# EndurantTransmission
# TRTS0950 EN-US

July 2019

AUTOMATED TRANSMISSION™
TECHNOLOGIES

BACKED BY
Roadranger
SUPPORT

## General Information



## Electrical Pretest Procedures



## Fault Isolation Procedures

## Fault Isolation Procedures (Cont'd)

## Fault Isolation Procedures (Cont'd)



## Symptom Isolation Procedures



## Appendix

# Warnings and Cautions

**DANGER:** Indicates you will be Severely Injured or Killed if you do not follow the indicated procedure

**WARNING:** Indicates an Immediate Hazard, which could result in Severe Personal Injury or death if you do not follow the indicated procedure.

**CAUTION:** Indicates vehicle or property damage could occur if you do not follow the indicated procedure.

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

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

## Before starting a vehicle:

- Refer to the vehicle's OEM operator's manual prior to operating the vehicle.

**WARNING:** Failure to follow OEM instructions could result in vehicle component damage, property damage, personal injury or death.

- Confirm vehicle parking brake is set.
- Confirm Neutral is selected on the Transmission Driver Interface Device.
- Confirm the vehicle air system achieves normal operating range prior to operating the transmission.

**CAUTION:** Refer to OEM regarding vehicle air system operation. For vehicles equipped with an air brake system, do not release the parking brake or attempt to select a gear until the vehicle's air system achieves normal operating pressure. Failure to allow the system to achieve normal operating pressure could result in vehicle component damage, property damage or personal injury.

## When parking or working on a vehicle, or leaving the vehicle cab with engine running:

1. Safely come to a complete stop.
2. Continue to depress and hold the service brake.
3. Select Neutral on the Transmission Driver Interface Device.
4. Confirm Neutral was achieved; indicated by a solid “N” (neutral) in the vehicle display.
5. Set vehicle parking brake and chock wheels.

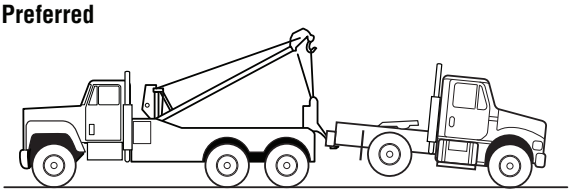
**WARNING:** Apply vehicle parking brake and follow vehicle manufacturer parking instructions. Failure to follow these instructions could cause unintended movement and may result in major vehicle component damage, property damage, severe injury or death.

## Vehicle Towing:

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

**CAUTION:** Failure to follow the Vehicle Towing procedure could result in transmission damage and voids the transmission warranty

**Preferred**



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

# Required Tools

## Diagnostic Tools

- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- 3-Way Eaton Diagnostic Adapter - RR1060TR
- Rail B Synchronizer Engagement Tool - RR1088TR
- MTM Alignment Tool - RR1086TR-1
- 0-200 psi (0-1379 kPa) air pressure gauge

Available at www.klineind.com or contact K-Line at 1-800-824-5546

## Volt/Ohm Meter

- Digital Volt/Ohm Meter (DVOM)

## PC-Based Service Tool

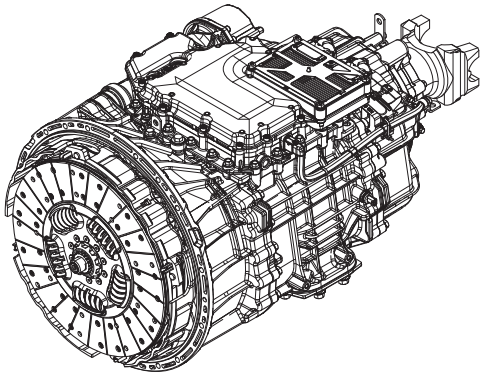
- ServiceRanger
- Approved Communication Adapter
- 9-Pin Deutsch Diagnostic Adapter

### Service Publications

| Publication | Title |
|---|---|
| TRSM0950 | Endurant Transmission Service Manual |
| TRDR0950 | Endurant Transmission Driver Instructions |
| TCMT0072 | ServiceRanger™ User's Guide |
| TCMT0073 | ServiceRanger™ Quick Start Guide |
| TCMT0020 | Eaton Approved Lubricant Suppliers |
| TCMT0021 | Roadranger Lubricant Products Manual |
| TRIG0950 | Installation Guide |
| TRIG2600 | PTO Installation Guide |
| TCWY0900 | Eaton Warranty Guide |

For additional information, go to www.EatonCumminsJV.com or contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions.

# Transmission Models



*EEO-14F112C*
*EEO-15F112C*
*EEO-16F112C*
*EEO-17F112C*
*EEO-18F112C*
*EE-17F111B*

# Transmission Service Lamps and Display Descriptions

## Overview

The Endurant Transmission utilizes the OEM display to indicate the current state of the transmission. Two transmission service lamps, amber and red, may also be illuminated to indicate an issue exists with the transmission system. The service lamps and display are controlled by the Transmission Control Module (TCM) with a message over the vehicles J1939 Data Link.

## Transmission Service Lamps

The amber transmission service lamp indicates a least severe issue exists. In the event the amber lamp is illuminated the transmission may experience a degraded mode and requires service as soon as possible. The amber and red transmission service lamps together indicate a most severe issue exists. In the event both the amber and red lamps are illuminated the transmission may experience a degraded mode and requires immediate service.

- Under normal conditions, the transmission service lamps are on momentarily at key-on as part of the TCM self-test.
- A solid transmission service lamp indicates a fault code is currently active. However, not all fault codes will turn on the service lamp.

## Display Descriptions

### Solid “N” in Display

Indicates that the transmission is currently in Neutral.

### Flashing “F” in Display

Indicates that the transmission has detected an Active fault code. This fault code can be accessed with diagnostic software. Go to the *Diagnostic Procedure* on page 10.

### Double Stars “* *” in Display

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

### Double Dashes “- -” in Display

Indicates that the gear display has lost communication with the TCM over the data link. The gear display may communicate over the J1939 data link depending upon the specific display type. If no problem is found, troubleshoot the display connection to the J1939 data link per OEM guidelines.

### Blank Gear Display

Indicates the display has lost communication over the data link.

## “PD” in Display


Indicates that the transmission is in Product Diagnostic (PD) Test. Refer to *Product Diagnostic (PD) Test* on page 6.

## “CA” in Display


Indicates that a clutch abuse event is occurring.

## “ST” in Display


Indicates a Driver Triggered Snapshot was requested and recorded. Snapshot is a diagnostic tool used to capture specific data at the time an event is occurring. This data should be collected and reviewed at the direction of Eaton Cummins Automated Transmission Technologies.

## “CC” in Display


Indicates that a clutch calibration is required or in process.

# Product Diagnostic (PD) Test

PD Test is used to diagnose Inactive fault codes that may have set during normal operation. This diagnostic test increases the fault sensing capability of the transmission system, making it more likely to detect intermittent electrical or wiring issues. The PD Test 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 Test 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 Test may be used to troubleshoot intermittent electrical fault issues when there are no Active fault codes present.

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

## PD Test Inactive Fault Codes

PD Test supports specific Inactive fault codes and their associated FMIs. To verify PD Test supports the fault code and FMI set, reference the *Fault Code Isolation Procedure Index* on page 13.

## Entering PD Test

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

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Service Routines”
4. Start “Product Diagnostic Test” and follow on-screen prompts.

**Note:** Solid “PD” may appear in display when PD Test is active.


## Troubleshooting Using PD Test

- Wiggle the wiring harness and connector bodies appropriate for the intermittent fault condition while the transmission is in PD Test.
- “PD” will remain in display until an Active fault code has been set during the PD Test fault isolation procedure.
- If an Active fault code is set during PD Test, the display will flash “F” and “PD” until PD Test is completed. A warning tone will sound when the fault code is Active. “PD” will continue to be shown in the display until the transmission has powered down.
- Fault codes that occur in PD Test will not be stored in the TCM as Inactive fault codes.

## Identifying a Problem in PD Test

- Identify any areas of wear or damage to wiring harnesses or connectors.
- If a fault occurs while wiggling the wiring harness and/or connector, exit PD Test. 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.

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

## Driver Questionnaire

Fleet: _____ Fleet Unit # _____ Date: _____

Dealer: _____ RO # _____ Email to auto.rtw@eaton.com

| | | | | |
|---|---|---|---|---|
| 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:<br>a. What gears is the transmission trying to shift? Circle any that apply or describe.<br>1-2 4-5 5-6 6-7 7-8 8-9 9-10 10-11 11-12 | | | | |
| 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:<br>a. What gears does the transmission stick in? Circle one or more below.<br>1 2 3 4 5 6 7 8 9 10 11 12 | | | | |
| 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 display when the problem happens? Circle one or more below.<br><br>"-" Single dash "- -" Double dash Flashing gear number Solid gear number flashing "F" Flashing "CA"<br><br>Blank display | | | | |
| 10. Does the transmission service, check engine or anti-lock brake light come on when the problem happens? | Trans Service Red / Amber | Check Engine | ABS | None |
| 11. If there is a transmission service light did you experience a degraded mode? | Yes | No | Don't Know | NA |
| 12. Is your vehicle air pressure above 90 PSI? | Yes | No | Don't Know | NA |
| 13. Does the problem happen when the transmission is cold, hot or both? | Cold | Hot | Both | NA |
| 14. Does the problem happen when operating in wet weather, dry weather or both? | Wet | Dry | Both | NA |
| 15. How many times a day, week or month does the problem happen?<br>Number of times _____ | Day | Week | Month | NA |
| 16. How long has the truck had the problem? | First Time | Past 2 weeks | Past Month | Several Months |
| 17. How long have you been driving this truck? | Days | Weeks | Months | Years |
| 18. List any known problems the truck has had in the past: Circle one or more below or describe known problem.<br><br>OEM electrical ABS (truck) ABS (trailer) Accident Flood damage Lightning strike | | | | |
| 19. 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

| Electrical Pretest Procedures | Symptom | Page # |
|---|---|---|
| Power-up Sequence Test | Transmission fails to power up at ignition | page 26 |

| Isolation Procedures | Symptom | Page # |
|---|---|---|
| Start Enable Relay Contact Test | Engine cranking issues without any fault codes | page 500 |
| Brake Switch Functionality Test | Transmission does not engage a gear from Neutral (N) | page 510 |
| Transmission Shift Complaint Test | Shift complaint exists without any fault codes | page 513 |
| J1939 Vehicle Data Link Test | No J1939 communication | page 517 |

# 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 7.
2. Set vehicle parking brake and chock wheels.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Select “Service Activity Report”.
6. Enter information and select “Start Report”.

   **Note:** Transmission information is downloaded into the report.
7. Select “Send to Eaton”.

   **Note:** Internet connection is required.
8. Update TCM to the latest available software.

   **Note:** To avoid damaging the TCM, 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 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 Control Module (TCM), go to the *Power-Up Sequence* on page 26

**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”, go to *Start Enable Relay Contact Test* on page 500.

     **Note:** If the engine was shut off with the transmission in gear, confirm the vehicle parking brake is set and service brake is depressed when attempting to start the engine.

**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 510

## 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. Contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions.

## E

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

1. Set vehicle parking brake and chock wheels.
2. Key off and allow the TCM to perform a complete power down.
3. Key on.
4. Connect ServiceRanger.
5. Select “Service Activity Report”.
6. Enter information and select “Start Report”.

   **Note:** Transmission information is downloaded into the report.
7. Select “Send to Eaton”.

   **Note:** Internet connection is required.
   - 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* on page 513.

**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: Vehicle Interface Fault Codes 100-199
   - Priority 2: Component Fault Codes 200-499
   - Priority 3: System Fault Codes 500-899
   - Priority 4: Feature Fault Codes 900-999
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 9

# Fault Code Isolation Procedure Index

| Fault Code | SPN | FMI | Description | Page Number |
|---|---|---|---|---|
| 187 | 7830 | 9, 13, 19 | Idle Governor Fueling Inhibit | page 182 |
| 188 | 1483 | 12, 13, 19 | Source Address (SA) of Controlling Device for Engine Control | page 184 |
| 190 | 905 | 13, 19 | Front Axle Left Wheel Speed | page 187 |
| 191 | 906 | 13, 19 | Front Axle Right Wheel Speed | page 189 |
| 192 | 907 | 13, 19 | Rear Axle 1 Left Wheel Speed | page 191 |
| 193 | 908 | 13, 19 | Rear Axle 1 Right Wheel Speed | page 193 |
| 199 | 1571 | 12 | Direction Mismatch | page 195 |
| 200 | 629 | 0, 1, 8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21 | TCM Operation 1 | page 197 |
| 205 | 609 | 9, 12, 19 | TCM Operation 2 | page 201 |
| 206 | 628 | 2, 11, 12, 13, 14, 31 | TCM Program Memory | page 204 |
| 210 | 127 | 1, 3, 4, 5, 6, 18, 20, 21 | Transmission Oil Pressure | page 207 |
| 215 | 37 | 0, 1, 2, 3, 4, 5, 6, 17, 18, 20, 21 | Transmission Air Supply Pressure | page 216 |
| 250 | 33 | 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 20 | Linear Clutch Actuator (LCA) Position | page 227 |
| 275 | 4219 | 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 16, 18, 20, 21, 31 | Rail B Position | page 235 |
| 295 | 4220 | 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21, 31 | Rail C Position | page 245 |
| 315 | 5941 | 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21, 31 | Rail D Position | page 253 |
| 320 | 5942 | 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 16, 18, 20, 21 | Rail E Position | page 261 |
| 345 | 5052 | 0 | Engine Over Speed | page 268 |
| 350 | 161 | 2, 4, 5, 6, 8, 9, 14, 20, 21, 31 | Input Speed | page 270 |
| 370 | 160 | 2, 4, 5, 6, 8, 9, 14, 20, 21, 31 | Countershaft Speed | page 278 |
| 375 | 191 | 2, 4, 5, 6, 8, 9, 14, 20, 21, 31 | Output Speed | page 286 |
| 385 | 583 | 2, 8, 10, 11, 12, 13, 14, 19, 20, 21, 31 | Grade | page 292 |
| 390 | 5912 | 17 | Transmission Control Module Temperature | page 295 |
| 511 | 5614 | 0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 16, 18 | Clutch Engage Solenoid 1 (C4) | page 297 |
| 512 | 5615 | 0, 1, 3, 4, 5, 6, 8, 10, 12, 16, 18 | Clutch Engage Solenoid 2 (C3) | page 304 |
| 513 | 5616 | 0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 16, 18 | Clutch Release Solenoid 1 (C5) | page 311 |
| 514 | 5617 | 0, 1, 3, 4, 5, 6, 8, 10, 12, 16, 18 | Clutch Release Solenoid 2 (C6) | page 319 |
| 570 | 787 | 0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 18 | Inertia Brake Solenoid (B2) | page 327 |
| 596 | 5901 | 0, 1, 3, 4, 5, 6, 8, 12, 16, 17, 18, 31 | Rail B Fore Solenoid (A5) | page 334 |
| 597 | 5909 | 0, 1, 3, 4, 5, 6, 8, 12, 16, 17, 18, 31 | Rail B Aft Solenoid (A1) | page 342 |
| 616 | 5902 | 0, 1, 3, 4, 5, 6, 8, 12, 14, 15, 16, 17, 18, 31 | Rail C Fore Solenoid (C1) | page 350 |
| 617 | 5910 | 0, 1, 3, 4, 5, 6, 8, 12, 14, 15, 16, 17, 18, 31 | Rail C Aft Solenoid (B1) | page 358 |
| 636 | 5903 | 0, 1, 3, 4, 5, 6, 8, 12, 14, 15, 16, 17, 18, 31 | Rail D Fore Solenoid (C2) | page 366 |

| Fault Code | SPN | FMI | Description | Page Number |
|---|---|---|---|---|
| 637 | 4216 | 0, 1, 3, 4, 5, 6, 8, 12, 14, 15, 16, 17, 18, 31 | Rail D Aft Solenoid (B3) | page 374 |
| 646 | 768 | 0, 1, 3, 4, 5, 6, 8, 12, 16, 17, 18 | Rail E Fore Solenoid (A6) | page 382 |
| 647 | 769 | 0, 1, 3, 4, 5, 6, 8, 12, 16, 17, 18 | Rail E Aft Solenoid (A4) | page 389 |
| 700 | 6150 | 0, 1, 12, 14, 17, 18 | Clutch Operation | page 397 |
| 701 | 7847 | 14, 31 | Clutch Engagement Status | page 402 |
| 702 | 560 | 2, 12, 14, 20, 21, 31 | Driveline Engagement | |
| 705 | 788 | 12, 14 | Transmission Clutch Actuator | page 410 |
| 715 | 523 | 9 | Transmission Current Gear | page 413 |
| 716 | 524 | 12 | Transmission Selected Gear | page 415 |
| 717 | 525 | 12 | Transmission Requested Gear | |
| 740 | 6145 | 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21 | Rail B Operation | page 421 |
| 760 | 6146 | 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21 | Rail C Operation | page 428 |
| 775 | 6147 | 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21 | Rail D Operation | page 435 |
| 780 | 6148 | 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21 | Rail E Operation | page 441 |
| 786 | 5952 | 7, 20, 21, 31 | Rail B Calibration | page 447 |
| 787 | 5953 | 7, 20, 21, 31 | Rail C Calibration | page 452 |
| 788 | 5954 | 7, 20, 21, 31 | Rail D Calibration | page 457 |
| 789 | 5955 | 7, 20, 21, 31 | Rail E Calibration | page 462 |
| 815 | 5939 | 0, 15, 16 | Clutch Temperature | page 467 |
| 900 | 3452 | 3, 9, 13, 19, 20, 21 | PTO 1 Request | page 470 |
| 905 | 3453 | 9, 13, 19, 20 | PTO 2 Request | page 473 |
| 910 | 3456 | 3, 4, 5, 7, 12, 13 | PTO 1 Engage | page 476 |
| 915 | 3457 | 3, 4, 5, 7 | PTO 2 Engage | page 479 |
| 920 | 3460 | 3, 7, 9, 13, 19, 20, 21 | PTO 1 Confirm | page 482 |
| 925 | 3461 | 7, 9, 13, 19 | PTO 2 Confirm | page 485 |
| 950 | 3648 | 12 | Neutral Status 1 | page 489 |
| 960 | 6159 | 12 | Neutral Status 2 | page 491 |
| 970 | 604 | 3, 4, 5 | Neutral Output | page 493 |
| 975 | 767 | 3, 4, 5 | Reverse Output | page 496 |

# 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 OEM supplied Vehicle Harness, Body Harness, 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 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 Cummins Automated Transmission Technologies approved contact and connector fluid.
5. When reconnecting, Eaton Cummins Automated Transmission Technologies recommends the use of NyoGel 760G on electrical contacts. Make sure all connectors are clean and tight.

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

## Use PD Test for Intermittent Issues

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

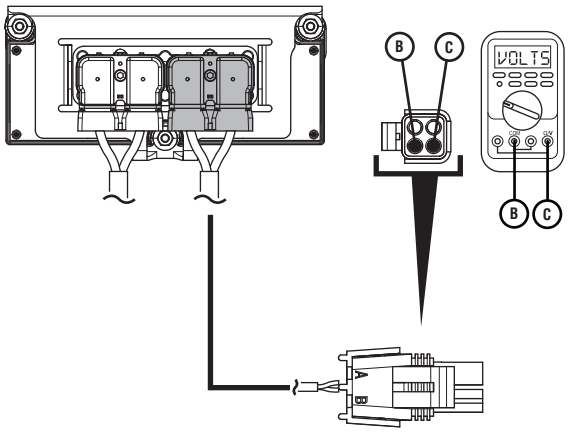
## Recommendations for Using a Volt/Ohm Meter

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 without power.

## 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.

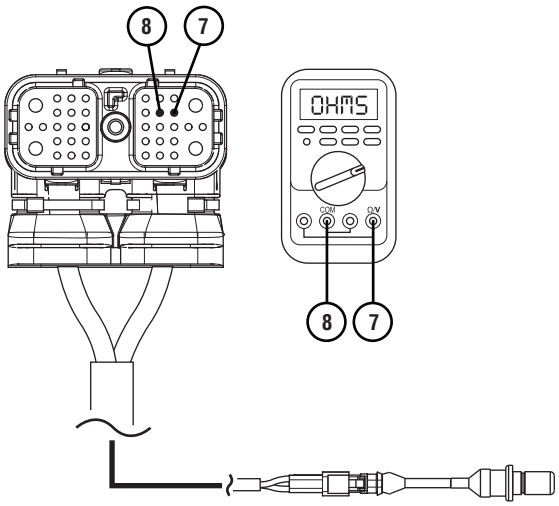



| Pins | Range | Reading(s) |
|---|---|---|
| B to C | Within 0.6 V of Battery Voltage | 12.5 V |

## Example Circuit Continuity Readings

### Circuit has Continuity

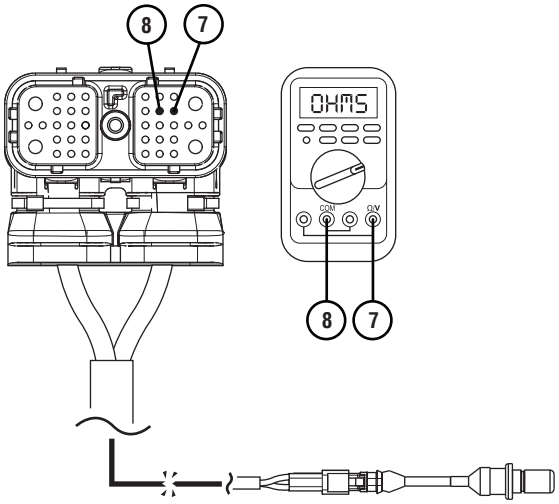
The circuit is complete when the resistance reading is within range. A circuit reading infinite resistance or Open Lead (OL) does not have continuity.




| 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.

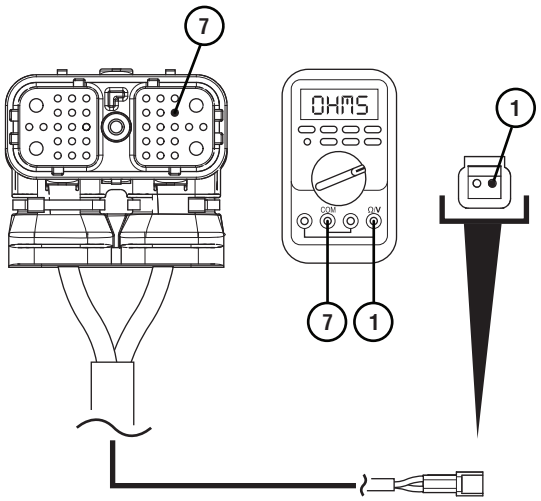



| Pins | Range | Reading(s) |
|---|---|---|
| 7 to 8 | 2.0k – 4.5k ohms | OL |

## Example End to End Resistance

### End to End Resistance is Within Range

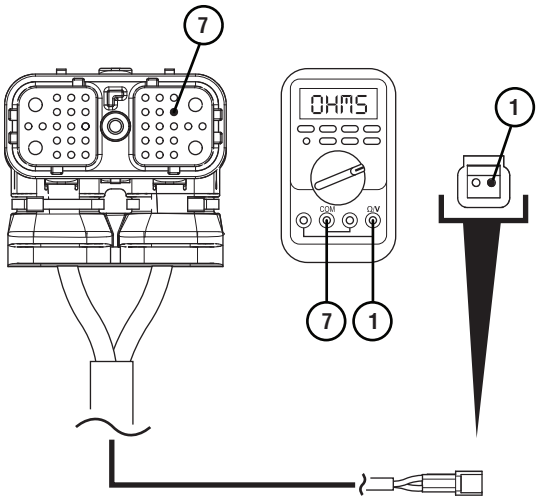
The wire has continuity when the resistance reading is within range. A wire reading infinite resistance or Open Lead (OL) does not have continuity.




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

## End to End Resistance is Too High

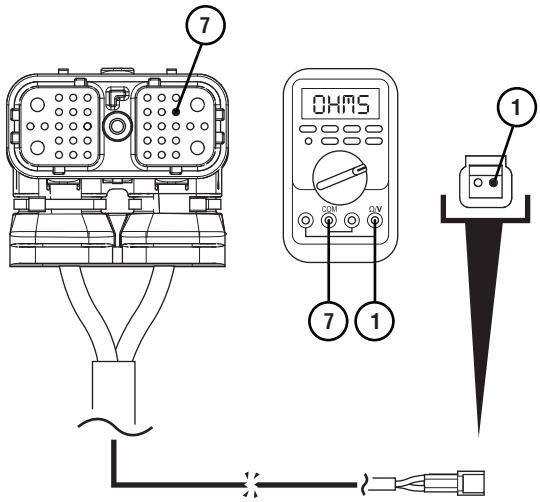
When the resistance is higher than the acceptable range there is additional resistance in this wire. Check for corrosion, loose or spread pins or damage to the harness.




| 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.

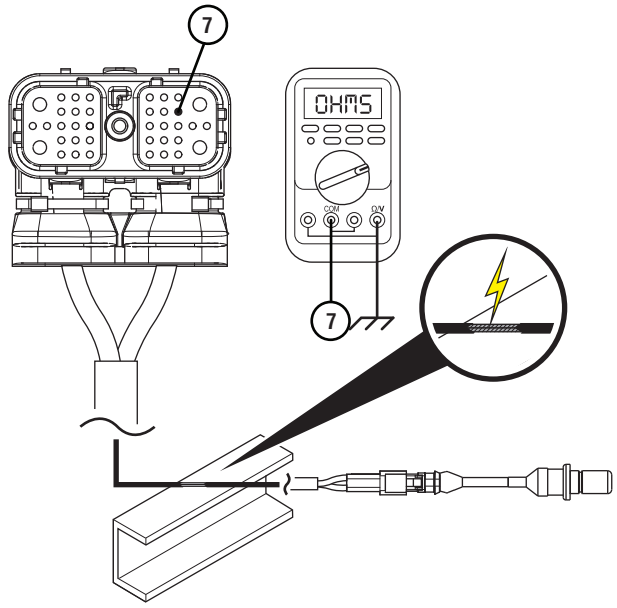



| Pins | Range | Reading(s) |
|---|---|---|
| 7 to 1 | 0.0 – 0.3 ohms | OL |

## Short Circuit to Chassis Ground

### Short to Ground

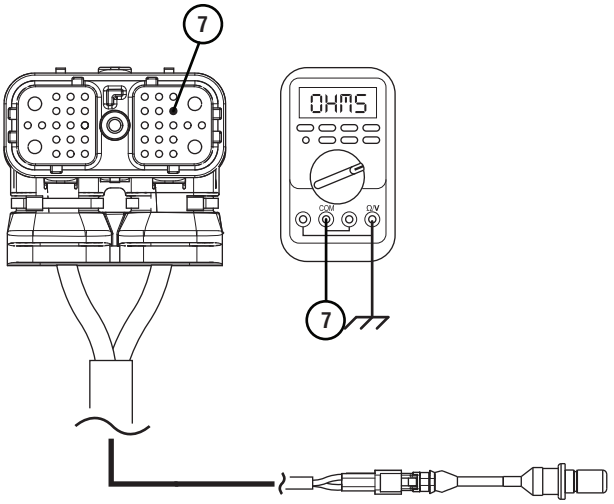
A wire is shorted to ground when the resistance between a non-ground wire and chassis ground shows continuity. Low resistance values (near 0 ohms) indicate a direct short to ground. Higher resistance values may indicate a partial-short.




| 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.

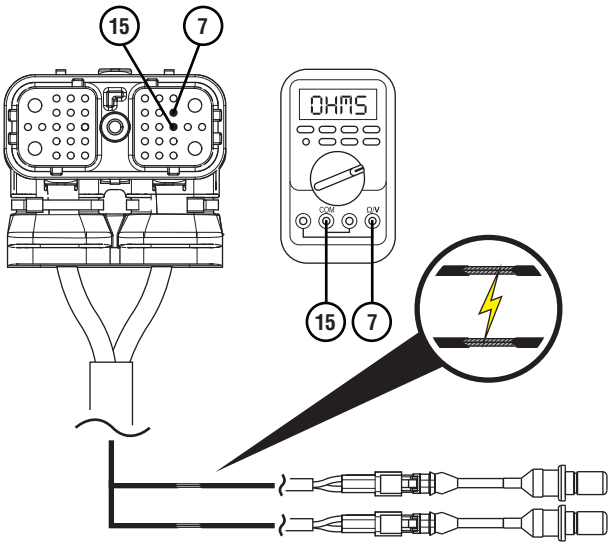



| Pins | Range | Reading(s) |
|---|---|---|
| 7 to Ground | Open Circuit (OL) | OL |

# Short to Another Circuit

## Two Circuits Shorted Together

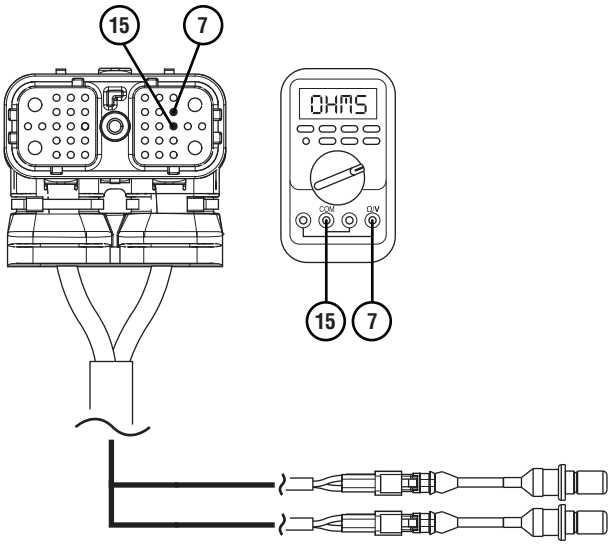
When wires from two unrelated circuits show continuity (low resistance) to one another, these circuits are shorted together.




| 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.

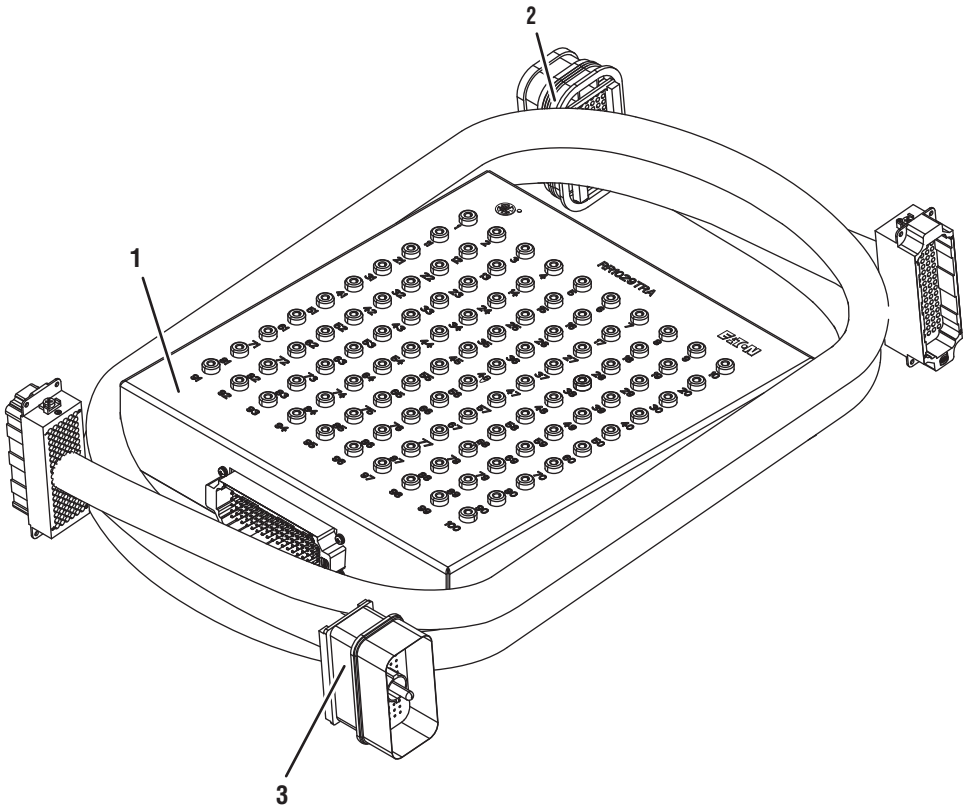



| Pins | Range | Reading(s) |
|---|---|---|
| 7 to 15 | Open Circuit (OL) | OL |

# Eaton Breakout Box and Eaton Diagnostic Adapter Procedure

## Overview

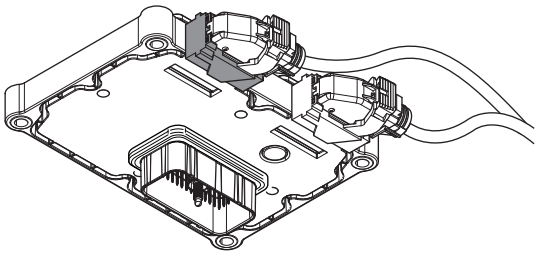
This procedure describes how to use the RR1029TR Eaton Breakout Box. This diagnostic tool improves the trouble-shooting process by eliminating the need for a diagnostic pin kit and simplifying access to component electrical circuits.



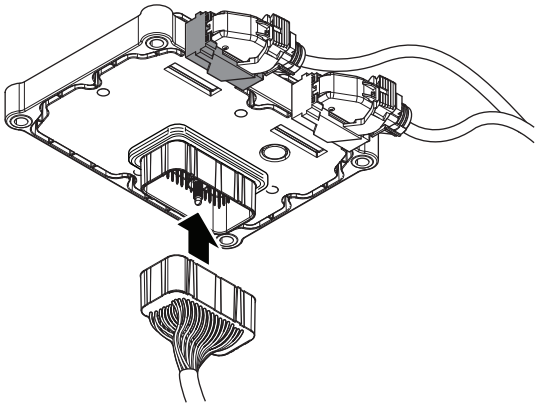

*1. Eaton Breakout Box (RR1029TR)*
*2. 74-Way EDA Transmission Control Module Connector - part of RR1029TR*
*3. 74-Way EDA Transmission Harness Connector - part of RR1029TR*

## Troubleshooting TCM Signals with the Eaton Breakout Box

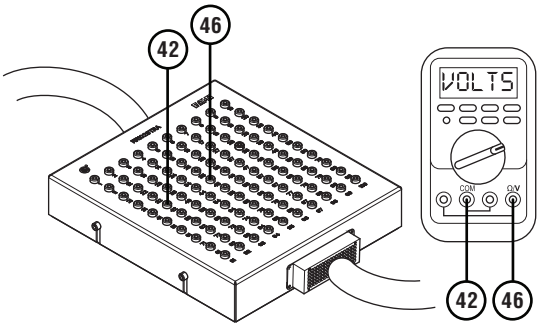
1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.



3. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector and hand tighten TCM jack screw.

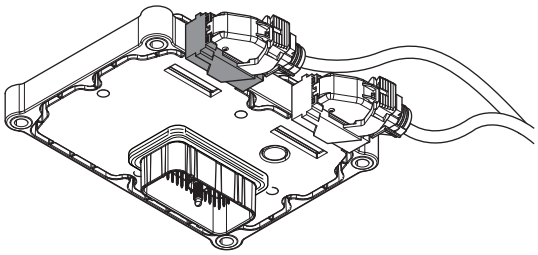


4. Key on.
5. Measure voltage at the Eaton Breakout Box between Pin 42 and Pin 46.

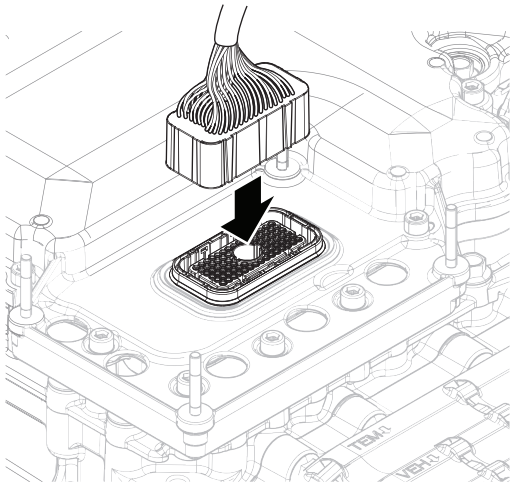



## Troubleshooting Internal Components and Circuits with the Eaton Breakout Box

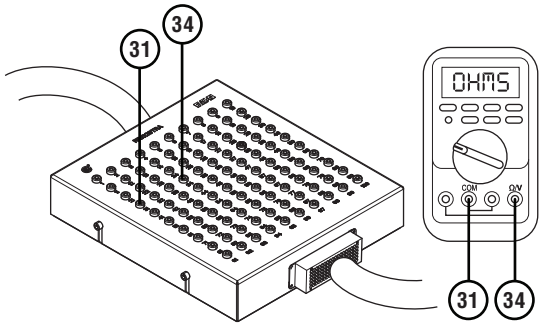
1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.



3. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector and hand tighten jack screw on connector.



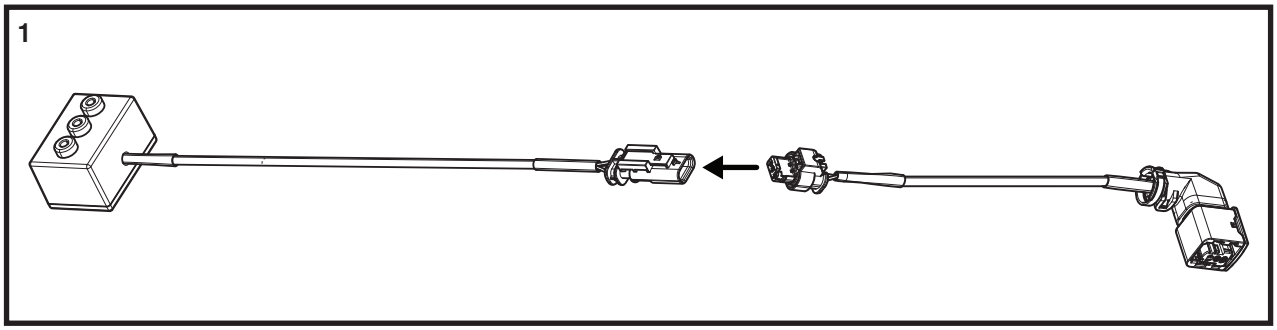
4. Measure resistance at the Eaton Breakout Box between Pin 31 and Pin 34.

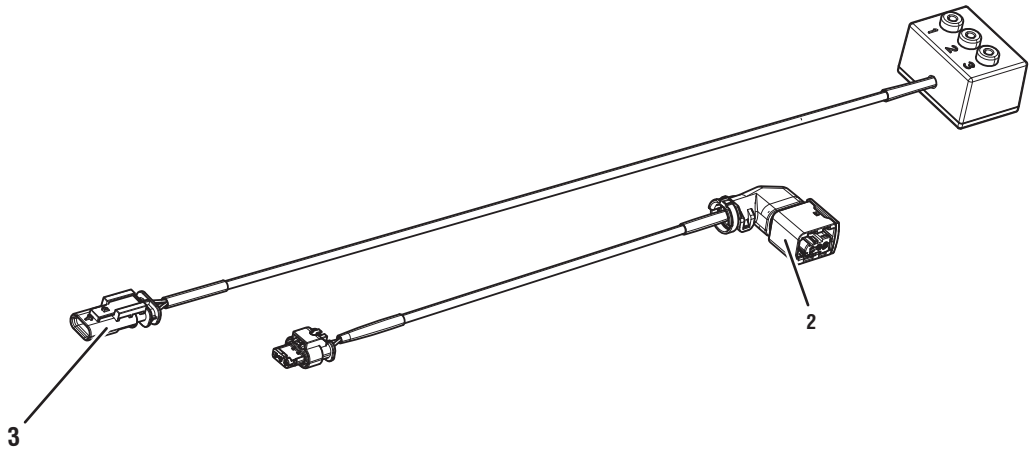


# 3-Way Eaton Diagnostic Adapter (3-Way EDA)

## Overview

This procedure describes how to use RR1060TR 3-Way Eaton Diagnostic Adapter (3-Way EDA). This diagnostic tool improves the troubleshooting process by eliminating the need for a diagnostic pin kit and simplifying access to component electrical circuits. 3-Way EDA is one tool containing two pieces that troubleshoots both the Fluid Pressure Sensor and Output Speed Sensor circuits.

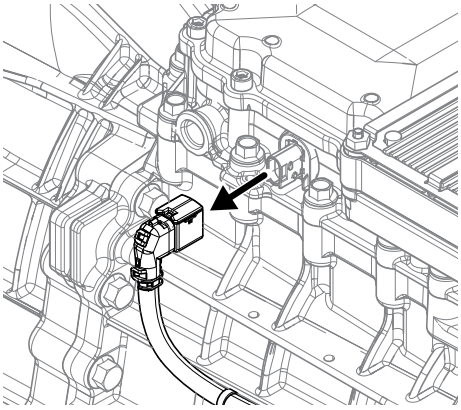


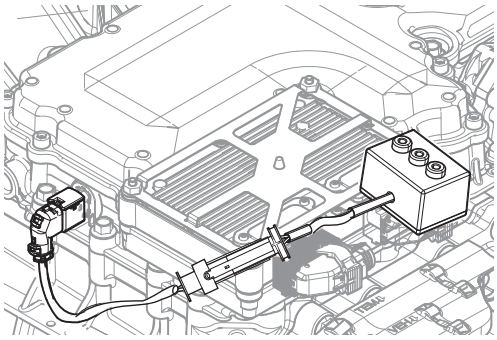

*1. 3-Way EDA (RR1060TR)*
*2. Output Speed Sensor Connector - part of RR1060TR*
*3. Fluid Pressure Sensor Connector - part of RR1060TR*

## Troubleshooting the Output Speed Sensor using the 3-Way Eaton Diagnostic Adapter

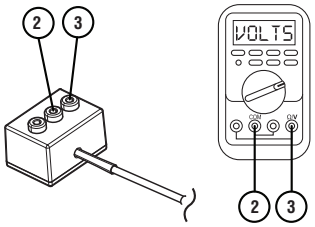
1. Key off.
2. Disconnect the 3-Way Output Speed Sensor Connector at the MTM by lifting up on the yellow latch.



3. Connect the 3-Way Eaton Diagnostic Adapter (EDA) to the 3-Way Output Speed Sensor Connector at the MTM.

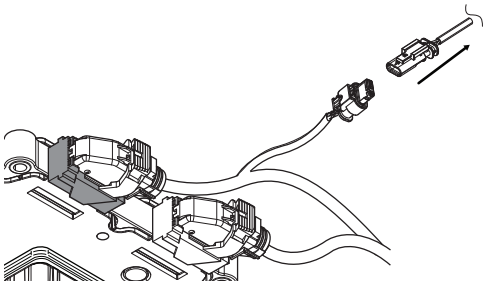


4. Key on.
5. Measure voltage at the 3-Way EDA between Pin 2 (signal) and Pin 3 (5V). Record reading in table.

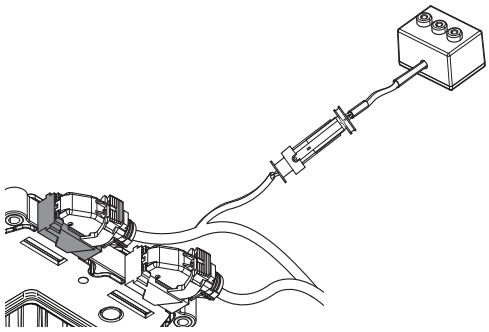



## Troubleshooting the Fluid Pressure Sensor using the 3-Way Eaton Diagnostic Adapter

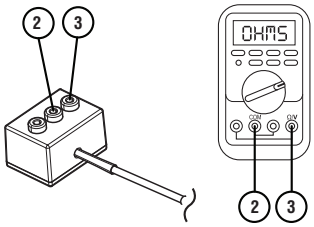
1. Key off.
2. Disconnect the 3-Way FPS Harness Connector.



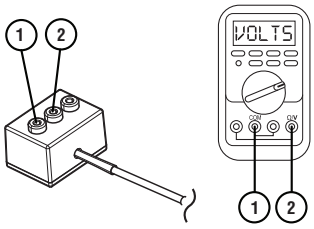
3. Connect the 3-Way Eaton Diagnostic Adapter (EDA) to the 3-Way FPS Harness Connector.



4. Measure resistance between 3-Way EDA Pin 2 (Ground) and Pin 3 (Signal).




5. Key on.
6. Measure voltage at the 3-Way EDA Pin 1 (5V) and Pin 2 (Ground). Record reading in table.



# Power-Up Sequence

## Overview

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

## Detection

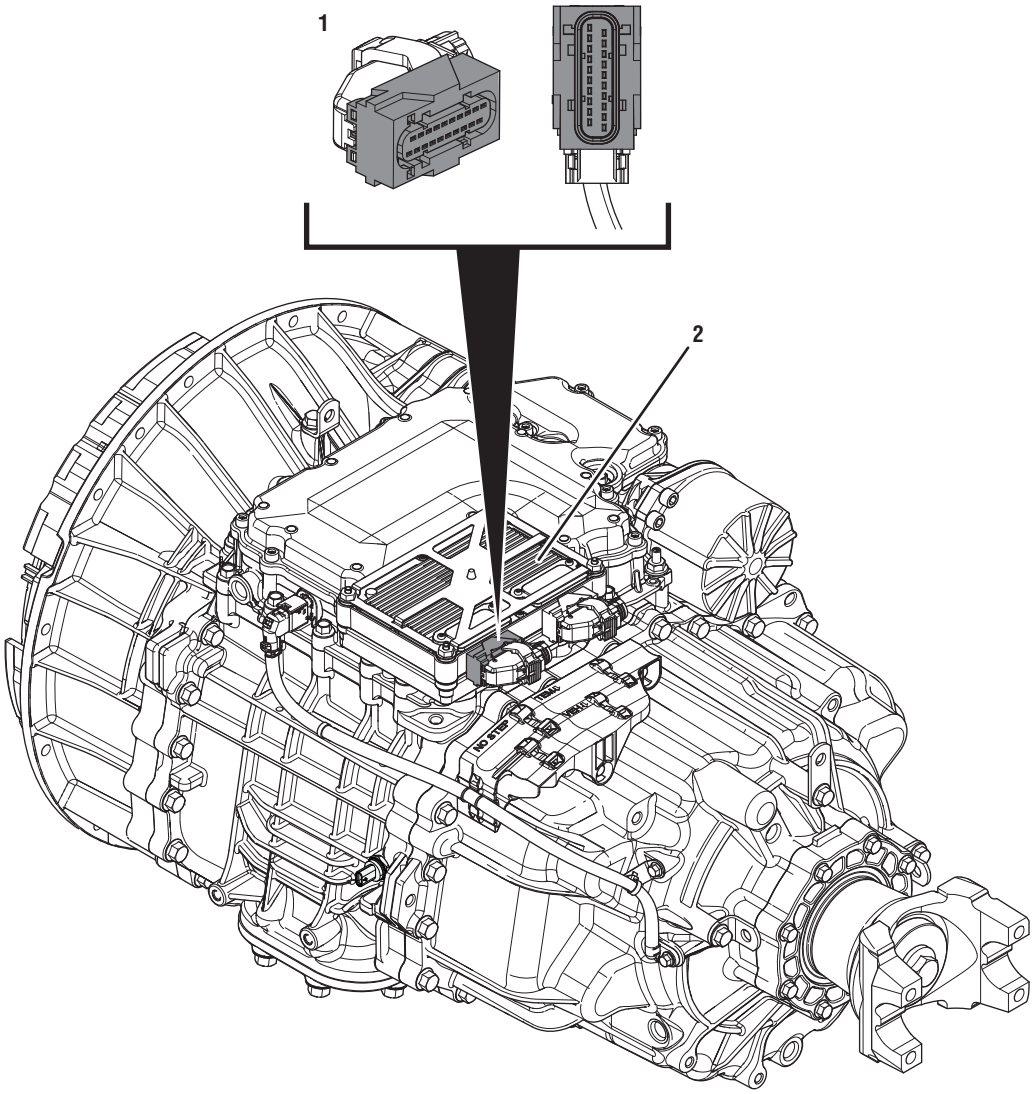
- Display may be blank.
- Engine may not crank.
- ServiceRanger may not connect to Transmission Control Module (TCM).

**Note:** Fault codes that set give additional information about performance issues detected on the vehicle. If a unit has an Active fault code, or repeated occurrences of an Inactive fault code, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

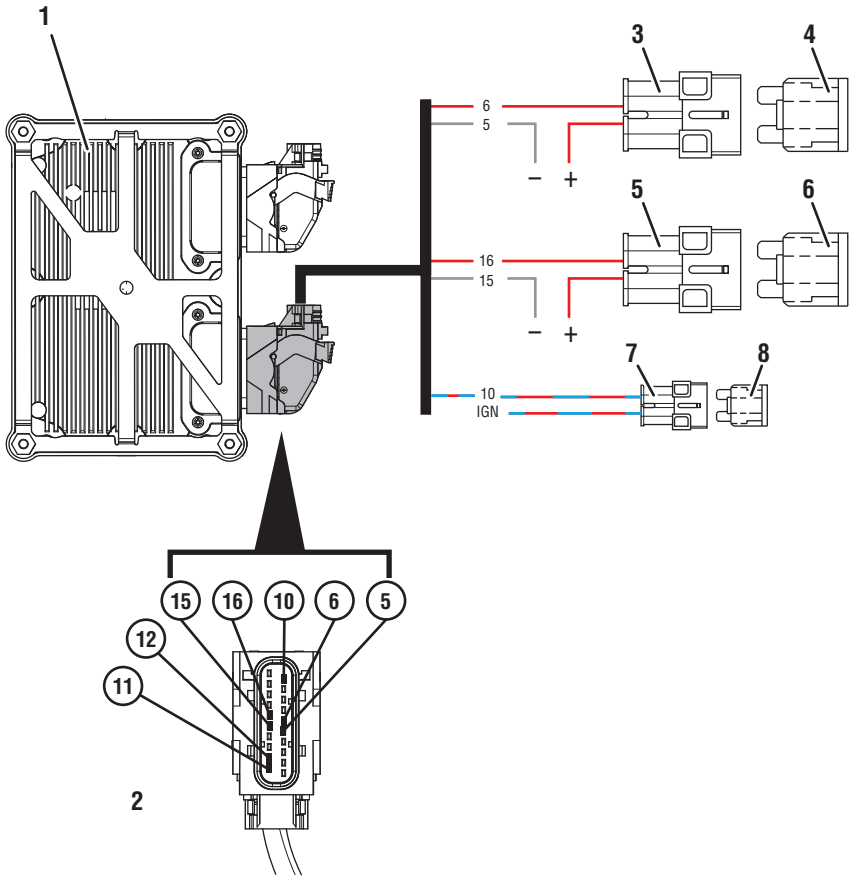
## Possible Causes

- Vehicle Power Supply Wiring
  - Poor power or ground supply to TCM
  - Bent, spread, corroded or loose terminals
  - Wires grounded, open or shorted
- Vehicle Batteries
  - Internal failure
- Vehicle Primary Data Link (J1939 A)
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, or loose terminals
- TCM
  - Internal Failure

## Component Identification




*1. 20-Way TCM Vehicle Harness Connector*
*2. Transmission Control Module (TCM)*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. In-line Fuse Holder Battery Voltage1*
*4. 15-amp Fuse Battery Voltage1*
*5. In-line Fuse Holder Battery Voltage2*
*6. 15-amp Fuse Battery Voltage2*
*7. In-line Fuse Holder*
*8. 10-amp Fuse*

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

# Power-Up Sequence Test

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

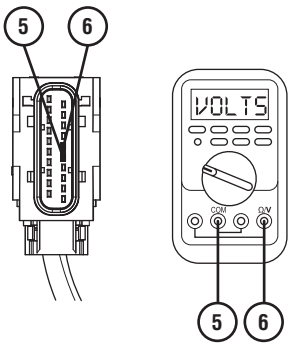
1. Set vehicle parking brake and chock wheels.
2. Key off.
3. Inspect the vehicle charging/battery system and connections, verify the connectors are free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector bodies.
4. Inspect the transmission 10-amp Ignition and both 15-amp fuses/fusible links, verify the connectors are free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector bodies.
5. Inspect the vehicle harness and connectors from the power supply to the 20-Way TCM Vehicle Harness Connector, verify the connectors are free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector bodies or harness.

   **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.
6. Measure voltage across all batteries. Record reading in table.
7. Compare reading(s) in table.
   - If readings are out of range or damage is found, refer to OEM guidelines for repair or replacement of the vehicle charging/battery system, vehicle harness and/or 20-Way TCM Vehicle Harness Connector. Test complete.
   - If readings are in range and no damage is found, go to **Step B.**

| Range | Reading(s) |
|---|---|
| 11–15 V | |

**B** ***Purpose:*** *Verify Battery Voltage1 at the TCM.*

1. Key off.
2. Disconnect the 20-Way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Inspect the TCM side of the 20-Way TCM Vehicle Harness 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. Measure voltage between 20-Way TCM Vehicle Harness Connector Pin 6 (Battery positive) and Pin 5 (Battery negative). Record reading in table.



6. 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 the power supply to the TCM.

| Pins | Range | Reading(s) |
|---|---|---|
| 5 to 6 | 11–15 V | |

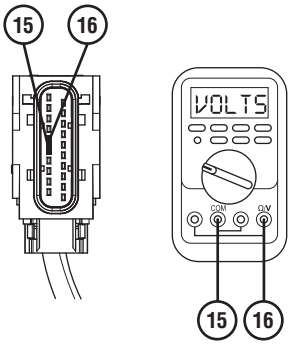
3. Compare reading(s) in table.
   - If readings are in range, go to **Step D.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the power supply to the TCM.

| Pins | Range | Reading(s) |
|---|---|---|
| 15 to 16 | 11–15 V | |

## C

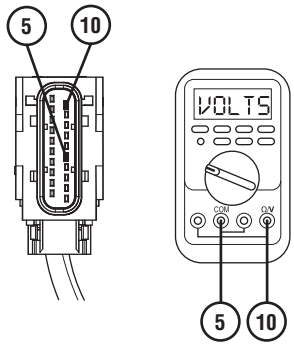
***Purpose:*** *Verify Battery Voltage2 at the TCM.*

1. Key off.
2. Measure voltage between 20-Way TCM Vehicle Harness Connector Pin 16 (Battery positive) and Pin 15 (Battery negative). Record reading in table.



**D** ***Purpose:*** *Verify Ignition Voltage at the TCM.*

1. Key on with engine off.
2. Measure voltage between 20-Way TCM Vehicle Harness Connector Pin 10 (Ignition positive) and Pin 5 (Battery negative). Record reading in table.



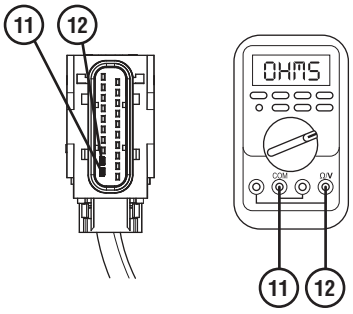

3. Compare reading(s) in table.
   - If readings are in range, go to **Step E.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of ignition voltage supply to TCM.

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key on | 5 to 10 | 11–15 V | |

## E

***Purpose:*** *Verify resistance of Vehicle J1939 Data Link at 20-Way TCM Vehicle Harness Connector.*

1. Key off.
2. Disconnect the 20-Way TCM Vehicle Harness Connector.
3. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 11 and Pin 12. Record reading in table.




4. Reconnect 20-Way TCM Vehicle Harness Connector.
5. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step F.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 11 to 12 | 50-70 Ohms | |

## 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, FMIs, occurrences, and timestamps.
   - If ServiceRanger connects and a fault code is Active, go to **Step G.**
   - If ServiceRanger connects and no fault code is Active, an intermittent wiring issue exists within the Vehicle Harness between the:
     - Vehicle power supply and 20-Way TCM Vehicle Harness Connector.

       or

     - Vehicle Primary Data Link (J1939 A) and the 20-Way TCM Vehicle Harness Connector.

     Refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If ServiceRanger does not connect, replace the TCM, go to **Step V.**

## G

***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: Vehicle Interface Fault Codes 100-199
   - Priority 2: Component Fault Codes 200-499
   - Priority 3: System Fault Codes 500-899
   - Priority 4: Feature Fault Codes 900-999
     - Go to the *Fault Code Isolation Procedure Index* on page 13 and troubleshoot the fault code with the highest priority level.

## 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. Operate 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 a fault code sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 100: Battery Voltage1

**J1939: SA 3 SPN 168 FMI 0, 1, 4, 17, 18**

## Overview

The Transmission Control Module (TCM) requires a battery power and ground supply. The TCM has redundant power and ground sources (Battery Voltage1 and Battery Voltage2) and will function normally if either source becomes unavailable. The Battery Voltage1 circuit is contained within the 20-Way TCM Vehicle Harness Connector.

## Detection

The TCM monitors Battery Voltage1 power and ground source. If the system detects voltage out of range, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** Battery Voltage1 more than 16.5V for 1 second.

**FMI 1 – Data Valid But Below Normal (Most Severe):** Battery Voltage1 less than 8V for 1 second.

**FMI 4 – Voltage Below Normal or Shorted Low:** Battery Voltage1 less than 4V during power up.

**FMI 17 – Data Valid But Below Normal (Least Severe):** Battery Voltage1 less than 11V for 1 second with engine above 1000 RPM.

**FMI 18 – Data Valid But Below Normal (Moderately Severe):** Battery Voltage1 less than 10.2V for 1 second with engine above 550 RPM.

## Fallback

**FMI 0:**

- No degraded performance

**FMI 1, 18:**

- Amber warning lamp on
- No degraded performance
- If Fault Code 100 and 105 are Active:
  - Non neutral modes prohibited
  - PTO Mode prohibited
- If Fault Code 100 and 105 are Active and the vehicle is moving:
  - Red stop lamp on
  - Clutch engagement prohibited, vehicle may coast to a stop

**FMI 4, 17:**

- Amber warning lamp on
- No degraded performance

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 17, 18:** Battery Voltage1 in range for 10 seconds.

**FMI 4:** Key cycle.

## Possible Causes

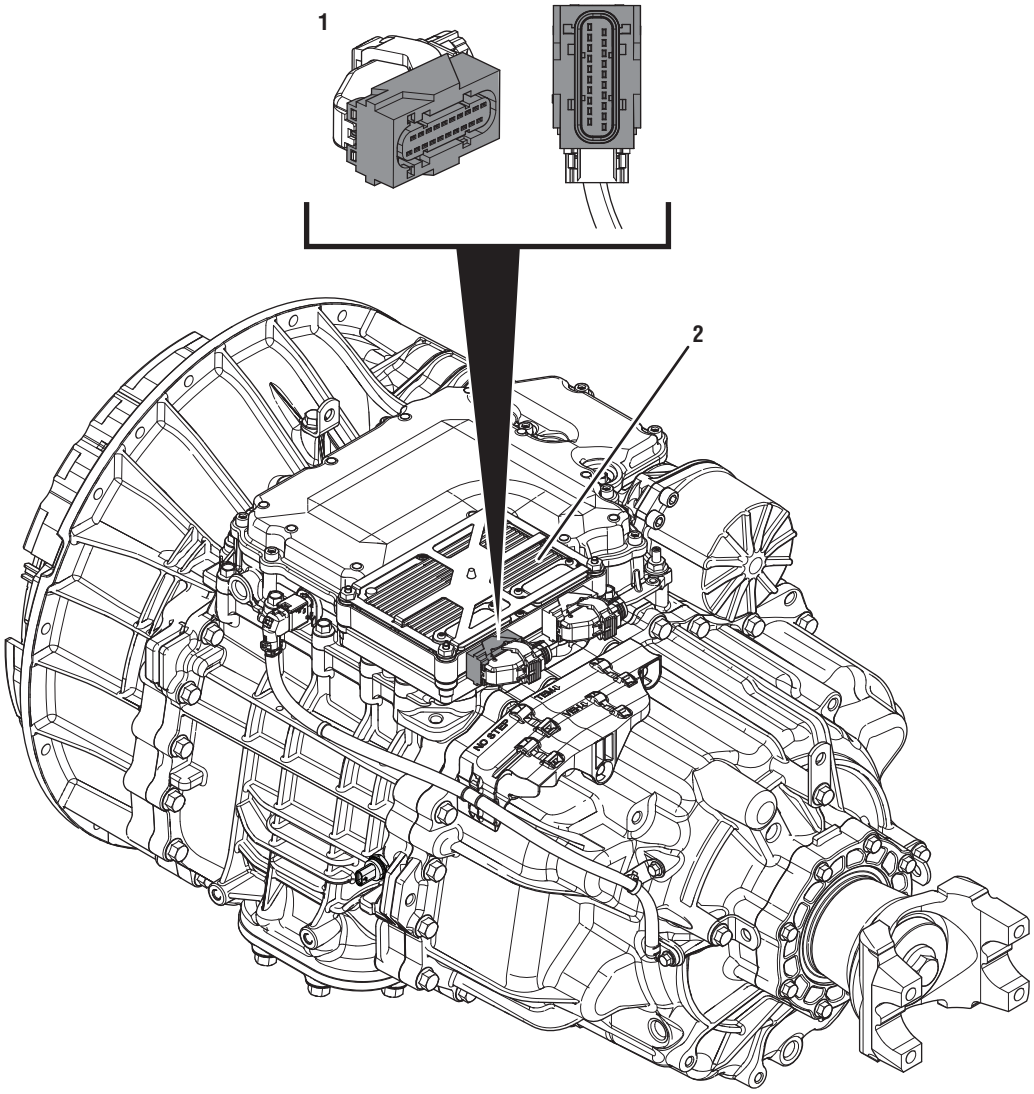
**FMI 0:**

- Vehicle jump-started
- Vehicle charging/battery system failure

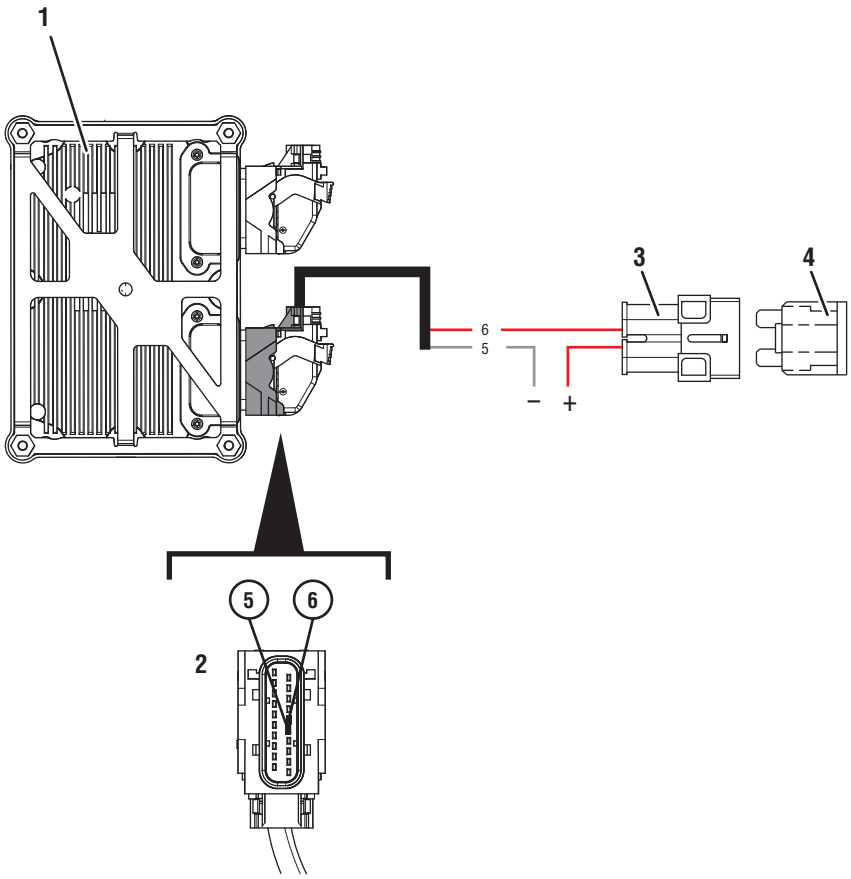
**FMI 1, 4, 17, 18:**

- Vehicle Harness
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded or loose
- Vehicle charging/battery system failure

## Component Identification




*1. 20-Way TCM Vehicle Harness Connector*
*2. Transmission Control Module (TCM)*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. In-line Fuse Holder Battery Voltage1*
*4. 15-amp Fuse Battery 1*

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

# Fault Code 100 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 100 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 100 FMI 0 is Active, go to **Step G.**
   - If Fault Code 100 FMI 0 is Inactive, the TCM experienced an over-voltage condition. Vehicle may have been jump-started or vehicle charging/battery system is failing. Refer to OEM guidelines for repair or replacement of the vehicle charging/battery system. Go to **Step V.**
   - If Fault Code 100 FMI 1, 17 or 18 is Active, go to **Step C.**
   - If Fault Code 100 FMI 1, 17 or 18 is Inactive, go to **Step B.**
   - If Fault Code 100 FMI 4 is Active or Inactive, create a Service Activity Report, select "Send to Eaton" and contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**.

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Service Routines”
4. Start Product Diagnostic Test and follow on-screen prompts.

   **Note:** Solid “PD” may appear in display when PD Test is active.

   **Note:** TCM will not enter PD Test mode when there are Active fault code.


5. Wiggle the vehicle harness and connections between the charging/battery system and 20-Way TCM Vehicle Harness Connector. Look for signs of rubbing or chafing on the wires. Refer to OEM wiring diagrams.
6. To end the test, press the stop button.
   - If fault codes set Active while wiggling the vehicle harness, refer to OEM guidelines for repair or replacement of the vehicle harness and/or the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

## C

***Purpose:*** *Verify Battery Voltage1 supply to the TCM with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From the “Default Parameter Files” tab, select “Transmission Supplied Voltages”.
5. Monitor 168 - Battery voltage value. Record reading in table.
6. Monitor 444 - Battery 2 voltage value. Record reading in table.
7. Compare reading(s) in table.
   - If readings are out of range, go to **Step D.**
   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Vehicle Harness between the charging/battery system and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of the Vehicle Harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Parameter | Range | Reading(s) |
|---|---|---|
| 168-Battery voltage | 11–15 V | |
| 444-Battery 2 voltage | 11–15 V | |

## D

***Purpose:*** *Verify condition of charging/battery system, fuse, power and ground supplies to the TCM.*

1. Key off.
2. Inspect the vehicle charging/battery system and fuses, verify the connectors are free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector bodies.
   - If no fault found, go to **Step E.**
   - If fault found, refer to OEM guidelines for repair or replacement of the vehicle charging/battery system. Go to **Step V.**

   **Note:** Some chassis use a power distribution system separate from the batteries, inspect all connections.

## E

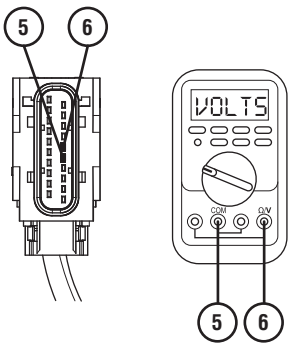
***Purpose:*** *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect the 20-Way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Inspect the TCM side of the 20-Way TCM Vehicle Harness 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 contamination or damage is found, refer to OEM guidelines for repair or replacement of the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no contamination or damage is found, go to **Step F.**

## F

***Purpose:*** *Verify Battery Voltage1 at the 20-Way TCM Vehicle Harness Connector.*

1. Key off.
2. Measure voltage between 20-Way TCM Vehicle Harness Connector Pin 5 (-) and Pin 6 (+). 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 vehicle charging/battery system, Vehicle Harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is between the vehicle charging/battery system and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of the Vehicle Harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 5 to 6 | 11–15V | |

## G

***Purpose:*** *Verify Battery Voltage1 supply to the TCM with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From the “Default Parameter Files” tab, select “Transmission Supplied Voltages”.
5. Monitor 168 - Battery voltage value. Record reading in table.
6. Monitor 444 - Battery 2 voltage value. Record reading in table.
7. Key on with engine running.
8. Monitor 168 - Battery voltage value. Record reading in table.
9. Monitor 444 - Battery 2 voltage value. Record reading in table.
10. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the vehicle charging/battery system. Go to **Step V.**
    - If readings are in range and Fault Code 100 FMI 0 is Inactive, vehicle may have been jump-started or the intermittent nature of the fault makes it likely that the problem is with the vehicle charging/battery system. Refer to OEM guidelines for diagnosing the vehicle charging/battery system. Go to **Step V.**
    - If readings are in range and Fault Code 100 FMI 0 is Active, replace the TCM. Go to **Step V.**

      **Note:** Troubleshooting indicates no fault found with the wiring or connections to the TCM. Ensure an intermittent issue does not exist with the wiring or connections.

| Condition | Parameter | Range | Reading(s) |
|---|---|---|---|
| Key on with engine off | 168-Battery voltage | 11–13 V | |
| Key on with engine off | 444-Battery 2 voltage | 11–13 V | |
| Key on with engine running | 168-Battery voltage | 13–15V | |
| Key on with engine running | 444-Battery 2 voltage | 13–15V | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
    - If no fault codes set and the vehicle operates properly, test complete.
    - If Fault Code 100 sets Active during Operation, go to **Step A.**
    - If a fault code other than 100 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 105: Battery Voltage2

**J1939: SA 3 SPN 444 FMI 0, 1, 4, 17, 18**

## Overview

The Transmission Control Module (TCM) requires a battery power and ground supply. The TCM has redundant power and ground sources (Battery Voltage1 and Battery Voltage2) and will function normal if either source becomes unavailable. The Battery Voltage2 circuit is contained within the 20-Way TCM Vehicle Harness Connector.

## Detection

The TCM monitors Battery Voltage2 power and ground source. If the system detects voltage out of range, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** Battery Voltage2 more than 16.5V for 1 second.

**FMI 1 – Data Valid But Below Normal (Most Severe):** Battery Voltage2 less than 8V for 1 second.

**FMI 4 – Voltage Below Normal or Shorted Low:** Battery Voltage2 less than 4V during power up.

**FMI 17 – Data Valid But Below Normal (Least Severe)**: Battery Voltage2 less than 11V for 1 second with engine above 1000 RPM.

**FMI 18 – Data Valid But Below Normal (Moderately Severe):** Battery Voltage2 less than 10.2V for 1 second with engine above 550 RPM.

## Fallback

**FMI 0:**

- No degraded performance

**FMI 1, 4, 17, 18:**

- Amber warning lamp on
- No degraded performance

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 17, 18:** Battery Voltage2 in range for 10 seconds.

**FMI 4:** Key cycle.

## Possible Causes

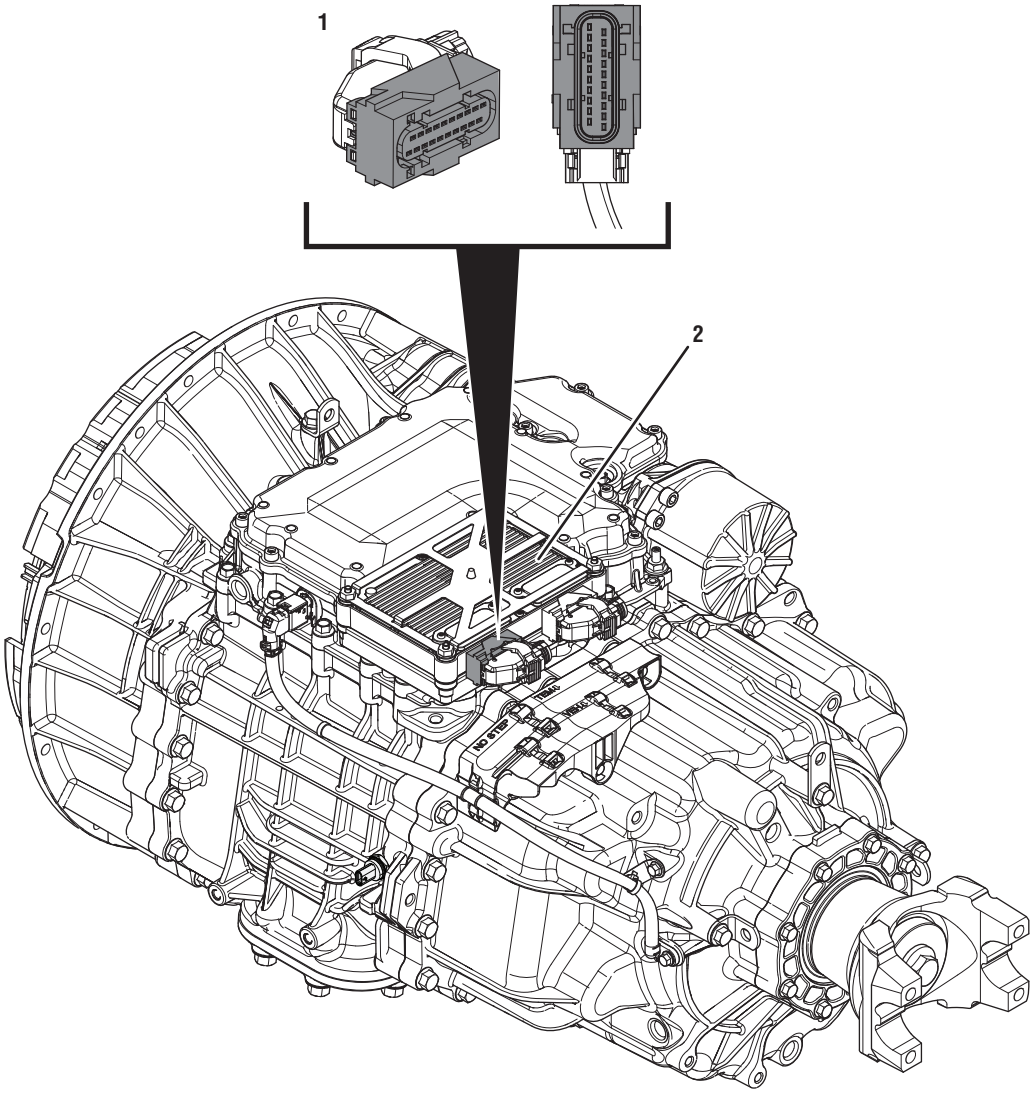
**FMI 0:**

- Vehicle jump-started
- Vehicle charging system failure

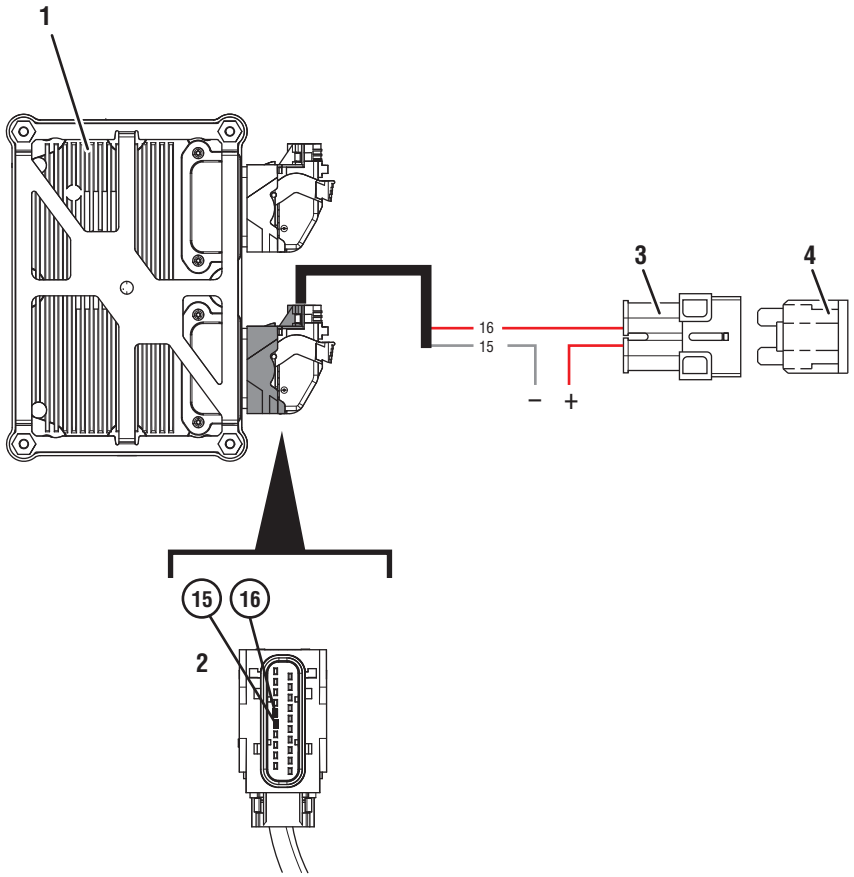
**FMI 1, 4, 17, 18:**

- Vehicle Harness
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded or loose
- Vehicle charging/battery system failure

## Component Identification




*1. 20-Way TCM Vehicle Harness Connector*
*2. Transmission Control Module (TCM)*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. In-line Fuse Holder Battery Voltage2*
*4. 15-amp Fuse Battery Voltage2*

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

# Fault Code 105 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 105 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 105 FMI 0 is Active, go to **Step G.**
   - If Fault Code 105 FMI 0 is Inactive, the TCM experienced an over-voltage condition. Vehicle may have been jump-started or vehicle charging/battery system is failing. Refer to OEM guidelines for repair or replacement of the vehicle charging/battery system. Go to **Step V.**
   - If Fault Code 105 FMI 1, 17 or 18 is Active, go to **Step C.**
   - If Fault Code 105 FMI 1, 17 or 18 is Inactive, go to **Step B.**
   - If Fault Code 105 FMI 4 is Active or Inactive, create a Service Activity Report, select "Send to Eaton" and contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**.

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Service Routines”
4. Start Product Diagnostic Test and follow on-screen prompts.

   **Note:** Solid “PD” may appear in display when PD Test is active.

   **Note:** TCM will not enter PD Test mode when there are Active fault code.


5. Wiggle the vehicle harness and connections between the charging/battery system and 20-Way TCM Vehicle Harness Connector. Look for signs of rubbing or chafing on the wires. Refer to OEM wiring diagrams.
6. To end the test, press the stop button.
   - If fault codes set Active while wiggling the vehicle harness, refer to OEM guidelines for repair or replacement of the vehicle harness and/or the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

## C

***Purpose:*** *Verify Battery Voltage2 supply to the TCM with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From the “Default Parameter Files” tab, select “Transmission Supplied Voltages”.
5. Monitor 168 - Battery voltage value. Record reading in table.
6. Monitor 444 - Battery 2 voltage value. Record reading in table.
7. Compare reading(s) in table.
   - If readings are out of range, go to **Step D.**
   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Vehicle Harness between the charging/battery system and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of the Vehicle Harness and/or 20-Way TCM Vehicle Harness Connector.Go to **Step V.**

| Parameter | Range | Reading(s) |
|---|---|---|
| 168-Battery voltage | 11–15 V | |
| 444-Battery 2 Voltage | 11–15 V | |

## D

***Purpose:*** *Verify condition of charging/battery system, fuse, power and ground supplies to the TCM.*

1. Key off.
2. Inspect the vehicle charging/battery system and fuses, verify the connectors are free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector bodies.
   - If no fault found, go to **Step E.**
   - If fault found, refer to OEM guidelines for repair or replacement of the vehicle charging/battery system. Go to **Step V.**

   **Note:** Some chassis use a power distribution system separate from the batteries, inspect all connections.

## E

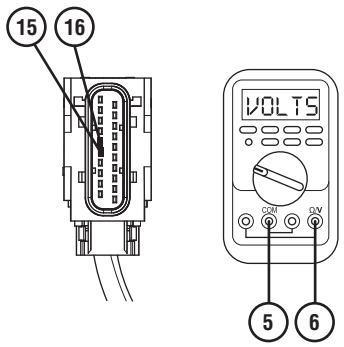
***Purpose:*** *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect the 20-Way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Inspect the TCM side of the 20-Way TCM Vehicle Harness 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 contamination or damage is found, refer to OEM guidelines for repair or replacement of the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no contamination or damage is found, go to **Step F.**

## F

***Purpose:*** *Verify Battery Voltage2 at the 20-Way TCM Vehicle Harness Connector.*

1. Key off.
2. Measure voltage between 20-Way TCM Vehicle Harness Connector Pin 15 (-) and Pin 16 (+). 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 vehicle charging/battery system, Vehicle Harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is between the vehicle charging/battery system and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of the Vehicle Harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 15 to 16 | 11–15 V | |

## G

***Purpose:*** *Verify Battery Voltage2 supply to the TCM with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From the “Default Parameter Files” tab, select “Transmission Supplied Voltages”.
5. Monitor 168 - Battery voltage value. Record reading in table.
6. Monitor 444 - Battery 2 voltage value. Record reading in table.
7. Key on with engine running.
8. Monitor 168 - Battery voltage value. Record reading in table.
9. Monitor 444 - Battery 2 voltage value. Record reading in table.
10. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the vehicle charging/battery system. Go to **Step V.**
    - If readings are in range and Fault Code 105 FMI 0 is Inactive, vehicle may have been jump-started or the intermittent nature of the fault makes it likely that the problem is with the vehicle charging/battery system. Refer to OEM guidelines for diagnosing the vehicle charging/battery system. Go to **Step V.**
    - If readings are in range and Fault Code 105 FMI 0 is Active, replace the TCM. Go to **Step V.**

      **Note:** Troubleshooting indicates no fault found with the wiring or connections to the TCM. Ensure an intermittent issue does not exist with the wiring or connections.

| Condition | Parameter | Range | Reading(s) |
|---|---|---|---|
| Key on with engine off | 168-Battery voltage | 11–13 V | |
| Key on with engine off | 444-Battery 2 Voltage | 11–13 V | |

| Condition | Parameter | Range | Reading(s) |
|---|---|---|---|
| Key on with engine running | 168-Battery voltage | 13–15V | |
| Key on with engine running | 444-Battery 2 Voltage | 13–15V | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
    - If no fault codes set and the vehicle operates properly, test complete.
    - If Fault Code 105 sets Active during operation, go to **Step A.**
    - If a fault code other than 105 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13

# Fault Code 110: Ignition Voltage

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

## Overview

The Transmission Control Module (TCM) requires a key on battery voltage ignition supply. The Ignition Voltage initiates TCM operation at and during key on. The Ignition Voltage circuit is contained within the 20-Way TCM Vehicle Harness Connector.

## Detection

The TCM monitors the vehicle's Ignition Voltage supply. If the system detects a loss of Ignition Voltage while driving, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** Loss of Ignition Voltage with output shaft speed greater than 10 RPM.

## Fallback

**FMI 2:**

- Engine communications may not be available
- If vehicle comes to a stop, TCM will shut down

**Note:** Refer to OEM for troubleshooting a failed system. Engine fallback modes may vary. If Engine ECU loses Ignition supply, Engine may shut down.

## Conditions to Set Fault Code Inactive

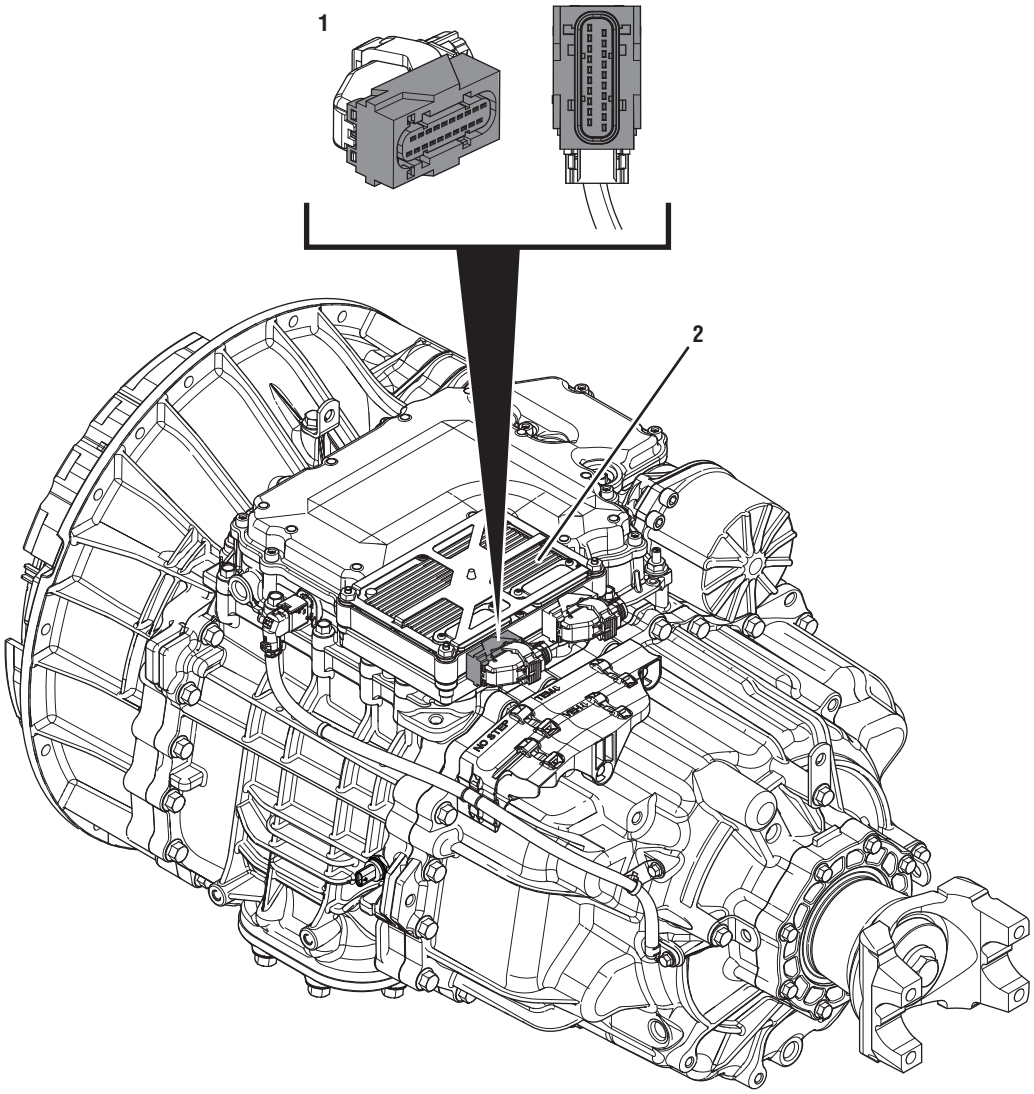
**FMI 2:** Ignition Voltage is available with output shaft speed less than 10 RPM.

## Possible Causes

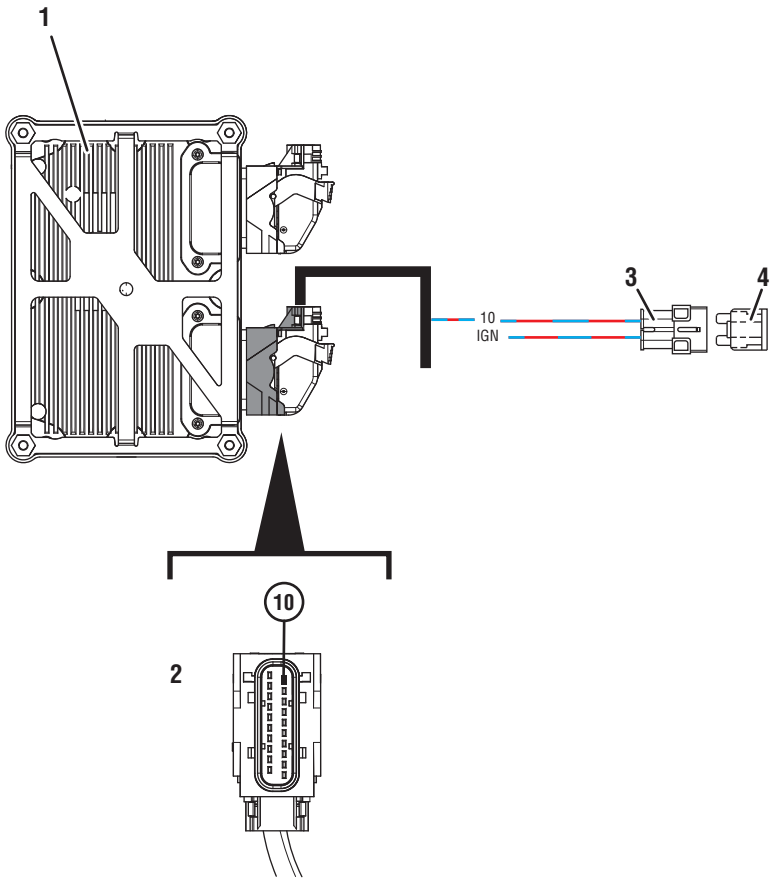
**All FMIs:**

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

## Component Identification




*1. 20-Way TCM Vehicle Harness Connector*
*2. Transmission Control Module (TCM)*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. In-line Fuse Holder*
*4. 10-amp Fuse*

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

# Fault Code 110 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 vehicle comes to a stop, TCM will shut down, and Fault Code 110 will be Inactive.

   - If Fault Code 110 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 110 FMI 2 is Inactive, go to **Step B.**

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”
4. From the “Default Parameter Files” tab, select “Transmission Supplied Voltages”.
5. Monitor 158 - Battery voltage - switched value. Record reading in table.
6. Compare reading(s) in table.
   - If readings are within range:
     - Driver may have cycled the key off while the vehicle was moving.

       or
     - The intermittent nature of the fault makes it likely that the problem is between the vehicle’s Ignition Voltage supply and 20-Way TCM Vehicle Harness Connector Pin 10. Refer to OEM guidelines for repair or replacement of the Ignition Voltage supply circuit. Go to **Step V.**

| Parameter | Range | Reading(s) |
|---|---|---|
| 158-Battery voltage - switched | 11–15 V | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 110 sets Active during operation, go to **Step A.**
   - If a fault code other than 110 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 115: Primary Data Link (J1939 A)

**J1939: SA 3 SPN 639 FMI 2, 8, 9, 14, 19, 31**

## Overview

The Transmission Control Module (TCM) communicates with other vehicle Electronic Control Units (ECUs) over the vehicle J1939 data link. The TCM uses two vehicle J1939 data links to send and receive messages called the Primary Data Link and Secondary Data Link. The Primary Data Link is used by the TCM to communicate with the Engine, ABS, Body, and other vehicle ECUs during normal operation. The Secondary Data Link is used as a backup in the event that the Primary Data Link is inoperative. The Primary Data Link is connected to the TCM at the 20-Way TCM Vehicle Harness Connector.

## Detection

The TCM monitors messages broadcast over the vehicle Primary Data Link (J1939 A). If vehicle or engine messages are not received or in error, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** Vehicle Primary Data Link (J1939 A) messages not received for 1 second (Service).

**FMI 8 – Abnormal Frequency:** Engine Primary Data Link (J1939 A) messages not received for 1 second while the TCM is receiving messages from other vehicle ECUs (Service).

**FMI 9 – Abnormal Update Rate:** Vehicle Primary Data Link (J1939 A) messages not received for 5 seconds.

**FMI 14 – Special Instructions:** Engine Primary Data Link (J1939 A) messages not received for 5 seconds while the TCM is receiving messages from other vehicle ECUs.

**FMI 19 – Received Network Data In Error:** Vehicle Primary Data Link (J1939 A) messages received but in error.

**FMI 31 – Condition Exists:** Vehicle Primary Data Link (J1939 A) receiving a "Stop Start Broadcast" message.

## Fallback

**FMI 2, 8, 19:**

- Amber warning lamp on
- No degraded modes

**FMI 9, 14:**

- Amber warning lamp on
- If vehicle is configured for J1939 Start Enable feature, engine may not crank
- Lowest available start gear only
- Urge to Move and Creep prohibited
- Launch quality may degrade
- Upshifts prohibited
- PTO mode prohibited
- If vehicle is moving and transmission is in a gear higher than the lowest available start gear and Secondary Data Link is not available:
  - Red stop lamp on
  - Clutch engagement prohibited, vehicle may coast to stop
  - Transmission downshifts to lowest available start gear

**FMI 31:**

- Amber warning lamp on
- If vehicle is configured for J1939 Start Enable feature, engine may not crank
- Lowest available start gear only
- Urge to Move and Creep prohibited
- Launch quality may degrade
- Upshifts prohibited
- PTO mode prohibited
- Non-Neutral modes prohibited

## Conditions to Set Fault Code Inactive

**FMI 2:** Valid vehicle Primary Data Link (J1939 A) messages received for 20 seconds.

**FMI 8:** Valid engine Primary Data Link (J1939 A) messages received for 20 seconds.

**FMI 9:** Valid vehicle Primary Data Link (J1939 A) messages received for 10 seconds.

**FMI 14:** Valid engine Primary Data Link (J1939 A) messages received for 10 seconds.

**FMI 19:** Key cycle and condition no longer exists.

**FMI 31:** Condition no longer exists.

## Possible Causes

**FMI 2, 9:**

- Vehicle Primary Data Link (J1939 A)
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, or loose terminals
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Other Vehicle ECU(s)
  - Internal failure

**FMI 8, 14:**

- Vehicle Primary Data Link (J1939 A) – Between Engine ECU and TCM
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, or loose terminals
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Engine ECU
  - Not powering up
  - Internal failure

**FMI 19:**

- Other Vehicle ECU(s)
  - Internal failure

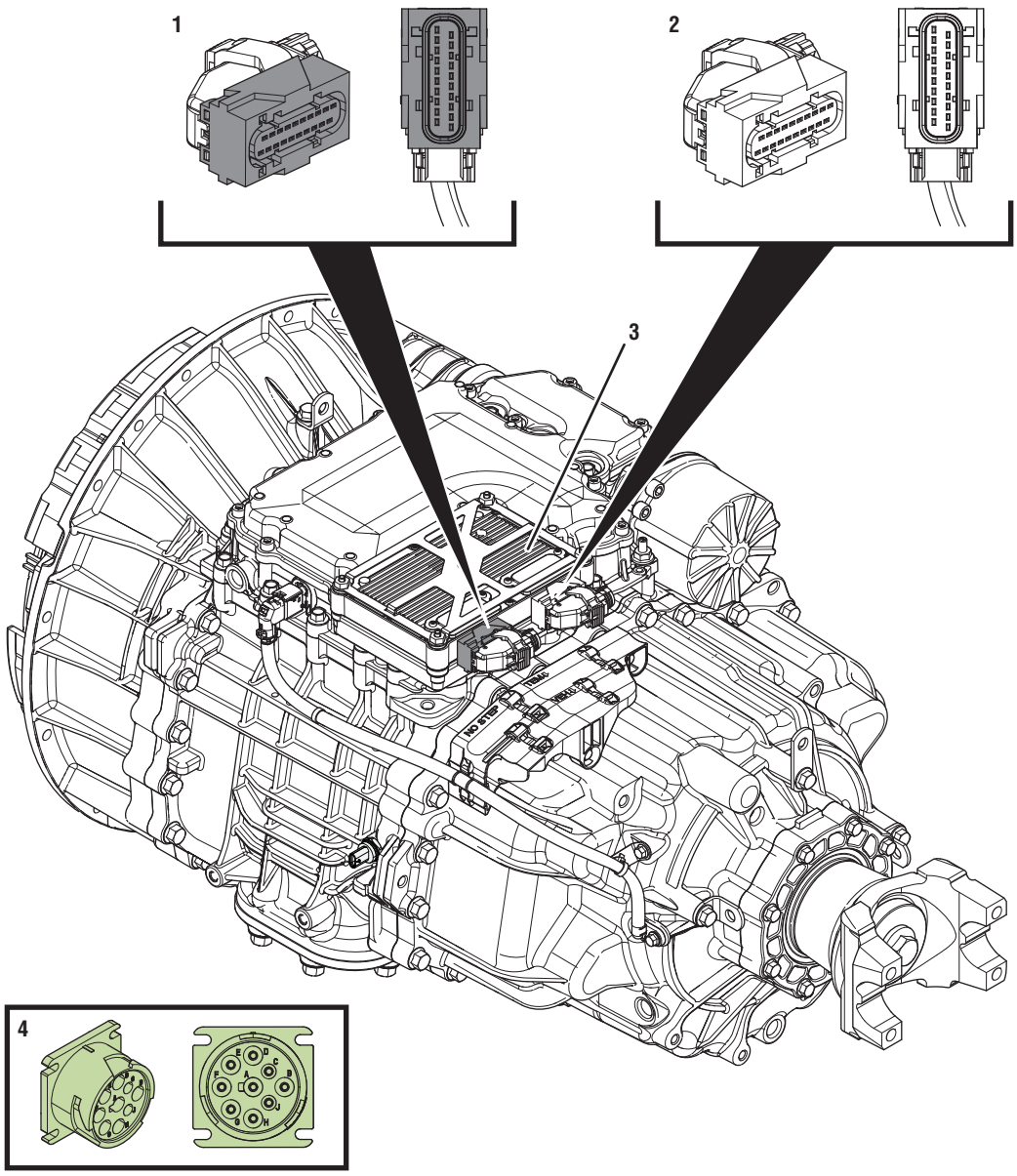
**FMI 31:**

- Other Vehicle ECU(s)
  - Informational only, indicates a Vehicle ECU experienced a programming event.

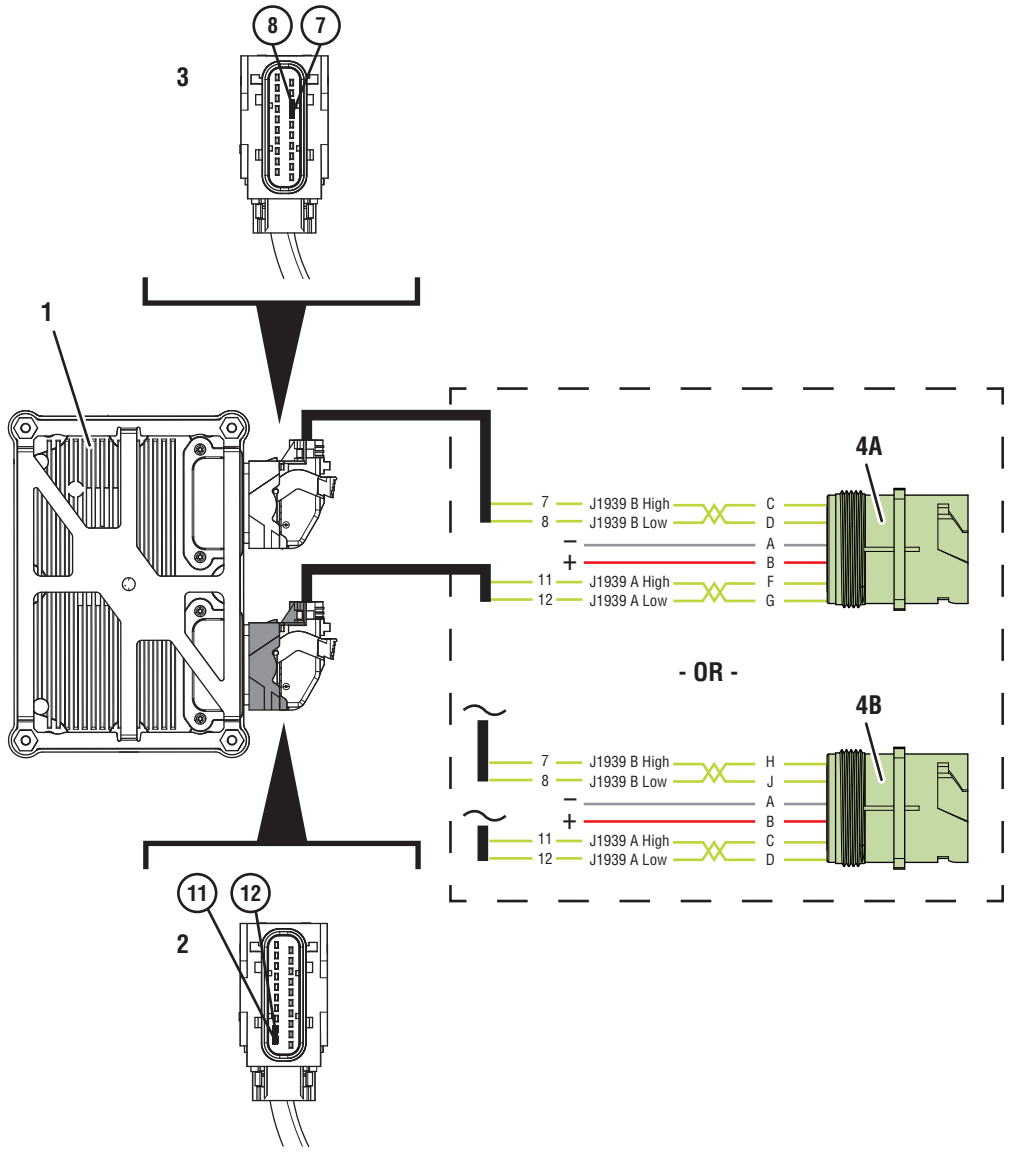
## Additional Tools

- Endurant Service Manual TRSM0950
- Digital Volt Ohm Meter (DVOM)

## Component Identification




*1. 20-Way TCM Vehicle Harness Connector*
*2. 20-Way TCM Body Harness Connector*
*3. Transmission Control Module (TCM)*
*4. 9-Way Type 2 Diagnostic Connector (In Cab)*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. 20-Way TCM Body Harness Connector*
*4A. 9-Way Type 2 Diagnostic Connector (OEM-Specific Primary Data Link FG)*
*4B. 9-Way Type 2 Diagnostic Connector (OEM-Specific Primary Data Link CD)*

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

# Fault Code 115 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 115 FMI 2, 9 is Active, go to **Step C.**
   - If Fault Code 115 FMI 2, 9 is Inactive, go to **Step B.**

     **Note:** If ServiceRanger connects to the TCM, the vehicle data link is currently functional between the 9-Way Diagnostic Connector and TCM. Refer to OEM guidelines for vehicle data link diagnostic instructions.
   - If Fault Code 115 FMI 14 is Active, go to **Step O.**

     **Note:** If ServiceRanger connects to the TCM, the vehicle data link is currently functional between the 9-Way Diagnostic Connector and TCM. Refer to OEM guidelines for Engine ECU and vehicle data link diagnostic instructions.
   - If Fault Code 115 FMI 14 is Inactive, an intermittent condition may exist on the Primary Data Link with the following:
     - Power up issue with the Engine ECU
     - Vehicle Primary Data Link to the Engine ECU
     - Fault(s) reported from the Engine ECU
     - Refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939A) or Engine ECU. Go to **Step V.**
   - If Fault Code 115 FMI 19 is Active, a condition may exist on the Primary Data Link with the Engine ECU or other Vehicle ECU(s) reporting an issue. Refer to OEM for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 115 FMI 19 is Inactive, an intermittent condition may exist on the Primary Data Link with the Engine ECU or other Vehicle ECU(s) reporting an issue. Contact OEM for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 115 FMI 31 is Inactive or Active, informational only, indicates a vehicle ECU experienced a programming event. Test complete.

## B

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Service Routines”
4. Start Product Diagnostic Test and follow on-screen prompts.

   **Note:** Solid “PD” may appear in display when PD Test is active.

   **Note:** TCM will not enter PD Test mode when there are Active fault code.


5. Wiggle the vehicle harness and connections between the charging/battery system and 20-Way TCM Vehicle Harness Connector. Look for signs of rubbing or chafing on the wires. Refer to OEM wiring diagrams.
6. To end the test, press the stop button.
   - If fault codes set Active while wiggling the vehicle harness, refer to OEM guidelines for repair or replacement of the vehicle harness and/or the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no fault codes become Active, go to **Step D.**

## C

***Purpose:*** *Verify fault status with 20-Way TCM Body Harness Connector disconnected.*

1. Key off.
2. Disconnect 20-Way TCM Body Harness Connector.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 115 is now Inactive, a wiring issue exists with the Secondary Data Link (J1939 B) within the 20-Way TCM Body Harness Connector or harness. Refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If Fault Code 115 was Inactive or remains Active, key off and reconnect 20-Way TCM Body Harness Connector. Go to **Step D.**

## D

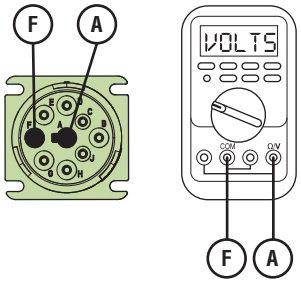
***Purpose:*** *Identify TCM location on Vehicle Primary Data Link (J1939 A).*

1. Key off.
2. Refer to the OEM and identify the TCM location on the Vehicle Primary Data Link (J1939A) at the 9-Way Diagnostic Connector.
   - If the TCM is on 9-Way Diagnostic Connector Pin C and Pin D, go to **Step J.**
   - If the TCM is on 9-Way Diagnostic Connector Pin F and Pin G, go to **Step E.**

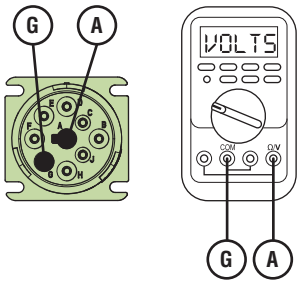
**E**

***Purpose:*** *Verify Vehicle Primary Data Link (J1939 A) signal voltage.*

1. Key on with engine off.
2. Measure voltage between 9-Way Diagnostic Connector Pin F and Pin A. Record reading in table.




3. Measure voltage between 9-Way Diagnostic Connector Pin G and Pin A. Record reading in table.



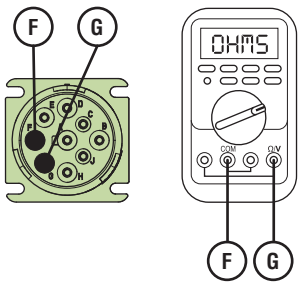

4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step F.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| F to A | N/A | |
| G to A | N/A | + |
| Total Voltage | 4.5–5.5 V | = |

## F

***Purpose:*** *Verify resistance of Vehicle Primary Data Link (J1939 A).*

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 vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step G.**

| Pins | Range | Reading(s) |
|---|---|---|
| F to G | 50–70 Ohms | |

## G

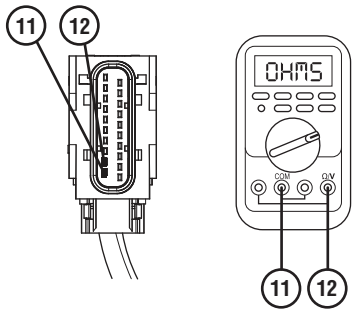
***Purpose:*** *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect the 20-way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Inspect the TCM side of the 20-Way TCM Vehicle Harness 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 contamination or damage is found, refer to OEM guidelines for repair or replacement of the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no contamination or damage is found, go to **Step H.**

## H

***Purpose:*** *Verify resistance of Vehicle Primary Data Link (J1939 A) at 20-Way TCM Vehicle Harness Connector.*

1. Key off.
2. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 11 and Pin 12. 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 vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step I.**

| Pins | Range | Reading(s) |
|---|---|---|
| 11 to 12 | 50–70 Ohms | |

## I

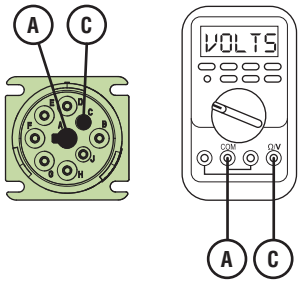
***Purpose:*** *Purpose: Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 115 is Inactive, an intermittent wiring issue exists within the vehicle Primary Data Link (J1939 A), refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If Fault Code 115 is Active and no fault was found with the vehicle Primary Data Link (J1939 A), replace the TCM. Go to **Step V.**

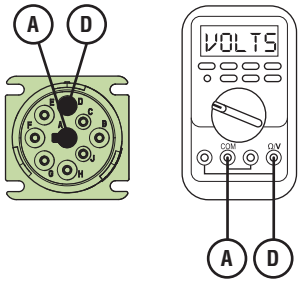
     **Note:** Troubleshooting indicates no fault found with the wiring or connections to the TCM. Ensure an intermittent issue does not exist with the wiring or connections.

**J** ***Purpose:*** *Verify Vehicle Primary Data Link (J1939 A) signal voltage.*

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




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



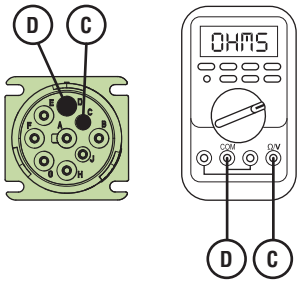

4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step K.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**

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

## K

***Purpose:*** *Verify resistance of Vehicle Primary Data Link (J1939 A).*

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 vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step L.**

| Pins | Range | Reading(s) |
|---|---|---|
| C to D | 50–70 Ohms | |

## L

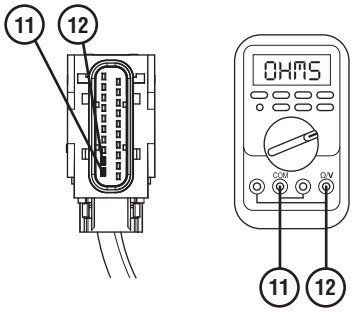
***Purpose:*** *Verify 20-Way Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect the 20-Way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Inspect the TCM side of the 20-Way TCM Vehicle Harness 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 contamination or damage is found, refer to OEM guidelines for repair or replacement of the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no contamination or damage is found, go to **Step M.**

## M

***Purpose:*** *Verify resistance of Vehicle Primary Data Link (J1939 A) at 20-Way TCM Vehicle Harness Connector.*

1. Key off.
2. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 11 and Pin 12. Record reading in table.




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

| Pins | Range | Reading(s) |
|---|---|---|
| 11 to 12 | 50–70 Ohms | |

## N

***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.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 115 is Inactive, an intermittent wiring issue exists within the vehicle Primary Data Link (J1939 A), refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If Fault Code 115 is Active and no fault was found with the vehicle Primary Data Link (J1939 A), replace the TCM. Go to **Step V.**

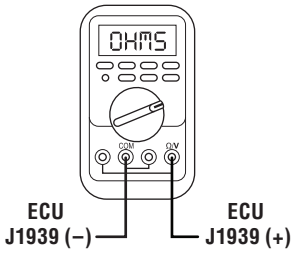
     **Note:** Troubleshooting indicates no fault found with the wiring or connections to the TCM. Ensure an intermittent issue does not exist with the wiring or connections.

## O

***Purpose:*** *Verify resistance of the Vehicle Primary Data Link (J1939 A) at Engine ECU Vehicle Harness Connector.*

1. Key off.
2. Locate and disconnect the Engine ECU vehicle harness connector containing the vehicle Primary Data Link (J1939 A).

   **Note:** Refer to OEM guidelines for Engine ECU vehicle harness connector location, connector removal, and J1939 High (+) and J1939 Low (-) connector pin locations.
3. Measure resistance between Engine ECU vehicle harness connector Pin J1939 High (+) and Pin J1939 Low (-). Record reading in table.




4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, Engine ECU has continuity to the vehicle Primary Data Link (J1939 A). A condition may exist with the following:
     - Power up issue with the Engine ECU
     - Fault message from the Engine ECU
     - Contact OEM for further diagnostic instructions. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| J1939 High (+) to J1939 Low (-) | 50–70 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. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 115 sets Active during operation, go to **Step A.**
   - If a fault code other than 115 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13

# Fault Code 116: Secondary Data Link (J1939 B)

**J1939: SA 3 SPN 1231 FMI 9, 14**

## Overview

The Transmission Control Module (TCM) communicates with other vehicle Electronic Control Units (ECUs) via the vehicle J1939 data link. The TCM uses two vehicle J1939 data links to send and receive messages called the Primary Data Link and Secondary Data Link. The Primary Data Link is used by the TCM to communicate with the Engine, ABS, Body, and other vehicle ECUs during normal operation. The Secondary Data Link is used as a backup in the event that the Primary Data Link is inoperative. The Secondary Data Link is connected to the TCM at the 20-Way TCM Body Harness Connector.

## Detection

The TCM monitors messages broadcast over the vehicle Secondary Data Link (J1939 B). If engine or vehicle messages are not received or in error, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 9 – Abnormal Update Rate:** Vehicle Secondary Data Link (J1939 B) messages not received for 5 seconds.

**FMI 14 – Special Instructions:** Vehicle Secondary Data Link (J1939 B) Engine messages not received for 5 seconds while the TCM is receiving messages from other vehicle ECUs.

## Fallback

**FMI 9, 14:**

- Amber warning lamp on
- If Fault Code 115, 165 or 176 is Active and the transmission is in neutral:
  - Non neutral modes prohibited
  - PTO Mode prohibited
- If Fault Code 115, 165 or 176 is Active, the vehicle is moving or the transmission is in a gear higher than the lowest available start gear:
  - Red stop lamp on
  - Clutch engagement prohibited, vehicle may coast to a stop
  - Transmission downshifts to lowest available start gear

## Conditions to Set Fault Code Inactive

**FMI 9:** Valid vehicle Secondary Data Link (J1939 B) messages received for 10 seconds.

**FMI 14:** Valid vehicle Secondary Data Link (J1939 B) Engine messages received for 10 seconds.

## Possible Causes

**FMI 9:**

- Secondary Data Link (J1939 B) not configured correctly in the TCM
- Vehicle Secondary Data Link (J1939 B)
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, or loose terminals
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Other Vehicle ECU(s)
  - Internal failure

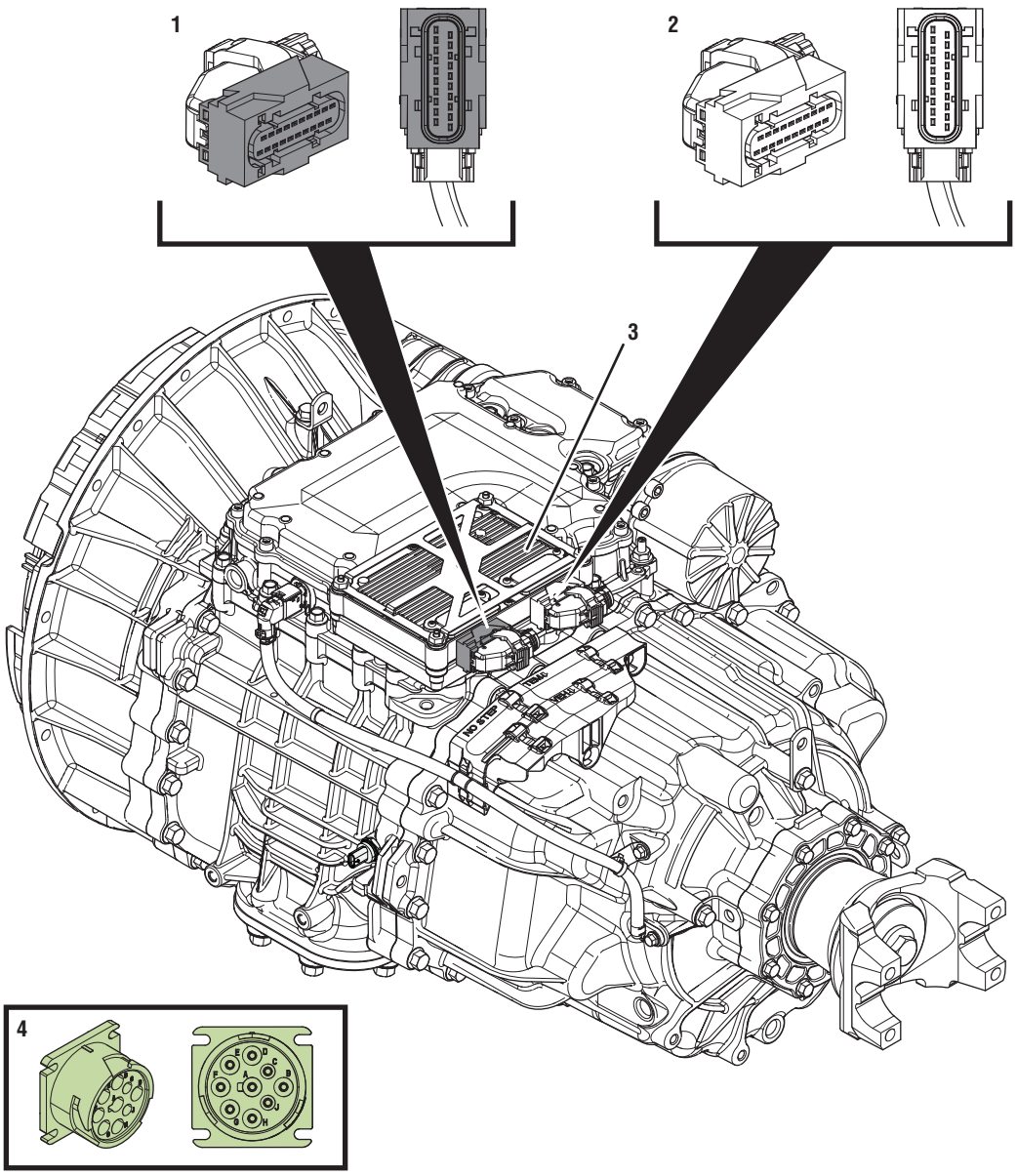
**FMI 14:**

- Vehicle Secondary Data Link (J1939 B) – Between Engine ECU and TCM
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, or loose terminals
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Engine ECU
  - Not powering up
  - Internal failure

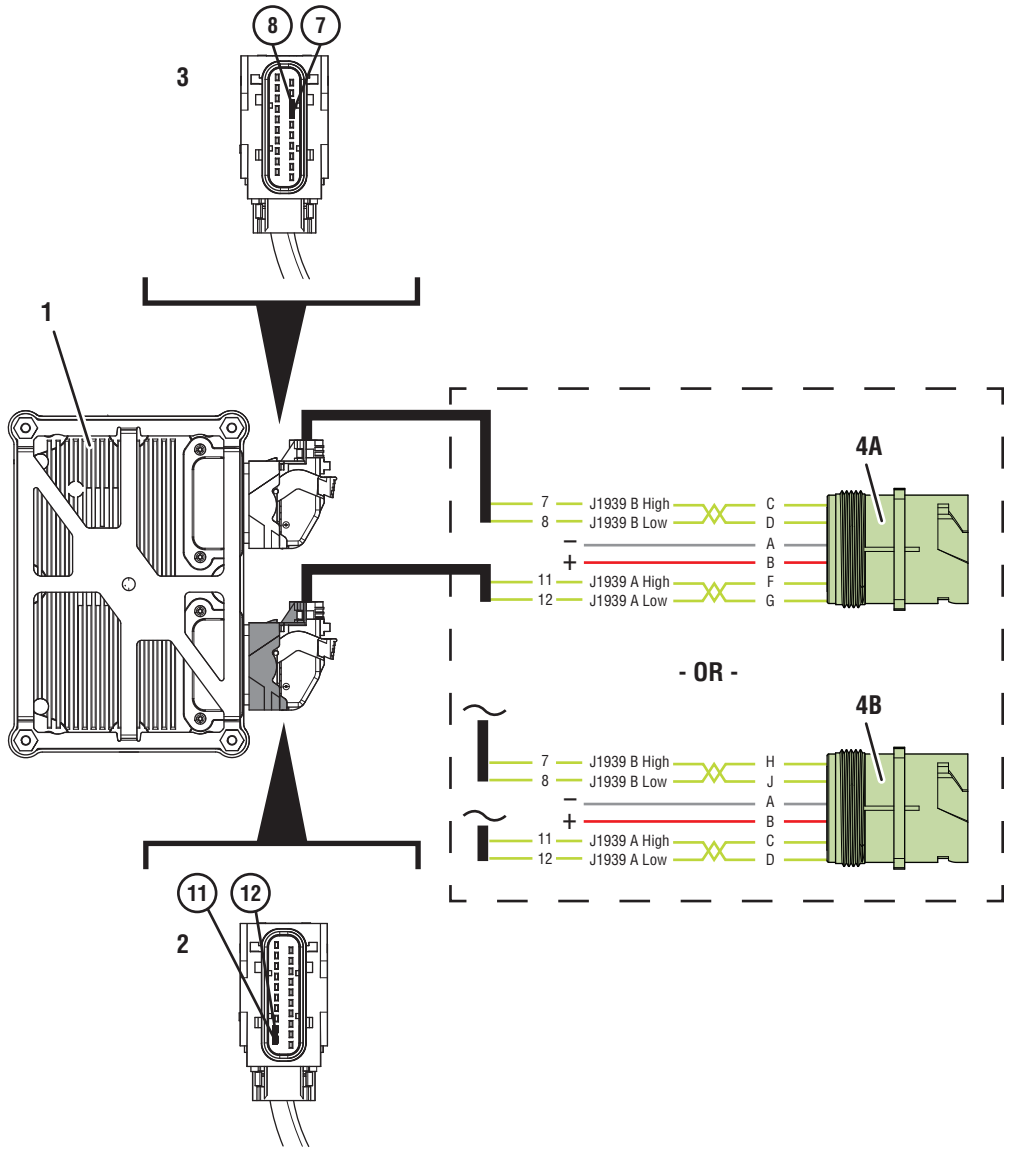
## Additional Tools

- Endurant Service Manual TRSM0950
- Digital Volt Ohm Meter (DVOM)

## Component Identification




*1. 20-Way TCM Vehicle Harness Connector*
*2. 20-Way TCM Body Harness Connector*
*3. Transmission Control Module (TCM)*
*4. 9-Way Type 2 Diagnostic Connector (In Cab)*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. 20-Way TCM Body Harness Connector*
*4A. 9-Way Type 2 Diagnostic Connector (OEM-Specific Primary Data Link FG)*
*4B. 9-Way Type 2 Diagnostic Connector (OEM-Specific Primary Data Link CD)*

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

# Fault Code 116 Troubleshooting

**A**

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 116 FMI 9 is Active or Inactive, go to **Step B.**
   - If Fault Code 116 FMI 14 is Active, go to **Step N.**
   - If Fault Code 116 FMI 14 is Inactive, an intermittent condition may exist on the Secondary Data Link with the following:
     - Power up issue with the Engine ECU
     - Vehicle Secondary Data Link to the Engine ECU
     - Fault(s) reported from the Engine ECU
     - Refer to OEM guidelines for repair or replacement of vehicle Secondary Data Link (J1939A) or Engine ECU. Go to **Step V.**

**B**

***Purpose:*** *Verify Secondary Data Link (J1939 B) Baud Rate configured in the TCM and installed on the vehicle.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Configuration”.
6. Select “Vehicle”.
7. Record the “Secondary J1939 Baud Rate” "Current Value" in table.
8. Record the “Secondary J1939 Baud Rate” installed on the vehicle in table.

   **Note:** The vehicle's Secondary J1939 Baud Rate (250K or 500K) is determined by OEM. Refer to the OEM regarding the Secondary J1939 Baud Rate installed on the vehicle.
9. Compare reading(s) in table.
   - If “Secondary J1939 Baud Rate” 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.**
   - If FMI 9 is Active and “Secondary J1939 Baud Rate” is configured correctly, go to **Step C.**

| Location | Secondary J1939 Baud Rate |
|---|---|
| TCM (ServiceRanger) | |
| Vehicle | |

## C

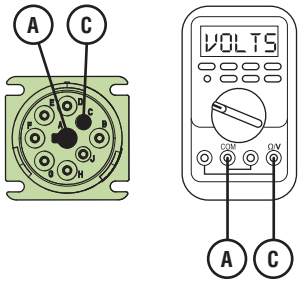
***Purpose:*** *Identify TCM location on Secondary Data Link (J1939 B).*

1. Key off.
2. Refer to the OEM and identify the TCM location on the Vehicle Secondary Data Link (J1939 B) at the 9-Way Diagnostic Connector.
   - If the TCM is on 9-Way Diagnostic Connector Pin C and Pin D, go to go to **Step D.**
   - If the TCM is on 9-Way Diagnostic Connector Pin H and Pin J, go to **Step I.**

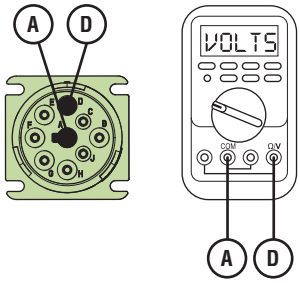
## D

***Purpose:*** *Verify Vehicle Secondary Data Link (J1939 B) signal voltage.*

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




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



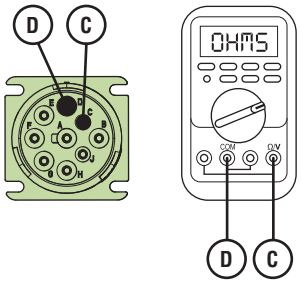

4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step E.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Secondary Data Link (J1939 B). Go to **Step V.**

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

## E

***Purpose:*** *Verify resistance of Vehicle Secondary Data Link (J1939 B).*

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 vehicle Secondary Data Link (J1939 B). Go to **Step V.**
   - If readings are in range, go to **Step F.**

| Pins | Range | Reading(s) |
|---|---|---|
| C to D | 50–70 Ohms | |

## F

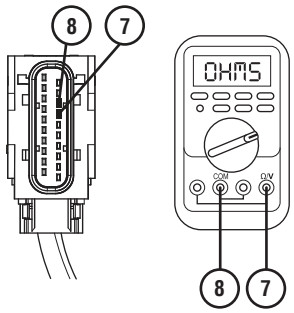
***Purpose:*** *Verify 20-Way TCM Body Harness Connector condition.*

1. Key off.
2. Disconnect the 20-way TCM Body Harness Connector.
3. Inspect the 20-Way TCM Body Harness 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.
4. Inspect the TCM side of the 20-Way TCM Body Harness 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 contamination or damage is found, refer to OEM guidelines for repair or replacement of the 20-Way TCM Body Harness Connector. Go to **Step V.**
   - If no contamination or damage is found, go to **Step G.**

## G

***Purpose:*** *Verify resistance of Vehicle Secondary Data Link (J1939 B) at 20-Way TCM Body Harness Connector.*

1. Key off.
2. Measure resistance between 20-Way TCM Body Harness Connector Pin 7 and Pin 8. 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 vehicle Secondary Data Link (J1939 B). Go to **Step V.**
   - If readings are in range, go to **Step H.**

| Pins | Range | Reading(s) |
|---|---|---|
| 7 to 8 | 50–70 Ohms | |

## H

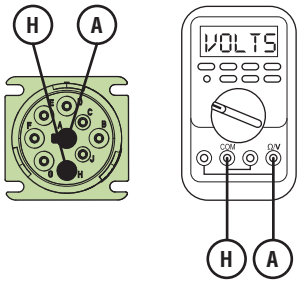
***Purpose:*** *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 116 is Inactive, an intermittent wiring issue exists within the vehicle Secondary Data Link (J1939 B), refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If Fault Code 116 is Active and no fault was found with the vehicle Secondary Data Link (J1939 B), replace the TCM. Go to **Step V.**

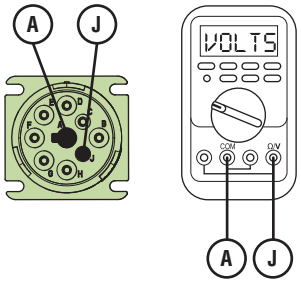
     **Note:** Troubleshooting indicates no fault found with the wiring or connections to the TCM. Ensure an intermittent issue does not exist with the wiring or connections.

**I** ***Purpose:*** *Verify Vehicle Secondary Data Link (J1939 B) signal voltage.*

1. Key on with engine off.
2. Measure voltage between 9-Way Diagnostic Connector Pin H and Pin A. Record reading in table.




3. Measure voltage between 9-Way Diagnostic Connector Pin J and Pin A. Record reading in table.



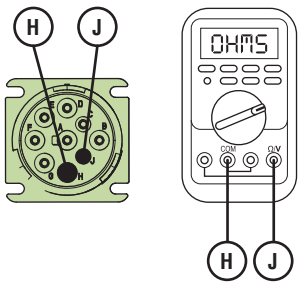

4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step J.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Secondary Data Link (J1939 B). Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| H to A | N/A | |
| J to A | N/A | + |
| Total Voltage | 4.7–5.3 V | = |

## J

***Purpose:*** *Verify resistance of the Vehicle Secondary Data Link (J1939 B).*

1. Key off.
2. Measure resistance between 9-Way Diagnostic Connector Pin H and Pin J. Record reading in table.




3. Compare reading(s) in table.
   - If reading is out of range, refer to OEM guidelines for repair or replacement of vehicle Secondary Data Link (J1939 B). Go to **Step V.**
   - If reading is in range, go to **Step K.**

| Pins | Range | Reading(s) |
|---|---|---|
| H to J | 50–70 Ohms | |

## K

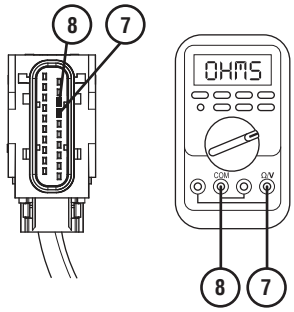
***Purpose:*** *Verify 20-Way TCM Body Harness Connector condition.*

1. Key off.
2. Disconnect the 20-way TCM Body Harness Connector.
3. Inspect the 20-Way TCM Body Harness 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.
4. Inspect the TCM side of the 20-Way TCM Body Harness 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 contamination or damage is found, refer to OEM guidelines for repair or replacement of the 20-Way TCM Body Harness Connector. Go to **Step V.**
   - If no contamination or damage is found, go to **Step L.**

## L

***Purpose:*** *Verify resistance of Vehicle Secondary Data Link (J1939 B) at 20-Way TCM Body Harness Connector.*

1. Key off.
2. Measure resistance between 20-Way TCM Body Harness Connector Pin 7 and Pin 8. 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 vehicle Secondary Data Link (J1939 B). Go to **Step V.**
   - If readings are in range, go to **Step M.**

| Pins | Range | Reading(s) |
|---|---|---|
| 7 to 8 | 50–70 Ohms | |

## M

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

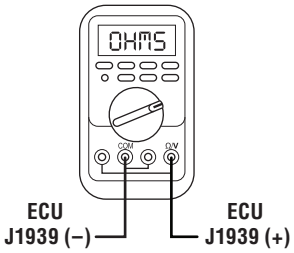
1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on, engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 116 is Inactive, an intermittent wiring issue exists within the vehicle Secondary Data Link (J1939 B), refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If Fault Code 116 is Active and no fault was found with the vehicle Secondary Data Link (J1939 B), replace the TCM. Go to **Step V.**

     **Note:** Troubleshooting indicates no fault found with the wiring or connections to the TCM. Ensure an intermittent issue does not exist with the wiring or connections.

**N** ***Purpose:*** *Verify resistance of the Vehicle Secondary Data Link (J1939 B) at Engine ECU Vehicle Harness Connector.*

1. Key off.
2. Locate and disconnect the Engine ECU vehicle harness connector containing the vehicle Secondary Data Link (J1939 B).

   **Note:** Refer to OEM guidelines for Engine ECU vehicle harness connector location, connector removal, and J1939 High (+) and J1939 Low (-) connector pin locations.
3. Measure resistance between Engine ECU vehicle harness connector Pin J1939 High (+) and Pin J1939 Low (-). Record reading in table.




4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Secondary Data Link (J1939 B). Go to **Step V.**
   - If readings are in range, Engine ECU has continuity to the vehicle Secondary Data Link (J1939 B). A condition may exist with the following:
     - Power up issue with the Engine ECU
     - Fault message from the Engine ECU

     Contact OEM for further diagnostic instructions. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| J1939 High (+) to J1939 Low (-) | 50–70 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. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 116 sets Active during operation, go to **Step A.**
   - If a fault code other than 116 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13

# Fault Code 120: Start Enable Relay

## J1939: SA 3 SPN 1321 FMI 3, 4, 5, 7, 12

### Overview
The Endurant Transmission disables 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 (SER) actuated by the Transmission Control Module (TCM) to interrupt power to the starter. Other vehicles rely on the TCM to send a Transmission Engine Crank Enable message over the Primary Data Link before the engine ECU will allow cranking. The SER and control circuits are contained within the 20-Way TCM Vehicle Harness Connector. Consult OEM wiring diagrams.

This fault indicates an electrical failure was detected in the SER or control circuits when the start enable type is configured for a relay in the TCM. This fault code will not set on vehicles that use J1939 messaging to enable engine cranking.

### Detection
The TCM monitors the SER control circuits. If a system failure is detected, the fault is set active.

### Conditions to Set Fault Code Active
**FMI 3 – Voltage Above Normal or Shorted High:**
SER circuit shorted to power for 1 second.

**FMI 4 – Voltage Below Normal or Shorted Low:**
SER circuit shorted to ground for 1 second.

**FMI 5 – Current Below Normal or Open Circuit:**
SER circuit open for 1 second.

**FMI 7 – Mechanical System Not Responding:** Engine cranked when SER was not energized by the TCM for 2 seconds.

**FMI 12 – Bad Intelligent Device:** SER enabled under inappropriate conditions.

### Fallback
**FMI 3, 4, 5, 7:**

- Amber Warning lamp on
- No degraded modes
- Engine may not crank

**FMI 12:**

- Amber Warning lamp on
- Engine cranking prohibited

### Conditions to Set Fault Code Inactive
**FMI 3:** SER circuit not shorted to power for 10 seconds.

**FMI 4:** SER circuit not shorted to ground for 10 seconds.

**FMI 5:** SER circuit not open for 10 seconds.

**FMI 7:** SER wiring issue corrected and ignition key cycle.

**FMI 12:** Key cycle.

### Possible Causes
**FMI 3, 4, 5:**

- Start enable type not configured correctly in the TCM
- SER
  - Internal failure
- SER circuit wiring
  - Wiring shorted to power, shorted to ground, or open.
  - Terminals may be bent, spread, or corroded.

**FMI 7:**

- SER
  - Internal failure
- SER circuit wiring
  - Incorrectly wired
  - Bypassed or “jumped” circuit wiring

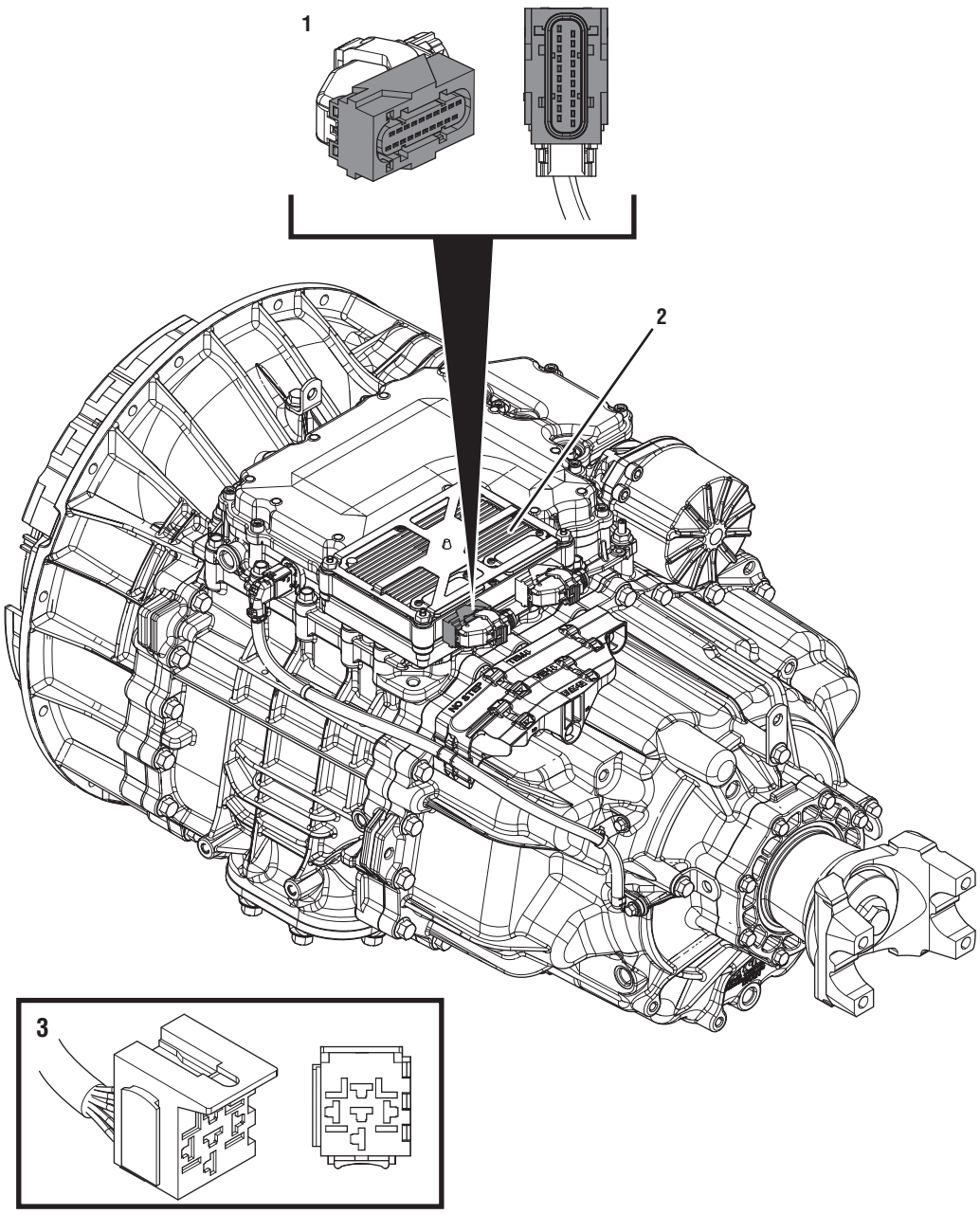
**FMI 12:**

- TCM
  - Internal failure
  - Software issue

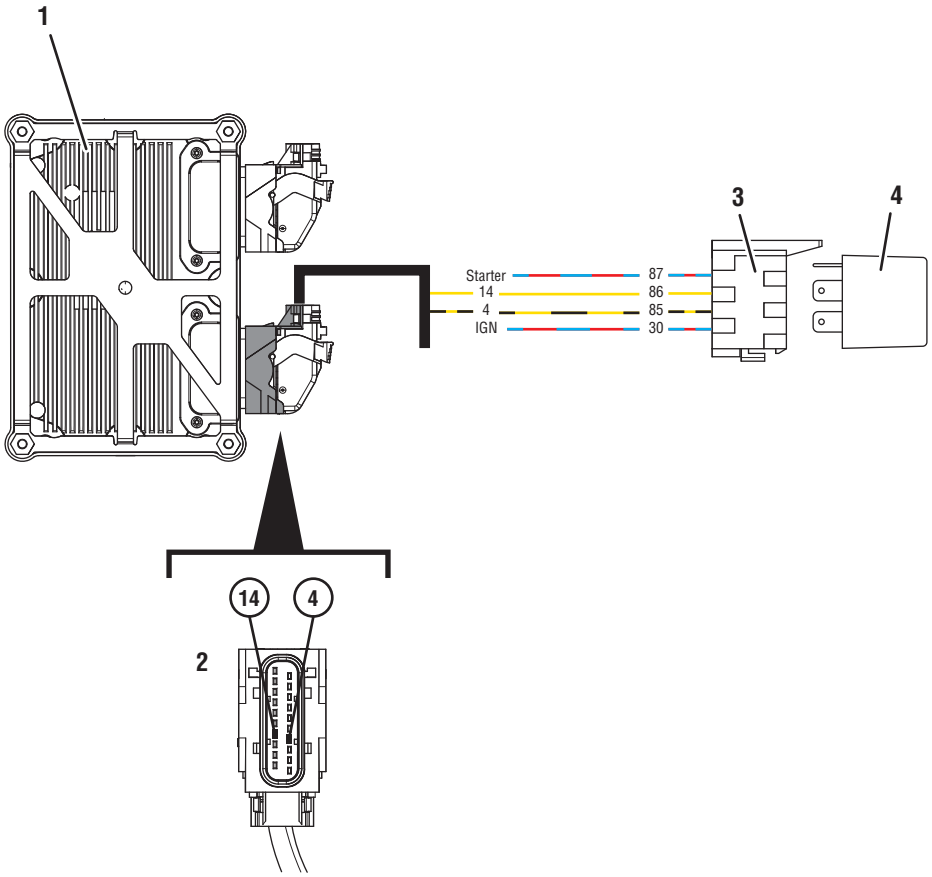
**Note:** Refer to OEM for troubleshooting a failed system.

### Additional Tools
Digital Volt Ohm Meter

## Component Identification

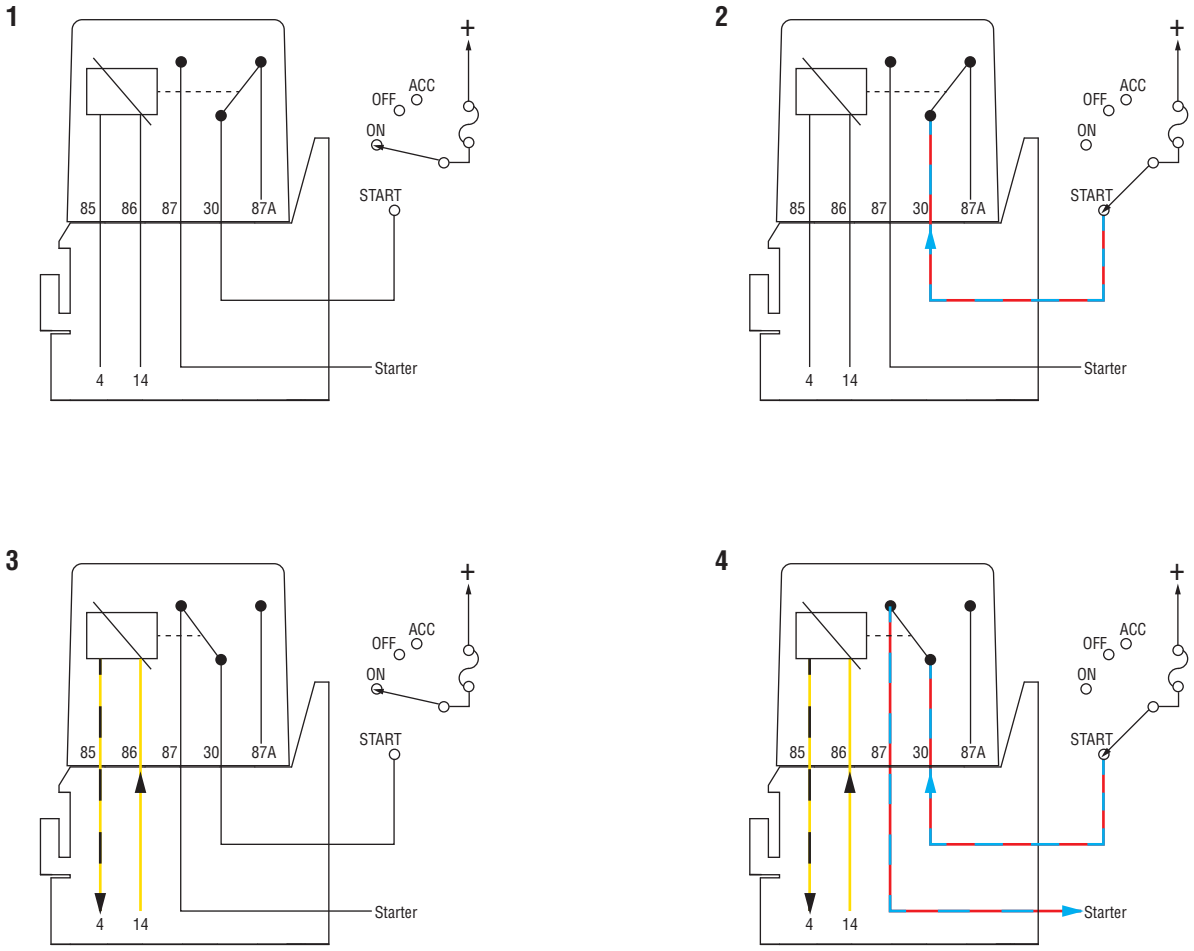



*1. 20-Way TCM Vehicle Harness Connector*
*2. Transmission Control Module (TCM)*
*3. 5-Way Start Enable Relay Socket*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. 5-Way Start Enable Relay Socket*
*4. 5-Way Start Enable Relay*

Battery Voltage
Ignition Voltage
Switched Battery from TCM
Switched 5V from TCM
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*

# Fault Code 120 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 120 is inactive and engine cranks, but does not run, refer to OEM for troubleshooting a failed system.

   **Note:** Some OEMs and chassis may use an alternate wiring pattern, which may include the use of second relay for other vehicle systems. Consult OEM wiring diagrams.

   - If Fault Code 120 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 120 FMI 3, 4, or 5 is Active, go to **Step B.**
   - If Fault Code 120 FMI 3, 4 or 5 is Inactive, go to **Step C.**
   - If Fault Code 120 FMI 7 is set, go to **Step K.**
   - If Fault Code 120 FMI 12 is Active or Inactive, go to **Step O.**

**B** ***Purpose:*** *Verify Start Enable Relay Type configured in the TCM and installed on the vehicle.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Configuration”.
6. Select “Vehicle”.
7. Record the “Start Enable Type” "Current Value" in table.
8. Record the “Start Enable Type” installed on the vehicle in table.

   **Note:** The vehicle's start enable type (Start Enable Relay or J1939) is determined by OEM. Refer to the OEM regarding the start enable type installed on the vehicle.
9. Compare reading(s) in table.
   - 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.**
   - If FMI 3, 4 or 5 is active and “Start Enable Type” is configured correctly, go to **Step D.**

| Location | Start Enable Type |
|---|---|
| TCM (ServiceRanger) | |
| Vehicle | |

## C

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Service Routines”
4. Start Product Diagnostic Test and follow on-screen prompts.

   **Note:** Solid “PD” may appear in display when PD Test is active.

   **Note:** TCM will not enter PD Test mode when there are Active fault code.

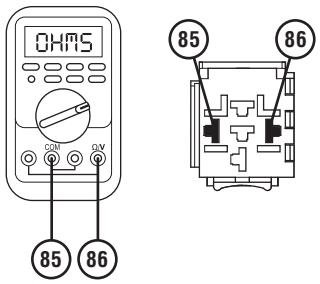

5. Wiggle the vehicle harness and connections between the charging/battery system and 20-Way TCM Vehicle Harness Connector. Look for signs of rubbing or chafing on the wires. Refer to OEM wiring diagrams.
6. To end the test, press the stop button.
   - If fault codes set Active while wiggling the vehicle harness, refer to OEM guidelines for repair or replacement of the vehicle harness and/or the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no fault codes become Active, go to **Step D.**

## D

***Purpose:*** *Verify SER coil supply voltage.*

1. Key off.
2. Remove SER.
3. Inspect SER and connector body for damage, bent, spread, corroded or loose terminals.
4. Key on with engine off.
5. Measure voltage between SER socket Pin 86 and Pin 85. Record reading in table.

   **Note:** SER types may vary, refer to OEM wiring diagrams and connector views.



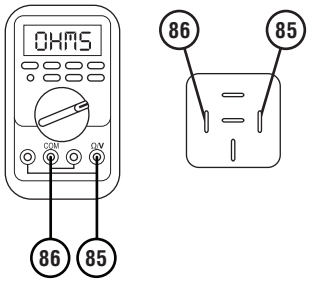

6. Compare reading(s) in table.
   - If readings are in range, go to **Step E.**
   - If readings are out of range, go to **Step G.**

| Pins | Range | Reading(s) |
|---|---|---|
| 85 to 86 | 11–13 V | |

## E

***Purpose:*** *Verify SER coil resistance.*

1. Key off.
2. Measure resistance across the SER Pin 85 and Pin 86. Record reading 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 SER replacement. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 85 to 86 | 40–200 ohms | |

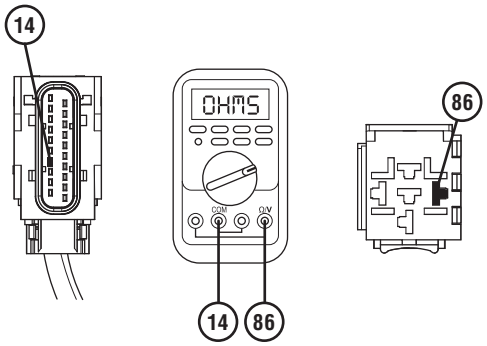
## F

***Purpose:*** *Verify 20-Way TCM Vehicle Harness Connector condition.*

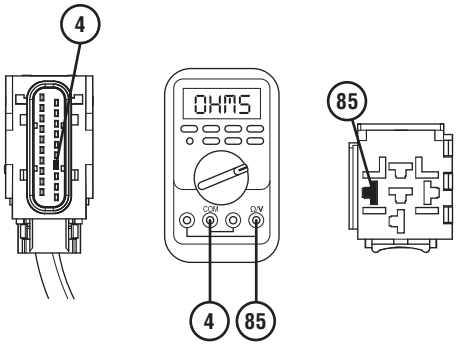
1. Key off.
2. Disconnect the 20-Way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Body Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM side of the 20-Way TCM Body Harness 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 contamination or damage is found, refer to OEM guidelines for repair or replacement of the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no contamination or damage is found, go to **Step G.**

**G** ***Purpose:*** *Verify SER coil control circuits continuity and not shorted together.*

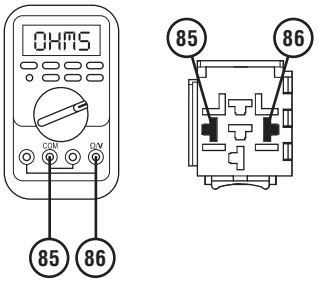
1. Key off.
2. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 14 and SER socket Pin 86. Record reading in table.




3. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 4 and SER socket Pin 85. Record reading in table.




4. Measure resistance between SER socket Pin 85 and Pin 86. Record reading in table.



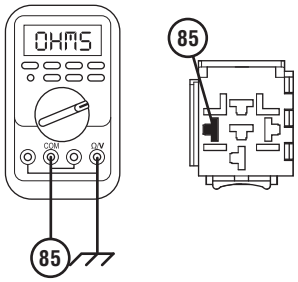

5. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If readings are in range, go to **Step H.**

| Pins | Range | Reading(s) |
|---|---|---|
| 14 to 86 | 0.0–0.3 Ohms | |
| 4 to 85 | 0.0–0.3 Ohms | |
| 85 to 86 | Open Circuit (OL) | |

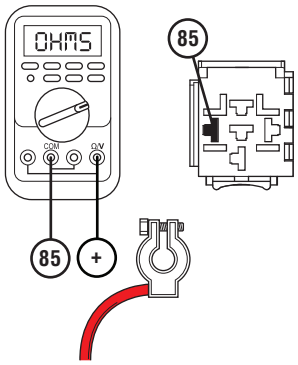
## H

***Purpose:*** *Verify SER Negative (-) circuit is not shorted to ground or power.*

1. Key off.
2. Measure resistance between SER socket Pin 85 and Ground. Record reading.




3. Measure resistance between SER socket Pin 85 and Battery Positive. Record reading.



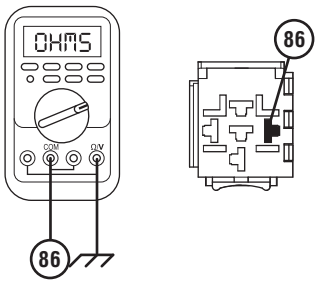

4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If readings are in range, go to **Step I.**

| Pins | Range | Reading(s) |
|---|---|---|
| 85 to Ground | Open Circuit (OL) | |
| 85 to Battery Positive (+) | Open Circuit (OL) | |

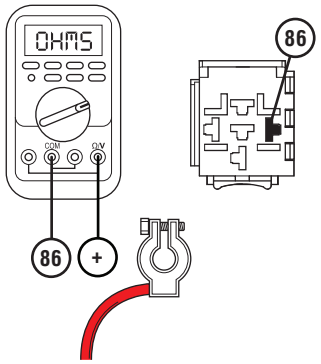
## I

***Purpose:*** *Verify SER Positive (+) circuit is not shorted to ground or power.*

1. Key off.
2. Measure resistance between SER socket Pin 86 and Ground. Record reading in table.



3. Measure resistance between SER socket Pin 86 and Battery Positive. Record reading in table.




4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If readings are in range, go to **Step J.**

| Pins | Range | Reading(s) |
|---|---|---|
| 86 to Ground | Open Circuit (OL) | |
| 86 to Battery Positive (+) | Open Circuit (OL) | |

## J

***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.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 120 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the SER Socket and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If Fault Code 120 is Active and no fault was found with the vehicle SER wiring, replace the TCM. Go to **Step V.**

     **Note:** Troubleshooting indicates no fault found with the wiring or connections to the TCM. Ensure an intermittent issue does not exist with the wiring or connections.

## K

***Purpose:*** *Verify if fault was inadvertently set.*

1. Key off.
2. Verify SER is properly installed and wired, refer to OEM wiring diagrams and connector views.

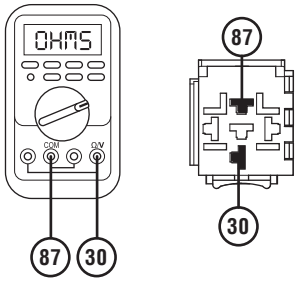
   **Note:** Fault Code 120 FMI 7 sets Active only during engine cranking.
3. Key on with engine off
4. Connect ServiceRanger.
5. Attempt to crank engine.
6. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 120 FMI 7 is Inactive and the engine cranks, SER may have been incorrectly wired and repaired or bypassed (jumped). Test complete. Go to **Step V.**
   - If Fault Code 120 FMI 7 sets Active, go to **Step L.**

## L

***Purpose:*** *Verify SER latch control circuits are not shorted together.*

1. Key off.
2. Remove SER.
3. Measure resistance between SER socket Pin 30 and Pin 87. Record reading in table.

   **Note:** SER types may vary, refer to OEM wiring diagrams and connector views.



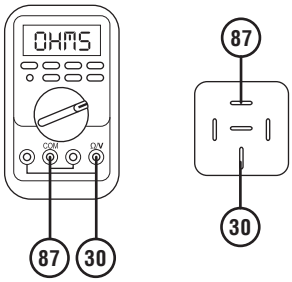

4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the SER latch control circuits. Go to **Step V.**
   - If readings are in range, go to **Step M.**

| Pins | Range | Reading(s) |
|---|---|---|
| 30 to 87 | Open Circuit (OL) | |

## M

***Purpose:*** *Verify SER latch (internal) is not shorted closed.*

1. Key off
2. Measure resistance across the SER Pin 30 and Pin 87. Record reading in table.




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

| Pins | Range | Reading(s) |
|---|---|---|
| 30 to 87 | Open Circuit (OL) | |

## N

***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.
5. Attempt to crank engine.
6. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 120 FMI 7 is Inactive and engine cranks, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the SER, SER socket and/or the OEM starting system wiring. Refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If Fault Code 120 FMI 7 is Active and no fault was found with the SER and OEM starting system wiring, replace the TCM. Go to **Step V.**

## O

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 120 sets Active during operation, go to **Step A.**
   - If a fault code other than 120 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 135: Primary Shift Device (J1939)

**J1939: SA 3 SPN 751 FMI 2, 9, 11, 12, 13, 14, 19**

## Overview

The Transmission Control Module (TCM) receives a primary shift mode request messages from the OEM Driver Interface Device over the Primary Data Link. The TCM also receives a secondary shift mode request signal from the OEM Driver Interface Device over a separate circuit. The secondary shift mode request allows a driver to engage the transmission into gear in the event the primary shift mode request message is not available. The primary and secondary shift mode requests are contained within the 20-Way TCM Vehicle Harness.

## Detection

The TCM monitors the Primary shift mode request message. If an invalid message is received, the TCM sets the fault code active.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** Primary shift mode request message out of range for 5 seconds.

**FMI 9 – Abnormal Update Rate:** Primary shift mode request message not received for 5 seconds.

**FMI 11 – Root Cause Unknown:** Primary and Secondary shift mode requests do not match.

**FMI 12 – Bad Intelligent Device:** Shift mode request into a gear that is in the opposite direction of vehicle travel at a speed greater than allowable shuttle shifting speed (Service).

**FMI 13 – Out Of Calibration:** Primary shift mode message not available.

**FMI 14 – Special Instructions:** Shift mode request into a gear from Neutral received but delayed acceptance of mode request (Service).

**FMI 19 – Received Network Data In Error:** Primary shift mode request message received but in error for 5 seconds.

## Fallback

**FMI 2, 9, 11, 19:**

- Amber warning lamp on
- Manual shifting not available
- If fault codes 135 and 145 are active:
  - Engine may not crank
  - Transmission stays in current gear
  - PTO mode prohibited
  - Hill Start Aid prohibited
- If the vehicle is moving and the transmission is configured:
  - Red stop lamp on

**FMI 12:**

- Transmission stays in current gear

**FMI 13:**

- Amber warning lamp on
- Engine cranking prohibited

**FMI 14:**

- Non neutral modes prohibited
- PTO mode prohibited

## Conditions to Set Fault Code Inactive

**FMI 2:** Primary shift mode request message in range for 10 seconds.

**FMI 9:** Primary shift mode request message received for 10 second.

**FMI 11:** Primary and Secondary shift mode requests match for 10 seconds.

**FMI 12:** Key cycle.

**FMI 13:** Driver Interface Type properly configured or condition no longer exists.

**FMI 14:** Neutral mode re-selected and achieved.

**FMI 19:** Primary shift mode request message valid for 10 seconds.

## Possible Causes

**FMI 2, 9, 19:**

- Vehicle Wiring (power supply and J1939 Data Link)
  - Wires shorted to ground, shorted to power or open
  - Terminals bent, spread, corroded or loose
- Driver Interface Device
  - Internal Failure

**FMI 11:**

- Vehicle Wiring (power supply, J1939 Data Link and secondary shift mode request)
  - Wires shorted to ground, shorted to power or open
  - Terminals bent, spread, corroded or loose
- Driver Interface Device
  - Internal Failure

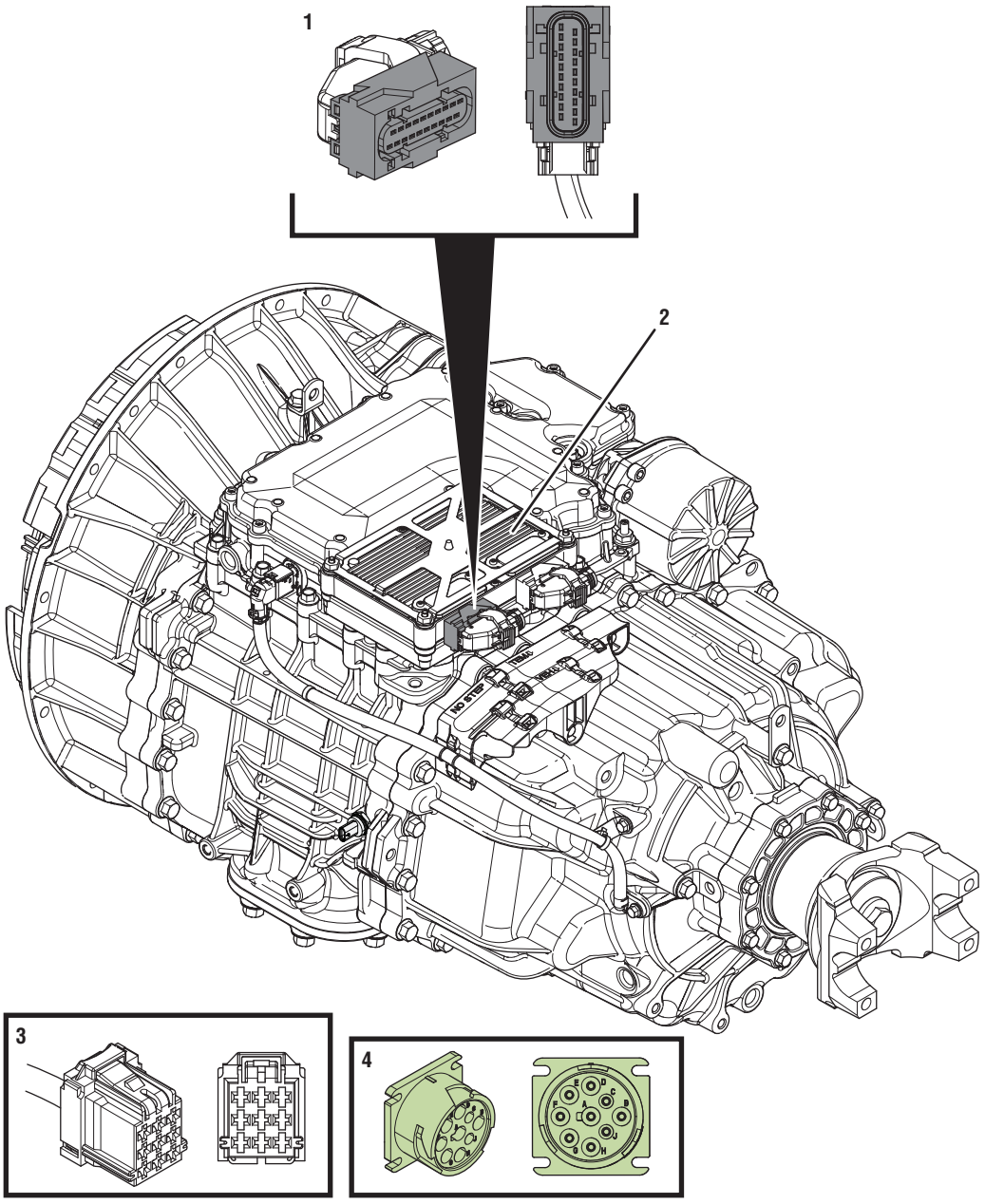
**FMI 12, 14:**

- TCM
  - Software issue
  - Internal failure

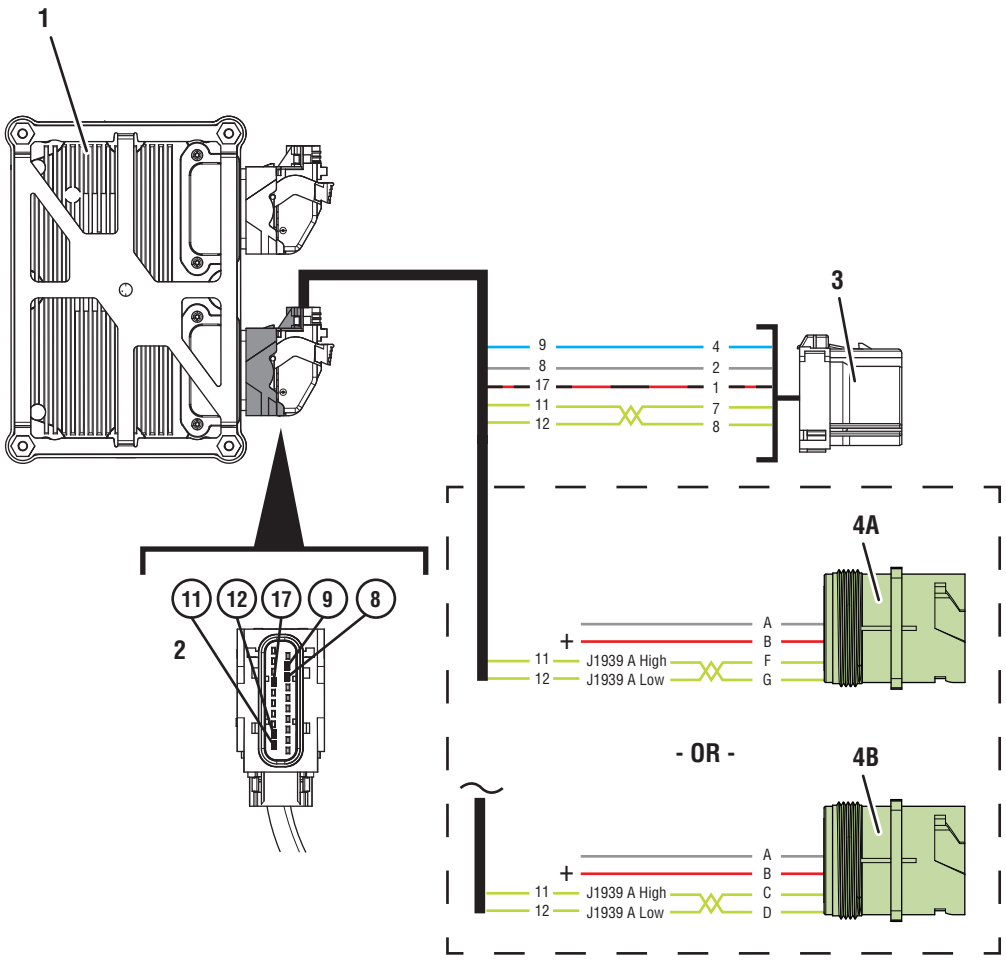
**FMI 13:**

- TCM
  - Driver Interface Device not configured

## Component Identification




*1. 20-Way TCM Vehicle Harness Connector*
*2. Transmission Control Module (TCM)*
*3. 9-Way Driver Interface Device Connector*
*4. 9-Way Type 2 Diagnostic Connector (In Cab)*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. 9-Way Driver Interface Device Connector*
*4A. 9-Way Type 2 Diagnostic Connector (OEM-Specific Primary Data Link FG)*
*4B. 9-Way Type 2 Diagnostic Connector (OEM-Specific Primary Data Link CD)*

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

# Fault Code 135 Troubleshooting

**A**

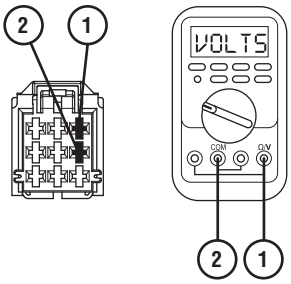
***Purpose:*** *Check for Active or Inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 135 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 135 FMI 2, 9, or 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 135 FMI 11 is Active or Inactive, go to **Step E.**
   - If Fault Code 135 FMI 12 or 14 is Active or Inactive, go to **Step H.**
   - If Fault Code 135 FMI 13 is Active, configure Driver Interface Device using ServiceRanger. Test complete.
   - If Fault Code 135 FMI 13 is Inactive, Driver Interface Device is configured. Test complete.

**B** ***Purpose:*** *Verify power and ground supply at the 9-Way Driver Interface Device Connector.*

1. Key off.
2. Disconnect the 9-Way Driver Interface Device Connector.
3. Inspect the 9-Way Driver Interface Device 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.
4. Key on.
5. Measure voltage between 9-Way Driver Interface Connector Pin 1 (TCM supplied 12v) and Pin 2 (TCM supplied ground). Record reading in table.

   **Note:** Refer to OEM wiring diagrams.



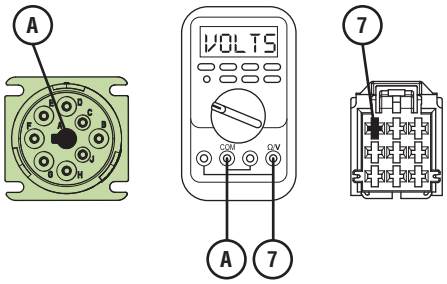

6. Compare reading(s) in table.
   - If readings are in range, go to **Step C.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the Driver Interface Device power supply circuits between the 9-Way Driver Interface Device Connector and 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 1 to 2 | 11–13 V | |

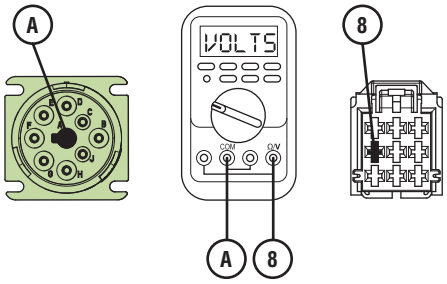
**C** ***Purpose:*** *Verify voltage of the J1939 Data Link at the 9-Way Driver Interface Device Connector.*

1. Key on.
2. Measure voltage between 9-Way Driver Interface Device Connector Pin 7 (J1939 Data Link High) and 9-Way Diagnostic Connector Pin A (ground). Record reading in table.

   **Note:** Refer to OEM wiring diagrams.




3. Measure voltage between 9-Way Driver Interface Device Connector Pin 8 (J1939 Data Link Low) and 9-Way Diagnostic Connector Pin A (ground). Record reading in table.




4. 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 vehicle J1939 Data Link. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 7 to A | 2.25–2.75 V | |
| 8 to A | 2.25–2.75 V | |

## D

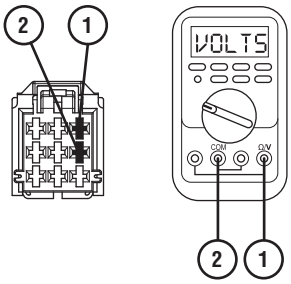
***Purpose:*** *Verify fault code status.*

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 fault codes, FMIs, occurrences and timestamps.
   - If Fault Code 135 is Active, refer to OEM guidelines for repair or replacement of the Driver Interface Device.Go to **Step V.**
   - If Fault Code 135 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is with the:
     - Driver Interface Device
     - J1939 Data link wiring to the Driver Interface Device
     - Power and ground supply wiring to the Driver Interface Device from the 20-Way TCM Vehicle Harness Connector
     - Refer to OEM for further diagnostic instructions.

**E** ***Purpose:*** *Verify power and ground supply at the 9-Way Driver Interface Device Connector.*

1. Key off.
2. Disconnect the 9-Way Driver Interface Device Connector.
3. Inspect the 9-Way Driver Interface Device 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.
4. Key on.
5. Measure voltage between 9-Way Driver Interface Device Connector Pin 1 (TCM supplied 12v) and Pin 2 (TCM supplied ground). Record reading in table.

   **Note:** Refer to OEM wiring diagrams.



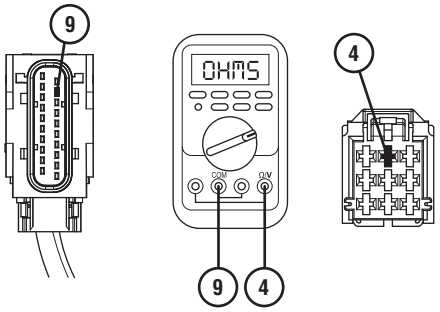

6. Compare reading(s) in table.
   - If readings are in range, go to **Step F.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the Driver Interface Device power supply circuits between the 9-Way Driver Interface Device Connector and 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 1 to 2 | 11–13 V | |

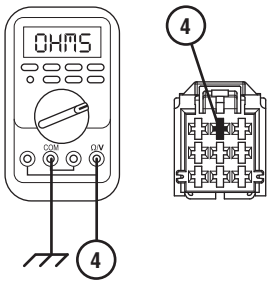
**F** ***Purpose:*** *Verify continuity of the secondary shift mode request circuit and not shorted to ground.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Measure resistance between the 9-Way Driver Interface Device Connector Pin 4 and 20-Way TCM Vehicle Harness Connector Pin 9. Record reading in table.

   **Note:** Refer to OEM wiring diagrams.




5. Measure resistance between the 9-Way Driver Interface Device Connector Pin 4 and Ground. Record reading 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 the secondary shift mode request circuit between the 9-Way Driver Interface Device Connector and the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 4 to 9 | 0.0 –0.3 Ohms | |
| 4 to Ground | Open Circuit (OL) | |

## G

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Connect ServiceRanger.
5. Retrieve and record the fault codes, FMIs, occurrences and timestamps.
   - If Fault Code 135 is Active, refer to OEM guidelines for repair or replacement of the Driver Interface Device. Go to **Step V.**
   - If Fault Code 135 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is with the:
     - Driver Interface Device
     - Secondary shift mode request circuit between the Driver Interface Device and 20-Way TCM Vehicle Harness Connector.
     - J1939 Data link wiring to the Driver Interface Device
     - Power and ground supply wiring to the Driver Interface Device from the 20-Way TCM Vehicle Harness Connector
     - Contact OEM for further diagnostic instructions.

## H

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 135 sets Active during test drive, go to **Step A.**
   - If a fault code other than 135 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 145: Secondary Shift Device (PWM)

**J1939: SA 3 SPN 752 FMI 2, 3, 4, 5, 8, 12, 13, 14**

## Overview

The Transmission Control Module (TCM) receives a primary shift mode request messages from the OEM Driver Interface Device over the Primary Data Link. The TCM also receives a secondary shift mode request signal from the OEM Driver Interface Device over a separate circuit. The secondary shift mode request allows a driver to engage the transmission into gear in the event the primary shift mode request message is not available. The primary and secondary shift mode requests are contained within the 20-Way TCM Vehicle Harness.

## Detection

The TCM monitors the Secondary shift mode request signal. If an invalid signal is received, the TCM sets the fault code active.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** Secondary shift mode request signal invalid for 5 seconds.

**FMI 3 – Voltage Above Normal or Shorted High:** Secondary shift mode request signal greater than 5.25 volts for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** Secondary shift mode request circuit shorted to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** Secondary shift mode request signal less than 4.75 volts for 5 seconds.

**FMI 8 – Abnormal Frequency:** Secondary shift mode request signal frequency out of range for 5 seconds.

**FMI 12 – Bad Intelligent Device:** Inappropriate acceptance of non-neutral mode without service brake depressed.

**FMI 13 – Out of Calibration:** Driver Interface Device not configured.

**FMI 14 – Special Instructions:** Gear engagement delayed after mode change (Service).

## Fallback

**FMI 2, 3, 4, 5, 8**

- Amber warning lamp on
- No degraded performance
- If engine off and fault codes 135 and 145 are active:
  - Engine cranking prohibited
- If engine running and fault codes 135 and 145 are active:
  - Transmission stays in current gear
  - PTO mode prohibited
- If vehicle is moving and fault codes 135 and 145 are active:
  - Red stop lamp on

**FMI 12:**

- Amber warning lamp on
- Transmission stays in current gear
- PTO mode prohibited
- If vehicle is moving
  - Red stop lamp on

**FMI 13:**

- Amber warning lamp on
- Engine cranking prohibited

**FMI 14:**

- Non neutral modes prohibited
- PTO mode prohibited

## Conditions to Set Fault Code Inactive

**FMI 2:** Secondary shift mode request signal valid for 10 seconds.

**FMI 3, 4, 5:** Secondary shift mode request signal open or short circuit condition not detected for 10 seconds.

**FMI 8:** Secondary shift mode request signal frequency in range for 10 seconds.

**FMI 12, 14:** Key cycle.

**FMI 13:** Driver interface device configured.

## Possible Causes

**FMI 2, 3, 5, 8:**

- Vehicle Harness
  - Wires shorted to power, shorted to ground, or open
  - Terminals bent, spread, corroded or loose
- OEM Driver Interface Device
  - Internal Failure
- TCM
  - Internal Failure

**FMI 4:**

- Fluid Pressure Sensor and/or Vehicle Harness
  - Power supply shorted to ground (low)
- Vehicle Harness
  - Wires shorted to power, shorted to ground, or open
  - Terminals bent, spread, corroded or loose
- OEM Driver Interface Device
  - Internal Failure
- TCM
  - Internal Failure

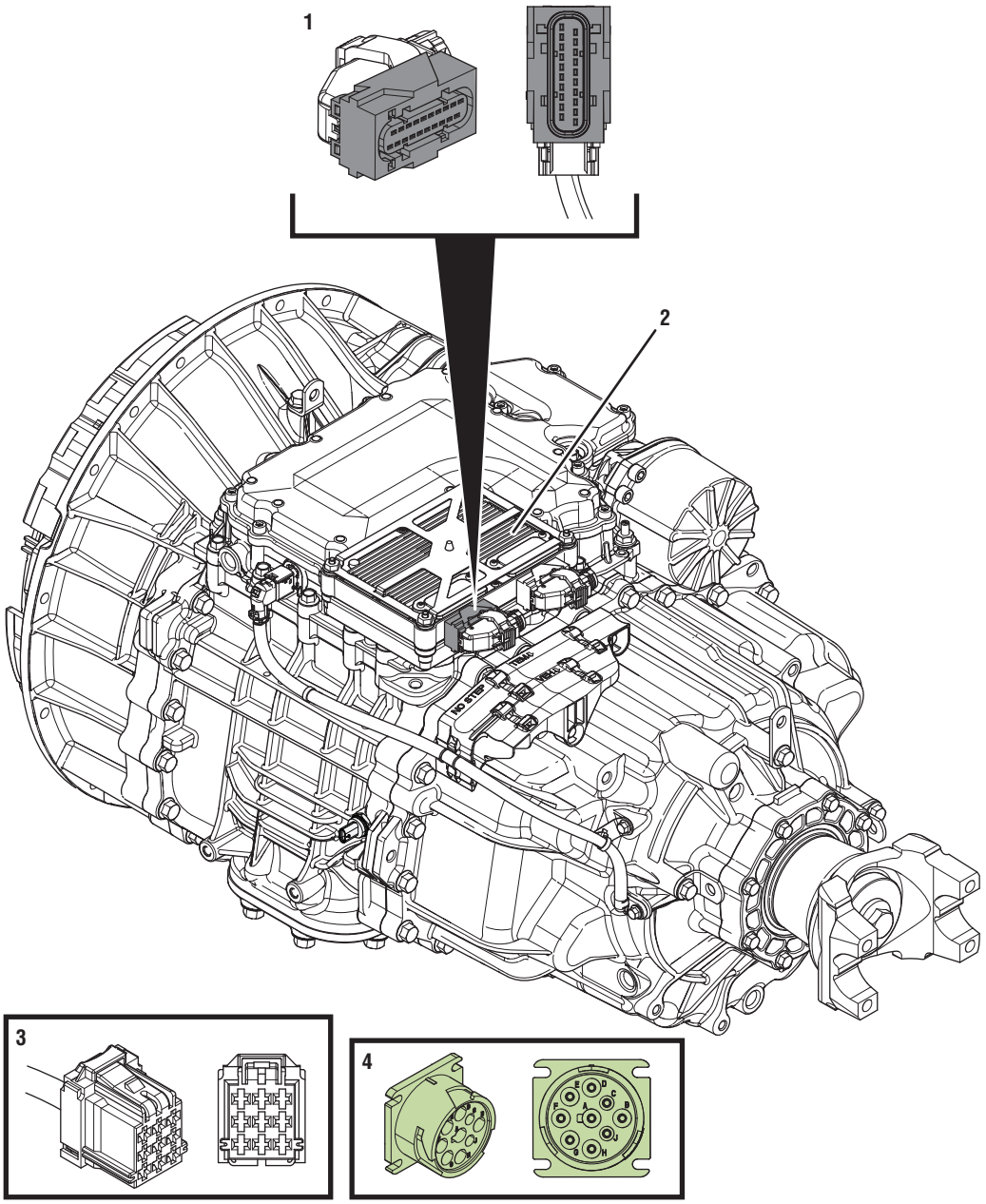
**FMI 12, 14:**

- TCM
  - Software Issue
  - Internal Issue

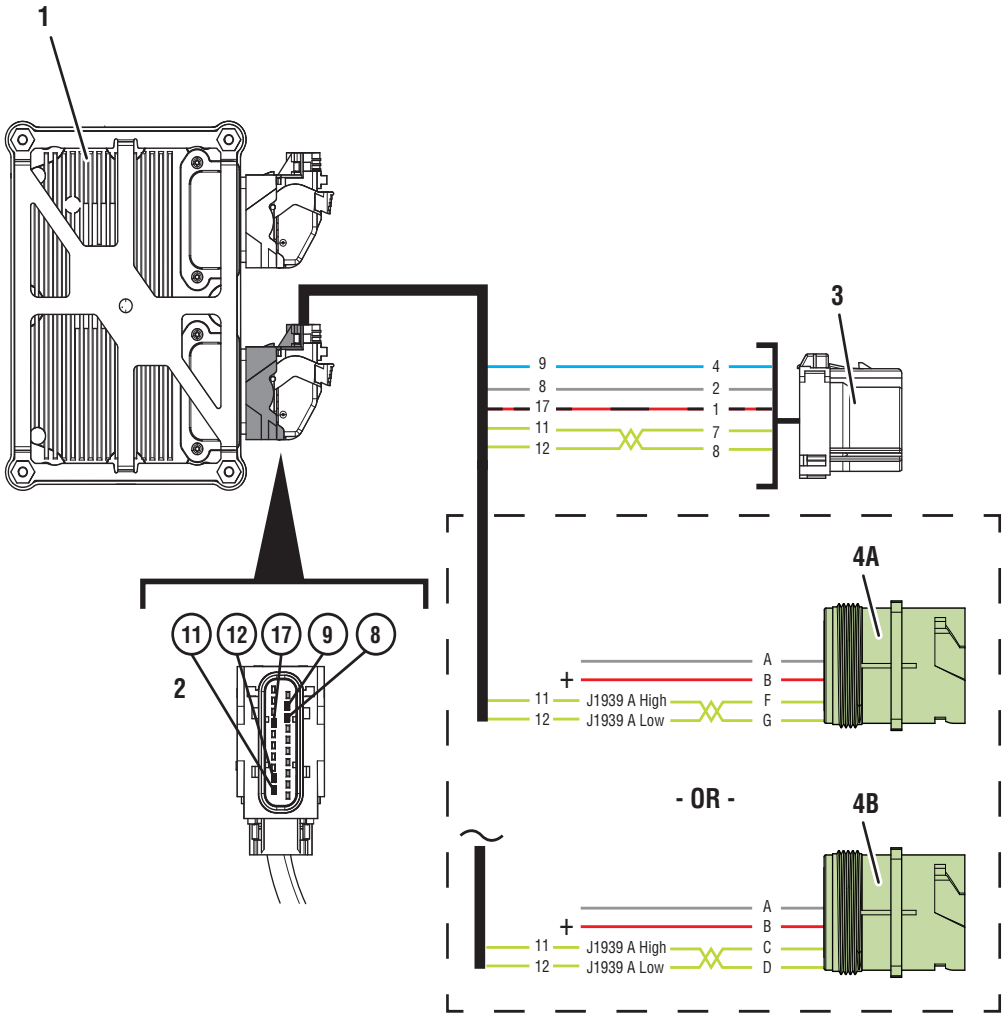
**FMI 13:**

- TCM
  - Driver Interface Device not configured

## Component Identification




*1. 20-Way TCM Vehicle Harness Connector*
*2. Transmission Control Module (TCM)*
*3. 9-Way Driver Interface Device Connector*
*4. 9-Way Type 2 Diagnostic Connector (In Cab)*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. 9-Way Driver Interface Device Connector*
*4. 9-Way Type 2 Diagnostic Connector - OEM Specific CD (in cab)*
*5. 9-Way Type 2 Diagnostic Connector - OEM Specific FG (in cab)*

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

# Fault Code 145 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 145 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes.Go to **Step V.**
   - If Fault Code 145 FMI 4 and Fault Code 210 FMI 4 are both set Active or Inactive, troubleshoot per *Fault Code 210: Transmission Oil Pressure (Fluid Pressure Sensor)* on page 207.
   - If Fault Code 145 FMI 2, 3, 4, 5, 8 is Inactive, go to **Step B.**
   - If Fault Code 145 FMI 2, 3, 4, 5, 8 is Active, go to **Step C.**
   - If Fault Code 145 FMI 13 is Active, configure Driver Interface Device using ServiceRanger. Test complete.
   - If Fault Code 145 FMI 13 is Inactive, Driver Interface Device is configured. Test complete.
   - If Fault Code 145 FMI 12, 14 is Active or Inactive, go to **Step F.**

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Service Routines”
4. Start Product Diagnostic Test and follow on-screen prompts.

   **Note:** Solid “PD” may appear in display when PD Test is active.

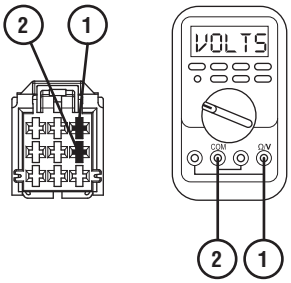
   **Note:** TCM will not enter PD Test mode when there are Active fault code.


5. Wiggle the vehicle harness and connections between the charging/battery system and 20-Way TCM Vehicle Harness Connector. Look for signs of rubbing or chafing on the wires. Refer to OEM wiring diagrams.
6. To end the test, press the stop button.
   - If fault codes set Active while wiggling the vehicle harness, refer to OEM guidelines for repair or replacement of the vehicle harness and/or the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

## C

***Purpose:*** *Verify power and ground supply at the 9-Way Driver Interface Device Connector.*

1. Key off.
2. Disconnect the 9-Way Driver Interface Device Connector.
3. Inspect the 9-Way Driver Interface Device 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.
4. Key on.
5. Measure voltage between 9-Way Driver Interface Connector Pin 1 (TCM supplied 12v) and Pin 2 (TCM supplied ground). Record reading in table.



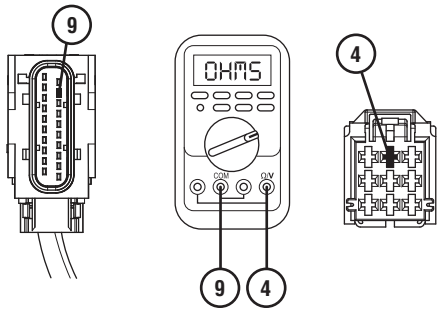

6. Compare reading(s) in table.
   - If readings are in range, go to **Step D.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the Driver Interface Device power supply circuits between the 9-Way Driver Interface Device Connector and 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 1 to 2 | 11–13 V | |

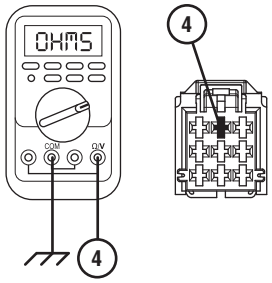
## D

***Purpose:*** *Verify continuity of the secondary shift mode request circuit and not shorted to ground.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Measure resistance between the 9-Way Driver Interface Device Connector Pin 4 and 20-Way TCM Vehicle Harness Connector Pin 9. Record reading in table.




5. Measure resistance between the 9-Way Driver Interface Device Connector Pin 4 and Ground. Record reading in table.



6. 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 the secondary shift mode request circuit between the 9-Way Driver Interface Device Connector and the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 4 to 9 | 0.0 –0.3 Ohms | |
| 4 to Ground | Open Circuit (OL) | |

## E

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

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, FMIs, occurrences, and timestamps.
   - If Fault Code 145 is Active, refer to OEM guidelines for repair or replacement of the Driver Interface Device. Go to **Step V.**
   - If Fault Code 145 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is with the:
     - Driver Interface Device
     - Secondary shift mode request circuit between the Driver Interface Device and 20-Way TCM Vehicle Harness Connector
     - Power and ground supply wiring to the Driver Interface Device from the 20-Way TCM Vehicle Harness Connector
     - Contact OEM for further diagnostic instructions.

## F

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 145 sets Active during test drive, go to **Step A.**
   - If a fault code other than 145 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 150: ASR Engine Control Active

**J1939: SA 3 SPN 561 FMI 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Anti-Slip Regulation (ASR) Engine Control Active message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the ASR Engine Control Active message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 13 - Out of Calibration:** ASR Engine Control Active message not available for 5 seconds.

**FMI 19: ASR Engine Control Active message** invalid for 5 seconds.

## Fallback
**FMI 13, 19:**

- Amber warning lamp on
- Engine commanded features prohibited

## Conditions to Set Fault Code Inactive
**FMI 13, 19:** ASR Engine Control Active message.

## Possible Causes
**FMI 13, 19:**

- Vehicle Components
  - Module(s)
  - ASR Engine Control Active message
  - Primary Data Link

## Additional Tools
- None

# Fault Code 150 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 150 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 150 FMI 13 is Active, refer to OEM and enable vehicle ASR Engine Control Active SPN 561. Go to **Step V.**
   - If Fault Code 150 FMI 13 is Inactive, go to **Step V.**.
   - If Fault Code 150 FMI 19 is Active or Inactive, refer to OEM guidelines regarding ASR Engine Control Active message repair or replacement. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 150 sets Active during operation, go to **Step A.**
   - If a fault code other than 150 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 151: ASR Brake Control Active

**J1939: SA 3 SPN 562 FMI 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Anti-Slip Regulation (ASR) Brake Control Active message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the ASR Brake Control Active message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 13 - Out of Calibration:** ASR Brake Control Active message not available for 5 seconds.

**FMI 19: ASR Brake Control Active message** invalid for 5 seconds.

## Fallback
**FMI 13, 19:**

- Amber warning lamp on
- Engine commanded features prohibited

## Conditions to Set Fault Code Inactive
**FMI 13, 19:** ASR Brake Control Active message.

## Possible Causes
**FMI 13, 19:**

- Vehicle Components
  - Module(s)
  - ASR Brake Control Active message
  - Primary Data Link

## Additional Tools
- None

# Fault Code 151 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 151 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes.Go to **Step V.**
   - If Fault Code 151 FMI 13 is Active, refer to OEM and enable vehicle ASR Brake Control Active SPN 562. Go to **Step V.**
   - If Fault Code 151 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 151 FMI 19 is Active or Inactive, refer to OEM guidelines regarding ASR Brake Control Active message repair or replacement. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 151 sets Active during operation, go to **Step A.**
   - If a fault code other than 151 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 152: ABS Active

**J1939: SA 3 SPN 563 FMI 9, 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Anti-Lock Brake System (ABS) Active message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the ABS Active message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 9** - **Abnormal Update Rate:** ABS Active message not received for 5 seconds.

**FMI 13 - Out of Calibration:** ABS Active message not available for 5 seconds.

**FMI 19: ABS Active message** invalid for 5 seconds.

## Fallback
**FMI 9, 13, 19:**

- Amber warning lamp on
- Engine commanded features prohibited

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 19:** ABS Active message.

## Possible Causes
**FMI 9, 13, 19:**

- Vehicle Components
  - Module(s)
  - ABS Active
  - Primary Data Link

## Additional Tools
- None

# Fault Code 152 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 152 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 152 FMI 13 is Active, refer to OEM and enable vehicle ABS Active SPN 563. Go to **Step V.**
   - If Fault Code 152 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 152 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines regarding ABS Active message repair or replacement. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 152 sets Active during operation, go to **Step A.**
   - If a fault code other than 152 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 153: ASR Hill Holder Switch

**J1939: SA 3 SPN 577 FMI 9, 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Anti-Slip Regulation (ASR) Hill Holder Switch message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the ASR Hill Holder Switch message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 9** - **Abnormal Update Rate:** ASR Hill Holder Switch message not received for 5 seconds.

**FMI 13 - Out of Calibration:** ASR Hill Holder Switch message not available for 5 seconds.

**FMI 19:** ASR Hill Holder Switch message invalid for 5 seconds.

## Fallback
**FMI 9, 13, 19:**

- Amber warning lamp on
- Hill Start Aid prohibited

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 19:** ASR Hill Holder Switch message.

## Possible Causes
**FMI 9, 13, 19:**

- Vehicle Components
  - Module(s)
  - ASR Hill Holder Switch
  - Primary Data Link

## Additional Tools
- None

# Fault Code 153 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 153 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 153 FMI 13 is Active, refer to OEM and enable vehicle ASR Hill Holder Switch SPN 2912. Go to **Step V.**
   - If Fault Code 153 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 153 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines regarding ASR Hill Holder Switch repair or replacement. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 153 sets Active during operation, go to **Step A.**
   - If a fault code other than 153 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 154: Hill Holder Mode

**J1939: SA 3 SPN 2912 FMI 9, 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Hill Holder Mode message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the Hill Holder Mode message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** Hill Holder Mode message not received for 5 seconds.

**FMI 13 - Out of Calibration:** Hill Holder Mode message not available for 5 seconds.

**FMI 19:** Hill Holder Mode message invalid for 5 seconds.

## Fallback
**FMI 9, 13, 19:**

- Amber warning lamp on
- Hill Start Aid prohibited

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 19:** Hill Holder Mode message.

## Possible Causes
**FMI 9, 13, 19:**

- Vehicle Components
  - Module(s)
  - Hill Holder Mode
  - Primary Data Link

## Additional Tools
- None

# Fault Code 154 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 154 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 154 FMI 13 is Active, refer to OEM and enable vehicle Hill Holder Mode SPN 2912. Go to **Step V.**
   - If Fault Code 154 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 154 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines regarding Hill Holder Mode repair or replacement. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 154 sets Active during operation, go to **Step A.**
   - If a fault code other than 154 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 155: Park Brake Switch

**J1939: SA 3 SPN 70 FMI 9, 13, 19**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Park Brake Switch message over the Primary Data Link. This information is used by the Transmission Control Module (TCM) to determine the vehicle state.

## Detection

The Transmission Control Module (TCM) monitors the Park Brake Switch signal. If the message is not received or invalid, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 9 – Abnormal Update Rate:** Park Brake Switch message not received for 10 seconds.

**FMI 13 – Out of Calibration:** Park Brake Switch message not available.

**FMI 19 – Received Network Data in Error:** Park Brake Switch message invalid for 1 second.

## Fallback

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

- Amber warning lamp on
- Urge-to-Move and Creep Mode prohibited

## Conditions to Set Fault Code Inactive

**All FMIs:** Valid Park Brake Switch message received for 10 seconds.

## Possible Causes

**All FMIs:**

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

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

# Fault Code 155 Troubleshooting

**A**

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 155 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 155 FMI 13 is Active, refer to OEM and enable vehicle Parking Brake Switch SPN 70. Go to **Step V.**
   - If Fault Code 155 FMI 13 is Inactive, go to **Step V.**.
   - If Fault Code 155 FMI 9 or 19 is Active or Inactive, go to **Step B.**

## B

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

1. Key on with engine running.
2. Allow air pressure to build to governor cut off.
3. Key off.
4. Key on with engine off.
5. Connect ServiceRanger.
6. Go To “Data Monitor”.
7. Select “Status”.
8. Select “Parking brake switch status”.
9. Select all of the “- 70” SPN sources.

   **Note:** Not all sources will indicate a value.
10. Monitor 70 - Parking brake switch status value. Record reading in table.
11. Depress and hold service brake.
12. Release vehicle parking brake.
13. Monitor 70 - Parking brake switch status value. Record reading in table.
14. Set vehicle parking brake.
15. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the Park Brake Switch signal message. Go to **Step V.**
    - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Park Brake Switch signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

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

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 155 sets Active, go to **Step A.**
   - If a fault code other than 160 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 156: Brake Pedal Position

**J1939: SA 3 SPN 521 FMI 9, 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Brake Pedal Position message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the Brake Pedal Position message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** Brake Pedal Position message not received for 5 seconds.

**FMI 13 - Out of Calibration:** Brake Pedal Position message not available for 5 seconds.

**FMI 19:** Brake Pedal Position message invalid for 5 seconds.

## Fallback
**FMI 9, 13, 19:**

- Amber warning lamp on
- Urge-to-Move and Creep Mode prohibited
- Hill Start Aid prohibited

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 19:** Brake Pedal Position message.

## Possible Causes
**FMI 9, 13, 19:**

- Vehicle Components
  - Module(s)
  - Brake Pedal Position
  - Primary Data Link

## Additional Tools
- None

# Fault Code 156 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 156 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 156 FMI 13 is Active, refer to OEM and enable vehicle Brake Pedal Position SPN 521. Go to **Step V.**
   - If Fault Code 156 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 156 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines regarding Brake Pedal Position repair or replacement. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 156 sets Active during operation, go to **Step A.**
   - If a fault code other than 156 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 157: XBR System State

**J1939: SA 3 SPN 2917 FMI 13**

## Overview
The Transmission Control Module (TCM) receives the vehicle's eXternal Brake Request (XBR) System State message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the XBR System State message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 13 - Out of Calibration:** XBR System State message is available but TCM is not configured to support External Braking Integration.

## Fallback
**FMI 13:**

- Urge-to-Move and Creep Mode Prohibited

## Conditions to Set Fault Code Inactive
**FMI 13:** External Braking Integration configuration is properly configured in the TCM.

## Possible Causes
**FMI 13:**

- External Braking Integration is not configured in the TCM to support the XBR System State message.

## Additional Tools
- None

# Fault Code 157 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 157 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 157 FMI 13 is Active, go to **Step B.**
   - If Fault Code 157 FMI 13 is Inactive, External Braking Integration configuration is properly configured. Go to **Step V.**

**B** ***Purpose:*** *Verify External Braking Integration configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “Vehicle”.
5. Record External Braking Integration Current Value.
   - If External Braking Integration Current Value indicates “Not Supported”, select “Supported” 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. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 157 sets Active during operation, go to **Step A.**
   - If a fault code other than 157 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 158: XBR Active Control Mode

**J1939: SA 3 SPN 2918 FMI 9, 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's eXternal Brake Request (XBR) Active Control Mode message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the XBR Active Control Mode message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** XBR Active Control Mode message not received for 5 seconds.

**FMI 13 - Out of Calibration:** XBR Active Control Mode message not available for 5 seconds.

**FMI 19:** XBR Active Control Mode message invalid for 5 seconds.

## Fallback
**FMI 9, 13, 19:**

- Amber warning lamp on
- Urge-to-Move and Creep Mode Prohibited

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 19:** XBR Active Control Mode message valid for 10 seconds.

## Possible Causes
**FMI 9, 13, 19:**

- Vehicle Components
  - Module(s)
  - Primary Data Link

## Additional Tools
- None

# Fault Code 158 Troubleshooting

**A**

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 158 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 158 FMI 13 is Active, go to **Step B.**
   - If Fault Code 158 FMI 13 is Inactive, the XBR Active Control Mode message is available. Go to **Step V.**
   - If Fault Code 158 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines regarding XBR Active Control Mode message repair or replacement. Go to **Step V.**

**B**

***Purpose:*** *Verify External Braking Integration configuration with ServiceRanger and availability of vehicle XBR Active Control Mode message.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “Vehicle”.
5. Record External Braking Integration Current Value.
6. Refer to OEM and verify availability of the vehicle XBR Active Control Mode SPN 2918 message.
   - If the vehicle XBR Active Control Mode SPN 2918 message is available, refer to OEM and enable vehicle XBR Active Control Mode SPN 2918 message. Go to **Step V.**
   - If the vehicle XBR Active Control Mode SPN 2918 message is not available and the External Braking Integration Current Value in ServiceRanger indicates “Supported”, select “Not Supported” 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. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 158 sets Active during operation, go to **Step A.**
   - If a fault code other than 158 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 159: Service Brake Circuit 2

**J1939: SA 3 SPN 1088 FMI 9, 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Service Brake Circuit 2 message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the Service Brake Circuit 2 message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** Service Brake Circuit 2 message not received for 5 seconds.

**FMI 13 - Out of Calibration:** Service Brake Circuit 2 message not available for 10 seconds.

**FMI 19:** Service Brake Circuit 2 message invalid for 10 seconds.

## Fallback
**FMI 9, 13, 19:**

- Amber warning lamp on
- No degraded mode

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 19:** Service Brake Circuit 2 message.

## Possible Causes
**FMI 9, 13, 19:**

- Vehicle Components
  - Module(s)
  - Service Brake Circuit 2
  - Primary Data Link

## Additional Tools
- None

# Fault Code 159 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 159 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 159 FMI 13 is Active, refer to OEM and enable vehicle Service Brake Circuit 2 SPN 1088. Go to **Step V.**
   - If Fault Code 159 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 159 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines regarding Service Brake Circuit 2 repair or replacement. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 159 sets Active during operation, go to **Step A.**
   - If a fault code other than 159 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 160: Service Brake Switch

**J1939: SA 3 SPN 597 FMI 9, 13, 14, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Service Brake Switch signal message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The Transmission Control Module (TCM) monitors the Service Brake Switch signal. If the message is not received or invalid, the fault is set active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** Service Brake Pedal Switch signal not received for 5 seconds.

**FMI 13 – Out Of Calibration:** Service Brake Switch message not available for 5 seconds.

**FMI 14 – Special Instructions:** Service Brake Switch signal not received after a launch for 1 second.

**FMI 19 – Received Network Data In Error:** Service Brake Switch message invalid for 5 seconds.

## Fallback
**All FMIs:**

- Amber warning lamp on
- Urge-to-Move and Creep Mode prohibited
- Transmission may not allow a shift out of neutral

**Note:** Refer to OEM regarding vehicle fallback modes.

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 14, 19:** Service Brake Switch signal received and valid for 10 seconds.

## Possible Causes
**All FMIs:**

- Vehicle Components
  - Module(s)
  - Service Brake Switch
  - J1939 Data link

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

## Additional Tools
None

# Fault Code 160 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 160 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 160 FMI 13 is Active, refer to OEM and enable vehicle Brake Switch SPN 597. Go to **Step V.**
   - If Fault Code 160 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 160 FMI 9, 14 or 19 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Monitor Service Brake Switch signal message.*

1. Key on with engine running.
2. Allow air pressure to build to governor cut off.
3. Key off.
4. Key on with engine off.
5. Connect ServiceRanger.
6. Go To “Data Monitor”.
7. Select “Status”.
8. Select “Brake switch”.
9. Select all of the “- 597” SPN sources.

   **Note:** Not all sources will indicate a value.
10. Monitor 597 - Brake switch value. Record reading in table.
11. Depress and hold service brake.
12. Monitor 597 - Brake switch value. Record reading in table.
13. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the Service Brake Switch signal message. Go to **Step V.**
    - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Service Brake Switch signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Service Brake State | Parameter | Range | Reading(s) |
|---|---|---|---|
| Released | 597 - Brake Switch | Released | |
| Depressed | 597 - Brake Switch | Depressed | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 160 sets Active during operation, go to **Step A.**
   - If a fault code other than 160 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 161: Brake Application Pressure

**J1939: SA 3 SPN 116 FMI 9, 13, 14, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Brake Application Pressure signal message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The Transmission Control Module (TCM) monitors the Brake Application Pressure signal. If the message is not received or invalid, the fault is set active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** Brake Application Pressure signal not received for 5 seconds.

**FMI 13 – Out Of Calibration:** Brake Application Pressure message not available for 5 seconds.

**FMI 14 – Special Instructions:** Brake Application Pressure signal not received after a launch for 1 second.

**FMI 19 – Received Network Data In Error:** Brake Application Pressure message invalid for 5 seconds.

## Fallback
**All FMIs:**

- Amber warning lamp on
- Urge-to-Move and Creep Mode prohibited
- Transmission may not allow a shift out of neutral

**Note:** Refer to OEM regarding vehicle fallback modes.

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 14, 19:** Brake Application Pressure signal received and valid for 10 seconds.

## Possible Causes
**All FMIs:**

- Vehicle Components
  - Module(s)
  - Brake Application Pressure
  - J1939 Data link

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

## Additional Tools
- None

# Fault Code 161 Troubleshooting

**A**

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 161 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 161 FMI 13 is Active, refer to OEM and enable vehicle Brake Application Pressure SPN 116. Go to **Step V.**
   - If Fault Code 161 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 161 FMI 9, 14 or 19 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Monitor Brake Application Pressure signal message.*

1. Key on with engine running.
2. Allow air pressure to build to governor cut off.
3. Key off.
4. Key on with engine off.
5. Connect ServiceRanger.
6. Go To “Data Monitor”.
7. Select “Pressure”.
8. Select “Brake application pressure”.
9. Select all of the “- 116” SPN sources.

   **Note:** Not all sources will indicate a value.
10. Monitor 116 - Brake application pressure value. Record reading in table.
11. Depress and hold service brake.
12. Monitor 116 - Brake application pressure value. Record reading in table.
13. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the Brake application pressure signal message. Go to **Step V.**
    - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Brake application pressure signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Service Brake State | Parameter | Range | Reading(s) |
|---|---|---|---|
| Released | 116 - Brake Application Pressure | 0 PSI | |
| Depressed | 116 - Brake Application Pressure | Greater Than 0 PSI | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 161 sets Active during operation, go to **Step A.**
   - If a fault code other than 161 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 162: Brake Secondary Pressure

**J1939: SA 3 SPN 118 FMI 9, 13, 18, 19**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Brake Secondary Pressure signal message over the Primary Data Link. The Brake Secondary Pressure signal is used as a secondary vehicle air pressure input by the TCM to ensure air pressure is adequate for transmission operation.

**Note:** The vehicle air supply comes from a dedicated transmission air tank. The primary and secondary air gauges in the cab of the vehicle may not reflect the pressure of the transmission air supply line. The transmission air tank is often isolated from the rest of the vehicle air system with a Pressure Protection Valve and/or Check Valve.

## Detection

The TCM monitors the Brake Secondary Pressure signal. If the message is not received or invalid, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 9 - Abnormal Update Rate:** Brake Secondary Pressure signal not received for 10 seconds.

**FMI 13 - Out of Calibration:** Brake Secondary Pressure message not available for 10 seconds.

**FMI 18 - Data Valid but Below Normal (Moderately Severe):** Brake Secondary Pressure and Transmission Air Supply Pressure reported greater than 90 psi (6.2 bar) and then fell below 80 psi (5.5 bar) with the vehicle stationary and the transmission in neutral.

**FMI 19:** Brake Secondary Pressure message invalid for 10 seconds.

## Fallback

**FMI 9, 13, 19:**

- Amber warning lamp on
- No degraded performance

**FMI 18:**

- Amber warning lamp on
- Non-neutral modes prohibited
- PTO mode prohibited
- If vehicle is moving
  - Red stop lamp on
  - Upshifts prohibited

## Conditions to Set Fault Code Inactive

**FMI 9, 13, 19:** Brake Secondary Pressure signal received and valid for 10 seconds.

**FMI 18:** Brake Secondary Pressure above 90 psi.

## Possible Causes

**FMI 9, 13, 19:**

- Vehicle Components
  - Module(s)
  - Brake Secondary Pressure Sensor
  - Primary Data Link

**FMI 18:**

- Vehicle Components
  - Air system

## Additional Tools

- None

# Fault Code 162 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 162 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 162 FMI 13 is Active, refer to OEM and enable vehicle Brake Secondary Pressure SPN 118. Go to **Step V.**
   - If Fault Code 162 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 162 FMI 9 or 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 162 FMI 18 is Active or Inactive, go to **Step C.**

**B** ***Purpose:*** *Monitor Brake Secondary Pressure and vehicle air pressure.*

1. Key on with engine running.
2. Allow air pressure to build to governor cut off.
3. Key off.
4. Key on with engine off.
5. Connect ServiceRanger.
6. Go To “Data Monitor”.
7. Select “Pressure”.
8. Select “Brake secondary pressure”.
9. Select all of the “- 118” SPN sources.

   **Note:** Not all sources will indicate a value.
10. Monitor 118 - Brake secondary pressure value. Record reading in table.
11. Monitor vehicle in-dash air pressure gauge. Record reading in table.
12. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the vehicle air system or Brake Secondary Pressure signal. Go to **Step V.**
    - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the vehicle air system or Brake Secondary Pressure signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Parameter/ Source | Range | Reading(s) |
|---|---|---|
| 118 - Brake secondary pressure | Within 0-20 psi of Vehicle air pressure | |
| Vehicle in-dash secondary air pressure gauge | 100-135 psi | |

**C** ***Purpose:*** *Monitor Brake Secondary Pressure, Transmission Air Supply Pressure and vehicle air pressure.*

1. Key on with engine running.
2. Allow air pressure to build to governor cut off.
3. Key off.
4. Key on with engine off.
5. Connect ServiceRanger.
6. Go To “Data Monitor”.
7. From the “Default Parameter Files” tab, select “Transmission Pressure”.
8. Monitor 520524 - Line Pressure Feedback value. Record reading in table.
9. Select “Pressure”.
10. Select “Brake secondary pressure”.
11. Select all of the “- 118" SPN sources.

    **Note:** Not all sources will indicate a value.
12. Monitor 118 - Brake secondary pressure value. Record reading in table.
13. Monitor vehicle in-dash air pressure gauge. Record reading in table.
14. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the vehicle air system. Go to **Step V.**
    - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the vehicle air system. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Parameter/ Source | Range | Reading(s) |
|---|---|---|
| 520524 - Line Pressure Feedback | Within 0–20 psi of Vehicle air pressure | |
| 118 - Brake secondary pressure | Within 0–20 psi of Vehicle air pressure | |
| Vehicle in-dash secondary air pressure gauge | 100–135 psi | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 162 sets Active during operation, go to **Step A.**
   - If a fault code other than 162 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 163: Demanded Brake Application Pressure

**J1939: SA 3 SPN 8484 FMI 9, 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Demanded Brake Application Pressure signal message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the Demanded Brake Application Pressure signal message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** Demanded Brake Application Pressure signal not received for 10 seconds.

**FMI 13 - Out of Calibration:** Demanded Brake Application Pressure message not available for 5 seconds.

**FMI 19:** Demanded Brake Application Pressure message invalid for 5 seconds.

## Fallback
**FMI 9, 13, 19:**

- Amber warning lamp on
- Urge-to-Move and Creep Mode prohibited

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 19:** Demanded Brake Application Pressure signal received and valid for 10 seconds.

## Possible Causes
**FMI 9, 13, 19:**

- Vehicle Components
  - Module(s)
  - Demanded Brake Application Pressure Sensor
  - Primary Data Link

## Additional Tools
- None

# Fault Code 163 Troubleshooting

**A**

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 163 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 163 FMI 13 is Active, refer to OEM and enable vehicle Demanded Brake Application Pressure SPN 8484. Go to **Step V.**
   - If Fault Code 163 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 163 FMI 9 or 19 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Monitor Demanded Brake Application Pressure signal message.*

1. Key on with engine running.
2. Allow air pressure to build to governor cut off.
3. Key off.
4. Key on with engine off.
5. Connect ServiceRanger.
6. Go To “Data Monitor”.
7. Select “Pressure”.
8. Select “Demanded brake application pressure”.
9. Select all of the “- 8484” SPN sources.

   **Note:** Not all sources will indicate a value.
10. Monitor 8484 - Demanded brake application pressure value. Record reading in table.
11. Depress and hold service brake.
12. Monitor 8484 - Demanded brake application pressure value. Record reading in table.
13. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the Demanded brake application pressure signal message. Go to **Step V.**
    - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Demanded brake application pressure signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Service Brake State | Parameter | Range | Reading(s) |
|---|---|---|---|
| Released | 8484 - Demanded Brake Application Pressure | 0 PSI | |
| Depressed | 8484 - Demanded Brake Application Pressure | Greater Than 0 PSI | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 163 sets Active during operation, go to **Step A.**
   - If a fault code other than 163 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 164: Service Brake Switch 2

**J1939: SA 3 SPN 603 FMI 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Service Brake Switch 2 message over the Primary Data Link. This information is used to determine transmission operation.

## Detection
The TCM monitors the Service Brake Switch 2 message. If a failure is detected the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** Service Brake Switch 2 message not received for 5 seconds.

**FMI 13 - Out of Calibration:** Service Brake Switch 2 message not available for 5 seconds.

**FMI 19:** Service Brake Switch 2 message invalid for 5 seconds.

## Fallback
**FMI 9, 13, 19:**

- Urge-to-Move and Creep Mode prohibited
- Hill Start Aid prohibited

## Conditions to Set Fault Code Inactive
**FMI 9, 13, 19:** Service Brake Switch 2 message.

## Possible Causes
**FMI 9, 13, 19:**

- Vehicle Components
  - Module(s)
  - Service Brake Switch 2
  - Primary Data Link

## Additional Tools
- None

# Fault Code 164 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 164 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 164 FMI 13 is Active, refer to OEM and enable vehicle Service Brake Switch 2 SPN 603. Go to **Step V.**
   - If Fault Code 164 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 164 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines regarding Service Brake Switch 2 repair or replacement. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 164 sets Active during operation, go to **Step A.**
   - If a fault code other than 164 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 165: Primary Accelerator Pedal Position

**J1939: SA 3 SPN 91 FMI 9, 13, 19**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Primary Accelerator Pedal Position message over the Primary Data Link. The Primary Accelerator Pedal Position provides the TCM with the driver's demand to launch and accelerate the vehicle. The TCM also receives a Secondary Accelerator Pedal Position message over the Secondary Data Link. The Secondary Accelerator Pedal Position message allows the vehicle to operate in a degraded mode in the event the Primary Accelerator Pedal Position message is not available.

## Detection

The TCM monitors the Primary Accelerator Pedal Position message. If an invalid message is received, the TCM sets the fault code active.

## Conditions to Set Fault Code Active

**FMI 9 - Abnormal Update Rate:** Primary Accelerator Pedal Position message not received for 5 seconds.

**FMI 13 - Out of Calibration:** Primary Accelerator Pedal Position message not available for 5 seconds.

**FMI 19 - Received Network Data in Error:** Primary Accelerator Pedal Position message invalid for 5 seconds.

## Fallback

**All FMIs:**

- Amber warning lamp on
- Lowest available start gear only
- Urge to move and Creep prohibited
- PTO mode prohibited
- If the vehicle is moving and the transmission is in a gear higher than the lowest available start gear:
  - Red stop lamp on
  - Upshifts prohibited

## Conditions to Set Fault Code Inactive

**All FMIs:** Primary Accelerator Pedal Position signal received and valid for 10 seconds.

## Possible Causes

**All FMIs:**

- Vehicle components
  - Module(s)
  - Accelerator Pedal Position Sensor and/or wiring
  - J1939 Data Link

## Additional Tools

- None

# Fault Code 165 Troubleshooting

**A**

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 165 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 165 FMI 13 is Active, refer to OEM and enable vehicle Primary Accelerator Pedal Position SPN 91. Go to **Step V.**
   - If Fault Code 165 FMI 13 is Inactive, go to **Step V.**.
   - If Fault Code 165 FMI 9 or 19 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Monitor Primary Accelerator Pedal Position signal message.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. Select “Position”.
5. Select “Percent accelerator pedal position”.
6. Select all of the “-91” SPN sources.

   **Note:** Not all sources will indicate a value.
7. Monitor Percent accelerator pedal position and record reading in table.
8. Depress and hold the accelerator pedal.
9. Monitor Percent accelerator pedal position and record reading in table.
10. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the Primary Accelerator Pedal Position signal message. Go to **Step V.**
    - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Primary Accelerator Pedal Position signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Accelerator Pedal State | Parameter | Range | Reading(s) |
|---|---|---|---|
| Released | 91 - Percent accelerator pedal position | 0% | |
| Depressed | 91 - Percent accelerator pedal position | Greater than 0% | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 165 sets Active during operation, go to **Step A.**
   - If a fault code other than 165 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13

# Fault Code 166: Secondary Accelerator Pedal Position

**J1939: SA 3 SPN 29 FMI 9, 13, 19**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Secondary Accelerator Pedal Position message over the Secondary Data Link. The Primary Accelerator Pedal Position provides the TCM with the driver's demand to launch and accelerate the vehicle. The TCM also receives a Secondary Accelerator Pedal Position message over the Secondary Data Link. The Secondary Accelerator Pedal Position message allows the vehicle to operate in a degraded mode in the event the Primary Accelerator Pedal Position message is not available. The Secondary Accelerator Pedal Position message is contained within the 20-Way TCM Body Harness Connector.

## Detection

The TCM monitors the Secondary Accelerator Pedal Position message. If an invalid message is received, the TCM sets the fault code active.

## Conditions to Set Fault Code Active

**FMI 9 - Abnormal Update Rate:** Secondary Accelerator Pedal Position message not received for 5 seconds.

**FMI 13 - Out of Calibration:** Secondary Accelerator Pedal Position message not available for 5 seconds.

**FMI 19 - Received Network Data in Error:** Secondary Accelerator Pedal Position message invalid for 5 seconds.

## Fallback

**All FMIs:**

- Amber warning lamp on
- No degraded mode
- If Fault Code 135, 165, 166 and 177 are Active and the transmission is in neutral:
  - Non neutral modes prohibited
  - PTO mode prohibited
- If Fault Code 135, 165, 166 and 177 are Active, the vehicle is moving and the transmission is in a gear higher than the lowest available start gear:
  - Red stop lamp on
  - Clutch engagement prohibited, vehicle may coast to a stop
  - Transmission downshifts to lowest available start gear
  - Non neutral modes prohibited

## Conditions to Set Fault Code Inactive

**All FMIs:** Secondary Accelerator Pedal Position signal received and valid for 10 seconds.

## Possible Causes

**All FMIs:**

- Vehicle components
  - Module(s)
  - Accelerator Pedal Position Sensor and/or wiring
  - J1939 Data Link

## Additional Tools

- None

# Fault Code 166 Troubleshooting

**A**

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 166 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 166 FMI 13 is Active, refer to OEM and enable vehicle Secondary Accelerator Pedal Position SPN 29. Go to **Step V.**
   - If Fault Code 166 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 166 FMI 9 or 19 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Monitor Secondary Accelerator Pedal Position signal message.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. Select “Position”.
5. Select “Percent accelerator pedal position 2”.
6. Select all of the “-29” SPN sources.

   **Note:** Not all sources will indicate a value.
7. Monitor Percent accelerator pedal position 2 and record reading in table.
8. Depress and hold the accelerator pedal.
9. Monitor Percent accelerator pedal position 2 and record reading in table.
10. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the Secondary Accelerator Pedal Position signal message. Go to **Step V.**
    - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Secondary Accelerator Pedal Position signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Accelerator Pedal State | Parameter | Range | Reading(s) |
|---|---|---|---|
| Released | 29 - Percent accelerator pedal position 2 | 0% | |
| Depressed | 29 - Percent accelerator pedal position 2 | Greater than 0% | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 165 sets Active during operation, go to **Step A.**
   - If a fault code other than 165 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13

# Fault Code 167: Accelerator Pedal Kickdown Switch

**J1939: SA 3 SPN 559 FMI 13, 19, 20**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Accelerator Pedal Kickdown Switch message over the Primary Data Link. The Accelerator Pedal Kickdown Switch provides the TCM with the driver's demand to operate the vehicle.

## Detection

The TCM monitors the Accelerator Pedal Kickdown Switch message. If an invalid message is received, the TCM sets the fault code Active.

## Conditions to Set Fault Code Active

**FMI 13 - Out of Calibration:** Accelerator Pedal Kickdown Switch message not available for 5 seconds.

**FMI 19: Received Network Data in Error:** Accelerator Pedal Kickdown Switch message invalid for 5 seconds.

**FMI 20 - Data Drifted High:** Accelerator Pedal Kickdown Switch message not received for 5 seconds.

## Fallback

**FMI 13, 19, 20:**

- Amber warning lamp on
- No degraded mode
- Accelerator Pedal Kickdown Switch may be inoperative

## Conditions to Set Fault Code Inactive

**FMI 13, 19, 20:** Accelerator Pedal Kickdown Switch message.

## Possible Causes

**FMI 13, 19, 20:**

- Vehicle Components
  - Module(s)
  - Accelerator Pedal Kickdown Switch
  - J1939 Data Link

## Additional Tools

- None

# Fault Code 167 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 167 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 167 FMI 13 is Active, refer to OEM and enable vehicle Accelerator Pedal Kickdown Switch SPN 559. Go to **Step V.**
   - If Fault Code 167 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 167 FMI 19 or 20 is Active or Inactive, refer to OEM guidelines regarding Accelerator Pedal Kickdown Switch repair or replacement. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 167 sets Active during operation, go to **Step A.**
   - If a fault code other than 167 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 170: Front Axle Speed

**J1939: SA 3 SPN 904 FMI 9, 13, 19**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Front Axle Speed message over the Primary Data Link. The transmission can utilize this input in the event Output Shaft Speed is unavailable.

## Detection

The Transmission Control Module (TCM) monitors the Front Axle Speed message. If message is not received or invalid, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 9 – Abnormal Update Rate:** Front Axle Speed message not received for 10 seconds.

**FMI 13 – Out of Calibration:** Front Axle Speed message not available for 10 seconds.

**FMI 19 – Received Network Data in Error:** Front Axle Speed message invalid for 10 seconds.

## Fallback

**All FMIs:**

**Note:** Refer to OEM for troubleshooting a failed system. Brake system fallback modes will vary.

- Amber warning lamp on
- No degraded performance

## Conditions to Set Fault Code Inactive

**All FMIs:** Front Axle Speed signal received and valid for 10 seconds.

## Possible Causes

**All FMIs:**

- Front Axle Speed Sensor
  - Internal or circuit failure
  - Not configured or installed
- Vehicle ECU
  - Internal failure

# Fault Code 170 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 170 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 170 FMI 13 is Active, refer to OEM and enable vehicle Front Axle Speed SPN 904. Go to **Step V.**
   - If Fault Code 170 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 170 FMI 9 or 19 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Monitor Front Axle Speed signal message.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. Select “Speed”.
5. Select “Front axle speed”.
6. Select all of the “-904” SPN sources.

   **Note:** Not all sources will indicate a value.
7. Monitor Front axle speed and record reading in table.
8. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the Front Axle Speed signal message. Go to **Step V.**
   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Front Axle Speed signal message. Contact OEM for further diagnostic instructions.

| Parameter | Range | Reading(s) |
|---|---|---|
| 904 - Front Axle Speed | 0 RPM | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 170 sets Active during operation, go to **Step A.**
   - If a fault code other than 170 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13

# Fault Code 171: Engine Speed

**J1939: SA 3 SPN 190 FMI 9, 13, 19**

## Overview
The Transmission Control Module (TCM)) receives the vehicle's Engine Speed message over the Primary Data Link and Engine Speed Sensor #2 message over the Secondary Data Link. The TCM uses the Engine Speed as the primary engine speed message during normal transmission operation. If Engine Speed becomes unavailable, the Engine Speed Sensor #2 message allows the transmission to operate in a degraded mode.

## Detection
The TCM monitors the Engine Speed message. If the message is not received or invalid, the TCM sets the fault code active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** Engine Speed message not received for 5 seconds.

**FMI 13 – Out Of Calibration:** Engine Speed message not available for 5 seconds.

**FMI 19 – Received Network Data In Error:** Engine Speed messages invalid for 5 seconds.

## Fallback
**All FMIs:**

- Amber warning lamp on
- PTO Mode prohibited
- If the vehicle is moving:
  - Lowest available start gear only
  - Urge to Move and Creep Modes prohibited

**Note:** Engine fallback modes will vary.

## Conditions to Set Fault Code Inactive
**All FMIs:** Engine Speed signal received and valid for 10 seconds.

## Possible Causes
**All FMIs:**

Vehicle Components

- Module(s)
- Engine speed sensor
- J1939 Data link

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

## Additional Tools
- None

# Fault Code 171 Troubleshooting

## A

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 171 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 171 FMI 13 is Active, refer to OEM and enable vehicle Engine speed SPN 190 signal message. Go to **Step V.**
   - If Fault Code 171 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 171 FMI 9 or 19 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Verify Engine speed signal message.*

1. Key on with engine on at idle.
2. Connect ServiceRanger.
3. Go to “Data Monitor”.
4. Select “Speed”.
5. Select “Engine speed”.
6. Select all of the “- 190” SPN sources.

   **Note:** Not all sources will indicate a value.
7. Monitor vehicle tachometer and record engine idle RPM value in table.
8. Monitor ServiceRanger and record “Engine speed” rpm value in table.
9. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the Engine speed signal message. Go to **Step V.**
   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Engine speed signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Engine Speed Signal Source | Range | Reading(s) |
|---|---|---|
| Vehicle Tachometer | Idle RPM | |
| 190 - Engine Speed | Within 150 RPM of Engine Idle | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 171 sets Active during operation, go to **Step A.**
   - If a fault code other than 171 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 172: Secondary Engine Speed

**J1939: SA 3 SPN 723 FMI 9, 13, 19**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Engine Speed message over the Primary Data Link and Secondary Engine Speed message over the Secondary Data Link. The TCM uses the Engine Speed as the primary engine speed message during normal transmission operation. If the Engine Speed becomes unavailable, the Secondary Engine Speed allows the transmission to operate in a degraded mode.

## Detection

The TCM monitors the Secondary Engine Speed message. If the message is not received or invalid, the TCM sets the fault code active.

## Conditions to Set Fault Code Active

**FMI 9 - Abnormal Update Rate:** Secondary Engine Speed message not received for 5 seconds.

**FMI 13 – Out Of Calibration:** Secondary Engine Speed message not available for 5 seconds.

**FMI 19 – Received Network Data In Error:** Secondary Engine Speed messages invalid for 5 seconds.

## Fallback

**All FMIs:**

- Amber warning lamp on
- No degraded modes
- If Fault Code 115, 165 or 171 is Active:
  - Non neutral modes prohibited
  - PTO Mode prohibited
- If Fault Code 115, 165 or 171 is Active and vehicle is moving:
  - Red stop lamp on
  - Upshifts prohibited

**Note:** Engine fallback modes will vary.

## Conditions to Set Fault Code Inactive

**All FMIs:** Secondary Engine Speed signal received and valid for 10 seconds.

## Possible Causes

**All FMIs:**

- Vehicle Components
  - Module(s)
  - Engine speed sensor
  - J1939 Data link

**Note:** Refer to OEM or engine manufacture for trouble-shooting a failed system.

## Additional Tools

- None

# Fault Code 172 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 172 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 172 FMI 13 is Active, refer to OEM and enable vehicle Engine speed sensor #2 SPN 723 signal message. Go to **Step V.**
   - If Fault Code 172 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 172 FMI 9 or 19 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Verify Engine speed sensor #2 signal message.*

1. Key on with engine on at idle.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. Select “Speed”.
5. Select “Engine speed sensor #2”.
6. Select all of the SPN “- 723” sources.

   **Note:** Not all sources will indicate a value.
7. Monitor vehicle tachometer and record engine idle RPM value in table.
8. Monitor ServiceRanger and record “Engine speed sensor #2” RPM value in table.
9. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the Engine speed sensor #2 signal message. Go to **Step V.**
   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Engine speed sensor#2 signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Engine Speed Signal Source | Range | Reading(s) |
|---|---|---|
| Vehicle Tachometer | Idle RPM | |
| 723 - Engine Speed Sensor #2 | Within 150 RPM of Engine Idle | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 176 sets Active during operation, go to **Step A.**
   - If a fault code other than 176 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 174: Engine Default Torque Limit

## J1939: SA 3 SPN 1846 FMI 12, 13, 19

### Overview
The Transmission Control Module (TCM) sends and receives the Engine Default Torque Limit (EDTL) message from the Engine Electronic Control Unit (ECU) over the Primary Data Link. This message is used by the TCM to confirm the Engine ECU is receiving and responding to the requested torque limit.

### Detection
The TCM monitors the EDTL message. If the message is not received or invalid, the TCM sets the fault code active.

### Conditions to Set Fault Code Active
**FMI 12 – Bad Intelligent Device:** EDTL message does not match SPN 1845 – Transmission Torque Limit (TTL) message for 30 seconds.

**FMI 13 – Out Of Calibration:** EDTL message not available for 30 seconds.

**FMI 19 – Received Network Data In Error:** EDTL message was received but in error for 30 seconds.

### Fallback
**All FMIs:**

- Amber warning lamp on
- No degraded mode

**Note:** Vehicle may have additional fallback modes.

### Conditions to Set Fault Code Inactive
**FMI 12:** EDTL and TTL messages match for 10 seconds.

**FMI 13, 19:** EDTL message available and valid for 10 seconds.

### Possible Causes
**All FMIs:**

- Vehicle Components
  - Engine ECU software configuration incompatible

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

### Additional Tools
- None

# Fault Code 174 Troubleshooting

## A

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 174 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 174 FMI 13 is Active, refer to OEM and enable vehicle Engine Default Torque Limit SPN 1846. Go to **Step V.**
   - If Fault Code 174 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 174 FMI 12 is Active or Inactive, go to **Step B.**
   - If Fault Code 174 FMI 19 is Active or Inactive, there is a fault with the Engine Default Torque Limit message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

## B

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 174 sets Active during operation, go to **Step A.**
   - If a fault code other than 174 sets Active, *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 175: Engine Requested Torque

**J1939: SA 3 SPN 518 FMI 11, 12, 14**

## Overview
The Transmission Control Module (TCM) sends torque request messages to the Engine Electronic Control Unit (ECU) over the Primary Data Link. This message is used in normal operation of transmission.

## Detection
The Transmission Control Module (TCM) monitors the torque request message. If the message is invalid, the fault is set active.

## Conditions to Set Fault Code Active
**FMI 11 – Root Cause Unknown:** TCM did not command 0 engine torque when the engaged gear direction did not match the driver's selected mode direction.

**FMI 12 – Bad Intelligent Device:** TCM commanded inappropriately high engine torque.

**FMI 14 – Special Instructions:** TCM commanded inappropriately high engine retarder torque.

## Fallback
**All FMIs:**

- Amber warning lamp on

**Note:** If vehicle is moving:

- Red stop lamp on
- Torque above idle prohibited
- Accelerator pedal may be unresponsive
- Vehicle may not move

## Conditions to Set Fault Code Inactive
**All FMIs:** Key cycle

## Possible Causes
**All FMIs:**

- TCM
  - Software issue
  - Internal failure

## Additional Tools
- None

# Fault Code 175 Troubleshooting

## A

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 175 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 175 FMI 11, 12, 14 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 175 sets Active during operation, go to **Step A.**
   - If a fault code other than 175 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 180: Engine Configuration Message

## J1939 SA 3 SPN 188 FMI 1, 9, 13, 19

### Overview
The Transmission Control Module (TCM) receives an Engine Configuration message from the Engine Electronic Control Unit (ECU) over the Primary Data Link. The Engine Configuration message provides the TCM with the torque and speed limits of the engine.

### Detection
The TCM monitors the Engine Configuration message. If an invalid message is received, the TCM sets the fault code active.

### Conditions to Set Fault Code Active
**FMI 1 – Data Valid But Below Normal (Most Severe):** Engine idle speed set below 550 rpm for 10 seconds.

**FMI 9 – Abnormal Update Rate:** Engine Configuration message not received for 25 seconds.

**FMI 13 – Out Of Calibration:** Engine Configuration message not available for 10 seconds.

**FMI 19 – Received Network Data In Error:** Engine Configuration message invalid for 10 seconds.

### Fallback
**All FMIs:**

- Amber warning lamp on
- Launch and shift quality may be degraded
  - TCM uses a default Engine Configuration

**Note:** Refer to OEM for troubleshooting a failed system. Vehicle may have additional fallback modes.

### Conditions to Set Fault Code Inactive
**FMI 1:** Engine idle speed configuration setting is correct in the Engine ECU.

**FMI 9, 13, 19:** Engine Configuration message received and valid for 10 seconds.

### Possible Causes
**All FMIs:**

- Vehicle Components
  - Engine ECU
  - Engine incompatible or mis-configured
  - J1939 Data Link

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

### Additional Tools
- None

# Fault Code 180 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 180 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 180 FMI 13 is Active, refer to OEM and enable vehicle Engine Configuration message SPN 188. Go to **Step V.**
   - If Fault Code 180 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 180 FMI 1 is Active with the engine running at idle, refer to OEM regarding Engine idle speed configuration setting.
   - If Fault Code 180 FMI 1 is Inactive with the engine running at idle, Engine idle speed configuration setting is correct. go to **Step V.**
   - If Fault Code 180 FMI 9 or 19 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Verify Idle engine speed signal message.*

1. Key on with engine on at idle.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. Select “Speed”.
5. Select “Idle engine speed”.
6. Select all of the “- 188” SPN sources.

   **Note:** Not all sources will indicate a value.
7. Monitor vehicle tachometer and record engine RPM value in table.
8. Monitor ServiceRanger and record “Idle engine speed” rpm value in table.
9. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair of the Idle engine speed signal message. Go to **Step V.**
   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Idle engine speed signal message. Contact OEM for further diagnostic instructions. Go to **Step V.**

| Engine Speed Signal Source | Range | Reading(s) |
|---|---|---|
| Vehicle tachometer | Idle RPM | |
| 188 - Idle engine speed | Within 150 RPM of engine idle | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 180 sets Active during operation, go to **Step A.**
   - If a fault code other than 180 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 184: Engine Demand Percent Torque

**J1939: SA 3 SPN 2432 FMI 13, 19**

## Overview
The Transmission Control Module (TCM) receives the Engine Demand Percent Torque message over the Secondary Data Link. This information is used to determine transmission performance. The Engine Demand Percent Torque message is contained in the 20-Way TCM Body Harness Connector.

## Detection
The TCM monitors the Engine Demand Percent Torque message. If the message is not available or in error, the fault is set active.

## Conditions to Set Fault Code Active
**FMI 13 – Out of Calibration:** Engine Demand Percent Torque message not available for 5 seconds.

**FMI 19 – Received Network Data in Error:** Engine Demand Percent Torque message received but in error for 5 second.

## Fallback
**All FMIs**

- Amber warning lamp on
- Lowest available start gear only
- Urge to move and Creep mode prohibited
- Launch quality may degrade
- PTO mode prohibited

**Note:** If the vehicle is moving:

- Red stop lamp on
- Clutch engagement prohibited, vehicle may coast to a stop
- Transmission downshifts to lowest available start gear

**Note:** Vehicle fallback modes may vary.

## Conditions to Set Fault Code Inactive
**All FMIs:** Engine Demand Percent Torque message available and valid for 10 seconds.

## Possible Causes
**All FMIs:**

- Vehicle Components
  - Module(s)

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

# Fault Code 184 Troubleshooting

**A** ***Purpose:*** *Direct troubleshooting to OEM.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 184 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 184 FMI 13 is Active, refer to OEM and enable vehicle Engine Demand Percent Torque SPN 2432. Go to **Step V.**
   - If Fault Code 184 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 184 FMI 19 is Active or Inactive, there is a fault with the Engine Demand Percent Torque message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 184 sets Active during operation, go to **Step A.**
   - If a fault code other than 184 sets Active, go to Fault Code Isolation Procedure Index.

# Fault Code 185: Driver Demanded Torque

**J1939: SA 3 SPN 512 FMI 13, 19**

## Overview
The Transmission Control Module (TCM) receives the Driver Demanded Torque message over the Primary Data Link. The message is determined by a vehicle module based off of accelerator pedal position and other inputs. This information is used to determine transmission performance.

## Detection
The TCM monitors the Driver Demanded Torque message. If the message is not available or in error, the fault is set active.

## Conditions to Set Fault Code Active
**FMI 13 – Out of Calibration:** Driver Demanded Torque message not available for 5 seconds.

**FMI 19 – Received Network Data in Error:** Driver Demanded Torque message received but in error for 5 second.

## Fallback
**All FMIs**

- Amber warning lamp on
- Lowest available start gear only
- Urge to move and Creep mode prohibited
- Launch quality may degrade
- PTO mode prohibited

**Note:** If the vehicle is moving:

- Red stop lamp on
- Clutch engagement prohibited, vehicle may coast to a stop
- Transmission downshifts to lowest available start gear

**Note:** Vehicle fallback modes may vary.

## Conditions to Set Fault Code Inactive
**All FMIs:** Driver Demanded Torque message available and valid for 10 seconds.

## Possible Causes
**All FMIs:**

- Vehicle Components
  - Module(s)

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

# Fault Code 185 Troubleshooting

**A** ***Purpose:*** *Direct troubleshooting to OEM.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 185 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 185 FMI 13 is Active, refer to OEM and enable vehicle Driver Demanded Torque SPN 512. Go to **Step V.**
   - If Fault Code 185 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 185 FMI 19 is Active or Inactive, there is a fault with the Driver Demanded Torque message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 185 sets Active during operation, go to **Step A.**
   - If a fault code other than 185 sets Active, go to *Fault Code 185: Driver Demanded Torque* on page 177.

# Fault Code 186: Engine Default Idle Torque Limit

**J1939: SA 3 SPN 7828 FMI 12, 13, 19**

## Overview

The Transmission Control Module (TCM) sends and receives the Engine Default Idle Torque Limit (EDITL) message from the Engine Electronic Control Unit (ECU) over the Primary Data Link. This message is used by the TCM to confirm the Engine ECU is receiving and responding to the requested idle torque limit.

## Detection

The TCM monitors the EDITL message. If the message is not received or invalid, the TCM sets the fault code active.

## Conditions to Set Fault Code Active

**FMI 12 – Bad Intelligent Device:** EDITL message does not match SPN 1845 – Transmission Communications Failure Idle Torque Limit (TCFITL) message for 30 seconds.

**FMI 13 – Out Of Calibration:** EDITL message not available for 30 seconds.

**FMI 19 – Received Network Data In Error:** EDITL message was received but in error for 30 seconds.

## Fallback

**All FMIs:**

- Amber warning lamp on

**Note:** Vehicle may have additional fallback modes.

## Conditions to Set Fault Code Inactive

**FMI 12:** EDITL and TCFITL messages match for 10 seconds.

**FMI 13, 19:** EDITL message available and valid for 10 seconds.

## Possible Causes

**All FMIs**

- Vehicle Components
  - Engine ECU software configuration incompatible

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

## Additional Tools

- None

# Fault Code 186 Troubleshooting

## A

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

1. Set the vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 186 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 186 FMI 13 is Active, refer to OEM and enable vehicle Engine Default Idle Torque Limit SPN 7828. Go to **Step V.**
   - If Fault Code 186 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 186 FMI 12 is Active or Inactive, go to **Step B.**
   - If Fault Code 186 FMI 19 is Active or Inactive, there is a fault with the Engine Default Idle Torque Limit message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

## B

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

**V**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 186 sets Active during operation, go to **Step A.**
   - If a fault code other than 186 sets Active, go to *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 187: Idle Governor Fueling Inhibit

**J1939: SA 3 SPN 7830 FMI 9, 13, 19**

## Overview
The Transmission Control Module (TCM) sends and receives the Idle Governor Fueling Inhibit (IGFI) message from the Engine Electronic Control Unit (ECU) over the Primary Data Link. This message is used by the TCM to confirm the Engine ECU is receiving and responding to the requested fueling limit.

## Detection
The TCM monitors the IGFI message. If the message is not received or invalid, the TCM sets the fault code active.

## Conditions to Set Fault Code Active
**FMI 9 - Abnormal Update Rate:** The engine ECU did not respond to a request from the TCM IGFI message.

**FMI 13 – Out Of Calibration:** IGFI message not available for 30 seconds.

**FMI 19 – Received Network Data In Error:** The Engine ECU transmitted the IGFI message to the TCM in error.

## Fallback
**All FMIs:**

- Amber warning lamp on
- No degraded mode

**Note:** Vehicle may have additional fallback modes.

## Conditions to Set Fault Code Inactive
**All FMIs:** IGFI message received and valid for 10 seconds.

## Possible Causes
**All FMIs:**

- Vehicle Components
  - Engine ECU software configuration incompatible

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

## Additional Tools
- None

# Fault Code 187 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 187 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 187 FMI 13 is Active, refer to OEM and enable vehicle Transmission Idle Governor Fueling Inhibit Support SPN 7830. Go to **Step V.**
   - If Fault Code 187 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 187 FMI 9, 19 is Active or Inactive, there is a fault with the Idle Governor Fueling Inhibit message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 187 sets Active during operation, go to **Step A.**
   - If a fault code other than 187 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 188: Source Address (SA) of Controlling Device for Engine Control

**J1939: SA 3 SPN 1483 FMI 12, 13, 19**

## Overview

The Transmission Control Module (TCM) sends and receives the Source Address of Controlling Device for Engine Control message from the vehicle over the Primary Data Link. This message is used to confirm the vehicle is receiving and responding to the TCM.

## Detection

The TCM monitors the Source Address of Controlling Device for Engine Control message. If the message is not received or invalid, the TCM sets the fault code active.

## Conditions to Set Fault Code Active

**FMI 12 – Bad Intelligent Device:** Engine is not responding to transmission commands for 5 seconds.

**FMI 13 – Out Of Calibration:** Source Address of Controlling Device for Engine Control message not available for 5 seconds.

**FMI 19 – Received Network Data In Error:** Source Address of Controlling Device for Engine Control message received but in error for 5 seconds.

## Fallback

**All FMIs:**

- Amber warning lamp on

**Note:** Vehicle may have additional fallback modes.

## Conditions to Set Fault Code Inactive

**FMI 12:** Engine responding to transmission commands for 10 seconds.

**FMI 13, 19:** Source Address of Controlling Device for Engine Control is available and valid for 10 seconds.

## Possible Causes

**All FMIs**

- Vehicle Components
  - Module(s)
  - Software configuration incompatible

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

## Additional Tools

- None

# Fault Code 188 Troubleshooting

## A

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

1. Set the vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 188 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 188 FMI 13 is Active, refer to OEM and enable vehicle Source Address of Engine Controlling Device SPN 1483. Go to **Step V.**
   - If Fault Code 188 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 188 FMI 12 is Active or Inactive, go to **Step B.**
   - If Fault Code 188 FMI 19 is Active or Inactive, there is a fault with the Source Address of Engine Controlling Device message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

## B

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
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**V** ***Purpose:*** *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no Fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 188 sets Active during operation, go to **Step A.**
   - If a fault code other than 188 sets Active, go to *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 190: Front Axle Left Wheel Speed

**J1939: SA 3 SPN 905 FMI 13, 19**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Front Axle Left Wheel Speed message over the Primary Data Link. The transmission utilizes this input as a redundant wheel speed.

## Detection

The Transmission Control Module (TCM) monitors the Front Axle Left Wheel Speed message. If message is not received or invalid, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 13 – Out of Calibration:** Front Axle Left Wheel Speed message not available for 10 seconds.

**FMI 19 – Received Network Data in Error:** Front Axle Left Wheel Speed message invalid for 10 seconds.

## Fallback

**All FMIs:**

**Note:** Refer to OEM for troubleshooting a failed system. Brake system fallback modes will vary.

- Amber warning lamp on
- No degraded performance

## Conditions to Set Fault Code Inactive

**All FMIs:** Front Axle Left Wheel Speed message received and valid for 10 seconds.

## Possible Causes

**All FMIs:**

- Vehicle ECU - Front Axle Left Wheel Speed Message
  - Not available
  - Not valid

# Fault Code 190 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 190 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 190 FMI 13 is Active, refer to OEM and enable vehicle Front Axle Left Wheel Speed SPN 905. Go to **Step V.**
   - If Fault Code 190 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 190 FMI 19 is Active or Inactive, there is a fault with the Front Axle Left Wheel Speed message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 190 sets Active during operation, go to **Step A.**
   - If a fault code other than 190 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 191: Front Axle Right Wheel Speed

**J1939: SA 3 SPN 906 FMI 13, 19**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Front Axle Right Wheel Speed message over the Primary Data Link. The transmission utilizes this input as a redundant wheel speed.

## Detection

The Transmission Control Module (TCM) monitors the Front Axle Right Wheel Speed message. If message is not received or invalid, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 13 – Out of Calibration:** Front Axle Right Wheel Speed message not available for 10 seconds.

**FMI 19 – Received Network Data in Error:** Front Axle Right Wheel Speed message invalid for 10 seconds.

## Fallback

**All FMIs:**

**Note:** Refer to OEM for troubleshooting a failed system. Brake system fallback modes will vary.

- Amber warning lamp on
- No degraded performance

## Conditions to Set Fault Code Inactive

**All FMIs:** Front Axle Right Wheel Speed message received and valid for 10 seconds.

## Possible Causes

**All FMIs:**

- Vehicle ECU Front Axle Right Wheel Speed Message
  - Not available
  - Not valid

# Fault Code 191 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 191 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 191 FMI 13 is Active, refer to OEM and enable vehicle Front Axle Right Wheel Speed SPN 906. Go to **Step V.**
   - If Fault Code 191 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 191 FMI 19 is Active or Inactive, there is a fault with the Front Axle Right Wheel Speed message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 191 sets Active during operation, go to **Step A.**
   - If a fault code other than 191 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 192: Rear Axle 1 Left Wheel Speed

**J1939: SA 3 SPN 907 FMI 13, 19**

## Overview

The Transmission Control Module (TCM) receives the vehicle's Rear Axle 1 Left Wheel Speed message over the Primary Data Link. The transmission utilizes this input as a redundant wheel speed.

## Detection

The Transmission Control Module (TCM) monitors the Rear Axle 1 Left Wheel Speed message. If message is not received or invalid, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 13 – Out of Calibration:** Rear Axle 1 Left Wheel Speed message not available for 10 seconds.

**FMI 19 – Received Network Data in Error:** Rear Axle 1 Left Wheel Speed message invalid for 10 seconds.

## Fallback

**All FMIs:**

**Note:** Refer to OEM for troubleshooting a failed system. Brake system fallback modes will vary.

- Amber warning lamp on
- No degraded performance

## Conditions to Set Fault Code Inactive

**All FMIs:** Rear Axle 1 Left Wheel Speed message received and valid for 10 seconds.

## Possible Causes

**All FMIs:**

- Vehicle ECU - Rear Axle 1 Left Wheel Speed Message
  - Not available
  - Not valid

# Fault Code 192 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 192 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 192 FMI 13 is Active, refer to OEM and enable vehicle Rear Axle 1 Left Wheel Speed SPN 907. Go to **Step V.**
   - If Fault Code 192 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 192 FMI 19 is Active or Inactive, there is a fault with the Rear Axle 1 Left Wheel Speed message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 192 sets Active during operation, go to **Step A.**
   - If a fault code other than 192 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 193: Rear Axle 1 Right Wheel Speed

**J1939: SA 3 SPN 908 FMI 13, 19**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Rear Axle 1 Right Wheel Speed message over the Primary Data Link. The transmission utilizes this input as a redundant wheel speed.

## Detection
The Transmission Control Module (TCM) monitors the Rear Axle 1 Right Wheel Speed message. If message is not received or invalid, the fault is set active.

## Conditions to Set Fault Code Active
**FMI 13 – Out of Calibration:** Rear Axle 1 Right Wheel Speed message not available for 10 seconds.

**FMI 19 – Received Network Data in Error:** Rear Axle 1 Right Wheel Speed message invalid for 10 seconds.

## Fallback
**All FMIs:**

**Note:** Refer to OEM for troubleshooting a failed system. Brake system fallback modes will vary.

- Amber warning lamp on
- No degraded performance

## Conditions to Set Fault Code Inactive
**All FMIs:** Rear Axle 1 Right Wheel Speed message received and valid for 10 seconds.

## Possible Causes
**All FMIs:**

- Vehicle ECU - Rear Axle 1 Right Wheel Speed Message
  - Not available
  - Not valid

# Fault Code 193 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 193 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 193 FMI 13 is Active, refer to OEM and enable vehicle Rear Axle 1 Right Wheel Speed SPN 908. Go to **Step V.**
   - If Fault Code 193 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 193 FMI 19 is Active or Inactive, there is a fault with the Rear Axle 1 Right Wheel Speed message sent from a vehicle module. Contact OEM for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 193 sets Active during operation, go to **Step A.**
   - If a fault code other than 193 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 199: Direction Mismatch

**J1939: SA 3 SPN 1571 FMI 12**

## Overview

The Transmission Control Module (TCM) receives the drivers shift mode request from the driver interface device and engages the appropriate gear based on the driver's request. The TCM then broadcasts the gear position to the vehicle display.

## Detection

The TCM monitors the engaged gear and the gear position that is broadcast to the gear display. If the parameters do not match, the TCM sets the fault code active.

## Conditions to Set Fault Code Active

**FMI 12 – Bad Intelligent Device:** The transmission displayed gear position does not match engaged gear position.

## Fallback

**FMI 12:**

- Amber warning lamp on
- Non neutral modes prohibited
- PTO Mode prohibited
- If the vehicle is moving:
  - Red stop lamp on
  - Clutch engagement prohibited, vehicle may coast to a stop

## Conditions to Set Fault Code Inactive

**FMI 12:** Key cycle.

## Possible Causes

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

# Fault Code 199 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 199 is Active or Inactive create a Service Activity Report, select "Send to Eaton" and contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 199 sets Active during test drive, go to **Step A.**
   - If a fault code other than 199 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 200: Transmission Operation 1

**J1939: SA 3 SPN 629 FMI 0, 1, 8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21**

## Overview

The Endurant Transmission is equipped with a Transmission Control Module (TCM). The TCM communicates with other vehicle Electronic Control Units (ECUs), receives feedback from sensors and actuates solenoids to control transmission operation. The TCM is mounted to the transmission and connected to the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector. The TCM is connected to the transmission sensors and solenoids at the 74-Way Transmission Harness Connector.

## Detection

The TCM performs a self-check during operation. If a failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal – Most Severe:** The TCM has detected an internal processing error.

**FMI 1 – Data Valid But Below Normal – Most Severe:** The TCM has detected an internal processing error.

**FMI 8 – Abnormal Frequency:** The TCM has detected an internal processing error.

**FMI 9 – Abnormal Update Rate:** The TCM has detected an internal processing error.

**FMI 10 – Abnormal Rate of Change:** The TCM has detected an internal processing error.

**FMI 11 – Root Cause Unknown:** The TCM has detected an internal processing error.

**FMI 12 – Bad Intelligent Device:** The TCM has detected an internal processing error.

**FMI 13 – Out of Calibration:** The TCM has detected an internal processing error.

**FMI 14 – Special Instructions:** The TCM detects it is installed on the wrong transmission model.

**FMI 18 – Data Valid But Below Normal - Least Severe:** The TCM has detected an internal processing error.

**FMI 19 – Received Network Data Error:** The TCM has detected an internal processing error.

**FMI 20 – Data Drifted High:** The TCM has detected an internal processing error.

**FMI 21 – Data Drifted Low:** The TCM has detected an internal processing error.

## Fallback

**0, 1, 8, 9, 10, 11, 12, 13, 18, 19, 20, 21:**

- Amber warning lamp on
- No degraded modes

**FMI 14:**

- Amber warning lamp on
- Engine will not crank
- Non neutral modes prohibited
- Clutch engagement prohibited
- PTO mode prohibited

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 8, 9, 10, 11, 12, 13, 18, 19, 20, 21:** Key cycle

**FMI 14:** The TCM is installed on the correct transmission model.

## Possible Causes

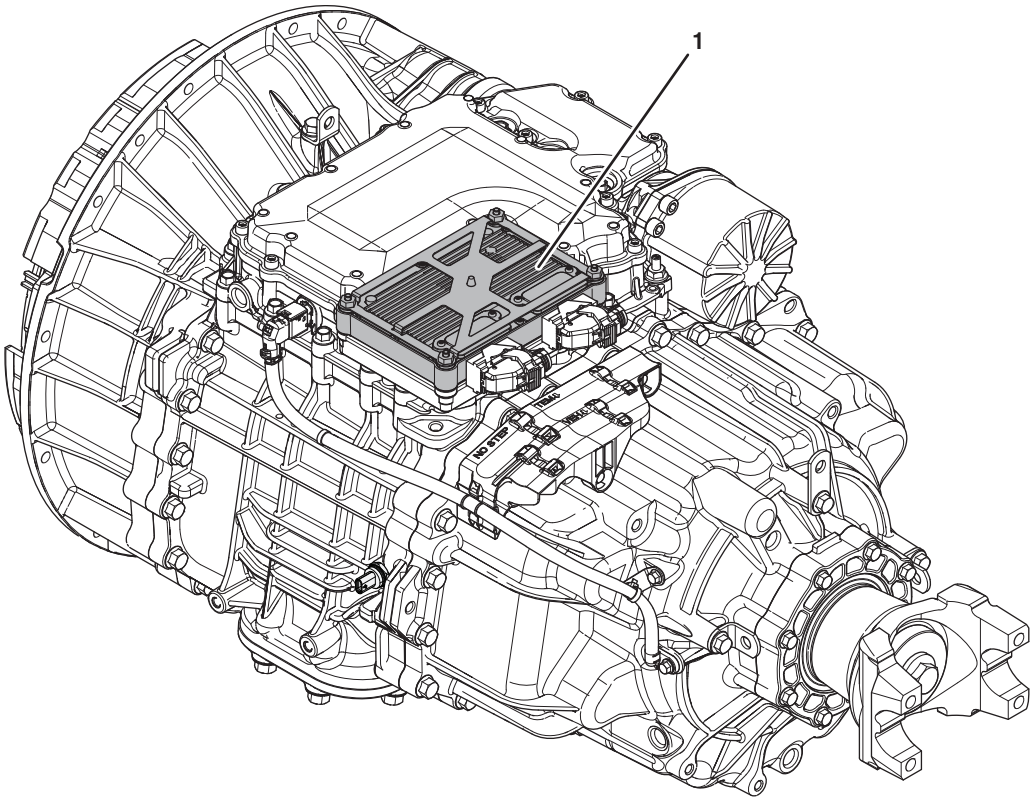
**All FMIs:**

- TCM
  - Software issue
  - Internal failure

## Additional Tools

- Endurant Service Manual TRSM0950

## Component Identification




*1. Transmission Control Module (TCM)*

# Fault Code 200 Troubleshooting

## A

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 200 FMI 0, 1, 8, 9, 10, 11, 12, 13, 18, 19, 20, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 200 FMI 14 is Active, the TCM installed on the transmission is not correct for the transmission model. Verify the transmission model number and install the correct TCM.
   - If Fault Code 200 FMI 14 is Inactive, the TCM is installed on the correct transmission model. Test complete, go to **Step V.**

## B

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 200 sets Active during operation, go to **Step A.**
   - If a fault code other than 200 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 205: Transmission Operation 2

**J1939: SA 3 SPN 609 FMI 9, 12, 19**

## Overview

The Endurant Transmission is equipped with a Transmission Control Module (TCM). The TCM communicates with other vehicle Electronic Control Units (ECUs), receives feedback from sensors and actuates solenoids to control transmission operation. The TCM is mounted to the transmission and connected to the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector. The TCM is connected to the transmission sensors and solenoids at the 74-Way Transmission Harness Connector.

## Detection

The TCM performs a self-check during operation. If a failure is detected, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 9 – Abnormal Update Rate:** The TCM has detected an internal processing error.

**FMI 12 – Bad Intelligent Device:** The TCM has detected an internal processing error.

**FMI 19 – Received Network Data Error:** The TCM has detected an internal processing error.

## Fallback

**FMI 9, 12, 19:**

- Amber warning lamp on
- Engine will not crank
- Non neutral modes prohibited
- Clutch engagement prohibited
- PTO mode prohibited

## Conditions to Set Fault Code Inactive

**FMI 9, 12, 19:** Key cycle

## Possible Causes

**All FMIs:**

- TCM
  - Software issue
  - Internal failure

## Additional Tools

- Endurant Service Manual TRSM0950

# Fault Code 205 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 205 FMI 9, 12, 19 is Active or Inactive,go to **Step B.**

**B** ***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 205 sets Active during operation, go to **Step A.**
   - If a fault code other than 205 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 206: TCM Program Memory

**J1939: SA 3 SPN 628 FMI 2, 11, 12, 13, 14, 31**

## Overview

The Endurant Transmission is equipped with a Transmission Control Module (TCM). The TCM communicates with other vehicle Electronic Control Units (ECUs), receives feedback from sensors and actuates solenoids to control transmission performance. The TCM is mounted to the transmission and connected to the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector. The TCM is connected to the transmission sensors and solenoids at the 74-Way Transmission Harness Connector.

## Detection

The TCM performs a self-check during operation. If a failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** The TCM detected the calibration file is incompatible with the application software version.

**FMI 11 – Root Cause Unknown:** The TCM detected an internal processing error.

**FMI 12 – Bad Intelligent Device:** The TCM detected an internal processing error.

**FMI 13 – Out of Calibration:** The TCM detected an internal processing error.

**FMI 14 – Special Instructions:** The TCM detected the calibration file is incompatible with the application software version.

**FMI 31 – Condition Exists:** The TCM has detected that the End Of Line Test Calibration file is present.

## Fallback

**FMI 2, 11, 12, 13, 14:**

- Amber warning lamp on
- Engine will not crank
- Non neutral modes prohibited
- Clutch engagement prohibited
- PTO mode prohibited

**FMI 31:**

- Amber warning lamp on
- Upshifts prohibited
- High start gears prohibited

## Conditions to Set Fault Code Inactive

**FMI 11, 12, 13:** Key cycle

**FMI 2, 14, 31:** Correct calibration file is configured in the TCM.

## Possible Causes

**FMI 11, 12,13:**

- TCM
  - Software issue
  - Internal failure

**FMI 2, 14, 31:**

- TCM
  - Incorrect calibration file configured in the TCM or missing

## Additional Tools

- Endurant Service Manual TRSM0950

# Fault Code 206 Troubleshooting

## A

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 206 FMI 11, 12, 13 is Active or Inactive, go to **Step B.**
   - If Fault Code 206 FMI 2, 14 or 31 is Active, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions.Go to **Step V.**
   - If Fault Code 206 FMI 2, 14 or 31 is Inactive, the correct calibration file is installed. go to **Step V.**

## B

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 206 sets Active during operation, go to **Step A.**
   - If a fault code other than 206 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 210: Transmission Oil Pressure (Fluid Pressure Sensor)

**J1939: SA 3 SPN 127 FMI 1, 3, 4, 5, 6, 13, 18, 20, 21**

## Overview

The Endurant Transmission is equipped with a Fluid Pressure Sensor (FPS) to monitor lubricant oil pressure. The transmission oil pump provides the supply oil for the lubrication system. The FPS taps into the lubrication system and provides a pressure input to the Transmission Control Module (TCM). The TCM monitors the pressure input to verify the transmission is properly filled with oil to lubricate the transmission. The FPS is mounted externally and connected to the TCM at the 20-Way TCM Vehicle Harness Connector.

## Detection

The TCM monitors the FPS. If a system failure is detected, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 1 – Data Valid But Below Normal (Most Severe):** FPS reported transmission oil pressure is critically low for 5 seconds.

**FMI 3 – Voltage Above Normal or Shorted High:** FPS circuit shorted to power for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** FPS circuit shorted to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** FPS circuit open or shorted to ground for 5 seconds.

**FMI 6 – Current Above Normal or Grounded Circuit:** FPS reference voltage not between 4.75V to 5.25V for 5 seconds.

**FMI 13 – Out Of Calibration:** FPS and OEM wiring installed but not configured in the TCM (Service).

**FMI 18 – Data Valid But Below Normal Operating Range - Moderately Severe:** FPS reported transmission oil pressure is moderately low for 5 seconds.

**FMI 20 – Data Drifted High:** FPS reporting pressure too high in error when Countershaft is stationary.

**FMI 21 – Data Drifted Low:** FPS reporting pressure too low in error.

## Fallback

**FMI 1:**

- Configurable
- Amber warning lamp on
- If vehicle is moving
  - Red stop lamp on
  - Low start gears only
  - Upshifts prohibited

**FMI 3, 4, 5, 6, 13, 20, 21:**

- Amber warning lamp on
- No degraded modes

## Conditions to Set Fault Code Inactive

**FMI 1:** FPS oil pressure in range for 10 seconds

**FMI 3, 4, 5, 6:** FPS in range for 10 seconds.

**FMI 13:** FPS configured in the TCM.

**FMI 20, 21:** FPS sends valid pressure for 10 seconds.

## Possible Causes

**FMI 1, 18:**

- Low transmission oil level
  - Not properly filled
  - Leak
- FPS
  - Damaged
  - Internal failure
- Internal transmission
  - Lubrication system mechanical failure

**FMI 3, 4, 5, 6:**

- FPS
  - Damaged
  - Internal failure
- FPS OEM vehicle harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Software issue
  - Internal failure

**FMI 13:**

- FPS not configured in the TCM
  - FPS recently installed
  - Replacement TCM installed
- Configurable
  - Amber warning lamp on
- If vehicle is moving:
  - Red stop lamp on

**FMI 20:**

- FPS OEM vehicle harness
  - Wiring shorted to power, shorted to ground or open
- FPS
  - Internal failure

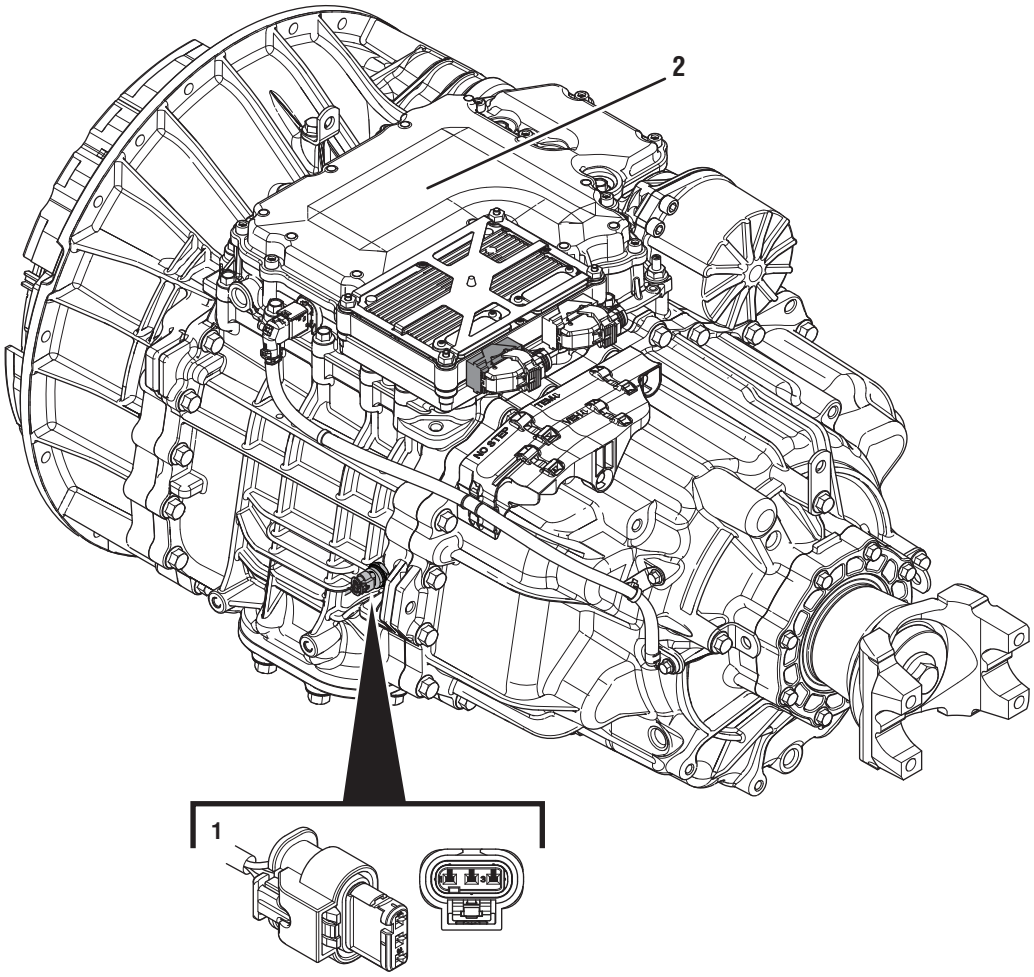
**FMI 21:**

- FPS OEM vehicle harness
  - Wiring shorted to power, shorted to ground or open
- FPS
  - Internal failure
- Low transmission oil level
  - Not properly filled
  - Leak

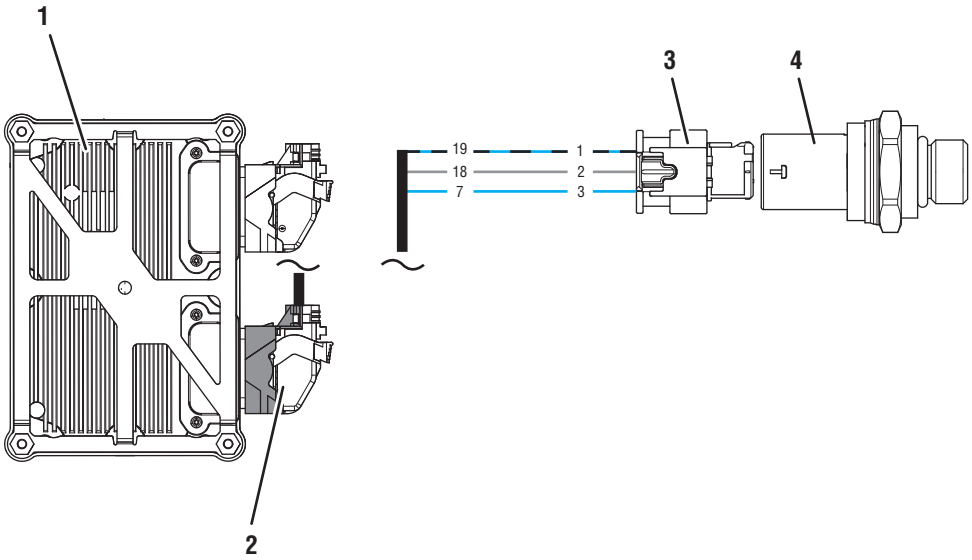
## Additional Tools

- Endurant Service Manual TRSM0950
- 3-Way Eaton Diagnostic Adapter - RR1060TR
- Digital Volt/Ohm Meter (DVOM)
- Digital Pressure Gauge (or Analog 0-100 psi maximum)
- Oil Pressure Adapter (M14 x 1.5 O-ring Straight Thread)

## Component Identification




*1. Fluid Pressure Sensor (FPS)*
*2. Transmission Control Module (TCM)*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. 3-Way Fluid Pressure Sensor Connector*
*4. Fluid Pressure Sensor (FPS)*

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

# Fault Code 210 Troubleshooting

**A**

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 210 FMI 1, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 210 FMI 3, 4, 5, 6, 20, 21 is Active or Inactive, go to **Step D.**
   - If Fault Code 210 FMI 13 is Inactive, the Fluid Pressure Sensor and wiring are installed and configured in the TCM. Test Complete, go to **Step V.**
   - If Fault Code 210 FMI 13 is Active, the Fluid Pressure Sensor and wiring were installed but not configured in the TCM. Contact Eaton Cummins Automated Transmission Technologies Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

**B**

***Purpose:*** *Verify transmission oil level and inspect for leaks.*

1. Key off.
2. Perform Oil Level Inspection Procedure.

   **Note:** Reference *Endurant Service Manual TRSM0950, Oil Level Inspection Procedure*.
   - If FMI 1, 18 and transmission oil level is in range, go to **Step F.**
   - If FMI 21 and transmission oil level is in range, replace the Fluid Pressure Sensor. Go to **Step V.**
   - If FMI 1, 18, 21 and transmission oil level is out of range, go to **Step C.**

## C

***Purpose:*** *Verify residual transmission oil and inspect internal transmission.*

1. Key off.
2. Perform Oil Drain Removal.

   **NOTICE:** Place a suitable container under the Oil Drain Plug.

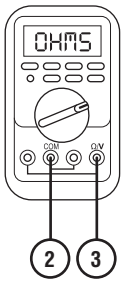
   **Note:** Reference *Endurant Service Manual TRSM0950, Oil Drain Removal Service Procedure*.
3. Record residual oil volume in table.
4. Remove PTO cover and inspect for damage.
   - Contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

| Residual Oil Volume |
| --- |
| |

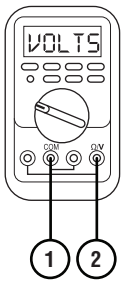
## D

***Purpose:*** *Verify TCM Fluid Pressure Sensor internal resistance and power supply through vehicle harness.*

1. Key off.
2. Disconnect the 3-Way FPS Harness Connector.
3. Inspect the 3-Way FPS Harness 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.
4. Connect the 3-Way Eaton Diagnostic Adapter (EDA) to the 3-Way FPS Harness Connector.
5. Measure resistance between 3-Way EDA Pin 2 (Ground) and Pin 3 (Signal). Record reading in table.




6. Key on.
7. Measure voltage at the 3-Way EDA Pin 1 (5V) and Pin 2 (Ground). Record reading in table.



**8.** Compare reading(s) in table.

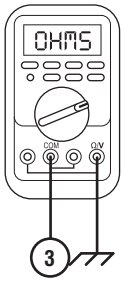
- If readings are in range, go to **Step E.**
- If readings are out of range, refer to OEM guidelines for repair or replacement of the FPS signal, power and/or ground circuit(s) between the 3-Way FPS Connector and 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 2 to 3 | 3k-9k Ohms | |
| Key on | 1 to 2 | 4.75–5.25 V | |

**E**

***Purpose:*** *Inspect 20-Way TCM Vehicle Harness Connector and verify Fluid Pressure Sensor signal circuit is not shorted to ground.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Measure resistance between 3-Way EDA Pin 3 (signal) and Ground. Record reading in table.




5. Compare reading(s) in table.
   - If FMI 3, 4, 5, 6, 20 and readings are in range, replace the Fluid Pressure Sensor. Go to **Step V.**
   - If FMI 21 and readings are in range, go to **Step B.**
   - If FMI 3, 4, 5, 6, 20, 21 and readings are out of range, refer to OEM guidelines for repair or replacement of the FPS signal circuit between the 3-Way Fluid Pressure Sensor Connector and 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| 3 to ground | Open Circuit (OL) | |

## F

***Purpose:*** *Verify transmission oil pressure.*

1. Key off.
2. Perform Fluid Pressure Sensor (FPS) Removal.
3. Install Oil Pressure Adapter (M14x1.5 O-ring Straight Thread) and torque to 19-23 Nm (14-17 lb-ft).
4. Connect Digital Pressure Gauge (or Analog 0-100 psi maximum) to Oil Pressure Adapter.
5. Key on with engine running.
6. Idle engine (650-750 RPM) for 2 minutes to stabilize transmission oil pressure.
7. With engine idling at 650-750 RPM, monitor pressure gauge and record reading in table.
8. Increase and hold engine at 950-1050 RPM, monitor pressure gauge and record reading in table.
9. Increase and hold engine at 1150-1250 RPM, monitor pressure gauge and record reading in table.
10. Increase and hold engine at 1350-1450 RPM, monitor pressure gauge and record reading in table.
11. Key off.
12. Compare reading(s) in table.
    - If readings are in range, replace the Fluid Pressure Sensor. Go to **Step V.**
    - If readings are out of range, go to **Step C.**

| Engine RPM | Range | Reading(s) |
|---|---|---|
| 650-750 | 5-15 psi | |
| 950-1050 | 10-20 psi | |
| 1150-1250 | 15-25 psi | |
| 1350-1450 | 20-35 psi | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
    - If no fault codes set and vehicle operates properly, test complete.
    - If Fault Code 210 sets Active during operation, go to **Step A.**
    - If a fault code other than 210 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 215: Transmission Air Supply Pressure Sensor

**J1939: SA 3 SPN 37 FMI 0, 1, 2, 3, 4, 5, 6, 17, 18, 20, 21**

## Overview

The Endurant Transmission is equipped with a Transmission Air Supply Pressure Sensor (TASPS) that monitors the air pressure supplied to the transmission from the vehicle. The TASPS taps into the air supply passage and provides a pressure input to the Transmission Control Module (TCM). The TCM monitors the pressure input to verify the transmission has the proper air pressure to actuate the clutch and shift rails. The TASPS is mounted in the MTM and connected to the TCM at the 74-way Transmission Harness Connector.

**Note:** The vehicle air supply comes from a dedicated transmission air tank. The primary and secondary air gauges in the cab of the vehicle may not reflect the pressure of the transmission air supply line. The transmission air tank is often isolated from the rest of the vehicle air system with a Pressure Protection Valve and/or Check Valve.

## Detection

The TCM monitors the Transmission Air Supply Pressure Sensor. If a system failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** TASPS reports greater than 145 psi (1000 kPa) for 1 second.

**FMI 1 – Data Valid But Below Normal (Most Severe):** TASPS reports less than 75 psi (517 kPa) for 1 second after the vehicle has been running for more than 4 minutes or the vehicle is moving.

**FMI 2 – Data Erratic:** TASPS is out of range less than 5 psi (34.5 kPa) or greater than 162 psi (1117 kPa) for 5 seconds.

**FMI 3 – Voltage Above Normal or Shorted High:** TASPS circuit shorted to power for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** TASPS circuit shorted to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** TASPS circuit open or shorted to ground for 5 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** TASPS reference voltage out of range not between 4.75V to 5.25V for 5 seconds.

**FMI 17 – Data Valid but Below Normal (Least Severe):** TASPS reports less than 75 psi (517 kPa) for 2 seconds with the engine off and the transmission in gear.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** TASPS reports less than 80 psi (552 kPa) for 2 second after the vehicle has been running for more than 4 minutes or the vehicle is moving.

**FMI 20 – Data Drifted High:** TASPS incorrectly reporting high.

**FMI 21 – Data Drifted Low:** TASPS incorrectly reporting low.

## Fallback

**FMI 0:**

- Amber warning lamp on
- Shift performance may be degraded

**FMI 1:**

- Non-Neutral Modes prohibited
- Amber warning lamp on
- PTO Mode prohibited
- If vehicle is moving
  - Red stop lamp on
  - Transmission may remain in current gear
  - Clutch may remain in current position
  - Engine may shut down

**FMI 2, 3, 4, 5, 6, 20, 21:**

- Amber warning lamp on
- Shift performance may be degraded

**FMI 17:**

- Amber warning lamp on
- No degraded modes
- Engine may not crank

**FMI 18:**

- Amber warning lamp on
- Non-Neutral Modes prohibited
- PTO Mode prohibited
- If vehicle is moving
  - Red stop lamp on
  - Up shifts prohibited

## Conditions to Set Fault Code Inactive

**FMI 0:** TASPS below 145psi (1000 kPa) for 1 second.

**FMI 1:** TASPS above 75psi (517 kPa) for 1 second.

**FMI 2, 3, 4, 5, 6:** TASPS in range for 10 seconds.

**FMI 17:** TASPS above 75psi (517 kPa) and transmission in neutral.

**FMI 18:** TASPS above 80psi (552 kPa) for 1 second.

**FMI 20, 21:** TASPS in range.

## Possible Causes

**FMI 0:**

- Vehicle air system
  - Air compressor governor “off” set too high or damaged
- Vehicle service event
  - Connected to an auxiliary air supply

**FMI 1, 18:**

- Vehicle air system
  - High system demand
  - Air compressor governor “on” set too low or damaged
  - Air compressor mechanically damaged
  - Pressure Protection Valve stuck closed
  - Air leak
- Internal transmission
  - Air leak

**FMI 2, 3, 4, 5, 6:**

- Transmission Air Supply Pressure Sensor
  - Damaged
  - Internal failure
- Transmission Air Supply Pressure Sensor harness
  - Wiring shorted to power, shorted to ground or open
- MTM Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Software issue
  - Internal failure

**FMI 17:**

- Engine shut down with the loss of transmission air supply pressure with the transmission in gear
- Transmission service event
  - Transmission assembled in gear

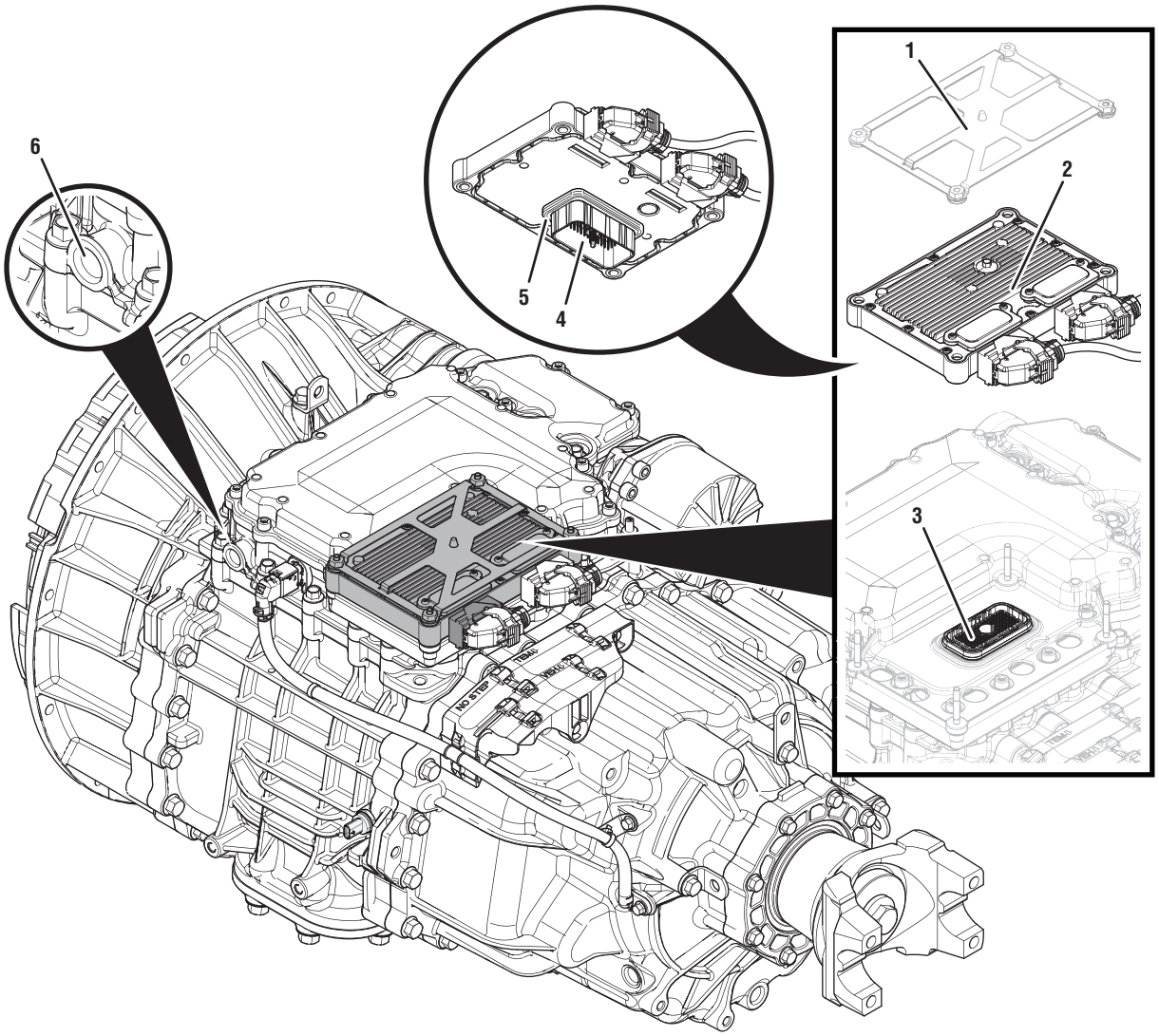
**FMI 20, 21:**

- Vehicle air system
  - Contamination
  - Moisture
- Transmission Air Supply Pressure Sensor
  - Contamination
  - Damaged
  - Internal failure
- TCM
  - Software issue
  - Internal failure

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- 0-200 psi (0-1379 kPa) air pressure gauge

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector*
*4. TCM Side of 74-Way Transmission Harness Connector*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

# Fault Code 215 Troubleshooting

**A** ***Purpose:*** *Vent LCA and Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 215 FMI 2, 3, 4, 5, 6 is Active or Inactive, go to **Step D.**
   - If Fault Code 215 FMI 0, 1, 18 is Active, go to **Step H.**
   - If Fault Code 215 FMI 0, 1, 18 is Inactive, vehicle air supply pressure is in range. Refer to OEM guidelines and verify operation and maintenance of the vehicle air system.
   - If Fault Code 215 FMI 20, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 215 FMI 17 is Active, connect an auxiliary air supply to the vehicle, air up the vehicle air system and key on. Go to **Step V.**
   - If Fault Code 215 FMI 17 is Inactive, the transmission air supply pressure is in range and transmission is in neutral. Go to **Step V.**

**B** ***Purpose:*** *Verify operation and condition of the vehicle air system.*

1. Key off.
2. Refer to OEM guidelines and verify operation and maintenance of the vehicle air system.
3. Inspect the vehicle air system for contamination, moisture, corrosion and/or debris.
   - If an issue is found with the vehicle air system, refer to OEM guidelines for repair or replacement of the vehicle air system. Go to **Step C.**
   - If no issue is found with the vehicle air system, go to **Step C.**

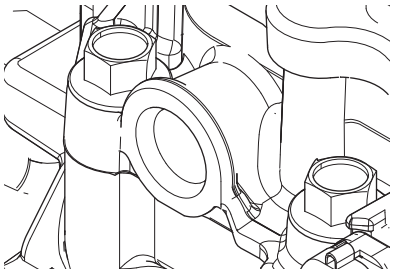
## C

***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
2. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
3. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

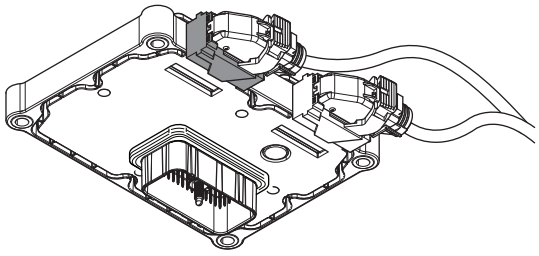


- If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**
- If no contamination is found, go to **Step D.**

## D

***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.



3. Inspect the TCM side of the 74-Way Transmission Harness 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.
4. Inspect the TCM Seal, verify the seal is properly installed and there is no damage to the seal.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**
   - If no contamination or damage is found, go to **Step E.**

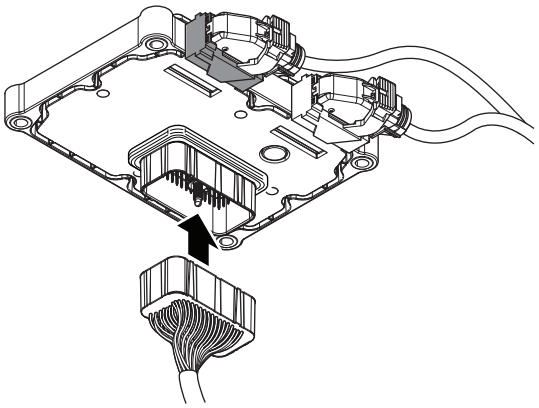
**E**

***Purpose:*** *Review the Service Activity Report and record the MTM Serial Number.*

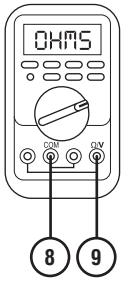
1. Review the Service Activity Report (SAR) and record the MTM Serial Number.
   - If the MTM Serial Number is greater than or equal to 12S17137123221. Go to **Step F.**
   - If the MTM Serial Number is less than or equal to 12S17137123220. Go to **Step G.**

**F** ***Purpose:*** *Verify TASPS internal resistance and power supply at TCM.*

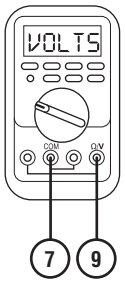
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 8 and Pin 9. Record reading in table.




4. Key on.
5. Measure voltage at the Eaton Breakout Box between Pin 7 and Pin 9. Record reading in table.




6. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

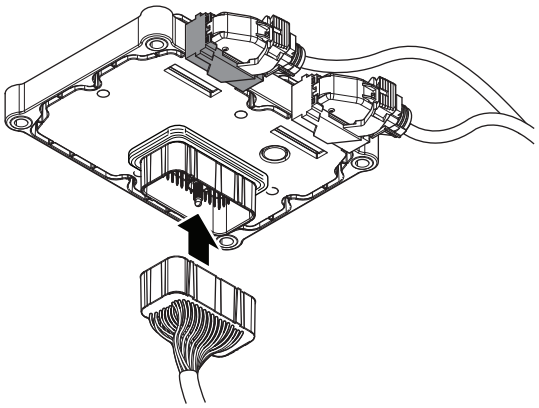
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 8 to 9 | 3k-9k Ohms | |
| Key on | 7 to 9 | 4.75–5.25 V | |

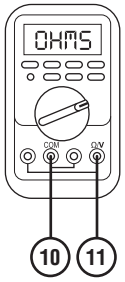
## G

***Purpose:*** *Verify TASPS internal resistance and power supply at TCM.*

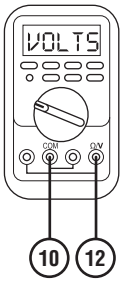
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 10 and Pin 11. Record reading in table.




4. Key on.
5. Measure voltage at the Eaton Breakout Box between Pin 10 and Pin 12. Record reading in table.




6. Compare reading(s) in table.
   - If readings are in range, replace the MTM.Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 10 to 11 | 3k-9k Ohms | |
| Key on | 10 to 12 | 4.75–5.25 V | |

**H** ***Purpose:*** *Verify operation of the vehicle air system.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From the Parameter List, select “Pressure”.
5. Key on with engine running.
6. Allow air pressure to build to governor cut off.
7. Key on with engine off.
8. Monitor in-dash vehicle air system pressure gauge and record value in table.
9. In ServiceRanger, monitor 520524 - Line Pressure Feedback and record value in table.
10. Wait 1 minute.
11. Monitor in-dash vehicle air system pressure gauge and record value in table.
12. In ServiceRanger, monitor 520524 - Line Pressure Feedback and record value in table.
13. Compare reading(s) in table.
    - If readings are out of range or system cannot hold pressure, go to **Step I.**
    - If readings are in range and the vehicle air system holds pressure, replace the MTM. Go to **Step V.**

      **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

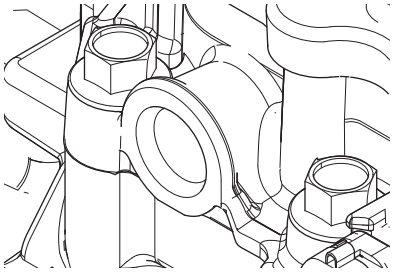
| Source | Range | Reading(s) |
|---|---|---|
| In-dash air pressure gauge | 100–135 PSI (690-930 kPa) | |
| 520524 - Line Pressure Feedback | 100–135 PSI (690-930 kPa) (6.5-9.5 bar) | |
| After 1 minute | | |
| In-dash air pressure gauge | 100–135 PSI (690-930 kPa) | |
| 520524 - Line Pressure Feedback | 100–135 PSI (690-930 kPa) (6.5-9.5 bar) | |

## I

***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
2. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
3. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guideline for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

   - If no contamination is found, go to **Step J.**

## J

***Purpose:*** *Verify operation of the vehicle air system.*

1. Key off.
2. Install a 0-200 PSI air pressure gauge on the vehicle air supply line at the MTM.
3. Key on with engine running.
4. Allow air pressure to build to governor cut off.
5. Key off.
6. Monitor air pressure gauge installed in the vehicle air supply line and record reading in table.
7. Wait 1 minute.
8. Monitor air pressure gauge installed in the vehicle air supply line and record reading in table.
9. Compare reading(s) in table.

   - If readings are out of range or the vehicle air system cannot hold pressure, refer to OEM guidelines for repair or replacement of the vehicle air system. Go to **Step V.**
   - If readings are in range, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Source | Range | Reading(s) |
|---|---|---|
| Air pressure gauge | 100–135 PSI (690-930 kPa) | |
| **After 1 Minute** | | |
| Air pressure gauge | 100–135 PSI (690-930 kPa) | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 215 sets Active during operation, go to **Step A.**
   - If a fault code other than 215 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 250 Linear Clutch Actuator (LCA) Position Sensor

**J1939: SA 3 SPN 33 FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 20**

## Overview

The Endurant Transmission is equipped with a Linear Clutch Actuator (LCA) Position Sensor to monitor clutch position. The LCA is mounted in the Mechatronic Transmission Module (MTM) and pneumatically controls the clutch position. The LCA is equipped with a magnet that the position sensor uses to detect the proximity of the LCA to determine clutch position. The LCA Position Sensor is located in the MTM and connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the LCA Position Sensor signal. If a system failure or uncommanded movement is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 0 - Data Valid But Above Normal (Most Severe):** Clutch position signal indicates uncommanded movement toward engagement position for 2 seconds.

**FMI 1 - Data Valid But Below Normal (Most Severe):** Clutch position signal indicates uncommanded movement toward disengagement position for 2 seconds.

**FMI 2 – Data Erratic:** LCA position out of range for 1 second.

**FMI 3 – Voltage Above Normal or Shorted High:** LCA Position Sensor circuit shorted to power for 1 second.

**FMI 4 – Voltage Below Normal or Shorted Low:** LCA Position Sensor circuit shorted to ground for 1 second.

**FMI 5 – Current Below Normal or Open Circuit:** LCA Position Sensor circuit open for 1 second.

**FMI 6 - Current Above Normal or Grounded Circuit:** LCA Position Sensor reference voltage not between 4.75V to 5.25V for 1 second.

**FMI 7 - Mechanical System Not Responding:** During the clutch calibration the expected fully engaged (closed) clutch position was not achieved.

**FMI 8 – Abnormal Frequency:** LCA Position Sensor signal abnormal pulse width for 1 second.

**FMI 9 - Abnormal Update Rate:** LCA Position Sensor magnet not detected for 1 second.

**FMI 12 – Bad Intelligent Device:** LCA Position Sensor internal self-check failure for 1 second.

**FMI 13 – Out Of Calibration:** LCA Position Sensor calibration required.

**FMI 14 – Special Instructions:** Incorrect LCA position command relative to torque command.

**FMI 15 - Data Valid But Above Normal (Least Severe):** During the clutch calibration the expected Torque Transfer Touch Point clutch position was not achieved.

**FMI 16 – Data Valid But Above Normal (Moderately Severe):** During the clutch calibration the expected Torque Transfer Touch Point clutch position was not available.

**FMI 17 – Data Valid But Below Normal (Least Severe):** During the clutch calibration the expected 10 Nm torque transfer clutch position was not achieved.

**FMI 18 – Data Valid But Below Normal (Moderately Severe):** During the clutch calibration the expected 10 Nm torque transfer clutch position was not available.

**FMI 20 – Data Drifted High:** LCA Position Sensor incorrectly reports the clutch is released (opened).

## Fallback

**FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 15, 16, 17, 18, 20:**

- Amber warning lamp on
- Non-Neutral Modes prohibited
- PTO Mode prohibited

**Note:** If vehicle is moving:

- Red warning lamp on
- Upshifts prohibited

**FMI 14:**

- Clutch engagement prohibited

## Conditions to Set Fault Code Inactive

**FMI 0, 1:** LCA position values match commanded values for 10 seconds.

**FMI 2:** LCA position in range for 10 seconds.

**FMI 3, 4, 5, 6, 8:** LCA Position Sensor in range for 10 seconds.

**FMI 12:** LCA Position Sensor has no self-check failures for 10 seconds.

**FMI 13:** Successful Clutch Calibration performed.

**FMI 7, 9, 14, 15, 16, 17, 18:** Key cycle.

**FMI 20:** Condition no longer exists.

## Possible Causes

**FMI 0, 1:**

- LCA
  - Air leak
  - Self-adjustment mechanism
- MTM
  - Air leak
- Valve Pack C
  - Stuck open clutch exhaust valve(s)
- Clutch Release System
  - Release Yoke
  - Release Bearing
- LCA Position Sensor
  - Internal failure

**FMI 7**

- LCA
  - Self-adjustment mechanism
- Valve Pack C
  - Stuck open clutch fill valve(s)
- Clutch Release System
  - Release Yoke
  - Release Bearing
- LCA Position Sensor
  - Internal failure
- Incorrect engine flywheel housing

**FMI 15, 16, 17, 18:**

- LCA
  - Self-adjustment mechanism
- Valve Pack C
  - Stuck open clutch fill valve(s)
- Clutch Release System
  - Release Yoke
  - Release Bearing
- LCA Position Sensor
  - Internal failure

**FMI 2, 3, 4, 5, 6, 8, 20:**

- LCA Position Sensor
  - Internal failure
  - Damaged
- 74-Way MTM Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 9:**

- LCA
  - Magnet Loose
  - Magnet Detached
- LCA Position Sensor (MTM)
  - Loose
  - Damaged
- Incorrect engine flywheel housing

**FMI 12, 14:**

- TCM
  - Software issue
  - Internal failure

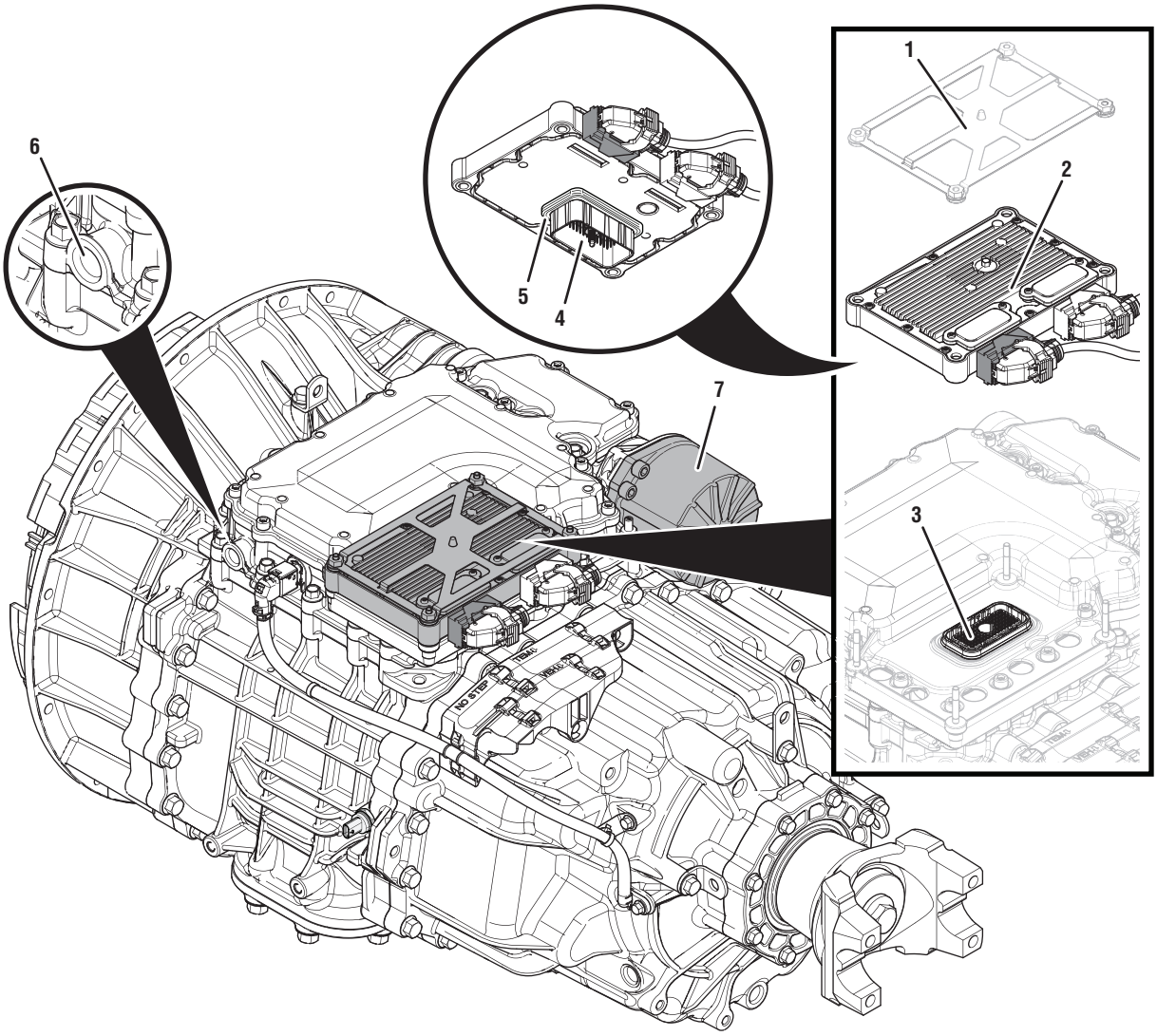
**FMI 13:**

- Clutch Calibration required

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector*
*4. TCM Side of 74-Way TCM Transmission Harness Connector*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*
*7. Linear Clutch Actuator (LCA)*

# Fault Code 250 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

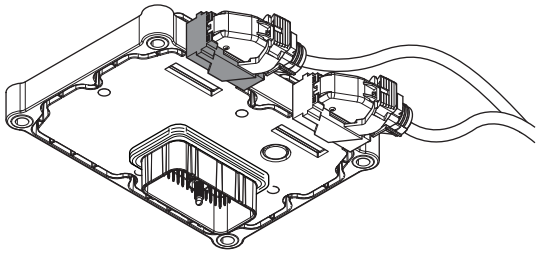
1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.

   **Note:** If the engine flywheel housing was just replaced and Fault Code 250 set immediately after repair, contact OEM and/or engine manufacturer and ensure the correct housing part number was installed based on the transmission model.

   - If Fault Code 250 FMI 13 is Active, perform the Clutch Calibration with ServiceRanger. Test complete, go to **Step V.**.
   - If Fault Code 250 FMI 13 is Inactive, Clutch Calibration already performed. Test complete, go to **Step V.**.
   - If Fault Code 250 FMI 2, 3, 4, 5, 6, 8, 20 is Active or Inactive, go to **Step B.**
   - If Fault Code 250 FMI 9 is Active or Inactive, go to **Step E.**
   - If Fault Code 250 FMI 0, 1, 7, 15, 16, 17, 18 is Active or Inactive, go to **Step D.**
   - If Fault Code 250 FMI 12, 14 is Active or Inactive, go to **Step F.**

**B** ***Purpose:*** *Verify TCM and 74-Way Harness Connector condition.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.



3. Inspect the TCM side of the 74-Way Transmission Harness 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.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.

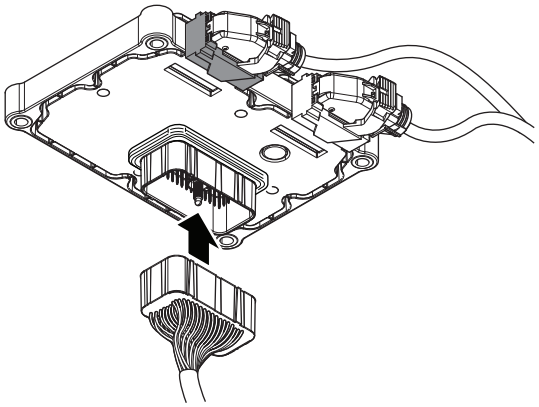
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

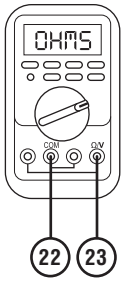
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify TCM LCA Position Sensor internal resistance and power supply.*

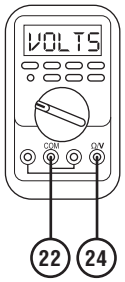
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 22 and Pin 23. Record reading in table.




4. Key on.
5. Measure voltage at the Eaton Breakout Box between Pin 22 and Pin 24. Record reading in table.




6. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

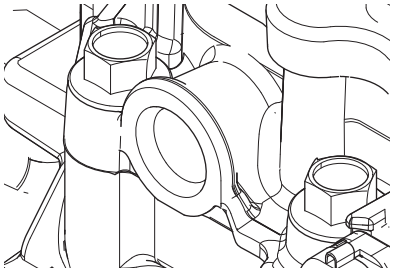
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 22 to 23 | 14.25k-15.75k Ohms | |
| Key on | 22 to 24 | 4.75-5.25 V | |

**D** ***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



- If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

  **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

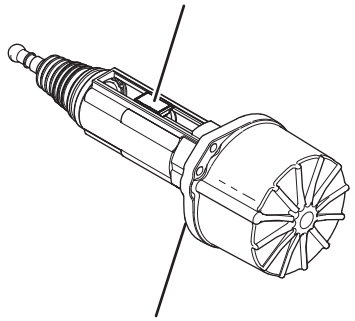
- If no contamination is found, go to **Step E.**

**E** ***Purpose:*** *Inspect LCA Magnet, Seal and Position Sensor.*

**Note:** Fault Code 250 FMI 9 sets Active if the LCA is removed with the key on (TCM powered up).

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Remove the LCA.

   **NOTICE:** Ensure the key is off and 20-Way TCM Vehicle Harness Connector is disconnected prior to removal of the LCA from the MTM.
4. Inspect the LCA Position Sensor Magnet.



5. Inspect LCA to MTM Seal.
6. Inspect the LCA to MTM sealing surface on the MTM.
7. Inspect LCA Position Sensor in the MTM through the LCA mounting opening and verify the LCA Position Sensor is properly secured.

   - If the LCA Position Sensor Magnet is damaged and no other fault is found, replace the LCA. Go to **Step V.**
   - If the LCA to MTM Seal is damaged and no fault is found with the LCA to MTM sealing surface on the MTM, replace the LCA. Go to **Step V.**
   - If the LCA to MTM sealing surface on the MTM is damaged, replace the MTM (includes LCA). Go to **Step V.**
   - If the LCA Position Sensor in the MTM is not properly secured, replace the MTM (includes LCA). Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no fault is found with the LCA, MTM or LCA Position Sensor, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

## F

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 250 sets Active during operation, go to **Step A.**
   - If a fault code other than 250 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 275: Rail B Position

**J1939: SA 3 SPN 4219 FMI 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 16, 18, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with position sensors to monitor shift rails B, C, D and E. The position sensors detect the rail position through the proximity of a magnet mounted to each shift rail. Shift Rail B actuates the Rail B synchronizer to engage the Primary or Secondary Drive Gear. The position sensors are located in the Mechatronic Transmission Module (MTM) and connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Rail B Position. If a system failure is detected, the TCM sets the fault code Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal – Most Severe:** Rail B Position Sensor indicated Rail B moved beyond the calibrated Secondary Drive Gear engagement position for 1 second.

**FMI 1 – Data Valid But Below Normal – Most Severe:** Rail B Position Sensor indicated Rail B moved beyond the calibrated Primary Drive Gear engagement position for 1 second.

**FMI 2 – Data Erratic:** Rail B Position Sensor out of normal operating duty cycle (5% to 95%) for 1 second.

**FMI 3 – Voltage Above Normal or Shorted High:** Rail B Position Sensor shorted to power for 1 second.

**FMI 4 – Voltage Below Normal or Shorted Low:** Rail B Position Sensor shorted to ground for 1 second.

**FMI 5 – Current Below Normal or Open Circuit:** Rail B Position Sensor open circuit for 1 second.

**FMI 6 – Current Above Normal or Grounded Circuit:** Rail B Position Sensor out of normal operating voltage (4.75V to 5.25V) for 1 second.

**FMI 8 – Abnormal Frequency:** Rail B Position Sensor out of normal operating frequency for 1 second.

**FMI 9 – Abnormal Update Rate:** Rail B Position Sensor could not detect magnet for 1 second.

**FMI 10 – Abnormal Rate Of Change:** Rail B Position Sensor reporting rate of change exceeded when no movement commanded for 1 second.

**FMI 11 – Root Cause Unknown:** Rail B Position Sensor and speed sensors report a mismatch for 1 second.

**FMI 12 – Bad Intelligent Device:** Rail B Position Sensor internal self-check out of range for 1 second.

**FMI 14 – Special Instructions:** Rail B Position Sensor reporting a Secondary Drive Gear engagement position while speed sensors report a gear ratio different to a Secondary Drive Gear ratio for 1 second.

**FMI 16 - Data Valid but Above Normal (Moderately Severe):** Rail B Position Sensor reporting uncommanded movement toward neutral from Secondary Drive Gear engagement position while speed sensors report a valid Secondary Drive Gear ratio.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** Rail B Position Sensor reporting uncommanded movement toward neutral from Primary Drive Gear engagement position while speed sensors report a valid Primary Drive Gear ratio.

**FMI 20 – Data Drifted High:** Rail B Position Sensor reporting Secondary Drive Gear disengagement while speed sensors report a valid Secondary Drive Gear ratio for 1 second.

**FMI 21 – Data Drifted Low:** Rail B Position Sensor reporting Primary Drive Gear disengagement while speed sensors report a valid Primary Drive Gear ratio for 1 second.

**FMI 31 – Condition Exists:** Rail B Position Sensor reporting Primary Drive Gear engagement while speed sensors report a gear ratio different to a Primary Drive Gear ratio for 1 second.

## Fallback

**FMI 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 16, 18, 20, 21, 31**

- If Rail B position is known and fully engaged:
  - Amber warning lamp on
  - Shift Rail B movement prohibited
- If Rail B position is not known or not fully engaged:
  - Amber warning lamp on
  - Shift Rail B movement prohibited
  - Non-Neutral Modes prohibited
  - PTO mode prohibited
  - If vehicle is moving – Red stop lamp on

## Conditions to Set Fault Code Inactive

**FMI 2, 3, 4, 5, 6, 8, 9:** Rail B Position Sensor in range for 10 seconds.

**FMI 0, 1, 10, 11, 14, 16, 18, 20, 21, 31:** Key cycle and condition no longer exists.

**FMI 12:** Rail B Position Sensor internal self-checks in range for 10 seconds.

## Possible Causes

**FMI 0, 1:**

- MTM
  - Rail B Yoke
- Internal Transmission
  - Rail B Synchronizer

**FMI 2, 3, 4, 5, 6, 8:**

- MTM - Rail B Position Sensor
  - Damaged
  - Internal failure
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open.
- TCM
  - Software issue
  - Internal failure

**FMI 9:**

- MTM - Rail B Cylinder
  - Magnet loose
  - Magnet detached
- MTM - Rail B Position Sensor
  - Loose
  - Damaged

**FMI 10, 14, 20, 21, 31:**

- MTM - Rail B Position Sensor
  - Internal failure

**FMI 11:**

- MTM - Rail B Position Sensor
  - Internal failure
- MTM - Countershaft Speed Sensor
  - Internal failure
- MTM - Input Shaft Speed Sensor
  - Internal failure
- TCM
  - Software issue
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

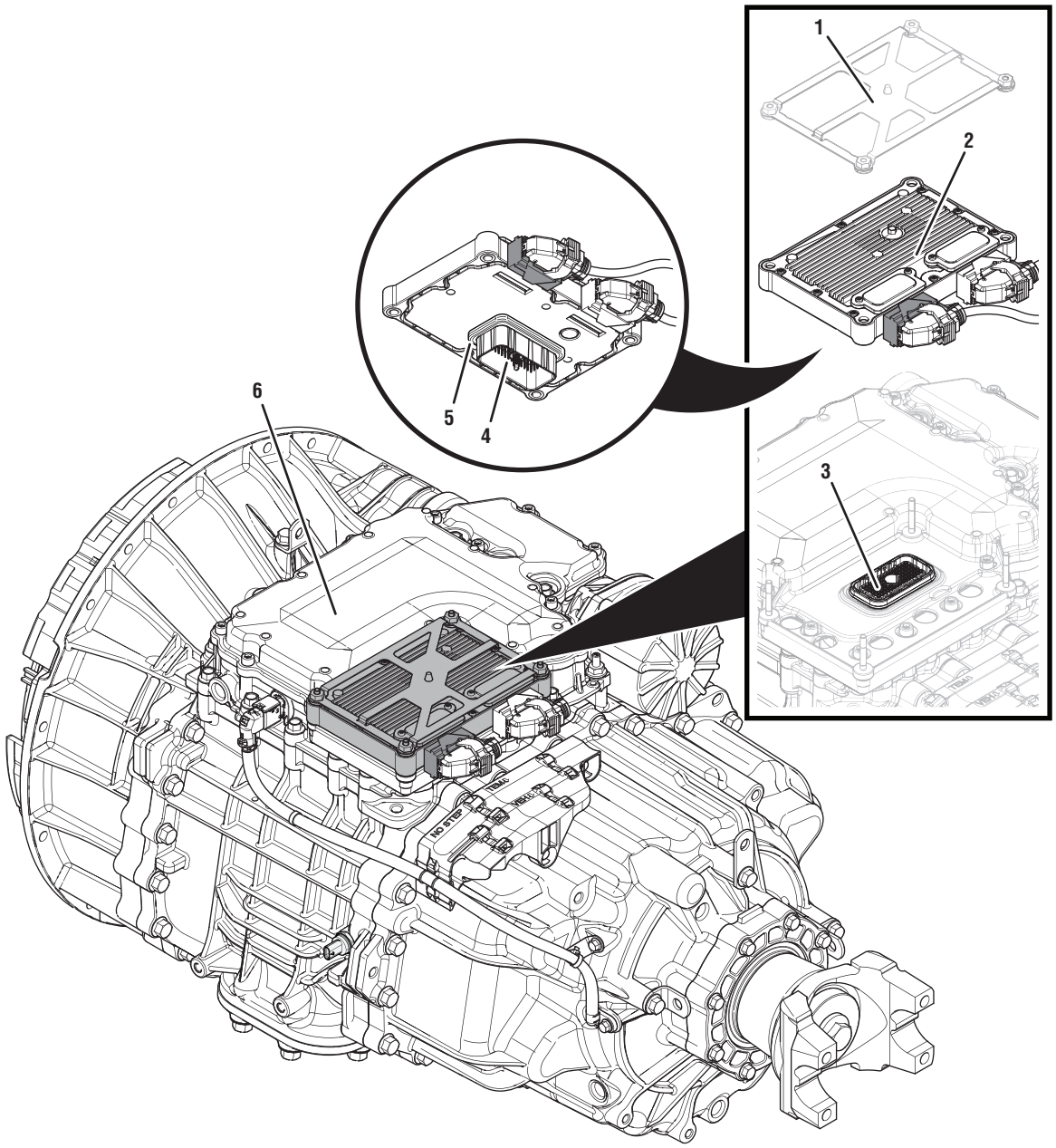
**FMI 16, 18:**

- MTM - Rail B Position Sensor
  - Internal failure
- MTM - Rail B Detent
  - Weak or broken spring
  - Worn shift rail or detent

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- Rail B Synchronizer Engagement Tool - RR1088TR

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

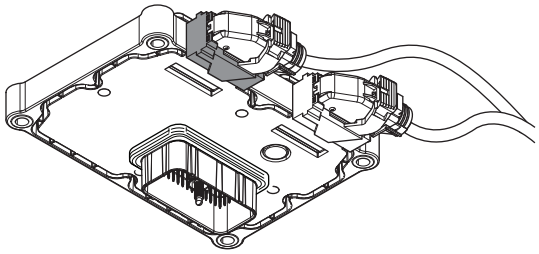
# Fault Code 275 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 275 FMI 2, 3, 4, 5, 6, 8, 9, 10, 14, 16, 18, 20, 21, 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 275 FMI 0, 1, 7 is Active or Inactive, go to **Step D.**
   - If Fault Code 275 FMI 11 is Active or Inactive, go to **Step G.**
   - If Fault Code 275 FMI 12 is Active or Inactive, go to **Step I.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

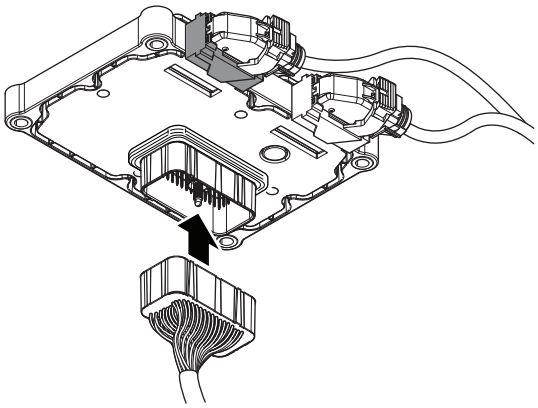


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

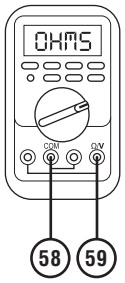
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail B Position Sensor internal resistance and power supply at TCM.*

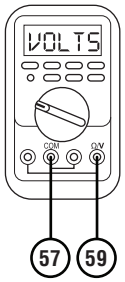
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 58 and Pin 59. Record reading in table.




4. Key on.
5. Measure voltage at the Eaton Breakout Box between Pin 57 and Pin 59. Record reading in table.




6. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 58 to 59 | 7.5k–22k Ohms | |
| Key on | 57 to 59 | 4.75–5.25 V | |

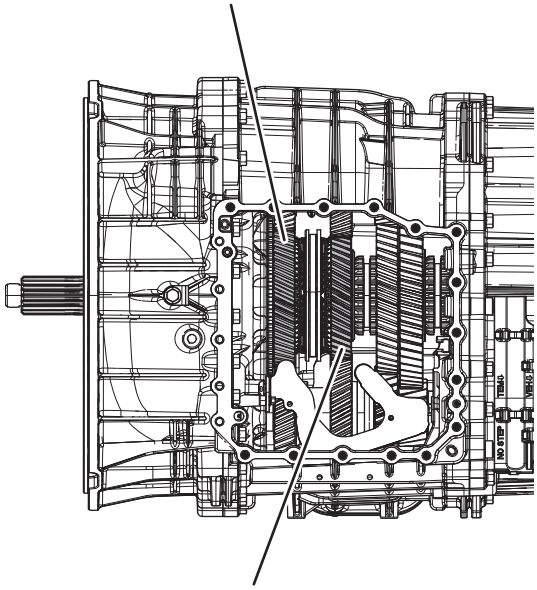
## D

***Purpose:*** *Verify mechanical condition of the Primary and Secondary Drive Gears.*

1. Key off.
2. Remove MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

3. Inspect the Secondary Drive Gear for excessive fore and aft movement.



4. Inspect the Primary Drive Gear for excessive fore and aft movement
   - If excessive gear movement is evident, inspect the Main Shaft assembly and input shaft assembly and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step E.**

## E

***Purpose:*** *Verify mechanical condition of the Rail B Synchronizer.*

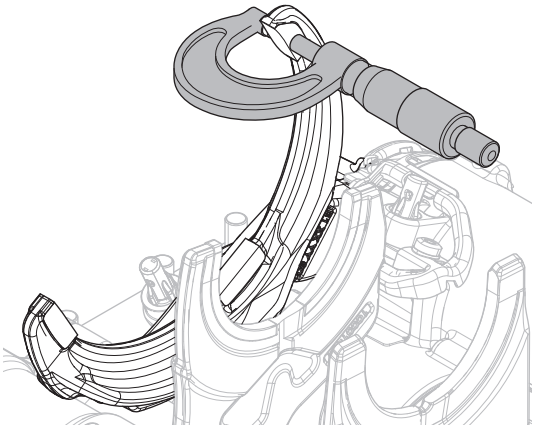
1. Inspect the Rail B Synchronizer Sliding Sleeve yoke slot for wear.
2. Install the Rail B Synchronizer Engagement Tool (RR1088TR).

   **Note:** Reference *Manually Actuate Rail B Procedure* on page 526 of the Appendix.

3. Shift the Rail B Synchronizer Sliding Sleeve into neutral (if necessary).
4. Shift the Rail B Synchronizer Sliding Sleeve into the Secondary Drive Gear engagement position (fore) and return to neutral.
5. Shift the Rail B Synchronizer Sliding Sleeve into the Primary Drive Gear engagement position (aft) and return to neutral.
   - If the Rail B Synchronizer Sliding Sleeve shifts into all three positions, replace the MTM. Go to **Step V.**
   - If the Rail B Synchronizer Sliding Sleeve does not shift into all three positions, go to **Step F.**

**F** ***Purpose:*** *Verify mechanical condition of the Rail B Yoke.*

1. Measure Rail B Yoke wear pads with a micrometer. Record reading in table.



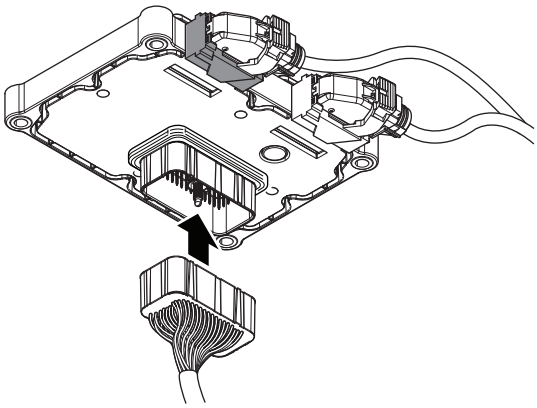
- If readings are in range, replace the Rail B Synchronizer Assembly. Go to **Step V.**
- If readings are out of range, replace the Rail B Synchronizer Assembly and MTM. Go to **Step V.**

| Shift Yoke | Range | Reading(s) |
|---|---|---|
| Rail B Yoke Wear Pads | 9.500–9.950 mm (0.374-0.392 in) | |

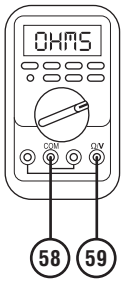
## G

***Purpose:*** *Verify Rail B Position Sensor internal resistance and power supply at TCM.*

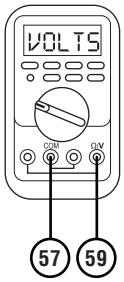
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 58 and Pin 59. Record reading in table.




4. Key on.
5. Measure voltage at the Eaton Breakout Box between Pin 57 and Pin 59. Record reading in table.



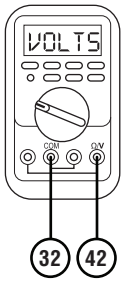

6. Compare reading(s) in table.
   - If readings are in range, go to **Step H.**
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 58 to 59 | 7.5k–22k Ohms | |
| Key on | 57 to 59 | 4.75–5.25 V | |

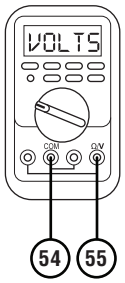
**H**

***Purpose:*** *Verify Input and Countershaft speed sensor supply voltage at TCM.*

1. Key on.
2. Measure voltage at the Eaton Breakout Box between Pin 32 and Pin 42. Record reading in table.




3. Measure voltage at the Eaton Breakout Box between Pin 54 and Pin 55. Record reading in table.




4. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key on | 32 to 42 | 4.75–5.25 V | |
| Key on | 54 to 55 | 4.75–5.25 V | |

## I

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 275 sets Active during operation, go to **Step A.**
   - If a fault code other than 275 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 295: Rail C Position

**J1939: SA 3 SPN 4220 FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with position sensors to monitor shift rails B, C, D and E. The position sensors detect the rail position through the proximity of a magnet mounted to each shift rail. Rail C actuates the Rail C sliding clutch to engage the Primary Drive Gear or Secondary Driven Gear. The position sensors are located in the Mechatronic Transmission Module (MTM) and connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Rail C Position. If a system failure is detected, the TCM sets the fault code Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal – Most Severe:** Rail C Position Sensor indicated Rail C moved beyond the calibrated Primary Drive Gear engagement position for 1 second.

**FMI 1 – Data Valid But Below Normal – Most Severe:** Rail C Position Sensor indicated Rail C moved beyond the calibrated Secondary Driven Gear engagement position for 1 second.

**FMI 2 – Data Erratic:** Rail C Position Sensor out of normal operating duty cycle (5% to 95%) for 1 second.

**FMI 3 – Voltage Above Normal or Shorted High:** Rail C Position Sensor shorted to power for 1 second.

**FMI 4 – Voltage Below Normal or Shorted Low:** Rail C Position Sensor shorted to ground for 1 second.

**FMI 5 – Current Below Normal or Open Circuit:** Rail C Position Sensor open circuit for 1 second.

**FMI 6 – Current Above Normal or Grounded Circuit:** Rail C Position Sensor out of normal operating voltage (4.75V to 5.25V) for 1 second.

**FMI 7 – Mechanical System Not Responding:** Rail C Position Sensor indicated movement from neutral while Rail D was engaged into the Primary Driven Gear or Reverse Gear during an interlock function test.

**FMI 8 – Abnormal Frequency:** Rail C Position Sensor out of normal operating frequency for 1 second.

**FMI 9 – Abnormal Update Rate:** Rail C Position Sensor could not detect magnet for 1 second.

**FMI 10 – Abnormal Rate Of Change:** Rail C Position Sensor reporting rate of change exceeded when no movement commanded for 1 second.

**FMI 12 – Bad Intelligent Device:** Rail C Position Sensor internal self-check out of range for 1 second.

**FMI 14 – Special Instructions:** Rail C Position Sensor reporting a partial or full Secondary Driven Gear engagement position while speed sensors and Rail D Position Sensor reports a Primary Driven Gear or Reverse Gear engagement position for 1 second.

**FMI 15 - Data Valid but Above Normal (Least Severe):** Rail C Position Sensor reporting uncommanded movement toward the Primary Drive Gear from the neutral position while D Position Sensor reports a Primary Driven Gear or Reverse gear engagement position for 2 second.

**FMI 16 - Data Valid but Above Normal (Moderately Severe):** Rail C Position Sensor reporting uncommanded movement toward neutral from the Primary Drive Gear engagement position while speed sensors report a valid Primary Drive Gear ratio.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail C Position Sensor reporting uncommanded movement toward the Secondary Driven Gear from the neutral position while Rail D Position Sensor reports a Primary Driven Gear or Reverse gear engagement position for 2 second.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** Rail C Position Sensor reporting uncommanded movement toward neutral from the Secondary Driven Gear engagement position while speed sensors report a valid Secondary Driven Gear ratio.

**FMI 20 – Data Drifted High:** Rail C Position Sensor reporting Primary Drive Gear disengagement while speed sensors report a valid Primary Drive Gear ratio for 1 second.

**FMI 21 – Data Drifted Low:** Rail C Position Sensor reporting Secondary Driven Gear disengagement while speed sensors report a valid Secondary Driven Gear ratio for 1 second.

**FMI 31 – Condition Exists:** Rail C Position Sensor reporting a partial or full Primary Drive Gear engagement while speed sensors and Rail D Position Sensor reports a Primary Driven Gear or Reverse Gear engagement position for 1 second.

## Fallback

**FMI 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21, 31**

- If Rail C position is known and fully engaged
  - Amber warning lamp on
  - Shift Rail C movement prohibited
- If Rail C position is not known or not fully engaged:
  - Amber warning lamp on
  - Shift Rail C movement prohibited
  - Non-neutral modes prohibited
  - PTO Mode Prohibited
  - If vehicle is moving - Red stop lamp on

**FMI 7**

- Amber warning lamp on
- No degraded performance

## Conditions to Set Fault Code Inactive

**FMI 2, 3, 4, 5, 6, 8, 9:** Rail C Position Sensor in range for 10 seconds.

**FMI 0, 1, 7, 10, 11, 14, 15, 16, 18, 20, 21, 31:** Key cycle and condition no longer exists.

**FMI 12:** Rail C Position Sensor internal self-checks in range for 10 seconds.

## Possible Causes

**FMI 0, 1:**

- MTM
  - Rail C Yoke
- Internal Transmission
  - Rail C Sliding Clutch

**FMI 2, 3, 4, 5, 6, 8:**

- MTM - Rail C Position Sensor
  - Damaged
  - Internal failure
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open.
- TCM
  - Software issue
  - Internal failure

**FMI 7:**

- MTM - Rail C
  - Valve Pack B
  - Valve Pack C
  - Rail C cylinder
  - Rail C yoke
  - Rail C detent
- Internal Transmission
  - Rail C sliding clutch
  - Main Shaft

**FMI 9:**

- MTM - Rail C Cylinder
  - Magnet loose
  - Magnet detached
- MTM - Rail C Position Sensor
  - Loose
  - Damaged

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

**FMI 10, 14, 20, 21, 31:**

- MTM- Rail C Position Sensor
  - Internal failure

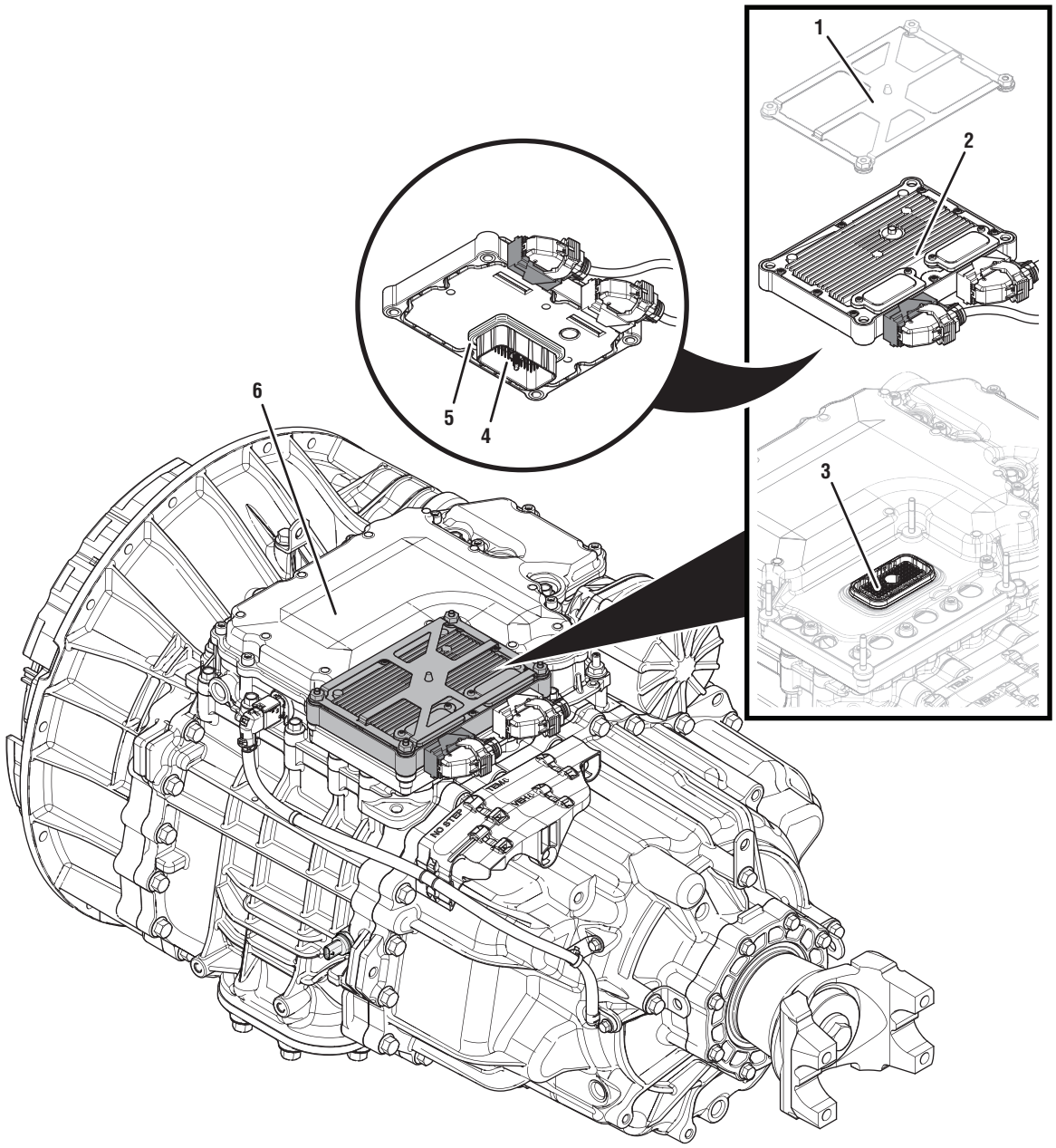
**FMI 15, 16, 17, 18:**

- MTM - Rail C Position Sensor
  - Internal failure
- MTM - Rail C Detent
  - Weak or broken spring
  - Worn shift rail or detent

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

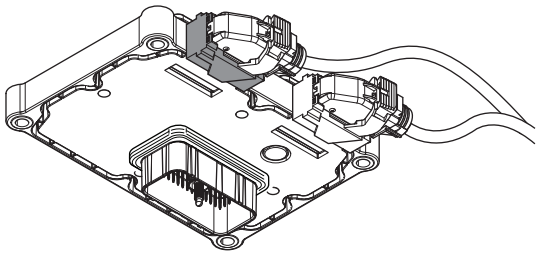
# Fault Code 295 Troubleshooting

**A** ***Purpose:*** *Vent LCA and Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 295 FMI 2, 3, 4, 5, 6, 8, 9, 14, 15, 16, 17, 18, 20, 21, 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 295 FMI 0, 1, 7 is Active or Inactive, go to **Step D.**
   - If Fault Code 295 FMI 12 is Active or Inactive, go to **Step G.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

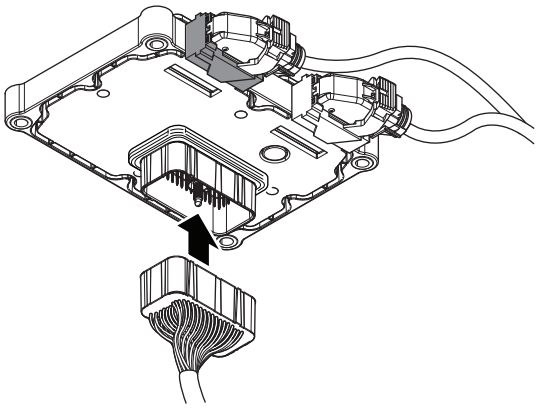


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from any corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

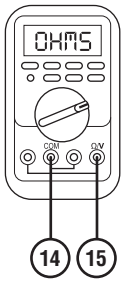
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail C Position Sensor internal resistance and power supply at TCM.*

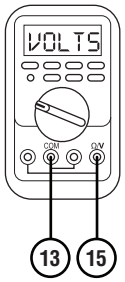
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 14 and Pin 15. Record reading in table.




4. Key on.
5. Measure voltage at the Eaton Breakout Box between Pin 13 and Pin 15. Record reading in table.




6. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace TCM. Go to **Step V.**

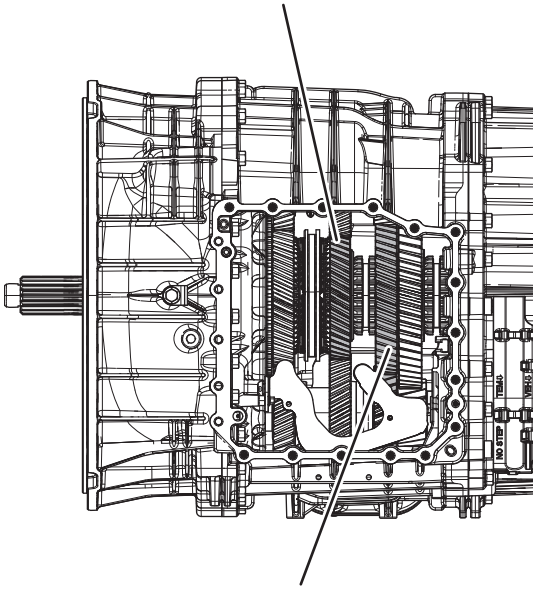
| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 14 to 15 | 7.5k–22k Ohms | |
| Key on | 13 to 15 | 4.75–5.25 V | |

## D

***Purpose:*** *Verify mechanical condition of the Primary Drive and Secondary Driven Gears.*

1. Key off.
2. Remove MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the Primary Drive Gear for excessive fore and aft movement.

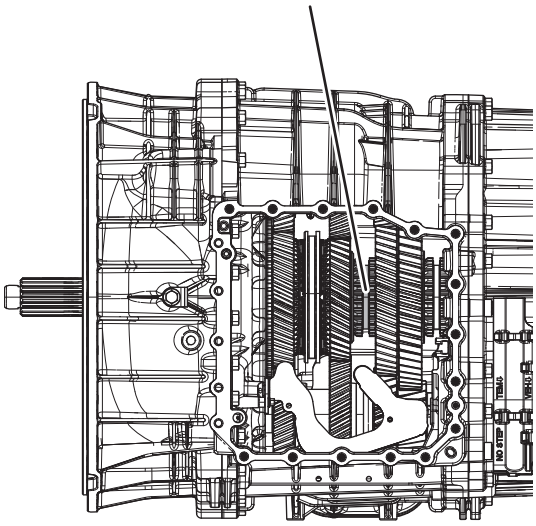


4. Inspect the Secondary Driven Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect the Main Shaft for cause of excessive movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step E.**

## E

***Purpose:*** *Verify mechanical condition of the Rail C Sliding Clutch.*

1. Inspect the Rail C Sliding Clutch yoke slot for wear.

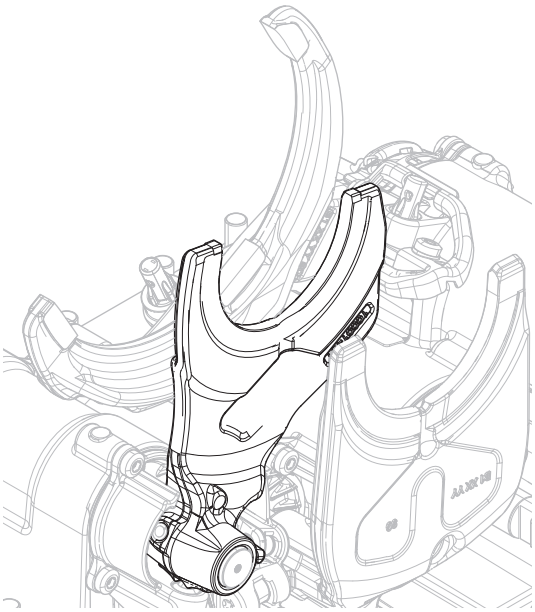


2. Shift the Rail C Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail C Sliding Clutch into the Primary Drive Gear engagement position and return to neutral.
4. Shift the Rail C Sliding Clutch into the Secondary Driven Gear engagement position and return to neutral.
   - If the Rail C Sliding Clutch shifts into all three positions, replace MTM. Go to **Step V.**
   - If the Rail C Sliding Clutch does not shift into all three positions, go to **Step F.**

## F

***Purpose:*** *Verify mechanical condition of the Rail C Yoke.*

1. Inspect Rail C Yoke for wear.



- If no yoke wear is evident, inspect Rail C Sliding Clutch and Main Shaft for cause of restricted movement and repair. Go to **Step V.**
- If yoke wear is evident, inspect Rail C Sliding Clutch and Main Shaft for cause of restricted movement and repair. Replace MTM. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 295 sets Active during operation, go to **Step A.**
   - If a fault code other than 295 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 315: Rail D Position

**J1939: SA 3 SPN 5941 FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with position sensors to monitor shift rails B, C, D and E. The position sensors detect the rail position through the proximity of a magnet mounted to each shift rail. Rail D actuates the Rail D sliding clutch to engage the Primary Driven Gear or Reverse Gear. The position sensors are located in the Mechatronic Transmission Module (MTM) and connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Rail D Position. If a system failure is detected, the TCM sets the fault code Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal – Most Severe:** Rail D Position Sensor indicated Rail D moved beyond the calibrated Primary Driven Gear engagement position for 1 second.

**FMI 1 – Data Valid But Below Normal – Most Severe:** Rail D Position Sensor indicated Rail D moved beyond the calibrated Reverse Gear engagement position for 1 second.

**FMI 2 – Data Erratic:** Rail D Position Sensor out of normal operating duty cycle (5% to 95%) for 1 second.

**FMI 3 – Voltage Above Normal or Shorted High:** Rail D Position Sensor shorted to power for 1 second.

**FMI 4 – Voltage Below Normal or Shorted Low:** Rail D Position Sensor shorted to ground for 1 second.

**FMI 5 – Current Below Normal or Open Circuit:** Rail D Position Sensor open circuit for 1 second.

**FMI 6 – Current Above Normal or Grounded Circuit:** Rail D Position Sensor out of normal operating voltage (4.75V to 5.25V) for 1 second.

**FMI 7 – Mechanical System Not Responding:** Rail D Position Sensor indicated movement from neutral while Rail C was engaged into the Primary Drive Gear or Secondary Driven Gear during an interlock function test.

**FMI 8 – Abnormal Frequency:** Rail D Position Sensor out of normal operating frequency for 1 second.

**FMI 9 – Abnormal Update Rate:** Rail D Position Sensor could not detect magnet for 1 second.

**FMI 10 – Abnormal Rate Of Change:** Rail D Position Sensor reporting rate of change exceeded when no movement commanded for 1 second.

**FMI 12 – Bad Intelligent Device:** Rail D Position Sensor internal self-check out of range for 1 second.

**FMI 14 – Special Instructions:** Rail D Position Sensor reporting a partial or full Reverse Gear engagement position while speed sensors and Rail C Position Sensor reports a Primary Drive Gear or Secondary Driven Gear engagement position for 1 second.

**FMI 15 - Data Valid but Above Normal (Least Severe):** Rail D Position Sensor reporting uncommanded movement toward the Primary Driven Gear from the neutral position while C Position Sensor reports a Primary Drive Gear or Secondary Driven Gear engagement position for 2 seconds.

**FMI 16 - Data Valid but Above Normal (Moderately Severe):** Rail D Position Sensor reporting uncommanded movement toward neutral from the Primary Driven Gear engagement position while speed sensors report a valid Primary Driven Gear ratio.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail D Position Sensor reporting uncommanded movement toward the Reverse Gear from the neutral position while Rail C Position Sensor reports a Primary Drive Gear or Secondary Driven Gear engagement position for 2 seconds.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** Rail D Position Sensor reporting uncommanded movement toward neutral from the Reverse Gear engagement position while speed sensors report a valid Reverse Gear ratio.

**FMI 20 – Data Drifted High:** Rail D Position Sensor reporting Primary Driven Gear disengagement while speed sensors report a valid Primary Driven Gear ratio for 1 second.

**FMI 21 – Data Drifted Low:** Rail D Position Sensor reporting Reverse Gear disengagement while speed sensors report a valid Reverse Gear ratio for 1 second.

**FMI 31 – Condition Exists:** Rail D Position Sensor reporting a partial or full Primary Driven Gear engagement while speed sensors and Rail C Position Sensor reports a Primary Drive Gear or Secondary Driven Gear engagement position for 1 second.

## Fallback

**FMI 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21, 31**

- If Rail D position is known and fully engaged
  - Amber warning lamp on
  - Shift Rail D movement prohibited
- If Rail D position is not known or not fully engaged:
  - Amber warning lamp on
  - Shift Rail D movement prohibited
  - Non-neutral modes prohibited
  - PTO Mode Prohibited
  - If vehicle is moving - Red stop lamp on

**FMI 7**

- Amber warning lamp on
- No degraded performance

## Conditions to Set Fault Code Inactive

**FMI 2, 3, 4, 5, 6, 8, 9, 10:** Rail D Position Sensor in range for 10 seconds.

**FMI 0, 1, 7, 11, 14, 15, 16, 18, 20, 21, 31:** Key cycle and condition no longer exists.

**FMI 12:** Rail D Position Sensor internal self-checks in range for 10 seconds.

## Possible Causes

**FMI 0, 1:**

- MTM
  - Rail D Yoke
- Internal Transmission
  - Rail D Sliding Clutch

**FMI 2, 3, 4, 5, 6, 8:**

- MTM - Rail D Position Sensor
  - Damaged
  - Internal failure
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open.
- TCM
  - Software issue
  - Internal failure

**FMI 7:**

- MTM - Rail D
  - Valve Pack B
  - Valve Pack C
  - Rail D cylinder
  - Rail D yoke
  - Rail D detent
- Internal Transmission
  - Rail D sliding clutch
  - Main Shaft

**FMI 9:**

- MTM - Rail D Cylinder
  - Magnet loose
  - Magnet detached
- MTM - Rail D Position Sensor
  - Loose
  - Damaged

**FMI 10, 14, 20, 21, 31:**

- MTM - Rail D Position Sensor
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

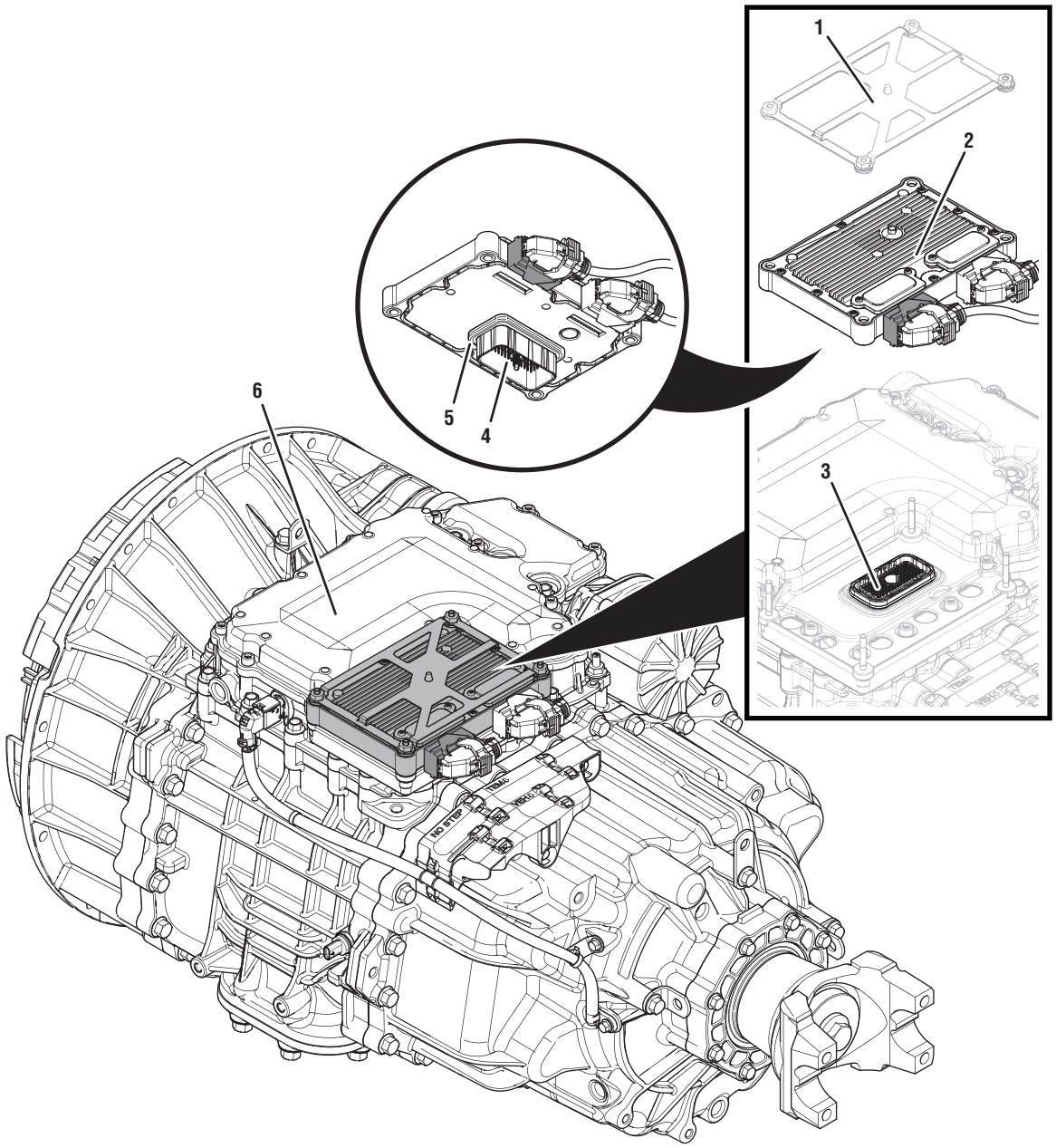
**FMI 15, 16, 17, 18:**

- MTM - Rail D Position Sensor
  - Internal failure
- MTM - Rail D Detent
  - Weak or broken spring
  - Worn shift rail or detent

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

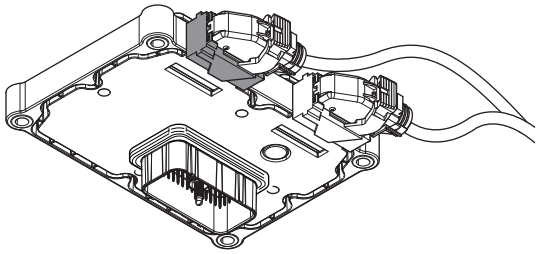
# Fault Code 315 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 315 FMI 2, 3, 4, 5, 6, 8, 9, 10, 14, 15, 16, 17, 18, 20, 21, 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 315 FMI 0, 1, 7 is Active or Inactive, go to **Step D.**
   - I If Fault Code 315 FMI 12 is Active or Inactive, go to **Step G.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

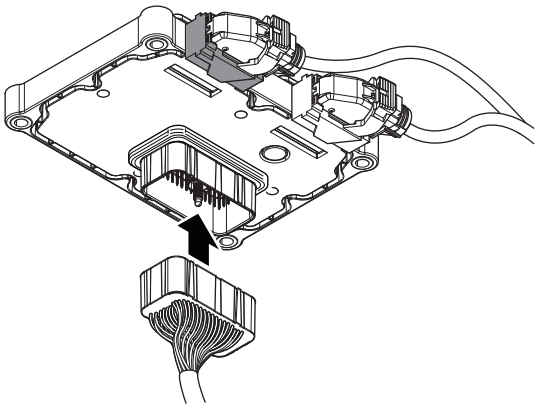


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

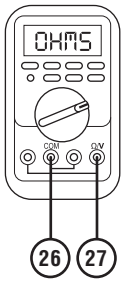
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail D Position Sensor internal resistance and power supply at TCM.*

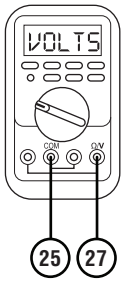
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 26 and Pin 27. Record reading in table.




4. Key on.
5. Measure voltage at the Eaton Breakout Box between Pin 25 and Pin 27. Record reading in table.




6. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace the TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 26 to 27 | 7.5k–22k Ohms | |
| Key on | 25 to 27 | 4.75–5.25 V | |

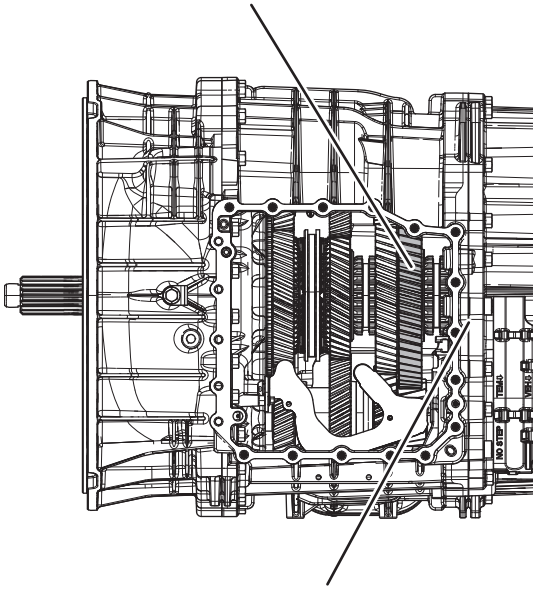
## D

***Purpose:*** *Verify mechanical condition of the Primary Driven and Reverse Gears.*

1. Key off.
2. Remove MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

3. Inspect the Primary Driven Gear for excessive fore and aft movement.

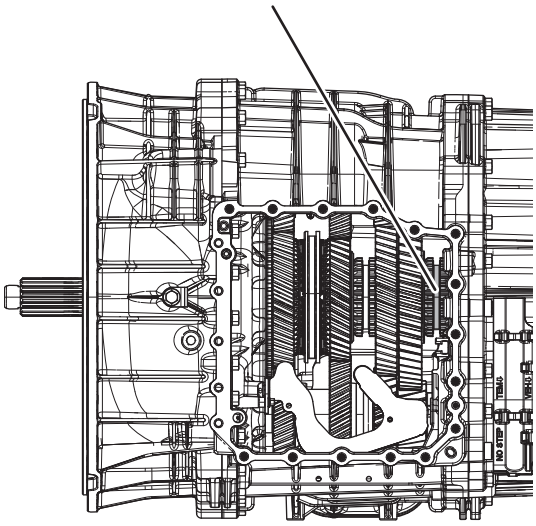


4. Inspect the Reverse Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect the Main Shaft for cause of excessive movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step E.**

## E

***Purpose:*** *Verify mechanical condition of the Rail D Sliding Clutch.*

1. Inspect the Rail D Sliding Clutch yoke slot for wear.

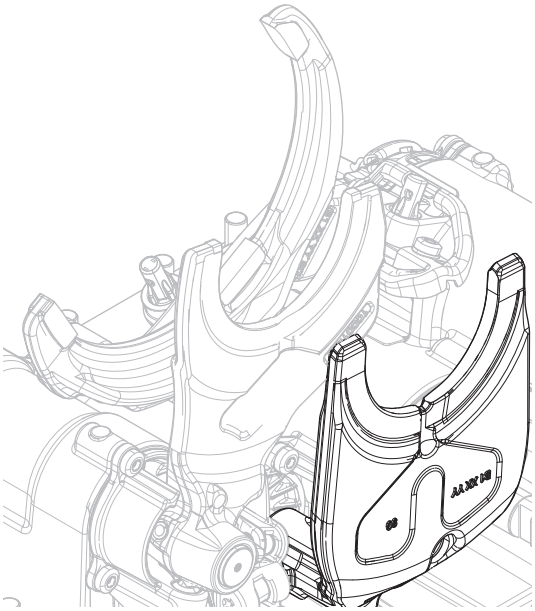


2. Shift the Rail D Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail D Sliding Clutch into the Primary Driven Gear engagement position and return to neutral.
4. Shift the Rail D Sliding Clutch into the Reverse Gear engagement position and return to neutral.
   - If the Rail D Sliding Clutch shifts into all three positions, replace the MTM. Go to **Step V.**
   - If the Rail D Sliding Clutch does not shift into all three positions, go to **Step F.**

## F

***Purpose:*** *Verify mechanical condition of the Rail D Yoke.*

1. Inspect Rail D Yoke for wear.



- If no yoke wear is evident, inspect Rail D Sliding Clutch and Main Shaft for cause of restricted movement and repair. Go to **Step V.**
- If yoke wear is evident, inspect Rail C Sliding Clutch and Main Shaft for cause of restricted movement and repair. Replace MTM. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 315 sets Active during operation, go to **Step A.**
   - If a fault code other than 315 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 320: Rail E Position

**J1939: SA 3 SPN 5942 FMI 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 16, 18, 20, 21**

## Overview

The Endurant Transmission is equipped with position sensors to monitor shift rails B, C, D and E. The position sensors detect the rail position through the proximity of a magnet mounted to each shift rail. Shift Rail E actuates the Rail E synchronizer to engage High or Low Range. The position sensors are located in the Mechatronic Transmission Module (MTM) and connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Rail E Position. If a system failure is detected, the TCM sets the fault code Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal – Most Severe:** Rail E Position Sensor indicated Rail E moved beyond the calibrated High Range engagement position for 1 second.

**FMI 1 – Data Valid But Below Normal – Most Severe:** Rail E Position Sensor indicated Rail E moved beyond the calibrated Low Range engagement position for 1 second.

**FMI 2 – Data Erratic:** Rail E Position Sensor out of normal operating duty cycle (5% to 95%) for 1 second.

**FMI 3 – Voltage Above Normal or Shorted High:** Rail E Position Sensor shorted to power for 1 second.

**FMI 4 – Voltage Below Normal or Shorted Low:** Rail E Position Sensor shorted to ground for 1 second.

**FMI 5 – Current Below Normal or Open Circuit:** Rail E Position Sensor open circuit for 1 second.

**FMI 6 – Current Above Normal or Grounded Circuit:** Rail E Position Sensor out of normal operating voltage (4.75V to 5.25V) for 1 second.

**FMI 8 – Abnormal Frequency:** Rail E Position Sensor out of normal operating frequency for 1 second.

**FMI 9 – Abnormal Update Rate:** Rail E Position Sensor could not detect magnet for 1 second.

**FMI 10 – Abnormal Rate Of Change:** Rail E Position Sensor reporting rate of change exceeded when no movement commanded for 1 second.

**FMI 12 – Bad Intelligent Device:** Rail E Position Sensor internal self-check out of range for 1 second.

**FMI 16 - Data Valid but Above Normal (Moderately Severe):** Rail E Position Sensor reporting uncommanded movement toward neutral from High Range engagement position while speed sensors report a valid High Range ratio.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** Rail E Position Sensor reporting uncommanded movement toward neutral from Low Range engagement position while speed sensors report a valid Low Range ratio.

**FMI 20 – Data Drifted High:** Rail E Position Sensor reporting High Range disengagement while speed sensors report a valid High Range ratio for 1 second.

**FMI 21 – Data Drifted Low:** Rail E Position Sensor reporting Low Range disengagement while speed sensors report a valid Low Range ratio for 1 second.

## Fallback

**FMI 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 16, 18, 20, 21**

- If Rail E position is known and fully engaged:
  - Amber warning lamp on
  - Shift Rail E movement prohibited
- If Rail E position is not known or not fully engaged:
  - Amber warning lamp on
  - Shift Rail E movement prohibited
  - Non-Neutral Modes prohibited
  - PTO mode prohibited
  - If vehicle is moving – Red stop lamp on

## Conditions to Set Fault Code Inactive

**FMI 2, 3, 4, 5, 6, 8, 9:** Rail E Position Sensor in range for 10 seconds.

**FMI 0, 1, 10, 16, 18, 20, 21:** Key cycle and condition no longer exists.

**FMI 12:** Rail E Position Sensor internal self-checks in range for 10 seconds.

## Possible Causes

**FMI 0, 1:**

- MTM
  - Rail E Yoke
- Internal Transmission
  - Rail E Synchronizer

**FMI 2, 3, 4, 5, 6, 8:**

- MTM - Rail E Position Sensor
  - Damaged
  - Internal failure
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open.
- TCM
  - Software issue
  - Internal failure

**FMI 9:**

- MTM - Rail E Cylinder
  - Magnet loose
  - Magnet detached
- MTM - Rail E Position Sensor
  - Loose
  - Damaged

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

**FMI 10, 20, 21:**

- MTM - Rail E Position Sensor
  - Internal failure

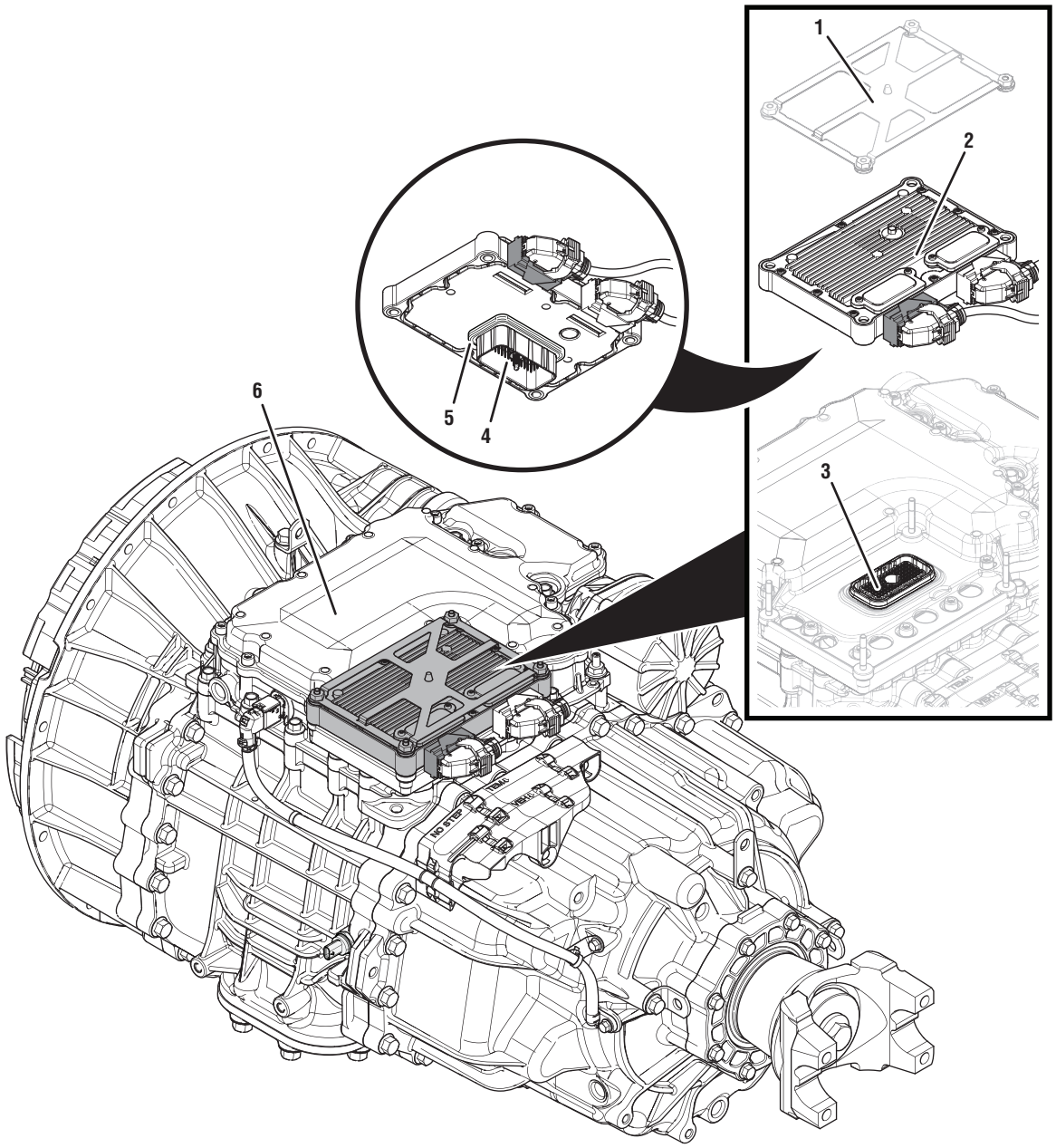
**FMI 16, 18:**

- MTM - Rail E Position Sensor
  - Internal failure
- MTM - Rail E Detent
  - Weak or broken spring
  - Worn shift rail or detent

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

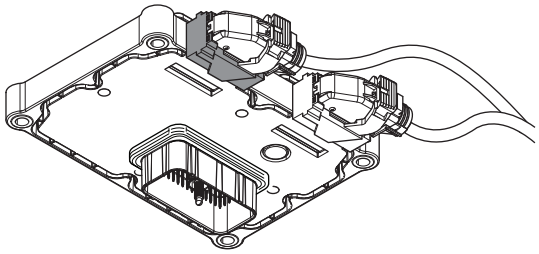
# Fault Code 320 Troubleshooting

**A** ***Purpose:*** Check for active or inactive fault codes.

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 320 FMI 2, 3, 4, 5, 6, 8, 9, 10, 16, 18, 20, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 320 FMI 0, 1 is Active or Inactive, go to **Step D.**
   - If Fault Code 320 FMI 12 is Active or Inactive,go to **Step E.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

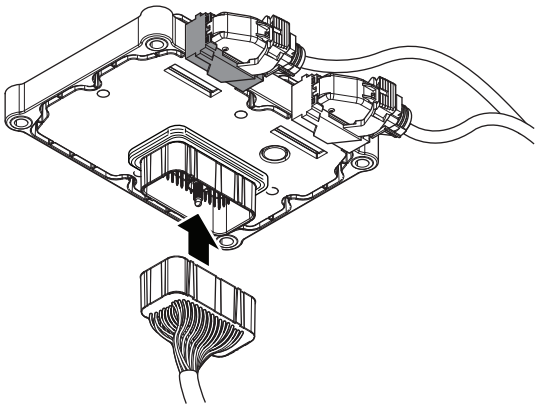


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

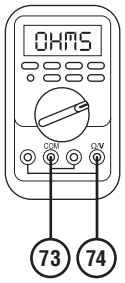
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail E Position Sensor internal resistance and power supply at TCM.*

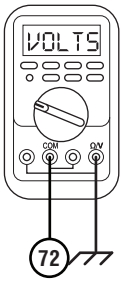
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 73 and Pin 74. Record reading in table.




4. Key on.
5. Measure voltage at the Eaton Breakout Box between Pin 72 and Pin 74. Record reading in table.




6. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key off | 73 to 74 | 7.5k–22k Ohms | |
| Key on | 72 to 74 | 4.75–5.25 V | |

## D

***Purpose:*** *Verify mechanical movement of the Rail E Synchronizer.*

1. Key off.
2. Remove MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Install the MTM Alignment Tool (RR1086TR-1) onto the main housing.

   **Note:** Reference Appendix, Manually Actuate Rail E Procedure.
4. Using the Rail E Lever, move Rail E to neutral (if necessary).
5. Shift Rail E into the High Range (fore) engagement position and return to neutral.
6. Shift Rail E into the Low Range (aft) engagement position and return to neutral.
   - Contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

## E

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 320 sets Active during operation, go to **Step A.**
   - If a fault code other than 320 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 345 Engine (Over) Speed

**J1939: SA 3 SPN 5052 FMI 0**

## Overview
The Transmission Control Module (TCM) receives the vehicle's Engine Speed message over the Primary Data Link (J1939 A). The TCM uses the Engine Speed as the primary engine speed message during normal transmission operation. The Primary Data Link is connected to the TCM at the 20-Way TCM Vehicle Harness Connector.

## Detection
The TCM monitors the Engine Speed message. If an engine over speed is reported, the fault is set Active.

## Conditions to Set Fault Code Active
**FMI 0 – Data Erratic:** Engine speed message indicates engine rpm greater than 2600 rpm with the clutch open.

## Fallback
**FMI 0:**

- No degraded performance

## Conditions to Set Fault Code Inactive
**FMI 0:** Engine speed message indicates engine speed less than 2500 rpm or clutch closed for 10 seconds.

## Possible Causes
**FMI 0:**

- Descending an overly steep grade
- Excessive vehicle weight

## Additional Tools
- None

# Fault Code 345 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 345 FMI 0 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 345 sets Active during operation, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 345 sets Active, go to *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 350 Input Speed

**J1939: SA 3 SPN 161 FMI 2, 4, 5, 6, 8, 9, 14, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with speed sensors to monitor input, Countershaft and output speeds. The speed sensors provide rotational speed inputs to the Transmission Control Module (TCM) to verify clutch operation and calculate gear ratios. The Input Speed Sensor measures the rotational speed of the input shaft. The Input Shaft and Countershaft Speed Sensors are mounted internally and attached to the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Input Speed Signal. If a system failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** Input Speed Sensor out of normal operating RPM (-7500 to 11250) for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** Input Speed Sensor circuit shorted to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** Input Speed Sensor circuit open or shorted to power for 5 seconds.

**FMI 6 - Current Above Normal or Grounded Circuit:** Input Speed Sensor out of normal operating voltage (4.75V to 5.25V) for 5 seconds.

**FMI 8 – Abnormal Frequency:** Input Speed Sensor out of normal operating frequency for 5 seconds.

**FMI 9 – Abnormal Update Rate:** Input Speed Sensor direction unknown for 5 seconds.

**FMI 14 – Special Instructions:** Input Speed dropped out when compared to a valid J1939 Data Link Engine RPM with the LCA Position Sensor reporting the clutch is closed or Countershaft Speed RPM with the Rail B Synchronizer engaged for 5 seconds.

**FMI 20 – Data Drifted High:** Input Speed greater than expected when compared to either a valid J1939 Data Link Engine RPM with the LCA Position Sensor reporting the clutch is closed or a valid Countershaft Speed RPM with Rail B engaged for 2 seconds.

**FMI 21 – Data Drifted Low:** Input Speed less than expected when compared to either a valid J1939 Data Link Engine RPM with the LCA Position Sensor reporting the clutch is closed or a valid Countershaft Speed RPM with Rail B engaged for 2 seconds.

**FMI 31 – Condition Exists:** Input Speed dropped out when compared to a valid J1939 Data Link Engine Speed RPM and Front Axle Speed RPM with the LCA Position Sensor reporting the clutch is closed and the Rail Position Sensors reporting the transmission is in gear for 5 seconds.

## Fallback

**All FMIs**

- Amber warning lamp on
- No degraded performance
- If Fault Code 350 and 370 are both Active and Rail C or D is engaged:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Up Shifts Prohibited
  - Clutch Engagements prohibited
  - Non neutral modes prohibited
  - PTO Mode prohibited
- If Fault Code 350 and 370 are both Active and Rail C or D is disengaged:
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Non neutral modes prohibited
  - PTO Mode prohibited

## Conditions to Set Fault Code Inactive

**FMI 2, 3, 4, 5, 6, 8, 9:** Input Shaft Speed Sensor in range for 10 seconds.

**FMI 14, 31:** Key cycle and condition no longer exists.

**FMI 20, 21:** Input Shaft Speed signal matches calculated Input Shaft Speed for 10 seconds.

## Possible Causes

**FMI 2, 14, 20, 21, 31:**

- MTM - Input Speed Sensor
  - Internal failure
  - Damaged
- Internal Transmission
  - Mechanical failure
- TCM
  - Software issue
  - Internal failure

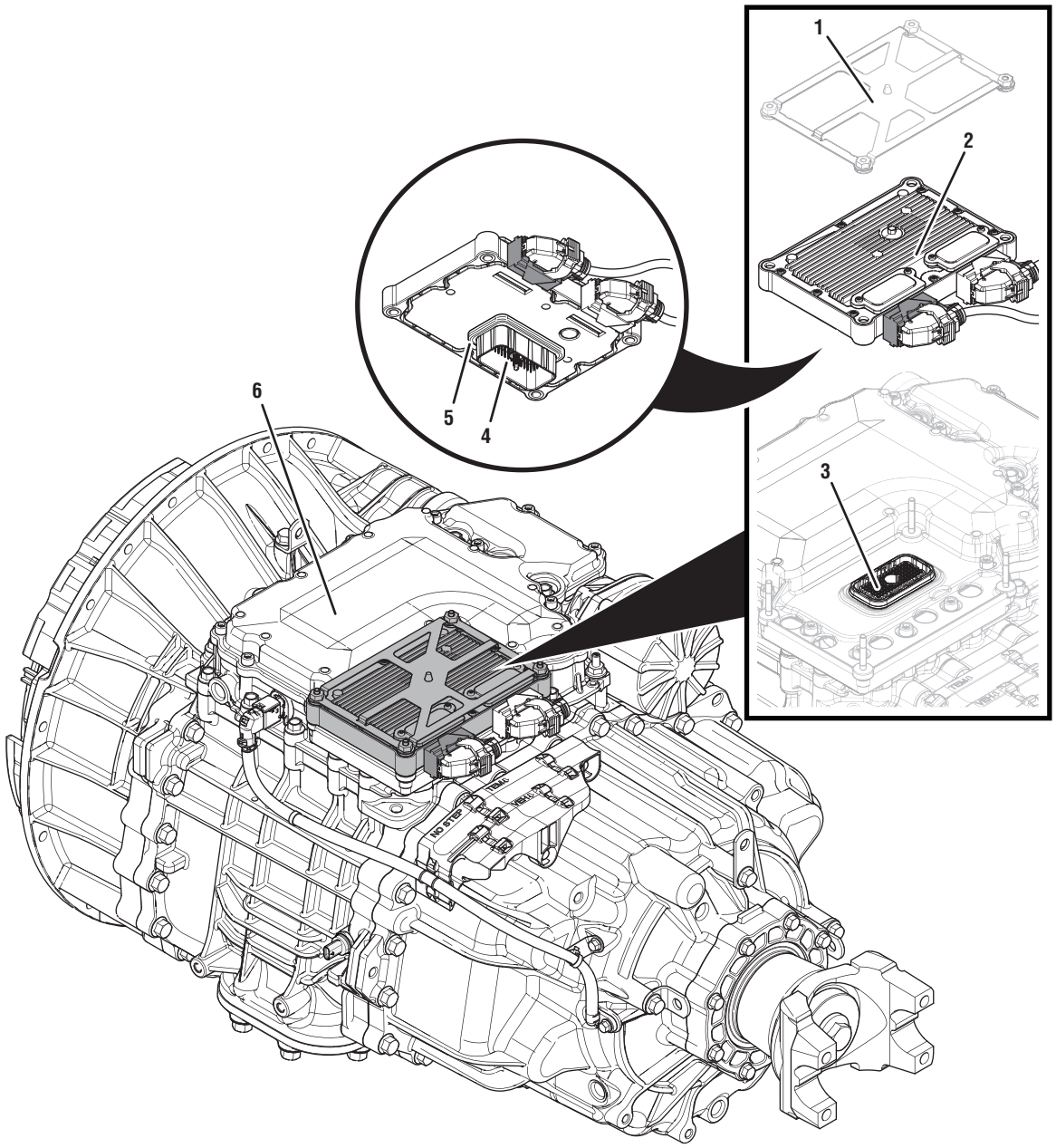
**FMI 4, 5, 6, 8, 9:**

- MTM - Input Speed Sensor
  - Internal failure
  - Damaged
- MTM - Input Shaft Speed Sensor Harness
  - Wiring shorted to power, shorted to ground or open
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Software issue
  - Internal failure

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

# Fault Code 350 Troubleshooting

## A

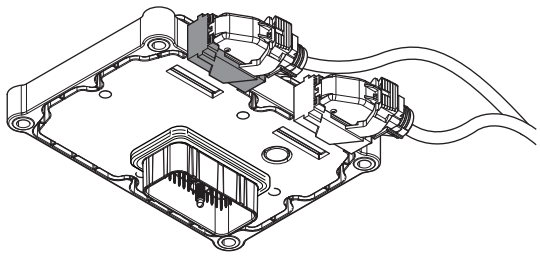
***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 350 FMI 4, 5, 6, 8, 9 is Active or Inactive, go to **Step B.**
   - If Fault Code 350 FMI 2, 14, 20, 21, 31 is Active or Inactive, go to **Step D.**

## B

***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

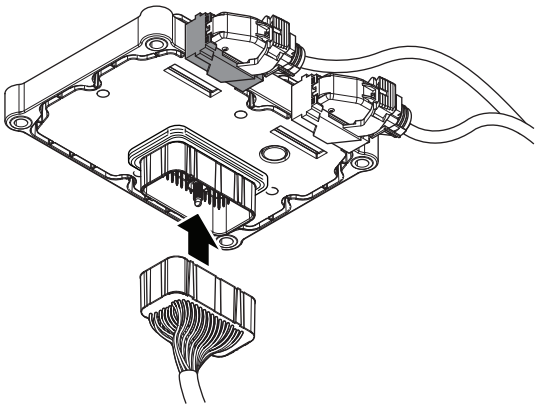


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

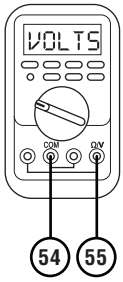
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** Verify Input Speed Sensor power supply at TCM.

1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Key on.
4. Measure voltage at the Eaton Breakout Box between Pin 54 and Pin 55. Record reading in table.



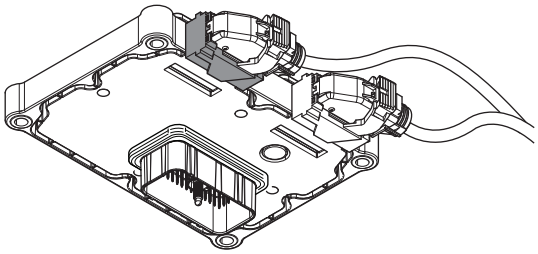

5. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key on | 54 to 55 | 4.75–5.25 V | |

**D** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

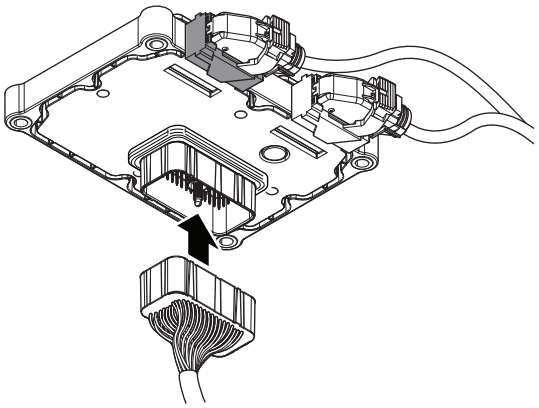


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

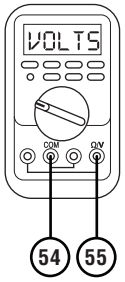
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step E.**

**E** ***Purpose:*** *Verify Input Speed Sensor power supply at TCM.*

1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Key on.
4. Measure voltage at the Eaton Breakout Box between Pin 54 and Pin 55. Record reading in table.



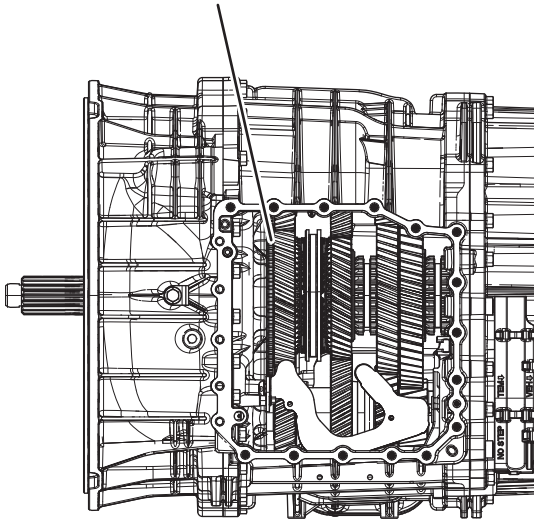

5. Compare reading(s) in table.
   - If readings are in range, go to **Step F.**
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key on | 54 to 55 | 4.75–5.25 V | |

**F** ***Purpose:*** *Verify mechanical condition of the Input Shaft Tone Wheel.*

1. Key off.
2. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the Input Shaft Tone Wheel for missing teeth and excessive movement.



- If no missing teeth or no excessive movement evident, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**
- If missing teeth and/or excessive movement evident, identify cause for missing teeth and/or excessive movement and repair. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 350 sets Active during operation, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 350 sets Active, go to *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 370 Countershaft Speed

**J1939: SA 3 SPN 160 FMI 2, 4, 5, 6, 8, 9, 14, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with speed sensors to monitor input, countershaft and output speeds. The speed sensors provide rotational speed inputs to the Transmission Control Module (TCM) to verify clutch operation and calculate gear ratios. The Countershaft Speed Sensor measures the rotational speed of the countershafts. The Input Shaft and Countershaft Speed Sensors are mounted internally and attached to the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Countershaft Speed signal. If a system failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** Countershaft Speed Sensor out of normal operating RPM (-7500 to 11250) for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** Countershaft Speed Sensor circuit shorted to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** Countershaft Speed Sensor circuit open or shorted to power for 5 seconds.

**FMI 6 - Current Above Normal or Grounded Circuit:** Countershaft Speed Sensor out of normal operating voltage (4.75V to 5.25V) for 5 seconds.

**FMI 8 – Abnormal Frequency:** Countershaft Speed Sensor out of normal operating frequency for 5 seconds.

**FMI 9 – Abnormal Update Rate:** Countershaft Speed Sensor direction unknown for 5 seconds.

**FMI 14 – Special Instructions:** Countershaft Speed dropped out when compared to a valid Input Shaft and Output Shaft RPM with the LCA Position Sensor reporting the clutch is closed and either:

- Rail C, D, E engaged and Rail B in neutral for 5 seconds.
- or
- Rail C, D, E in neutral and Rail B engaged into the Primary Drive Gear for 5 seconds.

**FMI 20 – Data Drifted High:** Countershaft Speed greater than expected when compared to a valid Input Shaft Speed and Output Shaft Speed RPM with the Rail Position Sensors reporting the transmission is in gear for 2 seconds.

**FMI 21 – Data Drifted Low:** Countershaft Speed less than expected when compared to valid Input Shaft Speed and Output Shaft Speed RPM with the Rail Position Sensors reporting the transmission is in gear for 2 seconds.

**FMI 31 – Condition Exists:** Countershaft Speed dropped out when compared to a valid J1939 Data Link Engine Speed RPM and Front Axle Speed RPM with the LCA Position Sensor reporting the clutch is closed and the Rail Position Sensors reporting the transmission is in gear for 5 seconds.

## Fallback

**All FMIs**

- Amber warning lamp on
- No degraded performance
- If Fault Code 350 and 375 are both Active and Rail C or D is engaged:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Up Shifts Prohibited
  - Clutch Engagements prohibited
  - Non neutral modes prohibited
  - PTO Mode prohibited
- If Fault Code 350 and 375 are both Active and Rail C or D is disengaged:
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Non neutral modes prohibited
  - PTO Mode prohibited

## Conditions to Set Fault Code Inactive

**FMI 2, 3, 4, 5, 6, 8, 9:** Countershaft Speed Sensor in range for 10 seconds.

**FMI 14, 31:** Key cycle and condition no longer exists.

**FMI 20, 21:** Countershaft Speed signal matches calculated Countershaft Speed for 10 seconds.

## Possible Causes

**FMI 2, 14, 20, 21, 31:**

- MTM - Countershaft Speed Sensor
  - Internal failure
  - Damaged
- Internal Transmission
  - Mechanical failure
- TCM
  - Software issue
  - Internal failure

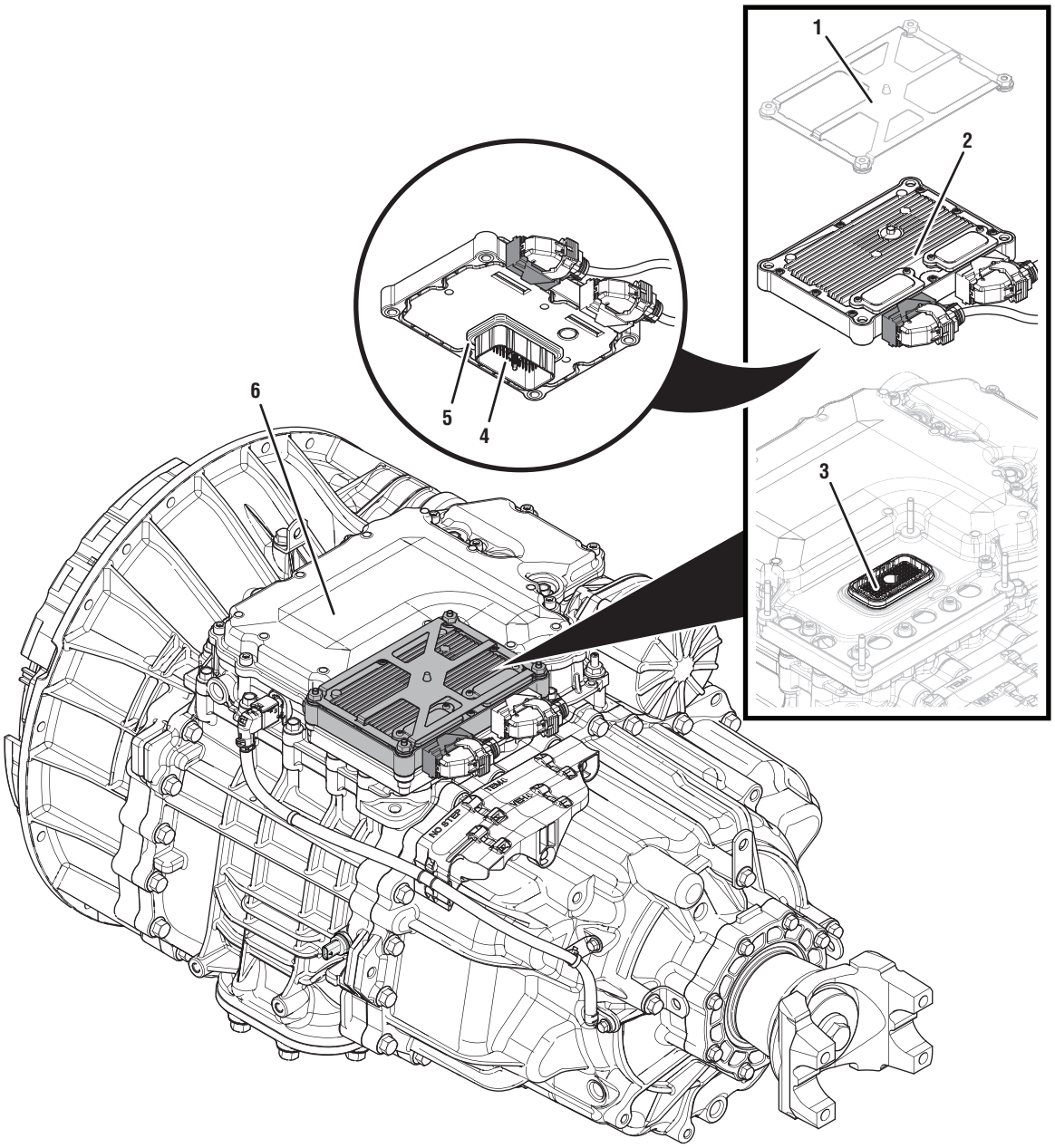
**FMI 4, 5, 6, 8, 9:**

- MTM - Countershaft Speed Sensor
  - Internal failure
  - Damaged
- MTM - Countershaft Speed Sensor Harness
  - Wiring shorted to power, shorted to ground or open
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Software issue
  - Internal failure

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

# Fault Code 370 Troubleshooting

## A

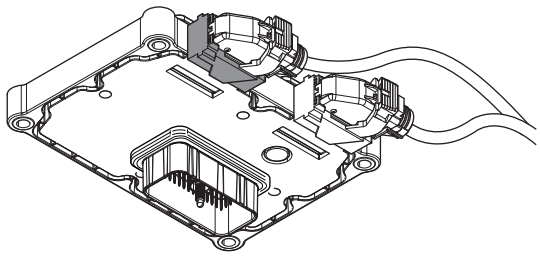
***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 370 FMI 4, 5, 6, 8, 9 is Active or Inactive, go to **Step B.**
   - If Fault Code 370 FMI 2, 14, 20, 21, 31 is Active or Inactive, go to **Step D.**

## B

***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

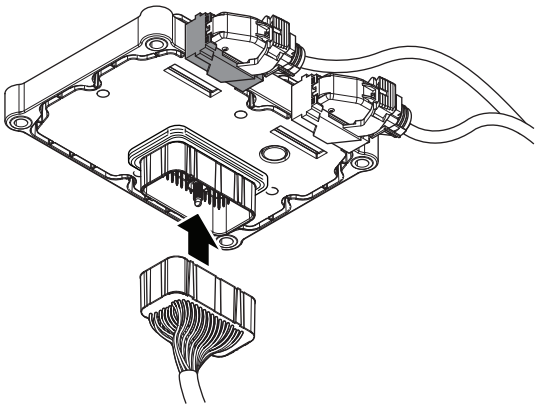


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

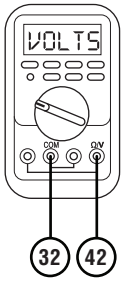
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** Verify Countershaft Speed Sensor power supply at TCM.

1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Key on.
4. Measure voltage at the Eaton Breakout Box between Pin 32 and Pin 42. Record reading in table.



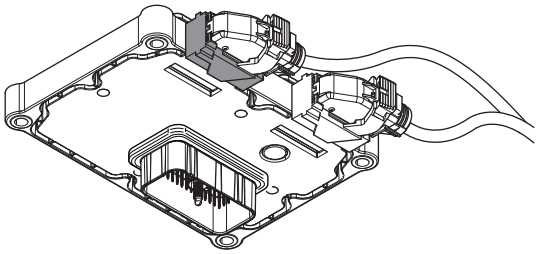

5. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key on | 32 to 42 | 4.75–5.25 V | |

**D** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

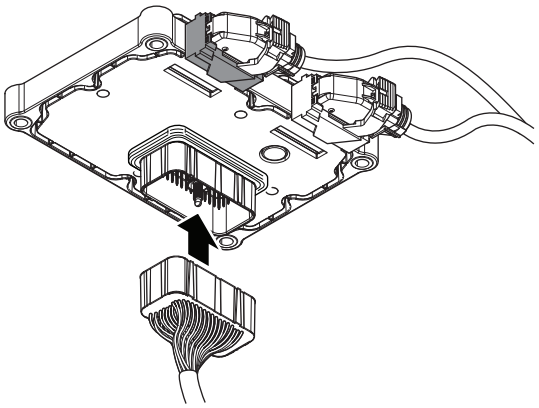


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

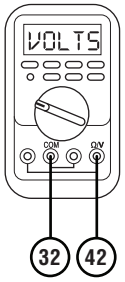
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step E.**

**E** ***Purpose:*** *Verify Countershaft Speed Sensor power supply at TCM.*

1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Key on.
4. Measure voltage at the Eaton Breakout Box between Pin 32 and Pin 42. Record reading in table.




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

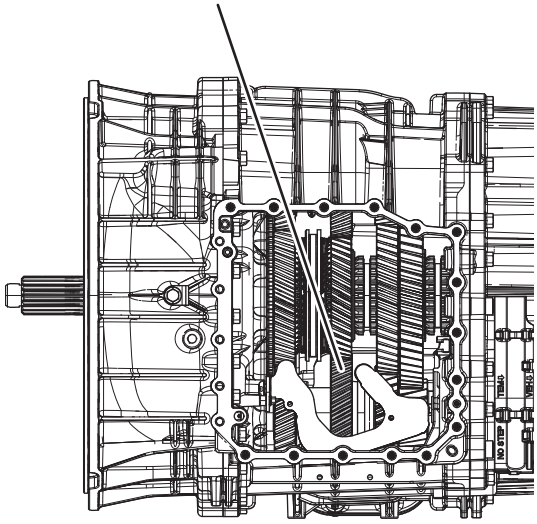
| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key on | 32 to 42 | 4.75–5.25 V | |

## F

***Purpose:*** *Verify mechanical condition of the lower countershaft.*

1. Key off.
2. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the lower countershaft Primary Drive Gear for missing teeth and excessive movement.



- If no missing teeth or no excessive movement evident, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**
- If missing teeth and/or excessive movement evident, identify cause for missing teeth and/or excessive movement and repair. Go to **Step V.**

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 370 sets Active during operation, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 370 sets Active, go to *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 375 Output Speed

## J1939: SA 3 SPN 191 FMI 2, 4, 5, 6, 8, 9, 14, 20, 21, 31

### Overview

The Endurant Transmission is equipped with speed sensors to monitor input, Countershaft and output speeds. The speed sensors provide rotational speed inputs to the Transmission Control Module (TCM) to verify clutch operation and calculate gear ratios. The Output Speed Sensor measures the rotational speed and direction of the Planetary Output Shaft Assembly. The Output Speed Sensor is mounted externally and connects at the Mechatronic Transmission Module (MTM) Housing. The 3-Way Output Speed Sensor Connector connects to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the Output Speed signal. If a system failure is detected, the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** Output Speed Sensor out of normal operating RPM (-7500 to 11250) for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** Output Speed Sensor circuit shorted to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** Output Speed Sensor circuit open or shorted to power for 5 seconds.

**FMI 6 - Current Above Normal or Grounded Circuit:** Output Speed Sensor out of normal operating voltage (4.75V to 5.25V) for 5 seconds.

**FMI 8 – Abnormal Frequency:** Output Speed Sensor out of normal operating frequency for 5 seconds.

**FMI 9 – Abnormal Update Rate:** Output Speed Sensor direction unknown for 5 seconds.

**FMI 14 – Special Instructions:** Output Speed dropped out when compared to a valid Input Shaft and Output Shaft RPM with the LCA Position Sensor reporting the clutch is closed and either:

- Rail C, D, E engaged and Rail B in neutral for 5 seconds.
- Rail C, D, E in neutral and Rail B engaged into the Primary Drive Gear for 5 seconds.

**FMI 20 – Data Drifted High:** Output Speed greater than expected when compared to a valid Input Shaft Speed and Output Shaft Speed RPM with the Rail Position Sensors reporting the transmission is in gear for 2 seconds.

**FMI 21 – Data Drifted Low:** Output Speed less than expected when compared to valid Input Shaft Speed and Output Shaft Speed RPM with the Rail Position Sensors reporting the transmission is in gear for 2 seconds.

**FMI 31 – Condition Exists:** Output Speed dropped out when compared to valid J1939 Data Link Engine and Front Axle Speed RPM with the LCA Position Sensor reporting the clutch is closed and the Rail Position Sensors reporting the transmission is in gear for 5 seconds.

### Fallback

**All FMIs**

- Amber warning lamp on
- No degraded performance
- If Fault Code 375 and 170 are both Active and Rail C or D is engaged:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Up Shifts Prohibited
  - Clutch Engagements prohibited
  - Non neutral modes prohibited
  - PTO Mode prohibited
- If Fault Code 375 and 170 are both Active and Rail C or D is disengaged:
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Non neutral modes prohibited
  - PTO Mode prohibited

### Conditions to Set Fault Code Inactive

**FMI 2, 3, 4, 5, 6, 8, 9:** Output Speed Sensor in range for 10 seconds.

**FMI 14, 31:** Key cycle and condition no longer exists.

**FMI 20, 21:** Output Speed signal matches calculated Output Shaft Speed for 10 seconds.

## Possible Causes

**FMI 2, 14, 20, 21, 31:**

- MTM - Output Speed Sensor
  - Internal failure
  - Damaged
- Internal Transmission
  - Mechanical failure
- TCM
  - Software issue
  - Internal failure

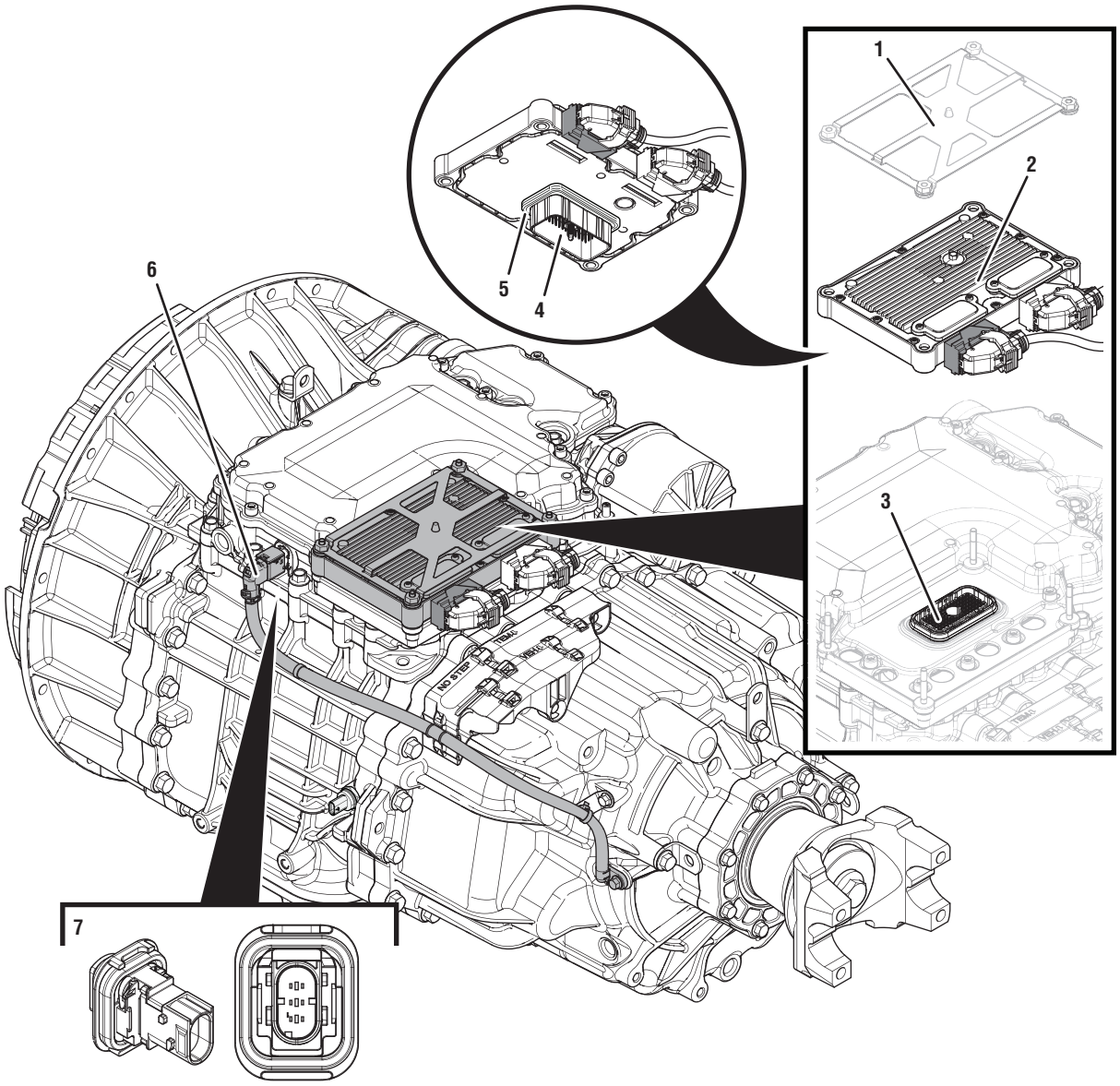
**FMI 4, 5, 6, 8, 9:**

- MTM - Output Speed Sensor
  - Internal failure
  - Damaged
- MTM - Output Speed Sensor Harness
  - Wiring shorted to power, shorted to ground or open
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Software issue
  - Internal failure

## Additional Tools

- Endurant Service Manual TRSM0950
- 3-Way Eaton Diagnostic Adapter - RR1060TR
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. 3-Way Output Speed Sensor*
*7. 3-Way Output Speed Sensor Connector*

# Fault Code 375 Troubleshooting

## A

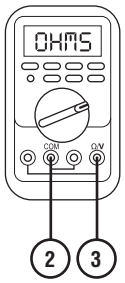
***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 375 FMI 2, 4, 5, 6, 8, 9, 14, 20, 21, 31 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Verify condition of 3-Way Output Speed Sensor Connector and power supply.*

1. Key off.
2. Disconnect the 3-Way Output Speed Sensor Connector at the MTM by lifting up on the yellow latch.
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. Connect the 3-Way Eaton Diagnostic Adapter (EDA) to the 3-Way Output Speed Sensor Connector at the MTM.
5. Key on.
6. Measure voltage at the 3-Way EDA between Pin 2 (signal) and Pin 3 (5V). Record reading in table.

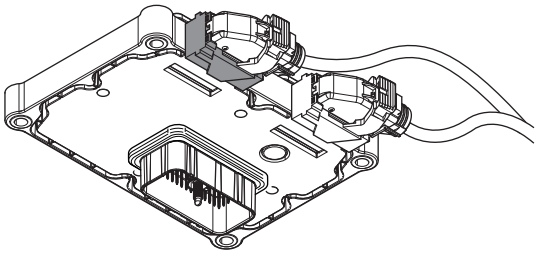



7. Compare reading(s) in table.
   - If readings are in range, replace the Output Speed Sensor. Go to **Step V.**
   - If readings are out of range, go to **Step C.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key on | 2 to 3 | 4.75–5.25 V | |

**C** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.



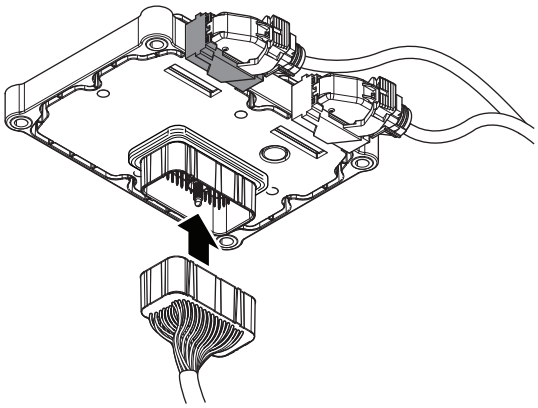
3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step D.**

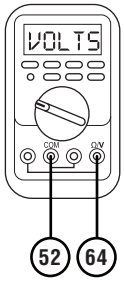
## D

***Purpose:*** *Verify Output Speed Sensor power supply at TCM.*

1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the TCM side of the 74-Way Transmission Harness Connector.



3. Key on.
4. Measure voltage at the Eaton Breakout Box between Pin 52 and Pin 64. Record reading in table.




5. Compare reading(s) in table.
   - If readings are in range, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If readings are out of range, replace the TCM. Go to **Step V.**

| Ignition State | Pins | Range | Reading(s) |
|---|---|---|---|
| Key on | 52 to 64 | 4.75–5.25 V | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 375 sets Active during operation, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 375 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 385: Grade Sensor

**J1939: SA 3 SPN 583 FMI 2, 8, 10, 11, 12, 13, 14, 19, 20, 21, 31**

## Overview

The Transmission Control Module (TCM) 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 Control Module (TCM).

**Note:** Initial calibration of the Grade Sensor must be completed at the OEM assembly plant or anytime the TCM is replaced. The Grade Sensor Calibration requires ServiceRanger to complete the procedure.

## Detection

The TCM monitors the Grade Sensor signal. If the signal is out of range or a system failure is detected, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic:** Grade Sensor signal out of hardware limits. Greater than 100% or less than -100% for 1 second.

**FMI 8 – Abnormal Frequency:** Grade Sensor signal out of range.

**FMI 10 – Abnormal Rate of Change:** No change in grade detected over significant distance.

**FMI 11 – Failure Mode Not Identifiable:** Acceleration up a grade with no accelerator input for 3 seconds.

**FMI 12 – Bad Intelligent Device:** Grade Sensor self-check failure.

**FMI 13 – Out of Calibration:** Grade Sensor calibration required.

**FMI 14 – Special Instructions:** Deceleration down a grade with near maximum accelerator input for 3 seconds.

**FMI 19 – Received Network Data in Error:** Grade sensor message received in error.

**FMI 20 – Data Drifted High:** Grade percentage average greater than 25%.

**FMI 21 – Data Drifted Low:** Grade percentage average less than -25%.

**FMI 31 – Condition Exists:** Grade Sensor signal out of range. Greater than 50% or less than -50% for 2 seconds.

## Fallback

**FMI 2, 8, 10, 11, 12, 13, 14, 19, 20, 21, 31:**

- Amber warning lamp on
- HSA may be reduced
- Shift strategy may be altered
- Shift and launch quality may degrade

## Conditions to Set Fault Code Inactive

**FMI 10, 11, 14, 20, 21:** Key cycle.

**FMI 2, 8, 12, 31:** Condition no longer exists.

## Possible Causes

**FMI 2, 8, 10, 11, 12, 14, 19, 20, 21, 31:**

- TCM
  - Internal failure
  - Software issue

**FMI 13:**

- Calibration
  - Grade Sensor not calibrated

## Additional Tools

- Endurant Service Manual TRSM0950

# Fault Code 385 Troubleshooting

## A

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 385 FMI 13 is Active, go to **Step C.**
   - If Fault Code 385 FMI 13 is Inactive, Grade Sensor Calibration has been completed. Go to **Step V.**
   - If Fault Code 385 FMI 2, 8, 10, 11, 12, 14, 19, 20, 21, or 31 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step C.**
   - If a TCM software update is available, update TCM software. Go to **Step C.**
   - If the TCM is at the latest available software, go to **Step C.**

| TCM Software |
| --- |
| |

## C

***Purpose:*** *Perform Grade Sensor Calibration.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Service Routines”.
6. Select "Start" Grade Sensor Calibration and follow on-screen prompts.
   - If the Grade Sensor Calibration completed with no errors or faults indicated, go to **Step V.**
   - If the Grade Sensor Calibration could not be performed or errors or faults are indicated, replace the TCM. Go to **Step V.**

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 385 sets Active during operation, go to **Step A.**
   - If a fault code other than 385 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 390: Transmission Control Module Temperature

**J1939: SA 3 SPN 5912 FMI 17**

## Overview

The Transmission Control Module (TCM) is equipped with an internal temperature sensor to monitor ambient temperature.

## Detection

The TCM monitors the internal temperature sensor. If an extreme cold ambient temperature is reported and transmission operation is requested, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 17 – Data Valid but Below Normal:** TCM Temperature reports less than -30ºC (-20ºF) with the engine running and vehicle stationary and the driver requests a gear engagement or PTO operation.

## Fallback

**FMI 17**

- Amber warning lamp on
- Non neutral modes prohibited
- PTO Mode prohibited

## Conditions to Set Fault Code Inactive

**FMI 17:** TCM Temperature indicates the transmission is ready for operation.

## Possible Causes

**FMI 17**

- Extreme ambient cold temperature

# Fault Code 390 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 390 FMI 17 is Active, the TCM Temperature is reporting extreme cold ambient temperatures and requires a warm-up cycle. Continue to run the engine to increase the transmission temperature. When the amber warning lamp goes out, the transmission is ready for operation. Go to **Step V.**.
   - If Fault Code 390 FMI 17 is Inactive, the TCM Temperature experienced extreme cold ambient temperatures. Go to **Step V.**.

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 390 sets Active during operation, *V* on page 296
   - If a fault code other than 390 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 511: Clutch Engage Solenoid 1 (C4) – Coarse Vent

**J1939: SA 3 SPN 5614 FMI 0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 16, 18**

## Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow to release and engage the clutch. The Clutch Engage Solenoid 1 (CES1) is energized by the Transmission Control Module (TCM) to exhaust air pressure from the Linear Clutch Actuator (LCA) and engage the clutch. The clutch control system requires four solenoids to control the clutch position – two clutch engage solenoids and two clutch release solenoids. The CES1 quickly exhausts air pressure from the LCA to engage the clutch. The CES1 is located in the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the CES1. If a system failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** CES1 low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** CES1 low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** CES1 shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** CES1 commanded off and shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** CES1 open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** CES1 commanded on and shorted to ground.

**FMI 7 – Mechanical System Not Responding:** The LCA Position Sensor reports the clutch is engaged while the clutch control system is attempting to release the clutch.

**FMI 8 – Abnormal Frequency:** CES1 out of normal operating frequency for 4 seconds.

**FMI 10 – Abnormal Rate of Change:** The clutch release solenoid has been commanded on for a longer duty cycle than expected to maintain clutch release.

**FMI 12 – Bad Intelligent Device:** CES1 commanded on beyond expected duty cycle.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** CES1 commanded on for longer than expected increasing solenoid temperature.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** CES1 commanded on below expected voltage.

## Fallback

**FMI 0, 1, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- Clutch Engage Solenoid 1 operation prohibited
- May experience slow clutch engagement

**FMI 3, 4:**

- Amber warning lamp on
- Clutch Engage Solenoid 1 operation prohibited
- Clutch Release Solenoid 2 operation prohibited
- Urge to Move and Creep mode prohibited
- Raised shift points

**FMI 7, 10:**

- Amber warning lamp on
- Non-Neutral modes prohibited
- PTO mode prohibited
- If transmission is in gear and moving
  - Red stop lamp on
  - Urge to Move and Creep Mode prohibited
  - Upshifts prohibited
  - Raised shift points
  - Engine may shut down

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 7, 8, 10, 12, 16, 18:** Key cycle

**FMI 3, 4, 5, 8:** CES1 in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 18**

- MTM – Clutch Engage Solenoid 1
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 7, 16:**

- LCA
  - Stuck piston
  - LCA to MTM seal air leak
  - Internal failure
- MTM – Clutch Engage Solenoid 1 and/or 2
  - Stuck open
  - Air leak
- Clutch Housing
  - Damaged Release Bearing
  - Damaged Front Bearing Cover
  - Damaged Release Yoke
  - Damaged Clutch

FMI 12:

- TCM
  - Software issue
  - Internal failure

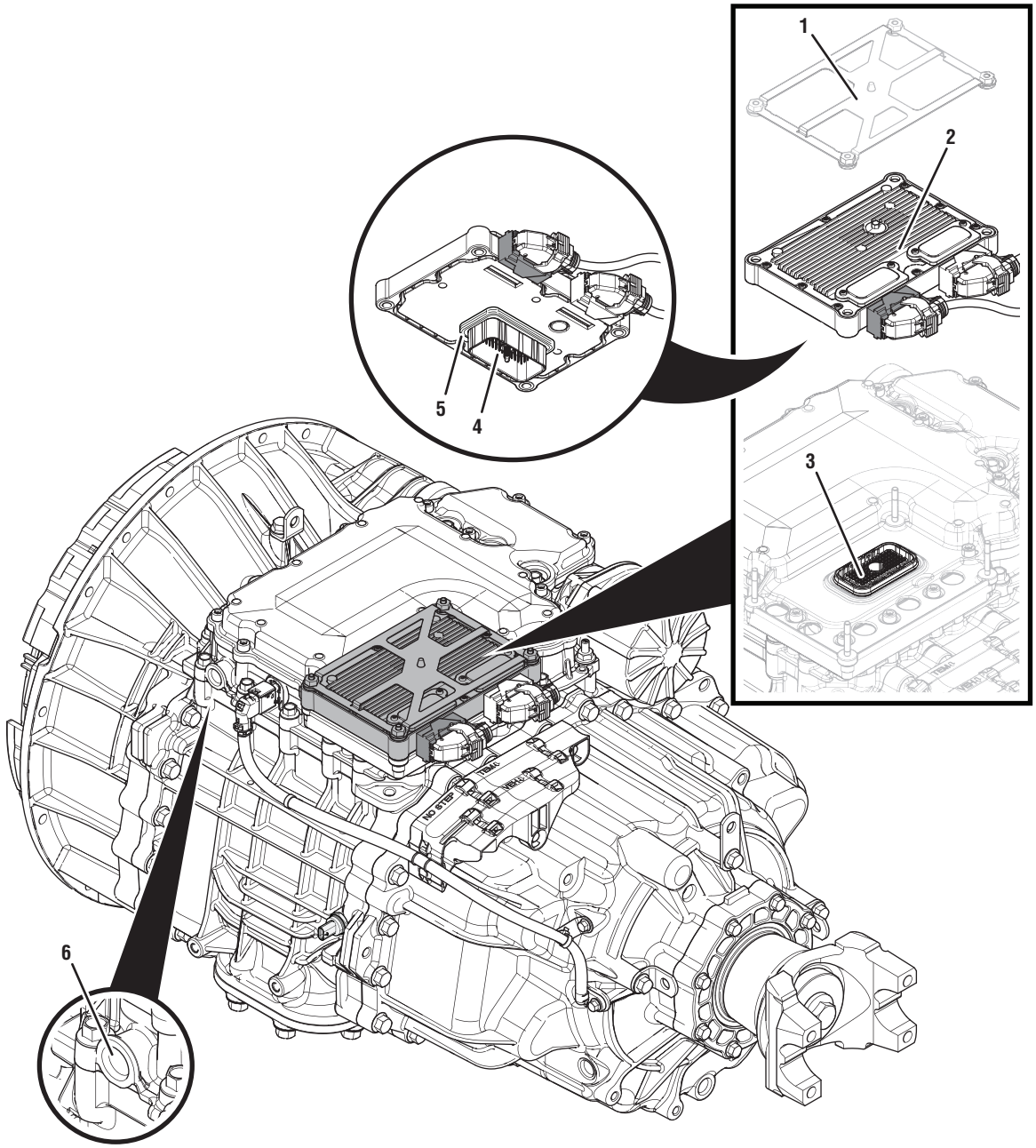
**FMI 10:**

- MTM – Clutch Engage Solenoid 1 and/or 2
  - Stuck open
  - Air leak

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

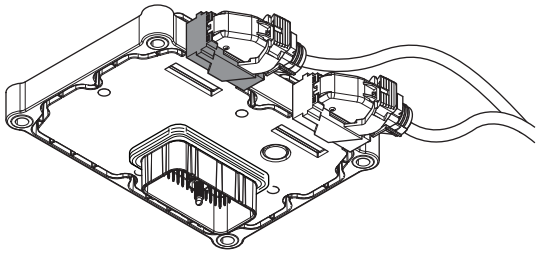
# Fault Code 511 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 511 FMI 0, 1, 3, 4, 5, 6, 8, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 511 FMI 7, 10, 16 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. go to **Step V.**
   - If Fault Code 511 FMI 12 is Active or Inactive, go to **Step E.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

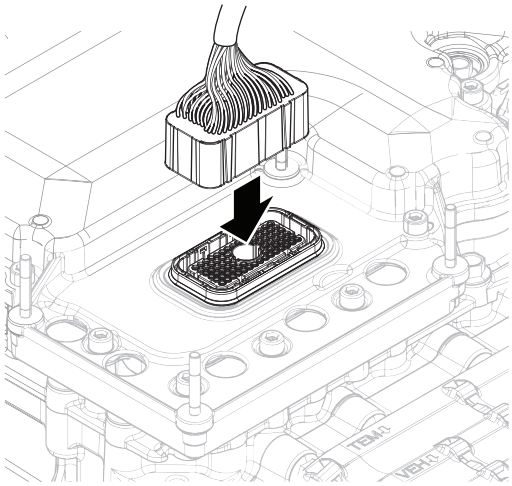


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

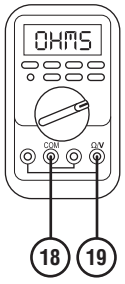
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Clutch Engage Solenoid 1 resistance and not shorted to ground.*

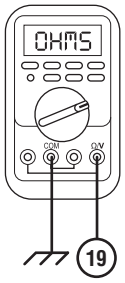
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 18 and Pin 19. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 19 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Pins | Range | Reading(s) |
|---|---|---|
| 18 to 19 | 2.5–3.1 Ohms | |
| 19 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 511 FMI 0, 1, 3, 4, 5, 6, 8, 18 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 511 FMI 0, 1, 3, 4, 5, 6, 8, 18 is Inactive, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 511 sets Active during operation, go to **Step A.**
   - If a fault code other than 511 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 512: Clutch Engage Solenoid 2 (C3) – Fine Vent

**J1939: SA 3 SPN 5615 FMI 0, 1, 3, 4, 5, 6, 8, 10, 12, 16, 18**

## Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow to release and engage the clutch. The Clutch Engage Solenoid 2 (CES2) is energized by the Transmission Control Module (TCM) to exhaust air pressure from the Linear Clutch Actuator (LCA) and engage the clutch. The clutch control system requires four solenoids to control the clutch position – two clutch engage solenoids and two clutch release solenoids. The CES2 slowly exhausts air pressure from the LCA to engage the clutch. The CES2 is located in the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the CES2. If a system failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** CES2 low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** CES2 low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** CES2 shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** CES2 commanded off and shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** CES2 open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** CES2 commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** CES2 out of normal operating frequency.

**FMI 10 – Abnormal Rate of Change:** The clutch release solenoid has been commanded on for a longer duty cycle than expected to maintain clutch release for 10 seconds.

**FMI 12 – Bad Intelligent Device:** CES2 commanded on beyond expected duty cycle.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** CES2 commanded on for longer than expected increasing solenoid temperature.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** CES2 commanded on below expected voltage.

## Fallback

**FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- Clutch Engage Solenoid 2 operation prohibited
- May experience harsh clutch engagement

**FMI 10:**

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Raised shift points

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 8, 10, 12, 16, 18:** Key cycle

**FMI 3, 4, 5:** CES2 in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM – Clutch Engage Solenoid 2
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

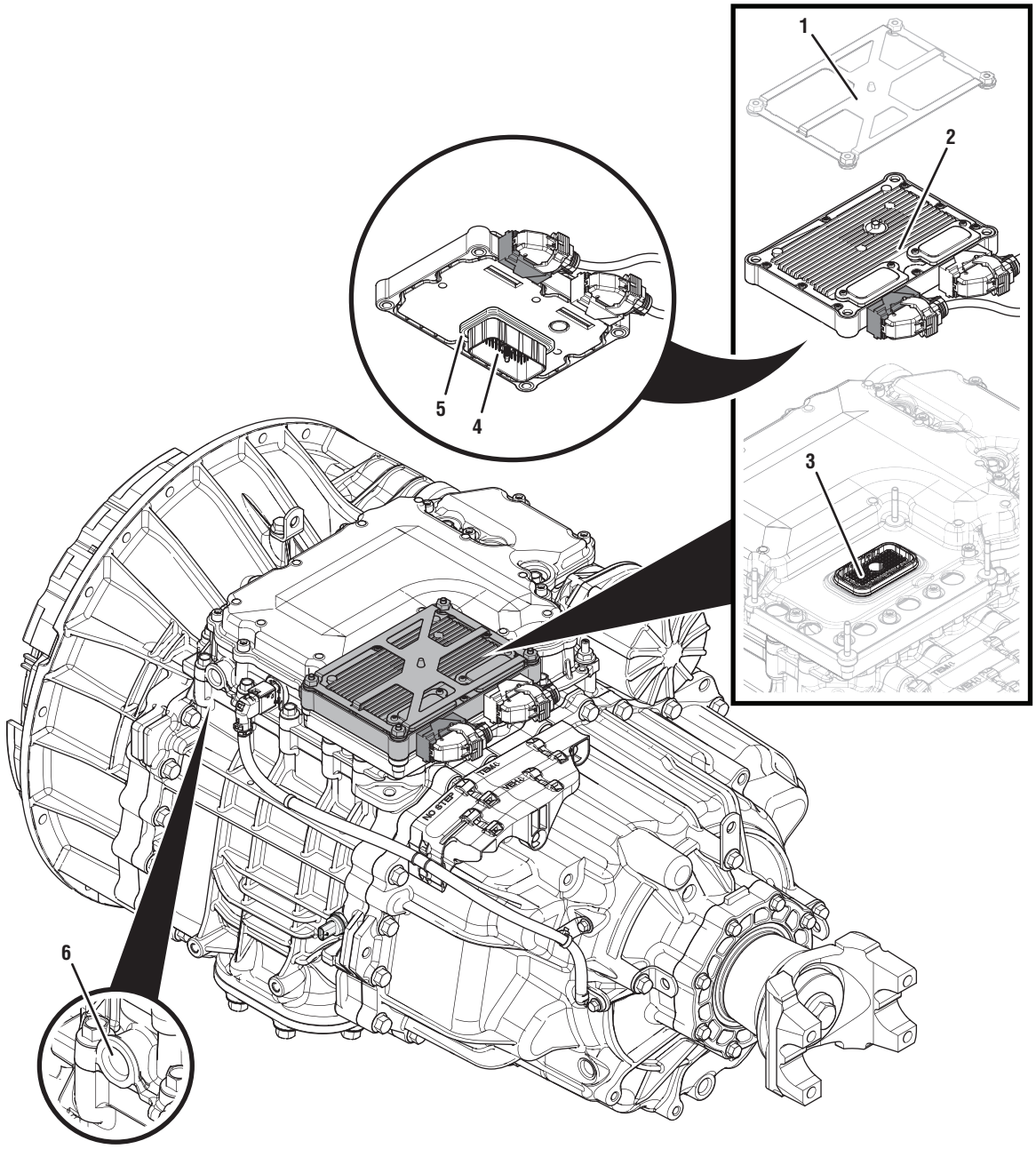
**FMI 10:**

- MTM – Clutch Engage Solenoid 1 and/or 2
  - Stuck open
  - Air leak

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

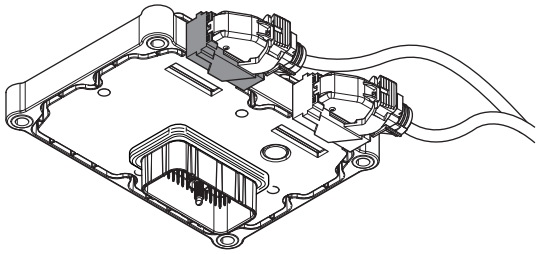
# Fault Code 512 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 512 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 512 FMI 10 is Active or Inactive, go to **Step E.**
   - If Fault Code 512 FMI 12 is Active or Inactive, go to **Step G.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

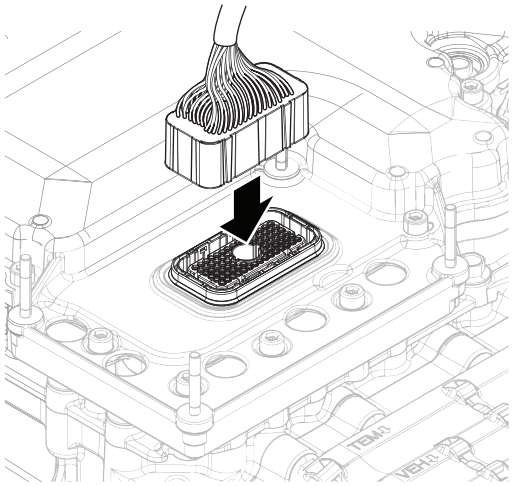


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

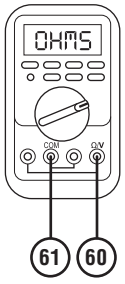
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Inertia Brake Solenoid resistance and not shorted to ground.*

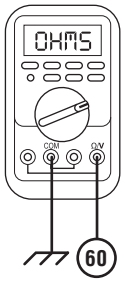
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 60 and Pin 61. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 60 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Pins | Range | Reading(s) |
|---|---|---|
| 60 to 61 | 2.5–3.1 Ohms | |
| 60 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 512 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 512 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace the MTM. Go to **Step V.**

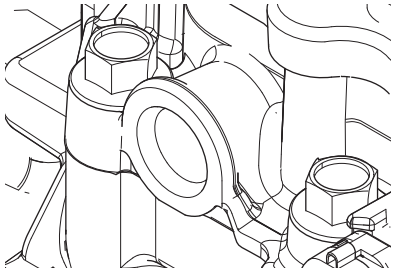
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step F.**

## F

***Purpose:*** *Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke.*

1. Key off.
2. Remove the transmission.

   **Note:** Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
3. Inspect the Clutch, Release Bearing, Front Bearing Cover and Release Yoke for binding or damage.
   - If no binding or damage is found, replace the MTM. Go to **Step V.**
   - If binding or damage is found, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 512 sets Active during operation, go to **Step A.**
   - If a fault code other than 512 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 513: Clutch Release Solenoid 1 (C5) – Coarse Fill

**J1939: SA 3 SPN 5616 FMI 0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 16, 18**

## Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow to release and engage the clutch. The Clutch Release Solenoid 1 (CRS1) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure into the Linear Clutch Actuator (LCA) and release the clutch. The clutch control system requires four solenoids to control the clutch position – two clutch engage solenoids and two clutch release solenoids. The CRS1 quickly applies air pressure to the LCA and releases the clutch. The CRS1 is located in the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the CRS1. If a system failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** CRS1 low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** CRS1 low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** CRS1 shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** CRS1 commanded off and shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** CRS1 open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** CRS1 commanded on and shorted to ground.

**FMI 7 – Mechanical System Not Responding:** The LCA Position Sensor reports the clutch is released while the clutch control system is attempting to engage the clutch.

**FMI 8 – Abnormal Frequency:** CRS1 out of normal operating frequency.

**FMI 10 – Abnormal Rate of Change:** The clutch engage solenoid has been commanded on for a longer duty cycle than expected to maintain clutch engagement for 10 seconds.

**FMI 12 – Bad Intelligent Device:** CRS1 commanded on beyond expected duty cycle.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** CRS1 commanded on for longer than expected increasing solenoid temperature.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** CRS1 commanded on below expected voltage.

## Fallback

**FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- Clutch Release Solenoid 1 operation prohibited
- Urge to Move and Creep mode prohibited
- Raised shift points

**FMI 7, 10:**

- Amber warning lamp on
- Non-Neutral modes prohibited
- PTO mode prohibited
- If vehicle is moving and the transmission is in gear
  - Red stop lamp on
  - Urge to Move and Creep Mode prohibited
  - Upshifts prohibited
  - Raised shift points

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 7, 8, 10, 12, 16, 18:** Key cycle

**FMI 3, 4, 5:** CRS1 in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - Clutch Release Solenoid 1
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 7:**

- Clutch Housing
  - Damaged Release Bearing
  - Damaged Front Bearing Cover
  - Damaged Release Yoke
  - Damaged Clutch
- LCA
  - Stuck piston
  - LCA to MTM seal air leak
- MTM - Clutch Release Solenoid 1 and/or 2
  - Stuck open
  - Air leak

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

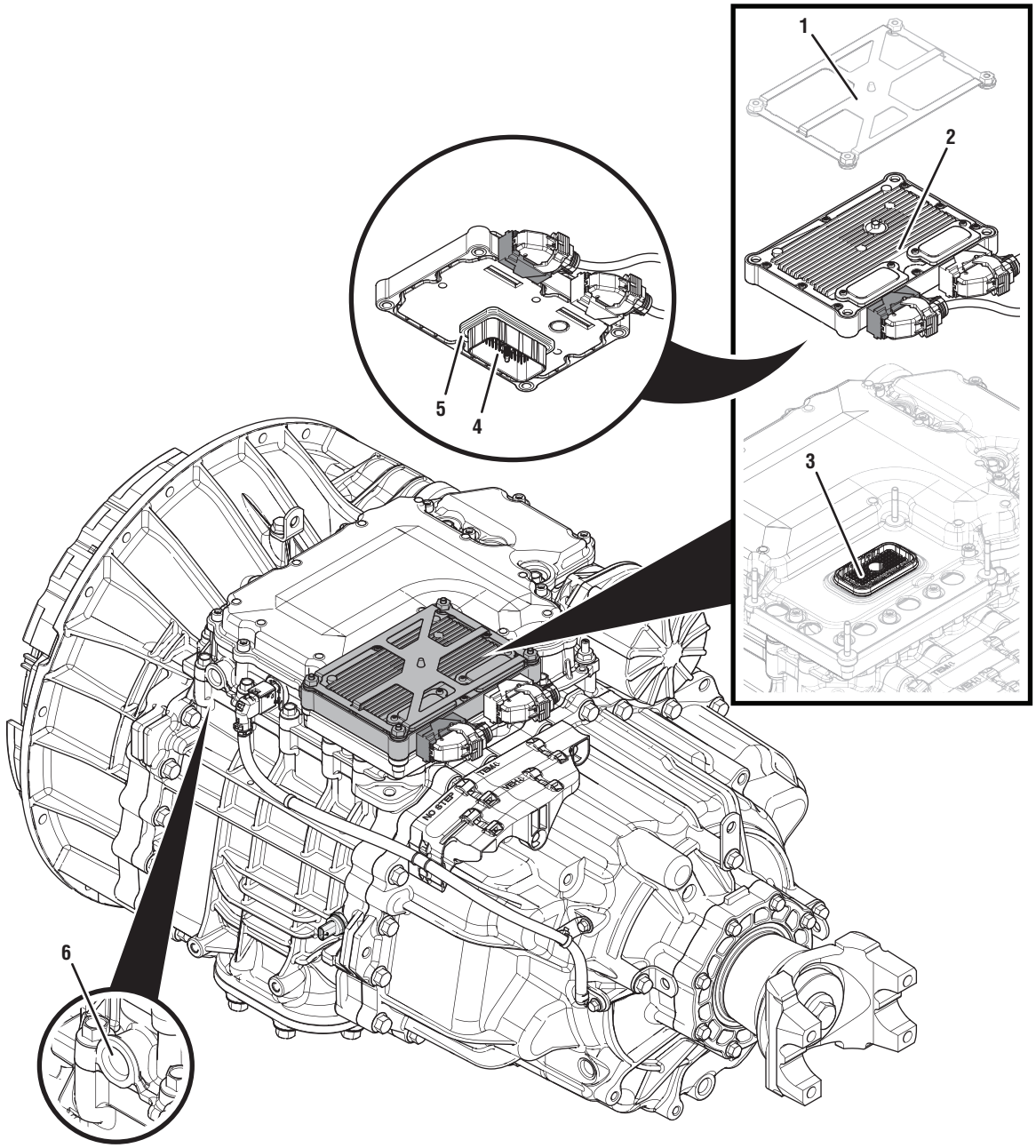
**FMI 10:**

- MTM - Clutch Release Solenoid 1 and/or 2
  - Stuck open
  - Air leak

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

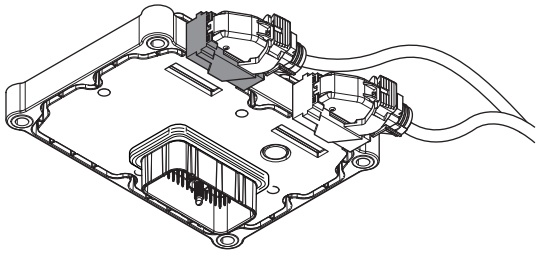
# Fault Code 513 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 513 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 513 FMI 7, 10 is Active or Inactive, go to **Step E.**
   - If Fault Code 513 FMI 12 is Active or Inactive, go to **Step G.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

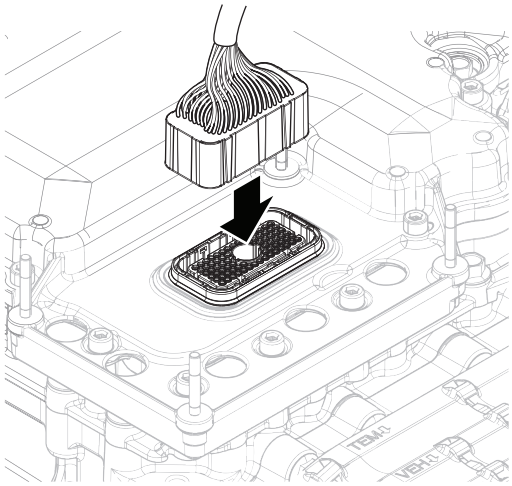


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

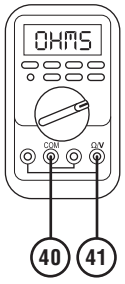
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Clutch Release Solenoid 1 resistance and not shorted to ground.*

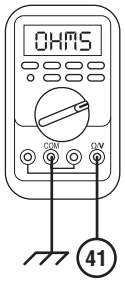
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 40 and Pin 41. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 41 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Pins | Range | Reading(s) |
|---|---|---|
| 40 to 41 | 2.5–3.1 Ohms | |
| 41 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 513 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 513 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace the MTM. Go to **Step V.**

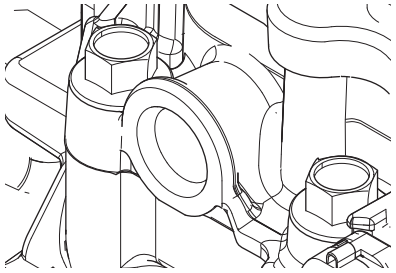
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*

## E

***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
   - If no contamination is found, go to **Step F.**

## F

***Purpose:*** *Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke.*

1. Key off.
2. Remove the transmission.

   **Note:** Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
3. Inspect the Clutch, Release Bearing, Front Bearing Cover and Release Yoke for binding or damage.
   - If no binding or damage is found, replace the MTM. Go to **Step V.**
   - If binding or damage is found, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 513 sets Active during operation, go to **Step A.**
   - If a fault code other than 513 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 514: Clutch Release Solenoid 2 (C6) – Fine Fill

**J1939: SA 3 SPN 5617 FMI 0, 1, 3, 4, 5, 6, 8, 10, 12, 16, 18**

## Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow to release and engage the clutch. The Clutch Release Solenoid 2 (CRS2) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure into the Linear Clutch Actuator (LCA) and release the clutch. The clutch control system requires four solenoids to control the clutch position – two clutch engage solenoids and two clutch release solenoids. The CRS2 slowly applies air pressure to the LCA and releases the clutch. The CRS2 is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the CRS2. If a system failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** CRS2 low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** CRS2 low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** CRS2 shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** CRS2 commanded off and shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** CRS2 open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** CRS2 commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** CRS2 out of normal operating frequency.

**FMI 10 – Abnormal Rate of Change:** The clutch release solenoid has been commanded on for a longer duty cycle than expected to maintain clutch release for 10 seconds.

**FMI 12 – Bad Intelligent Device:** CRS2 commanded on beyond expected duty cycle.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** CRS2 commanded on for longer than expected increasing solenoid temperature.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** CRS2 commanded on below expected voltage.

## Fallback

**FMI 0, 1, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- Clutch Release Solenoid 2 operation prohibited
- Urge to Move and Creep mode prohibited
- Raised shift points

**FMI 3, 4:**

- Amber warning lamp on
- Clutch Release Solenoid 2 operation prohibited
- Clutch Engagement Solenoid 1 operation prohibited
- Urge to Move and Creep mode prohibited
- Raised shift points

**FMI 10:**

- Amber warning lamp on
- No degraded mode

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 8, 10, 12, 16, 18:** Key cycle

**FMI 3, 4, 5:** CRS2 in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM – Clutch Release Solenoid 2
  - Internal failure
  - Damaged
- MTM – Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

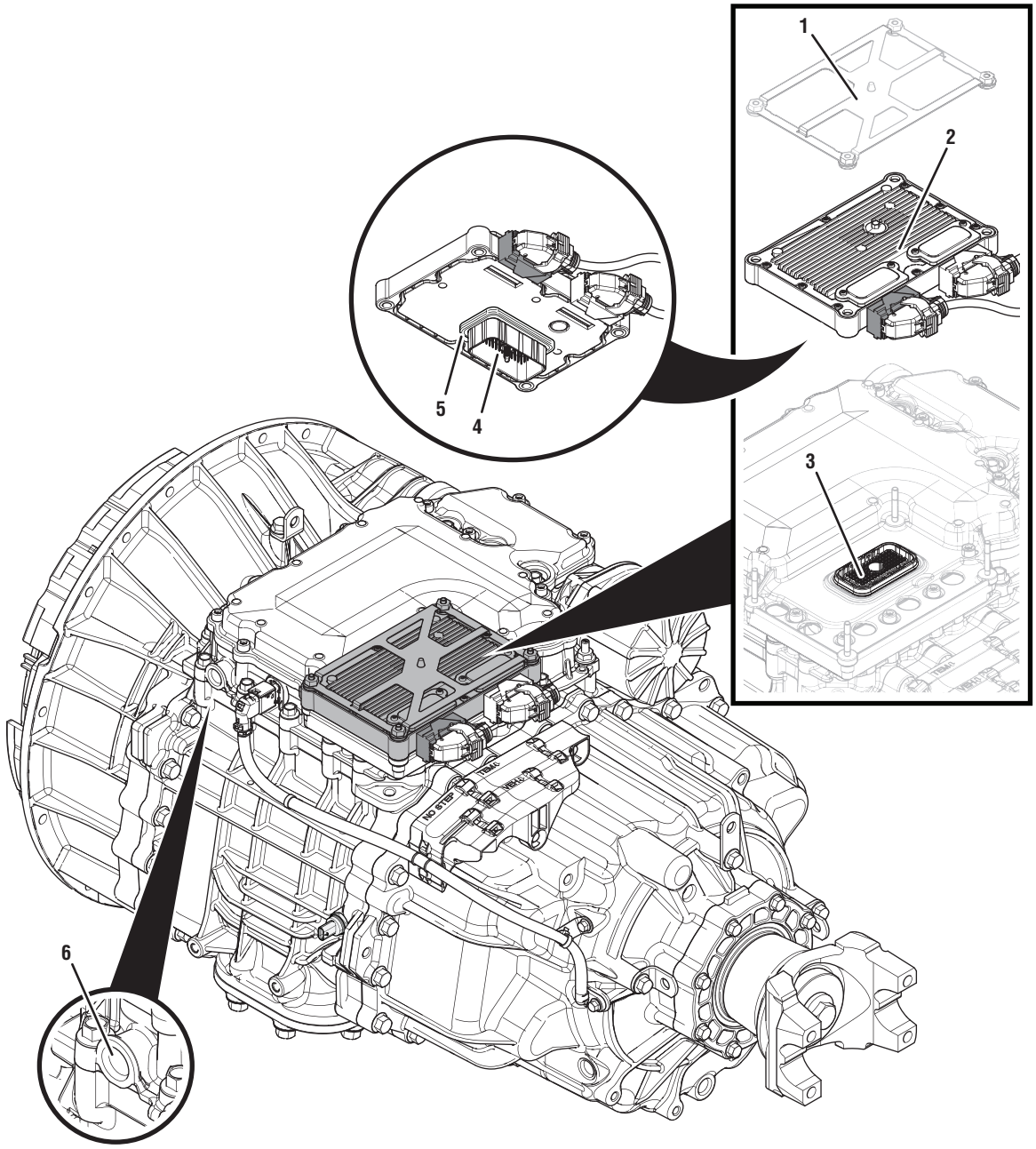
**FMI 10:**

- MTM – Clutch Release Solenoid 1 and/or2
  - Stuck open
  - Air leak

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

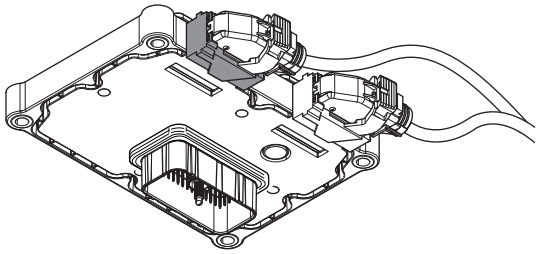
# Fault Code 514 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 514 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 514 FMI 10 is Active or Inactive, go to **Step E.**
   - If Fault Code 514 FMI 12 is Active or Inactive, go to **Step G.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

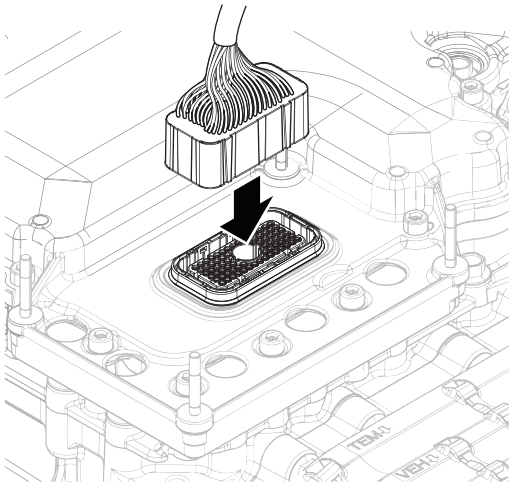


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

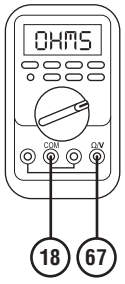
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Inertia Brake Solenoid resistance and not shorted to ground.*

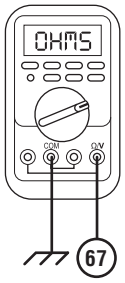
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 18 and Pin 67. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 67 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Pins | Range | Reading(s) |
|---|---|---|
| 18 to 67 | 3.0–3.6 Ohms | |
| 67 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 514 FMI 0, 1, 3, 4, 5, 6, 8, 18 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 514 FMI 0, 1, 3, 4, 5, 6, 8, 18 is Inactive, replace the MTM. Go to **Step V.**

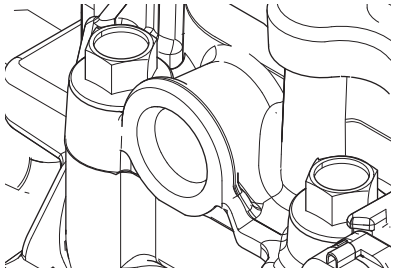
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step F.**

## F

***Purpose:*** *Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke.*

1. Key off.
2. Remove the transmission.

   **Note:** Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
3. Inspect the Clutch, Release Bearing, Front Bearing Cover and Release Yoke for binding or damage.
   - If no binding or damage is found, replace the MTM. Go to **Step V.**
   - If binding or damage is found, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 514 sets Active during operation, go to **Step A.**
   - If a fault code other than 514 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 570: Inertia Brake Solenoid (A5)

**J1939: SA 3 SPN 787 FMI 0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 18**

## Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow. The Inertia Brake Solenoid (IBS) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure to actuate the Inertia Brake. The Inertia Brake is normally released by spring pressure and when actuated with air pressure slows down the lower countershaft to synchronize gear engagement. The Inertia Brake is mounted in the clutch housing.The IBS is located in the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the IBS. If a system failure is detected, the fault is set Active.

## Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** IBS low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** IBS low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** IBS shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** IBS shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** IBS open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** IBS commanded on and shorted to ground.

**FMI 7 – Mechanical System Not Responding:** During a Clutch Calibration the Inertia Brake was unable to slow the Countershaft.

**FMI 8 – Abnormal Frequency:** IBS out of normal operating frequency.

**FMI 10 – Abnormal Rate of Change:** Inertia Brake did not slow down the countershaft as expected for 2 seconds.

**FMI 12 – Bad Intelligent Device:** IBS commanded on beyond expected duty cycle.

**FMI 14 – Special Instructions:** IBS inappropriately commanded on when:

- Rail C or Rail D sliding clutch is engaged in a gear

  or

- The clutch is applied and Rail B Synchronizer is engaged in the Primary or Secondary Drive Gear

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** IBS commanded on for longer than expected increasing solenoid temperature.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** IBS commanded on below expected voltage.

## Fallback

**FMI 0, 1, 3, 4, 5, 6, 8, 12, 14, 16, 18:**

- Amber warning lamp on
- Inertia Brake engagement prohibited
- May delay engagement of start gear
- May experience long shift times

**FMI 7:**

- Amber warning lamp on
- Non neutral modes prohibited
- PTO mode prohibited

**FMI 10:**

- Amber warning lamp on
- May delay engagement of a start gear
- May experience long shift times

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 7, 8, 12, 14, 16, 18:** Key cycle

**FMI 3, 4, 5, 10:** IBS in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - IBS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 7:**

- MTM - IBS
  - Stuck closed
  - MTM to Main Housing o-ring air leak
- Clutch Housing
  - Air leak
  - Inertia Brake air line and/or fitting air leak
- Inertia Brake
  - Air leak
  - Clutch pack worn
  - Internal failure

**FMI 10:**

- MTM
  - Air leak
- Clutch Housing
  - Air leak
  - Inertia Brake air line and/or fitting air leak
- Inertia Brake
  - Worn
  - Internal failure
- Clutch
  - Drag
- Transmission fluid
  - Ambient extreme cold
  - Incorrect grade

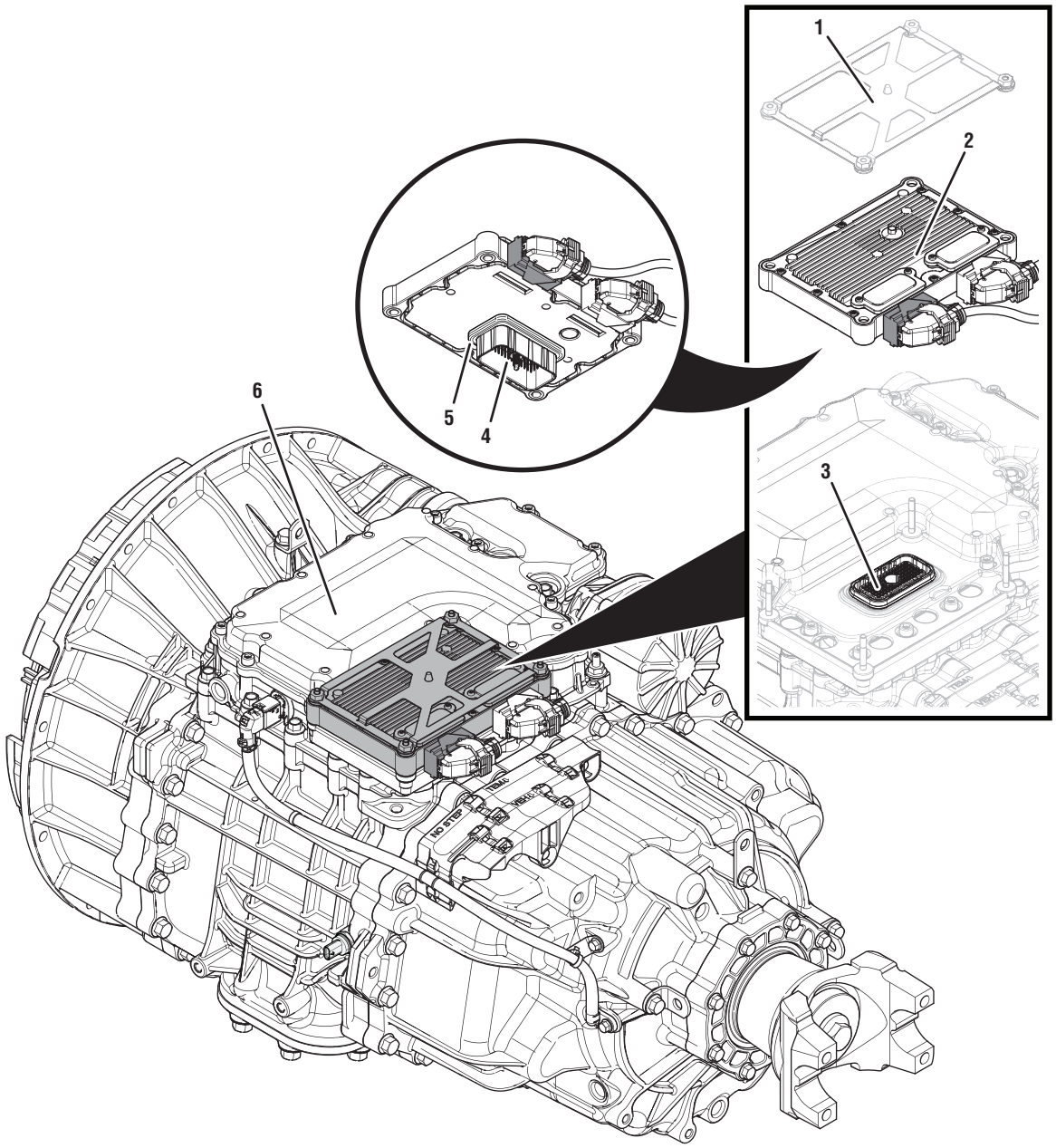
**FMI 12, 14:**

- TCM
  - Software issue
  - Internal failure

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

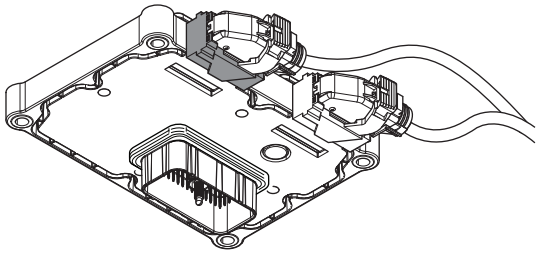
# Fault Code 570 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 570 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 570 FMI 7, 10 is Active or Inactive, go to **Step E.**
   - If Fault Code 570 FMI 12, 14 is Active or Inactive, go to **Step F.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

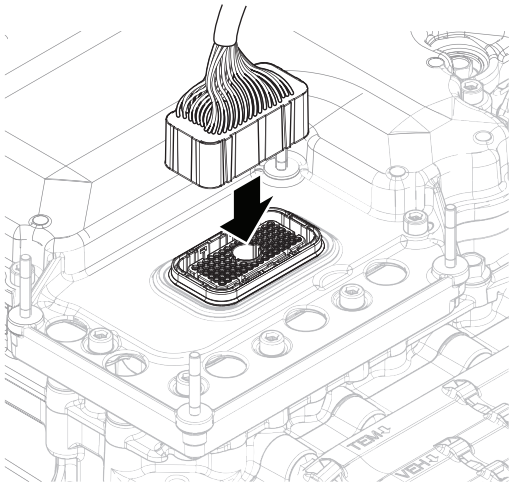


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

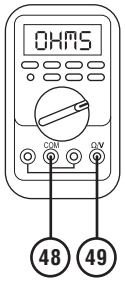
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Inertia Brake Solenoid resistance and not shorted to ground.*

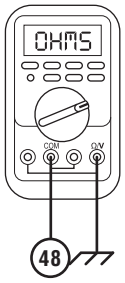
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 48 and Pin 49. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 48 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*

| Pins | Range | Reading(s) |
|---|---|---|
| 48 to 49 | 3.6–4.4 Ohms | |
| 48 to ground (TCM mounting stud) | Open Circuit (OL) | |

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

1. Key off.
2. Remove the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 570 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 570 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, go to **Step E.**

**E** ***Purpose:*** *Use Inertia Brake Deceleration Test to Verify Inertia Brake Performance.*

1. Key on.
2. Connect ServiceRanger.
3. Go To Service Routines.
4. Start Inertia Brake Deceleration Test and follow on-screen prompts.
5. Key off and perform a complete power down.
6. Key on with engine off.
7. Connect ServiceRanger.
8. Select “Service Activity Report”.
9. Enter information and select “Start Report”.

   **Note:** Transmission information is downloaded into the report.
10. Select “Send to Eaton”.

    **Note:** Internet connection is required.
    - Contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

## F

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 570 sets Active during operation, go to **Step A.**
   - If a fault code other than 570 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 596: Rail B Fore Solenoid (A5)

## J1939 SA 3 SPN 5901 FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 17, 18, 31

### Overview
The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow. The Rail B Fore Solenoid (RBFS) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure to actuate the Rail B Synchronizer in the fore or forward direction. The RBFS is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection
The TCM monitors the RBFS. If a system failure is detected, the fault is set Active.

### Conditions to Set Fault Code Active
**FMI 0 – Data Valid But Above Normal (Most Severe):** RBFS low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** RBFS low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** RBFS shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** RBFS shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** RBFS open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** RBFS commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** RBFS out of normal operating frequency.

**FMI 12 – Bad Intelligent Device:** RBFS commanded on beyond expected duty cycle.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** RBFS commanded on for longer than expected increasing solenoid temperature.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail B Position Sensor reported uncommanded movement fore, out of the Primary Drive Gear, and speed sensors confirmed the loss of Primary Drive Gear engagement.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** RBFS commanded on below expected voltage.

**FMI 31 – Condition Exists:** During a Rail Calibration, Rail B Position Sensor reported uncommanded movement fore, out of neutral toward the Secondary Drive Gear.

### Fallback
**FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- If Rail B is not engaged
  - Rail B movement in the fore direction prohibited
- If Rail B is engaged
  - Rail B movement prohibited

**FMI 17:**

- Amber warning lamp on
- Rail B engagement of the Primary Drive Gear prohibited

**FMI 31:**

- Amber warning lamp on
- Non neutral modes prohibited

### Conditions to Set Fault Code Inactive
**FMI 0, 1, 6, 8, 12, 16, 17, 18, 31:** Key cycle

**FMI 3, 4, 5:** RBFS in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - RBFS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

**FMI 17:**

- MTM - RBFS
  - Partially stuck open
- Internal transmission
  - Primary Drive Gear
  - Rail B Synchronizer

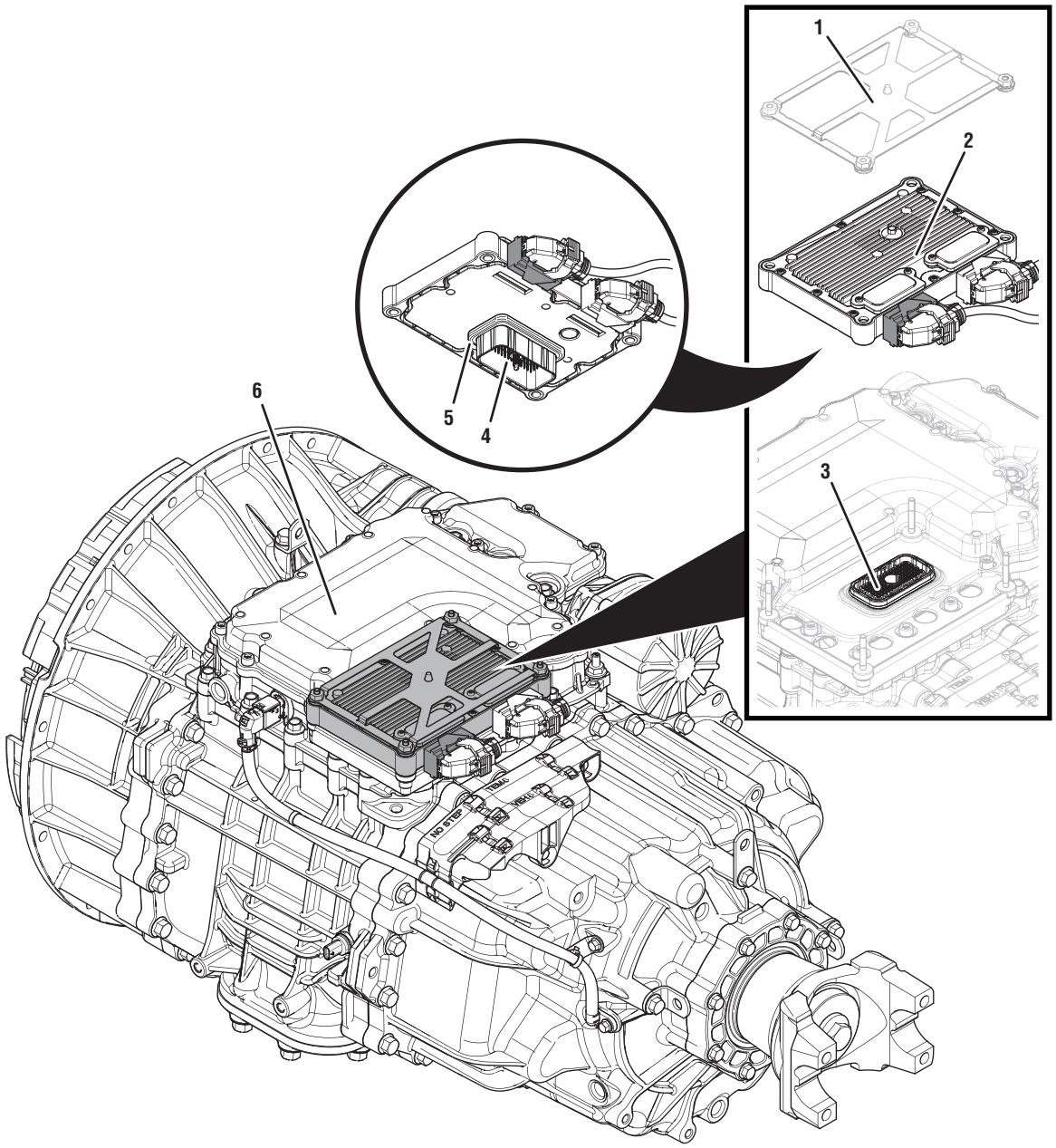
**FMI 31:**

- MTM - RBFS
  - Partially stuck open

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- Rail B Synchronizer Engagement Tool (RR1088TR)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

# Fault Code 596 Troubleshooting

## A

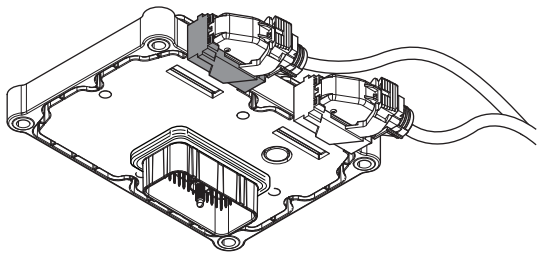
***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 596 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 596 FMI 12 is Active or Inactive, go to **Step G.**
   - If Fault Code 596 FMI 17 is Active or Inactive, go to **Step E.**

## B

***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

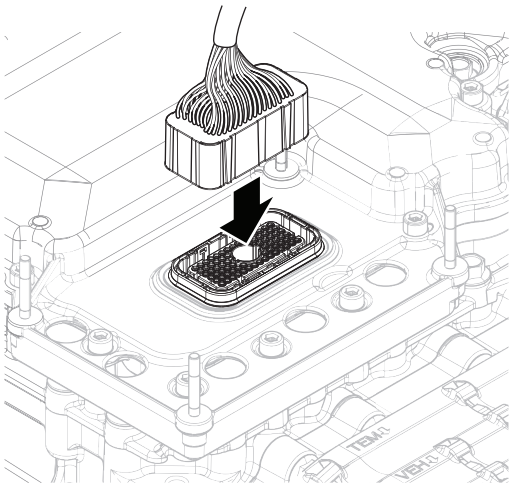


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

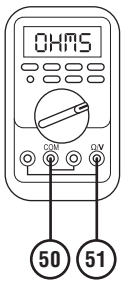
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail B Fore Solenoid resistance and not shorted to ground.*

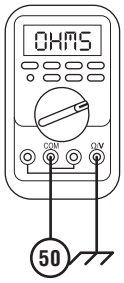
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 50 and Pin 51. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 50 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Pins | Range | Reading(s) |
|---|---|---|
| 50 to 51 | 3.6–4.4 Ohms | |
| 50 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 596 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 596 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace the MTM. Go to **Step V.**

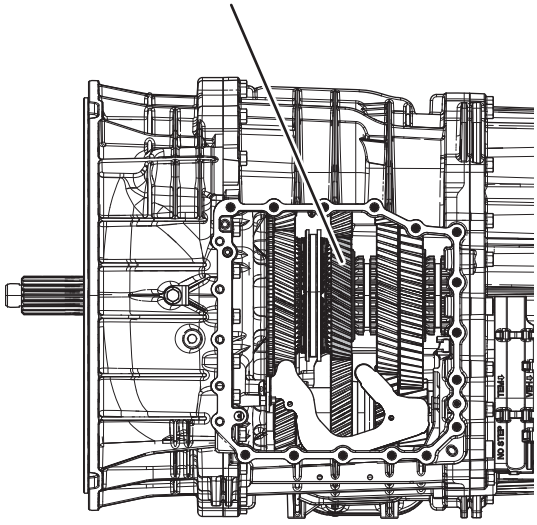
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify mechanical condition of the Primary Drive Gear.*

1. Key off.
2. Remove MTM.

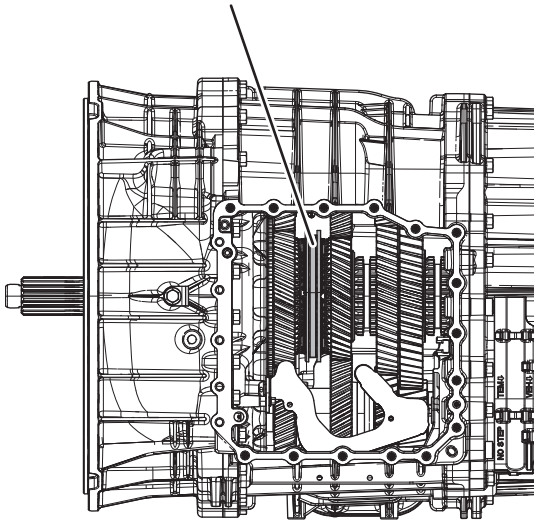
   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the Primary Drive Gear for excessive fore and aft movement.



   - If excessive gear movement is evident, inspect the Primary Drive Gear and Main Shaft Assembly and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

**F** ***Purpose:*** *Verify mechanical condition of the Rail B Synchronizer and clutching teeth.*

1. Inspect the Rail B Synchronizer Sliding Sleeve yoke slot for wear.



2. Install the Rail B Synchronizer Engagement Tool (RR1088TR).

   **Note:** Reference *Appendix, Manually Actuate Rail B Procedure*.

3. Shift the Rail B Synchronizer Sliding Sleeve into neutral (if necessary).
4. Shift the Rail B Synchronizer Sliding Sleeve into the Secondary Drive Gear engagement position (fore).
5. Inspect the Primary Drive Gear and synchronizer ring clutching teeth for wear.
6. Return the Rail B Synchronizer Sliding Sleeve to neutral.
7. Shift the Rail B Synchronizer Sliding Sleeve into the Primary Drive Gear engagement position (aft).
8. Inspect the Secondary Drive Gear and synchronizer ring clutching teeth for wear.
9. Return the Rail B Synchronizer Sliding Sleeve to neutral.
   - If the Rail B Synchronizer Sliding Sleeve shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail B Synchronizer Sliding Sleeve does not shift into all three positions or clutching teeth wear is present, replace the Rail B Synchronizer Assembly, Primary Drive Gear, Secondary Drive Gear and MTM. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 596 sets Active during operation, go to **Step A.**
   - If a fault code other than 596 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13

# Fault Code 597: Rail B Aft Solenoid (A1)

## J1939 SA 3 SPN 5909 FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 17, 18, 31

### Overview
The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow. The Rail B Aft Solenoid (RBAS) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure to actuate the Rail B Synchronizer in the aft or rearward direction. The RBAS is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection
The TCM monitors the RBAS. If a system failure is detected, the fault is set Active.

### Conditions to Set Fault Code Active
**FMI 0 – Data Valid But Above Normal (Most Severe):** RBAS low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** RBAS low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** RBAS shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** RBAS shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** RBAS open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** RBFS commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** RBAS out of normal operating frequency.

**FMI 12 – Bad Intelligent Device:** RBAS commanded on beyond expected duty cycle.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** RBFS commanded on for longer than expected increasing solenoid temperature.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail B Position Sensor reported uncommanded movement aft, out of the Secondary Drive Gear, and speed sensors confirmed the loss of Secondary Drive Gear engagement.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** RBFS commanded on below expected voltage.

**FMI 31 – Condition Exists:** During a Rail Calibration, Rail B Position Sensor reported uncommanded movement aft, out of neutral toward the Primary Drive Gear.

### Fallback
**FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- If Rail B is not engaged
  - Rail B movement in the aft direction prohibited
- If Rail B is engaged
  - Rail B movement prohibited

**FMI 17:**

- Amber warning lamp on
- Rail B engagement of the Secondary Drive Gear prohibited

**FMI 31:**

- Amber warning lamp on
- Non neutral modes prohibited

### Conditions to Set Fault Code Inactive
**FMI 0, 1, 6, 8, 12, 16, 17, 18:** Key cycle

**FMI 3, 4, 5, 8:** RBAS in range for 10 seconds

### Possible Causes
**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - RBAS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

**FMI 17:**

- MTM - RBAS
  - Partially stuck open
- Internal transmission
  - Secondary Drive Gear
  - Rail B Synchronizer

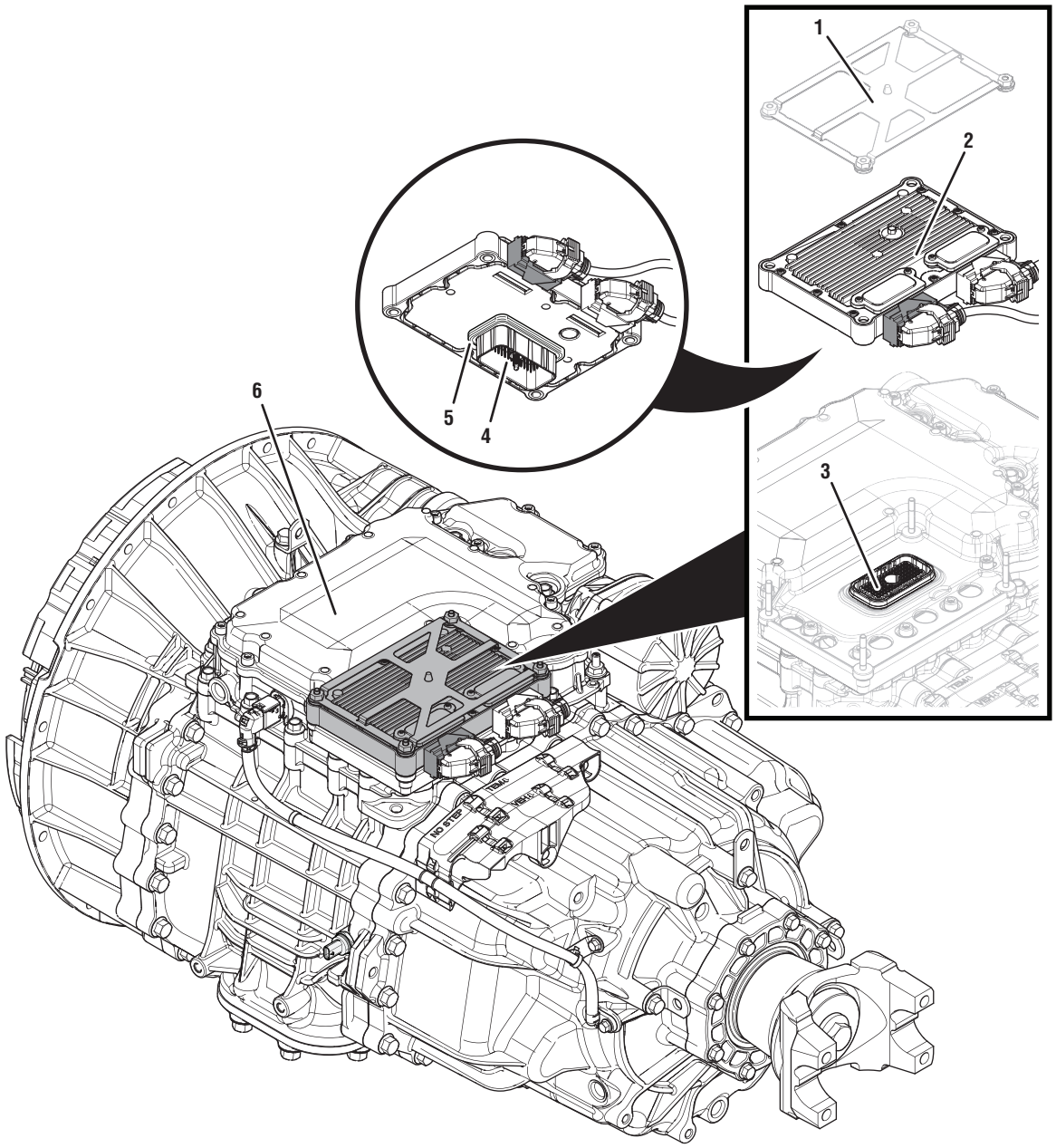
**FMI 31:**

- MTM - RBAS
  - Partially stuck open

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- Rail B Synchronizer Engagement Tool (RR1088TR)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

# Fault Code 597 Troubleshooting

## A

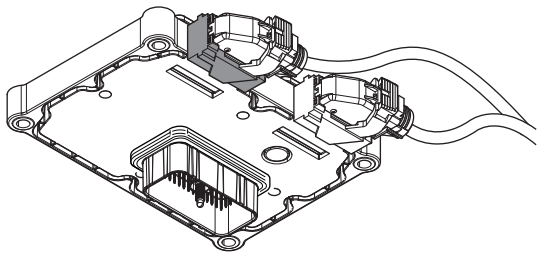
***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 597 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 597 FMI 12 is Active or Inactive, go to **Step G.**
   - If Fault Code 597 FMI 17 is Active or Inactive, go to **Step E.**

## B

***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

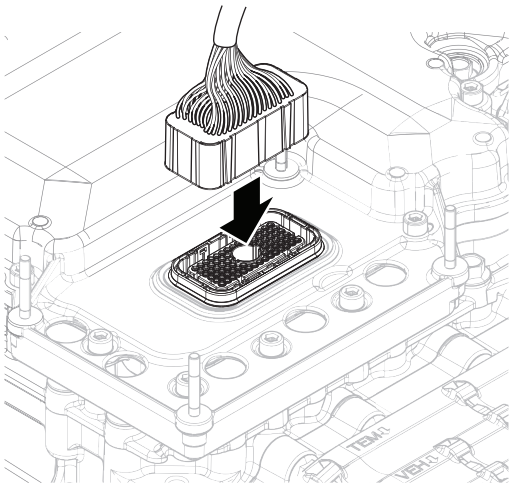


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

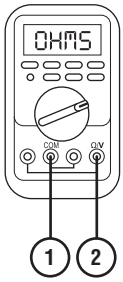
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail B Aft Solenoid resistance and not shorted to ground.*

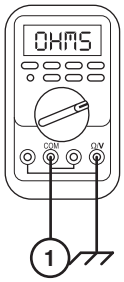
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 1 and Pin 2. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 1 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*

| Pins | Range | Reading(s) |
|---|---|---|
| 1 to 2 | 3.6–4.4 Ohms | |
| 1 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 597 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 597 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace the MTM. Go to **Step V.**

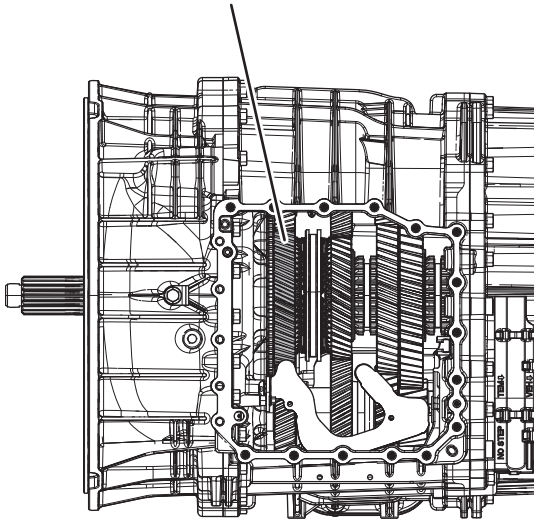
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify mechanical condition of the Secondary Drive Gear.*

1. Key off.
2. Remove MTM.

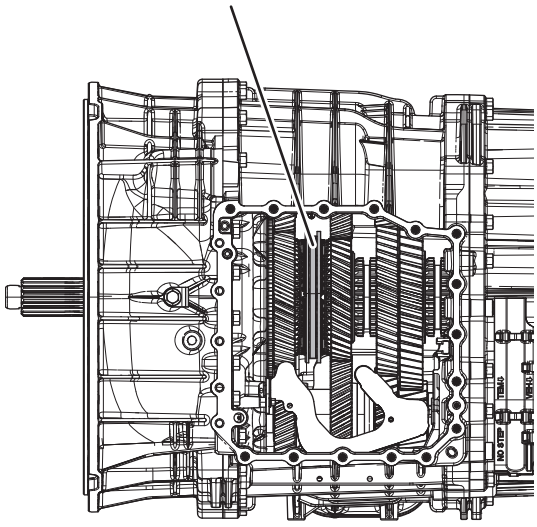
   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the Secondary Drive Gear for excessive fore and aft movement.



   - If excessive gear movement is evident, inspect the Secondary Drive Gear and Input Shaft Assembly and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

**F** ***Purpose:*** *Verify mechanical condition of the Rail B Synchronizer and clutching teeth.*

1. Inspect the Rail B Synchronizer Sliding Sleeve yoke slot for wear.



2. Install the Rail B Synchronizer Engagement Tool (RR1088TR).

   **Note:** Reference *Appendix, Manually Actuate Rail B Procedure*.

3. Shift the Rail B Synchronizer Sliding Sleeve into neutral (if necessary).
4. Shift the Rail B Synchronizer Sliding Sleeve into the Secondary Drive Gear engagement position (fore).
5. Inspect the Primary Drive Gear and synchronizer ring clutching teeth for wear.
6. Return the Rail B Synchronizer Sliding Sleeve to neutral.
7. Shift the Rail B Synchronizer Sliding Sleeve into the Primary Drive Gear engagement position (aft).
8. Inspect the Secondary Drive Gear and synchronizer ring clutching teeth for wear.
9. Return the Rail B Synchronizer Sliding Sleeve to neutral.
   - If the Rail B Synchronizer Sliding Sleeve shifts into all three positions and no clutching teeth wear is present, replace the MTM. go to **Step V.**
   - If the Rail B Synchronizer Sliding Sleeve does not shift into all three positions or clutching teeth wear is present, replace the Rail B Synchronizer Assembly, Primary Drive Gear, Secondary Drive Gear and MTM. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 597 sets Active during operation, go to **Step A.**
   - If a fault code other than 597 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 616: Rail C Fore Solenoid (C1)

## J1939 SA 3 SPN 5902 FMI 0, 1, 3, 4, 5, 6, 8, 12, 14, 15, 16, 17, 18, 31

### Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow. The Rail C Fore Solenoid (RCFS) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure to actuate the Rail C Sliding Clutch in the fore or forward direction. The RCFS is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the RCFS. If a system failure is detected, the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** RCFS low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** RCFS low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** RCFS shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** RCFS shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** RCFS open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** RCFS commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** RCFS out of normal operating frequency.

**FMI 12 – Bad Intelligent Device:** RCFS commanded on beyond expected duty cycle.

**FMI 14 – Special Instructions:** Rail C Position Sensor reported uncommanded movement from Neutral toward the Primary Drive Gear immediately after a shift to Neutral for 2 seconds.

**FMI 15 – Data Valid but Above Normal (Least Severe):** Rail C Position Sensor reported uncommanded movement from Neutral toward the Primary Drive Gear for 2 seconds.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** RCFS commanded on for longer than expected increasing solenoid temperature.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail C Position Sensor reported uncommanded movement fore, out of the Secondary Driven Gear, and speed sensors confirmed the loss of Secondary Driven Gear engagement.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** RCFS commanded on below expected voltage.

**FMI 31 – Condition Exists:** During a Rail Calibration, Rail C Position Sensor reported uncommanded movement fore, out of neutral toward the Primary Drive Gear.

### Fallback

**FMI 0, 1, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- If vehicle is stationary and Rail C is not in Neutral
  - Rail C movement in the fore direction prohibited
- If vehicle is moving and Rail C is in Neutral
  - Rail C movement prohibited

**FMI 3, 4:**

- Amber warning lamp on
- Rail C movement prohibited
- If the vehicle is moving and no start gear is available
  - Red stop lamp on

**FMI 14, 15:**

- Amber warning lamp on
- Non neutral modes prohibited
- PTO mode prohibited
- If the vehicle is moving and the transmission is in gear
  - Red stop lamp on
  - Transmission shifts to neutral when vehicle comes to a stop

**FMI 17:**

- Amber warning lamp on
- Rail C engagement of the Secondary Driven Gear prohibited

**FMI 31:**

- Amber warning lamp on
- Non neutral modes prohibited

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 8, 12, 14, 15, 16, 17, 18, 31:** Key cycle

**FMI 3, 4, 5:** RCFS in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - RCFS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

**FMI 14, 15:**

- MTM - RCFS
  - Partially stuck open
- MTM - Rail C Position Sensor
  - Internal failure

**FMI 17:**

- MTM - RCFS
  - Partially stuck open
- Internal transmission
  - Secondary Driven Gear

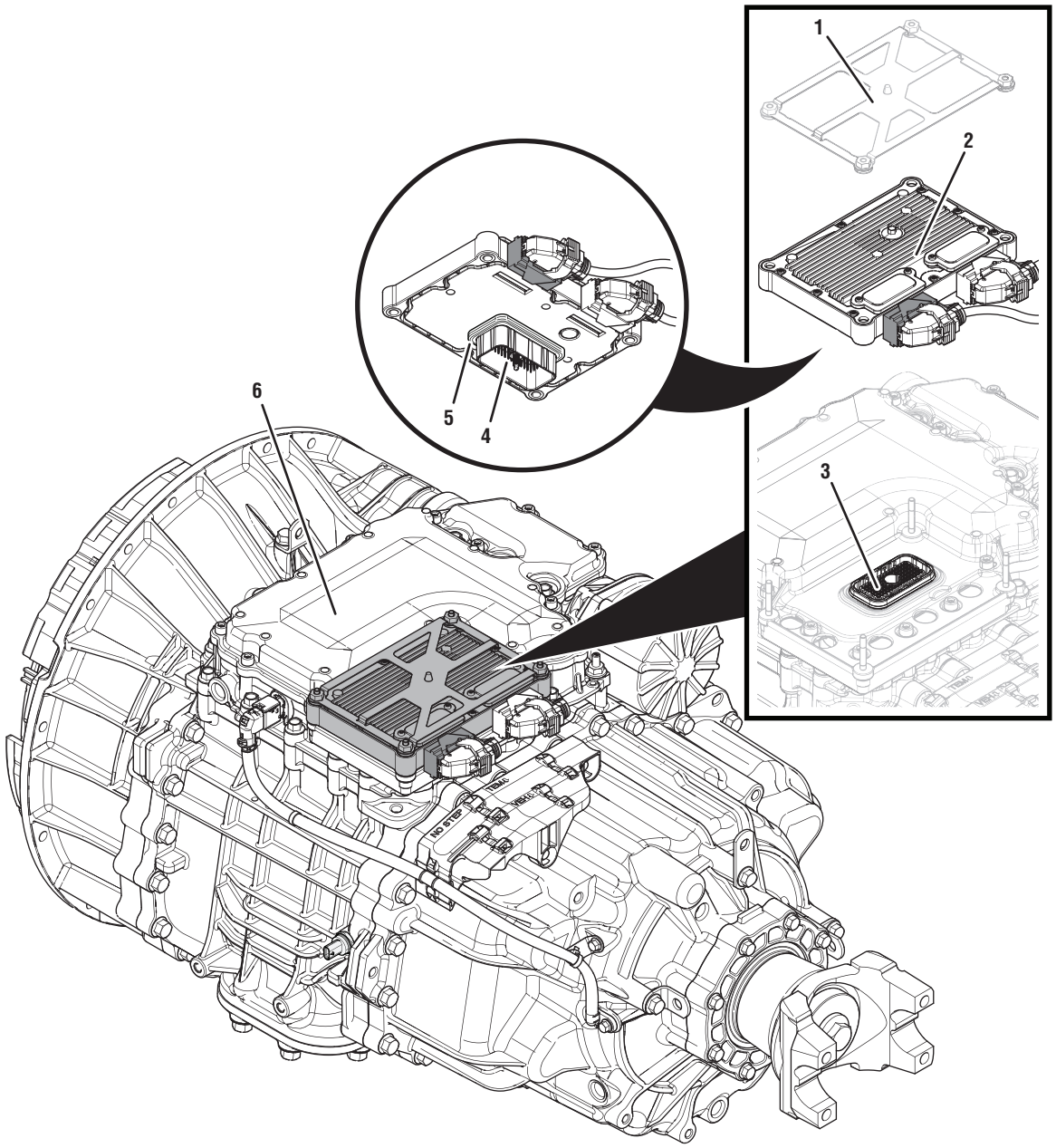
**FMI 31:**

- MTM - RCFS
- Partially stuck open

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

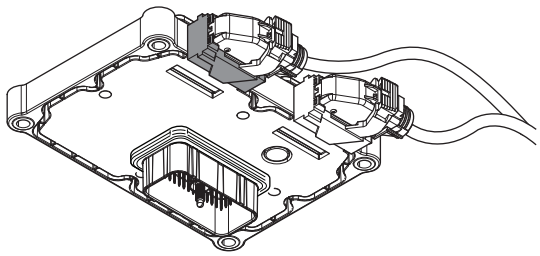
# Fault Code 616 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 616 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 616 FMI 12 is Active or Inactive, go to **Step G.**
   - If Fault Code 616 FMI 14, 15, 17 is Active or Inactive, go to **Step E.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

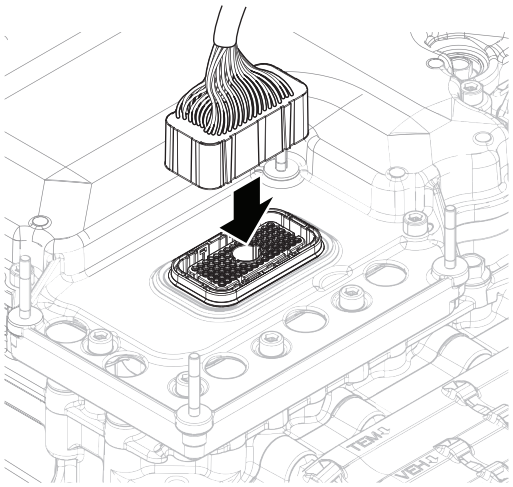


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

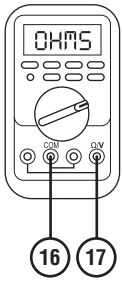
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail C Fore Solenoid resistance and not shorted to ground.*

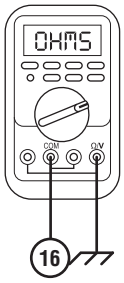
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 16 and Pin 17. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 16 and Ground (TCM mounting stud). Record reading in table.




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

| Pins | Range | Reading(s) |
|---|---|---|
| 16 to 17 | 3.6–4.4 Ohms | |
| 16 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 616 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 616 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace the MTM. Go to **Step V.**

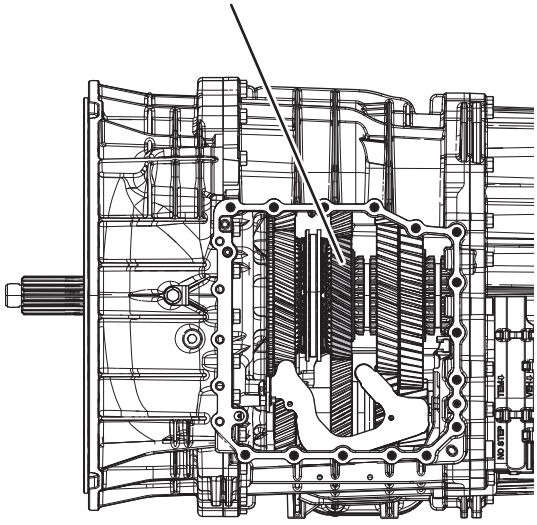
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify mechanical condition of the Primary Drive Gear.*

1. Key off.
2. Remove MTM.

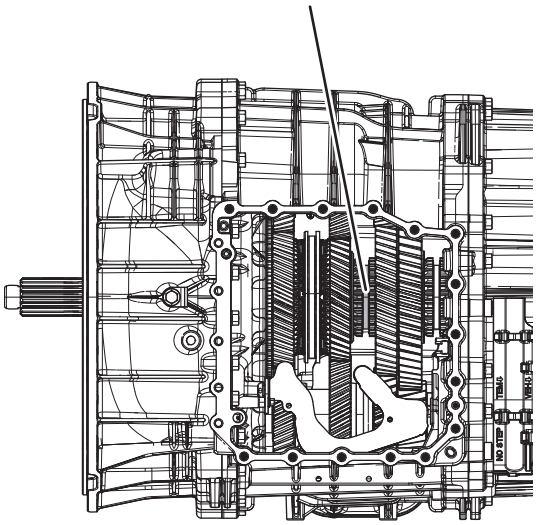
   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the Primary Drive Gear for excessive fore and aft movement.



   - If excessive gear movement is evident, inspect the Main Shaft Assembly and Primary Drive Gear and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

**F** ***Purpose:*** *Verify mechanical condition of the Rail C Sliding Clutch and clutching teeth.*

1. Inspect the Rail C Sliding Clutch yoke slot for wear.



2. Shift the Rail C Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail C Sliding Clutch into the Primary Drive Gear engagement position (fore).
4. Inspect the Rail C Sliding Clutch clutching teeth for wear.
5. Return the Rail C Sliding Clutch to neutral.
6. Shift the Rail C Sliding Clutch into the Secondary Driven Gear engagement position (aft).
7. Inspect the Rail C Sliding Clutch clutching teeth for wear.
8. Return the Rail C Sliding Clutch to neutral.
   - If the Rail C Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail C Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace the Rail C Sliding Clutch, Primary Drive Gear, Secondary Driven Gear and MTM. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 616 sets Active during operation, go to **Step A.**
   - If a fault code other than 616 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 617: Rail C Aft Solenoid (B1)

## J1939 SA 3 SPN 5910 FMI 0, 1, 3, 4, 5, 6, 8, 12, 14, 15, 16, 17, 18, 31

### Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow. The Rail C Aft Solenoid (RCAS) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure to actuate the Rail C Sliding Clutch in the aft or rearward direction. The RCAS is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the RCAS. If a system failure is detected, the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** RCAS low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** RCAS low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** RCAS shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** RCAS shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** RCAS open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** RCAS commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** RCAS out of normal operating frequency.

**FMI 12 – Bad Intelligent Device:** RCAS commanded on beyond expected duty cycle.

**FMI 14 – Special Instructions:** Rail C Position Sensor reported uncommanded movement from Neutral toward the Secondary Driven Gear immediately after a shift to Neutral for 2 seconds.

**FMI 15 – Data Valid but Above Normal (Least Severe):** Rail C Position Sensor reported uncommanded movement from Neutral toward the Secondary Driven Gear for 2 seconds.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** RCAS commanded on for longer than expected increasing solenoid temperature.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail C Position Sensor reported uncommanded movement aft, out of the Primary Drive Gear, and speed sensors confirmed the loss of Primary Drive Gear engagement.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** RCAS commanded on below expected voltage.

**FMI 31 – Condition Exists:** During a Rail Calibration, Rail C Position Sensor reported uncommanded movement aft, out of neutral toward the Secondary Driven Gear.

### Fallback

**FMI 0, 1, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- If vehicle is stationary and Rail C is not engaged in the Secondary Driven Gear
  - Rail C movement in the aft direction prohibited
- If vehicle is moving and Rail C is engaged in the Secondary Driven Gear
  - Rail C movement prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

**FMI 3, 4:**

- Amber warning lamp on
- Rail C movement in the aft direction prohibited

**FMI 14, 15:**

- Amber warning lamp on
- Non neutral modes prohibited
- PTO mode prohibited
- If the vehicle is moving and the transmission is in gear
  - Red stop lamp on
  - Transmission shifts to neutral when vehicle comes to a stop

**FMI 17:**

- Amber warning lamp on
- Rail C engagement of the Primary Drive Gear prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

**FMI 31:**

- Amber warning lamp on
- Non Neutral Modes prohibited

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 8, 12, 14, 15, 16, 17, 18, 31:** Key cycle

**FMI 3, 4, 5:** RCAS in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - RCAS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

**FMI 14, 15:**

- MTM - RCAS
  - Partially stuck open
- MTM - Rail C Position Sensor
  - Internal failure

**FMI 17:**

- MTM - RCAS
  - Partially stuck open
- Internal transmission
  - Primary Drive Gear
  - Rail C Sliding Clutch

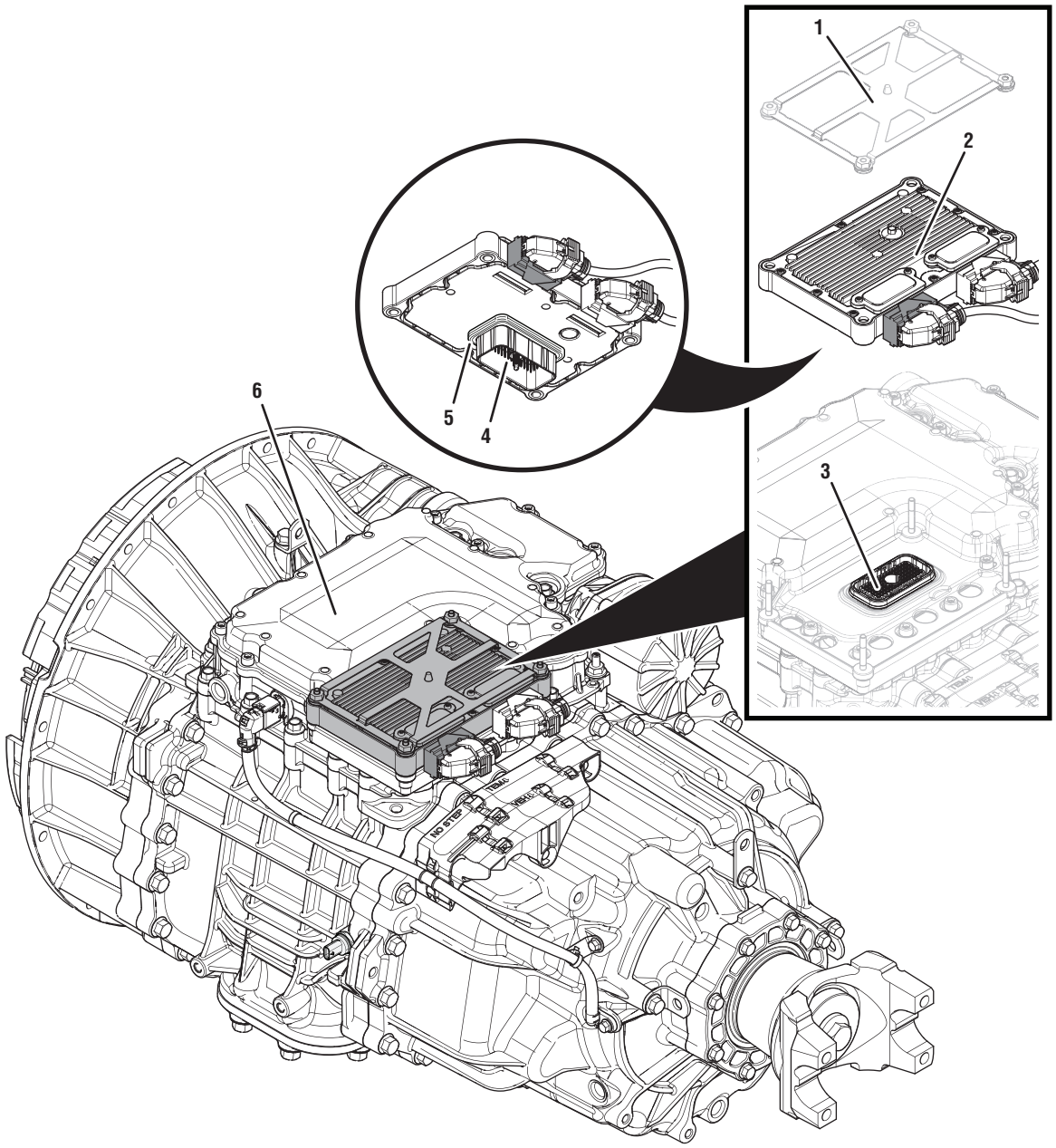
**FMI 31:**

- MTM - RCAS
- Partially stuck open

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

# Fault Code 617 Troubleshooting

## A

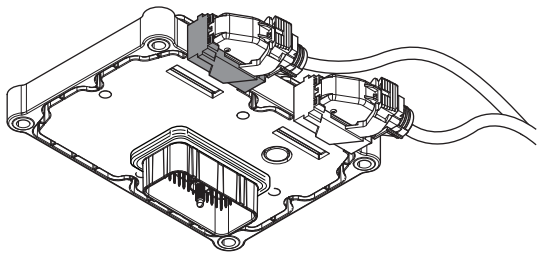
***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 617 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 617 FMI 12 is Active or Inactive, go to **Step G.**
   - If Fault Code 617 FMI 14, 15, 17 is Active or Inactive, go to **Step E.**

## B

***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

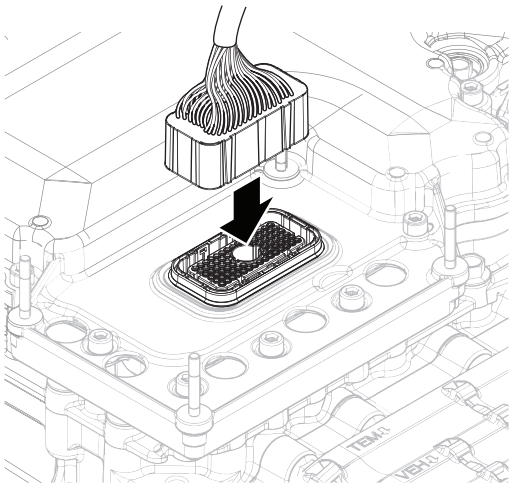


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

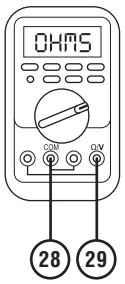
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail C Aft Solenoid resistance and not shorted to ground.*

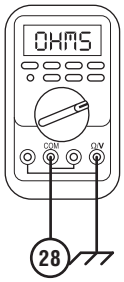
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 28 and Pin 29. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 28 and Ground (TCM mounting stud). Record reading in table.




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

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Pins | Range | Reading(s) |
|---|---|---|
| 28 to 29 | 3.6–4.4 Ohms | |
| 28 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 617 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 617 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace the MTM. Go to **Step V.**

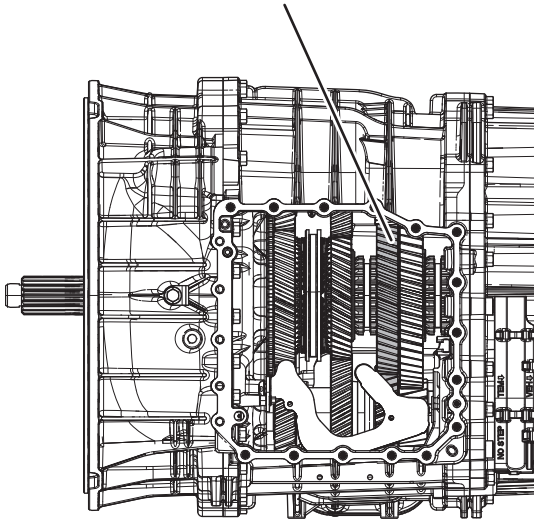
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify mechanical condition of the Secondary Driven Gear.*

1. Key off.
2. Remove MTM.

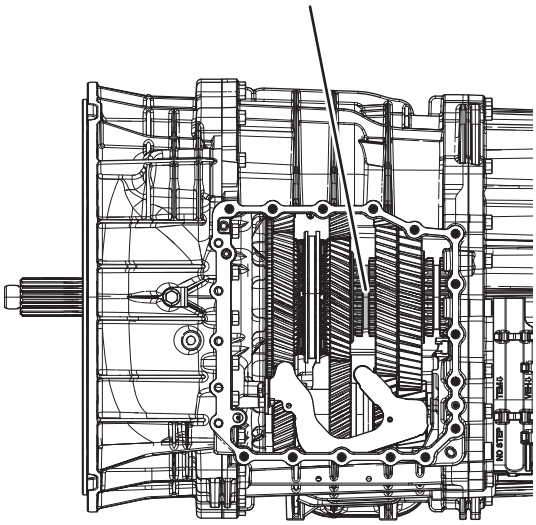
   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the Secondary Driven Gear for excessive fore and aft movement.



   - If excessive gear movement is evident, inspect the Main Shaft Assembly and Secondary Driven Gear and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

**F** ***Purpose:*** *Verify mechanical condition of the Rail C Sliding Clutch and clutching teeth.*

1. Inspect the Rail C Sliding Clutch yoke slot for wear.



2. Shift the Rail C Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail C Sliding Clutch into the Primary Drive Gear engagement position (fore).
4. Inspect the Rail C Sliding Clutch clutching teeth for wear.
5. Return the Rail C Sliding Clutch to neutral.
6. Shift the Rail C Sliding Clutch into the Secondary Driven Gear engagement position (aft).
7. Inspect the Rail C Sliding Clutch clutching teeth for wear.
8. Return the Rail C Sliding Clutch to neutral.
   - If the Rail C Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail C Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace the Rail C Sliding Clutch, Primary Drive Gear, Secondary Driven Gear and MTM. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 617 sets Active during operation, go to **Step A.**
   - If a fault code other than 617 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 636: Rail D Fore Solenoid (C2)

## J1939 SA 3 SPN 5903 FMI 0, 1, 3, 4, 5, 6, 8, 12, 14, 15, 16, 17, 18, 31

### Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow. The Rail D Fore Solenoid (RDFS) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure to actuate the Rail D Sliding Clutch in the fore or forward direction. The RDFS is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the RDFS. If a system failure is detected, the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** RDFS low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** RDFS low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** RDFS shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** RDFS shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** RDFS open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** RDFS commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** RDFS out of normal operating frequency.

**FMI 12 – Bad Intelligent Device:** RDFS commanded on beyond expected duty cycle.

**FMI 14 – Special Instructions:** Rail D Position Sensor reported uncommanded movement from Neutral toward the Primary Driven Gear immediately after a shift to Neutral for 2 seconds.

**FMI 15 – Data Valid but Above Normal (Least Severe):** Rail D Position Sensor reported uncommanded movement from Neutral toward the Primary Driven Gear for 2 seconds.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** RDFS commanded on for longer than expected increasing solenoid temperature.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail D Position Sensor reported uncommanded movement fore, out of the Reverse Gear, and speed sensors confirmed the loss of Reverse Gear engagement.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** RDFS commanded on below expected voltage.

**FMI 31 – Condition Exists:** During a Rail Calibration, Rail D Position Sensor reported uncommanded movement fore, out of neutral toward the Primary Driven Gear.

### Fallback

**FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- If vehicle is stationary and Rail D is not in Neutral
  - Rail D movement in the fore direction prohibited
- If vehicle is moving and Rail D is in Neutral
  - Rail D movement prohibited

**FMI 14, 15:**

- Amber warning lamp on
- Non neutral modes prohibited
- PTO mode prohibited
- If the vehicle is moving and the transmission is in gear
  - Red stop lamp on
  - Transmission shifts to neutral when vehicle comes to a stop

**FMI 17:**

- Amber warning lamp on
- Rail D engagement of the Reverse Gear prohibited

**FMI 31:**

- Amber warning lamp on
- Non Neutral Modes prohibited

### Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 8, 12, 14, 15, 16, 17, 18:** Key cycle

**FMI 3, 4, 5:** RDFS in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - RDFS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

**FMI 14, 15:**

- MTM - RDFS
  - Partially stuck open
- MTM - Rail D Position Sensor
  - Internal failure

**FMI 17:**

- MTM - RDFS
  - Partially stuck open
- Internal transmission
  - Reverse Gear
  - Rail D Sliding Clutch

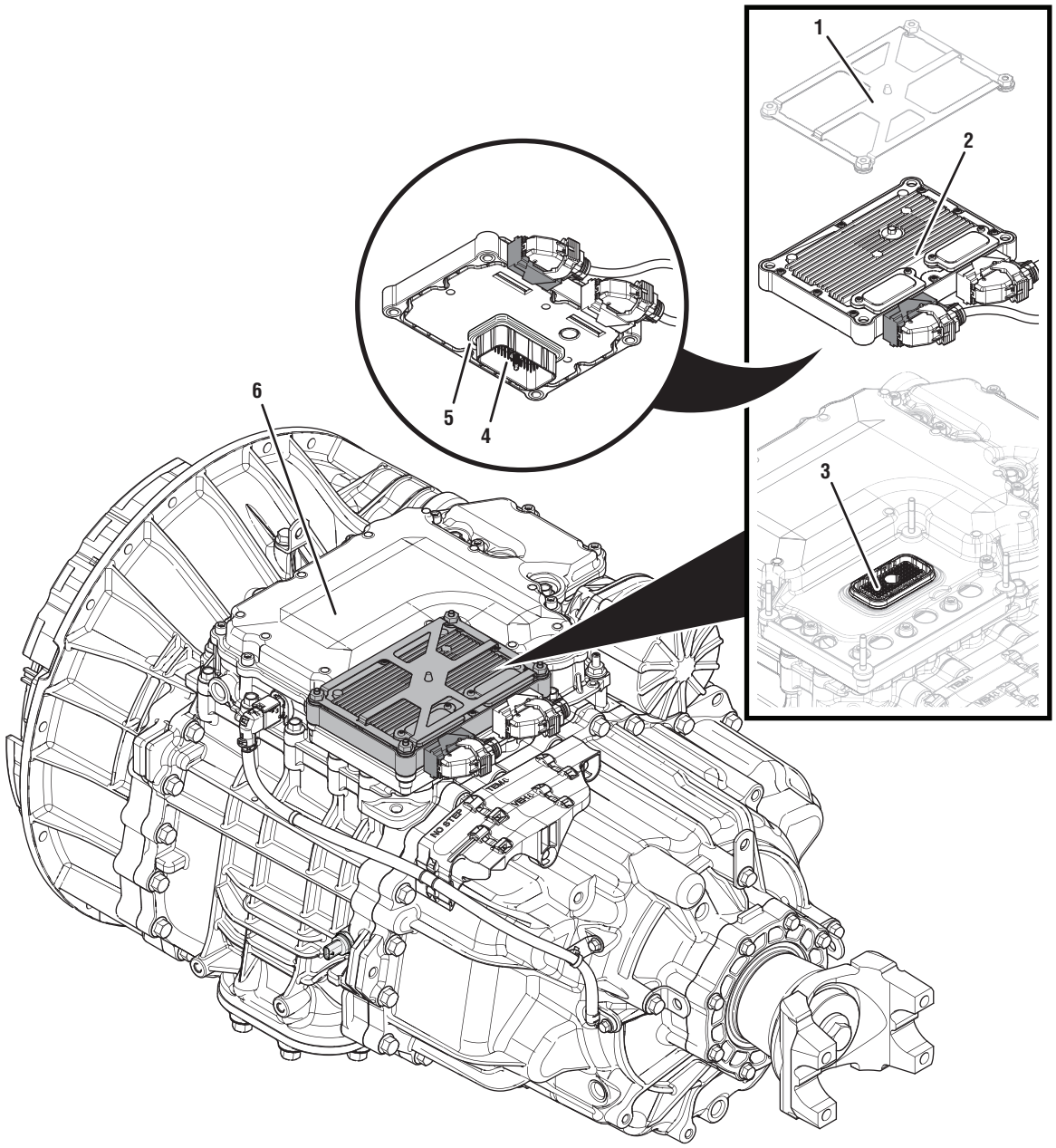
**FMI 31:**

- MTM - RDFS
- Partially stuck open

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

# Fault Code 636 Troubleshooting

## A

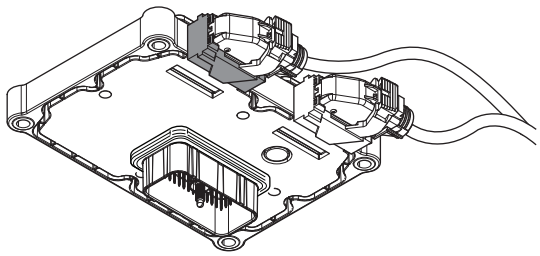
***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 636 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active or Inactive,go to **Step B.**
   - If Fault Code 636 FMI 12 is Active or Inactive, go to **Step G.**
   - If Fault Code 636 FMI 14, 15, 17 is Active or Inactive, go to **Step E.**

## B

***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

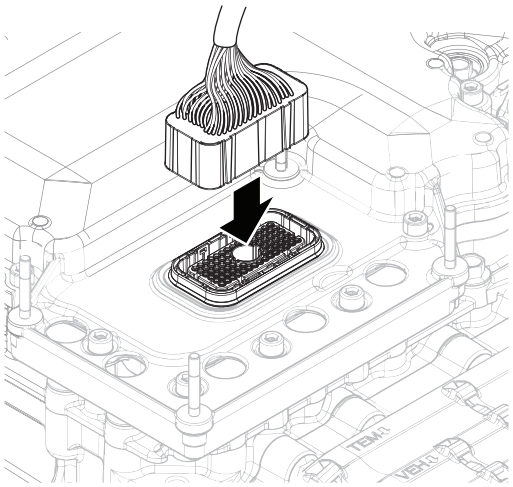


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

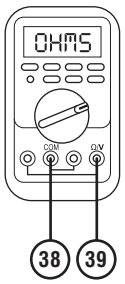
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail D Fore Solenoid resistance and not shorted to ground.*

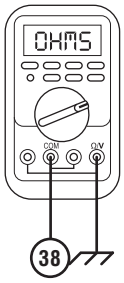
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 38 and Pin 39. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 38 and Ground (TCM mounting stud). Record reading in table.




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

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Pins | Range | Reading(s) |
|---|---|---|
| 38 to 39 | 3.6–4.4 Ohms | |
| 38 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 636 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 636 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace the MTM. Go to **Step V.**

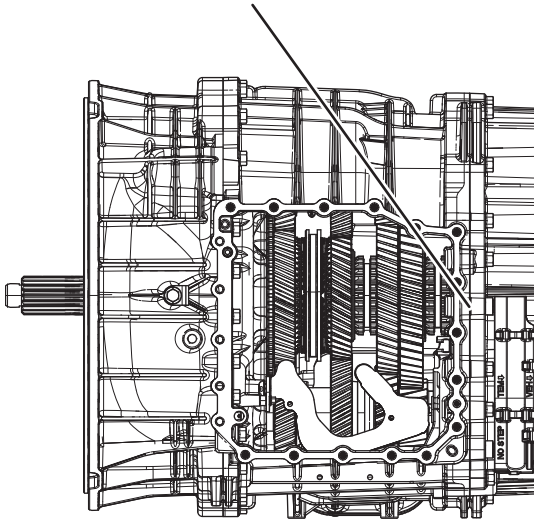
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify mechanical condition of the Reverse Gear.*

1. Key off.
2. Remove MTM.

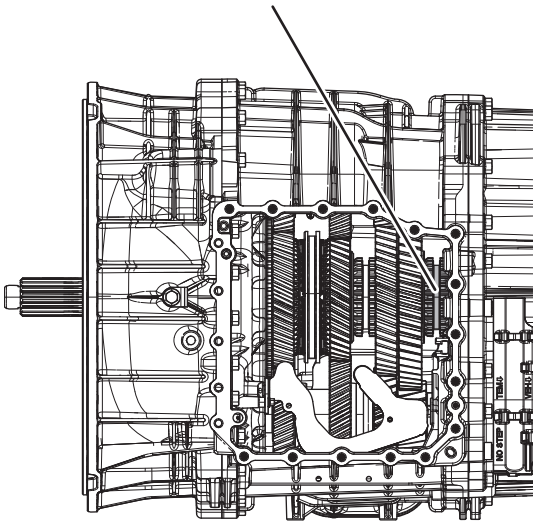
   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the Reverse Gear for excessive fore and aft movement.



   - If excessive gear movement is evident, inspect the Main Shaft Assembly and Reverse Gear and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

**F** ***Purpose:*** Verify mechanical condition of the Rail D Sliding Clutch and clutching teeth.

1. Inspect the Rail D Sliding Clutch yoke slot for wear.



2. Shift the Rail D Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail D Sliding Clutch into the Primary Driven Gear engagement position (fore).
4. Inspect the Rail D Sliding Clutch clutching teeth for wear.
5. Return the Rail D Sliding Clutch to neutral.
6. Shift the Rail D Sliding Clutch into the Reverse Gear engagement position (aft).
7. Inspect the Rail D Sliding Clutch clutching teeth for wear.
8. Return the Rail D Sliding Clutch to neutral.
   - If the Rail D Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail D Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace the Rail D Sliding Clutch, Primary Driven Gear, Reverse Gear and MTM. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 636 sets Active during operation, go to **Step A.**
   - If a fault code other than 636 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 637: Rail D Aft Solenoid (B3)

## J1939 SA 3 SPN 4216 FMI 0, 1, 3, 4, 5, 6, 8, 12, 14, 15, 16, 17, 18, 31

### Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow. The Rail D Aft Solenoid (RDAS) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure to actuate the Rail D Sliding Clutch in the aft or rearward direction. The RDAS is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the RDAS. If a system failure is detected, the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** RDAS low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** RDAS low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** RDAS shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** RDAS shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** RDAS open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** RDAS commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** RDAS out of normal operating frequency.

**FMI 12 – Bad Intelligent Device:** RDAS commanded on beyond expected duty cycle.

**FMI 14 – Special Instructions:** Rail D Position Sensor reported uncommanded movement from Neutral toward the Reverse Gear immediately after a shift to Neutral for 2 seconds.

**FMI 15 – Data Valid but Above Normal (Least Severe):** Rail D Position Sensor reported uncommanded movement from Neutral toward the Reverse Gear for 2 seconds.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** RDAS commanded on for longer than expected increasing solenoid temperature.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail D Position Sensor reported uncommanded movement aft, out of the Primary Driven Gear, and speed sensors confirmed the loss of Primary Driven Gear engagement.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** RDAS commanded on below expected voltage.

**FMI 31 – Condition Exists:** During a Rail Calibration, Rail D Position Sensor reported uncommanded movement aft, out of neutral toward the Reverse Gear.

### Fallback

**FMI 0, 1, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- If vehicle is stationary and Rail D is not engaged in the Secondary Driven Gear
  - Rail D movement in the aft direction prohibited
- If vehicle is moving and Rail D is engaged in the Secondary Driven Gear
  - Rail D movement prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

**FMI 3, 4:**

- Amber warning lamp on
- Rail D movement in the aft direction prohibited

**FMI 14, 15:**

- Amber warning lamp on
- Non neutral modes prohibited
- PTO mode prohibited
- If the vehicle is moving and the transmission is in gear
  - Red stop lamp on
  - Transmission shifts to neutral when vehicle comes to a stop

**FMI 17:**

- Amber warning lamp on
- Rail D engagement of the Primary Driven Gear prohibited

**FMI 31:**

- Amber warning lamp on
- Non neutral modes prohibited

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 8, 12, 14, 15, 16, 17, 18, 31:** Key cycle

**FMI 3, 4, 5:** RDAS in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - RDAS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

**FMI 14, 15:**

- MTM - RDAS
  - Partially stuck open
- MTM - Rail D Position Sensor
  - Internal failure

**FMI 17:**

- MTM - RDAS
  - Partially stuck open
- Internal transmission
  - Primary Driven Gear
  - Rail D Sliding Clutch

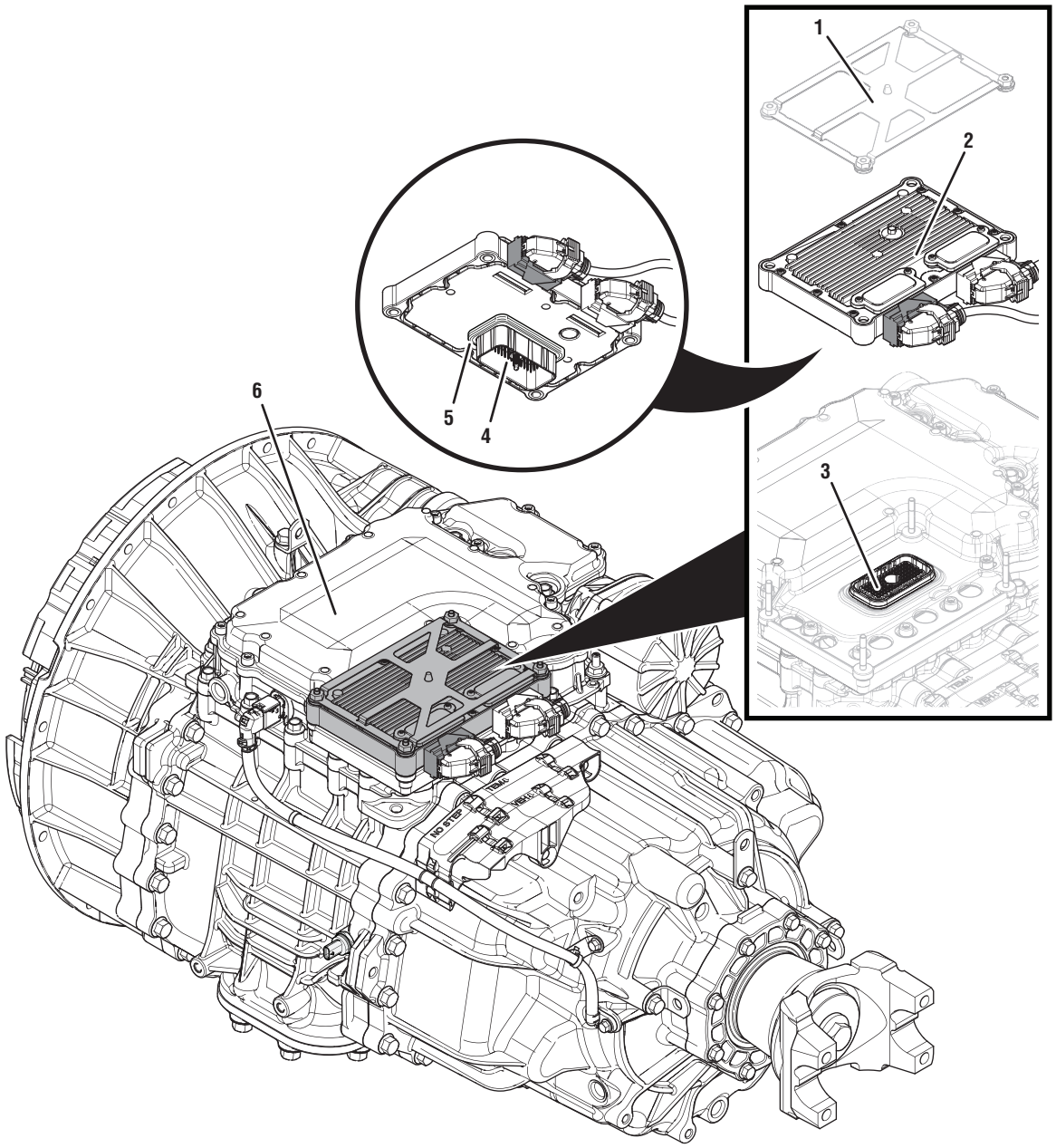
**FMI 31:**

- MTM - RDAS
- Partially stuck open

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

# Fault Code 637 Troubleshooting

**A**

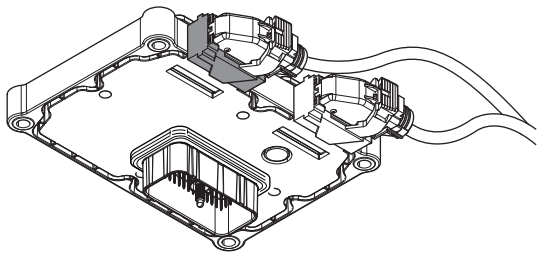
***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 637 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 637 FMI 12 is Active or Inactive, go to **Step G.**
   - If Fault Code 637 FMI 14, 15, 17 is Active or Inactive, go to **Step E.**

**B**

***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

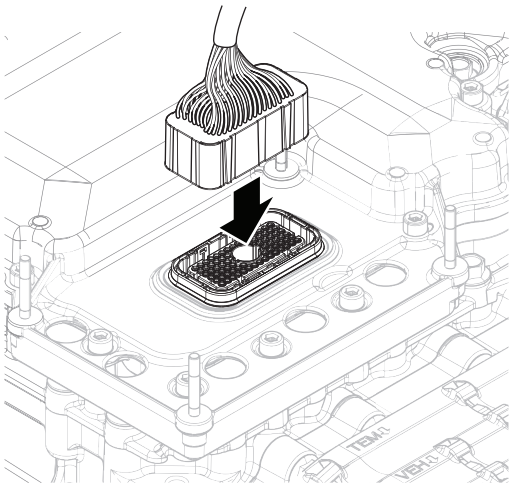


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

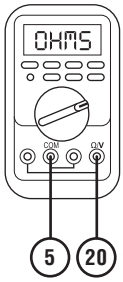
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail D Aft Solenoid resistance and not shorted to ground.*

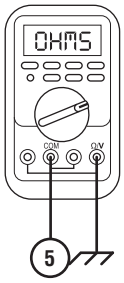
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 5 and Pin 20. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 5 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*

| Pins | Range | Reading(s) |
|---|---|---|
| 5 to 20 | 3.6–4.4 Ohms | |
| 5 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 637 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 637 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace the MTM. Go to **Step V.**

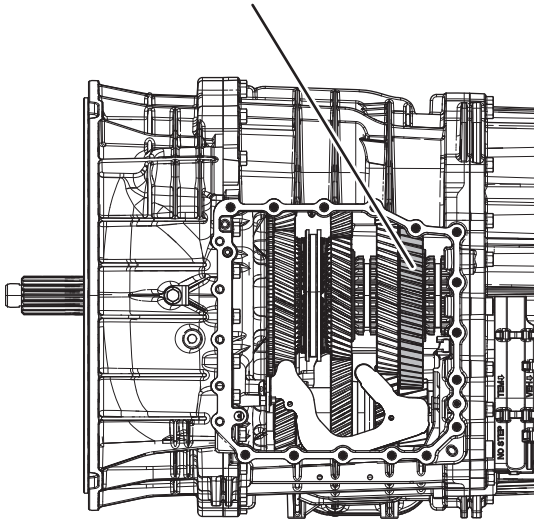
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify mechanical condition of the Primary Driven Gear.*

1. Key off.
2. Remove the MTM.

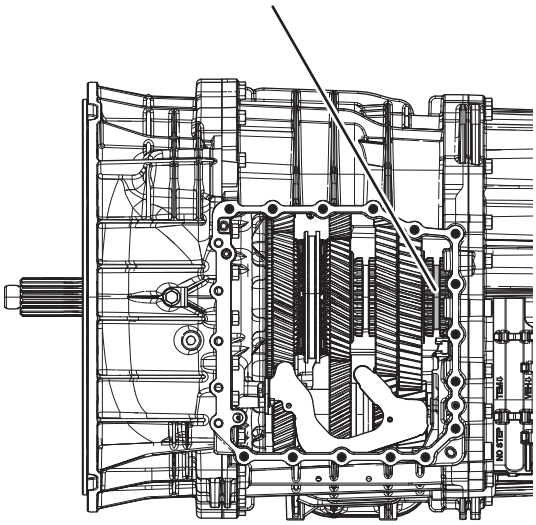
   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the Primary Driven Gear for excessive fore and aft movement.



   - If excessive gear movement is evident, inspect the Main Shaft Assembly and Primary Driven Gear and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

**F** ***Purpose:*** *Verify mechanical condition of the Rail D Sliding Clutch and clutching teeth.*

1. Inspect the Rail D Sliding Clutch yoke slot for wear.



2. Shift the Rail D Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail D Sliding Clutch into the Primary Driven Gear engagement position (fore).
4. Inspect the Rail D Sliding Clutch clutching teeth for wear.
5. Return the Rail D Sliding Clutch to neutral.
6. Shift the Rail D Sliding Clutch into the Reverse Gear engagement position (aft).
7. Inspect the Rail D Sliding Clutch clutching teeth for wear.
8. Return the Rail D Sliding Clutch to neutral.
   - If the Rail D Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail D Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace the Rail D Sliding Clutch, Primary Driven Gear, Reverse Gear and MTM. Go to **Step V.**

## G

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 637 sets Active during operation, go to **Step A.**
   - If a fault code other than 637 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 646: Rail E Fore Solenoid (A6)

## J1939 SA 3 SPN 768 FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 17, 18

### Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow. The Rail E Aft Solenoid (REFS) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure to actuate the Rail E Sliding Clutch in the aft or rearward direction. The REFS is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the REFS. If a system failure is detected, the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** REFS low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** REFS low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** REFS shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** REFS shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** REFS open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** REFS commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** REFS out of normal operating frequency.

**FMI 12 – Bad Intelligent Device:** REFS commanded on beyond expected duty cycle.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** REFS commanded on for longer than expected increasing solenoid temperature.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail E Position Sensor reported uncommanded movement fore, out of Low Range, and speed sensors confirmed the loss of Low Range engagement.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** REFS commanded on below expected voltage.

### Fallback

**FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18:**

- Amber warning lamp on
- If vehicle is stationary and Rail E is not engaged in High Range or Neutral
  - Rail E movement in the fore direction prohibited

**FMI 17:**

- Amber warning lamp on
- If vehicle is stationary in a non-neutral mode and engine is running
  - Rail E engagement of Low Range prohibited

### Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 8, 12, 16, 17, 18:** Key cycle

**FMI 3, 4, 5:** REFS in range for 10 seconds

## Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - REFS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

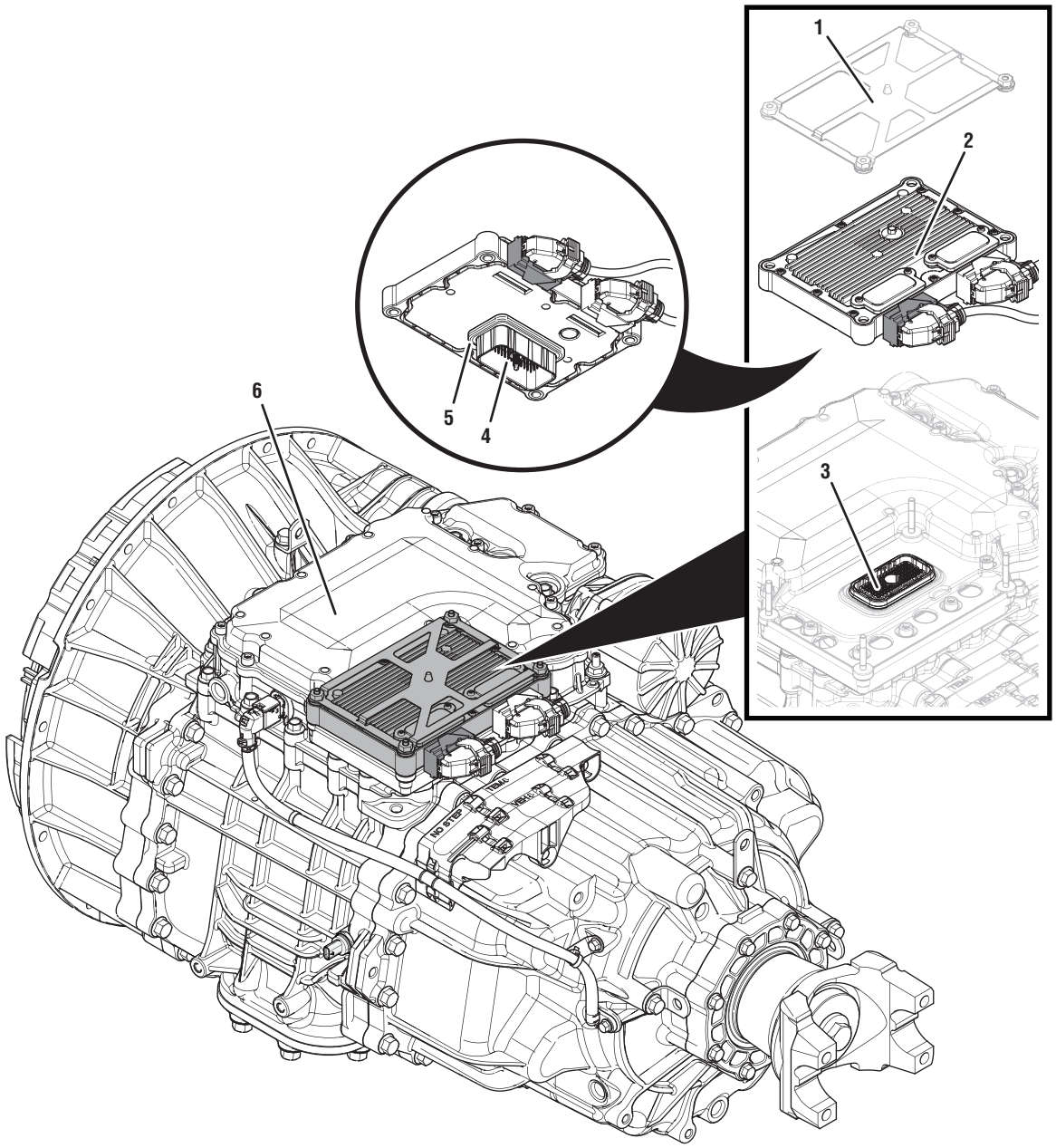
**FMI 17:**

- MTM - REFS
  - Partially stuck open
- Internal transmission
  - Rail E Detent
  - Rail E Synchronizer

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- MTM Alignment Tool (RR1086TR-1)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

# Fault Code 646 Troubleshooting

**A**

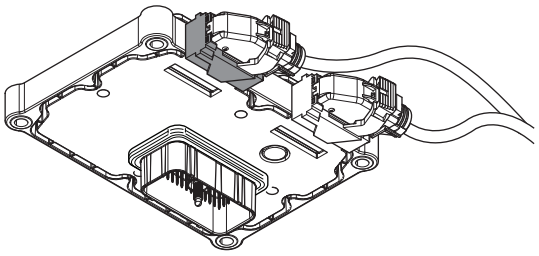
***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Key off.
3. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 646 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 646 FMI 12 is Active or Inactive, go to **Step F.**
   - If Fault Code 646 FMI 17 is Active or Inactive, go to **Step E.**

**B**

***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

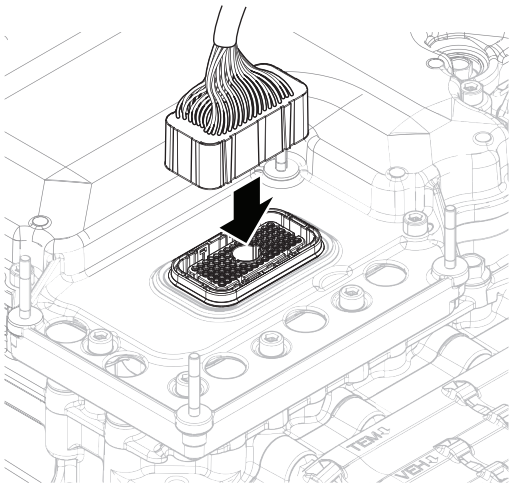


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

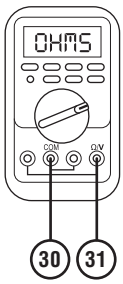
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail E Fore Solenoid resistance and not shorted to ground.*

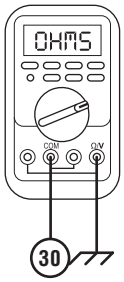
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 30 and Pin 31. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 31 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Pins | Range | Reading(s) |
|---|---|---|
| 30 to 31 | 3.6–4.4 Ohms | |
| 31 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 646 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 646 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. *Reference Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify mechanical movement of the Rail E Range Synchronizer*

1. Key off.
2. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Install the MTM Alignment Tool (RR1086TR-1) onto the main housing.

   **Note:** Reference *Appendix/Manually Actuate Rail E Procedure*.
4. Using the Rail E Lever, move Rail E to neutral (if necessary).
5. Shift Rail E into the High Range (fore) engagement position and return to neutral.
6. Shift Rail E into the Low Range (aft) engagement position and return to neutral.
   - Contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

## F

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 646 sets Active during operation, go to **Step A.**
   - If a fault code other than 646 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 647: Rail E Aft Solenoid (A4)

## J1939 SA 3 SPN 769 FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 17, 18

### Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow. The Rail E Aft Solenoid (REAS) is energized by the Transmission Control Module (TCM) to direct vehicle supplied air pressure to actuate the Rail E Sliding Clutch in the aft or rearward direction. The REAS is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the REAS. If a system failure is detected, the fault is set Active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** REAS low side current is greater than commanded current.

**FMI 1 – Data Valid But Below Normal (Most Severe):** REAS low side current is less than commanded current.

**FMI 3 – Voltage Above Normal or Shorted High:** REAS shorted to power for 2 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** REAS shorted to ground for 2 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** REAS open circuit for 2 seconds.

**FMI 6 – Current Above Normal or Shorted Circuit:** REAS commanded on and shorted to ground.

**FMI 8 – Abnormal Frequency:** REAS out of normal operating frequency.

**FMI 12 – Bad Intelligent Device:** REAS commanded on beyond expected duty cycle.

**FMI 16 – Data Valid but Above Normal (Moderately Severe):** REAS commanded on for longer than expected increasing solenoid temperature.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail E Position Sensor reported uncommanded movement aft, out of High Range, and speed sensors confirmed the loss of High Range engagement.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** REAS commanded on below expected voltage.

### Fallback

**FMI 0, 1, 3, 4, 5, 6, 8, 12, 18:**

- Amber warning lamp on
- If Rail E is engaged
  - Rail E movement toward Low Range prohibited
  - Rail E engagement of High Range prohibited
- If Rail E is not engaged
  - Rail E movement toward Low Range prohibited
  - Urge to move prohibited
  - Non neutral modes prohibited
  - PTO Mode Prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

**FMI 16:**

- Amber warning lamp on
  - Red stop lamp on

**FMI 17:**

- Amber warning lamp on
  - Rail E movement toward Low Range prohibited

### Conditions to Set Fault Code Inactive

**FMI 0, 1, 6, 8, 12, 16, 17, 18:** Key cycle

**FMI 3, 4, 5:** REAS in range for 10 seconds

### Possible Causes

**FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:**

- MTM - REAS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

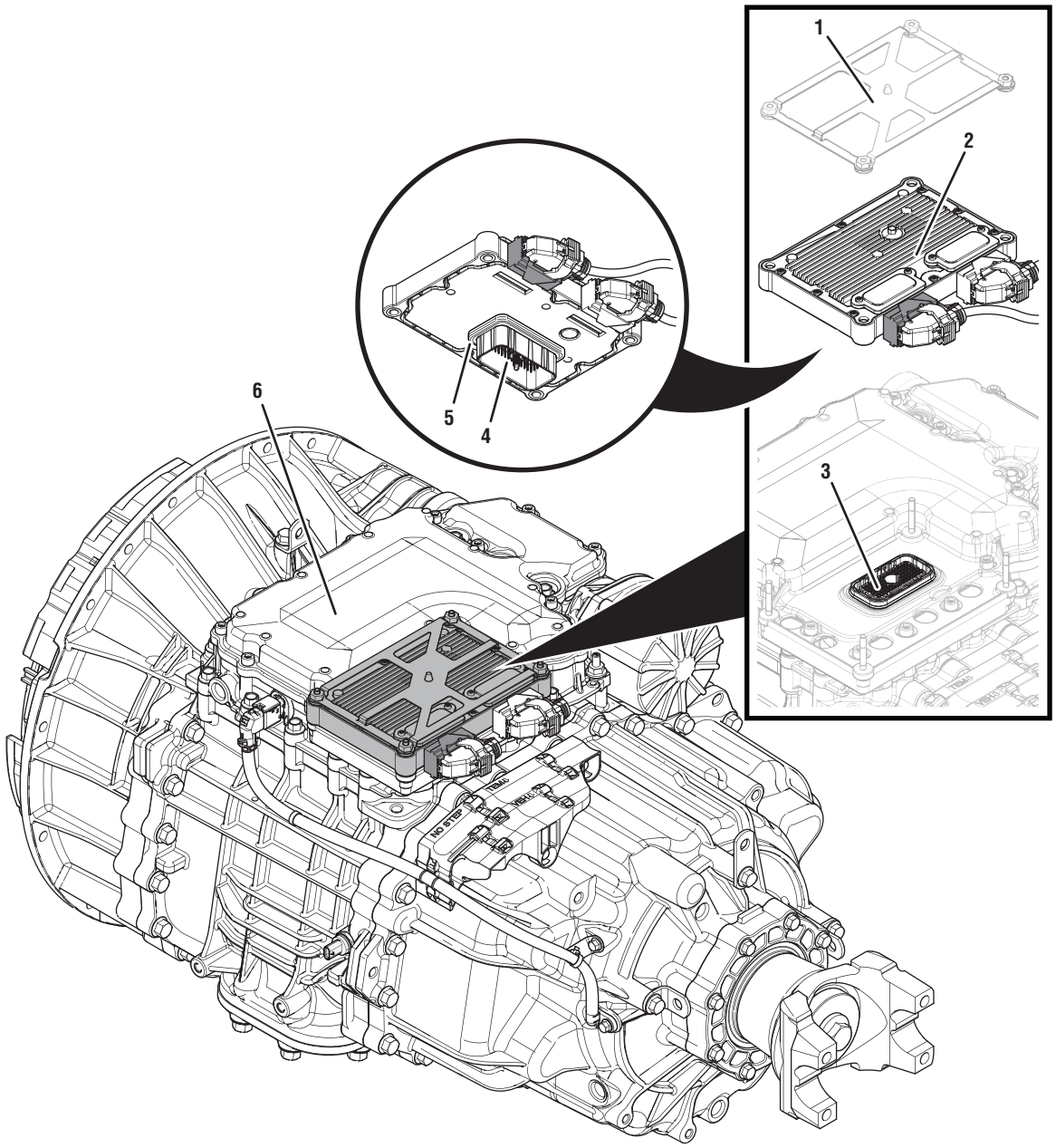
**FMI 17:**

- MTM - REAS
  - Partially stuck open
- Internal transmission
  - Rail E Detent
  - Rail E Synchronizer

## Additional Tools

- Endurant Service Manual TRSM0950
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- MTM Alignment Tool (RR1086TR-1)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. Mechatronic Transmission Module (MTM)*

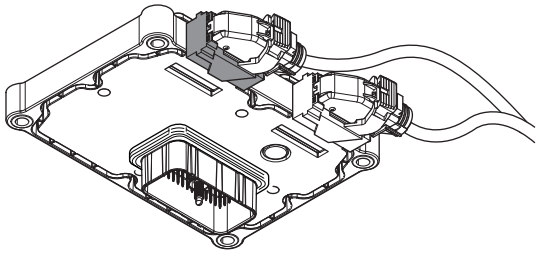
# Fault Code 647 Troubleshooting

**A** ***Purpose:*** *Vent LCA and Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 647 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 647 FMI 12 is Active or Inactive, go to **Step H.**
   - If Fault Code 647 FMI 17 is Active or Inactive, go to **Step E.**

**B** ***Purpose:*** *Verify condition of 74-Way Transmission Harness Connector.*

1. Key off.
2. Remove the TCM from the MTM with the 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.

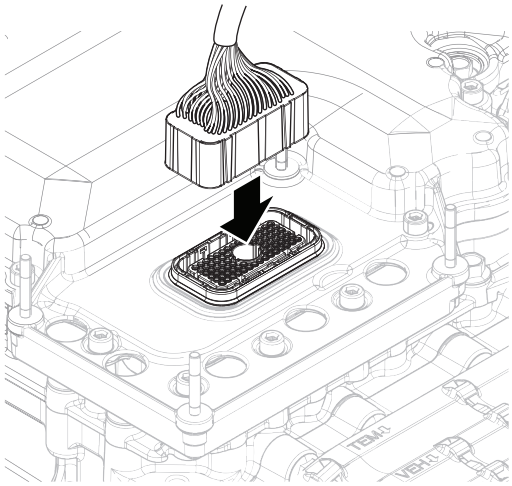


3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM Seal, verify the seal is properly installed and not damaged.
   - If contamination or damage is found to the TCM side of the 74-Way Transmission Harness Connector, replace the TCM and MTM. Go to **Step V.**

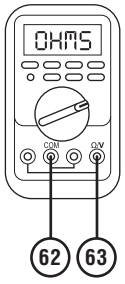
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. *Reference Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
   - If no contamination or damage is found, go to **Step C.**

**C** ***Purpose:*** *Verify Rail E Aft Solenoid resistance and not shorted to ground.*

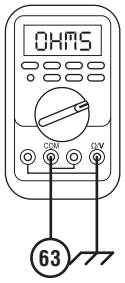
1. Key off.
2. Connect the Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to the MTM side of the 74-Way Transmission Harness Connector.



3. Measure resistance at the Eaton Breakout Box between Pin 62 and Pin 63. Record reading in table.




4. Measure resistance at the Eaton Breakout Box between Pin 63 and Ground (TCM mounting stud). Record reading in table.




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

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

| Pins | Range | Reading(s) |
|---|---|---|
| 62 to 63 | 3.6–4.4 Ohms | |
| 63 to ground (TCM mounting stud) | Open Circuit (OL) | |

## D

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

1. Key off.
2. Remove the 74-Way Eaton Diagnostic Adapter.
3. Reinstall the TCM to the MTM.
4. Reconnect all connectors and verify that all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 647 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace the TCM. Go to **Step V.**
   - If Fault Code 647 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace the MTM. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

## E

***Purpose:*** *Verify mechanical movement of the Rail E Synchronizer.*

1. Key off.
2. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal and MTM Removal Service Procedures*.
3. Install the MTM Alignment Tool (RR1086TR-1) onto the main housing.

   **Note:** Reference *Appendix/Manually Actuate Rail E Procedure.*
4. Using the Rail E Lever, move Rail E to neutral (if necessary).
5. Shift Rail E into the High Range (fore) engagement position and return to neutral.
6. Shift Rail E into the Low Range (aft) engagement position and return to neutral.
   - If Rail E shifts between neutral, High and Low Range, replace the MTM. Go to **Step V.**
   - If Rail E does not shift between neutral, High or Low Range, go to **Step F.**

## F

***Purpose:*** *Verify mechanical movement of the Rail E Range Synchronizer without detent.*

1. Remove the Rail E Detent Plug, Spring and Detent.
2. Install the MTM Alignment Tool (RR1086TR-1) onto the main housing.
3. Using the Rail E Lever, move Rail E to neutral (if necessary).
4. Shift Rail E into the High Range (fore) engagement position and return to neutral.
5. Shift Rail E into the Low Range (aft) engagement position and return to neutral.
   - If the Rail E Detent could not be removed, go to **Step G.**
   - If Rail E shifts between neutral, High and Low Range, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Rail E does not shift between neutral, High and Low Range, go to **Step G.**

## G

***Purpose:*** *Verify mechanical condition of the Rail E Synchronizer and Shift Rail.*

1. Remove the Rear Housing.
2. Inspect the Rail E Synchronizer, Shift Rail, Detent and Rear Housing Detent bore.
   - Contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

## H

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 647 sets Active during operation, go to **Step A.**
   - If a fault code other than 647 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 700: Clutch Operation

## J1939 SA 3 SPN 6150 FMI 0, 1, 12, 14, 17, 18

### Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow to actuate the clutch and a sensor to monitor clutch position. The Transmission Control Module (TCM) compares the clutch command, clutch position and input shaft speed to ensure proper clutch operation. The Linear Clutch Actuator (LCA) is mounted to the Mechatronic Transmission Module (MTM). The solenoids and sensors are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the Clutch Operation. If a system failure is detected, the fault is set active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** Clutch Assembly over speed exceeding positive 3,000 RPM.

**FMI 1 – Data Valid But Below Normal (Most Severe):** Severe clutch slip while clutch is fully closed/engaged – engine speed 80 RPM or greater than input shaft speed.

**FMI 12 – Bad Intelligent Device:** Clutch Pressure Touch Point (PTP) is out of range.

**FMI 14 – Special Instructions:** Inappropriate clutch close/engage command based on operating conditions.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Clutch over speed exceeding negative 1,300 RPM when attempting to close/engage clutch.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** Clutch over speed exceeding negative 1,300 RPM.

### Fallback

**FMI 0, 17, 18:**

- Amber warning lamp on
- Non neutral modes prohibited
- Clutch Engagements prohibited
- PTO Mode prohibited
- Urge to Move and Creep Mode prohibited
- Red stop lamp on

**FMI 1:**

- Amber warning lamp on
- High start gears prohibited

**FMI 12:**

- Amber warning lamp on
- Clutch engagement prohibited
- PTO Mode prohibited
- Red stop lamp on

**FMI 14:**

- Amber warning lamp on
- Non neutral modes prohibited
- Clutch engagement prohibited
- PTO Mode prohibited
- Urge to Move and Creep Mode prohibited
- Red stop lamp on

### Conditions to Set Fault Code Inactive

**FMI 0, 17, 18:** Condition no longer exists

**FMI 1, 12, 14:** Key cycle

## Possible Causes

**FMI 0, 17, 18:**

- Vehicle Air System
  - Contamination
- Clutch Housing
  - Clutch Assembly
  - Release Bearing
  - Release Yoke
  - Input Shaft Cover
- MTM
  - LCA
  - Clutch Control Solenoids
- TCM
  - Software issue
  - Internal failure

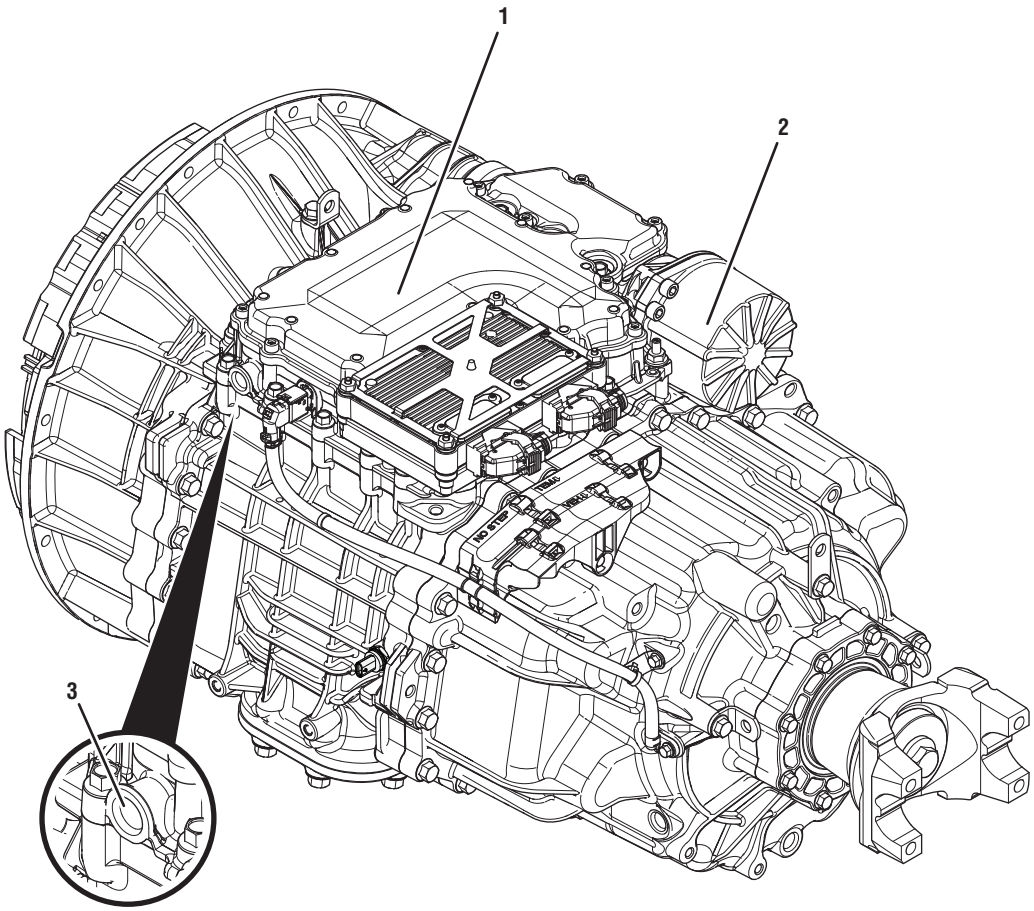
**FMI 1, 12, 14:**

- Vehicle Air System
  - Contamination
- Clutch Housing
  - Clutch Assembly
  - Release Bearing
  - Release Yoke
  - Input Shaft Cover
- MTM
  - LCA
  - LCA Position Sensor
  - Clutch Control Solenoids

## Additional Tools

- Endurant Service Manual TRSM0950

## Component Identification




*1. Mechatronic Transmission Module (MTM)*
*2. Linear Clutch Actuator (LCA)*
*3. MTM Air Inlet Port*

# Fault Code 700 Troubleshooting

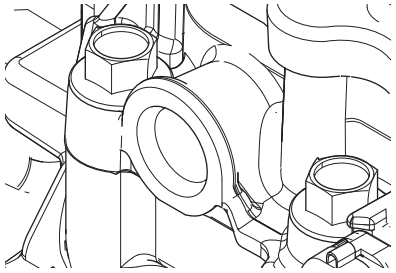
**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set the vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 700 FMI 1 is Active or Inactive, go to **Step B.**
   - If Fault Code 700 FMI 0, 12, 14, 17, 18 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

**B** ***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step C.**

## C

***Purpose:*** *Inspect Clutch, Release Bearing, Release Yoke and Input Shaft Cover.*

1. Key off.
2. Remove the transmission.

   **Note:** Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
3. Inspect the Clutch Assembly, Release Bearing, Release Yoke and Input Shaft Cover.
   - Contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 700 sets Active during operation, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 700 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 13

# Fault Code 701: Clutch Engagement Status

## J1939 SA 3 SPN 7847 FMI 14, 31

### Overview
The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow to actuate the clutch and a sensor to monitor clutch position. The Transmission Control Module (TCM) compares the clutch command, clutch position and input shaft speed to ensure proper clutch operation. The Linear Clutch Actuator (LCA) is mounted to the MTM. The solenoids and sensors are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection
The TCM monitors the Clutch Engagement Status. If a system failure is detected, the fault is set active.

### Conditions to Set Fault Code Active
**FMI 14 – Special Instructions:** Clutch commanded to close/engage in a gear which is in the opposite direction of the selected mode.

**FMI 31 – Condition Exists:** Clutch commanded to close/engage and launch vehicle without driver input or request.

### Fallback
**FMI 14, 31:**

- Amber warning lamp on
- Non neutral modes prohibited
- Clutch engagement prohibited
- PTO Mode prohibited
- Urge to Move and Creep Mode prohibited
- If vehicle is moving
  - Red stop lamp on

### Conditions to Set Fault Code Inactive
**FMI 14, 31:** Key cycle

### Possible Causes
**FMI 14, 31:**

- TCM
  - Software issue
  - Internal failure

### Additional Tools
- Endurant Service Manual TRSM0950

# Fault Code 701 Troubleshooting

**A**

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 701 FMI 14 is Active or Inactive, go to **Step B.**
   - If Fault Code 701 FMI 31 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

**B**

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 701 sets Active during operation, go to **Step A.**
   - If a fault code other than 701 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 702: Driveline Engagement

**J1939: SA 3 SPN 560 FMI 2, 12, 14, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow to actuate the clutch and shift rails and sensors to monitor the clutch and shift rail positions. The Transmission Control Module (TCM) compares the clutch and shift rail commands with the clutch and shift rail positions including speed sensors (ratio calculation) to ensure proper operation. The solenoids, sensors, Linear Clutch Actuator (LCA) and shift rails are located in the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

The TCM monitors the clutch and shift rail operation. If a system failure is detected, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 2 – Data Erratic, Intermittent Or Incorrect:** During a Clutch Calibration, the speed sensors could not confirm the main shaft was neutralized while Rail C or D Position Sensor reported neutral.

**FMI 12 – Bad Intelligent Device or Component:** Speed sensors did not confirm the main shaft was neutralized during clutch engagement.

**FMI 14 – Special Instructions:** Shift rail engagement was commanded that would result in a drive line engagement with the vehicle stationary.

**FMI 20 – Data Drifted High:** Rail C or E Position Sensors indicated gear engagement when not expected for 2 seconds.

**FMI 21 – Data Drifted Low:** Rail D or E Position Sensors indicated gear engagement when not expected for 2 seconds.

**FMI 31 – Condition Exists:** Urge to Move and Creep Mode were not commanded when expected.

## Fallback

**FMI 2:**

- Amber warning lamp on
- Non neutral modes prohibited
- Clutch engagement prohibited
- PTO Mode prohibited
- Urge to Move and Creep Mode prohibited
- If vehicle is moving
  - Red stop lamp on

**FMI 12, 31:**

- Amber warning lamp on
- Clutch engagement prohibited
- Rail B, C and D shift to neutral
- PTO Mode prohibited
- Urge to Move and Creep Mode prohibited
- If vehicle is moving
  - Red stop lamp on

**FMI 20, 21:**

- Amber warning lamp on
- Clutch engagement prohibited
- Rail B shifts to neutral
- PTO Mode prohibited
- Urge to Move and Creep Mode prohibited
- If vehicle is moving
  - Red stop lamp on

**FMI 14:**

- Amber warning lamp on
- Red stop lamp on
- Rail C and D shift to neutral

## Conditions to Set Fault Code Inactive

**FMI 2, 12, 14, 31:** Power down (key cycle)

## Possible Causes

**FMI 2:**

- Rail C or D Position Sensors

**FMI 12, 14:**

- TCM
  - Internal failure
  - Software issue

**FMI 20, 21:**

- Rail C, D or E Position Sensors

**FMI 31:**

- Parking Brake Switch/signal
  - Vehicle Parking Brake Set and the driver selected a Reverse or Drive Mode
  - Internal failure
- TCM
  - Internal failure
  - Software issue

## Additional Tools

- None

# Fault Code 702 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 702 FMI 2, 20, 21 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 702 FMI 12, 14 is Active or Inactive, go to **Step B.**
   - If Fault Code 702 FMI 31 is Active or Inactive, go to **Step C.**

**B** ***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under “Software Information” record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

**C** ***Purpose:*** *Verify Vehicle Parking Brake Switch signal with ServiceRanger.*

1. Key on with engine running.
2. Allow air pressure to build to governor cut off.
3. Key off.
4. Key on with engine off.
5. Connect ServiceRanger.
6. Go To “Data Monitor”.
7. From the “Default Parameter Files” tab, select “Vehicle Brake Messages”.
8. Monitor 70 - Parking brake switch status. Record reading in table.
9. Depress and hold service brake.
10. Release vehicle parking brake.
11. Monitor 70 - Parking brake switch status value. Record reading in table.
12. Set vehicle parking brake.
13. Monitor 70 - Parking brake switch status. Record reading in table.
14. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the Parking Brake Switch/signal.
    - f readings are in range, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

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

**V**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 702 sets Active during operation, go to **Step A.**
   - If a fault code other than 702 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 705: Transmission Clutch Actuator

## J1939 SA 3 SPN 788 FMI 12, 14

### Overview
The Endurant Transmission is equipped with solenoids to direct pneumatic flow to actuate the clutch and a sensor to monitor clutch position. The Transmission Control Module (TCM) compares vehicle inputs, clutch command, clutch position and input shaft speed to ensure proper clutch operation. The Linear Clutch Actuator (LCA) is mounted to the Mechatronic Transmission Module (MTM). The solenoids and sensors are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection
The TCM monitors the Transmission Clutch Actuator. If a system failure is detected, the fault is set active.

### Conditions to Set Fault Code Active
**FMI 12 – Bad Intelligent Device:** TCM did not prohibit Creep Mode when expected based on the operating conditions.

**FMI 14 – Special Instructions:** TCM did not release/open the clutch when expected based on the operating conditions.

### Fallback
**FMI 12, 14:**

- Amber warning lamp on
- Non neutral modes prohibited
- Clutch engagement prohibited
- PTO Mode prohibited
- Urge to Move and Creep Mode prohibited
- If vehicle is moving
  - Red stop lamp on
  - Transmission shifts to neutral, vehicle may coast to a stop

### Conditions to Set Fault Code Inactive
**FMI 12, 14:** Key cycle

### Possible Causes
**FMI 12, 14:**

- TCM
  - Software issue
  - Internal failure

### Additional Tools
- Endurant Service Manual TRSM0950

# Fault Code 705 Troubleshooting

**A**

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 705 FMI 12, 14 is Active or Inactive, go to **Step B.**

**B**

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 705 sets Active during operation, go to **Step A.**
   - If a fault code other than 705 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13

# Fault Code 715: Transmission Current Gear

## J1939 SA 3 SPN 523 FMI 9

### Overview
The Transmission Control Module (TCM) communicates with other vehicle Electronic Control Units (ECUs) over the vehicle Primary Data Link. The TCM sends the Transmission Current Gear and monitors the message to confirm the correct message is being sent.

### Detection
The TCM monitors the Transmission Current Gear message. If the message is invalid, the TCM sets the fault code Active.

### Conditions to Set Fault Code Active
**FMI 9 – Abnormal Update Rate:** The Transmission Current Gear message monitor reported the message failed to update.

### Fallback
**FMI 9:**

- Amber warning lamp on
- No degraded mode

### Conditions to Set Fault Code Inactive
**FMI 9:** Key cycle

### Possible Causes
**FMI 9:**

- TCM
  - Software issue
  - Internal failure

### Additional Tools
- None

# Fault Code 715 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 715 FMI 9 is Inactive or Active, contact Eaton Cummins Automated Transmission Technologies at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 715 sets Active during operation, go to **Step A.**
   - If a fault code other than 715 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 716: Transmission Selected Gear

## J1939 SA 3 SPN 524 FMI 12

### Overview
The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow to actuate the clutch and shift rails and sensors to monitor the clutch and shift rail positions. The Transmission Control Module (TCM) compares the clutch and shift rail commands with the clutch and shift rail positions including speed sensors (ratio calculation) to ensure proper operation.

### Detection
The TCM monitors the Transmission Select Gear command, if the command is invalid, the TCM sets the fault code Active.

### Conditions to Set Fault Code Active
**FMI 12 – Bad Intelligent Device or Component:** Inappropriate selected gear relative to output shaft speed.

### Fallback
**FMI 12:**

- Transmission shifts to Neutral
- PTO Mode prohibited

### Conditions to Set Fault Code Inactive
**FMI 12:** Condition no longer exists

### Possible Causes
**FMI 12:**

- TCM
  - Software issue
  - Internal failure

### Additional Tools
- None

# Fault Code 716 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 716 FMI 12 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 716 sets Active during operation, go to **Step A.**
   - If a fault code other than 716 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 717: Transmission Requested Gear

## J1939: SA 3 SPN 525 FMI 12

### Overview
The Transmission Control Module (TCM) monitors the vehicle and transmission operating conditions to ensure the requested gear is appropriate for the conditions.

### Detection
The TCM monitors the Transmission Requested Gear. If the requested gear is invalid, the fault is set Active.

### Conditions to Set Fault Code Active
**FMI 12 – Bad Intelligent Device:** The Transmission Requested Gear is invalid for the current operating conditions.

### Fallback
**FMI 12:**

- Amber warning lamp on
- Transmission main box shifts to neutral
- If vehicle is moving
  - Red stop lamp on

### Conditions to Set Fault Code Inactive
**FMI 12:** Key cycle

### Possible Causes
**FMI 12:**

- TCM
  - Software issue
  - Internal failure

### Additional Tools
- None

# Fault Code 717 Troubleshooting

**A**

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 717 FMI 12 is Active or Inactive, go to **Step B.**

**B**

***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 717 sets Active during operation, go to **Step A.**
   - If a fault code other than 717 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 740: Rail B Operation

## J1939 SA 3 SPN 6145 FMI 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21

### Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow to actuate shift rails and sensors to monitor rail positions. The Transmission Control Module (TCM) compares the rail command and position to ensure proper rail operation. The solenoids, positions sensors and shift rails are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the Rail B Operation. If a system failure is detected, the fault is set active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** Rail B is unable to disengage the Secondary Drive Gear, move aft, for 2 seconds.

**FMI 1 – Data Valid But Below Normal (Most Severe):** Rail B is unable to disengage the Primary Drive Gear, move fore, for 2 seconds.

**FMI 2 – Data Erratic:** Rail B is unable to move the synchronizer to neutral during a rail calibration.

**FMI 7 – Mechanical System Not Responding:** Rail B is unable move from neutral toward the Secondary Drive Gear for 2 seconds.

**FMI 10 – Abnormal Rate of Change:** Rail B is unable to confirm low rail speed velocity during a rail calibration.

**FMI 14 – Special Instructions:** Rail B is unable to move from neutral toward the Primary Drive Gear for 2 seconds.

**FMI 15 – Data Valid but Above Normal (Least Severe):** Rail B is unable to fully engage the Secondary Drive Gear for 2 seconds.

**FMI 16 - Data Valid but Above Normal (Moderately Severe):** Rail B is unable to achieve neutral from the Secondary Drive Gear for 2 seconds.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail B is unable to fully engage the Primary Drive Gear for 2 seconds.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** Rail B is unable to achieve neutral from the Primary Drive Gear for 2 seconds.

**FMI 20 – Data Drifted High:** Rail B travel was greater than expected during a rail calibration.

**FMI 21 – Data Drifted Low:** Rail B travel was less than expected during a rail calibration.

### Fallback

**FMI 0:**

- Amber warning lamp on
- Rail B engagement of the synchronizer into neutral prohibited
- Rail B engagement of the Primary Drive Gear prohibited

**FMI 1:**

- Amber warning lamp on
- Rail B engagement of the synchronizer into neutral prohibited
- Rail B engagement of the Secondary Drive Gear prohibited
- PTO Mode prohibited

**FMI 2, 10, 20, 21:**

- Amber warning lamp on
- Non neutral modes prohibited
- PTO Mode prohibited
- If the vehicle is moving
  - Red stop lamp on

**FMI 7, 15:**

- Amber warning lamp on
- Rail B engagement of the Secondary Drive Gear prohibited
- PTO Mode prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

**FMI 14, 17:**

- Amber warning lamp on
- Rail B engagement of the Primary Drive Gear prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

**FMI 16, 18:**

- Amber warning lamp on
- Rail B engagement of the synchronizer into neutral prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 7, 14, 16, 18:** Condition no longer exists

**FMI 2, 10, 20, 21:** Successful rail calibration

**FMI 15, 17:** Key cycle

## Possible Causes

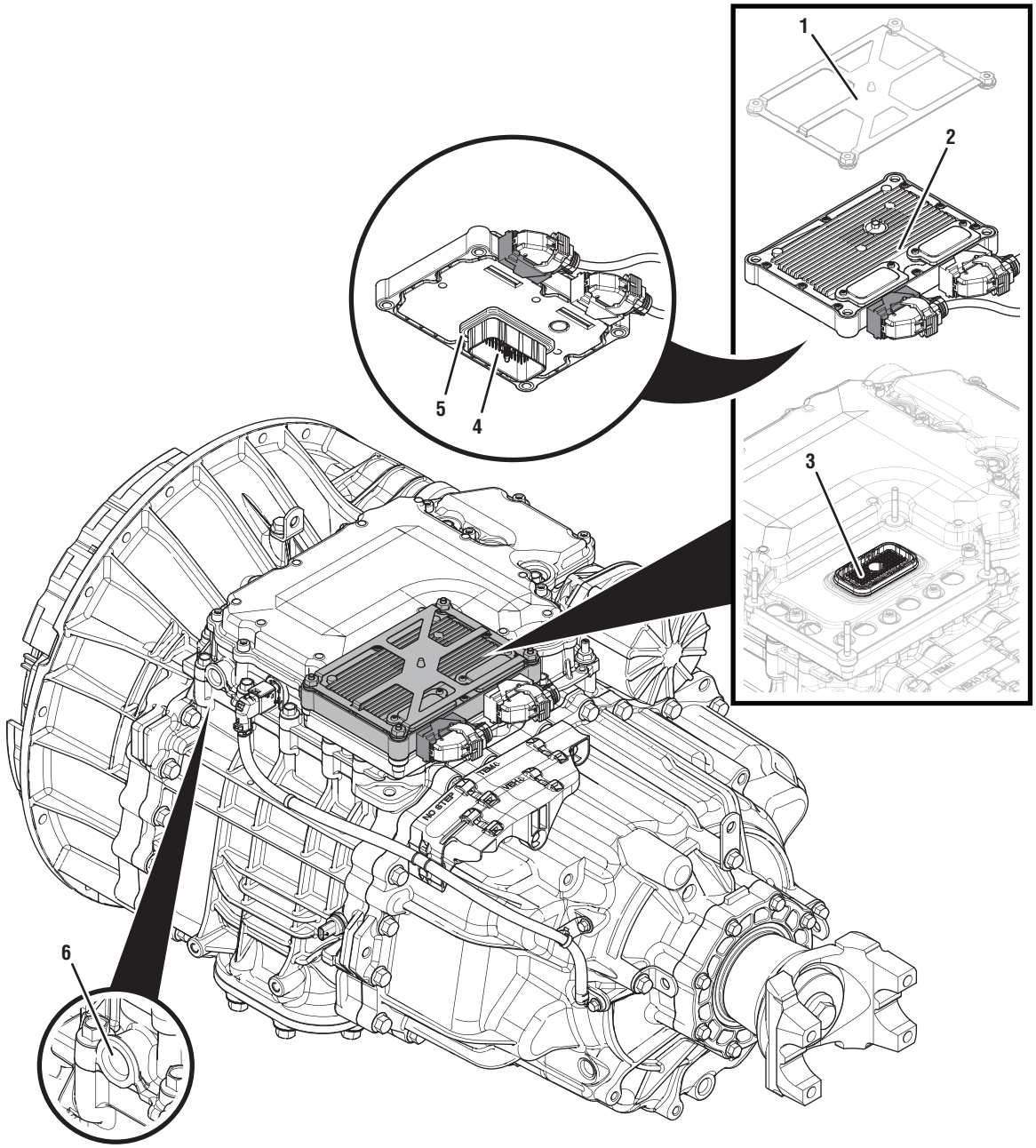
**All FMIs:**

- MTM
  - Contamination from vehicle air system
  - Air leaks
  - Rail B Fore Solenoid – internal failure
  - Rail B Aft Solenoid – internal failure
  - Rail B Position Sensor – in range internal failure
  - Rail B shift cylinder – stuck piston or damaged seals
  - Rail B shift rail or yoke – broken
- Internal transmission
  - Rail B Synchronizer
  - Secondary Drive Gear
  - Primary Drive Gear

## Additional Tools

- Endurant Service Manual TRSM0950
- Rail B Synchronizer Engagement Tool - RR1088TR

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

# Fault Code 740 Troubleshooting

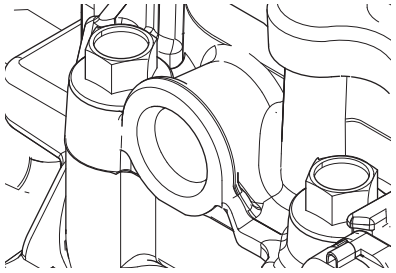
**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 740 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

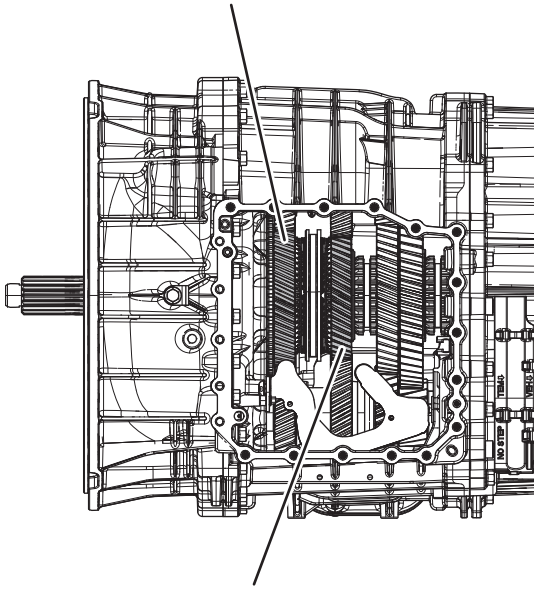
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step C.**

**C** ***Purpose:*** *Verify mechanical condition of the Primary and Secondary Drive Gears.*

1. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

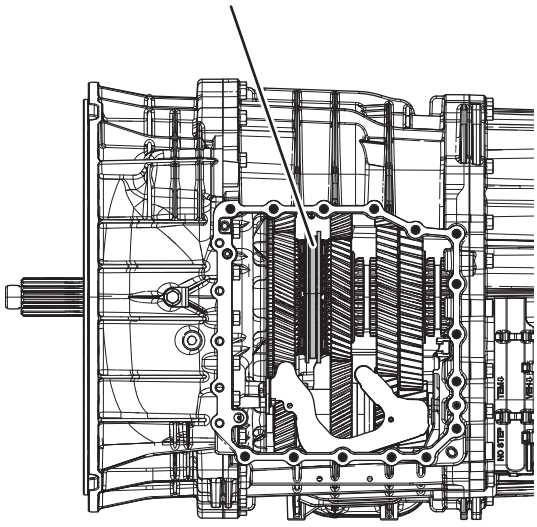
2. Inspect the Secondary Drive Gear for excessive fore and aft movement.



3. Inspect the Primary Drive Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect for cause of excessive gear movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

**D** ***Purpose:*** *Verify mechanical condition of the Rail B Synchronizer and clutching teeth.*

1. Inspect the Rail B Synchronizer Sliding Sleeve yoke slot for wear.



2. Install the Rail B Synchronizer Engagement Tool (RR1088TR).

   **Note:** Reference *Appendix, Manually Actuate Rail B Procedure*.

3. Shift the Rail B Synchronizer Sliding Sleeve into neutral (if necessary).
4. Shift the Rail B Synchronizer Sliding Sleeve into the Secondary Drive Gear engagement position (fore).
5. Inspect the Primary Drive Gear and synchronizer ring clutching teeth for wear.
6. Return the Rail B Synchronizer Sliding Sleeve to neutral.
7. Shift the Rail B Synchronizer Sliding Sleeve into the Primary Drive Gear engagement position (aft).
8. Inspect the Secondary Drive Gear and synchronizer ring clutching teeth for wear.
9. Return the Rail B Synchronizer Sliding Sleeve to neutral.
   - If the Rail B Synchronizer Sliding Sleeve shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail B Synchronizer Sliding Sleeve does not shift into all three positions or clutching teeth wear is present, replace the Rail B Synchronizer Assembly Primary Drive Gear, Secondary Drive Gear and MTM. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 740 sets Active during operation, go to **Step A.**
   - If a fault code other than 740 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 760: Rail C Operation

## J1939 SA 3 SPN 6146 FMI 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21

### Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow to actuate shift rails and sensors to monitor rail positions. The Transmission Control Module (TCM) compares the rail command and position to ensure proper rail operation. The solenoids, positions sensors and shift rails are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the Rail C Operation. If a system failure is detected, the fault is set active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** Rail C is unable to disengage the Primary Drive Gear, move aft, for 2 seconds.

**FMI 1 – Data Valid But Below Normal (Most Severe):** Rail C is unable to disengage the Secondary Driven Gear, move fore, for 2 seconds.

**FMI 2 – Data Erratic:** Rail C is unable to move the sliding clutch to neutral during a rail calibration.

**FMI 7 – Mechanical System Not Responding:** Rail C is unable move from neutral toward the Primary Drive Gear for 2 seconds.

**FMI 10 – Abnormal Rate of Change:** Rail C is unable to confirm low rail speed velocity during a rail calibration.

**FMI 14 – Special Instructions:** Rail C is unable to move from neutral toward the Secondary Driven Gear for 2 seconds.

**FMI 15 – Data Valid but Above Normal (Least Severe):** Rail C is unable to fully engage the Primary Drive Gear for 2 seconds.

**FMI 16 - Data Valid but Above Normal (Moderately Severe):** Rail C is unable to achieve neutral from the Primary Drive Gear for 2 seconds.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail C is unable to fully engage the Secondary Driven Gear for 2 seconds.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** Rail C is unable to achieve neutral from the Secondary Driven Gear for 2 seconds.

**FMI 20 – Data Drifted High:** Rail C travel was greater than expected during a rail calibration.

**FMI 21 – Data Drifted Low:** Rail C travel was less than expected during a rail calibration.

### Fallback

**FMI 0, 1:**

- Amber warning lamp on
- Rail C movement prohibited
- If vehicle is moving and no start gear is available
  - Red stop lamp on

**FMI 2, 10, 20, 21:**

- Amber warning lamp on
- Non neutral modes prohibited
- PTO Mode prohibited
- If the vehicle is moving
  - Red stop lamp on

**FMI 7, 15:**

- Amber warning lamp on
- Rail C engagement of the Primary Drive Gear prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

**FMI 14, 17:**

- Amber warning lamp on
- Rail C engagement of the Secondary Driven Gear prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

**FMI 16, 18:**

- Amber warning lamp on
- Rail C engagement of the sliding clutch into neutral prohibited
- If vehicle is moving
  - Rail C movement prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 7, 14, 16, 18:** Condition no longer exists

**FMI 2, 10, 20, 21:** Successful rail calibration

**FMI 15, 17:** Key cycle

## Possible Causes

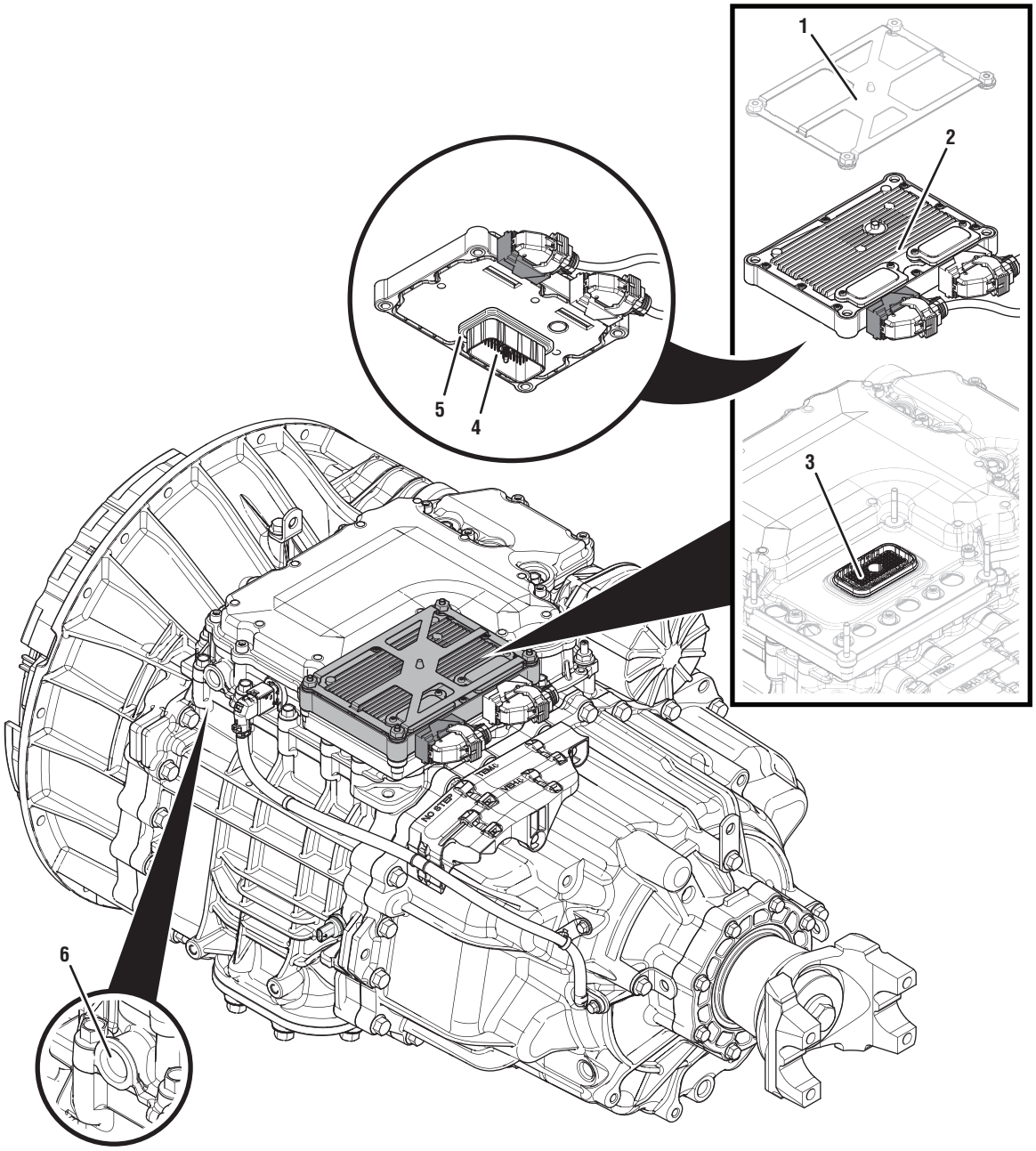
**All FMIs:**

- MTM
  - Contamination from vehicle air system
  - Air leaks
  - Rail C Fore Solenoid – internal failure
  - Rail C Aft Solenoid – internal failure
  - Rail C Position Sensor – in range internal failure
  - Rail C shift cylinder – stuck piston or damaged seals
  - Rail C shift rail or yoke – broken
- Internal transmission
  - Rail C Sliding Clutch
  - Primary Drive Gear
  - Secondary Driven Gear

## Additional Tools

- Endurant Service Manual TRSM0950

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

# Fault Code 760 Troubleshooting

## A

***Purpose:*** *Check for active or inactive fault codes.*

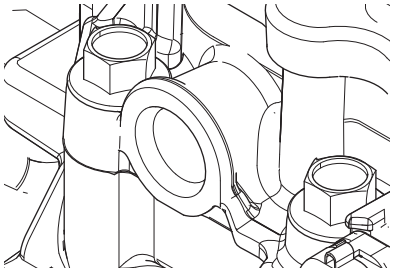
1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 760 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

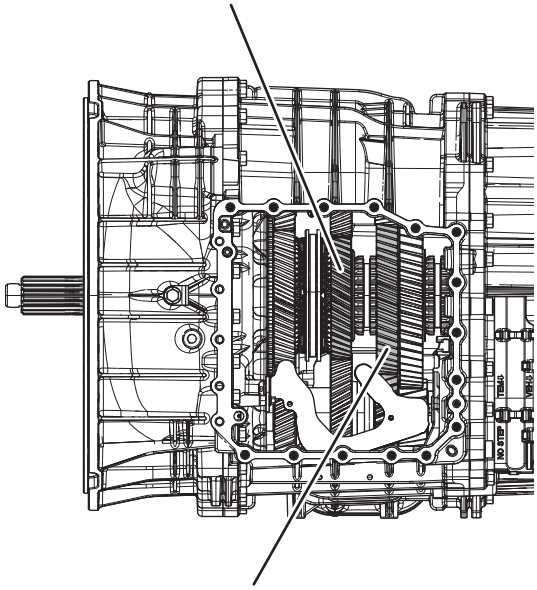
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step C.**

**C** ***Purpose:*** *Verify mechanical condition of the Primary Drive Gear and Secondary Driven Gear.*

1. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

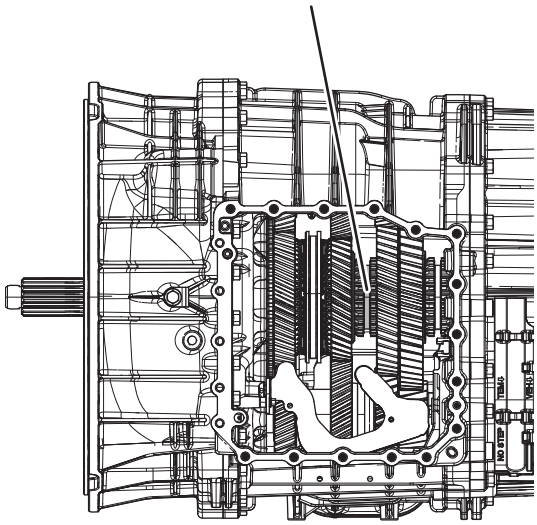
2. Inspect the Primary Drive Gear for excessive fore and aft movement.



3. Inspect the Secondary Driven Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect for cause of excessive gear movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

**D** ***Purpose:*** *Verify mechanical condition of the Rail C Sliding Clutch and clutching teeth.*

1. Inspect the Rail C Sliding Clutch yoke slot for wear.



2. Shift the Rail C Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail C Sliding Clutch into the Primary Drive Gear engagement position (fore).
4. Inspect the Rail C Sliding Clutch clutching teeth for wear.
5. Return the Rail C Sliding Clutch to neutral.
6. Shift the Rail C Sliding Clutch into the Secondary Driven Gear engagement position (aft).
7. Inspect the Rail C Sliding Clutch clutching teeth for wear.
8. Return the Rail C Sliding Clutch to neutral.
   - If the Rail C Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail C Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace the Rail C Sliding Clutch, Primary Drive Gear, Secondary Driven Gear and MTM. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 760 sets Active during operation, go to **Step A.**
   - If a fault code other than 760 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 775: Rail D Operation

## J1939 SA 3 SPN 6147 FMI 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21

### Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow to actuate shift rails and sensors to monitor rail positions. The Transmission Control Module (TCM) compares the rail command and position to ensure proper rail operation. The solenoids, positions sensors and shift rails are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection

The TCM monitors the Rail D Operation. If a system failure is detected, the fault is set active.

### Conditions to Set Fault Code Active

**FMI 0 – Data Valid But Above Normal (Most Severe):** Rail D is unable to disengage the Primary Driven Gear, move aft, for 2 seconds.

**FMI 1 – Data Valid But Below Normal (Most Severe):** Rail D is unable to disengage the Reverse Gear, move fore, for 2 seconds.

**FMI 2 – Data Erratic:** Rail D is unable to move the sliding clutch to neutral during a rail calibration.

**FMI 7 – Mechanical System Not Responding:** Rail D is unable move from neutral toward the Primary Driven Gear for 2 seconds.

**FMI 10 – Abnormal Rate of Change:** Rail D is unable to confirm low rail speed velocity during a rail calibration.

**FMI 14 – Special Instructions:** Rail D is unable to move from neutral toward the Reverse Gear for 2 seconds.

**FMI 15 – Data Valid but Above Normal (Least Severe):** Rail D is unable to fully engage the Primary Driven Gear for 2 seconds.

**FMI 16 - Data Valid but Above Normal (Moderately Severe):** Rail D is unable to achieve neutral from the Primary Driven Gear for 2 seconds.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail D is unable to fully engage the Reverse Gear for 2 seconds.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** Rail D is unable to achieve neutral from the Reverse Gear for 2 seconds.

**FMI 20 – Data Drifted High:** Rail D travel was greater than expected during a rail calibration.

**FMI 21 – Data Drifted Low:** Rail D travel was less than expected during a rail calibration.

### Fallback

**FMI 0, 1:**

- Amber warning lamp on
- Rail D movement prohibited

**FMI 2, 10, 20, 21:**

- Amber warning lamp on
- Rail D movement prohibited
- Non neutral modes prohibited
- PTO Mode prohibited
- If the vehicle is moving
  - Red stop lamp on

**FMI 7, 15:**

- Amber warning lamp on
- Rail D engagement of the Primary Driven Gear prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

**FMI 14, 17:**

- Amber warning lamp on
- Rail D engagement of the Reverse gear prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on
- Amber warning lamp on
- Rail D engagement of the sliding clutch into neutral prohibited

**FMI 16, 18:**

- If vehicle is moving
  - Rail D movement prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

## Conditions to Set Fault Code Inactive

**FMI 0, 1, 7, 14, 16, 18:** Condition no longer exists

**FMI 2, 10, 20, 21:** Successful rail calibration

**FMI 15, 17:** Key cycle

## Possible Causes

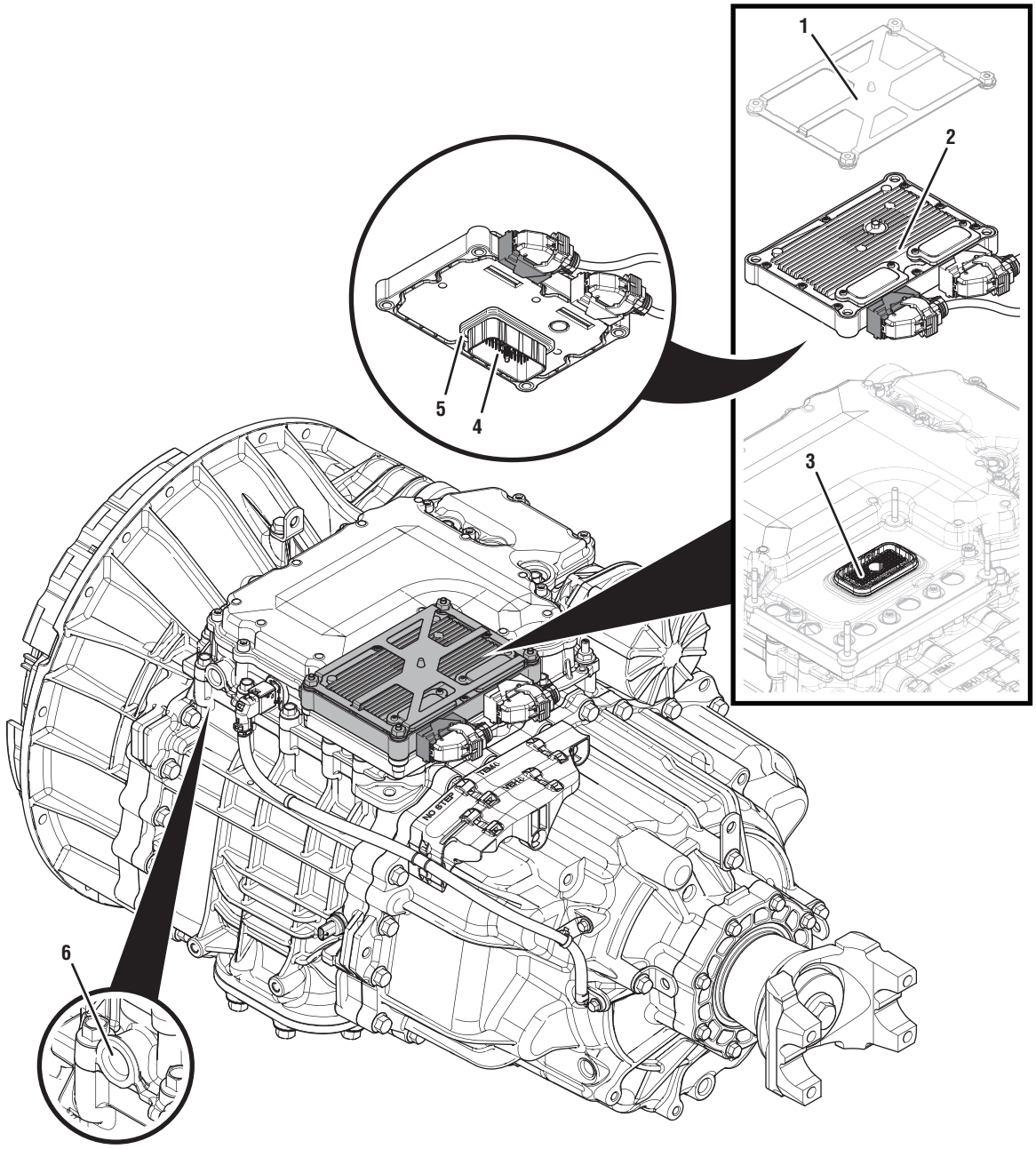
**All FMIs:**

- MTM
  - Contamination from vehicle air system
  - Air leaks
  - Rail D Fore Solenoid – internal failure
  - Rail D Aft Solenoid – internal failure
  - Rail D Position Sensor – in range internal failure
  - Rail D shift cylinder – stuck piston or damaged seals
  - Rail D shift rail or yoke – broken
- Internal transmission
  - Rail D Sliding Clutch
  - Primary Driven Gear
  - Reverse Gear

## Additional Tools

- Endurant Service Manual TRSM0950

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

# Fault Code 775 Troubleshooting

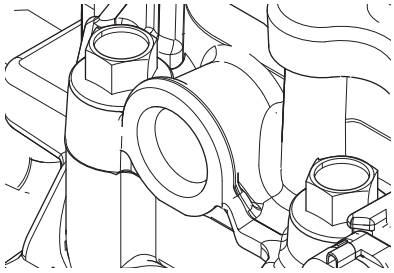
**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 775 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

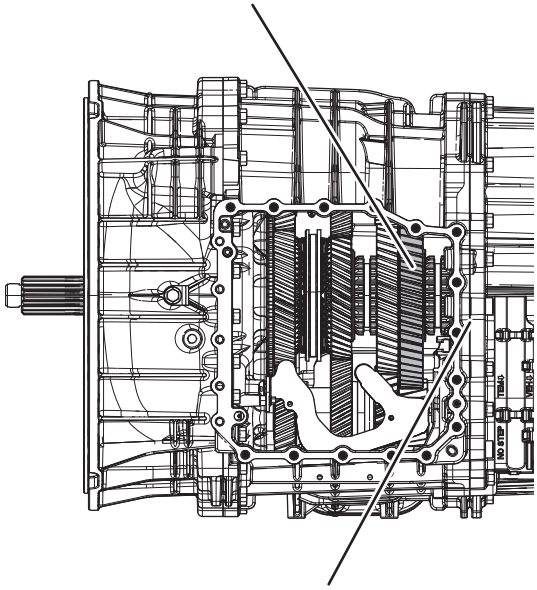
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step C.**

**C** ***Purpose:*** *Verify mechanical condition of the Primary Driven Gear and Reverse Gear.*

1. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

2. Inspect the Primary Driven Gear for excessive fore and aft movement.

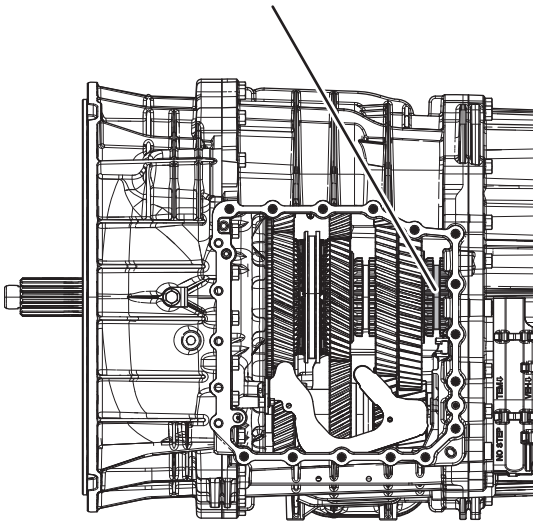


3. Inspect the Reverse Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect for cause of excessive gear movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

## D

***Purpose:*** *Verify mechanical condition of the Rail D Sliding Clutch and clutching teeth.*

1. Inspect the Rail D Sliding Clutch yoke slot for wear.



2. Shift the Rail D Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail D Sliding Clutch into the Primary Driven Gear engagement position (fore).
4. Inspect the Rail D Sliding Clutch clutching teeth for wear.
5. Return the Rail D Sliding Clutch to neutral.
6. Shift the Rail D Sliding Clutch into the Reverse Gear engagement position (aft).
7. Inspect the Rail D Sliding Clutch clutching teeth for wear.
8. Return the Rail D Sliding Clutch to neutral.
   - If the Rail D Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail D Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace the Rail D Sliding Clutch, Primary Driven Gear, Reverse Gear and MTM. Go to **Step V.**

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 775 sets Active during operation, go to **Step A.**
   - If a fault code other than 775 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 780: Rail E Operation

## J1939 SA 3 SPN 6148 FMI 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21

### Overview
The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow to actuate shift rails and sensors to monitor rail positions. The Transmission Control Module (TCM) compares the rail command and position to ensure proper rail operation. The solenoids, positions sensors and shift rails are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

### Detection
The TCM monitors the Rail E Operation. If a system failure is detected, the fault is set active.

### Conditions to Set Fault Code Active
**FMI 0 – Data Valid** But Above Normal (Most Severe): Rail E is unable to disengage High Range, move aft, for 2 seconds.

**FMI 1 – Data Valid But Below Normal (Most Severe):** Rail E is unable to disengage Low Range, move fore, for 2 seconds.

**FMI 2 – Data Erratic:** During a Rail Calibration unable to achieve neutral.

**FMI 7 – Mechanical System Not Responding:** Rail E is unable move from neutral toward High Range for 2 seconds.

**FMI 10 – Abnormal Rate of Change:** Rail E is unable to confirm low rail speed velocity during a rail calibration.

**FMI 14 – Special Instructions:** Rail E is unable to move from neutral toward Low Range for 2 seconds.

**FMI 15 – Data Valid but Above Normal (Least Severe):** Rail E is unable to fully engage High Range for 2 seconds.

**FMI 16 - Data Valid but Above Normal (Moderately Severe):** Rail E is unable to achieve neutral from High Range for 2 seconds.

**FMI 17 – Data Valid but Below Normal (Least Severe):** Rail E is unable to fully engage Low Range for 2 seconds.

**FMI 18 – Data Valid but Below Normal (Moderately Severe):** Rail E is unable to achieve neutral from Low Range for 2 seconds.

**FMI 20 – Data Drifted High:** Rail E travel was greater than expected during a rail calibration.

**FMI 21 – Data Drifted Low:** Rail E travel was less than expected during a rail calibration.

### Fallback
**FMI 0, 14, 16, 17:**

- Amber warning lamp on
- If vehicle stationary
  - Rail E engagement of Low Range prohibited
- If vehicle was moving and comes to stop
  - Transmission may launch in High Range

**FMI 1:**

- Amber warning lamp on
- Rail E engagement of High Range prohibited

**FMI 2:**

- Amber warning lamp on
- Non neutral modes prohibited

**FMI 10, 20, 21:**

- Amber warning lamp on
- Rail E movement prohibited
- Non neutral modes prohibited
- PTO Mode prohibited
- If the vehicle is moving
  - Red stop lamp on
- If vehicle was moving and comes to stop
  - Transmission may launch in High Range

**FMI 7, 15, 18:**

- Amber warning lamp on
- Rail E engagement of High Range prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

### Conditions to Set Fault Code Inactive
**FMI 7, 14, 16, 18:** Condition no longer exists

**FMI 10, 20, 21:** Successful rail calibration

**FMI 0, 1, 2, 15, 17:** Key cycle

## Possible Causes

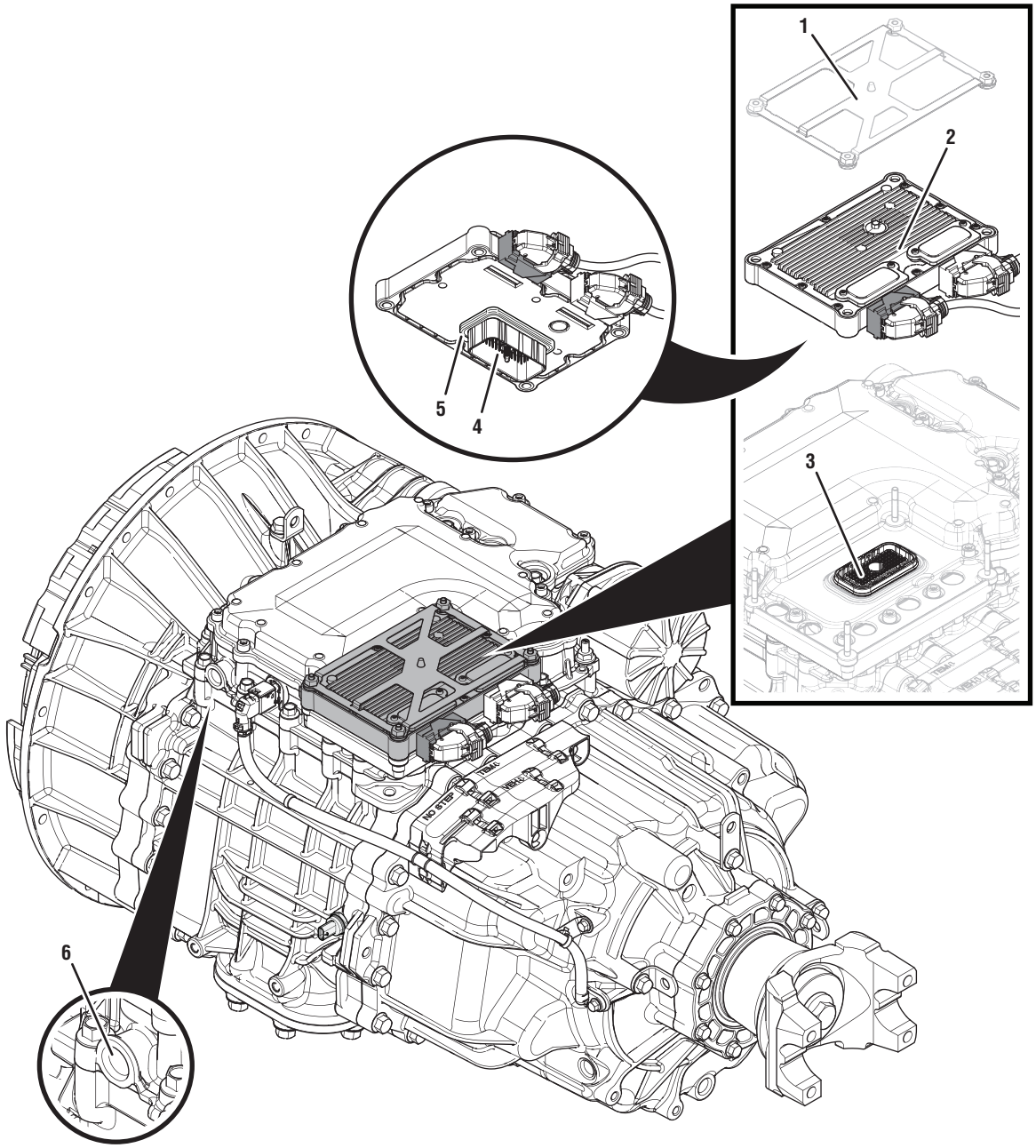
**All FMIs:**

- Vehicle Air System
  - Contamination
- MTM
  - Rail E Fore Solenoid – internal failure
  - Rail E Aft Solenoid – internal failure
  - Rail E Shift Cylinder – stuck piston or damaged seals
  - Rail E Position Sensor – in range internal failure
  - Rail E Shift Rail – broken, detached
  - Rail E Shift Yoke – broken, detached
- Rear Housing
  - Rail E Detent – binding
  - Rail E Shift Rail – binding
  - Rail E Bushing – worn
  - Rail E Synchronizer

## Additional Tools

- Endurant Service Manual TRSM0950
- MTM Alignment Tool (RR1086TR-1)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

# Fault Code 780 Troubleshooting

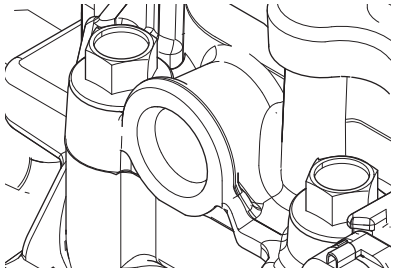
**A** ***Purpose:*** *Check for active or inactive fault codes.*

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.
   - f Fault Code 780 FMI 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step C.**

## C

***Purpose:*** *Verify mechanical movement of the Rail E Synchronizer.*

1. Key off.
2. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal and MTM Removal Service Procedures*.
3. Install the MTM Alignment Tool (RR1086TR-1) onto the main housing.

   **Note:** Reference *Appendix/Manually Actuate Rail E Procedure.*
4. Using the Rail E Lever, move Rail E to neutral (if necessary).
5. Shift Rail E into the High Range (fore) engagement position and return to neutral.
6. Shift Rail E into the Low Range (aft) engagement position and return to neutral.
   - If Rail E shifts between neutral, High and Low Range, replace the MTM. Go to **Step V.**
   - If Rail E does not shift between neutral, High or Low Range, go to **Step D.**

## D

***Purpose:*** *Verify mechanical movement of the Rail E Range Synchronizer without detent.*

1. Remove the Rail E Detent Plug, Spring and Detent.
2. Install the MTM Alignment Tool (RR1086TR-1) onto the main housing.
3. Using the Rail E Lever, move Rail E to neutral (if necessary).
4. Shift Rail E into the High Range (fore) engagement position and return to neutral.
5. Shift Rail E into the Low Range (aft) engagement position and return to neutral.
   - If the Rail E Detent could not be removed, go to **Step E.**
   - If Rail E shifts between neutral, High and Low Range, replace the Rail E Detent Plug, Spring and Detent and Rear Housing. Go to **Step V.**
   - If Rail E does not shift between neutral, High and Low Range, go to **Step E.**

## E

***Purpose:*** *Verify mechanical condition of the Rail E Synchronizer and Shift Rail.*

1. Remove the Rear Housing.
2. Inspect the Rail E Synchronizer, Shift Rail, Detent and Rear Housing Detent bore.
   - Contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 780 sets Active during operation, go to **Step A.**
   - If a fault code other than 780 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13

# Fault Code 786: Rail B Calibration

**J1939: SA 3 SPN 5952 FMI 7, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow to actuate shift rails and sensors to monitor rail positions. The Transmission Control Module (TCM) compares the rail command and position to ensure proper rail operation. A Rail Calibration is performed to actuate each shift rail through all their positions. The shift rail positions are stored in memory and used to precisely actuate a shift rail during normal operation. The solenoids, positions sensors and shift rails are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Rail B Calibration. If a system failure is detected, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 7 – Mechanical System Not Responding:** Rail B Position Sensor indicated no movement in the Aft direction during a rail calibration.

**FMI 20 – Data Drifted High:** Rail B Position Sensor indicated insufficient movement in the Aft direction during a rail calibration.

**FMI 21 – Data Drifted Low:** Rail B Position Sensor indicated insufficient movement in the Fore direction during a rail calibration.

**FMI 31 – Condition Exists:** Rail B Position Sensor indicated no movement in the Fore direction during a rail calibration.

## Fallback

**FMI 7, 20, 21, 31:**

- If Rail B position is known and fully engaged
  - Amber warning lamp on
  - Shift Rail B movement prohibited
- If Rail B position is not known or not fully engaged:
  - Amber warning lamp on
  - Shift Rail B movement prohibited
  - Non-neutral modes prohibited
  - Urge to Move and Creep Mode prohibited
  - PTO Mode Prohibited
  - If vehicle is moving - Red stop lamp on

## Conditions to Set Fault Code Inactive

**FMI 7, 20, 21, 31:** Successful Rail Calibration

## Possible Causes

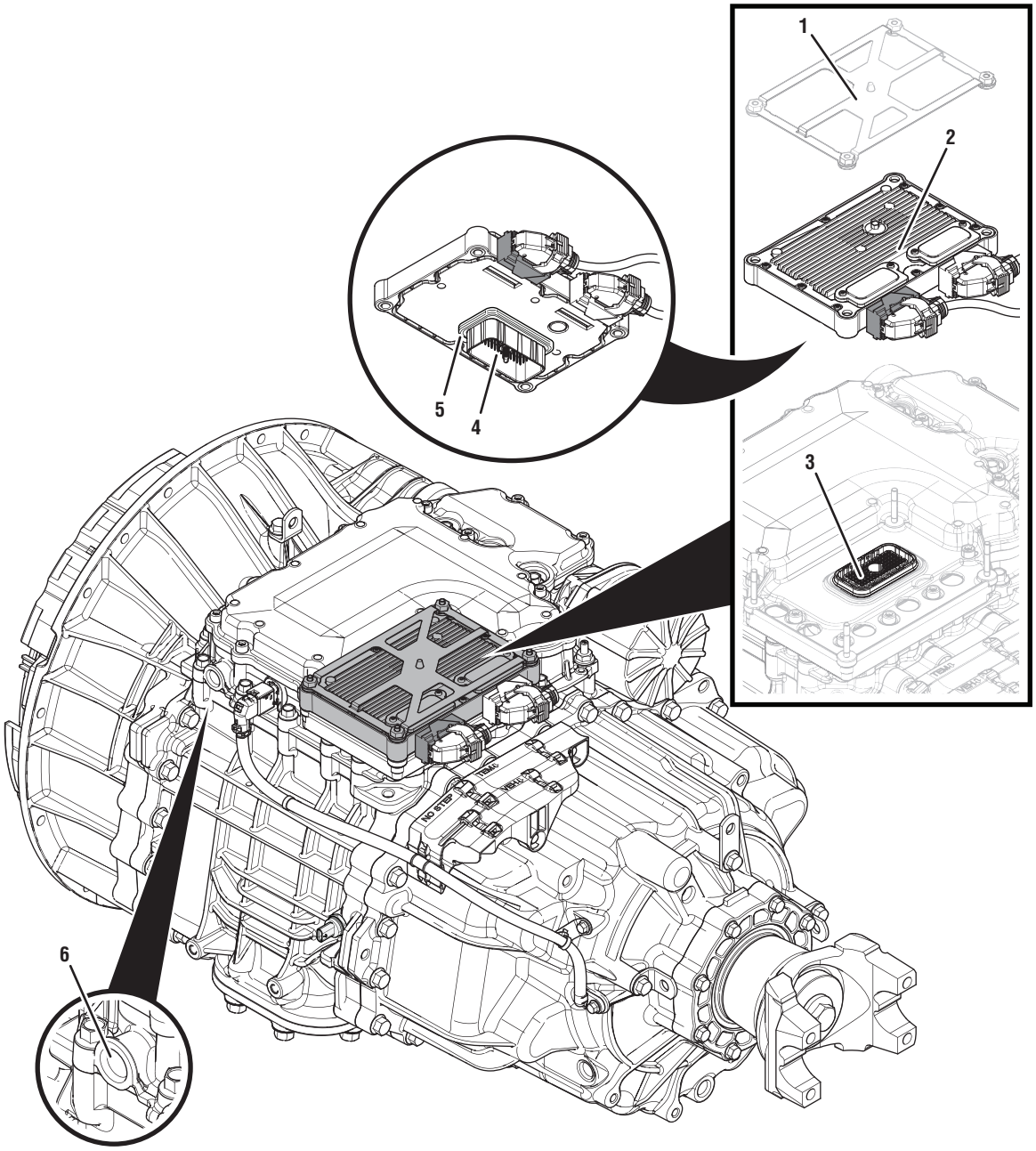
**FMI 7, 20, 21, 31:**

- MTM - Rail B
  - Rail B Solenoids
  - Rail B Cylinder
  - Rail B Detent
  - Rail B Yoke
  - Rail B Position Sensor
- Internal Transmission
  - Rail B Synchronizer
  - Input Shaft Assembly

## Additional Tools

- Endurant Service Manual TRSM0950
- Rail B Synchronizer Engagement Tool - RR1088TR

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

# Fault Code 786 Troubleshooting

## A

***Purpose:*** *Check for active or inactive fault codes.*

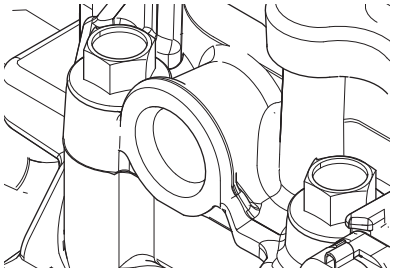
1. Set the vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 786 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step C.**

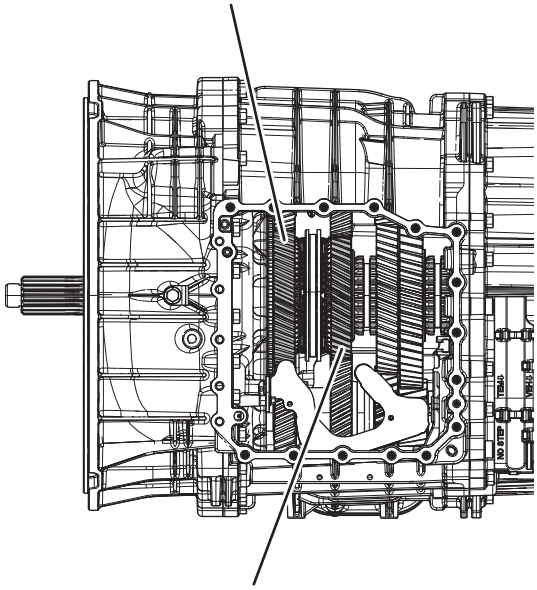
## C

***Purpose:*** *Verify mechanical condition of the Primary and Secondary Drive Gears.*

1. Key off.
2. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

3. Inspect the Secondary Drive Gear for excessive fore and aft movement.



4. Inspect the Primary Drive Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect for cause of excessive gear movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

## D

***Purpose:*** *Verify mechanical condition of the Rail B Synchronizer and clutching teeth.*

1. Inspect the Rail B Synchronizer Sliding Sleeve yoke slot for wear.
2. Install the Rail B Synchronizer Engagement Tool (RR1088TR).

   **Note:** Reference *Appendix, Manually Actuate Rail B Procedure*.

3. Shift the Rail B Synchronizer Sliding Sleeve into neutral (if necessary).
4. Shift the Rail B Synchronizer Sliding Sleeve into the Secondary Drive Gear engagement position (fore).
5. Inspect the Primary Drive Gear and synchronizer ring clutching teeth for wear.
6. Return the Rail B Synchronizer Sliding Sleeve to neutral.
7. Shift the Rail B Synchronizer Sliding Sleeve into the Primary Drive Gear engagement position (aft).
8. Inspect the Secondary Drive Gear and synchronizer ring clutching teeth for wear.
9. Return the Rail B Synchronizer Sliding Sleeve to neutral.
   - If the Rail B Synchronizer Sliding Sleeve shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail B Synchronizer Sliding Sleeve does not shift into all three positions or clutching teeth wear is present, replace the Rail B Synchronizer Assembly Primary Drive Gear, Secondary Drive Gear and MTM. Go to **Step V.**

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 786 sets Active during operation, go to **Step A.**
   - If a fault code other than 786 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 787: Rail C Calibration

**J1939: SA 3 SPN 5953 FMI 7, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow to actuate shift rails and sensors to monitor rail positions. The Transmission Control Module (TCM) compares the rail command and position to ensure proper rail operation. A Rail Calibration is performed to actuate each shift rail through all their positions. The shift rail positions are stored in memory and used to precisely actuate a shift rail during normal operation. The solenoids, positions sensors and shift rails are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Rail C Calibration. If a system failure is detected, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 7 – Mechanical System Not Responding:** Rail C Position Sensor indicated no movement in the Aft direction during a rail calibration.

**FMI 20 – Data Drifted High:** Rail C Position Sensor indicated insufficient movement in the Aft direction during a rail calibration.

**FMI 21 – Data Drifted Low:** Rail C Position Sensor indicated insufficient movement in the Fore direction during a rail calibration.

**FMI 31 – Condition Exists:** Rail C Position Sensor indicated no movement in the Fore direction during a rail calibration.

## Fallback

**FMI 7, 20, 21, 31:**

- If Rail C position is known and fully engaged
  - Amber warning lamp on
  - Shift Rail C movement prohibited
- If Rail C position is not known or not fully engaged:
  - Amber warning lamp on
  - Shift Rail C movement prohibited
  - Shift Rail D movement prohibited
  - Non neutral modes prohibited
  - Urge to Move and Creep Mode prohibited
  - PTO Mode Prohibited
  - If vehicle is moving - Red stop lamp on

## Conditions to Set Fault Code Inactive

**FMI 7, 20, 21, 31:** Successful Rail Calibration

## Possible Causes

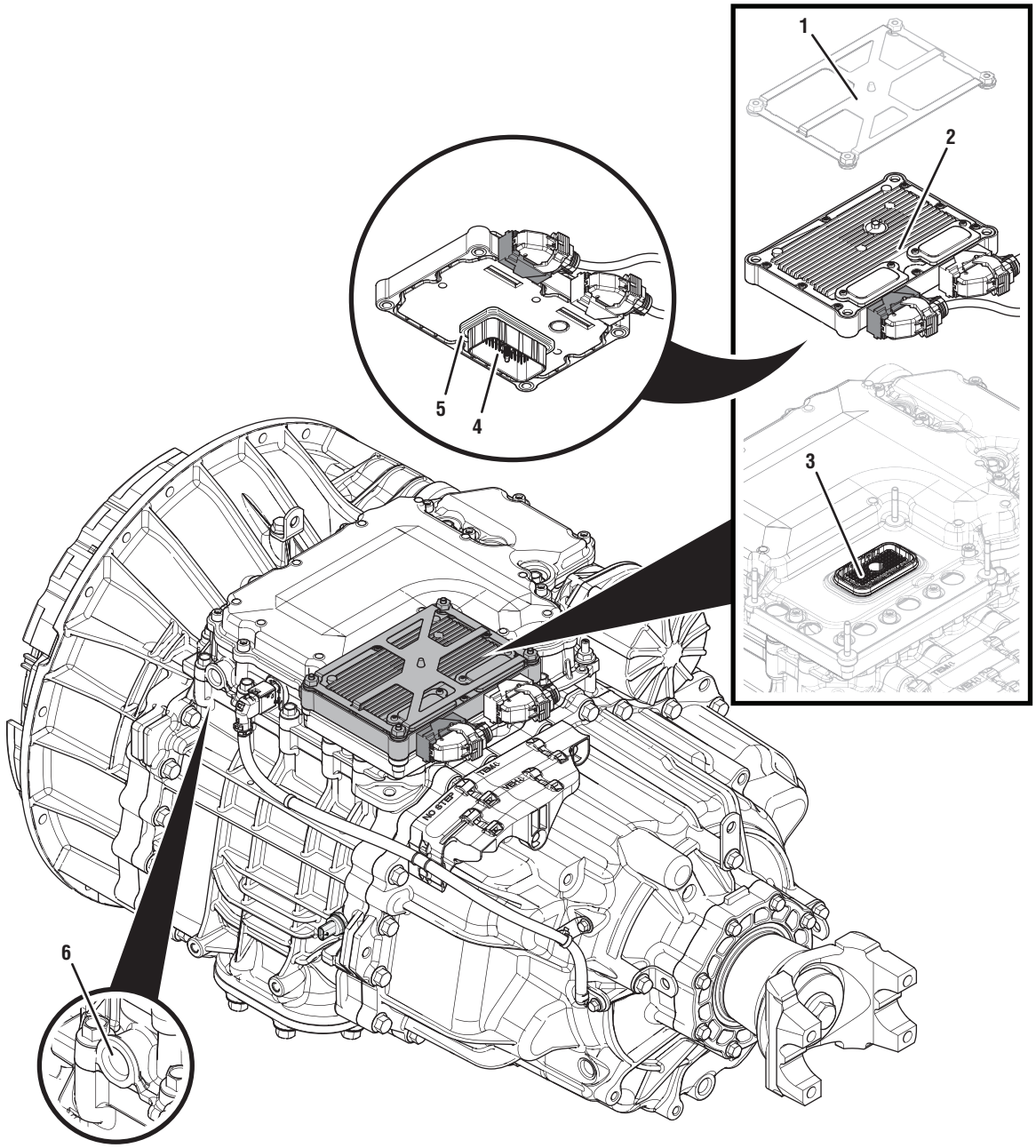
**FMI 7, 20, 21, 31:**

- MTM - Rail C
  - Rail C Solenoids
  - Rail C Cylinder
  - Rail C Detent
  - Rail C Yoke
  - Rail C Position Sensor
- Internal Transmission
  - Rail C Sliding Clutch
  - Main Shaft Assembly
  - Primary Drive Gear
  - Secondary Driven Gear

## Additional Tools

- Endurant Service Manual TRSM0950

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

# Fault Code 787 Troubleshooting

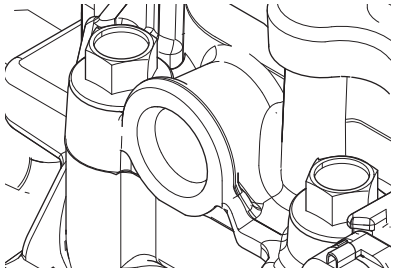
**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set the vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 787 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

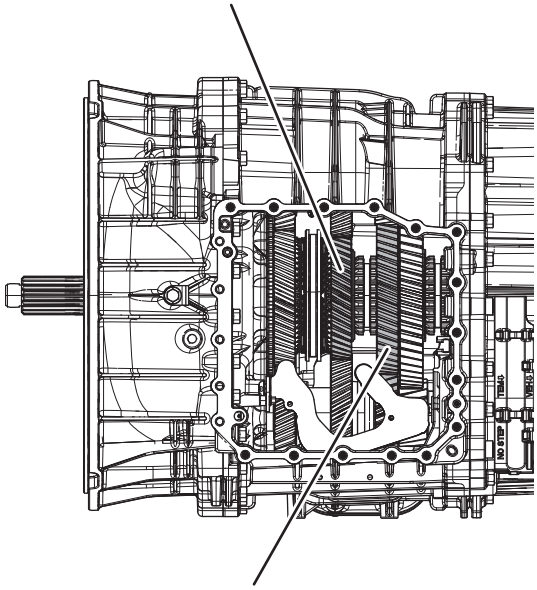
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step C.**

## C

***Purpose:*** *Verify mechanical condition of the Primary Drive and Secondary Driven Gears.*

1. Key off.
2. Remove the MTM.

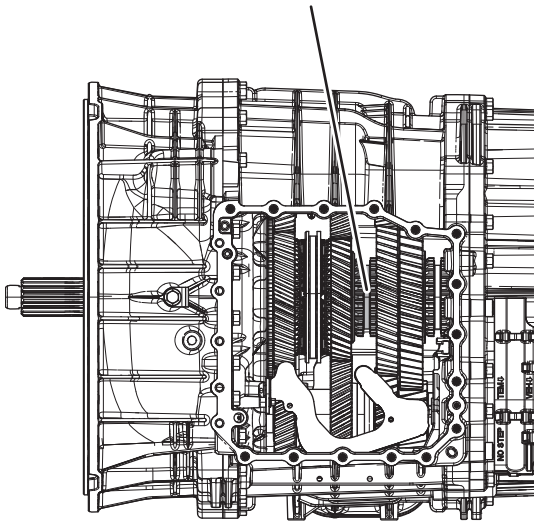
   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Inspect the Primary Drive Gear for excessive fore and aft movement.



4. Inspect the Secondary Driven Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect for cause of excessive gear movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

**D** ***Purpose:*** *Verify mechanical condition of the Rail C Sliding Clutch and clutching teeth.*

1. Inspect the Rail C Sliding Clutch yoke slot for wear.



2. Shift the Rail C Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail C Sliding Clutch into the Primary Drive Gear engagement position (fore).
4. Inspect the Rail C Sliding Clutch clutching teeth for wear.
5. Return the Rail C Sliding Clutch to neutral.
6. Shift the Rail C Sliding Clutch into the Secondary Driven Gear engagement position (aft).
7. Inspect the Rail C Sliding Clutch clutching teeth for wear.
8. Return the Rail C Sliding Clutch to neutral.
   - If the Rail C Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail C Sliding Clutch does not shift into all three positions or clutching teeth wear is present, inspect the Main Shaft; replace the Rail C Sliding Clutch, Primary Drive Gear, Secondary Driven Gear and MTM. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 787 sets Active during operation, go to **Step A.**
   - If a fault code other than 787 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 788: Rail D Calibration

**J1939: SA 3 SPN 5954 FMI 7, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow to actuate shift rails and sensors to monitor rail positions. The Transmission Control Module (TCM) compares the rail command and position to ensure proper rail operation. A Rail Calibration is performed to actuate each shift rail through all their positions. The shift rail positions are stored in memory and used to precisely actuate a shift rail during normal operation. The solenoids, positions sensors and shift rails are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Rail D position during a Rail Calibration. If a system failure is detected, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 7 – Mechanical System Not Responding:** Rail D Position Sensor indicated no movement in the Aft direction during a rail calibration.

**FMI 20 – Data Drifted High:** Rail D Position Sensor indicated insufficient movement in the Aft direction during a rail calibration.

**FMI 21 – Data Drifted Low:** Rail D Position Sensor indicated insufficient movement in the Fore direction during a rail calibration.

**FMI 31 – Condition Exists:** Rail D Position Sensor indicated no movement in the Fore direction during a rail calibration.

## Fallback

**FMI 7, 20, 21, 31:**

- If Rail D position is known and fully engaged
  - Amber warning lamp on
  - Shift Rail D movement prohibited
- If Rail D position is not known or not fully engaged:
  - Amber warning lamp on
  - Shift Rail C movement prohibited
  - Shift Rail D movement prohibited
  - Non neutral modes prohibited
  - PTO Mode prohibited
  - If vehicle is moving - Red stop lamp on

## Conditions to Set Fault Code Inactive

**FMI 7, 20, 21, 31:** Key cycle and condition no longer exists.

## Possible Causes

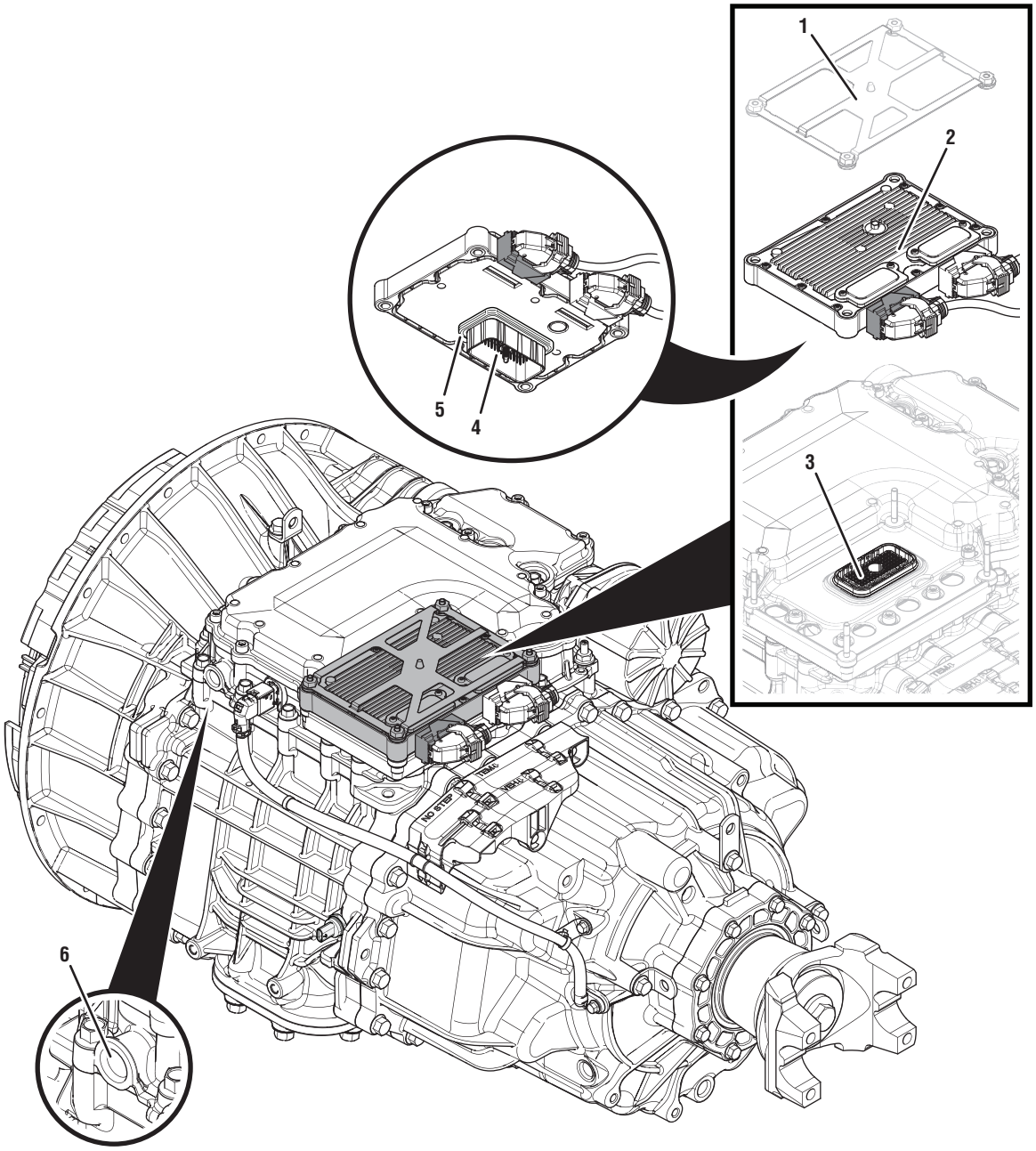
FMI 7, 20, 21, 31:

- MTM - Rail D
  - Rail D Solenoids
  - Rail D Cylinder
  - Rail D Detent
  - Rail D Yoke
  - Rail D Position Sensor
- Internal Transmission
  - Rail D Sliding Clutch
  - Main Shaft Assembly
  - Primary Driven Gear
  - Reverse Gear

## Additional Tools

- Endurant Service Manual TRSM0950

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

# Fault Code 788 Troubleshooting

## A

***Purpose:*** *Check for active or inactive fault codes.*

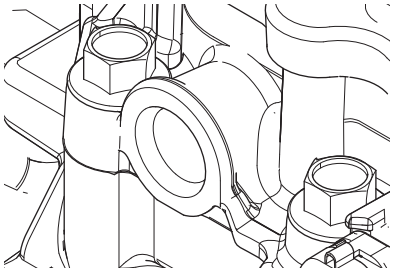
1. Set the vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 788 is Active or Inactive, go to **Step B.**

## B

***Purpose:*** *Verify mechanical condition of the Primary Driven Gear and Reverse Gear.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

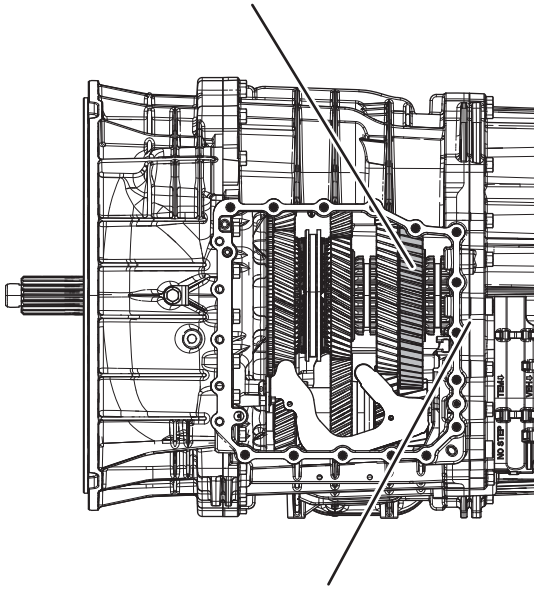
     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure.*
   - If no contamination is found, go to **Step C.**

**C** ***Purpose:*** *Verify mechanical condition of the Primary Driven Gear and Reverse Gear.*

1. Key off.
2. Remove the MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.

3. Inspect the Primary Driven Gear for excessive fore and aft movement.

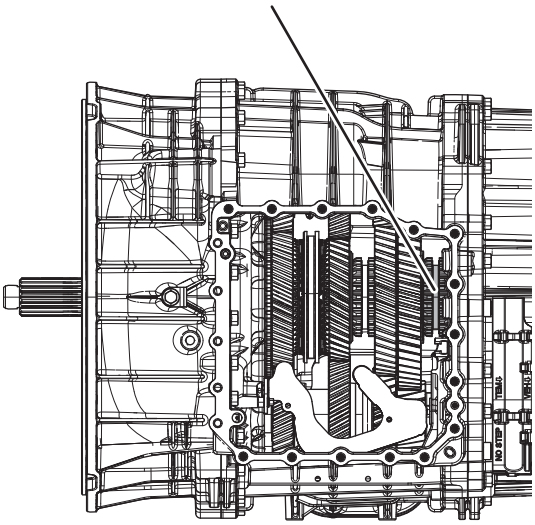


4. Inspect the Reverse Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect for cause of excessive gear movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

## D

***Purpose:*** *Verify mechanical condition of the Rail D Sliding Clutch and clutching teeth.*

1. Inspect the Rail D Sliding Clutch yoke slot for wear.



2. Shift the Rail D Sliding Clutch to the neutral position (if necessary).
3. Shift the Rail D Sliding Clutch into the Primary Driven Gear engagement position (fore).
4. Inspect the Rail D Sliding Clutch clutching teeth for wear.
5. Return the Rail D Sliding Clutch to neutral.
6. Shift the Rail D Sliding Clutch into the Reverse Gear engagement position (aft).
7. Inspect the Rail D Sliding Clutch clutching teeth for wear.
8. Return the Rail D Sliding Clutch to neutral.
   - If the Rail D Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace the MTM. Go to **Step V.**
   - If the Rail D Sliding Clutch does not shift into all three positions or clutching teeth wear is present, inspect the Main Shaft; replace the Rail D Sliding Clutch, Primary Driven Gear, Reverse Gear and MTM. Go to **Step V.**

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 788 sets Active during operation, go to **Step A.**
   - If a fault code other than 788 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 789: Rail E Calibration

**J1939: SA 3 SPN 5955 FMI 7, 20, 21, 31**

## Overview

The Endurant Transmission is equipped with solenoids to direct pneumatic flow to actuate shift rails and sensors to monitor rail positions. The Transmission Control Module (TCM) compares the rail command and position to ensure proper rail operation. A Rail Calibration is performed to actuate each shift rail through all their positions. The shift rail positions are stored in memory and used to precisely actuate a shift rail during normal operation. The solenoids, positions sensors and shift rails are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

## Detection

The TCM monitors the Rail E Calibration. If a system failure is detected, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 7 – Mechanical System Not Responding:** Rail E Position Sensor indicated no movement in the Aft direction during a rail calibration.

**FMI 20 – Data Drifted High:** Rail E Position Sensor indicated insufficient movement in the Aft direction during a rail calibration.

**FMI 21 – Data Drifted Low:** Rail E Position Sensor indicated insufficient movement in the Fore direction during a rail calibration.

**FMI 31 – Condition Exists:** Rail E Position Sensor indicated no movement in the Fore direction during a rail calibration.

## Fallback

**FMI 7, 20, 21, 31:**

- If Rail E position is known and fully engaged
  - Amber warning lamp on
  - Shift Rail E movement prohibited
- If Rail E position is not known or not fully engaged:
  - Amber warning lamp on
  - Shift Rail E movement prohibited
  - Non neutral modes prohibited
  - Urge to Move and Creep Mode prohibited
  - PTO Mode Prohibited
  - If vehicle is moving - Red stop lamp on

## Conditions to Set Fault Code Inactive

**FMI 7, 20, 21, 31:** Successful rail calibration

## Possible Causes

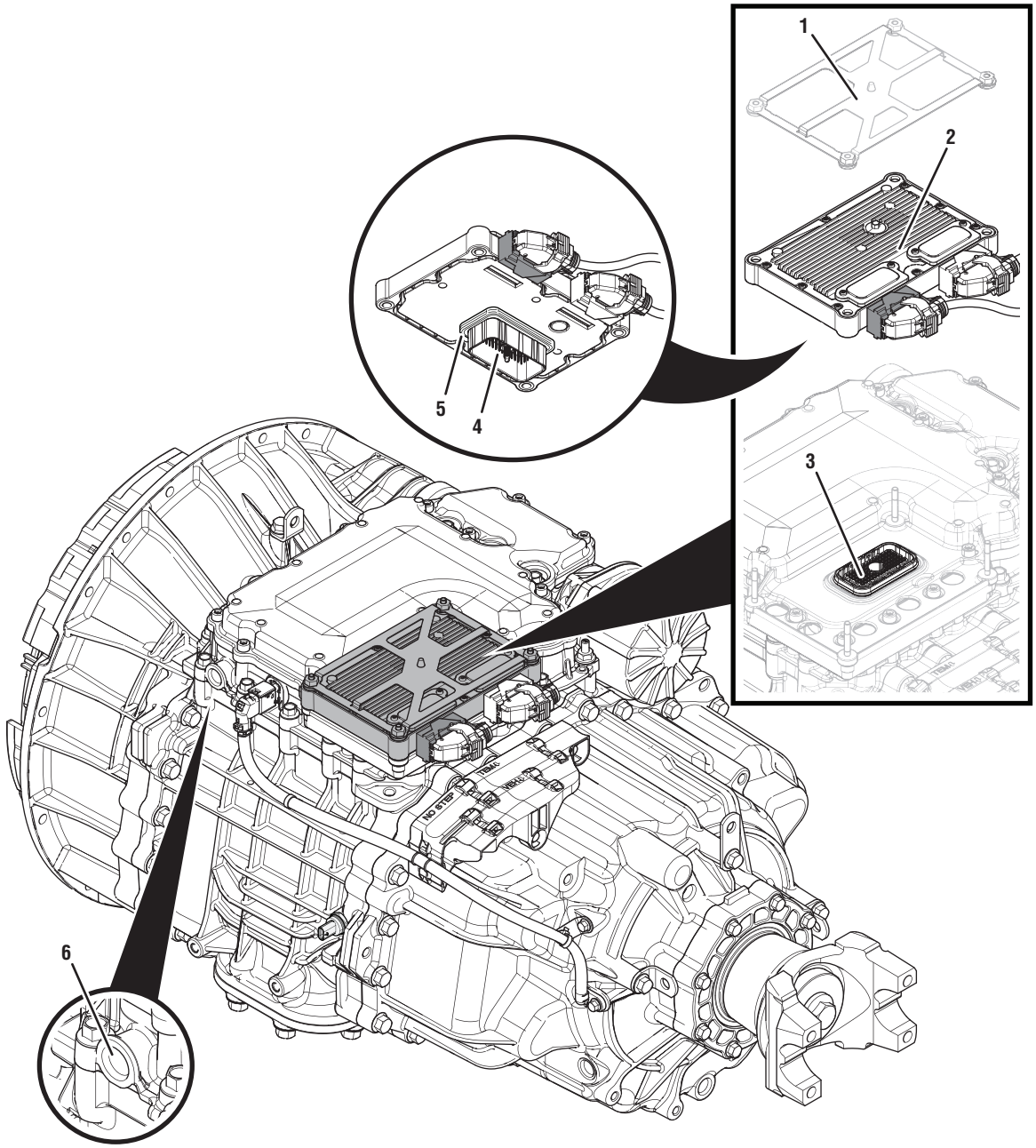
**FMI 7, 20, 21, 31:**

- MTM - Rail E
  - Rail E Solenoids
  - Rail E Cylinder
  - Rail E Yoke
  - Rail E Position Sensor
- Rear Housing
  - Rail E Detent
- Internal Transmission
  - Rail E Synchronizer
  - Range Assembly

## Additional Tools

- Endurant Service Manual TRSM0950
- MTM Alignment Tool (RR1086TR-1)

## Component Identification




*1. Transmission Control Module (TCM) Cover*
*2. Transmission Control Module (TCM)*
*3. 74-Way Transmission Harness Connector (TCM-side)*
*4. 74-Way Transmission Harness Connector (MTM-side)*
*5. Transmission Control Module (TCM) Seal*
*6. MTM Air Inlet Port*

# Fault Code 789 Troubleshooting

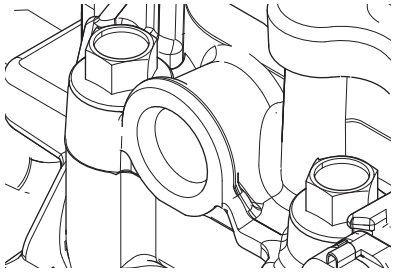
**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set the vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 789 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Verify condition of the vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent the vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove the vehicle air supply line at the MTM.
4. Inspect the vehicle air supply line and the MTM air inlet port for contamination, moisture, corrosion and/or debris.

   **Note:** Verify the MTM inlet screen is installed and free of contamination and/or debris.



   - If contamination is found, refer to OEM guidelines for repair or replacement of the vehicle air system. Replace the MTM and Inertia Brake Assembly. Go to **Step V.**

     **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
   - If no contamination is found, go to **Step C.**

## C

***Purpose:*** *Verify mechanical movement of the Rail E Synchronizer.*

1. Key off.
2. Remove MTM.

   **Note:** MTM removal and installation requires the transmission to be removed from the vehicle. Reference *Endurant Service Manual TRSM0950, Transmission Removal Service Procedure*.
3. Install the MTM Alignment Tool (RR1086TR-1) onto the main housing.
4. Using the Rail E Lever, move Rail E to neutral (if necessary).
5. Shift Rail E into the High Range (fore) engagement position and return to neutral.
6. Shift Rail E into the Low Range (aft) engagement position and return to neutral.
   - If Rail E shifts between neutral, High and Low Range, replace the MTM. Go to **Step V.**
   - If Rail E does not shift into High or Low Range, go to **Step D.**

## D

***Purpose:*** *Verify mechanical movement of the Rail E Range Synchronizer without detent.*

1. Remove the Rail E Detent Plug, Spring and Detent.
2. Install the MTM Alignment Tool (RR1086TR-1) onto the main housing.
3. Using the Rail E Lever, move Rail E to neutral (if necessary).
4. Shift Rail E into the High Range (fore) engagement position and return to neutral.
5. Shift Rail E into the Low Range (aft) engagement position and return to neutral.
   - If the Rail E Detent could not be removed. go to **Step E.**
   - If Rail E shifts between neutral, High and Low Range, replace the Rail E Detent Plug, Spring and Detent and Rear Housing. Go to **Step V.**
   - If Rail E does not shift between neutral, High and Low Range,
   - go to **Step E.**

## E

***Purpose:*** *Verify mechanical condition of the Rail E Synchronizer and Shift Rail.*

1. Key off.
2. Remove the Rear Housing.
3. Inspect the Rail E Synchronizer, Shift Rail, Detent and Rear Housing Detent bore.
   - Contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 789 sets Active during operation, go to **Step A.**
   - If a fault code other than 789 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 815: Clutch Temperature

## J1939 SA 3 SPN 5939 FMI 0, 15, 16

### Overview
The Transmission Control Module (TCM) monitors clutch performance to calculate the operating Clutch Temperature. If the Clutch Temperature is above normal, the TCM will adjust transmission operation to prevent clutch damage and notify the driver that a clutch abuse event is occurring.

### Detection
The TCM monitors the Clutch Temperature. If the calculated temperature is above the normal operating range, the fault is set active.

### Conditions to Set Fault Code Active
FMI 0 – Data Valid But Above Normal (Most Severe): The Clutch Temperature reports above normal, most severe, and clutch protection is required.

FMI 15 – Data Valid but Above Normal (Least Severe): The Clutch Temperature reports above normal, least severe, and clutch abuse is indicated.

FMI 16 - Data Valid but Above Normal (Moderately Severe): The Clutch Temperature reports above normal, moderately severe, and clutch abuse is indicated.

### Fallback
FMI 0:

- Red stop lamp on
- Audible warning tone
- CA (Clutch Abuse) indicated in the display
- Non neutral modes prohibited
- PTO Mode prohibited
- High Start Gears prohibited
- Urge to Move and Creep Mode prohibited
- If the operation being performed causing clutch over-temp continues:
  - Clutch opens

FMI 15:

- High Start Gears prohibited

FMI 16:

- Amber warning lamp on
- Audible warning tone
- CA (Clutch Abuse) indicated in the display
- High Start Gears prohibited

### Conditions to Set Fault Code Inactive
All FMIs: The operation that is overheating the clutch is discontinued and the Clutch Temperature reports a normal operating range.

### Possible Causes
All FMIs:

- Using the accelerator pedal to hold the vehicle on a grade
- Overloading the vehicle
- Abusive or extreme operating conditions

### Additional Tools

# Fault Code 815 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 815 FMI 0, 15, 16 is Active or Inactive, the clutch experienced abusive or extreme operating conditions. Go to **Step B.**

**B** ***Purpose:*** *Verify TCM software.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Programming”.
6. Under "Software Information", record TCM software in table.
   - If the TCM was updated to the latest available software during the Diagnostic Procedure, go to **Step V.**
   - If a TCM software update is available, update TCM software. Go to **Step V.**
   - If the TCM is at the latest available software, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

| TCM Software |
| --- |
| |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 815 sets Active during operation, go to **Step A.**
   - If a fault code other than 815 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 900: PTO 1 Request

## J1939: SA 3 SPN 3452 FMI 3, 9, 13, 19, 20, 21

### Overview

The Endurant Transmission incorporates enhanced controls for PTO operation. The Transmission Control Module (TCM) receives a request (input) to actuate the PTO, determines if conditions are suitable for PTO operation and supplies an output to engage the PTO. Once the PTO is engaged the TCM receives a confirmation (input) that the PTO is engaged to complete the operation. The TCM can be configured to control the PTO with messages over the vehicle Primary Data Link (J1939 controlled) and/or circuits hardwired directly to the TCM (Hardwire controlled). The PTO J1939 controlled messages are received from an OEM ECU and the PTO Hardwire controlled signals are contained in the 20-Way TCM Body Harness Connector. PTO and wiring are installed by the OEM or body builder, reference TRIG200 for PTO system installation and wiring diagrams.

At the 20-Way TCM Body Harness Connector to the PTO 1 request switch, Pin 14 provides a return ground and Pin 15 provides a 2.5 - 5.5 V reference. When PTO 1 operation is requested, the request switch is closed completing the circuit between Pin 14 return ground and Pin 15 reference voltage causing the reference voltage to go low.

### Detection

The TCM monitors the PTO 1 Request J1939 controlled message or the hardwire controlled input signal circuit If the PTO 1 Request message or input signal is out of range, the fault is set active.

### Conditions to Set Fault Code Active

**FMI 3 – Voltage Above Normal or Shorted High:** PTO 1 Request hardwire controlled signal indicated greater than 5.25 V for 5 seconds.

**FMI 9 – Abnormal Update Rate:** PTO 1 Request J1939 controlled message not received for 5 second.

**FMI 13 – Out of Calibration:** PTO 1 Request J1939 controlled message not available for 5 seconds.

**FMI 19 – Received Network Data in Error:** PTO 1 Request J1939 controlled message invalid for 5 second.

**FMI 20 – Data Drifted High:** PTO 1 Request hardwire controlled signal indicated 4.00–5.25 V for 5 seconds.

**FMI 21 – Data Drifted Low:** PTO 1 Request hardwire controlled signal indicated 1.5–2.5 V for 5 seconds.

### Fallback

**All FMIs:**

- Amber warning lamp on
- PTO 1 Mode Prohibited

### Conditions to Set Fault Code Inactive

**FMI 3, 20, 21:** PTO 1 Request hardwired signal in range for 10 seconds.

**FMI 9, 13, 19:** OEM Module configured correctly or PTO 1 disabled

### Possible Causes

**FMI 3:**

- PTO 1 Request Wiring
  - Wiring shorted to power

**FMI 9, 13, 19:**

- PTO 1 J1939 control message not received or incorrect
  - OEM Module configuration setting

**FMI 20:**

- PTO 1 Request Wiring
  - High resistance short to power

**FMI 21:**

- PTO 1 Request Wiring
  - High resistance short to ground

# Fault Code 900 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 900 FMI 3, 20, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 900 FMI 9, 13, 19 is Active, go to **Step C.**
   - If Fault Code 900 FMI 9, 13, 19 is Inactive, PTO 1 is properly configured and communicating valid PTO messages in the TCM and OEM ECU. Go to **Step V.**.

**B** ***Purpose:*** *Verify PTO 1 Hardwire controlled configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 1 Current Value.
   - If PTO 1 Current Value indicates “Disabled” and PTO 1 is properly installed and wired, select “Hardwire controlled” and follow on-screen prompts. Go to **Step V.**
   - If PTO 1 Current Value indicates “Hardwire controlled” and PTO 1 is properly installed and wired, refer to OEM or body builder guidelines for repair or replacement of PTO Request switch or circuits. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

**C** ***Purpose:*** *Verify PTO 1 J1939 controlled configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 1 Current Value.
   - If PTO 1 Current Value indicates “J1939 controlled” or “J1939 request and enable with hardwire confirmation” and a PTO is not installed, select “Disabled” and follow on-screen prompts. Go to **Step V.**
   - If PTO 1 Current Value indicates “J1939 controlled” or “J1939 request and enable with hardwire confirmation” and PTO 1 is properly installed and wired, refer to OEM guidelines regarding OEM ECU PTO configuration settings. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 900 sets Active, go to **Step A.**
   - If a fault code other than 900 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 905: PTO 2 Request

**J1939: SA 3 SPN 3453 FMI 9, 13, 19, 20**

## Overview

The Endurant Transmission incorporates enhanced controls for PTO operation. The Transmission Control Module (TCM) receives a request (input) to actuate the PTO, determines if conditions are suitable for PTO operation and supplies an output to engage the PTO. Once the PTO is engaged the TCM receives a confirmation (input) that the PTO is engaged to complete the operation. The TCM can be configured to control the PTO with messages over the vehicle Primary Data Link (J1939 controlled) and/or circuits hardwired directly to the TCM (Hardwire controlled). The PTO J1939 controlled messages are received from an OEM ECU and the PTO Hardwire controlled signals are contained in the 20-Way TCM Body Harness Connector. PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

At the 20-Way TCM Body Harness Connector to the PTO request switch, Pin 14 provides a return ground and Pin 15 provides a 2.5 - 5.5 V reference. When PTO operation is requested, the request switch is closed completing the circuit between Pin 14 return ground and Pin 15 reference voltage causing the reference voltage to go low.

## Detection

The TCM monitors the PTO Request J1939 controlled message or the hardwire controlled input signal circuit If the PTO Request message or input signal is out of range, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 9 – Abnormal Update Rate:** PTO 2 Request J1939 controlled message not received for 5 second.

**FMI 13 – Out of Calibration:** PTO 2 Request J1939 controlled message not available for 5 seconds.

**FMI 19 – Received Network Data in Error:** PTO 2 Request J1939 controlled message invalid for 5 second.

**FMI 20 – Data Drifted High:** PTO 2 Request hardwire controlled signal indicated 4.00–5.25 V for 5 seconds.

## Fallback

**All FMIs:**

- Amber warning lamp on
- PTO 2 Mode Prohibited

## Conditions to Set Fault Code Inactive

**FMI 20:** PTO 2 Request hardwired signal in range for 10 seconds.

**FMI 9, 13, 19:** OEM Module configured correctly or PTO 2 disabled

## Possible Causes

**FMI 9, 13, 19:**

- PTO 2 J1939 control message not received or incorrect
  - OEM Module configuration setting

**FMI 20:**

- PTO 2 Request Wiring
  - High resistance short to power

# Fault Code 905 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 905 FMI 20 is Active or Inactive, go to **Step B.**
   - If Fault Code 905 FMI 9, 13, 19 is Active, go to **Step C.**
   - If Fault Code 905 FMI 9, 13, 19 is Inactive, PTO 2 is properly configured and communicating valid PTO messages in the TCM and OEM ECU. Go to **Step V.**.

**B** ***Purpose:*** *Verify PTO 2 Hardwire controlled configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 2 Current Value.
   - If PTO 2 Current Value indicates “Disabled” and PTO 2 is properly installed and wired, select “Hardwire controlled” and follow on-screen prompts. Go to **Step V.**
   - If PTO 2 Current Value indicates “Hardwire controlled” and PTO 2 is properly installed and wired, refer to OEM or body builder guidelines for repair or replacement of PTO Request switch or circuits. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

## C

***Purpose:*** *Verify PTO 2 J1939 controlled configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 2 Current Value.
   - If PTO 2 Current Value indicates “J1939 controlled” or “J1939 request and enable with hardwire confirmation” and a PTO is not installed, select “Disabled” and follow on-screen prompts. Go to **Step V.**
   - If PTO 2 Current Value indicates “J1939 controlled” or “J1939 request and enable with hardwire confirmation” and PTO 2 is properly installed and wired, refer to OEM guidelines regarding OEM ECU PTO configuration settings. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 905 sets Active, go to **Step A.**
   - If a fault code other than 905 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 910: PTO 1 Engage

## J1939: SA 3 SPN 3456 FMI 3, 4, 5, 7, 12, 13

### Overview

The Endurant Transmission incorporates enhanced controls for PTO operation. The Transmission Control Module (TCM) receives a request (input) to actuate the PTO, determines if conditions are suitable for PTO operation and supplies an output to engage the PTO. Once the PTO is engaged the TCM receives a confirmation (input) that the PTO is engaged to complete the operation. The TCM can be configured to control the PTO with messages over the vehicle Primary Data Link (J1939 controlled) and/or circuits hardwired directly to the TCM (Hardwire controlled). The PTO J1939 controlled messages are received from an OEM ECU and the PTO Hardwire controlled signals are contained in the 20-Way TCM Body Harness Connector. PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

After conditions are met to engage the PTO, the 20-Way TCM Body Harness Connector Pin 2 supplies 12 V and Pin 5 supplies ground to energize a relay/solenoid to engage PTO 1.

### Detection

The TCM monitors the PTO 1 Engage hardwire controlled output circuits. If the PTO 1 Engage output circuits are out of range, the fault is set active.

### Conditions to Set Fault Code Active

**FMI 3 – Voltage Above Normal or Shorted High:** PTO 1 Engage hardwire controlled output signal indicated short to power for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** PTO 1 Engage hardwire controlled output signal indicated short to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** PTO 1 Engage hardwire controlled output signal indicated open circuit for 5 seconds.

**FMI 7 – Mechanical System Not Responding:** PTO 1 commanded to engage, but PTO 1 Confirm message or signal not received.

**FMI 12 – Bad Intelligent Device:** Inappropriate PTO 1 consent engagement.

**FMI 13 – Out of Calibration:** PTO 1 Engage hardwire controlled signal circuit installed but not configured.

### Fallback

**All FMIs:**

- Amber warning lamp on
- PTO 1 Mode Prohibited

### Conditions to Set Fault Code Inactive

**FMI 3:** PTO 1 Engage signal not shorted to power.

**FMI 4:** PTO 1 Engage signal not shorted to ground.

**FMI 5:** PTO 1 Engage circuit not open.

**FMI 7:** PTO 1 Confirm circuit corrected.

**FMI 12:** Key cycle.

**FMI 13:** PTO 1 Mode configured.

### Possible Causes

**FMI 3, 4, 5:**

- PTO 1 Engage Wiring
  - Wiring shorted to power, shorted to ground, or open

**FMI 7:**

- PTO 1 Confirm Switch Wiring
  - Open circuit
- PTO 1 Confirm Switch
  - Stuck open
- PTO 1 Engage Relay
  - Latch failure
- PTO 1 Mechanical
  - PTO fails to engage

**FMI 12:**

- TCM
  - Internal failure
  - Software issue

**FMI 13:**

- PTO 1 Engage Circuit
  - PTO 1 Mode not configured and PTO 1 Engage circuit installed

# Fault Code 910 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 910 FMI 3, 4, 5 is Active or Inactive, go to **Step B.**
   - If Fault Code 910 FMI 7 is Active or Inactive, go to **Step C.**
   - If Fault Code 910 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies at 800-826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 910 FMI 13 is Inactive, PTO 1 is properly configured. Go to **Step V.**.
   - If Fault Code 910 FMI 13 is Active, go to **Step B.**

**B** ***Purpose:*** *Verify Hardwire controlled PTO 1 configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 1 Current Value.
   - If PTO 1 Current Value indicates “Disabled” and PTO 1 is properly installed and wired, select “Hardwire controlled” and follow on-screen prompts. Go to **Step V.**
   - If PTO 1 Current Value indicates “Hardwire controlled” and PTO 1 is properly installed and wired, refer to OEM or body builder guidelines for repair or replacement of the PTO 1 Engage circuits. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

## C

***Purpose:*** *Verify PTO 1 operation and Confirm feedback.*

1. Key on with engine running.
2. Select transmission PTO 1 request switch to off (if necessary).
3. Connect ServiceRanger.
4. Go To “Data Monitor”
5. From the “Default Parameter Files” tab, select “Transmission PTO”.
6. Monitor 520536 – PTO Confirmation Voltage value. Record reading in table.
7. Select transmission PTO 1 request switch to on.
8. Monitor 520536 – PTO Confirmation Voltage value. Record reading in table.
9. Compare reading(s) in table.

   **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the PTO, PTO 1 confirmation switch and/or wiring. Refer to OEM or body builder guidelines for repair or replacement. Go to **Step V.**
   - If readings are out of range, refer to OEM or body builder guidelines for repair or replacement of the PTO, PTO 1 confirmation switch and/or wiring.Go to **Step V.**

| Parameter | Range | Reading(s) |
|---|---|---|
| **PTO 1 Off** | | |
| 520536 – PTO Confirmation Voltage | 4.5–5.5 V | |
| **PTO 1 On** | | |
| 520536 – PTO Confirmation Voltage | 0.0–0.5 V | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 910 sets Active, go to **Step A.**
   - If a fault code other than 910 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 915: PTO 2 Engage

**J1939: SA 3 SPN 3457 FMI 3, 4, 5, 7**

## Overview

The Endurant Transmission incorporates enhanced controls for PTO operation. The Transmission Control Module (TCM) receives a request (input) to actuate the PTO, determines if conditions are suitable for PTO operation and supplies an output to engage the PTO. Once the PTO is engaged the TCM receives a confirmation (input) that the PTO is engaged to complete the operation. The TCM can be configured to control the PTO with messages over the vehicle Primary Data Link (J1939 controlled) and/or circuits hardwired directly to the TCM (Hardwire controlled). The PTO J1939 controlled messages are received from an OEM ECU and the PTO Hardwire controlled signals are contained in the 20-Way TCM Body Harness Connector. PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

After conditions are met to engage the PTO, the 20-Way TCM Body Harness Connector Pin 2 supplies 12 V and Pin 5 supplies ground to energize a relay/solenoid to engage PTO 2.

## Detection

The TCM monitors the PTO 2 Engage hardwire controlled output circuits. If the PTO 2 Engage output circuits are out of range, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 3 – Voltage Above Normal or Shorted High:** PTO 2 Engage hardwire controlled output signal indicated short to power for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** PTO 2 Engage hardwire controlled output signal indicated short to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** PTO 2 Engage hardwire controlled output signal indicated open circuit for 5 seconds.

**FMI 7 – Mechanical System Not Responding:** PTO 2 commanded to engage, but PTO 2 Confirm message or signal not received.

## Fallback

**All FMIs:**

- Amber warning lamp on
- PTO 2 Mode Prohibited

## Conditions to Set Fault Code Inactive

**FMI 3:** PTO 2 Engage signal not shorted to power.

**FMI 4:** PTO 2 Engage signal not shorted to ground.

**FMI 5:** PTO 2 Engage circuit not open.

**FMI 7:** PTO 2 Confirm circuit corrected.

## Possible Causes

**FMI 3, 4, 5:**

- PTO 2 Engage Wiring
  - Wiring shorted to power, shorted to ground, or open

**FMI 7:**

- PTO 2 Confirm Switch Wiring
  - Open circuit
- PTO 2 Confirm Switch
  - Stuck open
- PTO 2 Engage Relay
  - Latch failure
- PTO 2 Mechanical
  - PTO fails to engage

# Fault Code 915 Troubleshooting

**A**

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 915 FMI 3, 4, 5 is Active or Inactive, go to **Step B.**
   - If Fault Code 915 FMI 7 is Active or Inactive, go to **Step C.**

**B**

***Purpose:*** *Verify Hardwire controlled PTO 2 configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 2 Current Value.
   - If PTO 2 Current Value indicates “Disabled” and PTO 2 is properly installed and wired, select “Hardwire controlled” and follow on-screen prompts. Go to **Step V.**
   - If PTO 2 Current Value indicates “Hardwire controlled” and PTO 2 is properly installed and wired, refer to OEM or body builder guidelines for repair or replacement of the PTO 2 Engage circuits. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

**C** ***Purpose:*** *Verify PTO 2 operation and Confirm feedback.*

1. Key on with engine running.
2. Select transmission PTO 2 request switch to off (if necessary).
3. Connect ServiceRanger.
4. Go To “Data Monitor”
5. From the “Default Parameter Files” tab, select “Transmission PTO”.
6. Monitor 520536 – PTO Confirmation Voltage value. Record reading in table.
7. Select transmission PTO 2 request switch to on.
8. Monitor 520536 – PTO Confirmation Voltage value. Record reading in table.
9. Compare reading(s) in table.

   **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the PTO, PTO 2 confirmation switch and/or wiring. Refer to OEM or body builder guidelines for repair or replacement. Go to **Step V.**
   - If readings are out of range, refer to OEM or body builder guidelines for repair or replacement of the PTO, PTO 2 confirmation switch and/or wiring.Go to **Step V.**

| Parameter | Range | Reading(s) |
|---|---|---|
| **PTO 2 Off** | | |
| 520536 – PTO Confirmation Voltage | 4.5–5.5 V | |
| **PTO 2 On** | | |
| 520536 – PTO Confirmation Voltage | 0.0–0.5 V | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 915 sets Active, go to **Step A.**
   - If a fault code other than 915 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 920: PTO 1 Confirm

## J1939: SA 3 SPN 3460 FMI 3, 7, 9, 13, 19, 20, 21

### Overview

The Endurant Transmission incorporates enhanced controls for PTO operation. The Transmission Control Module (TCM) receives a request (input) to actuate the PTO, determines if conditions are suitable for PTO operation and supplies an output to engage the PTO. Once the PTO is engaged the TCM receives a confirmation (input) that the PTO is engaged to complete the operation. The TCM can be configured to control the PTO with messages over the vehicle Primary Data Link (J1939 controlled) and/or circuits hardwired directly to the TCM (Hardwire controlled). The PTO J1939 controlled messages are received from an OEM ECU and the PTO Hardwire controlled signals are contained in the 20-Way TCM Body Harness Connector. PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

At the 20-Way TCM Body Harness Connector to the PTO 1 confirm switch, Pin 16 provides a 2.5 - 5.5 V reference. When the PTO is engaged, the confirm switch is closed to vehicle ground completing the circuit between Pin 16 reference voltage and ground causing the reference voltage to go low.

### Detection

The TCM monitors the PTO 1 Confirm J1939 controlled message and/or the hardwire controlled input signal circuit. If the PTO 1 Confirm message or input signal is out of range, the fault is set active.

### Conditions to Set Fault Code Active

**FMI 3 – Voltage Above Normal or Shorted High:** PTO 1 Confirm hardwire controlled signal indicated greater than 5.25 V for 5 seconds.

**FMI 7 – Mechanical System Not Responding:** PTO 1 Engage command not given, but PTO 1 Confirm message or signal indicates engaged.

**FMI 9 – Abnormal Update Rate:** PTO 1 Confirm J1939 controlled message not received for 5 second.

**FMI 13 – Out of Calibration:** PTO 1 Confirm J1939 controlled message not available for 5 seconds.

**FMI 19 – Received Network Data in Error:** PTO 1 Confirm J1939 controlled message invalid for 5 second.

**FMI 20 – Data Drifted High:** PTO 1 Confirm hardwire controlled signal indicated 4.00–5.25 V for 5 seconds.

**FMI 21 – Data Drifted Low:** PTO 1 Confirm hardwire controlled signal indicated 1.5–2.5 V for 5 seconds.

### Fallback

**All FMIs:**

- Amber warning lamp on
- PTO 1 Mode Prohibited

### Conditions to Set Fault Code Inactive

**FMI 3, 20:** PTO 1 Confirm signal not shorted to power.

**FMI 7:** PTO 1 Confirm signal not continuously grounded.

**FMI 9, 13, 19:** OEM Module configured correctly or PTO 1 disabled TCM

**FMI 21:** PTO 1 Confirm signal not shorted to ground.

### Possible Causes

**FMI 3:**

- PTO 1 Confirm Wiring
  - Wiring shorted to power

**FMI 7:**

- PTO 1 Confirm Switch Wiring
  - Shorted to ground
- PTO 1 Confirm Switch
  - Stuck closed
- PTO 1 Mechanical
  - PTO always engaged

**FMI 9, 13, 19:**

- PTO 1 J1939 control message not received or incorrect
  - OEM Module configuration setting

**FMI 20:**

- PTO 1 Confirm Wiring
  - High resistance short to power

**FMI 21:**

- PTO 1 Confirm Wiring
  - High resistance short to ground

# Fault Code 920 Troubleshooting

## A

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 920 FMI 3, 20, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 920 FMI 7 is Active or Inactive, go to **Step D.**
   - If Fault Code 920 FMI 9, 13, 19 is Active, go to **Step C.**
   - If Fault Code 920 FMI 9, 13, 19 is Inactive, PTO 1 is properly configured and communicating valid PTO messages in the TCM and OEM ECU. Go to **Step V.**.

## B

***Purpose:*** *Verify PTO 1 Hardwire controlled configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 1 Current Value.
   - If PTO 1 Current Value indicates “Disabled” and PTO 1 is properly installed and wired, select “Hardwire controlled” or “J1939 request and engage with hardwire confirmation” and follow on-screen prompts. Go to **Step V.**
   - If PTO 1 Current Value indicates “Hardwire controlled” or “J1939 request and engage with hardwire confirmation” and PTO 1 is properly installed and wired, refer to OEM or body builder guidelines for repair or replacement of the PTO Confirm switch or circuit. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

## C

***Purpose:*** *Verify PTO 1 J1939 controlled configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 1 Current Value.
   - If PTO 1 Current Value indicates “J1939 controlled” and a PTO is not installed, select “Disabled” and follow on-screen prompts. Go to **Step V.**
   - If PTO 1 Current Value indicates “J1939 controlled” and PTO 1 is properly installed and wired, refer to OEM guidelines regarding OEM ECU PTO configuration settings. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

**D** ***Purpose:*** *Verify PTO 1 operation and Confirm feedback.*

1. Key on with engine running.
2. Select transmission PTO 1 request switch to off (if necessary).
3. Connect ServiceRanger.
4. Go To “Data Monitor”
5. From the “Default Parameter Files” tab, select “Transmission PTO”.
6. Monitor 520536 – PTO Confirmation Voltage value. Record reading in table.
7. Select transmission PTO 1 request switch to on.
8. Monitor 520536 – PTO Confirmation Voltage value. Record reading in table.
9. Compare reading(s) in table.

   **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the PTO, PTO 1 confirmation switch and/or wiring. Refer to OEM or body builder guidelines for repair or replacement.Go to **Step V.**
   - If readings are out of range, refer to OEM or body builder guidelines for repair or replacement of the PTO, PTO 1 confirmation switch and/or wiring.Go to **Step V.**

| Parameter | Range | Reading(s) |
|---|---|---|
| **PTO 1 Off** | | |
| 520536 – PTO Confirmation Voltage | 4.5–5.5 V | |
| **PTO 1 On** | | |
| 520536 – PTO Confirmation Voltage | 0.0–0.5 V | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 920 sets Active, go to **Step A.**
   - If a fault code other than 920 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 925: PTO 2 Confirm

**J1939: SA 3 SPN 3461 FMI 7, 9, 13, 19**

## Overview

The Endurant Transmission incorporates enhanced controls for PTO operation. The Transmission Control Module (TCM) receives a request (input) to actuate the PTO, determines if conditions are suitable for PTO operation and supplies an output to engage the PTO. Once the PTO is engaged the TCM receives a confirmation (input) that the PTO is engaged to complete the operation. The TCM can be configured to control the PTO with messages over the vehicle Primary Data Link (J1939 controlled) and/or circuits hardwired directly to the TCM (Hardwire controlled). The PTO J1939 controlled messages are received from an OEM ECU and the PTO Hardwire controlled signals are contained in the 20-Way TCM Body Harness Connector. PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

At the 20-Way TCM Body Harness Connector to the PTO 2 confirm switch, Pin 16 provides a 2.5 - 5.5 V reference. When the PTO is engaged, the confirm switch is closed to vehicle ground completing the circuit between Pin 16 reference voltage and ground causing the reference voltage to go low.

## Detection

The TCM monitors the PTO Confirm J1939 controlled message and/or the hardwire controlled input signal circuit. If the PTO 2 Confirm message or input signal is out of range, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 7 – Mechanical System Not Responding:** PTO 2 Engage command not given, but PTO 2 Confirm message or signal indicates engaged.

**FMI 9 – Abnormal Update Rate:** PTO 2 Confirm J1939 controlled message not received for 5 second.

**FMI 13 – Out of Calibration:** PTO 2 Confirm J1939 controlled message not available for 5 seconds.

**FMI 19 – Received Network Data in Error:** PTO 2 Confirm J1939 controlled message invalid for 5 second.

## Fallback

**All FMIs:**

- Amber warning lamp on
- PTO 2 Mode Prohibited

## Conditions to Set Fault Code Inactive

**FMI 7:** PTO 2 Confirm signal not continuously grounded.

**FMI 9, 13, 19:** OEM Module configured correctly or PTO 2 disabled TCM

## Possible Causes

**FMI 7:**

- PTO 2 Confirm Switch Wiring
  - Shorted to ground
- PTO 2 Confirm Switch
  - Stuck closed
- PTO 2 Mechanical
  - PTO always engaged

**FMI 9, 13, 19:**

- PTO 2 J1939 control message not received or incorrect
  - OEM Module configuration setting

# Fault Code 925 Troubleshooting

**A**

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 925 FMI 3, 20, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 925 FMI 7 is Active or Inactive, go to **Step D.**
   - If Fault Code 925 FMI 9, 13, 19 is Active, go to **Step C.**
   - If Fault Code 925 FMI 9, 13, 19 is Inactive, PTO 2 is properly configured and communicating valid PTO messages in the TCM and OEM ECU. Go to **Step V.**.

**B**

***Purpose:*** *Verify PTO 2 Hardwire controlled configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 2 Current Value.
   - If PTO 2 Current Value indicates “Disabled” and PTO 2 is properly installed and wired, select “Hardwire controlled” or “J1939 request and engage with hardwire confirmation” and follow on-screen prompts. Go to **Step V.**
   - If PTO 2 Current Value indicates “Hardwire controlled” or “J1939 request and engage with hardwire confirmation” and PTO 2 is properly installed and wired, refer to OEM or body builder guidelines for repair or replacement of the PTO Confirm switch or circuit. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

**C** ***Purpose:*** *Verify PTO 2 J1939 controlled configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “PTO”.
5. Record PTO 2 Current Value.
   - If PTO 2 Current Value indicates “J1939 controlled” and a PTO is not installed, select “Disabled” and follow on-screen prompts. Go to **Step V.**
   - If PTO 2 Current Value indicates “J1939 controlled” and PTO 2 is properly installed and wired, refer to OEM guidelines regarding OEM ECU PTO configuration settings. Go to **Step V.**

     **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

**D** ***Purpose:*** *Verify PTO 2 operation and Confirm feedback.*

1. Key on with engine running.
2. Select transmission PTO 2 request switch to off (if necessary).
3. Connect ServiceRanger.
4. Go To “Data Monitor”
5. From the “Default Parameter Files” tab, select “Transmission PTO”.
6. Monitor 520536 – PTO Confirmation Voltage value. Record reading in table.
7. Select transmission PTO 2 request switch to on.
8. Monitor 520536 – PTO Confirmation Voltage value. Record reading in table.
9. Compare reading(s) in table.

   **Note:** PTO and wiring are installed by the OEM or body builder, reference TRIG2600 for PTO system installation and wiring diagrams.

   - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the PTO, PTO 2 confirmation switch and/or wiring. Refer to OEM or body builder guidelines for repair or replacement.Go to **Step V.**
   - If readings are out of range, refer to OEM or body builder guidelines for repair or replacement of the PTO, PTO 2 confirmation switch and/or wiring.Go to **Step V.**

| Parameter | Range | Reading(s) |
|---|---|---|
| **PTO 2 Off** | | |
| 520536 – PTO Confirmation Voltage | 4.5–5.5 V | |
| **PTO 2 On** | | |
| 520536 – PTO Confirmation Voltage | 0.0–0.5 V | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 925 sets Active, go to **Step A.**
   - If a fault code other than 925 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 950: Neutral Status 1

**J1939: SA 3 SPN 3648 FMI 12**

## Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow to actuate the clutch and shift rails and sensors to monitor the clutch and shift rail positions. The Transmission Control Module (TCM) compares current gear and requested gear to ensure proper operation.

## Detection

The TCM monitors the Neutral Mode request and current gear, if current gear is invalid, the TCM sets the fault code Active.

## Conditions to Set Fault Code Active

**FMI 12 – Bad Intelligent Device:** Inappropriate selection of a Non Neutral Mode when Neutral is requested.

## Fallback

**FMI 12:**

- Non neutral modes prohibited
- Clutch engagement prohibited
- PTO Mode prohibited
- Urge to Move and Creep Mode prohibited

## Conditions to Set Fault Code Inactive

**FMI 12:** Power down (key cycle)

## Possible Causes

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

## Additional Tools

- None

# Fault Code 950 Troubleshooting

**A**

***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 950 FMI 12 is Inactive or Active, contact Eaton Cummins Automated Transmission Technologies at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

**V**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 950 sets Active during test drive, Go to **Step A.**
   - If a fault code other than 950 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 960: Neutral Status 2

**J1939: SA 3 SPN 6159 FMI 12**

## Overview

The Mechatronic Transmission Module (MTM) is equipped with solenoids to direct pneumatic flow to actuate the clutch and shift rails and sensors to monitor the clutch and shift rail positions. The Transmission Control Module (TCM) compares current gear and requested gear to ensure proper operation.

## Detection

The TCM monitors the Neutral Mode request and current gear, if current gear is invalid, the TCM sets the fault code Active.

## Conditions to Set Fault Code Active

**FMI 12 –Bad Intelligent Device:** Unable to achieve Neutral when Neutral is requested.

## Fallback

**FMI 12:**

- Non neutral modes prohibited
- Clutch engagement prohibited
- PTO Mode prohibited
- Urge to Move and Creep Mode prohibited

## Conditions to Set Fault Code Inactive

**FMI 12:** Power down (key cycle)

## Possible Causes

**FMI 12:**

- TCM
  - Software issue
  - Internal failure

## Additional Tools

- None

# Fault Code 960 Troubleshooting

**A** ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity report created during the Diagnostic Procedure.
   - If Fault Code 960 FMI 12 is Inactive or Active, contact Eaton Cummins Automated Transmission Technologies at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

**B** ***Purpose:*** *Verify Neutral Select Mode configuration with ServiceRanger.*

1. Key on.

   **Note:** Neutral Select Mode switch and wiring is installed by the OEM or body builder. Reference TRIG0950 for Force/Hold/Momentary Neutral system operation and recommended wiring configuration.
2. Connect ServiceRanger.
3. Check Neutral Select Mode Configuration:
   - If Neutral Select Mode is disabled and an external switch and wiring is installed, enable a Neutral Select Mode based on desired configuration. Go to **Step V.**
   - If Neutral Select Mode is properly configured and an external switch and wiring is installed, refer to OEM or body builder guidelines for repair or replacement of Neutral Input circuit. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 960 sets Active during test drive, Go to **Step A.**
   - If a fault code other than 960 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 970: Neutral Output

**J1939: SA 3 SPN 604 FMI 3, 4, 5**

## Overview

The Endurant Transmission can provide a Neutral Output signal to other devices on the vehicle. The Transmission Control Module (TCM) is configurable to provide a 12-volt hardwire signal to indicate when the transmission is in neutral. The Neutral Output signal is contained in the 20-Way TCM Body Harness Connector.

## Detection

The TCM monitors the Neutral Output signal circuits (Pin 3 supplies 12 V when the transmission is in Neutral and Pin 5 provides a return ground). If the Neutral Output signal is out of range, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 3 – Voltage Above Normal or Shorted High:** Neutral Output signal shorted to power for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** Neutral Output signal shorted to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** Neutral Output circuit open for 5 seconds.

## Fallback

**All FMIs:**

- Amber warning lamp on
- Devices requiring Neutral Output signal may not function

## Conditions to Set Fault Code Inactive

**FMI 3, 4, 5:** Neutral Output signal in range for 10 seconds.

## Possible Causes

**FMI 3, 4, 5:**

- Neutral Output wiring
  - Neutral Output is configured “Enabled” in the TCM but wiring is not installed.
  - Wiring shorted to power, shorted to ground or open.

# Fault Code 970 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 970 is Active or Inactive, go to **Step B.**

**B** ***Purpose:*** *Verify Neutral Output wiring.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configurations”.
4. Select “Options”.
5. Record the “Neutral Output Signal” “Current Value” in table.
   - If the Neutral Output Signal Current Value indicates “Enabled” and the Neutral Output signal circuit is not installed, select “Disabled” and follow on-screen prompts. Go to **Step V.**
   - If the Neutral Output Signal Current Value indicates “Enabled” and the Neutral Output is properly installed and wired, refer to OEM or body builder guidelines for repair or replacement of the Neutral Output signal wiring. Go to **Step V.**

     **Note:** Neutral Output signal wiring is installed by the OEM or body builder, reference OEM or body builder wiring diagrams.

| Parameter | Value |
|---|---|
| Neutral Output Signal | |

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 970 sets Active during operation, go to **Step A.**
   - If a fault code other than 970 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Fault Code 975: Reverse Output

**J1939: SA 3 SPN 767 FMI 3, 4, 5**

## Overview

The Transmission Control Module (TCM) can provide a Reverse Output signal to other devices on the vehicle. The TCM is configurable to provide a 12-volt hardwire signal to indicate when the transmission is in reverse. The Reverse Output signal is contained in the 20-Way TCM Body Harness Connector.

## Detection

The TCM monitors the Reverse Output signal circuit (Pin 1 supplies 12 V when the transmission is in Reverse and Pin 5 provides a return ground). If the Reverse Output signal is out of range, the fault is set active.

## Conditions to Set Fault Code Active

**FMI 3 – Voltage Above Normal or Shorted High:** Reverse Output signal shorted to power for 5 seconds.

**FMI 4 – Voltage Below Normal or Shorted Low:** Reverse Output signal shorted to ground for 5 seconds.

**FMI 5 – Current Below Normal or Open Circuit:** Reverse Output circuit open for 5 seconds.

## Fallback

**FMI 3, 4, 5:**

- Amber warning lamp on
- Devices requiring Reverse Output signal may not function

## Conditions to Set Fault Code Inactive

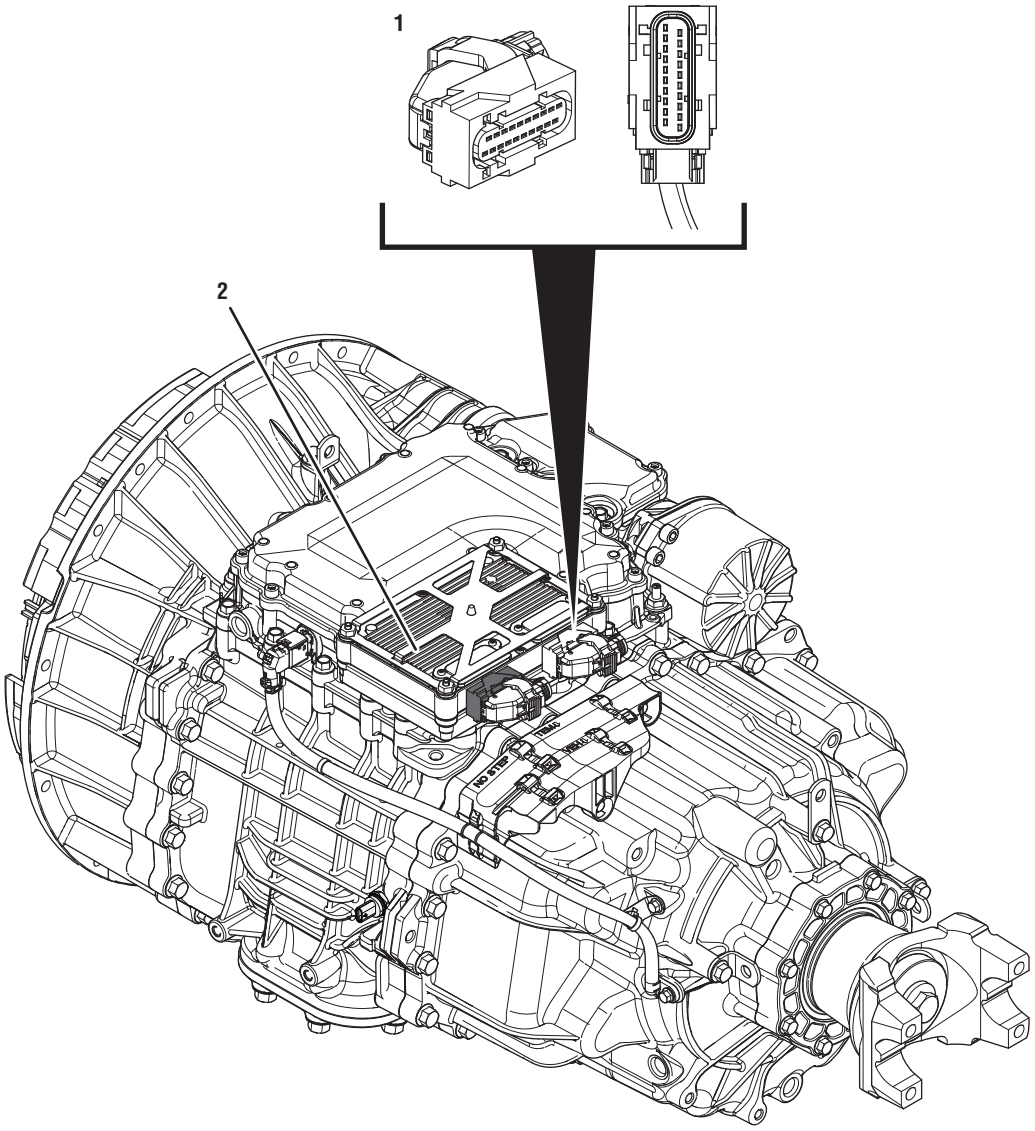
**FMI 3, 4, 5:** Reverse Output signal in range for 10 seconds.

## Possible Causes

**FMI 3, 4, 5:**

- Reverse Output wiring
  - Reverse Output is configured “Enabled” in the TCM but wiring is not installed.
  - Wiring shorted to power, shorted to ground or open.

## Component Identification




*1. 20-Way TCM Body Harness Connector*
*2. Transmission Control Module (TCM)*

# Fault Code 975 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 975 is Active, go to **Step V.**
   - If Fault Code 975 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Reverse Output signal wiring. Contact OEM for further diagnostic instructions. Go to **Step V.**

     **Note:** Reverse Output signal wiring is installed by the OEM, reference OEM wiring diagrams.

**B** ***Purpose:*** *Verify Reverse Output Signal configured in the TCM and installed on the vehicle.*

1. Key off.
2. Allow TCM to perform a complete power down.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Configuration”.
6. Select “Options”.
7. Record the “Reverse Output Signal” "Current Value" in table.
8. Record the “Reverse Output Signal” installed on the vehicle in table.

   **Note:** The vehicle's Reverse Output Signal (Disable or Enable) is determined by OEM. Refer to the OEM regarding the Reverse Output Signal installed on the vehicle.
9. Compare reading(s) in table.
   - If “Reverse Output Signal” 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.**
   - If FC975 is Active and “Reverse Output Signal” is configured correctly, refer to OEM guidelines for repair or replacement of the Reverse Output signal wiring. Go to **Step V.**

| Location | Reverse Output Signal |
|---|---|
| TCM (ServiceRanger) | |
| Vehicle | |

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 975 sets Active during test drive, go to **Step A.**
   - If a fault code other than 975 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

# Start Enable Relay Contact Test

## 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

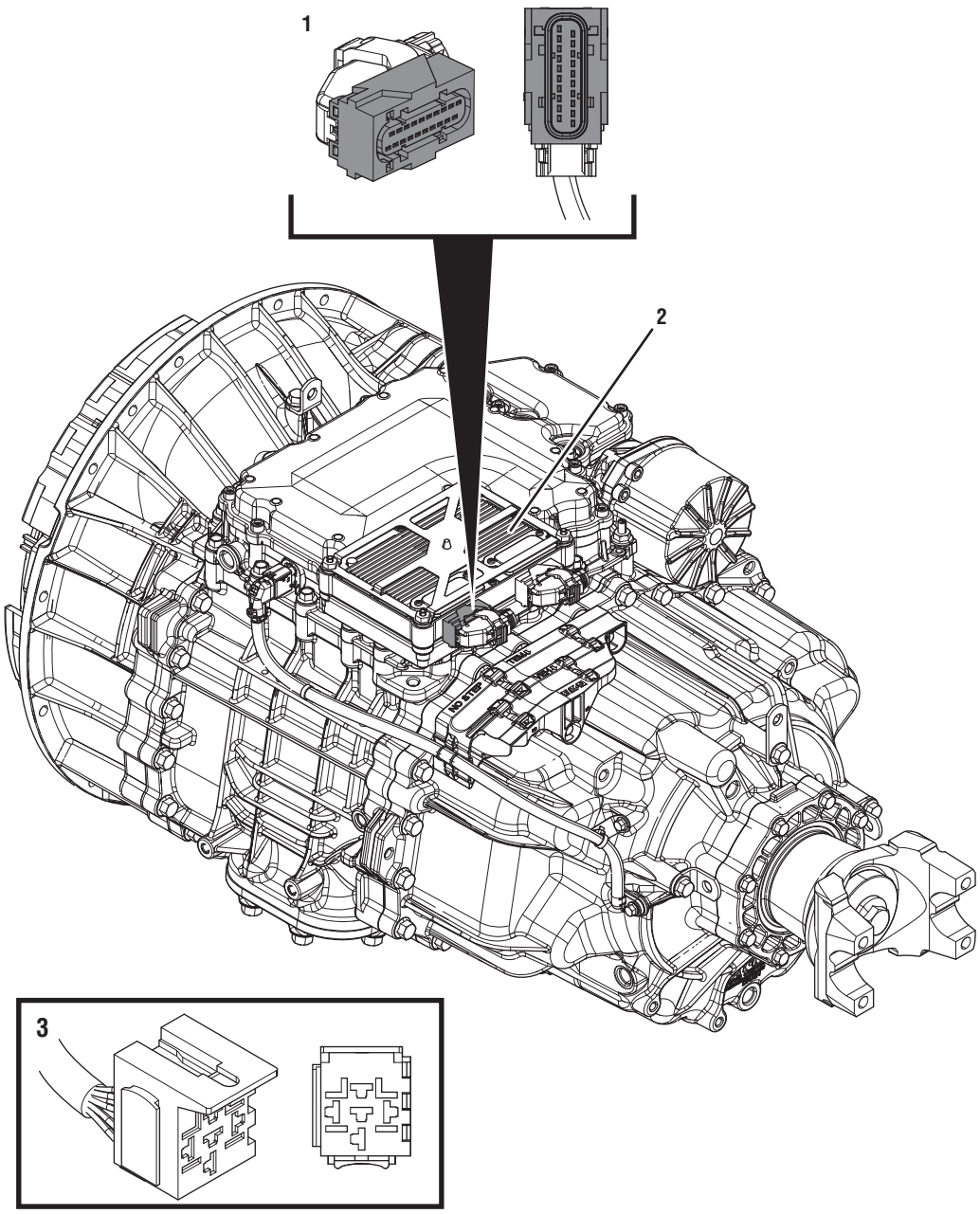
- Engine does not crank with the transmission in park or neutral.
- Engine cranks with the transmission in a non-neutral position.

**Note:** If the engine was shut off with the transmission in gear, confirm the vehicle air supply pressure is in range and the vehicle parking brake is set or service brake is depressed when attempting to start the engine.

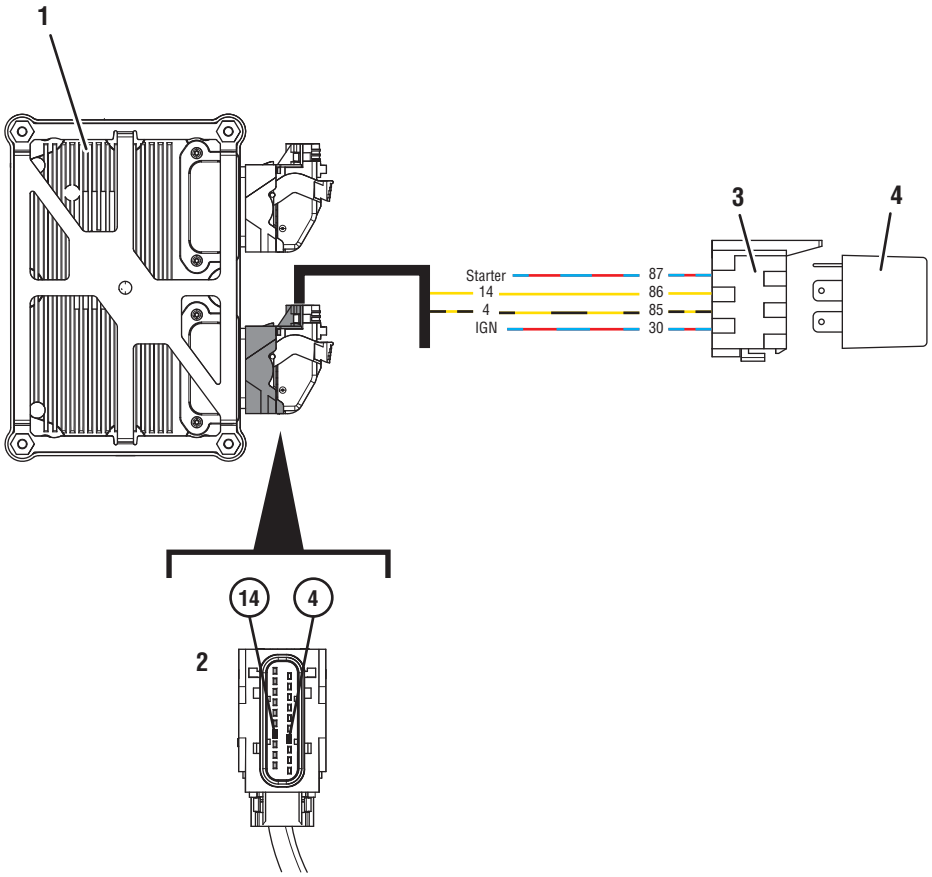
## Possible Causes

- Start Enable Type
  - Mis-configured in the TCM
  - J1939 start enable message not received by vehicle
- Start Enable Relay
  - Internal failure
- Start Enable Relay Circuit Wiring
  - Bypassed or “jumped” Start Enable Relay circuit
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open

## Component Identification

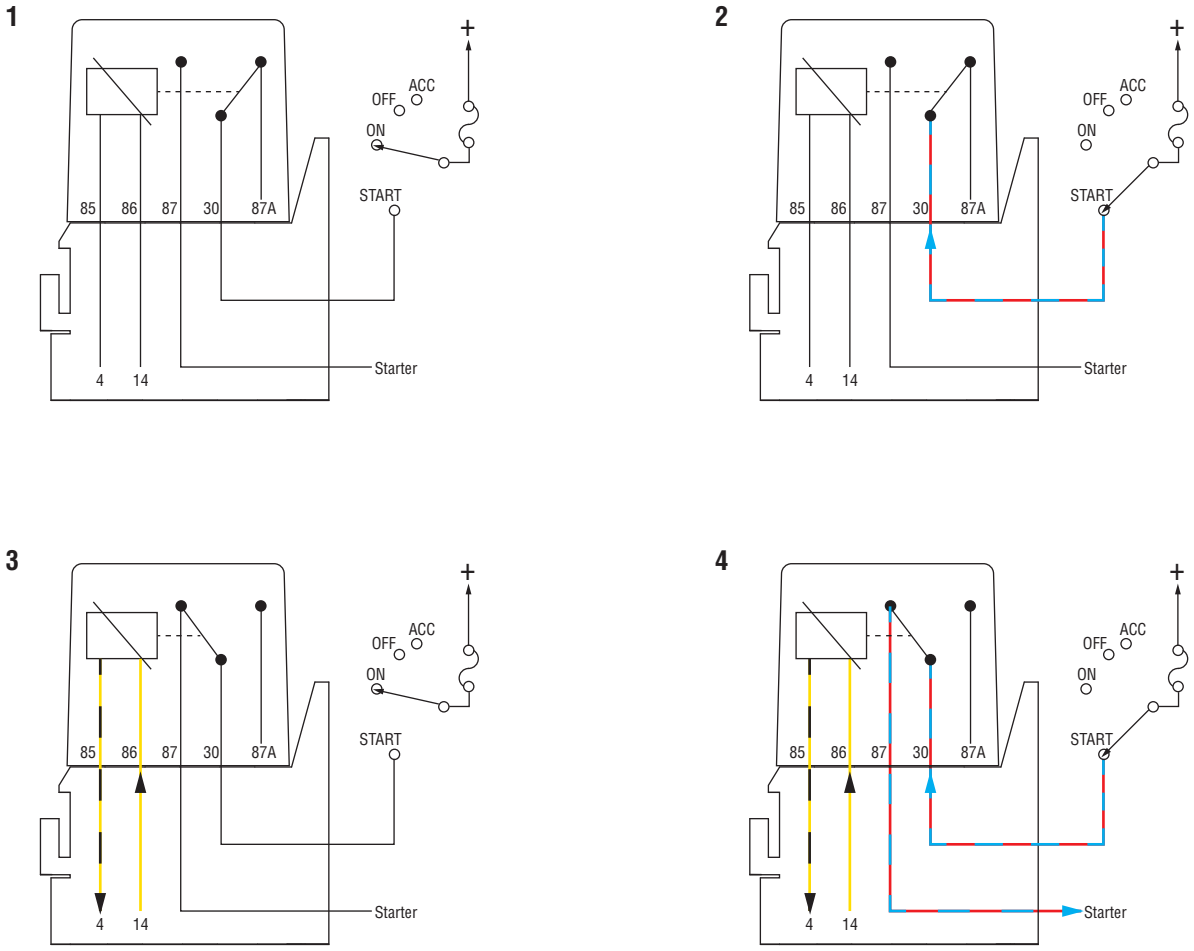



*1. 20-Way TCM Vehicle Harness Connector*
*2. Transmission Control Module (TCM)*
*3. 5-Way Start Enable Relay Socket*




*1. Transmission Control Module (TCM)*
*2. 20-Way TCM Vehicle Harness Connector*
*3. 5-Way Start Enable Relay Socket*
*4. 5-Way Start Enable Relay*

Battery Voltage
Ignition Voltage
Switched Battery from TCM
Switched 5V from TCM
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*

# Start Enable Relay Contact Test

## A

***Purpose:*** *Confirm Driver Interface Device is in Neutral and the Display indicates "N".*

1. Set vehicle parking brake and chock wheels.
2. Key on with engine off.
3. Verify that the Transmission Driver Interface Device is in the Neutral (N) position.
4. Verify the transmission is in Neutral, indicated by an "N" in the display.
   - If the display indicates "N", go to **Step B.**
   - If the display does not indicate "N", contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**

## B

***Purpose:*** *Verify condition of vehicle starting and charging system.*

1. Key off.
2. Inspect vehicle starting/charging/battery system per OEM guidelines.
   - If a fault was found, refer to OEM guidelines for repair or replacement of the vehicle starting/charging/battery system. Go to **Step V.**
   - If no fault found, go to **Step C.**

## C

***Purpose:*** *Update TCM to the latest available software and determine if the Start Enable system is a hard-wired relay or a J1939 message.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Select "Service Activity Report".
4. Enter information and select "Start Report".

   **Note:** Transmission information is downloaded into report.
5. Select "Send to Eaton".

   **Note:** Internet connection is required.
6. Update TCM to the latest available software.

   **Note:** To avoid damaging the TCM, 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.
8. 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 a Start Enable message is sent over J1939 by the TCM, go to **Step D.**
   - If a Start Enable Relay is hardwired to the TCM, go to **Step G.**

## D

***Purpose:*** *Connect ServiceRanger and determine if the "Start Enable Type" is configured correctly.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To "Configuration".
4. Select "Vehicle".
5. Record the "Start Enable Type" "Current Value" in table.
6. Confirm the configuration matches the vehicle's start enable system.
7. Compare reading(s) in table.
   - If readings are in range, go to **Step E.**
   - If readings are out of range, select "J1939" from the "New Value" drop down, select "Apply" and follow on-screen prompts. Go to **Step V.**

| Parameter | Range | Reading(s) |
|---|---|---|
| Start Enable Type | J1939 | |

## E

***Purpose:*** *Attempt to crank the engine when the engine should crank.*

1. Key on with engine off.
2. Verify that the Transmission Driver Interface Device is in Neutral (N).
3. Verify the transmission is in Neutral, indicated by an "N" in the display.
4. Depress and hold the service brake, attempt to crank the engine.
   - If engine cranks, 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. Go to **Step V.**

## F

***Purpose:*** *Attempt to crank the engine when the engine should not crank.*

1. Key on with engine off.
2. Place the Transmission Driver Interface Device in a non-Neutral position.
3. Depress and hold the service brake, attempt to crank the engine.
4. Return the Transmission Driver Interface Device to Neutral (N).
   - If the engine cranks, a vehicle system allowed the engine to crank when the transmission system requested cranking disabled. Contact OEM for further diagnostic instructions. Go to **Step V.**
   - If the engine does not crank, no fault was found. Test Complete. If additional troubleshooting is required, contact OEM for additional information about this system. Go to **Step V.**

## G

***Purpose:*** *Connect ServiceRanger and determine if the "Start Enable Relay Type" is configured correctly.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To "Configuration".
4. Select "Vehicle".
5. Record the "Start Enable Type" "Current Value" in table.
6. Confirm the configuration matches the vehicle's start enable system.
7. Compare reading(s) in table.
   - If readings are in range, go to **Step H.**
   - If readings are out of range, select "Relay" from the "New Value" drop down, select "Apply" and follow on-screen prompts. Go to **Step V.**

| Parameter | Range | Reading(s) |
|---|---|---|
| Start Enable Type | Relay | |

## H

***Purpose:*** *Attempt to crank the engine when the engine should crank.*

1. Key on with engine off.
2. Verify that the Transmission Driver Interface Device is in Neutral (N).
3. Verify the transmission is in Neutral, indicated by an “N” in the display.
4. Depress and hold the service brake, attempt to crank the engine.
   - If the engine cranks, go to **Step I.**
   - If the engine does not crank, go to **Step L.**

## I

***Purpose:*** *Attempt to crank the engine when the engine should not crank.*

1. Key on with engine off.
2. Place the Transmission Driver Interface Device in a non-Neutral position.
3. Depress and hold the service brake, attempt to crank the engine.
4. Return the Transmission Driver Interface Device to Neutral (N).
   - If the engine cranks, go to **Step J.**
   - If the engine does not crank, go to **Step K.**

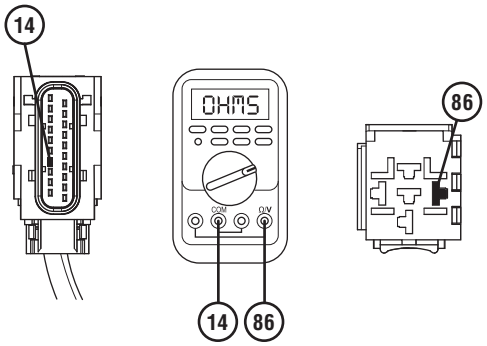
## J

***Purpose:*** *Remove the Start Enable Relay and attempt to crank the engine.*

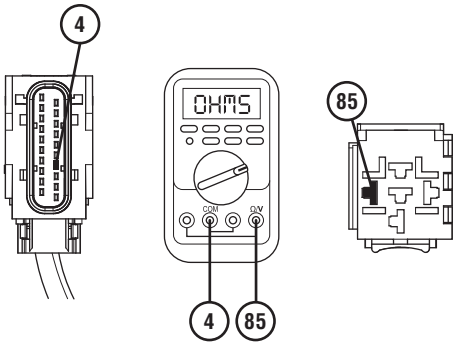
1. Key on with engine off.
2. Remove the Start Enable Relay.
3. Key on with engine off.
4. Place the Transmission Driver Interface Device in a non-Neutral position.
5. Depress and hold the service brake, attempt to crank the engine.
6. Return the Transmission Driver Interface Device to Neutral (N).
   - If the engine cranks, refer to OEM guidelines for repair or replacement of Start Enable Relay wiring. 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.
2. Refer to OEM wiring diagrams and verify the Start Enable Relay wiring is properly installed.
3. Disconnect the Start Enable Relay from the socket.
4. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 14 and Start Enable Relay Socket Pin 86. Record reading in table.




5. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 4 and Start Enable Relay Socket Pin 85. Record reading in table.



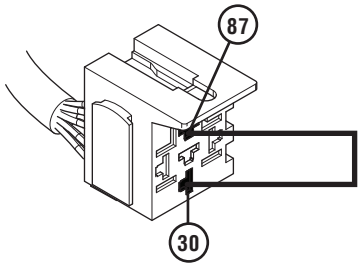

6. Compare reading(s) in table.
   - If readings are in range, go to **Step L.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the Start Enable Relay wiring. Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| VH 14 to SER 86 | 0.0–0.3 ohms | |
| VH 4 to SER 85 | 0.0–0.3 ohms | |

## L

***Purpose:*** *Verify system will crank with the relay bypassed.*

1. Set vehicle parking brake and chock wheels.
2. Key on with engine off.
3. Verify the Transmission Driver Interface Device is in the Neutral (N) position.
4. Verify the transmission is in Neutral indicated by an “N” in the display.
5. Key off.
6. Remove the Start Enable Relay.
7. Place a jumper wire between socket Pin 30 and Pin 87.




8. Key on with engine off.
9. Verify that the Transmission Driver Interface Device is in Neutral (N) position.
10. Verify the transmission is in Neutral, indicated by an “N” in the display.
11. Depress and hold the service brake, attempt to crank the engine.
    - If the engine cranks, replace the Start Enable Relay. Go to **Step V.**
    - If the engine does not crank, contact OEM for further diagnostic instructions. Go to **Step V.**

## V

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Clear fault codes using ServiceRanger.
5. Verify that the Driver Interface Device is in Neutral (N).
6. Verify the transmission is in Neutral, indicated by an “N” in the 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 OEM for further diagnostic instructions.

# Brake Switch Functionality Test

## Overview

This procedure does not relate to any specific fault code, but verifies that the Transmission Control Module (TCM) is receiving service brake switch input and park brake switch input from the vehicle.

## Detection

- Transmission does not engage a gear from Neutral.

**Note:** The transmission will not engage a gear from Neutral if the service brake is not depressed.

## Possible Causes

- Vehicle Service Brake Switch Input Messages
  - Not available, not sent or in error
- Service Brake Switch
  - Internal failure
- Park Brake Switch
  - Internal failure

# Brake Switch Functionality Test

**A** ***Purpose:*** *Monitor Service Brake Switch signal in ServiceRanger.*

1. Set vehicle parking brake and chock wheels.
2. Key on with engine running.
3. Allow air pressure to build to governor cut off.
4. Key off.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Go To “Data Monitor”.
8. From the Default Parameter Files select “Vehicle Brake Messages”.

   **Note:** Not all sources will indicate a value.
9. Monitor two Vehicle Brake parameters. Record parameters and their values in table.
10. Depress and hold service brake.
11. Monitor the same two Vehicle Brake parameters and record their values in table.
12. Release service brake.
13. Compare reading(s) in table.
    - If two parameters with values are not indicated or values did not change with the service brake depressed, refer to OEM guidelines for repair or replacement of the service brake switch/signal. Go to **Step V.**

      **Note:** The transmission requires a minimum of two valid service brake switch input messages from the vehicle to engage a gear from Neutral.
    - If two or more parameters are indicated and their values changed with the service brake depressed, no fault was found. Go to **Step B.**

| Service Brake State | Service Brake Parameters Indicated | Value(s) |
|---|---|---|
| Released | 1. | |
| | 2. | |
| Depressed | 1. | |
| | 2. | |

**B** ***Purpose:*** *Verify Vehicle Parking Brake Switch signal with ServiceRanger.*

1. Key on with engine running.
2. Allow air pressure to build to governor cut off.
3. Key off.
4. Key on with engine off.
5. Connect ServiceRanger.
6. Go To “Data Monitor”.
7. From the “Default Parameter Files” tab, select “Vehicle Brake Messages”.
8. Monitor 70 - Parking brake switch status. Record reading in table.
9. Depress and hold service brake.
10. Release vehicle parking brake.
11. Monitor 70 - Parking brake switch status value. Record reading in table.
12. Set vehicle parking brake.
13. Monitor 70 - Parking brake switch status. Record reading in table.
14. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the Parking Brake Switch/signal.
    - If readings are in range, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions.

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

# Transmission Shift Complaint

## Overview

This symptom-driven test is performed if a shift complaint exists and there are no fault codes.

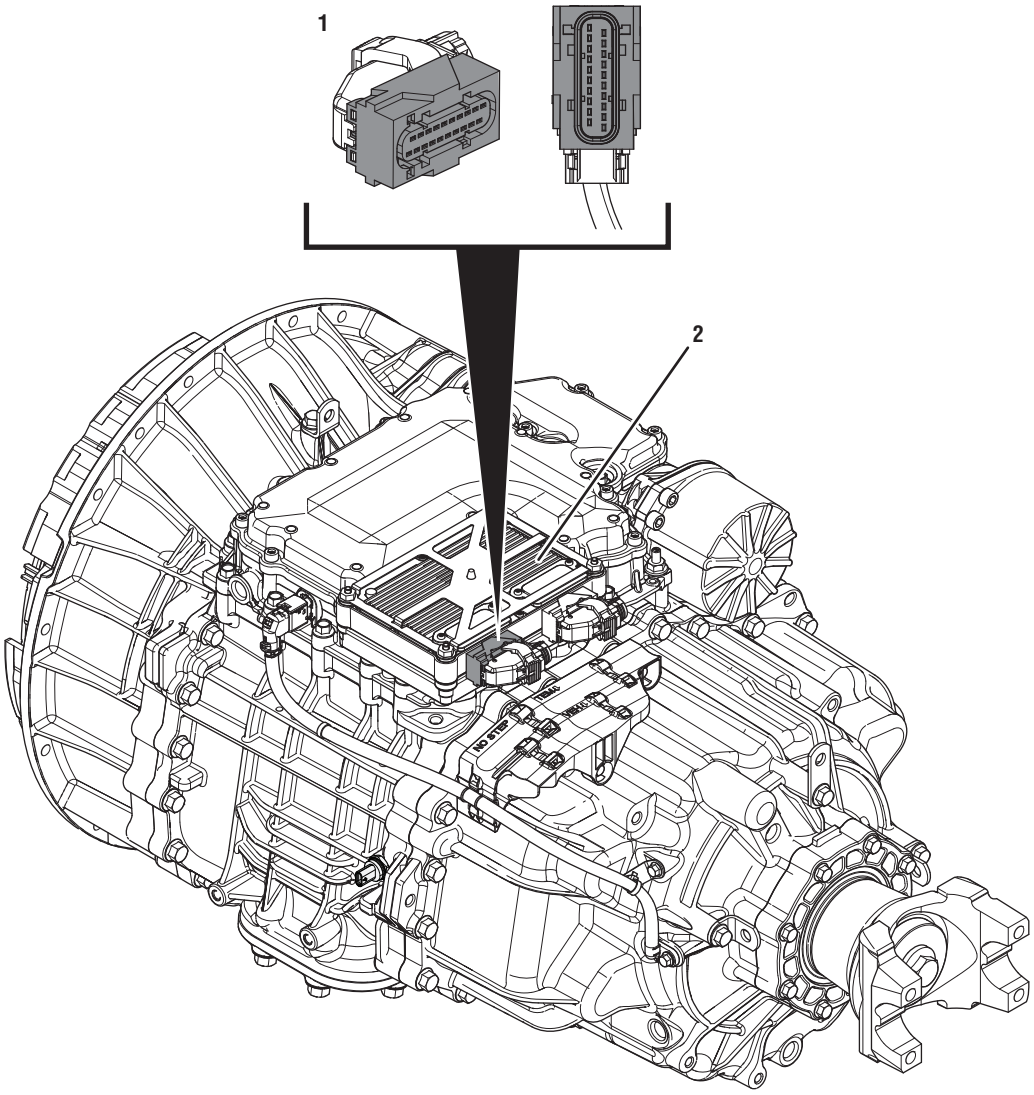
## Detection

- Transmission may exhibit slow or harsh launch from a stop.
- Transmission may not be able to complete a shift.
- Transmission may exhibit slow or harsh shifting.

## Possible Causes

- Vehicle
  - Varies
- Engine
  - Varies
- Transmission
  - Varies

## Component Identification




*1. 20-Way TCM Vehicle Harness Connector*
*2. Transmission Control Module (TCM)*

# Transmission Shift Complaint Test

## 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 7.
2. Set vehicle parking brake and chock wheels.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Select “Service Activity Report”.
6. Enter information and select “Start Report”.

   **Note:** Transmission information is downloaded into report.
7. Select “Send to Eaton”.

   **Note:** Internet connection is required.
8. Update TCM to the latest available software.

   **Note:** To avoid damaging the TCM, 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 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 D.**
   - If a transmission fault code is not set, go to **Step B.**

## B

***Purpose:*** *Operate vehicle and attempt to duplicate the vehicle symptom.*

1. Drive or operate the vehicle (road test) and attempt to duplicate the vehicle symptom under the conditions reported in the Driver Questionnaire.
2. If the vehicle symptom is duplicated, capture a driver triggered snapshot of the event by using the Transmission Driver Interface Device and performing the sequence below:
   - Select “upshift”, “downshift”, “upshift”, “downshift” (up, down, up, down) within 1.5 seconds.

   **Note:** Recording the driver triggered snapshot is time sensitive; for the best results, perform this sequence immediately after the symptom occurs.
3. The display indicates “ST” and the vehicle may set a tone when a snapshot is recorded.


- If the symptom was duplicated and the display indicated “ST” and/or “F”, go to **Step C.**
- If the symptom was not duplicated, no problem was found. Contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions.

## C

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

1. Set vehicle parking brake and chock wheels.
2. Key off and allow the TCM to perform a complete power down.
3. Key on.
4. Connect ServiceRanger.
5. Select “Service Activity Report”.
6. Enter information and select “Start Report”.

   **Note:** Transmission information is downloaded into report.
7. Select “Send to Eaton”.

   **Note:** Internet connection is required.
8. Update TCM to the latest available software.

   **Note:** To avoid damaging the TCM, 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 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 D.**
   - If a fault code did not set and the symptom was duplicated during the road test, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions.

## D

***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: Vehicle Interface Fault Codes 100-199
   - Priority 2: Component Fault Codes 200-499
   - Priority 3: System Fault Codes 500-899
   - Priority 4: Feature Fault Codes 900-999
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 time stamp.
   - If no fault codes are found, match the vehicle symptom to the appropriate item in the *Symptom-Driven Diagnostics Index* on page 9

# 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 115. 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 TCM 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

# J1939 Vehicle Data Link Test

**A** ***Purpose:*** *Check for active or inactive fault codes.*

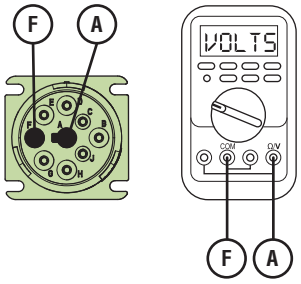
1. Set vehicle parking brake and chock wheels.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Retrieve and record the transmission fault codes and FMIs, and their occurrences and timestamps.
   - If a vehicle/engine fault code(s) is Active, contact OEM for further diagnostic instructions.
   - If Fault Code 115 is Active or Inactive, troubleshoot per “Fault Code Isolation Procedure Index” on page 13.
   - If ServiceRanger does not connect to the Transmission Control Module (TCM), go to **Step B.**

**B** ***Purpose:*** *Identify TCM location on Vehicle Primary Data Link (J1939 A).*

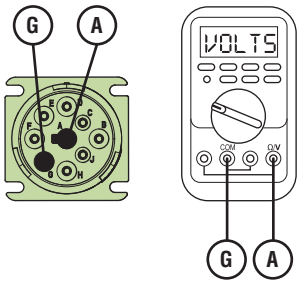
1. Key off.
2. Refer to the OEM and identify the TCM location on the Vehicle Primary Data Link (J1939A) at the 9-Way Diagnostic Connector.
   - If the TCM is on 9-Way Diagnostic Connector Pin C and Pin D, go to **Step G.**
   - If the TCM is on 9-Way Diagnostic Connector Pin F and Pin G, go to **Step C.**

**C** ***Purpose:*** *Verify Vehicle Primary Data Link (J1939 A) signal voltage.*

1. Key on with engine off.
2. Measure voltage between 9-Way Diagnostic Connector Pin F and Pin A. Record reading in table.




3. Measure voltage between 9-Way Diagnostic Connector Pin G and Pin A. Record reading in table.



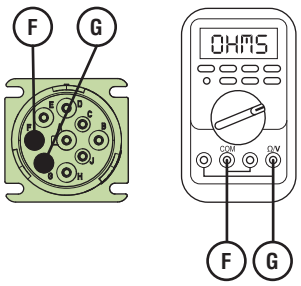

4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step D.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**

| Pins | Range | Reading(s) |
|---|---|---|
| F to A | N/A | |
| G to A | N/A | + |
| Total Voltage | 4.5–5.5 V | = |

## D

***Purpose:*** *Verify resistance of Vehicle Primary Data Link (J1939 A).*

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 vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step E.**

| Pins | Range | Reading(s) |
|---|---|---|
| F to G | 50–70 Ohms | |

## E

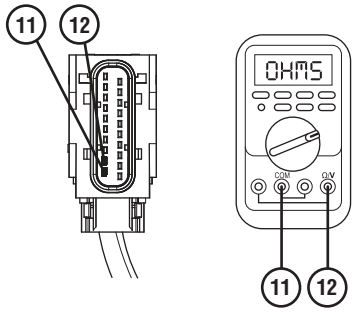
***Purpose:*** *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect the 20-way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Inspect the TCM side of the 20-Way TCM Vehicle Harness 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 contamination or damage is found, refer to OEM guidelines for repair or replacement of the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no contamination or damage is found, go to **Step F.**

**F**

***Purpose:*** *Verify resistance of Vehicle Primary Data Link (J1939 A) at 20-Way TCM Vehicle Harness Connector.*

1. Key off.
2. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 11 and Pin 12. Record reading in table.



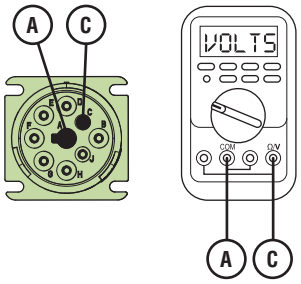

3. Reconnect 20-Way TCM Vehicle Harness Connector
4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step I.**

| Pins | Range | Reading(s) |
|---|---|---|
| 11 to 12 | 50–70 Ohms | |

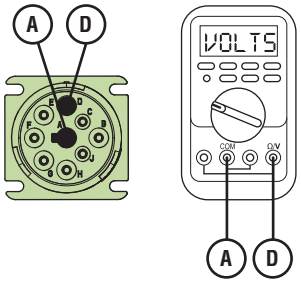
## G

***Purpose:*** *Verify Vehicle Primary Data Link (J1939 A) signal voltage.*

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




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



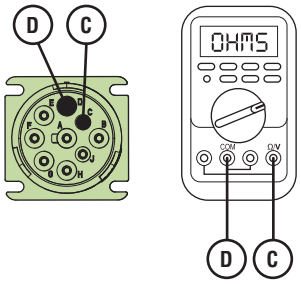

4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step H.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**

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

## H

***Purpose:*** *Verify resistance of Vehicle Primary Data Link (J1939 A).*

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 vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step I.**

| Pins | Range | Reading(s) |
|---|---|---|
| C to D | 50–70 Ohms | |

## I

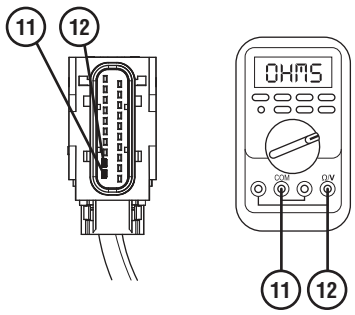
***Purpose:*** *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect the 20-Way TCM Vehicle Harness Connector.
3. Inspect the 20-Way TCM Vehicle Harness 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.
4. Inspect the TCM side of the 20-Way TCM Vehicle Harness 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 contamination or damage is found, refer to OEM guidelines for repair or replacement of the 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no contamination or damage is found, go to **Step J.**

## J

***Purpose:*** *Verify resistance of Vehicle J1939 Data Link at 20-Way TCM Vehicle Harness Connector.*

1. Key off.
2. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 11 and Pin 12. Record reading in table.




3. Reconnect 20-Way TCM Vehicle Harness Connector.
4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step K.**

| Pins | Range | Reading(s) |
|---|---|---|
| 11 to 12 | 50–70 Ohms | |

## K

***Purpose:*** *Use ServiceRanger to monitor ECU communication on the Primary Data Link (J1939 A).*

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 Primary Data Link (J1939 A).
8. Compare this list to the roster of vehicle ECUs that should be communicating on the Primary Data Link (J1939 A).

   **Note:** Contact OEM for information about which vehicle ECUs should be on the Primary Data Link (J1939 A).

   - If no vehicle ECUs are present on the ServiceRanger roster, go to **Step L.**
   - If all vehicle ECUs are present on the ServiceRanger roster, no problem was found. Test complete. Contact OEM for further diagnostic instructions.
   - If a vehicle ECU is missing from the ServiceRanger roster, investigate that device to verify that it is properly powered and wired to the Primary Data Link (J1939 A). Refer to OEM guidelines for repair or replacement. Go to **Step V.**

## L

***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 Primary Data Link (J1939 A).
6. Individually remove each vehicle ECU from the Primary Data Link (J1939 A).
7. After removing each device, monitor the ServiceRanger ECU roster.
   - If the removal of an ECU from the Primary Data Link (J1939 A) allows Other Vehicle ECU(s) to appear in the ServiceRanger ECU roster, the removed ECU may have an internal failure preventing communication over the Primary Data Link (J1939 A). Refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If no problems are found, Contact OEM 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. Connect ServiceRanger.
5. Go to “Fault Codes”.
6. Select “Clear All Faults”.
7. Operate vehicle and attempt to reset the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger.
   - If no fault codes set and the vehicle operates properly, test complete.
   - If Fault Code 115 sets Active during operation, go to **Step A.**
   - If a fault code other than 115 sets Active, troubleshoot per the “Fault Code Isolation Procedure Index” on page 13.

# Manually Actuate Rail B Procedure

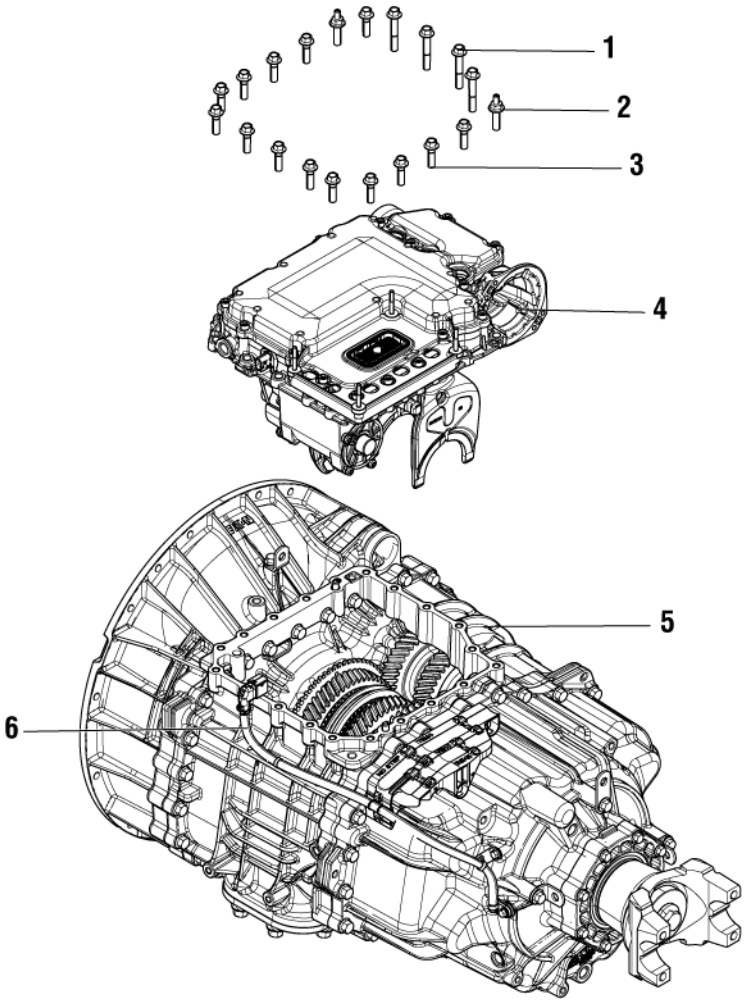
## Special Instructions

None

## Special Tools

- Mechanical Diagnostic Kit (RR2011TR)

## Component Identification

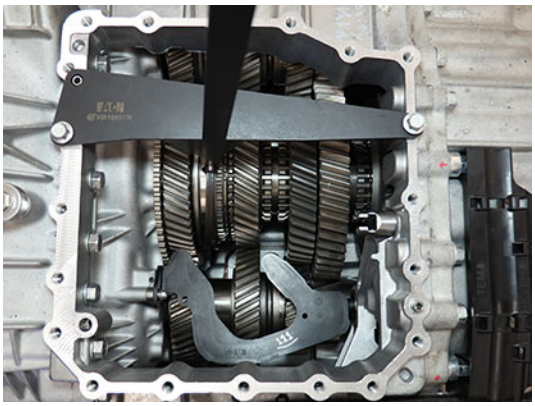


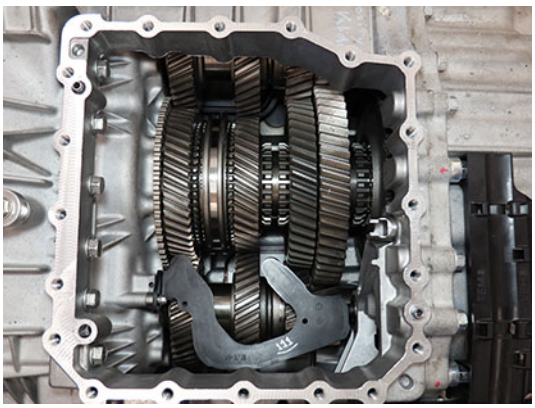

*1. MTM Cap Screws, Long (x4) - 13 mm*
*2. MTM Cap Screws, Special (x2) - 15 mm*
*3. MTM Cap Screws (x14) - 13 mm*
*4. Mechatronic Transmission Module (MTM)*
*5. Main Housing*
*6. Output Speed Sensor*

## Procedure – Manually Actuate Rail B

1. Install the Rail B Engagement Tool (RR1088TR) to the Main Housing and hand tighten with 2 MTM cap screws.

2. Shift the Rail B Synchronizer to neutral.





3. Return to troubleshooting procedure

# Manually Actuate Rail E Procedure

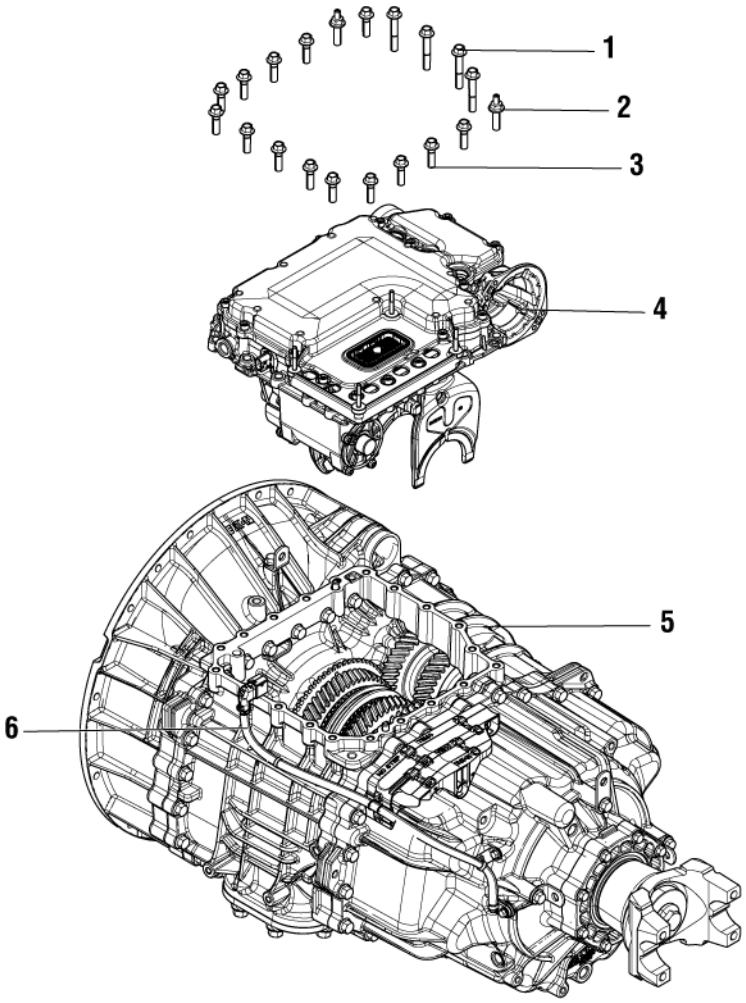
## Special Instructions

None

## Special Tools

- Mechanical Diagnostic Kit (RR2011TR)

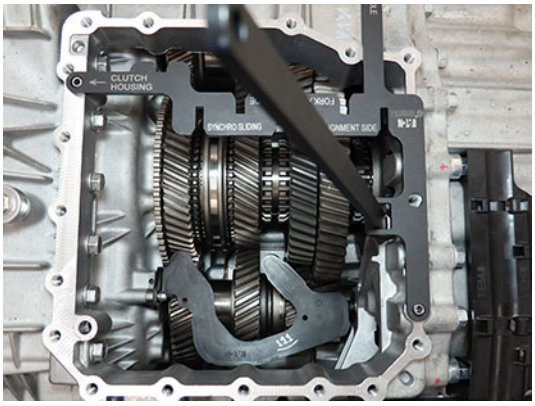
## Component Identification



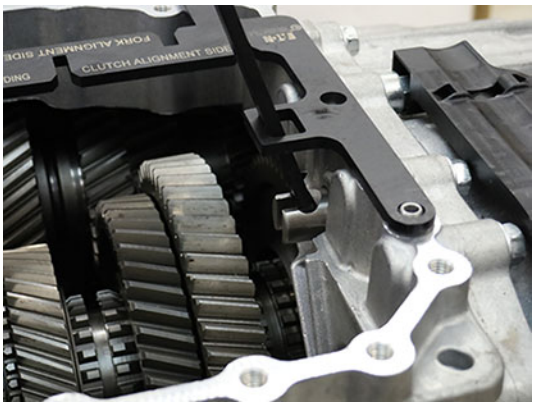

*1. MTM Cap Screws, Long (x4) - 13 mm*
*2. MTM Cap Screws, Special (x2) - 15 mm*
*3. MTM Cap Screws (x14) - 13 mm*
*4. Mechatronic Transmission Module (MTM)*
*5. Main Housing*
*6. Output Speed Sensor*

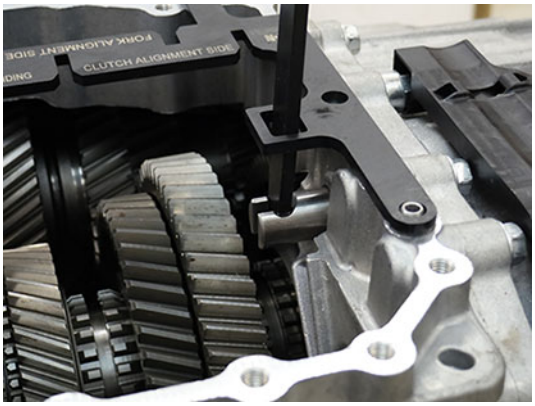
## Procedure – Manually Actuate Rail E

1. Install the MTM Alignment Tool (RR1086TR-1) on the main housing.




2. Using the Rail E Lever, move Rail E to neutral.

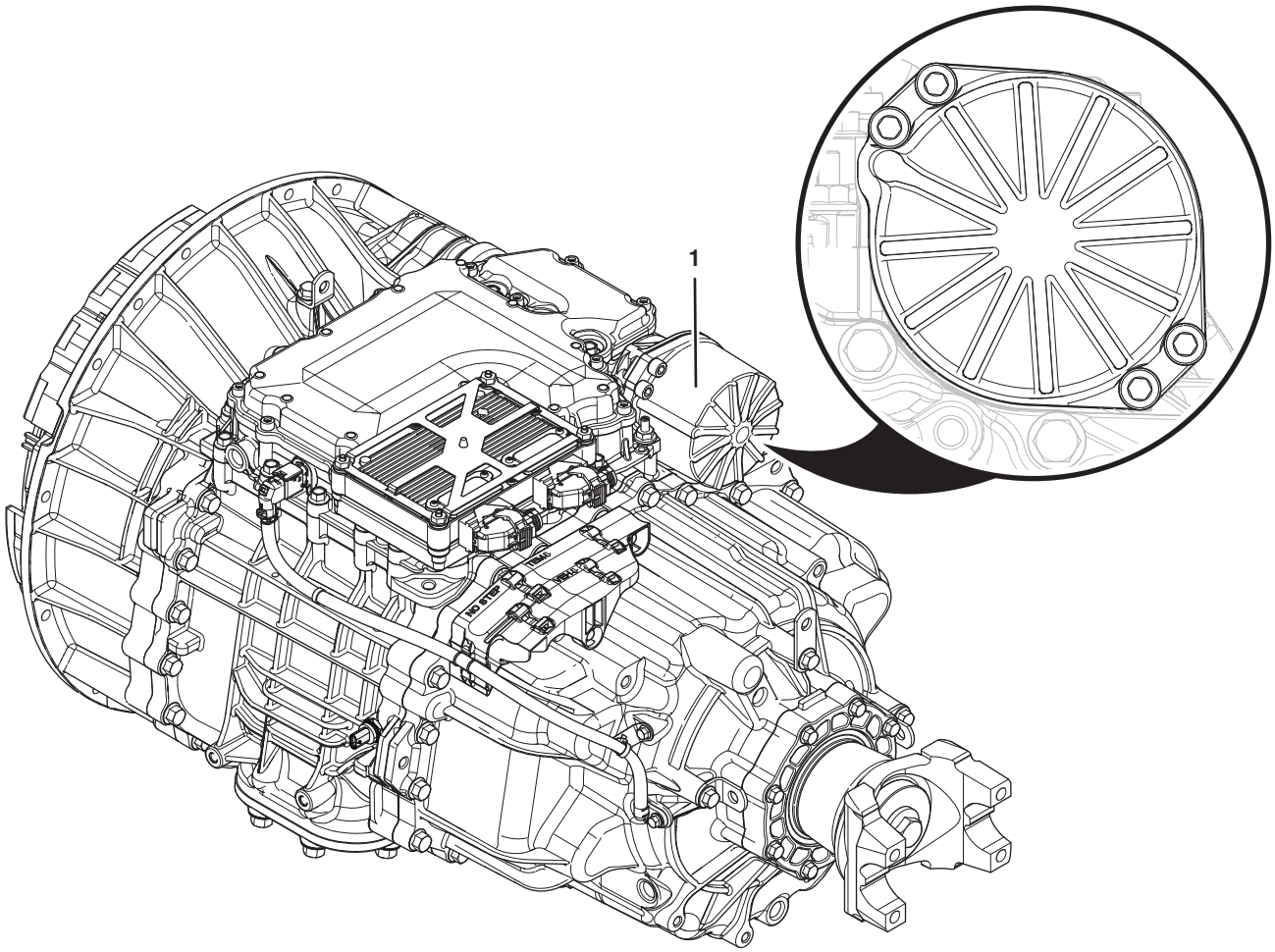



3. Return to troubleshooting procedure.

# Manually Vent Linear Clutch Actuator (LCA) Procedure

## Component Identification

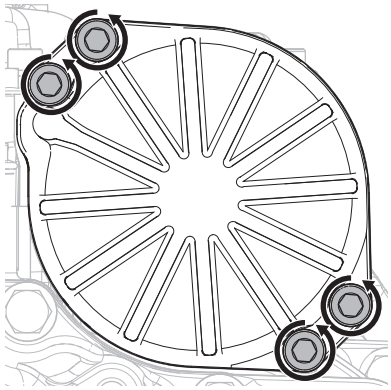



*1. Linear Clutch Actuator (LCA)*

## Procedure - Manually Vent LCA

1. Set vehicle parking brake and chock wheels.
2. Loosen (do not remove) the 4 LCA cap screws 1-2 turns with a T45 Torx.

**Note:** Residual air pressure in the LCA cylinder exhausts between the LCA and MTM housings when the cap screws are loosened.

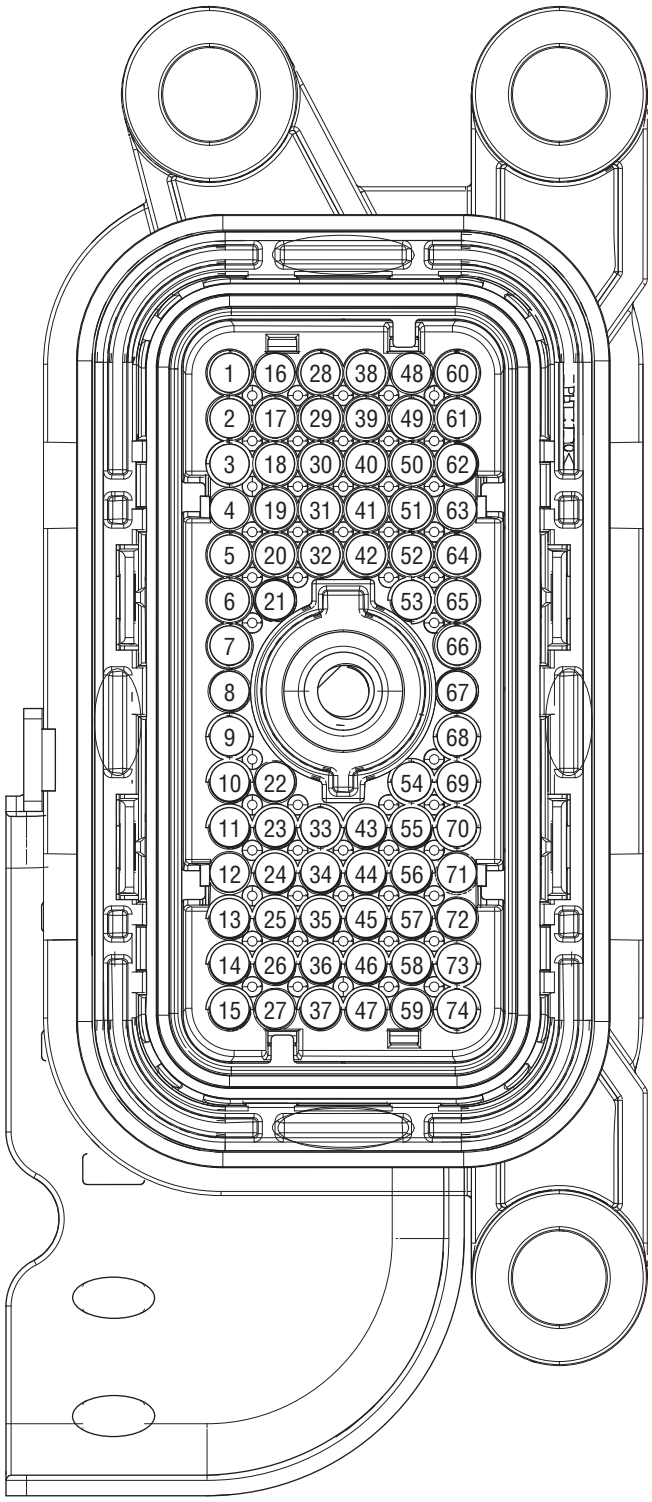


3. Torque the 4 LCA cap screws to 23-27 Nm.

# Connector Pin Descriptions

Note: This section is intended as a quick reference.

## 74-Way Transmission Harness Connector

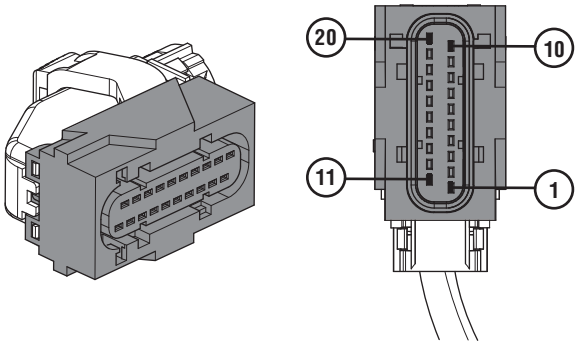



| Pin | Description |
|---|---|
| 1 | Valve A1, Rail B Aft High |
| 2 | Valve A1, Rail B Aft Low |
| 3 | Not Used |
| 4 | Not Used |
| 5 | Valve B3, Rail D Aft High |
| 6 | Not Used |
| 7 | Air Pressure Sensor Supply (5V) |
| 8 | Air Pressure Sensor Signal |
| 9 | Air Pressure Sensor Ground |
| 10 | Ignition Voltage |
| 11 | Not Used |
| 12 | Not Used |
| 13 | Rail C Position Sensor Supply (5V) |
| 14 | Rail C Position Sensor Signal |
| 15 | Rail C Position Sensor Ground |
| 16 | Valve C1, Rail C Fore High |
| 17 | Valve C1, Rail C Fore Low |
| 18 | Valve C4, LCA Course Exhaust Low |
| | Valve C6, LCA Fine Fill Low |
| 19 | Valve C4, LCA Coarse Exhaust High |
| 20 | Valve B3, Rail D Aft Low |
| 21 | Not Used |
| 22 | LCA Position Sensor Ground |
| 23 | LCA Position Sensor Signal |
| 24 | LCA Position Sensor Supply (5V) |
| 25 | Rail D Position Sensor Supply (5V) |
| 26 | Rail D Position Sensor Signal |
| 27 | Rail D Position Sensor Ground |

| Pin | Description |
|---|---|
| 28 | Valve B1, Rail C Aft High |
| 29 | Valve B1, Rail C Aft Low |
| 30 | Valve A6, Rail E Fore Low |
| 31 | Valve A6, Rail E Fore High |
| 32 | Countershaft Speed Sensor Signal |
| 33 | Not Used |
| 34 | Not Used |
| 35 | Not Used |
| 36 | Not Used |
| 37 | Not Used |
| 38 | Valve C2, Rail D Fore High |
| 39 | Valve C2, Rail D Fore Low |
| 40 | Valve C5, LCA Coarse Fill Low |
| 41 | Valve C5, LCA Coarse Fill High |
| 42 | Countershaft Speed Sensor Ground |
| 43 | Not Used |
| 44 | Not Used |
| 45 | Not Used |
| 46 | Not Used |
| 47 | Not Used |
| 48 | Valve B2, Inertia Brake High |
| 49 | Valve B2, Inertia Brake Low |
| 50 | Valve A5, Rail B Fore Low |
| 51 | Valve A5, Rail B Fore High |
| 52 | Output Shaft Speed Sensor Signal |
| 53 | Not Used |
| 54 | Input Shaft Speed Sensor Ground |
| 55 | Input Shaft Speed Sensor Signal |
| 56 | Not Used |
| 57 | Rail B Position Sensor Supply (5V) |
| 58 | Rail B Position Sensor Signal |

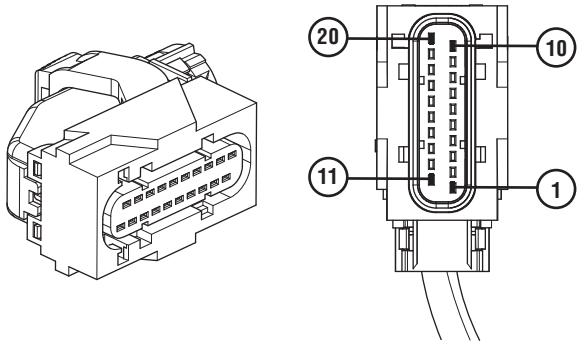
| Pin | Description |
|---|---|
| 59 | Rail B Position Sensor Ground |
| 60 | Valve C3, LCA Fine Exhaust High |
| 61 | Valve C3, LCA Fine Exhaust Low |
| 62 | Valve A4, Rail E Aft Low |
| 63 | Valve A4, Rail E Aft High |
| 64 | Output Shaft Speed Sensor Supply (5V) |
| 65 | Not Used |
| 66 | Not Used |
| 67 | Valve C6, LCA Fine Fill High |
| 68 | Not Used |
| 69 | Not Used |
| 70 | Not Used |
| 71 | Not Used |
| 72 | Rail E Position Sensor Supply (5V) |
| 73 | Rail E Position Sensor Signal |
| 74 | Rail E Position Sensor Ground |

## 20-Way TCM Vehicle Harness Connector



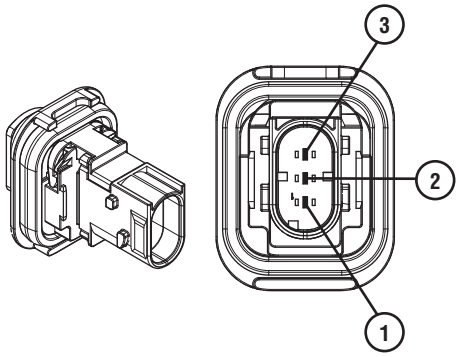

| Pin | Description |
|---|---|
| 1 | Not Used |
| 2 | Not Used |
| 3 | Not Used |
| 4 | Start Enable Negative |
| 5 | Battery Voltage1 (-) |
| 6 | Battery Voltage1 (+) |
| 7 | Fluid Pressure Sensor - Signal |
| 8 | Protected Power (Return) |
| 9 | Transmission Driver Interface Device - Mode Request |
| 10 | Not Used |
| 11 | J1939 A High (Input) |
| 12 | J1939 A Low (Input) |
| 13 | J1939 A Shield (Input) |
| 14 | Start Enable Positive |
| 15 | Battery Voltage2 (-) |
| 16 | Battery Voltage2 (+) |
| 17 | Protected Power (Output) |
| 18 | Fluid Pressure Sensor - Ground |
| 19 | Fluid Pressure Sensor - Power |
| 20 | Not Used |

## 20-Way TCM Body Harness Connector




| Pin | Description |
|---|---|
| 1 | Reverse Output |
| 2 | PTO Engage Output - Output to enable PTO |
| 3 | Range Output |
| 4 | Not Used |
| 5 | Body I/O (Return) (1) |
| 6 | Not Used |
| 7 | J1939 B High |
| 8 | J1939 B Low |
| 9 | Not Used |
| 10 | Not Used |
| 11 | Service Test Port - Battery Voltage (+) |
| 12 | Service Test Port - Ignition (+) |
| 13 | Service Test Port - Battery Voltage (-) |
| 14 | Body I/O (Return) (2) |
| 15 | PTO Request - Input from driver to activate PTO function |
| 16 | PTO Confirm - Feedback signal from PTO indicating PTO is engaged |
| 17 | Not Used |
| 18 | Not Used |
| 19 | J1939 A Low |
| 20 | J1939 A High |

## 3-Way Output Speed Sensor Connector

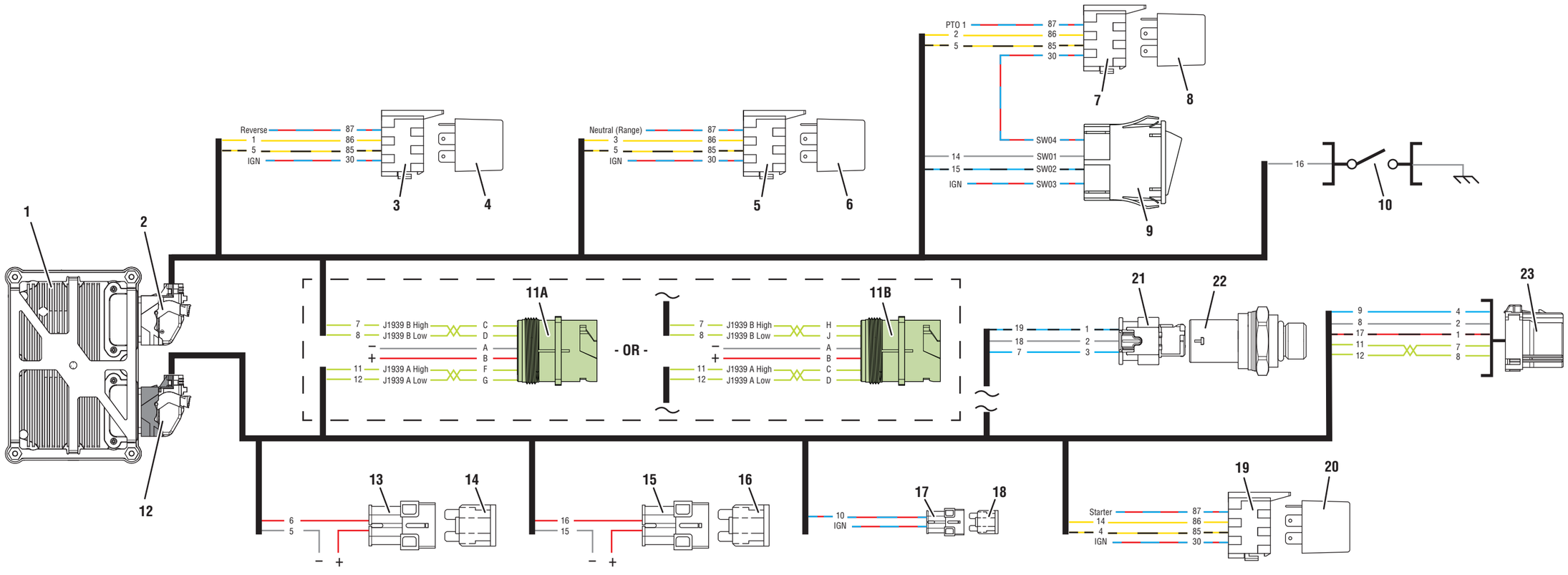



| Pin | Description | 74-Way Transmission Harness Connector Pin |
|---|---|---|
| 1 | Not Used | Plug |
| 2 | Output Speed Sensor Signal | 52 |
| 3 | Output Speed Sensor Supply (5V) | 64 |

# Wiring Diagrams

## Vehicle and Body Harness Connections

**Note:** Refer to OEM guidelines for wiring details.




*1. Transmission Control Module (TCM)*
*2. 20-Way OEM Body Harness Connector*
*3. 5-Way Reverse Range Output Relay Socket*
*4. 5-Way Reverse Range Output Relay*
*5. 5-Way Neutral Range Output Relay Socket*
*6. 5-Way Neutral Range Output Relay*
*7. Power Take-Off (PTO) Relay Socket*
*8. Power Take-Off (PTO) Relay*
*9. Power Take-Off (PTO) 1 Dashboard Switch*
*10. Power Take-Off (PTO) 1 Confirm Switch*
*11A. 9-Way Type 2 Diagnostic Connector (OEM-Specific Primary Data Link FG)*
*11B. 9-Way Type 2 Diagnostic Connector (OEM-Specific Primary Data Link CD)*
*12. 20-Way TCM Vehicle Harness Connector*
*13. In-line Fuse Holder Battery Voltage1*
*14. 15-amp Fuse Battery Voltage1*
*15. In-line Fuse Holder Battery Voltage2*
*16. 15-amp Fuse Battery Voltage2*
*17. In-line Fuse Holder Ignition*
*18. 10-amp Fuse Ignition*
*19. 5-Way Start Enable Relay Socket*
*20. 5-Way Start Enable Relay*
*21. 3-Way Fluid Pressure Sensor Connector*
*22. Fluid Pressure Sensor*
*23. 9-Way Driver Interface Device Connector*

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

# Change Log

-

| Date | Description |
|---|---|
| July 2019 | Updated Fault Codes: 210, 250, 596, 597, 616, 617, 636, 637, 701, 715, 786, 787 |
| June 2019 | **Updated all Fault Codes**<br>**Updated:** Fault Code Isolation Procedure Index, Eaton-Diagnostic Adapter Procedures, Power-Up Sequence,<br>**Added:** General Information-Using the 3-Way Eaton Diagnostic Adapter, Fault Code 157, Fault Code 158, Appendix-Manually Actuate Rail B |
| April 2019 | **Updated:** Required Tools, Transmissions Models, Diagnostic Procedure, Fault Code Isolation Procedure Index, Power-Up Sequence Test, Start Enable Relay Contact Test, Manually Vent LCA<br>**Updated Fault Codes:** 100, 105, 115, 116, 120, 135, 145, 174, 175, 184, 186, 187, 188, 190, 191, 192, 193, 200, 205, 206, 210, 215, 250, 275, 295, 315, 320, 350, 370, 375, 385, 511, 512, 513, 514, 570, 596, 597, 616, 617, 636, 637, 646, 647, 701, 705, 716, 717, 780, 789, 815, 975,<br>**Added:** Manually Actuate Rail E<br>**Modified the book with:**<br>transmission component to TCM<br>Eaton to Eaton Cummins Automated Transmission Technologies<br>RR1086TR to RR1086TR-1)<br>Ranges in tables<br>MTM removal and installation notes<br>test drive to operation |
| March 2019 | **Updated** Fault Code 511<br>**Added** Fault Codes 150, 151, 152, 153, 154, 156, 159, 164, 167, 184, 950, & 960 |
| January 2019 | **Updated** Fault Codes 100, 105, 110, 115, 135, 145, 161, 210, 215, 250, 275, 295, 315, 320, 350, 370, 375, 385, 511, 512, 513, and 514<br>**Updated** Fault Code Isolation Procedure Index<br>**Updated** Diagnostic Procedure<br>**Added** Fault Codes 188, 190, 191, 192, 193, 716, 905, 915, and 925 |
| June 2018 | **Updated** Fault Code 210<br>**Updated** Fault Code 250 |

**Note:** Features and specifications listed in this document are subject to change without notice and represent the maximum capabilities of the software and products with all options installed. Although every attempt has been made to ensure the accuracy of information contained within, Eaton makes no representation about the completeness, correctness or accuracy and assumes no responsibility for any errors or omissions. Features and functionality may vary depending on selected options.

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