Endurant XD Automated Transmission

TRTS0960 EN-US

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EXD-xxF118D
EXDP-xxF118D
EXD-18F118D-N

AUTOMATED TRANSMISSION™
TECHNOLOGIES

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SUPPORT

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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.

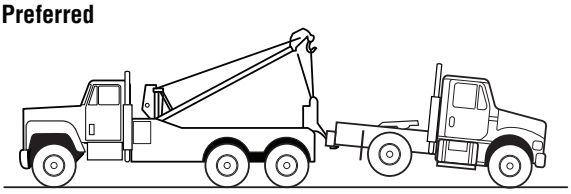
WARNING: Apply vehicle parking brake and follow vehicle manufacturer parking instructions. Failure to follow these instructions could cause unintended movement and may result in major vehicle component damage, property damage, severe injury or death.

Vehicle Towing:

When towing a vehicle equipped with the Endurant XD 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



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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
TRSM0960	Endurant XD Automated Transmission Service Manual
TRDR0960	Endurant XD Automated Transmission Driver Instructions
TCMT0072	ServiceRanger™ User's Guide
TCMT0073	ServiceRanger™ Quick Start Guide
TCMT0020	Eaton Approved Lubricant Suppliers
TCMT0021	Roadranger Lubricant Products Manual
TRIG0960	Installation Guide
TRIG2620	PTO Installation Guide
ECWY3000	Eaton Cummins Warranty Manual
TRIG2630	Endurant Series I/O Calibration Package Installation Guide

For additional information, go to www.eatoncummins.com/us/en-us.html or Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to Contact Information.

Contact Information

- U.S. and Canada Help Line: +1-800-826-4357
- Mexico Help Line: +52-800-800-6801

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ServiceRanger Connection Settings - Add Profile

Overview

This procedure provides direction to ensure proper Eaton® ServiceRanger 4 connectivity with a Transmission Electronic Control Unit (TECU) and Transmission Control Module (TCM).

Special Instructions

- An approved Universal Serial Bus (USB) type vehicle link adapter (Communication Adapter) is required for TECU and TCM programming. For a list of approved adapters, go to ServiceRanger webpage below and select “Resources” tab.



CAUTION: A hardwired USB connection between computer, communication adapter and vehicle diagnostic connector is required for programming a TECU and TCM. Do not use a wireless connection (Bluetooth or WiFi). Failure to use a hard-wired USB connection when programming may result in a damaged TECU or TCM and void component warranty.

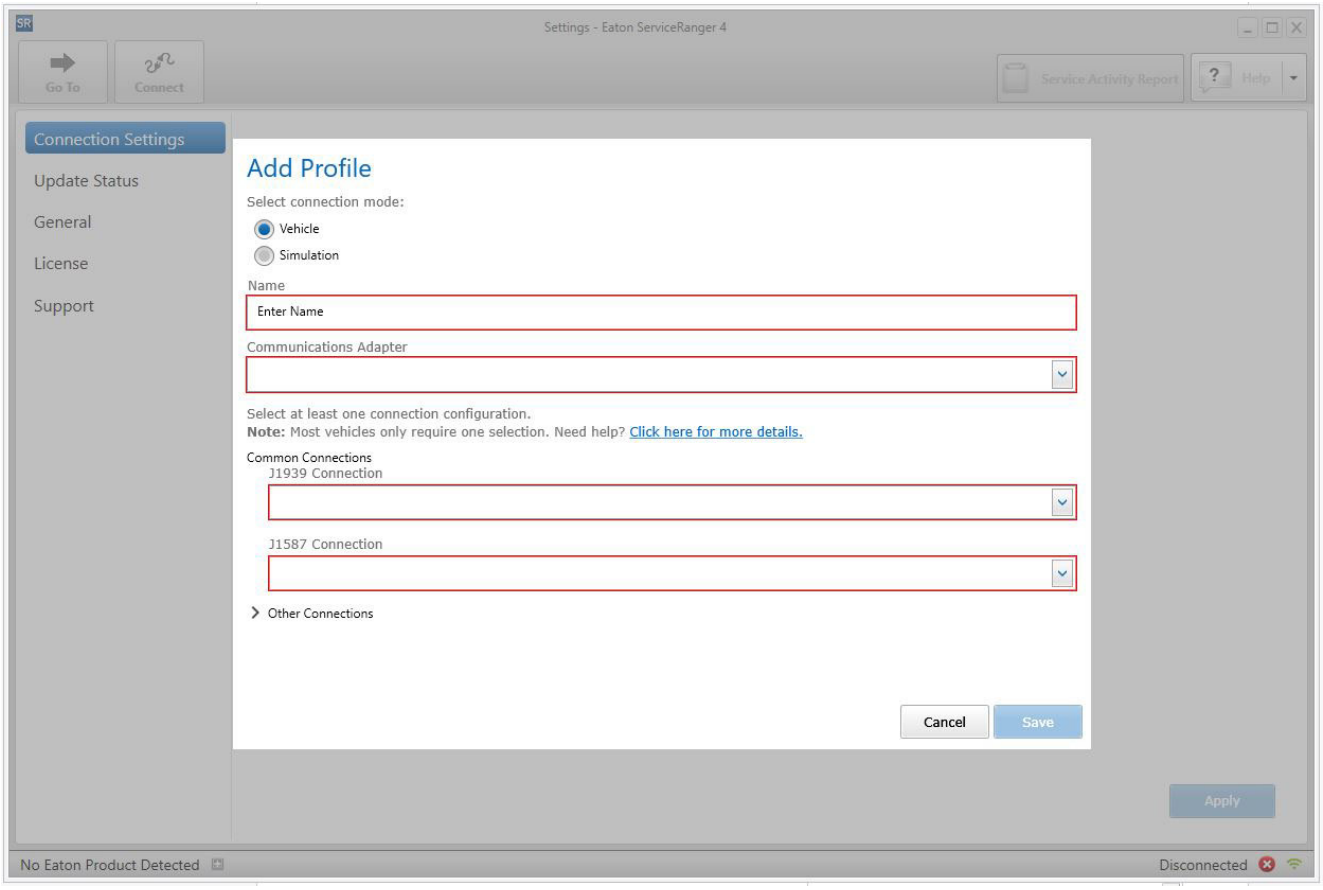
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ServiceRanger Connection Settings - Add Profile

A **Purpose:** Add Profile - ServiceRanger Connection Settings.

1. Open ServiceRanger.

   Note: Physical connection to a vehicle or communication adapter is **not** required to add a profile.
2. Go To “Settings”.
3. Select “Connection Settings”.
4. Select “+” Add Profile.
5. Select connection mode: “Vehicle”.
6. Enter profile name.
   -



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B

Purpose: Identify vehicle Original Equipment Manufacture (OEM).

1. Record Original Equipment Manufacture (OEM).
   - If Freightliner, International Motors or Western Star, go to **Step C.**
   - If Kenworth or Peterbilt, go to **Step D.**
   - If Volvo, go to **Step E.**
   - If Bluebird, go to **Step I.**

C

Purpose: Identify vehicle model year for Freightliner, International Motors or Western Star.

1. Record vehicle Model Year (MY).
   - If Model Year is 2006 or earlier, from the J1587 Connection drop down - select the following, then select Save. Go to **Step V.**

J1587 Connection
USB- *comm. adapter:* Protocol=J1708; Speed=9600

   - If Model Year is 2007 or later, from the J1939 Connection drop down - select the following, then select Save. Go to **Step V.**

J1939 Connection
USB- *comm. adapter:* Protocol=J1939; Channel=1; Speed=Auto

D

Purpose: Identify vehicle model year for Kenworth or Peterbilt.

1. Record vehicle Model Year (MY).
   - If Model Year is 2006 or earlier, from the J1587 Connection drop down - select the following, then select Save. Go to **Step V.**

J1587 Connection
USB- *comm. adapter:* Protocol=J1708; Speed=9600

   - If Model Year is 2007 to 2015, from the J1939 Connection drop down - select the following, then select Save. Go to **Step V.**

J1939 Connection
USB- *comm. adapter:* Protocol=J1939; Channel=1; Speed=Auto

   - If Model Year is 2016 or later, go to **Step F.**

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E **Purpose:** Identify vehicle model year for Volvo.

1. Record vehicle Model Year (MY).
   - If Model Year is 2006 or earlier, from the J1587 Connection drop down - select the following, then select Save. Go to **Step V.**

J1587 Connection
USB- *comm. adapter:* Protocol=J1708; Speed=9600

   - If Model Year is 2007 to 2015, from the J1939 Connection drop down - select the following, then select Save. Go to **Step V.**

J1939 Connection
USB- *comm. adapter:* Protocol=J1939; Channel=1; Speed=Auto

   - If Model Year is 2016 or later, go to **Step G.**

F **Purpose:** Identify vehicle equipment for Kenworth or Peterbilt.

1. Determine if vehicle is equipped with a Vehicle Electronic Control Unit (VECU), refer to OEM.
   - If vehicle is **not** equipped with a VECU, go to **Step H.**
   - If vehicle is equipped with a VECU, from the J1939 drop down - select the following, then select Save. Go to **Step V.**

J1939 Connection
USB- *comm. adapter:* Protocol=J1939; Channel=1; Speed=Auto

   Note: The following may assist in determining if vehicle is equipped with a VECU. Refer to service bulletin MDIB-0051 ServiceRanger 4 Connection Settings - Add Profile for additional information.

   - Vehicles equipped with a full digital display (dash) are equipped with a VECU.
   - Vehicles equipped with analog gauges and a digital display - Use digital display push-scroll dial, go to Truck Info: Chassis tab, scroll through list of components to determine if vehicle is equipped with a VECU or not.

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G

Purpose: Identify Communications Adapter Model for Volvo.

1. Record your Communications Adapter Model.

   - If your Communications Adapter is:
     - NEXIQ USB-Link
     - DG Technologies DPA 4 Plus
     - Noregon JPRO DLA+
     - Cummins INLINE 6

     Note: Crossover cable required: NEXIQ CAN 3 - CAN 1 (P/N 406004)

     From the J1939 Connection drop down - select the following, then select Save. Go to **Step V.**

J1939 Connection
USB- *comm. adapter:* Protocol=J1939; Channel=1; Speed=Auto

   - If your Communications Adapter is:
     - NEXIQ USB-Link 2 or 3
     - DG Technologies DPA 5
     - Noregon JPRO DLA+ 2.0
     - Cummins INLINE 7

     Note: Crossover cable **not** required.

     From the J1939 Connection drop down - select the following, then select Save. Go to **Step V.**

J1939 Connection
USB- *comm. adapter:* Protocol=J1939; Channel=3; Speed=Auto

H

Purpose: Identify Communication Adapter Model for Kenworth or Peterbilt.

1. Record your Communications Adapter Model.

   - If your Communications Adapter is:
     - NEXIQ USB-Link
     - DH Technologies DPA 4 PLUS
     - Noregon JPRO DLA+
     - Cummins INLINE 6

     Note: Crossover cable required: NEXIQ CAN 3 - CAN 1 (P/N 406004) or PACCAR Y - Cable (P/N 42-02848)

     From the J1939 Connection drop down - select the following, then select Save. Go to **Step V.**

J1939 Connection
USB- *comm. adapter:* Protocol=J1939; Channel=1; Speed=Auto

   - If your Communications Adapter is:
     - NEXIQ USB-Link 2 or 3
     - DG Technologies DPA 5
     - Noregon JPRO DLA+ 2.0
     - Cummins INLINE 7

     Note: Crossover cable **not** required.

     From the J1939 Connection drop down - select the following, then select Save. Go to **Step V.**

J1939 Connection
USB- *comm. adapter:* Protocol=J1939; Channel=3; Speed=Auto

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I **Purpose:** Identify Connection Setting for Bluebird.

1. Connection Setting:
   - If OEM is Bluebird, from the J1939 Connection drop down - select the following, then select Save. Go to **Step V.**

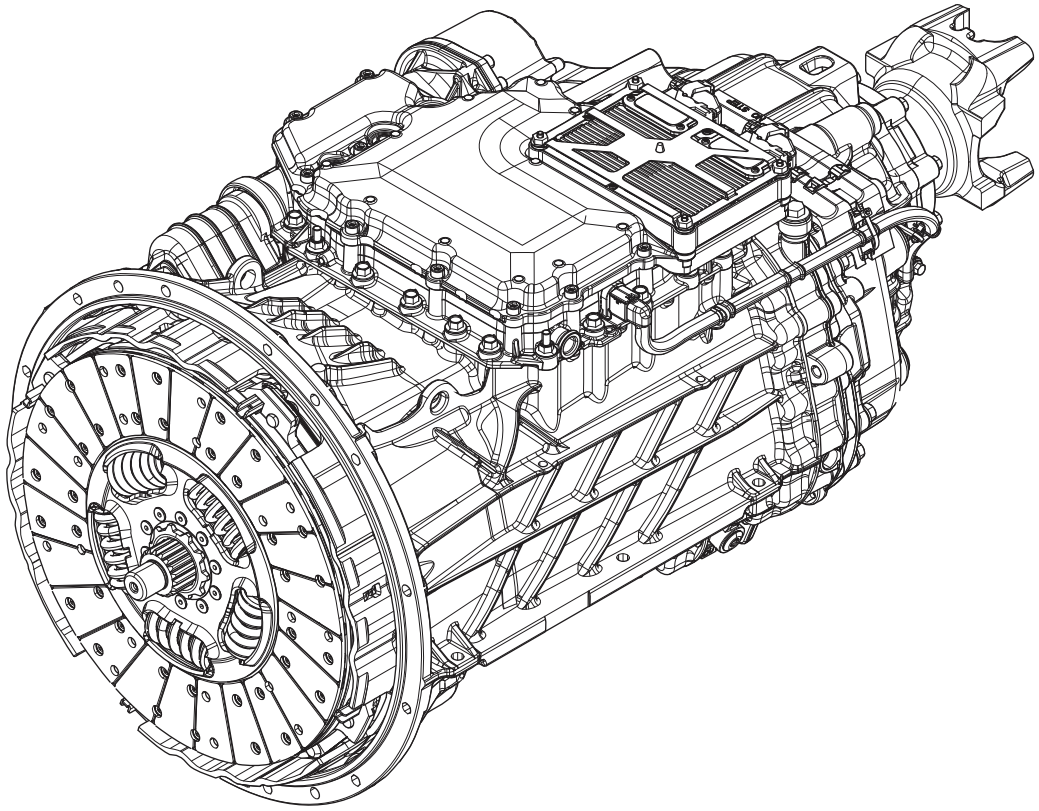
J1939 Connection
USB- *comm. adapter:* Protocol=J1939; Channel=2; Speed=Auto

V **Purpose:** Connect Communications Adapter to Computer and Vehicle.

1. Connect communication adapter:
   - USB cable and connector to computer.
   - Diagnostic cable and connector to vehicle.
2. Key on.
3. Select Connect.
   - If “Successfully Connected”, **process complete**. Go to *Diagnostic Procedure* on page 16.
   - If “no Eaton product detected”, go to **Step A.**

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Transmission Models



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Transmission Service Lamps and Display Descriptions

Overview

The Endurant XD 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 16.

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 on 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 on 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.

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“PD” in Display



Indicates that the transmission is in Product Diagnostic (PD) Test. Refer to *Product Diagnostic (PD) Test* on page 12.

“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.

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Product Diagnostic (PD) Test

PD Test is used to diagnose Inactive fault codes that may have set during normal operation. PD Test is a “Wiggle Test” used to identify intermittent Open or Short circuit conditions in a connector, component, or wire in a circuit. PD Test increases the fault sensing capability of the Transmission Control Module (TCM) making it more likely to detect any intermittent electrical or wiring issues as a result of loose or degraded 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 19.

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

- Once the PD Test is activated, wiggle the wiring harness and connector bodies appropriate for the intermittent fault condition.
- During the PD Test fault isolation procedure “PD” will remain in display until an Active fault code has been set.
- If an Active fault code is set, the display will flash “F” and “PD”. A warning tone will sound when the fault code is Active. “F” and “PD” will continue to be shown in the display until the key is turned off and the TCM has performed a complete power 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 fault codes set Active, refer to OEM guidelines for repair or replacement of vehicle harness and/or 20-Way TCM Vehicle Harness Connector.
- Refer to the *Fault Code Isolation Procedure Index* on page 19 for the troubleshooting procedures for a specific fault code.

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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: a. What gears is the transmission trying to shift? Circle any that apply or describe. 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 10-11 11-12 13-14 14-15 15-16 17-18				
b. Does the transmission eventually make the shift?	Yes	No	Don't Know	NA
c. Does the transmission shift back into the gear it is trying to shift out of?	Yes	No	Don't Know	NA
If No: a. What gears does the transmission get stuck in? Circle one or more below. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18				
b. Are you able to go to Manual mode and make the transmission shift?	Yes	No	Don't Know	NA
4. Do you have to stop the truck when the problem happens?	Yes	No	Don't Know	NA
5. Does the transmission find neutral?	Yes	No	Don't Know	NA
6. Do you have to shut the truck off in gear?	Yes	No	Don't Know	NA
7. Does the transmission find neutral after turning the key back on?	Yes	No	Don't Know	NA

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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. "-" Single dash "- -" Double dash Flashing gear number Solid gear number flashing "F" Flashing "CA" 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 operating 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? 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. 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

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Symptom-Driven Diagnostics Index

Electrical Pretest Procedures	Symptom	Page #
Power-up Sequence Test	Transmission fails to power up at ignition	page 34

Isolation Procedures	Symptom	Page #
Start Enable Relay Contact Test	Engine cranking issues without any fault codes	page 664
Brake Switch Functionality Test	Transmission does not engage a gear from Neutral (N)	page 674
Transmission Shift Complaint Test	Shift complaint exists without any fault codes	page 677
J1939 Vehicle Data Link Test	No J1939 communication	page 681

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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 13.
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: Fault code and transmission information is downloaded into the report.
7. Select “Send to Eaton”.

   Note: Internet connection is required.
8. 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 G.**
   - If a transmission fault code(s) is Inactive, go to **Step B.**
   - If a transmission fault code is not set, go to **Step C.**
   - If ServiceRanger does not connect to the Transmission Control Module (TCM), go to the *Power-Up Sequence* on page 34.

B ***Purpose:*** *Clear Inactive Transmission Fault Code(s).*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To Fault Codes.
   - Select "Clear Eaton Faults" and follow on-screen prompts. Go to **Step C.**

C ***Purpose:*** *Verify the engine cranks.*

1. Key on with engine running.
   - If the engine cranks and runs, go to **Step D.**
   - If the display indicates “F” during the engine crank or while the engine is running, retrieve fault code(s) with ServiceRanger. Go to **Step G.**
   - If the engine does not crank and the display indicates “N”, go to *Start Enable Relay Contact Test* on page 664.

     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.

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D

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 Shift Mode from Neutral.
   - If the transmission engages a gear, re-select Neutral mode. Go to **Step E.**
   - 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 G.**
   - 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 674.

E

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 F.**
   - If the symptom was not duplicated, no problem was found. Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2.

F

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 with engine off.
4. Connect ServiceRanger.
5. Select “Service Activity Report”.
6. Enter information and select “Start Report”.

   Note: Fault code and 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 G.**
   - If a fault code did not set during the road test and the symptom was duplicated, go to the *Transmission Shift Complaint* on page 677.

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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
2. Go to the *Fault Code Isolation Procedure Index* on page 19 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 15

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Fault Code Isolation Procedure Index

Fault Code	SPN	FMI	Description	Page Number
100	168	0, 1, 4, 17, 18	Battery Voltage 1	page 41
105	444	0, 1, 4, 17, 18	Battery Voltage 2	page 49
110	158	2	Ignition Voltage	page 56
115	639	2, 8, 9, 14, 19, 31	Primary Data Link (J1939A)	page 61
116	1231	9, 14	Secondary Data Link	page 74
117	2000	9	Engine Source Address	page 87
120	1321	3, 4, 5, 7, 12	Start Enable Relay	page 89
122	3651	2, 9, 10, 11, 13, 19, 31	Primary ADS	page 101
123	3654	2, 9, 10, 11, 13, 19, 31	Secondary ADS	page 103
125	20870	9, 13, 14, 19	Primary ADS Operation Status	page 105
126	20874	9, 13, 14, 19	Secondary ADS Operation Status	page 107
127	595	13, 19	Cruise Control Active	page 109
128	5604	9, 13, 19	Cruise Control Resume Command	page 111
135	751	2, 9, 11, 12, 13, 14, 19	Primary Shift Device (J1939)	page 113
136	3652	14	Transmission Primary Shift Up Selector	page 122
137	11756	9, 10, 11, 13, 31	Source Address of Controlling Device for TSC1 Control Purpose P7	page 124
143	3653	2, 9, 10, 11, 13, 19, 31	Transmission Primary Shift Down Selector	page 126
144	3656	2, 9, 10, 11, 13, 19, 31	Transmission Secondary Shift Down Selector	page 128
145	752	2, 4, 5, 8, 12, 13, 14	Secondary Shift Device (PWM)	page 130
147	4050	9, 13, 19	Transmission Secondary Mode Switch	page 138
148	630	13, 14, 31	Performance Goal Calibrations	page 141
150	561	13, 19	ASR Engine Control Active	page 143
151	562	13, 19	ASR Brake Control Active	page 145
152	563	9, 13, 19	ABS Active	page 147
153	577	9, 13, 19	ASR Hill Holder Switch	page 149
154	2912	9, 13, 19	Hill Holder Mode	page 151
155	70	9, 13, 14, 19	Park Brake Switch	page 153
156	521	13, 19	Brake Pedal Position	page 156
157	2917	13	XBR System State	page 158
158	2918	9, 13, 19	XBR Active Control Mode	page 160
159	1088	9, 13, 19	Service Brake Circuit 2	page 163
160	597	9, 13, 14, 19	Service Brake Switch	page 165

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Fault Code	SPN	FMI	Description	Page Number
161	116	9, 13, 14, 19	Brake Application Pressure	page 168
162	118	9, 13, 18, 19	Brake Secondary Pressure	page 171
163	8484	9, 13, 19	Demanded Brake Application Pressure	page 174
164	603	9, 13, 19	Service Brake Switch 2	page 177
165	91	9, 13, 19	Primary Accelerator Pedal Position	page 180
166	29	9, 13, 19	Secondary Accelerator Pedal Position	page 183
167	559	13, 19, 20	Accelerator Pedal Kickdown Switch	page 186
168	117	9, 13, 18, 19	Brake Primary Pressure	page 188
169	1087	9, 13, 19	Service Brake Circuit 1	page 191
170	904	9, 13, 19	Front Axle Speed	page 193
171	190	9, 13, 19	Engine Speed	page 196
172	723	9, 13, 19	Secondary Engine Speed	page 199
173	898	12	Engine Requested Speed	page 202
174	1846	12, 13, 19	Engine Default Torque Limit	page 204
175	518	11, 12, 14	Engine Requested Torque	page 206
180	188	1, 9, 13, 19	Engine Configuration Message	page 208
181	6395	13	Engine Configuration Identification	page 211
183	10294	13, 14	Powertrain Adaptive Cruise Control	page 213
184	2432	13, 19	Engine Demand Percent Torque	page 216
185	512	13, 19	Driver Demanded Torque	page 218
186	7828	12, 13, 19	Engine Default Idle Torque Limit	page 220
187	7830	9, 13, 19	Idle Governor Fueling Inhibit	page 222
188	1483	12, 13, 19	Source Address (SA) of Controlling Device for Engine Control	page 224
190	905	13, 19	Front Axle Left Wheel Speed	page 226
191	906	13, 19	Front Axle Right Wheel Speed	page 228
192	907	13, 19	Rear Axle 1 Left Wheel Speed	page 230
193	908	13, 19	Rear Axle 1 Right Wheel Speed	page 232
194	1594	9, 13, 19	Rear Axle Left Wheel Speed	page 234
195	1595	13, 19	Rear Axle Right Wheel Speed	page 236
199	1571	12	Direction Mismatch	page 238
200	629	0, 1, 8, 9, 10, 11, 13, 18, 19, 20, 21, 31	TCM Operation 1	page 240
201	21150	2, 13, 14	TCM Protection 1	page 244
202	21151	0, 1, 15, 16, 17, 18	TCM Protection 2	page 246
205	609	9, 12, 19	TCM Operation 2	page 248
206	628	2, 11, 12, 13, 14, 31	TCM Program Memory	page 251
210	127	1, 3, 4, 5, 6, 18, 20, 21	Transmission Oil Pressure	page 254

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Fault Code	SPN	FMI	Description	Page Number
212	177	0, 2, 4, 5, 6, 10, 15, 16	Transmission Oil Temperature	page 262
215	37	0, 1, 2, 3, 4, 5, 6, 10, 17, 18	Transmission Air Supply Pressure Sensor	page 270
250	33	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 20, 31	Linear Clutch Actuator (LCA) Position Sensor	page 279
255	4218	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 20	Rail A Position	page 289
275	4219	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 20, 21, 31	Rail B Position	page 298
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 308
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 316
320	5942	0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 16, 18, 20, 21	Rail E Position	page 324
345	5052	0	Engine (Over) Speed	page 331
350	161	2, 3, 4, 5, 6, 8, 9, 10, 14, 20, 21	Input Speed	page 333
370	160	2, 3, 4, 5, 6, 8, 9, 10, 14, 20, 21	Countershaft Speed	page 340
375	191	2, 3, 4, 5, 6, 8, 9, 10, 11, 14, 20, 21, 31	Output Speed	page 348
385	583	2, 8, 10, 11, 12, 13, 14, 19, 20, 21, 31	Grade Sensor	page 354
511	5614	0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 16, 18	Clutch Engage Solenoid 1 (C4)	page 356
512	5615	0, 1, 3, 4, 5, 6, 8, 10, 12, 16, 18	Clutch Engage Solenoid 2 (C3)	page 364
513	5616	0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 16, 18	Clutch Release Solenoid 1 (C5)	page 371
514	5617	0, 1, 3, 4, 5, 6, 8, 10, 12, 16, 18	Clutch Release Solenoid 2 (C6)	page 378
570	787	0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 13, 14, 15, 16, 18	Inertia Brake Solenoid (A5)	page 385
576	5900	0, 1, 3, 4, 5, 6, 7, 8, 12, 16, 17, 18	Rail A Fore Solenoid (A3)	page 392
577	5908	0, 1, 3, 4, 5, 6, 8, 12, 16, 18	Rail A Aft Solenoid (A2)	page 399
596	5901	0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 16, 17, 18, 31	Rail B Fore Solenoid (A5)	page 405
597	5909	0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 16, 17, 18, 31	Rail B Aft Solenoid (A1)	page 413
616	5902	0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31	Rail C Fore Solenoid (C1)	page 421
617	5910	0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31	Rail C Aft Solenoid (B1)	page 429
636	5903	0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31	Rail D Fore Solenoid (C2)	page 437
637	4216	0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31	Rail D Aft Solenoid (B3)	page 445
646	768	0, 1, 3, 4, 5, 6, 7, 8, 12, 16, 17, 18	Rail E Fore Solenoid (A6)	page 453
647	769	0, 1, 3, 4, 5, 6, 7, 8, 12, 16, 17, 18	Rail E Aft Solenoid (A4)	page 460
700	6150	0, 1, 14, 17, 18	Clutch Operation	page 467
701	7847	14, 31	Clutch Engagement Status	page 472
702	560	2, 11, 12, 14, 20, 21, 31	Driveline Engagement	page 475
705	788	12, 14	Transmission Clutch Actuator	page 480
706	2983	17, 18	Clutch Position Out of Range	page 483
716	524	12	Transmission Selected Gear	page 485

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Fault Code	SPN	FMI	Description	Page Number
717	525	12	Transmission Requested Gear	page 487
730	6144	1, 2, 10, 14, 17, 18, 20, 21	Rail A Operation	page 489
740	6145	0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21	Rail B Operation	page 495
760	6146	0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21	Rail C Operation	page 502
775	6147	0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21	Rail D Operation	page 508
780	6148	0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 20, 21	Rail E Operation	page 514
785	5951	7, 20, 31	Rail A Calibration	page 520
786	5952	7, 20, 21, 31	Rail B Calibration	page 525
787	5953	7, 20, 21, 31	Rail C Calibration	page 530
788	5954	7, 20, 21, 31	Rail D Calibration	page 535
789	5955	7, 20, 21, 31	Rail E Calibration	page 540
815	5939	0, 15, 16	Clutch Temperature	page 545
900	3452	4, 9, 12, 13, 14, 19, 20, 31	PTO 1 Request	page 547
902	3454	4, 9, 12, 13, 14, 19, 20, 31	Split Shaft PTO Request	page 552
905	3453	4, 9, 12, 13, 14, 19, 20, 31	PTO 2 Request	page 557
910	3456	3, 4, 5, 6, 7, 11, 12, 13, 14, 31	PTO 1 Engage	page 562
912	3458	3, 4, 5, 6, 7, 12, 14, 31	Split Shaft PTO Engage	page 568
915	3457	3, 4, 5, 6, 7, 12, 14, 31	PTO 2 Engage	page 574
920	3460	4, 7, 9, 12, 13, 14, 19, 31	PTO 1 Confirm	page 580
922	3462	4, 7, 9, 12, 13, 14, 19, 20, 31	Split Shaft PTO Confirm	page 586
925	3461	4, 7, 9, 12, 13, 14, 19, 20, 31	PTO 2 Confirm	page 591
950	3648	12	Neutral Status 1	page 596
960	6159	12	Neutral Status 2	page 598
962	7694	3, 4, 5, 13, 14	Force Hold Neutral Output	page 600
963	7695	5, 8, 9, 12, 13, 14, 19, 20	Force Hold Neutral Input	page 604
965	7941	9, 13, 19	Rail Road Mode Switch	page 609
970	604	3, 4, 5, 6, 12, 14, 31	Neutral Output	page 611
975	767	3, 4, 5, 6, 12, 14, 31	Reverse Output	page 615
977	6160	3, 4, 5, 6, 11, 12, 13, 14, 20, 31	Alternate Shift Schedule Selector	page 620
980	3957	4, 12, 13, 14, 20	Auxiliary Trans Constant Supply Actuator	page 625
981	3958	4, 12, 13, 14, 20	Auxiliary Trans High Range Actuator	page 630
982	3959	4, 12, 13, 14, 20	Auxiliary Trans Neutral Range Actuator	page 635
983	3960	4, 12, 13, 14, 20	Auxiliary Trans Range Switch	page 640
984	15202	9, 13, 19	Auxiliary Trans Selected Gear	page 645
985	69	13, 19	Two Speed Axle Message	page 647
986	4056	4, 12, 13, 14, 20	Two Speed Axle Switch	page 649

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Fault Code	SPN	FMI	Description	Page Number
987	12939	3, 4, 5, 6, 11, 12, 13, 14, 20, 31	Rock Free Mode Switch	page 653
988	12949	9, 13, 19	Rock Free Mode Message	page 658
990	5399	9, 13, 19	DPF Thermal Management Active	page 660
991	5400	9, 13, 19	SCR Thermal Management Active	page 662

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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 on 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.

The Product Diagnostic (PD) Test is a “Wiggle Test” used to identify intermittent Open or Short circuit conditions in a connector, component, or wire in a circuit. Instructions for the PD Test are included on page 12. 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.

Possible Causes

- Vehicle Harness
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
  - 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 check for signs of pinched or chafed wiring.
3. Inspect connectors for debris and contamination. Only clean if necessary.
4. When taking a volt/ohm meter reading at a connector, inspect for loose terminals, corrosion and bent or spread pins.

   Note: If damage is found to OEM wiring, refer to OEM guidelines for repair or replacement of wiring and connectors.

5. When reconnecting, the use of NyoGel 760G on electrical contacts is recommended. Ensure all connectors are clean and tight.

Use PD Test mode for Intermittent Issues

- If there are no Active fault codes, refer to *Product Diagnostic (PD) Test* on page 12 to diagnose intermittent wiring or connection issues.

Recommendations for Using a Volt/Ohm Meter

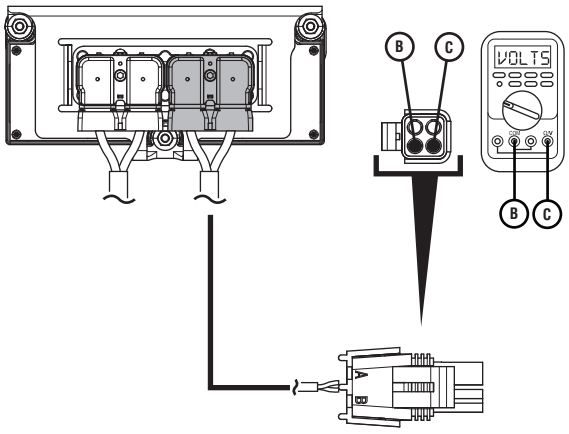
1. Use a quality digital auto-ranging volt/ohm meter.
2. When using a volt/ohm meter without auto-ranging capabilities, use the correct range setting for the reading.
3. Verify that the battery and fuse are in good working order.
4. Some volt/ohm meters have multiple sockets for test leads. Use the correct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

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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.

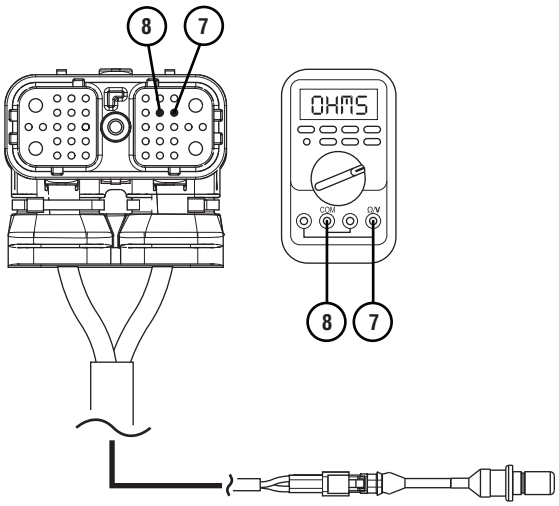


Pins	Range	Reading(s)
B to C	Within 0.6 V of Battery Voltage	12.5 V

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.

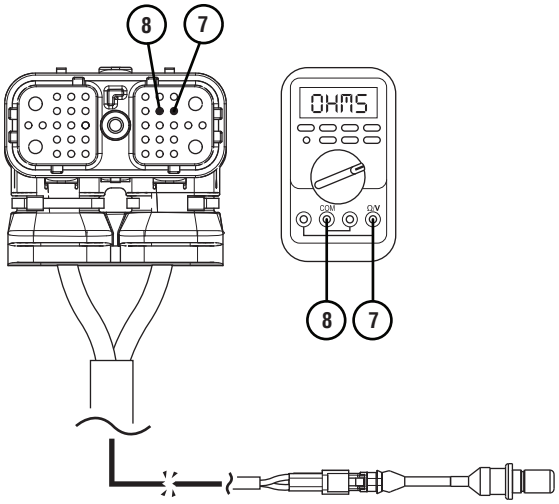


Pins	Range	Reading(s)
7 to 8	2.0k – 4.5k ohms	3.2k ohms

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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.

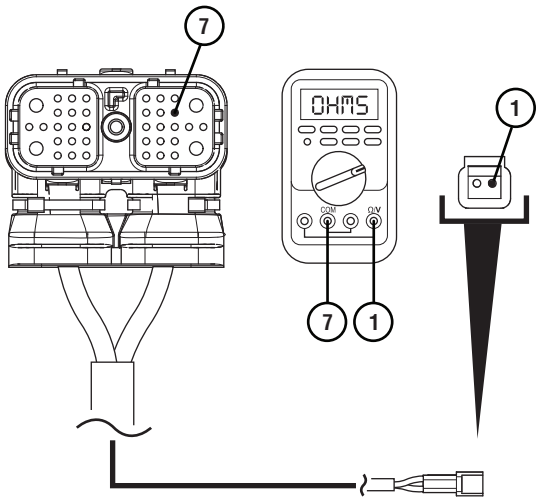


Pins	Range	Reading(s)
7 to 8	2.0k – 4.5k ohms	OL

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.

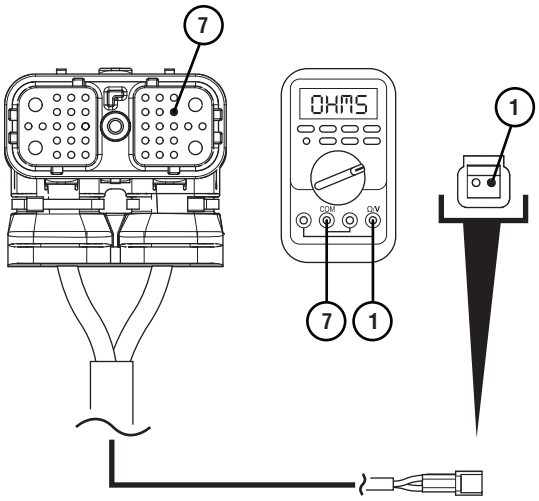


Pins	Range	Reading(s)
7 to 1	0.0 – 0.3 ohms	0.2 ohms

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End to End Resistance is Too High

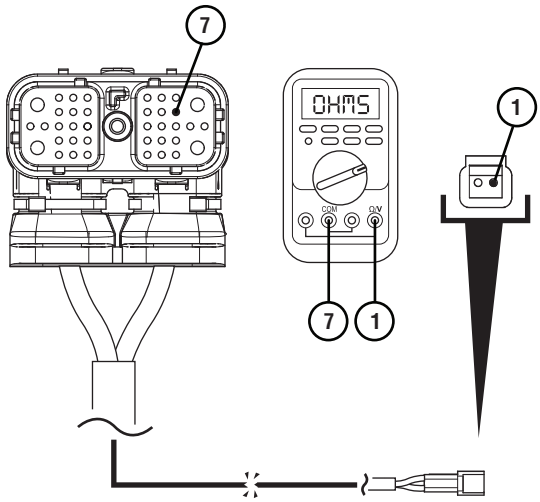
When the resistance is higher than the acceptable range there is additional resistance in this wire. Check for corrosion, loose or spread pins or damage to the harness.



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.



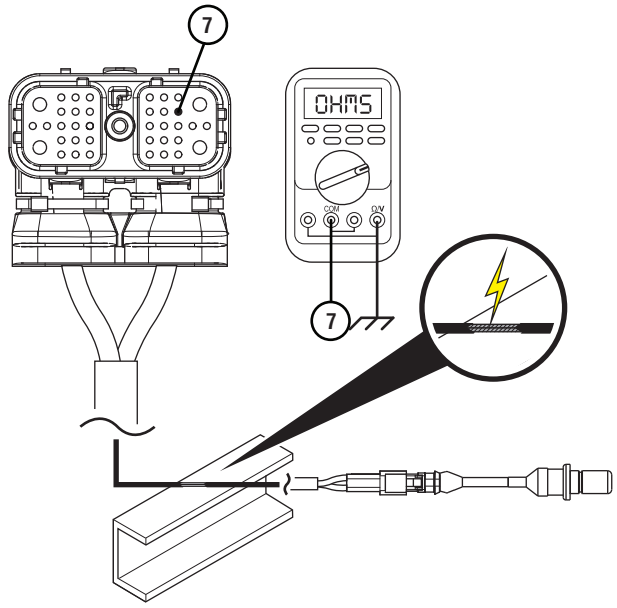
Pins	Range	Reading(s)
7 to 1	0.0 – 0.3 ohms	OL

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Short Circuit to Chassis Ground

Short to Ground

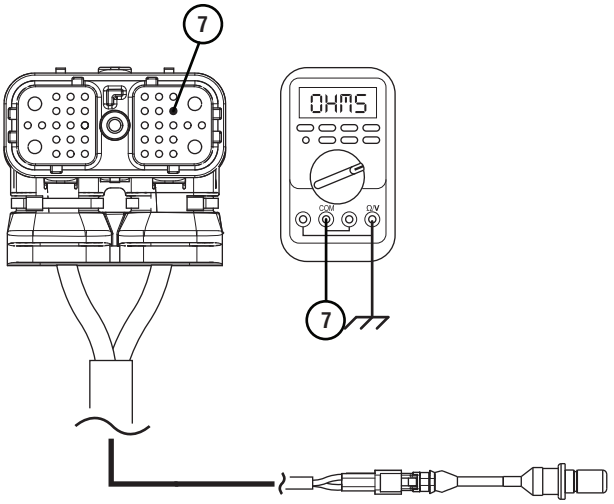
A wire is shorted to ground when the resistance between a non-ground wire and chassis ground shows continuity. Low resistance values (near 0 ohms) indicate a direct short to ground. Higher resistance values may indicate a partial-short.



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.



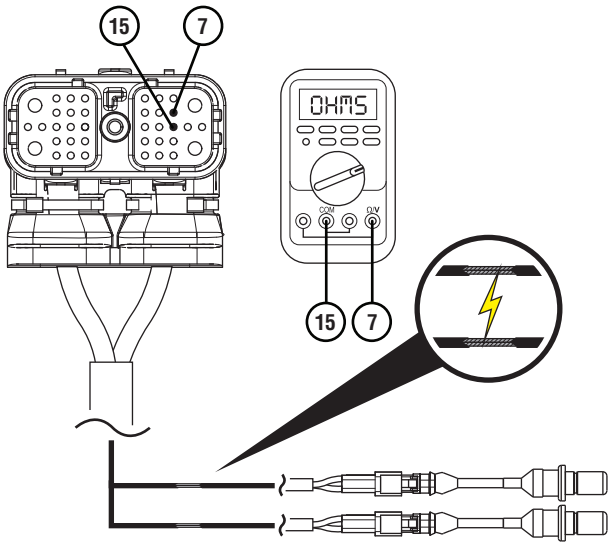
Pins	Range	Reading(s)
7 to Ground	Open Circuit (OL)	OL

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Short to Another Circuit

Two Circuits Shorted Together

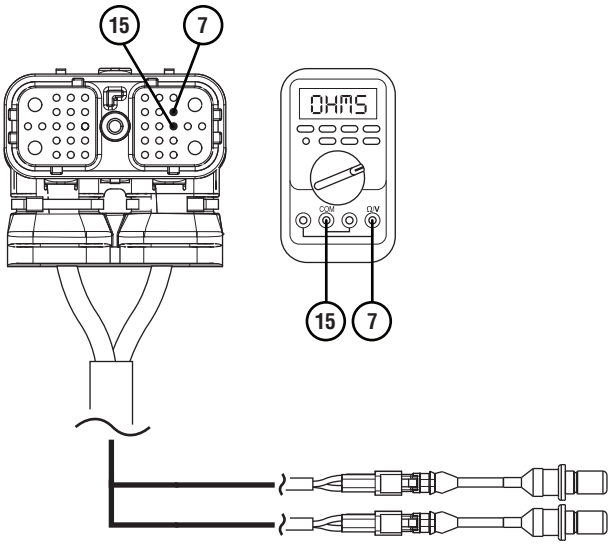
When wires from two unrelated circuits show continuity (low resistance) to one another, these circuits are shorted together.



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.



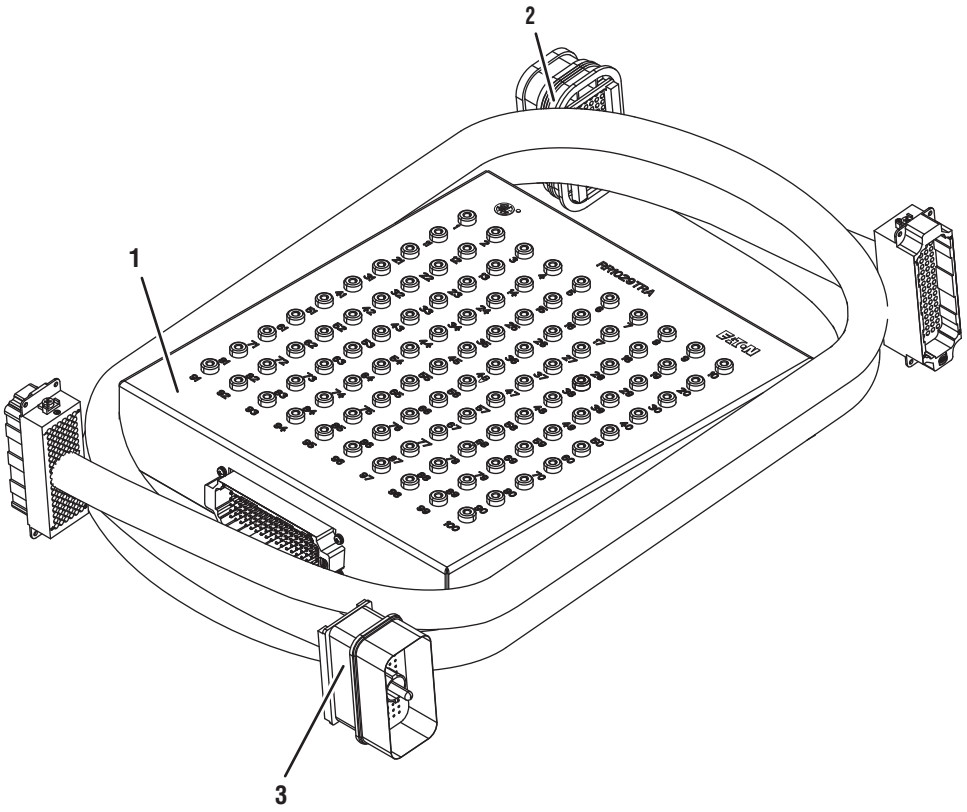
Pins	Range	Reading(s)
7 to 15	Open Circuit (OL)	OL

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Eaton Breakout Box and Eaton Diagnostic Adapter Procedure

Overview

This procedure describes how to use the Eaton Breakout Box (RR1029TR). This diagnostic tool eliminates the need for a diagnostic pin kit and simplifies access to component electrical circuits.

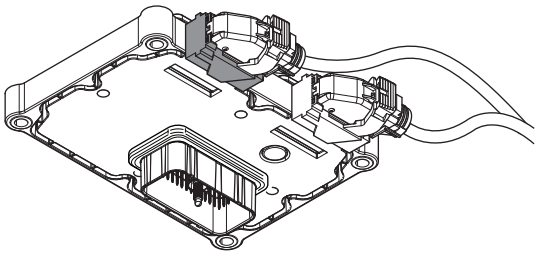


1. Eaton Breakout Box (RR1029TR)
2. 74-Way EDA Transmission Control Module Connector - part of RR1029TR
3. 74-Way EDA Transmission Harness Connector - part of RR1029TR

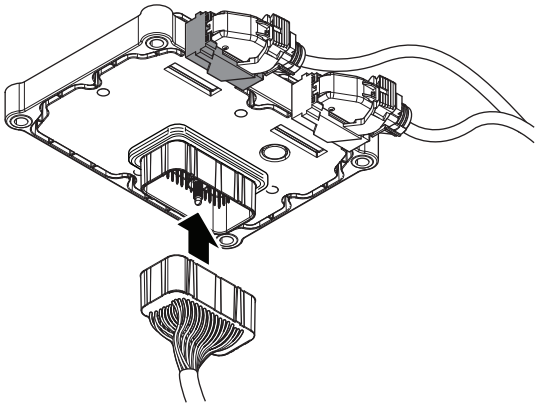
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Troubleshooting TCM Signals with the Eaton Breakout Box

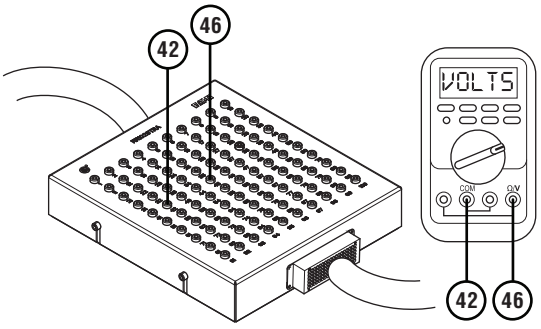
1. Key off.
2. Remove TCM from MTM with 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.



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.

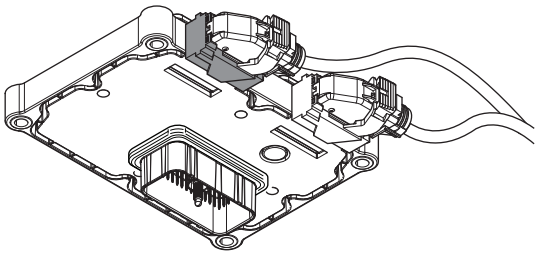


4. Key on with engine off.
5. Measure voltage at Eaton Breakout Box between Pin 42 and Pin 46.

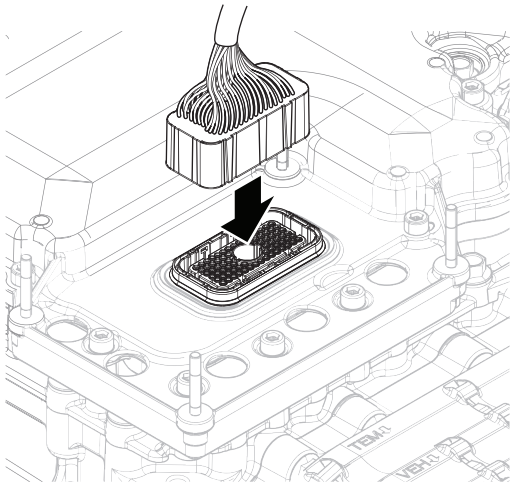


Troubleshooting Internal Components and Circuits with the Eaton Breakout Box

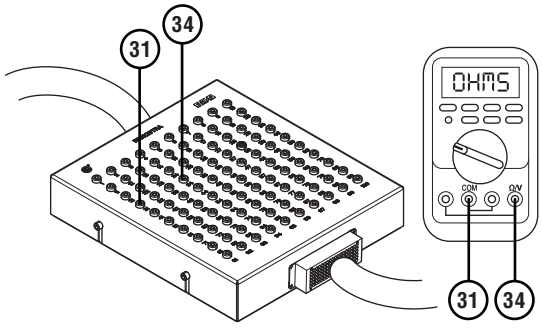
1. Key off.
2. Remove TCM from MTM with 20-Way TCM Vehicle Harness Connector and 20-Way TCM Body Harness Connector connected.



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 Eaton Breakout Box between Pin 31 and Pin 34.

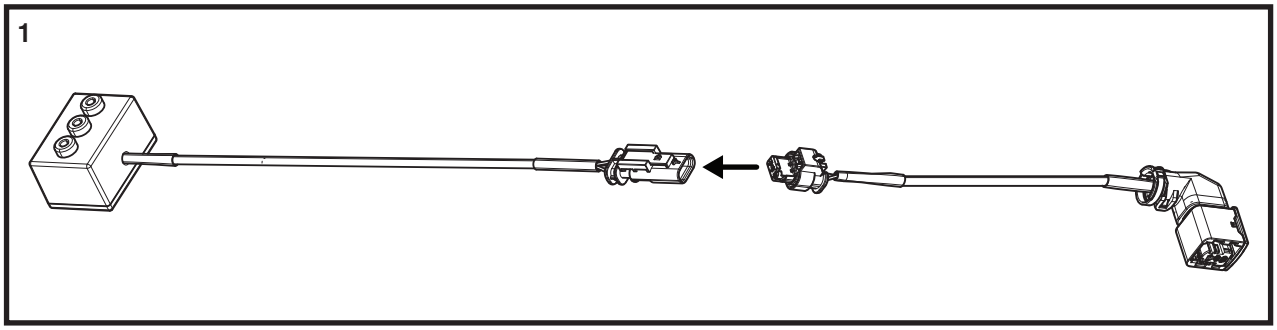


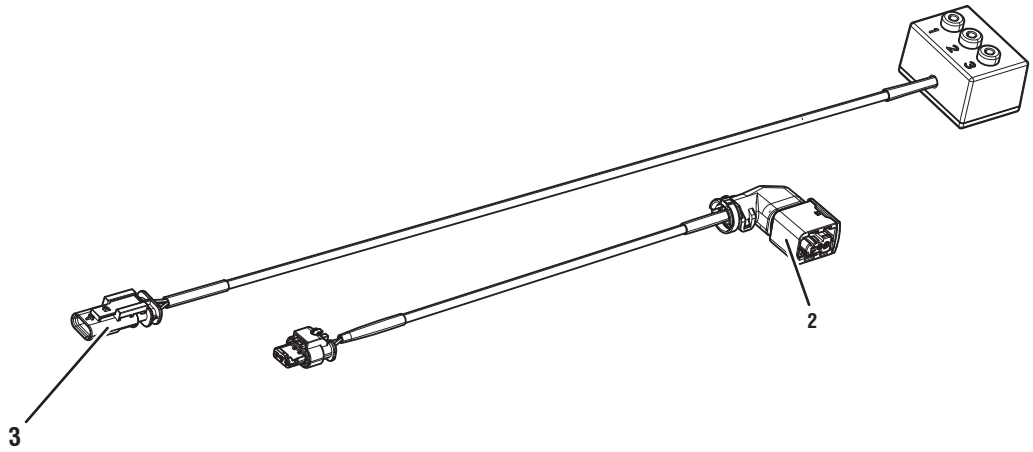
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3-Way Eaton Diagnostic Adapter (3-Way EDA)

Overview

This procedure describes how to use RR1060TR 3-Way Eaton Diagnostic Adapter (3-Way EDA). This diagnostic tool eliminates the need for a diagnostic pin kit and simplifies 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.



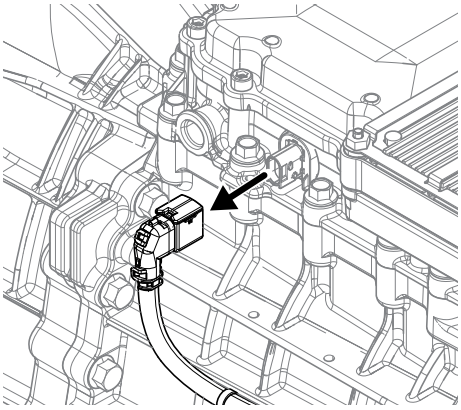


1. 3-Way EDA (RR1060TR)
2. Output Speed Sensor Connector - part of RR1060TR
3. Fluid Pressure Sensor Connector - part of RR1060TR

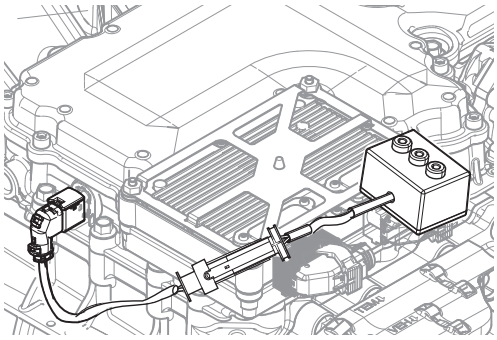
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Troubleshooting the Output Speed Sensor using the 3-Way Eaton Diagnostic Adapter

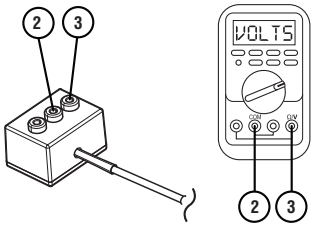
1. Key off.
2. Disconnect the 3-Way Output Speed Sensor Connector at the MTM by lifting up on the yellow latch.



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

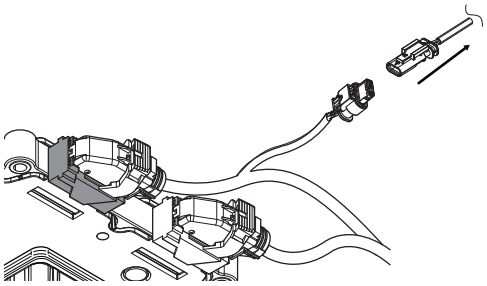


4. Key on with engine off.
5. Measure voltage at the 3-Way EDA between Pin 2 (signal) and Pin 3 (5V). Record reading in table.

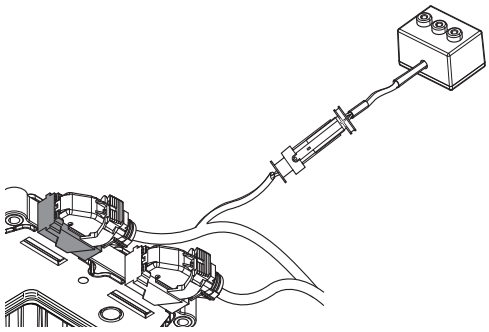


Troubleshooting the Fluid Pressure Sensor using the 3-Way Eaton Diagnostic Adapter

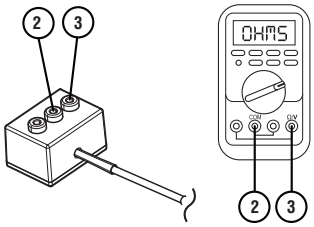
1. Key off.
2. Disconnect the 3-Way FPS Harness Connector.



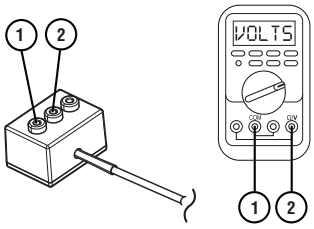
3. Connect the 3-Way Eaton Diagnostic Adapter (EDA) to the 3-Way FPS Harness Connector.



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



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



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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 cranking prohibited.
- ServiceRanger may not connect to Transmission Control Module (TCM).

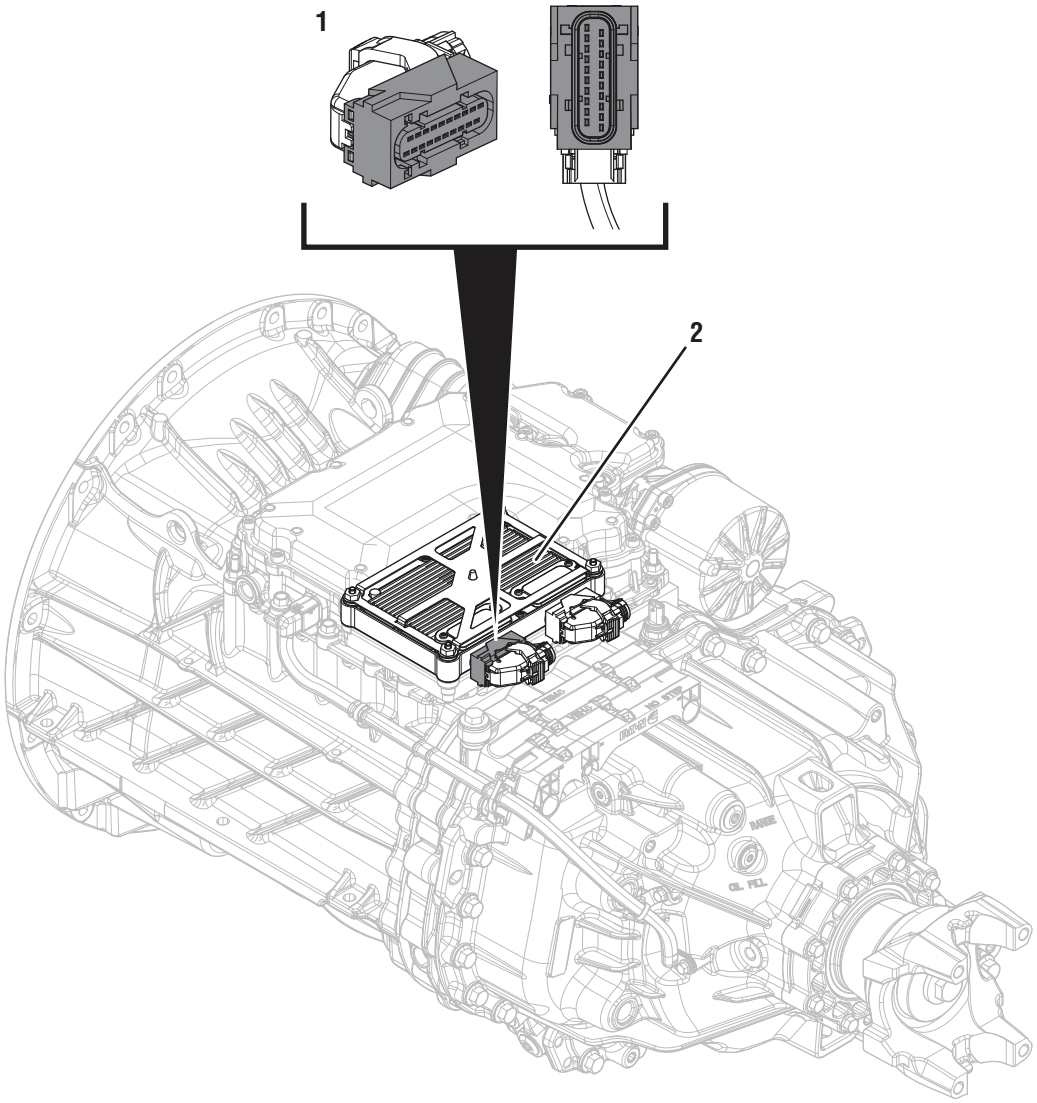
Note: Fault codes that set give additional information about performance issues detected on the vehicle. If a unit has an Active fault code, or repeated occurrences of an Inactive fault code, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

Possible Causes

- Vehicle Components
  - Batteries internal failure
- Vehicle Harness - Power supply and Primary Data Link (J1939A)
  - Power or ground connections
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
- TCM
  - Internal Failure

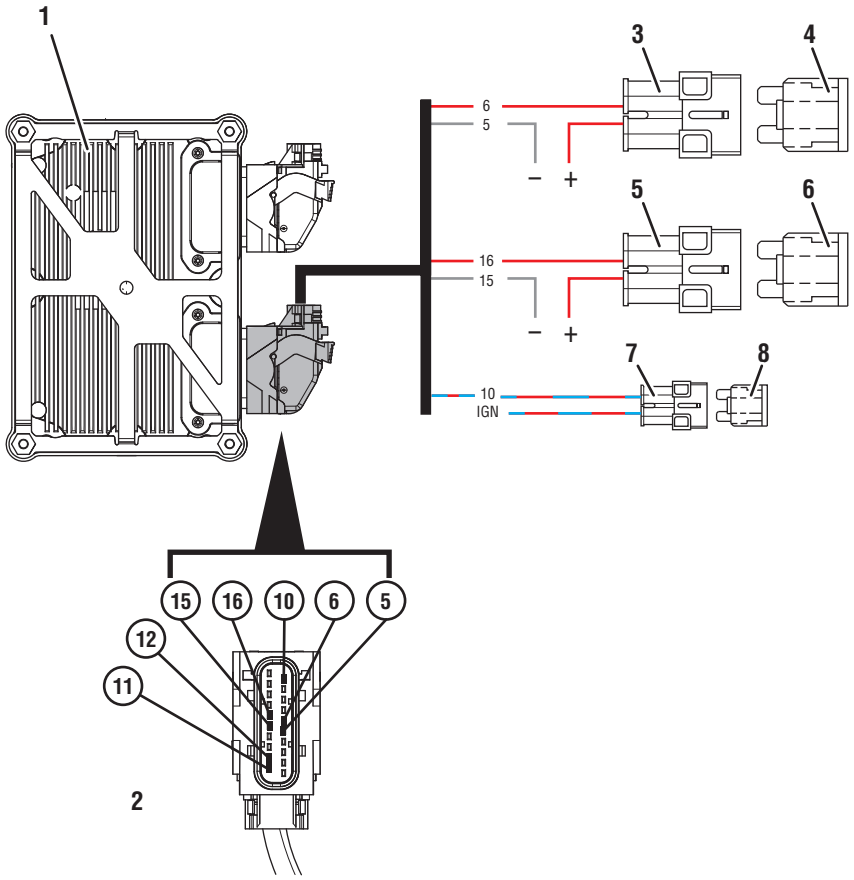
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Component Identification



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

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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

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Power-Up Sequence Test

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

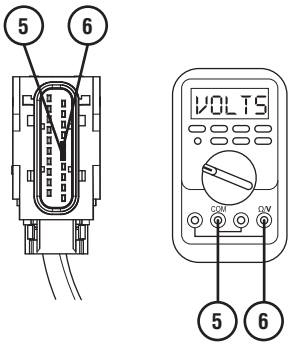
1. Set vehicle parking brake and chock wheels.
2. Key off.
3. Inspect the vehicle charging/battery system and connections, verify the connectors are free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector bodies.
4. Inspect the transmission 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 20-Way TCM Vehicle Harness Connector from TCM.
3. Inspect 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect 20-Way TCM Vehicle Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to 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.



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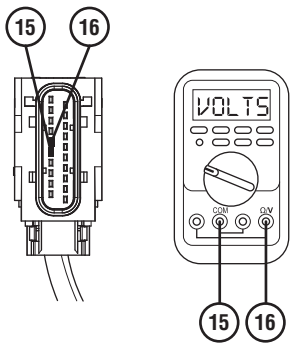
6. Compare reading(s) in table.
   - If readings are in range, go to **Step C.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the vehicle charging/battery system, vehicle harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

Pins	Range	Reading(s)
5 to 6	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.



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 vehicle charging/battery system, vehicle harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

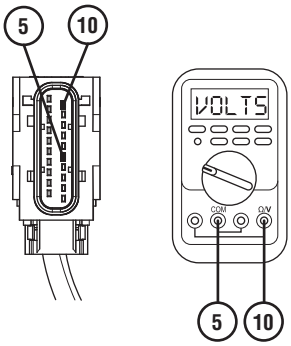
Pins	Range	Reading(s)
15 to 16	11–15 V	

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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.



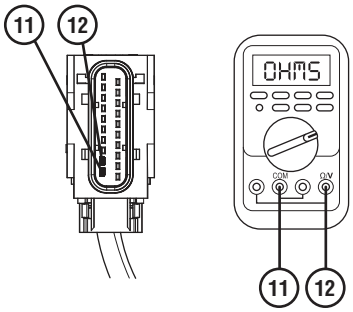
3. Compare reading(s) in table.
   - If readings are in range, go to **Step E.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of the vehicle ignition circuit, vehicle harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

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 20-Way TCM Vehicle Harness Connector from TCM.
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 (J1939A). 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	

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F

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

1. Key off.
2. Reconnect all connectors and verify all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record 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 (J1939A) 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 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 19 and troubleshoot the fault code with the highest priority level.

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify all components are properly installed.
3. Key on with engine off.
4. Clear fault codes using ServiceRanger.
5. Operate vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and vehicle operates properly, test complete.
   - If a fault code sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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) that maintain normal function if either source becomes unavailable. The Battery Voltage1 wiring connects to the TCM through the 20-Way TCM Vehicle Harness Connector.

Detection

The TCM monitors Battery Voltage1 power and ground source. If the voltage is 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 greater than 16.5 volts for 5 seconds.

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

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

FMI 17 – Data Valid But Below Normal (Least Severe): Battery Voltage1 less than 11V for 5 seconds with engine above 1000 RPM.

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

Fallback

FMI 0:

- No degraded modes

FMI 1, 18:

- Amber warning lamp on
- If Fault Code 100 and 105 are both Active and transmission is in gear:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO Mode prohibited
- If Fault Code 100 and 105 are both Active and transmission is not in gear:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch disengagements prohibited
  - Non-Neutral modes prohibited
  - PTO Mode prohibited
  - If vehicle is moving - Red stop lamp on

FMI 4, 17:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

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

FMI 4: Key cycle and fault condition no longer exist.

Possible Causes

FMI 0:

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

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FMI 1, 4, 17, 18:

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

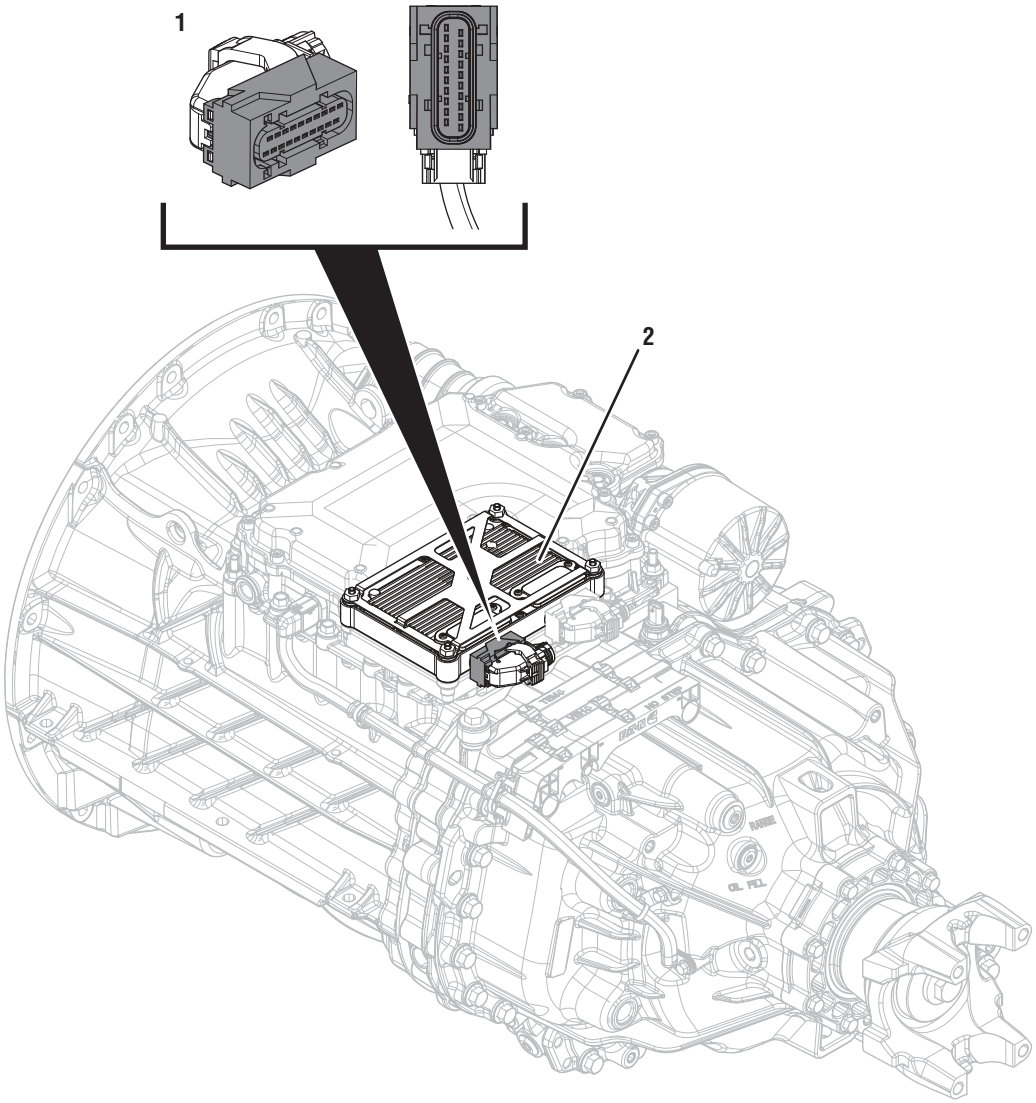
Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- Endurant XD Service Manual TRSM0960
- Digital Volt Ohm Meter (DVOM)

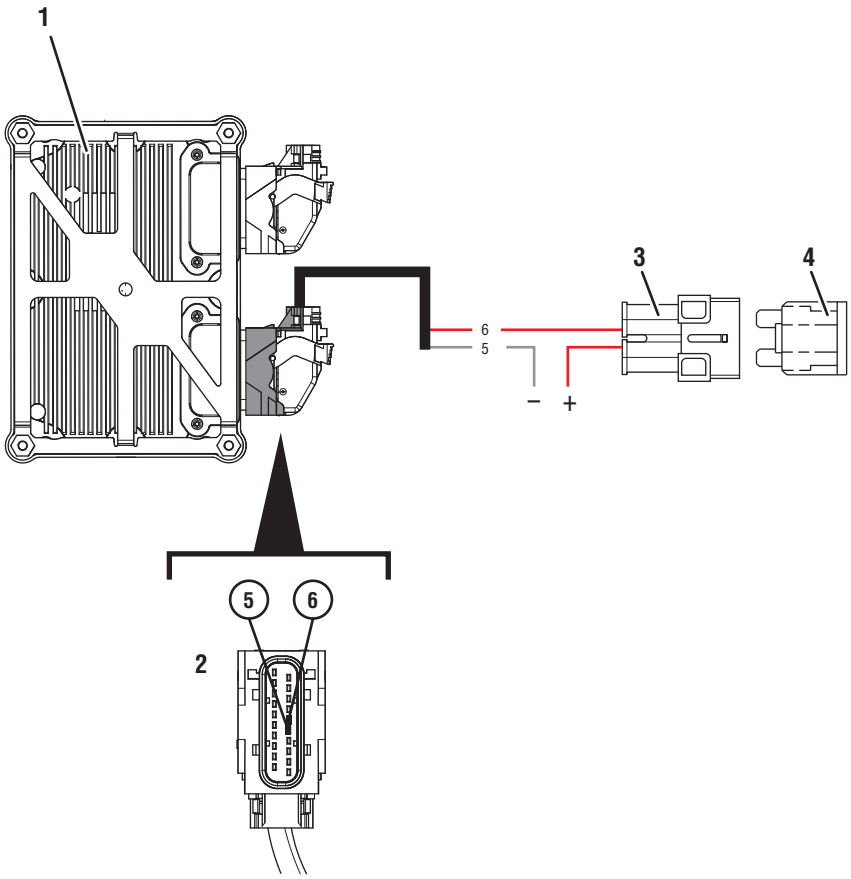
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Component Identification



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

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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

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Fault Code 100 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 vehicle charging/battery system. Go to **Step V.**
   - If Fault Code 100 FMI 1, 17, 18 is Active, go to **Step C.**
   - If Fault Code 100 FMI 1, 17, 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 Auto-mated Transmission Technologies at +1 800-826-4357 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 codes.



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

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C

Purpose: *Verify Battery Voltage1 supply to TCM.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From "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 and no fault was found, the intermittent nature of the fault makes it likely there is a wiring problem between the vehicle charging/battery system and 20-Way TCM Vehicle 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	Readings
168 - Battery voltage	11-15V	
444 - Battery 2 voltage	11-15V	

D

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

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

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

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E

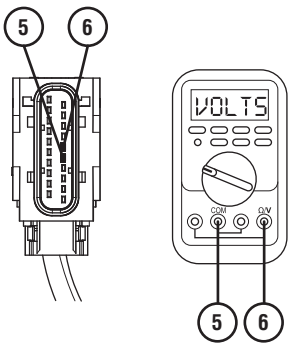
Purpose: *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector from TCM.
3. Inspect 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect 20-Way TCM Vehicle Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
   - If contamination or damage is found, refer to OEM guidelines for repair or replacement of 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 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 and no fault was found, the intermittent nature of the fault makes it likely there is a wiring problem between the vehicle charging/battery system and 20-Way TCM Vehicle Connector. Refer to OEM guidelines for repair or replacement of vehicle harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

Pins	Range	Reading(s)
5 to 6	11–15V	

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G

Purpose: *Verify Battery Voltage1 supply to TCM.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor.”
4. From "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 in the vehicle charging/battery system. Refer to OEM guidelines for diagnosing vehicle charging/battery system. Go to **Step V.**
    - If readings are in range and Fault Code 100 FMI 0 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**.

      Note: If troubleshooting indicated no fault found in wiring or connections to TCM, ensure an intermittent issue does not exist in wiring or connections before replacing TCM.

Condition	Parameter	Range	Reading(s)
Key on with engine off	168 - Battery voltage	11–13V	
Key on with engine off	444 - Battery 2 voltage	11–13V	
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 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 100 sets Active, go to **Step A.**
    - If a fault code other than 100 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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) that maintain normal function if either source becomes unavailable. The Battery Voltage2 wiring connects to the TCM through the 20-Way TCM Vehicle Harness Connector.

Detection

The TCM monitors Battery Voltage2 power and ground source. If the voltage is 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 greater than 16.5 volts for 5 seconds.

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

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

FMI 17 – Data Valid But Below Normal (Least Severe): Battery Voltage2 less than 11 volts for 5 seconds with engine above 1000 RPM.

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

Fallback

FMI 0:

- No degraded modes

FMI 1, 4, 17, 18:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

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

FMI 4: Key cycle and fault condition no longer exist.

Possible Causes

FMI 0:

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

FMI 1, 4, 17, 18:

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

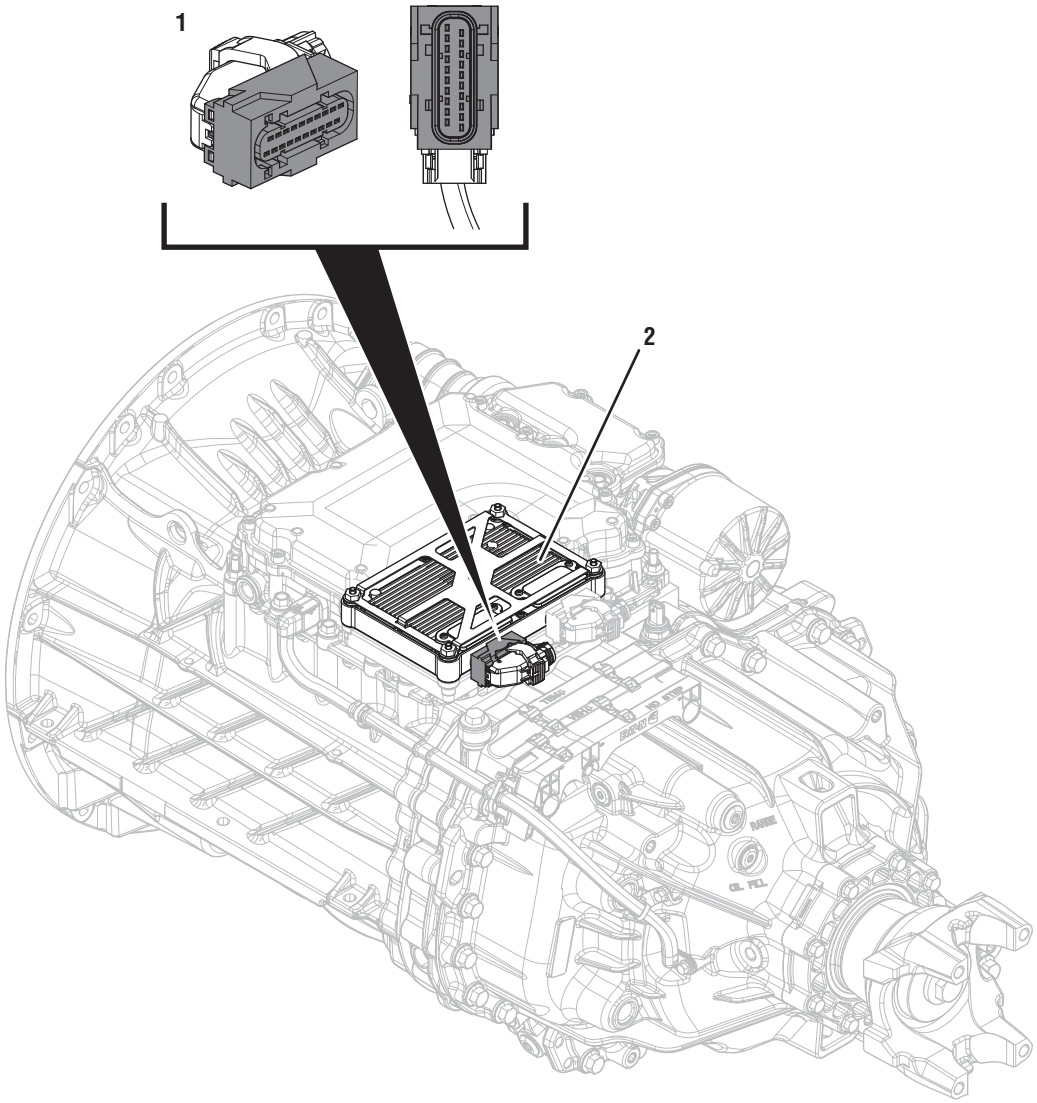
Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- Endurant XD Service Manual TRSM0960
- Digital Volt Ohm Meter (DVOM)

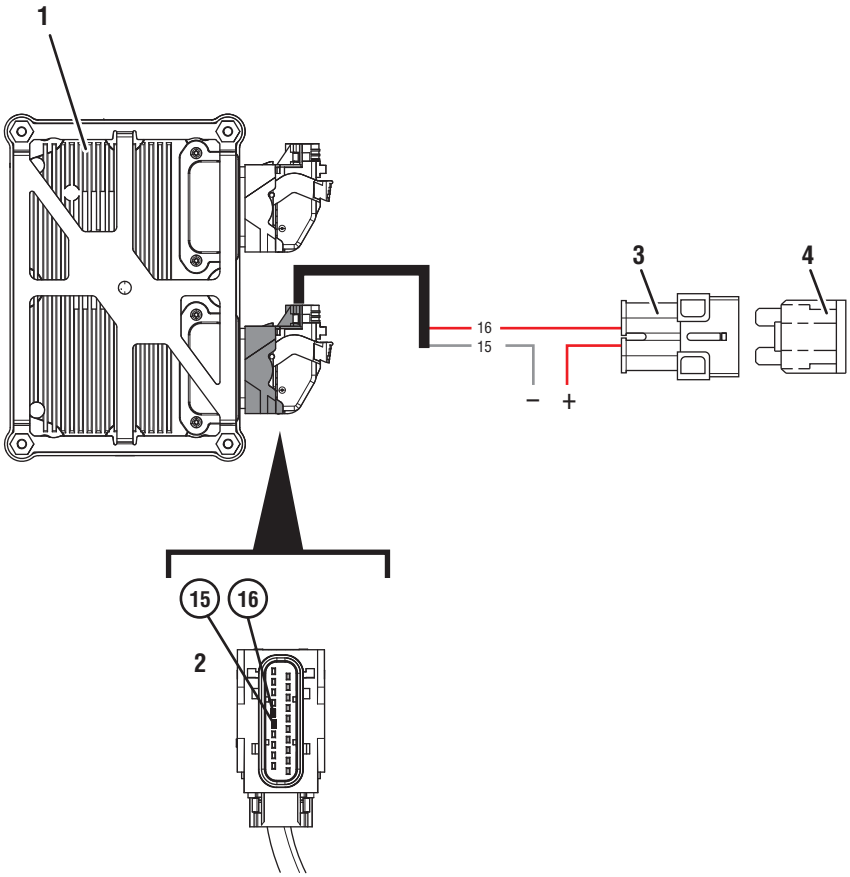
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Component Identification



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

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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

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Fault Code 105 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 vehicle charging/battery system. Go to **Step V.**
   - If Fault Code 105 FMI 1, 17, 18 is Active, go to **Step C.**
   - If Fault Code 105 FMI 1, 17, 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 +1 800-826-4357 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 codes.



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

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C

Purpose: *Verify Battery Voltage2 supply to TCM.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From "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 and no fault was found, the intermittent nature of the fault makes it likely there is a wiring problem between the vehicle charging/battery system and 20-Way TCM Vehicle Connector. Refer to OEM guidelines for repair or replacement of vehicle harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

Parameter	Range	Readings
168 - Battery voltage	11-15V	
444 - Battery 2 voltage	11-15V	

D

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

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

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

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E

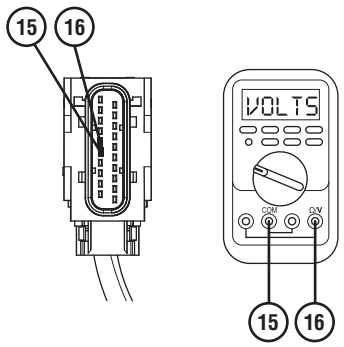
Purpose: *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector from TCM.
3. Inspect 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect 20-Way TCM Vehicle Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
   - If contamination or damage is found, refer to OEM guidelines for repair or replacement of 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 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 and no fault was found, the intermittent nature of the fault makes it likely there is a wiring problem between the vehicle charging/battery system and 20-Way TCM Vehicle Connector. Refer to OEM guidelines for repair or replacement of vehicle harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

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

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G

Purpose: *Verify Battery Voltage2 supply to TCM.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor.”
4. From "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 in the vehicle charging/battery system. Refer to OEM guidelines for diagnosing vehicle charging/battery system. Go to **Step V.**
    - If readings are in range and Fault Code 105 FMI 0 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**

      Note: If troubleshooting indicates no fault found in wiring or connections to TCM, ensure an intermittent issue does not exist in wiring or connections before replacing TCM.

Condition	Parameter	Range	Reading(s)
Key on with engine off	168 - Battery voltage	11–13V	
Key on with engine off	444 - Battery 2 voltage	11–13V	
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 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 105 sets Active, go to **Step A.**
    - If a fault code other than 105 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19

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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 wiring connects to the TCM through the 20-Way TCM Vehicle Harness Connector.

Detection

The TCM monitors the vehicle's Ignition Voltage supply. If there is a loss of Ignition Voltage while driving, the fault code is set Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Ignition Voltage available with output shaft speed less than 10 RPM.

Fallback

FMI 2:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited
- Upshifts prohibited
- Engine communications may not be available
- If vehicle comes to a stop, TCM will shut down

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

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

Possible Causes

FMI 2:

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

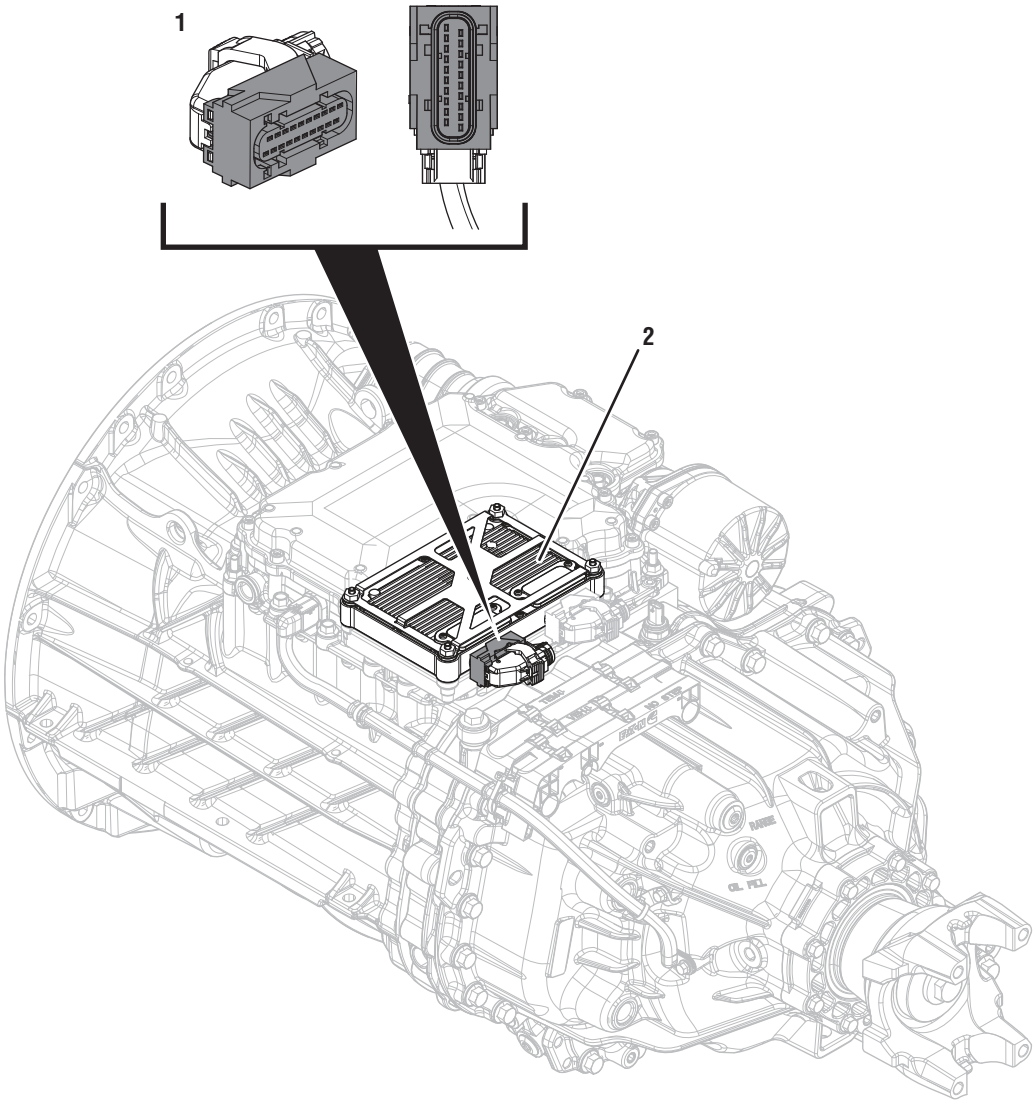
Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

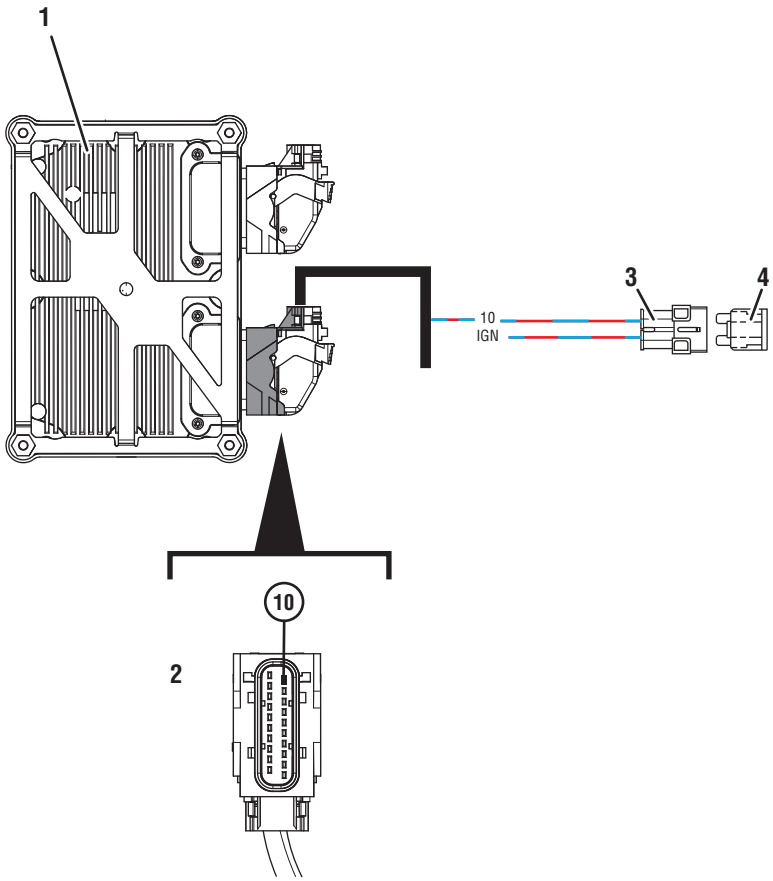
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Component Identification



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

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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

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Fault Code 110 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Set vehicle parking brake and chock wheels.
3. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 Ignition voltage supply.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. From “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 out of range, refer to OEM guidelines for repair or replacement of the vehicle's Ignition Voltage supply.

     Note: Some chassis use a power distribution system, inspect all connections.

   - If readings are in range:
     - Vehicle operator may have cycled key off while vehicle was moving. Go to **Step V.**

     or

     - The intermittent nature of the fault makes it likely there is a wiring problem between vehicle’s Ignition Voltage supply and 20-Way TCM Vehicle Connector. Refer to OEM guidelines for repair or replacement of vehicle's ignition voltage circuit, vehicle harness, and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**

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

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

1. Key off.
2. Reconnect all connectors and verify 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 110 sets Active, go to **Step A.**
   - If a fault code other than 110 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 115: Primary Data Link (J1939A)

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: the Primary Data Link (J1939A) and the Secondary Data Link (J1939B).

The Primary Data Link is used by the TCM to send and receive messages to and from the Engine ECU, Anti-Lock Brake ECU and other vehicle ECUs to complete transmission shift operations. The Secondary Data Link is used in the event that the Primary Data Link is inoperative.

The Primary Data Link (J1939A) is connected to the TCM at the 20-Way TCM Vehicle Harness Connector. The Secondary Data Link (J1939B) is connected to the TCM at the 20-Way TCM Body Harness Connector.

Detection

The TCM monitors vehicle and Engine ECU broadcast messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Primary Data Link (J1939A) vehicle ECU(s) messages not received for 1 second.

FMI 8 – Abnormal Frequency: Primary Data Link (J1939A) Engine ECU messages not received for 1 second while the TCM is receiving messages from other vehicle ECU(s).

FMI 9 – Abnormal Update Rate: Primary Data Link (J1939A) vehicle messages not received for 5 seconds.

FMI 14 – Special Instructions: Primary Data Link (J1939A) Engine ECU messages not received for 5 seconds while the TCM is receiving messages from other vehicle ECU(s).

FMI 19 – Received Network Data In Error: Primary Data Link (J1939A) vehicle ECU(s) messages received but in error.

FMI 31 – Condition Exists: Primary Data Link (J1939A) receiving a vehicle ECU(s) “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
- If vehicle is moving and transmission is in a gear higher than the lowest available start gear:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
- If vehicle is moving and transmission is in a gear higher than the lowest available start gear and Secondary Data Link (J1939B) is not available:
  - Red stop lamp on
  - Clutch engagements prohibited, vehicle may coast to a 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
- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch disengagements prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited
- Hill Start Aid prohibited

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Conditions to Set Fault Code Inactive

FMI 2: Primary Data Link (J1939A) vehicle ECU(s) messages received and valid for 20 seconds.

FMI 8: Primary Data Link (J1939A) Engine ECU messages received and valid for 20 seconds.

FMI 9: Primary Data Link (J1939A) vehicle ECU(s) messages received and valid for 10 seconds.

FMI 14: Primary Data Link (J1939A) Engine ECU messages received and valid for 10 seconds.

FMI 19: Key cycle and fault condition no longer exist.

FMI 31: Fault condition no longer exists.

Possible Causes

FMI 2, 9:

- Vehicle Components
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
  - Excessive electrical noise
  - Missing or additional terminating resistors

FMI 8, 14:

- Vehicle Components
  - Engine ECU internal failure
  - Engine ECU not powering up
- Vehicle Harness - Primary Data Link (J1939A) between Engine ECU and TCM
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
  - Excessive electrical noise
  - Missing or additional terminating resistors

FMI 19:

- Other Vehicle ECU(s)
  - Internal failure

FMI 31:

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

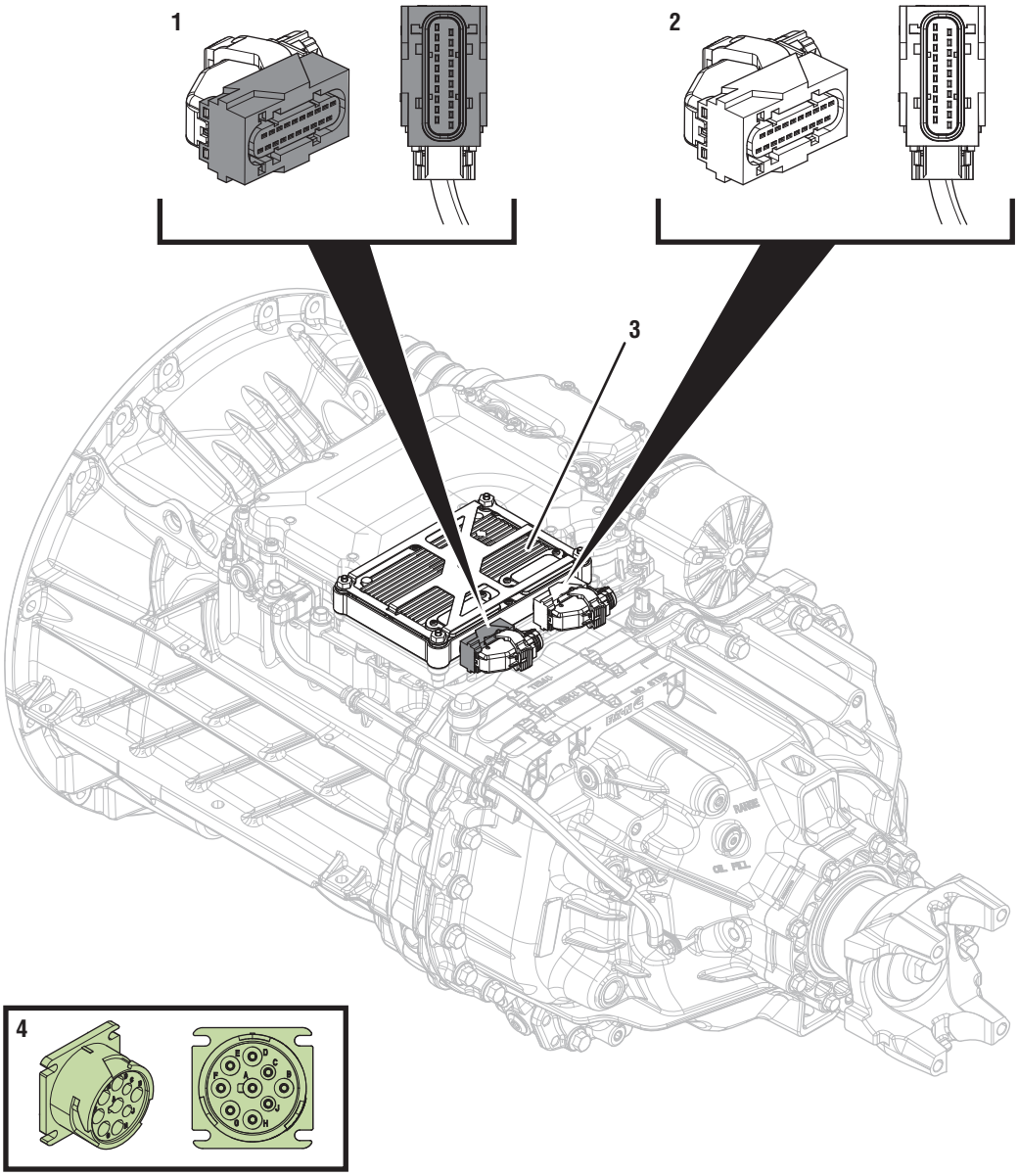
Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- Endurant XD Service Manual TRSM0960
- Digital Volt Ohm Meter (DVOM)

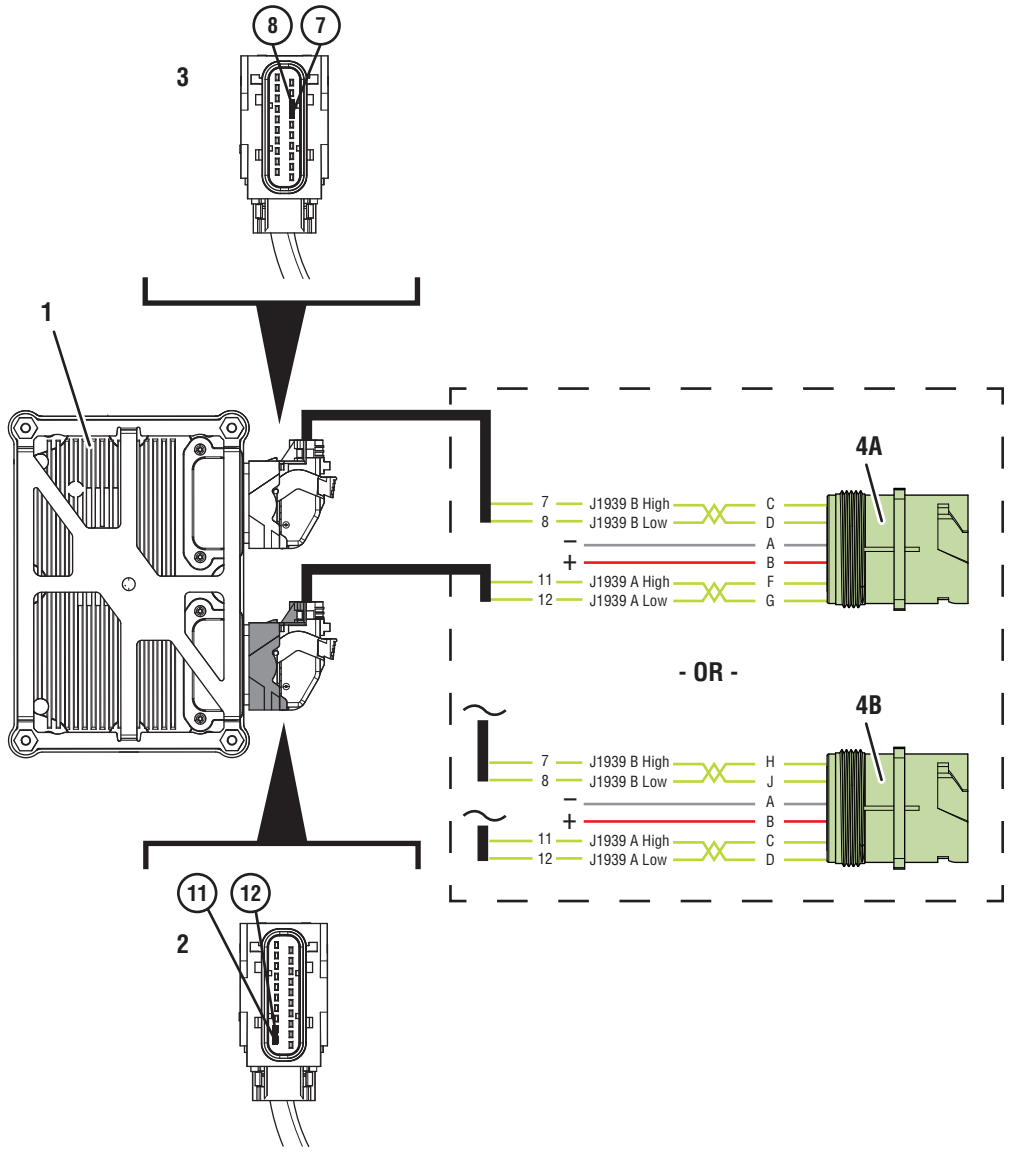
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Component Identification



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)

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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

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Fault Code 115 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 115 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes first. Go to **Step V.**
   - 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 TCM, vehicle Primary Data Link (J1939A) is currently functional between vehicle 9-Way Diagnostic Connector and TCM. Refer to OEM guidelines for vehicle J1939 Data Link diagnostic instructions.
   - If Fault Code 115 FMI 14 is Active, go to **Step O.**

     Note: If ServiceRanger connects to TCM, vehicle data link is currently functional between vehicle 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, there may be an intermittent wiring problem in the vehicle Primary Data Link (J1939A) to the Engine ECU, an Engine ECU message fault may exist, and/or the Engine ECU may intermittently not be powering up. 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 or Inactive, a fault condition exists on the Primary Data Link (J1939A) with the Engine ECU or another Vehicle ECU(s). Contact OEM for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 115 FMI 31 is Inactive or Active, this indicates a vehicle ECU experienced a programming event (Informational only). 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 codes.



5. Wiggle Primary Data Link (J1939A) harness and connections throughout vehicle, including 20-Way TCM Vehicle Harness Connector. Check for signs of rubbing or chafing on wires. Refer to OEM wiring diagrams.
6. To end the test, press Stop button.
   - If fault codes set Active, refer to OEM guidelines for repair or replacement of vehicle harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If no fault codes become Active, go to **Step D.**

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C

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

1. Key off.
2. Disconnect 20-Way TCM Body Harness Connector from TCM.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 115 is Inactive, a wiring problem exists in the vehicle Secondary Data Link (J1939B). Refer to OEM guidelines for repair or replacement of the vehicle Secondary Data Link (J1939B) harness and/or 20-Way TCM Vehicle Harness Connector. 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

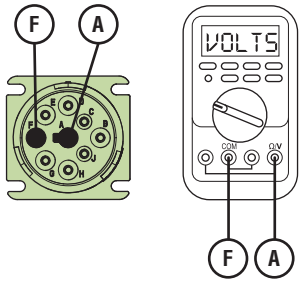
Purpose: *Identify TCM location on vehicle Primary Data Link (J1939A).*

1. Key off.
2. Refer to OEM to identify TCM J1939 pin locations on vehicle 9-Way J1939 Diagnostic Connector.
   - If TCM is on Pins C and D, go to **Step J.**
   - If TCM is on Pins F and G, go to **Step E.**

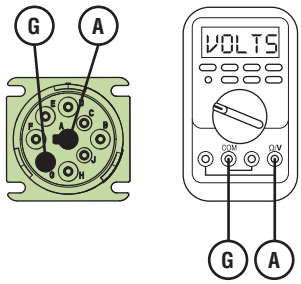
E

Purpose: *Verify vehicle Primary Data Link (J1939A) 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.



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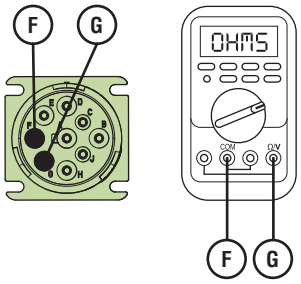
4. Record Total Voltage in table by adding voltage readings together.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step F.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939A). Go to **Step V.**

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 (J1939A).*

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 (J1939A). Go to **Step V.**
   - If readings are in range, go to **Step G.**

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

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G

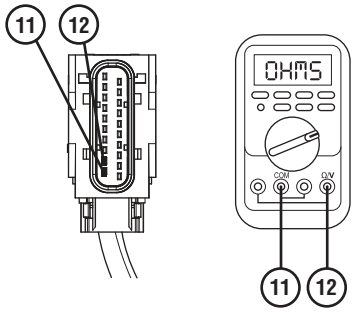
Purpose: *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector from TCM.
3. Inspect 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect 20-Way TCM Vehicle Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
   - If contamination or damage is found, refer to OEM guidelines for repair or replacement of 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 (J1939A) 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 (J1939A). Go to **Step V.**
   - If readings are in range, go to **Step I.**

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

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I

Purpose: *Verify fault code status.*

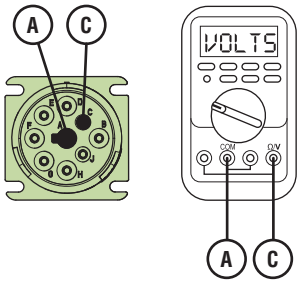
1. Key off.
2. Reconnect all connectors and verify all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 115 is Inactive, an intermittent wiring problem exists in the vehicle Primary Data Link (J1939A). Refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939A) harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If Fault Code 115 is Active and no fault was found with the vehicle Primary Data Link (J1939A), replace **Transmission Control Module (TCM)**. Go to **Step V.**

     Note: If troubleshooting indicates no fault found in wiring or connections to TCM, ensure an intermittent issue does not exist in wiring or connections before replacing TCM.

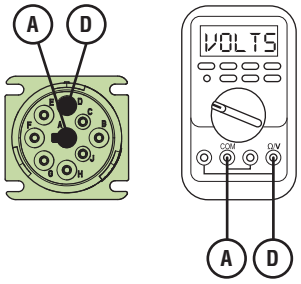
J

Purpose: *Verify vehicle Primary Data Link (J1939A) 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.



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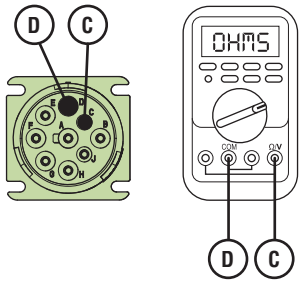
4. Record Total Voltage in table by adding voltage readings together.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step K.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939A). Go to **Step V.**

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 (J1939A).*

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 (J1939A). Go to **Step V.**
   - If readings are in range, go to **Step L.**

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

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L

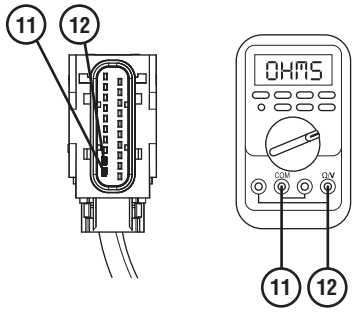
Purpose: *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector from TCM.
3. Inspect 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect 20-Way TCM Vehicle Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
   - If contamination or damage is found, refer to OEM guidelines for repair or replacement of 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 (J1939A) 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 (J1939A). Go to **Step V.**
   - If readings are in range, go to **Step N.**

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

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N

Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 115 is Inactive, an intermittent wiring problem exists in the vehicle Primary Data Link (J1939A). Refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939A) harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If Fault Code 115 is Active and no fault was found with the vehicle Primary Data Link (J1939A), replace **Transmission Control Module (TCM)**. Go to **Step V.**

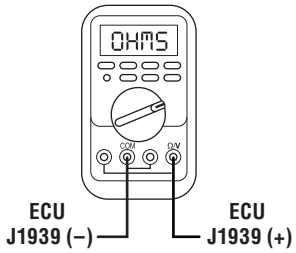
     Note: If troubleshooting indicates no fault found in wiring or connections to TCM, ensure an intermittent issue does not exist in wiring or connections before replacing TCM.

O

Purpose: *Verify resistance of vehicle Primary Data Link (J1939A) at Engine ECU vehicle harness connector.*

1. Key off.
2. Locate and disconnect Engine ECU vehicle harness connector containing vehicle Primary Data Link (J1939A).

   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.



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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 (J1939A). Go to **Step V.**
   - If readings are in range, Engine ECU has continuity to the vehicle Primary Data Link (J1939A). The intermittent nature of the fault makes it likely one of the following conditions exists: an Engine ECU message fault exists and/or the Engine ECU may intermittently not be powering up. 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 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 115 sets Active, go to **Step A.**
   - If a fault code other than 115 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19

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Fault Code 116: Secondary Data Link (J1939B)

J1939: SA 3 SPN 1231 FMI 9, 14

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: the Primary Data Link (J1939A) and the Secondary Data Link (J1939B).

The Primary Data Link is used by the TCM to send and receive messages to and from the Engine ECU, Anti-Lock Brake ECU and other vehicle ECUs to complete transmission shift operations. The Secondary Data Link is used in the event that the Primary Data Link is inoperative.

The Primary Data Link (J1939A) is connected to the TCM at the 20-Way TCM Vehicle Harness Connector. The Secondary Data Link (J1939B) is connected to the TCM at the 20-Way TCM Body Harness Connector.

Detection

The TCM monitors vehicle and Engine ECU broadcast messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Secondary Data Link (J1939B) vehicle ECU(s) messages not received for 5 seconds.

FMI 14 – Special Instructions: Secondary Data Link (J1939B) Engine ECU messages not received for 5 seconds while the TCM is receiving messages from other vehicle ECU(s).

Fallback

FMI 9, 14:

- Amber warning lamp on
- If Fault Code 115, 165, 171, or 185 is Active and the transmission is in gear:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
- If Fault Code 115, 165, 171, or 185 is Active and the transmission is not in gear:
  - Red stop lamp on
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch disengagements prohibited
  - Non-Neutral modes prohibited
  - Hill Start Aid prohibited

Conditions to Set Fault Code Inactive

FMI 9: Secondary Data Link (J1939B) vehicle ECU(s) messages received and valid for 10 seconds.

FMI 14: Valid vehicle Secondary Data Link (J1939B) Engine ECU messages received for 10 seconds.

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Possible Causes

FMI 9:

- Vehicle Components
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Secondary Data Link (J1939B)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
  - Excessive electrical noise
  - Missing or additional terminating resistors

FMI 14:

- Vehicle Components
  - Engine ECU internal failure
  - Engine ECU not powering up
- Vehicle Harness - Secondary Data Link (J1939B) between Engine ECU and TCM
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
  - Excessive electrical noise
  - Missing or additional terminating resistors

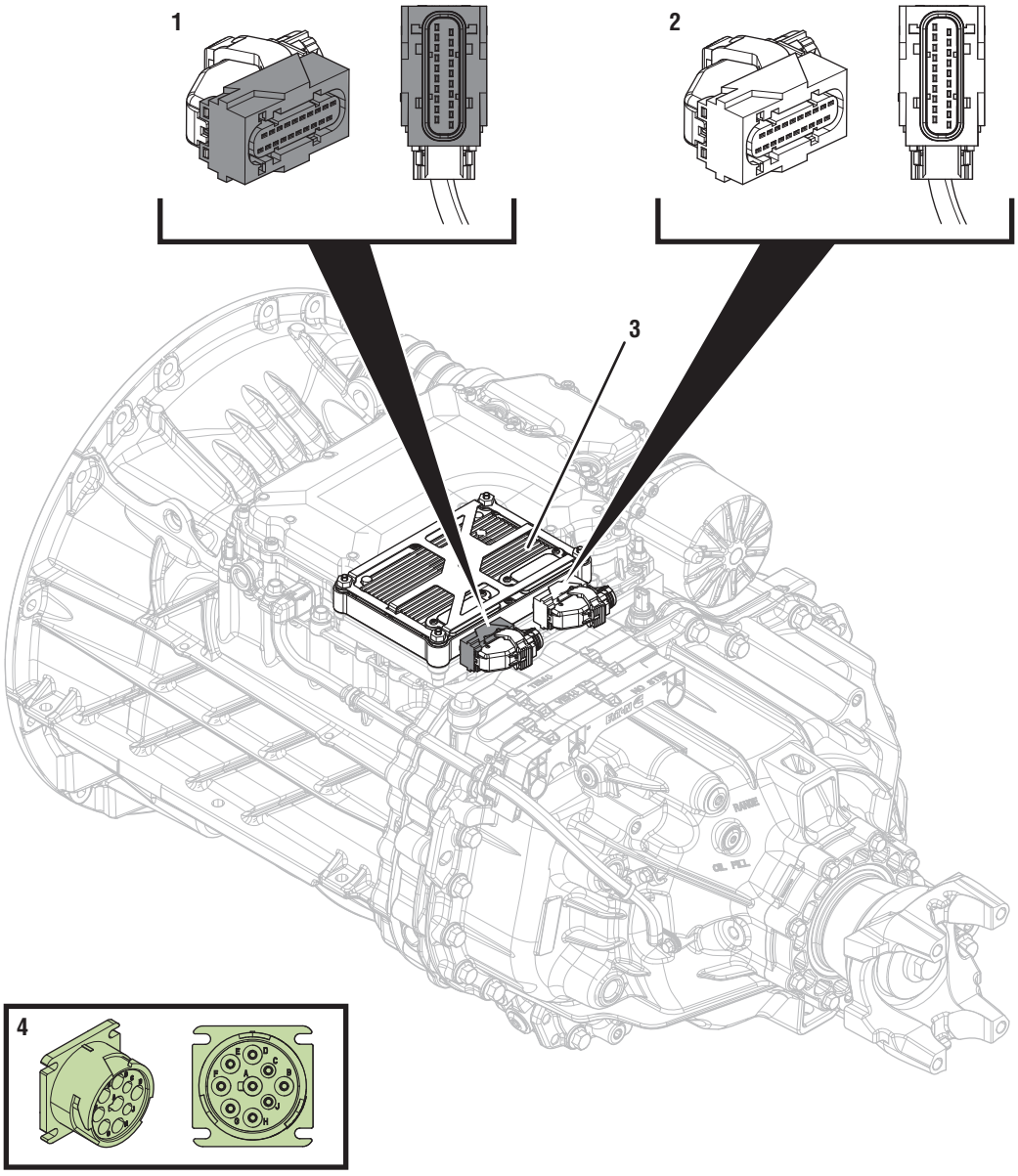
Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- Endurant XD Service Manual TRSM0960
- Digital Volt Ohm Meter (DVOM)

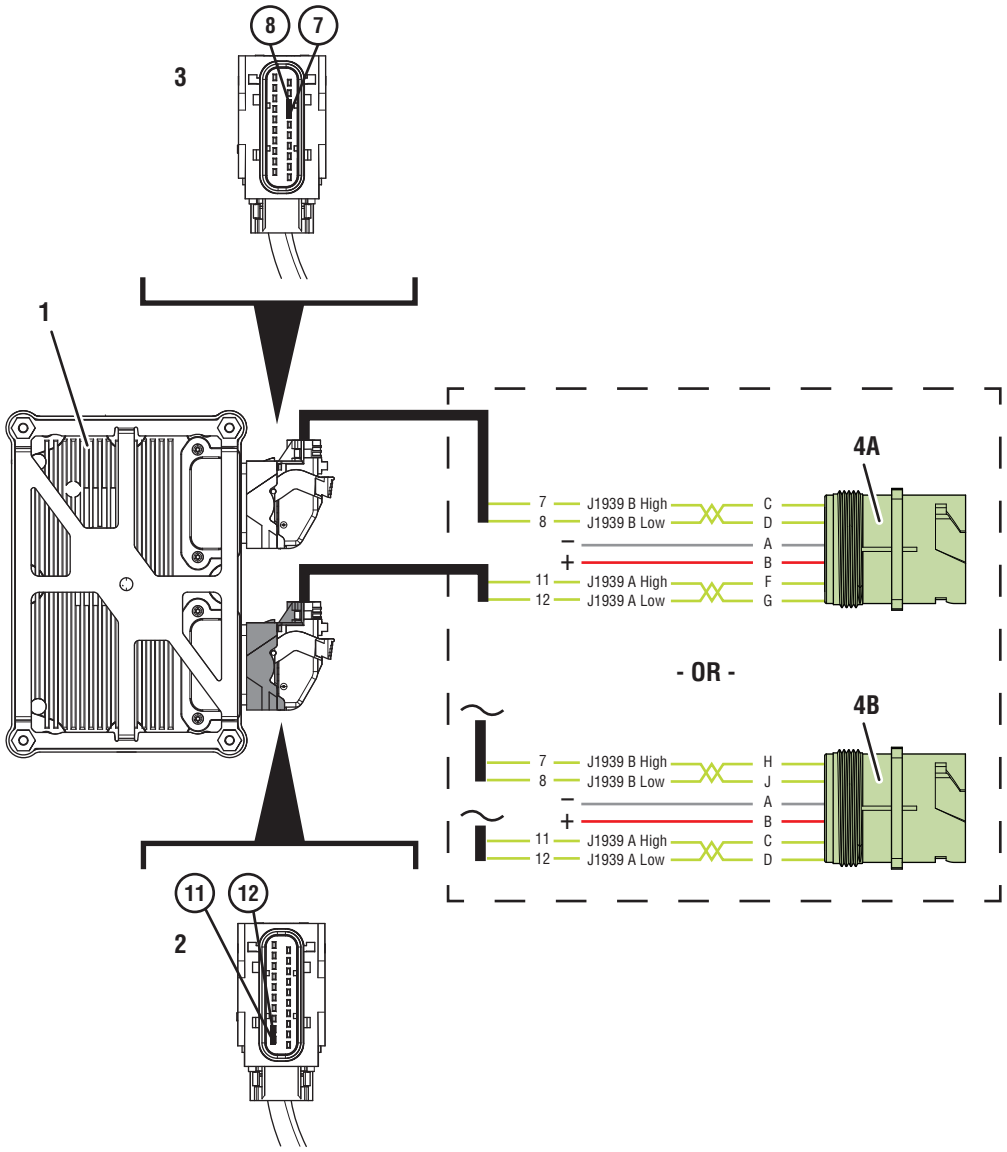
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Component Identification



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)

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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

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Fault Code 116 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 116 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes first. Go to **Step V.**

     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, the intermittent nature of the fault makes it likely one of the following conditions exists:
     - Wiring problem between the Secondary Data Link (J1939 B) and the Engine ECU
     - Engine ECU message fault
     - Engine ECU may intermittently not be powering up

     Refer to OEM guidelines for repair or replacement of the vehicle Secondary Data Link (J1939 B), vehicle harness, or Engine ECU. Go to **Step V.**

B ***Purpose:*** *Verify Secondary Data Link (J1939B) Baud Rate configured in TCM and installed on 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 “Secondary J1939 Baud Rate” Current Value in table.
8. Record secondary J1939 baud rate installed on vehicle in table.

   Note: Vehicle's secondary J1939 baud rate (250K or 500K) is determined by OEM. Refer to OEM regarding secondary J1939 baud rate installed on the vehicle.
9. Compare reading(s) in table.
   - If “Secondary J1939 Baud Rate” is not configured correctly, select correct configuration from “New Value” drop down list, select “Apply” and follow on screen prompts. 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	

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C

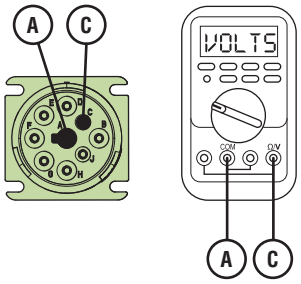
Purpose: *Identify TCM location on vehicle Secondary Data Link (J1939B).*

1. Key off.
2. Refer to OEM to identify TCM J1939 pin locations on vehicle 9-Way J1939 Diagnostic Connector.
   - If the TCM is on Pins C and D, go to **Step D.**
   - If the TCM is on Pins H and J, go to **Step I.**

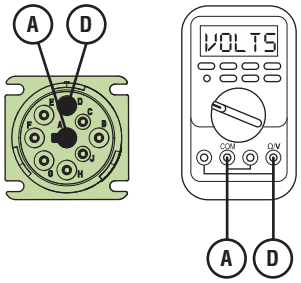
D

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.



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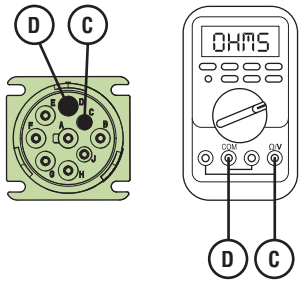
4. Record Total Voltage in table by adding voltage readings together.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step E.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Secondary Data Link (J1939B). Go to **Step V.**

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 (J1939B).*

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 (J1939B). Go to **Step V.**
   - If readings are in range, go to **Step F.**

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

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F

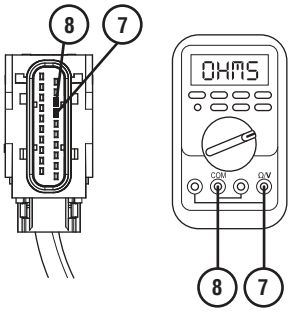
Purpose: *Verify 20-Way TCM Body Harness Connector condition.*

1. Key off.
2. Disconnect 20-Way TCM Body Harness Connector from TCM.
3. Inspect 20-Way TCM Body Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect 20-Way TCM Body Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
   - If contamination or damage is found, refer to OEM guidelines for repair or replacement of 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 (J1939B) 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 (J1939B). Go to **Step V.**
   - If readings are in range, go to **Step H.**

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

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H

Purpose: *Verify fault code status.*

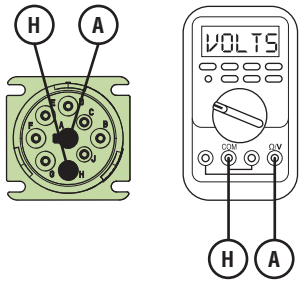
1. Key off.
2. Reconnect all connectors and verify all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 116 is Inactive, an intermittent wiring problem exists in the vehicle Secondary Data Link (J1939B). Refer to OEM guidelines for repair or replacement of vehicle Secondary Data Link (J1939B) harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If Fault Code 116 is Active and no fault was found with the vehicle Secondary Data Link (J1939B), replace **Transmission Control Module (TCM)**. Go to **Step V.**

     Note: If troubleshooting indicates no fault found in wiring or connections to TCM, ensure an intermittent issue does not exist in wiring or connections before replacing TCM.

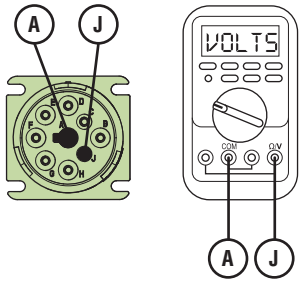
I

Purpose: *Verify vehicle Secondary Data Link (J1939B) 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.



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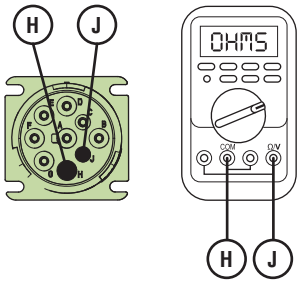
4. Record Total Voltage in table by adding voltage readings together.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step J.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Secondary Data Link (J1939B). Go to **Step V.**

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 vehicle Secondary Data Link (J1939B).*

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 (J1939B). Go to **Step V.**
   - If reading is in range, go to **Step K.**

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

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K

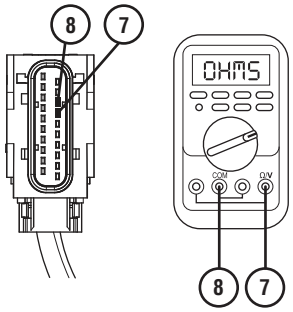
Purpose: *Verify 20-Way TCM Body Harness Connector condition.*

1. Key off.
2. Disconnect 20-Way TCM Body Harness Connector from TCM.
3. Inspect 20-Way TCM Body Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect 20-Way TCM Body Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
   - If contamination or damage is found, refer to OEM guidelines for repair or replacement of 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 (J1939B) 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 (J1939B). Go to **Step V.**
   - If readings are in range, go to **Step M.**

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

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M

Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 116 is Inactive, an intermittent wiring problem exists in the vehicle Secondary Data Link (J1939B). Refer to OEM guidelines for repair or replacement of the vehicle Secondary Data Link (J1939B) harness and/or 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If Fault Code 116 is Active and no fault was found with the vehicle Secondary Data Link (J1939B), replace **Transmission Control Module (TCM)**. Go to **Step V.**

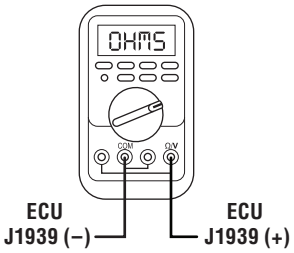
     Note: If troubleshooting indicates no fault found in wiring or connections to TCM, ensure an intermittent issue does not exist in wiring or connections before replacing TCM.

N

Purpose: *Verify resistance of vehicle Secondary Data Link (J1939B) at Engine ECU vehicle harness connector.*

1. Key off.
2. Locate and disconnect Engine ECU vehicle harness connector containing the vehicle Secondary Data Link (J1939B).

   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.



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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 (J1939B). Go to **Step V.**
   - If readings are in range, Engine ECU has continuity to the vehicle Secondary Data Link (J1939B). The intermittent nature of the fault makes it likely one of the following conditions exists: an Engine ECU message fault exists and/or the Engine ECU may intermittently not be powering up. 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 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 116 sets Active, go to **Step A.**
   - If a fault code other than 116 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19

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Fault Code 117: Engine Source Address

J1939: SA 3 SPN 2000 FMI 9

Overview
The Transmission Control Module (TCM) receives a Source Address message from the engine control module over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors Engine Source Address messages. If messages are not received, the fault is set Active.

Conditions to Set Fault Code Active
FMI 9: Abnormal Update Rate: Engine Source Address message not received.

Fallback
FMI 9:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive
FMI 9: Key cycle and fault condition no longer exist.

Possible Causes
FMI 9:

- Vehicle Components - Vehicle ECU(s)
  - Engine Source Address message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 117 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 117 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 117 FMI 9 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Engine Source Address (SPN 2000). 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 117 sets Active, go to **Step A.**
   - If a fault code other than 117 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 120: Start Enable Relay

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

Overview

The Transmission Control Module (TCM) disables engine cranking when the transmission is in a non-Neutral gear position. The TCM configuration parameter "Start Enable Type" is set to one of two different options depending on the method used on the vehicle. One method uses the TCM and a normally-open Start Enable Relay (SER) to interrupt power to the engine Starter. The second method relies on the TCM to send a Transmission Engine Crank Enable message to the Engine ECU over the vehicle Primary Data Link (J1939A) when engine cranking is allowed. The SER and Primary Data Link (J1939A) wiring connect to the TCM through the 20-Way TCM Vehicle Harness Connector.

Detection

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

Note: This fault code will not set on vehicles that use the Transmission Engine Crank Enable message on the Primary Data Link (J1939A).

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

FMI 12:

- 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 and fault condition no longer exist.

Possible Causes

FMI 3, 4, 5, 7:

- Vehicle Components
  - SER internal failure
- Vehicle Harness - SER Circuit
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
- TCM
  - “Start Enable Type” incorrectly configured as “Relay” on vehicle equipped with a “J1939” start enable system.

FMI 12:

- TCM
  - Internal failure
  - Software issue

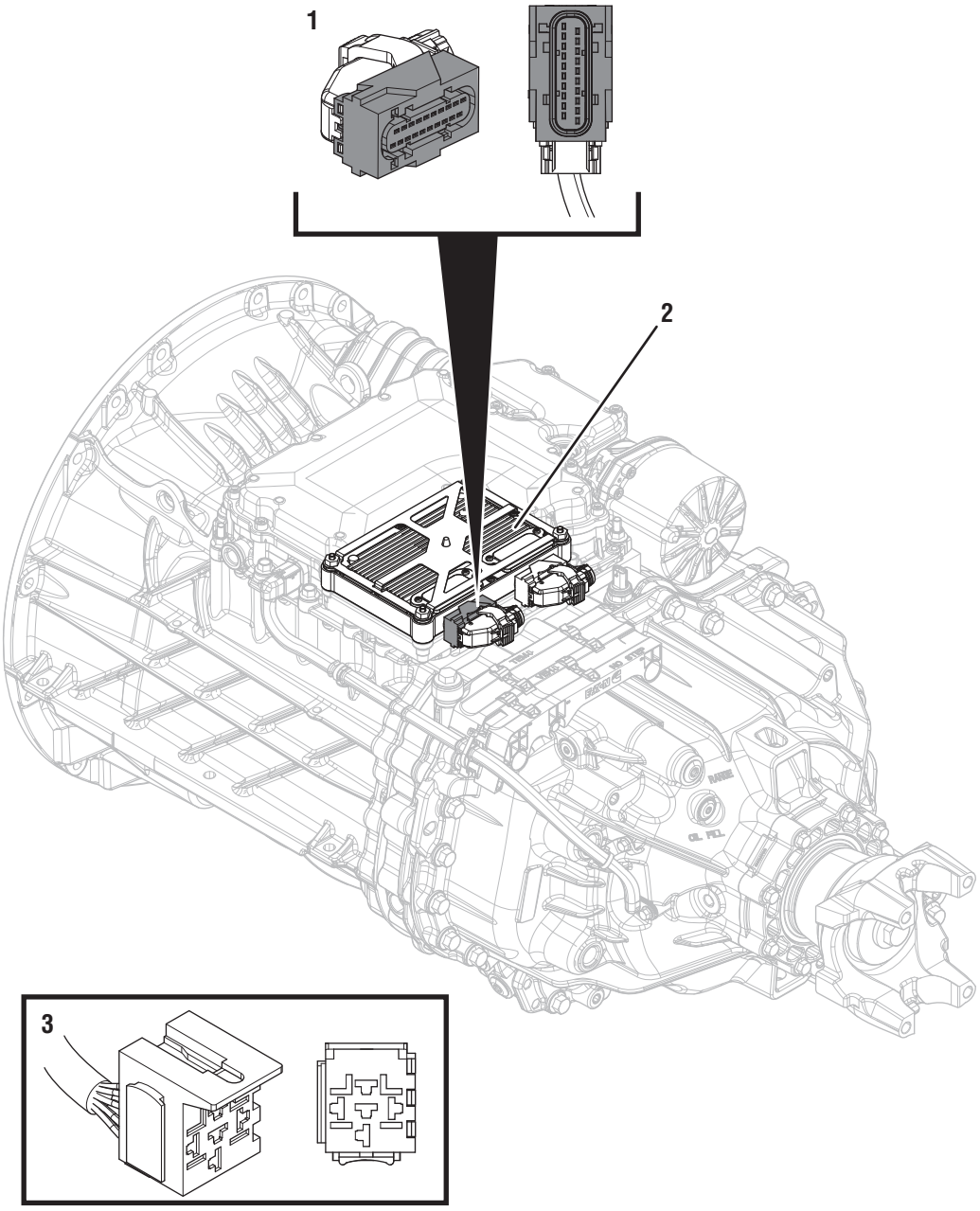
Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- Endurant XD Service Manual TRSM0960
- Digital Volt Ohm Meter (DVOM)

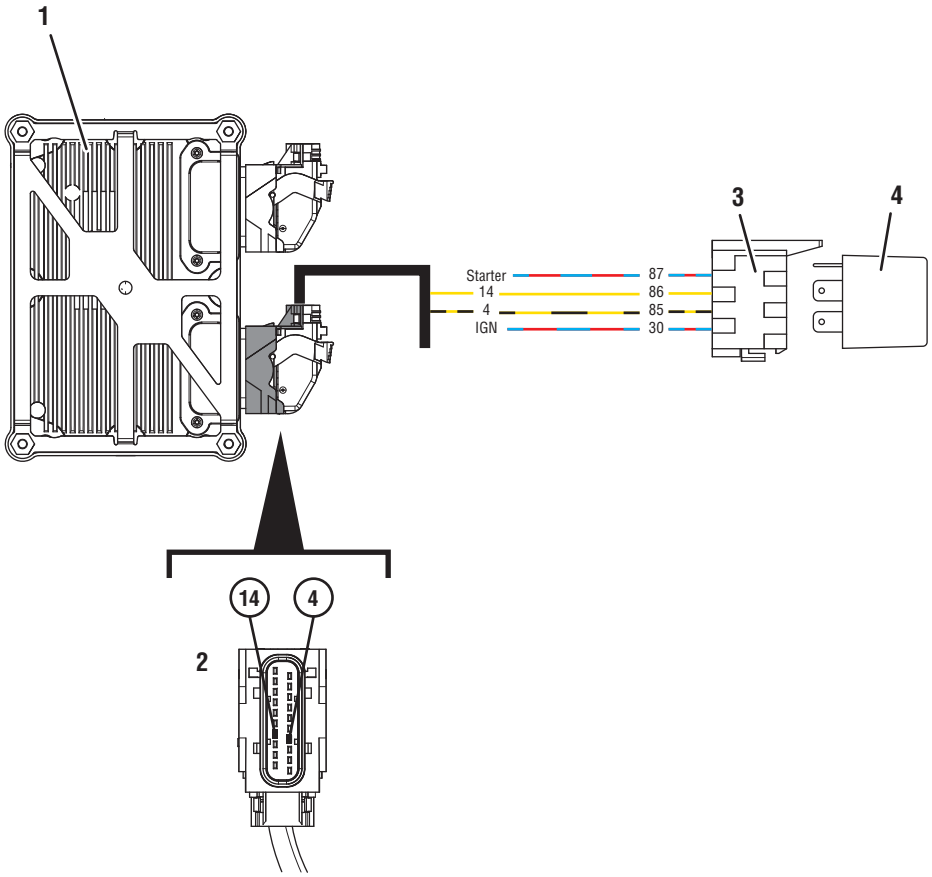
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Component Identification



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

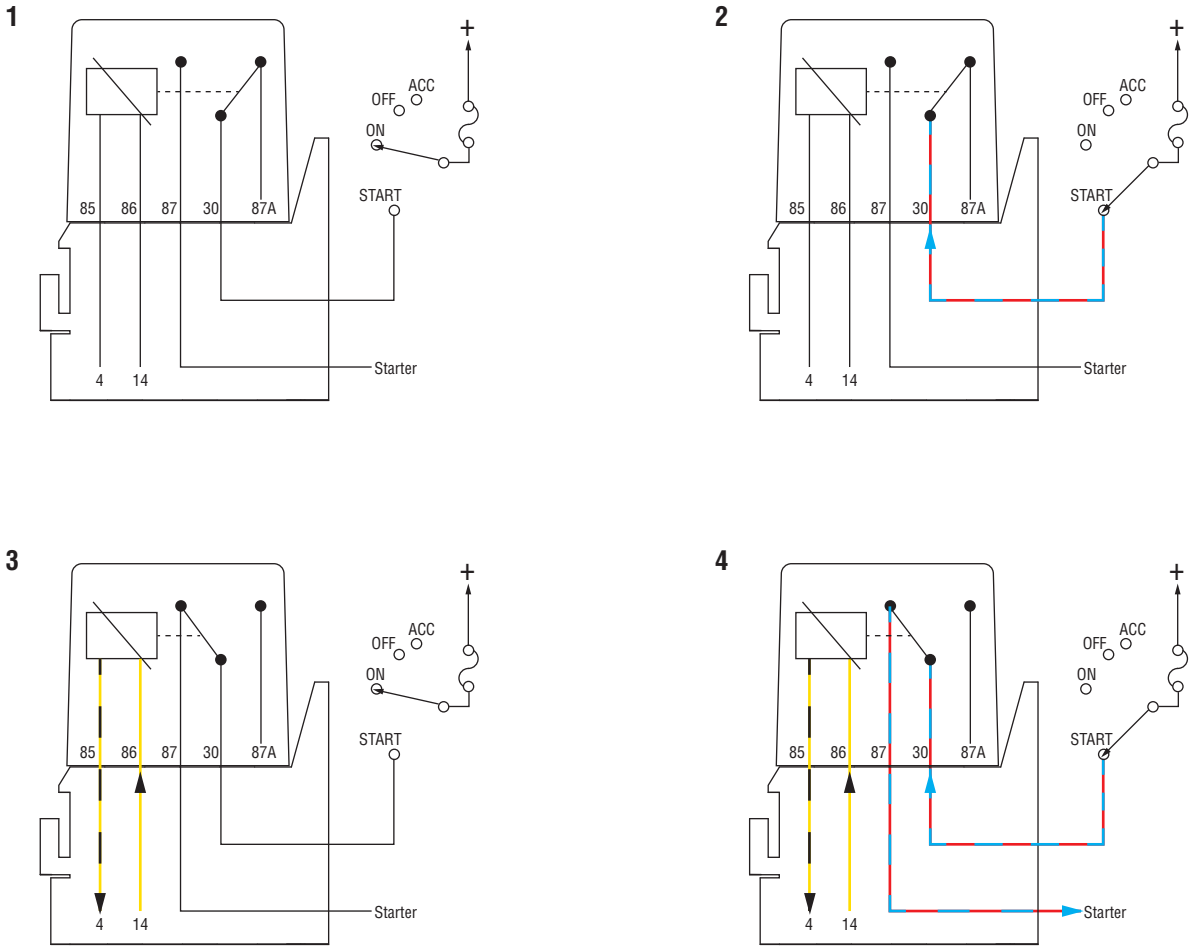
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1. Transmission Control Module (TCM)
2. 20-Way TCM Vehicle Harness Connector
3. 5-Way Start Enable Relay Socket
4. 5-Way Start Enable Relay

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

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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



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Fault Code 120 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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, 5 is Active, go to **Step B.**
   - If Fault Code 120 FMI 3, 4, 5 is Inactive, go to **Step C.**
   - If Fault Code 120 FMI 7 is Active or Inactive, go to **Step L.**
   - If Fault Code 120 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B ***Purpose:*** *Verify Start Enable Relay Type configured in TCM and installed on 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 “Start Enable Type” Current Value in table.
8. Record start enable type installed on vehicle in table.

   Note: Vehicle's start enable type (Start Enable Relay or J1939) is determined by OEM. Refer to OEM regarding the start enable type installed on vehicle.
9. Compare reading(s) in table.
   - If “Start Enable Type” is not configured correctly, select correct configuration option from “New Value” drop down list, select “Apply” and follow on screen prompts. 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	

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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 codes.



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

D

Purpose: *Verify SER Connector condition.*

1. Key off.
2. Remove SER from 4-Way relay socket.
3. Inspect SER and 4-Way relay socket, verify SER socket is not damaged, is free from contamination and corrosion, and terminals are not bent, spread or loose.
   - If contamination or damage is found, refer to OEM guidelines for repair or replacement of SER and/or 4-Way relay socket. Go to **Step V.**
   - If no contamination or damage is found, go to **Step E.**

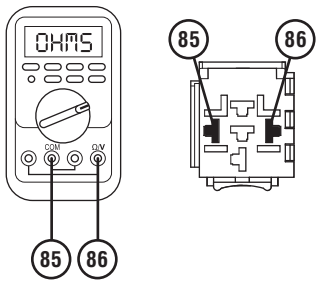
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E

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.



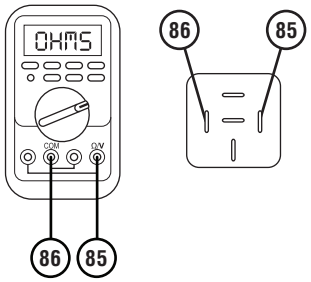
6. Compare reading(s) in table.
   - If readings are in range, go to **Step F.**
   - If readings are out of range, go to **Step H.**

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

F

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	

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G

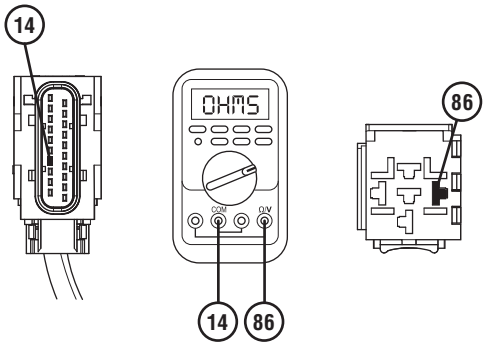
Purpose: *Verify 20-Way TCM Vehicle Harness Connector condition.*

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

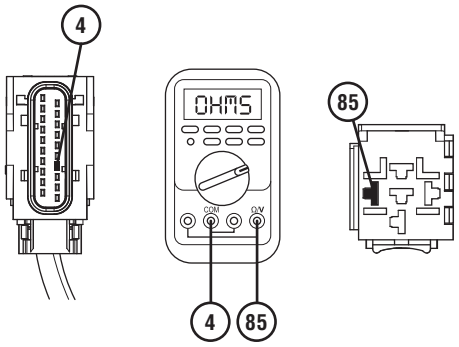
H

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

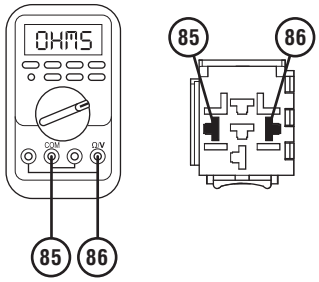
1. Key off.
2. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 14 and SER socket Pin 86. Record reading in table.



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 vehicle harness to 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If readings are in range, go to **Step I.**

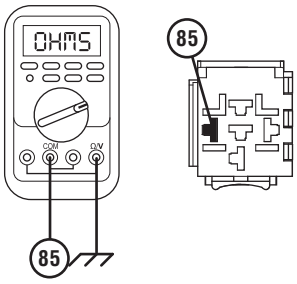
Pins	Range	Reading(s)
14 to 86	0.0–0.3 Ohms	
4 to 85	0.0–0.3 Ohms	
85 to 86	Open Circuit (OL)	

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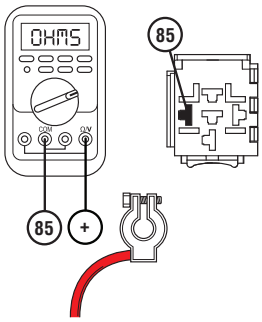
I

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.



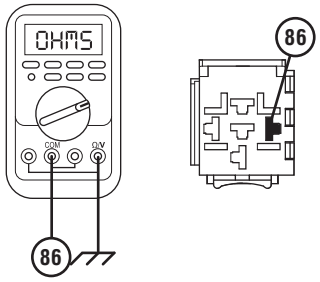
4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle harness to 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If readings are in range, go to **Step J.**

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

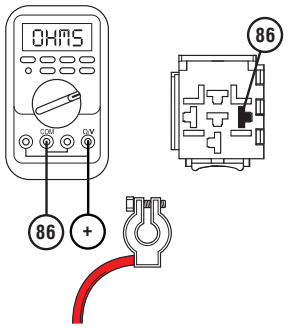
J

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 vehicle harness to 20-Way TCM Vehicle Harness Connector. Go to **Step V.**
   - If readings are in range, go to **Step K.**

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

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K

Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 120 is Inactive, the intermittent nature of the fault makes it likely there is a wiring problem between the SER and 20-Way TCM Vehicle Connector. Refer to OEM guidelines for repair or replacement of the vehicle harness. Go to **Step V.**
   - If Fault Code 120 is Active and no fault was found with vehicle SER wiring, replace **Transmission Control Module (TCM)**. Go to **Step V.**

     Note: If troubleshooting indicates no fault found in wiring or connections to TCM, ensure an intermittent issue does not exist in wiring or connections before replacing TCM.

L

Purpose: *Verify if fault was inadvertently set.*

1. Key off.

   Note: FC 120 FMI 7 will only set Active during engine cranking.
2. Allow TCM to power down.
3. Key on with engine off
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
7. Verify Fault Code 120 FMI 7 is Inactive.
   - If Fault Code 120 FMI 7 is Inactive and 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 M.**

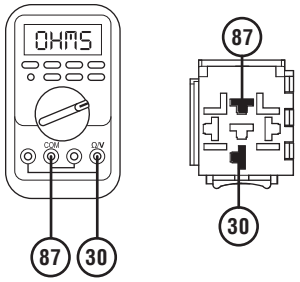
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M

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.



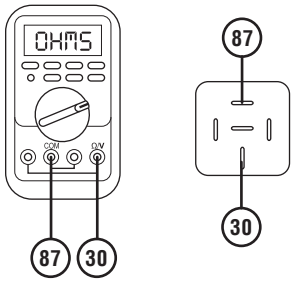
4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of SER latch control circuits. Go to **Step V.**
   - If readings are in range, go to **Step N.**

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

N

Purpose: *Verify 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 V.**

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

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

1. Key off.
2. Reconnect all connectors and verify 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 120 sets Active, go to **Step A.**
   - If a fault code other than 120 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 122: Primary ADS

J1939: SA 3 SPN 3651 FMI 2, 9, 10, 11, 13, 19, 31

Overview

The Transmission Control Module (TCM) receives the vehicle's Primary Automated Driving System (ADS) Select message from the vehicle ADS Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to verify the transmission Shift Mode from the transmission driver interface device to the vehicle ADS ECU.

The TCM also receives a Secondary Automated Driving System (ADS) Select message from the vehicle ADS Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This redundancy allows the TCM to maintain transmission function in a degraded mode in the event either message is not available.

Detection

The TCM monitors Primary ADS Select messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Primary ADS Select messages out of range for 5 seconds.

FMI 9 – Abnormal Update Rate: Primary ADS Select message not received for 5 seconds.

FMI 10 - Abnormal Rate of Change: Primary ADS Select message error for 5 seconds.

FMI 11 – Root Cause Unknown: Primary ADS Select message not received for 5 seconds.

FMI 13 – Out Of Calibration: Primary ADS Select messages not available for 5 seconds.

FMI 19 – Received Network Data In Error: Primary ADS Select messages invalid for 5 seconds.

FMI 31 - Condition Exists: Primary ADS Select message error for 5 seconds.

Fallback

All FMIs:

- Amber warning lamp on
- ADS operation prohibited

Conditions to Set Fault Code Inactive

All FMIs: Primary ADS Select messages received and valid for 10 seconds.

Possible Causes

All FMIs:

- Vehicle Components - Vehicle ECU(s)
  - Primary ADS Select message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 122 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 122 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 122 FMI 2, 9, 10, 11, 19, 31 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Primary ADS Select message (SPN 3651). Go to **Step V.**
   - If Fault Code 122 FMI 13 is Active, refer to OEM and enable vehicle Primary ADS Select message (SPN 3651). Go to **Step V.**
   - If Fault Code 122 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 122 sets Active, go to **Step A.**
   - If a fault code other than 122 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 123: Secondary ADS

J1939: SA 3 SPN 3654 FMI 2, 9, 10, 11, 13, 19, 31

Overview

The Transmission Control Module (TCM) receives the vehicle's Primary Automated Driving System (ADS) Select message from the vehicle ADS Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to verify the transmission Shift Mode from the transmission driver interface device to the vehicle ADS ECU.

The TCM also receives a Secondary Automated Driving System (ADS) Select message from the vehicle ADS Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This redundancy allows the TCM to maintain transmission function in a degraded mode in the event either message is not available.

Detection

The TCM monitors Secondary ADS Select messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 2 - Data Erratic: Secondary ADS Select messages out of range for 5 seconds.

FMI 9 – Abnormal Update Rate: Secondary ADS Select message not received for 5 seconds.

FMI 10 - Abnormal Rate of Change: Secondary ADS Select message error for 5 seconds.

FMI 11 - Root Cause Unknown: Secondary ADS Select message not received for 5 seconds.

FMI 13 – Out of Calibration: Secondary ADS Select messages not available for 5 seconds.

FMI 19 – Received Network Data In Error: Secondary ADS Select messages invalid for 5 seconds.

FMI 31 - Condition Exists: Secondary ADS Select message error for 5 seconds.

Fallback

All FMIs

- Amber warning lamp on
- ADS operation prohibited

Conditions to Set Fault Code Inactive

All FMIs: Secondary ADS Select messages received and valid for 10 seconds.

Possible Causes

All FMIs:

- Vehicle Components - Vehicle ECU(s)
  - Secondary ADS Select message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 123 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 123 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 123 FMI 2, 9, 10, 11, 19, 31 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Secondary ADS Select message (SPN 3654). Go to **Step V.**
   - If Fault Code 123 FMI 13 is Active, refer to OEM and enable vehicle Secondary ADS Select message (SPN 3654). Go to **Step V.**
   - If Fault Code 123 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 123 sets Active, go to **Step A.**
   - If a fault code other than 123 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 125: Primary ADS Operation Status

J1939: SA 3 SPN 20870 FMI 9, 13, 14, 19

Overview

The Transmission Control Module (TCM) receives the vehicle's Primary Automated Driving System (ADS) Operation Status message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

The TCM also receives a Secondary Automated Driving System (ADS) Operation Status message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This redundancy allows the TCM to maintain transmission function in a degraded mode in the event either message is not available.

Detection

The TCM monitors Primary ADS Operation Status messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Primary ADS Operation Status message not received for 5 seconds.

FMI 13 - Out of Calibration: Primary ADS Operation Status messages not available for 5 seconds.

FMI 14 - Special Instructions: Primary and Secondary ADS Operation Status message sources not configured.

FMI 19 - Received Network Data in Error: Primary ADS Operation Status messages invalid for 5 seconds.

Fallback

FMI 9, 13, 14, 19:

If fault codes 125 and 126 are Active:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- ADS Operation prohibited

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Primary ADS Operation Status messages received and valid for 10 seconds.

FMI 14: Key cycle and fault condition no longer exists.

Possible Causes

FMI 9, 13, 14, 19:

- Vehicle Components - Vehicle ECU(s)
  - Primary ADS Operation Status message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 125 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 125 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 125 FMI 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Primary ADS Operation Status message (SPN 20870). Go to **Step V.**
   - If Fault Code 125 FMI 13 is Active, refer to OEM and enable vehicle Primary ADS Operation Status message (SPN 20870). Go to **Step V.**
   - If Fault Code 125 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 125 FMI 14 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 125 FMI 14 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 125 sets Active, go to **Step A.**
   - If a fault code other than 125 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 126: Secondary ADS Operation Status

J1939: SA 3 SPN 20874 FMI 9, 13, 14, 19

Overview

The Transmission Control Module (TCM) receives the vehicle's Primary Automated Driving System (ADS) Operation Status message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

The TCM also receives a Secondary Automated Driving System (ADS) Operation Status message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This redundancy allows the TCM to maintain transmission function in a degraded mode in the event either message is not available.

Detection

The TCM monitors Secondary ADS Operation Status messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Secondary ADS Operation Status message not received for 5 seconds.

FMI 13 - Out of Calibration: Secondary ADS Operation Status messages not available for 5 seconds.

FMI 14 - Special Instructions: Primary and Secondary ADS Operation Status messages do not match for 5 seconds.

FMI 19 - Received Network Data in Error: Secondary ADS Operation Status messages invalid for 5 seconds.

Fallback

FMI 9, 13, 14, 19:

If fault codes 125 and 126 are Active:

- Amber warning lamp on
- ADS Operation prohibited

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Secondary ADS Operation Status messages received and valid for 10 seconds.

FMI 14: Primary and Secondary ADS Operation Status messages match for 1 second.

Possible Causes

FMI 9, 13, 14, 19:

- Vehicle Components - Vehicle ECU(s)
  - Secondary ADS Operation Status message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 126 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 126 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 126 FMI 9, 14, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Secondary ADS Operation Status message (SPN 20874). Go to **Step V.**
   - If Fault Code 126 FMI 13 is Active, refer to OEM and enable vehicle Secondary ADS Operation Status message (SPN 20874). Go to **Step V.**
   - If Fault Code 126 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 126 sets Active, go to **Step A.**
   - If a fault code other than 126 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 127: Cruise Control Active

J1939: SA 3 SPN 595 FMI 13, 19

Overview
The Transmission Control Module (TCM) receives the vehicle's Cruise Control Active message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors Cruise Control Active messages. If messages are not available or are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 13 - Out of Calibration: Cruise Control Active messages not available for 5 seconds.

FMI 19: Received Network Data In Error: Cruise Control Active messages invalid for 5 seconds.

Fallback
FMI 13, 19:

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

Conditions to Set Fault Code Inactive
FMI 13, 19: Cruise Control Active messages available and valid for 10 seconds.

Possible Causes
FMI 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - Cruise Control Active message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 127 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 127 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 127 FMI 13 is Active, refer to OEM and enable vehicle Cruise Control Active message (SPN 595). Go to **Step V.**
   - If Fault Code 127 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 127 FMI 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Cruise Control Active message (SPN 595). 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 127 sets Active, go to **Step A.**
   - If a fault code other than 127 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 128: Cruise Control Resume Command

J1939: SA 3 SPN 5604 FMI 9, 13, 19

Overview

The Transmission Control Module (TCM) receives the vehicle's Cruise Control Resume Command message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection

The TCM monitors Cruise Control Resume Command messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Cruise Control Resume Command message not received for 5 seconds.

FMI 13 - Out of Calibration: Cruise Control Resume Command messages not available for 5 seconds

FMI 19: Received Network Data In Error: Cruise Control Resume Command messages 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: Cruise Control Resume Command messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - Vehicle Cruise Control Resume Command J1939 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 128 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 128 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 128 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Cruise Control Resume Command message (SPN 5604). Go to **Step V.**
   - If Fault Code 128 FMI 13 is Active, refer to OEM and enable vehicle Cruise Control Resume Command message (SPN 5604). Go to **Step V.**
   - If Fault Code 128 FMI 13 is Inactive, 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 128 sets Active during operation, go to **Step A.**
   - If a fault code other than 128 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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) is configured to accept Primary Shift Device messages from the transmission driver interface device over the Primary Data Link (J1939A). This information is used to determine transmission operation.

A Secondary Shift Device request signal from the transmission driver interface device is also provided on a separate hardwired circuit. The Secondary Shift Device request signal allows a driver to engage the transmission into a Shift Mode in the event the Primary Shift Device message is not available.

The Primary Data Link (J1939A), transmission driver interface device, and Secondary Shift Device hardwired circuit and wiring are installed by the OEM and connect to the TCM through the 20-Way TCM Vehicle Harness Connector.

Detection

The TCM monitors Primary Shift Device messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Primary Shift Device message out of range for 5 seconds.

FMI 9 – Abnormal Update Rate: Primary Shift Device message not received for 5 seconds.

FMI 11 – Root Cause Unknown: Primary and Secondary Shift Device values do not match for 1 second.

FMI 12 – Bad Intelligent Device: Primary Shift Device request in opposite direction of vehicle travel at a speed greater than allowable shuttle shifting speed.

FMI 13 – Out Of Calibration: Primary Shift Device message not available for 5 seconds.

FMI 14 – Special Instructions: Delayed gear engagement after shift mode change.

FMI 19 – Received Network Data In Error: Primary Shift Device messages invalid for 5 seconds.

Fallback

FMI 2, 9, 13, 19:

- Amber warning lamp on
- If vehicle is moving and fault codes 135 and 145 are Active:
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
  - Engine cranking prohibited
- If vehicle is not moving and fault codes 135 and 145 are Active:
  - Urge to Move and Creep Mode prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
  - Engine cranking prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 11:

- Amber warning lamp on
- Engine cranking prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited
- Hill Start Aid prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 12:

- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited

FMI 14:

- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited

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Conditions to Set Fault Code Inactive

FMI 2: Primary Shift Device messages in range for 10 seconds.

FMI 9, 19: Primary Shift Device messages received and valid for 10 seconds.

FMI 11: Primary and Secondary Shift Device values match for 1 second.

FMI 12, 14: Key cycle and fault condition no longer exist.

FMI 13: Primary Shift Device messages received and valid for 1 second.

Possible Causes

FMI 2, 9, 11, 13, 19:

- Vehicle Components
  - Transmission driver interface device internal failure
- Vehicle Harness - Power supply, Primary Data Link (J1939A) and Secondary Shift Device request circuit
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

FMI 12, 14:

- TCM
  - Software issue
  - Internal failure

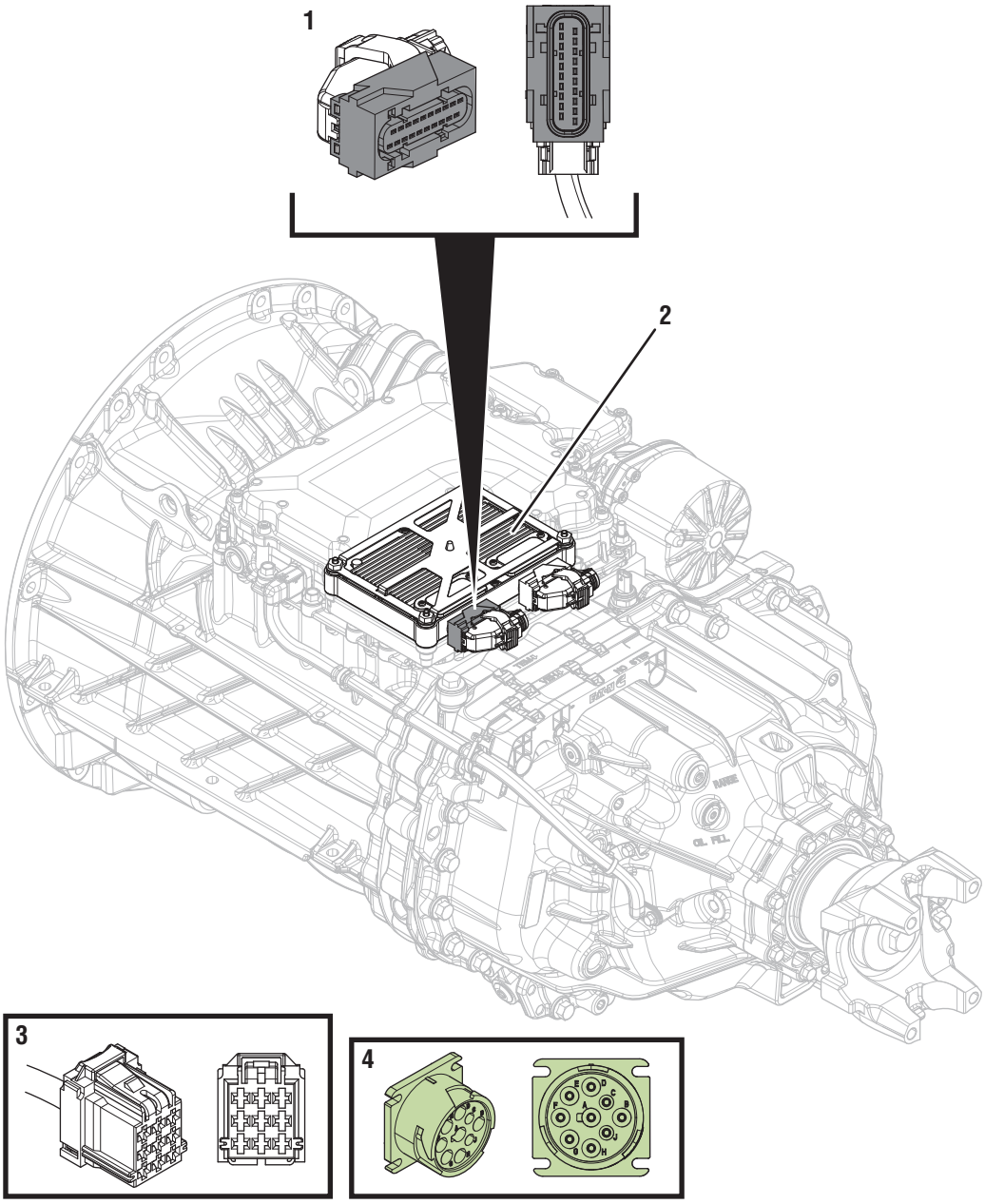
Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- Endurant XD Service Manual TRSM0960
- Digital Volt Ohm Meter (DVOM)

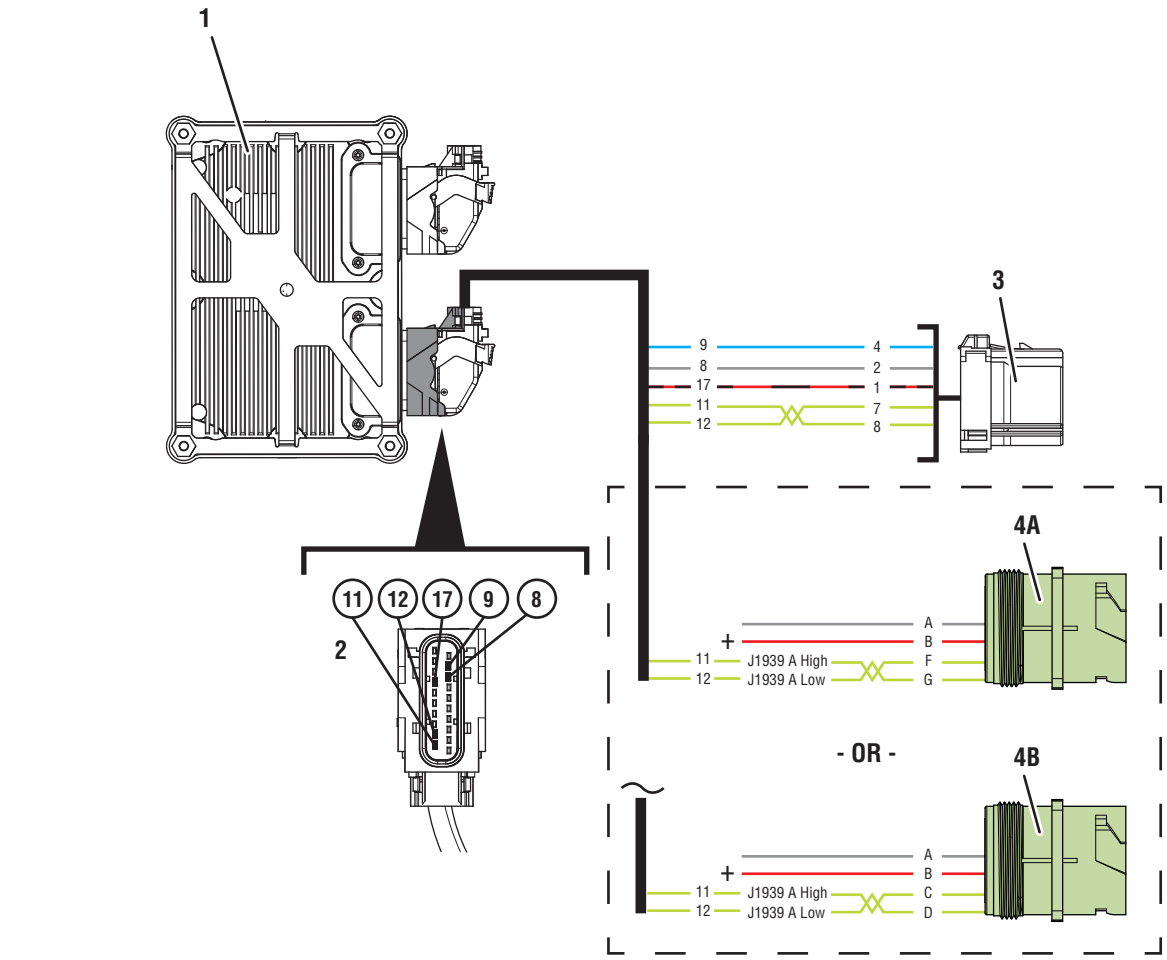
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Component Identification



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

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1. Transmission Control Module (TCM)
2. 20-Way TCM Vehicle Harness Connector
3. 9-Way Transmission Driver Interface Device Connector (OEM Specific)
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

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Fault Code 135 Troubleshooting

A

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

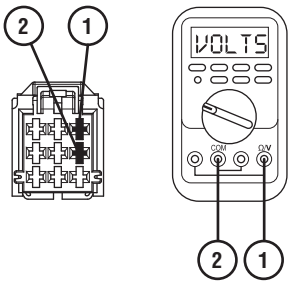
1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 135 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 135 FMI 2, 9, 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, 14 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 135 FMI 13 is Active, configure Driver Interface Type in TCM using ServiceRanger. Go to **Step V.**
   - If Fault Code 135 FMI 13 is Inactive, Driver Interface Type is configured in TCM. Go to **Step V.**

B

Purpose: *Verify power and ground supply at 9-Way transmission driver interface device connector.*

1. Key off.
2. Disconnect 9-Way transmission driver interface device connector.
3. Inspect 9-Way transmission driver interface device connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Key on with engine off.
5. Measure voltage between 9-Way transmission driver interface device connector Pin 1 (TCM supplied 12v) and Pin 2 (TCM supplied ground). Record reading in table.

   Note: Refer to OEM transmission driver interface device 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 transmission driver interface device power supply circuits between 9-Way transmission driver interface device connector and 20-Way TCM Vehicle Connector. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	11–13 V	

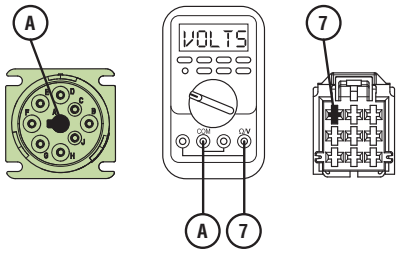
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C

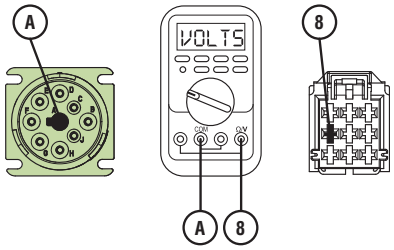
Purpose: *Verify voltage of J1939 Data Link at 9-Way transmission driver interface device connector.*

1. Key on with engine off.
2. Measure voltage between 9-Way transmission 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 transmission driver interface device wiring diagrams.



3. Measure voltage between 9-Way transmission 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	

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D

Purpose: *Verify fault code status.*

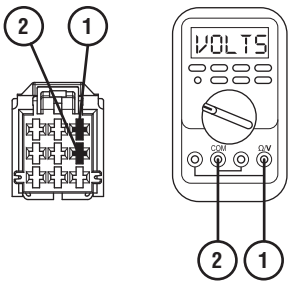
1. Key off.
2. Reconnect all connectors and verify all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record fault codes, FMIs, occurrences and timestamps.
   - If Fault Code 135 is Active, refer to OEM guidelines for repair or replacement of the transmission driver interface device. Go to **Step V.**
   - If Fault Code 135 is Inactive, the intermittent nature of the fault makes it likely one of the following conditions exists. Contact OEM for further diagnostic instructions. Go to **Step V.**
     - Wiring problem between transmission driver interface device and 20-Way TCM Vehicle Connector.
     - Wiring problem between Primary Data Link (J1939A) and transmission driver interface device.
     - Transmission driver interface device may intermittently not be powering up.

E

Purpose: *Verify power and ground supply at 9-Way transmission driver interface device connector.*

1. Key off.
2. Disconnect 9-Way transmission driver interface device connector.
3. Inspect 9-Way transmission driver interface device connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Key on with engine off.
5. Measure voltage between 9-Way transmission driver interface device connector Pin 1 (TCM supplied 12v) and Pin 2 (TCM supplied ground). Record reading in table.

   Note: Refer to OEM transmission driver interface device 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 transmission driver interface device power supply circuits between 9-Way transmission driver interface device connector and 20-Way TCM Vehicle Connector. Go to **Step V.**

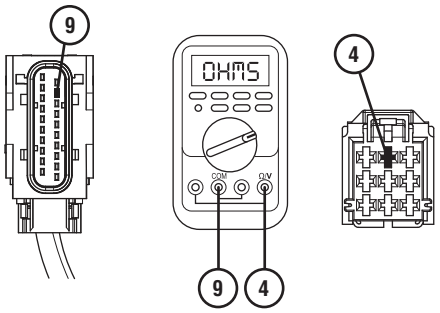
Pins	Range	Reading(s)
1 to 2	11–13 V	

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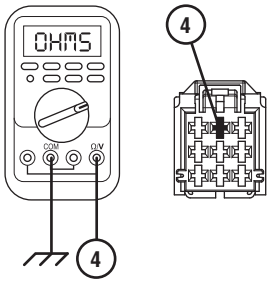
F ***Purpose:*** *Verify continuity of Secondary Shift Device request circuit and not shorted to ground.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector from TCM.
3. Inspect 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Measure resistance between 9-Way transmission 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 9-Way transmission 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 Secondary Shift Device request circuit between 9-Way transmission driver interface device connector and 20-Way TCM Vehicle Connector. Go to **Step V.**

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

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G

Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record fault codes, FMIs, occurrences and timestamps.
   - If Fault Code 135 is Active, refer to OEM guidelines for repair or replacement of the transmission 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 in one of the following. Contact OEM for further diagnostic instructions. Go to **Step V.**
     - Transmission driver interface device
     - Secondary Shift Device hardwired circuit between transmission driver interface device and 20-Way TCM Vehicle Connector.
     - Primary Data link (J1939A) wiring to transmission driver interface device.
     - Power and ground supply wiring to transmission driver interface device from 20-Way TCM Vehicle Connector.

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 135 sets Active, go to **Step A.**
   - If a fault code other than 135 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 136: Transmission Primary Shift Up Selector

J1939: SA 3 SPN 3652 FMI 14

Overview

The Transmission Control Module (TCM) receives the Transmission Requested Gear (PRNDL) message from the Primary and Secondary Automated Driving System (ADS) sources in the ADS Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This redundancy allows the TCM to maintain transmission function in a degraded mode in the event the message is not available from one of the ADS sources.

Detection

The TCM monitors Transmission Requested Gear (PRNDL) messages from the Primary and Secondary ADS sources. If messages do not match, the fault is set Active.

Conditions to Set Fault Code Active

FMI 14 – Special Instructions: Primary and Secondary ADS Transmission Requested Gear (PRNDL) messages from do not match for 1 second.

Fallback

FMI 14:

If fault codes 122, 123 and 136 are Active:

- Amber warning lamp on
- Engine cranking prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited
- Hill Start Aid prohibited
- ADS operation prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 14: Primary and Secondary ADS Transmission Requested Gear (PRNDL) messages match for 1 second.

Possible Causes

FMI 14:

- Vehicle Components - Vehicle ECU(s)
  - Transmission Requested Gear (PRNDL) message not enabled
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 136 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 136 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 136 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Transmission Requested Gear (PRNDL) message (SPN 525). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 136 sets Active, go to **Step A.**
   - If a fault code other than 136 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 137: Source Address of Controlling Device for TSC1 Control Purpose P7

J1939: SA 3 SPN 11756 FMI 9, 10, 11, 13, 31

Overview

The Transmission Control Module (TCM) receives a Source Address message from the Automated Driving System (ADS) controlling device for TSC1 Control Purpose P7 over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection

The TCM monitors Source Address of Controlling Device for TSC1 Control Purpose P7 messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Source Address of Controlling Device for TSC1 Control Purpose P7 message not received for 5 seconds.

FMI 10 - Abnormal Rate of Change: Source Address of Controlling Device for TSC1 Control Purpose P7 Safety Header Message (SHM) invalid for 5 seconds.

FMI 11 - Root Cause Unknown: Source Address of Controlling Device for TSC1 Control Purpose P7 SHM not received for 5 seconds.

FMI 13 - Out of Calibration: Source Address of Controlling Device for TSC1 Control Purpose P7 messages not available for 5 seconds.

FMI 31 - Condition Exists: Source Address of Controlling Device for TSC1 Control Purpose P7 SHM invalid for 5 seconds.

Fallback

All FMIs:

- Amber warning lamp on
- ADS operation prohibited

Conditions to Set Fault Code Inactive

All FMIs: Source Address of Controlling Device for TSC1 Control Purpose P7 messages received and valid for 10 seconds.

Possible Causes

All FMIs:

- Vehicle Components - Vehicle ECU(s)
  - Source Address of Controlling Device for TSC1 Control Purpose P7 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 137 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 137 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 137 FMI 9, 10, 11, 31 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Source Address of Controlling Device for TSC1 Control Purpose P7 message (SPN 11756). Go to **Step V.**
   - If Fault Code 137 FMI 13 is Active, refer to OEM and enable vehicle Source Address of Controlling Device for TSC1 Control Purpose P7 message (SPN 11756). Go to **Step V.**
   - If Fault Code 137 FMI 13 is Inactive, 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 137 sets Active during operation, go to **Step A.**
   - If a fault code other than 137 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 143: Transmission Primary Shift Down Selector

J1939: SA 3 SPN 3653 FMI 2, 9, 10, 11, 13, 19, 31

Overview

The Transmission Control Module (TCM) receives the vehicle's Primary Automated Driving System (ADS) Transmission Requested Gear message from the vehicle ADS Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to verify the transmission Shift Mode from the transmission driver interface device to the vehicle ADS ECU.

The TCM also receives a Secondary Automated Driving System (ADS) Transmission Requested Gear message from the vehicle ADS Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This redundancy allows the TCM to maintain transmission function in a degraded mode in the event either message is not available.

Detection

The TCM monitors Primary ADS Transmission Requested Gear messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Primary ADS Transmission Requested Gear messages out of range for 5 seconds.

FMI 9 – Abnormal Update Rate: Primary ADS Transmission Requested Gear message not received for 5 seconds.

FMI 10 - Abnormal Rate of Change: Primary ADS Transmission Requested Gear message error for 5 seconds.

FMI 11 – Root Cause Unknown: Primary ADS Transmission Requested Gear message not received for 5 seconds.

FMI 13 – Out Of Calibration: Primary ADS Transmission Requested Gear messages not available for 5 seconds.

FMI 19 – Received Network Data In Error: Primary ADS Transmission Requested Gear messages invalid for 5 seconds.

FMI 31 - Condition Exists: Primary ADS Transmission Requested Gear message error for 5 seconds.

Fallback

All FMIs:

- Amber warning lamp on
- ADS operation prohibited

Conditions to Set Fault Code Inactive

All FMIs: Primary ADS Transmission Requested Gear messages received and valid for 10 seconds.

Possible Causes

All FMIs:

- Vehicle Components - Vehicle ECU(s)
  - Primary ADS Transmission Requested Gear message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 143 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 143 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 143 FMI 2, 9, 10, 11, 19, 31 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Primary ADS Transmission Requested Gear message (SPN 3653). Go to **Step V.**
   - If Fault Code 143 FMI 13 is Active, refer to OEM and enable vehicle Primary ADS Transmission Requested Gear message (SPN 3653). Go to **Step V.**
   - If Fault Code 143 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 143 sets Active, go to **Step A.**
   - If a fault code other than 143 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 144: Transmission Secondary Shift Down Selector

J1939: SA 3 SPN 3656 FMI 2, 9, 10, 11, 13, 19, 31

Overview

The Transmission Control Module (TCM) receives the vehicle's Primary Automated Driving System (ADS) Transmission Requested Gear message from the vehicle ADS Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to verify the transmission Shift Mode from the transmission driver interface device to the vehicle ADS ECU.

The TCM also receives a Secondary Automated Driving System (ADS) Transmission Requested Gear message from the vehicle ADS Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This redundancy allows the TCM to maintain transmission function in a degraded mode in the event either message is not available.

Detection

The TCM monitors Secondary ADS Transmission Requested Gear messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 2 - Data Erratic: Secondary ADS Transmission Requested Gear messages out of range for 5 seconds.

FMI 9 – Abnormal Update Rate: Secondary ADS Transmission Requested Gear message not received for 5 seconds.

FMI 10 - Abnormal Rate of Change: Secondary ADS Transmission Requested Gear message error for 5 seconds.

FMI 11 - Root Cause Unknown: Secondary ADS Transmission Requested Gear message not received for 5 seconds.

FMI 13 – Out of Calibration: Secondary ADS Transmission Requested Gear messages not available for 5 seconds.

FMI 19 – Received Network Data In Error: Secondary ADS Transmission Requested Gear messages invalid for 5 seconds.

FMI 31 - Condition Exists: Secondary ADS Transmission Requested Gear message error for 5 seconds.

Fallback

All FMIs

- Amber warning lamp on
- ADS operation prohibited

Conditions to Set Fault Code Inactive

All FMIs: Secondary ADS Transmission Requested Gear messages received and valid for 10 seconds.

Possible Causes

All FMIs:

- Vehicle Components - Vehicle ECU(s)
  - Secondary ADS Transmission Requested Gear message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 144 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 144 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 144 FMI 2, 9, 10, 11, 19, 31 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Secondary ADS Transmission Requested Gear message (SPN 3656). Go to **Step V.**
   - If Fault Code 144 FMI 13 is Active, refer to OEM and enable vehicle Secondary ADS Transmission Requested Gear message (SPN 3656). Go to **Step V.**
   - If Fault Code 144 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 144 sets Active, go to **Step A.**
   - If a fault code other than 144 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 145: Secondary Shift Device (PWM)

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

Overview

The Transmission Control Module (TCM) is configured to accept Primary Shift Device messages from the transmission driver interface device over the Primary Data Link (J1939A). This information is used to determine transmission operation.

A Secondary Shift Device request signal from the transmission driver interface device is also provided on a separate hardwired circuit. The Secondary Shift Device request signal allows a driver to engage the transmission into a Shift Mode in the event the Primary Shift Device message is not available.

The Primary Data Link (J1939A), transmission driver interface device, and Secondary Shift Device hardwired circuit and wiring are installed by the OEM and connect to the TCM through the 20-Way TCM Vehicle Harness Connector.

Detection

The TCM monitors Secondary Shift Device request signal. If the signal is not received or invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Secondary Shift Device request signal value out of range for 5 seconds.

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

FMI 5 – Current Below Normal or Open Circuit: Secondary Shift Device request circuit shorted to power or open for 5 seconds.

FMI 8 – Abnormal Frequency: Secondary Shift Device request signal frequency out of range for 5 seconds.

FMI 12 – Bad Intelligent Device: Inappropriate acceptance of non-Neutral Shift Mode without Service Brake depressed.

FMI 13 – Out of Calibration: Driver Interface Device incorrectly configured.

FMI 14 – Special Instructions: Delayed gear engagement after Shift Mode change.

Fallback

FMI 2, 4, 5, 8:

- Amber warning lamp on
- If vehicle is moving and fault codes 135 and 145 are Active:
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
  - Engine cranking prohibited
- If vehicle is not moving and fault codes 135 and 145 are Active:
  - Urge to Move and Creep Mode prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
  - Engine cranking prohibited

FMI 12:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited
- If vehicle is moving
  - Red stop lamp on

FMI 13:

- Amber warning lamp on
- Red stop lamp on
- If vehicle is moving:
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
  - Engine cranking prohibited
- If vehicle is not moving:
  - Urge to Move and Creep Mode prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
  - Engine cranking prohibited

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FMI 14:

- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited

Conditions to Set Fault Code Inactive

FMI 2: Secondary Shift Device request signal in range for 10 seconds.

FMI 4: Secondary Shift Device request signal not shorted to ground for 10 seconds.

FMI 5: Secondary Shift Device request signal not shorted to power or open for 10 seconds.

FMI 8: Secondary Shift Device request signal frequency in range for 10 seconds.

FMI 12, 14: Key cycle and fault condition no longer exist.

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

Possible Causes

FMI 2, 4, 5, 8:

- Vehicle Components
- OEM Driver Interface Device
  - Freightliner and Western Star incorrectly configured in TCM
  - Internal failure
- Vehicle Harness
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
- TCM
  - Internal Failure

FMI 12, 14:

- TCM
  - Software Issue
  - Internal Issue

FMI 13:

- TCM
  - Driver Interface Type not configured

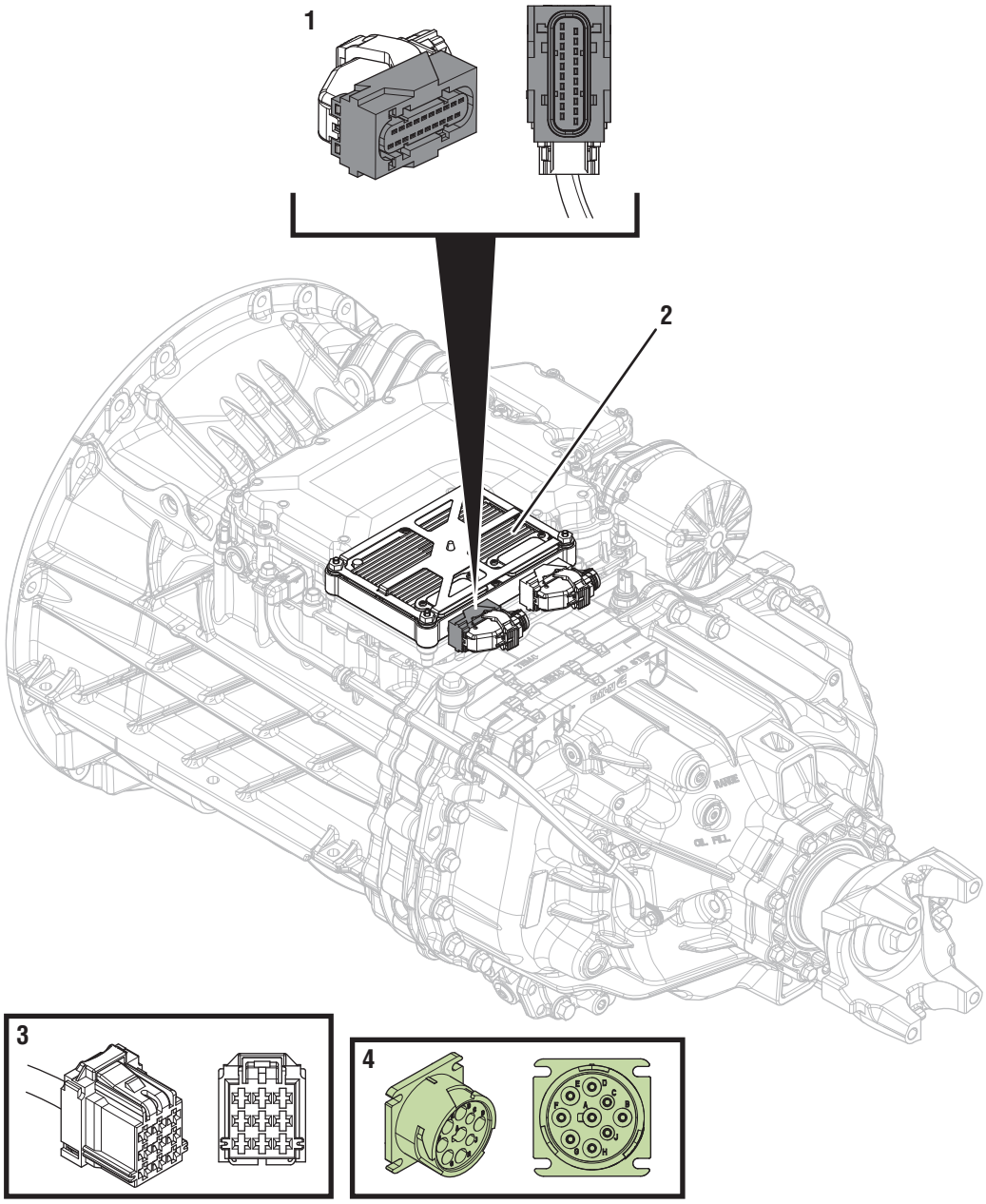
Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- Endurant XD Service Manual TRSM0960
- Digital Volt Ohm Meter (DVOM)

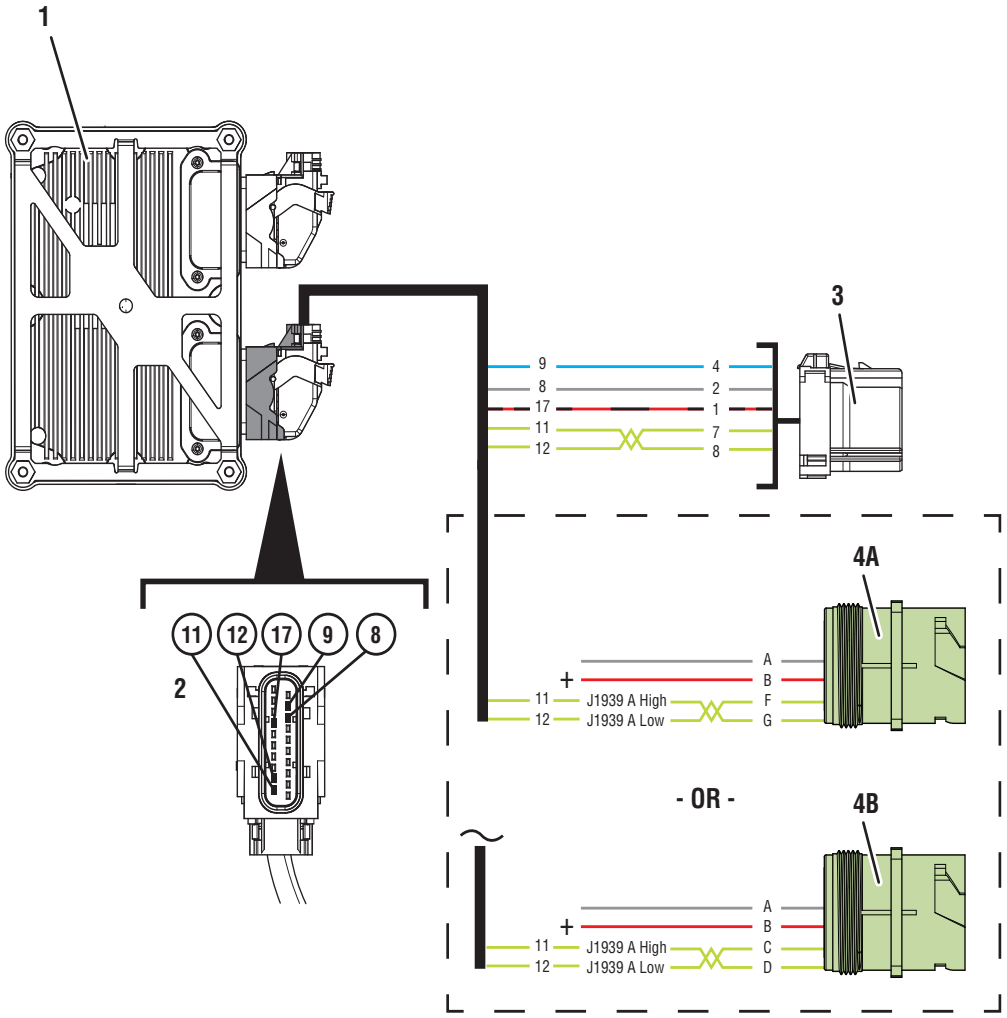
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Component Identification



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

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1. Transmission Control Module (TCM)
2. 20-Way TCM Vehicle Harness Connector
3. 9-Way Transmission Driver Interface Device Connector (OEM Specific)
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

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Fault Code 145 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 254.
   - If Fault Code 145 FMI 5 is Active and OEM is Freightliner or Western Star, connect ServiceRanger, Go To Configuration, select Vehicle and configure Driver Interface Device to J1939 CAN Device w/o PWM (includes Freightliner and Western Star). Process complete.
   - If Fault Code 145 FMI 2, 4, 5, 8 is Inactive, go to **Step B.**
   - If Fault Code 145 FMI 2, 4, 5, 8 is Active, go to **Step C.**
   - If Fault Code 145 FMI 12, 14 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 145 FMI 13 is Active, configure Driver Interface Type in TCM using ServiceRanger. Go to **Step V.**
   - If Fault Code 145 FMI 13 is Inactive, Driver Interface Type is configured in TCM. Go to **Step V.**

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 codes.



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

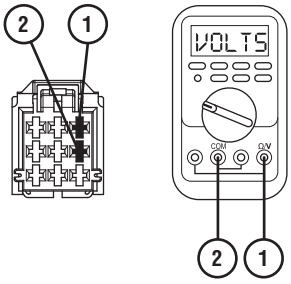
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C

Purpose: *Verify power and ground supply at 9-Way transmission driver interface device connector.*

1. Key off.
2. Disconnect 9-Way transmission driver interface device connector.
3. Inspect 9-Way transmission driver interface device connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Key on with engine off.
5. Measure voltage between 9-Way transmission driver interface device connector Pin 1 (TCM supplied 12v) and Pin 2 (TCM supplied ground). Record reading in table.

   Note: Refer to OEM transmission driver interface device wiring diagrams.



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 transmission driver interface device power supply circuits between 9-Way transmission driver interface device connector and 20-Way TCM Vehicle Connector. Go to **Step V.**

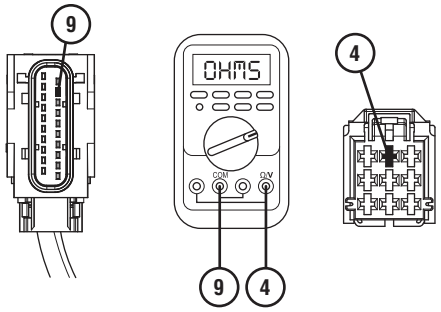
Pins	Range	Reading(s)
1 to 2	11–13 V	

D

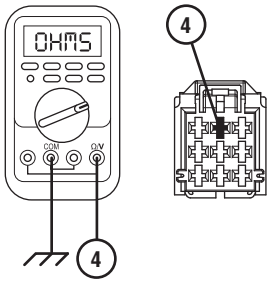
Purpose: *Verify continuity of Secondary Shift Device request circuit and not shorted to ground.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector from TCM.
3. Inspect 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Measure resistance between 9-Way transmission 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 9-Way transmission driver interface device connector Pin 4 and Ground. Record reading in table.



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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 Secondary Shift Device request circuit between 9-Way transmission driver interface device connector and 20-Way TCM Vehicle 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 all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Fault Codes”.
6. Retrieve and record fault codes, FMIs, occurrences and timestamps.
   - If Fault Code 145 is Active, refer to OEM guidelines for repair or replacement of the transmission 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 in the following. Contact OEM for further diagnostic instructions. Go to **Step V.**
     - Transmission driver interface device
     - Secondary Shift Device hardwired circuit between the transmission driver interface device and 20-Way TCM Vehicle Connector.
     - Power and ground supply wiring to transmission driver interface device from 20-Way TCM Vehicle Connector.

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

1. Key off.
2. Reconnect all connectors and verify 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 145 sets Active, go to **Step A.**
   - If a fault code other than 145 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 147: Transmission Secondary Mode Switch

J1939: SA 3 SPN 4050 FMI 9, 13, 19

Overview

The Endurant XD Series transmission incorporates Secondary Mode feature that allows the driver to change transmission system behavior affecting shift strategy, launch or maneuvering characteristics, and ON/OFF road behaviors to suit vehicle operating conditions.

The Transmission Control Module (TCM) receives a transmission Secondary Mode (A/B Mode) request message to activate the transmission secondary configuration, determines if conditions are suitable, implements the change, and supplies an output notification to the driver.

The TCM is configured to accept the Secondary Mode (A/B Mode) request messages from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939 Message) or from a separate vehicle hardwired switch circuit. The hardwired secondary mode switch circuit and wiring are installed by the OEM and connect to TCM through the 20-Way TCM Vehicle Harness Connector.

Detection

The TCM monitors transmission Secondary Mode request messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Transmission Secondary Mode message not received for 10 seconds.

FMI 13 - Out of Calibration: Transmission Secondary Mode message not available for 10 seconds.

FMI 19 - Received Network Data in Error: Transmission Secondary Mode messages invalid for 10 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Transmission Secondary Mode messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Secondary Mode switch internal failure
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A) and Secondary Configuration Mode Switch circuit
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 147 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 147 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 147 FMI 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle transmission Secondary Mode (A/B Mode) message (SPN 4050). Go to **Step V.**
   - If Fault Code 147 FMI 13 is Active, go to **Step B.**
   - If Fault Code 147 FMI 13 is Inactive, the vehicle transmission Secondary Mode (A/B Mode) message is available. Go to **Step V.**

B

Purpose: *Verify Secondary Mode Switch configuration and availability of vehicle secondary configuration mode message.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Secondary Config”.
5. Record "Secondary Configuration Switch" Current Value.
6. Refer to OEM and verify availability of the Transmission Secondary Configuration Mode message (SPN 4050) from an OEM ECU.
   - If message is available, refer to OEM and enable Transmission Secondary Configuration Mode message (SPN 4050). Go to **Step V.**
   - If message is not available, verify OEM Transmission Secondary Mode Switch circuit and wiring are installed in vehicle, select "TCM Hardwired Switch” from “New Value” drop down list, select “Apply” and follow on-screen prompts. Go to **Step V.**
   - If message is not available, verify OEM Transmission Secondary Mode Switch circuit and wiring are not installed in the vehicle, select "Not Configured" from “New Value” drop down list, select “Apply” and follow on-screen prompts. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 147 sets Active, go to **Step A.**
   - If a fault code other than 147 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 148: Performance Goal Calibrations

J1939: SA 3 SPN 630 FMI 13, 14, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls that allow the driver to select a different transmission performance mode to suit vehicle operating conditions.

The Transmission Control Module (TCM) can be configured with two selectable performance modes, a Primary and a Secondary, each providing different launch characteristics and shift strategies for improved performance in specific driving conditions, on and off highway. Reference Endurant XD Driver Instructions TRDR0960 for Secondary Configuration Mode operation.

Detection

The TCM monitors the Primary and Secondary performance mode configuration. If the configuration is invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 13 - Out of Calibration: TCM invalid calibration.

FMI 14 - Special Instructions: TCM invalid calibration.

FMI 31 - Condition Exists: TCM invalid calibration.

Fallback

FMI 13, 14, 31:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited
- Upshifts prohibited
- High start gears prohibited

Conditions to Set Fault Code Inactive

FMI 13, 14, 31: Key cycle and fault condition no longer exists.

Possible Causes

FMI 13, 14, 31:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960

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Fault Code 148 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 148 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 148 FMI 13, 14, 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 148 sets Active, go to **Step A.**
   - If a fault code other than 148 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors ASR Engine Control Active messages. If messages are not received or are invalid, 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 - Received Network Data in Error: ASR Engine Control Active messages 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 messages available and valid for 10 seconds.

Possible Causes
FMI 13, 19:

- Vehicle Components
  - ASR Engine Control Active message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 150 Troubleshooting

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

1. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (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 for repair of the vehicle ASR Engine Control Active message (SPN 561). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 150 sets Active, go to **Step A.**
   - If a fault code other than 150 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection

The TCM monitors ASR Brake Control Active messages. If messages are not available or are invalid, 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 - Received Network Data in Error: ASR Brake Control Active messages 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 messages available and valid for 10 seconds.

Possible Causes

FMI 13, 19:

- Vehicle Components
  - ASR Brake Control Active message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 151 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (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 for repair of the vehicle ASR Brake Control Active message (SPN 562). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 151 sets Active, go to **Step A.**
   - If a fault code other than 151 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors ABS Active messages. If messages are not received or are invalid, 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 - Received Network Data in Error: ABS Active messages 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 messages received and valid for 10 seconds.

Possible Causes
FMI 9, 13, 19:

- Vehicle Components
  - ABS Active message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 152 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle ABS Active message (SPN 563). Go to **Step V.**
   - If Fault Code 152 FMI 13 is Active, refer to OEM and enable vehicle ABS Active message (SPN 563). Go to **Step V.**
   - If Fault Code 152 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 152 sets Active, go to **Step A.**
   - If a fault code other than 152 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection

The TCM monitors ASR Hill Holder Switch messages. If messages are not received or are invalid, 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 - Received Network Data in Error: ASR Hill Holder Switch messages 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 messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - ASR Hill Holder Switch message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 153 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle ASR Hill Holder Switch message (SPN 577). Go to **Step V.**
   - If Fault Code 153 FMI 13 is Active, refer to OEM and enable vehicle ASR Hill Holder Switch message (SPN 577). Go to **Step V.**
   - If Fault Code 153 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 153 sets Active, go to **Step A.**
   - If a fault code other than 153 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors Hill Holder Mode messages. If messages are not received or are invalid, 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 - Received Network Data in Error: Hill Holder Mode messages 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 messages received and valid for 10 seconds.

Possible Causes
FMI 9, 13, 19:

- Vehicle Components
  - Hill Holder Mode message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 154 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Hill Holder Mode message (SPN 2912). Go to **Step V.**
   - If Fault Code 154 FMI 13 is Active, refer to OEM and enable vehicle Hill Holder Mode message (SPN 2912). Go to **Step V.**
   - If Fault Code 154 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 154 sets Active, go to **Step A.**
   - If a fault code other than 154 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 155: Park Brake Switch

J1939: SA 3 SPN 70 FMI 9, 13, 14, 19

Overview
The Transmission Control Module (TCM) receives the vehicle's Parking Brake Switch message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine the vehicle state.

Detection
The TCM monitors Parking Brake Switch messages. If messages are not received or are invalid, the fault is set Active.

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

FMI 13 – Out of Calibration: Parking Brake Switch message not available for 5 seconds.

FMI 14 – Special Instructions: Parking Brake Switch message not received during launch for 1 second.

FMI 19 – Received Network Data in Error: Parking Brake Switch messages invalid for 5 seconds.

Fallback
FMI 9, 13, 14, 19:

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

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive
FMI 9, 13, 14, 19: Parking Brake Switch messages received and valid for 10 seconds.

Possible Causes
FMI 9, 13, 14, 19:

- Vehicle Components
  - Parking Brake Switch message not enabled
  - Parking Brake Switch internal failure
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 155 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 14, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 155 FMI 13 is Active, refer to OEM and enable vehicle Parking Brake Switch message (SPN 70). Go to **Step V.**
   - If Fault Code 155 FMI 13 is Inactive, go to **Step V.**

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B

Purpose: *Monitor Parking Brake Switch 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 “- 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 of the vehicle Parking Brake Switch message (SPN 70). Go to **Step V.**
    - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Parking Brake Switch message (SPN 70). 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 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 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 19.

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Fault Code 156: Brake Pedal Position

J1939: SA 3 SPN 521 FMI 13, 19

Overview
The Transmission Control Module (TCM) receives the vehicle's Brake Pedal Position message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors Brake Pedal Position messages. If messages are not available or are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 13 - Out of Calibration: Brake Pedal Position message not available for 10 seconds.

FMI 19 – Received Network Data in Error: Brake Pedal Position messages invalid for 10 seconds.

Fallback
FMI 13, 19:

- If Fault Code 156, 161 and 163 are all Active:
  - Amber warning lamp on
  - Urge to Move and Creep Mode prohibited
  - Hill Start Aid prohibited

Conditions to Set Fault Code Inactive
FMI 13, 19: Brake Pedal Position messages available and valid for 10 seconds.

Possible Causes
FMI 13, 19:

- Vehicle Components
  - Brake Pedal Position message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 156 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Brake Pedal Position message (SPN 521). Go to **Step V.**
   - If Fault Code 156 FMI 13 is Active, refer to OEM and enable vehicle Brake Pedal Position message (SPN 521). Go to **Step V.**
   - If Fault Code 156 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 156 sets Active, go to **Step A.**
   - If a fault code other than 156 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors XBR System State messages. If messages are not received or are invalid, 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:

- Amber warning lamp on
- 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

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Fault Code 157 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Record "External Braking Integration" Current Value.
   - If External Braking Integration Current Value indicates “Not Supported”, select appropriate "Supported” option and follow on-screen prompts. Go to **Step V.**

     Note: Contact OEM for vehicle External Braking Integration system "Supported" option.

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

1. Key off.
2. Reconnect all connectors and verify 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 157 sets Active, go to **Step A.**
   - If a fault code other than 157 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection

The TCM monitors XBR Active Control Mode messages. If messages are not received or are invalid, 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 - Received Network Data in Error: XBR Active Control Mode messages 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 messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - XBR Active Control Mode message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 158 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle XBR Active Control Mode message (SPN 2918). 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.**

B

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Record "External Braking Integration" Current Value.
6. Refer to OEM and verify availability of the vehicle XBR Active Control Mode message (SPN 2918) from an OEM ECU.
   - If message is available, refer to OEM and enable vehicle XBR Active Control Mode message (SPN 2918). Go to **Step V.**
   - If message is not available and the "External Braking Integration" Current Value indicates “Supported”, select “Not Supported” from New Value drop down list and follow on-screen prompts. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 158 sets Active, go to **Step A.**
   - If a fault code other than 158 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 Air Pressure message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection

The TCM monitors Service Brake Circuit 2 Air Pressure messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Service Brake Circuit 2 Air Pressure message not received for 10 seconds.

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

FMI 19 – Received Network Data In Error: Service Brake Circuit 2 Air Pressure messages invalid for 10 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Service Brake Circuit 2 Air Pressure messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Service Brake Circuit 2 Air Pressure message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 159 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Service Brake Circuit 2 Air Pressure message (SPN 1088). Go to **Step V.**
   - If Fault Code 159 FMI 13 is Active, refer to OEM and enable vehicle Service Brake Circuit 2 Air Pressure message (SPN 1088). Go to **Step V.**
   - If Fault Code 159 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 159 sets Active, go to **Step A.**
   - If a fault code other than 159 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 Pedal Switch message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors Service Brake Pedal Switch messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 9 – Abnormal Update Rate: Service Brake Pedal Switch message not received for 10 seconds.

FMI 13 – Out Of Calibration: Service Brake Pedal Switch message not available for 10 seconds.

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

FMI 19 – Received Network Data In Error: Service Brake Pedal Switch messages invalid for 10 seconds.

Fallback
FMI 9, 13, 14, 19:

- If Fault Code 140, 160 and 164 are all Active:
  - Amber warning lamp on
  - Urge to Move and Creep Mode prohibited
  - Hill Start Aid prohibited
  - Transmission may not allow a shift out of Neutral

Note: Vehicle may have additional fallback modes. Refer to OEM.

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

Possible Causes
FMI 9, 13, 14, 19:

- Vehicle Components
  - Service Brake Pedal Switch message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 160 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 14, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 160 FMI 13 is Active, refer to OEM and enable vehicle Service Brake Pedal Switch message (SPN 597). Go to **Step V.**
   - If Fault Code 160 FMI 13 is Inactive, go to **Step V.**

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B ***Purpose:*** *Monitor Service Brake Pedal Switch 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 “- 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. Release vehicle parking brake.
13. Monitor 597 - Brake switch 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 of the vehicle Service Brake Pedal Switch message (SPN 597). Go to **Step V.**
    - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Service Brake Pedal Switch message (SPN 597). 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 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 160 sets Active, go to **Step A.**
   - If a fault code other than 160 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 Service Brake Application Pressure message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors Service Brake Application Pressure messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 9 - Abnormal Update Rate: Service Brake Application Pressure message not received for 10 seconds.

FMI 13 – Out Of Calibration: Service Brake Application Pressure message not available for 10 seconds.

FMI 14 – Special Instructions: Service Brake Application Pressure message not received after a launch.

FMI 19 – Received Network Data In Error: Brake Application Pressure messages invalid for 10 seconds.

Fallback
FMI 9, 13, 14, 19:

- If Fault Code 156, 161 and 163 are all Active:
  - Amber warning lamp on
  - Urge to Move and Creep Mode prohibited
  - Hill Start Aid prohibited
  - Transmission may not allow a shift out of Neutral

Note: Vehicle may have additional fallback modes. Refer to OEM.

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

Possible Causes
FMI 9, 13, 14, 19:

- Vehicle Components
  - Service Brake Application Pressure message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 161 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 14 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 161 FMI 13 is Active, refer to OEM and enable vehicle Service Brake Application Pressure message (SPN 116). Go to **Step V.**
   - If Fault Code 161 FMI 13 is Inactive, go to **Step V.**

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B

Purpose: *Monitor Service Brake Application Pressure 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 “- 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 of the vehicle Service Brake Application Pressure message (SPN 116). Go to **Step V.**
    - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Service Brake Application Pressure message (SPN 116). 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 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 161 sets Active, go to **Step A.**
   - If a fault code other than 161 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 Tank Pressure message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). The Brake Secondary Tank Pressure message is used as a secondary vehicle air pressure input by the TCM to ensure adequate air pressure is maintained 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 Brake Secondary Tank Pressure messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

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

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

FMI 18 - Data Valid but Below Normal (Moderately Severe): Brake Secondary Tank 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 – Received Network Data In Error: Brake Secondary Tank Pressure messages invalid for 10 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes

FMI 18:

- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch disengagements prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited

Conditions to Set Fault Code Inactive

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

FMI 18: Brake Secondary Tank Pressure above 90 psi.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Brake Secondary Tank Pressure message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

FMI 18:

- Vehicle Components
  - Air system

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 162 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 162 FMI 13 is Active, refer to OEM and enable vehicle Brake Secondary Tank Pressure message (SPN 118). Go to **Step V.**
   - If Fault Code 162 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 162 FMI 18 is Active or Inactive, go to **Step C.**

B ***Purpose:*** *Monitor Brake Secondary Tank 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 “- 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 Tank Pressure message (SPN 118). Go to **Step V.**
    - If readings are in range and 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 Tank Pressure message (SPN 118). 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	

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C ***Purpose:*** *Monitor Brake Secondary Tank 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 “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 “- 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 vehicle air system. Go to **Step V.**
    - If readings are in range and 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	

Parameter/ Source	Range	Reading(s)
Vehicle in-dash secondary air pressure gauge	100–135 psi	

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

1. Key off.
2. Reconnect all connectors and verify 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 162 sets Active, go to **Step A.**
   - If a fault code other than 162 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors Demanded Brake Application Pressure messages. If messages are not received or are invalid, the fault is set Active.

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

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

FMI 19 – Received Network Data In Error: Demanded Brake Application Secondary Pressure messages invalid for 10 seconds.

Fallback
FMI 9, 13, 19:

- If Fault Code 156, 161 and 163 are all Active:
  - Amber warning lamp on
  - Urge to Move and Creep Mode prohibited
  - Hill Start Aid prohibited
  - Transmission may not allow a shift out of Neutral

Note: Vehicle may have additional fallback modes. Refer to OEM.

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

Possible Causes
FMI 9, 13, 19:

- Vehicle Components
  - Demanded Brake Application Pressure message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 163 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 163 FMI 13 is Active, refer to OEM and enable vehicle Demanded Brake Application Pressure message (SPN 8484). Go to **Step V.**
   - If Fault Code 163 FMI 13 is Inactive, go to **Step V.**

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B

Purpose: *Monitor Demanded Brake Application Pressure 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 “- 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 of the vehicle Demanded Brake Application Pressure message (SPN 8484). Go to **Step V.**
    - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Demanded Brake Application Pressure message (SPN 8484). 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 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 163 sets Active, go to **Step A.**
   - If a fault code other than 163 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 164: Service Brake Switch 2

J1939: SA 3 SPN 603 FMI 9, 13, 19

Overview
The Transmission Control Module (TCM) receives the vehicle's Brake Switch 2 message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors Brake Switch 2 messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 9 - Abnormal Update Rate: Brake Switch 2 message not received for 10 seconds.

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

FMI 19 – Received Network Data In Error: Brake Switch 2 messages invalid for 10 seconds.

Fallback
FMI 9, 13, 19:

- If Fault Code 140, 160 and 164 are all Active:
  - Amber warning lamp on
  - Urge to Move and Creep Mode prohibited
  - Hill Start Aid prohibited
  - Transmission may not allow a shift out of Neutral

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive
FMI 9, 13, 19: Brake Switch 2 messages received and valid for 10 seconds.

Possible Causes
FMI 9, 13, 19:

- Vehicle Components
  - Brake Switch 2 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 164 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 164 FMI 13 is Active, refer to OEM and enable vehicle Brake Switch 2 message (SPN 603). Go to **Step V.**
   - If Fault Code 164 FMI 13 is Inactive, go to **Step V.**

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B

Purpose: *Monitor Brake Pedal Switch 2 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 Pedal Switch 2”.
9. Select all “- 603” SPN sources.

   Note: Not all sources will indicate a value.
10. Monitor 603 - Brake Pedal Switch 2 value. Record reading in table.
11. Depress and hold service brake.
12. Release vehicle parking brake.
13. Monitor 603 - Brake Pedal Switch 2 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 of the vehicle Brake Switch 2 message (SPN 603). Go to **Step V.**
    - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Brake Switch 2 message (SPN 603). Contact OEM for further diagnostic instructions. Go to **Step V.**

Service Brake State	Parameter	Range	Reading(s)
Released	603 - Brake Switch	Released	
Depressed	603 - Brake Switch	Depressed	

V

Purpose: *Verify Repair.*

1. Key off.
2. Reconnect all connectors and verify 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 164 sets Active, go to **Step A.**
   - If a fault code other than 164 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 Accelerator Pedal Position 1 message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). The Accelerator Pedal Position 1 message provides the TCM with the driver's demand to launch and accelerate the vehicle.

The TCM also receives the Accelerator Pedal Position 1 message over the Secondary Data Link (J1939B). The Secondary Data Link is used in the event that the Primary Data Link is inoperative and allows the transmission to operate in a degraded mode.

The Primary Data Link (J1939A) is connected to the TCM at the 20-Way TCM Vehicle Harness Connector. The Secondary Data Link (J1939B) is connected to the TCM at the 20-Way TCM Body Harness Connector.

Detection

The TCM monitors Accelerator Pedal Position 1 messages on the Primary Data Link (J1939A). If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Accelerator Pedal Position 1 message not received for 5 seconds.

FMI 13 - Out of Calibration: Accelerator Pedal Position 1 message not available for 5 seconds.

FMI 19 - Received Network Data in Error: Accelerator Pedal Position 1 messages invalid for 5 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Accelerator Pedal Position 1 messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Accelerator Pedal Position 1 message not enabled on Primary Data Link (J1939A)
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 165 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 165 FMI 13 is Active, refer to OEM and enable vehicle Accelerator Pedal Position 1 message (SPN 91). Go to **Step V.**
   - If Fault Code 165 FMI 13 is Inactive, go to **Step V.**

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B ***Purpose:*** *Monitor Accelerator Pedal Position 1 message on Primary Data Link (1939A).*

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 “- 91” SPN sources.

   Note: Not all sources will indicate a value.
7. Monitor 91 - Percent accelerator pedal position value. Record reading in table.
8. Depress and hold accelerator pedal.
9. Monitor 91 - Percent accelerator pedal position value. Record reading in table.
10. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair of the vehicle Accelerator Pedal Position 1 message (SPN 91) on Primary Data Link (1939A). Go to **Step V.**
    - If readings are in range and no fault was found, the intermittent nature of fault makes it likely that the problem is in the vehicle Accelerator Pedal Position 1 message (SPN 91) on Primary Data Link (1939A). 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 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 165 sets Active, go to **Step A.**
   - If a fault code other than 165 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19

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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 Accelerator Pedal Position 1 message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). The Accelerator Pedal Position 1 message provides the TCM with the driver's demand to launch and accelerate the vehicle.

The TCM also receives the Accelerator Pedal Position 1 message over the Secondary Data Link (J1939B). The Secondary Data Link is used in the event that the Primary Data Link is inoperative and allows the transmission to operate in a degraded mode.

The Primary Data Link (J1939A) is connected to the TCM at the 20-Way TCM Vehicle Harness Connector. The Secondary Data Link (J1939B) is connected to the TCM at the 20-Way TCM Body Harness Connector.

Detection

The TCM monitors Accelerator Pedal Position 1 messages on the Secondary Data Link (J1939B). If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Accelerator Pedal Position 1 message not received for 5 seconds.

FMI 13 - Out of Calibration: Accelerator Pedal Position 1 message not available for 5 seconds.

FMI 19 - Received Network Data in Error: Accelerator Pedal Position 1 messages invalid for 5 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- If Fault Code 115, 171, or 185 are Active and the transmission is in gear:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
- If Fault Code 115, 171, or 185 are Active and the transmission is not in gear:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch disengagements prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Accelerator Pedal Position 1 messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Accelerator Pedal Position 1 message not enabled on Secondary Data Link (J1939B)
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Secondary Data Link (J1939B)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 166 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 166 FMI 13 is Active, refer to OEM and enable vehicle Accelerator Pedal Position 1 message (SPN 29). Go to **Step V.**
   - If Fault Code 166 FMI 13 is Inactive, go to **Step V.**

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B ***Purpose:*** *Monitor Accelerator Pedal Position 1 message on Secondary Data Link (J1939B).*

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 “- 29” SPN sources.

   Note: Not all sources will indicate a value.
7. Monitor 29 - Percent accelerator pedal position 2 value. Record reading in table.
8. Depress and hold the accelerator pedal.
9. Monitor 29 - Percent accelerator pedal position 2 value. Record reading in table.
10. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair of the vehicle Accelerator Pedal Position 1 message (SPN 29) on Secondary Data Link (J1939B). Go to **Step V.**
    - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Accelerator Pedal Position 1 message (SPN 29) on Secondary Data Link (J1939B). 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 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 165 sets Active, go to **Step A.**
   - If a fault code other than 165 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). The Accelerator Pedal Kickdown Switch provides the TCM with the driver's accelerator pedal demand.

Detection

The TCM monitors Accelerator Pedal Kickdown Switch messages. If messages are not available or are invalid, the fault is set 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 messages 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 modes
- Accelerator Pedal Kickdown Switch may be inoperative

Conditions to Set Fault Code Inactive

FMI 13, 19: Accelerator Pedal Kickdown Switch messages available and valid for 10 seconds.

FMI 20: Key cycle and fault condition no longer exists.

Possible Causes

FMI 13, 19, 20:

- Vehicle Components
  - Accelerator Pedal Kickdown Switch message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 167 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (SPN 559). Go to **Step V.**
   - If Fault Code 167 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 167 FMI 19, 20 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Accelerator Pedal Kickdown Switch message (SPN 559). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 167 sets Active, go to **Step A.**
   - If a fault code other than 167 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 168: Brake Primary Pressure

J1939: SA 3 SPN 117 FMI 9, 13, 18, 19

Overview
The Transmission Control Module (TCM) receives the vehicle's Brake Primary Tank Pressure message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). The Brake Primary Tank Pressure message is used as a secondary vehicle air pressure input by the TCM to ensure adequate air pressure is maintained 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 Brake Primary Tank Pressure messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 9 - Abnormal Update Rate: Brake Primary Tank Pressure message not received for 10 seconds.

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

FMI 18 - Data Valid but Below Normal (Moderately Severe): Brake Primary Tank 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 – Received Network Data In Error: Brake Primary Tank Pressure messages invalid for 10 seconds.

Fallback
FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes

FMI 18:

- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch disengagements prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited

Conditions to Set Fault Code Inactive
FMI 9, 13, 19: Brake Primary Tank Pressure messages received and valid for 10 seconds.

FMI 18: Brake Primary Tank Pressure above 90 psi.

Possible Causes
FMI 9, 13, 19:

- Vehicle Components
  - Primary Brake Tank Pressure message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

FMI 18:

- Vehicle Components
  - Air system

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 168 Troubleshooting

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

1. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 168 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 168 FMI 9, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 168 FMI 13 is Active, refer to OEM and enable vehicle Brake Primary Tank Pressure message (SPN 117). Go to **Step V.**
   - If Fault Code 168 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 168 FMI 18 is Active or Inactive, go to **Step C.**

B ***Purpose:*** *Monitor Brake Primary Tank 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 primary pressure”.
9. Select all “- 117” SPN sources.

   Note: Not all sources will indicate a value.
10. Monitor 117 - Brake primary 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 vehicle air system or Brake Primary Tank Pressure message (SPN 117). Go to **Step V.**
    - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in vehicle air system or Brake Primary Tank Pressure message (SPN 117). Contact OEM for further diagnostic instructions. Go to **Step V.**

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

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C

Purpose: *Monitor Brake Primary Tank 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 “Default Parameter Files” tab, select “Transmission Pressure”.
8. Monitor 520524 - Line Pressure Feedback value. Record reading in table.
9. Select “Pressure”.
10. Select “Brake primary pressure”.
11. Select all “- 117" SPN sources.

    Note: Not all sources will indicate a value.
12. Monitor 117 - Brake primary 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 vehicle air system. Go to **Step V.**
    - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in 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	
117 - Brake primary pressure	Within 0–20 psi of Vehicle air pressure	

Parameter/ Source	Range	Reading(s)
Vehicle in-dash primary air pressure gauge	100–135 psi	

V

Purpose: *Verify Repair.*

1. Key off.
2. Reconnect all connectors and verify 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 168 sets Active, go to **Step A.**
   - If a fault code other than 168 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 169: Service Brake Circuit 1

J1939: SA 3 SPN 1087 FMI 9, 13, 19

Overview

The Transmission Control Module (TCM) receives the vehicle's Service Brake Circuit 1 Air Pressure message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection

The TCM monitors Service Brake Circuit 1 Air Pressure messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Service Brake Circuit 1 Air Pressure message not received for 10 seconds.

FMI 13 - Out of Calibration: Service Brake Circuit 1 Air Pressure message not available for 10 seconds.

FMI 19 - Received Network Data in Error: Service Brake Circuit 1 Air Pressure messages invalid for 10 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Service Brake Circuit 1 Air Pressure messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Service Brake Circuit 1 Air Pressure message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 169 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 169 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 169 FMI 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Service Brake Circuit 1 Air Pressure message (SPN 1087). Go to **Step V.**
   - If Fault Code 169 FMI 13 is Active, refer to OEM and enable vehicle Service Brake Circuit 1 Air Pressure message (SPN 1087). Go to **Step V.**
   - If Fault Code 169 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 169 sets Active, go to **Step A.**
   - If a fault code other than 169 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to maintain transmission operation in the event the transmission output shaft sensor fails.

Detection

The TCM monitors Front Axle Speed messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Front Axle Speed message not received for 5 seconds.

FMI 13 – Out of Calibration: Front Axle Speed message not available for 5 seconds.

FMI 19 – Received Network Data in Error: Front Axle Speed messages invalid for 5 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Front Axle Speed messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Front Axle Speed Sensor message not
  - enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 170 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 170 FMI 13 is Active, refer to OEM and enable vehicle Front Axle Speed message (SPN 904). Go to **Step V.**
   - If Fault Code 170 FMI 13 is Inactive, go to **Step V.**

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 “- 904” SPN sources.

   Note: Not all sources will indicate a value.
7. Monitor 904 - Front axle speed value. Record reading in table.
8. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair of the vehicle Front Axle Speed message (SPN 904). Go to **Step V.**
   - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Front Axle Speed message (SPN 904). Contact OEM for further diagnostic instructions. Go to **Step V.**

Parameter	Range	Reading(s)
904 - Front Axle Speed	0 RPM	

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

1. Key off.
2. Reconnect all connectors and verify 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 170 sets Active, go to **Step A.**
   - If a fault code other than 170 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

The TCM also receives the Engine Speed message over the Secondary Data Link (J1939B). The Secondary Data Link is used in the event that the Primary Data Link is inoperative and allows the transmission to operate in a degraded mode.

The Primary Data Link (J1939A) is connected to the TCM at the 20-Way TCM Vehicle Harness Connector. The Secondary Data Link (J1939B) is connected to the TCM at the 20-Way TCM Body Harness Connector.

Detection

The TCM monitors Engine Speed messages on the Primary Data Link (J1939A). If messages are not received or are invalid, the fault is set 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

FMI 9, 13, 19:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited
- Hill Start Aid prohibited
- If vehicle is moving:
  - Red stop lamp on

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Engine Speed messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Engine Speed message not enabled on Primary Data Link (J1939A)
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 171 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 171 FMI 13 is Active, refer to OEM and enable vehicle Engine Speed message (SPN 190).Go to **Step V.**
   - If Fault Code 171 FMI 13 is Inactive, go to **Step V.**

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 “- 190” SPN sources.

   Note: Not all sources will indicate a value.
7. Monitor 190 - Engine speed value. Record reading in table.
8. Monitor vehicle tachometer engine idle RPM value. Recording reading in table.
9. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair of the vehicle Engine Speed message (SPN 190) on Primary Data Link (1939A). Go to **Step V.**
   - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Engine Speed message (SPN 190) on Primary Data Link (J1939A). 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	

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

1. Key off.
2. Reconnect all connectors and verify 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 171 sets Active, go to **Step A.**
   - If a fault code other than 171 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

The TCM also receives the Engine Speed message over the Secondary Data Link (J1939B). The Secondary Data Link is used in the event that the Primary Data Link is inoperative and allows the transmission to operate in a degraded mode.

The Primary Data Link (J1939A) is connected to the TCM at the 20-Way TCM Vehicle Harness Connector. The Secondary Data Link (J1939B) is connected to the TCM at the 20-Way TCM Body Harness Connector.

Detection

The TCM monitors Engine Speed messages on the Secondary Data Link (J1939B). If messages are not received or are invalid, the fault is set 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

FMI 9, 13, 19:

- Amber warning lamp on
- If Fault Code 115, 165, 171, or 185 is Active:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
- If vehicle is moving:
  - Red stop lamp on

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Engine Speed messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Engine Message not enabled on Secondary Data Link (J1939B)
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Secondary Data Link (J1939B)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 172 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 9, 19 is Active or Inactive, go to **Step B.**
   - If Fault Code 172 FMI 13 is Active, refer to OEM and enable vehicle Engine Speed message (SPN 723). Go to **Step V.**
   - If Fault Code 172 FMI 13 is Inactive, go to **Step V.**

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 “- 723” SPN sources.

   Note: Not all sources will indicate a value.
7. Monitor 190 - Engine speed sensor #2 value. Record reading in table.
8. Monitor vehicle tachometer engine idle RPM value. Recording reading in table.
9. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair of the vehicle Engine Speed message (SPN 723) on Secondary Data Link (J1939B). Go to **Step V.**
   - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Engine Speed message (SPN 723) on Secondary Data Link (J1939B). 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	

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

1. Key off.
2. Reconnect all connectors and verify 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 172 sets Active, go to **Step A.**
   - If a fault code other than 172 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 173: Engine Requested Speed

J1939: SA 3 SPN 898 FMI 12

Overview

The Transmission Control Module (TCM) sends and receives Engine Requested Speed messages to and from the engine Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to confirm the Engine ECU is receiving and responding to the requested speed.

Detection

The TCM monitors Engine Requested Speed messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 12 – Bad Intelligent Device: TCM inappropriately commanded engine speed.

Fallback

FMI 12:

- Torque above idle prohibited
- Accelerator pedal may be unresponsive
- Vehicle may not move

Conditions to Set Fault Code Inactive

FMI 12: Key cycle and fault condition no longer exist.

Possible Causes

FMI 12:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- None

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Fault Code 173 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 173 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 173 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 173 sets Active, go to **Step A.**
   - If a fault code other than 173 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 Engine Default Torque Limit (EDTL) messages to and from the engine Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to confirm the Engine ECU is receiving and responding to the default torque limit.

Detection
The TCM monitors EDTL messages. If messages are not available or are invalid, the fault is set 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 messages invalid for 30 seconds.

Fallback
FMI 12, 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive
FMI 12: EDTL and TTL messages match for 10 seconds.

FMI 13, 19: EDTL messages available and valid for 10 seconds.

Possible Causes
FMI 12, 13, 19:

- Vehicle Components
  - Engine Default Torque Limit message not enabled
  - Engine ECU software configuration incompatible
  - Engine ECU internal failure
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 174 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 174 FMI 13 is Active, refer to OEM and enable vehicle Engine Default Torque Limit message (SPN 1846). Go to **Step V.**
   - If Fault Code 174 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 174 FMI 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Engine Default Torque Limit message (SPN 1846). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 174 sets Active, go to **Step A.**
   - If a fault code other than 174 sets Active, *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 175: Engine Requested Torque

J1939: SA 3 SPN 518 FMI 11, 12, 14

Overview

The Transmission Control Module (TCM) sends and receives Engine Requested Torque messages to and from the engine Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to confirm the Engine ECU is receiving and responding to the requested torque.

Detection

The TCM monitors Engine Requested Torque messages. If messages are not received or are 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

FMI 11:

- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Upshifts prohibited
- Torque above idle prohibited

FMI 12:

- Torque above idle prohibited

FMI 14:

- Engine retarder torque prohibited

Conditions to Set Fault Code Inactive

FMI 11, 12, 14: Key cycle and fault condition no longer exists

Possible Causes

FMI 11, 12, 14:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- None

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Fault Code 175 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 175 sets Active, go to **Step A.**
   - If a fault code other than 175 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 180: Engine Configuration Message

J1939: SA 3 SPN 188 FMI 1, 9, 13, 19

Overview

The Transmission Control Module (TCM) receives Engine Configuration messages from the engine Electronic Control Unit (ECU) over the Primary Data Link (J1939A). The Engine Configuration messages provide the TCM with the engine torque and speed limits.

Detection

The TCM monitors Engine Configuration messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 1 – Data Valid But Below Normal (Most Severe): Engine idle speed set below 550 rpm for 60 seconds.

FMI 9 – Abnormal Update Rate: Engine Configuration message not received for 10 seconds.

FMI 13 – Out Of Calibration: Engine Configuration message not available for 30 seconds.

FMI 19 – Received Network Data In Error: Engine Configuration messages invalid for 30 seconds.

Fallback

FMI 1, 9, 13, 19:

- Amber warning lamp on
- Launch and shift quality may be degraded
  - TCM uses a default Engine Configuration

Note: Vehicle may have additional fallback modes. Refer to OEM.

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 messages received and valid for 10 seconds.

Possible Causes

FMI 1, 9, 13, 19:

- Vehicle Components
  - Engine Configuration message not enabled
  - Engine ECU mis-configured or internal failure
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 180 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 1 is Active with the engine running at idle speed, refer to OEM regarding engine Idle Speed configuration setting.
   - If Fault Code 180 FMI 1 is Inactive with the engine running at idle speed, engine Idle Speed configuration setting is correct. Go to **Step V.**
   - If Fault Code 180 FMI 9, 19 is Active or Inactive, go to **Step B.**
   - 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.**

B ***Purpose:*** *Verify Idle engine speed message.*

1. Key on with engine running at idle.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. Select “Speed”.
5. Select “Idle engine speed”.
6. Select all “- 188” SPN sources.

   Note: Not all sources will indicate a value.
7. Monitor 188 - Idle engine speed value. Record reading in table.
8. Monitor vehicle tachometer engine idle RPM value. Recording reading in table.
9. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair of the vehicle Idle Engine Speed message (SPN 188). Go to **Step V.**
   - If readings are in range and no fault was found, the intermittent nature of the fault makes it likely that the problem is in the vehicle Idle Engine Speed message (SPN 188). 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	

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V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 180 sets Active, go to **Step A.**
   - If a fault code other than 180 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 181: Engine Configuration Identification

J1939: SA 3 SPN 6395 FMI 13

Overview
The Transmission Control Module (TCM) receives the vehicle Engine Identification message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors Engine Identification messages. If messages are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 13 - Out of Calibration: TCM invalid calibration.

Fallback
FMI 13:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive
FMI 13: Key cycle and fault condition no longer exists.

Possible Causes
FMI 13:

- TCM
  - Software issue
  - Internal failure

Additional Tools
- None

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Fault Code 181 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 181 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 181 FMI 13 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 181 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 181 sets Active, go to **Step A.**
   - If a fault code other than 181 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 183: Powertrain Adaptive Cruise Control

J1939: SA 3 SPN 10294 FMI 13, 14

Overview

The Transmission Control Module (TCM) receives the vehicle's Powertrain Adaptive Cruise Control Type message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection

The TCM monitors Powertrain Adaptive Cruise Control Type messages. If messages are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 13 - Out of Calibration: TCM incorrectly configured.

FMI 14 - Special Instructions: TCM incorrectly configured.

Fallback

FMI 13, 14:

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

Conditions to Set Fault Code Inactive

FMI 13, 14: TCM configured correctly and Powertrain Adaptive Cruise Control Type messages received and valid for 10 seconds.

Possible Causes

FMI 13, 14:

- TCM
  - Incorrect configuration

Additional Tools

- None

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Fault Code 183 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 183 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 183 FMI 13 is Active, go to **Step B.**
   - If Fault Code 183 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 183 FMI 14 is Active, go to **Step C.**
   - If Fault Code 183 FMI 14 is Inactive, go to **Step V.**

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

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Record "External Braking Integration" Current Value.
6. Select "Supported (Stop and Auto System Go)" from “New Value” drop down list, select “Apply” and follow on-screen prompts.
   - Go to **Step V.**

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C ***Purpose:*** *Verify External Braking Integration configuration.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Record "External Braking Integration" Current Value.
6. Select "Not Supported" or "Supported (Stop and Driver Go)" from New Value drop down list, and follow on-screen prompts.
   - Go to **Step V.**

     Note: Contact OEM for appropriate vehicle External Braking Integration system option.

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

1. Key off.
2. Reconnect all connectors and verify 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 183 sets Active during operation, go to **Step A.**
   - If a fault code other than 183 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 184: Engine Demand Percent Torque

J1939: SA 3 SPN 2432 FMI 13, 19

Overview
The Transmission Control Module (TCM) receives Engine Demand Percent Torque messages from a vehicle Electronic Control Unit (ECU) over the Secondary Data Link (J1939B). This information is used to determine transmission performance. The Secondary Data Link is connected to the TCM at the 20-Way TCM Body Harness Connector.

Detection
The TCM monitors Engine Demand Percent Torque messages. If messages are not available or are invalid, 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 messages invalid for 5 seconds.

Fallback
FMI 13, 19:

- Amber warning lamp on
- If Fault Code 115, 165, 171, or 185 is Active:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
- If vehicle is moving:
  - Red stop lamp on

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive
FMI 13, 19: Engine Demand Percent Torque messages available and valid for 10 seconds.

Possible Causes
FMI 13, 19:

- Vehicle Components
  - Engine Demand Percent Torque message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Secondary Data Link (J1939B)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 184 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to OEM.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (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, refer to OEM guidelines for repair of the vehicle Engine Demand Percent Torque message (SPN 2432). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 184 sets Active, go to **Step A.**
   - If a fault code other than 184 sets Active, go to Fault Code Isolation Procedure Index.

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Fault Code 185: Driver Demanded Torque

J1939: SA 3 SPN 512 FMI 13, 19

Overview
The Transmission Control Module (TCM) receives Driver Demanded Torque messages from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). The messages are based off of the accelerator pedal position and other inputs. This information is used to determine transmission performance.

Detection
The TCM monitors Driver Demanded Torque messages. If messages are not available or are invalid, 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 messages invalid for 5 seconds.

Fallback
FMI 13, 19:

- Amber warning lamp on
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Hill Start Aid prohibited
- If vehicle is moving:
  - Red stop lamp on
  - Transmission downshifts to lowest available start gear

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive
FMI 13, 19: Driver Demanded Torque messages available and valid for 10 seconds.

Possible Causes
FMI 13, 19:

- Vehicle Components
  - Driver Demanded Torque message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 185 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to OEM.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (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, refer to OEM guidelines for repair of the Driver Demanded Torque message (SPN 512). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 185 sets Active, go to **Step A.**
   - If a fault code other than 185 sets Active, go to *Fault Code 185: Driver Demanded Torque* on page 218.

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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) messages to and from the engine Electronic Control Unit (ECU) over the Primary Data Link (J1939A). 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 EDITL messages. If message are not available or are invalid, the fault code is set 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 messages invalid for 30 seconds.

Fallback

FMI 12, 13, 19:

- Amber warning lamp on

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

FMI 12: EDITL and TCFITL messages match for 10 seconds.

FMI 13, 19: EDITL messages available and valid for 10 seconds.

Possible Causes

FMI 12, 13, 19:

- Vehicle Components
  - EDITL message not enabled
  - Engine ECU mis-configured or internal failure
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 186 Troubleshooting

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

1. Set the vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 186 FMI 13 is Active, refer to OEM and enable vehicle Engine Default Idle Torque Limit message (SPN 7828). Go to **Step V.**
   - If Fault Code 186 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 186 FMI 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Engine Default Idle Torque Limit message (SPN 7828). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 186 sets Active, go to **Step A.**
   - If a fault code other than 186 sets Active, go to *Fault Code Isolation Procedure Index* on page 19.

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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) messages to and from the engine Electronic Control Unit (ECU) over the Primary Data Link (J1939A). 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 IGFI messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: No response from Engine ECU to request from TCM IGFI message for 30 seconds.

FMI 13 – Out Of Calibration: IGFI message not available for 30 seconds.

FMI 19 – Received Network Data In Error: IGFI messages invalid for 30 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: IGFI messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - IGFI message not enabled
  - Engine ECU mis-configured or internal failure
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 187 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (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, refer to OEM guidelines for repair of the vehicle Idle Governor Fueling Inhibit message (SPN 7830). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 187 sets Active, go to **Step A.**
   - If a fault code other than 187 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 to and from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to confirm the Engine ECU is receiving messages and responding to its messages.

Detection

The TCM monitors Source Address of Controlling Device for Engine Control messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 12 – Bad Intelligent Device: Engine ECU did not respond TCM command messages 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

FMI 12, 13, 19:

- Amber warning lamp on

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

FMI 12: Engine ECU responding to TCM messages for 1 second.

FMI 13, 19: Source Address of Controlling Device for Engine Control messages available and valid for 10 seconds.

Possible Causes

FMI 12, 13, 19:

• Vehicle Components

- Vehicle Components
  - Source Address of Controlling Device for Engine Control message not enabled
  - Engine ECU mis-configured or internal failure
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools

- None

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Fault Code 188 Troubleshooting

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

1. Set the vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 188 FMI 13 is Active, refer to OEM and enable vehicle Source Address of Engine Controlling Device message (SPN 1483). Go to **Step V.**
   - If Fault Code 188 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 188 FMI 19 is Active or Inactive, refer to OEM guidelines for repair of the Source Address of Engine Controlling Device message (SPN 1483). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 188 sets Active, go to **Step A.**
   - If a fault code other than 188 sets Active, go to *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to maintain transmission operation in the event the transmission output shaft sensor fails.

Detection
The TCM monitors Front Axle Left Wheel Speed messages. If messages are not available or are 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 5 seconds.

FMI 19 – Received Network Data in Error: Front Axle Left Wheel Speed messages invalid for 5 seconds.

Fallback
FMI 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive
FMI 13, 19: Front Axle Left Wheel Speed messages available and valid for 10 seconds.

Possible Causes
FMI 13, 19:

- Vehicle Components
  - Front Axle Left Wheel Speed message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 190 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (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, refer to OEM guidelines for repair of the vehicle Front Axle Left Wheel Speed message (SPN 905). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 190 sets Active, go to **Step A.**
   - If a fault code other than 190 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to maintain transmission operation in the event the transmission output shaft sensor fails.

Detection
The TCM monitors Front Axle Right Wheel Speed messages. If messages are not available or are 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 5 seconds.

FMI 19 – Received Network Data in Error: Front Axle Right Wheel Speed messages invalid for 5 seconds.

Fallback
FMI 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive
FMI 13, 19: Front Axle Right Wheel Speed messages available and valid for 10 seconds.

Possible Causes
FMI 13, 19:

- Vehicle Components
  - Front Axle Right Wheel Speed message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 191 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (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, refer to OEM guidelines for repair of the vehicle Front Axle Right Wheel Speed message (SPN 906). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 191 sets Active, go to **Step A.**
   - If a fault code other than 191 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to maintain transmission operation in the event the transmission output shaft sensor fails.

Detection
The TCM monitors Rear Axle 1 Left Wheel Speed messages. If messages are not available or are 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 5 seconds.

FMI 19 – Received Network Data in Error: Rear Axle 1 Left Wheel Speed messages invalid for 5 seconds.

Fallback
FMI 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive
FMI 13, 19: Rear Axle 1 Left Wheel Speed messages available and valid for 10 seconds.

Possible Causes
FMI 13, 19:

- Vehicle Components
  - Rear Axle 1 Left Wheel Speed message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 192 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (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, refer to OEM guidelines for repair of the vehicle Rear Axle 1 Left Wheel Speed message (SPN 907). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 192 sets Active, go to **Step A.**
   - If a fault code other than 192 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to maintain transmission operation in the event the transmission output shaft sensor fails.

Detection

The TCM monitors Rear Axle 1 Right Wheel Speed messages. If messages are not available or are 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 5 seconds.

FMI 19 – Received Network Data in Error: Rear Axle 1 Right Wheel Speed messages invalid for 5 seconds.

Fallback

FMI 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

FMI 13, 19: Rear Axle 1 Right Wheel Speed messages available and valid for 10 seconds.

Possible Causes

FMI 13, 19:

- Vehicle Components
  - Vehicle Rear Axle 1 Right Wheel Speed message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 193 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 message (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, refer to OEM guidelines for repair of the vehicle Rear Axle 1 Right Wheel Speed message (SPN 908). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 193 sets Active, go to **Step A.**
   - If a fault code other than 193 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 194: Rear Axle Left Wheel Speed

J1939: SA 3 SPN 1594 FMI 9, 13, 19

Overview

The Transmission Control Module (TCM) receives the vehicle's Rear Axle Left Wheel Speed message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to maintain transmission operation in the event the transmission output shaft sensor fails.

Detection

The TCM monitors Rear Axle Left Wheel Speed messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 - Abnormal Update Rate: Rear Axle Left Wheel Speed message not received for 5 seconds.

FMI 13 – Out of Calibration: Rear Axle Left Wheel Speed message not available for 5 seconds.

FMI 19 – Received Network Data in Error: Rear Axle Left Wheel Speed messages invalid for 5 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Rear Axle Left Wheel Speed messages available and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Rear Axle Left Wheel Speed message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 194 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 194 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 194 FMI 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Rear Axle Left Wheel Speed message (SPN 1594). Go to **Step V.**
   - If Fault Code 194 FMI 13 is Active, refer to OEM and enable vehicle Rear Axle Left Wheel Speed message (SPN 1594). Go to **Step V.**
   - If Fault Code 194 FMI 13 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 194 sets Active, go to **Step A.**
   - If a fault code other than 194 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 195: Rear Axle Right Wheel Speed

J1939: SA 3 SPN 1595 FMI 13, 19

Overview
The Transmission Control Module (TCM) receives the vehicle's Rear Axle Right Wheel Speed message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This message is used by the TCM to maintain transmission operation in the event the transmission output shaft sensor fails.

Detection
The TCM monitors Rear Axle Right Wheel Speed messages. If messages are not available or are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 13 – Out of Calibration: Rear Axle Right Wheel Speed message not available for 5 seconds.

FMI 19 – Received Network Data in Error: Rear Axle Right Wheel Speed messages invalid for 5 seconds.

Fallback
FMI 13, 19:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes. Refer to OEM.

Conditions to Set Fault Code Inactive
FMI 13, 19: Rear Axle Right Wheel Speed messages available and valid for 10 seconds.

Possible Causes
FMI 13, 19:

- Vehicle Components
  - Vehicle Rear Axle Right Wheel Speed message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

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Fault Code 195 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 195 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 195 FMI 13 is Active, refer to OEM and enable vehicle Rear Axle Right Wheel Speed message (SPN 1595). Go to **Step V.**
   - If Fault Code 195 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 195 FMI 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Rear Axle Right Wheel Speed message (SPN 1595). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 195 sets Active, go to **Step A.**
   - If a fault code other than 195 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 199: Direction Mismatch from a Vehicle Electronic Control Unit

J1939: SA 3 SPN 1571 FMI 12

Overview

The Transmission Control Module (TCM) receives the driver's Shift Mode request from the transmission 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 fault is set 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
  - Urge to Move and Creep Mode prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited
  - Clutch disengagements prohibited
- If 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 and fault condition no longer exist.

Possible Causes

FMI 12:

- TCM
  - Software issue
  - Internal failure

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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 +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 199 sets Active, go to **Step A.**
   - If a fault code other than 199 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 200: TCM Operation 1

J1939: SA 3 SPN 629 FMI 0, 1, 8, 9, 10, 11, 13, 18, 19, 20, 21, 31

Overview

The Endurant XD Series transmissions are 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 through 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): TCM has detected an internal processing error.

FMI 1 – Data Valid But Below Normal (Most Severe): TCM has detected an internal processing error.

FMI 8 – Abnormal Frequency: TCM has detected an internal processing error.

FMI 9 – Abnormal Update Rate: TCM has detected an internal processing error.

FMI 10 – Abnormal Rate of Change: TCM has detected an internal processing error.

FMI 11 – Root Cause Unknown: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: The TCM is incorrectly configured as non-Endurant model.

FMI 18 – Data Valid But Below Normal (Moderately Severe): TCM has detected an internal processing error.

FMI 19 – Received Network Data in Error: TCM has detected an internal processing error.

FMI 20 – Data Drifted High: TCM has detected an internal processing error.

FMI 21 – Data Drifted Low: TCM has detected an internal processing error.

FMI 31 – Condition Exists: The TCM is incorrectly configured for Endurant HD or Procision model.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

All FMIs: Key cycle and fault condition no longer exist

Possible Causes

All FMIs:

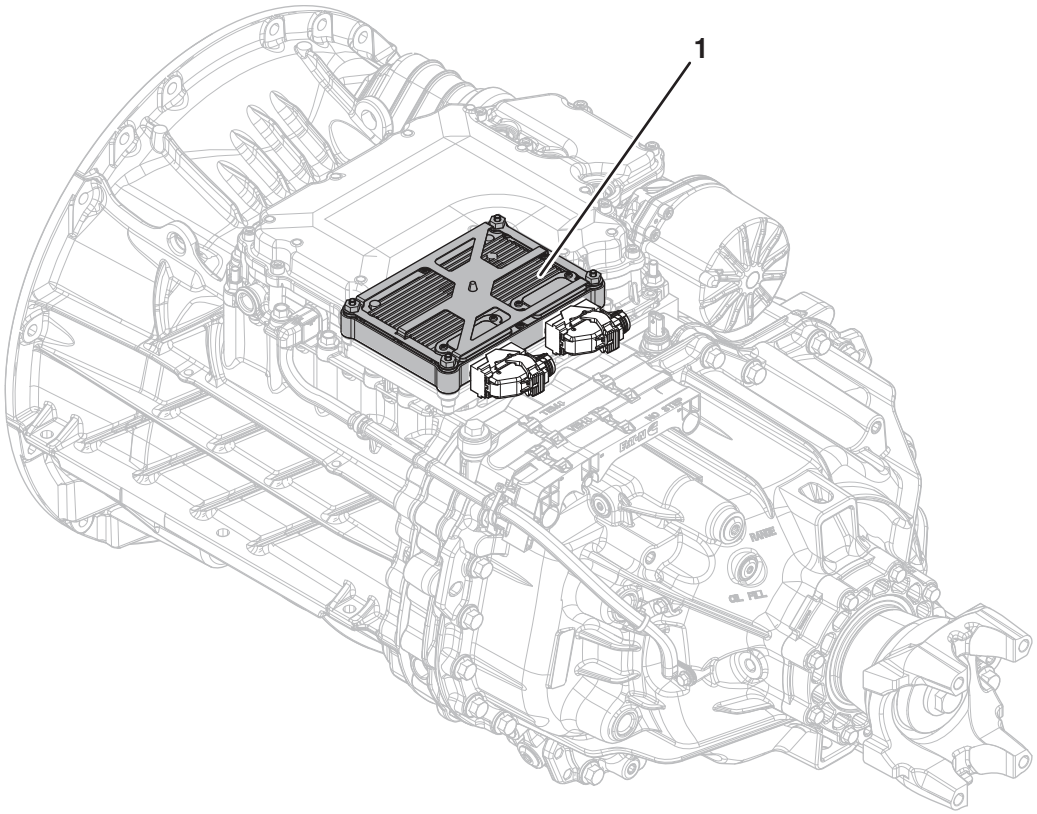
- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960

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Component Identification



1. Transmission Control Module (TCM)

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Fault Code 200 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 200 FMI 0, 1, 8, 9, 10, 11, 18, 19, 20, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 200 FMI 13, 31 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. Go to **Step V.**
   - If Fault Code 200 FMI 13, 31 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 was not updated during the Diagnostic Procedure and is at the latest available software, replace **Transmission Control Module (TCM)**. Go to **Step V.**

TCM Software

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

1. Key off.
2. Reconnect all connectors and verify 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 200 sets Active, go to **Step A.**
   - If a fault code other than 200 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 201: TCM Protection 1

J1939: SA 3 SPN 21150 FMI 2, 13, 14

Overview

The Endurant XD Series transmissions are 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 through 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: TCM has detected an internal processing error.

FMI 13 – Out Of Calibration: TCM has detected an internal processing error.

FMI 14 – Special Instructions: TCM has detected an internal processing error.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes.

Conditions to Set Fault Code Inactive

All FMIs: Key cycle and fault condition no longer exist

Possible Causes

All FMIs:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- None

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Fault Code 201 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 201 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 201 FMI 2, 13, 14 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to Contact Information on page 2. 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 201 sets Active during operation, go to **Step A.**
   - If a fault code other than 201 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 202: TCM Protection 2

J1939: SA 3 SPN 21151 FMI 0, 1, 15, 16, 17, 18

Overview
The Endurant XD Series transmissions are 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): TCM has detected an internal processing error.

FMI 1 - Data Valid But Below Normal (Most Severe): TCM has detected an internal processing error.

FMI 15 - Data Valid But Above Normal (Least Severe): TCM has detected an internal processing error.

FMI 16 - Data Valid But Above Normal (Moderately Severe): TCM has detected an internal processing error.

FMI 17 - Data Valid But Below Normal (Least Severe): TCM has detected an internal processing error.

FMI 18 - Data Valid But Below Normal (Moderately Severe): TCM has detected an internal processing error.

Fallback
All FMIs:

- Amber warning lamp on
- No degraded modes

Note: Vehicle may have additional fallback modes.

Conditions to Set Fault Code Inactive
All FMIs: Key cycle and fault condition no longer exist

Possible Causes
All FMIs:

- TCM
  - Software issue
  - Internal failure

Additional Tools
- None

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Fault Code 202 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 202 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 202 FMI 0, 1, 15, 16, 17, 18 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. 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 202 sets Active during operation, go to **Step A.**
   - If a fault code other than 202 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 205: TCM Operation 2

J1939: SA 3 SPN 609 FMI 9, 12, 19

Overview

The Endurant XD 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: TCM has detected an internal processing error.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 19 – Received Network Data in Error: TCM has detected an internal processing error.

Fallback

FMI 9, 12, 19:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 9, 12, 19: Key cycle and fault condition no longer exist

Possible Causes

All FMIs:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960

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Fault Code 205 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If fault code 205 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes first. Go to **Step V.**
   - 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 was not updated during the Diagnostic Procedure and is at the latest available software, replace **Transmission Control Module (TCM)**. Go to **Step V.**

TCM Software

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

1. Key off.
2. Reconnect all connectors and verify 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 205 sets Active, go to **Step A.**
   - If a fault code other than 205 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 206: TCM Program Memory

J1939: SA 3 SPN 628 FMI 2, 11, 12, 13, 14, 31

Overview

The Endurant XD 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, 14:

- Amber warning lamp on
- Engine cranking prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- Clutch engagements may be harsh

FMI 12, 13:

- Amber warning lamp on
- No degraded modes

FMI 31:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited
- Upshifts prohibited
- High start gears prohibited

Conditions to Set Fault Code Inactive

FMI 11, 12, 13: Key cycle and fault condition no longer exist.

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

Additional Tools

- Endurant XD Service Manual TRSM0960

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Fault Code 206 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 +1 800-826-4357 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 was not updated during the Diagnostic Procedure and is at the latest available software, replace **Transmission Control Module (TCM)**. Go to **Step V.**

TCM Software

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

1. Key off.
2. Reconnect all connectors and verify 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 206 sets Active, go to **Step A.**
   - If a fault code other than 206 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 210: Transmission Oil Pressure (Fluid Pressure Sensor)

J1939: SA 3 SPN 127 FMI 1, 3, 4, 5, 6, 18, 20, 21

Overview

The Endurant XD Series transmissions are equipped with a Fluid Pressure Sensor (FPS) to monitor oil pressure. The transmission oil pump provides the supply oil for the lubrication system. The FPS provides a pressure input to the Transmission Control Module (TCM). The TCM monitors oil pressure to ensure the transmission is being properly cooled and lubricated. If the oil pressure is out of range, the TCM will adjust transmission operation to perform properly and prevent damage. The FPS is mounted externally to the side of the transmission and connects to the TCM at the 20-Way TCM Vehicle Harness Connector.

Detection

The TCM monitors the FPS oil pressure signal. If oil pressure is outside of normal operating range or 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): Transmission oil pressure 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 18 – Data Valid But Below Normal Operating Range (Moderately Severe): Transmission oil pressure moderately low for 5 seconds.

FMI 20 – Data Drifted High: Transmission oil pressure too high in error when Countershaft is stationary.

FMI 21 – Data Drifted Low: Transmission oil pressure too low in error.

Fallback

FMI 1:

- Amber warning lamp on (OEM specific)
- Red stop lamp on (OEM specific)
- Coast Mode and Neutral Coast prohibited
- Upshifts prohibited
- High start gears prohibited

FMI 3, 4, 5, 6, 18, 20, 21:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 1: Transmission oil pressure in range.

FMI 3: FPS circuit not shorted to power for 10 seconds.

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

FMI 5: FPS circuit not open or shorted to ground for 10 seconds.

FMI 6: FPS reference voltage in range for 10 seconds.

FMI 18: Transmission oil pressure in range for 10 seconds.

FMI 20, 21: Key cycle and fault condition no longer exists.

Possible Causes

FMI 1, 18:

- Low transmission oil level
  - Not properly filled
  - Leak
- FPS
  - Damaged
  - Internal failure
- Internal transmission
  - Lubrication system mechanical failure

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FMI 3, 4, 5, 6:

- FPS
  - Damaged
  - Internal failure
- Vehicle Harness - FPS
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
- TCM
  - Software issue
  - Internal failure

FMI 20:

- Vehicle Harness - FPS
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
- FPS
  - Internal failure

FMI 21:

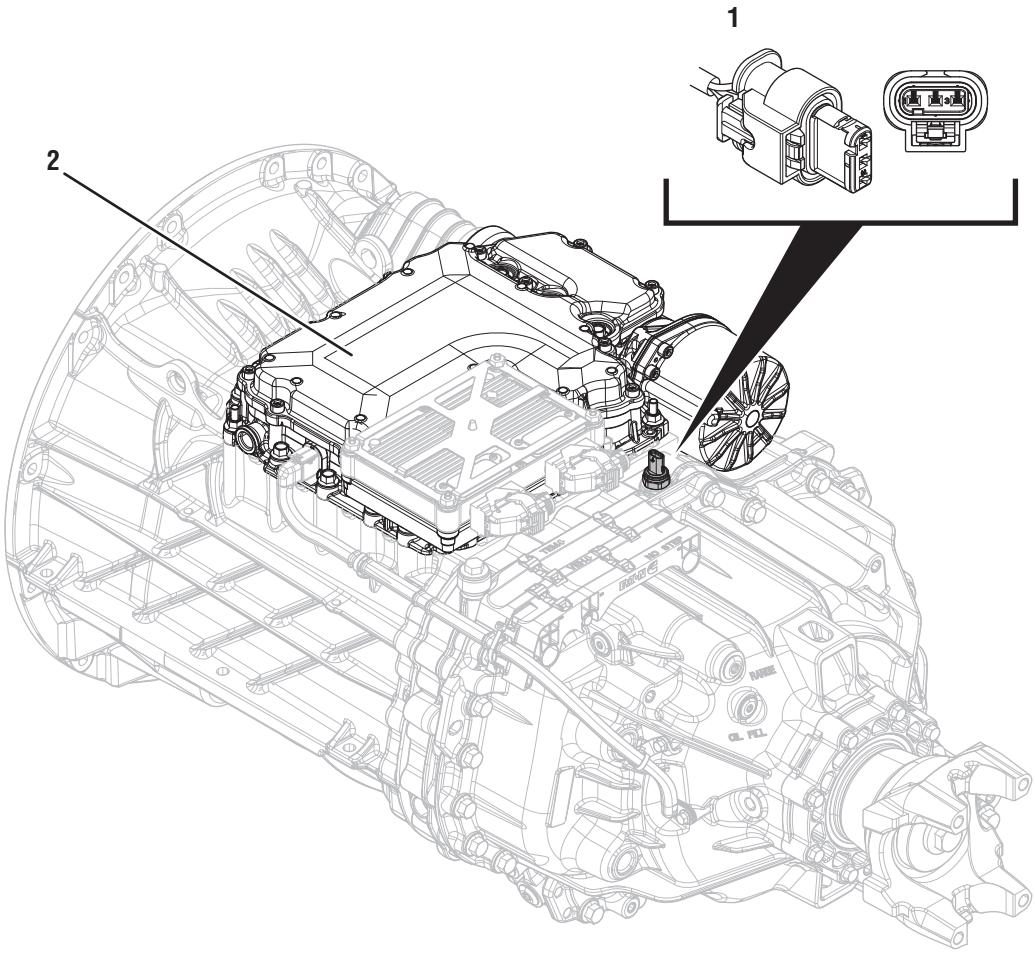
- Vehicle Harness - FPS
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose
- FPS
  - Internal failure
- Low transmission oil level
  - Not properly filled
  - Leak

Additional Tools

- Endurant XD Service Manual TRSM0960
- 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)

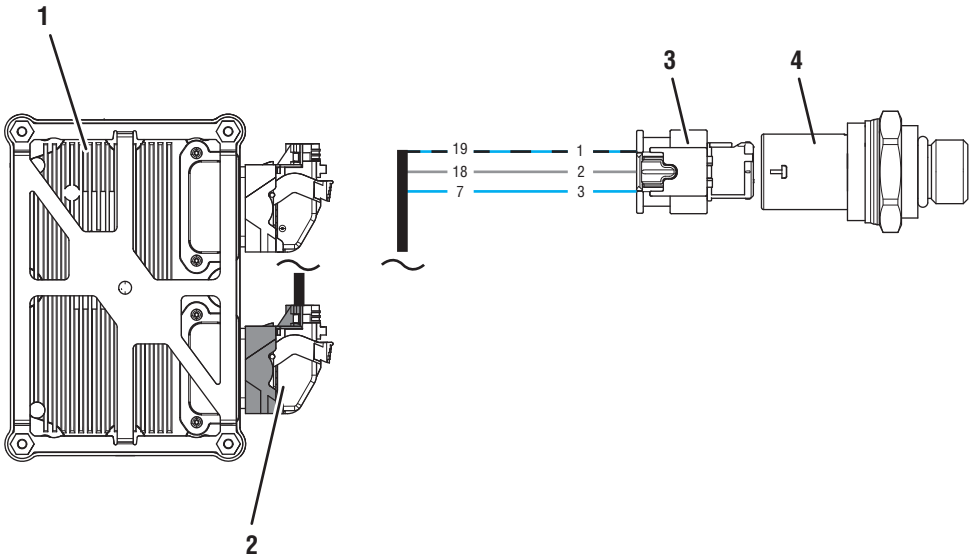
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Component Identification



1. Fluid Pressure Sensor (FPS)
2. Transmission Control Module (TCM)

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1. Transmission Control Module (TCM)
2. 20-Way TCM Vehicle Harness Connector
3. 3-Way Fluid Pressure Sensor Connector
4. Fluid Pressure Sensor (FPS)



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Fault Code 210 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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.**

B ***Purpose:*** *Verify transmission oil level and inspect for leaks.*

1. Key off.
2. Perform Oil Level Inspection Procedure.

   Note: Reference Endurant XD Service Manual TRSM0960, 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 (FPS)**. 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 XD Service Manual TRSM0960, 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 +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

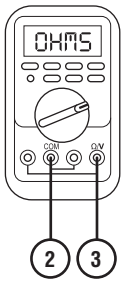
Residual Oil Volume

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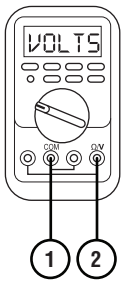
D

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.**

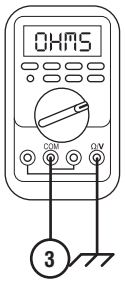
Ignition State	Pins	Range	Reading(s)
Key off	2 to 3	3k-9k Ohms	
Key on	1 to 2	4.75–5.25 V	

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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 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to 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 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	

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

1. Key off.
2. Reconnect all connectors and verify 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, go to **Step A.**
   - If a fault code other than 210 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 212: Transmission Oil Temperature (Fluid Temperature Sensor)

J1939: SA 3 SPN 177 FMI 0, 2, 4, 5, 6, 10, 15, 16

Overview

The Endurant XD Series transmissions are equipped with a Fluid Temperature Sensor (FTS) to monitor sump oil temperature. Sump oil temperature represents the overall operating temperature of the transmission. The FTS provides a temperature input to the Transmission Control Module (TCM). The TCM monitors oil temperature to ensure the transmission is being properly cooled and lubricated. If the oil temperature is extreme, the TCM will adjust transmission operation to perform properly and prevent damage. The normal temperature operating range is 86 - 250°F (30 - 121°C). The FTS is mounted in the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-way Transmission Harness Connector.

Detection

The TCM monitors the FTS oil temperature signal. If oil temperature is outside of normal operating range or 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): Transmission oil temperature greater than 275°F (135°C) for 10 seconds.

FMI 2 – Data Erratic: Transmission oil temperature out of range, greater than 302°F (150°C) or less than -41.8°F (-41°C), for 5 seconds.

FMI 4 - Voltage Below Normal or Shorted Low: FTS circuit shorted to ground for 5 seconds.

FMI 5 - Current Below Normal or Open Circuit: FTS circuit open or shorted to power for 5 seconds.

FMI 6 - Current Above Normal or Shorted Circuit: FTS reference voltage not between 4.75V to 5.25V for 5 seconds.

FMI 10 - Abnormal Rate of Change: Transmission Oil Temperature rate of change greater than 20°F (11°C) per second.

FMI 15 - Data Valid but Above Normal (Least Severe): Transmission oil temperature greater than 252°F (122°C) for 15 minutes or above 273°F (134°C) for 1 minute.

FMI 16 – Data Valid but Above Normal (Moderately Severe): Transmission oil temperature greater than 252°F (122°C) for 30 minutes or above 273°F (134°C) for 2 minutes.

Fallback

FMI 0, 15, 16

- Amber warning lamp on (OEM specific)
- Red stop lamp on (OEM specific)
- Shift performance may be degraded

FMI 2, 4, 5, 6, 10

- Amber warning lamp on (OEM specific)
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 0, 15, 16: Transmission oil temperature below 252°F (122° C) for 1 minute.

FMI 2: Transmission oil temperature in range for 10 seconds.

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

FMI 5: FTS circuit not open or shorted to power for 10 seconds.

FMI 6: FTS reference voltage in range for 10 seconds.

FMI 10: Key cycle and fault condition no longer exists.

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Possible Causes

FMI 0, 15, 16:

- Low transmission oil level
  - Not properly filled
  - Leak
- FTS not configured in the TCM
  - Replacement TCM installed
- FTS
  - Internal failure
- Internal transmission
  - Lubrication system mechanical failure

FMI 2, 4, 5, 6, 10:

- FTS
  - Internal Failure
- MTM Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960
- Non-contact (infrared) temperature gun
- Digital Volt/Ohm Meter (DVOM)

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Fault Code 212 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 212 FMI 0, 15, 16 is Active or Inactive, go to **Step B.**
   - If Fault Code 212 FMI 2, 4, 5, 6, 10 is Active or Inactive, go to **Step D.**

B ***Purpose:*** *Verify transmission oil level and inspect for leaks.*

1. Key off.
2. Perform Oil Level Inspection Procedure.

   Note: Reference Endurant XD Service Manual TRSM0960, Oil Level Inspection Procedure.

   - If FMI 0, 15, 16 and transmission oil level is in range, FTS indicated a higher than expected oil sump temperature. Check external transmission cooler system operation. Go to **Step V.**

     Note: An external transmission oil cooler system is required when vehicle Gross Combination Weight (GCW) exceeds 110,000 lbs (50 Metric Tons).
   - If FMI 0,15,16 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.

   Note: Place a suitable container under Oil Drain Plug.

   Note: Reference Endurant XD Service Manual TRSM0960, 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 +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

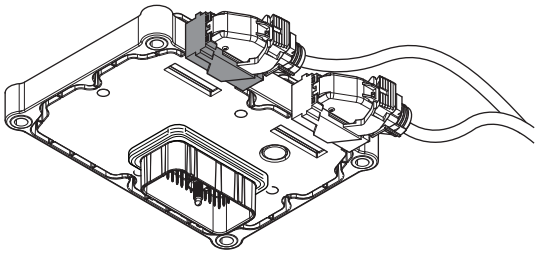
Residual Oil Volume

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D

Purpose: *Verify condition of TCM 74-Way Connector.*

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



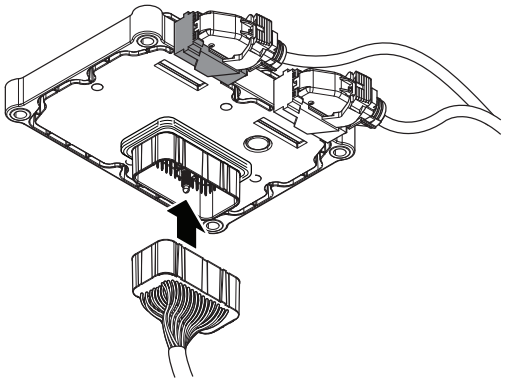
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and there is no damage.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step E.**

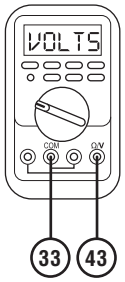
E

Purpose: *Verify TCM Fluid Temperature Sensor reference voltage.*

1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Key on with engine off.
4. Measure voltage at Eaton Breakout Box between Pin 33 and Pin 43. Record reading in table.



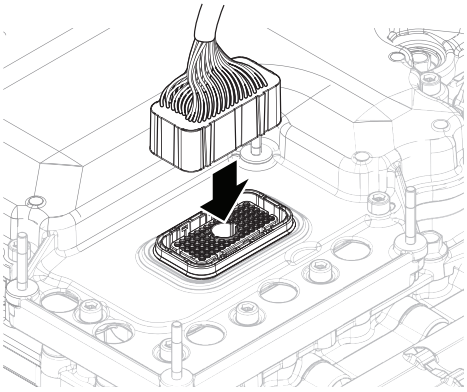
5. Compare reading(s) in table.
   - If readings are in range, Go to **Step F.**
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

Ignition State	Pins	Range	Reading(s)
Key on	33 to 43	4.75–5.25 V	

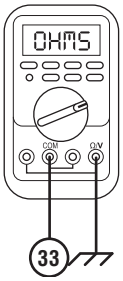
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F ***Purpose:*** *Verify TFS not shorted to ground.*

1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 33 and Ground (TCM mounting stud). Record reading in table.



- If readings are in range, go to **Step G.**
- If readings are out of range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

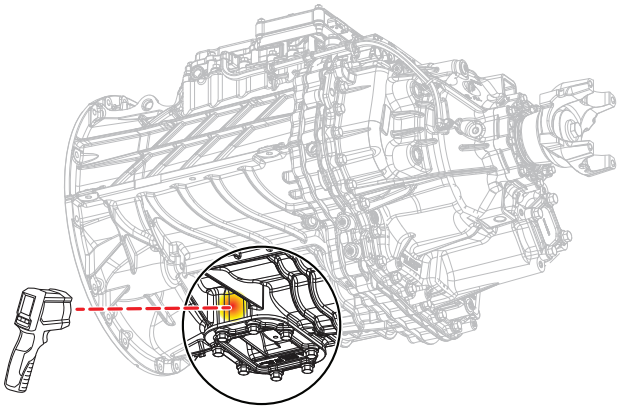
  Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
33 to Ground	Open Circuit (OL)	

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G ***Purpose:*** *Verify Resistance of FTS Compared to Main Case Temperature.*

1. Key off.
2. Use Non-contact (infrared) temperature gun to measure main case temperature in area indicated. Record reading in table.



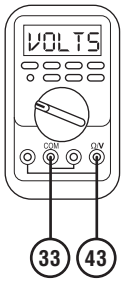
3. Use Temperature/TFS Resistance Range chart to determine expected FTS resistance range based on Main Case Temperature. Record Resistance Range in table.

   Note: Results may not be an exact match.

Temperature		TFS Resistance Range	
ºC	ºF	Min	Max
0	32	90285	99789
5	41	70996	78470
10	50	55961	61851
15	59	44349	49017
20	68	35447	39179
25	77	28500	31500
30	86	22993	25413
35	95	18650	20614
40	104	15206	16806
45	113	12460	13772
50	122	10260	11340
55	131	8499	9393
60	140	7075	7820
65	149	5917	6540
70	158	4972	5495
75	167	4196	4637
80	176	3557	3931
85	185	3028	3347
90	194	2590	2863
95	203	2225	2459
100	212	1918	2120
105	221	1658	1833
110	230	1439	1590
115	239	1252	1384
120	248	1093	1209
125	257	958	1059
130	266	841	930
135	275	741	819

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4. Measure resistance at Eaton Breakout Box between Pin 33 and Pin 43. Record reading in table.



- If readings are in range, go to **Step H.**
- If readings are out of range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

  Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Main Case Temperature	TFS Resistance Range	Pins	Reading(s)
		33 to 43	

H

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

1. Key off.
2. Remove 74-Way Eaton Diagnostic Adapter from MTM.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 212 FMI 2, 4, 5, 6, 10 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 212 FMI 2,4,5,6,10 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

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

1. Key off.
2. Reconnect all connectors and verify 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 set the fault code or duplicate the previous complaint.
8. Check for fault codes using ServiceRanger:
   - If no codes set and vehicle operates properly, test complete.
   - If Fault Code 212 sets Active, go to **Step A.**
   - If a fault code other than 212 sets Active, troubleshoot per Fault Code Isolation Procedure Index on page 13.

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Fault Code 215: Transmission Air Supply Pressure Sensor

J1939: SA 3 SPN 37 FMI 0, 1, 2, 3, 4, 5, 6, 10, 17, 18

Overview

The Endurant XD Series transmissions are equipped with a Transmission Air Supply Pressure Sensor (TASPS) to monitor the air pressure supplied to the transmission. The TASPS connects into the vehicle air supply 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 Mechatronic Transmission Module (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 TASPS air pressure signal. If air pressure is outside of normal operating range or 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): Transmission air pressure greater than 145 psi (1000 kPa) for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): Transmission air pressure less than 75 psi (517 kPa) for 1 second and one of the following is true:

- a non-Neutral mode is selected
- the vehicle is moving
- the engine has been running for 8 minutes

FMI 2 – Data Erratic: Transmission air pressure out of range, less than 5 psi (34.5 kPa) or greater than 203 psi (1400 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 10 - Abnormal Rate of Change: TASPS value rate of change exceeded for 1 second.

FMI 17 – Data Valid but Below Normal (Least Severe): Transmission air pressure less than 75 psi (517 kPa) for 2 seconds with engine off and transmission shutdown in gear.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Transmission air pressure less than 80 psi (552 kPa) for 2 seconds and one of the following is true:

- a non-Neutral mode is selected
- the vehicle is moving
- the engine has been running for 8 minutes

Fallback

FMI 0:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Shift performance may be degraded

FMI 1:

- If transmission is in gear:
  - Amber warning lamp on (OEM Specific)
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO Mode prohibited
- If transmission is not in gear:
  - Red stop lamp on (OEM specific)
  - Clutch disengagements prohibited

FMI 2, 3, 4, 5, 6, 10, 17:

- Amber warning lamp on
- No degraded modes

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FMI 18:

- Amber warning lamp on (OEM specific)
- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0: TASPS indicated air pressure below 145psi (1000 kPa) for 1 second.

FMI 1: TASPS indicated air pressure above 75psi (517 kPa) for 1 second.

FMI 2: TASPS indicated air pressure in range for 10 seconds.

FMI 3: TASPS circuit not shorted to power for 10 seconds.

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

FMI 5: TASPS circuit not open or shorted to ground for 10 seconds.

FMI 6: TASPS reference voltage in range for 10 seconds.

FMI 10: Key cycle and fault condition no longer exists.

FMI 17: TASPS indicated air pressure above 75psi (517 kPa) and transmission in Neutral.

FMI 18: TASPS indicated air pressure above 80psi (552 kPa) for 1 second.

Possible Causes

FMI 0:

- Vehicle Components - Air System
  - Air compressor governor “off” set too high or damaged
- Vehicle service event
  - Connected to a Service facility air supply source

FMI 1, 18:

- Vehicle Components - 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, 10:

- 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:

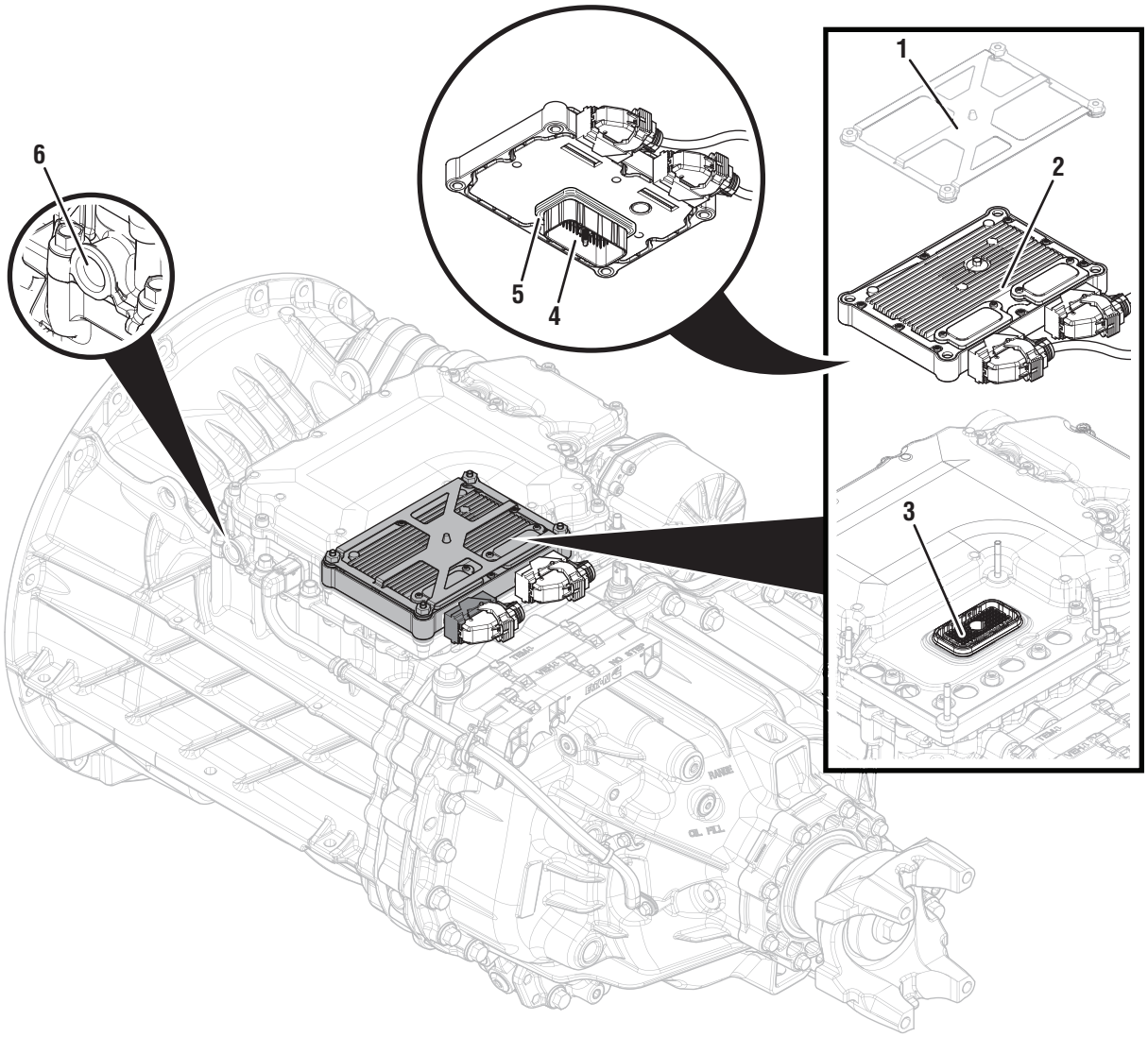
- Engine was shutdown when air supply pressure low and transmission still in gear
- Transmission service event
  - Transmission mis-assembled in a gear position instead of a neutral position.

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- 0-200 psi (0-1379 kPa) air pressure gauge

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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

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Fault Code 215 Troubleshooting

A

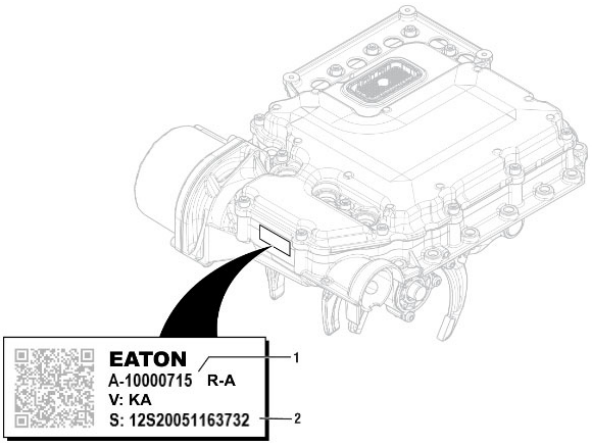
Purpose: *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 215 FMI 3, 4, 5, 6, 10 is Active or Inactive, go to **Step C.**
   - If Fault Code 215 FMI 0, 1, 2, 18 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 to 100-135 PSI (690-930 kPa) 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: *Record MTM Serial Number and determine next steps.*

1. Record MTM Serial Number.



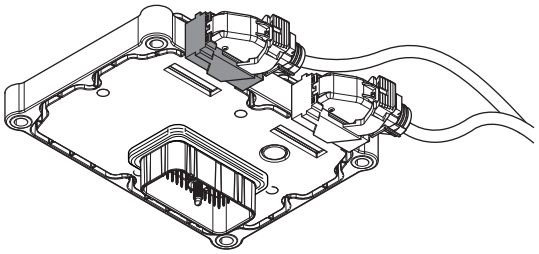
   - If MTM Serial Number is less than 18S25036075335, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2.
   - If MTM Serial Number greater than or equal to 18S25036075335, go to **Step E.**

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C

Purpose: *Verify condition of TCM 74-Way Connector.*

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



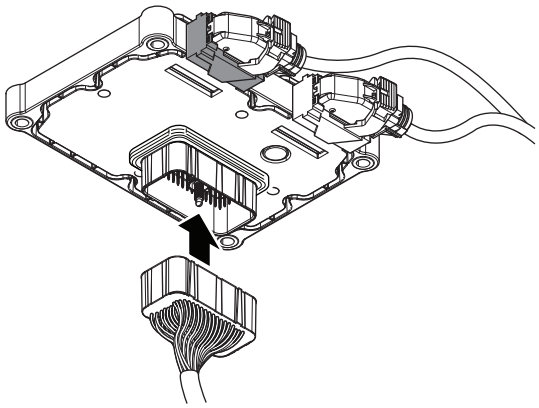
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and there is no damage.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step D.**

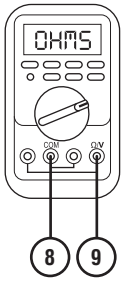
D

Purpose: *Verify TASPS internal resistance and power supply at TCM.*

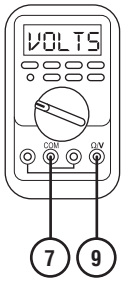
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Measure resistance at Eaton Breakout Box between Pin 8 and Pin 9. Record reading in table.



4. Key on.
5. Measure voltage at Eaton Breakout Box between Pin 7 and Pin 9. Record reading in table.



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6. Compare reading(s) in table.

- If readings are in range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

  Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

- If readings are out of range, replace **Transmission Control Module (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	

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E ***Purpose:*** *Verify operation of the vehicle air system.*

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. Monitor vehicle in-dash air pressure gauge. Record reading in table.
10. Wait 1 minute.
11. Monitor 520524 - Line Pressure Feedback value. Record reading in table.
12. Monitor vehicle in-dash air pressure gauge. Record reading in table.
13. Compare reading(s) in table.
    - If readings are out of range and/or system cannot hold pressure, go to **Step F.**
    - If readings are in range and the vehicle air system holds pressure and FMI 1 or 18 are Inactive, refer to service bulletin **TAIB-0876** in the TRIB-0900. Go to **Step V.**
    - If readings are in range and FMI 0 is Inactive, refer to OEM guidelines and verify operation and maintenance of the vehicle air system. Go to **Step V.**
    - If reading are in range and FMI 2 is Inactive, go to **Step C.**
    - If readings are in range, the vehicle air system holds pressure and FMI 0, 1, 2 or 18 are Active, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

      Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, 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)	
After 1 minute		
In-dash air pressure gauge	100–135 PSI (690-930 kPa)	
520524 - Line Pressure Feedback	100–135 PSI (690-930 kPa)	

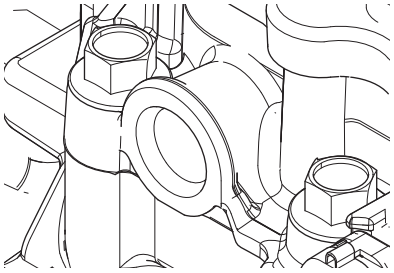
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F

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Refer to OEM guidelines and vent vehicle air supply line to MTM.
2. Refer to OEM guidelines and remove vehicle air supply line at MTM.
3. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and reference **Lower Countershaft Cover and Inertia Brake** Service Procedure for replacement of the Inertia Brake Assembly. Go to **Step V.**

  Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

- If no contamination is found, go to **Step G.**

G

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 vehicle air system. Go to **Step V.**
   - If readings are in range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, 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)	

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

1. Key off.
2. Reconnect all connectors and verify 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 215 sets Active, go to **Step A.**
   - If a fault code other than 215 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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, 20, 31

Overview

The Endurant XD Series transmissions are equipped with a Linear Clutch Actuator (LCA) Position Sensor to monitor clutch position. The LCA is mounted to the Mechatronic Transmission Module (MTM) and pneumatically controls the clutch position. The LCA contains a magnet that allows the LCA Position Sensor to sense clutch position and provide it to the Transmission Control Module (TCM). The LCA Position Sensor is mounted in the MTM and connected to the TCM at the 74-way Transmission Harness Connector.

Detection

The TCM monitors the LCA Position Sensor signal. If LCA position is outside of normal operating range or 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): Uncommanded clutch movement toward engaged position for 2 seconds.

FMI 1 - Data Valid But Below Normal (Most Severe): Uncommanded clutch movement toward disengaged position for 2 seconds.

FMI 2 – Data Erratic: LCA Position Sensor signal 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 a clutch calibration the expected fully engaged (closed) clutch position was not achieved.

FMI 8 – Abnormal Frequency: LCA Position Sensor signal frequency out of range for 1 second.

FMI 9 - Abnormal Update Rate: LCA magnet not detected by LCA Position Sensor for 1 second.

FMI 12 – Bad Intelligent Device: LCA Position Sensor circuit self-check failure for 1 second.

FMI 13 – Out Of Calibration: LCA Position Sensor out of calibration.

FMI 14 – Special Instructions: Inappropriate clutch position command relative to torque command.

FMI 15 - Data Valid But Above Normal (Least Severe): During a LCA Position Sensor calibration the Torque Transfer Touch Point clutch position was out of range.

FMI 16 – Data Valid But Above Normal (Moderately Severe): During a LCA Position Sensor calibration the Torque Transfer Touch Point clutch position was not available.

FMI 17 – Data Valid But Below Normal (Least Severe): During a LCA Position Sensor calibration the 10 Nm torque transfer clutch position was out of range.

FMI 20 – Data Drifted High: LCA Position Sensor incorrectly reports clutch is disengaged near engine idle when torque is elevated and service brake is applied.

FMI 31 – Condition Exists: LCA Position Sensor incorrectly reports clutch is disengaged near engine idle when torque is elevated and parking brake is applied.

Fallback

FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 20, 31:

- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 0, 1: Clutch position in range for 10 seconds.

FMI 2: LCA Position Sensor signal in range for 10 seconds.

FMI 3: LCA Position Sensor circuit not shorted to power for 10 seconds.

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FMI 4: LCA Position Sensor circuit not shorted to ground for 10 seconds.

FMI 5: LCA Position Sensor circuit not open for 10 seconds.

FMI 6: LCA Position Sensor reference voltage in range for 10 seconds.

FMI 8: LCA Position Sensor signal frequency in range for 10 seconds.

FMI 9: LCA magnet detected for 10 seconds.

FMI 12: LCA Position Sensor circuit self-checks in range for 10 seconds.

FMI 13: Successful LCA Position Sensor calibration.

FMI 14, 20, 31: Key cycle and fault condition no longer exists.

FMI 7, 15, 16, 17: During LCA position sensor calibration clutch position value was available and in range.

Possible Causes

FMI 0, 1:

- LCA
  - Air leak
  - Self-adjustment mechanism
- MTM
  - Air leak
- MTM - Valve Pack C
  - Stuck open clutch exhaust valve(s)
- Clutch Release System
  - Release Yoke
  - Release Bearing
- MTM - LCA Position Sensor
  - Internal failure

FMI 7

- LCA
  - Self-adjustment mechanism
- MTM - Valve Pack C
  - Stuck open clutch fill valve(s)
- Clutch Release System
  - Release Yoke
  - Release Bearing
- MTM - LCA Position Sensor
  - Internal failure
- Incorrect engine flywheel housing

FMI 15, 16, 17:

- LCA
  - Self-adjustment mechanism
- MTM - Valve Pack C
  - Stuck open clutch fill valve(s)
- Clutch Release System
  - Release Yoke
  - Release Bearing
- MTM - LCA Position Sensor
  - Internal failure

FMI 2, 3, 4, 5, 6, 8, 20, 31:

- MTM - LCA Position Sensor
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

FMI 9:

- LCA
  - Magnet Loose
  - Magnet Detached
- MTM - LCA Position Sensor
  - Loose
  - Damaged
- Incorrect engine flywheel housing

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FMI 12, 14:

- TCM
  - Software issue
  - Internal failure

FMI 13:

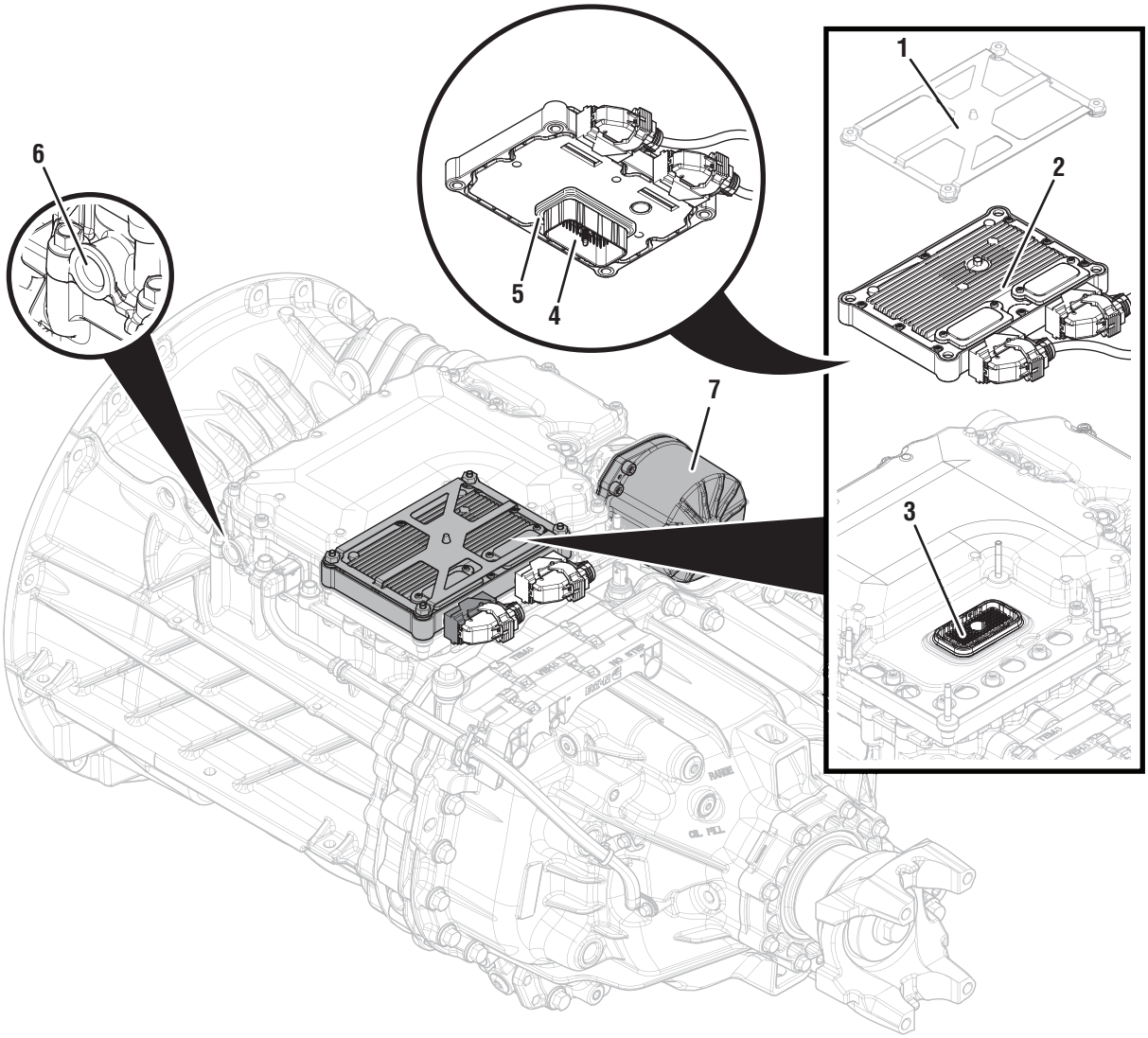
- Clutch calibration required

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt Ohm Meter (DVOM)

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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)

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Fault Code 250 Troubleshooting

A

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

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

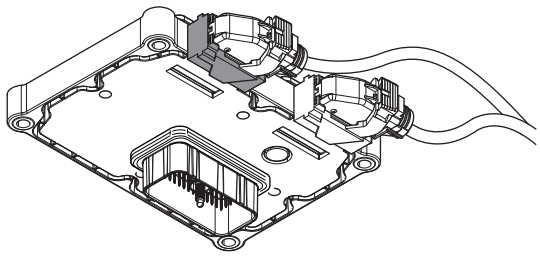
   Note: If the engine flywheel housing was just replaced and Fault Code 250 set immediately after repair, contact OEM and/or engine manufacturer and ensure the correct housing part number was installed based on the transmission model.

   - If Fault Code 250 FMI 0, 1, 15, 16, 17 is Active or Inactive, go to **Step D.**
   - If Fault Code 250 FMI 2, 3, 4, 5, 6, 8, 20, 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 250 FMI 7 is Active or Inactive, go to **Step G.**
   - If Fault Code 250 FMI 9 is Active or Inactive, go to **Step E.**
   - If Fault Code 250 FMI 12, 14 is Active or Inactive, go to **Step F.**
   - 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.**

B

Purpose: *Verify TCM and 74-Way Harness Connector condition.*

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



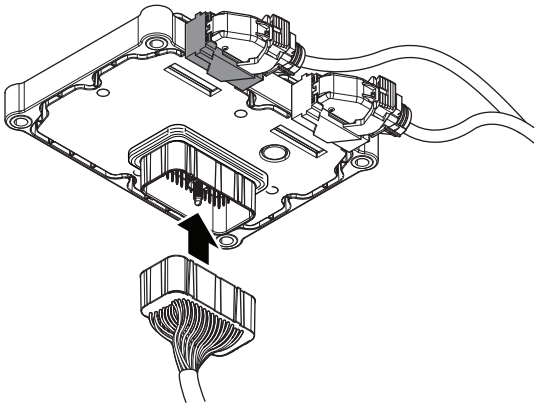
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and there is no damage.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

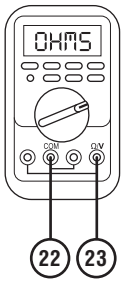
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C ***Purpose:*** *Verify TCM LCA Position Sensor internal resistance and power supply.*

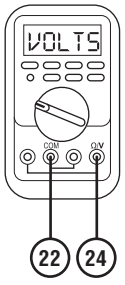
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Measure resistance at Eaton Breakout Box between Pin 22 and Pin 23. Record reading in table.



4. Key on.
5. Measure voltage at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

Ignition State	Pins	Range	Reading(s)
Key off	22 to 23	7.5k-22k Ohms	
Key on	22 to 24	4.75-5.25 V	

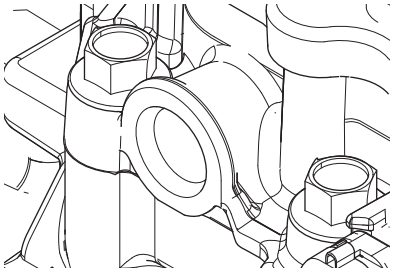
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D

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

  Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

- If no contamination is found, go to **Step E.**

E

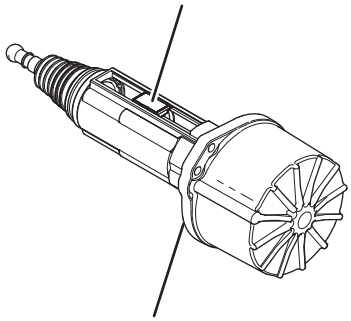
Purpose: *Inspect LCA Magnet, Seal and Position Sensor.*

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.



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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 **Linear Clutch Actuator (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 **Linear Clutch Actuator (LCA)**. Go to **Step V.**
   - If the LCA to MTM sealing surface on the MTM is damaged, replace **Mechatronic Transmission Module (MTM)** (includes LCA). Go to **Step V.**
   - If the LCA Position Sensor in the MTM is not properly secured, replace **Mechatronic Transmission Module (MTM)** (includes LCA). Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no fault is found with the LCA, MTM or LCA Position Sensor, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. 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 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 for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

TCM Software

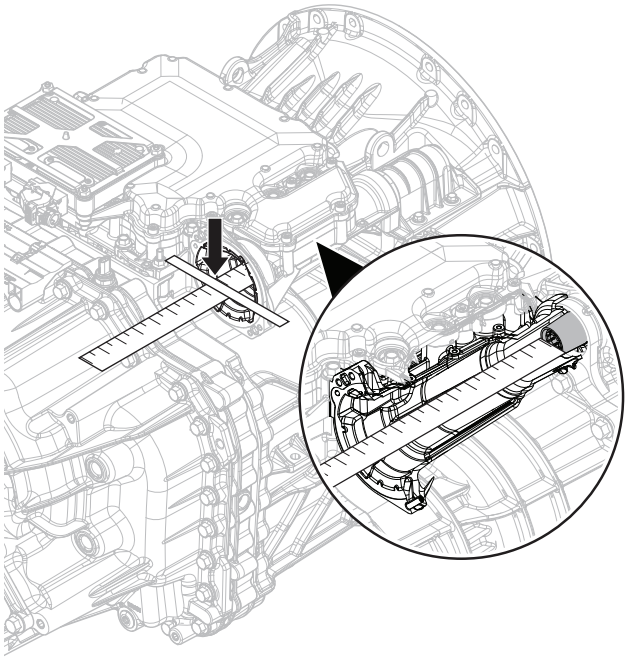
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G ***Purpose:*** *Measure Distance from Release Yoke to LCA Mounting Surface.*

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. Using steel ruler or suitable measurement device, measure distance from Release Yoke to LCA mounting surface.

   NOTICE: Ensure end of measurement device is resting on flat face of Release Yoke.



5. Record measurement in table.
   - If reading is less than 276 mm (10 13/16”), contact OEM and/or engine manufacturer and ensure the correct engine flywheel housing part number was installed based on the transmission model. Go to **Step V.**
   - If reading is greater than 290 mm (11 7/16”), reference the **Clutch** Service Procedure for replacement of the Clutch Assembly. Go to **Step V.**
   - If reading is between 276 – 290 mm (10 13/16” – 11 7/16”), contact Eaton Cummins Automated Transmission Technologies at +1-800-826-4357 for further diagnostic instructions. Go to **Step V.**

Release Yoke to LCA Mounting Surface Distance	Measurement
276 – 290 mm (10 13/16” – 11 7/16”)	

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

1. Key off.
2. Reconnect all connectors and verify 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 250 sets Active, go to **Step A.**
   - If a fault code other than 250 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 255: Rail A Position

J1939: SA 3 SPN 4218 FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 20

Overview

The Endurant XD Series transmissions are equipped with 5 shift rail position sensors and 5 magnets mounted on shift rails A, B, C, D and E. The shift rail position sensors monitor the position of the shift rail magnet and provide the information to the Transmission Control Module for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. Shift Rail A actuates the Rail A Synchronizer to engage the Main 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 Shift Rail A position. 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): Shift Rail A movement beyond the calibrated Main Drive Gear engagement position for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): Shift Rail A movement beyond the calibrated Neutral Stop position for 1 second.

FMI 2 – Data Erratic: Rail A Position duty cycle out of range for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail A Position Sensor circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail A Position Sensor circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail A Position Sensor circuit open for 1 second.

FMI 6 – Current Above Normal or Grounded Circuit: Rail A Position Sensor signal out of normal operating voltage (4.75V to 5.25V) for 1 second.

FMI 7 – Mechanical System Not Responding: Shift Rail A failed interlock function test. Uncommanded Shift Rail A movement from neutral position while Main Drive Gear Low or Splitter Gear was engaged.

FMI 8 – Abnormal Frequency: Rail A Position Sensor signal frequency out of range for 1 second.

FMI 9 – Abnormal Update Rate: Rail A Position Sensor did not detect Shift Rail A magnet for 1 second.

FMI 10 – Abnormal Rate Of Change: Rail A Position value rate of change exceeded when no Shift Rail A movement commanded for 1 second.

FMI 11 – Root Cause Unknown: Rail A Position value indicated Main Drive Gear engagement, but speed sensors did not indicate a Main Drive Gear ratio for 2 seconds.

FMI 12 – Bad Intelligent Device: Rail A Position Sensor circuit self-check failure for 1 second.

FMI 14 – Special Instructions: Rail A Position value indicated Main Drive Gear engagement, but speed sensors did not indicate a Main Drive Gear ratio for 1 second.

FMI 15 - Data Valid but Above Normal (Least Severe): Uncommanded Shift Rail A movement from neutral position toward Main Drive Gear while Main Drive Gear Low or Splitter Gear was engaged for 2 seconds.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Uncommanded Shift Rail A movement from Main Drive Gear toward neutral position while speed sensors continued to indicate a Main Drive Gear ratio.

FMI 20 – Data Drifted High: Rail A Position value indicated Main Drive Gear disengagement, but speed sensors and torque continued to indicate a Main Drive Gear ratio for 2 seconds.

Fallback

FMI 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 15, 16, 20

- If Rail A position is known and Rail A is either fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail A movement prohibited
- If Rail A position is not known and Rail A is either not fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail A movement prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Non-Neutral Modes prohibited
  - PTO mode prohibited
  - If vehicle is moving – Red stop lamp on

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FMI 7

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 0, 1, 7, 10, 11, 14, 15, 16, 20: Key cycle and fault condition no longer exist.

FMI 2: Rail A Position duty cycle in range for 10 seconds.

FMI 3: Rail A Position Sensor circuit not shorted to power for 10 seconds.

FMI 4: Rail A Position Sensor circuit not shorted to ground for 10 seconds.

FMI 5: Rail A Position Sensor circuit not open for 10 seconds.

FMI 6: Rail A Position Sensor signal voltage between 4.75 and 5.25 volts for 10 seconds.

FMI 8: Rail A Position Sensor signal frequency in range for 10 seconds.

FMI 9: Shift Rail A magnet detected for 10 seconds.

FMI 12: Rail A Position Sensor circuit self-checks in range for 10 seconds.

Possible Causes

FMI 0, 1, 7:

- MTM
  - Rail A Yoke
- Internal Transmission
  - Rail A Synchronizer

FMI 2, 3, 4, 5, 6, 8:

- MTM - Rail A 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 Installation
  - Rail A notch facing down
- MTM - Rail A Cylinder
  - Magnet loose
  - Magnet detached
- MTM - Rail A Position Sensor
  - Loose
  - Damaged

FMI 10, 14, 20:

- MTM - Rail A Position Sensor
  - Internal failure

FMI 11:

- MTM - Rail A 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 15, 16:

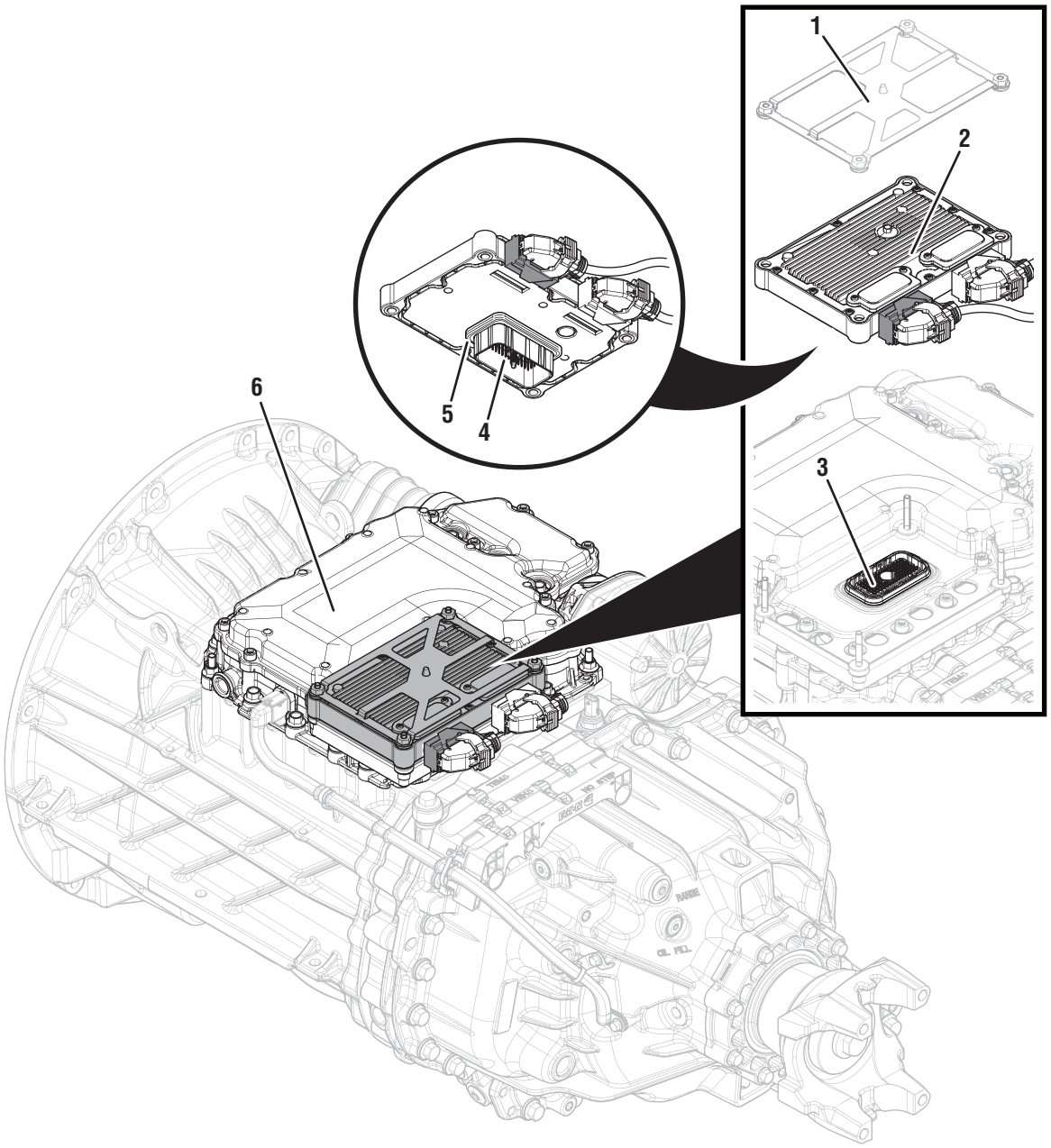
- MTM - Rail A Position Sensor
  - Internal failure
- Internal transmission
  - Rail A Detent
  - Rail A Shift Rail
  - Rail A Synchronizer

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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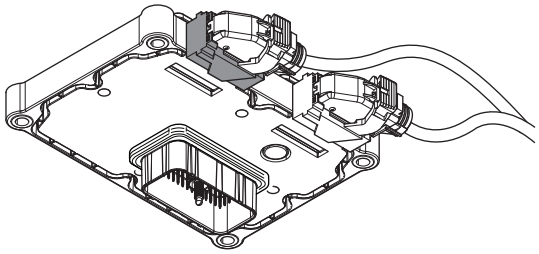
Fault Code 255 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 255 FMI 0, 1, 7 is Active or Inactive, go to **Step D.**
   - If Fault Code 255 FMI 2, 3, 4, 5, 6, 8, 10, 14, 15, 16, 20 is Active or Inactive, go to **Step B.**
   - If Fault Code 255 FMI 9 is Active and MTM was recently replaced, go to **Step H.**
   - If Fault Code 255 FMI 9 is Active or Inactive and MTM was not recently replaced, go to **Step B.**
   - If Fault Code 255 FMI 11 is Active or Inactive, go to **Step F.**
   - If Fault Code 255 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



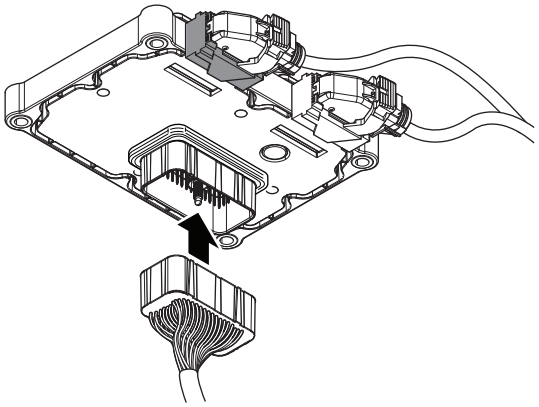
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found to TCM side of 74-Way Transmission Harness Connector, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission to be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

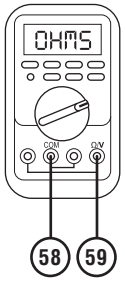
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C ***Purpose:*** *Verify Rail A Position Sensor internal resistance and power supply at TCM.*

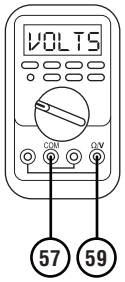
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Measure resistance at Eaton Breakout Box between Pin 58 and Pin 59. Record reading in table.



4. Key on with engine off.
5. Measure voltage at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (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	

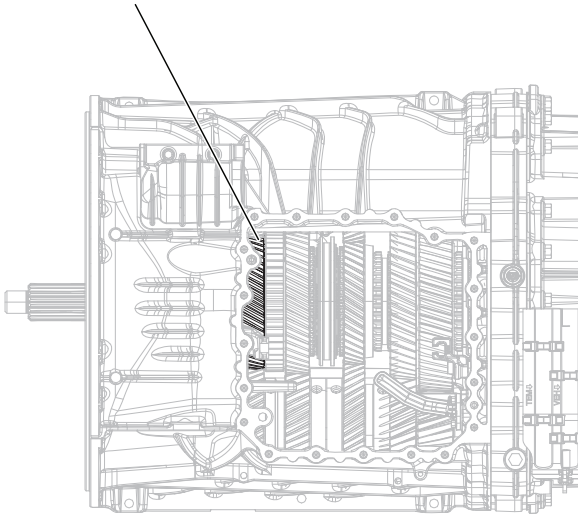
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D

Purpose: *Verify mechanical condition of the Main Drive Gear.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Main Drive Gear for excessive fore and aft movement.



- If excessive gear movement is evident, inspect 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 A Synchronizer.*

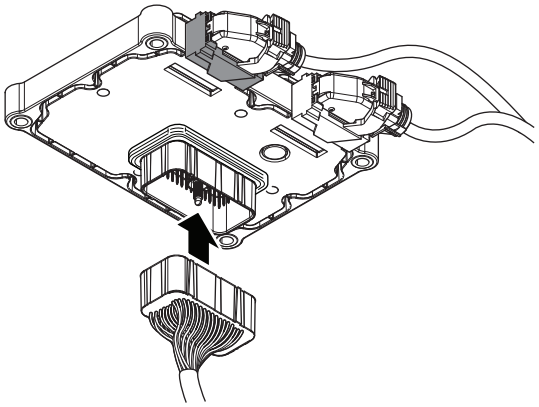
Note: Reference *Manually Actuate Rail A Procedure* on page 689 of the Appendix.

1. Shift Rail A Synchronizer Sliding Sleeve into neutral position (if necessary).
2. Shift Rail A Synchronizer Sliding Sleeve into Main Drive Gear engagement position (aft) and return to neutral position.
   - If Rail A Synchronizer Sliding Sleeve shifts into both positions, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail A Synchronizer Sliding Sleeve does not shift into both positions, replace Rail A Yoke, Rail A Synchronizer Assembly and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

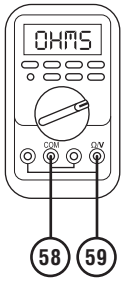
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F ***Purpose:*** *Verify Rail A Position Sensor internal resistance and power supply at TCM.*

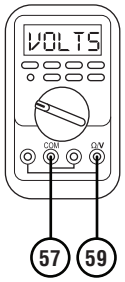
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Measure resistance at Eaton Breakout Box between Pin 58 and Pin 59. Record reading in table.



4. Key on with engine off.
5. Measure voltage at Eaton Breakout Box between Pin 57 and Pin 59. Record reading in table.



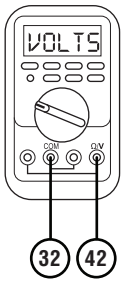
6. Compare reading(s) in table.
   - If readings are in range, go to **Step G.**
   - If readings are out of range, replace TCM. Go to **Step V.**

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	

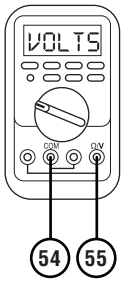
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G ***Purpose:*** *Verify Input and Countershaft speed sensor supply voltage at TCM.*

1. Key on with engine off.
2. Measure voltage at Eaton Breakout Box between Pin 32 and Pin 42. Record reading in table.



3. Measure voltage at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

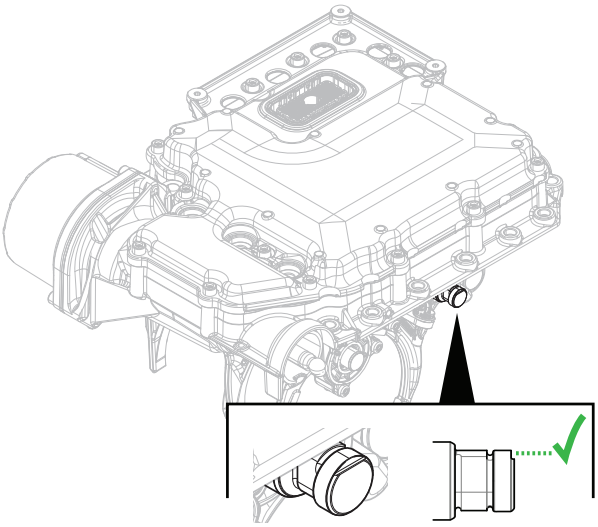
Ignition State	Pins	Range	Reading(s)
Key on	32 to 42	4.75–5.25 V	
Key on	54 to 55	4.75–5.25 V	

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H

Purpose: *Verify orientation of Rail A.*

1. Refer to Endurant XD Service Manual TRSM0960, Mechatronic Transmission Module (MTM) Service Procedure.
2. Verify notch on Rail A is facing up.



- If MTM was installed with notch on Rail A facing down, reference Endurant XD Service Manual TRSM0960, Mechatronic Transmission Module (MTM) Service Procedure. Go to **Step V.**

  Note: If MTM is installed on the transmission with the notch on Rail A facing down, Fault Code 255 (SPN 4218) FMI 9 sets Active and the transmission will not shift out of neutral.

- If MTM was installed with notch on Rail A facing up, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 255 sets Active, go to **Step A.**
   - If a fault code other than 255 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 275: Rail B Position

J1939: SA 3 SPN 4219 FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 20, 21, 31

Overview

The Endurant XD Series transmissions are equipped with 5 shift rail position sensors and 5 magnets mounted on shift rails A, B, C, D and E. The shift rail positions sensors monitor the position of the shift rail magnet and provide the information to the Transmission Control Module for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. Shift Rail B actuates the Rail B Synchronizer to engage the Main Drive Gear Low or Splitter 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 Shift Rail B position. 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): Shift Rail B movement beyond the calibrated Main Drive Gear Low engagement position for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): Shift Rail B movement beyond the calibrated Splitter Gear engagement position for 1 second.

FMI 2 – Data Erratic: Rail B Position duty cycle out of range for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail B Position Sensor circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail B Position Sensor circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail B Position Sensor circuit open for 1 second.

FMI 6 – Current Above Normal or Grounded Circuit: Rail B Position Sensor signal out of normal operating voltage (4.75V to 5.25V) for 1 second.

FMI 7 – Mechanical System Not Responding: Shift Rail B failed interlock function test. Uncommanded Shift Rail B movement from neutral position while Main Drive Gear was engaged.

FMI 8 – Abnormal Frequency: Rail B Position Sensor signal frequency out of range for 1 second.

FMI 9 – Abnormal Update Rate: Rail B Position Sensor did not detect Shift Rail B magnet for 1 second.

FMI 10 – Abnormal Rate Of Change: Rail B Position value rate of change exceeded when no Shift Rail B movement commanded for 1 second.

FMI 11 – Root Cause Unknown: Rail B Position value indicated Main Drive Gear Low or Splitter Gear engagement, but speed sensors did not indicate a Main Drive Gear Low or Splitter Gear ratio for 2 seconds.

FMI 12 – Bad Intelligent Device: Rail B Position Sensor circuit self-check failure for 1 second.

FMI 14 – Special Instructions: Rail B Position value indicated Main Drive Gear Low engagement position, but Rail A Position Sensor and speed sensors confirmed Main Drive Gear engagement for 1 second.

FMI 15 - Data Valid but Above Normal (Least Severe): Uncommanded Shift Rail B movement from neutral position toward Main Drive Gear Low while Main Drive Gear was engaged for 2 seconds.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Uncommanded Shift Rail B movement from Main Drive Gear Low toward neutral position while speed sensors continued to indicate a Main Drive Gear Low ratio.

FMI 17 – Data Valid but Below Normal (Least Severe): Uncommanded Shift Rail B movement from neutral position toward Splitter Gear while Main Drive Gear was engaged for 2 seconds.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Uncommanded Shift Rail B movement from Splitter Gear toward neutral position while speed sensors continued to indicate a Splitter Gear ratio.

FMI 20 – Data Drifted High: Rail B Position value indicated Main Drive Gear Low disengagement but speed sensors and torque continued to indicate a Main Drive Gear Low ratio for 2 seconds.

FMI 21 – Data Drifted Low: Rail B Position value indicated Splitter Gear disengagement but speed sensors and torque continued to indicate a Splitter Gear ratio for 2 seconds.

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FMI 31 – Condition Exists: Rail B Position value indicated Splitter Gear engagement position, but Rail A Position Sensor and speed sensors confirmed Main Drive Gear engagement for 1 second.

Fallback

FMI 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 20, 21, 31

- If Rail B position is known and Rail B is either fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail B movement prohibited
- If Rail B position is not known and Rail B is either not fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail B movement prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Non-Neutral Modes prohibited
  - PTO Mode prohibited
  - If vehicle is moving – Red stop lamp on

FMI 7

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 0, 1, 7, 10, 11, 14, 15, 16, 17, 18, 20, 21, 31: Key cycle and fault condition no longer exist.

FMI 2: Rail B Position duty cycle in range for 10 seconds.

FMI 3: Rail B Position Sensor circuit not shorted to power for 10 seconds.

FMI 4: Rail B Position Sensor circuit not shorted to ground for 10 seconds.

FMI 5: Rail B Position Sensor circuit not open for 10 seconds.

FMI 6: Rail B Position Sensor signal voltage between 4.75 and 5.25 volts for 10 seconds.

FMI 8: Rail B Position Sensor signal frequency in range for 10 seconds.

FMI 9: Shift Rail B magnet detected for 10 seconds.

FMI 12: Rail B Position Sensor circuit 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 7:

- MTM - Rail B
  - Valve Pack A
  - Valve Pack B
  - Rail B cylinder
  - Rail B yoke
  - Rail B detent
- Internal Transmission
  - Rail B sliding clutch
  - Main Shaft

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

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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 15, 16, 17, 18:

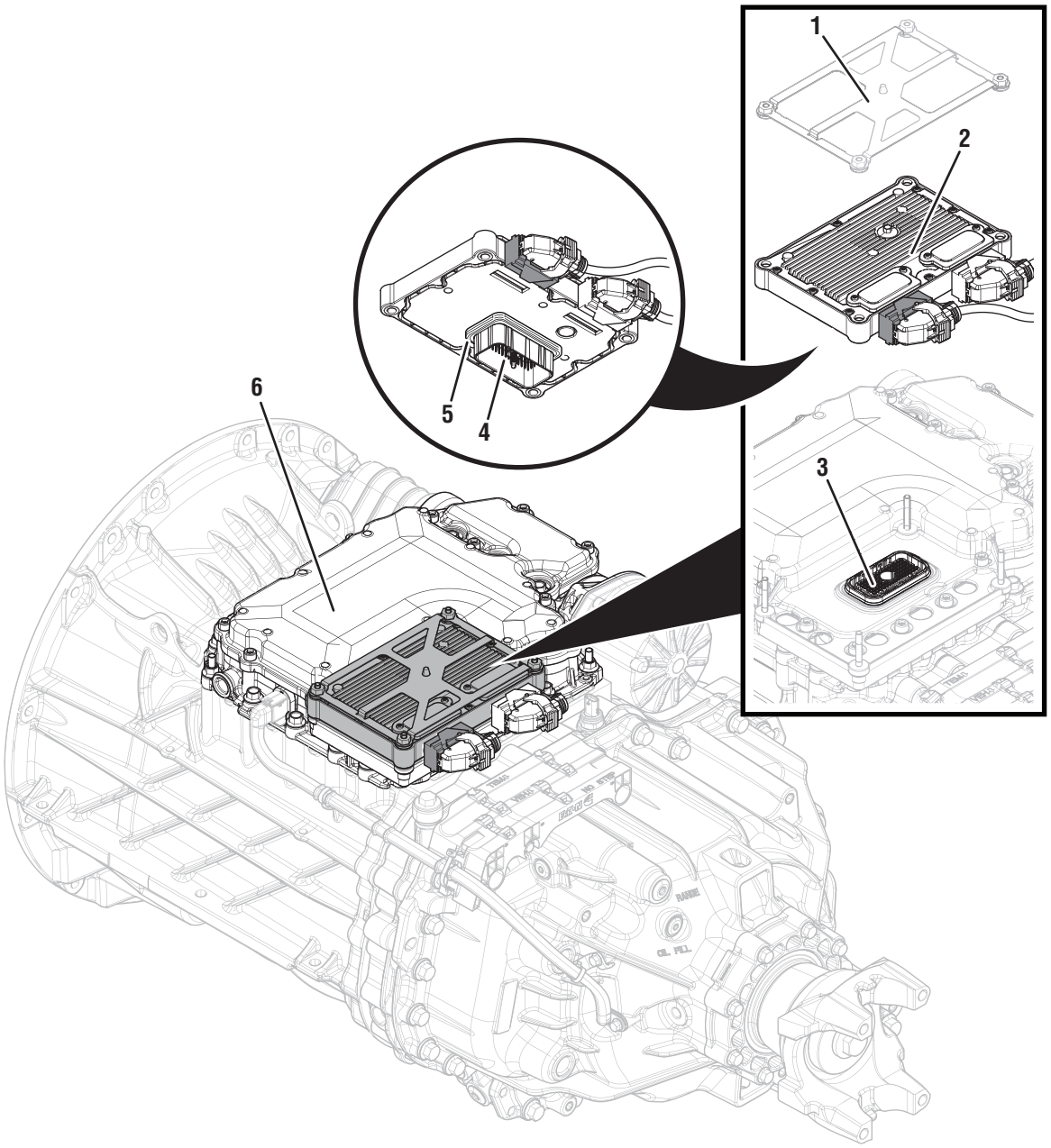
- MTM - Rail B Position Sensor
  - Internal failure
- MTM - Rail B Detent
  - Weak or broken spring
  - Worn shift rail or detent

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- Rail B Synchronizer Engagement Tool - RR1088TR

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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)

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Fault Code 275 Troubleshooting

A

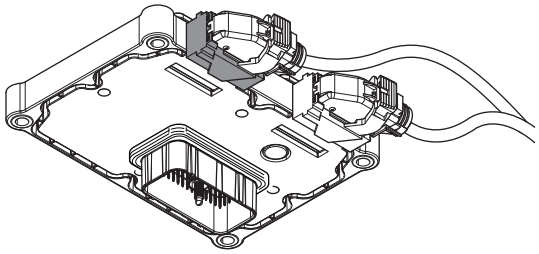
Purpose: *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 275 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 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, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B

Purpose: *Verify condition of TCM 74-Way 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.



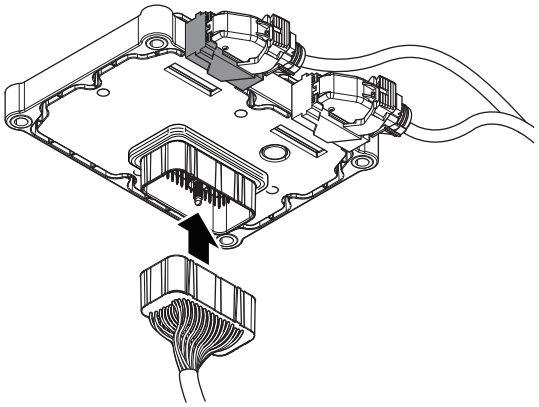
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and there is no damage.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

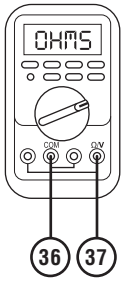
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C ***Purpose:*** *Verify Rail B Position Sensor internal resistance and power supply at TCM.*

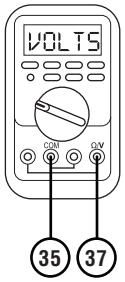
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Measure resistance at Eaton Breakout Box between Pin 36 and Pin 37. Record reading in table.



4. Key on.
5. Measure voltage at Eaton Breakout Box between Pin 35 and Pin 37. Record reading in table.



6. Compare reading(s) in table.
   - If readings are in range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

Ignition State	Pins	Range	Reading(s)
Key off	36 to 37	7.5k–22k Ohms	
Key on	35 to 37	4.75–5.25 V	

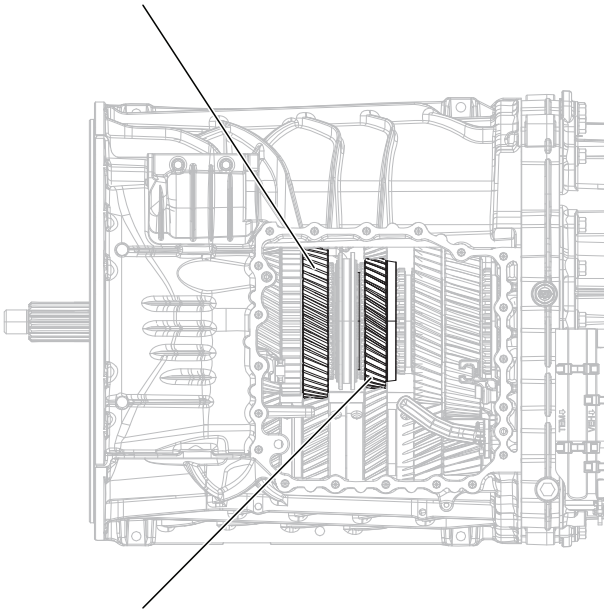
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D

Purpose: *Verify mechanical condition of Main Drive Gear Low and Splitter Gear.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Main Drive Gear Low for excessive fore and aft movement.

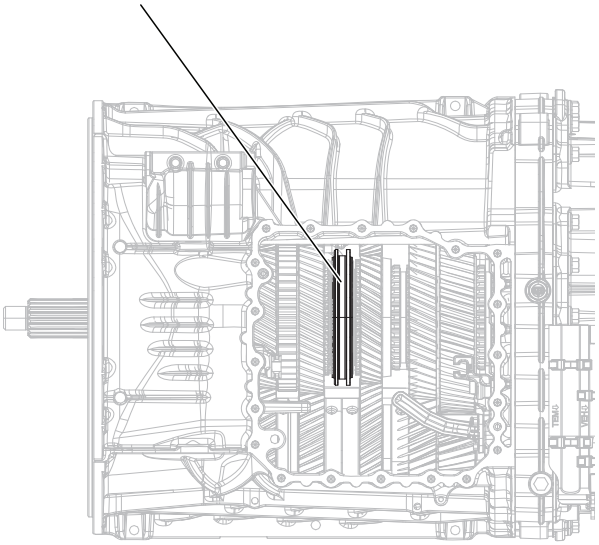


4. Inspect Splitter Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft assembly for cause of excessive movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step E.**

E

Purpose: *Verify mechanical condition of the Rail B Synchronizer.*

1. Inspect Rail B Synchronizer Sliding Sleeve yoke slot for wear.



2. Install Rail B Synchronizer Engagement Tool (RR1088TR).

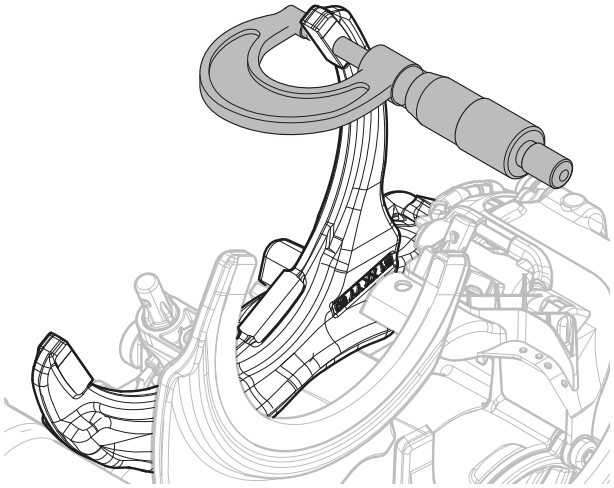
   Note: Reference *Manually Actuate Rail B Procedure* on page 691 of the Appendix.
3. Shift Rail B Synchronizer Sliding Sleeve into neutral (if necessary).
4. Shift Rail B Synchronizer Sliding Sleeve into Main Drive Gear Low engagement position (fore) and return to neutral.
5. Shift Rail B Synchronizer Sliding Sleeve into Splitter Gear engagement position (aft) and return to neutral.
   - If Rail B Synchronizer Sliding Sleeve shifts into all three positions, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail B Synchronizer Sliding Sleeve does not shift into all three positions, go to **Step F.**

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F

Purpose: *Verify mechanical condition of the Rail B Yoke.*

1. Measure Rail B Yoke wear pads with a micrometer. Record reading in table.



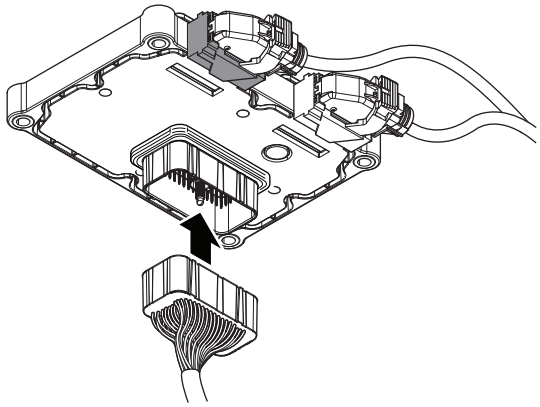
- If readings are in range, replace Rail B Synchronizer Assembly. Go to **Step V.**
- If readings are out of range, replace Rail B Synchronizer Assembly and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

Shift Yoke	Range	Reading(s)
Rail B Yoke Wear Pads	9.500–9.950 mm (0.374-0.392 in)	

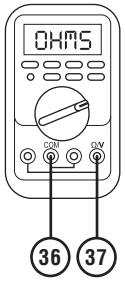
G

Purpose: *Verify Rail B Position Sensor internal resistance and power supply at TCM.*

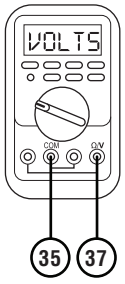
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Measure resistance at Eaton Breakout Box between Pin 36 and Pin 37. Record reading in table.



4. Key on.
5. Measure voltage at Eaton Breakout Box between Pin 35 and Pin 37. Record reading in table.



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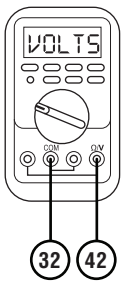
6. Compare reading(s) in table.
   - If readings are in range, go to **Step H.**
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

Ignition State	Pins	Range	Reading(s)
Key off	36 to 37	7.5k–22k Ohms	
Key on	35 to 37	4.75–5.25 V	

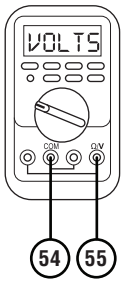
H

Purpose: *Verify Input and Countershaft speed sensor supply voltage at TCM.*

1. Key on.
2. Measure voltage at Eaton Breakout Box between Pin 32 and Pin 42. Record reading in table.



3. Measure voltage at Eaton Breakout Box between Pin 54 and Pin 55. Record reading in table.



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4. Compare reading(s) in table.
   - If readings are in range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (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	

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 275 sets Active, go to **Step A.**
   - If a fault code other than 275 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 XD Series transmissions are equipped with 5 shift rail position sensors and 5 magnets mounted shift rails A, B, C, D and E. The shift rail positions sensors monitor the position of the shift rail magnet and provide the information to the Transmission Control Module for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. Shift Rail C actuates the Rail C Sliding Clutch to engage the Splitter Gear or Driven Gear 2nd. 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 Shift Rail C position. 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): Shift Rail C movement beyond the calibrated Splitter Gear engagement position for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): Shift Rail C movement beyond the calibrated Driven Gear 2nd engagement position for 1 second.

FMI 2 – Data Erratic: Rail C Position duty cycle out of range for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail C Position Sensor circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail C Position Sensor circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail C Position Sensor circuit open for 1 second.

FMI 6 – Current Above Normal or Grounded Circuit: Rail C Position Sensor signal out of normal operating voltage (4.75V to 5.25V) for 1 second.

FMI 7 – Mechanical System Not Responding: Shift Rail C failed interlock function test. Uncommanded Shift Rail C movement from neutral position while Driven Gear 1st or Reverse Gear was engaged.

FMI 8 – Abnormal Frequency: Rail C Position Sensor signal frequency out of range for 1 second.

FMI 9 – Abnormal Update Rate: Rail C Position Sensor did not detect Shift Rail C magnet for 1 second.

FMI 10 – Abnormal Rate Of Change: Rail C Position value rate of change exceeded when no Shift Rail C movement commanded for 1 second.

FMI 12 – Bad Intelligent Device: Rail C Position Sensor circuit self-check failure for 1 second.

FMI 14 – Special Instructions: Rail C Position value indicated Driven Gear 2nd engagement position, but Rail D Position Sensor and speed sensors confirmed Driven Gear 1st or Reverse Gear engagement for 1 second.

FMI 15 - Data Valid but Above Normal (Least Severe): Uncommanded Shift Rail C movement from neutral position toward Splitter Gear while Driven Gear 1st or Reverse Gear was engaged for 2 seconds.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Uncommanded Shift Rail C movement from Splitter Gear toward neutral position while speed sensors continued to indicate a Splitter Gear ratio.

FMI 17 – Data Valid but Below Normal (Least Severe): Uncommanded Shift Rail C movement from neutral position toward Driven Gear 2nd while Driven Gear 1st or Reverse Gear was engaged for 2 seconds.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Uncommanded Shift Rail C movement from Driven Gear 2nd toward neutral position while speed sensors continued to indicate a Driven Gear 2nd ratio.

FMI 20 – Data Drifted High: Rail C Position value indicated Splitter Gear disengagement but speed sensors and torque continued to indicate a Splitter Gear ratio for 2 seconds.

FMI 21 – Data Drifted Low: Rail C Position value indicated Driven Gear 2nd disengagement but speed sensors and torque continued to indicate a Driven Gear 2nd ratio for 2 seconds.

FMI 31 – Condition Exists: Rail C Position value indicated Splitter Gear engagement position, but Rail D Position Sensor and speed sensors confirmed Driven Gear 1st or Reverse Gear engagement for 1 second.

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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 Rail C is either fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail C movement prohibited
- If Rail C position is not known and Rail C is either not fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail C movement prohibited
  - Inertia Brake activation prohibited
  - Non-Neutral modes prohibited
  - PTO Mode Prohibited
  - If vehicle is moving - Red stop lamp on

FMI 7

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 0, 1, 7, 10, 14, 15, 16, 17, 18, 20, 21, 31: Key cycle and fault condition no longer exist.

FMI 2: Rail C Position duty cycle in range for 10 seconds.

FMI 3: Rail C Position Sensor circuit not shorted to power for 10 seconds.

FMI 4: Rail C Position Sensor circuit not shorted to ground for 10 seconds.

FMI 5: Rail C Position Sensor circuit not open for 10 seconds.

FMI 6: Rail C Position Sensor signal voltage between 4.75 and 5.25 volts for 10 seconds.

FMI 8: Rail C Position Sensor signal frequency in range for 10 seconds.

FMI 9: Shift Rail C magnet detected for 10 seconds.

FMI 12: Rail C Position Sensor circuit 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

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FMI 10, 14, 20, 21, 31:

- MTM- Rail C Position Sensor
  - Internal failure

FMI 15, 16, 17, 18:

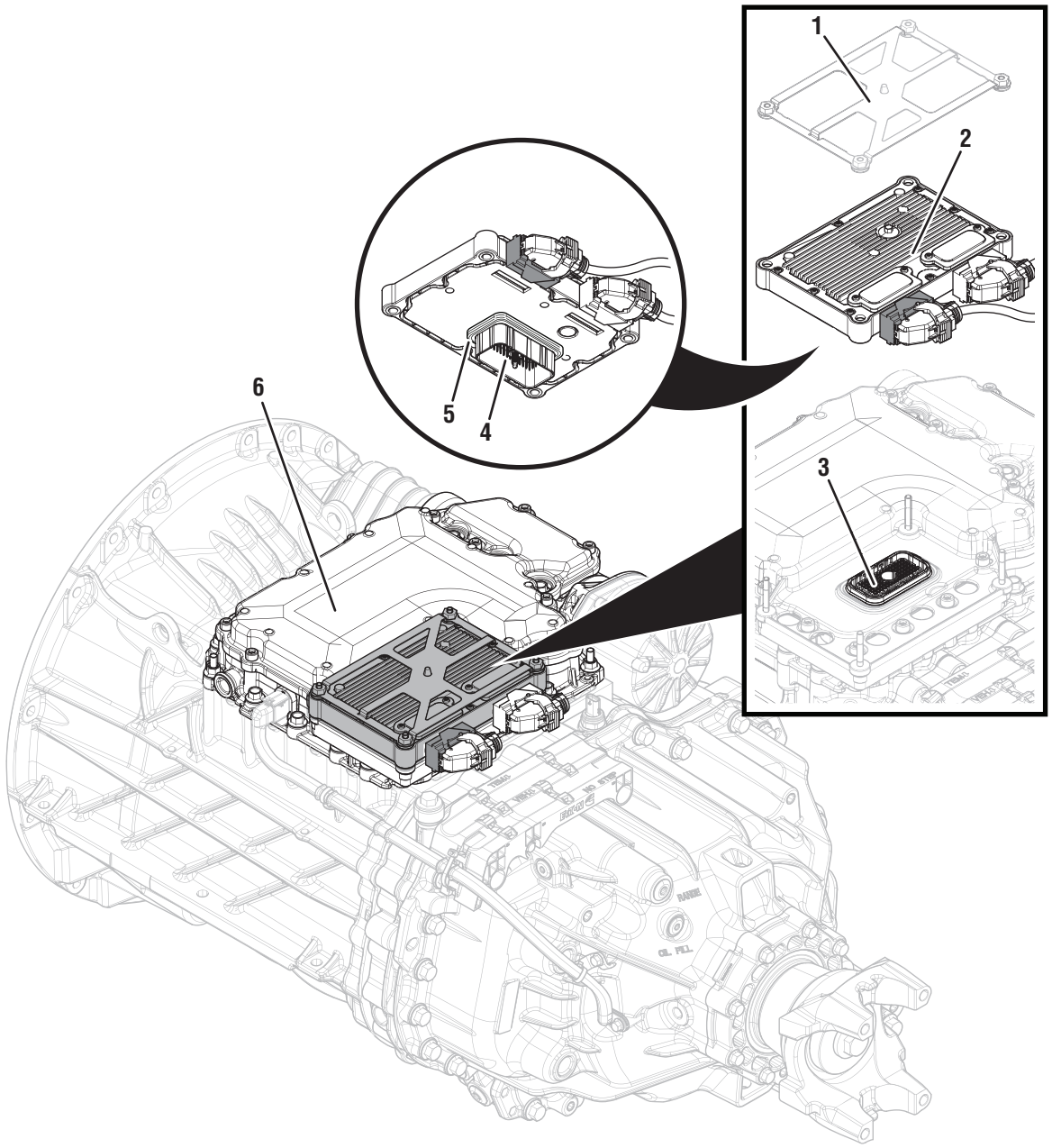
- MTM - Rail C Position Sensor
  - Internal failure
- MTM - Rail C Detent
  - Weak or broken spring
  - Worn shift rail or detent

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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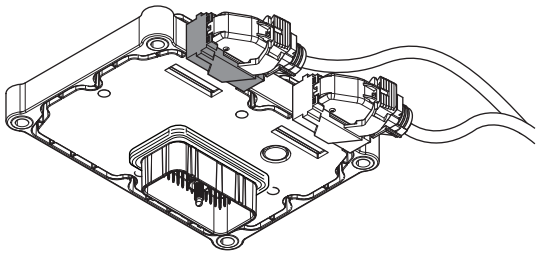
Fault Code 295 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 295 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 295 FMI 0, 1, 7 is Active or Inactive, go to **Step D.**
   - If Fault Code 295 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B ***Purpose:*** *Verify condition of TCM 74-Way 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.



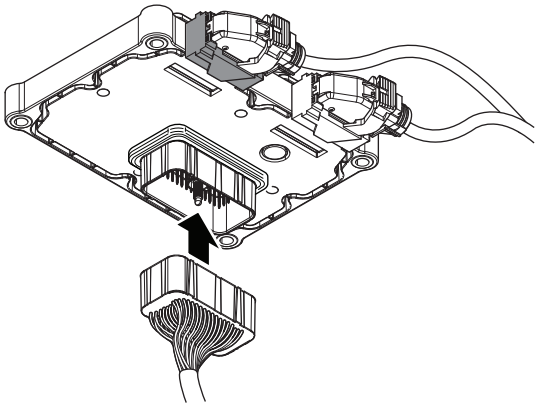
3. Inspect the TCM side of the 74-Way Transmission Harness Connector, verify the connector is free from any corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

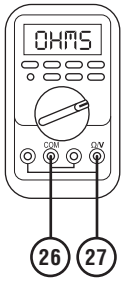
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C ***Purpose:*** *Verify Rail C Position Sensor internal resistance and power supply at TCM.*

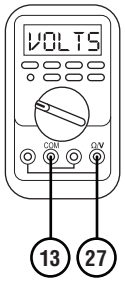
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Measure resistance at Eaton Breakout Box between Pin 26 and Pin 27. Record reading in table.



4. Key on.
5. Measure voltage at Eaton Breakout Box between Pin 13 and Pin 27. Record reading in table.



6. Compare reading(s) in table.
   - If readings are in range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

Ignition State	Pins	Range	Reading(s)
Key off	26 to 27	7.5k–22k Ohms	
Key on	13 to 27	4.75–5.25 V	

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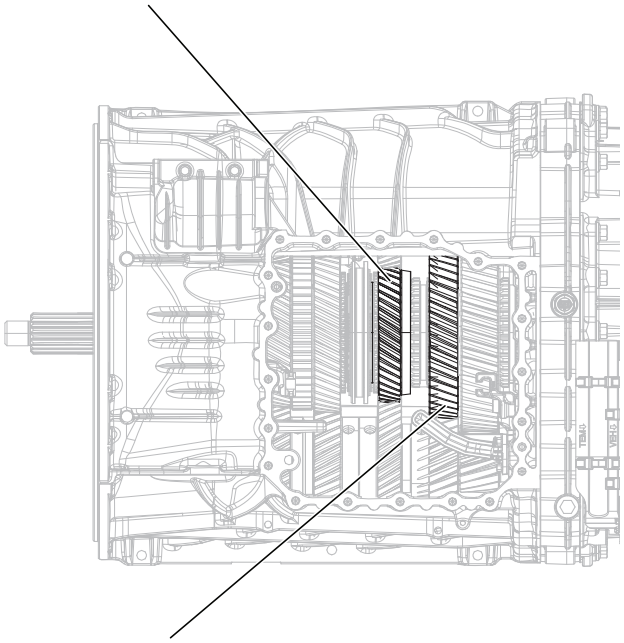
D

Purpose: *Verify mechanical condition of Splitter Gear and Driven Gear 2nd.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

3. Inspect Splitter Gear for excessive fore and aft movement.

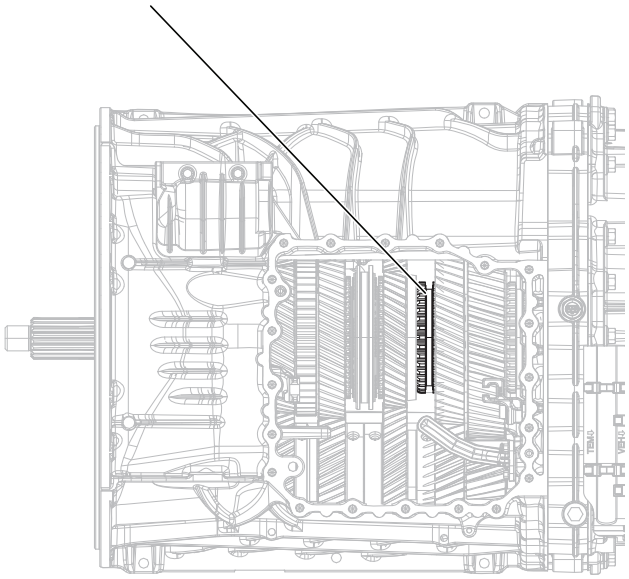


4. Inspect Driven Gear 2nd for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft for cause of excessive movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step E.**

E

Purpose: *Verify mechanical condition of the Rail C Sliding Clutch.*

1. Inspect Rail C Sliding Clutch yoke slot for wear.



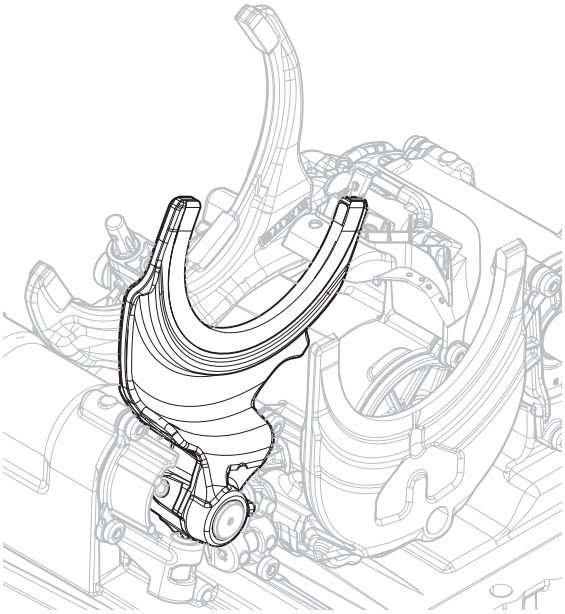
2. Shift Rail C Sliding Clutch into neutral position (if necessary).
3. Shift Rail C Sliding Clutch into Splitter Gear engagement position (fore) and return to neutral.
4. Shift Rail C Sliding Clutch into Driven Gear 2nd engagement position (aft) and return to neutral.
   - If Rail C Sliding Clutch shifts into all three positions, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail C Sliding Clutch does not shift into all three positions, go to **Step F.**

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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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 295 sets Active, go to **Step A.**
   - If a fault code other than 295 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 XD Series transmissions are equipped with 5 shift rail position sensors and 5 magnets mounted on shift rails A, B, C, D and E. The shift rail position sensors monitor the position of the shift rail magnet and provide the information to the Transmission Control Module for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. Shift Rail D actuates the Rail D Sliding Clutch to engage the Driven Gear 1st or Reverse Gear. The position sensors are located in the Mechatronic Transmission Module (MTM) and are connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors Shift Rail D position. 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): Shift Rail D movement beyond the calibrated Driven Gear 1st engagement position for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): Shift Rail D movement beyond the calibrated Reverse Gear engagement position for 1 second.

FMI 2 – Data Erratic: Rail D Position duty cycle out of range for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail D Position Sensor circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail D Position Sensor circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail D Position Sensor circuit open for 1 second.

FMI 6 – Current Above Normal or Grounded Circuit: Rail D Position Sensor circuit supply voltage out of normal operating range (4.75V to 5.25V) for 1 second.

FMI 7 – Mechanical System Not Responding: Shift Rail D failed interlock function test. Uncommanded Shift Rail D movement from neutral position while Splitter Gear or Driven Gear 2nd was engaged.

FMI 8 – Abnormal Frequency: Rail D Position Sensor signal frequency out of range for 1 second.

FMI 9 – Abnormal Update Rate: Rail D Position Sensor did not detect Shift Rail D magnet for 1 second.

FMI 10 – Abnormal Rate Of Change: Rail D Position value rate of change exceeded when no Shift Rail D movement commanded for 1 second.

FMI 12 – Bad Intelligent Device: Rail D Position Sensor circuit self-check failure for 1 second.

FMI 14 – Special Instructions: Rail D Position value indicated Reverse Gear engagement position, but Rail C Position Sensor and speed sensors confirmed Splitter Gear or Driven Gear 2nd engagement for 1 second.

FMI 15 - Data Valid but Above Normal (Least Severe): Uncommanded Shift Rail D movement from neutral position toward Driven Gear 1st while Splitter Gear or Driven Gear 2nd was engaged for 2 seconds.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Uncommanded Shift Rail D movement from Driven Gear 1st toward neutral position while speed sensors continued to indicate a Driven Gear 1st ratio.

FMI 17 – Data Valid but Below Normal (Least Severe): Uncommanded Shift Rail D movement from neutral position toward Reverse Gear while Splitter Gear or Driven Gear 2nd was engaged for 2 seconds.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Uncommanded Shift Rail D movement from Reverse Gear toward neutral position while speed sensors continued to indicate a Reverse Gear ratio.

FMI 20 – Data Drifted High: Rail D Position value indicated Driven Gear 1st disengagement but speed sensors and torque continued to indicate a Driven Gear 1st ratio for 2 seconds.

FMI 21 – Data Drifted Low: Rail D Position value indicated Reverse Gear disengagement but speed sensors and torque continued to indicate a Reverse Gear ratio for 2 seconds.

FMI 31 – Condition Exists: Rail D Position value indicated Driven Gear 1st engagement position, but Rail C Position Sensor and speed sensors confirmed Splitter Gear or Driven Gear 2nd engagement for 1 second.

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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 Rail D is either fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail D movement prohibited
- If Rail D position is not known and Rail D is either not fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail D movement prohibited
  - Inertia Brake activation prohibited
  - Non-Neutral modes prohibited
  - PTO Mode Prohibited
  - If vehicle is moving - Red stop lamp on

FMI 7

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 0, 1, 7, 14, 15, 16, 17, 18, 20, 21, 31: Key cycle and fault condition no longer exist.

FMI 2: Rail D Position duty cycle in range for 10 seconds.

FMI 3: Rail D Position Sensor circuit not shorted to power for 10 seconds.

FMI 4: Rail D Position Sensor circuit not shorted to ground for 10 seconds.

FMI 5: Rail D Position Sensor circuit not open for 10 seconds.

FMI 6: Rail D Position Sensor signal voltage between 4.75 and 5.25 volts for 10 seconds.

FMI 8: Rail D Position Sensor signal frequency in range for 10 seconds.

FMI 9: Shift Rail D magnet detected for 10 seconds.

FMI 12: Rail D Position Sensor circuit 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 C
  - Valve Pack D
  - 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

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FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 15, 16, 17, 18:

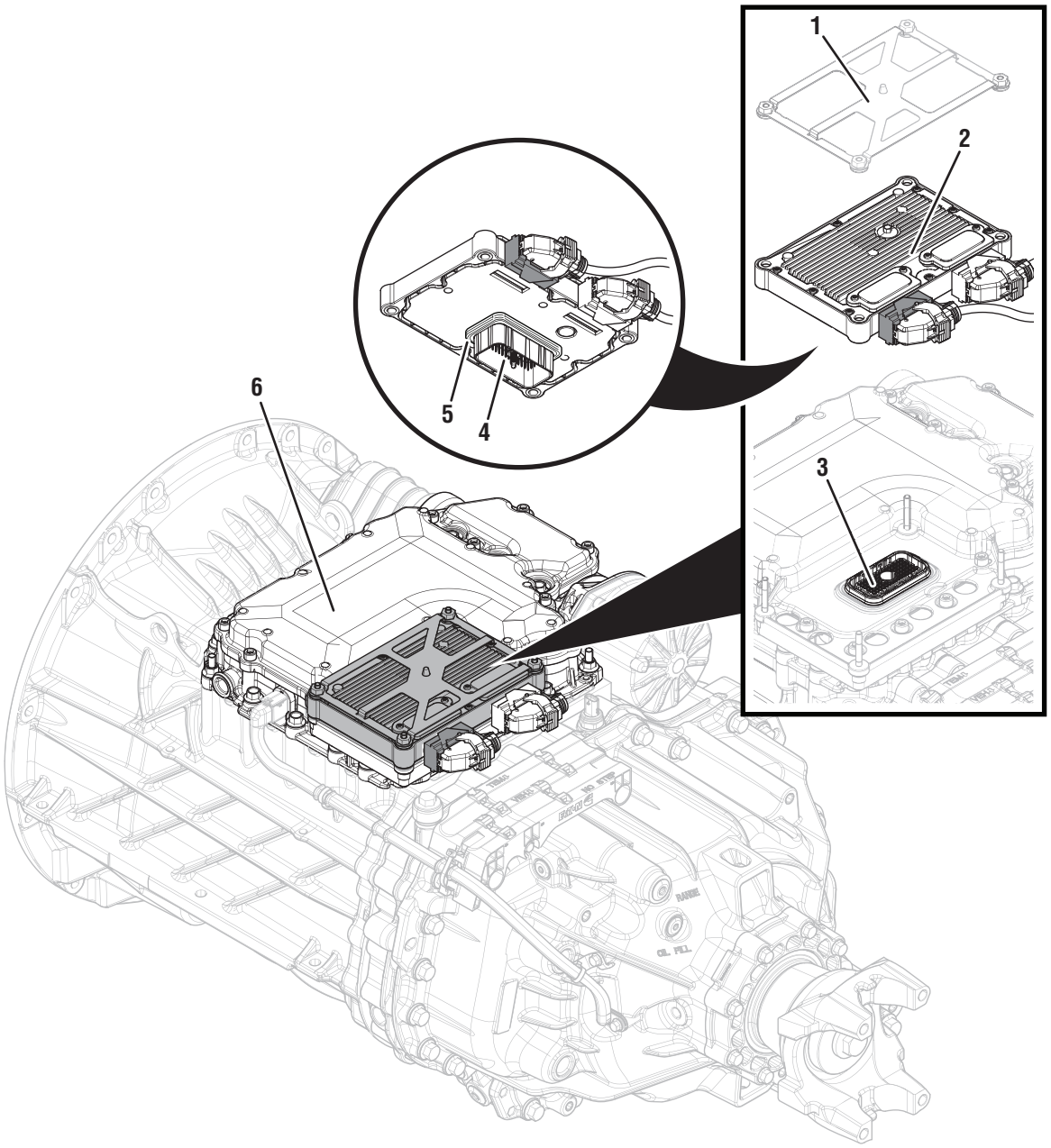
- MTM - Rail D Position Sensor
  - Internal failure
- MTM - Rail D Detent
  - Weak or broken spring
  - Worn shift rail or detent

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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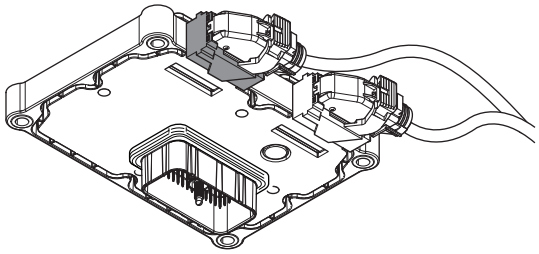
Fault Code 315 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B ***Purpose:*** *Verify condition of TCM 74-Way 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.



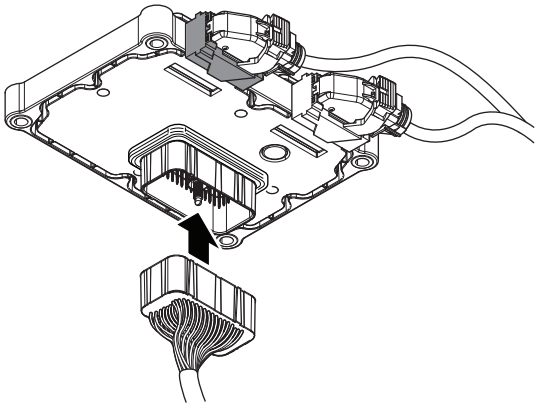
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

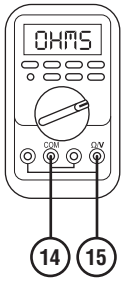
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C ***Purpose:*** *Verify Rail D Position Sensor internal resistance and power supply at TCM.*

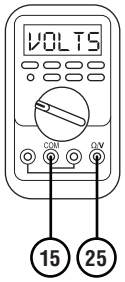
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Measure resistance at Eaton Breakout Box between Pin 14 and Pin 15. Record reading in table.



4. Key on.
5. Measure voltage at Eaton Breakout Box between Pin 15 and Pin 25. Record reading in table.



6. Compare reading(s) in table.
   - If readings are in range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

Ignition State	Pins	Range	Reading(s)
Key off	14 to 15	7.5k–22k Ohms	
Key on	15 to 25	4.75–5.25 V	

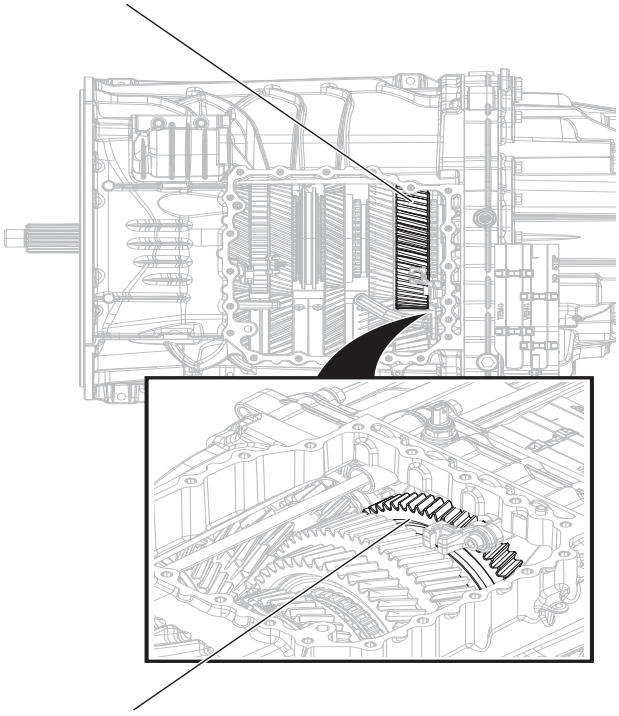
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D

Purpose: *Verify mechanical condition of Driven Gear 1st and Reverse Gear.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Driven Gear 1st for excessive fore and aft movement.

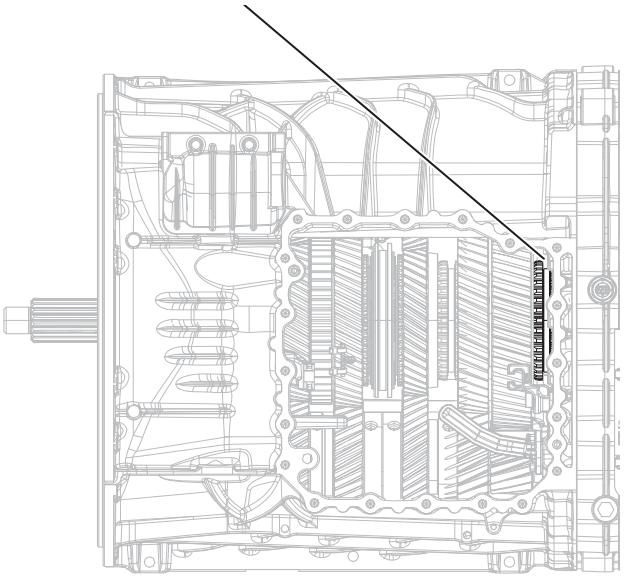


4. Inspect Reverse Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect the Main Shaft for cause of excessive movement and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step E.**

E

Purpose: *Verify mechanical condition of the Rail D Sliding Clutch.*

1. Inspect Rail D Sliding Clutch yoke slot for wear.



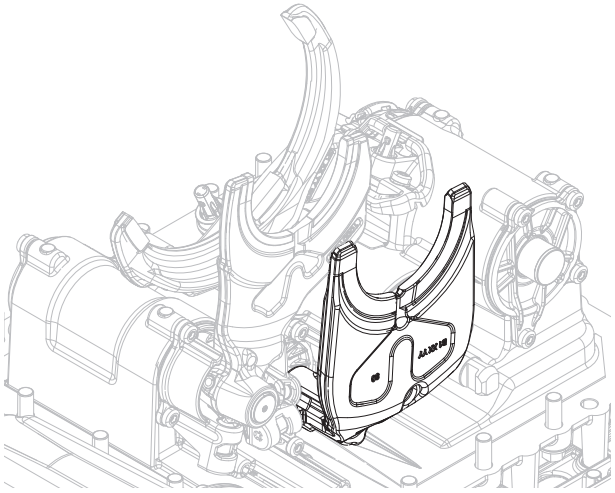
2. Shift Rail D Sliding Clutch into neutral position (if necessary).
3. Shift Rail D Sliding Clutch into Driven Gear 1st engagement position (fore) and return to neutral.
4. Shift Rail D Sliding Clutch into the Reverse Gear engagement position (aft) and return to neutral.
   - If Rail D Sliding Clutch shifts into all three positions, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail D Sliding Clutch does not shift into all three positions, go to **Step F.**

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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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 315 sets Active, go to **Step A.**
   - If a fault code other than 315 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 XD Series transmissions are equipped with 5 shift rail position sensors and 5 magnets mounted on shift rails A, B, C, D and E. The shift rail position sensors monitor the position of the shift rail magnet and provide the information to the Transmission Control Module for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. Shift Rail E actuates the Rail E Synchronizer to engage High and Low Range. The position sensors are located in the Mechatronic Transmission Module (MTM) and are connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors Shift Rail E position. 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): Shift Rail E movement beyond the calibrated High Range engagement position for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): Shift Rail E movement beyond the calibrated Low Range engagement position for 1 second.

FMI 2 – Data Erratic: Rail E Position duty cycle out of range for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail E Position Sensor circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail E Position Sensor circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail E Position Sensor circuit open for 1 second.

FMI 6 – Current Above Normal or Grounded Circuit: Rail E Position Sensor circuit supply voltage out of normal operating range (4.75V to 5.25V) for 1 second.

FMI 8 – Abnormal Frequency: Rail E Position Sensor signal frequency out of range for 1 second.

FMI 9 – Abnormal Update Rate: Rail E Position Sensor did not detect Shift Rail E magnet for 1 second.

FMI 10 – Abnormal Rate Of Change: Rail E Position value rate of change exceeded when no Shift Rail E movement commanded for 1 second.

FMI 12 – Bad Intelligent Device: Rail E Position Sensor circuit self-check failure for 1 second.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Uncommanded Shift Rail E movement from High Range toward neutral position while speed sensors continued to indicate a High Range gear ratio.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Uncommanded Shift Rail E movement from Low Range toward neutral position while speed sensors continued to indicate a Low Range gear ratio.

FMI 20 – Data Drifted High: Rail E Position value indicated High Range disengagement but speed sensors and torque continued to indicate a High Range gear ratio for 2 seconds.

FMI 21 – Data Drifted Low: Rail E Position Sensor indicated Low Range disengagement but speed sensors and torque continued to indicate a Low Range gear ratio for 2 seconds.

Fallback

FMI 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 16, 18, 20, 21

- If Rail E position is known and Rail E is either fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail E movement prohibited
- If Rail E position is not known and Rail E is either not fully engaged or disengaged:
  - Amber warning lamp on
  - Shift Rail E movement prohibited
  - Urge to Move and Creep Mode prohibited
  - Non-Neutral Modes prohibited
  - PTO mode prohibited
  - If vehicle is moving – Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 0, 1, 10, 16, 18, 20, 21: Key cycle and fault condition no longer exists.

FMI 2: Rail E Position duty cycle in range for 10 seconds.

FMI 3: Rail E Position Sensor circuit not shorted to power for 10 seconds.

FMI 4: Rail E Position Sensor circuit not shorted to ground for 10 seconds.

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FMI 5: Rail E Position Sensor circuit not open for 10 seconds.

FMI 6: Rail E Position Sensor signal voltage between 4.75 and 5.25 volts for 10 seconds.

FMI 8: Rail E Position Sensor signal frequency in range for 10 seconds.

FMI 9: Shift Rail E magnet detected for 10 seconds.

FMI 12: Rail E Position Sensor circuit 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 Installation
  - Rail E notch facing down
- 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:

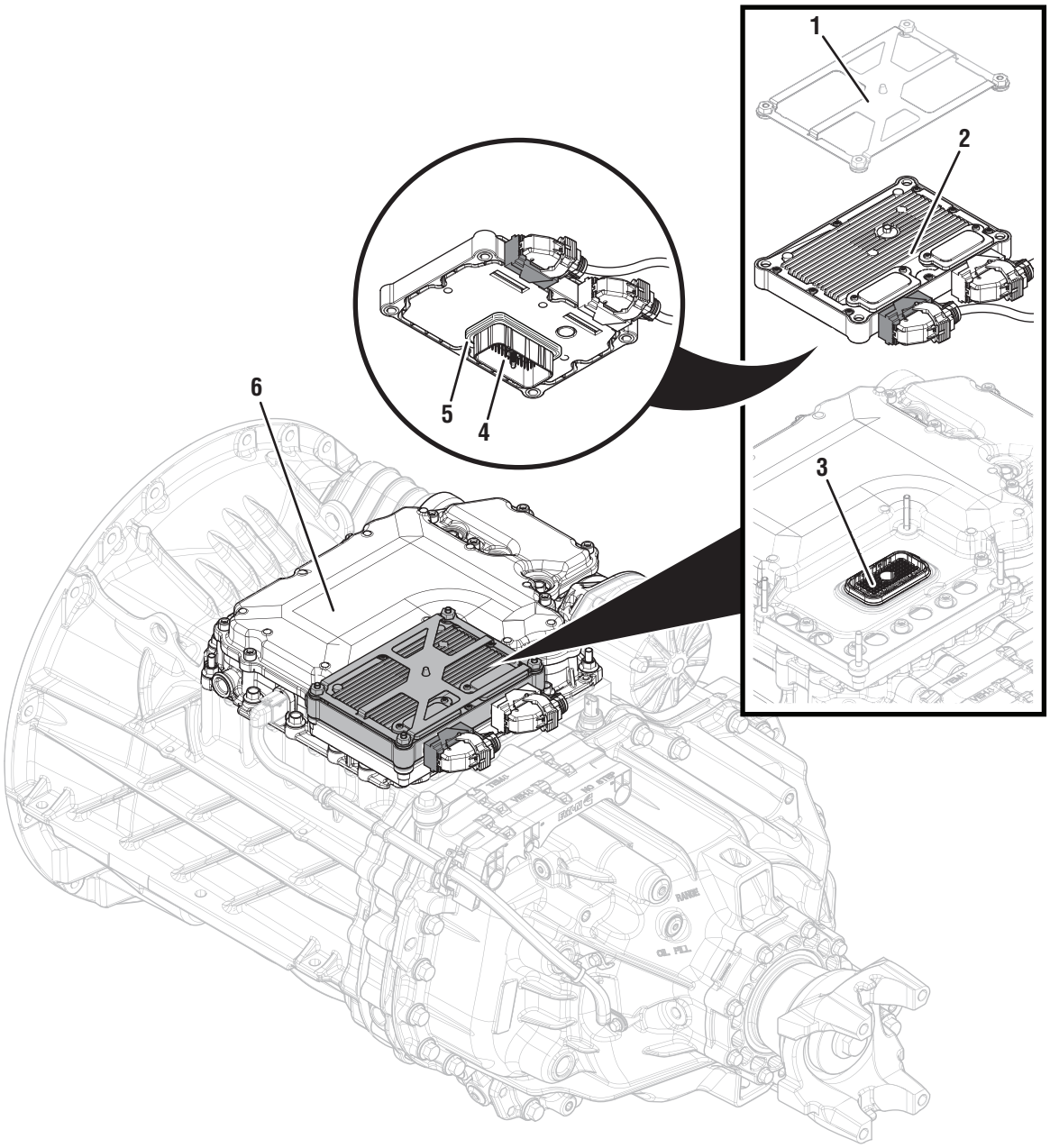
- MTM - Rail E Position Sensor
  - Internal failure
- Internal transmission
  - Rail E Detent
  - Rail E Shift Rail
  - Rail E Synchronizer

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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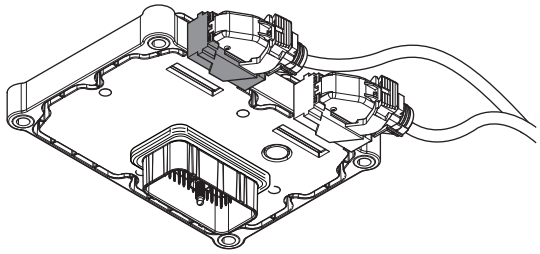
Fault Code 320 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 320 FMI 0, 1 is Active or Inactive, go to **Step D.**
   - If Fault Code 320 FMI 2, 3, 4, 5, 6, 8, 10, 16, 18, 20, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 320 FMI 9 is Active and MTM was recently replaced, go to **Step E.**
   - If Fault Code 320 FMI 9 is Active or Inactive and MTM was not recently replaced, go to **Step B.**
   - If Fault Code 320 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



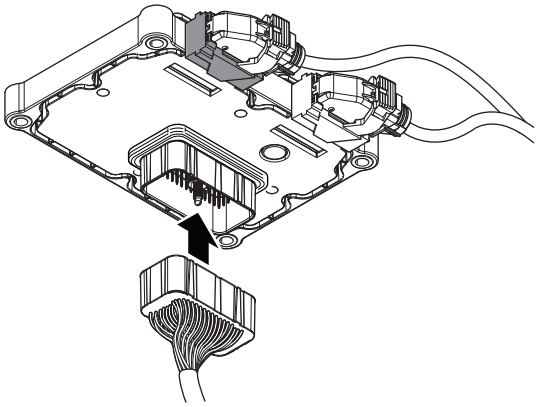
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

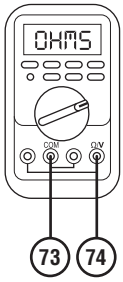
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C ***Purpose:*** *Verify Rail E Position Sensor internal resistance and power supply at TCM.*

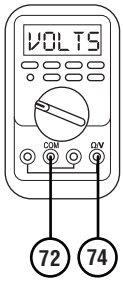
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Measure resistance at Eaton Breakout Box between Pin 73 and Pin 74. Record reading in table.



4. Key on.
5. Measure voltage at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (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	

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D

Purpose: *Verify mechanical movement of the Rail E Synchronizer.*

1. Key off.
2. Remove MTM.

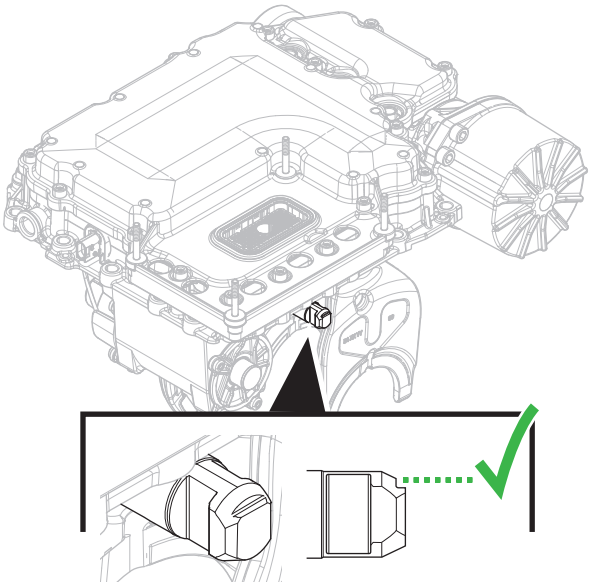
   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Install MTM Alignment Tool (RR1086TR-1) onto main housing.

   Note: Reference Appendix, Manually Actuate Rail E Procedure.
4. Using the Rail E Lever, move Rail E to neutral position (if necessary).
5. Shift Rail E into High Range engagement position (fore) and return to neutral position.
6. Shift Rail E into Low Range engagement position (aft) and return to neutral position.
   - Contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

E

Purpose: *Verify orientation of Rail E.*

1. Refer to Endurant XD Service Manual TRSM0960, Mechatronic Transmission Module (MTM) Service Procedure.
2. Verify notch on Rail E is facing up.



   - If MTM was installed with notch on Rail E facing down, refer Endurant XD Service Manual TRSM0960, Mechatronic Transmission Module (MTM) Service Procedure. Go to **Step V.**

     Note: If MTM is installed on the transmission with the notch on Rail E facing down, Fault Code 320 (SPN 5942) FMI 9 sets Active and the transmission will not shift out of neutral.
   - If MTM was installed with notch on Rail E facing up, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 320 sets Active, go to **Step A.**
   - If a fault code other than 320 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 messages from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). 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 Engine Speed messages. If messages are not received or are invalid, the TCM sets the fault code 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 modes

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

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Fault Code 345 Troubleshooting

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

1. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 345 sets Active, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 345 sets Active, go to *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 350: Input Speed

J1939: SA 3 SPN 161 FMI 2, 3, 4, 5, 6, 8, 9, 10, 14, 20, 21

Overview

The Endurant XD Series transmissions are equipped with speed sensors to monitor: Input, Countershaft and Output speeds. The speed sensors provide rotational speed inputs to the Transmission Control Module (TCM) for the purpose of verifying clutch engagement, making shift decisions, and confirming gear engagements. The Input Speed Sensor measures the rotational speed of the Input Shaft. The Input and Countershaft speed sensors are located in the Mechatronic Transmission Module (MTM) and are connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the Input Speed Sensor 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 signal out of range for 5 seconds.

FMI 3 – Voltage Above Normal or Shorted High: Input Speed Sensor circuit shorted to power 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 Shorted Circuit: Input Speed Sensor circuit supply voltage out of normal operating range (4.75V to 5.25V) for 5 seconds.

FMI 8 – Abnormal Frequency: Input Speed Sensor signal frequency out of range for 5 seconds.

FMI 9 – Abnormal Update Rate: Input Speed Sensor speed direction unknown for 5 seconds.

FMI 10 – Abnormal Rate of Change: Input Speed Sensor signal rate of change exceeded for 2 seconds.

FMI 14 – Special Instructions: Input Speed value out of range (near 0 RPM) when compared to calculated input speeds based on known Engine, Countershaft, and Output speeds and gear ratio, for 5 seconds.

FMI 20 – Data Drifted High: Input Speed value greater than expected when compared to calculated input speeds based on known Engine, Countershaft, and Output speeds and gear ratio, for 2 seconds.

FMI 21 – Data Drifted Low: Input Speed value less than expected when compared to calculated input speeds based on known Engine, Countershaft, and Output speeds and gear ratio, for 2 seconds.

Fallback

All FMIs

- Amber warning lamp on
- If vehicle is moving - Red stop lamp on
- If Fault Codes 350 and 370 are both Active and transmission is in gear:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO Mode prohibited
- If Fault Codes 350 and 370 are both Active and transmission is not in gear:
  - 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: Input Speed Sensor signal in range for 10 seconds.

FMI 3: Input Speed Sensor circuit not shorted to power for 10 seconds.

FMI 4: Input Speed Sensor circuit not shorted to ground for 10 seconds.

FMI 5: Input Speed Sensor circuit not open or shorted to power for 10 seconds.

FMI 6: Input Speed Sensor circuit supply voltage between 4.75V and 5.25V for 10 seconds.

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FMI 8: Input Speed Sensor signal frequency in range for 10 seconds.

FMI 9: Input Speed Sensor speed direction known for 10 seconds.

FMI 10: Input Speed Sensor signal rate of change in range for 10 seconds.

FMI 14, 20, 21: Input Speed Sensor signal matches calculated input speeds for 10 seconds.

Possible Causes

FMI 2, 14, 20, 21:

- MTM - Input Speed Sensor
  - Internal failure
  - Damaged
- Internal Transmission
  - Mechanical failure
- TCM
  - Software issue
  - Internal failure

FMI 3:

- TCM
  - Internal failure

FMI 4, 5, 6, 8, 9, 10:

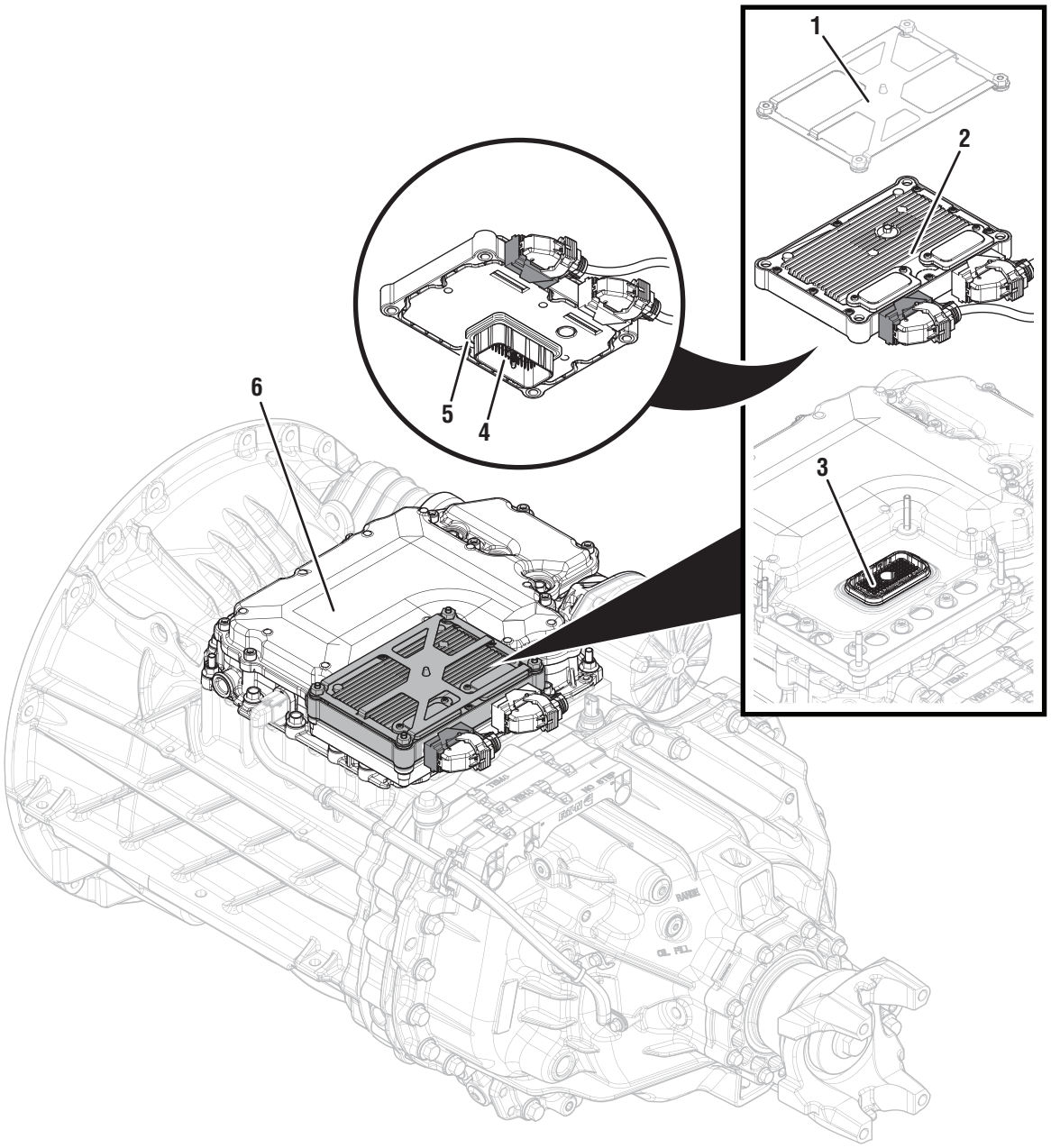
- MTM - Input Speed Sensor
  - Internal failure
  - Damaged
- MTM - Input Shaft Speed Sensor Harness
  - Wiring shorted to power, shorted to ground or open
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter
- Digital Volt/Ohm Meter (DVOM)

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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)

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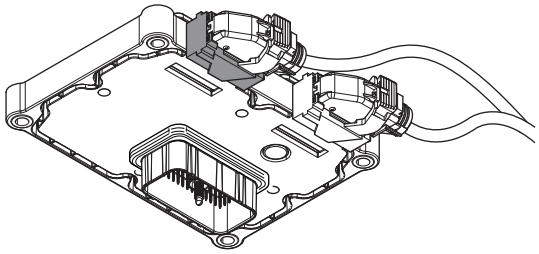
Fault Code 350 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 350 FMI 3 is Active or Inactive, go to **Step G.**
   - If Fault Code 350 FMI 4, 5, 6, 8, 9, 10 is Active or Inactive, go to **Step B.**
   - If Fault Code 350 FMI 2, 14, 20, 21 is Active or Inactive, go to **Step D.**

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



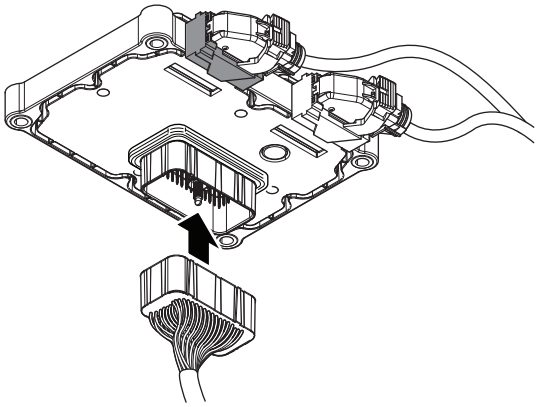
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

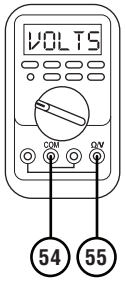
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C ***Purpose:*** *Verify Input Speed Sensor power supply at TCM.*

1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Key on.
4. Measure voltage at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

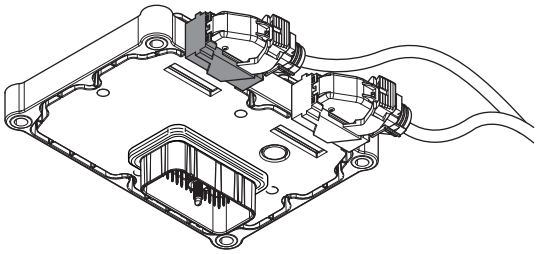
Ignition State	Pins	Range	Reading(s)
Key on	54 to 55	4.75–5.25 V	

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D

Purpose: *Verify condition of TCM 74-Way Connector.*

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



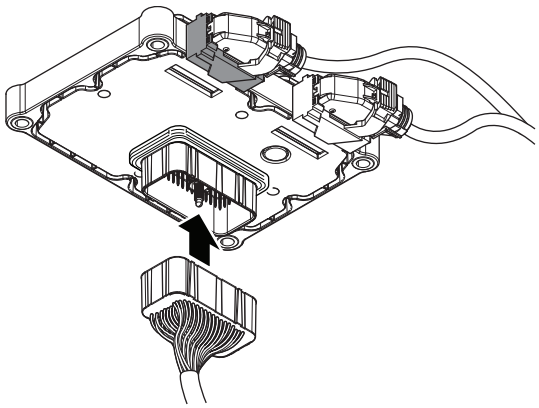
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step E.**

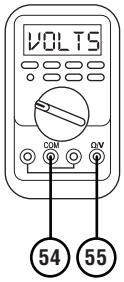
E

Purpose: *Verify Input Speed Sensor power supply at TCM.*

1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Key on.
4. Measure voltage at 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 **Transmission Control Module (TCM)**. Go to **Step V.**

Ignition State	Pins	Range	Reading(s)
Key on	54 to 55	4.75–5.25 V	

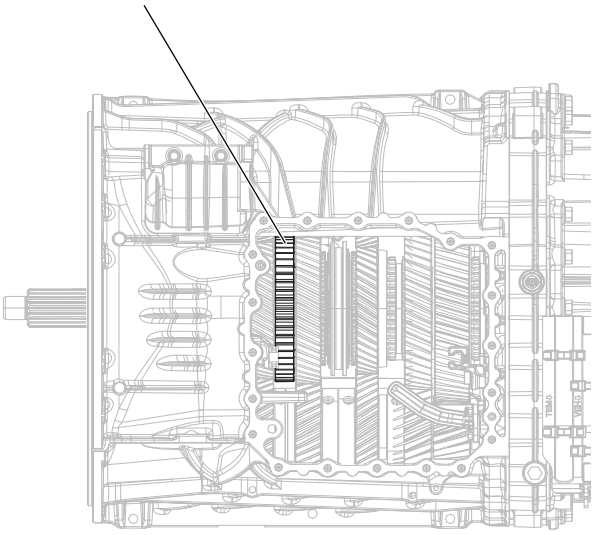
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F

Purpose: *Verify mechanical condition of the PTO Drive Gear.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect the PTO Drive Gear for missing teeth and excessive movement.



- If no missing teeth or no excessive movement evident, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. 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.**

G

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

1. Confirm a Service Activity Report was downloaded and sent to Eaton.
2. Retrieve and record the transmission fault codes and FMI's, and their occurrences and timestamps.
   - If Fault Code 350 FMI 3 is Active or Inactive, replace **Transmission Control Module (TCM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 350 sets Active, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 350 sets Active, go to *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 370: Countershaft Speed

J1939: SA 3 SPN 160 FMI 2, 3, 4, 5, 6, 8, 9, 10, 14, 20, 21

Overview

The Endurant XD Series transmissions are equipped with speed sensors to monitor Input, Countershaft and Output speeds. The speed sensors provide rotational speed inputs to the Transmission Control Module (TCM) for the purpose of verifying clutch engagement, making shift decisions, and confirming gear engagements. The Countershaft Speed Sensor measures the rotational speed of the Countershaft. The Input and Countershaft speed sensors are located in the Mechatronic Transmission Module (MTM) and are connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the Countershaft Speed Sensor 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 signal out of range for 5 seconds.

FMI 3 – Voltage Above Normal or Shorted High: Countershaft Speed Sensor circuit shorted to power 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 Shorted Circuit: Countershaft Speed Sensor circuit supply voltage out of normal operating range (4.75V to 5.25V) for 5 seconds.

FMI 8 – Abnormal Frequency: Countershaft Speed Sensor signal frequency out of range for 5 seconds.

FMI 9 – Abnormal Update Rate: Countershaft Speed Sensor speed direction unknown for 5 seconds.

FMI 10 – Abnormal Rate of Change: Countershaft Speed Sensor signal rate of change exceeded for 2 seconds.

FMI 14 – Special Instructions: Countershaft Speed value out of range (near 0 RPM) when compared to calculated countershaft speeds based on known Input speed, Output speed and gear ratio, for 5 seconds.

FMI 20 – Data Drifted High: Countershaft Speed value greater than expected when compared to calculated countershaft speeds based on known Input speed, Output speed and gear ratio, for 2 seconds.

FMI 21 – Data Drifted Low: Countershaft Speed value less than expected when compared to calculated countershaft speeds based on known Input speed, Output speed and gear ratio, for 2 seconds.

Fallback

FMI 2, 3, 4, 5, 6, 8, 9, 10, 14, 20, 21:

- Amber warning lamp on
- Inertia Brake activation prohibited
- If Fault Codes 350 and 375 are both Active and vehicle is moving
  - Red stop lamp on
  - 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: Countershaft Speed Sensor signal in range for 10 seconds.

FMI 3: Countershaft Speed Sensor circuit not shorted to power for 10 seconds.

FMI 4: Countershaft Speed Sensor circuit not shorted to ground for 10 seconds.

FMI 5: Countershaft Speed Sensor circuit not open or shorted to power for 10 seconds.

FMI 6: Countershaft Speed Sensor circuit supply voltage between 4.75V and 5.25V for 10 seconds.

FMI 8: Countershaft Speed Sensor signal frequency in range for 10 seconds.

FMI 9: Countershaft Speed Sensor speed direction known for 10 seconds.

FMI 10: Countershaft Speed Sensor signal rate of change in range for 10 seconds.

FMI 14, 20, 21: Countershaft Speed Sensor signal matches calculated countershaft speeds for 10 seconds.

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Possible Causes

FMI 2, 14, 20, 21:

- MTM - Countershaft Speed Sensor
  - Internal failure
  - Damaged
- Internal Transmission
  - Mechanical failure
- TCM
  - Software issue
  - Internal failure

FMI 3:

- TCM
  - Internal failure

FMI 4, 5, 6, 8, 9, 10:

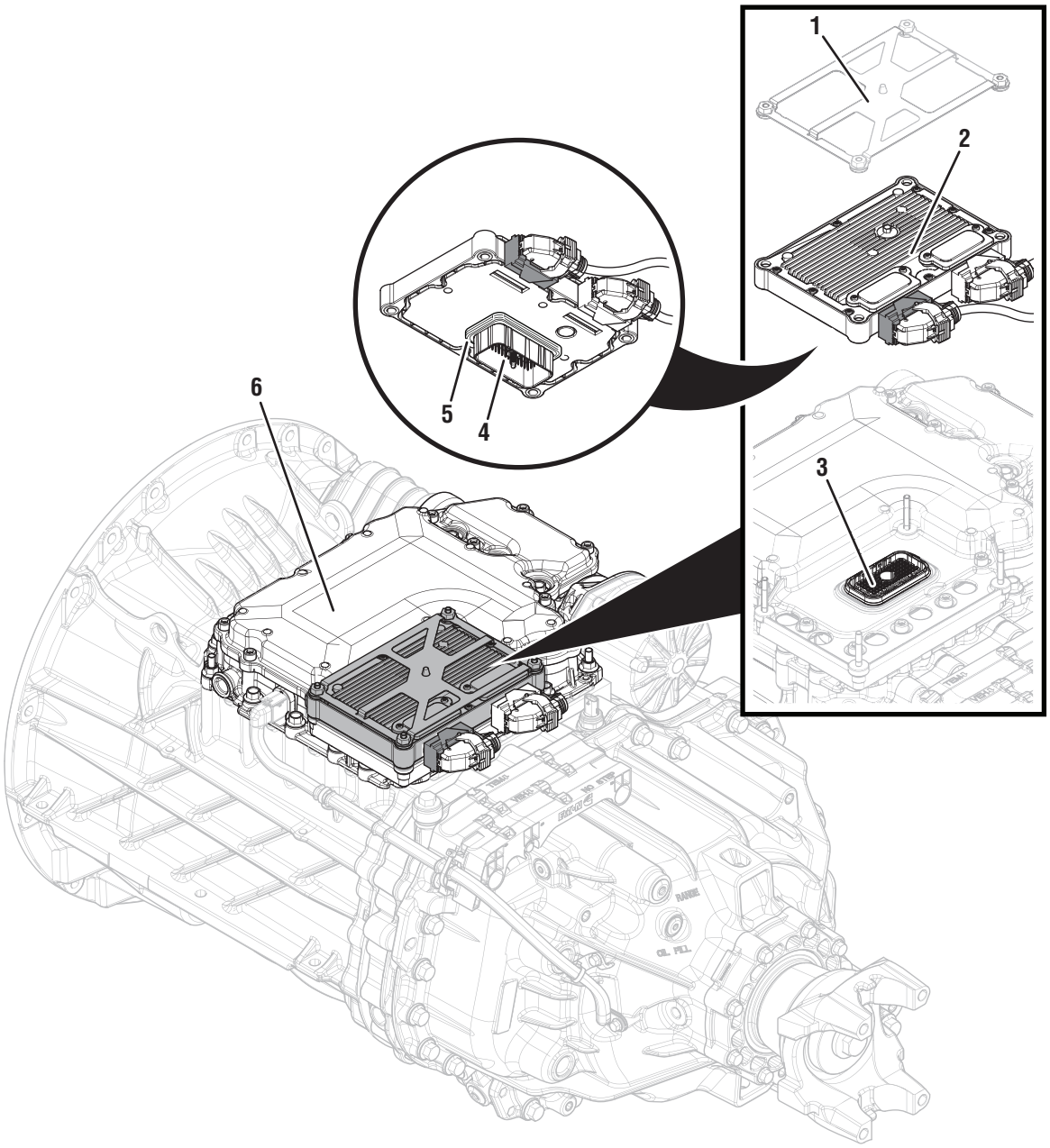
- MTM - Countershaft Speed Sensor
  - Internal failure
  - Damaged
- MTM - Countershaft Speed Sensor Harness
  - Wiring shorted to power, shorted to ground or open
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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Fault Code 370 Troubleshooting

A

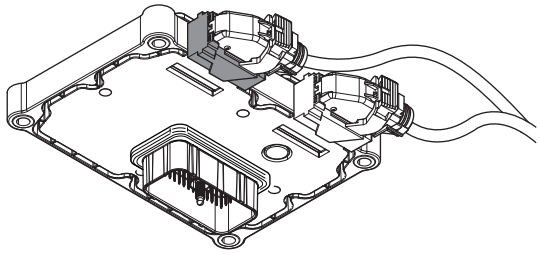
Purpose: *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 370 FMI 3 is Active or Inactive, go to **Step H.**
   - If Fault Code 370 FMI 4, 5, 6, 8, 9, 10 is Active or Inactive, go to **Step B.**
   - If Fault Code 370 FMI 2, 14, 20, 21 is Active or Inactive, go to **Step D.**

B

Purpose: *Verify condition of TCM 74-Way Connector.*

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



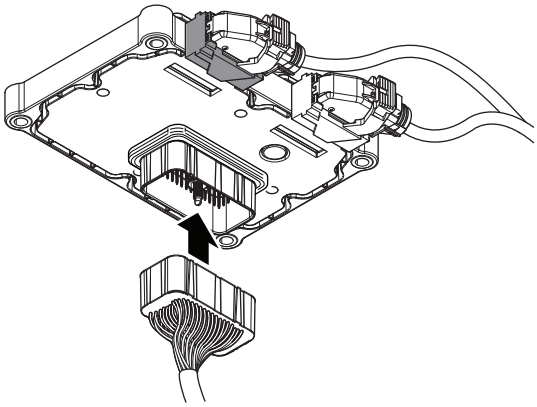
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

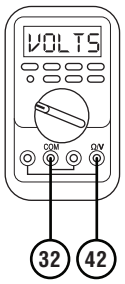
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C ***Purpose:*** *Verify Countershaft Speed Sensor power supply at TCM.*

1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Key on.
4. Measure voltage at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

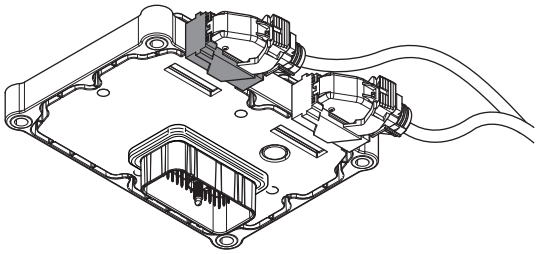
Ignition State	Pins	Range	Reading(s)
Key on	32 to 42	4.75–5.25 V	

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D

Purpose: *Verify condition of TCM 74-Way Connector.*

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



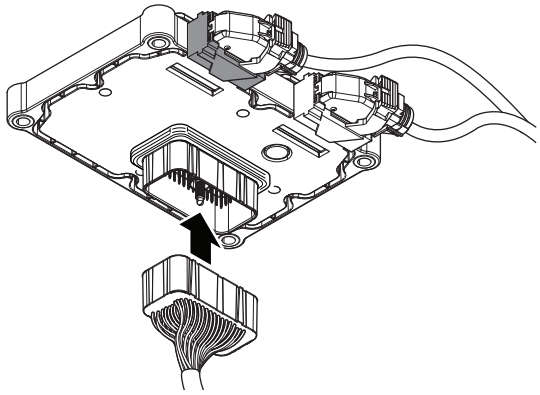
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step E.**

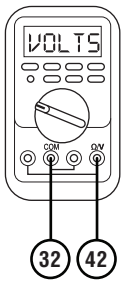
E

Purpose: *Verify Countershaft Speed Sensor power supply at TCM.*

1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Key on.
4. Measure voltage at 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 **Transmission Control Module (TCM)**. Go to **Step V.**

Ignition State	Pins	Range	Reading(s)
Key on	32 to 42	4.75–5.25 V	

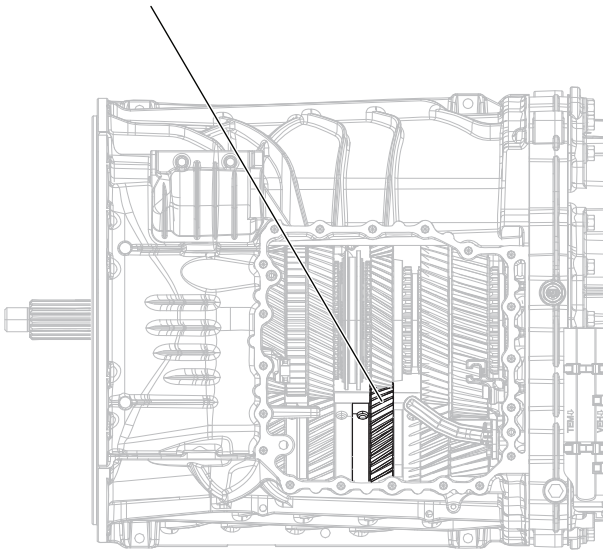
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F

Purpose: *Verify mechanical condition of the lower countershaft.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect the lower countershaft Splitter Driven Gear for missing teeth and excessive movement.

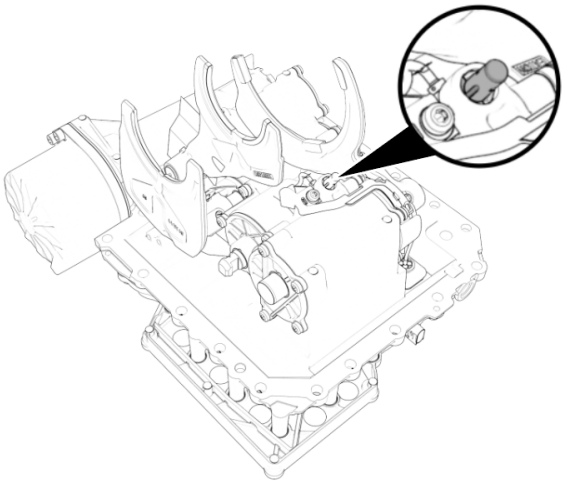


- If no missing teeth or no excessive movement evident, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
- If missing teeth and/or excessive movement evident, identify cause for missing teeth and/or excessive movement and repair. Go to **Step G.**

G

Purpose: *Verify condition of the Countershaft Speed Sensor.*

1. Inspect the Countershaft Speed Sensor in the MTM for damage.



- If no Countershaft Speed Sensor damage is evident, go to **Step V.**
- If Countershaft Speed Sensor damage is evident, Replace the **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

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H

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

1. Confirm a Service Activity Report was downloaded and sent to Eaton.
2. Retrieve and record the transmission fault codes and FMI's, and their occurrences and timestamps.
   - If Fault Code 370 FMI is Active or Inactive, replace **Transmission Control Module (TCM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 370 sets Active, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 370 sets Active, go to *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 375: Output Speed

J1939: SA 3 SPN 191 FMI 2, 3, 4, 5, 6, 8, 9, 10, 11, 14, 20, 21, 31

Overview

The Endurant XD Series transmissions are equipped with speed sensors to monitor Input, Countershaft, and Output speeds. The speed sensors provide rotational speed inputs to the Transmission Control Module (TCM) for the purpose of verifying clutch engagement, making shift decisions, and confirming gear engagements. The Output Speed Sensor measures the rotational speed and direction of the Planetary Output Shaft Assembly. The Output Speed Sensor is mounted externally on the rear of the transmission and connects to a 3-Way connector on the side of the Mechatronic Transmission Module (MTM). The 3-Way connector is connected to the Transmission Control Module (TCM) at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the Output Speed Sensor 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 signal out of range for 5 seconds.

FMI 3 – Voltage Above Normal or Shorted High: Output Speed Sensor circuit shorted to power 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 circuit supply voltage out of normal operating range (4.75V to 5.25V) for 5 seconds.

FMI 8 – Abnormal Frequency: Output Speed Sensor signal out of normal operating frequency for 5 seconds.

FMI 9 – Abnormal Update Rate: Output Speed Sensor signal frequency out of range for 5 seconds.

FMI 10 – Abnormal Rate of Change: Output Speed Sensor signal rate of change exceeded for 2 seconds.

FMI 11 – Root Cause Unknown: Output Speed value above 1 RPM when known countershaft and J1939 Front Axle speeds indicated 0 RPM for 5 seconds.

FMI 14 – Special Instructions: Output Speed value out of range (near 0 RPM) when compared to calculated output speeds based on known Input, Countershaft, and J1939 Front Axle speeds and gear ratio, for 5 seconds.

FMI 20 – Data Drifted High: Output Speed value greater than expected when compared to calculated output speeds based on known Input, Countershaft, and J1939 Front Axle speeds and gear ratio, for 2 seconds.

FMI 21 – Data Drifted Low: Output Speed value less than expected when compared to calculated output speeds based on known Input, Countershaft, and J1939 Front Axle speeds and gear ratio, for 2 seconds.

FMI 31 – Condition Exists: Output Speed value out of range (near 0 RPM) when compared to calculated output speeds based on known Input, Countershaft, and J1939 Front Axle speeds and gear ratio, for 2 seconds.

Fallback

All FMIs

- Amber warning lamp on
- If vehicle is moving - Red stop lamp on
- If Fault Code 375 and 170 are both Active and transmission is in gear:
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO Mode prohibited
- If Fault Code 375 and 170 are both Active and transmission is not in gear:
  - 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: Output Speed Sensor signal in range for 10 seconds.

FMI 3: Output Speed Sensor circuit not shorted to power for 10 seconds.

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FMI 4: Output Speed Sensor circuit not shorted to ground for 10 seconds.

FMI 5: Output Speed Sensor circuit not open or shorted to power for 10 seconds.

FMI 6: Output Speed Sensor circuit supply voltage between 4.75V and 5.25V for 10 seconds.

FMI 8: Output Speed Sensor signal frequency in range for 10 seconds.

FMI 9: Output Speed Sensor speed direction known for 10 seconds.

FMI 10: Output Speed Sensor signal rate of change in range for 10 seconds.

FMI 11, 14, 20, 21, 31: Output Speed Sensor signal matches calculated output speeds for 10 seconds.

Possible Causes

FMI 2, 11, 14, 20, 21, 31:

- MTM - Output Speed Sensor
  - Internal failure
  - Damaged
- Internal Transmission
  - Mechanical failure
- TCM
  - Software issue
  - Internal failure

FMI 3:

- TCM
  - Internal failure

FMI 4, 5, 6, 8, 9, 10:

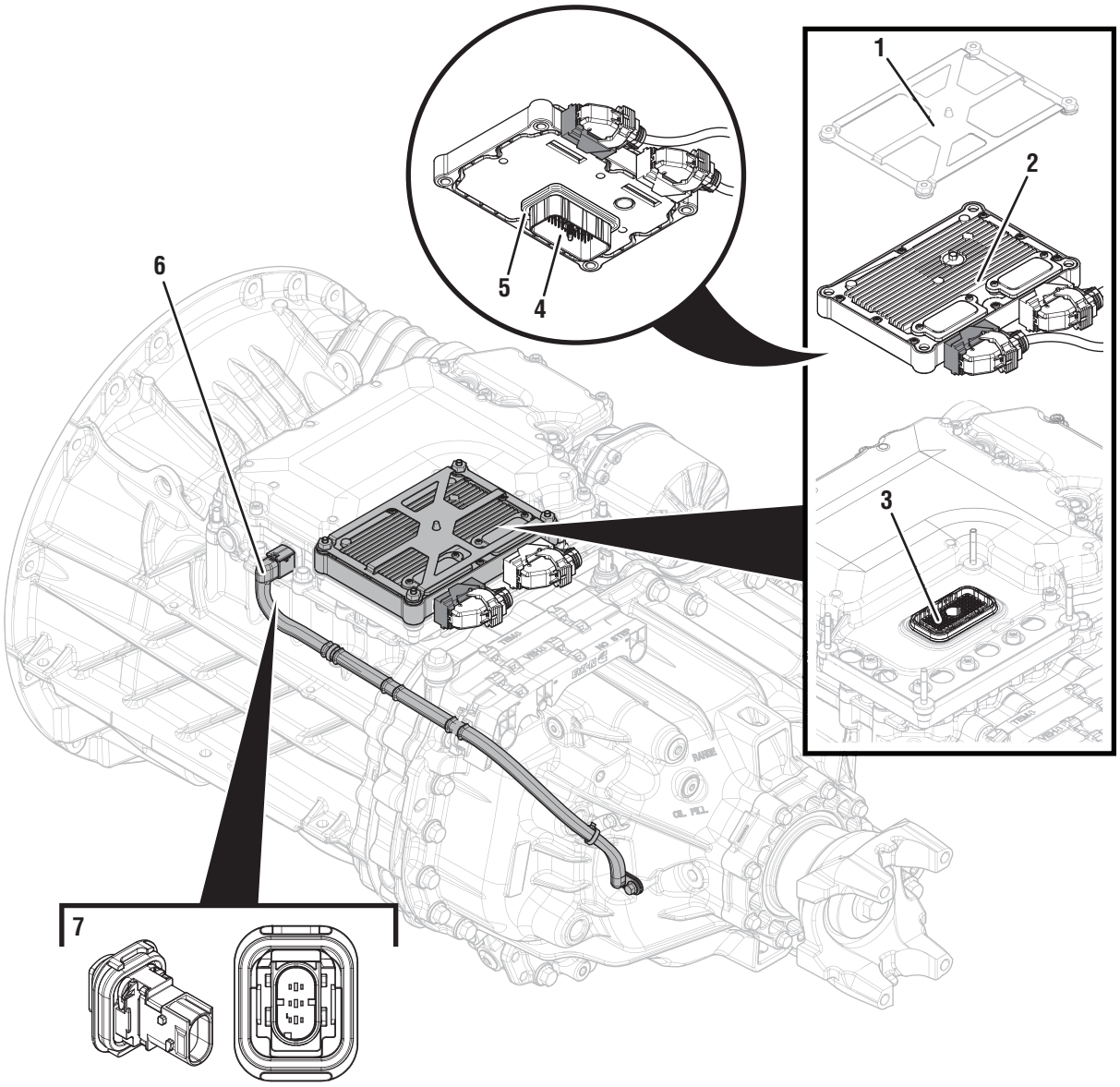
- Output Speed Sensor
  - Internal failure
  - Damaged
- Output Speed Sensor Harness
  - Wiring shorted to power, shorted to ground or open.
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960
- 3-Way Eaton Diagnostic Adapter - RR1060TR
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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

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Fault Code 375 Troubleshooting

A

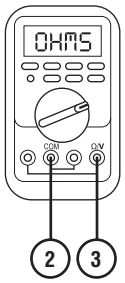
Purpose: *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 375 FMI 3 is Active or Inactive, go to **Step E.**
   - If Fault Code 375 FMI 2, 4, 5, 6, 8, 9, 10, 11, 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.**

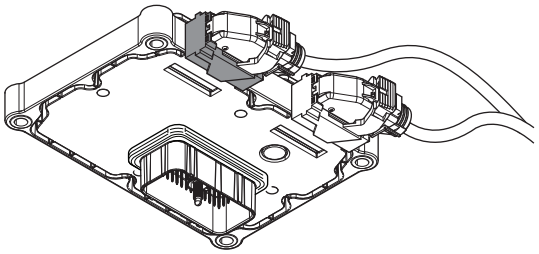
Ignition State	Pins	Range	Reading(s)
Key on	2 to 3	4.75–5.25 V	

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C

Purpose: *Verify condition of TCM 74-Way Connector.*

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



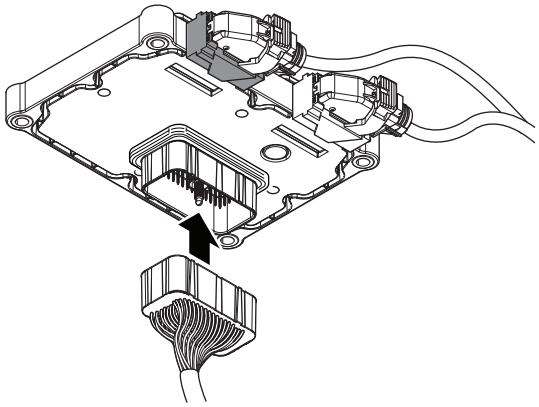
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step D.**

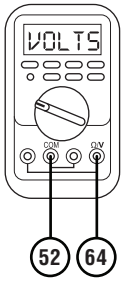
D

Purpose: *Verify Output Speed Sensor power supply at TCM.*

1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to TCM 74-Way Connector.



3. Key on.
4. Measure voltage at Eaton Breakout Box between Pin 52 and Pin 64. Record reading in table.



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5. Compare reading(s) in table.
   - If readings are in range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If readings are out of range, replace **Transmission Control Module (TCM)**. Go to **Step V.**

Ignition State	Pins	Range	Reading(s)
Key on	52 to 64	4.75–5.25 V	

E

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

1. Confirm a Service Activity Report was downloaded and sent to Eaton.
2. Retrieve and record the transmission fault codes and FMI's, and their occurrences and timestamps.
   - If Fault Code 375 FMI 3 is Active or Inactive, replace **Transmission Control Module (TCM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 375 sets Active, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 375 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 385: Grade Sensor

J1939: SA 3 SPN 583 FMI 2, 8, 10, 11, 12, 13, 14, 19, 20, 21, 31

Overview

The Endurant XD Series transmissions are equipped with a Grade Sensor to monitor the vehicle's incline position. The Grade Sensor is internal to the Transmission Control Module (TCM) and provides incline input information needed for the purpose of making launch and shift decisions. The Grade Sensor is critical for the Hill Start Aid feature.

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 range for 1 second.

FMI 8 – Abnormal Frequency: Grade Sensor signal out of range.

FMI 10 – Abnormal Rate of Change: No change in Grade Sensor value 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 for 1 second.

FMI 13 – Out of Calibration: Grade Sensor out of calibration.

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 2: Grade Sensor signal in range for 10 seconds

FMI 12: Grade Sensor circuit self-checks in range for 10 seconds.

FMI 13: Successful Grade Sensor calibration

FMI 8, 10, 11, 13, 14, 20, 21, 31: Key cycle and fault condition no longer exists.

Possible Causes

FMI 2, 8, 10, 11, 12, 13, 14, 19, 20, 21, 31:

- TCM
  - Internal failure
  - Software issue
  - Grade Sensor not calibrated

FMI 13:

- Calibration
  - Grade Sensor not calibrated

Additional Tools

- Endurant XD Service Manual TRSM0960

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Fault Code 385 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 385 FMI 13 is Active, go to **Step B.**
   - 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: *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 **Transmission Control Module (TCM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 385 sets Active, go to **Step A.**
   - If a fault code other than 385 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the Linear Clutch Actuator (LCA) to control clutch position. The clutch control system includes four solenoid valves – two for engagement (Vent) and two for disengagement (Fill).

The Clutch Engage Solenoid 1 (CES1) valve is energized by the Transmission Control Module (TCM) to exhaust Supply Air from the LCA, engaging the clutch. The CES1 valve 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 circuit. If a circuit or 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): CES1 Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: CES1 circuit shorted to power for 2 seconds after CES1 commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: CES1 circuit shorted to ground for 2 seconds after CES1 commanded off.

FMI 5 – Current Below Normal or Open Circuit: CES1 circuit open for 2 seconds after CES1 commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: CES1 circuit shorted to ground for 2 seconds after CES1 commanded on.

FMI 7 – Mechanical System Not Responding: Unable to achieve clutch disengagement while clutch control system is attempting to disengage clutch for 1 second.

FMI 8 – Abnormal Frequency: CES1 signal frequency out of range for 1 second.

FMI 10 – Abnormal Rate of Change: Clutch Release Solenoid commanded on longer than expected to maintain clutch disengagement for 10 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

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 longer than expected increasing solenoid temperature.

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

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FMI 7, 10:

- If the transmission is in gear:
  - Amber warning lamp on
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO Mode prohibited
  - Raised shift points
- If transmission is not in gear:
  - Red stop lamp on
  - 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 0, 1, 6, 7, 8, 10, 12, 16, 18: Key cycle and fault condition no longer exists.

FMI 3: CES1 circuit not shorted to power for 10 seconds.

FMI 4: CES1 circuit not shorted to ground for 10 seconds.

FMI 5: CES1 circuit not open 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:

- 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
- TCM
  - Software issue

FMI 10:

- MTM – Clutch Engage Solenoid 1 and/or 2
  - Stuck open
  - Air leak
- TCM
  - Software issue
- LCA
  - Internal failure

FMI 12:

- TCM
  - Software issue
  - Internal failure

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FMI 16

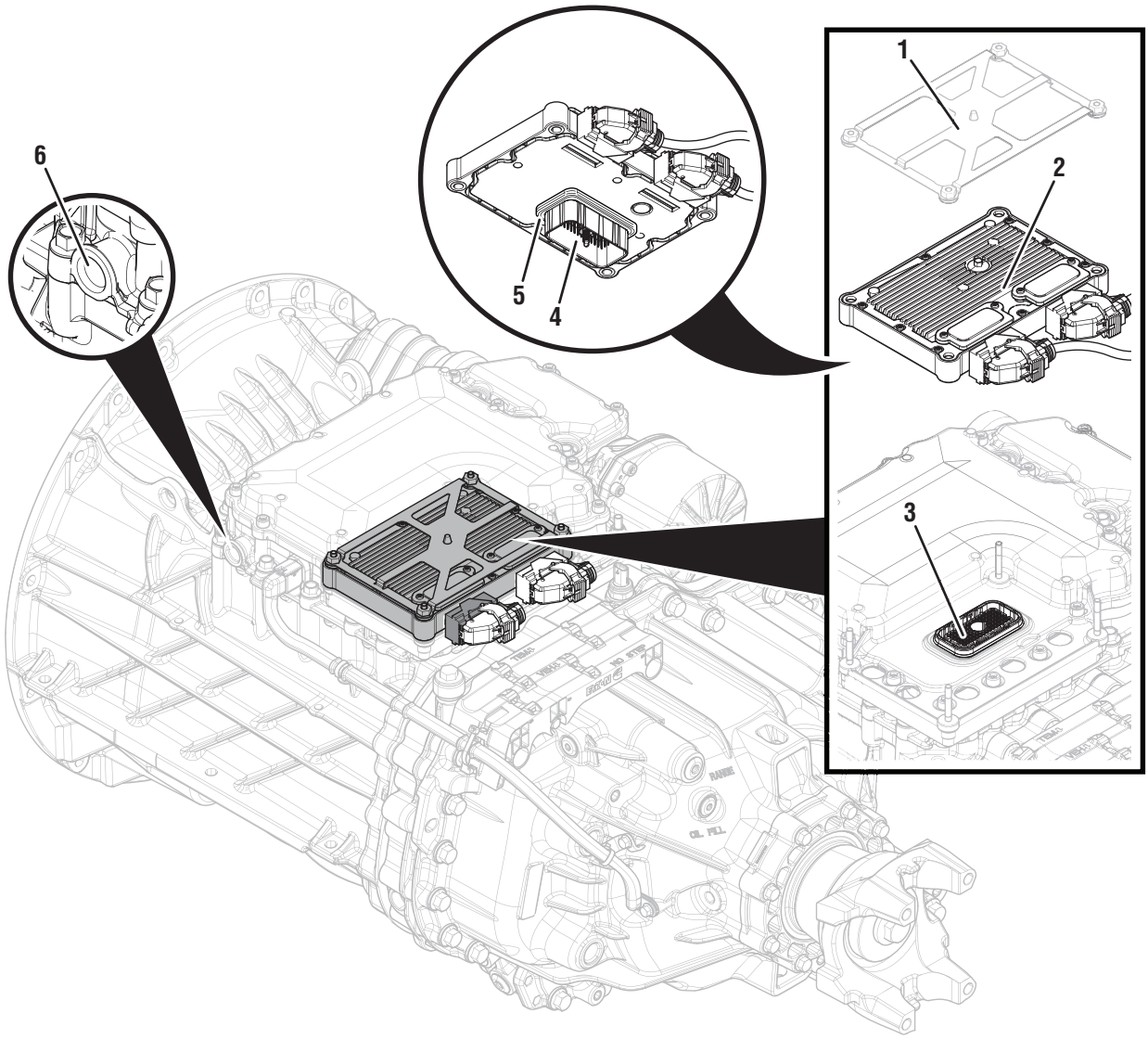
- LCA
  - Stuck piston
  - LCA to MTM seal air leak
  - Internal failure
- MTM – Clutch Engage Solenoid 1 and/or 2
  - Stuck open
  - Air leak
- Clutch Housing
  - Damaged Release Bearing
  - Damaged Front Bearing Cover
  - Damaged Release Yoke
  - Damaged Clutch

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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

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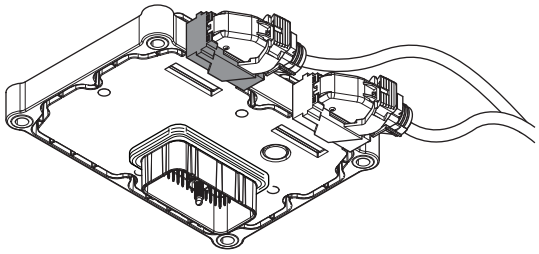
Fault Code 511 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 or 10 is Active or Inactive, go to **Step E.**
   - If Fault Code 511 FMI 12 or 16 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



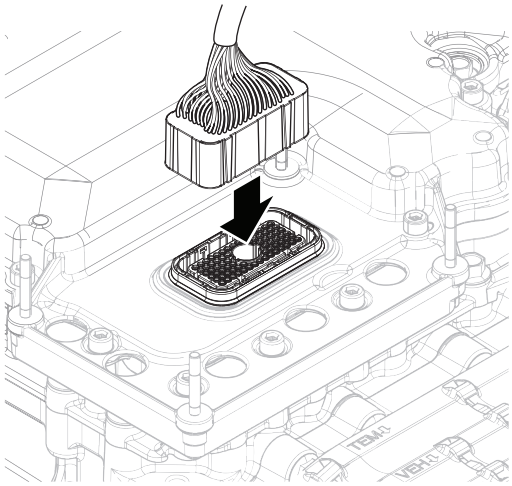
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals re not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found to TCM side of 74-Way Transmission Harness Connector, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission to be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

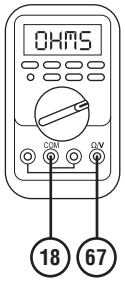
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C ***Purpose:*** *Verify Clutch Engage Solenoid 1 resistance and not shorted to ground.*

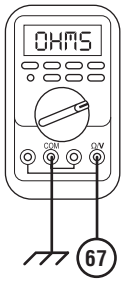
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 18 and Pin 67. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
18 to 67	2.3-3.9 Ohms	
67 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 511 FMI 0, 1, 3, 4, 5, 6, 8, 18 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 511 FMI 0, 1, 3, 4, 5, 6, 8, 18 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

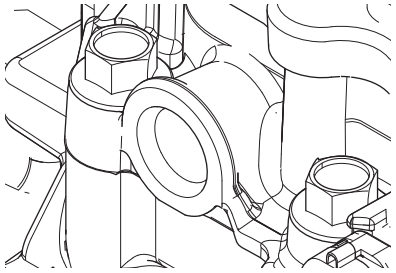
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step F.**

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F

Purpose: *Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke.*

1. Key off.
2. Remove transmission.

   Note: Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke for binding or damage.
   - If no binding or damage is found, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If binding or damage is found, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 511 sets Active, go to **Step A.**
   - If a fault code other than 511 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the Linear Clutch Actuator (LCA) to control clutch position. The clutch control system includes four solenoid valves – two for engagement (Vent) and two for disengagement (Fill).

The Clutch Engage Solenoid 2 (CES2) valve is energized by the Transmission Control Module (TCM) to exhaust Supply Air from the LCA, engaging the clutch. The CES2 valve 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 circuit. If a circuit or 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): CES2 Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: CES2 circuit shorted to power for 2 seconds after CES2 commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: CES2 circuit shorted to ground for 2 seconds after CES2 commanded off.

FMI 5 – Current Below Normal or Open Circuit: CES2 circuit open for 2 seconds after CES2 commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: CES2 circuit shorted to ground for 2 seconds after CES2 commanded on.

FMI 8 – Abnormal Frequency: CES2 signal frequency out of range for 1 second.

FMI 10 – Abnormal Rate of Change: Clutch Release Solenoid commanded on longer than expected to maintain clutch disengagement for 10 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 16 – Data Valid but Above Normal (Moderately Severe): CES2 commanded on longer than expected increasing solenoid temperature.

FMI 18 – Data Valid but Below Normal (Moderately Severe): CES2 circuit voltage lower than expected for 1 second after CES2 commanded on.

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 and fault condition no longer exist.

FMI 3: CES2 circuit not shorted to power for 10 seconds.

FMI 4: CES2 circuit not shorted to ground for 10 seconds.

FMI 5: CES2 circuit not open for 10 seconds.

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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:

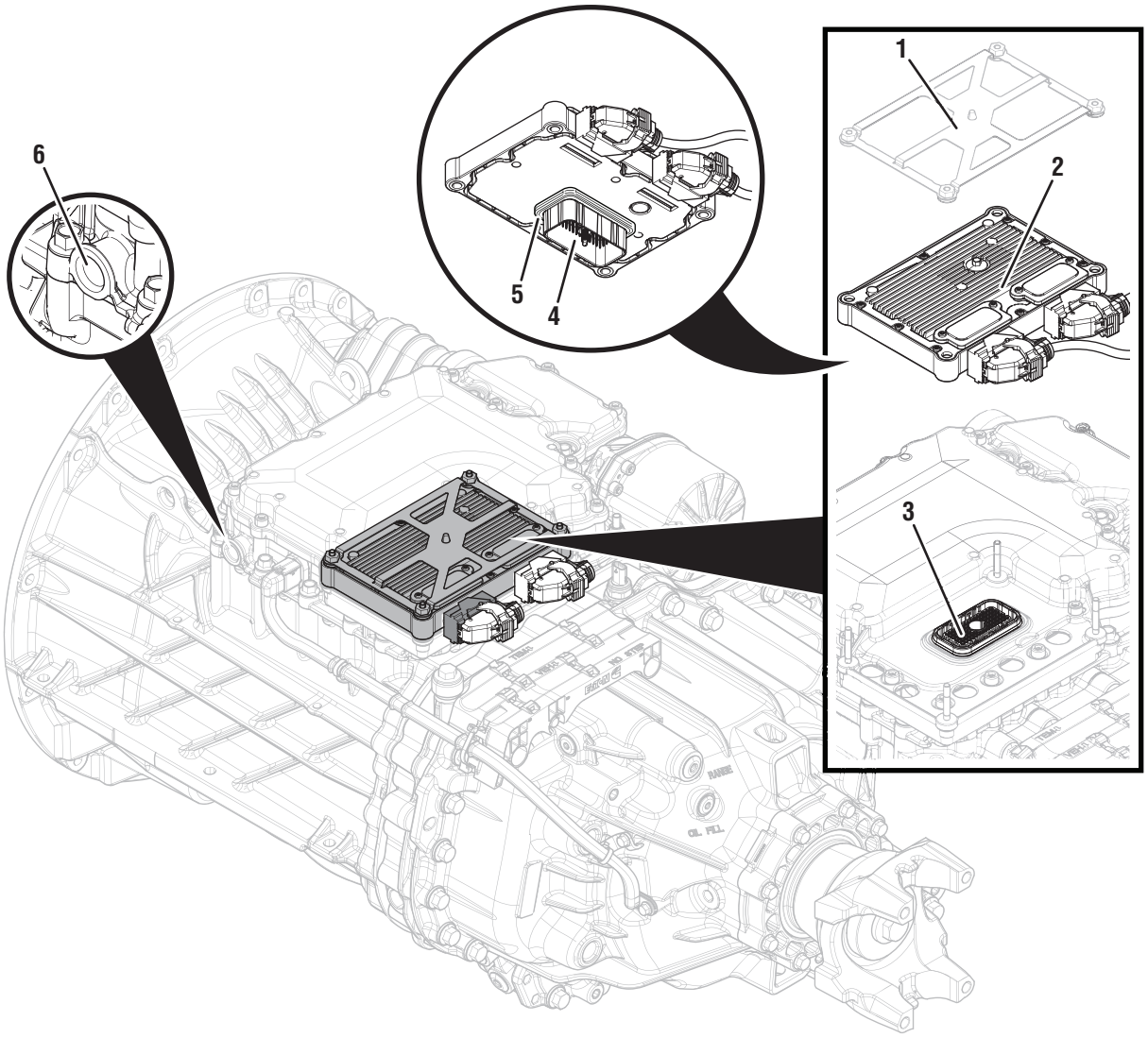
- MTM – Clutch Engage Solenoid 1 and/or 2
  - Stuck open
  - Air leak

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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

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Fault Code 512 Troubleshooting

A

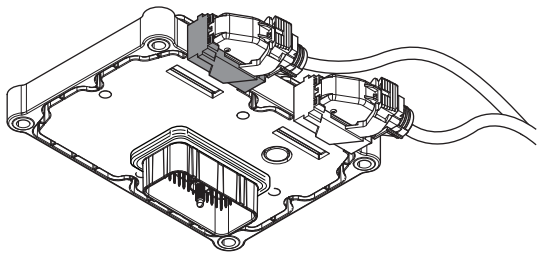
Purpose: *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B

Purpose: *Verify condition of TCM 74-Way Connector.*

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



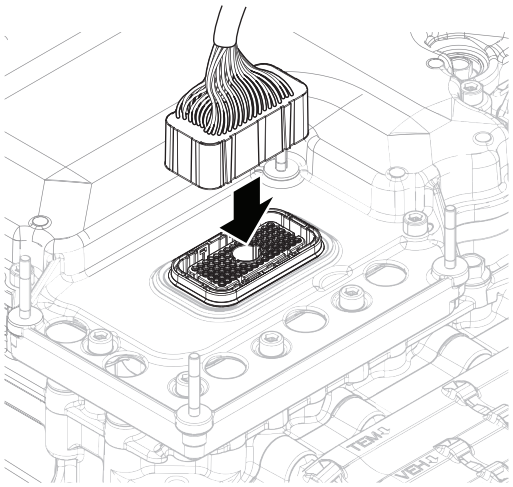
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found to TCM side of 74-Way Transmission Harness Connector, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission to be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

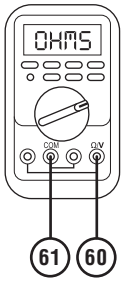
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C ***Purpose:*** *Verify Clutch Engage Solenoid 2 resistance and not shorted to ground.*

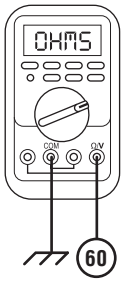
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 60 and Pin 61. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
60 to 61	3.4-5.5 Ohms	
60 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 512 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 512 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

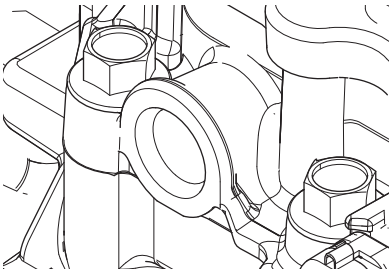
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to the MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step F.**

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F ***Purpose:*** *Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke.*

1. Key off.
2. Remove transmission.

   Note: Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke for binding or damage.
   - If no binding or damage is found, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If binding or damage is found, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 512 sets Active, go to **Step A.**
   - If a fault code other than 512 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the Linear Clutch Actuator (LCA) to control clutch position. The clutch control system includes four solenoid valves – two for engagement (Vent) and two for disengagement (Fill).

The Clutch Release Solenoid 1 (CRS1) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the LCA, disengaging the clutch. The CRS1 valve 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 circuit. If a circuit or 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): CRS1 Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: CRS1 circuit shorted to power for 2 seconds after CRS1 commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: CRS1 circuit shorted to ground for 2 seconds after CRS1 commanded off.

FMI 5 – Current Below Normal or Open Circuit: CRS1 circuit open for 2 seconds after CRS1 commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: CRS1 circuit shorted to ground for 2 seconds after CRS1 commanded on.

FMI 7 – Mechanical System Not Responding: Unable to achieve clutch engagement while clutch control system is attempting to engage clutch for 1 second.

FMI 8 – Abnormal Frequency: CRS1 signal frequency out of range for 1 second.

FMI 10 – Abnormal Rate of Change: Clutch Engage Solenoid commanded on longer than expected to maintain clutch engagement for 10 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 16 – Data Valid but Above Normal (Moderately Severe): CRS1 commanded on longer than expected increasing solenoid temperature.

FMI 18 – Data Valid but Below Normal (Moderately Severe): CRS1 circuit voltage lower than expected for 1 second after CRS1 commanded on.

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:

- If the transmission is in gear:
  - Amber warning lamp on
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO Mode prohibited
  - Raised shift points
- If transmission is not in gear:
  - Red stop lamp on
  - Urge to Move and Creep mode prohibited
  - Non-Neutral modes prohibited
  - PTO mode prohibited

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 10, 12, 16, 18: Key cycle and fault condition no longer exists.

FMI 3: CRS1 circuit not shorted to power for 10 seconds.

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FMI 4: CRS1 circuit not shorted to ground for 10 seconds.

FMI 5: CRS1 circuit not open 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:

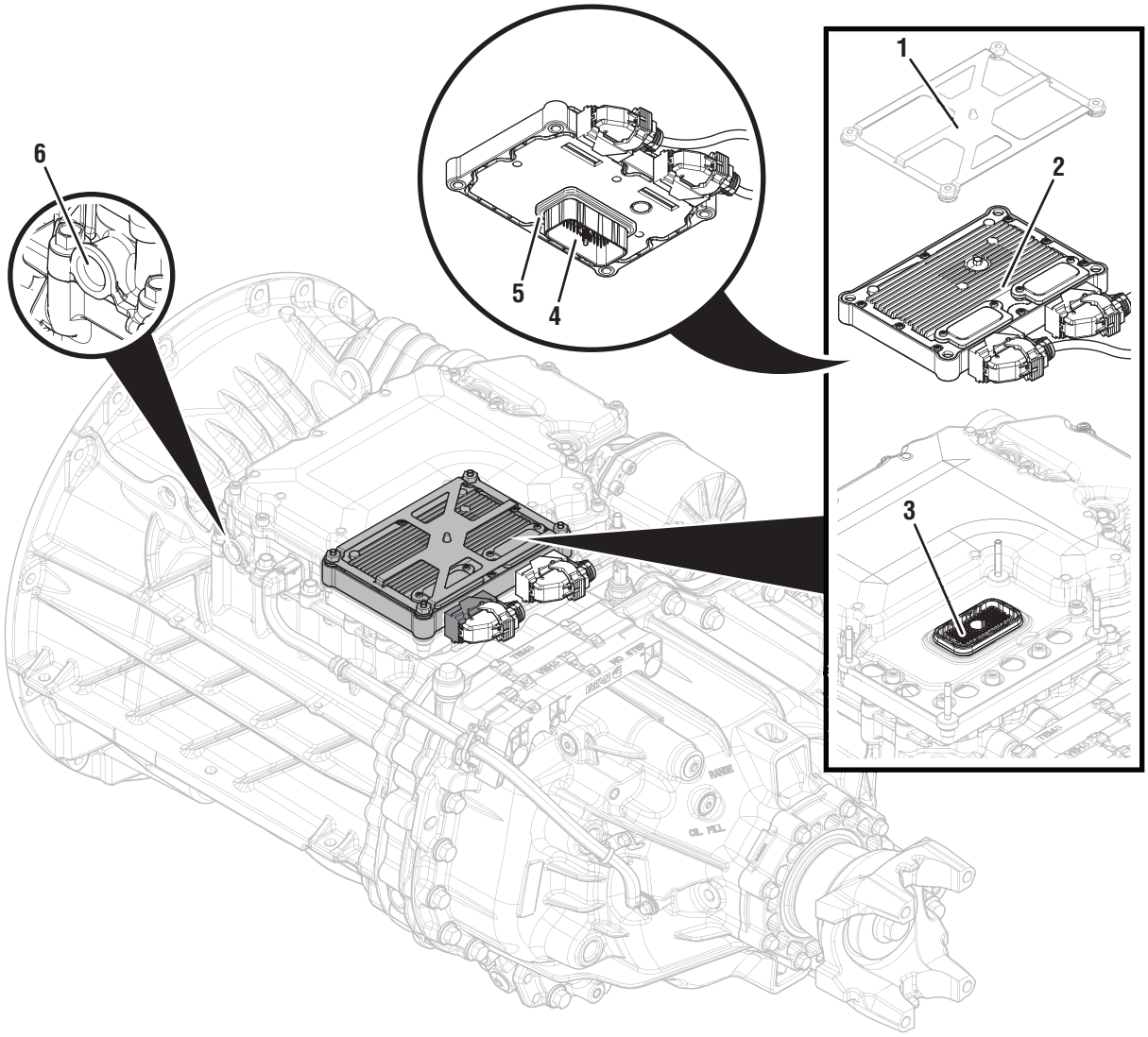
- MTM - Clutch Release Solenoid 1 and/or 2
  - Stuck open
  - Air leak

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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

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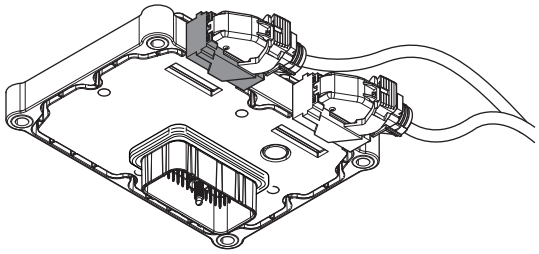
Fault Code 513 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



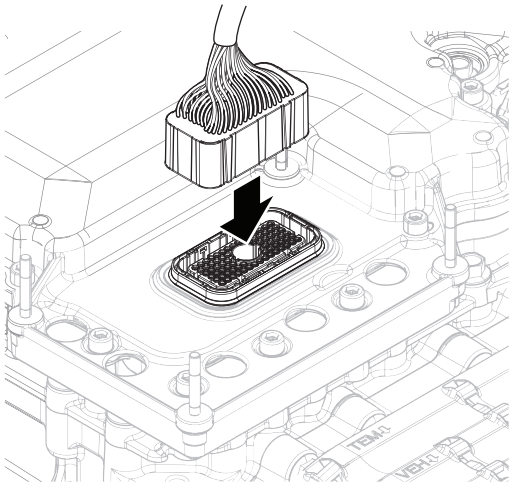
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found to TCM side of 74-Way Transmission Harness Connector, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission to be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

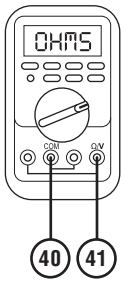
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C ***Purpose:*** *Verify Clutch Release Solenoid 1 resistance and not shorted to ground.*

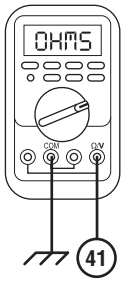
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box
4. between Pin 40 and Pin 41. Record reading in table.



5. Measure resistance at Eaton Breakout Box between Pin 41 and Ground (TCM mounting stud). 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, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission to be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
40 to 41	2.3–3.9 Ohms	
41 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 513 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 513 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

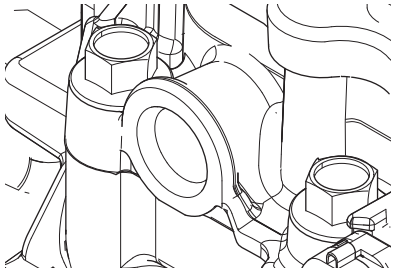
     Note: MTM removal and installation requires transmission to be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission to be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step F.**

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F

Purpose: *Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke.*

1. Key off.
2. Remove transmission.

   Note: Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke for binding or damage.
   - If no binding or damage is found, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If binding or damage is found, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 513 sets Active, go to **Step A.**
   - If a fault code other than 513 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the Linear Clutch Actuator (LCA) to control clutch position. The clutch control system includes four solenoid valves – two for engagement (Vent) and two for disengagement (Fill).

The Clutch Release Solenoid 2 (CRS2) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the LCA, disengaging the clutch. The CRS2 valve 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 CRS2 circuit. If a circuit or 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): CRS2 Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: CRS2 circuit shorted to power for 2 seconds after CRS2 commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: CRS2 circuit shorted to ground for 2 seconds after CRS2 commanded off.

FMI 5 – Current Below Normal or Open Circuit: CRS2 circuit open for 2 seconds after CRS2 commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: CRS2 circuit shorted to ground for 2 seconds after CRS2 commanded on.

FMI 8 – Abnormal Frequency: CRS2 signal frequency out of range for 1 second.

FMI 10 – Abnormal Rate of Change: Clutch Engage Solenoid commanded on longer than expected to maintain clutch engagement for 10 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 16 – Data Valid but Above Normal (Moderately Severe): CRS2 commanded on longer than expected increasing solenoid temperature.

FMI 18 – Data Valid but Below Normal (Moderately Severe): CRS2 circuit voltage lower than expected for 1 second after CRS2 commanded on.

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 modes

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 8, 10, 12, 16, 18: Key cycle and fault condition no longer exist.

FMI 3: CRS2 circuit not shorted to power for 10 seconds.

FMI 4: CRS2 circuit not shorted to ground for 10 seconds.

FMI 5: CRS2 circuit not open for 10 seconds.

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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:

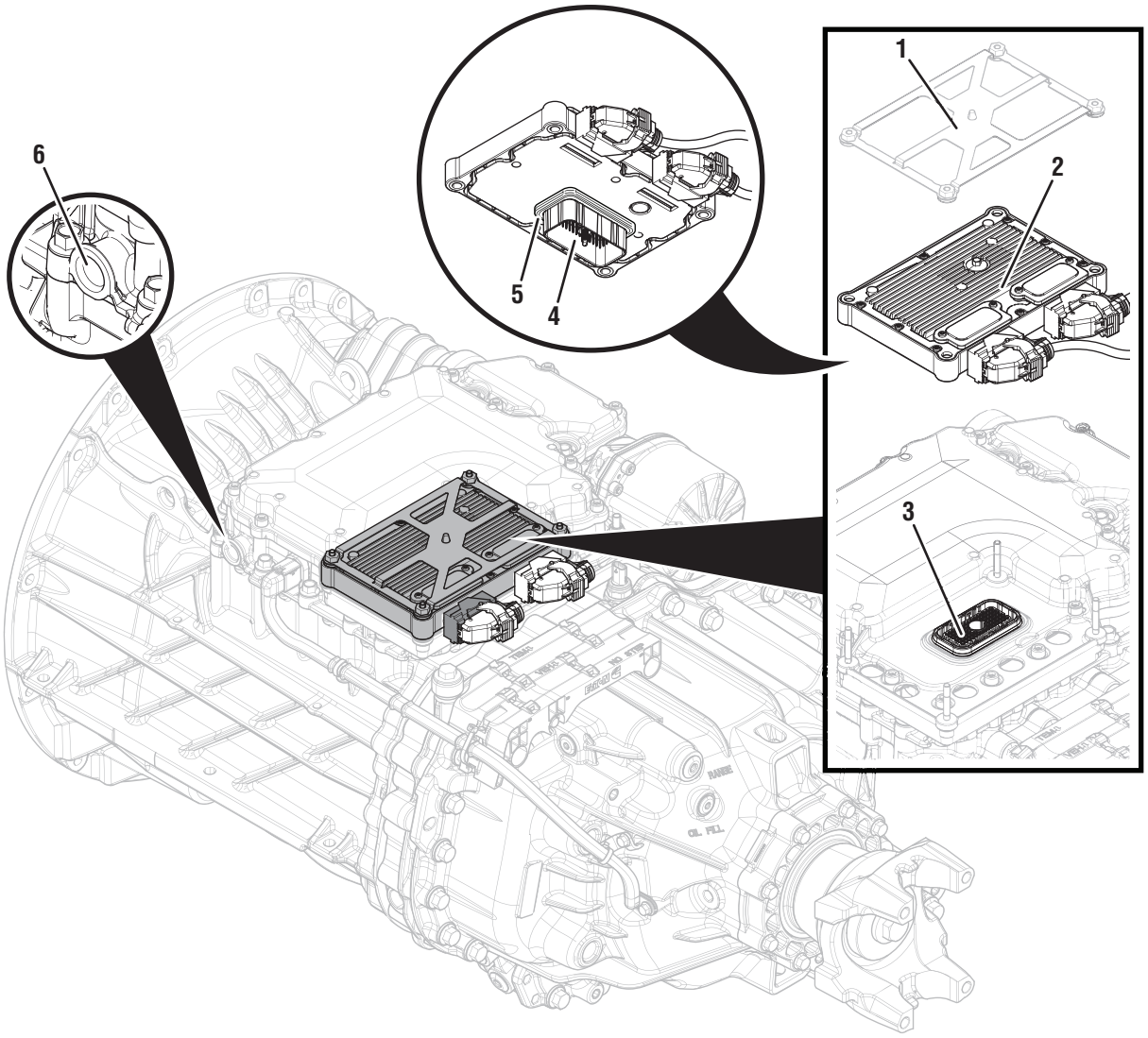
- MTM – Clutch Release Solenoid 1 and/or 2
  - Stuck open
  - Air leak

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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

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Fault Code 514 Troubleshooting

A

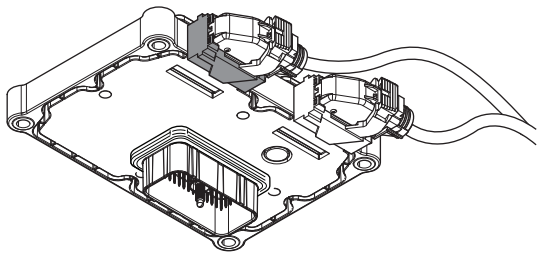
Purpose: *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B

Purpose: *Verify condition of TCM 74-Way Connector.*

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



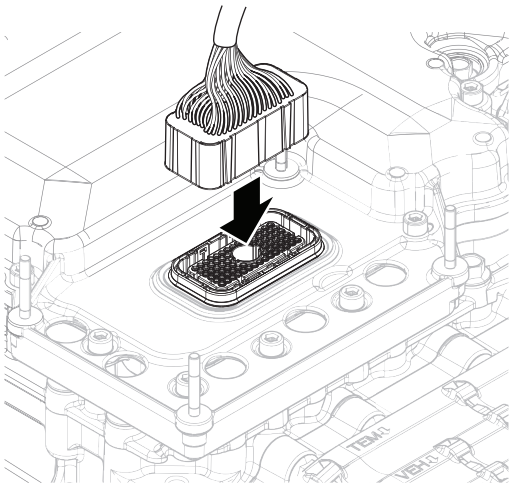
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found to TCM side of 74-Way Transmission Harness Connector, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission to be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

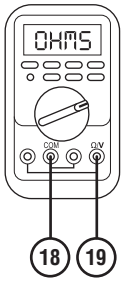
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C ***Purpose:*** *Verify Clutch Release Solenoid 2 resistance and not shorted to ground.*

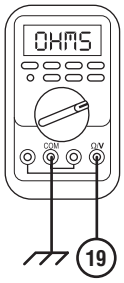
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 18 and Pin 19. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
18 to 19	3.4–5.5 Ohms	
19 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 514 FMI 0, 1, 3, 4, 5, 6, 8, 18 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 514 FMI 0, 1, 3, 4, 5, 6, 8, 18 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

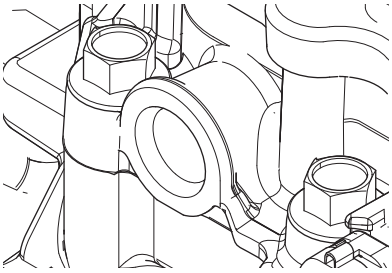
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step F.**

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F ***Purpose:*** *Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke.*

1. Key off.
2. Remove transmission.

   Note: Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Clutch, Release Bearing, Front Bearing Cover and Release Yoke for binding or damage.
   - If no binding or damage is found, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If binding or damage is found, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 514 sets Active, go to **Step A.**
   - If a fault code other than 514 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 570: Inertia Brake Solenoid (A5)

J1939: SA 3 SPN 787 FMI 0, 1, 3, 4, 5, 6, 7, 8, 10, 12, 13, 14, 15, 16, 18

Overview

The Endurant XD Series transmissions are equipped with a solenoid valve that directs vehicle Supply Air to and from the Inertia Brake. When actuated the Inertia Brake slows countershaft speed allowing for synchronized gear engagement.

The Inertia Brake Solenoid (IBS) valve is energized by the Transmission Control Module (TCM) to direct supply air to the Inertia Brake. Once the gear shift is complete the IBS is de-energized, venting supply air, and allowing the Inertia Brake to release by return spring pressure. The Inertia Brake assembly is mounted in the clutch housing. The IBS valve is located in the Mechatronic Transmission Module (MTM) and is connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the IBS circuit. If a circuit or 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): IBS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: IBS circuit shorted to power for 2 seconds after IBS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: IBS circuit shorted to ground for 2 seconds after IBS commanded off.

FMI 5 – Current Below Normal or Open Circuit: IBS circuit open for 2 seconds after IBS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: IBS circuit shorted to ground for 2 seconds after IBS commanded on.

FMI 7 – Mechanical System Not Responding: During a clutch calibration, the Inertia Brake was unable to slow the countershaft.

FMI 8 – Abnormal Frequency: IBS signal frequency out of range for 1 second.

FMI 10 – Abnormal Rate of Change: Inertia Brake did not slow countershaft speed as expected for 2 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: During a clutch calibration, Inertia Brake did not slow countershaft speed as expected for 2 seconds.

FMI 14 – Special Instructions: IBS hold current greater than commanded current when:

- Transmission is gear

  or

- Clutch and Splitter are still engaged

FMI 15 - Data Valid But Above Normal (Least Severe): Inertia Brake temperature was higher than expected when PTO was engaged.

FMI 16 – Data Valid but Above Normal (Moderately Severe): IBS circuit voltage lower than expected for 1 second after CRS2 commanded on.

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 longer shift times

FMI 7:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

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FMI 10, 13:

- Amber warning lamp on
- May delay engagement of a start gear
- May experience longer shift times

FMI 15:

- Inertia Brake engagement prohibited
- May delay engagement of a start gear
- May experience longer shift times

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 14, 15, 16, 18: Key cycle and fault condition no longer exist.

FMI 3: IBS circuit not shorted to power for 10 seconds.

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

FMI 5: IBS circuit not open for 10 seconds.

FMI 10, 13: IBS performance 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, 13:

- MTM
  - Air leak
- Clutch Housing
  - Air leak
  - Inertia Brake air line and/or fitting air leak
- Inertia Brake
  - Air leak
  - Clutch pack worn
  - Internal failure
- Clutch
  - Drag
- Transmission fluid
  - Ambient extreme cold
  - Incorrect grade

FMI 12, 14:

- TCM
  - Software issue
  - Internal failure

FMI 15:

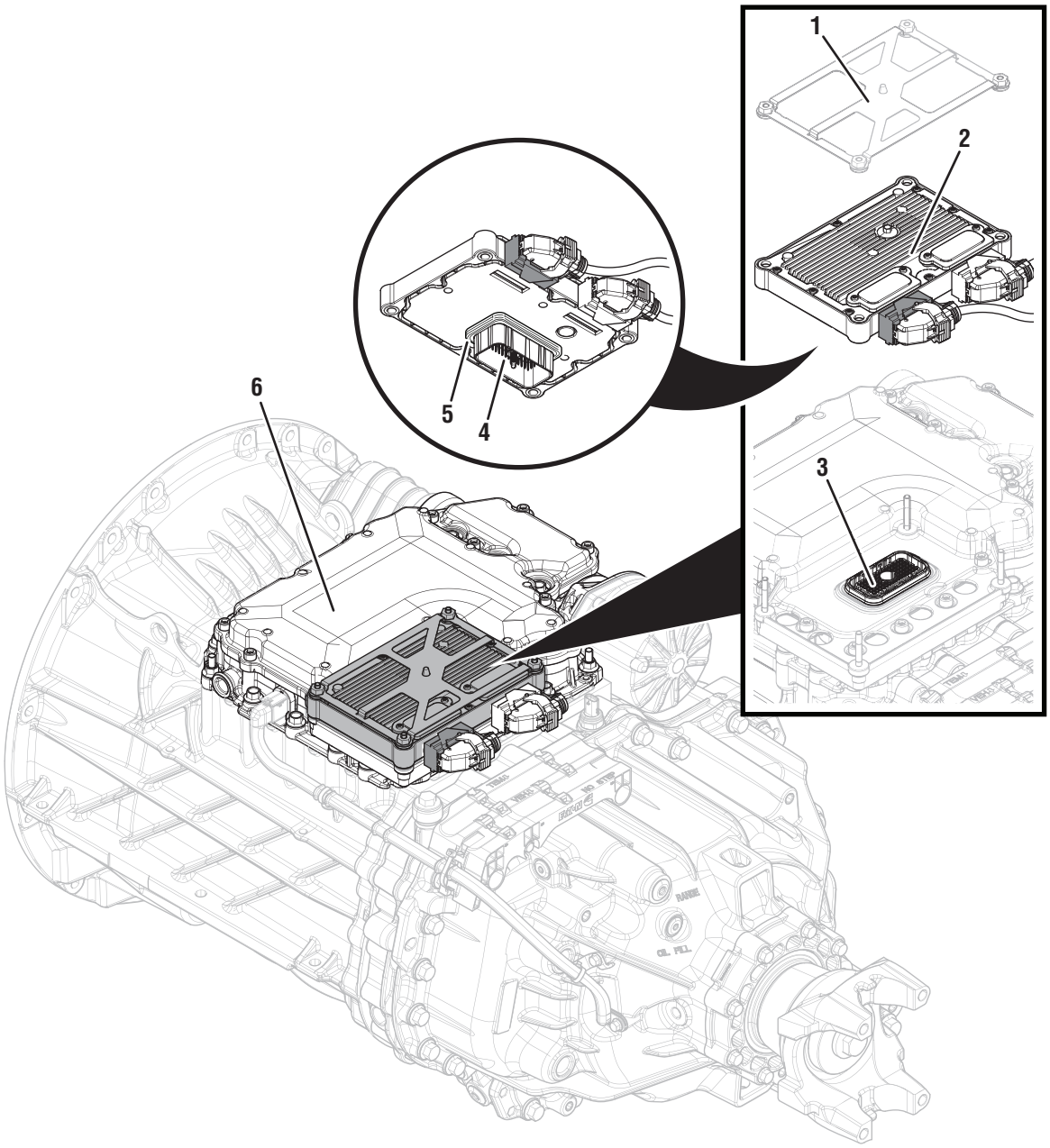
- PTO
  - Installation
  - Operation
  - Specification

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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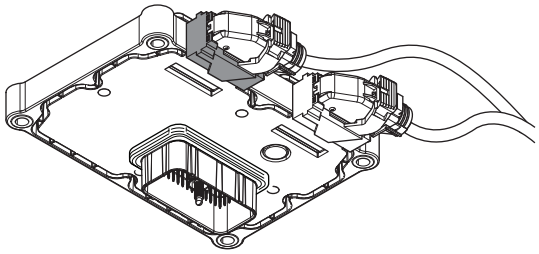
Fault Code 570 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 13 is Active or Inactive, go to **Step F.**
   - If Fault Code 570 FMI 15 is Active or Inactive, go to **Step G.**
   - If Fault Code 570 FMI 12, 14 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



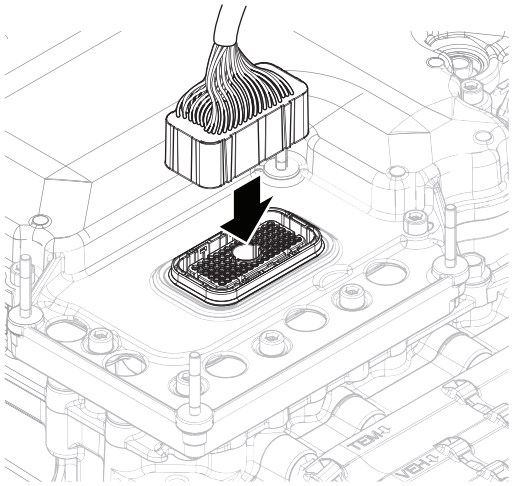
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found to TCM side of 74-Way Transmission Harness Connector, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

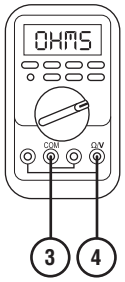
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C ***Purpose:*** *Verify Inertia Brake Solenoid resistance and not shorted to ground.*

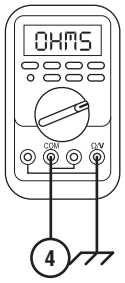
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 3 and Pin 4. Record reading in table.



4. Measure resistance at Eaton Breakout Box between Pin 4 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
3 to 4	3.4–5.5 Ohms	
4 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 570 FMI 0, 1, 3, 4, 5, 6, 8, 15, 16, 18 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 570 FMI 0, 1, 3, 4, 5, 6, 8, 15, 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 Test" and follow on-screen prompts.
5. Key off and allow TCM to 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 +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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F

Purpose: *Perform Clutch Calibration.*

Note: If Fault Code 250 FMI 13 was set Active after clutch installation and a Clutch Calibration was not successful, clutch assembly is not releasing properly.

1. Key off and perform a complete power down.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Go To Service Routines.
5. Select "Start" Clutch Calibration and follow on-screen prompts.
   - If the Clutch Calibration was successful and Fault Code 250 FMI 13 and Fault Code 570 FMI 3 are Inactive, go to **Step V.**
   - If the Clutch Calibration was not successful and Fault Code 250 FMI 13 and Fault Code 570 FMI 13 are Active, Contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

G

Purpose: *Verify PTO Installation, Operation and Specification.*

Note: Fault Code 570 FMI 15 sets Active when Inertia Brake temperature is higher than expected during PTO operation, indicating an excessive PTO load condition.

1. Key off.
2. Inspect PTO installation, operation and specification.
   - Refer to OEM and/or Body Builder guidelines for repair or replacement of PTO. Go to **Step V.**

     Note: Reference Eaton PTO Information Guide TRIG2600; PTO Configurations, Heavy-Duty Automated - Endurant.

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 570 sets Active, go to **Step A.**
   - If a fault code other than 570 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 576: Rail A Fore Solenoid (A3)

J1939: SA 3 SPN 5900 FMI 0, 1, 3, 4, 5, 6, 7, 8, 12, 16, 17, 18

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the shift rail cylinders in the Mechatronic Transmission Module (MTM). Movement of each shift rail is controlled 2 solenoids; a Fore and a Aft.

The Rail A Fore Solenoid (RAFS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail A Cylinder to move the Rail A Shift Yoke and Rail A Synchronizer in the fore or forward direction. The RAFS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the RAFS circuit and Shift Rail A position. 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): RAFS Low-Side Current value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): RAFS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RAFS circuit shorted to power for 2 seconds after RAFS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: RAFS circuit shorted to ground for 2 seconds after RAFS commanded off.

FMI 5 – Current Below Normal or Open Circuit: RAFS circuit open for 2 seconds after RAFS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: RAFS circuit shorted to ground for 2 seconds after RAFS commanded on.

FMI 7 - Mechanical System Not Responding: Rail A Position value and speed sensors confirmed uncommanded movement from Main Drive Gear toward neutral position.

FMI 8 – Abnormal Frequency: RAFS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 16 – Data Valid but Above Normal (Moderately Severe): RAFS commanded on longer than expected increasing solenoid temperature.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail A Position value and speed sensors confirmed uncommanded movement from Main Drive Gear toward neutral position.

FMI 18 – Data Valid but Below Normal (Moderately Severe): RAFS circuit voltage lower than expected for 1 second after RAFS commanded on.

Fallback

FMI 0, 1, 3, 5, 6, 8, 12, 18:

- Amber warning lamp on
- If Main Drive Gear is disengaged
  - Shift Rail A movement prohibited
- If Main Drive Gear is engaged
  - Shift Rail A movement in fore direction prohibited

FMI 4:

- Amber warning lamp on
- Shift Rail A movement prohibited
- Shift Rail B movement prohibited

FMI 7:

- No degraded modes

FMI 16:

- Amber warning lamp on
- Shift Rail A movement in fore direction prohibited

FMI 17:

- Amber warning lamp on
- Shift Rail A movement in aft direction prohibited

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 16, 17, 18: Key cycle and fault condition no longer exist.

FMI 3: RAFS circuit not shorted to power for 10 seconds.

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

FMI 5: RAFS circuit not open for 10 seconds.

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Possible Causes

FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:

- MTM - RAFS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

FMI 7, 17:

- MTM - RAFS
  - Partially stuck open
- Internal transmission
  - Main Drive Gear
  - Rail A Synchronizer

FMI 12:

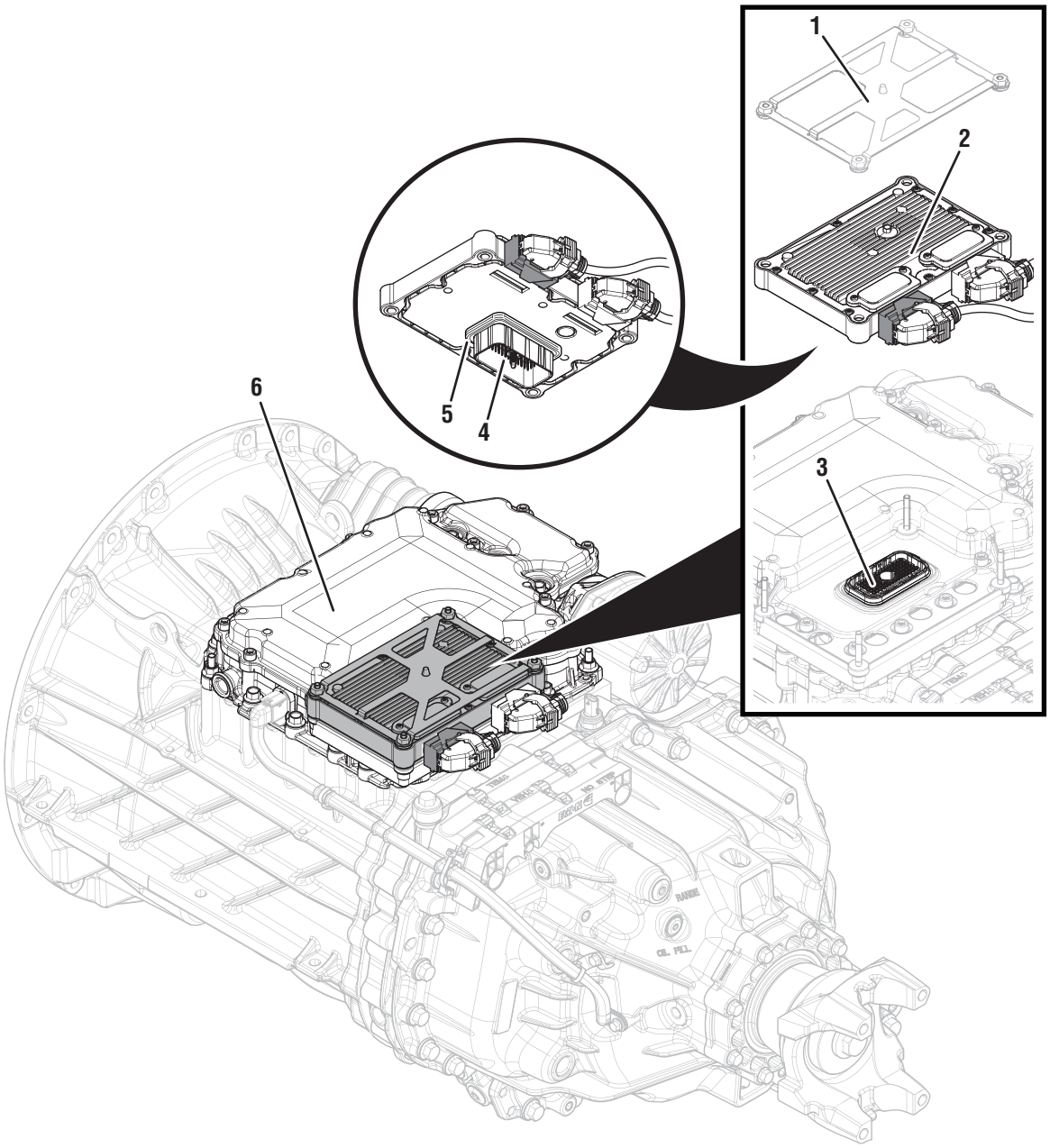
- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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Fault Code 576 Troubleshooting

A

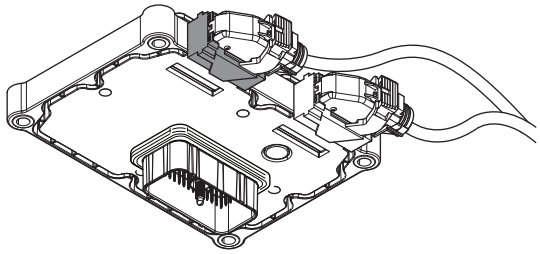
Purpose: *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 576 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 576 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 576 FMI 7, 17 is Active or Inactive, Go to **Step E.**

B

Purpose: *Verify condition of TCM 74-Way Connector.*

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



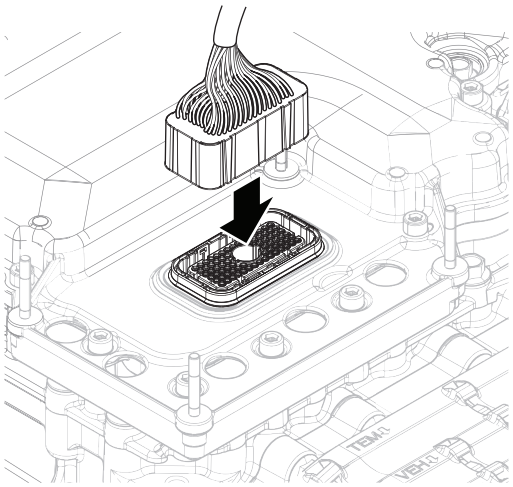
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

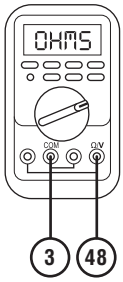
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C ***Purpose:*** *Verify Rail A Fore Solenoid resistance and not shorted to ground.*

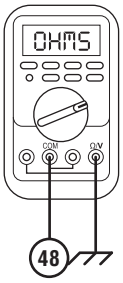
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 3 and Pin 48. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
3 to 48	3.4–5.5 Ohms	
48 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 576 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 576 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

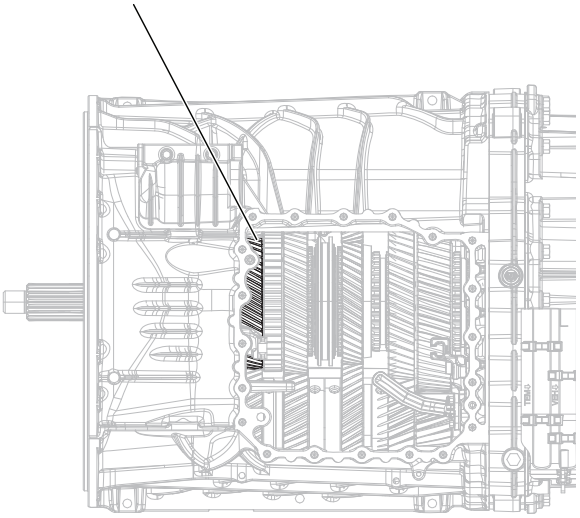
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify mechanical condition of Main Drive Gear.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Main Drive Gear for excessive fore and aft movement.



   - If excessive gear movement is evident, inspect Main Drive Gear and Main Shaft Assembly for cause and repair. Go to **Step V.**

     Note: Reference Endurant XD Service Manual TRSM0960, Main Shaft Disassembly/Assembly Service Procedure
   - If no excessive gear movement is evident, go to **Step F.**

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F

Purpose: *Verify mechanical condition of Rail A Synchronizer and clutching teeth.*

Note: Reference Manually Actuate Rail A Procedure on page of the Appendix.

1. Shift Rail A Synchronizer Sliding Sleeve into neutral position (if necessary).
2. Inspect Main Drive Gear and Rail A Synchronizer Sleeve clutching teeth for wear.
3. Shift Rail A Synchronizer Sliding Sleeve into Main Drive Gear engagement position (aft).
   - If Rail A Synchronizer Sliding Sleeve shifts into both positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail A Synchronizer Sliding Sleeve does not shift into both positions or clutching teeth wear is present, replace Rail A Synchronizer Assembly, Main Drive Gear, and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 576 sets Active, go to **Step A.**
   - If a fault code other than 576 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19

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Fault Code 577: Rail A Aft Solenoid (A2)

J1939: SA 3 SPN 5908 FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the shift rail cylinders in the Mechatronic Transmission Module (MTM). Movement of each shift rail is controlled 2 solenoids; a Fore and a Aft.

The Rail A Aft Solenoid (RAAS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail A Cylinder to move the Rail A Shift Yoke and Rail A Synchronizer in the aft or rearward direction. The RAAS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the RAAS circuit and Shift Rail A position. 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): RAAS Low-Side Current value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): RAAS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RAAS circuit shorted to power for 2 seconds after RAAS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: RAAS circuit shorted to ground for 2 seconds after RAAS commanded off.

FMI 5 – Current Below Normal or Open Circuit: RAAS circuit open for 2 seconds after RAAS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: RAAS circuit shorted to ground for 2 seconds after RAAS commanded on.

FMI 8 – Abnormal Frequency: RAAS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 16 – Data Valid but Above Normal (Moderately Severe): RAAS commanded on longer than expected increasing solenoid temperature.

FMI 18 – Data Valid but Below Normal (Moderately Severe): RAAS circuit voltage lower than expected for 1 second after RAAS commanded on.

Fallback

FMI 0, 1, 3, 5, 6, 8, 12, 18:

- Amber warning lamp on
- If Main Drive Gear is disengaged
  - Shift Rail A movement prohibited
- If Main Drive Gear is engaged
  - Shift Rail A movement in aft direction prohibited

FMI 4:

- Amber warning lamp on
- Shift Rail A movement prohibited
- Shift Rail B movement prohibited

FMI 16:

- Amber warning lamp on
- Shift Rail A movement in aft direction prohibited

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 8, 12, 16, 18: Key cycle and fault condition no longer exist.

FMI 3: RAAS circuit not shorted to power for 10 seconds.

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

FMI 5: RAAS circuit not open for 10 seconds.

Possible Causes

FMI 0, 1, 3, 4, 5, 6, 8, 16, 18:

- MTM - RAAS
  - Internal failure
  - Damaged
- MTM - Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- TCM
  - Internal failure

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FMI 12:

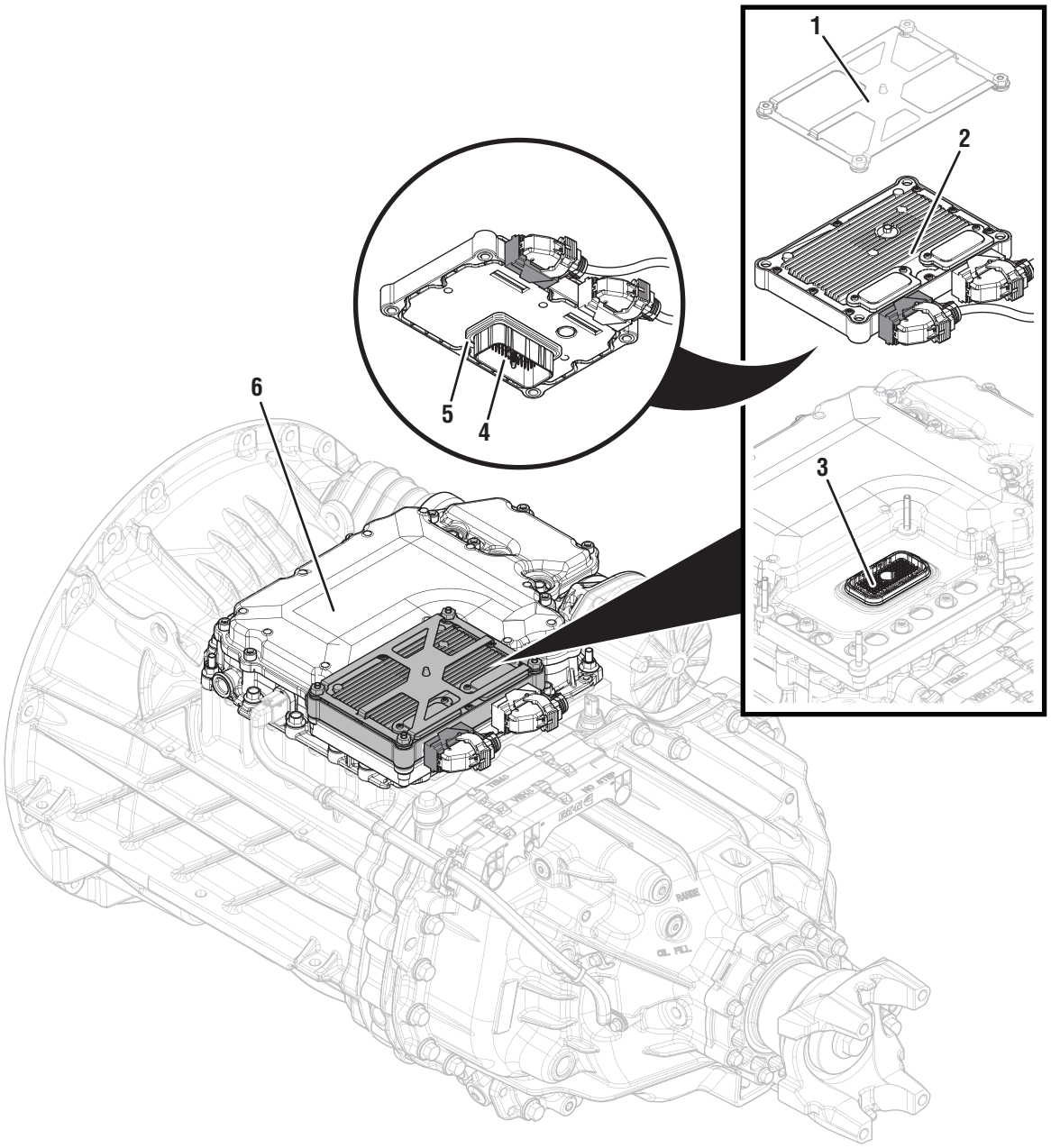
- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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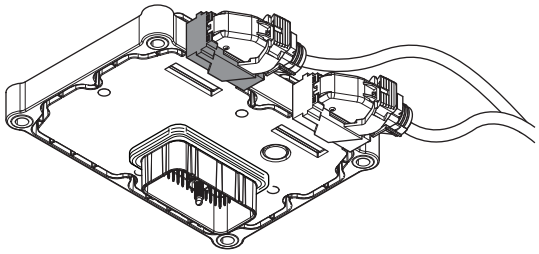
Fault Code 577 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 577 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 577 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



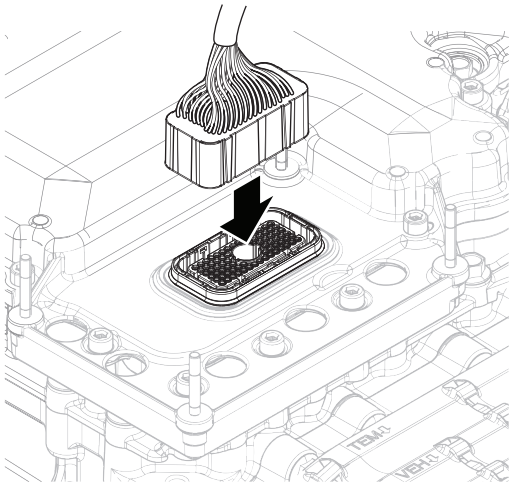
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

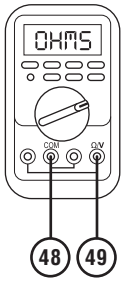
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C ***Purpose:*** *Verify Rail A Aft Solenoid resistance and not shorted to ground.*

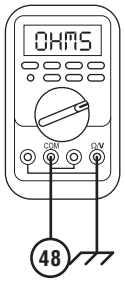
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 48 and Pin 49. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
48 to 49	3.4–5.5 Ohms	
48 to ground (TCM mounting stud)	Open Circuit (OL)	

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 577 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 577 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

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

1. Key off.
2. Reconnect all connectors and verify 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 577 sets Active, go to **Step A.**
   - If a fault code other than 577 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 596: Rail B Fore Solenoid (A5)

J1939: SA 3 SPN 5901 FMI 0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 16, 17, 18, 31

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the shift rail cylinders in the Mechatronic Transmission Module (MTM). Movement of each shift rail is controlled 2 solenoids; a Fore and a Aft.

The Rail B Fore Solenoid (RBFS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail B Cylinder to move the Rail B Shift Yoke and Rail B Synchronizer in the fore or forward direction. The RBFS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the RBFS circuit and Shift Rail B position. 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): RBFS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RBFS circuit shorted to power for 2 seconds after RBFS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: RBFS circuit shorted to ground for 2 seconds after RBFS commanded off.

FMI 5 – Current Below Normal or Open Circuit: RBFS circuit open for 2 seconds after RBFS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: RBFS circuit shorted to ground for 2 seconds after RBFS commanded on.

FMI 7 – Mechanical System Not Responding: Rail B Position value and speed sensors confirmed uncommanded movement from Splitter Gear toward neutral position.

FMI 8 – Abnormal Frequency: RBFS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 14 – Special Instructions: Rail B Position value indicated uncommanded movement from neutral position toward Main Drive Gear Low immediately after a shift into neutral position.

FMI 16 – Data Valid but Above Normal (Moderately Severe): RBFS commanded on longer than expected increasing solenoid temperature.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail B Position value and speed sensors confirmed uncommanded movement from Splitter Gear toward neutral position.

FMI 18 – Data Valid but Below Normal (Moderately Severe): RBFS circuit voltage lower than expected for 1 second after RBFS commanded on.

FMI 31 – Condition Exists: During a rail calibration, Rail B Position value indicated uncommanded movement from neutral position toward Main Drive Gear Low immediately after a shift into neutral position.

Fallback

FMI 0, 1, 5, 6, 8, 12, 16, 18:

- Amber warning lamp on
- If Shift Rail B is in neutral position
  - Shift Rail B movement prohibited
- If Shift Rail B is not in neutral position
  - Shift Rail B movement in fore direction prohibited
  - Shift Rail A movement prohibited

FMI 3, 4:

- Amber warning lamp on
- Shift Rail B movement prohibited
- Shift Rail A movement prohibited

FMI 7:

- No degraded modes

FMI 14, 31:

- Amber warning lamp on
- Shift Rail B movement prohibited

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FMI 16:

- Amber warning lamp on
- Shift Rail B movement in fore direction prohibited

FMI 17:

- Amber warning lamp on
- Splitter Gear engagement prohibited

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 14, 16, 17, 18, 31: Key cycle and fault condition no longer exist.

FMI 3: RBFS circuit not shorted to power for 10 seconds.

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

FMI 5: RBFS circuit not open 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 7, 14, 17:

- MTM - RBFS
  - Partially stuck open
- Internal transmission
  - Splitter Gear
  - Rail B Synchronizer

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 31:

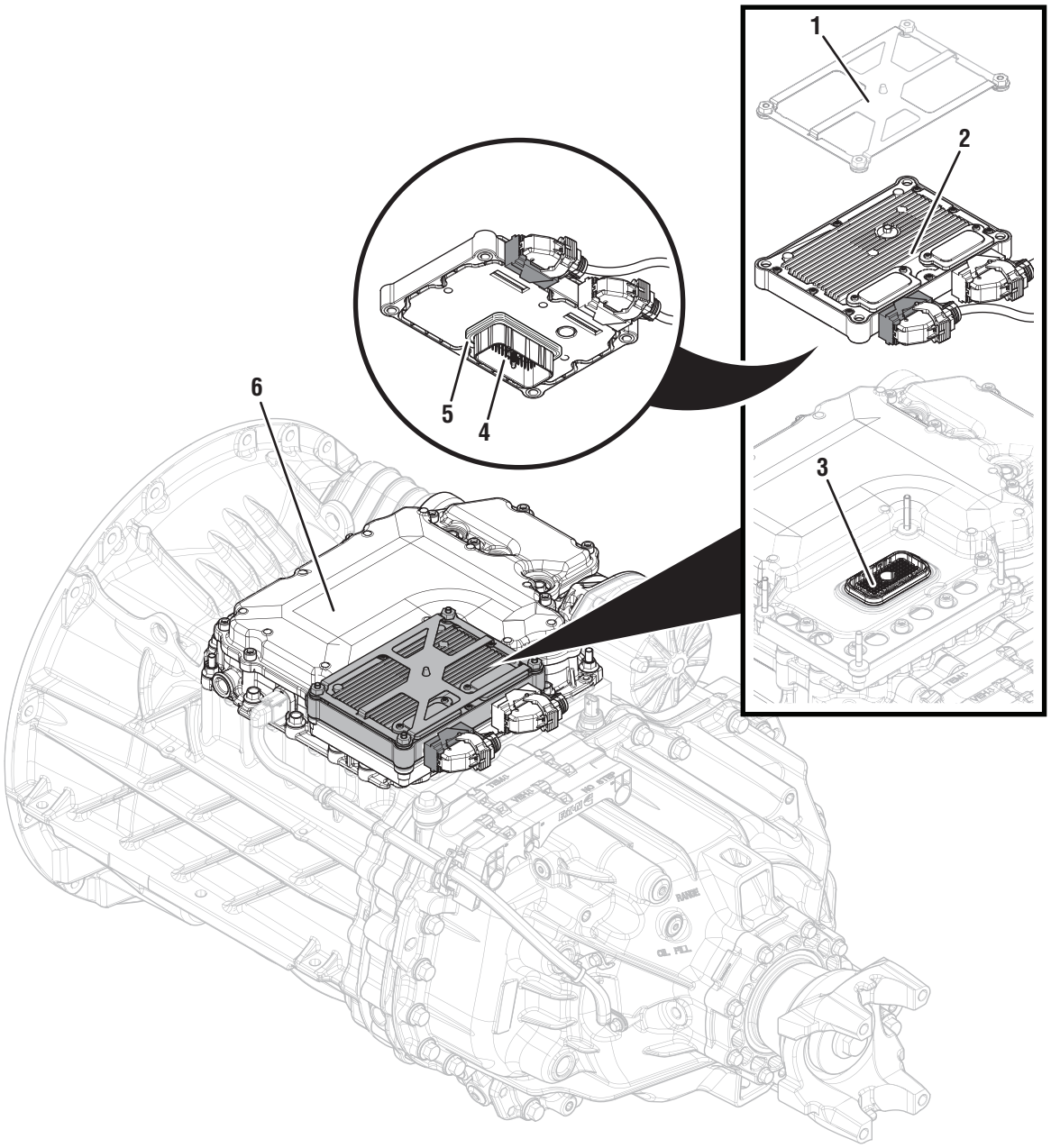
- MTM - RBFS
  - Partially stuck open

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- Rail B Synchronizer Engagement Tool (RR1088TR)

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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)

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Fault Code 596 Troubleshooting

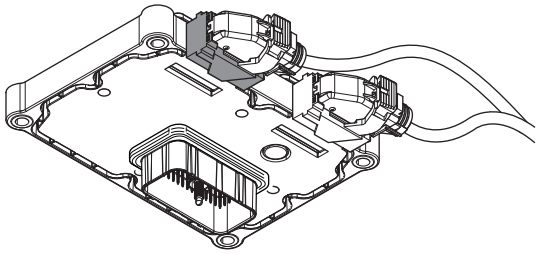
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 596 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 596 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 596 FMI 7, 31 is Active or Inactive, go to **TAIB-1006** *MTM Solenoid Fault Codes and Vehicle Air System Contamination*.
   - If Fault Code 596 FMI 14 is Active or Inactive, Go to **Step E.**
   - If Fault Code 596 FMI 17 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

     NOTICE: Refer to Vehicle Maintenance Recommendations in TRSM0960 regarding vehicle air system requirements to ensure proper air supply and air quality.

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



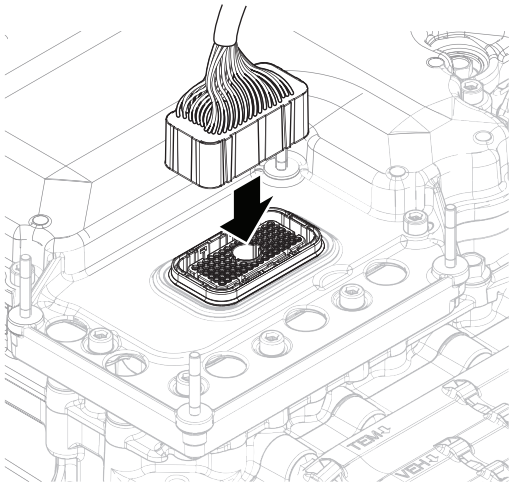
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

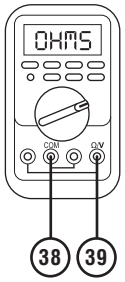
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C ***Purpose:*** *Verify Rail B Fore Solenoid resistance and not shorted to ground.*

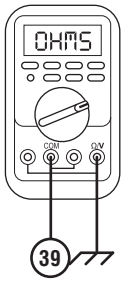
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 38 and Pin 39. Record reading in table.



4. Measure resistance at Eaton Breakout Box between Pin 39 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
38 to 39	3.4–5.5 Ohms	
39 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on.
6. Connect ServiceRanger.
7. Retrieve and record 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 **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 596 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

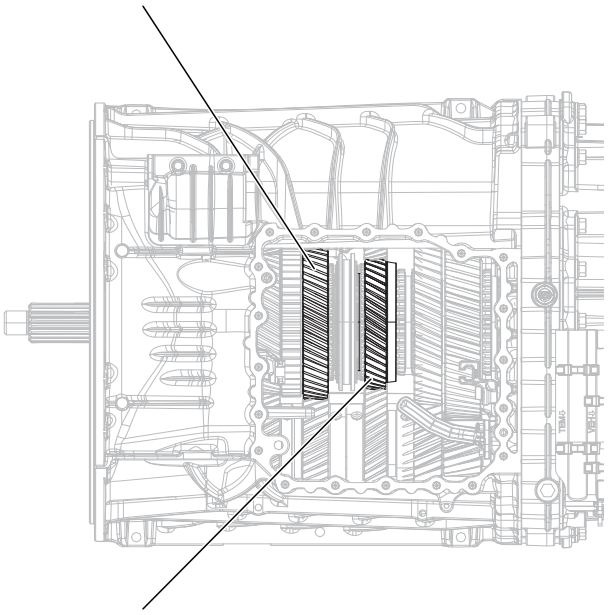
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify mechanical condition of Main Drive Gear Low and Splitter Gear.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Main Drive Gear Low for excessive fore and aft movement.

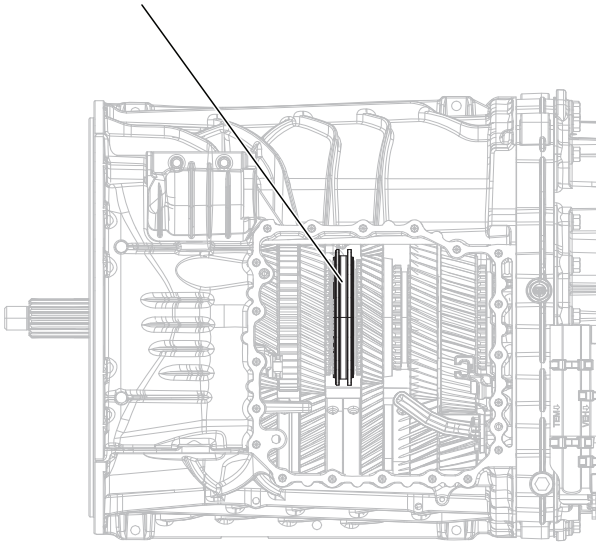


4. Inspect Splitter Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

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F ***Purpose:*** *Verify mechanical condition of Rail B Synchronizer and clutching teeth.*

1. Inspect 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 Rail B Synchronizer Sliding Sleeve into neutral (if necessary).
4. Shift Rail B Synchronizer Sliding Sleeve into Main Drive Gear Low engagement position (fore).
5. Inspect Splitter Gear and Rail B Synchronizer Sleeve clutching teeth for wear.
6. Return Rail B Synchronizer Sliding Sleeve to neutral position.
7. Shift Rail B Synchronizer Sliding Sleeve into Splitter Gear engagement position (aft).
8. Inspect the Splitter Gear and Rail B Synchronizer Sliding Sleeve clutching teeth for wear.
9. Return Rail B Synchronizer Sliding Sleeve to neutral position.

   - If Rail B Synchronizer Sliding Sleeve shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail B Synchronizer Sliding Sleeve does not shift into all three positions or clutching teeth wear is present, replace Rail B Synchronizer Assembly, Main Drive Gear Low, Splitter Gear and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 596 sets Active, go to **Step A.**
   - If a fault code other than 596 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19

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Fault Code 597: Rail B Aft Solenoid (A1)

J1939: SA 3 SPN 5909 FMI 0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 16, 17, 18, 31

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the shift rail cylinders in the Mechatronic Transmission Module (MTM). Movement of each shift rail is controlled 2 solenoids; a Fore and an Aft.

The Rail B Aft Solenoid (RBAS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail B Cylinder to move the Rail B Shift Yoke and Rail B Synchronizer in the aft or rearward direction. The RBAS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the RBAS circuit and Shift Rail B position. 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): RBAS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RBAS circuit shorted to power for 2 seconds after RBAS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: RBAS circuit shorted to ground for 2 seconds after RBAS commanded off.

FMI 5 – Current Below Normal or Open Circuit: RBAS circuit open for 2 seconds after RBAS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: RBAS circuit shorted to ground for 2 seconds after RBAS commanded on.

FMI 7 – Mechanical System Not Responding: Rail B Position value and speed sensors confirmed uncommanded movement from Main Drive Gear Low toward neutral position.

FMI 8 – Abnormal Frequency: RBAS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 14 – Special Instructions: Rail B Position value indicated uncommanded movement from neutral position toward Splitter Gear immediately after a shift into neutral position.

FMI 16 – Data Valid but Above Normal (Moderately Severe): RBAS commanded on longer than expected increasing solenoid temperature.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail B Position value and speed sensors confirmed uncommanded movement from Main Drive Gear Low toward neutral position.

FMI 18 – Data Valid but Below Normal (Moderately Severe): RBAS circuit voltage lower than expected for 1 second after RBAS commanded on.

FMI 31 – Condition Exists: During a rail calibration, Rail B Position value indicated uncommanded movement from neutral position toward Splitter Gear immediately after a shift into neutral position.

Fallback

FMI 0, 1, 5, 6, 8, 12, 16, 18:

- Amber warning lamp on
- If Shift Rail B is in neutral position
  - Shift Rail B movement prohibited
- If Shift Rail B is not in neutral position
  - Shift Rail B movement in aft direction prohibited
  - Shift Rail A movement prohibited

FMI 3,4:

- Amber warning lamp on
- Shift Rail B movement prohibited
- Shift Rail A movement prohibited

FMI 7:

- No degraded modes

FMI 14, 31:

- Amber warning lamp on
- Shift Rail B movement prohibited

FMI 16:

- Amber warning lamp on
- Shift Rail B movement in aft direction prohibited

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FMI 17:

- Amber warning lamp on
- Main Drive Gear Low engagement prohibited

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 14, 16, 17, 18, 31: Key cycle and fault condition no longer exist.

FMI 3: RBAS circuit not shorted to power for 10 seconds.

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

FMI 5: RBAS circuit not open 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 7, 14, 17:

- MTM - RBAS
  - Partially stuck open
- Internal transmission
  - Main Drive Gear Low
  - Rail B Synchronizer

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 31:

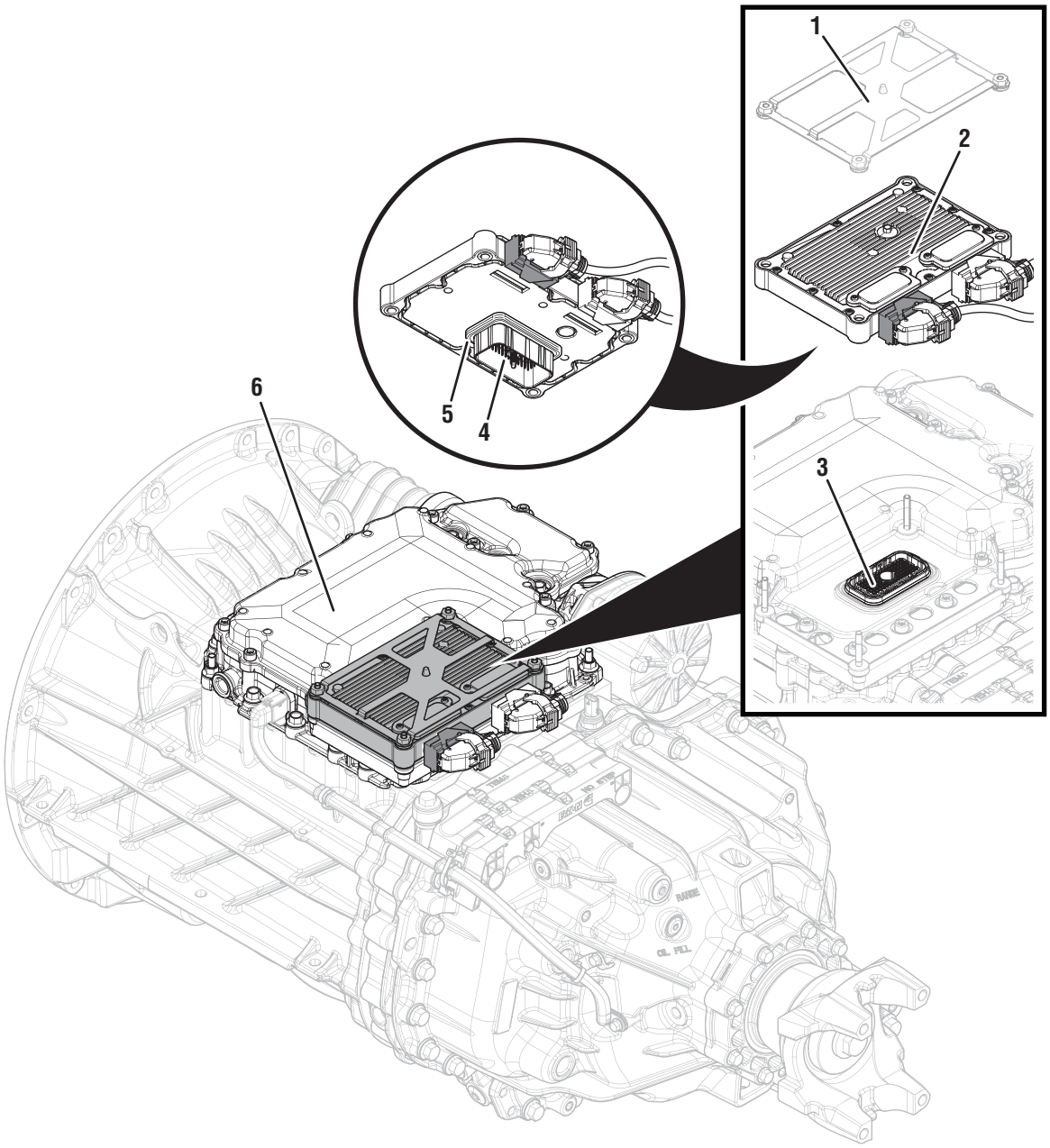
- MTM - RBAS
  - Partially stuck open

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- Rail B Synchronizer Engagement Tool (RR1088TR)

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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)

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Fault Code 597 Troubleshooting

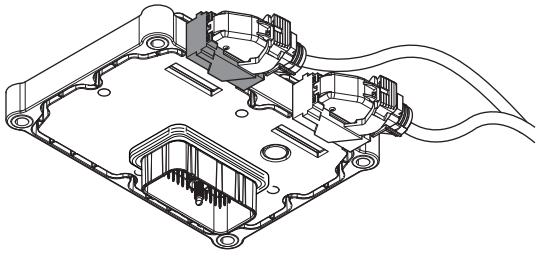
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 597 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 597 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 597 FMI 7, 31 is Active or Inactive, go to **TAIB-1006** *MTM Solenoid Fault Codes and Vehicle Air System Contamination*.
   - If Fault Code 597 FMI 14 is Active or Inactive, go to **Step E.**
   - If Fault Code 597 FMI 17 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

     NOTICE: Refer to Vehicle Maintenance Recommendations in TRSM0960 regarding vehicle air system requirements to ensure proper air supply and air quality.

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



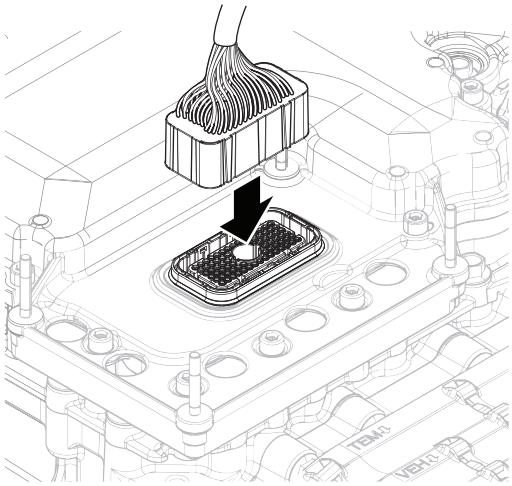
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

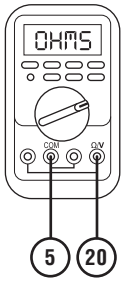
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C ***Purpose:*** *Verify Rail B Aft Solenoid resistance and not shorted to ground.*

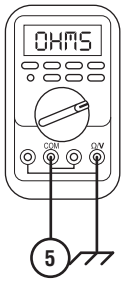
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 5 and Pin 20. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
5 to 20	3.4–5.5 Ohms	
5 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record 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 **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 597 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

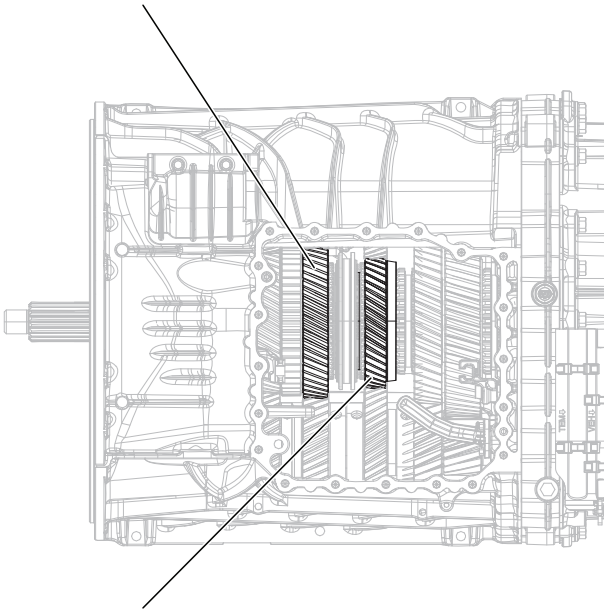
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify mechanical condition of Main Drive Gear Low and Splitter Gear.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Main Drive Gear Low for excessive fore and aft movement.

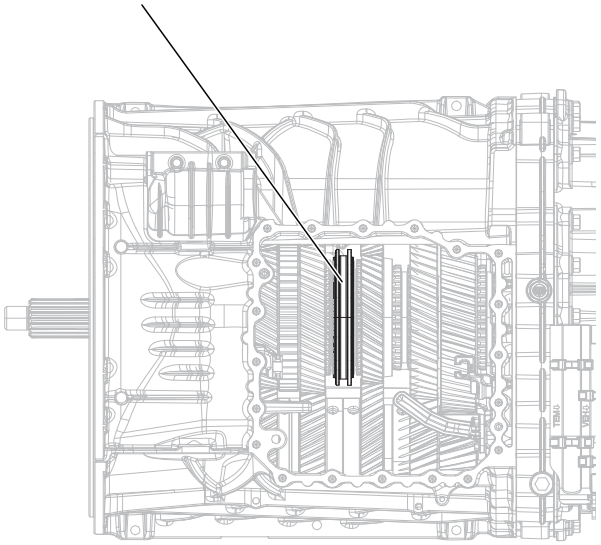


4. Inspect Splitter Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

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F ***Purpose:*** *Verify mechanical condition of Rail B Synchronizer and clutching teeth.*

1. Inspect 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 Rail B Synchronizer Sliding Sleeve into neutral position (if necessary).
4. Shift Rail B Synchronizer Sliding Sleeve into Main Drive Gear Low engagement position (fore).
5. Inspect Splitter Gear and Rail B Synchronizer Sleeve clutching teeth for wear.
6. Return Rail B Synchronizer Sliding Sleeve to neutral position.
7. Shift Rail B Synchronizer Sliding Sleeve into Splitter Gear engagement position (aft).
8. Inspect Splitter Gear and Rail B Synchronizer Sliding Sleeve clutching teeth for wear.
9. Return Rail B Synchronizer Sliding Sleeve to neutral position.
   - If Rail B Synchronizer Sliding Sleeve shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. go to **Step V.**
   - If Rail B Synchronizer Sliding Sleeve does not shift into all three positions or clutching teeth wear is present, replace Rail B Synchronizer Assembly, Main Drive Gear Low, Splitter Gear and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 597 sets Active, go to **Step A.**
   - If a fault code other than 597 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 616: Rail C Fore Solenoid (C1)

J1939: SA 3 SPN 5902 FMI 0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the shift rail cylinders in the Mechatronic Transmission Module (MTM). Movement of each shift rail is controlled 2 solenoids; a Fore and an Aft.

The Rail C Fore Solenoid (RCFS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail C Cylinder to move the Rail C Shift Yoke and Rail C Sliding Clutch in the fore or forward direction. The RCFS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the RCFS circuit and Shift Rail C position. 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): RCFS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RCFS circuit shorted to power for 2 seconds after RCFS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: RCFS circuit shorted to ground for 2 seconds after RCFS commanded off.

FMI 5 – Current Below Normal or Open Circuit: RCFS circuit open for 2 seconds after RCFS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: RCFS circuit shorted to ground for 2 seconds after RCFS commanded on.

FMI 7 – Mechanical System Not Responding: Rail C Position value and speed sensors confirmed uncommanded movement from Driven Gear 2nd toward neutral position.

FMI 8 – Abnormal Frequency: RCFS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 14 – Special Instructions: Rail C Position value indicated uncommanded movement from neutral position toward Splitter Gear immediately after a shift into neutral position.

FMI 15 – Data Valid but Above Normal (Least Severe): Rail C Position value indicated uncommanded movement from neutral position toward Splitter Gear for 2 seconds.

FMI 16 – Data Valid but Above Normal (Moderately Severe): RCFS commanded on longer than expected increasing solenoid temperature.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail C Position value and speed sensors confirmed uncommanded movement from Driven Gear 2nd toward neutral position.

FMI 18 – Data Valid but Below Normal (Moderately Severe): RCFS circuit voltage lower than expected for 1 second after RCFS commanded on.

FMI 31 – Condition Exists: During a rail calibration, Rail C Position value indicated uncommanded movement from neutral position toward Splitter Gear immediately after a shift into neutral position.

Fallback

FMI 0, 1, 5, 6, 8, 12, 16, 18:

- Amber warning lamp on
- If vehicle is stationary and Shift Rail C is not in neutral position
  - Shift Rail C movement in the fore direction prohibited
- If vehicle is moving and Shift Rail C is in neutral position
  - Shift Rail C movement prohibited

FMI 3, 4:

- Amber warning lamp on
- Shift Rail C movement prohibited
- If vehicle is moving and no start gear is available
  - Red stop lamp on

FMI 7:

- No degraded modes

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FMI 14:

- Amber warning lamp on
- Shift Rail C movement prohibited

FMI 15:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 17:

- Amber warning lamp on
- Driven Gear 2nd engagement prohibited

FMI 31:

If Shift Rail C is in a fully engaged or fully disengaged position:

- Amber warning lamp on
- Shift Rail C movement prohibited

If Shift Rail C is not in a fully engaged or fully disengaged position:

- Shift Rail C movement prohibited
- Shift Rail D movement prohibited
- Inertia Brake activation prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31: Key cycle and fault condition no longer exist.

FMI 3: RCFS circuit not shorted to power for 10 seconds.

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

FMI 5: RCFS circuit not open 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 7, 17:

- MTM - RCFS
  - Partially stuck open
- Internal transmission
  - Splitter Gear
  - Rail C Sliding Clutch

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 14, 15:

- MTM - RCFS
  - Partially stuck open
- MTM - Rail C Position Sensor
  - Internal failure

FMI 31:

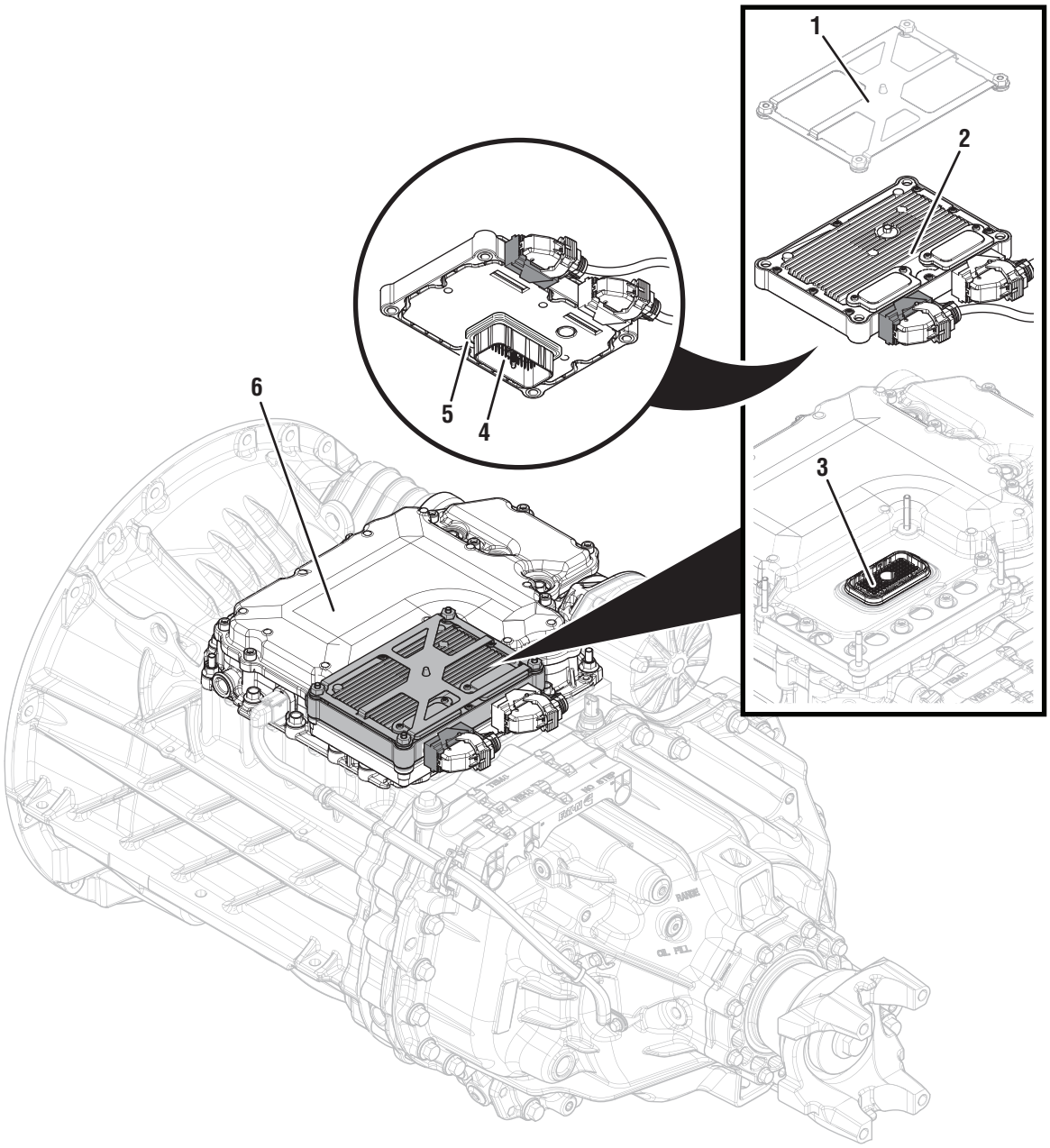
- MTM - RCFS
  - Partially stuck open

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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Fault Code 616 Troubleshooting

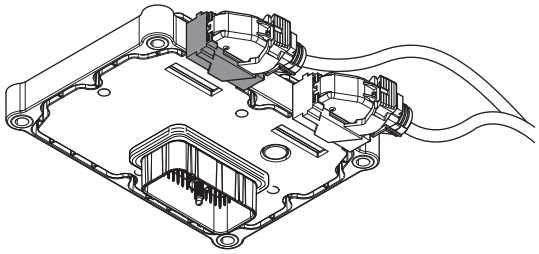
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 616 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 616 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 616 FMI 7, 14, 15, 31 is Active or Inactive, go to **TAIB-1006** *MTM Solenoid Fault Codes and Vehicle Air System Contamination*.
   - If Fault Code 616 FMI 17 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

     NOTICE: Refer to Vehicle Maintenance Recommendations in TRSM0960 regarding vehicle air system requirements to ensure proper air supply and air quality.

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



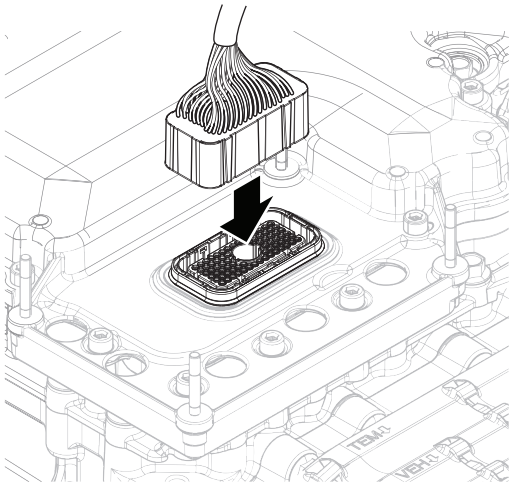
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

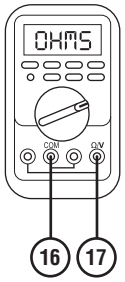
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C ***Purpose:*** *Verify Rail C Fore Solenoid resistance and not shorted to ground.*

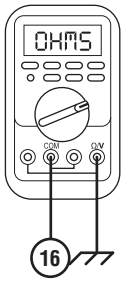
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 16 and Pin 17. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
16 to 17	3.4–5.5 Ohms	
16 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record 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 **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 616 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

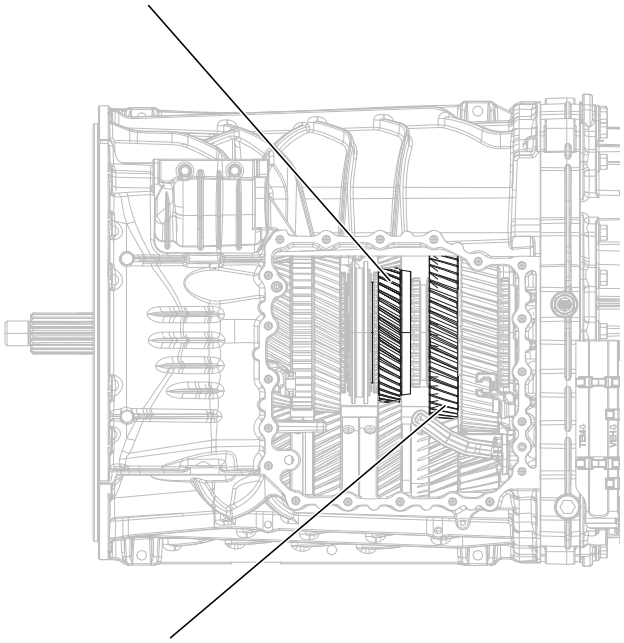
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify mechanical condition of Splitter Gear and Driven Gear 2nd.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Splitter Gear for excessive fore and aft movement.

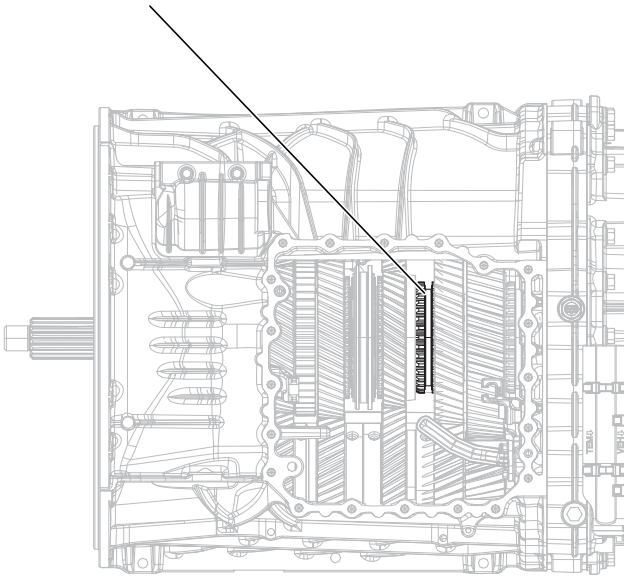


4. Inspect Driven Gear 2nd for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

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F ***Purpose:*** *Verify mechanical condition of Rail C Sliding Clutch and clutching teeth.*

1. Inspect Rail C Sliding Clutch yoke slot for wear.



2. Shift Rail C Sliding Clutch into neutral position (if necessary).
3. Shift Rail C Sliding Clutch into Splitter Gear engagement position (fore).
4. Inspect Rail C Sliding Clutch clutching teeth for wear.
5. Return Rail C Sliding Clutch to neutral position.
6. Shift Rail C Sliding Clutch into Driven Gear 2nd engagement position (aft).
7. Inspect Rail C Sliding Clutch clutching teeth for wear.
8. Return Rail C Sliding Clutch to neutral position.
   - If Rail C Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail C Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace Rail C Sliding Clutch, Splitter Gear, Driven Gear 2nd and MTM. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 616 sets Active, go to **Step A.**
   - If a fault code other than 616 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 617: Rail C Aft Solenoid (B1)

J1939: SA 3 SPN 5910 FMI 0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31

Overview

The Rail C Aft Solenoid (RCAS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail C Cylinder to move the Rail C Shift Yoke and Rail C Sliding Clutch in the aft or rearward direction. The RCAS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

The Transmission Control Module (TCM) energizes the Rail C Aft Solenoid (RCAS) valve, allowing vehicle supplied air pressure to the Shift Rail C Cylinder to move the Rail C Shift Yoke and 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 circuit and Shift Rail C position. 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): RCAS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RCAS circuit shorted to power for 2 seconds after RCAS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: RCAS circuit shorted to ground for 2 seconds after RCAS commanded off.

FMI 5 – Current Below Normal or Open Circuit: RCAS circuit open for 2 seconds after RCAS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: RCAS circuit shorted to ground for 2 seconds after RCAS commanded on.

FMI 7 – Mechanical System Not Responding: Rail C Position value and speed sensors confirmed uncommanded movement from Splitter Gear toward neutral position.

FMI 8 – Abnormal Frequency: RCAS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 14 – Special Instructions: Rail C Position value indicated uncommanded movement from neutral position toward Driven Gear 2nd immediately after a shift into neutral position.

FMI 15 – Data Valid but Above Normal (Least Severe): Rail C Position value indicated uncommanded movement from neutral position toward Driven Gear 2nd for 2 seconds.

FMI 16 – Data Valid but Above Normal (Moderately Severe): RCAS commanded on longer than expected increasing solenoid temperature.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail C Position value and speed sensors confirmed uncommanded movement from Splitter Gear toward neutral position.

FMI 18 – Data Valid but Below Normal (Moderately Severe): RCAS circuit voltage lower than expected for 1 second after RCAS commanded on.

FMI 31 – Condition Exists: During a rail calibration, Rail C Position value indicated uncommanded movement from neutral position toward Driven Gear 2nd immediately after a shift into neutral position.

Fallback

FMI 0, 1, 5, 6, 8, 12, 16, 18:

- Amber warning lamp on
- If vehicle is stationary and Shift Rail C is not in Driven Gear 2nd or neutral position:
  - Shift Rail C movement in the aft direction prohibited
- If vehicle is moving and Shift Rail C is in the Driven Gear 2nd or neutral position:
  - Shift Rail C movement prohibited

FMI 3, 4:

- Amber warning lamp on
- Shift Rail C movement prohibited
- If vehicle is moving and no start gear is available:
  - Red stop lamp on

FMI 7:

- No degraded modes

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FMI 14:

- Amber warning lamp on
- Shift Rail C movement prohibited

FMI 15:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited

FMI 17:

- Amber warning lamp on
- Splitter Gear engagement prohibited

FMI 31:

If Shift Rail C is in a fully engaged or fully disengaged position:

- Amber warning lamp on
- Shift Rail C movement prohibited

If Shift Rail C is not in a fully engaged or fully disengaged position:

- Shift Rail C movement prohibited
- Shift Rail D movement prohibited
- Inertia Brake activation prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31: Key cycle and fault condition no longer exist.

FMI 3: RCAS circuit not shorted to power for 10 seconds.

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

FMI 5: RCAS circuit not open 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 7, 17:

- MTM - RCAS
  - Partially stuck open
- Internal transmission
  - Driven Gear 2nd
  - Rail C Sliding Clutch

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 14, 15:

- MTM - RCAS
  - Partially stuck open
- MTM - Rail C Position Sensor
  - Internal failure

FMI 31:

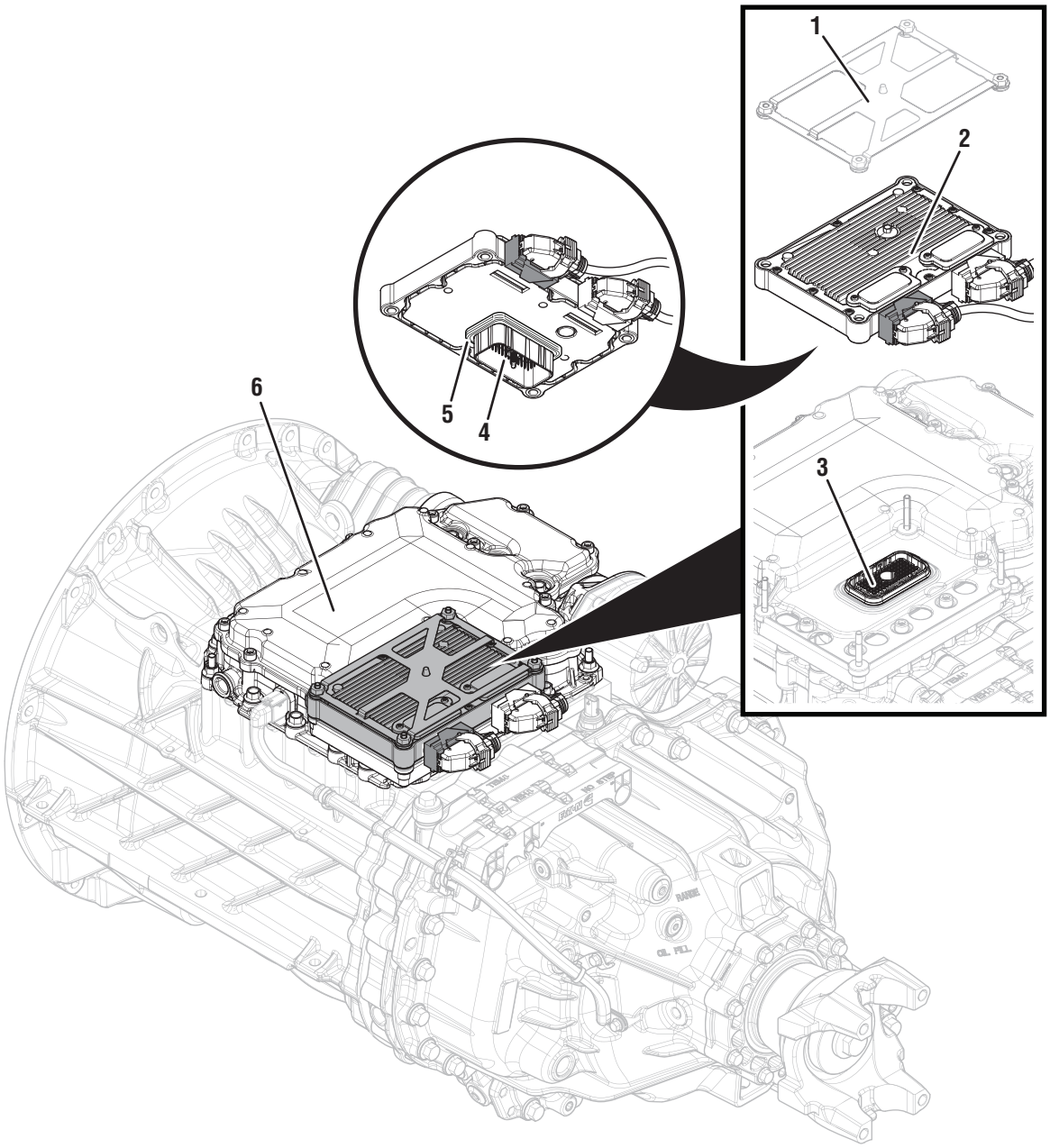
- MTM - RCAS
  - Partially stuck open

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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Fault Code 617 Troubleshooting

A

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

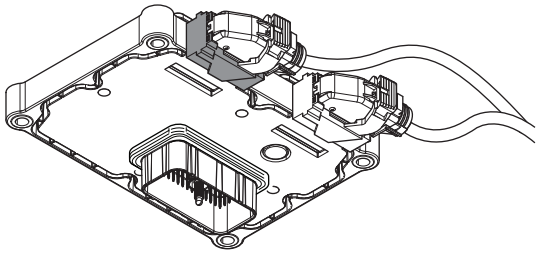
1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 617 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 617 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 617 FMI 7, 14, 15, 31 is Active or Inactive, go to **TAIB-1006** *MTM Solenoid Fault Codes and Vehicle Air System Contamination*.
   - If Fault Code 617 FMI 17 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

     NOTICE: Refer to Vehicle Maintenance Recommendations in TRSM0960 regarding vehicle air system requirements to ensure proper air supply and air quality.

B

Purpose: *Verify condition of TCM 74-Way Connector.*

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



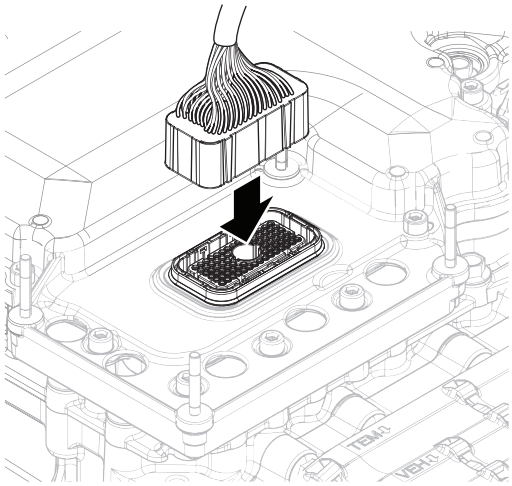
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

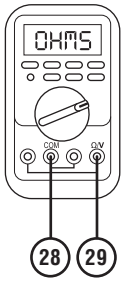
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C ***Purpose:*** *Verify Rail C Aft Solenoid resistance and not shorted to ground.*

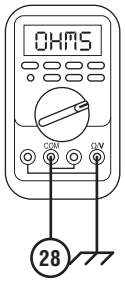
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 28 and Pin 29. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
28 to 29	3.4–5.5 Ohms	
28 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record 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 **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 617 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

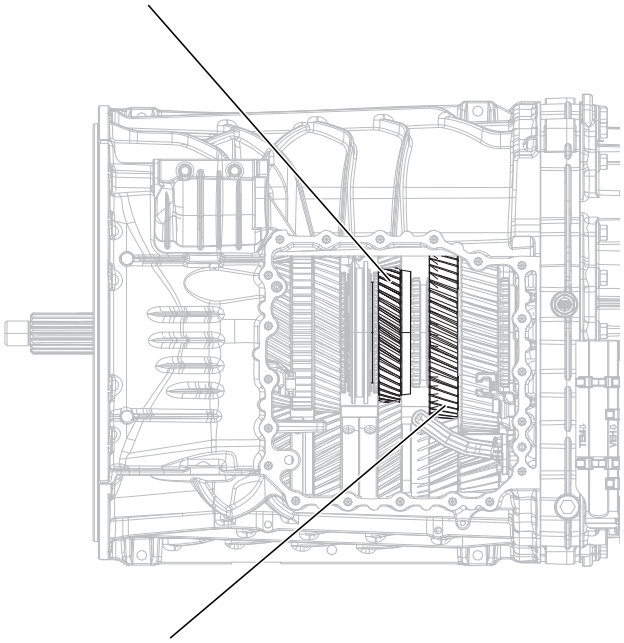
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify mechanical condition of Splitter Gear and Driven Gear 2nd.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Splitter Gear for excessive fore and aft movement.

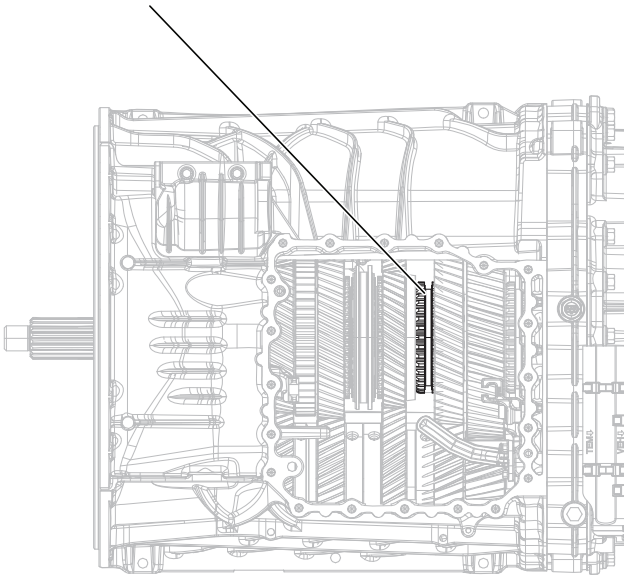


4. Inspect Driven Gear 2nd for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

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F ***Purpose:*** *Verify mechanical condition of Rail C Sliding Clutch and clutching teeth.*

1. Inspect Rail C Sliding Clutch yoke slot for wear.



2. Shift Rail C Sliding Clutch into neutral position (if necessary).
3. Shift Rail C Sliding Clutch into Splitter Gear engagement position (fore).
4. Inspect Rail C Sliding Clutch clutching teeth for wear.
5. Return Rail C Sliding Clutch to neutral position.
6. Shift Rail C Sliding Clutch into Driven Gear 2nd engagement position (aft).
7. Inspect Rail C Sliding Clutch clutching teeth for wear.
8. Return Rail C Sliding Clutch to neutral position.
   - If Rail C Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail C Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace Rail C Sliding Clutch, Splitter Gear, Driven Gear 2nd and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 617 sets Active, go to **Step A.**
   - If a fault code other than 617 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 636: Rail D Fore Solenoid (C2)

J1939: SA 3 SPN 5903 FMI 0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the shift rail cylinders in the Mechatronic Transmission Module (MTM). Movement of each shift rail is controlled 2 solenoids; a Fore and a Aft.

The Rail D Fore Solenoid (RDFS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail D Cylinder to move the Rail D Shift Yoke and Rail D Sliding Clutch in the fore or forward direction. The RDFS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the RDFS circuit and Shift Rail D position. 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): RDFS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RDFS circuit shorted to power for 2 seconds after RDFS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: RDFS circuit shorted to ground for 2 seconds after RDFS commanded off.

FMI 5 – Current Below Normal or Open Circuit: RDFS circuit open for 2 seconds after RDFS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: RDFS circuit shorted to ground for 2 seconds after RDFS commanded on.

FMI 7 – Mechanical System Not Responding: Rail D Position value and speed sensors confirmed uncommanded movement from Reverse Gear toward neutral position.

FMI 8 – Abnormal Frequency: RDFS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 14 – Special Instructions: Rail D Position value indicated uncommanded movement from neutral position toward Driven Gear 1st immediately after a shift into neutral position.

FMI 15 – Data Valid but Above Normal (Least Severe): Rail D Position value indicated uncommanded movement from neutral position toward Driven Gear 1st for 2 seconds.

FMI 16 – Data Valid but Above Normal (Moderately Severe): RDFS commanded on longer than expected increasing solenoid temperature.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail D Position value and speed sensors confirmed uncommanded movement from Reverse Gear toward neutral position.

FMI 18 – Data Valid but Below Normal (Moderately Severe): RDFS circuit voltage lower than expected for 1 second after RDFS commanded on.

FMI 31 – Condition Exists: During a rail calibration, Rail D Position value indicated uncommanded movement from neutral position toward Driven Gear 1st immediately after a shift into neutral position.

Fallback

FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18:

- Amber warning lamp on
- If vehicle is stationary and Shift Rail D is not in Driven Gear 1st or neutral position:
  - Shift Rail D movement in the fore direction prohibited
- If vehicle is moving and Shift Rail D is in Driven Gear 1st or neutral position:
  - Shift Rail D movement prohibited

FMI 7:

- No degraded modes

FMI 14:

- Amber warning lamp on
- Shift Rail D movement prohibited

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FMI 15:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO mode prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 17:

- Amber warning lamp on
- Reverse Gear engagement prohibited

FMI 31:

If Shift Rail D is in a fully engaged or fully disengaged position:

- Amber warning lamp on
- Shift Rail D movement prohibited

If Shift Rail D is not in a fully engaged or fully disengaged position:

- Shift Rail C movement prohibited
- Shift Rail D movement prohibited
- Inertia Brake activation prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 14, 15, 16, 17, 18: Key cycle and fault condition no longer exist.

FMI 3: RDFS circuit not shorted to power for 10 seconds.

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

FMI 5: RDFS circuit not open 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 7, 17:

- MTM - RDFS
  - Partially stuck open
- Internal transmission
  - Driven Gear 1st
  - Rail D Sliding Clutch

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 14, 15:

- MTM - RDFS
  - Partially stuck open
- MTM - Rail D Position Sensor
  - Internal failure

FMI 31:

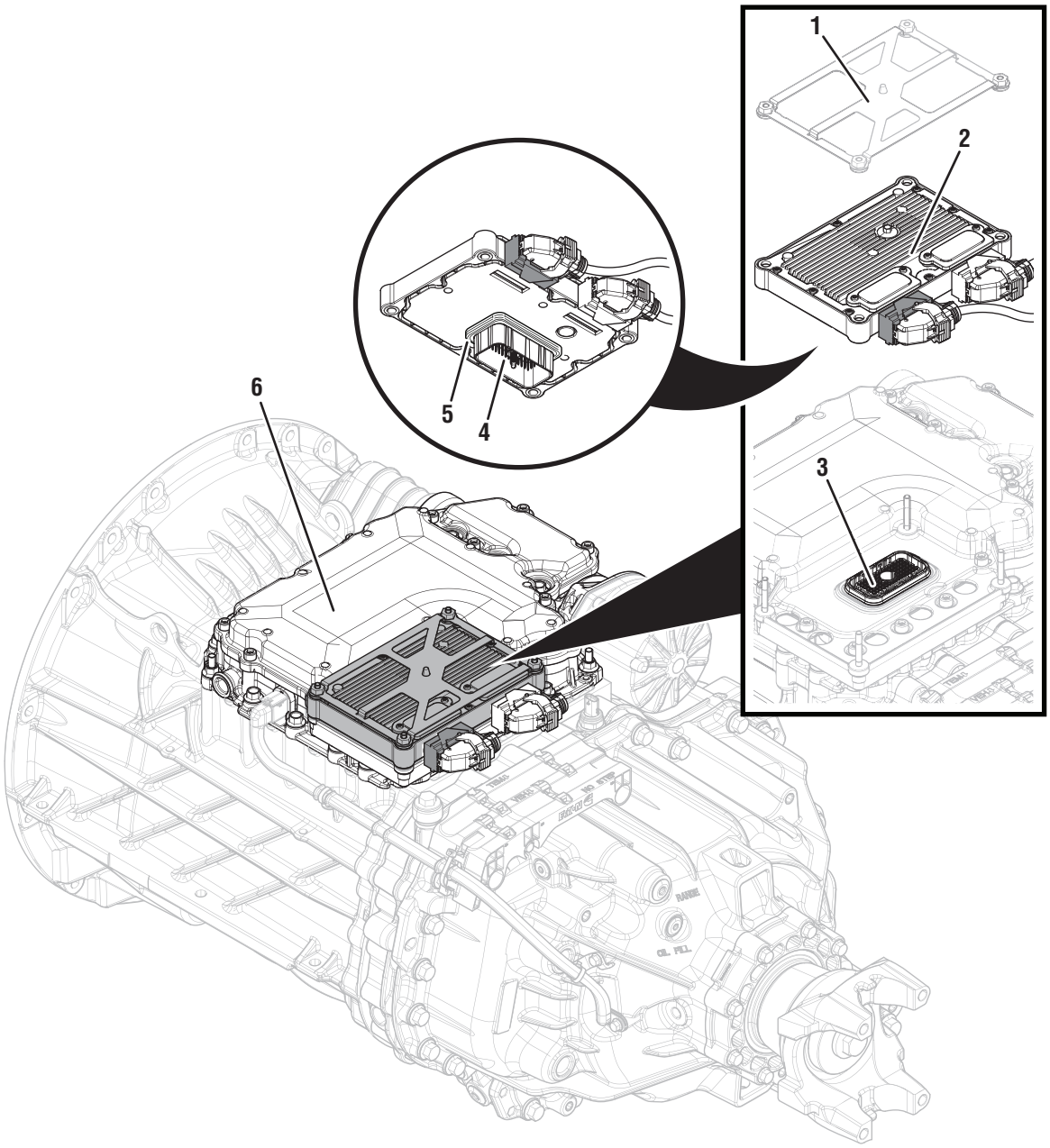
- MTM - RDFS
- Partially stuck open

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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Fault Code 636 Troubleshooting

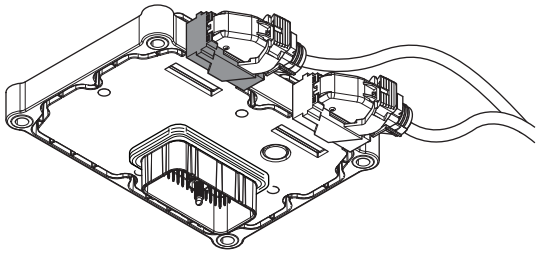
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 636 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive,go to **Step B.**
   - If Fault Code 636 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 636 FMI 7, 14, 15, 31 is Active or Inactive, go to **TAIB-1006** *MTM Solenoid Fault Codes and Vehicle Air System Contamination*.
   - If Fault Code 636 FMI 17 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

     NOTICE: Refer to Vehicle Maintenance Recommendations in TRSM0960 regarding vehicle air system requirements to ensure proper air supply and air quality.

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



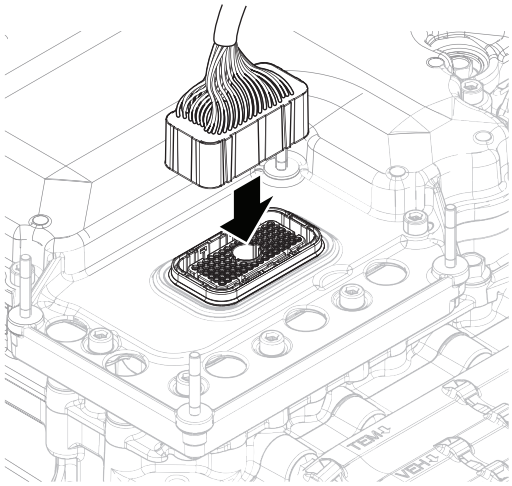
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

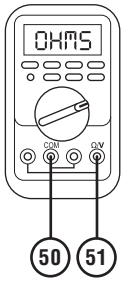
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C ***Purpose:*** *Verify Rail D Fore Solenoid resistance and not shorted to ground.*

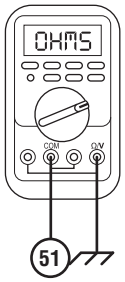
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 50 and Pin 51. Record reading in table.



4. Measure resistance at Eaton Breakout Box between Pin 51 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
50 to 51	3.4–5.5 Ohms	
51 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record 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 **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 636 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

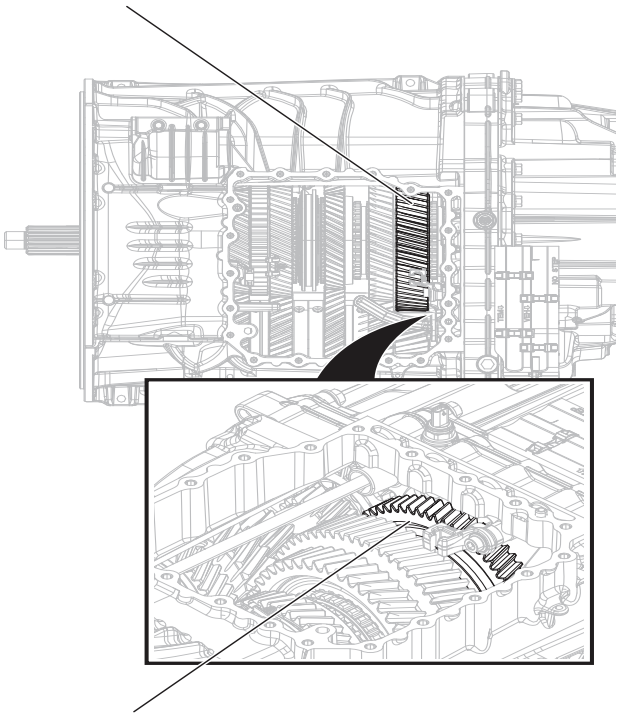
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify mechanical condition of Driven Gear 1st and Reverse Gear.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Driven Gear 1st for excessive fore and aft movement.

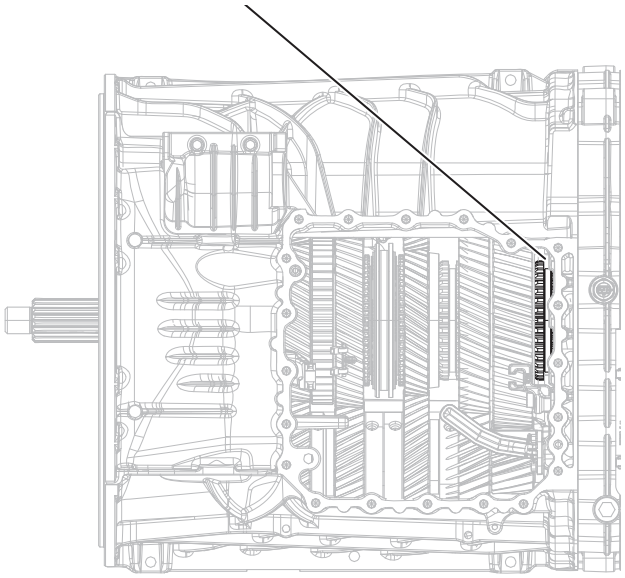


4. Inspect Reverse Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

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F ***Purpose:*** *Verify mechanical condition of Rail D Sliding Clutch and clutching teeth.*

1. Inspect Rail D Sliding Clutch yoke slot for wear.



2. Shift Rail D Sliding Clutch to neutral position (if necessary).
3. Shift Rail D Sliding Clutch into Driven Gear 1st engagement position (fore).
4. Inspect Rail D Sliding Clutch clutching teeth for wear.
5. Return Rail D Sliding Clutch to neutral position.
6. Shift Rail D Sliding Clutch into Reverse Gear engagement position (aft).
7. Inspect Rail D Sliding Clutch clutching teeth for wear.
8. Return Rail D Sliding Clutch to neutral position.
   - If Rail D Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail D Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace Rail D Sliding Clutch, Driven Gear 1st, Reverse Gear, and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 636 sets Active, go to **Step A.**
   - If a fault code other than 636 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 637: Rail D Aft Solenoid (B3)

J1939: SA 3 SPN 4216 FMI 0, 1, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the shift rail cylinders in the Mechatronic Transmission Module (MTM). Movement of each shift rail is controlled 2 solenoids; a Fore and a Aft.

The Rail D Aft Solenoid (RDAS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail D Cylinder to move the Rail D Shift Yoke and Rail D Sliding Clutch in the aft or rearward direction. The RDAS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the RDAS circuit and Shift Rail D position. 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): RDAS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RDAS circuit shorted to power for 2 seconds after RDAS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: RDAS circuit shorted to ground for 2 seconds after RDAS commanded off.

FMI 5 – Current Below Normal or Open Circuit: RDAS circuit open for 2 seconds after RDAS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: RDAS circuit shorted to ground for 2 seconds after RDAS commanded on.

FMI 7 – Mechanical System Not Responding: Rail D Position value and speed sensors confirmed uncommanded movement from Driven Gear 1sst toward neutral position.

FMI 8 – Abnormal Frequency: RDAS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 14 – Special Instructions: Rail D Position value indicated uncommanded movement from neutral position toward Reverse Gear immediately after a shift into neutral position.

FMI 15 – Data Valid but Above Normal (Least Severe): Rail D Position value indicated uncommanded movement from neutral position toward Reverse Gear for 2 seconds.

FMI 16 – Data Valid but Above Normal (Moderately Severe): RDAS commanded on longer than expected increasing solenoid temperature.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail D Position value and speed sensors confirmed uncommanded movement from Driven Gear 1st toward neutral position.

FMI 18 – Data Valid but Below Normal (Moderately Severe): RDAS circuit voltage lower than expected for 1 second after RDAS commanded on.

FMI 31 – Condition Exists: During a rail calibration, Rail D Position value indicated uncommanded movement from neutral position toward Reverse Gear immediately after a shift into neutral position.

Fallback

FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18:

- Amber warning lamp on
- If vehicle is stationary and Shift Rail D is not in the neutral position:
  - Shift Rail D movement in the aft direction prohibited
- If vehicle is moving and Shift Rail D is in neutral position:
  - Shift Rail D movement prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

FMI 7:

- No degraded modes

FMI 14:

- Amber warning lamp on
- Shift Rail D movement prohibited

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FMI 15:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 17:

- Amber warning lamp on
- Driven Gear 1st engagement prohibited

FMI 31:

If Shift Rail D is not in a fully engaged or fully disengaged position:

- Amber warning lamp on
- Shift Rail D movement prohibited

If Shift Rail D is in a fully engaged or fully disengaged position:

- Shift Rail C movement prohibited
- Shift Rail D movement prohibited
- Inertia Brake activation prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 14, 15, 16, 17, 18, 31: Key cycle and fault condition no longer exists.

FMI 3: RDAS circuit not shorted to power for 10 seconds.

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

FMI 5: RDAS circuit not open 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 7, 17:

- MTM - RDAS
  - Partially stuck open
- Internal transmission
  - Reverse Gear
  - Rail D Sliding Clutch

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 14, 15:

- MTM - RDAS
  - Partially stuck open
- MTM - Rail D Position Sensor
  - Internal failure

FMI 31:

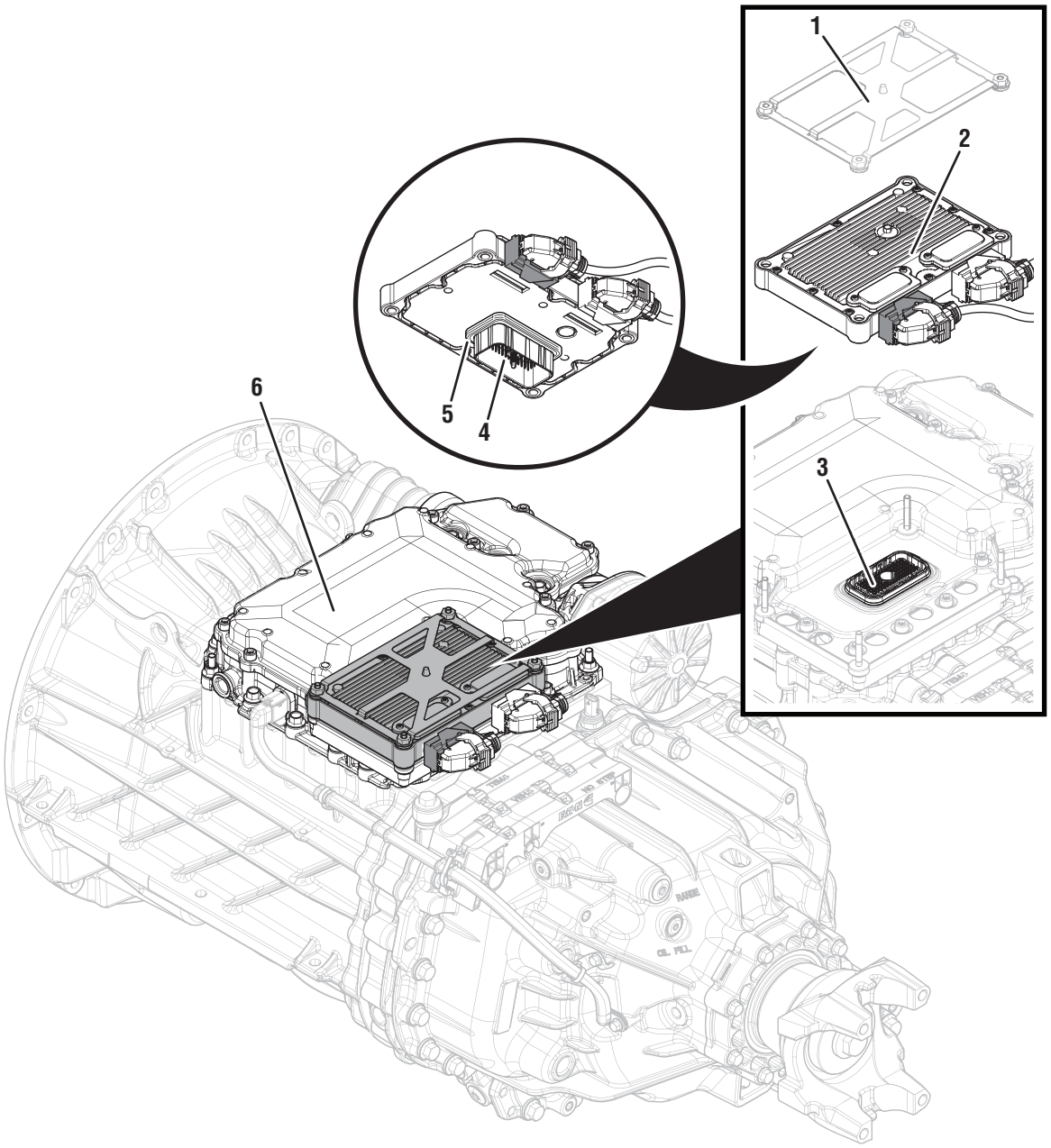
- MTM - RDAS
- Partially stuck open

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)

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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)

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Fault Code 637 Troubleshooting

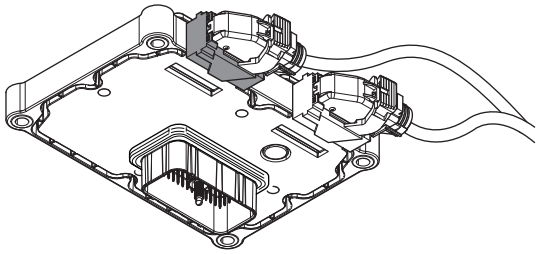
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 637 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 637 FMI 12 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 637 FMI 7, 14, 15, 31 is Active or Inactive, go to **TAIB-1006** *MTM Solenoid Fault Codes and Vehicle Air System Contamination*.
   - If Fault Code 637 FMI 17 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line numbers, go to *Contact Information* on page 2. Go to **Step V.**

     NOTICE: Refer to Vehicle Maintenance Recommendations in TRSM0960 regarding vehicle air system requirements to ensure proper air supply and air quality.

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



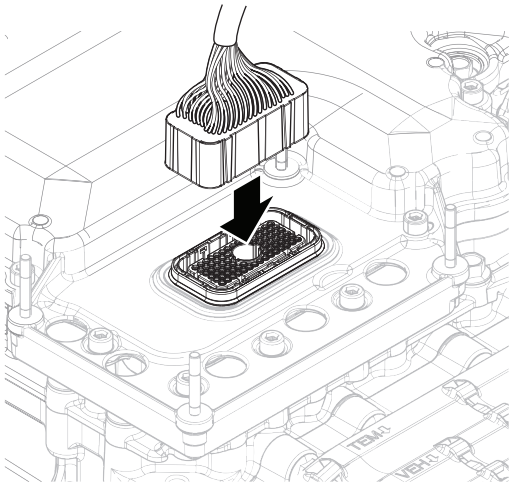
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

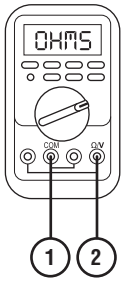
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C ***Purpose:*** *Verify Rail D Aft Solenoid resistance and not shorted to ground.*

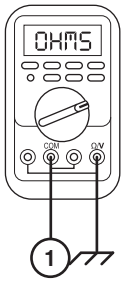
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 1 and Pin 2. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
1 to 2	3.4–5.5 Ohms	
1 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record 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 **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 637 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18, 31 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

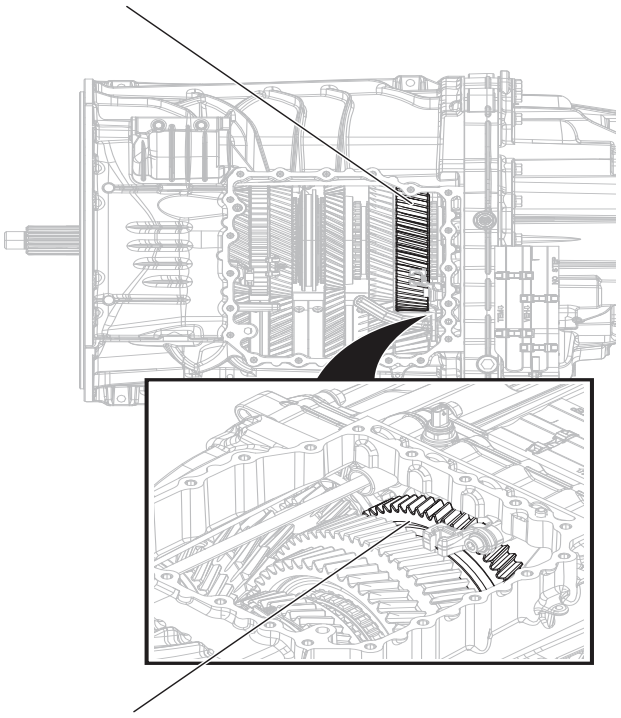
     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify mechanical condition of Driven Gear 1st and Reverse Gear.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Driven Gear 1st for excessive fore and aft movement.

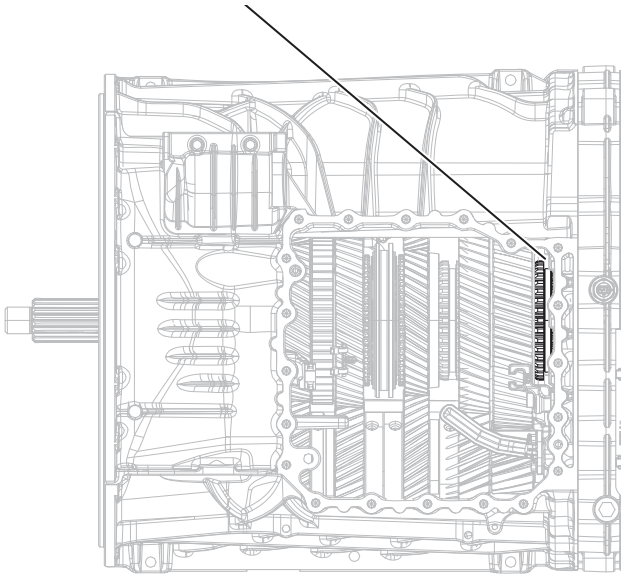


4. Inspect Reverse Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step F.**

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F ***Purpose:*** *Verify mechanical condition of Rail D Sliding Clutch and clutching teeth.*

1. Inspect Rail D Sliding Clutch yoke slot for wear.



2. Shift Rail D Sliding Clutch to neutral position (if necessary).
3. Shift Rail D Sliding Clutch into Driven Gear 1st engagement position (fore).
4. Inspect Rail D Sliding Clutch clutching teeth for wear.
5. Return Rail D Sliding Clutch to neutral position.
6. Shift Rail D Sliding Clutch into Reverse Gear engagement position (aft).
7. Inspect Rail D Sliding Clutch clutching teeth for wear.
8. Return Rail D Sliding Clutch to neutral position.
   - If Rail D Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail D Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace Rail D Sliding Clutch, Driven Gear 1st, Reverse Gear, and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 637 sets Active, go to **Step A.**
   - If a fault code other than 637 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 646: Rail E Fore Solenoid (A6)

J1939: SA 3 SPN 768 FMI 0, 1, 3, 4, 5, 6, 7, 8, 12, 16, 17, 18

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the shift rail cylinders in the Mechatronic Transmission Module (MTM). Movement of each shift rail is controlled 2 solenoids; a Fore and a Aft.

The Rail E Fore Solenoid (REFS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail E Cylinder to move the Rail E Shift Yoke and Rail E Synchronizer in the fore or forward direction. The REFS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the REFS circuit and Shift Rail E position. 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): REFS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: REFS circuit shorted to power for 2 seconds after REFS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: REFS circuit shorted to ground for 2 seconds after REFS commanded off.

FMI 5 – Current Below Normal or Open Circuit: REFS circuit open for 2 seconds after REFS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: REFS circuit shorted to ground for 2 seconds after REFS commanded on.

FMI 7 – Mechanical System Not Responding: Rail E Position value and speed sensors confirmed uncommanded movement from Low Range toward neutral position.

FMI 8 – Abnormal Frequency: REFS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM detected an internal processing error.

FMI 16 – Data Valid but Above Normal (Moderately Severe): REFS commanded on longer than expected increasing solenoid temperature.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail E Position value and speed sensors confirmed uncommanded movement from Low Range toward neutral position.

FMI 18 – Data Valid but Below Normal (Moderately Severe): REFS circuit voltage lower than expected for 1 second after REFS commanded on.

Fallback

FMI 0, 1, 3, 4, 5, 6, 8, 12, 16, 18:

- Amber warning lamp on
- Shift Rail E movement in the fore direction prohibited

FMI 7:

- No degraded modes

FMI 17:

- Amber warning lamp on
- Low Range engagement prohibited

Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 16, 17, 18: Key cycle and fault condition no longer exists.

FMI 3: REFS circuit not shorted to power for 10 seconds.

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

FMI 5: REFS circuit not open 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

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FMI 7, 17:

- MTM - REFS
  - Partially stuck open
- Internal transmission
  - Rail E Detent
  - Rail E Synchronizer

FMI 12:

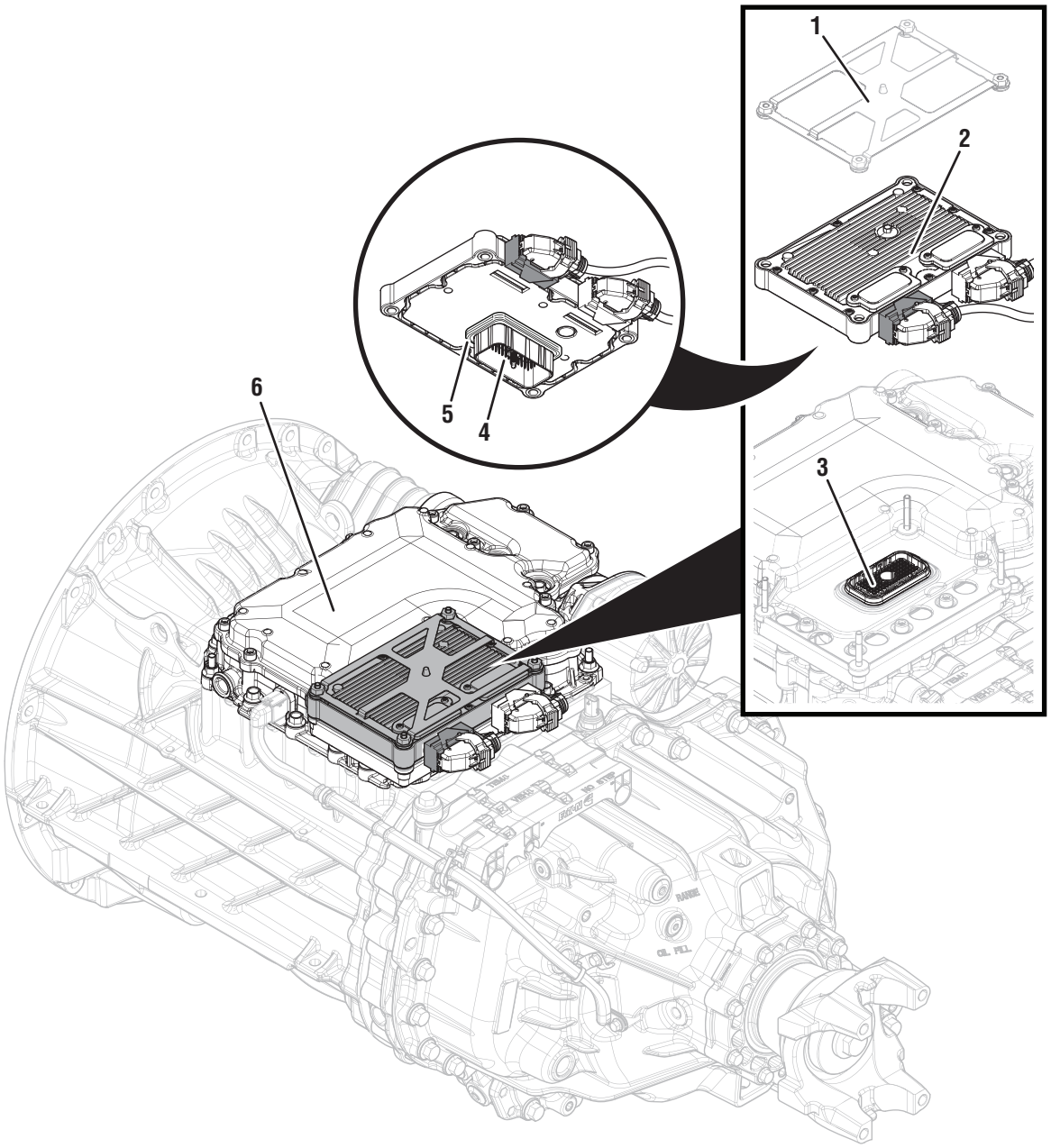
- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- MTM Alignment Tool (RR1086TR-1)

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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)

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Fault Code 646 Troubleshooting

A

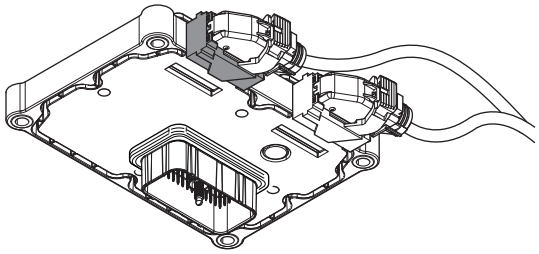
Purpose: *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Key off.
3. Record transmission fault codes, FMIs, occurrences, and timestamps from 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, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 646 FMI 7, 17 is Active or Inactive, go to **Step E.**

B

Purpose: *Verify condition of TCM 74-Way Connector.*

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



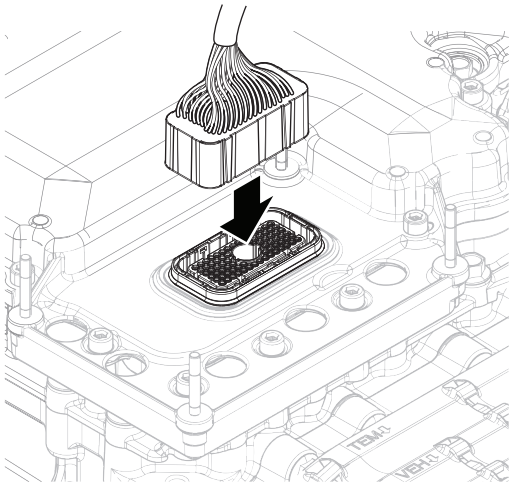
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

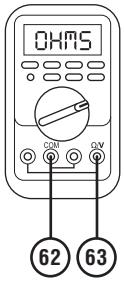
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C ***Purpose:*** *Verify Rail E Fore Solenoid resistance and not shorted to ground.*

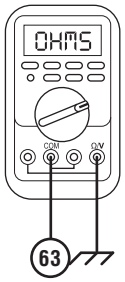
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 62 and Pin 63. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
62 to 63	3.4–5.5 Ohms	
63 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 646 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 646 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify mechanical movement of Rail E Range Synchronizer.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Install MTM Alignment Tool (RR1086TR-1) onto main housing.

   Note: Reference Appendix/Manually Actuate Rail E Procedure.
4. Using Rail E Lever, shift Rail E into neutral position (if necessary).
5. Shift Rail E into High Range engagement position (fore) and return to neutral position.
6. Shift Rail E into Low Range engagement position (aft) and return to neutral position.
   - Contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 646 sets Active, go to **Step A.**
   - If a fault code other than 646 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 647: Rail E Aft Solenoid (A4)

J1939: SA 3 SPN 769 FMI 0, 1, 3, 4, 5, 6, 7, 8, 12, 16, 17, 18

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the shift rail cylinders in the Mechatronic Transmission Module (MTM). Movement of each shift rail is controlled 2 solenoids; a Fore and a Aft.

The Rail E Aft Solenoid (REAS) valve is energized by the Transmission Control Module (TCM) to direct Supply Air to the Shift Rail E Cylinder to move the Rail E Shift Yoke and Rail E Synchronizer in the aft or reward direction. The REAS valve is located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the REAS circuit and Shift Rail E position. 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 value greater than commanded current for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): REAS Low-Side Current value less than commanded current for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: REAS circuit shorted to power for 2 seconds after REAS commanded off.

FMI 4 – Voltage Below Normal or Shorted Low: REAS circuit shorted to ground for 2 seconds after REAS commanded off.

FMI 5 – Current Below Normal or Open Circuit: REAS circuit open for 2 seconds after REAS commanded off.

FMI 6 – Current Above Normal or Shorted Circuit: REAS circuit shorted to ground for 2 seconds after REAS commanded on.

FMI 7 – Mechanical System Not Responding: Rail E Position value and speed sensors confirmed uncommanded movement from High Range toward neutral position.

FMI 8 – Abnormal Frequency: REAS signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: TCM detected an internal processing error.

FMI 16 – Data Valid but Above Normal (Moderately Severe): REAS commanded on longer than expected increasing solenoid temperature.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail E Position value and speed sensors confirmed uncommanded movement from High Range toward neutral position.

FMI 18 – Data Valid but Below Normal (Moderately Severe): REAS circuit voltage lower than expected for 1 second after REAS commanded on.

Fallback

FMI 0, 1, 3, 4, 5, 6, 8, 12, 18:

- Amber warning lamp on
- If Range is in a fully engaged position
  - Shift Rail E movement prohibited
- If Range Shift is not in a fully engaged position
  - Shift 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 7:

- No degraded modes

FMI 16:

- Amber warning lamp on
- Shift Rail E movement toward Low Range prohibited

FMI 17:

- Amber warning lamp on
- High Range engagement prohibited

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Conditions to Set Fault Code Inactive

FMI 0, 1, 6, 7, 8, 12, 16, 17, 18: Key cycle and fault condition no longer exist.

FMI 3: REAS circuit not shorted to power for 10 seconds.

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

FMI 5: REAS circuit not open 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 7, 17:

- MTM - REAS
  - Partially stuck open
- Internal transmission
  - Rail E Detent
  - Rail E Synchronizer

FMI 12:

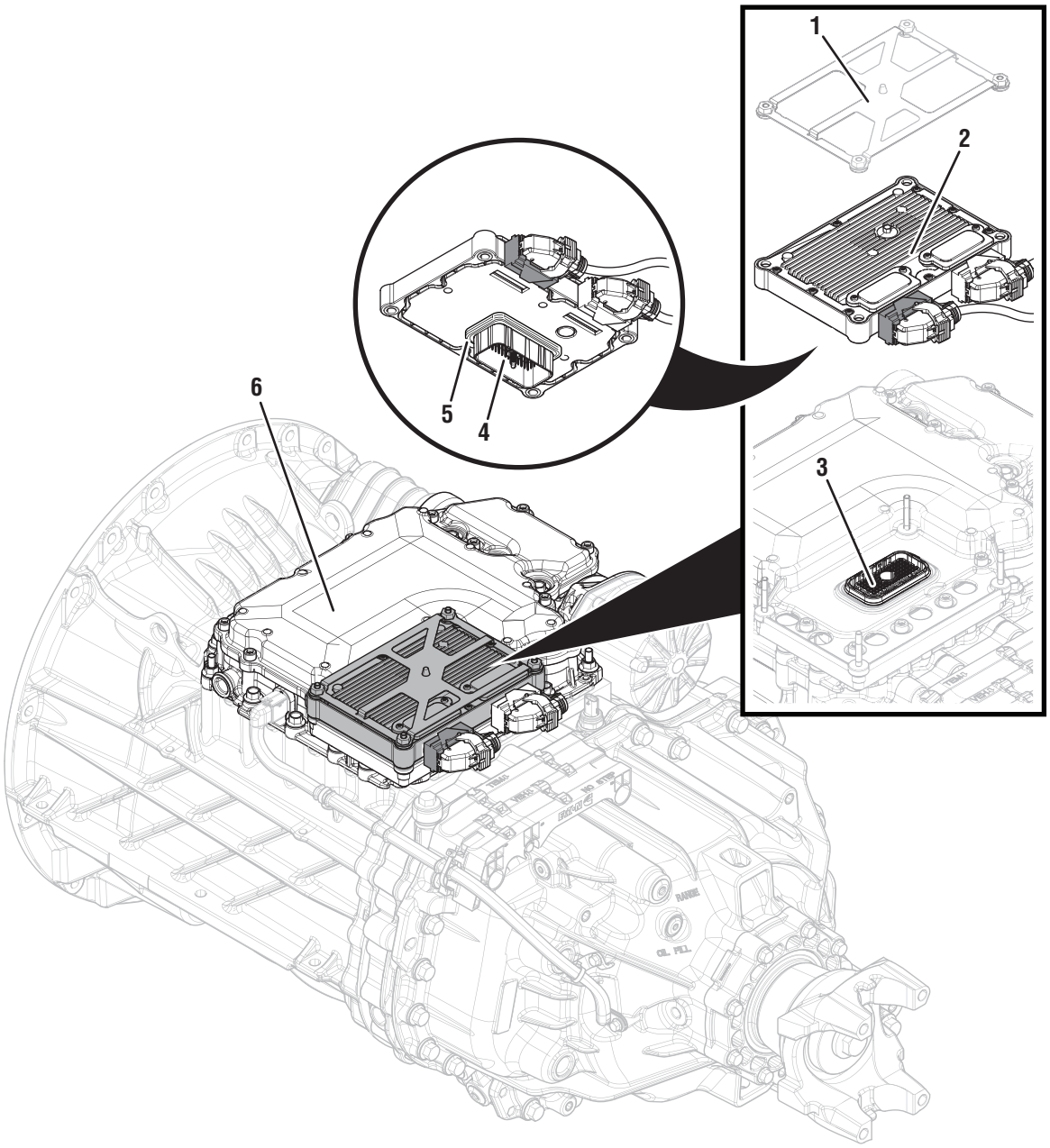
- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960
- Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter - RR1029TR
- Digital Volt/Ohm Meter (DVOM)
- MTM Alignment Tool (RR1086TR-1)

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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)

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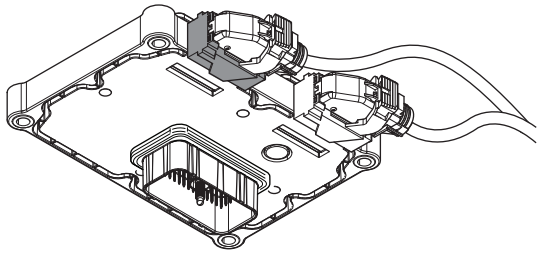
Fault Code 647 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 647 FMI 7, 17 is Active or Inactive, go to **Step E.**

B ***Purpose:*** *Verify condition of TCM 74-Way Connector.*

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



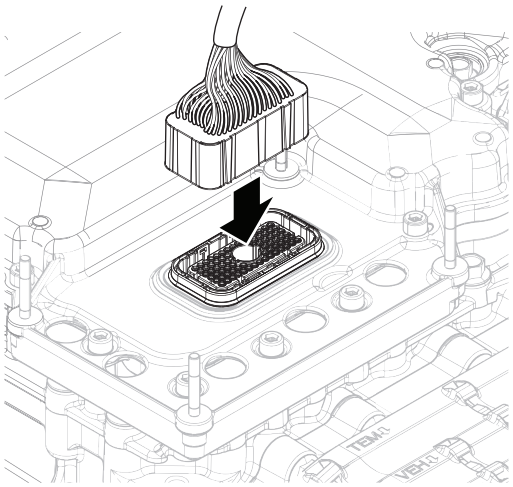
3. Inspect TCM side of the 74-Way Transmission Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect TCM Seal, verify seal is properly installed and not damaged.
   - If contamination or damage is found, replace **Transmission Control Module (TCM)** and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination or damage is found, go to **Step C.**

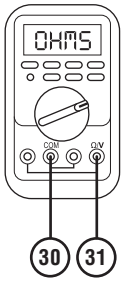
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C ***Purpose:*** *Verify Rail E Aft Solenoid resistance and not shorted to ground.*

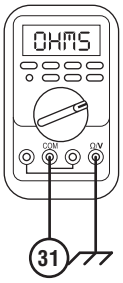
1. Key off.
2. Connect Eaton Breakout Box with 74-Way Eaton Diagnostic Adapter to MTM side of 74-Way Transmission Harness Connector.



3. Measure resistance at Eaton Breakout Box between Pin 30 and Pin 31. Record reading in table.



4. Measure resistance at 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 **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

Pins	Range	Reading(s)
30 to 31	3.4–5.5 Ohms	
31 to ground (TCM mounting stud)	Open Circuit (OL)	

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D

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

1. Key off.
2. Remove Eaton Breakout Box 74-Way Eaton Diagnostic Adapter.
3. Reinstall TCM to MTM.
4. Reconnect all connectors and verify all components are properly installed.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Retrieve and record transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 647 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 647 FMI 0, 1, 3, 4, 5, 6, 8, 16, 18 is Inactive, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

E

Purpose: *Verify mechanical movement of Rail E Range Synchronizer.*

1. Key off.
2. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal and MTM Removal Service Procedures.
3. Install MTM Alignment Tool (RR1086TR-1) onto main housing.

   Note: Reference Appendix/Manually Actuate Rail E Procedure.
4. Using Rail E Lever, shift Rail E into neutral position (if necessary).
5. Shift Rail E into High Range engagement position (fore) and return to neutral position.
6. Shift Rail E into Low Range engagement position (Low) and return to neutral position.
   - If Rail E shifts between neutral, High and Low Range, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail E does not shift between neutral, High or Low Range, go to **Step F.**

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F

Purpose: *Verify mechanical movement of Rail E Range Synchronizer without detent.*

1. Remove the Rail E Detent Plug, Spring and Detent.
2. Install MTM Alignment Tool (RR1086TR-1) onto main housing.
3. Using Rail E Lever, shift Rail E into neutral position (if necessary).
4. Shift Rail E into High Range engagement position (fore) and return to neutral position.
5. Shift Rail E into Low Range engagement position (aft) and return to neutral position.
   - If 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 +1 800-826-4357 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 Rail E Synchronizer and Shift Rail E.*

1. Remove Rear Housing.
2. Inspect Rail E Synchronizer, Shift Rail, Detent and Rear Housing Detent bore.
   - Contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 647 sets Active, go to **Step A.**
   - If a fault code other than 647 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 700: Clutch Operation

J1939: SA 3 SPN 6150 FMI 0, 1, 14, 17, 18

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the Linear Clutch Actuator (LCA) to control clutch position. A position sensor monitors clutch position and provides the information to the Transmission Control Module (TCM) for the purpose of making clutch engagement or disengagement decisions. The TCM compares the clutch command, clutch position and input shaft speed to ensure the transmission is operating properly.

The LCA is mounted to the Mechatronic Transmission Module (MTM). The solenoids and position sensor are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors 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 operation overspeed, exceeding 3,000 RPM for 1 second.

FMI 1 – Data Valid But Below Normal (Most Severe): Severe clutch slip when clutch is fully engaged and a shift is not in process. Engine Speed 80 RPM or greater than Input Speed for 1 second.

FMI 14 – Special Instructions: Inappropriate clutch engagement command based on operating conditions.

FMI 17 – Data Valid but Below Normal (Least Severe): Clutch operation overspeed during clutch engagement. Input Speed 1,300 RPM or less than Engine Speed for 1 second.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Clutch operation overspeed. Input Speed 3000 RPM or less than Engine Speed for 1 second.

Fallback

FMI 0, 17, 18:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 1:

- Amber warning lamp on
- High start gears prohibited

FMI 14:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 0, 14, 17, 18: Key cycle and fault Condition no longer exists

FMI 1: Clutch operating speeds in range for 10 seconds.

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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, 14:

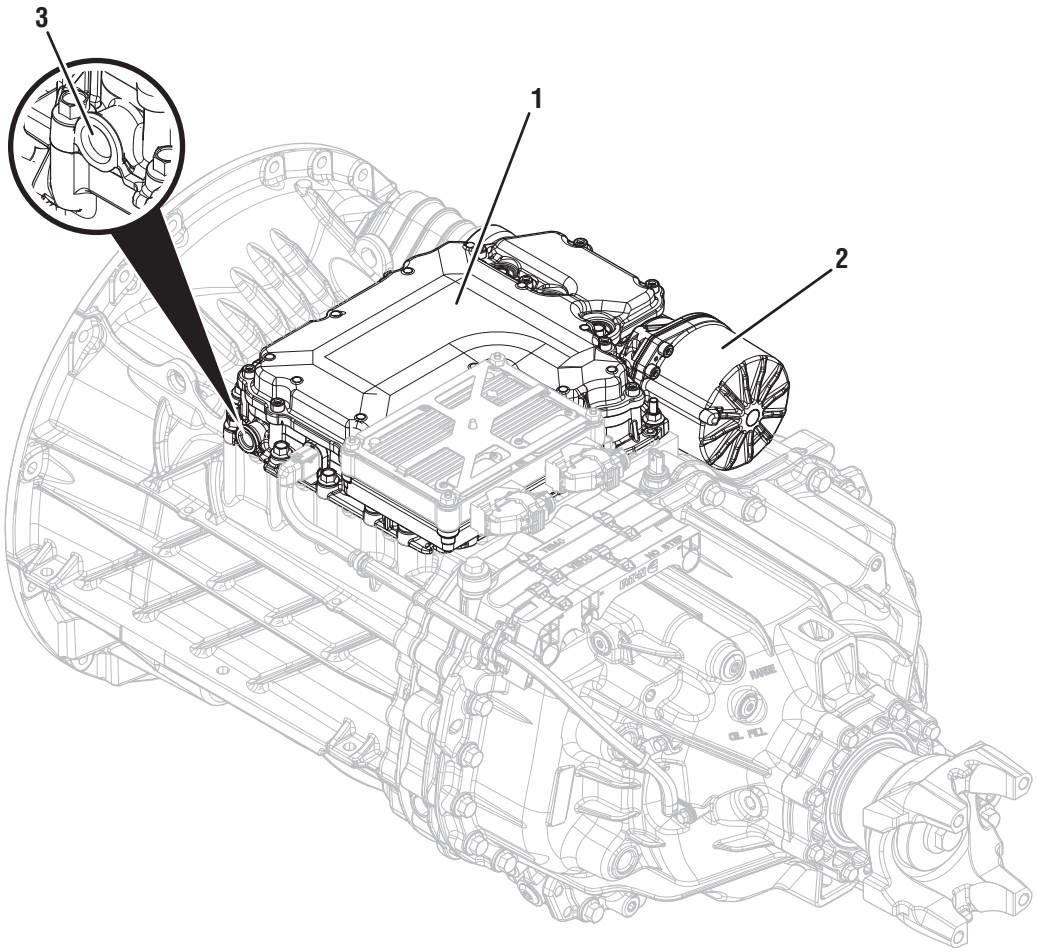
- Vehicle Air System
  - Contamination
- Clutch Housing
  - Clutch Assembly
  - Release Bearing
  - Release Yoke
  - Input Shaft Cover
- MTM
  - LCA
  - LCA Position Sensor
  - Clutch Control Solenoids

Additional Tools

- Endurant XD Service Manual TRSM0960

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Component Identification



1. Mechatronic Transmission Module (MTM)
2. Linear Clutch Actuator (LCA)
3. MTM Air Inlet Port

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Fault Code 700 Troubleshooting

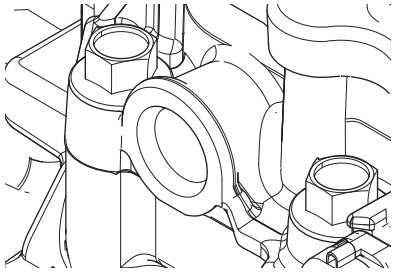
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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, 14, 17, 18 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

B ***Purpose:*** *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

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C

Purpose: *Inspect Clutch, Release Bearing, Release Yoke and Input Shaft Cover.*

1. Key off.
2. Remove transmission.

   Note: Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
3. Inspect Clutch Assembly, Release Bearing, Release Yoke and Input Shaft Cover.
   - Contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 700 sets Active, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 700 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19

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Fault Code 701: Clutch Engagement Status

J1939: SA 3 SPN 7847 FMI 14, 31

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the Linear Clutch Actuator (LCA) to control clutch position. A position sensor monitors clutch position and provides the information to the Transmission Control Module (TCM) for the purpose of making clutch engagement or disengagement decisions. The TCM compares the clutch command, clutch position and input shaft speed to ensure the transmission is operating properly.

The LCA is mounted to the Mechatronic Transmission Module (MTM). The solenoids and position sensor are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors clutch operation. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 14 – Special Instructions: Inappropriate clutch engagement command based on operating conditions. Engaged gear direction doesn't match driver selected mode.

FMI 31 – Condition Exists: Inappropriate clutch engagement command based on operating conditions. Vehicle launch without driver input.

Fallback

FMI 14:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 31:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 14, 31: Key cycle and fault condition no longer exist.

Possible Causes

FMI 14, 31:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960

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Fault Code 701 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 +1 800-826-4357 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 TCM software is less than 5516018, update TCM software to latest available version. Go to **Step V.**
   - If TCM software is equal to or greater than 5516018, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

TCM Software Version

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

1. Key off.
2. Reconnect all connectors and verify 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 701 sets Active, go to **Step A.**
   - If a fault code other than 701 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 702: Driveline Engagement

J1939: SA 3 SPN 560 FMI 2, 11, 12, 14, 20, 21, 31

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the Linear Clutch Actuator (LCA) and shift rail cylinders for clutch and shift rail actuation. Position sensors monitor clutch and shift rail positions, and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making clutch engagement or disengagement decisions, making shift decisions, and confirming gear engagement. The TCM compares the clutch and shift rail commands to the clutch and shift rail positions and the shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The solenoids, sensors, LCA and shift rails are located in the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors 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, position sensor values indicated main shaft neutral position but speed sensors indicated in gear ratio.

FMI 11 – Root Cause Unknown: Output Speed Sensor signal and Countershaft Speed Sensor signal direction mismatch for 2 seconds.

FMI 12 – Bad Intelligent Device: Inappropriate clutch engagement on disengaged main shaft without speed sensor confirmation of mainshaft neutral for 1 second.

FMI 14 – Special Instructions: Inappropriate shift rail movement commanded when vehicle is stationary resulting in drive line engagement for 1 second.

FMI 20 – Data Drifted High: Shift Rail C and E Position Sensor values indicated gear engagement but speed sensors did not for 2 seconds.

FMI 21 – Data Drifted Low: Shift Rail D and E Position Sensor values indicated gear engagement but speed sensors did not for 2 seconds.

FMI 31 – Condition Exists: Inappropriate delay in clutch torque after commanded during vehicle launch.

Fallback

FMI 2:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Upshifts prohibited
- Clutch engagements prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 11:

If Shift Rail D is disengaged:

- Amber warning lamp on
- Driven Gear 1st engagement prohibited Amber warning lamp on
- Reverse Gear engagement prohibited

If Shift Rail D is engaged:

- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 12, 14, 31:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

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FMI 20, 21:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Clutch engagements prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

All FMIs: Key cycle and fault condition no longer exist.

Possible Causes

FMI 2:

- Rail C or D Position Sensors

FMI 11, 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

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Fault Code 702 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 702 FMI 2, 14, 20, 21 is Active or Inactive, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 702 FMI 31 is Active or Inactive, go to **Step B.**
   - If Fault Code 702 FMI 11, 12 is Active or Inactive, go to **Step C.**

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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. Go to **Step V.**
    - f readings are in range, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. 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	

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C

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 TCM software is less than 5516018, update TCM software to latest available version. Go to **Step V.**
   - If TCM software is equal to or greater than 5516018, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

TCM Software Version

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 702 sets Active, go to **Step A.**
   - If a fault code other than 702 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 705: Transmission Clutch Actuator

J1939: SA 3 SPN 788 FMI 12, 14

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the Linear Clutch Actuator (LCA) to control clutch position. A position sensor monitors clutch position and provides the information to the Transmission Control Module (TCM) for the purpose of making clutch engagement or disengagement decisions. The TCM compares the clutch command, clutch position and input shaft speed to ensure the transmission is operating properly.

The LCA is mounted to the Mechatronic Transmission Module (MTM). The solenoids and position sensor are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors clutch operation. 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 as expected based on operating conditions.

FMI 14 – Special Instructions: TCM did not disengage clutch as expected based on operating conditions.

Fallback

FMI 12, 14:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 12, 14: Key cycle and fault condition no longer exist.

Possible Causes

FMI 12, 14:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- Endurant XD Service Manual TRSM0960

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Fault Code 705 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 705 FMI 14 is Active or Inactive, and the vehicle is equipped with a International Motors A26 engine, go to **Step B.**
   - If Fault Code 705 FMI 12 is Active or Inactive, Go to **Step C.**
   - If Fault Code 705 FMI 14 is Active or Inactive and the vehicle is not equipped with a International Motors A26 engine, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. 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 TCM software is less than 5516014, update TCM software to latest available version. Go to **Step V.**
   - If TCM software is equal to or greater than 5516014, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

TCM Software Version

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C

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 TCM software is less than 5516018, update TCM software to latest available version. Go to **Step V.**
   - If TCM software is equal to or greater than 5516018, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

TCM Software Version

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 705 sets Active, go to **Step A.**
   - If a fault code other than 705 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19

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Fault Code 706: Clutch Position Out of Range

J1939: SA 3 SPN 2983 FMI 17, 18

Overview

The Endurant XD Series transmissions are equipped with solenoid valves that direct vehicle Supply Air to and from the Linear Clutch Actuator (LCA) to control clutch position. A position sensor monitors clutch position and provides the information to the Transmission Control Module (TCM) for the purpose of making clutch engagement or disengagement decisions. The TCM compares the clutch command, clutch position - Full Exhaust Position (FEP) and input shaft speed to ensure proper clutch operation.

The LCA is mounted to the Mechatronic Transmission Module (MTM). The solenoids and position sensor are located in the MTM and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors clutch FEP. If FEP is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 17 – Data Valid but Below Normal (Least Severe): Clutch calibrated FEP is above 35 mm after more than 10 actuations during a key cycle.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Clutch calibrated FEP is above 37 mm after more than 10 actuations during a key cycle.

Fallback

FMI 17, 18:

- Amber warning lamp on
- No degraded modes

Conditions to Set Fault Code Inactive

FMI 17, 18:

- Key cycle and fault condition no longer exist.

Possible Causes

FMI 17, 18:

- Clutch Housing
  - Clutch Assembly
  - Release Bearing
  - Release Yoke

Additional Tools

- Endurant XD Service Manual TRSM0960

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Fault Code 706 Troubleshooting

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

1. Set the vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 706 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 706 FMI 17, 18 is Active or Inactive, clutch components (i.e. related linkages / and or clutch) resulted in the fully engaged position to be out of range. Clutch components must be inspected. Contact Eaton Cummins Automated Transmission Technologies at +1-800-826-4357 for further diagnostic instructions. Go to **Step V.**

     Note: Refer to Endurant XD Service Manual TRSM0960, Clutch Service Procedure.

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

1. Key off.
2. Reconnect all connectors and verify 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 706 sets Active, contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions.
   - If a fault code other than 706 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19

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Fault Code 716: Transmission Selected Gear

J1939: SA 3 SPN 524 FMI 12

Overview

The Endurant XD Series transmissions are equipped with position sensors to monitor shift rail positions and speed sensors to monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The sensors and shift rails are located in the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the transmission operation. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 12 – Bad Intelligent Device or Component: Inappropriate selected gear commanded relative to output shaft speed.

Fallback

FMI 12:

- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- Gear engagements prohibited
- Range engagement prohibited

Conditions to Set Fault Code Inactive

FMI 12: Key on and fault condition no longer exist.

Possible Causes

FMI 12:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- None

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Fault Code 716 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 716 FMI 12 is Active or Inactive, If the TCM is greater than 5516014, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 716 sets Active, go to **Step A.**
   - If a fault code other than 716 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 717: Transmission Requested Gear

J1939: SA 3 SPN 525 FMI 12

Overview

The Endurant XD Series transmissions are equipped with position sensors to monitor shift rail positions and speed sensors to monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The sensors and shift rails are located in the Mechatronic Transmission Module (MTM) and connected to the TCM at the 74-Way Transmission Harness Connector.

Detection

The TCM monitors the transmission operation. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 12 – Bad Intelligent Device: Inappropriate requested gear commanded relative to the selected gear.

Fallback

FMI 12:

- Amber warning lamp on
- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 12: Key cycle and fault condition no longer exist.

Possible Causes

FMI 12:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- None

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Fault Code 717 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 717 FMI 12 is Active or Inactive, If the TCM is greater than 5516014, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 717 sets Active, go to **Step A.**
   - If a fault code other than 717 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 730: Rail A Operation

J1939: SA 3 SPN 6144 FMI 1, 2, 10, 14, 17, 18, 20, 21

Overview

The Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 Shift Rail A operation. 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): Rail A unable to disengage Main Drive Gear, move fore, for 2 seconds.

FMI 2 – Data Erratic: During a rail calibration, Rail A unable to move to neutral position.

FMI 10 – Abnormal Rate of Change: During a rail calibration, Rail A Position Sensor unable to confirm low rail velocity.

FMI 14 – Special Instructions: Rail A unable to move from neutral position toward Main Drive Gear, move aft, for 2 seconds.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail A unable to engage Main Drive Gear, move aft, for 2 seconds.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Rail A unable to move from Main Drive Gear to neutral position, move fore, for 2 seconds.

FMI 20 – Data Drifted High: During a rail calibration, Rail A travel was greater than expected.

FMI 21 – Data Drifted Low: During a rail calibration, Rail A travel was less than expected.

Fallback

FMI 1:

- Amber warning lamp on
- Main Drive Gear disengagement prohibited

FMI 2, 10, 20, 21:

If Rail A position is known and Rail A is either fully engaged or fully disengaged:

- Amber warning lamp on
- Shift Rail A movement prohibited

If Rail A position is not known and Rail A is not fully engaged or fully disengaged:

- Shift Rail A movement prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 14, 17:

- Amber warning lamp on
- Main Drive Gear engagement prohibited
- If vehicle is moving and no start gear available:
  - Red stop lamp on

FMI 18:

- Amber warning lamp on
- Main Drive Gear disengagement prohibited
- If vehicle is moving and no start gear available:
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 1, 14, 18: Fault condition no longer exists for 1 second.

FMI 2, 10, 17, 20, 21: Key cycle and fault condition no longer exists.

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Possible Causes

All FMIs:

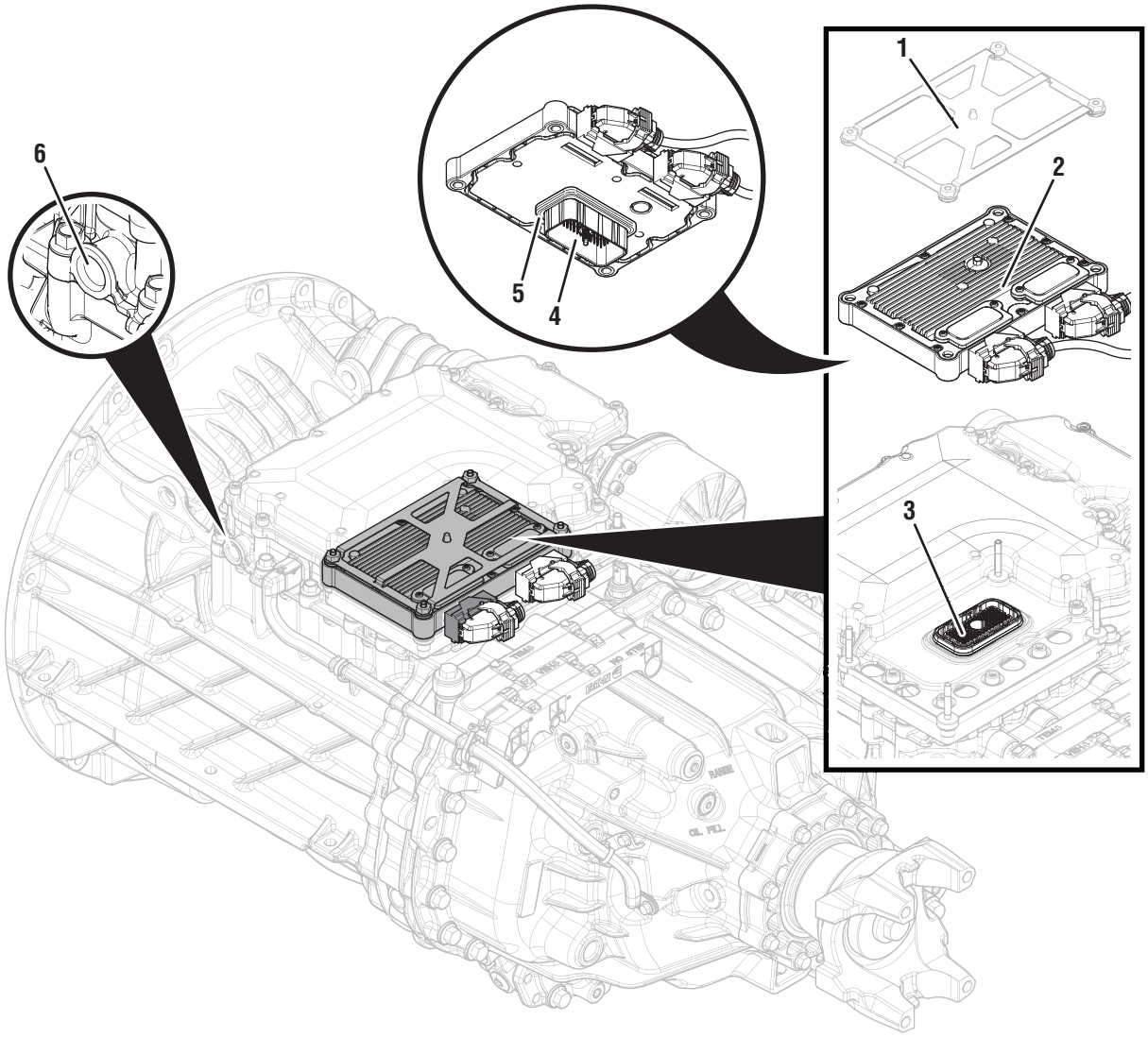
- MTM
  - Contamination from vehicle air system
  - Air leaks
  - Rail A Fore Solenoid – internal failure
  - Rail A Aft Solenoid – internal failure
  - Rail A Position Sensor – in range internal failure
  - Rail A shift cylinder – stuck piston or damaged seals
  - Rail A shift rail or yoke – broken
- Internal transmission
  - Rail A Synchronizer
  - Main Drive Gear

Additional Tools

- Endurant XD Service Manual TRSM0960

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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

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Fault Code 730 Troubleshooting

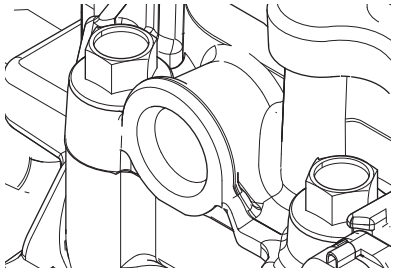
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 730 is Active or Inactive, go to **Step B.**

B ***Purpose:*** *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

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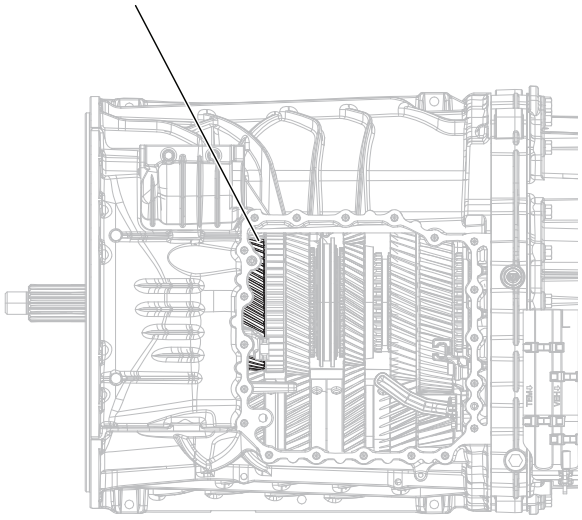
C

Purpose: *Verify mechanical condition of Main Drive Gear.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

2. Inspect the Main Drive Gear for excessive fore and aft movement.



- If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
- If no excessive gear movement is evident, go to **Step D.**

D

Purpose: *Verify mechanical condition of Rail A Synchronizer and clutching teeth.*

Note: Reference *Manually Actuate Rail A Procedure* on page 689 of the Appendix.

1. Shift Rail A Synchronizer Sliding Sleeve into neutral position (if necessary).
2. Inspect Main Drive Gear and Rail A Synchronizer Sleeve clutching teeth for wear.
3. Shift Rail A Synchronizer Sliding Sleeve into Main Drive Gear engagement position (aft).
4. Return Rail A Synchronizer Sliding Sleeve to neutral position.
   - If Rail A Synchronizer Sliding Sleeve shifts into both positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail A Synchronizer Sliding Sleeve does not shift into both positions or clutching teeth wear is present, replace Rail A Yoke, Rail A Synchronizer Assembly, Main Drive Gear and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 730 sets Active, go to **Step A.**
   - If a fault code other than 730 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 Shift 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 unable to disengage Main Drive Gear Low, move aft, for 2 seconds.

FMI 1 – Data Valid But Below Normal (Most Severe): Rail B unable to disengage Splitter Gear, move fore, for 2 seconds.

FMI 2 – Data Erratic: During a rail calibration, Rail B unable to move to neutral position.

FMI 7 – Mechanical System Not Responding: Rail B unable move from neutral position toward Main Drive Gear Low, move fore, for 2 seconds.

FMI 10 – Abnormal Rate of Change: During a rail calibration, Rail B Position Sensor unable to confirm low rail velocity.

FMI 14 – Special Instructions: Rail B unable to move from neutral position toward Splitter Gear, move aft, for 2 seconds.

FMI 15 – Data Valid but Above Normal (Least Severe): Rail B unable to engage Main Drive Gear Low, move fore, for 2 seconds.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Rail B unable to move from Main Drive Gear Low to neutral position, move aft, for 2 seconds.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail B unable to engage Splitter Gear, move aft, for 2 seconds.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Rail B unable to move from Splitter Gear to neutral position, move fore, for 2 seconds.

FMI 20 – Data Drifted High: During a rail calibration, Rail B travel was greater than expected.

FMI 21 – Data Drifted Low: During a rail calibration, Rail B travel was less than expected.

Fallback

FMI 0:

- Amber warning lamp on
- Splitter Gear engagement prohibited
- Rail B movement to neutral position prohibited

FMI 1:

- Amber warning lamp on
- Splitter Gear engagement prohibited
- Rail B movement to neutral position prohibited
- PTO Mode prohibited

FMI 2, 10, 20, 21:

If Rail B position is known and Rail B is either fully engaged or fully disengaged:

- Amber warning lamp on
- Shift Rail B movement prohibited

If Rail B position is not known and Rail B is not fully engaged or fully disengaged:

- Shift Rail B movement prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation prohibited
- Non-neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

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FMI 7, 15:

- Amber warning lamp on
- Main Drive Gear Low engagement prohibited
- PTO Mode prohibited
- If vehicle is moving and no start gear available:
  - Red stop lamp on

FMI 14, 17:

- Amber warning lamp on
- Splitter Gear engagement prohibited
- If vehicle is moving and no start gear available:
  - Red stop lamp on

FMI 16, 18:

- Amber warning lamp on
- Rail B movement to neutral position 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: Fault condition no longer exists for 1 second.

FMI 2, 10, 15, 17, 20, 21: Key cycle and fault condition no longer exist.

Possible Causes

All FMIs:

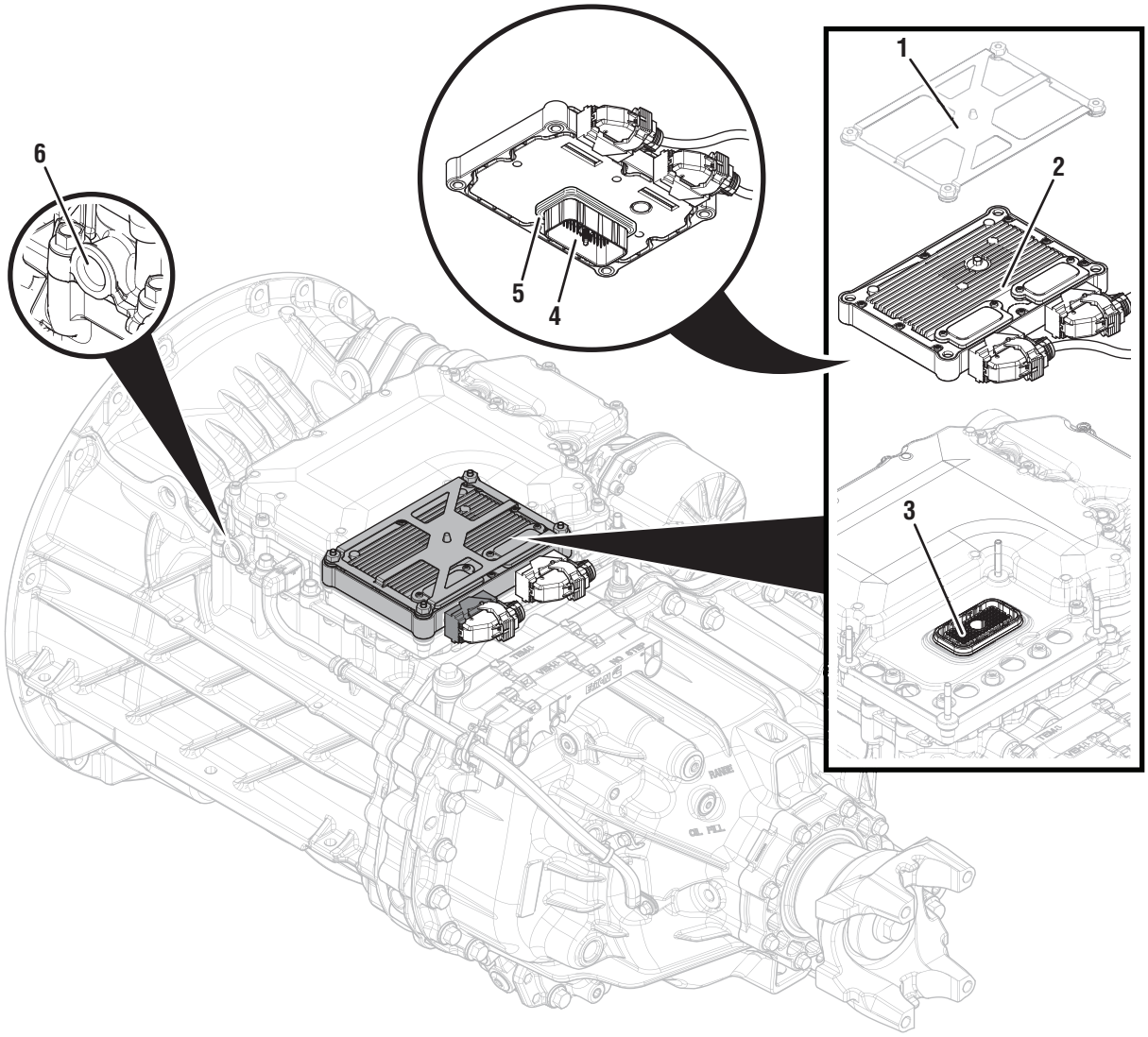
- MTM
  - Contamination from vehicle air system
  - Air leaks
  - Rail B Fore Solenoid – internal failure
  - Rail B Aft Solenoid – internal failure
  - Rail B Position Sensor – in range internal failure
  - Rail B shift cylinder – stuck piston or damaged seals
  - Rail B shift rail or yoke – broken
- Internal transmission
  - Rail B Synchronizer
  - Main Drive Gear Low
  - Splitter Gear

Additional Tools

- Endurant XD Service Manual TRSM0960
- Rail B Synchronizer Engagement Tool - RR1088TR

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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

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Fault Code 740 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 740 FMI 0, 1, 2, 10, 14, 15, 20, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 740 FMI 7, 16, 17 is Active or Inactive and MTM was **not** recently installed or replaced, go to **TAIB-1006** *MTM Solenoid Fault Codes and Vehicle Air System Contamination*.
   - If Fault Code 740 FMI 16, 18 is Active or Inactive and MTM was recently installed or replaced, go to **Step E.**
   - If Fault Code 740 FMI 18 is Active or Inactive and MTM was **not** recently installed or replaced, go to **Step B.**

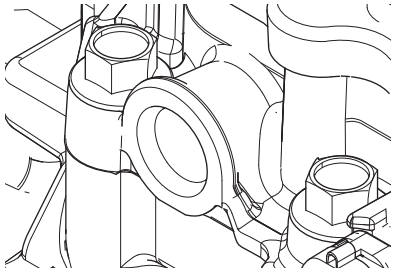
     NOTICE: Refer to Vehicle Maintenance Recommendations in TRSM0960 regarding vehicle air system requirements to ensure proper air supply and air quality.

B

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

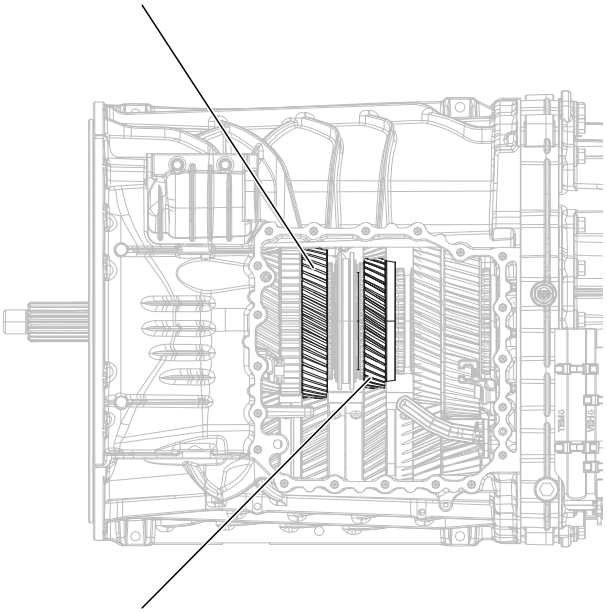
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C ***Purpose:*** *Verify mechanical condition of Main Drive Gear Low and Splitter Gear.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

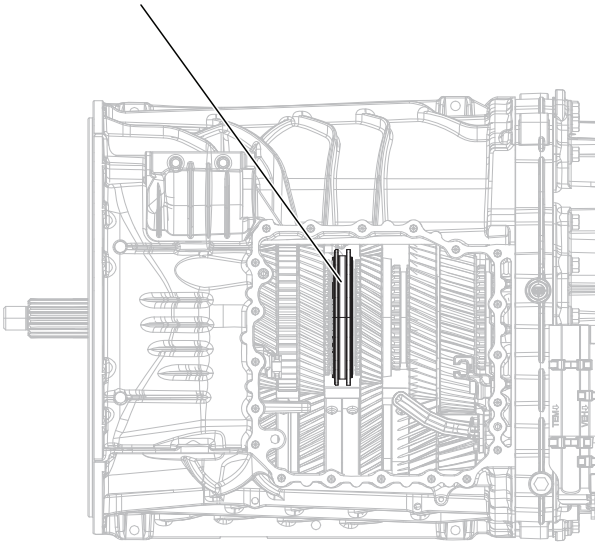
2. Inspect Main Drive Gear Low for excessive fore and aft movement.



3. Inspect Splitter Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

D ***Purpose:*** *Verify mechanical condition of Rail B Synchronizer and clutching teeth.*

1. Inspect 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* on page 691

3. Shift Rail B Synchronizer Sliding Sleeve into neutral position (if necessary).
4. Shift Rail B Synchronizer Sliding Sleeve into Main Drive Gear Low engagement position (fore).
5. Inspect Splitter Gear and Rail B Synchronizer Sliding Sleeve clutching teeth for wear.

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6. Return Rail B Synchronizer Sliding Sleeve to neutral position.
7. Shift Rail B Synchronizer Sliding Sleeve into Splitter Gear engagement position (aft).
8. Inspect Main Drive Gear Low and Rail B Synchronizer Sliding Sleeve clutching teeth for wear.
9. Return Rail B Synchronizer Sliding Sleeve to neutral position.
   - If Rail B Synchronizer Sliding Sleeve shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail B Synchronizer Sliding Sleeve does not shift into all three positions or clutching teeth wear is present, replace Rail B Synchronizer Assembly, Main Drive Gear Low, Splitter Gear and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

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: Fault code and transmission information is downloaded into the report.
7. Select “Send to Eaton”.

   Note: Internet connection is required.
8. Retrieve and record the transmission fault codes and FMIs and their occurrences and timestamps.
   - If Fault Code 740 FMI 16, 18 is Active or Inactive and MTM was recently installed or replaced, contact Eaton Cummins Automated Transmission Technologies at 1-800-826-HELP (4357) for further diagnostic instructions.

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

1. Key off.
2. Reconnect all connectors and verify 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 740 sets Active, go to **Step A.**
   - If a fault code other than 740 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 Shift 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 unable to disengage Splitter Gear, move aft, for 2 seconds.

FMI 1 – Data Valid But Below Normal (Most Severe): Rail C unable to disengage Driven Gear 2nd, move fore, for 2 seconds.

FMI 2 – Data Erratic: During a rail calibration, Rail C unable to move to neutral position.

FMI 7 – Mechanical System Not Responding: Rail C unable move from neutral position toward Splitter Gear, move fore, for 2 seconds.

FMI 10 – Abnormal Rate of Change: During a rail calibration, Rail C Position Sensor unable to confirm low rail velocity.

FMI 14 – Special Instructions: Rail C unable to move from neutral position toward Driven Gear 2nd, move aft, for 2 seconds.

FMI 15 – Data Valid but Above Normal (Least Severe): Rail C unable to engage Splitter Gear, move fore, for 2 seconds.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Rail C unable to move from Splitter Gear to neutral position, move aft, for 2 seconds.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail C unable to engage Driven Gear 2nd, move aft, for 2 seconds.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Rail C unable to move from Driven Gear 2nd to neutral position, move fore, for 2 seconds.

FMI 20 – Data Drifted High: During a rail calibration, Rail C travel was greater than expected.

FMI 21 – Data Drifted Low: During a rail calibration, Rail C travel was less than expected.

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:

If Rail C position is known and Rail C is either fully engaged or fully disengaged:

- Amber warning lamp on
- Shift Rail C movement prohibited

If Rail C position is not known and Rail C is not fully engaged or fully disengaged:

- Shift Rail C movement prohibited
- Shift Rail D movement prohibited
- Inertia Brake activation prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

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FMI 7, 15:

- Amber warning lamp on
- Splitter Gear engagement prohibited
- If vehicle is moving and no start gear available:
  - Red stop lamp on

FMI 14, 17:

- Amber warning lamp on
- Driven Gear 2nd engagement prohibited
- If vehicle is moving and no start gear available:
  - Red stop lamp on

FMI 16, 18:

- Amber warning lamp on
- If the vehicle is not moving:
  - Rail C movement to neutral position 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: Fault condition no longer exists for 1 second.

FMI 2, 10, 15, 17, 20, 21: Key cycle and fault condition no longer exists.

Possible Causes

All FMIs:

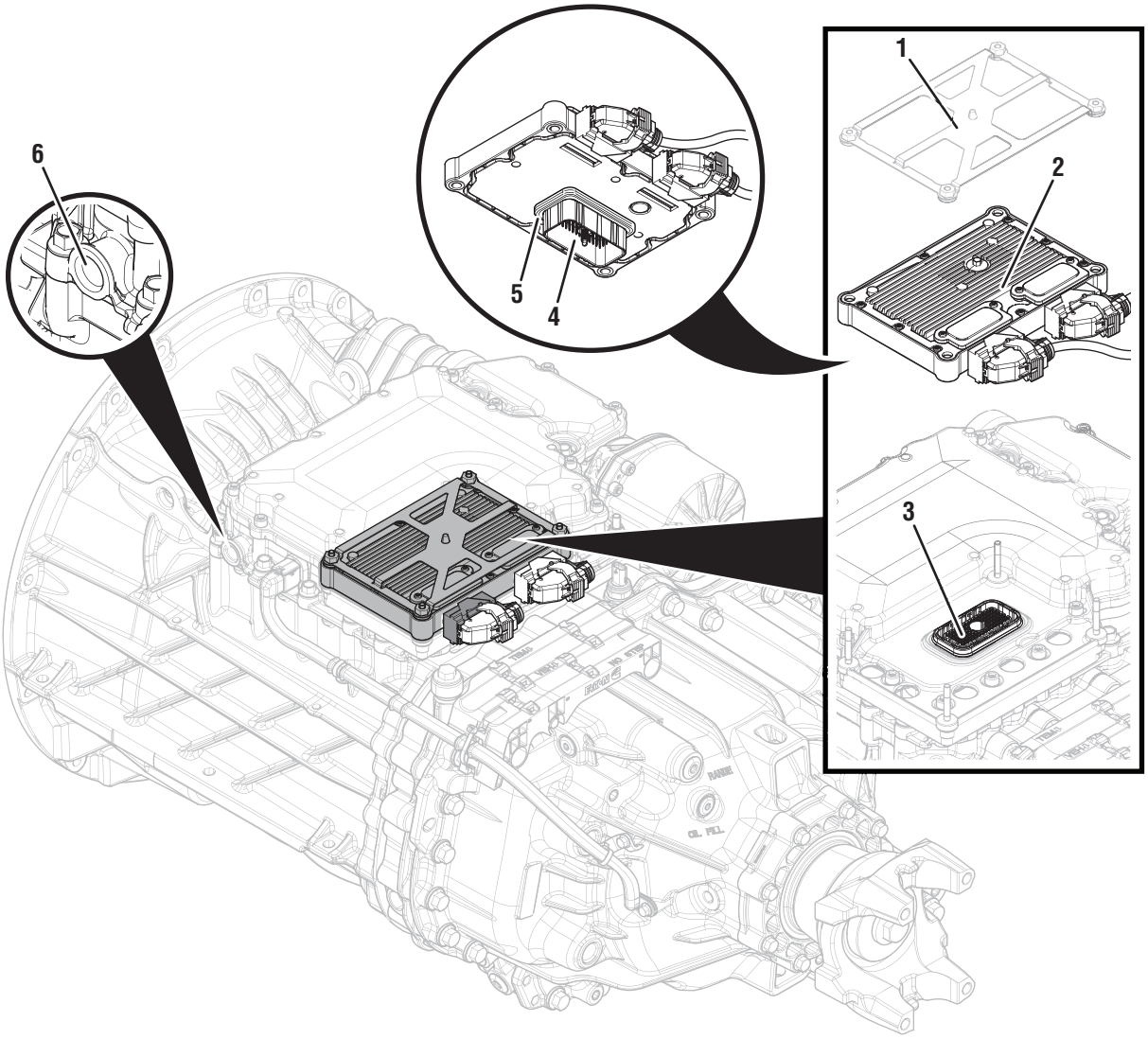
- MTM
  - Contamination from vehicle air system
  - Air leaks
  - Rail C Fore Solenoid – internal failure
  - Rail C Aft Solenoid – internal failure
  - Rail C Position Sensor – in range internal failure
  - Rail C shift cylinder – stuck piston or damaged seals
  - Rail C shift rail or yoke – broken
- Internal transmission
  - Rail C Sliding Clutch
  - Splitter Gear
  - Driven Gear 2nd

Additional Tools

- Endurant XD Service Manual TRSM0960

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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

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Fault Code 760 Troubleshooting

A

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

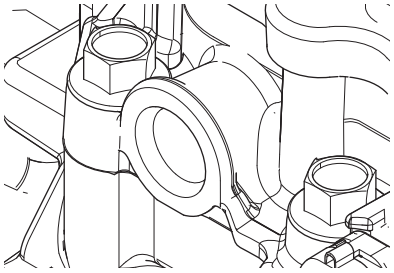
1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 760 is Active or Inactive, go to **Step B.**

B

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

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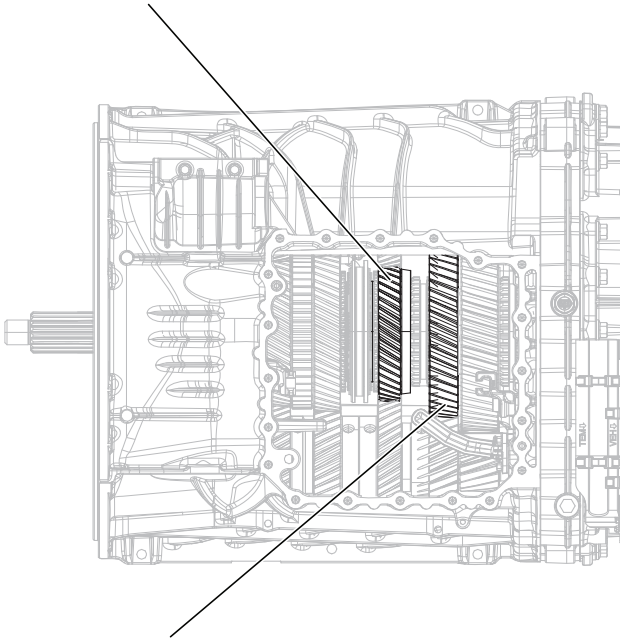
C

Purpose: *Verify mechanical condition of Splitter Gear and Driven Gear 2nd.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

2. Inspect Splitter Gear for excessive fore and aft movement.

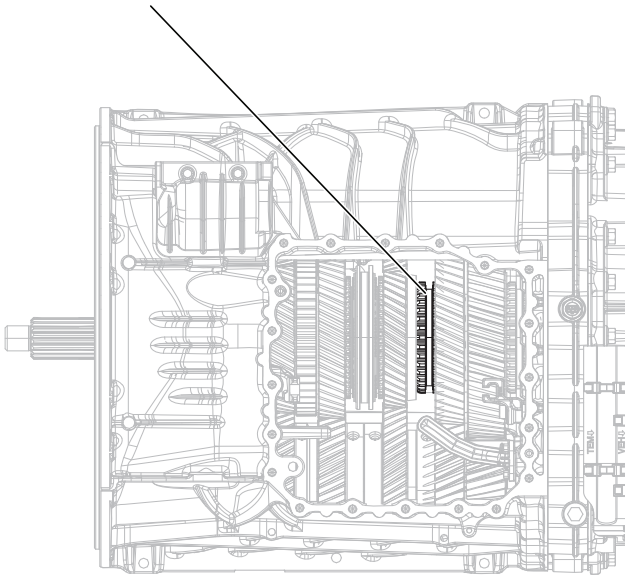


3. Inspect Driven Gear 2nd for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

D

Purpose: *Verify mechanical condition of Rail C Sliding Clutch and clutching teeth.*

1. Inspect Rail C Sliding Clutch yoke slot for wear.



2. Shift Rail C Sliding Clutch into neutral position (if necessary).
3. Shift Rail C Sliding Clutch into Splitter Gear engagement position (fore).

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4. Inspect Driven Gear 2nd and Rail C Sliding Clutch clutching teeth for wear.
5. Return Rail C Sliding Clutch to neutral position.
6. Shift Rail C Sliding Clutch into Driven Gear 2nd engagement position (aft).
7. Inspect Splitter Gear and Rail C Sliding Clutch clutching teeth for wear.
8. Return Rail C Sliding Clutch to neutral position.
   - If Rail C Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail C Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace Rail C Sliding Clutch, Splitter Gear, Drive Gear 2nd and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 760 sets Active, go to **Step A.**
   - If a fault code other than 760 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 Shift 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 unable to disengage Driven Gear 1st, move aft, for 2 seconds.

FMI 1 – Data Valid But Below Normal (Most Severe): Rail D unable to disengage Reverse Gear, move fore, for 2 seconds.

FMI 2 – Data Erratic: During a rail calibration, Rail D unable to move to neutral position.

FMI 7 – Mechanical System Not Responding: Rail D unable move from neutral position toward Driven Gear 1st, move fore, for 2 seconds.

FMI 10 – Abnormal Rate of Change: During a rail calibration, Rail D Position Sensor unable to confirm low rail velocity.

FMI 14 – Special Instructions: Rail D unable to move from neutral position toward Reverse Gear, move aft, for 2 seconds.

FMI 15 – Data Valid but Above Normal (Least Severe): Rail D unable to engage Driven Gear 1st, move fore, for 2 seconds.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Rail D unable to move from Driven Gear 1st to neutral position, move aft, for 2 seconds.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail D unable to engage Reverse Gear, move aft, for 2 seconds.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Rail D unable to move from Reverse Gear to neutral position, move fore, for 2 seconds.

FMI 20 – Data Drifted High: During a rail calibration, Rail D travel was greater than expected.

FMI 21 – Data Drifted Low: During a rail calibration, Rail D travel was less than expected.

Fallback

FMI 0, 1:

- Amber warning lamp on
- Rail D movement prohibited

FMI 2, 10, 20, 21:

If Rail D position is known and Rail D is either fully engaged or fully disengaged:

- Amber warning lamp on
- Shift Rail D movement prohibited

If Rail D position is not known and Rail D is not fully engaged or fully disengaged:

- Shift Rail C movement prohibited
- Shift Rail D movement prohibited
- Inertia Brake activation prohibited
- Rail D movement prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving
  - Red stop lamp on

FMI 7, 15:

- Amber warning lamp on
- Driven Gear 1st engagement prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

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FMI 14, 17:

- Amber warning lamp on
- Reverse Gear engagement prohibited
- If vehicle is moving and no start gear available
  - Red stop lamp on

FMI 16, 18:

- Amber warning lamp on
- If vehicle is not moving
  - Rail D movement to neutral position prohibited
- If vehicle is moving and no start gear available
  - Rail D movement prohibited
  - Red stop lamp on

Conditions to Set Fault Code Inactive

FMI 0, 1, 7, 14, 16, 18: Fault condition no longer exists for 1 second.

FMI 2, 10, 15, 17, 20, 21: Key cycle and fault condition no longer exists.

Possible Causes

FMI 0, 16, 18:

- Transmission PTO
  - Not properly configured in TCM
  - Not properly wired or installed
  - Always engaged
- MTM
  - Contamination from vehicle air system
  - Air leaks
  - Rail D For Solenoid - internal failure
  - Rail D Aft Solenoid - internal failure
  - Rail D Position Sensor - in range internal failure
  - Rail D shift cylinder - stuck piston to damaged seals
  - Rail D shift rail or yoke - broken
- Internal transmission
  - Rail D Sliding Clutch
  - Driven Gear 1st
  - Reverse Gear

FMI 1, 2, 7, 10, 14, 15, 17, 20, 21:

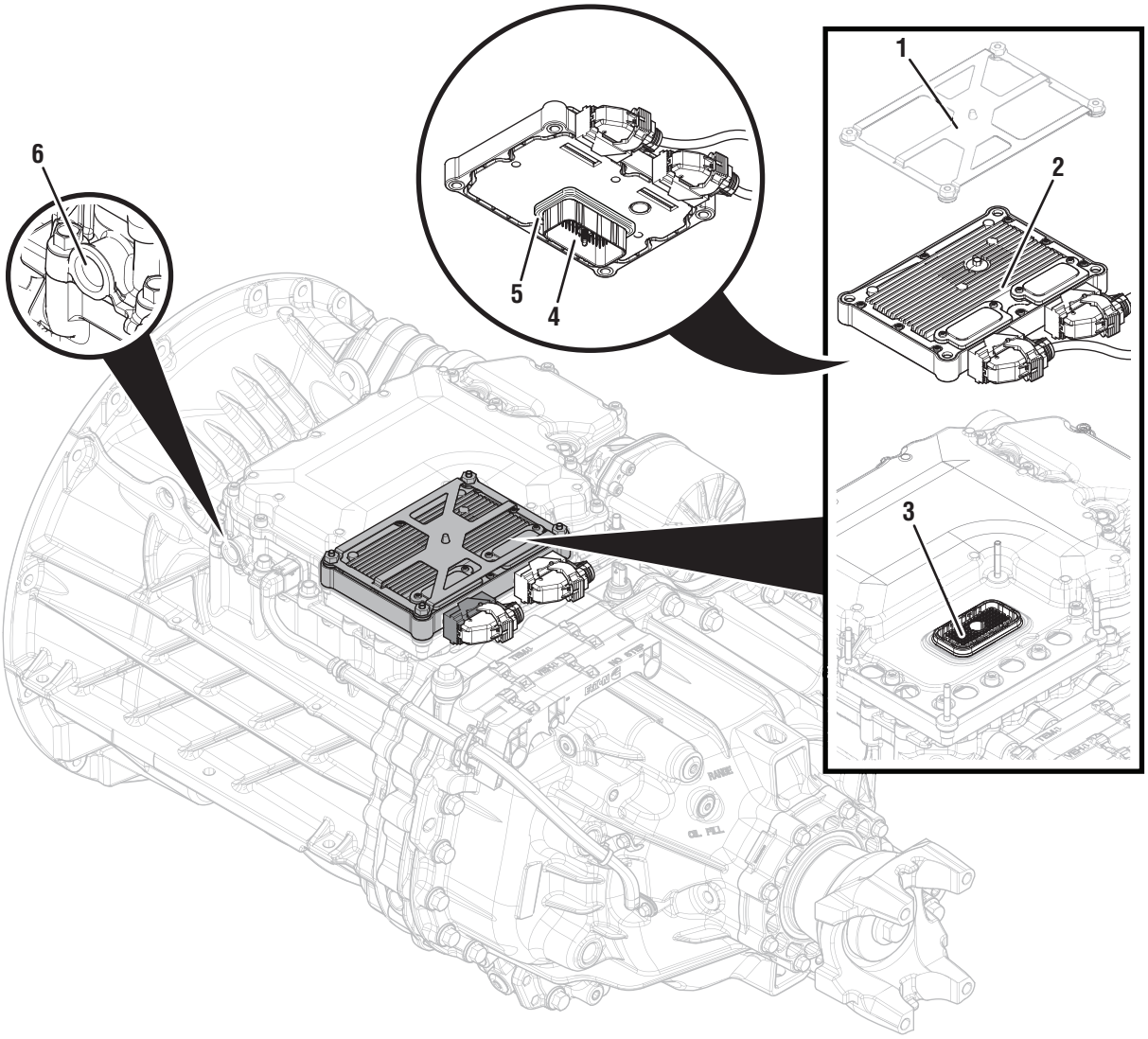
- MTM
  - Contamination from vehicle air system
  - Air leaks
  - Rail D For Solenoid - internal failure
  - Rail D Aft Solenoid - internal failure
  - Rail D Position Sensor - in range internal failure
  - Rail D shift cylinder - stuck piston or damaged seals
  - Rail D shift rail or yoke - broken
- Internal transmission
  - Rail D Sliding Clutch
  - Driven Gear 1st
  - Reverse Gear

Additional Tools

- Endurant XD Service Manual TRSM0960

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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

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Fault Code 775 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 775 FMI 0, 16, 18 is Active or Inactive, go to **Step B.**
   - If Fault Code 775 FMI 1, 2, 7, 10, 14, 15, 17, 20, 21 is Active or Inactive, go to **Step C.**

B

Purpose: *Inspect for a Transmission PTO.*

1. Inspect for a transmission mounted PTO.
   - If transmission is not equipped with a PTO, go to **Step C.**
   - If transmission is equipped with a PTO:
     - Verify PTO operation and installation: Properly wired and configured in TCM.

     Note: After PTO inspection:

     - If PTO issue is found repair as needed, refer to TRIG2620 Endurant XD Series PTO Installation and Body Integration Guide. Recheck for fault codes.

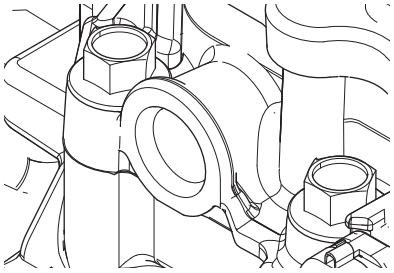
     - If no PTO issue found, go to **Step C.**

C

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

   - If no contamination is found, go to **Step D.**

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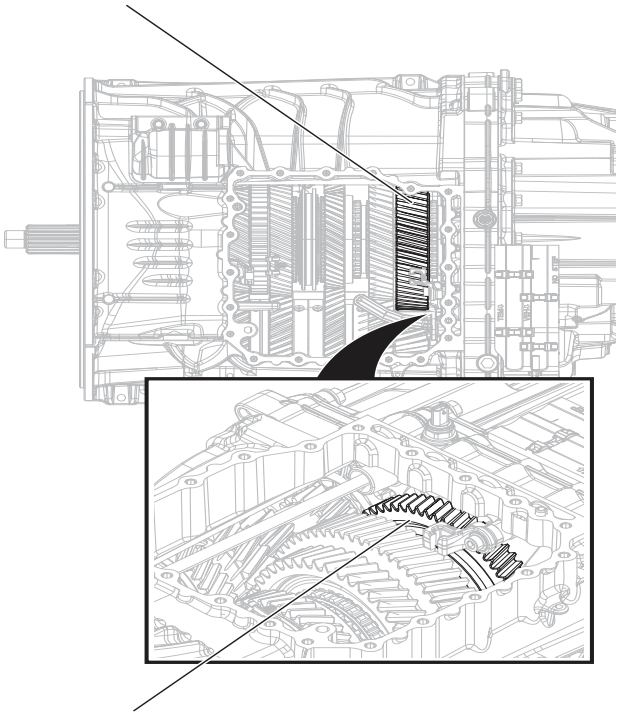
D

Purpose: *Verify mechanical condition of Driven Gear 1st and Reverse Gear.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

2. Inspect Driven Gear 1st for excessive fore and aft movement.

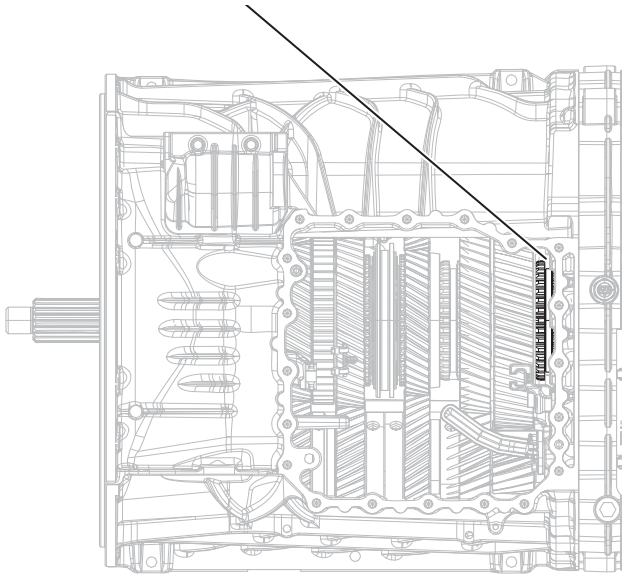


3. Inspect Reverse Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step E.**

E

Purpose: *Verify mechanical condition of Rail D Sliding Clutch and clutching teeth.*

1. Inspect Rail D Sliding Clutch yoke slot for wear.



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2. Shift Rail D Sliding Clutch into neutral position (if necessary).
3. Shift Rail D Sliding Clutch into Driven gear 1st engagement position (fore).
4. Inspect Reverse Gear and Rail D Sliding Clutch clutching teeth for wear.
5. Return Rail D Sliding Clutch to neutral position.
6. Shift Rail D Sliding Clutch into Reverse Gear engagement position (aft).
7. Inspect Driven Gear 1st and Rail D Sliding Clutch clutching teeth for wear.
8. Return Rail D Sliding Clutch to neutral position.
   - If Rail D Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail D Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace Rail D Sliding Clutch, Driven Gear 1st, Reverse Gear and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 775 sets Active, go to **Step A.**
   - If a fault code other than 775 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 Shift 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 E unable to disengage High Range, move aft, for 2 seconds.

FMI 1 – Data Valid But Below Normal (Most Severe): Rail E unable to disengage Low Range, move fore, for 2 seconds.

FMI 2 – Data Erratic: During a rail calibration, Rail E unable to move to neutral position.

FMI 7 – Mechanical System Not Responding: Rail E unable move from neutral position toward High Range for 2 seconds.

FMI 10 – Abnormal Rate of Change: During a rail calibration, Rail E Position Sensor unable to confirm low rail velocity.

FMI 14 – Special Instructions: Rail E unable to move from neutral position toward Low Range for 2 seconds.

FMI 15 – Data Valid but Above Normal (Least Severe): Rail E unable to engage High Range for 2 seconds.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Rail E unable to move from High Range to neutral position for 2 seconds.

FMI 17 – Data Valid but Below Normal (Least Severe): Rail E unable to engage Range Low for 2 seconds.

FMI 18 – Data Valid but Below Normal (Moderately Severe): Rail E unable to move from Low Range to neutral position for 2 seconds.

FMI 20 – Data Drifted High: During a rail calibration, Rail E travel was greater than expected.

FMI 21 – Data Drifted Low: During a rail calibration, Rail E travel was less than expected.

Fallback

FMI 0, 14, 16, 17:

- Amber warning lamp on
- Low Range engagement prohibited
- Transmission may launch in High Range

FMI 1:

- Amber warning lamp on
- High Range engagement prohibited

FMI 2:

If Rail C and D positions are known and Rail C or D are either fully engaged or fully disengaged:

- Amber warning lamp on
- Shift Rail C movement prohibited
- Shift Rail D movement prohibited

If Rail C and D positions are not known and Rail C or D are not fully engaged or fully disengaged:

- Shift Rail C movement prohibited
- Shift Rail D movement prohibited
- Inertia Brake activation prohibited
- PTO Mode prohibited
- If vehicle is moving:
  - Red stop lamp on

FMI 10, 20, 21:

If Rail E position is known and Rail E is fully engaged in either High or Low Range:

- Amber warning lamp on
- Shift Rail E movement prohibited

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If Rail E position is not known and Rail E is not fully engaged in High or Low Range:

- Shift Rail E movement prohibited
- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- If vehicle is moving
  - Red stop lamp on

FMI 7, 15, 18:

- Amber warning lamp on
- High Range engagement 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: Fault condition no longer exists for 1 second.

FMI 0, 1, 2, 10, 15, 17, 20, 21: Key cycle and fault condition no longer exists.

Possible Causes

All FMIs:

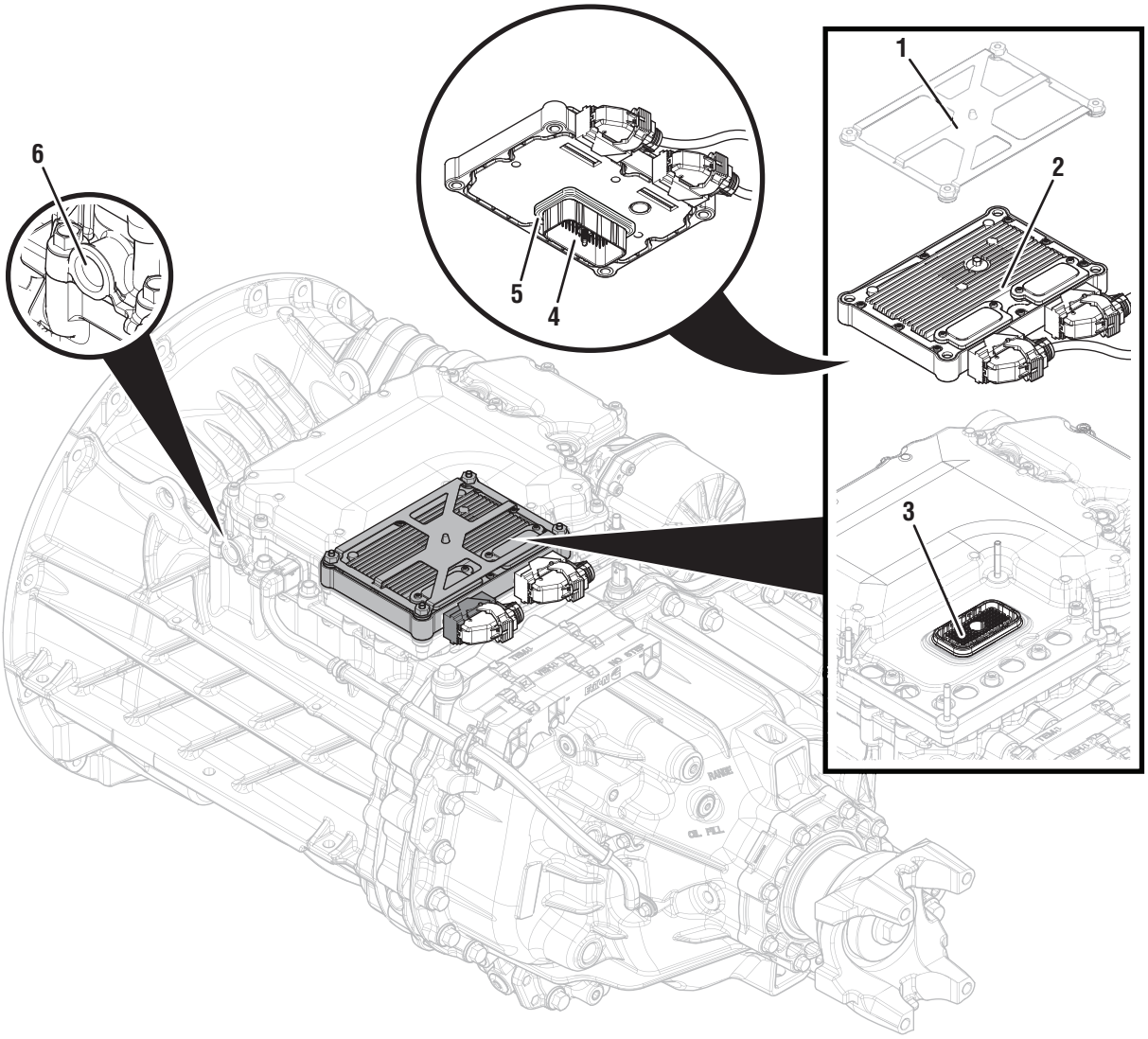
- Vehicle Air System
  - Contamination
- MTM
  - Rail E Fore Solenoid – internal failure
  - Rail E Aft Solenoid – internal failure
  - Rail E Shift Cylinder – stuck piston or damaged seals
  - Rail E Position Sensor – in range internal failure
  - Rail E Shift Rail – broken, detached
  - Rail E Shift Yoke – broken, detached
- Rear Housing
  - Rail E Detent – binding
  - Rail E Shift Rail – binding
  - Rail E Bushing – worn
  - Rail E Synchronizer

Additional Tools

- Endurant XD Service Manual TRSM0960
- MTM Alignment Tool (RR1086TR-1)

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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

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Fault Code 780 Troubleshooting

A

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

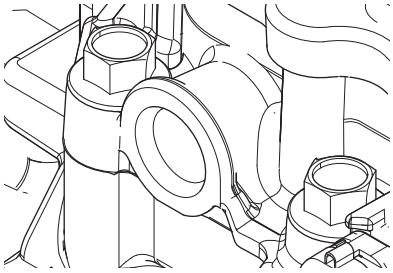
1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 780 FMI 0, 1, 2, 7, 10, 14, 15, 16, 17, 18, 21 is Active or Inactive, go to **Step B.**
   - If Fault Code 780 FMI 20 is Active or Inactive, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2, Go to **Step V.**

B

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

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C

Purpose: *Verify mechanical movement of Rail E Synchronizer.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedures.

2. Install MTM Alignment Tool (RR1086TR-1) onto main housing.

   Note: Reference Appendix/Manually Actuate Rail E Procedure.

3. Using Rail E Lever, shift Rail E into neutral position (if necessary).
4. Shift Rail E into High Range engagement position (fore).
5. Return Rail E to neutral position.
6. Shift Rail E into Low Range engagement position (aft).
7. Return Rail E to neutral position.
   - If Rail E shifts into all three positions replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail E does not shift into all three positions, go to **Step D.**

D

Purpose: *Verify mechanical movement of Rail E Range Synchronizer without detent.*

1. Remove the Rail E Detent Plug, Spring and Detent.
2. Install MTM Alignment Tool (RR1086TR-1) onto main housing.
3. Using Rail E Lever, shift Rail E into neutral position (if necessary).
4. Shift Rail E into High Range engagement position (fore).
5. Return Rail E to neutral position.
6. Shift Rail E into Low Range engagement position (aft).
7. Return Rail E to neutral position.
   - If Rail E Detent could not be removed, go to **Step E.**
   - If Rail E shifts into all three positions, replace Rail E Detent Plug, Spring, Detent and Rear Housing. Go to **Step V.**
   - If Rail E does not into all three positions, go to **Step E.**

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E

Purpose: *Verify mechanical condition of Rail E Synchronizer and Shift Rail E.*

1. Remove Rear Housing.
2. Inspect Rail E Synchronizer, Shift Rail, Detent and Rear Housing Detent bore.
   - Contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 780 sets Active, go to **Step A.**
   - If a fault code other than 780 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19

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Fault Code 785: Rail A Calibration

J1939: SA 3 SPN 5951 FMI 7, 20, 31

Overview

The Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM routinely performs shift rail calibrations to ensure gear engagement and disengagement positions are within specifications. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 calibration. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: During a rail calibration, Rail A Position Sensor indicated no movement in aft direction.

FMI 20 – Data Drifted High: During a rail calibration, Rail A Position Sensor indicated insufficient movement in aft direction.

FMI 31 – Condition Exists: During a rail calibration, Rail A Position Sensor indicated no movement in fore direction.

Fallback

FMI 7, 20, 31:

If Rail A position is known and Rail A is either fully engaged or fully disengaged:

- Amber warning lamp on
- Shift Rail A movement prohibited

If Rail A position is not known and Rail A is not fully engaged or fully disengaged:

- Shift Rail A movement prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation 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, 31: Key on and fault condition no longer exists.

Possible Causes

FMI 7, 20, 31:

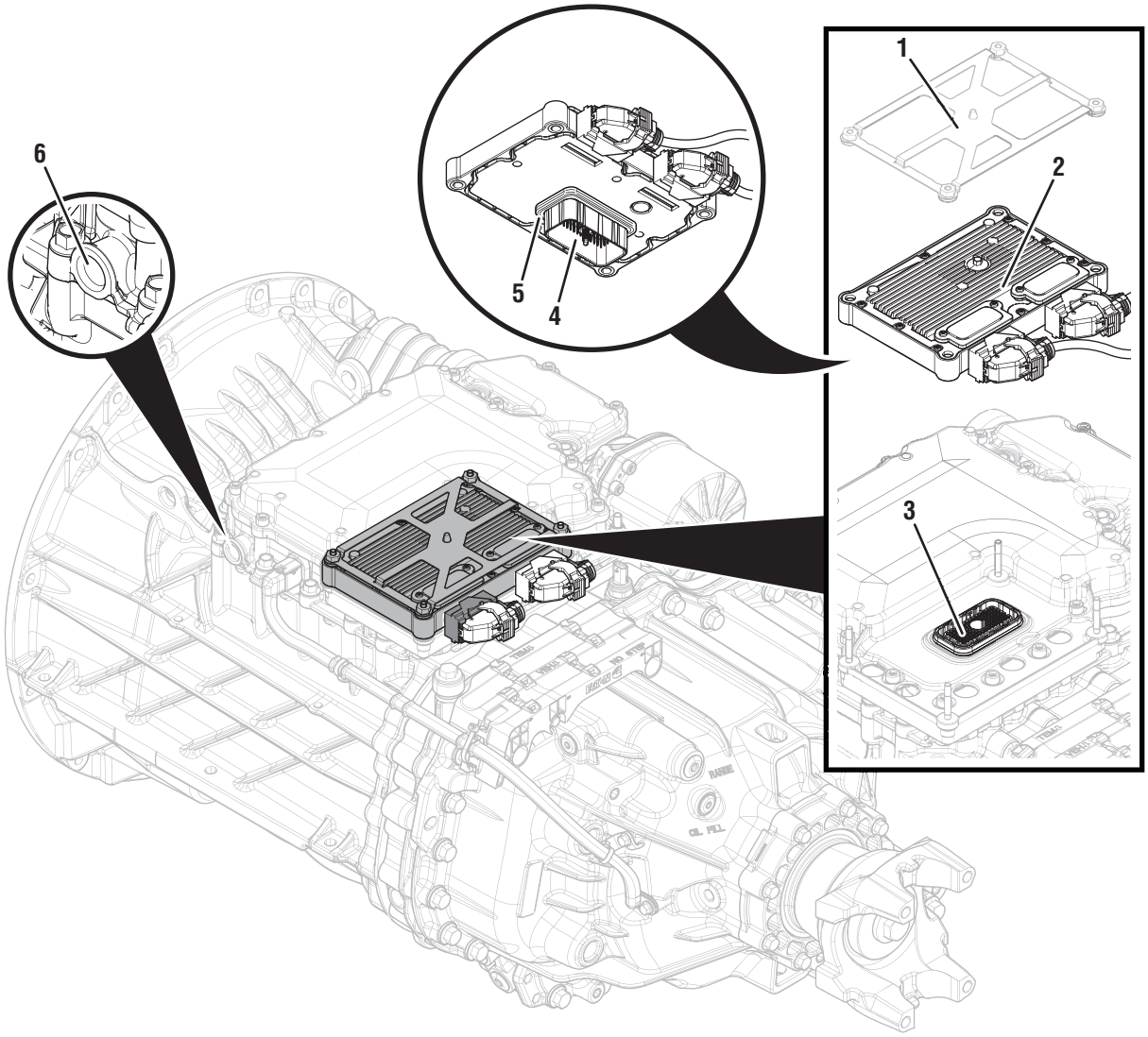
- MTM - Rail A
  - Rail A Solenoids
  - Rail A Cylinder
  - Rail A Detent
  - Rail A Yoke
  - Rail A Position Sensor
- Internal transmission
  - Rail A Synchronizer
  - Main Drive Gear

Additional Tools

- Endurant XD Service Manual TRSM0960

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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

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Fault Code 785 Troubleshooting

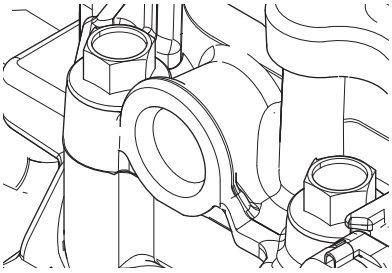
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set the vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

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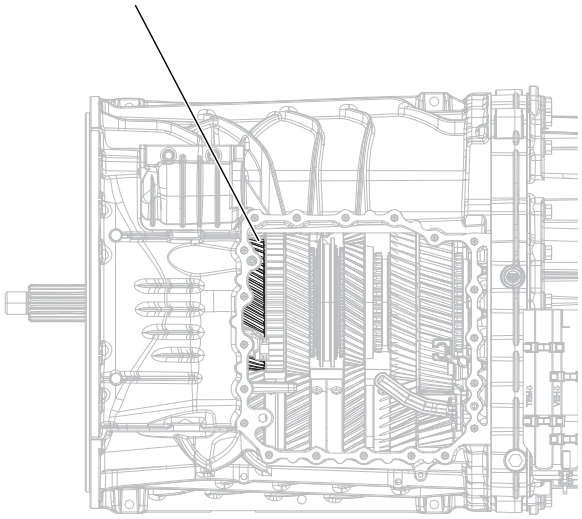
C

Purpose: *Verify mechanical condition of Main Drive Gear.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

2. Inspect Main Drive Gear for excessive fore and aft movement.



- If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**

  Note: Reference Endurant XD Service Manual TRSM0960, Main Shaft Disassembly/Assembly Service Procedure.

- If no excessive gear movement is evident, go to **Step D.**

D

Purpose: *Verify mechanical condition of Rail C Sliding Clutch and clutching teeth.*

Note: Reference Appendix; *Manually Actuate Rail A Procedure* on page 689.

1. Shift Rail A Synchronizer Sliding Sleeve into neutral position (if necessary).
2. Inspect Main Drive Gear and Rail A Synchronizer Sleeve clutching teeth for wear.
3. Shift Rail A Synchronizer Sliding Sleeve into Main Drive Gear engagement position (aft).

   - If Rail A Synchronizer Sliding Sleeve shifts into both positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail A Synchronizer Sliding Sleeve does not shift into both positions or clutching teeth wear is present, replace Rail A Yoke, Rail A Synchronizer Assembly, Main Drive Gear and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 785 sets Active, go to **Step A.**
   - If a fault code other than 785 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 786: Rail B Calibration

J1939: SA 3 SPN 5952 FMI 7, 20, 21, 31

Overview

The Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM routinely performs shift rail calibrations to ensure gear engagement and disengagement positions are within specifications. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 calibration. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: During a rail calibration, Rail B Position Sensor indicated no movement in aft direction.

FMI 20 – Data Drifted High: During a rail calibration, Rail B Position Sensor indicated insufficient movement in aft direction.

FMI 21 – Data Drifted Low: During a rail calibration, Rail B Position Sensor indicated insufficient movement in fore direction.

FMI 31 – Condition Exists: During a rail calibration, Rail B Position Sensor indicated no movement in fore direction.

Fallback

FMI 7, 20, 21, 31:

If Rail B position is known and Rail B is either fully engaged or fully disengaged:

- Amber warning lamp on
- Shift Rail B movement prohibited

If Rail B position is not known and Rail B is not fully engaged or fully disengaged:

- Shift Rail B movement prohibited
- Urge to Move and Creep Mode prohibited
- Inertia Brake activation 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 on and fault condition no longer exists.

Possible Causes

FMI 7, 20, 21, 31:

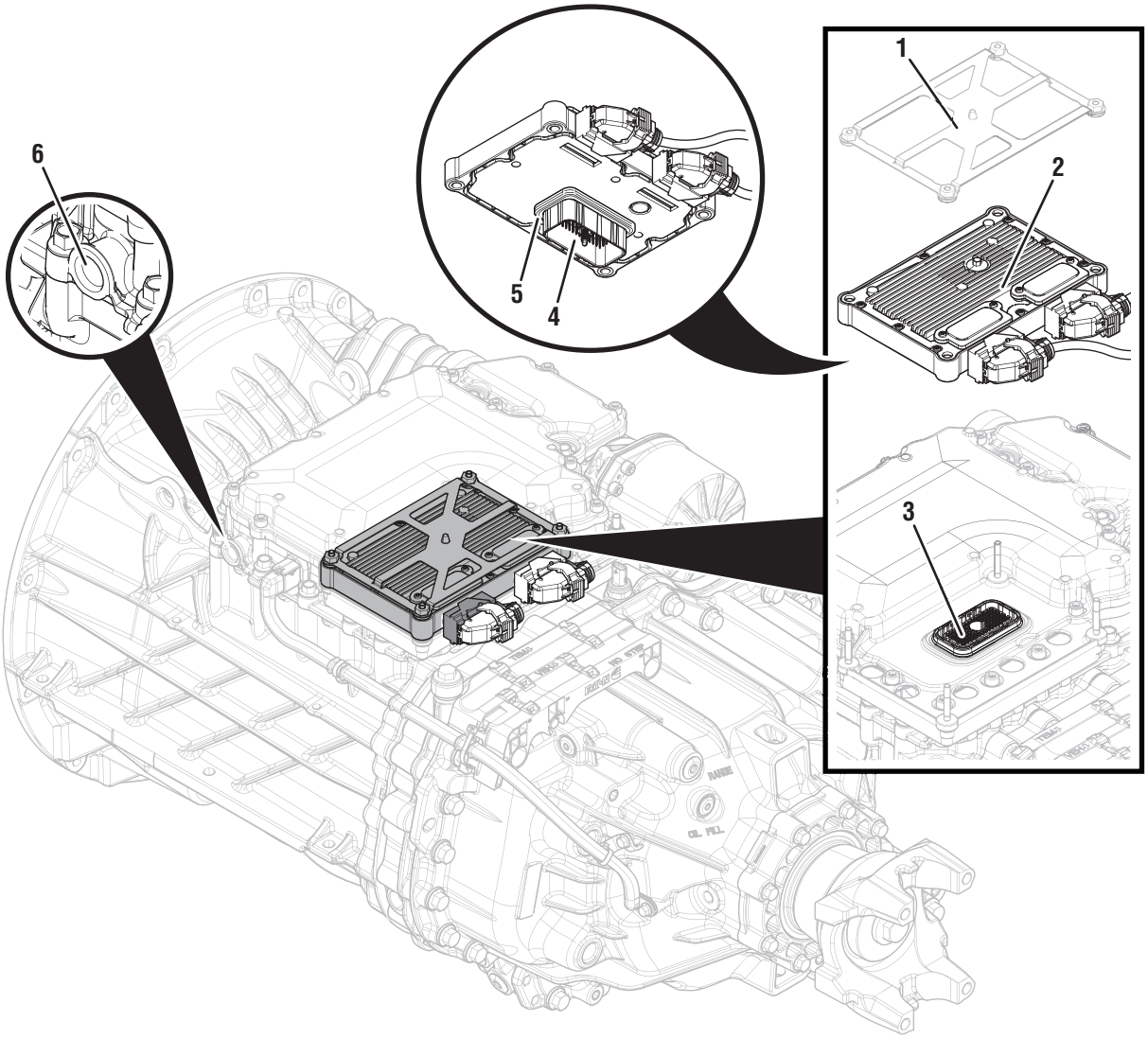
- MTM - Rail B
  - Rail B Solenoids
  - Rail B Cylinder
  - Rail B Detent
  - Rail B Yoke
  - Rail B Position Sensor
- Internal transmission
  - Rail B Synchronizer
  - Main Drive Gear Low
  - Splitter Gear

Additional Tools

- Endurant XD Service Manual TRSM0960
- Rail B Synchronizer Engagement Tool - RR1088TR

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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

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Fault Code 786 Troubleshooting

A

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

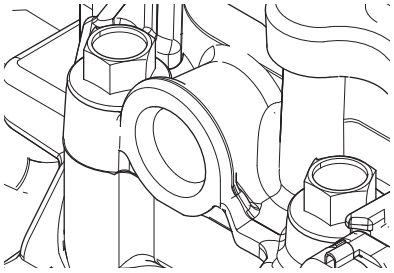
1. Set the vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 786 is Active or Inactive, go to **Step B.**

B

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

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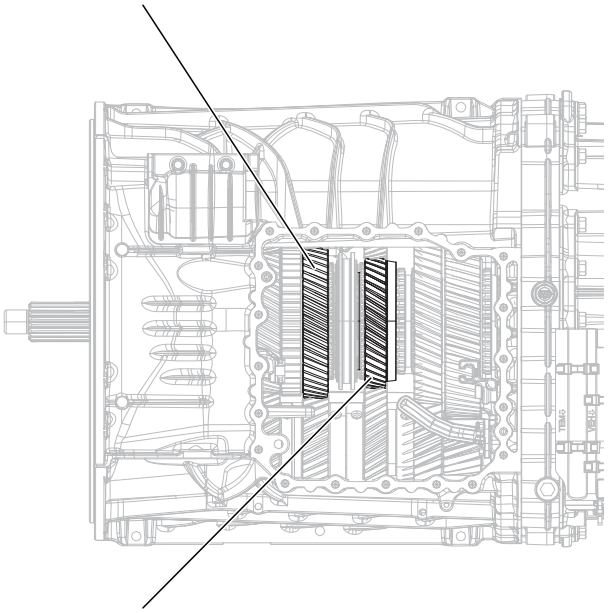
C

Purpose: *Verify mechanical condition of Main Drive Gear Low and Splitter Gear.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

2. Inspect Main Drive Gear Low for excessive fore and aft movement.

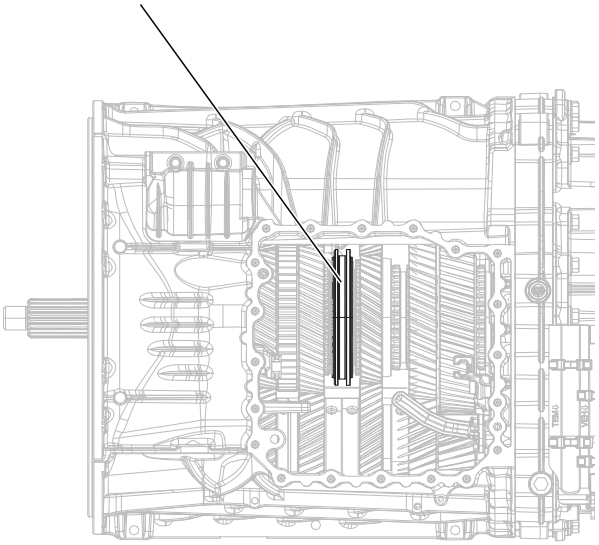


3. Inspect Splitter Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

D

Purpose: *Verify mechanical condition of Rail B Synchronizer and clutching teeth.*

1. Inspect Rail B Synchronizer Sliding Sleeve yoke slot for wear.



2. Install Rail B Synchronizer Engagement Tool (RR1088TR).

   Note: Reference Appendix, Manually Actuate Rail B Procedure.

3. Shift Rail B Synchronizer Sliding Sleeve into neutral position (if necessary).
4. Shift Rail B Synchronizer Sliding Sleeve into Main Drive Gear Low engagement position (fore).
5. Inspect Splitter Gear and Rail B Synchronizer Sliding Sleeve clutching teeth for wear.

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6. Return Rail B Synchronizer Sliding Sleeve to neutral position.
7. Shift Rail B Synchronizer Sliding Sleeve into Splitter Gear engagement position (aft).
8. Inspect Main Drive Gear Low and Rail B Synchronizer Sliding Sleeve clutching teeth for wear.
9. Return Rail B Synchronizer Sliding Sleeve to neutral position.
    - If Rail B Synchronizer Sliding Sleeve shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
    - If Rail B Synchronizer Sliding Sleeve does not shift into all three positions or clutching teeth wear is present, replace Rail B Synchronizer Assembly, Main Drive Gear Low, Splitter Gear and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 786 sets Active, go to **Step A.**
    - If a fault code other than 786 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 787: Rail C Calibration

J1939: SA 3 SPN 5953 FMI 7, 20, 21, 31

Overview

The Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM routinely performs shift rail calibrations to ensure gear engagement and disengagement positions are within specifications. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 calibration. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: During a rail calibration, Rail C Position Sensor indicated no movement in aft direction.

FMI 20 – Data Drifted High: During a rail calibration, Rail C Position Sensor indicated insufficient movement in aft direction.

FMI 21 – Data Drifted Low: During a rail calibration, Rail C Position Sensor indicated insufficient movement in fore direction.

FMI 31 – Condition Exists: During a rail calibration, Rail C Position Sensor indicated no movement in fore direction.

Fallback

FMI 7, 20, 21, 31:

If Rail C position is known and Rail C is either fully engaged or fully disengaged:

- Amber warning lamp on
- Shift Rail C movement prohibited

If Rail C position is not known and Rail C is not fully engaged or fully disengaged:

- Shift Rail C movement prohibited
- Shift Rail D movement prohibited
- Inertia Brake activation 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 on and fault condition no longer exists.

Possible Causes

FMI 7, 20, 21, 31:

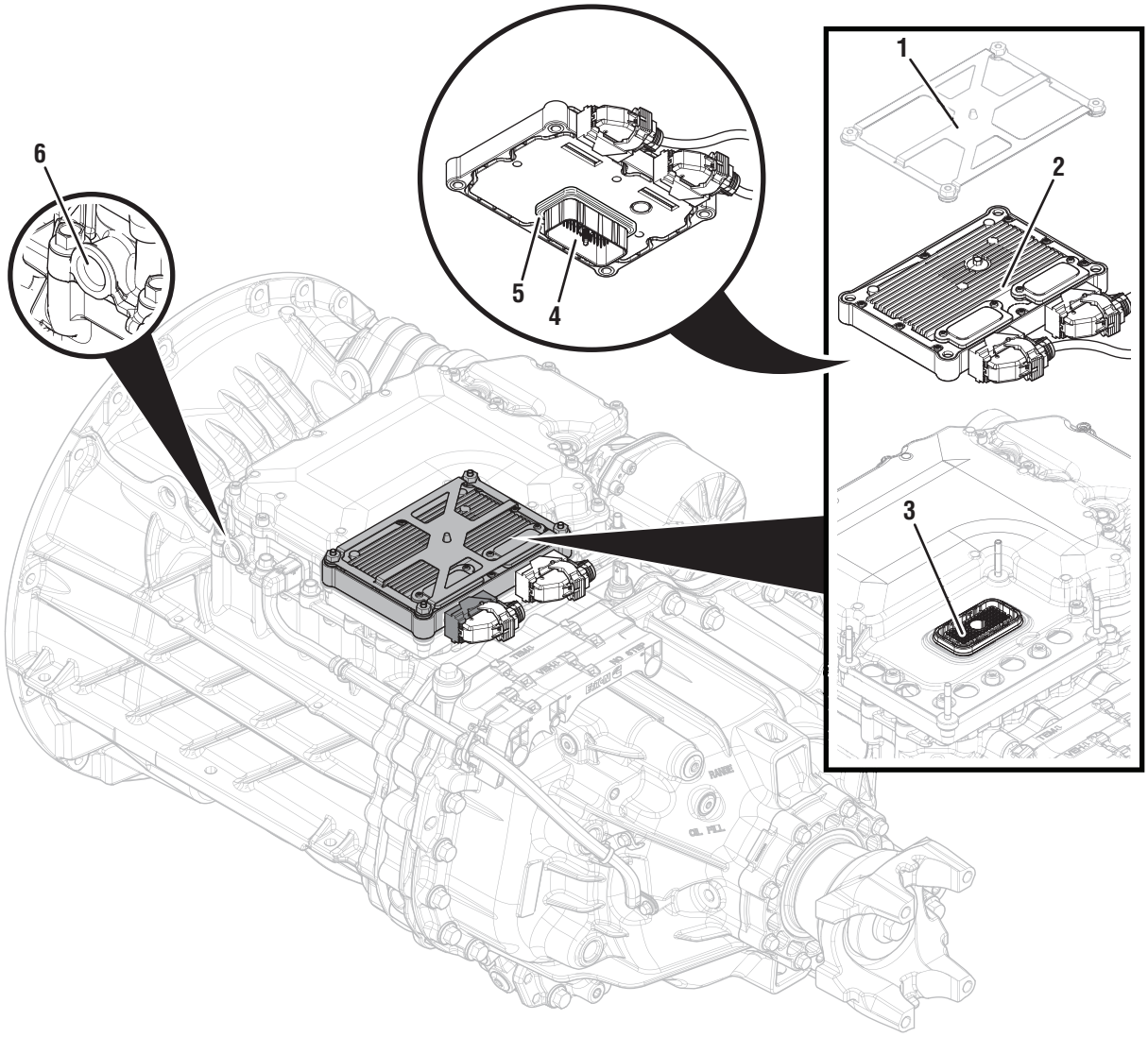
- MTM - Rail C
  - Rail C Solenoids
  - Rail C Cylinder
  - Rail C Detent
  - Rail C Yoke
  - Rail C Position Sensor
- Internal transmission
  - Rail C Sliding Clutch
  - Main Shaft Assembly
  - Splitter Gear
  - Driven Gear 2nd

Additional Tools

- Endurant XD Service Manual TRSM0960

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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

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Fault Code 787 Troubleshooting

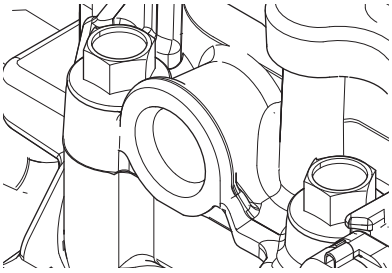
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set the vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

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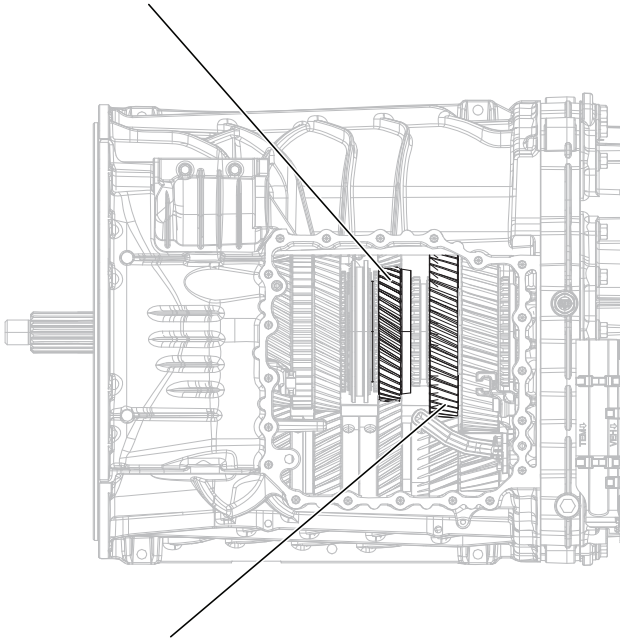
C

Purpose: *Verify mechanical condition of Splitter Gear and Driven Gear 2nd.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

2. Inspect Splitter Gear for excessive fore and aft movement.

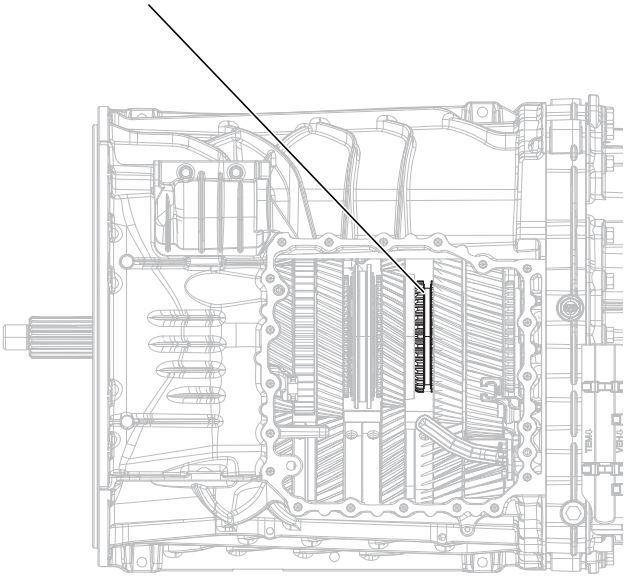


3. Inspect Driven Gear 2nd for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

D

Purpose: *Verify mechanical condition of Rail C Sliding Clutch and clutching teeth.*

1. Inspect Rail C Sliding Clutch yoke slot for wear.



2. Shift Rail C Sliding Clutch into neutral position (if necessary).
3. Shift Rail C Sliding Clutch into Splitter Gear engagement position (fore).
4. Inspect Driven Gear 2nd and Rail C Sliding Clutch clutching teeth for wear.
5. Return Rail C Sliding Clutch to neutral position.

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6. Shift Rail C Sliding Clutch into Driven Gear 2nd engagement position (aft).
7. Inspect Splitter Gear and Rail C Sliding Clutch clutching teeth for wear.
8. Return 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 **Mechatronic Transmission Module (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 Rail C Sliding Clutch, Splitter Gear, Drive Gear 2nd and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 787 sets Active, go to **Step A.**
   - If a fault code other than 787 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 788: Rail D Calibration

J1939: SA 3 SPN 5954 FMI 7, 20, 21, 31

Overview

The Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM routinely performs shift rail calibrations to ensure gear engagement and disengagement positions are within specifications. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 calibration. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: During a rail calibration, Rail D Position Sensor indicated no movement in aft direction.

FMI 20 – Data Drifted High: During a rail calibration, Rail D Position Sensor indicated insufficient movement in aft direction.

FMI 21 – Data Drifted Low: During a rail calibration, Rail D Position Sensor indicated insufficient movement in fore direction.

FMI 31 – Condition Exists: During a rail calibration, Rail D Position Sensor indicated no movement in fore direction.

Fallback

FMI 7, 20, 21, 31:

If Rail D position is known and Rail D is either fully engaged or fully disengaged:

- Amber warning lamp on
- Shift Rail D movement prohibited

If Rail D position is not known and Rail D is not fully engaged or fully disengaged:

- Shift Rail C movement prohibited
- Shift Rail D movement prohibited
- Inertia Brake activation 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 fault condition no longer exist.

Possible Causes

FMI 7, 20, 21, 31:

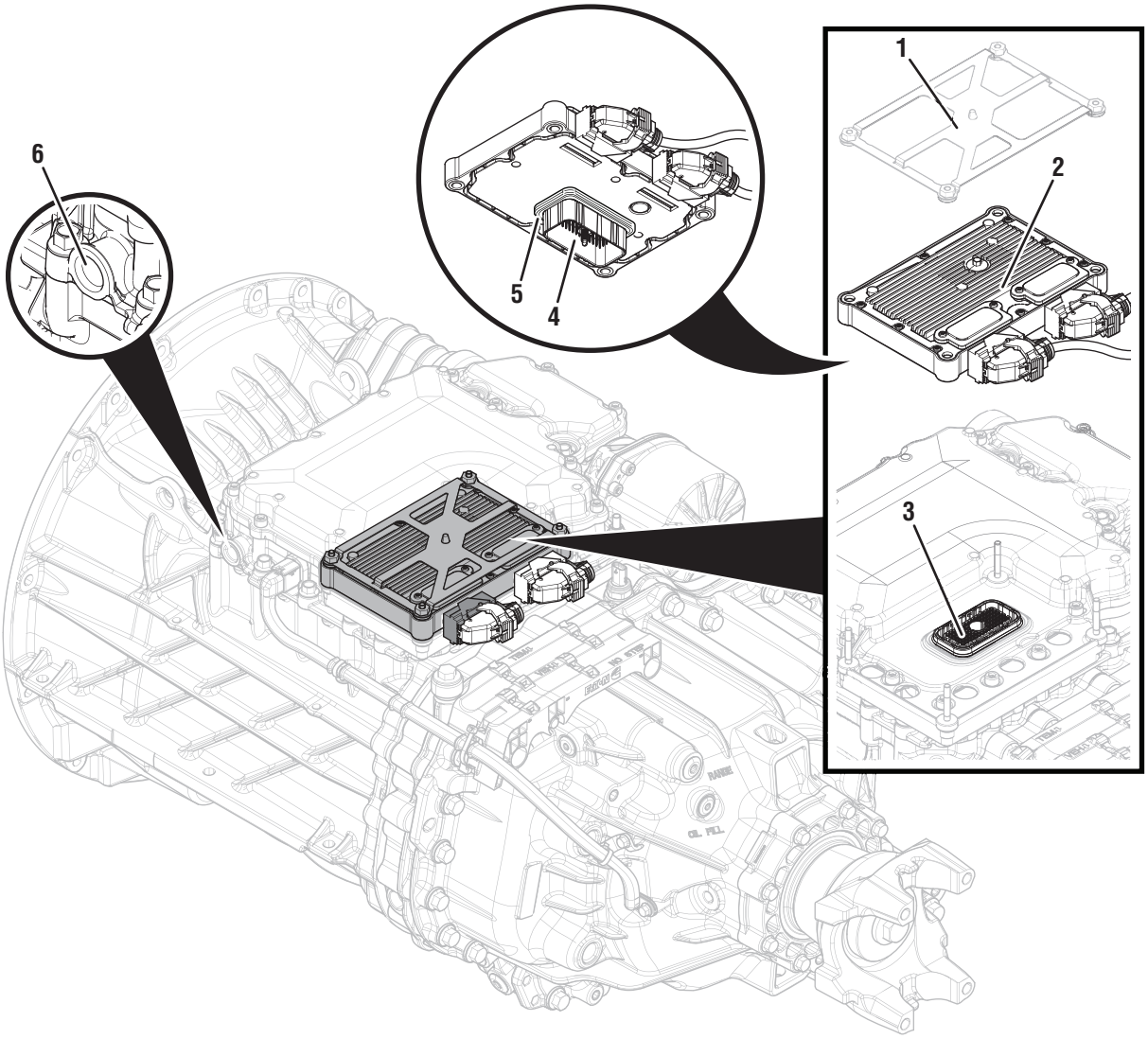
- MTM - Rail D
  - Rail D Solenoids
  - Rail D Cylinder
  - Rail D Detent
  - Rail D Yoke
  - Rail D Position Sensor
- Internal transmission
  - Rail D Sliding Clutch
  - Main Shaft Assembly
  - Driven Gear 1st
  - Reverse Gear

Additional Tools

- Endurant XD Service Manual TRSM0960

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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

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Fault Code 788 Troubleshooting

A

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

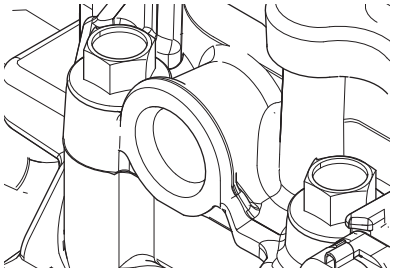
1. Set the vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 788 is Active or Inactive, go to **Step B.**

B

Purpose: *Verify condition of vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

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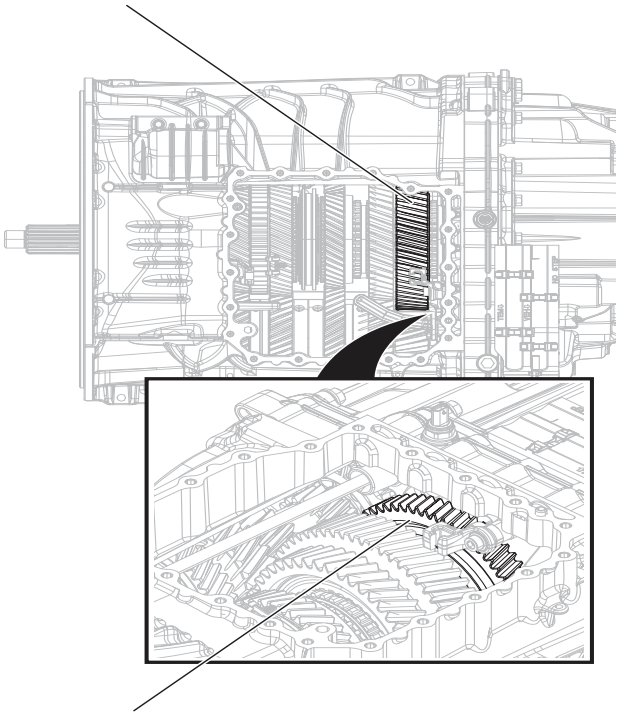
C

Purpose: *Verify mechanical condition of Driven Gear 1st and Reverse Gear.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

2. Inspect Driven Gear 1st for excessive fore and aft movement.

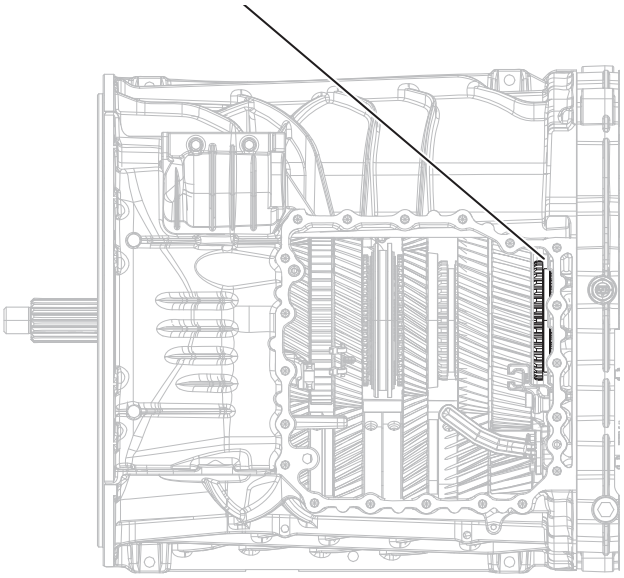


3. Inspect Reverse Gear for excessive fore and aft movement.
   - If excessive gear movement is evident, inspect Main Shaft Assembly for cause and repair. Go to **Step V.**
   - If no excessive gear movement is evident, go to **Step D.**

D

Purpose: *Verify mechanical condition of Rail D Sliding Clutch and clutching teeth.*

1. Inspect Rail D Sliding Clutch yoke slot for wear.



2. Shift Rail D Sliding Clutch into neutral position (if necessary).
3. Shift Rail D Sliding Clutch into Driven gear 1st engagement position (fore).
4. Inspect Reverse Gear and Rail D Sliding Clutch clutching teeth for wear.
5. Return Rail D Sliding Clutch to neutral position.

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6. Shift Rail D Sliding Clutch into Reverse Gear engagement position (aft).
7. Inspect Driven Gear 1st and Rail D Sliding Clutch clutching teeth for wear.
8. Return Rail D Sliding Clutch to neutral position.
   - If Rail D Sliding Clutch shifts into all three positions and no clutching teeth wear is present, replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail D Sliding Clutch does not shift into all three positions or clutching teeth wear is present, replace Rail D Sliding Clutch, Driven Gear 1st, Reverse Gear and **Mechatronic Transmission Module (MTM)**. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 788 sets Active, go to **Step A.**
   - If a fault code other than 788 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 789: Rail E Calibration

J1939: SA 3 SPN 5955 FMI 7, 20, 21, 31

Overview

The Endurant XD Series transmissions are equipped with five Shift Rails: A, B, C, D, and E. The shift rails are mounted in shift rail cylinders in the Mechatronic Transmission Module (MTM). Solenoid valves direct vehicle Supply Air to and from the shift rail cylinders for shift rail actuation. Position sensors monitor shift rail positions and speed sensors monitor shaft speeds.

The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions. The TCM routinely performs shift rail calibrations to ensure gear engagement and disengagement positions are within specifications. The TCM compares the shift rail commands to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

The 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 calibration. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: During a rail calibration, Rail E Position Sensor indicated no movement in aft direction.

FMI 20 – Data Drifted High: During a rail calibration, Rail E Position Sensor indicated insufficient movement in aft direction.

FMI 21 – Data Drifted Low: During a rail calibration, Rail E Position Sensor indicated insufficient movement in fore direction.

FMI 31 – Condition Exists: During a rail calibration, Rail E Position Sensor indicated no movement in fore direction.

Fallback

FMI 7, 20, 21, 31:

If Rail E position is known and Rail E is fully engaged in either High or Low Range:

- Amber warning lamp on
- Shift Rail E movement prohibited

If Rail E position is not known and Rail E is not fully engaged in High or Low Range:

- Shift Rail E movement prohibited
- Urge to Move and Creep Mode 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 fault condition no longer exists

Possible Causes

FMI 7, 20, 21, 31:

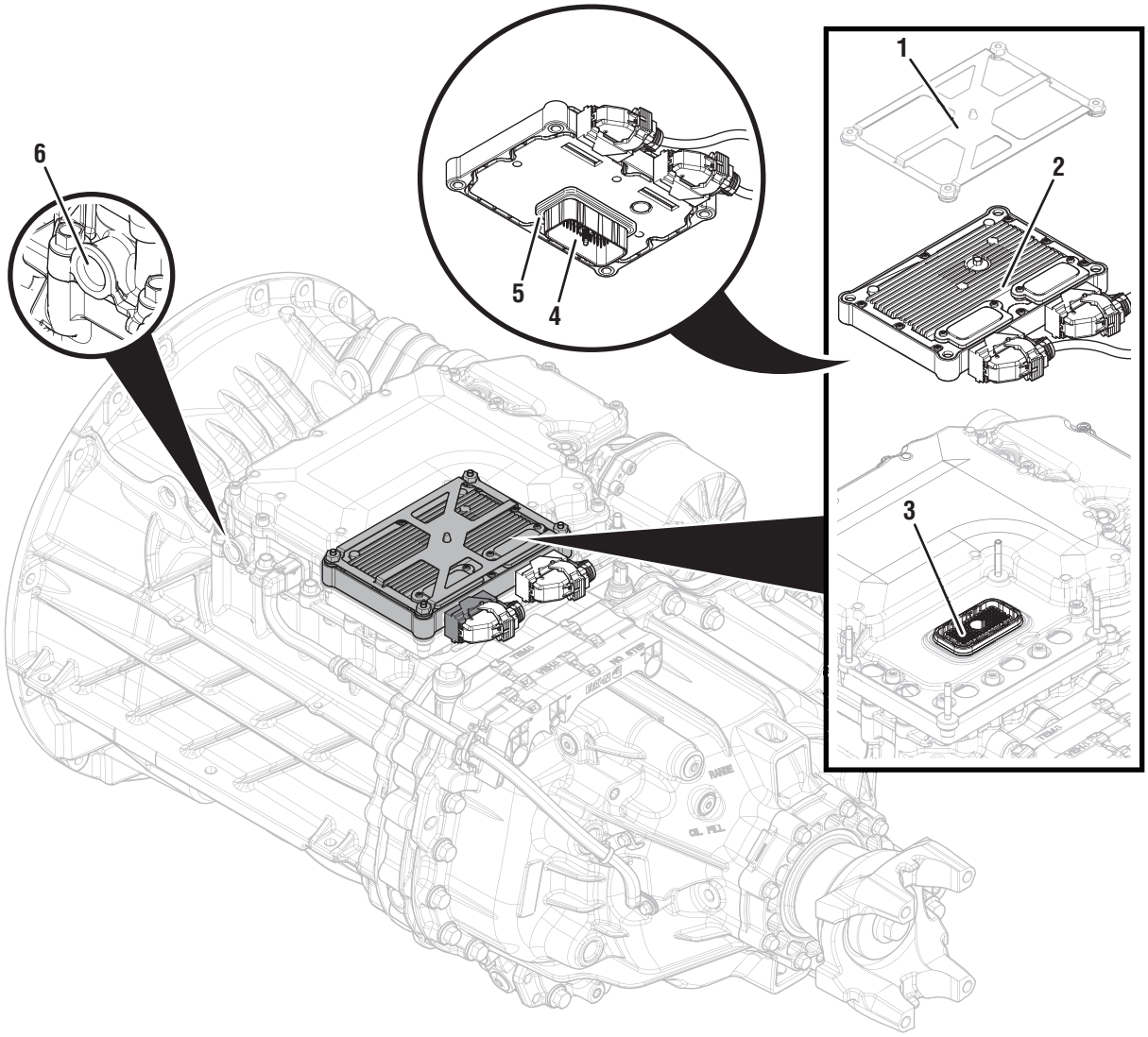
- MTM - Rail E
  - Rail E Solenoids
  - Rail E Cylinder
  - Rail E Yoke
  - Rail E Position Sensor
- Rear Housing
  - Rail E Detent
- Internal Transmission
  - Rail E Synchronizer
  - Range Assembly

Additional Tools

- Endurant XD Service Manual TRSM0960
- MTM Alignment Tool (RR1086TR-1)

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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

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Fault Code 789 Troubleshooting

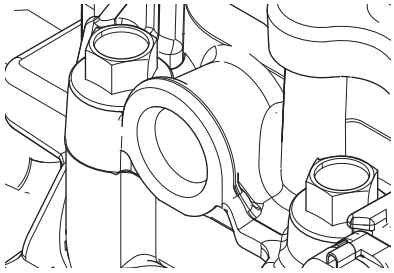
A ***Purpose:*** *Check for active or inactive fault codes.*

1. Set the vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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 vehicle air system supply line and MTM air inlet port.*

1. Key off.
2. Refer to OEM guidelines and vent vehicle air supply line to MTM.
3. Refer to OEM guidelines and remove vehicle air supply line at MTM.
4. Inspect vehicle air supply line and MTM air inlet port for contamination, moisture, corrosion and/or debris.

   Note: Verify 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 vehicle air system. Replace **Mechatronic Transmission Module (MTM)** and Inertia Brake Assembly. Go to **Step V.**

     Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.
   - If no contamination is found, go to **Step C.**

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C

Purpose: *Verify mechanical movement of Rail E Synchronizer.*

1. Remove MTM.

   Note: MTM removal and installation requires transmission be removed from vehicle. Reference Endurant XD Service Manual TRSM0960, Transmission Removal Service Procedure.

2. Install MTM Alignment Tool (RR1086TR-1) onto main housing.

   Note: Reference Appendix, *Manually Actuate Rail E Procedure* on page 694.

3. Using Rail E Lever, shift Rail E into neutral position (if necessary).
4. Shift Rail E into High Range engagement position (fore).
5. Return Rail E to neutral position.
6. Shift Rail E into Low Range engagement position (aft).
7. Return Rail E to neutral position.
   - If Rail E shifts into all three positions replace **Mechatronic Transmission Module (MTM)**. Go to **Step V.**
   - If Rail E does not shift into all three positions, go to **Step D.**

D

Purpose: *Verify mechanical movement of Rail E Range Synchronizer without detent.*

1. Remove Rail E Detent Plug, Spring and Detent.
2. Install MTM Alignment Tool (RR1086TR-1) onto main housing.
3. Using Rail E Lever, shift Rail E into neutral position (if necessary).
4. Shift Rail E into High Range engagement position (fore).
5. Return Rail E to neutral position.
6. Shift Rail E into Low Range engagement position (aft).
7. Return Rail E to neutral position.
   - If Rail E Detent could not be removed. Go to **Step E.**
   - If Rail E shifts into all three positions, replace Rail E Detent Plug, Spring, Detent and Rear Housing. Go to **Step V.**
   - If Rail E does not into all three positions, go to **Step E.**

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E ***Purpose:*** *Verify mechanical condition of Rail E Synchronizer and Shift Rail E.*

1. Remove Rear Housing.
2. Inspect Rail E Synchronizer, Shift Rail, Detent and Rear Housing Detent bore.
   - Contact Eaton Cummins Automated Transmission Technologies at +1 800-826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 789 sets Active, go to **Step A.**
   - If a fault code other than 789 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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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 Clutch Temperature. If the Clutch Temperature exceeds the normal operating range the TCM will modify transmission operation to prevent clutch damage and notify the driver that a clutch abuse event is occurring.

Detection
The TCM monitors clutch operation. If the calculated Clutch Temperature value exceeds the normal operating range, the fault is set Active.

Conditions to Set Fault Code Active
FMI 0 – Data Valid But Above Normal (Most Severe): Clutch Temperature value above normal, most severe, clutch protection is required.

FMI 15 – Data Valid but Above Normal (Least Severe): Clutch Temperature value above normal, least severe, clutch abuse is warning is displayed.

FMI 16 - Data Valid but Above Normal (Moderately Severe): Clutch Temperature reports above normal, moderately severe, clutch abuse warning is displayed.

Fallback
FMI 0:

- Amber warning lamp on (OEM specific)
- Red stop lamp on (OEM specific)
- Audible warning tone (OEM specific)
- Clutch Temperature Message (OEM specific)
- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- PTO Mode prohibited
- High Start Gears prohibited

FMI 15:

- High Start Gears prohibited

FMI 16:

- Amber warning lamp on (OEM specific)
- Audible warning tone (OEM specific)
- Clutch Temperature Message (OEM specific)
- High Start Gears prohibited

Conditions to Set Fault Code Inactive
The operation that is overheating the clutch is discontinued and Clutch Temperature value is within normal operating range.

Possible Causes
FMI 0, 15, 16

- Using accelerator pedal to hold vehicle on a grade
- Vehicle overloading
- Abusive or extreme operating conditions

Additional Tools
- Endurant XD Driver Instructions TRDR0960

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Fault Code 815 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from 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. Refer to service bulletin **TAIB-0876**. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 815 sets Active, go to **Step A.**
   - If a fault code other than 815 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 900: PTO 1 Request

J1939: SA 3 SPN 3452 FMI 4, 9, 12, 13, 14, 19, 20, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls for Power Take-Off (PTO) operation. When PTO operation is required the Transmission Control Module (TCM) receives a request (Input) for PTO operation, determines if operating conditions are suitable, and supplies a signal (Output) to engage the PTO. Once engaged the TCM receives a confirmation to complete the operation. Reference Endurant XD Driver Instructions TRDR0960 for PTO operation.

The TCM can be configured to operate a PTO with messages over the vehicle Primary Data Link J1939A or from a PTO switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Control Only", PTO operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to "Hardwire Control Only, PTO operation is controlled by Input and Output signals from a hardwired switch circuit. The TCM has the functionality to support operation of two PTOs at the same time; one over the Primary Data Link J1939A and one from a hardwired PTO switch circuit.

PTO circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The PTO and PTO circuit are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended PTO circuit wiring diagrams.

Detection

The TCM monitors the PTO 1 Request J1939 messages or the hardwired PTO 1 Request circuit input signal. If the messages or signal are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: PTO 1 Request circuit input signal indicated short to ground for 5 seconds.

FMI 9 – Abnormal Update Rate: PTO 1 Request messages not received for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: PTO 1 Request message not available for 5 seconds.

FMI 14 – Special Instructions: The TCM has detected invalid I/O Package calibration.

FMI 19 – Received Network Data in Error: PTO 1 Request messages invalid for 5 seconds.

FMI 20 – Data Drifted High: PTO 1 Request circuit input signal out of range (4.00–5.25 V) for 5 seconds.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 1 Mode prohibited

Conditions to Set Fault Code Inactive

FMI 4: PTO 1 Request circuit not shorted to ground for 10 seconds.

FMI 9, 13, 19: PTO 1 Request messages received and valid for 10 seconds.

FMI 12: Key cycle and fault condition no longer exists.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

FMI 20: PTO 1 Request circuit input signal in range for 10 seconds.

Possible Causes

FMI 4, 20:

- Vehicle Harness - PTO 1 Request circuit
  - Shorted to power, shorted to ground or open circuit

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FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - PTO 1 Request J1939 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 900 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 900 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 900 FMI 4, 20 is Active, go to **Step B.**
   - If Fault Code 900 FMI 4, 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the PTO 1 Request circuit. Go to **Step C.**

     Note: PTO and circuit wiring are installed by OEM or body builder.
   - If Fault Code 900 FMI 9, 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle PTO 1 Request message (SPN 3452). Go to **Step V.**
   - If Fault Code 900 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 900 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 900 FMI 13 is Active, refer to OEM and enable PTO 1 Request message (SPN 3452). Go to **Step V.**
   - If Fault Code 900 FMI 13 is Inactive, PTO 1 is properly configured. Go to **Step V.**
   - If Fault Code 900 FMI 14, 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 900 FMI 14, 31 is Inactive, go to **Step V.**

B

Purpose: *Verify PTO 1 configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “PTO”.
5. Record "PTO 1" Current Value.
   - If "PTO 1" Current Value indicates “Disabled” and PTO 1 circuit is properly installed and wired, select “Hardwire control only” and follow on-screen prompts. Go to **Step V.**
   - If "PTO 1" Current Value indicates “Hardwire control only" and PTO 1 Request circuit is properly installed and wired, go to **Step C.**

C

Purpose: *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "PTO 1" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of PTO 1 Request circuit. Go to **Step V.**

     Note: PTO and circuit wiring are installed by OEM or body builder.

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Fault Code 900: PTO 1 Request			
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)
Input / Output Calibration Package 1 on page 15 of TRIG2630: Neutral Output + PTO 1 + Reverse Output	14	15	PTO1 Request Switch DPST
Input / Output Calibration Package 4 on page 18 of TRIG2630: PTO 1	14	15	
Input / Output Calibration Package 5 on page 19 of TRIG2630: PTO 1 + PTO 2	5	15	
Input / Output Calibration Package 6 on page 20 of TRIG2630: PTO 1 + Secondary Shift Mode	14	15	
Input / Output Calibration Package 7 on page 21 of TRIG2630: PTO 1 + Rock Free Mode + Secondary Shift Mode	14	15	
Input / Output Calibration Package 8 on page 22 of TRIG2630: PTO 1 + Reverse Output + Rock Free Mode	14	15	
Input / Output Calibration Package 11 on page 25 of TRIG2630: PTO 1 + Reverse Output	14	15	
Input / Output Calibration Package 18 on page 31 of TRIG2630: 2-Speed Axle + PTO 1	14	15	
Input / Output Calibration Package 22 and 25 on page 35: of TRIG2630 Force Neutral + PTO 1 and Hold Neutral + PTO 1	14	15	
Input / Output Calibration Package 23 and 26 on page 36 of TRIG2630: PTO 1 + PTO 2 + Force Neutral and Hold Neutral + PTO 1 + PTO 2	5	15	
Input / Output Calibration Package 29 on page 38 of TRIG2630: PTO 1 + Rock Free Mode	14	15	
Input / Output Calibration Package 34 on page 43 of TRIG2630: PTO 1 + PTO 2 + Reverse Output	5	15	

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

1. Key off.
2. Reconnect all connectors and verify 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 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 19.

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Fault Code 902: Split Shaft PTO Request

J1939: SA 3 SPN 3454 FMI 4, 9, 12, 13, 14, 19, 20, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls for Power Take-Off (PTO) operation. When PTO operation is required the Transmission Control Module (TCM) receives a request (Input) for PTO operation, determines if operating conditions are suitable, and supplies a signal (Output) to engage the PTO. Once engaged the TCM receives a confirmation to complete the operation. Reference Endurant XD Driver Instructions TRDR0960 for PTO operation.

The TCM can be configured to operate a PTO with messages over the vehicle Primary Data Link J1939A or from a PTO switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Control Only", PTO operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to "Hardwire Control Only, PTO operation is controlled by Input and Output signals from a hardwired switch circuit. The TCM has the functionality to support operation of two PTOs at the same time; one over the Primary Data Link J1939A and one from a hardwired PTO switch circuit.

PTO circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The PTO and PTO circuit are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended PTO circuit wiring diagrams.

Detection

The TCM monitors the Split Shaft PTO Request J1939 messages or the hardwired Split Shaft PTO Request circuit input signal. If the messages or signal are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: Split Shaft PTO Request circuit input signal indicated short to ground for 5 seconds.

FMI 9 – Abnormal Update Rate: Split Shaft PTO Request messages not received for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: Split Shaft PTO Request message not available for 5 seconds.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 19 – Received Network Data in Error: Split Shaft PTO Request messages invalid for 5 seconds.

FMI 20 – Data Drifted High: Split Shaft PTO Request circuit input signal out of range (4.00–5.25 V) for 5 seconds.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- Split Shaft PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 4: Split Shaft PTO Request circuit not shorted to ground for 10 seconds.

FMI 9, 13, 19: Split Shaft PTO Request messages received and valid for 10 seconds.

FMI 12: Key cycle and fault condition no longer exists.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

FMI 20: Split Shaft PTO Request circuit input signal in range for 10 seconds.

Possible Causes

FMI 4, 20:

- Vehicle Harness - Split Shaft PTO Request circuit
  - Shorted to power, shorted to ground or open circuit

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FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - Split Shaft PTO Request J1939 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 902 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 902 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 902 FMI 4, 20 is Active, go to **Step B.**
   - If Fault Code 902 FMI 4, 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Split Shaft PTO Request circuit. Go to **Step C.**

     Note: Split Shaft PTO and circuit wiring are installed by OEM or body builder.
   - If Fault Code 902 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Split Shaft PTO Request message (SPN 3454). Go to **Step V.**
   - If Fault Code 902 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 902 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 902 FMI 13 is Active, refer to OEM and enable Split Shaft PTO Request message (SPN 3454). Go to **Step V.**
   - If Fault Code 902 FMI 13 is Inactive, Split Shaft PTO is properly configured. Go to **Step V.**
   - If Fault Code 902 FMI 14 or 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 902 FMI 14 or 31 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Split Shaft PTO configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “PTO”.
5. Record "Split-Shaft PTO Configuration" Current Value.
   - If "Split-Shaft PTO Configuration" Current Value indicates “Disabled” and Split-Shaft PTO circuit is properly installed and wired, select a Stationary or Mobile Analog (hardwired) option and follow on-screen prompts. Go to **Step V.**
   - If "Split-Shaft PTO Configuration" Current Value indicates a Stationary or Mobile Analog (hardwired) option and the Split-Shaft PTO Request circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Split Shaft PTO Request circuit. Go to **Step V.**

     Note: Split Shaft PTO and circuit wiring are installed by OEM or body builder.

Fault Code 902: SSPTO Request			
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)
Input / Output Calibration Package 20 on page 33 of TRIG2630: Split Shaft PTO	6	14	SSPTO Request Switch
Input / Output Calibration Package 21 on page 26 of TRIG2630: PTO 1 + Split Shaft PTO			

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V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 902 sets Active, go to **Step A.**
   - If a fault code other than 902 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 905: PTO 2 Request

J1939: SA 3 SPN 3453 FMI 4, 9, 12, 13, 14, 19, 20, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls for Power Take-Off (PTO) operation. When PTO operation is required the Transmission Control Module (TCM) receives a request (Input) for PTO operation, determines if operating conditions are suitable, and supplies a signal (Output) to engage the PTO. Once engaged the TCM receives a confirmation to complete the operation. Reference Endurant XD Driver Instructions TRDR0960 for PTO operation.

The TCM can be configured to operate a PTO with messages over the vehicle Primary Data Link J1939A or from a PTO switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Control Only", PTO operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to "Hardwire Control Only, PTO operation is controlled by Input and Output signals from a hardwired switch circuit. The TCM has the functionality to support operation of two PTOs at the same time; one over the Primary Data Link J1939A and one from a hardwired PTO switch circuit.

PTO circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The PTO and PTO circuit are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended PTO circuit wiring diagrams.

Detection

The TCM monitors the PTO 2 Request J1939 messages or the hardwired PTO 2 Request circuit input signal. If the messages or signal are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: PTO 2 Request circuit input signal indicated short to ground for 5 seconds.

FMI 9 – Abnormal Update Rate: PTO 2 Request messages not received for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: PTO 2 Request message not available for 5 seconds.

FMI 14 - Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 19 – Received Network Data in Error: PTO 2 Request messages invalid for 5 seconds.

FMI 20 – Data Drifted High: PTO 2 Request circuit input signal out of range (4.00–5.25 V) for 5 seconds.

FMI 31 - Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 2 Mode prohibited

Conditions to Set Fault Code Inactive

FMI 4: PTO 2 Request circuit not shorted to ground for 10 seconds.

FMI 9, 13, 19: PTO 2 Request messages received and valid for 10 seconds.

FMI 12: Key cycle and fault condition no longer exists.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

FMI 20: PTO 2 Request circuit input signal in range for 10 seconds.

Possible Causes

FMI 4, 20:

- Vehicle Harness - PTO 2 Request circuit
  - Shorted to power, shorted to ground or open circuit

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FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - PTO 2 Request J1939 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 905 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 905 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 905 FMI 4, 20 is Active, go to **Step B.**
   - If Fault Code 905 FMI 4, 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the PTO 2 Request circuit. Go to **Step C.**

     Note: PTO and circuit wiring are installed by OEM or body builder.
   - If Fault Code 905 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle PTO 2 Request message (SPN 3453). Go to **Step V.**
   - If Fault Code 905 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 905 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 905 FMI 13 is Active, refer to OEM and enable PTO 2 Request message (SPN 3453). Go to **Step V.**
   - If Fault Code 905 FMI 13 is Inactive, PTO 2 is properly configured. Go to **Step V.**
   - If Fault Code 905 FMI 14 or 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 905 FMI 14 or 31 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify PTO 2 configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “PTO”.
5. Record "PTO 2" Current Value.
   - If "PTO 2" Current Value indicates “Disabled” and PTO 2 circuit is properly installed and wired, select “Hardwire control only” and follow on-screen prompts. Go to **Step V.**
   - If "PTO 2" Current Value indicates “Hardwire control only" and PTO 2 Request circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of PTO 2 Request circuit. Go to **Step V.**

     Note: PTO and circuit wiring are installed by OEM or body builder.

Fault Code 905: PTO 2 Request			
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)
Input / Output Calibration Package 5 on page 19 of TRIG2630: PTO 1 + PTO 2	6	14	PTO2 Request Switch DPST
Input / Output Calibration Package 23 and 26 on page 36 of TRIG2630: PTO 1 + PTO 2 + Force Neutral and Hold Neutral + PTO 1 + PTO 2			
Input / Output Calibration Package 34 on page 43 of TRIG2630: PTO 1 + PTO 2 + Reverse Output			

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

1. Key off.
2. Reconnect all connectors and verify 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 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 19.

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Fault Code 910: PTO 1 Engage

J1939: SA 3 SPN 3456 FMI 3, 4, 5, 6, 7, 11, 12, 13, 14, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls for Power Take-Off (PTO) operation. When PTO operation is required the Transmission Control Module (TCM) receives a request (Input) for PTO operation, determines if operating conditions are suitable, and supplies a signal (Output) to engage the PTO. Once engaged the TCM receives a confirmation to complete the operation. Reference Endurant XD Driver Instructions TRDR0960 for PTO operation.

The TCM can be configured to operate a PTO with messages over the vehicle Primary Data Link J1939A or from a PTO switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Control Only", PTO operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to "Hardwire Control Only, PTO operation is controlled by Input and Output signals from a hardwired switch circuit. The TCM has the functionality to support operation of two PTOs at the same time; one over the Primary Data Link J1939A and one from a hardwired PTO switch circuit.

PTO circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The PTO and PTO circuit are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 in the Appendix for recommended PTO circuit wiring diagrams.

Detection

The TCM monitors the PTO 1 Engage J1939 messages or the hardwired PTO 1 Engage circuit output signal. If the messages or signal are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: PTO 1 Engage circuit output signal shorted to power for 5 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: PTO 1 Engage circuit output signal shorted to ground for 5 seconds.

FMI 5 – Current Below Normal or Open Circuit: PTO 1 Engage circuit open for 5 seconds.

FMI 6 – Current Above Normal or Grounded Circuit: PTO 1 Engage circuit output current out of range for 5 seconds.

FMI 7 – Mechanical System Not Responding: PTO 1 Engage commanded, but PTO 1 Confirm message or signal not received.

FMI 11 – Root Cause Unknown: TCM has detected an internal processing error.

FMI 12 – Bad Intelligent Device: Inappropriate PTO 1 consent engagement.

FMI 13 – Out of Calibration: The TCM detected I/O Package calibration file is incompatible with application software version.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 1 Mode prohibited

Conditions to Set Fault Code Inactive

FMI 3: PTO 1 Engage circuit not shorted to power for 10 seconds.

FMI 4: PTO 1 Engage circuit not shorted to ground for 10 seconds.

FMI 5: PTO 1 Engage circuit not open for 10 seconds.

FMI 6: PTO 1 Engage circuit output current in range for 10 seconds.

FMI 7: PTO 1 Confirm circuit corrected.

FMI 11, 12: Key cycle and fault condition no longer exits.

FMI 13: Correct I/O Package calibration file is configured in TCM.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

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Possible Causes

FMI 3, 4, 5, 6:

- Vehicle Harness - PTO 1 Engage Circuit
  - Shorted to power, shorted to ground, or open circuit

FMI 7:

- Vehicle Harness - PTO 1 Confirm Circuit
  - Open circuit
- Vehicle Components - PTO 1 Confirm and Engage Circuits
  - Switch stuck open
  - Relay latch failure
- Vehicle Components - PTO Mechanical
  - Failure to engage

FMI 11, 12:

- TCM
  - Internal failure
  - Software issue

FMI 13, 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 910 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 910 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 910 FMI 3, 4, 5, 6 is Active, go to **Step B.**
   - If Fault Code 910 FMI 3, 4, 5, 6 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the PTO 1 Engage circuit. Go to **Step D.**

     Note: PTO and circuit wiring are installed by OEM or body builder.
   - If Fault Code 910 FMI 7 is Active or Inactive, go to **Step C.**
   - If Fault Code 910 FMI 11, 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 910 FMI 11, 12 is Inactive, go to **Step V.**
   - If Fault Code 910 FMI 13, 14, 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 910 FMI 13, 14, 31 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify PTO 1 configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “PTO”.
5. Record "PTO 1" Current Value.
   - If "PTO 1" Current Value indicates “Disabled” and PTO 1 circuit is properly installed and wired, select “Hardwire control only” and follow on-screen prompts. Go to **Step V.**
   - If "PTO 1" Current Value indicates “Hardwire control only" and PTO 1 Engage circuit is properly installed and wired, go to **Step D.**

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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.
   - 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. Go to **Step D.**
   - If readings are out of range, go to **Step D.**

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	

D

Purpose: *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of PTO 1 Engage circuit. Go to **Step V.**

     Note: PTO and circuit wiring are installed by OEM or body builder.

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Fault Code 910: PTO 1 Engage					
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)		
Input / Output Calibration Package 1 on page 15 of TRIG2630: PTO 1 + Reverse Output + Neutral (Range) Output	2		PTO1 Engage Relay	PTO1 Fuse 2 Amp	Chassis Ground
Input / Output Calibration Package 4 on page 18 of TRIG2630: PTO 1					
Input / Output Calibration Package 5 on page 19 of TRIG2630: PTO 1 + PTO 2					
Input / Output Calibration Package 6 on page 20 of TRIG2630: PTO 1 + Secondary Shift Mode					
Input / Output Calibration Package 7 on page 21 of TRIG2630: PTO 1 + Rock Free Mode + Secondary Shift Mode					
Input / Output Calibration Package 8 on page 22 of TRIG2630: PTO 1 + Reverse Output + Rock Free Mode					
Input / Output Calibration Package 11 on page 25 of TRIG2630: PTO 1 + Reverse Output					
Input / Output Calibration Package 18 on page 31 of TRIG2630: 2-Speed Axle + PTO 1					
Input / Output Calibration Package 22 and 25 on page 35 of TRIG2630: Force Neutral + PTO 1 and Hold Neutral + PTO 1					
Input / Output Calibration Package 23 and 26 on page 36 of TRIG2630: PTO 1 + PTO 2 + Force Neutral and Hold Neutral + PTO 1 + PTO 2					
of TRIG2630*Input / Output Calibration Package 29* on page 38 PTO 1 + Rock Free Mode	14	15			

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

1. Key off.
2. Reconnect all connectors and verify 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 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 19.

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Fault Code 912: Split Shaft PTO Engage

J1939: SA 3 SPN 3458 FMI 3, 4, 5, 6, 7, 12, 14, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls for Power Take-Off (PTO) operation. When PTO operation is required the Transmission Control Module (TCM) receives a request (Input) for PTO operation, determines if operating conditions are suitable, and supplies a signal (Output) to engage the PTO. Once engaged the TCM receives a confirmation to complete the operation. Reference Endurant XD Driver Instructions TRDR0960 for PTO operation.

The TCM can be configured to operate a PTO with messages over the vehicle Primary Data Link J1939A or from a PTO switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Control Only", PTO operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to "Hardwire Control Only, PTO operation is controlled by Input and Output signals from a hardwired switch circuit. The TCM has the functionality to support operation of two PTOs at the same time; one over the Primary Data Link J1939A and one from a hardwired PTO switch circuit.

PTO circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The PTO and PTO circuit are installed by the OEM or body builder. Reference Input / Output Calibration on page 696 for recommended PTO circuit wiring diagrams.

Detection

The TCM monitors the Split Shaft PTO Engage J1939 messages or the hardwired Split Shaft PTO Engage circuit output signal. If the messages or signal are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: Split Shaft PTO Engage circuit output signal shorted to power for 5 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Split Shaft PTO Engage circuit output signal shorted to ground for 5 seconds.

FMI 5 – Current Below Normal or Open Circuit: Split Shaft PTO Engage circuit open for 5 seconds.

FMI 6 – Current Above Normal or Grounded Circuit: Split Shaft PTO Engage circuit output current out of range for 5 seconds.

FMI 7 - Mechanical System Not Responding: Split Shaft PTO Engage commanded, but Split Shaft PTO Confirm message or signal not received.

FMI 12 – Bad Intelligent Device: TCM had detected an internal processing error.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- Split Shaft PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 3: Split Shaft PTO Engage circuit not shorted to power for 10 seconds.

FMI 4: Split Shaft PTO Engage circuit not shorted to ground for 10 seconds.

FMI 5: Split Shaft PTO Engage circuit not open for 10 seconds.

FMI 6: Split Shaft PTO Engage circuit output current in range for 10 seconds.

FMI 7: Split Shaft PTO Confirm circuit corrected.

FMI 12: Key cycle and fault condition no longer exits.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

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Possible Causes

FMI 3, 4, 5, 6:

- Vehicle Harness - Split Shaft PTO Engage Circuit
  - Shorted to power, shorted to ground, or open circuit

FMI 7:

- Vehicle Harness - Split Shaft PTO Confirm Circuit
  - Open circuit
- Vehicle Components - Split Shaft PTO Confirm and Engage Circuits
  - Switch stuck open
  - Relay latch failure
- Vehicle Components - PTO Mechanical
  - Failure to engage

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 912 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 912 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 912 FMI 3, 4, 5, or 6 is Active, go to **Step B.**
   - If Fault Code 912 FMI 3, 4, 5, or 6 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Split Shaft PTO Engage circuit. Go to **Step D.**

     Note: PTO and circuit wiring are installed by OEM or body builder.
   - If Fault Code 912 FMI 7 is Active or Inactive, go to **Step C.**
   - If Fault Code 912 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 912 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 912 FMI 14 or 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 912 FMI 14 or 31 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Split Shaft PTO configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “PTO”.
5. Record "Split Shaft PTO Configuration" Current Value.
   - If "Split Shaft PTO Configuration" Current Value indicates “Disabled” and Split Shaft PTO circuit is properly installed and wired, select a Stationary or Mobile Analog (hardwired) option and follow on-screen prompts. Go to **Step V.**
   - If "Split Shaft PTO Configuration" Current Value indicates a Stationary or Mobile Analog (hardwired) option and the Split Shaft PTO Request circuit is properly installed and wired, go to **Step D.**

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C ***Purpose:*** *Verify Split Shaft PTO operation and Confirm feedback.*

1. Key on with engine running.
2. Select transmission Split Shaft PTO 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 Split Shaft PTO request switch to on.
8. Monitor 520536 - PTO Confirmation Voltage value. Record reading in table.
9. Compare reading(s) in table.
    - If readings are in range, no fault was found. The intermittent nature of the fault makes it likely that the problem is in the Split Shaft PTO, Split Shaft PTO confirmation switch and/or wiring. Go to **Step D.**
    - If readings are out of range, go to **Step D.**

Parameter	Range	Reading(s)
SSPTO Off		
520536 – PTO Confirmation Voltage	4.5–5.5 V	
SSPTO On		
520536 – PTO Confirmation Voltage	0.0–0.5 V	

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D ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Split Shaft PTO Engage circuit. Go to **Step V.**

     Note: Split Shaft PTO and circuit wiring are installed by OEM or body builder.

Fault Code 912: SSPTO Engage				
Package # and Description	20-Way TCM Body Connector Pin(s)	Component(s)		
Input / Output Calibration Package 20 on page 33 of TRIG2630: Split Shaft PTO	3	SSPTO Engage Relay	SSPTO Fuse 2 Amp	Chassis Ground
Input / Output Calibration Package 21 on page 26 of TRIG2630: PTO 1 + Split Shaft PTO				

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

1. Key off.
2. Reconnect all connectors and verify 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 912 sets Active, go to **Step A.**
   - If a fault code other than 912 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 915: PTO 2 Engage

J1939: SA 3 SPN 3457 FMI 3, 4, 5, 6, 7, 12, 14, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls for Power Take-Off (PTO) operation. When PTO operation is required the Transmission Control Module (TCM) receives a request (Input) for PTO operation, determines if operating conditions are suitable, and supplies a signal (Output) to engage the PTO. Once engaged the TCM receives a confirmation to complete the operation. Reference Endurant XD Driver Instructions TRDR0960 for PTO operation.

The TCM can be configured to operate a PTO with messages over the vehicle Primary Data Link J1939A or from a PTO switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Control Only", PTO operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to "Hardwire Control Only, PTO operation is controlled by Input and Output signals from a hardwired switch circuit. The TCM has the functionality to support operation of two PTOs at the same time; one over the Primary Data Link J1939A and one from a hardwired PTO switch circuit.

PTO circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The PTO and PTO circuit are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended PTO circuit wiring diagrams.

Detection

The TCM monitors the PTO 2 Engage J1939 messages or the hardwired PTO 2 Engage circuit output signal. If the messages or signal are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: PTO 2 Engage circuit output signal shorted to power for 5 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: PTO 2 Engage circuit output signal shorted to ground for 5 seconds.

FMI 5 – Current Below Normal or Open Circuit: PTO 2 Engage circuit open for 5 seconds.

FMI 6 – Current Above normal or Grounded Circuit: PTO 2 Engage circuit output current out of range for 5 seconds.

FMI 7 – Mechanical System Not Responding: PTO 2 Engage commanded, but PTO 2 Confirm message or signal not received.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 2 Mode prohibited

Conditions to Set Fault Code Inactive

FMI 3: PTO 2 Engage circuit not shorted to power for 10 seconds.

FMI 4: PTO 2 Engage circuit not shorted to ground for 10 seconds.

FMI 5: PTO 2 Engage circuit not open for 10 seconds.

FMI 6: PTO 2 Engage circuit output current in range for 10 seconds.

FMI 7: PTO 2 Confirm circuit corrected.

FMI 12: Key cycle and fault condition no longer exits.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

Possible Causes

FMI 3, 4, 5, 6:

- Vehicle Harness - PTO 2 Engage Circuit
  - Shorted to power, shorted to ground, or open circuit

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FMI 7:

- Vehicle Harness - PTO 2 Confirm Circuit
  - Open circuit
- Vehicle Components - PTO 2 Confirm and Engage Circuits
  - Switch stuck open
  - Relay latch failure
- Vehicle Components - PTO Mechanical
  - Failure to engage

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 915 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 915 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 915 FMI 3, 4, 5, or 6 is Active, go to **Step B.**
   - If Fault Code 915 FMI 3, 4, 5, or 6 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the PTO 2 Engage circuit. Go to **Step D.**

     Note: PTO and circuit wiring are installed by OEM or body builder.
   - If Fault Code 915 FMI 7 is Active or Inactive, go to **Step C.**
   - If Fault Code 915 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 915 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 915 FMI 14 or 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 915 FMI 14 or 31 is Inactive, go to **Step V.**

B

Purpose: *Verify PTO 2 configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “PTO”.
5. Record "PTO 2" Current Value.
   - If "PTO 2" Current Value indicates “Disabled” and PTO 2 circuit is properly installed and wired, select “Hardwire control only” and follow on-screen prompts. Go to **Step V.**
   - If "PTO 2" Current Value indicates “Hardwire control only" and PTO 2 Engage circuit is properly installed and wired, go to **Step D.**

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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.
   - 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. Go to **Step D.**
   - If readings are out of range, go to **Step D.**

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	

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D ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of PTO 2 Engage circuit. Go to **Step V.**

     Note: PTO and circuit wiring are installed by OEM or body builder.

Fault Code 915: PTO 2 Engage				
Package # and Description	20-Way TCM Body Connector Pin(s)	Component(s)		
Input / Output Calibration Package 5 on page 19 of TRIG2630: PTO 1 + PTO 2	3	PTO2 Engage Relay	PTO2 Fuse 2 Amp	Chassis Ground
Input / Output Calibration Package 23 and 26 on page 36 of TRIG2630: PTO 1 + PTO 2 + Force Neutral and Hold Neutral + PTO 1 + PTO 2				
Input / Output Calibration Package 34 on page 43 of TRIG2630: PTO 1 + PTO 2 + Reverse Output				

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

1. Key off.
2. Reconnect all connectors and verify 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 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 19.

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Fault Code 920: PTO 1 Confirm

J1939: SA 3 SPN 3460 FMI 4, 7, 9, 12, 13, 14, 19, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls for Power Take-Off (PTO) operation. When PTO operation is required the Transmission Control Module (TCM) receives a request (Input) for PTO operation, determines if operating conditions are suitable, and supplies a signal (Output) to engage the PTO. Once engaged the TCM receives a confirmation to complete the operation. Reference Endurant XD Driver Instructions TRDR0960 for PTO operation.

The TCM can be configured to operate a PTO with messages over the vehicle Primary Data Link J1939A or from a PTO switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Control Only", PTO operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to "Hardwire Control Only, PTO operation is controlled by Input and Output signals from a hardwired switch circuit. The TCM has the functionality to support operation of two PTOs at the same time; one over the Primary Data Link J1939A and one from a hardwired PTO switch circuit.

PTO circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The PTO and PTO circuit are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended PTO circuit wiring diagrams.

Detection

The TCM monitors the PTO 1 Confirm J1939 messages or the hardwired PTO 1 Confirm circuit input signal. If the messages or signal are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: PTO 1 Confirm circuit output signal shorted to ground for 5 seconds.

FMI 7 – Mechanical System Not Responding: PTO 1 Confirm message or signal received but PTO 1 Engage not commanded.

FMI 9 – Abnormal Update Rate: PTO 1 Confirm messages not received for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: PTO 1 Confirm message not available for 5 seconds.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 19 – Received Network Data in Error: PTO 1 Confirm messages invalid for 5 seconds.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 1 Mode prohibited

Conditions to Set Fault Code Inactive

FMI 4: PTO 1 Confirm circuit not shorted to ground for 10 seconds.

FMI 7: PTO 1 Confirm circuit signal not continuously grounded.

FMI 9, 13, 19: PTO 1 Confirm messages received and valid for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

Possible Causes

FMI 4:

- Vehicle Harness - PTO 1 Confirm Circuit
  - Shorted to ground

FMI 7:

- Vehicle Harness - PTO 1 Confirm Circuit
  - Shorted to ground
- Vehicle Components - PTO 1 Confirm Circuit
  - Switch stuck open
  - Relay latch failure
- Vehicle Components - PTO Mechanical
  - Failure to engage

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FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - PTO 1 Confirm J1939 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 920 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 920 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 920 FMI 4 or 7 is Active or Inactive, go to **Step B.**
   - If Fault Code 920 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle PTO 1 Confirm message (SPN 3460). Go to **Step V.**
   - If Fault Code 920 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 920 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 920 FMI 13 is Active, refer to OEM and enable PTO 1 Confirm message (SPN 3460). Go to **Step V.**
   - If Fault Code 920 FMI 13 is Inactive, PTO 1 is properly configured. Go to **Step V.**
   - If Fault Code 920 FMI 14 or 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 920 FMI 14 or 31 is Inactive, go to **Step V.**

B ***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.
   - 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. Go to **Step C.**
   - If readings are out of range, go to **Step C.**

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	

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of PTO 1 Confirm circuit. Go to **Step V.**

     Note: PTO and circuit wiring are installed by OEM or body builder.

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Fault Code 920: PTO 1 Confirm			
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)
Input / Output Calibration Package 1 on page 15 of TRIG2630: Neutral Output + PTO 1 + Reverse Output	5	16	PTO1 Confirm Relay
Input / Output Calibration Package 4 on page 18 of TRIG2630: PTO 1	5	16	
Input / Output Calibration Package 5 on page 19 of TRIG2630: PTO 1 + PTO 2	5	16	
Input / Output Calibration Package 6 on page 20 of TRIG2630: PTO 1 + Secondary Shift Mode	5	16	
Input / Output Calibration Package 7 on page 21 of TRIG2630: PTO 1 + Rock Free Mode + Secondary Shift Mode	14	16	
Input / Output Calibration Package 8 on page 22 of TRIG2630: PTO 1 + Reverse Output + Rock Free Mode	5	16	
Input / Output Calibration Package 11 on page 25 of TRIG2630: PTO 1 + Reverse Output	5	16	
Input / Output Calibration Package 18 on page 31 of TRIG2630: 2-Speed Axle + PTO 1	5	16	
Input / Output Calibration Package 22 and 25 on page 35 of TRIG2630: Force Neutral + PTO 1 and Hold Neutral + PTO 1	14	16	
Input / Output Calibration Package 23 and 26 on page 36 of TRIG2630: PTO 1 + PTO 2 + Force Neutral and Hold Neutral + PTO 1 + PTO 2	5	16	
Input / Output Calibration Package 29 on page 38 of TRIG2630: PTO 1 + Rock Free Mode	14	15	
Input / Output Calibration Package 34 on page 43 of TRIG2630: PTO 1 + PTO 2 + Reverse Output	5	15	

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

1. Key off.
2. Reconnect all connectors and verify 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 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 19.

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Fault Code 922: Split Shaft PTO Confirm

J1939: SA 3 SPN 3462 FMI 4, 7, 9, 12, 13, 14, 19, 20, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls for Power Take-Off (PTO) operation. When PTO operation is required the Transmission Control Module (TCM) receives a request (Input) for PTO operation, determines if operating conditions are suitable, and supplies a signal (Output) to engage the PTO. Once engaged the TCM receives a confirmation to complete the operation. Reference Endurant XD Driver Instructions TRDR0960 for PTO operation.

The TCM can be configured to operate a PTO with messages over the vehicle Primary Data Link J1939A or from a PTO switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Control Only", PTO operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to "Hardwire Control Only, PTO operation is controlled by Input and Output signals from a hardwired switch circuit. The TCM has the functionality to support operation of two PTOs at the same time; one over the Primary Data Link J1939A and one from a hardwired PTO switch circuit.

PTO circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The PTO and PTO circuit are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696of the Appendix for recommended PTO circuit wiring diagrams.

Detection

The TCM monitors the Split Shaft PTO Confirm J1939 messages or the hardwired Split Shaft PTO Confirm circuit input signal. If the messages or signal are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: Split Shaft PTO Confirm circuit output signal shorted to ground for 5 seconds.

FMI 7 – Mechanical System Not Responding: Split Shaft PTO Confirm message or signal received but Split Shaft PTO Engage not commanded.

FMI 9 – Abnormal Update Rate: Split Shaft PTO Confirm messages not received for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: Split Shaft PTO Confirm message not available for 5 seconds.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 19 – Received Network Data in Error: Split Shaft PTO Confirm messages invalid for 5 seconds.

FMI 20 – Data Drifted High: Split Shaft PTO Confirm circuit input signal out of range (4.00-5.25 V) for 5 seconds.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- Split Shaft PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 4: Split Shaft PTO Confirm circuit not shorted to ground for 10 seconds.

FMI 7: Split Shaft PTO Confirm circuit signal not continuously grounded.

FMI 9, 13, 19: Split Shaft PTO Confirm messages received and valid for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

FMI 20: Split Shaft PTO Confirm circuit input signal in range for 10 seconds.

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Possible Causes

FMI 4, 20:

- Vehicle Harness - Split Shaft PTO Confirm Circuit
  - Shorted to power, shorted to ground or open circuit

FMI 7:

- Vehicle Harness - Split Shaft PTO Confirm Circuit
  - Shorted to ground
- Vehicle Components - Split Shaft PTO Confirm Circuit
  - Switch stuck open
  - Relay latch failure
- Vehicle Components - PTO Mechanical
  - Failure to engage

FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - Split Shaft PTO Confirm J1939 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 922 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 922 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 922 FMI 4, 7 or 20 is Active or Inactive, go to **Step B.**
   - If Fault Code 922 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Split Shaft PTO Confirm message (SPN 3462). Go to **Step V.**
   - If Fault Code 922 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 922 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 922 FMI 13 is Active, refer to OEM and enable Split Shaft PTO Confirm message (SPN 3462). Go to **Step V.**
   - If Fault Code 922 FMI 14 or 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 922 FMI 14 or 31 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Split Shaft PTO operation and Confirm feedback.*

1. Key on with engine running.
2. Select transmission Split Shaft PTO 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 Split Shaft PTO request switch to on.
8. Monitor 520536 – PTO Confirmation Voltage value. Record reading in table.
9. Compare reading(s) in table.
   - 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, Split Shaft PTO confirmation switch and/or wiring. Go to **Step C.**
   - If readings are out of range, go to **Step C.**

Parameter	Range	Reading(s)
Split Shaft PTO Off		
520536 – PTO Confirmation Voltage	4.5–5.5 V	
Split Shaft PTO On		
520536 – PTO Confirmation Voltage	0.0–0.5 V	

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Split Shaft PTO Confirm circuit. Go to **Step V.**

     Note: Split Shaft PTO and circuit wiring are installed by OEM or body builder.

Fault Code 922: SSPTO Confirm			
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)
Input / Output Calibration Package 20 on page 33 of TRIG2630: Split Shaft PTO	4	5	SSPTO Confirm Relay
Input / Output Calibration Package 21 on page 26 of TRIG2630: PTO 1 + Split Shaft PTO	4	14	

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

1. Key off.
2. Reconnect all connectors and verify 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 922 sets Active, go to **Step A.**
   - If a fault code other than 922 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 925: PTO 2 Confirm

J1939: SA 3 SPN 3461 FMI 4, 7, 9, 12, 13, 14, 19, 20, 31

Overview

The Endurant XD Series transmission incorporates enhanced controls for Power Take-Off (PTO) operation. When PTO operation is required the Transmission Control Module (TCM) receives a request (Input) for PTO operation, determines if operating conditions are suitable, and supplies a signal (Output) to engage the PTO. Once engaged the TCM receives a confirmation to complete the operation. Reference Endurant XD Driver Instructions TRDR0960 for PTO operation.

The TCM can be configured to operate a PTO with messages over the vehicle Primary Data Link J1939A or from a PTO switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Control Only", PTO operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to "Hardwire Control Only, PTO operation is controlled by Input and Output signals from a hardwired switch circuit. The TCM has the functionality to support operation of two PTOs at the same time; one over the Primary Data Link J1939A and one from a hardwired PTO switch circuit.

PTO circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The PTO and PTO circuit are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended PTO circuit wiring diagrams.

Detection

The TCM monitors the PTO 2 Confirm J1939 messages or the hardwired PTO 2 Confirm circuit input signal. If the messages or signal are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: PTO 2 Confirm circuit output signal shorted to ground for 5 seconds.

FMI 7 – Mechanical System Not Responding: PTO 2 Confirm message or signal received but PTO 2 Engage not commanded.

FMI 9 – Abnormal Update Rate: PTO 2 Confirm messages not received for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: PTO 2 Confirm message not available for 5 seconds.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 19 – Received Network Data in Error: PTO 2 Confirm messages invalid for 5 seconds.

FMI 20 – Data Drifted High: PTO 2 Confirm circuit input signal out of range (4.00-5.25 V) for 5 seconds.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 2 Mode prohibited

Conditions to Set Fault Code Inactive

FMI 4: PTO 2 Confirm circuit not shorted to ground for 10 seconds.

FMI 7: PTO 2 Confirm circuit signal not continuously grounded.

FMI 9, 13, 19: PTO 2 Confirm messages received and valid for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

FMI 20: PTO 2 Confirm circuit input signal in range for 10 seconds.

Possible Causes

FMI 4, 20:

- Vehicle Harness - PTO 2 Confirm Circuit
  - Shorted to power, shorted to ground or open circuit

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FMI 7:

- Vehicle Harness - PTO 2 Confirm Circuit
  - Shorted to ground
- Vehicle Components - PTO 2 Confirm Circuit
  - Switch stuck open
  - Relay latch failure
- Vehicle Components - PTO Mechanical
  - Failure to engage

FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - PTO 2 Confirm J1939 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 925 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 925 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 925 FMI 4, 7 or 20 is Active or Inactive, go to **Step B.**
   - If Fault Code 925 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle PTO 2 Confirm message (SPN 3461). Go to **Step V.**
   - If Fault Code 925 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 925 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 925 FMI 13 is Active, refer to OEM and enable PTO 2 Confirm message (SPN 3461). Go to **Step V.**
   - If Fault Code 925 FMI 13 is Inactive, PTO 2 is properly configured. Go to **Step V.**
   - If Fault Code 925 FMI 14 or 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 925 FMI 14 or 31 is Inactive, go to **Step V.**

B ***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.
   - 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. Go to **Step C.**
   - If readings are out of range, go to **Step C.**

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	

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of PTO 2 Confirm circuit. Go to **Step V.**

     Note: PTO and circuit wiring are installed by OEM or body builder.

Fault Code 925: PTO 2 Confirm			
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)
Input / Output Calibration Package 5 on page 19 of TRIG2630: PTO 1 + PTO 2	4	14	PTO2 Confirm Relay
Input / Output Calibration Package 23 and 26 on page 36 of TRIG2630: PTO 1 + PTO 2 + Force Neutral and Hold Neutral + PTO 1 + PTO 2			

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

1. Key off.
2. Reconnect all connectors and verify 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 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 19.

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Fault Code 950: Neutral Status 1

J1939: SA 3 SPN 3648 FMI 12

Overview

The Endurant XD Series transmissions are equipped with position sensors to monitor shift rail positions and speed sensors to monitor shaft speeds. The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions.

The TCM is configured to accept Shift Mode request messages from the vehicle Driver Interface Device over the Primary Data Link (J1939A). A second Shift Mode request signal from the vehicle Driver Interface Device is also provided on a separate circuit.

The TCM compares Shift Mode requests to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

Detection

The TCM monitors Shift Mode request messages and gear position. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 12 – Bad Intelligent Device: Inappropriate selection of a non-Neutral Shift Mode when Neutral Shift Mode was requested.

Fallback

FMI 12:

- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- Clutch engagement prohibited
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 12: Key cycle and fault condition no longer exists.

Possible Causes

FMI 12:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- None

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Fault Code 950 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 950 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 950 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 950 FMI 12 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 950 sets Active, go to **Step A.**
   - If a fault code other than 950 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 960: Neutral Status 2

J1939: SA 3 SPN 6159 FMI 12

Overview

The Endurant XD Series transmissions are equipped with position sensors to monitor shift rail positions and speed sensors to monitor shaft speeds. The sensor information is provided to the Transmission Control Module (TCM) for the purpose of making shift decisions, confirming gear engagement, and monitoring shift rail positions.

The TCM is configured to accept Shift Mode request messages from the vehicle Driver Interface Device over the Primary Data Link (J1939A). A second Shift Mode request signal from the vehicle Driver Interface Device is also provided on a separate circuit.

The TCM compares Shift Mode requests to the shift rail positions and shaft speeds (ratio calculation) to ensure the transmission is operating properly.

Detection

The TCM monitors Shift Mode request messages and gear position. If a system failure is detected, the fault is set Active.

Conditions to Set Fault Code Active

FMI 12 – Bad Intelligent Device: Failed to disengage gear when Neutral Shift Mode was requested.

Fallback

FMI 12:

- Urge to Move and Creep Mode prohibited
- Non-Neutral modes prohibited
- Clutch engagement prohibited
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 12: Key cycle and fault condition no longer exist.

Possible Causes

FMI 12:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- None

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Fault Code 960 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 960 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes.Go to **Step V.**
   - If Fault Code 960 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 960 FMI 12 is Inactive, go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 960 sets Active, go to **Step A.**
   - If a fault code other than 960 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 962: Force Hold Neutral Output

J1939: SA 3 SPN 7694 FMI 3, 4, 5, 13, 14

Overview

The Endurant XD Series transmission incorporates a Force Neutral and a Hold Neutral feature that allow the use of a separate vehicle integrated switch "input" circuit to place and hold the transmission in a neutral state to prevent vehicle motion while a vehicle specific feature is performed or chassis mounted equipment is operated or deployed (e.g. PTO, Crane, Lift, etc.). When Force Neutral or Hold Neutral is active, an "HN" is displayed in the gear display. The Transmission Control Module (TCM) can be configured to enable Force Neutral (Force Neutral - TCM Hardwired) or Hold Neutral (Hold Neutral - TCM Hardwired) based on the vehicle's application.

When Force Neutral or Hold Neutral operation is required, the TCM reveives the operator's request (Input) from the vehicle integrated switch circuit, determines if operating conditions are suitable, then places the transmission in a neutral state regardless of the selected gear lever position (Shift Mode). The transmission remains in a neutral state and disallows any operator Shift Mode requests until the operator removes the Force Neutral or Hold Neutral request by returning the vehicle integrated switch circuit to the deactivated state and selecting Neutral on the Driver Interface Device. Reference Endurant XD Driver Instructions TRDR0960 for Force Neutral and Hold Neutral operation.

The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support these vocational features. The Force Neutral and Hold Neutral circuits are connected to the TCM in the 20-Way TCM Body Harness Connector. The Force Neutral and Hold Neutral circuits are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended Force Neutral and Hold Neutral circuit wiring diagrams.

Detection

The TCM monitors the hardwired Force Hold Neutral Output circuit signal. If the signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: Force Hold Neutral Output circuit signal shorted to power for 5 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Force Hold Neutral Output circuit signal shorted to ground for 5 seconds.

FMI 5 – Current Below Normal or Open Circuit: Force Hold Neutral Output circuit open for 5 seconds.

FMI 13 – Out of Calibration: The TCM detected invalid I/O Package calibration.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded modes
- Force Hold/Neutral Mode may not function

Conditions to Set Fault Code Inactive

FMI 3: Force Hold Neutral Output circuit not shorted to power for 10 seconds.

FMI 4: Force Hold Neutral Output circuit not shorted to ground for 10 seconds.

FMI 5: Force Hold Neutral Output circuit not open for 10 seconds.

FMI 13, 14: Valid I/O Package calibration file is configured in TCM.

Possible Causes

FMI 3, 4, 5:

- Vehicle Harness - Force Hold Neutral Output Circuit
  - Shorted to power, shorted to ground, or open circuit

FMI 13, 14:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 962 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 962 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 962 FMI 3, 4 or 5 is Active, go to **Step B.**
   - If Fault Code 962 FMI 3, 4 or 5 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Force Hold Neutral Output circuit. Go to **Step C.**

     Note: Force Hold Neutral Output circuit wiring is installed by OEM or body builder.
   - If Fault Code 962 FMI 13 or 14 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 962 FMI 13 or 14 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Force/Hold Neutral Control configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Options”.
5. Record "Force/Hold Neutral Control" Current Value.
   - If "Force/Hold Neutral Control" Current Value indicates “Disabled” and Force Hold Neutral Output switch or signal circuit is properly installed and wired, select “Force Neutral - TCM Hardwired" or "Hold Neutral - TCM Hardwired" and follow on-screen prompts. Go to **Step V.**
   - If "Force/Hold Neutral Control" Current Value indicates “Enabled” and Force Hold Neutral Output switch circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Force Hold Neutral Output signal circuit. Go to **Step V.**

     Note: Force Hold Neutral Output signal circuit wiring is installed by OEM or body builder.

Fault Code 962: Force Hold Neutral Output			
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)
Input / Output Calibration Package 14 and 15 on page 28 of TRIG2630: Force Neutral and Hold Neutral	1	17	Force or Hold Neutral Switch
Input / Output Calibration Package 22 and 25 on page 35 of TRIG2630: Force Neutral + PTO 1 and Hold Neutral + PTO 1			
Input / Output Calibration Package 23 and 26 on page 36 of TRIG2630: PTO 1 + PTO 2 + Force Neutral and Hold Neutral + PTO 1 + PTO 2			

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

1. Key off.
2. Reconnect all connectors and verify 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 962 sets Active, go to **Step A.**
   - If a fault code other than 962 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 963: Force Hold Neutral Input

J1939: SA 3 SPN 7695 FMI 5, 8, 9, 12, 13, 14, 19, 20

Overview

The Endurant XD Series transmission incorporates a Force Neutral and a Hold Neutral feature that allow the use of a separate vehicle integrated switch "input" circuit to place and hold the transmission in a neutral state to prevent vehicle motion while a vehicle specific feature is performed or chassis mounted equipment is operated or deployed (e.g. PTO, Crane, Lift, etc.). When Force Neutral or Hold Neutral is active, an "HN" is displayed in the gear display. The Transmission Control Module (TCM) can be configured to enable Force Neutral (Force Neutral - TCM Hardwired) or Hold Neutral (Hold Neutral - TCM Hardwired) based on the vehicle's application.

When Force Neutral or Hold Neutral operation is required, the TCM receives the operator's request (Input) from the vehicle integrated switch circuit, determines if operating conditions are suitable, then places the transmission in a neutral state regardless of the selected gear lever position (Shift Mode). The transmission remains in a neutral state and disallows any operator Shift Mode requests until the operator removes the Force Neutral or Hold Neutral request by returning the vehicle integrated switch circuit to the deactivated state and selecting Neutral on the Driver Interface Device. Reference Endurant XD Driver Instructions TRDR0960 for Force Neutral and Hold Neutral operation.

The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support these vocational features. The Force Neutral and Hold Neutral circuits are connected to the TCM in the 20-Way TCM Body Harness Connector. The Force Neutral and Hold Neutral circuits are installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended Force Neutral and Hold Neutral circuit wiring diagrams.

Detection

The TCM monitors the hardwired Force Hold Neutral Input circuit signal. If the signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 5 – Current Below Normal or Open Circuit: Force Hold Neutral Input circuit open for 5 seconds.

FMI 8 – Abnormal Frequency: Force Hold Neutral Input circuit signal frequency out of range for 1 second.

FMI 9 – Abnormal Update Rate: Force Hold Neutral Input message not received for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: Force Hold Neutral Input message not available for 5 seconds.

FMI 14 – Special Instructions: Force Hold Neutral Input circuit type not configured in TCM but circuit is installed or J1939 message is received.

FMI 19 – Received Network Data in Error: Force Hold Neutral Input message invalid for 5 seconds.

FMI 20 – Data Drifted High: Force Hold Neutral Input circuit input signal out of range (4.00-5.25 V) for 5 seconds.

Fallback

FMI 5, 8, 9, 12, 13, 19, 20:

- Amber warning lamp on
- No degraded modes
- Force Hold/Neutral Mode will not function

FMI 14:

- Amber warning lamp on
  - Coast Mode and Neutral Coast prohibited
  - Urge to Move and Creep Mode prohibited
  - Inertia Brake activation prohibited
  - Upshifts prohibited
  - Clutch engagements prohibited
  - Non-Neutral modes prohibited
  - PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 5, 8, 12, 14, 20: Key cycle and fault condition no longer exists.

FMI 9, 13, 19: Force Hold Neutral Input messages received and valid for 10 seconds.

Possible Causes

FMI 5:

- Vehicle Harness - Force Hold Neutral Input Circuit
  - Open circuit

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FMI 8:

- Vehicle Harness - Force Hold Neutral Input Circuit
  - Shorted to power, shorted to ground, or open circuit

FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - Force Hold Neutral Input J1939 message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 14:

- TCM
  - Not configured for Force Hold Neutral Input circuit type installed

FMI 20:

- Vehicle Harness - Force Hold Neutral Input Circuit
  - Shorted to power, shorted to ground or open circuit

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Fault Code 963 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 963 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 963 FMI 5, 8, 14 or 20 is Active, go to **Step B.**
   - If Fault Code 963 FMI 5, 8, 14 or 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Force Hold Neutral Input circuit. Go to **Step C.**

     Note: Force Hold Neutral Input circuit wiring is installed by OEM or body builder
   - If Fault Code 963 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Force Hold Neutral Input message (SPN 7695). Go to **Step V.**
   - If Fault Code 963 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 963 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 963 FMI 13 is Active, refer to OEM and enable Force Hold Neutral Input message (SPN 7695). Go to **Step V.**
   - If Fault Code 963 FMI 13 is Inactive, Force Hold Neutral Input is properly configured. Go to **Step V.**

B ***Purpose:*** *Verify Force/Hold Neutral Control configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Options”.
5. Record "Force/Hold Neutral Control" Current Value.
   - If "Force/Hold Neutral Control" Current Value indicates “Disabled” and Force Hold Neutral Input switch or signal circuit is properly installed and wired, select “Force Neutral - TCM Hardwired" or "Hold Neutral - TCM Hardwired" and follow on-screen prompts. Go to **Step V.**
   - If "Force/Hold Neutral Control" Current Value indicates “Enabled” and Force Hold Neutral Input circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Force Hold Neutral Output signal circuit. Go to **Step V.**

     Note: Force Hold Neutral Output signal circuit wiring is installed by OEM or body builder.

Fault Code 963: Force Hold Neutral Input			
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)
Input / Output Calibration Package 14 and 15 on page 28 of TRIG2630: Force Neutral and Hold Neutral	5	17	Force or Hold Neutral Switch
Input / Output Calibration Package 22 and 25 on page 35 of TRIG2630: Force Neutral + PTO 1 and Hold Neutral + PTO 1	5	17	
Input / Output Calibration Package 23 and 26 on page 36 of TRIG2630: PTO 1 + PTO 2 + Force Neutral and Hold Neutral + PTO 1 + PTO 2	14	17	

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

1. Key off.
2. Reconnect all connectors and verify 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 963 sets Active, go to **Step A.**
   - If a fault code other than 963 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 965: Rail Road Mode Switch

J1939: SA 3 SPN 7941 FMI 9, 13, 19

Overview

The Transmission Control Module (TCM) receives the vehicle's Rail Road Mode Switch message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection

The TCM monitors Rail Road Mode Switch messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Rail Road Mode Switch messages not received for 5 seconds.

FMI 13 – Out of Calibration: Rail Road Mode Switch message not available for 5 seconds.

FMI 19 – Received Network Data in Error: Rail Road Mode Switch messages invalid for 5 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes
- Rail Road Mode will not function

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Rail Road Mode Switch messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - Rail Road Mode Switch message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

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Fault Code 965 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 965 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 965 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Rail Road Mode Switch message (SPN 7941). Go to **Step V.**
   - If Fault Code 965 FMI 13 is Active, refer to OEM and enable Rail Road Mode Switch message (SPN 7941). Go to **Step V.**
   - If Fault Code 965 FMI 13 is Inactive, Rail Road Mode is properly configured. Go to **Step V.**.

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

1. Key off.
2. Reconnect all connectors and verify 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 965 sets Active, go to **Step A.**
   - If a fault code other than 965 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 970: Neutral Output

J1939: SA 3 SPN 604 FMI 3, 4, 5, 6, 12, 14, 31

Overview

The Transmission Control Module (TCM) is configurable to provide a Neutral Output signal to other circuits or devices on the vehicle for an application specific vehicle operation. When Neutral is selected on the Driver Interface Device and is confirmed from transmission rail position and speed sensors the TCM will provide a 12-volt hardwired output signal to an application specific vehicle circuit or device.

The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support this vocational feature. The Neutral Output circuit is connected to the TCM in the 20-Way TCM Body Harness Connector. The Neutral Output circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended Neutral Output circuit wiring diagrams.

Detection

The TCM monitors the hardwired Neutral Output circuit signal. If the 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 circuit signal shorted to power for 5 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Neutral Output circuit signal shorted to ground for 5 seconds.

FMI 5 – Current Below Normal or Open Circuit: Neutral Output circuit open for 5 seconds.

FMI 6 – Current Above Normal or Grounded Circuit: Neutral Output circuit current out of range for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- Devices requiring Neutral Output signal may not function

Conditions to Set Fault Code Inactive

FMI 3: Neutral Output circuit not shorted to power for 10 seconds.

FMI 4: Neutral Output circuit not shorted to ground for 10 seconds.

FMI 5: Neutral Output circuit not open for 10 seconds.

FMI 6: Neutral Output circuit current in range for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

Possible Causes

FMI 3, 4, 5, 6:

- Vehicle Neutral Output device
- Vehicle 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.

FMI 12:

- TCM
  - Software issue
  - Internal failure

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 970 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 970 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 970 FMI 3, 4, 5, 6 is Active, go to **Step B.**
   - If Fault Code 970 FMI 3, 4, 5, 6 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Neutral Output circuit. Go to **Step C.**

     Note: Neutral Output circuit and wiring are installed by OEM or body builder.
   - If Fault Code 970 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 970 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 970 FMI 14 or 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 970 FMI 14 or 31 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Neutral Output Signal configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Options”.
5. Record the “Neutral Output Signal” Current Value.
   - If "Neutral Output Signal" Current Value indicates “Disabled” and Neutral Output signal circuit is properly installed and wired, select “Enabled" and follow on-screen prompts. Go to **Step V.**
   - If "Neutral Output Signal" Current Value indicates “Enabled” and Neutral Output signal circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Neutral Output signal circuit. Go to **Step V.**

     Note: Neutral Output circuit and wiring are installed by OEM or body builder.

Fault Code 970: Neutral Output				
Package # and Description	20-Way TCM Body Connector Pin(s)	Component(s)		
Input / Output Calibration Package 1 on page 15 of TRIG2630: Neutral Output + PTO 1 + Reverse Output	3	Neutral Output Relay	Neutral Output Fuse 2 Amp	Chassis Ground
Input / Output Calibration Package 24 and 27 on page 37 of TRIG2630: Force Neutral + Neutral Output + Reverse Output and Hold Neutral + Neutral Output + Reverse Output				
Input / Output Calibration Package 35 on page 44 of TRIG2630: Reverse Output + Neutral Output				
Input / Output Calibration Package 36 on page 45 of TRIG2630: Neutral Output				

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

1. Key off.
2. Reconnect all connectors and verify 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 970 sets Active, go to **Step A.**
   - If a fault code other than 970 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 975: Reverse Output

J1939: SA 3 SPN 767 FMI 3, 4, 5, 6, 12, 14, 31

Overview

The Transmission Control Module (TCM) is configurable to provide a Reverse Output signal to other circuits or devices on the vehicle for an application specific vehicle operation. When Reverse is selected on the Driver Interface Device and is confirmed from transmission rail position and speed sensors the TCM will provide a 12-volt hardwired output signal to an application specific vehicle circuit or device.

The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support this vocational feature. The Reverse Output circuit is connected to the TCM in the 20-Way TCM Body Harness Connector. The Reverse Output circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended Reverse Output circuit wiring diagrams.

Detection

The TCM monitors the hardwired Reverse Output circuit signal. If the 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 circuit signal shorted to power for 5 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Reverse Output circuit signal shorted to ground for 5 seconds.

FMI 5 – Current Below Normal or Open Circuit: Reverse Output circuit open for 5 seconds.

FMI 6 – Current Above Normal or Grounded Circuit: Reverse Output circuit current out of range for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- Devices requiring Reverse Output signal may not function

Conditions to Set Fault Code Inactive

FMI 3: Reverse Output circuit not shorted to power for 10 seconds.

FMI 4: Reverse Output circuit not shorted to ground for 10 seconds.

FMI 5: Reverse Output circuit not open for 10 seconds.

FMI 6: Reverse Output circuit current in range for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 14, 31: Valid I/O Package calibration file is configured in TCM.

Possible Causes

FMI 3, 4, 5, 6:

- Vehicle Reverse Output device
- Vehicle 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.

FMI 12:

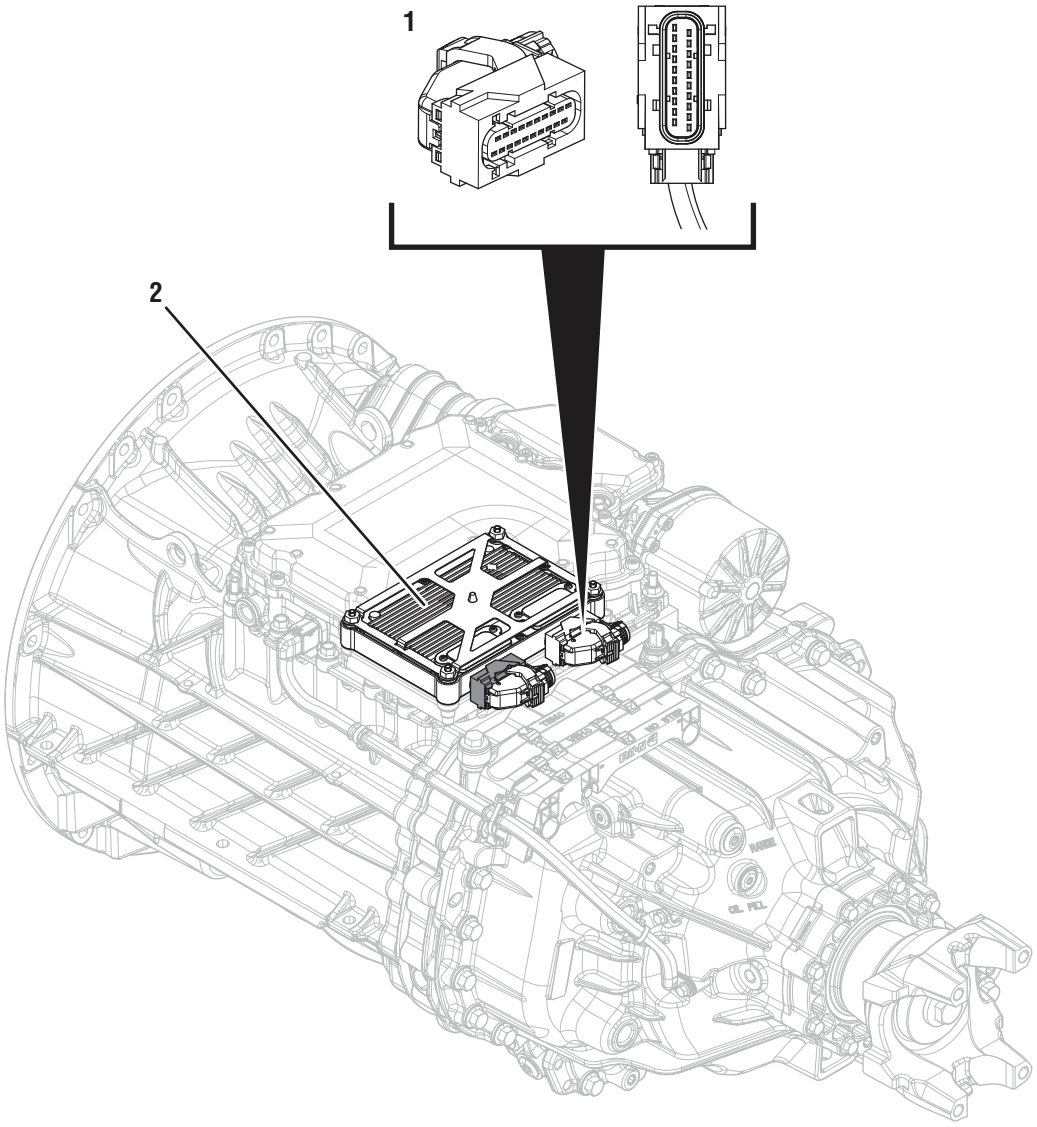
- TCM
  - Software issue
  - Internal failure

FMI 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Component Identification



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

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Fault Code 975 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 975 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 975 FMI 3, 4, 5, 6 is Active, go to **Step B.**
   - If Fault Code 975 FMI 3, 4, 5, 6 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Reverse Output circuit. Go to **Step C.**

     Note: Reverse Output circuit and wiring are installed by OEM or body builder.
   - If Fault Code 975 FMI 12 is Active replace, **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 975 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 975 FMI 14 or 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 975 FMI 14 or 31 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Reverse Output Signal configuration with ServiceRanger.*

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.
   - If "Reverse Output Signal" Current Value indicates “Disabled” and Reverse Output signal circuit is properly installed and wired, select “Enabled" and follow on-screen prompts. Go to **Step V.**
   - If "Reverse Output Signal" Current Value indicates “Enabled” and Reverse Output signal circuit is properly installed and wired, go to **Step C.**

C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table.Contact OEM or body builder for repair or replacement of Reverse Output signal circuit. Go to **Step V.**

     Note: Reverse Output circuit and wiring are installed by OEM or body builder.

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Fault Code 975: Reverse Output				
Package # and Description	20-Way TCM Body Connector Pin(s)	Component(s)		
Input / Output Calibration Package 1 on page 15 of TRIG2630: Neutral Output + PTO 1 + Reverse Output	1	Reverse Output Relay	Reverse Output Fuse 2 Amp	Chassis Ground
Input / Output Calibration Package 8 on page 22 of TRIG2630: PTO 1 + Reverse Output + Rock Free Mode	1			
Input / Output Calibration Package 10 on page 24 of TRIG2630: Reverse Output	1			
Input / Output Calibration Package 11 on page 25 of TRIG2630: PTO 1 + Reverse Output	1			
Input / Output Calibration Package 24 and 27 on page 37 of TRIG2630: Force Neutral + Neutral Output + Reverse Output and Hold Neutral + Neutral Output + Reverse Output	2			
Input / Output Calibration Package 30 on page 39 of TRIG2630: Reverse Output and Secondary Shift Mode	1			
Input / Output Calibration Package 31 on page 40 of TRIG2630: Reverse Output + Rock Free Mode	1			
Input / Output Calibration Package 32 on page 41 of TRIG2630: 2-Speed Aux Trans + Reverse Output	1			
Input / Output Calibration Package 33 on page 42 of TRIG2630: 2-Speed Axle + Reverse Output	1			
Input / Output Calibration Package 35 on page 44 of TRIG2630: Reverse Output + Neutral Output	1			

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

1. Key off.
2. Reconnect all connectors and verify 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 975 sets Active, go to **Step A.**
   - If a fault code other than 975 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 977: Alternate Shift Schedule Selector

J1939: SA 3 SPN 6160 FMI 3, 4, 5, 6, 11, 12, 13, 14, 20, 31

Overview

The Endurant XD Series transmission incorporates a Secondary Configuration Mode feature that allows the driver to change transmission system behavior, affecting the following: shift strategy, launch or maneuvering characteristics, and ON/OFF road behaviors. The driver can choose to switch between the Primary Configuration and the Secondary Configuration based on vehicle operating conditions. The Transmission Control Module (TCM) receives a request (Input) to activate Secondary Configuration Mode, determines if conditions are suitable, implements the change, and supplies a signal (Output) notification. Reference Endurant XD Driver Instructions TRDR0960 for Secondary Configuration Mode operation.

The TCM can be configured to switch to Secondary Configuration Mode with messages over the vehicle Primary Data Link J1939A or from switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to “J1939 Message” Secondary Configuration Mode control messages are exchanged between the TCM and an OEM vehicle ECU. If the TCM is configured to “TCM Hardwired Switch”, Secondary Configuration Mode operation is controlled by Input and Output signals from a hardwired switch circuit.

Secondary Configuration Mode circuit inputs and outputs are connected to the TCM in the 20-Way TCM Body Harness Connector. The Secondary Configuration Mode circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended Secondary Configuration Mode circuit wiring diagrams.

Detection

The TCM monitors the transmission Secondary Configuration Mode hardwired circuit input signal. If the signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: Secondary Configuration Mode circuit output signal shorted to power for 5 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Secondary Configuration Mode circuit output signal shorted to ground for 5 seconds.

FMI 5 – Current Below Normal or Open Circuit: Secondary Configuration Mode circuit open for 5 seconds.

FMI 6 – Current Above Normal or Grounded Circuit: Secondary Configuration Mode circuit output current out of range for 5 seconds.

FMI 11 – Root Cause Unknown: The TCM detected invalid I/O Package calibration.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: The TCM detected invalid I/O Package calibration.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 20 – Data Drifted High: Secondary Configuration Mode circuit input signal out of range (4.00-5.25 V) for 5 seconds.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded modes
- Secondary Configuration Mode switch inoperative

Conditions to Set Fault Code Inactive

FMI 3: Secondary Configuration Mode circuit not shorted to power for 10 seconds.

FMI 4: Secondary Configuration Mode circuit not shorted to ground for 10 seconds.

FMI 5: Secondary Configuration Mode circuit not open for 10 seconds.

FMI 6: Secondary Configuration Mode circuit output current in range for 10 seconds.

FMI 11, 12: Key cycle and fault condition no longer exits.

FMI 13, 14, 31: Valid I/O Package calibration file is configured in TCM.

FM 20: Secondary Configuration Mode circuit input signal in range for 10 seconds.

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Possible Causes

FMI 3, 4, 5, 6, 20:

- Vehicle Harness - Secondary Configuration Mode Circuit
  - Shorted to power, shorted to ground, or open circuit

FMI 11, 13, 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

FMI 12:

- TCM
  - Internal failure
  - Software issue

Additional Tools

- None

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Fault Code 977 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 977 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 977 FMI 3, 4, 5, 6 or 20 is Active, go to **Step B.**
   - If Fault Code 977 FMI 3, 4, 5, 6 or 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Secondary Configuration Mode switch circuit. Go to **Step C.**

     Note: Secondary Configuration Mode switch circuit wiring is installed by OEM or body builder.
   - If Fault Code 977 FMI 11, 13, 14, 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 977 FMI 11, 13, 14, 31 is Inactive, go to **Step V.**
   - If Fault Code 977 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 977 FMI 12 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Secondary Configuration Switch configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Secondary Config”.
5. Record "Secondary Configuration Switch" Current Value.
   - If “Secondary Configuration Switch” Current Value indicates “Not Configured” and Secondary Configuration Mode switch circuit is properly installed and wired, select “TCM Hardwired Switch” and follow on-screen prompts. Go to **Step V.**
   - If “Secondary Configuration Switch” Current Value indicates “TCM Hardwired Switch” and Secondary Configuration Mode switch circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record “I/O Package” Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM for repair or replacement of Secondary Configuration Mode switch circuit. Go to **Step V.**

     Note: Secondary Configuration Mode switch circuit wiring is installed by OEM or body builder.

Fault Code 977: Alternate Shift Schedule Selector (Secondary Shift Mode)							
Package # and Description	20-Way TCM Body Connector Pin(s)			Component(s)			
Input / Output Calibration Package 2 on page 16 of TRIG2630: Rock Free Mode + Secondary Shift Mode	1	4	14	Secondary Mode Momentary Switch	Secondary Mode Relay	Secondary Mode Fuse 2 Amp	Chassis Ground
Input / Output Calibration Package 6 on page 20 of TRIG2630: PTO 1 + Secondary Shift Mode	1	4	5				
Input / Output Calibration Package 7 on page 21 of TRIG2630: PTO 1 + Rock Free Mode + Secondary Shift Mode	1	4	5				
Input / Output Calibration Package 8 on page 22 of TRIG2630: PTO 1 + Reverse Output + Rock Free Mode	1	4	14				
Input / Output Calibration Package 11 on page 25 of TRIG2630: PTO 1 + Reverse Output	1	14	15				
Input / Output Calibration Package 30 on page 39 of TRIG2630: Reverse Output + Secondary Shift Mode	1	4	14				

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

1. Key off.
2. Reconnect all connectors and verify 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 977 sets Active, go to **Step A.**
   - If a fault code other than 977 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 980: Auxiliary Trans Constant Supply Actuator

J1939: SA 3 SPN 3957 FMI 4, 12, 13, 14, 20

Overview

The Endurant XD Pro Transmission can be combined with a 2, 3, or 4-speed auxiliary transmission for additional gear ratio coverage. When auxiliary transmission operation is required the Transmission Control Module (TCM) receives a gear engagement signal (Input) then adjusts the transmission shift strategy and launch characteristics for the new auxiliary transmission gear ratio. Reference Endurant XD Driver Instructions TRDR0960 for Auxiliary Transmission operation.

The TCM can be configured for operation with a 2, 3, or 4-speed auxiliary transmission with messages over the vehicle Primary Data Link J1939A or from a switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to “2, 3, or 4-Speed Aux Trans... -J1939”, auxiliary transmission gear engagement messages are provided to the TCM by an OEM vehicle ECU. If the TCM is configured to “2, 3, or 4-Speed Aux Trans... - TCM Hardwired”, auxiliary transmission gear engagement notification signal (Input) is provided to the TCM from a hardwired switch circuit.

The auxiliary transmission circuit input is connected to the TCM in the 20-Way TCM Body Harness Connector. The auxiliary transmission circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 of the Appendix for recommended Auxiliary Transmission circuit wiring diagrams.

Detection

The TCM monitors the Auxiliary Trans Constant Supply Actuator hardwired circuit input signal. If the signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: Auxiliary Trans Constant Supply Actuator circuit input signal shorted to ground for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: The TCM detected invalid I/O Package calibration.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 20 – Data Drifted High: Auxiliary Trans Constant Supply Actuator circuit input signal out of range (4.00–5.25 V) for 5 seconds.

Fallback

ALL FMI’s:

- Amber warning lamp on
- No degraded modes
- Auxiliary Trans Constant Supply Actuator inoperative

Conditions to Set Fault Code Inactive

FMI 4: Auxiliary Trans Constant Supply Actuator circuit not shorted to ground for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 13, 14: Valid I/O Package calibration file is configured in TCM.

FMI 20: Auxiliary Trans Constant Supply Actuator circuit input signal in range for 10 seconds.

Possible Causes

FMI 4, 20:

- Vehicle Harness - Auxiliary Trans Constant Supply Actuator Circuit
  - Shorted to power, shorted to ground or open circuit

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 13, 14:

- TCM
  - Invalid I/O Package calibration file configured in TCM

Additional Tools

- None

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Fault Code 980 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 980 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 980 FMI 4, 20 is Active, go to **Step B.**
   - If Fault Code 980 FMI 4, 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Auxiliary Trans Constant Supply Actuator circuit. Go to **Step C.**

     Note: Auxiliary Trans Constant Supply Actuator circuit wiring is installed by OEM or body builder.
   - If Fault Code 980 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 980 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 980 FMI 13 or 14 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 980 FMI 13 or 14 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Multi-Speed Driveline Configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Record "Multi-Speed Driveline Configuration" Current Value.
   - If "Multi-Speed Driveline Configuration" Current Value indicates "Not Installed" and Auxiliary Trans Constant Supply Actuator switch circuit is properly installed and wired, select the appropriate "- TCM Hardwired" option and follow on-screen prompts. Go to **Step V.**
   - If "Multi-Speed Driveline Configuration" Current Value indicates a " - TCM Hardwired" option and Auxiliary Trans Constant Supply Actuator switch circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Auxiliary Trans Constant Supply Actuator switch circuit. Go to **Step V.**

     Note: Auxiliary Trans Constant Supply Actuator switch circuit wiring is installed by the OEM.

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Fault Code 980: Auxiliary Trans Constant Supply Actuator						
Package # and Description	20-Way TCM Body Connector Pin(s)				Component(s)	
Input / Output Calibration Package 3 on page 17 of TRIG2630: 2-Speed Aux Trans + Rock Free Mode	14	15			Normally Open Pressure Switch	Aux Trans Vehicle Controls High Range Air Line
Input / Output Calibration Package 12 on page 26 of TRIG2630: 2-Speed Aux Trans	14	15				
Input / Output Calibration Package 13 on page 27 of TRIG2630: 2-Speed Aux Trans + Secondary Shift Mode	5	15				
Input / Output Calibration Package 32 on page 41 of TRIG2630: 2-Speed Aux Trans + Reverse Output	14	15				
Input / Output Calibration Package 38 on page 46 of TRIG2630: 3-Speed Aux Trans - Underdrive, Direct, Overdrive (UD, D, OD)	14	15	16			
Input / Output Calibration Package 39 on page 47 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Rock Free Mode	14	15	16			
Input / Output Calibration Package 40 on page 48 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Secondary Shift Mode	14	15	16			
Input / Output Calibration Package 41 on page 49 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Rock Free Mode + Secondary Shift Mode	14	15	16			
Input / Output Calibration Package 42 on page 50 of TRIG2630: 3-Speed Aux Trans - Underdrive, Neutral, Direct, Overdrive (UD, N, D, OD)	4	14	15	16		
Input / Output Calibration Package 43 on page 51 of TRIG2630: 3-Speed Aux Trans (UD, N, D, OD) + Rock Free Mode	4	14	15	16		
Input / Output Calibration Package 44 on page 52 of TRIG2630: 4-Speed Aux Trans - Low, Underdrive, Direct, Overdrive (L, UD, D, OD)	4	14	15	16		
Input / Output Calibration Package 45 on page 53 of TRIG2630: 4-Speed Aux Trans (L, UD, D, OD) + Rock Free Mode	4	14	15	16		
Input / Output Calibration Package 46 on page 54 of TRIG2630: 4-Speed Aux Trans - Low, Underdrive, Neutral, Direct, Overdrive (L, N, UD, D, OD)	4	14	15	16		

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V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 980 sets Active, go to **Step A.**
   - If a fault code other than 980 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 981: Auxiliary Trans High Range Actuator

J1939: SA 3 SPN 3958 FMI 4, 12, 13, 14, 20

Overview

The Endurant XD Pro Transmission can be combined with a 2, 3, or 4-speed auxiliary transmission for additional gear ratio coverage. When auxiliary transmission operation is required the Transmission Control Module (TCM) receives a gear engagement signal (Input) then adjusts the transmission shift strategy and launch characteristics for the new auxiliary transmission gear ratio. Reference Endurant XD Driver Instructions TRDR0960 for Auxiliary Transmission operation.

The TCM can be configured for operation with a 2, 3, or 4-speed auxiliary transmission with messages over the vehicle Primary Data Link J1939A or from a switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to “2, 3, or 4-Speed Aux Trans... -J1939”, auxiliary transmission gear engagement messages are provided to the TCM by an OEM vehicle ECU. If the TCM is configured to “2, 3, or 4-Speed Aux Trans... - TCM Hardwired”, auxiliary transmission gear engagement notification signal (Input) is provided to the TCM from a hardwired switch circuit.

The auxiliary transmission circuit input is connected to the TCM in the 20-Way TCM Body Harness Connector. The auxiliary transmission circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 in the Appendix for recommended Auxiliary Transmission circuit wiring diagrams.

Detection

The TCM monitors the Auxiliary Trans High Range Actuator hardwired circuit input signal. If the signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: Auxiliary Trans High Range Actuator circuit input signal shorted to ground for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: The TCM detected invalid I/O Package calibration.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 20 – Data Drifted High: Auxiliary Trans High Range Actuator circuit input signal out of range (4.00–5.25 V) for 5 seconds.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded modes
- Auxiliary Trans High Range Actuator inoperative

Conditions to Set Fault Code Inactive

FMI 4: Auxiliary Trans High Range Actuator circuit not shorted to ground for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 13, 14: Valid I/O Package calibration file is configured in TCM.

FMI 20: Auxiliary Trans High Range Actuator circuit input signal in range for 10 seconds.

Possible Causes

FMI 4, 20:

- Vehicle Harness - Auxiliary Trans High Range Actuator Circuit
  - Shorted to power, shorted to ground or open circuit

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 13, 14:

- TCM
  - Invalid I/O Package calibration file configured in TCM

Additional Tools

- None

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Fault Code 981 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 981 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 981 FMI 4, 20 is Active, go to **Step B.**
   - If Fault Code 981 FMI 4, 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Auxiliary Trans High Range Actuator circuit. Go to **Step C.**

     Note: Auxiliary Trans High Range Actuator circuit wiring is installed by OEM or body builder.
   - If Fault Code 981 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 981 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 981 FMI 13 or 14 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**.
   - If Fault Code 981 FMI 13 or 14 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Multi-Speed Driveline Configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Record "Multi-Speed Driveline Configuration" Current Value.
   - If "Multi-Speed Driveline Configuration" Current Value indicates "Not Installed" and Auxiliary Trans High Range Actuator switch circuit is properly installed and wired, select the appropriate "- TCM Hardwired" option and follow on-screen prompts. Go to **Step V.**
   - If "Multi-Speed Driveline Configuration" Current Value indicates a " - TCM Hardwired" option and Auxiliary Trans High Range Actuator switch circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Refer to OEM or body builder for repair or replacement of Auxiliary Trans High Range Actuator switch circuit. Go to **Step V.**

     Note: Auxiliary Trans High Range Actuator switch circuit wiring is installed by the OEM or body builder.

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Fault Code 981: Auxiliary Trans High Range Actuator						
Package # and Description	20-Way TCM Body Connector Pin(s)				Component(s)	
Input / Output Calibration Package 3 on page 17 of TRIG2630: 2-Speed Aux Trans + Rock Free Mode	14	15			Normally Open Pressure Switch	Aux Trans Vehicle Controls High Range Air Line
Input / Output Calibration Package 12 on page 26 of TRIG2630: 2-Speed Aux Trans	14	15				
Input / Output Calibration Package 13 on page 27 of TRIG2630: 2-Speed Aux Trans + Secondary Shift Mode	5	15				
Input / Output Calibration Package 32 on page 41 of TRIG2630: 2-Speed Aux Trans + Reverse Output	14	15				
Input / Output Calibration Package 38 on page 46 of TRIG2630: 3-Speed Aux Trans - Underdrive, Direct, Overdrive (UD, D, OD)	14	15	16			
Input / Output Calibration Package 39 on page 47 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Rock Free Mode	14	15	16			
Input / Output Calibration Package 40 on page 48 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Secondary Shift Mode	14	15	16			
Input / Output Calibration Package 41 on page 49 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Rock Free Mode + Secondary Shift Mode	14	15	16			
Input / Output Calibration Package 42 on page 50 of TRIG2630: 3-Speed Aux Trans - Underdrive, Neutral, Direct, Overdrive (UD, N, D, OD)	4	14	15	16		
Input / Output Calibration Package 43 on page 51 of TRIG2630: 3-Speed Aux Trans (UD, N, D, OD) + Rock Free Mode	4	14	15	16		
Input / Output Calibration Package 44 on page 52 of TRIG2630: 4-Speed Aux Trans - Low, Underdrive, Direct, Overdrive (L, UD, D, OD)	4	14	15	16		
Input / Output Calibration Package 45 on page 53 of TRIG2630: 4-Speed Aux Trans (L, UD, D, OD) + Rock Free Mode	4	14	15	16		
Input / Output Calibration Package 46 on page 54 of TRIG2630: 4-Speed Aux Trans - Low, Underdrive, Neutral, Direct, Overdrive (L, N, UD, D, OD)	4	14	15	16		

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V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 981 sets Active, go to **Step A.**
   - If a fault code other than 981 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 982: Auxiliary Trans Neutral Range Actuator

J1939: SA 3 SPN 3959 FMI 4, 12, 13, 14, 20

Overview

The Endurant XD Pro Transmission can be combined with a 2, 3, or 4-speed auxiliary transmission for additional gear ratio coverage. When auxiliary transmission operation is required the Transmission Control Module (TCM) receives a gear engagement signal (Input) then adjusts the transmission shift strategy and launch characteristics for the new auxiliary transmission gear ratio. Reference Endurant XD Driver Instructions TRDR0960 for Auxiliary Transmission operation.

The TCM can be configured for operation with a 2, 3, or 4-speed auxiliary transmission with messages over the vehicle Primary Data Link J1939A or from a switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to “2, 3, or 4-Speed Aux Trans... -J1939”, auxiliary transmission gear engagement messages are provided to the TCM by an OEM vehicle ECU. If the TCM is configured to “2, 3, or 4-Speed Aux Trans... - TCM Hardwired”, auxiliary transmission gear engagement notification signal (Input) is provided to the TCM from a hardwired switch circuit.

The auxiliary transmission circuit input is connected to the TCM in the 20-Way TCM Body Harness Connector. The auxiliary transmission circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 in the Appendix for recommended Auxiliary Transmission circuit wiring diagrams.

Detection

The TCM monitors the Auxiliary Trans Neutral Range Actuator hardwired circuit input signal. If the signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: Auxiliary Trans Neutral Range Actuator circuit input signal shorted to ground for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: The TCM detected invalid I/O Package calibration.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 20 – Data Drifted High: Auxiliary Trans Neutral Range Actuator circuit input signal out of range (4.00–5.25 V) for 5 seconds.

Fallback

ALL FMIs:

- Amber warning lamp on
- No degraded modes
- Auxiliary Trans Neutral Range Actuator inoperative

Conditions to Set Fault Code Inactive

FMI 4: Auxiliary Trans Neutral Range Actuator circuit not shorted to ground for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 13, 14: Valid I/O Package calibration file is configured in TCM.

FMI 20: Auxiliary Trans Neutral Range Actuator circuit input signal in range for 10 seconds.

Possible Causes

FMI 4, 20:

- Vehicle Harness - Auxiliary Trans Neutral Range Actuator Circuit
  - Shorted to power, shorted to ground or open circuit

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 13, 14:

- TCM
  - Invalid I/O Package calibration file configured in TCM

Additional Tools

- None

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Fault Code 982 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 982 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 982 FMI 4, 20 is Active, go to **Step B.**
   - If Fault Code 982 FMI 4, 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Auxiliary Trans Neutral Range Actuator circuit. Go to **Step C.**

     Note: Auxiliary Trans Neutral Range Actuator circuit wiring is installed by OEM or body builder.
   - If Fault Code 982 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 982 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 982 FMI 13 or 14 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 982 FMI 13 or 14 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Multi-Speed Driveline Configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Record "Multi-Speed Driveline Configuration" Current Value.
   - If "Multi-Speed Driveline Configuration" Current Value indicates "Not Installed" and Auxiliary Trans Neutral Range Actuator switch circuit is properly installed and wired, select the appropriate "- TCM Hardwired" option and follow on-screen prompts. Go to **Step V.**
   - If "Multi-Speed Driveline Configuration" Current Value indicates a " - TCM Hardwired" option and Auxiliary Trans Neutral Range Actuator switch circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Refer to OEM or body builder for repair or replacement of Auxiliary Trans Neutral Range Actuator switch circuit. Go to **Step V.**

     Note: Auxiliary Trans Neutral Range Actuator switch circuit wiring is installed by the OEM or body builder.

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Fault Code 982: Auxiliary Trans Neutral Range Actuator						
Package # and Description	20-Way TCM Body Connector Pin(s)				Component(s)	
Input / Output Calibration Package 3 on page 17 of TRIG2630: 2-Speed Aux Trans + Rock Free Mode	14	15			Normally Open Pressure Switch	Aux Trans Vehicle Controls High Range Air Line
Input / Output Calibration Package 12 on page 26 of TRIG2630: 2-Speed Aux Trans	14	15				
Input / Output Calibration Package 13 on page 27 of TRIG2630: 2-Speed Aux Trans + Secondary Shift Mode	5	15				
Input / Output Calibration Package 32 on page 41 of TRIG2630: 2-Speed Aux Trans + Reverse Output	14	15				
Input / Output Calibration Package 38 on page 46 of TRIG2630: 3-Speed Aux Trans - Underdrive, Direct, Overdrive (UD, D, OD)	14	15	16			
Input / Output Calibration Package 39 on page 47 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Rock Free Mode	14	15	16			
Input / Output Calibration Package 40 on page 48 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Secondary Shift Mode	14	15	16			
Input / Output Calibration Package 41 on page 49 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Rock Free Mode + Secondary Shift Mode	14	15	16			
Input / Output Calibration Package 42 on page 50 of TRIG2630: 3-Speed Aux Trans - Underdrive, Neutral, Direct, Overdrive (UD, N, D, OD)	4	14	15	16		
Input / Output Calibration Package 43 on page 51 of TRIG2630: 3-Speed Aux Trans (UD, N, D, OD) + Rock Free Mode	4	14	15	16		
Input / Output Calibration Package 44 on page 52 of TRIG2630: 4-Speed Aux Trans - Low, Underdrive, Direct, Overdrive (L, UD, D, OD)	4	14	15	16		
Input / Output Calibration Package 45 on page 53 of TRIG2630: 4-Speed Aux Trans (L, UD, D, OD) + Rock Free Mode	4	14	15	16		
Input / Output Calibration Package 46 on page 54 of TRIG2630: 4-Speed Aux Trans - Low, Underdrive, Neutral, Direct, Overdrive (L, N, UD, D, OD)	4	14	15	16		

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V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify 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 982 sets Active, go to **Step A.**
   - If a fault code other than 982 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 983: Auxiliary Trans Range Switch

J1939: SA 3 SPN 3960 FMI 4, 12, 13, 14, 20

Overview

The Endurant XD Pro Transmission can be combined with a 2, 3, or 4-speed auxiliary transmission for additional gear ratio coverage. When auxiliary transmission operation is required the Transmission Control Module (TCM) receives a gear engagement signal (Input) then adjusts the transmission shift strategy and launch characteristics for the new auxiliary transmission gear ratio. Reference Endurant XD Driver Instructions TRDR0960 for Auxiliary Transmission operation.

The TCM can be configured for operation with a 2, 3, or 4-speed auxiliary transmission with messages over the vehicle Primary Data Link J1939A or from a switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to “2, 3, or 4-Speed Aux Trans... - J1939”, auxiliary transmission gear engagement messages are provided to the TCM by an OEM vehicle ECU. If the TCM is configured to “2, 3, or 4-Speed Aux Trans... - TCM Hardwired”, auxiliary transmission gear engagement notification signal (Input) is provided to the TCM from a hardwired switch circuit.

The auxiliary transmission circuit input is connected to the TCM in the 20-Way TCM Body Harness Connector. The auxiliary transmission circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 in the Appendix for recommended Auxiliary Transmission circuit wiring diagrams.

Detection

The TCM monitors the Auxiliary Trans Range Switch hardwired circuit input signal. If the signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: Auxiliary Trans Range Switch circuit input signal shorted to ground for 5 seconds.

FMI 12 – Bed Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: The TCM detected invalid I/O Package calibration.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 20 – Data Drifted High: Auxiliary Trans Range Switch circuit input signal out of range (4.00–5.25 V) for 5 seconds.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded modes
- Auxiliary Trans Range Switch inoperative

Conditions to Set Fault Code Inactive

FMI 4: Auxiliary Trans Range Switch circuit not shorted to ground for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 13, 14: Valid I/O Package calibration file is configured in TCM.

FMI 20: Auxiliary Trans Range Switch circuit input signal in range for 10 seconds.

Possible Causes

FMI 4, 20:

- Vehicle Harness - Auxiliary Trans Range Switch Circuit
  - Shorted to power, shorted to ground or open circuit

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 13, 14:

- TCM
  - Invalid I/O Package calibration file configured in TCM

Additional Tools

- None

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Fault Code 983 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 983 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 983 FMI 4, 20 is Active, go to **Step B.**
   - If Fault Code 983 FMI 4, 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Auxiliary Trans Range Switch circuit. Go to **Step C.**

     Note: Auxiliary Trans Range Switch circuit wiring is installed by OEM or body builder.
   - If Fault Code 983 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 983 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 983 FMI 13 or 14 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**.
   - If Fault Code 983 FMI 13 or 14 is Inactive, go to **Step V.**

B

Purpose: *Verify Hardwire controlled Multi-Speed Driveline Configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Record "Multi-Speed Driveline Configuration" Current Value.
   - If "Multi-Speed Driveline Configuration" Current Value indicates "Not Installed" and Auxiliary Trans Range Switch circuit is properly installed and wired, select the appropriate "- TCM Hardwired" option and follow on-screen prompts. Go to **Step V.**
   - If "Multi-Speed Driveline Configuration" Current Value indicates a " - TCM Hardwired" option and Auxiliary Trans Range Switch circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Auxiliary Trans Neutral Range Actuator switch circuit. Go to **Step V.**

     Note: Auxiliary Trans Range Switch circuit wiring is installed by the OEM or body builder.

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Fault Code 983: Auxiliary Trans Range Switch						
Package # and Description	20-Way TCM Body Connector Pin(s)				Component(s)	
Input / Output Calibration Package 3 on page 17 of TRIG2630: 2-Speed Aux Trans + Rock Free Mode	14	15			Normally Open Pressure Switch	Aux Trans Vehicle Controls High Range Air Line
Input / Output Calibration Package 12 on page 26 of TRIG2630: 2-Speed Aux Trans	14	15				
Input / Output Calibration Package 13 on page 27 of TRIG2630: 2-Speed Aux Trans + Secondary Shift Mode	5	15				
Input / Output Calibration Package 32 on page 41 of TRIG2630: 2-Speed Aux Trans + Reverse Output	14	15				
Input / Output Calibration Package 38 on page 46 of TRIG2630: 3-Speed Aux Trans - Underdrive, Direct, Overdrive (UD, D, OD)	14	15	16			
Input / Output Calibration Package 39 on page 47 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Rock Free Mode	14	15	16			
Input / Output Calibration Package 40 on page 48 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Secondary Shift Mode	14	15	16			
Input / Output Calibration Package 41 on page 49 of TRIG2630: 3-Speed Aux Trans (UD, D, OD) + Rock Free Mode + Secondary Shift Mode	14	15	16			
Input / Output Calibration Package 42 on page 50 of TRIG2630: 3-Speed Aux Trans - Underdrive, Neutral, Direct, Overdrive (UD, N, D, OD)	4	14	15	16		
Input / Output Calibration Package 43 on page 51 of TRIG2630: 3-Speed Aux Trans (UD, N, D, OD) + Rock Free Mode	4	14	15	16		
Input / Output Calibration Package 44 on page 52 of TRIG2630: 4-Speed Aux Trans - Low, Underdrive, Direct, Overdrive (L, UD, D, OD)	4	14	15	16		
Input / Output Calibration Package 45 on page 53 of TRIG2630: 4-Speed Aux Trans (L, UD, D, OD) + Rock Free Mode	4	14	15	16		
Input / Output Calibration Package 46 on page 54 of TRIG2630: 4-Speed Aux Trans - Low, Underdrive, Neutral, Direct, Overdrive (L, N, UD, D, OD)	4	14	15	16		

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

1. Key off.
2. Reconnect all connectors and verify 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 983 sets Active, go to **Step A.**
   - If a fault code other than 983 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 984: Auxiliary Trans Selected Gear

J1939: SA 3 SPN 15202 FMI 9, 13, 19

Overview

The Endurant XD Series transmission can be combined with a 2-speed auxiliary transmission for additional gear ratio coverage. When auxiliary transmission operation is required the Transmission Control Module (TCM) receives a gear engagement signal (Input) then adjusts the transmission shift strategy and launch characteristics for the new auxiliary transmission gear ratio. Reference Endurant XD Driver Instructions TRDR0960 for Auxiliary Transmission operation.

The TCM can be configured for operation with a 2-speed auxiliary transmission with messages over the vehicle Primary Data Link J1939A or from a switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "2-Speed Aux Trans - (Low, (N), Direct) - J1939", auxiliary transmission gear engagement messages are provided to the TCM by an OEM vehicle ECU. If the TCM is configured to "2-Speed Aux Trans - (Low, (N), Direct) - TCM Hardwired", auxiliary transmission gear engagement notification signal (Input) is provided to the TCM from a hardwired switch circuit.

The auxiliary transmission circuit input is connected to the TCM in the 20-Way TCM Body Harness Connector. The auxiliary transmission circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 in the Appendix for recommended Auxiliary Transmission circuit wiring diagrams.

Detection

The TCM monitors Auxiliary Transmission Selected Gear messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Auxiliary Transmission Selected Gear messages not received for 5 seconds.

FMI 13 – Out of Calibration: Auxiliary Transmission Selected Gear message not available for 5 seconds.

FMI 19 – Received Network Data in Error: Auxiliary Transmission Selected Gear messages invalid for 5 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes
- Auxiliary Trans Selected Gear inoperative

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Auxiliary Transmission Selected Gear messages received and valid for 1 second.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - Auxiliary Transmission Selected Gear message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

Additional Tools

- None

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Fault Code 984 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 984 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 984 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Auxiliary Transmission Selected Gear message (SPN 15202). Go to **Step V.**
   - If Fault Code 984 FMI 13 is Active, refer to OEM and enable Auxiliary Transmission Selected Gear message (SPN 15202). Go to **Step V.**
   - If Fault Code 984 FMI 13 is Inactive, Auxiliary Transmission Selected Gear is properly configured. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 984 sets Active, go to **Step A.**
   - If a fault code other than 984 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 985: Two Speed Axle Message

J1939: SA 3 SPN 69 FMI 13, 19

Overview

The Endurant XD Series transmission can be combined with a 2-speed axle for additional gear ratio coverage. When 2-speed axle operation is required the Transmission Control Module (TCM) receives an axle gear engagement signal (Input) then adjusts the transmission shift strategy and launch characteristics for the new axle gear ratio. Reference Endurant XD Driver Instructions TRDR0960 for Two-Speed Axle operation.

The TCM can be configured for operation with a 2-speed axle with messages over the vehicle Primary Data Link J1939A or from a switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "2-Speed Axle - J1939", axle gear engagement messages are provided to the TCM by an OEM vehicle ECU. If the TCM is configured to "2-Speed Axle - TCM Hardwired", an axle gear engagement notification signal (Input) is provided to the TCM from a hardwired switch circuit.

The 2-speed axle circuit input is connected to the TCM in the 20-Way TCM Body Harness Connector. The 2-speed axle circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 in the Appendix for recommended 2-speed axle circuit wiring diagrams.

Detection

The TCM monitors Two Speed Axle messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 13 – Out of Calibration: Two Speed Axle message not available for 5 seconds.

FMI 19 – Received Network Data in Error: Two Speed Axle messages invalid for 5 seconds.

Fallback

FMI 13, 19:

- Amber warning lamp on
- No degraded modes
- 2-Speed Axle operation may not function

Conditions to Set Fault Code Inactive

FMI 13, 19: Two Speed Axle messages received and valid for 10 seconds.

Possible Causes

FMI 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - Two Speed Axle message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

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Fault Code 985 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 985 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 985 FMI 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Two Speed Axle Message (SPN 69). Go to **Step V.**
   - If Fault Code 985 FMI 13 is Active, refer to OEM and enable Two Speed Axle Message (SPN 69). Go to **Step V.**
   - If Fault Code 985 FMI 13 is Inactive, Two Speed Axle Message is properly configured. Go to **Step V.**.

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

1. Key off.
2. Reconnect all connectors and verify 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 985 sets Active, go to **Step A.**
   - If a fault code other than 985 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 986: Two Speed Axle Switch

J1939: SA 3 SPN 4056 FMI 4, 12, 13, 14, 20

Overview

The Endurant XD Series transmission can be combined with a 2-speed axle for additional gear ratio coverage. When 2-speed axle operation is required the Transmission Control Module (TCM) receives an axle gear engagement signal (Input) then adjusts the transmission shift strategy and launch characteristics for the new axle gear ratio. Reference Endurant XD Driver Instructions TRDR0960 for Two-Speed Axle operation.

The TCM can be configured for operation with a 2-speed axle with messages over the vehicle Primary Data Link J1939A or from a switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "2-Speed Axle - J1939", axle gear engagement messages are provided to the TCM by an OEM vehicle ECU. If the TCM is configured to "2-Speed Axle - TCM Hardwired", an axle gear engagement notification signal (Input) is provided to the TCM from a hardwired switch circuit.

The 2-speed axle circuit input is connected to the TCM in the 20-Way TCM Body Harness Connector. The 2-speed axle circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 in the Appendix for recommended 2-speed axle circuit wiring diagrams.

Detection

The TCM monitors the Two Speed Axle Switch hardwired circuit input signal. If the signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 4 – Voltage Below Normal or Shorted Low: Two Speed Axle Switch circuit input signal shorted to ground for 5 seconds.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: The TCM detected invalid I/O Package calibration.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 20 – Data Drifted High: Two Speed Axle Switch circuit input signal out of range (4.00–5.25 V) for 5 seconds.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded modes
- 2-Speed Axle operation may not function

Conditions to Set Fault Code Inactive

FMI 4: Two Speed Axle Switch circuit not shorted to ground for 10 seconds.

FMI 12: Key cycle and fault condition no longer exits.

FMI 13, 14: Valid I/O Package calibration file is configured in TCM.

FMI 20: Two Speed Axle Switch circuit input signal in range for 10 seconds.

Possible Causes

FMI 4, 20:

- Vehicle Harness - Two Speed Axle Switch Circuit
  - Shorted to power, shorted to ground or open circuit

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 13, 14:

- TCM
  - Invalid I/O Package calibration file configured in TCM

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Fault Code 986 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 986 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 986 FMI 4, 20 is Active, go to **Step B.**
   - If Fault Code 986 FMI 4, 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Two Speed Axle Switch circuit. Go to **Step C.**

     Note: Two Speed Axle Switch circuit wiring is installed by OEM or body builder.
   - If Fault Code 986 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 986 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 986 FMI 13 or 14 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 986 FMI 13 or 14 is Inactive, go to **Step V.**

B ***Purpose:*** *Verify Multi-Speed Driveline Configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Vehicle”.
5. Record "Multi-Speed Driveline Configuration" Current Value.
   - If "Multi-Speed Driveline Configuration" Current Value indicates "Not Installed" and Two Speed Axle Switch circuit is properly installed and wired, select "2-Speed Axle - TCM Hardwired" option and follow on-screen prompts. Go to **Step V.**
   - If "Multi-Speed Driveline Configuration" Current Value indicates a "2-Speed Axle - TCM Hardwired" option and Two Speed Axle Switch circuit is properly installed and wired, go to **Step C.**

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C ***Purpose:*** *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Two Speed Axle Switch signal circuit. Go to **Step V.**

     Note: Two Speed Axle Switch signal circuit wiring is installed by OEM or body builder.

Fault Code 986: Two Speed Axle Switch				
Package # and Description	20-Way TCM Body Connector Pin(s)		Component(s)	
Input / Output Calibration Package 16 on page 29 of TRIG2630: 2-Speed Axle	5	6	Normally Open Pressure Switch	2-Speed Vehicle Controls High Range Air Line
Input / Output Calibration Package 17 on page 30 of TRIG2630: 2-Speed Axle + Rock Free Mode	5	6		
Input / Output Calibration Package 18 on page 31 of TRIG2630: 2-Speed Axle + PTO 1	6	14		
Input / Output Calibration Package 19 on page 32 of TRIG2630: 2-Speed Axle + Secondary Shift Mode	5	6		
Input / Output Calibration Package 33 on page 42 of TRIG2630: 2-Speed Axle + Reverse Output	5	6		

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

1. Key off.
2. Reconnect all connectors and verify 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 986 sets Active, go to **Step A.**
   - If a fault code other than 986 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 987: Rock Free Mode Switch

J1939: SA 3 SPN 12939 FMI 3, 4, 5, 6, 11, 12, 13, 14, 20, 31

Overview

The Endurant XD Pro transmission incorporates a Rock Free Mode feature that allows the driver to perform a vehicle “rocking” maneuver by depressing and releasing the vehicle accelerator pedal. This maneuver is useful in situations where the vehicle’s wheels are stuck in terrain depressions that are preventing vehicle progress. When Rock Free Mode is required the Transmission Control Module (TCM) receives a request (Input) for Rock Free Mode operation, determines if operating conditions are suitable, implements the change, and supplies a signal (Output) notification. Reference Endurant XD Driver Instructions TRDR0960 for Rock Free Mode operation.

The TCM can be configured to activate Rock Free Mode with messages over the vehicle Primary Data Link J1939A or from a switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Message" Rock Free Mode operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to " TCM Hardwired Switch", Rock Free Mode operation is controlled by Input and Output signals from a hardwired switch circuit.

The Rock Free Mode circuit is connected to the TCM in the 20-Way TCM Body Harness Connector. The Rock Free Mode circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 in the Appendix for recommended Rock Free Mode circuit wiring diagrams.

Detection

The TCM monitors the Rock Free Mode Switch hardwired circuit input signal. If the signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: Rock Free Mode Switch circuit output signal shorted to power for 5 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Rock Free Mode Switch circuit output signal shorted to ground for 5 seconds.

FMI 5 – Current Above Normal or Open Circuit: Rock Free Mode Switch circuit open for 5 seconds.

FMI 6 – Current Above Normal or Grounded Circuit: Rock Free Mode Switch circuit output current out of range for 5 seconds.

FMI 11 – Root Cause Unknown: The TCM detected invalid I/O Package calibration.

FMI 12 – Bad Intelligent Device: TCM has detected an internal processing error.

FMI 13 – Out of Calibration: The TCM detected invalid I/O Package calibration.

FMI 14 – Special Instructions: The TCM detected invalid I/O Package calibration.

FMI 20 – Data Drifted High: Rock Free Mode Switch circuit input signal out of range (4.00–5.25 V) for 5 seconds.

FMI 31 – Condition Exists: The TCM detected invalid I/O Package calibration.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded modes
- Rock Free Mode will not function

Conditions to Set Fault Code Inactive

FMI 3: Rock Free Mode Switch circuit not shorted to power for 10 seconds.

FMI 4: Rock Free Mode Switch circuit not shorted to ground for 10 seconds.

FMI 5: Rock Free Mode Switch circuit not open for 10 seconds.

FMI 6: Rock Free Mode Switch circuit output current in range for 10 seconds.

FMI 11, 12: Key cycle and fault condition no longer exits.

FMI 13, 14, 31: Valid I/O Package calibration file is configured in TCM.

FMI 20: Rock Free Mode Switch circuit input signal in range for 10 seconds.

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Possible Causes

FMI 3, 4, 5, 6, 20:

- Vehicle Harness - Rock Free Mode Switch Circuit
  - Shorted to power, shorted to ground, or open circuit

FMI 11, 13, 14, 31:

- TCM
  - Invalid I/O Package calibration file configured in TCM

FMI 12:

- TCM
  - Internal failure
  - Software issue

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Fault Code 987 Troubleshooting

A

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 987 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 987 FMI 3, 4, 5, 6 or 20 is Active, go to **Step B.**
   - If Fault Code 987 FMI 3, 4, 5, 6 or 20 is Inactive, the intermittent nature of the fault makes it likely that the problem is in the Rock Free Mode Switch circuit. Go to **Step C.**

     Note: Rock Free Mode Switch circuit wiring is installed by OEM or body builder.
   - If Fault Code 987 FMI 12 is Active, replace **Transmission Control Module (TCM)**. Go to **Step V.**
   - If Fault Code 987 FMI 12 is Inactive, go to **Step V.**
   - If Fault Code 987 FMI 11, 13, 14, 31 is Active, Contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2. Go to **Step V.**
   - If Fault Code 987 FMI 11, 13, 14, 31 is Inactive, go to **Step V.**

B

Purpose: *Verify Rock Free Mode configuration with ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Options”.
5. Record "Rock-Free Mode" Current Value.
   - If "Rock-Free Mode" Current Value indicates “Disabled” and Rock Free Mode Switch circuit is properly installed and wired, select “TCM Hardwired Switch" and follow on-screen prompts. Go to **Step V.**
   - If "Rock-Free Mode" Current Value indicates “TCM Hardwired Switch” and Rock Free Mode Switch circuit is properly installed and wired, go to **Step C.**

C

Purpose: *Verify Input/Output Package type with ServiceRanger.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Configuration”.
4. Select “Calibrations” tab.
5. Record "I/O Package" Current Value.
   - Based on I/O package configured refer to I/O circuit schematic indicated in table. Contact OEM or body builder for repair or replacement of Rock Free Mode Switch signal circuit.Go to **Step V.**

     Note: Rock Free Mode Switch signal circuit wiring is installed by OEM or body builder.

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Fault Code 987: Rock Free Mode Switch								
Package # and Description	20-Way TCM Body Connector Pin(s)				Component(s)			
Input / Output Calibration Package 2 on page 16 of TRIG2630: Rock Free Mode + Secondary Shift Mode	3	5	6		Rock Free Momentary Switch	Rock Free Relay	Rock Free Fuse 2 Amp	Chassis Ground
Input / Output Calibration Package 3 on page 17 of TRIG2630: 2-Speed Aux Trans + Rock Free Mode	3	5	6					
Input / Output Calibration Package 7 on page 21 of TRIG2630: PTO 1 + Rock Free Mode + Secondary Shift Mode	3	5	6					
Input / Output Calibration Package 8 on page 22 of TRIG2630: PTO 1 + Reverse Output + Rock Free Mode	3	5	6					
Input / Output Calibration Package 9 on page 23 of TRIG2630: Rock Free Mode	3	5	6					
Input / Output Calibration Package 17 on page 30 of TRIG2630: 2-Speed Axle + Rock Free Mode	3	14	15					
Input / Output Calibration Package 29 on page 38 of TRIG2630: PTO 1 + Rock Free Mode	3	5	6	15				
Input / Output Calibration Package 31 on page 40 of TRIG2630: Reverse Output + Rock Free Mode	3	5	6					

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

1. Key off.
2. Reconnect all connectors and verify 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 987 sets Active, go to **Step A.**
   - If a fault code other than 987 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 988: Rock Free Mode Message

J1939: SA 3 SPN 12949 FMI 9, 13, 19

Overview

The Endurant XD Pro transmission incorporates a Rock Free Mode feature that allows the driver to perform a vehicle “rocking” maneuver by depressing and releasing the vehicle accelerator pedal. This maneuver is useful in situations where the vehicle’s wheels are stuck in terrain depressions that are preventing vehicle progress. When Rock Free Mode is required the Transmission Control Module (TCM) receives a request (Input) for Rock Free Mode operation, determines if operating conditions are suitable, implements the change, and supplies a signal (Output) notification. Reference Endurant XD Driver Instructions TRDR0960 for Rock Free Mode operation.

The TCM can be configured to activate Rock Free Mode with messages over the vehicle Primary Data Link J1939A or from a switch circuit hardwired directly to the TCM. The TCM is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Package to support various vocational features.

If the TCM is configured to "J1939 Message" Rock Free Mode operation messages are exchanged between the TCM and a OEM vehicle ECU. If the TCM is configured to " TCM Hardwired Switch", Rock Free Mode operation is controlled by Input and Output signals from a hardwired switch circuit.

The Rock Free Mode circuit is connected to the TCM in the 20-Way TCM Body Harness Connector. The Rock Free Mode circuit is installed by the OEM or body builder. The Rock Free Mode circuit is installed by the OEM or body builder. Reference *Input / Output Calibration* on page 696 in the Appendix for recommended Rock Free Mode circuit wiring diagrams.

Detection

The TCM monitors Rock Free Mode messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Rock Free Mode messages not received for 5 seconds.

FMI 13 – Out of Calibration: Rock Free Mode message not available for 5 seconds.

FMI 19 – Received Network Data in Error: Rock Free Mode messages invalid for 5 seconds.

Fallback

FMI 9, 13, 19:

- Amber warning lamp on
- No degraded modes
- Rock Free Mode will not function

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Rock Free Mode messages received and valid for 10 seconds.

Possible Causes

FMI 9, 13, 19:

- Vehicle Components - Vehicle ECU(s)
  - Rock Free Mode message not enabled
  - Other vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Shorted to power, shorted to ground or open circuit
  - Terminals bent, spread, corroded, or loose

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Fault Code 988 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 988 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 988 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle Rock Free Mode message (SPN 12949). Go to **Step V.**
   - If Fault Code 988 FMI 13 is Active, refer to OEM and enable Rock Free Mode message (SPN 12949). Go to **Step V.**
   - If Fault Code 988 FMI 13 is Inactive, Rock Free Mode is properly configured. Go to **Step V.**.

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

1. Key off.
2. Reconnect all connectors and verify 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 988 sets Active, go to **Step A.**
   - If a fault code other than 988 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 990: DPF Thermal Management Active

J1939: SA 3 SPN 5399 FMI 9, 13, 19

Overview
The Transmission Control Module (TCM) receives the vehicle's Diesel Particulate Filter (DPF) Thermal Management Active message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors DPF Thermal Management Active messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 9 - Abnormal Update Rate: DPF Thermal Management Active message not received for 5 seconds.

FMI 13 - Out of Calibration: DPF Thermal Management Active message not available for 5 seconds.

FMI 19: Received Network Data in Error: DPF Thermal Management Active messages invalid for 5 seconds.

Fallback
FMI 9, 13, 19:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited

Conditions to Set Fault Code Inactive
FMI 9, 13, 19: DPF Thermal Management Active messages received and valid for 10 seconds.

Possible Causes
FMI 9, 13, 19:

- Vehicle Components
  - Vehicle DPF Thermal Management Active message not enabled
  - Other Vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 990 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 990 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 990 FMI 13 is Active, refer to OEM and enable vehicle DPF Thermal Management Active message (SPN 5399). Go to **Step V.**
   - If Fault Code 990 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 990 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle DPF Thermal Management Active message (SPN 5399). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 990 sets Active, go to **Step A.**
   - If a fault code other than 990 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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Fault Code 991: SCR Thermal Management Active

J1939: SA 3 SPN 5400 FMI 9, 13, 19

Overview
The Transmission Control Module (TCM) receives the vehicle's Selective Catalytic Reduction (SCR) Thermal Management Active message from a vehicle Electronic Control Unit (ECU) over the Primary Data Link (J1939A). This information is used to determine transmission operation.

Detection
The TCM monitors SCR Thermal Management Active messages. If messages are not received or are invalid, the fault is set Active.

Conditions to Set Fault Code Active
FMI 9 - Abnormal Update Rate: SCR Thermal Management Active message not received for 5 seconds.

FMI 13 - Out of Calibration: SCR Thermal Management Active message not available for 5 seconds.

FMI 19: Received Network Data in Error: SCR Thermal Management Active messages invalid for 5 seconds.

Fallback
FMI 9, 13, 19:

- Amber warning lamp on
- Coast Mode and Neutral Coast prohibited

Conditions to Set Fault Code Inactive
FMI 9, 13, 19: SCR Thermal Management Active messages received and valid for 10 seconds.

Possible Causes
FMI 9, 13, 19:

- Vehicle Components
  - Vehicle SCR Thermal Management Active message not enabled
  - Other Vehicle ECU(s) faulted
- Vehicle Harness - Primary Data Link (J1939A)
  - Wiring shorted to power, shorted to ground or open
  - Terminals bent, spread, corroded, or loose

Note: Refer to OEM for troubleshooting a failed system.

Additional Tools
- None

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Fault Code 991 Troubleshooting

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

1. Set vehicle parking brake and chock wheels.
2. Record transmission fault codes, FMIs, occurrences, and timestamps from Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 991 is Inactive and there are other Active vehicle or transmission fault codes, troubleshoot all Active fault codes. Go to **Step V.**
   - If Fault Code 991 FMI 13 is Active, refer to OEM and enable vehicle SCR Thermal Management Active message (SPN 5400). Go to **Step V.**
   - If Fault Code 991 FMI 13 is Inactive, go to **Step V.**
   - If Fault Code 991 FMI 9 or 19 is Active or Inactive, refer to OEM guidelines for repair of the vehicle SCR Thermal Management Active message (SPN 5400). Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify 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 991 sets Active, go to **Step A.**
   - If a fault code other than 991 sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

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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 position, 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.

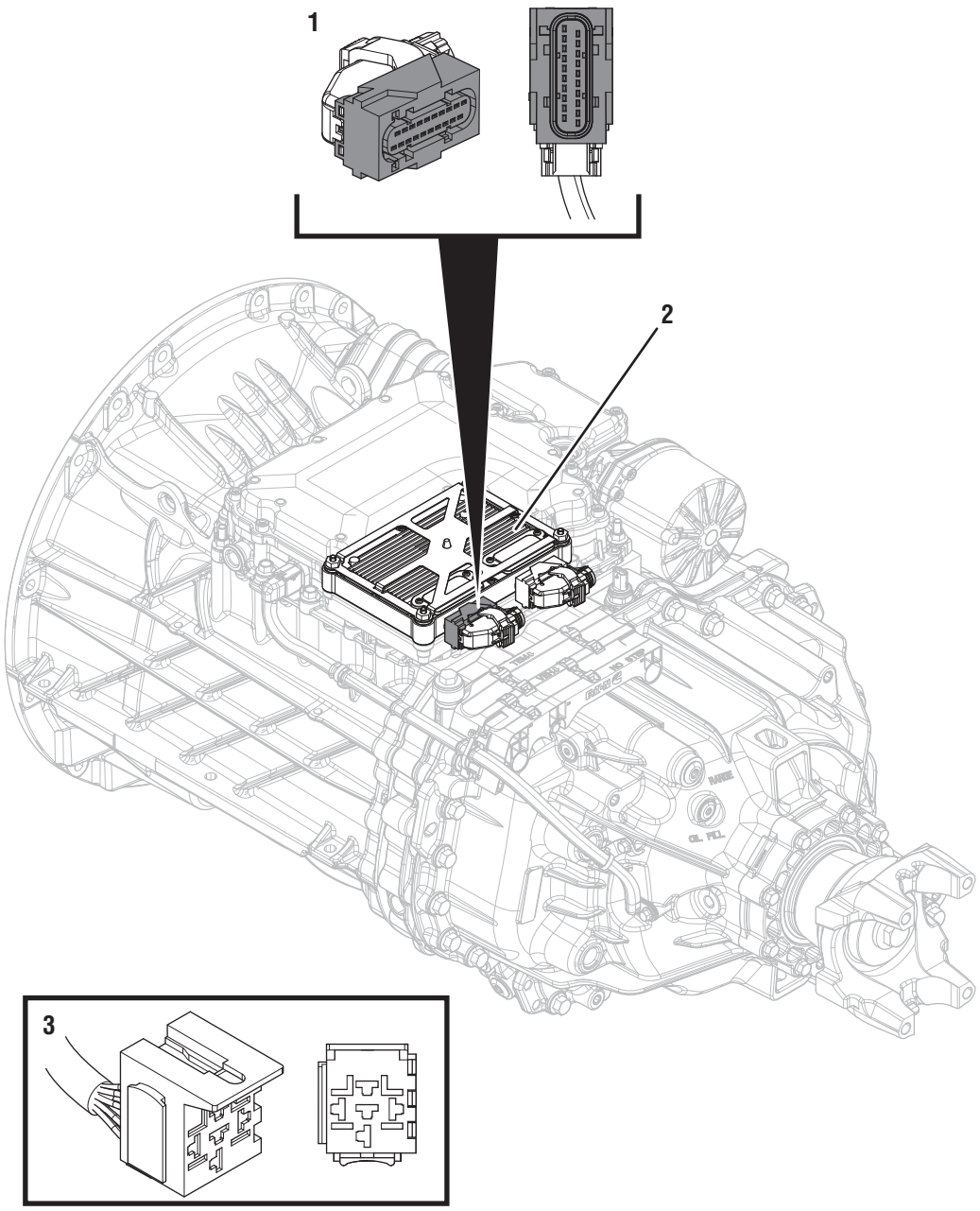
Note: If the engine was shut off with the transmission in gear, confirm the vehicle air supply pressure is in range and the vehicle parking brake is set or service brake is depressed when attempting to start the engine.

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
  - Terminals bent, spread, corroded, or loose
  - Wiring shorted to ground, shorted to power or open

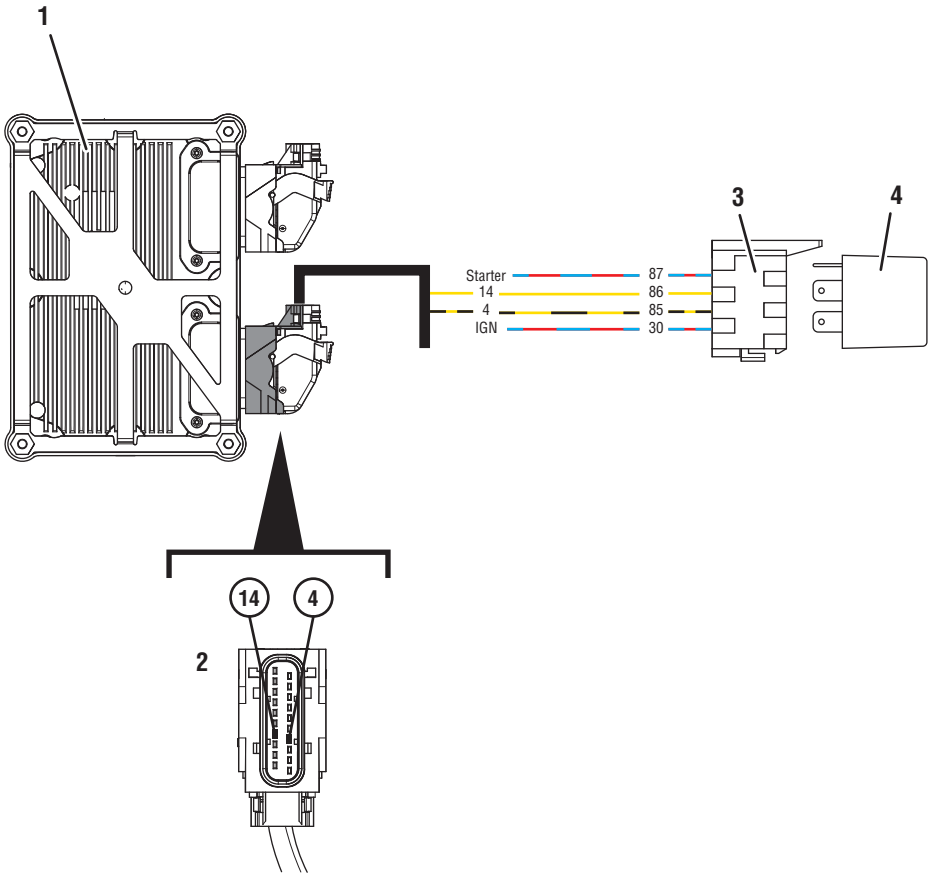
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Component Identification



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

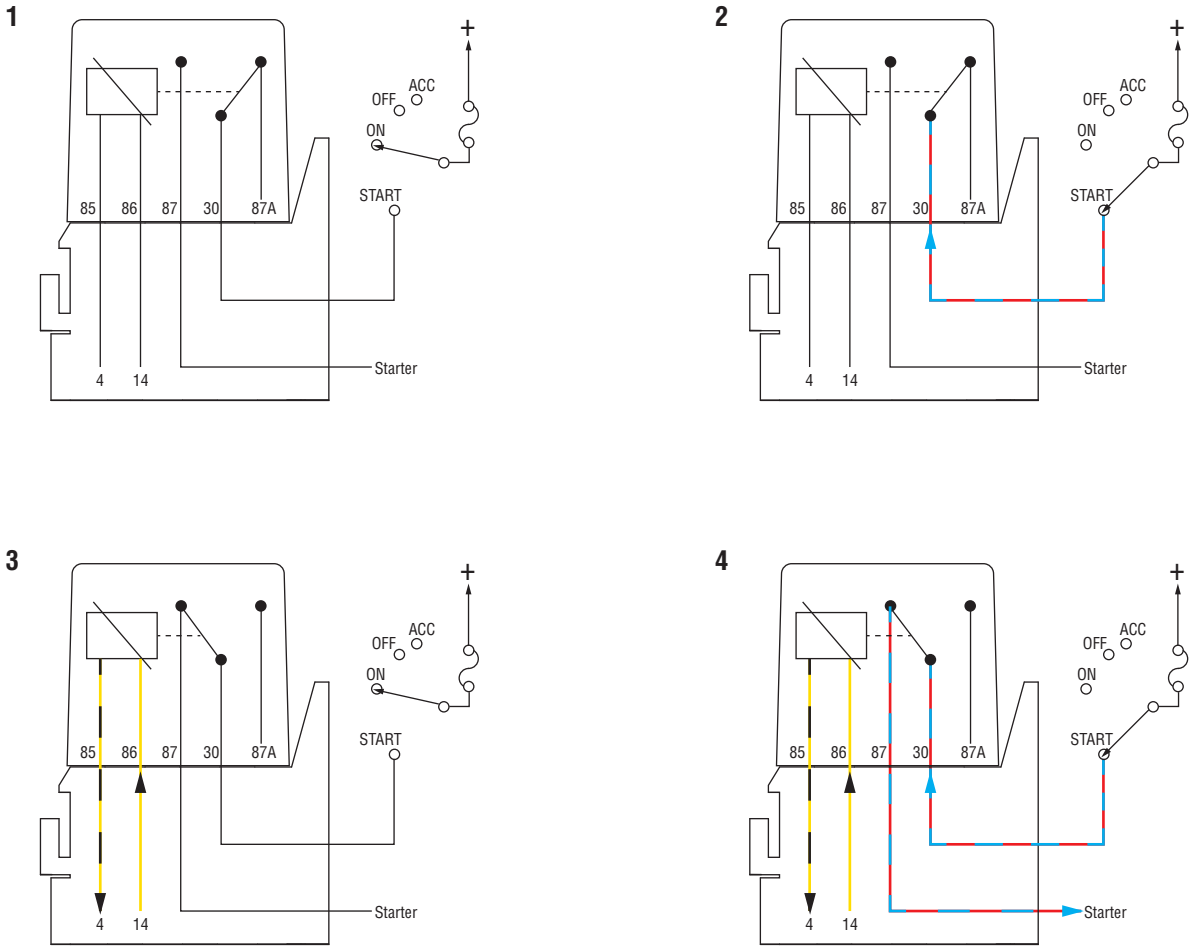
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1. Transmission Control Module (TCM)
2. 20-Way TCM Vehicle Harness Connector
3. 5-Way Start Enable Relay Socket
4. 5-Way Start Enable Relay

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

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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



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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: *Determine if the Start Enable system is a hard-wired relay or a J1939 message.*

1. 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.

   Note: Refer to OEM regarding vehicle Start Enable type system.

   - If a Start Enable message is sent over J1939By the TCM, go to **Step D.**
   - If a Start Enable Relay is hardwired to the TCM, go to **Step G.**

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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.**

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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	

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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.*

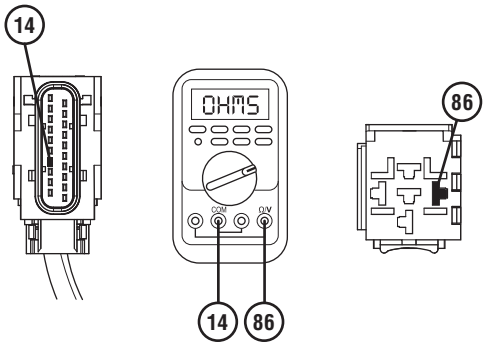
1. Key on with engine off.
2. Remove the Start Enable Relay.
3. Key on with engine off.
4. Place the Transmission Driver Interface Device in a non-Neutral position.
5. Depress and hold the service brake, attempt to crank the engine.
6. Return the Transmission Driver Interface Device to Neutral (N).
   - 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.**

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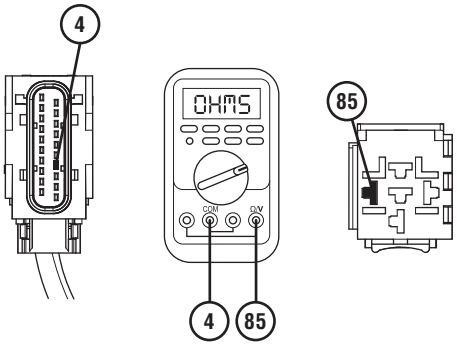
K

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.**

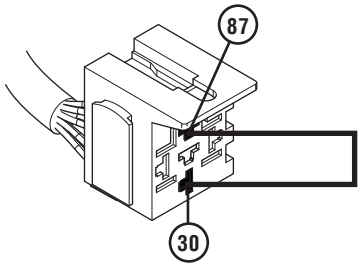
Pins	Range	Reading(s)
VH 14 to SER 86	0.0–0.3 ohms	
VH 4 to SER 85	0.0–0.3 ohms	

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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 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 19.
    - If the engine does not crank and no fault codes set, contact OEM for further diagnostic instructions.

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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

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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.	

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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 for further diagnostic instructions. For Help Line phone numbers, go to *Contact Information* on page 2.

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	

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Transmission Shift Complaint

Overview

This symptom-driven test is performed if a shift complaint exists and there are no fault codes.

Detection

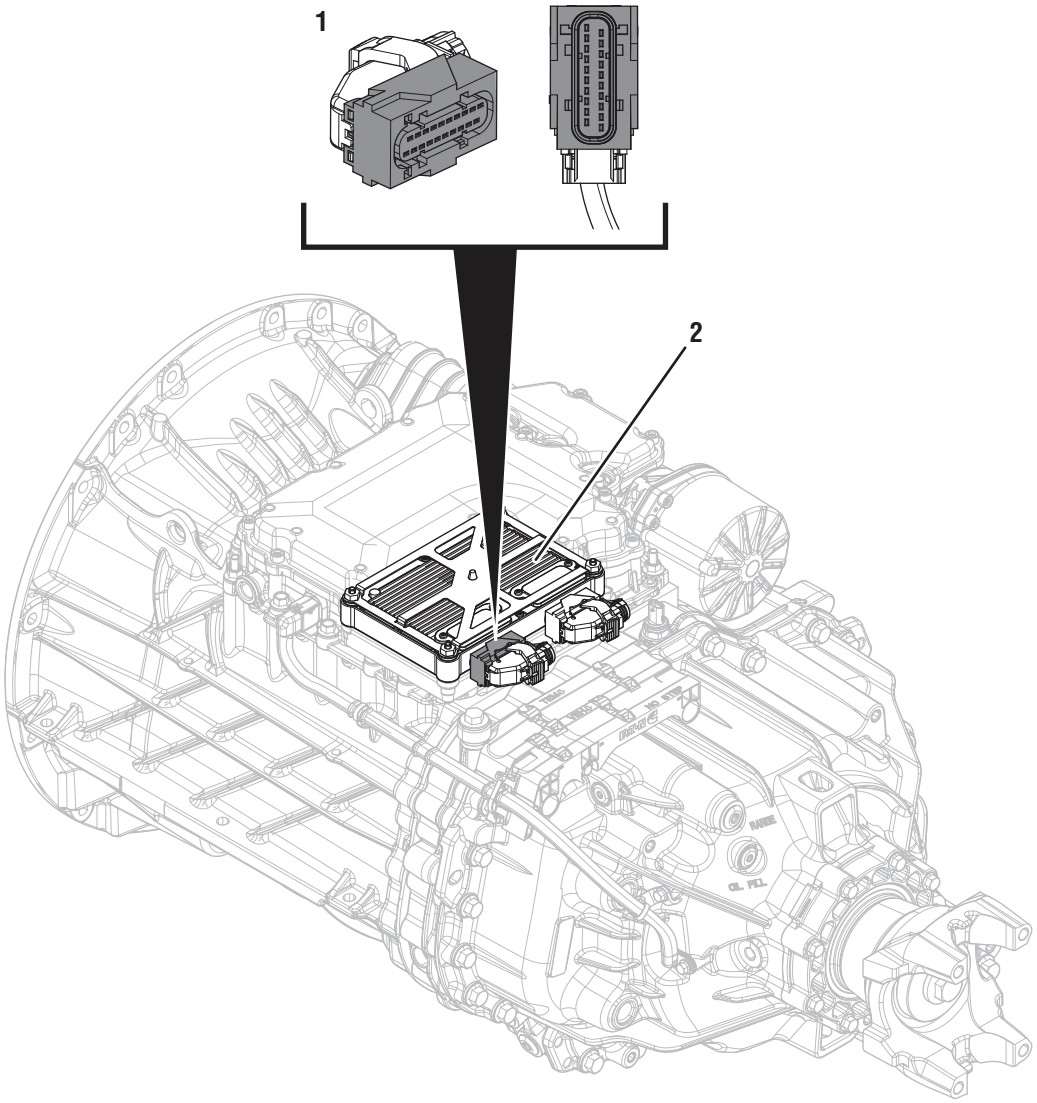
- Transmission may exhibit slow or harsh launch from a stop.
- Transmission may not be able to complete a shift.
- Transmission may exhibit slow or harsh shifting.

Possible Causes

- Vehicle
  - Varies
- Engine
  - Varies
- Transmission
  - Varies

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Component Identification



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

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Transmission Shift Complaint Test

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

Note: To ensure a successful Driver Triggered Snapshot, refer to **RRMT-0044: Driver Triggered Snapshot - Transmission Shift Complaint without Active Transmission Fault Codes Procedure**.

1. Document the vehicle symptoms by completing the Driver Questionnaire on page 13.
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: Fault code and transmission information is downloaded into the report.
7. Select “Send to Eaton”.

   Note: Internet connection is required.
8. 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” (upshift, downshift, upshift, downshift) 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.

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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: Fault code and transmission information is downloaded into the report.
7. Select “Send to Eaton”.

   Note: Internet connection is required.
8. 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 19 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 15

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J1939 Vehicle Data Link Test

Overview

This symptom driven test is performed if the J1939 Vehicle Data Link is failing to function in some way without setting transmission Fault Code 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
  - Terminals bent, spread, corroded, or loose
  - 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

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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 19.
   - 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 (J1939A).*

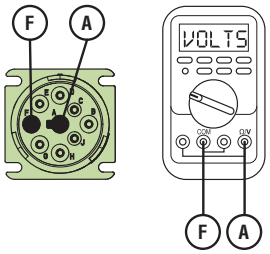
1. Key off.
2. Refer to the OEM and identify the TCM location on the Vehicle Primary Data Link (J1939A) at the 9-Way Diagnostic Connector.
   - If the TCM is on 9-Way Diagnostic Connector Pin C and Pin D, go to **Step G.**
   - If the TCM is on 9-Way Diagnostic Connector Pin F and Pin G, go to **Step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

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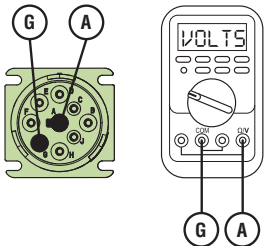
C

Purpose: *Verify Vehicle Primary Data Link (J1939A) 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.



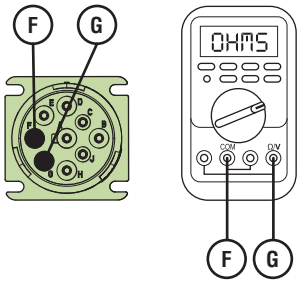
4. Record Total Voltage in table by adding voltage readings together.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step D.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939A). Go to **Step V.**

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 (J1939A).*

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 (J1939A). Go to **Step V.**
   - If readings are in range, go to **Step E.**

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

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E

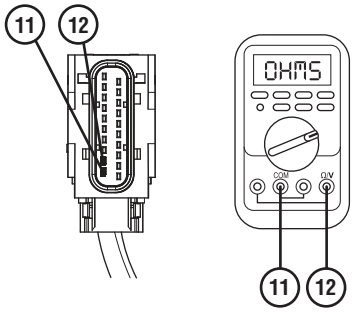
Purpose: *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector from TCM.
3. Inspect 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect 20-Way TCM Vehicle Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to 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 (J1939A) 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 (J1939A). Go to **Step V.**
   - If readings are in range, go to **Step I.**

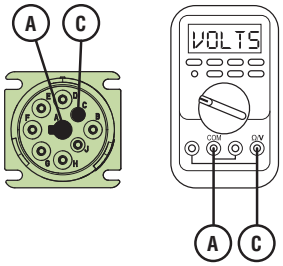
Pins	Range	Reading(s)
11 to 12	50–70 Ohms	

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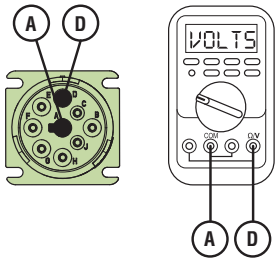
G

Purpose: *Verify Vehicle Primary Data Link (J1939A) 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.



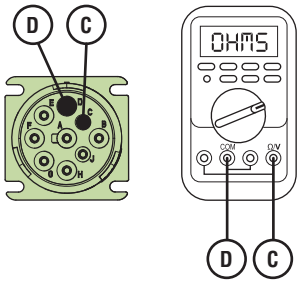
4. Record Total Voltage in table by adding voltage readings together.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step H.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939A). Go to **Step V.**

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 (J1939A).*

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 (J1939A). Go to **Step V.**
   - If readings are in range, go to **Step I.**

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

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I

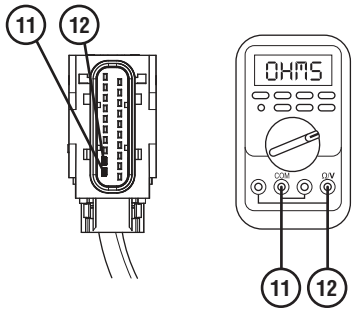
Purpose: *Verify 20-Way TCM Vehicle Harness Connector condition.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector from TCM.
3. Inspect 20-Way TCM Vehicle Harness Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to connector body.
4. Inspect 20-Way TCM Vehicle Connector, verify connector is free from contamination and corrosion; terminals are not bent, spread or loose; and there is no damage to 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 (J1939A). Go to **Step V.**
   - If readings are in range, go to **Step K.**

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

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K

Purpose: *Use ServiceRanger to monitor ECU communication on the Primary Data Link (J1939A).*

1. Key off.
2. Reconnect all connectors and verify 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 (J1939A).
8. Compare this list to the roster of vehicle ECUs that should be communicating on the Primary Data Link (J1939A).

   Note: Contact OEM for information about which vehicle ECUs should be on the Primary Data Link (J1939A).

   - 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 (J1939A). 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 (J1939A).
6. Individually remove each vehicle ECU from the Primary Data Link (J1939A).
7. After removing each device, monitor the ServiceRanger ECU roster.
   - If the removal of an ECU from the Primary Data Link (J1939A) 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 (J1939A). Refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If no problems are found, Contact OEM for further diagnostic instructions.

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

1. Key off.
2. Reconnect all connectors and verify 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 115 sets Active, go to **Step A.**
   - If a fault code other than 115 sets Active, troubleshoot per the “Fault Code Isolation Procedure Index” on page 19.

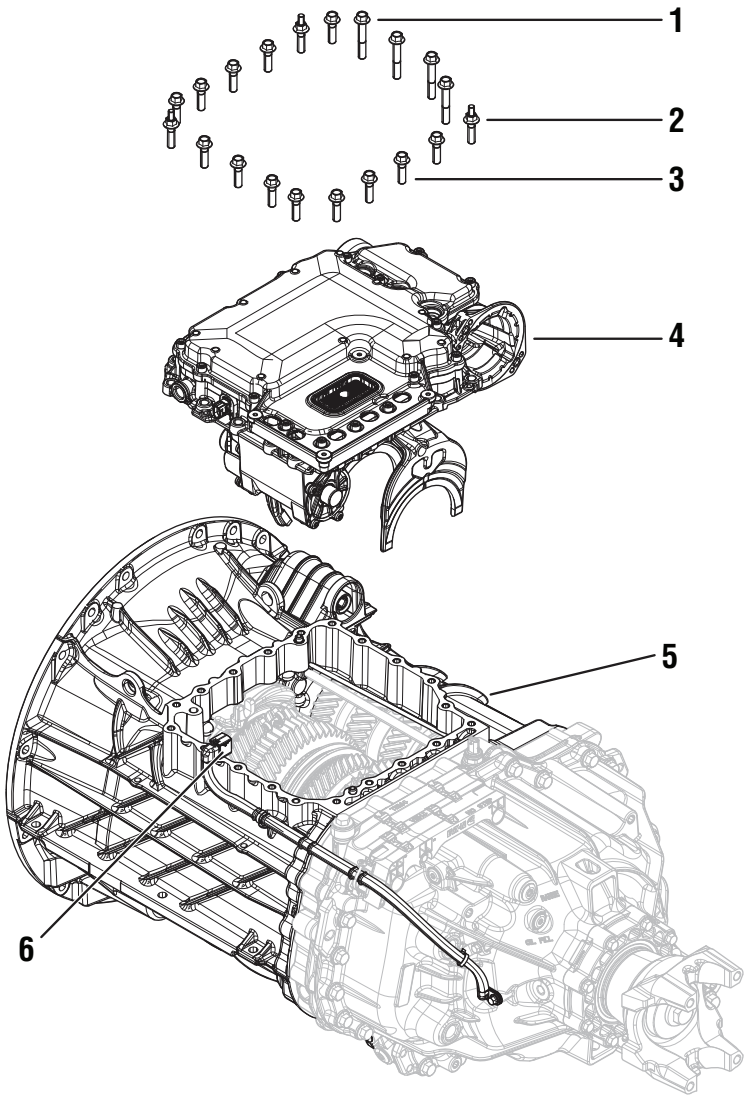
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Manually Actuate Rail A Procedure

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 Connector

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Procedure – Manually Actuate Rail A

1. Use hand to push Rail A Yoke forward, moving Rail A Synchronizer to neutral position (if necessary).

CAUTION: Keep fingers clear of pinch point between Rail A Yoke and Main Housing. Failure to keep clear of pinch points may result in personal injury.



2. Place pry-bar between Rail A Yoke and Main Housing.

CAUTION: Do not pry on sealing surfaces. Failure to avoid prying on sealing surface results in component damage.



3. Return to troubleshooting procedure and use pry-bar to shift Rail A as required.

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Manually Actuate Rail B Procedure

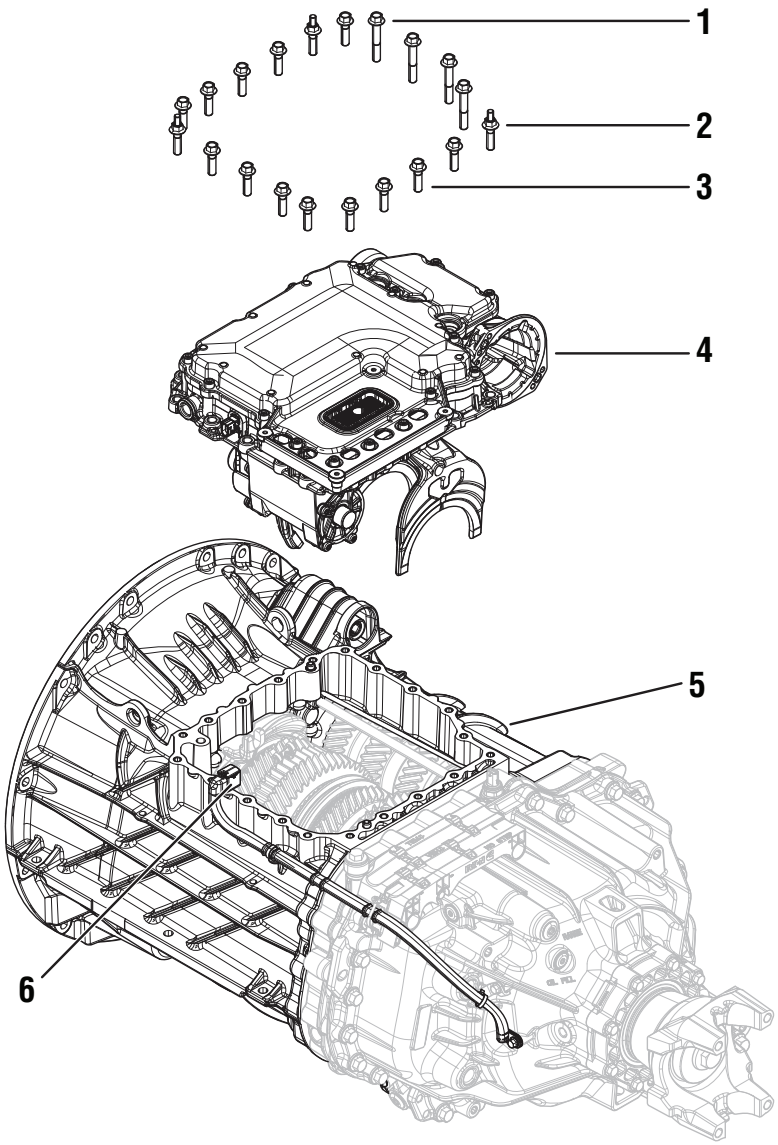
Special Instructions

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 Connector

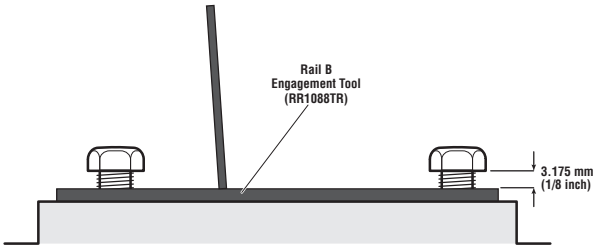
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Procedure – Manually Actuate Rail B

1. Install the Rail B Engagement Tool (RR1088TR) to the Main Housing
2. Install and hand tighten 2 MTM cap screws leaving a 3.175 mm (1/8 inch) gap between the cap screws and tool base.

   NOTICE: Hand tighten cap screws only, do not torque. Rail B Engagement Tool must remain loose to ensure complete movement of the synchronizer sliding sleeve. Over torqued cap screws result in binding between tool and sliding sleeve.

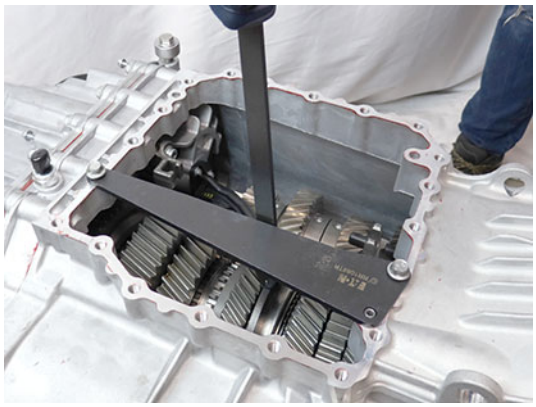




3. Shift Rail B Synchronizer Sliding Sleeve into the Fore position.

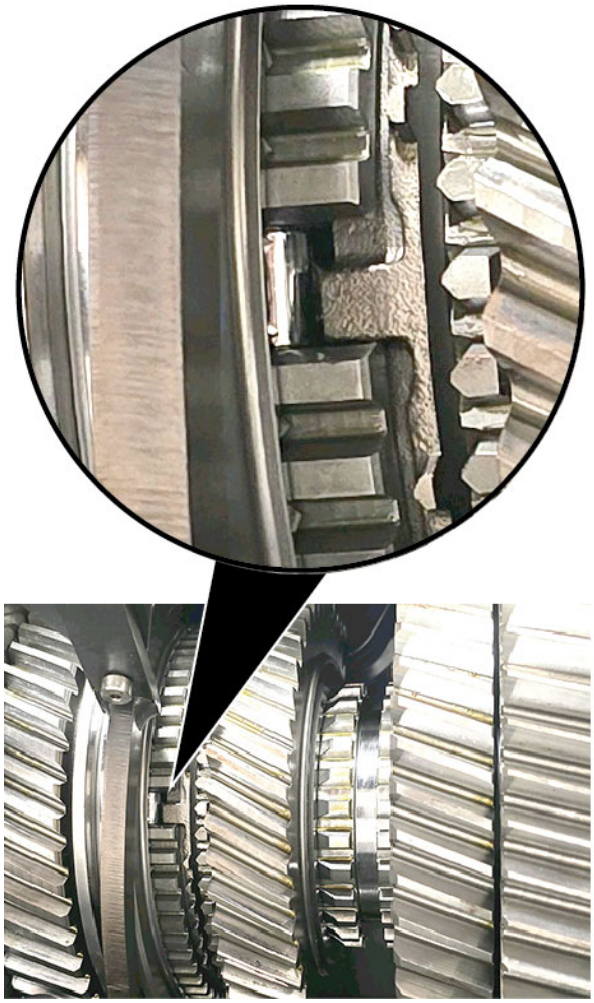
CAUTION: Keep fingers clear of pinch points between tool, synchronizer and gears. Failure to keep fingers clear results in personal injury.

NOTICE: Rotate the Input Shaft while shifting the Rail B Synchronizer sliding sleeve to allow synchronizer sleeve to mesh with gear. May need to neutralize Rail C and D sliding clutches.



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4. Inspect the Rail B Synchronizer for three synchronizer rollers. Rotate the Input Shaft to view the three rollers.
   - If all three synchronizer rollers are present, return to the troubleshooting procedure.
   - If one or more synchronizer rollers are not present, contact Eaton Cummins Automated Transmission Technologies for further diagnostic instructions. For Help Line phone numbers, go to “Contact Information” on page 2.



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Manually Actuate Rail E Procedure

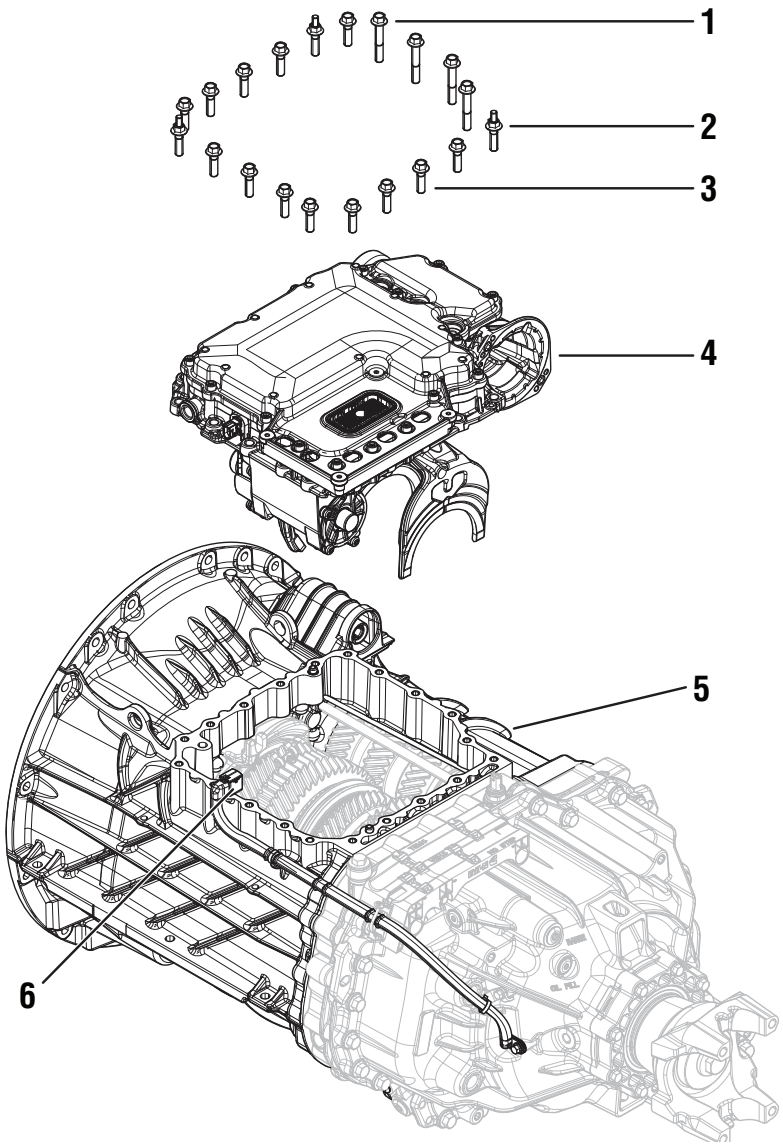
Special Instructions

None

Special Tools

- Mechanical Diagnostic Kit (RR2011TR)

Component Identification

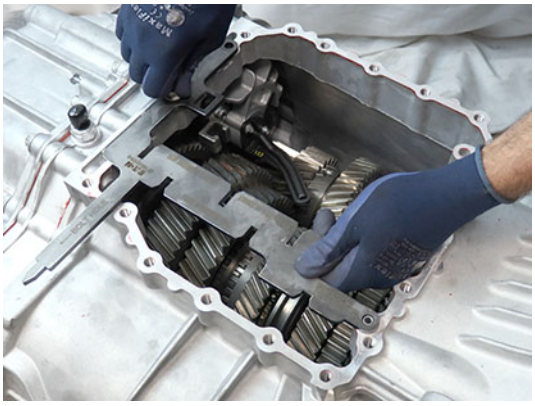


1. MTM Cap Screws, Long (x4) - 13 mm
2. MTM Cap Screws, Special (x2) - 15 mm
3. MTM Cap Screws (x14) - 13 mm
4. Mechatronic Transmission Module (MTM)
5. Main Housing
6. Output Speed Sensor Connector

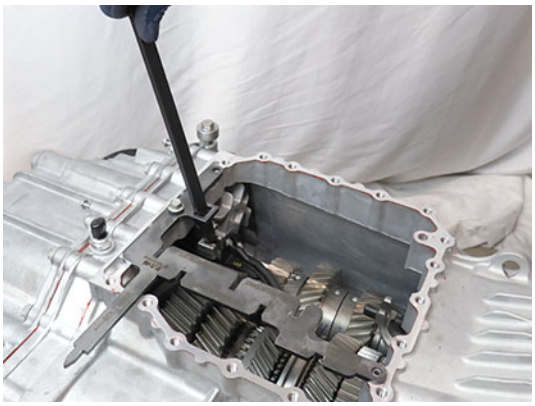
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Procedure – Manually Actuate Rail E

1. Install MTM Alignment Tool (RR1086TR-1) on Main Housing with one MTM cap screw and hand tighten.



2. Shift Rail E to neutral position (if necessary).



3. Return to troubleshooting procedure and use tool lever to shift Rail E as required. Remove MTM Alignment Tool (RR1086TR-1) when complete.

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Input / Output Calibration

Overview

The Endurant XD Pro Transmission incorporates enhanced controls to support various vocational features. Features include 2-Speed Axle, Auxiliary Transmission (Aux Trans), Force Neutral, Hold Neutral, Neutral Output, Power Take-Off (PTO): PTO 1 and PTO 2, Split Shaft PTO (SSPTO), Reverse Output, Rock Free Mode and Secondary Configuration Mode.

The Transmission Control Module (TCM) is equipped to receive 4 switch inputs and control 3 relay outputs that can be configured in an Input/Output (I/O) Calibration Package to support these vocational features. All external circuit inputs and outputs connect to the TCM in the 20-Way TCM Body Harness Connector.

Listed below are the Input / Output Calibration Packages and recommended wiring diagrams to assist the OEM or body builder with vocational feature integration. Once circuit and component installation is complete, ServiceRanger is required to configure the I/O Calibration Package in the TCM.

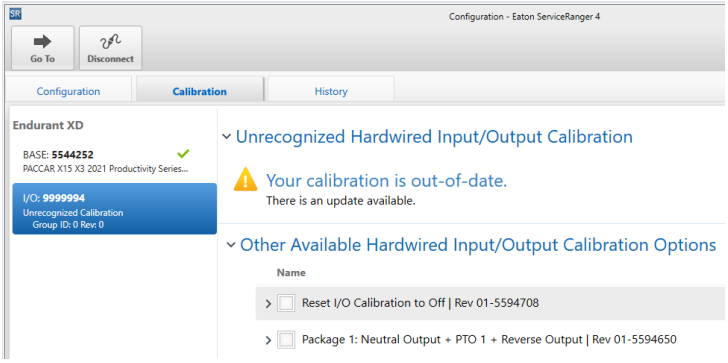
WARNING: All vehicle safety interlock circuitry is the responsibility of the OEM or body builder. Eaton Cummins Automated Transmission Technologies does not implement any safety interlock circuitry on the OEM vehicle chassis. Eaton Cummins Automated Transmission Technologies highly recommends that the OEM or body builder perform a thorough safety analysis to determine what safety interlocks are required to support the specific vehicle vocational feature. Failure to perform a thorough safety analysis may result in major vehicle component damage, severe injury or death.

NOTICE: Incorrect feature component and/or circuit integration resulting in transmission and/or TCM damage may void the transmission warranty.

Note: For additional information refer to Endurant XD Series PTO Installation and Body Integration Guide TRIG2620 and the Endurant XD Series Automated Transmissions Installation Guide TRIG0960.

Unrecognized Calibration Message

If the “Unrecognized Calibration” message is indicated, the TCM is currently not programmed with a Hardwired Input/Output Calibration package. I/O: “9999994” is the factory default setting, and no changes or updates are required. Only select from “Other Available Hardwired Input/Output Calibration Options” if a hardwired vocational feature has been installed. If an option was mistakenly applied and not required, select “Reset I/O Calibration to Off”, select Apply and follow on-screen prompts.



Package 37: Reset I/O Calibration to Off

This package is used to reset or turn off an I/O Calibration Package configured in the TCM. Use this procedure when:

- TCM is currently configured with an I/O Calibration Package and a new I/O Calibration Package is desired. Failure to reset TCM may result in an inoperable vocational feature and/or TCM I/O fault codes to set Active.
- TCM is currently configured with an I/O Calibration Package and no I/O Calibration Package is desired. For example: when a truck is being sold and PTO components and wiring have been removed from transmission. Use this procedure to turn off an I/O Calibration Package currently configured in the TCM. This will ensure no TCM I/O fault codes are set Active.

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I/O Calibration Package Installation Process

1. Identify I/O Calibration Package based on the vocational feature(s) to be installed - Reference I/O Calibration Package Index below.
2. Install vocational feature components (PTO, Reverse Switch, etc.) and associated wiring - Reference I/O Calibration Package wiring diagram.

WARNING: Follow all OEM and/or vocational feature manufacturer installation instructions and recommended wiring diagram. Failure to follow instructions and wiring diagrams may result in major vehicle component damage, severe injury or death.

3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Service Reports”.
6. Select “Service Activity Report”.
7. Enter required information and select “Start Report”.
8. Select “Send to Eaton”.
9. Go To “Configuration”.
10. Select “Calibration” tab.
11. From the “Other Available IO Calibration Options” section, select I/O Calibration Package identified in Step 1.
12. Select “Apply” and follow on-screen prompts.
13. Verify vocational feature operation, per OEM and/or vocational feature manufacturer guidelines.
    - If feature operates as intended and no fault code is set Active, process complete.
    - If feature does not operate as intended and a fault code sets Active, troubleshoot per *Fault Code Isolation Procedure Index* on page 19.

I/O Calibration Package Index

I/O Package	I/O Calibration Package Description	Wiring Diagram Link
1	Neutral Output + PTO 1 + Reverse Output	page 15 of TRIG2630
2	Rock Free Mode + Secondary Shift Mode	page 16 of TRIG2630
3	2-Speed Aux Trans + Rock Free Mode	page 17 of TRIG2630
4	PTO 1	page 18 of TRIG2630
5	PTO 1 + PTO 2	page 19 of TRIG2630
6	PTO 1 + Secondary Shift Mode	page 20 of TRIG2630
7	PTO 1 + Rock Free Mode + Secondary Shift Mode	page 21 of TRIG2630
8	PTO 1 + Reverse Output + Rock Free Mode	page 22 of TRIG2630
9	Rock Free Mode	page 23 of TRIG2630
10	Reverse Output	page 24 of TRIG2630
11	PTO 1 + Reverse Output	page 25 of TRIG2630

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I/O Package	I/O Calibration Package Description	Wiring Diagram Link
12	2-Speed Aux Trans	page 26 of TRIG2630
13	2-Speed Aux Trans + Secondary Shift Mode	page 27 of TRIG2630
14	Force Neutral	page 28 of TRIG2630
15	Hold Neutral	page 28 of TRIG2630
16	2-Speed Axle	page 29 of TRIG2630
17	2-Speed Axle + Rock Free Mode	page 30 of TRIG2630
18	2-Speed Axle + PTO 1	page 31 of TRIG2630
19	2-Speed Axle + Secondary Shift Mode	page 32 of TRIG2630
20	Split Shaft PTO	page 33 of TRIG2630
21	PTO 1 + Split Shaft PTO	page 26 of TRIG2630
22	Force Neutral + PTO 1	page 35 of TRIG2630
23	PTO 1 + PTO 2 + Force Neutral	page 36 of TRIG2630
24	Force Neutral + Neutral Output + Reverse Output	page 37 of TRIG2630
25	Hold Neutral + PTO 1	page 35 of TRIG2630
26	Hold Neutral + PTO 1 + PTO 2	page 36 of TRIG2630
27	Hold Neutral + Neutral Output + Reverse Output	page 37 of TRIG2630
29	PTO 1 + Rock Free Mode	page 38 of TRIG2630
30	Reverse Output + Secondary Shift Mode	page 39 of TRIG2630
31	Reverse Output + Rock Free Mode	page 40 of TRIG2630
32	2-Speed Aux Trans + Reverse Output	page 41 of TRIG2630
33	2-Speed Axle + Reverse Output	page 42 of TRIG2630
34	PTO 1 + PTO 2 + Reverse Output	page 43 of TRIG2630
35	Neutral Output + Reverse Output	page 44 of TRIG2630
36	Neutral Output	page 45 of TRIG2630
37	Reset I/O Calibration to Off Note: This package is used to reset or turn off an I/O Calibration Package configured in the TCM.	N/A
38	3-Speed Aux Trans - Underdrive, Direct, Overdrive (UD, D, OD)	page 46 of TRIG2630
39	3-Speed Aux Trans (UD, D, OD) + Rock Free Mode	page 47 of TRIG2630
40	3-Speed Aux Trans (UD, D, OD) + Secondary Shift Mode	page 48 of TRIG2630

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I/O Package	I/O Calibration Package Description	Wiring Diagram Link
41	3-Speed Aux Trans (UD, D, OD) + Rock Free Mode + Secondary Shift Mode	page 49 of TRIG2630
42	3-Speed Aux Trans - Underdrive, Neutral, Direct, Overdrive (UD, N, D, OD)	page 50 of TRIG2630
43	3-Speed Aux Trans (UD, N, D, OD) + Rock Free Mode	page 51 of TRIG2630
44	4-Speed Aux Trans - Low, Underdrive, Direct, Overdrive (L, UD, D, OD)	page 52 of TRIG2630
45	4-Speed Aux Trans (L, UD, D, OD) + Rock Free Mode	page 53 of TRIG2630
46	4-Speed Aux Trans - Low, Underdrive, Neutral, Direct, Overdrive (L, N, UD, D, OD)	page 54 of TRIG2630
47	Railroad Mode	page 55 of TRIG2630
48	Railroad Mode + PTO 1	page 56 of TRIG2630
49	PTO 1 (J1939 Request/Consent and Hardwired Confirm) + Reverse Output	page 57 of TRIG2630
50	PTO 1 (Remote Engine Start/Stop)	page 58 of TRIG2630
51	PTO 1 + PTO 2 (Remote Engine Start/Stop)	page 59 of TRIG2630
52	Split-Shaft PTO + Force Neutral	page 60 of TRIG2630
53	Split-Shaft PTO + PTO 1 + Forced Neutral	page 61 of TRIG2630
54	Split-Shaft PTO + Neutral Output	page 62 of TRIG2630
55	Split-Shaft PTO + PTO 1 + Neutral Output	page 63 of TRIG2630

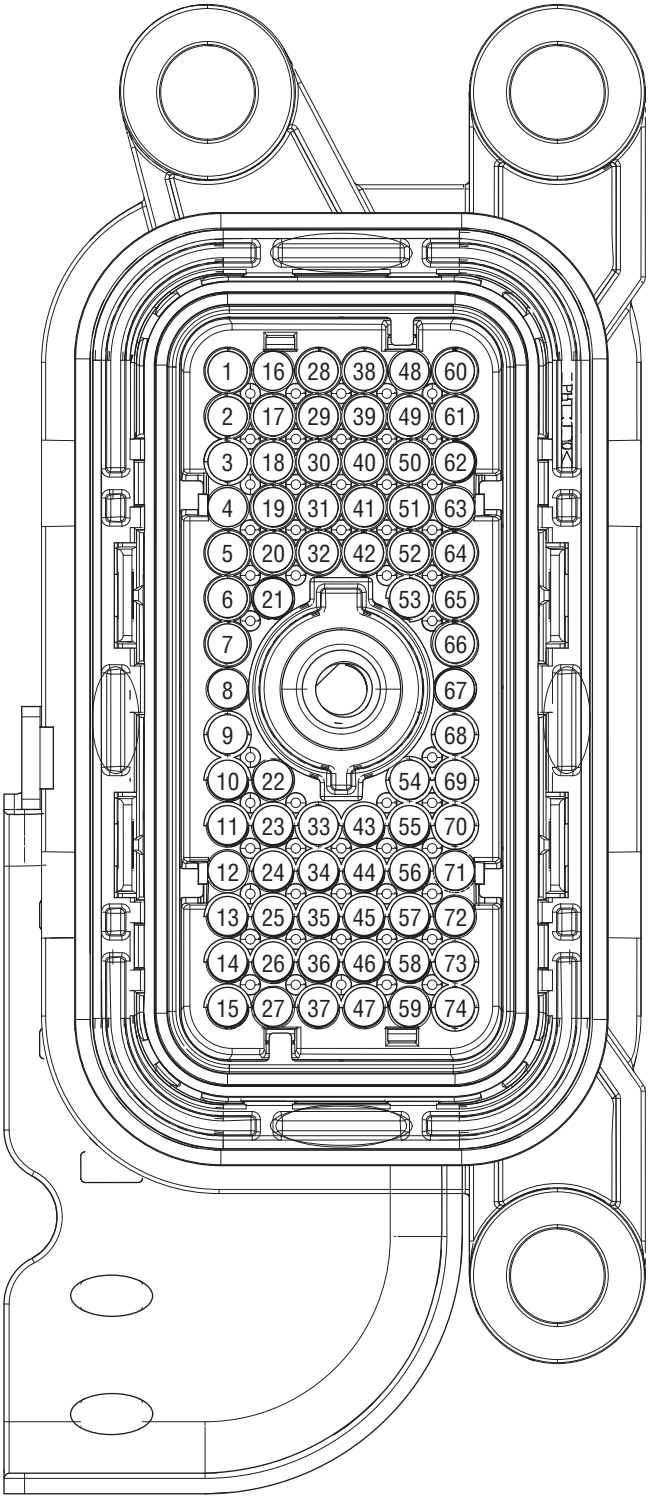
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Connector Pin Descriptions

Note: This section is intended as a quick reference.

74-Way Transmission Harness Connector

Pin	Description
1	Valve B3, Rail D Aft High
2	Valve B3, Rail D Aft Low
3	Valve A3, Rail A Fore Low
	Valve B2, Inertia Brake Low
4	Valve B2, Inertia Brake High
5	Valve A1, Rail B Aft High
6	Not Used
7	Air Pressure Sensor Supply (5V)
8	Air Pressure Sensor Signal
9	Air Pressure Sensor Ground
10	Not Used
11	Not Used
12	Not Used
13	Rail C Position Sensor Supply (5V)
14	Rail D Position Sensor Signal
15	Rail D Position Sensor Ground
16	Valve C1, Rail C Fore High
17	Valve C1, Rail C Fore Low
18	Valve C4, LCA Coarse Vent Low
	Valve C6, LCA Fine Fill Low
19	Valve C6, LCA Fine Fill High
20	Valve A1, Rail B Aft Low
21	Not Used
22	LCA Position Sensor Ground
23	LCA Position Sensor Signal
24	LCA Position Sensor Supply (5V)



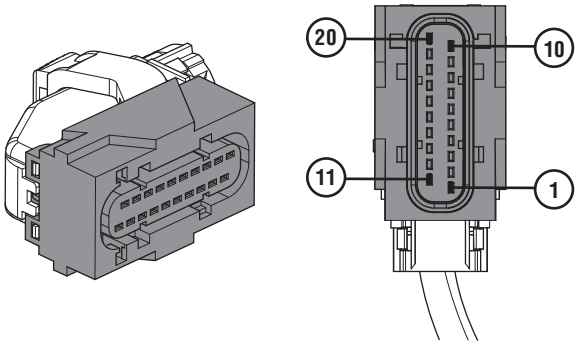
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Pin	Description
25	Rail D Position Sensor Supply (5V)
26	Rail C Position Sensor Signal
27	Rail C Position Sensor Ground
28	Valve B1, Rail C Aft High
29	Valve B1, Rail C Aft Low
30	Valve A4, Rail E Aft Low
31	Valve A4, Rail E Aft High
32	Countershaft Speed Sensor Signal
33	Oil Temperature Sensor Signal
34	Not Used
35	Rail B Position Sensor Supply (5V)
36	Rail B Position Sensor Signal
37	Rail B Position Sensor Ground
38	Valve A5, Rail B Fore High
39	Valve A5, Rail B Fore Low
40	Valve C5, LCA Coarse Fill Low
41	Valve C5, LCA Coarse Fill High
42	Countershaft Speed Sensor Ground
43	Oil Temperature Sensor Ground
44	Not Used
45	Not Used
46	Not Used
47	Not Used
48	Valve A2, Rail A Aft High
	Valve A3, Rail A Fore High
49	Valve A2, Rail A Aft Low
50	Valve C2, Rail D Fore Low
51	Valve C2, Rail D Fore High
52	Output Shaft Speed Sensor Ground
53	Not Used
54	Input Shaft Speed Sensor Ground

Pin	Description
55	Input Shaft Speed Sensor Signal
56	Not Used
57	Rail A Position Sensor Supply (5V)
58	Rail A Position Sensor Signal
59	Rail A Position Sensor Ground
60	Valve C3, LCA Fine Vent High
61	Valve C3, LCA Fine Vent Low
62	Valve A6, Rail E Fore Low
63	Valve A6, Rail E Fore High
64	Output Shaft Speed Sensor Signal
65	Not Used
66	Not Used
67	Valve C5, LCA Coarse Vent 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

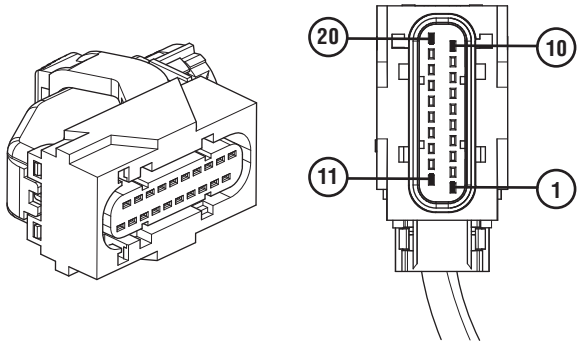
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20-Way TCM Vehicle Harness Connector



Pin	Description
1	Plugged (not used)
2	Plugged (not used)
3	Plugged (not used)
4	Start Enable - Negative
5	Battery Negative 1 (-)
6	Battery Positive 1 (+)
7	Fluid Pressure Sensor - Signal
8	Protected Power Return
9	Driver Interface Device (Mode Request from DID)
10	Ignition Wakeup (Input)
11	J1939A High (Input)
12	J1939A Low (Input)
13	J1939A Shield (Input)
14	Start Enable - Positive
15	Battery Negative 2 (-)
16	Battery Positive 2 (+)
17	Protected Power (Output)
18	Fluid Pressure Sensor - Ground
19	Fluid Pressure Sensor - Power
20	Plugged (not used)

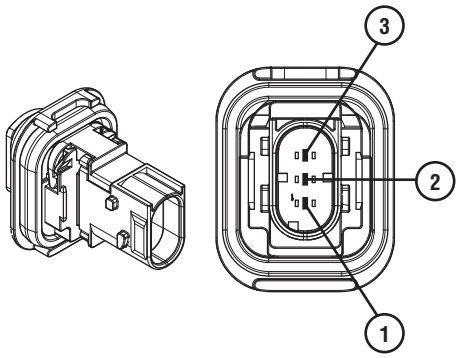
20-Way TCM Body Harness Connector



Pin	Description
1	Configurable Output 1
2	Configurable Output 2
3	Configurable Output 3
4	Configurable Input 2
5	Body I/O Return 1
6	Configurable Input 1
7	J1939B High
8	J1939B Low
9	Plugged (not used)
10	Plugged (not used)
11	Plugged (not used)
12	Plugged (not used)
13	Plugged (not used)
14	Body I/O Return 2
15	Configurable Input 3
16	Configurable Input 4
17	Plugged (not used)
18	Plugged (not used)
19	Plugged (not used)
20	Plugged (not used)

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3-Way Output Speed Sensor Connector

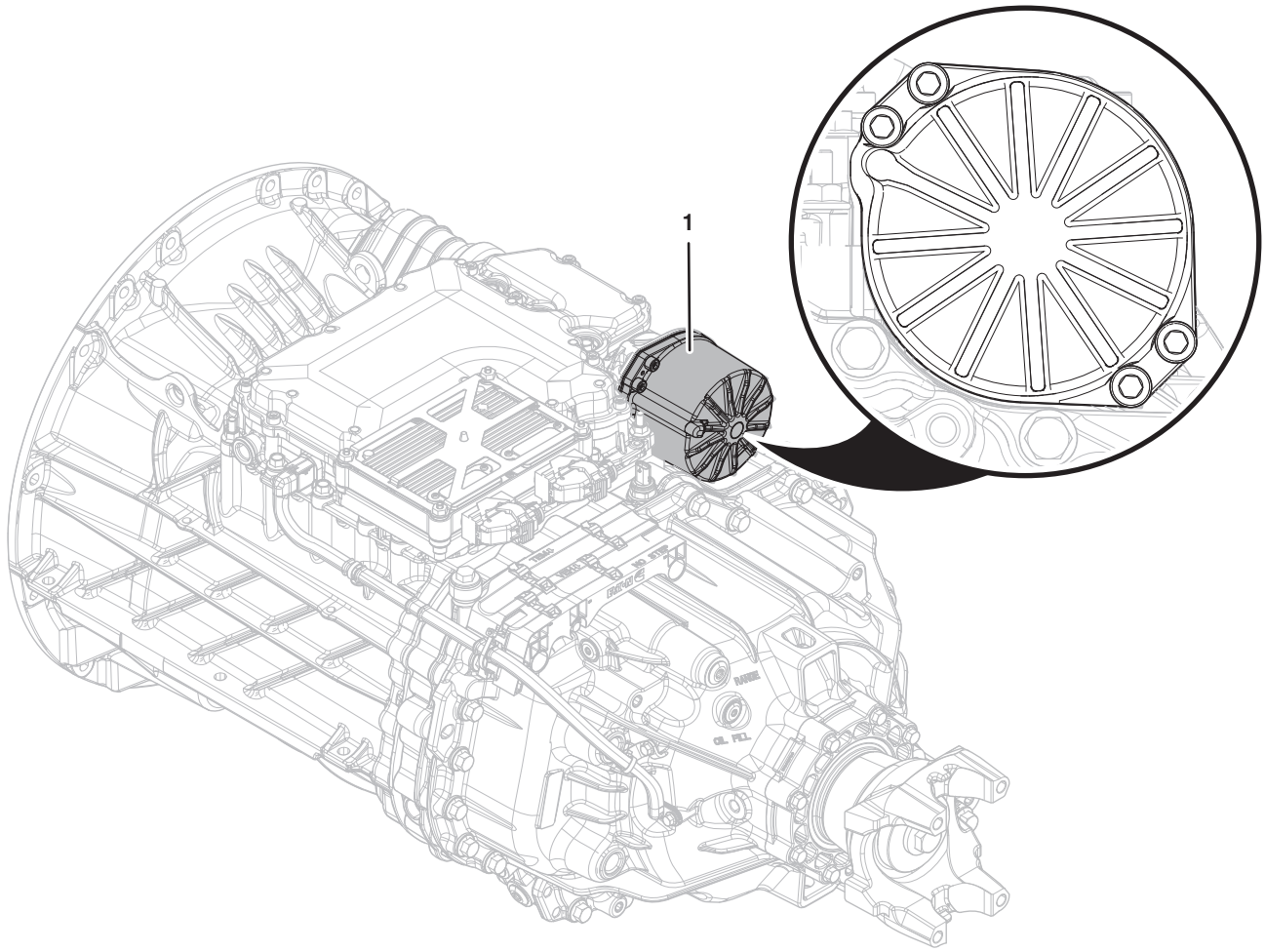


Pin	Description	74-Way Transmission Harness Connector Pin
1	Not Used	Plug
2	Output Speed Sensor Signal	52
3	Output Speed Sensor Supply (5V)	64

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Manually Vent Linear Clutch Actuator (LCA) Procedure

Component Identification



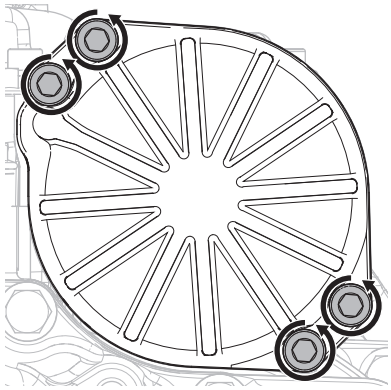
1. Linear Clutch Actuator (LCA)

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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.



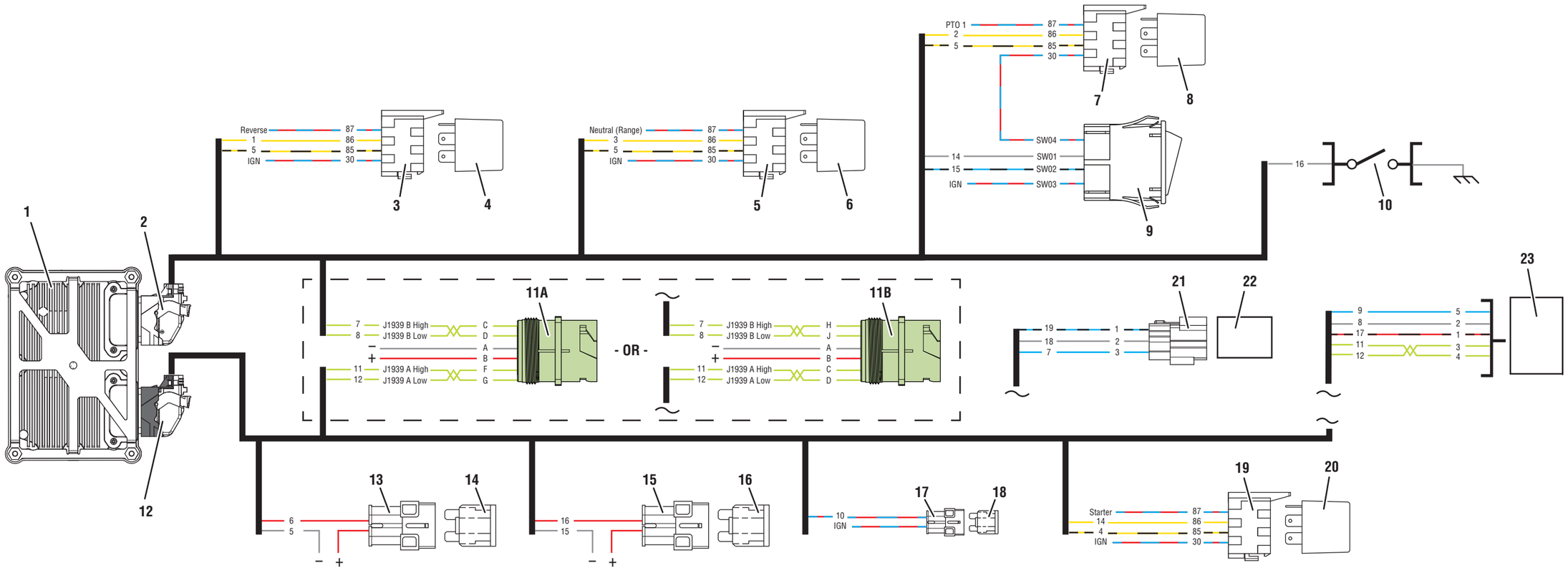
3. Torque the 4 LCA cap screws to 23-27 Nm.

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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

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Change Log

Date	Description (File Name, Fault Code, FMI)
June 2025	**Updated:** Config I/O Index, FC 215, FC 596, FC 597, FC 616, FC 617, FC 636, FC 637, FC 740
March 2025	**Updated:** FC 145 FMI 5
January 2025	**Added:** FC 128 **Updated:** FC 775 FMI 16, 18 **Removed:** TAIB-0876 (Bulletin relocated to Endurant Information Bulletin Book TRIB-0900)
December 2024	**Updated:** Switched references from “Navistar” to “International Motors”, Manually Actuate Rail B Procedure **Removed:** I/O Calibration Packages, Relocated to TRIG2630
September 2024	**Updated:** FC 145
July 2024	**Added:** ServiceRanger 4 Connection Settings Document
March 2024	**Updated:** MTM Solenoid Resistance Ranges, FC 775, FC 740
January 2024	**Updated:** FC 350, FC 370, FC 375
December 2023	**Updated:** FC 135, FC 145, FC 900, FC 902, FC 915, FC 920, FC 922, FC 925, FC 962, FC 963, FC 977, FC 980, FC 981, FC 982, FC 983, FC 984, FC 985, FC 986, FC 987, FC 988, FC 215 **Removed:** Product Functions - Redirected to TRDR0960
November 2023	**Updated:** FC 780
October 2023	**Updated:** FC 597
August 2023	**Added:** FC 117, FC 122 FMI 10, FC 122 FMI 31, FC 123 FMI 2, FC 123 FMI 10, FC 123 FMI 11, FC 123 FMI 31, FC 143, FC 144, FC 194, FC 195, FC 201, FC 202, FC 912 FMI 7, FC 122 FMI 7, FC 965 **Updated:** Transmission Shift Complaint Procedure
June 2023	**Added:** Configurable I/O Package 20, Configurable I/O Package 21, FC 912 FMI 6, FC 912 FMI 12, FC 915 FMI 6, FC 915 FMI 12, FC 920 FMI 4, FC 920 FMI 12, FC 922 FMI 4, FC 922 FMI 12, FC 922 FMI 20, FC 925 FMI 4, FC 925 FMI 12, FC 925 FMI 20, FC 962 FMI 5, FC 963 FMI 12, FC 963 FMI 20, FC 977 FMI 3, FC 977 FMI 4, FC 977 FMI 5, FC 977 FMI 6, FC 977 FMI 11, FC 977 FMI 12, FC 977 FMI 31, FC 980 FMI 4, FC 980 FMI 12, FC 983 FMI 4, FC 983 FMI 12, FC 981 FMI 4, FC 981 FMI 12, FC 986 FMI 4, FC 986 FMI 12, FC 982 FMI 4, FC 982 FMI 12, FC 987 FMI 3, FC 987 FMI 4, FC 987 FMI 5, FC 987 FMI 6, FC 987 FMI 11, FC 987 FMI 12, FC 987 FMI 31 **Updated:** FC 977, FC 987, I/O Calibration Package Index **Removed:** FC 900 FMI 3, FC 902 FMI 3, FC 905 FMI 3, FC 920 FMI 3
May 2023	**Added:** FC 215 FMI 10, FC 350 FMI 10, FC 370 FMI 10, FC 375 FMI 10, FC 375 FMI 11, Config IO Pack 47, Config IO Pack 48, FC 970 FMI 14, FC 970 FMI 31, FC 975 FMI 14, FC 975 FMI 31, Updated: Transmission Shift Complaint Procedure, I/O Calibration Package Index **Removed:** FC 370 FMI 11, FC 370 FMI 31
February 2023	**Added:** FC 990, FC 991 **Updated:** I/O Calibration Package Index **Removed:** FC 370 FMI 18

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Date	Description (File Name, Fault Code, FMI)
November 2022	**Added:** FC 127, FC 136, FC 137, FC 984, Configurable I/O Package 38, Configurable I/O Package 39, Configurable I/O Package 40, Configurable I/O Package 41, Configurable I/O Package 42, Configurable I/O Package 43, Configurable I/O Package 44, Configurable I/O Package 45, Configurable I/O Package 46 **Updated:** FC 122, FC 125, FC 126, FC 150, FC 157, FC 170, FC 250, FC 255, FC 320, FC 350, FC 370, FC 375, FC 514, FC 706, FC 900, FC 910, FC 970, FC 975, FC 980, Fault Code Isolation Procedure Index **Removed:** FC 149, FC 390
September 2022	**Updated:** Required Tools, 100 Series Fault Codes
August 2022	**Updated**: Config IO Index and Packages 3, 12, & 13
June 2022	Created Troubleshooting Guide

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