

Fuller Heavy Duty Transmissions TRTS0020 EN-US

October 2007

RT-11109A-AT	RTO-13109B-AT
RT-11109A-ATR	RTO-13109B-ATE
RT-11109A-ATS	RTO-14109A-ATE
RT-12109A-AT	RTO-14109A-ATS
RT-14109A-ATS	RTO-14109B-AT
RTO-11109A-AT	RTO-14109B-ATE
RTO-11109A-ATS	RTO-14109B-ATS
RTO-11109B-AT	RTO-16109A-AT
RTO-11109B-ATE	RTO-16109A-ATE
RTO-11109B-ATR	RTO-16109B-AT
RTO-11109B-ATS	RTO-16109B-ATE
RTO-12109A-AT	RTO-9109A-AT
RTO-12109B-AT	RTO-9109B-AT
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General Warnings:



Before starting a vehicle:

- Sit in the driver's seat
- Place shift lever in neutral
- Set the parking brake



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

- Place shift lever in neutral
- Set the parking brake
- Block the wheels



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



When parking the vehicle or leaving the cab:

- Place shift lever in neutral
- Set the parking brake



To avoid damage to the transmission during towing:

- Place shift lever in neutral
- Lift the drive wheels off of the ground or disconnect the driveline



Do not operate vehicle if alternator lamp is lit or if gauges indicate low voltage.

Suggested Tools:

Pressure Gauges:

- 0-300 PSI Hydraulic gauge
- 0-100 PSI Hydraulic gauge
- 0-100 PSI Air gauge

OTC Tool & Equipment Division, SPX Corporation

Eaton Part No.	Description
5505027	Volt /Ohm Meter (Standard commercially available VOM)

For ordering in U.S. and Canada call 1-800-533-0492. (In Minnesota call 507-455-7010.)

MPSI Micro Processor Systems, Inc.

MPSI Part No.	Description
104004	Pro-link Main (MPSI hand-held diagnostic tool)
205040	Heavy Duty Multi-Protocol Cartridge (MPC)
805001	MPC Eaton Systems Software

For MPSI phone orders call 1-800-639-6774.

Related Publications

Installation Guide - Eaton TRIG-0020
Driver Instructions - Eaton TRDR-0020
Service Manual - Eaton TRSM-0020
Illustrated Parts List - Eaton TRIP-0023 (11109)
Eaton TRIP-0025 (13109)
Eaton TRIP-0022 (14109)
Eaton TRIP-0026 (16109)

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

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Symptom Pretests

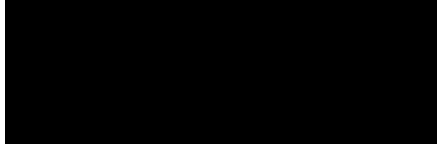
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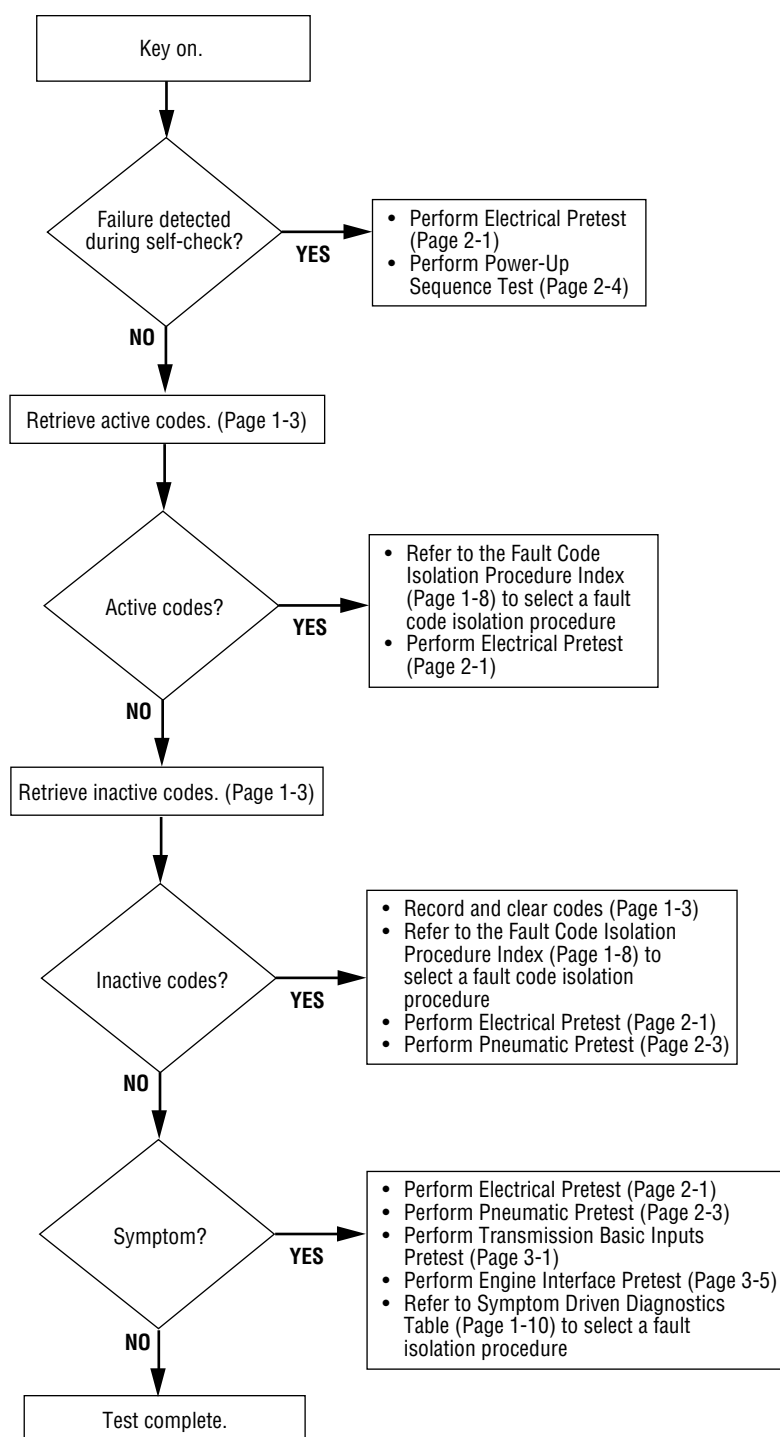
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Diagnostics Procedure

Follow the flowchart below for all CEEMAT transmission failures. Perform tests and procedures as directed by the flowchart.



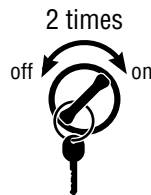
Fault Codes Retrieval/Clearing

Retrieving Fault Codes

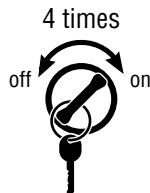
Retrieve CEEMAT fault codes by enabling the CEEMAT system's self-diagnostic mode.

Note: You can also use a diagnostic scan tool, such as the MPSI Pro Link Main, to retrieve CEEMAT fault codes. Refer to the OEM's documentation for more information.

1. Place the shift lever in neutral.
2. Set the parking brakes.
3. Turn the ignition key on but do *not* start the engine.
4. **To Retrieve Active Codes:** Start with the key in the on position. Turn the key off and on two times within five seconds ending with the key in the on position.

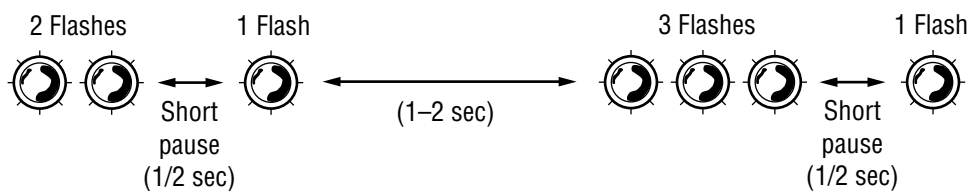


To Retrieve Inactive (Intermittent) Codes: Start with the key in the on position. Turn the key off and on four times within five seconds ending with the key in the on position.



After a brief pause, the service transmission indicator lamp begins flashing two-digit fault codes.

5. Observe the sequence of flashes on the indicator lamp and record the codes. A one to two second pause separates each stored code, and the sequence automatically repeats after all codes have been flashed.



Code 21

Code 31

Clearing Fault Codes

The following procedure clears all inactive (intermittent) fault codes from the ECU's memory. (Active fault codes are automatically cleared when the fault has been corrected.)

1. Place the shift lever in neutral.
2. Set the parking brakes.
3. Turn the ignition key on but do *not* start the engine.
4. Start with the key in the on position. Turn the key off and on six times within five seconds ending with the key in the on position.



Driving Techniques

Fault Codes	Description	Type of Code	Driving Technique
11	ECU	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
14	Shift Lever Fault	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat, vibration and selecting different shift lever positions.
15	Shift Lever Data Link	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
21	Interrupt Solenoid Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
22	Lockup/Bypass Solenoid Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
23	Engine Speed Sensor	Component	Operate the vehicle above 4th gear until the fault occurs. Maintain a steady speed. If may be necessary to operate the vehicle for a prolonged period of time if the cause of the failure is related to heat or vibration.
24	Hydraulic System Fault	Component	Complete several automatic shifts while driving the vehicle through terrain that loads the engine.
31	Engine Brake Relay Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
32	Defuel Solenoid Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.

Driving Techniques, continued

Fault Codes	Description	Type of Code	Driving Technique
33	System Voltage	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
34	Throttle Position Sensor	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat, vibration and varying levels of throttle demand.
35	Engine Control Failure (Mechanically-Governed Engines)	System	Operate the vehicle and shift the transmission up and down through the gears.
35	Engine Control Failure (Electronically-Governed Engines)	System	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat, vibration and varying levels of throttle demand.
41	Range Failed to Engage	System	Operate the vehicle and perform several range upshifts and downshifts. The failure is detected after 5 consecutive attempts to complete the same type of range shift. Several shifts (ten or more) may be necessary before the ECU confirms the failure.
43	Range Solenoid Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
44	Disc/Inertia Brake Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
45	Power Synchronizer Band/Engine Boost Solenoid Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
51	Center Rail Sensor	Component	Complete several front box gear shifts, including selections from NEUTRAL and automatic shifts while in motion.

Driving Techniques, continued

Fault Codes	Description	Type of Code	Driving Technique
52	Neutral Sensor	Component	Complete several front box gear shifts, including selections from NEUTRAL and automatic shifts while in motion.
53	Gear Engaged Sensor	Component	Complete several front box gear shifts, including selections from NEUTRAL and automatic shifts while in motion.
54	HI Range Sensor	Component	Complete several range shifts up and down across the entire range while the vehicle is in motion.
55	LO Range Sensor	Component	Complete several range shifts up and down across the entire range while the vehicle is in motion.
56	Input Speed Sensor	Component	Select a forward gear and drive at a steady speed for at least two minutes.
57	Output Speed Sensor	Component	Select a forward gear and drive at a steady speed for at least two minutes.
61	Autoshifter Solenoid 1 Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
62	Autoshifter Solenoid 2 Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
63	Autoshifter Solenoid 3 Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
64	Autoshifter Solenoid 4 Coil	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.

Driving Techniques, continued

Fault Codes	Description	Type of Code	Driving Technique
71	Stuck Engaged	System	Engage LO gear and allow the vehicle to slowly move forward. While the vehicle is in motion, move the shift lever to Reverse LO and slowly bring the vehicle to a stop. The vehicle will shift into Reverse LO. Several shifts (ten or more) may be required before the ECU confirms the failure.
72	Failed to Select a Rail	System	Complete several shifts while the vehicle is in motion, including selections from neutral. Also allow the transmission to complete several automatic shifts.
73	Failed to Engage Gear	System	Complete several shifts while the vehicle is in motion, including selections from neutral. Also allow the transmission to complete several automatic shifts.
74	Failed to Synchronize	System	Operate the vehicle at high speeds while shifting the transmission between 7th, 8th and 9th gears. Since the transmission makes several calculations before setting code 71, ten or more shifts may be required before the ECU confirms the failure.
81	Invalid Shift Lever at Start (Cable Only)	System	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat and vibration.
82	Multiple Non-Ajacent Sensors (Cable Only)	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat, vibration and varying levels of shift lever positions.
83	Shift Lever Missing (Cable Only)	System	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat, vibration or different lever positions.
83	Shift Lever Missing (Electronic Only)	Component	Key on. If the fault is present, the system should automatically detect the problem and set the code. If the fault is not present at key on, operate the vehicle and attempt to duplicate the driving conditions that triggered the fault code. Possible triggers include heat, vibration or different lever positions.

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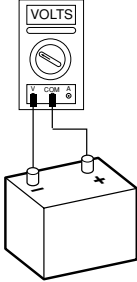
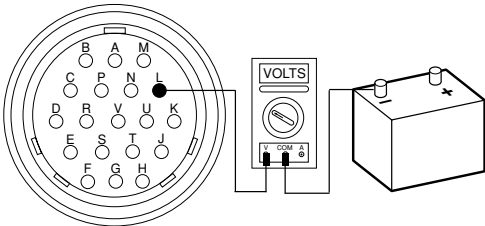
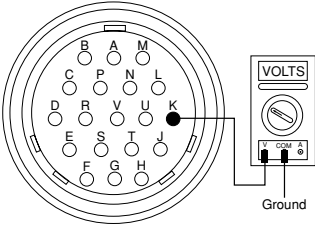
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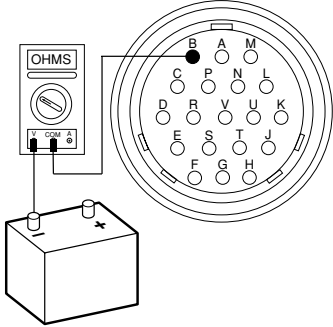
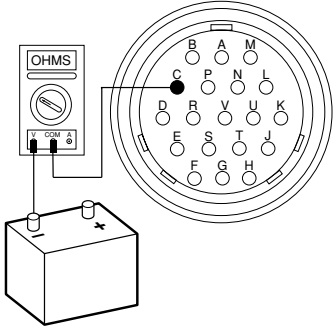
Symptom Driven Diagnostics

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Electrical Pretest

Step A	Procedure	Condition	Action
	1. Key off. 2. Measure battery voltage at the battery terminals. 	→ If voltage is 11 to 13 volts → If voltage is outside of range	→ Go to Step B. → Repair or replace battery and/or charging system as required. Repeat this step.
Step B	Procedure	Condition	Action
	1. Key off. 2. Disconnect vehicle interface harness from CEEMAT. 3. Measure voltage between vehicle interface harness pin L and battery negative (-) terminal. 	→ If voltage is within 1 volt of battery voltage → If voltage is outside of range	→ Go to Step C. → Repair or replace vehicle interface harness, battery circuit breaker or battery circuit as required. Repeat this step.
Step C	Procedure	Condition	Action
	1. Key on. 2. Measure voltage between vehicle interface harness pin K and ground. 	→ If voltage is within 1 volt of battery voltage → If voltage is outside of range	→ Go to Step D. → Repair or replace vehicle interface harness, ignition circuit breaker or ignition circuit as required. Repeat this step.

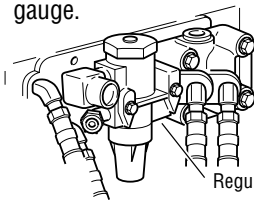
Electrical Pretest, continued

Step D	Procedure	Condition	Action
	1. Key off. 2. Disconnect positive battery cable. 3. Measure resistance between vehicle interface harness pin: • B and battery negative (–) terminal. • C and battery negative (–) terminal.	→ If resistance is 0 to .3 ohms → If resistance is outside of range →	Test complete. Repair or replace vehicle interface harness or ground connections as required. Repeat this step.
	 		

Pneumatic Pretest

Step A	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Key off.
2. Install a 0-150 PSI air gauge in the regulated test port of the CEEMAT air filter/regulator.
3. Start engine.
4. Allow air pressure to build to governor cutoff.
5. Read vehicle main air pressure gauge.



If air pressure cuts off at 90 to 120 PSI



Go to **Step B**.

If air pressure is outside of range



Repair vehicle air system as required. Repeat this step.

Step B	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Key off.
2. Monitor air pressure on vehicle main air pressure gauge.



If vehicle maintains air pressure



Go to **Step C**.

If vehicle loses air pressure



Repair leak in vehicle air system. Repeat this step.

Step C	Procedure	Condition	Action
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1. Read air pressure gauge installed in the air filter/regulator.



If air pressure is 75 to 85 PSI



Test complete.

If air pressure is outside of range



Go to **Step D**.

Step D	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Key off.
2. Remove air supply line to the air filter/regulator and check air flow.



If air flows from the supply line



Replace air filter/regulator. Go to **Step C**.

If air does not flow from the supply line



Repair vehicle air supply to air filter/regulator. Go to **Step C**.

Power-Up Sequence Test

Step A	Procedure	Condition	Action
	1. Key on. 2. Observe service transmission lamp.	→ If service transmission lamp lights for one second and goes off → Test complete. If service transmission lamp never comes on → Go to Step B. If service transmission lamp is on steady → Go to Step C.	
Step B	Procedure	Condition	Action
	1. Key off. 2. Disconnect vehicle interface harness from CEEMAT. 3. Place jumper wire across vehicle interface harness pins G and B.	→ If service transmission lamp turns on → Replace ECU. Go to Step A. If service transmission lamp never comes on → Repair or replace vehicle interface harness as required. Go to Step A.	
Step C	Procedure	Condition	Action
	1. Key on. 2. Disconnect vehicle interface connector at CEEMAT.	→ If service transmission lamp turns off → Replace ECU. Go to Step A. If service transmission lamp remains on → Repair or replace vehicle interface harness as required. Go to Step A.	

Component Code 11 ECU

Fault Description

This code indicates an electrical problem inside the electrical control unit which is part of the ECU.

Possible Causes

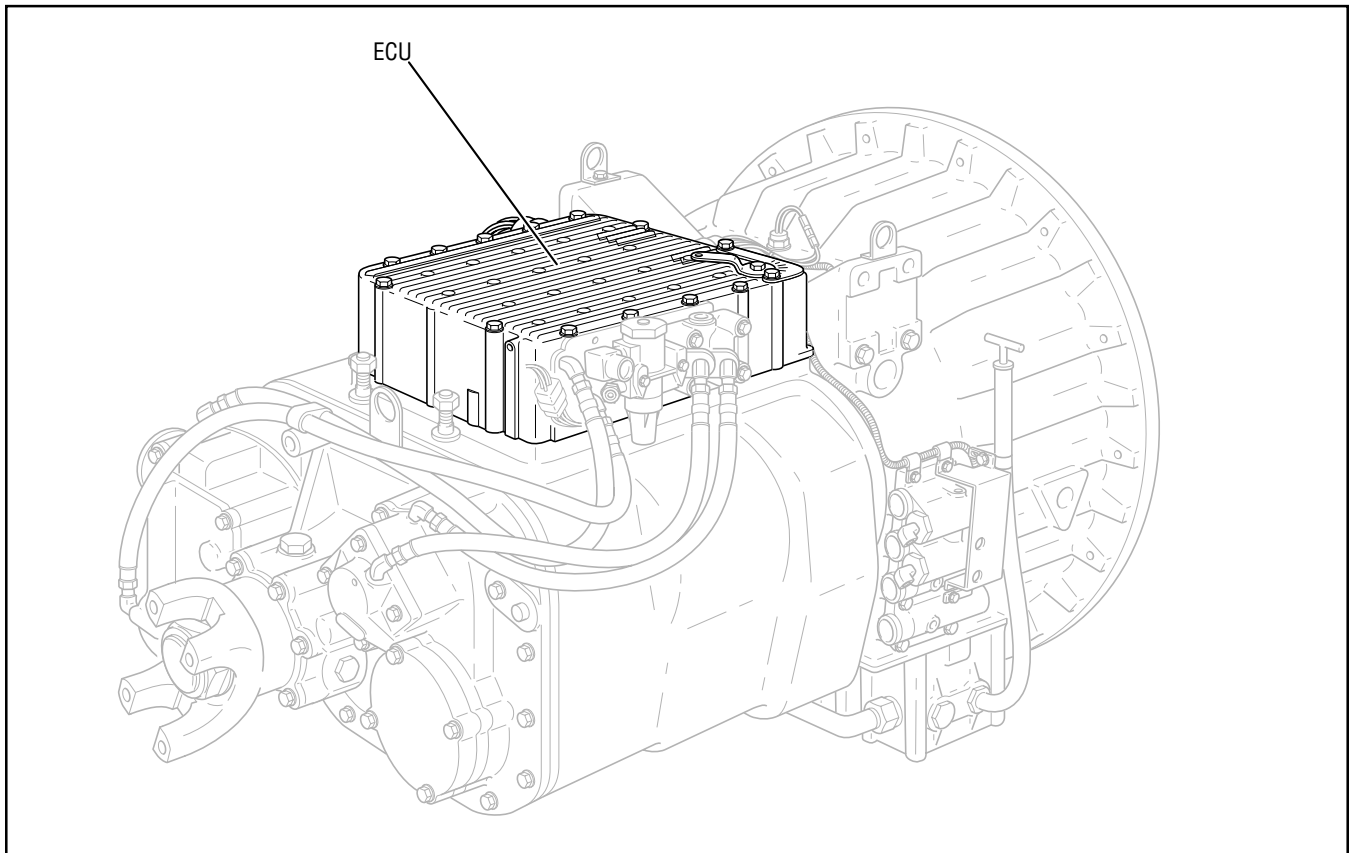
This code can be caused by any of the following conditions:

- Improper configuration software
- Faulty ECU

Required Tools

- CEEMAT Troubleshooting Guide

Likely Failed Components



Code 11, ECU Test

Step A	Procedure	Condition	Action
	1. Key on.		
	2. Retrieve codes (see page 1-3).	→ If code 11 is active	→ Replace ECU.
		If code 11 is inactive	→ Test complete.

Component Code 14 Shift Lever Fault

Fault Description

This code indicates an electrical problem inside the electronic shift lever. The ECU detects this failure when it receives fault information from the electronic shift lever.

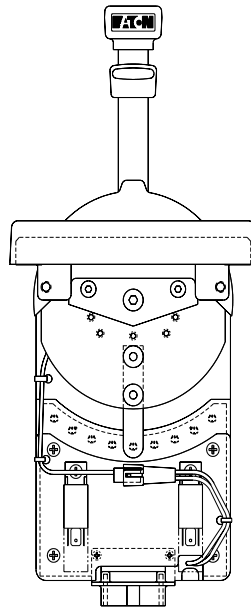
Possible Causes

This code is likely caused by a faulty shift lever.

Required Tools

- Basic Hand Tools
- CEEMAT Troubleshooting Guide

Likely Failed Component



Electronic shift lever (ESL)

Code 14, Shift Lever Fault Test

Step A	Procedure	Condition	Action
	1. Key on. 2. Retrieve codes (see page 1-3).	→ If code 14 is active	→ Replace electronic shift lever.
		If code 14 is inactive	→ Test complete.

Code 14

Component Code 15 Shift Lever Data Link

Fault Description

This code indicates the CEEMAT ECU did not receive an updated shift lever status signal from the electronic shift lever via the J-1922 data link.

Required Tools

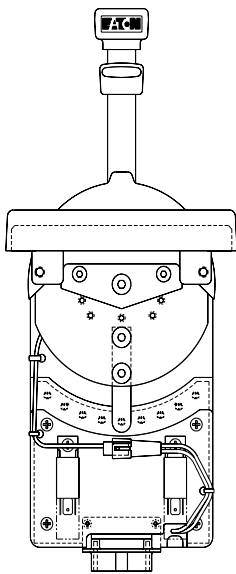
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

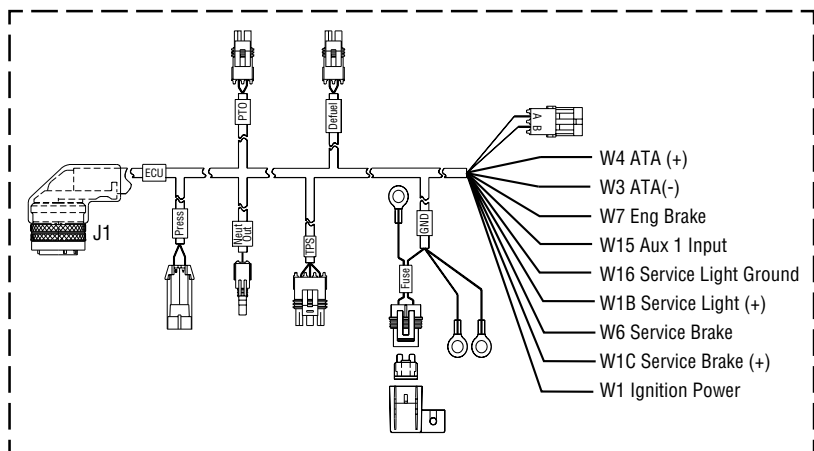
This code can be caused by any of the following conditions:

- Faulty J-1922 data link
- No electrical power to shift lever
- Faulty shift lever
- Faulty ECU

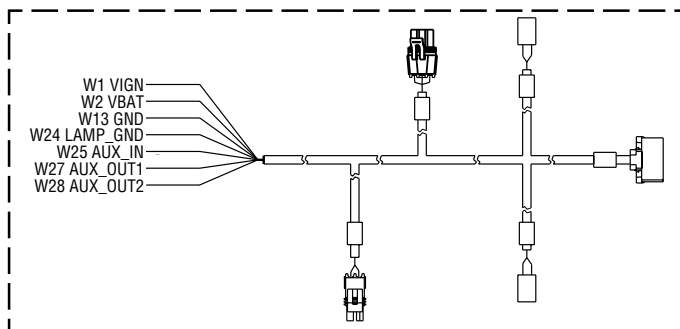
Likely Failure Locations



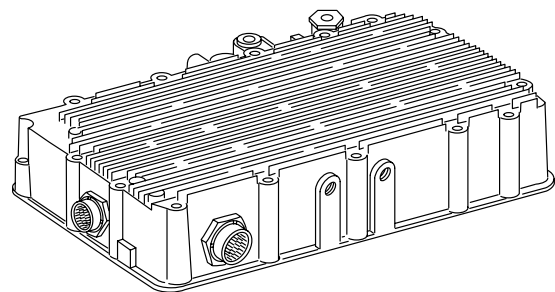
Electronic shift lever (ESL)



Typical vehicle interface harness
(OEM supplied)

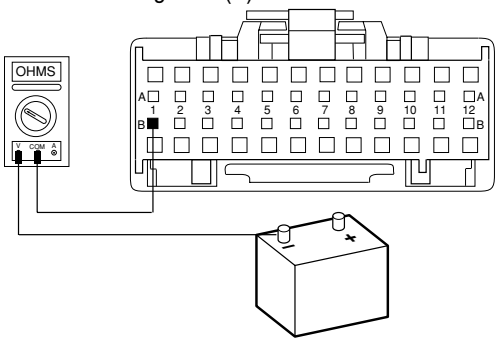
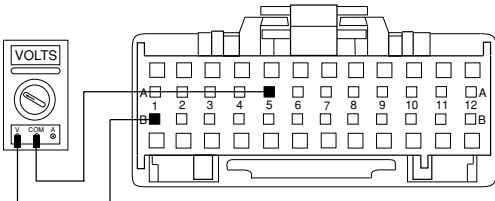
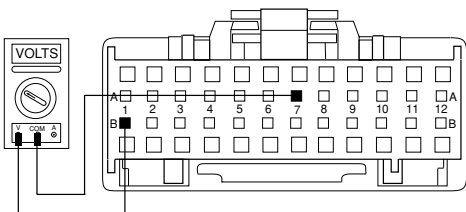


Typical shift lever harness
(OEM supplied)



ECU

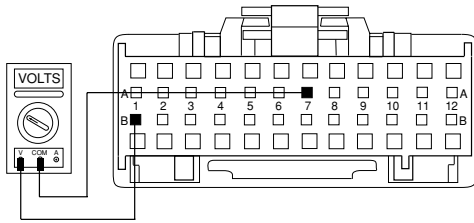
Code 15, Shift Lever Data Link Test

Step A	Procedure	Condition	Action
	1. Select the lever to be tested (driver or work lever). 2. Key off. 3. Disconnect connector from electronic shift lever. 4. Disconnect positive battery cable 5. Measure resistance between electronic shift lever harness pin B1 and battery negative (-) terminal.	→ If resistance is 0 to .3 ohms → If resistance is outside of range →	Go to Step B. Repair ground. Go to Step V.
			
Step B	Procedure	Condition	Action
	1. Measure voltage between electronic shift lever harness pins A5 and B1.	→ If voltage is within 1 volt of battery voltage → If voltage is outside of range →	Go to Step C. Repair harness to shift lever connector. Go to Step V.
			
Step C	Procedure	Condition	Action
	1. Measure voltage between electronic shift lever harness pins A7 and B1.	→ If voltage is 0 → If voltage is not 0 →	Go to Step D. Repair short to power or incorrectly wired circuit (should be ignition power). Go to Step V.
			

Code 15, Shift Lever Data Link Test, continued

Step D	Procedure	Condition	Action
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1. Key on.
2. Measure voltage between electronic shift lever harness pins A7 and B1.



If voltage is within 1 volt of battery voltage

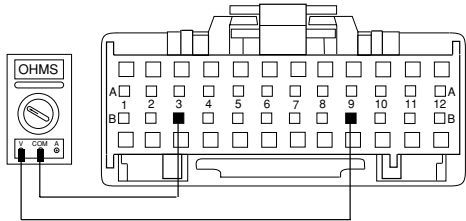
Go to **Step E**.

If voltage is outside of range

Repair ignition power line. Go to **Step V**.

Step E	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Measure resistance between electronic shift lever harness pins B9 and B3.



If resistance is 0 to .3 ohms

Go to **Step F**.

If resistance is outside of range

Repair open circuit between pins B9 and B3. Go to **Step V**.

Step F	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Check to see if there are two shift levers.

One shift lever

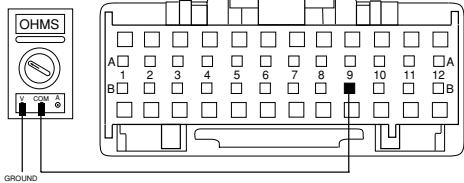
Go to **Step H**.

Two shift levers

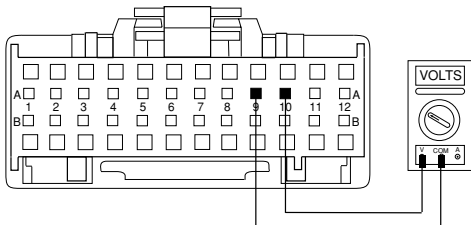
Go to **Step G**.

Code 15, Shift Lever Data Link Test, continued

Step G	Procedure	Condition	Action
	1. Disconnect connector from second electronic shift lever. 2. Measure resistance between electronic shift lever harness pin B9 and ground.	→ If resistance is more than 10K ohms or infinite → If resistance is less than 10K ohms	→ Go to Step H. → Both levers selected. Repair wiring harness to pin B9 to ensure infinite resistance on non-selected lever. Go to Step V.



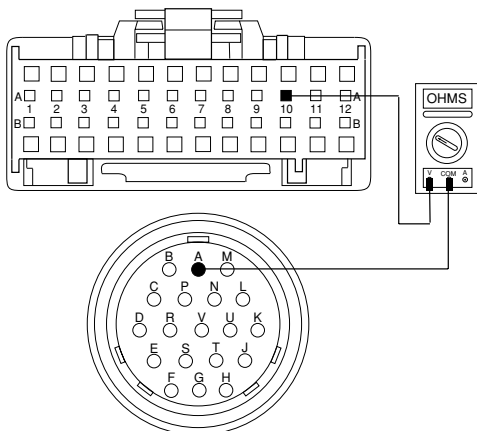
Step H	Procedure	Condition	Action
	1. Key off. 2. Disconnect J-1922 data link from engine ECM. 3. Disconnect harness from electronic shift lever. 4. Connect hand-held diagnostic tool. 5. Key on. 6. Select Perform Tests. 7. Select Throttle Dip Test. 8. Measure voltage between electronic shift lever pins A9 and A10 (connect positive lead to A10).	→ If voltage is +3.0 to +4.0 volts → If voltage is outside of range	→ Go to Step I. → Go to Step J.



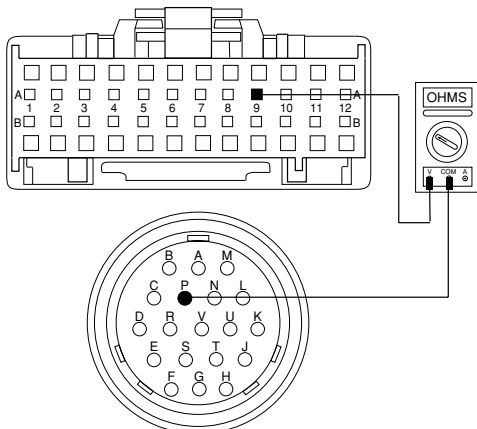
Code 15, Shift Lever Data Link Test, continued

Step I	Procedure	Condition	Action
	1. Activate Throttle Dip Test.	→ If voltage changes to -3.0 to -4.0 volts → If voltage does not change to -3.0 to -4.0 volts	→ Replace shift lever. Go to Step V. → Go to Step J.
Step J	Procedure	Condition	Action

1. Disconnect vehicle interface harness from CEEMAT.
2. Measure resistance between vehicle interface harness pin A and shift lever harness pin A10.



3. Measure resistance between vehicle interface harness pin P and shift lever harness pin A9.



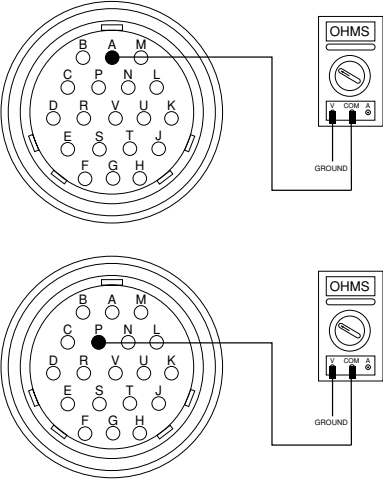
→ If resistance is 0 to .3 ohms

→ If resistance is outside of range

→ Go to **Step K**.

→ Repair or replace J-1922 data link between electronic shift lever and CEEMAT. Go to **Step V**.

Code 15, Shift Lever Data Link Test, continued

Step K	Procedure	Condition	Action
	1. Measure resistance between vehicle interface harness pins: • A to ground • P to ground 	→ If resistance is more than 10K ohms or infinite → If resistance is less than 10K ohms	→ Replace ECU. Go to Step V. → Repair or replace vehicle interface harness. Go to Step V.
Step V	Procedure	Condition	Action

1. Key off.
2. Reconnect all connectors.
3. Key on.
4. Clear codes (see Clearing Fault Codes, page 1-3).
5. Use Driving Technique to attempt to reset the code (page 1-4).
6. Check for codes (see Retrieving Fault Codes, page 1-3).

→ If no codes	→ Test complete.
→ If code 15 appears	→ Return to Step A to find error in testing.
→ If code other than 15 appears	→ Go to Fault Isolation Procedure Index (page 1-8).

Component Code 21 Interrupt Solenoid Coil

Fault Description

This code indicates an electrical problem in the interrupt solenoid circuit.

Required Tools

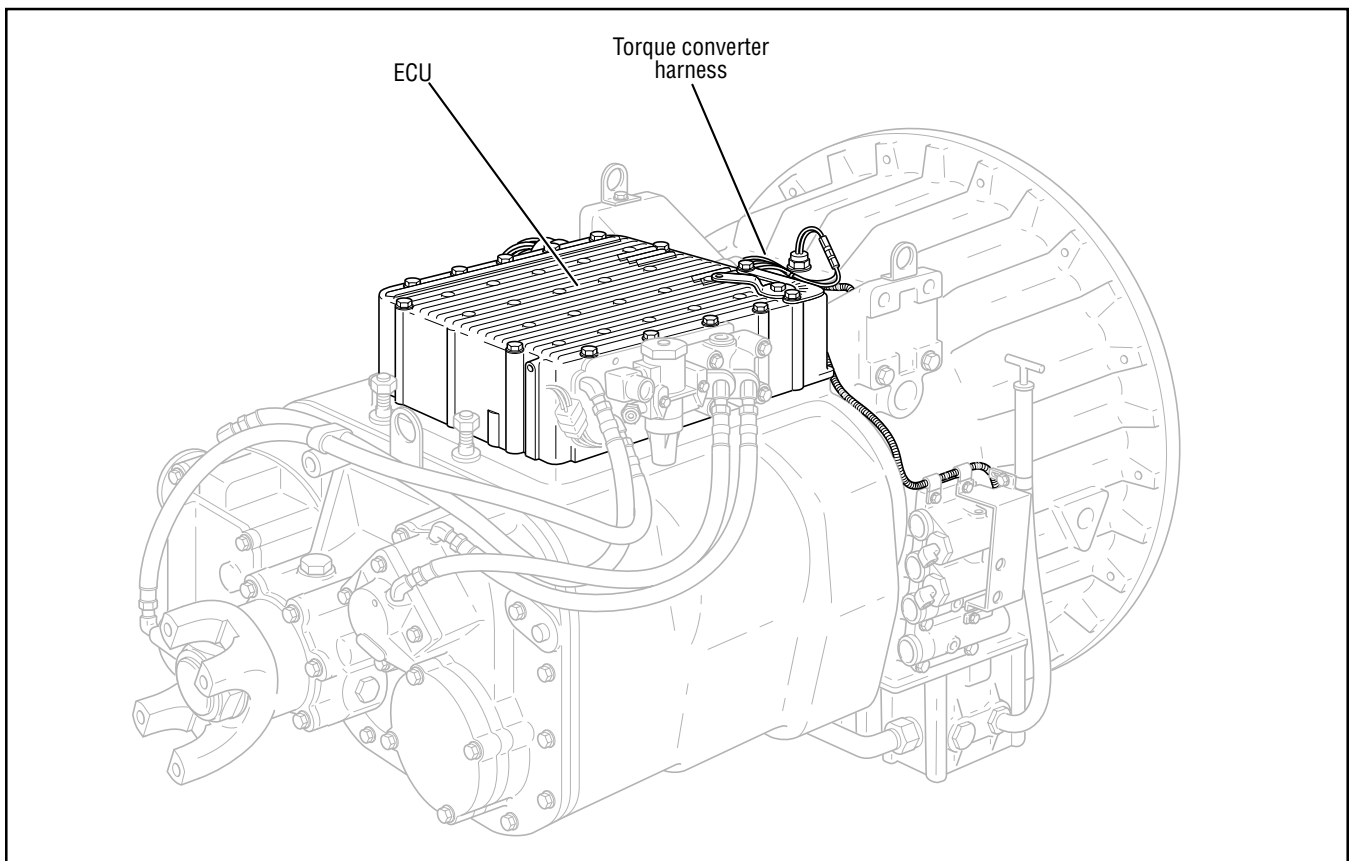
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by any of the following conditions:

- Damaged torque converter harness
- Interrupt solenoid coil open or shorted
- Faulty ECU

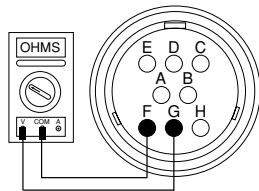
Likely Failed Components



Code 21, Interrupt Solenoid Coil Test

Step A	Procedure	Condition	Action
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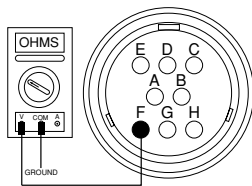
1. Key off.
2. Disconnect torque converter harness from ECU.
3. Measure resistance between torque converter harness pins F and G.



- If resistance is 2.5 to 5.0 ohms → Go to **Step B**.
- If resistance is outside of range → Replace torque converter harness. Go to **Step V**.

Step B	Procedure	Condition	Action
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1. Measure resistance between torque converter harness pin F and ground.



- If resistance is more than 10K ohms or infinite → Replace ECU. Go to **Step V**.
- If resistance is less than 10K ohms → Replace torque converter harness. Go to **Step V**.

Step V	Procedure	Condition	Action
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1. Key off.
2. Reconnect all connectors.
3. Key on.
4. Clear codes (see Clearing Fault Codes, page 1-3).
5. Use Driving Technique to attempt to reset the code (page 1-4).
6. Check for codes (see Retrieving Fault Codes, page 1-3).

- If no codes → Test complete.
- If code 21 appears → Return to **Step A** to find error in testing.
- If code other than 21 appears → Go to Fault Isolation Procedure Index (page 1-8).

Component Code 22

Lockup/Bypass Solenoid Coil

Fault Description

This code indicates an electrical problem in the lockup clutch solenoid circuit.

Required Tools

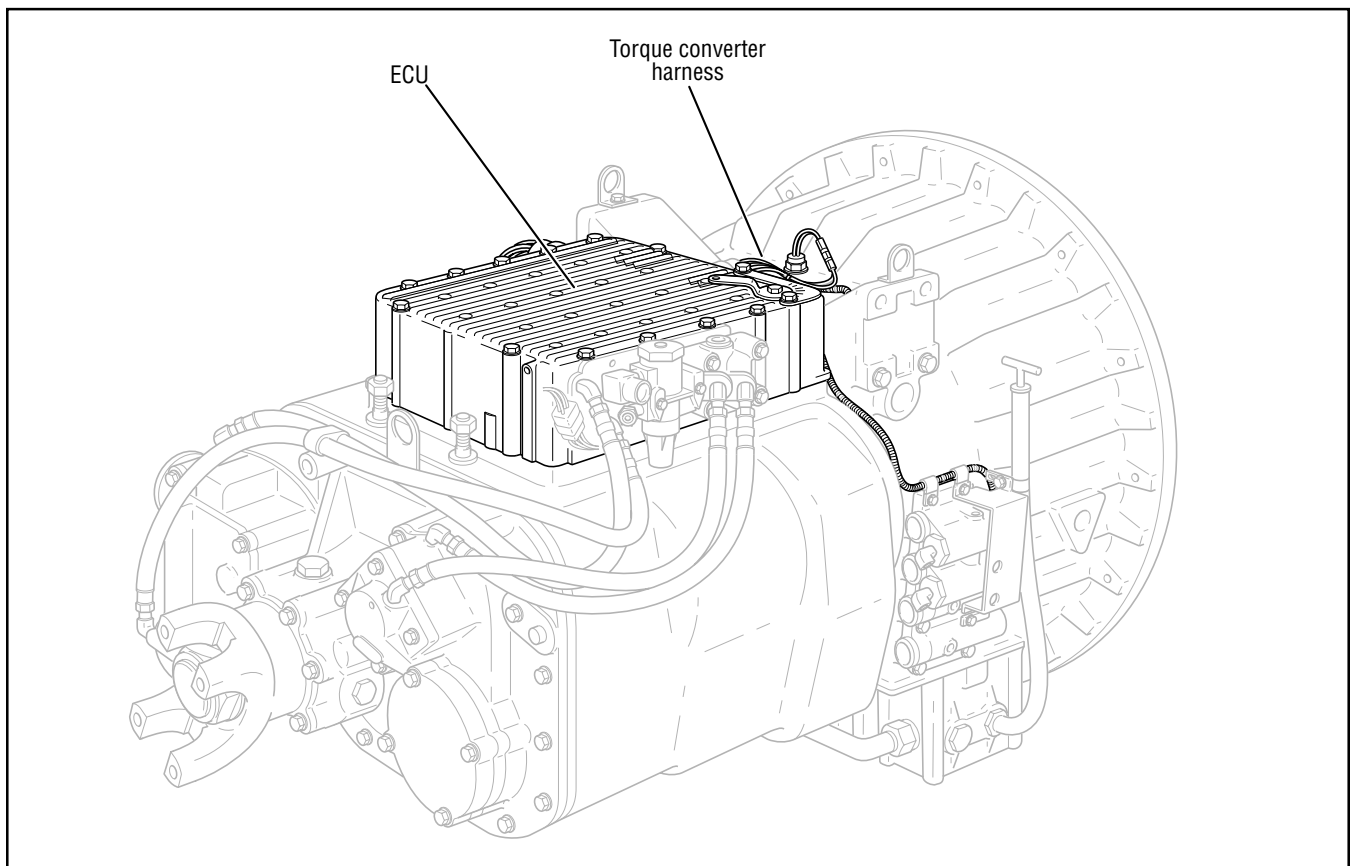
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

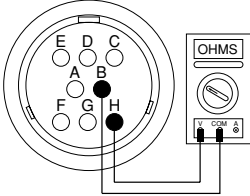
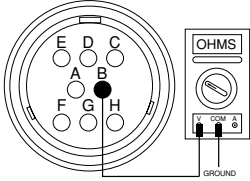
This code can be caused by any of the following conditions:

- Damaged torque converter harness
- Lockup/Bypass solenoid coil open or shorted
- Faulty ECU

Likely Failed Components



Code 22, Lockup/Bypass Solenoid Coil Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Disconnect torque converter harness from ECU. 3. Measure resistance between torque converter harness pins B and H. 	→ If resistance is 2.5 to 5.0 ohms → If resistance is outside of range →	Go to Step B. Replace torque converter harness. Go to Step V.
Step B	Procedure	Condition	Action
	1. Measure resistance between torque converter harness pin B and ground. 	→ If resistance is more than 10K ohms or infinite If resistance is less than 10K ohms	→ Replace ECU. Go to Step V. → Replace torque converter harness. Go to Step V.
Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes If code 22 appears If code other than 22 appears	→ Test complete. → Return to Step A to find error in testing. → Go to Fault Isolation Procedure Index (page 1-8).

Component Code 23 Engine Speed Sensor

Fault Description

This code indicates an electrical problem in the engine speed sensor circuit. The signal from the sensor did not match the current CEEMAT operating conditions.

Required Tools

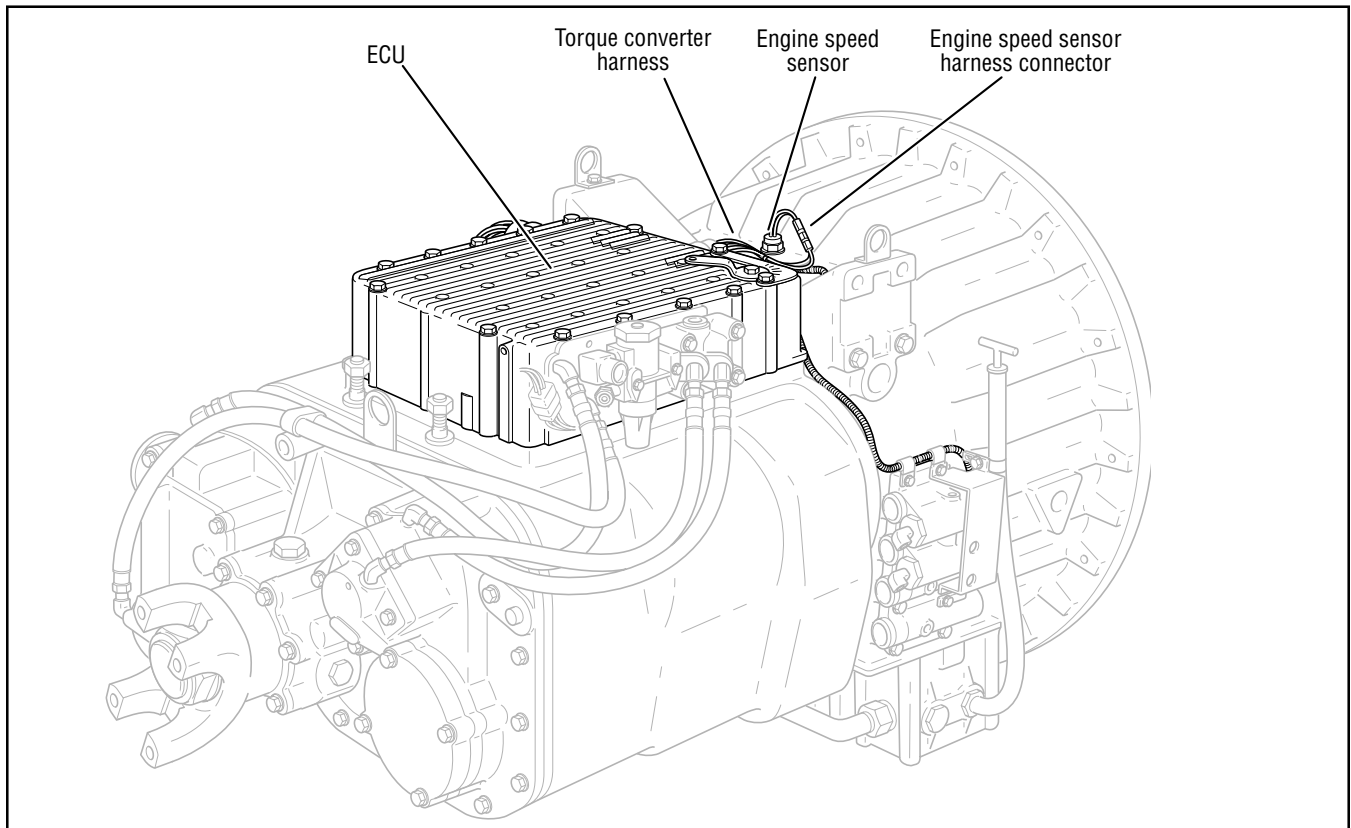
- Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

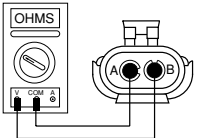
This code can be caused by any of the following conditions:

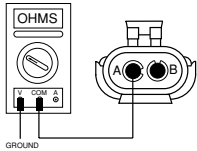
- Electrical open or short in the speed sensor circuit
- Faulty speed sensor harness or connector
- Incorrect speed sensor installation
- Incorrect configuration software
- Faulty ECU

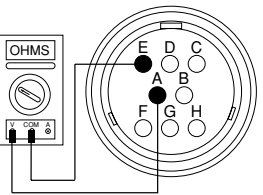
Likely Failed Components



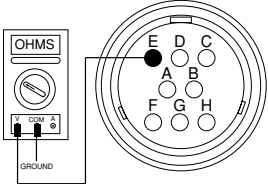
Code 23, Engine Speed Sensor Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Disconnect engine speed sensor from torque converter harness. 3. Measure resistance between engine speed sensor pins A and B.	→ If resistance is 3K to 4K ohms → → If resistance is outside of range →	Go to Step B. Replace engine speed sensor. Go to Step V.
			

Step B	Procedure	Condition	Action
	1. Measure resistance between engine speed sensor pin A and ground.	→ If resistance is more than 10K ohms or infinite → → If resistance is less than 10K ohms →	Go to Step C. Replace engine speed sensor. Go to Step V.
			

Step C	Procedure	Condition	Action
	1. Reconnect engine speed sensor. 2. Disconnect torque converter harness from CEEMAT. 3. Measure resistance between torque converter harness pins A and E.	→ If resistance is 3K to 4K ohms → → If resistance is outside of range →	Go to Step D. Repair or replace torque converter harness as required. Go to Step V.
			

Code 23, Engine Speed Sensor Test, continued

Step D	Procedure	Condition	Action
	1. Measure resistance between torque converter harness pin E and ground. 	→ If resistance is more than 10K ohms or infinite If resistance is less than 10K ohms	→ Replace ECU. Go to Step V. → Repair or replace torque converter harness as required. Go to Step V.

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes If code 23 appears If code other than 23 appears	→ Test complete. → Return to Step A to find error in testing. → Go to Fault Isolation Procedure Index (page 1-8).

Component Code 24 Hydraulic System Fault

Fault Description

This code indicates a problem in the CEEMAT hydraulic system. The ECU detected excessive slip across the torque converter.

Required Tools

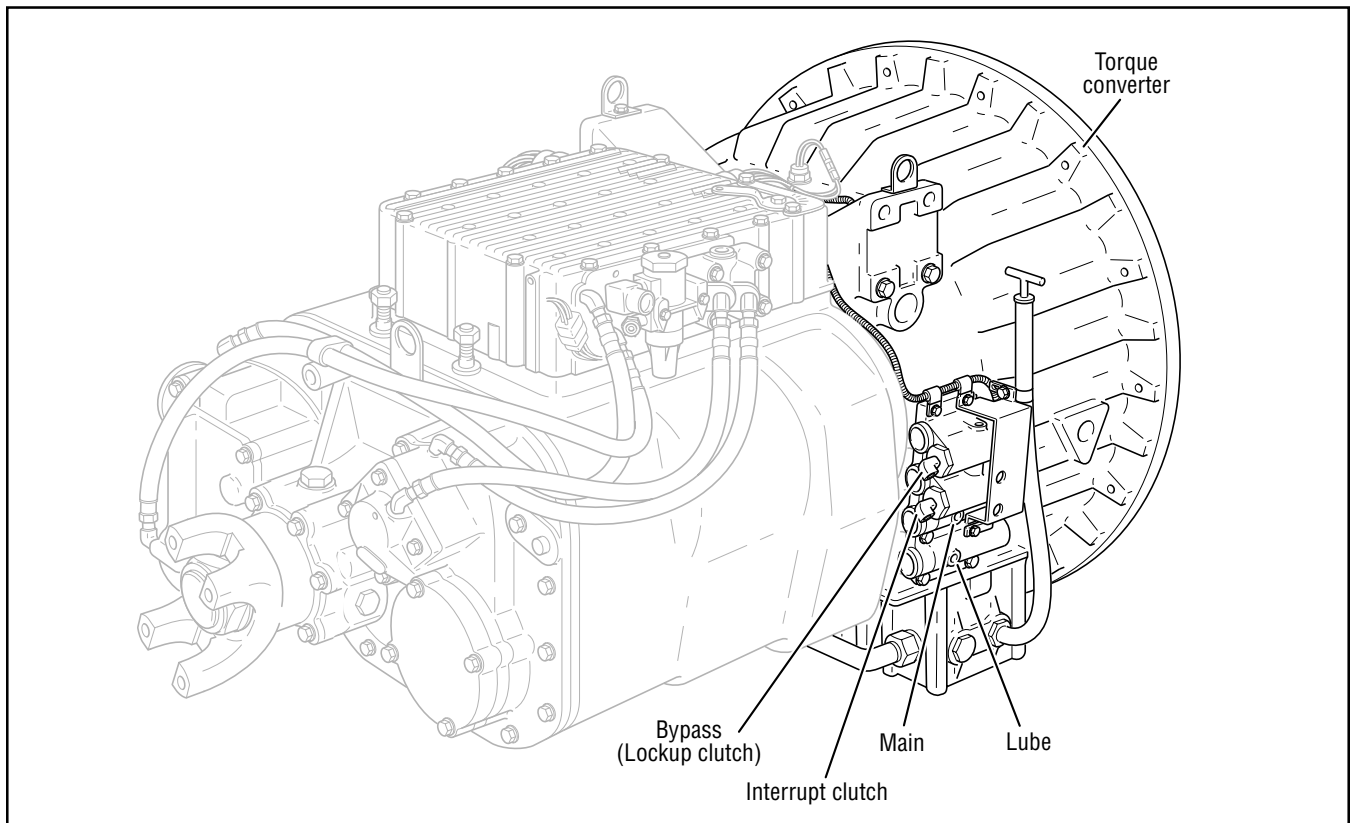
- Basic Hand Tools
- Hand-Held Diagnostic Tool
- 0-300 PDI Hydraulic Gauges
- 0-100 PSI Hydraulic Gauge
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by any of the following conditions:

- Low fluid level
- Low fluid pressure
- Excessive slip across the converter
- Faulty interrupt or lockup clutch
- Faulty hydraulic valve

Likely Failed Component and Diagnostic Port Locations



Code 24 Hydraulic System Fault Test

Note: This test is identical to the basic hydraulic test.

Step A	Procedure	Condition	Action
	1. Key on. 2. Place transmission in neutral. 3. Allow engine to idle at 600 to 700 RPM for a minimum of 2 minutes. Ensure transmission fluid temperature is 60 to 120° F. 4. Check transmission fluid level.	→ If fluid level is at or above the COLD-FULL mark If fluid level is below the COLD-ADD mark	→ Go to Step B. → Correct fluid level, check for leaks. Go to Step V.
Step B	Procedure	Condition	Action

1. Key off. 2. Install 0-300 PSI hydraulic gauges into diagnostic ports for: • Main • Interrupt clutch • Lockup/ bypass clutch 3. Install a 0-100 PSI hydraulic gauge into the lube diagnostic port. 4. Start engine and allow air pressure to build to governor cutoff. 5. Turn PTO off (if equipped). 6. With engine at idle, monitor gauges.	→ If pressure readings are: • Main = 225 to 255 PSI • Interrupt = 0 PSI of main • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI If pressure readings are not in the ranges shown above	→ Go to Step C. → Replace the hydraulic valve. Go to Step V.
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Code 24

Code 24 Hydraulic System Fault Test, continued

Step C	Procedure	Condition	Action
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1. Connect hand-held diagnostic tool.
2. Select Perform Tests.
3. Select Hydraulic Tests.
4. Select Interrupt Test.
5. Activate the Interrupt Test.
6. Monitor the gauges.

→ If pressure readings are:

- Main = 225 to 255 PSI
- Interrupt = ± 5 PSI of main
- Lockup/bypass = 0 PSI
- Lube = 15 to 35 PSI

→ Go to **Step D**.

If pressure readings are not in the ranges shown above

→ Replace the hydraulic valve. Go to **Step V**.

Step D	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Select Lockup Test.
2. Activate the Lockup Test.
3. Monitor the gauges.

→ If pressure readings are:

- Main = 225 to 255 PSI
- Interrupt = 0 PSI
- Lockup/bypass = ± 5 PSI of Main
- Lube = 15 to 35 PS

→ Replace transmission. Go to **Step V**.

If pressure readings are not in the ranges shown above

→ Replace the hydraulic valve. Go to **Step V**.

Step V	Verify normal operation	Condition	Action
--------	-------------------------	-----------	--------

1. Review or repeat **Steps C** and **D**.
2. Test drive vehicle.

→ If pressure readings are OK and vehicle operates normally

→ Test complete.

If pressure readings are wrong or vehicle does not operate normally

→ Go to **Step A**.

Component Code 31 Engine Brake Relay Coil

Fault Description

This code indicates an electrical problem in the engine brake relay circuit.

Required Tools

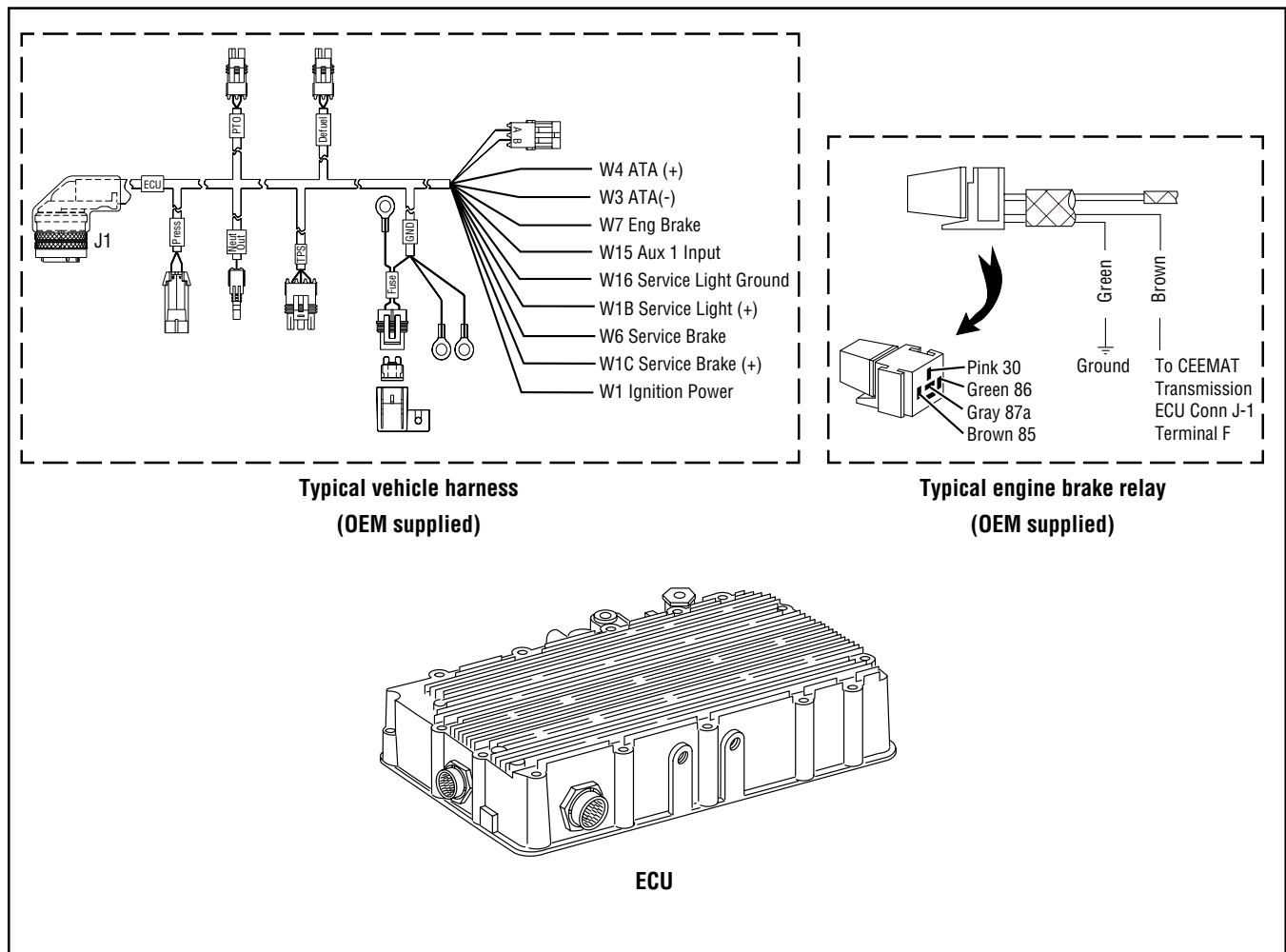
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by an electrical open or short in any of the following areas:

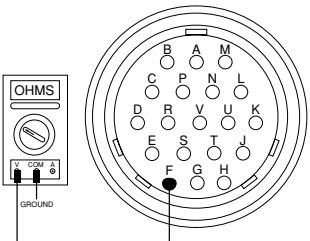
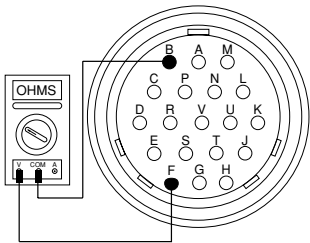
- Engine brake relay
- Vehicle interface harness
- Faulty ECU

Likely Failed Components



Code 31, Engine Brake Relay Coil Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Disconnect vehicle interface harness from transmission. 3. Measure resistance between vehicle interface harness pins F and B.	If resistance is 40 to 90 ohms If resistance is outside of range	Go to Step B. Inspect and repair or replace vehicle interface harness or engine brake relay. Go to Step V.
Step B	Procedure	Condition	Action



Code 31

Code 31, Engine Brake Relay Coil Test, continued

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 31 appears → If code other than 31 appears	→ Test complete. → Return to Step A to find error in testing. → Go to Fault Isolation Procedure Index (page 1-8).

Component Code 32 Defuel Solenoid Coil

Fault Description

This code indicates an electrical problem in the defuel solenoid coil circuit.

Required Tools

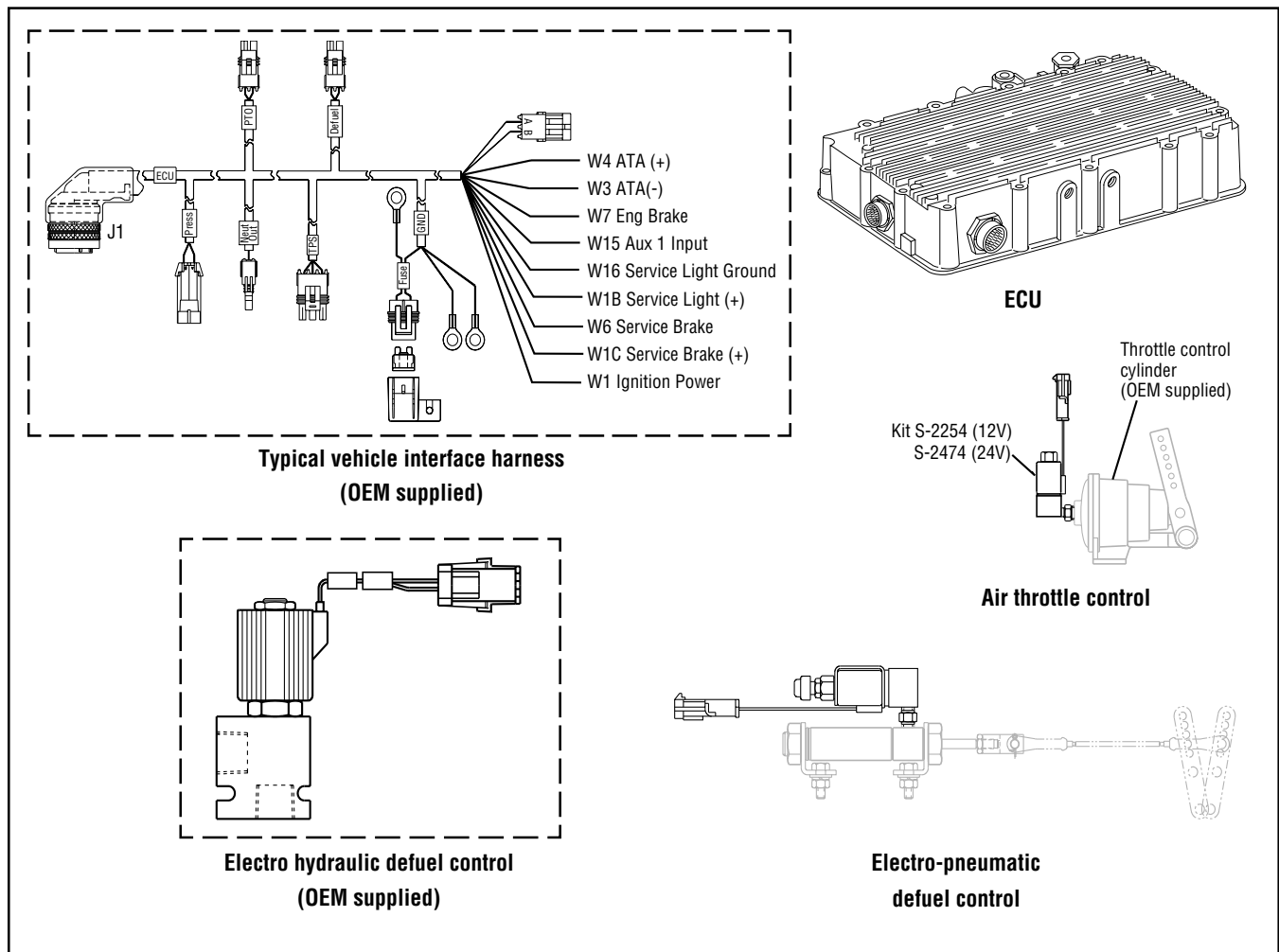
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

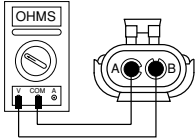
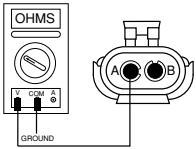
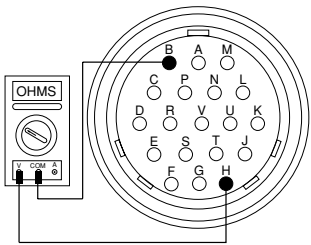
This code can be caused by an electrical short or open in any of the following areas:

- Defuel solenoid coil
- Vehicle interface harness
- Faulty ECU

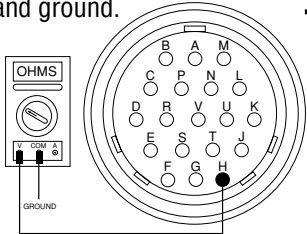
Likely Failed Components



Code 32, Defuel Solenoid Coil Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Disconnect vehicle interface harness from defuel solenoid coil. 3. Measure resistance between coil pins. 	If electro-pneumatic or air throttle coil resistance is 13 to 18 ohms and Electro-mechanical or air throttle coil resistance is 2.5 to 5.0 ohms If resistance is outside of range	Go to Step B. Replace defuel solenoid. Go to Step V.
Step B	Procedure	Condition	Action
	1. Measure resistance between defuel solenoid coil harness terminal A and ground. 	If resistance is more than 10K ohms or infinite If resistance is less than 10K ohms	Go to Step C. Replace defuel solenoid. Go to Step V.
Step C	Procedure	Condition	Action
	1. Reconnect defuel solenoid coil to interface harness. 2. Disconnect vehicle interface harness from ECU. 3. Measure resistance between vehicle interface harness pins H and B. 	If electro-pneumatic coil resistance is 13 to 18 ohms and Electro-mechanical coil resistance is 2.5 to 5.0 ohms If resistance is outside of range	Go to Step D. Repair or replace vehicle interface harness as required. Go to Step V.

Code 32, Defuel Solenoid Coil Test, continued

Step D	Procedure	Condition	Action
	1. Measure resistance between vehicle interface harness pin H and ground. 	→ If resistance is more than 10K ohms or infinite If resistance is less than 10K ohms	→ Replace ECU. Go to Step V. → Repair or replace vehicle interface harness. Go to Step V.

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes If code 32 appears If code other than 32 appears	→ Test complete. → Return to Step A to find error in testing. → Go to Fault Isolation Procedure Index (page 1-8).

Component Code 33 System Voltage

Fault Description

This code indicates low or no battery power in the vehicle interface harness. The ECU has detected that battery power is less than nine volts.

Required Tools

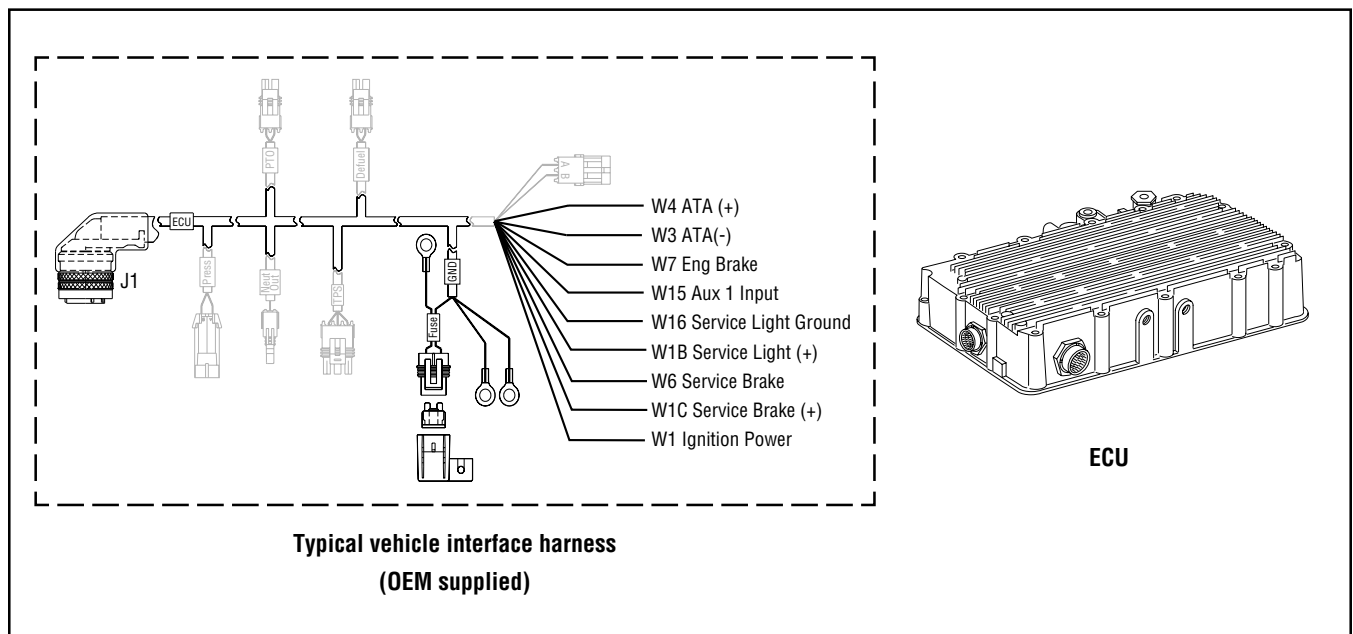
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by any of the following conditions:

- Vehicle batteries or charging system
- Battery bus fuse circuit breaker open
- Damaged vehicle interface harness
- Faulty ECU

Likely Failed Components



Code 33, System Voltage Test

Step A	Test battery voltage	Condition	Action
1. Key on. 2. Retrieve codes (page 1-3).		→ If code 33 is active	→ Perform Electrical Pretest on page 2-1.
		If code 33 is inactive	→ Test complete.

Code 33

Component Code 34 Throttle Position Sensor

Fault Description

This code indicates an electrical problem in the throttle position sensor circuit.

Required Tools

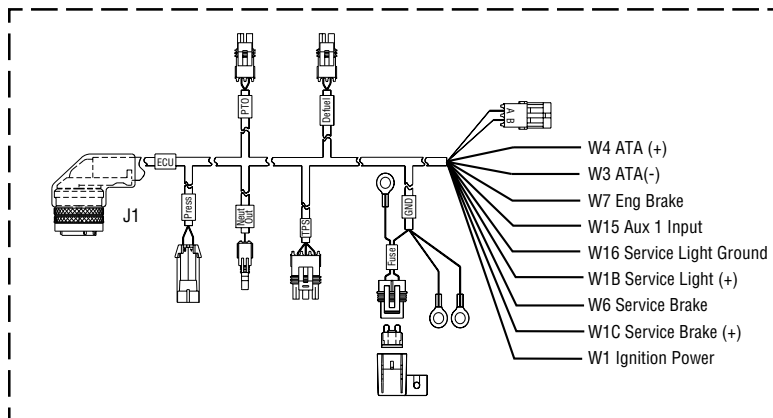
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

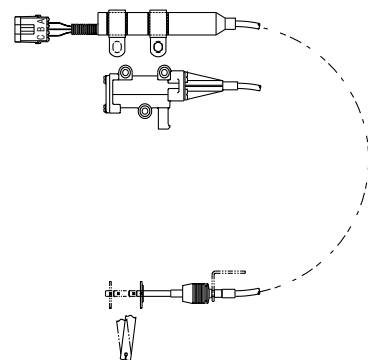
This code can be caused by an electrical short or open in any of the following areas:

- Throttle position sensor
- Vehicle interface harness
- Faulty ECU

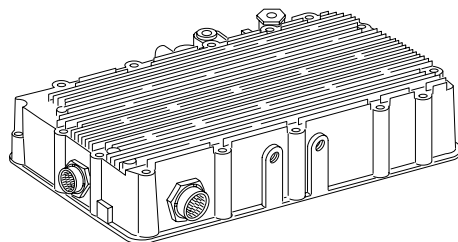
Likely Failed Components



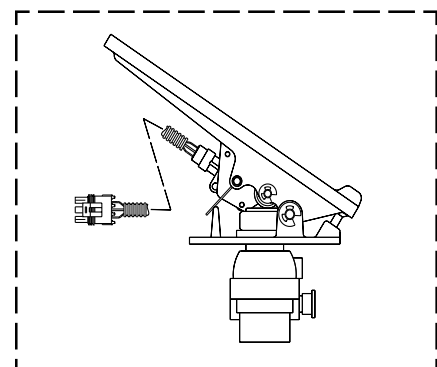
**Typical vehicle interface harness
(OEM supplied)**



Linear TPS

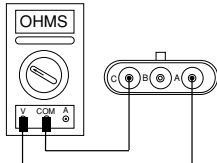
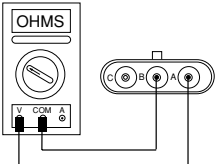
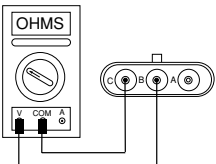
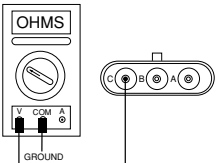


ECU

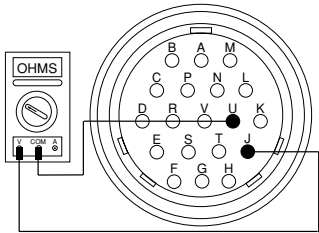
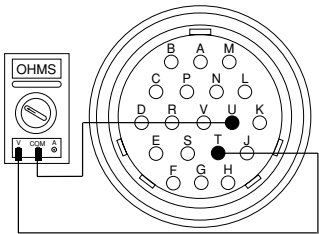
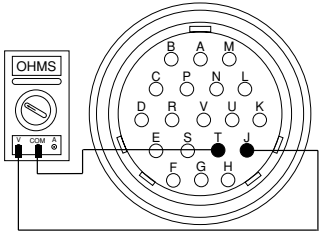
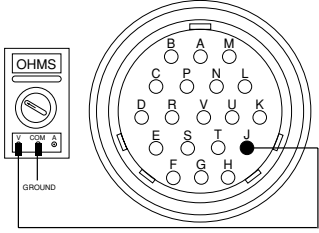


**Air throttle integral TPS
(OEM supplied)**

Code 34, Throttle Postition Sensor Test

Step A	Procedure	Condition	Action
	1. Disconnect vehicle interface harness from throttle position sensor. Measure resistance between sensor pins: • A and C • A and B while opening throttle • B and C while opening throttle • C and ground	→ If A and C resistance is 2K to 15K ohms and A and B resistance increases smoothly while opening throttle and B and C resistance decreases smoothly while opening throttle and C and ground resistance is 50K to infinity → Go to Step B. If any of the above conditions are not met → Repair or replace throttle position sensor. Go to Step V.	
			
			
			
			

Code 34, Throttle Postition Sensor Test, continued

Step B	Procedure	Condition	Action
	1. Reconnect throttle position sensor. 2. Disconnect vehicle interface harness from CEEMAT. 3. Measure resistance between harness pins: • J and U • T and U • J and T • J and ground		
		→ If J and U resistance is 2K to 15K ohms and T and U resistance increases smoothly while opening throttle and J and T resistance decreases smoothly while opening throttle and	
		J and ground resistance is 50K to infinity	→ Replace ECU. Go to Step V.
		If any of the above conditions are not met	→ Repair or replace vehicle interface harness. Go to Step V.
			

Code 34, Throttle Position Sensor Test, continued

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes If code 34 appears If code other than 34 appears	→ Test complete. → Return to Step A to find error in testing. → Go to Fault Isolation Procedure Index (page 1-8).

System Code 35 Engine Control Failure (Mechanically-Governed Engines)

Fault Description

This code indicates the engine failed to properly respond to throttle control during a transmission shift.

Required Tools

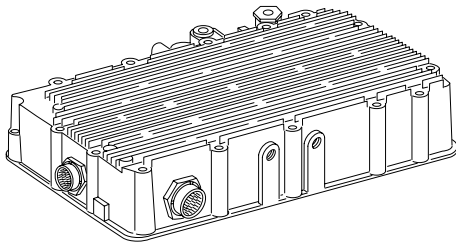
- Basic Hand Tools
- Hand-Held Diagnostic Tool
- CEEMAT Troubleshooting Guide

Likely Failure Locations

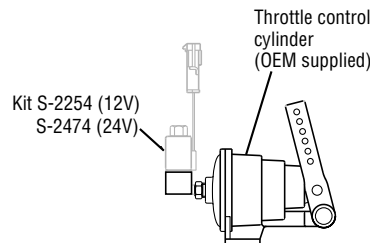
Possible Causes

This code can be caused by any of the following conditions:

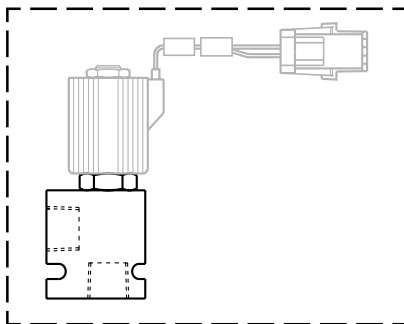
- Low air pressure
- Contaminated air supply
- Air leak
- Engine idle adjusted too high
- Faulty defuel solenoid coil
- Throttle control system out of adjustment
- Faulty boost solenoid (air throttle only)



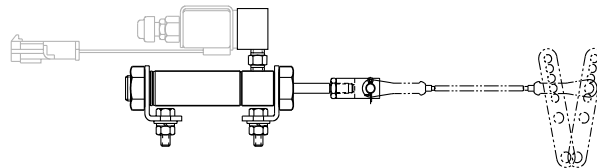
ECU



Air throttle control



Electro hydraulic defuel control
(OEM supplied)



Electro-pneumatic
defuel control

Code 35, Engine Control Failure Test (Mechanically-Governed Engines)

Note: Do not use this test on vehicles using electronic communication for throttle dip.

Step A	Procedure	Condition	Action
	1. Start engine and allow to idle. 2. Connect hand-held diagnostic tool. 3. Select Perform Tests. 4. Select Throttle Dip Test. 5. Run engine speed up to governed RPM and activate Throttle Dip Test. 6. Measure the time required for the RPM to drop to 1000 RPM.	If engine RPM dropped more than 275 RPM per second and throttle dip test did not abort If engine RPM dropped less than 275 RPM per second	Test complete. Inspect and adjust or repair defuel system as needed. If vehicle is equipped with an electro-pneumatic defuel system, see Appendix for procedure. Repeat this step.

Code 35

System Code 35 Engine Control Failure (Electronically-Governed Engines)

Fault Description

This code indicates the CEEMAT failed to receive information from the engine or the engine failed to properly respond to throttle control during a shift as commanded by the engine J-1922 data link.

Required Tools

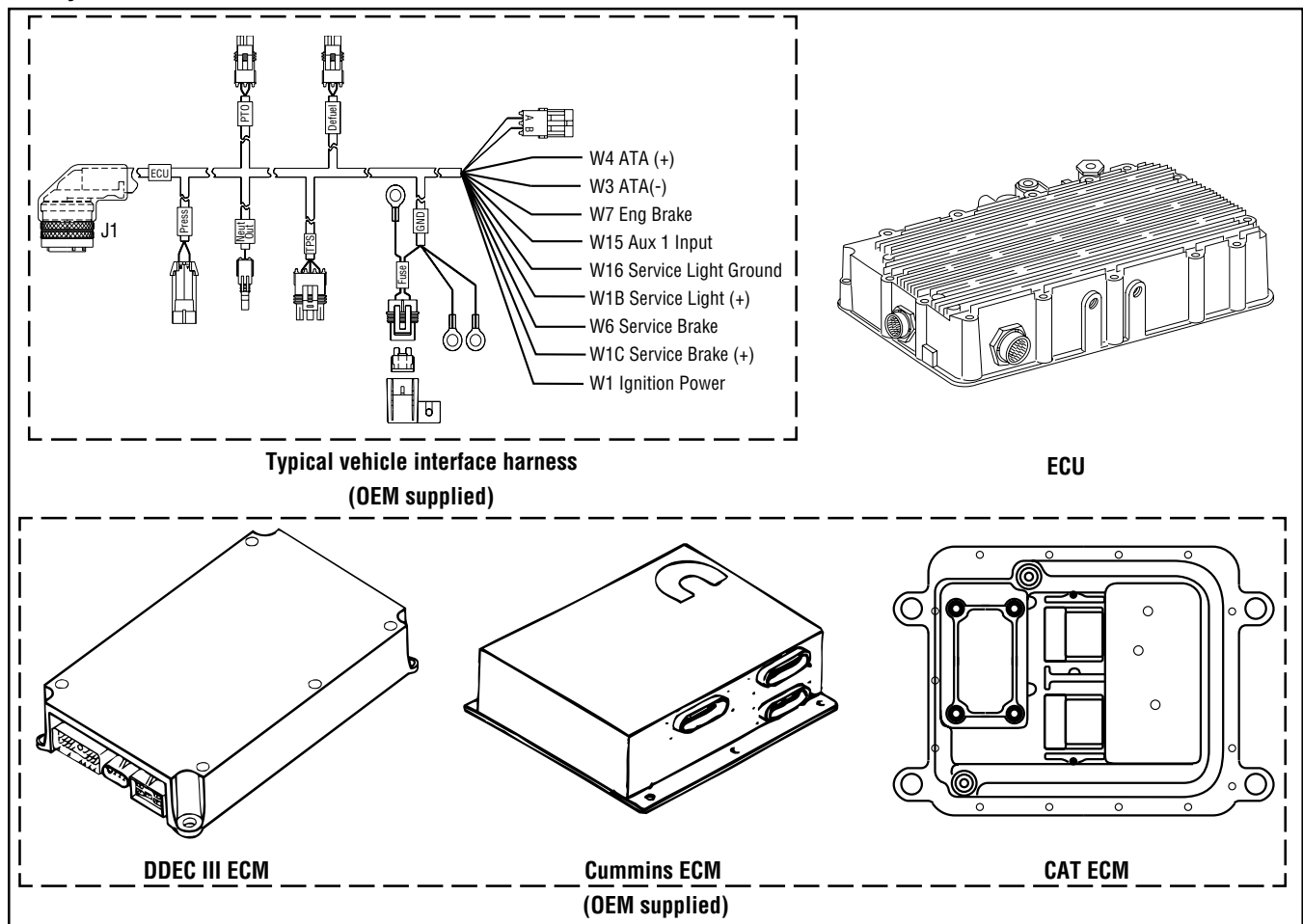
- Basic Hand Tools
- Hand-Held Diagnostic Tool
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by any of the following conditions:

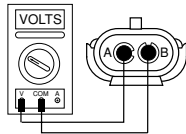
- Faulty J-1922 data link
- Faulty vehicle interface harness or connections
- Faulty engine harness or connections
- Excessive radio interference
- Faulty engine ECM
- Faulty engine fuel pump
- Faulty ECU

Likely Failure Locations



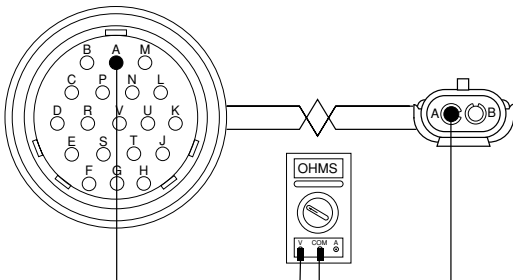
Code 35, Engine Control Failure Test (Electronically-Governed Engine)

Step A	Procedure	Condition	Action
	1. Key on. 2. Disconnect electronic shift lever (if equipped) 3. Disconnect J-1922 data link (attached to vehicle interface harness). 4. Connect hand-held diagnostic tool. 5. Select Perform Tests. 6. Select Throttle Dip Test. 7. On the CEEMAT side of the data link, measure voltage between pins A and B (connect (+) positive test lead to A). This connector is typically located at the engine.	If voltage is +3.0 to +4.0 If voltage is outside of range	Go to Step B. Go to Step C.

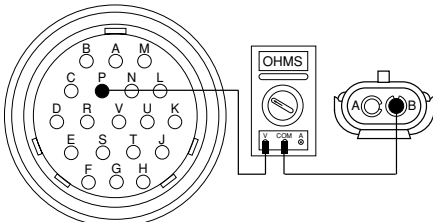


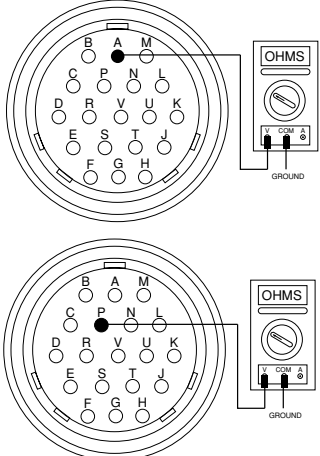
Step B	Procedure	Condition	Action
	1. Activate Throttle Dip Test.	If voltage changes to -3.0 to -4.0 volts If voltage does not change to -3.0 to -4.0 volts	CEEMAT ECU is OK. See OEM manuals to check engine ECM and harness. Go to Step V. Go to Step C.

Step C	Procedure	Condition	Action
	1. Key off. 2. Disconnect vehicle harness from CEEMAT. 3. Measure resistance between vehicle interface harness pin A and J-1922 data link pin A, typically located at the engine.	If resistance is 0 to .3 ohms If resistance is outside of range	Go to Step D. Repair or replace vehicle interface harness. Go to Step V.



Code 35, Engine Control Failure Test (Electronically-Governed Engine), continued

Step D	Procedure	Condition	Action
	1. Measure resistance between vehicle harness interface pin P and J-1922 data link pin B.	→ If resistance is 0 to .3 ohms → Go to Step E. → If resistance is outside of range → Repair or replace vehicle interface harness. Go to Step V.	
			

Step E	Procedure	Condition	Action
	1. Measure resistance between vehicle harness interface pins:		
	• A to ground • P to ground	→ If resistance is more than 10K ohms or infinite → Replace ECU. Go to Step V. → If resistance is less than 10K ohms → Repair or replace vehicle interface harness. Go to Step V.	
			

Code 35, Engine Control Failure Test (Electronically-Governed Engine), continued

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 35 appears → If code other than 35 appears	→ Repairs complete. → Return to Step A to find error in testing. → Go to Fault Isolation Procedure Index (page 1-8).

System Code 41 Range Failed to Engage

Fault Description

This code indicates the transmission is unable to complete a shift across the range. The range is either stuck in HI or LO, or cannot complete engagement in HI or LO.

Required Tools

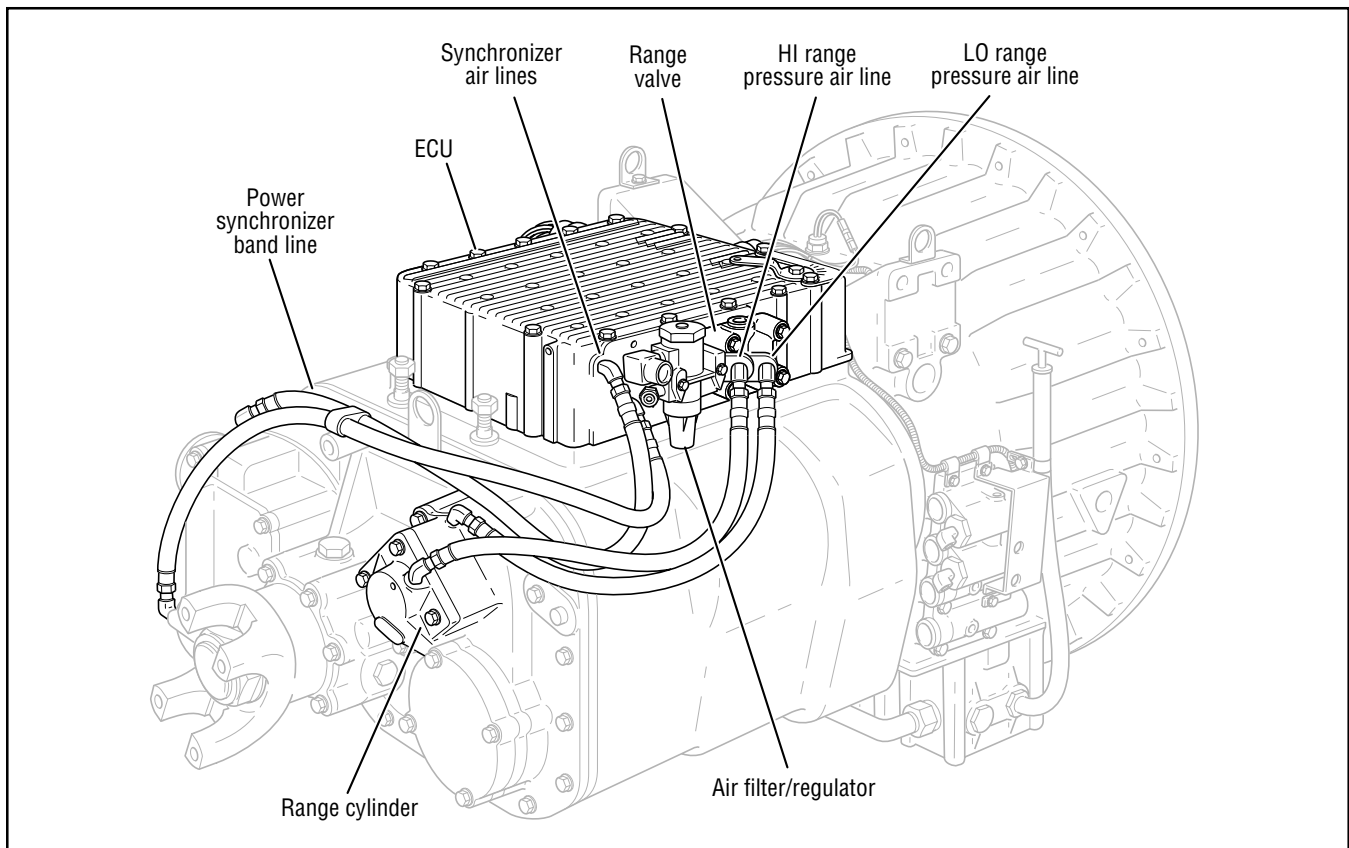
- Basic Hand Tools
- Air Pressure Gauges (0-100 PSI)
- CEEMAT Troubleshooting Guide
- Hand-Held Diagnostic Tool

Possible Causes

This code can be caused by any of the following conditions:

- Low air pressure
- Contaminated air supply
- Air leak
- Range solenoid stuck
- Failed range synchronizer
- Failed range actuator/cylinder/piston/yoke
- Dragging power synchronizer band
- Failed range slave valve

Likely Failure Locations



Code 41, Range Failed to Engage Test

Step A	Procedure	Condition	Action
	1. Install (in a "T" fashion) 0-100 PSI air gauges into the range air lines.		
	2. Start vehicle and allow air pressure to reach governor cut-off.		
	3. Connect hand-held diagnostic tool and select perform tests.		
	4. Select air system.		
	5. Select Range System Test.		
	6. Activate Test.	→ In HI range, if HI gauge is regulated air pressure and LO gauge is zero, and	
		In LO range, if LO gauge is regulated air pressure and HI gauge is zero	→ Repair auxiliary section as required and retest.
		If gauges do not read as described above	→ Repair range valve on side of ECU. If problem continues, replace ECU and retest.

Code 41

Component Code 43 Range Solenoid Coil

Fault Description

This code indicates an electrical problem in the range solenoid.

Required Tools

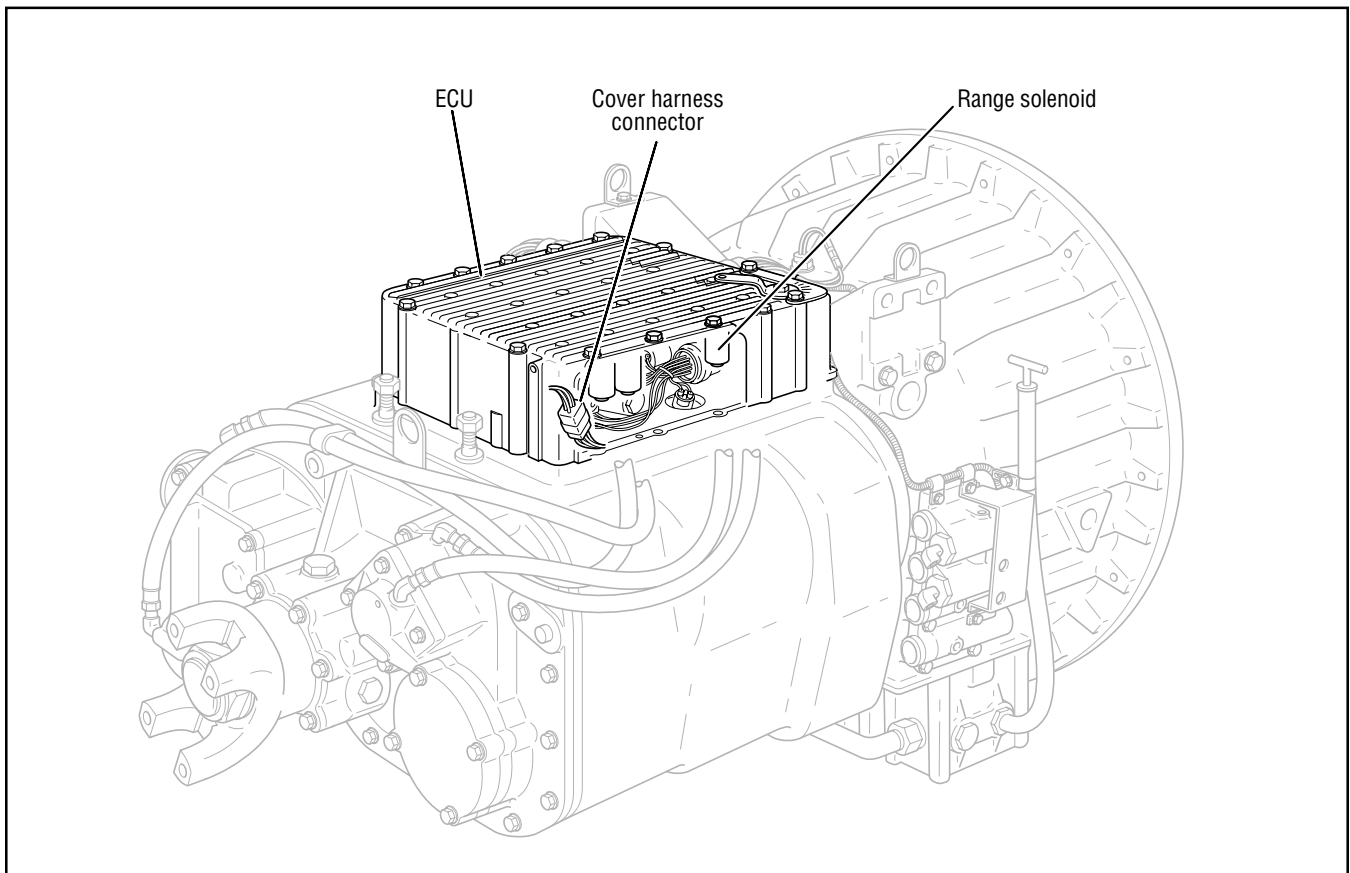
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

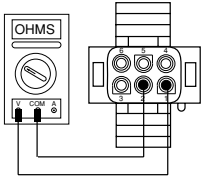
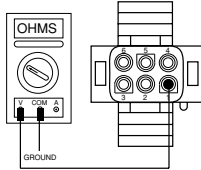
The code can be caused by an electrical open or short in one of the following areas:

- Shift bar housing cover harness
- Range solenoid coil
- Faulty ECU

Likely Failed Components



Code 43, Range Solenoid Coil Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect cover harness from ECU. 4. Measure resistance between cover harness pins 1 and 2.	→ If resistance is 11 to 18 ohms → If resistance is outside of range →	Go to Step B. Replace cover harness. Go to Step V.
			
Step B	Procedure	Condition	Action
	1. Measure resistance between cover harness pin 1 and ground.	→ If resistance is more than 10K ohms or infinite → If resistance is less than 10K ohms →	Replace ECU. Go to Step V. Replace cover harness. Go to Step V.
			
Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (Page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 43 appears → If code other than 43 appears →	Test complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (Page 1-8).

Component Code 44 Disc/Inertia Brake Solenoid Coil

Fault Description

This code indicates an electrical problem in the disk/inertia brake.

Required Tools

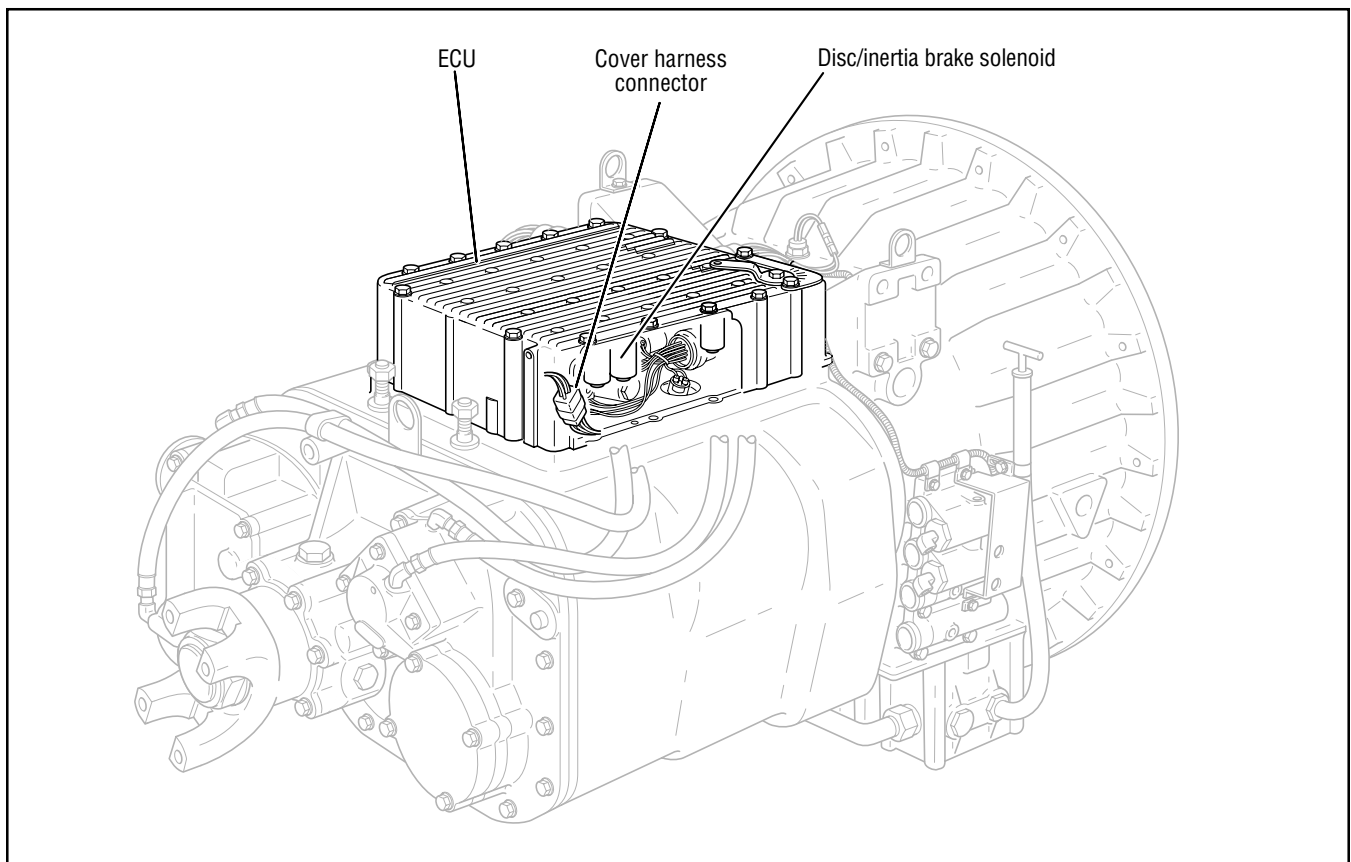
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

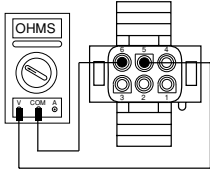
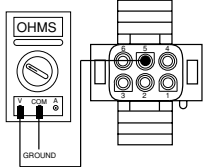
This code can be caused by an electrical open or short in one of the following areas:

- Shift bar housing cover harness
- Disc/inertia brake solenoid coil
- Faulty ECU

Likely Failed Components



Code 44, Disc/Inertia Brake Solenoid Coil Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect cover harness from ECU. 4. Measure resistance between cover harness pins 5 and 6.	→ If resistance is 11 to 18 ohms → If resistance is outside of range →	Go to Step B. Replace cover harness. Go to Step V.
			
Step B	Procedure	Condition	Action
	1. Measure resistance between cover harness pin 5 and ground.	→ If resistance is more than 10K ohms or infinite → If resistance is less than 10K ohms →	Replace ECU. Go to Step V. Replace cover harness. Go to Step V.
			
Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 44 appears → If code other than 44 appears →	Test complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Component Code 45

Power Synchronizer Band/Engine Boost Solenoid Coil

Fault Description

This code indicates an electrical problem in the band/engine boost solenoid.

Required Tools

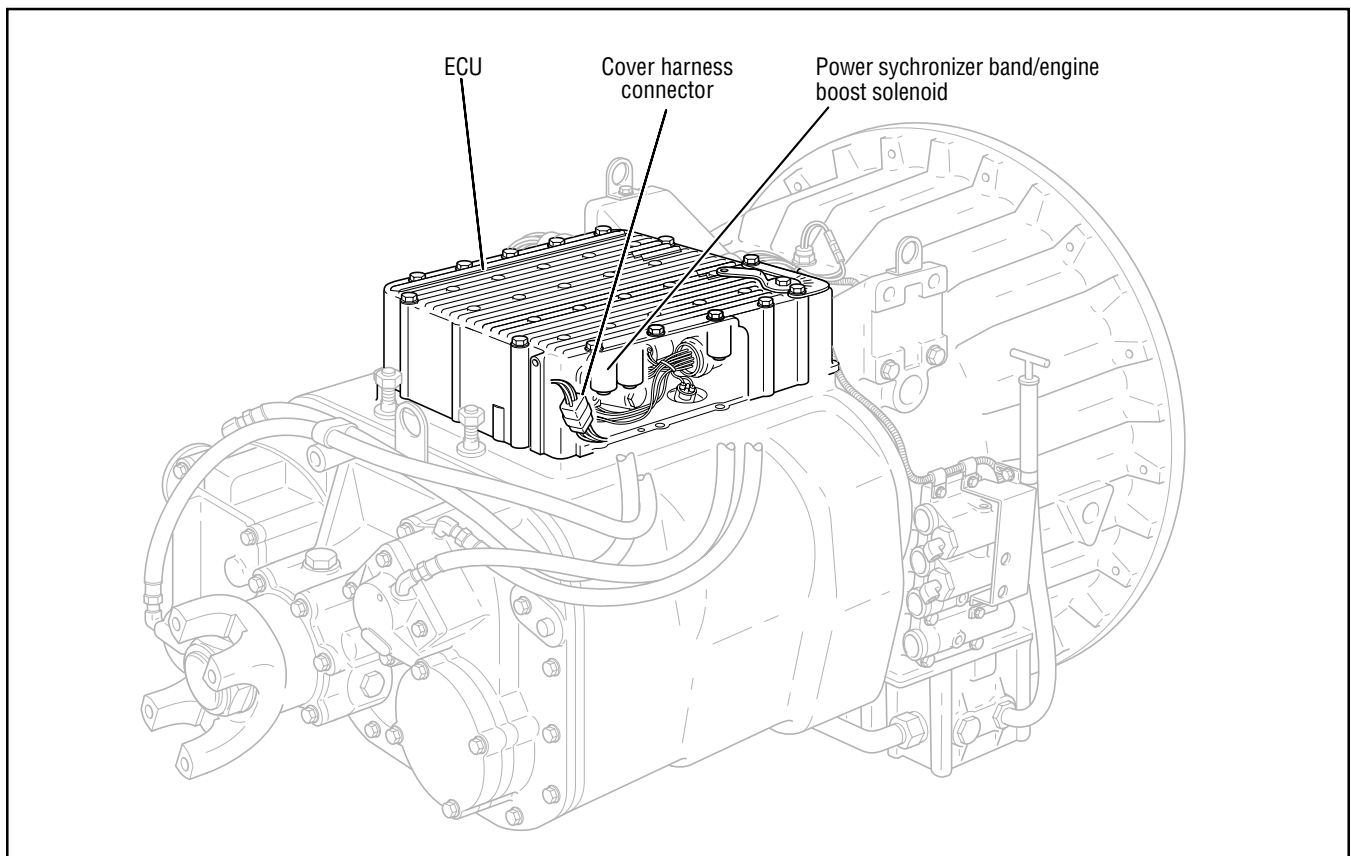
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

The code can be caused by an electrical open or short in one of the following areas:

- Shift bar housing cover harness
- Power synchronizer band/engine boost solenoid coil
- Faulty ECU

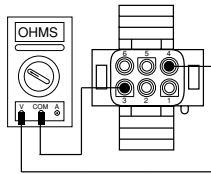
Likely Failed Components



Code 45, Power Synchronizer Band/Engine Boost Solenoid Coil Test

Step A	Procedure	Condition	Action
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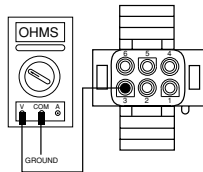
1. Key off.
2. Remove ECU from transmission.
3. Disconnect cover harness from ECU.
4. Measure resistance between cover harness pins 3 and 4.



- If resistance is 11 to 18 ohms → Go to **Step B**.
- If resistance is outside of range → Replace cover harness. Go to **Step V**.

Step B	Procedure	Condition	Action
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1. Measure resistance between cover harness pin 3 and ground.



- If resistance is more than 10K ohms or infinite → Replace ECU. Go to **Step V**.
- If resistance is less than 10K ohms → Replace cover harness. Go to **Step V**.

Step V	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Key off.
2. Reconnect all connectors.
3. Key on.
4. Clear codes (see Clearing Fault Codes, page 1-3).
5. Use Driving Technique to attempt to reset the code (page 1-4).
6. Check for codes (see Retrieving Fault Codes, page 1-3).

- If no codes → Test complete.
- If code 45 appears → Return to **Step A** to find error in testing.
- If code other than 45 appears → Go to Fault Isolation Procedure Index (page 1-8).

Component Code 51 Center Rail Sensor

Fault Description

This code indicates an electrical problem in the center rail sensor circuit.

Required Tools

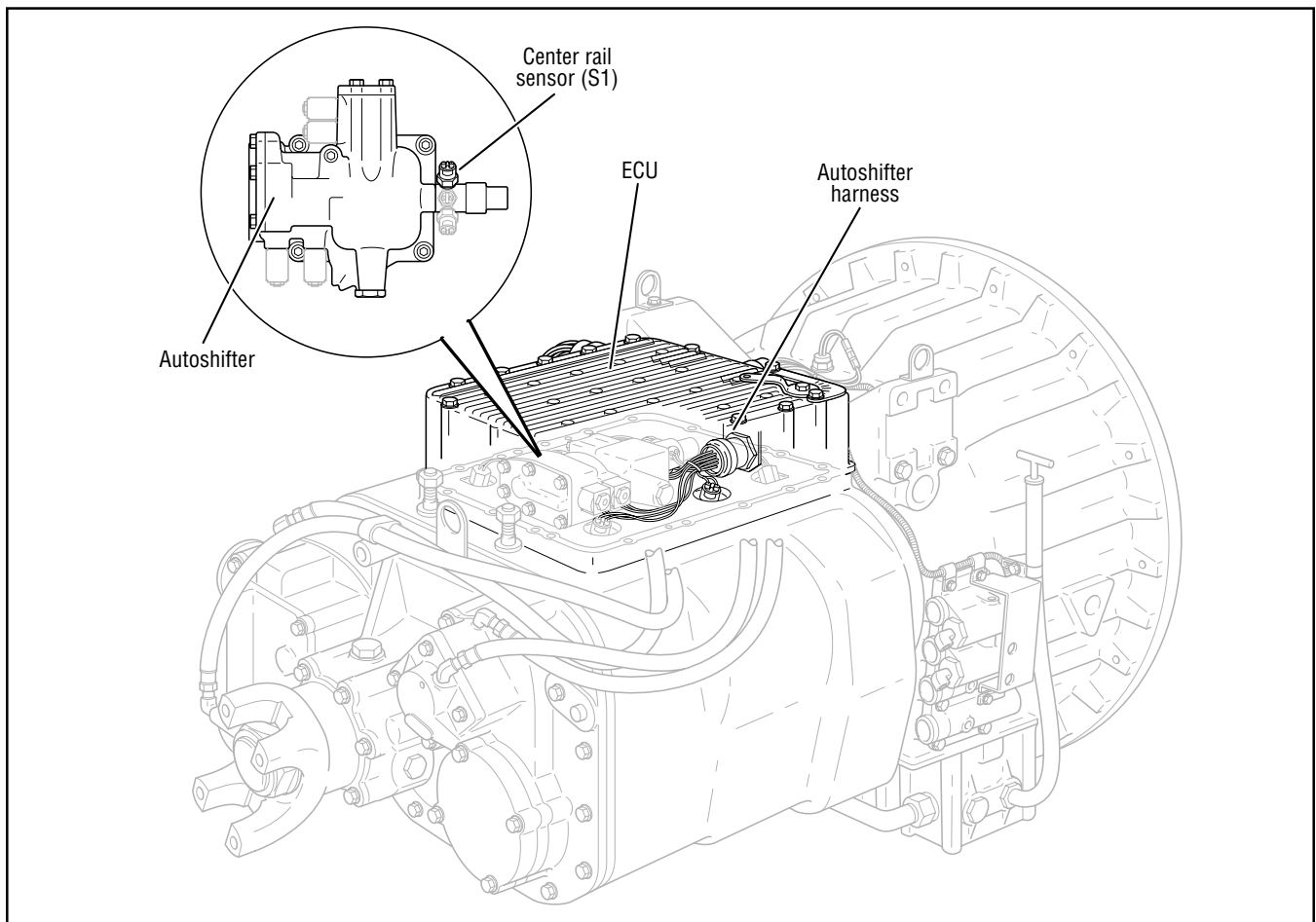
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by an electrical open or short in any of the following areas:

- Center rail sensor
- Autoshifter wiring harness
- Autoshifter
- Faulty ECU

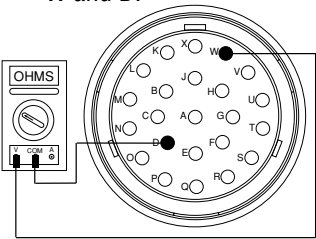
Likely Failed Components



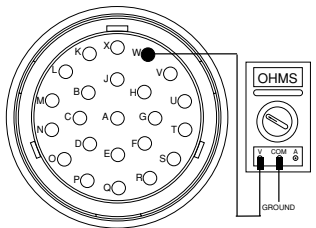
Code 51, Center Rear Sensor Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect autoshifter harness from ECU. 4. Inspect harness and position sensor connections for abrasions or corrosion.	→ If harness and connections are OK	→ Go to Step B .
		→ If harness or connections have poor connections, abrasions or corrosion	→ Repair connections as needed. Repeat this step.

Step B	Procedure	Condition	Action
	1. Disconnect connector on the gearbox center switch (S1). 2. Install a jumper wire between the two sensor pins. 3. Measure resistance between autoshifter harness terminals W and D.	→ If resistance is 0 to .3 ohms	→ Go to Step C .
		→ If resistance is outside of range	→ Repair or replace autoshifter harness. Go to Step V .



Step C	Procedure	Condition	Action
	1. With the jumper still connected, measure resistance between autoshifter harness terminal W and ground.	→ If resistance is more than 10K ohms or infinite	→ Go to Step D .
		→ If resistance is less than 10K ohms	→ Repair or replace autoshifter harness. Go to Step V .



Code 51

Code 51, Center Rear Sensor Test, continued

Step D	Procedure	Condition	Action
	1. Replace the gearbox center rail sensor (S1) and reassemble transmission. 2. Key on. 3. Clear codes (see Clearing Fault Codes, page 1-3). 4. Use Driving Technique to attempt to reset the code (page 1-4). 5. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If code 51 appears again → If code 51 does not reappear →	Replace the ECU. Go to Step V. Go to Step V.
Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 51 appears → If code other than 51 appears →	Test complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Component Code 52 Neutral Sensor

Fault Description

This code indicates an electrical problem in the neutral sensor circuit.

Possible Causes

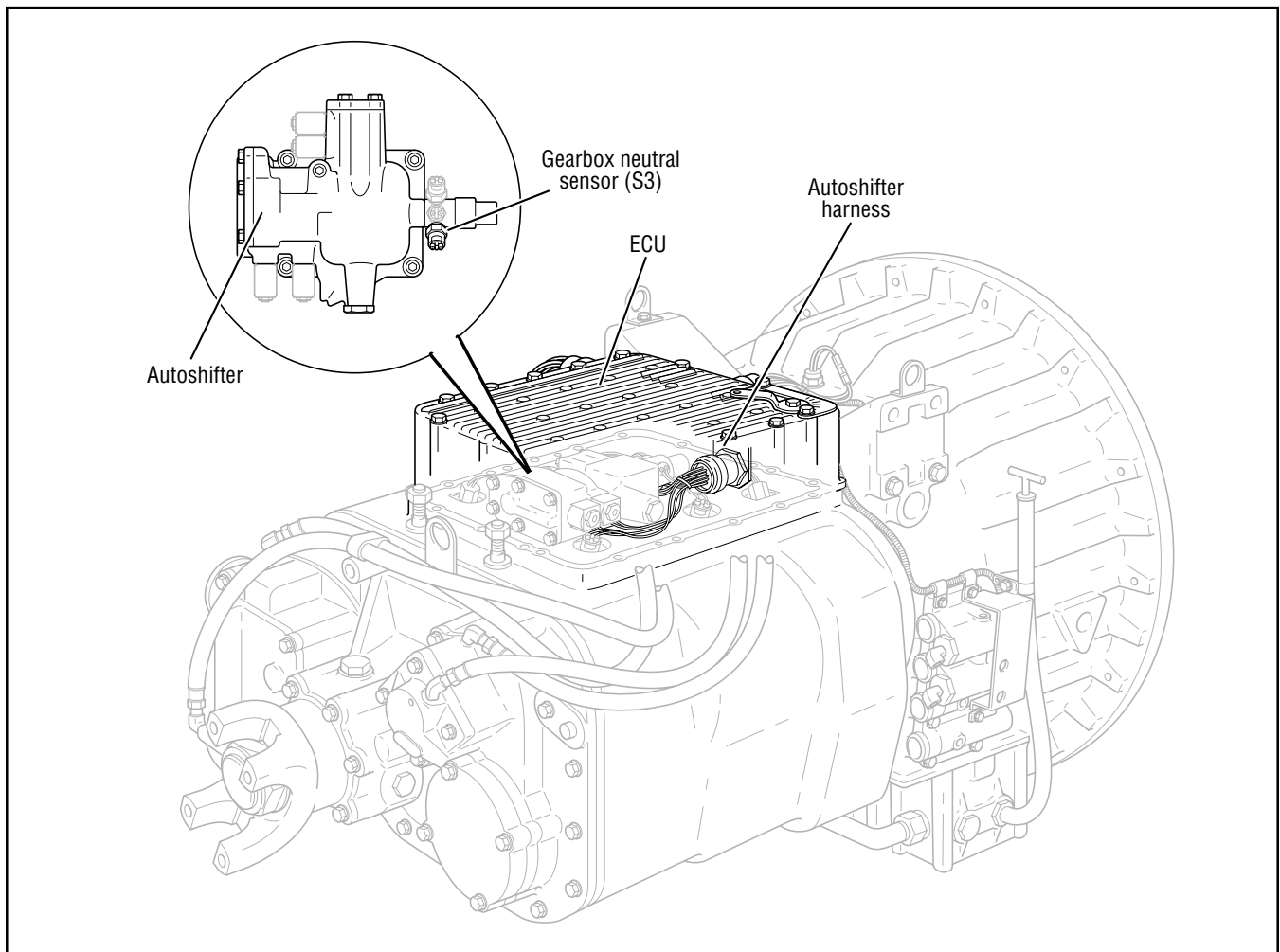
This code can be caused by an electrical open or short in any of the following areas:

- Gearbox neutral sensor
- Autoshifter wiring harness
- Autoshifter
- Faulty ECU

Required Tools

- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

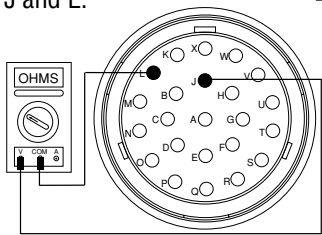
Likely Failed Components



Code 52, Neutral Sensor Test

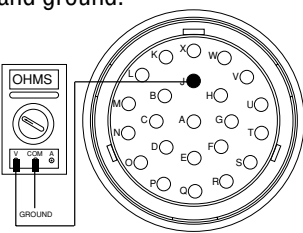
Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect autoshifter harness from ECU. 4. Inspect harness and position sensor connections for abrasions or corrosion.	→ If harness and connections are OK	→ Go to Step B .
		If harness or connections have poor connections, abrasions or corrosion	→ Repair connections as needed. Repeat this step.

Step B	Procedure	Condition	Action
	1. Disconnect connector on the gearbox neutral switch (S3). 2. Install a jumper wire between the two sensor pins. 3. Measure resistance between autoshifter harness terminals J and L.	→ If resistance is 0 to .3 ohms	→ Go to Step C .
		If resistance is outside of range	→ Repair or replace autoshifter harness. Go to Step V .



Code 52

Code 52, Neutral Sensor Test, continued

Step C	Procedure	Condition	Action
	1. With the jumper still connected, measure resistance between autoshibter harness terminal J and ground. 	If resistance is more than 10K ohms or infinite If resistance is less than 10K ohms	Go to Step D. Repair or replace autoshibter harness. Go to Step V.

Step D	Procedure	Condition	Action
	1. Replace the gearbox center rail sensor (S1) and reassemble transmission. 2. Key on. 3. Clear codes (see Clearing Fault Codes, page 1-3). 4. Use Driving Technique to attempt to reset the code (page 1-4). 5. Check for codes (see Retrieving Fault Codes, page 1-3).	If code 52 appears again If code 52 does not reappear	Replace the ECU. Go to Step V. Go to Step V.

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (Page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	If no codes If code 52 appears If code other than 52 appears	Test complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Component Code 53 Gear Engaged Sensor

Fault Description

This code indicates an electrical problem in the gear engaged sensor circuit.

Required Tools

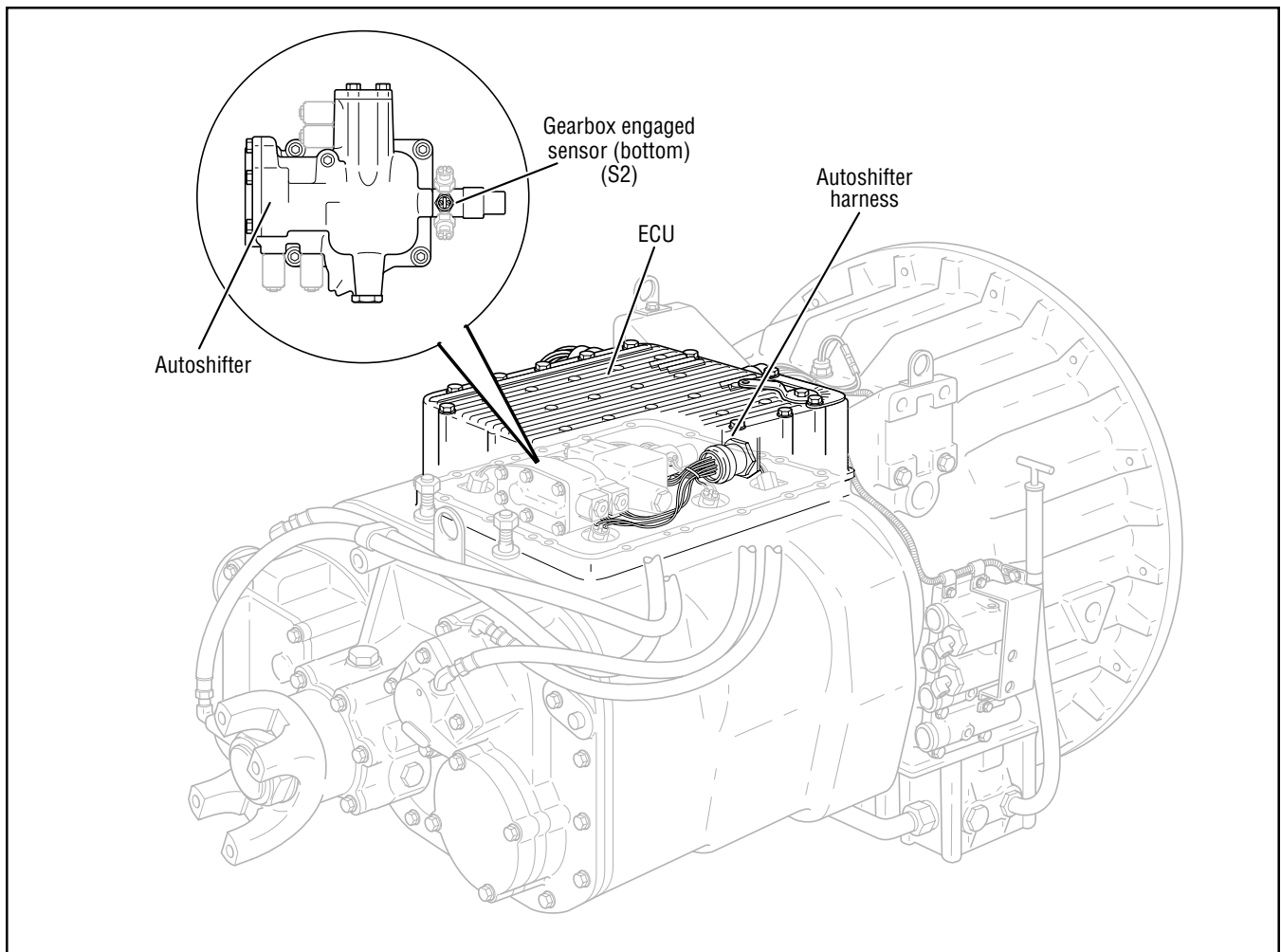
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by an electrical open or short in any of the following areas:

- Gearbox engaged sensor
- Autoshifter wiring harness
- Autoshifter
- Faulty ECU

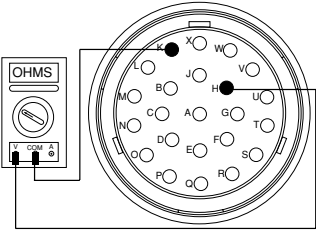
Likely Failed Components



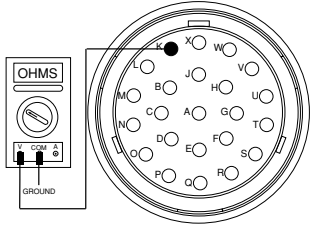
Code 53, Gear Engaged Sensor Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect autoshifter harness from ECU. 4. Inspect harness and position sensor connections for abrasions or corrosion.	→ If harness and connections are OK	→ Go to Step B .
		If harness or connections have poor connections, abrasions or corrosion	→ Repair connections as needed. Repeat this step.

Step B	Procedure	Condition	Action
	1. Disconnect connector on the gearbox engaged switch (S2). 2. Install a jumper wire between the two sensor pins. 3. Measure resistance between autoshifter harness terminals K and H.	→ If resistance is 0 to .3 ohms	→ Go to Step C .
		If resistance is outside of range	→ Repair or replace autoshifter harness. Go to Step V .



Step C	Procedure	Condition	Action
	1. With the jumper still connected, measure resistance between autoshifter harness terminal K and ground.	→ If resistance is more than 10K ohms or infinite	→ Go to Step D .
		If resistance is less than 10K ohms	→ Repair or replace autoshifter harness. Go to Step V .



Code 53

Code 53, Gear Engaged Sensor Test, continued

Step D	Procedure	Condition	Action
	1. Replace the gearbox engaged switch (S2) and reassemble transmission. 2. Key on. 3. Clear codes (see Clearing Fault Codes, page 1-3). 4. Use Driving Technique to attempt to reset the code (page 1-4). 5. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If code 53 appears again If code 53 does not reappear	→ Replace the ECU. Go to Step V. → Go to Step V.
Step V	Procedure	Condition	Action

	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes If code 53 appears If code other than 53 appears	→ Test complete. → Return to Step A to find error in testing. → Go to Fault Isolation Procedure Index (page 1-8).
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Component Code 54

HI Range Sensor

Fault Description

This code indicates an electrical problem in the HI range sensor circuit.

Required Tools

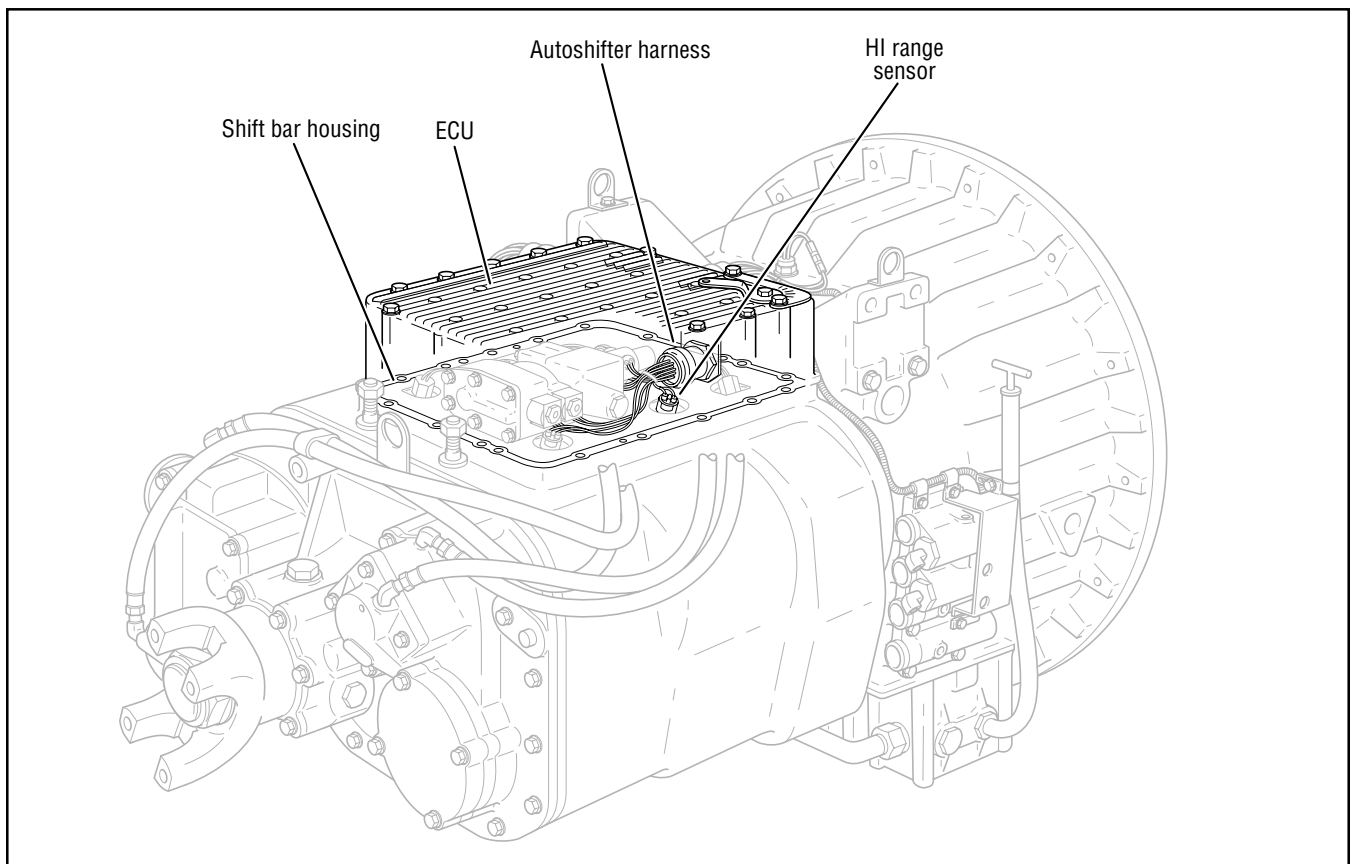
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by an electrical open or short in any of the following areas:

- HI range sensor
- Autoshifter wiring harness
- Range switch actuator shaft/pins
- Faulty ECU

Likely Failed Components



Code 54, HI Range Sensor Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect autoshibter harness from ECU. 4. Inspect harness and position sensor connections for abrasions or corrosion.	→ If harness and connections are OK	→ Go to Step B .
		→ If harness or connections have poor connections, abrasions or corrosion	→ Repair connections as needed. Go to Step A .

Step B	Procedure	Condition	Action
	1. Disconnect connector on the HI range switch (S4). 2. Install a jumper wire between the two sensor pins. 3. Measure resistance between autoshibter harness terminals B and U.	→ If resistance is 0 to .3 ohms	→ Go to Step C .
		→ If resistance is outside of range	→ Repair or replace autoshibter harness. Go to Step V .

Step C	Procedure	Condition	Action
	1. With the jumper still connected, measure resistance between autoshibter harness terminal B and ground.	→ If resistance is more than 10K ohms or infinite	→ Go to Step D .
		→ If resistance is less than 10K ohms	→ Repair or replace autoshibter harness. Go to Step V .

Code 54

Code 54, HI Range Sensor Test, continued

Step D	Procedure	Condition	Action
	1. Replace the gearbox center rail sensor (S1) and reassemble transmission. 2. Key on. 3. Clear codes (see Clearing Fault Codes, page 1-3). 4. Use Driving Technique to attempt to reset the code (page 1-4). 5. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If code 54 appears again → If code 54 does not reappear →	Replace the ECU. Go to Step V. Go to Step V.
Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 54 appears → If code other than 54 appears →	Test complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Component Code 55

LO Range Sensor

Fault Description

This code indicates an electrical problem in the LO range sensor circuit.

Required Tools

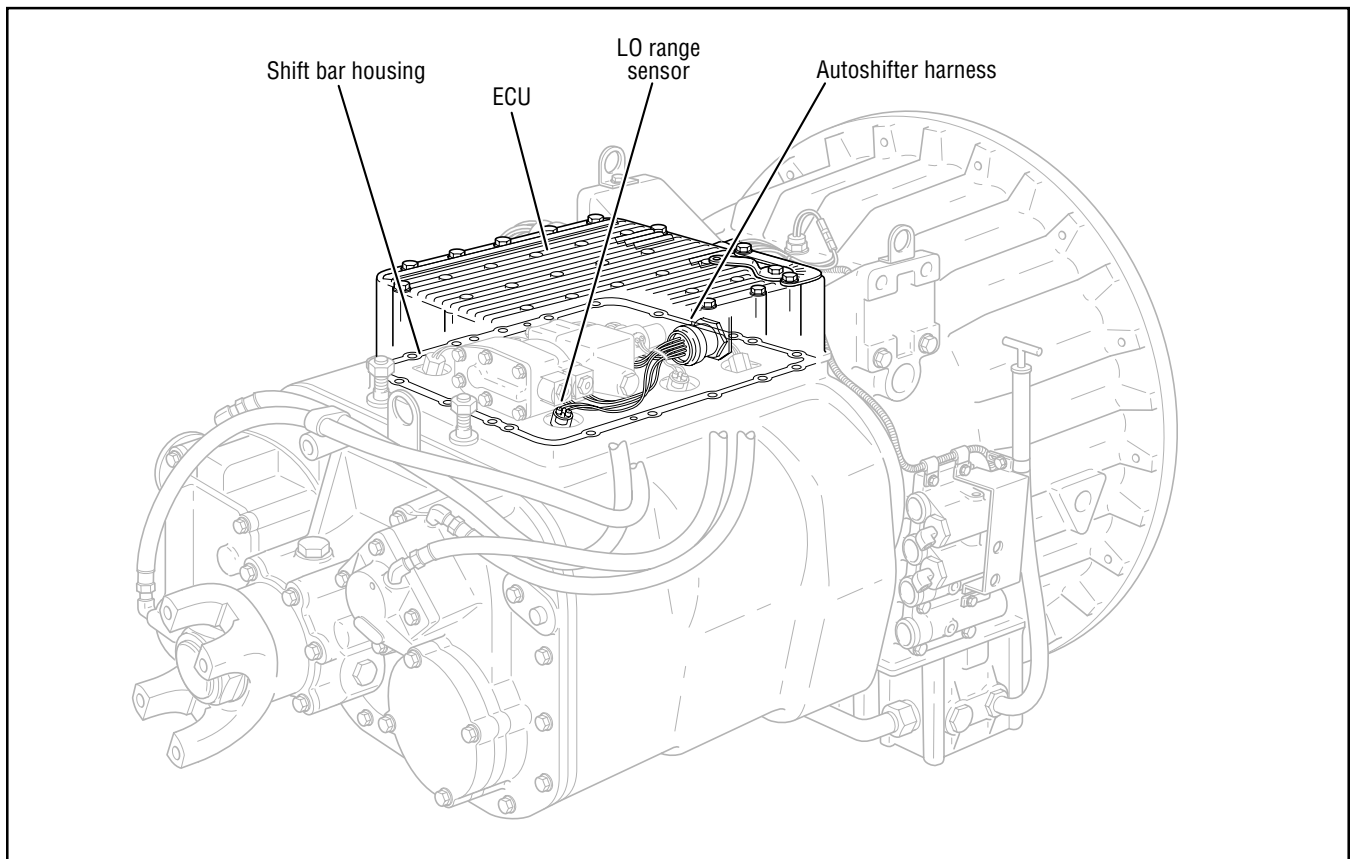
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by an electrical open or short in any of the following areas:

- LO range sensor
- Autoshifter wiring harness
- Range switch actuator shaft /pins
- Faulty ECU

Likely Failed Components



Code 55, LO Range Sensor Test

Step A	Procedure	Condition	Action
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1. Key off.
2. Remove ECU from transmission.
3. Disconnect autoshibter harness from ECU.
4. Inspect harness and position sensor connections for abrasions or corrosion.



If harness and connections are OK



Go to **Step B**.

If harness and connections have poor connections, abrasions or corrosion



Repair connections as needed. Go to **Step A**.

Step B	Procedure	Condition	Action
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1. Disconnect connector on the LO range switch (S5).
2. Install a jumper wire between the two sensor pins.
3. Measure resistance between autoshibter harness terminals U and X.



If resistance is 0 to .3 ohms

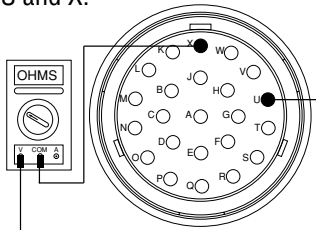


Go to **Step C**.

If resistance is outside of range



Repair or replace autoshibter harness. Go to **Step V**.



Step C	Procedure	Condition	Action
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1. With the jumper still connected, measure resistance between autoshibter harness terminal U and ground.



If resistance is more than 10K ohms or infinite

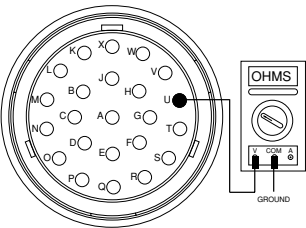


Go to **Step D**.

If resistance is less than 10K ohms



Repair or replace autoshibter harness. Go to **Step V**.



Code 55, LO Range Sensor Test, continued

Step D	Procedure	Condition	Action
	1. Replace the LO range switch (S5) and reassemble transmission. 2. Key on. 3. Clear codes (see Clearing Fault Codes, page 1-3). 4. Use Driving Technique to attempt to reset the code (page 1-4). 5. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If code 55 appears again If code 55 does not reappear	→ Replace the ECU. Go to Step V. → Go to Step V.

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes If code 55 appears If code other than 55 appears	→ Test complete. → Return to Step A to find error in testing. → Go to Fault Isolation Procedure Index (page 1-8).

Component Code 56 Input Speed Sensor

Fault Description

This code indicates an electrical problem in the input shaft speed sensor circuit. The signal from the sensor did not match the current CEEMAT operating conditions.

Required Tools

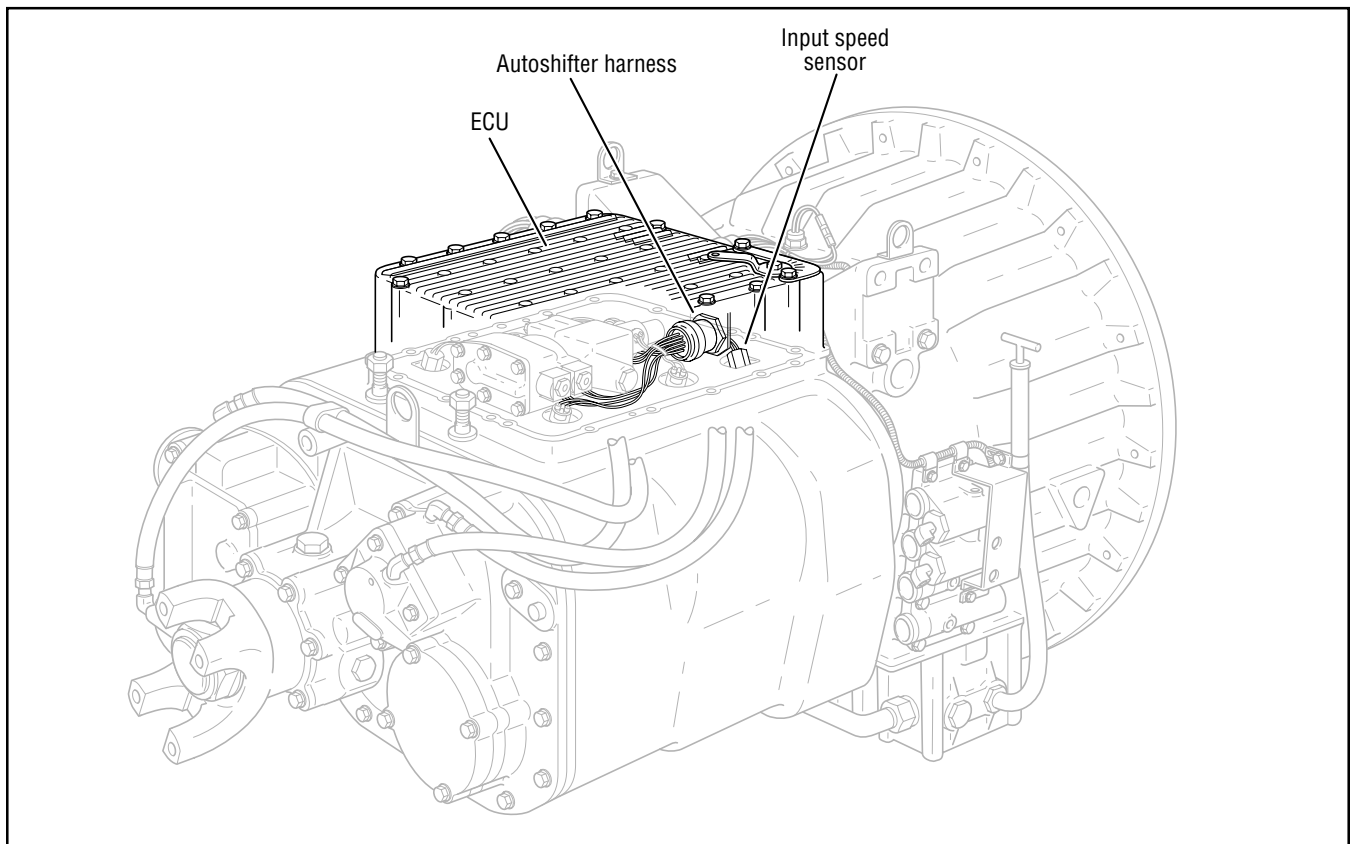
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by any of the following conditions:

- Poor vehicle electrical ground
- Improper input speed sensor installation
- Defective input speed sensor
- Defective countershaft gear
- Electrical open or short in the autoshifter harness
- Incorrect configuration software
- Faulty ECU

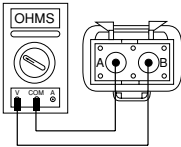
Likely Failed Components



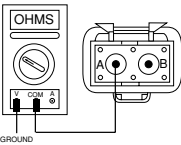
Code 56, Input Speed Sensor Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect autoshifter harness from ECU. 4. Inspect harness and input speed sensor connections for abrasions or corrosion.	→ If harness and connections are OK	→ Go to Step B .
		→ If harness and connections have poor connections, abrasions or corrosion	→ Repair connections as needed. Go to Step A .

Step B	Procedure	Condition	Action
	1. Disconnect input speed sensor from autoshifter harness. 2. Measure resistance of input speed sensor between pins A and B.	→ If resistance is 3K to 4K ohms	→ Go to Step C .
		→ If resistance is outside of range	→ Replace input speed sensor. Go to Step V .

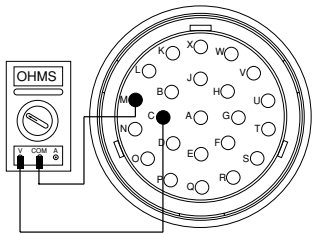


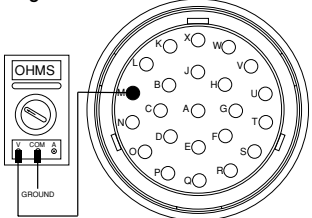
Step C	Procedure	Condition	Action
	1. Measure resistance of input speed sensor between pin A and ground.	→ If resistance is more than 10K ohms or infinite	→ Go to Step D .
		→ If resistance is less than 10K ohms	→ Replace input speed sensor. Go to Step V .



Code 56

Code 56, Input Speed Sensor Test, continued

Step D	Procedure	Condition	Action
	1. Reconnect speed sensor to autoshifter harness. 2. Disconnect autoshifter harness from ECU. 3. Measure resistance between autoshifter harness pins M and C.	→ If resistance is 3K to 4K ohms → Go to Step E. If resistance is outside of range → Repair or replace autoshifter harness as required. Go to Step V.	
			

Step E	Procedure	Condition	Action
	1. Measure resistance between autoshifter harness pin M and ground.	→ If resistance is more than 10K ohms or infinite → Replace ECU. Go to Step V. If resistance is less than 10K ohms → Repair or replace autoshifter harness as required. Go to Step V.	
			

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → Test complete. If code 56 appears → Return to Step A to find error in testing. If code other than 56 → Go to Fault Isolation Procedure Index (page 1-8).	

Component Code 57 Output Speed Sensor

Fault Description

This code indicates an electrical problem in the output shaft speed sensor circuit. The signal from the sensor did not match the current CEEMAT operating conditions.

Required Tools

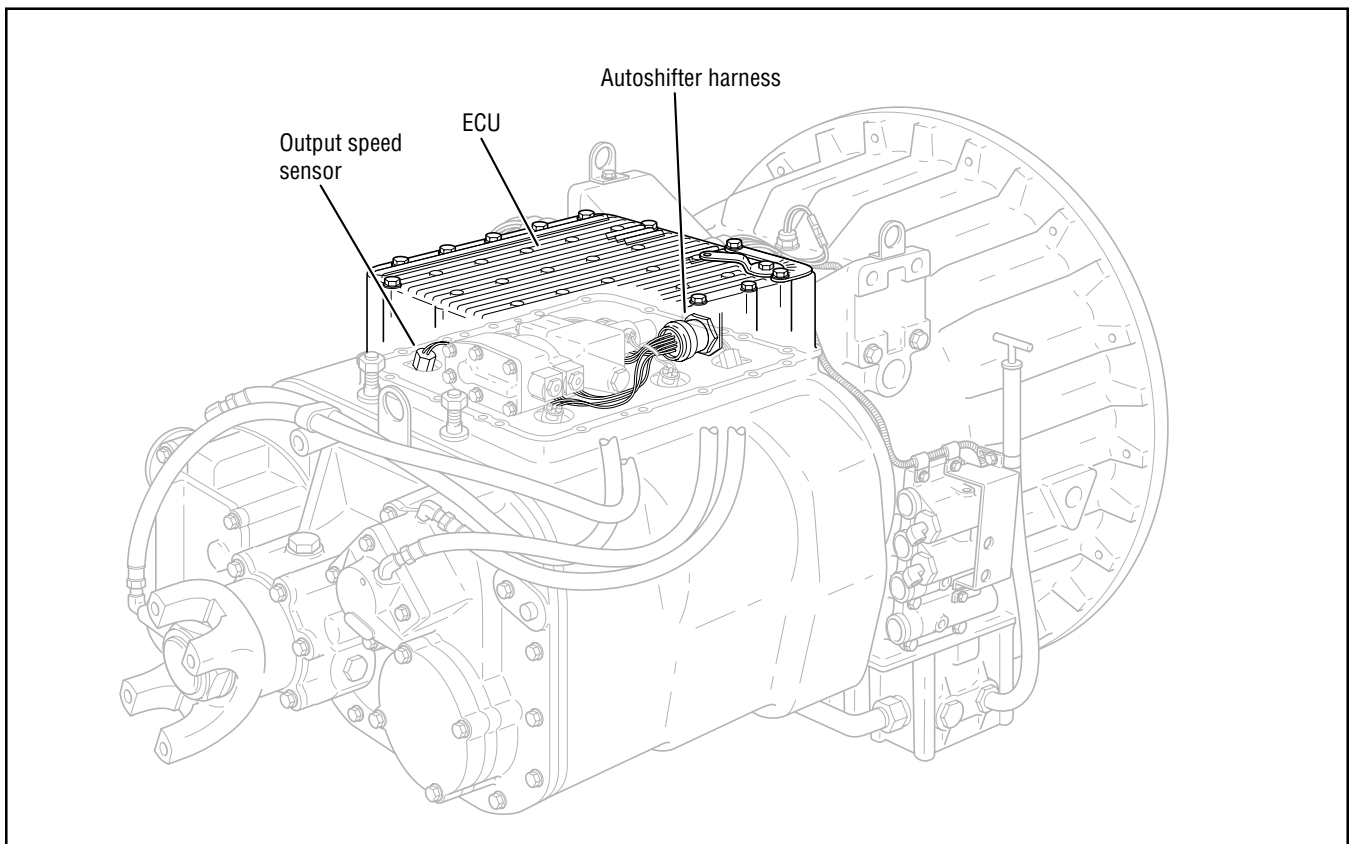
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by any of the following conditions:

- Poor vehicle electrical ground
- Improper output speed sensor installation
- Defective output speed sensor
- Defective auxiliary countershaft gear
- Electrical open or short in the autoshifter harness
- Incorrect configuration software
- Faulty ECU

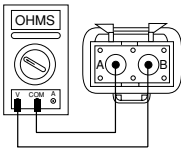
Likely Failed Components



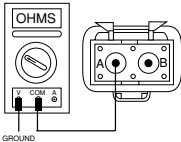
Code 57, Output Speed Sensor Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect autoshifter harness from ECU. 4. Inspect harness and output speed sensor connections for abrasions or corrosion.	→ If harness and connections are OK	→ Go to Step B .
		→ If harness and connections have poor connections, abrasions or corrosion	→ Repair connections as needed. Go to Step A .

Step B	Procedure	Condition	Action
	1. Disconnect output speed sensor from autoshifter harness. 2. Measure resistance of output speed sensor between pins A and B.	→ If resistance is 3K to 4K ohms	→ Go to Step C .
		→ If resistance is outside of range	→ Replace input speed sensor. Go to Step V .

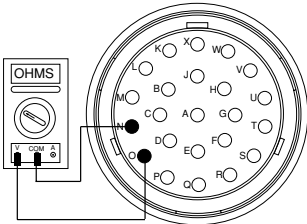


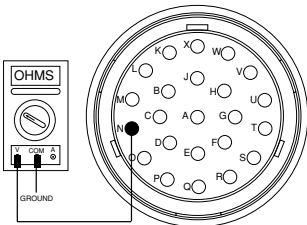
Step C	Procedure	Condition	Action
	1. Measure resistance of output speed sensor between pin A and ground.	→ If resistance is more than 10K ohms or infinite	→ Go to Step D .
		→ If resistance is less than 10K ohms	→ Replace output speed sensor. Go to Step V .



Code 57

Code 57, Output Speed Sensor Test, continued

Step D	Procedure	Condition	Action
	1. Reconnect speed sensor to autoshifter harness. 2. Disconnect autoshifter harness from CEEMAT. 3. Measure resistance between autoshifter harness pins N and O.	→ If resistance is 3K to 4K ohms → Go to Step E. If resistance is outside of range → Repair or replace autoshifter harness as required. Go to Step V.	
			

Step E	Procedure	Condition	Action
	1. Measure resistance between autoshifter harness pin N and ground.	→ If resistance is more than 10K ohms or infinite → Replace ECU. Go to Step V. If resistance is less than 10K ohms → Repair or replace autoshifter harness as required. Go to Step V.	
			

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → Test complete. If code 57 appears → Return to Step A to find error in testing. If code other than 57 → Go to Fault Isolation Procedure Index (page 1-8).	

Component Code 61 Autoshifter Solenoid 1 Coil

Fault Description

This code indicates an electrical problem in the autoshifter solenoid 1 coil circuit.

Required Tools

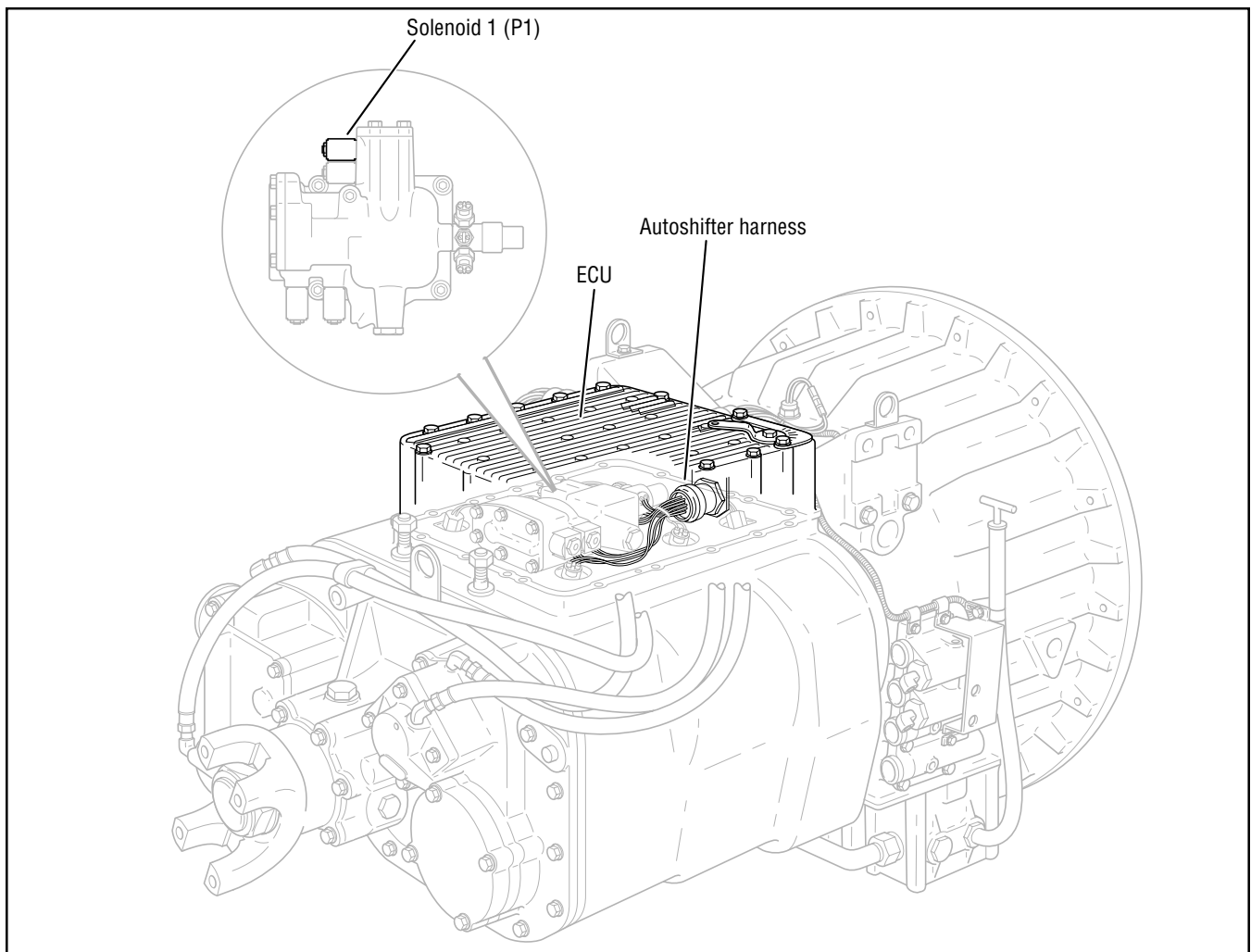
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by an electrical open or short in any of the following areas:

- Autoshifter wiring harness
- Solenoid coil
- Faulty ECU

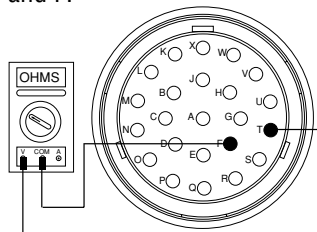
Likely Failed Components



Code 61, Autoshifter Solenoid 1 Coil Test

Step A	Procedure	Condition	Action
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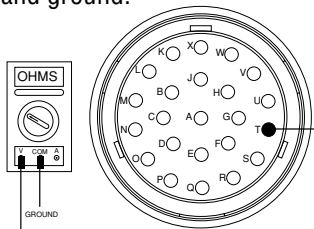
1. Key off.
2. Remove ECU from transmission.
3. Disconnect autoshifter harness from ECU.
4. Measure resistance between autoshifter harness pins T and F.



- If resistance is 11 to 18 ohms → Go to **Step B**.
- If resistance is outside of range → Replace autoshifter harness and retest. Go to **Step V**.

Step B	Procedure	Condition	Action
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1. Measure resistance between autoshifter harness pin T and ground.



- If resistance is more than 10K ohms or infinite → Replace the ECU. Go to **Step V**.
- If resistance is less than 10K ohms → Replace autoshifter harness. Go to **Step V**.

Step V	Procedure	Condition	Action
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1. Key off.
2. Reconnect all connectors.
3. Key on.
4. Clear codes (see Clearing Fault Codes, page 1-3).
5. Use Driving Technique to attempt to reset the code (page 1-4).
6. Check for codes (see Retrieving Fault Codes, page 1-3).

- If no codes → Test complete.
- If code 61 appears → Return to **Step A** to find error in testing.
- If code other than 61 appears → Go to Fault Isolation Procedure Index (page 1-8).

Component Code 62

Autoshifter Solenoid 2 Coil

Fault Description

This code indicates an electrical problem in the autoshifter solenoid 2 coil circuit.

Required Tools

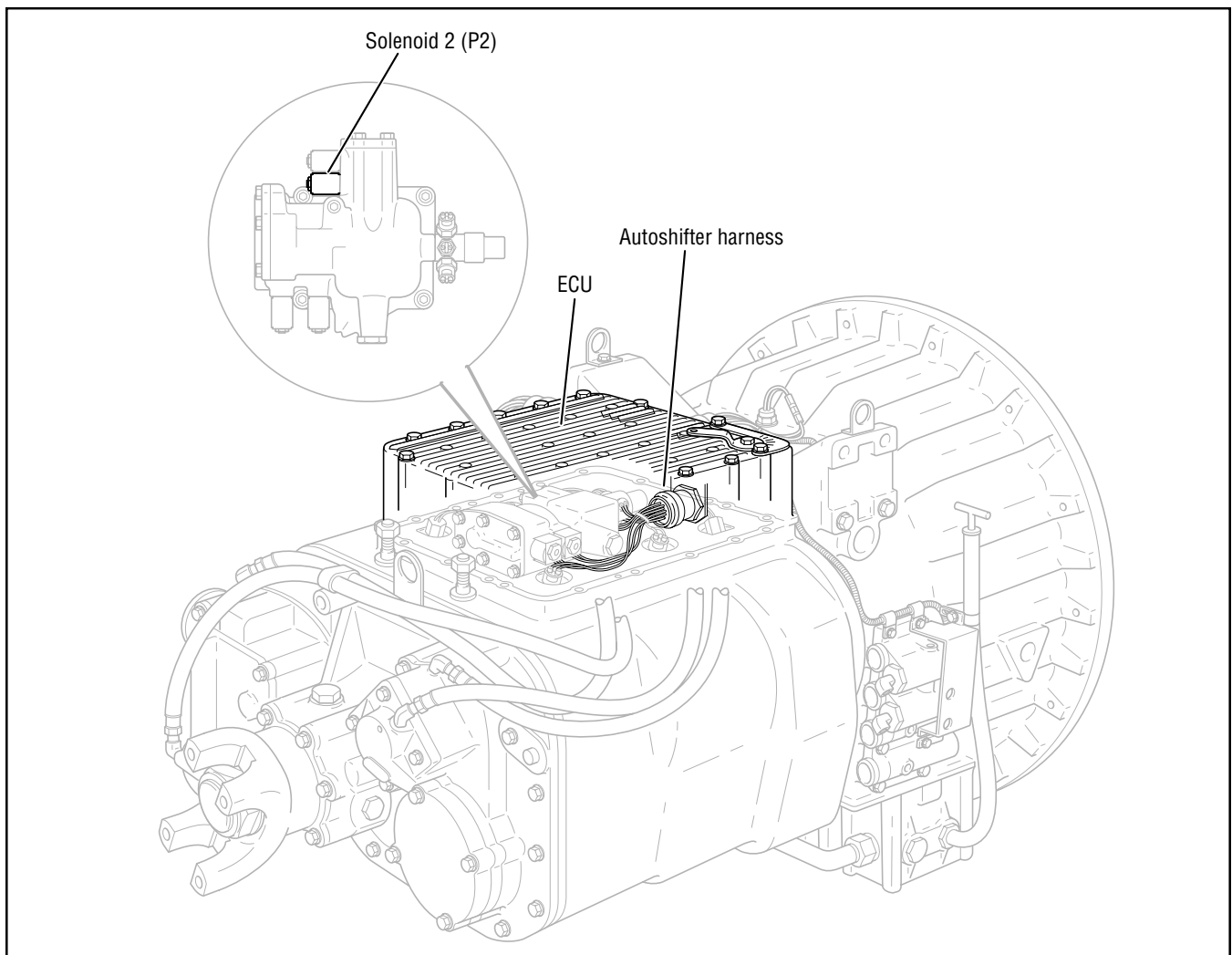
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

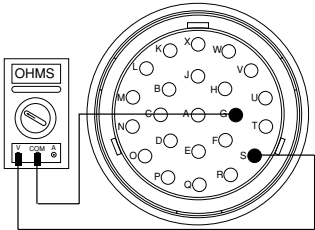
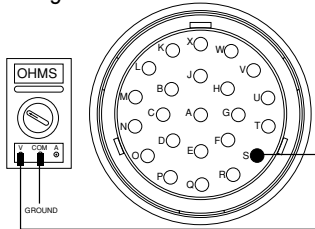
This code can be caused by an electrical open or short in any of the following areas:

- Autoshifter wiring harness
- Solenoid coil
- Faulty ECU

Likely Failed Components



Code 62, Autoshifter Solenoid 2 Coil Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect autoshifter harness from ECU. 4. Measure resistance between autoshifter harness pins G and S. 	If resistance is 11 to 18 ohms If resistance is outside of range	Go to Step B. Replace autoshifter harness. Go to Step V.
Step B	Procedure	Condition	Action
	1. Measure resistance between autoshifter harness pin S and ground. 	If resistance is more than 10K ohms or infinite If resistance is less than 10K ohms	Replace the ECU. Go to Step V. Replace autoshifter harness. Go to Step V.
Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	If no codes If code 62 appears If code other than 62 appears	Test complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Code 62

Component Code 63 Autoshifter Solenoid 3 Coil

Fault Description

This code indicates an electrical problem in the autoshifter solenoid 3 coil circuit.

Required Tools

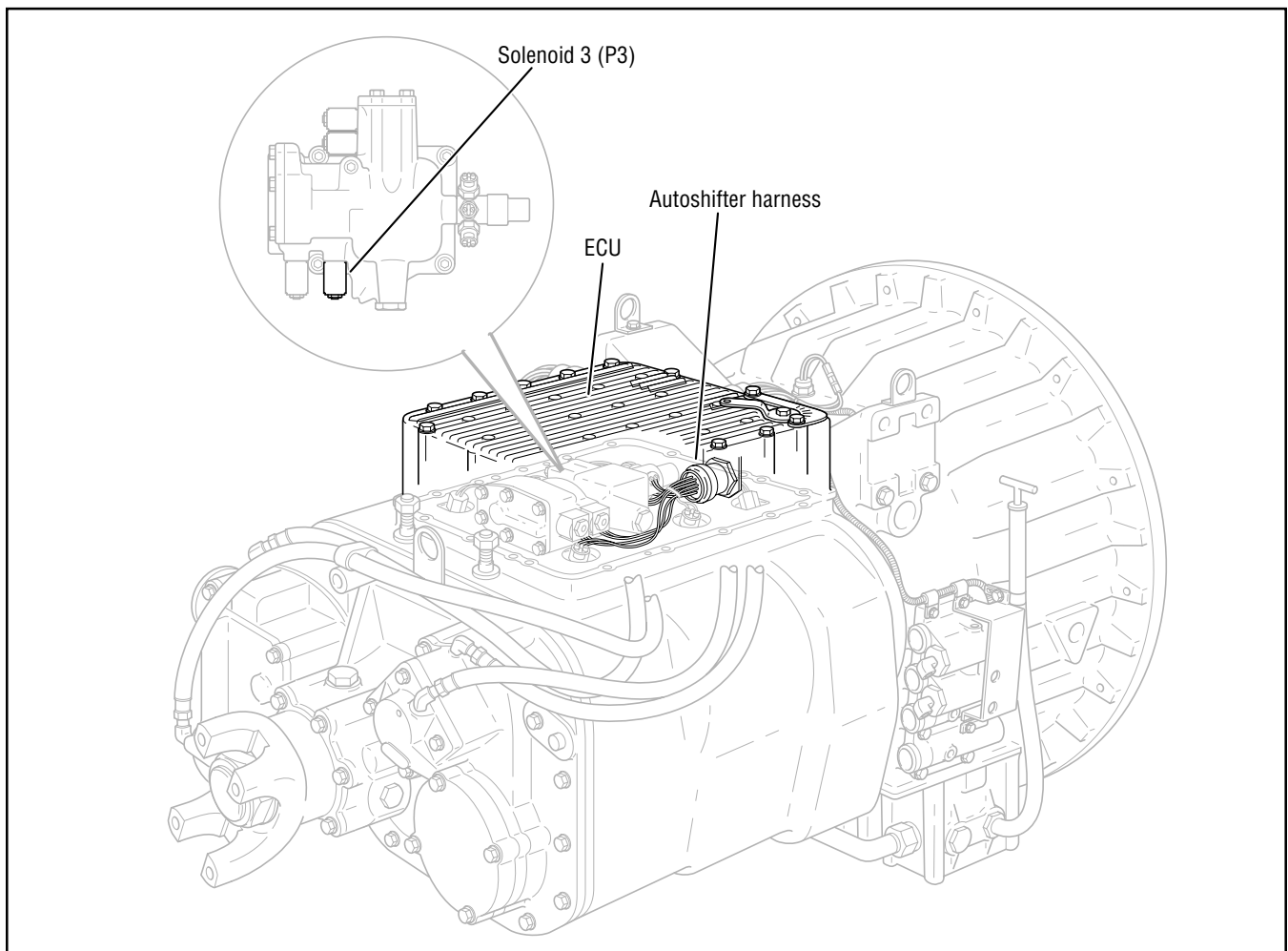
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by an electrical open or short in any of the following areas:

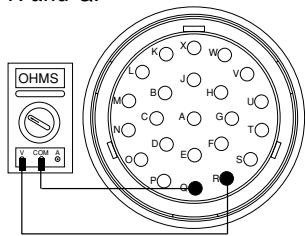
- Autoshifter wiring harness
- Solenoid coil
- Faulty ECU

Likely Failed Components

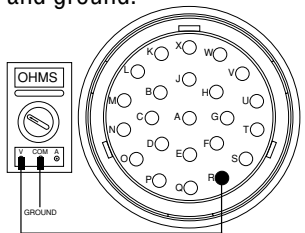


Code 63, Autoshifter Solenoid 3 Coil Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect autoshifter harness from ECU. 4. Measure resistance between autoshifter harness pins R and Q.	→ If resistance is 11 to 18 ohms → If resistance is outside of range →	Go to Step B. Replace autoshifter harness. Go to Step V.



Step B	Procedure	Condition	Action
	1. Measure resistance between autoshifter harness pin R and ground.	→ If resistance is more than 10K ohms or infinite → If resistance is less than 10K ohms →	Replace the ECU. Go to Step V. Replace autoshifter harness. Go to Step V.



Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 63 appears → If code other than 63 appears →	Test complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Component Code 64 Autoshifter Solenoid 4 Coil

Fault Description

This code indicates an electrical problem in the autoshifter solenoid 4 coil circuit.

Required Tools

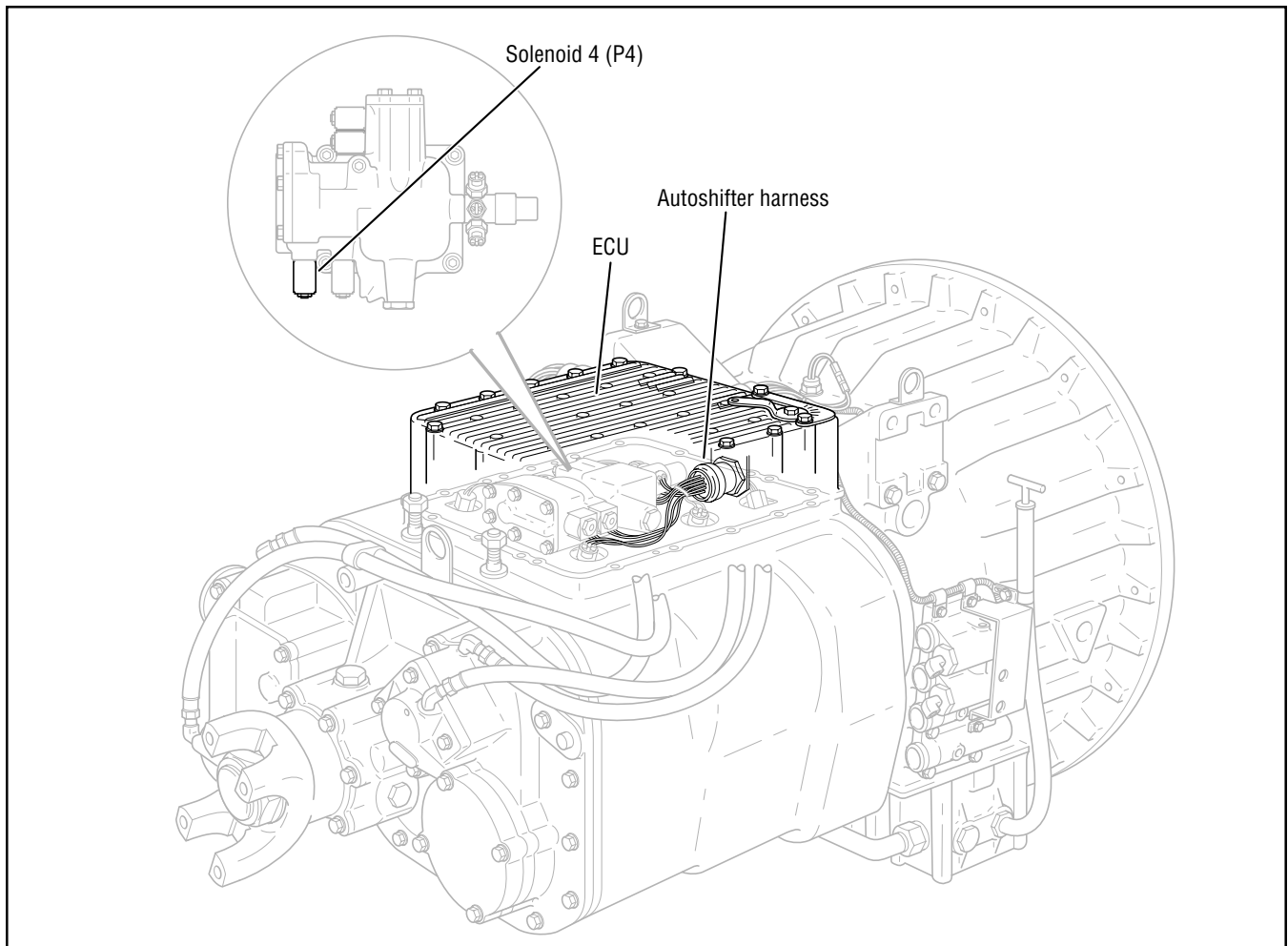
- Basic Hand Tools
- Digital Volt/Ohm Meter
- CEEMAT Troubleshooting Guide

Possible Causes

This code can be caused by an electrical open or short in any of the following areas:

- Autoshifter wiring harness
- Solenoid coil
- Faulty ECU

Likely Failed Components



Code 64, Autoshifter Solenoid 4 Coil Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Remove ECU from transmission. 3. Disconnect autoshifter harness from ECU. 4. Measure resistance between autoshifter harness pins E and P.	If resistance is 11 to 18 ohms If resistance is outside of range	Go to Step B. Replace autoshifter harness. Go to Step V.

Step B	Procedure	Condition	Action
	1. Measure resistance between autoshifter harness pin E and ground.	If resistance is more than 10K ohms or infinite If resistance is less than 10K ohms	Replace the ECU. Go to Step V. Replace autoshifter harness. Go to Step V.

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	If no codes If code 64 appears If code other than 64 appears	Test complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Code 64

System Code 71 Stuck Engaged

Fault Description

This code indicates the transmission was unable to move the front box to neutral during a shift as requested.

Required Tools

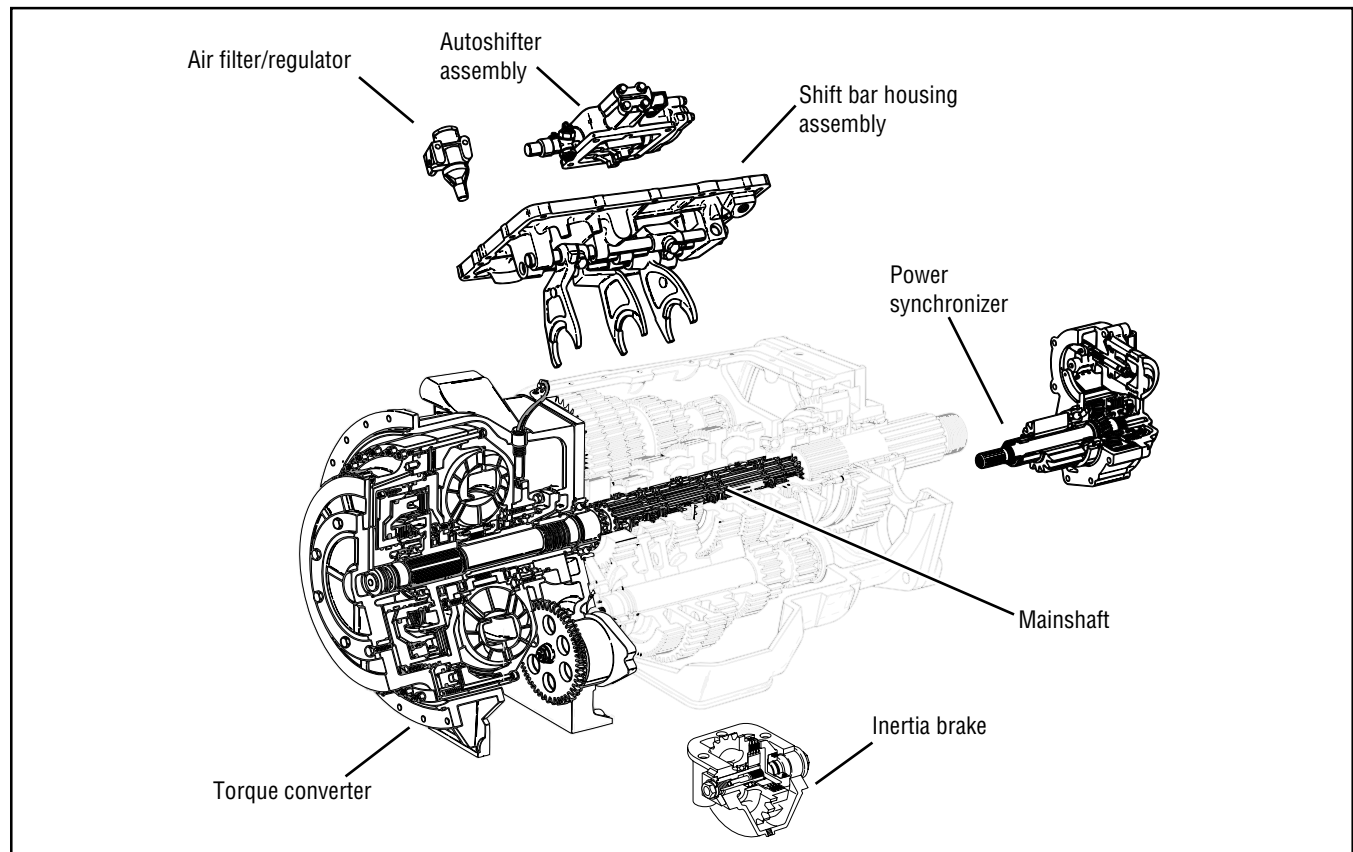
- Basic Hand Tools
- Air Pressure Gauges (0-100 psi)
- CEEMAT Troubleshooting Guide
- Hand-Held Diagnostic Tool
- 0-300 PSI Hydraulic Gauges
- 0-100 PSI Hydraulic Gauge

Possible Causes

This code can be caused any of the following conditions:

- Low air pressure
- Contaminated air supply
- Excessive drag in the hydraulic system
- Malfunctioning yoke, clutch, or mainshaft
- Failed shift block
- Faulty autoshifter assembly
- Dragging inertia brake/power synchronizer

Likely Failure Locations



Code 71, Stuck Engaged Test

Step A	Procedure	Condition	Action
	1. Connect hand-held diagnostic tester. 2. View the following data: • Engine speed • Input speed • Output speed • Torque converter 3. Turn off PTO switch (if equipped). 4. Start engine. 5. When the hand-held diagnostic tool display indicates the torque converter is open, quickly and fully press the throttle. 6. Observe engine speed and input speed readings.	→ If engine speed and input speed separate → If engine speed and input speed always match	→ Go to Step C. → Go to Step B.

Step B	Procedure	Condition	Action
	1. Install 0-300 PSI hydraulic gauges into diagnostic ports for: • Main • Interrupt clutch • Lockup/bypass clutch 2. Install a 0-100 PSI hydraulic gauge into the lube diagnostic port on the hydraulic valve assembly. 3. Turn PTO off (if equipped). 4. On the hand-held diagnostic tool, Select Perform Tests. 5. Select Hydraulic Tests. 6. Monitor the gauges.	→ If pressures are in the ranges: • Main = 225 to 255 PSI • Interrupt = 0 PSI • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI → If pressures are not in the ranges shown above	→ Replace the transmission. Go to Step V. → Replace the hydraulic valve assembly. Go to Step V.

Code 71, Stuck Engaged Test, continued

Step C	Procedure	Condition	Action
	1. Start engine. Allow air pressure to reach governor cutoff. 2. On the hand-held diagnostic tool, monitor: • Current gear • Gearbox center • Gearbox engage • Gearbox neutral 3. Place the shift lever in RL, N, 4, 3, 2 and 1 and observe the hand-held diagnostic display. Compare the display with the table.	→ If signals correspond to table → If signals do not correspond to table →	Replace autoshifter. Go to Step V. Go to Step D.

Step D	Procedure	Condition	Action
	1. Remove autoshifter and attempt to move shift blocks in and out of gear.	→ If shift bar housing is OK → If shift bar housing is not OK →	Replace autoshifter. Go to Step V. Repair shift bar housing as required. Go to Step V.

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 71 appears → If code other than 71 appears →	Repairs complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Code 71, Stuck Engaged Test, continued

Current gear	Gearbox Neutral	Gearbox Center	Gearbox Engaged
RL	Off	Off	On
N	On	On	Off
4	Off	Off	On
3	Off	On	On
2	Off	On	On
1	Off	Off	On

Note: Service brakes must be applied when selecting 2 or 1 from another shift lever position except neutral or reverse.

System Code 72 Failed to Select Rail

Fault Description

This code indicates the transmission was unable to select the desired rail in the front box.

Required Tools

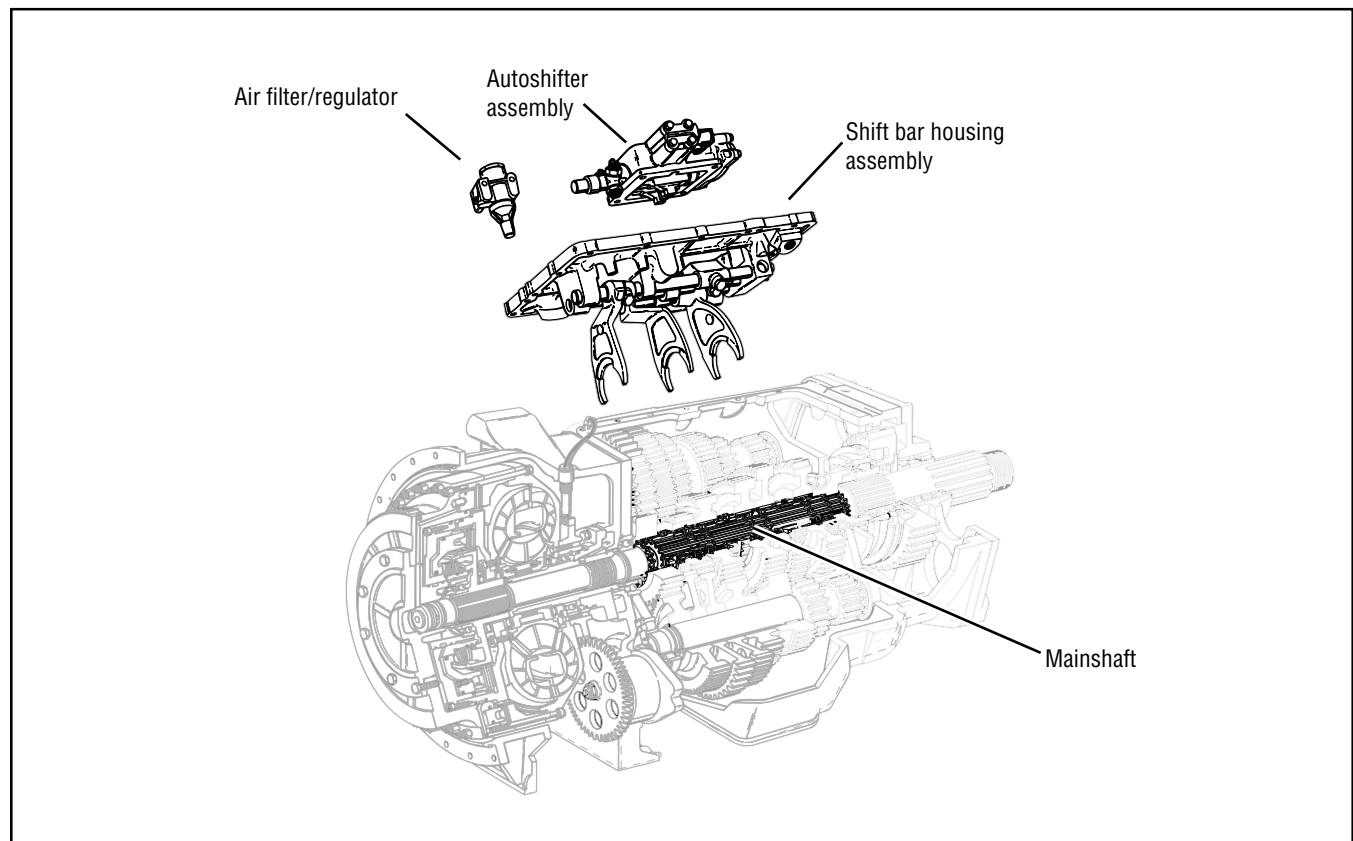
- Basic Hand Tools
- Air Pressure Gauges (0-100 PSI)
- CEEMAT Troubleshooting Guide
- Hand-Held Diagnostic Tool

Possible Causes

This code can be caused by any of the following conditions:

- Low air pressure
- Contaminated air supply
- Faulty autoshifter assembly
- Faulty shift block
- Faulty center rail sensor circuit

Likely Failure Locations



Code 72, Failed to Select a Rail Test

Step A	Procedure	Condition	Action
	1. Start engine. Allow air pressure to reach governor cut-off. 2. Connect hand-held diagnostic tool and select monitor mode. 3. View the following data: • Current gear • Neutral sensor • Center rail sensor • Engaged sensor 4. Place the shift lever in RL, N, 4, 3, 2, and 1 and observe the hand-held diagnostic display. Compare the display with the table.	→ If signals correspond to table → If signals do not correspond to table →	Replace autoshibter. Go to Step V. Go to Step B.
Step B	Procedure	Condition	Action
	1. Remove autoshibter and inspect for obstructions to rail travel across the shift blocks.	→ If shift bar housing is OK → If shift bar housing is not OK →	Replace autoshibter. Go to Step V. Repair shift bar housing as required. Go to Step V.
Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 72 appears → If code other than 72 appears →	Repairs complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Code 72, Failed to Select a Rail Test, continued

Current gear	Gearbox Neutral	Gearbox Center	Gearbox Engaged
RL	Off	Off	On
N	On	On	Off
4	Off	Off	On
3	Off	On	On
2	Off	On	On
1	Off	Off	On

Note: Service brakes must be applied when selecting 2 or 1 from another shift lever position except neutral or reverse.

System Code 73 Failed to Engage Gear

Fault Description

This code indicates the autoshifter failed to engage a gear during a shift.

Required Tools

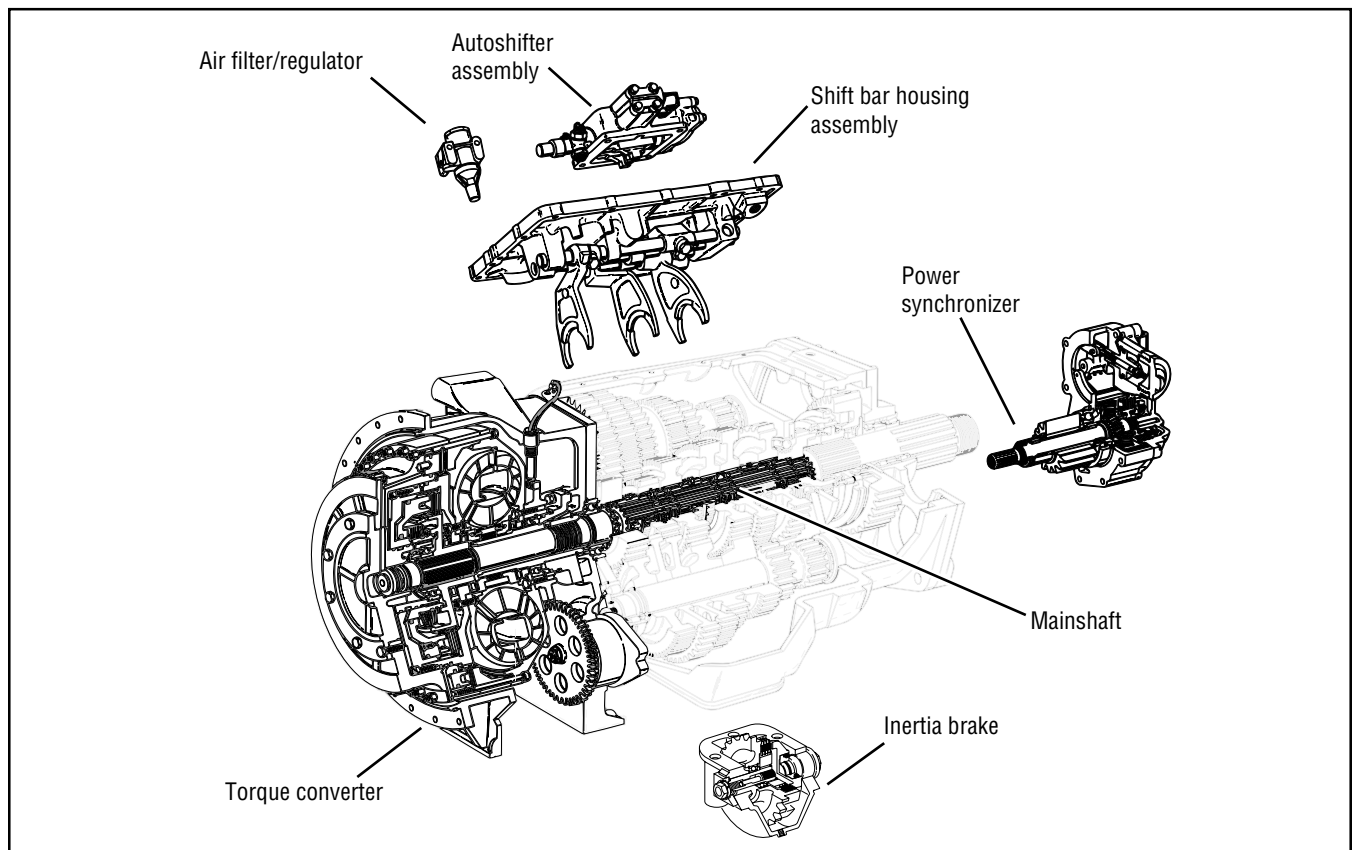
- Basic Hand Tools
- CEEMAT Troubleshooting Guide
- Air Pressure Gauges 0-100 PSI
- 0-300 PSI Hydraulic Gauges
- 0-100 PSI Hydraulic Gauge
- Hand-Held Diagnostic Tool

Possible Causes

This code can be caused by any of the following conditions:

- Low air pressure
- Contaminated air supply
- Excessive drag in the hydraulic system
- Faulty autoshifter assembly
- Faulty yoke, clutch or mainshaft
- Faulty shift block
- Dragging inertia brake/power synchronizer
- Faulty gear engaged sensor circuit

Likely Failure Locations



Code 73, Failed to Engage Gear Test

Step A	Procedure	Condition	Action
	1. Key on. 2. Connect hand-held diagnostic tool. 3. View the following data: • Engine speed • Input speed • Output speed • Torque converter 4. Turn off PTO switch (if equipped). 5. Start engine. 6. When hand-held diagnostic tool display indicates the torque converter is open, quickly and fully press the throttle. 7. Observe engine speed and input speed readings.	→ If engine speed and input speed separate → If engine speed and input speed always match	→ Go to Step C. → Go to Step B.

Step B	Procedure	Condition	Action
	1. Install 0-300 PSI hydraulic gauges into diagnostic ports for: • Main • Interrupt clutch • Lockup/bypass clutch 2. Install a 0-100 PSI hydraulic gauge into the lube diagnostic port. 3. Start engine. Allow air pressure to build to governor cutoff. 4. Turn PTO off (if equipped). 5. Monitor the gauges.	→ If pressures are in the ranges: • Main = 225 to 255 PSI • Interrupt = 0 PSI • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI → If pressure are not in the ranges shown above	→ Replace the transmission. Go to Step V. → Replace the hydraulic valve assembly. Go to Step V.

Code 73, Failed to Engage Gear Test, continued

Step C	Procedure	Condition	Action
	1. Select monitor mode and view input shaft speed. 2. Engage different starting gears with the service brakes applied.	→ If input speed drops when a starting gear is engaged and increases when neutral is selected → Go to Step E. If input speed does not drop or is always 0 → Go to Step D.	

Step D	Procedure	Condition	Action
	1. Install 0-100 PSI tee air gauges into the band and disc or inertia brake air lines at the synchronizing device. 2. Start vehicle and allow air pressure to reach governor cut-off. 3. Select perform tests, air system, power synchronizer test and activate the power synchronizer test.	→ If hand-held indicates power synchronizer is on and percent modulation varies from 0-100% and Air gauges vary between 0-80 PSI, increasing with percent modulation → If air gauges do not vary between 0-80 PSI, increasing with percent modulation	→ Repair or replace synchronizer assembly as required. Go to Step V. → Replace ECU assembly and retest.

Current gear	Gearbox Neutral	Gearbox Center	Gearbox Engaged
RL	Off	Off	On
N	On	On	Off
4	Off	Off	On
3	Off	On	On
2	Off	On	On
1	Off	Off	On

Note: Service brakes must be applied when selecting 2 or 1 from another shift lever position except neutral or reverse.

Code 73, Failed to Engage Gear Test, continued

Step E	Procedure	Condition	Action
	1. Select monitor mode and view the following data: • Current gear • Gearbox center • Gearbox engage • Gearbox neutral 2. Place the shift lever in RL, N, 4, 3, 2 and 1 and observe the hand-held diagnostic display. Compare the display with the table.	→ If signals correspond to table → If signals do not correspond to table →	Replace autoshifter. Go to Step V. Go to Step F.
Step F	Procedure	Condition	Action
	1. Remove autoshifter and attempt to move shift blocks in and out of gear.	→ If shift bar cover is OK → If shift bar cover is not OK →	Replace autoshifter. Go to Step V. Repair shift bar housing as required. Go to Step V.
Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 73 appears → If code other than 73 appears →	Repairs complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

System Code 74 Failed to Synchronize

Fault Description

This code indicates the transmission's synchronizing system is not performing as expected. During shifts between top gears, the transmission monitors input shaft acceleration and deceleration, and determines whether performance is satisfactory. Code 74 sets if the performance is outside of the satisfactory range.

Required Tools

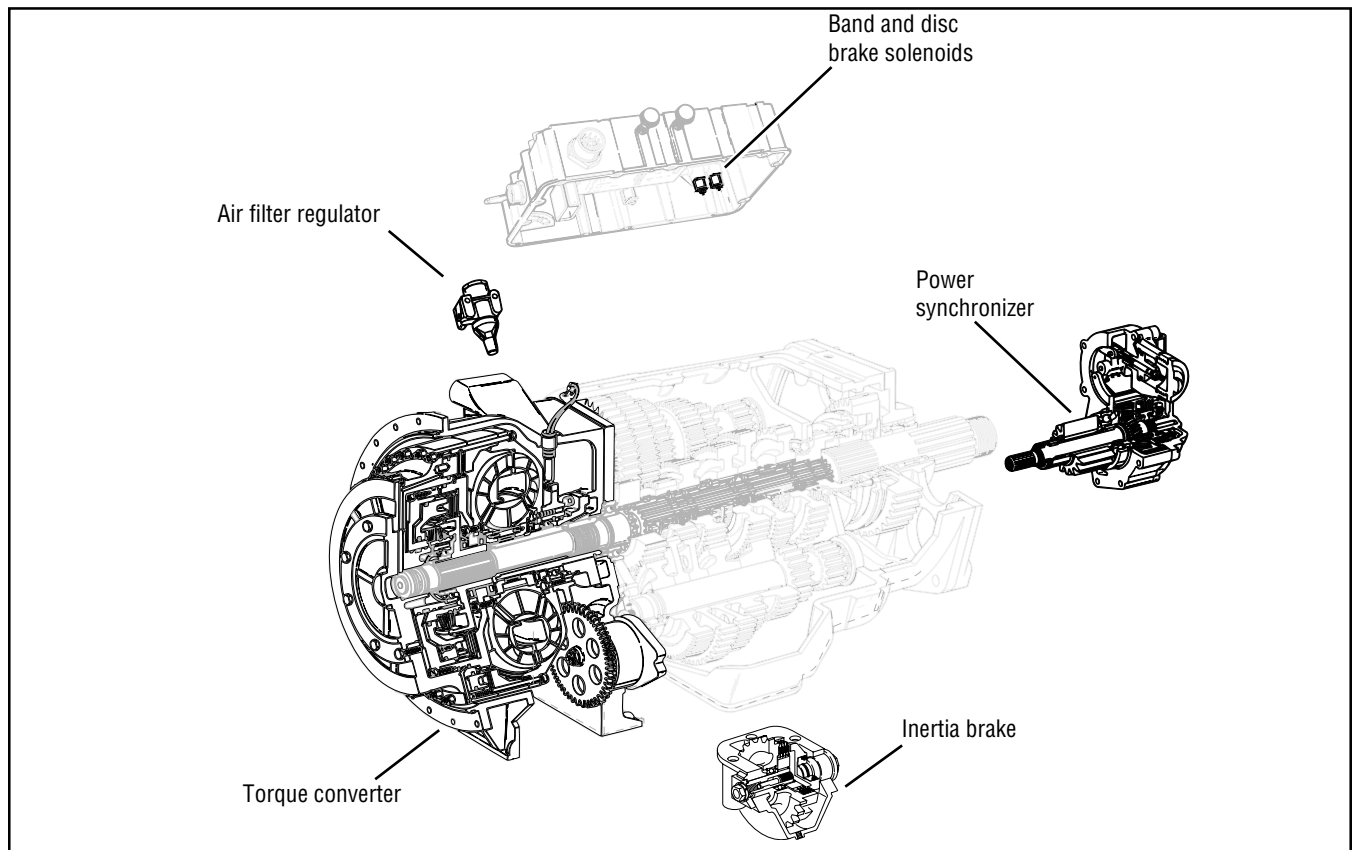
- Basic Hand Tools
- Air Pressure Gauges (0-100 psi)
- CEEMAT Troubleshooting Guide
- Hand-Held Diagnostic Tool
- 0-300 PSI Hydraulic Gauges
- 0-100 PSI Hydraulic Gauge

Possible Causes

This code can be caused by any of the following conditions:

- Low air pressure
- Contaminated air supply
- Interrupt clutch is dragging
- Malfunctioning of the power synchronizer/inertia brake
- Malfunctioning synchronizer air valves

Likely Failure Locations



Code 74, Failed to Synchronize Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Connect hand-held diagnostic tool. 3. View the following data: • Engine speed • Input speed • Output speed • Torque converter 4. Turn off PTO switch (if equipped). 5. Start engine. 6. When hand-held diagnostic tool display indicates the torque converter is open, quickly and fully press the throttle. 7. Observe engine speed and input speed readings.	→ If engine speed and input speed separate → If engine speed and input speed always match	→ Go to Step C. → Go to Step B.
Step B	Procedure	Condition	Action
	1. Install 0-300 PSI hydraulic gauges into diagnostic ports for: • Main • Interrupt clutch • Lockup/bypass clutch 2. Install a 0-100 PSI hydraulic gauge into the Lube diagnostic port. 3. Start engine. Allow air pressure to build to governor cut-off. 4. Turn PTO off (if equipped). 5. On the hand-held diagnostic tool, select Perform Tests. 6. Select Hydraulic Tests.	→ If pressures are in the ranges: • Main = 225 to 255 PSI • Interrupt = 0 PSI • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI → If pressures are not in the ranges shown above	→ Replace the transmission. Go to Step V. → Replace the hydraulic valve assembly. Go to Step V.

Code 74

Code 74, Failed to Synchronize Test, continued

Step C	Procedure	Condition	Action
	1. Tee 0-100 PSI air gauges into the power synchronizer band and disc lines OR the inertia brake air line. 2. Start engine and allow air pressure to build to governor cut-off. 3. Connect hand-held diagnostic tool. 4. Select Perform Test. 5. Select Air System Test. 6. Select Power Synchronizer Test. 7. Activate the Power Synchronizer Test. 8. Observe the gauges and the hand-held diagnostic tool.	→ If hand-held diagnostic tool indicates: • Power Synchronizer = on • Percent Modulation = 0-100% variation and If gauges vary between 0 and 80 PSI, increasing with Percent Modulation → If gauges do not vary between 0 and 80 PSI, increasing with Percent Modulation →	Repair or replace the power synchronizer. Go to Step V. Replace ECU. Go to Step V.
Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes If code 74 appears → If code other than 74 appears →	Repairs complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

System Code 81 Invalid Shift Lever at Start (Cable Only)

Fault Description

This code indicates the engine was able to start without the shift lever being positioned in Neutral.

Required Tools

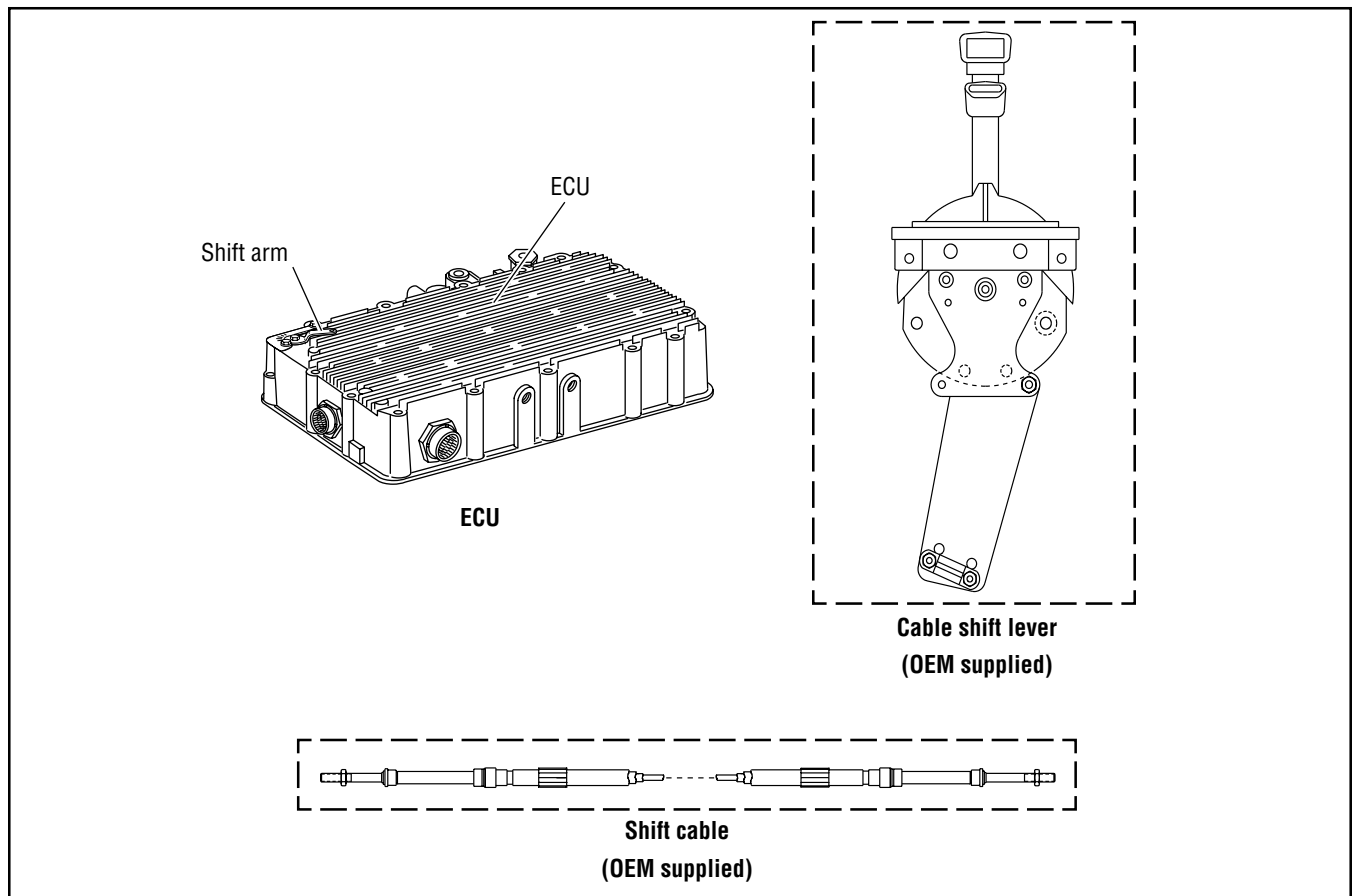
- Basic Hand Tools
- CEEMAT Troubleshooting Guide
- Hand-Held Diagnostic Tool

Possible Causes

This code can be caused by any of the following conditions:

- Faulty lever cable
- Faulty shift lever
- Lever or shift cable out of adjustment
- Malfunctioning neutral start circuit
- Faulty ECU

Likely Failure Locations



Code 81, Invalid Shift Lever at Start Test (Cable Only)

Step A	Procedure	Condition	Action
	1. Key on. 2. Retrieve codes (page 1-3).	→ If code 81 is active	→ Adjust shift lever. See procedure in Appendix.
		If code 81 is inactive	→ Test complete

Code 81

Component Code 82

Multiple Non-Adjacent Sensors (Cable Only)

Fault Description

This fault indicates an electrical problem inside the ECU. The shift lever is sensing more than one lever position and the sensed positions are not adjacent to one another.

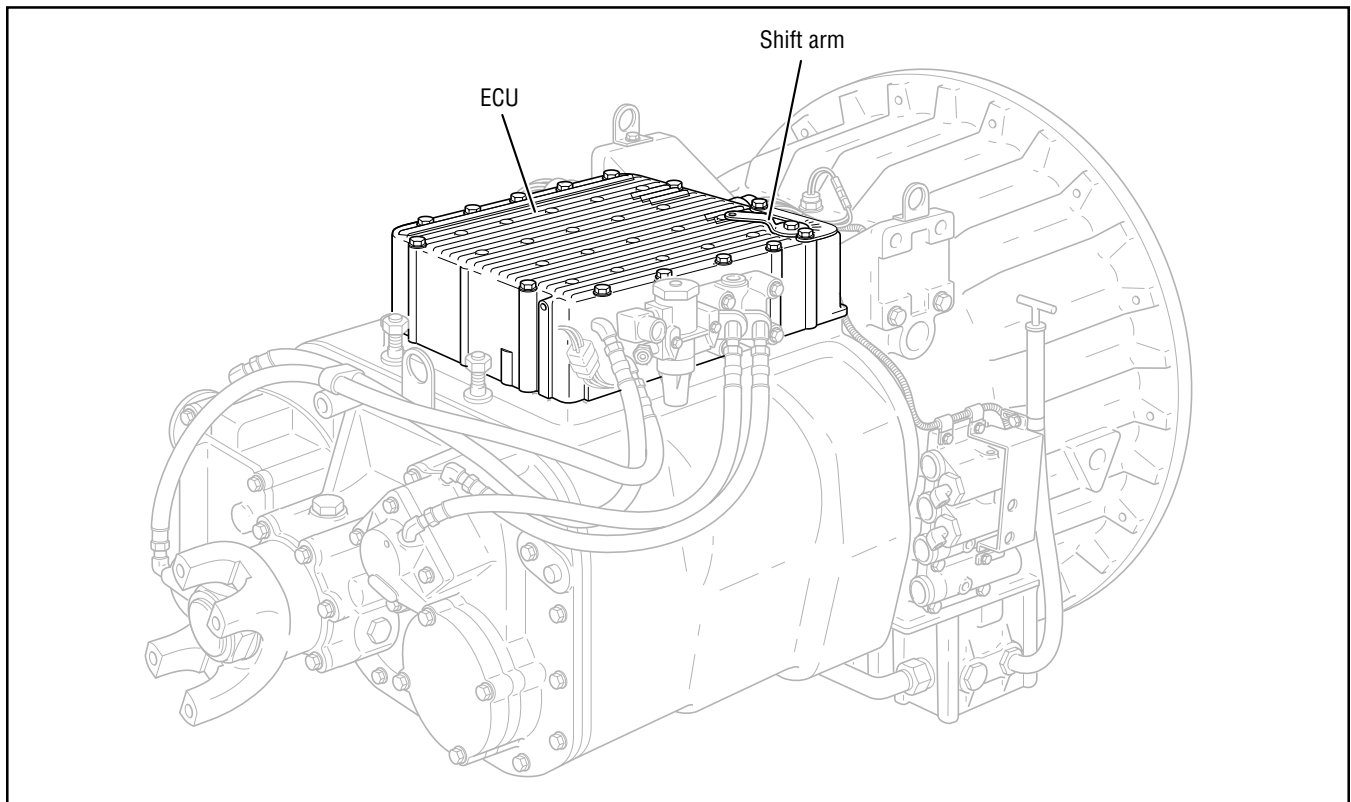
Possible Causes

This code is likely caused by a faulty shift lever.

Required Tools

- Basic Hand Tools
- CEEMAT Troubleshooting Guide
- Hand-Held Diagnostic Tool

Likely Failed Components



Code 82, Multiple Non-Adjacent Sensors Test (Cable Only)

Step A	Procedure	Condition	Action
	1. Key on.		
	2. Retrieve codes (page 1-3).	→ If code 82 is active	→ Replace ECU.
		If code 82 is inactive	→ Test complete.

Code 82

System Code 83 Shift Lever Missing (Cable Only)

Fault Description

This fault indicates the shift lever is not sensing any lever positions.

Required Tools

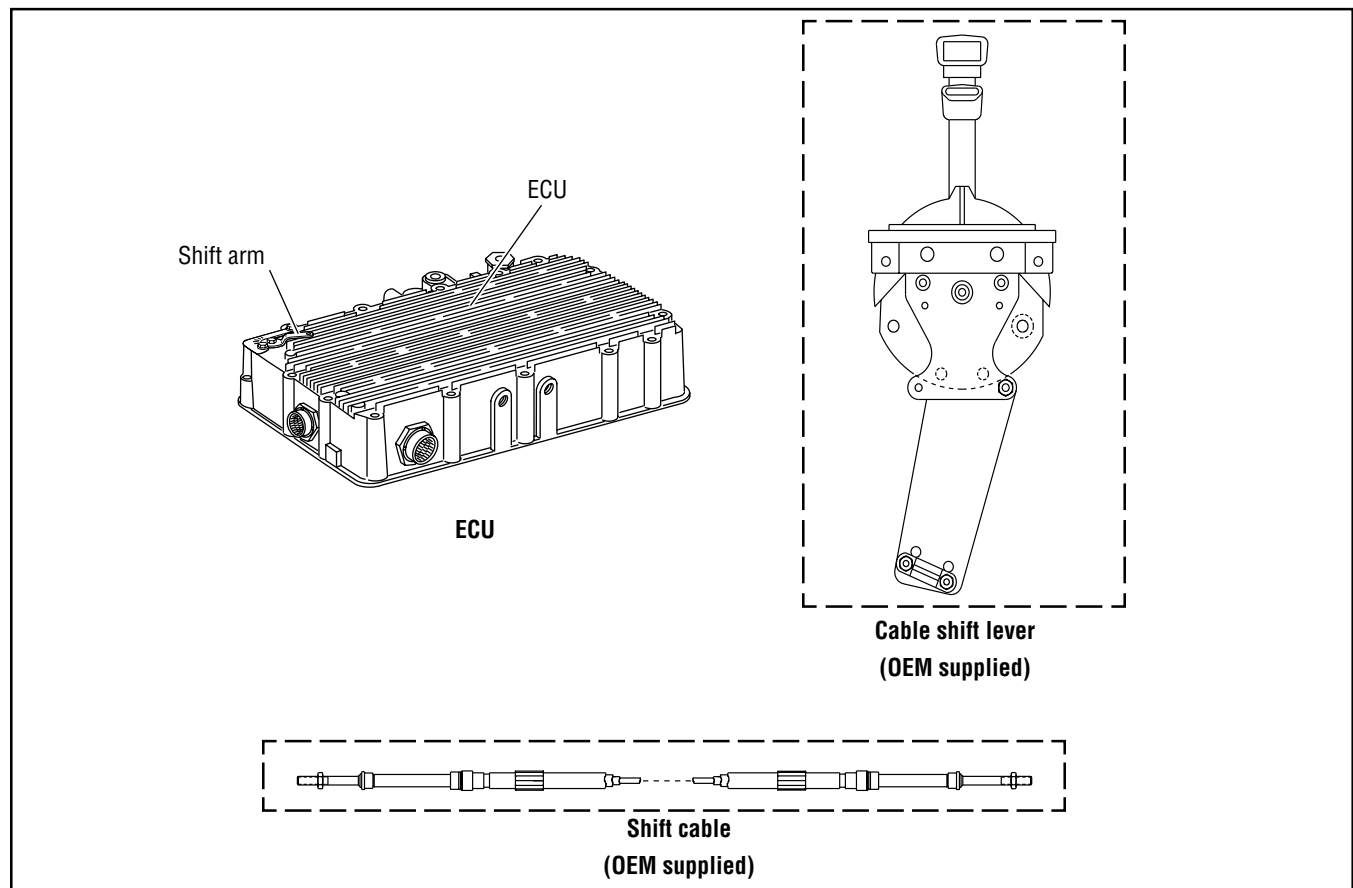
- Basic Hand Tools
- Hand-Held Diagnostic Tool
- CEEMAT Troubleshooting Guide

Possible Causes (Cable Only)

This code can be caused by any of the following conditions:

- Faulty lever cable
- Faulty shift lever
- Lever or shift cable out of adjustment
- Faulty ECU

Likely Failure Locations



Code 83 Shift Lever Missing Test (Cable)

Step A	Procedure	Condition	Action
	1. Key on. 2. Connect hand-held diagnostic tool. 3. Select Perform Tests. 4. Select Shift Lever Test. 5. Move the shift lever through all positions while observing the hand-held diagnostic tool.	→ If hand-held diagnostic tool display matches position of shift lever → If hand-held diagnostic tool display does not match position of shift lever →	Test complete. Go to Step B.

Step B	Procedure	Condition	Action
	1. Disconnect shift cable from ECU arm assembly. 2. Move the shift arm through all positions while observing the hand-held diagnostic tool.	→ If hand-held diagnostic tool display matches position of shift arm → If hand-held diagnostic tool display does not match position of shift arm →	Check and adjust cable backlash. Adjust shift cable. See procedure in Appendix. Go to Step V. Replace ECU. Go to Step V.

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 83 appears → If code other than 83 appears →	Repairs complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

Component Code 83 Shift Lever Missing (Electronic Only)

Fault Description

This code indicates the shift lever is not sensing any lever positions.

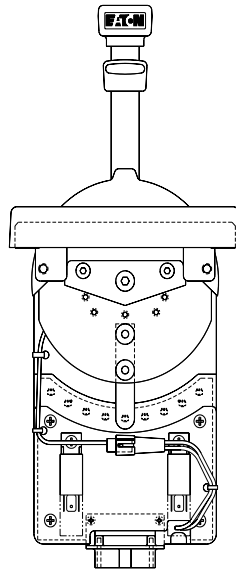
Possible Causes (Electronic Only)

This code is caused by a faulty shift lever.

Required Tools

- Basic Hand Tools
- Hand-Held Diagnostic Tool
- CEEMAT Troubleshooting Guide

Likely Failure Locations



Electronic shift lever (ESL)

Code 83 Shift Lever Missing Test (Electronic)

Step A	Procedure	Condition	Action
	1. Key on. 2. Connect hand-held diagnostic tool. 3. Select Perform Tests. 4. Select Shift Lever Test. 5. Move the shift lever through all positions while observing the hand-held diagnostic tool.	→ If hand-held diagnostic tool display matches position of shift lever → If hand-held diagnostic tool display does not match position of shift lever →	Test complete. Replace electronic shift lever. Go to Step V.

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Clear codes (see Clearing Fault Codes, page 1-3). 5. Use Driving Technique to attempt to reset the code (page 1-4). 6. Check for codes (see Retrieving Fault Codes, page 1-3).	→ If no codes → If code 83 appears → If code other than 83 appears →	Repairs complete. Return to Step A to find error in testing. Go to Fault Isolation Procedure Index (page 1-8).

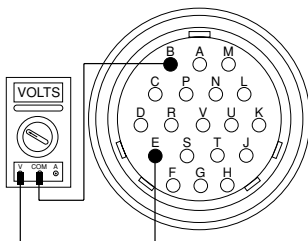
Transmission Basic Inputs Pretest

Step A	Procedure	Condition	Action
	1. Connect the hand-held diagnostic tool. 2. Start engine and allow to idle. 3. Select vehicle interface and monitor throttle percentage. 4. Quickly and fully press throttle three times.	→ If throttle percentage reads 0 to 100% as demand increases → If throttle percentage reads 100 to 0% as demand increases → If throttle position does not change	→ Go to Step B. → Repair reversed wires at vehicle interface harness connection to the throttle position sensor. Repeat this step. → Inspect throttle position sensor installation and linkage. Repair as required. See procedure in Appendix. Repeat this step.

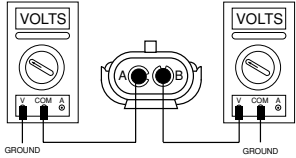
Step B	Procedure	Condition	Action
	1. Monitor brake switch on hand-held diagnostic tool. 2. Apply and release service brakes.	→ If brake switch corresponds with brake application → If brake switch does not correspond with service brake application	→ Go to Step E. → Go to Step C.

Step C	Procedure	Condition	Action
	1. Disconnect vehicle interface harness from transmission. 2. Measure voltage between vehicle interface harness pins B and E. 3. Apply and release service brakes. Observe the voltmeter.	→ If voltage is within 1 volt of battery voltage with service brake applied and → If voltage is less than 1 volt with brakes released → If voltage does not change with service brake application	→ Replace ECU. Go to Step B. → Go to Step D.

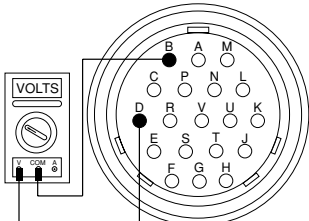
Transmission Basic Input Pretest



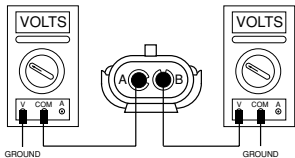
Transmission Basic Inputs Pretest, continued

Step D	Procedure	Condition	Action
	1. Locate service brake switch. 2. Measure voltage between each terminal and ground with the brakes applied and released.		
		If there is voltage on both terminals with service brake applied	Repair or replace vehicle interface harness as necessary. Go to Step B .
		If there is no voltage on either terminal	Repair power supply to brake switch. Go to Step B .
		If there is voltage on both terminals when the service brake is not applied	Replace brake switch or repair system air pressure as required. Go to Step V .
		If there is voltage on only one terminal with the service brake is applied	Replace the service brake switch. Go to Step B .

Step E	Procedure	Condition	Action
	Note: If vehicle is not equipped with a countershaft PTO, go to Step H .		
	1. Monitor PTO input on hand-held diagnostic tool. 2. Start engine. 3. Engage and disengage countershaft PTO.		
		If PTO input display corresponds with PTO engagement	Go to Step H .
		If PTO input display does not correspond with PTO engagement	Go to Step F .

Step F	Procedure	Condition	Action
	1. Disconnect vehicle interface harness from transmission. 2. Measure voltage between vehicle interface harness pins D and B. 3. Engage and disengage the PTO. Observe the voltmeter.		
		If voltage is within 1 volt of battery voltage with PTO engaged and	
		Voltage is less than 1 volt with PTO disengaged	Replace ECU. Go to Step E .
		If voltage does not change with PTO application	Go to Step G .

Transmission Basic Inputs Pretest, continued

Step G	Procedure	Condition	Action
	1. Locate countershaft PTO switch. 2. Key on. 3. Measure voltage between each PTO switch terminal and ground with the PTO engaged and disengaged.	→ If there is voltage on both terminals with PTO engaged	→ Repair or replace vehicle interface harness as necessary. Go to Step E .
		→ If there is no voltage on either terminal	→ Repair power supply to PTO switch. Go to Step E .
		→ If there is voltage on both terminals when the PTO is not engaged	→ Repair or replace PTO switch or PTO engagement system as required. Go to Step E .
		→ If there is voltage on only one terminal with the PTO engaged	→ Replace the PTO switch. Go to Step E .

Step H	Procedure	Condition	Action
	1. Determine the type of shift lever control.	→ If the shift lever is electronic	→ Test complete.
		→ If the shift lever is the cable type	→ Go to Step I .

Step I	Procedure	Condition	Action
	1. On the hand-held diagnostic tool, select Shift Lever Test.		
	2. Move the shift lever through all shift lever positions. Observe the hand-held tool.	→ If hand-held tool display corresponds with shift lever positions	→ Test complete.
		→ If hand-held tool display does not correspond with shift lever positions	→ Go to Step J .

Transmission Basic Inputs Pretest, continued

Step J	Procedure	Condition	Action
	1. Disconnect shift cable from the shift arm on the ECU. 2. Move the shift arm on the ECU through the shifter positions. Observe the hand-held tool. →	If hand-held tool display corresponds with shift lever positions →	Check cable backlash and adjust as necessary. See procedure in Appendix. Go to Step I .
		If hand-held tool display does not correspond with shift lever positions →	Replace ECU. Go to Step I .

Engine Interface Pretest

Step A	Procedure	Condition	Action
	1. Start engine and allow it to idle. Adjust to idle 600 to 700 RPM if necessary. 2. Connect hand-held diagnostic tool. 3. View engine speed. 4. Fully press throttle.	→ If the engine achieves no-load rated speed → If the engine does not achieve no-load rated speed →	Go to Step B . Adjust engine for proper performance. Go to Step B .
Step B	Procedure	Condition	Action
	1. Select Throttle Dip Test on the hand-held diagnostic tool. 2. Run engine at governed speed. 3. Activate Throttle Dip Test and observe engine RPM.	→ If engine RPM drops 275 RPM per second or more for a total of 1000 RPM decrease → If engine RPM does not drop at least 275 RPM per second →	Go to Step C . Repair the throttle defuel system as necessary. Repeat this step.
Step C	Procedure	Condition	Action
	1. On the hand-held diagnostic tool, view engine speed. 2. Load vehicle with a typical load. Drive at full throttle.	→ If engine reaches rated speed but transmission does not shift → If engine does not reach rated speed → If engine reaches rated speed and transmission shifts →	Go to Step D . Repair engine power problem, according to engine OEM. Repeat this step. Test complete.

Engine Interface Pretest, continued

Step D	Procedure	Condition	Action
	1. Use the hand-held diagnostic tool to view the software part number. Record the number.		
	2. Contact an Eaton representative to confirm proper software. →	If the software is correct →	Test complete.
		If the software is not correct →	The Eaton representative will help obtain the correct software.

Shift Complaint Test

Step A	Procedure	Condition	Action
	1. Key on. Make sure the PTO switch is off (if equipped) 2. Connect hand-held diagnostic tool. 3. View the following data: • Engine speed • Input speed • Output speed • Torque converter 4. When the torque converter is Open, quickly and fully press the throttle pedal open.	→ If engine speed and input speed separate If engine speed and input speed match while engine speed increases	→ Go to Step C . → Go to Step B .

Step B	Procedure	Condition	Action
	1. Install 0-300 PSI hydraulic gauges into diagnostic ports for: • Main • Interrupt clutch • Lockup/ bypass clutch 2. Install a 0-100 PSI hydraulic gauge into the lube diagnostic port. 3. Monitor gauges.	→ If pressure readings are: • Main = 225 to 255 PSI • Interrupt = 0 PSI • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI If pressure readings are not in the ranges shown above	→ Replace transmission. Go to Step V . → Replace the hydraulic valve assembly. Go to Step V .

Shift Complaint Test, continued

Step C	Procedure	Condition	Action
	1. Drive vehicle under load in 7th gear or above. 2. At a steady speed, observe the hand-held diagnostic tool and verify torque converter lockup.	→ If engine speed and input speed separate If engine speed and input speed match while engine speed increases	→ Go to Step D . → Go to Step H .
Step D	Procedure	Condition	Action
	1. Place transmission in neutral. 2. Allow engine to idle at 600 to 700 RPM for a minimum of 2 minutes. Ensure transmission fluid temperature is 60 to 120° F. 3. Check transmission fluid level.	→ If fluid level is at or above the COLD-FULL mark If fluid level is below the COLD-ADD mark	→ Go to Step E . → Correct fluid level, check for leaks. Go to Step V .
Step E	Procedure	Condition	Action
	1. Install 0-300 PSI hydraulic gauges into diagnostic ports for: • Main • Interrupt clutch • Lockup/ bypass clutch 2. Install a 0-100 PSI hydraulic gauge into the lube diagnostic port. 3. Start engine and allow air pressure to build to governor cut-off. 4. Turn PTO off (if equipped). 5. Connect hand-held tool and select Perform Tests, Hydraulic Test. 6. Allow engine to idle and observe the pressure gauges.	→ If pressure readings are: • Main = 225 to 255 PSI • Interrupt = 0 PSI • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI If pressure readings are not in the ranges shown above	→ Go to Step F . → Replace the hydraulic valve assembly. Go to Step V .

Shift Complaint Test, continued

Step F	Procedure	Condition	Action
	1. Connect the hand-held diagnostic tool. Select Perform Tests. 2. Select Interrupt Test. Activate the test and observe the gauges.	If pressure readings are: • Main = 225 to 255 PSI • Interrupt = ± 5 PSI of Main • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI If pressure readings are not in the ranges shown above	Go to Step G. Replace the hydraulic valve assembly. Go to Step V.

Step G	Procedure	Condition	Action
	1. Select Lockup Test. Activate the test and observe the gauges.	If pressure readings are: • Main = 225 to 255 PSI • Interrupt = 0 PSI • Lockup/bypass = ± 5 PSI of Main • Lube = 15 to 35 PSI If pressure readings are not in the ranges shown above	Replace the transmission. Go to Step V. Replace the hydraulic valve assembly. Go to Step V.

Shift Complaint Test, continued

Step H	Procedure	Condition	Action
	1. Place transmission in neutral. 2. Allow engine to idle at 600 to 700 RPM for a minimum of 2 minutes. Ensure transmission fluid temperature is 60 to 120° F. 3. Check transmission fluid level.	→ If fluid level is at or above the COLD-FULL mark	→ Go to Step I .
		If fluid level is below the COLD-ADD mark	→ Correct fluid level, check for leaks. Go to Step V .

Step I	Procedure	Condition	Action
	1. Install 0-300 PSI hydraulic gauges into diagnostic ports for: • Main • Interrupt clutch • Lockup/ bypass clutch 2. Install a 0-100 PSI hydraulic gauge into the lube diagnostic port. 3. Start engine and allow air pressure to build to governor cut-off. 4. Turn PTO off (if equipped). 5. Connect hand-held tool and select Perform Tests, Hydraulic Test. 6. Allow engine to idle and observe the pressure gauges.	→ If pressure readings are: • Main = 225 to 255 PSI • Interrupt = 0 PSI • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI If pressure readings are not in the ranges shown above	→ Go to Step J . → Replace the hydraulic valve assembly. Go to Step V .

Shift Complaint Test, continued

Step J	Procedure	Condition	Action
	1. Connect the hand-held diagnostic tool. Select Perform Tests.		
	2. Select Interrupt Test. Activate the test and observe the gauges.	→ If pressure readings are: • Main = 225 to 255 PSI • Interrupt = ± 5 PSI of Main • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI → Go to Step K. If pressure readings are not in the ranges shown above → Replace the hydraulic valve assembly. Go to Step V.	
Step K	Procedure	Condition	Action
	1. Select Lockup Test. Activate the test and observe the gauges.	→ If pressure readings are: • Main = 225 to 255 PSI • Interrupt = 0 PSI • Lockup/bypass = ± 5 PSI of Main • Lube = 15 to 35 PSI → Go to Step L. If pressure readings are not in the ranges shown above → Replace the hydraulic valve assembly. Go to Step V.	

Shift Complaint Test, continued

Step L	Procedure	Condition	Action
	1. Key off. 2. Tee 0-100 PSI air gauges into the power synchronizer disc and band lines, or Tee a 0-100 PSI air gauge into the inertia brake line. 3. Start engine and allow air pressure to build to governor cutoff. 4. Connect hand-held diagnostic tool. 5. Select Perform Tests. 6. Select Air System. 7. Select Power Synchronizer Test. Activate Power Synchronizer Test.	→ If the hand-held diagnostic tool display indicates: • Power synchronizer ON • 0-100% modulation and	
		Air gauges vary between 0 and 80 PSI, increasing with % modulation	→ Go to Step M .
		If air gauges do not vary between 0 and 80 PSI, increasing with % modulation	→ Replace ECU. Go to Step V .

Step M	Procedure	Condition	Action
	1. Key off. 2. Tee 0-100 PSI air gauges into the range air lines. 3. Start engine and allow air pressure to build to governor cut-off. 4. Connect hand-held diagnostic tool. 5. Select Perform Tests. 6. Select Air System. 7. Select and activate Range System Test.	→ If in HI range: • HI gauge = regulated pressure • LO gauge = 0 and	
		If in LO range: • HI gauge = 0 • LO gauge = regulated pressure	→ Contact Eaton representative for further assistance.
		If pressure readings are not in the ranges shown above	→ Replace the range valve on side of ECU. Go to Step V . If the problem persists, replace the ECU.

Shift Complaint Test, continued

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Drive the vehicle to determine whether shift complaint has been repaired.	→ If the shift complaint was repaired	→ Test complete.
		If the shift complaint was not repaired	→ Return to Step A to find error in testing.

High Operating Temperature Test

Normal operating temperature is 275° F (130° C).

Step A	Procedure	Condition	Action
	1. Check transmission temperature gauge, sending unit and associated components for proper operation.	→ If the temperature gauge functions properly	→ Go to Step B .
		If the temperature gauge does not function properly	→ Repair the temperature gauge circuit as necessary. Go to Step V .
Step B	Procedure	Condition	Action
	1. Check transmission for proper lubricant type (specified in the Driver Instructions).	→ If fluid is OK	→ Go to Step C .
		If the fluid is not correct	→ Fully drain transmission and transmission cooling system. Refill with recommended fluid. Go to Step V .
Step C	Procedure	Condition	Action
	1. Check cooling system for proper installation and capacity.		
	2. Check for any blockage or restrictions in the system.	→ If transmission cooling system is OK	→ Go to Step D .
		If transmission cooling system is not OK	→ Repair cooling system as necessary. Go to Step V .
Step D	Procedure	Condition	Action
	1. Drive vehicle under load in 7th gear or above.		
	2. At a steady speed, observe the hand-held diagnostic to verify torque converter lockup.		
	3. Monitor engine speed and input speed on the hand-held diagnostic tool.	→ If engine speed and input speed separate	→ Go to Step E .
		If engine speed and input speed match while engine speed increases	→ Contact an Eaton Representative for further information.

High Operating Temperature Test, continued

Step E	Procedure	Condition	Action
	1. Check oil level. 2. Key on. 3. Place transmission in neutral. 4. Allow engine to idle at 600 to 700 RPM for a minimum of 2 minutes. Ensure transmission fluid temperature is 60 to 120° F. 5. Check transmission fluid level.	→ If fluid level is at or above the COLD-FULL mark If fluid level is below the COLD-ADD mark	→ Go to Step B . → Correct fluid level, check for leaks. Go to Step V .
Step F	Procedure	Condition	Action
	1. Install 0-300 PSI hydraulic gauges into diagnostic ports for: • Main • Interrupt clutch • Lockup/ bypass clutch 2. Install a 0-100 PSI hydraulic gauge into the lube diagnostic port. 3. Start engine and allow air pressure to build to governor cut-off. 4. Turn PTO off (if equipped). 5. Connect the hand-held diagnostic tool. Select Perform Tests. 6. Select Hydraulic Test. 7. Observe the gauges.	→ If pressure readings are: • Main = 225 to 255 PSI • Interrupt = 0 PSI • Lockup/bypass = 0 PSI • Lube = 15 to 35 PSI If pressure readings are not in the ranges shown above	→ Go to Step G . → Replace hydraulic valve assembly. Go to Step V .

High Operating Temperature Test, continued

Step G	Procedure	Condition	Action
	1. Select interrupt test and activate test while monitoring the pressure gauges.	→ If pressures match the specifications: • Main: 225-255 PSI • Interrupt: ± 5 of main • Lockup: 0 PSI • Lube: 15-35 PSI → Go to Step H. If pressures do not match specifications → Replace hydraulic valve assembly. Go to Step V.	
Step H	Procedure	Condition	Action
	1. Select lockup test and activate test while monitoring the pressure gauges.	→ If pressures match the specifications: • Main: 225-255 PSI • Interrupt: 0 PSI • Lockup: ± 5 of main • Lube: 15-35 PSI → Contact Eaton Truck Components for further assistance. If pressures do not match specifications → Replace hydraulic valve assembly. Go to Step V.	
Step V	Procedure	Condition	Action
	1. Operate vehicle and that transmission does not rise above 275° F (130° C) when operating under load.	→ If transmission temperature does not rise above 275° → Go to Step G. If transmission temperature rises above 275° → Test complete. Go to Step A.	

Hand-Held Diagnostic Tool Failed to Operate Test

Step A	Procedure	Condition	Action
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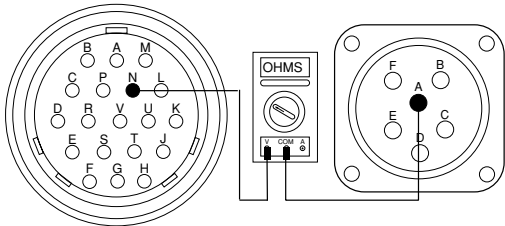
1. Key on.
2. Connect hand-held diagnostic tool.
- If hand-held diagnostic tool powers up → Go to **Step B**.
- If hand-held diagnostic tool does not power up → Go to **Step G**.

Step B	Procedure	Condition	Action
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1. On the hand-held diagnostic tool, select CEEMAT product.
- If the display reads "Failed to Communicate" → Go to **Step C**.
- If the display does not read "Failed to Communicate" → Replace the hand-held diagnostic tool. Go to **Step V**.

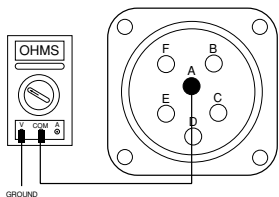
Step C	Procedure	Condition	Action
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1. Disconnect vehicle interface harness from ECU.
2. Measure resistance from vehicle interface harness pin N and diagnostic connector pin A.
- If resistance is 0 to .3 ohms → Go to **Step D**.
- If resistance is outside of range → Repair or replace vehicle interface harness. Repeat this step.



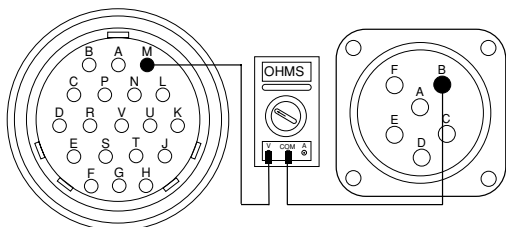
Step D	Procedure	Condition	Action
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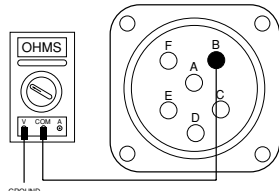
1. Measure resistance between diagnostic connector pin A and ground.
- If resistance is greater than 10K ohms or infinite → Go to **Step E**.
- If resistance is less than 10K ohms → Repair or replace vehicle interface harness. Go to **Step V**.

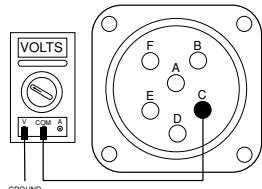


Hand-Held Diagnostic Tool
Failed to Operate Test

Hand-Held Diagnostic Tool Failed to Operate Test, continued

Step E	Procedure	Condition	Action
	1. Measure resistance between vehicle interface harness pin M and diagnostic connector pin B.  The diagram illustrates the setup for measuring resistance. On the left is a circular vehicle interface harness with pins labeled B, A, M, N, L, C, P, V, U, K, D, R, S, T, J, E, G, H, and F. A wire connects pin M to the positive terminal of a digital multimeter. The multimeter is set to the 'OHMS' mode. Another wire connects the negative terminal of the multimeter to pin B of a square diagnostic connector. The diagnostic connector has pins labeled F, A, B, E, D, and C. Pin B is highlighted with a black dot.	→ If resistance is 0 to .3 ohms If resistance is outside of range	→ Go to Step F. → Repair or replace vehicle interface harness. Go to Step V.

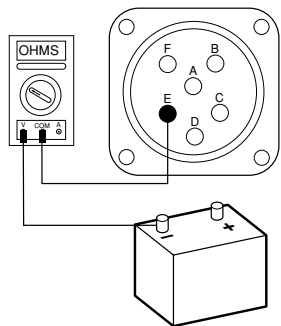
Step F	Procedure	Condition	Action
	1. Measure resistance between diagnostic connector pin B and ground. 	→ If resistance is greater than 10K ohms or infinite If resistance is less than 10K ohms	→ Replace ECU. Go to Step V. → Repair or replace vehicle interface harness. Go to Step V.

Step G	Procedure	Condition	Action
	1. Disconnect hand-held diagnostic tool from vehicle connector. 2. Measure voltage between diagnostic connector pin C and ground.	→ If voltage is within 1 volt of battery voltage If voltage is outside of range	→ Go to Step H. → Repair battery power line to vehicle diagnostic connector. Go to Step V.
			

Hand-Held Diagnostic Tool Failed to Operate Test, continued

Step H	Procedure	Condition	Action
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- 1. Key off.
- 2. Disconnect the positive (+) battery cable.
- 3. Measure resistance between diagnostic connector pin E and battery negative (–) terminal.



→	If resistance is 0 to .3 ohms	→	Repair the hand-held diagnostic tool harness. Go to Step V . If the problem persists, replace the hand-held diagnostic tool.
	If resistance is outside of range	→	Repair ground wire to vehicle diagnostic connector harness. Go to Step V .

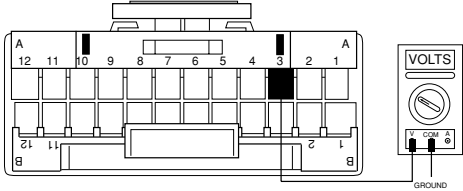
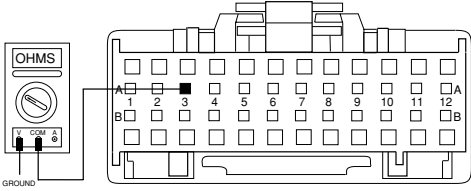
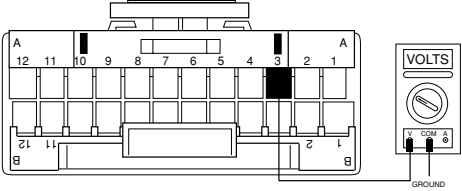
Step V	Procedure	Condition	Action
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- 1. Key on.
- 2. Connect hand-held diagnostic tool.

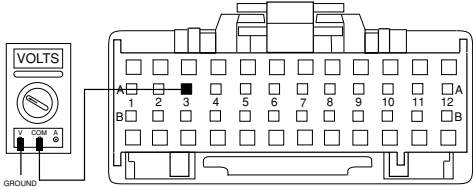
→	If hand-held diagnostic tool powers up normally	→	Test complete.
	If hand-held diagnostic tool does not power up	→	Go to Step B .

Hand-Held Diagnostic Tool
Failed to Operate Test

Shift Lever In Gear Signal Test

Step A	Procedure	Condition	Action
	1. Key on. 2. Shift transmission to any position other than neutral. 3. Locate 24-way connector on the shift lever. Do not disconnect the connector. 4. Measure voltage between 24-way connector pin A3 and ground. Note: Do not short pins in connector while performing measurement. 	→ If voltage is within 1 volt of battery voltage → Go to Step C. If voltage is outside of range → Go to Step B.	
Step B	Procedure	Condition	Action
	1. Disconnect the 24-way connector from the shift lever. 2. Measure resistance between pin A3 and ground. 	→ If resistance is greater than 30 ohms → Replace the shift lever. Go to Step V. If resistance is outside of range → Repair conflict in the circuit driven by the shift lever output. See OEM manuals for procedures. Go to Step V.	
Step C	Procedure	Condition	Action
	1. Shift transmission to neutral. 2. Measure voltage between pin A3 and ground. Note: Do not short pins in connector while performing measurement. 	→ If voltage is 0 to 0.5 volts → Shift lever is OK. Repair in-gear output circuit. See OEM manuals for procedures. Go to Step V. If voltage is outside of range → Go to Step D.	

Shift Lever In Gear Signal Test, continued

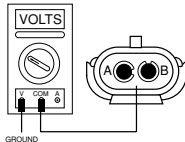
Step D	Procedure	Condition	Action
	1. Disconnect the 24-way connector from the shift lever. 2. Measure resistance between pin A3 and ground.	→ If voltage is 0 to 0.5 volts	→ Replace shift lever. Go to Step V .
		→ If voltage is outside of range	→ Repair constant power to OEM function that uses the in-gear signal. See OEM manuals for procedures. Go to Step V .

Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Operate vehicle to determine whether the shift lever in-gear signal is operating correctly.	→ If the function operates correctly	→ Repairs are complete.
		→ If the function does not operate correctly	→ Return to Step A to find error in testing.

Shift Lever In Gear Signal Test

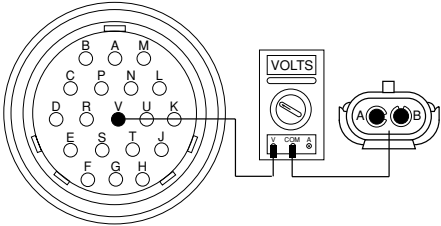
Neutral Output Test

Step A	Procedure	Condition	Action
	1. Key on. 2. Connect hand-held diagnostic tool. 3. Put transmission in neutral and monitor the following information: • Current gear • Gearbox center • Gearbox neutral • Gearbox engage	→ If specifications are: • Current gear: neutral • Gearbox center: on • Gearbox neutral: on • Gearbox engage: off If specifications do not match those above	→ Go to Step B . → Perform isolation procedure for Code 71 (page 2-92).

Step B	Procedure	Condition	Action
	1. Locate connection from CEEMAT neutral output and vehicle function. 2. Measure voltage between vehicle connection and ground. 	→ If voltage is Engaged=0 volts Neutral=1 volt within battery voltage If voltage does not match conditions above	→ Vehicle equipment is not responding properly to transmission neutral output. Repair as required. → Go to Step C .

Neutral Output Test, continued

Step C	Procedure	Condition	Action
	1. Key off. 2. Disconnect vehicle interface harness from ECU. 3. Measure resistance between vehicle interface harness pin V and vehicle connection.	→ If resistance is 0 to .3 ohms → → If the resistance is outside of range →	Replace ECU. Go to Step V. Repair vehicle interface harness or wiring to vehicle connection. Go to Step V.

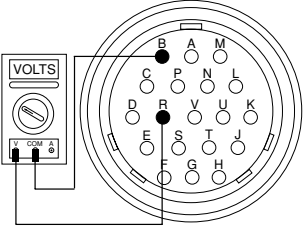


Step V	Procedure	Condition	Action
	1. Key off. 2. Reconnect all connectors. 3. Key on. 4. Operate vehicle to determine whether the shift lever in-gear signal is operating correctly.	→ If the function operates correctly → If the function does not operate correctly	→ Repairs are complete. → Return to Step A to find error in testing.

Splitshaft PTO Switch Test

Step A	Procedure	Condition	Action
	1. Key on. 2. Connect hand-held diagnostic tool. 3. View the following data: • Current gear • Torque converter 4. Move shift lever into drive. 5. Engage and disengage split shaft pump while monitoring hand-held diagnostic tool.	→ If the following readings are displayed: With pump on: • Current gear = 8th • Torque converter = LOCK With pump off: • Current gear = 3rd or 4th • Torque converter = ENGD If display does not match conditions above	→ Repair or replace split shaft pump. Go to Step V. → Go to Step B.
Step B	Procedure	Condition	Action
	1. Retrieve hand-held software part number. 2. Contact Eaton representative to verify that ECU is programmed for quick to neutral	→ If ECU is not programmed for quick to neutral If ECU is not programmed correctly	→ Replace ECU and retest. → Contact Eaton representative for assistance in correcting ECU.

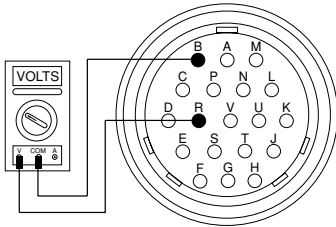
Splitshaft PTO Switch Test, continued

Step C	Procedure	Condition	Action
	1. Disconnect vehicle interface harness from ECU. 2. Move shift lever into neutral 3. Measure voltage between vehicle interface harness pins R and B. 4. Observe voltmeter while switching split shaft pump on and off. 	→ If the following voltage is observed: • Pump on = 1 volt of battery voltage • Pump off = 0 volts → If display does not match conditions above	→ Replace ECU. Go to Step C. → Repair or replace vehicle interface harness, split shaft PTO switch or switch power supply as required. Go to Step V.

Step V	Procedure	Condition	Action
	1. View the following data on the hand-held diagnostic tool: • Current gear • Torque converter 2. Engage and disengage split shaft pump while monitoring hand-held diagnostic tool.	→ If the following readings are displayed With pump on: • Current gear = 8th • Torque converter = lock With pump off: • Current gear = N • Torque converter = open → If display does not match conditions above	→ Test complete. → Go to Step C.

Quick to Neutral Test

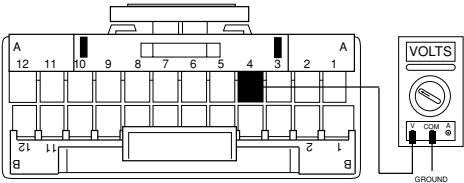
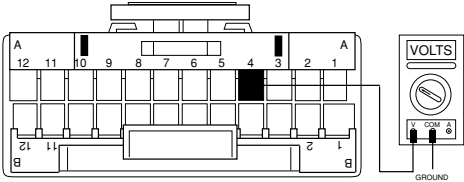
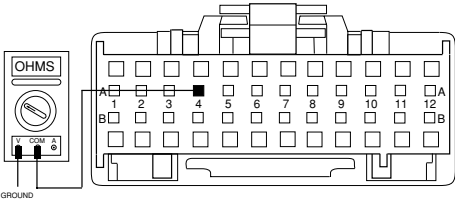
Step A	Procedure	Condition	Action
	1. Key off. 2. Disconnect vehicle interface harness from transmission. 3. Key on. 4. Measure voltage between vehicle interface harness pins R and B while engaging and disengaging switches.	→ If voltage is: • Switch on = within 1 volt of battery voltage • Switch off = 0 volts → If voltage is outside of range	→ Go to Step B. → Repair quick to neutral signal input to CEEMAT according to OEM service information. Go to Step V.



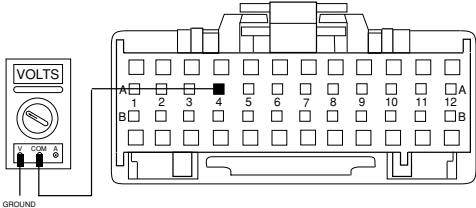
Step B	Procedure	Condition	Action
	1. Retrieve hand-held software part number. 2. Contact Eaton representative to verify that ECU is programmed for quick to neutral	→ If ECU is not programmed for quick to neutral → If ECU is not programmed correctly	→ Replace ECU and retest. → Contact Eaton representative for assistance in correcting ECU.

Step V	Procedure	Condition	Action
	1. Operate vehicle and verify normal quick to neutral operation.	→ If normal operation → If not operating normally	→ Test complete. → Go to Step A.

Shift Lever Auxiliary Output 2 Test

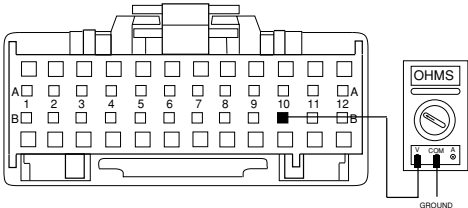
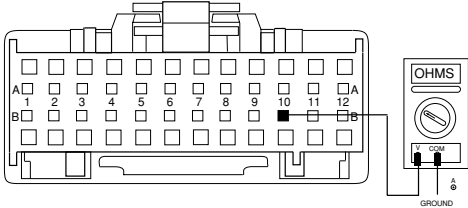
Step A	Procedure	Condition	Action
	1. Key on. 2. Locate shift lever harness connector. 3. Without removing connector, measure voltage between shift lever harness connector pin A4 and ground.  Note: Do not short pins in connector to each other or any surface. Note: Shift lever requires special programming to enable auxiliary output 2.	→ If voltage is within 1 volt of battery voltage → → If voltage is outside of range →	Go to Step B. Go to Step C.
Step B	Procedure	Condition	Action
	1. Move shift lever to turn off auxiliary output 2. 2. Without disconnecting the harness, measure voltage between shift lever harness connector pin A4 and ground. 	→ If voltage is 0 to .5 volts → → If voltage is outside of range →	Test complete. Go to Step D.
Step C	Procedure	Condition	Action
	1. Disconnect shift lever harness connector and measure resistance between pin A4 and ground. 	→ If resistance is more than 30 ohms → → If resistance is outside of range →	Replace shift lever. Go to Step V. Repair or replace circuit driven by auxiliary output 2. Go to Step V.

Shift Lever Auxiliary Output 2 Test, continued

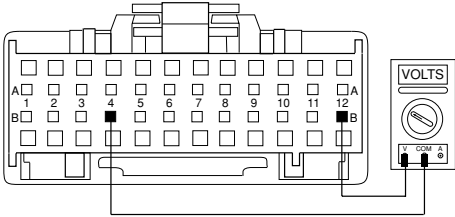
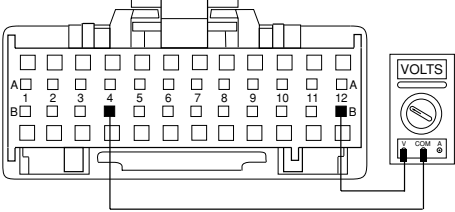
Step D	Procedure	Condition	Action
	1. Disconnect shift lever harness connector and measure voltage between pin A4 and ground.		
		→ If voltage is within .5 volts of battery voltage → If voltage is outside of range	→ Replace shift lever. Go to Step V. → Repair/replace harness. Go to Step V.

Step V	Procedure	Condition	Action
	1. Operate shift lever. 2. Verify that output function is operating normally.	→ If operating normally → If not operating normally	→ Test complete. → Go to Step A.

Shift Lever Auto Neutral Input Test

Step A	Procedure	Condition	Action
	1. Key off. 2. Disconnect harness from electronic shift lever. 3. Activate parking brake. 4. Measure resistance between shift lever harness pin B10 and ground. 	→ If resistance is 0 to .3 ohms → Go to Step B. If resistance is outside of range → Repair line between parking brake switch and shift lever. Go to Step V.	
Step B	Procedure	Condition	Action
	1. Deactivate function which connects to transmission input. 2. Measure resistance between shift lever harness pin B10 and ground. Note: Insure truck will not roll. 	→ If resistance is more than 10K ohms or infinite → Replace shift lever. Go to Step V. If resistance is less than 10K ohms → Repair line between parking brake switch and shift lever. Go to Step V.	
Step V	Procedure	Condition	Action
	1. Connect shift lever harness to shift lever. 2. Check for proper function.	→ If harness operates properly → Clear transmission fault codes. Test complete. If harness does not operate properly → Replace shift lever harness. Repeat this step.	

Shift Lever Back Light Test

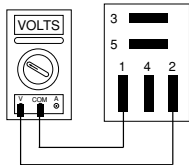
Step A	Procedure	Condition	Action
	1. Key off. 2. Disconnect shift lever harness. 3. Key on. 4. Measure voltage between shift lever harness connector pins B4 and B12 while adjusting dash light brightness.	→ If voltage varies between 0 and battery voltage → Go to Step B. If voltage does not vary between 0 and battery voltage → Repair shifter harness wiring.	Note: Vehicle may be wired for constant voltage when lights are on. Voltage will not vary.
			
Step B	Procedure	Condition	Action
	1. Turn lights off. 2. Measure voltage between shift lever harness connector pins B4 and B12.	→ If voltage is within 1 volt of battery voltage → Go to Step C. If voltage is outside of range → Repair short to power or miswired vehicle harness. Go to Step V.	
			
Step C	Procedure	Condition	Action
	1. Replace light bulb in shift lever and test backlight.	→ If backlight works correctly → Test complete. If backlight does not work correctly → Replace shift lever. Go to Step V.	
Step V	Procedure	Condition	Action
	1. Turn lights on. 2. Vary dash light brightness while observing shift lever.	→ If backlight operates normally (may vary with dash lights) → Test complete. If backlight does not operate normally → Go to Step A.	

Reverse Relay Indicator Test

Step A	Procedure	Condition	Action
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Note: Reverse indicator relay installation may vary. Verify the proper wiring through OEM wiring schematic and CEEMAT installation guide.

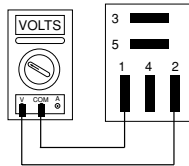
- 1. Key off.
- 2. Disconnect reverse relay harness connector.
- 3. Key on.
- 4. While moving shift lever through non-reverse positions, measure voltage between reverse relay harness connector pins 1 and 2.



- If voltage is 0 to .5 volts → Go to **Step B**.
- If voltage is outside of range → Replace shift lever. Go to **Step V**.

Step B	Procedure	Condition	Action
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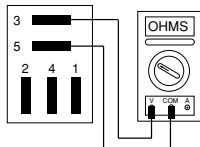
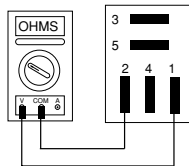
- 1. Place shift lever in reverse.
- 2. Measure voltage between reverse relay harness connector pins 1 and 2.



- voltage is 0 to .5 volts → Go to **Step C**.
- If voltage is outside of range → Go to **Step D**.

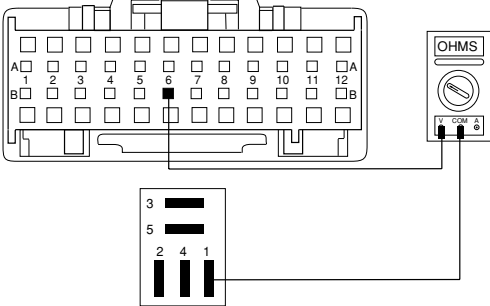
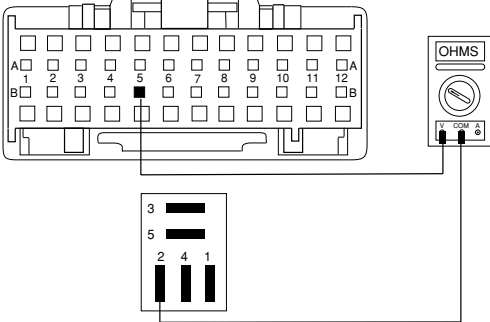
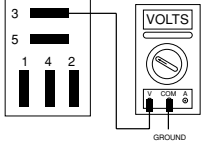
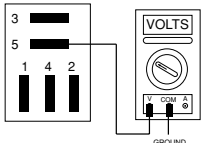
Step C	Procedure	Condition	Action
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- 1. Measure resistance between reverse relay pins:
 - 1 and 2
 - 3 and 5

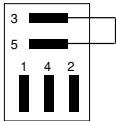


- If resistance is:
 - Relay pins 1 and 2 = 40 to 90 ohms
 - Relay pins 3 and 5 = 10K ohms or infinite→ Go to **Step E**.
- If resistance is outside of range → Replace reverse indicator relay. Go to **Step V**.

Reverse Relay Indicator Test, continued

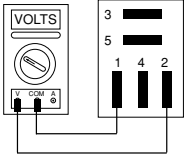
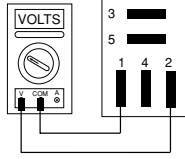
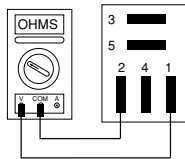
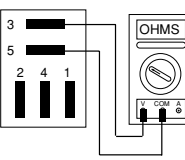
Step D	Procedure	Condition	Action
	1. Disconnect harness connector from shift lever. 2. Measure resistance between reverse relay connector pin 1 and shift lever harness connector pin B6.		
			
	3. Measure resistance between reverse relay connector pins 2 and shift lever pin B5.	If resistance is 0 to .3 ohms If resistance is outside of range	Replace shift lever. Go to Step V. Repair or replace shifter harness. Go to Step V.
			
Step E	Procedure	Condition	Action
	1. Key on. 2. Measure voltage between reverse relay harness connector pin: • 3 and ground • 5 and ground	If one pin has voltage within 1.0 volt of battery voltage If voltage is outside of range	Go to Step F. Ignition power not getting to reverse indicator relay, repair harness. Go to Step V.
			
			

Reverse Relay Indicator Test, continued

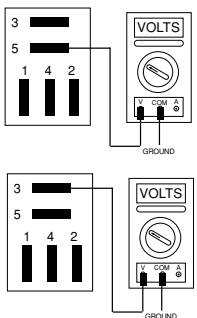
Step F	Procedure	Condition	Action
	1. Place jumper wire between relay harness connector pins 3 and 5. 	→ If reverse indicators active	→ Replace reverse relay. Go to Step V .
		If reverse indicators do not activate	→ Problem exists in reverse indicator circuit beyond shift lever relay. Repair wiring. Go to Step V .

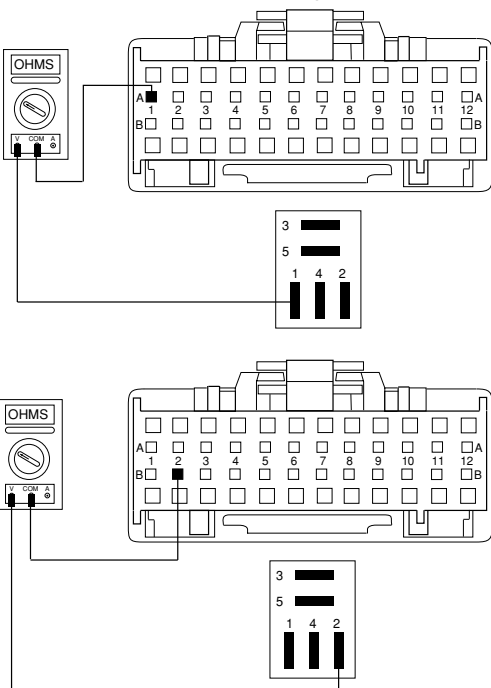
Step V	Procedure	Condition	Action
	1. Operate shift lever to verify that reverse indicators are operating normally.	→ If indicators are operating normally	→ Test complete.
		If indicators are not operating normally	→ Go to Step A .

Start Enable Relay Test

Step A	Procedure	Condition	Action
	Note: Start enable relay installation may vary. Review proper wiring in OEM schematics and CEEMAT installation guide. 1. Key off. 2. Disconnect neutral relay harness connector from relay. 3. Key on. 4. While selecting all non-neutral positions, measure voltage between relay harness pin 1 and 2.		
		→ If voltage is 0 to .5 volts → If voltage is outside of range	→ Go to Step B. → Replace shift lever.
Step B	Procedure	Condition	Action
	1. Place shift lever(s) in neutral. 2. Measure voltage between harness pins 1 and 2.		
		→ If voltage is within 1 volt of battery voltage → If voltage is outside of range	→ Go to Step C. → Go to Step E.
Step C	Procedure	Condition	Action
	1. Measure resistance between relay pins: • 1 and 2 • 3 and 5.		
	 	→ If resistance is: • Pins 1 and 2 = 40 to 90 ohms • Relay pins 3 and 5 = 10K ohms or infinite → If resistance is outside of range	→ Go to Step D. → Replace start enable relay. Go to Step A.

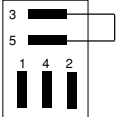
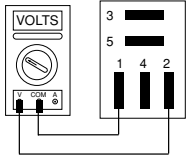
Start Enable Relay Test, continued

Step D	Procedure	Condition	Action
	1. While engaging starter switch, measure voltage between start enable relay harness pin 5 and ground and relay harness pin 3 and ground. 	→ If one pin has voltage within 1 volt of battery voltage If voltage is outside of range	→ Go to Step F. → Go to Step G.

Step E	Procedure	Condition	Action
	1. Disconnect harness from shift lever. 2. Measure resistance between relay harness pin 1 and shift lever harness pin A1. 3. Measure resistance between relay harness pin 2 and shift lever harness pin B2. 	→ If resistance is 0 to .3 ohms If resistance is outside of range	→ Replace shifter harness. Go to Step V. → Replace or replace shift lever harness. Go to Step V.

Start Enable Relay Test

Start Enable Relay Test, continued

Step F	Procedure	Condition	Action
	1. Place jumper wire between relay harness connector pins 3 and 5 and engage starter. 	→ If starter engages properly If starter does not engage at all	→ Replace start enable relay. Go to Step V . → Repair starter line, system wiring or starter as required. Go to Step V .
Step G	Procedure	Condition	Action
	1. Check to see if the vehicle has two shift levers.	→ If two shift levers If only one shift lever	→ Go to Step H . → Repair OEM starter wiring between starter switch and relay. Go to Step V .
Step H	Procedure	Condition	Action
	1. Put shift levers in neutral. 2. Reconnect first shift lever. 3. Disconnect neutral relay harness from second shifter relay. 4. Key on. 5. Measure voltage between relay harness connector pins 1 and 2. 	→ If voltage is within 1 volt of battery voltage If voltage is outside of range	→ Go to Step J . → Go to Step I .

Start Enable Relay Test, continued

Step I	Procedure	Condition	Action
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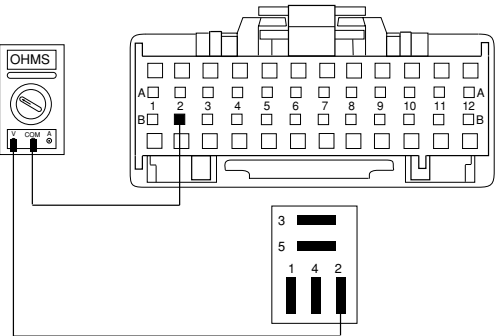
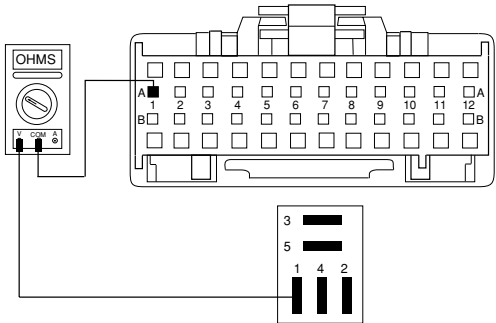
1. Disconnect harness from second shift lever.
2. Measure resistance between relay connector pin 1 and shift lever harness connector pin A1.
3. Measure resistance between relay connector pin 2 and shift lever harness connector pin B2.

→ If resistance is 0 to .3 ohms

→ Replace shift lever.
Go to **Step V**.

If resistance is outside of range

→ Repair or replace shifter harness. Go to **Step V**.



Step J	Procedure	Condition	Action
--------	-----------	-----------	--------

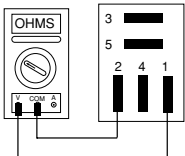
1. Measure resistance between relay pins 1 and 2.

→ If resistance equals 40 to 90 ohms

→ Go to **Step K**.

If resistance does not equal 40 to 90 ohms

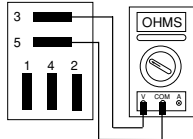
→ Replace start enable relay. Go to **Step V**.



Start Enable Relay Test, continued

Step K	Procedure	Condition	Action
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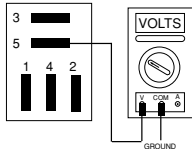
1. Measure resistance between relay harness connector pins 3 and 5.



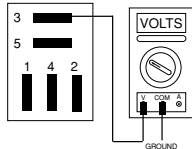
→ If resistance is more than 10K ohms or infinite	→ Replace start enable relay. Go to Step L .
→ If resistance is less than 10K ohms	→ Go to Step V .

Step L	Procedure	Condition	Action
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1. While engaging starter switch, measure voltage between relay harness connector pin:
- 5 and ground
 - 3 and ground.

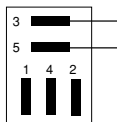


→ If one pin has voltage within 1 volt of battery voltage	→ Go to Step M .
→ If voltage is outside of range	→ Repair starter systems wiring or starter as required. Go to Step V .



Step M	Procedure	Condition	Action
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1. Place jumper wire between relay harness connector pins 3 and 5 and engage starter.

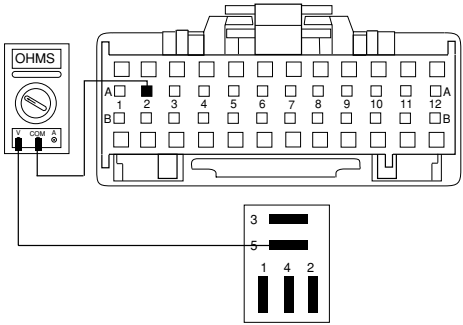


→ If starter engages properly	→ Replace start enable relay and test.
→ If starter does not engage at all	→ Repair starter systems wiring or starter as required. Go to Step V .
→ If starter engages intermittently or inadvertently	→ Go to Step N .

Start Enable Relay Test, continued

Step N	Procedure	Condition	Action
	1. Insure start enable solenoid circuit is wired according to the wiring diagram. Refer to Appendix .	→ If wiring is correct	→ Go to Step O .
		If wiring is not correct	→ Repair wiring. Go to Step V .

Step O	Procedure	Condition	Action
	1. Remove 24-pin connector from shift lever. 2. Remove start enable relay from harness. 3. Measure resistance between relay harness connector pin 5 and shift lever harness connector pin A2.	→ If resistance is 0 to .3 ohms	→ Replace shift lever. Go to Step V .
		If resistance is outside of range	→ Repair harness. Go to Step V .



Step V	Procedure	Condition	Action
	1. Place shift lever in neutral and engage starter. 2. Place shift lever in non-neutral position and engage starter.	→ If starter engages in neutral and does not engage in non-neutral position	→ Test complete.
		If starter does not engage in neutral or engages in non-neutral position	→ Go to Step A .

Start Enable Relay Test

Start Enable Relay Latch Test

Step A	Procedure	Condition	Action
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1. Make sure starter solenoid circuit is wired as shown in figures 1 and 2.

→ If wiring is correct

→ Go to **Step B**.

→ If wiring is not correct

→ Repair wiring conflict.
Go to **Step V**.

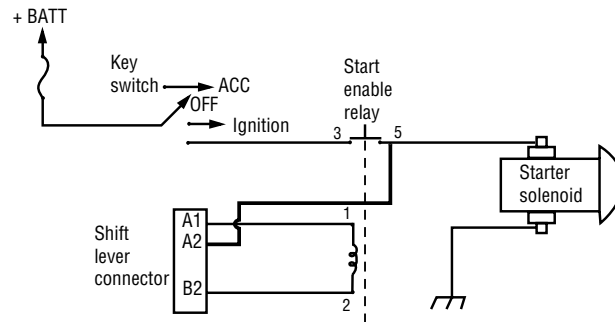


Figure 1:
Starter solenoid circuit with key switch.

Note: Dual station starter solenoid circuit in Appendix.

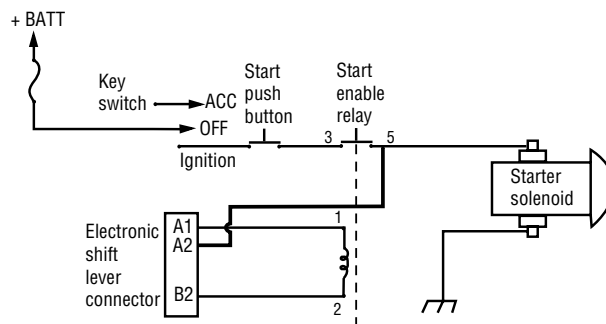


Figure 2:
Starter solenoid circuit with push button start.

Start Enable Relay Latch Test, continued

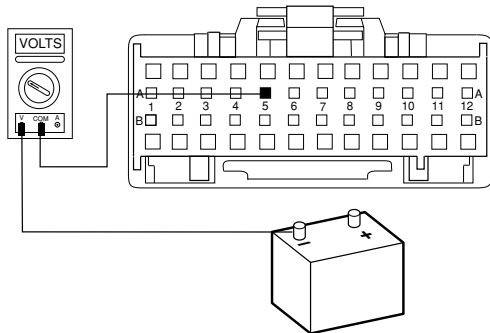
Step B	Procedure	Condition	Action
	1. Key off. 2. Disconnect the shift lever harness connector. 3. Disconnect start enable relay from harness. 4. Measure resistance between start enable relay harness connector pin 5 and shift lever harness connector pin A2.	If resistance is less than 0.3 ohms If resistance is not less than 0.3 ohms	Replace shift lever. Go to Step V. Repair start enable relay latch. Go to Step V.

Step V	Procedure	Condition	Action
	1. Start engine.	If operation is normal If operation is not normal	Test complete. Go to Step A.

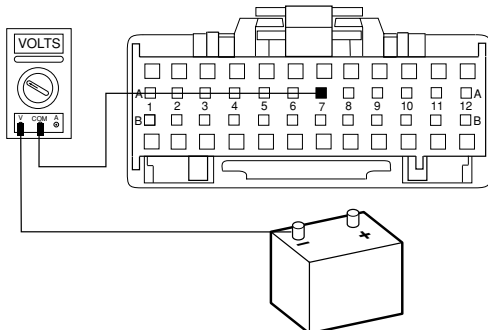
Shift Lever Voltage Test (Driver Lever)

Step A	Procedure	Condition	Action
	1. Key off. 2. Measure battery voltage at the battery terminals.	→ If voltage is 11 to 13 volts → If voltage is not 11 to 13 volts (above or below) →	Go to Step B. Repair or replace battery and charging system as required. Repeat this step.

Step B	Procedure	Condition	Action
	1. Key off. 2. Disconnect harness from shift lever (driver lever). 3. Measure voltage between shift lever harness pin A5 and battery negative (–) terminal.	→ If voltage is within 1 volt of battery voltage → If voltage is outside of range →	Go to Step C. Repair or replace vehicle interface harness, circuit breaker or battery circuit as required. Repeat this step.



Step C	Procedure	Condition	Action
	1. Key on. 2. Measure voltage between shift lever harness pin A7 and battery negative (–) terminal.	→ If voltage is within 1 volt of battery voltage → If voltage is outside of range →	Go to Step D. Repair or replace vehicle interface harness, circuit breaker or ignition circuit as required. Repeat this step.



Shift Lever Voltage Test (Driver Lever), continued

Step D	Procedure	Condition	Action
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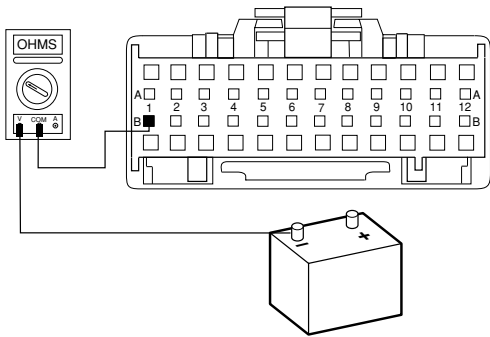
1. Key off.
2. Disconnect positive battery cable.
3. Measure resistance between shift lever harness pin:
- B1 and battery negative (–) terminal.

→ If resistance is 0 to .3 ohms

→ Test complete.

If resistance outside of range

→ Repair or replace vehicle interface harness or ground connections as required. Repeat this step.



Shift Lever Voltage Test (Work Lever)

Step A	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Key off.
2. Measure battery voltage at the battery terminals.



If voltage is 11 to 13 volts



Go to **Step B**.

If voltage is outside of range



Repair or replace battery and charging system as required. Repeat this step.

Step B	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Key off.
2. Disconnect harness from shift lever (work lever).
3. Measure voltage between shift lever harness pin A5 and battery negative (-) terminal.



If voltage is within 1 volt of battery voltage

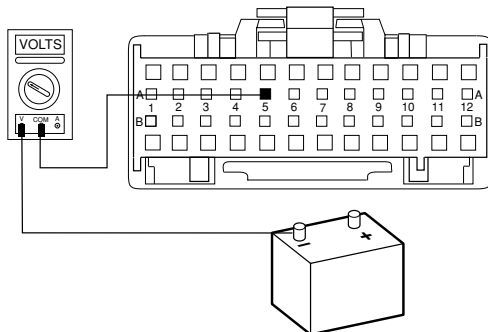


Go to **Step C**.

If voltage is outside of range



Repair or replace vehicle interface harness, circuit breaker or battery circuit as required. Repeat this step.



Step C	Procedure	Condition	Action
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1. Key on.
2. Measure voltage between shift lever harness pin A7 and battery negative (-) terminal.



If voltage is within 1 volt of battery voltage

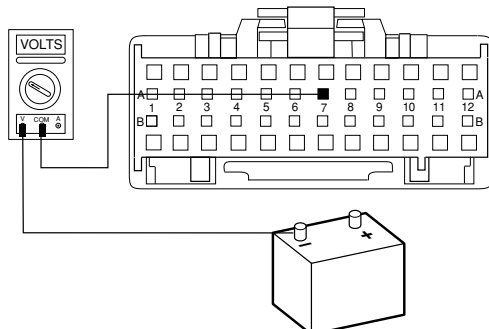


Go to **Step D**.

If voltage is outside of range



Repair or replace vehicle interface harness, circuit breaker or ignition circuit as required. Repeat this step.



Shift Lever Voltage Test (Work Lever), continued

Step D	Procedure	Condition	Action
--------	-----------	-----------	--------

1. Key off.
2. Disconnect positive battery cable.
3. Measure resistance between shift lever harness pin B1 and battery negative (-) terminal.



If resistance is 0 to .3 ohms

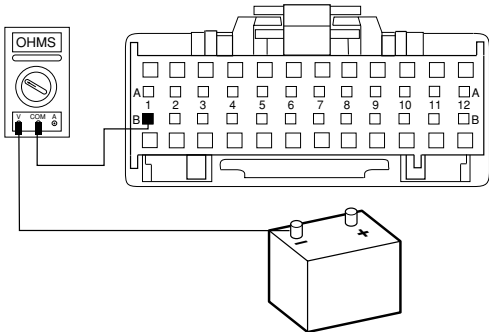


Test complete.

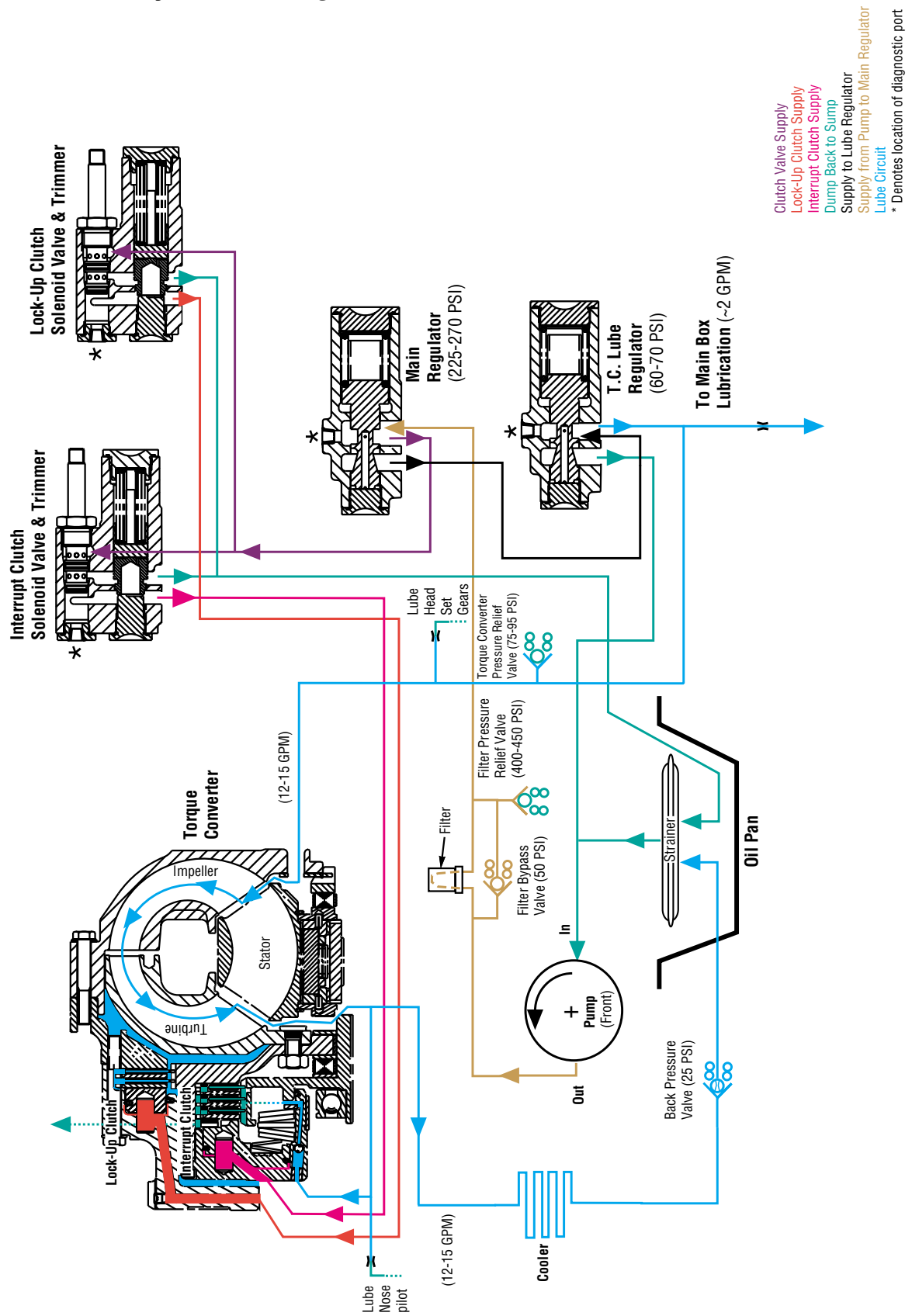
If resistance is outside of range



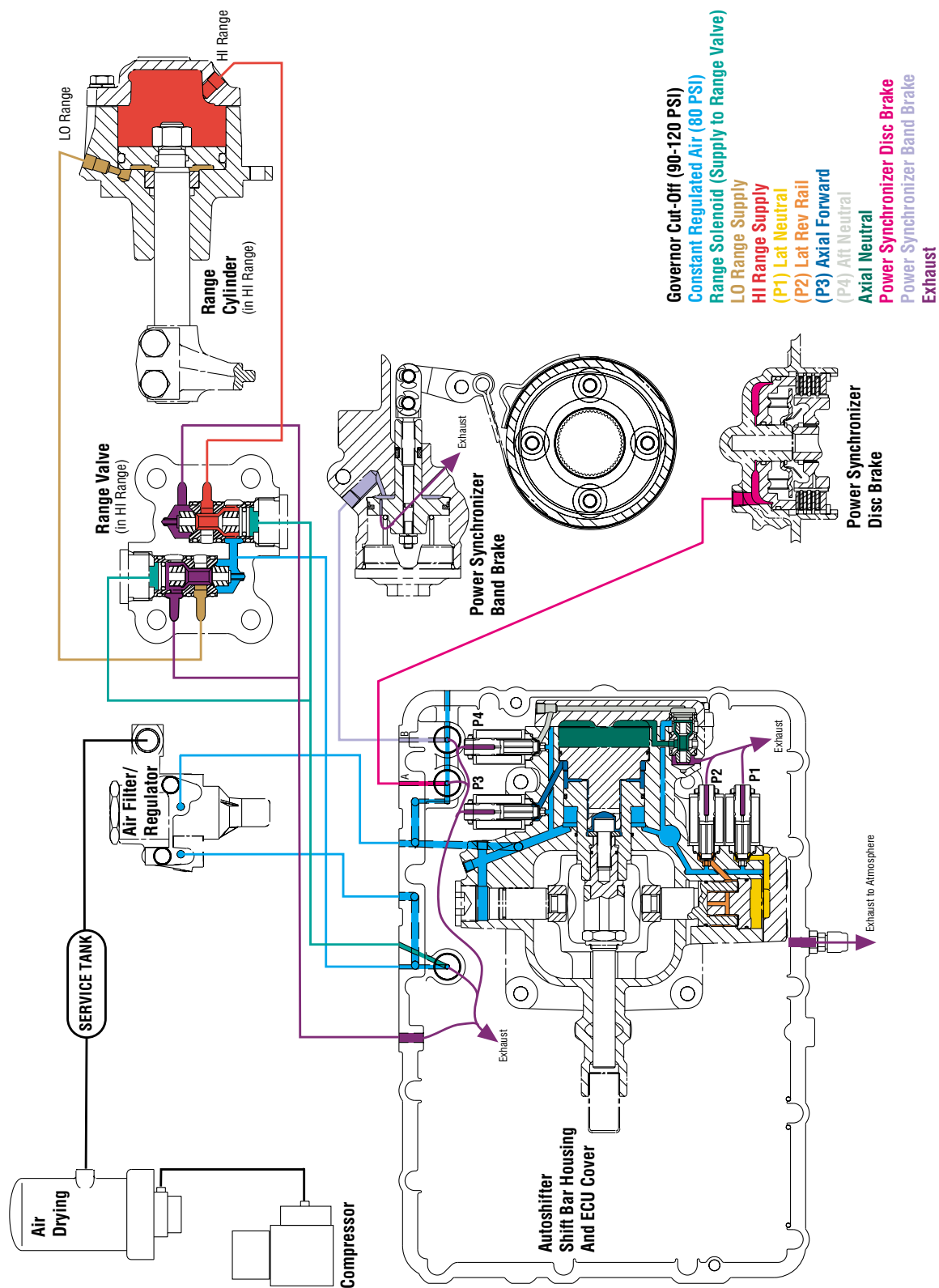
Repair or replace vehicle interface harness or ground connections as required. Repeat this step.



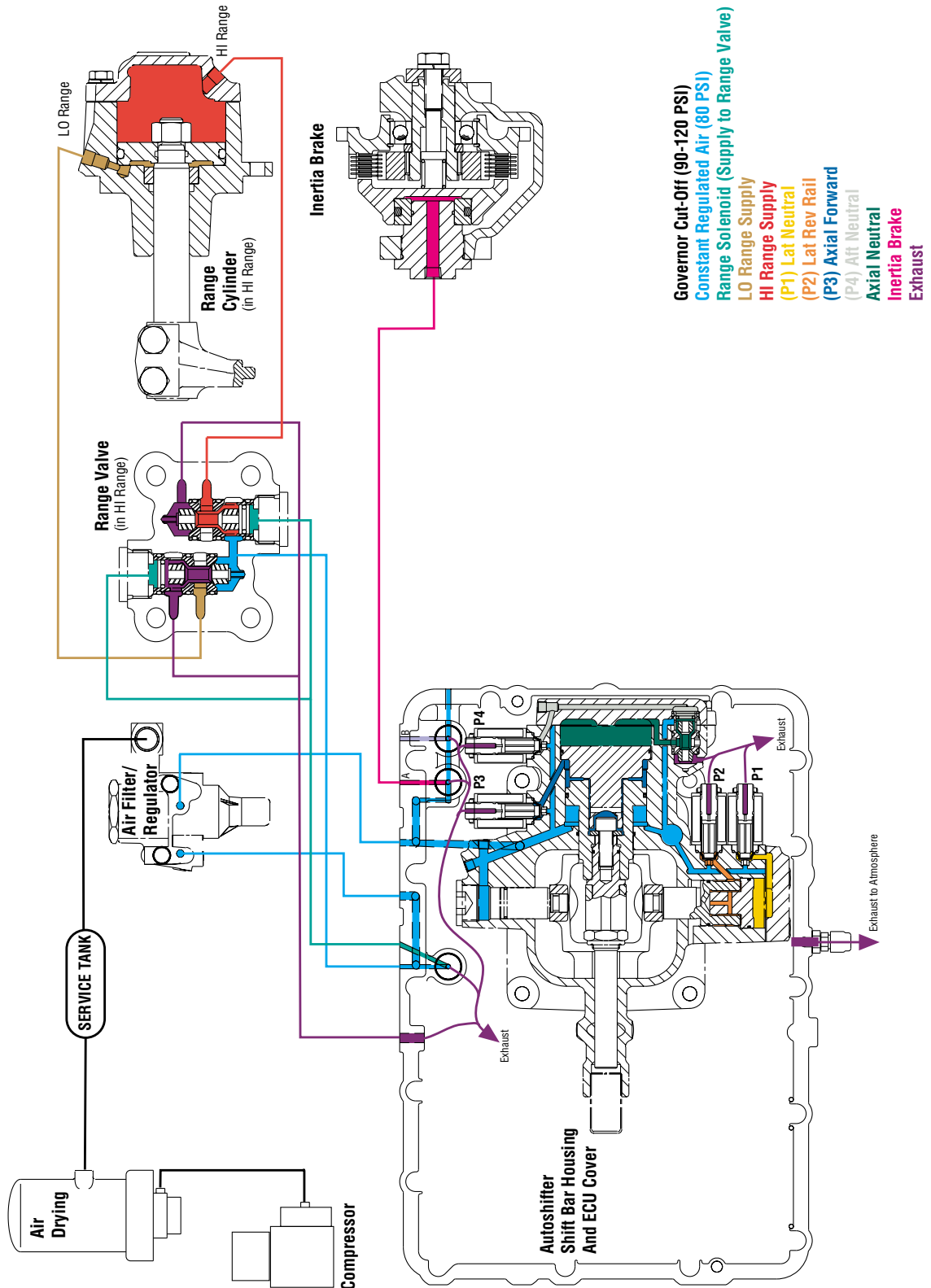
Torque Converter Hydraulic Diagram



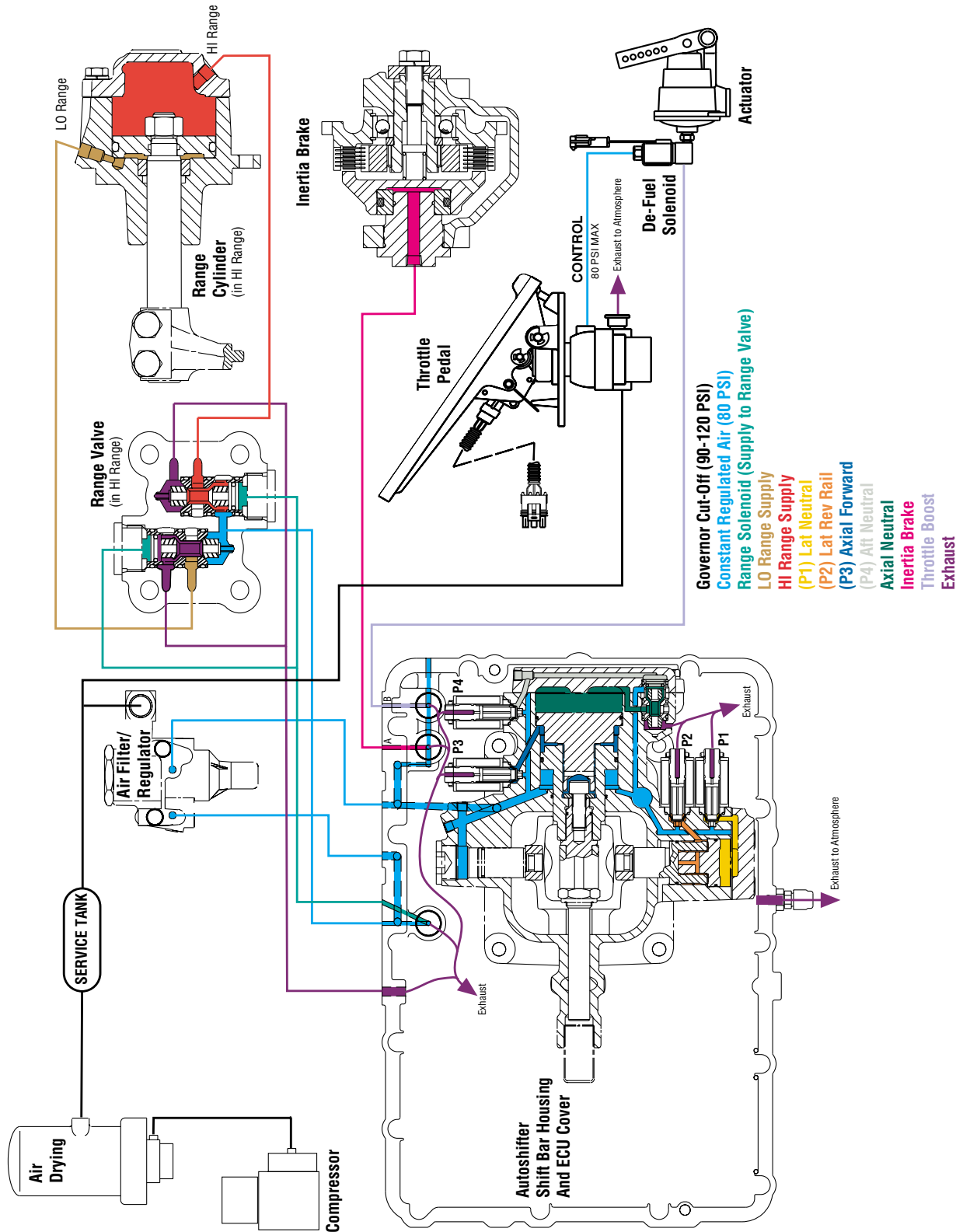
Pneumatic Diagram AT, ATR and ATS



Pneumatic Diagram ATE

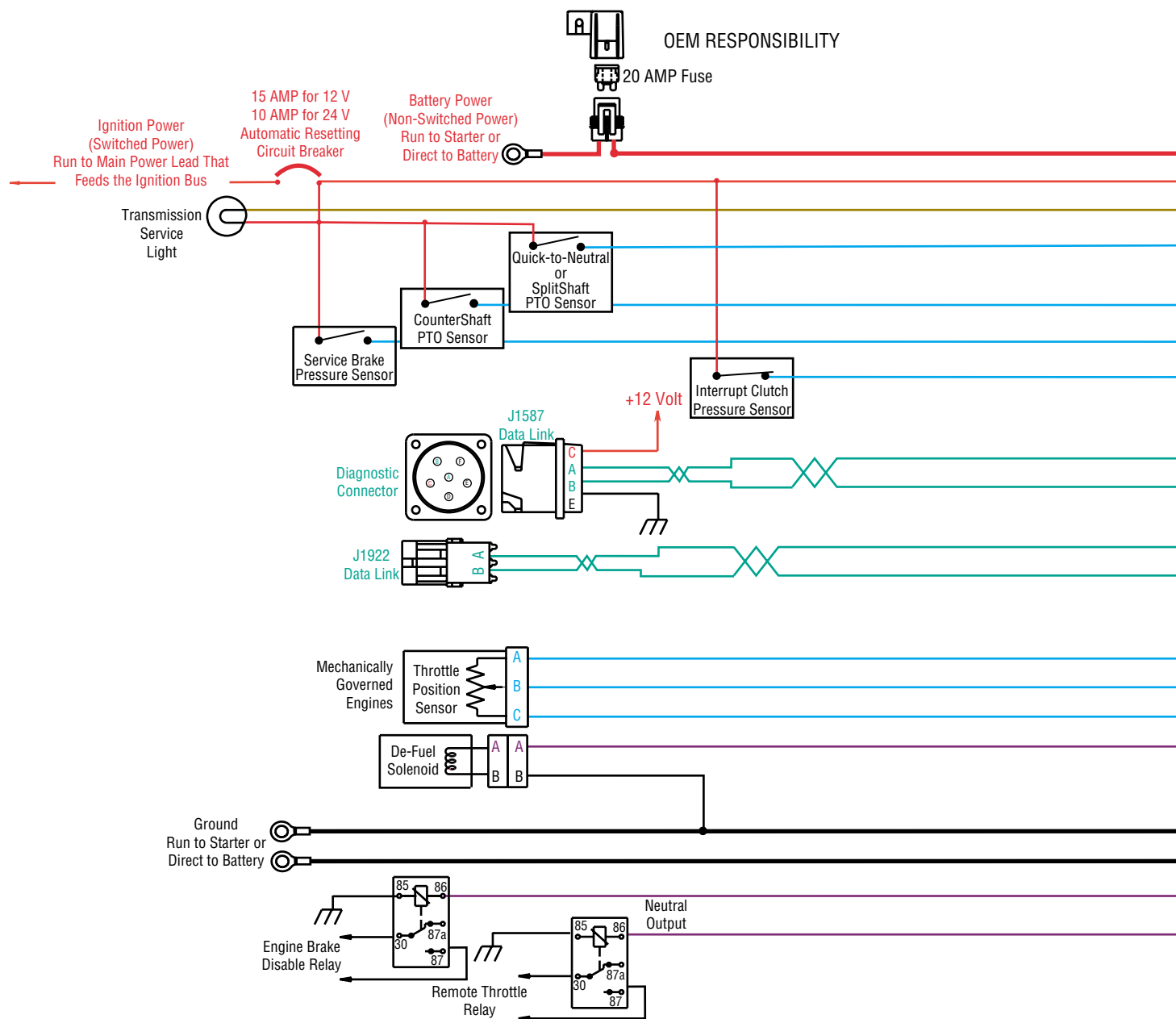


Pneumatic Diagram Mechanical ATE with Throttle Boost



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Cable Shift Lever Wiring Diagram



All OEM responsible wiring is "typical". Consult specific application.

Power supplied by ECU and Battery, +12 or +24VDC input

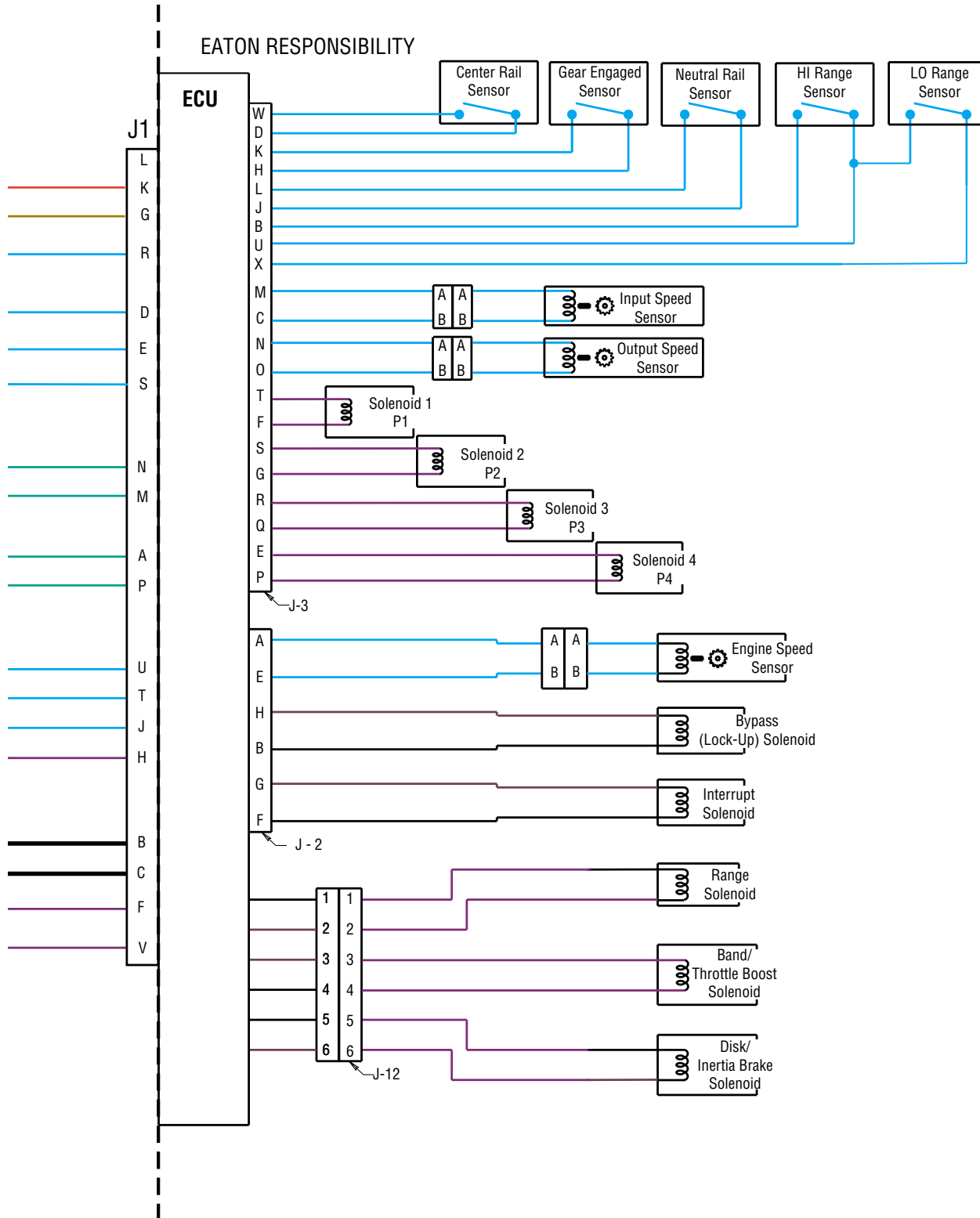
Signals into the ECU

Communication from and to the ECU

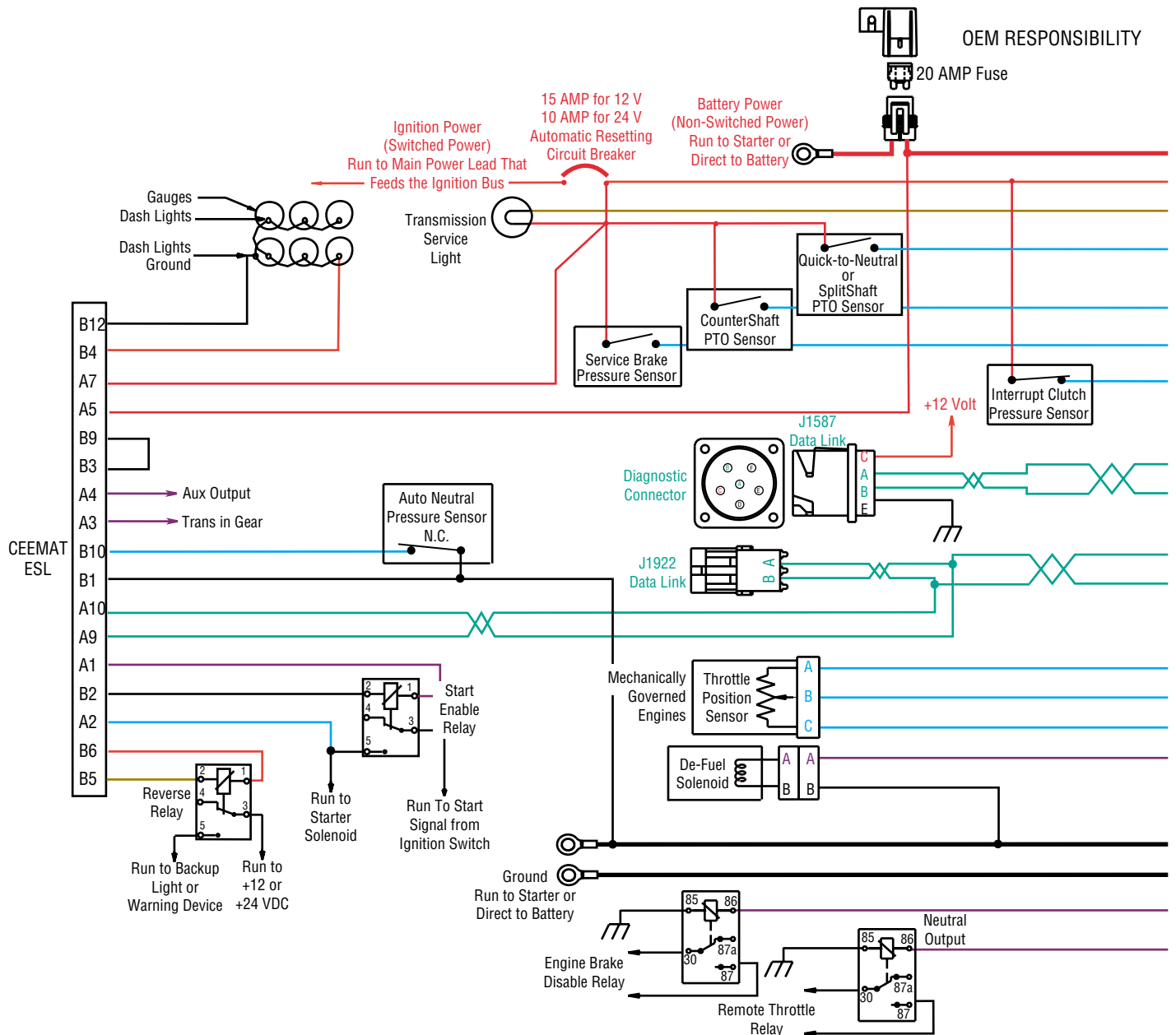
Signal returns, grounds, and general OEM wiring

+12 or +24 volt solenoid source

Ground solenoid source from ECU



Single Station Electronic Shift Lever Wiring Diagram



All OEM responsible wiring is "typical". Consult specific application.

Power supplied by ECU and Battery, +12 or +24VDC input

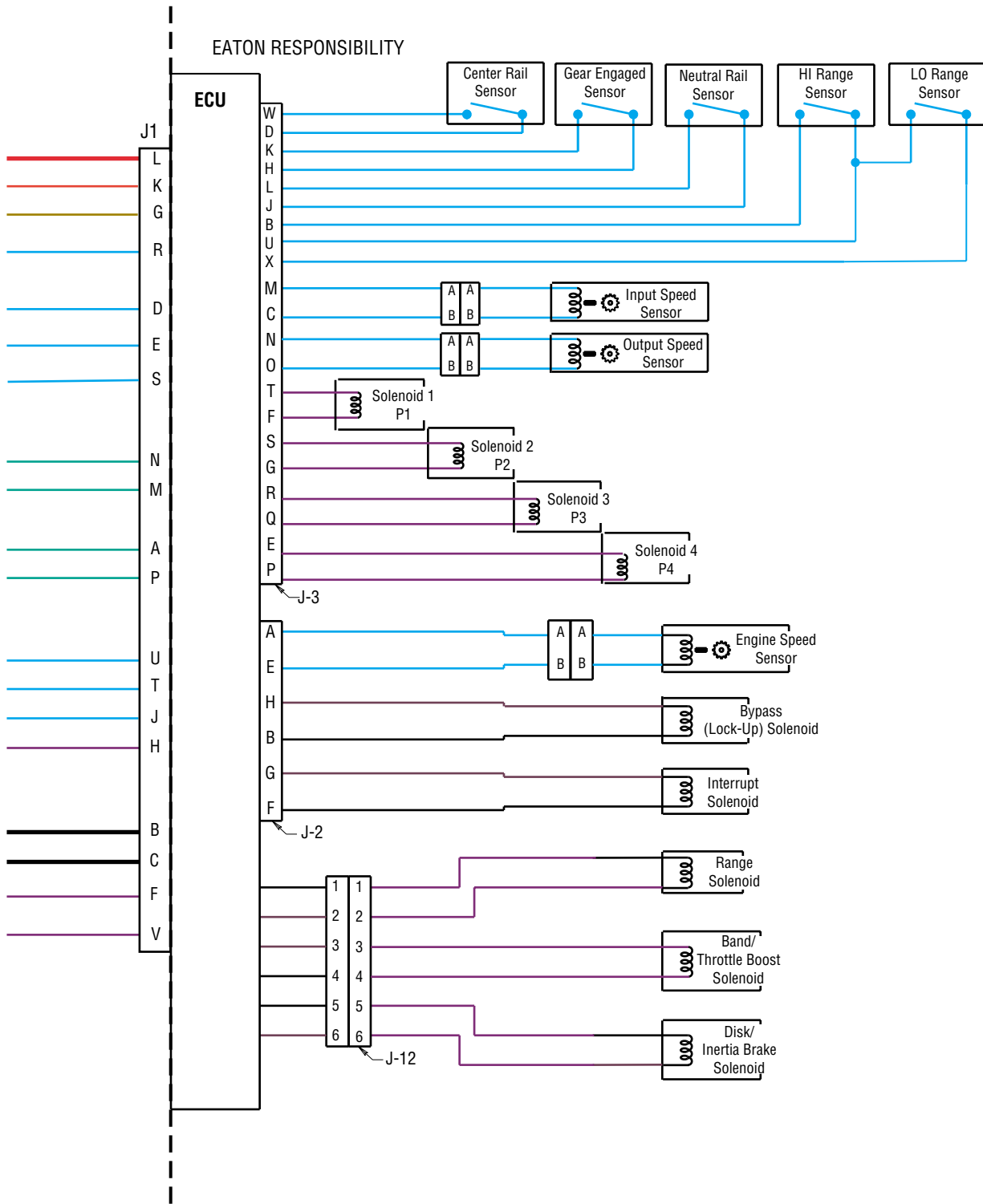
Signals into the ECU

Communication from and to the ECU

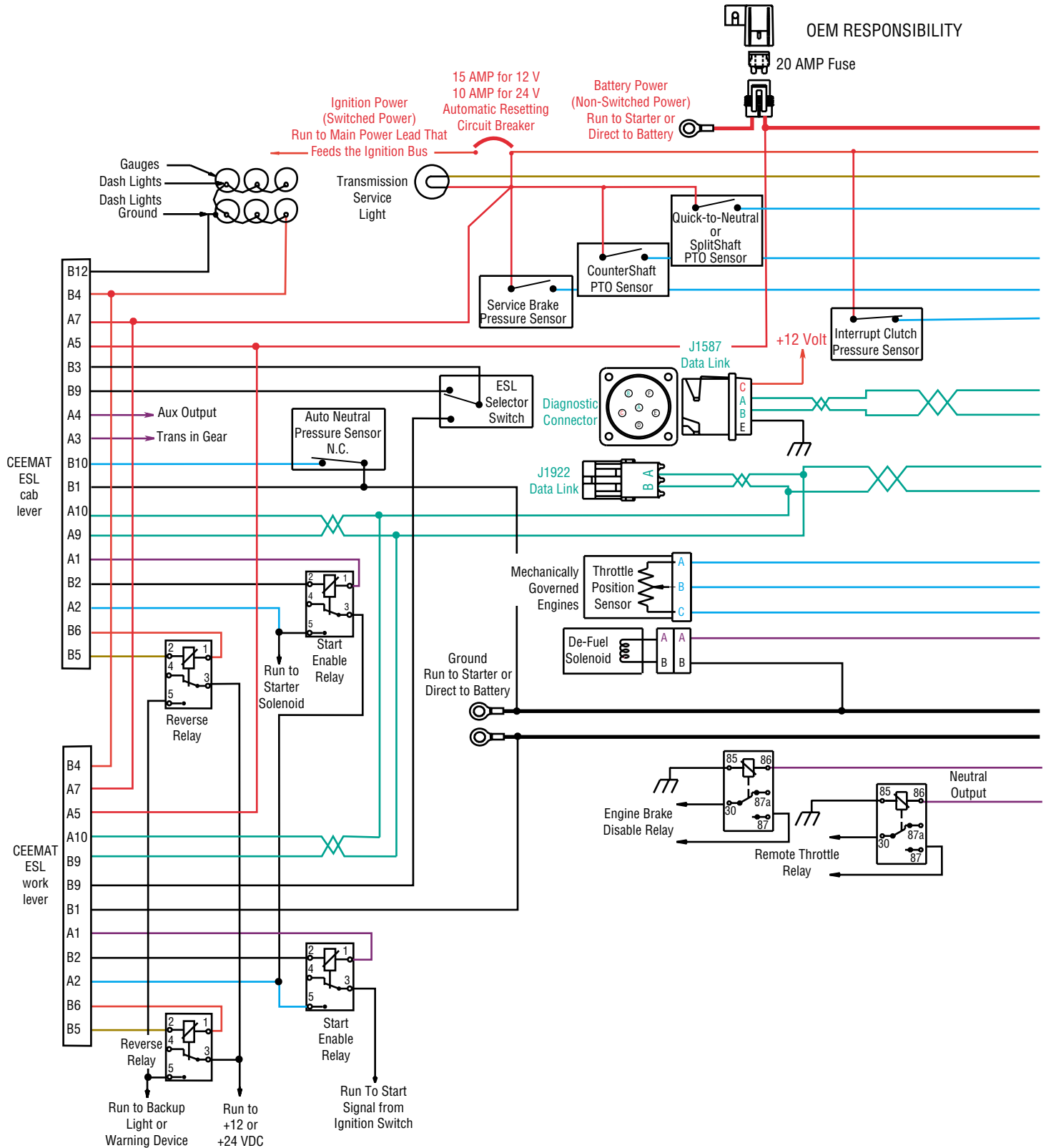
Signal returns, grounds, and general OEM wiring

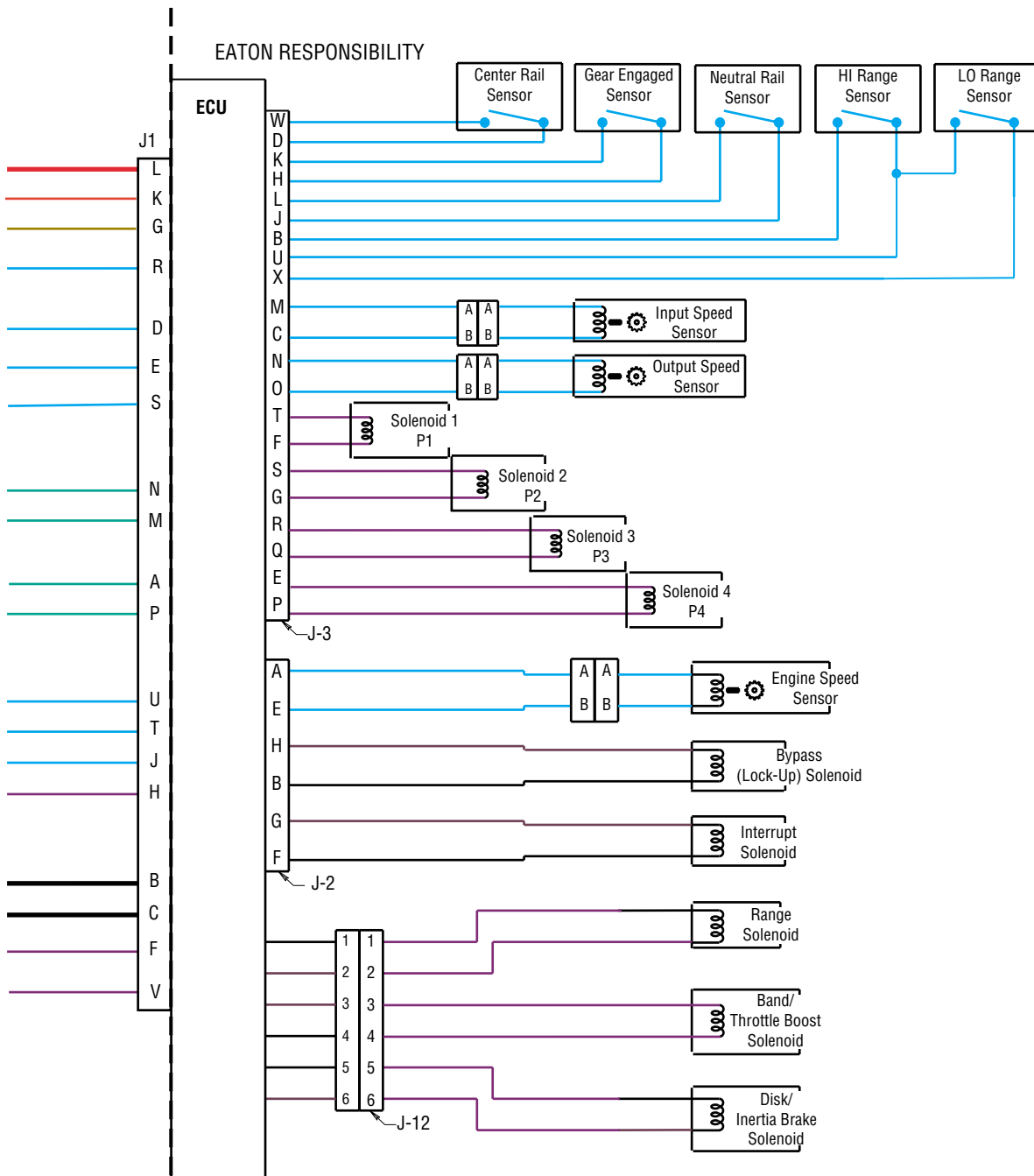
+12 or +24 volt solenoid source

Ground solenoid source from ECU



Dual Station Electronic Shift Lever Wiring Diagram





All OEM responsible wiring is "typical". Consult specific application.

Power supplied by ECU and Battery, +12 or +24VDC input

Signals into the ECU

Communication from and to the ECU

Signal returns, grounds, and general OEM wiring

+12 or +24 volt solenoid source

Ground solenoid source from ECU

Cable Shift Lever Adjustment Procedure

Note: Install and suitably retain the shift cable in its permanent routing position before attempting adjustment. Improper gear selection may result if this step is omitted.

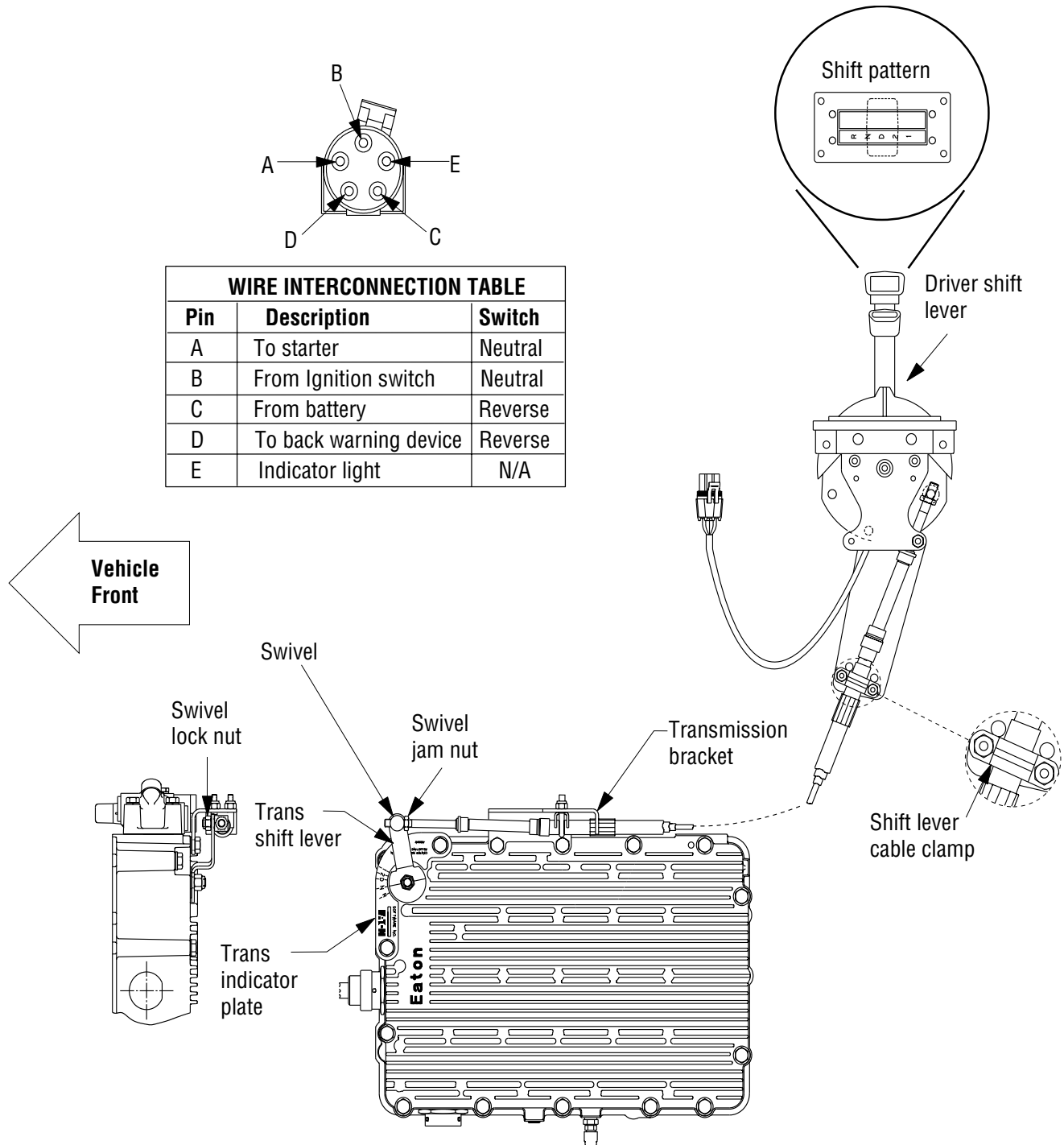
Note: Disconnect shift cable from transmission lever before starting this procedure.

1. Place driver shift lever in neutral "N".
2. Place transmission shift lever in neutral "N" per transmission shift indicator plate.

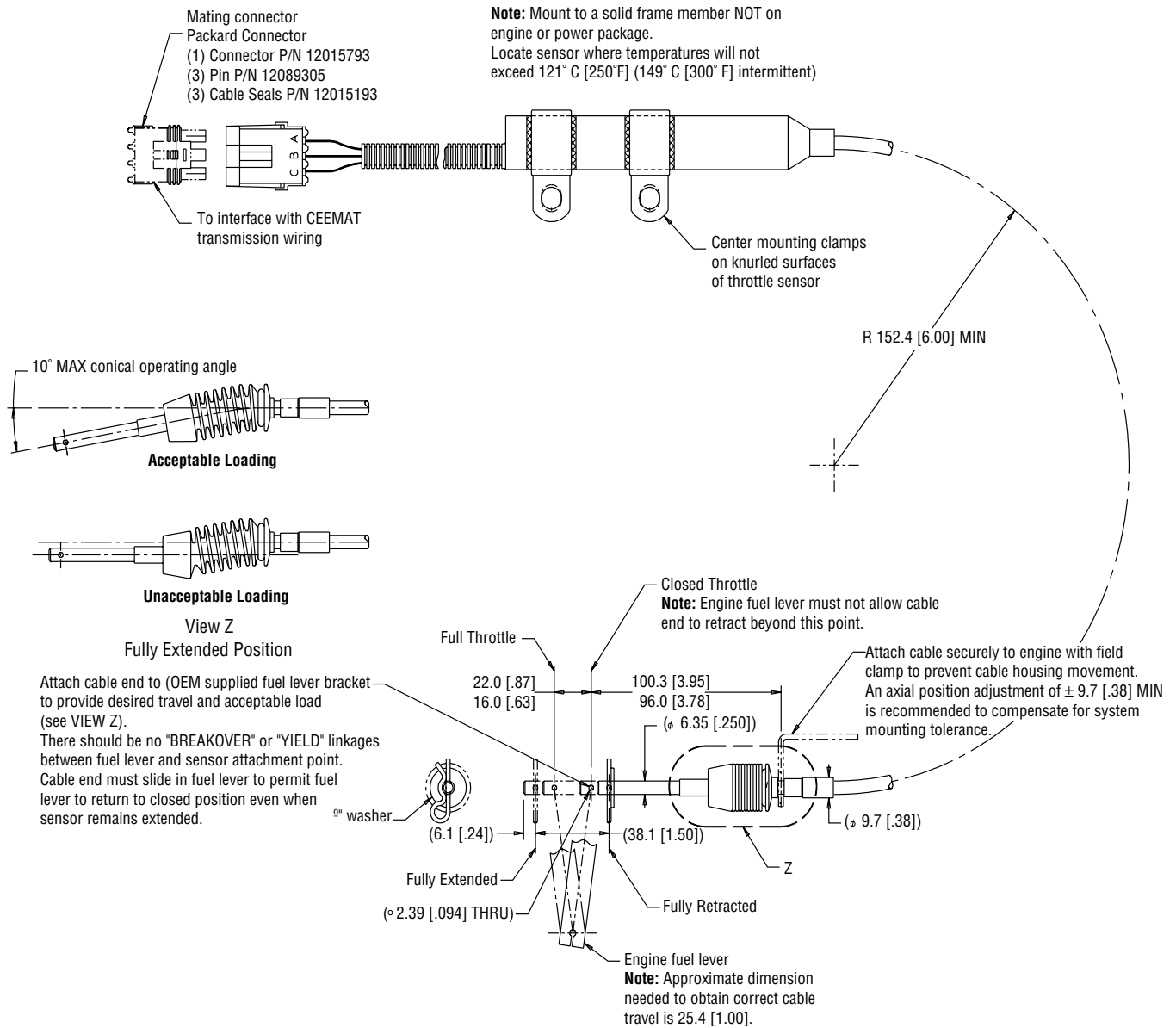
Note: If view of indicator plate is obstructed, obtain neutral by:

- a. Rotating transmission lever counterclockwise (as viewed from top) to the last detent position.
 - b. Rotating clockwise (as viewed from top) 2 detente positions to neutral.
3. Thread transmission swivel and jam nut onto cable end to a position which permits swivel to slip easily in and out of transmission lever hole. Place swivel in transmission lever hole.
 4. Place driver shift lever in 1st gear position.
 5. Check cable swivel to transmission lever hole alignment. Swivel should continue to slip easily in and out of transmission lever hole. Place swivel in transmission lever hole.
 6. Place driver shift lever in reverse "R" (Rh if so equipped) position.
 7. Check cable swivel to transmission lever hole alignment. Swivel should slip easily in and out of transmission lever hole.
 8. After suitable adjustment is accomplished torque swivel lock nut and jam nut to 8-14 lb-ft.
 9. Use the hand-held diagnostic tool and select Perform Test, Select Shift Lever Test to verify correct engagement of each gear position.

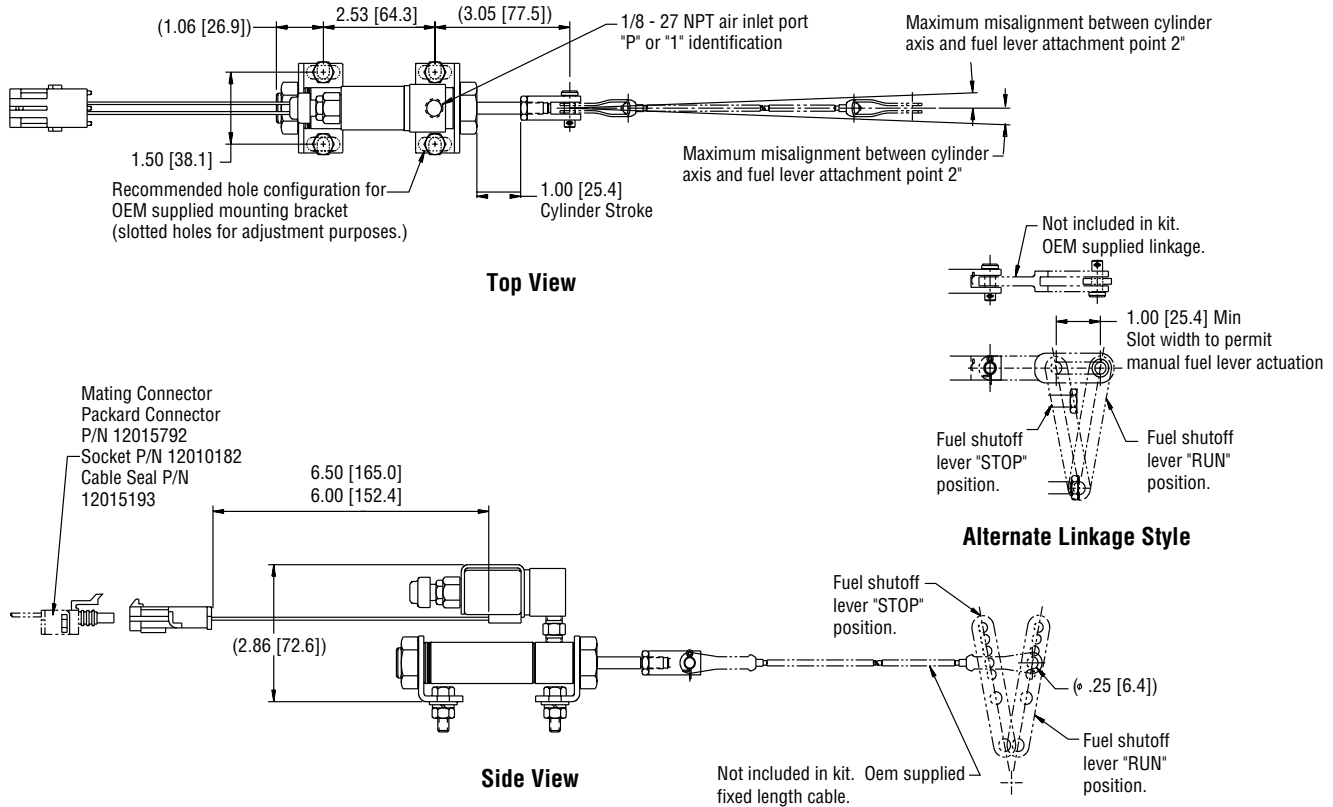
Cable Shift Lever Adjustment Procedure, continued



Linear Throttle Position Adjustment Procedure



Electro-Pneumatic Defuel Control Adjustment Procedure

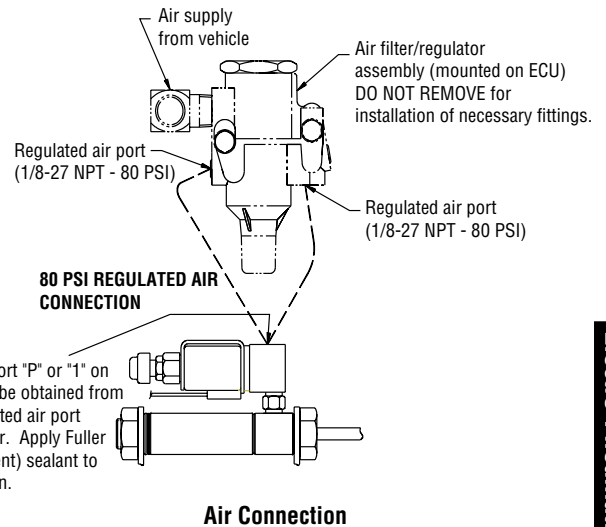


ASSEMBLY INSTRUCTIONS

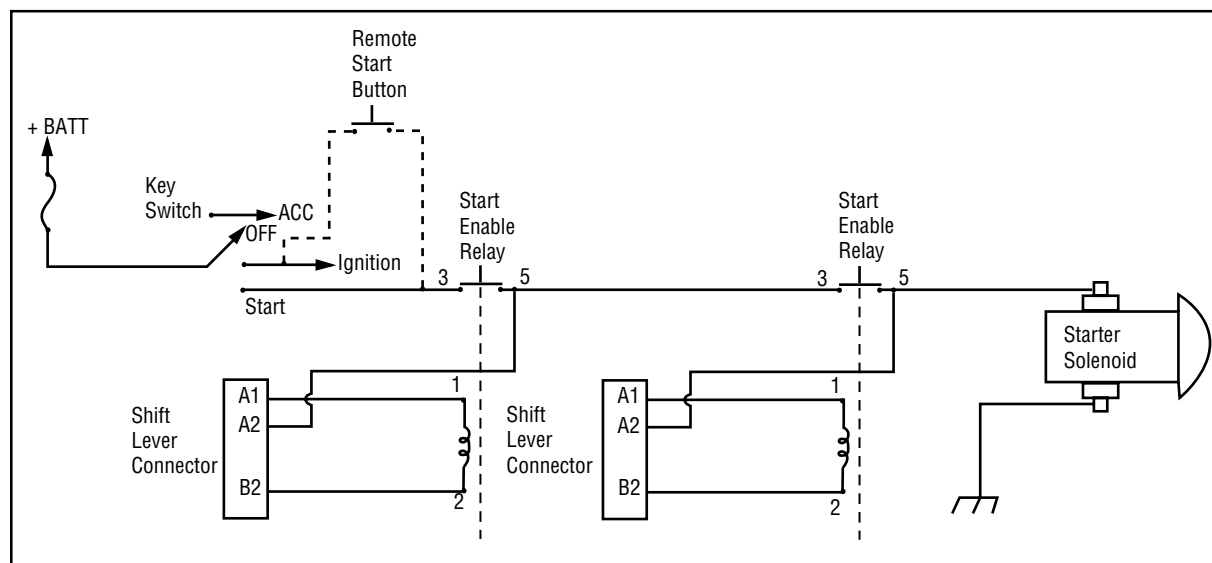
With fuel pump lever in (engine) "STOP" position and solenoid CYLINDER) energized. Connect cable/linkage.

Check operation for the following conditions:

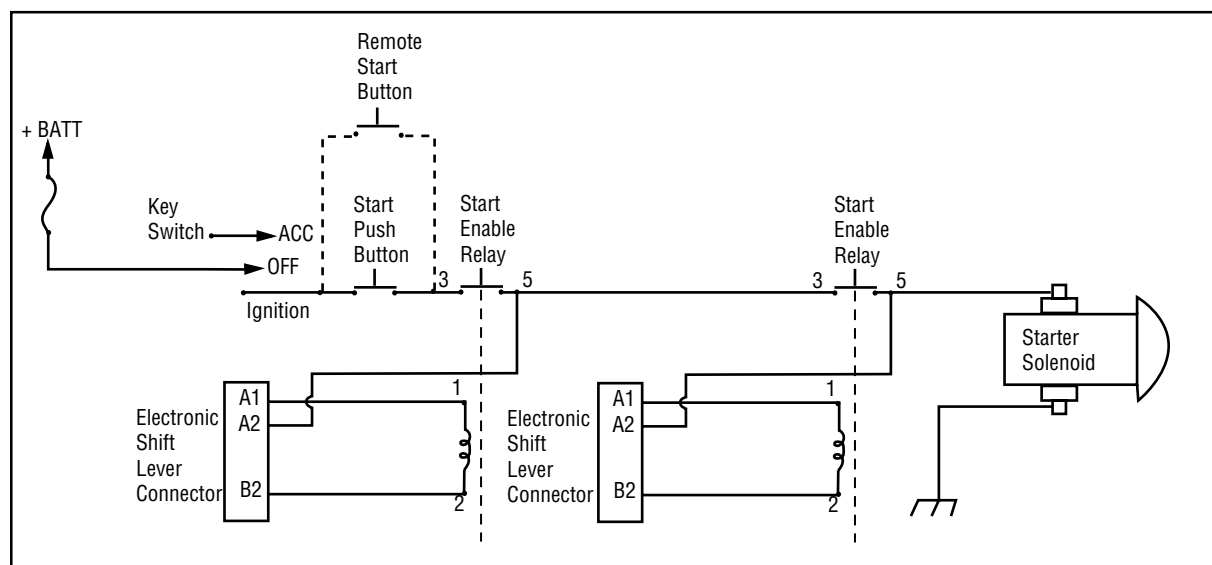
1. With solenoid energized (on) fuel lever must NOT contact internal pump stop but must turn off fuel to engine.
2. With solenoid de-energized (off) fuel lever must return to "RUN" position with no binding or drag.



Dual Station Start Enable Solenoid Circuit



Dual Station Start Enable Circuit with key switch



Dual Station Start Enable Circuit with push button start

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