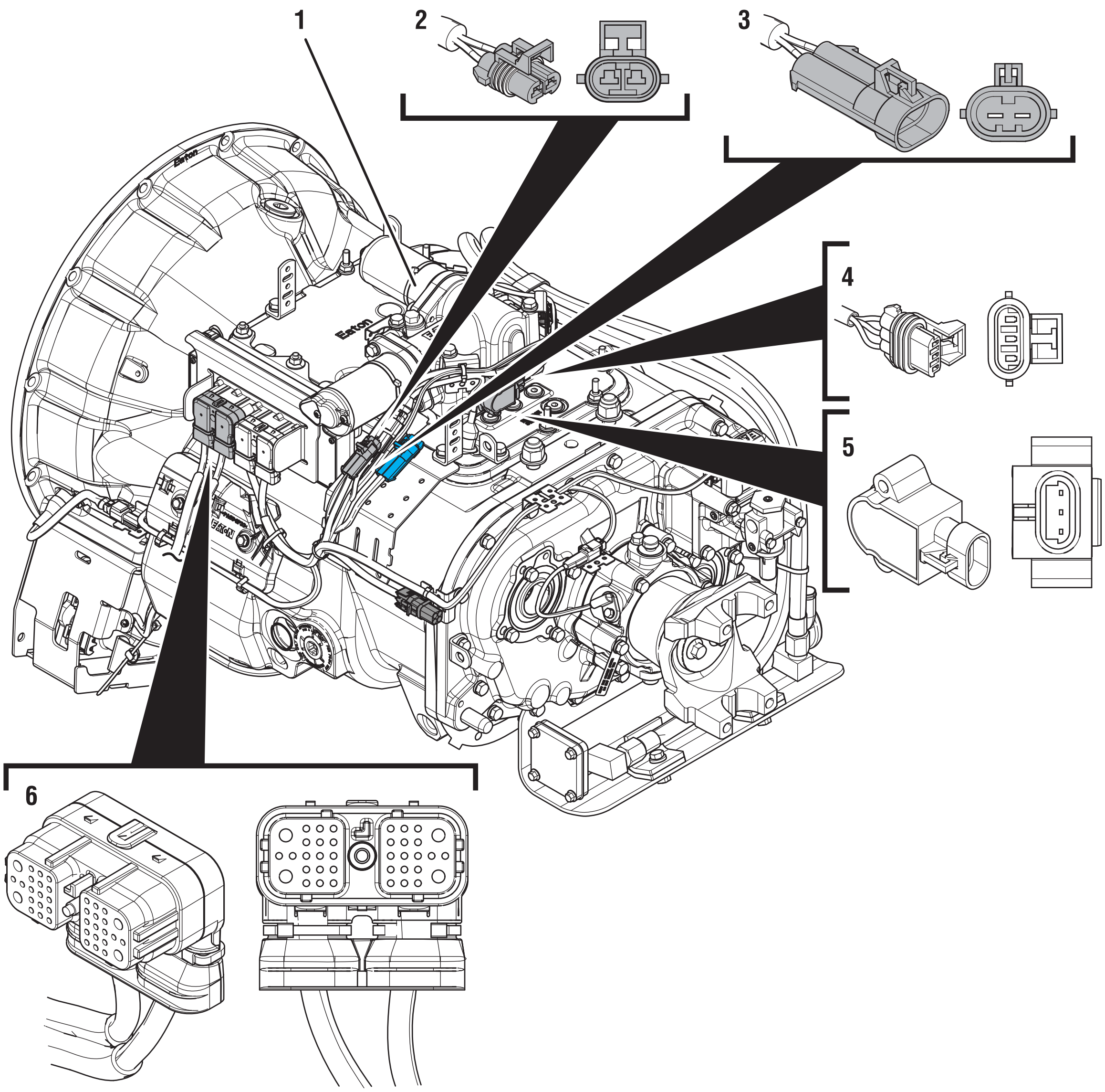
FMI 11

- Go to Service Bulletin CLIB0035.

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 11 is Active, go to Service Bulletin CLIB0035.
   - If Fault Code 71 FMI 11 is Inactive, go to **Step V.**
   - If Fault Code 71 FMI 7 is Active or Inactive and/or Fault Codes 27, 33, 34, 51, 52, 61, 63 or 64 are Active or Inactive, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 71 FMI 7 is Inactive, go to **Step B.**
   - If Fault Code 71 FMI 7 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 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.

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.

Important: 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.**

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

1. Key off.

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

2. Inspect Starter, 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.**

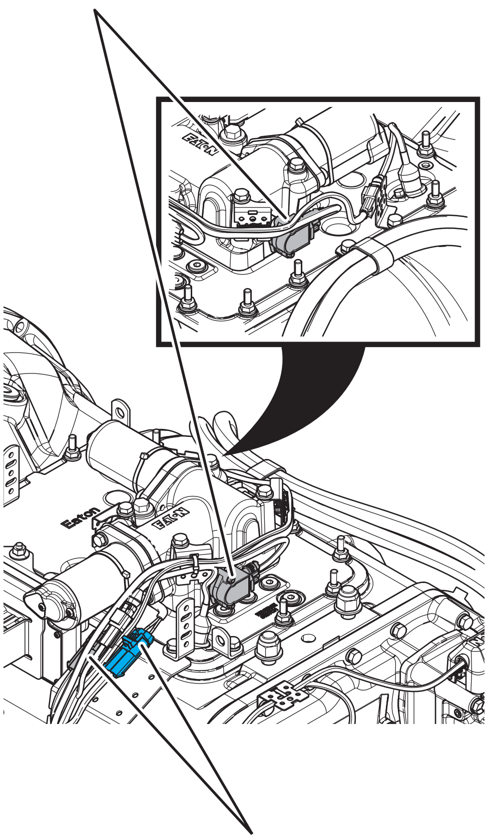
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

E	**Purpose:** Inspect X-Y Shifter and Transmission Harness for physical damage.

1. Key off.

Important: 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.

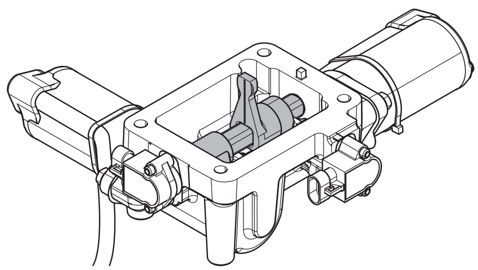


5. Disconnect both 2-Way X-Y Motor Connectors to the Transmission Harness.
6. Inspect connectors for corrosion, loose terminals, bent or spread pin or damage to the connector bodies.
   - If damage to the X-Y Shifter or X-Y Shifter wiring is found, replace X-Y Shifter. Go to **Step V.**
   - If damage 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 coolant contamination.

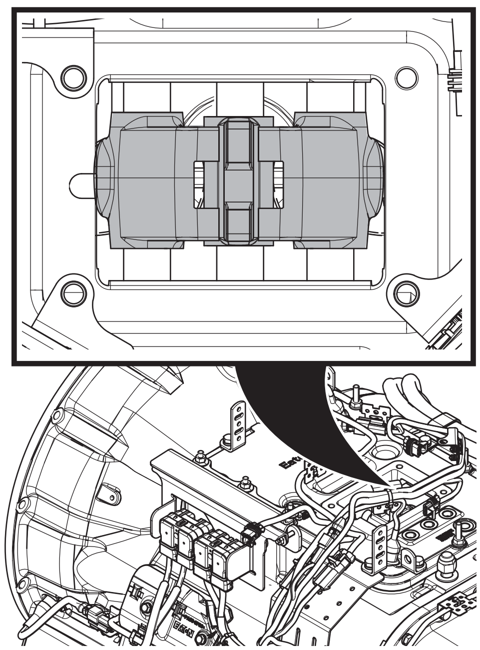
   For the latest Service Bulletin updates, visit Roadranger.com.

   - If coolant contamination is found, repair the vehicle coolant system leak and follow Service Bulletin TMIB0124 for complete repair procedure. X-Y Shifter must be replaced upon completion of service bulletin. Go to **Step V.**
   - If damage to the X-Y Shifter is found, replace X-Y Shifter. Go to **Step V.**
   - If no damage is found, go to **Step G.**

G

Purpose: Inspect condition of Shift Bar Housing.

1. Key off.
2. Inspect condition of the Shift Bar Housing 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 Bar Housing.



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. See the *Shift Interlock Inspection Procedure* on page 552.
   - If damage to the Shift Bar Housing is found, repair Shift Bar Housing. Go to **Step V.**
   - If no damage is found, go to **Step H.**

H

Purpose: Inspect condition of the internal transmission components.

1. Key off.
2. Drain and save the transmission oil. Inspect oil for significant metal fragments.
3. Remove 8-bolt PTO cover.
4. Inspect main case gears for damage or excessive movement.
5. 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, replace X-Y Shifter and Transmission Harness. Go to **Step V.**

     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 and contact Eaton at (800) 826-4357.

V

Purpose: Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed, including X-Y Shifter.
3. Reinstall 8-bolt PTO cover.
4. Refill transmission with lubricant.
5. Key on with engine off.
6. Clear fault codes using ServiceRanger.
7. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set Active and vehicle operates properly, test complete.
   - If a fault code other than 71 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 71 sets Active, contact Eaton at (800) 826-4357 for further diagnostics.

Fault Code 72: Failed to Select Rail

J1587: MID 130 SID 59 FMI 7
J1939: SA 3 SPN 772 FMI 7

Overview

The UltraShift *PLUS* 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 Bar Housing. Certain shifts require the transmission to engage a different rail on the Shift Bar Housing. 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 Bar Housing 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

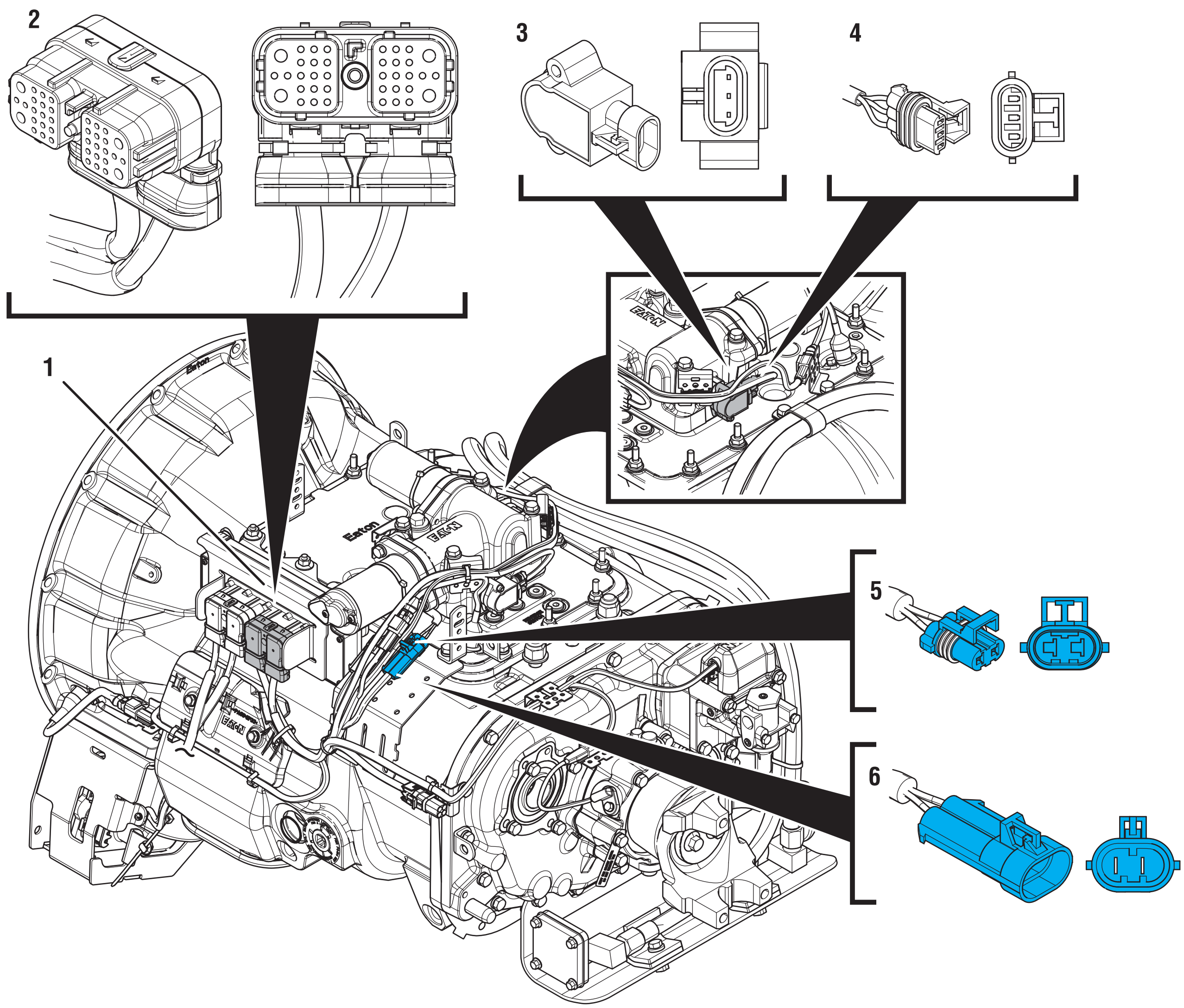
FMI 7: The system successfully positions the Shift Finger on the proper rail.

Possible Causes

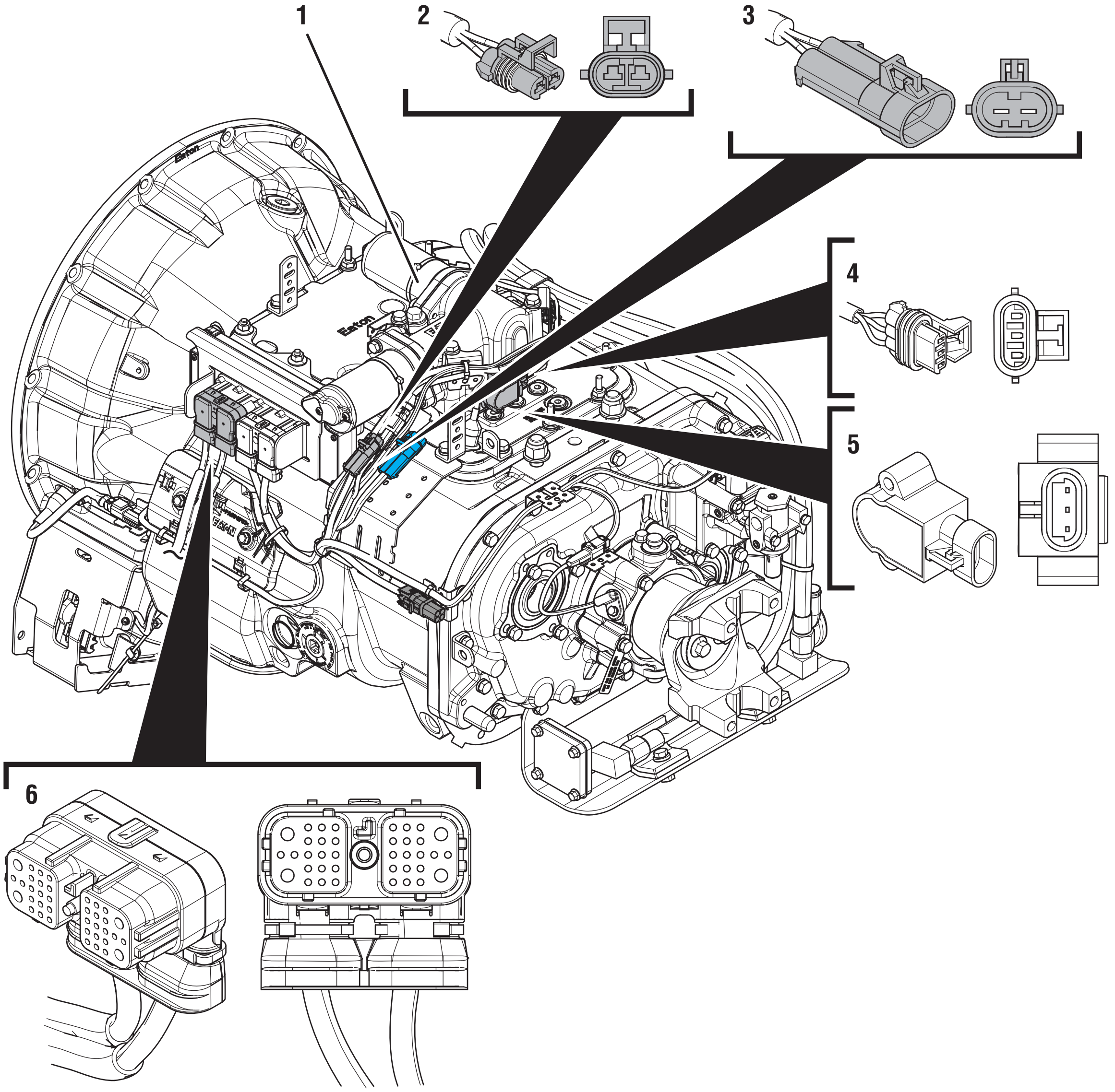
FMI 7:

- 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 Bar Housing
  - 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. 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, 63 or 64 are Active or Inactive, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - 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.

Important: 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.

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

2. Inspect Starter, 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.**

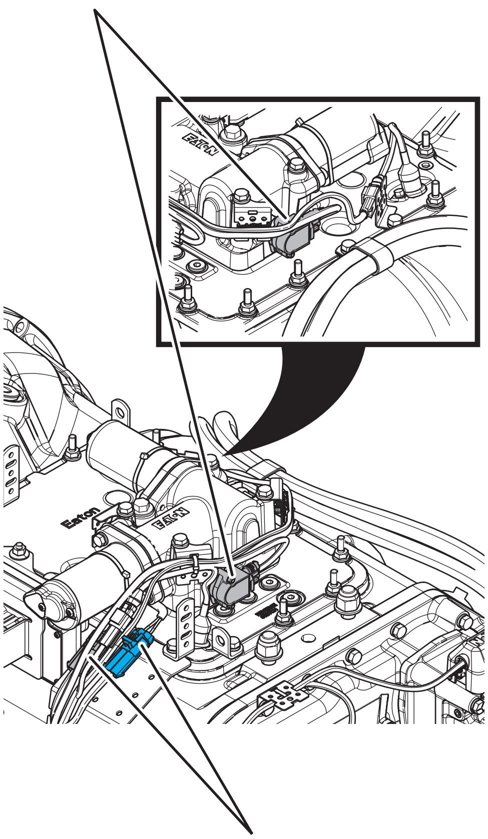
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

E ***Purpose:*** *Inspect X-Y Shifter and Transmission Harness for physical damage.*

1. Key off.

Important: 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.

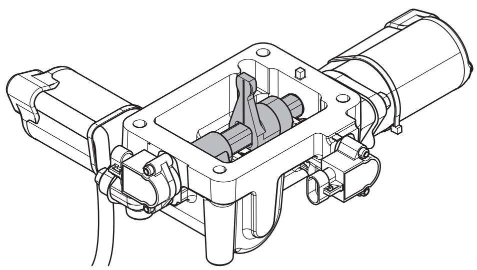


5. Disconnect both 2-Way X-Y Motor Connectors to the Transmission Harness.
6. Inspect connectors for corrosion, loose terminals, bent or spread pin or damage to the connector bodies.
   - If damage to the X-Y Shifter or X-Y Shifter wiring is found, replace X-Y Shifter. Go to **Step V.**
   - If damage 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 coolant contamination.

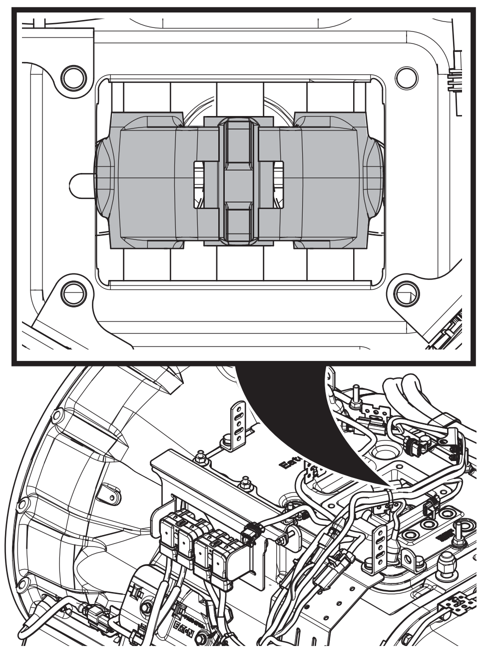
   For the latest Service Bulletin updates, visit Roadranger.com.

   - If coolant contamination is found, repair the vehicle coolant system leak and follow Service Bulletin TMIB0124 for complete repair procedure. X-Y Shifter must be replaced upon completion of service bulletin. Go to **Step V.**
   - If damage to the X-Y Shifter is found, replace X-Y Shifter. Go to **Step V.**
   - If no damage is found, go to **Step G.**

G

Purpose: *Inspect condition of Shift Bar Housing.*

1. Key off.
2. Inspect condition of the Shift Bar Housing 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 Bar Housing.



4. Verify transmission shifts fully in to and out of each gear.
5. Test the Shift Interlock to verify that the transmission will not engage two gears at once. See the *Shift Interlock Inspection Procedure* on page 552.
   - If damage to the Shift Bar Housing is found, repair Shift Bar Housing. Go to **Step V.**
   - If no damage is found, go to **Step H.**

H

Purpose: *Inspect condition of the internal transmission components.*

1. Key off.
2. Drain and save the transmission oil. Inspect oil for significant metal fragments.
3. Remove 8-bolt PTO cover.
4. Inspect main case gears for damage or excessive movement.
5. 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, replace X-Y Shifter and Transmission Harness. Go to **Step V.**

     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 and contact Eaton at (800) 826-4357.

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed, including X-Y Shifter.
3. Reinstall 8-bolt PTO cover.
4. Refill transmission with lubricant.
5. Key on with engine off.
6. Clear fault codes using ServiceRanger.
7. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set Active and vehicle operates properly, test complete.
   - If a fault code other than 72 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 72 sets Active, contact Eaton at (800) 826-4357 for further diagnostics.

Fault Code 73: Failed to Engage Gear

J1587: MID 130 SID 58 FMI 7
J1939: SA 3 SPN 781 FMI 7

Overview

The UltraShift *PLUS* transmission uses the X-Y Shifter to engage and disengage a gear based on the driver's selected mode of operation. Gear engagement 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 Bar Housing Shift Blocks guides the Shift Yoke to engage the Sliding Clutch into 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 and Rail Position Sensors.

Fault Code 73 is set when the X-Y Shift Finger attempts to engage a gear, but the X-Y 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 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 engage a gear.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: If the X-Y Gear Position Sensor does not meet the minimum gear engagement value after five consecutive attempts to engage the desired gear, this fault code sets Active.

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.
- Engine may not crank.
- Gear display may flash current or destination gear.

Conditions to Set Fault Code Inactive

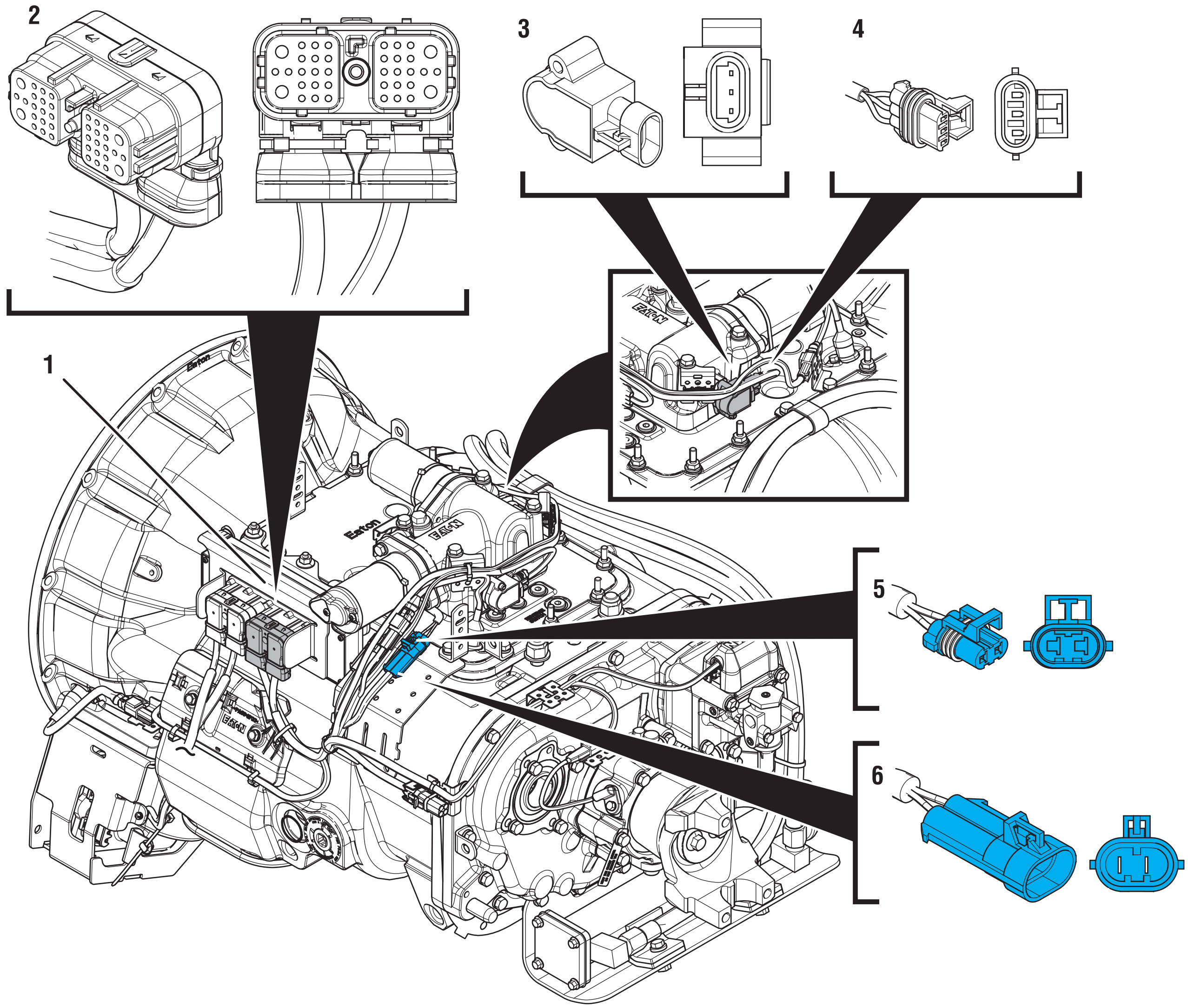
FMI 7: The system successfully engages the desired gear.

Possible Causes

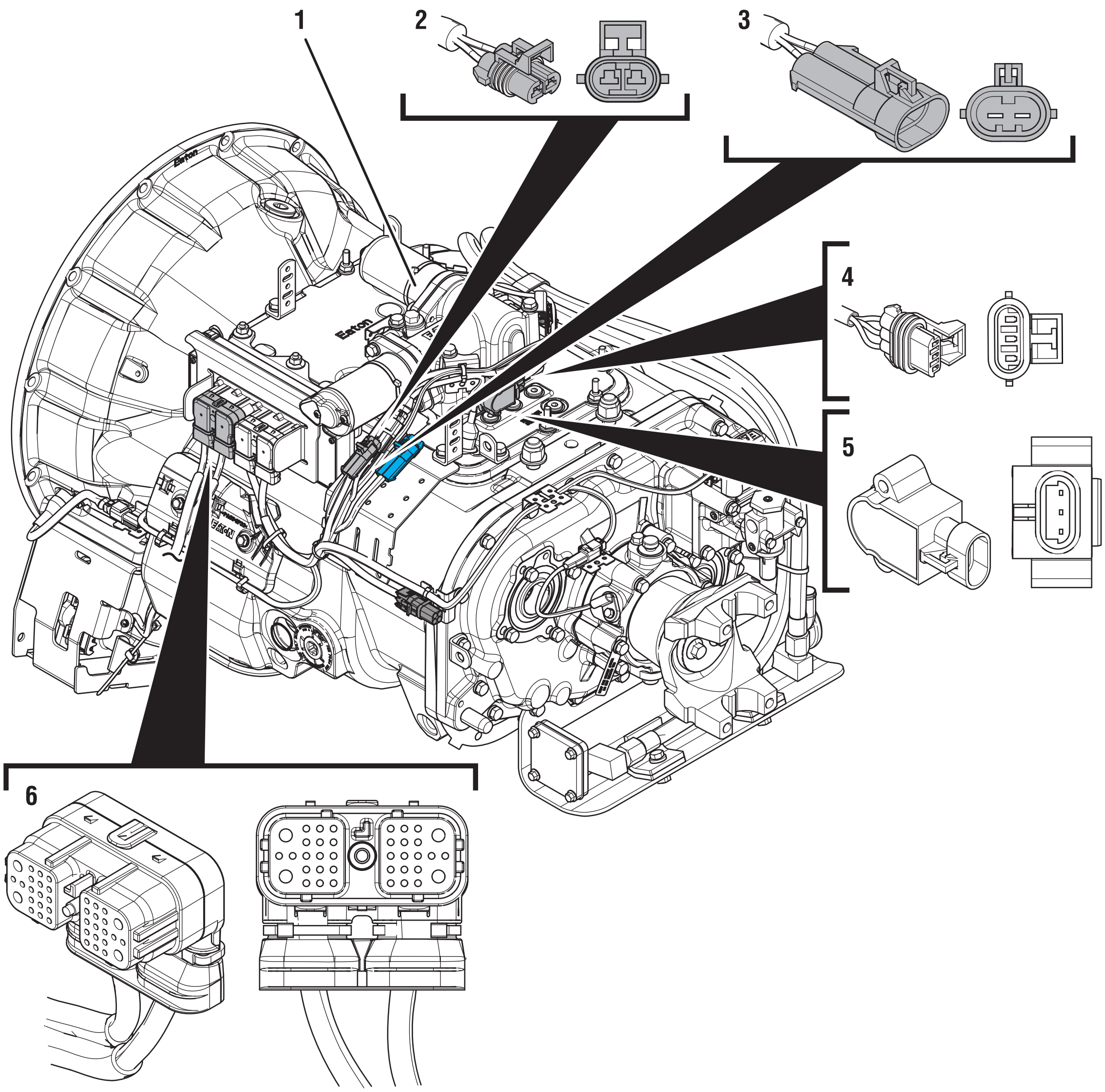
FMI 7

- 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 Bar Housing
  - 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 73 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

Note: If Fault Code 73 is Inactive and there are other Active fault codes, troubleshoot all Active fault codes first.

- If Fault Codes 33, 34, 51, 52, 61, 63 or 64 are Active or Inactive, troubleshoot per *Fault Code Isolation Procedure*.
- If Fault Code 73 is Inactive, go to **Step B.**
- If Fault Code 73 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 73 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.

Important: 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.**

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

1. Key off.

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

2. Inspect Starter, 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.**

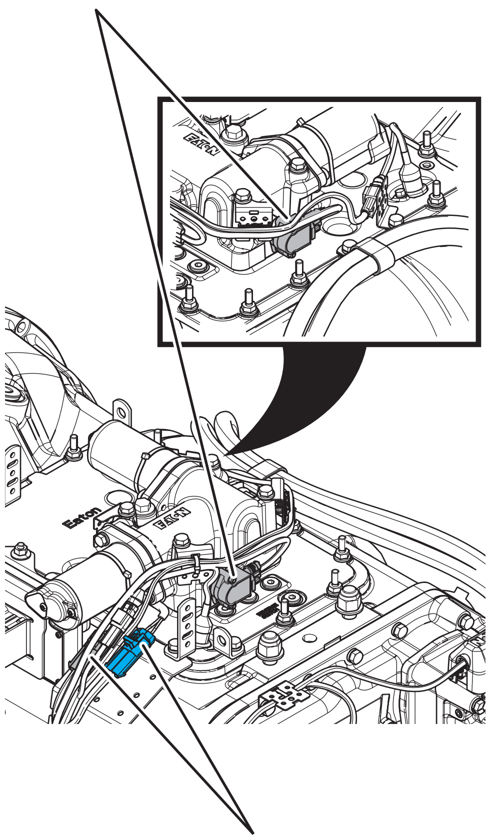
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

E ***Purpose:*** *Inspect X-Y Shifter and Transmission Harness for physical damage.*

1. Key off.

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

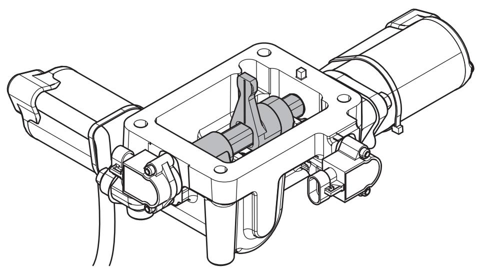
2. Inspect the physical condition of X-Y Shifter and all connections.
3. Inspect Transmission Harness for any pinched, chafed, corroded or shorted wiring.
4. Disconnect both 2-Way X-Y Gear and Rail Position Sensor Connectors.



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 Shifter. 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.



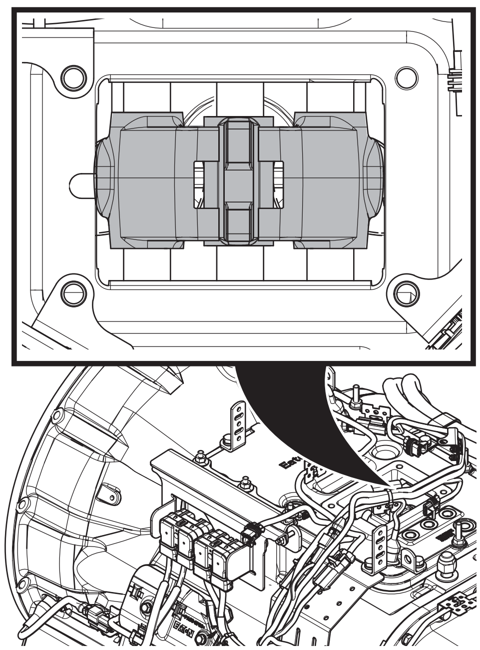
4. Inspect the X-Y Shifter ball screw for signs of coolant contamination.

   For the latest Service Bulletin updates, visit Roadranger.com.

   - If coolant contamination is found, repair the vehicle coolant system leak and follow Service Bulletin TMIB0124 for complete repair procedure. X-Y Shifter must be replaced upon completion of service bulletin. Go to **Step V.**
   - If damage to the X-Y Shifter is found, replace X-Y Shifter. Go to **Step V.**
   - If no damage is found, go to **Step G.**

G ***Purpose:*** *Inspect Condition of Shift Bar Housing.*

1. Key off.
2. Inspect condition of the Shift Bar Housing 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 Bar Housing.



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. See the *Shift Interlock Inspection Procedure* on page 552.
   - If damage to the Shift Bar Housing is found, repair Shift Bar Housing. Go to **Step V.**
   - If no damage is found, go to **Step H.**

H

Purpose: *Inspect condition of the internal transmission components.*

1. Key off.
2. Drain and save the transmission oil. Inspect oil for significant metal fragments.
3. Remove 8-bolt PTO cover.
4. Inspect main case gears for damage or excessive movement.
5. 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, replace X-Y Shifter and Transmission Harness. Go to **Step V.**

   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 and contact Eaton at (800) 826-4357.

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed, including X-Y Shifter.
3. Reinstall 8-bolt PTO cover.
4. Refill transmission with lubricant.
5. Key on with engine off.
6. Clear fault codes using ServiceRanger.
7. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set Active and vehicle operates properly, test complete.
   - If a fault code other than 73 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 73 sets Active, contact Eaton at (800) 826-4357 for further diagnostics.

Fault Code 74: Engine Speed / Torque Response

J1587: MID 130	**PID 93**	**FMI 7**
J1587: MID 130	**PID 190**	**FMI 7**
J1939: SA 3	**SPN 518**	**FMI 7**
J1939: SA 3	**SPN 898**	**FMI 7**

Overview

The UltraShift *PLUS* transmission Transmission Electronic Control Unit (TECU) communicates with the engine ECU over the J1939 Data Link. During every shift, the TECU receives speed and torque information from the engine and requests changes in speed or torque from the engine to synchronize shifts. If the engine does not respond to speed or torque commands and no J1939 communication fault codes are present, the fault is set.

Detection

TECU monitors the net torque output and calculates the synchronization speed required to shift efficiently. If a request is sent to increase or decrease engine torque or speed and the engine does not respond or does not respond fully, the fault is set. Fault Code 74 sets Active when one of these conditions exists.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: TECU detects no speed or torque response from the engine for more than 2 consecutive seconds after the request is sent.

Fallback

FMI 7

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Transmission may not attempt a shift.
- Transmission may engage a start or reverse gear from neutral, but will not shift out of that gear.

Conditions to Set Fault Code Inactive

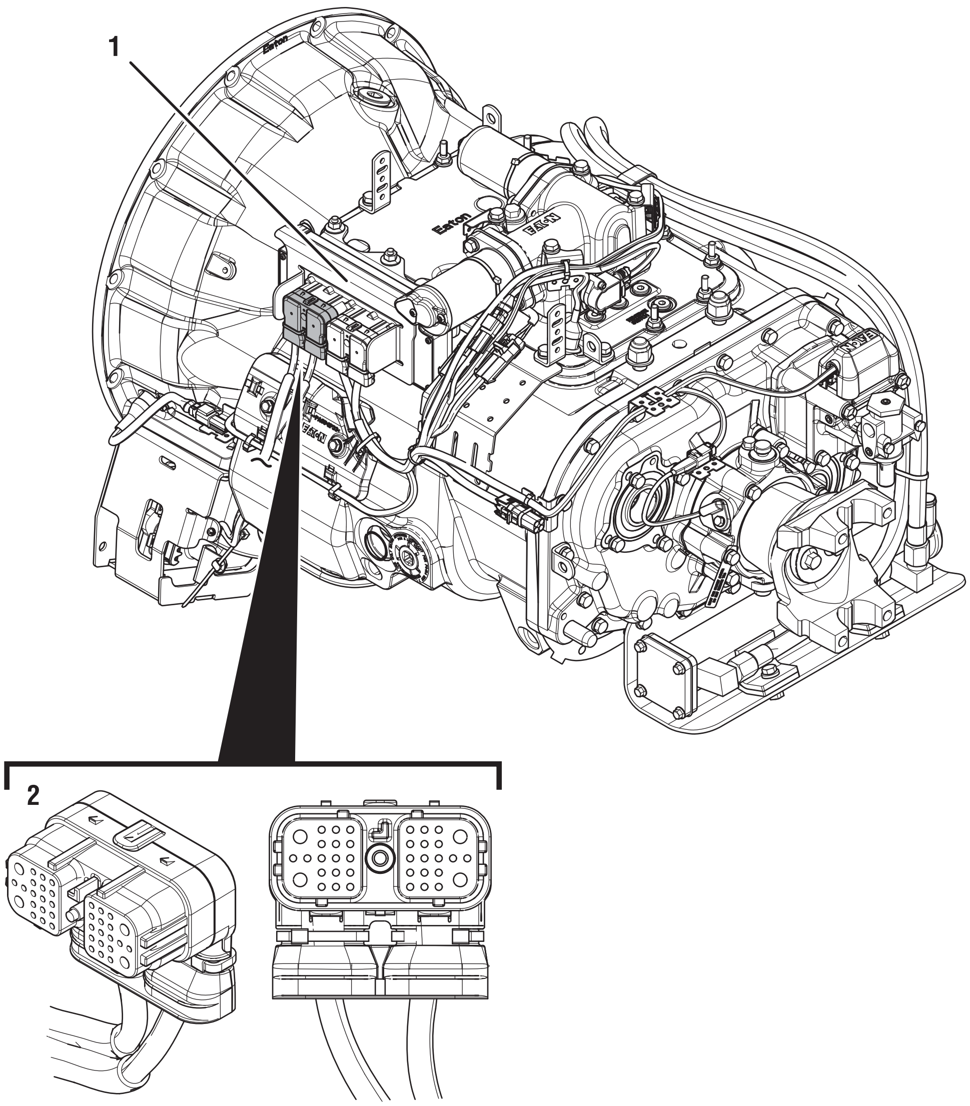
FMI 7: Four seconds after the engine responds to TECU speed or torque request.

Possible Causes

FMI 7

- Engine
  - Incorrect engine software settings
  - Low engine power or mechanical engine issues
  - Engine ECU

Component Identification



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

Fault Code 74 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.

Important: Fault Code 74 sets due to the engine failing to respond to torque or speed requests sent by the TECU. Possible causes for this fault are due to OEM issues and cannot be caused by the transmission wiring or TECU.

- If an engine software update was recently performed and Fault Code 74 is Inactive, go to **Step D.**
- If Fault Code 74 is Active or Inactive, go to **Step B.**

B

Purpose: *Verify proper engine software level and engine settings.*

1. Set parking brake and chock wheels.
2. Verify that engine software is at latest level.
3. Ensure that the engine configuration settings are correct for the transmission installed in the vehicle.
   - If all settings are correct, go to **Step C.**
   - If settings are incorrect, refer to OEM guidelines for proper engine configurations and software settings. Go to **Step V.**

     Note: Reference engine configuration settings in the *Eaton Automated Transmission Engine Configuration Settings Guide*, TRIG0910, for settings as defined by Eaton for UltraShift *PLUS* transmissions.

C

Purpose: *Verify mechanical condition of engine.*

1. Key off.
2. Inspect engine and engine systems for any issue causing low or reduced engine power (e.g., leaking fuel injectors, boost leaks, cooling problems, etc.)
   - If no engine issues are present, refer to OEM guidelines for diagnostic procedure for engine power. Go to **Step V.**
   - If engine issues are present, refer to engine manufacturer for engine repair diagnostics. Go to **Step V.**

D *Purpose:* *Verify status of fault code.*

1. Set parking brake and chock wheels.

Important: Fault Code 74 may set due to a recent engine software update.

2. Key on with engine off.
3. Connect ServiceRanger.
4. Record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 74 is Inactive, test complete. Go to **Step V.**
   - If Fault Code 74 is Active, go to **Step D.**

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. 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 74 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 74 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 75: Power Down in Gear

J1587: MID 130 SID 60 FMI 14
J1939: SA 3 SPN 560 FMI 14

Overview

The UltraShift *PLUS* Transmission Electronic Control Unit (TECU) monitors gear and rail position sensors to determine the position of the X-Y Shifter Shift Finger. Fault Code 75 indicates the transmission was powered down with the Shift Finger in a non-neutral gear position.

Detection

Ignition key is turned off with the X-Y Shifter Shift Finger in a non-neutral position.

Conditions to Set Fault Code Active

FMI 14 – Special Instructions: TECU detects a non-neutral gear position during power down.

Fallback

No fallback mode is associated with this fault.

Conditions to Set Fault Code Inactive

FMI 14: Fault code sets Inactive upon the next power-up cycle.

Possible Causes

FMI 14

- Driver Behavior
  - Driver turned the ignition off with the transmission in a non-neutral state
- Vehicle Ignition Supply
  - Unintentional loss of ignition supply to TECU

Component Identification

None

Fault Code 75 Troubleshooting

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If a fault code other than 75 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If Fault Code 75 is Inactive, no action necessary. This code indicates the driver powered down the system before selecting neutral. Test complete.

Fault Code 76: Neutral Coast Mode

J1939: SA 3 SPN 639 FMI 11, 31

Overview

When available and enabled, Neutral Coast Mode allows the transmission to disengage the driveline by pulling out of gear on slight downhill grades, where little to no engine power is required, when the vehicle is in cruise control and the transmission is in Drive Mode.

Neutral Coast may refer to one of several different systems that control various elements of vehicle cruise control logic. The transmission controlled version is an Eaton proprietary logic where the transmission makes the decisions when the driveline should be engaged or disengaged. Engine/J1939 controlled systems use an engine or another vehicle ECU to determine the appropriate times to engage or disengage the driveline. Engine/J1939 controlled systems have several different variations and brand names based on the manufacturer.

Fault Code 76 indicates that either the Transmission ECU or Engine/Vehicle ECU are mis-configured for use with a Neutral Coast system.

Detection

Incorrect engine/vehicle or transmission configuration settings can set this fault. When the engine/vehicle and transmission configurations are not matched for use with Neutral Coast systems, this fault will set Active.

Conditions to Set Fault Code Active

- **FMI 11 – FMI Unknown:** Transmission configurations are incorrectly set for use with a Neutral Coast system.
- **FMI 31 – Condition Exists:** Engine or vehicle configurations and/or software are incorrectly set for use with a Neutral Coast system.

Fallback

All FMIs: Neutral Coast systems will not function.

Conditions to Set Fault Code Inactive

All FMIs: This fault is set inactive when the transmission and engine/vehicle Neutral Coast system configurations or software are correctly set.

Possible Causes

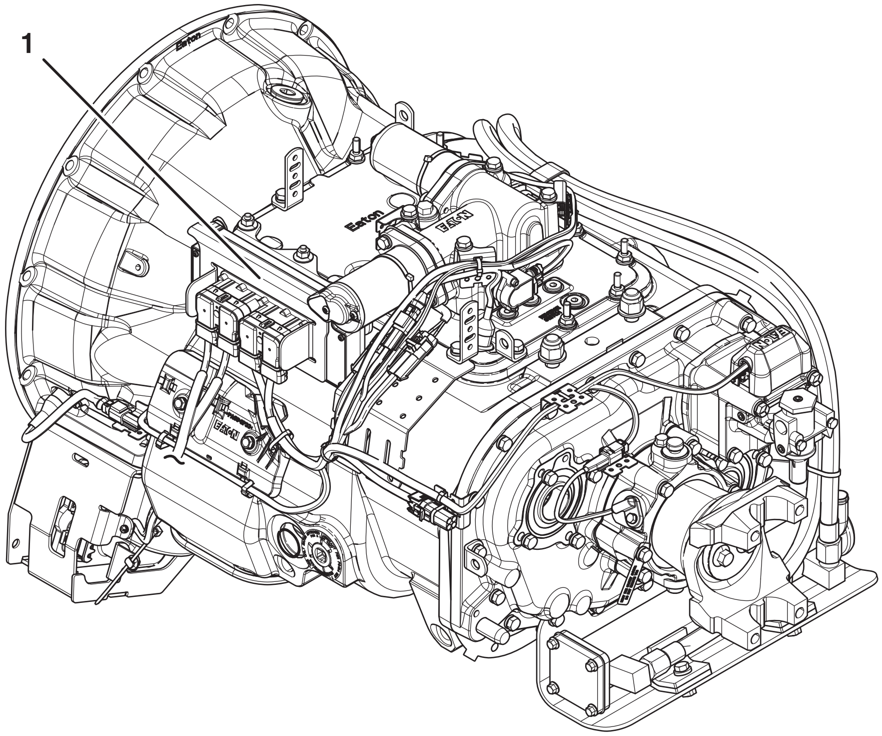
FMI 11

- TECU
  - Incorrect Transmission Neutral Coast Mode configuration settings

FMI 31

- Engine ECM
  - Incorrect engine software settings

Component Identification



1. Transmission Electronic Control Unit (TECU)

Fault Code 76 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
2. Determine if the vehicle was built or retrofitted to have a Neutral Coast Management system enabled.
   - If Fault Code 76 FMI 31 is set, go to **Step D.**
   - If a Neutral Coast system is supposed to be enabled, go to **Step B.**
   - If a Neutral Coast system is not present or supposed to be disabled, go to **Step E.**

B

Purpose: *Determine which Neutral Coast system the vehicle uses.*

1. Determine if the vehicle uses the Eaton Transmission Controlled or Engine/J1939 Controlled Neutral Coast system.

Important: Some engines can only be configured to use their proprietary Neutral Coast system and do not support the Eaton transmission-based Neutral Coast system. Engine systems are marketed under a variety of brand names. Contact the engine OEM for more information.

- If the vehicle uses the Eaton Transmission Controlled Neutral Coast system, go to **Step C.**
- If the vehicle uses an Engine/J1939 Controlled Neutral Coast system, go to **Step D.**

C

Purpose: *Configure Neutral Coast Mode for the Eaton transmission based system.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. In ServiceRanger, go to Configuration.
4. Record current value of the Neutral Coast Mode configuration.
5. Change the Neutral Coast Mode configuration to "Transmission Control". If ServiceRanger permissions do not allow you to change this configuration, contact Eaton at (800) 826-8347 for support.

Important: Some engines can only be configured to use their proprietary Neutral Coast system and do not support the Eaton transmission-based Neutral Coast system. Engine systems are marketed under a variety of brand names. Contact the engine OEM for more information.

- If any engine fault codes set, contact the engine manufacturer to properly set engine settings to operate with Neutral Coast Mode. Go to **Step V.**
- If no engine fault codes set, test complete. Go to **Step V.**

D ***Purpose:*** *Check for Active or Inactive Engine/J1939 Controlled Neutral Coast system fault codes.*

1. Check for Engine/J1939 Controlled fault codes associated to the Neutral Coast system using appropriate engine/vehicle software diagnostic tool.
   - If any Engine/J1939 fault codes associated to the Neutral Coast system are set Active, contact the engine/vehicle manufacturer to properly set engine software. Go to **Step V.**
   - If any Engine/J1939 fault codes associated to the Neutral Coast system are set Inactive, test complete. Go to **Step V.**

E ***Purpose:*** *Disable Neutral Coast Mode.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. In ServiceRanger, go to Configuration.
4. Record current value of the Neutral Coast Mode configuration.
5. Change the Neutral Coast Mode configuration to “Disabled”. If ServiceRanger permissions do not allow you to change this configuration, contact Eaton at (800) 826-8347 for support.

Important: Some engine based Neutral Coast systems auto-configure with the transmission, overriding the Neutral Coast Mode configuration setting in the transmission. These systems must be turned on or off in the engine ECM. Contact the engine OEM for more information.

6. Properly set any engine configuration settings required to disable Neutral Coast per manufacturer requirements.

Warning: Contact the engine OEM or reference the Eaton Automated Transmission Engine Configuration Settings Guide (TRIG0910) for more information about engine settings.

   - If any engine fault codes set, contact the engine manufacturer to properly set engine Neutral Coast settings. Go to **Step V.**
   - If no engine fault codes set, 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 engine off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for transmission fault codes using ServiceRanger.
7. Check for engine/vehicle fault codes using an appropriate engine/vehicle software.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If transmission Fault Code 76 is Active, contact Eaton at (800) 826-4357.
   - If an engine/vehicle fault code is Active, troubleshoot the fault code per OEM guidelines. Go to **Step A.**
   - If a transmission fault code other than 76 sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13

Fault Code 81: Gear Engagement Detected

J1587: MID 130 SID 47 FMI 7
J1939: SA 3 SPN 780 FMI 7

Overview

The UltraShift *PLUS* 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 Bar Housing 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: This fault sets in one of two ways:

- 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.
- Vehicle is stationary and the transmission is in neutral. Three seconds after releasing the brake pedal, the clutch begins to close. If the engine begins to stall as the clutch closes, the system will set the fault Active due to the possibility that the transmission is improperly engaged in a gear.

Fallback

FMI 7

- "F" flashes in gear display.
- Service light flashes (if equipped).
- Transmission may remain in current gear.
- Engine 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:

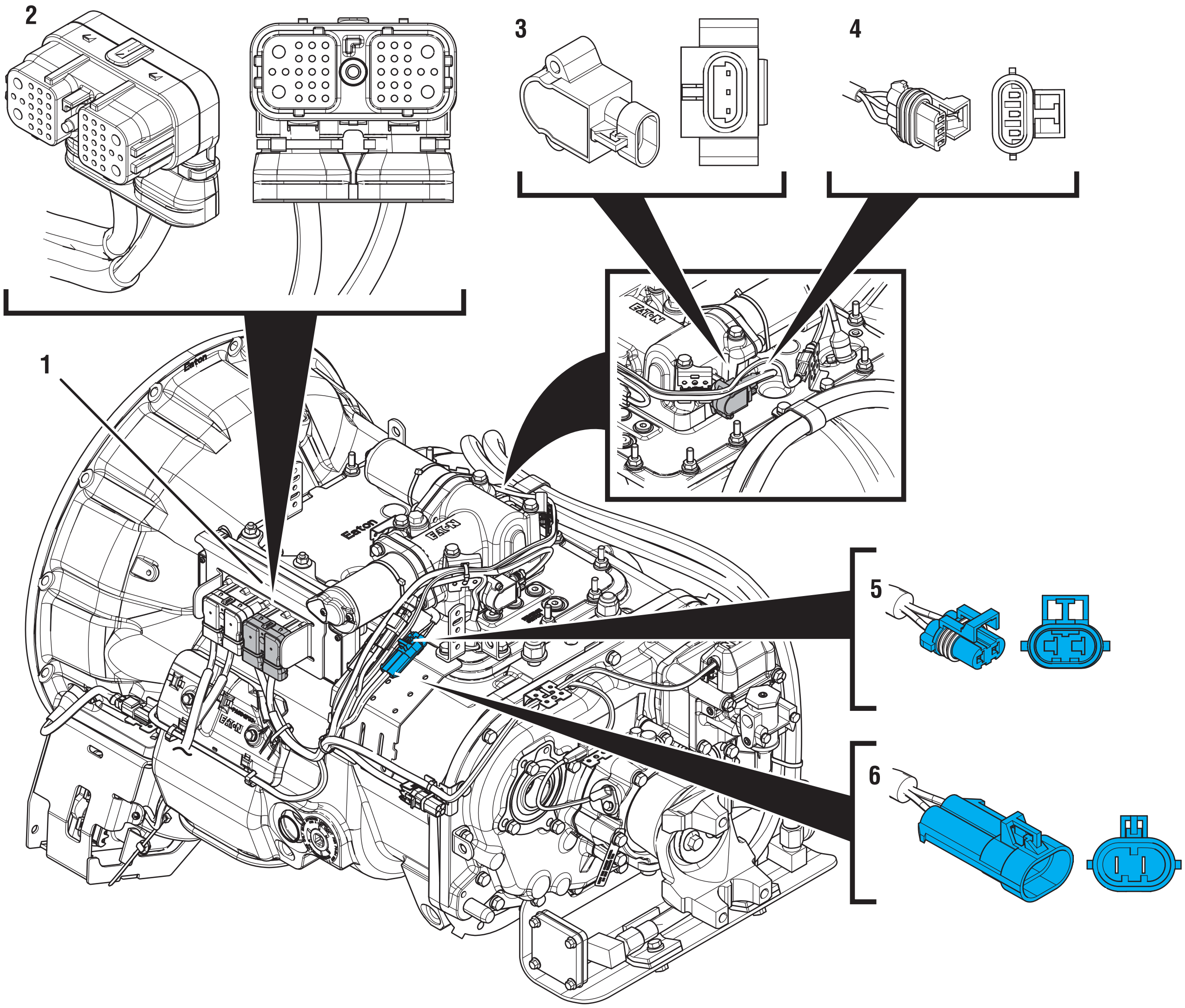
- Ignition key is turned off and TECU is powered down.
- The system successfully engages the desired gear.

Possible Causes

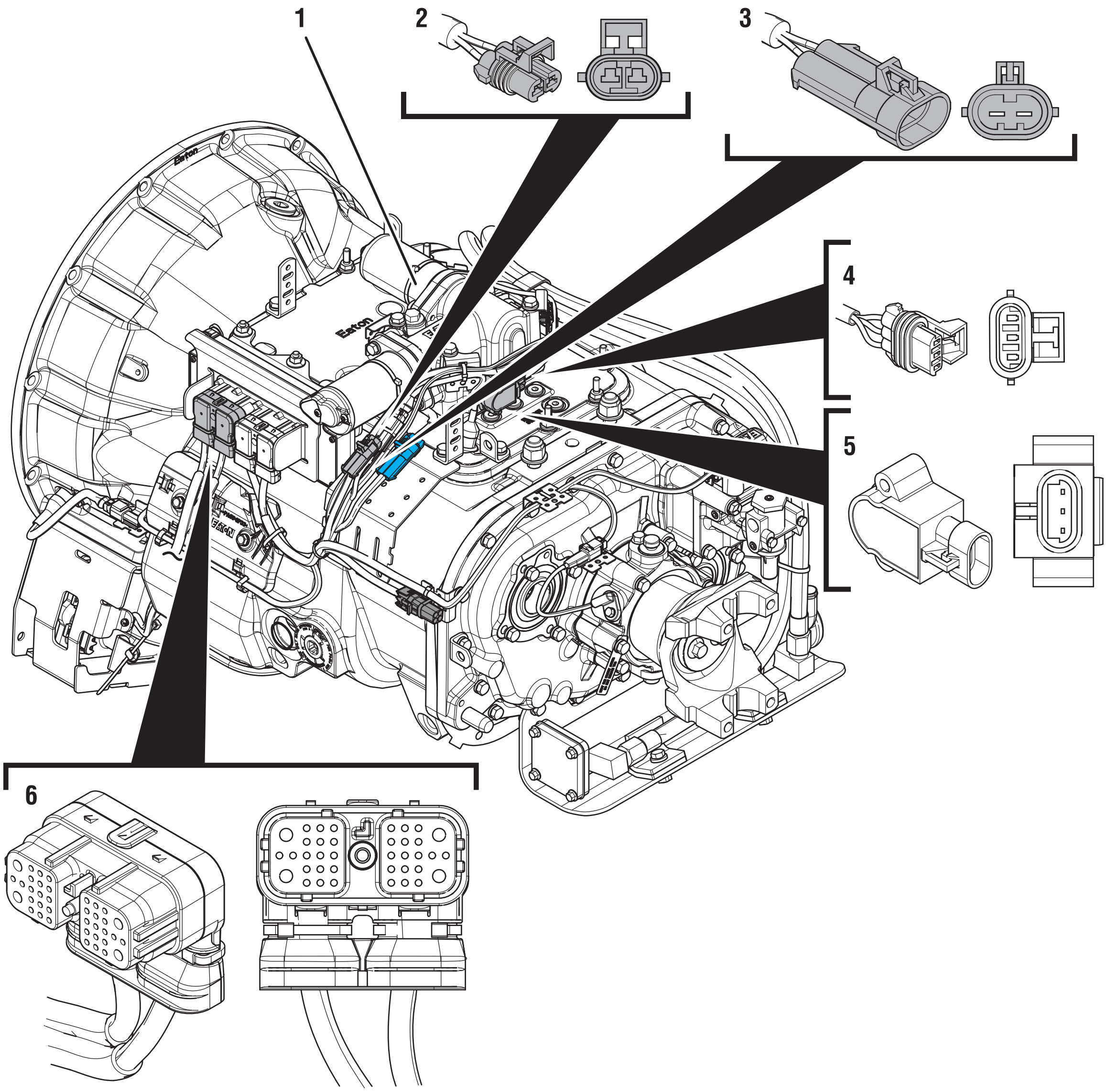
FMI 7

- 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 Bar Housing
  - 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. 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 13 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.

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

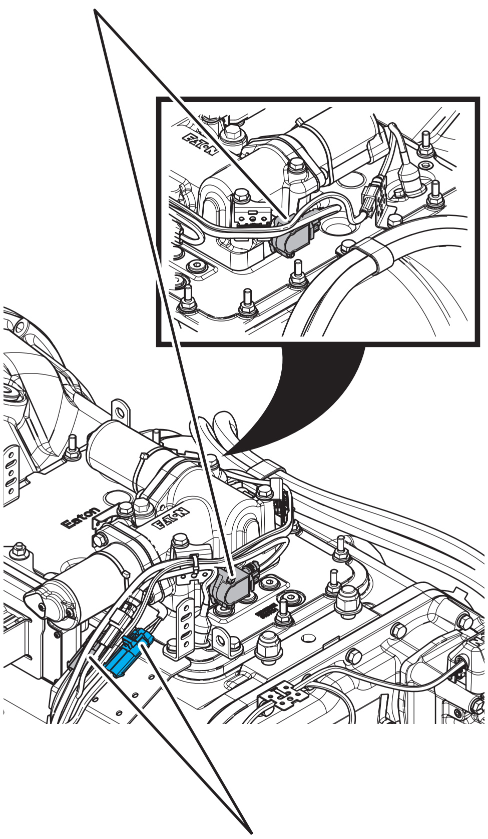
- If any fault codes set Active while wiggling the Transmission Harness, replace Transmission Harness. Go to **Step C.**
- If no fault codes set Active, go to **Step C.**

C **Purpose:** Inspect X-Y Shifter and Transmission Harness for physical damage.

1. Key off.

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

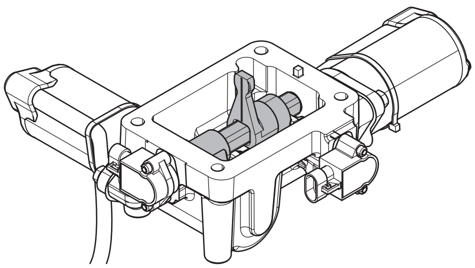
2. Inspect the physical condition of X-Y Shifter and all connections to X-Y Shifter.
3. Inspect Transmission Harness for any pinched, chafed, corroded or shorted wiring.
4. Disconnect both 2-Way X-Y Gear and Rail Position Sensor Connectors.



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 Shifter. 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.



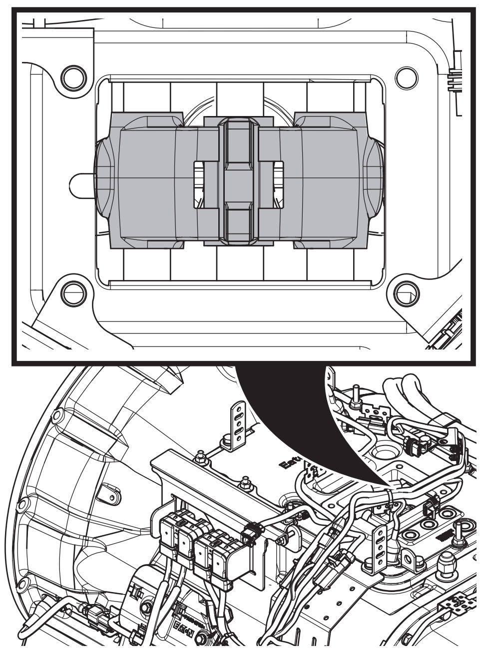
4. Inspect the X-Y Shifter ball screw for signs of coolant contamination.

   For the latest Service Bulletin updates, visit Roadranger.com.

   - If coolant contamination is found, repair the vehicle coolant system leak and follow Service Bulletin TMIB0124 for complete repair procedure. X-Y Shifter must be replaced upon completion of service bulletin. Go to **Step V.**
   - If damage to the X-Y Shifter is found, replace X-Y Shifter. Go to **Step V.**
   - If no damage is found, go to **Step E.**

E **Purpose:** Inspect condition of shift bar housing.

1. Key off.
2. Inspect condition of the Shift Bar Housing 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 Bar Housing.



4. Verify transmission shifts fully in to and out of each gear.
5. Test the Shift Interlock to verify that the transmission will not engage two gears at once. See the *Shift Interlock Inspection Procedure* on page 552.
   - If damage to the Shift Bar Housing is found, repair Shift Bar Housing. Go to **Step V.**
   - If no damage is found, go to **Step F.**

F

Purpose: Inspect condition of the internal transmission components.

1. Key off.
2. Drain and save the transmission oil. Inspect oil for significant metal fragments.
3. Remove 8-bolt PTO cover.
4. Inspect main case gears for damage or excessive movement.
5. Inspect Shift Yokes and Sliding Clutches for damage or excessive wear. See Service Bulletin TAIB0818 for complete inspection procedure.
   - 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, go to **Step G.**

   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 and contact Eaton at (800) 826-4357.

G

Purpose: Collect Service Activity Report.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed, including X-Y Shifter.
3. Reinstall 8-bolt PTO cover.
4. Refill transmission with lubricant.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve Snapshot and VPA data by creating a *Service Activity Report* within ServiceRanger.
8. Update transmission software to latest available level.

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

9. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
   - Contact Eaton at (800) 826-4357 for further diagnostic instructions.

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. 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 13.

Fault Code 83: Invalid Shift Lever Position

J1587 MID 130 SID 18 FMI 14
J1939 SA 3 SPN 751 FMI 14

Overview

The UltraShift *PLUS* 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 83 indicates the TECU did not identify a Shift Lever position.

Detection

The TECU monitors Shift Lever position by supplying voltage to the Shift Lever and measuring the returned voltage. When the return voltage received by the TECU does not match any known shift mode this fault code sets Active.

Conditions to Set Fault Code Active

FMI 14 – Special Instructions: Selected lever position is invalid for 0.5 seconds or longer.

Fallback

FMI 14

- “F” flashes in gear display.
- Service light flashes (if equipped).
- Transmission may not engage a gear from neutral.
- Transmission enters downshift-only mode.

Conditions to Set Fault Code Inactive

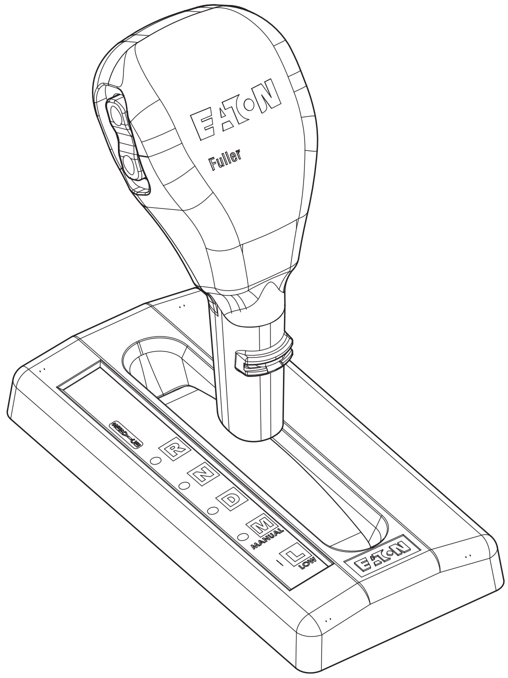
FMI 14: TECU recognizes a valid Shift Lever position from the Shift Lever after 0.2 seconds.

Possible Causes

FMI 14

- Vehicle Analog Shift Device
  - Internal failure
  - Lever positioned between two modes
- Eaton Cobra Shift Lever
  - Internal failure
  - Lever positioned between two modes

Component Identification



Eaton Cobra Lever

Fault Code 83 Troubleshooting

A

Purpose: Check for Active or Inactive fault codes.

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 83 is Active, replace Shift Lever. Go to **Step V.**
   - If Fault Code 83 is Inactive, go to **Step B.**

B

Purpose: Verify lever positions in gear display.

1. Key on with engine off.
2. Set parking brake and chock wheels.
3. Depress service brake pedal.
4. Shift the Lever into Reverse (R), Drive (D), Low (L) and Neutral (N) modes.
5. Monitor the vehicle gear display and Shift Lever mode lights (if equipped). Ensure that when each mode is selected an appropriate gear is engaged by the transmission.
   - If lever positions do not match gear display, replace Shift Lever. Go to **Step V.**
   - If lever positions match gear display, 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 engine 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 83 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 83 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

Fault Code 84: Shift Device Not Configured

J1587: MID 130 SID 18 FMI 13
J1939: SA 3 SPN 751 FMI 13

Overview

The UltraShift *PLUS* 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).
- Engine may not crank.
- Transmission will not engage a gear from neutral.

Conditions to Set Fault Code Inactive

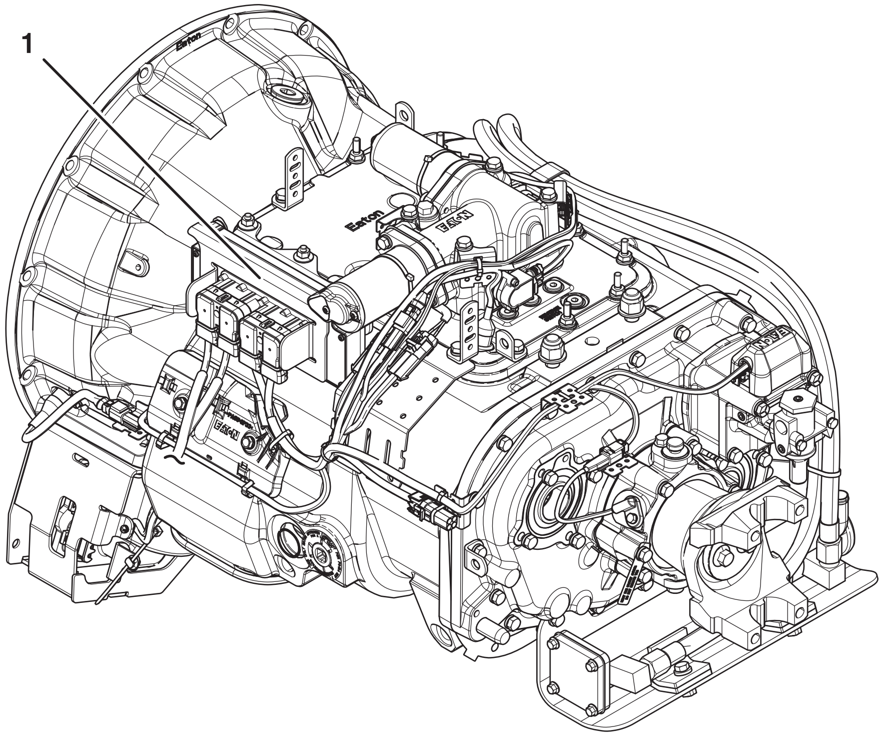
FMI 13: This fault code is never set Inactive. Fault Code 84 only sets in an Active state.

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. 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 engine 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.

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

7. Key on with engine 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 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 engine 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 13.

Fault Code 85: Shift Control Device Incompatible

J1587: MID 130	**SID 18**	**FMI 12**
J1939: SA 3	**SPN 751**	**FMI 12**

Overview

The UltraShift *PLUS* 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.

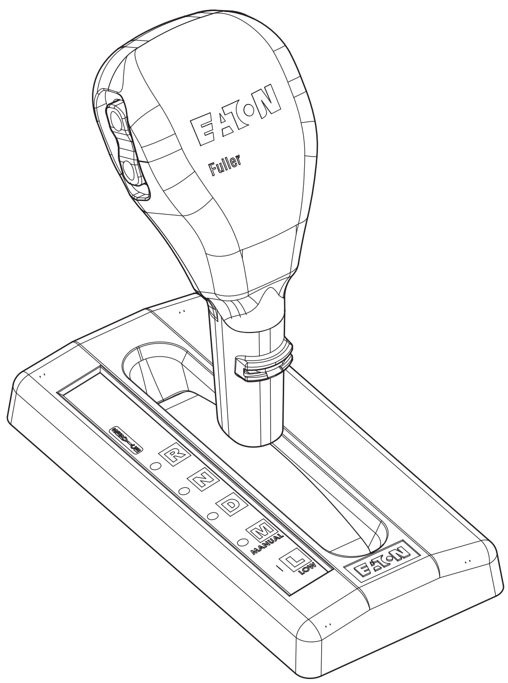
Possible Causes

FMI 12

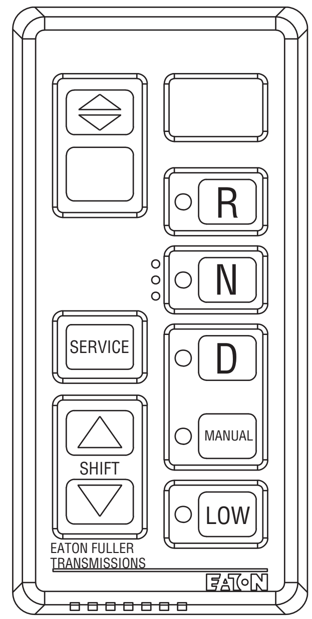
- Shift Control Device
  - Improper Shift Control Device installed on vehicle

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. 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 engine 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 13.

Fault Code 99: Direction Mismatch

J1587: MID 130 SID 58 FMI 12, 14
J1939: SA 3 SPN 781 FMI 12, 14

Overview

The UltraShift *PLUS* 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 TECU X-Y commanded finger position does not match the X-Y Position Sensors reported finger position.

FMI 14 – Special Instructions: If the requested gear position commanded by the TECU is different than the current Shift Finger position the fault code is set Active.

Fallback

All FMIs:

- "F" flashes in gear display.
- Service light flashes (if equipped).
- Transmission remains in current gear.
- May not engage a start gear from neutral.
- Engine 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

All FMIs:

- 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

Component Identification

None

Fault Code 99 Troubleshooting

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - Contact Eaton at (800) 826-4357 for repair strategy.

Start Enable Relay Contact

Overview

This symptom-driven test is performed if the engine does not crank with the Driver Interface Device in neutral, the transmission confirming neutral, and there are no Active or Inactive fault codes.

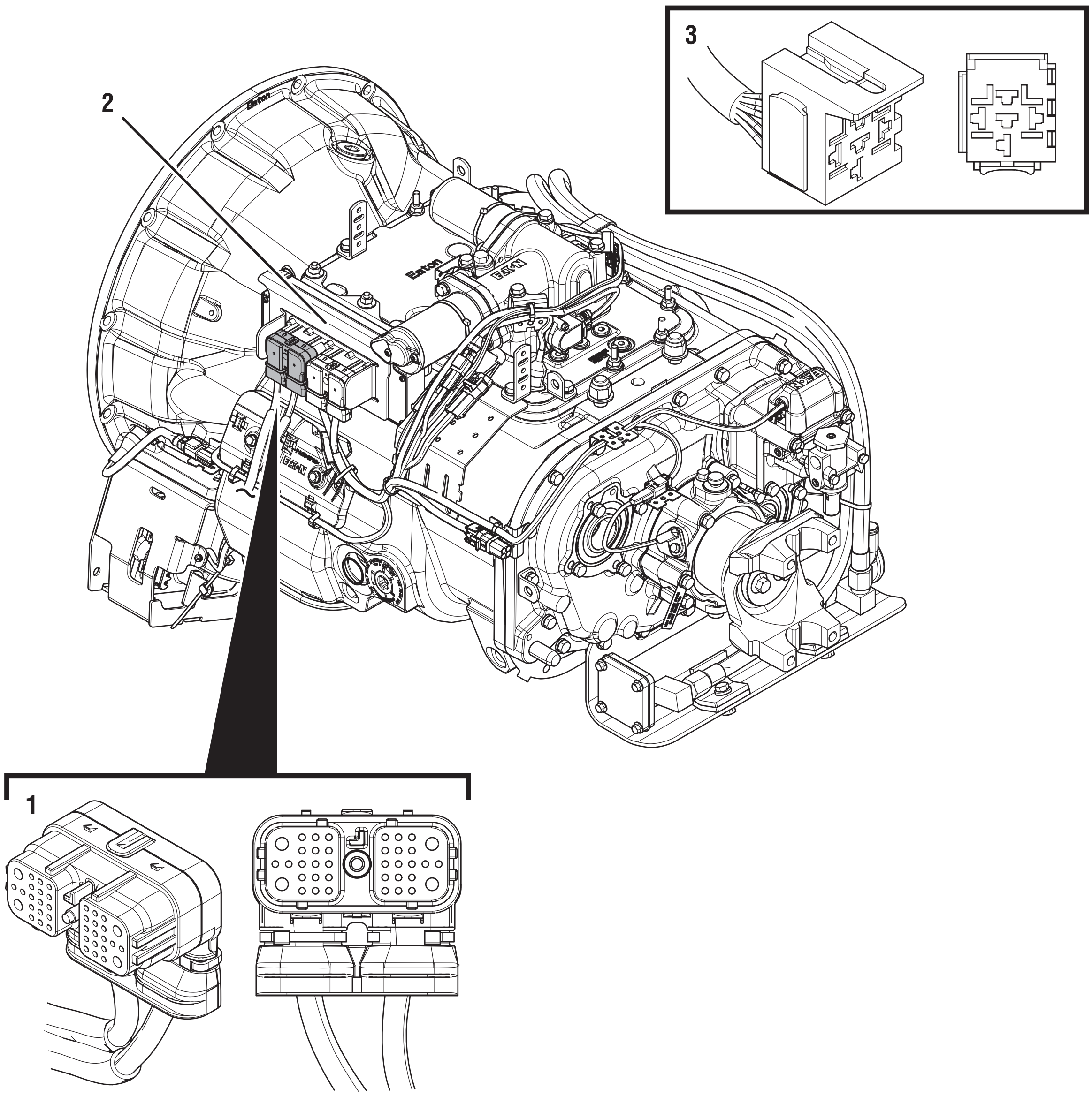
Detection

- Engine does not crank with the transmission in neutral.
- Engine cranks with the transmission in a non-neutral position.

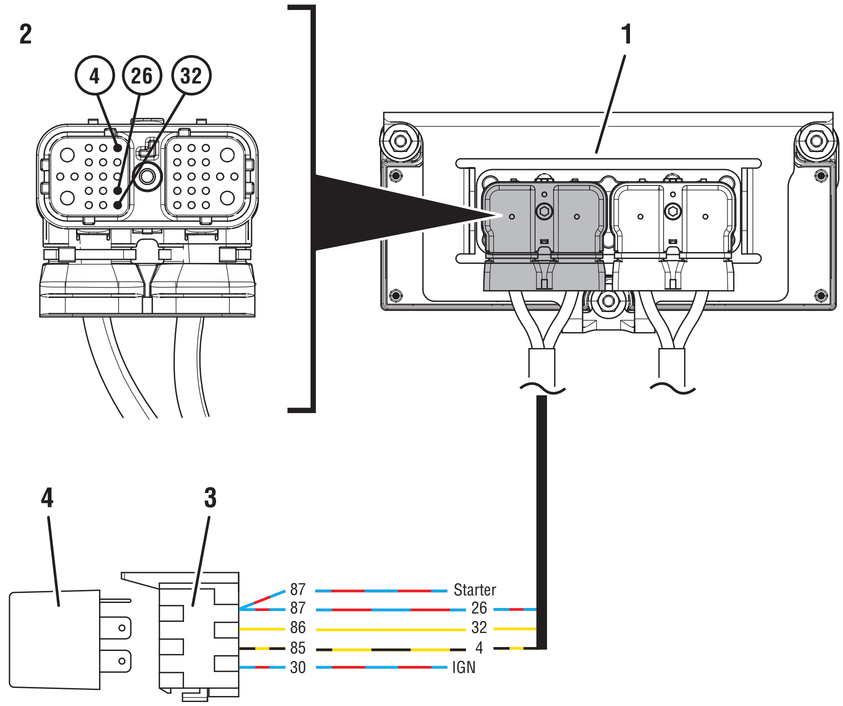
Possible Causes

- Vehicle Power and Ground
  - Poor power or ground supply to TECU
  - Battery failure
  - Bent, spread, corroded or loose terminals
- Start Enable Relay
  - Internal failure
- Start Enable Relay Circuit
  - Bypassed or “jumped” Start Enable Relay circuit
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open

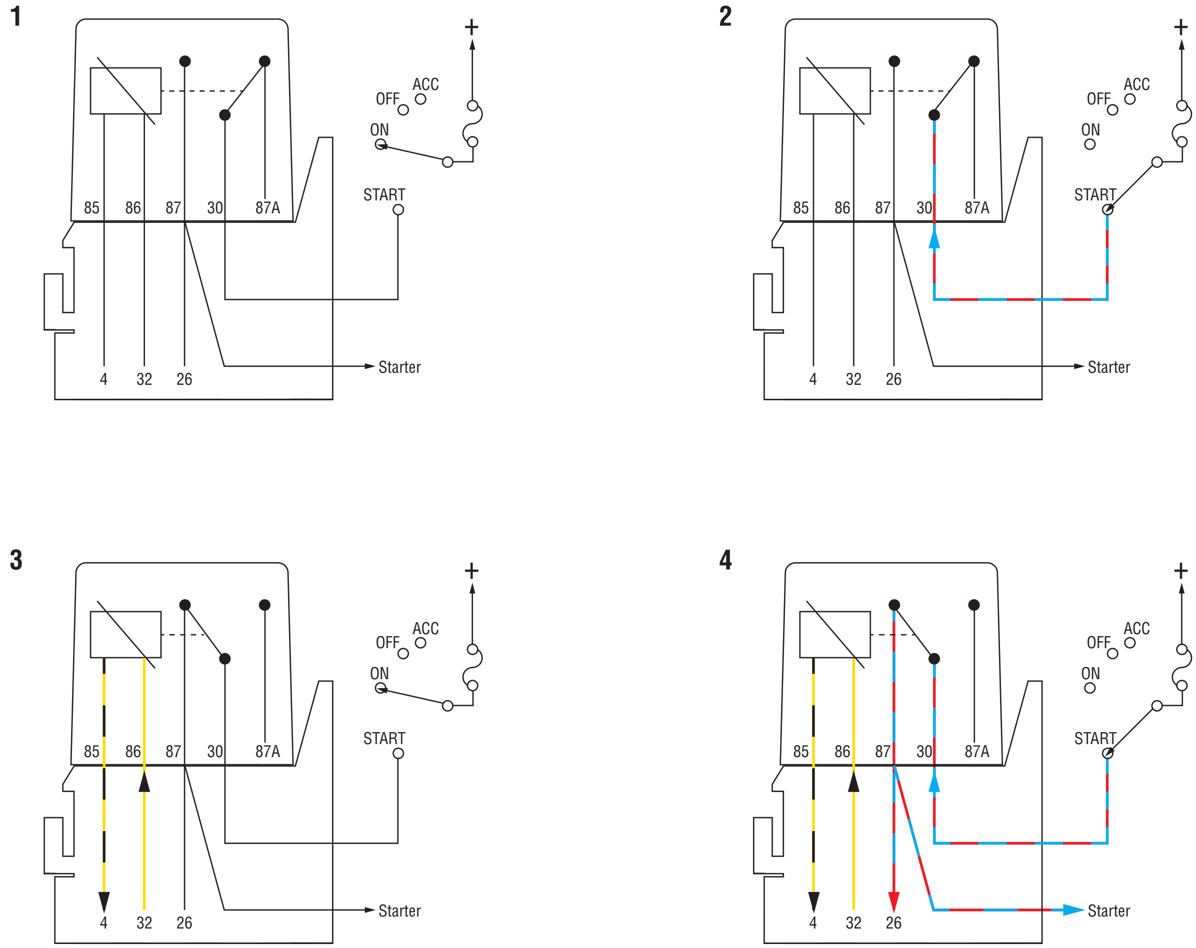
Component Identification



1. *38-Way Vehicle Harness Connector*
2. *Transmission Electronic Control Unit (TECU)*
3. *5-Way Start Enable Relay Socket*



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Vehicle Harness Connector
3. 5-Way Start Enable Relay Socket
4. 5-Way Start Enable Relay



Start Enable Relay Circuit States (Normally Open)
1. Open Relay - Key On and Transmission is Unable to Confirm Neutral
2. Open Relay - Key Start and Transmission is Unable to Confirm Neutral
3. Closed Relay - Key On and Transmission Confirmed in Neutral
4. Closed Relay - Key Start and Transmission Confirmed in Neutral

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

Start Enable Relay Contact Test

A ***Purpose:*** *Confirm Driver Interface Device is in Neutral and the Gear Display shows "N".*

1. Key off.

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

2. Verify that the Driver Interface Device is in the Neutral (N) position.
3. Key on with engine off.
4. Verify that the transmission confirms Neutral ("N") in the gear display.
   - If the transmission confirms Neutral, go to **Step B.**
   - If the transmission will not find Neutral, troubleshoot per the *Main Case Control Test* on page 525.

B ***Purpose:*** *Verify condition of power and ground supply.*

1. Perform the *Electrical Pretest*. Reference the *Electronic Clutch Actuator (ECA) Identification Overview* on page 22. Record the reading(s) from the Load Test in Step C of the Electrical Pretest in the table.
   - If *Electrical Pretest* fails, repair per *Electrical Pretest* instructions and retest vehicle operation.
   - If *Electrical Pretest* passes, go to **Step C.**

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

C

Purpose: *Update transmission software and determine if the Start Enable system is a hard-wired relay or a J1939 message.*

1. Key on with engine off.
2. Set parking brake and chock wheels.
3. Connect ServiceRanger.
4. Create a *Service Activity Report* within ServiceRanger to retrieve Snapshot and VPA data.
5. Update transmission software to latest available level.

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

6. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
7. Inspect the vehicle to determine if the Start Enable function is performed through a physically hard-wired relay or a transmission message broadcast over the J1939 Data Link.
   - If the Start Enable is performed by a message over the J1939 Data Link, go to **Step D.**
   - If a Start Enable Relay is directly hard-wired to the TECU, go to **Step G.**

D

Purpose: *Verify Start Enable Type (Relay or J1939) configured in the TECU and installed on the vehicle.*

1. Key off.

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

2. Key on with engine off.
3. Connect ServiceRanger.
4. Go To “Configuration”.
5. Select “Vehicle”.
6. Record the “Current Value” for the “Start Enable Type”.
7. Record the “Start Enable Type” installed on the vehicle.

   Note: The vehicle's “Start Enable Type” (Relay or J1939), is determined by the OEM. Refer to the OEM regarding “Start Enable Type” installed on the vehicle.

8. Compare reading(s) in table.
   - If “Start Enable Type” is configured correctly, go to **Step E.**
   - If “Start Enable Type” is not configured correctly, select the correct configuration from the “New Value” drop down, select “Apply” and follow on screen prompt. Go to **Step V.**

Location	Start Enable Type
TECU (ServiceRanger)	
Vehicle	

E

Purpose: *Attempt to crank the engine when the engine should crank.*

1. Key on with engine off.
2. Set parking brake and chock wheels.
3. Verify that the Driver Interface Device is in the Neutral (“N”) position.
4. Verify that the transmission confirms Neutral (“N”) in the gear display.
5. Attempt to crank the engine.
   - If engine cranks, go to **Step F.**
   - If engine does not crank, contact Eaton at (800) 826-4357 for further diagnostics.

F

Purpose: *Attempt to crank the engine when the engine should not crank.*

1. Key on with engine off.
2. Set parking brake and chock wheels.
3. Place the Driver Interface Device in a non-Neutral position.
4. Attempt to crank the engine.
5. Return the Driver Interface Device to Neutral (“N”).
   - If the engine cranks, contact Eaton at (800) 826-4357 for further diagnostics.
   - If the engine does not crank, no fault was found. Test Complete. If additional troubleshooting is required, contact the OEM for additional information about this system.

G

Purpose: *Use ServiceRanger to determine if the “J1939 Start Enable” configuration is set to “No”.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. In ServiceRanger, go to “Configuration”.
4. Record current configuration of “J1939 Start Enable”.
5. Confirm the configuration matches the vehicle start enable system.
   - If the current configuration is “No” (matches), go to **Step H.**
   - If the current configuration is “Yes” (no match), contact Eaton at (800) 826-4357 for further diagnostics.

H

Purpose: *Attempt to crank the engine when the engine should crank.*

1. Key on with engine off.
2. Set parking brake and chock wheels.
3. Verify that the Driver Interface Device is in the Neutral (“N”) position.
4. Verify that the transmission confirms Neutral (“N”) in the gear display.
5. Attempt to crank the engine.
   - If the engine cranks, go to **Step I.**
   - If the engine does not crank, go to **Step M.**

I

Purpose: *Attempt to crank the engine when the engine should not crank.*

1. Key on with engine off.
2. Set parking brake and chock wheels.
3. Place the Driver Interface Device in a non-Neutral position.
4. Attempt to crank the engine.
5. Return the Driver Interface Device to Neutral ("N").
   - If the engine cranks, go to **Step J.**
   - If the engine does not crank, go to **Step K.**

J

Purpose: *Remove the Start Enable Relay and attempt to crank the engine.*

1. Key off.

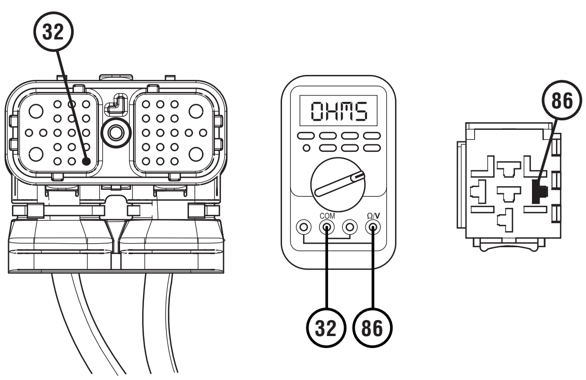
   Important: Allow 2–3 minutes for the TECU to perform a complete power-down sequence before proceeding.
2. Set parking brake and chock wheels.
3. Remove the Start Enable Relay.
4. Key on with engine off.
5. Place the Driver Interface Device in a non-Neutral position.
6. Attempt to crank the engine.
7. Return the Driver Interface Device to Neutral ("N").
   - If the engine cranks, repair the short to power in the Start Enable Relay wiring. Repair or replace wiring per OEM requirements. Go to **Step V.**
   - If the engine does not crank, replace the Start Enable Relay. Go to **Step V.**

K ***Purpose:*** *Verify correct Start Enable Relay wiring.*

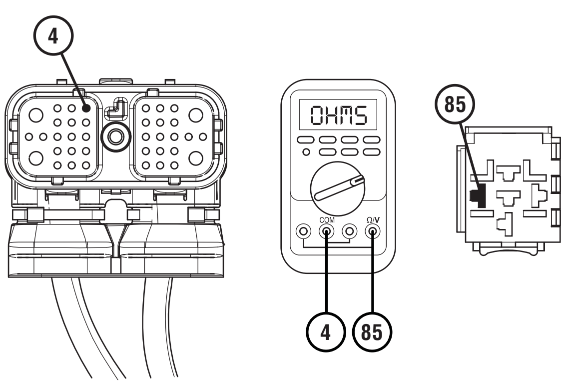
1. Key off.

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

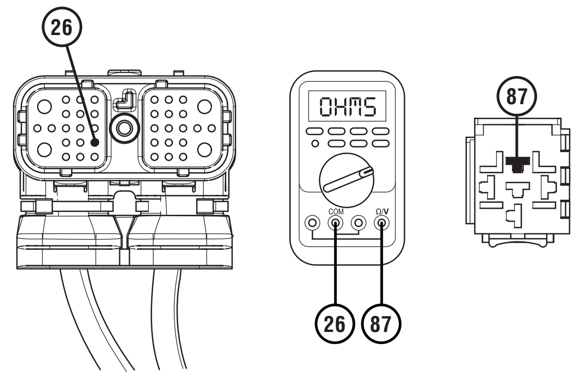
2. Verify that the Start Enable Relay is wired per the UltraShift *PLUS* requirements in the wiring schematic.
3. Key off.
4. Disconnect the Start Enable Relay from the socket.
5. Measure resistance between 38-Way Vehicle Harness Connector Pin 32 and Start Enable Relay Socket Pin 86. Record reading(s) in table.



6. Measure resistance between 38-Way Vehicle Harness Connector Pin 4 and Start Enable Relay Socket Pin 85. Record reading(s) in table.



7. Measure resistance between 38-Way Vehicle Harness Connector Pin 26 and Start Enable Relay Socket Pin 87. Record reading(s) in table.



8. Compare reading(s) in table.
   - If all readings are in range, go to **Step L.**
   - If any reading is out of range, repair or replace Start Enable Relay wiring per OEM requirements. Go to **Step V.**

Pins	Range	Reading(s)
VH 32 to SER 86	0.0–0.3 ohms	
VH 4 to SER 85	0.0–0.3 ohms	
VH 26 to SER 87	0.0–0.3 ohms	

L

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 Start Enable Relay wiring from the 38-Way Vehicle Harness Connector to the Start Enable Relay. Look for signs of rubbing or chafing. Consult OEM for specific wire routing locations.
4. Exit PD Mode by powering down.

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

- If any fault code sets Active during wiggle wire test, repair or replace the Start Enable Relay wiring per OEM requirements. Go to **Step V.**
- If no fault codes set Active, no problem was identified. Test complete. If additional troubleshooting is required, contact the OEM for additional information about this system.

M

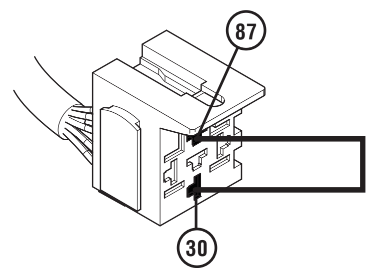
Purpose: *Verify system will crank with the relay bypassed.*

1. Key off.

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

⚠ **Warning:** Set parking brake and chock wheels.

2. Remove the Start Enable Relay.
3. Place a jumper wire between socket Pin 30 and Pin 87.



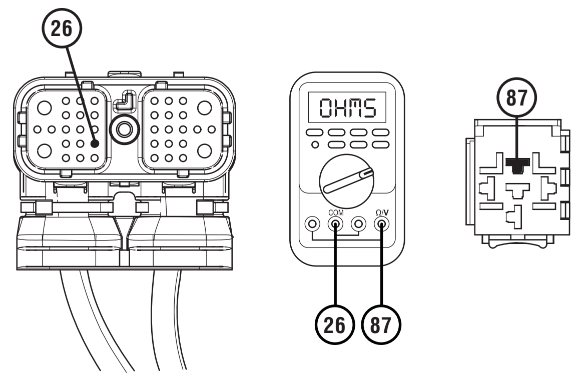
4. Key on with engine off.
5. Verify that the Driver Interface Device is in the Neutral (“N”) position.
6. Verify that the transmission confirms Neutral (“N”) in the gear display.
7. Attempt to crank the engine.
   - If the engine cranks, replace the Start Enable Relay. Go to **Step N.**
   - If the engine does not crank, go to **Step O.**

N ***Purpose:*** *Verify continuity of Start Enable Latch wire.*

1. Key off.

Important: 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. Inspect 38-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Remove the Start Enable Relay.
5. Measure resistance between 38-Way Vehicle Harness Pin 26 and Start Enable Relay socket Pin 87.



- If readings are in range, no problem was identified. Test Complete. Go to **Step V.**
- If any readings are out of range, repair or replace wiring per OEM requirements. Go to **Step V.**

Pins	Range	Reading(s)
VH 26 to SER 87	0.0–0.3 ohms	

0 ***Purpose:*** *Verify Correct Start Enable Relay Wiring.*

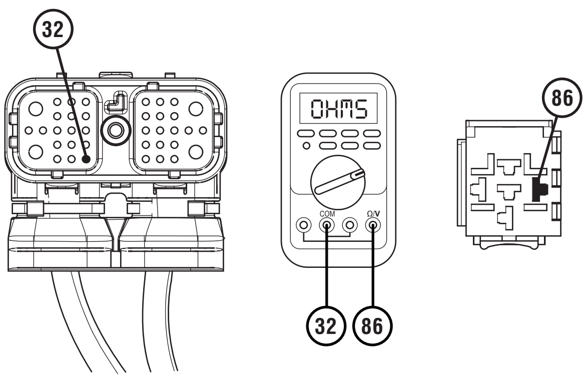
1. Key off.

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

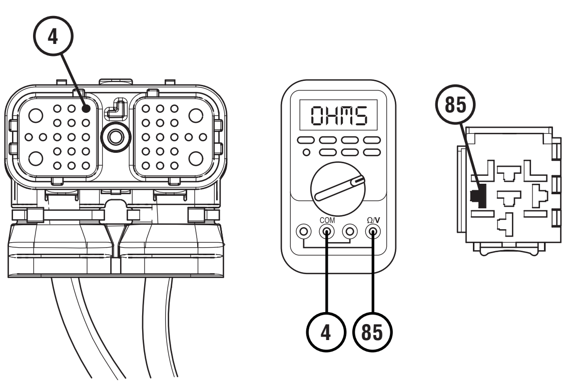
2. Verify that the Start Enable Relay is wired per the UltraShift *PLUS* requirements in the wiring schematic.

   Note: If the Start Enable Relay is wired in a manner different than the wiring schematic, contact the OEM for further information.

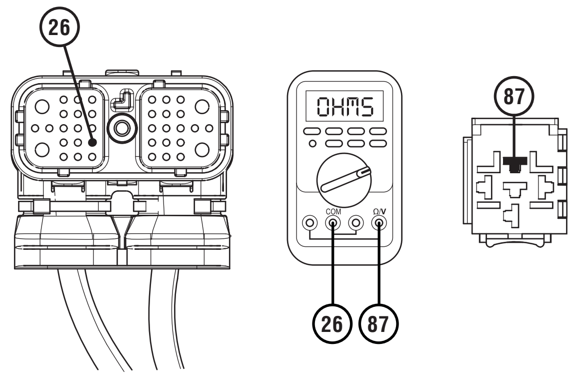
3. Remove the Start Enable Relay from the socket.
4. Measure resistance between 38-Way Vehicle Harness Connector Pin 32 and Start Enable Relay Socket Pin 86. Record reading(s) in table.



5. Measure resistance between 38-Way Vehicle Harness Connector Pin 4 and Start Enable Relay Socket Pin 85. Record reading(s) in table.



6. Measure resistance between 38-Way Vehicle Harness Connector Pin 26 and Start Enable Relay Socket Pin 87. Record reading(s) in table.



7. Compare reading(s) in table.
   - If all readings are in range, diagnose wiring or Starter issue per OEM requirements. Go to **Step V.**
   - If any readings are out of range, repair or replace wiring per OEM requirements. Go to **Step V.**

Pins	Range	Reading(s)
VH 32 to SER 86	0.0–0.3 ohms	
VH 4 to SER 85	0.0–0.3 ohms	
VH 26 to SER 87	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 engine off.
4. Clear fault codes using ServiceRanger.
5. Verify that the Driver Interface Device is in the Neutral ("N") position.
6. Verify that the transmission confirms Neutral ("N") in the gear display.
7. Test the Start Enable system by attempting to crank the Starter multiple times. Verify that the starting system operates properly.
8. Check for fault codes using ServiceRanger.
   - If no codes set and the engine cranks, test complete.
   - If the engine does not crank and a fault code sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If the engine does not crank and no fault codes set, contact Eaton at (800) 826-4357.

J1587 Data Link

Overview

This symptom-driven test is performed if there is a failure of the J1587 Data Link on the vehicle. Most UltraShift *PLUS* transmission functions use J1939 as the primary communication method and utilize J1587 as a redundant or backup communication method. Therefore, a loss of J1587 Data Link may not have a significant affect on the transmission system.

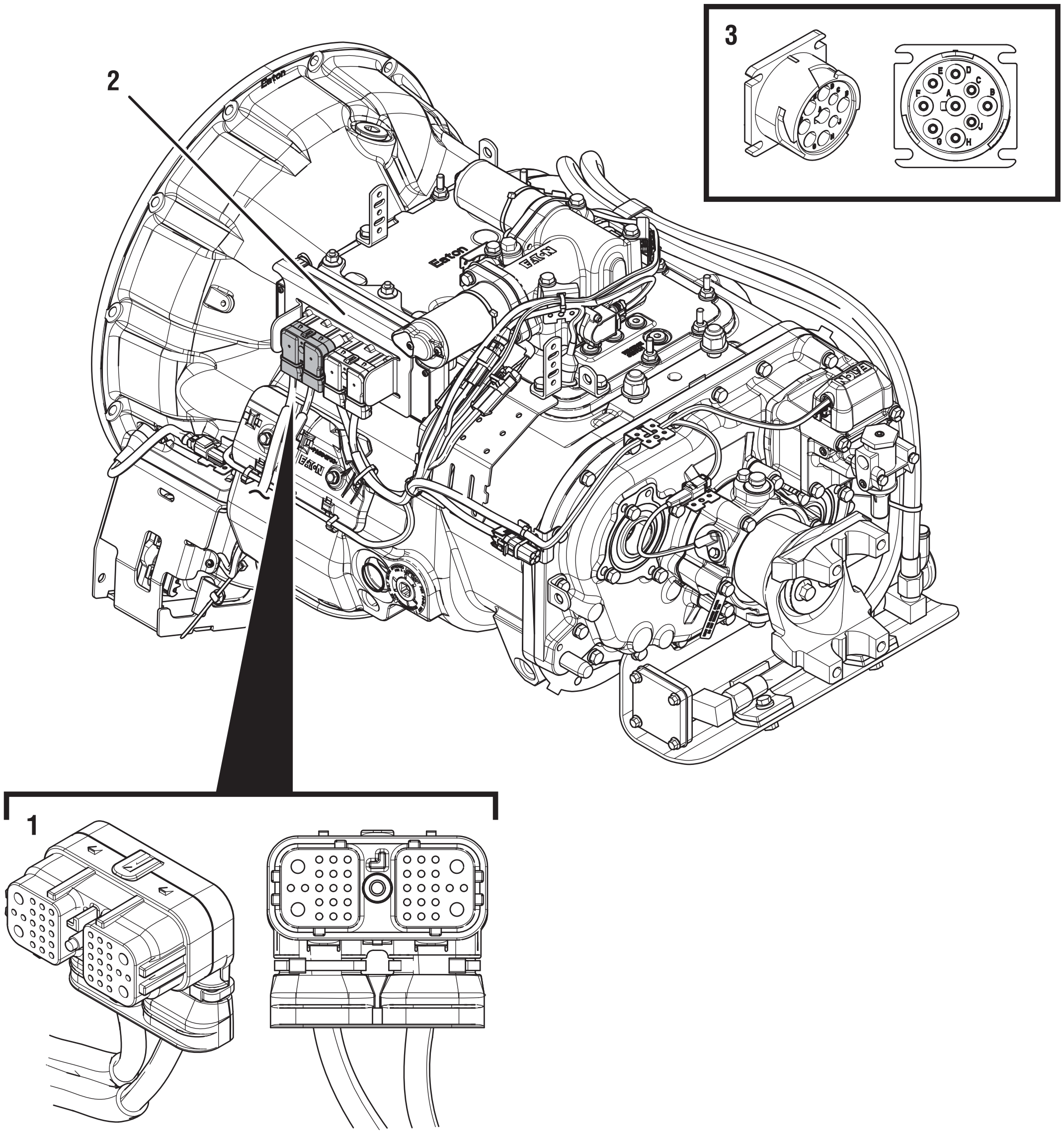
Detection

- ServiceRanger or other diagnostic tools has limited functionality.
- Other vehicle ECUs may set J1587 fault codes.

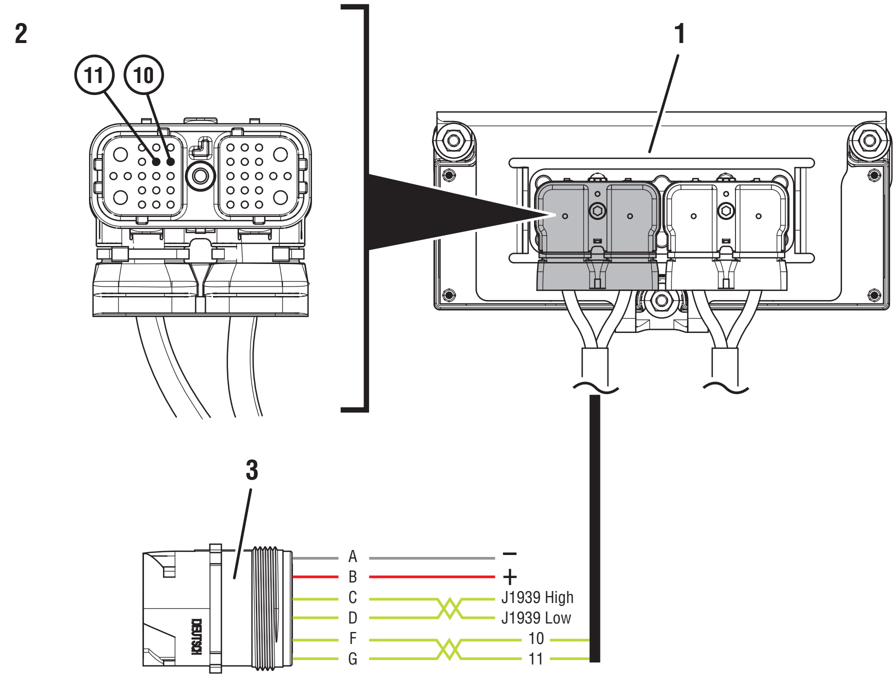
Possible Causes

- J1587 Data Link
  - Damage between TECU and 9-Way Diagnostic Connector
  - Bent, spread, corroded or loose terminals
  - 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 (in cab)

J1587 Data Link Test

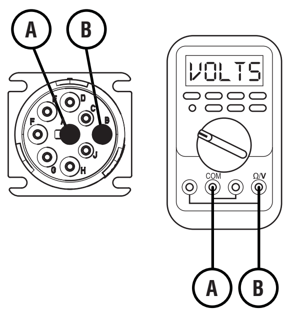
A

Purpose: *Verify battery voltage supply to the vehicle diagnostic connector.*

1. Key off.

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

2. Measure voltage between 9-Way Diagnostic Connector Pin B and Pin A.



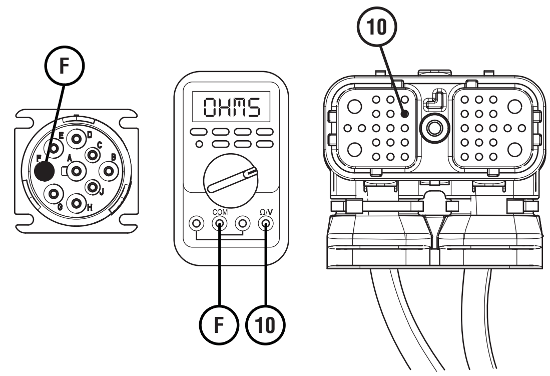
3. Compare reading(s) in table.
   - If readings are in range, go to **Step B.**
   - If readings are out of range, repair battery or ground wire to vehicle diagnostic connector. Go to **Step V.**

Pins	Range	Reading
B to A	Within 0.6 V of Battery Voltage	

B

Purpose: *Verify continuity of J1587 positive (+) wire between the TECU and the vehicle diagnostic connector.*

1. Key off.
2. Disconnect 38-Way Vehicle Harness Connector from TECU.
3. Measure resistance between 9-Way Diagnostic Connector Pin F and 38-Way Vehicle Harness Connector Pin 10.



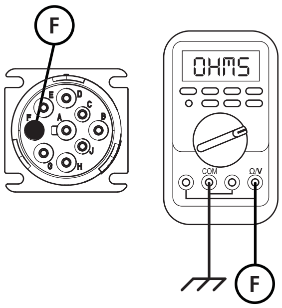
4. Compare reading(s) in table.
   - If readings are in range, go to **Step C.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of J1587 Data Link. Go to **Step V.**

Pins	Range	Reading
10 to F	0–0.3 ohms	

C

Purpose: *Verify J1587 Positive (+) is not shorted to ground.*

1. Measure resistance between 9-Way Diagnostic Connector Pin F and ground. Record reading(s) in table.



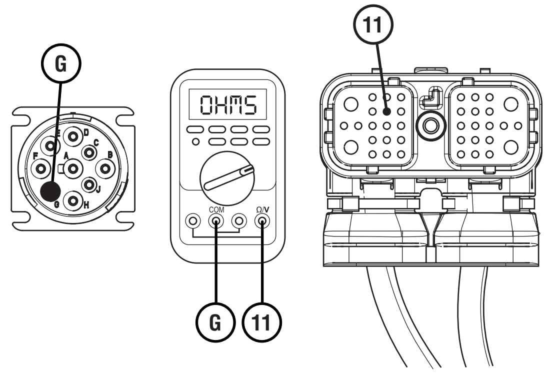
2. Compare reading(s) in table.
   - If readings are in range, go to **Step D.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of J1587 Data Link. Go to **Step V.**

Pins	Range	Reading
F to Ground	Open Circuit (OL)	

D

Purpose: *Verify continuity of J1587 negative (-) wire between the TECU and the vehicle diagnostic connector.*

1. Measure resistance between 9-Way Diagnostic Connector Pin G and 38-Way Vehicle Harness Connector Pin 11. Record reading(s) in table.



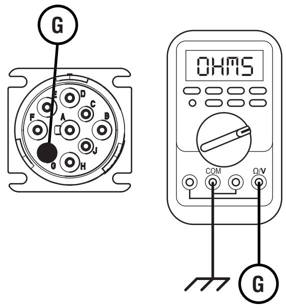
2. Compare reading(s) in table.
   - If readings are in range, go to **Step E.**
   - If reading are out of range, refer to OEM guidelines for repair or replacement of J1587 Data Link. Go to **Step V.**

Pins	Range	Reading
11 to G	0–0.3 ohms	

E

Purpose: *Verify J1587 Negative (-) is not shorted to ground.*

1. Measure resistance between either 9-Way Diagnostic Connector Pin G and ground.



2. Compare reading(s) in table.
   - If readings are in range, no problem identified. Go to **Step V.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of J1587 Data Link. Go to **Step V.**

Pins	Range	Reading
G to Ground	Open Circuit (OL)	

V

Purpose: *Verify repair.*

1. Key on with engine off.
2. Connect ServiceRanger.

   Note: If ServiceRanger does not communicate with the transmission and other vehicle devices, verify proper ServiceRanger communication adapter settings before continuing. For more information, see the *ServiceRanger User's Guide* TCMT0072.

3. Attempt to communicate with vehicle components.
   - If ServiceRanger communicates with other vehicle devices, test complete.
   - If ServiceRanger does not communicate with other devices, go to **Step A.**

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.

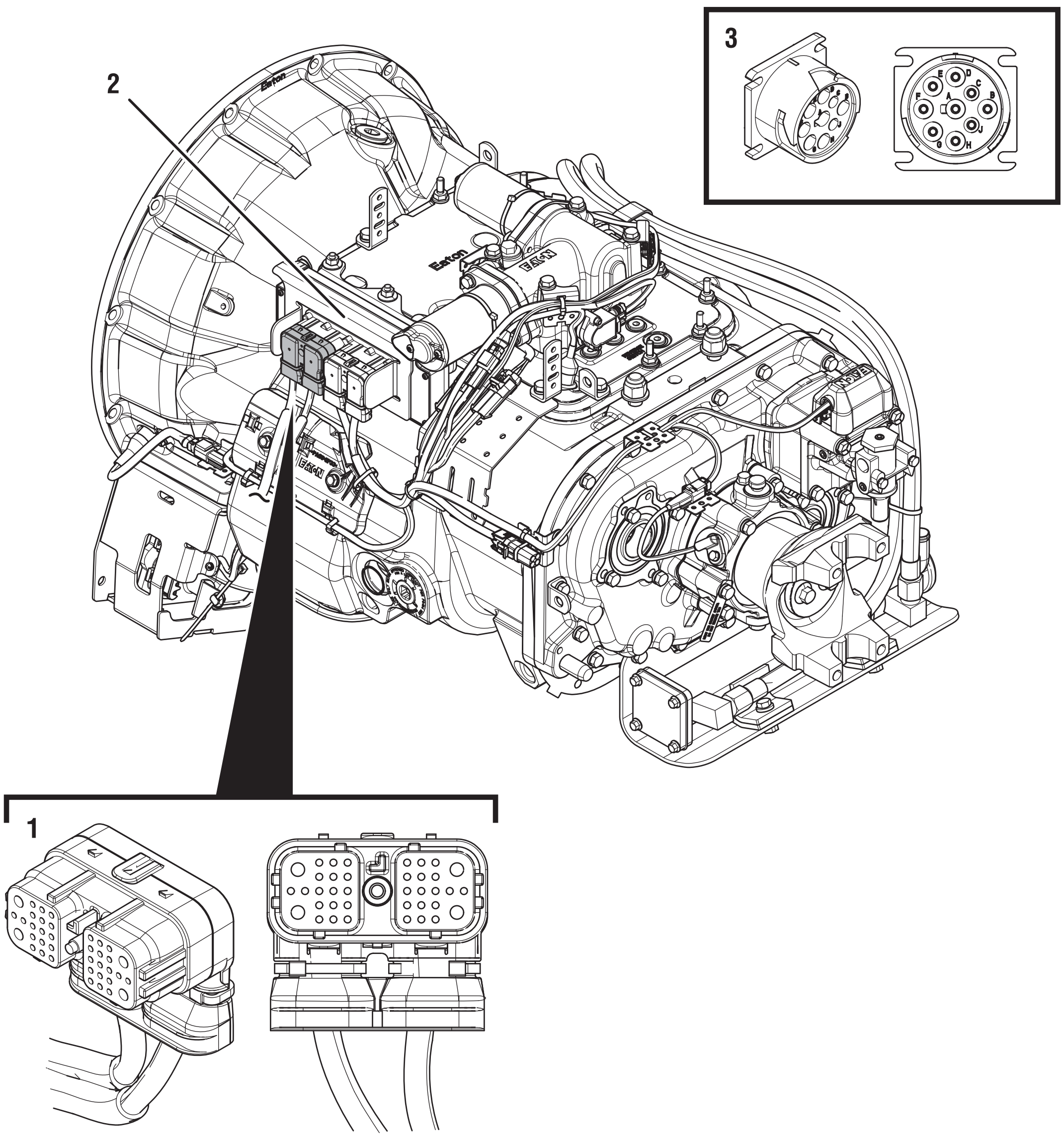
Detection

- Various communication problems between vehicle ECUs.
- ServiceRanger or other diagnostic software may not be able to communicate with TECU or vehicle ECUs.
- If vehicle is configured for the J1939 Start Enable feature the engine may not crank.

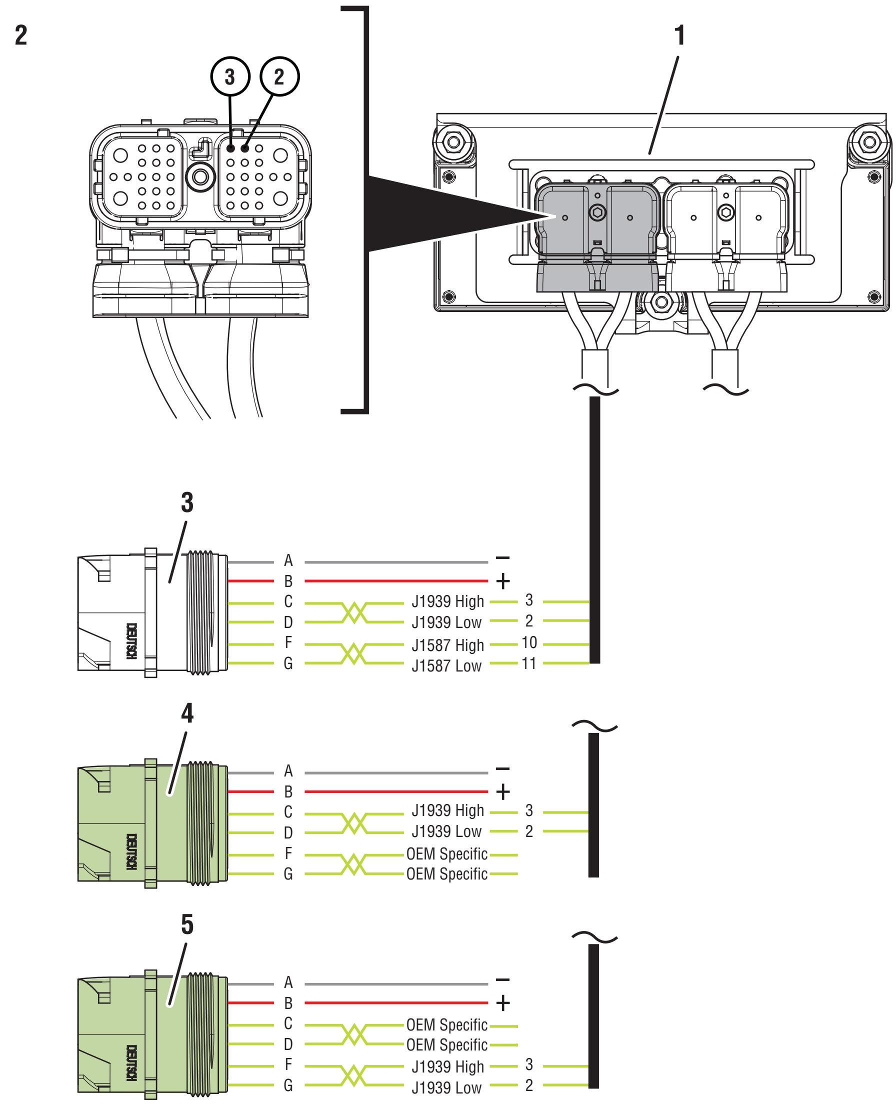
Possible Causes

- 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)
5. 9-way Diagnostic Connector (Green) - OEM Specific FG (in cab)

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

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 engine 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

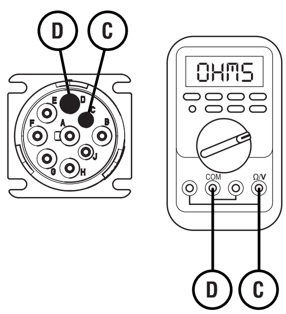
Purpose: *Identify TECU location on J1939 Vehicle Data Link.*

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.**
   - If Green 9-Way Diagnostic Connector on Pin F and Pin H, go to **Step H.**

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.



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	

E

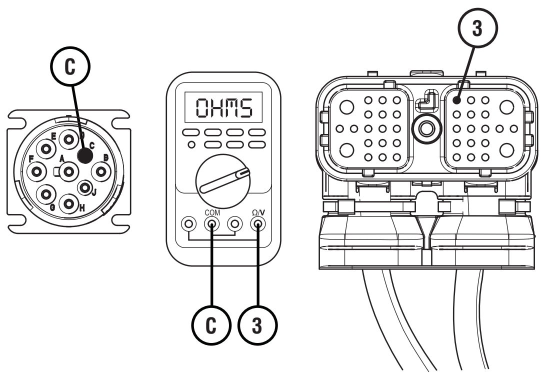
Purpose: *Verify 38-Way TECU Vehicle Harness Connector condition.*

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.



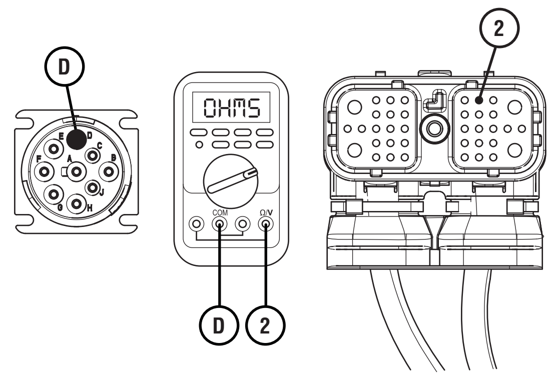
3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Vehicle Data Link. Go to **Step V.**
   - If readings are in range, go to **Step G.**

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.



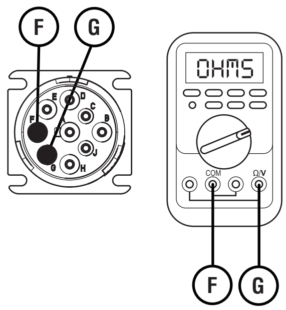
3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Vehicle Data Link. Go to **Step V.**
   - If readings are in range, go to **Step L.**

Pins	Range	Reading(s)
2 to D	0–0.3 Ohms	

H

Purpose: *Verify resistance of J1939 Vehicle Data Link at 9-Way Diagnostic Connector (FG).*

1. Key off.
2. Measure resistance between 9-Way Diagnostic Connector Pin F and Pin G. 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 I.**

Pins	Range	Reading(s)
F to G	50–70 Ohms	

I

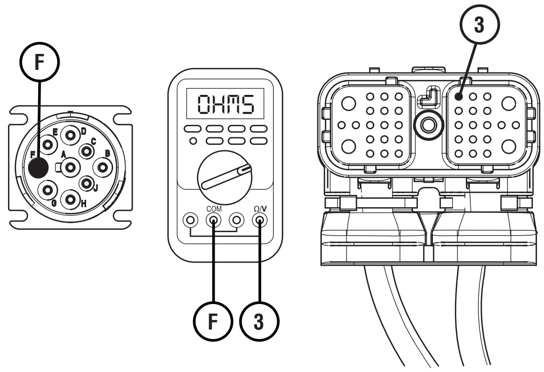
Purpose: *Verify 38-Way TECU Vehicle Harness Connector condition.*

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 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 J.**

J

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 F. Record reading in table.



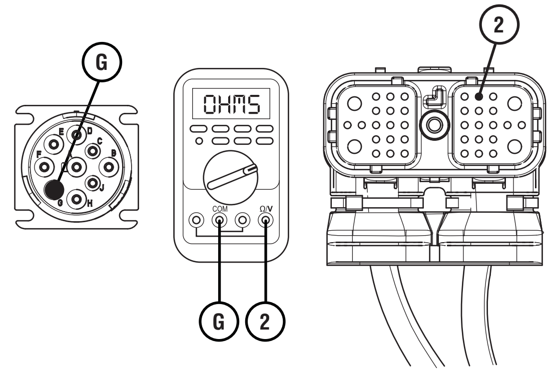
3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Vehicle Data Link. Go to **Step V.**
   - If readings are in range, go to **Step K.**

Pins	Range	Reading(s)
3 to F	0–0.3 Ohms	

K

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 G. 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 J1939 Vehicle Data Link. Go to **Step V.**
   - If readings are in range, go to **Step L.**

Pins	Range	Reading(s)
2 to G	0–0.3 Ohms	

L

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 engine 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 M.**
   - 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.**

M

Purpose: *Remove vehicle devices from the J1939 Vehicle Data Link.*

1. Key on with engine 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.
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 13.

Brake Switch Functionality

Overview

This procedure does not relate to any specific fault code, but verifies that the UltraShift *PLUS* transmission is receiving service brake switch input and park brake switch input from the vehicle.

Possible Causes

- Service Brake Switch
  - Internal failure
- Park Brake Switch
  - Internal failure
- Other
  - See Vehicle OEM for further possible causes

Brake Switch Functionality Test

A

Purpose: *Monitor Service Brake Switch in ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. In ServiceRanger, go to Data Monitor.
4. Select the “Engine and Brake” default parameter file.
5. Monitor Parameter 597 “Brake Switch”.
6. Depress Service Brake and verify that Brake Switch status changes to “Depressed”.
7. Release Service Brake and verify that Brake Switch status changes to “Released”.

   Note: ServiceRanger covers Brake Switch status input from several possible sources. If the vehicle uses a Brake Switch source other than those programmed in ServiceRanger, the use of an OEM diagnostic tool may be required to see Brake Switch status.

   - If parameter matches Service Brake position, go to **Step B.**
   - If parameter does not match Service Brake position, repair Brake Switch input to the Transmission Electronic Control Unit (TECU) per OEM guidelines.

B

Purpose: *Monitor Parking Brake Switch Status in ServiceRanger.*

1. Within Data Monitor, Monitor Parameter 70 “Parking Brake Switch Status”.
2. Set Parking Brake Switch in the cab and verify that Brake Switch status changes to “Set”.
3. Release Parking Brake Switch in the cab and verify that Parking Brake Switch Status changes to “Not set”.
   - If parameter does not match Parking Brake Switch position, repair Parking Brake Switch input to the Transmission Electronic Control Unit (TECU) per OEM guidelines.
   - If parameter matches Parking Brake Switch position, no problem was detected, test complete.

Main Case Control

Overview

This symptom-driven test is performed if a single dash (-) appears in the gear display and there are no Active or Inactive fault codes. In this case, the transmission is unable to shift into neutral. This test investigates conditions within the transmission that may cause this symptom.

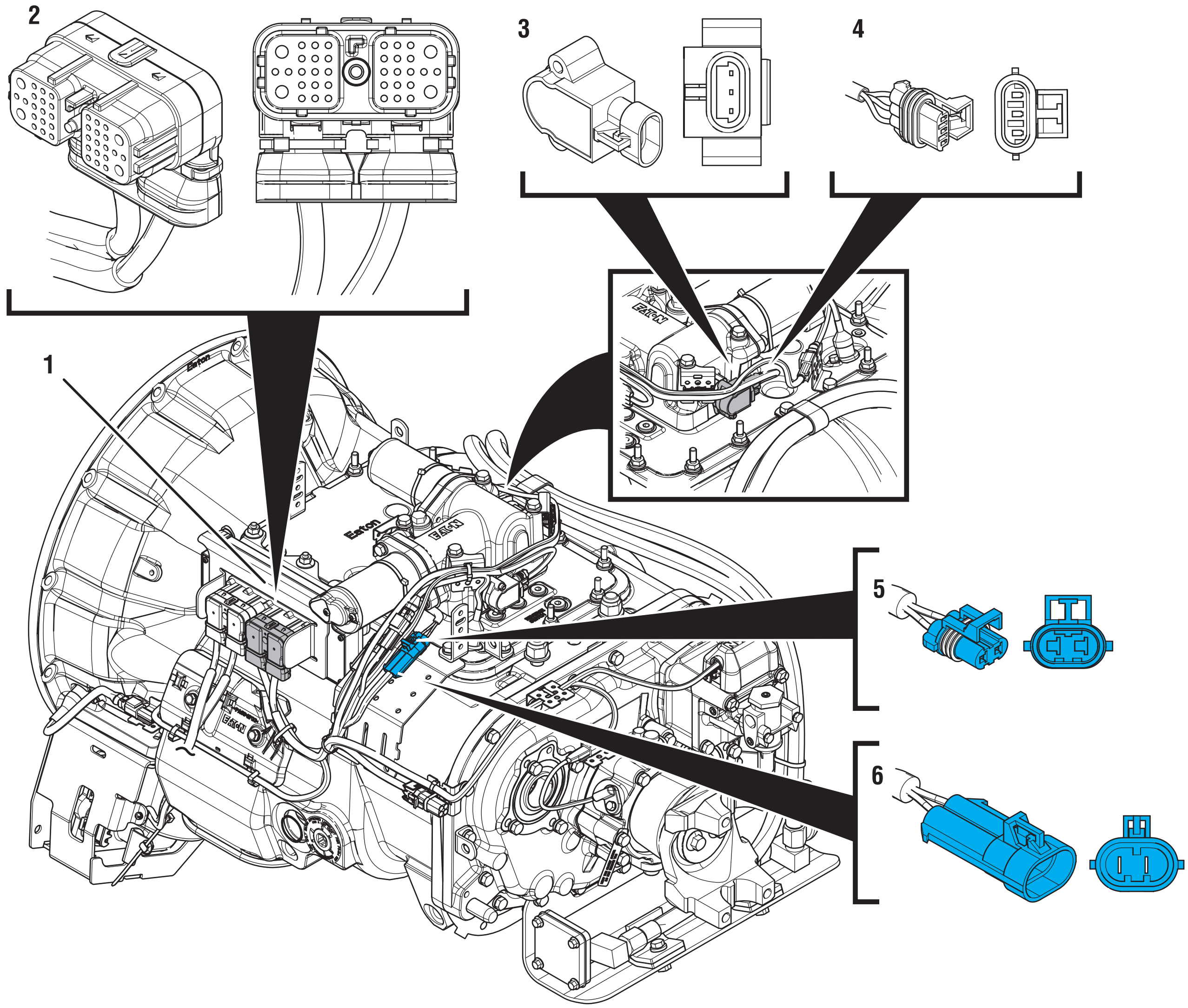
Detection

- A dash "-" appears in the gear display.
- Transmission is unable to confirm neutral.
- Transmission will not attempt to shift.

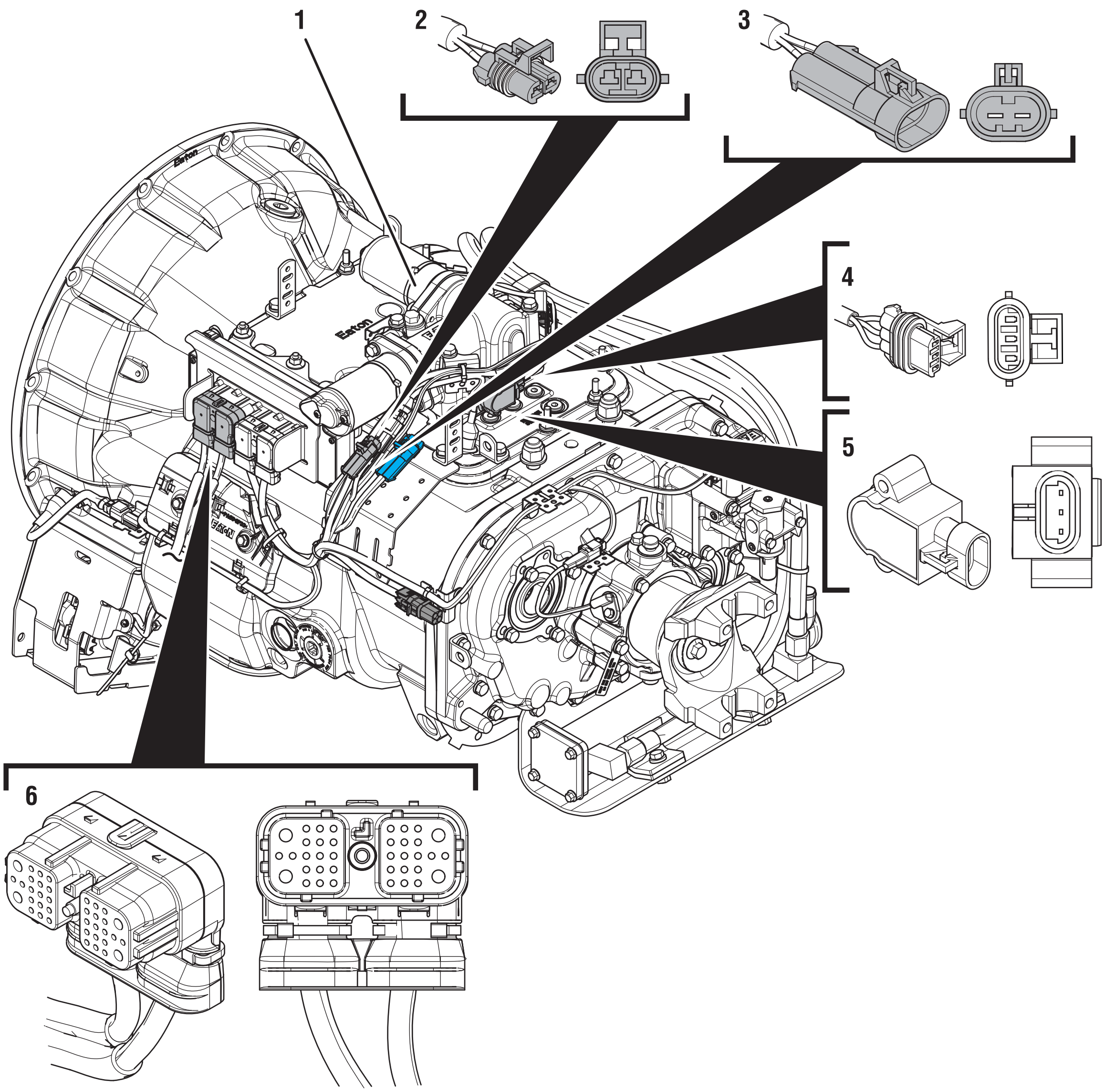
Possible Causes

- Vehicle Power and Ground
  - Poor power or ground supply to TECU
  - Battery failure
  - Bent, spread, corroded or loose terminals
- X-Y Shifter
  - Internal failure
  - Gear Position Sensor failure
  - Rail Position Sensor failure
  - Bent, spread, corroded or loose terminals
- Mechanical Transmission
  - Wear or damage to Shift Bar Housing
  - Wear to Sliding Clutch slot width
  - Wear or damage to Shift Yokes
  - Wear or damage to internal transmission components
- Clutch
  - Clutch stuck engaged or dragging clutch

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

Main Case Control Test

A

Purpose: Verify conditions to enter Main Case Control Test.

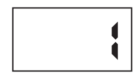
1. Set parking brake and chock wheels.
2. Key on with engine off.
3. Depress and hold service brake. Use the shift device to select Neutral.

4. Observe the gear display.
   - If gear display shows a solid "N," go to **Step B.**
   - If gear display shows a dash (-) or a flashing gear number, go to **Step C.**

B

Purpose: Confirm operation of main case gearing.

1. Set parking brake and chock wheels.
2. Key on with engine off.
3. Depress and hold service brake. Select Drive with the shift device.
4. Observe the gear display.
5. Depress and hold service brake. Use the shift device to select Neutral.



- If gear display showed a solid gear number and returned to neutral, test complete.
- If gear display showed a dash (-) or a flashing gear number, go to **Step C.**

C

Purpose: Verify condition of power and ground supply.

1. Perform the *Electrical Pretest*. Reference the *Electronic Clutch Actuator (ECA) Identification Overview* on page 22. Record the reading(s) from the Load Test in Step C of the Electrical Pretest in the table.
   - If *Electrical Pretest* fails, repair per *Electrical Pretest* instructions and retest vehicle operation.
   - If *Electrical Pretest* passes, go to **Step D.**

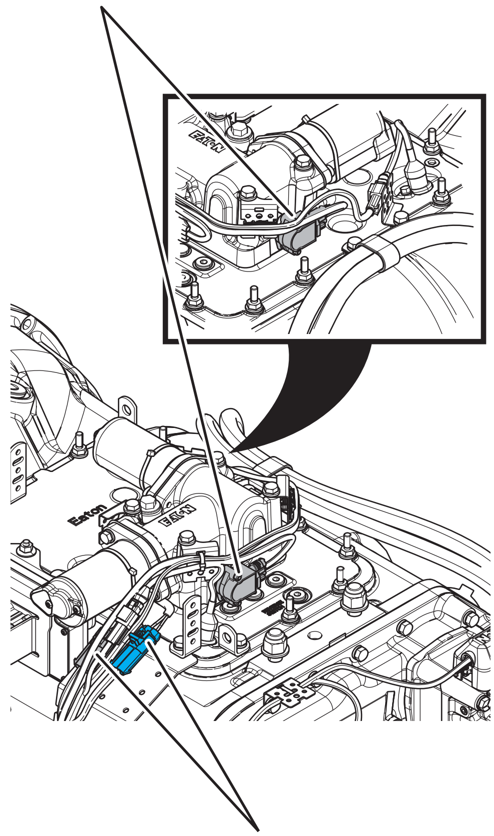
Battery	Voltage Drop	Load Test Status (Pass/Fail)
1		
2		
3		
4		
5		

D **Purpose:** Inspect X-Y Shifter for physical damage.

1. Key off.

Important: 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.

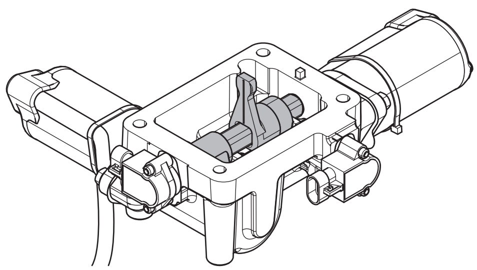


5. Disconnect both 2-Way X-Y Motor Connectors to the Transmission Harness.
6. Inspect connectors for corrosion, loose terminals, bent or spread pin or damage to the connector bodies.
   - If damage to the X-Y Shifter or X-Y Shifter wiring is found, replace X-Y Shifter. Go to **Step V.**
   - If damage to the Transmission Harness is found, replace Transmission Harness. Go to **Step V.**
   - If no damage is found, go to **Step E.**

E

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 coolant contamination.

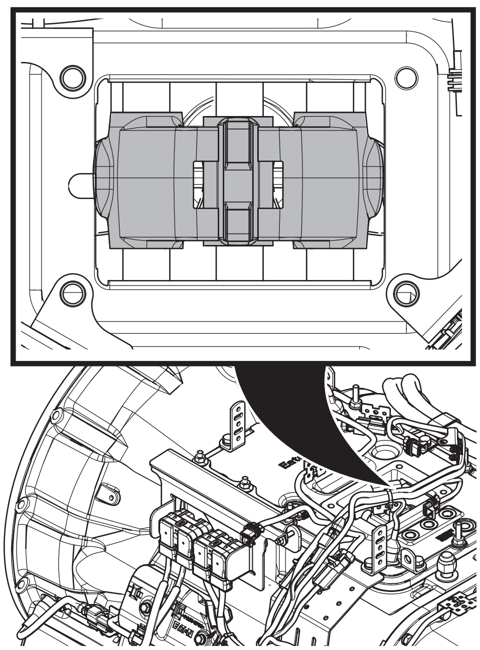
   For the latest Service Bulletin updates, visit Roadranger.com.

   - If coolant contamination is found, repair the vehicle coolant system leak and follow Service Bulletin TMIB0124 for complete repair procedure. X-Y Shifter must be replaced upon completion of service bulletin. Go to **Step V.**
   - If damage to the X-Y Shifter is found, replace X-Y Shifter. Go to **Step V.**
   - If no damage is found, go to **Step F.**

F

Purpose: Inspect condition of Shift Bar Housing.

1. Key off.
2. Inspect condition of the Shift Bar Housing 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 Bar Housing.



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. See the *Shift Interlock Inspection Procedure* on page 552.
   - If damage to the Shift Bar Housing is found, repair Shift Bar Housing. Go to **Step V.**
   - If no damage is found, go to **Step G.**

G

Purpose: Inspect condition of the internal transmission components.

1. Key off.
2. Drain and save the transmission oil. Inspect oil for significant metal fragments.
3. Remove 8-bolt PTO cover.
4. Inspect main case gears for damage or excessive movement.
5. Inspect Shift Yokes and Sliding Clutches for damage or excessive wear.
   - If damage is found or if 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, go to **Step H.**

   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 and contact Eaton at (800) 826-4357.

H

Purpose: Collect Service Activity Report.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed, including X-Y Shifter.
3. Reinstall 8-bolt PTO cover.
4. Refill transmission with lubricant.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve Snapshot and VPA data by creating a *Service Activity Report* within ServiceRanger.
8. Update transmission software to latest available level.

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

9. Retrieve and record the transmission fault codes, and FMIs, and their occurrences and timestamps.
   - If fault codes are present, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If no fault codes are present, replace X-Y Shifter 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 engine off.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt several shifts into various gears.
   - If the transmission finds neutral and shifts through the gears properly, test complete.
   - If the transmission does not find neutral or does not shift through the gears properly, contact Eaton at 800-826-4357 for further diagnostics.

Transmission Not Engaging a Gear From Neutral

Overview

This symptom-driven test is performed if the transmission does not engage a gear from neutral and there are no Active or Inactive fault codes.

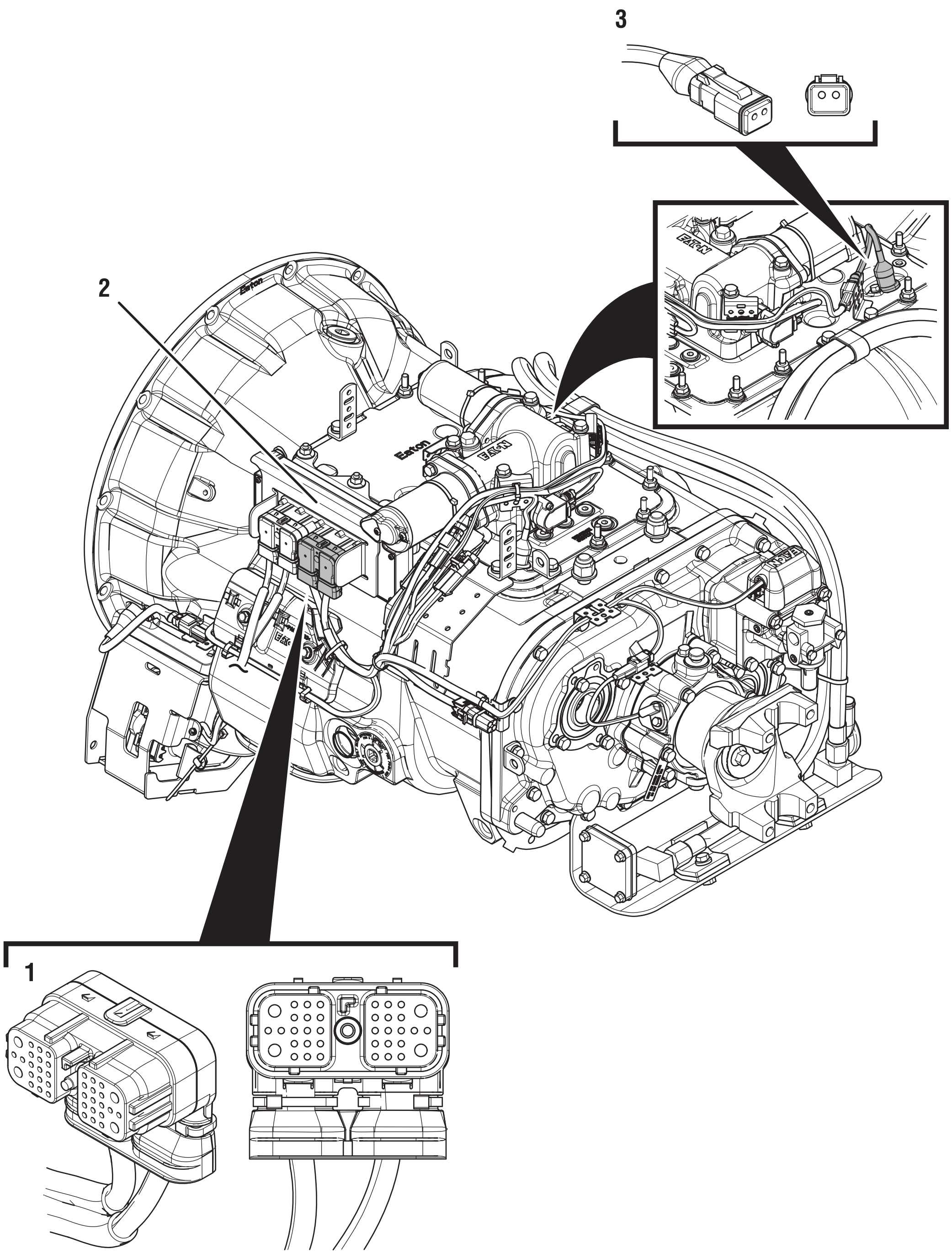
Detection

Transmission not engaging a gear from Neutral.

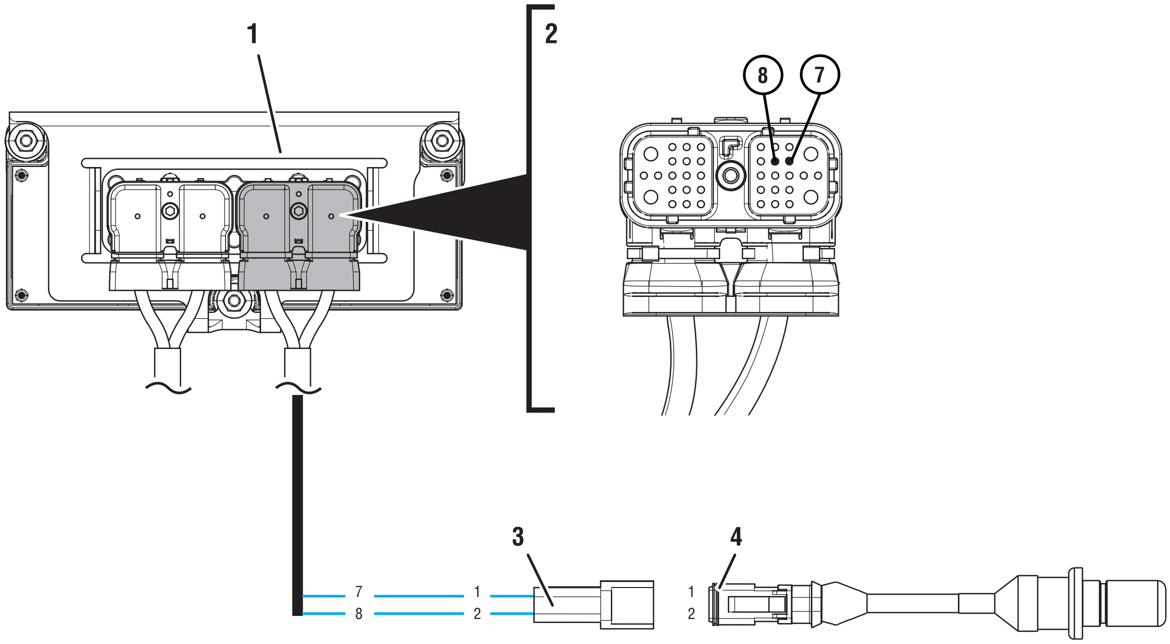
Possible Causes

- Vehicle Power and Ground
  - Poor power or ground supply to TECU
  - Bent, spread, corroded or loose terminals
- OEM Batteries
  - Internal Failure
- Input Shaft Speed Sensor
  - Internal Failure
- Parking Brake Switch
  - Internal Failure
- Clutch
  - Excessive abuse or damage
  - Improper removal or installation
  - Over-adjustment
- Electronic Clutch Actuator (ECA)
  - Internal Failure

Component Identification



1. 38-Way Transmission Harness Connector
2. Transmission Electronic Control Unit (TECU)
3. Input Shaft Speed Sensor



1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. Input Shaft Speed Sensor Connector
4. Input Shaft Speed Sensor

Transmission Not Engaging a Gear From Neutral Test

A

Purpose: *Verify condition of power and ground supply.*

1. Perform the *Electrical Pretest*. Reference the *Electronic Clutch Actuator (ECA) Identification Overview* on page 22. Record the reading(s) from the Load Test in Step C of the Electrical Pretest in the table.
   - If Electrical Pretest fails, repair per *Electrical Pretest* instructions. Retest vehicle operation.
   - If Electrical Pretest passes, go to **Step B.**

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

B

Purpose: *Test transmission gear engagement from Neutral.*

1. Set parking brake and chock wheels.
2. Key on with engine running.
3. Verify shift device is in Neutral (N) position.
4. Verify Gear Display indicates Neutral (N).
5. Depress and hold service brake. Use the shift device to select Drive (D).
6. Monitor gear engagement and Gear Display reading.
   - If transmission goes into gear and the vehicle moves, go to **Step C.**
   - If transmission does not go into gear, go to **Step D.**

C ***Purpose:*** *Test vehicle operation.*

1. Drive vehicle and attempt to duplicate the previous complaint.
2. Return the transmission to Neutral and engage a gear from Neutral several times during the test drive.
   - If a fault code sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If no fault codes set Active, but the complaint can be duplicated, take note of the Gear Display reading, go to **Step D.**
   - If no fault codes set Active and the complaint cannot be duplicated, test complete. If the complaint persists, contact Eaton at (800) 826-4357 for further diagnostics.

D

Purpose: *Observe gear display when the transmission does not engage a gear.*

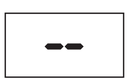
1. Observe gear display when the transmission does not engage a gear from Neutral.

- If gear display shows a solid "N", go to **Step E.**

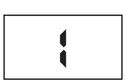
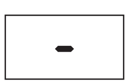
- If gear display shows an "F", check for fault codes using ServiceRanger and troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

- If gear display is blank, troubleshoot per the *Power-Up Sequence Test*. Reference the *Electronic Clutch Actuator (ECA) Identification Overview* on page 22.

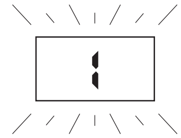
- If gear display shows a "- -" (double dash) or "* *" (double star), troubleshoot per the *Power-Up Sequence Test*. Reference the *Electronic Clutch Actuator (ECA) Identification Overview* on page 22.



- If gear display shows a solid number or "-" (single dash), troubleshoot per the *Main Case Control Test* on page 525.

- If gear display shows a blinking number, go to **Step N.**



E

Purpose: *Verify the required conditions to put the transmission in gear are met.*

1. The transmission requires the following conditions to be met in order to engage a gear from Neutral:

a. The vehicle must be stopped, or must be moving at speeds lower than 2 miles per hour.

b. The throttle must not be depressed.

c. The brake pedal must be depressed before selecting a gear.

2. Verify that these operator influenced conditions are being met and attempt to engage a gear from Neutral.

- If transmission engages a gear, go to **Step C.**
- If transmission still does not engage a gear, go to **Step F.**

F

Purpose: *Observe the brake switch status when placing the transmission into drive.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. In ServiceRanger, go to Data Monitor.
4. Select the “Engine and Brake” default parameter file.
5. Monitor Parameter 597 “Brake Switch”.
6. Depress Service Brake and verify that Brake Switch status changes to “Depressed”.
7. Release Service Brake and verify that Brake Switch status changes to “Released”.

   Note: ServiceRanger covers Brake Switch status input from several possible sources. If the vehicle uses a Brake Switch source other than those programmed in ServiceRanger, the use of an OEM diagnostic tool may be required to see Brake Switch status.

   - If parameter matches Service Brake position, go to **Step G.**
   - If parameter does not match Service Brake position, repair Brake Switch input to the Transmission Electronic Control Unit (TECU) per OEM guidelines. Go to **Step V.**

G

Purpose: *Monitor Input Shaft Speed in ServiceRanger.*

1. In ServiceRanger “Data Monitor,” clear selected parameters.
2. Select the “J1939 Transmission Speeds” default parameter file.
3. Monitor Parameter 161 “Input Shaft Speed”.
4. Start engine and monitor “Input Shaft Speed” with engine idling.
5. Record Input Shaft Speed reading in table.

   Important: Do not depress the service brake when recording Input Shaft reading.

6. Compare reading(s) in table.
   - If readings are out of range, go to **Step H.**
   - If readings are in range, no problem identified, test complete. If the complaint persists, contact Eaton at (800) 826-4357 for further diagnostics.

Sensor	Range	Reading
Input Shaft Speed	Within 25 RPM of Engine Idle Speed	

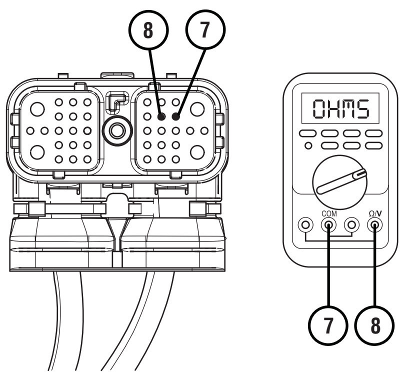
H

Purpose: *Verify the continuity of Input Shaft Speed Sensor circuit.*

1. Key off.

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

2. Disconnect 38-Way Transmission Harness Connector from the TECU.
3. Verify no issues with 38-Way connector body for damage and bent, spread, corroded or loose terminals.
4. Measure resistance between 38-Way Transmission Harness Pin 7 and Pin 8. Record reading(s) in table.



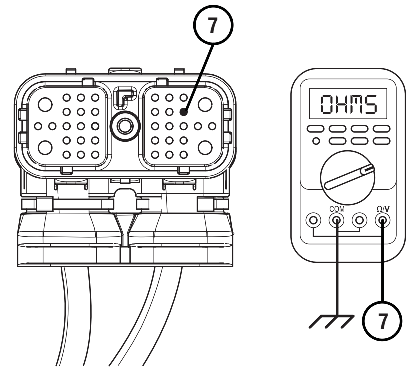
5. Compare reading(s) in table.
   - If readings are in range, go to **Step I.**
   - If readings are out of range, go to **Step M.**

Pins	Range	Reading
7 to 8	2.0k–4.5k ohms	

I

Purpose: *Verify Input Shaft Speed Sensor circuit is not shorted to ground.*

1. Measure resistance between 38-Way Transmission Pin 7 and ground. Record reading(s) in table.



2. Compare reading(s) in table.
   - If readings are in range, go to **Step J.**
   - If readings are out of range, go to **Step L.**

Pins	Range	Reading
7 to Ground	Open Circuit (OL)	

J ***Purpose:*** *Remove and inspect Input Shaft Speed Sensor.*

1. Disconnect the 2-Way Transmission Harness Connector from the Input Shaft Speed Sensor.
2. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals.
3. Remove the Input Shaft Speed Sensor from the transmission.
4. Check the sensor body for any cracks or visual damage.
   - If damage is found, replace the Input Shaft Speed Sensor. Inspect the transmission for any internal damage and repair if required. Go to **Step V.**
   - If no damage is found, go to **Step K.**

K ***Purpose:*** *Inspect condition of internal transmission components.*

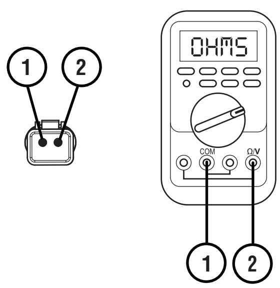
1. Key off.
2. Drain and save the transmission oil. Inspect oil for significant metal fragments.
3. Remove 8-bolt PTO cover.
4. Inspect main case gears for damage or excessive movement.
5. Inspect Shift Yokes and Sliding Clutches for damage or excessive wear.
   - If damage is found, repair or replace transmission as necessary. Go to **Step V.**
   - If no damage is present and Input Shaft Speed Sensor is secure and properly seated, replace Transmission Harness and Input Shaft Speed Sensor. Go to **Step V.**

   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 and contact Eaton at (800) 826-4357.

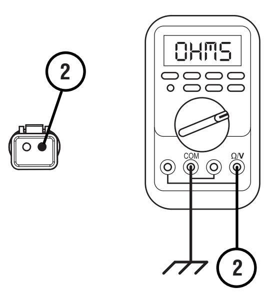
L

Purpose: *Measure the Input Shaft Speed Sensor resistance for a short to ground at the Input Shaft Speed Sensor.*

1. Key off.
2. Disconnect the 2-Way Input Shaft Speed Sensor Harness Connector.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Check the sensor body for any cracks or visual damage.
5. Measure resistance between 2-Way Input Shaft Speed Sensor Connector Pin 2 and Pin 1. Record reading(s) in table.



6. Measure resistance between 2-Way Input Shaft Speed Sensor Connector Pin 2 and ground. Record reading(s) in table.

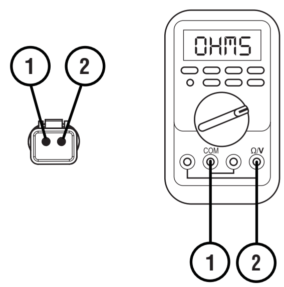


7. Compare reading(s) in table.
   - If readings are out of range, replace Input Shaft Speed Sensor. Inspect the transmission for any internal damage and repair if required. Go to **Step V.**
   - If readings are in range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
2 to 1	2.0k–4.5k ohms	
2 to Ground	Open Circuit (OL)	

M ***Purpose:*** *Measure the Input Shaft Speed Sensor resistance at the Input Shaft Speed Sensor.*

1. Key off.
2. Disconnect the 2-Way Input Shaft Speed Sensor Harness Connector.
3. Inspect 2-Way Connector body for damage and bent, spread, corroded or loose terminals.
4. Check the sensor body for any cracks or visual damage.
5. Measure resistance between 2-Way Input Shaft Speed Sensor Connector Pin 2 and Pin 1. Record reading(s) in table.



6. Compare reading(s) in table.
    - If readings are out of range, replace Input Shaft Speed Sensor. Inspect the transmission for any internal damage and repair if required. Go to **Step V.**
    - If readings are in range, replace Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
2 to 1	2.0k–4.5k ohms	

N ***Purpose:*** *Verify Input Shaft Speed slows during gear engagement.*

1. In ServiceRanger go to "Data Monitor," and clear selected parameters.
2. Select the "J1939 Transmission Speeds" default parameter file.
3. Monitor Parameter 161 "Input Shaft Speed".
4. Start engine and monitor "Input Shaft Speed" with engine idling.
5. Depress and hold the service brake.
6. Place the Driver Interface Device in Drive (D).
7. Measure Input Shaft Speed while attempting to put the transmission into Drive. Record Reading(s) in table.
8. Compare reading(s) in table.
   - If readings are in range, troubleshoot per *Main Case Control Test* on page 525.
   - If readings are out of range, go to **Step O.**

Sensor	Range	Reading(s)
Input Shaft Speed (while engaging a gear)	Less than 150 RPM	

O ***Purpose:*** *Perform LCIB Deceleration Test in ServiceRanger.*

1. Key on with engine running.
2. Set parking brake and chock wheels.
3. Connect ServiceRanger.
4. In ServiceRanger, go to "Service Routines".
5. Run "Low Capacity Inertia Brake Test".
   - If test passes, go to **Step P.**
   - If test fails, replace LCIB. Go to **Step V.**

P *Purpose: Inspect physical condition of LCIB and ECA Clutch.*

1. Key off.
2. Remove single retaining bolt securing Clutch Housing cover.
3. Through the Clutch Housing cover opening, inspect LCIB for grease contamination or blue heat discoloration.
4. Inspect inside Clutch Housing for signs of LCIB friction material or other signs of LCIB failure.
5. Inspect clutch for any sign of a failure including excessive clutch dust, broken springs, corrosion, or any condition that may contribute to the driver's complaint.

   Note: Reference *Heavy-Duty Clutch Service Manual* (CLSM0200) for full LCIB and Clutch inspection procedures.

   - If signs of a Clutch failure are found, replace ECA Clutch and LCIB. Go to **Step V.**
   - If signs of an LCIB failure are found, replace LCIB. Go to **Step V.**
   - If no issues are found, use ServiceRanger to collect the Snapshot and VPA files and contact Eaton at (800) 826-4357 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 engine 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 a fault code sets Active during the test drive, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If no fault codes set Active and the vehicle complaint is duplicated, contact Eaton at (800) 826-4357 for further diagnostics.

Transmission Shift Complaint

Overview

This symptom-driven test is performed if a shift complaint exists and there are no Active or Inactive fault codes.

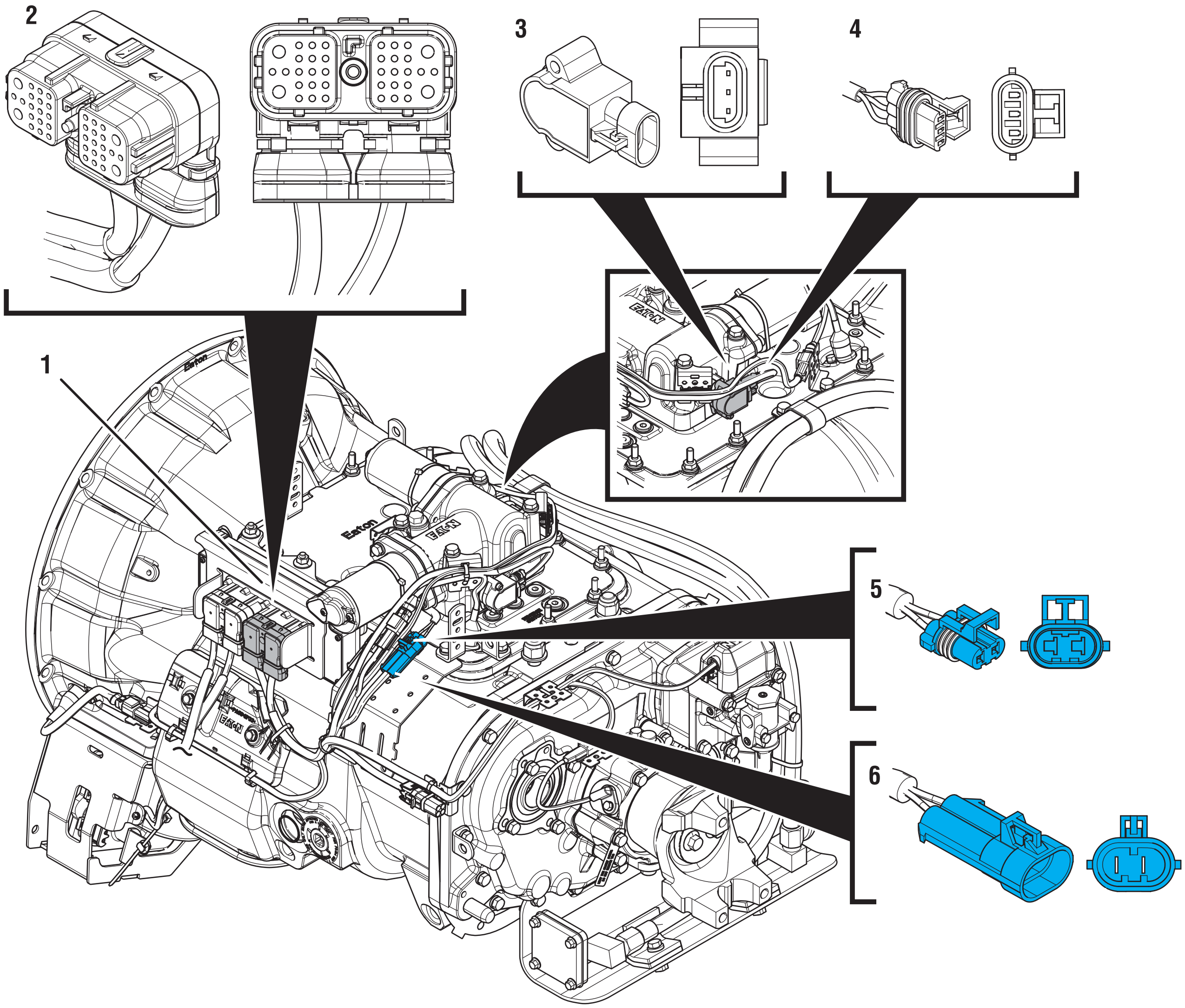
Detection

- Transmission may not be able to complete a shift.
- Transmission may exhibit slow or harsh shifting.

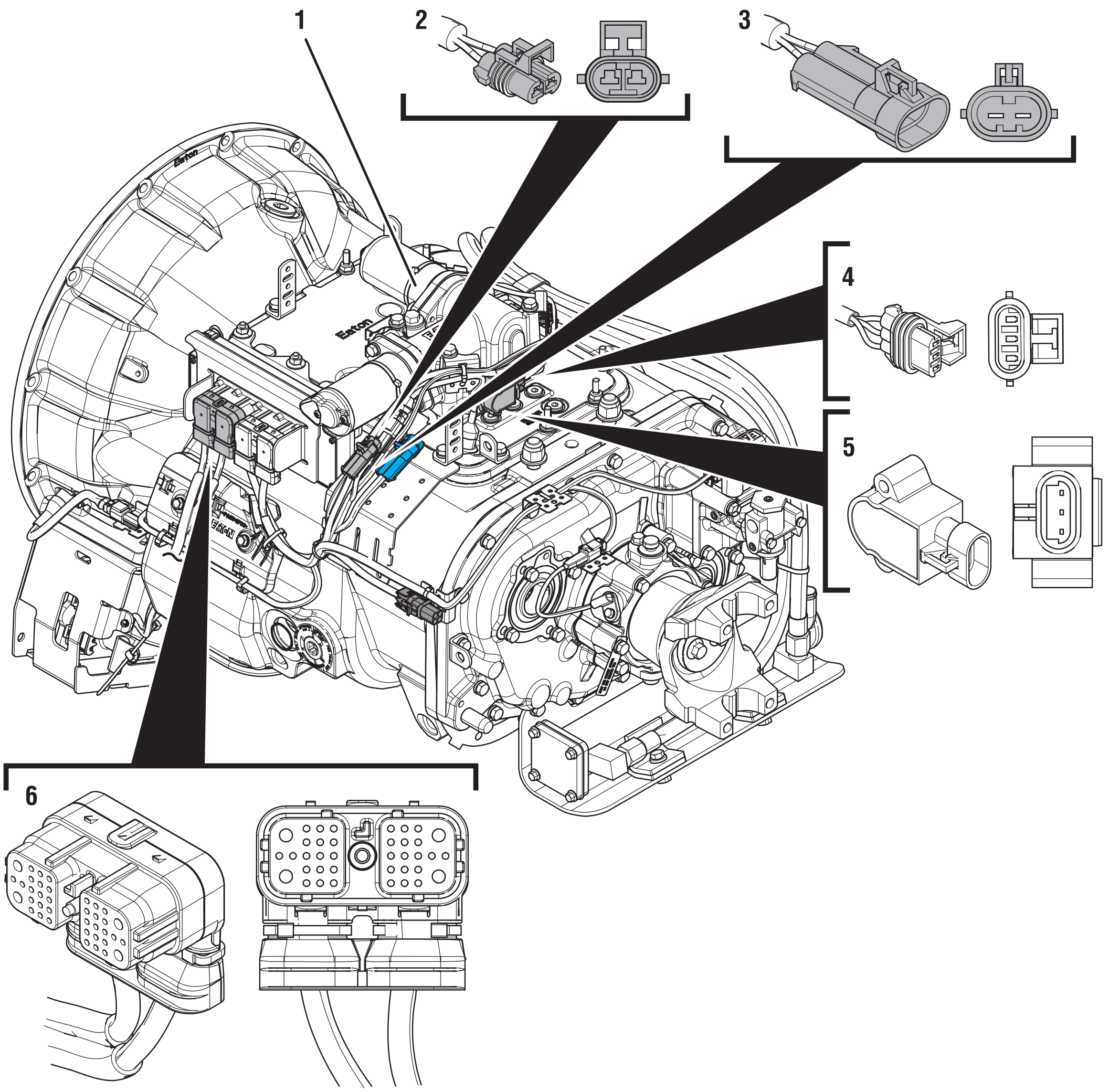
Possible Causes

- Low Capacity Inertia Brake (LCIB)
  - Internal Failure
- Input Shaft Speed Sensor
  - Internal Failure
- Transmission Electronic Control Unit (TECU)
  - Internal Failure
- Transmission Harness
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Vehicle Air System
  - Low vehicle air pressure
  - Contamination in air supply
  - Air leaks
  - Filter-Regulator Failure
- Range Solenoid Valve
  - Mechanical Failure
- Splitter Solenoid Valve
  - Mechanical Failure
- Mechanical Transmission
  - Failed Auxiliary Transmission components
  - Tone Wheel damage
  - Range Synchronizer Failure
  - Range Cylinder, Piston or Yoke wear or damage
  - Range Cover Gasket Failure
  - Splitter Cylinder, Piston or Yoke wear or damage
  - Splitter Cover Gasket Failure

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

Transmission Shift Complaint Test

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Retrieve Snapshot and VPA data by creating a *Service Activity Report* within ServiceRanger.
4. Update transmission software to latest available level.

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

5. Retrieve transmission and vehicle fault codes and FMIs, and their occurrences and timestamps.
   - If any Engine, ABS or other Vehicle ECU fault codes are set, troubleshoot per OEM requirements.
   - If any transmission fault codes set Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If no fault codes set Active, go to **Step B.**

B ***Purpose:*** *Verify condition of power and ground supply.*

1. Perform the *Electrical Pretest*. Reference the *Electronic Clutch Actuator (ECA) Identification Overview* on page 22. Record the reading(s) from the Load Test in Step C of the Electrical Pretest in the table.
   - If *Electrical Pretest* passes, go to **Step C.**
   - If *Electrical Pretest* fails, repair per *Electrical Pretest* instructions. Retest vehicle operation.

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

C ***Purpose:*** *Document the vehicle symptoms by filling out the Driver Questionnaire.*

1. Document the vehicle shift complaint by completing the *Driver Questionnaire* on page 9.
   - Go to **Step D.**

D

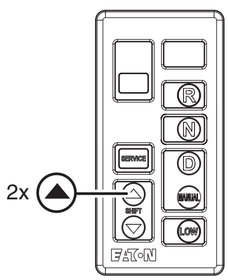
Purpose: *Operate vehicle and attempt to recreate vehicle symptom.*

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

Important: 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, while driving capture a driver triggered snapshot of the event by placing the transmission shift device into Low (L) mode, and quickly pressing the upshift button twice.

Important: Capturing the driver triggered snapshot is time sensitive; for the best results, perform this sequence immediately after the symptoms occur.



3. The transmission will set a tone and the letters “ST” will appear in the gear display if the Snapshot is captured.

Note: A driver triggered snapshot will capture data that cannot otherwise be captured. This data can be reviewed with Eaton technical support.

- Go to **Step E.**

E

Purpose: *Collect a new Service Activity Report.*

1. Key off and allow the transmission to perform a complete power down.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Retrieve Snapshot and VPA data by creating a Service Activity Report and select “Send to Eaton”.
5. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
   - If any fault codes set Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If no fault codes set Active, contact Eaton at (800) 826-4357 for review.

Shift Interlock Inspection

Overview

This procedure is used to properly inspect and test the interlock mechanism of the Heavy-Duty Eaton automated transmissions.

The interlock is a mechanism built into the Shift Bar Housing that physically prevents the transmission from engaging two gears at once.

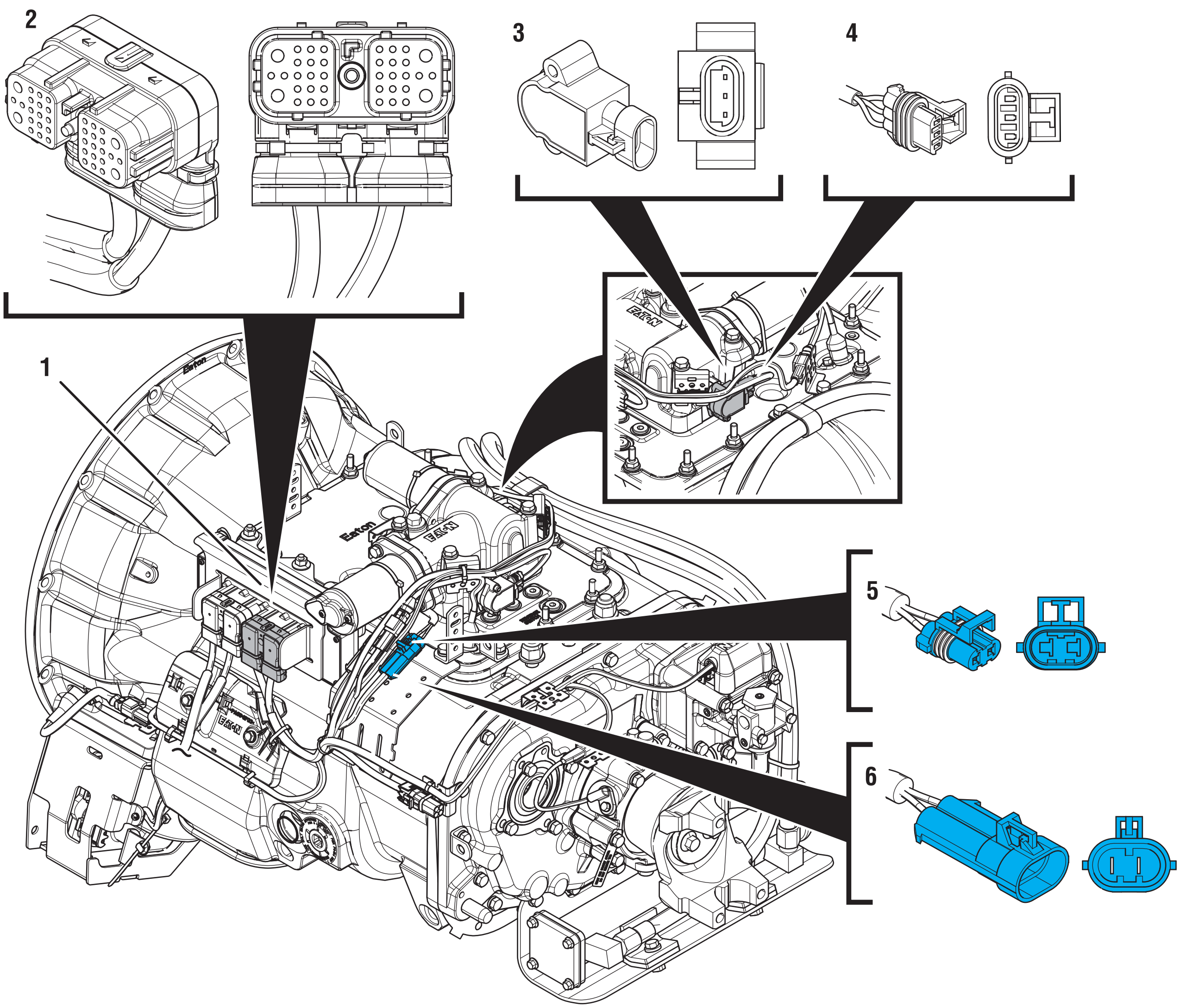
Detection

- Transmission not able to engage a gear.
- Transmission has difficulty shifting from one gear to another.
- Mechanical transmission damage occurs.

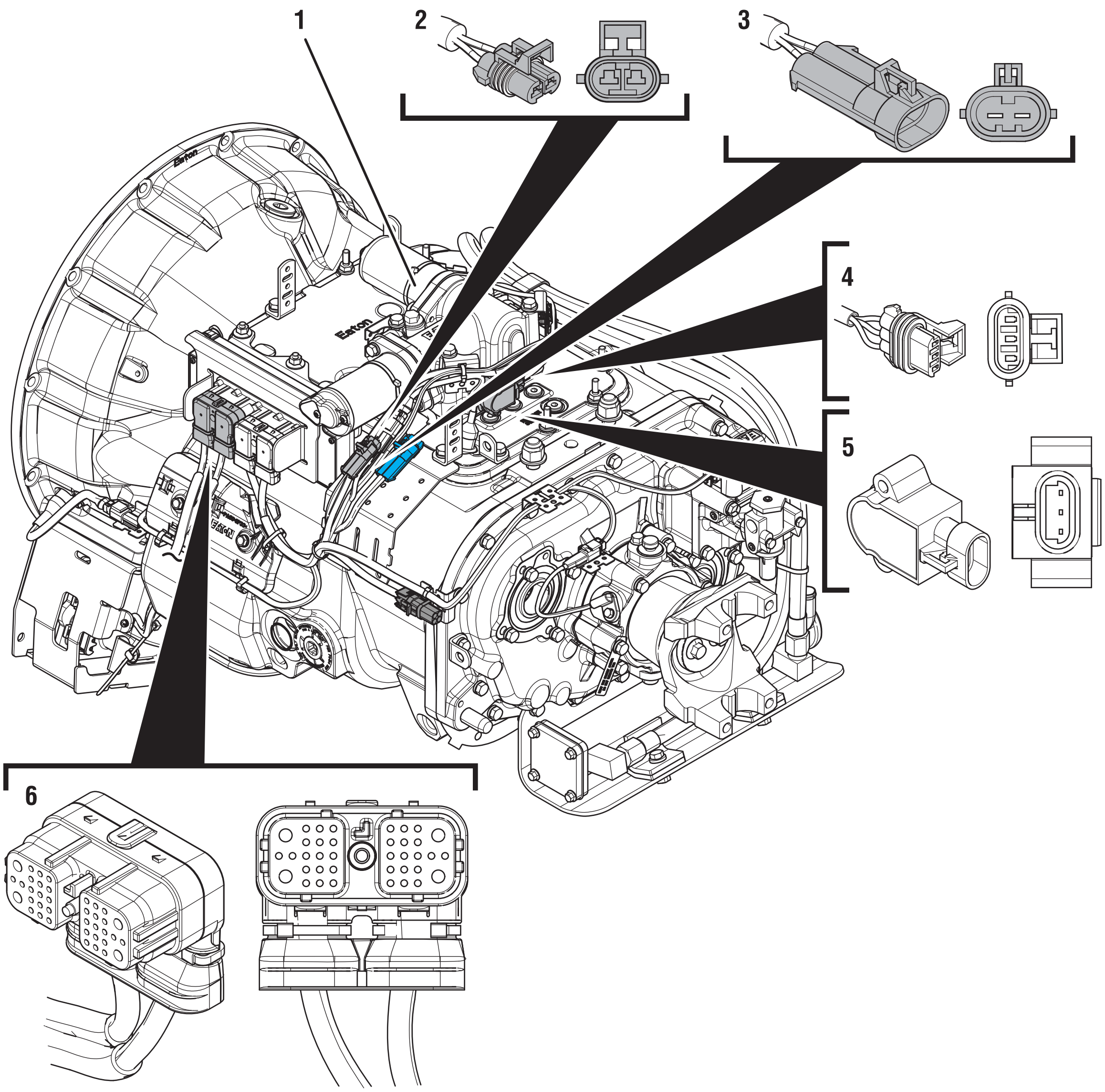
Possible Causes

- Shift Bar Housing
  - Wear or damage to Shift Bar Housing
  - Wear or damage to Shift Yokes
- Mechanical Transmission
  - Wear or damage to sliding clutch slot width
  - Wear or damage to 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

Shift Interlock Inspection Procedure

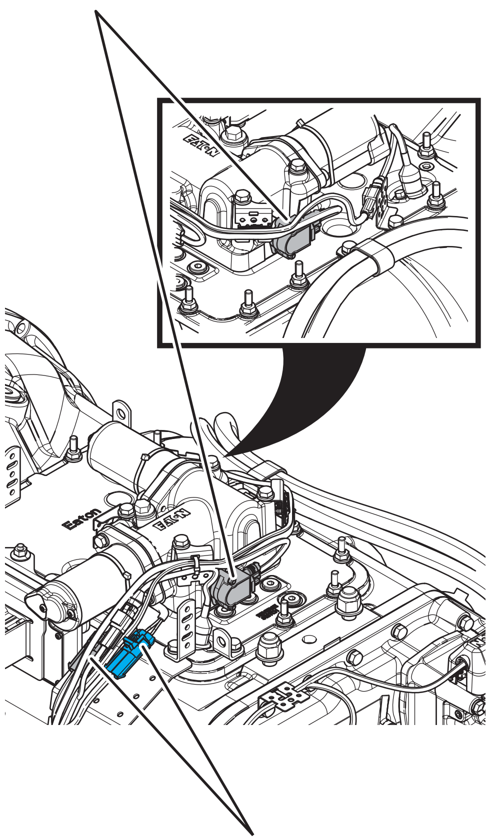
A

Purpose: *Remove the X-Y Shifter from the Shift Bar Housing.*

1. Key off.

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

2. Disconnect both 2-Way X-Y Gear and Rail Position Sensor Connectors.

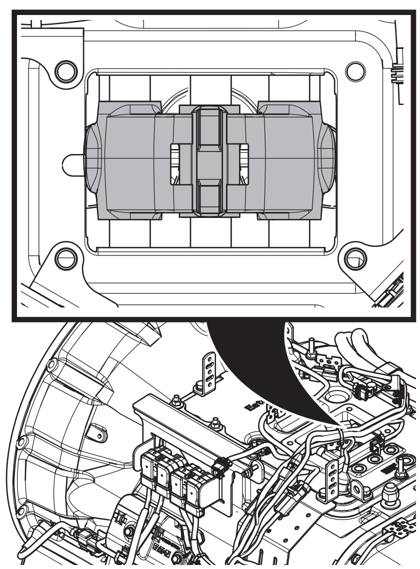


3. Disconnect both 2-Way X-Y Motor Connectors to the Transmission Harness.
4. Remove the X-Y Shifter.
   - Go to **Step B.**

B

Purpose: Inspect condition of Shift Bar Housing.

1. Key off.
2. Inspect condition of the Shift Bar Housing 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 Bar Housing.



4. Verify transmission shifts fully in to 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.

5. Return the transmission to neutral position when complete.
   - If transmission engages a gear, go to **Step D.**
   - If transmission will not engage a gear, go to **Step C.**

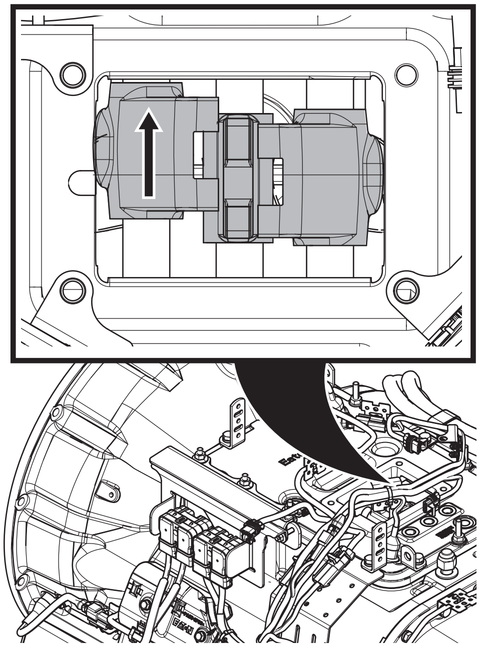
C ***Purpose:*** *Inspect the mechanical transmission components.*

1. Key off.
2. Drain and save the transmission oil. Inspect oil for significant metal fragments.
3. Remove 8-bolt PTO cover.
4. Inspect main case gears for damage or excessive movement.
5. 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. Retest operation, go to **Step A.**
   - 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 and contact Eaton at (800) 826-4357.

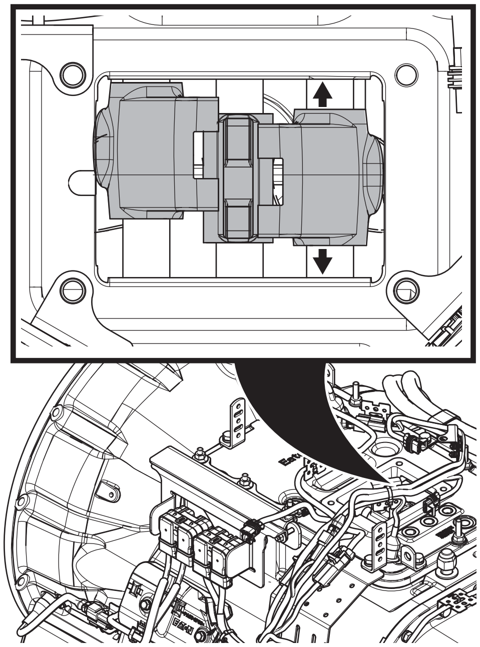
D ***Purpose:*** *Test the shift bar housing interlock by attempting to engage two gears at the same time.*

1. Use a small pry-bar to engage the left-hand shift rail forward until fully engaged into the drive 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.

2. With the left-hand shift rail still engaged in a gear, use a small pry-bar and attempt to engage the right-hand shift rail into a gear. You can attempt to move the right-hand rail forward or backward, whichever is easiest.



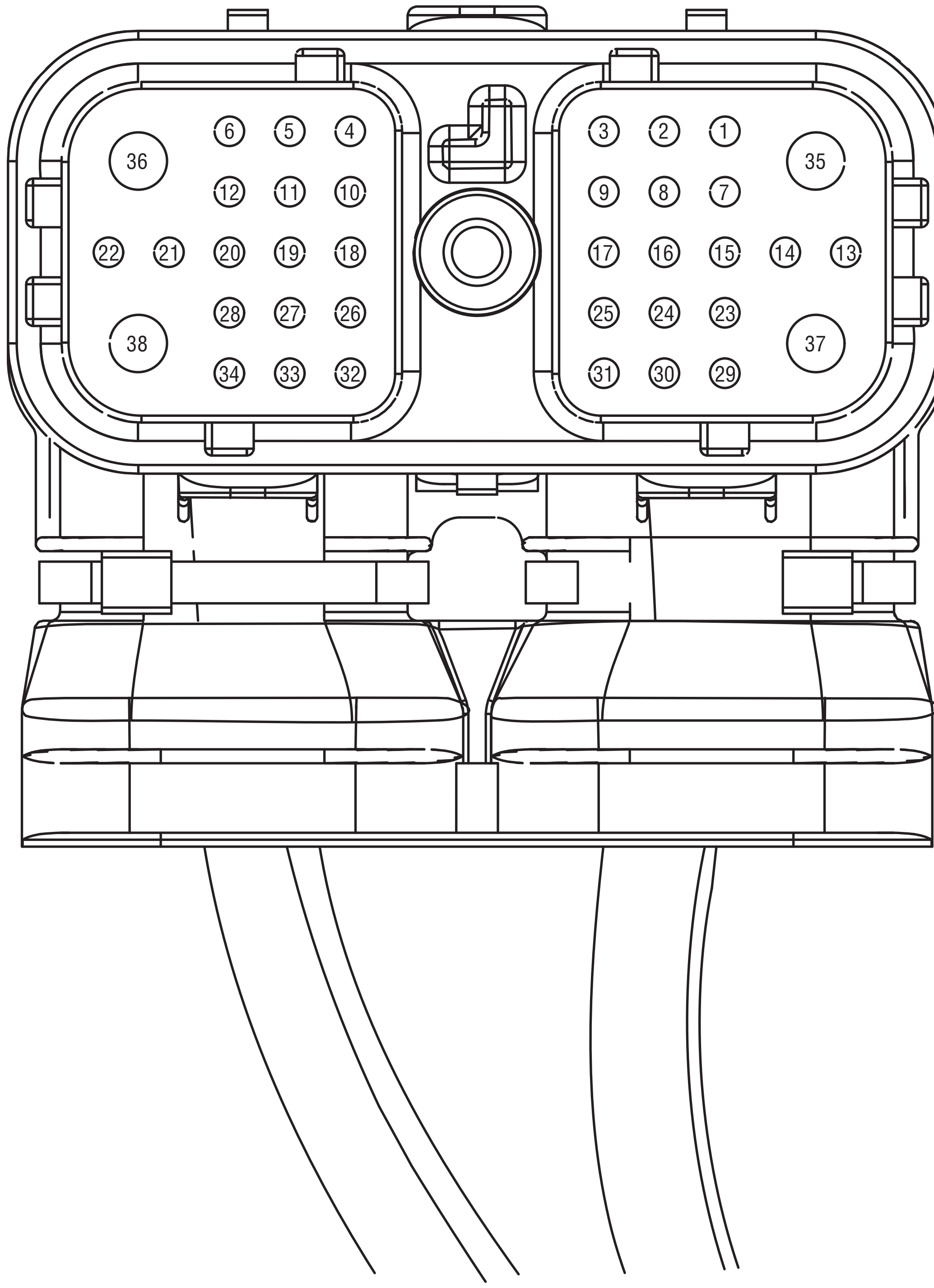
Note: You should expect to see a maximum of 1/8" to 1/4" movement on this rail.

3. Return the transmission to neutral position.
   - If the transmission did not engage two gear positions at once, the Shift Bar Housing is working as designed, test complete.
   - If the transmission engaged two gears at once, repair the Shift Bar Housing. Retest operation, go to **Step A.**

Connector Pin Descriptions

Note: This section is intended as a quick reference. For specific instructions, see the UltraShift *PLUS* Installation Guide TRIG1110.

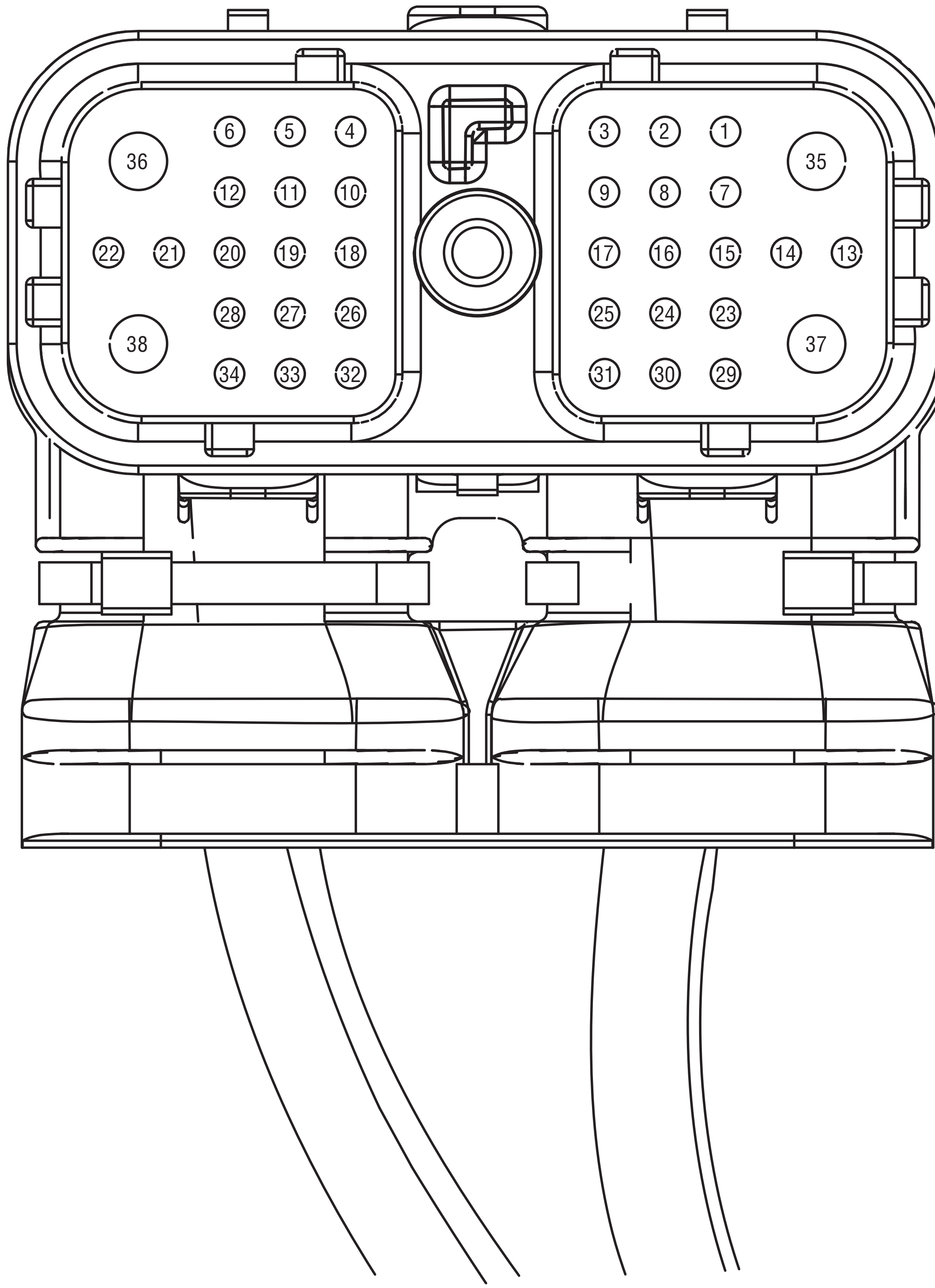
38-Way Vehicle Harness Connector



38-Way Pin	Description	Wire
1	J1939 Shield	18 TXL
2	J1939 Low (-)	18 TXL
3	J1939 High (+)	18 TXL
4	Start Enable Relay Driver Common	18 TXL
5	Not Used	Plug
6	Not Used	Plug
7	Not Used	Plug
8	Not Used	Plug
9	Not Used	Plug
10	J1587 High (+)	18 TXL
11	J1587 Low (-)	18 TXL
12	ISO9141 K Line	18 TXL
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	PTO Switch Input	18 TXL
19	Auto Neutral Switch Input	18 TXL

38-Way	Description	Wire
20	Not Used	Plug
21	Not Used	Plug
22	Not Used	Plug
23	Service Light Supply	18 TXL
24	Remote Throttle Switch Input	18 TXL
25	Shift Control Protected Battery Negative (-)	18 TXL
26	Start Enable Latch Return Signal	18 TXL
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	Start Enable Relay Driver High	18 TXL
33	Auto Neutral Signal Common	18 TXL
34	PTO Switch Input Common	18 TXL
35	Ignition	12 GXL or 14SXL
36	Battery Negative (-)	12 GXL
37	Not Used	Plug
38	Battery Positive (+)	12 GXL

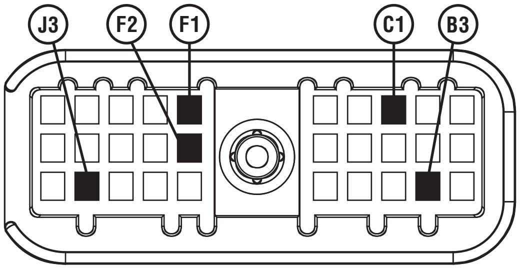
38-Way Heavy-Duty Transmission Harness Connector



38-Way Pin	Description	Wire
1	Not Used	Plug
2	Not Used	Plug
3	Not Used	Plug
4	Splitter Solenoid Valve Driver Common *	18 GXL
5	Not Used	Plug
6	Range Solenoid Valve Driver Common	18 GXL
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	Ignition Supply to ECA	18 GXL
14	Not Used	Plug
15	Main Shaft Speed Signal High (+)	18 GXL
16	Main Shaft Speed Signal Low (-)	18 GXL
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

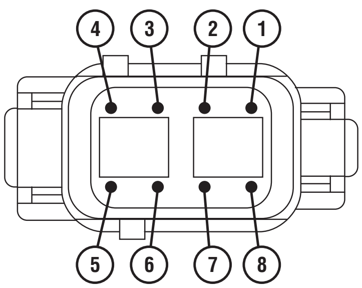
38-Way	Description	Wire
20	X-Y Rail Position Sensor Ground	18 GXL
21	Output Shaft Speed Sensor (Hall Effect) Signal Low (-)	18 GXL
22	Output Shaft Speed Sensor (Hall Effect) Signal High (+)	18 GXL
23	Not Used	Plug
24	Not Used	Plug
25	Service Ignition	18 GXL
26	Splitter Solenoid Valve Driver Indirect *	18 GXL
27	Not Used	Plug
28	Range Solenoid Valve Driver High	18 GXL
29	HIL Low (-)	18 GXL
30	HIL High (+)	18 GXL
31	Service Battery Negative (-)	18 GXL
32	Splitter Solenoid Valve Driver Direct *	18 GXL
33	Not Used	Plug
34	Range Solenoid Valve Driver Low	18 GXL
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

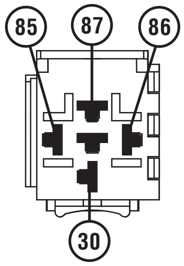
3-Way Pin	Description	Wire	38-Way Vehicle Harness Connector Pin
A	Shift Control Manual Mode Signal (+)	16 TXL	16
B	Auto Mode Signal (+)	16 TXL	15
C	Shift Control Common 1 (-)	16 TXL	17
	Service Lamp	16 TXL	23

2-Way Power Take Off (PTO) Switch

Description	Wire	38-Way Vehicle Harness Connector Pin
PTO Switch Input	16 TXL	18
PTO Switch Input Common	16 TXL	34

2-Way Auto Neutral Park Brake Pressure Switch

Description	Wire	38-Way Vehicle Harness Connector Pin
Auto Neutral Signal	16 TXL	19
Auto Neutral Return	16 TXL	33



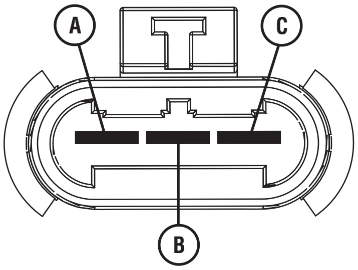
5-Way OEM Start Enable Relay Connector

5-Way Pin	Description	Wire	38-Way Vehicle Harness Connector Pin
30	Ignition	16 TXL	N/A
85	Start Enable Relay Driver Common	16 TXL	4
86	Start Enable Relay Driver High	16 TXL	32
87	Start Enable Latch Return Signal	16 TXL	26 (and Vehicle Starter)
87A	Not Used		N/A

5-Way OEM Remote Throttle Enable Relay Connector

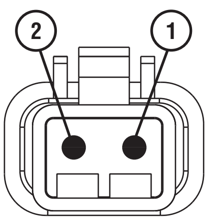
5-Way Pin	Description	Wire	38-Way Vehicle Harness Connector Pin
30	Set/Resume Switch	16 TXL	N/A
85	Chassis Ground	16 TXL	N/A
86	Remote Throttle Switch Input	16 TXL	24
87	Cruise Control Switch	16 TXL	N/A
87A	Not Used		N/A

3-Way Electronic Clutch Actuator (ECA) Power Connector Gen1 ECA



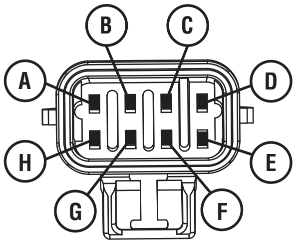
3-Way Pin	Description	Wire
A	Not Used	Plug
B	Battery Negative (-)	10 SXL
C	Battery Positive (+)	10 SXL

2-Way Electronic Clutch Actuator (ECA) Power Connector Gen2 ECA



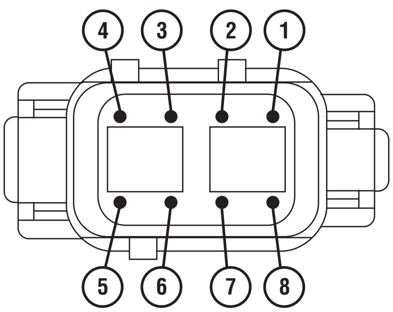
2-Way Pin	Description
1	Battery Negative (-)
2	Battery Positive (+)

8-Way Electronic Clutch Actuator (ECA) Connector Gen1 ECA



8-Way Pin	Description	Wire	38-Way Vehicle Harness Connector Pin
A	HIL High (+)	18 GXL	30
B	HIL Low (-)	18 GXL	29
C	HIL Low (-) Resistor Pigtail	18 GXL	N/A
D	Not Used	Plug	N/A
E	HIL High (+) Resistor Pigtail	18 GXL	N/A
F	ECA Speed Sensor (+)	18 GXL	N/A
G	ECA Speed Sensor (-)	18 GXL	N/A
H	Ignition Supply to ECA	18 GXL	13

8-Way Electronic Clutch Actuator (ECA) Connector Gen2 ECA



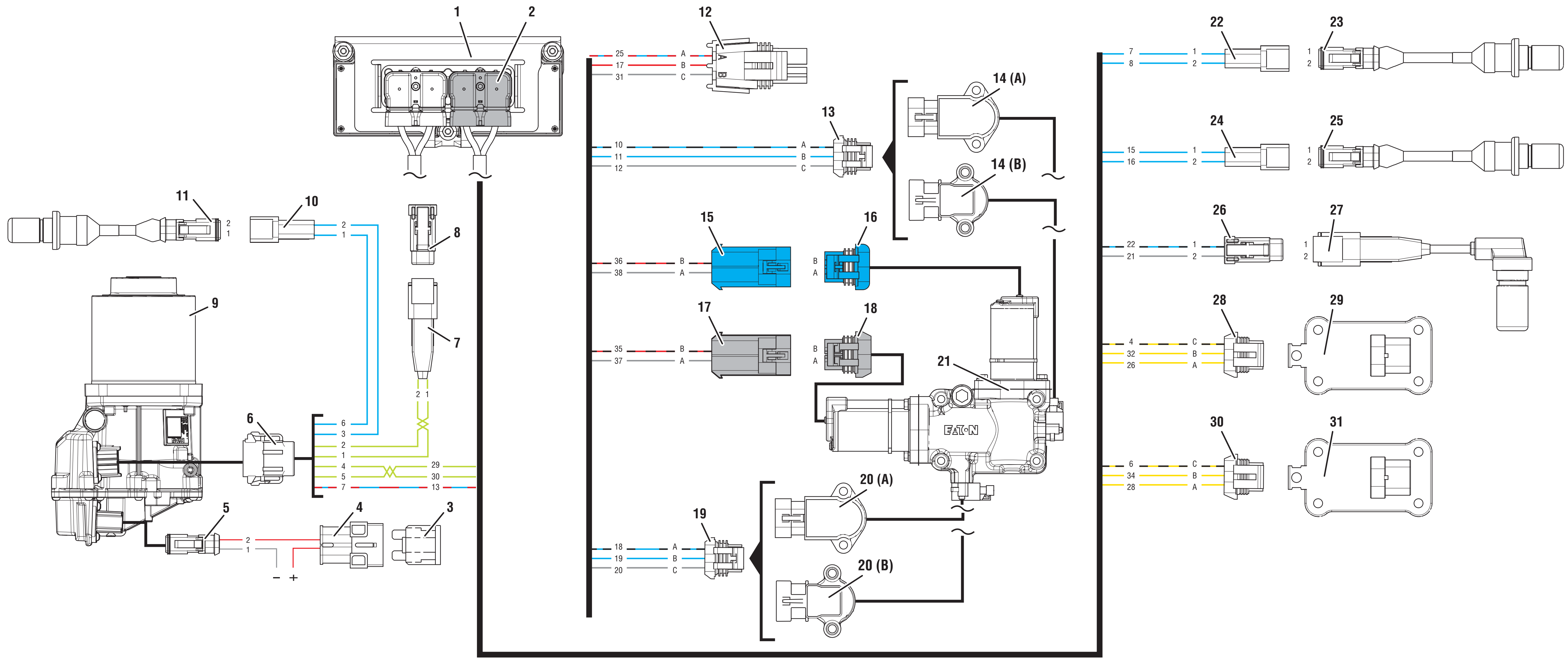
8-Way Pin	Description
1	HIL Low (-) Resistor Pigtail
2	HIL High (+) Resistor Pigtail
3	ECA Speed Sensor (-)
4	HIL Low (-)

8-Way Pin	Description
5	HIL High (+)
6	ECA Speed Sensor (+)
7	Ignition Supply (+) to ECA
8	Not Used

Notes

Wiring Diagrams

Transmission Harness Connections

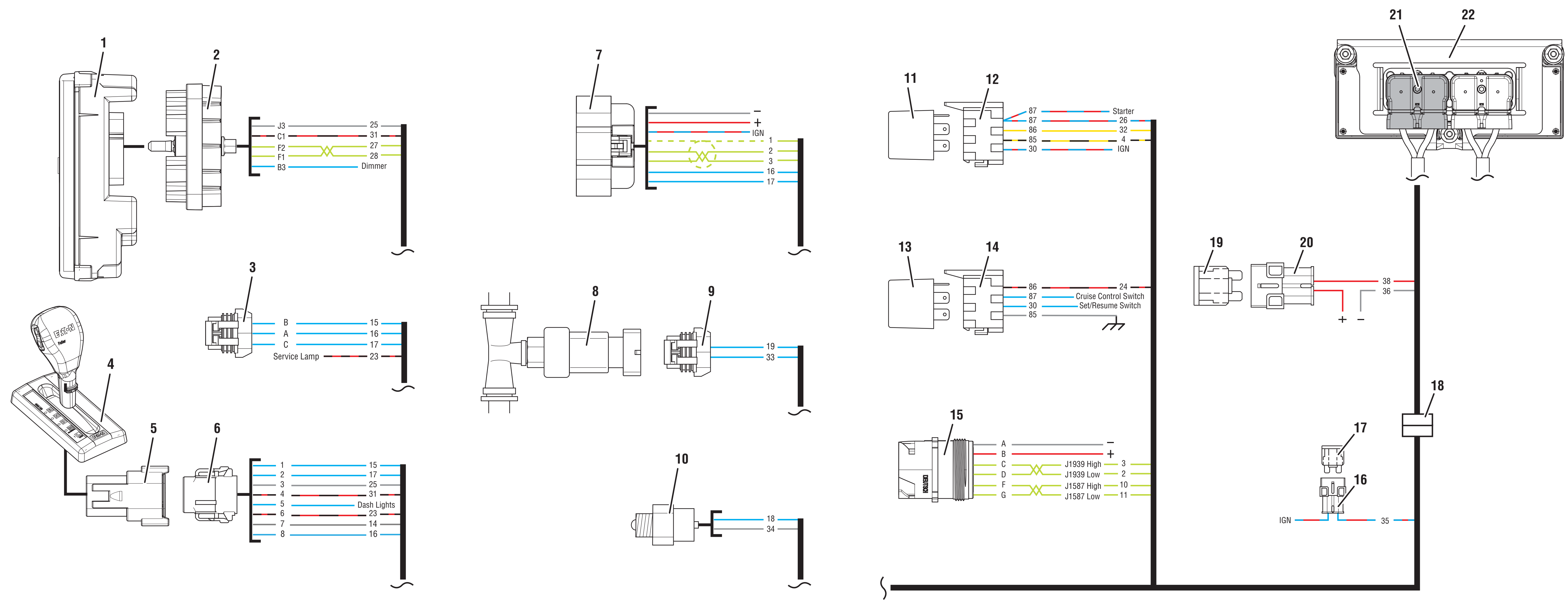


1. Transmission Electronic Control Unit (TECU)
2. 38-Way Transmission Harness Connector
3. 40-amp Fuse
4. In-line Fuse Holder
5. 2-Way ECA Connector
6. 8-Way ECA Connector
7. 2-Way Terminating Resistor Connector Body
8. 2-Way High Integrity Link (HIL) Terminating Resistor
9. Electronic Clutch Actuator (ECA)
10. 2-Way ECA Speed Sensor Connector Body
11. 2-Way ECA Speed Sensor
12. 4-Way Diagnostic Connector
13. 3-Way Gear Position Sensor Connector
14. 3-Way Gear Position Sensor
15. 2-Way Gear Motor Connector Body (blue)
16. 2-Way Gear Motor Connector (blue)
17. 2-Way Rail Motor Connector Body (black)
18. 2-Way Rail Motor Connector (black)
19. 3-Way Rail Position Sensor Connector
20. 3-Way Rail Position Sensor
21. X-Y Shifter
22. 2-Way Input Shaft Speed Sensor Connector Body
23. 2-Way Input Shaft Speed Sensor
24. 2-Way Main Shaft Speed Sensor Connector Body
25. 2-Way Main Shaft Speed Sensor
26. 2-Way Output Shaft Speed Sensor Connector
27. 2-Way Output Shaft Speed Sensor
28. 3-Way Splitter Solenoid Valve Connector
29. 3-Way Splitter Solenoid Valve
30. 3-Way Range Solenoid Valve Connector
31. 3-Way Range Solenoid Valve

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

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. 2-Way AutoNeutral Park Brake Pressure Switch
9. 2-Way AutoNeutral Park Brake Connector
10. 2-Way Power Take-Off (PTO) Switch
11. 5-Way Start Enable Relay
12. 5-Way Start Enable Relay Socket
13. 5-Way Remote Throttle Enable Relay
14. 5-Way Remote Throttle Enable Relay Socket
15. 9-Way Diagnostic Connector (in cab)
16. In-line Fuse Holder
17. 10-amp Fuse
18. Bulkhead Connector
19. 30-amp Fuse
20. In-line Fuse Holder
21. 38-Way Vehicle Harness Connector
22. Transmission Electronic Control Unit (TECU)

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

Change Log

Date	Description
August 2019	Updated EPT Gen2, FC13, FC19, FC43, FC46, FC64, FC66, FC71, Wiring Diagram
June 2019	Updated Fault Code 13
April 2019	Updated Fault Codes: FC19Gen2, FC27, FC71, FC72, FC73
March 2019	Update Fault Codes 16, 19, 23, 35, 43, 46, 51, 52, 61, 63, 64, 65, 66, 67, and 71 Updated Diagnostic Procedure Updated Electronic Clutch Actuator (ECA) Identification Overview Updated Power-Up Sequence Added Transmission Service Light Status Test Added Fault Codes 16 (Gen2), 19 (Gen2), 64 (Gen2), 65 (Gen2), 66 (Gen2), and 67 (Gen2) Removed Fault Codes 86, 89, 94, 95, 96, and 97 Removed Power-Up Sequence Gen2 Updated Wiring Diagrams

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