Troubleshooting Guide

Procision™ Dual Clutch Automatic Transmission

TRTS0990 EN-US

March 2019

EDCO-6F107A
EDCO-6F107A-M
EDCO-6F107A-B
EDCO-6F107A-P

AUTOMATED TRANSMISSION™ TECHNOLOGIES

BACKED BY Roadranger SUPPORT

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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:

- Ensure vehicle has adequate fuel level.
- Sit in the driver's seat.
- Confirm vehicle parking brake is set.
- Confirm Park is selected if equipped with **Shift Lever**.

1. Confirm Neutral is selected if equipped with **Push Button.**

- Do not operate the vehicle if Alternator light is lit or if gauges indicate low voltage.

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

2. Safely come to a complete stop.
3. Continue to depress and hold service brake and:
    - Select Park if equipped with **Shift Lever** and slowly release service brake to engage park pawl.
    - Select Neutral if equipped with **Push Button.**
4. Apply vehicle parking brake.

When parking the vehicle or leaving the cab:

- Select Park if equipped with **Shift Lever**.
- Select Neutral if equipped with **Push Button**.
- Set the vehicle parking brake.

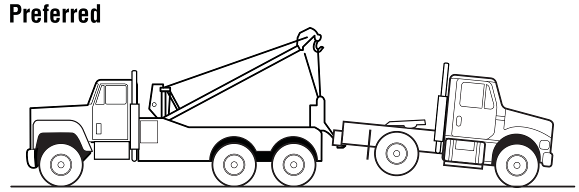
CAUTION: For vehicles equipped with an air brake system, do not release the parking brake or attempt to select a gear until the vehicle air pressure is at the correct level.

To avoid damage to the transmission during towing:

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

NOTICE: Serious internal transmission damage can result from improper vehicle towing.

Preferred



Must remove vehicle axle shafts or driveline prior to towing

Required Tools

Diagnostic Tools

- Pin Out Adapter Jumper Kit (RR1009HY)
- Hydraulic Diagnostic Kit (RR2009HY)

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

Volt/Ohm Meter

- Digital Auto-Ranging Volt/Ohm Meter

PC-Based Service Tool

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

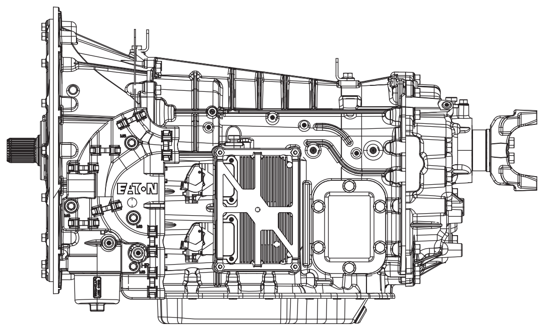
For support go to www.eaton.com/roadranger or contact Eaton at (800) 826-4357

Service Publications

Publication	Title
TRSM0990	Procision Transmission Service Manual
TRDR0990	Procision Transmission Driver Instructions
TCMT0072	ServiceRanger™ 4 User's Guide
TCMT0073	ServiceRanger™ 4 Quick Start Guide
TCMT0020	Eaton Approved Lubricant Suppliers
TCMT0021	Roadranger Lubricant Products Manual
TRIG0990	Installation Guide
TRIG2600	PTO Installation Guide
TCWY0900	Eaton Warranty Guide

For additional information, go to www.eaton.com/roadranger or contact Eaton at (800) 826-HELP (4357)

Transmission Models



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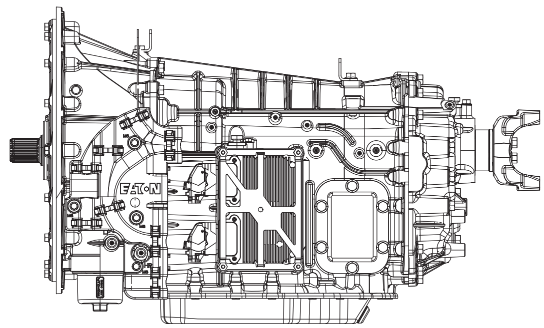

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Transmission Service Lamp and Display Descriptions

Overview

The Procision transmission utilizes a service lamp that is illuminated when certain system failures are detected. The service lamp may be part of the driver interface device or may be a separate lamp on the vehicle Dashboard.

The Procision transmission utilizes a display that indicates the current condition of the transmission. The display may be an integral part of the vehicle Dashboard or may be a separate Dashboard mounted display.

The service lamp and display are controlled by the Transmission Control Module (TCM) via Hard Wire, J1939 data link, or Proprietary Network Link (PNL) communications.

Transmission Service Lamp

The Transmission Service Lamp is usually an amber light that reads “Service”. However, on some chassis an amber transmission symbol or “Check Trans” lamp may be substituted for amber Service Lamp. It may be located on the Push Button Shift Control, Shift Lever, or on the vehicle Dashboard.

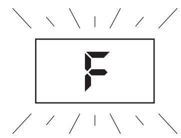
- Under normal conditions, the service lamp is on momentarily at key-on as part of the TCM self-test.
- A solid or flashing service lamp indicates a fault code is currently Active. However, not all fault codes will turn on the service lamp.

Display Descriptions

Solid “N” in Display

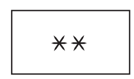
Indicates that the transmission is currently in Neutral.

Flashing “F” in Display



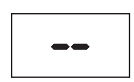
Indicates the TCM has detected an Active fault condition and logged a Active fault code. This fault code can be accessed with the ServiceRanger diagnostic software. See *Diagnostic Procedure* on page 10.

Double Stars “* *” in Display



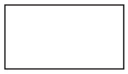
Indicates that the gear display is receiving no communication over the data link. The display may communicate over the J1939 data link depending upon the specific display type. If no problem is found, troubleshoot the display connection to the J1939 data link per OEM guidelines.

Double Dashes “- -” in Display



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

Blank Gear Display



Indicates that the gear display has lost power or has lost communication with the TCM over the data link. If no problem is found, troubleshoot the gear display power and ground supply per OEM guidelines.

"PD" in Display

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

"CA" in Display

Indicates that a clutch abuse event is occurring.

"ST" in Display

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

To collect a Driver Triggered Snapshot:

1. Operate vehicle and attempt to duplicate the shift complaint.

   Note: The purpose of this test is to duplicate the complaint and set a fault code or capture a Driver Triggered Snapshot of the event occurring.

2. If the shift complaint is duplicated, capture a Driver Triggered Snapshot of the event by performing the appropriate procedure below:
   - Shift Lever - Select "H" (Hold) mode then quickly select "L" (Low)-"H"-"L" (H-L-H-L)
   - Push Button - Select "Low" mode then quickly depress "^" (Upshift Button) twice (Low-^-^).

   Note: Capturing the driver triggered snapshot is time sensitive; for the best results, perform this sequence immediately after the symptoms occur.

3. The transmission will set a tone and the letters "ST" will appear in the display if the Snapshot is captured.
4. Return the transmission Driver Interface Device to the mode that was selected prior to initiating the Driver Triggered Snapshot.

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

1. Key off and allow the Transmission Control Module (TCM) to power down.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Retrieve Snapshot and VPA data by creating a Service Activity Report and Send to Eaton.
5. Contact Eaton at (800) 826-4357 for review.

Product Diagnostic (PD) Test

The PD Test is used to diagnose Inactive fault codes that may have set during normal operation. The PD Test is a "Wiggle Test" used to identify intermittent Open or Short circuit conditions in a connector, component, or wire in a circuit. The 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.

When troubleshooting an Inactive fault code, use the Fault Isolation Procedures to guide you to the wiring and connectors associated with that fault. Once the 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. The PD Test may also be used to troubleshoot intermittent electrical fault issues when there are no Active fault codes present.

Note: The vehicle will not start when the PD Test is Active. To stop the PD Test, key off and allow the Transmission Control Module (TCM) to perform a complete power down.

PD Test Inactive Fault Codes

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

Entering PD Test

Note: Vehicle must have no Active fault codes.

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

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

Note: Solid "PD" may appear in display when PD Test is active.

Troubleshooting Using PD Test

- Once the PD Test is activated, flex 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 perform a complete power down.
- Fault codes that occur during PD Test will not be stored in the TCM as Inactive fault codes. They will only be shown in ServiceRanger.

Identifying a Problem in PD Test

- Identify any areas of wear or damage to wiring harnesses or connectors.
- If a fault occurs while flexing a connector, exit PD Test. Disconnect the connector and inspect both sides for damage, corrosion and spread or loose pins.
- Refer to the *Fault Code Isolation Procedure Index* on page 13 for the troubleshooting procedures for a specific fault code.

Driver Questionnaire Overview

Overview

The Driver Questionnaire is used to document the Driver's account of the vehicle and transmission symptoms.

The questionnaire should be completed by the driver whenever possible. The information provided may be critical to the diagnosis and repair of the vehicle and/or transmission.

The Driver Questionnaire can be printed from this Troubleshooting Guide or is available as document RRCC0015 on roadranger.com.

Driver Questionnaire

Fleet: ____________ Fleet Unit # ____________ Date: ____________

Dealer: ____________ RO # ____________

Fax to 269-746-6965
Email to auto.rtw@eaton.com

1. Describe what happened (report any observations not captured below):				
2. If problem happens when first turning the key, on skip to question #8.				
3. Does engine RPM rev up and down a few times in an effort to make a shift?	Yes	No	Don't Know	NA
If Yes: a. What gears is the transmission trying to shift? Circle any that apply or describe. 1-2 4-5 5-6 6-7				
b. Does the transmission eventually make the shift?	Yes	No	Don't Know	NA
c. Does the transmission shift back into the gear it is trying to shift out of?	Yes	No	Don't Know	NA
If No: a. What gears does the transmission stick in? Circle one or more below. 1 2 3 4 5 6 7				
b. Are you able to go to Manual mode and make the transmission shift?	Yes	No	Don't Know	NA
4. Do you have to stop the truck when the problem happens?	Yes	No	Don't Know	NA
5. Does the transmission find neutral?	Yes	No	Don't Know	NA
6. Do you have to shut the truck off in gear?	Yes	No	Don't Know	NA
7. Does the transmission find neutral after turning the key back on?	Yes	No	Don't Know	NA
8. Does the engine start with the key?	Yes	No	Don't Know	NA
9. What is in the display when the problem happens? Circle one or more below. - 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	Check Engine	ABS	None
11. Does the problem happen when the transmission is cold, hot or both?	Cold	Hot	Both	NA
12. Does the problem happen when operating in wet weather, dry weather or both?	Wet	Dry	Both	NA
13. How many times a day, week or month does the problem happen? Number of times __________	Day	Week	Month	NA
14. How long has the truck had the problem?	First Time	Past 2 weeks	Past Month	Several Months
15. How long have you been driving this truck?	Days	Weeks	Months	Years
16. List any known problems the truck has had in the past: Circle one or more below or describe known problem. Engine Transmission Cooling system OEM electrical ABS (truck) ABS (trailer) Accident Flood damage Lightning strike				
17. How long has it been since any known problems listed above happened?	First Time	Past 2 weeks	Past Month	Several Months

Symptom-Driven Diagnostics Index

Diagnostic Procedure

A

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

1. Document the vehicle and/or transmission symptoms by completing the *Driver Questionnaire* on page 8.
2. Set parking brake and chock wheels.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Select "Service Activity Report" to retrieve Snapshot and Vehicle Performance Analysis (VPA) data.
6. Select "Send to Eaton".
7. Update Transmission Control Module (TCM) software to latest available level.

   Note: To avoid damaging the TCM, use an Eaton approved vehicle communication adapter and ensure all satellite systems are disabled before updating software.
8. Review the vehicle fault codes:
   - If a vehicle or engine fault code(s) is Active, contact OEM for further diagnostic instructions.
   - If a transmission fault code(s) is Active, go to **Step F.**
   - If a transmission fault code(s) is Inactive or not set, go to **Step B.**
   - If ServiceRanger does not connect to the Transmission Control Module (TCM), *Power-Up Sequence Test* on page 21.

B

Purpose: *Verify the engine cranks.*

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

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

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

1. Key on with engine running.
2. Depress and hold the service brake.
3. Select Drive (D) and Reverse (R) mode from Neutral (N).
   - If the transmission engages a gear, re-select Neutral mode. Go to **Step D.**
   - If the display indicates "F" during the mode selection and/or engagement of a gear, re-select Neutral mode. Retrieve fault code(s) with ServiceRanger, go to **Step F.**
   - If the transmission does not engage a gear and the display indicates "N", re-select Neutral mode and go to the *Brake Switch Functionality Test* on page 531.

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

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

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

1. Set 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" to retrieve Snapshot and Vehicle Performance Analysis (VPA) data.
6. Select "Send to Eaton".
7. Review the vehicle fault codes:
   - If a vehicle or engine fault code(s) set during the road test, contact OEM for further diagnostic instructions.
   - If a transmission fault code(s) set during the road test, go to **Step F.**
   - If a fault code did not set during the road test and the symptom was duplicated, go to the *Transmission Shift Complaint Test* on page 533.

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

1. Determine the fault code to troubleshoot first by using the priority index below (with 1 highest priority and 4 lowest priority).
   - Priority 1: Vehicle Interface Fault Codes 100-199
   - Priority 2: Component Fault Codes 200-499
   - Priority 3: System Fault Codes 500-899
   - Priority 4: Feature Fault Codes 900-999
2. Go to the *Fault Code Isolation Procedure Index* on page 13 and troubleshoot the fault code with the highest priority level.
   - If more than one fault code within a level applies, troubleshoot Active fault codes before Inactive fault codes.
   - If only Inactive fault codes are present, troubleshoot the fault code that has the highest occurrence count or most recent timestamp.
   - If no fault codes are found, match the vehicle symptom to the appropriate item in the *Symptom-Driven Diagnostics Index* on page 9.

Fault Code Isolation Procedure Index

Fault Code	SPN	FMI	Description	Page Number
100	168	0, 1, 17, 18	Battery Voltage1	page 27
105	444	0, 1, 17, 18	Battery Voltage2	page 34
110	158	2	Ignition Voltage	page 41
115	639	9, 14	J1939 Data Link	page 45
120	1321	3, 4, 5, 7, 12, 13	Start Enable Relay	page 54
130	625	9	Proprietary Network Link (PNL)	page 68
135	751	2, 4, 9, 11, 12, 19	Push Button Controller (PNL) - Primary	page 77
135	751	0, 1, 2, 3, 5, 6, 8, 11, 12, 13	Shift Lever (TRS1) - Primary	page 90
145	752	2, 3, 4, 5, 6, 8, 12, 13, 14	Push Button Controller (PWM) - Secondary	page 101
145	752	0, 1, 3, 5, 6, 8, 12, 13, 14	Shift Lever (TRS2) - Secondary	page 111
155	70	9, 13, 19	Park Brake Switch Message (OEM Supplied)	page 122
160	597	9, 13, 19, 20	Service Brake Switch Message (OEM Supplied)	page 124
165	91	9, 13, 19	Accelerator Pedal Position Message (OEM Supplied)	page 126
166	972	9, 13, 19	Accelerator Interlock Switch Message (OEM Supplied)	page 128
170	904	9, 13, 19	Front Axle Speed Message (OEM Supplied)	page 130
175	518	12, 14	Engine Requested Torque	page 132
176	593	31	Engine Idle Shutdown	page 134
180	188	1, 2, 9	Engine Configuration Message (OEM Supplied)	page 136
185	512	9, 13, 19	Driver Demanded Torque Message (OEM Supplied)	page 138
195	1110	31	Engine Protection Mode	page 140
199	1571	12	Direction Mismatch	page 142
200	629	11, 13, 14, 31	TCM Operation 1	page 144
205	609	9, 19	TCM Operation 2	page 147
210	127	0, 1, 2, 3, 5, 6, 7, 13, 15, 17, 18, 20, 21, 31	Line Pressure	page 150
225	123	0, 1, 2, 3, 5, 6, 7, 10, 15, 17, 20, 21	Primary Clutch Pressure	page 165
240	5937	0, 1, 2, 3, 5, 6, 7, 10, 15, 17, 20, 21	Secondary Clutch Pressure	page 176
255	4218	0, 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 15, 16, 17, 18, 20, 21, 31	Rail A Primary Position	page 187
275	4219	0, 1, 2, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 20, 21, 31	Rail B Position	page 208

Fault Code	SPN	FMI	Description	Page Number
295	4220	0, 1, 2, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 20, 21, 31	Rail C Position	page 226
315	5941	0, 2, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 20	Rail D Position	page 243
330	5942	0, 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 15, 16, 17, 18, 20, 21, 31	Rail A Secondary Position	page 257
345	5052	2, 4, 5, 6, 8, 14, 20, 21	Engine Speed	page 273
355	5960	2, 4, 5, 6, 8, 14, 20, 21, 31	Primary Input Speed	page 281
365	5961	2, 4, 5, 6, 8, 14, 20, 21, 31	Secondary Input Speed	page 285
375	191	2, 4, 5, 6, 8, 14, 20, 21, 31	Output Speed	page 291
385	583	2, 10, 11, 12, 13, 14, 19, 20, 21, 31	Grade	page 295
400	177	0, 2, 4, 5, 6, 10, 11, 14, 15, 16, 20, 21, 31	Sump Oil Temperature	page 297
420	5938	0, 2, 4, 5, 6, 10, 11, 14, 15, 16, 20, 21, 31	Cooler Oil Temperature	page 307
500	5946	3, 4, 5, 12, 16, 18, 19	Line Pressure Solenoid (LPS)	page 317
510	5944	0, 3, 4, 5, 14, 16, 18, 19, 31	Pressure Control Primary Solenoid (Clutch)	page 326
520	5945	0, 3, 4, 5, 12, 14, 16, 18, 19, 31	Pressure Control Secondary Solenoid (Clutch)	page 334
535	5949	0, 1, 3, 4, 5, 19	Clutch Cooling Primary Solenoid	page 342
545	5950	0, 1, 3, 4, 5, 19	Clutch Cooling Secondary Solenoid	page 350
555	5947	0, 1, 3, 4, 5, 19	Shift Pressure Solenoid 1	page 358
565	5948	0, 1, 3, 4, 5, 19	Shift Pressure Solenoid 2	page 366
575	5951	0, 1, 3, 4, 5, 7, 12, 14, 15, 16, 17, 18, 19, 20, 21, 31	Rail A Valve Solenoid	page 374
595	595	0, 1, 3, 4, 5, 7, 12, 14, 15, 16, 17, 18, 19, 20, 21, 31	Rail B Valve Solenoid	page 387
615	5953	0, 1, 3, 4, 5, 7, 12, 14, 15, 16, 17, 18, 19, 20, 21, 31	Rail C Valve Solenoid	page 400
635	5954	0, 1, 3, 4, 5, 7, 12, 15, 16, 17, 19, 20, 21	Rail D Valve Solenoid	page 412
700	6150	0, 1, 10, 11, 12, 13, 15, 17, 31	Primary Clutch Operation	page 423
710	6151	0, 1, 10, 11, 12, 14, 15, 17, 31	Secondary Clutch Operation	page 427
720	6144	0, 1, 2, 7, 10, 11, 13, 14, 15, 16, 17, 18, 20, 21, 31	Rail A Primary Operation	page 431
740	6145	0, 1, 2, 7, 10, 11, 14, 15, 16, 17, 18, 20, 21, 31	Rail B Operation	page 437
760	6146	0, 1, 2, 7, 10, 11, 14, 15, 16, 17, 18, 20, 21, 31	Rail C Operation	page 443
775	6147	1, 2, 10, 11, 14, 15, 18, 20, 21, 31	Rail D Operation	page 449
790	6148	2, 10, 20, 21	Rail A Secondary Operation	page 455
800	5955	7, 20, 21	Rail A Secondary Calibration	page 460
805	5616	0, 12, 16	Clutch Disable Valve	page 465
810	560	0, 1, 16	Gear Engagement	page 468
815	5939	0, 15, 16	Primary Clutch Temperature	page 470
820	5940	0, 15, 16	Secondary Clutch Temperature	page 472
900	3452	3, 4, 9, 13, 19, 20, 21	PTO 1 Request	page 474

Fault Code	SPN	FMI	Description	Page Number
905	3452	3, 4, 9, 13, 19, 20, 21	PTO 2 Request	page 477
910	3456	3, 4, 5, 7	PTO 1 Engage	page 480
915	3456	3, 4, 5, 7, 13	PTO 2 Engage	page 483
920	3460	3, 4, 7, 9, 13, 19, 20, 21	PTO 1 Confirm	page 486
925	3460	3, 4, 7, 9, 13, 19, 20, 21	PTO 2 Confirm	page 489
950	3648	3, 4, 12, 13, 14, 20, 21, 31	Neutral Input 1	page 492
960	6159	3, 4, 12, 14, 20, 21, 31	Neutral Input 2	page 496
970	604	3, 4, 5	Range Output	page 500
975	767	3, 4, 5	Reverse Output	page 503
980	6160	3, 4, 5, 13, 20, 21	Alternate Shift Schedule	page 506

Wiring Inspection and Troubleshooting Procedure

Overview

This is a set of recommendations for how to troubleshoot potential wiring issues in the vehicle. These issues may be resident in the Transmission Harness, Vehicle Harness, Power Supply Harnesses or other ancillary wiring, depending upon the fault code or condition that is taking place. When troubleshooting wiring, consider that wiring failures can be either intermittent, constant or there may be no wiring failure 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 6.

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

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

Use PD Mode for Intermittent Issues

- If there are no Active fault codes, refer to *Product Diagnostic (PD) Test* on page 6 to diagnose intermittent wiring or connection issues.

Visual Inspection

1. Make sure all connectors are clean and tight.
2. Inspect the length of the wiring between connections and look for signs of pinched or chafed wiring.
3. Inspect connectors for debris and contamination. If needed, clean connector and contacts only with an Eaton approved contact and connector fluid.
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.

NOTICE: When reconnecting, Eaton recommends the use of NyoGel 760G on electrical contacts. Make sure all connectors are clean and tight.

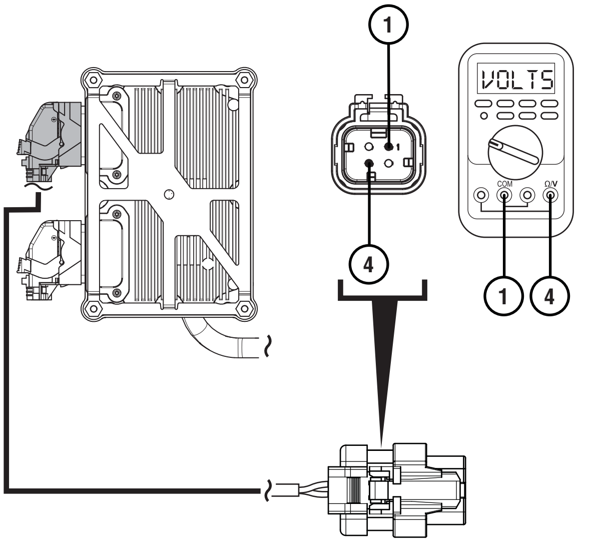
Recommendations for Using a Volt/Ohm Meter

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.

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.

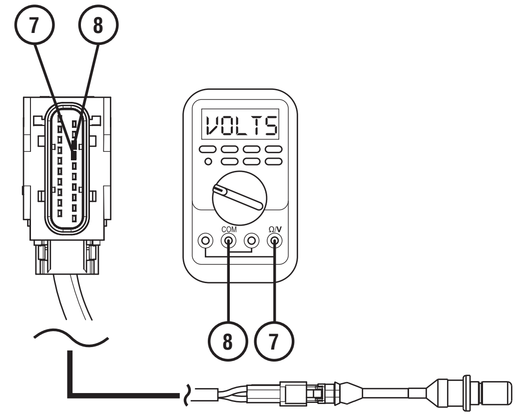


Pins	Range	Reading(s)
1 to 4	4.75–5.25 V	***5 V***

Example Circuit Continuity Readings

Circuit has Continuity

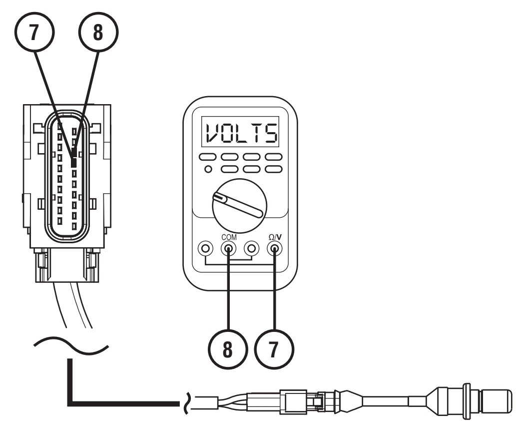
The circuit is complete when the resistance reading is within range. A circuit reading infinite resistance or Open Lead (OL) does not have continuity.



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

Open Circuit

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

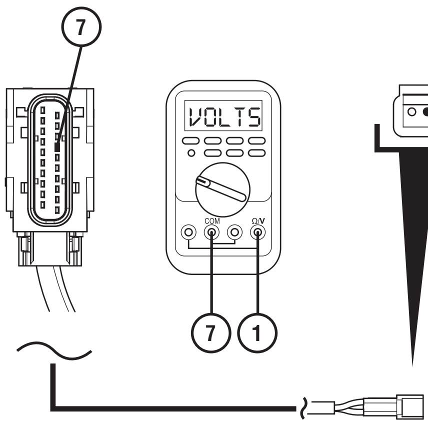


Pins	Range	Reading(s)
7 to 8	2.0k – 4.5k ohms	***OL***

Example End to End Resistance

End to End Resistance is Within Range

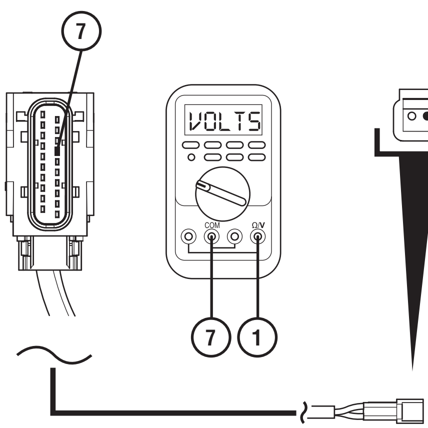
The wire has continuity when the resistance reading is within range. A wire reading infinite resistance or Open Lead (OL) does not have continuity.



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

End to End Resistance is Too High

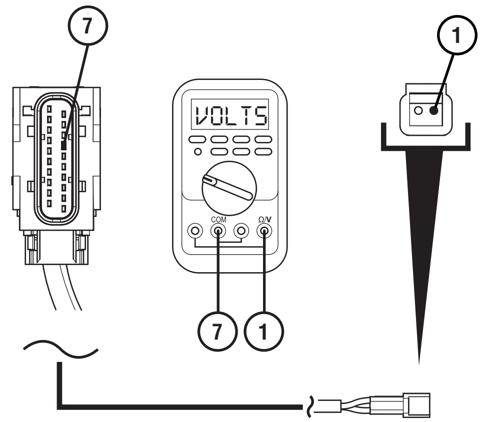
When the resistance is higher than the acceptable range there is additional resistance in this wire. Check for corrosion, loose or spread pins or damage to the harness.



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

Open Circuit

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

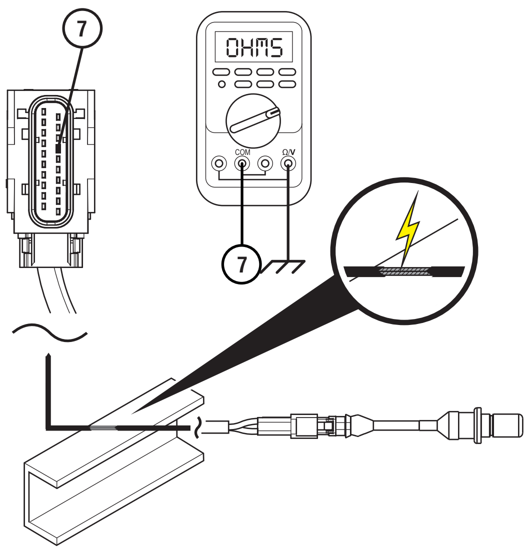


Pins	Range	Reading(s)
7 to 1	0.0 – 0.3 ohms	***OL***

Short Circuit to Chassis Ground

Short to Ground

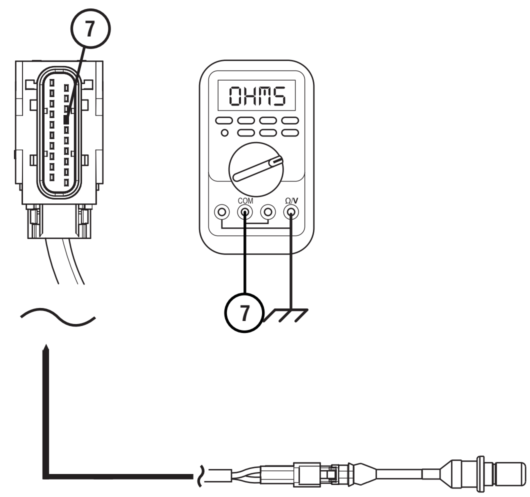
A wire is shorted to ground when the resistance between a non-ground wire and chassis ground shows continuity. Low resistance values (near 0 ohms) indicate a direct short to ground. Higher resistance values may indicate a partial-short.



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

No Short to Ground

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

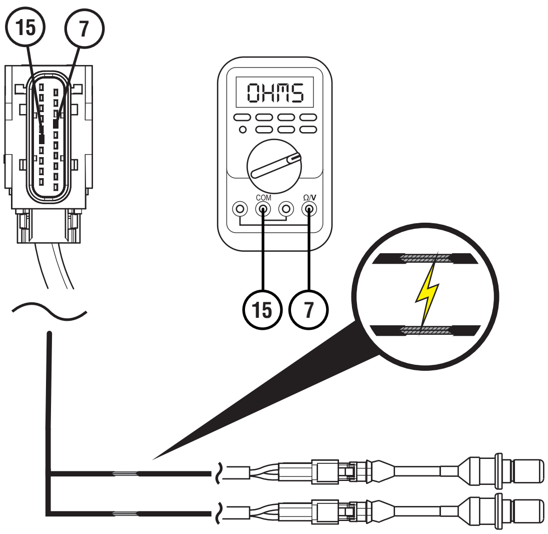


Pins	Range	Reading(s)
7 to Ground	Open Circuit (OL)	***OL***

Short to Another Circuit

Two Circuits Shorted Together

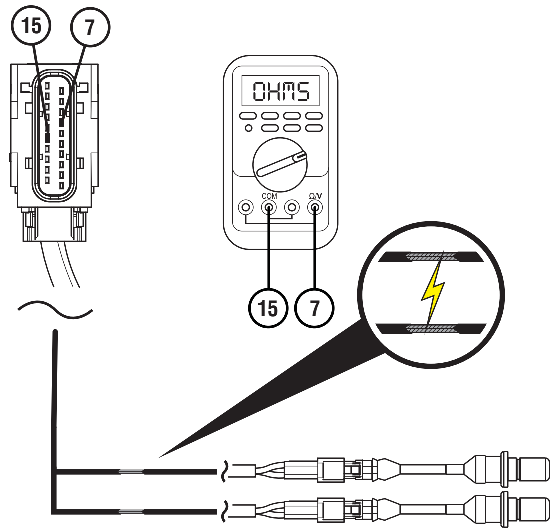
When wires from two unrelated circuits show continuity (low resistance) to one another, these circuits are shorted together.



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

Two Circuits Not Shorted Together

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



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

Power-Up Sequence Test

Overview

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

Detection

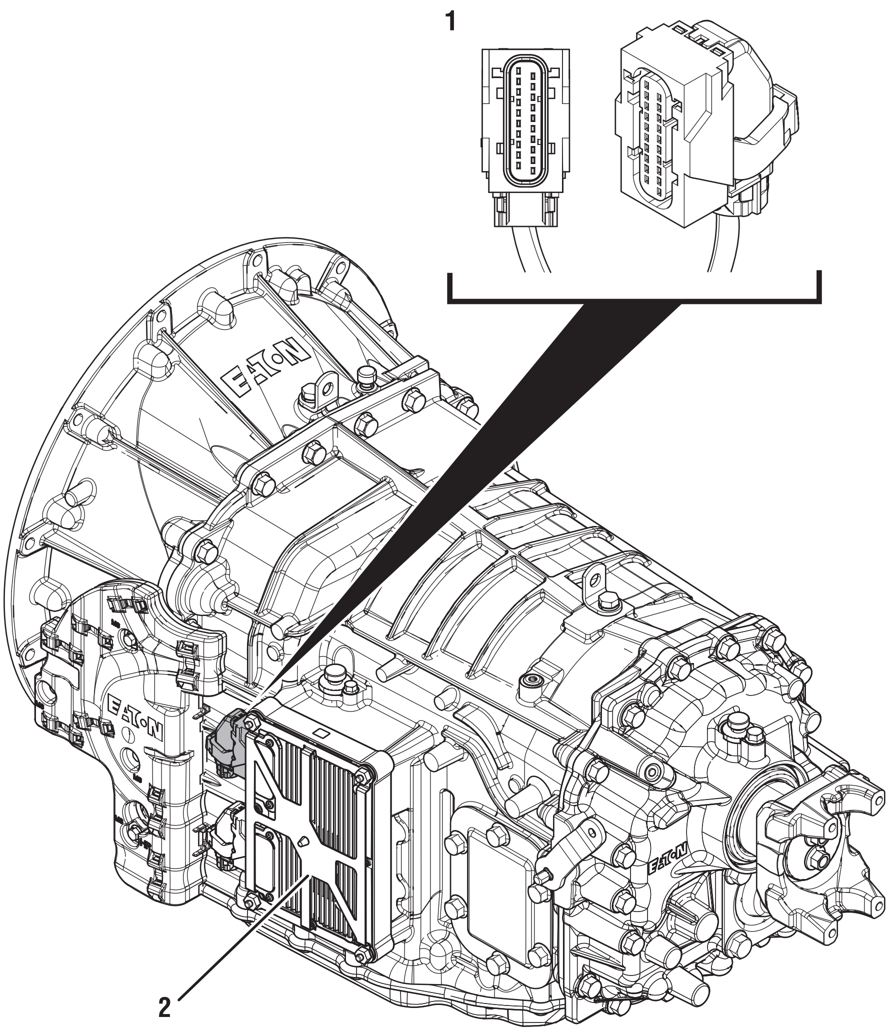
- Display may be blank.
- Display may show double dashes “- -”.
- Display may show double stars “* *”.
- Engine may not crank.
- ServiceRanger may not connect to Transmission Control Module (TCM).

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

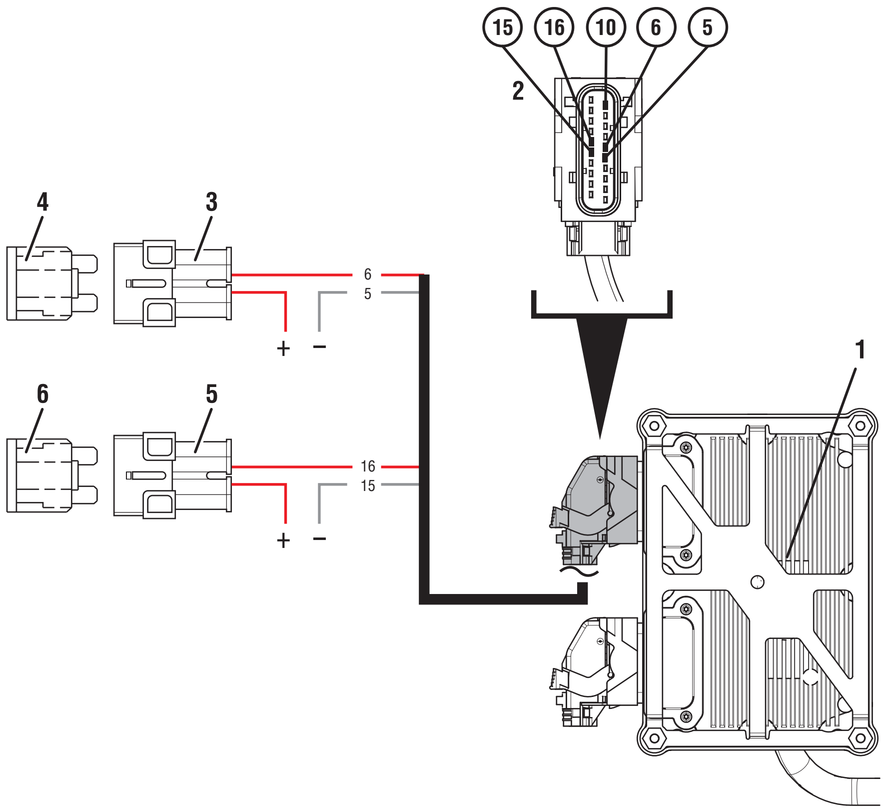
Possible Causes

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

Component Identification



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



1. Transmission Control Module (TCM)
2. 20-Way Vehicle Harness Connector
3. In-line Fuse Holder
4. 15-amp Fuse
5. In-line Fuse Holder
6. 15-amp Fuse

Power-Up Sequence Test

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

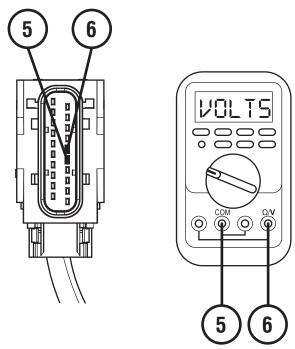
1. Set parking brake and chock wheels.
2. Key off.
3. Inspect the vehicle charging/battery system and connections, verify the connectors are free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector bodies.
4. Inspect the transmission 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 and from 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.
3. Inspect the 20-Way TCM Vehicle Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
4. Inspect the TCM side of the 20-Way TCM Vehicle Harness Connector, verify the connector is free from contamination and corrosion; the terminals are not bent, spread or loose; and there is no damage to the connector body.
5. Measure voltage between 20-Way TCM Vehicle Harness Connector Pin 6 (Battery positive) and Pin 5 (Battery negative). Record reading in table.



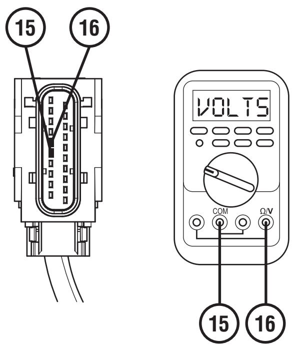
6. Compare reading(s) in table.
   - If readings are in range, go to **Step C.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of battery power and ground supply to TCM.

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(s) in table.



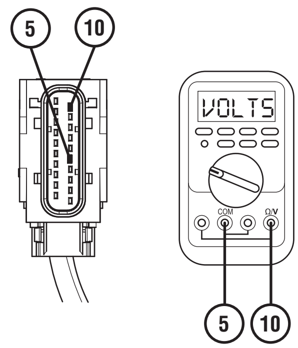
3. Compare reading(s) in table.
   - If readings are in range, go to **Step D.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of battery power and ground supply to TCM.

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

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(s) in table.



3. Compare reading(s) in table.
   - If readings are in range, contact Eaton at (800) 826-4357 for further diagnostic instructions.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of ignition voltage supply to TCM.

Pins	Range	Reading(s)
5 to 10	11–15 V	

Fault Code 100: Battery Voltage1

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

Overview

The Procision transmission is equipped with a Transmission Control Module (TCM) and requires 12-volt power and ground supply. The TCM has redundant power and ground sources (Battery Voltage1 and 2). If one power and/or ground source is unavailable, a transmission service alert is indicated and transmission maintains normal operation. The Battery Voltage1 circuit is contained within the 20-Way TCM Vehicle Harness.

Detection

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

Conditions to Set Fault Code Active

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

FMI 1 – Data Valid But Below Normal (Most Severe): Battery Voltage1 less than 7 V.

FMI 17 – Data Valid But Below Normal (Least Severe): Battery Voltage1 less than 11 V with engine above 1200 RPM.

FMI 18 – Data Valid But Below Normal (Moderately Severe): Battery Voltage1 less than 9 V.

Fallback

FMI 0:

- Shift quality may degrade

FMI 1:

- Amber warning lamp on
- No degraded performance

Note: If fault codes 100 and 105 are Active:

- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

FMI 17:

- Amber warning lamp on
- No degraded performance

Note: If fault codes 100 and 105 are Active:

- Engine torque limited to reduce possibility of clutch slip

FMI 18:

- Amber warning lamp on
- No degraded performance

Note: If fault codes 100 and 105 are Active:

- Transmission stays in current gear
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0: Battery Voltage1 less than 16 V for 5 seconds.

FMI 1: Battery Voltage1 greater than 7.5 V for 5 seconds.

FMI 17: Battery Voltage1 greater than 11.5 V for 50 seconds.

FMI 18: Battery Voltage1 greater than 9.5 V for 50 seconds.

Possible Causes

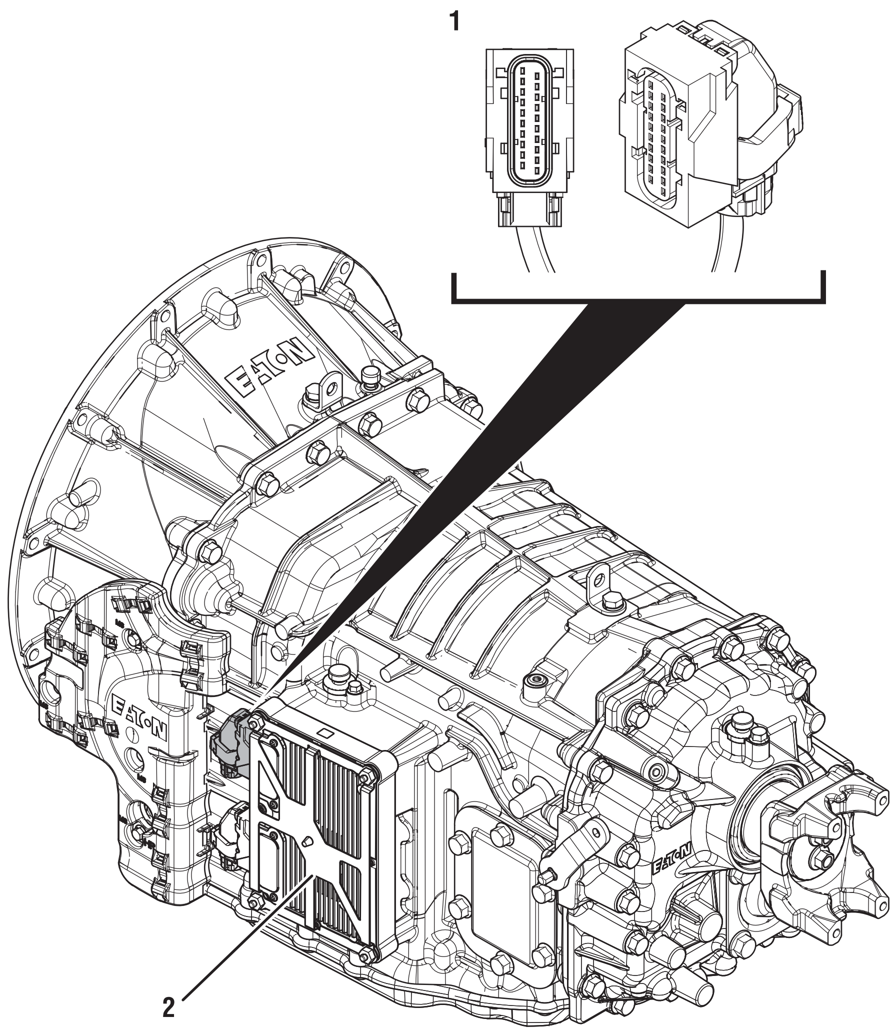
FMI 0:

- Vehicle jump-started
- Vehicle charging system failure

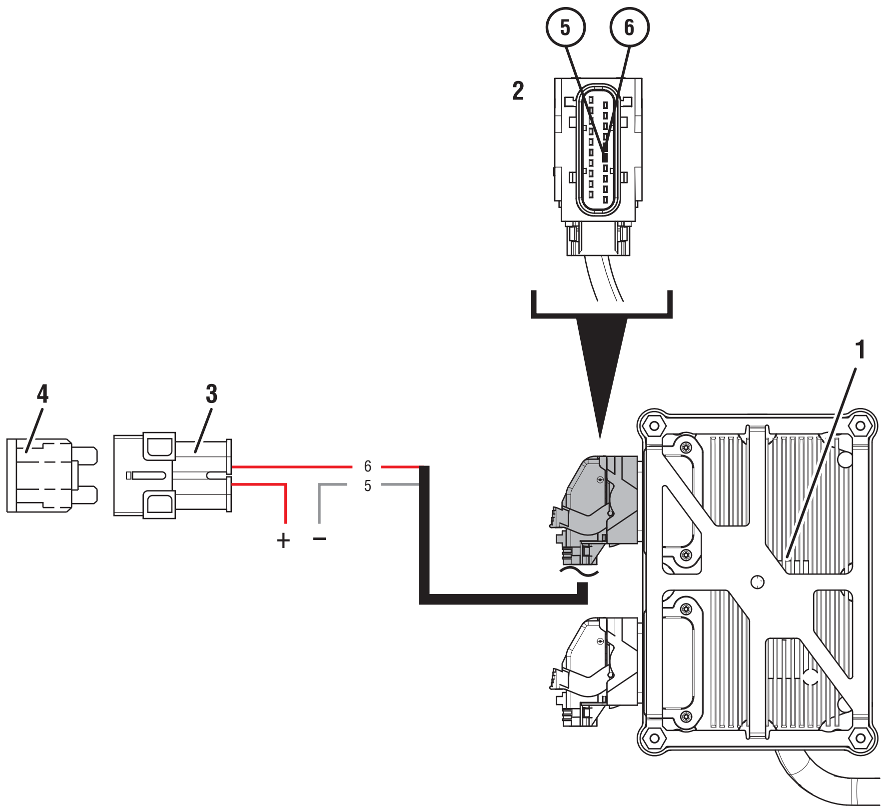
FMI 1, 17, 18:

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

Component Identification



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



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

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

Fault Code 100 Troubleshooting

A

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

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

   Note: If transmission Fault Codes 100 and 105 are Inactive and there are Active vehicle Battery & Charging System faults, troubleshoot all Active faults first.

   - If Fault Code 100 FMI 0 is Active, go to **Step F.**
   - If Fault Code 100 FMI 0 is Inactive. TCM experienced an over-voltage condition. Truck may have been jump started or charging system is failing.
   - If Fault Code 100 FMI 1, 17, or 18 is Active, go to **Step C.**
   - If Fault Code 100 FMI 1, 17, or 18 is Inactive, go to **Step B.**

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger
3. Select Service Routine and PD Mode.

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

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections between 20-Way TCM Vehicle Harness Connector and OEM 12-volt battery supply. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

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

1. Set parking brake and chock wheels
2. Key on.
3. Connect ServiceRanger.
4. Select Data Monitor.
5. Monitor Battery Voltage. Record voltage reading.
6. Compare reading(s) in table.
   - If Battery Voltage reading is out of range, go to **Step D.**
   - If Battery Voltage reading is in range, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 12-volt battery supply and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of the charging system or 20-Way TCM Vehicle Harness. Go to **Step V.**

Parameter	Range	Reading(s)
Battery Voltage	11–15 V	

D

Purpose: *Verify condition of batteries, fuse, power and ground supplies to the TCM.*

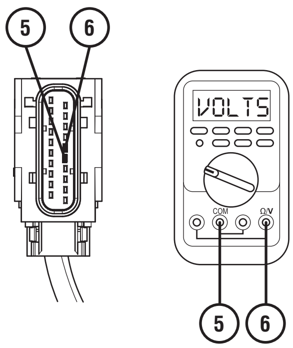
1. Key off.
2. Inspect charging system, batteries, fuses and connections for corrosion, loose terminals, bent or spread pins.
   - If no fault found, go to **Step E.**
   - If fault found, refer to OEM guidelines for repair or replacement of the charging system. Go to **Step V.**

   Note: Some chassis use a power distribution system separate from the batteries. Be sure to inspect all connections.

E

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

1. Key off.
2. Disconnect the 20-way TCM Vehicle Harness connector.
3. Inspect connector body for corrosion, damage, loose, spread or bent terminals.
4. Measure voltage between 20-way TCM Vehicle Harness Connector Pin 5 (-) and Pin 6 (+). Record reading in table.



5. Compare reading(s) in table.
   - If reading is outside of range, refer to OEM guidelines for repair or replacement of the 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If reading is within range, the intermittent nature of the fault makes it likely that the problem is between the 12-volt battery supply and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of OEM Vehicle Harness. Go to **Step V.**

Pins	Range	Reading(s)
5 to 6	11–15 V	

F

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

1. Set parking brake and chock wheels
2. Key on.
3. Connect ServiceRanger.
4. Select Data Monitor.
5. Monitor Battery Voltage. Record reading in table.
6. Key on with engine running.
7. Monitor Battery Voltage. Record reading in table.
8. Compare reading(s) in table.
   - If reading is out of range, refer to OEM guidelines for repair or replacement of vehicle charging system. Go to **Step V.**
   - If reading is in range, go to **Step G.**

Parameter	Conditions	Range	Reading(s)
Battery Voltage	Key On	11–15 V	
Battery Voltage	Key On with the engine running	11–15 V	

G

Purpose: *Verify condition of batteries, fuse, power and ground supplies to the TCM.*

1. Key off.
2. Inspect charging system, batteries, fuses and connections for corrosion, loose terminals, bent or spread pins.

   Note: Some chassis use a power distribution system separate from the batteries. Be sure to inspect all connections.

   - If fault found, refer to OEM guidelines for repair or replacement of the charging system. Go to **Step V.**
   - If no fault found, send Service Activity Report and contact Eaton at (800) 826-4357 for further diagnostic instructions.

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 100 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 100 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 105: Battery Voltage2

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

Overview

The Procision transmission is equipped with a Transmission Control Module (TCM) and requires 12-volt power and ground supply. The TCM has redundant power and ground sources (Battery Voltage1 and 2) and will function normal if either source becomes unavailable. The Battery Voltage2 circuit is contained within the 20-Way TCM Vehicle Harness.

Detection

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

Conditions to Set Fault Code Active

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

FMI 1 – Data Valid But Below Normal (Most Severe): Battery Voltage2 less than 7 V.

FMI 17 – Data Valid But Below Normal (Least Severe): Battery Voltage2 less than 11 V with engine above 1200 RPM.

FMI 18 – Data Valid But Below Normal (Moderately Severe): Battery Voltage2 less than 9 V.

Fallback

FMI 0:

- Shift quality may degrade

FMI 1:

- Amber warning lamp on
- No degraded performance

Note: If fault codes 105 and 100 are Active:

- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

FMI 17:

- Amber warning lamp on
- No degraded performance

Note: If fault codes 105 and 100 are Active:

- Engine torque limited to reduce possibility of clutch slip

FMI 18:

- Amber warning lamp on
- No degraded performance

Note: If fault codes 105 and 100 are Active:

- Transmission stays in current gear
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0: Battery Voltage2 less than 16 V for 5 seconds.

FMI 1: Battery Voltage2 greater than 7.5 V for 5 seconds.

FMI 17: Battery Voltage2 greater than 11.5 V for 50 seconds.

FMI 18: Battery Voltage2 greater than 9.5 V for 50 seconds.

Possible Causes

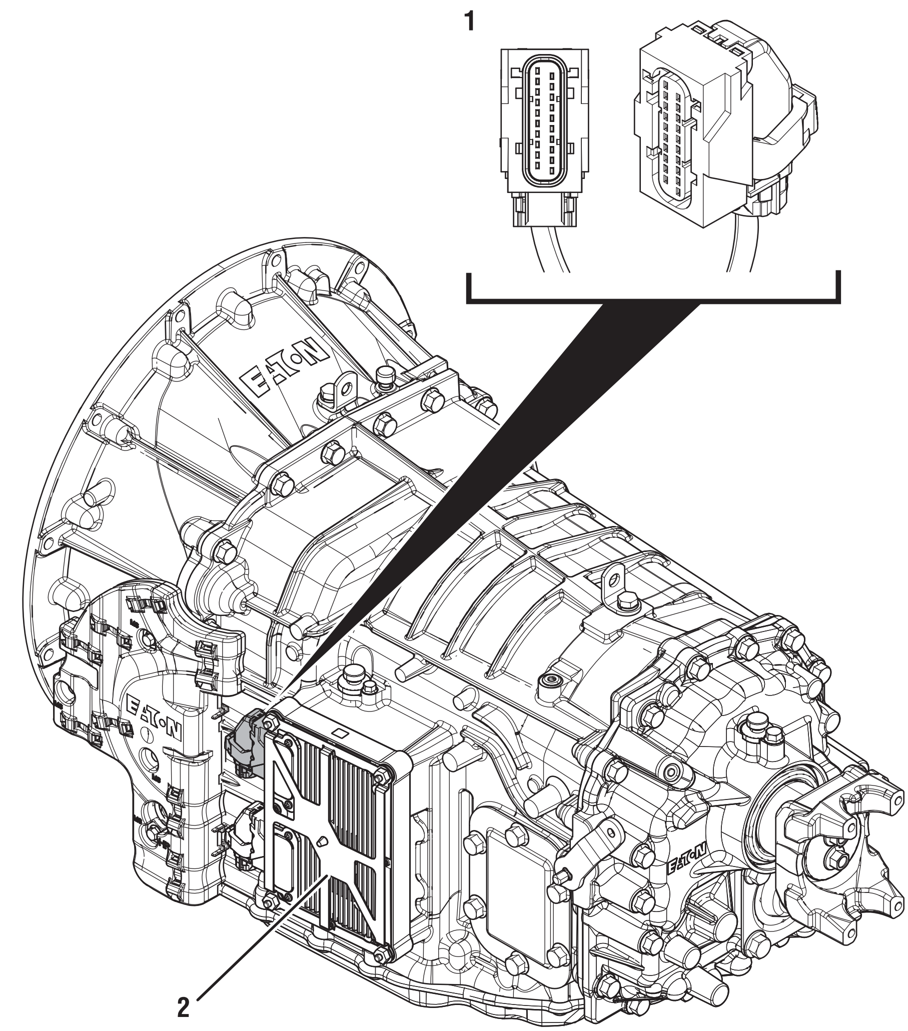
FMI 0:

- Vehicle jump-started
- Vehicle charging system failure

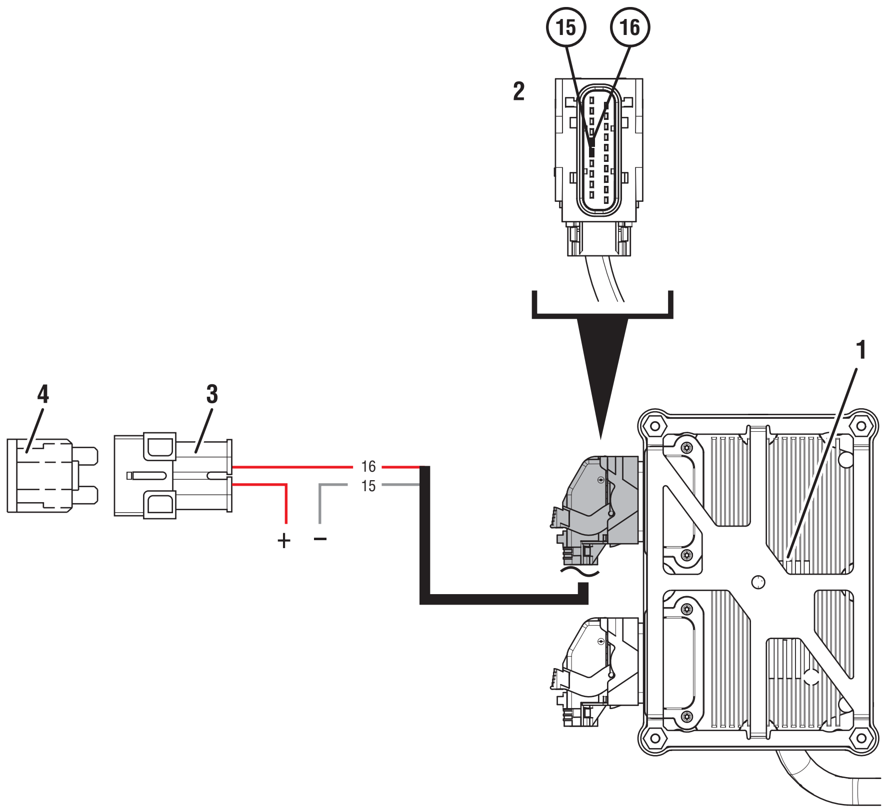
FMI 1, 17, 18:

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

Component Identification



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



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

Fault Code 105 Troubleshooting

A

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

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

   Note: If Fault Code 105 is Inactive and there are other Active faults including vehicle Charging System faults, troubleshoot all Active faults first.

   - If Fault Code 105 FMI 0 is Active, go to **Step F.**
   - If Fault Code 105 FMI 0 is Inactive. TCM experienced an over-voltage condition. Truck may have been jump started or charging system is failing.
   - If Fault Code 105 FMI 1, 17, or 18 is Active, go to **Step C.**
   - If Fault Code 105 FMI 1, 17, or 18 is Inactive, go to **Step B.**

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger
3. Select Service Routine and PD Mode.

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

   Note: Solid "PD" in display when PD Mode is active.

4. Wiggle wiring and connections between 20-Way TCM Vehicle Harness Connector and OEM 12-volt battery supply. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM for specific wire routing locations.
5. Exit PD Mode:
   - If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

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

1. Set parking brake and chock wheels
2. Key on.
3. Connect ServiceRanger.
4. Select Data Monitor.
5. Monitor Battery Voltage2. Record voltage reading.
6. Compare reading(s) in table.
   - If Battery Voltage2 reading is out of range, go to **Step D.**
   - If Battery Voltage2 reading is in range, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 12-volt battery supply and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of the charging system or 20-Way TCM Vehicle Harness. Go to **Step V.**

Parameter	Range	Reading(s)
Battery Voltage2	11–15 V	

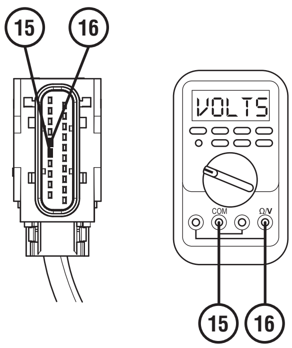
D ***Purpose:*** *Verify condition of batteries, fuse, power and ground supplies to the TCM.*

1. Key off.
2. Inspect charging system, batteries, fuses and connections for corrosion, loose terminals, bent or spread pins.
   - If no fault found, go to **Step E.**
   - If fault found, refer to OEM guidelines for repair or replacement of the charging system. Go to **Step V.**

   Note: Some chassis use a power distribution system separate from the batteries. Be sure to inspect all connections.

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

1. Key off.
2. Disconnect the 20-way TCM Vehicle Harness connector.
3. Inspect connector body for corrosion, damage, loose, spread or bent terminals.
4. Measure voltage between 20-way TCM Vehicle Harness Connector Pin 15 (-) and Pin 16 (+). Record reading in table.



5. Compare reading(s) in table.
   - If reading is outside of range, refer to OEM guidelines for repair or replacement of the 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If reading is within range, the intermittent nature of the fault makes it likely that the problem is between the 12-volt battery supply and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of OEM Vehicle Harness. Go to **Step V.**

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

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

1. Set parking brake and chock wheels
2. Key on.
3. Connect ServiceRanger.
4. Select Data Monitor.
5. Monitor Battery Voltage2. Record reading in table.
6. Key on with engine running.
7. Monitor Battery Voltage2. Record reading in table.
8. Compare reading(s) in table.
   - If reading is out of range, refer to OEM guidelines for repair or replacement of vehicle charging system. Go to **Step V.**
   - If reading is in range, go to **Step G.**

Parameter	Conditions	Range	Reading(s)
Battery Voltage2	Key On	11–15 V	
Battery Voltage2	Key On with the engine running	11–15 V	

G

Purpose: *Verify condition of batteries, fuse, power and ground supplies to the TCM.*

1. Key off.
2. Inspect charging system, batteries, fuses and connections for corrosion, loose terminals, bent or spread pins.

   Note: Some chassis use a power distribution system separate from the batteries. Be sure to inspect all connections.

   - If fault found, refer to OEM guidelines for repair or replacement of the charging system. Go to **Step V.**
   - If no fault found, send Service Activity Report and contact Eaton at (800) 826-4357 for further diagnostic instructions.

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 105 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 105 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 110: Ignition Voltage

J1939: SA 3 SPN 158 FMI 2

Overview

The Procision transmission is equipped with a Transmission Control Module (TCM) that requires a 12-volt Ignition supply. This signal initiates TCM operation at and during key on 12-volt Ignition is supplied to the TCM via the 20-Way TCM Vehicle Harness.

Detection

The TCM monitors the vehicle's 12-volt Ignition supply. If the system detects a loss of ignition voltage while driving, the fault is set Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Loss of 12-volt Ignition supply with output shaft speed greater than 10 RPM.

Fallback

FMI 2: See OEM for troubleshooting a failed system. Engine fallback modes may vary.

- 7th gear unavailable
- Engine communications may be unavailable
- PTO Mode prohibited
- Creep Mode prohibited

Note: If vehicle comes to a stop, TCM will shut down.

Note: If Engine ECU loses Ignition supply, Engine may shut down.

Conditions to Set Fault Code Inactive

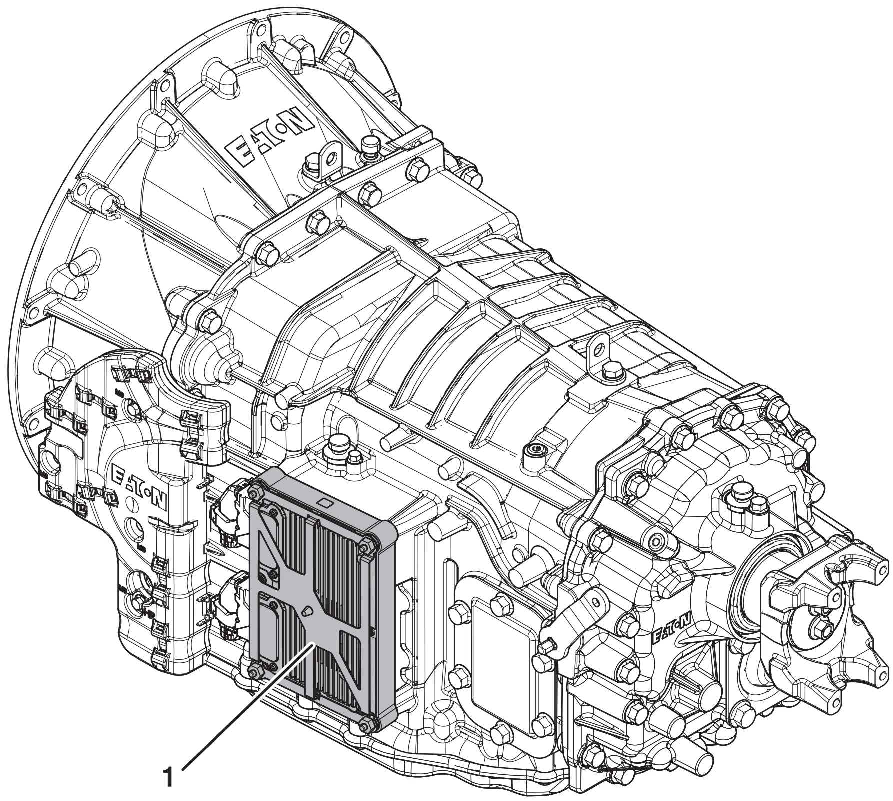
FMI 2: 12-volt Ignition supply returned with output shaft speed less than 10 RPM.

Possible Causes

All FMIs:

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

Component Identification



1. Transmission Control Module (TCM)

Fault Code 110 Troubleshooting

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

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

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

   Note: If Fault Code 110 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 110 FMI 2 is Inactive, go to **Step B.**

B ***Purpose:*** *Verify 12-volt Ignition supply.*

1. Set parking brake and chock wheels
2. Key on.
3. Connect ServiceRanger.
4. Select “Data Monitor”
5. Monitor Battery Voltage – Switched (12-volt Ignition supply). Record reading in table.
6. Compare reading(s) in table.
   - If reading is within range:
     - It is possible the driver cycled the key off while the vehicle was moving.
       or
     - The intermittent nature of the fault makes it likely that the problem is between the vehicle’s 12-volt Ignition supply and 20-Way TCM Vehicle Harness Connector Pin 10. Refer to OEM guidelines for repair or replacement of the 12-volt Ignition supply circuit. Go to **Step V.**

Parameter	Range	Reading(s)
Battery Voltage - Switched	11–15 V	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
    - If no codes set and the vehicle operates properly, Test Complete.
    - If Fault Code 110 sets Active during the test drive, go to **Step A.**
    - If a fault code other than 110 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 115: J1939 Data Link

J1939: SA 3 SPN 639 FMI 9, 14

Overview

The J1939 Data Link is a Controller Area Network (CAN) communication bus. The Procision transmission uses the J1939 Data Link to communicate with other vehicle Electronic Control Units (ECU) such as Engine, ABS, Body, etc. The Transmission Control Module (TCM) sends and receives messages from other ECUs on the Data Link to determine when to initiate a shift, hold a gear, command engine torque to make shifts, as well as other functions.

Detection

TCM has either lost communication or received erratic signals over the J1939 Data Link.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: No J1939 messages received for 5 seconds.

FMI 14 – Special Instructions: No J1939 engine messages received for 5 seconds.

Fallback

All FMIs:

- Amber warning lamp on
- If vehicle is configured for the J1939 Start Enable feature, the engine may not crank.
- Shift and launch quality may degrade
- 7th gear unavailable

Note: See OEM for troubleshooting the J1939 Data Link.

Conditions to Set Fault Code Inactive

FMI 9: J1939 messages have been received within 100ms.

FMI 14: J1939 engine messages have been received within 100ms.

Possible Causes

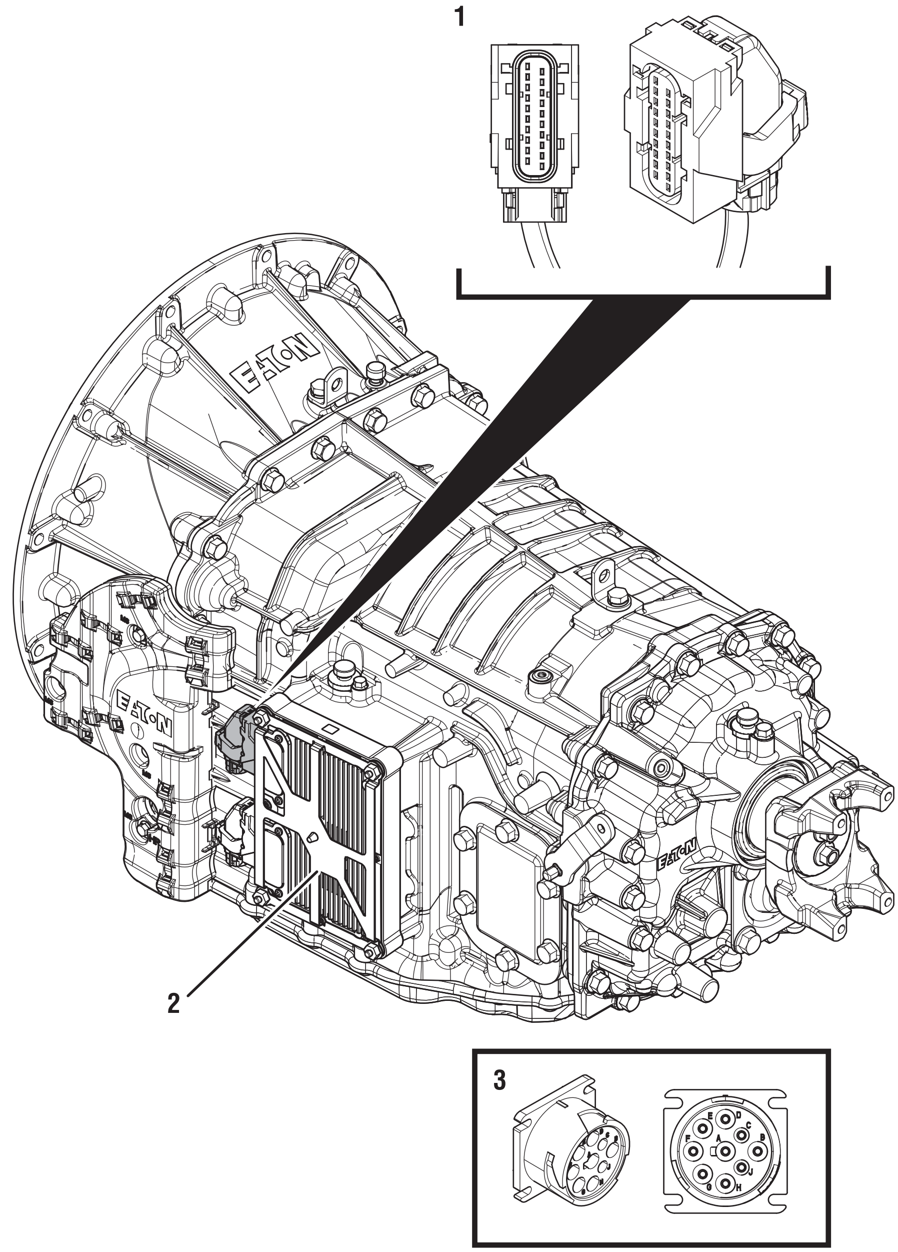
FMI 9:

- J1939 Data Link
  - Wiring shorted to ground, shorted to power or open
  - Bent, spread, or loose terminals
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Other ECUs
  - Internal failure
- TCM
  - Internal Failure

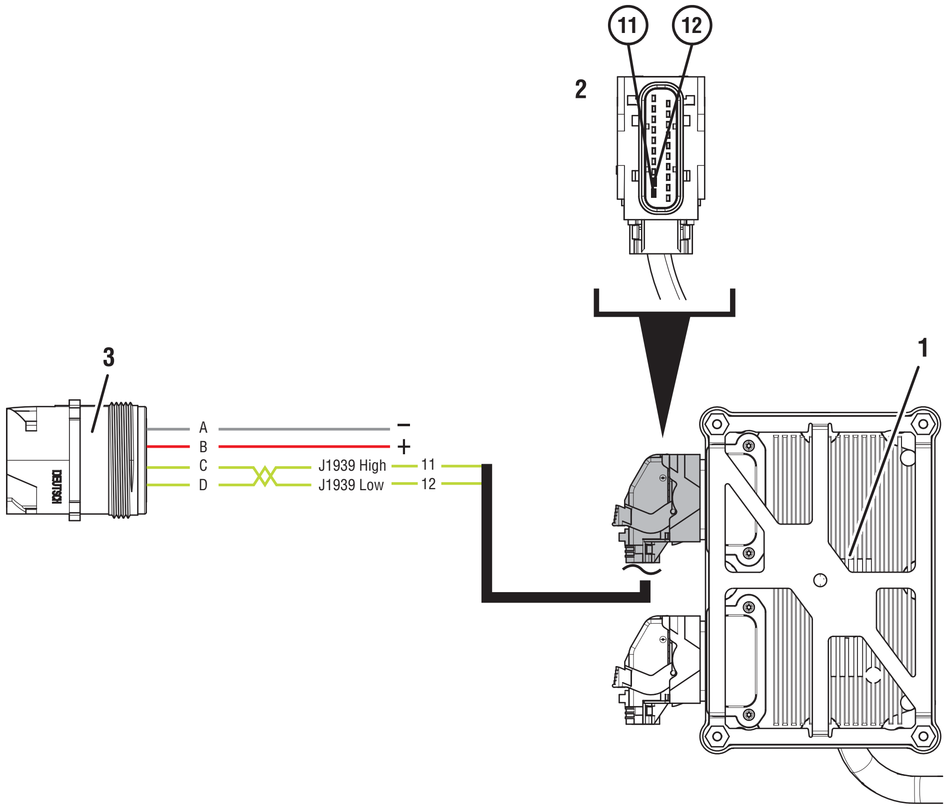
FMI 14:

- Engine ECU
  - Not powering up
  - No connection to J1939 Data Link
  - Internal failure

Component Identification



1. 20-Way Vehicle Harness Connector
2. Transmission Control Module (TCM)
3. 9-Way Diagnostic Connector (in cab)



1. Transmission Control Module (TCM)
2. 20-Way Vehicle Harness Connector
3. 9-Way Diagnostic Connector (in cab)

Fault Code 115 Troubleshooting

A

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

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

   Note: If Fault Code 115 is Inactive and there are other Active fault codes troubleshoot all Active faults first.

   - If Fault Code 115 FMI 9 is Active, go to **Step C.**
   - If Fault Code 115 FMI 9 is Inactive, go to **Step B.**
   - If Fault Code 115 FMI 14 is Active, go to **Step H.**
   - If Fault Code 115 FMI 14 is Inactive, an intermittent wiring issue in the J1939 Data Link to the Engine ECU or engine message fault may exist, or the Engine ECU may not be powering up intermittently.

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger
3. Select Service Routine and PD Mode.

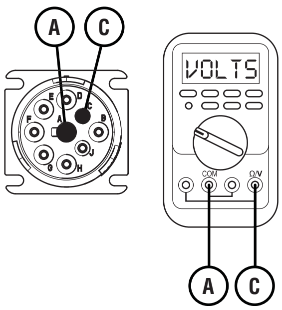
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

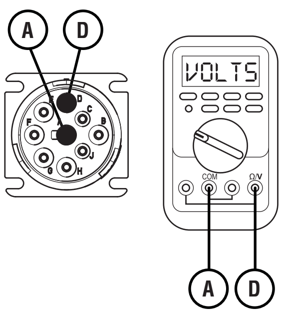
4. Wiggle wiring and connections through out the entire J1939 Data Link up to the 20-Way TCM Vehicle Harness. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM for specific wire routing locations.
5. Exit PD Mode.
   - If fault code 115 became Active or connection to vehicle was lost while wiggling the J1939 Data Link, refer to OEM guidelines for repair or replacement J1939 Data Link. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

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

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



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

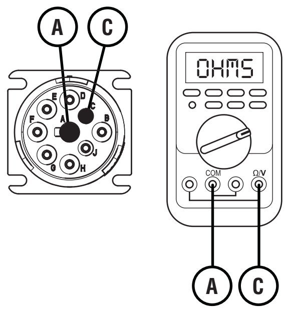


4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If reading is within range, go to **Step E.**
   - If reading is out of range, go to **Step D.**

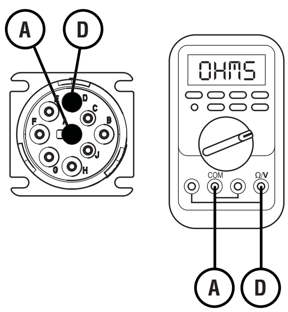
Pins	Range	Reading(s)
C to A	N/A	
D to A	N/A	+
Total Voltage	4.7–5.3 V	=

D ***Purpose:*** *Verify J1939 + / - are not shorted to ground.*

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



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



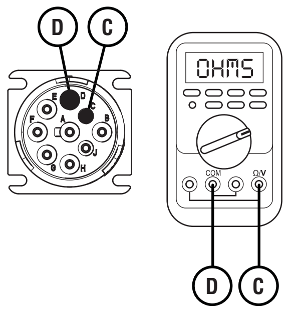
4. Compare reading(s) in table.
   - If any reading is out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**
   - If all readings are within range, go to **Step E.**

Pins	Range	Reading(s)
A to D	Open Circuit (OL)	
A to C	Open Circuit (OL)	

E

Purpose: *Verify resistance of the J1939 Data Link.*

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



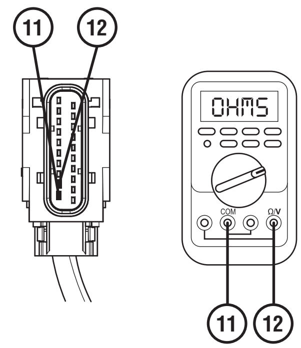
3. Compare reading(s) in table.
   - If reading is out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**
   - If reading is in range. go to **Step F.**

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

F

Purpose: *Verify TCM has continuity to J1939 Data Link.*

1. Key off.
2. Disconnect the 20-way TCM Vehicle Harness connector.
3. Inspect connector body for corrosion, damage, loose, spread or bent terminals.
4. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 11 and Pin 12. Record reading in table.



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

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

G

Purpose: *Verify fault code status.*

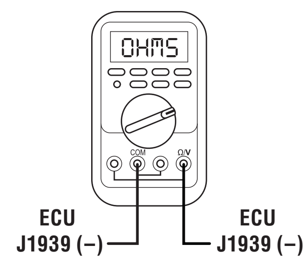
1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on, engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 115 is Inactive, an intermittent wiring issue exist within the J1939 Data Link, refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If Fault Code 115 is Active, replace TCM. Go to **Step V.**

H

Purpose: *Verify proper resistance of J1939 Data Link at Engine ECU.*

1. Key off.
2. Locate and disconnect Engine ECU connector containing J1939 Data Link.

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



- If readings are out of range, refer to OEM guidelines for repair or replacement of J1939 Data Link. Go to **Step V.**
- If readings are in range, Engine ECU has continuity to J1939 Data Link. Engine ECU may not be powering up or has an internal issue. Refer to OEM guidelines for repair or replacement. Go to **Step V.**

Pins	Range	Reading(s)
J1939 High (+) to J1939 Low (-)	50–70 Ohms	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 115 sets Active during test drive, go to **Step A.**
   - If a fault code other than 115 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 120 Start Enable Relay

J1939: SA 3 SPN 1321 FMI 3, 4, 5, 7, 12, 13

Overview

The Procision Transmission disables engine cranking when the transmission is in a non-neutral gear position. Some vehicles prevent non-neutral engine cranking through the use of a normally open Start Enable Relay (SER) actuated by the Transmission Control Module (TCM) to interrupt power to the starter. Other vehicles rely on the TCM to send a Transmission Engine Crank Enable message over the J1939 data link before the engine ECU will allow cranking. The SER circuit is supplied and wired by the truck OEM.

For vehicles equipped with a physical SER circuit, the TCM will only latch the relay when:

- Engine not running
- Driver Interface Device in Park or Neutral
- One of the following:
  - TCM determines the transmission is physically in neutral
  - Parking Brake Set or Service Brake Depressed

Under these conditions the TCM supplies voltage and ground to the SER coil, latching the relay (closed). The latched relay allows engine starter engagement when the ignition key is in the Start position. If these conditions are not met, the TCM removes voltage and ground to the SER (open) preventing engagement of the starter.

This fault indicates that an electrical failure in the SER circuit was detected. The fault will not set on vehicles that use J1939 messaging to enable engine cranking. A new TCM self-detects the crank enable system a vehicle uses during an initial power-up.

Detection

This fault can only be detected on transmission systems that are configured for Start Enable type “Relay”. The fault can be detected when the ignition key is on, the engine is not running, and the SER coil is not latched.

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 latched.

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

FMI 13 – Out of Calibration: Hardwired SER invalid configuration for 1 second.

Fallback

All FMIs:

- Amber warning lamp on
- Engine may not crank

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.

FMI 13: Hardwired SER valid configuration for 10 seconds.

Possible Causes

FMI 3:

- SER
  - Internal failure
- SER circuit wiring
  - Wiring shorted to power, shorted to ground, or open
  - Terminals may be bent, spread, or corroded
- "Start Enable Type" is incorrectly configured as "Relay" in the TCM on a vehicle equipped with a "J1939" start enable system.

FMI 4, 5

- SER
  - Internal failure
- SER circuit wiring
  - Wiring shorted to power, shorted to ground, or open
  - Terminals may be bent, spread, or corroded

FMI 7:

- SER
  - Internal failure
- SER circuit wiring
  - Incorrectly wired
  - Bypassed or "jumped" circuit wiring

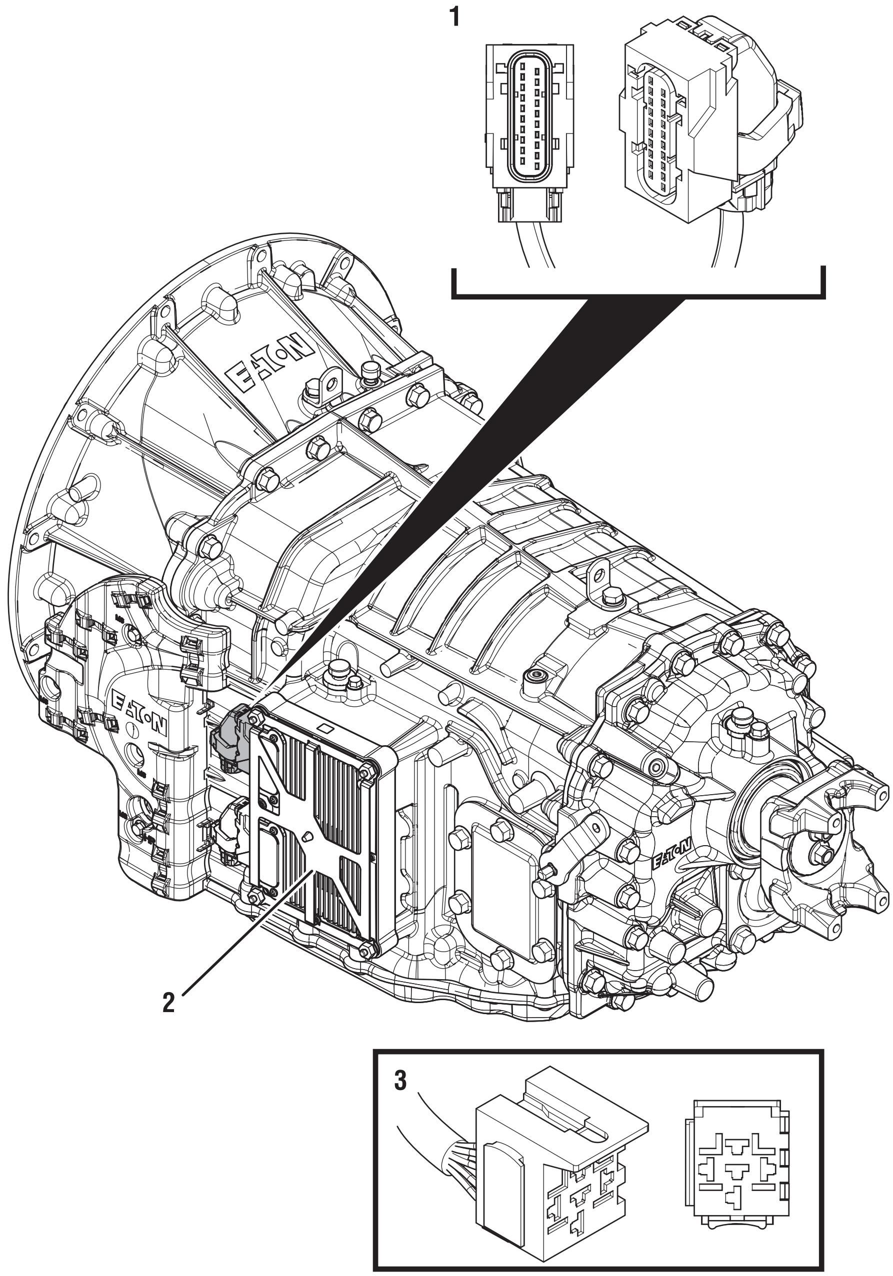
FMI 12:

- TCM
  - Internal failure
  - Software issue

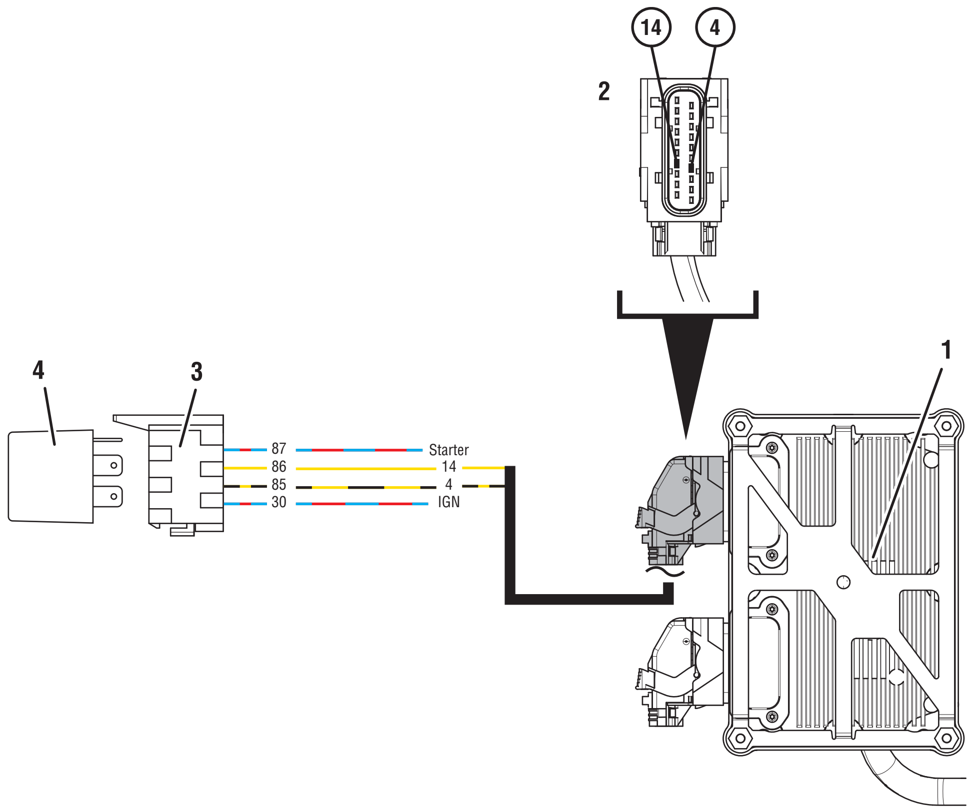
FMI 13:

- "Start Enable Type" is incorrectly configured as "J1939" in the TCM on a vehicle equipped with a "Relay" start enable system.

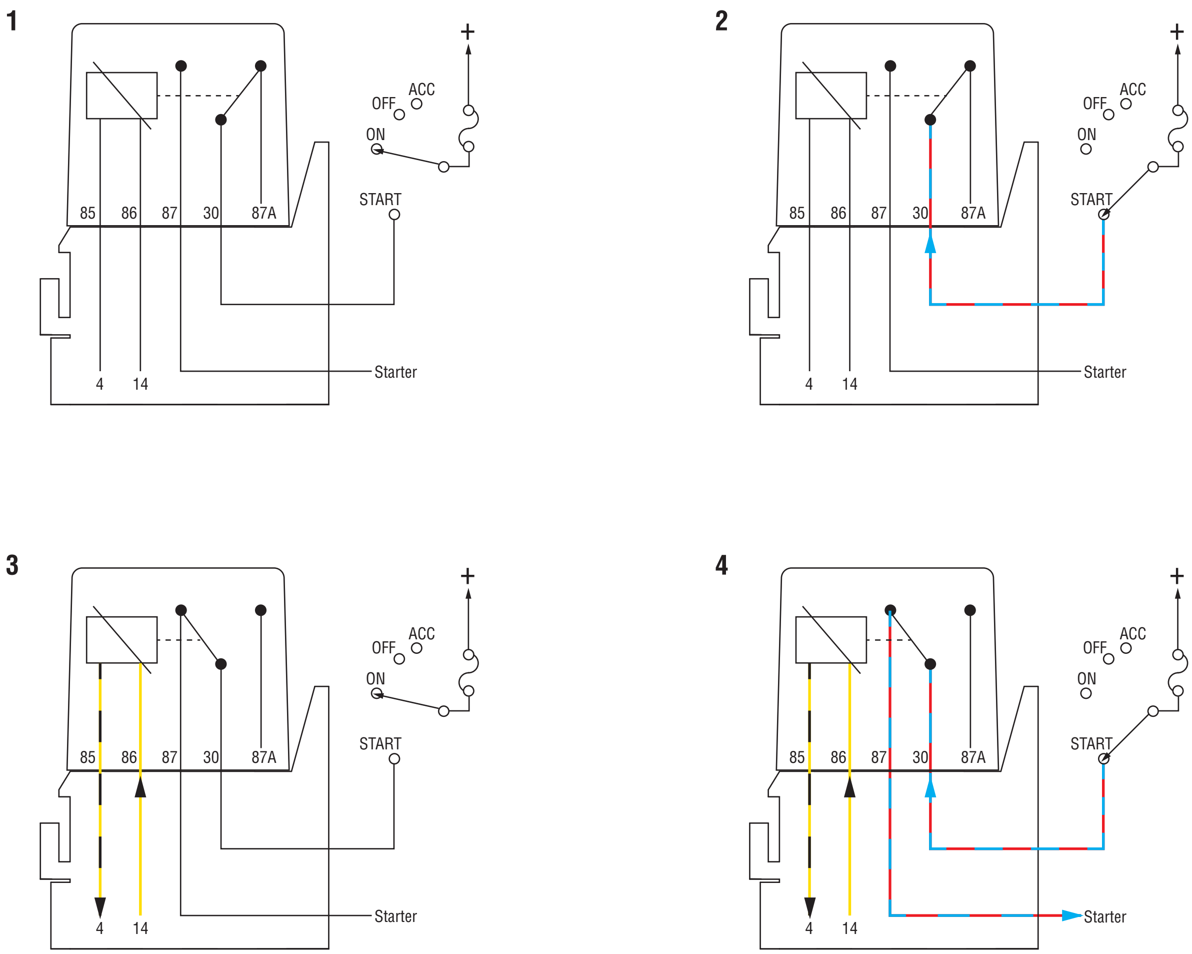
Component Identification



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



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



Start Enable Relay Circuit States (Normally Open)
1. Open Relay - Key On and Transmission is Unable to Confirm Neutral
2. Open Relay - Key Start and Transmission is Unable to Confirm Neutral
3. Closed Relay - Key On and Transmission Confirmed in Neutral
4. Closed Relay - Key Start and Transmission Confirmed in Neutral

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

Fault Code 120 Troubleshooting

A

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

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

   Note: If Fault Code 120 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   Note: If Fault Code 120 is Inactive and engine cranks, but does not start, troubleshoot vehicle starting system per OEM requirements.

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

   - If Fault Code 120 FMI 3 or 13 is Active, go to **Step B.**
   - If Fault Code 120 FMI 3, 4 or 5 is Inactive, go to **Step C.**
   - If Fault Code 120 FMI 4 or 5 is Active, go to **Step D.**
   - If Fault Code 120 FMI 7 is set, go to **Step J.**
   - If Fault Code 120 FMI 12 is set, send Service Activity Report via ServiceRanger and contact Eaton at (800) 826-4357 for further diagnostic instructions.
   - If Fault Code 120 FMI 13 is Inactive, test complete. Go to **Step V.**

B

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

1. Refer to OEM to determine the “Start Enable Type” system installed on the vehicle (Relay or J1939).
2. Record the “Start Enable Type” system installed on the vehicle in table.
3. Key off.
4. Allow TCM to power down.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Select “Configurations”.
8. Select “Vehicle”.
9. Record the “Start Enable Type” setting indicated In ServiceRanger under “Current Value” in table.
10. Compare reading(s) in table.
    - If Fault Code 120 FMI 3 or 13 is Active and the “Start Enable Type” is not configured correctly, select the correct configuration from the “New Value” drop down, select “Apply” and follow on screen prompts. Go to **Step V.**
    - If Fault Code 120 FMI 3 is Active and “Start Enable Type” is configured correctly, go to **Step D.**
    - If Fault Code 120 FMI 13 is Active and “Start Enable Type” is configured correctly, send Service Activity Report via ServiceRanger and contact Eaton at (800) 826-4357 for further diagnostic instructions.

Location	Start Enable Relay Type
Vehicle	
TCM (ServiceRanger)	

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

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

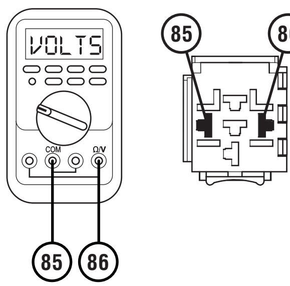
   Note: Solid "PD" in display when PD Mode is active.

4. Wiggle wiring and connections between the SER and 20-way TCM Vehicle Harness. Look for any obvious signs of rubbing or chafing on any of the wires. Consult the OEM for specific wire routing locations.
5. Exit PD Mode:
   - If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step D.**

D

Purpose: *Verify proper voltage is supplied to the SER.*

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.



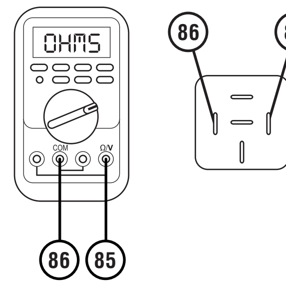
6. Compare reading(s) in table.
   - If reading is within range, go to **Step E.**
   - If reading is outside of range, go to **Step F.**

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

E

Purpose: *Verify proper resistance across the SER coil.*

1. Key off.
2. Measure the resistance across SER Pins 85 and 86. Record reading in table.

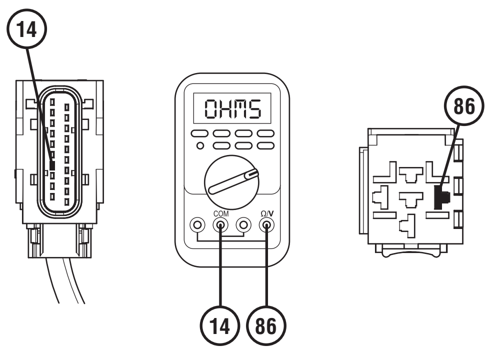


3. Compare reading(s) in table.
   - If reading is within range, go to **Step F.**
   - If reading is outside of range, replace SER. Go to **Step V.**

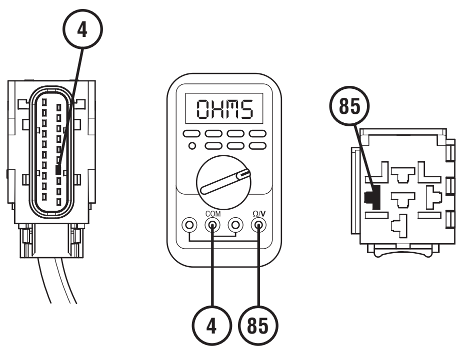
Pins	Range	Reading(s)
85 to 86	40–200 ohms	

F ***Purpose:*** *Verify continuity of SER coil control circuits. Verify circuits are not shorted together.*

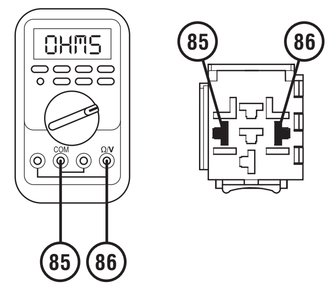
1. Key off.
2. Disconnect the 20-way TCM Vehicle Harness Connector.
3. Measure resistance between 20-way TCM Vehicle Harness Connector Pin 14 and SER socket Pin 86. Record reading in table.



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



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

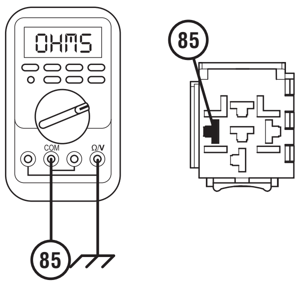


6. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If readings are within range, go to **Step G.**

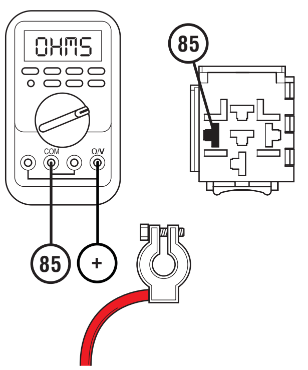
Pins	Range	Reading(s)
14 to 86	0.0–0.3 Ohms	
4 to 85	0.0–0.3 Ohms	
85 to 86	Open Circuit (OL)	

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

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



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

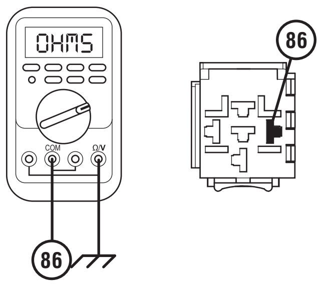


4. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If readings are within range, go to **Step H.**

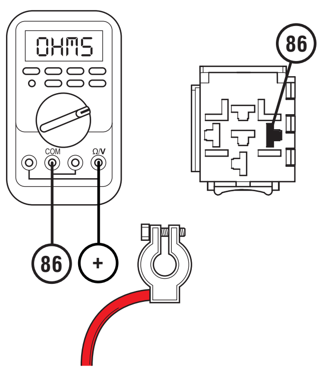
Pins	**Range**	**Reading(s)**
85 to Ground	Open Circuit (OL)	
85 to Battery Positive (+)	Open Circuit (OL)	

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

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



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



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

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

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 120 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the SER Socket and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If Fault Code 120 is Active, Contact Eaton at (800) 826-4357 for further diagnostic instructions.

J

Purpose: *Verify if fault was inadvertently set.*

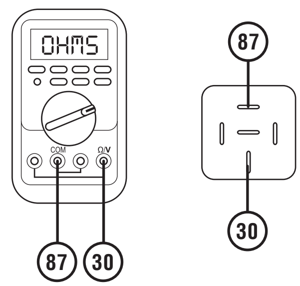
1. Set parking brake and chock wheels.
2. Key off.

   Note: FC 120 FMI 7 will only set Active during engine cranking.
3. Allow TCM to power down.
4. Key on with engine off
5. Connect ServiceRanger.
6. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
7. Verify Fault Code 120 FMI 7 is Inactive.
8. Attempt to crank engine.
9. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 120 FMI 7 is Inactive, test complete. Go to **Step V.**
   - If Fault Code 120 FMI 7 sets Active, go to **Step K.**

K

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

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

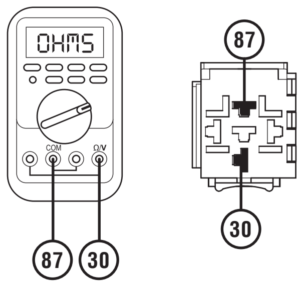


4. Compare reading(s) in table.
   - If reading is out of range, refer to OEM guidelines for replacement of SER. Go to **Step V.**
   - If reading is within range, go to **Step L.**

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

L ***Purpose:*** *Verify SER latch circuit is not shorted together.*

1. Key off
2. Measure the resistance across SER socket Pin 30 and Pin 87. 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 SER latch circuit. Go to **Step V.**
   - If reading is within range, go to **Step M.**

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

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 120 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the SER, SER socket, and the OEM starting system wiring. Refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If Fault Code 120 is Active, contact Eaton at (800) 826-4357 for further diagnostic instructions.

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Clear fault codes using ServiceRanger.
5. Test the Start Enable Relay system by attempting to crank the starter multiple times. Verify that the starting system operates properly.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 120 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 120 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 130: Proprietary Network Link (PNL)

J1939: SA 3 SPN 625 FMI 9

Overview

Vehicles equipped with a Procision Transmission may have an Eaton Push Button Controller (PBC). The PBC broadcasts primary driver shift mode requests to the Transmission Control Module (TCM) through a high speed data link called the Proprietary Network Link (PNL). The PNL is contained within the 20-Way TCM Vehicle Harness.

Note: In the event the PNL signal is unavailable, the PBC will perform a "bulb check" at power up, then go out. If a mode is selected, the mode indicator will continually flash and the transmission will operate normal with the exception of Manual Mode, Upshift and Downshift buttons.

Detection

The TCM monitors the PBC driver's shift mode request signal. If no messages are received, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: PNL communications are not received for 5 seconds.

Fallback

FMI 9:

- Amber warning lamp on
- Manual shifting not available
- No degraded performance

Note: If PBC loses power, amber warning lamp will not be illuminated and audible warnings will not be possible.

Note: If fault code 130 and 145 are Active:

- Transmission stays in current gear

Conditions to Set Fault Code Inactive

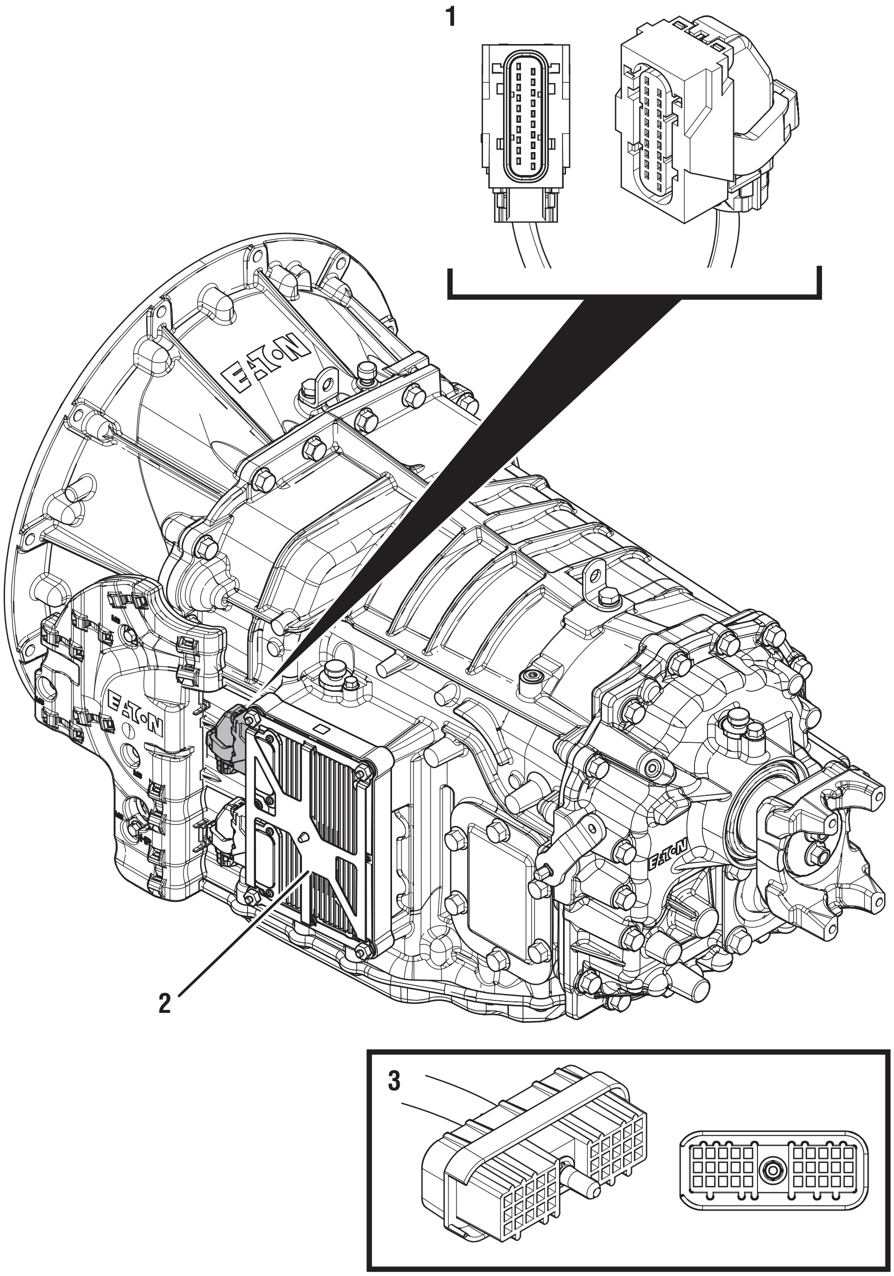
FMI 9: PNL communications received within 100 ms

Possible Causes

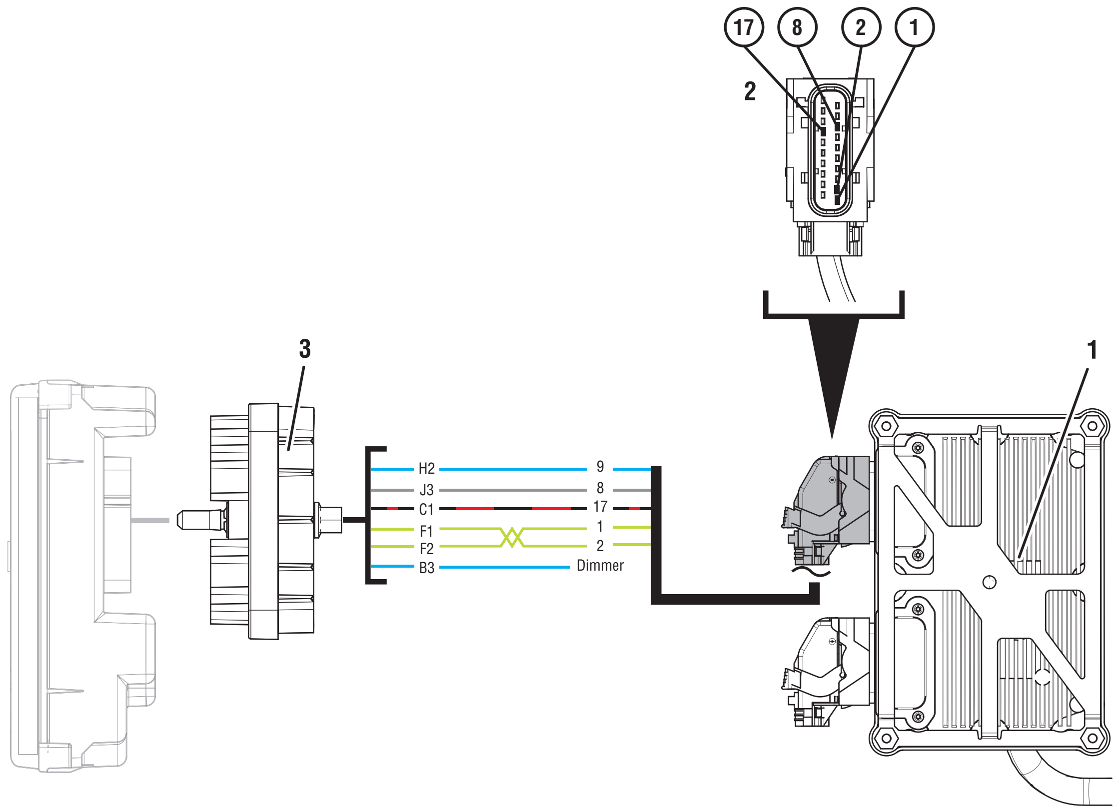
FMI 9:

- Vehicle Harness
  - Wires shorted to ground, shorted to power or open
  - Terminals bent, spread, corroded or loose
- PBC
  - No power up
  - Internal Failure
- TCM
  - Internal Failure

Component Identification



1. 20-Way Vehicle Harness Connector
2. Transmission Control Module (TCM)
3. 30-Way Eaton Push Button Controller (PBC) Connector (In Cab)



1. *Transmission Control Module (TCM)*
2. *20-Way Vehicle Harness Connector*
3. *30-Way Eaton Push Button Controller (PBC) Connector*

Fault Code 130 Troubleshooting

A

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

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

   Note: If Fault Code 130 is Inactive and there are other Active fault codes troubleshoot all Active faults first.

   - If Fault Code 130 FMI 9 is Active, go to **Step C.**
   - If Fault Code 130 FMI 9 is Inactive, go to **Step B.**

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger
3. Select Service Routine and PD Mode.

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

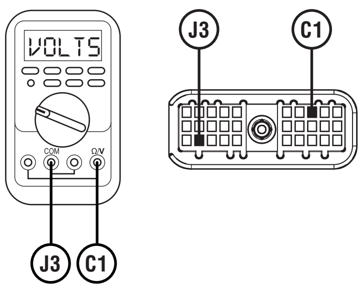
   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections between the 30-Way PBC and 20-Way TCM Vehicle Harness. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify power and ground supply to PBC.*

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



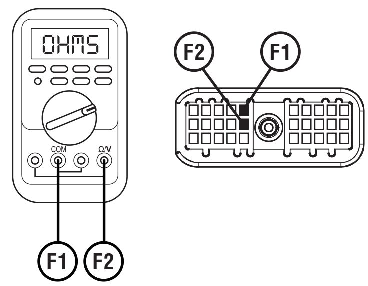
6. Compare reading(s) in table.
   - If reading is within range, go to **Step D.**
   - If reading is out of range, go to **Step E.**

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

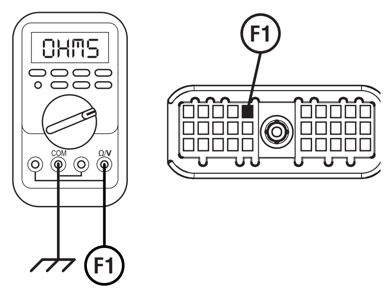
D

Purpose: *Verify resistance of PNL circuits and TCM terminating resistor.*

1. Key off.
2. Measure resistance between 30-Way PBC Harness Connector Pin F1 and Pin F2. Record reading in table.



3. Measure resistance between 30-Way PBC Harness Connector Pin F1 and ground. Record reading in table.



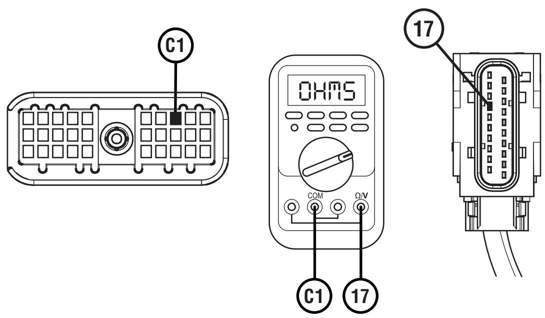
4. Compare reading(s) in table.

- If any reading is out of range, refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
- If all readings are within range, go to **Step F.**

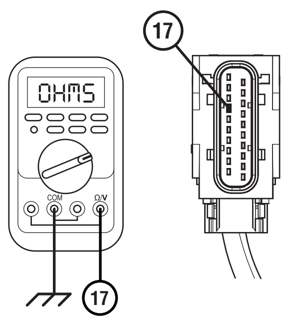
Pins	Range	Reading(s)
F1 to F2	110–130 Ohms	
F1 to Ground	Open Circuit (OL)	

E ***Purpose:*** *Verify continuity of PBC power and ground circuit.*

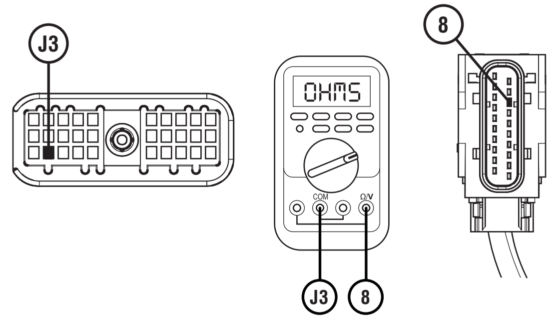
1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Inspect 20-Way TCM Vehicle Harness Connector for corrosion, loose terminals, and bent or spread pins.
4. Measure resistance between 30-Way PBC Harness Connector Pin C1 and 20-Way TCM Vehicle Harness Connector Pin 17. Record reading in table.



5. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 17 and ground. Record reading in table.



6. Measure resistance between 30-Way PBC Connector Pin J3 and 20-Way TCM Vehicle Harness Connector Pin 8. Record reading in table.



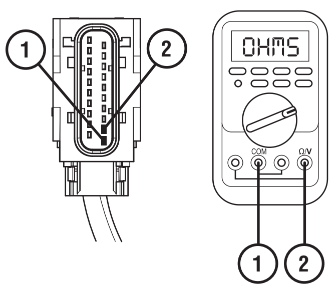
7. Compare reading(s) in table.
   - If any reading is out of range, refer to OEM guidelines for repair or replacement of vehicle harness between 30-way PBC and 20-way TCM Connectors. Go to **Step V.**
   - If all readings are within range, go to **Step H.**

Pins	Range	Reading(s)
C1 to 17	0–0.3 Ohms	
17 to Ground	Open Circuit (OL)	
J3 to 8	0–0.3 Ohms	

F

Purpose: *Verify resistance of PNL circuits and PBC terminating resistor.*

1. Key off.
2. Reconnect 30-Way PBC Harness Connector.
3. Disconnect 20-Way TCM Vehicle Harness Connector.
4. Inspect 20-Way TCM Vehicle Harness Connector for corrosion, loose terminals, and bent or spread pins.
5. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 1 and Pin 2. Record reading in table.



6. Compare reading(s) in table.
   - If reading is out of range, replace PBC. Go to **Step V.**
   - If reading is in range. go to **Step G.**

Pins	Range	Reading(s)
1 to 2	110–130 Ohms	

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. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 130 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 30-Way PBC Harness Connector and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If Fault Code 130 is Active, contact Eaton at (800) 826-4357 for further diagnostic instructions.

H

Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
    - If Fault Code 130 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 30-Way PBC Harness Connector and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
    - If Fault Code 130 is Active, replace TCM. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
    - If no codes set and the vehicle operates properly, test complete.
    - If Fault Code 130 sets Active during test drive, go to **Step A.**
    - If a fault code other than 130 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 135: Push Button Controller (PNL) - Primary

J1939: SA 3 SPN 751 FMI 2, 4, 9, 11, 12, 19

Overview

Vehicles equipped with a Procision Transmission may have an Eaton Push Button Controller (PBC). The PBC broadcasts primary driver shift mode requests to the Transmission Control Module (TCM) through a high speed data link called the Proprietary Network Link (PNL). A redundant secondary Pulse Width Modulated (PWM) signal is broadcast over a separate circuit. This allows for a driver shift mode request to engage the transmission into gear in the event one signal is not available. The PNL and PWM circuits are contained within the 20-Way TCM Vehicle Harness.

Note: In the event the PNL signal is unavailable, the PBC will perform a "bulb check" at power up, then go out. If a mode is selected, the mode indicator will continually flash and the transmission will operate normal with the exception of Manual Mode, Upshift and Downshift buttons.

Detection

The TCM monitors the PBC driver's shift mode request signal. If an invalid signal is received, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Transmission Primary Shift Selector signal out of range for 10 seconds.

FMI 4 – Voltage below normal or shorted low: Primary PWM device short to ground for 1 second.

FMI 9 – Abnormal Update Rate: PNL message not received for 1 second.

FMI 11 – Failure Mode Not Identifiable: Driver's shift mode request signals (PNL and PWM) do not match for 10 consecutive messages.

FMI 12 – Bad Intelligent Device: Shift mode acquired disagrees with shift mode requested.

FMI 19 – Received Network Data Error: CAN device message error for 10 seconds.

Fallback

FMI 2, 4, 9, 19:

Note: If PBC loses power, PBC Service lamp and audible tone are inoperative.

- Amber warning lamp on
- Manual shifting not available
- No degraded performance

Note: If fault codes 135 and 145 are Active and output shaft speed is below 30 RPM:

- Transmission stays in correct gear
- Primary and Secondary Clutch disengaged
- PTO mode prohibited

FMI 11:

- Amber warning lamp on
- No degraded performance

Note: When output shaft speed is below 30 RPM:

- Transmission stays in current gear
- Primary and Secondary Clutch disengaged
- PTO mode prohibited

FMI 12:

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

FMI 2: Transmission Primary Shift Selector signal in range for 10 seconds.

FMI 4: Short to Vbatt not detected for 10 seconds.

FMI 11: Driver's shift mode request signals (PNL and PWM) match for 10 seconds.

FMI 12: Key cycle.

FMI 19: CAN device message in range for 10 seconds.

Possible Causes

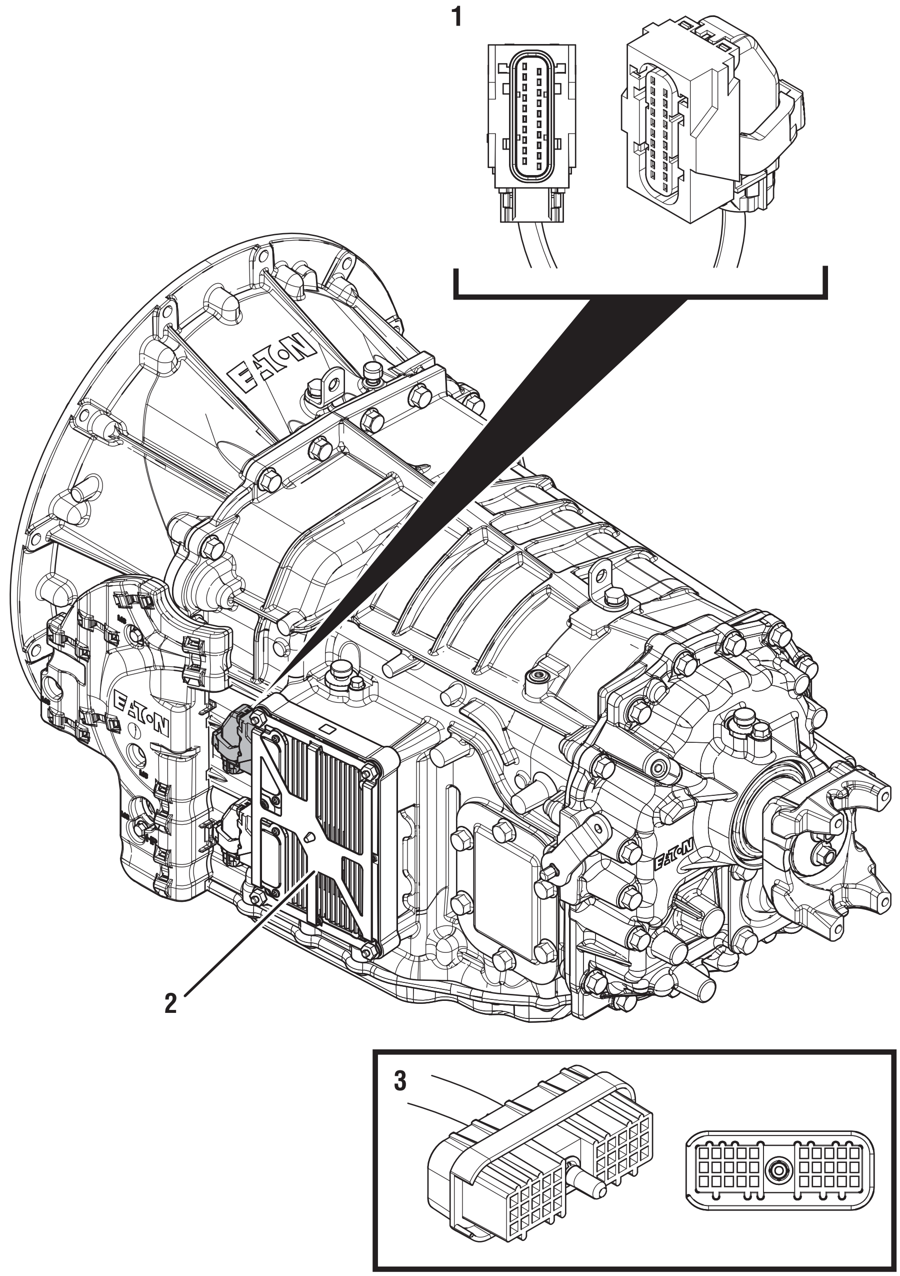
FMI 2, 4, 9, 11, 19:

- Vehicle Harness
  - Wires shorted to ground, shorted to power or open
  - Terminals bent, spread, corroded or loose
- PBC
  - No power up
  - Internal Failure
- TCM
  - Internal Failure

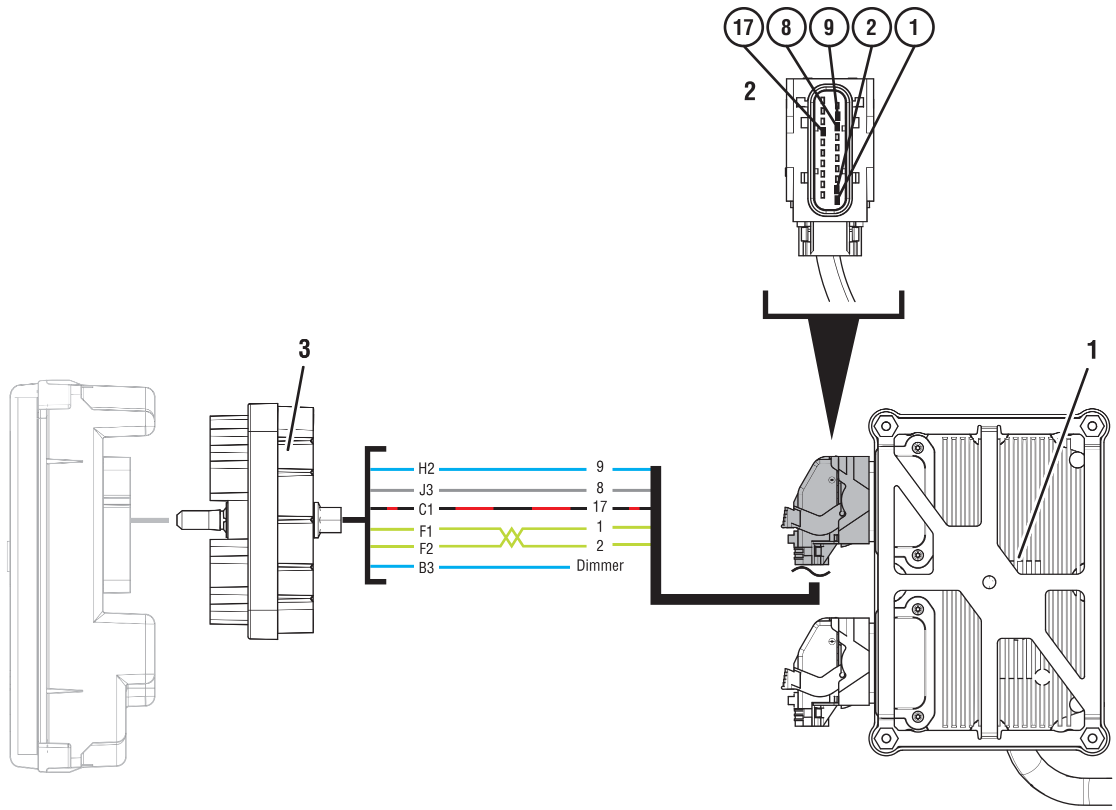
FMI 12:

- TCM
  - Software issue
  - Internal failure

Component Identification



1. 20-Way Vehicle Harness Connector
2. Transmission Control Module (TCM)
3. 30-Way Eaton Push Button Controller (PBC) Connector (In Cab)



1. Transmission Control Module (TCM)
2. 20-Way Vehicle Harness Connector
3. 30-Way Eaton Push Button Controller (PBC) Connector

Fault Code 135 PNL Troubleshooting

A

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

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

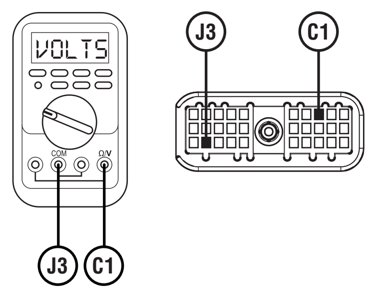
   Note: If Fault Code 135 is Inactive and there are other Active fault codes troubleshoot all Active faults first.

   - If Fault Code 135 FMI 2, 4, 9, or 19 is set, go to **Step B.**
   - If Fault Code 135 FMI 11 is set, go to **Step H.**
   - If Fault Code 135 FMI 12 is set, send Service Activity Report via ServiceRanger and contact Eaton at (800) 826-4357 for further diagnostic instructions.

B

Purpose: *Verify power and ground supply to PBC.*

1. Set parking brake and chock wheels.
2. Key off.
3. Disconnect 30-Way PBC Harness Connector.
4. Inspect 30-Way PBC Harness Connector for corrosion, loose terminals, and bent or spread pins.
5. Key on with engine off.
6. Measure voltage at 30-Way PBC Harness Connector Pin C1 and Pin J3. Record reading in table.

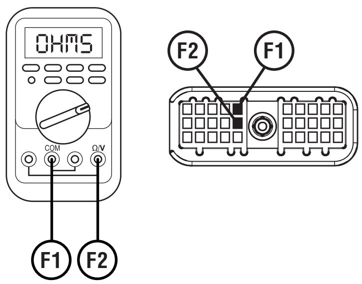


7. Compare reading(s) in table.
   - If readings are in range, go to **Step C.**
   - If readings are out of range, go to **Step G.**

Pins	Range	Reading(s)
C1 to J3	11 – 13 V	

C ***Purpose:*** *Verify resistance of PNL circuits and TCM terminating resistor.*

1. Key off.
2. Measure resistance between 30-Way PBC Harness Connector Pin F1 and Pin F2. Record reading in table.

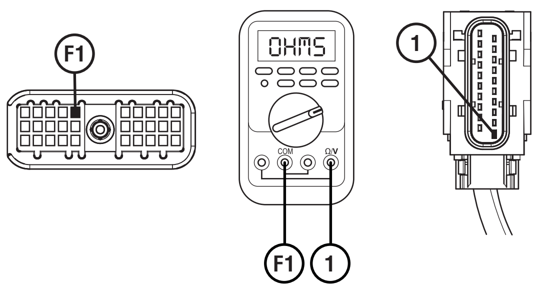


3. Compare reading(s) in table.
   - If readings are out of range, Go to **Step D.**
   - If readings are in range, go to **Step E.**

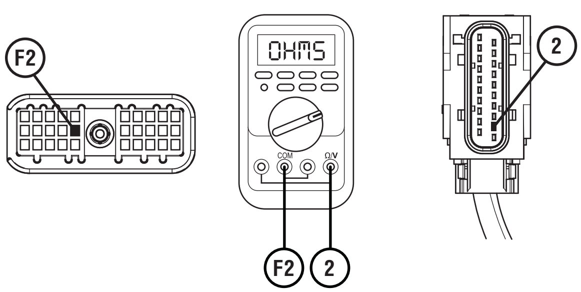
Pins	Range	Reading(s)
F1 to F2	110 –130 Ohms	

D	***Purpose:*** *Verify continuity of PNL circuits.*

1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Inspect 20-Way TCM Vehicle Harness Connector for corrosion, loose terminals, and bent or spread pins.
4. Measure resistance between 30-Way PBC Pin F1 and 20-Way Vehicle Harness Connector Pin 1. Record reading in table.



5. Measure resistance between 30-Way PBC Pin F2 and 20-Way Vehicle Harness Connector Pin 2. Record reading in table.

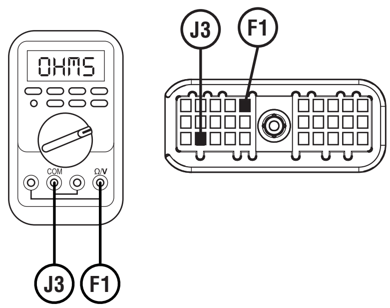


6. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle harness between 30-Way PBC and 20-Way TCM Vehicle Harness Connectors. Go to **Step V.**
   - If readings are in range, go to **Step E.**

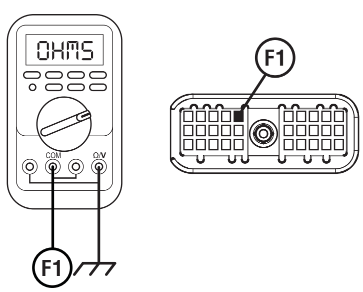
Pins	Range	Reading(s)
F1 to 1	0.0 –0.3 Ohms	
F2 to 2	0.0 –0.3 Ohms	

E ***Purpose:*** *Verify PNL circuits not shorted in the vehicle harness or to ground.*

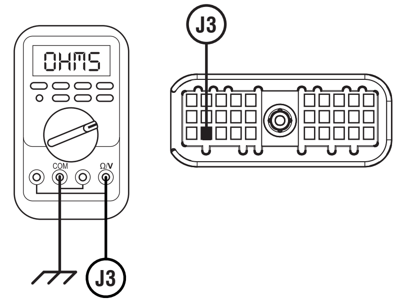
1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector. (Go to 4 if already disconnected)
3. Inspect 20-Way TCM Vehicle Harness Connector for corrosion, loose terminals, and bent or spread pins.
4. Measure resistance between 30-Way PBC Pin F1 and Pin J3. Record reading in table.



5. Measure resistance between 30-Way PBC Pin F1 and ground. Record reading in table.



6. Measure resistance between 30-Way PBC Pin J3 and ground. Record reading in table.



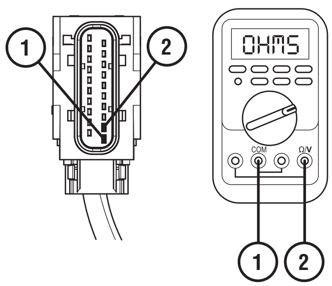
7. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle harness between 30-way PBC and 20-way TCM Vehicle Harness Connectors. Go to **Step V.**
   - If readings are in range, go to **Step F.**

Pins	Range	Reading(s)
F1 to J3	0.0 –0.3 Ohms	
F1 to Ground	Open Circuit (OL)	
J3 to Ground	Open Circuit (OL)	

F

Purpose: *Verify resistance of PNL circuits and PBC terminating resistor.*

1. Key off.
2. Reconnect 30-Way PBC Harness Connector.
3. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 1 and Pin 2. Record reading in table.



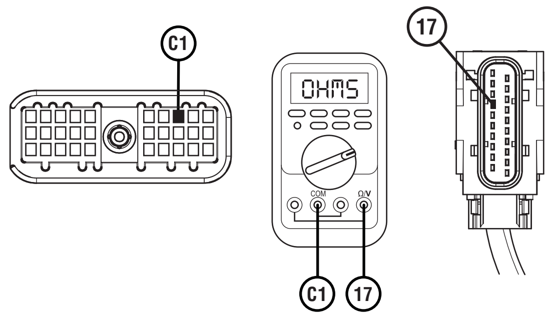
4. Compare reading(s) in table.
   - If readings are out of range, replace PBC. Go to **Step V.**
   - If readings are range. go to **Step K.**

Pins	Range	Reading(s)
1 to 2	110 –130 Ohms	

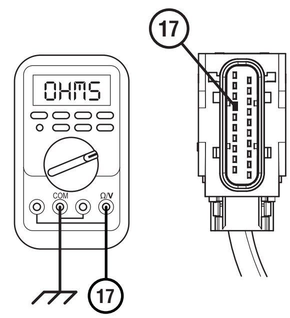
G

Purpose: *Verify continuity of PBC power and ground circuit.*

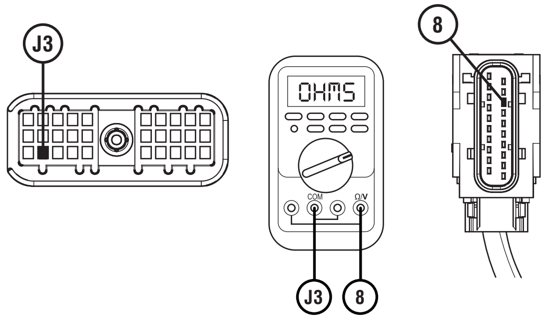
1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Inspect 20-Way TCM Vehicle Harness Connector for corrosion, loose terminals, and bent or spread pins.
4. Measure resistance between 30-Way PBC Harness Connector Pin C1 and 20-Way TCM Vehicle Harness Connector Pin 17. Record reading in table.



5. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 17 and ground. Record reading in table.



6. Measure resistance between 30-Way PBC Connector Pin J3 and 20-Way TCM Vehicle Harness Connector Pin 8. Record reading in table.



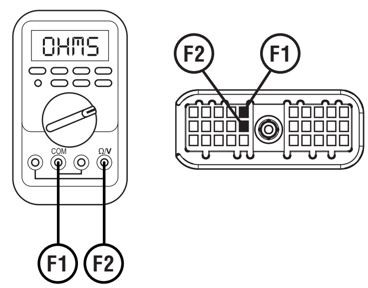
7. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle harness between 30-way PBC and 20-way TCM Connectors. Go to **Step V.**
   - If readings are in range, go to **Step J.**

Pins	Range	Reading(s)
C1 to 17	0.0 –0.3 Ohms	
17 to Ground	Open Circuit (OL)	
J3 to 8	0.0 –0.3 Ohms	

H

***Purpose:** Verify resistance of PNL circuits and TCM terminating resistor.*

1. Set parking brake and chock wheels.
2. Key off.
3. Disconnect 30-Way PBC Harness Connector.
4. Inspect 30-Way PBC Harness Connector for corrosion, loose terminals, and bent or spread pins.
5. Measure resistance between 30-Way PBC Harness Connector Pin F1 and Pin F2. Record reading in table.

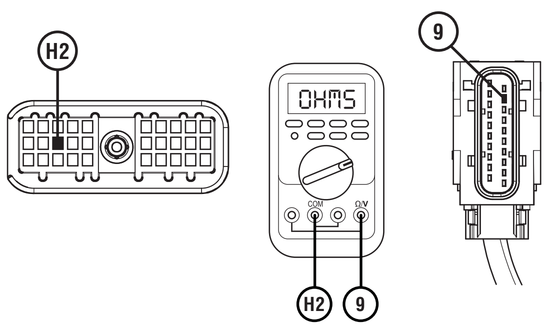


6. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle harness between 30-way PBC and 20-way TCM Connectors. Go to **Step V.**
   - If readings are in range, go to **Step I.**

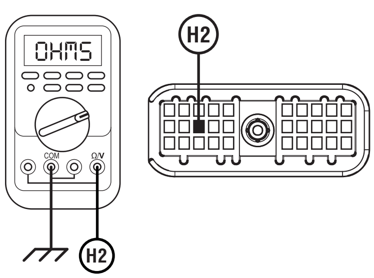
Pins	Range	Reading(s)
F1 to F2	110 –130 Ohms	

I	***Purpose:*** *Verify continuity of Pulse Width Modulated (PWM) signal wire.*

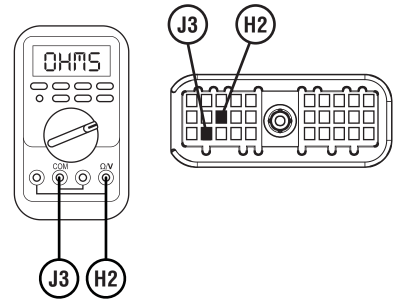
1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Inspect 20-Way TCM Vehicle Harness Connector for corrosion, loose terminals, and bent or spread pins.
4. Measure resistance between 30-Way PBC Vehicle Harness Connector Pin H2 and 20-Way TCM Vehicle Harness Connector Pin 9. Record reading in table.



5. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin H2 and ground. Record reading in table.



6. Measure resistance between 30-Way PBC Vehicle Harness Connector Pin H2 and Pin J3. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If all readings are in range, go to **Step K.**

Pins	Range	Reading(s)
H2 to 9	0.0 –0.3 Ohms	
H2 to Ground	Open Circuit (OL)	
H2 to J3	Open Circuit (OL)	

J

Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 135 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 30-Way PBC Harness Connector and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If Fault Code 135 is Active, replace TCM, Go to **Step V.**

K

Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 135 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 30-Way PBC Harness Connector and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If Fault Code 135 is Active, contact Eaton at (800) 826-4357 for further diagnostic instructions.

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

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

Fault Code 135: Shift Lever (TRS1) - Primary

J1939: SA 3 SPN 751 FMI 0, 1, 2, 3, 5, 6, 8, 11, 12, 13

Overview

The Procision Transmission equipped with a Park Pawl includes a Transmission Ranger Sensor (TRS) to supply the driver's shift mode request signal to the Transmission Control Module (TCM).

The TRS is a dual output sensor, primary (TRS1) and secondary (TRS2). This allows for a redundant driver's shift mode request signal to engage the transmission into gear in the event one signal is not available. The TRS is mounted externally to the transmission at the park pawl linkage and is connected to the TCM via the 20-way TCM Vehicle Harness.

Detection

The TCM monitors the TRS1 driver's mode request signal. If an invalid signal is received, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: TRS calibration failed above the primary sensor range limit.

FMI 1 – Data Valid but Below Normal: TRS calibration failed below the primary sensor range limit.

FMI 2 – Data Erratic: Transmission Primary Shift Selector signal out of range for 10 seconds.

FMI 3 – Voltage Above Normal or Shorted High: TRS1 signal greater than 5.25 volts for 1 second.

FMI 5 – Current Below Normal or Open Circuit: TRS1 signal less than 4.75 volts for 1 second.

FMI 6 – Current Above Normal or Shorted Circuit: TRS1 signal less than 4 volts or greater than 6 volts for 1 second.

FMI 8 – Abnormal Frequency: TRS1 signal frequency out of range for 1 second.

FMI 11 – Failure Mode Not Identifiable: TRS1 and TRS2 drivers shift mode request signals do not match for 1 second.

FMI 12 – Bad Intelligent Device: Shift mode acquired disagrees with shift mode requested.

FMI 13 – Out of Calibration: No valid calibration data stored or incorrect cable adjustment.

Fallback

FMI 0, 1, 2, 3, 5, 6, 8:

- Amber warning lamp on
- No degraded performance

Note: If fault codes 135 and 145 are Active and Output Shaft Speed is below 30 RPM:

- Transmission stays in current gear
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

FMI 11:

- Amber warning lamp on
- No degraded performance

Note: If output shaft speed is below 30 RPM:

- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

FMI 12:

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

FMI 13:

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 2: Transmission Primary Shift Selector signal in range for 10 seconds.

FMI 3, 5, 6: Open or short circuit condition not detected for 10 seconds.

FMI 8: TRS1 signal frequency in range for 10 seconds.

FMI 11: TRS1 and TRS2 shift mode request signals match for 10 seconds.

FMI 0, 1, 12: Key cycle.

FMI 13: TRS calibration complete.

Possible Causes

FMI 2, 3, 5, 6:

- Vehicle Harness
  - Wiring shorted to power, shorted to ground, or open
  - Terminals bent, spread, corroded or loose
- TRS
  - Internal failure
- TCM
  - Internal failure

FMI 8:

- Configuration
  - Driver interface device configured as a Push Button Controller (PBC)
- Vehicle Harness
  - TRS1 and TRS2 signal circuits wired in reverse
- TRS
  - Internal failure

FMI 11:

- Vehicle Harness
  - Terminals bent, spread, corroded or loose
- TRS
  - Internal failure

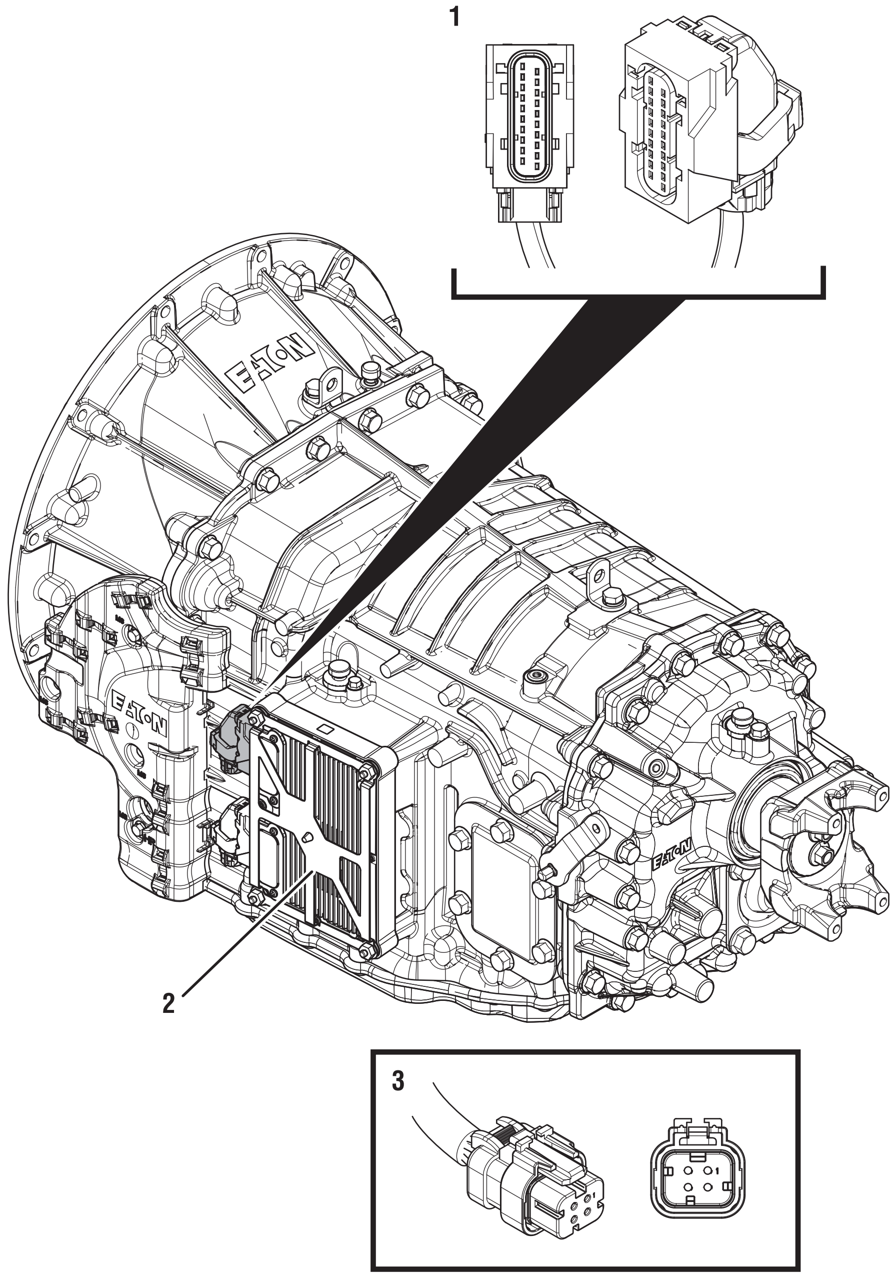
FMI 12:

- TCM
  - Software issue
  - Internal failure

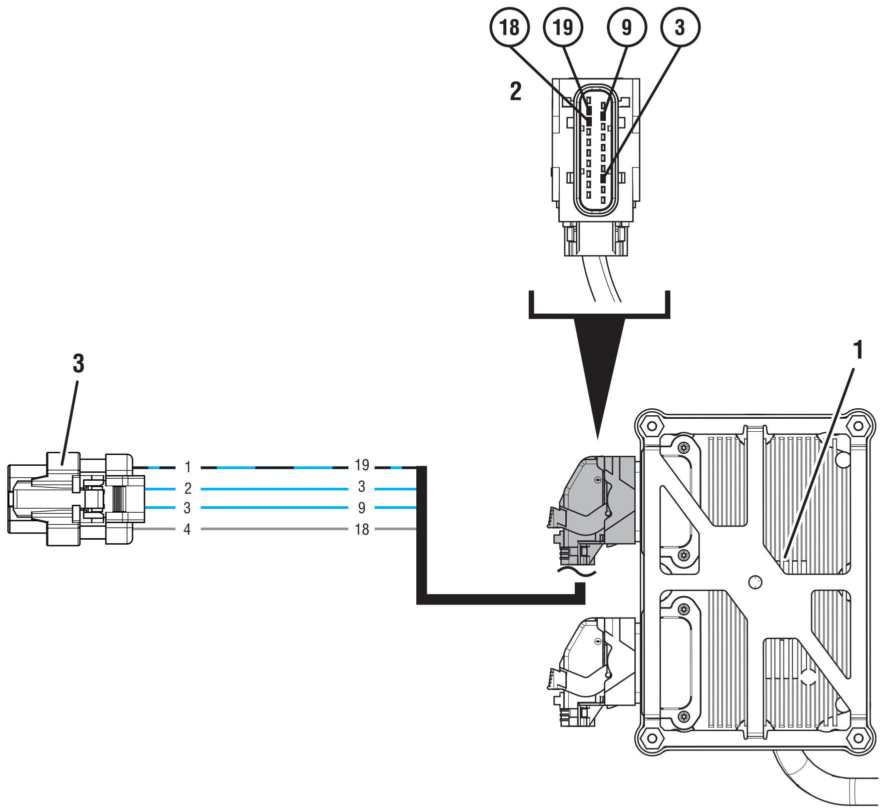
FMI 0, 1, 13:

- Calibration
  - Cable out of adjustment
  - TRS not calibrated

Component Identification



1. 20-Way Vehicle Harness Connector
2. Transmission Control Module (TCM)
3. 4-Way Transmission Range Sensor (TRS) Connector



1. Transmission Control Module (TCM)
2. 20-Way Vehicle Harness Connector
3. 4-Way Transmission Range Sensor (TRS) Connector

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

Fault Code 135 TRS1 Troubleshooting

A

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

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

   Note: If Fault Code 135 is Inactive and there are other Active fault codes troubleshoot all Active faults first.

   - If Fault Code 135 FMI 2, 3, 5, or 6 is Active, go to **Step C.**
   - If Fault Code 135 FMI 2, 3, 5, or 6 is Inactive, go to **Step B.**
   - If Fault Code 135 FMI 8 is Active, go to **Step G.**
   - If Fault Code 135 FMI 8 is Inactive, TRS is wired correctly and Driver Interface Device is configured as TRS, test complete.
   - If Fault Code 135 FMI 11 is set, go to **Step I.**
   - If Fault Code 135 FMI 12 is set, send Service Activity Report via ServiceRanger and contact Eaton at (800) 826-4357 for further diagnostic instructions.
   - If Fault Code 135 FMI 0, 1, 13 is Active, perform shift lever cable adjustment per OEM guidelines and TRS Calibration with ServiceRanger.
   - If Fault Code 135 FMI 0, 1, 13 is Inactive, TRS is calibrated, test complete.

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger
3. Select Service Routine and PD Mode.

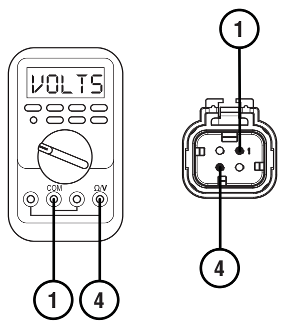
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections between the 4-Way TRS and 20-Way TCM Vehicle Harness Connectors. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C ***Purpose:*** *Verify supply voltage to TRS.*

1. Key off.
2. Disconnect 4-Way TRS Harness Connector.
3. Key on with engine off.
4. Measure voltage between 4-Way TRS Harness Connector Pin 1 and Pin 4. Record reading in table.

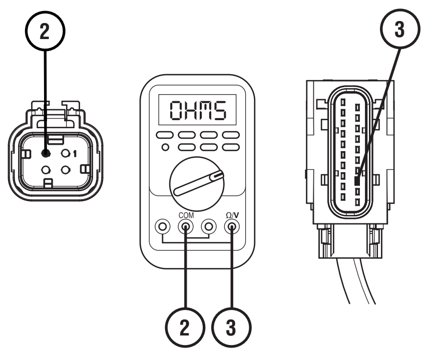


5. Compare reading(s) in table.
   - If reading is within range, go to **Step D.**
   - If reading is out of range, go to **Step E.**

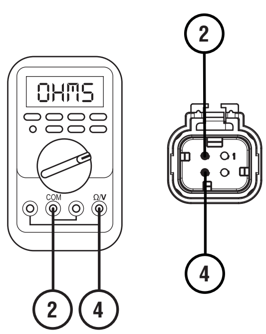
Pins	Range	Reading(s)
1 to 4	4.75–5.25 V	

D ***Purpose:*** *Verify continuity in TRS1 signal wiring. Verify wiring is not shorted to ground.*

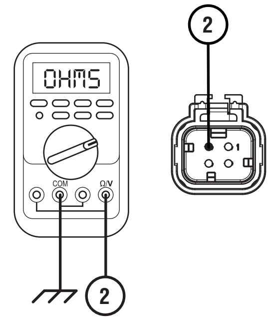
1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Measure resistance between 4-Way TRS Harness Connector Pin 2 and 20-Way TCM Vehicle Harness connector Pin 3. Record reading in table.



4. Measure resistance between 4-Way TRS Harness Connector Pin 2 and Pin 4. Record reading in table.



5. Measure resistance between 4-Way TRS Harness Connector Pin 2 and ground. Record reading in table.

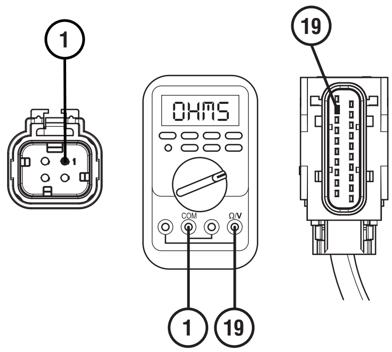


6. Compare reading(s) in table.
   - If any reading is out of range, refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If all readings are in range, replace TRS, perform cable adjustment per OEM guidelines and TRS Calibration with ServiceRanger. Go to **Step V.**

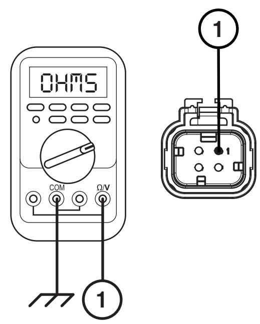
Pins	Range	Reading(s)
2 to 3	0.0–0.3 Ohms	
2 to Ground	Open Circuit (OL)	

E ***Purpose:*** *Verify continuity of TRS power and ground circuit.*

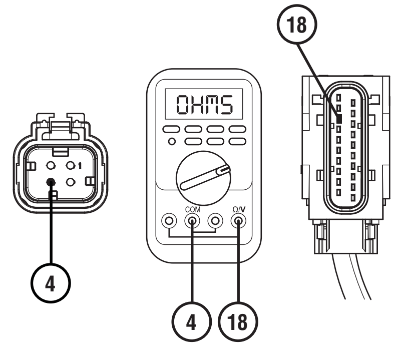
1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Measure resistance between 4-Way TRS Harness Connector Pin 1 and 20-Way TCM Vehicle Harness Connector Pin 19. Record reading in table.



4. Measure resistance between 4-Way TRS Harness Connector Pin 1 and ground. Record reading in table.



5. Measure resistance between 4-Way TRS Harness Connector Pin 4 and 20-Way TCM Vehicle Harness Connector Pin 18. Record reading in table.



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

Pins	Range	Reading(s)
1 to 19	0.0–0.3 Ohms	
1 to Ground	Open Circuit (OL)	
4 to 18	0.0–0.3 Ohms	

F

Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 135 FMI 3, 5, or 6 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 4-Way TRS and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of 20-Way TCM Vehicle Harness. Go to **Step V.**
   - If Fault Code 135 FMI 3, 5, or 6 is Active, replace TCM. Go to **Step V.**

G

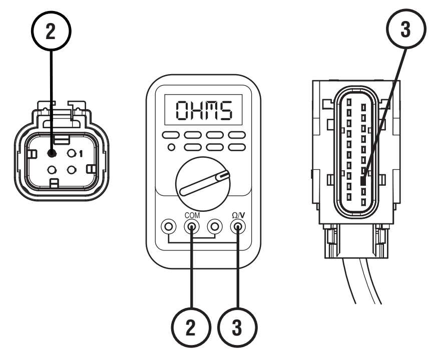
Purpose: Verify Driver Interface Device Configuration with ServiceRanger.

1. Key on.
2. Connect ServiceRanger.
3. Check Driver Interface Device Configuration.
   - If Configured as PBC, change to TRS. Go to **Step V.**
   - If Configured as TRS, go to **Step H.**

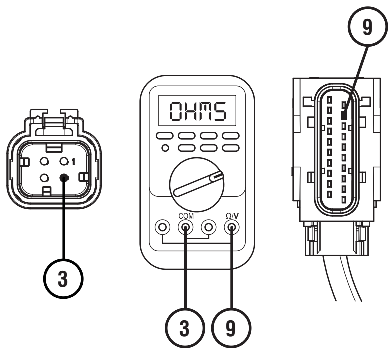
H

Purpose: *Verify continuity of TRS1 and TRS2 signal wiring.*

1. Key off.
2. Disconnect 4-Way TRS Harness Connector.
3. Disconnect 20-Way TCM Vehicle Harness Connector.
4. Measure resistance between 4-Way TRS Harness Connector Pin 2 and 20-Way TCM Vehicle Harness connector Pin 3. Record reading in table.



5. Measure resistance between 4-Way TRS Harness Connector Pin 3 and 20-Way TCM Vehicle Harness connector Pin 9. Record reading in table.



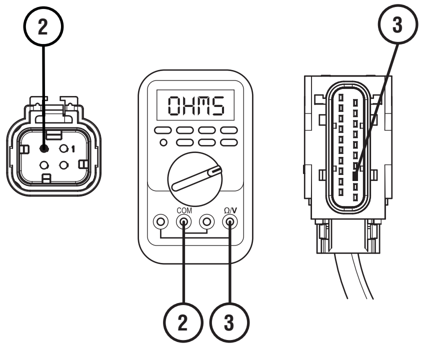
6. Compare reading(s) in table.

- If any reading is out of range, TRS1 and TRS2 signal wires are reversed. Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
- If all readings are in range, replace TRS, perform cable adjustment per OEM guidelines and TRS Calibration with ServiceRanger. Go to **Step V.**

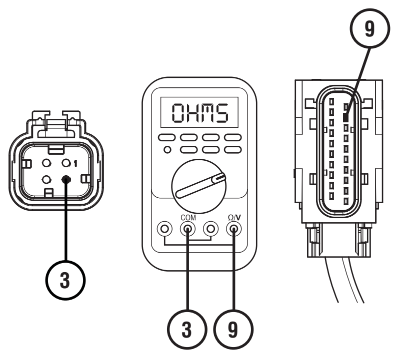
Pins	Range	Reading(s)
2 to 3	0.0–0.3 Ohms	
3 to 9	0.0–0.3 Ohms	

I ***Purpose:*** *Verify continuity of TRS1 and TRS2 signal wiring.*

1. Key off.
2. Disconnect 4-Way TRS Harness Connector.
3. Disconnect 20-Way TCM Vehicle Harness Connector.
4. Measure resistance between 4-Way TRS Harness Connector Pin 2 and 20-Way TCM Vehicle Harness connector Pin 3. Record reading in table.



5. Measure resistance between 4-Way TRS Harness Connector Pin 3 and 20-Way TCM Vehicle Harness connector Pin 9. Record reading in table.



6. Compare reading(s) in table.
   - If any reading is out of range, refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If all readings are in range, replace TRS, perform cable adjustment per OEM guidelines and TRS Calibration with ServiceRanger. Go to **Step V.**

Pins	Range	Reading(s)
2 to 3	0.0–0.3 Ohms	
3 to 9	0.0–0.3 Ohms	

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

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

Fault Code 145: Push Button Controller (PWM) - Secondary

J1939: SA 3 SPN 752 FMI 2, 3, 4, 5, 6, 8, 12, 13, 14

Overview

Vehicles equipped with an Procision Transmission may have an Eaton Push Button Controller (PBC). The PBC broadcasts primary driver shift mode requests to the Transmission Control Module (TCM) through a high speed data link called the Proprietary Network Link (PNL). A redundant secondary Pulse Width Modulated (PWM) signal is broadcast over a separate circuit. This allows for a driver shift mode request to engage the transmission into gear in the event one signal is not available. The PNL and PWM circuits are contained within the 20-Way TCM Vehicle Harness.

Detection

The TCM monitors the PBC driver's shift mode request signal. If an invalid signal is received, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: PWM signal invalid for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: PWM signal greater than 5.25 volts for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Secondary PWM device shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: PWM signal less than 4.75 volts for 1 second.

FMI 6 – Current Below Normal or Shorted Circuit: PWM device voltage less than 4 volts or greater than 6 volts for 1 second.

FMI 8 – Abnormal Frequency: PWM signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: Inappropriate acceptance of non-neutral or non-park mode without brake depression.

FMI 13 – Out of Calibration: Driver interface device not configured.

FMI 14 – Special Instructions: Gear engagement too late after mode change.

Fallback

FMI 2, 3, 4, 5, 6, 8:

- Amber warning lamp on
- No degraded performance

Note: If fault codes 145 and 135 are Active and vehicle is stopped:

- Transmission will not engage a gear from neutral

FMI 13:

- Amber warning lamp on
- Transmission will not engage a gear from neutral
- Primary and Secondary Clutch disengaged
- PTO mode prohibited

FMI 12, 14:

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged
- PTO mode prohibited

Conditions to Set Fault Code Inactive

FMI 2: PWM signal valid for 10 seconds.

FMI 3, 5: Open or short circuit condition not detected for 10 seconds.

FMI 4: Secondary PWM device shorted to ground condition not detected for 10 seconds.

FMI 6: Open or short circuit condition not detected for 10 seconds.

FMI 8: PWM signal frequency in range for 10 seconds.

FMI 13: Driver interface device configured.

FMI 12, 14: Key cycle.

Possible Causes

FMI 2, 3, 4, 5, 6, 8:

- Vehicle Harness
  - Wires shorted to power, shorted to ground, or open
  - Terminals bent, spread, corroded or loose
- PBC
  - Internal Failure
- TCM
  - Internal Failure

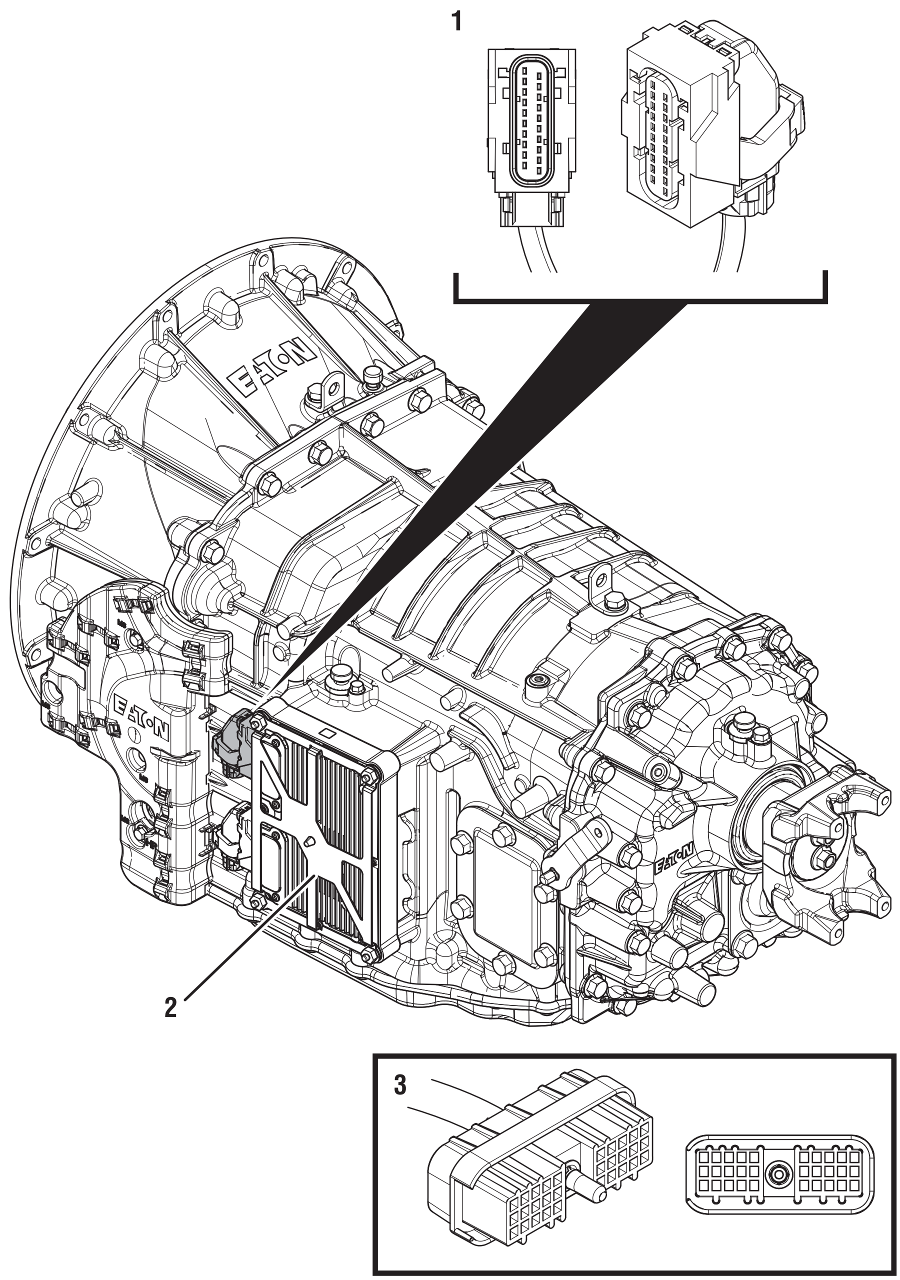
FMI 13:

- Configuration
  - Driver interface device not configured

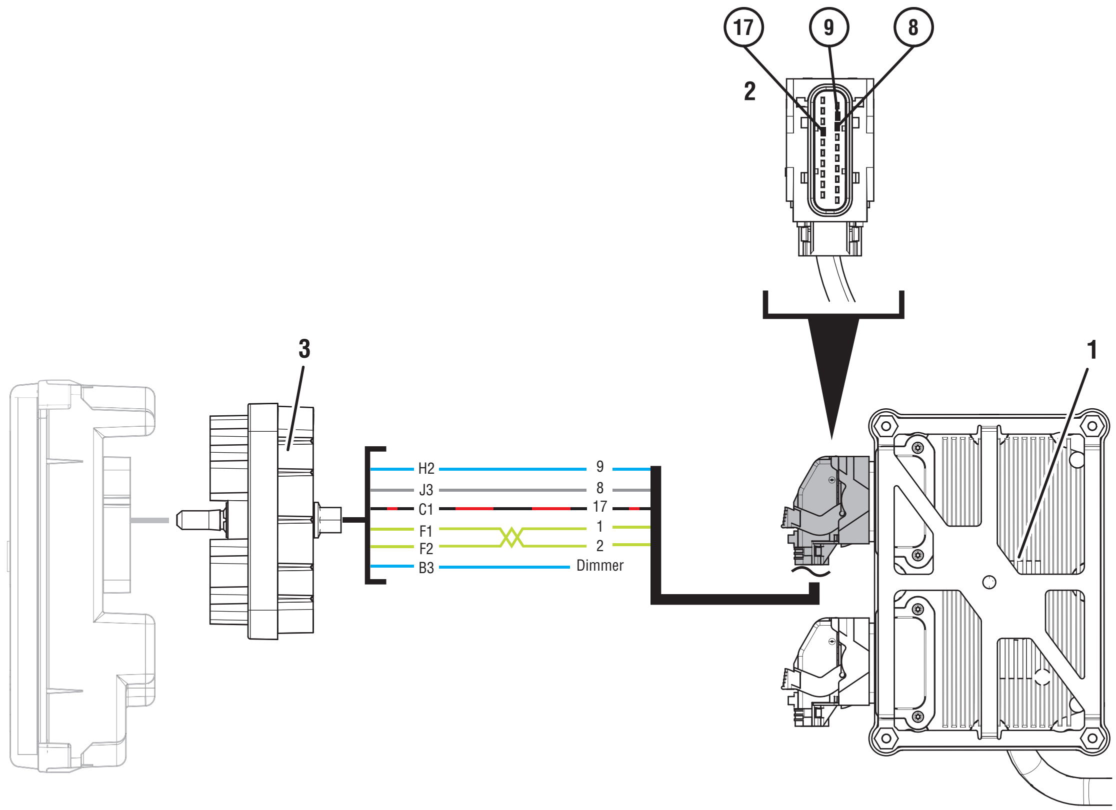
FMI 12, 14:

- Service Brake Signal
  - No signal broadcasted over J1939
  - Incomplete warm up on the transmission

Component Identification



1. 20-Way Vehicle Harness Connector
2. Transmission Control Module (TCM)
3. 30-Way Eaton Push Button Controller (PBC) Connector (In Cab)



1. Transmission Control Module (TCM)
2. 20-Way Vehicle Harness Connector
3. 30-Way Eaton Push Button Controller (PBC) Connector

Fault Code 145 PWM Troubleshooting

A

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

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

   Note: If Fault Code 145 is Inactive and there are other Active fault codes troubleshoot all Active faults first.

   - If Fault Code 145 FMI 2 is set, go to **Step D.**
   - If Fault Code 145 FMI 3, 4, 5, 6, or 8 is Active, go to **Step C.**
   - If Fault Code 145 FMI 3, 4, 5, 6, or 8 is Inactive, go to **Step B.**
   - If Fault Code 145 FMI 13 is Active, Configure Driver Interface Device for Push Button Controller (PBC) using ServiceRanger.
   - If Fault Code 145 FMI 13 is Inactive, Driver Interface Device is configured for Push Button Controller (PBC), test complete.
   - If Fault Code 145 FMI 12 or 14 is set, Contact the Roadranger Call Center at (800)-826-4357 for further instructions.
   - If Fault Code 145 FMI 12 or 14 is set, Use ServiceRanger monitor the Service Brake signal and selector position.

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

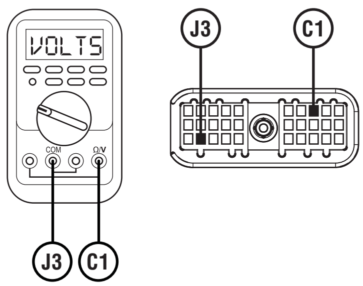
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections between 30-Way PBC and 20-Way TCM Vehicle Harness Connectors. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C ***Purpose:*** Verify power supply to 30-Way PBC Harness Connector.

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

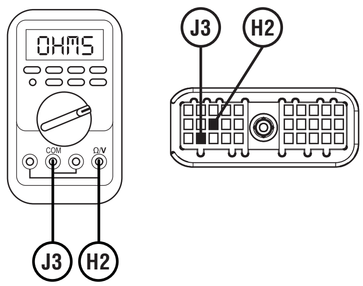


6. Compare reading(s) in table.
   - If reading is within range, go to **Step D.**
   - If reading is out of range, go to **Step F.**

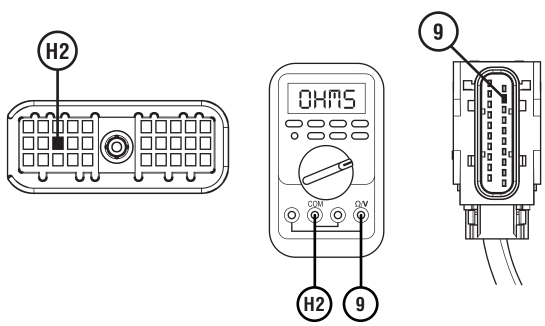
Pins	Range	Reading(s)
C1 to J3	Within 1.2 V of Battery +	

D ***Purpose:*** *Verify continuity of PWM signal wire. Verify wire is not shorted to ground.*

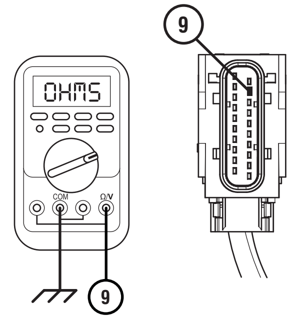
1. Key off.
2. Disconnect 30-Way PBC Harness Connector.
3. Disconnect 20-Way TCM Vehicle Harness Connector.
4. Inspect connectors for corrosion, loose terminals, and bent or spread pins.
5. Measure resistance between 30-Way PBC Harness Connector Pin H2 and Pin J3. Record reading in table.



6. Measure resistance between 30-Way PBC Harness Connector Pin H2 and 20-Way TCM Vehicle Harness Connector Pin 9. Record reading in table.



7. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 9 and ground. Record reading in table.



8. Compare reading(s) in table.
   - If any reading is out of range, refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If all readings are within range, go to **Step E.**

Pins	Range	Reading(s)
H2 to J3	Open Circuit (OL)	
H2 to 9	0.0–0.3 Ohms	
9 to Ground	Open Circuit (OL)	

E

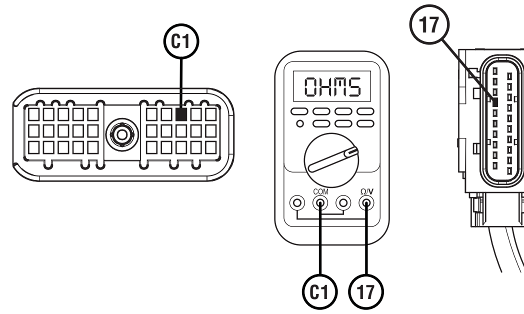
Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 145 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 30-Way PBC and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If Fault Code 145 is Active, send Service Activity Report and contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

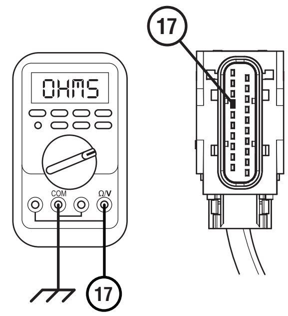
F

Purpose: *Verify continuity of PBC power and ground circuit. Verify power wire is not shorted to ground.*

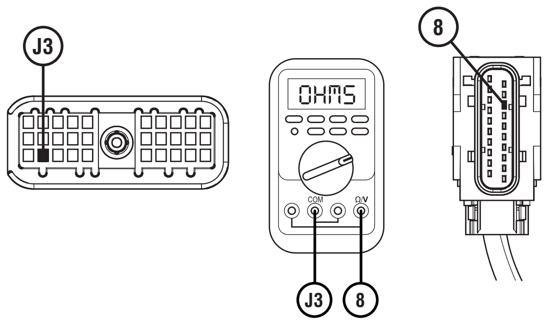
1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Measure resistance between 30-Way PBC Harness Connector Pin C1 and 20-Way TCM Vehicle Harness Connector Pin 17. Record reading in table.



4. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 17 and ground. Record reading in table.



5. Measure resistance between 30-Way PBC Connector Pin J3 and 20-Way TCM Vehicle Harness Connector Pin 8. Record reading in table.



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

Pins	Range	Reading(s)
C1 to 17	0.0–0.3 Ohms	
17 to Ground	Open Circuit (OL)	
J3 to 8	0.0–0.3 Ohms	

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. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 145 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 30-Way PBC and 20-Way TCM Vehicle Harness Connectors. Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If Fault Code 145 is Active, replace TCM. Go to **Step V.**

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

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

Fault Code 145: Shift Lever (TRS2) - Secondary

J1939: SA 3 SPN 752 FMI 0, 1, 3, 5, 6, 8, 12, 13, 14

Overview

The Procision Transmission equipped with a Park Pawl includes a Transmission Ranger Sensor (TRS) to supply the driver's shift mode request signal to the Transmission Control Module (TCM).

The TRS is a dual output sensor, primary (TRS1) and secondary (TRS2). This allows for a redundant driver's shift mode request signal to engage the transmission into gear in the event one signal is not available. The TRS is mounted externally to the transmission at the park pawl linkage and is connected to the TCM via the 20-way TCM Vehicle Harness.

Detection

The TCM monitors the TRS2 driver's mode request signal, If an invalid signal is received, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: TRS calibration failed above the secondary sensor range limit

FMI 1 – Data Valid but Below Normal: TRS calibration failed below the secondary sensor range limit.

FMI 3 – Voltage Above Normal or Shorted High: TRS2 signal greater than 5.25 volts for 1 second.

FMI 5 – Current Below Normal or Open Circuit: TRS2 signal less than 4.75 volts for 1 second.

FMI 6 – Current Above Normal or Shorted Circuit: TRS2 signal less than 4 volts or greater than 6 volts for 1 second.

FMI 8 – Abnormal Frequency: TRS2 signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: Inappropriate acceptance of non-neutral or non-park without brake depression.

FMI 13 – Out of Calibration: Driver interface device not configured.

FMI 14 – Special Instructions: Gear engagement too late after mode change.

Fallback

FMI 0, 1, 3, 5, 6, 8:

- Amber warning lamp on
- No degraded performance

Note: If fault codes 145 and 135 are Active and Output Shaft Speed is below 30 RPM:

- Transmission will not engage a gear from neutral
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

FMI 12, 14

- Transmission will not engage a gear from neutral
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0, 1, 12, 14: Key cycle.

FMI 3, 5, 6: Open or short circuit condition not detected for 10 seconds.

FMI 8: TRS2 signal frequency in range for 10 seconds.

FMI 13: Driver interface device configured.

Possible Causes

FMI 0, 1:

- Shift Lever stuck in between positions during calibration

FMI 3, 5, 6:

- Vehicle Harness
  - Wiring shorted to power, shorter to ground, or open
  - Terminals bent, spread, corroded or loose

FMI 3, 5, 6:

- Vehicle Harness
  - Wiring shorted to power, shorter to ground, or open
  - Terminals bent, spread, corroded or loose
- TRS
  - Internal failure
- TCM
  - Internal failure

FMI 8:

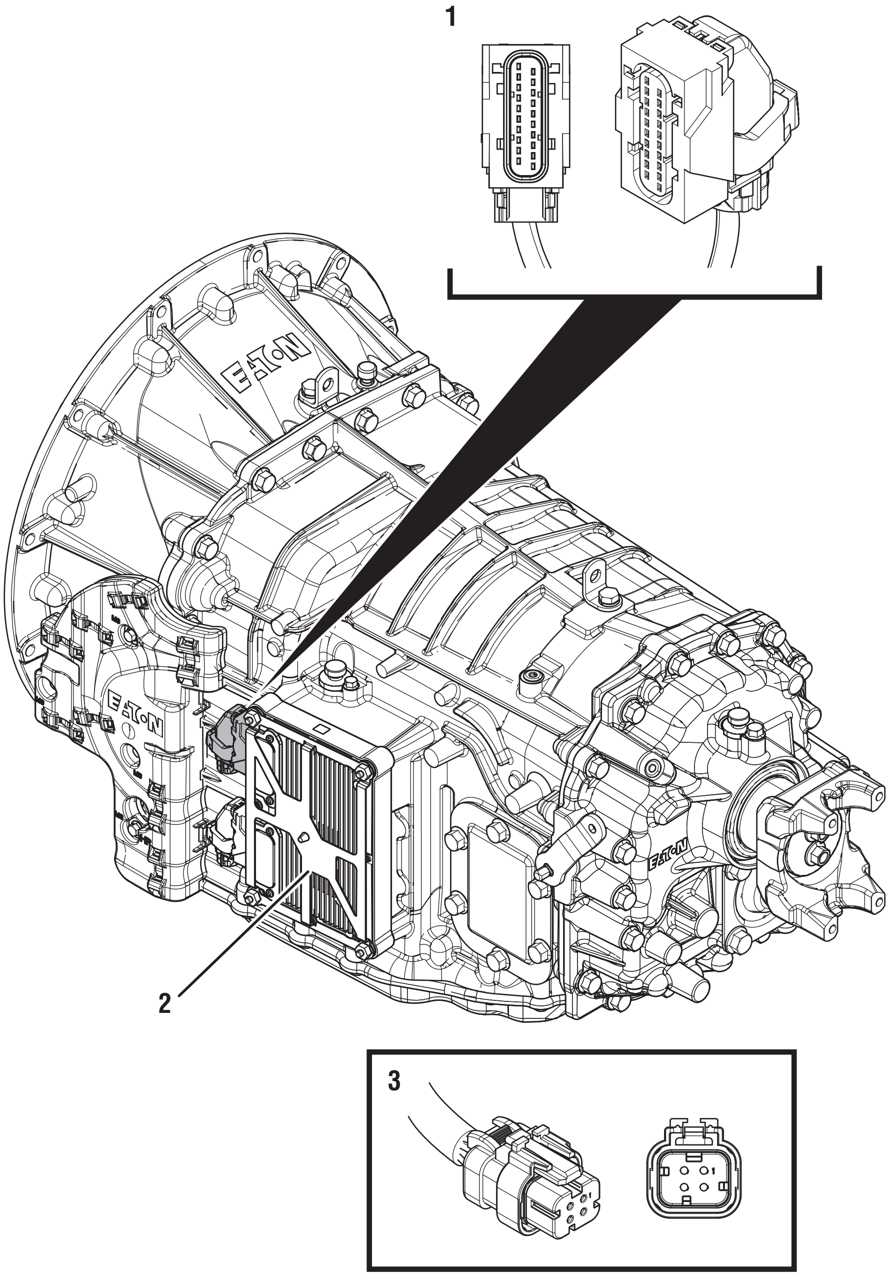
- Configuration
  - Driver interface device configured as a Push Button Controller (PBC)
- Vehicle Harness
  - TRS1 and TRS2 signal circuits wired in reverse
- TRS
  - Internal failure

FMI 13:

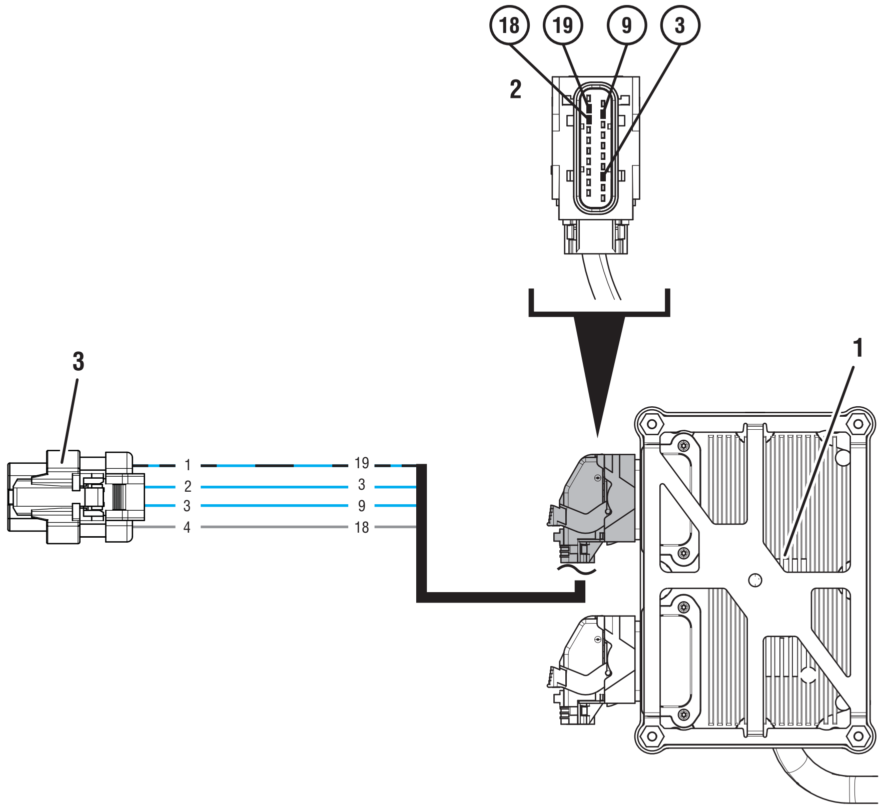
- Configuration
  - Driver interface device not configured

FMI 12, 14:

Component Identification



1. 20-Way Vehicle Harness Connector
2. Transmission Control Module (TCM)
3. 4-Way Transmission Range Sensor (TRS) Connector



1. Transmission Control Module (TCM)
2. 20-Way Vehicle Harness Connector
3. 4-Way Transmission Range Sensor (TRS) Connector

Fault Code 145 TRS2 Troubleshooting

A

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

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

   Note: If Fault Code 145 is Inactive and there are other Active fault codes troubleshoot all Active faults first.

   - If Fault Code 145 FMI 3, 5, or 6 is Active, go to **Step C.**
   - If Fault Code 145 FMI 3, 5, or 6 is Inactive, go to **Step B.**
   - If Fault Code 145 FMI 8 is Active, go to **Step G.**
   - If Fault Code 145 FMI 8 is Inactive, TRS is wired correctly and Driver Interface Device is configured as TRS, test complete.
   - If Fault Code 145 FMI 0 or 1 is set, the TRS calibration failed. Follow ServiceRanger Service Routine and calibrate TRS.
   - If Fault Code 145 FMI 12 or 14 is set, Contact the Roadranger Call Center at 1(800)-413-2866.

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

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

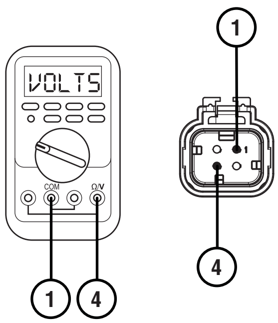
   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections between the 4-Way TRS and 20-Way TCM Vehicle Harness. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the Vehicle Harness, refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify supply voltage to TRS.*

1. Key off.
2. Disconnect 4-Way TRS Harness Connector.
3. Key on with engine off.
4. Measure voltage at 4-Way TRS Harness Connector Pin 1 and Pin 4. Record reading in table.



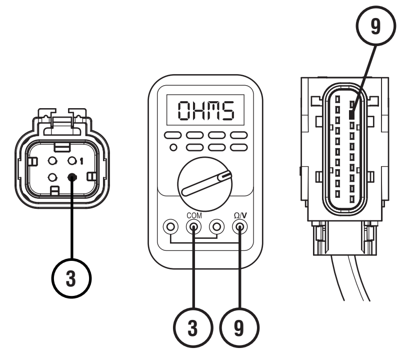
5. Compare reading(s) in table.
   - If reading is within range, go to **Step D.**
   - If reading is out of range, go to **Step E.**

Pins	Range	Reading(s)
1 to 4	4.75–5.25 V	

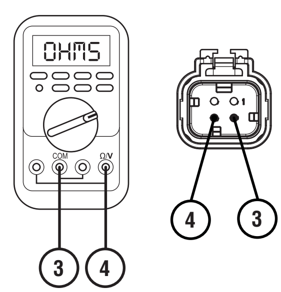
D

Purpose: *Verify continuity of TRS2 signal wiring. Verify wiring is not shorted to ground.*

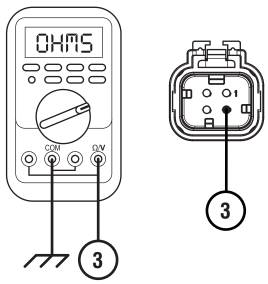
1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Measure resistance between 4-Way TRS Harness Connector Pin 3 and 20-Way TCM Vehicle Harness connector Pin 9. Record reading in table.



4. Measure resistance between 4-Way TRS Harness Connector Pin 3 and Pin 4. Record reading in table.



5. Measure resistance between 4-Way TRS Harness Connector Pin 3 and ground. Record reading in table.



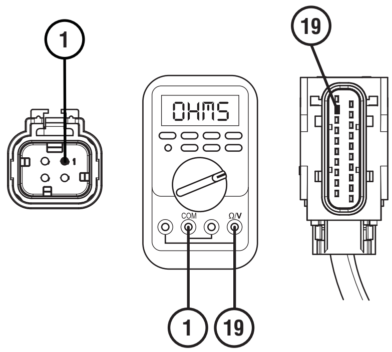
6. Compare reading(s) in table.

- If any reading is out of range, refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
- If all readings are in range, replace TRS, perform cable adjustment per OEM guidelines and TRS Calibration with ServiceRanger. Go to **Step V.**

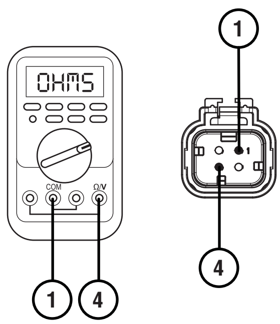
Pins	Range	Reading(s)
3 to 9	0.0–0.3 Ohms	
3 to 4	Open Circuit (OL)	
3 to Ground	Open Circuit (OL)	

E ***Purpose:*** *Verify continuity of TRS power and ground circuit.*

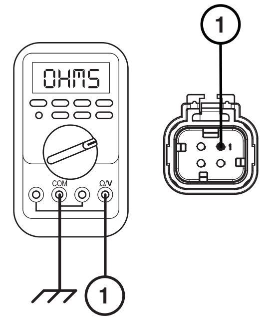
1. Key off.
2. Disconnect 20-Way TCM Vehicle Harness Connector.
3. Measure resistance between 4-Way TRS Harness Connector Pin 1 and 20-Way TCM Vehicle Harness Connector Pin 19. Record reading in table.



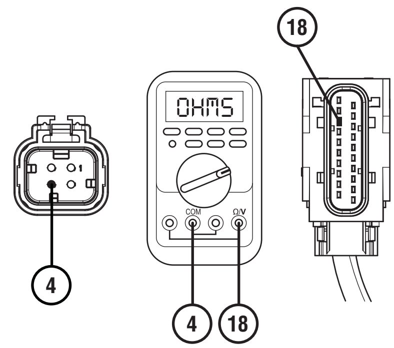
4. Measure resistance between 4-Way TRS Harness Connector Pin 1 and Pin 4. Record reading in table.



5. Measure resistance between 4-Way TRS Harness Connector Pin 1 and ground. Record reading in table.



6. Measure resistance between 4-Way TRS Harness Connector Pin 4 and 20-Way TCM Vehicle Harness Connector Pin 18. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If all readings are within range, go to **Step F.**

Pins	Range	Reading(s)
1 to 19	0.0–0.3 Ohms	
1 to 4	Open Circuit (OL)	
1 to ground	Open Circuit (OL)	
4 to 18	0.0–0.3 Ohms	

F

Purpose: *Verify fault code status.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 145 FMI 3, 5, or 6 is Inactive, no problem was found. The intermittent nature of the fault makes it likely that the problem is between the 4-Way TRS and 20-Way TCM Vehicle Harness Connector. Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If Fault Code 145 FMI 3, 5, or 6 is Active, replace TCM. Go to **Step V.**

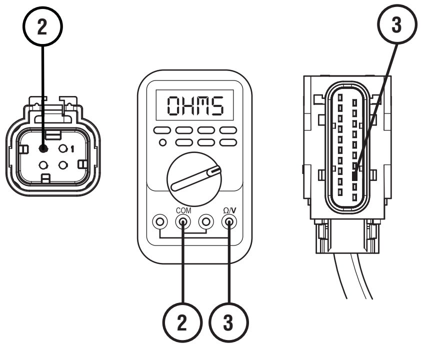
G

Purpose: *Confirm Driver Interface Device configuration with ServiceRanger.*

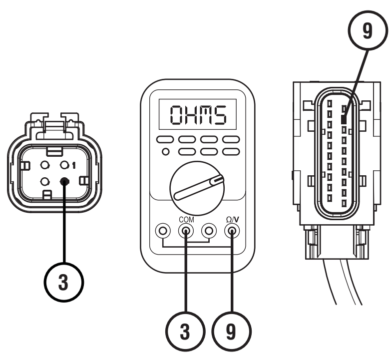
1. Key on with engine off.
2. Connect ServiceRanger.
3. Check Driver Interface Device Configuration:
   - If Configured as PBC, change to TRS, Go to **Step V.**
   - If Configured as TRS, go to **Step H.**

H ***Purpose:*** *Verify continuity of TRS1 and TRS2 signal wiring.*

1. Key off.
2. Disconnect 4-Way TRS Harness Connector.
3. Disconnect 20-Way TCM Vehicle Harness Connector.
4. Measure resistance between 4-Way TRS Harness Connector Pin 2 and 20-Way TCM Vehicle Harness connector Pin 3. Record reading in table.



5. Measure resistance between 4-Way TRS Harness Connector Pin 3 and 20-Way TCM Vehicle Harness connector Pin 9. Record reading in table.



6. Compare reading(s) in table.
   - If any reading is out of range, TRS1 and TRS2 signal wires are reversed. Refer to OEM guidelines for repair or replacement of Vehicle Harness. Go to **Step V.**
   - If all readings are in range, replace TRS, perform TRS Calibration with ServiceRanger. Go to **Step V.**

Pins	Range	Reading(s)
2 to 3	0.0–0.3 Ohms	
3 to 9	0.0–0.3 Ohms	

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

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

Fault Code 155: Park Brake Switch Message (OEM Supplied)

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

Overview

The Procision transmission receives the vehicle's Park Brake Switch message via the J1939 Data Link. This information is used to determine transmission operation.

Detection

The Transmission Control Module (TCM) monitors the Park Brake Switch message. If no Park Brake Switch message is received, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Park Brake Switch message not received for 1 second.

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

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

Fallback

All FMIs: See OEM for troubleshooting a failed system. Brake system fallback modes may vary.

- Amber warning lamp on
- Engine may not crank if vehicle powered down in gear

Note: If powered down in gear and Fault Code 155 is Active, engine may not crank. Apply Service Brake to crank engine.

Conditions to Set Fault Code Inactive

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

Possible Causes

All FMIs:

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

Note: See OEM for troubleshooting a failed system.

Fault Code 155 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to OEM.*

1. There is a fault with the vehicle Park Brake Switch message.

   Note: If fault is Inactive, possible intermittent issue.

   - See OEM for troubleshooting and confirm vehicle Park Brake Switch operation.

Fault Code 160: Service Brake Switch Message (OEM Supplied)

J1939: SA 3 SPN 597 FMI 9, 13, 19, 20

Overview

The Procision transmission receives the vehicle's Service Brake Switch message via the J1939 Data Link. This information is used to determine transmission operation.

Detection

The Transmission Control Module (TCM) monitors the Service Brake Switch message. If message is not received or invalid, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

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

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

FMI 19 – Received Network Data in Error: Service Brake Switch message invalid for 10 seconds.

FMI 20 – Data Drifted High: Service Brake Switch message continuously indicates "Depressed" during acceleration.

Fallback

All FMIs: See OEM for troubleshooting a failed system. Brake system fallback modes may vary.

- Amber warning lamp on
- Creep Mode prohibited
- PTO Mode prohibited
- Transmission may not engage a gear from neutral

Note: If powered down in gear and Fault Code 160 is Active, engine may not crank. Apply Parking Brake to crank engine.

Conditions to Set Fault Code Inactive

FMI 9, 13, 19: Service Brake Switch message received.

FMI 20: Service Brake Switch message indicates "released".

Possible Causes

FMI 9, 13, 19:

- Vehicle Components
  - Service Brake Switch and/or Wiring
  - Module(s)

Note: See OEM for troubleshooting a failed system.

FMI 20:

- Driver Induced
  - Brake pedal continuously depressed while accelerating (two foot)
- Brake Pedal Linkage
  - Obstruction or binding causing brake pedal to stay depressed
- Vehicle Components
  - Service Brake Switch and/or Wiring

Note: See OEM for troubleshooting a failed system.

Fault Code 160 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to OEM.*

1. There is a fault with the vehicle Service Brake Switch message.

   Note: If fault is Inactive, possible intermittent issue.

   - See OEM for troubleshooting and confirm vehicle Service Brake Switch operation.

Fault Code 165: Accelerator Pedal Position Message (OEM Supplied)

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

Overview

The Procision transmission receives the vehicle's Accelerator Pedal Position message via the J1939 Data Link. This information is used to determine transmission performance.

Detection

The Transmission Control Module (TCM) monitors the Accelerator Pedal Position message. If message is not received or invalid, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Accelerator Pedal Position message not received for 1 second.

FMI 13 – Out of Calibration: Accelerator Pedal Position message not available.

FMI 19 – Received Network Data in Error: Accelerator Pedal Position message invalid for 1 second.

Fallback

All FMIs: See OEM for troubleshooting a failed system. Engine fallback modes may vary.

- Amber warning lamp on
- Shift strategy may be altered

Conditions to Set Fault Code Inactive

All FMIs: Valid Accelerator Pedal Position messages received for 10 seconds.

Possible Causes

All FMIs:

- Vehicle Components
  - Accelerator Pedal Position Sensor and/or Wiring
  - Module(s)

Note: See OEM for troubleshooting a failed system.

Fault Code 165 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to OEM.*

1. There is a fault with the vehicle Accelerator Pedal Position message.

   Note: If fault is Inactive, possible intermittent issue.

   - See OEM for troubleshooting and confirm vehicle Accelerator Pedal Position operation.

Fault Code 166: Accelerator Interlock Switch Message (OEM Supplied)

J1939: SA 3 SPN 972 FMI 9, 13, 19

Overview
The Procision transmission receives the vehicle's Accelerator Interlock Switch message via the J1939 Data Link. This information is used to determine transmission performance.

Detection
The Transmission Control Module (TCM) monitors the Accelerator Interlock Switch message. If message is not received or invalid, the TCM will set the fault code Active.

Conditions to Set Fault Code Active
FMI 9 – Abnormal Update Rate: Accelerator Interlock Switch message not received for 1 second.

FMI 13 – Out of Calibration: Accelerator Interlock Switch message not available.

FMI 19 – Received Network Data in Error: Accelerator Interlock Switch message invalid for 1 second.

Fallback
All FMIs: See OEM for troubleshooting a failed system. Engine fallback modes may vary.

- Amber warning lamp on
- Shift strategy may be altered

Conditions to Set Fault Code Inactive
All FMIs: Valid Accelerator Interlock Switch messages received for 10 seconds.

Possible Causes
All FMIs:

- Vehicle Components
  - Accelerator Interlock Switch Sensor and/or Wiring
  - Module(s)

Note: See OEM for troubleshooting a failed system.

Fault Code 166 Troubleshooting

A *Purpose: Direct troubleshooting to OEM.*

1. There is a fault with the vehicle Accelerator Interlock Switch message.

   Note: If fault is Inactive, possible intermittent issue.

   - See OEM for troubleshooting and confirm vehicle Accelerator Interlock Switch operation.

Fault Code 170: Front Axle Speed Message (OEM Supplied)

J1939: SA 3 SPN 904 FMI 9, 13, 19

Overview

The Procision transmission receives the vehicle's Front Axle Speed message via the J1939 data link. The transmission can utilize this input in the event Output Shaft Speed is unavailable.

Detection

The Transmission Control Module (TCM) monitors the Front Axle Speed message. If message is not received or invalid, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Front Axle Speed message not received for 10 seconds.

FMI 13 – Out of Calibration: Front Axle Speed message not available for 10 seconds.

FMI 19 – Received Network Data in Error: Front Axle Speed message invalid for 10 seconds.

Fallback

All FMIs: See OEM for troubleshooting a failed system. Brake system fallback modes will vary.

- Amber warning lamp on
- No degraded performance

Conditions to Set Fault Code Inactive

All FMIs: Valid Front Axle Speed messages received for 10 seconds.

Possible Causes

All FMIs:

- Vehicle Components
  - Front Axle Speed Sensor and/or Wiring
  - Module(s)

Note: See OEM for troubleshooting a failed system.

Fault Code 170 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to OEM.*

1. There is a fault with the vehicle Front Axle Speed message.

   Note: If fault is Inactive, possible intermittent issue.

   - See OEM for troubleshooting and confirm vehicle Front Axle Speed operation.

Fault Code 175: Engine Requested Torque

J1939: SA 3 SPN 518 FMI 12, 14

Overview

The Procision transmission broadcasts the Engine Requested Torque message to the Engine ECU via the J1939 data link. This message is used to command engine torque output.

Detection

The Transmission Control Module (TCM) monitors the Engine Requested Torque message. If message is invalid, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 12 – Bad Intelligent Device: Inappropriately high engine torque commanded.

FMI 14 – Special Instructions: Inappropriately high engine retarder torque commanded.

Fallback

All FMIs:

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

All FMIs: Key cycle

Possible Causes

All FMIs:

- TCM
  - Software issue
  - Internal failure

Additional Tools

Reference TRSM0990 for all removal, installation, and service procedures

Fault Code 175 Troubleshooting

A ***Purpose:*** *Contact Roadranger Call Center for assistance.*

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

- Contact Eaton at (800) 826-4357 for further diagnostic instructions.

Fault Code 176: Engine Idle Shutdown

J1939: SA 3 SPN 593 FMI 31

Overview

The Procision transmission monitors engine operation via the J1939 Data Link. This information is used to determine transmission performance.

Detection

The Transmission Control Module (TCM) monitors the engine, if the engine shuts down due to excessive idle time, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 31 – Condition Exists: Engine has shut down due to excessive idle time.

Fallback

FMI 31: See OEM for troubleshooting a failed system. Engine fallback modes may vary.

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 31: Key cycle.

Possible Causes

FMI 31:

- Engine
  - Idle shutdown requirements

Fault Code 176 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to OEM.*

1. Verify operation of the engine idle shut down system.
   - If no fault sets, normal operation, test complete.
   - If fault sets, see OEM for troubleshooting and confirm vehicle engine idle shut down system operation.

Fault Code 180: Engine Configuration Message (OEM Supplied)

J1939: SA 3 SPN 188 FMI 1, 2, 9

Overview

The Procision transmission receives the vehicle's Engine Configuration Message via the J1939 data link. This information is used to determine transmission performance.

Detection

The Transmission Control Module (TCM) monitors the Engine Configuration Message. If message is not received or invalid, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 1 – Data Valid but Below Normal: Idle speed message less than 700 RPM for 5 seconds.

FMI 2 – Data Erratic, Intermittent, or Incorrect: Engine torque output message out of range for 5 seconds.

FMI 9 – Abnormal Update Rate: Engine Configuration Message not received for 5 seconds.

Fallback

All FMIs: See OEM for troubleshooting a failed system. Engine fallback modes may vary.

- Amber warning lamp on
- Shift strategy may be altered
- Shift and launch quality may degrade

Conditions to Set Fault Code Inactive

All FMIs: Valid Engine Configuration Message received.

Possible Causes

All FMIs:

- Vehicle Components
  - Setting(s)
  - Module(s)

Note: See OEM for troubleshooting a failed system.

Fault Code 180 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to OEM.*

1. There is a fault with the vehicle Engine Configuration Message.

   Note: If fault is Inactive, possible intermittent issue.

   - See OEM for troubleshooting.

Fault Code 185: Driver Demanded Torque Message (OEM Supplied)

J1939: SA 3 SPN 512 FMI 9, 13, 19

Overview

The Procision transmission receives the Driver's Demanded (Engine Percent) Torque message via the J1939 data link. The demand is based off of accelerator pedal position and other inputs. This information is used to determine transmission performance.

Detection

The Transmission Control Module (TCM) monitors the Driver Demanded Torque messages. If messages are not received or invalid, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Driver Demanded Torque message not received for 1 second.

FMI 13 – Out of Calibration: Driver Demanded Torque not available.

FMI 19 – Received Network Data in Error: Driver Demanded Torque message invalid for 1 second.

Fallback

All FMIs: See OEM for troubleshooting a failed system. Engine fallback modes will vary.

- Amber warning lamp on
- Shift strategy may be altered
- Shift and launch quality may degrade

Conditions to Set Fault Code Inactive

All FMIs: Valid Engine Percent Torque messages received for 10 seconds.

Possible Causes

All FMIs:

- Vehicle Components
  - Module(s)

Note: See OEM for troubleshooting a failed system.

Fault Code 185 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to OEM.*

1. There is a fault with the Driver Demanded Torque message sent from the Engine ECU.

   Note: If fault is Inactive, there is an intermittent issue.

   - See OEM for troubleshooting.

Fault Code 195: Engine Protection Mode

J1939: SA 3 SPN 1110 FMI 31

Overview
The Procision transmission receives the engine protection message via the J1939 Data Link. This information is used to determine transmission performance.

Detection
The Transmission Control Module (TCM) monitors the engine protection message. If the message is received, the TCM will set the fault code Active.

Conditions to Set Fault Code Active
FMI 31 – Condition Exists: Loss of Engine fueling, the fault code will set Active after 1 second.

Fallback
FMI 31: See Engine Manufacturer for troubleshooting a failed system. Engine fallback modes may vary.

- Amber warning lamp on
- Creep mode prohibited
- Primary and Secondary clutch disengaged
- PTO mode prohibited
- Stays in current gear

Conditions to Set Fault Code Inactive
FMI 31: Valid engine operation messages received for 10 seconds.

Possible Causes
FMI 31:

- Engine Components
  - Mechanical component(s)
  - Module(s)

Note: See Engine Manufacturer for troubleshooting a failed system.

Fault Code 195 Troubleshooting

A ***Purpose:*** *Direct troubleshooting to Engine Manufacturer.*

1. There is a fault with the Engine.

Note: If fault is Inactive, possible intermittent issue.

- See Engine Manufacturer for troubleshooting and confirm operation.

Fault Code 199: Direction Mismatch

J1939: SA 3 SPN 1571 FMI 12

Overview

The Procision transmission receives a driver shift mode request. The Transmission Control Module (TCM) commands gear engagement based on driver shift mode request.

Detection

The TCM monitors the driver shift mode request and the shift rail feedback position. If the shift rail position does not match the displayed gear position, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 12 – Bad Intelligent Device: The displayed gear position does not match requested gear position.

Fallback

FMI 12:

- Transmission will not engage a gear from neutral
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 12: Key cycle.

Possible Causes

FMI 12:

- TCM
  - Software issue
  - Internal failure

Fault Code 199 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 199 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 199 sets Active during test drive, go to **Step A.**
   - If a fault code other than 199 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 200 TCM Operation 1

J1939: SA 3 SPN 629 FMI 11, 13, 14, 31

Overview

The Procision transmission is equipped with a Transmission Control Module (TCM). The TCM communicates with the vehicle and receives feedback from sensors to control transmission performance. The TCM is mounted to the transmission and connected to the vehicle via the 20-way TCM Vehicle Harness and 20-way Body Harness (optional). The TCM is connected to the transmission sensors and solenoids via the 74-Way Transmission Harness.

Detection

The TCM performs a self-check during operation. If a failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 11 – Root Cause Unknown: TCM experienced a reset.

FMI 13 – Out of Calibration: Loss of calibration data.

FMI 14 – Special Instructions: TCM is not configured for a Procision transmission.

FMI 31 – Condition Exists: Power up sequence failed, corrupt data.

Fallback

FMI 11, 31:

- Amber warning lamp on
- No degraded performance

FMI 13, 14:

- Amber warning lamp on
- Engine may not crank
- Gear engagement prohibited
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

All FMIs:

- Condition no longer exists

Possible Causes

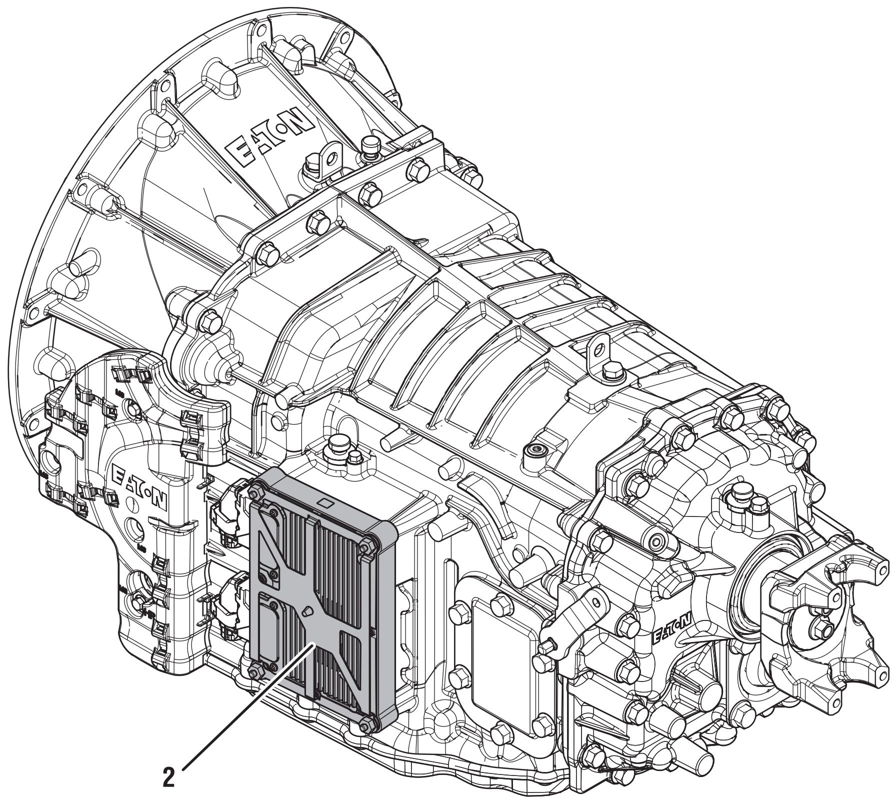
All FMIs:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)

Fault Code 200 Troubleshooting

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

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

   Note: If fault code 200 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 200 FMI 11 is Inactive and software update is available and performed, test complete. Go to **Step V.**
   - If Fault Code 200 FMI 11 is set and software update is not available, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 200 FMI 13 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 200 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 200 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 205 TCM Operation 2

J1939: SA 3 SPN 609 FMI 9, 19

Overview

The Procision transmission is equipped with a Transmission Control Module (TCM). The TCM communicates with the vehicle and receives feedback from sensors to control transmission performance. The TCM is mounted to the transmission and connected to the vehicle via the 20-way TCM Vehicle Harness and 20-way Body Harness (optional). The TCM is connected to the transmission sensors and solenoids via the 74-Way Transmission Harness.

Detection

The TCM performs a self-check during operation. If a failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 9 – Abnormal Update Rate: Processor time out detected.

FMI 19 – Received Network Data in Error: SPI bus error.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded performance

Conditions to Set Fault Code Inactive

All FMIs:

- Key cycle

Possible Causes

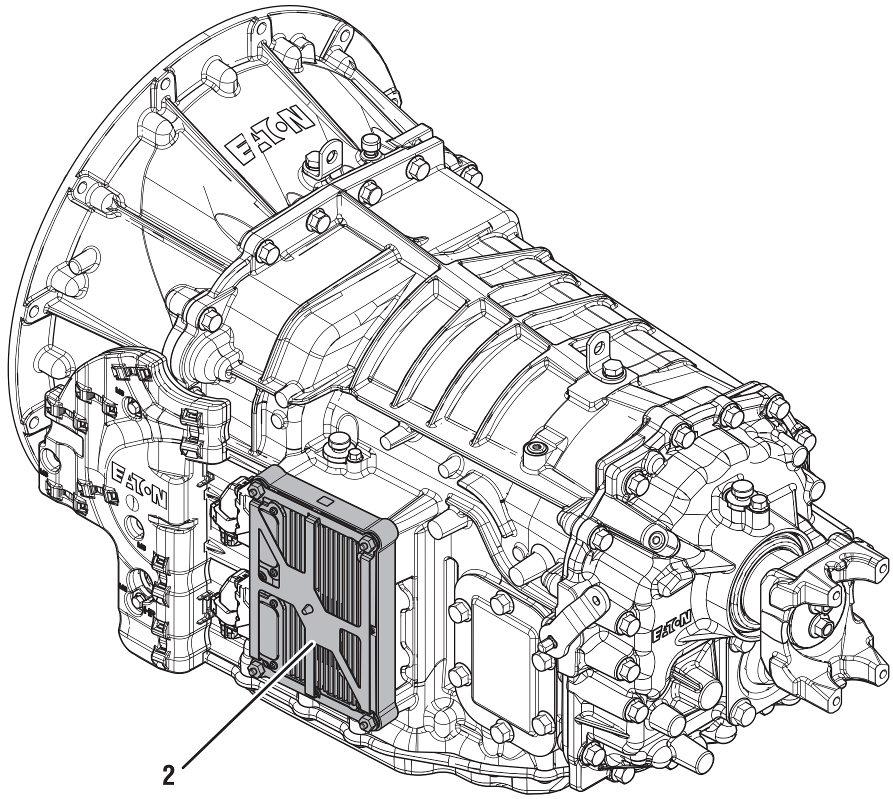
All FMIs:

- TCM
  - Software issue
  - Internal failure

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)

Fault Code 205 Troubleshooting

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

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

   Note: If fault code 205 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 205 FMI 9 or 19 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions.

Fault Code 210: Line Pressure

J1939 SA 3 SPN 127 FMI 0, 1, 2, 3, 5, 6, 7, 13, 15, 17, 18, 20, 21, 31

Overview

The Procision transmission is equipped with a Triple Pressure Sensor (TPS) to monitor oil pressures within the hydraulic system and sump oil temperature. The supply oil to the Actuation Control Manifold (ACM) controls all hydraulic operations. The pressure of the supply oil, or Line Pressure, is critical for proper transmission operation. The TPS is located on the ACM and is connected to the Transmission Control Module (TCM) via the Transmission Harness.

Detection

The TCM monitors the Line Pressure signal from the TPS. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Line Pressure greater than TCM requested.

FMI 1 – Data Valid but Below Normal (Most Severe): Line Pressure less than 36.25 psi (2.5 bar) for 2 seconds.

FMI 2 – Data Erratic: Line Pressure out of range for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Line Pressure Signal greater than 4.8 V for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Line Pressure Signal less than 0.25 V for 1 second.

FMI 6 - Current Above Normal or Shorted Circuit: TPS secondary power supply voltage out of range for 1 second.

FMI 7 – Mechanical System Not Responding: Line Pressure calibration failed consistency check. Rising Line Pressure does not match falling Line Pressure at same Current value.

FMI 13 – Out of Calibration: No Line Pressure calibration data stored.

FMI 15 – Data Valid but Above Normal: Line Pressure calibration greater than maximum limit.

FMI 17 – Data Valid but Below Normal: Line Pressure calibration less than minimum limit.

FMI 18 – Data Valid But Below Normal (Moderately Severe): Line Pressure less than requested for 2 seconds.

FMI 20 – Data Drifted High: Line Pressure falsely reported above 29 psi (2 bar) with engine not running.

FMI 21 - Data Drifted Low: Line Pressure falsely reported at least 43.5 psi (3 bar) below requested and 43.5 psi (3 bar) below Primary or Secondary Clutch pressure.

FMI 31 - Condition Exists: J1939 reports engine RPM, but transmission detects no engine speed or Line Pressure.

Fallback

FMI 1:

- Red and amber warning lamp on
- PTO Mode prohibited

FMI 0, 2, 3, 5, 6, 13, 20, 21, 31:

- Amber warning lamp on
- No degraded performance

FMI 7, 15, 17:

- No degraded performance

FMI 18:

- Amber warning lamp on
- PTO Mode prohibited
- Possible clutch slip or engine flare

Conditions to Set Fault Code Inactive

FMI 0: Line Pressure matches TCM requested for 10 seconds.

FMI 1: Line Pressure greater than 36.25 psi (2.5 bar) for 2 seconds.

FMI 2: Line Pressure in range for 10 seconds.

FMI 3: Line Pressure signal less than 4.8 V for 1 second.

FMI 5: Line Pressure signal greater than 0.25 V for 10 seconds.

FMI 6: Triple Pressure Sensor (TPS) secondary power supply voltage in range.

FMI 7, 13, 15, 17: Successful Line Pressure calibration performed.

FMI 18, 21: Key cycle

FMI 20: Line Pressure correctly reported as a realistic value for 10 seconds.

FMI 31: Transmission detects engine speed and Line Pressure with J1939 reporting engine RPM.

Possible Causes

FMI 0, 15:

- Line Pressure Valve (LPV)
  - Stuck closed
- Line Pressure Solenoid (LPS)
  - Stuck open

FMI 1, 7, 17, 18:

- Low oil level
- Sump Pan Filter
  - Clogged
  - O-ring damaged
  - Neck cracked
- TPS
  - O-ring leak
- LPV
  - Stuck open
- LPS
  - Stuck closed
- High Pressure Relief Valve (HRV)
  - Stuck open
- Low Pressure PTO (LPTO) and High Pressure PTO (HPTO) ports
  - External oil leaks
- Internal oil leaks

FMI 2, 3, 5, 6:

- Transmission Harness
  - Shorted to power, Shorted to ground, or Open.
- TPS
  - Internal failure
- TCM
  - Internal failure

FMI 13:

- No Line Pressure calibration data stored.

FMI 20, 21:

- TPS
  - Internal failure

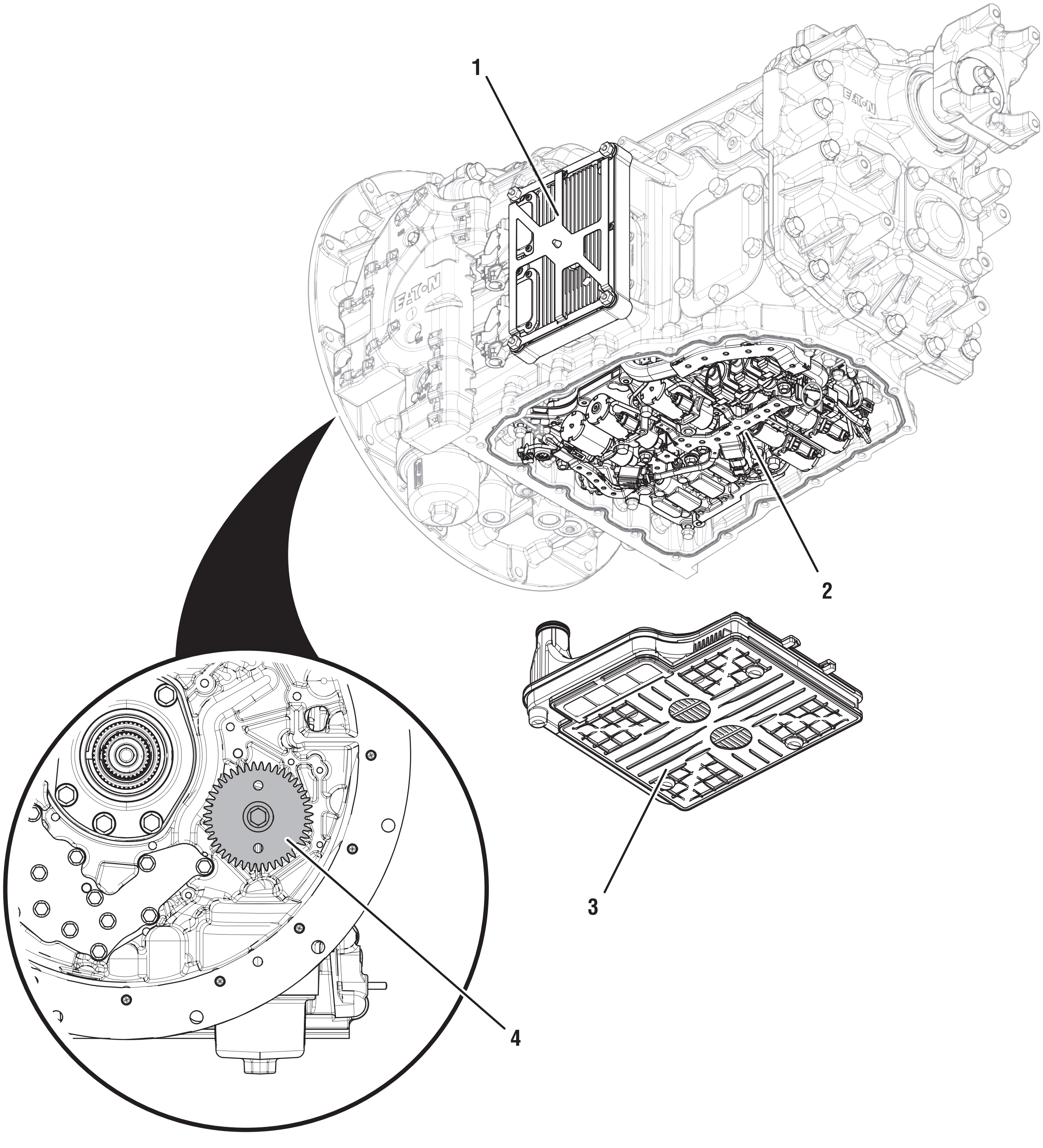
FMI 31:

- Pump Driven Gear
  - Teeth missing
- Pump Drive Gear
  - Teeth missing
- Pump
  - Drive shaft failure
- Damper
  - Internal failure
- Dual Clutch Module
  - Input shaft failure

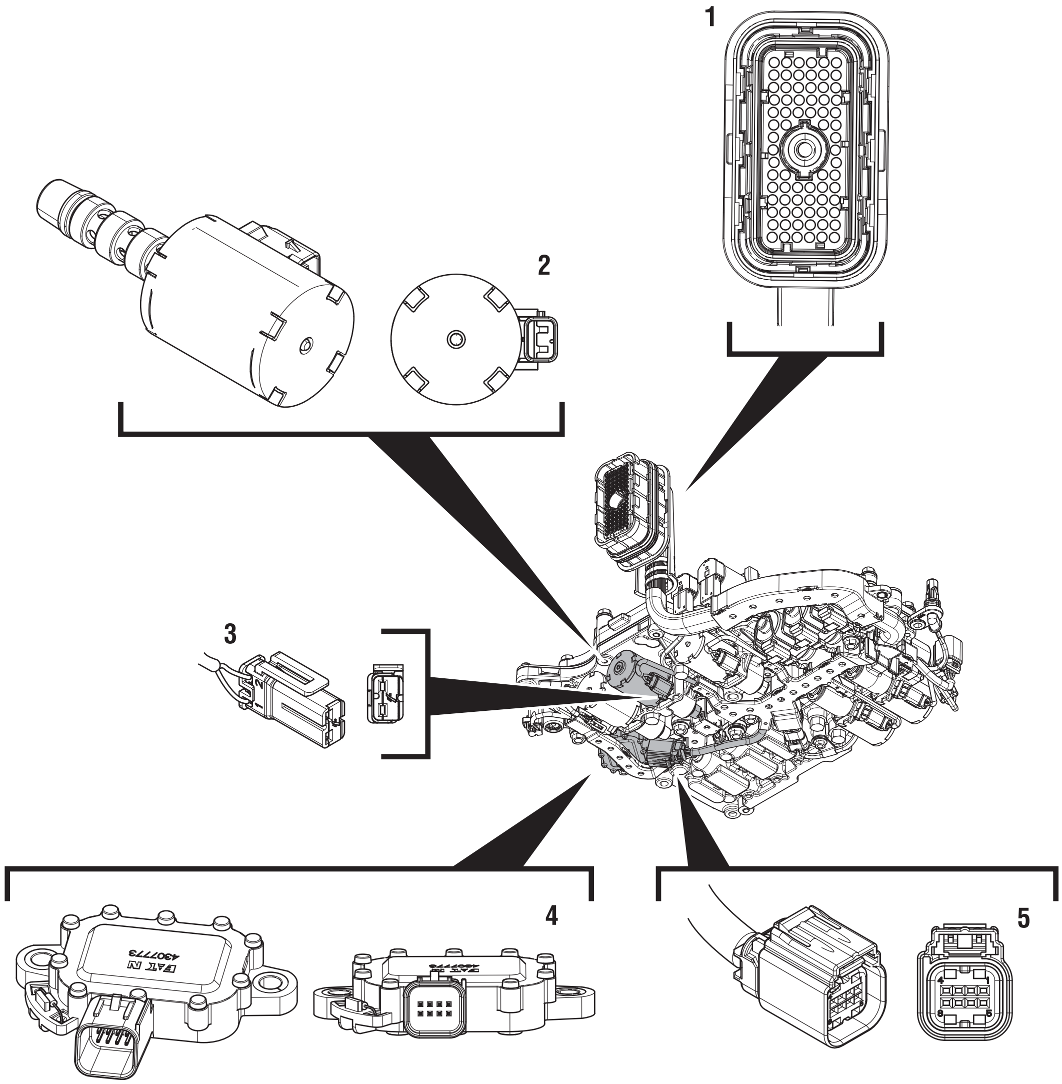
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

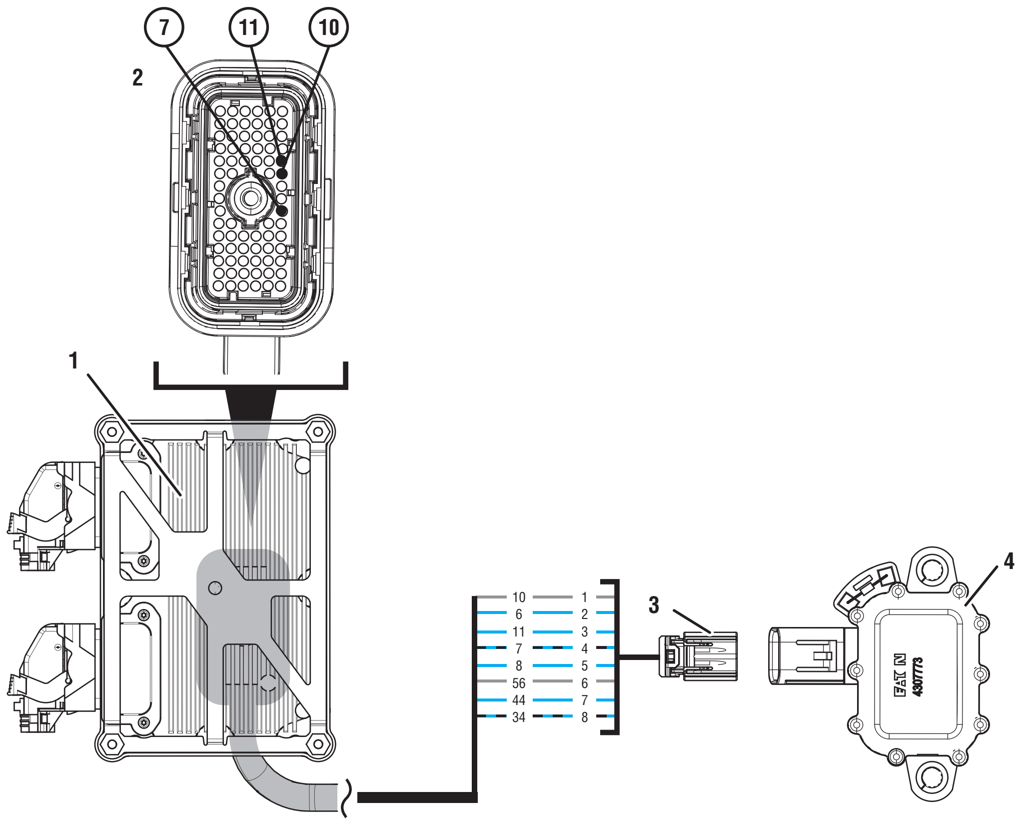
Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Sump Pan Filter
4. Pump Driven Gear (Inside Clutch Housing)



Actuation Control Manifold (ACM)
1. 74-Way Transmission Harness Connector
2. 2-Way Line Pressure Solenoid (LPS)
3. 2-Way Line Pressure Solenoid (LPS) Connector
4. 8-Way Triple Pressure Sensor (TPS)
5. 8-Way Triple Pressure Sensor (TPS) Connector



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *8-Way Triple Pressure Sensor (TPS) Connector*
4. *8-Way Triple Pressure Sensor (TPS)*

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

Fault Code 210 Troubleshooting

A

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

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

   Note: If fault code 210 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 210 FMI 0, 15, or 31 is set, go to **Step C.**
   - If Fault Code 210 FMI 1, 7, 17, or 18 is set, go to **Step B.**
   - If Fault Code 210 FMI 2, 3, 5, or 6 is Active, go to **Step I.**
   - If Fault Code 210 FMI 2, 3, 5, or 6 is Inactive, go to **Step H.**
   - If Fault Code 210 FMI 13 is set, perform Line Pressure Calibration. Test Complete.
   - If Fault Code 210 FMI 20 or 21 is set, replace TPS. Go to **Step V.**

B

Purpose: *Verify oil level.*

1. Verify oil level per service manual TRSM0990 - Oil Level Inspection Procedure.
   - If oil level is low, add correct amount of oil and inspect for leaks. Go to **Step V.**
   - If oil level is within normal operating range, go to **Step C.**

C

Purpose: *Perform Line Pressure test.*

1. Set parking brake and chock wheels.
2. Key on with engine off.
3. Select “Service Routines”.
4. Select “Line Pressure Test” and follow on-screen prompts.

   Note: If equipped with a PTO and PTO or hose(s) are leaking, this may cause Fault Code 210 to set.

   - If Line Pressure Test is successful, select “Service Activity Report” to retrieve Snapshot and Vehicle Performance Analysis (VPA) data.. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Line Pressure Test is unsuccessful and Fault Code 210 FMI 0 or 15 set, select “Service Activity Report” to retrieve Snapshot and VPA data. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Line Pressure Test is unsuccessful and Fault Code 210 FMI 1, 7, 17, or 18 set, go to **Step D.**
   - If Line Pressure Test is unsuccessful and Fault Code 210 FMI 31 set, go to **Step N.**

D

Purpose: *Inspect Sump Pan Filter.*

1. Key off.
2. Remove Oil Drain Plug and drain oil.
3. Remove Sump Pan and Sump Pan Filter.
4. Inspect for transmission damage and contamination.
5. Inspect Sump Pan Filter and O-ring seal for cracks or other damage.
    - If Sump Pan Filter or O-ring seal is damaged, replace. Go to **Step V.**
    - If transmission damage or contamination is found, contact Eaton at (800) 826-4357 for further diagnostic instructions.Go to **Step V.**
    - If no transmission damage or contamination is found, go to **Step E.**

E

Purpose: *Inspect Triple Pressure Sensor (TPS).*

1. Remove TPS from ACM.
2. Inspect TPS and O-rings for damage.
    - If TPS or O-rings are damaged, replace TPS. Go to **Step V.**
    - If no damage is found. go to **Step F.**

F

Purpose: *Inspect Line Pressure Solenoid (LPS).*

1. Remove LPS from ACM.
2. Inspect LPS for contamination.
    - If LPS is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
    - If LPS is not contaminated, go to **Step G.**

G

Purpose: *Inspect ACM to Interface Manifold (IM) gasket.*

1. Remove ACM.
2. Inspect ACM to IM gasket for damage.
    - If ACM to IM gasket is damaged, replace gasket. Go to **Step V.**
    - If no damage is found, replace LPS. Go to **Step V.**

H

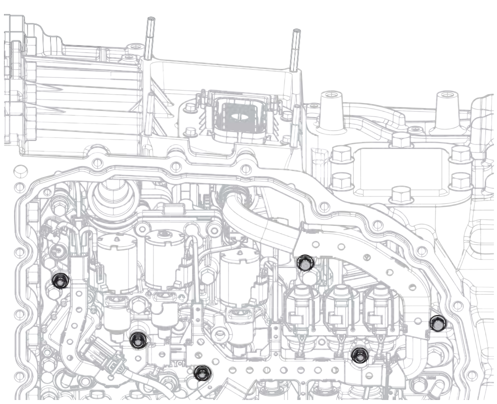
Purpose: *Use Product Diagnostic (PD) Test to identify intermittent wiring or connection.*

1. Set parking brake and chock wheels
2. Key off.
3. Remove Oil Drain Plug and drain oil.
4. Remove Sump Pan and Sump Pan Filter.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Go To “Service Routines”.
8. Start “Product Diagnostic Test” and follow on-screen prompts.

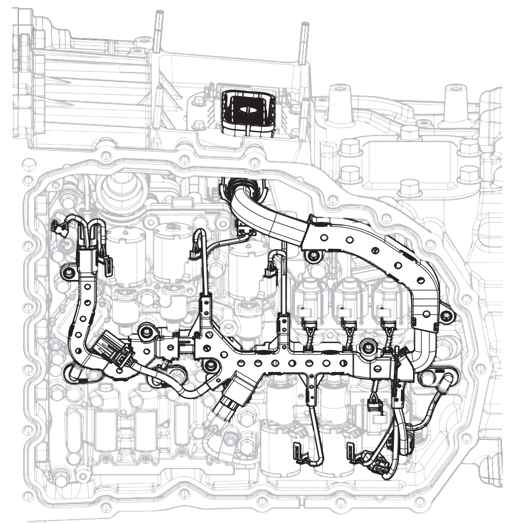
   Note: Solid “PD” may appear in display when PD Test is active.

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

9. Remove 6 Transmission Harness 10 mm cap screws.



10. Flex the wiring harness and connector bodies. Look for any signs of wire rubbing or chafing.



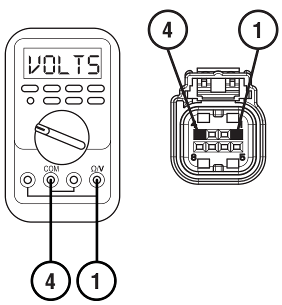
11. When complete select Stop to exit PD Test.
    - If any fault codes set Active replace Transmission Harness. Go to **Step V.**
    - If no fault codes set Active, go to **Step I.**

I

Purpose: *Verify Triple Pressure Sensor (TPS) secondary power supply.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove Oil Drain Plug and drain oil.
4. Remove Sump Pan and Sump Pan Filter.
5. Disconnect 8-Way TPS Harness Connector from TPS.

   Note: Connector red lock tab must be unlatched and the top of the connector depressed to remove.
6. Key on with engine off.
7. Measure voltage between TPS Harness Connector Pin 1 and Pin 4. Record reading in table.

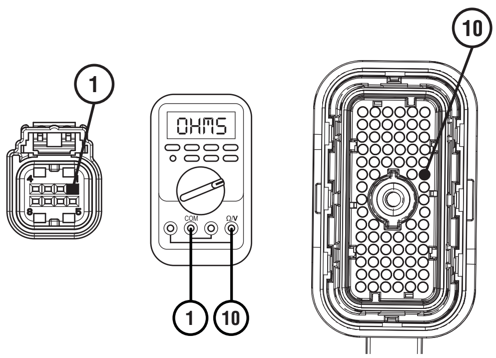


8. Compare reading(s) in table.
   - If reading is out of range, go to **Step J.**
   - If reading is in range, go to **Step K.**

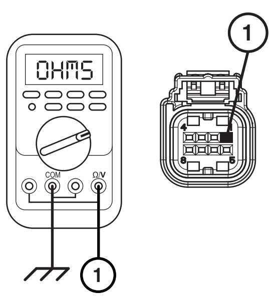
Pins	Range	Reading(s)
1 to 4	4.90–5.10 V	

J ***Purpose:*** *Verify continuity of Triple Pressure Sensor (TPS) secondary power supply circuit.*

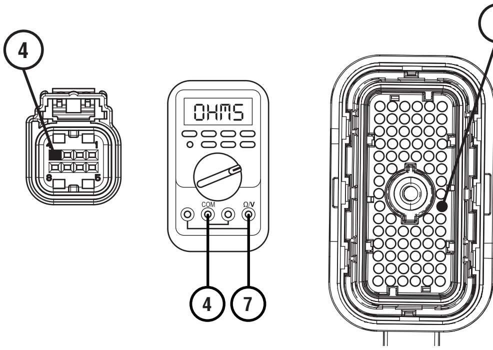
1. Key off.
2. Remove TCM.
3. Measure resistance between 74-Way Transmission Harness Connector Pin 10 and 8-Way TPS Harness Connector Pin 1. Record reading in table.



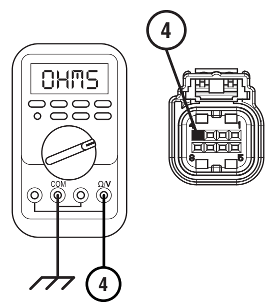
4. Measure resistance between 8-Way TPS Harness Connector Pin 1 and ground. Record reading in table.



5. Measure resistance between 74-Way Transmission Harness Connector Pin 7 and 8-Way TPS Harness Connector Pin 4. Record reading in table.



6. Measure resistance between 8-Way TPS Harness Connector Pin 4 and ground. Record reading in table.



7. Compare reading(s) in table.

- If any reading is out of range, replace Transmission Harness. Go to **Step V.**
- If all readings are in range, go to **Step K.**

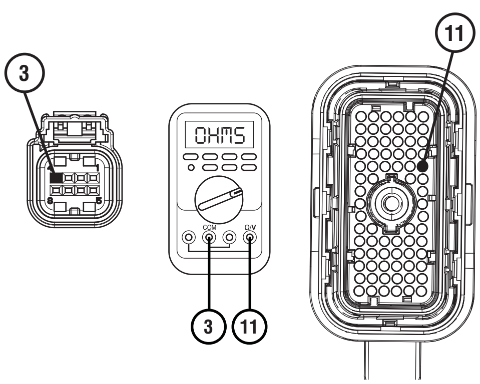
Pins	Range	Reading(s)
10 to 1	0–0.2 Ohms	
1 to ground	Open Circuit (OL)	
7 to 4	0–0.2 Ohms	
4 to ground	Open Circuit (OL)	

K ***Purpose:*** *Verify Line Pressure signal wire continuity.*

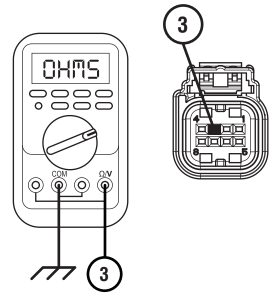
1. Key off.

2. Remove TCM.

3. Measure resistance between 74-Way Transmission Harness Connector Pin 11 and 8-Way Triple Pressure Sensor (TPS) Harness Connector Pin 3. Record reading in table.



4. Measure resistance between 8-Way TPS Harness Connector Pin 3 and ground. Record reading in table.



5. Compare reading(s) in table.

- If any reading is out of range, replace Transmission Harness. Go to **Step V.**
- If all readings are in range. go to **Step L.**

Pins	Range	Reading(s)
11 to 3	0–0.2 Ohms	
3 to ground	Open Circuit (OL)	

L

Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 210 FMI 2, 3, 5, or 6 is Inactive, replace TPS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 210 FMI 2, 3, 5, or 6 is Active, go to **Step M.**

M

Purpose: *Verify internal resistance of TCM.*

1. Key off.
2. Disconnect 8-Way Triple Pressure Sensor (TPS) Harness Connector.

   Note: Connector red lock tab must be unlatched and the top of the connector depressed to remove.
3. Measure resistance between TPS Harness Connector Pin 1 and Pin 3. Record reading in table.
4. Compare reading(s) in table.
   - If any reading is out of range, replace TCM. Go to **Step V.**
   - If all readings are in range, replace TPS and Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 3	5.9 – 6.5K Ohms	

N

Purpose: *Inspect Damper and Dual Clutch Module (DCM) Input Shaft.*

1. Remove transmission.
2. Inspect Damper and verify inner splines do not rotate inside assembly.
3. Inspect DCM Input Shaft for damage.
   - If Damper splines rotate inside assembly, replace Damper. Go to **Step V.**
   - If DCM Input Shaft damage is found, replace Transmission and Damper. Go to **Step V.**
   - If no damage is found, go to **Step O.**

O

Purpose: *Remove DCM Clutch and Inspect DCM Input Shaft.*

1. Remove Oil Drain Plug and drain oil.
2. Remove Front Cover with DCM.
3. Inspect DCM Input Shaft for damage.
    - If damage is found, replace Transmission and Damper. Go to **Step V.**
    - If no damage is found, go to **Step P.**

P

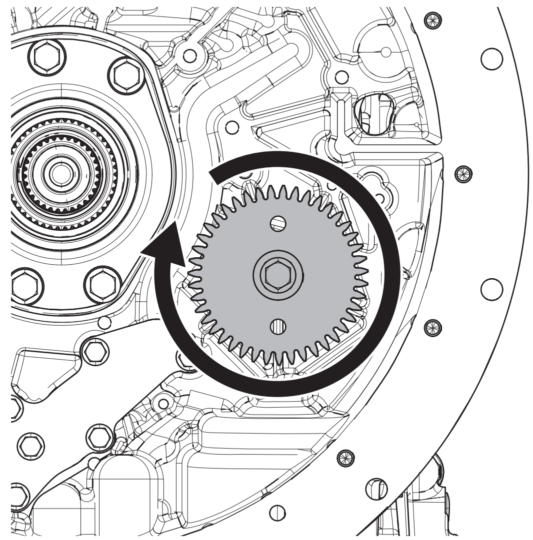
Purpose: *Inspect Pump Drive Gear and Pump Driven Gear.*

1. Inspect Pump Drive Gear and Pump Driven Gear for damage.
    - If damage is found, replace Transmission. Go to **Step V.**
    - If no damage is found, go to **Step Q.**

Q

Purpose: *Verify Pump Driven Gear rotation.*

1. Rotate Pump Driven Gear.



Note: Pump should turn freely with no binding.

- If Pump does not rotate freely, replace Transmission. Go to **Step V.**
- If Pump rotates freely, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no fault codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 210 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 210 sets Active, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 225: Primary Clutch Pressure

J1939: SA 3 SPN 123 FMI 0, 1, 2, 3, 5, 6, 7, 10, 15, 17, 20, 21

Overview

The Procision transmission is equipped with a Triple Pressure Sensor (TPS) to monitor pressure at multiple oil paths and sump temperature. Primary Clutch Pressure is regulated using feedback from the TPS to properly engage and disengage the clutch. The TPS is located in the Actuation Control Manifold (ACM) and connected to the Transmission Control Module (TCM) via the 74-Way Transmission Harness.

Detection

The TCM monitors the Primary Clutch Pressure signal. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Primary Clutch Pressure greater than command.

FMI 1 – Data Valid but Below Normal: Primary Clutch Pressure less than command.

FMI 2 – Data Erratic: Primary Clutch Pressure out of range for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Primary Clutch Pressure signal greater than 4.8 V for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Primary Clutch Pressure signal less than 0.25 V for 1 second.

FMI 6 - Current Above Normal or Shorted Circuit: TPS primary power supply voltage out of range for 1 second.

FMI 7 – Mechanical System Not Responding: Primary Clutch Pressure Calibration failed consistency check. Rising Primary Clutch Pressure does not match falling Primary Clutch Pressure at same current.

FMI 10 – Abnormal Rate of Change: Primary Clutch Pressure signal noisy during Calibration.

FMI 15 – Data Valid but Above Normal: Primary Clutch Pressure Calibration greater than maximum limit.

FMI 17 – Data Valid but Below Normal: Primary Clutch Pressure Calibration less than minimum limit.

FMI 20 – Data Drifted High: Primary Clutch Pressure falsely reported too high. Primary Clutch Pressure above 29 psi (2 bar) with engine not running or Primary Clutch Pressure above command by at least 43.5 psi (3 bar) and above Line Pressure by at least 43.5 psi (3 bar).

FMI 21 – Data Drifted Low: Primary Clutch Pressure falsely reported too low. Primary Clutch Pressure at least 43.5 psi (3 bar) below command and below pressure required to keep clutch engaged.

Fallback

FMI 0:

Primary Fallback: If transmission is not in Reverse Low, 1st, 3rd, or 5th:

- Amber warning lamp on
- PTO Mode prohibited
- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th and 7th gears unavailable
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a Primary Clutch Pressure fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

Secondary Fallback: If transmission is in Reverse Low, 1st, 3rd, or 5th:

- Amber warning lamp on
- PTO Mode prohibited
- Primary and Secondary Clutch disengaged

FMI 1, 2, 3, 5, 6, 7, 10, 15, 17, 20, 21:

- Amber warning lamp on
- PTO Mode prohibited
- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th and 7th gears unavailable
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a Primary Clutch Pressure fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

Conditions to Set Fault Code Inactive

FMI 0, 1, 20, 21: Key cycle

FMI 2: Primary Clutch Pressure in range for 10 seconds.

FMI 3: Primary Clutch Pressure signal less than 4.8 V for 10 seconds.

FMI 5: Primary Clutch Pressure signal greater than 0.25 V for 10 seconds.

FMI 6: Triple Pressure Sensor (TPS) primary power supply voltage in range for 10 seconds.

FMI 7, 10, 15, 17: Successful Primary Clutch Calibration performed.

Possible Causes

FMI 0, 15:

- Pressure Control Primary Solenoid (PCPS)
  - Stuck open

FMI 1, 7, 17:

- Pressure Control Primary Solenoid (PCPS)
  - Stuck closed
- TPS
  - O-ring leaking
- Clutch Disable Valve (CDV)
  - Stuck closed
- Internal leaks

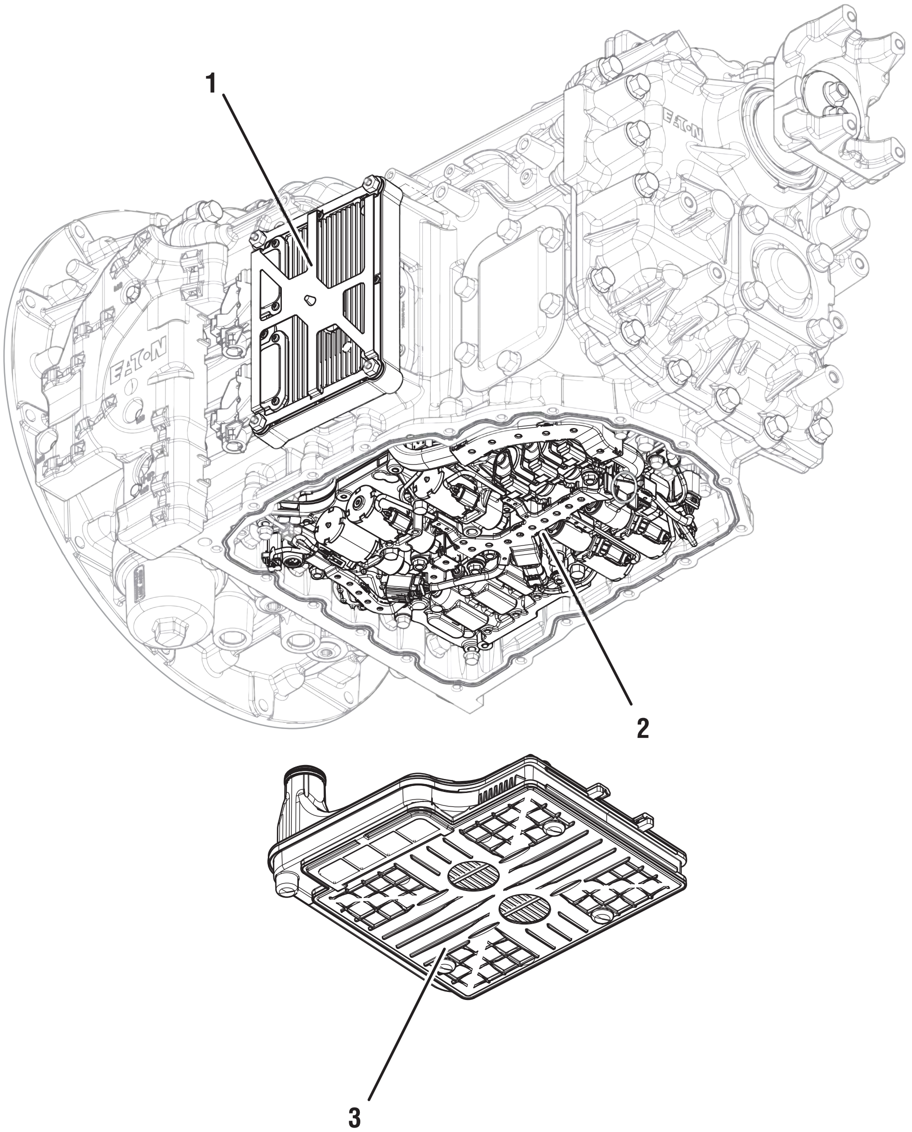
FMI 2, 3, 5, 6, 10, 20, 21:

- 74-Way Transmission Harness
  - Shorted to power, shorted to ground, or open.
- TPS
  - Internal failure
- TCM
  - Internal failure

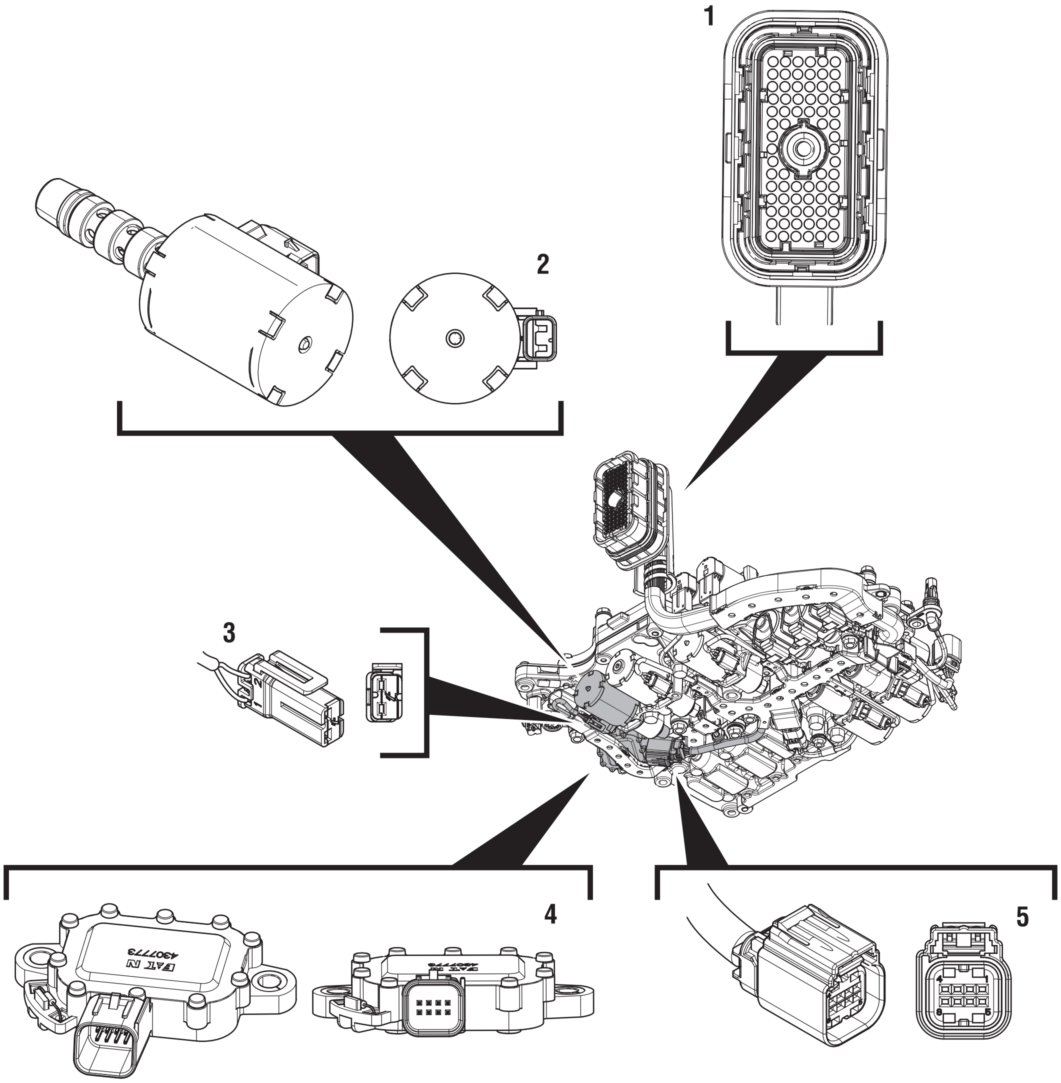
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

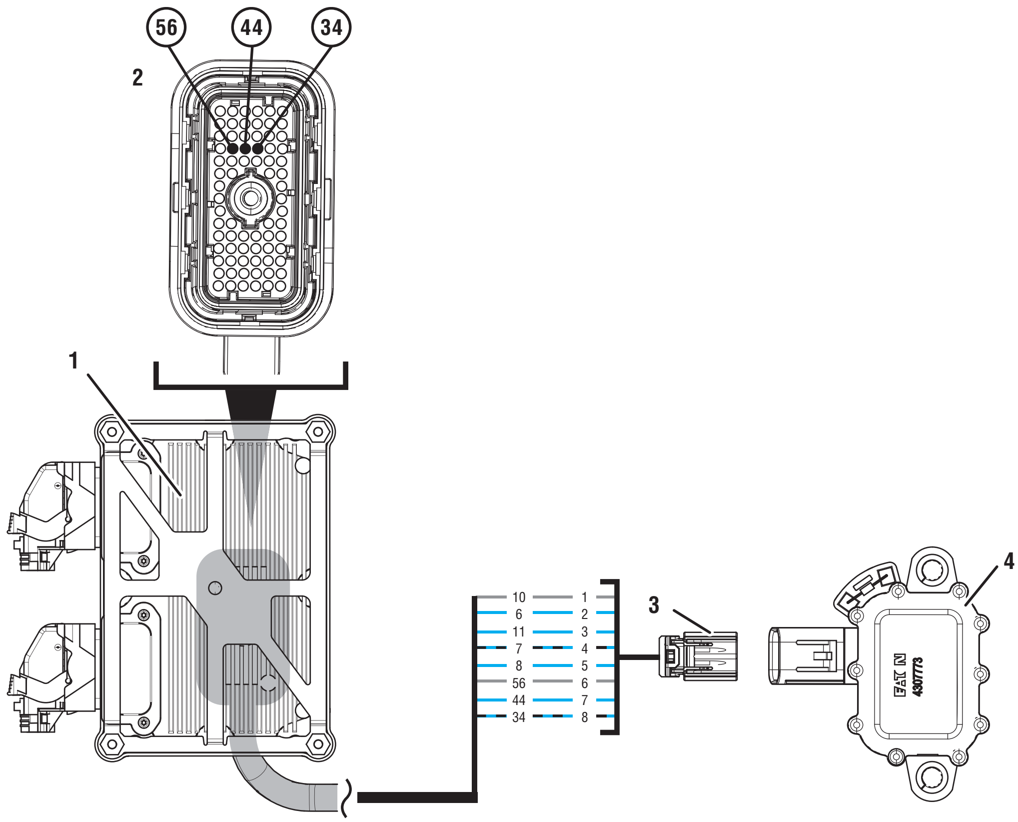
Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Sump Pan Filter



Actuation Control Manifold (ACM)
1. 74-Way Transmission Harness Connector
2. 2-Way Pressure Control Primary Clutch Solenoid (PCPS)
3. 2-Way Pressure Control Primary Clutch Solenoid (PCPS) Connector
4. 8-Way Triple Pressure Sensor (TPS)
5. 8-Way Triple Pressure Sensor (TPS) Connector



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *8-Way Triple Pressure Sensor (TPS) Connector*
4. *8-Way Triple Pressure Sensor (TPS)*

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

Fault Code 225 Troubleshooting

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

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

   Note: If Fault Code 225 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 225 FMI 0, 1, 7, 15, or 17 is set, go to **Step B.**
   - If Fault Code 225 FMI 2, 3, 5, 6, 10, 20, or 21 is Active, go to **Step G.**
   - If Fault Code 225 FMI 2, 3, 5, 6, 10, 20, or 21 is Inactive, go to **Step F.**

B ***Purpose:*** *Perform Clutch Pressure Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Clutch Pressure Calibration.
   - If Clutch Pressure Calibration is successful or Fault Code 225 FMI 0 or 15 set, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Clutch Pressure Calibration is unsuccessful and Fault Code 225 FMI 1, 7, or 17 set, go to **Step C.**

C ***Purpose:*** *Inspect Triple Pressure Sensor (TPS) and O-Rings.*

1. Drain oil.
2. Remove sump pan and filter.
3. Remove TPS.
4. Inspect TPS for contamination.
5. Inspect TPS and O-rings for damage.
   - If TPS or O rings are damaged and no contamination was found, replace TPS. Go to Step V.
   - If TPS and O-rings are not damaged and contamination is not found, go to **Step D.**
   - If contamination is found, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

D ***Purpose:*** *Inspect PCPS.*

1. Remove PCPS.
2. Inspect PCPS for contamination.
   - If contamination is found, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, go to **Step E.**

E

Purpose: *Inspect ACM to Interface Manifold (IM) gasket.*

1. Remove TCM.
2. Remove ACM.
3. Inspect ACM to IM gasket for damage.
   - If ACM to IM gasket is damaged, replace gasket. Go to **Step V.**
   - If no damage found. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**.

F

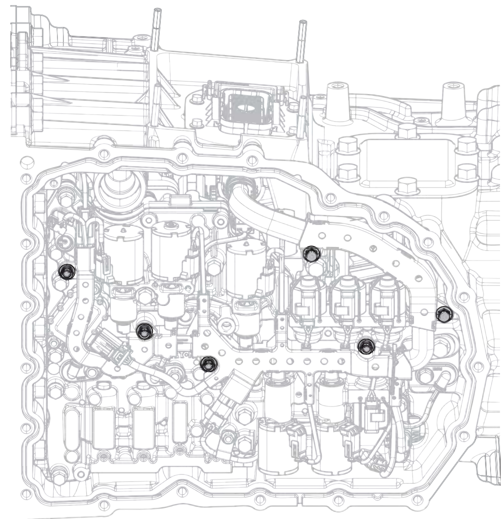
Purpose: *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels
2. Drain oil
3. Remove sump pan and filter.
4. Connect ServiceRanger.
5. Select Service Routine and PD Mode.

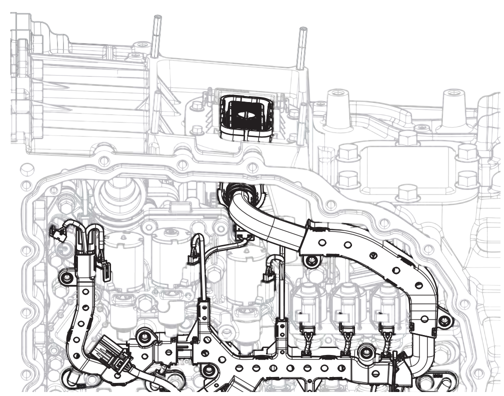
   Note: Transmission will not enter PD Mode when there are Active fault codes

   Note: Solid “PD” in display

6. Remove 6 Transmission Harness 10 mm cap screws.



7. Wiggle harness. Look for any obvious signs of rubbing or chafing on any of the wires.

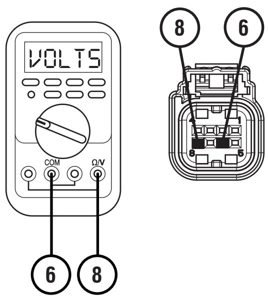


8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step G.**

G

Purpose: *Verify Triple Pressure Sensor (TPS) primary power supply.*

1. Key off.
2. Drain oil.
3. Remove sump pan and filter.
4. Disconnect 8-Way TPS Connector.
5. Key on.
6. Measure voltage between Pin 6 and Pin 8. Record reading in table.



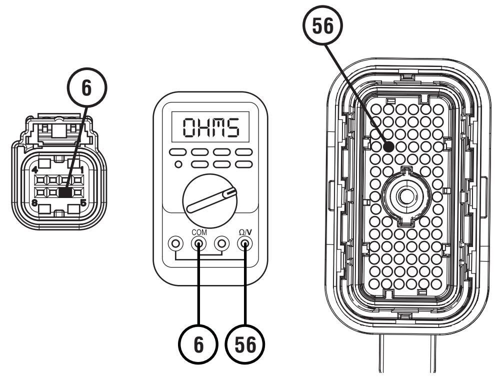
7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step H.**
   - If all readings are in range, go to **Step I.**

Pins	Range	Reading(s)
6 to 8	4.90–5.10 V	

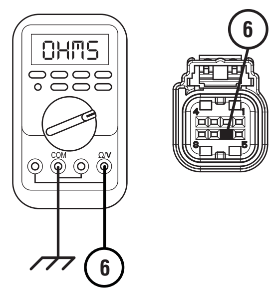
H

Purpose: *Verify continuity of TPS primary power supply circuit.*

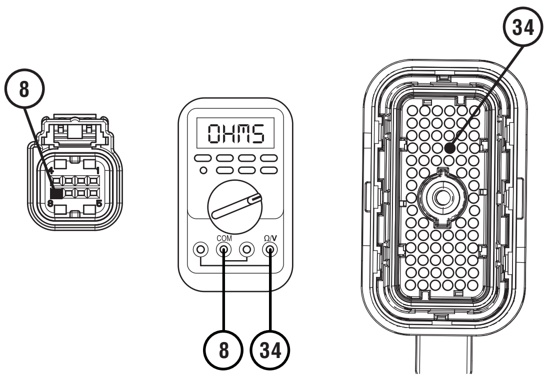
1. Key off.
2. Remove TCM.
3. Measure resistance between 74-Way Transmission Harness Pin 56 and 8-Way TPS Connector Pin 6. Record reading in table.



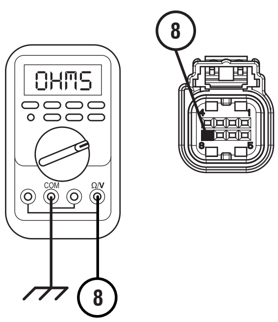
4. Measure resistance between 8-Way TPS Connector Pin 6 and ground. Record reading in table.



5. Measure resistance between 74-Way Transmission Harness Pin 34 and 8-Way Triple Pressure Sensor (TPS) Connector Pin 8. Record reading in table.



6. Measure resistance between 8-Way TPS Connector Pin 8 and ground. Record reading in table.



7. Compare reading(s) in table.

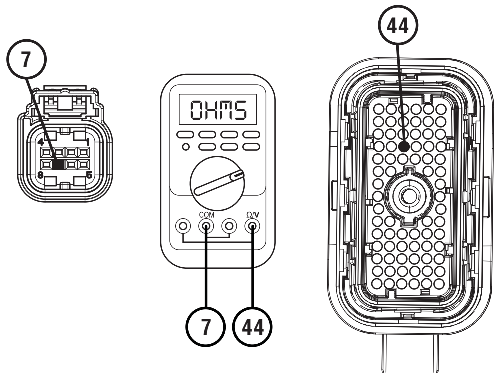
- If any reading is out of range, replace 74-Way Transmission Harness. Go to **Step V.**
- If all readings are in range, go to **Step I.**

Pins	Range	Reading(s)
56 to 6	0–0.2 Ohms	
6 to ground	Open Circuit (OL)	
34 to 8	0–0.2 Ohms	
8 to ground	Open Circuit (OL)	

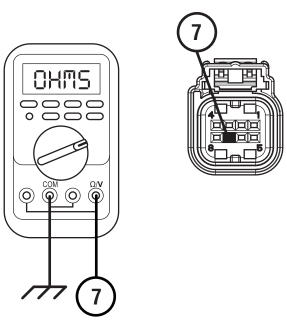
I

Purpose: *Verify primary clutch pressure signal wire continuity.*

1. Key off.
2. Remove TCM.
3. Measure resistance between 74-Way Transmission Harness Pin 44 and 8-Way Triple Pressure Sensor (TPS) Connector Pin 7. Record reading in table.



4. Measure resistance between 8-Way TPS Connector Pin 7 and ground. Record reading in table.



5. Compare reading(s) in table.
   - If any reading is out of range, replace 74-Way Transmission Harness. Go to **Step V.**
   - If all readings are in range, go to **Step J.**

Pins	Range	Reading(s)
44 to 7	0–0.2 Ohms	
7 to ground	Open Circuit (OL)	

J

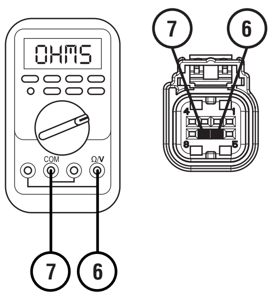
Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 225 FMI 2, 3, 5, 6, or 10 is Inactive, replace TPS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 225 FMI 2, 3, 5, 6, or 10 is Active, go to **Step K.**

K

Purpose: *Verify internal resistance of TCM.*

1. Key off.
2. Disconnect 8-Way Triple Pressure Sensor (TPS) Connector.
3. Measure resistance between Pin 6 and Pin 7. Record reading in table.



4. Compare reading(s) in table.
   - If any reading is out of range, replace TCM. Go to **Step V.**
   - If all readings are in range, replace TPS.Go to **Step V.**

Pins	Range	Reading(s)
6 to 7	5.9K-6.5K Ohms	

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 225 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 225 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 240: Secondary Clutch Pressure

J1939: SA 3 SPN 5937 FMI 0, 1, 2, 3, 5, 6, 7, 10, 15, 17, 20, 21

Overview

The Procision transmission is equipped with a Triple Pressure Sensor (TPS) to monitor pressure at multiple oil paths and sump temperature. Secondary Clutch Pressure is regulated using feedback from the TPS to properly engage and disengage the clutch. The TPS is located in the Actuation Control Manifold (ACM) and connected to the Transmission Control Module (TCM) via the 74-Way Transmission Harness.

Detection

The TCM monitors the Secondary Clutch Pressure signal. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Secondary Clutch Pressure greater than command.

FMI 1 – Data Valid but Below Normal: Secondary Clutch Pressure less than command.

FMI 2 – Data Erratic: Secondary Clutch Pressure out of range for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Secondary Clutch Pressure signal greater than 4.8 V for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Secondary Clutch Pressure signal less than 0.25 V for 1 second.

FMI 6 - Current Above Normal or Shorted Circuit: TPS secondary power supply voltage out of range for 1 second.

FMI 7 – Mechanical System Not Responding: Secondary Clutch Pressure Calibration failed consistency check. Rising Secondary Clutch Pressure does not match falling Secondary Clutch Pressure at same current.

FMI 10 – Abnormal Rate of Change: Secondary Clutch Pressure signal noisy during Calibration.

FMI 15 – Data Valid but Above Normal: Secondary Clutch Pressure Calibration greater than maximum limit.

FMI 17 – Data Valid but Below Normal: Secondary Clutch Pressure Calibration less than minimum limit.

FMI 20 – Data Drifted High: Secondary Clutch Pressure falsely reported too high. Secondary Clutch Pressure above 29 psi (2 bar) with engine not running or Secondary Clutch Pressure above command by at least 43.5 psi (3 bar) and above Line Pressure by at least 43.5 psi (3 bar).

FMI 21 – Data Drifted Low: Secondary Clutch Pressure falsely reported too low. Secondary Clutch Pressure at least 43.5 psi (3 bar) below command and below pressure required to keep clutch engaged.

Fallback

FMI 0:

Primary Fallback: If transmission is not in 2nd, 4th, 6th, or 7th:

- Amber warning lamp on
- PTO Mode prohibited
- Secondary Clutch disengaged
- 2nd, 4th, 6th and 7th gears unavailable

Secondary Fallback: If transmission is in 2nd, 4th, 6th, or 7th:

- Amber warning lamp on
- PTO Mode prohibited
- Primary and Secondary Clutch disengaged

FMI 1, 2, 3, 5, 6, 7, 10, 15, 17, 20, 21:

- Amber warning lamp on
- PTO Mode prohibited
- Secondary Clutch disengaged
- 2nd, 4th, 6th, and 7th gears unavailable

Conditions to Set Fault Code Inactive

FMI 0, 1, 20, 21: Key cycle

FMI 2: Secondary Clutch Pressure in range for 10 seconds.

FMI 3: Secondary Clutch Pressure signal less than 4.8 V for 10 seconds.

FMI 5: Secondary Clutch Pressure signal greater than 0.25 V for 10 seconds.

FMI 6: TPS secondary power supply voltage in range for 10 seconds.

FMI 7, 10, 15, 17: Successful Secondary Clutch Calibration performed.

Possible Causes

FMI 0, 15:

- Pressure Control Secondary Solenoid (PCSS)
  - Stuck open

FMI 1, 7, 17:

- Pressure Control Secondary Solenoid (PCSS)
  - Stuck closed
- Triple Pressure Sensor (TPS)
  - O-ring leaking
- Clutch Disable Valve (CDV)
  - Stuck closed
- Internal leaks

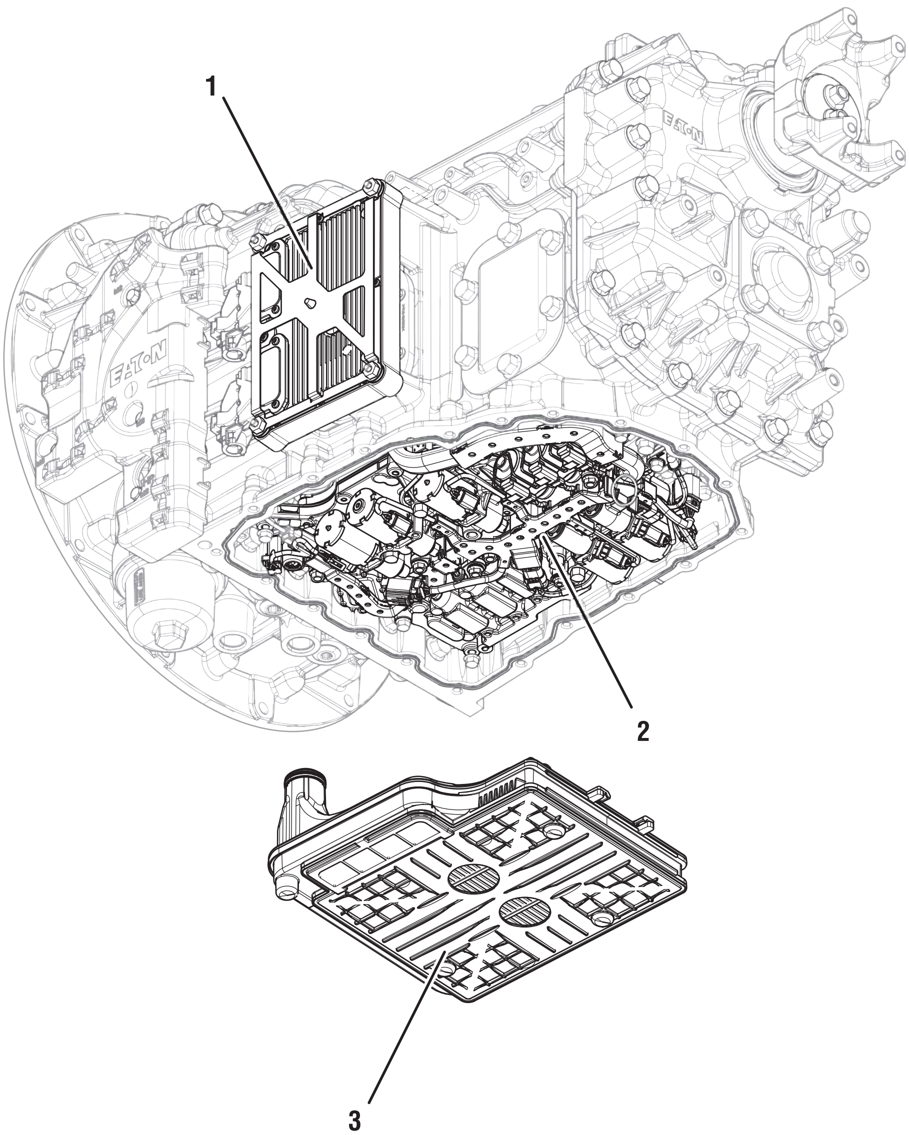
FMI 2, 3, 5, 6, 10, 20, 21:

- 74-Way Transmission Harness
  - Shorted to power, shorted to ground, or open.
- TPS
  - Internal failure
- TCM
  - Internal failure

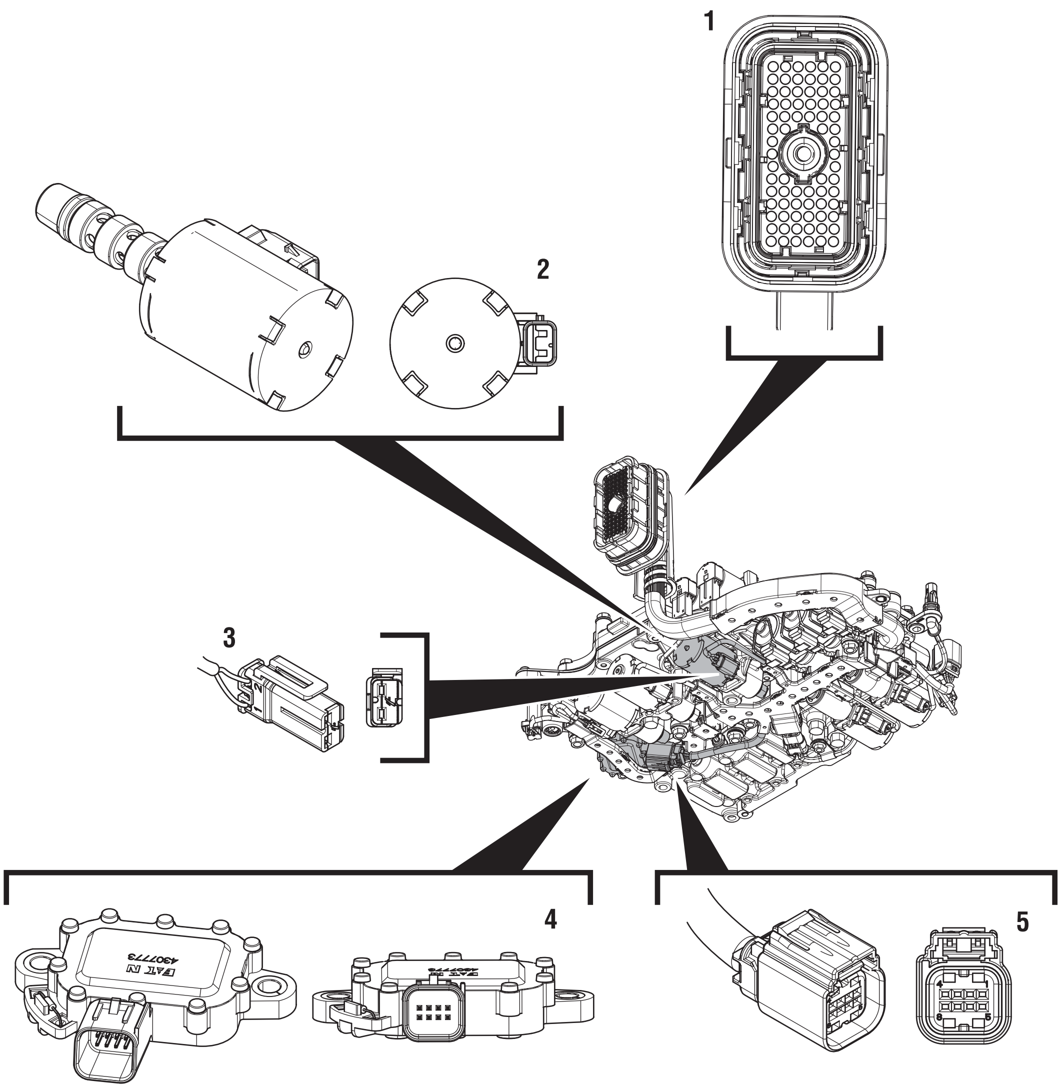
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

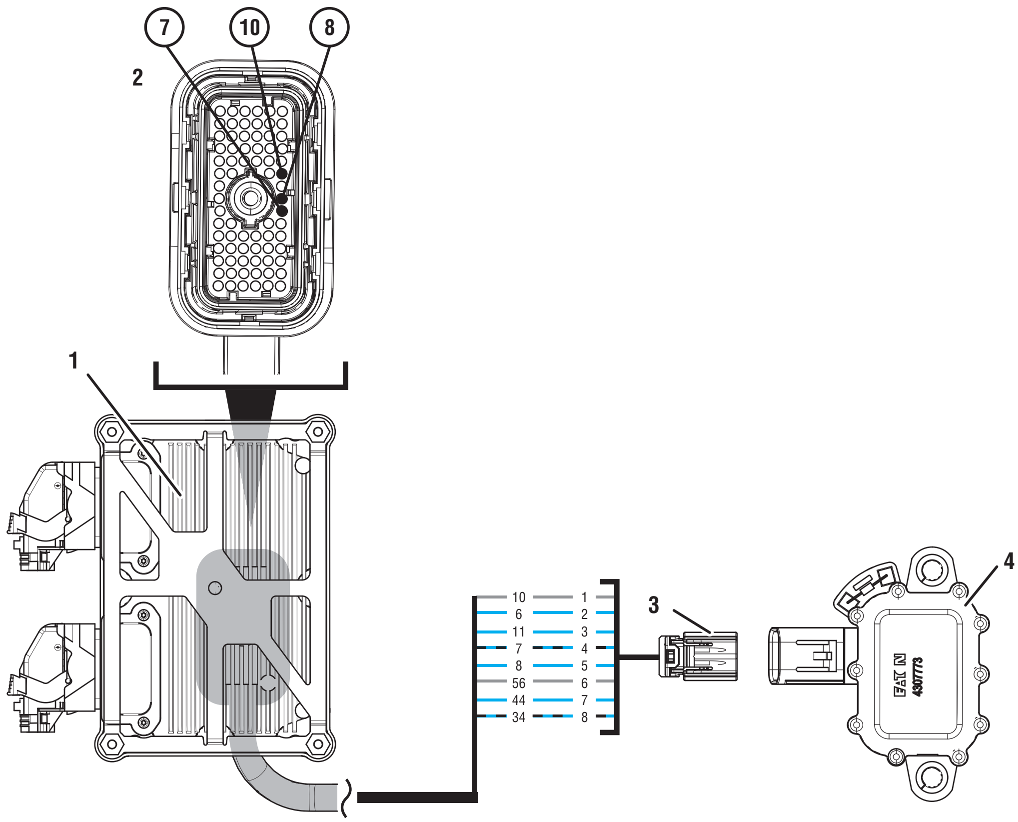
Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Sump Pan Filter



Actuation Control Manifold (ACM)
1. 74-Way Transmission Harness Connector
2. 2-Way Pressure Control Secondary Clutch Solenoid (PCSS)
3. 2-Way Pressure Control Secondary Clutch Solenoid (PCSS) Connector
4. 8-Way Triple Pressure Sensor (TPS)
5. 8-Way Triple Pressure Sensor (TPS) Connector



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 8-Way Triple Pressure Sensor (TPS) Connector
4. 8-Way Triple Pressure Sensor (TPS)

Fault Code 240 Troubleshooting

A

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

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

   Note: If Fault Code 240 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 240 FMI 0, 1, 7, 15, or 17 is set, go to **Step B.**
   - If Fault Code 240 FMI 2, 3, 5, 6, 10, 20, or 21 is Active, go to **Step G.**
   - If Fault Code 240 FMI 2, 3, 5, 6, 10, 20, or 21 is Inactive, go to **Step F.**

B

Purpose: *Perform Clutch Pressure Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Clutch Pressure Calibration.
   - If Clutch Pressure Calibration is successful or Fault Code 240 FMI 0 or 15 set, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton". Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Clutch Pressure Calibration is unsuccessful and Fault Code 240 FMI 1, 7, or 17 set, go to **Step C.**

C

Purpose: *Inspect Triple Pressure Sensor (TPS) and O-Rings.*

1. Drain oil.
2. Remove sump pan and filter.
3. Remove TPS.
4. Inspect TPS for contamination.
5. Inspect TPS and O-rings for damage.
   - If TPS or O rings are damaged and no contamination was found, replace TPS. Go to Step V.
   - If TPS and O-rings are not damaged and contamination is not found, go to **Step D.**
   - If contamination is found, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

D

Purpose: *Inspect PCSS.*

1. Remove PCSS.
2. Inspect PCSS for contamination.
   - If contamination is found, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, go to **Step E.**

E ***Purpose:*** *Inspect ACM to Interface Manifold (IM) gasket.*

1. Remove TCM.
2. Remove ACM.
3. Inspect ACM to IM gasket for damage.
   - If ACM to IM gasket is damaged, replace gasket. Go to Step V.
   - If no damage found. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

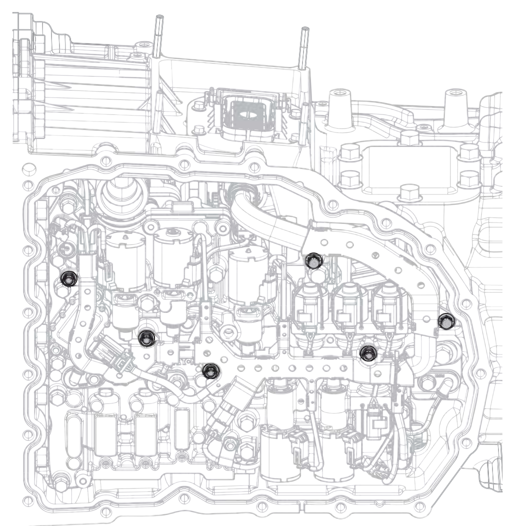
F ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels
2. Drain oil
3. Remove sump pan and filter.
4. Connect ServiceRanger.
5. Select Service Routine and PD Mode.

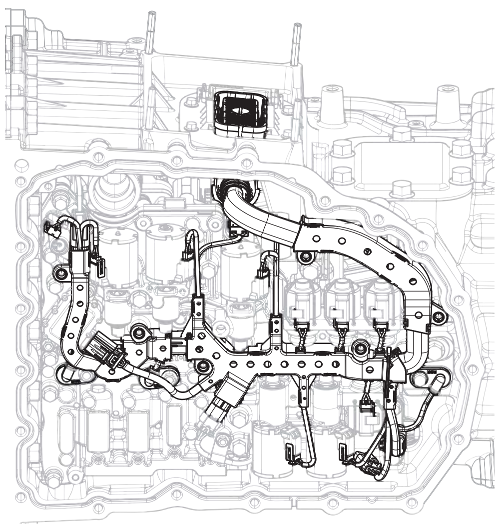
   Note: Transmission will not enter PD Mode when there are Active fault codes

   Note: Solid “PD” in display

6. Remove 6 Transmission Harness 10 mm cap screws.



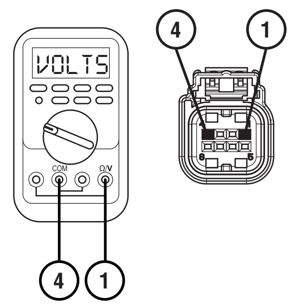
7. Wiggle harness. Look for any obvious signs of rubbing or chafing on any of the wires.



8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step G.**

G ***Purpose:*** *Verify Triple Pressure Sensor (TPS) secondary power supply.*

1. Key off.
2. Drain oil.
3. Remove sump pan and filter.
4. Disconnect 8-Way TPS Connector.
5. Key on.
6. Measure voltage between Pin 4 and Pin 1. Record reading in table.

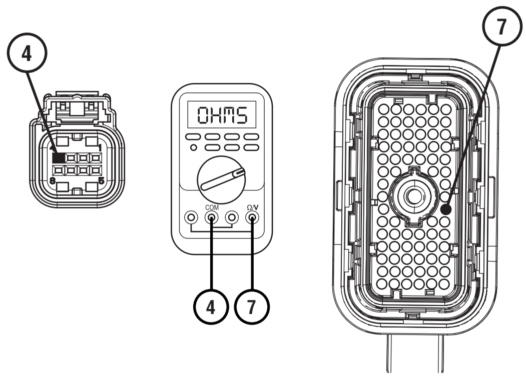


7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step H.**
   - If all readings are in range, go to **Step I.**

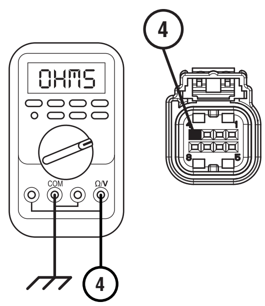
Pins	Range	Reading(s)
4 to 1	4.90–5.10 V	

H ***Purpose:*** *Verify continuity of Triple Pressure Sensor (TPS) secondary power supply circuit.*

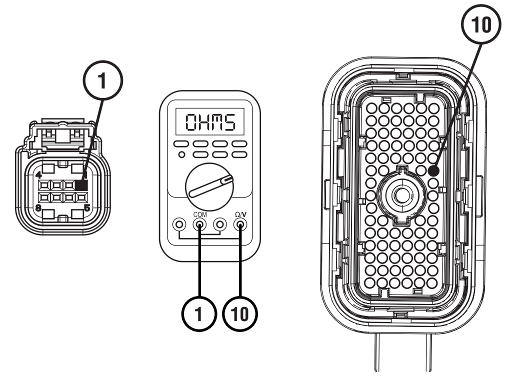
1. Key off.
2. Remove TCM.
3. Measure resistance between 74-Way Transmission Harness Pin 7 and 8-Way TPS Connector Pin 4. Record reading in table.



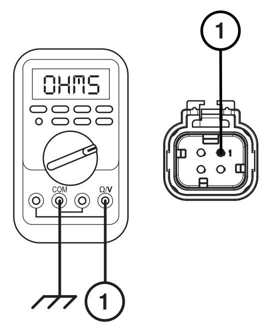
4. Measure resistance between 8-Way TPS Connector Pin 4 and ground. Record reading in table.



5. Measure resistance between 74-Way Transmission Harness Pin 10 and 8-Way TPS Connector Pin 1. Record reading in table.



6. Measure resistance between 8-Way TPS Connector Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.

- If any reading is out of range, replace 74-Way Transmission Harness. Go to **Step V.**
- If all readings are in range, go to **Step J.**

Pins	Range	Reading(s)
7 to 4	0–0.2 Ohms	
4 to ground	Open Circuit (OL)	
10 to 1	0–0.2 Ohms	
1 to ground	Open Circuit (OL)	

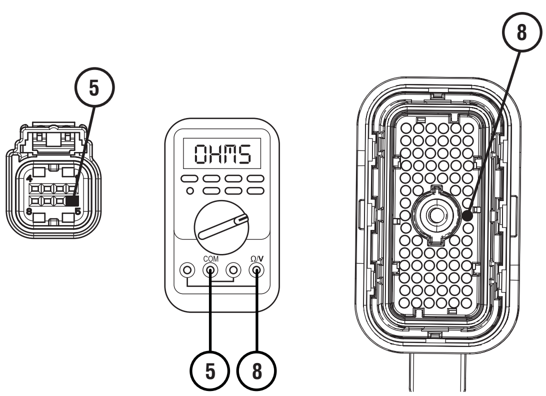
I

Purpose: *Verify secondary clutch pressure signal wire continuity.*

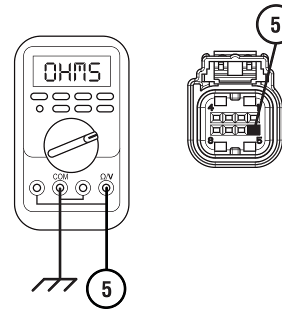
1. Key off.

2. Remove TCM.

3. Measure resistance between 74-Way Transmission Harness Pin 8 and 8-Way Triple Pressure Sensor (TPS) Connector Pin 5. Record reading in table.



4. Measure resistance between 8-Way TPS Connector Pin 5 and ground. Record reading in table.



5. Compare reading(s) in table.

- If any reading is out of range, replace 74-Way Transmission Harness. Go to **Step V.**
- If all readings are in range. go to **Step J.**

Pins	Range	Reading(s)
8 to 5	0–0.2 Ohms	
5 to ground	Open Circuit (OL)	

J

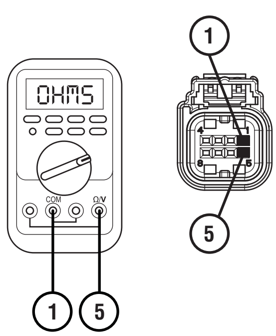
Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 240 FMI 2, 3, 5, 6, or 10 is Inactive, replace Triple Pressure Sensor (TPS) and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 240 FMI 2, 3, 5, 6, or 10 is Active, go to **Step K.**

K

Purpose: *Verify internal resistance of TCM.*

1. Key off.
2. Disconnect 8-Way TPS Connector.
3. Measure resistance between Pin 1 and Pin 5. Record reading in table.



4. Compare reading(s) in table.
   - If any reading is out of range, replace TCM. Go to **Step V.**
   - If all readings are in range, replace TPS. Go to **Step V.**

Pins	Range	Reading(s)
1 to 5	5.9–6.5K Ohms	

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 240 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 240 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 255: Rail A Primary Position

J1939: SA 3 SPN 4218 FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 15, 16, 17, 18, 20, 21, 31

Overview

The Procision transmission is equipped with a 3-Rail Position Sensor to monitor shift rail A, B, and C. There is a magnet mounted to each shift rail. The 3-Rail Position Sensor detects the proximity of the magnets to determine the position of each shift rail. The 3-Rail Position Sensor has dual sensors for Rail A; primary and secondary. This allows for a redundant Rail A signal to engage the transmission into gear in the event one signal is not available. The 3-Rail Position Sensor is located in the rear housing and connected to the Transmission Control Module (TCM) via the 8-Way 90-Degree Connectorand 74-Way Transmission Harness.

Detection

The TCM monitors shift Rail A Primary Position. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Uncommanded Rail A movement from 1st/2nd toward Neutral while not commanding other shift rails and shaft speeds do not indicate 1st or 2nd gear ratio (slip out). 5 occurrences required during key cycle.

FMI 1 – Data Valid but Below Normal: Uncommanded Rail A movement from Reverse toward Neutral while not commanding other shift rails and shaft speeds do not indicate Reverse gear ratio (slip out). 5 occurrences required during key cycle.

FMI 2 – Data Erratic: Rail A Primary Position operating range not between 0–30 mm for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail A Primary Position circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail A Primary Position circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail A Primary Position circuit open for 1 second.

FMI 6 - Current Above Normal or Shorted Circuit: Rail A Primary Position signal not between 4.25 V and 6.25 V for 1 second.

FMI 7 – Mechanical System Not Responding: No movement in fore direction during Rail A calibration.

FMI 8 – Abnormal Frequency: Rail A Primary Position signal frequency out of range for 1 second.

FMI 11 – Failure Mode Not Identifiable: Rail A Primary and Secondary positions do not match for 1 second.

FMI 12 – Bad Intelligent Device: Rail A Primary Position duty cycle out of range for 1 second.

FMI 14 – Special Instructions: Rail A Primary Position reports Reverse gear position, but shaft speeds do not indicate Reverse gear ratio.

FMI 15 – Data Valid but Above Normal: Uncommanded Rail A movement from Neutral toward 1st/2nd while not commanding other shift rails (sensor drift).

FMI 16 – Data Valid but Above Normal: Uncommanded Rail A movement from 1st/2nd toward Neutral while not commanding other shift rails and shaft speeds continuously indicate 1st or 2nd gear ratio (sensor drift).

FMI 17 – Data Valid but Below Normal: Uncommanded Rail A movement from Neutral toward Reverse while not commanding other shift rails (sensor drift).

FMI 18 – Data Valid but Below Normal: Uncommanded Rail A movement from Reverse toward Neutral while not commanding other shift rails and shaft speeds continuously indicate Reverse gear ratio (sensor drift).

FMI 20 – Data Drifted High: Rail A Primary Position reports Reverse gear disengagement, but shaft speeds indicate Reverse gear ratio.

FMI 21 – Data Drifted Low: Rail A Primary Position reports 1st/2nd gear disengagement, but shaft speeds indicate 1st or 2nd gear ratio.

FMI 31 – Condition Exists: Rail A Primary Position reports 1st/2nd gear position, but shaft speeds do not indicate 1st or 2nd gear ratio.

Fallback

FMI 0, 1:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

FMI 2, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 20, 21, 31:

- Amber warning lamp on
- No degraded performance

Note: If Rail A Secondary Position is not available:

- Transmission will stay in current gear
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

FMI 11:

- Amber warning lamp on
- Transmission will stay in current gear
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0, 1, 15, 16, 17, 18: Key cycle.

FMI 2: Rail A Primary Position operating range between 0 - 30 mm for 10 seconds.

FMI 3: Rail A Primary Position circuit not shorted to power for 10 seconds.

FMI 4: Rail A Primary Position circuit not shorted to ground for 10 seconds.

FMI 5: Rail A Primary Position circuit not open for 10 seconds.

FMI 6: Rail A Primary Position signal between 4.25 V and 6.25 V for 10 seconds.

FMI 7: Successful rail calibration performed.

FMI 8: Rail A Primary Position signal frequency in range for 10 seconds.

FMI 11: Rail A Primary and Secondary positions match for 10 seconds.

FMI 12: Rail A Primary Position duty cycle in range for 10 seconds.

FMI 14, 20, 21, 31: Rail A Primary Position is confirmed in 1st/2nd, Neutral, or Reverse for 10 seconds.

Possible Causes

FMI 0, 1:

- 1st/2nd, Reverse Synchronizer
  - Clutching teeth damaged or worn
- 1st/2nd, Reverse Gear
  - Clutching teeth damaged or worn
- Rail A Fork
  - Bent
  - Worn wear pads

FMI 2, 12:

- 3-Rail Position Sensor
  - Internal failure
- Rail A Magnet
  - Detached from shift rail

FMI 3, 4, 5:

- 74-Way Transmission Harness or 8-Way 90-Degree Connector
  - Wiring shorted to power, shorted to ground, or open
- 3-Rail Position Sensor
  - Internal failure

FMI 6, 8, 11:

- 3-Rail Position Sensor
  - Internal failure
- 74-Way Transmission Harness or 8-Way 90-Degree Connector
  - Wiring shorted to power, shorted to ground, or open
- TCM
  - Internal failure

FMI 7:

- Rail A Piston
  - Seal damaged
  - Snap ring missing
- SPS1
  - Stuck closed
- SPS2
  - Stuck open

FMI 14, 20, 21, 31:

- Rail A Fork
  - Roll pins sheared
  - Fork broken
- 3-Rail Position Sensor
  - Internal failure

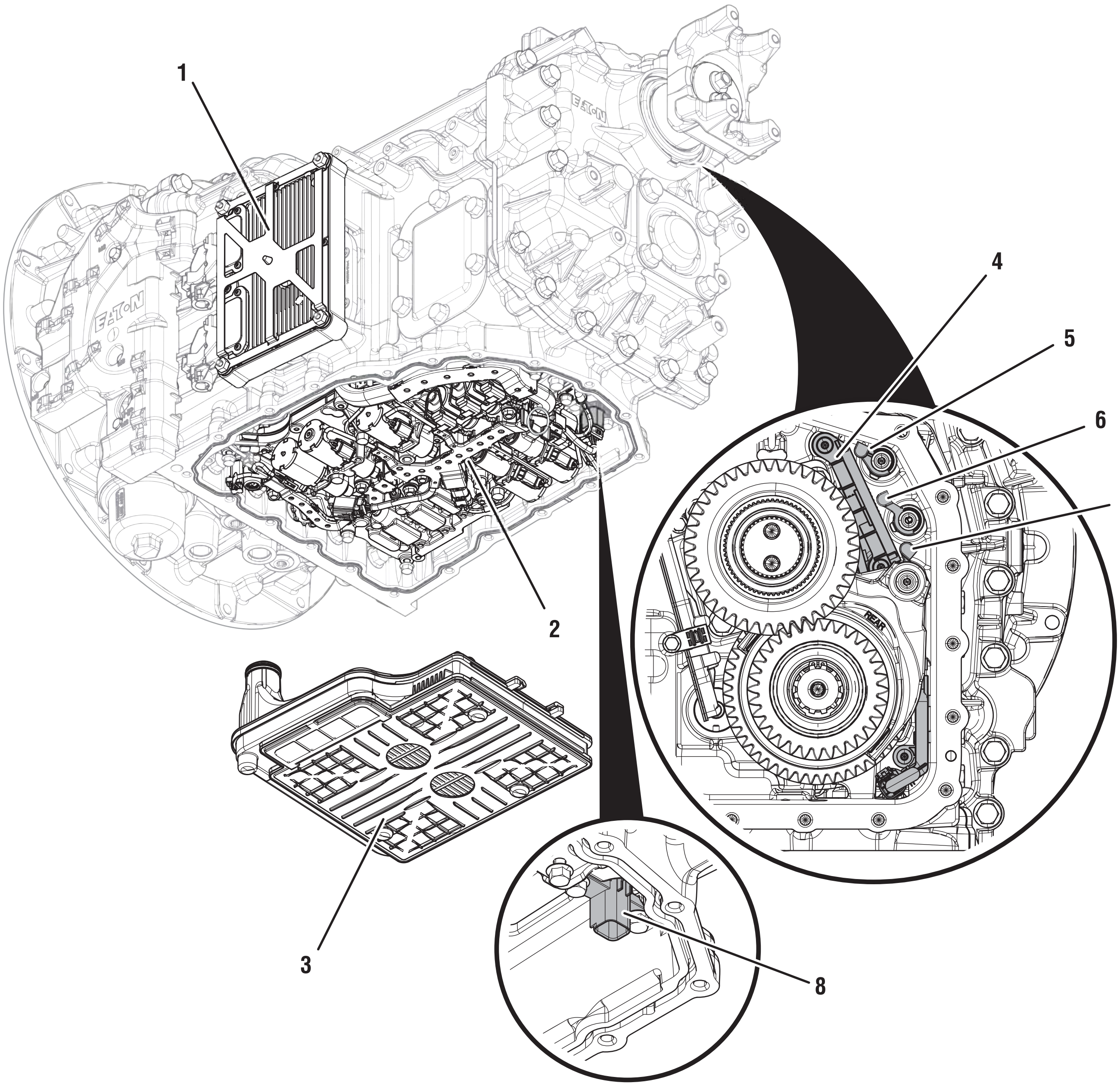
FMI 15, 16, 17, 18:

- 3-Rail Position Sensor
  - Internal failure
- Rail A Detent
  - Weak or broken spring
  - Worn shift rail or detent

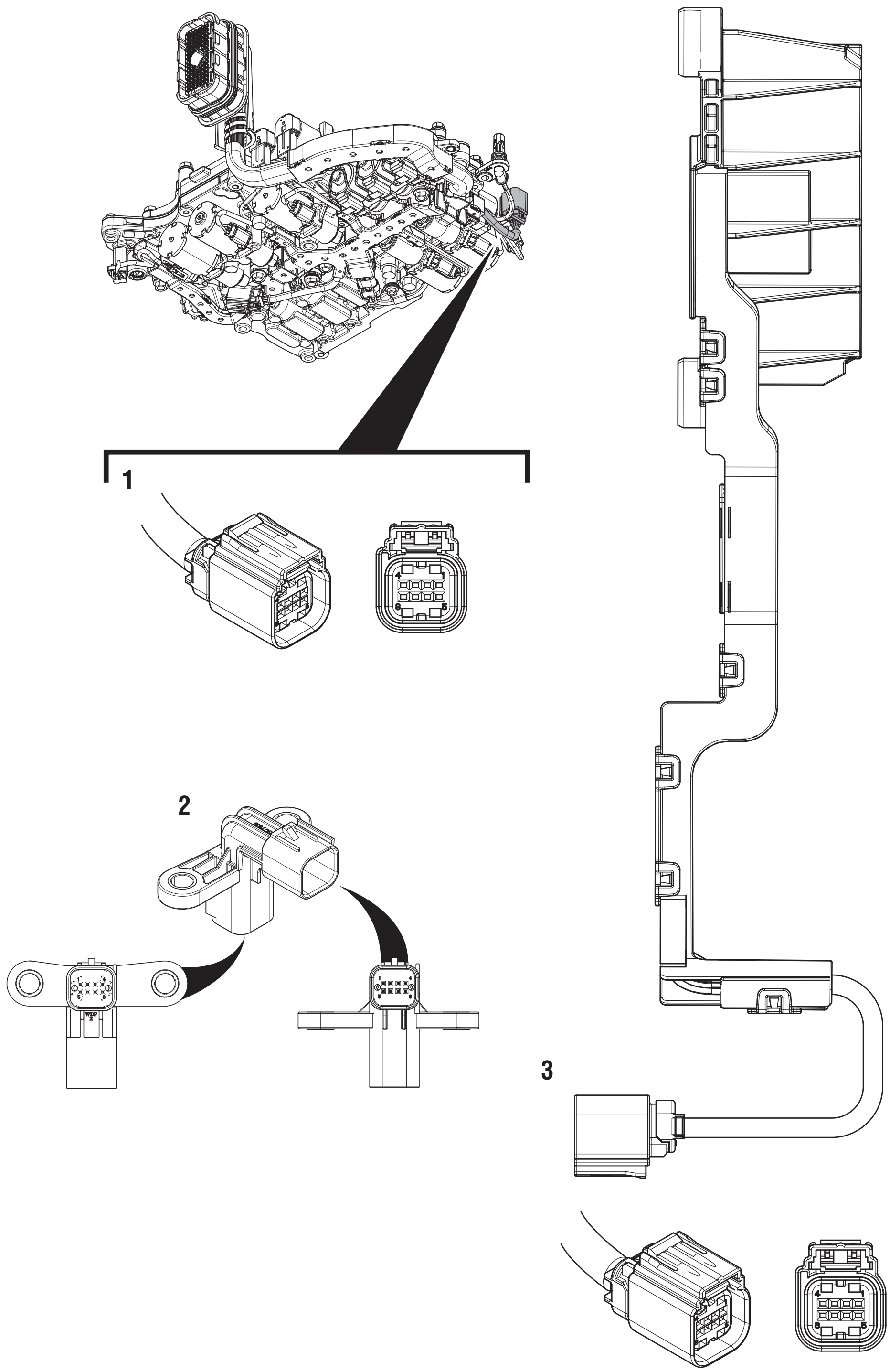
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

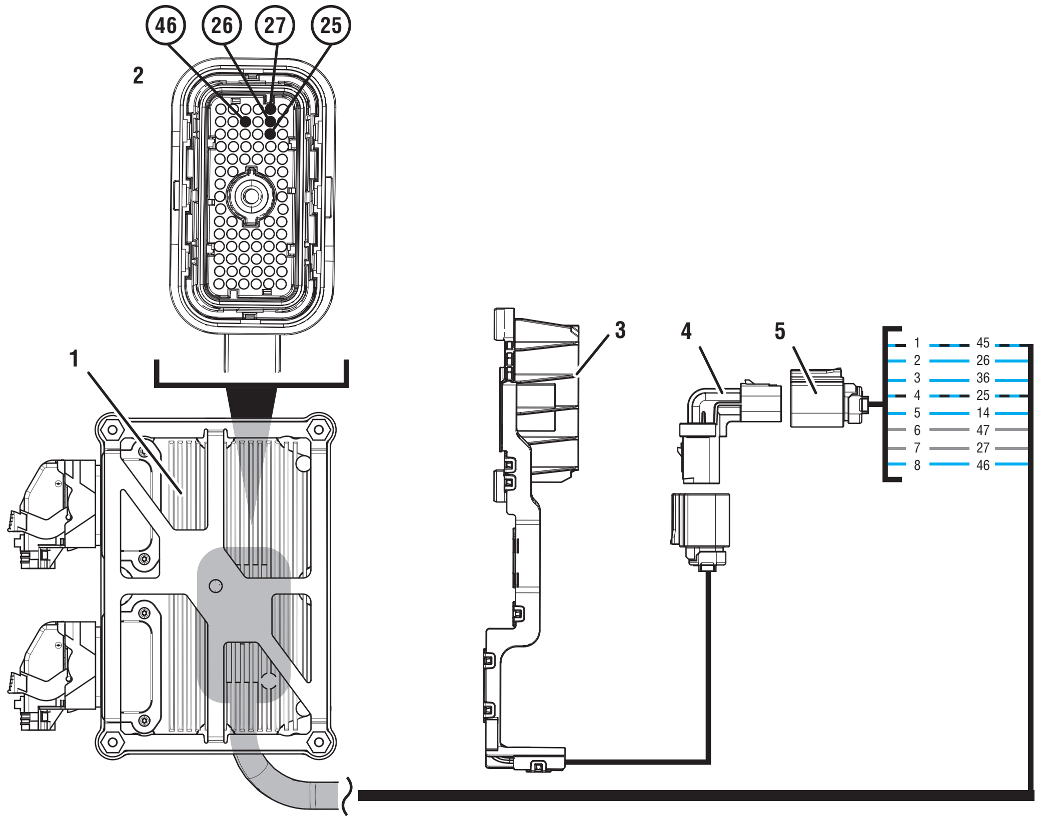
Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Sump Pan Filter
4. 8-Way 3-Rail Position Sensor (Inside Rear Housing)
5. Rail A Magnet (Inside Rear Housing)
6. Rail B Magnet (Inside Rear Housing)
7. Rail C Magnet (Inside Rear Housing)
8. 8-Way 90-Degree Connector (Shown with ACM Removed)



1. 8-Way 3-Rail Position Sensor Connector
2. 8-Way 90-Degree Connector
3. 8-Way 3-Rail Position Sensor



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *8-Way 3-Rail Position Sensor*
4. *8-Way 90-Degree Connector*
5. *8-Way Rail Position Sensor Connector*

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

Fault Code 255 Troubleshooting

A

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

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

   Note: If Fault Code 255 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 255 FMI 0 or 1 is set, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 1st/2nd, Reverse gears, synchronizer, Rail A fork or detent. Go to **Step V.**
   - If Fault Code 255 FMI 2 or 12 is Active, go to **Step J.**
   - If Fault Code 255 FMI 2 or 12 is Inactive, go to **Step B.**
   - If Fault Code 255 FMI 3, 4, 5, 6, or 8 is Active, go to **Step C.**
   - If Fault Code 255 FMI 3, 4, 5, 6, or 8 is Inactive, go to **Step B.**
   - If Fault Code 255 FMI 7 is set, go to **Step K.**.
   - If Fault Code 255 FMI 11 is set, go to **Step O.**
   - If Fault Code 255 FMI 14, 20, 21 or 31 is set, go to **Step Q.**
   - If Fault Code 255 FMI 15, 16, 17 or 18 is set, go to **Step R.**

B

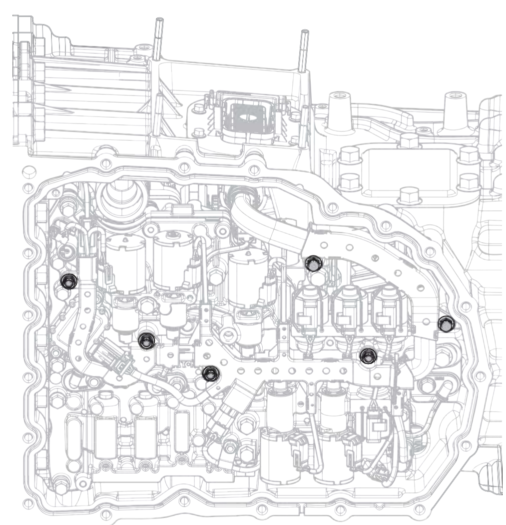
Purpose: *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Remove driveline and output yoke from transmission output shaft.
3. Drain oil.
4. Remove sump pan and filter.
5. Remove rear cover.
6. Connect ServiceRanger
7. Select Service Routine and PD Mode.

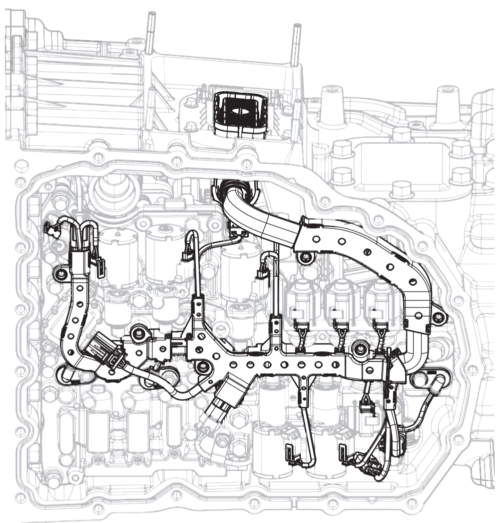
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

8. Remove 6 Transmission Harness 10 mm cap screws.



9. Wiggle 74-Way Transmission Harness and 3-Rail Position Sensor pigtail. Look for any obvious signs of rubbing or chafing on any of the wires.



10. Exit PD Mode.

- If any fault code sets Active while wiggling the 74-Way Transmission Harness, replace 74-Way Transmission Harness and 8-Way 90-Degree Connector. Go to **Step V.**
- If any fault code sets Active while wiggling the 3-Rail Position Sensor pigtail, replace 3-Rail Position Sensor and 8-Way 90-Degree Connector. Go to **Step V.**
- If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify 3-Rail Position Sensor primary power supply.*

1. Set parking brake and chock wheels.

2. Key off.

3. Remove driveline and output yoke from transmission output shaft.

4. Drain Oil.

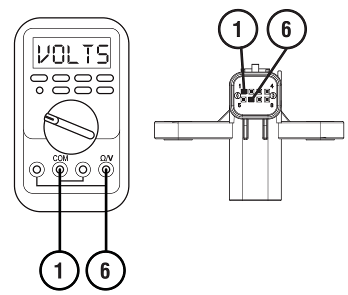
5. Remove rear cover.

Note: Position oil pan under rear cover as oil will drain upon removal.

6. Disconnect 8-Way 3-Rail Position Sensor Connector.

7. Key on with engine off.

8. Measure voltage between 8-Way 90-Degree ConnectorPin 1 and Pin 6. Record reading in table.



9. Compare reading(s) in table.

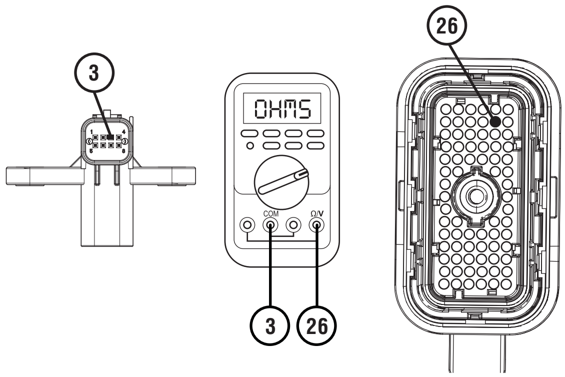
- If readings are out of range, go to **Step G.**
- If readings are in range, go to **Step D.**

Pins	Range	Reading(s)
1 to 6	4.75–5.25 V	

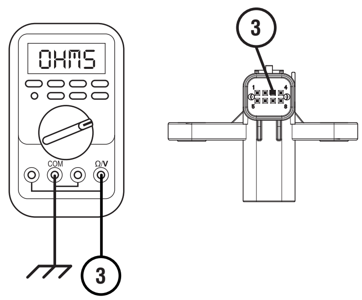
D

Purpose: *Verify continuity of Rail A Primary Position signal wire.*

1. Key off.
2. Remove TCM.
3. Inspect connector for bent or spread pins.
4. Measure resistance between 8-Way 90-Degree Connector Pin 3 and 74-Way Transmission Harness Pin 26. Record reading in table.



5. Measure resistance between 8-Way 90-Degree Connector Pin 3 and ground. Record reading in table.



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

Pins	Range	Reading(s)
3 to 26	0–0.3 Ohms	
3 to ground	Open Circuit (OL)	

E

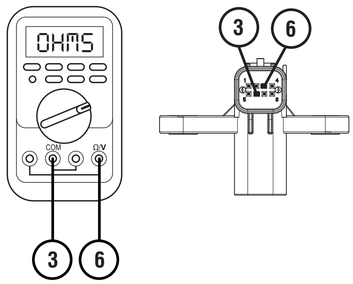
Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 255 FMI 2, 3, 4, 5, 6, 8, or 12 is Inactive, replace 3-Rail Position Sensor, 74-Way Transmission Harness and 8-Way 90-Degree Connector. Go to **Step V.**
   - If Fault Code 255 FMI 2, 3, 4, 5, 6, 8, or 12 is Active, go to **Step F.**

F

Purpose: *Verify internal resistance of TCM.*

1. Key off.
2. Disconnect 8-Way 3-Rail Position Sensor Connector.
3. Measure resistance between 8-Way 90-Degree Connector Pin 3 and Pin 6. Record reading in table.



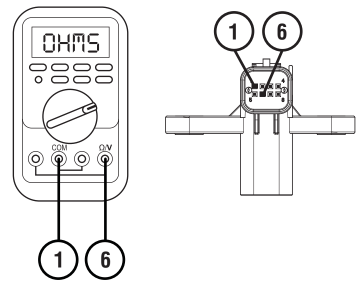
4. Compare reading(s) in table.
   - If any reading is out of range, replace TCM. Go to **Step V.**
   - If all readings are in range, replace 3-Rail Position Sensor. Go to **Step V.**

Pins	Range	Reading(s)
3 to 6	14.5–15.5K Ohms	

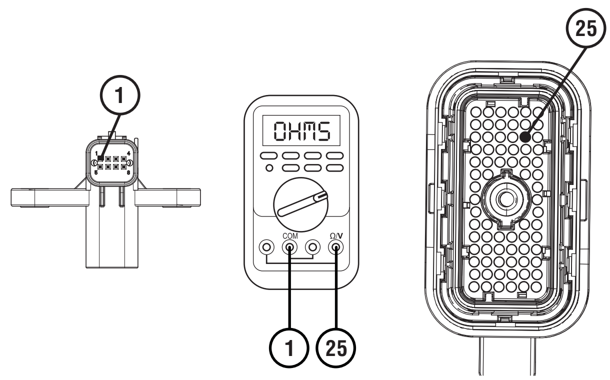
G

Purpose: *Verify continuity of 3-Rail Position Sensor primary power supply wiring.*

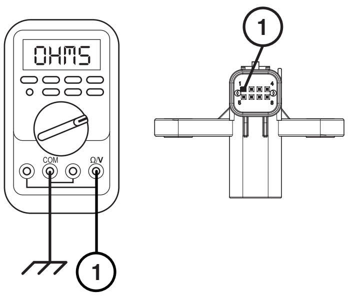
1. Key off.
2. Remove TCM.
3. Inspect connector for oil, corrosion, and bent or spread pins.
4. Measure resistance between 8-Way 90-Degree Connector Pin 1 and Pin 6. Record reading in table.



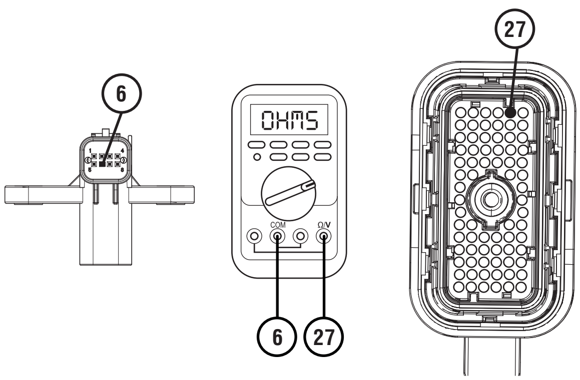
5. Measure resistance between 8-Way 90-Degree Connector Pin 1 and 74-Way Transmission Harness Pin 25. Record reading in table.



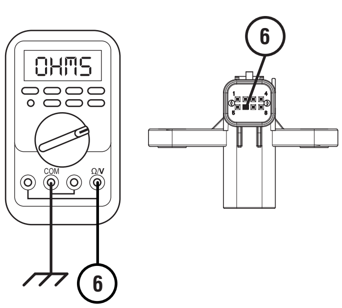
6. Measure resistance between 8-Way 90-Degree Connector Pin 1 and ground. Record reading in table.



7. Measure resistance between 8-Way 90-Degree Connector Pin 6 and 74-Way Transmission Harness Pin 27. Record reading in table.



8. Measure resistance between 8-Way 90-Degree Connector Pin 6 and ground. Record reading in table.



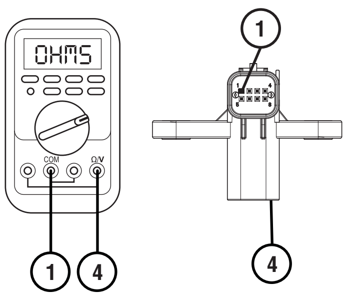
9. Compare reading(s) in table.

- If any reading is out of range, go to **Step H.**
- If all readings are in range, replace TCM. Go to **Step V.**

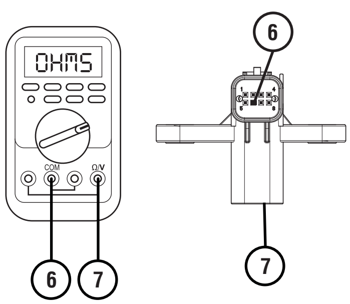
Pins	Range	Reading(s)
1 to 6	Open Circuit (OL)	
1 to 25	0–0.3 Ohms	
1 to ground	Open Circuit (OL)	
6 to 27	0–0.3 Ohms	
6 to ground	Open Circuit (OL)	

H ***Purpose:*** *Verify continuity of 8-Way 90-Degree Connector primary power supply wires.*

1. Drain oil.
2. Remove sump pan and filter.
3. Disconnect Transmission Harness 8-way from 8-Way 90-Degree Connector.
4. Measure resistance between 8-Way 90-Degree Connector Pin 1 and Pin 4. Record reading in table.



5. Measure resistance between 8-Way 90-Degree Connector Pin 6 and Pin 7. Record reading in table.



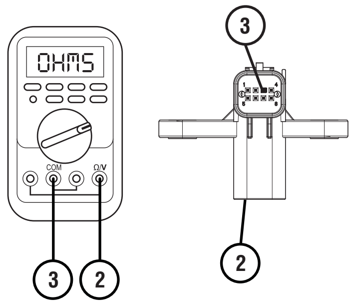
6. Compare reading(s) in table.
   - If any reading is out of range, replace 8-Way 90-Degree Connector. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 4	0–0.3 Ohms	
6 to 7	0–0.3 Ohms	

I

Purpose: *Verify continuity of 8-Way 90-Degree Connector Rail A Primary Position signal wire.*

1. Drain oil.
2. Remove sump pan and filter.
3. Disconnect 8-Way Transmission Harness from 8-Way 90 Degree Connector.
4. Measure resistance between 8-Way 90-Degree Connector Pin 3 and Pin 2. Record reading in table.



5. Compare reading(s) in table.
   - If any reading is out of range, replace 8-Way 90-Degree Connector. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
3 to 2	0–0.3 Ohms	

J

Purpose: *Verify condition of 3-Rail Position Sensor and Rail A Magnet.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove driveline and output yoke from output shaft.
4. Remove rear cover.

   Note: Position oil pan under rear cover as oil will drain upon removal.
5. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
6. Inspect Rail A Magnet for damage and proper mounting to Rail A.
   - If 3-Rail Position Sensor or Rail A Magnet is damaged, replace damaged components. Go to **Step V.**
   - If no damage is found, go to **Step C.**

K

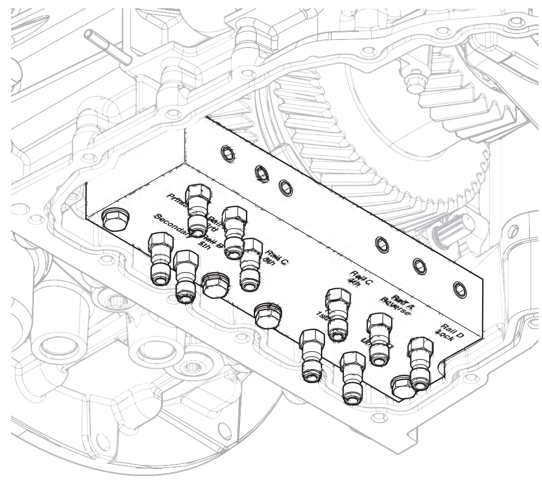
Purpose: *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
    - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
    - If only Shift Rail A fault codes set Active, go to **Step L.**

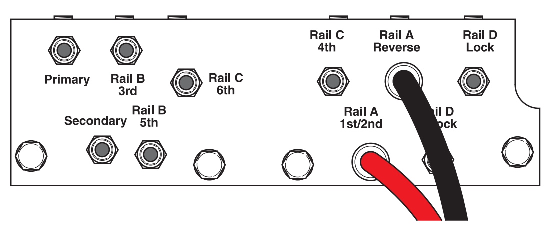
L

Purpose: *Actuate Rail A with Diagnostic Manifold tool.*

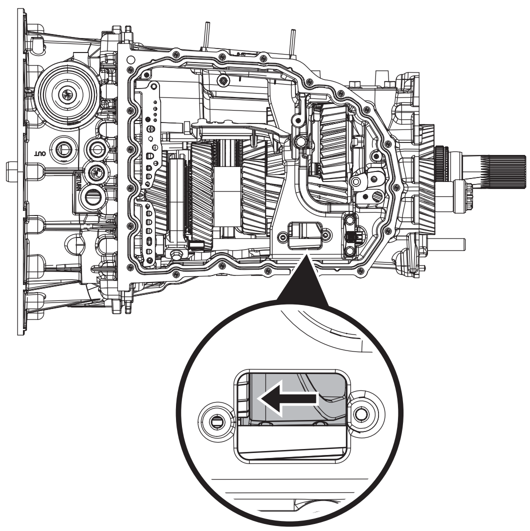
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



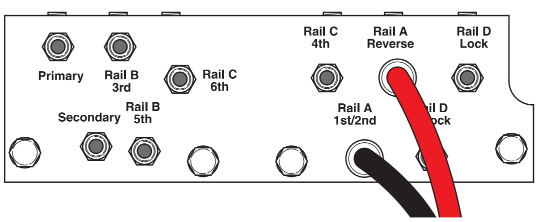
6. Apply air to Rail A 1st/2nd port.



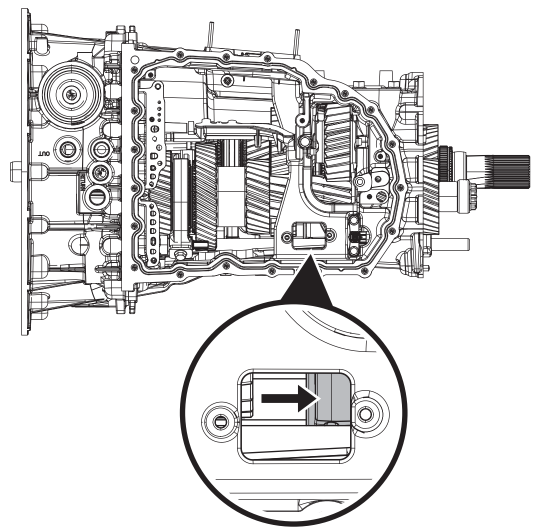
7. Watch for Rail A fork to fully engage synchronizer into 1st/2nd gear.



8. Apply air to Rail A Reverse port.



9. Watch for Rail A fork to fully engage synchronizer into Reverse gear.



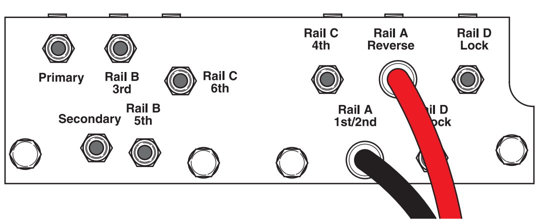
- If fork does not move or does not fully engage 1st/2nd or Reverse gear, go to **Step M.**
- If fork fully engages 1st/2nd and Reverse gear, go to **Step N.**

M ***Purpose:*** *Verify mechanical condition of 1st/2nd, Reverse synchronizer and detent.*

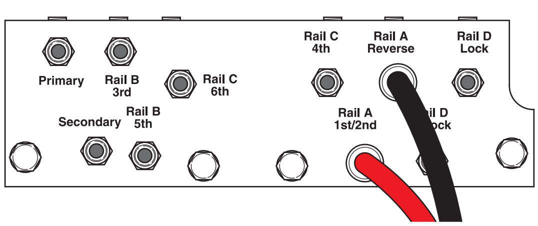
1. Use pry bar to engage Rail A fork into 1st/2nd and Reverse gears.
    - If fork does not move or does not fully engage 1st/2nd or Reverse gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 1st/2nd, Reverse synchronizer or detent. Go to **Step V.**
    - If fork fully engages 1st/2nd and Reverse gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**

N ***Purpose:*** *Verify condition of Rail A Piston and Rod Seals.*

1. Apply air to Rail A Reverse port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail A 1st/2nd port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

- If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**
- If all result(s) are in range, replace RAVS and ACM. Go to **Step V.**

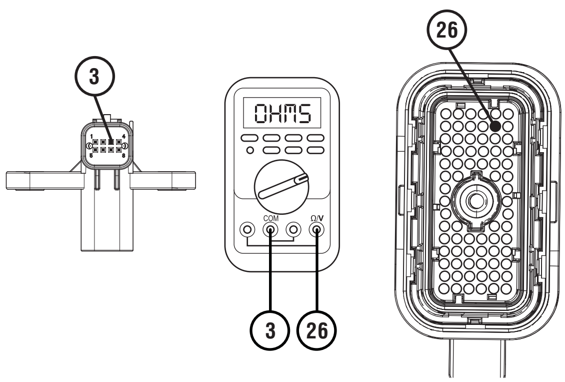
Air Application	Leak Down Range	Result
Rail A Reverse Port	0 PSI	
Rail A 1st/2nd Port	0 PSI	

0

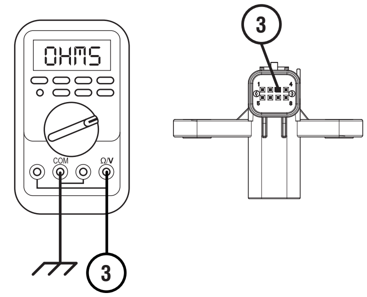
Purpose: *Verify continuity of Rail A Primary and Secondary Position Signal Wires.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove driveline and output yoke from output shaft.
4. Drain Oil.
5. Remove rear cover.

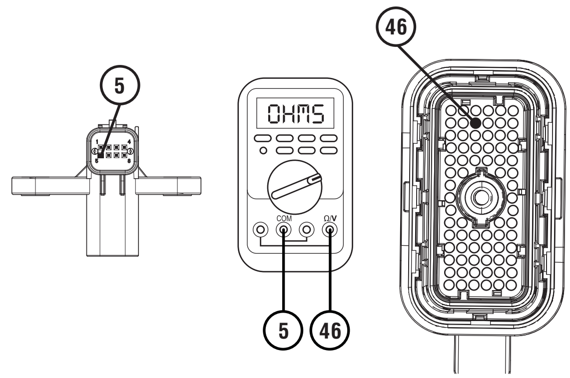
   Note: Position oil pan under rear cover as oil will drain upon removal.
6. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
7. Inspect Rail A Magnet for cracks and proper mounting to Rail A.
8. Remove TCM.
9. Measure resistance between 8-Way 90-Degree Connector Pin 3 and 74-Way Pin 26. Record reading in table.



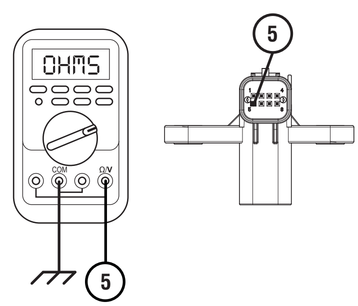
10. Measure resistance between 8-Way 90-Degree Connector Pin 3 and ground. Record reading in table.



11. Measure resistance between 8-Way 90-Degree Connector Pin 5 and 74-Way Pin 46. Record reading in table.



12. Measure resistance between 8-Way 90-Degree Connector Pin 5 and ground. Record reading in table.



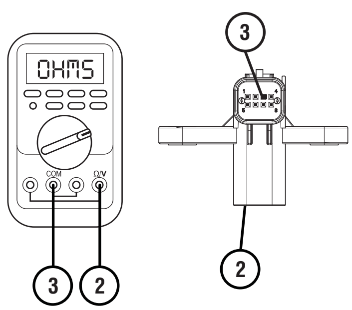
13. Compare reading(s) in table.
    - If any reading is out of range go to **Step P.**
    - If all readings are in range, replace 3-Rail Position Sensor assembly. Go to **Step V.**

Pins	Range	Reading(s)
3 to 26	0–0.3 Ohms	
3 to ground	Open Circuit (OL)	
5 to 46	0–0.3 Ohms	
5 to ground	Open Circuit (OL)	

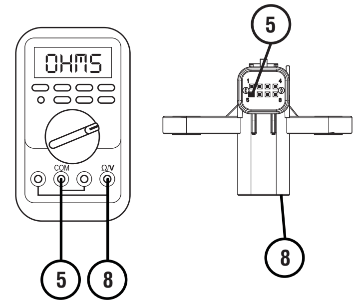
P

Purpose: *Verify continuity of 8-Way 90-Degree Connector.*

1. Remove sump pan and filter.
2. Disconnect 8-Way Transmission Harness from 8-Way 90 Degree Connector.
3. Measure resistance between 8-Way 90-Degree Connector Pin 3 and Pin 2. Record reading in table.



4. Measure resistance between 8-Way 90-Degree Connector Pin 5 and Pin 8. Record reading in table.



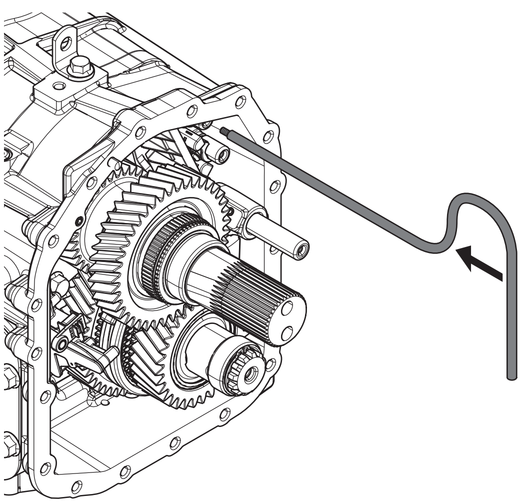
5. Compare reading(s) in table.
    - If any reading is out of range, replace 8-Way 90-Degree Connector. Go to **Step V.**
    - If all readings are in range, replace 74-way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
3 to 2	0–0.3 Ohms	
5 to 8	0–0.3 Ohms	

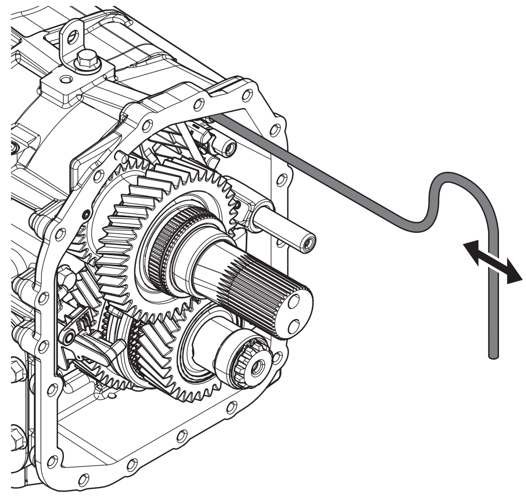
Q

Purpose: *Verify condition of 1st/2nd, Reverse gear assembly.*

1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Inspect Rail A fork for damage or wear.
6. Remove rear cover.
7. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
8. Inspect Rail A magnet for damage and proper mounting to Rail A.
9. Thread RR1039TR into Rail A.



10. Engage 1st/2nd, Reverse and Neutral using RR1039TR



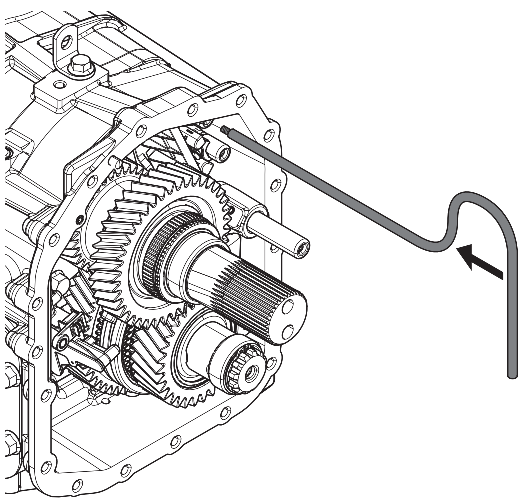
Note: Use rear cover bolt threaded into case for leverage.

11. Verify Rail A is moving fork into all gear positions.
    - If Rail A does not move fork or damage is found, Reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 1st/2nd, Reverse gears or Rail A fork. Go to **Step V.**
    - If Rail A does move the fork and no damage is found, replace 3-Rail Position Sensor assembly Go to **Step V.**

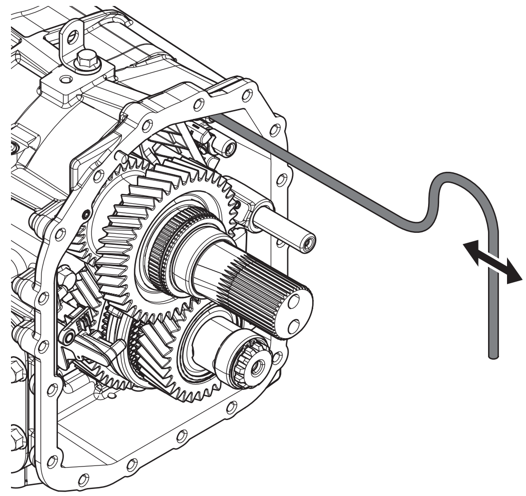
R ***Purpose:*** *Verify condition of 3-Rail Position Sensor and Rail A Detent.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove driveline and output yoke from output shaft.
4. Drain oil.
5. Remove rear cover.

   Note: Position oil pan under rear cover as oil will drain upon removal.
6. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
7. Inspect Rail A magnet for damage and proper mounting to Rail A.
8. Thread RR1039TR into Rail A.



9. Engage 1st/2nd, Reverse and Neutral using RR1039TR



   Note: Use rear cover bolt threaded into case for leverage.
10. Verify detent tension is proper.
    - If detent tension is proper and no damage is found, Replace 3-Rail Position Sensor. Go to **Step V.**
    - If 3-Rail Position Sensor or Rail A Magnet is damaged, replace 3-Rail Position Sensor assembly. Go to **Step V.**
    - If detent is weak or missing, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Detent. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 255 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 255 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 275: Rail B Position

J1939: SA 3 SPN 4219 FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 20, 21, 31

Overview

The Procision transmission is equipped with a 3-Rail Position Sensor to monitor shift Rail A, B, and C. There is a magnet mounted to each shift rail. The 3-Rail Position Sensor detects the proximity of the magnets to determine the position of each shift rail. The 3-Rail Position Sensor is located in the rear housing and connected to the Transmission Control Module (TCM) via the 8-Way 90-Degree Connector and 74-Way Transmission Harness.

Detection

The TCM monitors shift Rail B Position. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Uncommanded Rail B movement from 5th/7th toward Neutral while not commanding other shift rails and shaft speeds do not indicate 5th or 7th gear ratio (slip out). 5 occurrences required during key cycle.

FMI 1 – Data Valid but Below Normal: Uncommanded Rail B movement from 3rd toward Neutral while not commanding other shift rails and shaft speeds do not indicate 3rd gear ratio (slip out). 5 occurrences required during key cycle.

FMI 2 – Data erratic: Rail B Position operating range not between 0 - 24 mm for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail B Position circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail B Position circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail B Position circuit open for 1 second.

FMI 6 – Current Above Normal or Shorted Circuit: Rail B Position signal not between 4.25V and 6.25V for 1 second.

FMI 7 – Mechanical System Not Responding: No movement in fore direction during Rail B calibration.

FMI 8 – Abnormal Frequency: Rail B Position signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: Rail B Position duty cycle out of range for 1 second.

FMI 14 – Special Instructions: Rail B Position reports 3rd gear position, but shaft speeds do not indicate 3rd gear ratio.

FMI 15 – Data Valid but Above Normal: Uncommanded Rail B movement from Neutral toward 5th/7th while not commanding other shift rails (sensor drift).

FMI 16 – Data Valid but Above Normal: Uncommanded Rail B movement from 5th/7th toward Neutral while not commanding other shift rails and shaft speeds continuously indicate 5th or 7th gear ratio (sensor drift).

FMI 17 – Data Valid but Below Normal: Uncommanded Rail B movement from Neutral toward 3rd while not commanding other shift rails (sensor drift).

FMI 18 – Data Valid but Below Normal: Uncommanded Rail B movement from 3rd toward Neutral while not commanding other shift rails and shaft speeds continuously indicate 3rd gear ratio (sensor drift).

FMI 20 – Data Drifted High: Rail B Position reports 3rd gear disengagement, but shaft speeds indicate 3rd gear ratio.

FMI 21 – Data Drifted Low: Rail B Position reports 5th/7th gear disengagement, but shaft speeds indicate 5th or 7th gear ratio.

FMI 31 – Condition Exists: Rail B Position reports 5th/7th gear position, but shaft speeds do not indicate 5th or 7th gear ratio.

Fallback

All FMIs

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

Note: If Rail B is disengaged:

- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th, and 7th gears unavailable
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a Rail B Position fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

Conditions to Set Fault Code Inactive

FMI 0, 1, 15, 16, 17, 18: Key cycle.

FMI 2: Rail B Position operating range between 0–24 mm for 10 seconds.

FMI 3: Rail B Position circuit not shorted to power for 10 seconds.

FMI 4: Rail B Position circuit not shorted to ground for 10 seconds.

FMI 5: Rail B Position circuit not open for 10 seconds.

FMI 6: Rail B Position signal between 4.25 V and 6.25 V for 10 seconds.

FMI 7: Successful rail calibration performed.

FMI 8: Rail B Position signal frequency in range for 10 seconds.

FMI 12: Rail B Position duty cycle in range for 10 seconds.

FMI 14, 20, 21, 31: Rail B Position is confirmed in 5th/7th, Neutral, or 3rd for 10 seconds.

Possible Causes

FMI 0, 1:

- 5th/7th, 3rd Synchronizer
  - Clutching teeth damaged or worn
- 5th/7th, 3rd Gear
  - Clutching teeth damaged or worn
- Rail B Fork
  - Bent
  - Worn wear pads

FMI 2, 12:

- 3-Rail Position Sensor
  - Internal failure
- Rail B Magnet
  - Detached from shift rail

FMI 3, 4, 5:

- 74-Way Transmission Harness or 8-Way 90-Degree Connector
  - Wiring shorted to power, shorted to ground, or open
- 3-Rail Position Sensor
  - Internal failure

FMI 6, 8:

- 3-Rail Position Sensor
  - Internal failure
- 74-Way Transmission Harness or 8-Way 90-Degree Connector
  - Wiring shorted to power, shorted to ground, or open
- TCM
  - Internal failure

FMI 7:

- Rail B Piston
  - Seal damaged
  - Snap ring missing
- SPS1
  - Stuck closed
- SPS2
  - Stuck open

FMI 14, 20, 21, 31:

- Rail B Fork
  - Roll pins sheared
  - Broken
- 3-Rail Position Sensor
  - Internal failure

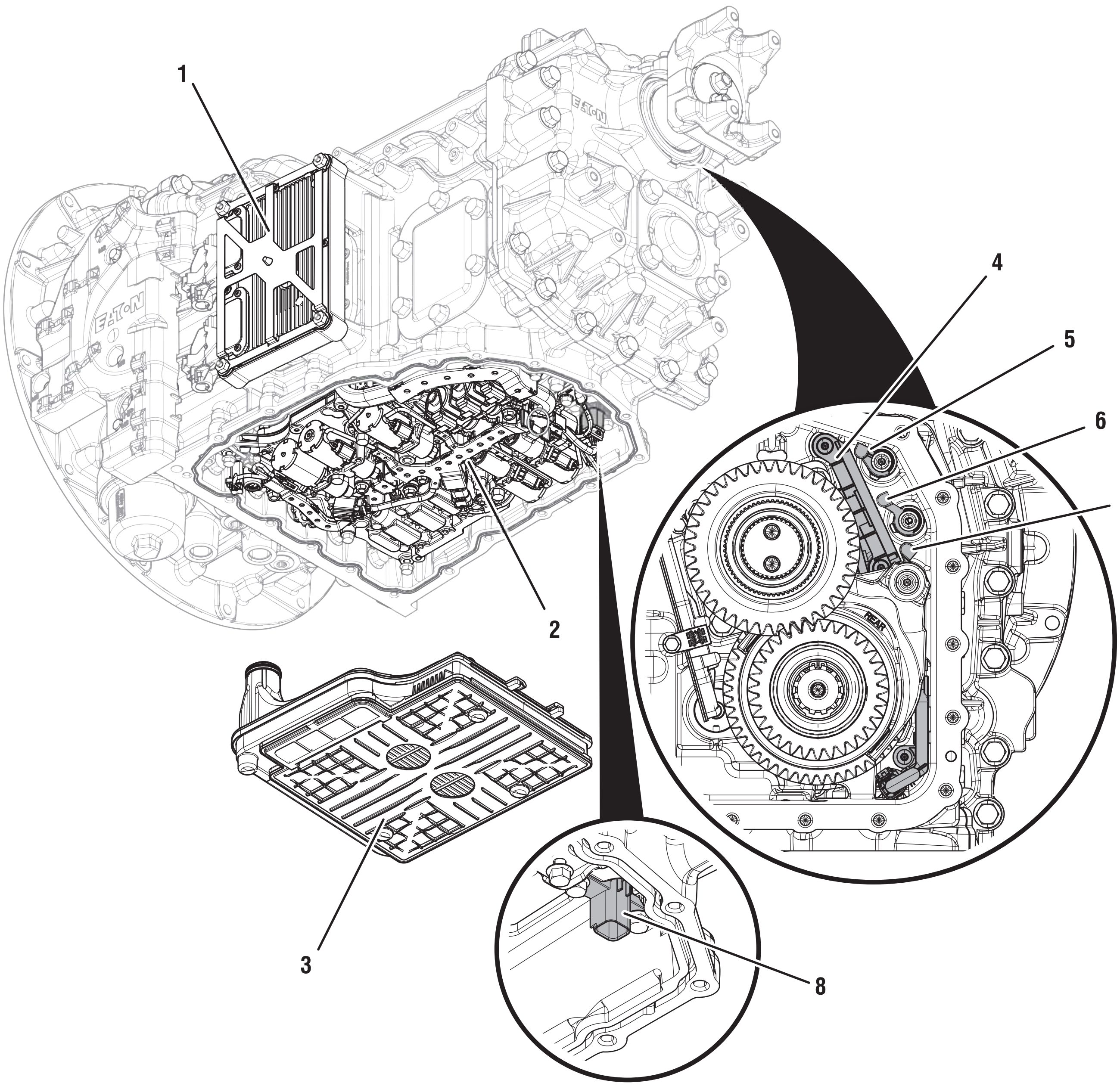
FMI 15, 16, 17, 18:

- 3-Rail Position Sensor
  - Internal failure
- Rail B Detent
  - Weak or broken spring
  - Worn shift rail or detent

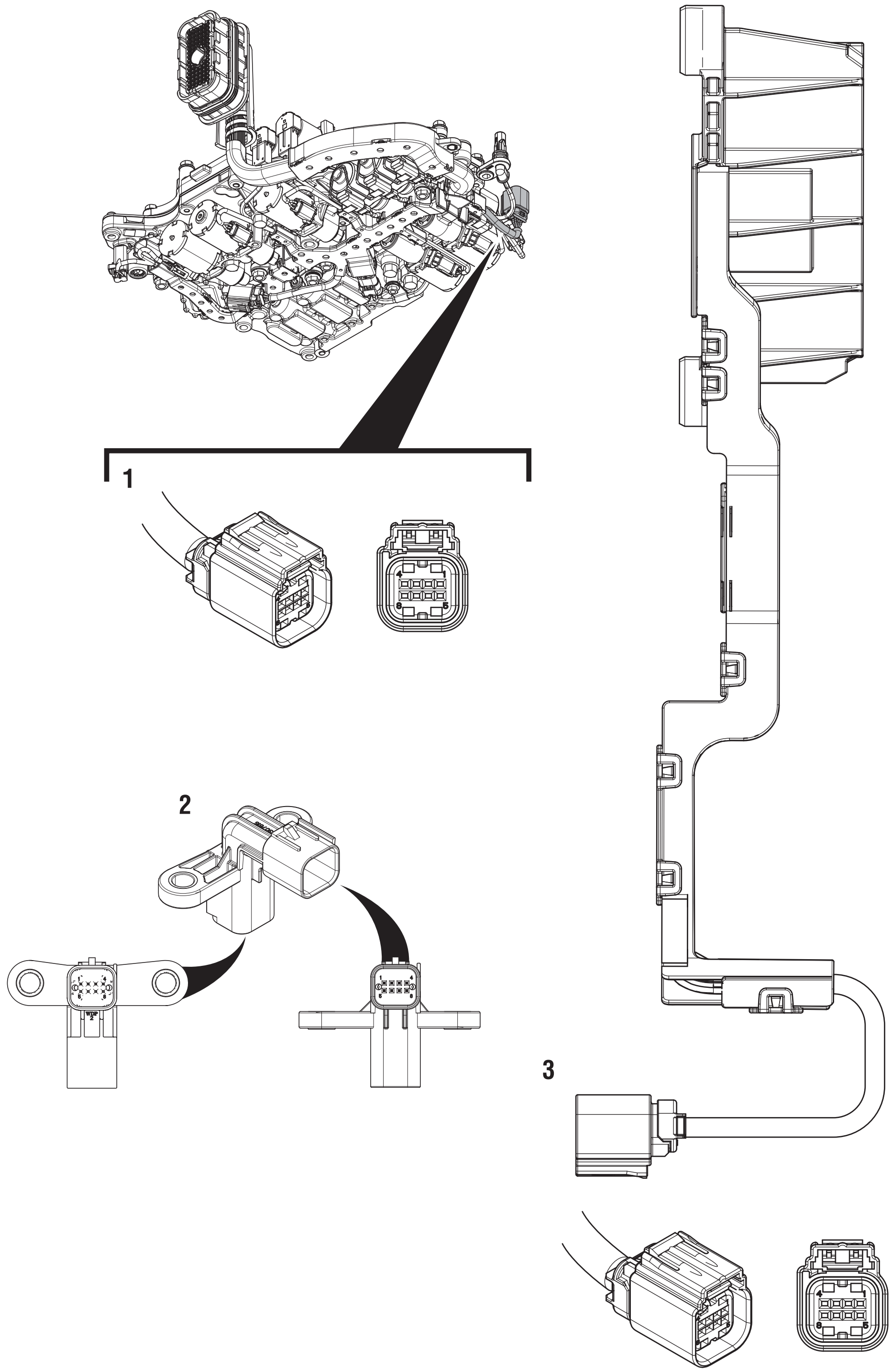
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

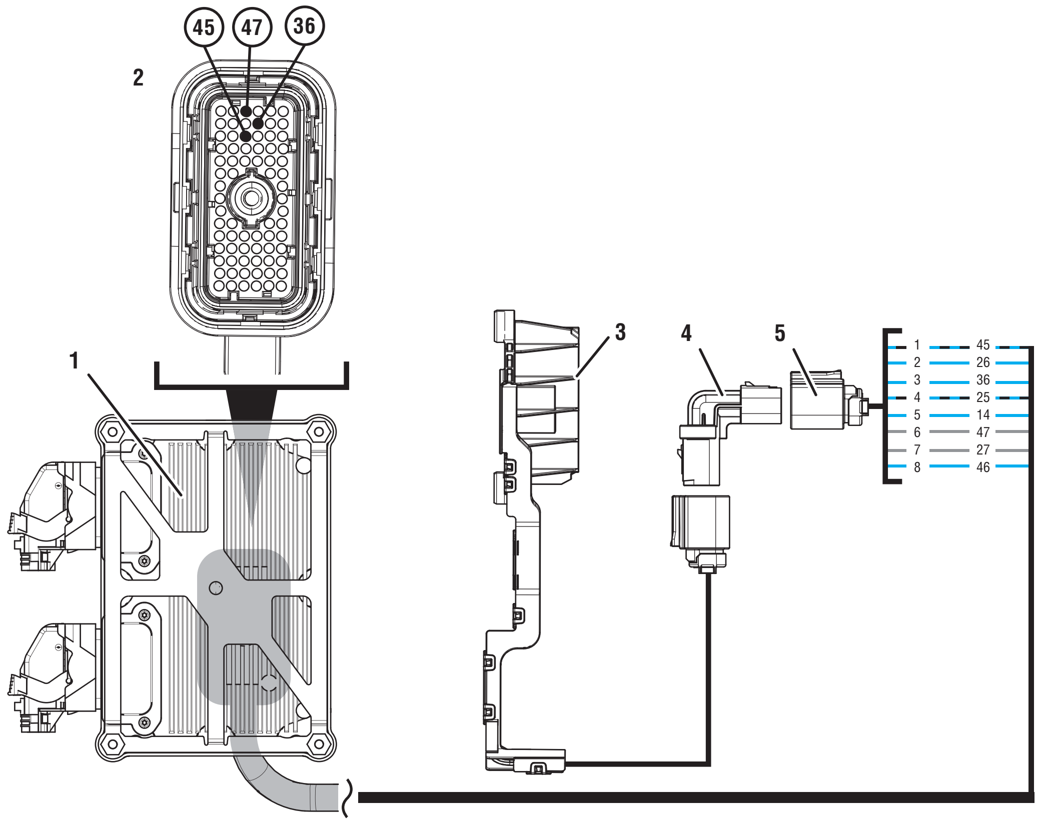
Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Sump Pan Filter
4. 8-Way 3-Rail Position Sensor (Inside Rear Housing)
5. Rail A Magnet (Inside Rear Housing)
6. Rail B Magnet (Inside Rear Housing)
7. Rail C Magnet (Inside Rear Housing)
8. 8-Way 90-Degree Connector (Shown with ACM Removed)



1. 8-Way 3-Rail Position Sensor Connector
2. 8-Way 90-Degree Connector
3. 8-Way 3-Rail Position Sensor



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 8-Way 3-Rail Position Sensor
4. 8-Way 90-Degree Connector
5. 8-Way Rail Position Sensor Connector

Fault Code 275 Troubleshooting

A

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

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

   Note: If Fault Code 275 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 275 FMI 0 or 1 is set, Reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 5th/7th, 3rd gears, synchronizer, Rail B fork or detent. Go to **Step V.**
   - If Fault Code 275 FMI 2 or 12 is Active, go to **Step J.**
   - If Fault Code 275 FMI 2 or 12 is Inactive, go to **Step B.**
   - If Fault Code 275 FMI 3, 4, 5, 6, or 8 is Active, go to **Step C.**
   - If Fault Code 275 FMI 3, 4, 5, 6, or 8 is Inactive, go to **Step B.**
   - If Fault Code 275 FMI 7 is set, go to **Step K.**
   - If Fault Code 275 FMI 14, 20, 21 or 31 is set, go to **Step O.**
   - If Fault Code 275 FMI 15, 16, 17 or 18 is set, go to **Step P.**

B

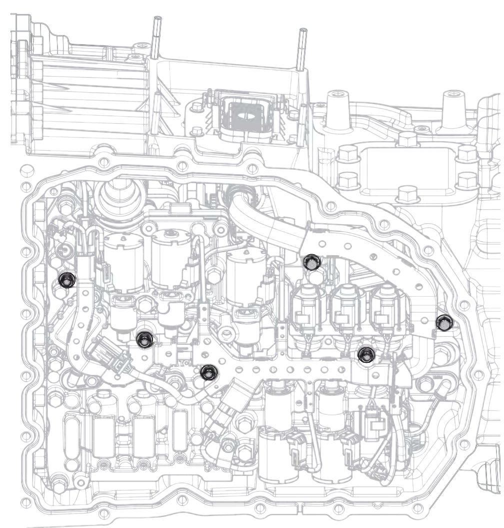
Purpose: *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Remove driveline and output yoke from transmission output shaft.
3. Drain oil.
4. Remove sump pan and filter.
5. Remove rear cover.
6. Connect ServiceRanger
7. Select Service Routine and PD Mode.

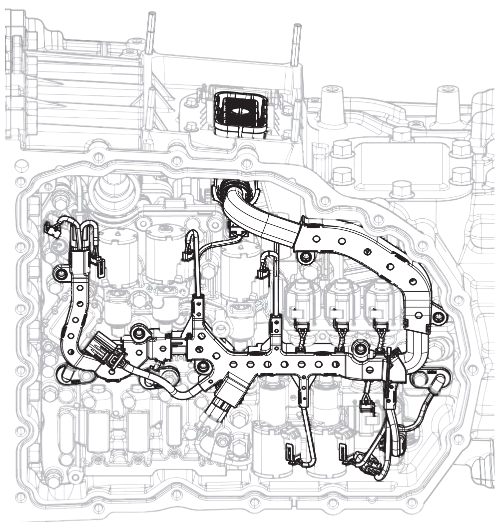
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

8. Remove 6 Transmission Harness 10 mm cap screws.



9. Wiggle 74-Way Transmission Harness and 3-Rail Position Sensor pigtail. Look for any obvious signs of rubbing or chafing on any of the wires.



10. Exit PD Mode.

- If any fault code sets Active while wiggling the 74-Way Transmission Harness, replace 74-Way Transmission Harness and 8-Way 90-Degree Connector. Go to **Step V.**
- If any fault code sets Active while wiggling the 3-Rail Position Sensor pigtail, replace 3-Rail Position Sensor and 8-Way 90-Degree Connector. Go to **Step V.**
- If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify 3-Rail Position Sensor secondary power supply.*

1. Set parking brake and chock wheels.

2. Key off.

3. Remove driveline and output yoke from transmission output shaft.

4. Drain oil.

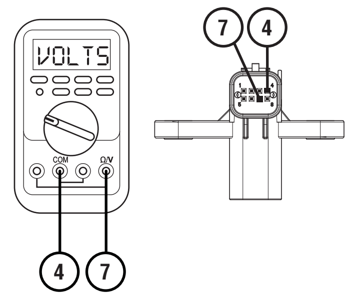
5. Remove rear cover.

Note: Position oil pan under rear cover as oil will drain upon removal.

6. Disconnect 8-Way 3-Rail Position Sensor Connector.

7. Key on with engine off.

8. Measure voltage between 8-Way 90-Degree Connector Pin 4 and Pin 7. Record reading in table.



9. Compare reading(s) in table.

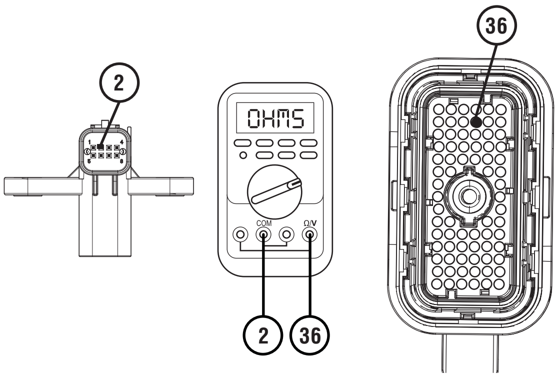
- If readings are out of range, go to **Step G.**
- If readings are in range, go to **Step D.**

Pins	Range	Reading(s)
4 to 7	4.75–5.25 V	

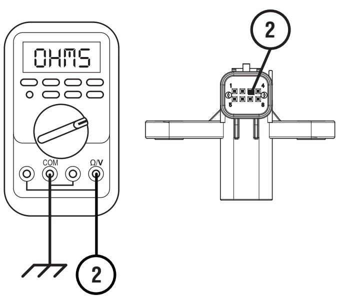
D

Purpose: *Verify continuity of Rail B Position signal wire.*

1. Key off.
2. Remove TCM.
3. Inspect connector for bent or spread pins.
4. Measure resistance between 8-Way 90-Degree Connector Pin 2 and 74-Way Transmission Harness Pin 36. Record reading in table.



5. Measure resistance between 8-Way 90-Degree Connector Pin 2 and ground. Record reading in table.



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

Pins	Range	Reading(s)
2 to 36	0–0.3 Ohms	
2 to ground	Open Circuit (OL)	

E

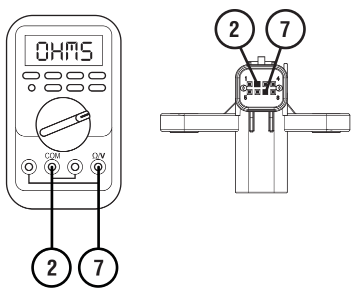
Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 275 FMI 2, 3, 4, 5, 6, 8, or 12 is Inactive, replace 3-Rail Position Sensor, 74-Way Transmission Harness and 8-Way 90-Degree Connector. Go to **Step V.**
   - If Fault Code 275 FMI 2, 3, 4, 5, 6, 8, or 12 is Active, go to **Step F.**

F

Purpose: *Verify internal resistance of TCM.*

1. Key off.
2. Disconnect 8-Way 3-Rail Position Sensor Connector.
3. Measure resistance between 8-Way 90-Degree Connector Pin 2 and Pin 7. Record reading in table.



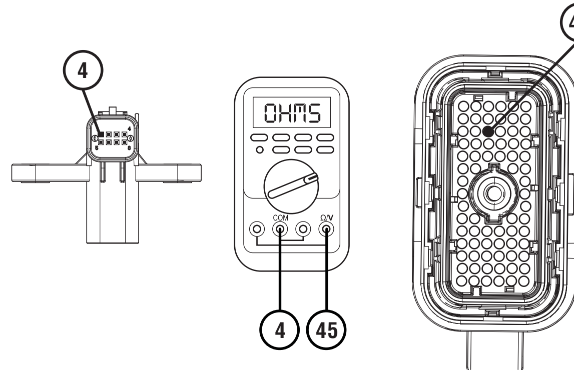
4. Compare reading(s) in table.
   - If any reading is out of range, replace TCM. Go to **Step V.**
   - If all readings are in range, replace 3-Rail Position Sensor. Go to **Step V.**

Pins	Range	Reading(s)
2 to 7	14.5–15.5K Ohms	

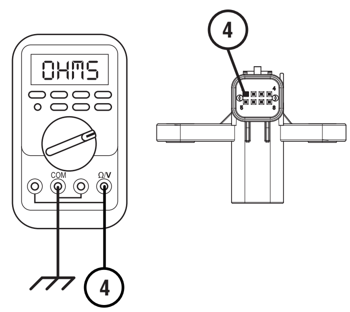
G

Purpose: *Verify continuity of 3-Rail Position Sensor secondary power supply wiring.*

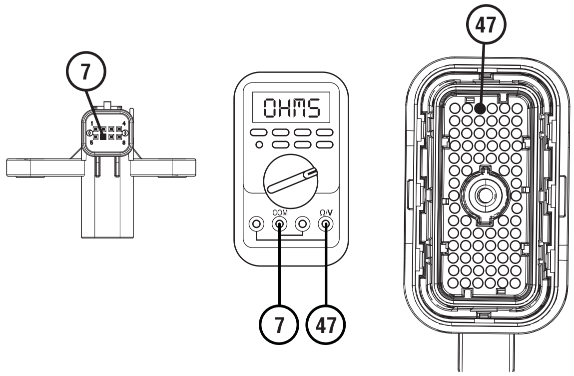
1. Key off.
2. Remove TCM.
3. Inspect connector for oil, corrosion, and bent or spread pins.
4. Measure resistance between 8-Way 90-Degree Connector Pin 4 and Pin 7. Record reading in table.
5. Measure resistance between 8-Way 90-Degree Connector Pin 4 and 74-Way Transmission Harness Pin 45. Record reading in table.



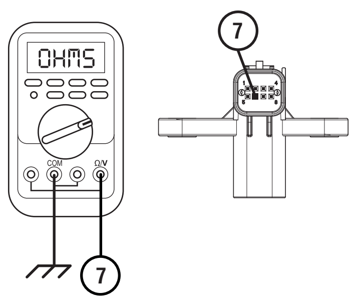
6. Measure resistance between 8-Way 90-Degree Connector Pin 4 and ground. Record reading in table.



7. Measure resistance between 8-Way 90-Degree Connector Pin 7 and 74-Way Transmission Harness Pin 47. Record reading in table.



8. Measure resistance between 8-Way 90-Degree Connector Pin 7 and ground. Record reading in table.



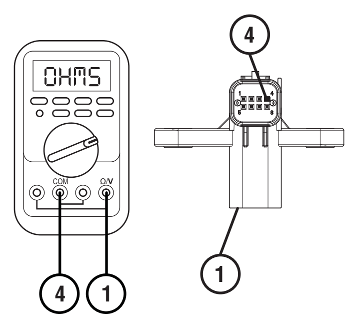
9. Compare reading(s) in table.
   - If any reading is out of range, go to **Step H.**
   - If all readings are in range, replace TCM. Go to **Step V.**

Pins	Range	Reading(s)
4 to 7	Open Circuit (OL)	
4 to 45	0–0.3 Ohms	
4 to ground	Open Circuit (OL)	
7 to 47	0–0.3 Ohms	
7 to ground	Open Circuit (OL)	

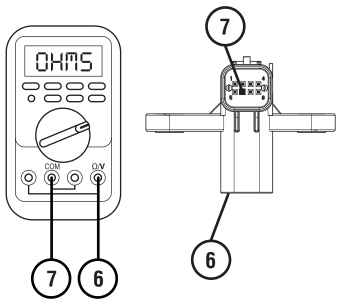
H

Purpose: *Verify continuity of 8-Way 90-Degree Connector secondary power supply wires.*

1. Drain oil.
2. Remove sump pan and filter.
3. Disconnect 8-Way Transmission Harness from 8-Way 90 Degree Connector.
4. Measure resistance between 8-Way 90-Degree Connector Pin 4 and Pin 1. Record reading in table.



5. Measure resistance between 8-Way 90-Degree Connector Pin 7 and Pin 6. Record reading in table.



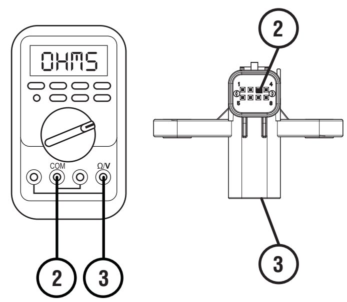
6. Compare reading(s) in table.
   - If any reading is out of range, replace 8-Way 90-Degree Connector. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
4 to 1	0–0.3 Ohms	
7 to 6	0–0.3 Ohms	

I

Purpose: *Verify continuity of 8-Way 90-Degree Connector Rail B Position signal wire.*

1. Drain oil.
2. Remove sump pan and filter.
3. Disconnect 8-Way Transmission Harness from 8-Way 90 Degree Connector.
4. Measure resistance between 8-Way 90-Degree Connector Pin 2 and Pin 3. Record reading in table.



5. Compare reading(s) in table.
   - If any reading is out of range, replace 8-Way 90-Degree Connector. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
2 to 3	0–0.3 Ohms	

J

Purpose: *Verify condition of 3-Rail Position Sensor and Rail B Magnet.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove driveline and output yoke from output shaft.
4. Remove rear cover.

   Note: Position oil pan under rear cover as oil will drain upon removal.
5. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
6. Inspect Rail B Magnet for damage and proper mounting to Rail B.
   - If 3-Rail Position Sensor or Rail B Magnet is damaged, replace damaged components. Go to **Step V.**
   - If no damage is found, go to **Step C.**

K

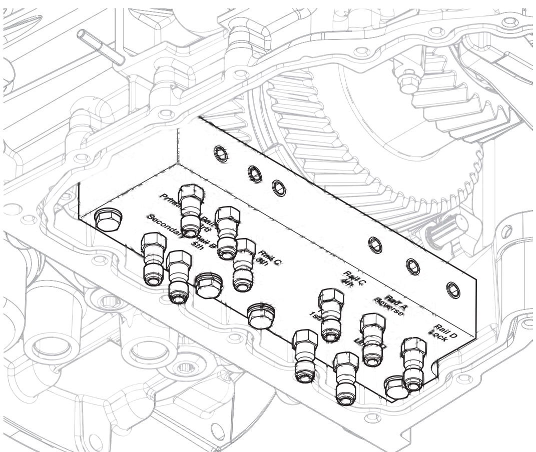
Purpose: *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail B fault codes set Active, go to **Step L.**

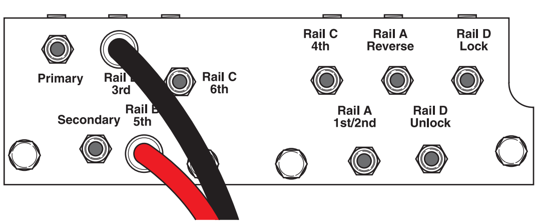
L

Purpose: *Actuate Rail B with Diagnostic Manifold tool.*

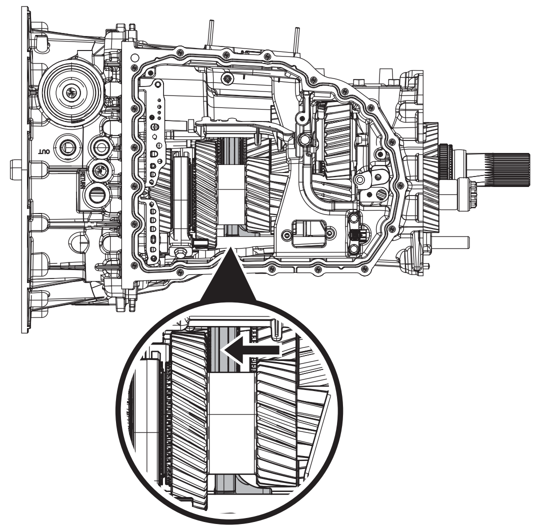
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



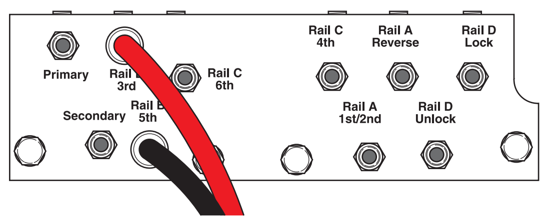
6. Apply air to Rail B 5th/7th port.



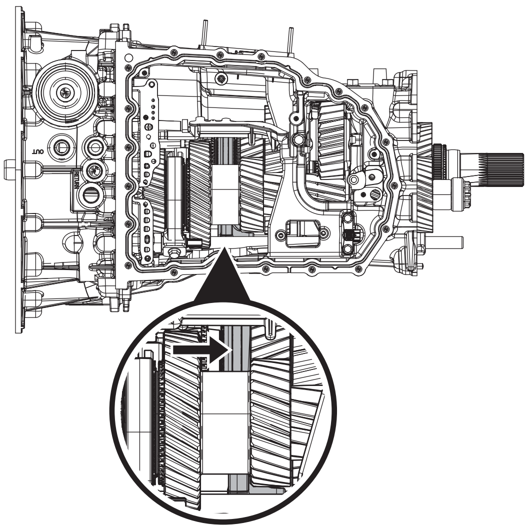
7. Watch for Rail B fork to fully engage synchronizer into 5th/7th gear.



8. Apply air to Rail B 3rd port.



9. Watch for Rail B fork to fully engage synchronizer into 3rd gear.



- If fork does not move or does not fully engage 5th/7th or 3rd gear, go to **Step M.**
- If fork fully engages 5th/7th and 3rd gear, go to **Step N.**

M

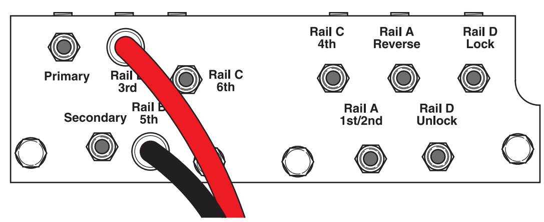
Purpose: *Verify mechanical condition of 5th/7th, 3rd synchronizer and detent.*

1. Use pry bar to engage Rail B fork into 5th/7th and 3rd gear.
   - If fork does not move or does not fully engage 5th/7th and 3rd gear, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 5th/7th and 3rd gear, synchronizer or detent. Go to **Step V.**
   - If fork fully engages 5th/7th and 3rd gear, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail B Piston and Rod Seals. Go to **Step V.**

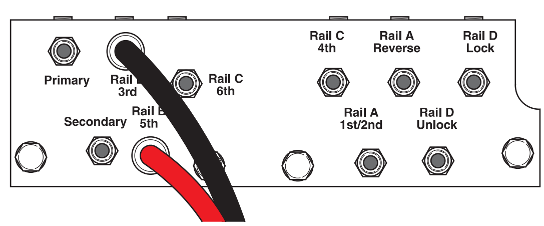
N

Purpose: *Verify condition of Rail B Piston and Rod Seals.*

1. Apply air to Rail B 3rd port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail B 5th/7th port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

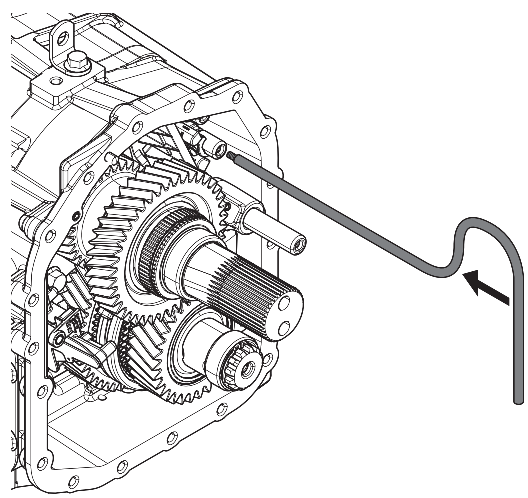
   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail B Piston and Rod Seals. Go to **Step V.**
   - If all result(s) are in range, replace RBVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail B 3rd Port	0 PSI	
Rail B 5th/7th Port	0 PSI	

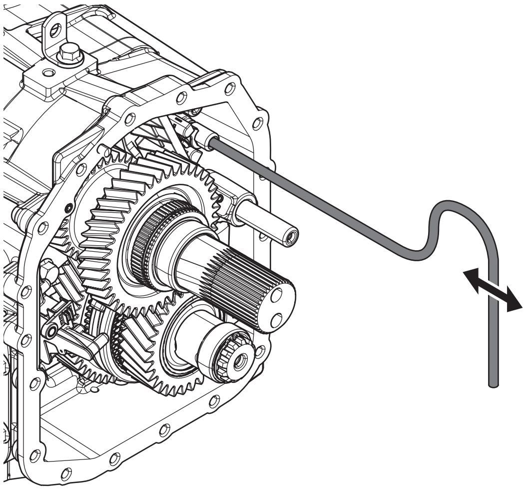
0

Purpose: *Verify condition of 5th/7th, 3rd gear assembly.*

1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Inspect Rail B fork for damage or wear.
6. Remove rear cover.
7. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
8. Inspect Rail B magnet for damage and proper mounting to Rail B.
9. Thread RR1039TR into Rail B



10. Engage 5th/7th, 3rd and Neutral using a pry bar.



Note: Use rear cover bolt threaded into case for leverage.

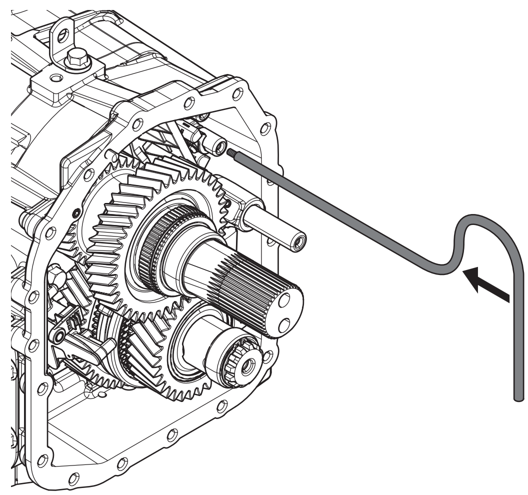
11. Verify Rail B is moving fork into all gear positions.

- If Rail B does not move fork or damage is found, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 5th/7th, 3rd gears or Rail B fork. Go to **Step V.**
- If Rail B does move the fork and no damage is found, replace 3-Rail Position Sensor. Go to **Step V.**

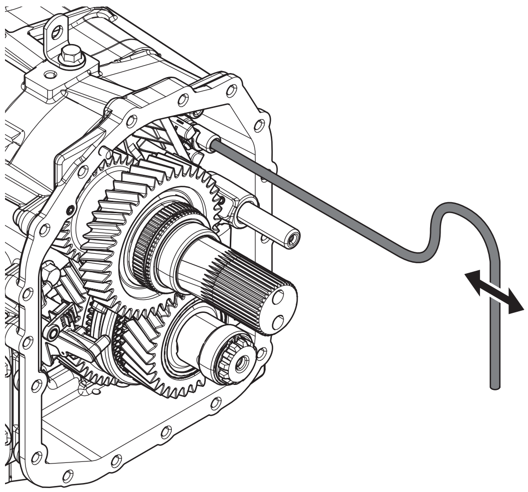
P ***Purpose:*** *Verify condition of 3-Rail Position Sensor and Rail B Detent.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove driveline and output yoke from output shaft.
4. Remove rear cover.

   Note: Position oil pan under rear cover as oil will drain upon removal.
5. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
6. Inspect Rail B magnet for damage and proper mounting to Rail B.
7. Thread RR1039TR into Rail B.



8. Engage 5th/7th, 3rd and Neutral using RR1039TR.



Note: Use rear cover bolt threaded into case for leverage.

9. Verify detent tension is proper.

- If detent tension is proper and no damage is found, replace 3-Rail Position Sensor. Go to **Step V.**
- If 3-Rail Position Sensor or Rail B Magnet is damaged, replace. Go to **Step V.**
- If detent is weak or missing, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail B detent. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.

2. Reconnect all connectors and verify that all components are properly installed.

3. Key on.

4. Clear fault codes using ServiceRanger.

5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.

6. Check for fault codes using ServiceRanger.

- If no codes set and the vehicle operates properly, Test Complete.
- If Fault Code 275 sets Active during the test drive, go to **Step A.**
- If a fault code other than 275 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 295: Rail C Position

J1939: SA 3 SPN 4220 FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 20, 21, 31

Overview

The Procision transmission is equipped with a 3-Rail Position Sensor to monitor shift Rail A, B, and C. There is a magnet mounted to each shift rail. The 3-Rail Position Sensor detects the proximity of the magnets to determine the position of each shift rail. The 3-Rail Position Sensor is located in the rear housing and connected to the Transmission Control Module (TCM) via the 8-Way 90-Degree Connector and 74-Way Transmission Harness.

Detection

The TCM monitors shift Rail C Position. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Uncommanded Rail C movement from 6th toward Neutral while not commanding other shift rails and shaft speeds do not indicate 6th gear ratio (slip out). 5 occurrences required during key cycle.

FMI 1 – Data Valid but Below Normal: Uncommanded Rail C movement from 4th toward Neutral while not commanding other shift rails and shaft speeds do not indicate 4th gear ratio (slip out). 5 occurrences required during key cycle.

FMI 2 – Data erratic: Rail C Position operating range not between 0 - 24 mm for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail C Position circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail C Position circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail C Position circuit open for 1 second.

FMI 6 - Current Above Normal or Shorted Circuit: Rail C Position signal not between 4.25 V and 6.25 V for 1 second.

FMI 7 – Mechanical System Not Responding: No movement in fore direction during Rail C calibration.

FMI 8 – Abnormal Frequency: Rail C Position signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: Rail C Position duty cycle out of range for 1 second.

FMI 14 – Special Instructions: Rail C Position reports 4th gear position, but shaft speeds do not indicate 4th gear ratio.

FMI 15 – Data Valid but Above Normal: Uncommanded Rail C movement from Neutral toward 6th while not commanding other shift rails (sensor drift).

FMI 16 – Data Valid but Above Normal: Uncommanded Rail C movement from 6th toward Neutral while not commanding other shift rails and shaft speeds continuously indicate 6th gear ratio (sensor drift).

FMI 17 – Data Valid but Below Normal: Uncommanded Rail C movement from Neutral toward 4th while not commanding other shift rails (sensor drift).

FMI 18 – Data Valid but Below Normal: Uncommanded Rail C movement from 4th toward Neutral while not commanding other shift rails and shaft speeds continuously indicate 4th gear ratio (sensor drift).

FMI 20 – Data Drifted High: Rail C Position reports 4th gear disengagement, but shaft speeds indicate 4th gear ratio.

FMI 21 – Data Drifted Low: Rail C Position reports 6th gear disengagement, but shaft speeds indicate 6th gear ratio.

FMI 31 – Condition Exists: Rail C Position reports 6th gear position, but shaft speeds do not indicate 6th gear ratio.

Fallback

All FMIs:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

Note: If Rail C is disengaged:

- Secondary Clutch disengaged
- 2nd, 4th, 6th, 7th gears unavailable

Conditions to Set Fault Code Inactive

FMI 0, 1, 15, 16, 17, 18: Key cycle.

FMI 2: Rail C Position operating range between 0–24 mm for 10 seconds.

FMI 3: Rail C Position circuit not shorted to power for 10 seconds.

FMI 4: Rail C Position circuit not shorted to ground for 10 seconds.

FMI 5: Rail C Position circuit not open for 10 seconds.

FMI 6: Rail C Position signal between 4.25 V and 6.25 V for 10 seconds.

FMI 7: Successful rail calibration performed.

FMI 8: Rail C Position signal frequency in range for 10 seconds.

FMI 12: Rail C Position duty cycle in range for 10 seconds.

FMI 14, 20, 21, 31: Rail C Position is confirmed in 6th, Neutral, or 4th for 10 seconds.

Possible Causes

FMI 0, 1:

- 6th/4th Synchronizer
  - Clutching teeth damaged or worn
- 6th, 4th Gear
  - Clutching teeth damaged or worn
- Rail C Fork
  - Bent
  - Worn wear pads

FMI 2, 12:

- 3-Rail Position Sensor
  - Internal failure
- Rail C Magnet
  - Detached from shift rail

FMI 3, 4, 5:

- 74-Way Transmission Harness or 8-Way 90-Degree Connector
  - Wiring shorted to power, shorted to ground, or open
- 3-Rail Position Sensor
  - Internal failure

FMI 6, 8:

- 3-Rail Position Sensor
  - Internal failure
- 74-Way Transmission Harness or 8-Way 90-Degree Connector
  - Wiring shorted to power, shorted to ground, or open
- TCM
  - Internal failure

FMI 7:

- Rail C Piston
  - Seal damaged
  - Snap ring missing
- SPS1
  - Stuck open
- SPS2
  - Stuck closed
- Rail C Valve Solenoid (RCVS)
  - Stuck closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail C Valve (RCV) stuck closed
  - Control Pressure Valve (CPV) stuck closed

FMI 14, 20, 21, 31:

- Shift Fork
  - Roll pins sheared
  - Fork broken
- 3-Rail Position Sensor
  - Internal failure

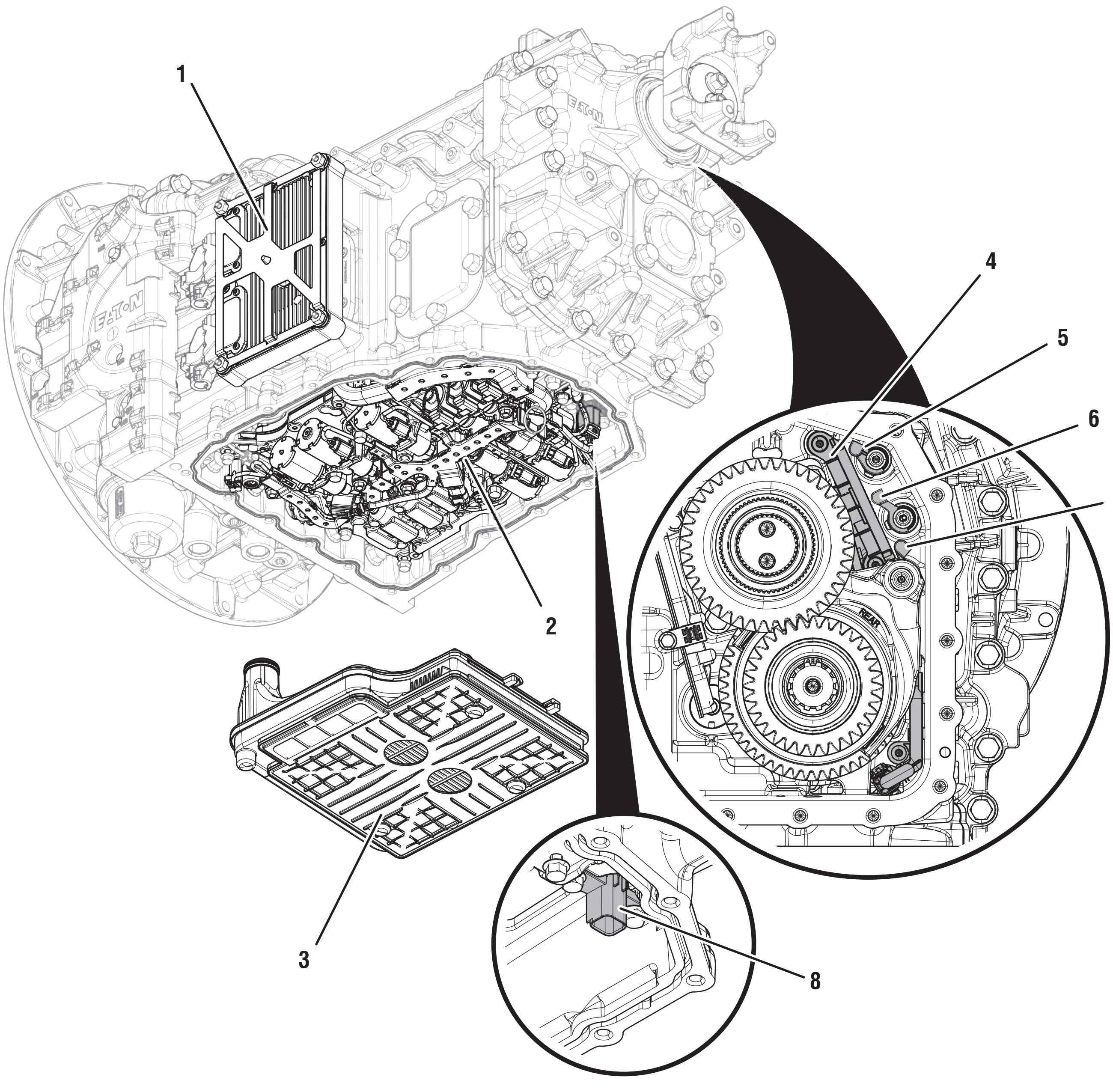
FMI 15, 16, 17, 18:

- 3-Rail Position Sensor
  - Internal failure
- Rail C Detent
  - Weak or broken spring
  - Worn shift rail or detent

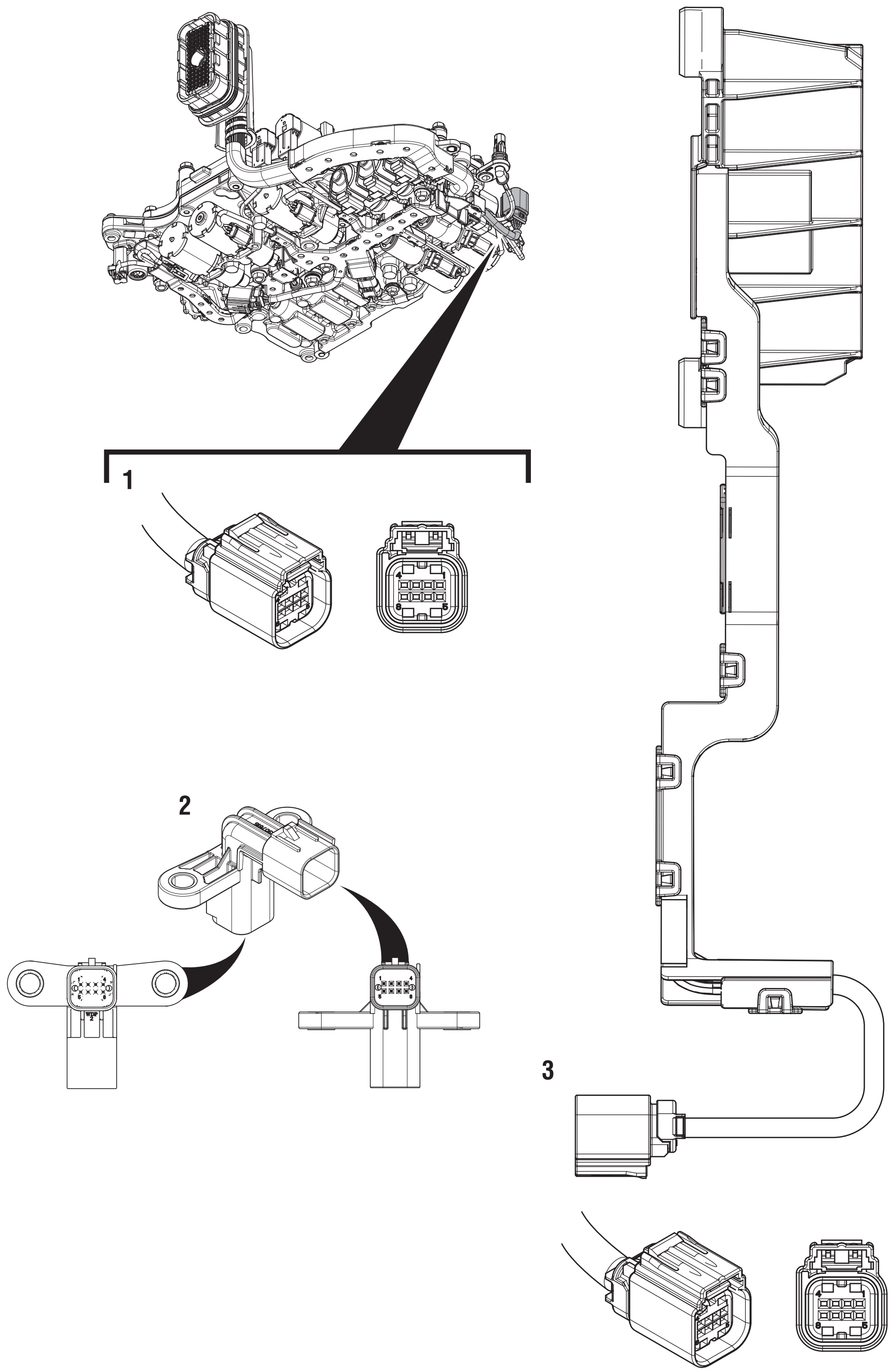
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

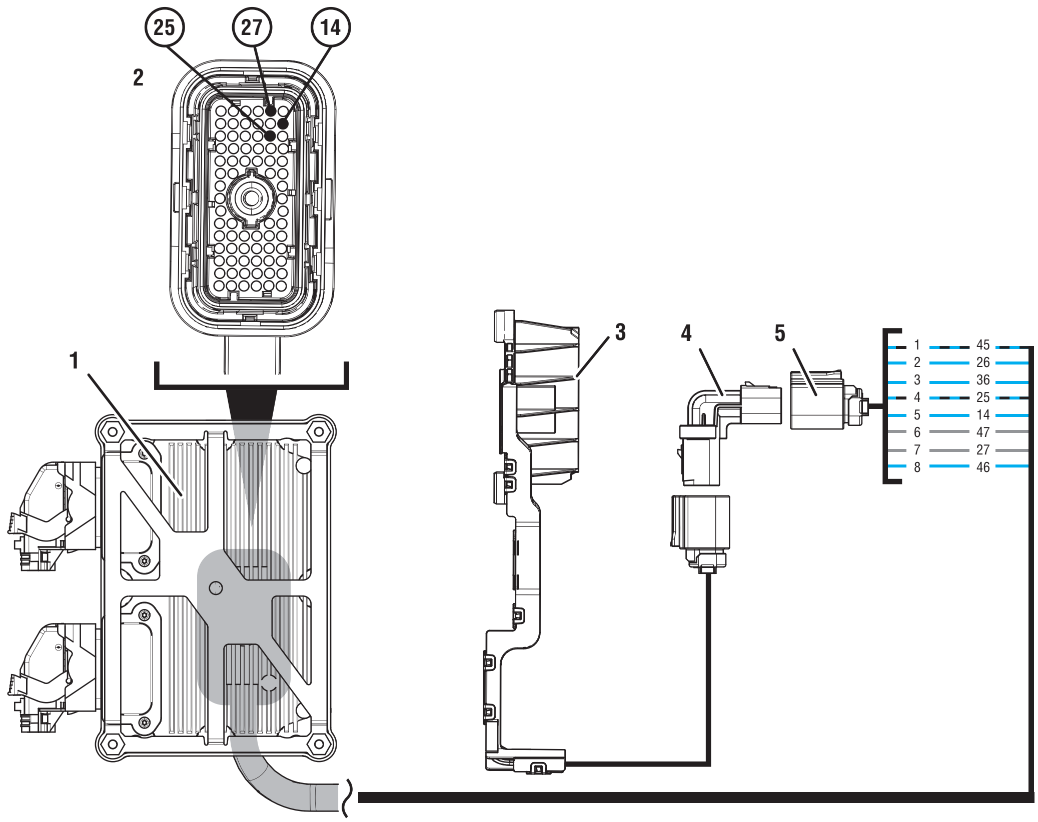
Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Sump Pan Filter
4. 8-Way 3-Rail Position Sensor (Inside Rear Housing)
5. Rail A Magnet (Inside Rear Housing)
6. Rail B Magnet (Inside Rear Housing)
7. Rail C Magnet (Inside Rear Housing)
8. 8-Way 90-Degree Connector (Shown with ACM Removed)



1. 8-Way 3-Rail Position Sensor Connector
2. 8-Way 90-Degree Connector
3. 8-Way 3-Rail Position Sensor



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 8-Way 3-Rail Position Sensor
4. 8-Way 90-Degree Connector
5. 8-Way Rail Position Sensor Connector

Fault Code 295 Troubleshooting

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

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

   Note: If Fault Code 295 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 295 FMI 0 or 1 is set, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 4th, 6th gears, synchronizer, Rail C fork or detent. Go to **Step V.**
   - If Fault Code 295 FMI 2 or 12 is Active, go to **Step J.**
   - If Fault Code 295 FMI 2 or 12 is Inactive, go to **Step B.**
   - If Fault Code 295 FMI 3, 4, 5, 6, or 8 is Active, go to **Step C.**
   - If Fault Code 295 FMI 3, 4, 5, 6, or 8 is Inactive, go to **Step B.**
   - If Fault Code 295 FMI 7 is set, go to **Step K.**
   - If Fault Code 295 FMI 14, 15, 16, 17, 18, 20, 21 or 31 is set, go to **Step O.**

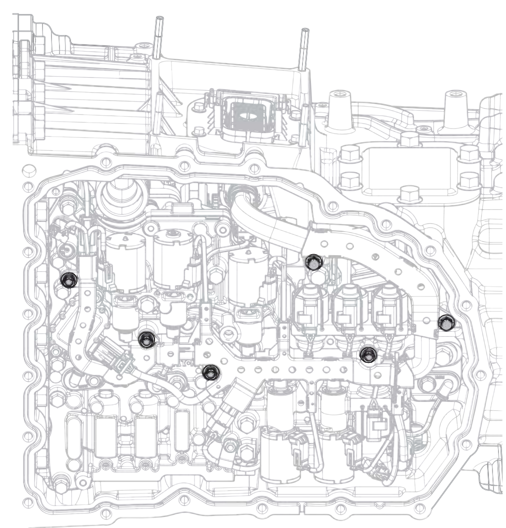
B ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Remove driveline and output yoke from transmission output shaft.
3. Drain oil.
4. Remove sump pan and filter.
5. Remove rear cover.
6. Connect ServiceRanger
7. Select Service Routine and PD Mode.

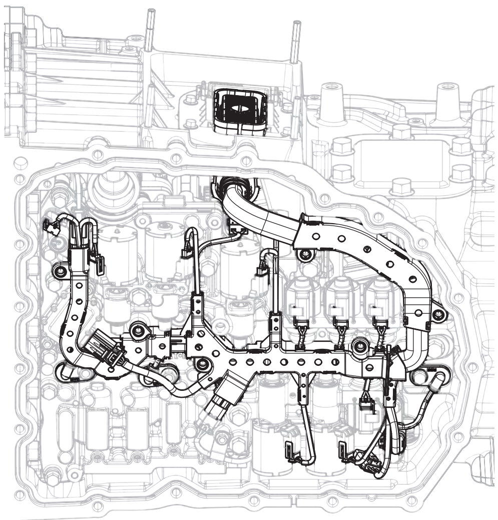
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

8. Remove 6 Transmission Harness 10 mm cap screws.



9. Wiggle 74-Way Transmission Harness and 3-Rail Position Sensor pigtail. Look for any obvious signs of rubbing or chafing on any of the wires.



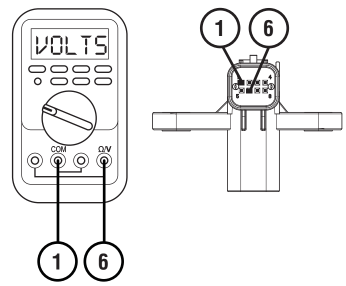
10. Exit PD Mode.
    - If any fault code sets Active while wiggling the 74-Way Transmission Harness, replace 74-Way Transmission Harness and 8-Way 90-Degree Connector. Go to **Step V.**
    - If any fault code sets Active while wiggling the 3-Rail Position Sensor pigtail, replace 3-Rail Position Sensor and 8-Way 90-Degree Connector. Go to **Step V.**
    - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify 3-Rail Position Sensor primary power supply.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove driveline and output yoke from transmission output shaft.
4. Drain oil.
5. Remove rear cover.

   Note: Position oil pan under rear cover as oil will drain upon removal.
6. Disconnect 8-Way 3-Rail Position Sensor Connector.
7. Key on with engine off.
8. Measure voltage between 8-Way 90-Degree Connector Pin 1 and Pin 6. Record reading in table.



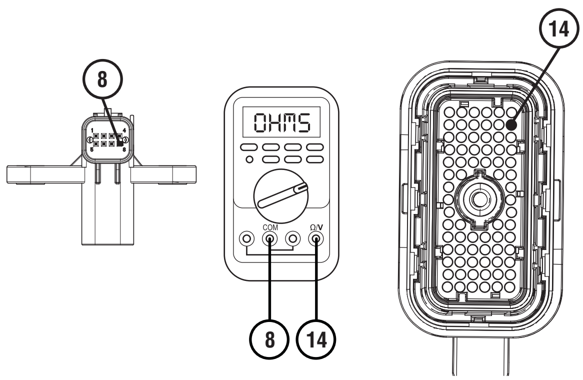
9. Compare reading(s) in table.
   - If readings are out of range, go to **Step G.**
   - If readings are in range, go to **Step D.**

Pins	Range	Reading(s)
1 to 6	4.75–5.25 V	

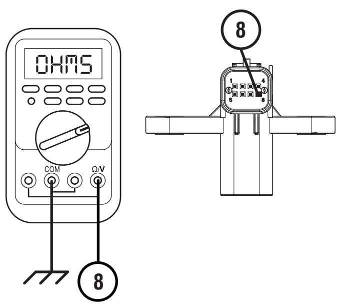
D

Purpose: *Verify continuity of Rail C Position signal wire.*

1. Key off.
2. Remove TCM.
3. Inspect connector for bent or spread pins.
4. Measure resistance between 8-Way 90-Degree Connector Pin 8 and 74-Way Transmission Harness Pin 14. Record reading in table.



5. Measure resistance between 8-Way 90-Degree Connector Pin 8 and ground. Record reading in table.



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

Pins	Range	Reading(s)
8 to 14	0–0.3 Ohms	
8 to ground	Open Circuit (OL)	

E

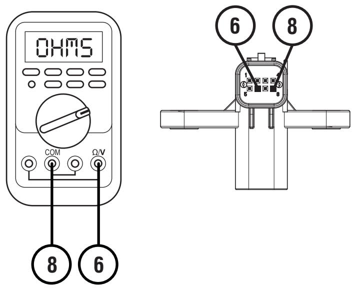
Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 295 FMI 2, 3, 4, 5, 6, 8, or 12 is Inactive, replace 3-Rail Position Sensor, 74-Way Transmission Harness and 8-Way 90-Degree Connector. Go to **Step V.**
   - If Fault Code 295 FMI 2, 3, 4, 5, 6, 8, or 12 is Active, go to **Step F.**

F

Purpose: *Verify internal resistance of TCM.*

1. Key off.
2. Disconnect 8-Way 3-Rail Position Sensor Connector.
3. Measure resistance between 8-Way 90-Degree Connector Pin 8 and Pin 6. Record reading in table.



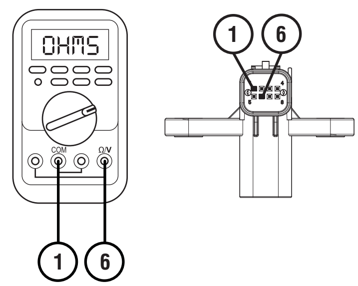
4. Compare reading(s) in table.
   - If any reading is out of range, replace TCM. Go to **Step V.**
   - If all readings are in range, replace 3-Rail Position Sensor. Go to **Step V.**

Pins	Range	Reading(s)
8 to 6	14.5–15.5K Ohms	

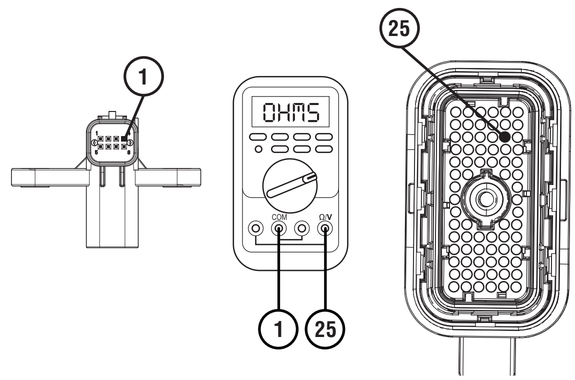
G

Purpose: *Verify continuity of 3-Rail Position Sensor primary power supply wiring.*

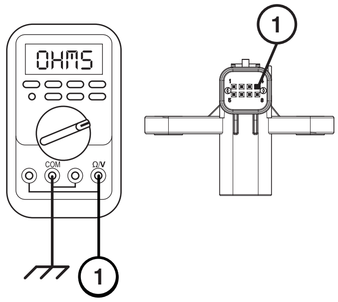
1. Key off.
2. Remove TCM.
3. Inspect connector for oil, corrosion, and bent or spread pins.
4. Measure resistance between 8-Way 90-Degree Connector Pin 1 and Pin 6. Record reading in table.



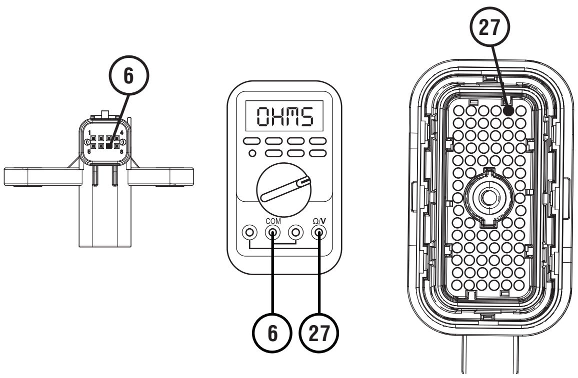
5. Measure resistance between 8-Way 90-Degree Connector Pin 1 and 74-Way Transmission Harness Pin 25. Record reading in table.



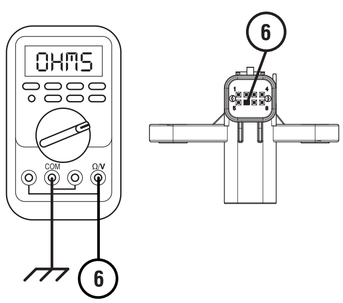
6. Measure resistance between 8-Way 90-Degree Connector Pin 1 and ground. Record reading in table.



7. Measure resistance between 8-Way 90-Degree Connector Pin 6 and 74-Way Transmission Harness Pin 27. Record reading in table.



8. Measure resistance between 8-Way 90-Degree Connector Pin 6 and ground. Record reading in table.



9. Compare reading(s) in table.

- If any reading is out of range. go to **Step H.**
- If all readings are in range, replace TCM. Go to **Step V.**

Pins	Range	Reading(s)
1 to 6	Open Circuit (OL)	
1 to 25	0–0.3 Ohms	
1 to ground	Open Circuit (OL)	
6 to 27	0–0.3 Ohms	
6 to ground	Open Circuit (OL)	

H

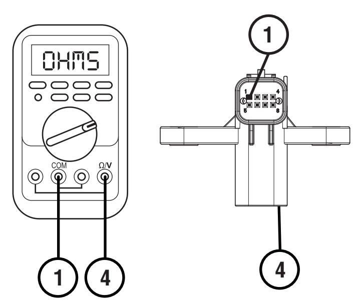
Purpose: *Verify continuity of 8-Way 90-Degree Connector primary power supply wires.*

1. Drain oil.

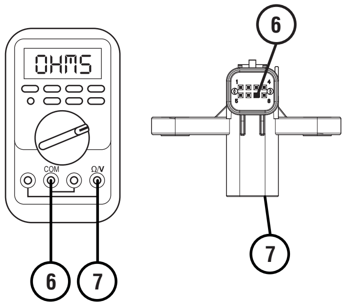
2. Remove sump pan and filter.

3. Disconnect 8-Way Transmission Harness from 8-Way 90 Degree Connector.

4. Measure resistance between 8-Way 90-Degree Connector Pin 1 and Pin 4. Record reading in table.



5. Measure resistance between 8-Way 90-Degree Connector Pin 6 and Pin 7. Record reading in table.

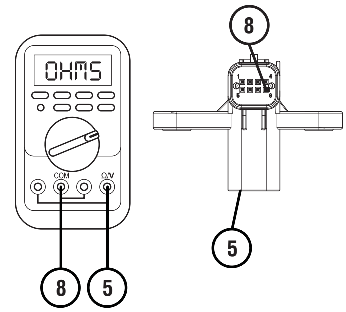


6. Compare reading(s) in table.
   - If any reading is out of range, replace 8-Way 90-Degree Connector. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 4	0–0.3 Ohms	
6 to 7	0–0.3 Ohms	

I ***Purpose:*** *Verify continuity of 8-Way 90-Degree Connector Rail C Position signal wire.*

1. Drain oil.
2. Remove sump pan and filter.
3. Disconnect 8-Way Transmission Harness from 8-Way 90 Degree Connector.
4. Measure resistance between 8-Way 90-Degree Connector Pin 8 and Pin 5. Record reading in table.



5. Compare reading(s) in table.
   - If any reading is out of range, replace 8-Way 90-Degree Connector. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
8 to 5	0–0.3 Ohms	

J

Purpose: *Verify condition of 3-Rail Position Sensor and Rail C Magnet.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove driveline and output yoke from output shaft.
4. Remove rear cover.

   Note: Position oil pan under rear cover as oil will drain upon removal.
5. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
6. Inspect Rail C Magnet for damage and proper mounting to Rail C.
   - If 3-Rail Position Sensor or Rail C Magnet is damaged, replace damaged components. Go to **Step V.**
   - If no damage is found, go to **Step C.**

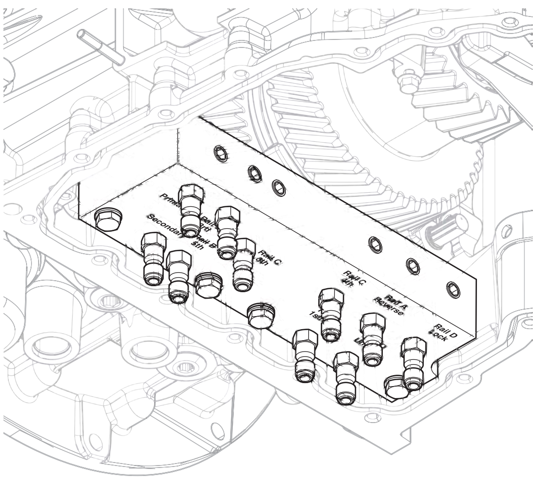
K

Purpose: *Perform Rail Calibration.*

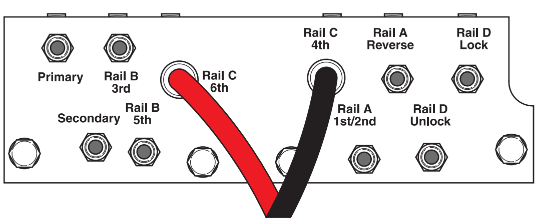
1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail C fault codes set Active, go to **Step L.**

L ***Purpose:*** *Actuate Rail C with Diagnostic Manifold tool.*

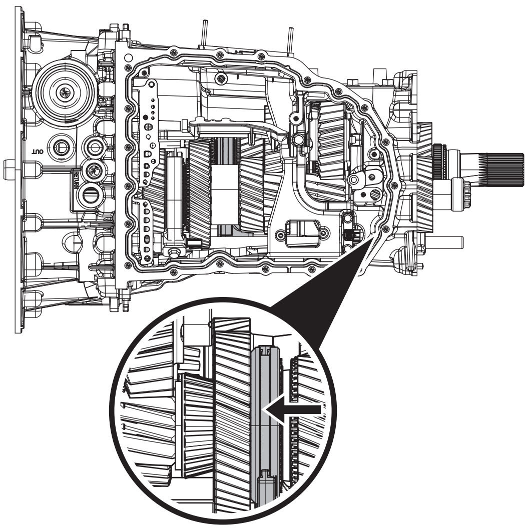
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



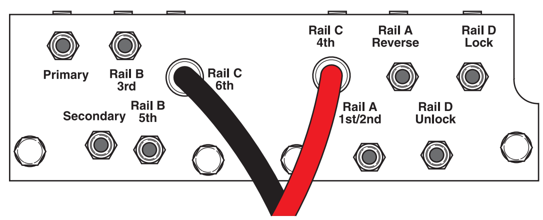
6. Apply air to Rail C 6th port.



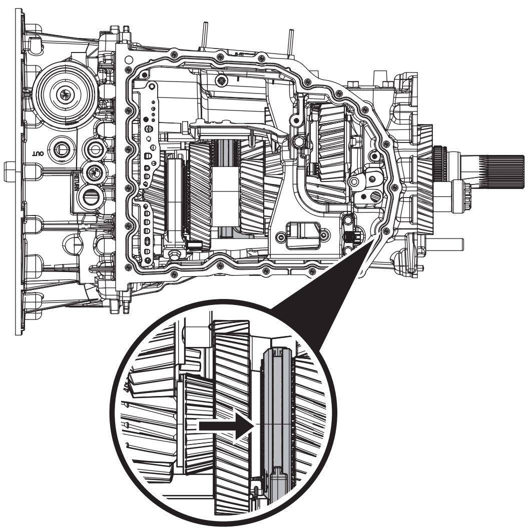
7. Watch for Rail C fork to fully engage synchronizer into 6th gear.



8. Apply air to Rail C 4th port.



9. Watch for Rail C fork to fully engage synchronizer into 4th gear.



- If fork does not move or does not fully engage 6th or 4th gear, go to **Step M.**
- If fork fully engages 6th and 4th gear, go to **Step M.**

M

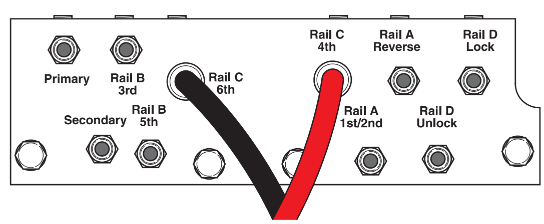
Purpose: *Verify mechanical condition of 6th and 4th gear, synchronizer and detent.*

1. Use pry bar to engage Rail C fork into 6th and 4th gear.
   - If fork does not move or does not fully engage 6th and 4th gear, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 6th and 4th gear, synchronizer or detent. Go to **Step V.**
   - If fork fully engages 6th and 4th gear, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail C Piston and Rod Seal. Go to **Step V.**

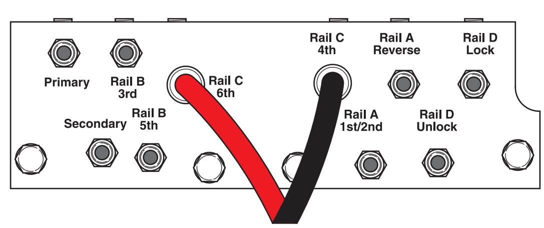
N

Purpose: *Verify condition of Rail C Piston and Rod Seal.*

1. Apply air to Rail C 4th port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail C 6th port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail C Piston and Rod Seal. Go to **Step V.**
   - If all result(s) are in range, replace RCVS and ACM. Go to **Step V.**

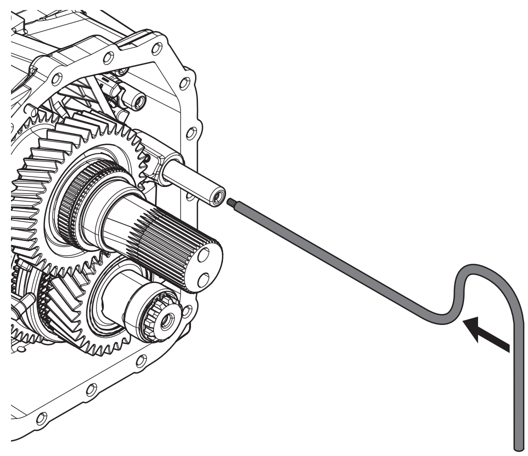
Air Application	Leak Down Range	Result
Rail C 4th Port	0 PSI	
Rail C 6th Port	0 PSI	

0

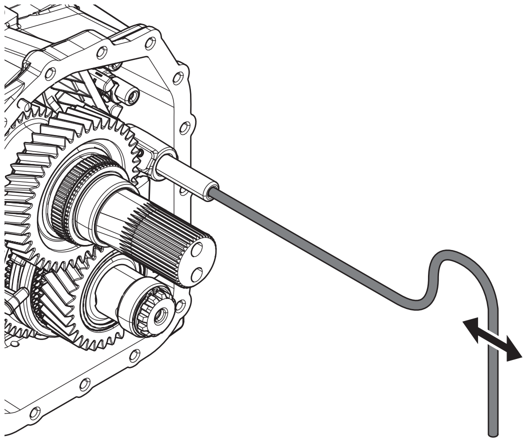
Purpose: *Verify condition of 6th, 4th gear assembly.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove driveline and output yoke from output shaft.
4. Drain oil.
5. Remove rear cover.

   Note: Position oil pan under rear housing cover as oil will drain upon removal.
6. Inspect Rail C fork for damage or wear.
7. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
8. Inspect Rail C magnet for damage and proper mounting to Rail C.
9. Thread RR1039TR into Rail C.



10. Engage 6th, 4th, and Neutral using RR1039TR.



Note: Use rear housing cover bolt threaded into case for leverage.

11. Verify Rail C is moving fork into all gear positions and detent tension is proper.

- If Rail C does move the fork and no damage is found, replace 3-Rail Position Sensor. Go to **Step V.**
- If Rail C does not move fork or damage is found, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 6th, 4th gears or Rail C fork. Go to **Step V.**
- If detent is weak or missing, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail C detent. Go to **Step V.**

V

Purpose: *Verify Repair*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 295 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 295 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 315: Rail D Position

J1939: SA 3 SPN 5941 FMI 0, 2, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16, 20

Overview

The Procision transmission is equipped with a Rail D Position Sensor to monitor shift Rail D. There is a magnet mounted to Rail D. The position sensor detects the proximity of the magnet to determine the position of the shift rail. The Rail D Position Sensor is mounted to the Actuation Control Manifold (ACM) and connected to the Transmission Control Module (TCM) via the 74-Way Transmission Harness.

Detection

The TCM monitors shift Rail D Position. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Uncommanded Rail D movement from Lock toward Unlock while not commanding other shift rails and shaft speeds do not indicate Locked gear ratio (slip out). 5 occurrences required during key cycle.

FMI 2 – Data erratic: Rail D Position operating range not between 0–16 mm for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail D Position circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail D Position circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail D Position circuit open for 1 second.

FMI 6 – Current Above Normal or Shorted Circuit: Rail D Position signal not between 4.25 V and 6.25 V for 1 second.

FMI 7 – Mechanical System Not Responding: No movement in fore direction during Rail D calibration.

FMI 8 – Abnormal Frequency: Rail D Position signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: Rail D Position duty cycle out of range for 1 second.

FMI 14 – Special Instructions: Rail D Position reports Lock, but shaft speeds indicate Unlock gear ratio.

FMI 15 – Data Valid but Above Normal: Uncommanded Rail D movement from Unlock toward Lock while not commanding other shift rails (sensor drift).

FMI 16 – Data Valid but Above Normal: Uncommanded Rail D movement from Lock toward Unlock while not commanding other shift rails and shaft speeds continuously indicate Locked gear ratio (sensor drift).

FMI 20 – Data Drifted High: Rail D Position reports Unlock, but shaft speeds indicate Lock gear ratio.

Fallback

All FMIs:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

Note: If Rail D is disengaged:

- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th, and 7th gears unavailable
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a RDVS fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

Conditions to Set Fault Code Inactive

FMI 0, 15, 16: Key cycle

FMI 2: Rail D Position operating range between 0–16 mm for 10 seconds.

FMI 3: Rail D Position circuit not shorted to power for 10 seconds.

FMI 4: Rail D Position circuit not shorted to ground for 10 seconds.

FMI 5: Rail D Position circuit not open for 10 seconds.

FMI 6: Rail D Position signal between 4.25 V and 6.25 V for 10 seconds.

FMI 7: Successful rail calibration performed.

FMI 8: Rail D Position signal frequency in range for 10 seconds.

FMI 12: Rail D Position duty cycle in range for 10 seconds.

FMI 14, 20: Rail D Position is confirmed in Unlock or Lock for 10 seconds.

Possible Causes

FMI 0:

- Lock Synchronizer
  - Clutching teeth damaged or worn
- Cluster Gear
  - Clutching teeth damaged or worn
- Rail D Fork
  - Bent
  - Worn wear pads

FMI 2, 12:

- Rail D Position Sensor
  - Internal failure
- Rail D Magnet
  - Detached from shift rail

FMI 3, 4, 5:

- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open
- Rail D Position Sensor
  - Internal failure

FMI 7:

- Rail D Piston
  - Seal damaged
  - Snap ring missing
- SPS1
  - Stuck open
- SPS2
  - Stuck closed
- Rail D Valve Solenoid (RDVS)
  - Stuck closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail D Valve (RDV) stuck closed
  - Control Pressure Valve (CPV) stuck closed

FMI 6, 8:

- Rail D Position Sensor
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open
- TCM
  - Internal failure

FMI 14, 20:

- Rail D Fork
  - Cap screw sheared
  - Broken
- Rail D Position Sensor
  - Internal failure

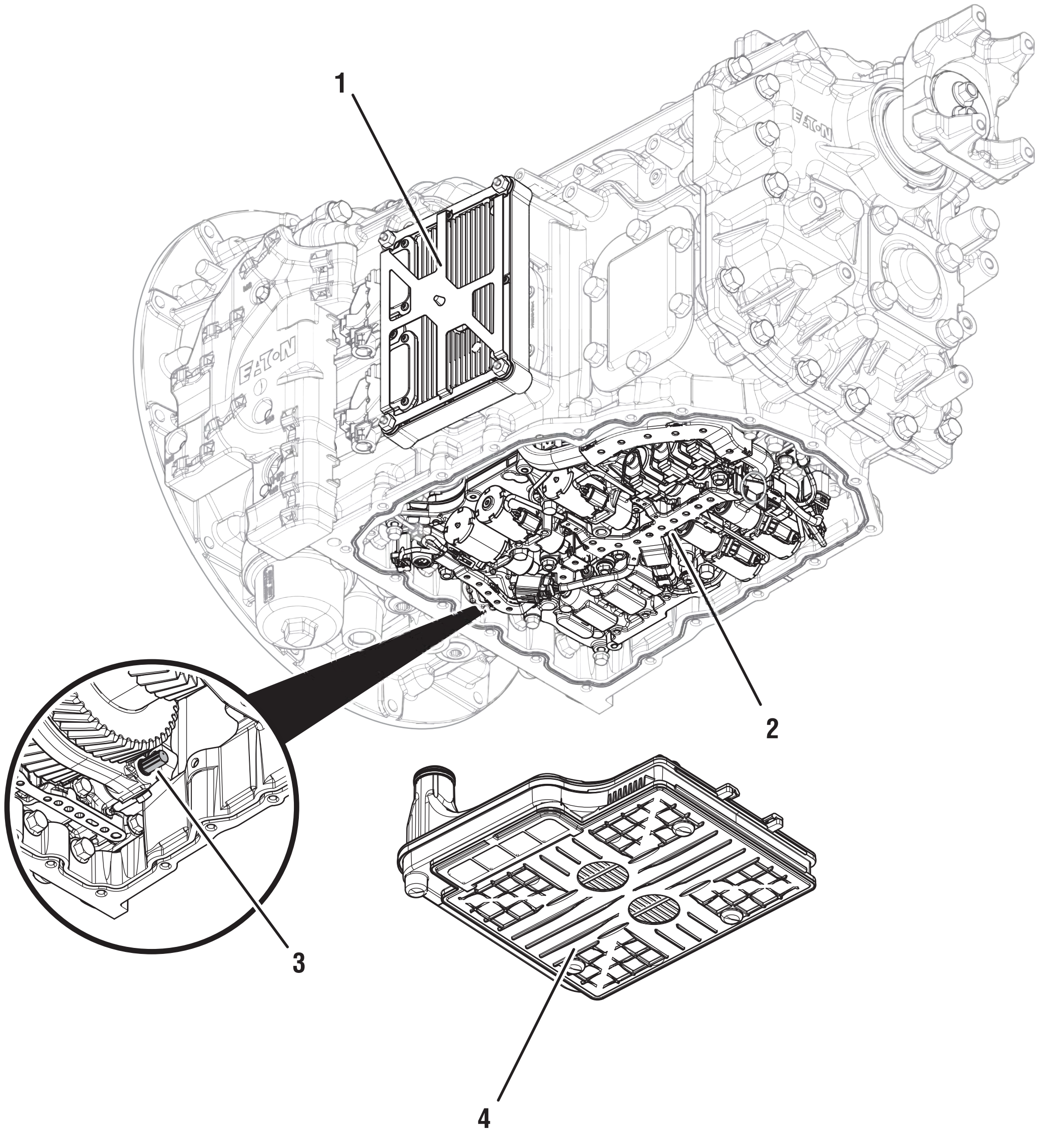
FMI 15, 16:

- Rail D Position Sensor
  - Internal failure
- Rail D Detent
  - Weak or broken spring
  - Worn shift rail or detent

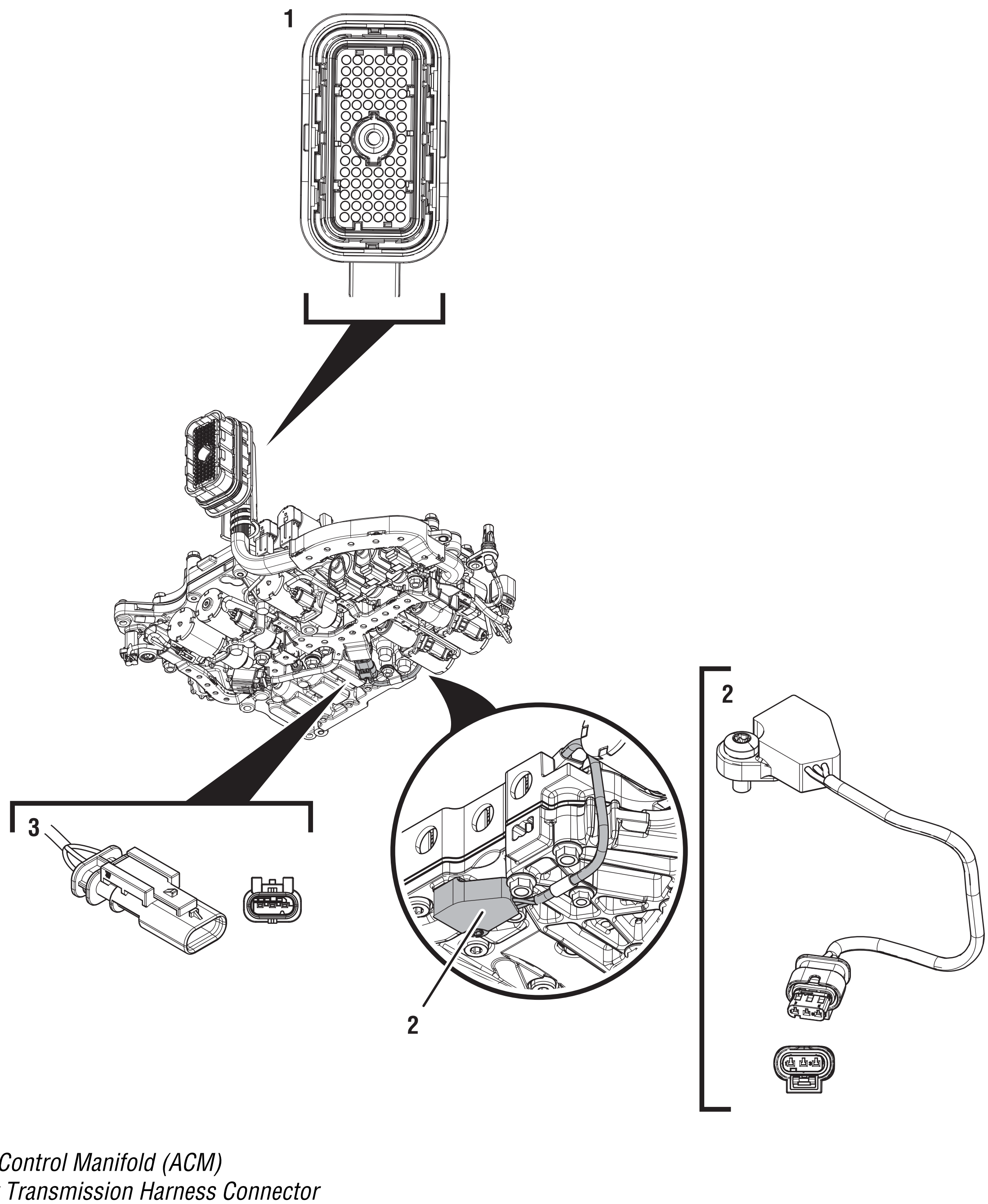
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

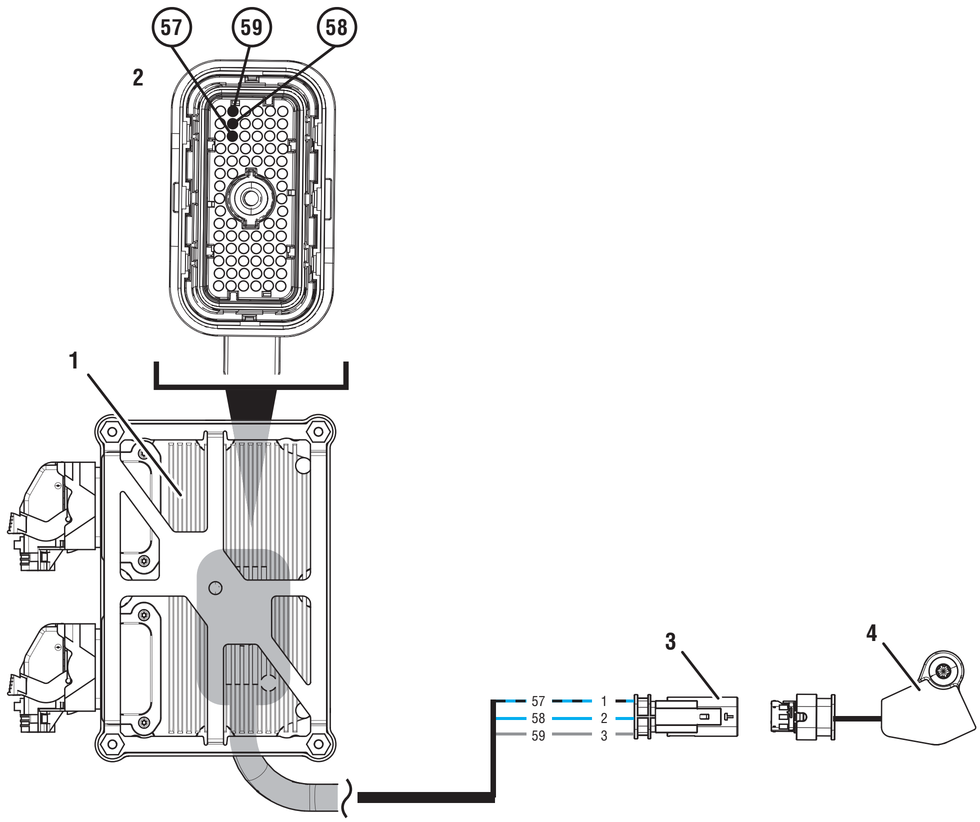
Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Rail D Magnet (Shown with ACM Removed)
4. Sump Pan Filter



Actuation Control Manifold (ACM)
1. 74-Way Transmission Harness Connector
2. 3-Way Rail D Position Sensor
3. 3-Way Rail D Position Sensor Connector



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 3-Way Rail D Position Sensor Connector
4. 3-Way Rail D Position Sensor

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

Fault Code 315 Troubleshooting

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

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

   Note: If Fault Code 315 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 315 FMI 0 is set, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Lock gear, synchronizer, Rail D fork or detent. Go to **Step V.**
   - If Fault Code 315 FMI 2, 3, 4, 5, 6, 8, or 12 is Active, go to **Step C.**
   - If Fault Code 315 FMI 2, 3, 4, 5, 6, 8, or 12 is Inactive, go to **Step B.**
   - If Fault Code 315 FMI 7 is set, go to **Step I.**
   - If Fault Code 315 FMI 14, 15, 16, or 20 is set, go to **Step M.**

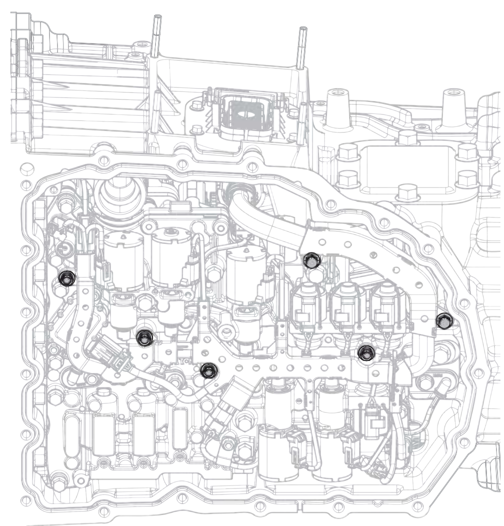
B ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan and filter.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

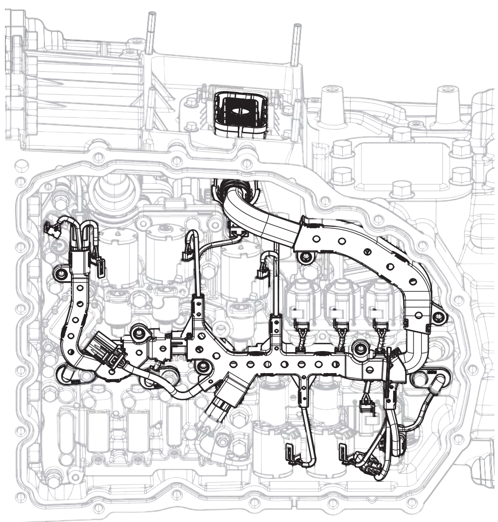
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



7. Wiggle 74-Way Transmission Harness and Rail D Position Sensor pigtail. Look for any obvious signs of rubbing or chafing on any of the wires.

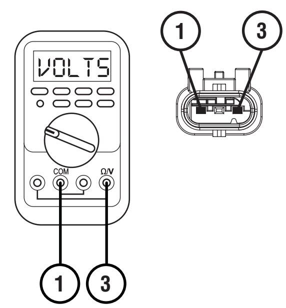


8. Exit PD Mode.
    - If any fault code sets Active while wiggling the harness or pigtail, replace 74-Way Transmission Harness and Rail D Position Sensor. Go to **Step V.**
    - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify Rail D Position Sensor power supply.*

1. Drain oil.
2. Remove sump pan and filter.
3. Disconnect 3-Way Rail D Position Sensor Connector.
4. Key on with engine off.
5. Measure voltage between Rail D Position Sensor harness connector Pin 1 and Pin 3. Record reading in table.

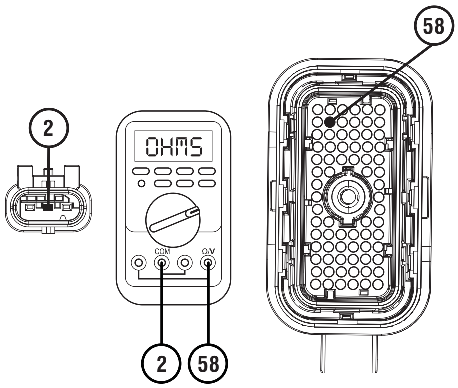


6. Compare reading(s) in table.
    - If any reading is out of range, go to **Step G.**
    - If all readings are in range, go to **Step D.**

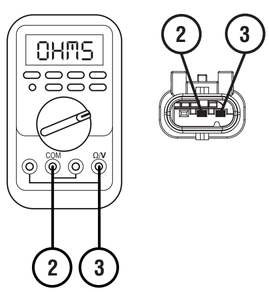
Pins	Range	Reading(s)
1 to 3	4.75–5.25 V	

D ***Purpose:*** *Verify continuity of Rail D Position signal wire.*

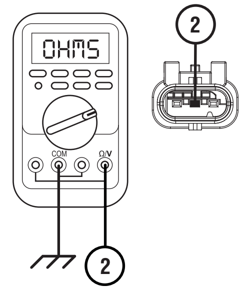
1. Key off.
2. Remove TCM.
3. Inspect connector for oil, corrosion, and bent or spread pins.
4. Measure resistance between Rail D Position Sensor harness connector Pin 2 and 74-Way Transmission Harness Pin 58. Record reading in table.



5. Measure resistance between Rail D Position Sensor harness connector Pin 2 and Pin 3. Record reading in table.



6. Measure resistance between Rail D Position Sensor harness connector Pin 2 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace 74-Way Transmission Harness. Go to **Step V.**
   - If all readings are in range, go to **Step E.**

Pins	Range	Reading(s)
2 to 58	0–0.3 Ohms	
2 to 3	Open Circuit (OL)	
2 to ground	Open Circuit (OL)	

E

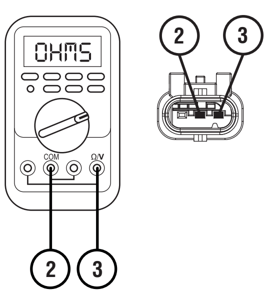
Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 315 FMI 2, 3, 4, 5, 6, 8, or 12 is Inactive, replace Rail D Position Sensor and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 315 FMI 2, 3, 4, 5, 6, 8, or 12 is Active, go to **Step F.**

F

Purpose: *Verify internal resistance of TCM.*

1. Key off.
2. Disconnect 3-Way Rail D Position Sensor Connector.
3. Measure resistance between Rail D Position Sensor harness connector Pin 2 and Pin 3. Record reading in table.



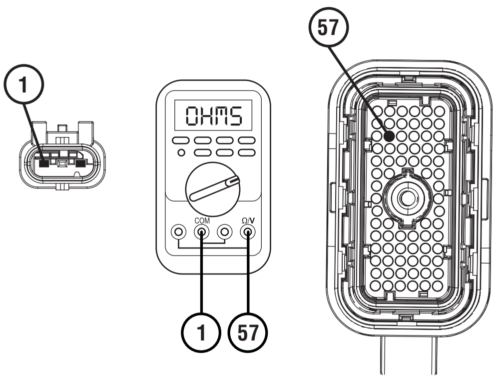
4. Compare reading(s) in table.
   - If any reading is out of range, replace TCM. Go to **Step V.**
   - If all readings are in range, go to **Step H.**

Pins	Range	Reading(s)
2 to 3	14.5–15.5K Ohms	

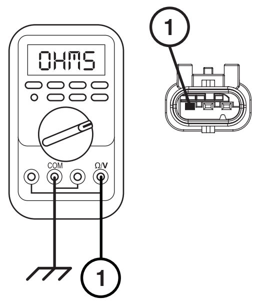
G

Purpose: *Verify continuity of Rail D Position Sensor power supply wiring.*

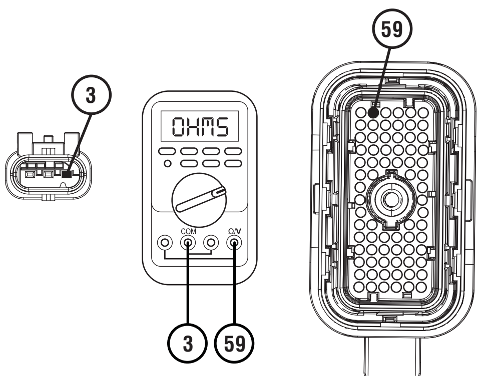
1. Key off.
2. Remove TCM.
3. Inspect connector for oil, corrosion, and bent or spread pins.
4. Measure resistance between Rail D Position Sensor harness connector Pin 1 and 74-Way Transmission Harness Pin 57. Record reading in table.



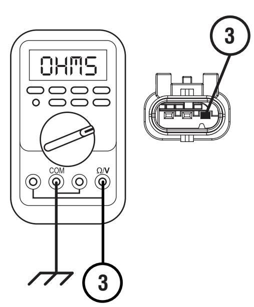
5. Measure resistance between Rail D Position Sensor harness connector Pin 1 and ground. Record reading in table.



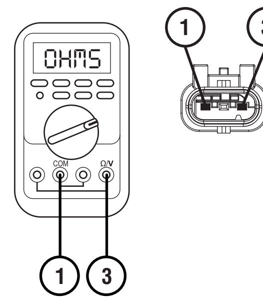
6. Measure resistance between Rail D Position Sensor harness connector Pin 3 and 74-Way Transmission Harness Pin 59. Record reading in table.



7. Measure resistance between Rail D Position Sensor harness connector Pin 3 and ground. Record reading in table.



8. Measure resistance between Rail D Position Sensor harness connector Pin 1 and Pin 3. Record reading in table.



9. Compare reading(s) in table.

- If any reading is out of range, replace 74-Way Transmission Harness. Go to **Step V.**
- If all readings are in range, replace TCM. Go to **Step V.**

Pins	Range	Reading(s)
1 to 57	0–0.3 Ohms	
1 to ground	Open Circuit (OL)	
3 to 59	0–0.3 Ohms	
3 to ground	Open Circuit (OL)	
1 to 3	Open Circuit (OL)	

H *__Purpose:__ Verify condition of Rail D Position Sensor and Rail D Magnet.*

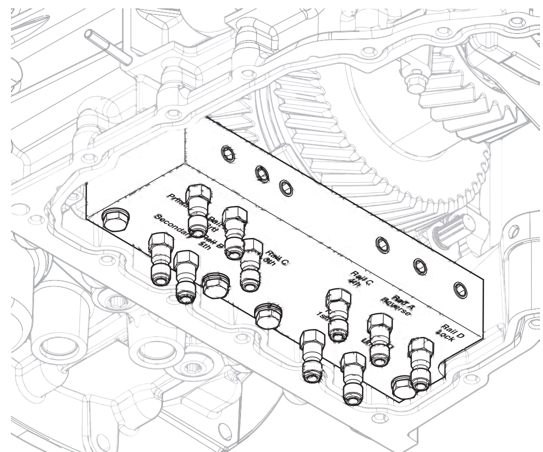
1. Key off.
2. Remove TCM.
3. Remove ACM.
4. Inspect Rail D Position Sensor for damage and proper mounting.
5. Inspect Rail D Magnet for damage and proper mounting to Rail D.
   - If Rail D Position Sensor or Rail D Magnet is damaged, replace damaged components. Go to **Step V.**
   - If no damage is found, replace Rail D Position Sensor. Go to **Step V.**

I *__Purpose:__ Perform Rail Calibration.*

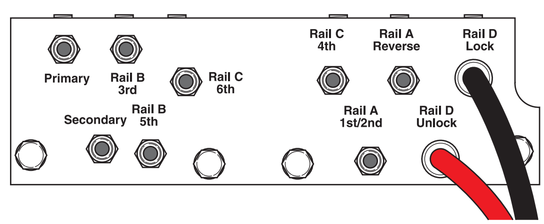
1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail D fault codes set Active, go to **Step J.**

J *__Purpose:__ Actuate Rail D with Diagnostic Manifold tool.*

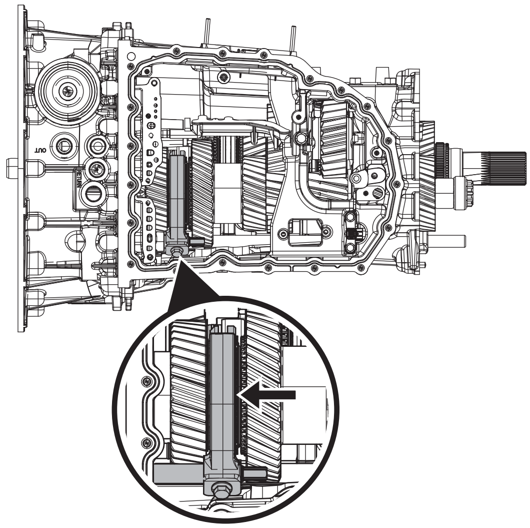
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



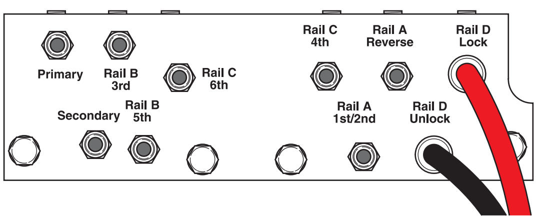
6. Apply air to Rail D Unlock port.



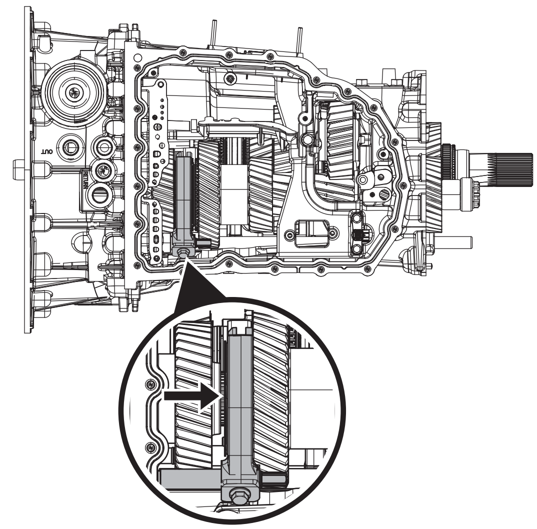
7. Watch for Rail D fork to Unlock synchronizer.



8. Apply air to Rail D Lock port.



9. Watch for Rail D Fork to fully engage synchronizer into Lock.



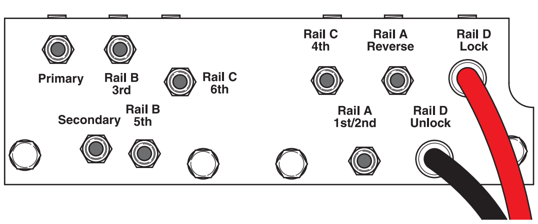
- If fork does not move or does not Unlock and fully engage Lock, go to **Step K.**
- If fork Unlocks and fully engages Lock, go to **Step L.**

K ***Purpose:*** *Verify mechanical condition of Lock synchronizer, detent and Rail D.*

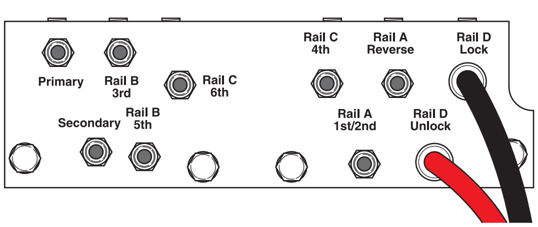
1. Use pry bar to Unlock Rail D fork and engage Lock.
   - If fork does not move or does not Unlock and fully engage Lock, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D assembly. Go to **Step V.**
   - If fork Unlocks and fully engages Lock, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D Piston and Rod Seals. Go to **Step V.**

L ***Purpose:*** *Verify condition of Rail D Piston and Rod Seals.*

1. Apply air to Rail D Lock port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail D Unlock port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

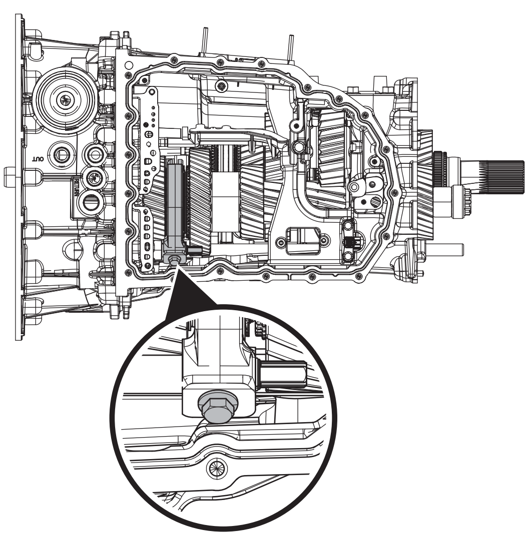
   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D Piston and Rod Seals. Go to **Step V.**
   - If all result(s) are in range, replace ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail D Lock Port	0 PSI	
Rail D Unlock Port	0 PSI	

M

Purpose: *Verify condition of Lock gear assembly.*

1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Inspect Rail D fork for damage or wear.
6. Inspect Rail D Position Sensor for damage and proper mounting.
7. Inspect Rail D magnet for damage and proper mounting to Rail D.
8. Engage Lock and Unlock using a pry bar.
9. Verify Rail D fork is mounted to Rail D via bolt and detent tension is proper.



- If damage is found, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D Fork, synchronizer, or Lock gear. Go to **Step V.**
- If no damage is found, replace Rail D Position Sensor. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 315 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 315 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 330: Rail A Secondary Position

J1939: SA 3 SPN 5942 FMI 0, 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 15, 16, 17, 18, 20, 21, 31

Overview

The Procision transmission is equipped with a 3-Rail Position Sensor to monitor shift rail A, B, and C. There is a magnet mounted to each shift rail. The 3-Rail Position Sensor detects the proximity of the magnets to determine the position of each shift rail. The 3-Rail Position Sensor has dual sensors for Rail A; primary and secondary. This allows for a redundant Rail A signal to engage the transmission into gear in the event one signal is not available. The 3-Rail Position Sensor is located in the rear housing and connected to the Transmission Control Module (TCM) via the 8-Way 90-Degree Connector and 74-Way Transmission Harness.

Detection

The TCM monitors shift Rail A Secondary Position. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 2 – Data erratic: Rail A Secondary Position operating range not between 0–30 mm for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: Rail A Secondary Position circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Rail A Secondary Position circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Rail A Secondary Position circuit open for 1 second.

FMI 6 – Current Above Normal or Shorted Circuit: Rail A Secondary Position signal not between 4.25 V and 6.25 V for 1 second.

FMI 7 – Mechanical System Not Responding: No movement in fore direction during Rail A calibration.

FMI 8 – Abnormal Frequency: Rail A Secondary Position signal frequency out of range for 1 second.

FMI 12 – Bad Intelligent Device: Rail A Secondary Position duty cycle out of range for 1 second.

FMI 14 – Special Instructions: Rail A Secondary Position reports Reverse gear position, but shaft speeds do not indicate Reverse gear ratio.

FMI 20 – Data Drifted High: Rail A Secondary Position reports Reverse gear disengagement, but shaft speeds indicate Reverse gear ratio.

FMI 21 – Data Drifted Low: Rail A Secondary Position reports 1st/2nd gear disengagement, but shaft speeds indicate 1st or 2nd gear ratio.

FMI 31 – Condition Exists: Rail A Secondary Position reports 1st/2nd gear position, but shaft speeds do not indicate 1st or 2nd gear ratio.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded performance

Note: If Rail A Primary Position is not available:

- Transmission will stay in current gear
- Primary and Secondary clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 2: Rail A Secondary Position operating range between 0–30 mm for 10 seconds.

FMI 3: Rail A Secondary Position circuit not shorted to power for 10 seconds.

FMI 4: Rail A Secondary Position circuit not shorted to ground for 10 seconds.

FMI 5: Rail A Secondary Position circuit not open for 10 seconds.

FMI 6: Rail A Secondary Position signal between 4.25 V and 6.25 V for 10 seconds.

FMI 7: Successful rail calibration performed.

FMI 8: Rail A Secondary Position signal frequency in range for 10 seconds.

FMI 12: Rail A Secondary Position duty cycle in range for 10 seconds.

FMI 14, 20, 21, 31: Rail A Secondary Position is confirmed in 1st/2nd, Neutral, or Reverse for 10 seconds.

Possible Causes

FMI 2, 12:

- 3-Rail Position Sensor
  - Internal failure
- Rail A magnet
  - Detached from shift rail

FMI 3, 4, 5:

- 74-Way Transmission Harness or 8-Way 90-Degree Connector
  - Wiring shorted to power, shorted to ground, or open
- 3-Rail Position Sensor
  - Internal failure

FMI 6, 8:

- 3-Rail Position Sensor
  - Internal failure
- 74-Way Transmission Harness or 8-Way 90-Degree Connector
  - Wiring shorted to power, shorted to ground, or open
- TCM
  - Internal failure

FMI 7:

- Rail A Piston
  - Seal damaged
  - Snap ring missing
- SPS1
  - Stuck closed
- SPS2
  - Stuck open

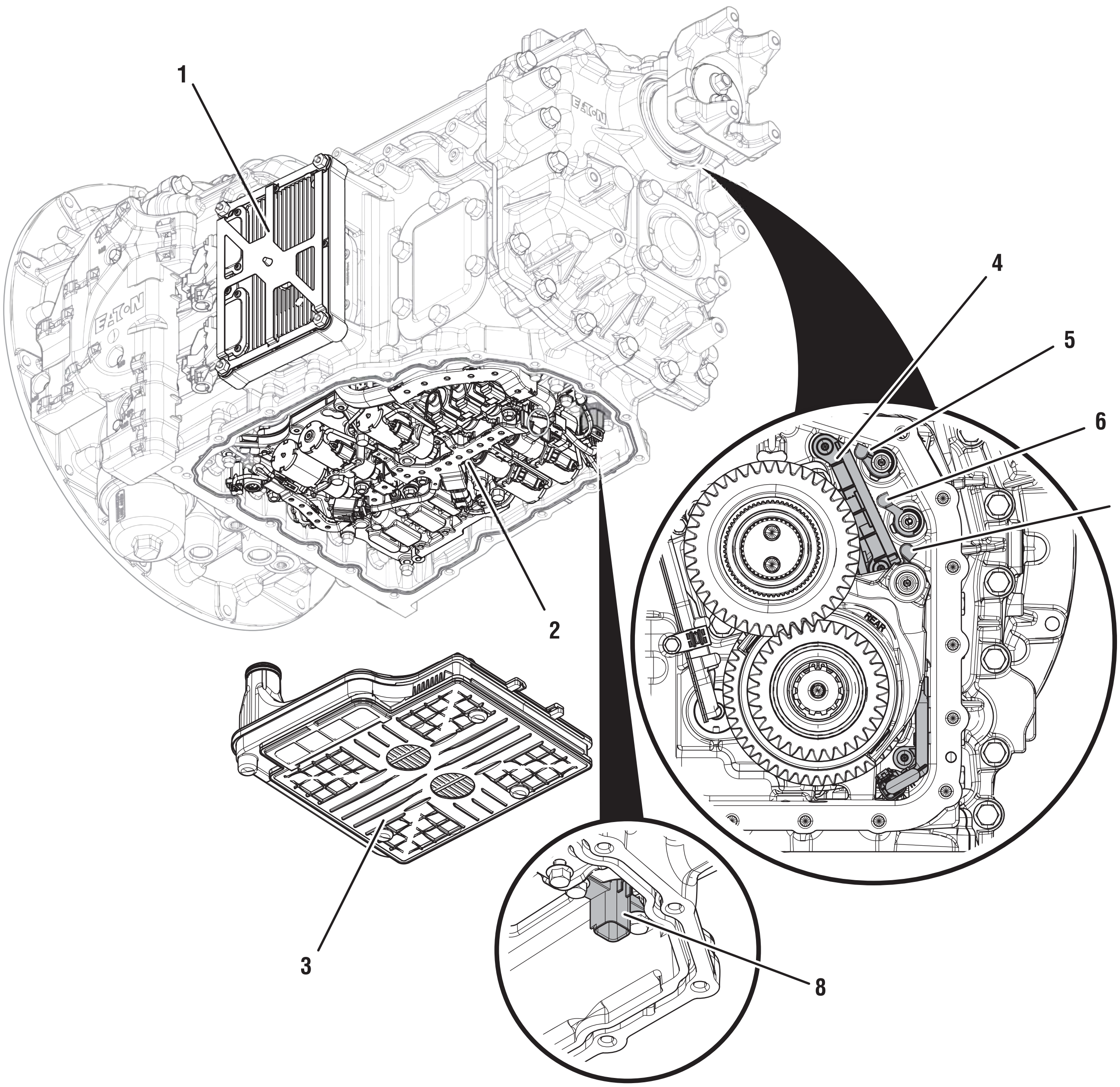
FMI 14, 20, 21, 31:

- 1st/2nd, Reverse Fork
  - Roll pins sheared
  - Broken
- 3-Rail Position Sensor
  - Internal failure

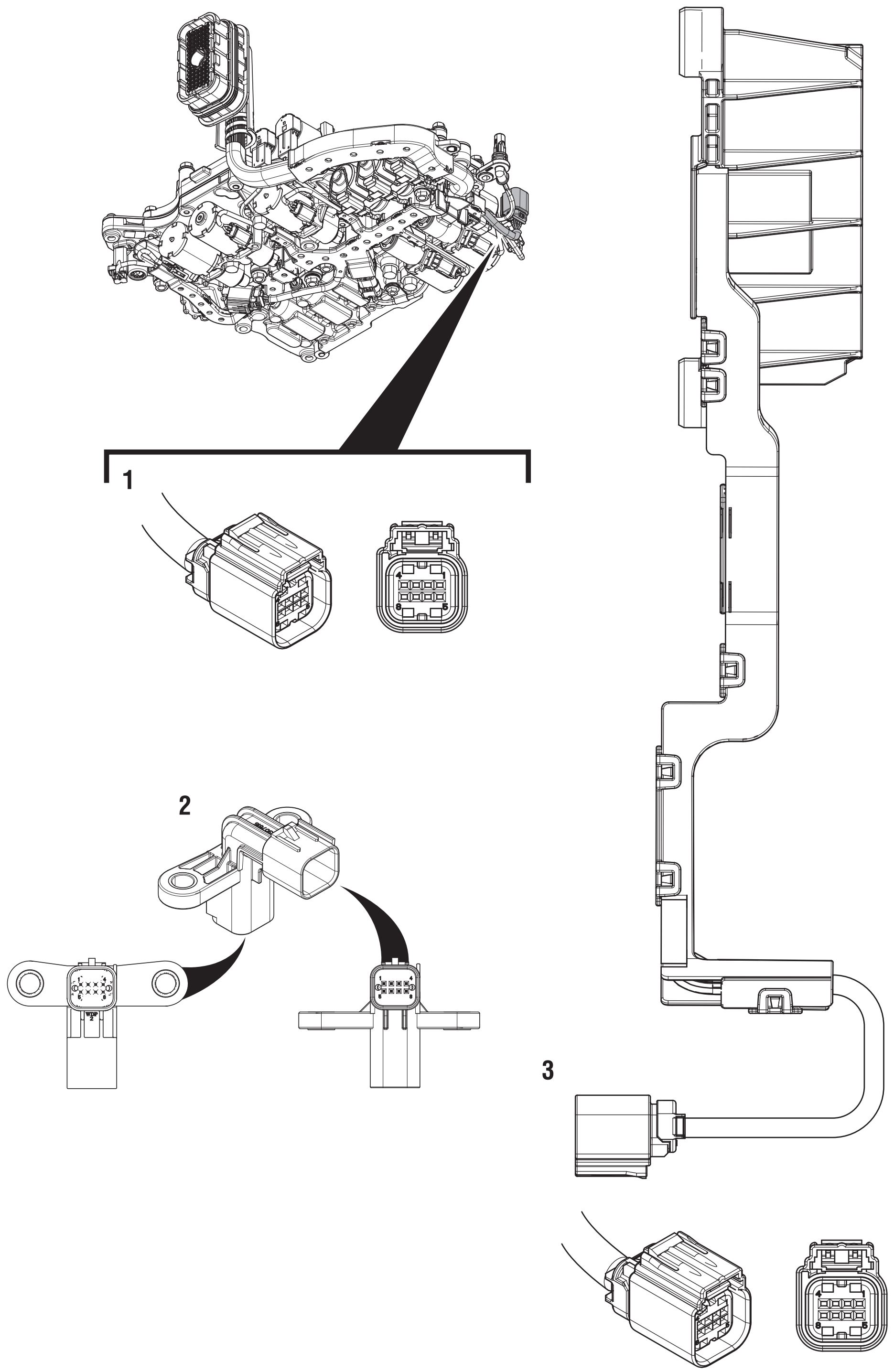
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

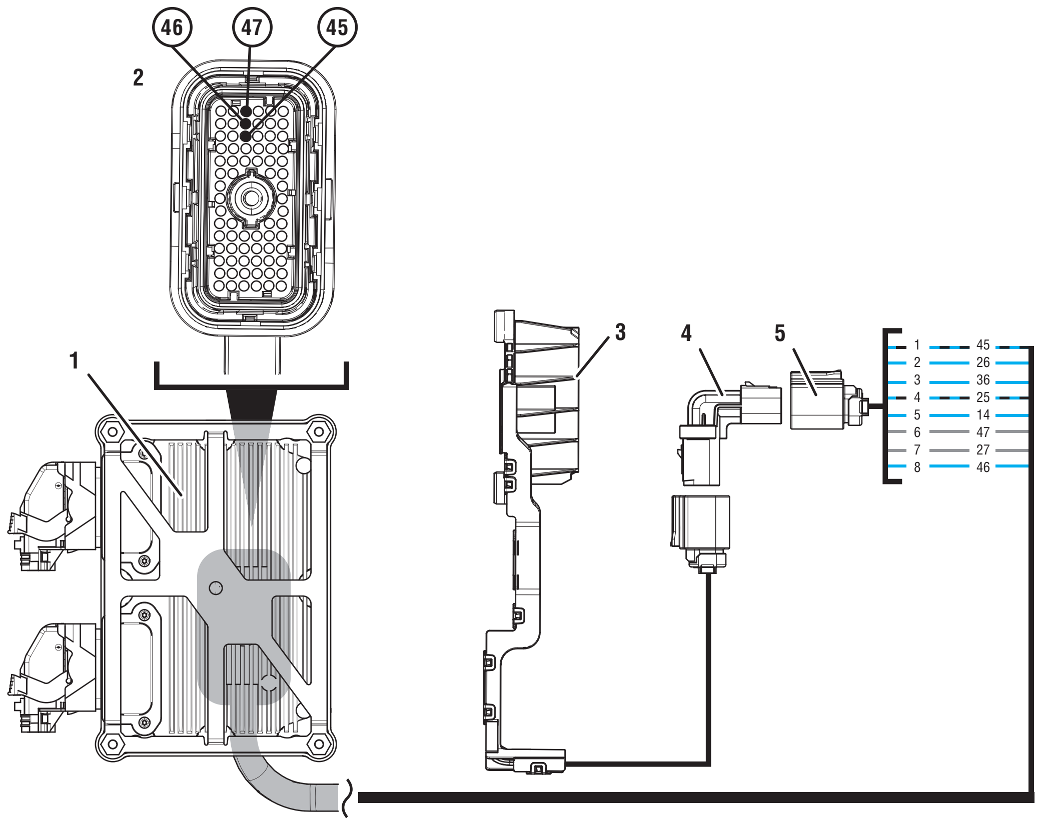
Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Sump Pan Filter
4. 8-Way 3-Rail Position Sensor (Inside Rear Housing)
5. Rail A Magnet (Inside Rear Housing)
6. Rail B Magnet (Inside Rear Housing)
7. Rail C Magnet (Inside Rear Housing)
8. 8-Way 90-Degree Connector (Shown with ACM Removed)



1. 8-Way 3-Rail Position Sensor Connector
2. 8-Way 90-Degree Connector
3. 8-Way 3-Rail Position Sensor



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *8-Way 3-Rail Position Sensor*
4. *8-Way 90-Degree Connector*
5. *8-Way Rail Position Sensor Connector*

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

Fault Code 330 Troubleshooting

A

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

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

   Note: If Fault Code 330 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 330 FMI 2 or 12 is Active, go to **Step J.**
   - If Fault Code 330 FMI 2 or 12 is Inactive, go to **Step B.**
   - If Fault Code 330 FMI 3, 4, 5, 6, or 8 is Active, go to **Step C.**
   - If Fault Code 330 FMI 3, 4, 5, 6, or 8 is Inactive, go to **Step B.**
   - If Fault Code 330 FMI 7 is set, go to **Step K.**
   - If Fault Code 330 FMI 14, 20, 21 or 31 is set, go to **Step O.**

B

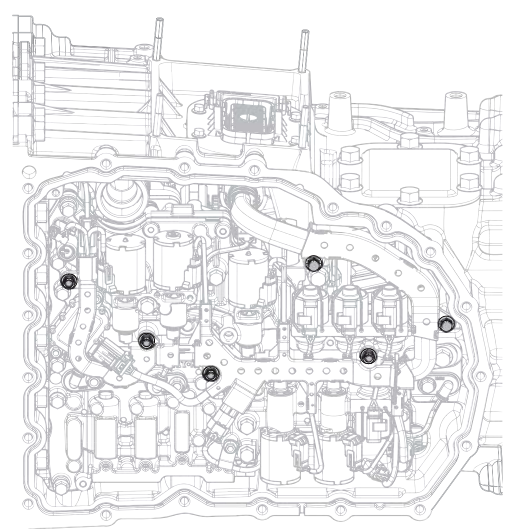
Purpose: *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Remove driveline and output yoke from transmission output shaft.
3. Drain oil.
4. Remove sump pan and filter.
5. Remove rear cover.
6. Connect ServiceRanger
7. Select Service Routine and PD Mode.

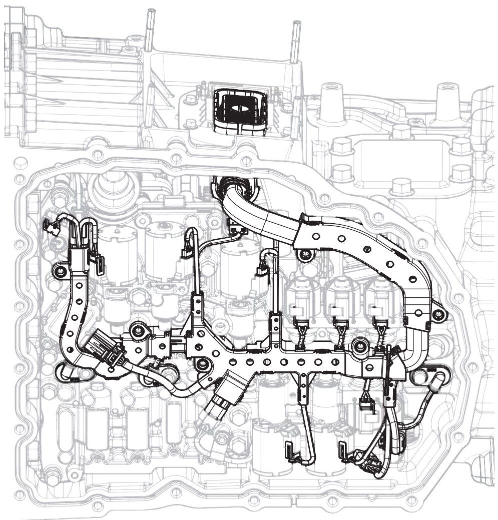
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid "PD" in display when PD Mode is active.

8. Remove 6 Transmission Harness 10 mm cap screws.



9. Wiggle 74-Way Transmission Harness and 3-Rail Position Sensor pigtail. Look for any obvious signs of rubbing or chafing on any of the wires.



10. Exit PD Mode.

- If any fault code sets Active while wiggling the 74-Way Transmission Harness, replace 74-Way Transmission Harness and 8-Way 90-Degree Connector. Go to Step V.
- If any fault code sets Active while wiggling the 3-Rail Position Sensor pigtail, replace 3-Rail Position Sensor and 8-Way 90-Degree Connector. Go to **Step V.**
- If no fault codes become Active, go to **Step C.**

C ***Purpose:*** *Verify 3-Rail Position Sensor secondary power supply.*

1. Set parking brake and chock wheels.

2. Key off.

3. Remove driveline and output yoke from transmission output shaft.

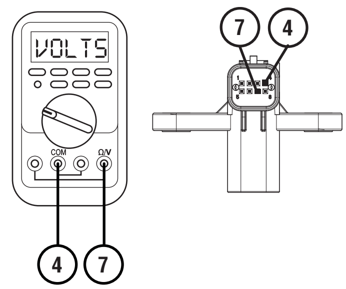
4. Remove rear cover.

Note: Position oil pan under rear housing cover as oil will drain upon removal.

5. Disconnect 8-Way 3-Rail Position Sensor Connector.

6. Key on with engine off.

7. Measure voltage between 8-Way 90-Degree Connector Pin 4 and Pin 7. Record reading in table.



8. Compare reading(s) in table.

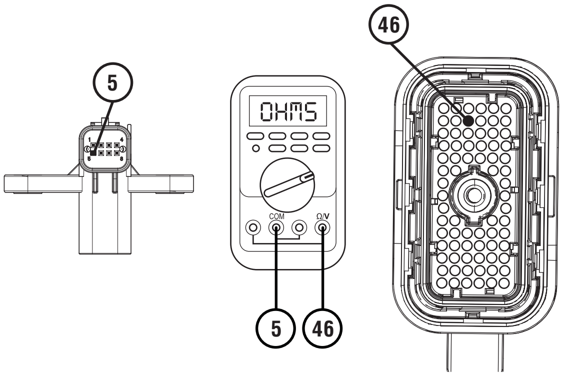
- If any reading is out of range, go to **Step G.**
- If all readings are in range, go to **Step D.**

Pins	Range	Reading(s)
4 to 7	4.75–5.25 V	

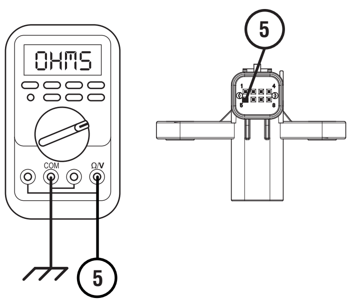
D

Purpose: *Verify continuity of Rail A Secondary Position signal wire.*

1. Key off.
2. Remove TCM.
3. Inspect connector for oil, corrosion, and bent or spread pins.
4. Measure resistance between 8-Way 90-Degree Connector Pin 5 and 74-Way Transmission Harness Pin 46. Record reading in table.



5. Measure resistance between 8-Way 90-Degree Connector Pin 5 and ground. Record reading in table.



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

Pins	Range	Reading(s)
5 to 46	0–0.3 Ohms	
5 to ground	Open Circuit (OL)	

E

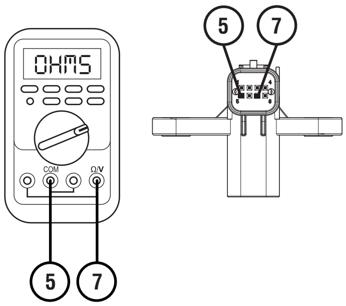
Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 330 FMI 2, 3, 4, 5, 6, 8, or 12 is Inactive, replace 3-Rail Position Sensor, 74-Way Transmission Harness and 8-Way 90-Degree Connector. Go to **Step V.**
   - If Fault Code 330 FMI 2, 3, 4, 5, 6, 8, or 12 is Active, go to **Step F.**

F

Purpose: *Verify internal resistance of TCM.*

1. Key off.
2. Disconnect 8-Way 3-Rail Position Sensor Connector.
3. Measure resistance between 8-Way 90-Degree Connector Pin 5 and Pin 7. Record reading in table.



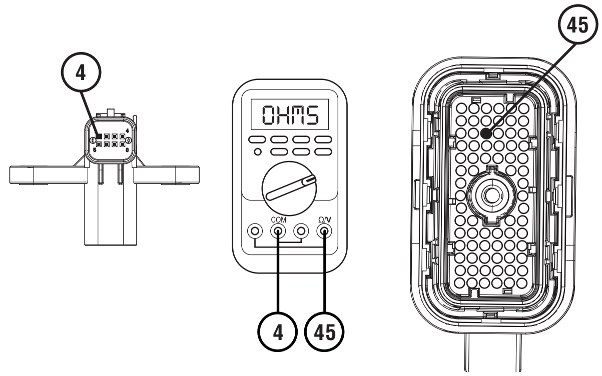
4. Compare reading(s) in table.
   - If any reading is out of range, replace TCM. Go to **Step V.**
   - If all readings are in range, replace 3-Rail Position Sensor. Go to **Step V.**

Pins	Range	Reading(s)
5 to 7	14.5–15.5K Ohms	

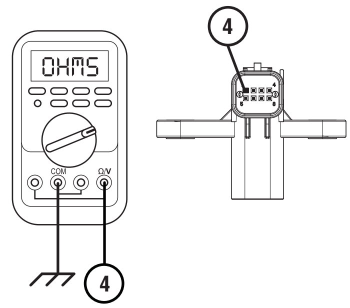
G

Purpose: *Verify continuity of 3-Rail Position Sensor secondary power supply wiring.*

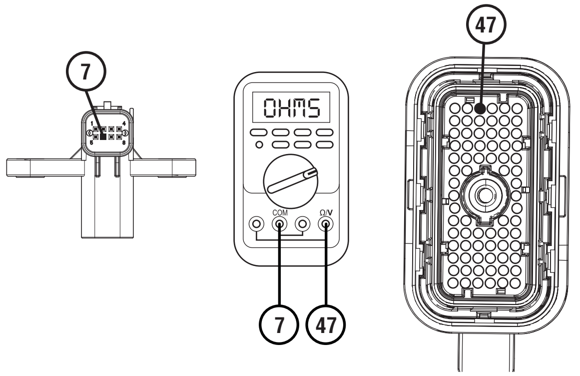
1. Key off.
2. Remove TCM.
3. Inspect connector for oil, corrosion, and bent or spread pins.
4. Measure resistance between 8-Way 90-Degree Connector Pin 4 and 74-Way Pin 45. Record reading in table.



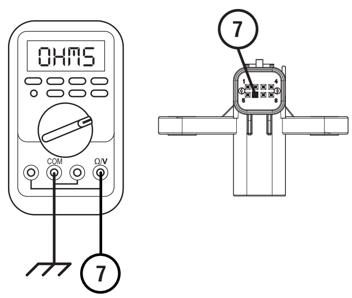
5. Measure resistance between 8-Way 90-Degree Connector Pin 4 and ground. Record reading in table.



6. Measure resistance between 8-Way 90-Degree Connector Pin 7 and 74-Way Pin 47. Record reading in table.



7. Measure resistance between 8-Way 90-Degree Connector Pin 7 and ground. Record reading in table.

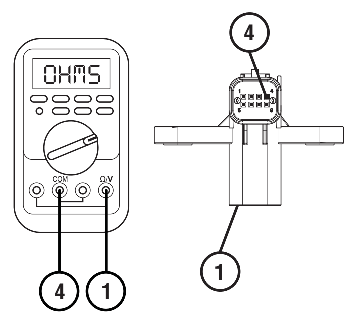


8. Compare reading(s) in table.
   - If any reading is out of range. go to **Step H.**
   - If all readings are in range, replace TCM. Go to **Step V.**

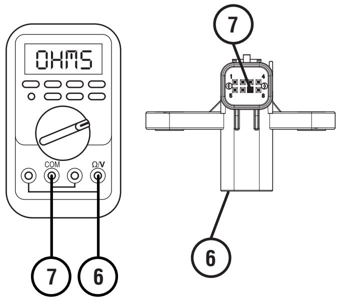
Pins	Range	Reading(s)
4 to 45	0–0.3 Ohms	
4 to ground	Open Circuit (OL)	
7 to 47	0–0.3 Ohms	
7 to ground	Open Circuit (OL)	

H ***Purpose:*** *Verify continuity of 8-Way 90-Degree Connector secondary power supply wires.*

1. Drain oil.
2. Remove sump pan and filter.
3. Disconnect 8-Way Transmission Harness from 8-Way 90 Degree Connector.
4. Measure resistance between 8-Way 90-Degree Connector Pin 4 and Pin 1. Record reading in table.



5. Measure resistance between 8-Way 90-Degree Connector Pin 7 and Pin 6. Record reading in table.



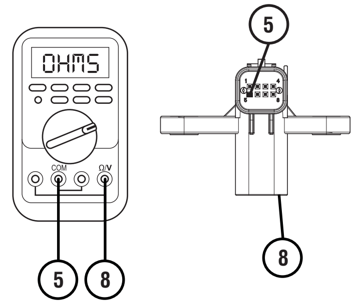
6. Compare reading(s) in table.
   - If any reading is out of range, replace 8-Way 90-Degree Connector. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
4 to 1	0–0.3 Ohms	
7 to 6	0–0.3 Ohms	

I

Purpose: *Verify continuity of 8-Way 90-Degree Connector Rail A Secondary Position signal wire.*

1. Disconnect 8-Way Transmission Harness from 8-Way 90 Degree Connector.
2. Measure resistance between 8-Way 90-Degree Connector Pin 5 and Pin 8. Record reading in table.



3. Compare reading(s) in table.
   - If any reading is out of range, replace 8-Way 90-Degree Connector. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
5 to 8	0–0.3 Ohms	

J ***Purpose:*** *Verify condition of 3-Rail Position Sensor and Rail A Magnet.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove driveline and output yoke from output shaft.
4. Remove rear cover.

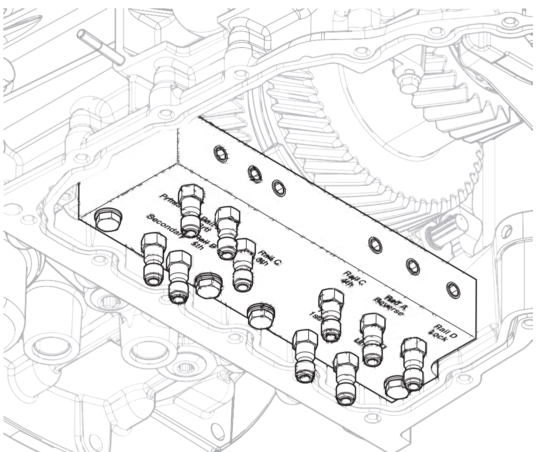
   Note: Position oil pan under rear housing cover as oil will drain upon removal.
5. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
6. Inspect Rail A Magnet for damage and proper mounting to Rail A.
   - If 3-Rail Position Sensor or Rail A Magnet is damaged, replace damaged components. Go to **Step V.**
   - If no damage is found, go to **Step C.**

K ***Purpose:*** *Perform Rail Calibration.*

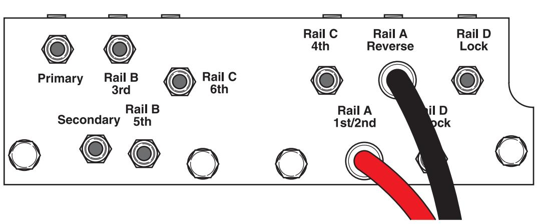
1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail A fault codes set Active, go to **Step L.**

L ***Purpose:*** *Actuate Rail A with Diagnostic Manifold tool.*

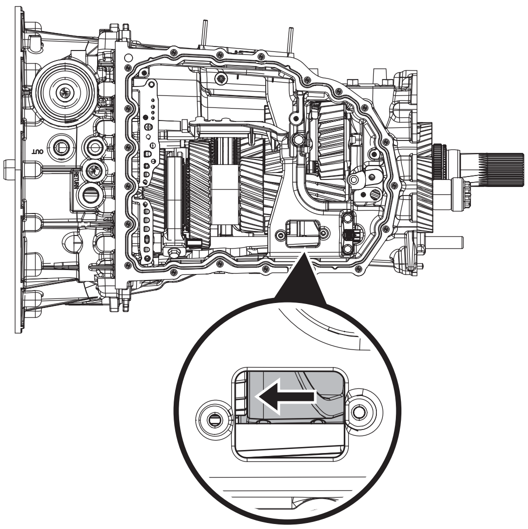
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



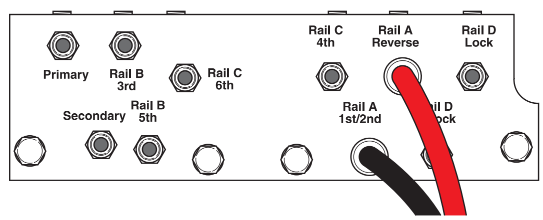
6. Apply air to Rail A 1st/2nd port.



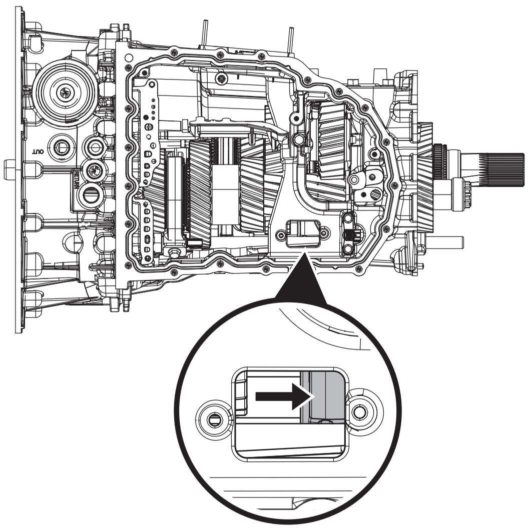
7. Watch for Rail A fork to fully engage synchronizer into 1st/2nd gear.



8. Apply air to Rail A Reverse port.



9. Watch for Rail A fork to fully engage synchronizer into Reverse gear.



- If fork does not move or does not fully engage 1st/2nd or Reverse gear, go to **Step M.**
- If fork fully engages 1st/2nd and Reverse gear, go to **Step N.**

M

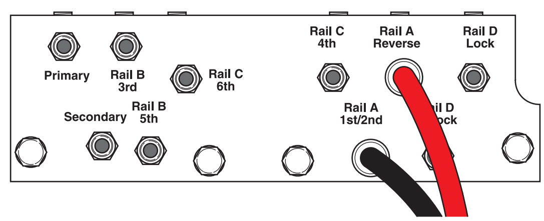
Purpose: *Verify mechanical condition of 1st/2nd, Reverse synchronizer and detent.*

1. Use pry bar to engage Rail A fork into 1st/2nd and Reverse gears.
   - If fork does not move or does not fully engage 1st/2nd or Reverse gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 1st/2nd, Reverse synchronizer or detent. Go to **Step V.**
   - If fork fully engages 1st/2nd and Reverse gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**

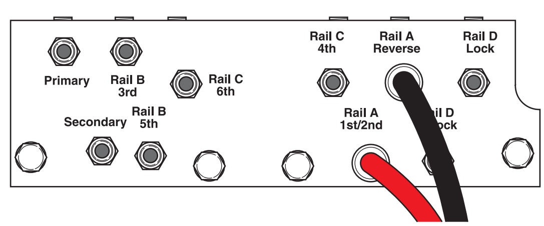
N

Purpose: *Verify condition of Rail A Piston and Rod Seals.*

1. Apply air to Rail A Reverse port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail A 1st/2nd port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

- If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**
- If all result(s) are in range, replace RAVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail A Reverse Port	0 PSI	
Rail A 1st/2nd Port	0 PSI	

0 ***Purpose:*** *Verify condition of 1st/2nd, Reverse gear assembly.*

1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Inspect Rail A fork for damage or wear.
6. Remove rear cover.
7. Inspect 8-Way 3-Rail Position Sensor for damage and proper mounting.
8. Inspect Rail A magnet for damage and proper mounting to Rail A.
9. Thread M6 x 1.0 bolt loosely into Rail A.
10. Engage 1st/2nd, Reverse and Neutral using a pry bar.

    Note: Use rear housing cover bolt threaded into case for leverage.
11. Verify Rail A is moving fork into all gear positions.
    - If Rail A does not move fork or damage is found, Reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 1st/2nd, Reverse gears or Rail A fork. Go to **Step V.**
    - If Rail A does move the fork and no damage is found, replace 3-Rail Position Sensor. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
    - If no codes set and the vehicle operates properly, Test Complete.
    - If Fault Code 330 sets Active during the test drive, go to **Step A.**
    - If a fault code other than 330 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 345 Engine Speed

J1939: SA 3 SPN 5052 FMI 2, 4, 5, 6, 8, 14, 20, 21

Overview

The Procision transmission is equipped with digital speed sensors. The Engine, Primary Input, Secondary Input and Output Speed sensors are used to verify clutch operation and calculate gear ratios. The Engine Speed Sensor measures engine RPM from the pump tone wheel. The Engine Speed Sensor is located on the pump assembly and connected to the Transmission Control Module (TCM) via the 74-Way Transmission Harness.

Detection

The TCM monitors the Engine Speed signal. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Engine Speed out of range for 2 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Engine Speed Sensor circuit shorted to ground for 2 seconds.

FMI 5 – Current Below Normal or Open Circuit: Engine Speed Sensor circuit open or shorted to power for 2 seconds.

FMI 6 - Current Above Normal or Shorted Circuit: Engine Speed Sensor power supply voltage not between 4.25V and 6.25V for 2 seconds.

FMI 8 – Abnormal Frequency: Engine Speed signal abnormal pulse width for 2 seconds.

FMI 14 – Special Instructions: Engine Speed drop out compared to J1939 Engine Speed with line pressure present for 2 seconds.

FMI 20 – Data Drifted High: Engine Speed signal greater than J1939 Engine Speed with clutch engaged for 2 seconds.

FMI 21 – Data Drifted Low: Engine Speed signal less than J1939 Engine Speed with clutch engaged for 2 seconds.

Fallback

All FMIs:

- Clutch micro-slipping prohibited
- Amber warning lamp on

Note: If speed substitution is not available:

- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 2: Engine Speed in range for 10 seconds.

FMI 4: Engine Speed Sensor circuit not shorted to ground for 10 seconds.

FMI 5: Engine Speed Sensor circuit not open or shorted to power for 10 seconds.

FMI 6: Engine Speed Sensor power supply voltage between 4.25V and 6.25V for 10 seconds.

FMI 8: Engine Speed signal pulse width correct for 10 seconds.

FMI 14, 20, 21: Engine Speed signal matches J1939 Engine Speed for 10 seconds.

Possible Causes

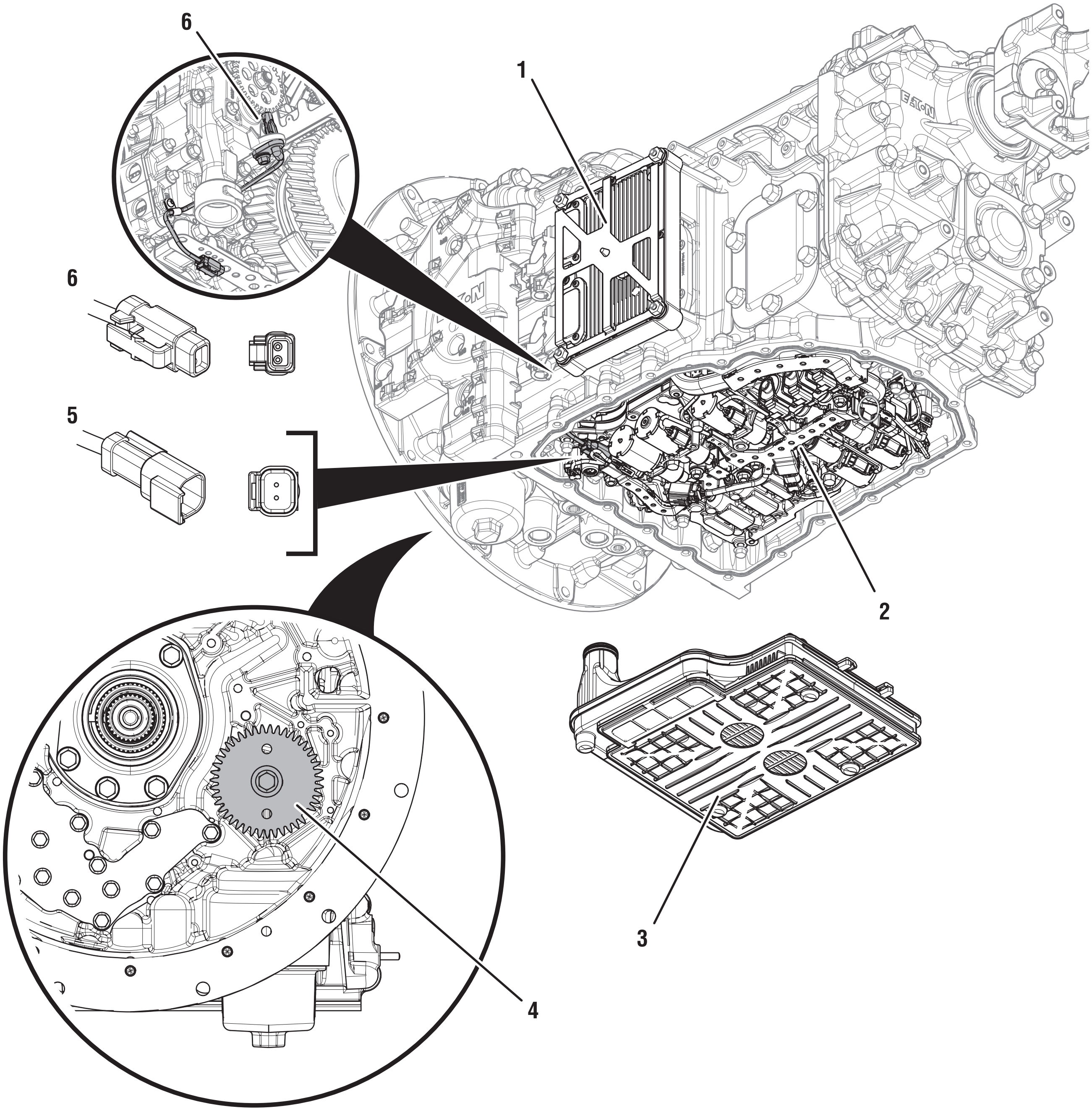
All FMIs:

- Engine Speed Sensor
  - Internal failure
  - Damaged
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- Mechanical failure
- J1939 Engine RPM reporting error
- TCM
  - Internal failure

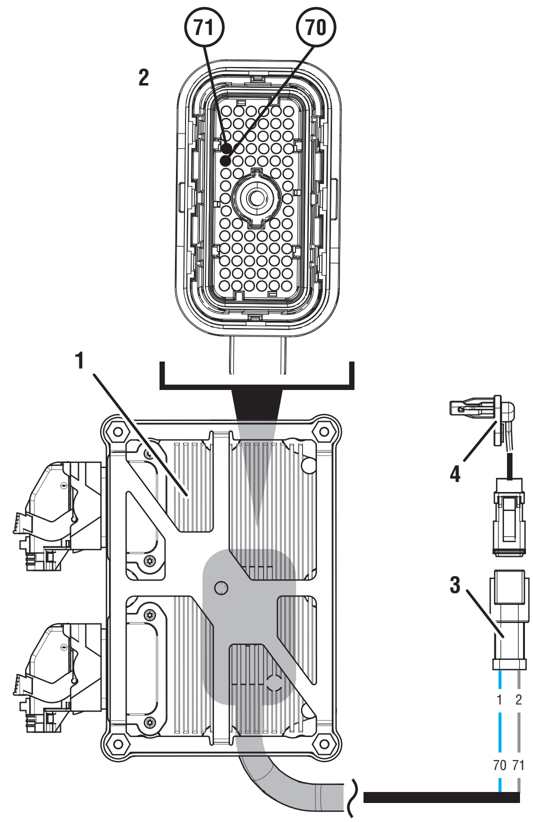
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Sump Pan Filter
4. Pump Driven Gear (Inside Clutch Housing)
5. 2-Way Engine Speed Sensor Connector
6. 2-Way Engine Speed Sensor



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *2-Way Engine Speed Sensor Connector*
4. *2-Way Engine Speed Sensor*

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

Fault Code 345 Troubleshooting

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

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

   Note: If fault code 345 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 345 FMI 2, 4, 5, 6, or 8 is Active, go to **Step C.**
   - If Fault Code 345 FMI 2, 4, 5, 6, or 8 is Inactive, go to **Step B.**
   - If Fault Code 345 FMI 14, 20, or 21 is set, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton". Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

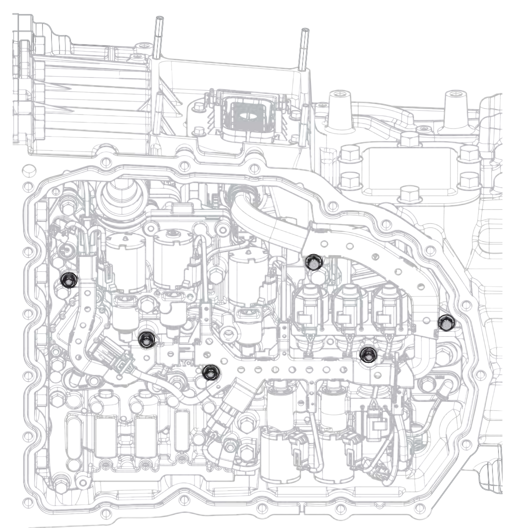
B ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Drain oil.
2. Remove sump pan and filter.
3. Connect ServiceRanger
4. Select Service Routine and PD Mode.

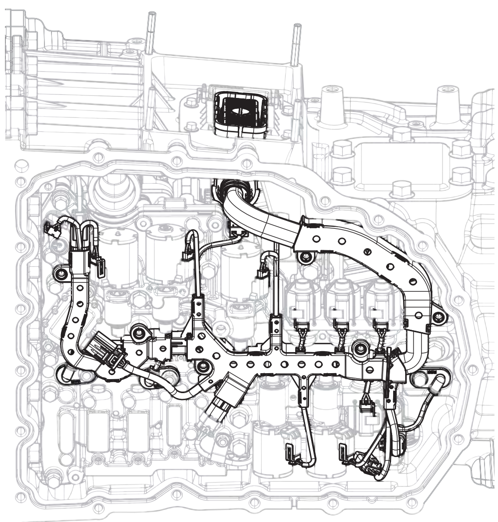
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid "PD" in display when PD Mode is active.

5. Remove 6 Transmission Harness 10 mm cap screws.



6. Wiggle 74-Way Transmission Harness and Engine Speed Sensor pigtail. Look for any obvious signs of rubbing or chafing on any of the wires.

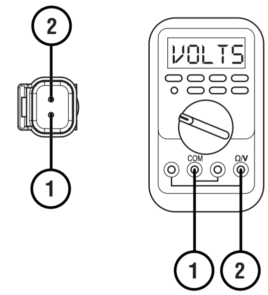


7. Exit PD Mode.
   - If any fault code sets Active while wiggling the harnesses, replace 74-Way Transmission Harness and Engine Speed Sensor. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify Engine Speed Sensor supply voltage.*

1. Set parking brake and chock wheels.
2. Key off.
3. Drain oil.
4. Remove sump pan and filter.
5. Disconnect Engine Speed Sensor 2-Way connector.
6. Key on with engine off.
7. Measure voltage between Engine Speed Sensor 2-Way connector Pin 1 and Pin 2. Record reading in table.



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

Pins	Range	Reading(s)
1 to 2	4.75–5.25 V	

D

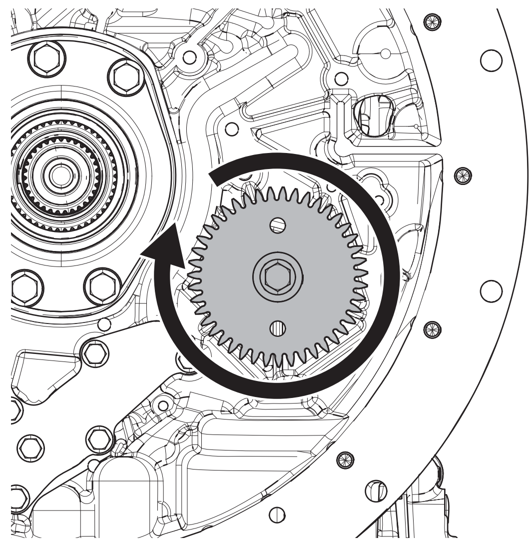
Purpose: *Verify fault code status.*

1. Reconnect all connectors.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 345 FMI 2, 4, 5, 6, or 8 is Active, replace Engine Speed Sensor. Go to **Step V.**
   - If Fault Code 345 FMI 2, 4, 5, 6, or 8 is Inactive, go to **Step E.**

E

Purpose: *Inspect pump tone wheel.*

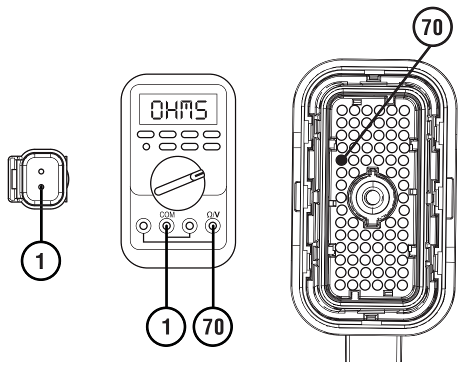
1. Key off.
2. Remove TCM.
3. Remove ACM.
4. Inspect pump tone wheel for damage.
5. Verify pump tone wheel does not spin by hand.



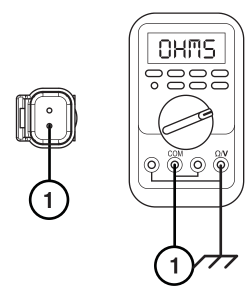
- If damage is found, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
- If no damage is found, replace 74-Way Transmission Harness and Engine Speed Sensor. Go to **Step V.**

F ***Purpose:*** *Verify continuity of Engine Speed Sensor circuit.*

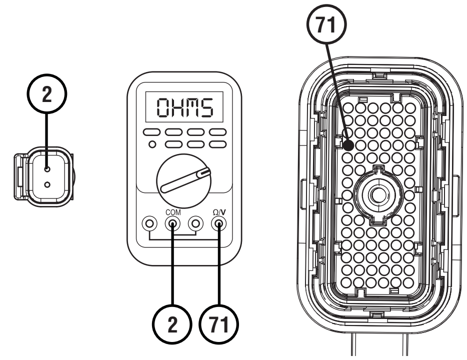
1. Key off.
2. Remove TCM.
3. Measure resistance between 74-Way Transmission Harness Pin 70 and Engine Speed Sensor 2-Way Connector Pin 1. Record reading in table.



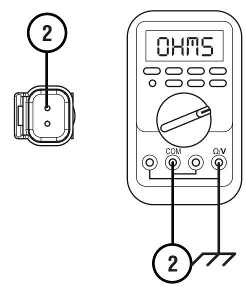
4. Measure resistance between Engine Speed Sensor 2-Way Connector Pin 1 and ground. Record reading in table.



5. Measure resistance between 74-Way Transmission Harness Pin 71 and Engine Speed Sensor 2-Way connector Pin 2. Record reading in table.



6. Measure resistance between Engine Speed Sensor 2-Way connector Pin 2 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace 74-Way Transmission Harness. Go to **Step V.**
   - If all readings are in range, go to **Step G.**

Pins	Range	Reading(s)
70 to 1	0–0.2 Ohms	
1 to ground	Open Circuit (OL)	
71 to 2	0–0.2 Ohms	
2 to ground	Open Circuit (OL)	

G

Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 345 FMI 2, 4, 5, 6, or 8 is Inactive, replace 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 345 FMI 2, 4, 5, 6, or 8 is Active, replace TCM. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 345 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 345 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 355 Primary Input Speed

J1939: SA 3 SPN 5960 FMI 2, 4, 5, 6, 8, 14, 20, 21, 31

Overview

The Procision transmission is equipped with digital speed sensors. The Engine, Primary Input, Secondary Input and Output Speed sensors are used to verify clutch operation and calculate gear ratios. The Primary Input Speed sensor is mounted in the Actuation Control Manifold (ACM) and measures the rotational speed of the primary clutch input shaft, taken from the Primary Driven Gear. The Primary Input Speed sensor is integrated into the 74-Way Transmission Harness which connects to the Transmission Control Module (TCM).

Detection

The TCM monitors the Primary Input Speed signal. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Primary Input Speed out of range for 2 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Primary Input Speed sensor circuit shorted to ground for 2 seconds.

FMI 5 – Current Below Normal or Open Circuit: Primary Input Speed sensor circuit open or shorted to power for 2 seconds.

FMI 6 - Current Above Normal or Shorted Circuit: Primary Input Speed sensor supply voltage not between 4.25V and 6.25V for 2 seconds.

FMI 8 – Abnormal Frequency: Primary Input Speed signal abnormal pulse width for 2 seconds.

FMI 14 – Special Instructions: Primary Input Speed near zero with transmission in gear and output speed present for 2 seconds.

FMI 20 – Data Drifted High: Primary Input Speed signal greater than calculated Primary Input Speed (based on output speed, J1939 engine speed, secondary input speed, and gear ratio) for 2 seconds.

FMI 21 – Data Drifted Low: Primary Input Speed signal less than calculated Primary Input Speed (based on output speed, J1939 engine speed, secondary input speed, and gear ratio) for 2 seconds.

FMI 31 – Condition Exists: Initial Primary Input Speed not detected.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded performance

Note: If speed substitution is not available:

- Only engaged gears allowed
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 2: Primary Input Speed in range for 10 seconds.

FMI 4: Primary Input Speed sensor circuit not shorted to ground for 10 seconds.

FMI 5: Primary Input Speed sensor circuit not open or shorted to power for 10 seconds.

FMI 6: Primary Input Speed sensor supply voltage between 4.25V and 6.25V for 10 seconds.

FMI 8: Primary Input Speed signal pulse width correct for 10 seconds.

FMI 14, 20, 21: Primary Input Speed signal matches calculated Primary Input Speed for 10 seconds.

FMI 31: Key cycle.

Possible Causes

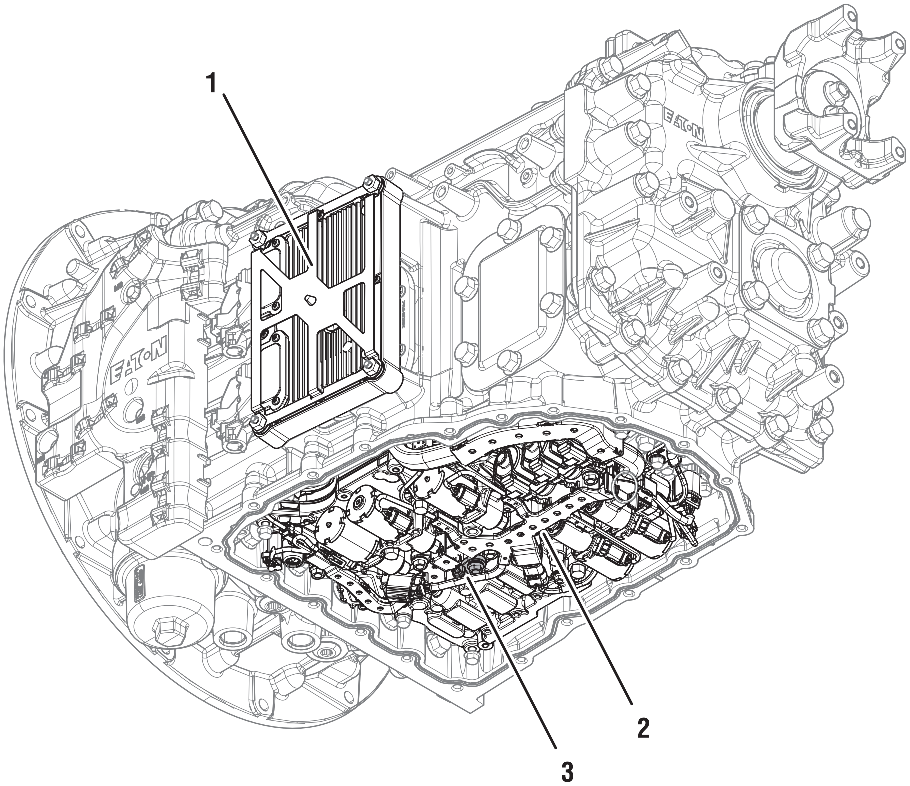
All FMIs:

- Primary Input Speed sensor
  - Internal failure
  - Damaged
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- Mechanical failure
- TCM
  - Internal failure

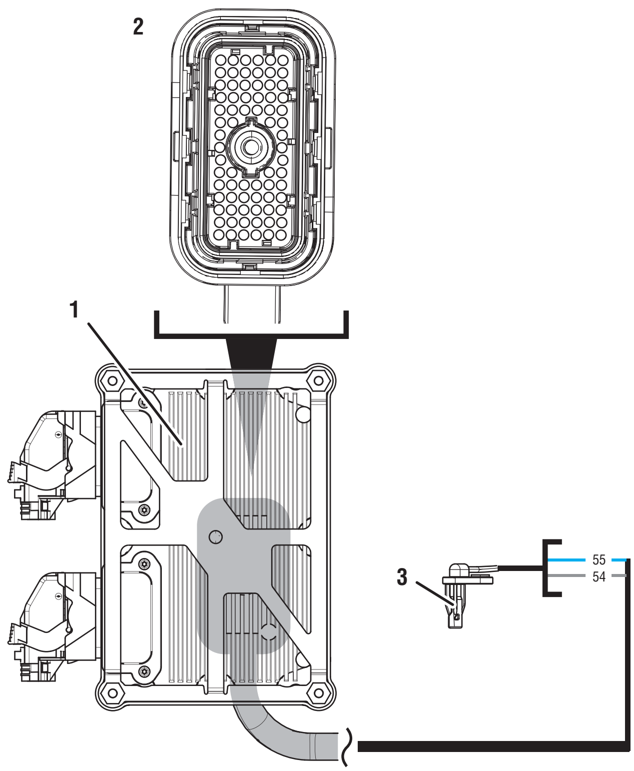
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Primary Input Speed Sensor



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *Primary Input Speed Sensor*

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

Fault Code 355 Troubleshooting

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

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

   Note: If fault code 355 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 355 FMI 2, 4, 5, 6, 8 14, 20, 21 or 31 is set, go to **Step B.**

B ***Purpose:*** *Verify Primary Input Speed sensor condition.*

1. Key off.
2. Set parking brake and chock wheels.
3. Drain oil.
4. Remove sump pan and filter.
5. Remove Primary Input Speed sensor from ACM.
6. Inspect for damage and contamination.
   - If damage and contamination is not found, replace 74-Way Transmission Harness. Go to **Step V.**
   - If damage or contamination is found, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 355 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 355 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 365 Secondary Input Speed

J1939: SA 3 SPN 5961 FMI 2, 4, 5, 6, 8, 14, 20, 21, 31

Overview

The Procision transmission is equipped with digital speed sensors. The Engine, Primary Input, Secondary Input and Output Speed sensors are used to verify clutch operation and calculate gear ratios. The Secondary Input Speed sensor is mounted in the Actuation Control Manifold (ACM) and measures the rotational speed of the secondary clutch input shaft, taken from the Secondary Driven Gear. The Secondary Input Speed sensor is integrated into the 74-Way Transmission Harness which connects to the Transmission Control Module (TCM).

Detection

The TCM monitors the Secondary Input Speed signal. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Secondary Input Speed out of range for 2 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Secondary Input Speed sensor circuit shorted to ground for 2 seconds.

FMI 5 – Current Below Normal or Open Circuit: Secondary Input Speed sensor circuit open or shorted to power for 2 seconds.

FMI 6 - Current Above Normal or Shorted Circuit: Secondary Input Speed sensor supply voltage not between 4.25V and 6.25V for 2 seconds.

FMI 8 – Abnormal Frequency: Secondary Input Speed signal abnormal pulse width for 2 seconds.

FMI 14 – Special Instructions: Secondary Input Speed near zero with transmission in gear and output speed present for 2 seconds.

FMI 20 – Data Drifted High: Secondary Input Speed signal greater than calculated Secondary Input Speed (based on output speed, J1939 engine speed, primary input speed, and gear ratio) for 2 seconds.

FMI 21 – Data Drifted Low: Secondary Input Speed signal less than calculated Secondary Input Speed (based on output speed, J1939 engine speed, primary input speed, and gear ratio) for 2 seconds.

FMI 31 – Condition Exists: Initial Secondary Input Speed not detected.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded performance

Note: If speed substitution is not available:

- Only engaged gears allowed
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 2: Secondary Input Speed in range for 10 seconds.

FMI 4: Secondary Input Speed sensor circuit not shorted to ground for 10 seconds.

FMI 5: Secondary Input Speed sensor circuit not open or shorted to power for 10 seconds.

FMI 6: Secondary Input Speed sensor supply voltage between 4.25V and 6.25V for 10 seconds.

FMI 8: Secondary Input Speed signal pulse width correct for 10 seconds.

FMI 14, 20, 21: Secondary Input Speed signal matches calculated Secondary Input Speed for 10 seconds.

FMI 31: Key cycle.

Possible Causes

FMI 2, 4, 5, 6, 8, 14, 20, 21:

- Secondary Input Speed sensor
  - Internal failure
  - Damaged
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- Mechanical failure
- TCM
  - Internal failure

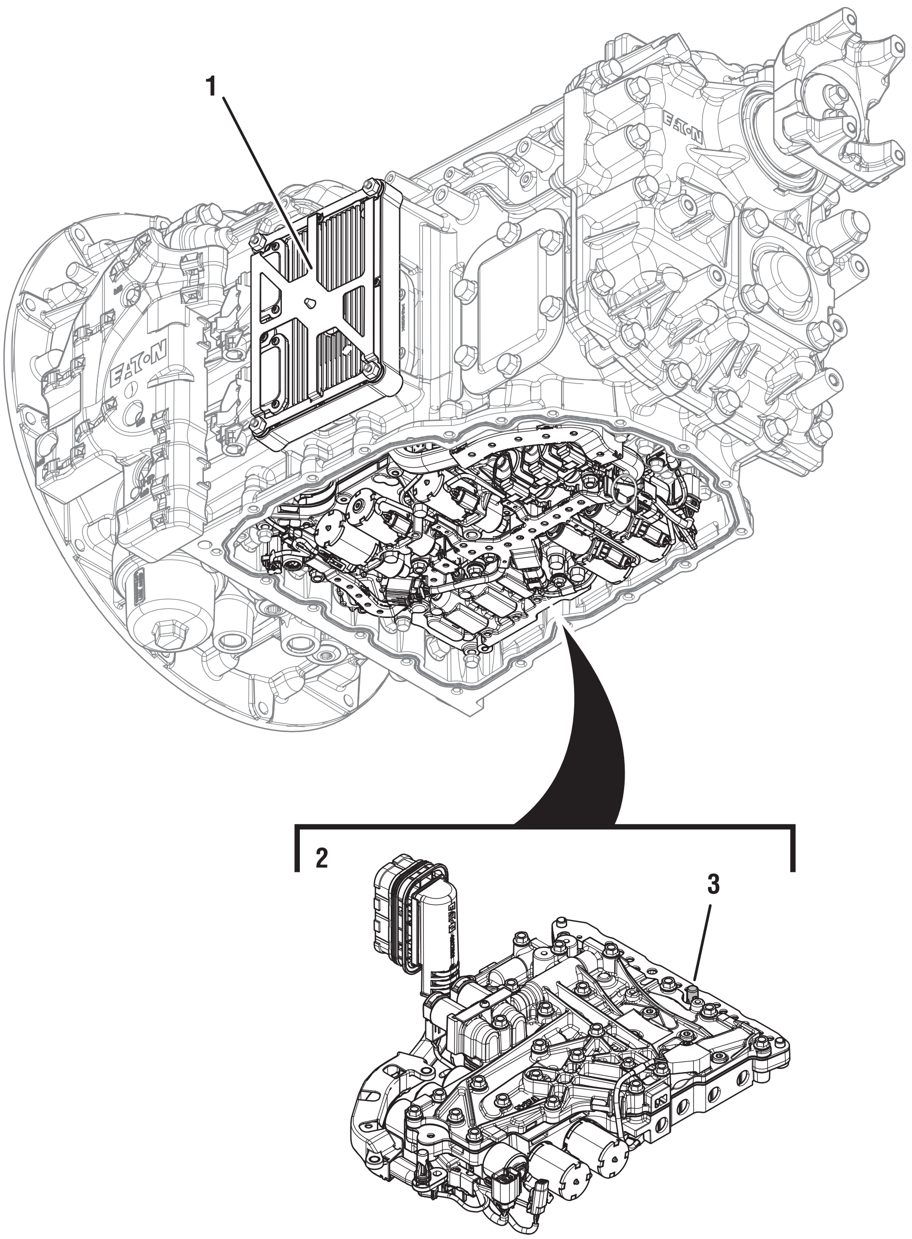
FMI 31:

- PTO (if equipped)
  - Improper installation (no backlash)
  - Mechanical failure
- Secondary Input Speed Sensor
  - Internal failure
  - Damaged
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground or open
- Mechanical failure
- TCM
  - Internal failure

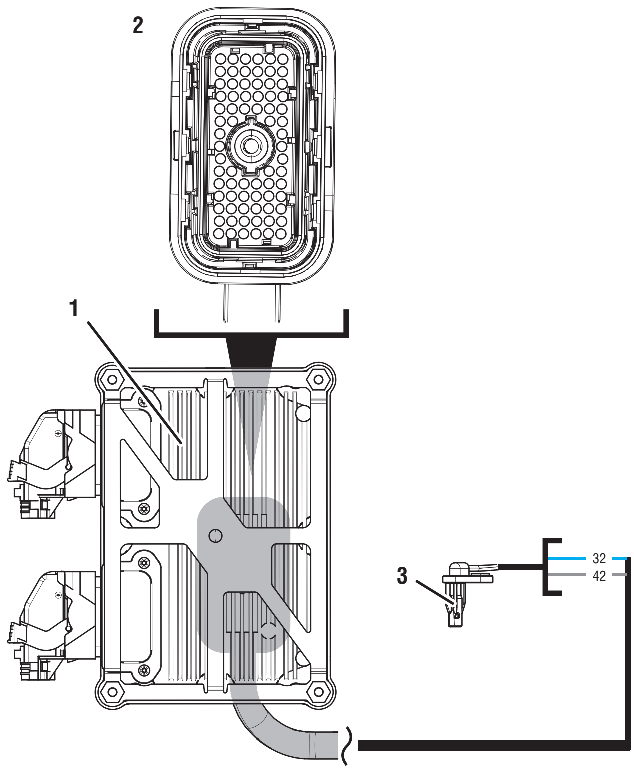
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Secondary Input Speed Sensor



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. Secondary Input Speed Sensor

Fault Code 365 Troubleshooting

A

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

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

   Note: If fault code 365 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 365 FMI 2, 4, 5, 6, 8 14, 20 or 21 is Active or Inactive, go to **Step D.**
   - If Fault Code 365 FMI 31 is Active or Inactive, go to **Step B.**

B

Purpose: *Inspect transmission for a PTO.*

1. Inspect transmission for a PTO.
   - If not equipped with a PTO, go to **Step D.**
   - If equipped with a PTO, go to **Step C.**

C

Purpose: *Inspect PTO for proper installation and condition.*

1. Inspect transmission PTO drive to driven gear backlash per PTO manufacture specification.
2. Inspect PTO for a mechanical failure.
   - If no fault found, go to **Step D.**
   - If fault found, reference OEM, Body Builder and/or PTO manufacture for repair or replacement. Go to **Step V.**

D

Purpose: *Verify Secondary Input Speed sensor condition.*

1. Key off.
2. Set parking brake and chock wheels.
3. Drain oil.
4. Remove sump pan and filter.
5. Remove Secondary Input Speed sensor from ACM.
6. Inspect for damage and contamination:
   - If damage and contamination is not found, replace 74-Way Transmission Harness. Go to **Step V.**
   - If damage or contamination is found, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 365 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 365 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 375: Output Speed

J1939: SA 3 SPN 191 FMI 2, 4, 5, 6, 8, 14, 20, 21, 31

Overview

The Procision transmission is equipped with digital speed sensors. The Engine, Primary Input, Secondary Input and Output Speed sensors are used to verify clutch operation and calculate gear ratio. The Output Speed sensor is mounted in the main case and measures the rotational speed and direction of the transmission output, taken from the 6th drive gear. The Output Speed sensor is integrated into the 74-Way Transmission Harness which connects to the Transmission Control Module (TCM).

Detection

The TCM monitors the Output Speed signal. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Output speed out of range for 2 seconds.

FMI 4 – Voltage Below Normal or Shorted Low: Output Speed sensor circuit shorted to ground for 2 seconds.

FMI 5 – Current Below Normal or Open Circuit: Output Speed sensor circuit open or shorted to power for 2 seconds.

FMI 6 - Current Above Normal or Shorted Circuit: Output Speed sensor power supply voltage not between 4.25V and 6.25V for 2 seconds.

FMI 8 – Abnormal Frequency: Output speed signal abnormal pulse width for 2 seconds.

FMI 14 – Special Instructions: Output speed signal less than J1939 Front Axle Speed and calculated output speed (based on input speed and gear ratio) for 2 seconds.

FMI 20 – Data Drifted High: Output speed signal greater than calculated output speed (based on both input speeds and gear ratio) for 2 seconds.

FMI 21 – Data Drifted Low: Output speed signal less than calculated output speed (based on both input speeds and gear ratio) for 2 seconds.

FMI 31 – Condition Exists: Output speed signal greater than J1939 Front Axle Speed and calculated output speed (based on input speed and gear ratio) for 2 seconds.

Fallback

All FMIs:

- Amber warning lamp on
- No degraded performance

Note: If speed substitution is not available:

- Only engaged gears allowed
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 2: Output speed in range for 10 seconds.

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 power supply voltage between 4.25V and 6.25V for 10 seconds.

FMI 8: Output speed signal pulse width correct for 10 seconds.

FMI 14, 31: Output speed signal matches J1939 Front Axle Speed and calculated output speed for 10 seconds.

FMI 20, 21: Output speed signal matches calculated output speed for 10 seconds.

Possible Causes

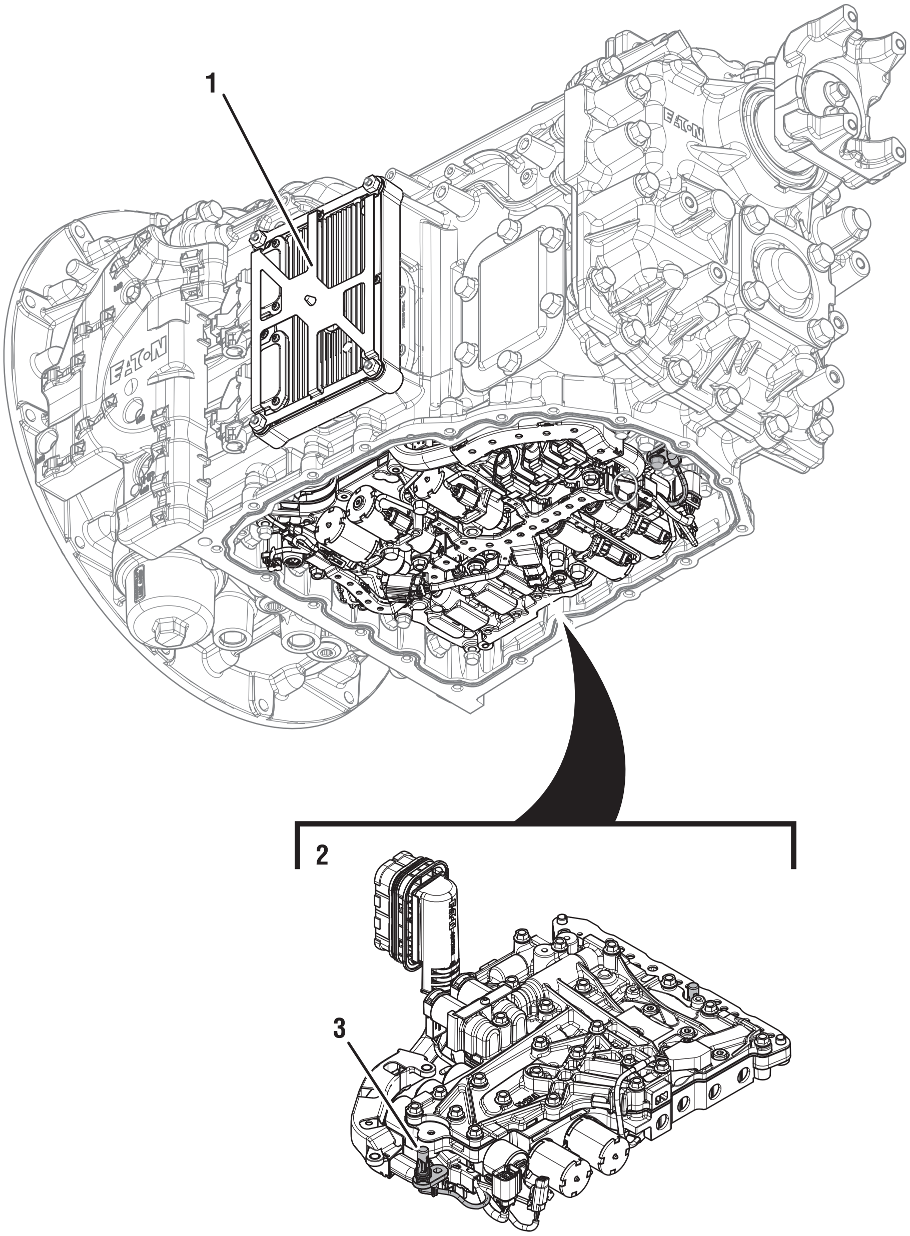
All FMIs:

- Output Speed sensor
  - Internal failure
  - Damaged
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground or open
  - Mechanical failure
- TCM
  - Internal failure

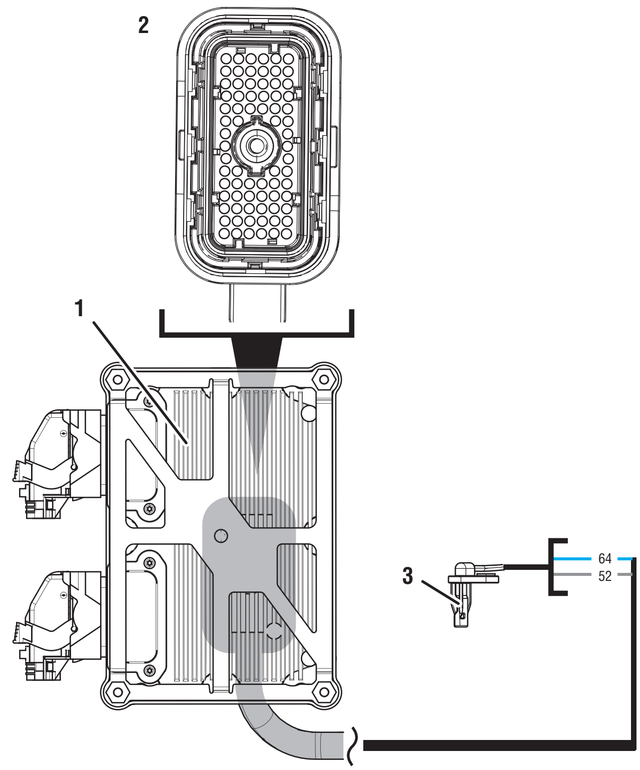
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. Output Speed Sensor



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *Output Speed Sensor*

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

Fault Code 375 Troubleshooting

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

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

   Note: If fault code 375 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 375 FMI 2, 4, 5, 6, 8, 14, 20, 21 or 31 is set, go to **Step B.**

B ***Purpose:*** *Verify Output Speed Sensor condition.*

1. Key off.
2. Set parking brake and chock wheels.
3. Drain oil.
4. Remove sump pan and filter.
5. Remove Output Speed Sensor from main case.
6. Inspect for damage and contamination.
   - If damage and contamination is not found, replace 74-Way Transmission Harness. Go to **Step V.**
   - If damage or contamination is found, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 375 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 375 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 385: Grade

J1939: SA 3 SPN 583 FMI 2, 10, 11, 12, 13, 14, 19, 20, 21, 31

Overview

The Procision transmission is equipped with a Grade Sensor, which calculates vehicle incline. The grade position is used for the Hill Helper feature and provides information to assist in vehicle launch and shifting. The Grade Sensor is internal to the Transmission Control Module (TCM).

Note: Initial calibration of the Grade Sensor must be completed at the OEM assembly plant or anytime the TCM is replaced. See Grade Sensor Calibration procedure in TRSM0990.

Detection

The TCM monitors the Grade Sensor signal. If the signal is out of range or a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 2 – Data Erratic: Grade Sensor signal out of hardware limits. Greater than 100% or less than -100% for 2 seconds.

FMI 10 – Abnormal Rate of Change: No change in grade detected over significant distance.

FMI 11 – Failure Mode Not Identifiable: Acceleration up a grade with no accelerator input for 3 seconds.

FMI 12 – Bad Intelligent Device: Grade Sensor self-check failure.

FMI 13 – Out of Calibration: Grade Sensor calibration required.

FMI 14 – Special Instructions: Deceleration down a grade with near maximum accelerator input for 3 seconds.

FMI 19 – Received Network Data in Error: SPI bus 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, 10, 11, 12, 13, 14, 19, 20, 21, 31:

- Amber warning lamp on
- Hill Helper may be reduced
- Shift strategy may be altered
- Shift and launch quality may degrade

Conditions to Set Fault Code Inactive

FMI 10, 11, 14, 20, 21: Key cycle.

FMI 2, 12, 31: Condition no longer exists.

Possible Causes

FMI 2, 10, 11, 12, 14, 19, 20, 21, 31:

- TCM
  - Internal failure
  - Software issue

FMI 13:

- Calibration
  - Grade Sensor not calibrated

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Fault Code 385 Troubleshooting

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

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

   Note: If Fault Code 385 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 385 FMI 2, 10, 11, 12, 14, 19, 20, 21, or 31 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions.
   - If Fault Code 385 FMI 13 is set, perform Grade Sensor Calibration. Test Complete.

Fault Code 400: Sump Oil Temperature

J1939: SA 3 SPN 177 FMI 0, 2, 4, 5, 6, 10, 11, 14, 15, 16, 20, 21, 31

Overview

The Procision transmission is equipped with a Triple Pressure Sensor (TPS) to monitor pressure at multiple oil paths and sump temperature. Sump Oil Temperature represents the overall operating temperature of the transmission. If the temperature is extreme, the Transmission Control Module (TCM) will adjust transmission operation to perform properly and prevent damage. The TPS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the Sump Oil Temperature signal. If temperatures are outside of preferred operating range or a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal (Most Severe): Sump Oil Temperature greater than 275°F (135°C) for 1 second.

FMI 2 – Data Erratic: Sump Oil Temperature out of range for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Sump Oil Temperature circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Sump Oil Temperature circuit open or shorted to power for 1 second.

FMI 6 - Current Above Normal or Shorted Circuit: Sump Oil Temperature supply voltage out of range for 1 second.

FMI 10 – Abnormal Rate of Change: Sump Oil Temperature rate of change greater than 20°F (11°C) per second.

FMI 11 – Root Cause Unknown: Sump Oil and Cooler Oil Temperature differential too large. At least 54° F (30°C) difference.

FMI 14 – Special Instructions: Sump Oil Temperature below threshold after warm up cycle and significantly below Cooler Oil Temperature after warm up cycle.

FMI 15 – Data Valid but Above Normal (Least Severe): Sump Oil Temperature greater than 230°F (110°C) for 10 seconds.

FMI 16 – Data Valid but Above Normal (Moderately Severe): Sump Oil Temperature greater than 257°F (125°C) for 1 second.

FMI 20 – Data Drifted High: Sump Oil Temperature significantly greater than Cooler Oil Temperature and TCM temperature.

FMI 21 – Data Drifted Low: Sump Oil Temperature significantly less than Cooler Oil Temperature and TCM temperature.

FMI 31 – Condition Exists: Sump Oil Temperature sustained above 257°F (125°C) and significantly greater than Cooler Oil Temperature when not micro-slipping clutch.

Fallback

FMI 0:

- Amber warning lamp on
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

FMI 2, 4, 5, 6, 10, 14, 20, 21, 31:

- Amber warning lamp on
- No degraded performance

Note: If Cooler Oil Temperature is not available:

- Gear engagement prohibited
- PTO Mode prohibited

FMI 11:

- Amber warning lamp on
- Power shifting prohibited
- PTO Mode prohibited

FMI 15:

- Clutch micro-slipping prohibited

FMI 16:

- Amber warning lamp on
- Creep prohibited
- Clutch micro-slipping prohibited
- Power shifting prohibited
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0: Sump Oil Temperature less than 259°F (126°C).

FMI 2: Sump Oil Temperature in range for 5 seconds.

FMI 4: Sump Oil Temperature circuit not shorted to ground for 5 seconds.

FMI 5: Sump Oil Temperature circuit not open or shorted to power for 5 seconds.

FMI 6: Sump Oil Temperature sensor power supply voltage in range for 5 seconds.

FMI 10: Sump Oil Temperature rate of change less than 20°F (11°C) per second for 5 seconds.

FMI 11: Sump Oil and Cooler Oil Temperature differential less than 54° F (30°C).

FMI 14: Key Cycle

FMI 15: Sump Oil Temperature less than 214°F (101°C).

FMI 16: Sump Oil Temperature less than 241°F (116°C).

FMI 20, 21, 31: Sump Oil, Cooler Oil, and TCM temperature differential normal.

Possible Causes

FMI 0, 15, 16:

- Engine overheating
- Oil cooler restricted
- Extreme operating conditions

FMI 2, 4, 5, 6, 10, 14, 20, 21, 31:

- 74-Way Transmission Harness
  - Shorted to power, shorted to ground, or open.
- Triple Pressure Sensor (TPS)
  - Internal failure
- TCM
  - Internal failure

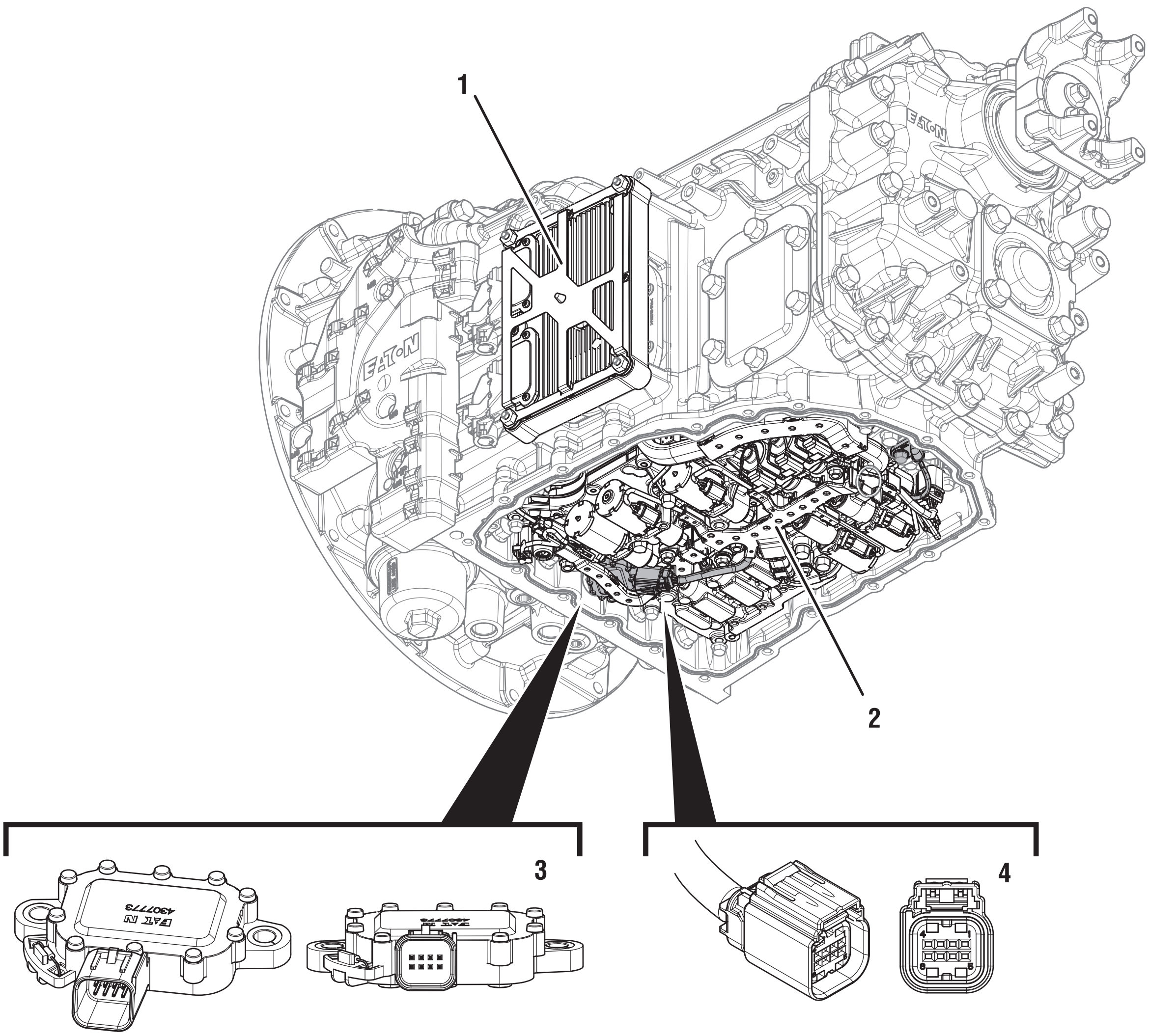
FMI 11:

- 74-Way Transmission Harness
  - Shorted to power, shorted to ground, or open.
- TPS
  - Internal failure
- Cooler Temperature Sensor (CTS)
  - Internal failure

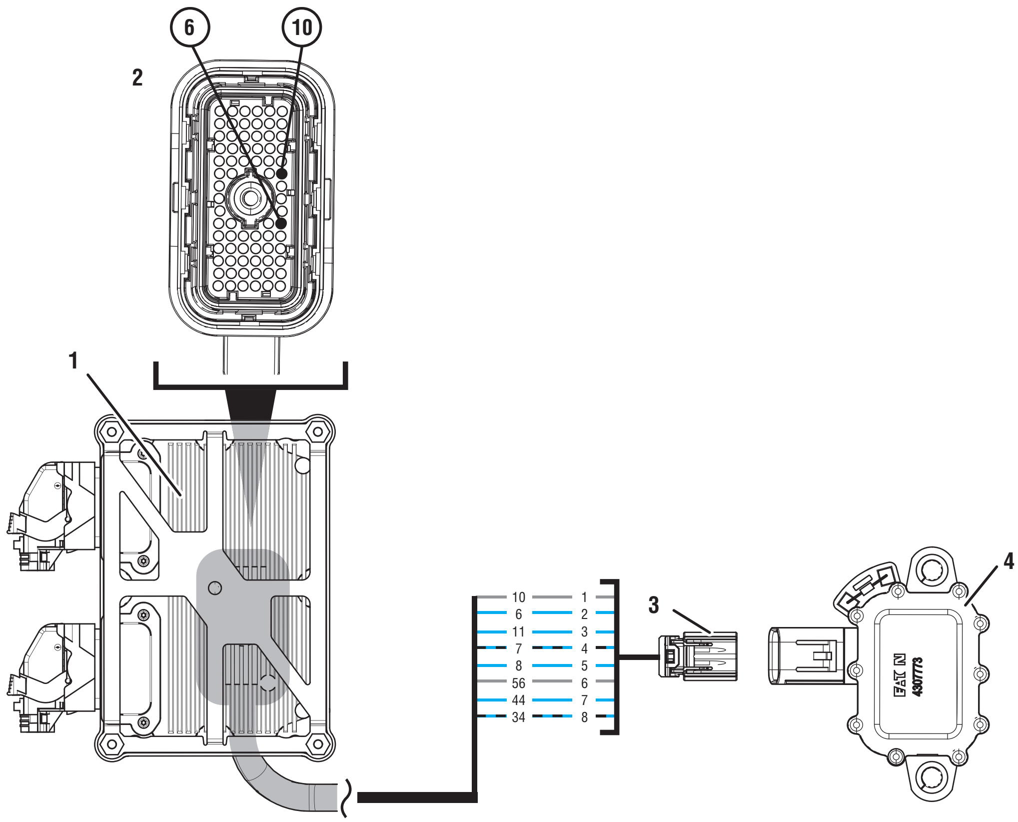
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Non-contact (infrared) temperature gun

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 8-Way Triple Pressure Sensor (TPS)
4. 8-Way Triple Pressure Sensor (TPS) Connector



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 8-Way Triple Pressure Sensor (TPS) Connector
4. 8-Way Triple Pressure Sensor (TPS)

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

Fault Code 400 Troubleshooting

A

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

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

   Note: If fault code 400 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 400 FMI 0 or 16 is set, go to **Step B.**
   - If Fault Code 400 FMI 15 is set, the Procision transmission detected normal temperatures outside of preferred operating range. Normal operation. Go to **Step V.**
   - If Fault Code 400 FMI 2, 4, 5, 6, or 10 is Active, go to **Step F.**
   - If Fault Code 400 FMI 2, 4, 5, 6, or 10 is Inactive, go to **Step E.**
   - If Fault Code 400 FMI 11 is set, go to **Step J.**
   - If Fault Code 400 FMI 14, 20, 21 or 31 is set, go to **Step D.**

B

Purpose: *Verify oil level.*

1. Verify oil level per service manual TRSM0990 - Oil Level Inspection Procedure.
   - If oil level is low, add correct amount of oil and inspect for leaks. Go to **Step V.**
   - If oil level is full, go to **Step C.**

C

Purpose: *Inspect engine cooling system.*

Note: The efficiency of the OEM oil cooler to regulate proper transmission temperatures may be greatly reduced if the engine cooling system is not performing correctly. If the OEM oil cooler is restricted, cooling efficiency will be greatly reduced.

Note: If the vehicle is abused, the Procision transmission operating temperatures may exceed normal levels.

1. Inspect engine cooling system for proper operation.
   - Go to **Step V.**

D

Purpose: *Verify oil level.*

1. Verify oil level per service manual TRSM0990 - Oil Level Inspection Procedure.
   - If oil level is low, add correct amount of oil and inspect for leaks. Go to **Step V.**
   - If oil level is full and Fault Code 400 FMI 14, 20, 21, or 31 is Active, go to **Step F.**
   - If oil level is full and Fault Code 400 FMI 14, 20, 21, or 31 is Inactive, go to **Step E.**

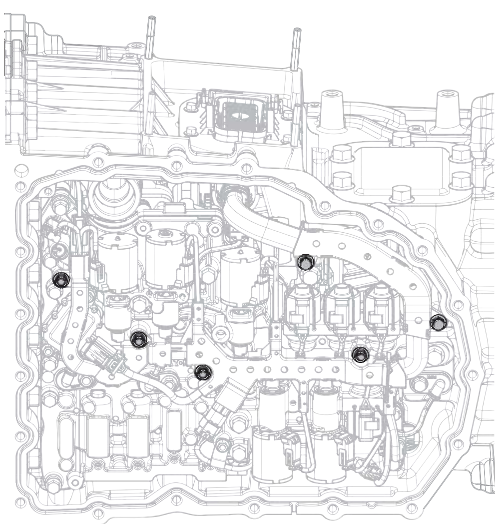
E ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels
2. Drain oil
3. Remove sump pan and filter.
4. Connect ServiceRanger.
5. Select Service Routine and PD Mode.

   Note: Transmission will not enter PD Mode when there are active fault codes

   Note: Solid "PD" in display

6. Remove 6 Transmission Harness 10 mm cap screws.

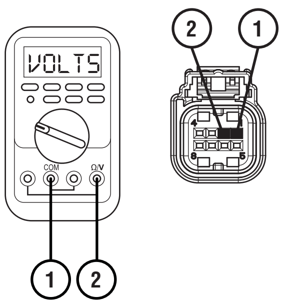


7. Wiggle harness. Look for any obvious signs of rubbing or chafing on any of the wires.
8. Exit PD Mode:
   - If any fault code sets Active while wiggling the harness, replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step F.**

F

Purpose: *Verify Sump Temperature supply voltage.*

1. Key off.
2. Drain oil.
3. Remove sump pan and filter.
4. Disconnect 8-Way Triple Pressure Sensor (TPS) Connector.
5. Key on.
6. Measure voltage between Pin 1 and 2. Record reading in table.



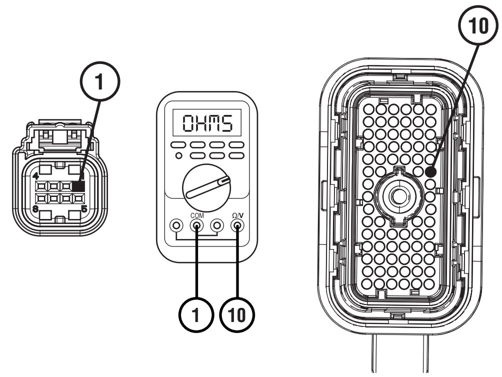
7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step G.**
   - If all readings are in range, go to **Step H.**

Pins	Range	Reading(s)
1 to 2	4.75–5.25 V	

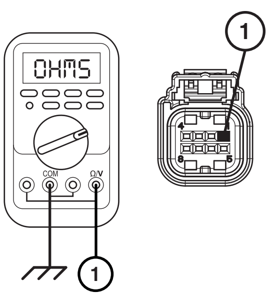
G

Purpose: *Verify continuity of Sump Temperature circuit.*

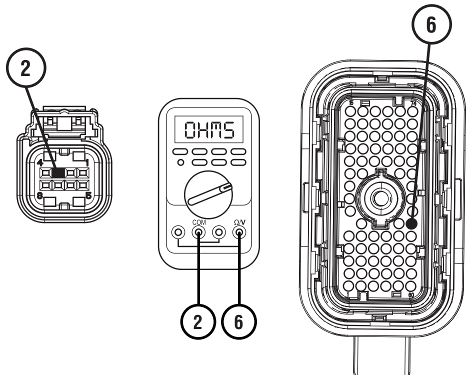
1. Key off.
2. Remove TCM.
3. Measure resistance between 74-Way Transmission Harness Pin 10 and 8-Way TPS Connector Pin 1. Record reading in table.



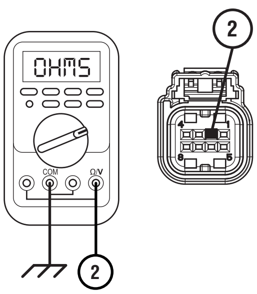
4. Measure resistance between 8-Way TPS Connector Pin 1 and ground. Record reading in table.



5. Measure resistance between 74-Way Transmission Harness Pin 6 and 8-Way Triple Pressure Sensor (TPS) Connector Pin 2. Record reading in table.



6. Measure resistance between 8-Way TPS Connector Pin 2 and ground. Record reading in table.



7. Compare reading(s) in table.

- If any reading is out of range, replace 74-Way Transmission Harness. Go to **Step V.**
- If all readings are in range, go to **Step I.**

Pins	Range	Reading(s)
10 to 1	0–0.2 Ohms	
1 to ground	Open Circuit (OL)	
6 to 2	0–0.2 Ohms	
2 to ground	Open Circuit (OL)	

H

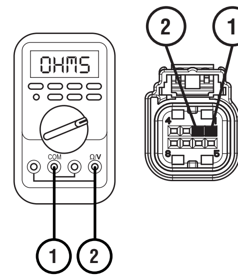
Purpose: *Verify continuity of Sump Temperature Sensor.*

1. Key off.
2. Record temperature around Triple Pressure Sensor (TPS) in table.
3. Reference temperature chart and record estimated temperature based on measured resistance.

   Note: Results may not be an exact match.

Temperature		Resistance	
°C	°F	Min	Max
-30	-22	192350	208357
-25	-13	139110	149703
-20	-4	101903	108975
-15	5	75552	80309
-10	14	56656	59874
-5	23	42945	45130
0	32	32883	34371
5	41	25422	26434
10	50	19833	20520
15	59	15607	16069
20	68	12382	12689
25	77	9900	10100
30	86	7939	8135
35	95	6413	6599
40	104	5215	5389
45	113	4269	4428
50	122	3516	3661
55	131	2913	3045
60	140	2427	2546
65	149	2033	2141
70	158	1712	1809
75	167	1449	1536
80	176	1232	1310
85	185	1052	1122
90	194	903	966
95	203	777	834
100	212	672	724
105	221	584	630
110	230	509	550
115	239	445	483
120	248	390	425
125	257	344	375
130	266	303	332
135	275	269	295

4. Measure resistance between TPS Pin 1 and Pin 2. Record reading in table.



- If any reading is out of range, replace TPS. Go to **Step V.**
- If all readings are in range, replace TPS and 74-Way Transmission Harness. Go to **Step V.**

Temperature	Resistance Range (Reference Chart)	Pins	Reading(s) (Ohms)
		1 to 2	

I

Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 400 FMI 2, 4, 5, 6, or 10 is Inactive, replace 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 400 FMI 2, 4, 5, 6, or 10 is Active, replace TCM. Go to **Step V.**

J

Purpose: *Verify oil level.*

1. Verify oil level per service manual TRSM0990 - Oil Level Inspection Procedure.
   - If oil level is low, add correct amount of oil and inspect for leaks. Go to **Step V.**
   - If oil level is full, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 400 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 400 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 420: Cooler Oil Temperature

J1939: SA 3 SPN 5938 FMI 0, 2, 4, 5, 6, 10, 11, 14, 15, 16, 20, 21, 31

Overview

The Procision transmission is equipped with a Cooler Temperature Sensor (CTS) to monitor oil cooler outlet temperature. If the temperature is extreme, the Transmission Control Module (TCM) will adjust transmission operation to perform properly and prevent damage. The CTS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the Cooler Oil Temperature signal. If temperatures are outside of normal operating range or a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal (Most Severe): Cooler Oil Temperature greater than 266°F (130°C) for 1 second.

FMI 2 – Data Erratic: Cooler Oil Temperature out of range for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Cooler Temperature Sensor circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: Cooler Temperature Sensor circuit open or shorted to power for 1 second.

FMI 6 - Current Above Normal or Shorted Circuit: Cooler Temperature Sensor supply voltage out of range for 1 second.

FMI 10 – Abnormal Rate of Change: Cooler Oil Temperature rate of change greater than 20°F (11°C) per second.

FMI 11 – Root Cause Unknown: Cooler Oil and Sump Oil Temperature differential too large. At least 54° F (30°C) difference.

FMI 14 – Special Instructions: Cooler Oil Temperature below threshold after warm up cycle and significantly below Sump Oil Temperature after warm up cycle.

FMI 15 – Data Valid but Above Normal (Least Severe): Cooler Oil Temperature greater than 230°F (110°C) for 10 seconds.

FMI 16 – Data Valid but Above Normal (Moderately Severe): Cooler Oil Temperature greater than 248°F (120°C) for 1 second.

FMI 20 – Data Drifted High: Cooler Oil Temperature significantly greater than Sump Oil Temperature and TCM temperature.

FMI 21 – Data Drifted Low: Cooler Oil Temperature significantly less than Sump Oil Temperature and TCM temperature.

FMI 31 – Condition Exists: Cooler Oil Temperature sustained above 248°F (120°C) and significantly greater than Sump Oil Temperature when not micro-slipping clutch.

Fallback

FMI 0:

- Amber warning lamp on
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

FMI 2, 4, 5, 6, 10, 14, 20, 21, 31:

- Amber warning lamp on
- No degraded performance

Note: If Sump Oil Temperature is not available:

- Gear engagement prohibited
- PTO Mode prohibited

FMI 11:

- Amber warning lamp on
- Power shifting prohibited
- PTO Mode prohibited

FMI 15:

- Clutch micro-slipping prohibited

FMI 16:

- Amber warning lamp on
- Creep prohibited
- Clutch micro-slipping prohibited
- Power shifting prohibited
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0: Cooler Oil Temperature less than 250°F (121°C).

FMI 2: Cooler Oil Temperature in range for 5 seconds.

FMI 4: CTS circuit not shorted to ground for 5 seconds.

FMI 5: CTS circuit not open or shorted to power for 5 seconds.

FMI 6: CTS supply voltage in range for 5 seconds.

FMI 10: Cooler Oil Temperature rate of change less than 20°F (11°C) per second for 5 seconds.

FMI 11: Sump Oil and Cooler Oil Temperature differential less than 54° F (30°C).

FMI 14: Key Cycle

FMI 15: Cooler Oil Temperature less than 214°F (101°C).

FMI 16: Cooler Oil Temperature less than 232°F (111°C).

FMI 20, 21, 31: Cooler Oil, Sump Oil, and TCM temperature differential normal.

Possible Causes

FMI 0, 15, 16:

- Engine overheating
- Oil cooler restricted
- Extreme operating conditions

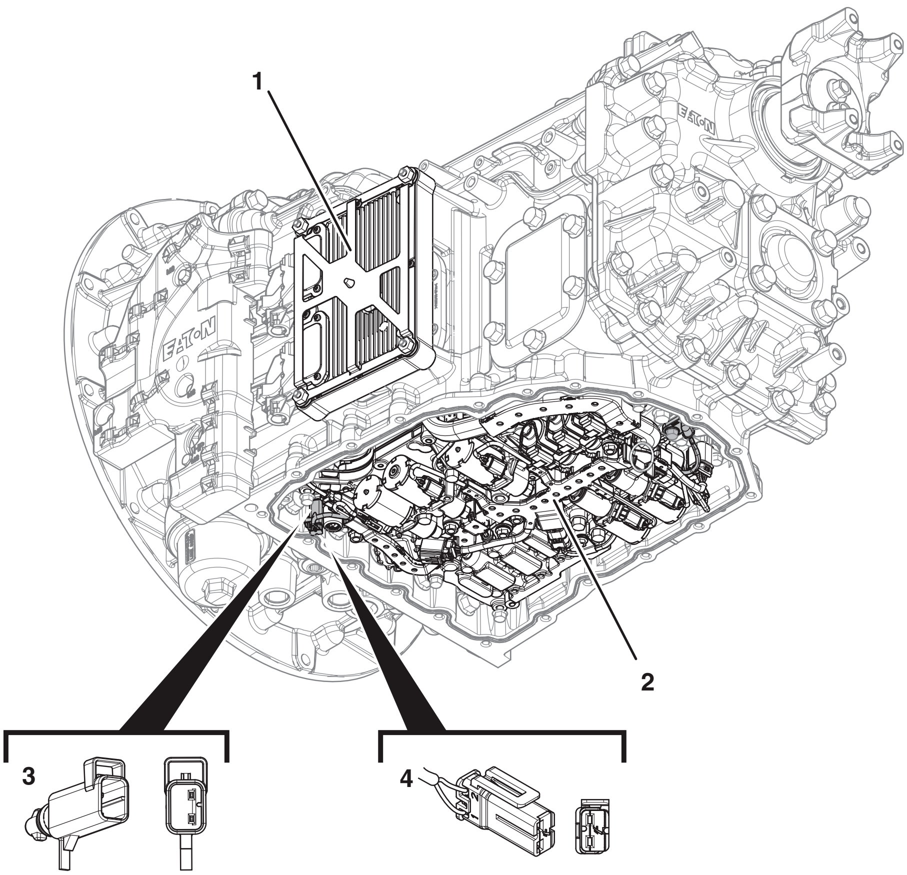
FMI 2, 4, 5, 6, 10, 14, 20, 21, 31:

- 74-Way Transmission Harness
  - Shorted to power, shorted to ground, or open.
- CTS
  - Internal failure
- TCM
  - Internal failure

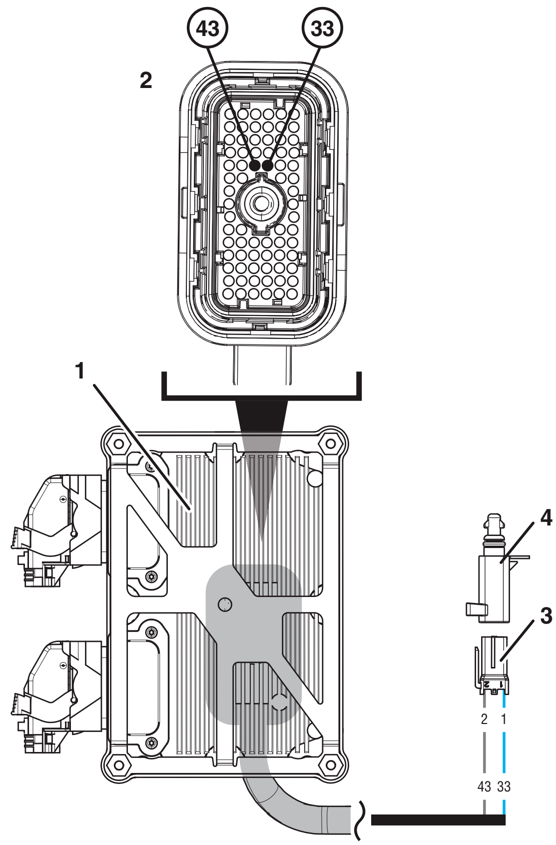
FMI 11:

- 74-Way Transmission Harness
  - Shorted to power, shorted to ground, or open.
- CTS
  - Internal failure
- Triple Pressure Sensor (TPS)
  - Internal failure

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Cooler Temperature Sensor (CTS)
4. 2-Way Cooler Temperature Sensor (CTS) Connector



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *2-Way Cooler Temperature Sensor (CTS) Connector*
4. *2-Way Cooler Temperature Sensor (CTS)*

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

Fault Code 420 Troubleshooting

A

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

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

   Note: If fault code 420 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 420 FMI 0 or 16 is set, go to **Step B.**
   - If Fault Code 420 FMI 2, 4, 5, 6, or 10 is Active, go to **Step F.**
   - If Fault Code 420 FMI 2, 4, 5, 6, or 10 is Inactive, go to **Step E.**
   - If Fault Code 420 FMI 11 is set, go to **Step J.**
   - If Fault Code 420 FMI 14, 20, 21 or 31 is set, go to **Step D.**
   - If Fault Code 420 FMI 15 is set, the Procision transmission detected normal temperatures outside of preferred operating range. Normal operation. Go to **Step V.**

B

Purpose: *Verify oil level.*

1. Verify oil level per service manual TRSM0990 - Oil Level Inspection Procedure.
   - If oil level is low, add correct amount of oil and inspect for leaks. Go to **Step V.**
   - If oil level is full, go to **Step C.**

C

Purpose: *Inspect engine cooling system.*

Note: The efficiency of the OEM oil cooler to regulate proper transmission temperatures may be greatly reduced if the engine cooling system is not performing correctly. If the OEM oil cooler is restricted, cooling efficiency will be greatly reduced.

1. Inspect engine cooling system for proper operation.

   Note: If the vehicle is abused, the Procision transmission operating temperatures may exceed normal levels.

   - Go to **Step V.**

D

Purpose: *Verify oil level.*

1. Verify oil level per service manual TRSM0990 - Oil Level Inspection Procedure.
   - If oil level is low, add correct amount of oil and inspect for leaks. Go to **Step V.**
   - If oil level is full and Fault Code 420 FMI 14, 20, 21, or 31 is Active, go to **Step F.**
   - If oil level is full and Fault Code 420 FMI 14, 20, 21, or 31 is Inactive, go to **Step E.**

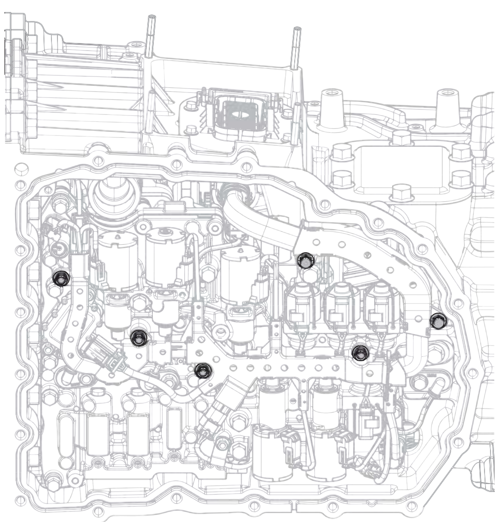
E ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels
2. Drain oil
3. Remove sump pan and filter.
4. Connect ServiceRanger.
5. Select Service Routine and PD Mode.

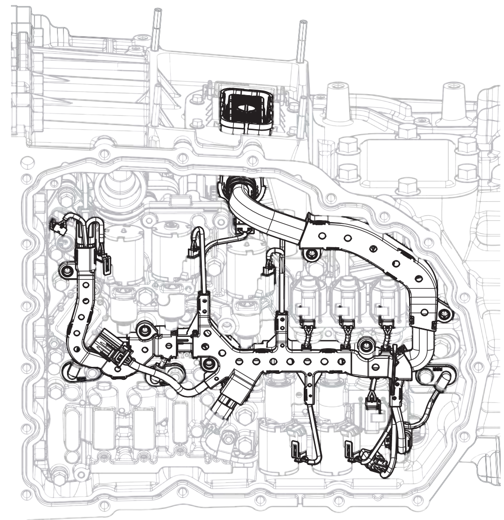
   Note: Transmission will not enter PD Mode when there are active fault codes

   Note: Solid “PD” in display

6. Remove 6 Transmission Harness 10 mm cap screws.



7. Wiggle harness. Look for any obvious signs of rubbing or chafing on any of the wires.

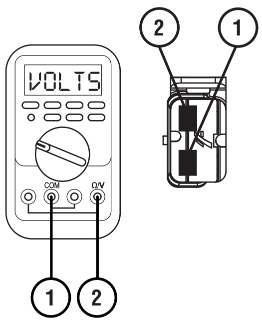


8. Exit PD Mode:
   - If any fault code sets Active while wiggling the harness, replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step F.**

F

Purpose: *Verify Cooler Temperature Sensor supply voltage.*

1. Key off.
2. Drain oil.
3. Remove sump pan and filter.
4. Disconnect CTS 2-Way Connector.
5. Key on.
6. Measure voltage between Pin 1 and 2. Record reading in table.



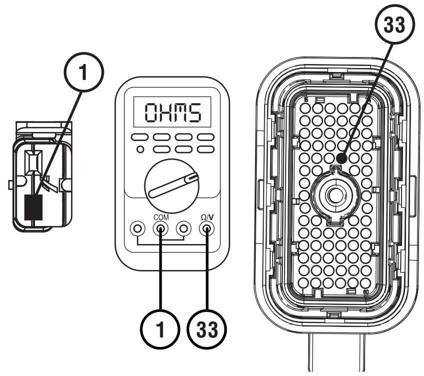
7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step G.**
   - If all readings are in range, go to **Step H.**

Pins	Range	Reading(s)
1 to 2	4.75–5.25 V	

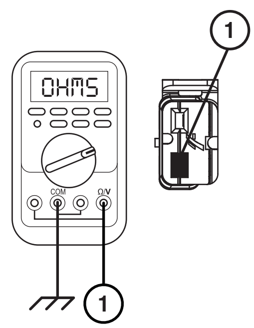
G

Purpose: *Verify continuity of Cooler Temperature Sensor circuit.*

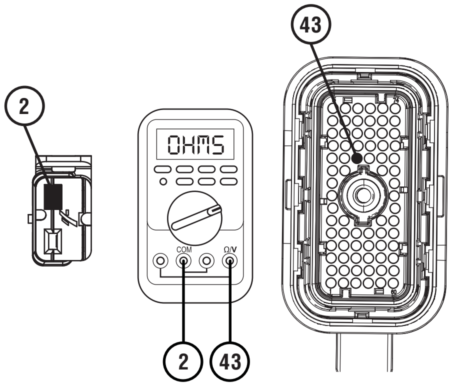
1. Key off.
2. Remove TCM.
3. Measure resistance between 74-Way Transmission Harness Pin 33 and CTS 2-Way Pin 1. Record reading in table.



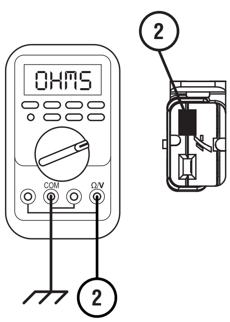
4. Measure resistance between CTS 2-Way Pin 1 and ground. Record reading in table.



5. Measure resistance between 74-Way Transmission Harness Pin 43 and CTS 2-Way Pin 2. Record reading in table.



6. Measure resistance between CTS 2-Way Pin 2 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace 74-Way Transmission Harness. Go to **Step V.**
   - If all readings are in range, go to **Step I.**

Pins	Range	Reading(s)
33 to 1	0–0.2 Ohms	
1 to ground	Open Circuit (OL)	
43 to 2	0–0.2 Ohms	
2 to ground	Open Circuit (OL)	

H

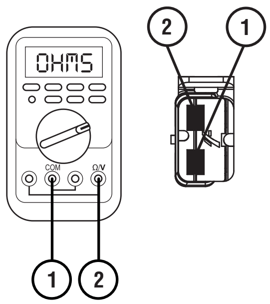
Purpose: *Verify continuity of Cooler Temperature Sensor.*

1. Key off.
2. Record temperature around CTS in table.
3. Reference temperature chart and record estimated temperature based on measured resistance.

   Note: Results may not be an exact match.

Temperature		Resistance	
°C	°F	Min	Max
-40	-40	832519	1017523
-20	-4	263111	290807
0	32	91058	100644
20	68	35473	39207
25	77	28500	31500
40	104	15307	16919
60	140	7171	7925
100	212	1976	2184
120	248	1131	1251

4. Measure resistance between CTS Pin 1 and Pin 2. Record reading in table.



5. Compare reading(s) in table.
   - If any reading is out of range, replace CTS. Go to **Step V.**
   - If all readings are in range, replace CTS and 74-Way Transmission Harness. Go to **Step V.**

Temperature	Resistance Range (Reference Chart)	Pins	Reading(s) (Ohms)
		1 to 2	

I

Purpose: *Verify fault code status.*

1. Reinstall TCM.
2. Reconnect all connectors.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 420 FMI 2, 4, 5, 6, or 10 is Inactive, replace 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 420 FMI 2, 4, 5, 6, or 10 is Active, replace TCM. Go to **Step V.**

J

Purpose: *Verify oil level.*

1. Verify oil level per service manual TRSM0990 - Oil Level Inspection Procedure.
   - If oil level is low, add correct amount of oil and inspect for leaks. Go to **Step V.**
   - If oil level is full, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
    - If no codes set and the vehicle operates properly, Test Complete.
    - If Fault Code 420 sets Active during the test drive, go to **Step A.**
    - If a fault code other than 420 sets, troubleshoot per the “Fault Code Isolation Procedure Index” on page 13.

Fault Code 500: Line Pressure Solenoid (LPS)

J1939: SA 3 SPN 5946 FMI 3, 4, 5, 12, 16, 18, 19

Overview

The Procision transmission is equipped with a pressure control solenoid to regulate overall fluid pressure. The Line Pressure Solenoid (LPS) is energized by the Transmission Control Module (TCM) to regulate hydraulic pressure. The LPS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the LPS circuit. If a circuit failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: LPS circuit shorted to power for 1 second.

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

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

FMI 12 – Bad Intelligent Device: Line pressure forced low.

FMI 16 – Data Valid But Above Normal: High side current above command.

FMI 18 – Data Valid But Below Normal: High side current below command.

FMI 19 – Received Network Data in Error: SPI bus error.

Fallback

FMI 3, 4, 16:

- Amber warning lamp on
- LPS disabled
- PTO Mode prohibited
- Possible clutch slip or engine flare

FMI 5, 18, 19:

- Amber warning lamp on
- LPS disabled
- PTO Mode prohibited

FMI 12:

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

FMI 3: LPS circuit not shorted to power for 10 seconds.

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

FMI 5: LPS circuit not open for 10 seconds.

FMI 12: Key cycle.

FMI 16: LPS high side current not above command for 10 seconds.

FMI 18: LPS high side current not below command for 10 seconds.

FMI 19: SPI bus functional.

Possible Causes

FMI 3, 4, 5:

- LPS
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

FMI 16:

- LPS
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 18:

- LPS
  - Internal failure
- TCM 74-Way Harness
  - High resistance in LPS circuit
- TCM
  - Internal failure

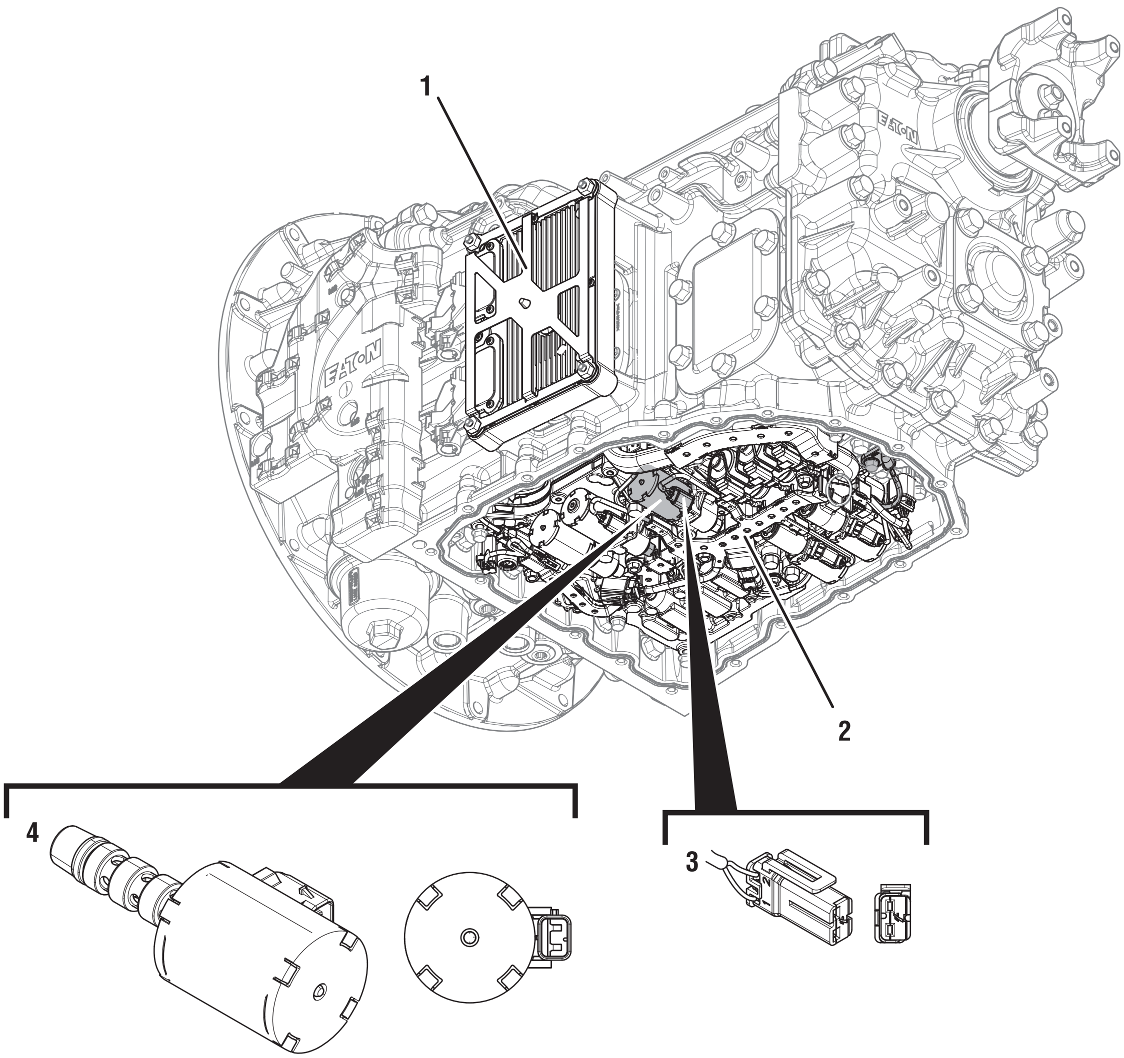
FMI 12, 19:

- TCM
  - Internal failure
  - Software issue

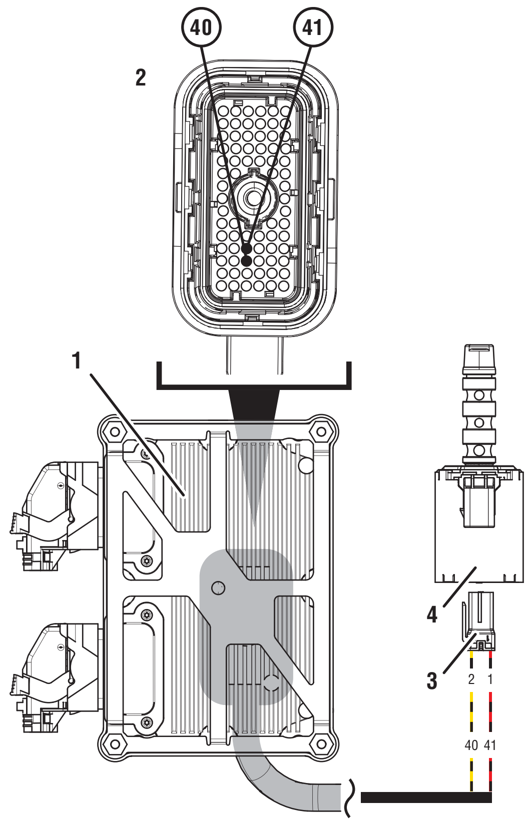
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Line Pressure Solenoid (LPS) Connector
4. 2-Way Line Pressure Solenoid (LPS)



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 2-Way Line Pressure Solenoid (LPS) Connector
4. 2-Way Line Pressure Solenoid (LPS)

Fault Code 500 Troubleshooting

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

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

   Note: If Fault Code 500 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 500 FMI 3, 4, 5, 16, or 18 is Active, go to **Step C.**
   - If Fault Code 500 FMI 3, 4, 5, 16, or 18 is Inactive, go to **Step B.**
   - If Fault Code 500 FMI 12 or 19 is set, send Service Activity Report via ServiceRanger and contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

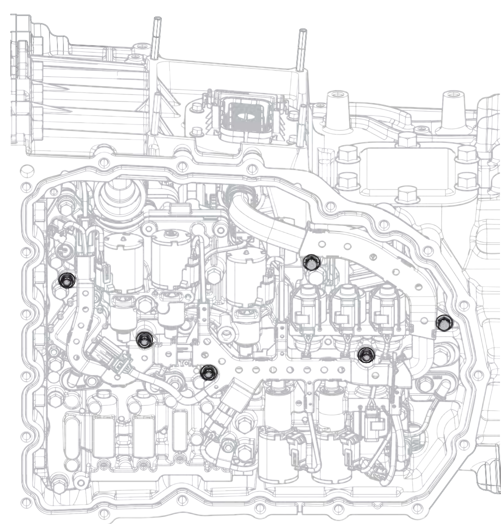
B ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan and filter.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

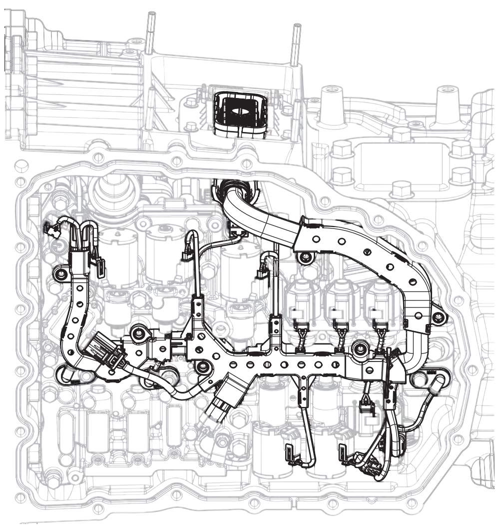
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.



8. Exit PD Mode.

- If any fault code sets Active while wiggling the harness, Replace TCM and the 74-Way Transmission Harness. Go to **Step V.**
- If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify proper resistance through 74-Way Transmission Harness and LPS.*

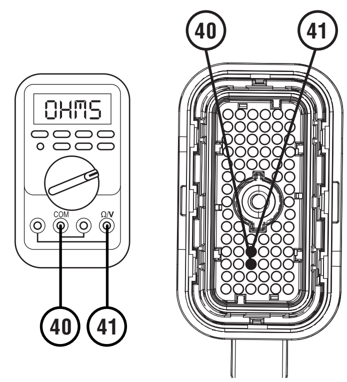
1. Set parking brake and chock wheels.

2. Key off.

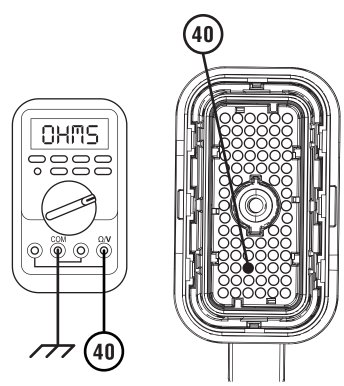
3. Remove TCM.

4. Inspect connector for oil, corrosion, and bent or spread pins.

5. Measure resistance between 74-Way Connector Pin 40 and Pin 41. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 40 and ground. Record reading in table.



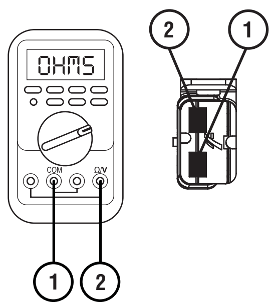
7. Compare reading(s) in table.

- If any reading is out of range, go to **Step D.**
- If all readings are in range, go to **Step E.**

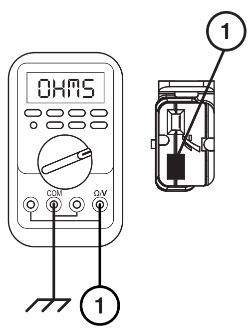
Pins	Range	Reading(s)
40 to 41	2.7–6.6 Ohms	
40 to ground	Open Circuit (OL)	

D ***Purpose:*** *Verify proper resistance of LPS.*

1. Key off.
2. Drain oil.
3. Remove sump pan.
4. Disconnect LPS connector.
5. Measure resistance between LPS Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between LPS Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace LPS. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	2.7–6.6 Ohms	
1 to ground	Open Circuit (OL)	

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

1. Key off.
2. Reinstall TCM
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 500 FMI 3, 4, 5, 16, or 18 is Inactive, replace LPS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 500 FMI 3, 4, 5, 16, or 18 is Active, replace TCM. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 500 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 500 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 510: Pressure Control Primary Solenoid (Clutch)

J1939: SA 3 SPN 5944 FMI 0, 3, 4, 5, 14, 16, 18, 19, 31

Overview

The Procision transmission is equipped with pressure control solenoids to actuate each clutch. The Pressure Control Primary Solenoid (PCPS) is energized by the Transmission Control Module (TCM) to regulate hydraulic pressure. This allows Primary Clutch application to be precisely controlled. The PCPS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the PCPS circuit. If a circuit failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: PCPS high side current above command (fast detection time).

FMI 3 – Voltage Above Normal or Shorted High: PCPS circuit shorted to power for 1 second.

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

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

FMI 14 – Special Instructions: Primary and Secondary clutch simultaneously engaged.

FMI 16 – Data Valid But Above Normal: PCPS high side current above command (normal detection time).

FMI 18 – Data Valid But Below Normal: PCPS high side current below command.

FMI 19 – Received Network Data in Error: SPI bus error.

FMI 31 – Condition Exists: Clutch engagement commanded when not requested by driver.

Fallback

FMI 0, 3, 4, 5, 16, 18, 19:

- Amber warning lamp on
- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th and 7th gears unavailable
- PTO Mode prohibited
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a PCPS fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

FMI 14, 31:

- Amber warning lamp on
- Transmission will stay in current gear
- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

FMI 0, 16: PCPS high side current not above command for 10 seconds.

FMI 3: PCPS circuit not shorted to power for 10 seconds.

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

FMI 5: PCPS circuit not open for 10 seconds.

FMI 14, 31: Key cycle.

FMI 18: PCPS high side current not below command for 10 seconds.

FMI 19: SPI bus functional.

Possible Causes

FMI 0, 16:

- PCPS
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 3, 4, 5:

- PCPS
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

FMI 14, 19, 31:

- TCM
  - Internal failure
  - Software issue

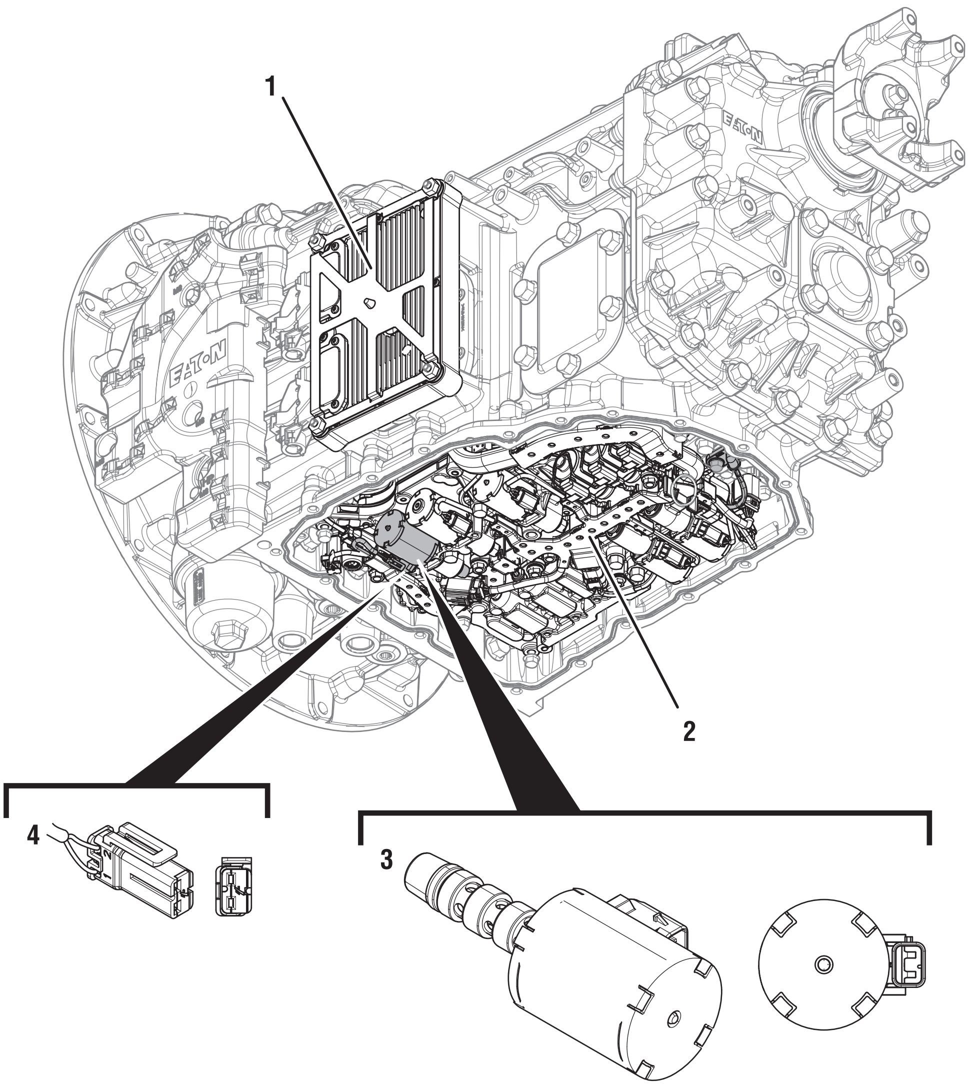
FMI 18:

- PCPS
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in PCPS circuit
- TCM
  - Internal failure

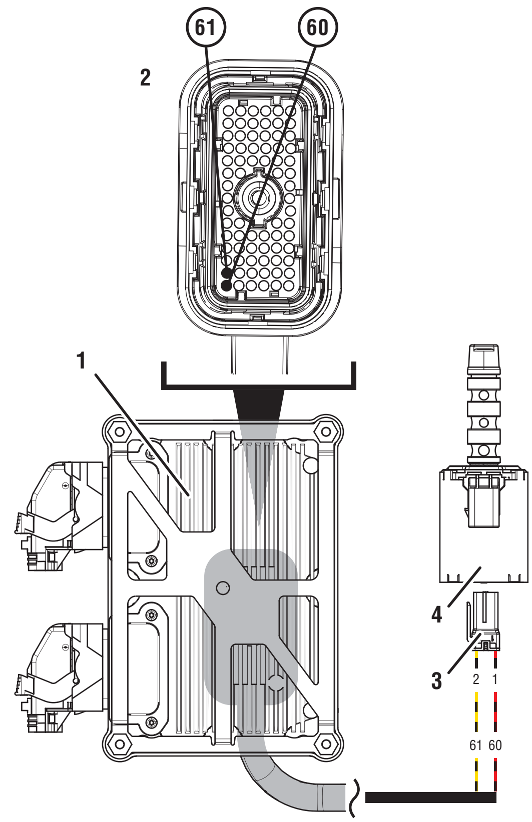
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Pressure Control Primary Clutch Solenoid (PCPS)
4. 2-Way Pressure Control Primary Clutch Solenoid (PCPS) Connector



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 2-Way Pressure Control Primary Clutch Solenoid (PCPS) Connector
4. 2-Way Pressure Control Primary Clutch Solenoid (PCPS)

Fault Code 510 Troubleshooting

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

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

   Note: If Fault Code 510 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 510 FMI 0, 3, 4, 5, 16, or 18 is Active, go to **Step C.**
   - If Fault Code 510 FMI 0, 3, 4, 5, 16, or 18 is Inactive. go to **Step B.**
   - If Fault Code 510 FMI 14, 19, or 31 is set, Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

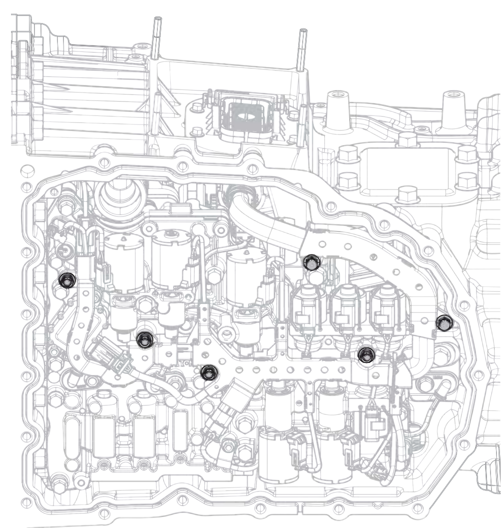
B ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan and filter.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

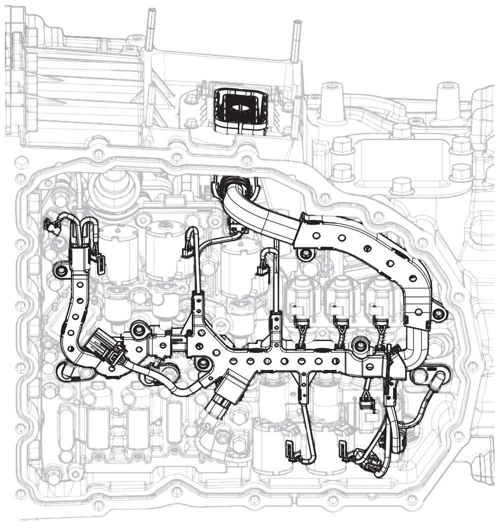
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



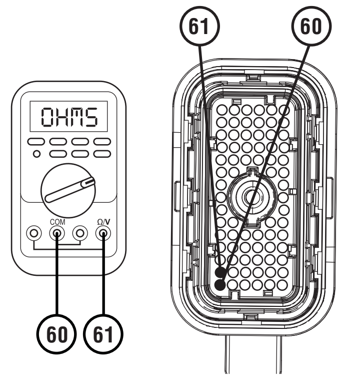
7. Wiggle harness. Look for any obvious signs of rubbing or chafing on any of the wires.



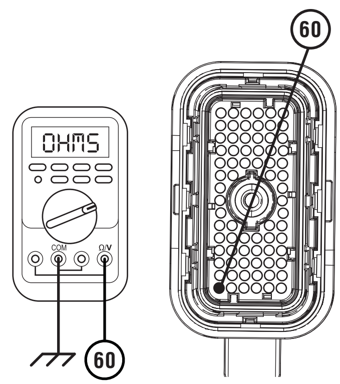
8. Exit PD Mode.
    - If any fault code sets Active while wiggling the harness, replace 74-Way Transmission Harness. Go to **Step V.**
    - If no fault codes become Active, go to **Step C.**

C ***Purpose:*** *Verify proper resistance through 74-Way Transmission Harness and PCPS.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove TCM.
4. Inspect connector for oil, corrosion, and bent or spread pins.
5. Measure resistance between 74-Way Connector Pin 60 and Pin 61. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 60 and ground. Record reading in table.



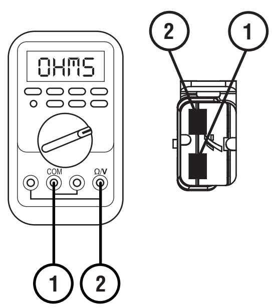
7. Compare reading(s) in table.
    - If any reading is out of range, go to **Step D.**
    - If all readings are in range, go to **Step E.**

Pins	Range	Reading(s)
60 to 61	2.7–6.6 Ohms	
60 to ground	Open Circuit (OL)	

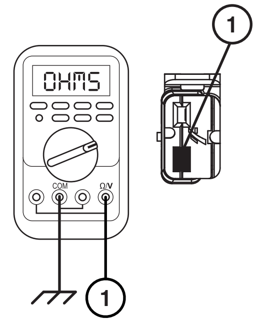
D

Purpose: *Verify proper resistance of PCPS.*

1. Key off.
2. Drain oil.
3. Remove sump pan.
4. Disconnect PCPS connector.
5. Measure resistance between PCPS Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between PCPS Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
    - If any reading is out of range, replace PCPS. Go to **Step V.**
    - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	2.7–6.6 Ohms	
1 to ground	Open Circuit (OL)	

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

1. Key off.
2. Reinstall TCM
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 510 FMI 0, 3, 4, 5, 16, or 18 is Inactive, replace PCPS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 510 FMI 0, 3, 4, 5, 16, or 18 is Active, replace TCM. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 510 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 510 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 520: Pressure Control Secondary Solenoid (Clutch)

J1939: SA 3 SPN 5945 FMI 0, 3, 4, 5, 12, 14, 16, 18, 19, 31

Overview

The Procision transmission is equipped with pressure control solenoids to actuate each clutch. The Pressure Control Secondary Solenoid (PCSS) is energized by the Transmission Control Module (TCM) to regulate hydraulic pressure. This allows Secondary Clutch application to be precisely controlled. The PCSS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the PCSS circuit. If a circuit failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: PCSS high side current above command (fast detection time).

FMI 3 – Voltage Above Normal or Shorted High: PCSS circuit shorted to power for 1 second.

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

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

FMI 12 – Bad Intelligent Device: Clutch engagement commanded when desired mode is Neutral, but transmission is in gear.

FMI 14 – Special Instructions: Clutch engagement commanded when engine RPM is outside of normal engagement RPM.

FMI 16 – Data Valid But Above Normal: PCSS high side current above command (normal detection time).

FMI 18 – Data Valid But Below Normal: PCSS high side current below command.

FMI 19 – Received Network Data in Error: SPI bus error.

FMI 31 – Condition Exists: Clutch engagement commanded when transmission direction does not match driver request.

Fallback

FMI 0, 3, 4, 5, 16, 18, 19:

- Amber warning lamp on
- Secondary Clutch disengaged
- 2nd, 4th, 6th, and 7th gears unavailable
- PTO Mode prohibited

FMI 12, 14, 31:

- Amber warning lamp on
- Transmission will stay in current gear
- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

FMI 0, 16: PCSS high side current not above command for 10 seconds.

FMI 3: PCSS circuit not shorted to power for 10 seconds.

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

FMI 5: PCSS circuit not open for 10 seconds.

FMI 12, 14, 31: Key cycle.

FMI 18: PCSS high side current not below command for 10 seconds.

FMI 19: SPI bus functional.

Possible Causes

FMI 0, 16:

- PCSS
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 3, 4, 5:

- PCSS
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

FMI 12, 14, 19, 31:

- TCM
  - Internal failure
  - Software issue

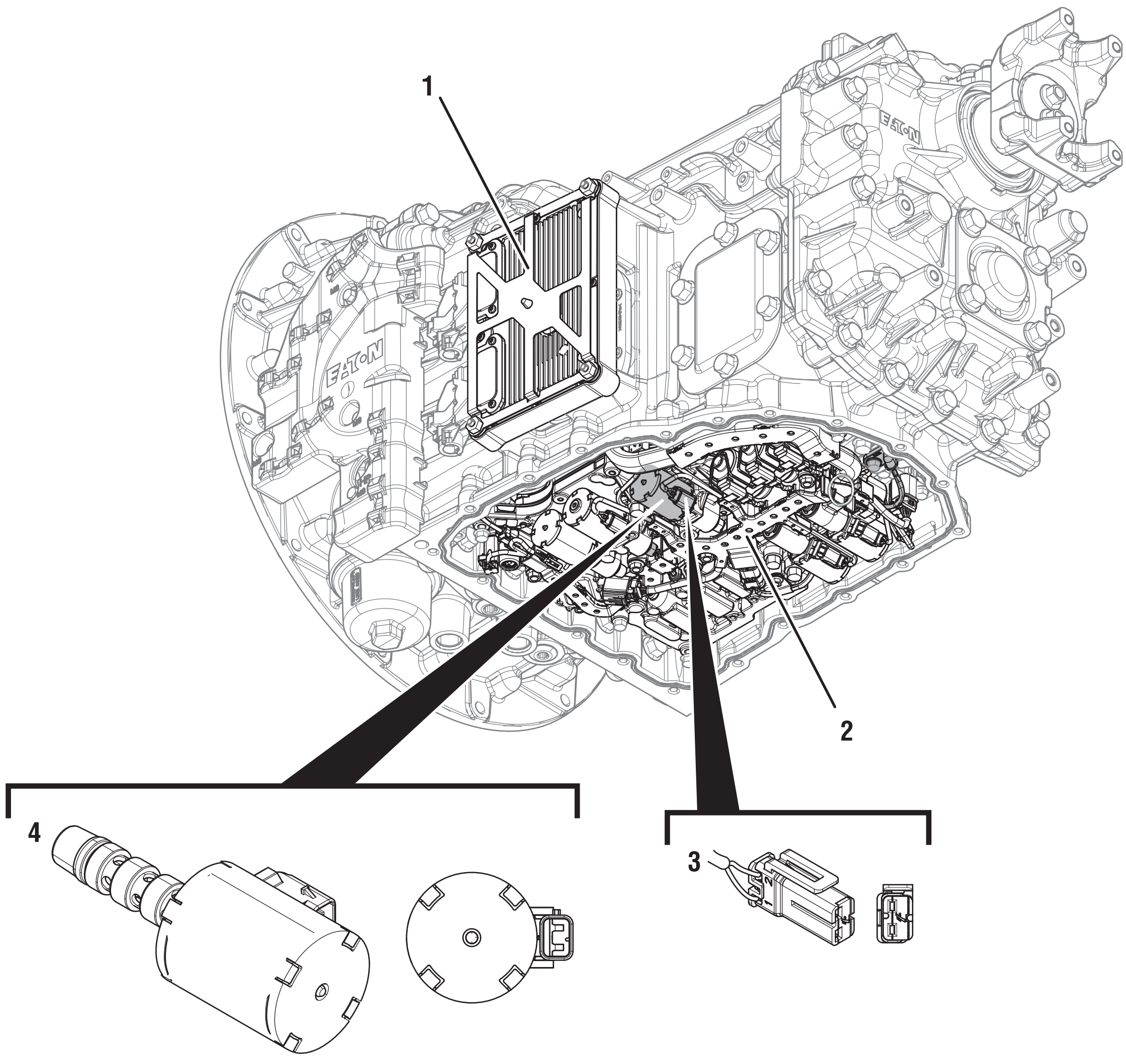
FMI 18:

- PCSS
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in PCSS circuit
- TCM
  - Internal failure

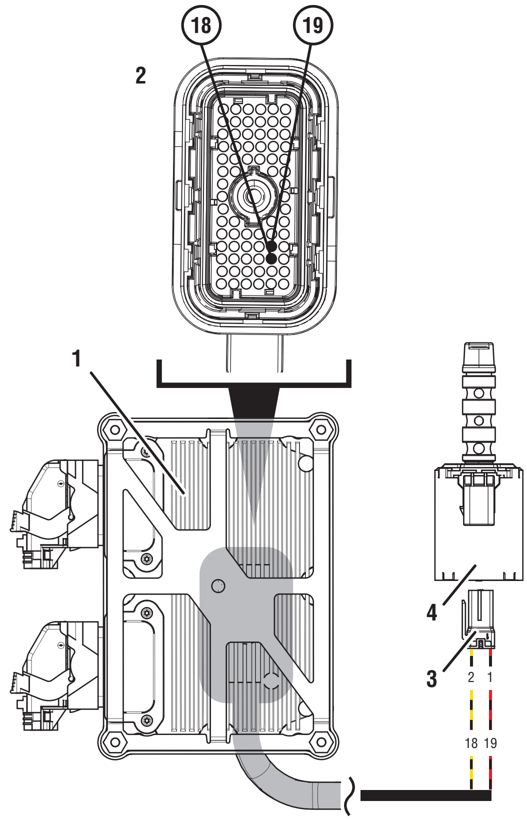
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Pressure Control Secondary Clutch Solenoid (PCSS) Connector
4. 2-Way Pressure Control Secondary Clutch Solenoid (PCSS)



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *2-Way Pressure Control Secondary Clutch Solenoid (PCSS) Connector*
4. *2-Way Pressure Control Secondary Clutch Solenoid (PCSS)*

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

Fault Code 520 Troubleshooting

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

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

   Note: If Fault Code 520 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 520 FMI 0, 3, 4, 5, 16, or 18 is Active, go to **Step C.**
   - If Fault Code 520 FMI 0, 3, 4, 5, 16, or 18 is Inactive. go to **Step B.**
   - If Fault Code 520 FMI 12, 14, 19, or 31 is Active, Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

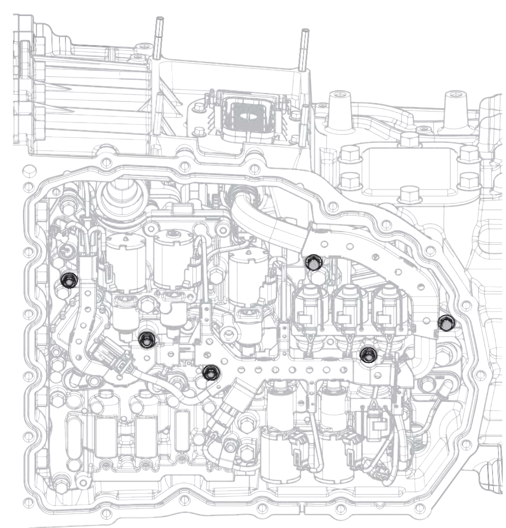
B ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan and filter.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

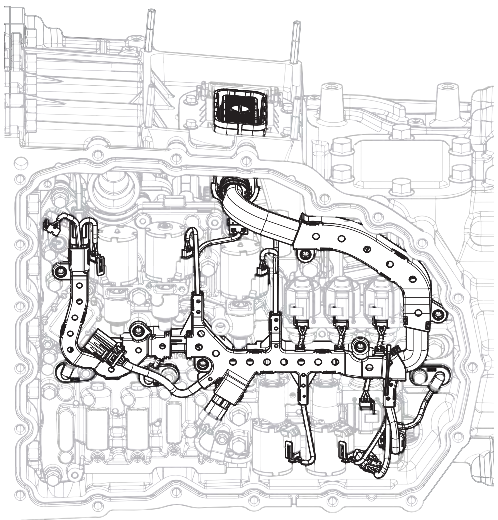
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



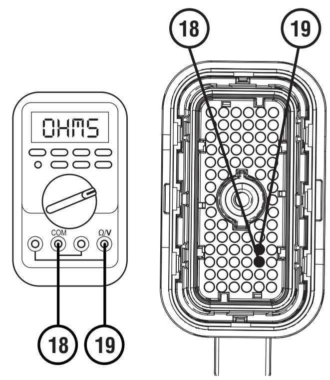
7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.



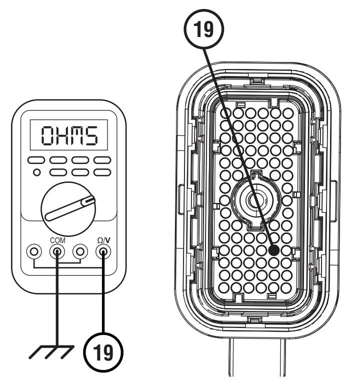
8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, Replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C ***Purpose:*** *Verify proper resistance through 74-Way Transmission Harness and PCSS.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove TCM.
4. Inspect connector for oil, corrosion, and bent or spread pins.
5. Measure resistance between 74-Way Connector Pin 18 and Pin 19. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 19 and ground. Record reading in table.



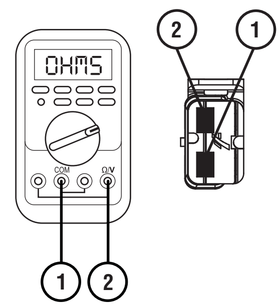
7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step D.**
   - If all readings are in range, go to **Step E.**

Pins	Range	Reading(s)
18 to 19	2.7–6.6 Ohms	
19 to ground	Open Circuit (OL)	

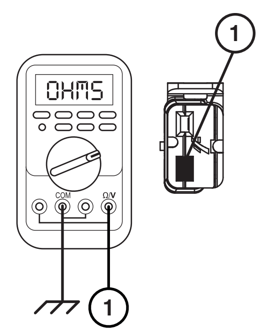
D

Purpose: *Verify proper resistance of PCSS.*

1. Key off.
2. Drain oil.
3. Remove sump pan.
4. Disconnect PCSS connector.
5. Measure resistance between PCSS Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between PCSS Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.

- If any reading is out of range, replace PCSS. Go to **Step V.**
- If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	2.7–6.6 Ohms	
1 to ground	Open Circuit (OL)	

E

Purpose: *Verify fault code status.*

1. Key off.

2. Reinstall TCM

3. Key on with engine off.

4. Connect ServiceRanger.

5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.

- If Fault Code 520 FMI 0, 3, 4, 5, 16, or 18 is Inactive, replace PCSS and 74-Way Transmission Harness. Go to **Step V.**
- If Fault Code 520 FMI 0, 3, 4, 5, 16, or 18 is Active, replace TCM. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.

2. Reconnect all connectors and verify that all components are properly installed.

3. Key on.

4. Clear fault codes using ServiceRanger.

5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.

6. Check for fault codes using ServiceRanger.

- If no codes set and the vehicle operates properly, Test Complete.
- If Fault Code 520 sets Active during the test drive, go to **Step A.**
- If a fault code other than 520 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 535: Clutch Cooling Primary Solenoid

J1939: SA 3 SPN 5949 FMI 0, 1, 3, 4, 5, 19

Overview

The Procision transmission is equipped with pressure control solenoids that regulate the flow of transmission fluid across the clutches. The Clutch Cooling Primary Solenoid (CCPS) is energized by the Transmission Control Module (TCM) to regulate fluid flow across the primary clutch. Fluid is applied to the clutches during micro-slip to lubricate and cool. The CCPS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the CCPS circuit. If a circuit failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: CCPS low side current above command for 1 second.

FMI 1 – Data Valid but Below Normal: CCPS low side current below command for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: CCPS circuit shorted to power for 1 second.

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

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

FMI 19 – Received Network Data in Error: SPI bus error.

Fallback

FMI 0, 1, 3, 4, 5, 19:

- Amber warning lamp on
- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th and 7th gears unavailable
- PTO Mode prohibited
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a CCPS fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

Conditions to Set Fault Code Inactive

FMI 0: CCPS low side current not above command for 10 seconds.

FMI 1: CCPS low side current not below command for 10 seconds.

FMI 3: CCPS circuit not shorted to power for 10 seconds.

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

FMI 5: CCPS circuit not open for 10 seconds.

FMI 19: SPI bus functional.

Possible Causes

FMI 0:

- CCPS
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 1:

- CCPS
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in CCPS circuit
- TCM
  - Internal failure

FMI 3, 4, 5:

- CCPS
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

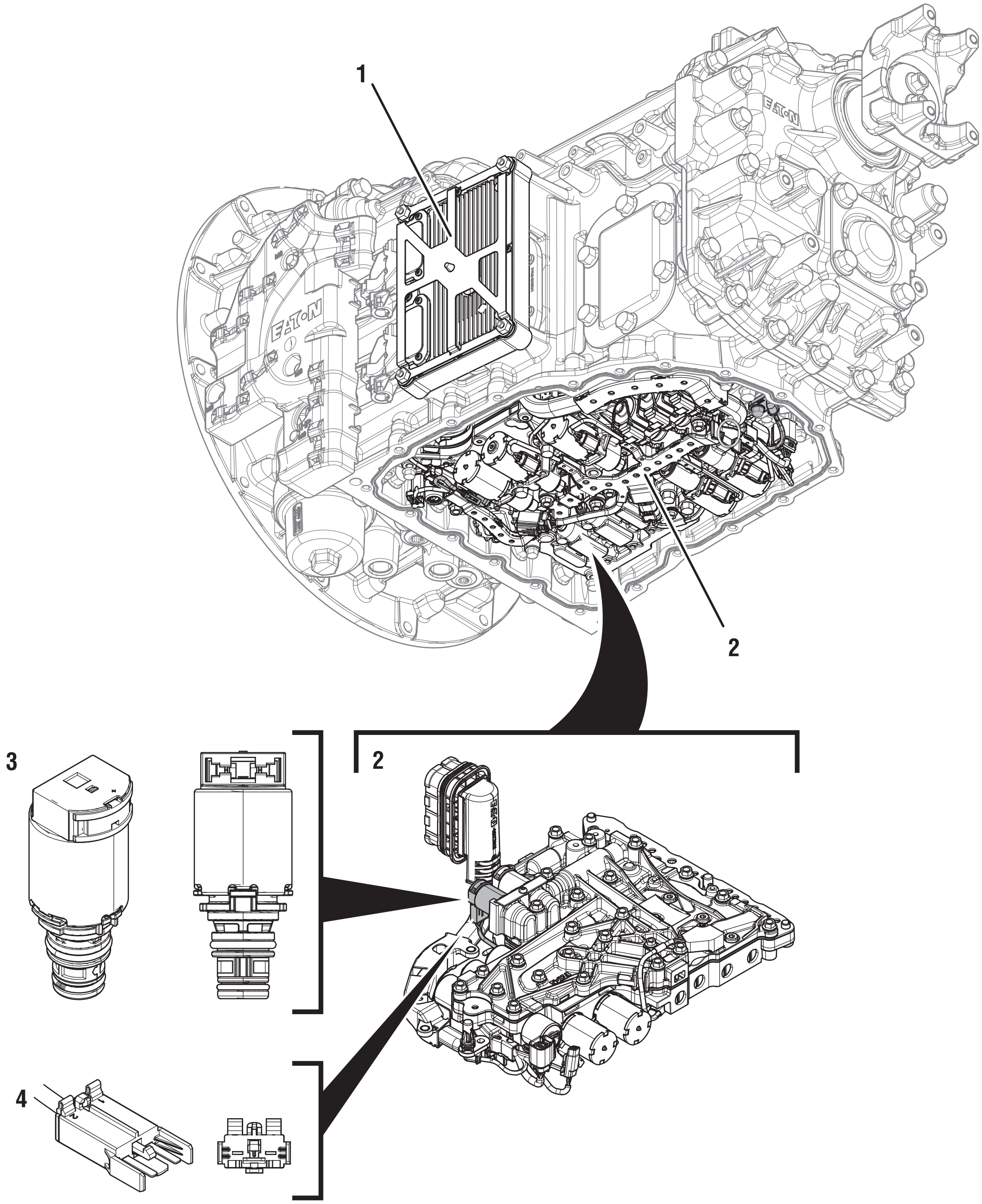
FMI 19:

- TCM
  - Internal failure
  - Software issue

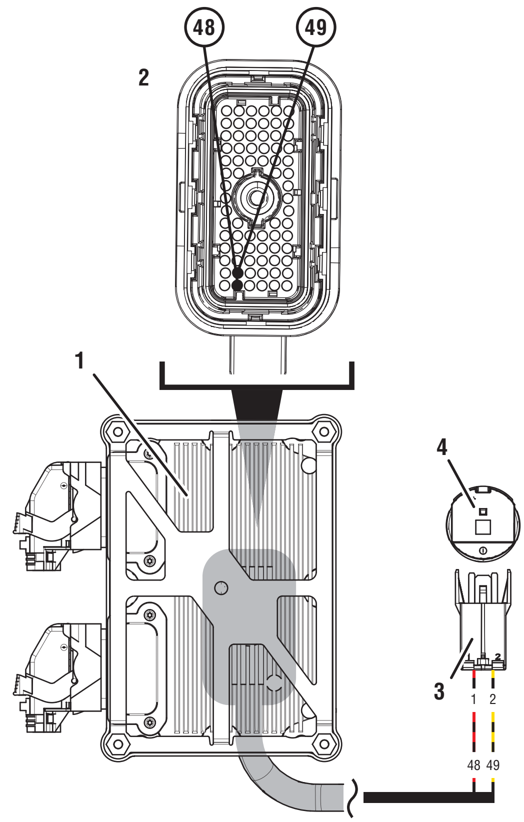
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Clutch Cooling Primary Solenoid (CCPS)
4. 2-Way Clutch Cooling Primary Solenoid (CCPS) Connector



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *2-Way Clutch Cooling Primary Solenoid (CCPS) Connector*
4. *2-Way Clutch Cooling Primary Solenoid (CCPS)*

Fault Code 535 Troubleshooting

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

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

   Note: If Fault Code 535 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 535 FMI 0, 1, 3, 4, or 5 is Active, go to **Step C.**
   - If Fault Code 535 FMI 0, 1, 3, 4, or 5 is Inactive. go to **Step B.**
   - If Fault Code 535 FMI 19 is set, Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

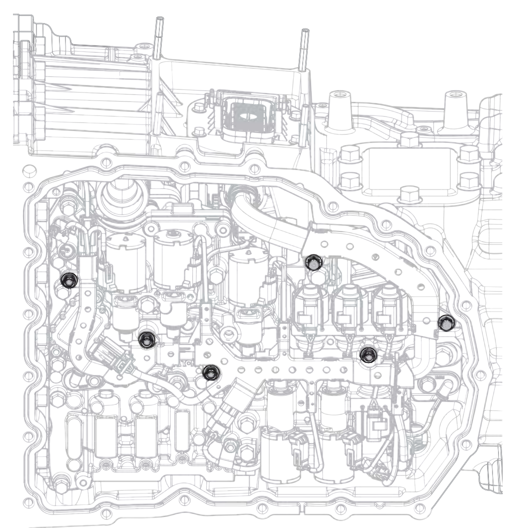
B ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

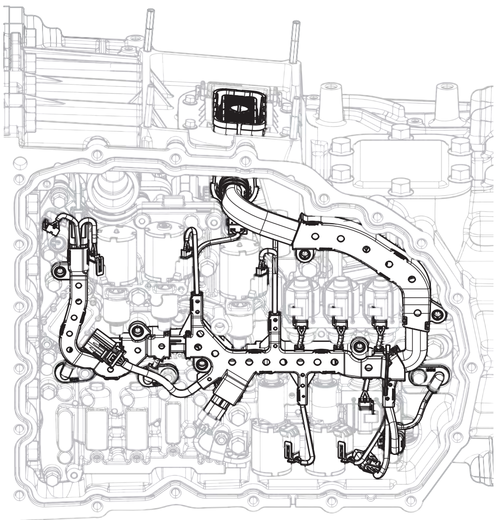
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.



8. Exit PD Mode.

- If any fault code sets Active while wiggling the harness, Replace CCPS and 74-Way Transmission Harness. Go to **Step V.**
- If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify proper resistance through 74-Way Transmission Harness and CCPS.*

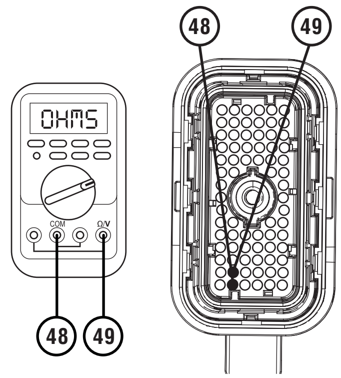
1. Set parking brake and chock wheels.

2. Key off.

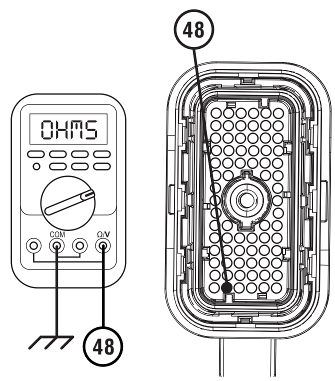
3. Remove TCM.

4. Inspect connector for oil, corrosion, and bent or spread pins.

5. Measure resistance between 74-Way Connector Pin 48 and Pin 49. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 48 and ground. Record reading in table.



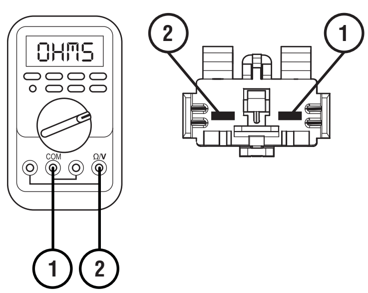
7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step D.**
   - If all readings are in range, go to **Step E.**

Pins	Range	Reading(s)
48 to 49	2.5–7.7 Ohms	
48 to ground	Open Circuit (OL)	

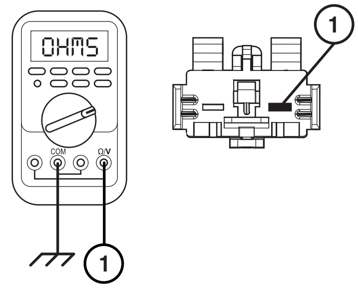
D

Purpose: *Verify proper resistance of CCPS.*

1. Key off.
2. Drain oil.
3. Remove sump pan.
4. Disconnect CCPS connector.
5. Measure resistance between CCPS Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between CCPS Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace CCPS. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	2.5–7.7 Ohms	
1 to ground	Open Circuit (OL)	

E

Purpose: *Verify fault code status.*

1. Key off.
2. Reinstall TCM
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 535 FMI 0, 1, 3, 4, or 5 is Inactive, replace CCPS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 535 FMI 0, 1, 3, 4, or 5 is Active, replace TCM. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 535 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 535 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 545: Clutch Cooling Secondary Solenoid

J1939: SA 3 SPN 5950 FMI 0, 1, 3, 4, 5, 19

Overview

The Procision transmission is equipped with pressure control solenoids that regulate the flow of transmission fluid across the clutches. The Clutch Cooling Secondary Solenoid (CCSS) is energized by the Transmission Control Module (TCM) to regulate fluid flow across the secondary clutch. Fluid is applied to the clutches during micro-slip to lubricate and cool. The CCSS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the CCSS circuit. If a circuit failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: CCSS low side current above command for 1 second.

FMI 1 – Data Valid but Below Normal: CCSS low side current below command for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: CCSS circuit shorted to power for 1 second.

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

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

FMI 19 – Received Network Data in Error: SPI bus error.

Fallback

FMI 0, 1, 3, 4, 5, 19:

- Amber warning lamp on
- Primary Clutch disengaged
- 2nd, 4th, 6th and 7th gears unavailable
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0: CCSS low side current not above command for 10 seconds.

FMI 1: CCSS low side current not below command for 10 seconds.

FMI 3: CCSS circuit not shorted to power for 10 seconds.

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

FMI 5: CCSS circuit not open for 10 seconds.

FMI 19: SPI bus functional.

Possible Causes

FMI 0:

- CCSS
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 1:

- CCSS
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in CCSS circuit
- TCM
  - Internal failure

FMI 3, 4, 5:

- CCSS
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

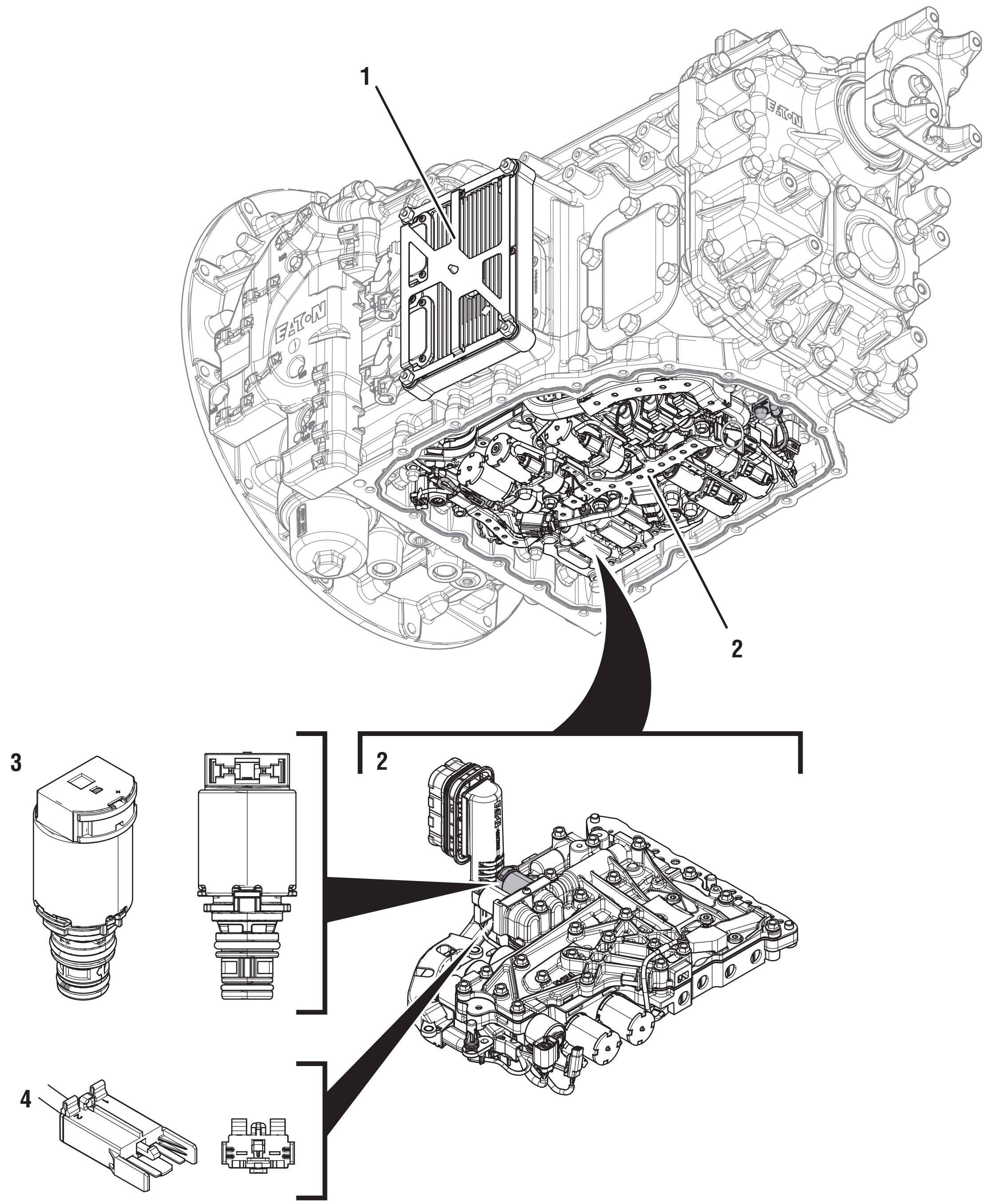
FMI 19:

- TCM
  - Internal failure
  - Software issue

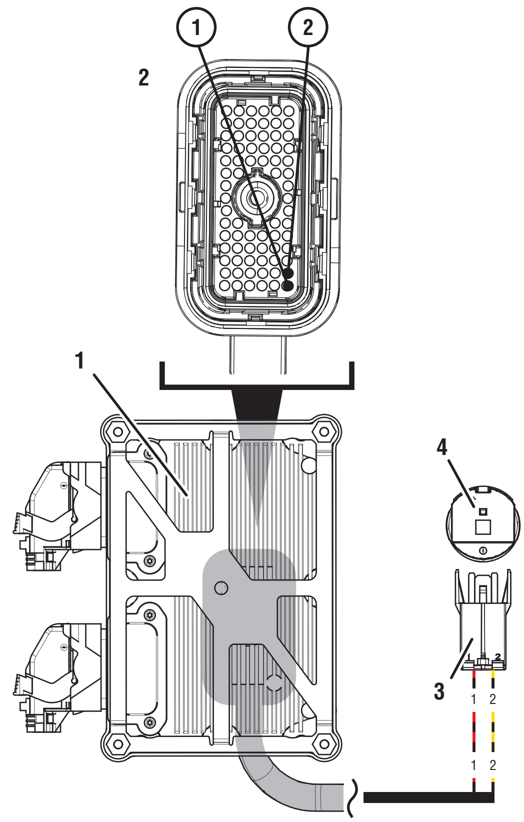
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Clutch Cooling Secondary Solenoid (CCSS)
4. 2-Way Clutch Cooling Secondary Solenoid (CCSS) Connector



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 2-Way Clutch Cooling Secondary Solenoid (CCPS) Connector
4. 2-Way Clutch Cooling Secondary Solenoid (CCPS)

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

Fault Code 545 Troubleshooting

A

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

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

   Note: If Fault Code 545 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 545 FMI 0, 1, 3, 4, or 5 is Active, go to **Step C.**
   - If Fault Code 545 FMI 0, 1, 3, 4, or 5 is Inactive, Go to **Step B.**
   - If Fault Code 545 FMI 19 is set, Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

B

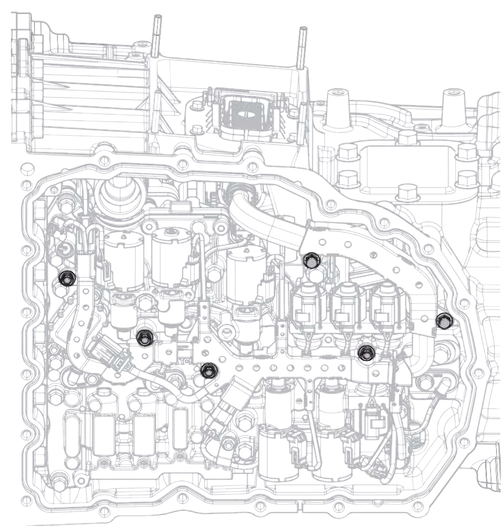
Purpose: *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

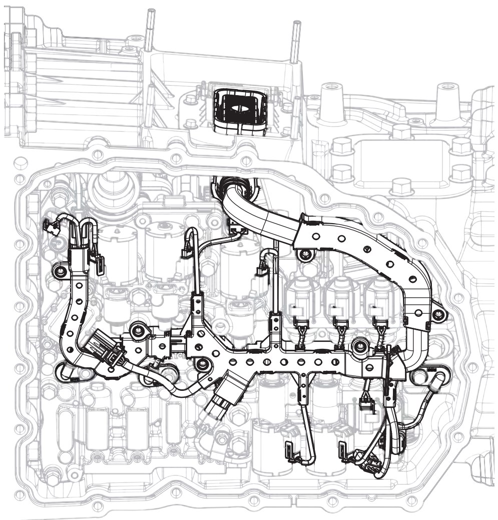
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



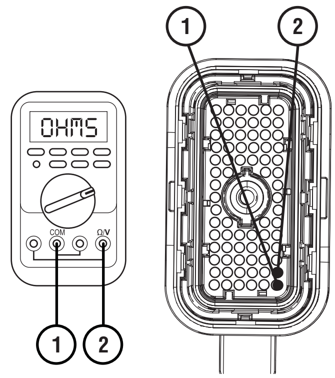
7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.



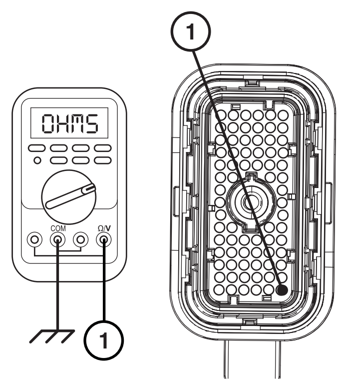
8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, Replace CCSS and 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C ***Purpose:*** *Verify proper resistance through 74-Way Transmission Harness and CCSS.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove TCM.
4. Inspect connector for oil, corrosion, and bent or spread pins.
5. Measure resistance between 74-Way Connector Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 1 and ground. Record reading in table.

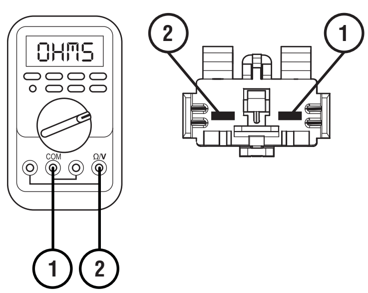


7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step D.**
   - If all readings are in range, go to **Step E.**

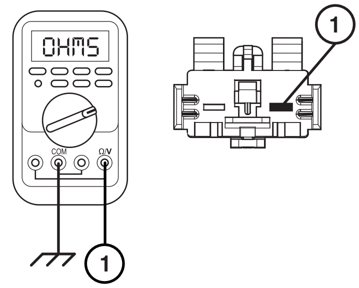
Pins	Range	Reading(s)
1 to 2	2.5–7.7 Ohms	
1 to ground	Open Circuit (OL)	

D ***Purpose:*** *Verify proper resistance of CCSS.*

1. Key off.
2. Drain oil.
3. Remove sump pan.
4. Disconnect CCSS connector.
5. Measure resistance between CCSS Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between CCSS Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace CCSS. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	2.5–7.7 Ohms	
1 to ground	Open Circuit (OL)	

E

Purpose: *Verify fault code status.*

1. Key off.
2. Reinstall TCM
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 545 FMI 0, 1, 3, 4, or 5 is Inactive, replace CCSS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 545 FMI 0, 1, 3, 4, or 5 is Active, replace TCM. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 545 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 545 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 555: Shift Pressure Solenoid 1

J1939: SA 3 SPN 5947 FMI 0, 1, 3, 4, 5, 19

Overview

The Procision transmission is equipped with pressure control solenoids to control direction and engagement of each shift rail. The Shift Pressure Solenoid 1 (SPS1) is energized by the Transmission Control Module (TCM) to regulate hydraulic pressure. This allows shift rail movement to be precisely controlled. The SPS1 is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the SPS1 circuit. If a circuit failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: SPS1 low side current above command for 1 second.

FMI 1 – Data Valid but Below Normal: SPS1 low side current below command for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: SPS1 circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: SPS1 circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: SPS1 circuit open for 1 second.

FMI 19 – Received Network Data in Error: SPI bus error.

Fallback

FMI 0, 1, 3, 4, 5, 19:

- Amber warning lamp on
- Transmission stays in current gear
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0: SPS1 low side current not above command for 10 seconds.

FMI 1: SPS1 low side current not below command for 10 seconds.

FMI 3: SPS1 circuit not shorted to power for 10 seconds.

FMI 4: SPS1 circuit not shorted to ground for 10 seconds.

FMI 5: SPS1 circuit not open for 10 seconds.

FMI 19: SPI bus functional.

Possible Causes

FMI 0:

- SPS1
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 1:

- SPS1
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in SPS1 circuit
- TCM
  - Internal failure

FMI 3, 4, 5:

- SPS1
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

FMI 19:

- TCM
  - Internal failure
  - Software issue

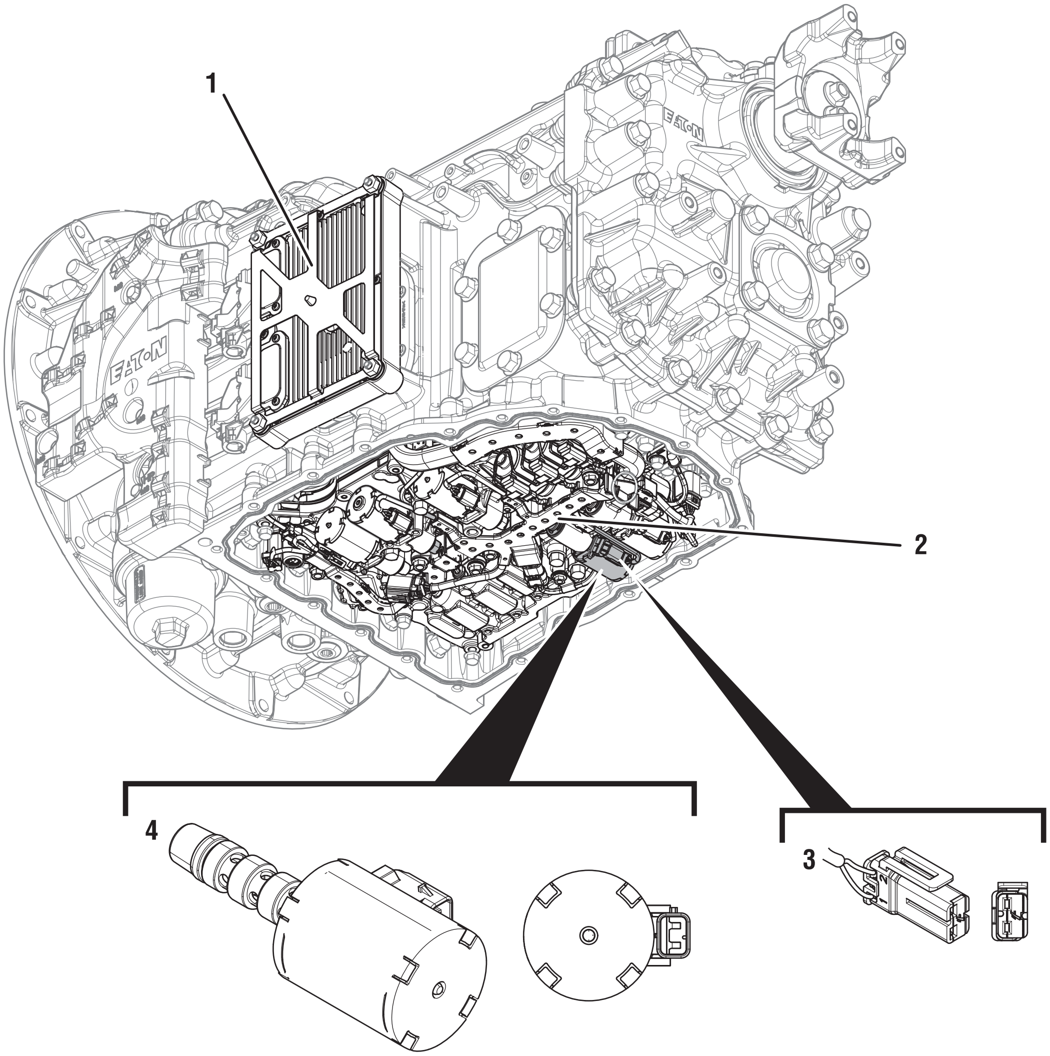
Additional Tools

1. Reference TRSM0990 for all removal, installation, and service procedures

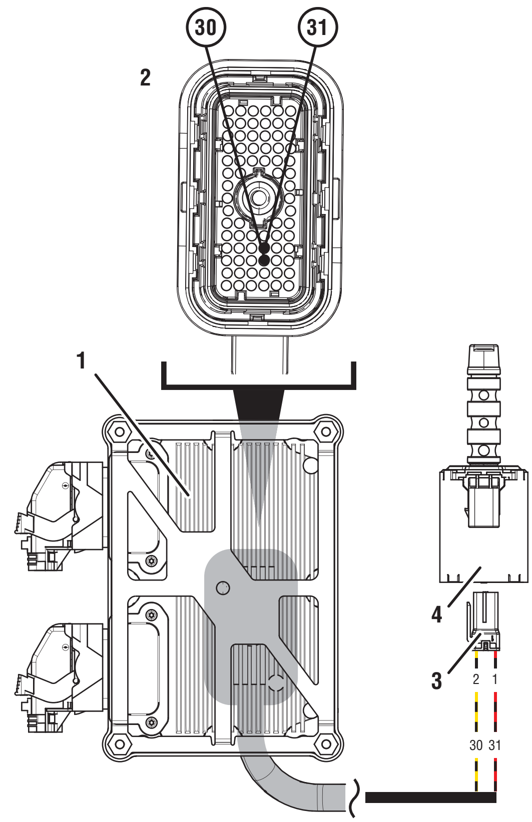
Shift Pressure Solenoid Rail Control

	Rail A		Rail B		Rail C		Rail D	
	Direction	Gear	Direction	Gear	Direction	Gear	Direction	Gear
SPS1	Fore	1 & 2	Fore	5 & 7	Aft	4	Aft	L
SPS2	Aft	R	Aft	3	Fore	6	Fore	UL

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Shift Pressure Solenoid 1 (SPS1) Connector
4. 2-Way Shift Pressure Solenoid 1 (SPS1)



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 2-Way Shift Pressure Solenoid 1 (SPS1) Connector
4. 2-Way Shift Pressure Solenoid 1 (SPS1)

Fault Code 555 Troubleshooting

A

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

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

   Note: If Fault Code 555 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 555 FMI 0, 1, 3, 4, or 5 is Active, go to **Step C.**
   - If Fault Code 555 FMI 0, 1, 3, 4, or 5 is Inactive. go to **Step B.**
   - If Fault Code 555 FMI 19 is set, Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

B

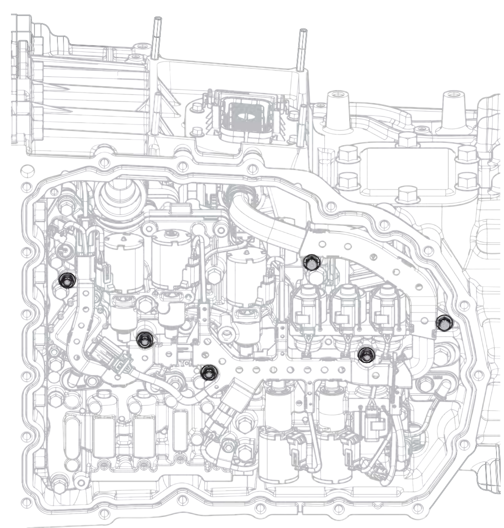
Purpose: *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

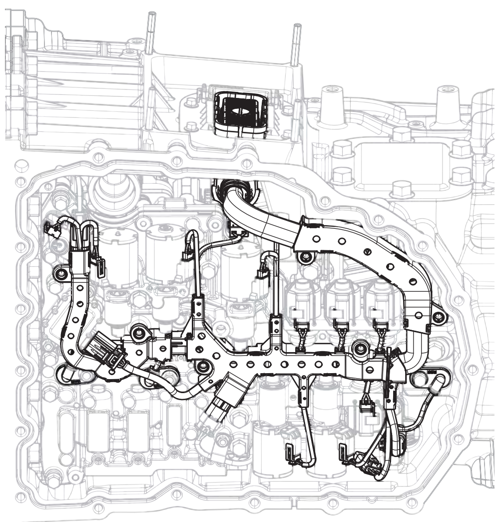
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.

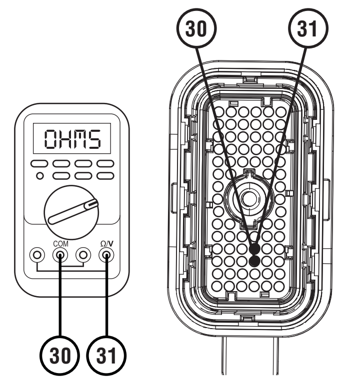


8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, Replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

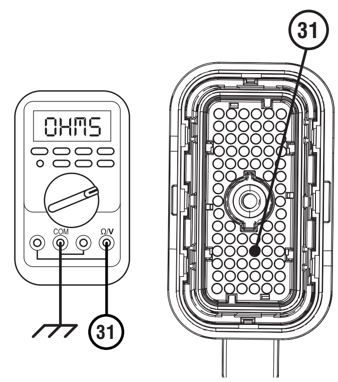
C

Purpose: *Verify proper resistance through 74-Way Transmission Harness and SPS1.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove TCM.
4. Inspect connector for oil, corrosion, and bent or spread pins.
5. Measure resistance between 74-Way Connector Pin 30 and Pin 31. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 31 and ground. Record reading in table.



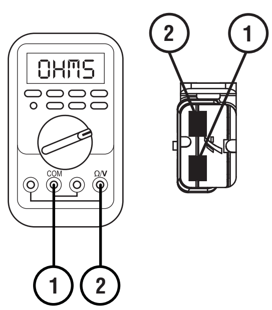
7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step D.**
   - If all readings are in range, go to **Step E.**

Pins	Range	Reading(s)
30 to 31	2.7–6.6 Ohms	
31 to ground	Open Circuit (OL)	

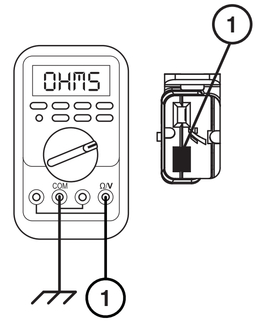
D

Purpose: *Verify proper resistance of SPS1.*

1. Key off.
2. Drain oil.
3. Remove sump pan.
4. Disconnect SPS1 connector.
5. Measure resistance between SPS1 Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between SPS1 Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace SPS1. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	2.7–6.6 Ohms	
1 to ground	Open Circuit (OL)	

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

1. Key off.
2. Reinstall TCM
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 555 FMI 0, 1, 3, 4, or 5 is Inactive, replace SPS1 and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 555 FMI 0, 1, 3, 4, or 5 is Active, replace TCM. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 555 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 555 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 565: Shift Pressure Solenoid 2

J1939: SA 3 SPN 5948 FMI 0, 1, 3, 4, 5, 19

Overview

The Procision transmission is equipped with pressure control solenoids to control direction and engagement of each shift rail. The Shift Pressure Solenoid 2 (SPS2) is energized by the Transmission Control Module (TCM) to regulate hydraulic pressure. This allows shift rail movement to be precisely controlled. The SPS2 is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the SPS2 circuit. If a circuit failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: SPS2 low side current above command for 1 second.

FMI 1 – Data Valid but Below Normal: SPS2 low side current below command for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: SPS2 circuit shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: SPS2 circuit shorted to ground for 1 second.

FMI 5 – Current Below Normal or Open Circuit: SPS2 circuit open for 1 second.

FMI 19 – Received Network Data in Error: SPI bus error.

Fallback

FMI 0, 1, 3, 4, 5, 19:

- Amber warning lamp on
- Transmission stays in current gear
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0: SPS2 low side current not above command for 10 seconds.

FMI 1: SPS2 low side current not below command for 10 seconds.

FMI 3: SPS2 circuit not shorted to power for 10 seconds.

FMI 4: SPS2 circuit not shorted to ground for 10 seconds.

FMI 5: SPS2 circuit not open for 10 seconds.

FMI 19: SPI bus functional.

Possible Causes

FMI 0:

- SPS2
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 1:

- SPS2
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in SPS2 circuit
- TCM
  - Internal failure

FMI 3, 4, 5:

- SPS2
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

FMI 19:

- TCM
  - Internal failure
  - Software issue

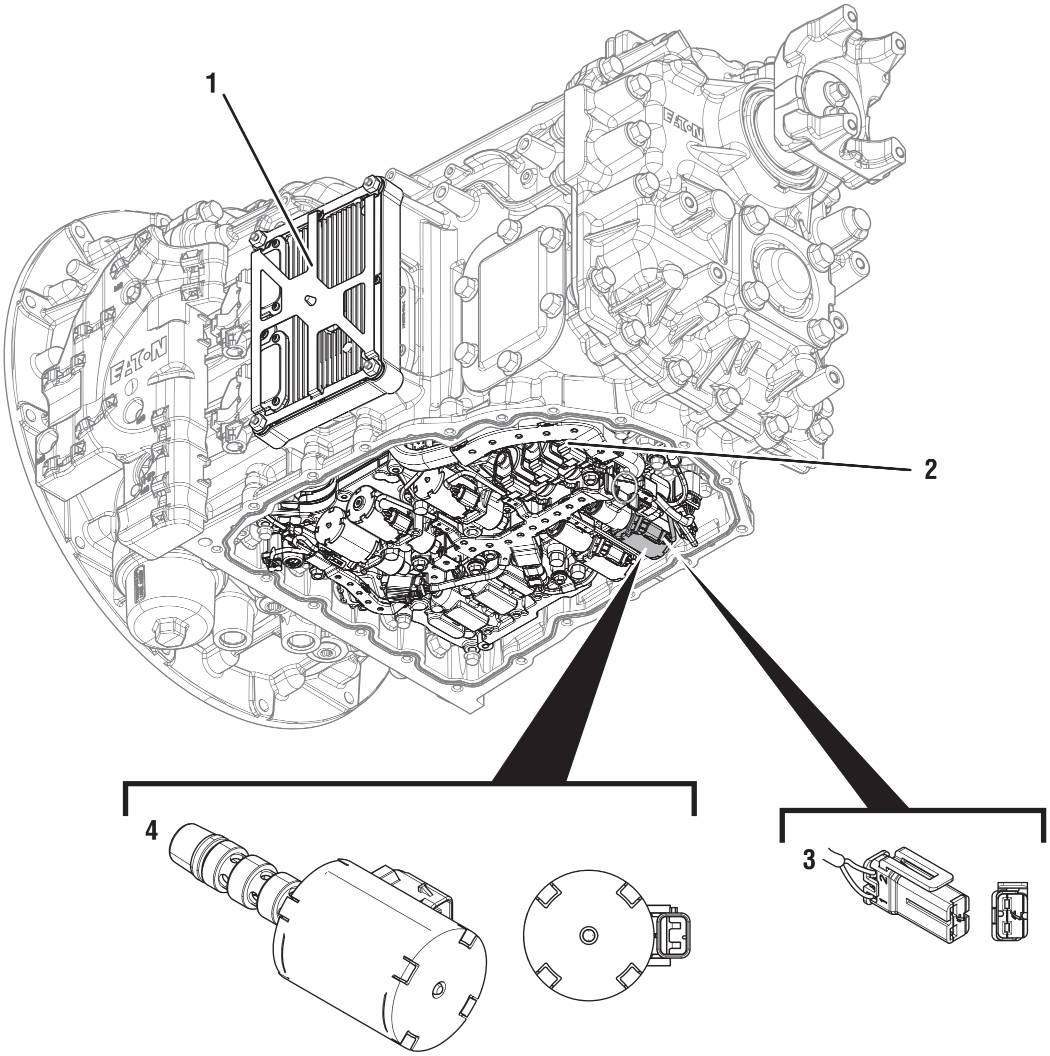
Additional Tools

1. Reference TRSM0990 for all removal, installation, and service procedures

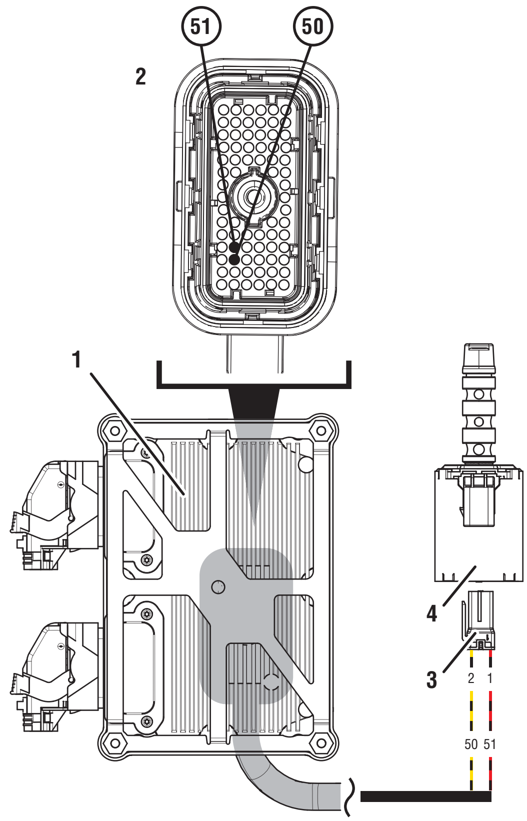
Shift Pressure Solenoid Rail Control

	Rail A		Rail B		Rail C		Rail D	
	Direction	Gear	Direction	Gear	Direction	Gear	Direction	Gear
SPS1	Fore	1 & 2	Fore	5 & 7	Aft	4	Aft	L
SPS2	Aft	R	Aft	3	Fore	6	Fore	UL

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Shift Pressure Solenoid 2 (SPS2) Connector
4. 2-Way Shift Pressure Solenoid 2 (SPS2)



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 2-Way Shift Pressure Solenoid 2 (SPS2) Connector
4. 2-Way Shift Pressure Solenoid 2 (SPS2)

Fault Code 565 Troubleshooting

A

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

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

   Note: If Fault Code 565 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 565 FMI 0, 1, 3, 4, or 5 is Active, go to **Step C.**
   - If Fault Code 565 FMI 0, 1, 3, 4, or 5 is Inactive. go to **Step B.**
   - If Fault Code 565 FMI 19 is set, Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

B

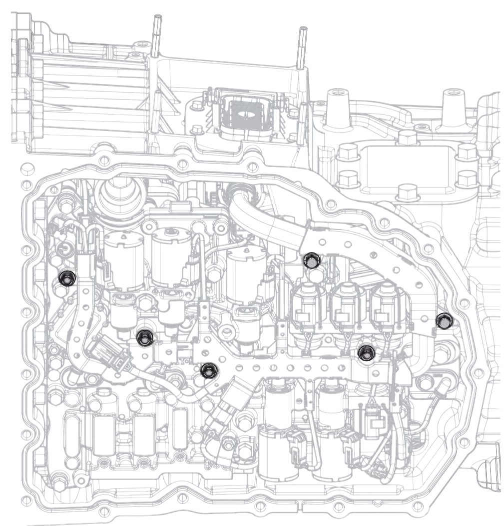
Purpose: *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

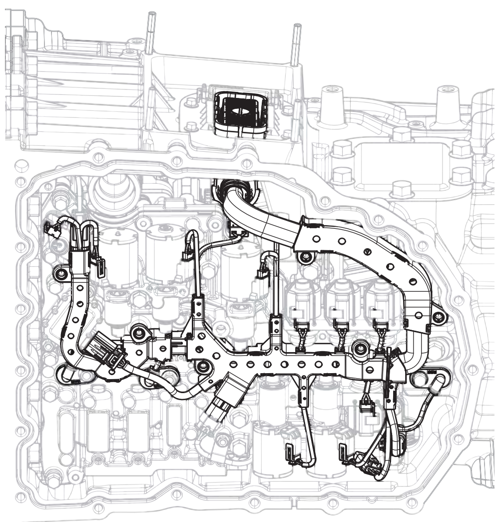
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



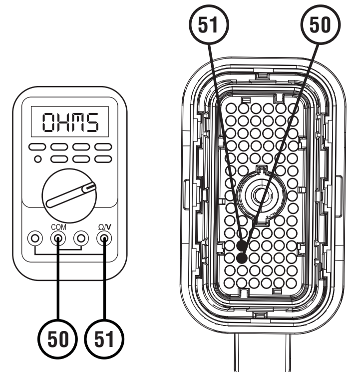
7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.



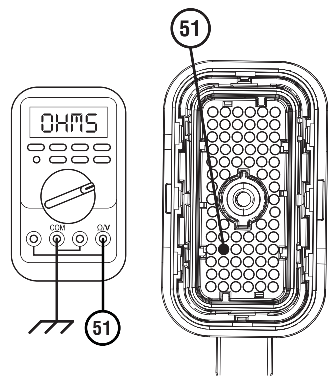
8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, Replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C ***Purpose:*** *Verify proper resistance through 74-Way Transmission Harness and SPS2.*

1. Set parking brake and chock wheels.
2. Key off.
3. Remove TCM.
4. Inspect connector for oil, corrosion, and bent or spread pins.
5. Measure resistance between 74-Way Connector Pin 50 and Pin 51. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 51 and ground. Record reading in table.



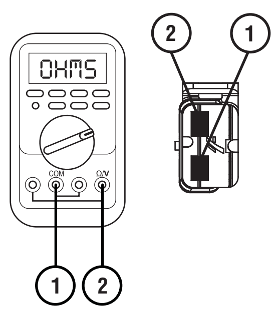
7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step D.**
   - If all readings are in range, go to **Step E.**

Pins	Range	Reading(s)
50 to 51	2.7–6.6 Ohms	
51 to ground	Open Circuit (OL)	

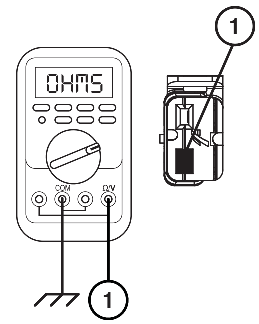
D

Purpose: *Verify proper resistance of SPS2.*

1. Key off.
2. Drain oil.
3. Remove sump pan.
4. Disconnect SPS2 connector.
5. Measure resistance between SPS2 Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between SPS2 Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace SPS2. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	2.7–6.6 Ohms	
1 to ground	Open Circuit (OL)	

E

Purpose: *Verify fault code status.*

1. Key off.
2. Reinstall TCM
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 565 FMI 0, 1, 3, 4, or 5 is Inactive, replace SPS2 and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 565 FMI 0, 1, 3, 4, or 5 is Active, replace TCM. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 565 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 565 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 575: Rail A Valve Solenoid

J1939: SA 3 SPN 5951 FMI 0, 1, 3, 4, 5, 7, 12, 14, 15, 16, 17, 18, 19, 20, 21, 31

Overview

The Procision transmission is equipped with valve control solenoids to direct hydraulic flow. The Rail A Valve Solenoid (RAVS) is energized by the Transmission Control Module (TCM) to allow pilot pressure to open the Rail A Valve (RAV). This results in motion of Rail A to engage 1st/2nd or Reverse. The RAVS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the RAVS circuit and shift rail A position. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: RAVS low side current above command for 1 second.

FMI 1 – Data Valid but Below Normal: RAVS low side current below command for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RAVS circuit shorted to power for 1 second.

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

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

FMI 7 – Mechanical System Not Responding: No movement in aft direction during Rail A calibration.

FMI 12 – Bad Intelligent Device: Inappropriate Rail (A, B, C, or D) movement commanded resulting in two gear engagement.

FMI 14 – Special Instructions: Rail A movement toward 1st/2nd while commanding Reverse.

FMI 15 – Data Valid but Above Normal: Uncommanded Rail A movement from Neutral toward 1st/2nd while commanding other rail.

FMI 16 – Data Valid but Above Normal: Uncommanded Rail A movement from 1st/2nd toward Neutral while commanding other rail.

FMI 17 – Data Valid but Below Normal: Uncommanded Rail A movement from Neutral toward Reverse while commanding other rail.

FMI 18 – Data Valid but Below Normal: Uncommanded Rail A movement from Reverse toward Neutral while commanding other rail.

FMI 19 – Received Network Data in Error: SPI bus error.

FMI 20 – Data Drifted High: Movement in aft direction insufficient during Rail A calibration.

FMI 21 – Data Drifted Low: Movement in fore direction insufficient during Rail A calibration.

FMI 31 – Condition Exists: Rail A movement toward Reverse while commanding 1st/2nd.

Fallback

FMI 0:

- Amber warning lamp on
- No degraded performance

FMI 1, 3, 5, 12, 14, 15, 16, 17, 18, 19, 31:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

FMI 4:

- Amber warning lamp on
- No degraded performance

Note: If high side is shorted to ground:

- Only engaged gears allowed
- PTO Mode prohibited
- Amber warning lamp on
- No degraded performance

FMI 7, 20, 21:

- Amber warning lamp on
- No degraded performance

Note: If Rail A Secondary Position is not available:

- Transmission will stay in current gear
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0: RAVS low side current not above command for 10 seconds.

FMI 1: RAVS low side current not below command for 10 seconds.

FMI 3: RAVS circuit not shorted to power for 10 seconds.

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

FMI 5: RAVS circuit not open for 10 seconds.

FMI 7, 20, 21: Successful rail calibration performed.

FMI 12: Key cycle.

FMI 14, 15, 16, 17, 18, 31: Key cycle and proper rail movement.

FMI 19: SPI bus functional.

Possible Causes

FMI 0:

- RAVS
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 1:

- RAVS
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in RAVS circuit
- TCM
  - Internal failure

FMI 3, 4, 5:

- RAVS
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

FMI 7:

- Rail A Piston
  - Seal damaged
- Rail A Valve Solenoid (RAVS)
  - Stuck closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail A Valve (RAV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- SPS1
  - Stuck open
- SPS2
  - Stuck closed

FMI 12, 19:

- TCM
  - Internal failure
  - Software issue

FMI 14:

- SPS1
  - Stuck open

FMI 15, 16, 17, 18:

- RAVS
  - Stuck open
- RAV
  - Stuck open

FMI 20, 21:

- Rail A Piston
  - Seal damaged
- Rail A Rod Seal
  - Seal damaged
- 1st/2nd and Reverse Gears
  - Clutching teeth damaged
- Rail A Fork
  - Fork bent
- Low hydraulic pressure

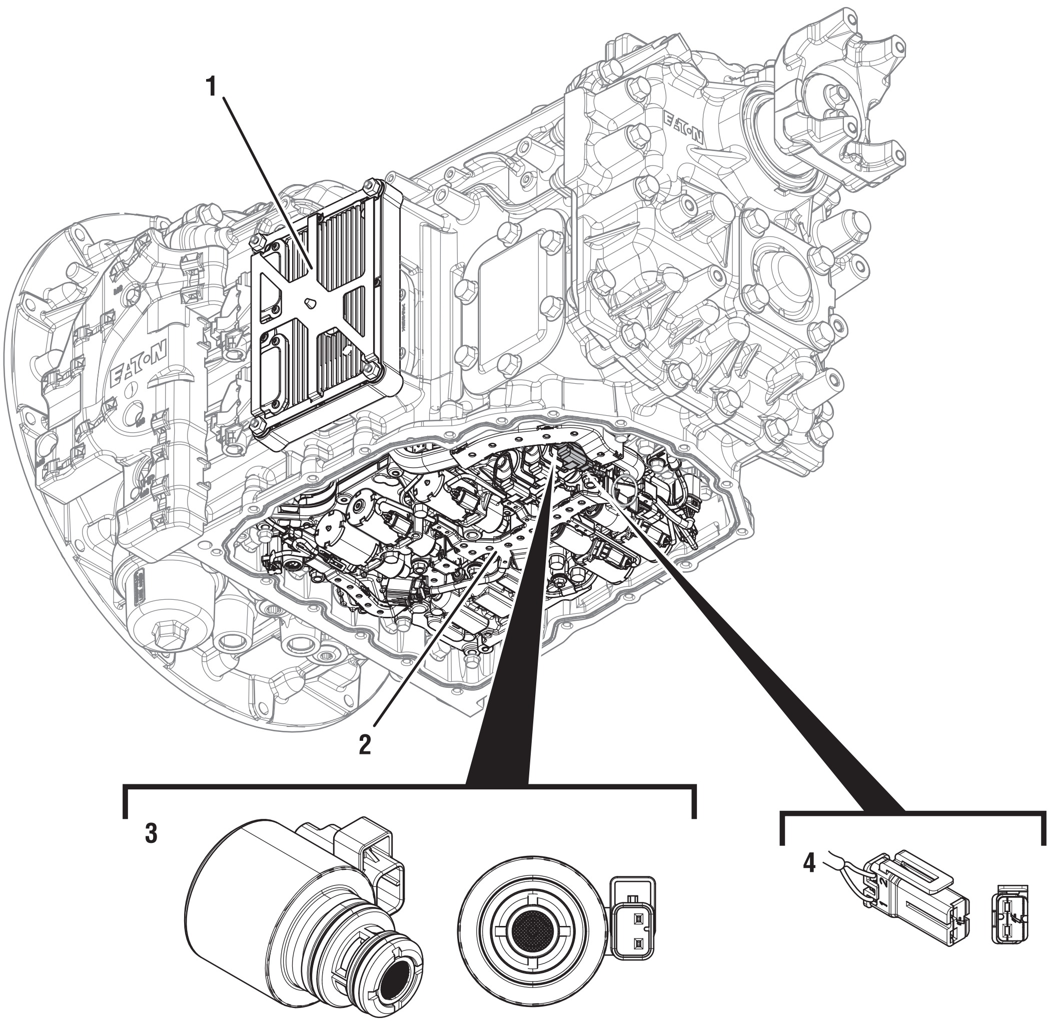
FMI 31:

- SPS2
  - Stuck open

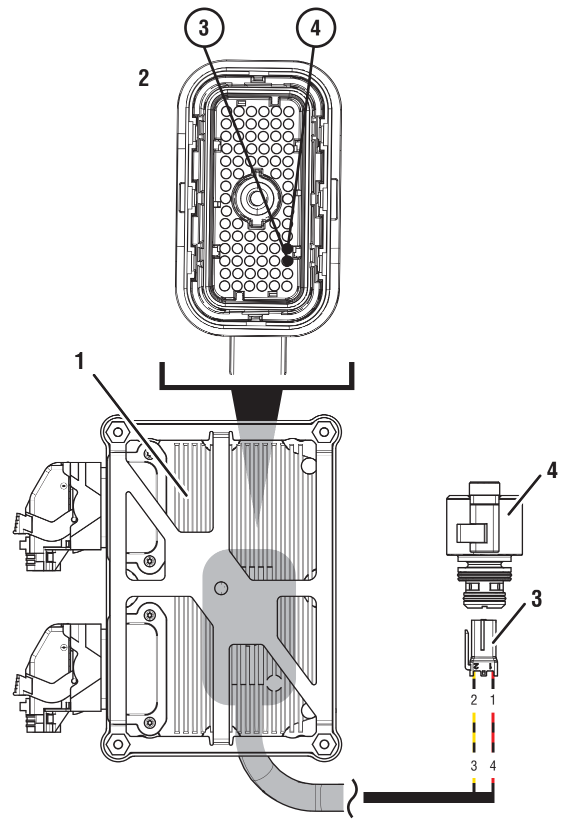
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Rail A Valve Solenoid (RAVS)
4. 2-Way Rail A Valve Solenoid (RAVS) Connector



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 2-Way Rail A Valve Solenoid (RAVS) Connector
4. 2-Way Rail A Valve Solenoid (RAVS)

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

Fault Code 575 Troubleshooting

A

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

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

   Note: If Fault Code 575 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 575 FMI 0, 1, 3, 4, or 5 is Active, go to **Step C.**
   - If Fault Code 575 FMI 0, 1, 3, 4, or 5 is Inactive. go to **Step B.**
   - If Fault Code 575 FMI 7, 20, or 21 is set, go to **Step K.**
   - If Fault Code 575 FMI 12 or 19 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 575 FMI 14, 15, 16, 17, 18 or 31 is set, go to **Step F.**

B

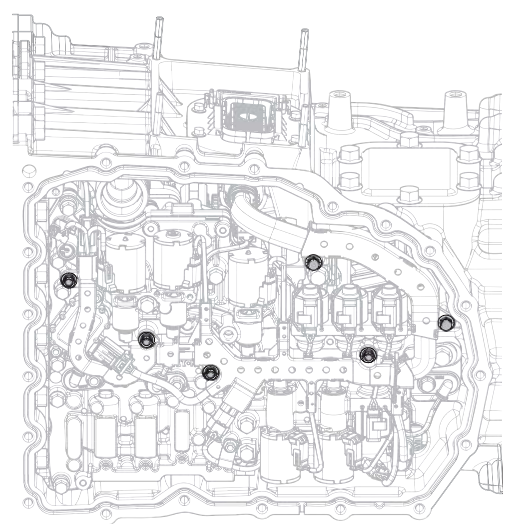
Purpose: *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan and filter.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

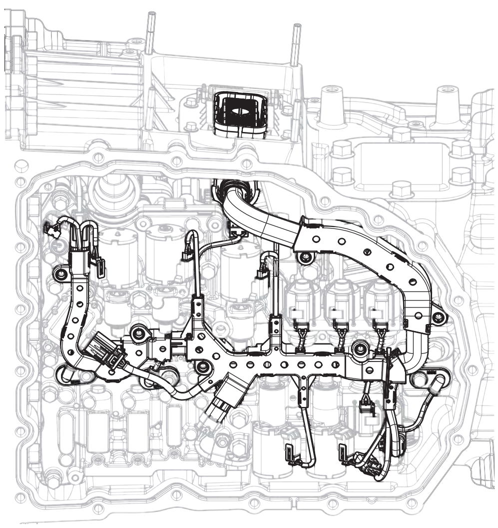
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.

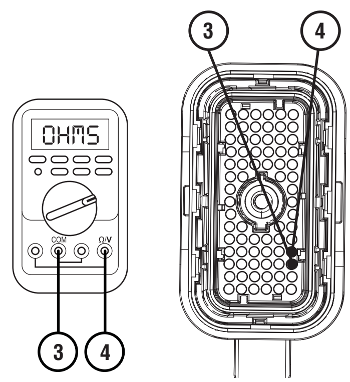


8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

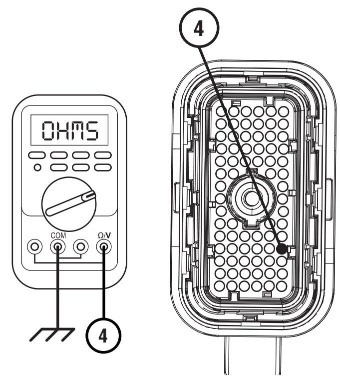
C

Purpose: *Verify proper resistance through 74-Way Transmission Harness and RAVS.*

1. Set parking brake and chock wheels
2. Key off.
3. Remove TCM.
4. Inspect for oil, corrosion, bent or spread pins.
5. Measure resistance between 74-Way Connector Pin 3 and Pin 4. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 4 and ground. Record reading in table.



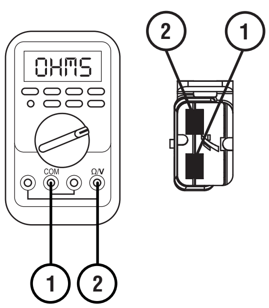
7. Compare reading(s) in table.

- If any reading is out of range, go to **Step D.**
- If all readings are in range, go to **Step E.**

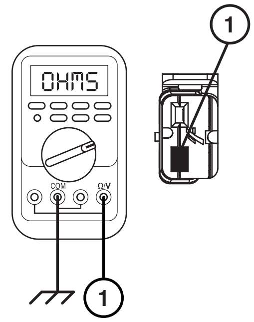
Pins	Range	Reading(s)
3 to 4	1.6–4.9 Ohms	
4 to ground	Open Circuit (OL)	

D ***Purpose:*** *Verify resistance of RAVS.*

1. Key off.
2. Drain oil.
3. Remove sump pan and filter.
4. Disconnect RAVS connector.
5. Measure resistance between RAVS Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between RAVS Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace RAVS. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	1.6–4.9 Ohms	
1 to ground	Open Circuit (OL)	

E

Purpose: *Verify fault code status.*

1. Key off.
2. Reinstall TCM.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 575 FMI 0, 1, 3, 4, or 5 is Inactive, replace RAVS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 575 FMI 0, 1, 3, 4, or 5 is Active, replace TCM. Go to **Step V.**

F

Purpose: *Perform Service Bay Initiated Test.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and Service Bay Initiated Tests.
4. Select Shift Rail Actuation
5. Retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger.
6. Select Send to Eaton.
   - go to **Step G.**

G

Purpose: *Verify condition of transmission oil.*

1. Drain oil.
2. Remove sump pan and filter.
3. Inspect transmission oil for contamination and debris.
   - If contamination or debris is found, contact Eaton at (800) 826-4357 for further diagnostic instructions.
   - If FMI 14 is set, go to **Step H.**
   - If FMI 31 is set, go to **Step I.**
   - If FMI 15, 16, 17, or 18 is set, go to **Step J.**

H

Purpose: *Verify condition of SPS1.*

1. Remove TCM.
2. Remove ACM.
3. Remove SPS1.
4. Inspect solenoid valve and bore for contamination.
   - If solenoid valve or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace SPS1. Go to **Step V.**

I

Purpose: *Verify condition of SPS2.*

1. Remove TCM.
2. Remove ACM.
3. Remove SPS2.
4. Inspect solenoid valve and bore for contamination.
   - If solenoid valve or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace SPS2. Go to **Step V.**

J

Purpose: *Verify condition of RAVS.*

1. Remove RAVS.
2. Inspect RAVS and bore for contamination.
   - If RAVS or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace RAVS and ACM. Go to **Step V.**

K

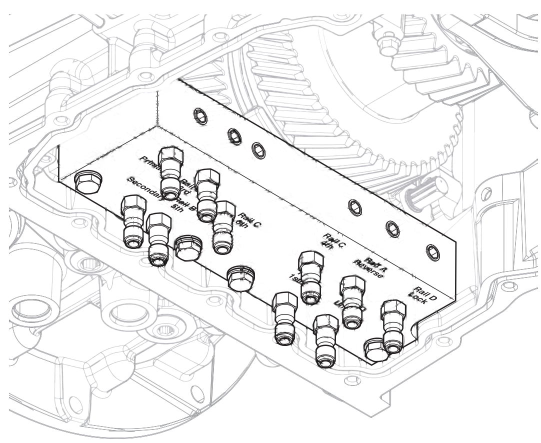
Purpose: *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail A fault codes set Active, go to **Step L.**

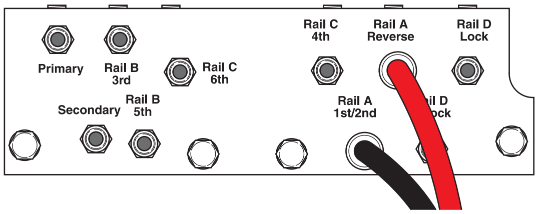
L

Purpose: *Actuate Rail A with Diagnostic Manifold tool.*

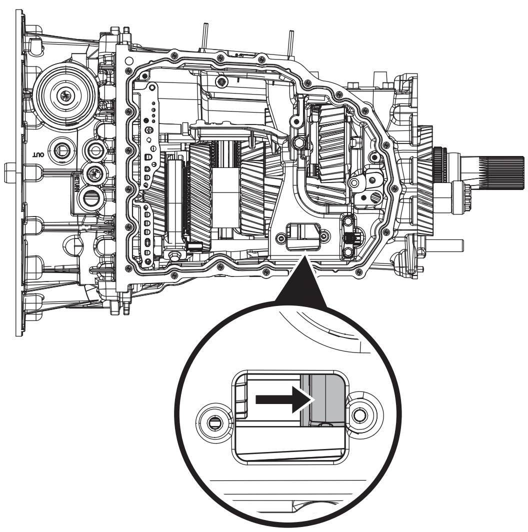
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



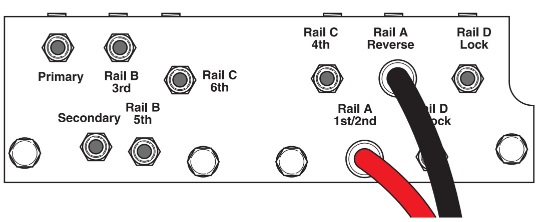
6. Apply air to Rail A Reverse port.



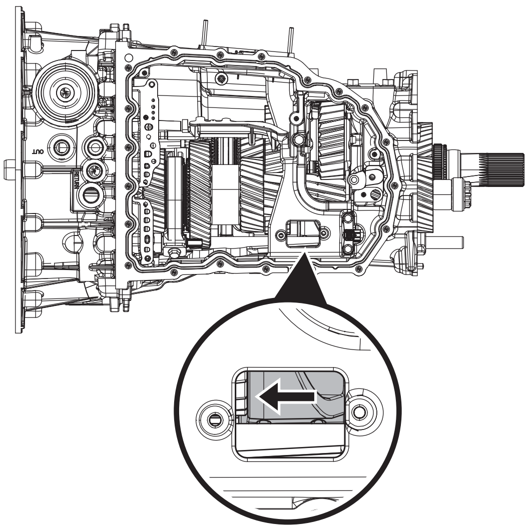
7. Watch for Rail A fork to fully engage synchronizer into Reverse gear.



8. Apply air to Rail A 1st/2nd port.



9. Watch for Rail A fork to fully engage synchronizer into 1st/2nd gear.



- If fork does not move or does not fully engage Reverse or 1st/2nd gear, go to **Step M.**
- If fork fully engages Reverse and 1st/2nd gear, go to **Step N.**

M

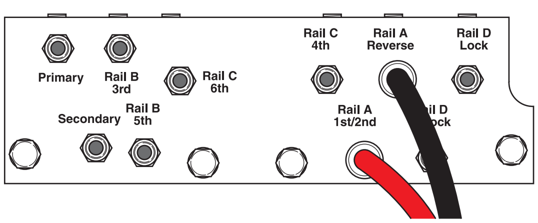
Purpose: *Verify mechanical condition of 1st/2nd, Reverse synchronizer and detent.*

1. Use pry bar to engage Rail A fork into Reverse and 1st/2nd gears.
   - If fork does not move or does not fully engage Reverse or 1st/2nd gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 1st/2nd, Reverse synchronizer or detent. Go to **Step V.**
   - If fork fully engages Reverse and 1st/2nd gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**

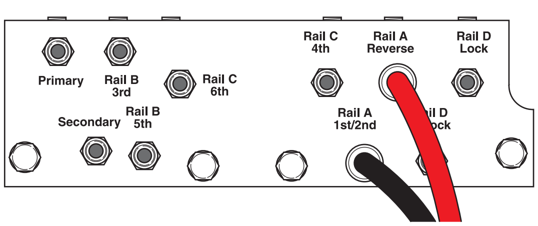
N

Purpose: *Verify condition of Rail A Piston and Rod Seals.*

1. Apply air to Rail A 1st/2nd port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail A Reverse port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**
   - If all result(s) are in range, replace RAVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail A 1st/2nd Port	0 PSI	
Rail A Reverse Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 575 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 575 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 595: Rail B Valve Solenoid

J1939: SA 3 SPN 5952 FMI 0, 1, 3, 4, 5, 7, 12, 14, 15, 16, 17, 18, 19, 20, 21, 31

Overview

The Procision transmission is equipped with valve control solenoids to direct hydraulic flow. The Rail B Valve Solenoid (RBVS) is energized by the Transmission Control Module (TCM) to allow pilot pressure to open the Rail B Valve (RBV). This results in motion of Rail B to engage 5th/7th or 3rd. The RBVS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the RBVS circuit and shift rail B position. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: RBVS low side current above command for 1 second.

FMI 1 – Data Valid but Below Normal: RBVS low side current below command for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RBVS circuit shorted to power for 1 second.

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

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

FMI 7 – Mechanical System Not Responding: No movement in aft direction during Rail B calibration.

FMI 12 – Bad Intelligent Device: Inappropriate Rail (A, B,C, or D) movement commanded with clutch closed or closing.

FMI 14 – Special Instructions: Rail B movement toward 5th/7th while commanding 3rd.

FMI 15 – Data Valid But Above Normal: Uncommanded Rail B movement from Neutral toward 5th/7th while commanding other rail.

FMI 16 – Data Valid But Above Normal: Uncommanded Rail B movement from 5th/7th toward Neutral while commanding other rail.

FMI 17 – Data Valid But Below Normal: Uncommanded Rail B movement from Neutral toward 3rd while commanding other rail.

FMI 18 – Data Valid But Below Normal: Uncommanded Rail B movement from 3rd toward Neutral while commanding other rail.

FMI 19 – Received Network Data in Error: SPI bus error.

FMI 20 – Data Drifted High: Movement in aft direction insufficient during Rail B calibration.

FMI 21 – Data Drifted Low: Movement in fore direction insufficient during Rail B calibration.

FMI 31 – Condition Exists: Rail B movement toward 3rd while commanding 5th/7th.

Fallback

FMI 0:

- Amber warning lamp on
- No degraded performance

FMI 1, 3, 5, 7, 14, 19, 20, 21, 31:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

Note: If Rail B is disengaged:

- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th, and 7th gears unavailable
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a RBVS fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

FMI 4:

- Amber warning lamp on
- No degraded performance

Note: If high side is shorted to ground:

- Only engaged gears allowed
- PTO Mode prohibited

FMI 12:

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

FMI 15, 16, 17, 18:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode Prohibited

Conditions to Set Fault Code Inactive

FMI 0: RBVS low side current not above command for 10 seconds.

FMI 1: RBVS low side current not below command for 10 seconds.

FMI 3: RBVS circuit not shorted to power for 10 seconds.

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

FMI 5: RBVS circuit not open for 10 seconds.

FMI 7, 20, 21: Successful rail calibration performed.

FMI 12: Key cycle.

FMI 14, 15, 16, 17, 18, 31: Key cycle and proper rail movement.

FMI 19: SPI bus functional.

Possible Causes

FMI 0:

- RBVS
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 1:

- RBVS
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in RBVS circuit
- TCM
  - Internal failure

FMI 3, 4, 5:

- RBVS
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

FMI 7:

- Rail B Piston
  - Seal damaged
- Rail B Valve Solenoid (RBVS)
  - Stuck closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail B Valve (RBV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- SPS1
  - Stuck open
- SPS2
  - Stuck closed

FMI 12, 19:

- TCM
  - Internal failure
  - Software issue

FMI 14:

- SPS1
  - Stuck open

FMI 15, 16, 17, 18:

- RBVS
  - Stuck open
- RBV
  - Stuck open

FMI 20, 21:

- Rail B Piston
  - Seal damaged
- Rail B Rod Seal
  - Seal damaged
- 5th/7th and 3rd Gears
  - Clutching teeth damaged
- Rail B Fork
  - Fork bent
- Low hydraulic pressure

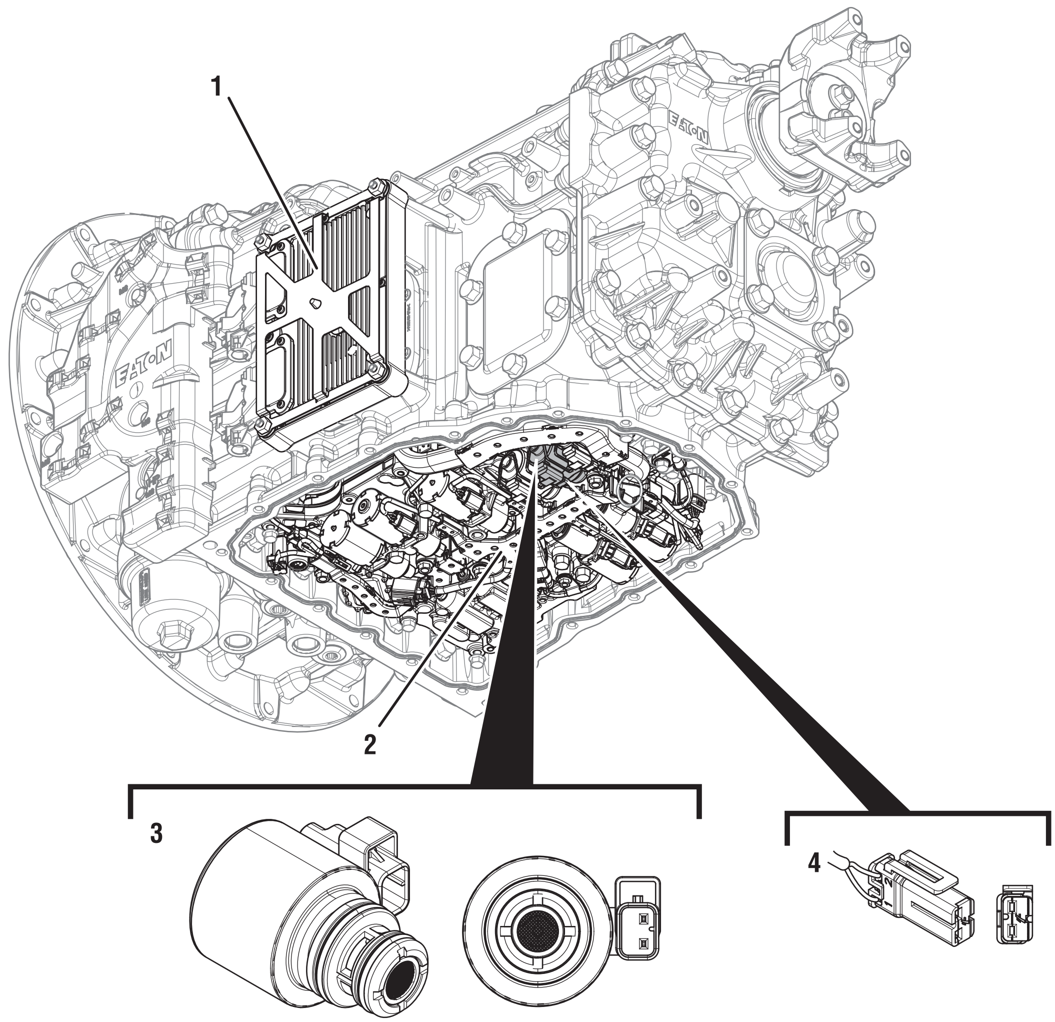
FMI 31:

- SPS2
  - Stuck open

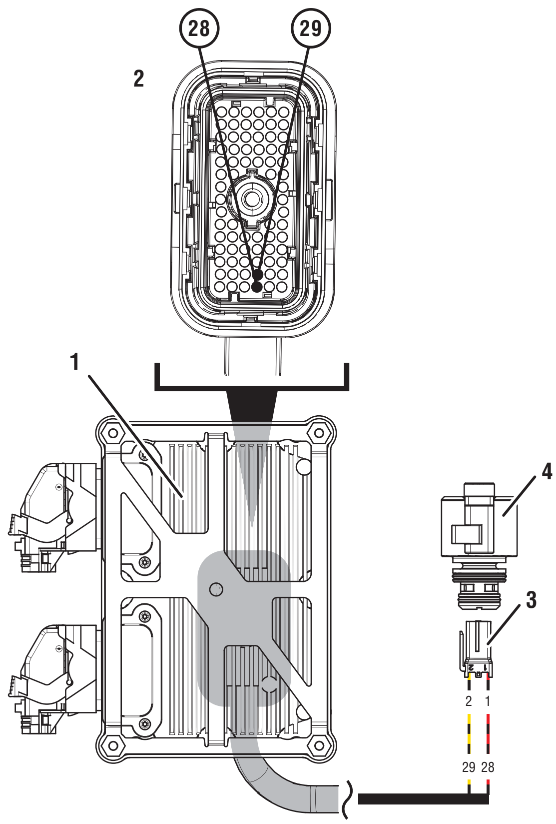
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Component Identification



1. *Transmission Control Module (TCM)*
2. *Actuation Control Manifold (ACM)*
3. *2-Way Rail B Valve Solenoid (RBVS)*
4. *2-Way Rail B Valve Solenoid (RBVS) Connector*



1. *Transmission Control Module (TCM)*
2. *74-Way Transmission Harness Connector*
3. *2-Way Rail B Valve Solenoid (RBVS) Connector*
4. *2-Way Rail B Valve Solenoid (RBVS)*

Fault Code 595 Troubleshooting

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

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

   Note: If Fault Code 595 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 595 FMI 0, 1, 3, 4, or 5 is Active, go to **Step C.**
   - If Fault Code 595 FMI 0, 1, 3, 4, or 5 is Inactive. go to **Step B.**
   - If Fault Code 595 FMI 7, 20, or 21 is set, go to **Step K.**
   - If Fault Code 595 FMI 12 or 19 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 595 FMI 14, 15, 16, 17, 18 or 31 is set, go to **Step F.**

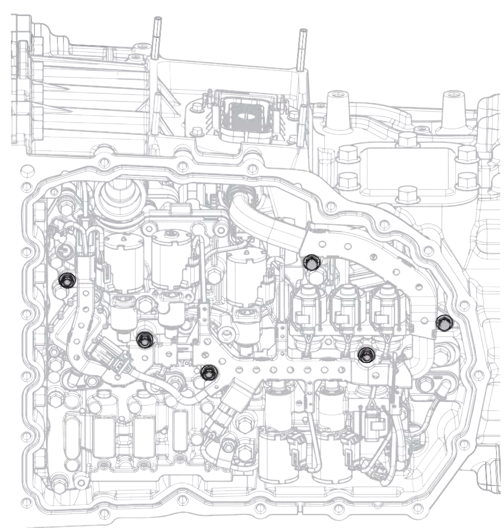
B ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan and filter.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

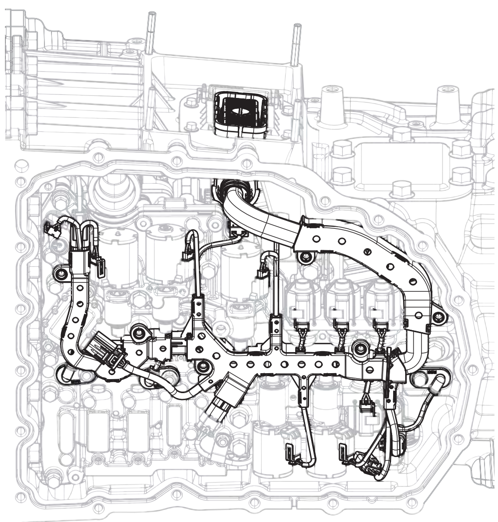
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.

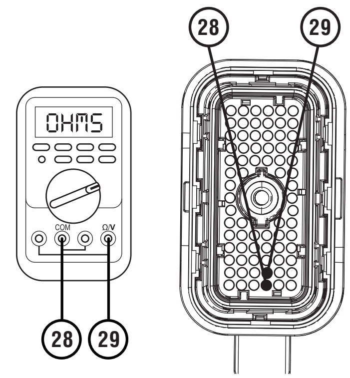


8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

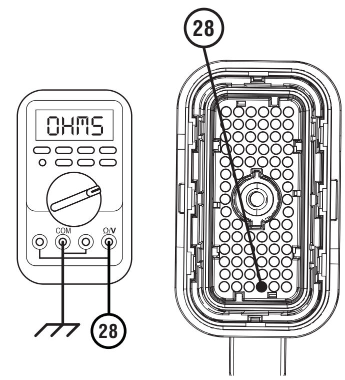
C

Purpose: *Verify proper resistance through 74-Way Transmission Harness and RBVS.*

1. Set parking brake and chock wheels
2. Key off.
3. Remove TCM.
4. Inspect for oil, corrosion, bent or spread pins.
5. Measure resistance between 74-Way Connector Pin 28 and Pin 29. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 28 and ground. Record reading in table.



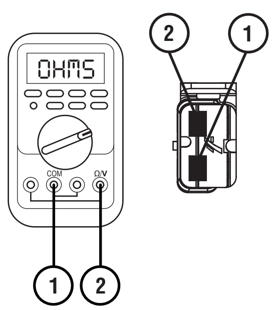
7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step D.**
   - If all readings are in range, go to **Step E.**

Pins	Range	Reading(s)
28 to 29	1.6–4.9 Ohms	
28 to ground	Open Circuit (OL)	

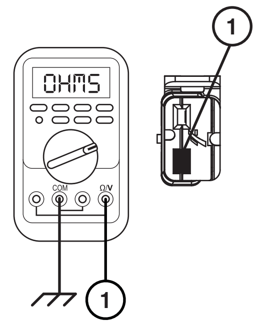
D

Purpose: *Verify resistance of RBVS.*

1. Key off.
2. Drain oil.
3. Remove sump pan and filter.
4. Disconnect RBVS connector.
5. Measure resistance between RBVS Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between RBVS Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace RBVS. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	1.6–4.9 Ohms	
1 to ground	Open Circuit (OL)	

E

Purpose: *Verify fault code status.*

1. Key off.
2. Reinstall TCM.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 595 FMI 0, 1, 3, 4, or 5 is Inactive, replace RBVS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 595 FMI 0, 1, 3, 4, or 5 is Active, replace TCM. Go to **Step V.**

F

Purpose: *Perform Service Bay Initiated Test.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and Service Bay Initiated Tests.
4. Select Shift Rail Actuation
5. Retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger.
6. Select Send to Eaton.
   - Go to **Step G.**

G

Purpose: *Verify condition of transmission oil.*

1. Drain oil.
2. Remove sump pan and filter.
3. Inspect transmission oil for contamination and debris.
   - If contamination or debris is found, contact Eaton at (800) 826-4357 for further diagnostic instructions.
   - If FMI 14 is set, go to **Step H.**
   - If FMI 31 is set, go to **Step I.**
   - If FMI 15, 16, 17, or 18 is set, go to **Step J.**

H

Purpose: *Verify condition of SPS1.*

1. Remove TCM.
2. Remove ACM.
3. Remove SPS1.
4. Inspect solenoid valve and bore for contamination.
   - If solenoid valve or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace SPS1. Go to **Step V.**

I

Purpose: *Verify condition of SPS2.*

1. Remove TCM.
2. Remove ACM.
3. Remove SPS2.
4. Inspect solenoid valve and bore for contamination.
   - If solenoid valve or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace SPS2. Go to **Step V.**

J

Purpose: *Verify condition of RBVS.*

1. Remove RBVS.
2. Inspect RBVS and bore for contamination.
   - If RBVS or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace RBVS and ACM. Go to **Step V.**

K

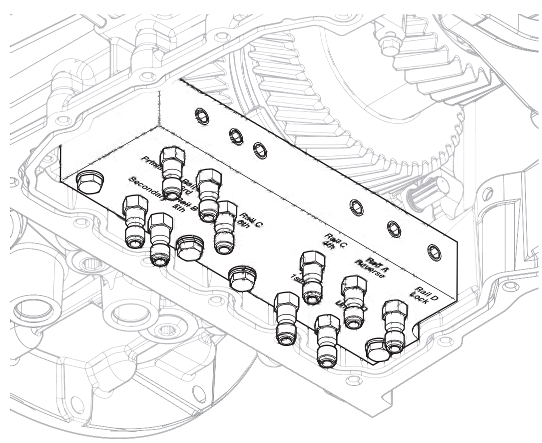
Purpose: *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail B fault codes set Active, go to **Step L.**

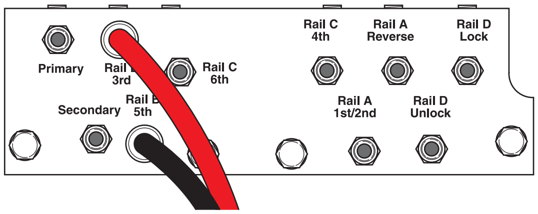
L

Purpose: *Actuate Rail B with Diagnostic Manifold tool.*

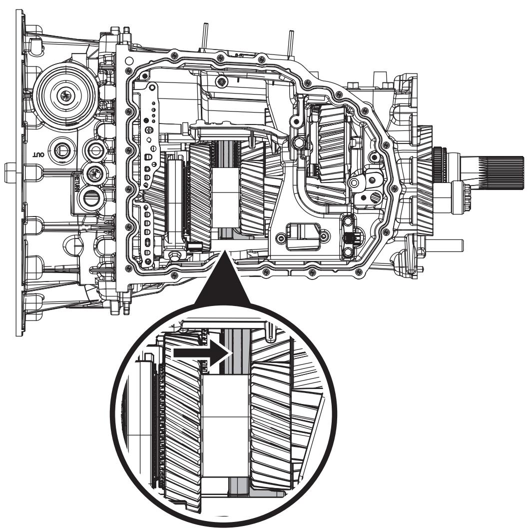
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



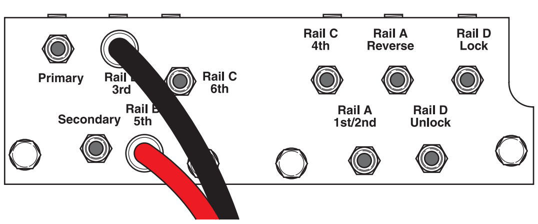
6. Apply air to Rail B 3rd port.



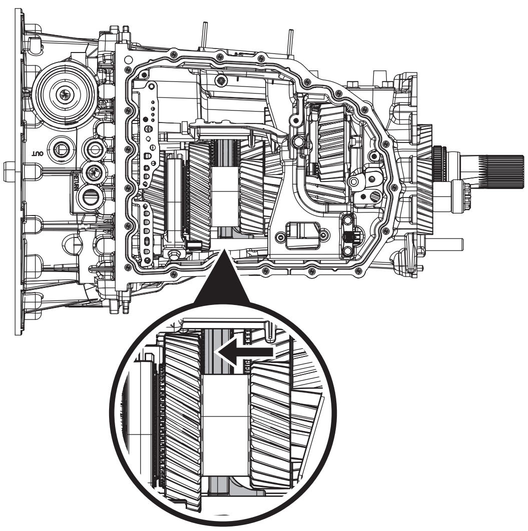
7. Watch for Rail B fork to fully engage synchronizer into 3rd gear.



8. Apply air to Rail B 5th/7th port.



9. Watch for Rail B fork to fully engage synchronizer into 5th/7th gear.



- If fork does not move or does not fully engage 3rd or 5th/7th gear, go to **Step M.**
- If fork fully engages 3rd and 5th/7th gear, go to **Step N.**

M

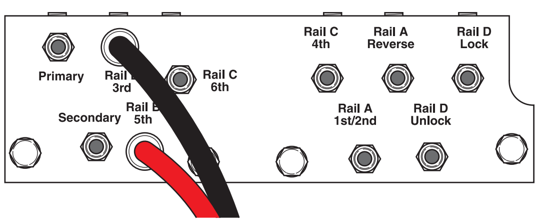
Purpose: *Verify mechanical condition of 5th/7th, 3rd synchronizer and detent.*

1. Use pry bar to engage Rail B fork into 3rd and 5th/7th gears.
   - If fork does not move or does not fully engage 3rd or 5th/7th gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 5th/7th, 3rd synchronizer or detent. Go to **Step V.**
   - If fork fully engages 3rd and 5th/7th gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail B Piston and Rod Seals. Go to **Step V.**

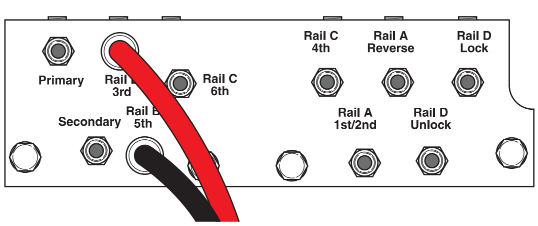
N

Purpose: *Verify condition of Rail B Piston and Rod Seals.*

1. Apply air to Rail B 5th/7th port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail B 3rd port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail B Piston and Rod Seals. Go to **Step V.**
   - If all result(s) are in range, replace RBVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail B 5th/7th Port	0 PSI	
Rail B 3rd Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 595 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 595 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 615: Rail C Valve Solenoid

J1939: SA 3 SPN 5953 FMI 0, 1, 3, 4, 5, 7, 12, 14, 15, 16, 17, 18, 19, 20, 21, 31

Overview

The Procision transmission is equipped with valve control solenoids to direct hydraulic flow. The Rail C Valve Solenoid (RCVS) is energized by the Transmission Control Module (TCM) to allow pilot pressure to open the Rail C Valve (RCV). This results in motion of Rail C to engage 6th or 4th. The RCVS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the RCVS circuit and shift rail C position. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: RCVS low side current above command for 1 second.

FMI 1 – Data Valid but Below Normal: RCVS low side current below command for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RCVS circuit shorted to power for 1 second.

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

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

FMI 7 – Mechanical System Not Responding: No movement in aft direction during Rail C calibration.

FMI 12 – Bad Intelligent Device: Inappropriate Rail (A, B, C, or D) commanded for given shift.

FMI 14 – Special Instructions: Rail C movement toward 4th while commanding 6th.

FMI 15 – Data Valid But Above Normal: Uncommanded Rail C movement from Neutral toward 6th while commanding other rail.

FMI 16 – Data Valid But Above Normal: Uncommanded Rail C movement from 6th toward Neutral while commanding other rail.

FMI 17 – Data Valid But Below Normal: Uncommanded Rail C movement from Neutral toward 4th while commanding other rail.

FMI 18 – Data Valid But Below Normal: Uncommanded Rail C movement from 4th toward Neutral while commanding other rail.

FMI 19 – Received Network Data in Error: SPI bus error.

FMI 20 – Data Drifted High: Movement in aft direction insufficient during Rail C calibration.

FMI 21 – Data Drifted Low: Movement in fore direction insufficient during Rail C calibration.

FMI 31 – Condition Exists: Rail C movement toward 6th while commanding 4th.

Fallback

FMI 0:

- Amber warning lamp on
- No degraded performance

FMI 1, 3, 5, 7, 14, 19, 20, 21, 31:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

Note: If Rail C is disengaged:

- Secondary Clutch disengaged
- 2nd, 4th, 6th, 7th gears unavailable

FMI 4:

- Amber warning lamp on
- No degraded performance

Note: If high side is shorted to ground:

- Only engaged gears allowed
- PTO Mode prohibited

FMI 12:

- Amber warning lamp on
- Only engaged gears allowed

FMI 15, 16, 17, 18:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode Prohibited

Conditions to Set Fault Code Inactive

FMI 0: RCVS low side current not above command for 10 seconds.

FMI 1: RCVS low side current not below command for 10 seconds.

FMI 3: RCVS circuit not shorted to power for 10 seconds.

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

FMI 5: RCVS circuit not open for 10 seconds.

FMI 7, 20, 21: Successful rail calibration performed.

FMI 12: Key cycle.

FMI 14, 15, 16, 17, 18, 31: Key cycle and proper rail movement.

FMI 19: SPI bus functional.

Possible Causes

FMI 0:

- RCVS
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 1:

- RCVS
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in RCVS circuit
- TCM
  - Internal failure

FMI 3, 4, 5:

- RCVS
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

FMI 7:

- SPS1
  - Stuck open
- SPS2
  - Stuck closed
- Rail C Piston
  - Seal damaged

FMI 12, 19:

- TCM
  - Internal failure
  - Software issue

FMI 14:

- SPS1
  - Stuck open

FMI 15, 16, 17, 18:

- RCVS
  - Stuck open
- RCV
  - Stuck open

FMI 20, 21:

- Rail C Piston
  - Seal damaged
- Rail C Rod Seal
  - Seal damaged
- 6th and 4th Gears
  - Clutching teeth damaged
- Rail C Fork
  - Fork bent
- Low hydraulic pressure

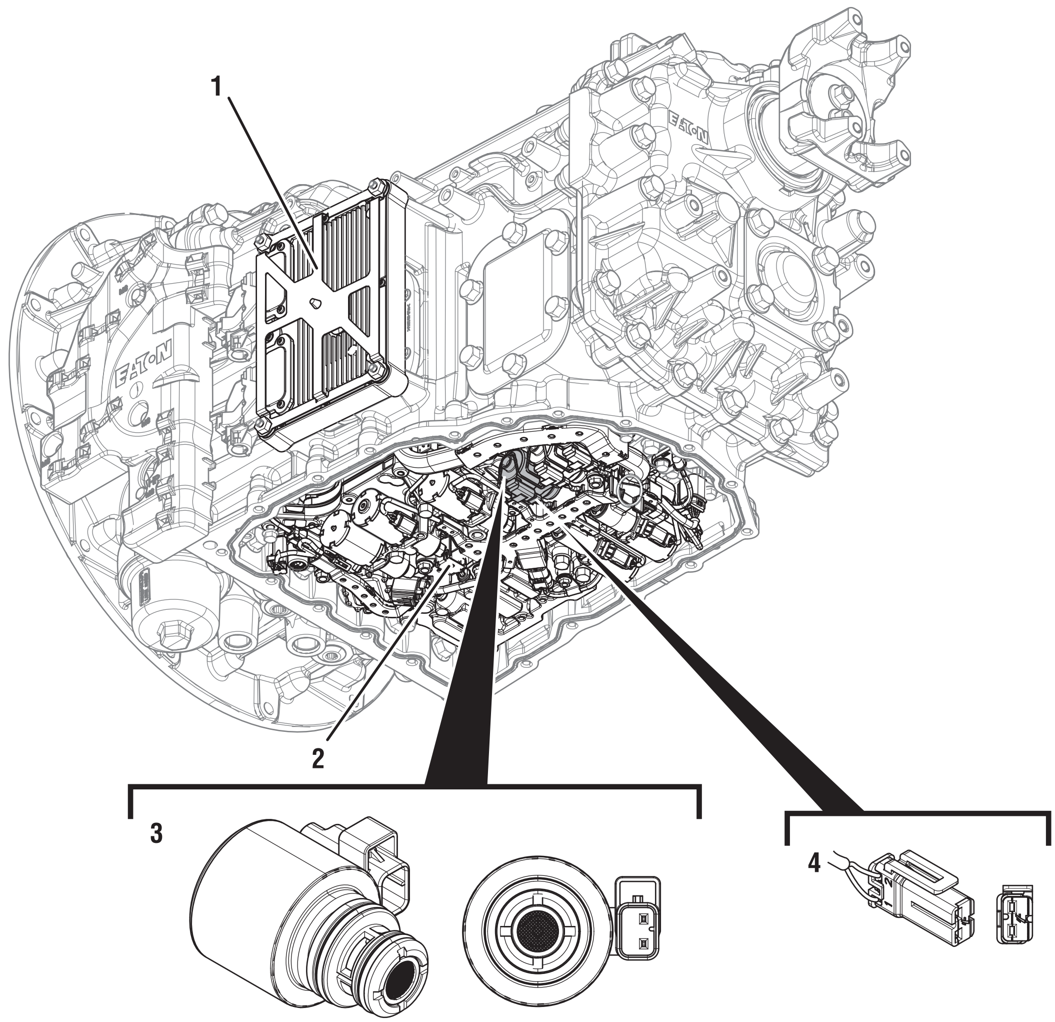
FMI 31:

- SPS2
  - Stuck open

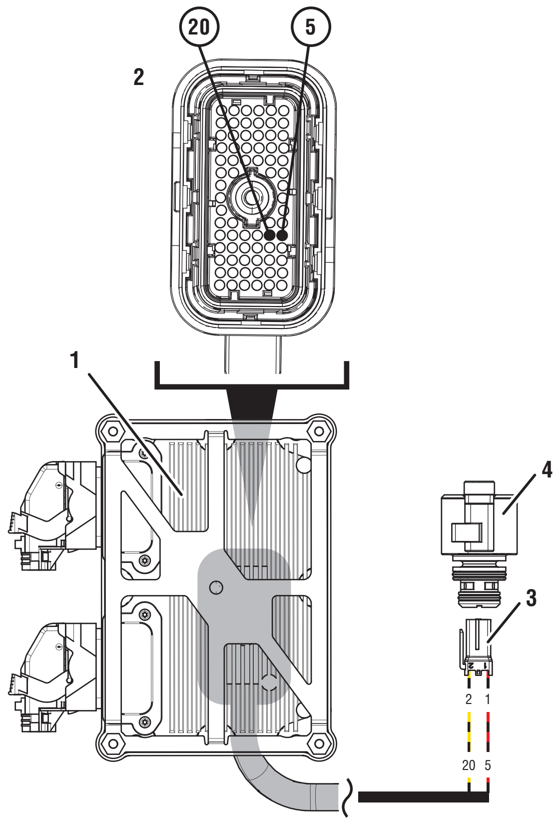
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Rail C Valve Solenoid (RCVS)
4. 2-Way Rail C Valve Solenoid (RCVS) Connector



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 2-Way Rail C Valve Solenoid (RCVS) Connector
4. 2-Way Rail C Valve Solenoid (RCVS)

Fault Code 615 Troubleshooting

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

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

   Note: If Fault Code 615 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 615 FMI 0, 1, 3, 4, or 5 is Active, go to **Step C.**
   - If Fault Code 615 FMI 0, 1, 3, 4, or 5 is Inactive. go to **Step B.**
   - If Fault Code 615 FMI 7, 20, or 21 is set, go to **Step K.**
   - If Fault Code 615 FMI 12 or 19 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 615 FMI 14, 15, 16, 17, 18 or 31 is set, go to **Step F.**

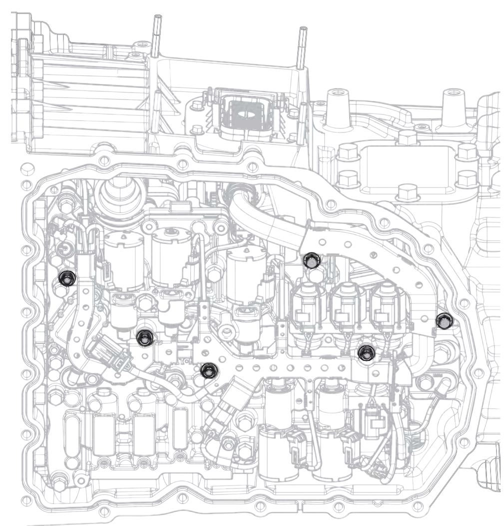
B ***Purpose:*** *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan and filter.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

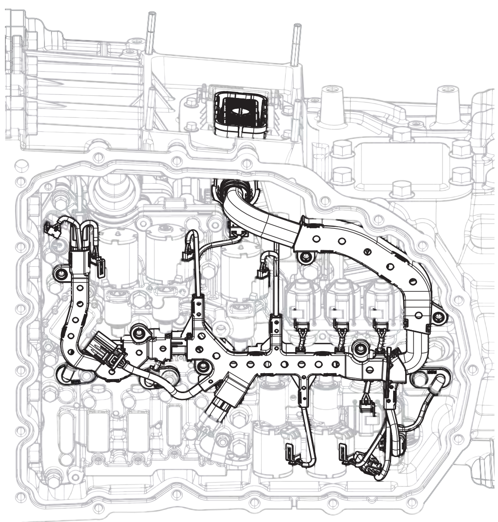
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid "PD" in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



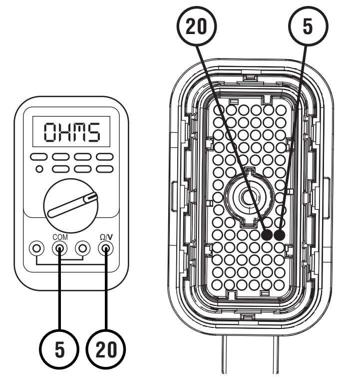
7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.



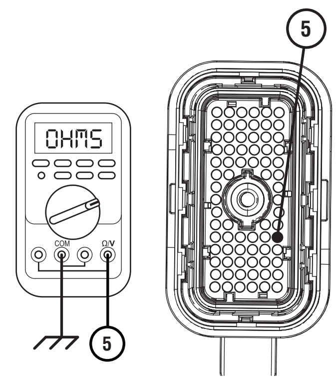
8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C ***Purpose:*** *Verify proper resistance through 74-Way Transmission Harness and RCVS.*

1. Set parking brake and chock wheels
2. Key off.
3. Remove TCM.
4. Inspect for oil, corrosion, bent or spread pins.
5. Measure resistance between 74-Way Connector Pin 5 and Pin 20. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 5 and ground. Record reading in table.

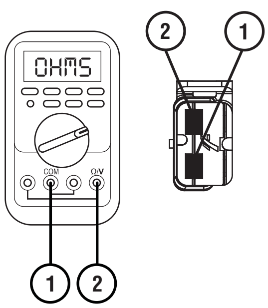


7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step D.**
   - If all readings are in range, go to **Step E.**

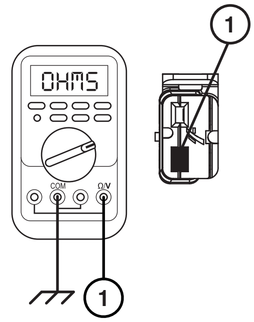
Pins	Range	Reading(s)
5 to 20	1.6–4.9 Ohms	
5 to ground	Open Circuit (OL)	

D ***Purpose:*** *Verify resistance of RCVS.*

1. Key off.
2. Drain oil.
3. Remove sump pan and filter.
4. Disconnect RCVS connector.
5. Measure resistance between RCVS Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between RCVS Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace RCVS. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	1.6–4.9 Ohms	
1 to ground	Open Circuit (OL)	

E

Purpose: *Verify fault code status.*

1. Key off.
2. Reinstall TCM.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 615 FMI 0, 1, 3, 4, or 5 is Inactive, replace RCVS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 615 FMI 0, 1, 3, 4, or 5 is Active, replace TCM. Go to **Step V.**

F

Purpose: *Perform Service Bay Initiated Test.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and Service Bay Initiated Tests.
4. Select Shift Rail Actuation
5. Retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger.
6. Select Send to Eaton.
   - Go to **Step G.**

G

Purpose: *Verify condition of transmission oil.*

1. Drain oil.
2. Remove sump pan and filter.
3. Inspect transmission oil for contamination and debris.
   - If contamination or debris is found, contact Eaton at (800) 826-4357 for further diagnostic instructions.
   - If FMI 14 is set, go to **Step H.**
   - If FMI 31 is set, go to **Step I.**
   - If FMI 15, 16, 17, or 18 is set, go to **Step J.**

H

Purpose: *Verify condition of SPS1.*

1. Remove TCM.
2. Remove ACM.
3. Remove SPS1.
4. Inspect solenoid valve and bore for contamination.
   - If solenoid valve or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace SPS1. Go to **Step V.**

I

Purpose: *Verify condition of SPS2.*

1. Remove TCM.
2. Remove ACM.
3. Remove SPS2.
4. Inspect solenoid valve and bore for contamination.
   - If solenoid valve or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace SPS2. Go to **Step V.**

J

Purpose: *Verify condition of RCVS.*

1. Remove RCVS.
2. Inspect RCVS and bore for contamination.
   - If RCVS or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace RCVS and ACM. Go to **Step V.**

K

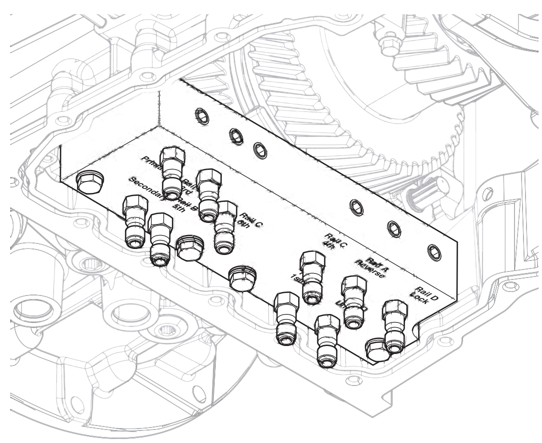
Purpose: *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail C fault codes set Active, go to **Step L.**

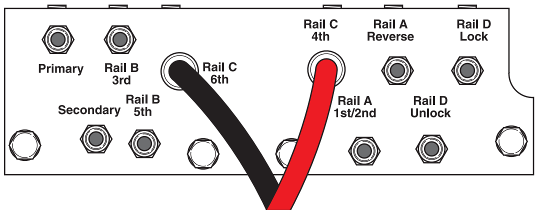
L

Purpose: *Actuate Rail C with Diagnostic Manifold tool.*

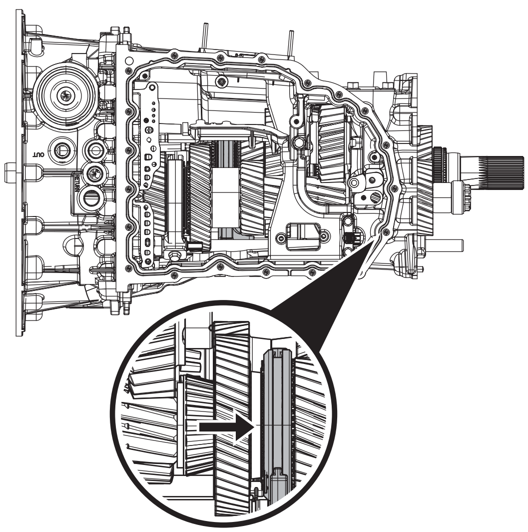
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



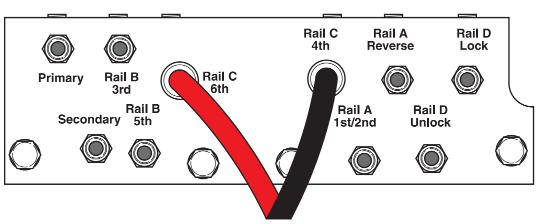
6. Apply air to Rail C 4th port.



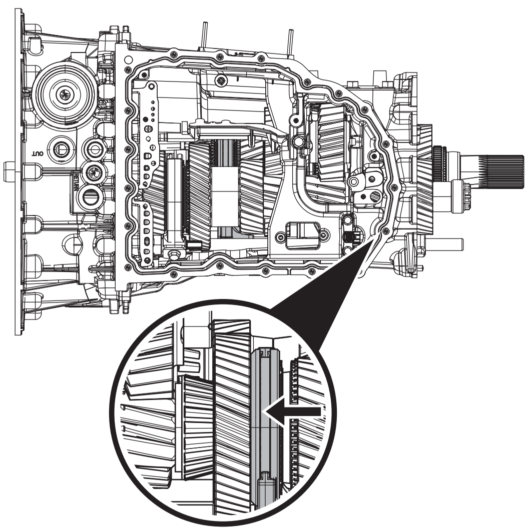
7. Watch for Rail C fork to fully engage synchronizer into 4th gear.



8. Apply air to Rail C 6th port.



9. Watch for Rail C fork to fully engage synchronizer into 6th gear.



- If fork does not move or does not fully engage 4th or 6th gear, go to **Step M.**
- If fork fully engages 4th and 6th gear, go to **Step N.**

M

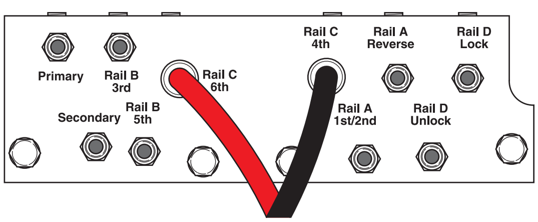
Purpose: *Verify mechanical condition of 6th, 4th synchronizer and detent.*

1. Use pry bar to engage Rail C fork into 4th and 6th gears.
    - If fork does not move or does not fully engage 4th or 6th gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 6th, 4th synchronizer or detent. Go to **Step V.**
    - If fork fully engages 4th and 6th gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail C Piston and Rod Seals. Go to **Step V.**

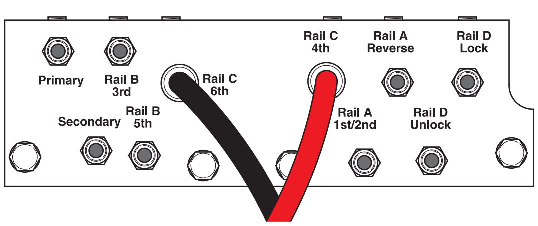
N

Purpose: *Verify condition of Rail C Piston and Rod Seals.*

1. Apply air to Rail C 6th port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail C 4th port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

    Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

    - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail C Piston and Rod Seals. Go to **Step V.**
    - If all result(s) are in range, replace RCVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail C 6th Port	0 PSI	
Rail C 4th Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 615 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 615 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 635: Rail D Valve Solenoid

J1939: SA 3 SPN 5954 FMI 0, 1, 3, 4, 5, 7, 12, 15, 16, 17, 19, 20, 21

Overview

The Procision transmission is equipped with valve control solenoids to direct hydraulic flow. The Rail D Valve Solenoid (RDVS) is energized by the Transmission Control Module (TCM) to allow pilot pressure to open the Rail D Valve (RDV). This results in motion of Rail D to engage Unlock or Lock. The RDVS is located in the Actuation Control Manifold (ACM) and connected to the TCM via the 74-Way Transmission Harness.

Detection

The TCM monitors the RDVS circuit and shift rail D position. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: RDVS low side current above command for 1 second.

FMI 1 – Data Valid but Below Normal: RDVS low side current below command for 1 second.

FMI 3 – Voltage Above Normal or Shorted High: RDVS circuit shorted to power for 1 second.

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

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

FMI 7 – Mechanical System Not Responding: No movement in aft direction during Rail D calibration.

FMI 12 – Bad Intelligent Device: Inappropriate Rail (A, B, or C) movement commanded to overshoot Neutral.

FMI 15 – Data Valid But Above Normal: Uncommanded Rail D movement from Unlock toward Lock while commanding other rail.

FMI 16 – Data Valid But Above Normal: Uncommanded Rail D movement from Lock toward Unlock while commanding other rail.

FMI 17 – Data Valid But Below Normal: Uncommanded Rail D movement from Unlock to beyond Unlock while commanding other rail.

FMI 19 – Received Network Data in Error: SPI bus error.

FMI 20 – Data Drifted High: Movement in aft direction insufficient during Rail D calibration.

FMI 21 – Data Drifted Low: Movement in fore direction insufficient during Rail D calibration.

Fallback

FMI 0:

- Amber warning lamp on
- No degraded performance

FMI 1, 3, 5, 7, 19, 20, 21:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

Note: If Rail D is disengaged:

- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th, and 7th gears unavailable
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a RDVS fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

FMI 4:

- Amber warning lamp on
- No degraded performance

Note: Note: If high side is shorted to ground:

- Only engaged gears allowed
- PTO Mode prohibited

FMI 12:

- Amber warning lamp on
- Only engaged gears allowed

FMI 15, 16, 17:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode Prohibited

Conditions to Set Fault Code Inactive

FMI 0: RDVS low side current not above command for 10 seconds.

FMI 1: RDVS low side current not below command for 10 seconds.

FMI 3: RDVS circuit not shorted to power for 10 seconds.

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

FMI 5: RDVS circuit not open for 10 seconds.

FMI 7, 20, 21: Successful rail calibration performed.

FMI 12: Key cycle.

FMI 15, 16, 17: Key cycle and proper rail movement.

FMI 19: SPI bus functional.

Possible Causes

FMI 0:

- RDVS
  - Internal failure
- 74-Way Transmission Harness
  - Low side shorted to ground
- TCM
  - Internal failure

FMI 1:

- RDVS
  - Internal failure
- 74-Way Transmission Harness
  - High resistance in RDVS circuit
- TCM
  - Internal failure

FMI 3, 4, 5:

- RDVS
  - Internal failure
- 74-Way Transmission Harness
  - Wiring shorted to power, shorted to ground, or open

FMI 7:

- SPS1
  - Stuck open
- SPS2
  - Stuck closed
- Rail D Piston
  - Seal damaged

FMI 12, 19:

- TCM
  - Internal failure
  - Software issue

FMI 15, 16, 17:

- RDVS
  - Stuck open
- RDV
  - Stuck open

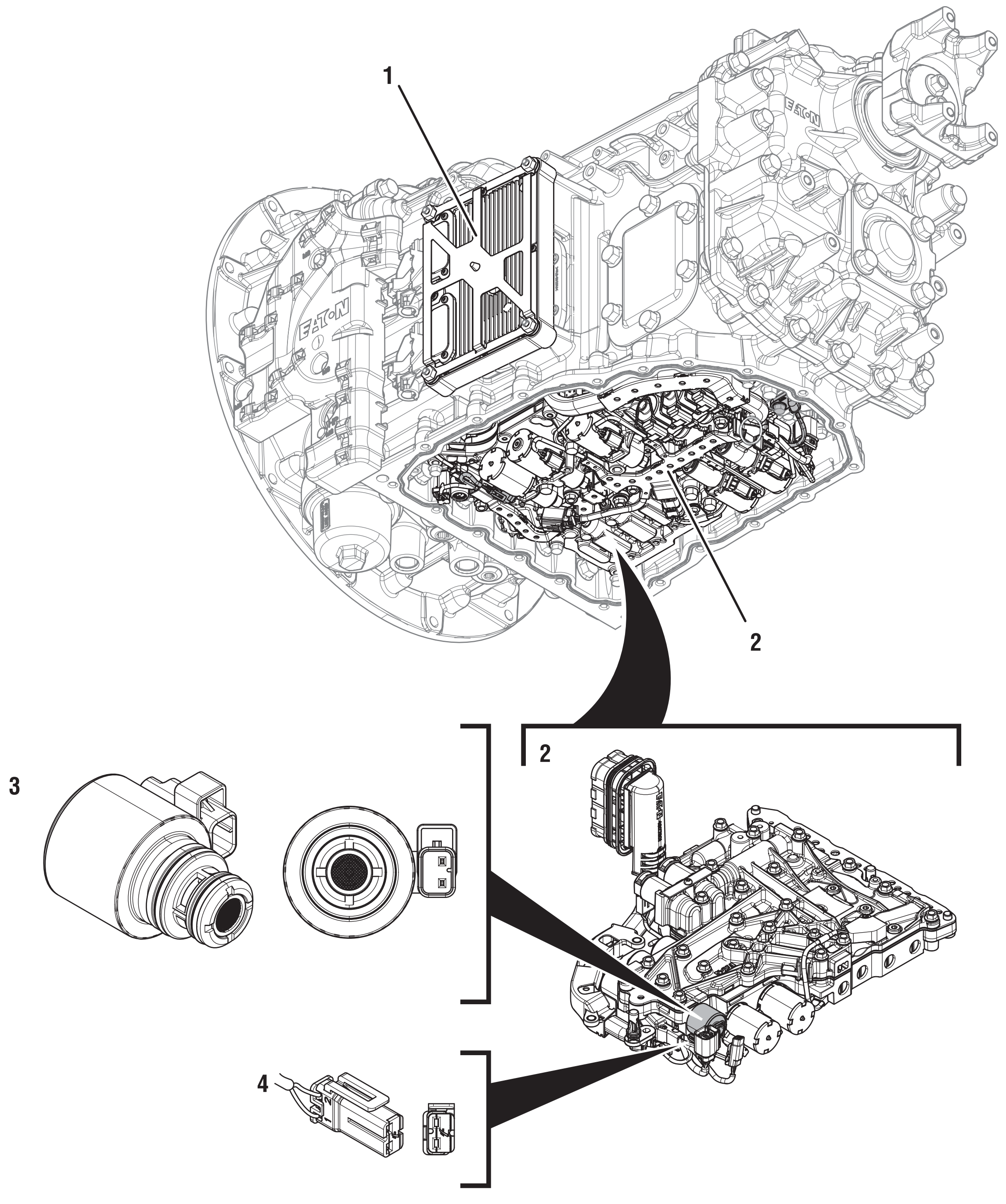
FMI 20, 21:

- Rail D Piston
  - Seal damaged
- Rail D Rod Seal
  - Seal damaged
- Lock Gear
  - Clutching teeth damaged
- Rail D Fork
  - Fork bent
- Low hydraulic pressure

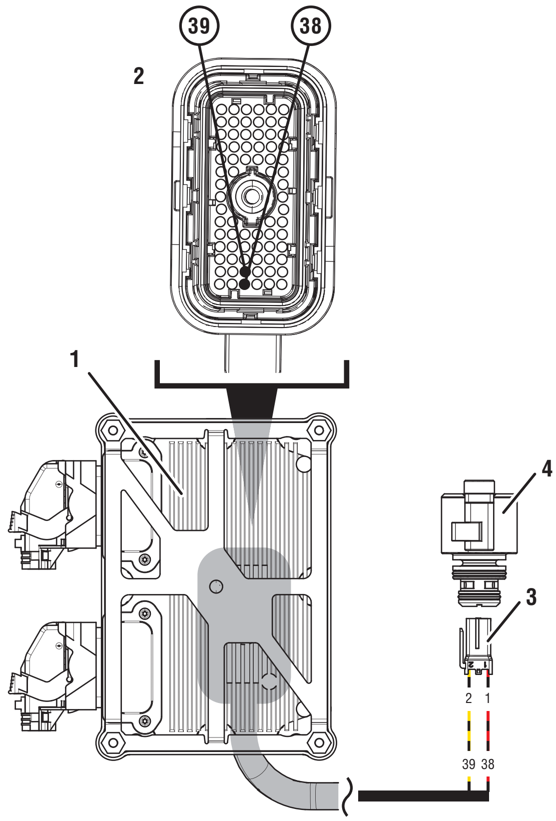
Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Component Identification



1. Transmission Control Module (TCM)
2. Actuation Control Manifold (ACM)
3. 2-Way Rail D Valve Solenoid (RDVS)
4. 2-Way Rail D Valve Solenoid (RDVS) Connector



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 2-Way Rail D Valve Solenoid (RDVS) Connector
4. 2-Way Rail D Valve Solenoid (RDVS)

Fault Code 635 Troubleshooting

A

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

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

   Note: If Fault Code 635 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 635 FMI 0, 1, 3, 4, or 5 is Active, go to **Step C.**
   - If Fault Code 635 FMI 0, 1, 3, 4, or 5 is Inactive. go to **Step B.**
   - If Fault Code 635 FMI 7, 20, or 21 is set, go to **Step I.**
   - If Fault Code 635 FMI 12 or 19 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 635 FMI 15, 16, or 17 is set, go to **Step F.**

B

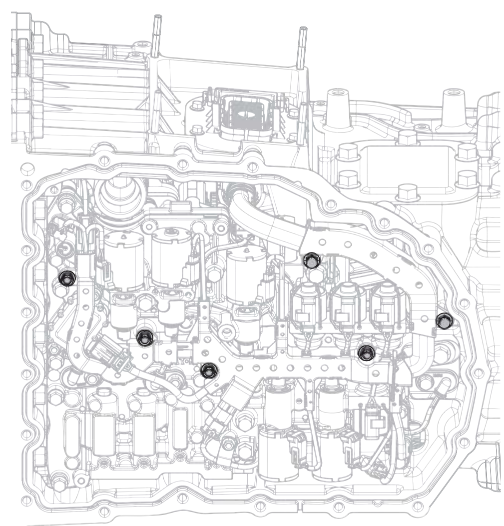
Purpose: *Use Product Diagnostic (PD) Mode to locate intermittent failures.*

1. Set parking brake and chock wheels.
2. Drain oil.
3. Remove sump pan and filter.
4. Connect ServiceRanger
5. Select Service Routine and PD Mode.

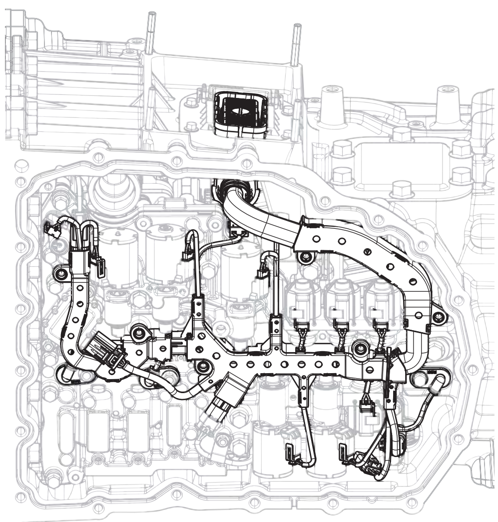
   Note: Transmission will not enter PD Mode when there are Active fault codes.

   Note: Solid “PD” in display when PD Mode is active.

6. Remove 6 Transmission Harness 10 mm cap screws.



7. Wiggle 74-Way Transmission Harness. Look for any obvious signs of rubbing or chafing on any of the wires.

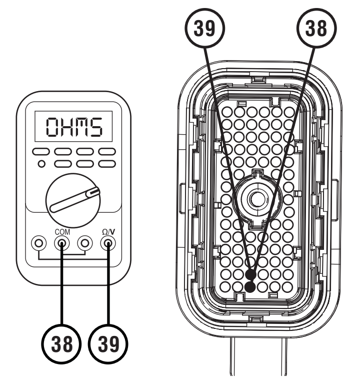


8. Exit PD Mode.
   - If any fault code sets Active while wiggling the harness, replace 74-Way Transmission Harness. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

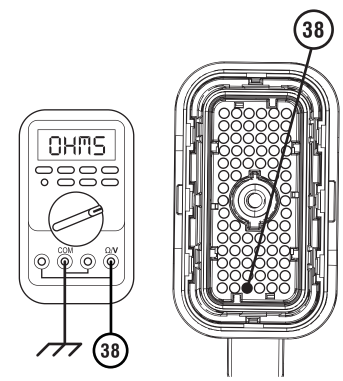
C

Purpose: *Verify proper resistance through 74-Way Transmission Harness and RDVS.*

1. Set parking brake and chock wheels
2. Key off.
3. Remove TCM.
4. Inspect for oil, corrosion, bent or spread pins.
5. Measure resistance between 74-Way Connector Pin 38 and Pin 39. Record reading in table.



6. Measure resistance between 74-Way Connector Pin 38 and ground. Record reading in table.



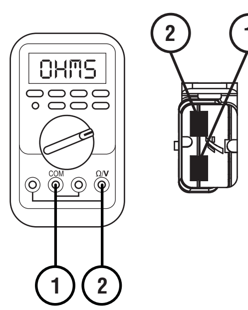
7. Compare reading(s) in table.
   - If any reading is out of range, go to **Step D.**
   - If all readings are in range, go to **Step E.**

Pins	Range	Reading(s)
38 to 39	1.6–4.9 Ohms	
38 to ground	Open Circuit (OL)	

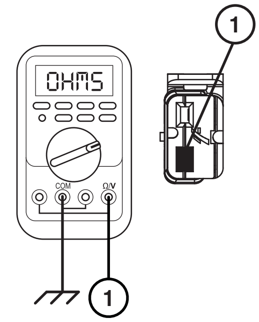
D

Purpose: *Verify resistance of RDVS.*

1. Key off.
2. Drain oil.
3. Remove sump pan and filter.
4. Disconnect RDVS connector.
5. Measure resistance between RDVS Pin 1 and Pin 2. Record reading in table.



6. Measure resistance between RDVS Pin 1 and ground. Record reading in table.



7. Compare reading(s) in table.
   - If any reading is out of range, replace RDVS. Go to **Step V.**
   - If all readings are in range, replace 74-Way Transmission Harness. Go to **Step V.**

Pins	Range	Reading(s)
1 to 2	1.6–4.9 Ohms	
1 to ground	Open Circuit (OL)	

E

Purpose: *Verify fault code status.*

1. Key off.
2. Reinstall TCM.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Retrieve and record the transmission fault codes, FMIs, occurrences, and timestamps.
   - If Fault Code 635 FMI 0, 1, 3, 4, or 5 is Inactive, replace RDVS and 74-Way Transmission Harness. Go to **Step V.**
   - If Fault Code 635 FMI 0, 1, 3, 4, or 5 is Active, replace TCM. Go to **Step V.**

F

Purpose: *Perform Service Bay Initiated Test.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and Service Bay Initiated Tests.
4. Select Shift Rail Actuation
5. Retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger.
6. Select Send to Eaton.
   - Go to Step G.

G

Purpose: *Verify condition of transmission oil.*

1. Drain oil.
2. Remove sump pan and filter.
3. Inspect transmission oil for contamination and debris.
   - If contamination or debris is found, contact Eaton at (800) 826-4357 for further diagnostic instructions.
   - If FMI 14 is set, go to **Step H.**
   - If FMI 31 is set, go to **Step I.**
   - If FMI 15, 16, 17, or 18 is set, go to **Step J.**

H

Purpose: *Verify condition of RDVS.*

1. Remove RDVS.
2. Inspect RDVS and bore for contamination.
   - If RDVS or bore is contaminated, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If no contamination is found, replace RDVS and ACM. Go to **Step V.**

I

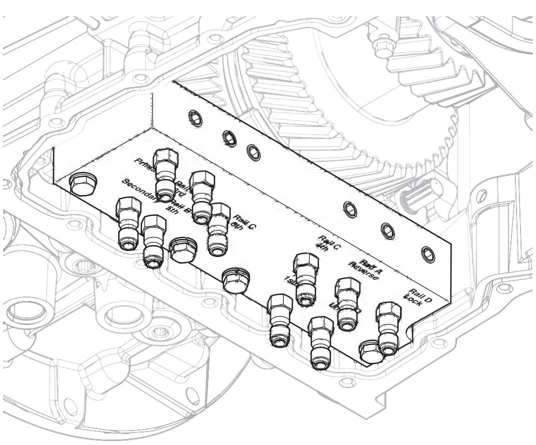
Purpose: *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail D fault codes set Active, go to **Step J.**

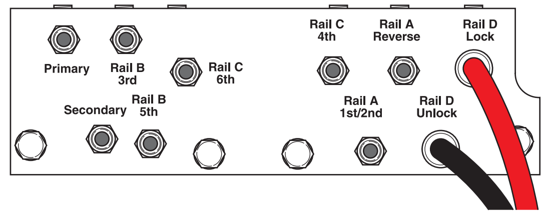
J

Purpose: *Actuate Rail D with Diagnostic Manifold tool.*

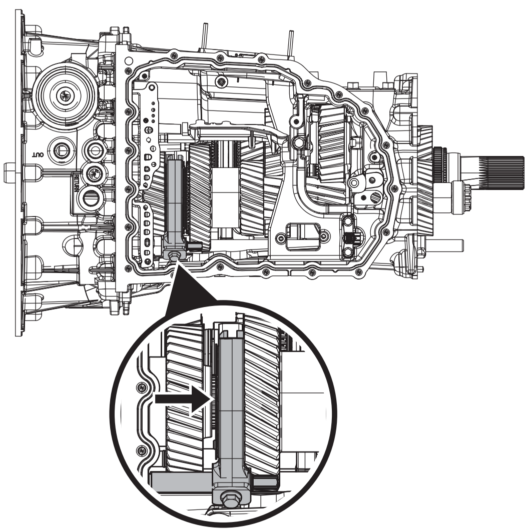
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



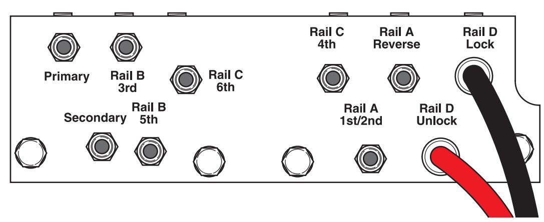
6. Apply air to Rail D Lock port.



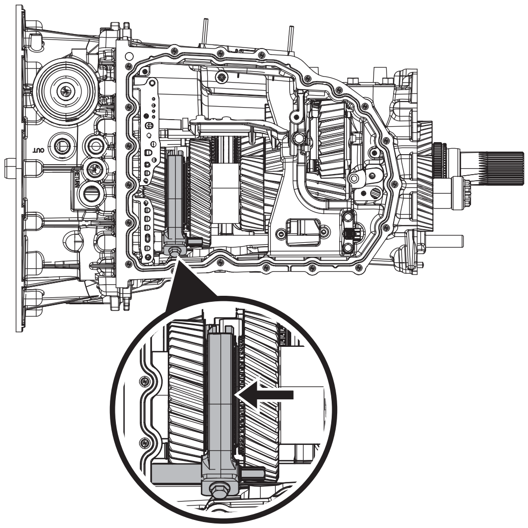
7. Watch for Rail D fork to fully engage synchronizer into Lock.



8. Apply air to Rail D Unlock port.



9. Watch for Rail D fork to Unlock synchronizer.



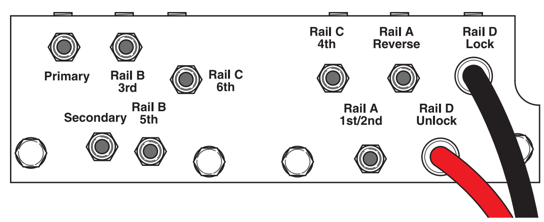
- If fork does not move or does not fully engage Lock and Unlock, go to **Step K.**
- If fork fully engages Lock and Unlocks, go to **Step L.**

K ***Purpose:*** *Verify mechanical condition of Lock synchronizer and detent.*

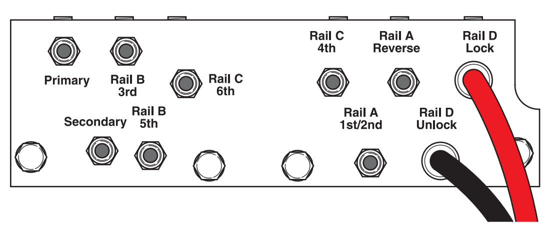
1. Use pry bar to engage Lock and Unlock of Rail D fork.
    - If fork does not move or does not fully engage Lock and Unlock, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D assembly. Go to **Step V.**
    - If fork fully engages Lock and Unlocks, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D Piston and Rod Seals. Go to **Step V.**

L ***Purpose:*** *Verify condition of Rail D Piston and Rod Seals.*

1. Apply air to Rail D Unlock port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail D Lock port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D Piston and Rod Seals. Go to **Step V.**
   - If all result(s) are in range, replace RDVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail D Unlock Port	0 PSI	
Rail D Lock Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 635 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 635 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 700: Primary Clutch Operation

J1939: SA 3 SPN 6150 FMI 0, 1, 10, 11, 12, 13, 15, 17, 31

Overview

The Procision transmission is equipped with a hydraulically actuated dual-clutch. The dual-clutch transfers engine torque to the primary input shaft. The Transmission Control Module (TCM) monitors primary clutch pressure and primary input speed to properly engage and disengage the dual-clutch.

Detection

The TCM monitors Primary Clutch Pressure and Primary Input Speed. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Primary Input Speed greater than 5000 RPM.

FMI 1 – Data Valid but Below Normal: Primary Clutch slip detected.

FMI 10 – Abnormal Rate of Change: Primary Clutch Calibration touch point not found.

FMI 11 – Failure Mode Not Identifiable: Primary shaft speed does not match selected gear.

FMI 12 – Bad Intelligent Device: Clutch actuation pressure mismatch.

FMI 13 – Out of Calibration: Primary or Secondary Clutch Calibration touch point invalid.

FMI 15 – Data Valid but Above Normal: Primary Clutch Calibration touch point failed above maximum limit.

FMI 17 – Data Valid but Below Normal: Primary Clutch Calibration touch point failed below minimum limit.

FMI 31 – Condition Exists: Initial Primary Input Speed not detected with working Primary Input Speed sensor.

Fallback

FMI 0:

- Amber and red warning lamp on
- No degraded performance

Note: Clutch damage may occur at excessively high RPMs.

FMI 1, 10, 11, 15, 17:

- Amber warning lamp on
- PTO Mode prohibited
- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th and 7th gears unavailable
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a Primary Clutch Operation fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

FMI 12, 13, 31:

- Amber warning lamp on
- PTO Mode prohibited
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

FMI 0: Primary input speed less than 4000 RPM.

FMI 1: Primary Clutch slip not detected.

FMI 10, 13, 15, 17: Successful Clutch Calibration performed.

FMI 11, 12, 31: Key cycle

Possible Causes

FMI 0:

- Grade back-drive
  - Torque locked
- Engine over speed

FMI 1:

- Oil contamination
- Dual-clutch
  - Worn or damaged
- Primary Input Shaft failure
- Primary Driven Gear failure
- Low hydraulic pressure
- J1939 engine torque reporting error

FMI 10, 13, 15, 17:

- Dual-clutch
  - Worn or damaged
- Low hydraulic pressure
- High hydraulic pressure

FMI 11:

- Rail Fork
  - Bent
  - Worn wear pads
  - Roll pins sheared
  - Fork broken
- Synchronizer failure
- Gear failure
- Upper or Lower Shaft failure

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 31:

- Primary Input Shaft
  - Shaft unable to rotate (transmission stuck in gear)
- Mechanical failure
- Clutch cooling system failure

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Fault Code 700 Troubleshooting

A

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

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

   Note: If Fault Code 700 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 700 FMI 0, 1, 11, or 12 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 700 FMI 10, 13, 15, or 17 is set, go to **Step B.**
   - If Fault Code 700 FMI 31 is set, go to **Step C.**

B

Purpose: *Perform Clutch Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Clutch Calibration.
   - If Clutch Calibration is successful, Test Complete.
   - If Clutch Calibration is unsuccessful, replace dual-clutch. Go to **Step V.**

C

Purpose: *Perform Service Bay Initiated Test.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and Service Bay Initiated Tests.
4. Select Clutch Cooling Actuation.
5. Retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”.
   - Contact Eaton at (800) 826-4357 for further diagnostic instructions.
   - Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 700 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 700 sets, troubleshoot per the “Fault Code Isolation Procedure Index” on page 13.

Fault Code 710: Secondary Clutch Operation

J1939: SA 3 SPN 6151 FMI 0, 1, 10, 11, 12, 14, 15, 17, 31

Overview

The Procision transmission is equipped with a hydraulically actuated dual-clutch. The dual-clutch transfers engine torque to the secondary input shaft. The Transmission Control Module (TCM) monitors secondary clutch pressure and secondary input speed to properly engage and disengage the dual-clutch.

Detection

The TCM monitors Secondary Clutch Pressure and Secondary Input Speed. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Secondary Input Speed greater than 5000 RPM.

FMI 1 – Data Valid but Below Normal: Secondary Clutch slip detected.

FMI 10 – Abnormal Rate of Change: Secondary Clutch Calibration touch point not found.

FMI 11 – Failure Mode Not Identifiable: Secondary shaft speed does not match selected gear.

FMI 12 – Bad Intelligent Device: Clutch engagement commanded with unknown rail position or calibration.

FMI 14 – Special Instructions: Primary or Secondary Clutch launch commanded when transmission engaged in opposite direction relative to driver's requested mode.

FMI 15 – Data Valid but Above Normal: Secondary Clutch Calibration touch point failed above maximum limit.

FMI 17 – Data Valid but Below Normal: Secondary Clutch Calibration touch point failed below minimum limit.

FMI 31 – Condition Exists: Initial Secondary Input Speed not detected with working Secondary Input Speed sensor.

Fallback

FMI 0:

- Amber and red warning lamp on
- No degraded performance

Note: Clutch damage may occur at excessively high RPMs.

FMI 1, 10, 11, 15, 17:

- Amber warning lamp on
- PTO Mode prohibited
- Secondary Clutch disengaged
- 2nd, 4th, 6th, and 7th gears unavailable

FMI 12, 14, 31:

- Amber warning lamp on
- PTO Mode prohibited
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

FMI 0: Secondary input speed less than 4000 RPM.

FMI 1: Secondary Clutch slip not detected.

FMI 10, 15, 17: Successful Clutch Calibration performed.

FMI 11, 12, 14, 31: Key cycle

Possible Causes

FMI 0:

- Grade back-drive
  - Torque locked
- Engine over speed

FMI 1:

- Oil contamination
- Dual-clutch
  - Worn or damaged
- Secondary Input Shaft failure
- Secondary Driven Gear failure
- Low hydraulic pressure
- J1939 engine torque reporting error

FMI 10, 15, 17:

- Dual-clutch
  - Worn or damaged
- Low hydraulic pressure
- High hydraulic pressure

FMI 11:

- Rail Fork
  - Bent
  - Worn wear pads
  - Roll pins sheared
  - Fork broken
- Synchronizer failure
- Gear failure
- Upper or Lower Shaft failure

FMI 12, 14:

- TCM
  - Internal failure
  - Software issue

FMI 31:

- PTO (if equipped)
  - Improper installation (no backlash)
  - Mechanical failure
- Secondary Input Shaft
  - Shaft unable to rotate (transmission stuck in gear)
- Mechanical failure
- Clutch cooling system failure

Additional Tools

Reference TRSM0990 for all removal, installation, and service procedures

Fault Code 710 Troubleshooting

A

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

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

   Note: If Fault Code 710 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 710 FMI 0, 1, 11, 12, or 14 is Active or Inactive, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If Fault Code 710 FMI 10,15, or 17 is Active or Inactive, go to **Step B.**
   - If Fault Code 710 FMI 31 is Active or Inactive, go to **Step C.**

B

Purpose: *Perform Clutch Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Go to “Service Routines”.
4. Select “Start” Clutch Touch Point (PTP) Calibration and follow on-screen instructions.
   - If Clutch Touch Point (PTP) Calibration is successful, Test Complete.
   - If Clutch Touch Point (PTP) Calibration is unsuccessful, replace dual-clutch. Go to **Step V.**

C

Purpose: *Inspect transmission for a PTO.*

1. Inspect transmission for a PTO.
   - If not equipped with a PTO, go to **Step E.**
   - If equipped with a PTO, go to **Step D.**

D

Purpose: *Inspect PTO for proper installation and condition.*

1. Inspect transmission PTO drive to driven gear backlash per PTO manufacture specification.
2. Inspect PTO for a mechanical failure.
   - If no fault found, go to **Step E.**
   - If fault found, reference OEM, Body Builder and/or PTO manufacture for repair or replacement. Go to **Step V.**

E

Purpose: *Perform Service Bay Initiated Test.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Go to “Service Routines”.
4. Select “Start” Clutch Cooling Test and follow on-screen instructions.
    - Retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
    - If no codes set and the vehicle operates properly, Test Complete.
    - If Fault Code 710 sets Active during the test drive, go to **Step A.**
    - If a fault code other than 710 sets, troubleshoot per the “Fault Code Isolation Procedure Index” on page 13.

Fault Code 720: Rail A Primary Operation

J1939: SA 3 SPN 6144 FMI 0, 1, 2, 7, 10, 11, 13, 14, 15, 16, 17, 18, 20, 21, 31

Overview

The Procision transmission utilizes Rail A to engage 1st/2nd and Reverse gears. Rail A operation is hydraulically controlled to mechanically engage a gear. Position of Rail A Primary is monitored by the 3-Rail Position Sensor.

Detection

The TCM monitors shift Rail A Primary Operation. If incorrect operation is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Rail A cannot disengage 1st/2nd gear.

FMI 1 – Data Valid but Below Normal: Rail A cannot disengage Reverse gear.

FMI 2 – Data Erratic: Rail A unable to achieve Neutral during calibration.

FMI 7 – Mechanical System Not Responding: Rail A cannot move towards 1st/2nd gear from Neutral.

FMI 10 – Abnormal Rate of Change: Rail A velocity insufficient during calibration.

FMI 11 – Failure Mode Not Identifiable: Rail A movement beyond 1st/2nd gear.

FMI 13 – Out of Calibration: Rail calibration required.

FMI 14 – Special Instructions: Rail A cannot move towards Reverse gear from Neutral.

FMI 15 – Data Valid but Above Normal: Rail A cannot fully engage reverse gear.

FMI 16 – Data Valid but Above Normal: Rail A cannot achieve Neutral from 1st/2nd gear.

FMI 17 – Data Valid but Below Normal: Rail A cannot fully engage 1st/2nd gear.

FMI 18 – Data Valid but Below Normal: Rail A cannot achieve Neutral from Reverse gear.

FMI 20 – Data Drifted High: Rail A full travel excessive during calibration.

FMI 21 – Data Drifted Low: Rail A full travel insufficient during calibration.

FMI 31 – Condition Exists: Rail A movement beyond Reverse gear.

Fallback

FMI 0, 1, 7, 14, 15, 16, 17, 18:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

FMI 2, 10, 20, 21:

- Amber warning lamp on
- No degraded performance

Note: If Rail A Position Secondary is not available:

- Transmission will stay in current gear
- Primary and Secondary clutch disengaged
- PTO Mode prohibited

FMI 11, 31:

- Amber warning lamp on
- Transmission will stay in current gear
- Primary and Secondary clutch disengaged
- PTO Mode prohibited

Note: If Rail A is disengaged:

- Only engaged gears allowed

FMI 13:

- Amber warning lamp on
- Transmission will stay in current gear
- Primary and Secondary clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 0, 1, 7, 14, 15, 16, 17, 18: Key cycle and successful rail sweep.

FMI 2, 10, 13, 20, 21: Successful rail calibration performed.

FMI 11, 31: Key Cycle

Possible Causes

FMI 0, 1, 15, 17, 21:

- Rail A Piston
  - Seal damaged
  - Snap ring missing (FMI 1 and 17)
- Rail A Rod Seal
  - Seal damaged
- 1st/2nd/Reverse Synchronizer
  - Clutching teeth damaged
  - Binding
- 1st/2nd and Reverse Gears
  - Clutching teeth damaged
- Rail A Fork
  - Fork bent
- Rail A Detent
  - Binding
- Rail A Valve Solenoid (RAVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail A Valve (RAV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Dual Clutch
  - Does not release (Except FMI 21)
- Low hydraulic pressure
- Extreme cold temperatures

FMI 2, 7, 10, 14, 16, 18:

- Rail A Piston
  - Seal damaged
  - Snap ring missing (FMI 7 and 18)
- Rail A Rod Seal
  - Seal damaged
- Rail A Valve Solenoid (RAVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail A Valve (RAV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Rail A Detent
  - Binding
- Rail A Fork
  - Fork bent (FMI 16 and 18)
- Low hydraulic pressure
- Extreme cold temperatures

FMI 11, 20, 31:

- Rail A Fork
  - Roll pin sheared
  - Worn wear pads
  - Fork broken
  - Fork bent

FMI 13:

- No rail calibration data stored

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Fault Code 720 Troubleshooting

A

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

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

   Note: If Fault Code 720 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 720 FMI 0, 1, 7, 11, 14, 15, 16, 17, 18 or 31 is set, go to **Step B.**
   - If Fault Code 720 FMI 2, 10, 13, 20 or 21 is set, go to **Step C.**

B

Purpose: *Perform Service Bay Initiated Test.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and Service Bay Initiated Tests.
4. Select Shift Rail Actuation
   - If Shift Rail Actuation is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton". Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail A fault codes set Active, go to **Step D.**

C

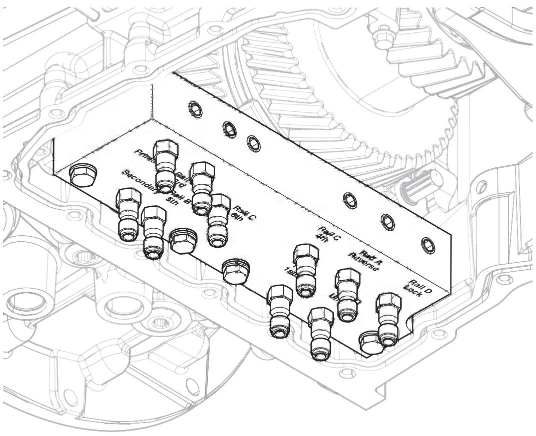
Purpose: *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton". Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

     Note: FMI 13 will set Active if no calibration data is stored. If fault code goes Inactive after Rail Calibration, Test Complete.
   - If only Shift Rail A fault codes set Active, go to **Step D.**

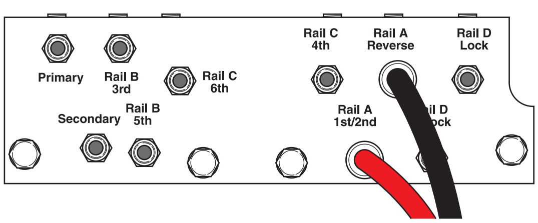
D	***Purpose:*** *Actuate Rail A with Diagnostic Manifold tool.*

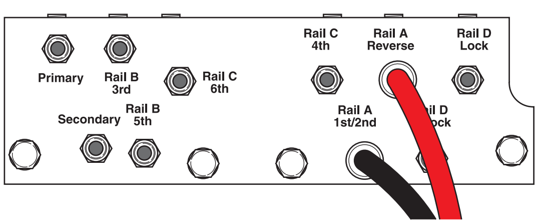
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



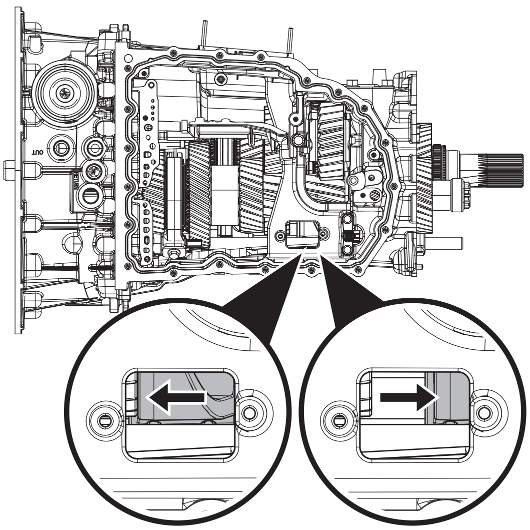
6. Apply air alternating between Rail A 1st/2nd port and Rail A Reverse port to cycle rail.

   Note: If synchronizer is engaged into gear, apply air to opposing port.





7. Watch for Rail A fork to fully engage synchronizer into 1st/2nd and Reverse gear. Cycle rail multiple times.



- If fork does not move or does not fully engage 1st/2nd or Reverse gear, go to **Step E.**
- If fork fully engages 1st/2nd and Reverse gear, go to **Step F.**

E

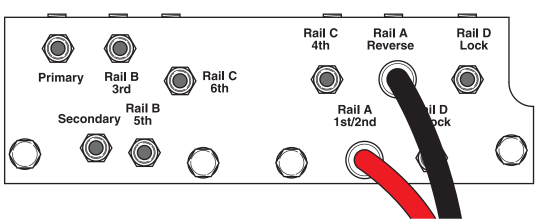
Purpose: *Verify mechanical condition of 1st/2nd, Reverse synchronizer and detent.*

1. Use pry bar to engage Rail A fork into 1st/2nd and Reverse gears.
   - If fork does not move or does not fully engage 1st/2nd or Reverse gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 1st/2nd, Reverse synchronizer or detent. Go to **Step V.**
   - If fork fully engages 1st/2nd and Reverse gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**

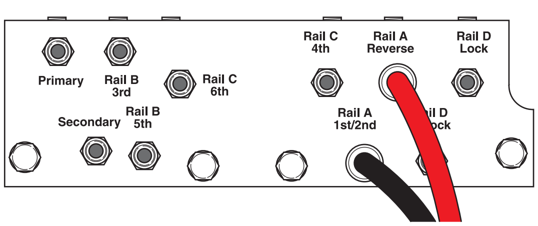
F

Purpose: *Verify condition of Rail A Piston and Rod Seals.*

1. Apply air to Rail A 1st/2nd port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail A Reverse port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**
   - If all result(s) are in range, replace RAVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail A 1st/2nd Port	0 PSI	
Rail A Reverse Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 720 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 720 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 740: Rail B Operation

J1939: SA 3 SPN 6145 FMI 0, 1, 2, 7, 10, 11, 14, 15, 16, 17, 18, 20, 21, 31

Overview
The Procision transmission utilizes Rail B to engage 5th/7th and 3rd gears. Rail B operation is hydraulically controlled to mechanically engage a gear. Position of Rail B is monitored by the 3-Rail Position Sensor.

Detection
The TCM monitors shift Rail B operation. If incorrect operation is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active
FMI 0 – Data Valid but Above Normal: Rail B cannot disengage 5th/7th gear.

FMI 1 – Data Valid but Below Normal: Rail B cannot disengage 3rd gear.

FMI 2 – Data Erratic: Rail B unable to achieve Neutral during calibration.

FMI 7 – Mechanical System Not Responding: Rail B cannot move towards 5th/7th gear from Neutral.

FMI 10 – Abnormal Rate of Change: Rail B velocity insufficient during calibration.

FMI 11 – Failure Mode Not Identifiable: Rail B movement beyond 5th/7th gear.

FMI 14 – Special Instructions: Rail B cannot move towards 3rd gear from Neutral.

FMI 15 – Data Valid but Above Normal: Rail B cannot fully engage 3rd gear.

FMI 16 – Data Valid but Above Normal: Rail B cannot achieve Neutral from 5th/7th gear.

FMI 17 – Data Valid but Below Normal: Rail B cannot fully engage 5th/7th gear.

FMI 18 – Data Valid but Below Normal: Rail B cannot achieve Neutral from 3rd gear.

FMI 20 – Data Drifted High: Rail B full travel excessive during calibration.

FMI 21 – Data Drifted Low: Rail B full travel insufficient during calibration.

FMI 31 – Condition Exists: Rail B movement beyond 3rd gear.

Fallback
All FMIs:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

Note: If Rail C is disengaged:

- Secondary Clutch disengaged
- 2nd, 4th, 6th, 7th gears unavailable

Conditions to Set Fault Code Inactive
FMI 0, 1, 7, 14, 15, 16, 17, 18: Key cycle and successful rail sweep.

FMI 2, 10, 20, 21: Successful rail calibration performed.

FMI 11, 31: Key Cycle

Possible Causes

FMI 0, 1, 15, 17, 21:

- Rail B Piston
  - Seal damaged
  - Snap ring missing (FMI 1 and 17)
- Rail B Rod Seal
  - Seal damaged
- 5th/7th/3rd Synchronizer
  - Clutching teeth damaged
  - Binding
- 5th/7th and 3rd Gears
  - Clutching teeth damaged
- Rail B Fork
  - Fork bent
- Rail B Detent
  - Binding
- Rail B Valve Solenoid (RBVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail B Valve (RBV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Dual Clutch
  - Does not release (Except FMI 21)
- Low hydraulic pressure
- Rail B Magnet
  - Detached
- Extreme cold temperatures

FMI 2, 7, 10, 14, 16, 18:

- Rail B Piston
  - Seal damaged
  - Snap ring missing (FMI 7 and 18)
- Rail B Rod Seal
  - Seal damaged
- Rail B Valve Solenoid (RBVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail B Valve (RBV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Rail B Detent
  - Binding
- Rail B Fork
  - Fork bent (FMI 16 and 18)
- Low hydraulic pressure
- Extreme cold temperatures

FMI 11, 20, 31:

- Rail B Fork
  - Roll pin sheared
  - Worn wear pads
  - Fork broken
  - Fork bent

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Fault Code 740 Troubleshooting

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

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

   Note: If Fault Code 740 is Inactive and there are other Active faults, troubleshoot all Active faults first.

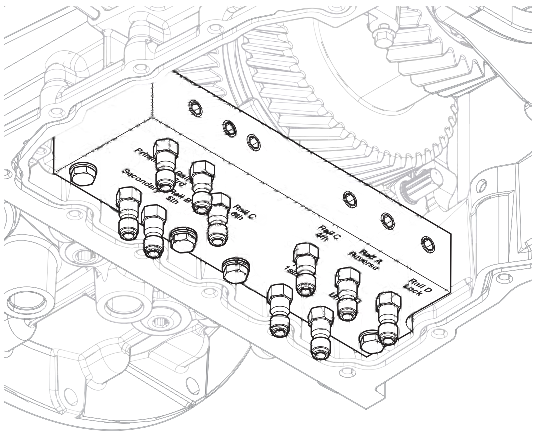
   - Go to **Step B.**

B ***Purpose:*** *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routines.
4. Select Start Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail B fault codes set Active, go to **Step C.**

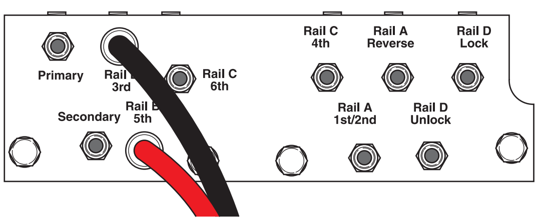
C ***Purpose:*** *Actuate Rail B with Diagnostic Manifold tool.*

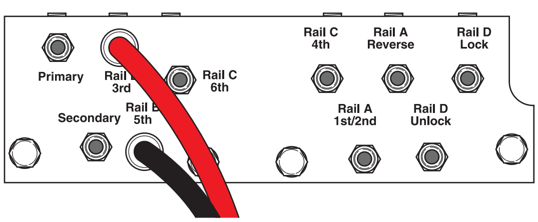
1. Install Diagnostic Manifold tool.



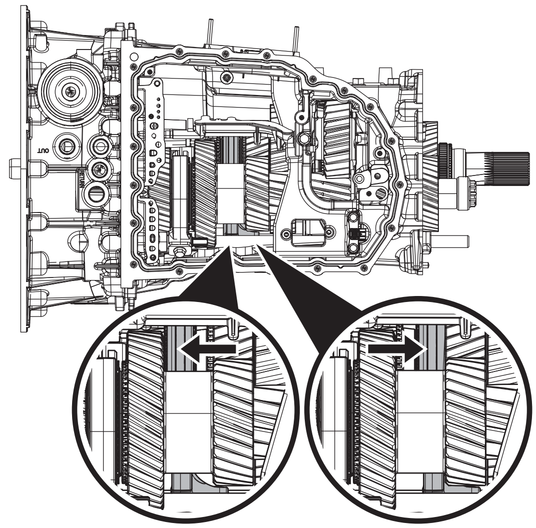
2. Apply air alternating between Rail B 5th/7th port and Rail B 3rd port to cycle rail.

Note: If synchronizer is engaged into gear, apply air to opposing port.





3. Watch for Rail B fork to fully engage synchronizer into 5th/7th and 3rd gear. Cycle rail multiple times.



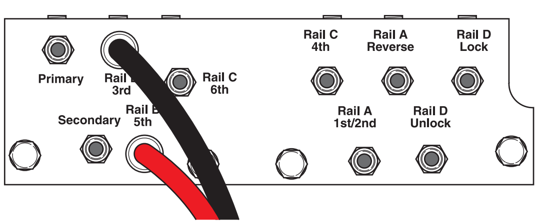
- If fork does not move or does not fully engage 5th/7th or 3rd gear, go to **Step D.**
- If fork fully engages 5th/7th and 3rd gear, go to **Step E.**

D ***Purpose:*** *Verify mechanical condition of 5th/7th, 3rd gear, synchronizer and detent.*

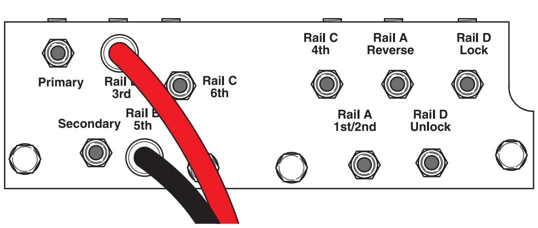
1. Use pry bar to engage Rail B fork into 5th/7th and 3rd gear.
   - If fork does not move or does not fully engage 5th/7th and 3rd gear, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 5th/7th and 3rd gear, synchronizer or detent. Go to **Step V.**
   - If fork fully engages 5th/7th and 3rd gear, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail B Piston and Rod Seals. Go to **Step V.**

E ***Purpose:*** *Verify condition of Rail B Piston and Rod Seals.*

1. Apply air to Rail B 5th/7th port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail B 3rd port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail B Piston and Rod Seals. Go to **Step V.**
   - If all result(s) are in range, replace RBVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail C 6th Port	0 PSI	
Rail C 4th Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 740 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 740 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 760: Rail C Operation

J1939: SA 3 SPN 6146 FMI 0, 1, 2, 7, 10, 11, 14, 15, 16, 17, 18, 20, 21, 31

Overview

The Procision transmission utilizes Rail C to engage 6th and 4th gears. Rail C operation is hydraulically controlled to mechanically engage a gear. Position of Rail C is monitored by the 3-Rail Position Sensor.

Detection

The TCM monitors shift Rail C operation. If incorrect operation is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Rail C cannot disengage 6th gear.

FMI 1 – Data Valid but Below Normal: Rail C cannot disengage 4th gear.

FMI 2 – Data Erratic: Rail C unable to achieve Neutral during calibration.

FMI 7 – Mechanical System Not Responding: Rail C cannot move towards 6th gear from Neutral.

FMI 10 – Abnormal Rate of Change: Rail C velocity insufficient during calibration.

FMI 11 – Failure Mode Not Identifiable: Rail C movement beyond 6th gear.

FMI 14 – Special Instructions: Rail C cannot move towards 4th gear from Neutral.

FMI 15 – Data Valid but Above Normal: Rail C cannot fully engage 4th gear.

FMI 16 – Data Valid but Above Normal: Rail C cannot achieve Neutral from 6th gear.

FMI 17 – Data Valid but Below Normal: Rail C cannot fully engage 6th gear.

FMI 18 – Data Valid but Below Normal: Rail C cannot achieve Neutral from 4th gear.

FMI 20 – Data Drifted High: Rail C full travel excessive during calibration.

FMI 21 – Data Drifted Low: Rail C full travel insufficient during calibration.

FMI 31 – Condition Exists: Rail C movement beyond 4th gear.

Fallback

All FMIs:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

Note: If Rail C is disengaged:

- Secondary Clutch disengaged
- 2nd, 4th, 6th, 7th gears unavailable

Conditions to Set Fault Code Inactive

FMI 0, 1, 7, 14, 15, 16, 17, 18: Key cycle and successful rail sweep.

FMI 2, 10, 20, 21: Successful rail calibration performed.

FMI 11, 31: Key Cycle

Possible Causes

FMI 0, 1, 15, 17, 21:

- Rail C Piston
  - Seal damaged
  - Snap ring missing (FMI 1 and 17)
- Rail C Rod Seal
  - Seal damaged
- 6th/4th Synchronizer
  - Clutching teeth damaged
  - Binding
- 6th and 4th Gears
  - Clutching teeth damaged
- Rail C Fork
  - Fork bent
- Rail C Detent
  - Binding
- Rail C Valve Solenoid (RCVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail C Valve (RCV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Dual Clutch
  - Does not release (Except FMI 21)
- Low hydraulic pressure
- Extreme cold temperatures

FMI 2, 7, 10, 14, 16, 18:

- Rail C Piston
  - Seal damaged
  - Snap ring missing (FMI 7 and 18)
- Rail C Rod Seal
  - Seal damaged
- Rail C Valve Solenoid (RCVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail C Valve (RCV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Rail C Detent
  - Binding
- Rail C Fork
  - Fork bent (FMI 16 and 18)
- Low hydraulic pressure
- Extreme cold temperatures

FMI 11, 20, 31:

- Rail C Fork
  - Roll pin sheared
  - Worn wear pads
  - Fork broken
  - Fork bent

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Fault Code 760 Troubleshooting

A

Purpose: Check for Active or Inactive fault codes.

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

   Note: If Fault Code 760 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 760 FMI 0, 1, 7, 11, 14, 15, 16, 17, 18 or 31 is set, go to **Step B.**
   - If Fault Code 760 FMI 2, 10, 20 or 21 is set, go to **Step C.**

B

Purpose: Perform Service Bay Initiated Test.

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and Service Bay Initiated Tests.
4. Select Shift Rail actuation
   - If Shift Rail Actuation is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton". Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail C fault codes set Active, go to **Step D.**

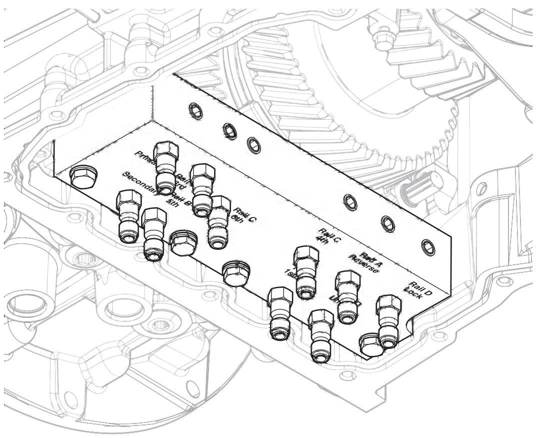
C

Purpose: Perform Rail Calibration.

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton". Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail C fault codes set Active, go to **Step D.**

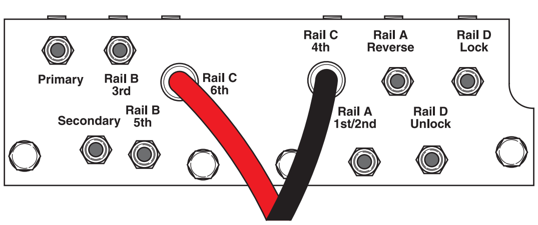
D | ***Purpose:*** *Actuate Rail C with Diagnostic Manifold tool.*

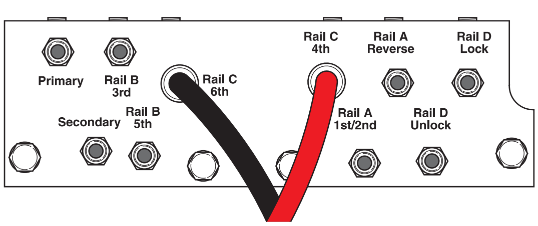
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



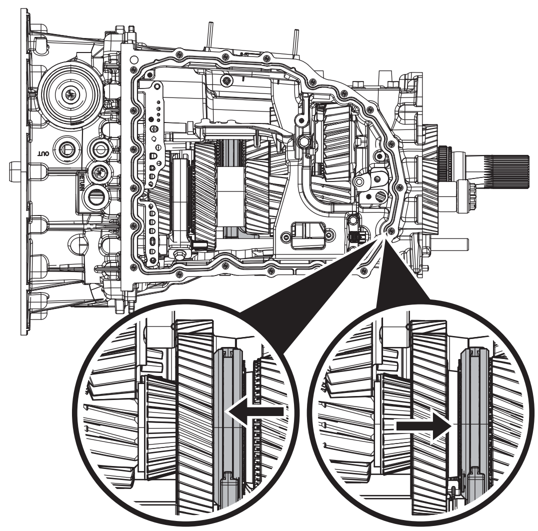
6. Apply air alternating between Rail C 6th port and Rail C 4th port to cycle rail.

   Note: If synchronizer is engaged into gear, apply air to opposing port.





7. Watch for Rail C fork to fully engage synchronizer into 6th and 4th gear. Cycle rail multiple times.



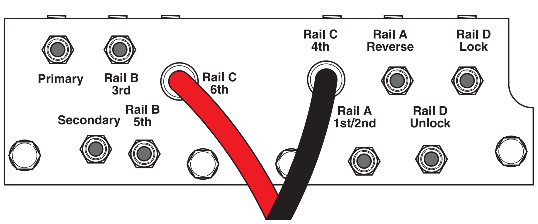
- If fork does not move or does not fully engage 6th or 4th gear, go to **Step E.**
- If fork fully engages 6th and 4th gear, go to **Step F.**

E ***Purpose:*** *Verify mechanical condition of 6th and 4th gear, synchronizer and detent.*

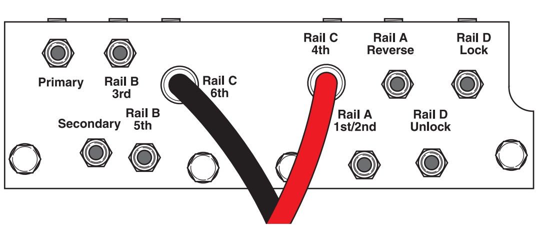
1. Use pry bar to engage Rail C fork into 6th and 4th gear.
   - If fork does not move or does not fully engage 6th and 4th gear, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 6th and 4th gear, synchronizer or detent. Go to **Step V.**
   - If fork fully engages 6th and 4th gear, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail C Piston and Rod Seal. Go to **Step V.**

F ***Purpose:*** *Verify condition of Rail C Piston and Rod Seal.*

1. Apply air to Rail C 6th port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail C 4th port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail C Piston and Rod Seal. Go to **Step V.**
   - If all result(s) are in range, replace RCVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail C 6th Port	0 PSI	
Rail C 4th Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 760 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 760 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 775: Rail D Operation

J1939: SA 3 SPN 6147 FMI 1, 2, 10, 11, 14, 15, 18, 20, 21, 31

Overview

The Procision transmission utilizes Rail D to Lock and Unlock the cluster gear to the lower shaft. Rail D operation is hydraulically controlled to mechanically engage a gear. Position of Rail D is monitored by the Rail D Position Sensor.

Detection

The TCM monitors shift Rail D operation. If incorrect operation is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 1 – Data Valid but Below Normal: Rail D cannot disengage Lock.

FMI 2 – Data Erratic: Rail D unable to achieve Unlock during calibration.

FMI 10 – Abnormal Rate of Change: Rail D velocity insufficient during calibration.

FMI 11 – Failure Mode Not Identifiable: Rail D movement beyond Lock.

FMI 14 – Special Instructions: Rail D cannot move towards Lock from Unlock.

FMI 15 – Data Valid but Above Normal: Rail D cannot fully engage Lock.

FMI 18 – Data Valid but Below Normal: Rail D cannot achieve Unlock from Lock.

FMI 20 – Data Drifted High: Rail D full travel excessive during calibration.

FMI 21 – Data Drifted Low: Rail D full travel insufficient during calibration.

FMI 31 – Condition Exists: Rail D movement beyond Unlock.

Fallback

All FMIs:

- Amber warning lamp on
- Only engaged gears allowed
- PTO Mode prohibited

Note: Note: If Rail D is disengaged:

- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th, and 7th gears unavailable
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a Rail D Position fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

Conditions to Set Fault Code Inactive

FMI 1, 14, 15, 18: Key cycle and successful rail sweep.

FMI 2, 10, 20, 21: Successful rail calibration performed.

FMI 11, 31: Key Cycle

Possible Causes

FMI 1, 15, 21:

- Rail D Piston
  - Seal damaged
  - Snap ring missing (FMI 1)
- Rail D Rod Seal
  - Seal damaged
- Lock Synchronizer
  - Clutching teeth damaged
  - Binding
- Cluster Gear
  - Clutching teeth damaged
- Rail D Fork
  - Fork bent
- Rail D Detent
  - Binding
- Rail D Valve Solenoid (RDVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail D Valve (RDV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Dual Clutch
  - Does not release (Except FMI 21)
- Low hydraulic pressure
- Extreme cold temperatures

FMI 2, 10, 14, 18:

- Rail D Piston
  - Seal damaged
  - Snap ring missing (FMI 2 and 18)
- Rail D Rod Seal
  - Seal damaged
- Rail D Valve Solenoid (RDVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail D Valve (RDV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Rail D Detent
  - Binding
- Rail D Fork
  - Fork bent (FMI 2 and 18)
- Low hydraulic pressure
- Extreme cold temperatures

FMI 11, 20, 31:

- Rail D Fork
  - Mounting cap screw sheared
  - Worn wear pads
  - Fork broken
  - Fork bent
  -

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Fault Code 775 Troubleshooting

A

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

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

   Note: If Fault Code 775 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 775 FMI 1, 11, 14, 15, 18 or 31 is set, go to **Step B.**
   - If Fault Code 775 FMI 2, 10, 20 or 21 is set, go to **Step C.**

B

***Purpose:** Perform Service Bay Initiated Test.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and Service Bay Initiated Tests.
4. Select Shift Rail actuation
   - If Shift Rail Actuation is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail D fault codes set Active, go to **Step D.**

C

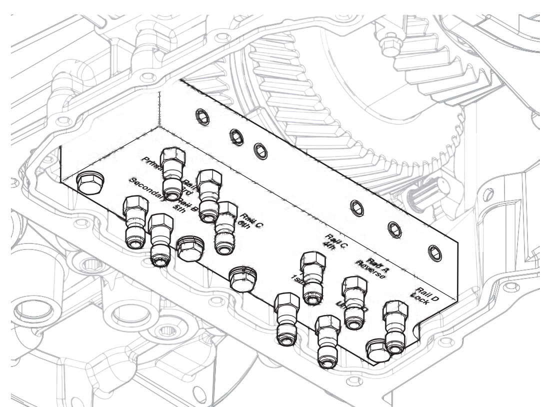
***Purpose:** Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail D fault codes set Active, go to **Step D.**

D

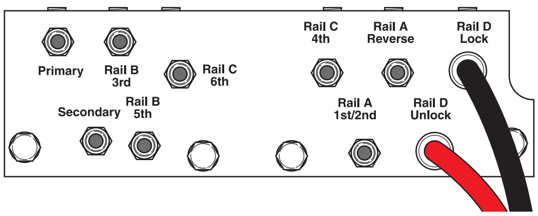
***Purpose:** Actuate Rail D with Diagnostic Manifold tool.*

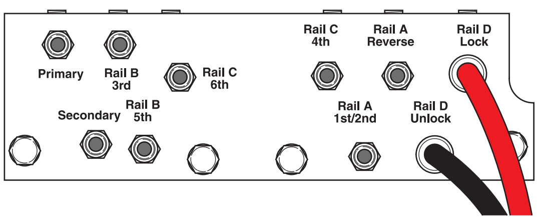
1. Install Diagnostic Manifold tool.



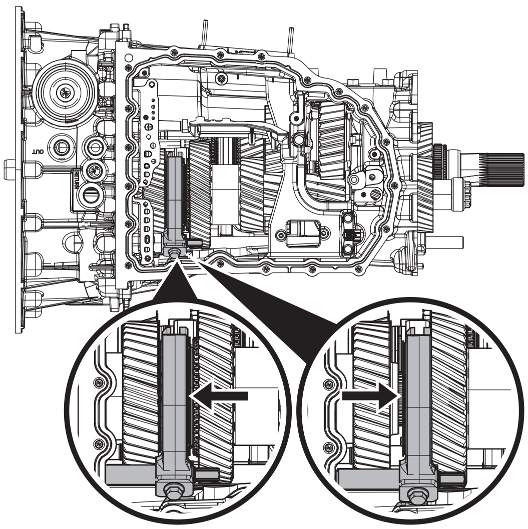
2. Apply air alternating between Rail D Unlock port and Rail D Lock port to cycle rail.

   Note: If synchronizer is engaged into gear, apply air to opposing port.





3. Watch for Rail D fork to Unlock synchronizer and fully engage Lock. Cycle rail multiple times.



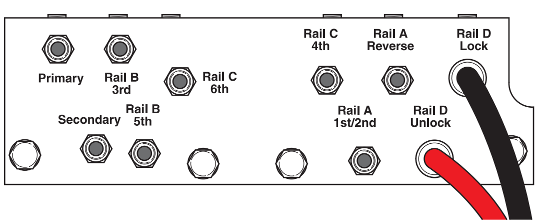
- If fork does not move or does not Unlock and fully engage Lock, go to **Step E.**
- If fork Unlocks and fully engages Lock, go to **Step F.**

E ***Purpose:*** *Verify mechanical condition of Lock synchronizer, detent and Rail D.*

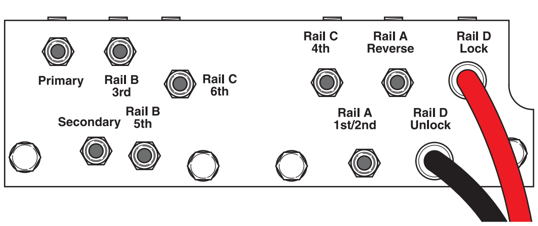
1. Use pry bar to Unlock Rail D fork and engage Lock.
   - If fork does not move or does not Unlock and fully engage Lock, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D assembly. Go to **Step V.**
   - If fork Unlocks and fully engages Lock, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D Piston and Rod Seals. Go to **Step V.**

F ***Purpose:*** *Verify condition of Rail D Piston and Rod Seals.*

1. Apply air to Rail D Unlock port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail D Lock port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail D Piston and Rod Seals. Go to **Step V.**
   - If all result(s) are in range, replace RDVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail D Unlock Port	0 PSI	
Rail D Lock Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 775 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 775 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 790: Rail A Secondary Operation

J1939: SA 3 SPN 6148 FMI 2, 10, 20, 21

Overview
The Procision transmission utilizes Rail A to engage 1st/2nd and Reverse gears. Rail A operation is hydraulically controlled to mechanically engage a gear. Position of Rail A Secondary is monitored by the 3-Rail Position Sensor.

Detection
The TCM monitors shift Rail A Secondary Operation. If incorrect operation is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active
FMI 2 – Data Erratic: Rail A unable to achieve Neutral during calibration.

FMI 10 – Abnormal Rate of Change: Rail A velocity insufficient during calibration.

FMI 20 – Data Drifted High: Rail A full travel excessive during calibration.

FMI 21 – Data Drifted Low: Rail A full travel insufficient during calibration.

Fallback
FMI 2, 10, 20, 21:

- Amber warning lamp on
- No degraded performance

Note: Note: If Rail A Primary Position is not available:

- Transmission will stay in current gear
- Primary and Secondary clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive
FMI 2, 10, 20, 21: Successful rail calibration performed.

Possible Causes
FMI 21:

- Rail A Piston
  - Seal damaged
- Rail A Rod Seal
  - Seal damaged
- 1st/2nd/Reverse Synchronizer
  - Clutching teeth damaged
  - Binding
- 1st/2nd and Reverse Gears
  - Clutching teeth damaged
- Rail A Fork
  - Fork bent
- Rail A Detent
  - Binding
- Rail A Valve Solenoid (RAVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail A Valve (RAV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Low hydraulic pressure
- Extreme cold temperatures

FMI 2, 10:

- Rail A Piston
  - Seal damaged
- Rail A Rod Seal
  - Seal damaged
- Rail A Valve Solenoid (RAVS)
  - Stuck closed
- Shift Pressure Solenoid 1 (SPS1)
  - Stuck open or closed
- Shift Pressure Solenoid 2 (SPS2)
  - Stuck open or closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail A Valve (RAV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- Rail A Detent
  - Binding
- Low hydraulic pressure
- Extreme cold temperatures

FMI 20:

- Rail A Fork
  - Roll pin sheared
  - Worn wear pads
  - Fork broken
  - Fork bent

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Fault Code 790 Troubleshooting

A

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

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

   Note: If Fault Code 790 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 790 FMI 2, 10, 20 or 21 is set, go to **Step B.**

B

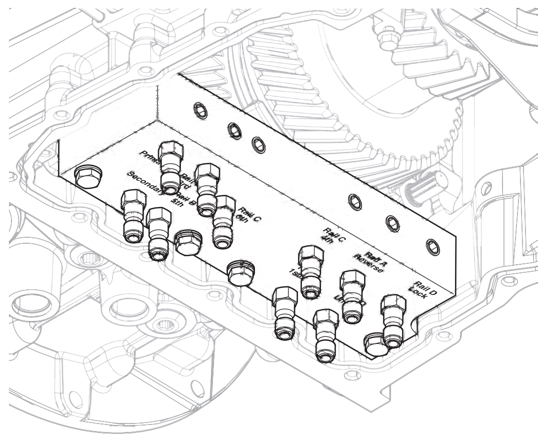
Purpose: *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton". Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail A fault codes set Active, go to **Step C.**

C

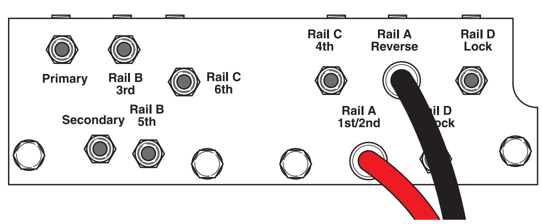
Purpose: *Actuate Rail A with Diagnostic Manifold tool.*

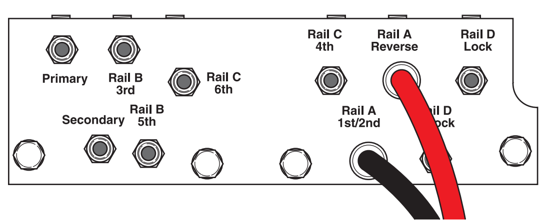
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



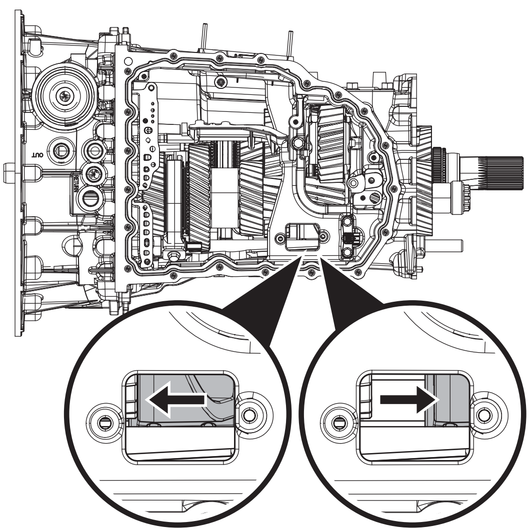
6. Apply air alternating between Rail A 1st/2nd port and Rail A Reverse port to cycle rail.

   Note: If synchronizer is engaged into gear, apply air to opposing port.





7. Watch for Rail A fork to fully engage synchronizer into 1st/2nd and Reverse gear. Cycle rail multiple times.



- If fork does not move or does not fully engage 1st/2nd or Reverse gear, go to **Step D.**
- If fork fully engages 1st/2nd and Reverse gear, go to **Step E.**

D

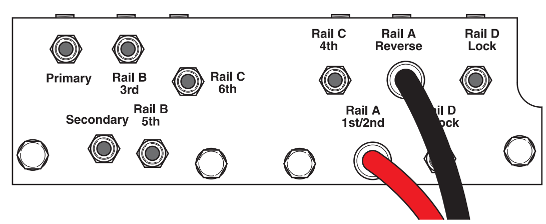
Purpose: *Verify mechanical condition of 1st/2nd, Reverse synchronizer and detent.*

1. Use pry bar to engage Rail A fork into 1st/2nd and Reverse.
   - If fork does not move or does not fully engage 1st/2nd or Reverse, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 1st/2nd, Reverse synchronizer or detent. Go to **Step V.**
   - If fork fully engages 1st/2nd and Reverse, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**

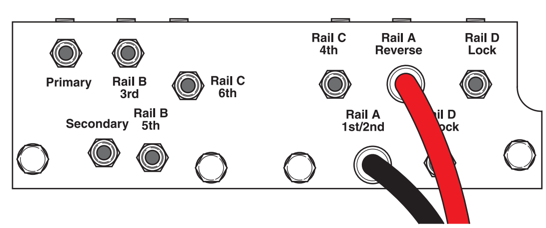
E

Purpose: *Verify condition of Rail A Piston and Rod Seals.*

1. Apply air to Rail A 1st/2nd port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail A Reverse port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

   Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

   - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**
   - If all result(s) are in range, replace RAVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail A 1st/2nd Port	0 PSI	
Rail A Reverse Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 790 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 790 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 800: Rail A Secondary Calibration

J1939: SA 3 SPN 5955 FMI 7, 20, 21

Overview

The Procision transmission is equipped with a 3-Rail Position Sensor to monitor shift rail A, B, and C. The 3-Rail Position Sensor has dual sensors for Rail A; primary and secondary. This allows for a redundant Rail A signal to engage the transmission into gear in the event one signal is not available. Calibration of Rail A Secondary Position is necessary for proper rail operation.

Detection

The TCM monitors shift Rail A Secondary Position during calibration. If a system failure is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 7 – Mechanical System Not Responding: No movement in aft direction during Rail A calibration.

FMI 20 – Data Drifted High: Movement in aft direction insufficient during Rail A calibration.

FMI 21 – Data Drifted Low: Movement in fore direction insufficient during Rail A calibration.

Fallback

FMI 7, 20, 21:

- Amber warning lamp on
- No degraded performance

Note: Note: If Rail A Primary Position is not available:

- Transmission will stay in current gear
- Primary and Secondary Clutch disengaged
- PTO Mode prohibited

Conditions to Set Fault Code Inactive

FMI 7, 20, 21: Successful rail calibration performed.

Possible Causes

FMI 7:

- Rail A Piston
  - Seal damaged
- Rail A Valve Solenoid (RAVS)
  - Stuck closed
- Actuation Control Manifold (ACM)
  - Restricted port
  - Rail A Valve (RAV) stuck closed
  - Control Pressure Valve (CPV) stuck closed
- SPS1
  - Stuck open
- SPS2
  - Stuck closed

FMI 20, 21:

- Rail A Piston
  - Seal damaged
- Rail A Rod Seal
  - Seal damaged
- 1st/2nd and Reverse Gears
  - Clutching teeth damaged
- Rail A Fork
  - Fork bent
- Low hydraulic pressure

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures
- Diagnostic Manifold

Fault Code 800 Troubleshooting

A

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

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

   Note: If Fault Code 800 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 800 FMI 7, 20, or 21 is set, go to **Step B.**

B

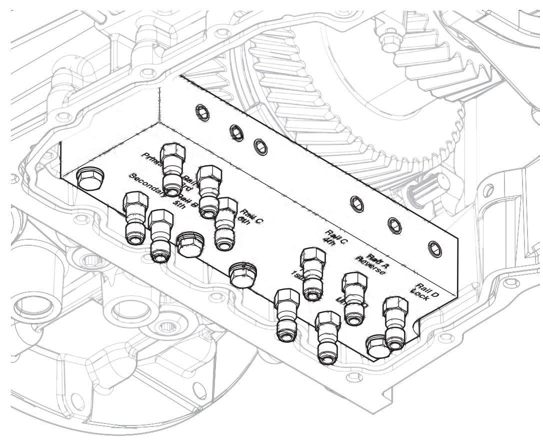
Purpose: *Perform Rail Calibration.*

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine.
4. Select Rail Calibration.
   - If Rail Calibration is successful or multiple rail fault codes set Active, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select “Send to Eaton”. Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If only Shift Rail A fault codes set Active, go to **Step C.**

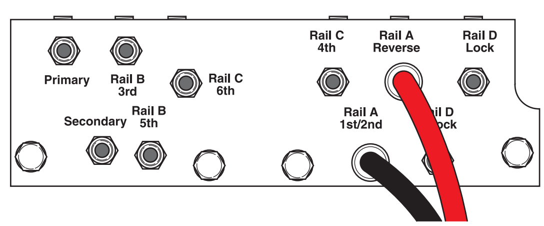
C

Purpose: *Actuate Rail A with Diagnostic Manifold tool.*

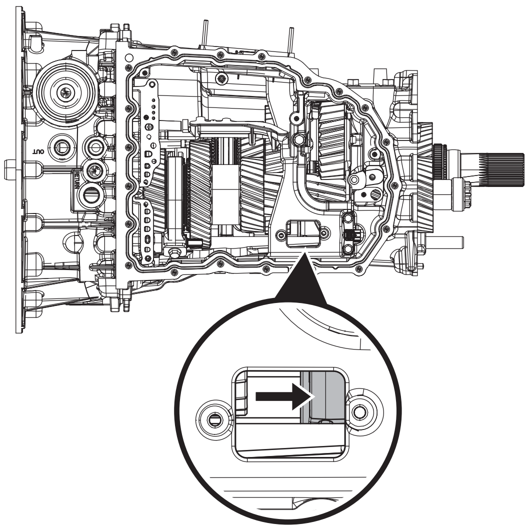
1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove ACM.
5. Install Diagnostic Manifold tool.



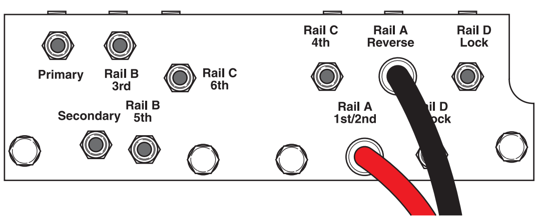
6. Apply air to Rail A Reverse port.



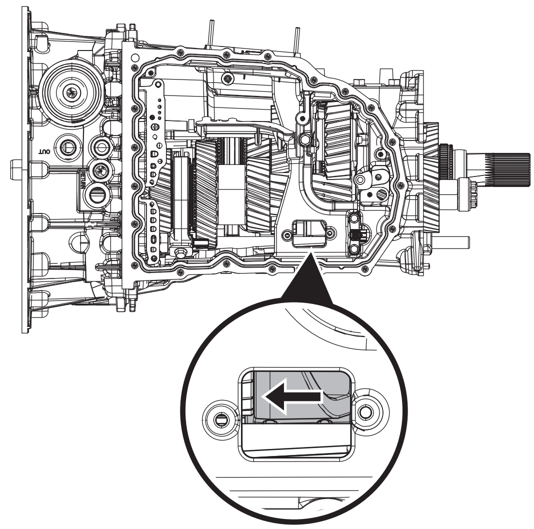
7. Watch for Rail A fork to fully engage synchronizer into Reverse gear.



8. Apply air to Rail A 1st/2nd port.



9. Watch for Rail A fork to fully engage synchronizer into 1st/2nd gear.



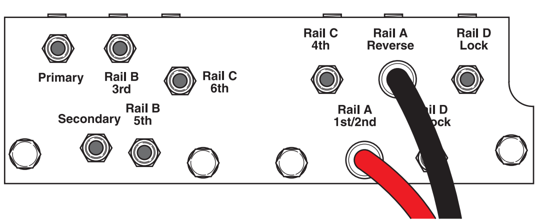
- If fork does not move or does not fully engage Reverse or 1st/2nd gear, go to **Step D.**
- If fork fully engages Reverse and 1st/2nd gear, go to **Step E.**

D ***Purpose:*** *Verify mechanical condition of 1st/2nd, Reverse synchronizer and detent.*

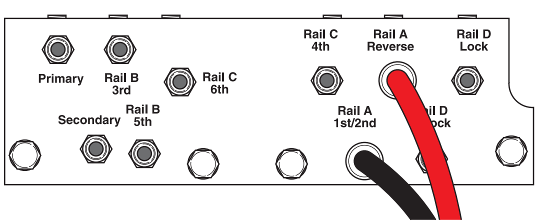
1. Use pry bar to engage Rail A fork into Reverse and 1st/2nd gears.
    - If fork does not move or does not fully engage Reverse or 1st/2nd gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of 1st/2nd, Reverse synchronizer or detent. Go to **Step V.**
    - If fork fully engages Reverse and 1st/2nd gears, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**

E ***Purpose:*** *Verify condition of Rail A Piston and Rod Seals.*

1. Apply air to Rail A 1st/2nd port.



2. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.
3. Apply air to Rail A Reverse port.



4. Release trigger and monitor pressure gauge for 10 seconds. Pressure (PSI) should not drop. Record results in table.

    Note: A poor seal at the diagnostic manifold tool or a leaky pressure regulator tool will cause improper leak down results.

    - If any result is out of range, reference service manual TRSM0990 for transmission disassembly, inspection, and repair of Rail A Piston and Rod Seals. Go to **Step V.**
    - If all result(s) are in range, replace RAVS and ACM. Go to **Step V.**

Air Application	Leak Down Range	Result
Rail A 1st/2nd Port	0 PSI	
Rail A Reverse Port	0 PSI	

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 800 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 800 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 805: Clutch Disable Valve

J1939: SA 3 SPN 5616 FMI 0, 12, 16

Overview
The Procision transmission is equipped with a hydraulically actuated dual-clutch. The transmission control module (TCM) can disengage the dual-clutch by closing the Clutch Disable Valve (CDV). CDV is normally closed via spring pressure and opened with line pressure. When CDV is open, this allows hydraulic pressure to engage the dual-clutch.

Detection
The TCM monitors Primary and Secondary Clutch Pressure. If pressure exists when CDV is commanded closed, the TCM will set the fault code Active.

Conditions to Set Fault Code Active
FMI 0 – Data Valid but Above Normal: CDV failed to disengage Primary Clutch.

FMI 12 – Bad Intelligent Device: Failed to command line pressure low during CDV check.

FMI 16 – Data Valid but Above Normal: CDV failed to disengage Secondary Clutch.

Fallback
All FMIs:

- Amber warning lamp on
- No degraded performance

Conditions to Set Fault Code Inactive
All FMIs: Key cycle

Possible Causes
FMI 0, 16:

- CDV
  - Stuck open

FMI 12:

- TCM
  - Software issue
  - Internal failure

Fault Code 805 Troubleshooting

A

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

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

   Note: If Fault Code 805 is Inactive and there are other Active faults, troubleshoot all Active faults first.

   - If Fault Code 805 FMI 0 or 16 is set, go to **Step B.**
   - If Fault Code 805 FMI 12 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions.

B

Purpose: *Inspect for contamination.*

1. Remove TCM.
2. Drain oil.
3. Remove sump pan and filter.
4. Remove Actuation Control Manifold (ACM).
5. Remove Pressure Control Primary Solenoid (PCPS).
6. Remove Pressure Control Secondary Solenoid (PCSS).
7. Remove Triple Pressure Sensor (TPS).
8. Inspect all components for contamination.
   - If contamination is found, contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**
   - If contamination is not found, replace ACM. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 805 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 805 sets, troubleshoot per the “Fault Code Isolation Procedure Index” on page 13.

Fault Code 810: Gear Engagement

J1939: SA 3 SPN 560 FMI: 0, 1, 16

Overview

The Procision transmission is equipped with Rail Position Sensors to monitor shift Rail A, B, C, and D. Gear engagement is determined by the position of each shift rail.

Detection

The Transmission Control Module (TCM) monitors all rail positions. If rail motion resulting in incompatible gear engagement is detected, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 0 – Data Valid but Above Normal: Shift Rail A and C engaged.

FMI 1 – Data Valid but Below Normal: Shift Rail A, B, and D engaged.

FMI 16 – Data Valid but Above Normal: Shift Rail B, C, and D engaged.

Fallback

All FMIs:

- Amber warning lamp on
- PTO Mode prohibited
- Transmission will stay in current gear

Note: If vehicle is stopped:

- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

All FMIs: Condition no longer exists.

Possible Causes

All FMIs:

- Rail (A, B, C, or D) Valve Solenoid
  - Stuck open
- Actuation Control Manifold (ACM)
  - Rail (A, B, C, or D) Valve stuck open

Additional Tools

- Reference TRSM0990 for all removal, installation, and service procedures

Fault Code 810 Troubleshooting

A

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

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

Note: If Fault Code 810 is Inactive and there are other Active faults, troubleshoot all Active faults first.

- If Fault Code 810 FMI 0, 1, or 16 is set, retrieve Snapshot and VPA data by creating a Service Activity Report within ServiceRanger. Select "Send to Eaton". Contact Eaton at (800) 826-4357 for further diagnostic instructions. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.

2. Reconnect all connectors and verify that all components are properly installed.

3. Key on.

4. Clear fault codes using ServiceRanger.

5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.

6. Check for fault codes using ServiceRanger.

- If no codes set and the vehicle operates properly, Test Complete.
- If Fault Code 810 sets Active during the test drive, go to **Step A.**
- If a fault code other than 810 sets, troubleshoot per the "Fault Code Isolation Procedure Index" on page 13.

Fault Code 815: Primary Clutch Temperature

J1939: SA 3 SPN 5939 FMI 0, 15, 16

Overview
The Procision transmission monitors Primary Clutch performance to calculate clutch operating temperature. If the temperature is extremely high, the Transmission Control Module (TCM) will adjust transmission operation to prevent damage.

Detection
The TCM monitors Primary Clutch Temperature. If the temperature is outside of preferred operating range, the TCM will set the fault code Active.

Conditions to Set Fault Code Active
FMI 0 – Data Valid but Above Normal (Most Severe): Primary Clutch Temperature most severe hot.

FMI 15 – Data Valid but Above Normal (Least Severe): Primary Clutch Temperature least severe hot.

FMI 16 – Data Valid but Above Normal (Moderately Severe): Primary Clutch Temperature moderately severe hot.

Fallback
FMI 0:

- Amber warning lamp on
- CA (Clutch Abuse) shown in display
- PTO Mode prohibited
- Primary Clutch disengaged
- Reverse Low, 1st, 3rd, 5th and 7th gears unavailable
- Reverse High (R2) available

Note: Reverse High (R2) is available only during a Primary Clutch Temperature fallback mode.

Note: Clutch Abuse (CA) may occur when launching in 2nd or Reverse High (R2).

FMI 15:

- CA (Clutch Abuse) shown in display
- Clutch micro-slipping prohibited

FMI 16:

- Amber warning lamp on
- CA (Clutch Abuse) shown in display
- Clutch torque reduced
- Creep prohibited
- Clutch micro-slipping prohibited
- Power shifting prohibited
- PTO Mode prohibited

Conditions to Set Fault Code Inactive
All FMIs: Primary Clutch Temperature cools to normal operating levels.

Possible Causes
All FMIs:

- Extreme or abusive operating conditions

Fault Code 815 Troubleshooting

A ***Purpose:*** *Clutch temperatures exceeded normal operating range.*

1. The Procision clutch experienced extreme or abusive operating conditions.

   Note: Attempting to hold the vehicle stationary on a grade using the accelerator may overheat the clutch and should not be performed.

   - Test complete

Fault Code 820: Secondary Clutch Temperature

J1939: SA 3 SPN 5940 FMI 0, 15, 16

Overview
The Procision transmission monitors Secondary Clutch performance to calculate clutch operating temperature. If the temperature is extremely high, the Transmission Control Module (TCM) will adjust transmission operation to prevent damage.

Detection
The TCM monitors Secondary Clutch Temperature. If the temperature is outside of preferred operating range, the TCM will set the fault code Active.

Conditions to Set Fault Code Active
FMI 0 – Data Valid but Above Normal (Most Severe): Secondary Clutch Temperature most severe hot.

FMI 15 – Data Valid but Above Normal (Least Severe): Secondary Clutch Temperature least severe hot.

FMI 16 – Data Valid but Above Normal (Moderately Severe): Secondary Clutch Temperature moderately severe hot.

Fallback
FMI 0:

- Amber warning lamp on
- CA (Clutch Abuse) shown in display
- PTO Mode prohibited
- Creep prohibited
- Secondary Clutch disengaged
- 2nd, 4th, 6th, and 7th gears unavailable

FMI 15:

- CA (Clutch Abuse) shown in display
- Clutch micro-slipping prohibited

FMI 16:

- Amber warning lamp on
- CA (Clutch Abuse) shown in display
- Clutch torque reduced
- Creep prohibited
- Clutch micro-slipping prohibited
- Power shifting prohibited
- PTO Mode prohibited

Conditions to Set Fault Code Inactive
All FMIs: Secondary Clutch Temperature cools to normal operating levels.

Possible Causes
All FMIs:

- Extreme or abusive operating conditions

Fault Code 820 Troubleshooting

A

Purpose: *Clutch temperatures exceeded normal operating range.*

1. The Procision clutch experienced extreme or abusive operating conditions.

   Note: Attempting to hold the vehicle stationary on a grade using the accelerator may overheat the clutch and should not be performed.

   - Test complete

Fault Code 900: PTO 1 Request

J1939: SA 3 SPN 3452 FMI 3, 4, 9, 13, 19, 20, 21

Overview

The Procision transmission is designed to provide enhanced controls for PTO 1 applications. The Transmission Control Module (TCM) receives a “PTO 1 Request” input from the vehicle to enter PTO 1 Mode. The TCM determines if conditions are suitable for PTO 1 Mode and supplies a “PTO 1 Engage” output to engage the PTO 1. Once the PTO 1 is engaged the TCM receives a “PTO 1 Confirm” input to complete the operation. The PTO 1 request message is connected to the TCM via J1939 control from the Body Control Module or the 20-Way TCM Body Harness. Refer to TRIG0990 for recommended PTO 1 wiring configuration.

Detection

The TCM monitors PTO 1 request signal via J1939 or the 20-Way TCM Body Harness Pin 15 to be “grounded” when PTO Mode is activated. If the PTO Request signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: PTO 1 Request signal greater than 5.25 V.

FMI 4 – Voltage Below Normal or Shorted Low: PTO 1 Request signal “grounded” when PTO 1 Mode is not configured.

FMI 9 – Abnormal Update Rate: PTO 1 message not received for 1 second.

FMI 13 – Out of Calibration: PTO 1 message not available.

FMI 19 – Received Network Data in Error: PTO 1 message invalid for 1 second.

FMI 20 – Data Drifted High: PTO 1 Request signal between 4–5.25 V.

FMI 21 – Data Drifted Low: PTO 1 Request signal between 1.5–2.5 V.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 1 Mode Prohibited

Conditions to Set Fault Code Inactive

FMI 3, 20: PTO 1 Request signal not shorted to power.

FMI 4: PTO 1 Mode configured or wiring corrected.

FMI 9, 13, 19: Body Control Module configured correctly or PTO 1 disabled

FMI 21: PTO 1 Confirm signal not shorted to ground.

Possible Causes

FMI 3:

- PTO 1 Request Wiring
  - Wiring shorted to power

FMI 4:

- PTO 1 Request Wiring
  - Wiring shorted to ground
- TCM not configured for PTO 1 Mode

FMI 9, 13, 19:

- PTO 1 J1939 control message not received or incorrect
  - Body Control Module configuration setting

FMI 20:

- PTO 1 Request Wiring
  - High resistance short to power

FMI 21:

- PTO 1 Request Wiring
  - High resistance short to ground

Fault Code 900 Troubleshooting

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 900 FMI 3, 4, 20, or 21 is Active, go to **Step C.**
   - If Fault Code 900 FMI 3, 4, 20, or 21 is Inactive, go to **Step B.**
   - If Fault Code 900 FMI 9, 13 or 19 is set, contact OEM regarding Body Control Module configuration settings. Go to **Step V.**

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

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

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the PTO 1 Request circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM or body builder for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the PTO 1 Request wiring, refer to OEM guidelines for repair or replacement of PTO 1 circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify PTO 1 wiring.*

1. Key on.

   Note: PTO 1 and wiring is installed by the OEM or body builder. Reference TRIG0990 for PTO Mode system operation and recommended wiring configuration.

2. Connect ServiceRanger.
3. Check PTO 1 Mode Configuration:
   - If PTO 1 Mode is disabled and PTO 1 wiring is installed, enable PTO 1 Mode. Go to **Step V.**
   - If PTO 1 Mode is properly configured and installed, refer to OEM or body builder guidelines for repair or replacement of PTO Request circuit. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on, engine off.
4. Clear fault codes using ServiceRanger.
5. Activate PTO 1 Mode and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 900 sets Active during test drive, go to **Step A.**
   - If a fault code other than 900 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 905: PTO 2 Request

J1939: SA 3 SPN 3452 FMI 3, 4, 9, 13, 19, 20, 21

Overview

The Procision transmission is designed to provide enhanced controls for PTO 2 applications. The Transmission Control Module (TCM) receives a “PTO 2 Request” input from the vehicle to enter PTO 2 Mode. The TCM determines if conditions are suitable for PTO 2 Mode and supplies a “PTO 2 Engage” output to engage the PTO 2. Once the PTO 2 is engaged the TCM receives a “PTO 2 Confirm” input to complete the operation. The PTO 2 request message is connected to the TCM via J1939 control from the Body Control Module or the 20-Way TCM Body Harness. Refer to TRIG0990 for recommended PTO 2 wiring configuration.

Detection

The TCM monitors PTO 2 request signal via J1939 or the 20-Way TCM Body Harness Pin 15 to be “grounded” when PTO Mode is activated. If the PTO Request signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: PTO 2 Request signal greater than 5.25 V.

FMI 4 – Voltage Below Normal or Shorted Low: PTO 2 Request signal “grounded” when PTO 2 Mode is not configured.

FMI 9 – Abnormal Update Rate: PTO 2 message not received for 1 second.

FMI 13 – Out of Calibration: PTO 2 message not available.

FMI 19 – Received Network Data in Error: PTO 2 message invalid for 1 second.

FMI 20 – Data Drifted High: PTO 2 Request signal between 4–5.25 V.

FMI 21 – Data Drifted Low: PTO 2 Request signal between 1.5–2.5 V.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 2 Mode Prohibited

Conditions to Set Fault Code Inactive

FMI 3, 20: PTO 2 Request signal not shorted to power.

FMI 4: PTO 2 Mode configured or wiring corrected.

FMI 9, 13, 19: Body Control Module configured correctly or PTO 2 disabled

FMI 21: PTO 2 Confirm signal not shorted to ground.

Possible Causes

FMI 3:

- PTO 2 Request Wiring
  - Wiring shorted to power

FMI 4:

- PTO 2 Request Wiring
  - Wiring shorted to ground
- TCM not configured for PTO 2 Mode

FMI 9, 13, 19:

- PTO 2 J1939 control message not received or incorrect
  - Body Control Module configuration setting

FMI 20:

- PTO 2 Request Wiring
  - High resistance short to power

FMI 21:

- PTO 2 Request Wiring
  - High resistance short to ground

Fault Code 905 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 905 FMI 3, 4, 20, or 21 is Active, go to **Step C.**
   - If Fault Code 905 FMI 3, 4, 20, or 21 is Inactive, go to **Step B.**
   - If Fault Code 905 FMI 9, 13 or 19 is set, contact OEM regarding Body Control Module configuration settings. Go to **Step V.**

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

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

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the PTO 2 Request circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM or body builder for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the PTO 2 Request wiring, refer to OEM guidelines for repair or replacement of PTO 2 circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify PTO 2 wiring.*

1. Key on.

   Note: PTO and wiring is installed by the OEM or body builder. Reference TRIG0990 for PTO Mode system operation and recommended wiring configuration.

2. Connect ServiceRanger.
3. Check PTO 2 Mode Configuration:
   - If PTO 2 Mode is disabled and PTO 2 wiring is installed, enable PTO Mode. Go to **Step V.**
   - If PTO 2 Mode is properly configured and installed, refer to OEM or body builder guidelines for repair or replacement of PTO Request circuit. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on, engine off.
4. Clear fault codes using ServiceRanger.
5. Activate PTO 2 Mode and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 905 sets Active during test drive, go to **Step A.**
   - If a fault code other than 905 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 910: PTO 1 Engage

J1939: SA 3 SPN 3456 FMI 3, 4, 5, 7, 13

Overview

The Procision transmission is designed to provide enhanced controls for PTO 1 applications. The Transmission Control Module (TCM) receives a "PTO 1 Request" input from the vehicle to enter PTO 1 Mode. The TCM determines if conditions are suitable for PTO 1 Mode and supplies a "PTO 1 Engage" output to engage the PTO 1. Once the PTO 1 is engaged the TCM receives a "PTO 1 Confirm" input to complete the operation. The hardwired PTO 1 control circuit is connected to the TCM via the 20-Way TCM Body Harness. Refer to TRIG0990 for recommended PTO 1 wiring configuration.

Detection

The TCM monitors 20-Way TCM Body Harness Pin 2. PTO 1 Engage supplies a 12-volt output to energize the PTO 1 Engage Relay.

If PTO 1 Engage output is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: PTO 1 Engage signal shorted to power.

FMI 4 – Voltage Below Normal or Shorted Low: PTO 1 Engage signal less than 1.5 V.

FMI 5 – Current Below Normal or Open Circuit: PTO 1 Engage circuit open.

FMI 7 – Mechanical System Not Responding: PTO 1 Engage signal output, but PTO 1 Confirm signal not received.

FMI 13 – Out of Calibration: PTO 1 Mode not configured, but PTO 1 Engage grounded.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 1 Mode Prohibited

Conditions to Set Fault Code Inactive

FMI 3: PTO 1 Engage signal not shorted to power.

FMI 4: PTO 1 Engage signal not shorted to ground.

FMI 5: PTO 1 Engage circuit not open.

FMI 7: PTO 1 Confirm circuit corrected.

FMI 13: PTO 1 Mode configured.

Possible Causes

FMI 3, 4, 5:

- PTO 1 Engage Wiring
  - Wiring shorted to power, shorted to ground, or open

FMI 7:

- PTO 1 Confirm Wiring
  - Wiring open
- PTO 1 Engage Relay
  - Latch failure
- PTO 1 Mounted Switch
  - Circuit failure

FMI 13:

- PTO 1 Engage Circuit
  - PTO 1 Mode not configured and PTO 1 Engage circuit installed

Fault Code 910 Troubleshooting

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 910 is Active, go to **Step C.**
   - If Fault Code 910 is Inactive, go to **Step B.**

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger
3. Select Service Routine and PD Mode.

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

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the PTO 1 Engage circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM or body builder for specific wire routing locations.
5. Exit PD Mode:
   - If any fault code sets Active while wiggling the PTO 1 Engage wiring, refer to OEM or body builder guidelines for repair or replacement of PTO 1 circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C ***Purpose:*** *Verify PTO 1 wiring.*

1. Key on.

   Note: PTO 1 and wiring is installed by the OEM or body builder. Reference TRIG0990 for PTO 1 Mode system operation and recommended wiring configuration.

2. Connect ServiceRanger.
3. Check PTO 1 Mode Configuration:
   - If PTO 1 Mode is disabled and PTO 1 wiring is installed, enable PTO 1 Mode. Go to **Step V.**
   - If PTO 1 Mode is properly configured and installed, refer to OEM or body builder guidelines for repair or replacement of PTO 1 Engage circuit. Go to **Step V.**

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on, engine off.
4. Clear fault codes using ServiceRanger.
5. Activate PTO 1 Mode and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 910 sets Active during test drive, go to **Step A.**
   - If a fault code other than 910 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 915: PTO 2 Engage

J1939: SA 3 SPN 3456 FMI 3, 4, 5, 7, 13

Overview

The Procision transmission is designed to provide enhanced controls for PTO 2 applications. The Transmission Control Module (TCM) receives a "PTO 2 Request" input from the vehicle to enter PTO 2 Mode. The TCM determines if conditions are suitable for PTO 2 Mode and supplies a "PTO 2 Engage" output to engage the PTO 2. Once the PTO 2 is engaged the TCM receives a "PTO 2 Confirm" input to complete the operation. The hardwired PTO 2 control circuit is connected to the TCM via the 20-Way TCM Body Harness. Refer to TRIG0990 for recommended PTO 2 wiring configuration.

Detection

The TCM monitors 20-Way TCM Body Harness Pin 2. PTO 2 Engage supplies a 12-volt output to energize the PTO 2 Engage Relay.

If PTO 2 Engage output is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: PTO 2 Engage signal shorted to power.

FMI 4 – Voltage Below Normal or Shorted Low: PTO 2 Engage signal less than 1.5 V.

FMI 5 – Current Below Normal or Open Circuit: PTO 2 Engage circuit open.

FMI 7 – Mechanical System Not Responding: PTO 2 Engage signal output, but PTO 2 Confirm signal not received.

FMI 13 – Out of Calibration: PTO 2 Mode not configured, but PTO 2 Engage grounded.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 2 Mode Prohibited

Conditions to Set Fault Code Inactive

FMI 3: PTO 2 Engage signal not shorted to power.

FMI 4: PTO 2 Engage signal not shorted to ground.

FMI 5: PTO 2 Engage circuit not open.

FMI 7: PTO 2 Confirm circuit corrected.

FMI 13: PTO 2 Mode configured.

Possible Causes

FMI 3, 4, 5:

- PTO 2 Engage Wiring
  - Wiring shorted to power, shorted to ground, or open

FMI 7:

- PTO 2 Confirm Wiring
  - Wiring open
- PTO 2 Engage Relay
  - Latch failure
- PTO 2 Mounted Switch
  - Circuit failure

FMI 13:

- PTO 2 Engage Circuit
  - PTO 2 Mode not configured in TCM but PTO 2 Engage circuit installed

Fault Code 915 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 915 is Active, go to **Step C.**
   - If Fault Code 915 is Inactive, go to **Step B.**

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger
3. Select Service Routine and PD Mode.

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

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the PTO 2 Engage circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM or body builder for specific wire routing locations.
5. Exit PD Mode:
   - If any fault code sets Active while wiggling the PTO 2 Engage wiring, refer to OEM or body builder guidelines for repair or replacement of PTO 2 circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify PTO 2 wiring.*

1. Key on.

   Note: PTO 2 and wiring is installed by the OEM or body builder. Reference TRIG0990 for PTO 2 Mode system operation and recommended wiring configuration.

2. Connect ServiceRanger.
3. Check PTO 2 Mode Configuration:
   - If PTO 2 Mode is disabled and PTO 2 wiring is installed, enable PTO 2 Mode. Go to **Step V.**
   - If PTO 2 Mode is properly configured and installed, refer to OEM or body builder guidelines for repair or replacement of PTO 2 Engage circuit. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on, engine off.
4. Clear fault codes using ServiceRanger.
5. Activate PTO 2 Mode and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 915 sets Active during test drive, go to **Step A.**
   - If a fault code other than 915 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 920: PTO 1 Confirm

J1939: SA 3 SPN 3460 FMI 3, 4, 7, 9, 13, 19, 20, 21

Overview

The Procision transmission is designed to provide enhanced controls for PTO 1 applications. The Transmission Control Module (TCM) receives a "PTO 1 Request" input from the vehicle to enter PTO 1 Mode. The TCM determines if conditions are suitable for PTO 1 Mode and supplies a "PTO 1 Engage" output to engage the PTO 1. Once the PTO 1 is engaged the TCM receives a "PTO 1 Confirm" input to complete the operation. The PTO 1 confirm message is connected to the TCM via J1939 control from the Body Control Module or the 20-Way TCM Body Harness. Refer to TRIG0990 for recommended PTO 1 wiring configuration.

Detection

The TCM monitors PTO 1 confirm signal via J1939 or the 20-Way TCM Body Harness Pin 16 to be "grounded" when the PTO 1-mounted switch is energized. If the PTO 1 Confirm signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: PTO 1 Confirm signal greater than 5.25 V.

FMI 4 – Voltage Below Normal or Shorted Low: PTO 1 Confirm signal "grounded" when PTO 1 Mode is not configured.

FMI 7 – Mechanical System Not Responding: PTO 1 Mode disengaged, but PTO 1 Confirm signal still "grounded".

FMI 9 – Abnormal Update Rate: PTO 1 message not received for 1 second.

FMI 13 – Out of Calibration: PTO 1 message not available.

FMI 19 – Received Network Data in Error: PTO 1 message invalid for 1 second.

FMI 20 – Data Drifted High: PTO 1 Confirm signal between 4–5.25 V.

FMI 21 – Data Drifted Low: PTO 1 Confirm signal between 1.5–2.5 V.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 1 Mode Prohibited

Conditions to Set Fault Code Inactive

FMI 3, 20: PTO 1 Confirm signal not shorted to power.

FMI 4: PTO 1 Mode configured and wiring corrected.

FMI 7: PTO 1 Confirm signal not continuously grounded.

FMI 9, 13, 19: Body Control Module configured correctly or PTO 1 disabled TCM

FMI 21: PTO 1 Confirm signal not shorted to ground.

Possible Causes

FMI 3:

- PTO 1 Confirm Wiring
  - Wiring shorted to power

FMI 4:

- PTO 1 Confirm Wiring
  - Wiring shorted to ground
- TCM not configured for PTO 1 Mode

FMI 7:

- PTO 1 Confirm Wiring
  - Wiring shorted to ground
- PTO 1-Mounted Switch
  - Circuit Failure

FMI 9, 13, 19:

- PTO 1 J1939 control message not received or incorrect
  - Body Control Module configuration setting

FMI 20:

- PTO 1 Confirm Wiring
  - High resistance short to power

FMI 21:

- PTO 1 Confirm Wiring
  - High resistance short to ground

Fault Code 920 Troubleshooting

A

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

1. Record the transmission fault codes, FMIs, occurrences, and timestamps from the Service Activity Report created during the Diagnostic Procedure.
   - If Fault Code 920 FMI 3, 4, 7, 20 or 21 is Active, go to **Step C.**
   - If Fault Code 920 FMI 3, 4, 7, 20 or 21 Inactive, go to **Step B.**
   - If Fault Code 920 FMI 9, 13, 19 is set, contact OEM regarding Body Control Module configuration settings. Go to **Step V.**

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

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

   Note: Solid "PD" in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the PTO 1 Confirm circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM or body builder for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the PTO 1 Confirm wiring, refer to OEM guidelines for repair or replacement of PTO 1 circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C *Purpose:* Verify PTO 1 wiring.

Note: PTO 1 and wiring is installed by the OEM or body builder. Reference TRIG0990 for PTO 1 Mode system operation and recommended wiring configuration.

1. Key on.
2. Connect ServiceRanger.
3. Check PTO 1 Mode Configuration:
   - If PTO 1 Mode is disabled and PTO 1 wiring is installed, enable PTO 1 Mode. Go to **Step V.**
   - If PTO 1 Mode is properly configured and installed, refer to OEM or body builder guidelines for repair or replacement of PTO 1 Confirm circuit. Go to **Step V.**

V *Purpose:* Verify repair.

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on, engine off.
4. Clear fault codes using ServiceRanger.
5. Activate PTO 1 Mode and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 920 sets Active during test drive, go to **Step A.**
   - If a fault code other than 920 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 925: PTO 2 Confirm

J1939: SA 3 SPN 3460 FMI 3, 4, 7, 9, 13, 19, 20, 21

Overview

The Procision transmission is designed to provide enhanced controls for PTO 2 applications. The Transmission Control Module (TCM) receives a “PTO 2 Request” input from the vehicle to enter PTO 2 Mode. The TCM determines if conditions are suitable for PTO 2 Mode and supplies a “PTO 2 Engage” output to engage the PTO 2. Once the PTO 2 is engaged the TCM receives a “PTO 2 Confirm” input to complete the operation. The PTO 2 confirm message is connected to the TCM via J1939 control from the Body Control Module or the 20-Way TCM Body Harness. Refer to TRIG0990 for recommended PTO 2 wiring configuration.

Detection

The TCM monitors PTO 2 confirm signal via J1939 or the 20-Way TCM Body Harness Pin 16 to be “grounded” when the PTO 2-mounted switch is energized. If the PTO 2 Confirm signal is out of range, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: PTO 2 Confirm signal greater than 5.25 V.

FMI 4 – Voltage Below Normal or Shorted Low: PTO 2 Confirm signal “grounded” when PTO 2 Mode is not configured.

FMI 7 – Mechanical System Not Responding: PTO 2 Mode disengaged, but PTO 2 Confirm signal still “grounded”.

FMI 9 – Abnormal Update Rate: PTO 2 message not received for 1 second.

FMI 13 – Out of Calibration: PTO 2 message not available.

FMI 19 – Received Network Data in Error: PTO 2 message invalid for 1 second.

FMI 20 – Data Drifted High: PTO 2 Confirm signal between 4–5.25 V.

FMI 21 – Data Drifted Low: PTO 2 Confirm signal between 1.5–2.5 V.

Fallback

All FMIs:

- Amber warning lamp on
- PTO 2 Mode Prohibited

Conditions to Set Fault Code Inactive

FMI 3, 20: PTO 2 Confirm signal not shorted to power.

FMI 4: PTO 2 Mode configured and wiring corrected.

FMI 7: PTO 2 Confirm signal not continuously grounded.

FMI 9, 13, 19: Body Control Module configured correctly or PTO 2 disabled TCM

FMI 21: PTO 2 Confirm signal not shorted to ground.

Possible Causes

FMI 3:

- PTO 2 Confirm Wiring
  - Wiring shorted to power

FMI 4:

- PTO 2 Confirm Wiring
  - Wiring shorted to ground
- TCM not configured for PTO 2 Mode

FMI 7:

- PTO 2 Confirm Wiring
  - Wiring shorted to ground
- PTO 2-Mounted Switch
  - Circuit Failure

FMI 9, 13, 19:

- PTO 2 J1939 control message not received or incorrect
  - Body Control Module configuration setting

FMI 20:

- PTO 2 Confirm Wiring
  - High resistance short to power

FMI 21:

- PTO 2 Confirm Wiring
  - High resistance short to ground

Fault Code 925 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 925 FMI 3, 4, 7, 20 or 21 is Active, go to **Step C.**
   - If Fault Code 925 FMI 3, 4, 7, 20 or 21 Inactive, go to **Step B.**
   - If Fault Code 925 FMI 9, 13, 19 is set, contact OEM regarding Body Control Module configuration settings. Go to **Step V.**

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

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

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the PTO 2 Confirm circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM or body builder for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the PTO 2 Confirm wiring, refer to OEM guidelines for repair or replacement of PTO 2 circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify PTO 2 wiring.*

Note: PTO 2 and wiring is installed by the OEM or body builder. Reference TRIG0990 for PTO 2 Mode system operation and recommended wiring configuration.

1. Key on.
2. Connect ServiceRanger.
3. Check PTO 2 Mode Configuration:
   - If PTO 2 Mode is disabled and PTO 2 wiring is installed, enable PTO 2 Mode. Go to **Step V.**
   - If PTO 2 Mode is properly configured and installed, refer to OEM or body builder guidelines for repair or replacement of PTO 2 Confirm circuit. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on, engine off.
4. Clear fault codes using ServiceRanger.
5. Activate PTO 2 Mode and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 925 sets Active during test drive, go to **Step A.**
   - If a fault code other than 925 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 950: Neutral Input 1

J1939: SA 3 SPN 3648 FMI 3, 4, 12, 13, 14, 20, 21, 31

Overview

The Procision transmission can be configured with ServiceRanger to select neutral via an external switch installed on the vehicle. There are three Neutral Select Modes available: Force, Hold & Momentary. The Transmission Control Module (TCM) requires dual inputs (Neutral Input 1 and Neutral Input 2) to enter a Neutral Select Mode. Neutral Input 1 toggles from either “grounded” or “open” to enter a Neutral Select Mode. The external switch is connected to the TCM via the 20-Way TCM Body Connector. Reference TRIG0990 for Force/Hold/Momentary Neutral system operation and recommended wiring configuration.

Detection

The TCM monitors 20-Way TCM Body Harness Pin 6. If the Neutral Input 1 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 Input 1 signal greater than 5.25 V

FMI 4 – Voltage Below Normal or Shorted Low: Neutral Input 1 signal “grounded” when Neutral Select mode not configured.

FMI 12 – Bad Intelligent Device: Neutral or Park selected, but Procision transmission non-responsive.

FMI 13 – Out of Calibration: Neutral Select Mode invalid configuration.

FMI 14 – Special Instructions: Neutral Input 1 and Neutral Input 2 “grounded” when configured for Force or Hold Neutral.

FMI 20 – Data Drifted High: Neutral Input 1 signal between 4–5.25 V.

FMI 21 – Data Drifted Low: Neutral Input 1 signal between 1.5–2.5 V.

FMI 31 – Condition Exists: Neutral Input 1 “open” and Neutral Input 2 “grounded” when configured for Momentary Neutral.

Fallback

FMI 3, 14, 20, 21:

- Amber warning lamp on
- Neutral Select Mode (Force, Hold & Momentary) not available

Note: If currently Forcing or Holding Neutral:

- Transmission will not engage a gear from neutral

FMI 4, 13, 31:

- Amber warning lamp on
- Neutral Select Mode (Force, Hold & Momentary) not available

FMI 12:

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

FMI 3, 20: Neutral Input 1 signal not shorted to power

FMI 4, 13, 14, 31:

- Neutral Select mode properly configured
- Neutral Input 1 not shorted to ground or open

FMI 12: Key cycle

FMI 21: Neutral Input 1 signal not shorted to ground

Possible Causes

FMI 3:

- Neutral Input 1 Wiring
  - Wiring shorted to power

FMI 4:

- TCM not configured for Neutral Select mode

FMI 12, 13:

- TCM
  - Internal failure
  - Software issue

FMI 14:

- Neutral Inputs wired for Momentary Neutral, but TCM configured for Force/Hold Neutral.
- Neutral Input 1 Wiring
  - Wiring shorted to ground.

FMI 20:

- Neutral Input 1 Wiring
  - High resistance short to power

FMI 21:

- Neutral Input 1 Wiring
  - High resistance short to ground

FMI 31:

- Neutral Inputs wired for Force/Hold Neutral, but TCM configured for Momentary Neutral
- Neutral Input 1 Wiring
  - Wiring open

Fault Code 950 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 950 FMI 3, 4, 14, 20, 21, 31 is Active, go to **Step C.**
   - If Fault Code 950 FMI 3, 4, 14, 20, 21, 31 is Inactive, go to **Step B.**
   - If Fault Code 950 FMI 12 or 13 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions.

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

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

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the Neutral Input 1 circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Refer to OEM or body builder for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the Neutral Input 1 wiring, refer to OEM or body builder guidelines for repair or replacement of Neutral Input 1 circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify Neutral Select Mode configuration with ServiceRanger.*

1. Key on.

   Note: Neutral Select Mode switch and wiring is installed by the OEM or body builder. Reference TRIG0990 for Force/Hold/Momentary Neutral system operation and recommended wiring configuration.

2. Connect ServiceRanger.
3. Check Neutral Select Mode Configuration:
   - If Neutral Select Mode is disabled and an external switch and wiring is installed, enable a Neutral Select Mode based on desired configuration. Go to **Step V.**
   - If Neutral Select Mode is properly configured and an external switch and wiring is installed, refer to OEM or body builder guidelines for repair or replacement of Neutral Input circuit. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Activate the vehicle's Neutral Select Mode and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 950 sets Active during test drive, go to **Step A.**
   - If a fault code other than 950 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 960: Neutral Input 2

J1939: SA 3 SPN 6159 FMI 3, 4, 12, 14, 20, 21, 31

Overview

The Procision transmission can be configured with ServiceRanger to select neutral via an external switch installed on the vehicle. There are three Neutral Select Modes available: Force, Hold & Momentary. The Transmission Control Module (TCM) requires dual inputs (Neutral Input 1 and Neutral Input 2) to enter a Neutral Select Mode. Neutral Input 2 toggles from “open” to “grounded” to enter a Neutral Select Mode. The external switch is connected to the TCM via the 20-Way TCM Body Connector. Reference TRIG0990 for Force/Hold/Momentary Neutral system operation and recommended wiring configuration.

Detection

The TCM monitors 20-Way TCM Body Harness Pin 4. If the Neutral Input 2 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 Input 2 signal greater than 5.25 V

FMI 4 – Voltage Below Normal or Shorted Low: Neutral Input 2 signal “grounded” when Neutral Select mode not configured.

FMI 12 –Bad Intelligent Device: Neutral selected, but transmission non-responsive.

FMI 14 – Special Instructions: Neutral Input 1 and Neutral Input 2 “open” when configured for Forced or Hold Neutral.

FMI 20 – Data Drifted High: Neutral Input 2 signal between 4–5.25 V.

FMI 21 – Data Drifted Low: Neutral Input 2 signal between 1.5–2.5 V.

FMI 31 – Condition Exists: Neutral Input 1 “grounded” and Neutral Input 2 “open” when configured for Momentary Neutral.

Fallback

FMI 3, 14, 20, 21:

- Neutral Select Mode not available

Note: If currently Forcing or Holding Neutral:

- Transmission will not engage a gear from neutral

FMI 4, 31:

- Amber warning lamp on
- Neutral Select Mode not available

FMI 12:

- Amber warning lamp on
- Transmission stays in current gear
- Primary and Secondary Clutch disengaged

Conditions to Set Fault Code Inactive

FMI 3, 20: Neutral Input 2 signal not shorted to power

FMI 4, 14, 31:

- Neutral Select mode properly configured
- Neutral Input 2 open

FMI 12: Key cycle

FMI 21: Neutral Input 2 signal not shorted to ground

Possible Causes

FMI 3:

- Neutral Input 1 Wiring
  - Wiring shorted to power

FMI 4:

- TCM not configured for Neutral Select mode

FMI 12:

- TCM
  - Internal failure
  - Software issue

FMI 14:

- Neutral Inputs wired for Momentary Neutral, but TCM configured for Force/Hold Neutral.
- Neutral Input 2 Wiring
  - Wiring open

FMI 20:

- Neutral Input 2 Wiring
  - High resistance short to power

FMI 21:

- Neutral Input 2 Wiring
  - High resistance short to ground

FMI 31:

- Neutral Inputs wired for Force/Hold Neutral, but TCM configured for Momentary Neutral
- Neutral Input 2 Wiring
  - Wiring open

Fault Code 960 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 960 FMI 3, 4, 14, 20, 21, 31 is Active, go to **Step C.**
   - If Fault Code 960 FMI 3, 4, 14, 20, 21, 31 is Inactive, go to **Step B.**
   - If Fault Code 960 FMI 12 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions.

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

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

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the Neutral Input 2 circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM or body builder for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the Neutral Input 2 wiring, refer to OEM or body builder guidelines for repair or replacement of Neutral Input 2 circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify Neutral Select Mode configuration with ServiceRanger.*

1. Key on.

   Note: Neutral Select Mode switch and wiring is installed by the OEM or body builder. Reference TRIG0990 for Force/Hold/Momentary Neutral system operation and recommended wiring configuration.

2. Connect ServiceRanger.
3. Check Neutral Select Mode Configuration:
   - If Neutral Select Mode is disabled and an external switch and wiring is installed, enable a Neutral Select Mode based on desired configuration. Go to **Step V.**
   - If Neutral Select Mode is properly configured and an external switch and wiring is installed, refer to OEM or body builder guidelines for repair or replacement of Neutral Input circuit. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Activate the vehicle's Neutral Select Mode and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 960 sets Active during test drive, go to **Step A.**
   - If a fault code other than 960 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 970: Range Output

J1939: SA 3 SPN 604 FMI 3, 4, 5

Overview

The Procision transmission can provide a gear Range Output to other devices on the vehicle. The Transmission Control Module (TCM) is configurable to provide a 12-volt signal to indicate when the transmission is in a specific gear range. The default configuration is Neutral. Selection of “Neutral” from the Driver Interface Device will signal the TCM to enable the Neutral output.

Detection

The TCM monitors the 20-Way TCM Body Harness Pin 3. If the Range Output signal is out of range, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: Range Output signal shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Range Output signal shorted to ground for 1 second.

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

Fallback

All FMIs:

- Amber warning lamp on
- Devices requiring Range Output signal may not function

Conditions to Set Fault Code Inactive

FMI 3: Range Output signal not shorted to power for 5 seconds.

FMI 4: Range Output signal not shorted to ground for 5 seconds.

FMI 5: Range Output circuit not open for 5 seconds.

Possible Causes

FMI 3, 4:

- Range Output wiring
  - Wiring shorted to power or shorted to ground

FMI 5:

- Range Output wiring
  - Wiring open
- Range Output is Enabled in ServiceRanger, but wiring is not installed

Fault Code 970 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 970 is Active, go to **Step C.**
   - If Fault Code 970 is Inactive, go to **Step B.**

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger
3. Select Service Routine and PD Mode.

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

   Note: Solid “PD” in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the Range Output circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM or body builder for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the Range Output wiring, refer to OEM or body builder guidelines for repair or replacement of Range Output circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C *Purpose:* *Verify Range Output wiring.*

1. Key on.

   Note: Range Output wiring is installed by the OEM or body builder. Reference TRIG0990 for recommended wiring configuration.

2. Connect ServiceRanger.
3. Check Range Output configuration.
   - If Range Output is disabled and wiring is installed, enable Range Output. Go to **Step V.**
   - If Range Output is properly configured and installed, refer to OEM or body builder guidelines for repair or replacement of Range Output circuit. Go to **Step V.**

V *Purpose:* *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger:
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 970 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 970 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 975: Reverse Output

J1939: SA 3 SPN 767 FMI 3, 4, 5

Overview

The Procision transmission can provide a Reverse Output to other devices on the vehicle. The Transmission Control Module (TCM) is configurable to provide a 12-volt signal to indicate when the transmission is in Reverse. Selection of "Reverse" from the Driver Interface Device will signal the TCM to provide the Reverse Output.

Detection

The TCM monitors 20-Way TCM Body Harness Pin 1. If the Reverse Output signal is out of range, the TCM will set the fault code Active.

Conditions to Set Fault Code Active

FMI 3 – Voltage Above Normal or Shorted High: Reverse Output signal shorted to power for 1 second.

FMI 4 – Voltage Below Normal or Shorted Low: Reverse Output signal shorted to ground for 1 second.

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

Fallback

FMI 3, 4, 5:

- Amber warning lamp on
- Devices requiring Reverse Output signal may not function

Conditions to Set Fault Code Inactive

FMI 3: Reverse Output signal not shorted to power for 5 seconds.

FMI 4: Reverse Output signal not shorted to ground for 5 seconds.

FMI 5: Reverse Output circuit not open for 5 seconds.

Possible Causes

FMI 3, 4:

- Reverse Output wiring
  - Wiring shorted to power or shorted to ground

FMI 5:

- Reverse Output wiring
  - Wiring open
- Reverse Output Enabled in Service Ranger, but wiring not installed

Fault Code 975 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 975 is Active, go to **Step C.**
   - If Fault Code 975 is Inactive, go to **Step B.**

B

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

1. Set parking brake and chock wheels.
2. Connect ServiceRanger.
3. Select Service Routine and PD Mode.

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

   Note: Solid "PD" in display when PD Mode is active.

4. Wiggle wiring and connections at the 20-Way TCM Body Harness connector and throughout the Reverse Output circuit. Look for any obvious signs of rubbing or chafing on any of the wires. Consult OEM or body builder for specific wire routing locations.
5. Exit PD Mode.
   - If any fault code sets Active while wiggling the Reverse Output wiring, refer to OEM or body builder guidelines for repair or replacement of Reverse Output circuit. Go to **Step V.**
   - If no fault codes become Active, go to **Step C.**

C

Purpose: *Verify Reverse Output wiring.*

1. Reverse Output wiring is installed by the OEM or body builder. Reference TRIG0990 for recommended wiring configuration.
2. Key on.
3. Connect ServiceRanger.
4. Check Reverse Output configuration.
   - If Reverse Output is disabled and wiring is installed, enable Reverse Output. Go to **Step V.**
   - If Reverse Output is properly configured and installed, refer to OEM or body builder guidelines for repair or replacement of Reverse Output circuit. Go to **Step V.**

V

Purpose: *Verify repair.*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the fault code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, test complete.
   - If Fault Code 975 sets Active during test drive, go to **Step A.**
   - If a fault code other than 975 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 13.

Fault Code 980: Alternate Shift Schedule

J1939: SA 3 SPN 6160 FMI 3, 4, 5, 13, 20, 21

Overview

The Procision transmission can be configured with ServiceRanger to select an Alternate Shift Schedule via an external switch installed on the vehicle. The Alternate Shift Strategy switch allows choosing from multiple configurable options. By default, no feature is present and the base Eaton Dynamic Shifting (EDS) shift schedule is Active. The external switch is connected to the TCM via the 20-Way TCM Body Connector. Reference TRIG0990 for Alternate Shift Strategy for operation and recommended wiring configuration.

Detection

In the default state (No Feature/Switch Present), if the TCM detects that inputs are present, the fault is set Active.

Conditions to Set Fault Code Active

FMI 3 - Voltage Above Normal or Shorted High: Alternate Shift Schedule signal greater than 5.25 V

FMI 4 – Voltage Below Normal or Shorted Low: Alternate Shift Schedule signal “grounded” when not configured for Alternate Shift Schedule.

FMI 5 – Current Below Normal or Open Circuit: Alternate Shift Schedule signal “open circuit” when configured for Alternate Shift Schedule.

FMI 13 – Out of Calibration: Alternate Shift Schedule invalid configuration.

FMI 20 – Data Drifted High: Alternate Shift Schedule signal between 4–5.25 V.

FMI 21 – Data Drifted Low: Alternate Shift Schedule signal between 1.5–2.5 V.

Fallback

FMI 3, 4, 5, 13, 20, 21:

- Amber warning lamp on
- No degraded performance

Conditions to Set Fault Code Inactive

FMI 3, 20:

- Alternate Shift Schedule signal not shorted to power

FMI 4, 5, 13:

- Alternate Shift Schedule properly configured
- Alternate Shift Schedule not shorted to ground or open

FMI 21:

- Alternate Shift Schedule signal not shorted to ground

Possible Causes

FMI 3:

- Alternate Shift Schedule Wiring
  - Wiring shorted to power

FMI 4:

- TCM not configured for Alternate Shift Schedule

FMI 5:

- Alternate Shift Schedule Wiring
  - Wiring open circuit

FMI 13:

- TCM
  - Software issue
  - Internal failure

FMI 20

- Alternate Shift Schedule Wiring
  - High resistance short to power

FMI 21:

- Alternate Shift Schedule Wiring
  - High resistance short to ground

Fault Code 980 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 980 FMI 3, 4, 5, 13, 20 or 21 is set, contact Eaton at (800) 826-4357 for further diagnostic instructions.

Start Enable Relay Contact Test

Overview

This symptom-driven test is performed when the engine will not crank and the following conditions exist: Park (P) or Neutral (N) is selected on the shift device, the P or N selection has been confirmed by the Transmission Control Module (TCM), P or N is shown in the display and there are no Active or Inactive fault codes.

Detection

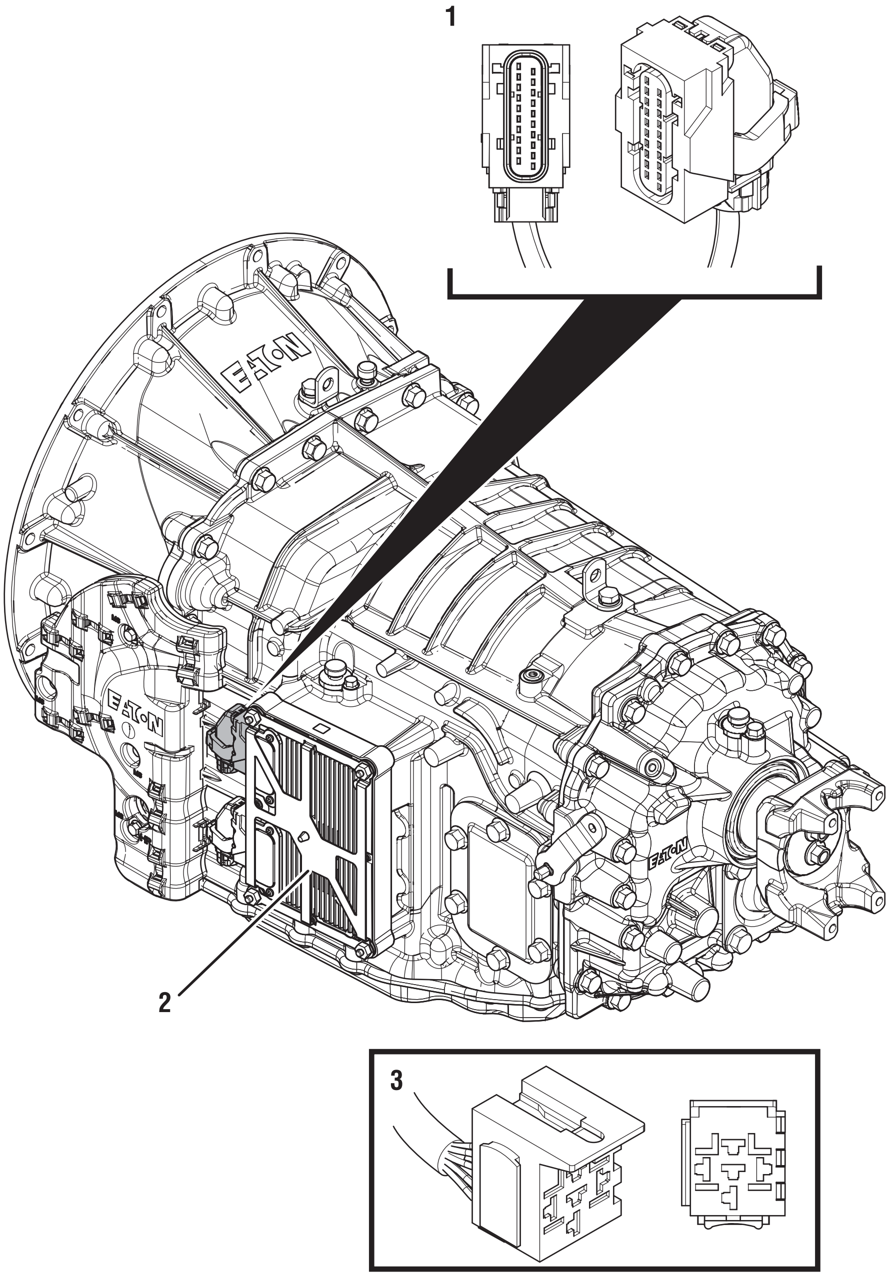
- Engine does not crank with the transmission in Park or Neutral.
- Engine cranks with the transmission in a non-neutral position.

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

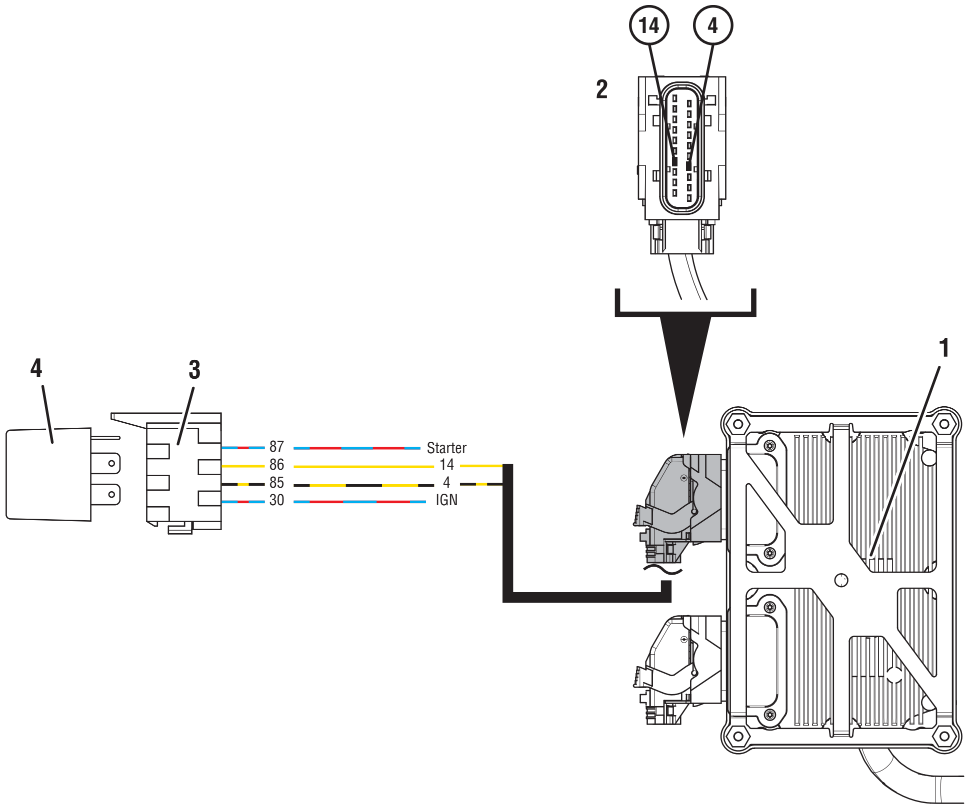
Possible Causes

- Vehicle Power and Ground
  - Poor power or ground supply to TCM
  - Battery failure
  - Bent, spread, corroded or loose terminals
- Start Enable Relay
  - Internal failure
- Start Enable Relay Circuit
  - Bypassed or “jumped” Start Enable Relay circuit
  - Bent, spread, corroded or loose terminals
  - Wiring shorted to ground, shorted to power or open
- Start Enable Type
  - Mis-configured in the TCM
  - J1939 start enable message not received by vehicle

Component Identification

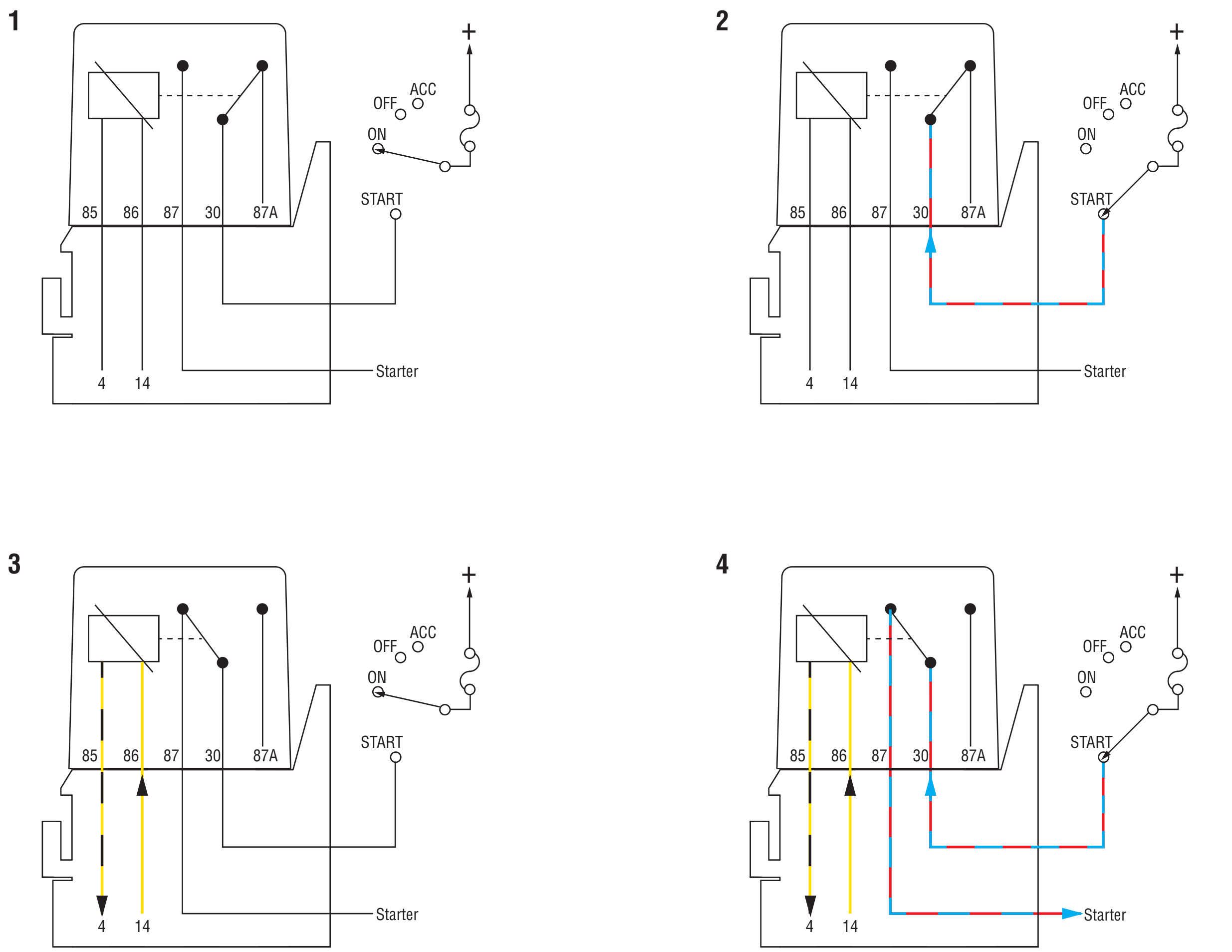


1. 20-Way Transmission Control Module (TCM) Vehicle Harness
2. Transmission Control Module (TCM)
3. 5-Way Start Enable Relay Socket



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

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



Start Enable Relay Circuit States (Normally Open)
1. Open Relay - Key On and Transmission is Unable to Confirm Neutral
2. Open Relay - Key Start and Transmission is Unable to Confirm Neutral
3. Closed Relay - Key On and Transmission Confirmed in Neutral
4. Closed Relay - Key Start and Transmission Confirmed in Neutral

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

Start Enable Relay Contact Test

A

Purpose: *Confirm Driver Interface Device is in Park or Neutral and their Display indicates "P" or "N".*

1. Key off.
2. Set parking brake and chock wheels.
3. Verify that the Driver Interface Device is in the Park (P) or Neutral (N) position.
4. Key on with engine off.
5. Verify the transmission is in Park or Neutral, indicated by a "P" or "N" in the display.
   - If the display indicates "P" or "N", go to **Step B.**
   - If the display does not indicate "P" or "N", contact Eaton at 1-800-826-HELP (4357) for further diagnostic instructions. Go to **Step V.**.

B

Purpose: *Verify condition of vehicle starting and charging system.*

1. Key off.
2. Inspect vehicle starting/charging/battery system per OEM guidelines.
   - If a fault was found, refer to OEM guidelines for repair or replacement of the vehicle starting/charging/battery system. Go to **Step V.**
   - If no fault found, go to **Step C.**

C

Purpose: *Update transmission software and determine if the Start Enable system is a hard-wired relay or a J1939 message.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Create a *Service Activity Report* within ServiceRanger to retrieve Snapshot and VPA data.
4. Select "Service Activity Report" to retrieve Snapshot and Vehicle Performance Analysis (VPA) data.
5. Select "Send to Eaton".
6. Update Transmission Control Module (TCM) software to latest available level.

   Note: To avoid damaging the TCM, use an Eaton approved vehicle communication adapter and ensure all satellite systems are disabled before updating software.
7. Inspect the vehicle to determine if the Start Enable function is performed through a physically hardwired relay or a transmission message broadcast over the J1939 Data Link.
   - If a Start Enable message is sent over J1939 by the TCM, go to **Step D.**
   - If a Start Enable Relay is hardwired to the TCM, go to **Step G.**

D ***Purpose:*** *Connect ServiceRanger and determine if the "Start Enable Type" is configured correctly.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To "Configuration".
4. Select "Vehicle".
5. Record the Start Enable Type "Current Value" in table.
6. Confirm the Current Value matches the vehicle's start enable system.
   - If Current Value matches, go to **Step E.**
   - If Current Value doesn't match, select "J1939" from the "New Value" drop down, select "Apply" and follow on-screen prompts. Go to **Step V.**

Start Enable Type Current Value	Reading(s)

E ***Purpose:*** *Attempt to crank the engine when the engine should crank.*

1. Key on with engine off.
2. Verify that the Driver Interface Device is in the Park (P) or Neutral (N) position.
3. Verify that the transmission confirms Park ("P") or Neutral ("N") in the display position.
4. Verify the transmission is in Park or Neutral, indicated by a "P" or "N" in the display.
5. Depress and hold the service brake, attempt to crank the engine.
   - If engine cranks, go to **Step F.**
   - If the engine does not crank and the display indicates "N", refer to OEM guidelines for repair or replacement of the vehicle starting/charging/battery system. Go to **Step V.**

F ***Purpose:*** *Attempt to crank the engine when the engine should not crank.*

1. Key on with engine off.
2. Place the Driver Interface Device in a non-Neutral position.
3. Place the Driver Interface Device in a non-Park or non-Neutral position.
4. Depress and hold the service brake, attempt to crank the engine.
5. Return the Driver Interface Device to Park (P) or Neutral (N) position.
   - 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 the OEM for additional information about this system.

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 Current Value matches the vehicle's start enable system.
   - If Current Value matches, go to **Step H.**
   - If Current Value doesn't match, select "J1939" from the "New Value" drop down, select "Apply" and follow on-screen prompts. Go to **Step V.**

Start Enable Type Current Value	Reading(s)

H ***Purpose:*** *Attempt to crank the engine when the engine should crank.*

1. Key on with engine off.
2. Verify that the Driver Interface Device is in the Park (P) or Neutral (N) position.
3. Verify the transmission is in Park or Neutral, indicated by a “P” or “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.*

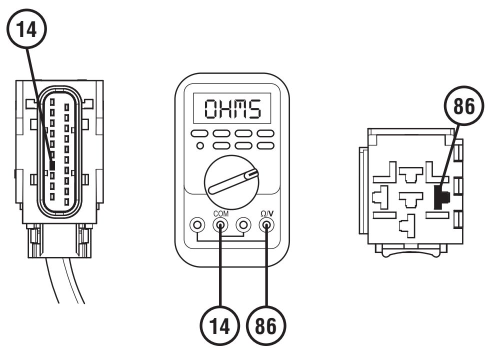
1. Key on with engine off.
2. Place the Driver Interface Device in a non-Park or non-Neutral position.
3. Depress and hold the service brake, attempt to crank the engine.
4. Return the Driver Interface Device to Park (P) or Neutral (N) position.
   - If the engine cranks, go to **Step J.**
   - If the engine does not crank, go to **Step K.**

J ***Purpose:*** *Remove the Start Enable Relay and attempt to crank the engine.*

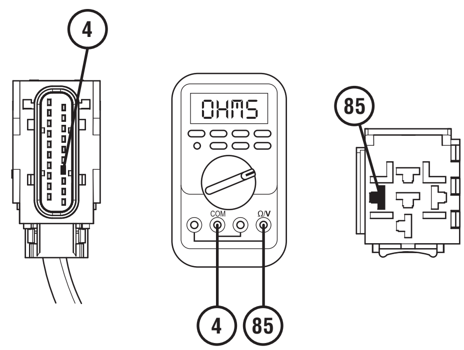
1. Key off.
2. Remove the Start Enable Relay.
3. Key on with engine off.
4. Place the Driver Interface Device in a non-Park or non-Neutral position.
5. Depress and hold the service brake, attempt to crank the engine.
6. Return the Driver Interface Device to Park (P) or Neutral (N) position.
   - If the engine cranks, refer to OEM guidelines for repair or replacement of Start Enable Relay wiring. Go to **Step V.**
   - If the engine does not crank, replace the Start Enable Relay. Go to **Step V.**

K ***Purpose:*** *Verify correct Start Enable Relay wiring.*

1. Refer to OEM wiring diagrams and verify the Start Enable Relay wiring is properly installed.
2. Key off.
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(s) in table.



5. Measure resistance between 20-Way TCM Vehicle Harness Connector Pin 4 and Start Enable Relay Socket Pin 85. Record reading(s) in table.



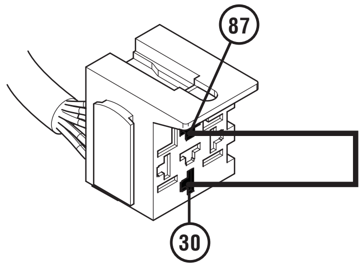
6. Compare reading(s) in table.
   - If all readings are in range, go to **Step L.**
   - If any reading is out of range, repair or replace Start Enable Relay wiring per OEM requirements. Go to **Step V.**

Pins	Range	Reading(s)
VH 14 to SER 86	0.0–0.3 ohms	
VH 4 to SER 85	0.0–0.3 ohms	

L

Purpose: *Verify system will crank with the relay bypassed.*

1. Set parking brake and chock wheels.
2. Key on with engine off.
3. Verify that the Driver Interface Device is in the Park (P) or Neutral (N) position.
4. Verify the transmission is in Park or Neutral, indicated by a “P” or “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 Driver Interface Device is in the Park (P) or Neutral (N) position.
10. Verify the transmission is in Park or Neutral, indicated by a “P” or “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. Set parking brake and chock wheels.
2. Key off.
3. Reconnect all connectors and verify that all components are properly installed.
4. Key on with engine off.
5. Clear fault codes using ServiceRanger.
6. Verify that the Driver Interface Device is in the Park (P) or Neutral (N) position.
7. Verify the transmission is in Park or Neutral, indicated by a “P” or “N” in the display.
8. Test the Start Enable system by attempting to crank the Starter multiple times. Verify that the starting system operates properly.
9. Check for fault codes using ServiceRanger.
    - If no codes set and the engine cranks, test complete.
    - If the engine does not crank and a fault code sets, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
    - If the engine does not crank and no fault codes set, contact OEM for further diagnostic instructions.

J1939 Data Link Test

Overview

This symptom driven test is performed if the vehicle J1939 Data Link is failing to function in some way without setting transmission Fault Code 115. Proper operation of the vehicle J1939 Data Link is critical for proper transmission shift performance.

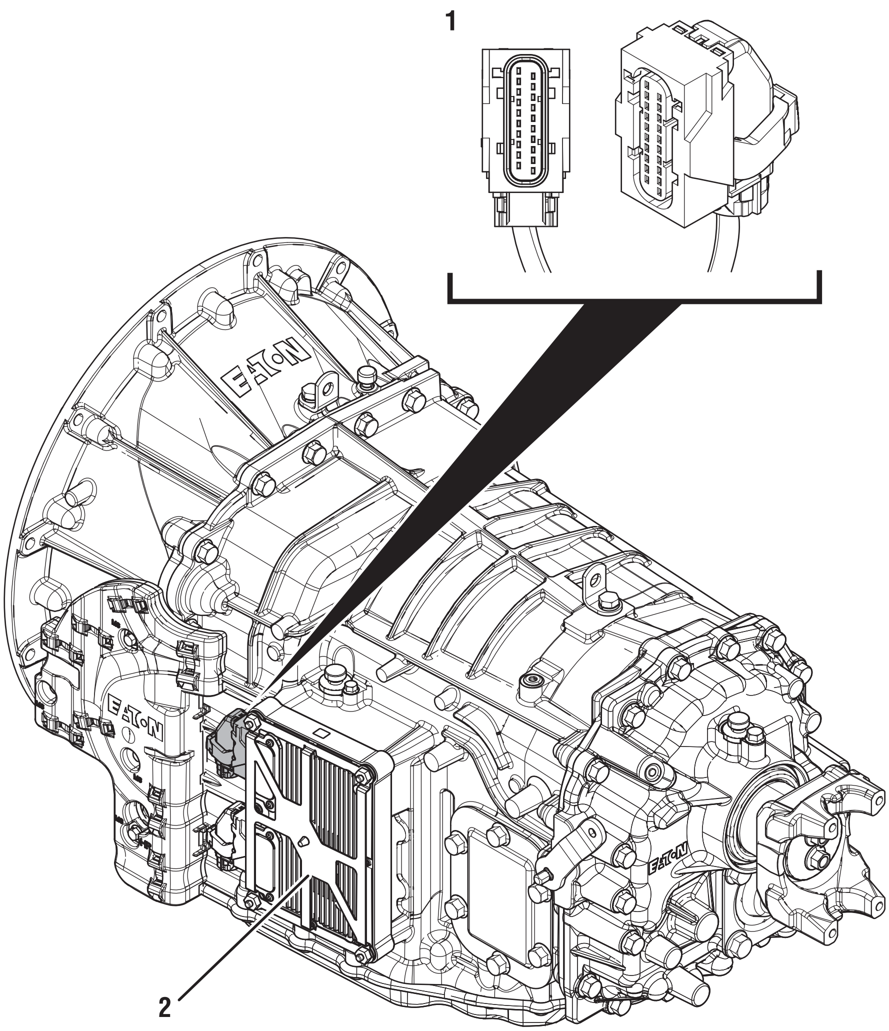
Detection

- Various communication problems between vehicle Electronic Control Units (ECUs).
- ServiceRanger or other diagnostic software may not be able to communicate with vehicle ECUs.
- If vehicle is configured for the J1939 Start Enable feature the engine does not crank.

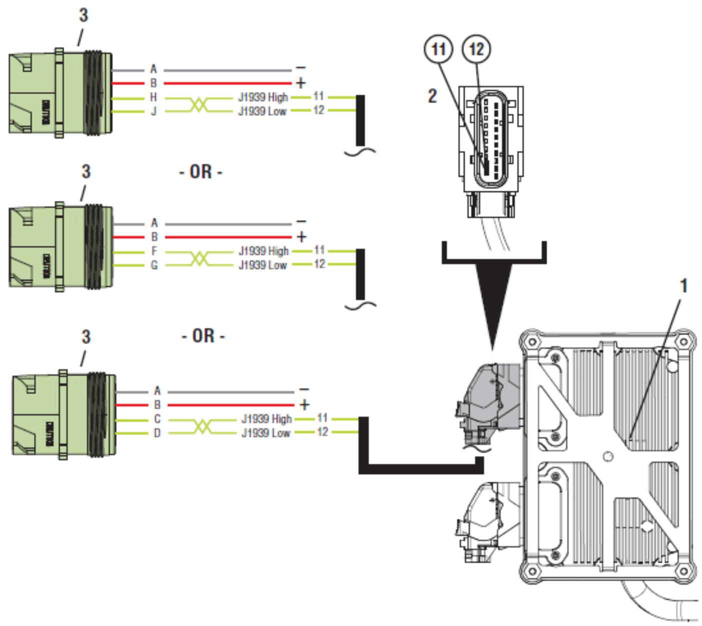
Possible Causes

- J1939 Data Link
  - Wiring Shorted to ground, Shorted to power, or Open
  - Bent, spread, corroded or loose terminals
  - Excessive electrical noise
  - Missing or additional terminating resistors
- Various Vehicle ECUs
  - Internal Failure
  - Loss of Power Supply to ECU
  - Poor connection to J1939 Data Link
  - Wiring Shorted to ground, Shorted to power or Open

Component Identification



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



1. Transmission Control Module (TCM)
2. 20-Way Vehicle Harness Connector
3. 9-Way Diagnostic Connector

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

J1939 Data Link Test

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

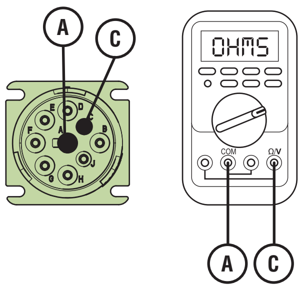
1. Set parking brake and chock wheels.
2. Key on with engine off.
3. Connect ServiceRanger.
4. Select “Service Activity Report” to retrieve Snapshot and Vehicle Performance Analysis (VPA) data.
5. Select “Send to Eaton”.
6. Review the vehicle fault codes:
   - If a vehicle/engine fault code(s) is Active, contact OEM for further diagnostic instructions.
   - If Fault Code 115 is Active or Inactive, troubleshoot per *Fault Code Isolation Procedure Index* on page 13.
   - If ServiceRanger does not connect to the Transmission Control Module (TCM); go to **Step B.**

B ***Purpose:*** *Identify Transmission Control Module (TCM) J1939 pin locations on Vehicle J1939 Data Link Connector.*

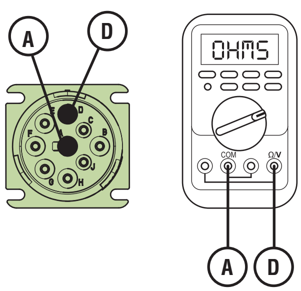
1. Key off.
2. Refer to OEM to identify TCM J1939 pin locations on vehicle 9-Way J1939 Diagnostic Connector.
   - If the TCM is on Pins C and D, go to **Step C.**
   - If the TCM is on Pins F and G, go to **Step E.**
   - If the TCM is on Pins H and J, go to **Step G.**

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

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



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

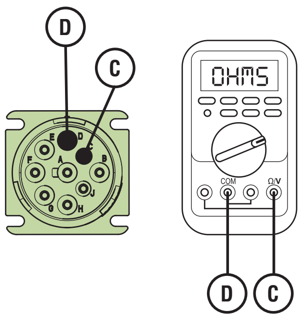


4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step D.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**

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

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

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

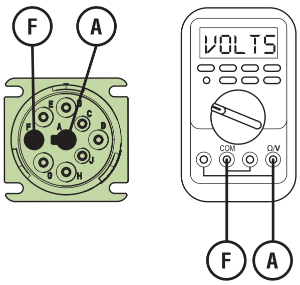


3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step I.**

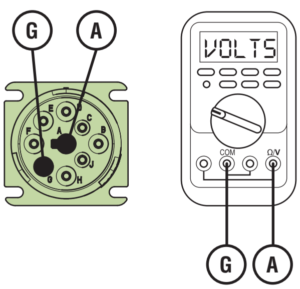
Pins	Range	Reading(s)
C to D	50–70 Ohms	

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

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



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

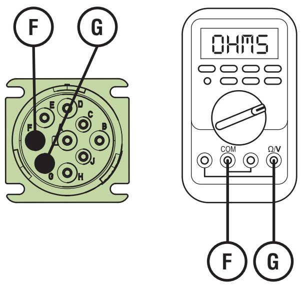


4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step F.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**

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

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

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



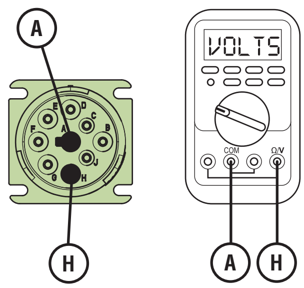
3. Compare reading(s) in table.
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**
   - If readings are in range, go to **Step I.**

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

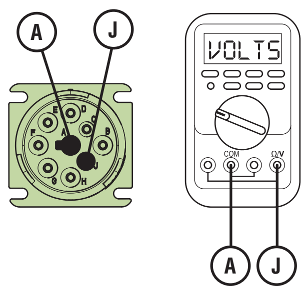
G

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

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



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

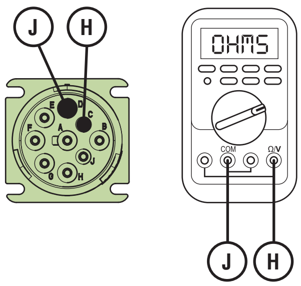


4. Record the total voltage by adding together the voltage readings.
5. Compare reading(s) in table.
   - If readings are in range, go to **Step I.**
   - If readings are out of range, refer to OEM guidelines for repair or replacement of vehicle Primary Data Link (J1939 A). Go to **Step V.**

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

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

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



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

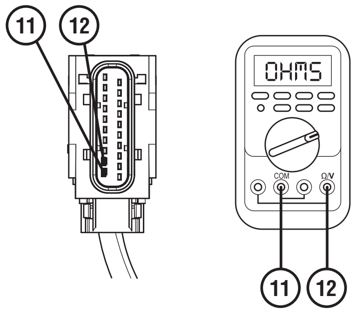
Pins	Range	Reading(s)
H to J	50–70 Ohms	

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

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

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

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



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

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

K ***Purpose:*** *Use ServiceRanger to monitor ECU communication on the Primary Data Link (J1939 A).*

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Data Monitor”.
6. Select “Components” tab.
7. Monitor the roster of vehicle ECUs currently communicating on the Primary Data Link (J1939 A).
8. Compare this list to the roster of vehicle ECUs that should be communicating on the Primary Data Link (J1939 A).

   Note: Contact OEM for information about which vehicle ECUs should be on the Primary Data Link (J1939 A).

   - If no vehicle ECUs are present on the ServiceRanger roster, go to **Step L.**
   - If all vehicle ECUs are present on the ServiceRanger roster, no problem was found. Test complete. Contact OEM for further diagnostic instructions.
   - If a vehicle ECU is missing from the ServiceRanger roster, investigate that device to verify that it is properly powered and wired to the Primary Data Link (J1939 A). Refer to OEM guidelines for repair or replacement. Go to **Step V.**

L ***Purpose:*** *Remove vehicle devices from the J1939 Vehicle Data Link.*

1. Key on with engine off.
2. Connect ServiceRanger.
3. Go To “Data Monitor”.
4. Select “Components” tab.
5. Monitor the roster of vehicle ECUs currently communicating on the Primary Data Link (J1939 A).
6. Individually remove each vehicle ECU from the Primary Data Link (J1939 A).
7. After removing each device, monitor the ServiceRanger ECU roster.
   - If the removal of an ECU from the Primary Data Link (J1939 A) allows other ECUs to appear in the ServiceRanger ECU roster, the removed ECU may have an internal failure preventing communication over the Primary Data Link (J1939 A). Refer to OEM guidelines for repair or replacement. Go to **Step V.**
   - If no problems are found, Contact OEM for further diagnostic instructions.

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

1. Key off.
2. Reconnect all connectors and verify that all components are properly installed.
3. Key on.
4. Clear fault codes using ServiceRanger.
5. Drive vehicle and attempt to reset the code or duplicate the previous complaint.
6. Check for fault codes using ServiceRanger.
   - If no codes set and the vehicle operates properly, Test Complete.
   - If Fault Code 115 sets Active during the test drive, go to **Step A.**
   - If a fault code other than 115 sets, troubleshoot per the *Fault Code Isolation Procedure Index* on page 12.

Brake Switch Functionality Test

Overview

This procedure verifies that the Procision Transmission Control Module (TCM) is receiving the both the Service and Brake Switch input signals from the vehicle.

Note: This procedure is not associated to a specific fault code.

Detection

1. Engine does not crank.

Note: The transmission will not allow the engine to crank if the engine was shut off with the transmission in gear unless the parking brake is applied or service brake depressed.

2. Transmission not engaging a gear from Park or Neutral.

Note: The transmission will not engage a gear from Park or Neutral if the service brake is not depressed.

Possible Causes

- Service Brake Switch
  - Internal failure
- Park Brake Switch
  - Internal failure
- Other
  - See Vehicle OEM for further possible causes

Brake Switch Functionality Test

A ***Purpose:*** *Monitor Service Brake Switch in ServiceRanger.*

1. Set parking brake and chock wheels.
2. Key on with engine running.
3. Allow vehicle air system pressure to build until Compressor governor cut-off.
4. Key off.
5. Key on with engine off.
6. Connect ServiceRanger.
7. Go To “Data Monitor”.
8. Select “Status” from Search parameter list.
9. Select “Brake switch”.
10. Select all of the “- 597” parameter sources.

    Note: Not all sources will indicate a value.
11. Monitor Brake switch value. Record reading in table.
12. Depress and hold service brake.
13. Monitor 597 - Brake switch value. Record reading in table.
14. Release service brake.
15. Compare reading(s) in table.
    - If readings are out of range, refer to OEM guidelines for repair or replacement of the Service Brake Switch signal message.
    - If readings are in range, no fault was found. Go to **Step B.**

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

B ***Purpose:*** *Monitor Parking Brake Switch Status in ServiceRanger.*

1. Key on.
2. Connect ServiceRanger.
3. Go to Data Monitor.
4. Select “Status” from Search parameter list.
5. Select “Parking brake switch status”.
6. Select all of the “- 70” parameter sources.

   Note: Not all sources will indicate a value.
7. Monitor Parking brake switch status value. Record reading in table.
8. Depress and hold service brake.
9. Release vehicle parking brake.
10. Monitor 70 - Parking brake switch status value. Record reading in table.
11. Set vehicle parking brake.
12. Compare reading(s) in table.
    - IIf readings are out of range, refer to OEM guidelines for repair or replacement of the Parking Brake Switch signal message.
    - If readings are in range, no fault was found. test complete.

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

Transmission Shift Complaint Test

Overview

This symptom-driven test is performed if a shift complaint exists and there are no fault codes.

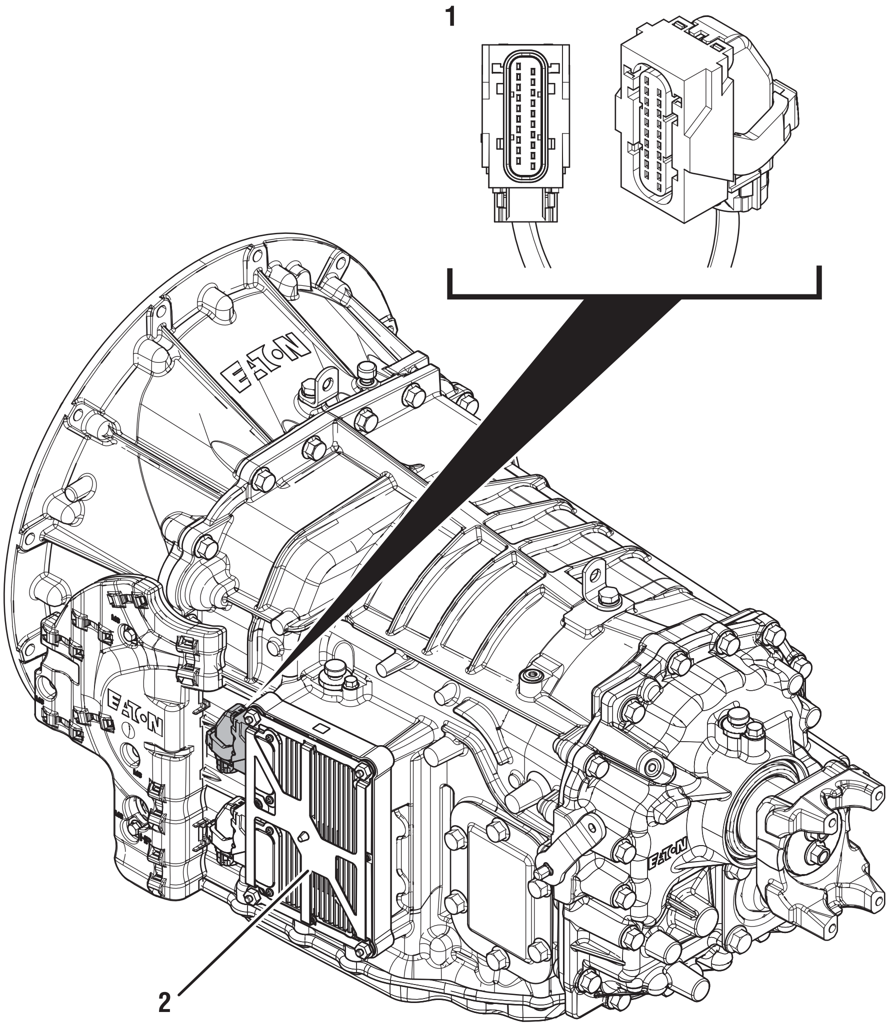
Detection

- Transmission may exhibit slow or harsh launch from a stop.
- Transmission may not be able to complete a shift.
- Transmission may exhibit slow or harsh shifting.

Possible Causes

- Vehicle
  - Varies
- Engine
  - Varies
- Transmission
  - Varies

Component Identification



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

Transmission Shift Complaint Test

A

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

1. Document the vehicle symptoms by completing the *Driver Questionnaire* on page 8.
2. Set parking brake and chock wheels.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Select "Service Activity Report" to retrieve Snapshot and Vehicle Performance Analysis (VPA) data.
6. Select “Send to Eaton”.
7. Update Transmission Control Module (TCM) software to latest available level.

   Note: To avoid damaging the TCM, use an Eaton approved vehicle communication adapter and ensure all satellite systems are disabled before updating software.
8. Review the vehicle fault codes:
   - 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(s) is Inactive or not set, go to **Step B.**

B

Purpose: *Operate vehicle and attempt to recreate vehicle symptom.*

1. 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 performing the appropriate procedure below based on the Driver Interface Device type:

   •Shift Lever - Select “H” (Hold) mode then quickly select “L” (Low)-”H”-”L” (H-L-H-L)

   •Push Button - Select “Low” mode then quickly depress “^” (Upshift Button) twice (Low-^-^).

   Note: Capturing the driver triggered snapshot is time sensitive; for the best results, perform this sequence immediately after the symptoms occur.
3. The transmission will set a tone and the letters “ST” will appear in the display if the Snapshot is captured and recorded in the Transmission Control Module (TCM).

   Note: A Driver Triggered Snapshot will capture data that cannot otherwise be captured. This data can be reviewed with Eaton technical support.
4. Return the Driver Interface Device to the mode that was selected prior to initiating the Driver Triggered Snapshot.
   - 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, test complete. Contact Eaton at 1-800-826-HELP (4357) for further diagnostic instructions.

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

1. Set 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” to retrieve Snapshot and Vehicle Performance Analysis (VPA) data.
6. Select “Send to Eaton”.
7. Review the vehicle fault codes:
   - 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 fault code did not set and the symptom was duplicated during the road test, contact Eaton at 1-800-826-HELP (4357) for further diagnostic instructions.

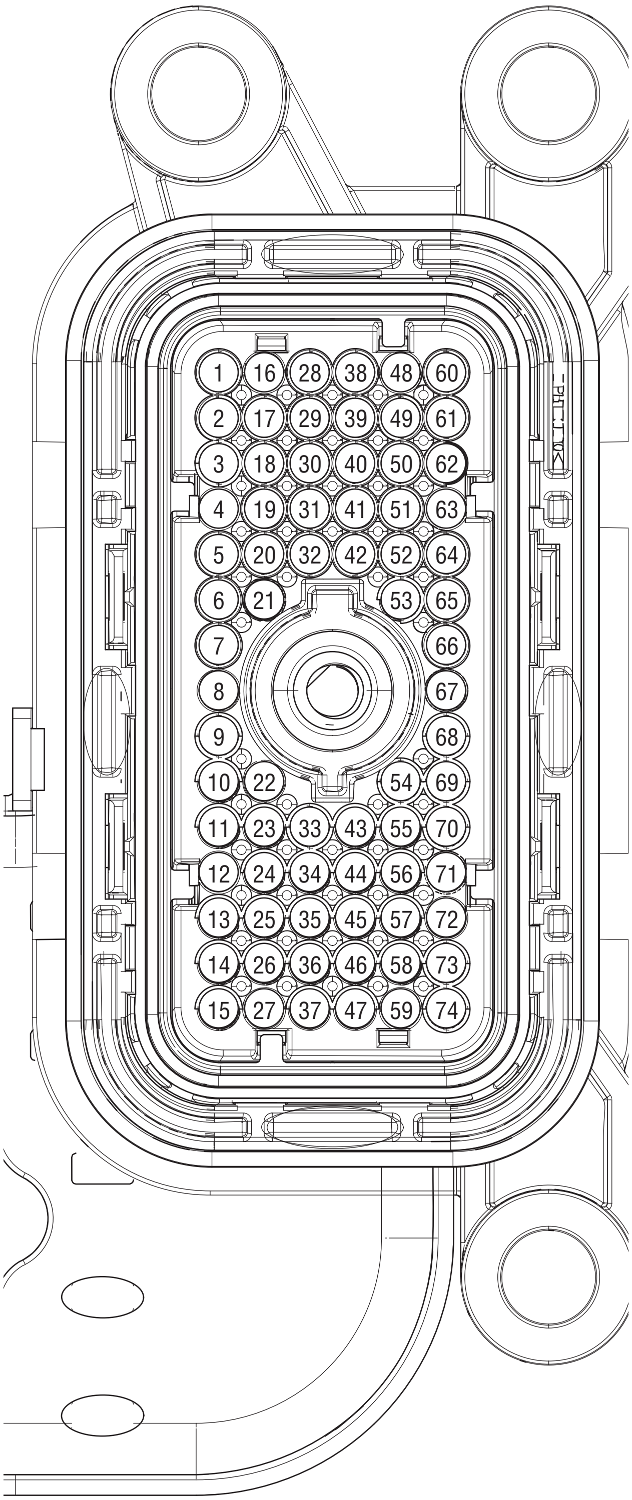
D ***Purpose:*** *Prioritize fault codes for troubleshooting.*

1. Determine the fault code to troubleshoot first by using the priority index below (with 1 highest priority and 4 least priority).
   - Priority 1: Vehicle Interface Fault Codes 100-199
   - Priority 2: Component Fault Codes 200-499
   - Priority 3: System Fault Codes 500-899
   - Priority 4: Feature Fault Codes 900-999
2. Go to the Fault Code Isolation Procedure Index on page 13 and troubleshoot the fault code with the highest priority level.
   - If more than one fault code within a level applies, troubleshoot Active fault codes before Inactive fault codes.
   - If only Inactive fault codes are present, troubleshoot the fault code that has the highest occurrence count or most recent time stamp.
   - If no fault codes are found, match the vehicle symptom to the appropriate item in the *Symptom-Driven Diagnostics Index* on page 9

Connector Pin Descriptions

Note: This section is intended as a quick reference. For specific instructions, see the Procision Transmission Installation Guide TRIG0900.

74-Way Transmission Harness Connector

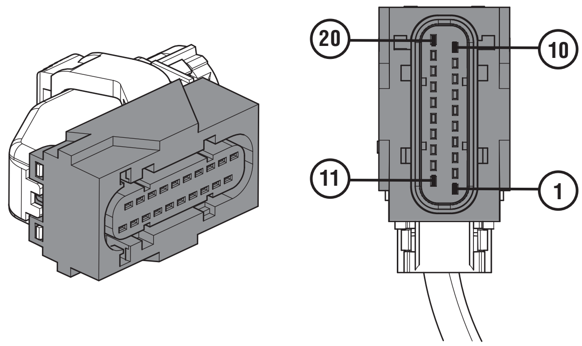


Pin	Description
1	Clutch Cooling Secondary Solenoid Valve (CCSS) High
2	Clutch Cooling Secondary Solenoid Valve (CCSS) Low
3	Rail A Valve Solenoid (RAVS) Low
4	Rail A Valve Solenoid (RAVS) High
5	Rail C Valve Solenoid (RCVS) High
6	Triple Pressure Sensor Sump Temp Signal
7	Triple Pressure Sensor Secondary Power Supply (SSD)
8	Triple Pressure Sensor Secondary Pressure Signal
9	Not Used
10	Triple Pressure Sensor Secondary Power Return
11	Triple Pressure Sensor Line Pressure Signal
12	Not Used
13	Not Used
14	Rail C Position Sensor Signal
15	Not Used
16	Not Used
17	Not Used
18	Pressure Control Shift Solenoid Valve (PCSS) Low
19	Pressure Control Shift Solenoid Valve (PCSS) High
20	Rail C Valve Solenoid (RCVS) Low
21	Not Used
22	Not Used
23	Not Used

Pin	Description
24	Not Used
25	3-Rail Position Sensor Primary Power
26	Rail A Position Sensor Signal
27	3-Rail Position Sensor Primary Return
28	Rail B Valve Solenoid (RBVS) High
29	Rail B Valve Solenoid (RBVS) Low
30	Shift Pressure Solenoid Valve 1 (SPS1) Low
31	Shift Pressure Solenoid Valve 1 (SPS1) High
32	Secondary Input Speed Sensor Signal
33	Cooler Temperature Sensor 1 Signal
34	Triple Pressure Sensor Primary Power Supply
35	Not Used
36	Rail B Position Sensor Signal
37	Not Used
38	Rail D Valve Solenoid (RDVS) High
39	Rail D Valve Solenoid (RDVS) Low
40	Line Pressure Solenoid Valve (LPS) Low
41	Line Pressure Solenoid Valve (LPS) High
42	Secondary Input Speed Sensor Return
43	Cooler Temperature Sensor 1 Return
44	Triple Pressure Sensor Primary Pressure Signal
45	3-Rail Position Sensor Secondary Power
46	Rail A Position Sensor Cross Check Triaxial Signal
47	3-Rail Position Sensor Secondary Return
48	Clutch Cooling Primary Solenoid Valve (CCPS) High
49	Clutch Cooling Primary Solenoid Valve (CCPS) Low
50	Shift Pressure Solenoid Valve 2 (SPS2) Low
51	Shift Pressure Solenoid Valve 2 (SPS2) High

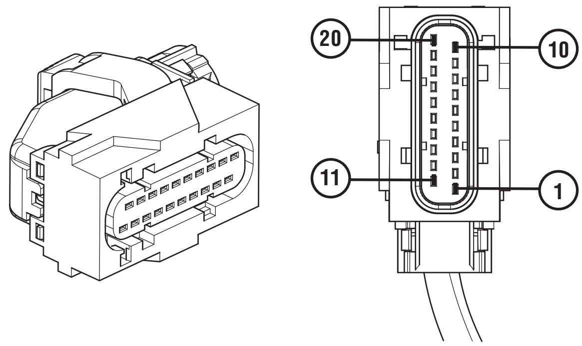
Pin	Description
52	Output Speed Sensor Return
53	Not Used
54	Primary Input Speed Sensor Return
55	Primary Input Speed Sensor Signal
56	Triple Pressure Sensor Primary Return
57	Rail D Position Sensor Power
58	Rail D Position Sensor Signal
59	Rail D Position Sensor Return
60	Primary Clutch Pressure Solenoid (PCPS) Valve High
61	Primary Clutch Pressure Solenoid (PCPS) Valve Low
62	Not Used
63	Not Used
64	Output Speed Sensor Signal
65	Not Used
66	Not Used
67	Not Used
68	Not Used
69	Not Used
70	Engine Speed Sensor Signal
71	Engine Speed Sensor Return
72	Not Used
73	Not Used
74	Not Used

20-Way TCM Vehicle Harness Connector



Pin	Description
1	PNL CAN C High (Input)
2	PNL CAN C Low (Input)
3	TRS Output 1
4	Start Enable Relay Negative
5	Battery Negative 1 (-)
6	Battery Positive 1 (+)
7	Plugged Not Used
8	Protected Power Return
9	TRS Output 2 / Push Button Mode Indicator
10	Ignition Wakeup (Input)
11	J1939 CAN A High (Input)
12	J1939 CAN A Low (Input)
13	J1939 CAN A Shield (Input)
14	Start Enable Relay Positive
15	Battery Negative 2 (-)
16	Battery Positive 2 (+)
17	Protected Power (Output)
18	Analog Return / TRS-4 Return
19	TRS 5.0 Volt Supply
20	Synchronization Wakeup

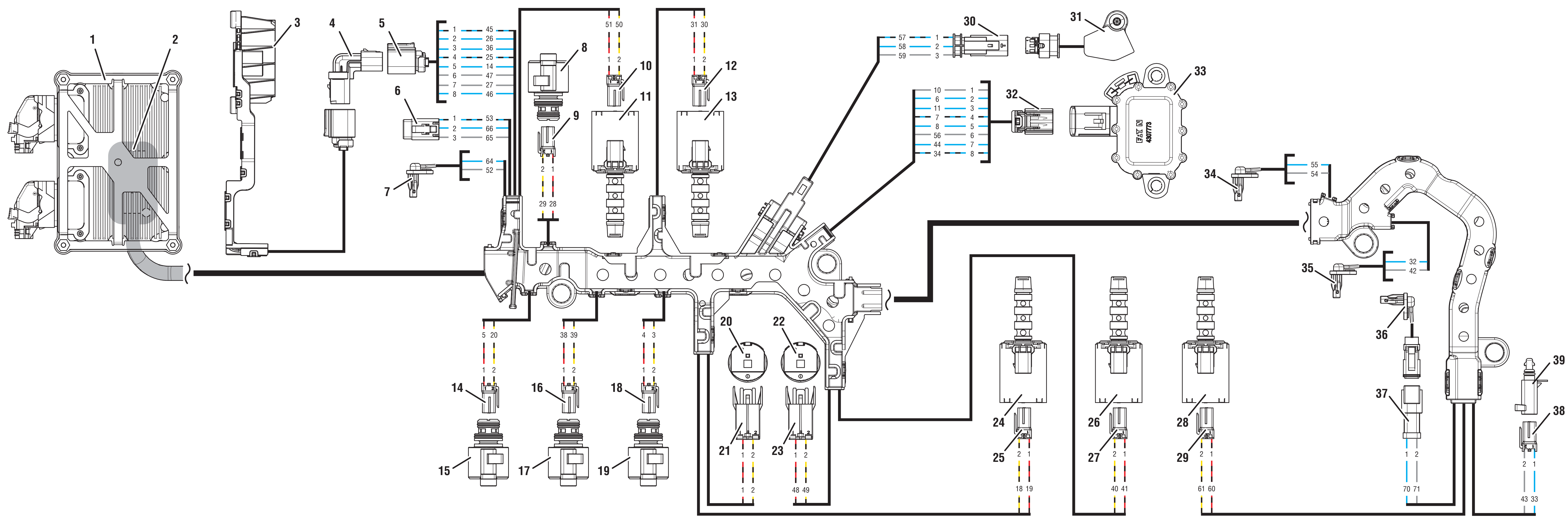
20-Way TCM Body Harness Connector



Pin	Description
1	Reverse Output 3
2	PTO Engage Output 2
3	Range Output 1
4	Hold/Force Neutral Input 2
5	Body I/O Return (RTN_1)
6	Hold/Force Neutral Input 1
7	CAN B High (Output)
8	CAN B Low (Output)
9	PNL CAN C Low (Pass Thru)
10	PNL CAN C High (Pass Thru)
11	Service Test Port – Battery Positive (+)
12	Service Test Port – Ignition (+)
13	Service Test Port – Battery Negative (-)
14	Body I/O Return (RTN_2)
15	PTO Request Input 3 - Input from driver to activate PTO function
16	PTO Confirm - Feedback signal from PTO indicating PTO is engaged
17	Alternative Shift Strategy Input 5
18	Alternate Shift Strategy Out
19	J1939 CAN A Low (Output)
20	J1939 CAN A High (Output)

Wiring Diagrams

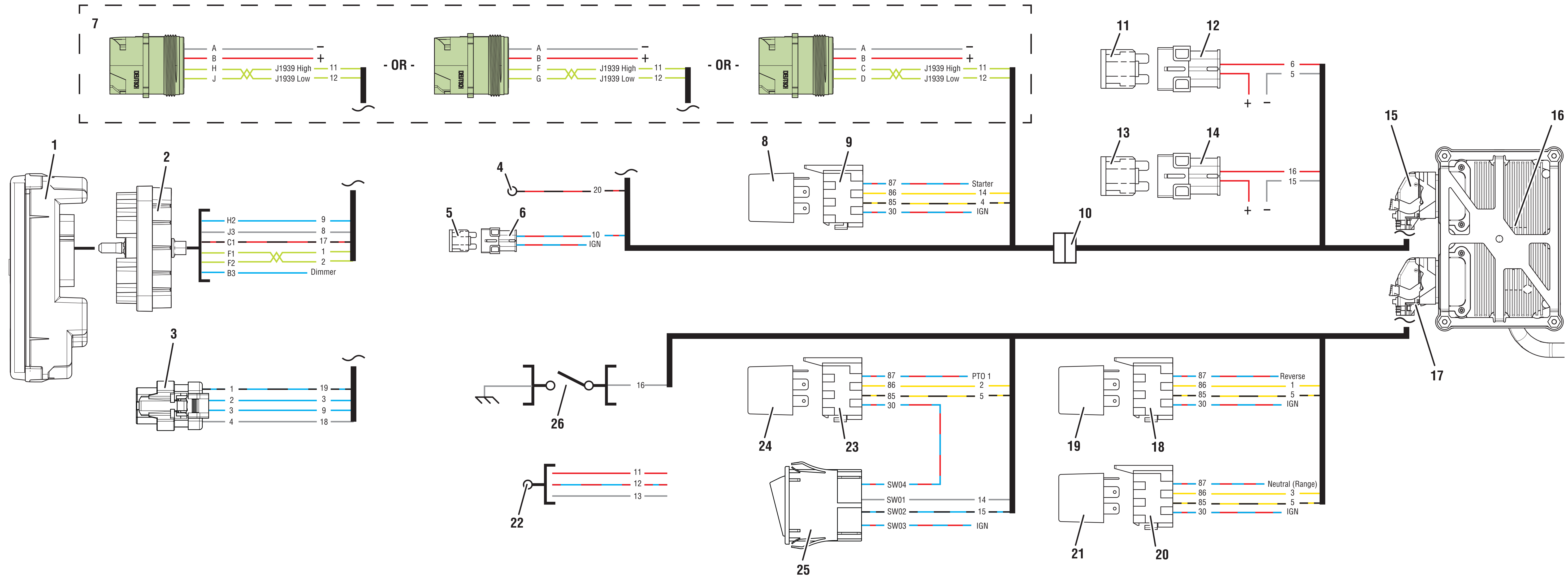
Transmission Harness Connections



1. Transmission Control Module (TCM)
2. 74-Way Transmission Harness Connector
3. 8-Way 3-Rail Position Sensor
4. 8-Way 90-Degree Connector
5. 8-Way Rail Position Sensor Connector
6. 3-Way Connector (Not Used)
7. Output Speed Sensor
8. 2-Way Rail B Valve Solenoid (RBVS)
9. 2-Way Rail B Valve Solenoid (RBVS) Connector
10. 2-Way Shift Pressure Solenoid 2 (SPS2) Connector
11. 2-Way Shift Pressure Solenoid 2 (SPS2)
12. 2-Way Shift Pressure Solenoid 1 (SPS1) Connector
13. 2-Way Shift Pressure Solenoid 1 (SPS1)
14. 2-Way Rail C Valve Solenoid (RCVS) Connector
15. 2-Way Rail C Valve Solenoid (RCVS)
16. 2-Way Rail D Valve Solenoid (RDVS) Connector
17. 2-Way Rail D Valve Solenoid (RDVS)
18. 2-Way Rail A Valve Solenoid (RAVS) Connector
19. 2-Way Rail A Valve Solenoid (RAVS)
20. 2-Way Clutch Cooling Secondary Solenoid (CCSS)
21. 2-Way Clutch Cooling Secondary Solenoid (CCSS) Connector
22. 2-Way Clutch Cooling Primary Solenoid (CCPS)
23. 2-Way Clutch Cooling Primary Solenoid (CCPS) Connector
24. 2-Way Pressure Control Secondary Clutch Solenoid (PCSS)
25. 2-Way Pressure Control Secondary Clutch Solenoid (PCSS) Connector
26. 2-Way Line Pressure Solenoid (LPS)
27. 2-Way Line Pressure Solenoid (LPS) Connector
28. 2-Way Pressure Control Primary Clutch Solenoid (PCPS)
29. 2-Way Pressure Control Primary Clutch Solenoid (PCPS) Connector
30. 3-Way Rail D Position Sensor Connector
31. 3-Way Rail D Position Sensor
32. 8-Way Triple Pressure Sensor (TPS) Connector
33. 8-Way Triple Pressure Sensor (TPS)
34. Primary Input Speed Sensor
35. Secondary Input Speed Sensor
36. 2-Way Engine Speed Sensor
37. 2-Way Engine Speed Sensor Connector
38. 2-Way Cooler Temperature Sensor (CTS) Connector
39. 2-Way Cooler Temperature Sensor (CTS)

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

Vehicle and Body Harness Connections



1. Eaton Push Button Controller (PBC)
2. 30-Way Eaton Push Button Controller (PBC) Connector
3. 4-Way Transmission Range Sensor (TRS) Connector
4. Synchronization Wakeup
5. In-line Fuse
6. 10-amp Fuse Holder
7. 9-Way Diagnostic Connector (OEM Specific)
8. 5-Way Start Enable Relay
9. 5-Way Start Enable Relay Socket
10. Bulkhead Connector
11. 15-amp Fuse
12. In-line Fuse Holder
13. 15-amp Fuse
14. In-line Fuse Holder
15. 20-Way Vehicle Harness Connector
16. Transmission Control Module (TCM)
17. 20-Way Body Harness Connector
18. 5-Way Reverse Output Relay Socket
19. 5-Way Reverse Output Relay
20. 5-Way Neutral Range Output Relay Socket
21. 5-Way Neutral Range Output Relay
22. Service Port
23. Power Take-Off (PTO) Relay Socket
24. Power Take-Off (PTO) Relay
25. Power Take-Off (PTO) Dashboard Switch
26. Power Take-Off (PTO) 1 Confirm Switch

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

Change Log

-

Date	Description
March 2019	Updated J1939 Data Link, SER, Brake Switch, Shift Complaint, & Pin Descriptions
February 2019	Updated General Information section, Fault Code 210, and Appendix
January 2019	Updated Fault Codes 225, 255, 275, 295, 330, and 740

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