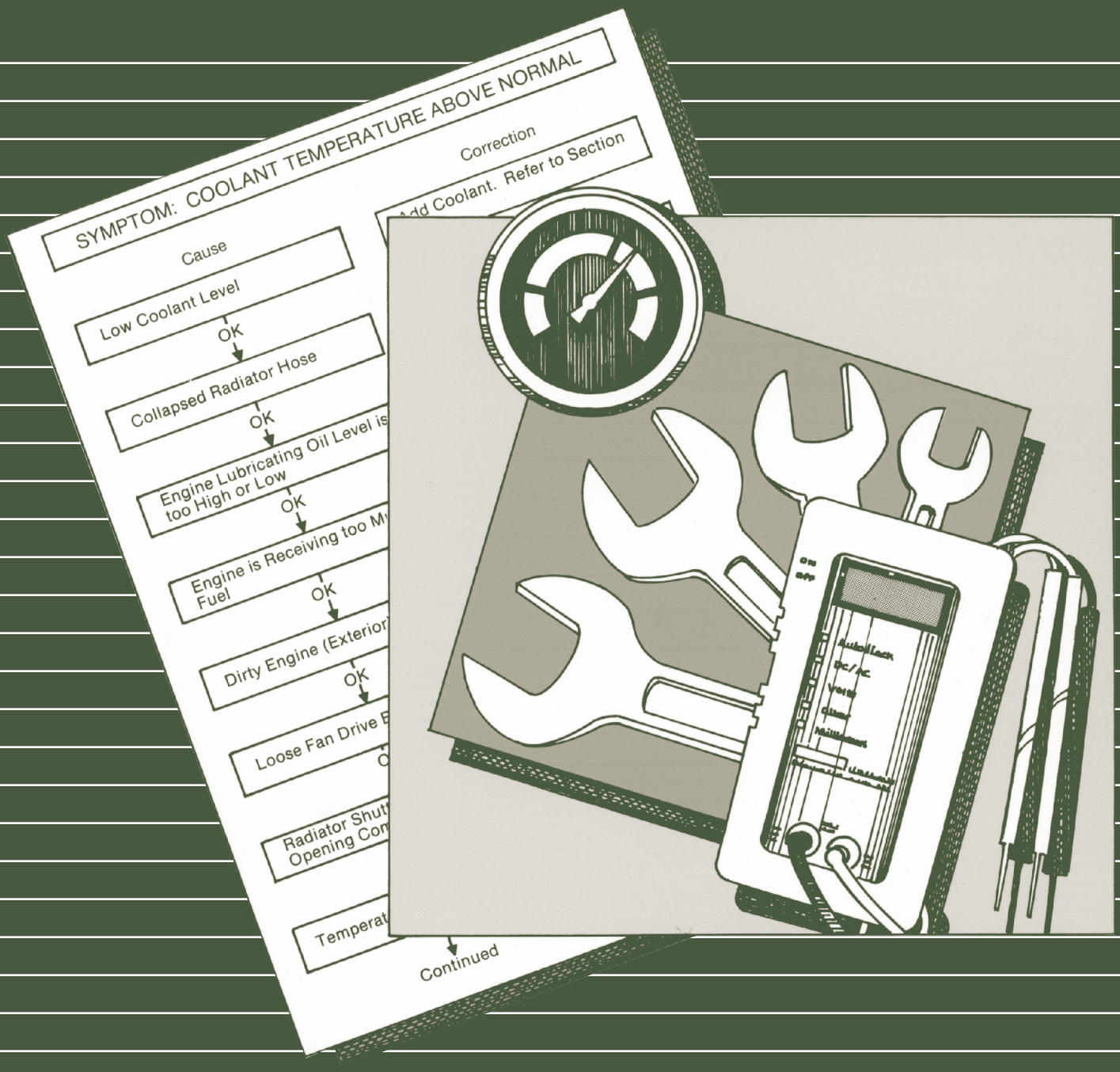
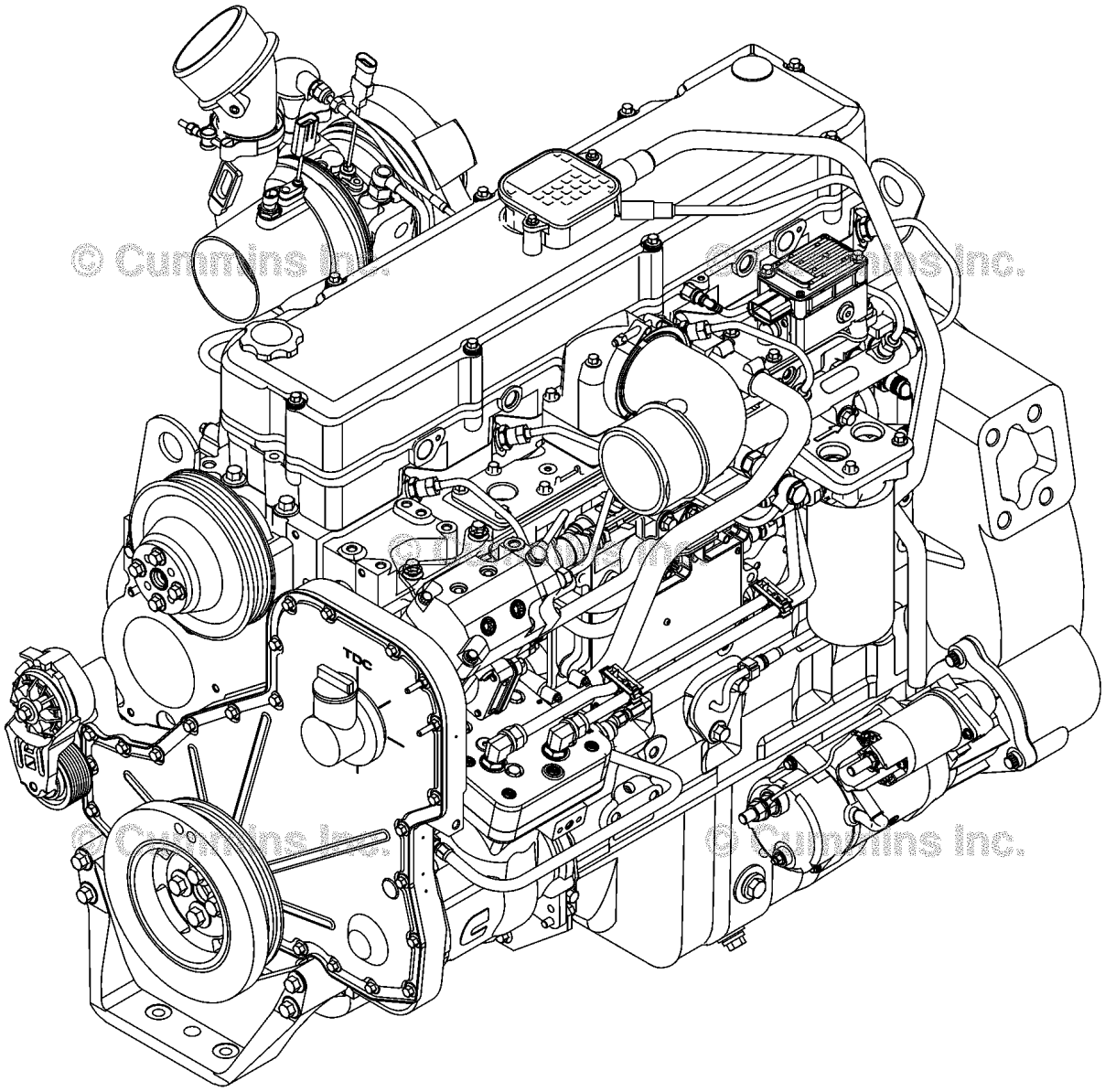
# Troubleshooting and Repair Manual ISB, ISBe2, ISBe3, ISBe4, QSB4.5, QSB5.9, QSB6.7, ISC, QSC8.3, ISL, ISLe3, ISLe4, and QSL9, CM850 Electronic Control System Volume 2



# Troubleshooting and Repair Manual
# ISB, ISBe2, ISBe3, ISBe4, QSB4.5, QSB5.9, QSB6.7, ISC, QSC8.3, ISL, ISLe3, ISLe4, and QSL9, CM850 Electronic Control System
# Volume 2



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# Foreword

This manual provides instructions for troubleshooting and repairing this engine in the chassis. Component and assembly rebuild procedures are provided in the engine shop manual. Refer to Section i - Introduction for instructions on how to use this manual.

**Read and follow all safety instructions. Refer to the WARNING in the General Safety Instructions in Section i - Introduction.**

The manual is organized to guide a service technician through the logical steps of identifying and correcting problems related to the engine. This manual does not cover vehicle or equipment problems. Consult the vehicle or equipment manufacturer for repair procedures.

A series of specific service manuals (for example: Shop, Specifications, and Alternative Repair) are available and can be ordered by Contacting your local area Cummins Regional office. A Cummins Regional office listing is located in Service Literature (Section L).

The repair procedures used in this manual are recommended by Cummins Inc. Some service procedures require the use of special service tools. Use the correct tools as described.

Cummins Inc. encourages the user of this manual to report errors, omissions, and recommendations for improvement. Please use the postage paid, pre-addressed Literature Survey Form in the back of this manual for communicating your comments.

The specifications and rebuild information in this manual are based on the information in effect at the time of printing. Cummins Inc. reserves the right to make any changes at any time without obligation. If differences are found between your engine and the information in this manual, contact a Cummins Authorized Repair Location or call 1-800-DIESELS (1-800-343-7357) toll free in the U.S. and Canada.

The latest technology and the highest quality components are used to manufacture Cummins engines. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts.

# Table of Contents

# Section i - Introduction

## Section Contents

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# About the Manual

## General Information

This Troubleshooting and Repair Manual is intended to aid in determining the cause of engine related problems and to provide recommended repair procedures.

The manual is divided into sections. Each section is equivalent to a group used in Cummins' filmcard system. Some sections contain **reference** numbers and **procedure** numbers. **Reference** numbers provide general information, specifications, diagrams, and service tools where applicable. **Procedure** numbers are used to identify and reference specific repair procedures for correcting the problem.

This manual **does not** contain fuel systems electronic troubleshooting. Use the troubleshooting trees in this manual, if there are no electronic fault codes.

This manual is designed so the troubleshooting trees are used to locate the cause of an engine problem. The troubleshooting trees then direct the user to the correct repair procedure. The repair procedures within a section are in numerical order. However, the repair steps within a given procedure are organized in the order the repair **must** be performed regardless of the numerical order of the steps. The user **must** use the contents pages or the index at the back of the manual to locate specific topics when **not** using the troubleshooting trees.

# How to Use the Manual

## General Information

This manual is organized to provide an easy flow from problem identification to problem correction.

A list of troubleshooting symptoms containing the most common problems is in the Troubleshooting Symptoms, Section (TS). The manual is designed to use the Troubleshooting Symptoms as a guide to locating the problem and directing the end user to the correct procedure for making the repair. Complete the following steps to locate and correct the problem.

1 Locate the symptom on the Section Contents pages of Section TS.
   - Reference to the page number where the Troubleshooting Symptom Tree is found is made to the right of the symptom tree title.

2 The left column of boxes in the Troubleshooting Symptom Charts indicates a probable cause of the problem, starting at the top with the simplest and easiest to repair, and continuing downward to the most difficult.
   - The right column of boxes provides a brief description of the corrective action with a reference number to the correct procedure used to make the repair.

3 Locate the probable cause in the left column then turn to the procedure referenced in the right column.

4 The Troubleshooting Symptom Charts are based on the following assumptions:
   - The components have been installed according to the manufacturer's specifications.
   - The easiest repairs are done first.
   - All generic solutions are designed for the most common applications and Original Equipment Manufacturer (OEM).

Refer to the Original Equipment Manufacturer's service manual for their specifications.

# Symbols

## General Information

The symbols have been used in this manual to help communicate the intent of the instructions. When one of the symbols appears, it conveys the meaning defined below.

**NOTE:** It is possible to have four symbols for each text and graphic combination.

**⚠ WARNING ⚠**
**Serious personal injury or extensive property damage can result if the warning instructions are not followed.**

**△ CAUTION △**
**Minor personal injury can result or a part, and assembly, or the engine can be damaged if the caution instructions are not followed.**

Indicates a **REMOVAL** or **Dissassembly** step.

Indicates an **INSTALLATION** or **ASSEMBLY** step.

**INSPECTION** is required.

**CLEAN** the part or assembly.

**PERFORM** a mechanical or time **MEASUREMENT**.

**LUBRICATE** the part or assembly.

Indicates that a **WRENCH** or **TOOL SIZE** will be given.

**TIGHTEN** to a specific torque.

**PERFORM** an electrical **MEASUREMENT**.

Refer to another location in this manual or another publication for additional information.

The component weighs 23kg [50 lbs] or more. To reduce the possibility of personal injury, use a hoist or get assistance to lift the component.

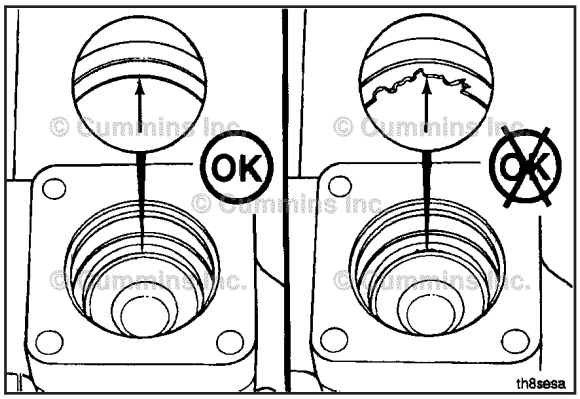
**To reduce the risk of high voltage shock, always follow all warnings and service instructions. Always assume the vehicle and its high voltage system are energized, even if the engine is not running.**

**Approved high voltage insulated gloves are required for this procedure.**

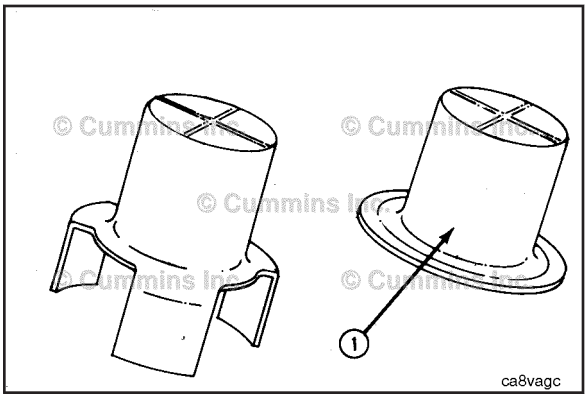
# Illustrations

## General Information

Some of the illustrations throughout this manual are generic and will **not** look exactly like the engine or parts used in your application. The illustrations can contain symbols to indicate an action required and an acceptable or **not** acceptable condition.




The illustrations are intended to show repair or replacement procedures. The procedure will be the same for all applications, although the illustration can differ.



# General Safety Instructions

## Important Safety Notice

**⚠ WARNING ⚠**

**Improper practices, carelessness, or ignoring the warnings can cause burns, cuts, mutilation, asphyxiation or other personal injury or death.**

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that **must** be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

- Work in an area surrounding the product that is dry, well lit, ventilated, free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Rotating parts can cause cuts, mutilation or strangulation.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery (negative [-] cable first) and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a "Do **Not** Operate" tag in the operator's compartment or on the controls.
- Use ONLY the proper engine barring techniques for manually rotating the engine. Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure.
- If an engine has been operating and the coolant is hot, allow the engine to cool before slowly loosening the filler cap to relieve the pressure from the cooling system.
- **Always** use blocks or proper stands to support the product before performing any service work. Do **not** work on anything that is supported ONLY by lifting jacks or a hoist.
- Relieve all pressure in the air, oil, fuel, and cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- To reduce the possibility of suffocation and frostbite, wear protective clothing and ONLY disconnect liquid refrigerant (Freon) lines in a well ventilated area. To protect the environment, liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas (fluorocarbons) into the atmosphere. Federal law requires capturing and recycling refrigerant.
- To reduce the possibility of personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded.
- Corrosion inhibitor, a component of SCA and lubricating oil, contains alkali. Do **not** get the substance in eyes. Avoid prolonged or repeated contact with skin. Do **not** swallow internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must** be used with caution. Follow the manufacturer's instructions to provide complete safety when using these materials. KEEP OUT OF REACH OF CHILDREN.
- To reduce the possibility of burns, be alert for hot parts on products that have just been turned off, exhaust gas flow, and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use the tools before performing any service work. Use ONLY genuine Cummins® or Cummins ReCon® replacement parts.
- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of lesser quality if replacements are necessary.
- When necessary, the removal and replacement of any guards covering rotating components, drives, and/or belts should only be carried out be a trained technician. Before removing any guards the engine **must** be turned off and any starting mechanisms **must** be isolated. All fasteners **must** be replaced on re-fitting the guards.
- Do **not** perform any repair when fatigued or after consuming alcohol or drugs that can impair your functioning.

- Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.
- Do **not** connect the jumper starting or battery charging cables to any ignition or governor control wiring. This can cause electrical damage to the ignition or governor.
- **Always** torque fasteners and fuel connections to the required specifications. Overtightening or undertightening can allow leakage. This is critical to the natural gas and liquefied petroleum gas fuel and air systems.
- **Always** test for fuel leaks as instructed, as odorant can fade.
- Close the manual fuel valves prior to performing maintenance and repairs, and when storing the vehicle inside.
- Coolant is toxic. If **not** reused, dispose of in accordance with local environmental regulations.
- The catalyst reagent contains urea. Do **not** get the substance in your eyes. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. Avoid prolonged contact with skin. In case of contact, immediately wash skin with soap and water. Do **not** swallow internally. In the event the catalyst reagent is ingested, contact a physician immediately.
- The catalyst substrate contains Vanadium Pentoxide. Vanadium Pentoxide has been determined by the State of California to cause cancer. Always wear protective gloves and eye protection when handling the catalyst assembly. Do not get the catalyst material in your eyes. In Case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. Avoid prolonged contact with skin. In case of contact, immediately wash skin with soap and water.
- The Catalyst substrate contains Vanadium Pentoxide. Vanadium Pentoxide has been determined by the State of California to cause cancer. In the event the catalyst is being replaced, dispose of in accordance with local regulations.
- California Proposition 65 Warning - Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

# General Repair Instructions

## General Information

This system incorporates the latest technology at the time it was manufactured; yet, it is designed to be repaired using normal repair practices performed to quality standards.

**⚠WARNING⚠**

**Cummins Inc. does not recommend or authorize any modifications or repairs to components except for those detailed in Cummins Service Information. In particular, unauthorized repair to safety-related components can cause personal injury or death. Below is a partial listing of components classified as safety-related:**

1 Air Compressor
2 Air Controls
3 Air Shutoff Assemblies
4 Balance Weights
5 Cooling Fan
6 Fan Hub Assembly
7 Fan Mounting Bracket(s)
8 Fan Mounting Capscrews
9 Fan Hub Spindle
10 Flywheel
11 Flywheel Crankshaft Adapter
12 Flywheel Mounting Capscrews
13 Fuel Shutoff Assemblies
14 Fuel Supply Tubes
15 Lifting Brackets
16 Throttle Controls
17 Turbocharger Compressor Casing
18 Turbocharger Oil Drain Line(s)
19 Turbocharger Oil Supply Line(s)
20 Turbocharger Turbine Casing
21 Vibration Damper Mounting Capscrews
22 Manual Service Disconnect
23 High Voltage Interlock Loop
24 High Voltage Connectors/Connections and Harnesses
25 High Voltage Battery System
26 Power Inverter
27 Generator Motor
28 Clutch Pressure Plate

- Follow all safety instructions noted in the procedures
- Follow the manufacturer's recommendations for cleaning solvents and other substances used during repairs. Some solvents have been identified by government agencies as toxic or carcinogenic. Avoid excessive breathing, ingestion and contact with such substances. **Always** use good safety practices with tools and equipment
- Provide a clean environment and follow the cleaning instructions specified in the procedures
- All components **must** be kept clean during any repair. Contamination of the components will cause premature wear.
- Perform the inspections specified in the procedures
- Replace all components or assemblies which are damaged or worn beyond the specifications

- Use genuine Cummins new or ReCon® service parts and assemblies
- The assembly instructions have been written to use again as many components and assemblies as possible. When it is necessary to replace a component or assembly, the procedure is based on the use of new Cummins or Cummins ReCon® components. All of the repair services described in this manual are available from all Cummins Distributors and most Dealer locations.
- Follow the specified disassembly and assembly procedures to reduce the possibility of damage to the components

## Welding on a Vehicle with an Electronic Controlled Fuel System

**⚠CAUTION⚠**

**Disconnect both the positive (+) and negative (-) battery cables from the battery before welding on the vehicle. Attach the welder ground cable no more than 0.61 meters [2 feet] from the part being welded. Do not connect the ground clamp of the welder to any of the sensors, wiring harness, electronic control units or the components. Direct welding of any electronic components must not be attempted. Sensors, wiring harness, and electronic control unit should be removed if nearby welding will expose these components to temperatures beyond normal operation. Additionally, all electronic control unit connectors must be disconnected**

# General Cleaning Instructions

## Definition of Clean

Parts **must** be free of debris that can contaminate any engine system. This does **not** necessarily mean they have to appear as new.

Sanding gasket surfaces until the factory machining marks are disturbed adds no value and is often harmful to forming a seal. It is important to maintain surface finish and flatness tolerances to form a quality sealing surface. Gaskets are designed to fill small voids in the specified surface finish.

Sanding gasket surfaces where edge-molded gaskets are used is most often unnecessary. Edge-molded gaskets are those metal carriers with sealing material bonded to the edges of the gasket to seal while the metal portion forms a metal to metal joint for stability. Any of the small amounts of sealing material that can stick to the parts are better removed with a blunt-edged scraper on the spots rather than spending time polishing the whole surface with an air sander or disc.

For those gaskets that do **not** have the edge molding, nearly all have a material that contains release agents to prevent sticking. Certainly this is **not** to say that some gaskets are **not** difficult to remove because the gasket has been in place a long time, has been overheated or the purpose of the release agent has been defeated by the application of some sealant. The object however is just to remove the gasket without damaging the surfaces of the mating parts without contaminating the engine (don't let the little bits fall where they can not be removed).

Bead blasting piston crowns until the dark stain is removed is unnecessary. All that is required is to remove the carbon build-up above the top ring and in the ring grooves. There is more information on bead blasting and piston cleaning later in this document.

Cummins Inc. does **not** recommend sanding or grinding the carbon ring at the top of cylinder liners until clean metal is visible. The liner will be ruined and any signs of a problem at the top ring reversal point (like a dust-out) will be destroyed. It is necessary to remove the carbon ring to provide for easier removal of the piston assembly. A medium bristle, high quality, steel wire wheel that is rated above the rpm of the power tool being used will be just as quick and there will be less damage. Yes, one **must** look carefully for broken wires after the piston is removed but the wires are more visible and can be attracted by a magnet.

Oil on parts that have been removed from the engine will attract dirt in the air. The dirt will adhere to the oil. If possible, leave the old oil on the part until it is ready to be cleaned, inspected and installed, and then clean it off along with any attracted dirt. If the part is cleaned then left exposed it can have to be cleaned again before installation. Make sure parts are lubricated with clean oil before installation. They do **not** need to be oiled all over but do need oil between moving parts (or a good lube system priming process conducted before cranking the engine).

Bead blasting parts to remove exterior paint is also usually unnecessary. The part will most likely be painted again so all that needs happen is remove any loose paint.

## Abrasive Pads and Abrasive Paper

The keyword here is "abrasive". There is no part of an engine designed to withstand abrasion. That is they are all supposed to lock together or slide across each other. Abrasives and dirt particles will degrade both functions.

**⚠WARNING⚠**

**Abrasive material must be kept out of or removed from oil passages and parts wear points. Abrasive material in oil passages can cause bearing and bushing failures that can progress to major component damage beyond reuse. This is particularly true of main and rod bearings.**

Cummins Inc. does **not** recommend the use of emery cloth or sand paper on any part of an **assembled** engine or component including but **not** limited to removing the carbon ridge from cylinder liners or to clean block decks or counterbores.

Great care **must** be taken when using abrasive products to clean engine parts, particularly on partially assembled engines. Abrasive cleaning products come in many forms and sizes. All of them contain aluminum oxide particles, silicon carbide, or sand or some other similar hard material. These particles are harder than most of the parts in the engine. Since they are harder, if they are pressed against softer material they will either damage the material or become embedded in it. These materials fall off the holding media as the product is used. If the products are used with power equipment the particles are thrown about the engine. If the particles fall between two moving parts, damage to the moving parts is likely.

If particles that are smaller than the clearance between the parts while they are at rest (engine stopped), but larger than the running clearance then damage will occur when the parts move relative to each other (engine started). While the engine is running and there is oil pressure, particles that are smaller than the bearing clearance are likely to pass between the parts without damage and be trapped in the oil filter. However, particles larger than the bearing clearance will remove material from one part and can become embedded in one of the parts. Once embedded in one part it will

abrade the other part until contact is no longer being made between the two parts. If the damage sufficiently degrades the oil film, the two parts will come into contact resulting in early wear-out or failure from lack of effective lubrication.

Abrasive particles can fly about during cleaning it is **very** important to block these particles from entering the engine as much as possible. This is particularly true of lubricating oil ports and oil drilling holes, especially those located downstream of the lubricating oil filters. Plug the holes instead of trying to blow the abrasive particles and debris with compressed air because the debris is often simply blown further into the oil drilling.

All old gasket material **must** be removed from the parts gasket surfaces. However, it is **not** necessary to clean and polish the gasket surface until the machining marks are erased. Excessive sanding or buffing can damage the gasket surface. Many newer gaskets are of the edge molded type (a steel carrier with a sealing member bonded to the steel). What little sealing material that can adhere is best removed with a blunt-edged scraper or putty knife. Cleaning gasket surfaces where an edge-molded gasket is used with abrasive pads or paper is usually a waste of time.

**⚠WARNING⚠**

**Excessive sanding or grinding the carbon ring from the top of the cylinder liners can damage the liner beyond reuse. The surface finish will be damaged and abrasive particles can be forced into the liner material which can cause early cylinder wear-out or piston ring failures.**

Tape off or plug all openings to any component interior before using abrasive pads or wire brushes. If really necessary because of time to use a power tool with abrasive pads, tape the oil drillings closed or use plug and clean as much of the surface as possible with the tool but clean around the oil hole/opening by hand so as to prevent contamination of the drilling. Then remove the tape or plug and clean the remaining area carefully and without the tool. DO NOT use compressed air to blow the debris out of oil drilling on an assembled engine! More likely than **not**, the debris can be blown further into the drilling. Using compressed air is fine if both ends of the drilling are open but that is rarely the case when dealing with an assembled engine.

## Gasket Surfaces

The object of cleaning gasket surfaces is to remove any gasket material, not refinish the gasket surface of the part.

Cummins Inc. does **not** recommend any specific brand of liquid gasket remover. If a liquid gasket remover is used, check the directions to make sure the material being cleaned will **not** be harmed.

Air powered gasket scrapers can save time but care must be taken to **not** damage the surface. The angled part of the scraper must be against the gasket surface to prevent the blade from digging into the surface. Using air powered gasket scrapers on parts made of soft materials takes skill and care to prevent damage.

Do **not** scrape or brush across the gasket surface if at all possible.

## Solvent and Acid Cleaning

Several solvent and acid-type cleaners can be used to clean the disassembled engine parts (other than pistons. See Below). Experience has shown that the best results can be obtained using a cleaner that can be heated to 90° to 95° Celsius (180° to 200° Fahrenheit). Kerosene emulsion based cleaners have different temperature specifications, see below. A cleaning tank that provides a constant mixing and filtering of the cleaning solution will give the best results. Cummins Inc. does not recommend any specific cleaners. Always follow the cleaner manufacturer's instructions. Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful not to damage any gasket surfaces. When possible, steam clean the parts before putting them in the cleaning tank.

**⚠WARNING⚠**

**When using solvents, acids, or alkaline materials for cleaning, follow the manufacturers recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.**

Experience has shown that kerosene emulsion based cleaners perform the best to clean pistons. These cleaners should **not** be heated to temperature in excess of 77°C (170°F). The solution begins to break down at temperatures in excess of 82°C (180°F) and will be less effective.

Do **not** use solutions composed mainly of chlorinated hydrocarbons with cresols, phenols and/or cresylic components. They often do **not** do a good job of removing deposits from the ring groove and are costly to dispose of properly.

Solutions with a pH above approximately 9.5 will cause aluminum to turn black; therefore do **not** use high alkaline solutions.

Chemicals with a pH above 7.0 are considered alkaline and those below 7.0 are acidic. As you move further away from the neutral 7.0, the chemicals become highly alkaline or highly acidic.

Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful to **not** damage any gasket surfaces. When possible use hot high

pressure water or steam clean the parts before putting them in the cleaning tank. Removing the heaviest dirt before placing in the tank will allow the cleaner to work more effectively and the cleaning agent will last longer.

Rinse all the parts in hot water after cleaning. Dry completely with compressed air. Blow the rinse water from all the capscrew holes and the oil drillings.

If the parts are **not** to be used immediately after cleaning, dip them in a suitable rust proofing compound. The rust proofing compound **must** be removed from the parts before assembly or installation on the engine.

## Steam Cleaning

Steam cleaning can be used to remove all types of dirt that can contaminate the cleaning tank. It is a good method for cleaning the oil drillings and coolant passages

**⚠WARNING⚠**

**When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.**

Do **not** steam clean the following components:

- Electrical Components
- Wiring Harnesses
- Belts and Hoses
- Bearings (ball or taper roller)
- Electronic Control Module (ECM)
- ECM Connectors
- Capacitive Coil Driver Module (CCD)
- Ignition Coils and Leads
- NOx Sensor
- Fuel Control Valve
- Throttle Driver and Actuator.

## Plastic Bead Cleaning

Cummins Inc. does **not** recommend the use of glass bead blast or walnut shell media on **any** engine part. Cummins Inc. recommends using **only** plastic bead media, Part Number 3822735 or equivalent on any engine part. **Never** use sand as a blast media to clean engine parts. Glass and walnut shell media when **not** used to the media manufacturer's recommendations can cause excess dust and can embed in engine parts that can result in premature failure of components through abrasive wear.

Plastic bead cleaning can be used on many engine components to remove carbon deposits. The cleaning process is controlled by the use of plastic beads, the operating pressure and cleaning time.

**△CAUTION△**

**Do not use bead blasting cleaning methods on aluminum pistons skirts or the pin bores in any piston, piston skirt or piston crown. Small particles of the media will embed in the aluminum or other soft metal and result in premature wear of the cylinder liner, piston rings, pins and pin bores. Valves, turbocharger shafts, etc., can also be damaged. Follow the cleaning directions listed in the procedures.**

**△CAUTION△**

**Do not contaminate wash tanks and tank type solvent cleaners with the foreign material and plastic beads. Remove the foreign material and plastic beads with compressed air, hot high pressure water or steam before placing them in tanks or cleaners. The foreign material and plastic beads can contaminate the tank and any other engine parts cleaned in the tank. Contaminated parts may cause failures from abrasive wear.**

Plastic bead blasting media, Part Number 3822735, can be used to clean all piston ring grooves. Do **not** sure any bead blasting media on piston pin bores or aluminum skirts.

Follow the equipment manufacturer's cleaning instructions. Make sure to adjust the air pressure in the blasting machine to the bead manufacturer's recommendations. Turning up the pressure can move material on the part and cause the plastic bead media to wear out more quickly. The following guidelines can be used to adapt to manufacturer's instructions:

1 Bead size: U.S. size Number 16 — 20 for piston cleaning with plastic bead media, Part Number 3822735

2 Operating Pressure — 270 kPa (40 psi) for piston cleaning. Pressure should not cause beads to break.

3 Steam clean or wash the parts with solvent to remove all of the foreign material and plastic beads after cleaning. Rinse with hot water. Dry with compressed air.

**⚠CAUTION⚠**

**The bead blasting operation must not disturb the metal surface. If the metal surface is disturbed the engine can be damaged due to increased parts clearance or inadequate surface finish on parts that move against other parts.**

When cleaning pistons, it is **not** necessary to remove all the dark stain from the piston. All that is necessary is to remove the carbon on the rim and in the ring grooves. This is best done by directing the blast across the part as opposed to straight at the part. If the machining marks are disturbed by the blasting process, then the pressure is too high or the blast is being held on one spot too long. The blast operation **must not** disturb the metal surface.

Walnut shell bead blast material is sometimes used to clean ferrous metals (iron and steel). Walnut shell blasting produces a great amount of dust particularly when the pressure if the air pressure on the blasting machine is increased above media manufacturer's recommendation. Cummins Inc. recommends **not** using walnut shell media to clean engine parts due to the risk media embedment and subsequent contamination of the engine.

Cummins Inc. now recommends glass bead media **NOT** used to clean any engine parts. Glass media is too easily embedded into the material particularly in soft materials and when air pressures greater than media manufacturer's recommend are used. The glass is an abrasive so when it is in a moving part, that part is abrading all the parts in contact with it. When higher pressures are used the media is broken and forms a dust of a very small size that floats easily in the air. This dust is very hard to control in the shop, particularly if **only** compressed air (and not hot water) is used to blow the media after it is removed from the blasting cabinet (blowing the part off inside the cabinet may remove large accumulations but never removes all the media).

Bead blasting is best used on stubborn dirt/carbon build-up that has **not** been removed by first steam/higher pressure washing then washing in a heated wash tank. This is particularly true of pistons. Steam and soak the pistons first then use the plastic bead method to safely remove the carbon remaining in the grooves (instead of running the risk of damaging the surface finish of the groove with a wire wheel or end of a broken piston ring. Make sure the parts are dry and oil free before bead blasting to prevent clogging the return on the blasting machine.

**Always** direct the bead blaster nozzle "across" rather than directly at the part. This allows the bead to get under the unwanted material. Keep the nozzle moving rather than hold on one place. Keeping the nozzle directed at one-place too long causes the metal to heat up and be moved around. Remember that the spray is **not** just hitting the dirt or carbon. If the machining marks on the piston groove or rim have been disturbed then there has **not** been enough movement of the nozzle and/or the air pressure is too high.

**Never** bead blast valve stems. Tape or use a sleeve to protect the stems during bead blasting. Direct the nozzle across the seat surface and radius rather than straight at them. The object is to remove any carbon build up and continuing to blast to remove the stain is a waste of time.

## Fuel System

When servicing any fuel system components, which can be exposed to potential contaminants, prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. If the surrounding areas are **not** cleaned, dirt or contaminants can be introduced into the fuel system.

The internal drillings of some injectors are extremely small and susceptible to plugging from contamination. Some fuel injection systems can operate at very high pressures. High pressure fuel can convert simple particles of dirt and rust into a highly abrasive contaminant that can damage the high pressure pumping components and fuel injectors.

Electrical contact cleaner can be used if steam cleaning tools are **not** available. Use electrical contact cleaner rather than compressed air, to wash dirt and debris away from fuel system fittings. Diesel fuel on exposed fuel system parts attracts airborne contaminants.

Choose lint free towels for fuel system work.

Cap and plug fuel lines, fittings, and ports whenever the fuel system is opened. Rust, dirt, and paint can enter the fuel system whenever a fuel line or other component is loosened or removed from the engine. In many instances, a good practice is to loosen a line or fitting to break the rust and paint loose, and then clean off the loosened material.

When removing fuel lines or fittings from a new or newly-painted engine, make sure to remove loose paint flakes/chips that can be created when a wrench contacts painted line nuts or fittings, or when quick disconnect fittings are removed.

Fuel filters are rated in microns. The word micron is the abbreviation for a micrometer, or one millionth of a meter. The micron rating is the size of the smallest particles that will be captured by the filter media. As a reference, a human hair

is 76 microns [0.003 in] in diameter. One micron measures 0.001 mm [0.00004 in.]. The contaminants being filtered out are smaller than can be seen with the human eye, a magnifying glass, or a low powered microscope.

The tools used for fuel system troubleshooting and repair are to be cleaned regularly to avoid contamination. Like fuel system parts, tools that are coated with oil or fuel attract airborne contaminants. Remember the following points regarding your fuel system tools:

- Fuel system tools are to be kept as clean as possible.
- Clean and dry the tools before returning them to the tool box.
- If possible, store fuel system tools in sealed containers.
- Make sure fuel system tools are clean before use.

# Acronyms and Abbreviations

## General Information

The following list contains some of the acronyms and abbreviations used in this manual.

| | |
|---|---|
| **ANSI** | American National Standards Institute |
| **API** | American Petroleum Institute |
| **ASTM** | American Society of Testing and Materials |
| **ATDC** | After Top Dead Center |
| **BTU** | British Thermal Unit |
| **BTDC** | Before Top Dead Center |
| **°C** | Celsius |
| **CAN** | Controller Area Network |
| **CO** | Carbon Monoxide |
| **CCA** | Cold Cranking Amperes |
| **CARB** | California Air Resources Board |
| **C.I.B.** | Customer Interface Box |
| **C.I.D.** | Cubic Inch Displacement |
| **CNG** | Compressed Natural Gas |
| **CPL** | Control Parts List |
| **cSt** | Centistokes |
| **DEF** | Diesel Exhaust Fluid |
| **DOC** | Diesel Oxidation Catalyst |
| **DPF** | Diesel Particulate Filter |
| **ECM** | Engine Control Module |
| **EFC** | Electronic Fuel Control |
| **EGR** | Exhaust Gas Recirculation |
| **EPA** | Environmental Protection Agency |
| **°F** | Fahrenheit |
| **ft-lb** | Foot-Pound Force |
| **FMI** | Failure Mode Indentifier |
| **GVW** | Gross Vehicle Weight |
| **Hg** | Mercury |
| **hp** | Horsepower |
| $H_2O$ | Water |
| **inHg** | Inches of Mercury |
| in $H_20$ | Inches of Water |
| **ICM** | Ignition Control Module |
| **IEC** | International Electrotechnical Commission |
| **km/l** | Kilometers per Liter |
| **kPa** | Kilopascal |
| **LNG** | Liquid Natural Gas |
| **LPG** | Liquified Petroleum Gas |
| **LTA** | Low Temperature Aftercooling |
| **MCRS** | Modular Common Rail System |
| **MIL** | Malfunction Indicator Lamp |
| **MPa** | Megapascal |
| **mph** | Miles Per Hour |
| **mpq** | Miles Per Quart |
| **N•m** | Newton-meter |

| | |
|---|---|
| **NOx** | Mono-Nitrogen Oxides |
| **NG** | Natural Gas |
| **O2** | Oxygen |
| **OBD** | On-Board Diagnostics |
| **OEM** | Original Equipment Manufacturer |
| **OSHA** | Occupational Safety and Health Administration |
| **PID** | Parameter Identification Descriptions |
| **ppm** | Parts Per Million |
| **psi** | Pounds Per Square Inch |
| **PTO** | Power Takeoff |
| **REPTO** | Rear Power Take Off |
| **RGT** | Rear Gear Train |
| **rpm** | Revolutions Per Minute |
| **SAE** | Society of Automotive Engineers |
| **SCA** | Supplemental Coolant Additive |
| **SCR** | Selective Catalytic Reduction |
| **STC** | Step Timing Control |
| **SID** | Subsystem Identification Descriptions |
| **TDC** | Top Dead Center |
| **VDC** | Volts of Direct Current |
| **VGT** | Variable Geometry Turbocharger |
| **VS** | Variable Speed |
| **VSS** | Vehicle Speed Sensor |

# Section TF - Troubleshooting Fault Codes

## Section Contents

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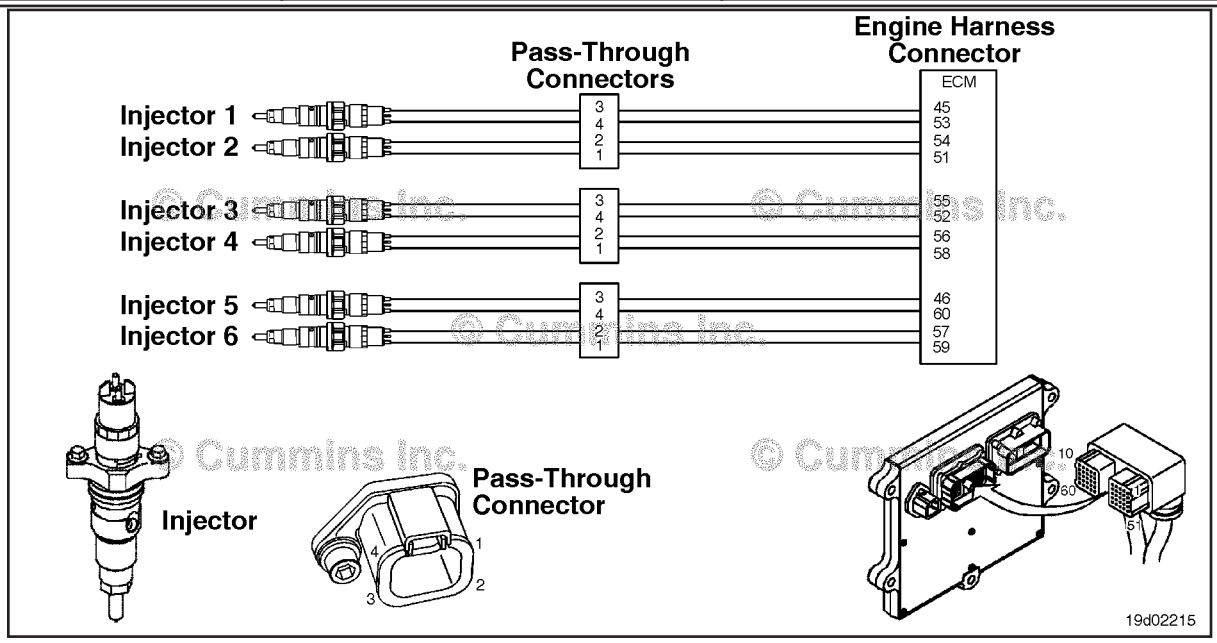
# Fault Code 351

## Injector Power Supply - Bad Intelligent Device or Component

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 351<br>PID(P), SID(S): S254<br>SPN: 627<br>FMI: 12<br>Lamp: Amber<br>SRT: | Injector Power Supply - Bad Intelligent Device or Component. The ECM measured injector boost voltage is low. | Possible smoke, low power, engine misfire, and/or engine will **not** start. |




Injector Circuit

**Circuit Description:**

Between each injection event, the electronic control module (ECM) attempts to recharge the injector power supply. The injector power supply consists of a bank of capacitors; this power supply is maintained at high voltage. Recharging is accomplished by recovering energy stored in the injector solenoids. For the injector power supply to remain fully charged, there **must** be good ECM battery power and ground, a good engine speed sensor, and good injector circuits.

**Component Location:**

The injector power supply is located inside the ECM.

**Shop Talk:**

This fault code will become active when the engine is running, the primary engine speed sensor signal is present, the battery charge is above a minimum threshold, and, at the same time, the measured injector power supply voltage is lower than the commanded injector power supply voltage.

This fault code will become inactive whenever the keyswitch is turned on.

This fault code will become inactive whenever the engine is running and measured injector power supply voltage reaches the commanded injector power supply voltage. These parameters can be monitored using INSITE™ electronic service tool.

## Refer to Troubleshooting Fault Code t05-351

# FAULT CODE 351 - Injector Power Supply - Bad Intelligent Device or Component

## TROUBLESHOOTING SUMMARY

**⚠WARNING⚠**

**Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.**

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3164133 - male Deutsch™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Read the fault codes. | Fault Code 322, 323, 324, 325, 331, and 332 active during engine operation? | |
| **STEP 2:** | **Check the ECM power supply.** | | |
| STEP 2A: | Inspect the ECM power supply connectors and fuses. | Damage observed? | |
| STEP 2B: | Check for an open circuit. | Less than 0.5 ohms? | |
| STEP 2C: | Check for an open circuit in the ECM power supply circuit. | Less than 10 ohms? | |
| **STEP 3:** | **Validate the occurrence of this fault code.** | | |
| STEP 3A: | Operate the engine and determine if fault code condition exists. | Fault Code 351 reoccurs during engine operation, while injector Fault Code 322, 323, 324, 325, 331, and 332 do not occur? | |
| **STEP 4:** | **Clear the fault codes.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 351 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 322, 323, 324, 325, 331, and 332 active during engine operation?<br>**YES** | Appropriate fault code troubleshooting tree |
| | Fault Code 322, 323, 324, 325, 331, and 332 active during engine operation?<br>**NO** | 2A |

### STEP 2: Check the ECM power supply.

**STEP 2A: Inspect the ECM power supply connectors and fuses.**

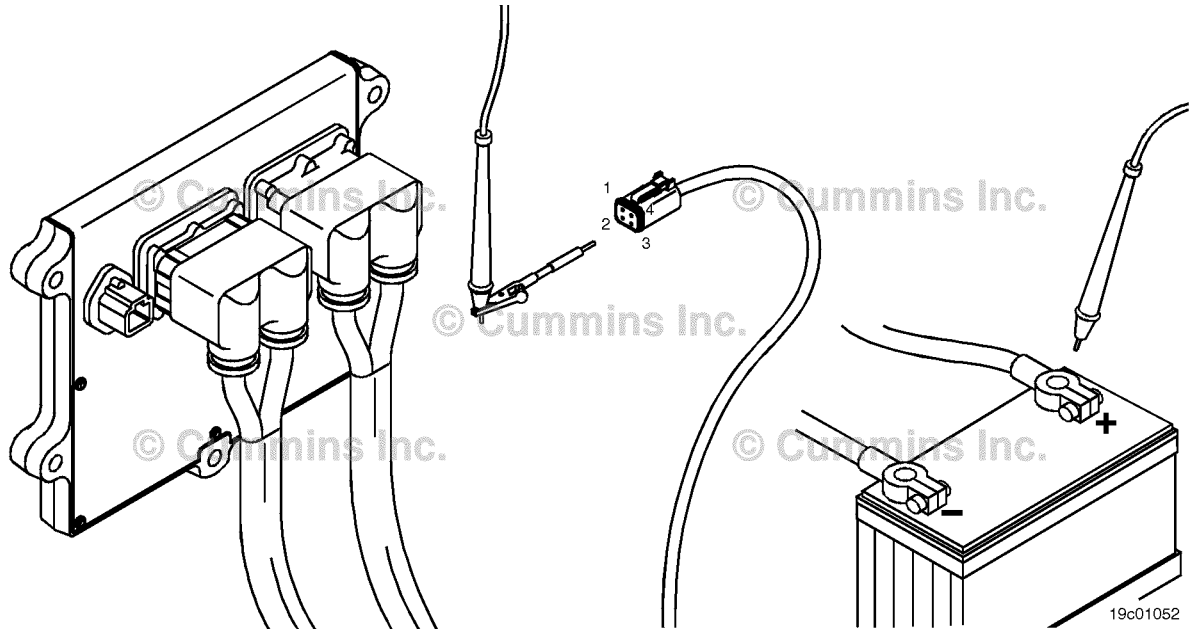
**Condition:**
- Turn keyswitch OFF.
- Disconnect the ECM power supply harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the ECM power supply and fuses connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Damage observed?<br>**YES**<br>**Repair:**<br>Clean the connector and pins. Repair or replace the damaged harness, pins, fuses, or connectors. Refer to Procedure 019-043 in Section 19. | 4A |
| | Damage observed?<br>**NO** | 2B |

**STEP 2B: Check for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the ECM power supply harness from the ECM.

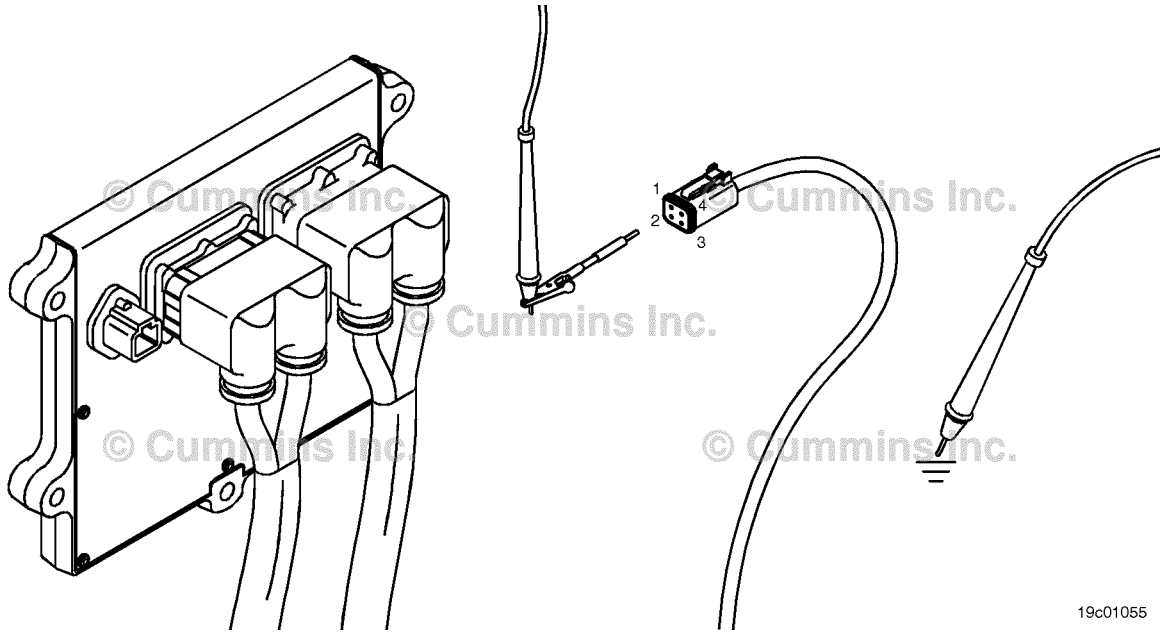
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the ECM battery SUPPLY (+) pins at the power connector of the ECM power supply harness and the battery positive (+) pins at the battery positive (+) connection.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 0.5 ohms?<br>**YES** | 2C |
| | Less than 0.5 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the ECM power supply harness, fuses, or fuse holders, or clean the battery terminal connections. | 4A |



**STEP 2C: Check for an open circuit in the ECM power supply circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the ECM power supply harness from the ECM.
- Disconnect the ECM power supply harness from the battery terminals.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit in the ECM power supply circuit.<br>• Measure the resistance between the battery negative (-) pins at the ECM power supply connector to engine block ground.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3A |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the ECM power supply harness, fuses, or fuse holders, or clean the battery terminal connections. | 4A |



## STEP 3: Validate the occurrence of this fault code.

**STEP 3A: Operate the engine and determine if fault code condition exists.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Operate the engine and determine whether the fault code condition still exists.<br>• Operate the engine at high idle, no load.<br>• Use INSITE™ electronic service tool to read the fault codes.<br>NOTE: The INSITE™ electronic service tool can also be used to monitor ECM power supply and injector power supply voltages. | Fault Code 351 reoccurs during engine operation, while injector Fault Code 322, 323, 324, 325, 331, and 332 do **not** occur?<br>**YES**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |
| | Fault Code 351 reoccurs during engine operation, while injector Fault Code 322, 323, 324, 325, 331, and 332 do **not** occur?<br>**NO**<br>**Repair:**<br>A marginal battery voltage condition is possible. Make sure that the batteries are fully charged. | 4A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 351 inactive?<br>**YES** | 4B |
| | Fault Code 351 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 352

## Sensor Supply Voltage Number 1 Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 352<br>PID(P), SID(S): S212<br>SPN: 1079<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Sensor Supply Voltage Number 1 Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected at sensor supply number 1 circuit. | Engine power derate. |

**Circuit Description:**

The sensor supply voltage number 1 of the electronic control module (ECM) provides (+) 5 volt supply for the barometric pressure sensor. On engines with a variable geometry turbocharger, this circuit also provides voltage to the turbocharger speed sensor and the turbocharger position sensor on the engine harness. This circuit also includes the return of all the sensors listed above, as well as the engine coolant temperature and recirculated exhaust gas temperature sensor. This +5 volt supply also powers three optional OEM sensors. The three sensors are digital vehicle speed sensor, remote accelerator sensor, and OEM pressure sensor. If these three sensors are **not** present, the OEM might have wired in other devices which require a +5 volt source.

**Component Location:**

The sensor supply number 1 is located in the ECM. The supply voltage is spliced off in the engine and OEM harness to each sensor it supports.

**Shop Talk:**

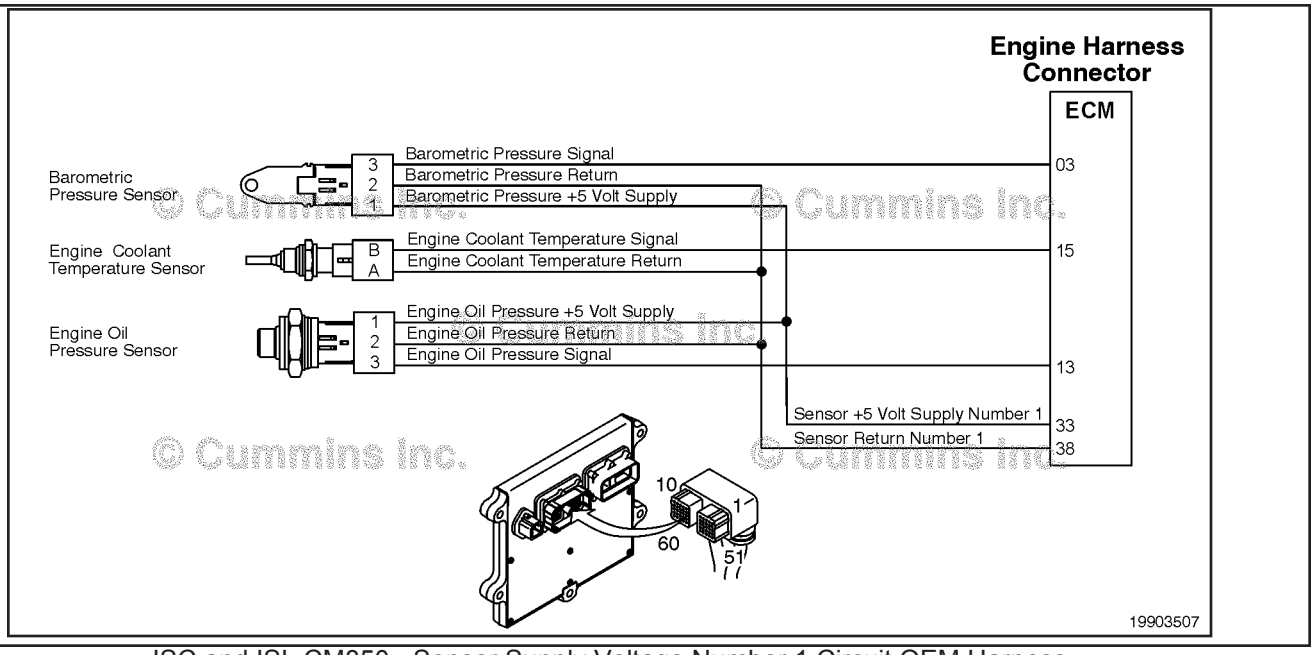
Low voltage on the (+) 5 volt supply line can be caused by a short circuit to ground in a supply line, a short circuit between a supply line and a return line, a failed sensor, or a failed ECM power supply.

On-Board Diagnostics (OBD) Information (Euro 4 Certified Engines):

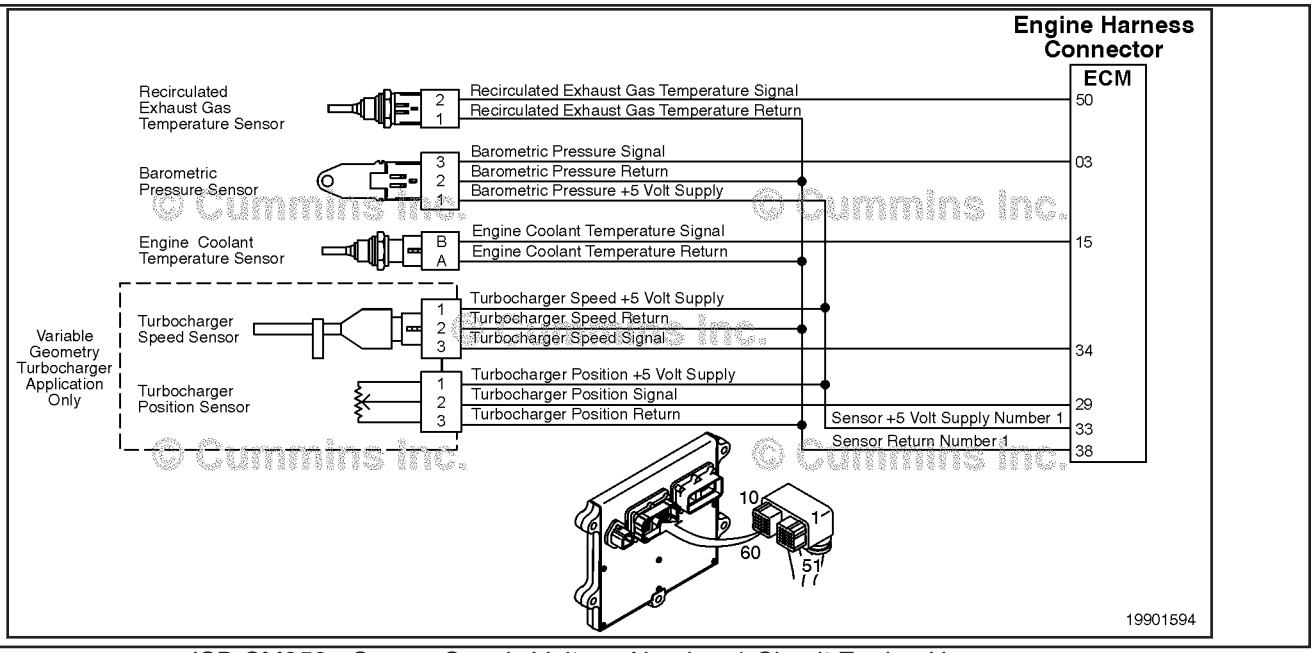
- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ electronic service tool.
- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

On-Board Diagnostics (OBD) Information (Euro 4 Stage 1+ Certified Engines):

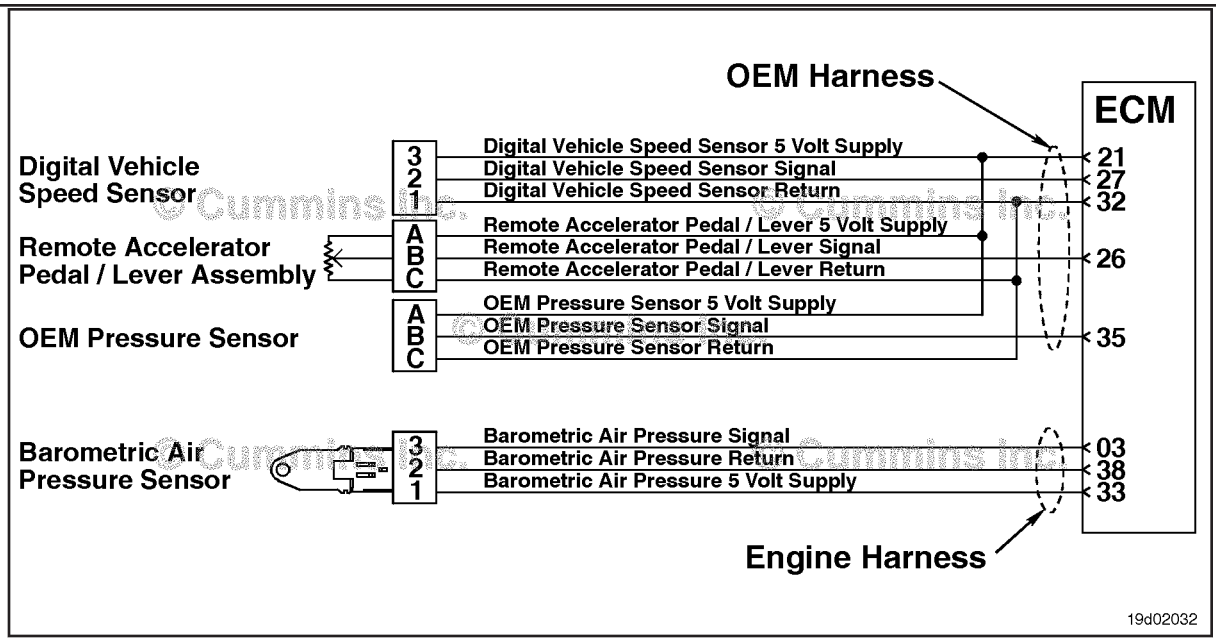
- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- An engine torque derate will be activated after 50 hours of engine operation with the fault code active.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 1 ignition cycle that the diagnostic runs and does **not** fail. The MIL lamp **cannot** be cleared using the INSITE™ electronic service tool.
- The fault code will be cleared from memory after 400 days or 9600 hours of engine operation.




ISC and ISL CM850 - Sensor Supply Voltage Number 1 Circuit OEM Harness




ISB CM850 - Sensor Supply Voltage Number 1 Circuit Engine Harness




ISBe CM850 / ISLe CM850 / QSB4.5, QSB5.9, QSB6.7 CM850 / QSC8.3 CM850/ QSL9 CM850 - Sensor Supply Voltage Number 1 Circuit Engine Harness

**Refer to Troubleshooting Fault Code t05-352**

# FAULT CODE 352 - Sensor Supply Voltage Number 1 Circuit - Voltage Below Normal or Shorted to Low Source
## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 352 active?** | |
| **STEP 2:** | **Check the sensors and circuits connected to the sensor number 1 supply and return.** | | |
| **STEP 2A:** | **Inspect the barometric pressure sensor and circuit connected to the sensor number 1 supply and return.** | **Dirty or damaged pins?** | |
| **STEP 2A-1:** | **Check the circuit response.** | **Fault Code 352 active?** | |
| **STEP 2B:** | **Inspect the engine coolant temperature sensor and circuit connected to the sensor number 1 return.** | **Dirty or damaged pins?** | |
| **STEP 2B-1:** | **Check the circuit response.** | **Fault Code 352 active?** | |
| **STEP 2C:** | **For engines equipped with recirculated exhaust gas, inspect the recirculated exhaust gas temperature sensor and circuit connected to the sensor number 1 return.** | **Dirty or damaged pins?** | |
| **STEP 2C-1:** | **Check the circuit response.** | **Fault Code 352 active?** | |
| **STEP 2D:** | **For engines equipped with variable geometry turbochargers, inspect the turbocharger speed sensor and circuit connected to the sensor number 1 supply and return.** | **Dirty or damaged pins?** | |
| **STEP 2D-1:** | **Check the circuit response.** | **Fault Code 352 active?** | |
| **STEP 2E:** | **For engines equipped with variable geometry turbochargers, inspect the turbocharger position sensor and circuit connected to the sensor number 1 supply and return.** | **Dirty or damaged pins?** | |
| **STEP 2E-1:** | **Check the circuit response.** | **Fault Code 352 active?** | |
| **STEP 2F:** | **Inspect the OEM pressure sensor and circuit connected to the sensor number 1 supply and return.** | **Dirty or damaged pins?** | |

| | | |
|---|---|---|
| **STEP 2F-1:** | **Check the circuit response.** | **Fault Code 352 active?** |
| **STEP 2G:** | **Inspect the digital vehicle speed sensor and circuit connected to the sensor number 1 supply and return.** | **Dirty or damaged pins?** |
| **STEP 2G-1:** | **Check the circuit response.** | **Fault Code 352 active?** |
| **STEP 2H:** | **Inspect the remote accelerator position sensor and circuit connected to the sensor number 1 supply and return.** | **Dirty or damaged pins?** |
| **STEP 2H-1:** | **Check the circuit response.** | **Fault Code 352 active?** |

## STEP 3: Check the ECM.

| | | |
|---|---|---|
| **STEP 3A:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** |
| **STEP 3B:** | **Check the circuit response.** | **Fault Code 352 active?** |
| **STEP 3C:** | **Inspect the vehicle for optional OEM devices.** | **OEM devices installed?** |
| **STEP 3D:** | **Inspect the ECM and OEM harness connector pins.** | **Dirty or damaged pins?** |
| **STEP 3E:** | **Check the OEM harness for short circuit to ground.** | **Greater than 100k ohms?** |
| **STEP 3F:** | **Check the OEM harness for short circuit pin-to-pin.** | **Greater than 100k ohms?** |
| **STEP 3G:** | **Check for a short circuit in the OEM harness ECM battery (-) circuit.** | **Greater than 100k ohms?** |

## STEP 4: Clear the fault codes.

| | | |
|---|---|---|
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 352 inactive?** |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 2A |
| | Fault Code 352 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the sensors and circuits connected to the sensor number 1 supply and return.

**STEP 2A: Inspect the barometric pressure sensor and circuit connected to the sensor number 1 supply and return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the barometric pressure sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the connector or engine harness.<br>Repair the damaged pins. Repair or replace the engine harness with the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2A-1 |

**STEP 2A-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the barometric pressure sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 2B |
| | Fault Code 352 active?<br>**NO**<br>**Repair:**<br>Replace the barometric pressure sensor. Refer to Procedure 019-004 in Section 19. | 4A |

**STEP 2B: Inspect the engine coolant temperature sensor and circuit connected to the sensor number 1 return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine coolant temperature sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the connector or engine harness.<br>Repair the damaged pins. Repair or replace the engine harness with the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B-1 |

**STEP 2B-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine coolant temperature sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 2C |
| | Fault Code 352 active?<br>**NO**<br>**Repair:**<br>Replace the engine coolant temperature sensor. Refer to Procedure 019-019 in Section 19. | 4A |

**STEP 2C: For engines equipped with recirculated exhaust gas, inspect the recirculated exhaust gas temperature sensor and circuit connected to the sensor number 1 return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the recirculated exhaust gas temperature sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the engine harness.<br>Repair the damaged pins. Repair or replace the engine harness with the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2C-1 |

**STEP 2C-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the EGR temperature sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 2D |
| | Fault Code 352 active?<br>**NO**<br>**Repair:**<br>Replace the EGR temperature sensor. Refer to Procedure 019-378 in Section 19. | 4A |

**STEP 2D: For engines equipped with variable geometry turbochargers, inspect the turbocharger speed sensor and circuit connected to the sensor number 1 supply and return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger speed sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the connector or engine harness.<br>Repair the damaged pins. Repair or replace the engine harness with the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2D-1 |

**STEP 2D-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger speed sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 2E |
| | Fault Code 352 active?<br>**NO**<br>**Repair:**<br>Replace the turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. | 4A |

**STEP 2E: For engines equipped with variable geometry turbochargers, inspect the turbocharger position sensor and circuit connected to the sensor number 1 supply and return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger position sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the engine harness.<br>Repair the damaged pins. Repair or replace the engine harness with the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2E-1 |

**STEP 2E-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger position sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 2F |
| | Fault Code 352 active?<br>**NO**<br>**Repair:**<br>Replace the turbocharger position sensor. Refer to Procedure 019-405 in Section 19. | 4A |

**STEP 2F: Inspect the OEM pressure sensor and circuit connected to the sensor number 1 supply and return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM pressure sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the engine harness.<br>Repair the damaged pins. Repair or replace the engine harness with the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2F-1 |

**STEP 2F-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM pressure sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 2G |
| | Fault Code 352 active?<br>**NO**<br>**Repair:**<br>Replace the OEM pressure sensor. Refer to Procedure 019-400 in Section 19. | 4A |

**STEP 2G: Inspect the digital vehicle speed sensor and circuit connected to the sensor number 1 supply and return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the digital vehicle speed sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the OEM harness.<br>Repair the damaged pins. Repair or replace the engine harness with the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2G-1 |

**STEP 2G-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the digital vehicle speed sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 2H |
| | Fault Code 352 active?<br>**NO**<br>**Repair:**<br>Replace the digital vehicle speed sensor. Refer to the OEM service manual. | 4A |

**STEP 2H: Inspect the remote accelerator position sensor and circuit connected to the sensor number 1 supply and return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the remote accelerator position sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the OEM harness.<br>Repair the damaged pins. Repair or replace the engine harness with the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2H-1 |

**STEP 2H-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the remote accelerator position sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 3A |
| | Fault Code 352 active?<br>**NO**<br>**Repair:**<br>Replace the remote accelerator position sensor. Refer to the OEM service manual. | 4A |

## STEP 3: Check the ECM.

**STEP 3A: Inspect the ECM and engine harness connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Repair the damaged pins. Repair or replace the engine harness, OEM harness, or replace the ECM, whichever has the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Replace the OEM harness. Refer to the OEM service manual.<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 352 active?<br>**YES** | 3C |
| | Fault Code 352 active?<br>**NO**<br>**Repair:**<br>There is a short in the engine harness pulling the sensor supply voltage down.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

**STEP 3C: Inspect the vehicle for optional OEM devices.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| OEM devices, digital vehicle speed sensor, remote accelerator position sensor, and OEM pressure sensor share a +5 volt supply with sensors on the engine harness.<br>• Check the vehicle for a digital vehicle speed sensor, remote accelerator position sensor, or OEM pressure sensor. | OEM devices installed?<br>**YES** | 3D |
| | OEM devices installed?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | Repair complete |

**STEP 3D: Inspect the ECM and OEM harness connector pins.**

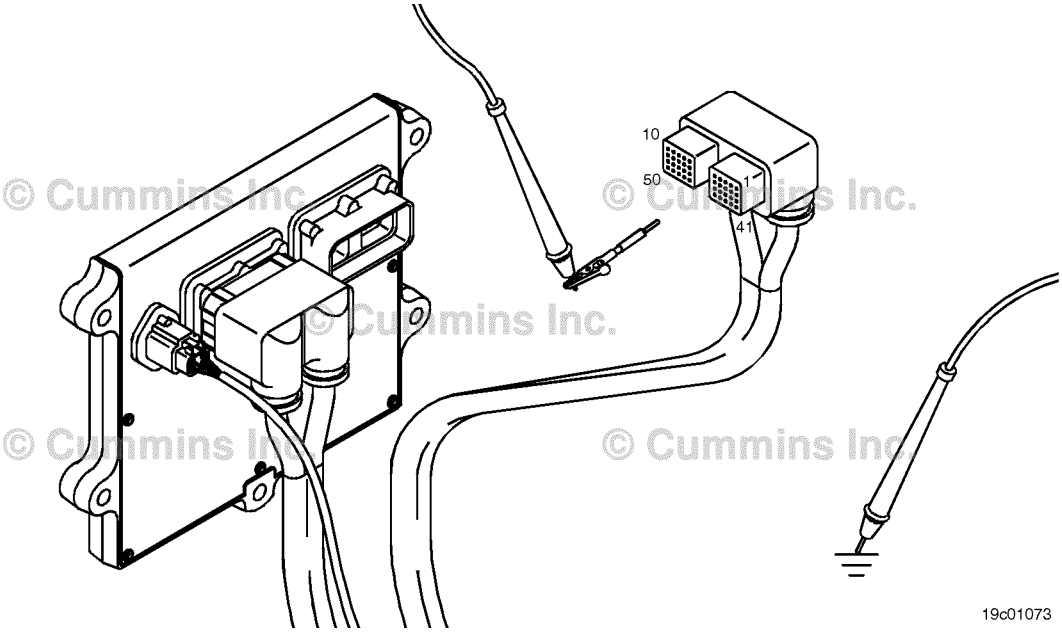
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Repair the damaged pins. Repair or replace the engine harness, OEM harness, or replace the ECM, whichever has the damaged pins.<br>• Refer to Procedure 019-071 in Section 19.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br><br>Replace the OEM harness. Refer to the OEM service manual.<br><br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3E |

**STEP 3E: Check the OEM harness for short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the digital vehicle speed sensor from the OEM harness, if equipped.
- Disconnect the remote accelerator position sensor from the OEM harness, if equipped.
- Disconnect the OEM pressure sensor from the OEM harness, if equipped.

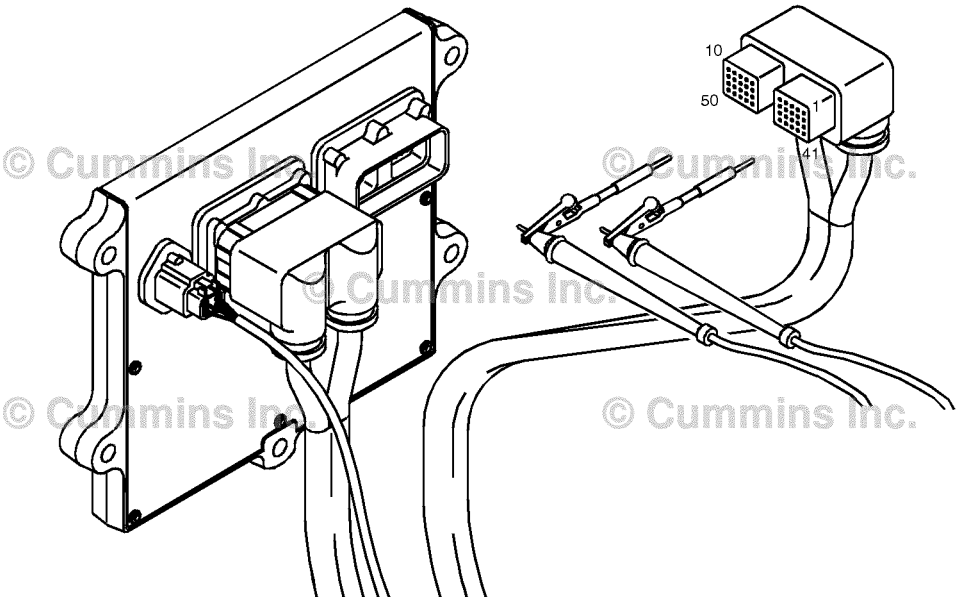
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the OEM harness for a short circuit to ground.<br>• Measure the resistance between the OEM +5 volt SUPPLY pin at the OEM harness ECM connector and engine block ground.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3F |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>There is a short to ground in the OEM harness.<br>A damaged connection has been detected in the engine harness.<br>• Repair the damaged pins. Repair or replace the engine harness with the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3F: Check the OEM harness for short circuit pin-to-pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the digital vehicle speed sensor from the OEM harness, if equipped.
- Disconnect the remote accelerator position sensor from the OEM harness, if equipped.
- Disconnect the remote accelerator position sensor from the OEM harness, if equipped.
- Disconnect the OEM pressure sensor from the OEM harness, if equipped.

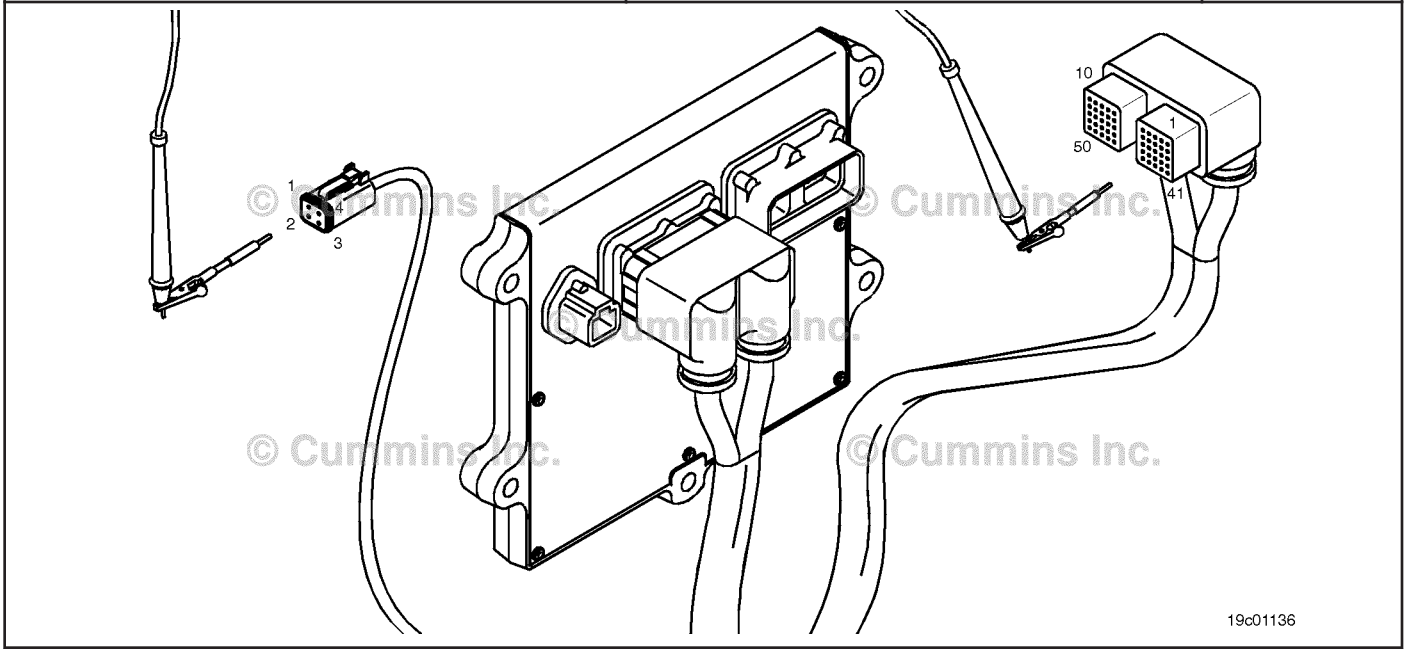
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the OEM harness for a short circuit pin-to-pin.<br>• Measure the resistance between the OEM +5 volt SUPPLY pin at the OEM harness ECM connector to all other pins in the connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3G |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3G: Check for a short circuit in the OEM harness ECM battery (-) circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the engine harness battery supply connector from the ECM.
- Disconnect the digital vehicle speed sensor from the OEM harness, if equipped.
- Disconnect the remote accelerator position sensor from the OEM harness, if equipped.
- Disconnect the OEM pressure sensor from the OEM harness, if equipped.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the resistance between the OEM +5 volt SUPPLY pin in the OEM harness ECM connector and the ECM battery (-) pins in the ECM power connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | Repair complete |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 352 inactive?<br>**YES** | 4B |
| | Fault Code 352 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a Cummins® Authorized Repair location if all steps have been completed and checked again. | 1A |

### STEP 4B: Clear the inactive fault codes.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooti ng steps |

# Fault Code 386

## Sensor Supply Voltage number 1 Circuit - Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 386<br>PID(P), SID(S): S212<br>SPN: 1079<br>FMI: 3/3<br>Lamp: Amber<br>SRT: | Sensor Supply Voltage number 1 Circuit - Voltage Above Normal or Shorted to High Source. High voltage detected at sensor supply number 1 circuit. | Engine power derate. |

**Circuit Description:**

The sensor supply voltage number 1 of the engine control module (ECM) provides (+) 5 VDC supply for the barometric pressure sensor on the engine harness. This +5 VDC supply also powers three optional OEM devices. The three devices are digital vehicle speed sensor, remote accelerator position sensor, and OEM pressure sensor.

**Component Location:**

The sensor supply number 1 is located in the ECM. The supply voltage is spliced off in the engine and OEM harness to each sensor it supports.

**Shop Talk:**

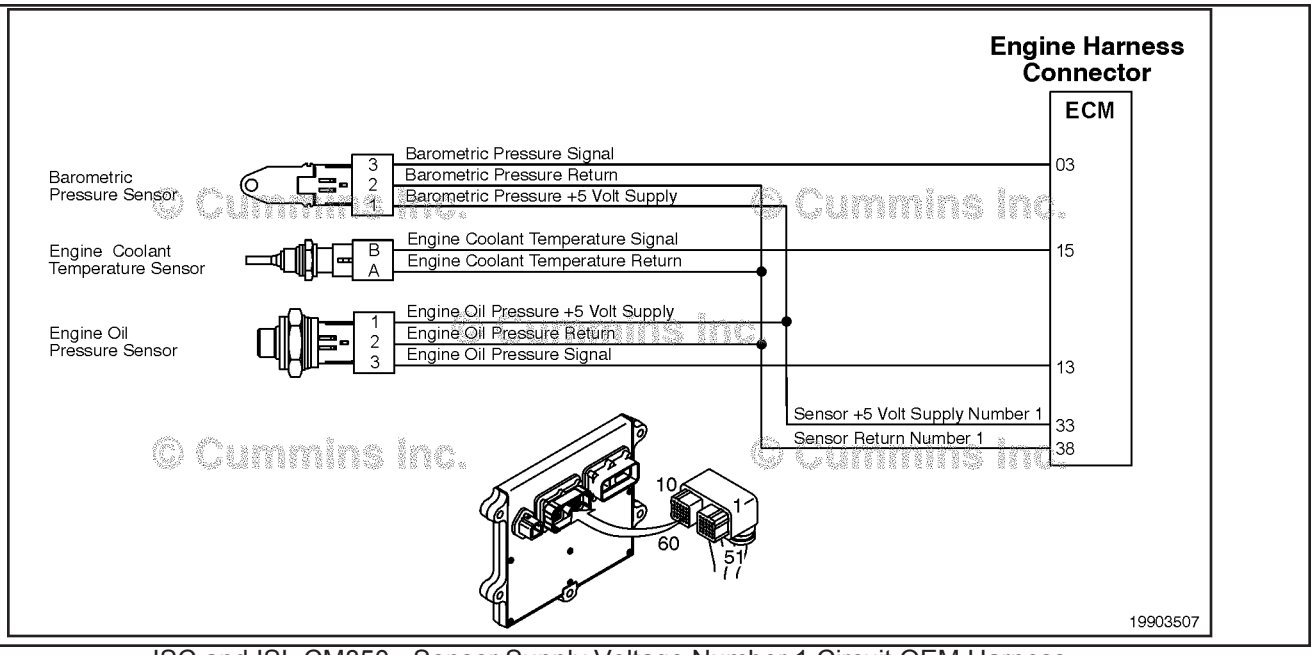
High voltage on the sensor supply line can be caused by an individual sensor supply wire in the harness shorted to battery voltage or a failed ECM power supply.

On-Board Diagnostics (OBD) Information (Euro 4 Certified Engines):

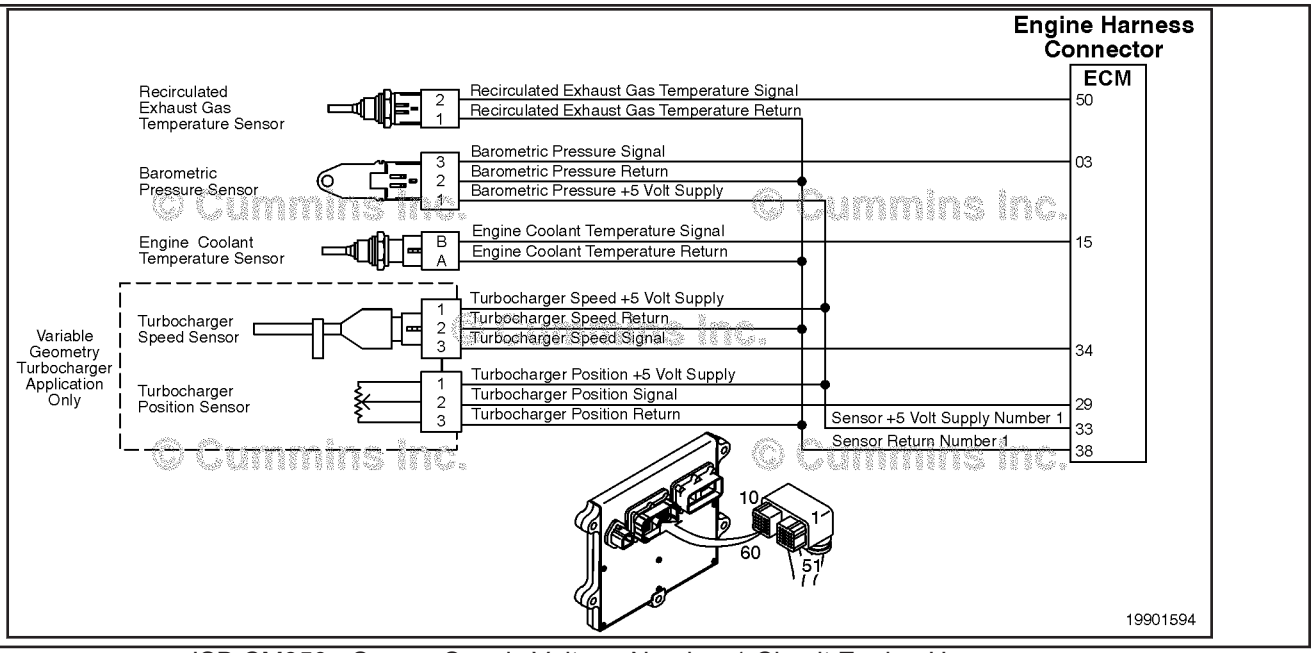
- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

On-Board Diagnostics (OBD) Information (Euro 4 Stage 1+ Certified Engines):

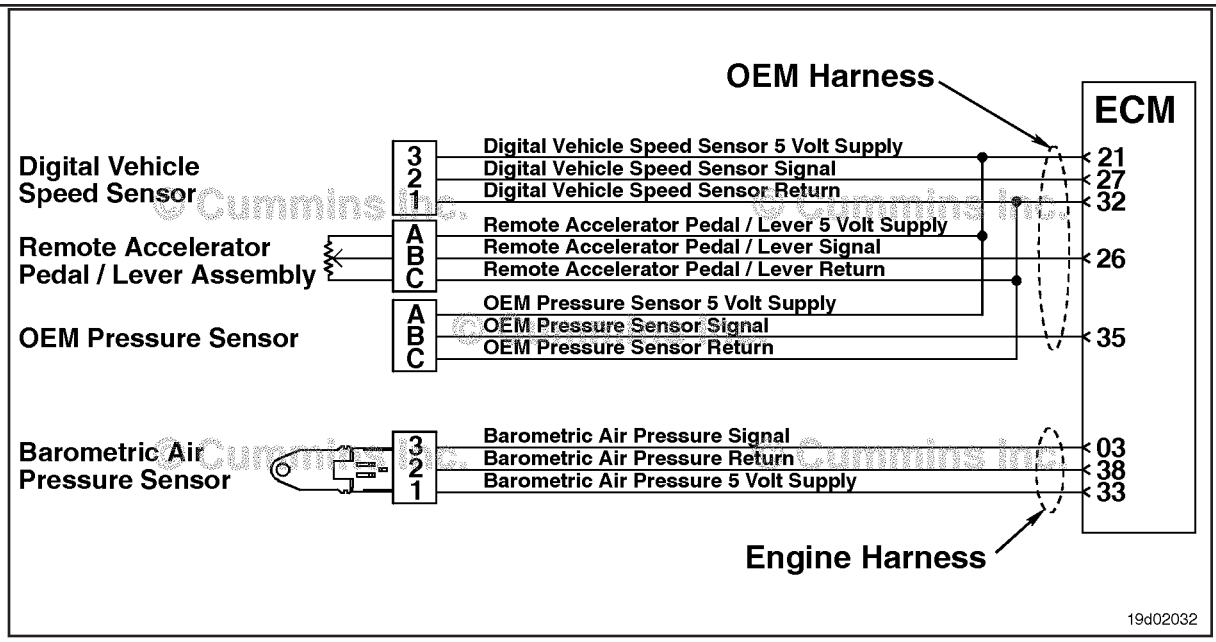
- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- An engine torque derate will be activated after 50 hours of engine operation with the fault code active.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 1 ignition cycle that the diagnostic runs and does **not** fail. The MIL lamp **cannot** be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 400 days or 9600 hours of engine operation.




ISC and ISL CM850 - Sensor Supply Voltage Number 1 Circuit OEM Harness




ISB CM850 - Sensor Supply Voltage Number 1 Circuit Engine Harness




ISBe CM850 / ISLe CM850 / QSB4.5, QSB5.9, QSB6.7 CM850 / QSC8.3 CM850/ QSL9 CM850 - Sensor Supply Voltage Number 1 Circuit

**Refer to Troubleshooting Fault Code t05-386**

# FAULT CODE 386 - Sensor Supply Voltage number 1 Circuit - Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3164133 - male Deutsch™ test lead and Part Number 3822758 - male Deutsch™/ AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 386 active?** | |
| **STEP 2:** | **Check the ECM and engine harness.** | | |
| **STEP 2A:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault Code 386 active?** | |
| **STEP 3:** | **Check the OEM +5-VDC supply.** | | |
| **STEP 3A:** | **Inspect the vehicle for optional OEM devices.** | **Digital vehicle speed sensor or remote accelerator sensor installed?** | |
| **STEP 3B:** | **Inspect ECM and OEM harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3C:** | **Check the OEM harness for a short circuit pin to pin.** | **Greater than 100k ohms?** | |
| **STEP 3D:** | **Check the OEM harness for a short circuit to ECM battery (+).** | **Greater than 100k ohms?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 386 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 386 active?<br>**YES** | 2A |
| | Fault Code 386 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the ECM.

**STEP 2A: Inspect the ECM and engine harness connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 386 active?<br>**YES** | 3A |
| | Fault Code 386 active?<br>**NO**<br>**Repair:**<br>There is a short in the engine harness causing the sensor +5-VDC supply line to have too high a voltage.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

## STEP 3: Check the OEM +5 VDC supply.

**STEP 3A: Inspect the vehicle for optional OEM devices.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| OEM devices, digital vehicle speed sensor, and remote accelerator position sensor share a +5-VDC supply with sensors on the engine harness.<br>• Check the vehicle for a digital vehicle speed sensor or remote accelerator position sensor. | Digital vehicle speed sensor or remote accelerator sensor installed?<br>**YES** | 3B |
| | Digital vehicle speed sensor or remote accelerator sensor installed?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | Repair complete |

**STEP 3B: Inspect the ECM and OEM harness connector pins.**

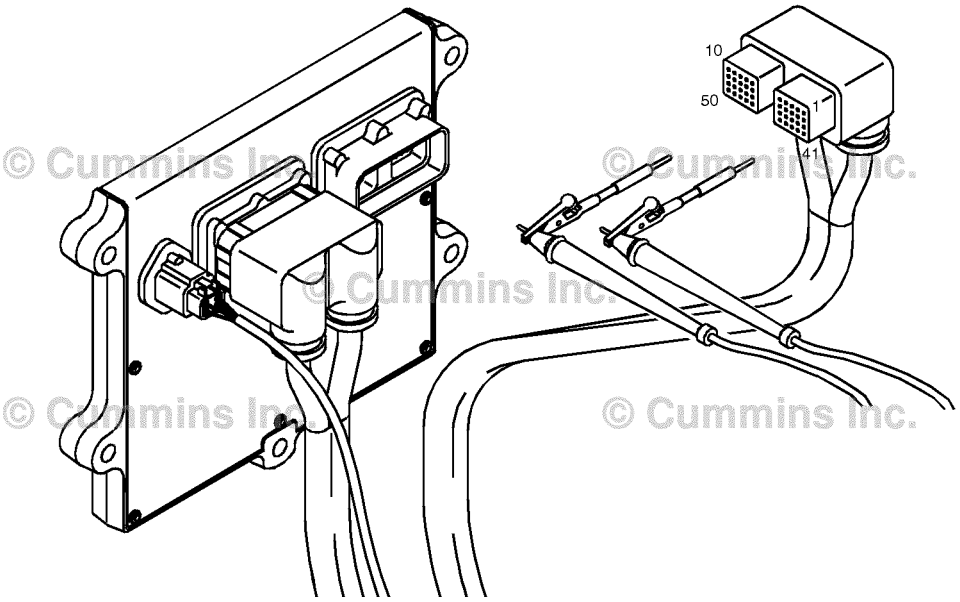
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3C |

**STEP 3C: Check the OEM harness for short circuit pin-to-pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the digital vehicle speed sensor from the OEM harness (if equipped).
- Disconnect the remote accelerator position sensor from the OEM harness (if equipped).
- Disconnect the OEM pressure sensor from the OEM harness (if equipped).

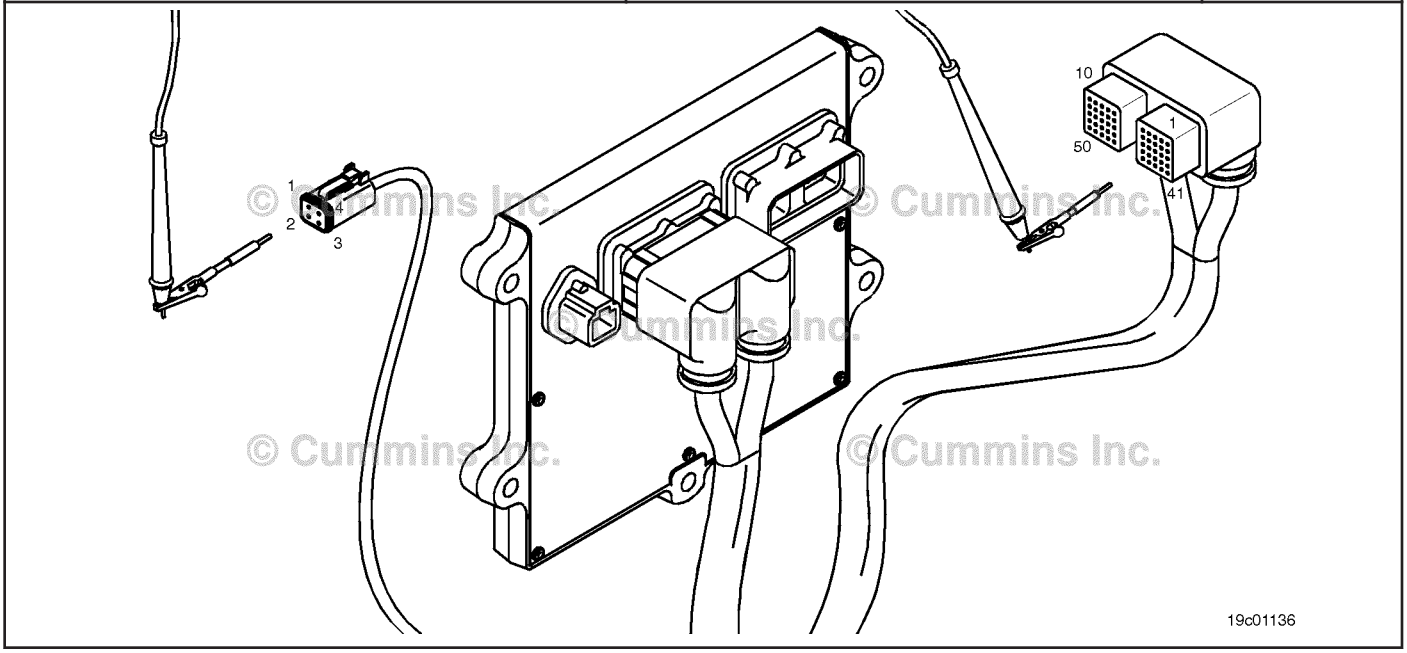
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the OEM harness for a short circuit pin-to-pin.<br>• Measure the resistance between the OEM +5-VDC SUPPLY pin at the OEM harness ECM connector to all other pins in the connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check the OEM harness for short circuit to ECM battery (+).**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the engine harness battery supply connector from the ECM.
- Disconnect the digital vehicle speed sensor from the OEM harness (if equipped).
- Disconnect the remote accelerator position sensor from the OEM harness (if equipped).
- Disconnect the OEM pressure sensor from the OEM harness (if equipped).

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ECM battery (+) in the OEM harness.<br>• Measure the resistance between the OEM +5-VDC SUPPLY pin at the OEM harness ECM connector to the ECM battery (+) pins at the ECM power connector on the engine harness battery supply.<br><br>Refer to the wiring diagram for connector pin identification.<br><br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 386 inactive?<br>**YES** | 4B |
| | Fault Code 386 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 4B: Clear the inactive fault codes.

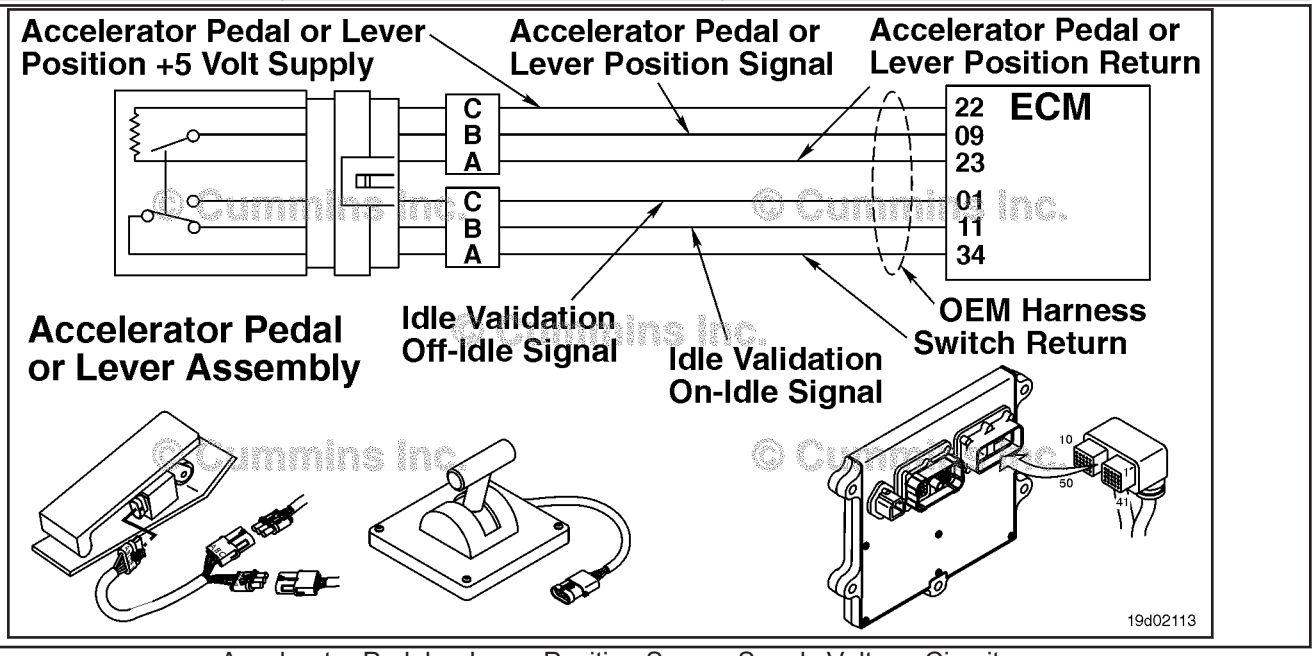
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooti ng steps |

# Fault Code 387

## Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit - Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 387<br>PID(P), SID(S): S221<br>SPN: 1043<br>FMI: 3/3<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit - Voltage Above Normal or Shorted to High Source. High voltage detected at sensor supply circuit for the accelerator pedal or lever position sensor. | Automotive and marine applications: Engine will **only** idle. |




Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit

**Circuit Description:**

The electronic control module (ECM) supplies the accelerator pedal or lever position sensor with +5 volts.

**Component Location:**

The accelerator pedal or lever assembly is located in the cab. For marine applications, the accelerator lever assembly is typically located in the engine compartment or helm.

**Shop Talk:**

This fault is logged when the ECM senses more than +5.25 volts on the accelerator pedal or lever position +5 volt supply line. This can be caused by a short circuit to a voltage source in the OEM harness or a short circuit to an actuator signal circuit that is greater than +5 volts.

## Refer to Troubleshooting Fault Code t05-387

# FAULT CODE 387 - Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit - Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3164133 - male Deutsch™/AMP™/Metri-Pack™ test lead, Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead, and Part Number 3822917 - female male Deutsch™/AMP™/ Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 387 active?** | |
| **STEP 2:** | **Check the ECM and OEM harness.** | | |
| **STEP 2A:** | **Inspect the ECM and OEM harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check for a pin-to-pin short circuit in the OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 2B-1:** | **Check for an unswitched battery supply OEM connector.** | **Dedicated unswitched battery supply OEM harness?** | |
| **STEP 2B-2:** | **Check for a pin-to-pin short circuit in the unswitched battery supply OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 3:** | **Clear the fault codes.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 387 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 387 active?<br>**YES** | 2A |
| | Fault Code 387 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the ECM and OEM harness.

**STEP 2A: Inspect the ECM and OEM harness connector pins.**

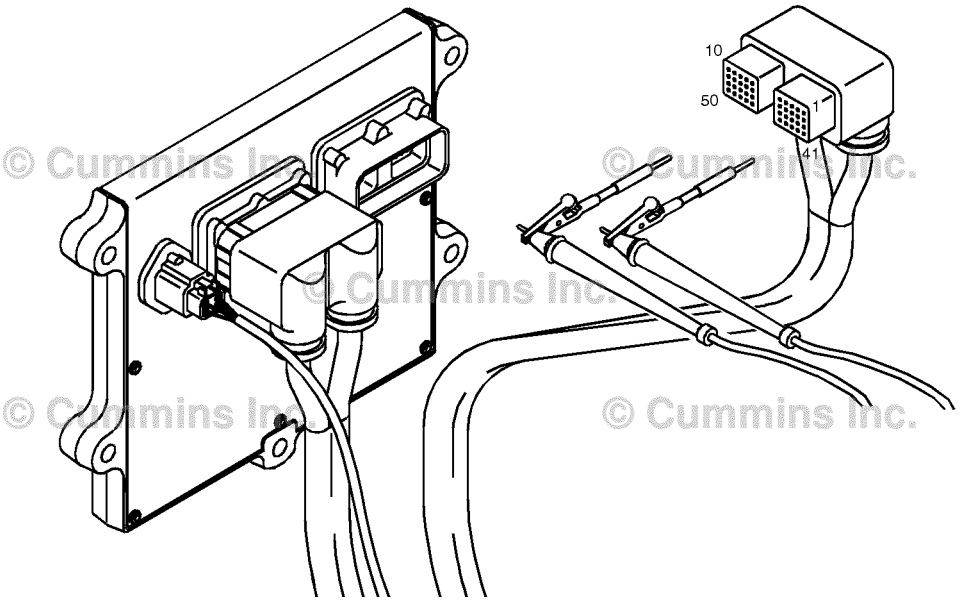
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.

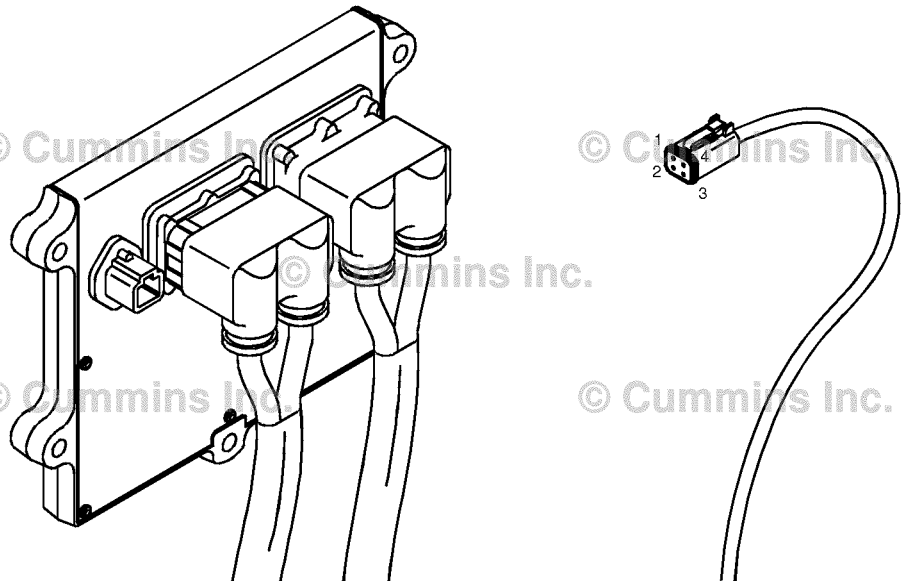
| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on one connector - pin-to-pin check:<br>Measure the resistance and check for a short circuit between the +5-VDC SUPPLY pin in the OEM harness ECM connector and all other pins in the connector:<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2B-1 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2B-1: Check for an unswitched battery supply OEM connector.**

**Condition:**
- Turn keyswitch OFF.

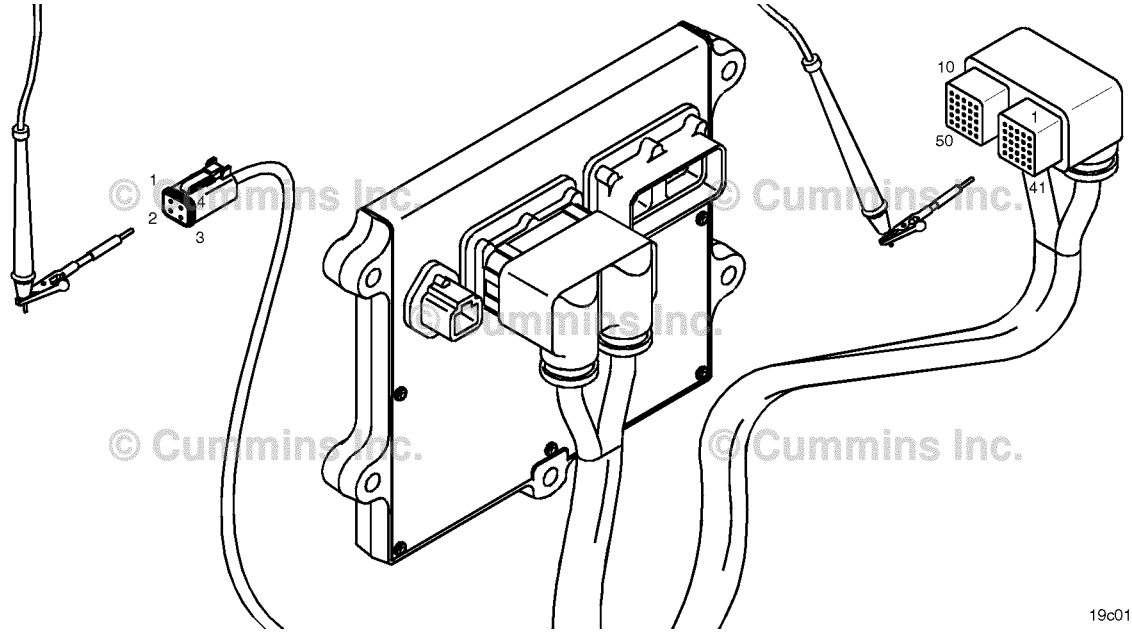
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the ECM for a dedicated unswitched battery supply OEM connector.<br>• This dedicated connector provides unswitched battery voltage to the ECM and will be in addition to the primary OEM connector. | Dedicated unswitched battery supply OEM connector?<br>**YES** | 2B-2 |
| | Dedicated unswitched battery supply OEM connector?<br>**NO** | 3A |



**STEP 2B-2: Check for a pin-to-pin short circuit in the unswitched battery supply OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.
- Disconnect the OEM power harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on two connectors - pin-to-pin check:<br>Measure the resistance and check for a short circuit between the accelerator pedal or lever position +5-VDC SUPPLY pin in the ECM OEM harness connector and the +5-VDC SUPPLY pin in the ECM power harness connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 3A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 387 inactive?<br>**YES** | 3B |
| | Fault Code 387 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 3B: Clear the inactive fault codes.

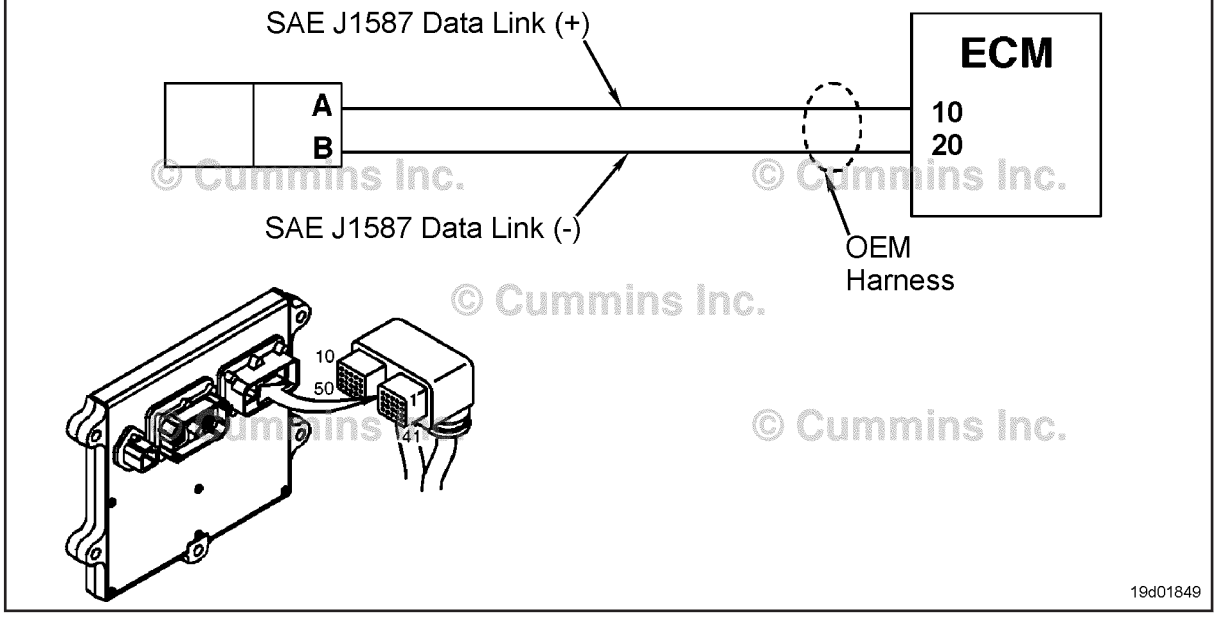
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 412

## SAE J1587/J1922 Data Link - Can Not Transmit

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 412<br>PID(P), SID(S): S250<br>SPN: 608<br>FMI: 2<br>Lamp: None<br>SRT: | SAE J1587/J1922 data link - can **not** transmit. Communication between the ECM and another device on the J1587/J1922 data link has been lost. | None on performance. Devices on the J1587/J1922 data link possibly will **not** operate. |




J1587/J1922 Data Link Circuit

**Circuit Description:**

Devices such as automatic braking system controllers, autoshift transmissions, vehicle electronic control module (ECM), automatic slip reduction systems, electronic displays, electronic information systems, electronic service tools, and Vehicle Electronic Control Units can communicate with the ECM over the J1587/J1922 data link. Messages sent from the devices are received by the ECM and used for controlling the engine. The ECM also transmits information to these devices over the J1587/J1922 data link on the 50-pin OEM harness.

**Component Location:**

The J1587/J1922 data link connector is located on the OEM harness. Refer to the OEM manual for the specific location.

**Shop Talk:**

This fault occurs whenever the ECM starts communicating with **any** other device with the J1587/J1922 data link and then can no longer transmit on the data link. Possible causes could be the following: Unplugthe electronic service tool before keying off the ECM, the J1587/J1922 data link having an intermittent electrical problem, and the ECM (or another J1587/J1922 device) tying up communications because of an electrical problem or by sending too many messages without stopping.

## Refer to Troubleshooting Fault Code t05-412

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement:Part Number 3163151 - ECM bench calibration harnessPart Number 3164185 - ECM bench calibration adapter cable.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check SAE J1587/J1922 communication.** | | |
| **STEP 1A:** | **Check for ECM communication with INSITE™ electronic service tool.** | **INSITE™ electronic service tool communicates with ECM?** | |
| **STEP 1B:** | **Inspect the OEM harness and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 1C:** | **Check ECM communication with the ECM bench calibration harness.** | **INSITE™ electronic service tool communicates with ECM?** | |
| **STEP 2:** | **Clear the fault codes.** | | |
| **STEP 2A:** | **Disable the fault code.** | **Fault Code 412 inactive?** | |
| **STEP 2B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check SAE J1587/J1922 communication.

**STEP 1A: Check for ECM communication with INSITE™ electronic service tool.**

**Condition:**
- Turn keyswitch ON.
- Connect INLINE™ II data link adapter to the vehicle SAE J1587/J1922 data link diagnostic connector.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Attempt to communicate with the ECM using INSITE™ electronic service tool.<br>• Start INSITE™ electronic service tool and connect to the ECM with an INLINE™ II (J1587/J1922) ECM connection. | INSITE™ electronic service tool communicates with ECM?<br>**YES**<br>**Repair:**<br>The ECM SAE J1587/J1922 data link circuit is functioning properly.<br>Refer to the OEM troubleshooting and repair manual for information on troubleshooting and vehicle SAE J1587/J1922 network. | Refer to the OEM troubleshooting and repair manual |
| | INSITE™ electronic service tool communicates with ECM?<br>**NO** | 1B |

**STEP 1B: Inspect the OEM harness and ECM connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins.<br>For general inspection techniques, refer to Component Connector and Pin Inspection, Refer to Procedure 019-361. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connectors, or pins if possible.<br>Refer to Resistance Measurements Using a Multimeter and Wiring Diagram, Refer to Procedure 019-360. | 2A |
| | Dirty or damaged pins?<br>**NO** | 1C |

**STEP 1C: Check ECM communication with the ECM bench calibration harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Connect the ECM bench calibration harness to the ECM.
- Connect INLINE™ II data link adapter.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Attempt to communicate with the ECM using INSITE™ electronic service tool.<br>• Start INSITE™ electronic service tool and connect to the ECM with an INLINE™ II (J1587/J1922) ECM connection. | INSITE™ electronic service tool communicates with ECM?<br>**YES**<br>**Repair:**<br>INSITE™ electronic service tool is able to communicate with the ECM. This indicates that the ECM data link circuit is functioning properly.<br>Refer to the OEM troubleshooting and repair manual for troubleshooting the vehicle SAE J1587/J1922 circuit and devices. | Refer to the OEM troubleshooting and repair manual |
| | INSITE™ electronic service tool communicates with ECM?<br>**NO** | Refer to the Communication Error - Electronic Service Tool or Control Device troubleshooting symptom tree. |

## STEP 2: Clear the fault codes.

### STEP 2A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool, verify that the fault code is inactive. | Fault Code 412 inactive?<br>**YES** | 2B |
| | Fault Code 412 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact your local Cummins Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 2B: Clear the inactive fault codes.

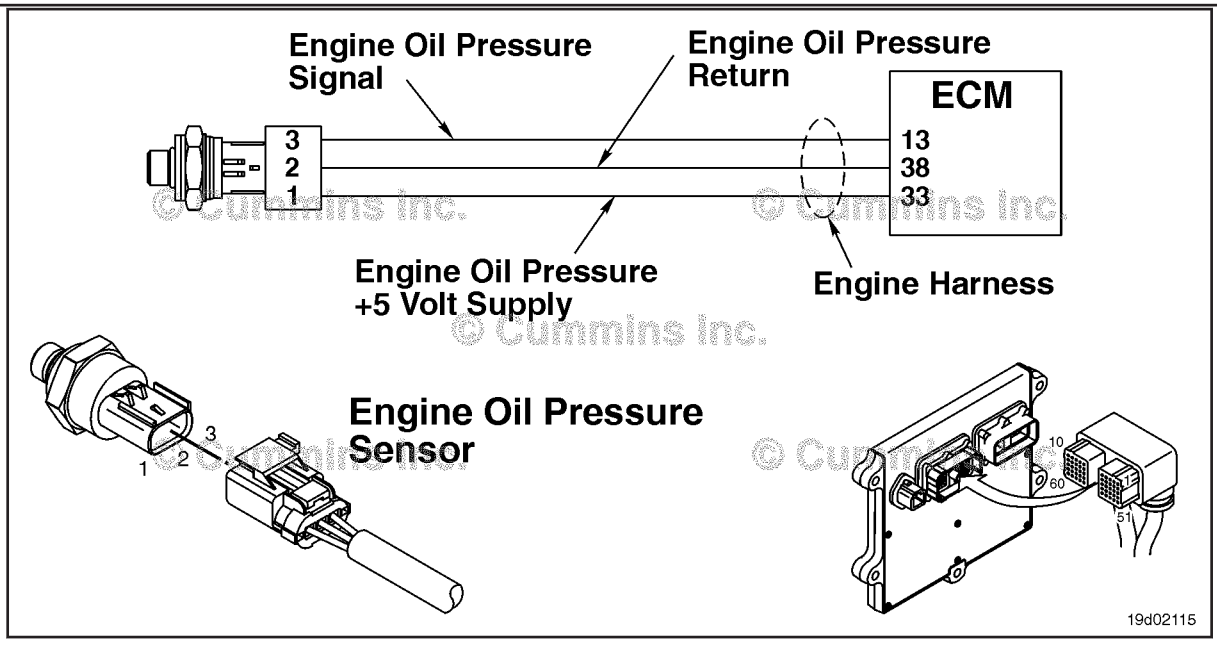
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool erase the inactive fault codes . | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 415

## Engine Oil Rifle Pressure - Data Valid but Below Normal Operational Range - Most Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 415<br>PID(P), SID(S): P100<br>SPN: 100<br>FMI: 1/1<br>Lamp: Red<br>SRT: | Engine Oil Rifle Pressure - Data Valid but Below Normal Operational Range - Most Severe Level. Oil pressure signal indicates oil pressure is below the engine protection critical limit. | Progressive power derate increasing in severity from time after alert. If the Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after the red STOP lamp starts flashing. Marine: Calibration dependent. |




Engine Oil Pressure Sensor Circuit

**Circuit Description:**

The engine oil pressure sensor is used by the electronic control module (ECM) to monitor the lubricating oil pressure. If the oil pressure drops below the engine protection limit, will cause Fault Code 415 to log.

**Component Location:**

The oil pressure sensor is located on the intake side of the engine, on the block, below the fuel filter. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

Possible causes of this fault code include:

- Low oil pressure
- Incorrect oil level.

## Refer to Troubleshooting Fault Code t05-415

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check fault codes.** | **Active or inactive counts of Fault Code 415?** | |
| **STEP 2:** | **Check engine oil pressure.** | | |
| **STEP 2A:** | **Check engine oil pressure with a mechanical gauge.** | **Is oil pressure greater than the minimum oil pressure limits?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine running at idle speed.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or inactive counts of Fault Code 415?<br>**YES** | 2A |
| | Active or inactive counts of Fault Code 415?<br>**NO** | Repair complete |

## STEP 2: Check engine oil pressure.

### STEP 2A: Check engine oil pressure with a mechanical gauge.

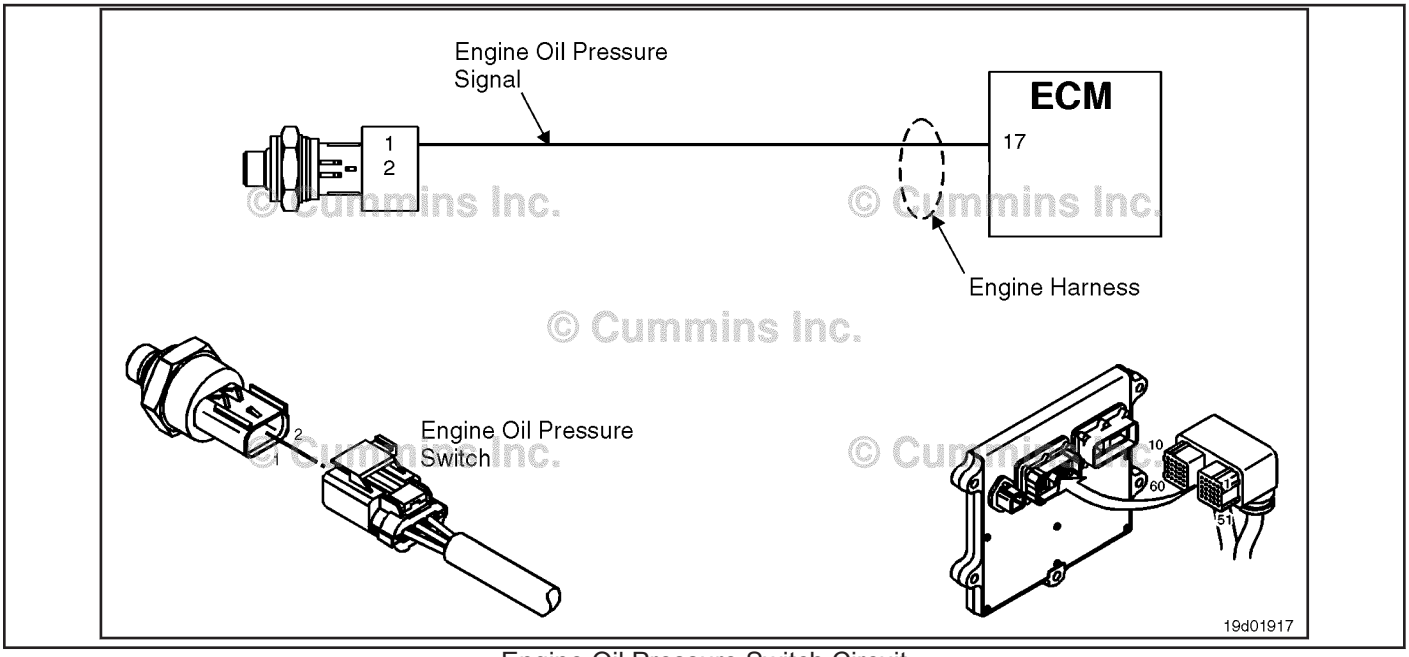
**Condition:**
- Turn keyswitch OFF.
- Connect mechanical oil pressure gauge.
- Turn keyswitch ON.
- Engine running at idle speed.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the engine oil pressure at the following engine speeds:<br>Engine Speed (rpm) Minimum Oil Pressure (psi)<br>600 8<br>1000 20<br>1600 30<br>2000 35<br>2200 32<br>• Refer to Procedure 007-052 in the Troubleshooting and Repair Manual, ISC, QSC8.3, ISL, and QSL9 Series Engines, Bulletin 4021418 or Troubleshooting and Repair Manual, ISB Series Engines, Bulletin 3666477. | Is oil pressure greater than the minimum oil pressure limits?<br>**YES** | Repair Complete |
| | Is oil pressure greater than the minimum oil pressure limits?<br>**NO** | Refer to the Lubricating Oil Pressure Low troubleshooting symptom tree |

# Fault Code 415

## Engine Oil Rifle Pressure - Data Valid but Below Normal Operational Range - Most Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 415<br>PID(P), SID(S): P100<br>SPN: 100<br>FMI: 1/1<br>Lamp: Red<br>SRT: | Engine Oil Rifle Pressure - Data Valid but Below Normal Operational Range - Most Severe Level. Oil pressure signal indicates oil pressure is below the engine protection critical limit. | Progressive power derate increasing in severity from time after alert. If the Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after the red STOP lamp starts flashing. |




Engine Oil Pressure Switch Circuit

**Circuit Description:**

The engine oil pressure sensor is used by the electronic control module (ECM) to monitor the lubricating oil pressure. If the oil pressure drops below the engine protection limit, the switch will close and cause Fault Code 415 to log. When the engine is **not** running, the oil pressure switch will be closed. The oil pressure switch will open when oil pressure is above 48 kPa [7 psi].

**Component Location:**

The oil pressure sensor is located on the intake side of the engine on the engine block, below the fuel filter.Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

**Shop Talk:**

Possible causes of this fault code include:

- Low oil pressure
- Incorrect oil level
- Damaged oil pressure switch
- Engine harness shorted to ground.

## Refer to Troubleshooting Fault Code t05-415

# FAULT CODE 415 - Engine Oil Rifle Pressure - Data Valid but Below Normal Operational Range - Most Severe Level

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3164596 - male Framatome™ test lead, Part Number 3822758 - male Deutsch™/ Amp™/Metri-Pack™ test lead, and Part Number 3822917 - female Deutsch/™Amp™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check fault codes.** | **Active or inactive counts of Fault Code 415?** | |
| **STEP 2:** | **Check engine oil pressure.** | | |
| **STEP 2A:** | **Check engine oil pressure with a mechanical gauge.** | **Is oil pressure greater than 48 kPa [7 psi]?** | |
| **STEP 3:** | **Check the engine harness and ECM.** | | |
| **STEP 3A:** | **Check the supply voltage at the oil pressure connector.** | **4.75 to 5.25 VDC?** | |
| **STEP 3B:** | **Check the supply voltage at the ECM.** | **4.75 to 5.25 VDC?** | |
| **STEP 4:** | **Clear the fault codes** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 415 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine running at idle speed.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or inactive counts of Fault Code 415?<br>**YES** | 2A |
| | Active or inactive counts of Fault Code 415?<br>**NO** | Repair complete |

## STEP 2: Check engine oil pressure.

### STEP 2A: Check engine oil pressure with a mechanical gauge.

**Condition:**
- Turn keyswitch OFF.
- Connect mechanical oil pressure gauge.
- Turn keyswitch ON.
- Engine running at idle speed.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the engine oil pressure.<br>• Refer to OEM service manual. | Is oil pressure greater than 48 kPa [7 psi]?<br>**YES** | 3A |
| | Is oil pressure greater than 48 kPa [7 psi]?<br>**NO** | Refer to the Lubricating Oil Pressure Low troubleshooting symptom tree |

## STEP 3: Check the engine harness and ECM.

### STEP 3A: Check the supply voltage at the oil pressure connector.

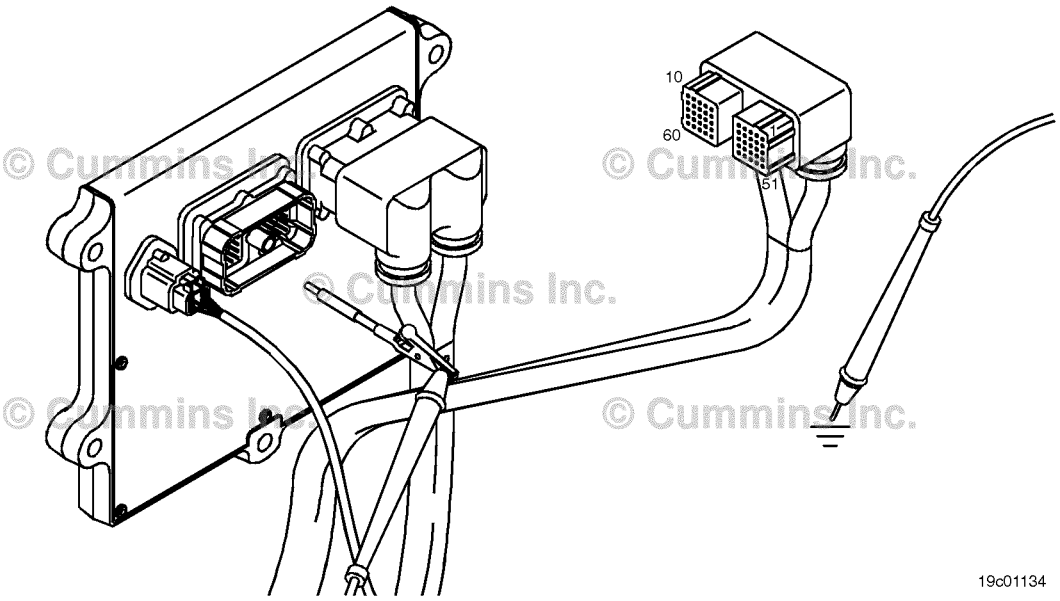
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the engine oil pressure switch.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the supply voltage.<br>• Measure the voltage between the engine oil pressure SIGNAL pin at the switch connector of the engine harness and engine block ground.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | 4.75 to 5.25 VDC?<br>**YES**<br>**Repair:**<br>Replace the oil pressure switch. Refer to Procedure 019-142 in Section 19. | 4A |
| | 4.75 to 5.25 VDC?<br>**NO** | 3B |

**STEP 3B: Check the supply voltage at the ECM.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the supply voltage at the ECM.<br>• Measure the voltage between the engine oil pressure SIGNAL pin at the engine harness ECM connector port and engine block ground.<br>Refer to the circuit diagram or wiring diagram form connector pin identification. | 4.75 to 5.25 VDC?<br>**YES**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |
| | 4.75 to 5.25 VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |




## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 415 inactive?<br>**YES** | 4B |
| | Fault Code 415 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

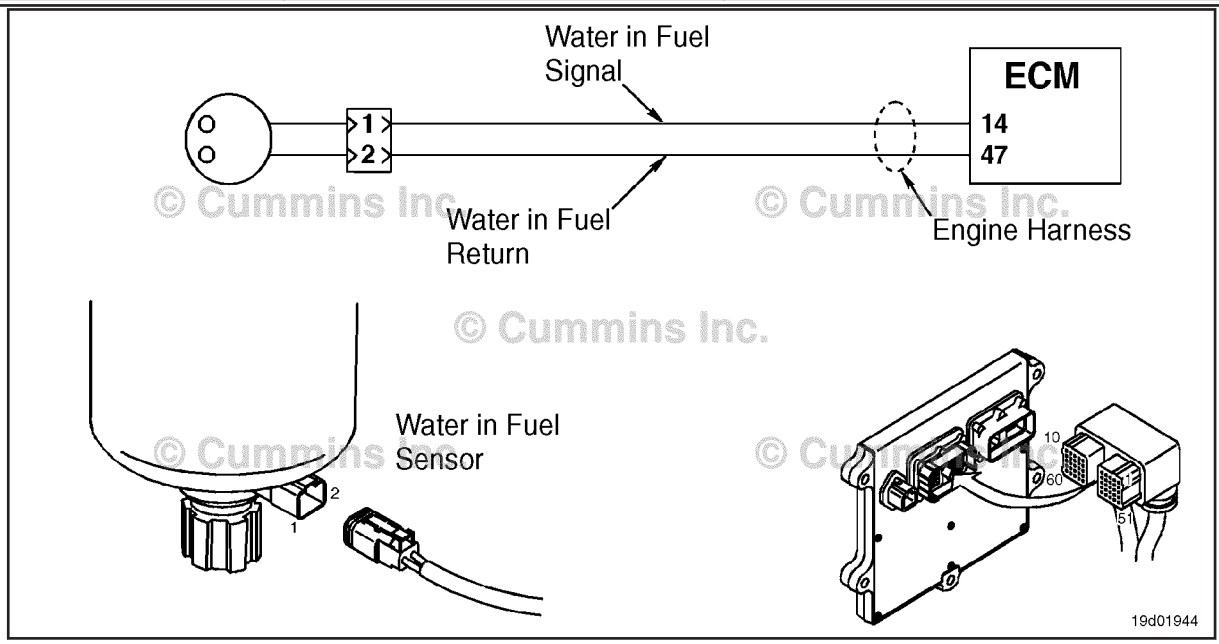
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps. |

# Fault Code 418 (Automotive Application)

## Water-In-Fuel Indicator - Data Valid but Above Normal Operational Range - Least Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 418<br>PID(P), SID(S): P097<br>SPN: 97<br>FMI: 0/15<br>Lamp: Amber (Maintenance flashout)<br>SRT: | Water-In-Fuel Indicator - Data Valid but Above Normal Operational Range - Least Severe Level. Water has been detected in the fuel filter. | Possible white smoke, loss of power, or hard starting. |




Water-In-Fuel Circuit

**Circuit Description:**

The water-in-fuel sensor is attached to the fuel filter. The water-in-fuel sensor sends a signal to the ECM when a set volume of water has accumulated in the fuel filter. The water-in-fuel circuit contains two wires: A ground wire and signal wire.

**Component Location:**

The water-in-fuel sensor is integrated into the bottom of the OEM supplied suction fuel filter. The OEM supplied fuel filter is located on the intake side of the engine. For marine applications the water-in-fuel sensor is mounted in a filter housing which contains a serviceable element. The filter housing location will vary with each OEM.

**Shop Talk:**

The water-in-fuel is integrated into the fuel filter. It is automatically replaced whenever the fuel filter is replaced. For marine applications the sensor is **not** integrated into the fuel filter and is a serviceable item.

## Refer to Troubleshooting Fault Code t05-418

## TROUBLESHOOTING SUMMARY

| STEPS | SPECIFICATIONS | SRT CODE |
|---|---|---|
| **STEP 1: Check the fault codes.** | | |
| **STEP 1A: Check for Fault Code 418.** | **Active or inactive counts of Fault Code 418?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 418.**

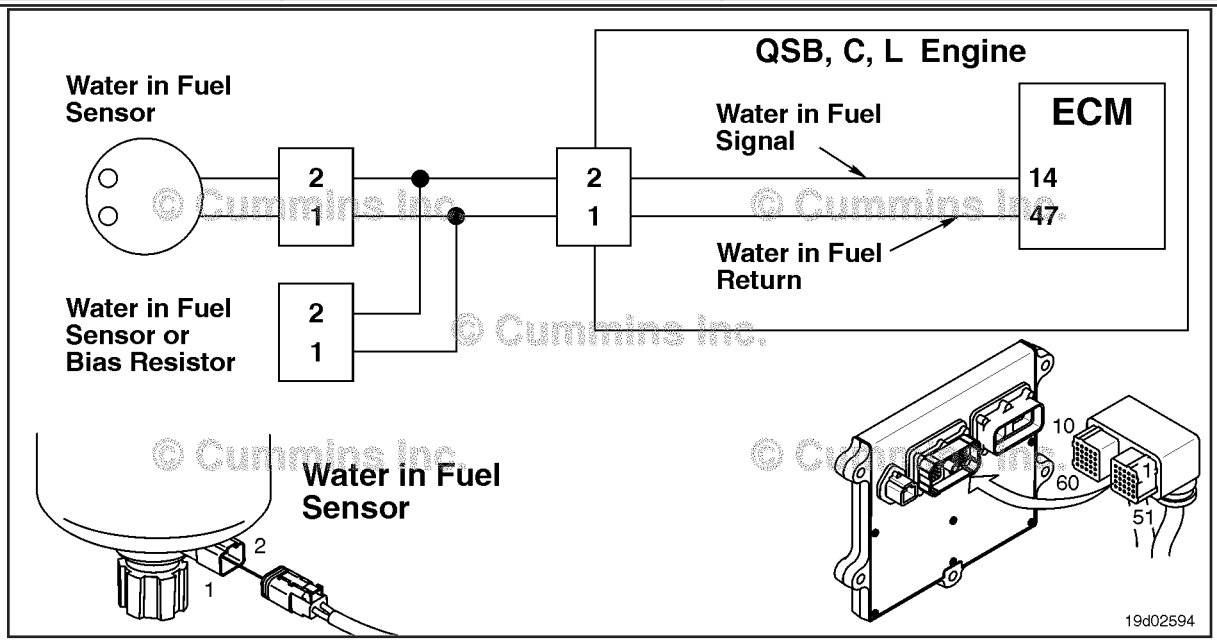
**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for Fault Code 418.<br>• Use INSITE™ electronic service tool, read the fault codes. | Active or inactive counts of Fault Code 418?<br>**YES**<br>**Repair:**<br>Drain the water from the fuel filter. | Repair complete |
| | Active or inactive counts of Fault Code 418?<br>**NO** | Repair complete |

# Fault Code 418 (Marine Application)

## Water-in-Fuel Indicator Data Valid but Above Normal Operational Range - Least Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 418<br>PID(P), SID(S): P097<br>SPN: 97<br>FMI: 0/15<br>Lamp: Amber (Maintenance flashout)<br>SRT: | Water-in-Fuel Indicator Data Valid but Above Normal Operational Range - Least Severe Level. Water has been detected in the fuel filter. | Possible white smoke, loss of power, or hard starting. |




Water-in-Fuel Sensor Circuit

**Circuit Description:**

The water-in-fuel sensor is attached the fuel filter housing. The ECM monitors the water-in-fuel sensor in order to flag a fault when a set volume of water has accumulated in the fuel filter. The water-in-fuel circuit contains two wires, a ground wire and a signal wire.

**Component Location:**

In automotive, industrial, and power generation applications, the water-in-fuel sensor is integrated into the bottom of the OEM supplied suction fuel filter. The OEM supplied fuel filter is located on the intake side of the engine. For marine applications, the water-in-fuel sensor is mounted at the base of the water/fuel separator bowl on the fuel filter housing. This fuel/water separator housing contains a serviceable element. The filter housing location will vary with each OEM. Marine applications utilize a dual WIF sensor configuration. This assembly incorporates a y-harness with either two WIF sensors (duplex filtering) or one WIF sensor and a terminating resistor.

**Shop Talk:**

In automotive, industrial, and power generation applications, the water-in-fuel sensor is integrated into the fuel filter. It is automatically replaced whenever the fuel filter is replaced. For marine applications the sensor is **not** integrated into the fuel filter and is a serviceable item. Possible causes for this fault code include:

- Water in fuel

- Damaged sensor
- Fuel contamination.

## Refer to Troubleshooting Fault Code t05-418

# FAULT CODE 418 (Marine Application) - Water-in-Fuel Indicator Data Valid but Above Normal Operational Range - Least Severe Level

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 418 active?** | |
| **STEP 1B:** | **Check for water in fuel/water separator bowl.** | **Fault Code 418 still active?** | |
| **STEP 2:** | **Check the water-in-fuel sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the engine harness and sensor connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the sensor resistance.** | **Within range of 210k - 230k ohms?** | |
| **STEP 2C:** | **Check the fault codes and verify sensor condition.** | **Fault Code 418 is active?** | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| **STEP 3A:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check the ECM response.** | **Fault Code 429 active and Fault Code 418 inactive?** | |
| **STEP 3C:** | **Check for an inactive fault code.** | **Fault Code 418 inactive?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 418 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 418 active?<br>**YES** | 1B |
| | Fault Code 418 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

**STEP 1B: Check for water in fuel/water separator bowl.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for water in fuel/water separator bowl.<br>• Drain the water from the fuel filter housing. | Fault Code 418 active?<br>**YES** | 2A |
| | Fault Code 418 active?<br>**NO** | 4A |

## STEP 2: Check the water-in-fuel sensor and circuit.

### STEP 2A: Inspect the water-in-fuel sensor and connector pins.

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the water-in-fuel sensor.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness, and water-in-fuel connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken.<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electronic cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>• Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

### STEP 2B: Check the sensor resistance.

**Condition:**
- Turn keyswitch OFF
- Disconnect the water-in-fuel sensor from the WIF sensor harness. (Check both in dual WIF configuration.)

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the sensor resistance.<br>• Measure the resistance between the water-in-fuel SIGNAL pin and the water-in-fuel RETURN pin at the water-in-fuel sensor connector.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Within 210k - 230k ohms?<br>**YES**<br>**Repair:**<br>Any corrosion, damage, or buildup on the probe tips is a sign of contaminated fuel. If there is fuel contamination present, refer to Service Bulletin 3379001 (Fuels for Cummins® Engines) for information on treating this condition. The primary and secondary fuel filters as well as all other water-in-fuel sensors on board **must** be replaced as well.<br>Replace the water-in-fuel sensor. Refer to Procedure 019-127 in Section 19. | 2C |
| | Within 210k - 230k ohms?<br>**NO** | 4A |

**STEP 2C: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF
- Connect the water-in-fuel sensor and WIF harness to the engine harness
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 4218 is active?<br>**YES** | 3A |
| | Fault Code 418 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the ECM and engine harness.

**STEP 3A: Inspect the ECM and engine harness connector pins.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electronic cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>• Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check the ECM response.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 429 active and Fault Code 418 inactive?<br>**YES** | 3C |
| | Fault Code 429 active and Fault Code 418 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check for an inactive fault code.**

**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 418 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Fault Code 418 inactive?<br>**NO**<br>**Repair:**<br>Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. | 1A |

## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 418 inactive?<br>**YES** | 4B |
| | Fault Code 418 inactive?<br>**NO** | 1A |

### STEP 4B: Clear the inactive fault codes.

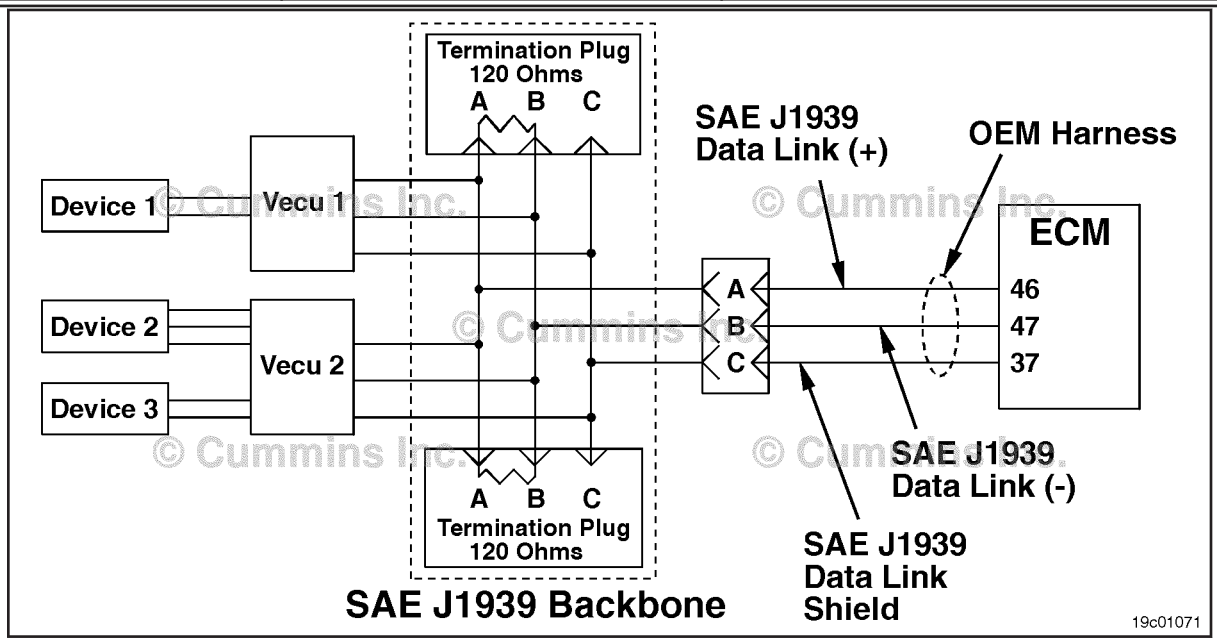
**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 426

## SAE J1939 Data Link - Cannot Transmit

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 426<br>PID(P), SID(S): S231<br>SPN: 639<br>FMI: 2<br>Lamp: None<br>SRT: | SAE J1939 data link - cannot transmit. Communication between the ECM and another device on the SAE J1939 data link has been lost. | None on performance. J1939 devices possibly do **not** operate. |




SAE J1939 Data Link Circuit

**Circuit Description:**

Devices such as automatic braking system controllers, autoshift transmissions, vehicle electronic control module (ECM), automatic slip reduction systems, electronic displays, electronic information systems, electronic service tools, and vehicle electronic control unit(s) can communicate with the ECM over the J1939 data link. Messages sent from the devices are received by the ECM and used for controlling the engine. The ECM also transmits information to these devices over the J1939 data link.

**Component Location:**

The ECM is located on the intake side of the engine, near the front. The J1939 data link wiring and the SAE J1939 devices vary by OEM options.

**Shop Talk:**

This fault occurs whenever the ECM starts communicating with **any** other device using the SAE J1939 data link and then can no longer transmit on the data link. Possible causes could be the following: Unplugging an electronic service tool before keying off the ECM, the SAE J1939 data link having an intermittent electrical problem, and the ECM (or another SAE J1939 device) tying up communications because of an electrical problem or by sending too many messages without stopping.

## Refer to Troubleshooting Fault Code t05-426

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following service tools when taking a measurement:Part Number 3163151 - ECM Bench Top Calibration Harness Part Number 3164185 - ECM Bench Calibration Adapter Cable.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the SAE J1939 communication.** | | |
| **STEP 1A:** | **Check for ECM communication with INSITE™ electronic service tool.** | **Does INSITE™ electronic service tool communicate with the ECM?** | |
| **STEP 1B:** | **Inspect the OEM harness and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 1C:** | **Check ECM communication with the ECM bench calibration harness.** | **Does INSITE™ electronic service tool communicate with the ECM?** | |
| **STEP 2:** | **Clear the fault codes.** | | |
| **STEP 2A:** | **Disable the fault code.** | **Fault Code 426 inactive?** | |
| **STEP 2B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the SAE J1939 communication.

**STEP 1A: Check for ECM communication with INSITE™ electronic service tool.**

**Condition:**
- Connect the INLINE™ II data link adapter to the vehicle SAE J1939 data link diagnostic connector.
- Connect the INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Attempt to communicate with the ECM use INSITE™ electronic service tool.<br>• Start INSITE™ electronic service tool and connect to the ECM use an INLINE™ II (J1939) ECM connection. | Does INSITE™ electronic service tool communicate with the ECM?<br>**YES**<br>**Repair:**<br>The ECM SAE J1939 data link circuit is functioning properly.<br>Refer to the OEM troubleshooting and repair manual for information on troubleshooting the vehicle SAE J1939 network. | Refer to the OEM troubleshooting and repair manual for information on troubleshooting and vehicle SAE J1939 network |
| | Does INSITE™ electronic service tool communicate with the ECM?<br>**NO** | 1B |

**STEP 1B: Inspect the OEM harness and ECM connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connectors for the following:<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins.<br>For general inspection techniques, refer to Component Connector and Pin Inspection, Refer to Procedure 019-361. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connectors and pins.<br>Repair the damaged harness, connectors, or pins if possible.<br>Refer to the Resistance Measurements Using a Multimeter and Wiring Diagram, Refer to Procedure 019-360. | 2A |
| | Dirty or damaged pins?<br>**NO** | 1C |

**STEP 1C: Check ECM communication with the ECM bench calibration harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Connect the ECM bench calibration harness to the ECM.
- Connect the INLINE™ II data link adapter.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Attempt to communicate with the ECM using INSITE™ electronic service tool.<br>• Start INSITE™ electronic service tool and connect to the ECM with an INLINE™ II (J1939) ECM connection. | Does INSITE™ electronic service tool communicate with the ECM?<br>**YES**<br>**Repair:**<br>INSITE™ electronic service tool is able to communicate with the ECM. This indicates that the ECM data link circuit is functioning properly.<br>Refer to the OEM troubleshooting and repair manual for information on troubleshooting the vehicle SAE J1939 network. | Refer to the OEM troubleshooting and repair manual |
| | Does INSITE™ electronic service tool communicate with the ECM?<br>**NO** | Refer to the Communication Error - Electronic Service Tool or Control Device troubleshooting symptom tree |

## STEP 2: Clear the fault codes.

### STEP 2A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Verify that Fault Code 426 is inactive. | Fault Code 426 inactive?<br>**YES** | 2B |
| | Fault Code 426 inactive?<br>**NO** | 1A |

### STEP 2B: Clear the inactive fault codes.

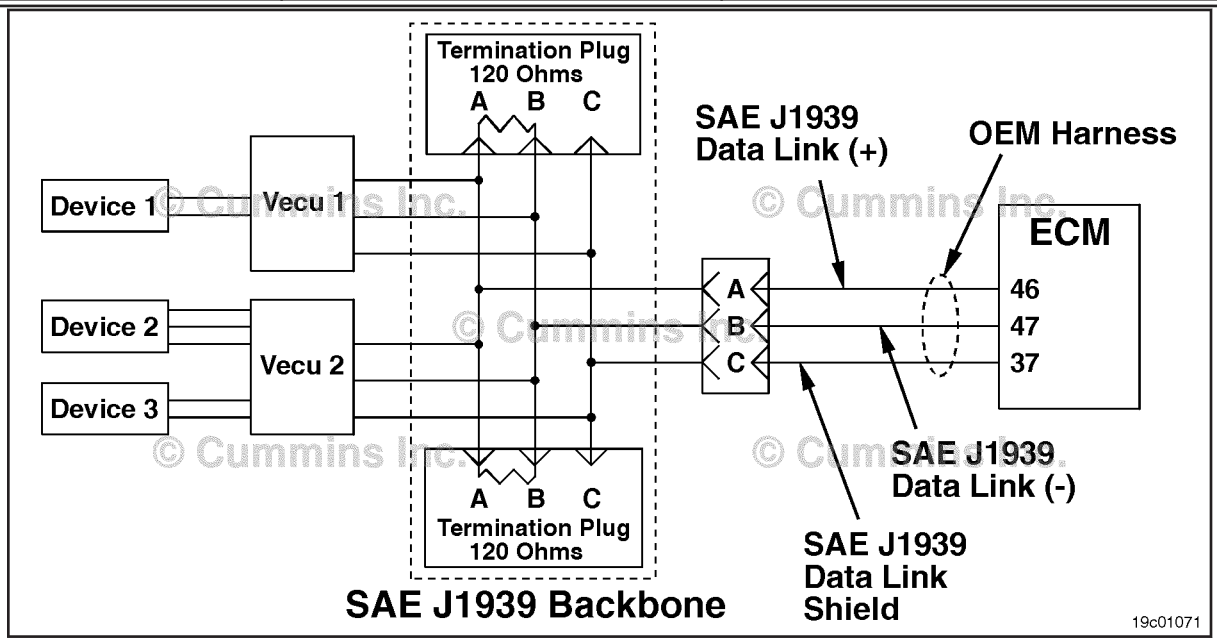
**Condition:**
- Connect all components.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool, erase the inactive fault codes . | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 427

## SAE J1939 Datalink - Abnormal Update Rate

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 427<br>PID(P), SID(S): S231<br>SPN: 639<br>FMI: 9<br>Lamp: None<br>SRT: | J1939 Datalink - Abnormal Update Rate. Communication between the electronic control module (ECM) and another device on the SAE J1939 data link has been lost. | Engine speed will ramp down and remain at idle. |




SAE J1939 Data Link Circuit

**Circuit Description:**

Devices such as ABS controllers, autoshift transmissions, ASR systems, electronic displays, electronic information systems, electronic service tools, and VECUs can communicate with the ECM over the SAE J1939 data link. Messages sent from the devices are received by the ECM and used for controlling the engine. The ECM also transmits information to these devices over the SAE J1939 data link.

**Component Location:**

The ECM is located on the intake side of the engine, near the front. The SAE J1939 data link wiring and the SAE J1939 devices vary by OEM options.

**Shop Talk:**

This fault occurs whenever the ECM has been receiving SAE J1939 datalink commands from an external OEM device and is no longer receiving the datalink commands. Possible causes of this fault include:

- Electrical problems with the SAE J1939 data link wiring such as grounded, shorted, or open circuits
- The ECM (or another SAE J1939 device) tying up communications by sending too many consecutive messages
- The external OEM controlling device has failed or can no longer transmit on the datalink.

## Refer to Troubleshooting Fault Code t05-427

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement:Part Number 3163151 - ECM bench calibration harnessPart Number 3164185 - ECM bench calibration adapter cable.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check SAE J1939 communication** | | |
| **STEP 1A:** | **Check for ECM communication with INSITE™ electronic service tool** | **Does INSITE™ electronic service tool communicate with the ECM?** | |
| **STEP 1B:** | **Inspect the OEM harness and ECM connector pins** | **Dirty or damaged pins?** | |
| **STEP 1C:** | **Check ECM communications with the ECM bench calibration harness.** | **INSITE™ electronic service tool communicates with ECM?** | |
| **STEP 2:** | **Clear the fault codes** | | |
| **STEP 2A:** | **Disable the fault code** | **Fault Code 427 inactive?** | |
| **STEP 2B:** | **Clear the inactive fault codes** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check SAE J1939 communication.

**STEP 1A: Check for ECM communication with INSITE™ electronic service tool.**

**Condition:**
- Turn keyswitch ON.
- Connect INLINE™ II data link adapter to the vehicle SAE J1939 data link diagnostic connector.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Attempt to communicate with the ECM using INSITE™.<br>• Start INSITE™ electronic service tool and connect to the ECM using an INLINE™ II (J1939) ECM connection. | Does INSITE™ electronic service tool communicate with the ECM?<br>**YES**<br>**Repair:**<br>The ECM SAE J1939 data link circuit is functioning properly.<br>Refer to the OEM troubleshooting and repair manual for information on troubleshooting the vehicle SAE J1939 network. | Refer to the OEM troubleshooting and repair manual. |
| | Does INSITE™ electronic service tool communicate with the ECM?<br>**NO** | 1B |

**STEP 1B: Inspect the OEM harness and ECM connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged locking tab connector.<br>For general inspection techniques, refer to Component Connector and Pin Inspection, Refer to Procedure 019-361. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins, if possible.<br>Refer to Procedure 019-071. | 2A |
| | Dirty or damaged pins?<br>**NO** | 1C |

**STEP 1C: Check ECM communications with the ECM bench calibration harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Connect the ECM bench calibration harness to the ECM.
- Connect INLINE™ II data link adapter.
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Attempt to communicate with the ECM using INSITE™.<br>• Start INSITE™ electronic service tool and connect to the ECM using an INLINE™ II (J1939) ECM connection. | INSITE™ electronic service tool communicates with ECM?<br>**YES**<br>**Repair:**<br>INSITE™ electronic service tool is able to communicate with the ECM. This indicates that the ECM data link circuit is functioning properly.<br>Refer to the OEM troubleshooting and repair manual for troubleshooting the vehicle SAE J1939 circuit and devices. | Refer to OEM troubleshooting and repair manual. |
| | INSITE™ electronic service tool communicates with ECM?<br>**NO** | See the Symptom troubleshooting tree Communication Error - Electronic Service Tool or Control Device. |

## STEP 2: Clear the fault codes.

### STEP 2A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Is Fault Code 427 inactive?<br>**YES** | 2B |
| | Is Fault Code 427 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact your local Cummins Authorized Repair Location if all the steps have been completed and checked again. | 1A |

### STEP 2B: Clear the inactive fault codes.

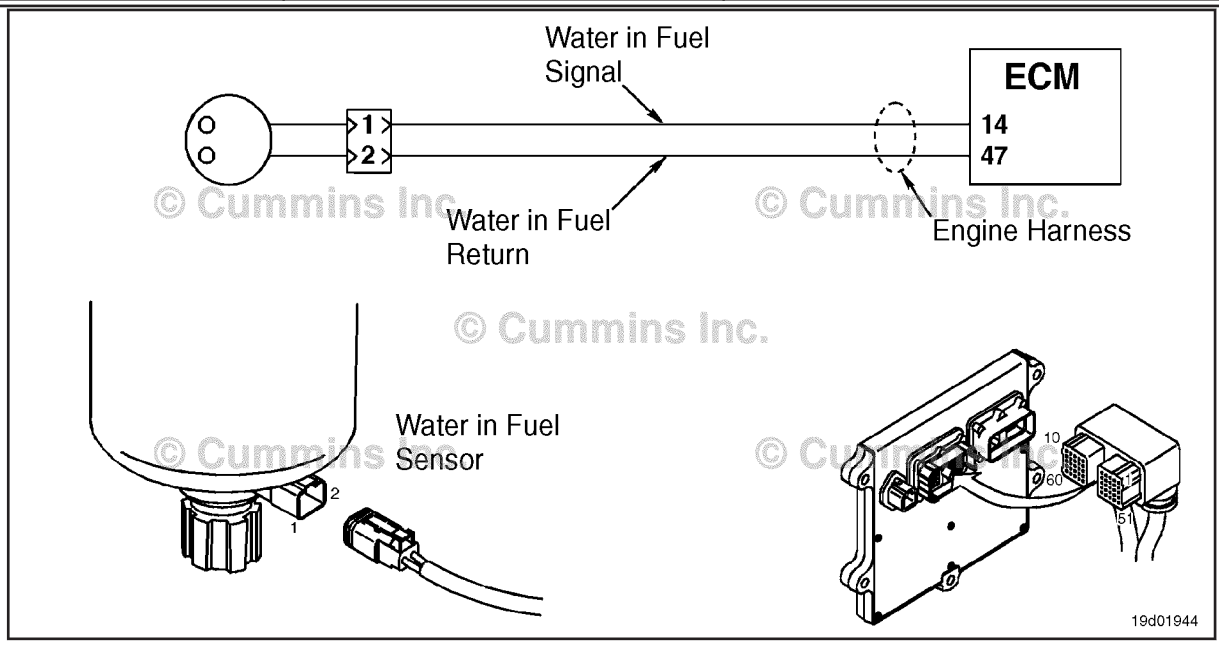
**Condition:**
- Connect all the components.
- Keyswitch "ON".
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All faults cleared?<br>**YES** | Repair complete |
| | All faults cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 428 (Automotive Application)

## Water-in-Fuel Indicator Sensor Circuit - Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 428<br>PID(P), SID(S): P097<br>SPN: 97<br>FMI: 3/3<br>Lamp: Amber<br>SRT: | Water-in-Fuel Indicator Sensor Circuit - Voltage Above Normal or Shorted to High Source. High voltage detected at the water-in-fuel circuit. | None on performance. No water-in-fuel warning available. |




Water-in-Fuel Sensor Circuit

**Circuit Description:**

The water-in-fuel sensor is attached to the fuel filter. The water-in-fuel sensor sends a signal to the ECM when a set volume of water has accumulated in the fuel filter. The water-in-fuel circuit contains two wires: A return ground and a SIGNAL wire.

**Component Location:**

The water-in-fuel sensor is integrated into the bottom of the OEM supplied suction fuel filter. The OEM supplied fuel filter is located on the intake side of the engine. For marine applications, the water-in-fuel sensor is mounted in a filter housing which contains a serviceable element. The filter housing location will vary with each OEM.

**Shop Talk:**

The water-in-fuel sensor is integrated into the fuel filter. It is automatically replaced whenever the fuel filter is replaced. For marine applications, the sensor is **not** integrated into the fuel filter and is a serviceable item. Possible causes for this fault code include:

- Open RETURN or SIGNAL circuit in the harness, connectors, or sensor.
- SIGNAL wire shorted to sensor supply or battery voltage.

## Refer to Troubleshooting Fault Code t05-428

# FAULT CODE 428 (Automotive Application) - Water-in-Fuel Indicator Sensor Circuit - Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 428 active?** | |
| **STEP 2:** | **Check the water-in-fuel sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the water-in-fuel sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the sensor resistance.** | **Greater than 100k ohms?** | |
| **STEP 2C:** | **Check the fault codes and verify sensor condition.** | **Fault Code 428 is active?** | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| **STEP 3A:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check the ECM response.** | **Fault Code 429 active and Fault Code 428 inactive?** | |
| **STEP 3C:** | **Check for an open circuit in the engine harness.** | **Less than 10 ohms?** | |
| **STEP 3C-1:** | **Check for an open circuit in the engine harness.** | **Less than 10 ohms?** | |
| **STEP 3D:** | **Check for a pin to pin short circuit in the engine harness.** | **Greater than 100k ohms?** | |
| **STEP 3E:** | **Check for an inactive fault code.** | **Fault Code 428 inactive?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 428 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 active?<br>**YES** | 2A |
| | Fault Code 428 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the water-in-fuel sensor and circuit.

**STEP 2A: Inspect the water-in-fuel sensor and connector pins.**

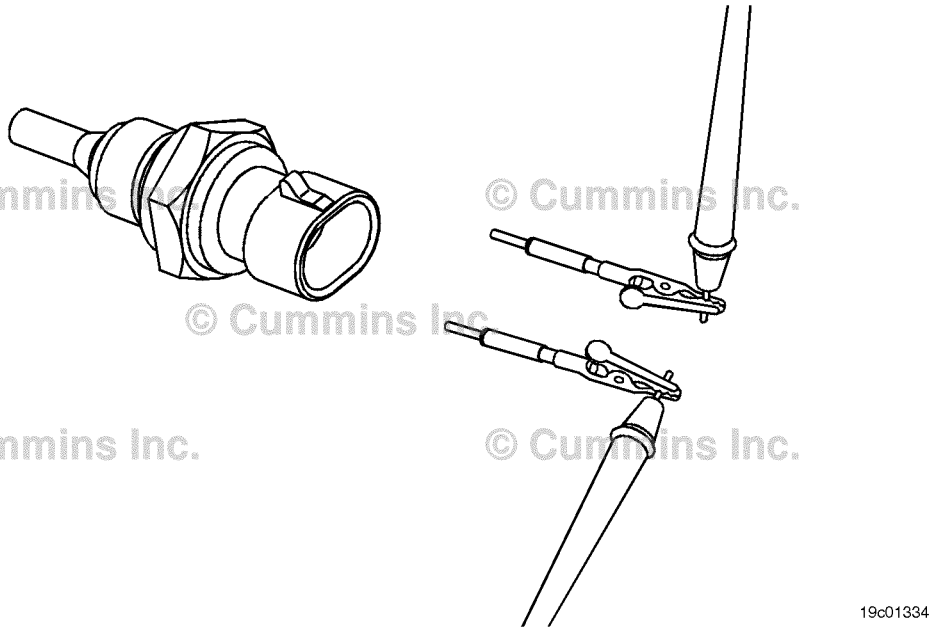
**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the water-in-fuel sensor.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness, and water-in-fuel connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken.<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>• Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the sensor resistance.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the water-in-fuel sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the sensor resistance.<br>• Measure the resistance between the water-in-fuel SIGNAL pin and the water-in-fuel RETURN pin at the water-in-fuel sensor connector.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the water-in-fuel sensor. Refer to Procedure 019-127 in Section 19. | 4A |
| | Greater than 100k ohms?<br>**NO** | 2C |




**STEP 2C: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF
- Connect the water-in-fuel sensor to the engine harness
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 is active?<br>**YES** | 3A |
| | Fault Code 428 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the ECM and engine harness.

### STEP 3A: Inspect the ECM and engine harness connector pins.

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

### STEP 3B: Check the ECM response.

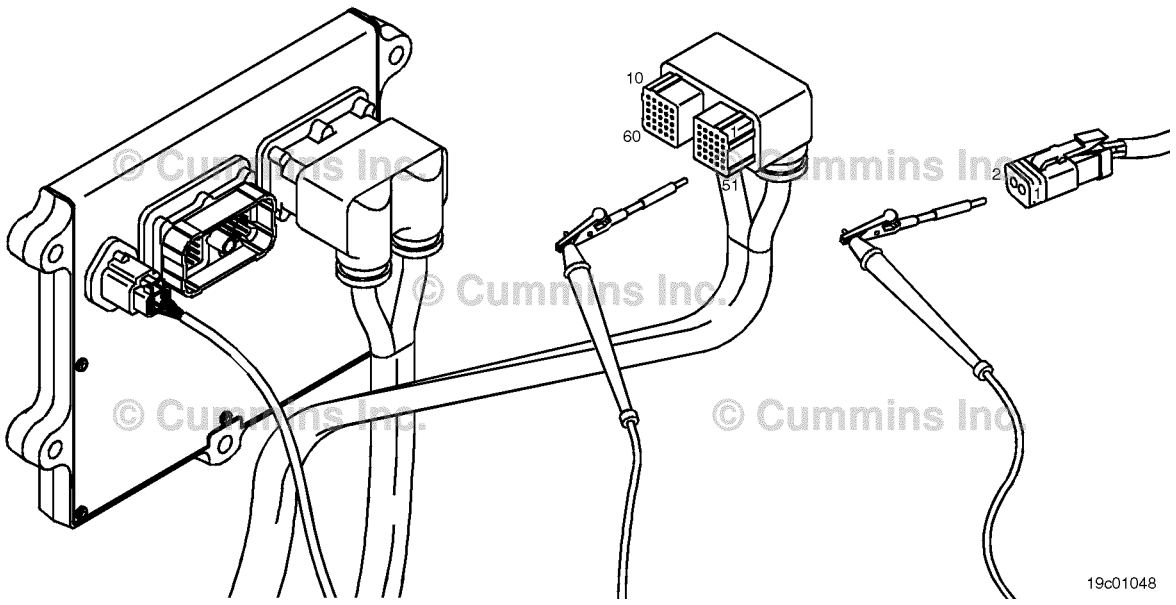
**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Place a jumper wire between pin 14 (water-in-fuel sensor SIGNAL pin) and pin 47 (water-in-fuel sensor RETURN pin) at the ECM connector
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 429 active and Fault Code 428 inactive?<br>**YES** | 3C |
| | Fault Code 429 active and Fault Code 428 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check for an open circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the water-in-fuel sensor from the engine harness.

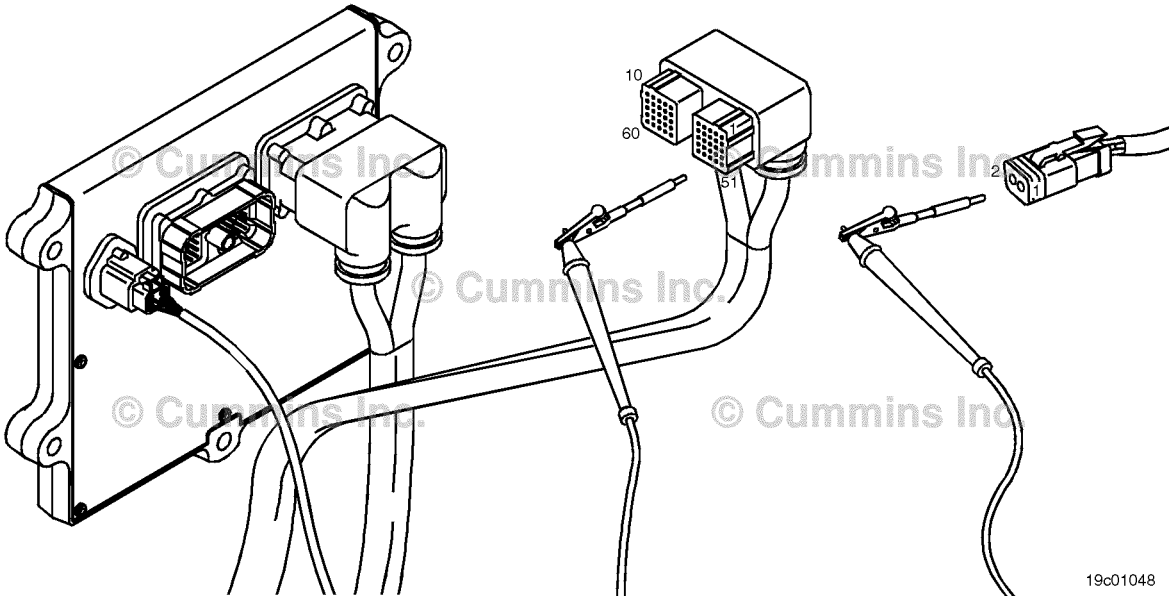
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the engine harness ECM connector water-in-fuel sensor RETURN pin and the engine harness water-in-fuel sensor connector RETURN pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C-1 |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open RETURN circuit has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3C-1: Check for an open circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the water-in-fuel sensor from the engine harness.

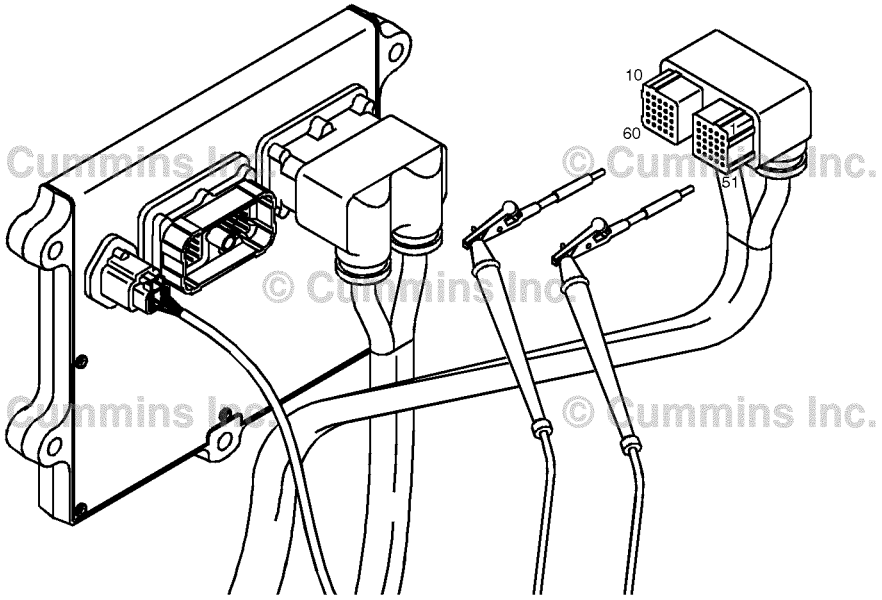
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the engine harness ECM connector water-in-fuel sensor SIGNAL pin and the engine water-in-fuel sensor connector SIGNAL pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open SIGNAL circuit has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3D: Check for a pin-to-pin short circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the water-in-fuel sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the water-in-fuel SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3E |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Fault Code 428 inactive?<br>**NO**<br>**Repair:**<br>Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. | 1A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 428 inactive?<br>**YES** | 4B |
| | Fault Code 428 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

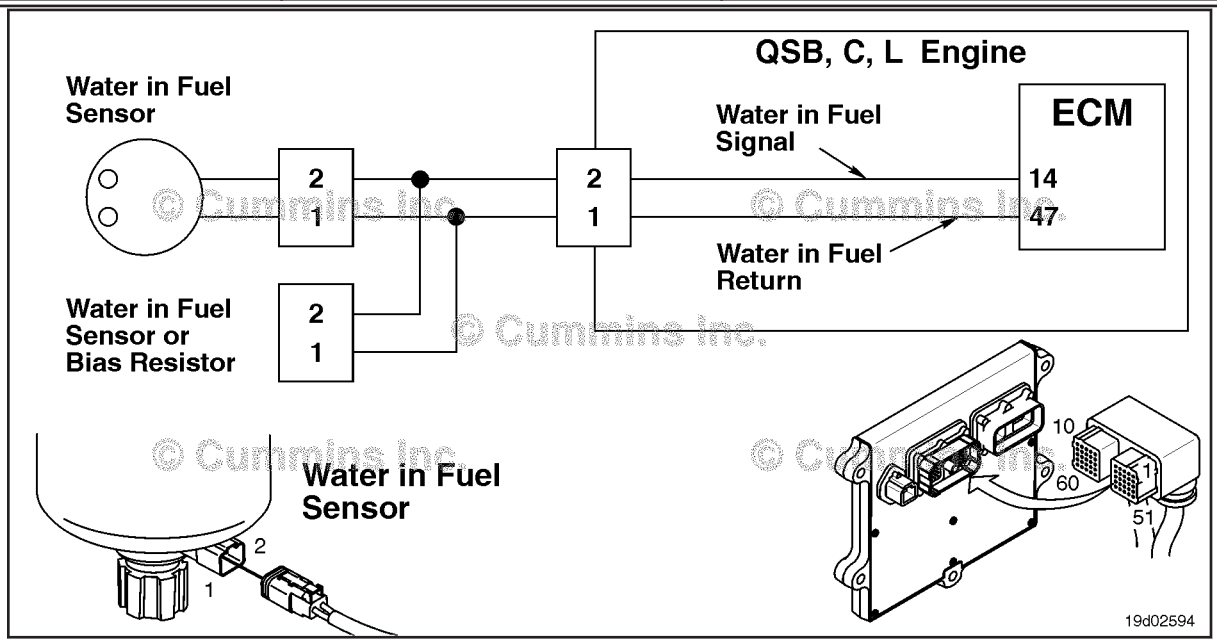
**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 428 (Marine Application)

## Water-in-Fuel Indicator Sensor Circuit - Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 428<br>PID(P), SID(S): P097<br>SPN: 97<br>FMI: 3/3<br>Lamp: Amber<br>SRT: | Water-in-Fuel Indicator Sensor Circuit - Voltage Above Normal or Shorted to High Source. High voltage detected at the water-in-fuel circuit. | None on performance. No water-in-fuel warning available. |




Water-in-Fuel Sensor Circuit

**Circuit Description:**

The water-in-fuel sensor is attached the fuel filter housing. The ECM monitors the water-in-fuel sensor in order to flag a fault when a set volume of water has accumulated in the fuel filter. The water-in-fuel circuit contains two wires, a ground wire and a signal wire.

**Component Location:**

In automotive, industrial, and power generation applications, the water-in-fuel sensor is integrated into the bottom of the OEM supplied suction fuel filter. The OEM supplied fuel filter is located on the intake side of the engine. For marine applications, the water-in-fuel sensor is mounted at the base of the water/fuel separator bowl on the fuel filter housing. This fuel/water separator housing contains a serviceable element. The filter housing location will vary with each OEM. Marine applications utilize a dual WIF sensor configuration. This assembly incorporates a y-harness with either two WIF sensors (duplex filtering) or one WIF sensor and a terminating resistor.

**Shop Talk:**

In automotive, industrial, and power generation applications, the water-in-fuel sensor is integrated into the fuel filter. It is automatically replaced whenever the fuel filter is replaced. For marine applications the sensor is **not** integrated into the fuel filter and is a serviceable item. Possible causes for this fault code include:

- Water in fuel
- Damaged sensor
- Fuel contamination.

## Refer to Troubleshooting Fault Code t05-428

# FAULT CODE 428 (Marine Application) - Water-in-Fuel Indicator Sensor Circuit - Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new engine control module (ECM), all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 428 active?** | |
| **STEP 2:** | **Check the water-in-fuel sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the water-in-fuel sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the sensor resistance.** | **Within range of 210k - 230k ohms?** | |
| **STEP 2C:** | **Check the fault codes and verify sensor condition.** | **Fault Code 428 is active?** | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| **STEP 3A:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check the ECM response.** | **Fault Code 429 active and Fault Code 428 inactive?** | |
| **STEP 3C:** | **Check for an open circuit in the engine harness.** | **Less than 10 ohms?** | |
| **STEP 3C-1:** | **Check for an open circuit in the engine harness.** | **Less than 10 ohms?** | |
| **STEP 3D:** | **Check for a pin-to-pin short circuit in the engine harness.** | **Greater than 100k ohms?** | |
| **STEP 3E:** | **Check for an inactive fault code.** | **Fault Code 428 inactive?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 428 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 active?<br>**YES** | 2A |
| | Fault Code 428 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the water-in-fuel sensor and circuit.

**STEP 2A: Inspect the water-in-fuel sensor and connector pins.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the water-in-fuel sensor.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness, and water-in-fuel connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken.<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the sensor resistance.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the water-in-fuel sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the sensor resistance.<br>• Measure the resistance between the water-in-fuel SIGNAL pin and the water-in-fuel RETURN pin at the water-in-fuel sensor connector.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Within 210k - 230k ohms?<br>**YES** | 2C |
| | Within 210k - 230k ohms?<br>**NO**<br>**Repair:**<br>Replace the water-in-fuel sensor. Refer to Procedure 019-127 in Section 19. | 4A |

**STEP 2C: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF
- Connect the water-in-fuel sensor to the engine harness
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 is active?<br>**YES** | 3A |
| | Fault Code 428 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the ECM and engine harness.

### STEP 3A: Inspect the ECM and engine harness connector pins.

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electrical cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

### STEP 3B: Check the ECM response.

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 429 active and Fault Code 428 inactive?<br>**YES** | 3C |
| | Fault Code 429 active and Fault Code 428 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check for an open circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the water-in-fuel sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the engine harness ECM connector water-in-fuel sensor RETURN pin and the engine harness water-in-fuel sensor connector RETURN pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C-1 |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open RETURN circuit has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

**STEP 3C-1: Check for an open circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the water-in-fuel sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the engine harness ECM connector water-in-fuel sensor SIGNAL pin and the engine water-in-fuel sensor connector SIGNAL pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open SIGNAL circuit has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

**STEP 3D: Check for a pin-to-pin short circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the water-in-fuel sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the water-in-fuel SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3E |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Fault Code 428 inactive?<br>**NO**<br>**Repair:**<br>Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. | 1A |

## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 428 inactive?<br>**YES** | 4B |
| | Fault Code 428 inactive?<br>**NO** | 1A |

### STEP 4B: Clear the inactive fault codes.

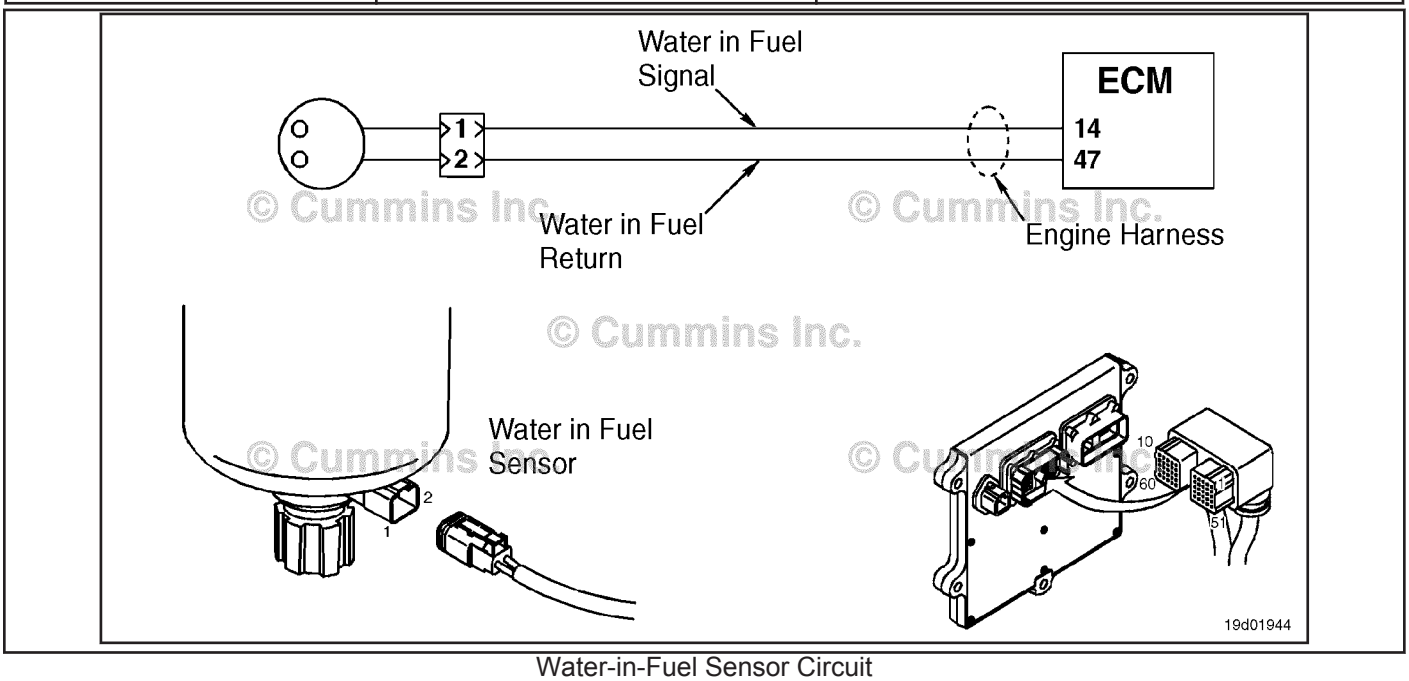
**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 429 (Automotive Application)

## Water-in-Fuel Indicator Sensor Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 429<br>PID(P), SID(S): P097<br>SPN: 97<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Water-in-Fuel Indicator Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected at the water-in-fuel circuit. | None on performance. No water-in-fuel warning available. |




Water-in-Fuel Sensor Circuit

**Circuit Description:**

The water-in-fuel sensor is attached to the fuel filter. The water-in-fuel sensor sends a signal to the ECM when a set volume of water has accumulated in the fuel filter. The water-in-fuel circuit contains two wires: A return ground and a signal wire.

**Component Location:**

The water-in-fuel sensor is integrated into the bottom of the OEM supplied suction fuel filter. The OEM supplied fuel filter is located on the intake side of the engine. For marine applications the water-in-fuel sensor is mounted in a filter housing which contains a serviceable element. The filter housing location will vary with each OEM.

**Shop Talk:**

The water-in-fuel sensor is integrated into the fuel filter; it is automatically replaced whenever the fuel filter is replaced. For marine applications the sensor is **not** integrated into the fuel filter and is a serviceable item. Possible causes of this fault code include:

- Signal circuit shorted to ground in the harness, sensor, or connector.

## Refer to Troubleshooting Fault Code t05-429

# FAULT CODE 429 (Automotive Application) - Water-in-Fuel Indicator Sensor Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 429 active?** | |
| **STEP 2:** | **Check the water-in-fuel sensor.** | | |
| **STEP 2A:** | **Inspect the engine harness and sensor connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault Code 428 active and Fault Code 429 inactive?** | |
| **STEP 2C:** | **Check the fault codes and verify sensor condition.** | **Fault Code 429 is active?** | |
| **STEP 3:** | **Check the engine harness.** | | |
| **STEP 3A:** | **Inspect the engine harness, sensor, and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check the ECM response.** | **Fault Code 428 active and Fault Code 429 inactive?** | |
| **STEP 3C:** | **Check for a short circuit from pin to pin.** | **Greater than 100k ohms?** | |
| **STEP 3D:** | **Check for a pin short circuit to ground.** | **Greater than 100k ohms?** | |
| **STEP 3E:** | **Check for an inactive fault code.** | **Fault Code 429 is inactive?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 429 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 429 active?<br>**YES** | 2A |
| | Fault Code 429 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the water-in-fuel sensor.

**STEP 2A: Inspect the engine harness and sensor connector pins.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the water-in-fuel sensor.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken.<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the water-in-fuel sensor
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 active and Fault Code 429 inactive?<br>**YES** | 2C |
| | Fault Code 428 active and Fault Code 429 inactive?<br>**NO** | 3A |

**STEP 2C: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF
- Connect the water-in-fuel sensor to the engine harness
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 429 is active?<br>**YES**<br>**Repair:**<br>A damaged sensor has been detected.<br>Replace the water-in-fuel sensor. Refer to Procedure 019-127 in Section 19. | 4A |
| | Fault Code 429 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the engine harness.

### STEP 3A: Inspect the engine harness, sensor, and ECM connector pins.

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the engine harness from the water-in-fuel sensor.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness, sensor, and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

### STEP 3B: Check the ECM response.

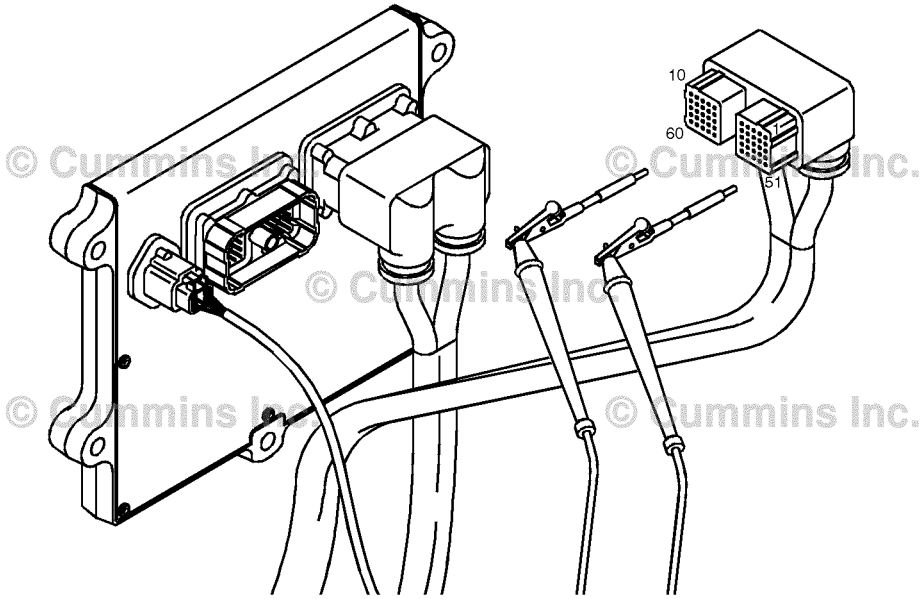
**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Turn keyswitch ON
- Connect INSITE™ electronic service tool electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 active and Fault Code 429 inactive?<br>**YES** | 3C |
| | Fault Code 428 active and Fault Code 429 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check for a short circuit from pin-to-pin.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the water-in-fuel sensor
- Disconnect the engine harness from the ECM.

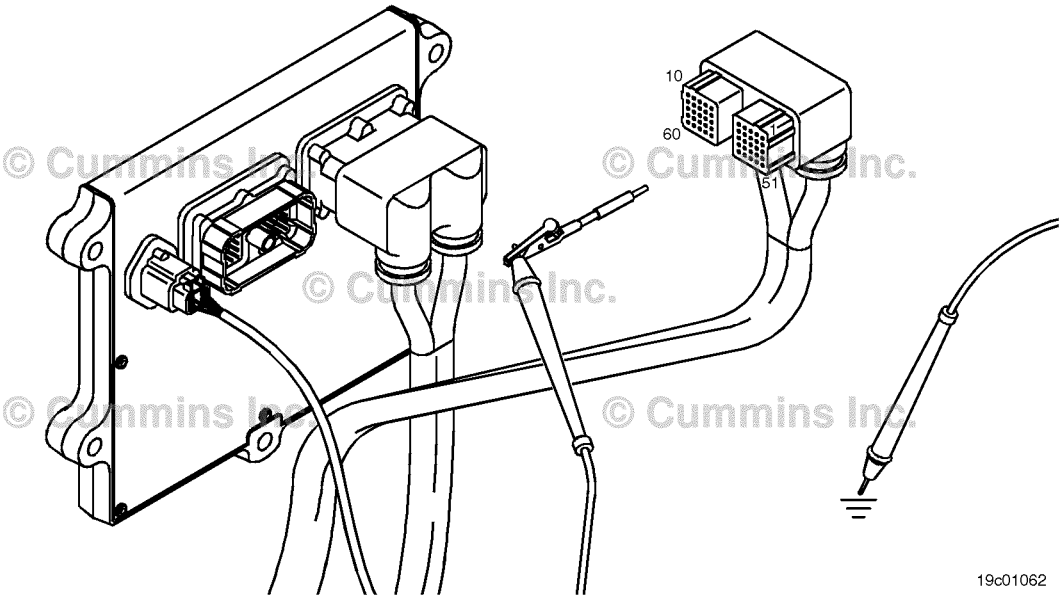
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the water-in-fuel SIGNAL pin at the ECM connector of the engine harness and all other pins in the ECM connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A short circuit has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3D: Check for a pin short circuit to ground.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the water-in-fuel sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-ground short.<br>• Measure the resistance between the water-in-fuel sensor SIGNAL pin in the engine harness ECM connector and ground.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3E |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-ground short circuit on the SIGNAL line has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 429 is inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the failure. | 4A |
| | Fault Code 429 is inactive?<br>**NO**<br>**Repair:**<br>Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. | 1A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 429 inactive?<br>**YES** | 4B |
| | Fault Code 429 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

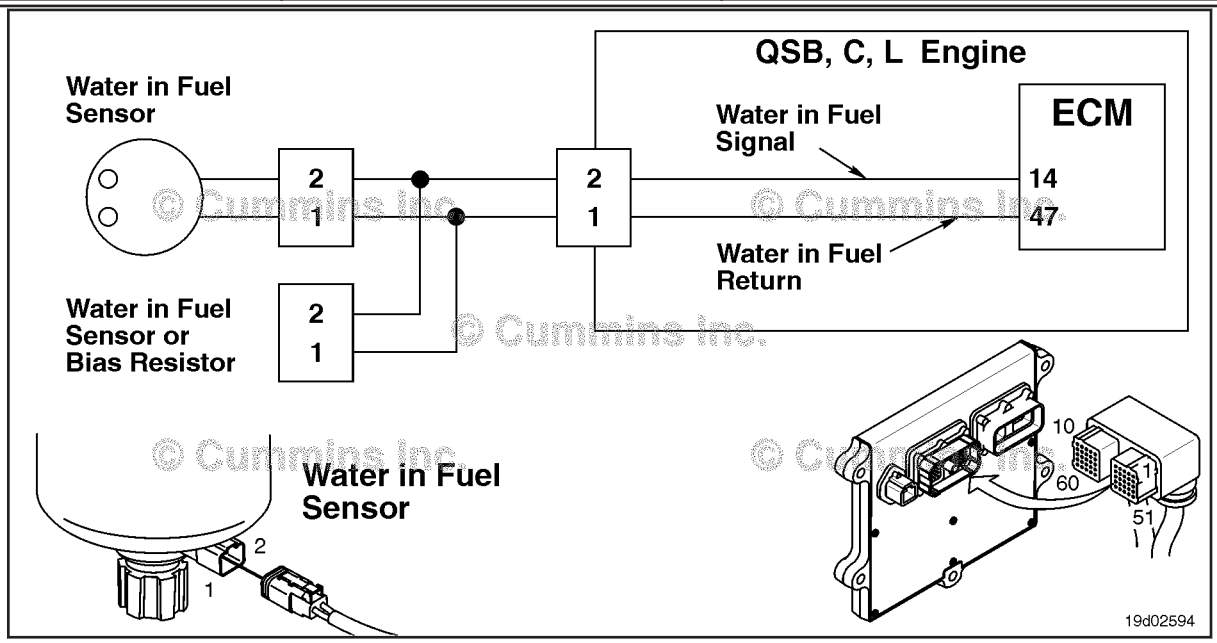
**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 429 (Marine Application)

## Water-in-Fuel Indicator Sensor Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 429<br>PID(P), SID(S): P097<br>SPN: 97<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Water-in-Fuel Indicator Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected at the water-in-fuel circuit. | None on performance. No water-in-fuel warning available. |




Water-in-Fuel Sensor Circuit

**Circuit Description:**

The water-in-fuel sensor is attached the fuel filter housing. The ECM monitors the water-in-fuel sensor in order to flag a fault when a set volume of water has accumulated in the fuel filter. The water-in-fuel circuit contains two wires, a ground wire and a signal wire.

**Component Location:**

In automotive, industrial, and power generation applications, the water-in-fuel sensor is integrated into the bottom of the OEM supplied suction fuel filter. The OEM supplied fuel filter is located on the intake side of the engine. For marine applications, the water-in-fuel sensor is mounted at the base of the water/fuel separator bowl on the fuel filter housing. This fuel/water separator housing contains a serviceable element. The filter housing location will vary with each OEM. Marine applications utilize a dual WIF sensor configuration. This assembly incorporates a y-harness with either two WIF sensors (duplex filtering) or one WIF sensor and a terminating resistor.

**Shop Talk:**

In automotive, industrial, and power generation applications, the water-in-fuel sensor is integrated into the fuel filter. It is automatically replaced whenever the fuel filter is replaced. For marine applications the sensor is **not** integrated into the fuel filter and is a serviceable item. Possible causes for this fault code include:

- Water in fuel
- Damaged sensor
- Fuel contamination.

## Refer to Troubleshooting Fault Code t05-429

# FAULT CODE 429 (Marine Application) - Water-in-Fuel Indicator Sensor Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 429 active?** | |
| **STEP 2:** | **Check the water-in-fuel sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the engine harness and sensor connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault Code 428 active and Fault Code 429 inactive?** | |
| **STEP 2C:** | **Check the fault codes and verify sensor condition.** | **Fault Code 429 is active?** | |
| **STEP 3:** | **Check the engine harness.** | | |
| **STEP 3A:** | **Inspect the engine harness, sensor, and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check the ECM response.** | **Fault Code 428 active and Fault Code 429 inactive?** | |
| **STEP 3C:** | **Check for a short circuit from pin to pin.** | **Greater than 100k ohms?** | |
| **STEP 3D:** | **Check for a pin short circuit to ground.** | **Greater than 100k ohms?** | |
| **STEP 3E:** | **Check for an inactive fault code.** | **Fault Code 429 is inactive?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 429 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 429 active?<br>**YES** | 2A |
| | Fault Code 429 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the water-in-fuel sensor.

**STEP 2A: Inspect the engine harness and sensor connector pins.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the water-in-fuel sensor.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken.<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electronic contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the water-in-fuel sensor
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 active and Fault Code 429 inactive?<br>**YES** | 2C |
| | Fault Code 428 active and Fault Code 429 inactive?<br>**NO** | 3A |

**STEP 2C: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF
- Connect the water-in-fuel sensor to the engine harness
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 429 is active?<br>**YES**<br>**Repair:**<br>A damaged sensor has been detected.<br>Replace the water-in-fuel sensor. Refer to Procedure 019-127 in Section 19. | 4A |
| | Fault Code 429 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the engine harness.

### STEP 3A: Inspect the engine harness, sensor, and ECM connector pins.

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the engine harness from the water-in-fuel sensor.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness, sensor, and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electronic contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

### STEP 3B: Check the ECM response.

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Turn keyswitch ON
- Connect INSITE™ electronic service tool electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 428 active and Fault Code 429 inactive?<br>**YES** | 3C |
| | Fault Code 428 active and Fault Code 429 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check for a short circuit from pin to pin.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the water-in-fuel sensor
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the water-in-fuel SIGNAL pin at the ECM connector of the engine harness and all other pins in the ECM connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A short circuit has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

**STEP 3D: Check for a pin short circuit to ground.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the water-in-fuel sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-ground short.<br>• Measure the resistance between the water-in-fuel sensor SIGNAL pin in the engine harness ECM connector and ground.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3E |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-ground short circuit on the SIGNAL line has been detected in the engine harness.<br>Repair or replace the damaged engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 429 is inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Fault Code 429 is inactive?<br>**NO**<br>**Repair:**<br>Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. | 1A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 429 inactive?<br>**YES** | 4B |
| | Fault Code 429 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

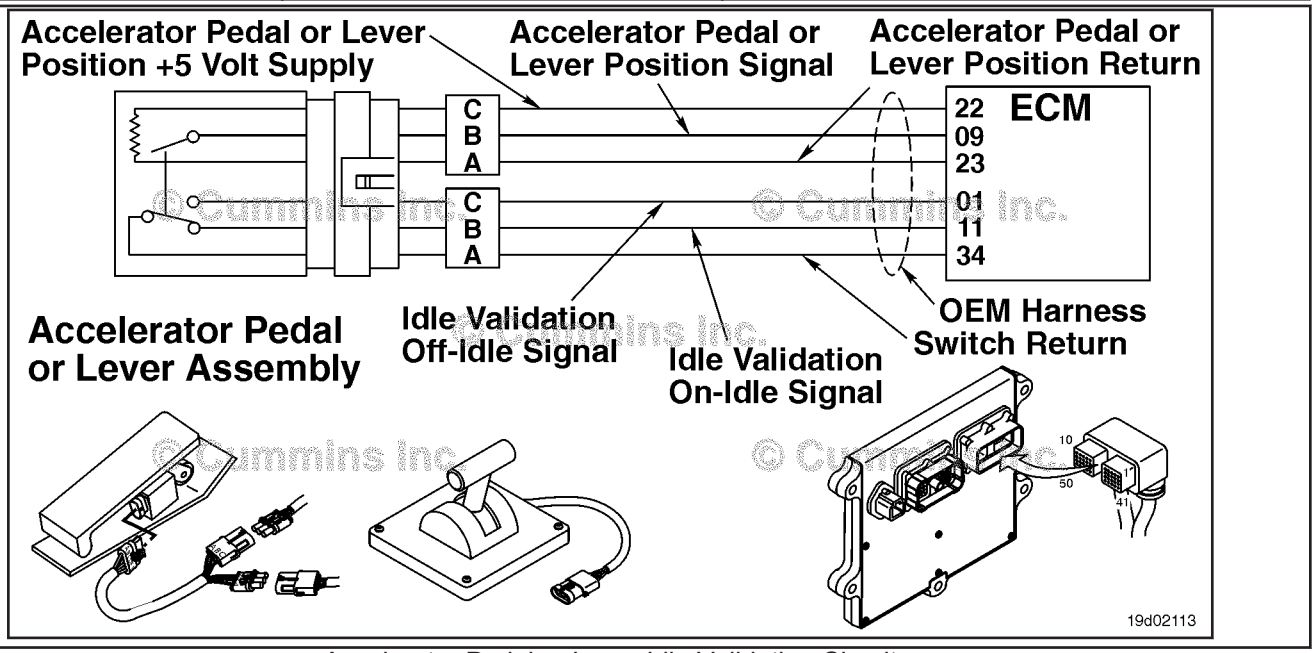
**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 431 (ISS)

## Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 431<br>PID(P), SID(S): S230<br>SPN: 558<br>FMI: 2/2<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect. Voltage detected simultaneously on both idle validation and off-idle validation switches. | Automotive: Engine will **only** idle.<br>Marine: Severe derate in engine speed. Limp home capability **only**. |




Accelerator Pedal or Lever Idle Validation Circuit

**Circuit Description:**

The idle validation switch is used by the electronic control module (ECM) to indicate when the accelerator pedal or lever is released (on-idle) or depressed (off-idle). The switch is adjusted at the factory to switch from on-idle to off-idle at the correct accelerator pedal or lever position. The switch return is a shared return with other OEM cab switches.

**Component Location:**

The integrated sensor switch (ISS) is located on the accelerator pedal or lever assembly.

**Shop Talk:**

- This fault code is usually caused by an open circuit on either the idle validation on-idle or off-idle signal circuit, a loose connection, uncalibrated accelerator pedal or lever assembly, or miswired idle validation switch.
- The integrated sensor switch (ISS) has a different internal resistance specification (125 ohms) than the nonintegrated sensor switch (NISS).
- When installing a new accelerator pedal or lever assembly, it **must** be calibrated before operating the engine. To calibrate, turn the keyswitch to the ON position and fully depress and release the pedal three times.

## Refer to Troubleshooting Fault Code t05-431

# FAULT CODE 431 (ISS) - Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

**⚠ WARNING ⚠**

**On Automotive applications, set the service brake using the trailer brake hand valve. Make sure there is enough air pressure to activate the brake pressure switch. Securely chock the wheels. Truck movement during troubleshooting can cause severe equipment damage, personal injury, or death.**

**⚠ CAUTION ⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠ CAUTION ⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead, Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead, and Part Number 3823995 - male Weather-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the ISS.** | | |
| **STEP 1A:** | **Verify the ISS is connected to the OEM harness.** | **ISS is connected to the OEM harness?** | |
| **STEP 1B:** | **Inspect the ISS and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 1C:** | **Check the ISS for an open circuit.** | **Less than 125 ohms?** | |
| **STEP 1D:** | **Check the ISS for a short circuit from pin to pin.** | **More than 100k ohms?** | |
| **STEP 2:** | **Check the OEM harness.** | | |
| **STEP 2A:** | **Check the OEM harness for an open circuit.** | **Greater than 4.0-VDC?** | |
| **STEP 2B:** | **Inspect the OEM harness and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2C:** | **Check the OEM harness for an open circuit.** | **Less than 10 ohms?** | |
| **STEP 2D:** | **Check the OEM harness switch return circuit.** | **Less than 10 ohms?** | |
| **STEP 2E:** | **Check for a pin-to-pin short circuit in the OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 2F:** | **Check for a short circuit in the OEM harness ECM battery (+) circuit.** | **Greater than 100k ohms?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 431 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the ISS.

**STEP 1A: Verify the ISS is connected to the OEM harness.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify the ISS is connected to the harness.<br>Verify the ISS is connected to the OEM harness. | ISS is connected to the OEM harness?<br>**YES** | 1B |
| | ISS is connected to the OEM harness?<br>**NO**<br>**Repair:**<br>Connect the ISS to the OEM harness. Refer to the OEM service manual. | 3A |

**STEP 1B: Inspect the ISS connector pins.**

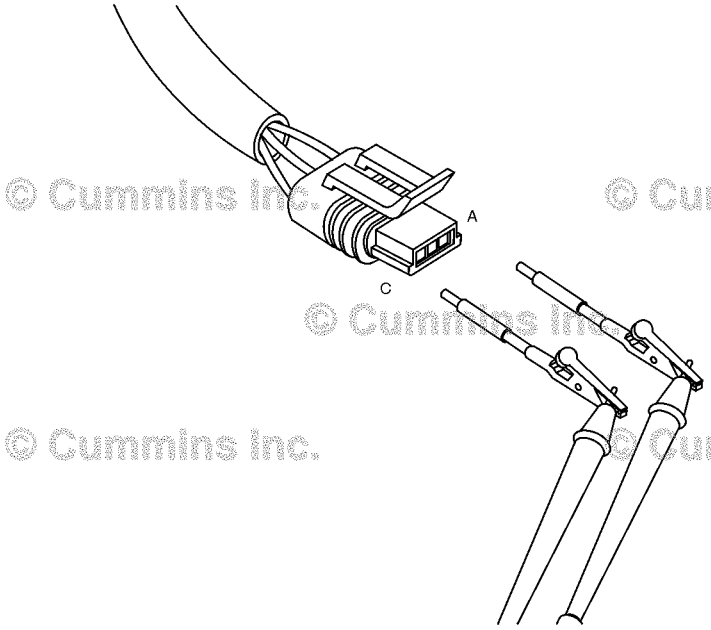
**Condition:**
- Turn keyswitch OFF.
- Disconnect the ISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ISS connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 1C |

**STEP 1C: Check the ISS for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the ISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin and switch RETURN pin of the ISS connector with the pedal or lever released.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin and switch RETURN pin of the ISS connector with the pedal or lever depressed.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 125 ohms?<br>**YES** | 1D |
| | Less than 125 ohms?<br>**NO**<br>**Repair:**<br>Replace the ISS. Refer to the OEM service manual. | 3A |

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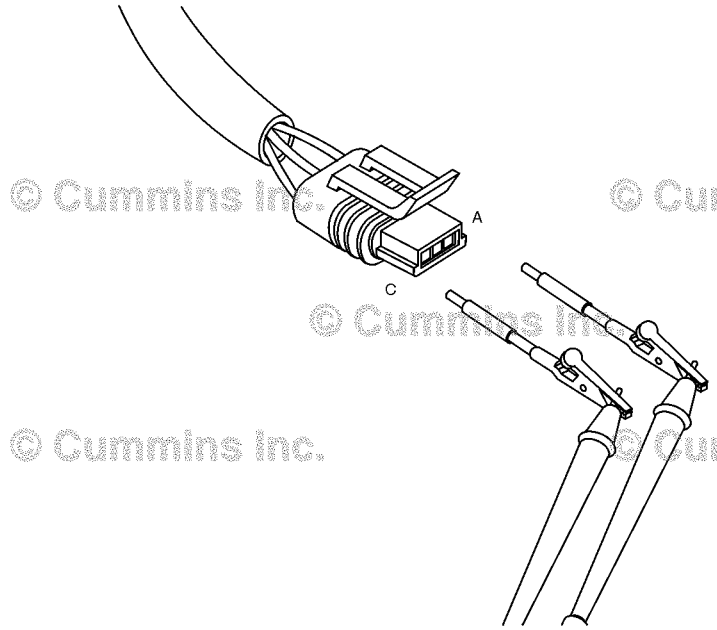
**STEP 1D: Check the ISS for a short circuit from pin to pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the ISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin and idle validation off-idle SIGNAL pin of the ISS connector with the pedal or lever released and depressed.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | More than 100k ohms?<br>**YES** | 2A |
| | More than 100k ohms?<br>**NO**<br>**Repair:**<br>Replace the ISS. Refer to the OEM service manual. | 3A |



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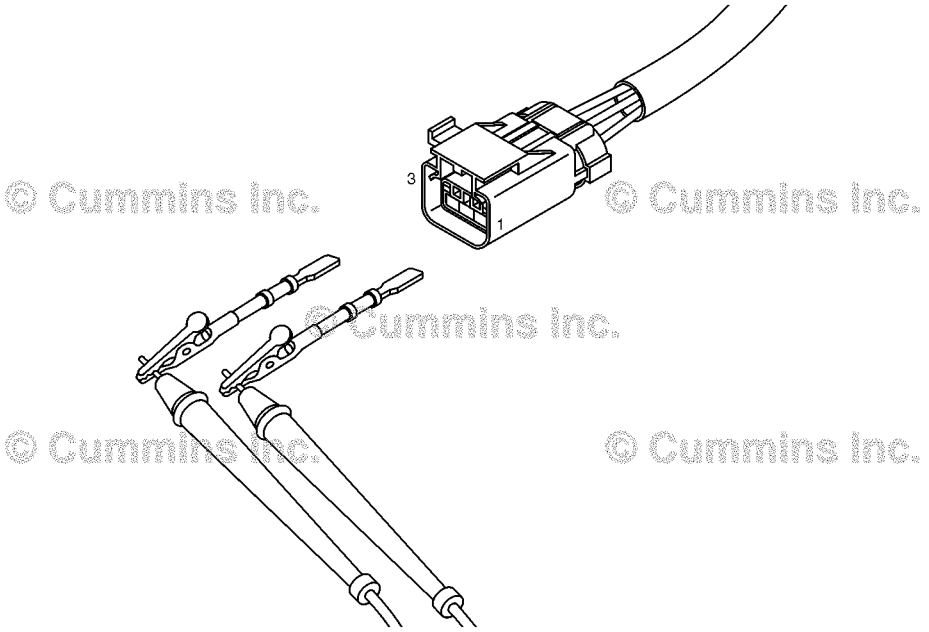
## STEP 2: Check the OEM harness.

### STEP 2A: Check the OEM harness for an open circuit.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the ISS from the OEM harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the voltage from the idle validation on-idle SIGNAL pin in the ISS connector of the OEM harness to the switch RETURN pin in the ISS connector of the OEM harness.<br>• Measure the voltage from the idle validation off-idle SIGNAL pin in the ISS connector of the OEM harness to the switch RETURN pin in the ISS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | Greater than 4.0-VDC?<br>**YES** | 2E |
| | Greater than 4.0-VDC?<br>**NO** | 2B |



**STEP 2B: Inspect the OEM harness and ECM connector pins.**

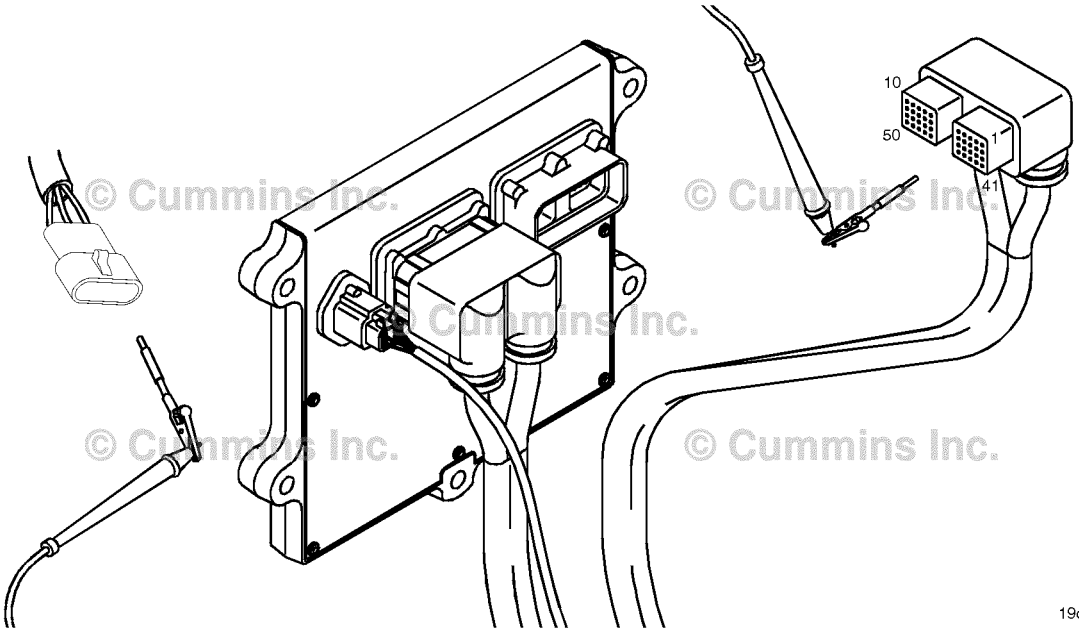
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2C |

**STEP 2C: Check the OEM harness for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the ISS from the OEM harness.

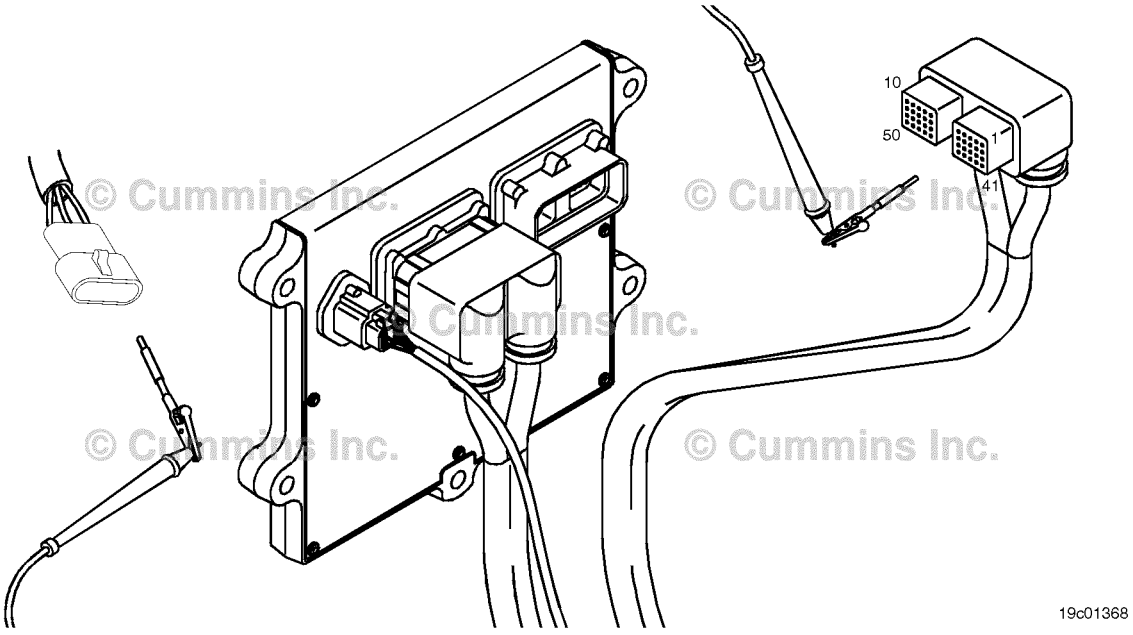
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance of the idle validation on-idle SIGNAL wire in the OEM harness between the ECM connector and the ISS connector.<br>• Measure the resistance of the idle validation off-idle SIGNAL wire in the OEM harness between the ECM connector and the ISS connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2D: Check the OEM harness switch return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the ISS from the OEM harness.

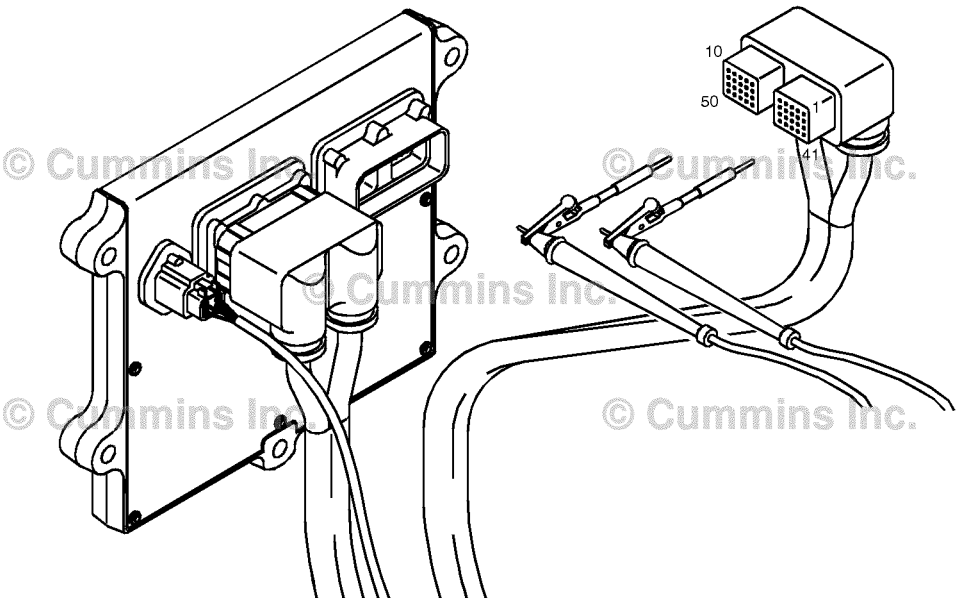
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open switch return circuit.<br>• Measure the resistance of the switch RETURN wire in the OEM harness between the ECM connector and the ISS connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2E |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2E: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the ISS from the OEM harness.

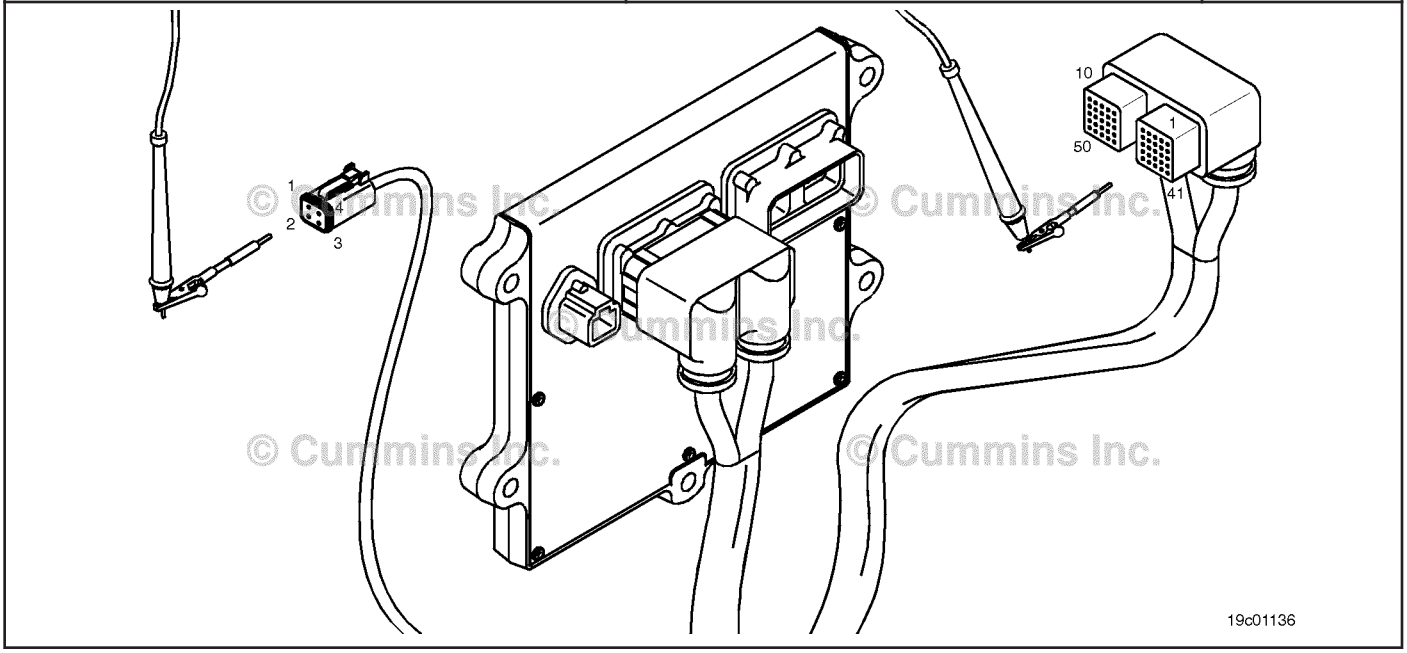
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open switch return circuit.<br>Measure the resistance and check for a short circuit between the following OEM harness ECM connector pins and all other pins in the connector:<br>• Idle validation on-idle SIGNAL pin<br>• Idle validation off-idle SIGNAL pin<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2F |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2F: Check for a short circuit in the OEM harness ECM.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the ISS from the OEM harness.
- Disconnect the OEM power harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on two connectors - pin-to-pin check.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin in the OEM harness ECM connector and the ECM battery (+) pins in the ECM power connector.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin in the OEM harness ECM connector and the ECM battery (+) pins in the ECM power connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | Repair complete |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



## STEP 3: Clear the fault code.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Turn the keyswitch ON and completely depress and release the accelerator pedal or lever three times.<br>• Use INSITE™ electronic service tool to verify that Fault Code 431 is inactive. | Fault Code 431 inactive?<br>**YES** | 3B |
| | Fault Code 431 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Service Location if all steps have been completed and checked again. | 1A |

### STEP 3B: Clear the inactive fault codes.

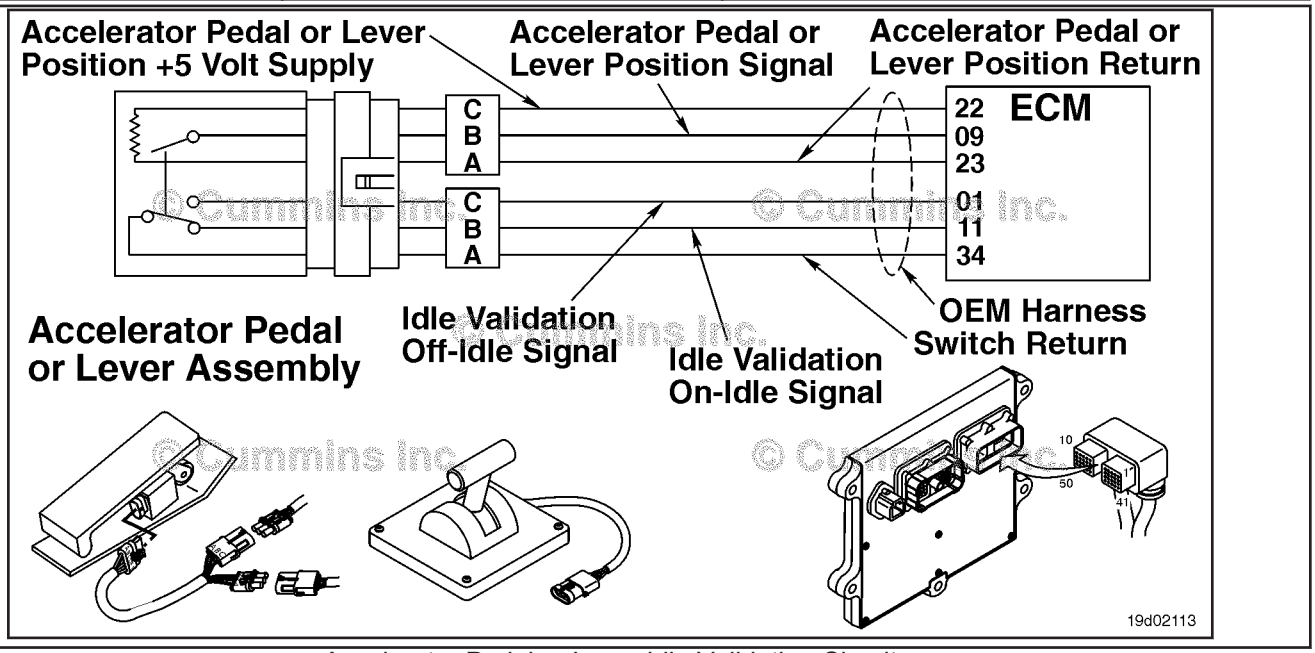
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair Complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 431 (NISS)

## Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 431<br>PID(P), SID(S): S230<br>SPN: 558<br>FMI: 2/2<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect. Voltage detected simultaneously on both idle validation and off-idle validation switches. | Automotive: Engine will **only** idle.<br>Marine: Severe derate in engine speed. Limp home capability **only**. |




Accelerator Pedal or Lever Idle Validation Circuit

**Circuit Description:**

The idle validation switch is used by the electronic control module (ECM) to indicate when the accelerator pedal or lever is released (on-idle) or depressed (off-idle). The switch is adjusted at the factory to switch from on-idle to off-idle at the correct accelerator pedal or lever position.

**Component Location:**

The nonintegrated sensor switch (NISS) is located on the accelerator pedal or lever assembly.

**Shop Talk:**

- This fault code is usually caused by an open circuit on either the idle validation on-idle or off-idle signal circuits, a loose connection, uncalibrated accelerator pedal or lever assembly, or miswired idle validation switch.
- The nonintegrated sensor switch has a different internal resistance specification (10 ohms) than the integrated sensor switch (ISS).
- When installing a new accelerator pedal or lever assembly, it **must** be calibrated before operating the engine. To calibrate, turn the keyswitch to ON position and fully depress and release the pedal or lever three times.

## Refer to Troubleshooting Fault Code t05-431

# FAULT CODE 431 (NISS) - Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

**⚠ WARNING ⚠**

**On Automotive applications, set the service brake using the trailer brake hand valve. Make sure there is enough air pressure to activate the brake pressure switch. Securely chock the wheels. Truck movement during troubleshooting can cause severe equipment damage, personal injury, or death.**

**⚠ CAUTION ⚠**

**To avoid damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠ CAUTION ⚠**

**To avoid pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead, Part Number 3822917 - female Deutsch™/AMP™/ Metri-Pack™ test lead, and Part Number 3823995 - male Weather-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the NISS.** | | |
| STEP 1A: | Verify the NISS is connected to the OEM harness. | NISS is connected to the OEM harness? | |
| STEP 1B: | Inspect the NISS and connector pins. | Dirty or damaged pins? | |
| STEP 1C: | Check the NISS for an open circuit. | Less than 10 ohms? | |
| STEP 1D: | Check the NISS for a short circuit from pin to pin. | More than 100k ohms? | |
| **STEP 2:** | **Check the OEM harness.** | | |
| STEP 2A: | Check the OEM harness for an open circuit. | Greater than 4.0-VDC? | |
| STEP 2B: | Inspect the OEM harness and ECM connector pins. | Dirty or damaged pins? | |
| STEP 2C: | Check the OEM harness for an open circuit. | Less than 10 ohms? | |
| STEP 2D: | Check the OEM harness switch return circuit. | Less than 10 ohms? | |
| STEP 2E: | Check for a pin-to-pin short circuit in the OEM harness. | Greater than 100k ohms? | |
| STEP 2F: | Check for a short circuit in the OEM harness ECM battery (+) circuit. | Greater than 100k ohms? | |
| **STEP 3:** | **Clear the fault code.** | | |
| STEP 3A: | Disable the fault code. | Fault Code 431 inactive? | |
| STEP 3B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the NISS.

**STEP 1A: Verify the NISS is connected to the OEM harness.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify the NISS is connected to the OEM harness.<br>- | NISS is connected to the OEM harness?<br>**YES** | 1B |
| | NISS is connected to the OEM harness?<br>**NO**<br>**Repair:**<br>Connect the NISS to the OEM harness. Refer to the OEM service manual. | 3A |

**STEP 1B: Inspect the NISS and connector pins.**

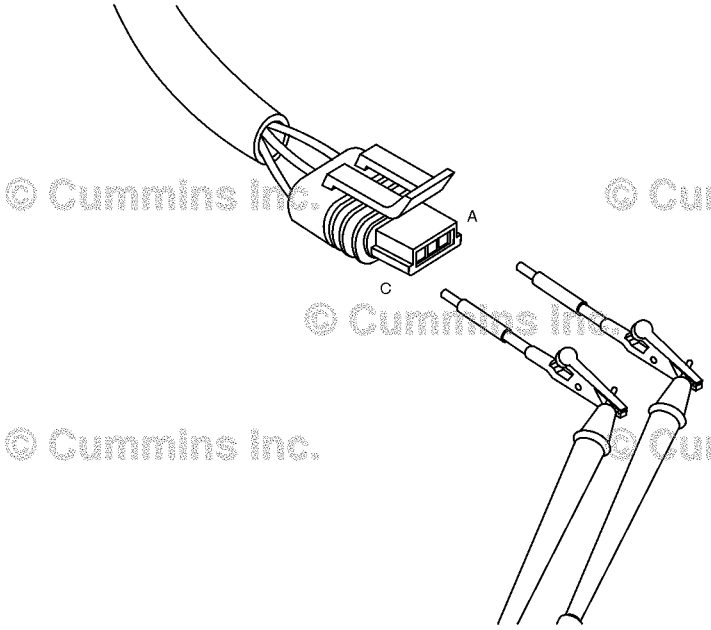
**Condition:**
- Turn keyswitch OFF.
- Disconnect the NISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the connector pins for the following:Inspect the OEM harness and NISS connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 1C |

**STEP 1C: Check the NISS for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the NISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin and switch RETURN pin of the NISS connector with the pedal or lever released.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin and switch RETURN pin of the NISS connector with the pedal or lever depressed.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 1D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Replace the NISS. Refer to the OEM service manual. | Repair Complete |

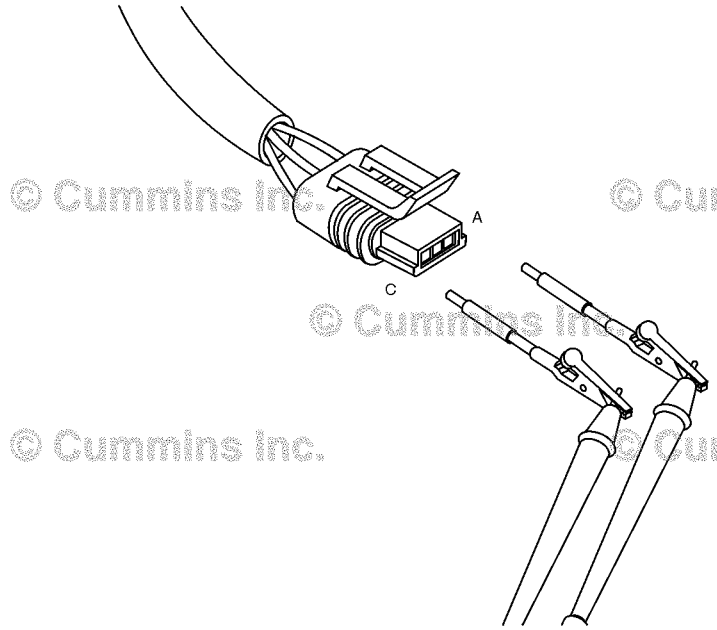



19c01100

**STEP 1D: Check the NISS for a short circuit from pin to pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the NISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin and idle validation off-idle SIGNAL pin of the NISS connector with the pedal or lever released and depressed.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | More than 100k ohms?<br>**YES** | 2A |
| | More than 100k ohms?<br>**NO**<br>**Repair:**<br>Replace the NISS. Refer to the OEM service manual. | 3A |





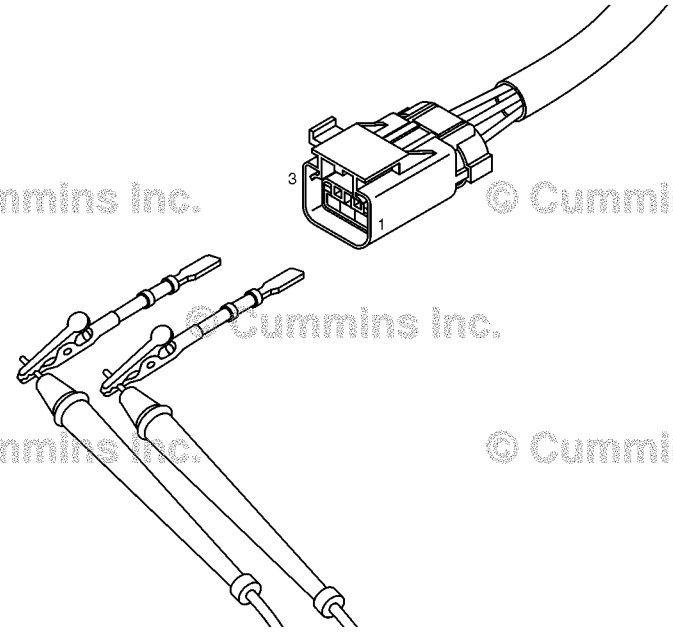

19c01100

## STEP 2: Check the OEM harness.

### STEP 2A: Check the OEM harness for an open circuit.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the NISS from the OEM harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the voltage from the idle validation on-idle SIGNAL pin in the NISS connector of the OEM harness to the switch RETURN pin in the NISS connector of the OEM harness.<br>• Measure the voltage from the idle validation off-idle SIGNAL pin in the NISS connector of the OEM harness to the switch RETURN pin in the NISS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | Greater than 4.0-VDC?<br>**YES** | 2E |
| | Greater than 4.0-VDC?<br>**NO** | 2B |




19c01108

**STEP 2B: Inspect the OEM harness and ECM connector pins.**

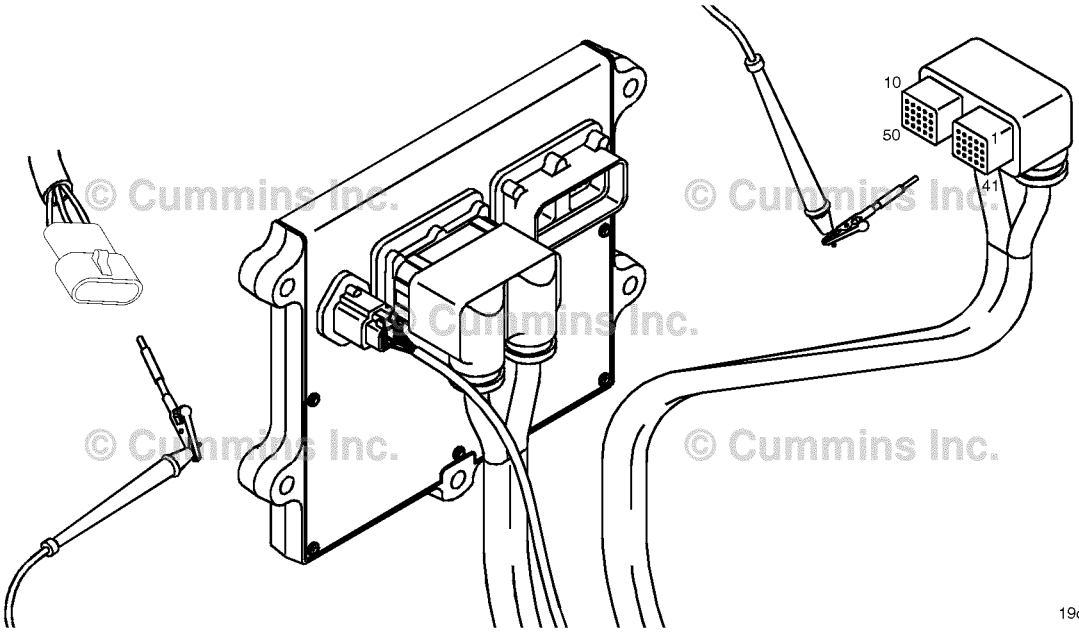
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2C |

**STEP 2C: Check the OEM harness for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the NISS from the OEM harness.

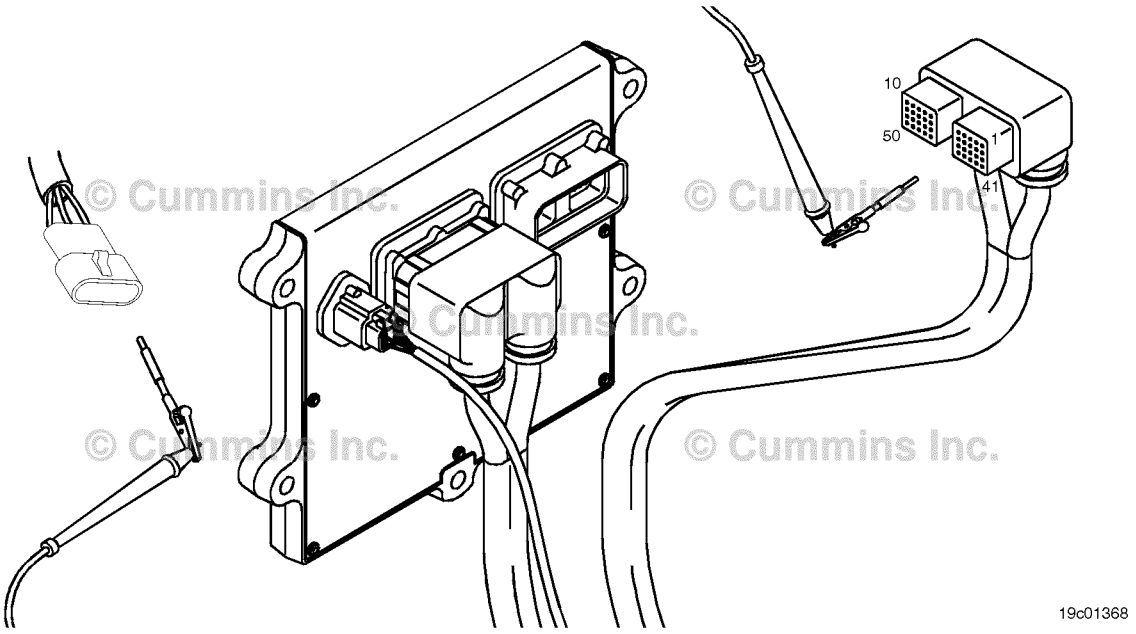
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance of the idle validation on-idle SIGNAL wire in the OEM harness between the ECM connector and the NISS connector.<br>• Measure the resistance of the idle validation off-idle SIGNAL wire in the OEM harness between the ECM connector and the NISS connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2D: Check the OEM harness switch return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the NISS from the OEM harness.

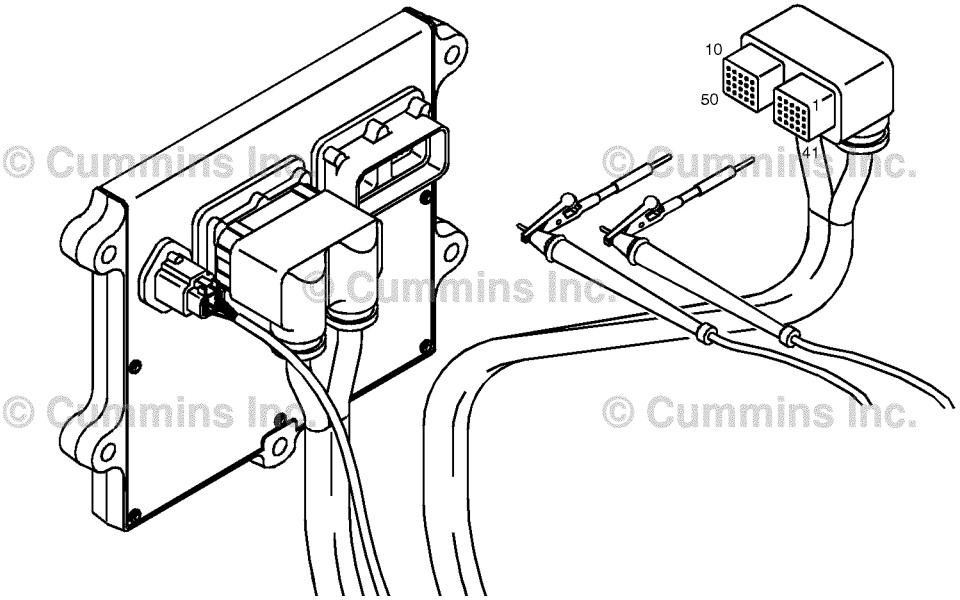
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open switch return circuit.<br>• Measure the resistance of the OEM harness switch RETURN wire in the OEM harness between the ECM connector and the NISS connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2E |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2E: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the NISS from the OEM harness.

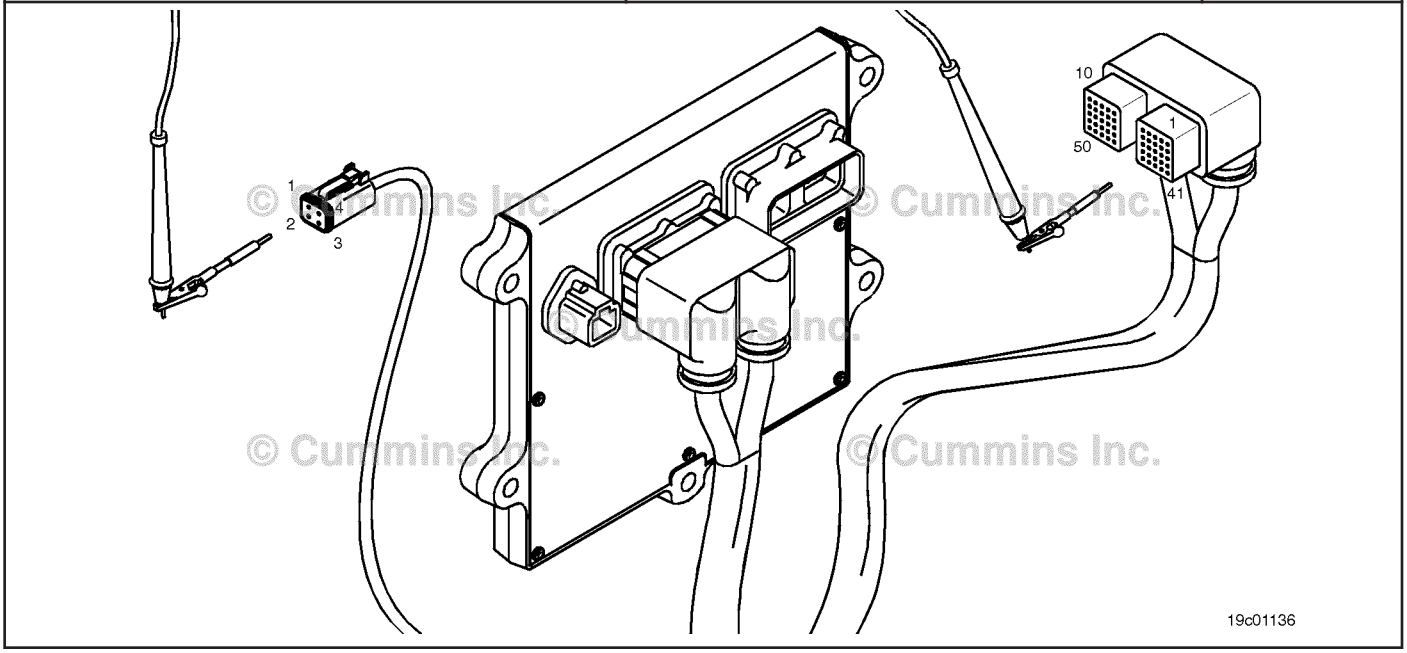
| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on one connector - pin to pin check:<br>Measure the resistance and check for a short circuit between the following OEM harness ECM connector pins and all other pins in the connector:<br>• Idle validation on-idle SIGNAL pin<br>• Idle validation off-idle SIGNAL pin.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2F |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2F: Check for a short circuit in the OEM harness ECM battery (+) circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the NISS from the OEM harness.
- Disconnect the OEM power harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on two connectors - pin-to-pin check:<br>• Measure the resistance between the idle validation on-idle SIGNAL pin in the OEM harness ECM connector and the ECM battery (+) pins in the ECM power connector.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin in the OEM harness ECM connector and the ECM battery (+) pins in the ECM power connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | Repair complete |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



## STEP 3: Clear the fault code.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Turn the keyswitch ON and completely depress and release the accelerator pedal or lever three times.<br>• Use INSITE™ electronic service tool to verify that Fault Code 431 is inactive. | Fault Code 431 inactive?<br>**YES** | 3B |
| | Fault Code 431 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 3B: Clear the inactive fault codes.

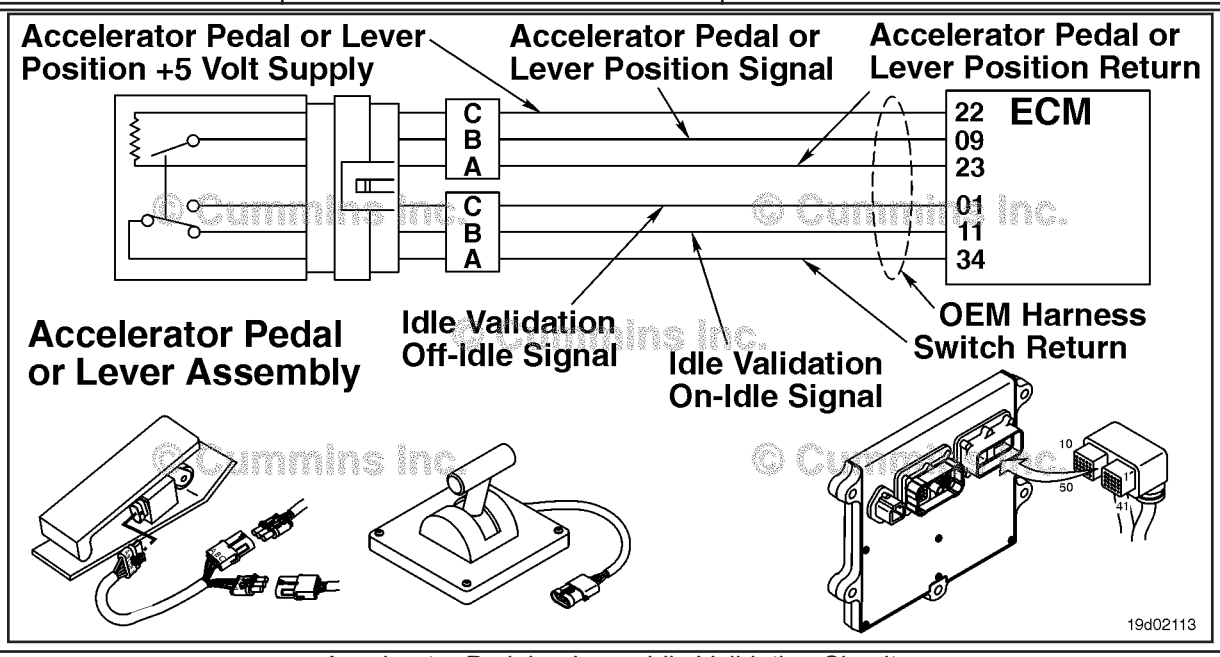
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair Complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 431 (SSS)

## Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 431<br>PID(P), SID(S): S230<br>SPN: 558<br>FMI: 2/2<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent or Incorrect. Voltage detected simultaneously on both idle validation and off-idle validation switches. | Automotive: Engine will **only** idle.<br>Marine: Severe derate in engine speed. Limp home capability **only**. |




Accelerator Pedal or Lever Idle Validation Circuit

**Circuit Description:**

The idle validation switch is used by the electronic control module (ECM) to indicate when the accelerator pedal or lever is released (on-idle) or depressed (off-idle). The switch is adjusted at the factory to switch from on-idle to off-idle at the correct accelerator pedal or lever position.

**Component Location:**

The solid state sensor switch (SSS) is located on the accelerator pedal or lever assembly.

**Shop Talk:**

- This fault code is usually caused by an open circuit on either the idle validation on-idle or off-idle signal circuits, a loose connection, uncalibrated accelerator pedal or lever assembly, or miswired idle validation switch.
- Since the solid state sensor switch (SSS) uses an integrated circuit to output idle and off-idle signals, the internal resistance can **not** be checked with a multimeter as it is for the integrated sensor switch and nonintegrated sensor switch.
- When installing a new accelerator pedal or lever assembly, it **must** be calibrated before operating the engine. To calibrate, turn the keyswitch to the ON position and fully depress and release the pedal three times.

## Refer to Troubleshooting Fault Code t05-431

# FAULT CODE 431 (SSS) - Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent or Incorrect

## TROUBLESHOOTING SUMMARY

**⚠ WARNING ⚠**

**On Automotive applications, set the service brake using the trailer brake hand valve. Make sure there is enough air pressure to activate the brake pressure switch. Securely chock the wheels. Truck movement during troubleshooting can cause severe equipment damage, personal injury, or death.**

**⚠ CAUTION ⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠ CAUTION ⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead, Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead, and Part Number 3823995 - male Weather-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the SSS.** | | |
| STEP 1A: | Verify the SSS is connected to the OEM harness. | SSS is connected to the OEM harness? | |
| STEP 1B: | Inspect the SSS connector pins. | Dirty or damaged pins? | |
| **STEP 2:** | **Check the OEM harness.** | | |
| STEP 2A: | Check the OEM harness for an open circuit. | Greater than 4.0 VDC? | |
| STEP 2B: | Inspect the OEM harness and ECM connector pins. | Dirty or damaged pins? | |
| STEP 2C: | Check the OEM harness for an open circuit. | Less than 10 ohms? | |
| STEP 2D: | Check the OEM harness switch return circuit. | Less than 10 ohms? | |
| STEP 2E: | Check for a pin to pin short circuit in the OEM harness. | Greater than 100k ohms? | |
| STEP 2F: | Check for a short circuit in the OEM harness ECM battery (+) circuit. | Greater than 100k ohms? | |
| **STEP 3:** | **Clear the fault code.** | | |
| STEP 3A: | Disable the fault code. | Fault Code 431 inactive? | |
| STEP 3B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the SSS.

**STEP 1A: Verify the SSS is connected to the OEM harness.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify the SSS is connected to the harness.<br>Verify the SSS is connected to the OEM harness. | SSS is connected to the OEM harness?<br>**YES** | 1B |
| | SSS is connected to the OEM harness?<br>**NO**<br>**Repair:**<br>Connect the SSS to the OEM harness. Refer to the OEM troubleshooting and repair manual | 3A |

**STEP 1B: Inspect the SSS connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the SSS from the OEM harness.

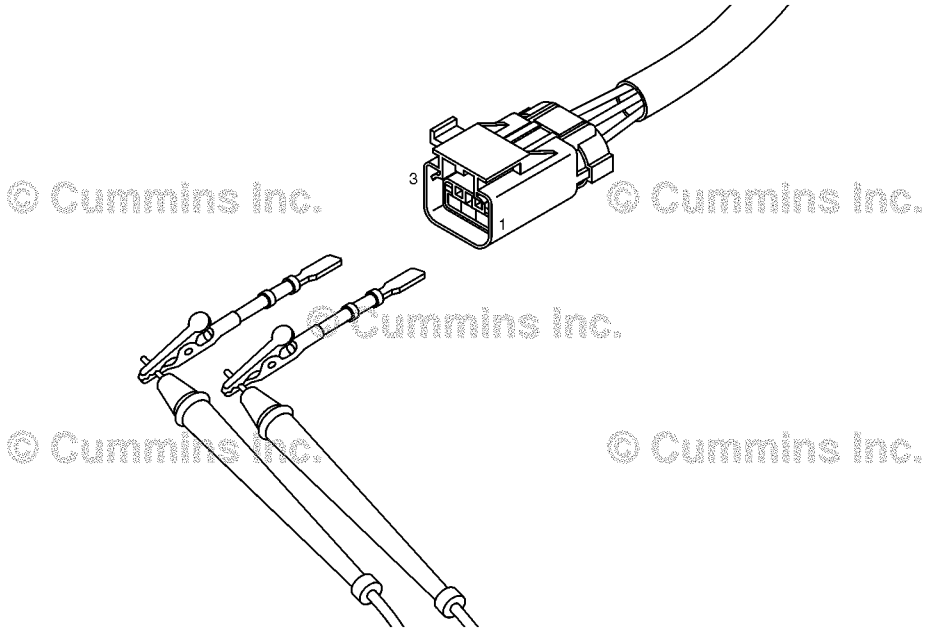
| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and the SSS connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 2A |

## STEP 2: Check the OEM harness.

### STEP 2A: Check the OEM harness for an open circuit.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the SSS from the OEM harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the voltage from the idle validation on-idle SIGNAL pin in the SSS connector of the OEM harness to the switch RETURN pin in the SSS connector of the OEM harness.<br>• Measure the voltage from the idle validation off-idle SIGNAL pin in the SSS connector of the OEM harness to the switch RETURN pin in the SSS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | Greater than 4.0 VDC?<br>**YES** | 2E |
| | Greater than 4.0 VDC?<br>**NO** | 2B |



**STEP 2B: Inspect the OEM harness and ECM connector pins.**

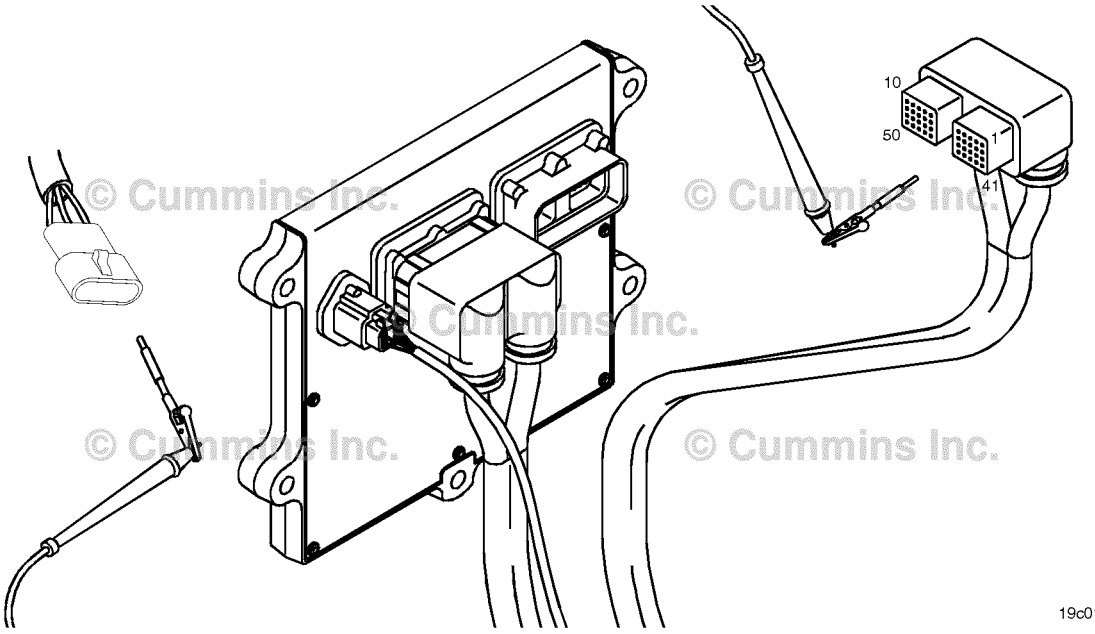
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19.. | 3A |
| | Dirty or damaged pins?<br>**NO** | 2C |

**STEP 2C: Check the OEM harness for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the SSS from the OEM harness.

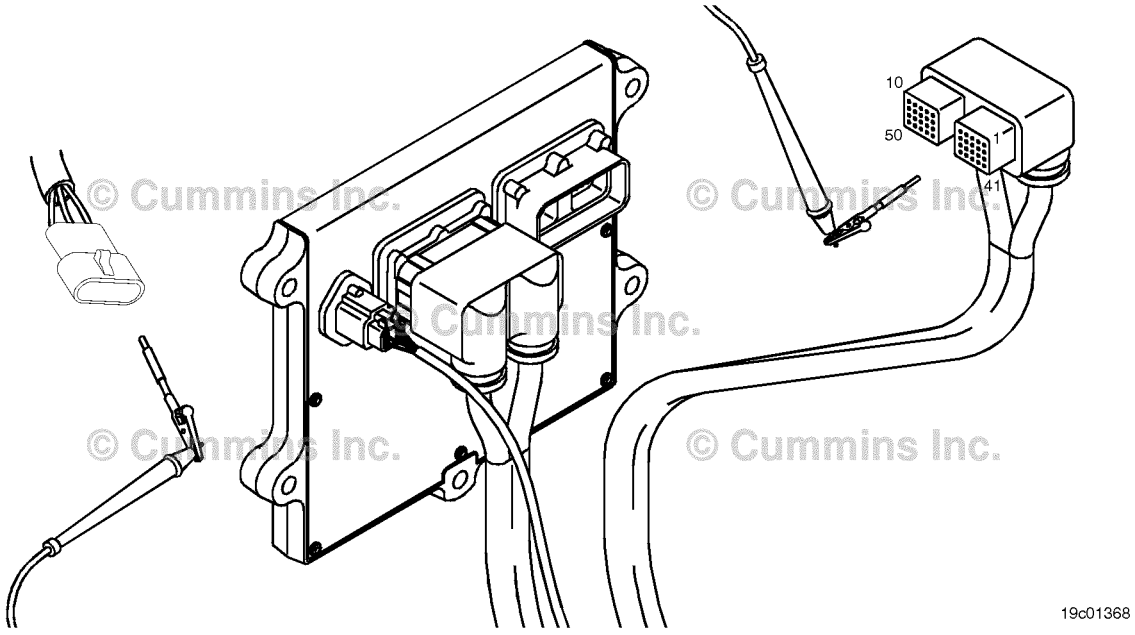
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance of the idle validation on-idle SIGNAL wire in the OEM harness between the ECM connector and the SSS connector.<br>• Measure the resistance of the idle validation off-idle SIGNAL wire in the OEM harness between the ECM connector and the SSS connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2D: Check the OEM harness return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the SSS from the OEM harness.

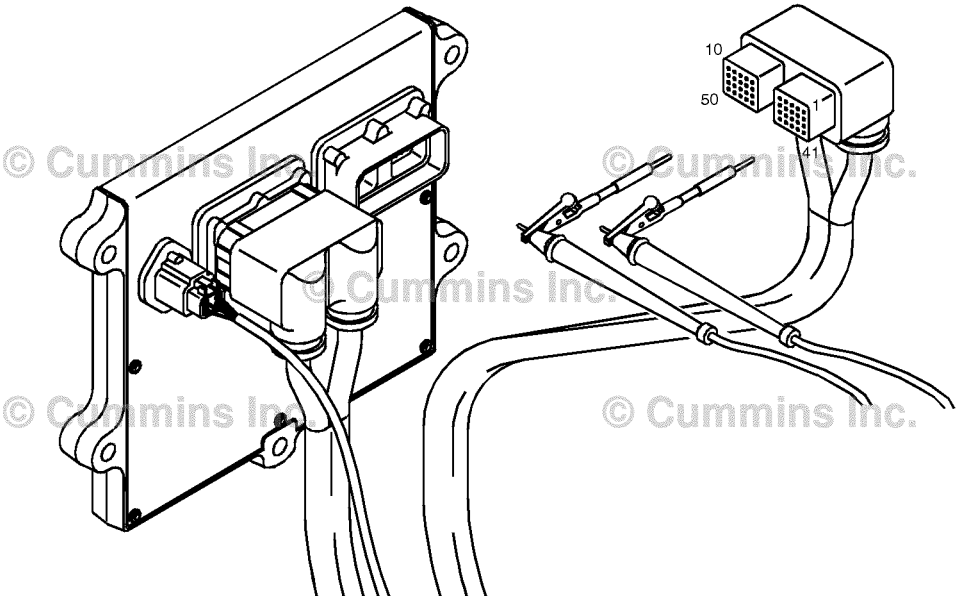
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance of the switch RETURN wire in the OEM harness between the ECM connector and the SSS connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2E |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2E: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the SSS from the OEM harness.

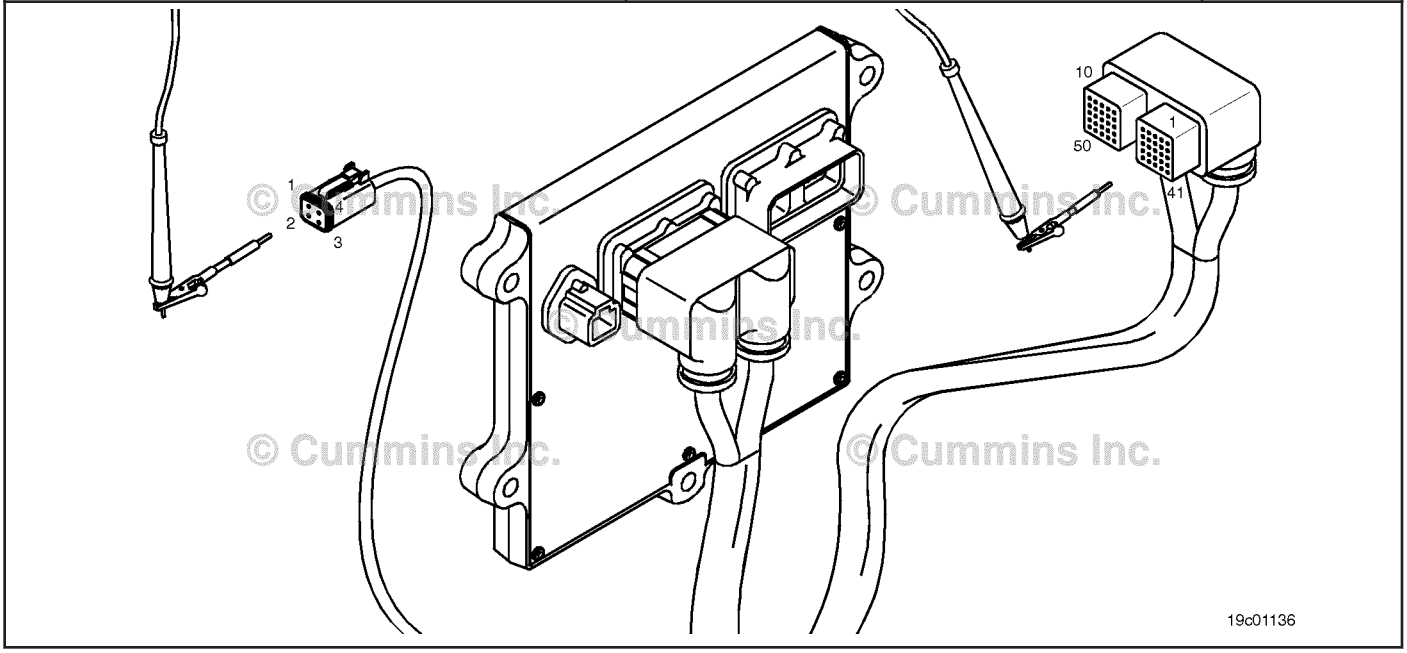
| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on one connector pin to pin check:<br>Measure the resistance and check for a short circuit between the following OEM harness ECM connector pins and all other pins in the connector:<br>• Idle validation on-idle SIGNAL pin<br>• Idle validation off-idle SIGNAL pin<br>Refer to the wiring diagram for connector pin identifications.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2F |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2F: Check for a short circuit in the OEM harness ECM battery (+) circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the SSS from the OEM harness.
- Disconnect the OEM power harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on two connectors pin to pin check:<br>• Measure the resistance between the idle validation on-idle SIGNAL pin in the OEM ECM connector and the ECM battery (+) pins in the ECM power connector.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin in the OEM ECM connector and the ECM battery (+) pins in the ECM power connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the SSS. Refer to the OEM service manual. | 3A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



## STEP 3: Clear the fault code.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Turn the keyswitch ON and completely depress and release the accelerator pedal or lever three times.<br>• Turn the keyswitch OFF for 30 seconds.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that Fault Code 431 is inactive. | Fault Code 431 inactive?<br>**YES** | 3B |
| | Fault Code 431 inactive?<br>**NO**<br>**Repair:**<br>Return to the troublleshooting steps or contact a local Cummins® Authorized Reapir Location if all steps have been completed and checked a second time. | 1A |

### STEP 3B: Clear the inactive fault codes.

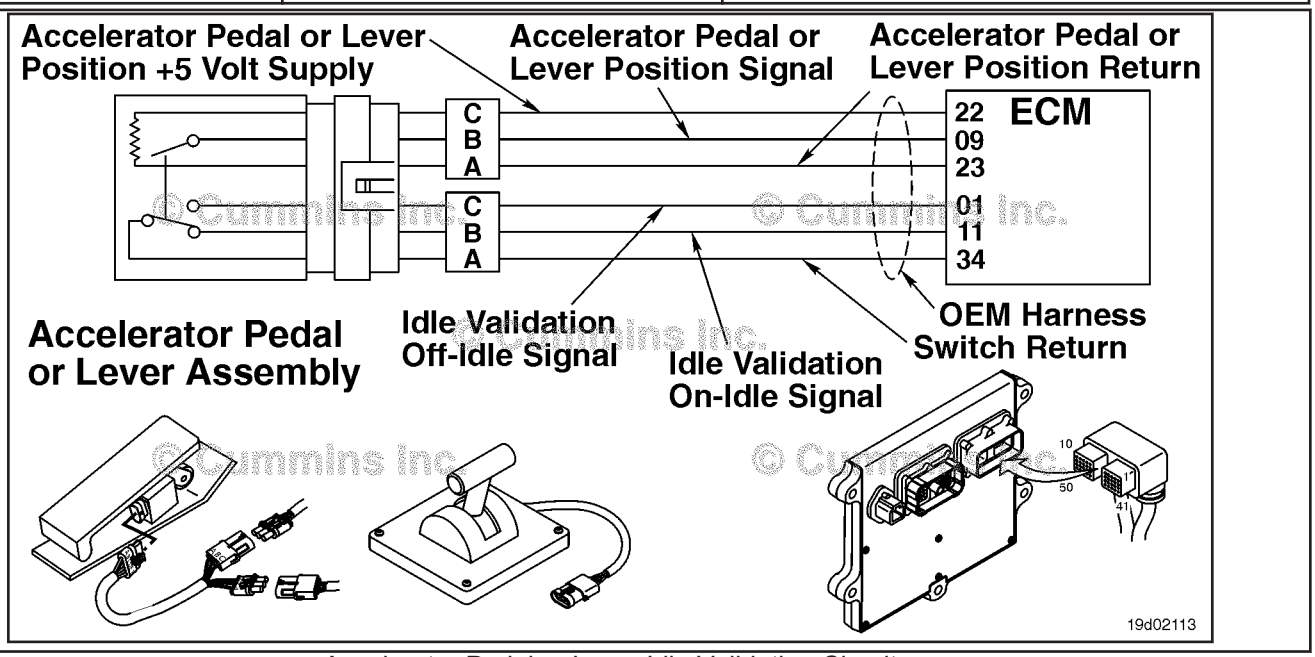
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair Complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooti ng steps |

# Fault Code 432

## Accelerator Pedal or Lever Idle Validation Circuit - Out of Calibration

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 432<br>PID(P), SID(S): S230<br>SPN: 558<br>FMI: 13/13<br>Lamp: Red<br>SRT: | Accelerator Pedal or Lever Idle Validation Circuit - Out of Calibration. Voltage at idle validation on-idle and off-idle circuit does **not** match accelerator pedal position. | Automotive: Engine will **only** idle.<br>Marine: Severe derate in engine speed. Limp home capability **only**. |




Accelerator Pedal or Lever Idle Validation Circuit

**Circuit Description:**

The accelerator pedal or lever position sensor is attached to the accelerator pedal or lever. The accelerator pedal or lever position sensor sends a signal to the electronic control module (ECM) when the accelerator pedal or lever is depressed and released. The accelerator pedal or lever position circuit contains three wires: accelerator pedal or lever position supply, accelerator pedal or lever position return, and accelerator pedal or lever position signal. The switch return circuit for the on-idle and off-idle validation circuit is a shared return with other OEM switches.

**Component Location:**

The accelerator pedal or lever position sensor is located on the accelerator pedal or lever.

**Shop Talk:**

This fault is logged when both the on idle and off idle validation switches disagree with the accelerator pedal or lever position signal. Turning the keyswitch ON while partially depressing the accelerator pedal or lever can cause this fault code to go active. This fault will stay active until the pedal or lever is cycled through its full travel.

## Refer to Troubleshooting Fault Code t05-432

# FAULT CODE 432 - Accelerator Pedal or Lever Idle Validation Circuit - Out of Calibration

## TROUBLESHOOTING SUMMARY

**⚠WARNING⚠**

**For Automotive applications, set the service brake using the trailer brake hand valve. Make sure there is enough air pressure to activate the brake pressure switch. Securely chock the wheels. Truck movement during troubleshooting can cause severe equipment damage, personal injury, or death.**

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead, Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead, and Part Number 3823995 - male Weather-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 432 active?** | |
| **STEP 2:** | **Check the fault codes.** | | |
| **STEP 2A:** | **Perform the fault code disable procedure.** | **Fault Code 432 active?** | |
| **STEP 3:** | **Check the OEM harness.** | | |
| **STEP 3A:** | **Inspect the OEM harness and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check the accelerator pedal or lever position sensor resistance.** | **1500 to 3000 Ohms (released)<br>250 to 1500 Ohms (depressed)?** | |
| **STEP 3B-1:** | **Check the resistance of the accelerator pedal or lever position sensor.** | **1500 to 3000 Ohms (released)<br>250 to 1500 Ohms (depressed)?** | |
| **STEP 3C:** | **Check for a pin-to-pin short circuit in the OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 4:** | **Clear the fault code.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 432 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault code.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 432 active?<br>**YES** | 2A |
| | Fault Code 432 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the fault codes.

**STEP 2A: Perform the fault code disable procedure.**

**Condition:**
- Turn keyswitch ON.
- All components connected.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Perform the fault code disable procedure.<br>• Slowly depress the accelerator pedal or lever to the full throttle position and release it completely three times.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 432 active?<br>**YES** | 3A |
| | Fault Code 432 active?<br>**NO**<br>**Repair:**<br>Replace the accelerator pedal or lever assembly. Refer to the OEM service manual. | 4A |

## STEP 3: Check the OEM harness.

### STEP 3A: Inspect the OEM harness and ECM connector pins.

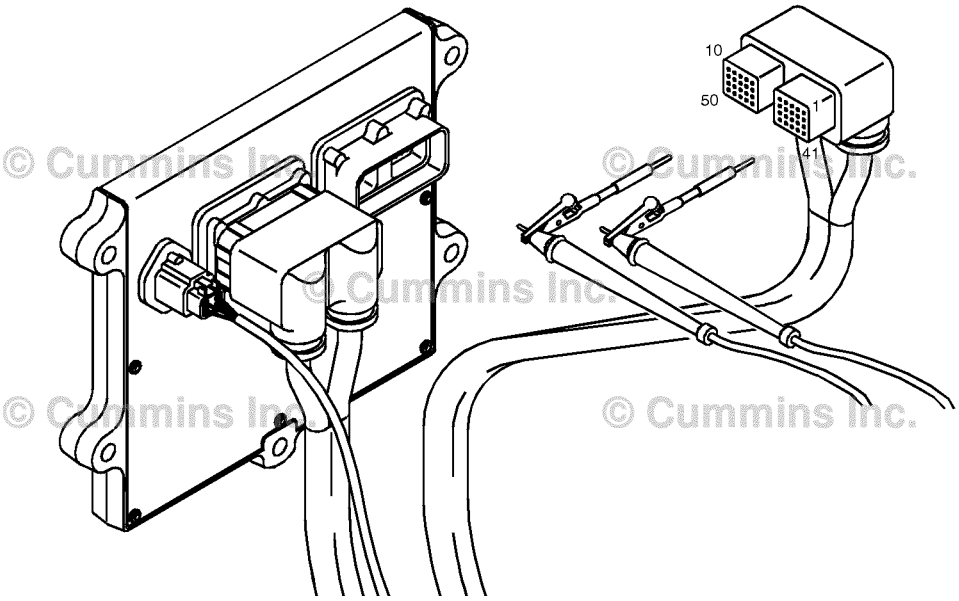
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check the accelerator pedal or lever position sensor resistance.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

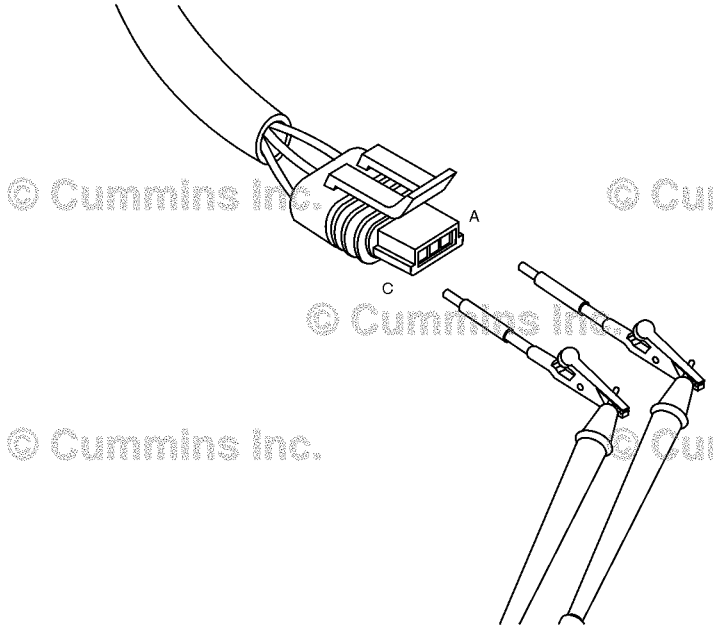
| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the resistance between the accelerator pedal or lever position SIGNAL pin and accelerator pedal or lever position +5 volt SUPPLY pin at the ECM connector of the OEM harness.<br>Refer to the wiring diagram for connector pin for identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | 1500 to 3000 Ohms (released) [250 to 1500 Ohms (depressed)]?<br>Released value **must** be at least 1000 ohms greater than depressed value.<br>**YES** | 3C |
| | 1500 to 3000 Ohms (released) [250 to 1500 Ohms (depressed)]?<br>Released value **must** be at least 1000 ohms greater than depressed value.<br>**NO** | 3B-1 |



**STEP 3B-1: Check the resistance of the accelerator pedal or lever position sensor.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the resistance between the accelerator pedal or lever position SIGNAL pin and accelerator pedal or lever position +5 volt SUPPLY pin at the accelerator pedal or lever position sensor connector.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | 1500 to 3000 Ohms (released) [250 to 1500 Ohms (depressed)]?<br>Released value **must** be at least 1000 ohms greater than depressed value.<br>**YES**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |
| | 1500 to 3000 Ohms (released) [250 to 1500 Ohms (depressed)]?<br>Released value **must** be at least 1000 ohms greater than depressed value.<br>**NO**<br>**Repair:**<br>Replace the accelerator pedal or lever assembly. Refer to the OEM service manual. | 4A |

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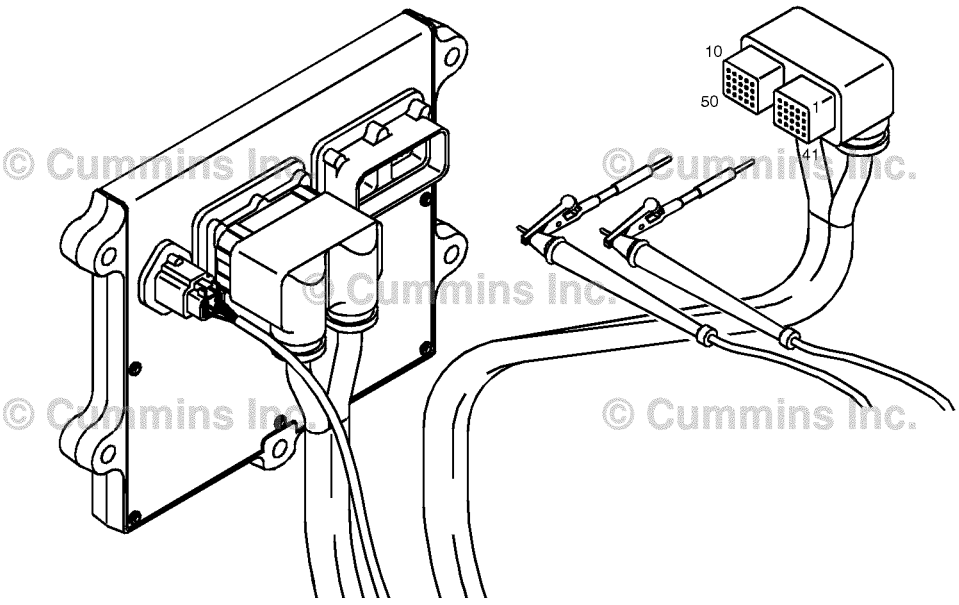
**STEP 3C: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on one connector pin-to-pin check:<br>Measure the resistance and check for a short circuit between the following OEM harness ECM connector pins and all other pins in the OEM harness ECM connector:<br>• Accelerator pedal or lever position +5 VDC SUPPLY pin<br>• Accelerator pedal or lever position SIGNAL pin.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 4A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 4: Clear the fault code.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Turn the keyswitch ON and completely depress and release the accelerator pedal or lever three times.<br>• Turn the keyswitch OFF for 30 seconds.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that Fault Code 432 is inactive. | Fault Code 432 inactive?<br>**YES** | 4B |
| | Fault Code 432 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked a second time. | 1A |

### STEP 4B: Clear the inactive fault codes.

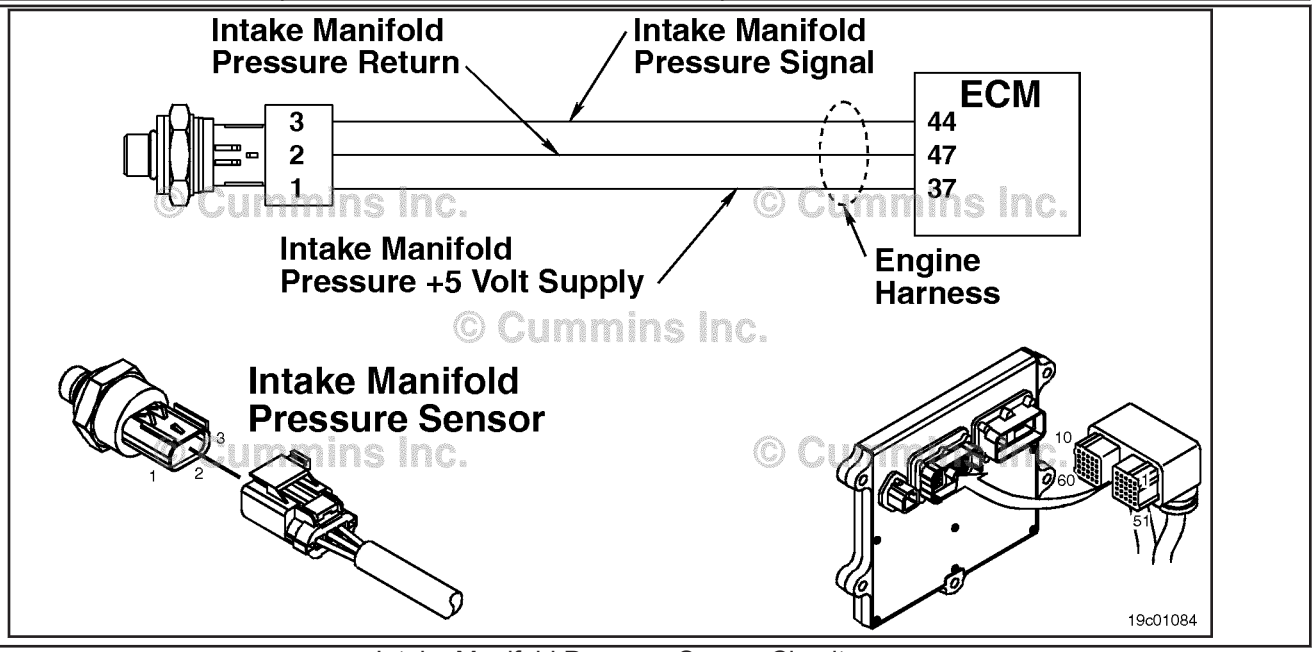
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 433

## Intake Manifold Pressure Sensor Circuit - Data Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 433<br>PID(P), SID(S): P102<br>SPN: 102<br>FMI: 2<br>Lamp: Amber<br>SRT: | Intake manifold pressure sensor circuit - data incorrect. An error in the intake manifold pressure sensor signal was detected by the ECM. | Derate in power output of the engine. |




Intake Manifold Pressure Sensor Circuit

**Circuit Description:**

The intake manifold pressure sensor monitors intake manifold pressure and passes information to the electronic control module (ECM) through the engine harness. This value is one of the many inputs used by the ECM to determine the correct air/fuel ratio for proper engine operation.

**Component Location:**

The intake manifold pressure sensor is located on the intake air manifold, behind the intake air horn. 100-002 for a detailed component location view.

**Shop Talk:**

At key-on, before the engine is started, the readings for intake manifold pressure, barometric pressure, and exhaust pressure are compared. This fault code occurs if the intake manifold pressure sensor reading is different from the other three. This check is **only** done once after the keyswitch is turned on.

## Refer to Troubleshooting Fault Code t05-433

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for engine speed and position fault codes.** | | |
| **STEP 1A:** | **Check for Fault Codes 689 and 778.** | **Fault Codes 689 and 778 active?** | |
| **STEP 2:** | **Check for a valid fault code.** | | |
| **STEP 2A:** | **Check for an active Fault Code 433.** | **Fault Code 433 inactive?** | |
| **STEP 3:** | **Clear the fault codes.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 433 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for engine speed and position fault codes.

**STEP 1A: Check for Fault Codes 689 and 778.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use INSITE™, electronic service tool read the fault codes. | Fault Codes 689 and 778 active?<br>**YES**<br>**Repair:**<br>Follow the troubleshooting trees of the appropriate fault code. | Fault Code 689 and/or 778 |
| | Fault Codes 689 and 778 active?<br>**NO** | 2A |

### STEP 2: Check for a valid fault code.

**STEP 2A: Check for an active Fault Code 433.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a valid fault code.<br>• Wait 30 seconds.<br>• Turn keyswitch ON; wait 15 seconds. | Fault Code 433 inactive?<br>**YES** | 3B |
| | Fault Code 433 inactive?<br>**NO**<br>**Repair:**<br>Replace the intake manifold pressure sensor.<br>Refer to Procedure 019-061. | 3A |

## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Verify Fault Code 433 is inactive. | Fault Code 433 inactive?<br>**YES** | 3B |
| | Fault Code 433 inactive?<br>**NO** | 1A |

### STEP 3B: Clear the inactive fault codes.

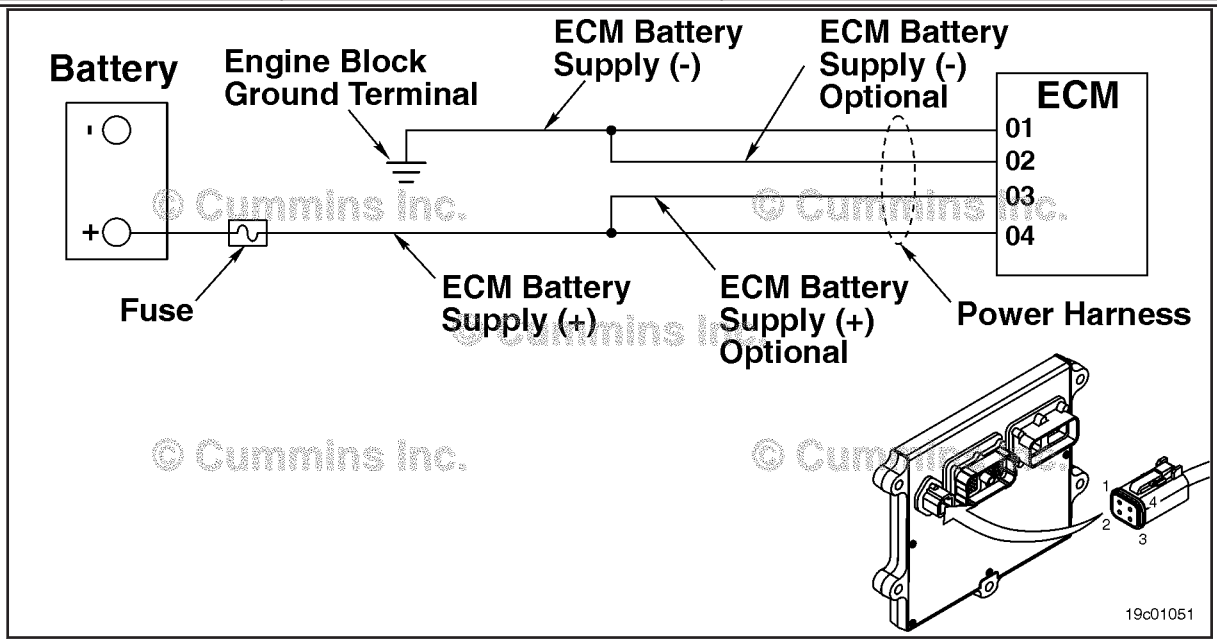
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault code.<br>• Use INSITE™ electronic service tool erase the inactive fault codes . | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 434 Automotive Application

## Power Supply Lost With Ignition On - Data Erratic, Intermittent or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 434<br>PID(P), SID(S): S251<br>SPN: 627<br>FMI: 2/2<br>Lamp: Amber<br>SRT: | Power Supply Lost With Ignition On - Data Erratic, Intermittent or Incorrect. Supply voltage to the ECM fell below 6.2 VDC momentarily, or the ECM was **not** allowed to power down correctly (retain battery voltage for 30 seconds after key OFF). | Possible no noticeable performance effects or engine dying or hard starting. Fault information, trip information, and maintenance monitor data can be inaccurate. |




ECM Power Supply Circuit

**Circuit Description:**

The electronic control module (ECM) receives constant voltage from the batteries through the unswitched battery wires that are connected directly to the positive (+) battery post. The ECM receives switched battery input through the vehicle keyswitch wire when the vehicle keyswitch is turned ON.

This fault code will be logged if a battery disconnect switch is used in the battery circuit to stop the engine. This fault code will also log if a battery disconnect switch is opened within 10 seconds of turning the keyswitch OFF.

**Component Location:**

The ECM is connected to the battery by the OEM power harness through the ECM battery supply stub. This provides a constant power supply for the ECM. The location of the battery will vary with the OEM. Refer to the OEM troubleshooting and repair manual.

**Conditions for Running the Diagnostics:**

This diagnostic runs continuously when the keyswitch is in the ON position.

**Conditions for Setting the Fault Codes:**

The ECM detects that primary ECM power supply dropped below 6.2 VDC while the keyswitch was in the ON position. The fault code will be active when the keyswitch is turned on following the incomplete power-down event.

**Action Taken When the Fault Code is Active:**

- The ECM records the fault code immediately when the diagnostic runs and fails.
- Power-down data like trip information, maintenance monitor, and fault code information will **not** get saved to permanent memory when the keyswitch is turned off.

**Conditions for Clearing the Fault Code:**

The ECM **must** see primary ECM battery voltage above 6.2 VDC when the keyswitch is turned off before the fault code will go inactive.

**Shop Talk:**

This fault is set active if the ECM battery supply voltage drops below 6.2 VDC while the keyswitch is in the ON position.

Make sure the ECM unswitched battery supply is coming directly from the battery and **not** the starter. If unswitched power is coming from the starter, it is possible for the battery voltage to drop low enough during cranking to set this fault active.

This fault can also be caused by resistance in the ECM battery supply (+) or (-) circuits. Resistance in these circuits can cause the voltage level at the ECM input to drop low enough to set Fault Code 434 active.

This fault can also be caused by a short to ground in the injector wiring harness. Check the injector wires are oriented so that they will **not** interfere with a rocker lever or other component in the overhead system. Remove the valve cover and check for proper alignment of the injector wiring harness.

On-Board Diagnostics (OBD) Information (Euro 4 Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

On-Board Diagnostics (OBD) Information (Euro 4 Stage 1+ Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- An engine torque derate will be activated after 50 hours of engine operation with the fault code active.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 1 ignition cycle that the diagnostic runs and does **not** fail. The MIL lamp **cannot** be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 400 days or 9600 hours of engine operation.

## Refer to Troubleshooting Fault Code t05-434

# FAULT CODE 434 Automotive Application - Power Supply Lost With Ignition On - Data Erratic, Intermittent or Incorrect

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM. To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3164133 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for fault codes.** | | |
| **STEP 1A:** | **Check for fault codes.** | **Fault Code 434 active?** | |
| **STEP 2:** | **Check the batteries and the power connector.** | | |
| **STEP 2A:** | **Check the batteries and the power connector.** | **Connections tight and corrosion-free?** | |
| **STEP 2B:** | **Check the battery voltage.** | **Normal conditions: At least (+) 12-VDC [(+) 24-VDC with 24 volt system]; During Cranking: At least (+) 6.2-VDC?** | |
| **STEP 2C:** | **Inspect the injector wiring harness.** | **Injector wiring harness pigtail wiring routed correctly and aligned properly so that rocker levers do not touch wiring?** | |
| **STEP 3:** | **Check the OEM power harness.** | | |
| **STEP 3A:** | **Inspect the harness and the ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check for an open circuit in the battery power circuit.** | **At least (+) 10-VDC [(+) 20-VDC for a 24 volt system]?** | |
| **STEP 3B-1:** | **Verify that the OEM fuse is installed correctly.** | **Is fuse installed correctly?** | |
| **STEP 3B-2:** | **Check if the OEM fuse is blown.** | **Is fuse blown?** | |
| **STEP 3B-3:** | **Check the add-on or accessory wiring at the (+) terminal of the battery.** | **Any damaged wires?** | |
| **STEP 3C:** | **Check the resistance of the battery supply circuit.** | **Less than 1.0 ohms?** | |
| **STEP 3D:** | **Check the keyswitch input-to-ECM wire.** | **Keyswitch input wire interrupted?** | |
| **STEP 3E:** | **Check the keyswitch input circuit.** | **Less than 5 ohms?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 434 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for fault codes.

**STEP 1A: Check for fault codes.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

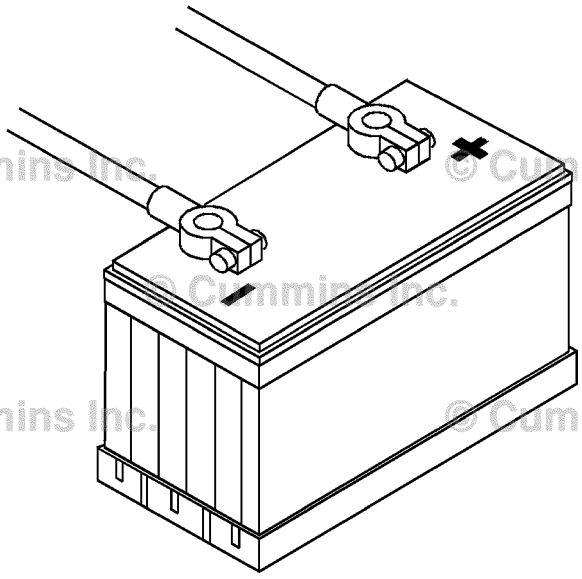
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 434 active?<br>**YES** | 2A |
| | Fault Code 434 active?<br>**NO**<br>**Repair:**<br>If high inactive counts of Fault Code 434 are found in the ECM, check the battery disconnect devices in the vehicle. If the keyswitch and ECM power are disconnected at the same time, Fault Code 434 will be logged. | 4A |

## STEP 2: Check the batteries and the power connector.

### STEP 2A: Check the batteries and the power connector.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery connections.<br>• Check the battery terminal connections. | Connections tight and corrosion-free?<br>**YES** | 2B |
| | Connections tight and corrosion-free?<br>**NO**<br>**Repair:**<br>Tighten the connections.<br>Tighten the loose connections, and clean the terminals. Refer to the OEM service manual. | 4A |



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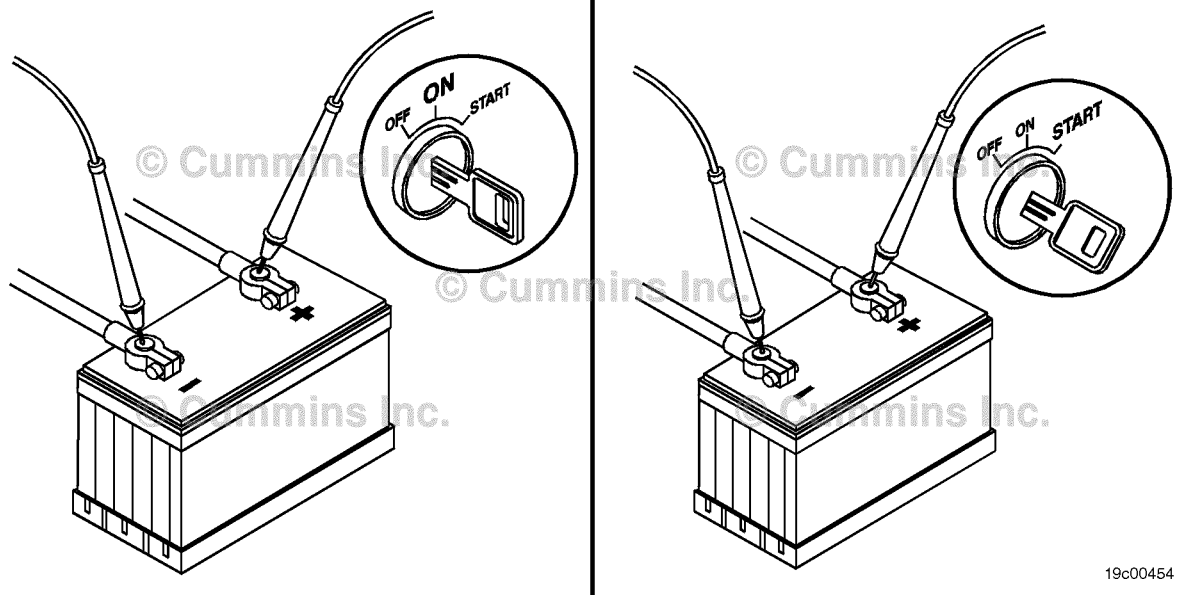
**STEP 2B: Check the battery voltage.**

**Condition:**
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Place the positive (+) probe of the multimeter on the positive battery terminal and touch the negative (-) probe to the negative battery terminal while trying to start the engine. | Normal conditions: At least (+) 12-VDC [(+) 24-VDC with 24 volt system]; During Cranking: At least (+) 6.2-VDC?<br>**YES** | 2C |
| | Normal conditions: At least (+) 12-VDC [(+) 24-VDC with 24 volt system]; During Cranking: At least (+) 6.2-VDC?<br>**NO**<br>**Repair:**<br>Charge or replace the battery. Refer to the OEM service manual. | 4A |



**STEP 2C: Inspect the injector wiring harness.**

**Condition:**
- Remove the rocker lever housing.

| Action | Specification/Repair | Next Step |
|---|---|---|
| This fault code can be caused by the injector pigtail wiring rubbing against the rocker levers under the rocker lever cover.<br>- | Is the injector wiring pigtail wiring correctly routed and aligned properly so that the rocker levers do **not** touch the wiring?<br>**YES** | 3A |
| | Is the injector wiring pigtail wiring correctly routed and aligned properly so that the rocker levers do **not** touch the wiring?<br>**NO**<br>**Repair:**<br>Align and route the injector wiring harness so it does **not** touch the rocker levers. | 4A |

## STEP 3: Check the OEM power harness.

**STEP 3A: Inspect the harness and the ECM connector pins.**

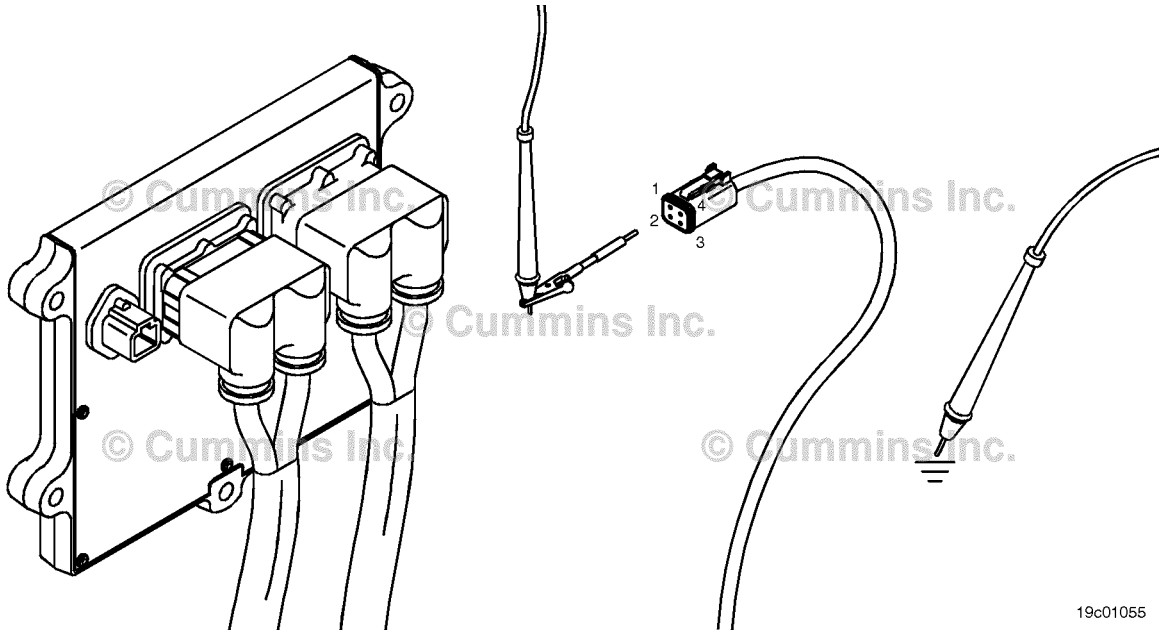
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness connector from the ECM

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the harness and the ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Wire insulation damage<br>• Connector shell broken.<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or OEM power harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for an open circuit in the battery power circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness ECM battery supply stub from the ECM.

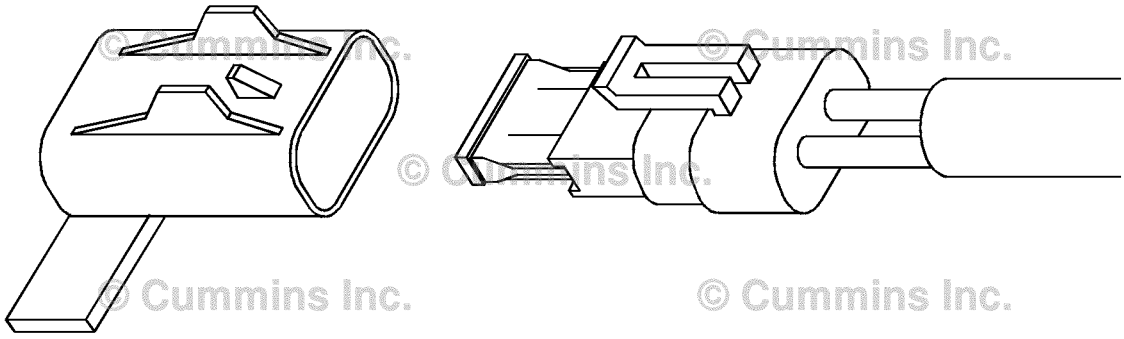
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit in the battery power circuits.<br>• Use a multimeter to measure the voltage from the ECM battery SUPPLY (+) pin of the engine harness ECM battery supply stub connector and engine block ground.<br>Refer to the wiring diagram for connector pin identification. | At least (+) 10-VDC [(+) 20-VDC for a 24 volt system]?<br>**YES** | 3C |
| | At least (+) 10-VDC [(+) 20-VDC for a 24 volt system]?<br>**NO** | 3B-1 |



**STEP 3B-1: Verify that the OEM fuse is installed correctly.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM fuse for correct installation.<br>- | Is fuse installed correctly?<br>**YES** | 3B-2 |
| | Is fuse installed correctly?<br>**NO**<br>**Repair:**<br>Install the fuse correctly. Refer to Procedure 019-198 in Section 19. | 4A |



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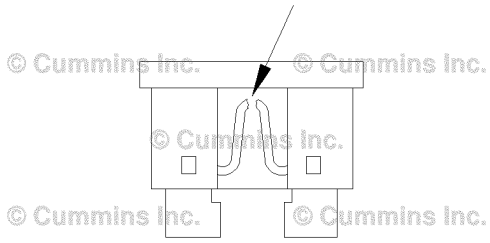
**STEP 3B-2: Check if the OEM fuse is blown.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify that the OEM fuse is not blown.<br>- | Is fuse blown?<br>**YES**<br>**Repair:**<br>Locate the short circuit.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.<br>Replace the blown fuse(s). Refer to Procedure 019-198 in Section 19. | 4A |
| | Is fuse blown?<br>**NO** | 3B-3 |

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**STEP 3B-3: Check the add-on or the accessory wiring at the (+) terminal of the battery.**

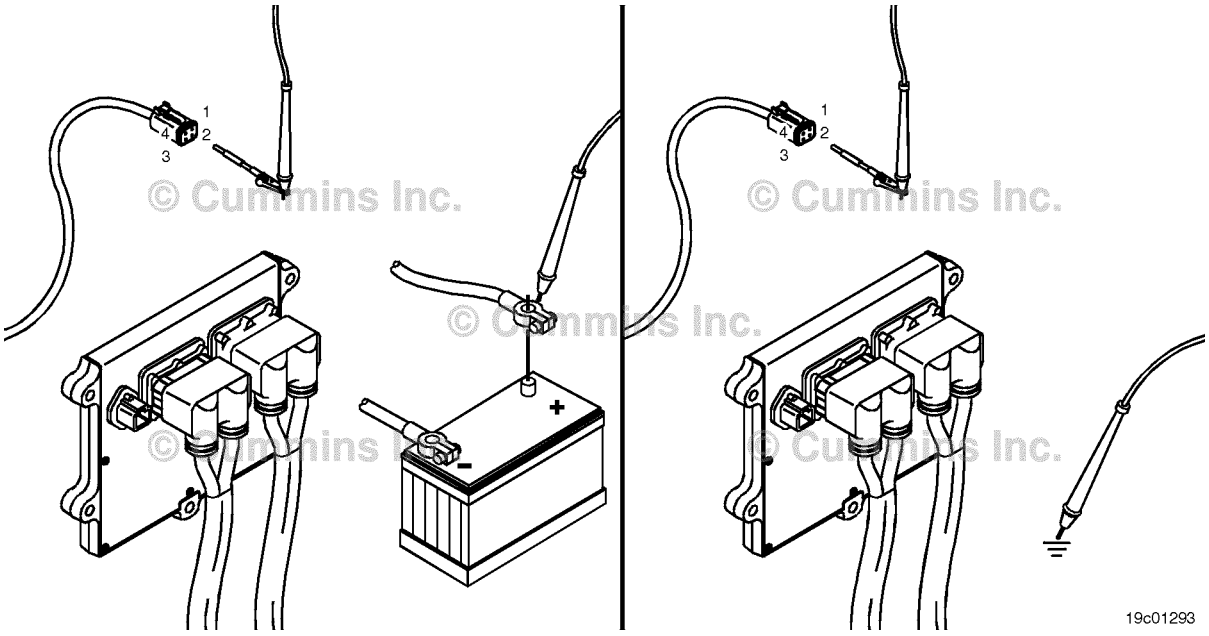
**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the add-on or the accessory wiring at the (+) terminal of the battery.<br>• Starting at the (+) terminal, follow any add-on or accessory wiring and examine wire(s) for damaged insulation or an installation error that can cause the supply wire to be shorted to the engine block. | Any damaged wires?<br>**YES**<br>**Repair:**<br>Repair or replace the damaged wiring. | 4A |
| | Any damaged wires?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM power harness from the OEM power connector to the batteries. | 4A |

**STEP 3C: Check the resistance of the battery supply circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness ECM battery supply stub from the ECM.
- Disconnect the positive terminal from the battery.
- Digital multimeter set to low resistance mode and calibrated to zero.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the resistance of the battery supply circuit.<br>• Measure the resistance between the ECM battery SUPPLY (+) pin of the engine harness ECM battery supply stub connector and the positive battery connector.<br>• Measure the resistance between the ECM battery SUPPLY (-) pin of the engine harness ECM battery supply stub connector and the negative battery connector.<br>Refer to the wiring diagram for connector pin identification.<br>Note: Since the battery supply circuit resistance is normally very low, it is necessary to use a digital multimeter calibrated to zero on the low resistance setting to accurately measure the circuit resistance.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 1.0 ohms?<br>**YES** | 3D |
| | Less than 1.0 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the ECM power harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check the keyswitch input-to-ECM wire.**

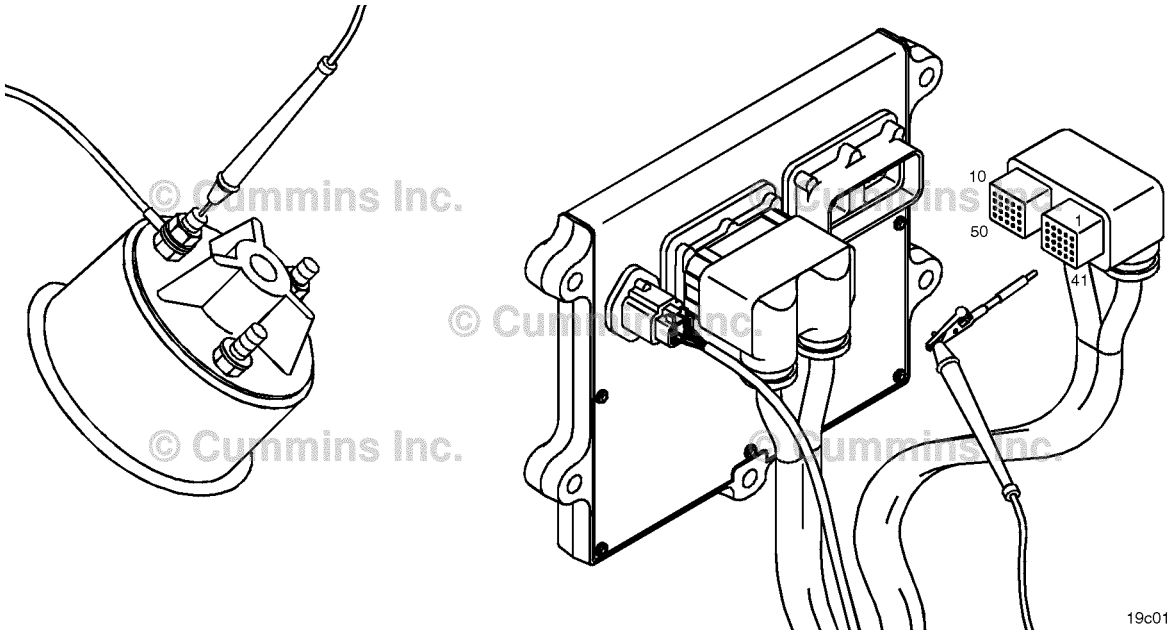
**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the keyswitch input wire from the keyswitch ignition post in the keyswitch assembly to the ECM to make sure there are no interruptions in the wire, that is, no solenoids or relays.<br>- | Keyswitch input wire interrupted?<br>**YES**<br>**Repair:**<br>Correct the wiring so the wire is uninterrupted. | 4A |
| | Keyswitch input wire interrupted?<br>**NO** | 3E |

**STEP 3E: Check the keyswitch input circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness connector from the ECM

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the keyswitch input circuit.<br>• Measure the resistance from the keyswitch ignition post in the keyswitch assembly to keyswitch input SIGNAL pin of the OEM harness connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques Refer to Procedure 019-360 in Section 19. | Less than 5 ohms?<br>**YES** | 4A |
| | Less than 5 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine, and let it idle for 1 minute.<br>• Turn the keyswitch to the OFF position for 30 seconds.<br>• Turn the keyswitch ON.<br>• Use INSITE™ electronic service tool to verify Fault Code 434 is inactive.<br>Note: For Fault Code 434 to become inactive, the ECM **must** go through one complete shutdown. | Fault Code 434 inactive?<br>**YES** | 4B |
| | Fault Code 434 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 4B: Clear the inactive fault codes.

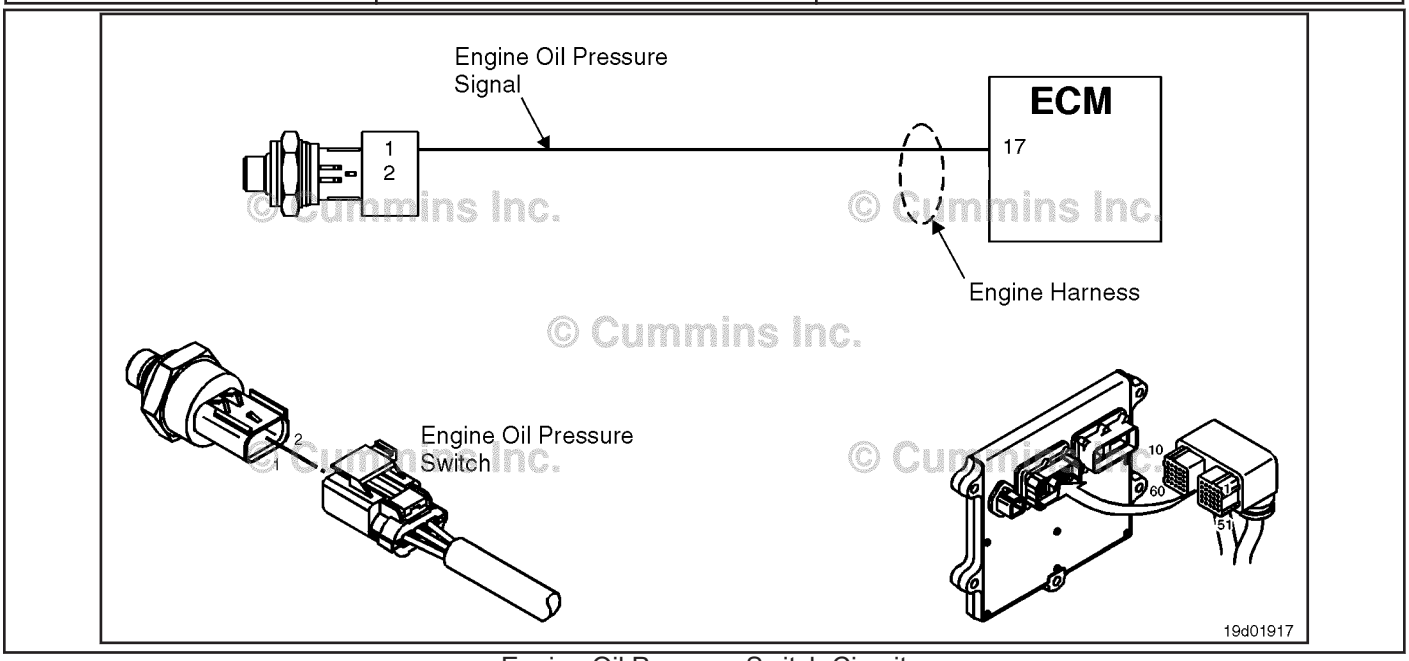
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 435

## Oil Pressure Switch Sensor Circuit - Data Erratic, Intermittent or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 435<br>PID(P), SID(S): P100<br>SPN: 100<br>FMI: 2/2<br>Lamp: Amber<br>SRT: | Oil Pressure Switch Sensor Circuit - Data Erratic, Intermittent or Incorrect. An error in the engine oil pressure switch signal was detected by the ECM. | None on performance. No engine protection for oil pressure. |




Engine Oil Pressure Switch Circuit

**Circuit Description:**

The engine oil pressure switch is used by the electronic control module (ECM) to monitor the lubricating oil pressure. If the oil pressure drops below the engine protection limit, the switch will open and cause Fault Code 435 to log.

**Component Location:**

The engine oil pressure switch is located on the intake side of the engine, on the block, below the fuel filter. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

The oil pressure switch is closed with the engine **not** running and open when oil pressure is present. This fault code is logged when an open circuit is detected for five consecutive key cycles when the ECM expected a closed circuit at key-on. Possible causes of this fault code include:

- Failed engine oil pressure switch
- Open circuit in the engine oil pressure switch signal wire
- Failed ECM
- Short circuit in the engine oil pressure switch signal wire to a voltage source.

## Refer to Troubleshooting Fault Code t05-435

# FAULT CODE 435 - Oil Pressure Switch Sensor Circuit - Data Erratic, Intermittent or Incorrect

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 382278 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 435 active?** | |
| **STEP 2:** | **Check the engine oil pressure switch and circuit.** | | |
| **STEP 2A:** | **Inspect the switch and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the resistance of the engine oil pressure switch.** | **Less than 10 ohms?** | |
| **STEP 3:** | **Check the engine harness.** | | |
| **STEP 3A:** | **Inspect the engine harness and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check for an open circuit.** | **Less than 10 ohms?** | |
| **STEP 3C:** | **Check for a pin-to-pin short circuit in the engine harness.** | **Greater than 100k ohms?** | |
| **STEP 3D:** | **Check for an inactive fault code.** | **Fault Code 435 inactive?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 435 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1: Check for an active fault code.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool, read the fault codes. | Fault Code 435 active?<br>**YES** | 2A |
| | Fault Code 435 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the engine oil pressure switch and circuit.

**STEP 2A: Inspect the switch and connector pins.**

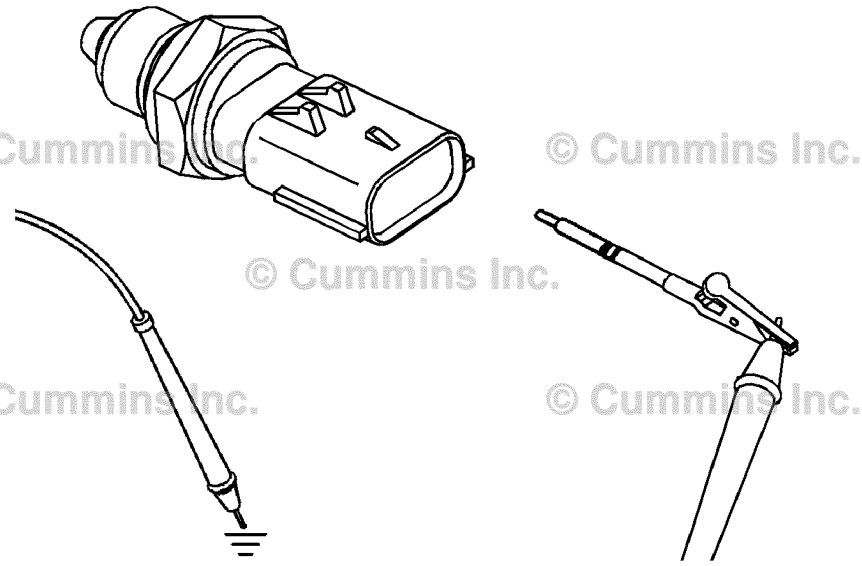
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the engine oil pressure switch.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the switch and connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the resistance of the engine oil pressure switch.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the engine oil pressure switch.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the resistance of the switch.<br>• Measure the resistance between the engine oil pressure SIGNAL pin of the engine oil pressure switch and ground.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3A |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the engine oil pressure switch. Refer to Procedure 019-066 in Section 19. | 4A |



## STEP 3: Check the engine harness.

### STEP 3A: Inspect the engine harness and ECM connector pins.

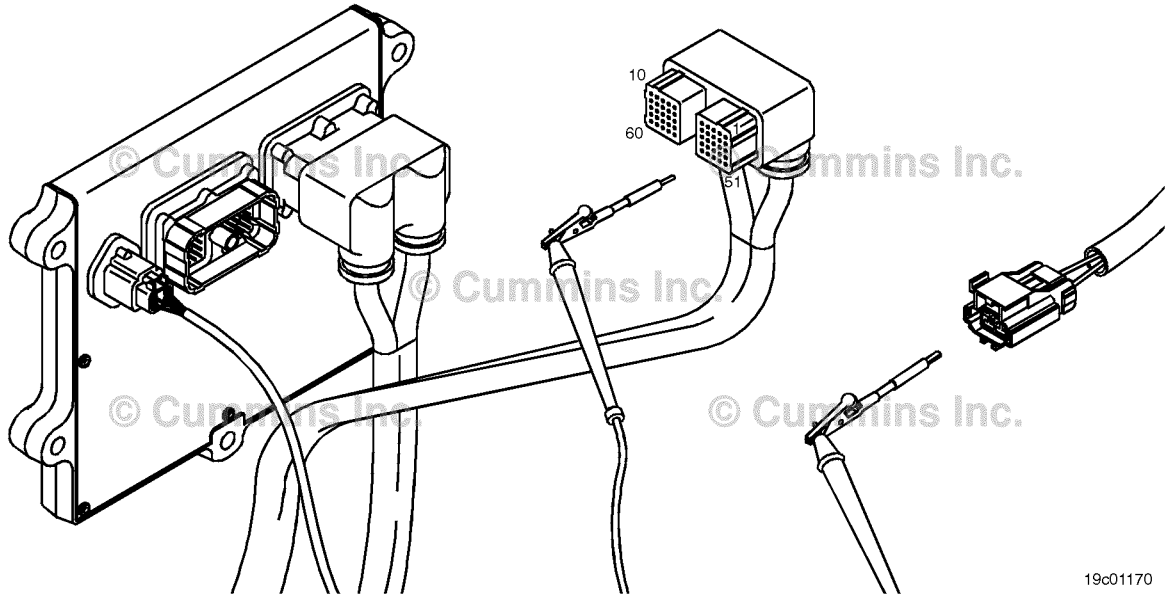
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the engine oil pressure switch.

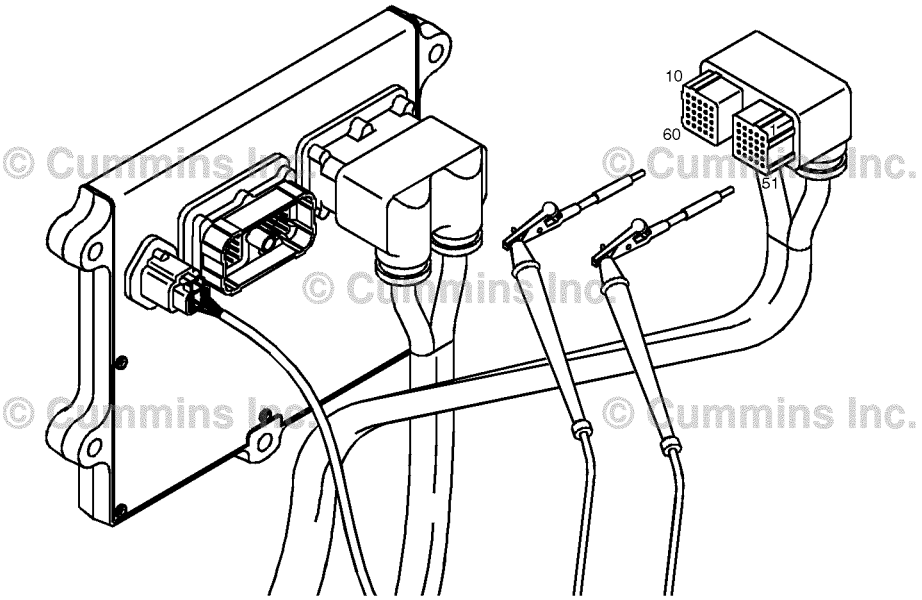
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the engine oil pressure SIGNAL pin at the switch connector of the engine harness and the engine oil pressure SIGNAL pin at the ECM connector of the engine harness.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3C: Check for a pin-to-pin short circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the engine harness from the engine oil pressure switch.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short circuit in the engine harness.<br>• Measure the resistance and check for a short circuit between the engine oil pressure SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector:<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3D: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool, read the fault codes. | Fault Code 435 is inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the problem. | 4A |
| | Fault Code 435 is inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Turn the keyswitch to the ON position for one minute.<br>• Use INSITE™ electronic service tool , verify that the fault code is inactive. | Fault Code 435 inactive?<br>**YES** | 4B |
| | Fault Code 435 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes.. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooti ng steps |

# Fault Code 436

## Intake Manifold 1 Temperature - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 436<br>PID(P), SID(S): P105<br>SPN: 105<br>FMI: 2<br>Lamp: Amber<br>SRT: | Intake Manifold 1 Temperature - Data Erratic, Intermittent, or Incorrect. The intake manifold temperature sensor is reading an erratic value at initial key ON. | The ECM will estimate engine intake manifold temperature. |

**Circuit Description:**

The engine intake manifold temperature sensor is used by the electronic control module (ECM) to monitor the engine intake manifold temperature. The ECM monitors the voltage on the SIGNAL pin and converts this to a temperature value.

The engine intake manifold temperature value is used by the ECM for the engine protection system and engine emission control.

**Component Location:**

The engine intake manifold temperature sensor is located in the air intake manifold. Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

**Shop Talk:**

The engine intake manifold temperature is compared to the engine coolant temperature and catalyst inlet temperature at initial key ON. The ECM **must not** see engine speed for a period of eight hours before this diagnostic will run. If the value of engine intake manifold temperature does **not** match the temperature readings from the engine coolant temperature and the catalyst inlet temperature within a pre-defined tolerance, this fault code is logged.

Possible causes of this fault code include:

- Stuck in-range engine intake manifold temperature sensor reading.
- High resistance in the engine intake manifold temperature sensor SIGNAL or RETURN wires.

On-Board Diagnostics (OBD) Information (Euro 4 and Euro 4 Stage 1+ Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM turns OFF the MIL after three consecutive ignition cycles that the diagnostic runs and passes. The MIL and fault code can also be cleared using INSITE™ electronic service tool.
- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

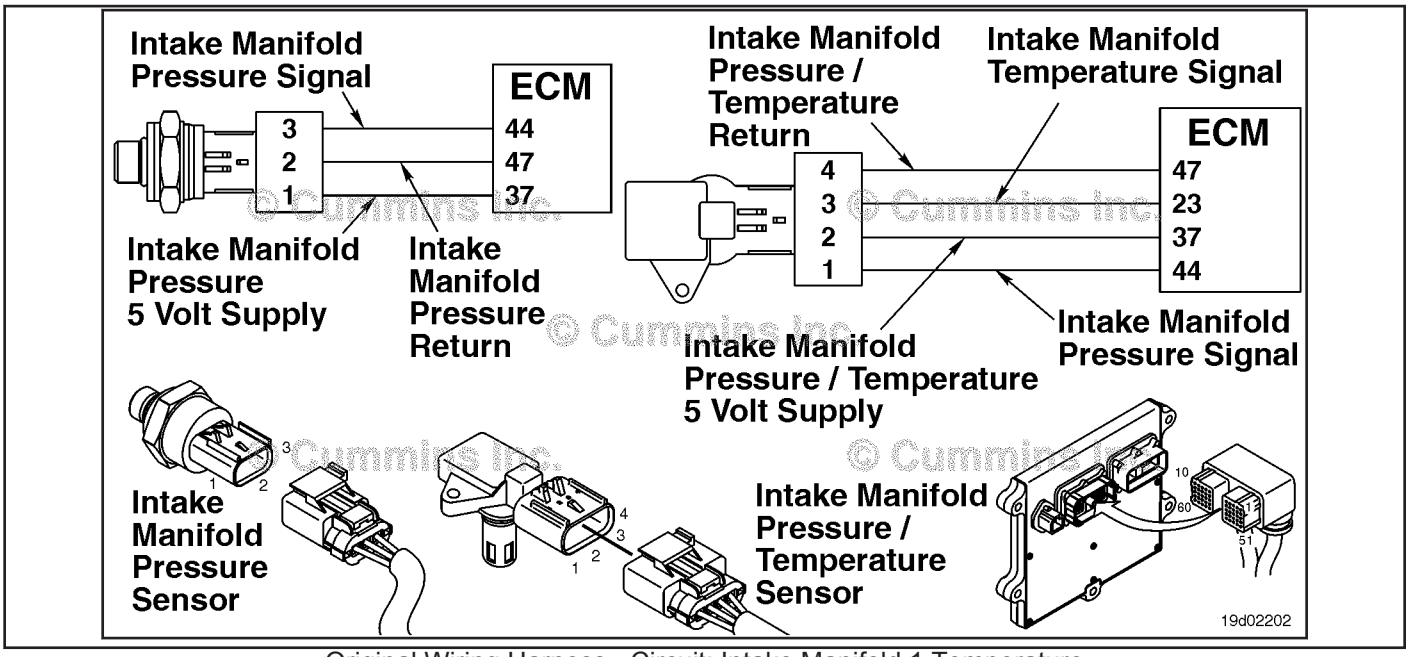
The sensor return configuration for Euro 4 ISB engines has been changed for automotive wiring harnesses manufactured from February 2012 onward. The new style wiring harnesses can be be identified using the method below:

- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin, and the camshaft position sensor RETURN pin
- Check for continuity between ECM pin 47 and the camshaft position sensor RETURN pin
- Use the table below to determine which harness is fitted to the engine.

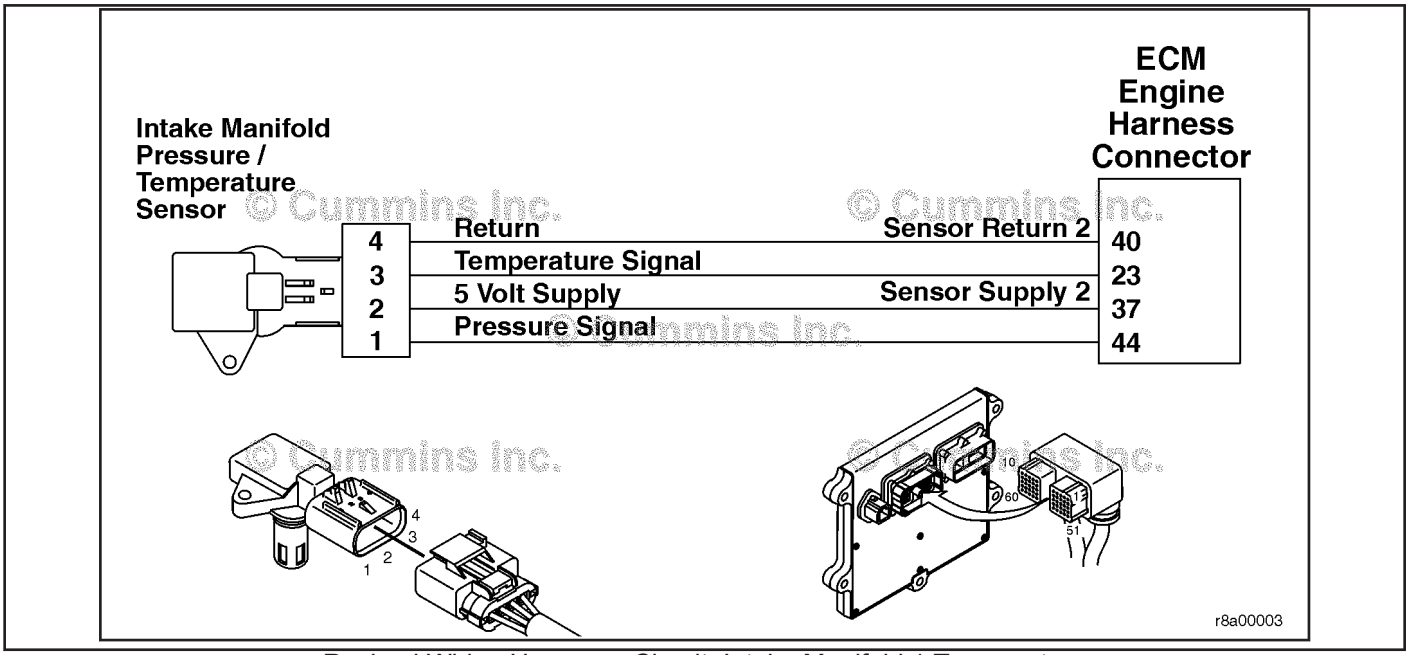
| Engine Harnesses | | | |
|---|---|---|---|
| From | To | New Harness | Old Harness |
| Intake manifold pressure/ temperature sensor RETURN pin | Camshaft position sensor RETURN pin | Open circuit | Short circut |

| Engine Harnesses | | | |
|---|---|---|---|
| ECM pin 47 | Camshaft position sensor RETURN pin | Open circuit | Short circuit |

NOTE: QSB engines, all C series engines, and all L series engines are **not** affected by this change.




Original Wiring Harness - Circuit: Intake Manifold 1 Temperature




Revised Wiring Harness - Circuit: Intake Manifold 1 Temperature

**Refer to Troubleshooting Fault Code t05-436.**

# FAULT CODE 436 - Intake Manifold 1 Temperature - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for sensor circuit fault codes.** | | |
| STEP 1A: | Check for active fault codes. | Fault code 436 is active? | |
| STEP 1B: | Check for fault codes 153 and 154. | Fault codes 153 or 154 is active? | |
| **STEP 2:** | **Check the engine intake manifold temperature sensor and circuit.** | | |
| STEP 2A: | Inspect the engine intake manifold temperature sensor and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the circuit response. | Fault Code 153 active? | |
| STEP 2C: | Check the circuit response. | Fault Code 154 active? | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| STEP 3A: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check the circuit response. | Fault Code 153 active? | |
| STEP 3C: | Check the circuit response. | Fault Code 154 active? | |
| **STEP 4:** | **Clear the fault codes.** | | |
| STEP 4A: | Verify the repair | Intake Manifold Temperature and Catalyst Inlet Temperature reading within 5.6°C or 10°F of each other? | |
| STEP 4B: | Clear the fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check for sensor circuit fault codes.

**STEP 1A: Check for active fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault codes.<br>• Use INSITE™ to read the fault codes. | Fault Code 436 is active?<br>**YES** | 1B |
| | Fault Code 436 is active?<br>**NO** | 4A |

**STEP 1B: Check for fault codes 153 and 154.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault codes.<br>• Use INSITE™ to read the fault codes. | Fault Code 153 or 154 is active?<br>**YES** | Appropriate fault code troubleshooting tree. |
| | Fault Code 153 or 154 is active?<br>**NO** | 2A |

## STEP 2: Check the engine intake manifold temperature sensor and circuit.

### STEP 2A: Inspect the engine intake manifold temperature sensor and connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine intake manifold temperature sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and engine intake manifold temperature sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

### STEP 2B: Check the circuit response.

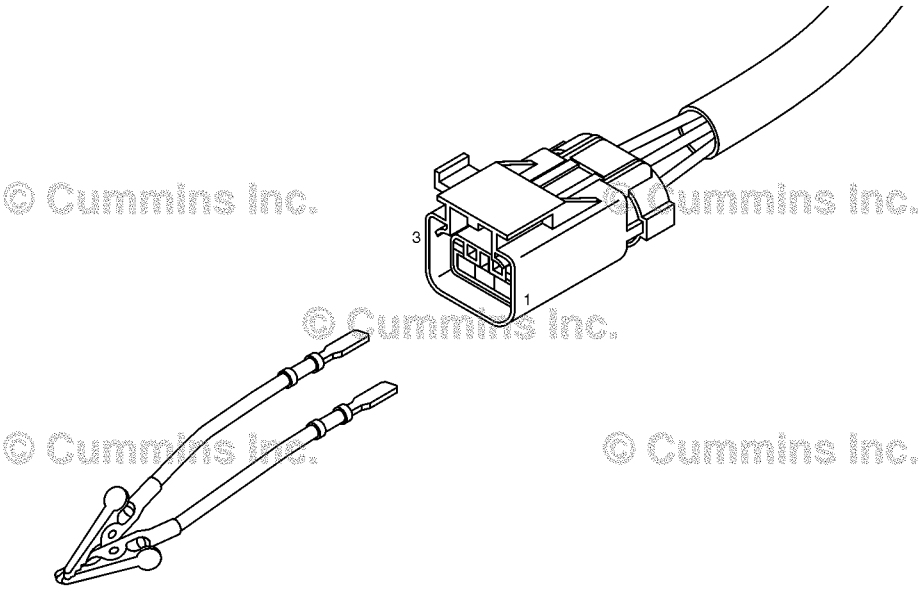
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine intake manifold temperature sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ to read the fault codes. | Fault code 153 active?<br>**YES** | 2C |
| Note: Fault code 123 will also be active when the intake manifold temperature sensor is disconnected. | Fault code 153 active?<br>**NO** | 3A |

**STEP 2C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine intake manifold temperature sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the engine intake manifold temperature SIGNAL pin and the engine intake manifold temperature RETURN pin at the engine intake manifold temperature connector of the engine harness.<br>Refer to the wiring diagram for connector pin identification.<br>Check the appropriate circuit response after 30 seconds.<br>• Use INSITE™ to read the fault codes. | Fault Code 154 is active?<br>**YES**<br>**Repair:**<br>An in-range failure of the intake manifold temperature sensor has been detected.<br>Replace the engine intake manifold temperature sensor. Refer to Procedure Procedure 019-059 in Section 19. | 4A |
| | Fault Code 154 is active?<br>**NO** | 3A |

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## STEP 3: Check the ECM and engine harness.

### STEP 3A: Inspect the ECM and engine harness connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or the engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

### STEP 3B: Check the circuit response.

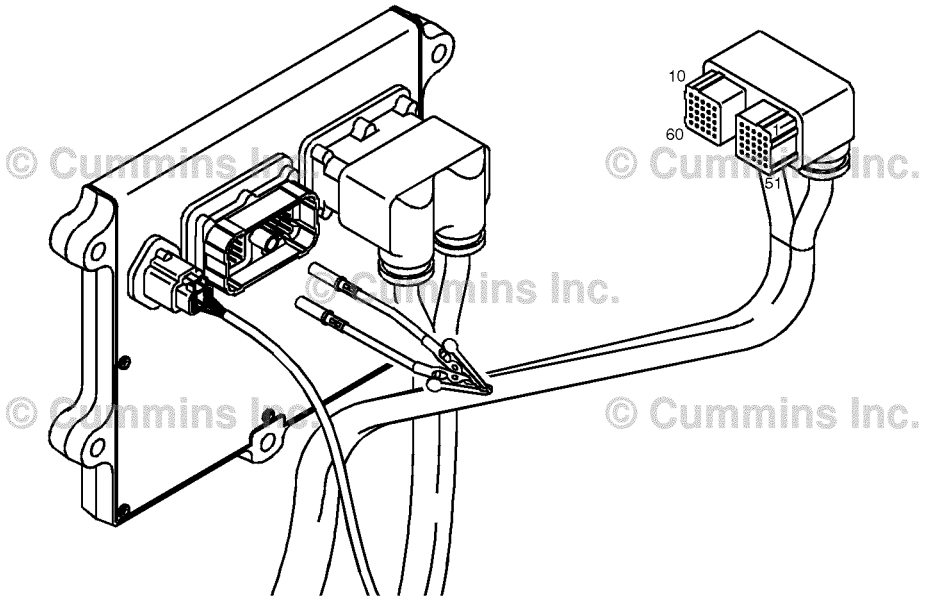
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ to read the fault codes. | Fault Code 153 is active?<br>**YES** | 3C |
| | Fault Code 153 is active?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the engine intake manifold temperature SIGNAL pin and engine intake manifold temperature RETURN pin at the ECM connector.<br>Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ to read the fault codes. | Fault Code 154 is active?<br>**YES**<br>**Repair:**<br>High resistance or a short circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |
| | Fault Code 154 is active?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



19c01111

## STEP 4: Clear the fault code.

### STEP 4A: Verify the repair.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Start the INSITE Data Monitor/Logger .<br>• Compare the INSITE™ reading for Intake Manifold Temperature and Catalyst Inlet Temperature. | Intake Manifold Temperature and Catalyst Inlet Temperature reading within 5.6°C or 10°F of each other?<br>**YES** | 4B |
| | Intake Manifold Temperature and Catalyst Inlet Temperature reading within 5.6°C or 10°F of each other?<br>**NO** | 1A |

### STEP 4B: Clear the fault codes.

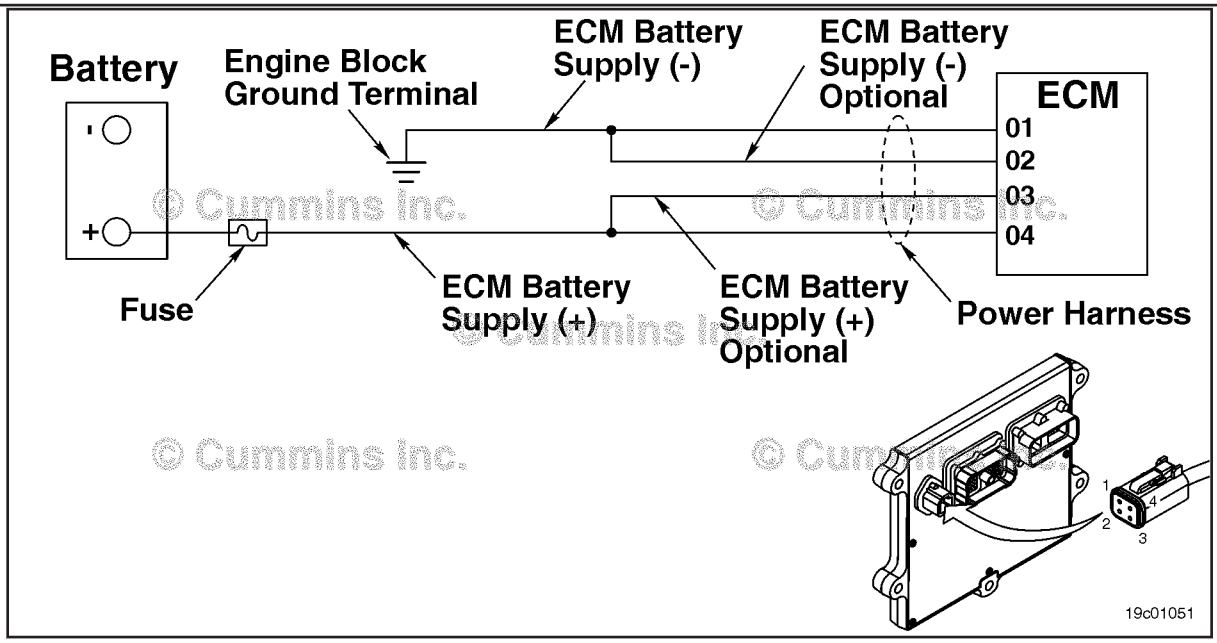
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to erase all active and inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 441

## Battery 1 Voltage - Data Valid but Below Normal Operational Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 441<br>PID(P), SID(S): S168<br>SPN: 168<br>FMI: 1/18<br>Lamp: Amber<br>SRT: | Battery 1 Voltage - Data Valid but Below Normal Operational Range - Moderately Severe Level. ECM supply voltage is below the minimum system voltage level. | Engine may stop running or be difficult to start. |




Unswitched Battery Supply

**Circuit Description:**

The ECM receives constant voltage from the batteries through the unswitched battery wires that are connected directly to the positive (+) battery post. There is one 30-amp fuse in the unswitched battery wires to protect the OEM harness. In marine applications this is a 25 ampere fuse on 12V systems and a 15 ampere fuse on 24V systems. The ECM receives switched battery input through the vehicle keyswitch wire when the vehicle keyswitch is turned on. The battery return wires are connected directly to the negative (-) battery post.

**Component Location:**

The ECM is located on the intake side of the engine. The ECM is connected to the battery by the OEM harness. This direct link provides a constant power supply for the ECM. In marine applications **only** circuits 1 and 3 are used for unswitched battery. The location of the battery will vary with the OEM. Refer to the OEM manual for battery location.

**Shop Talk:**

This fault code is logged when the ECM battery supply voltage drops below 6 volts.

- Verify that the ECM unswitched power is coming from the batteries and **not** the starter or other device. Check for possible weak batteries.
- If the ECM unswitched battery supply is taken from the starter, check for low voltage during cranking. Low voltage during cranking can cause the ECM power supply to drop below specifications and log Fault Code 441.

## Refer to Troubleshooting Fault Code t05-441

# FAULT CODE 441 - Battery 1 Voltage - Data Valid but Below Normal Operational Range - Moderately Severe Level
## TROUBLESHOOTING SUMMARY

**⚠WARNING⚠**

**Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the battery.** | | |
| **STEP 1A:** | **Check the battery connections.** | **Connections tight and corrosion-free?** | |
| **STEP 1B:** | **Check the battery voltage.** | **Battery voltage acceptable in normal and cranking conditions?** | |
| **STEP 2:** | **Check the fuse.** | | |
| **STEP 2A:** | **Verify that the fuse is installed correctly.** | **Fuse installed correctly?** | |
| **STEP 2B:** | **Check for a blown fuse.** | **Fuse blown?** | |
| **STEP 3:** | **Check the OEM power harness.** | | |
| **STEP 3A:** | **Inspect the OEM power harness and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check for an open circuit.** | **Less than 10 ohms?** | |
| **STEP 3C:** | **Check for a short circuit in the power harness.** | **Greater than 100k ohms?** | |
| **STEP 3D:** | **Check for a short circuit to ground.** | **Greater than 100k ohms?** | |
| **STEP 3E:** | **Check for a short circuit from pin to pin.** | **Greater than 100k ohms?** | |
| **STEP 3F:** | **Check the add-on or the accessory wiring at the positive (+) terminal of the battery.** | **Damaged wires?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 441 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the battery.

**STEP 1A: Check the battery connections.**

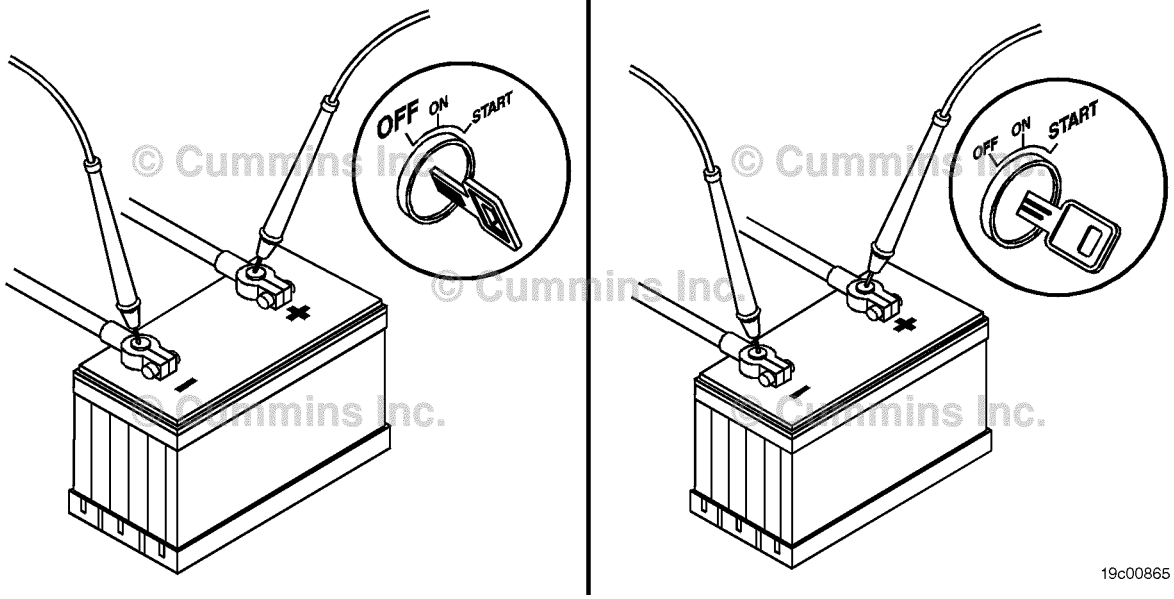
**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Check the battery terminal connections on both positive (+) and negative (-) terminals. | Connections tight and corrosion-free?<br>**YES** | 1B |
| | Connections tight and corrosion-free?<br>**NO**<br>**Repair:**<br>Tighten the loose connections, and clean the terminals.<br>Refer to the OEM service manual. | 4A |

**STEP 1B: Check the battery voltage.**

**Condition:**
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Measure the voltage from the positive (+) battery terminal to the negative (-) battery terminal while trying to start engine.<br>Normal conditions:<br>• At least 12-VDC (12-VDC systems)<br>• At least 24-VDC (24-VDC systems).<br>Cranking conditions:<br>• At least 6.2-VDC (12-VDC systems)<br>• At least 12-VDC (24-VDC systems). | Battery voltage acceptable in normal and cranking conditions?<br>**YES** | 2A |
| | Battery voltage acceptable in normal and cranking conditions?<br>**NO**<br>**Repair:**<br>Charge or replace the battery.<br>Refer to the OEM service manual. | 4A |

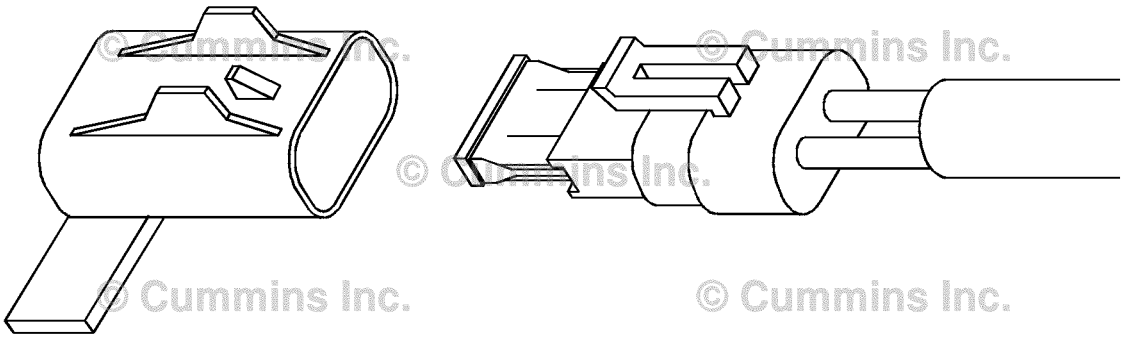


## STEP 2: Check the fuse.

### STEP 2A: Verify that the fuse is installed correctly.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify that the 30-amp fuse is installed correctly.<br>• Inspect the 30-amp fuse for correct installation. | Fuse installed correctly?<br>**YES** | 2B |
| | Fuse installed correctly?<br>**NO**<br>**Repair:**<br>Install the fuse correctly. Refer to Procedure 019-198 in Section 19. | 4A |

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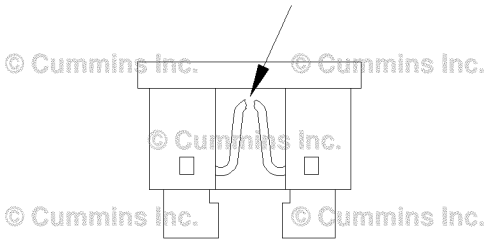
**STEP 2B: Check for a blown fuse.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a blown fuse.<br>• Inspect the 30-amp fuse to see if it is blown. | Fuse blown?<br>**YES**<br>**Repair:**<br>Replace the fuse. Refer to Procedure 019-198 in Section 19. | 4A |
| | Fuse blown?<br>**NO** | 3A |

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## STEP 3: Check the OEM power harness.

**STEP 3A: Inspect the OEM power harness and ECM connector pins.**

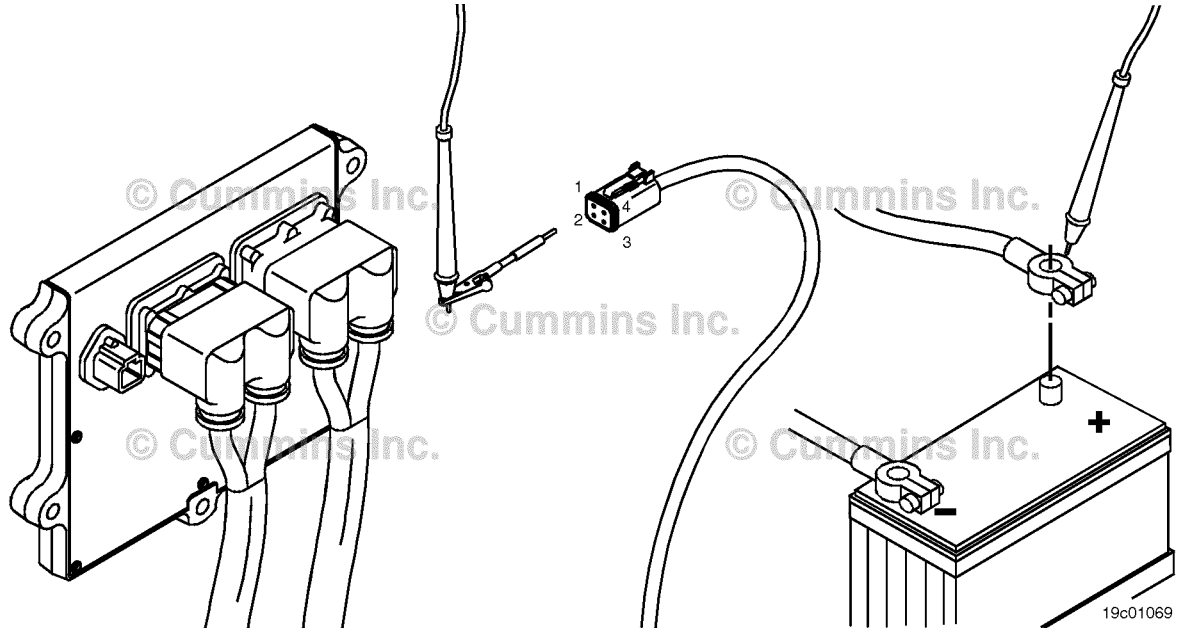
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the power harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connectors, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness connector from the ECM.

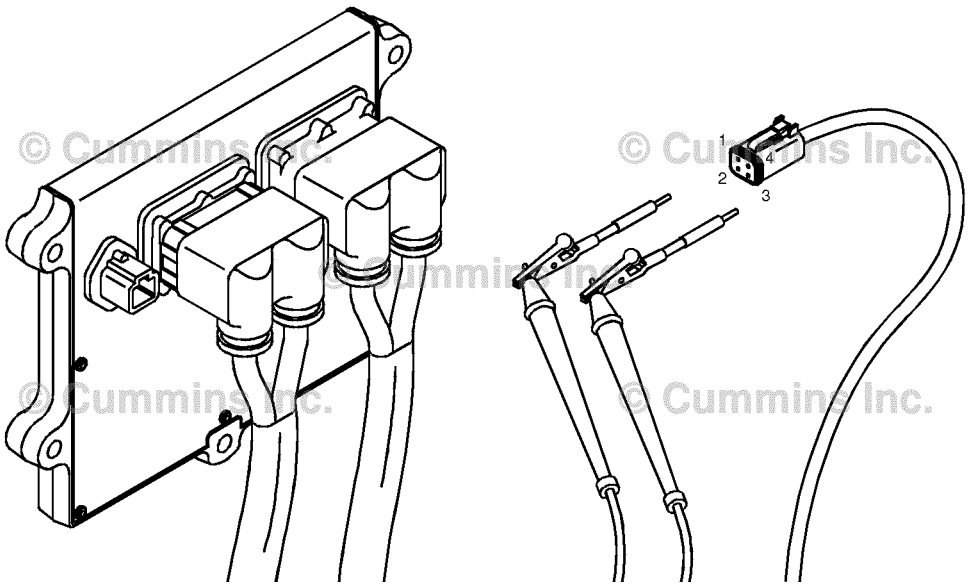
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance from the positive (+) battery terminal post to all ECM battery SUPPLY (+) pins, one at a time, in the OEM power harness ECM connector.<br>• Measure the resistance from the negative (-) battery terminal post to all ECM battery SUPPLY (-) pins, one at a time, in the OEM power harness ECM connector.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM power harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a short circuit in the power harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness connector from the ECM.
- Disconnect the battery.

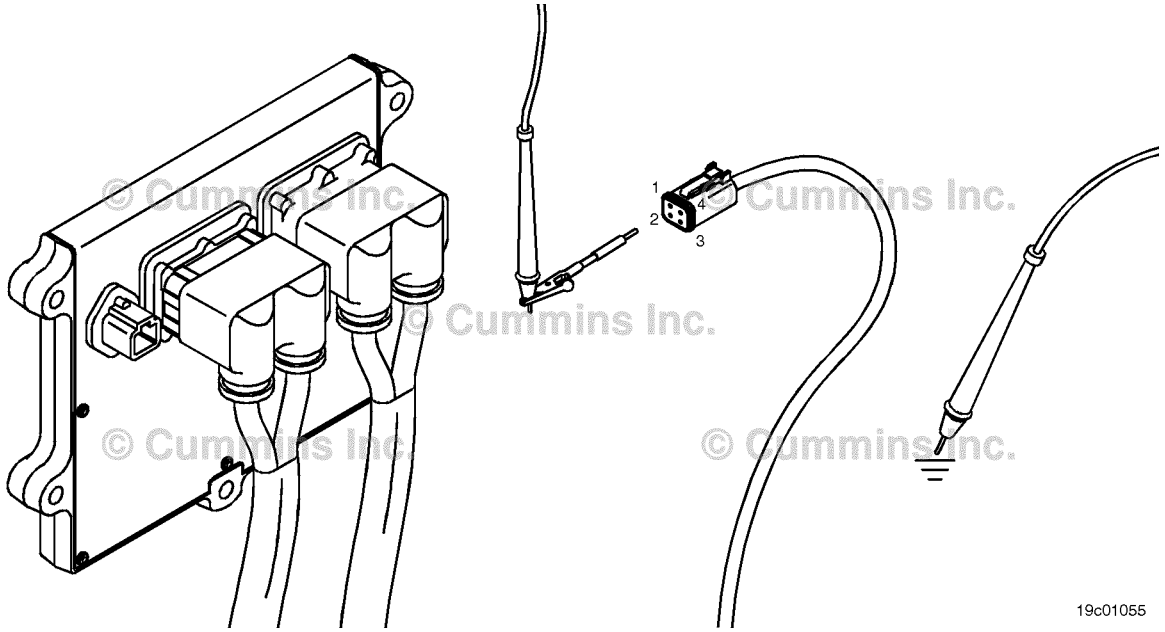
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit in the power harness.<br>• Measure the resistance from the ECM battery SUPPLY (+) pins in the OEM power harness ECM connector to the ECM battery SUPPLY (-) pins.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM power harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check for a short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness connector from the ECM.

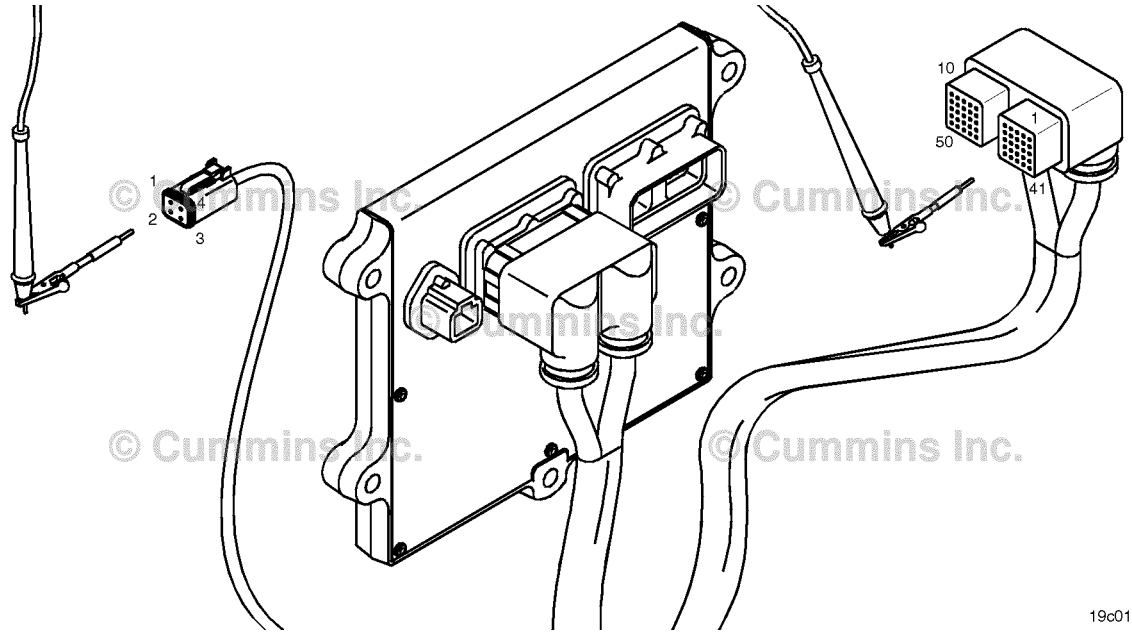
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the resistance from the ECM battery SUPPLY (+) pins in the OEM power harness ECM connector to engine block ground.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3E |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM power harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3E: Check for a short circuit from pin to pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness connector from the ECM.
- Disconnect the OEM harness connector from the ECM.
- Disconnect the battery.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance from one of the ECM battery SUPPLY (+) pins in the OEM power harness ECM connector to all pins in the OEM harness ECM connector.<br>• Measure the resistance from the second ECM battery SUPPLY (+) pin in the OEM power harness ECM connector to all pins in the OEM harness ECM connector.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3F |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM power harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3F: Check the add-on or accessory wiring at the positive (+) terminal of the battery.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the add-on or the accessory wiring at the positive (+) terminal of the battery.<br>• Starting at the positive (+) terminal, follow any add-on or accessory wiring, and examine wire(s) for damaged insulation or an installation error that can cause the supply wire to be shorted to the engine block. | Damaged wires?<br>**YES**<br>**Repair:**<br>Repair or replace the damaged wires.<br>Refer to the OEM service manual. | 4A |
| | Damaged wires?<br>**NO** | 4A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 441 inactive?<br>**YES** | 4B |
| | Fault Code 441 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

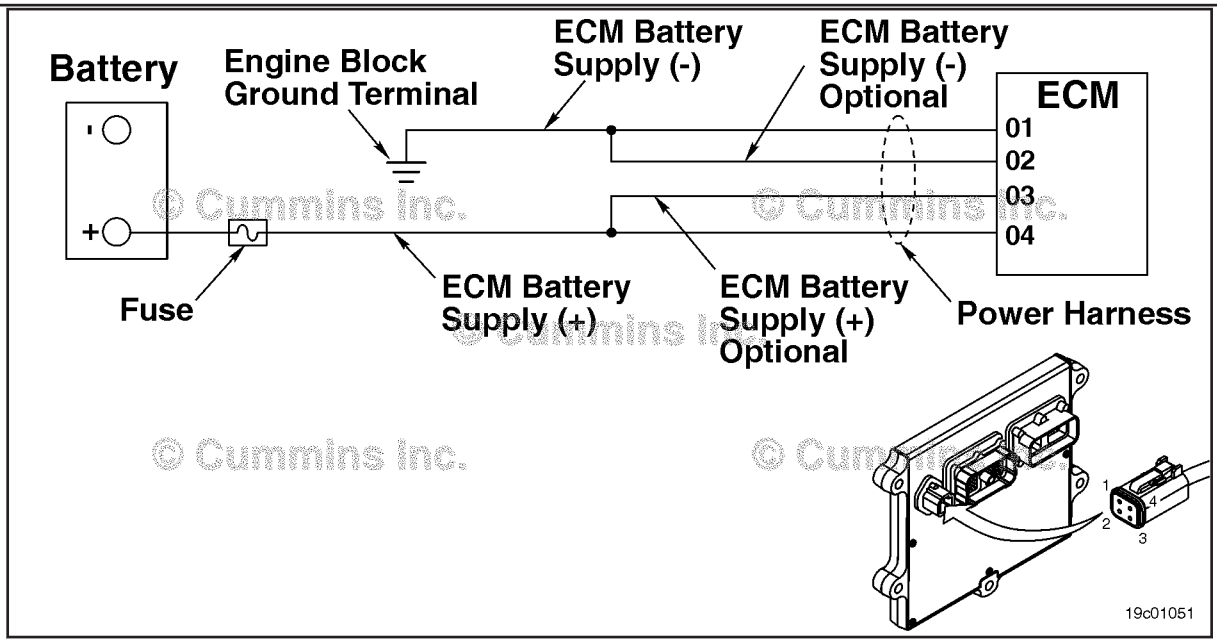
**Condition:**
- Connect all components.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting charts |

# Fault Code 442

## Battery 1 Voltage - Data Valid but Above Normal Operational Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 442<br>PID(P), SID(S): P168<br>SPN: 168<br>FMI: 0/16<br>Lamp: Amber<br>SRT: | Battery 1 Voltage - Data Valid but Above Normal Operational Range - Moderately Severe Level. ECM supply voltage is above the maximum system voltage level. | Possible electrical damage to all electrical components. |




Unswitched Battery Supply Circuit

**Circuit Description:**

The electronic control module (ECM) receives constant voltage from the batteries through the unswitched battery wires that are connected directly to the positive (+) battery post. There is one 30-amp fuse in the unswitched battery wire to protect the OEM harness. In marine applications this is a 25 ampere fuse on 12V systems an a 15 ampere fuse on 24V systems. The ECM receives switched battery input through the vehicle keyswitch wire when the vehicle keyswitch is turned on. The battery return wires are connected directly to the negative (-) battery post.

**Component Location:**

The ECM is located on the intake side of the engine. The ECM is connected to the battery by the OEM harness. This direct link provides a constant power supply for the ECM. In marine application **only** circuits 1 and 3 are use for unsiwtchd battery. The location of the battery will vary with the original equipment manufacturer (OEM). Refer to the OEM manual for battery location.

**Shop Talk:**

This fault code is logged when the ECM battery supply voltage exceed 36 volts. Causes of this fault code include:

- Faulty alternator or regulator that is overcharging the system
- Batteries connected in series instead of parallel
- Incorrect jump-starting procedure.

## Refer to Troubleshooting Fault Code t05-442

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement:Part Number 3822758 - male Deutsch/AMP/Metri-Pack test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fault Code 442 inactive** | |
| **STEP 2:** | **Check the equipment battery system.** | | |
| **STEP 2A:** | **Check the battery voltage.** | **Less than 20 VDC for 12-VDC system. Less than 32 VDC for 24-VDC system** | |
| **STEP 2B:** | **Check the alternator.** | **Alternator charging within OEM specifications?** | |
| **STEP 3:** | **Clear the fault codes.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 442 inactive** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect the INSITE™ electronic service tool.
- Turn keyswitch ON.

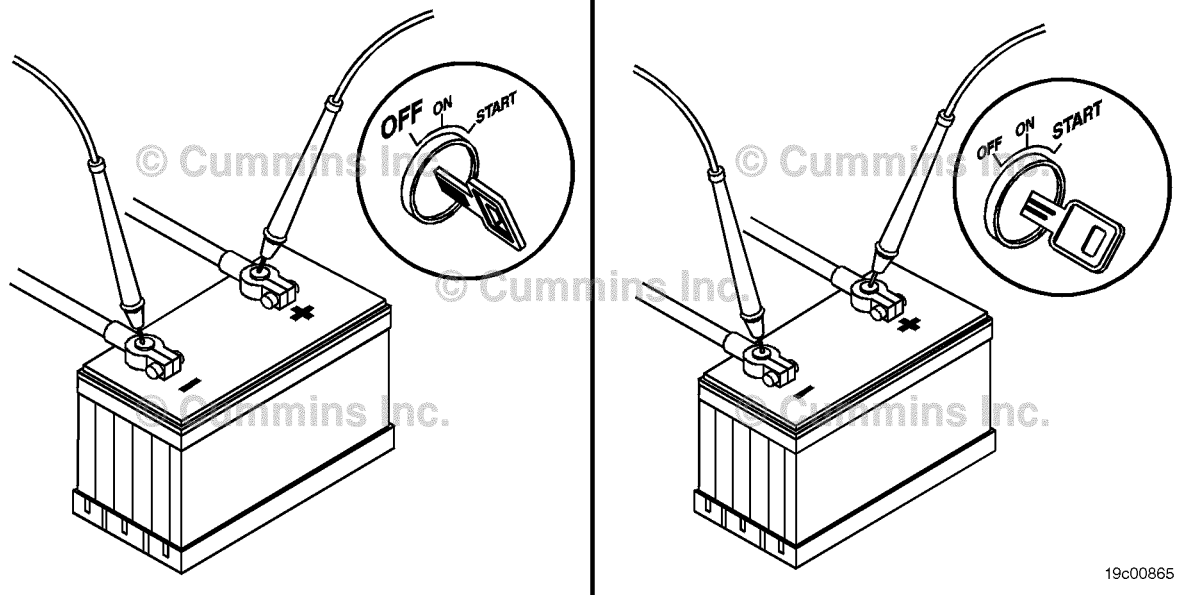
| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>• Start the engine and idle for one minute.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 442 active?<br>**YES** | 2A |
| | Fault Code 442 active?<br>**NO** | 3B |

## STEP 2: Check the equipment battery system.

### STEP 2A: Check the battery voltage.

**Condition:**
- Turn keyswitch OFF.
- Disconnect all aftermarket devices from the battery supply circuit.
- Disconnect the OEM power harness connector from the ECM.

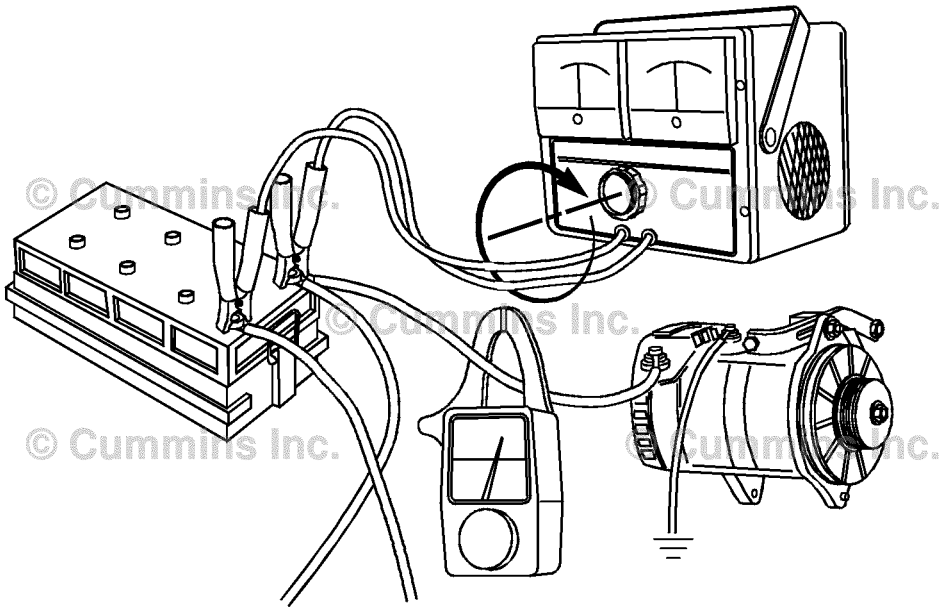
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Measure the battery voltage from one of the ECM battery SUPPLY (+) pins in the OEM power harness ECM connector to engine block ground.<br>• Repeat above step for the second ECM battery SUPPLY (+) pin in the OEM power harness ECM connector. | Less than 20 VDC for 12-VDC system and less than 32 VDC for 24-VDC system?<br>**YES** | 2B |
| | Less than 20 VDC for 12-VDC system and less than 32 VDC for 24-VDC system?<br>**NO**<br>**Repair:**<br>Install the battery system correctly. Refer to the equipment manufacturer's troubleshooting and repair manual. | 3A |



**STEP 2B: Check the alternator.**

**Condition:**
- Turn keyswitch OFF.
- Use an OEM ammeter or install an ammeter between the alternator and the battery.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the alternator.<br>• Start the engine and check the alternator charging rate (amps).<br>NOTE: Place a load on the batteries, if necessary, to measure the alternator output properly. | Alternator charging within OEM specifications?<br>**YES** | 3A |
| | Alternator charging within OEM specifications?<br>**NO**<br>**Repair:**<br>Repair or replace the alternator, regulator, and/or the OEM wiring to the alternator.<br>Refer to the OEM troubleshooting and repair manual. | 3A |




## STEP 3: Clear the fault codes.

**STEP 3A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• UseINSITE™ electronic service tool to verify Fault Code 442 is inactive. | Fault Code 442 inactive?<br>**YES** | 3B |
| | Fault Code 442 inactive?<br>**NO** | 1A |

**STEP 3B: Clear the inactive fault codes.**

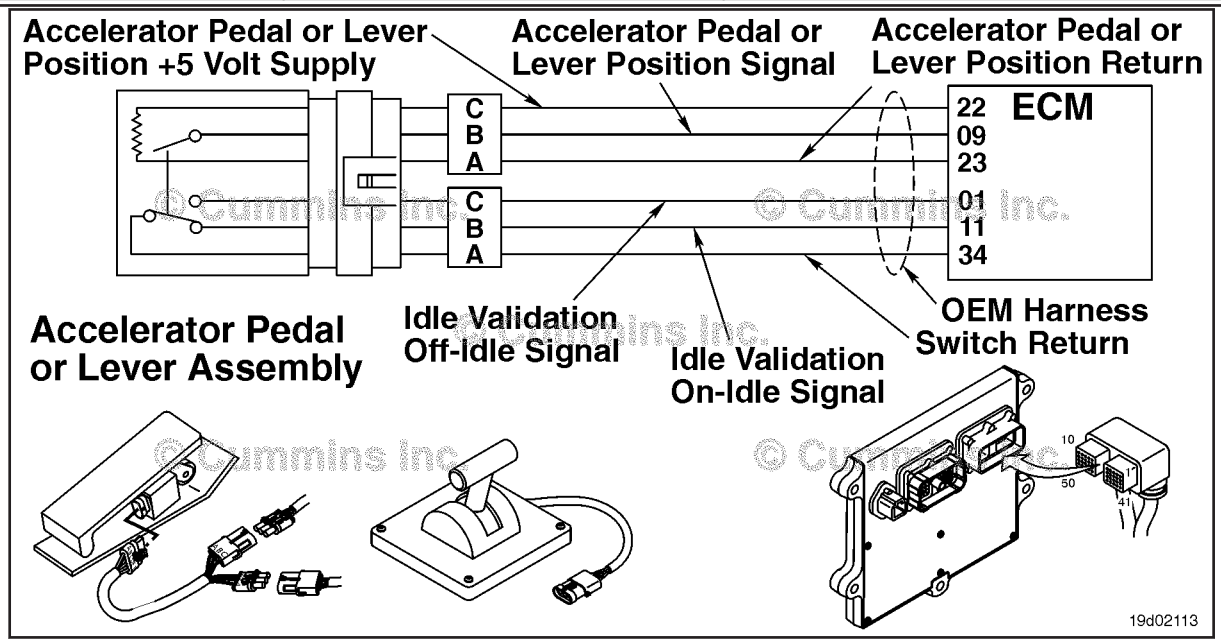
**Condition:**
- Connect all components.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool erase the inactive fault code. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting charts |

# Fault Code 443

## Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 443<br>PID(P), SID(S): S221<br>SPN: 1043<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected at sensor supply circuit to the accelerator pedal or lever position sensor. | Automotive: Engine will **only** die.<br>Marine: Severe derate in engine speed. Limp home capability **only**. |




Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit

**Circuit Description:**

The electronic control module (ECM) supplies the accelerator with +5 VDC. If the supply circuit to the accelerator is damaged, the accelerator will **not** work correctly.

**Component Location:**

For Automotive applications, the accelerator pedal or lever is located in the cab.

For Marine applications, the accelerator lever is typically located in the engine compartment or the helm.

**Shop Talk:**

Low voltage on the +5 VDC supply line can be caused by a short circuit to ground in the supply line, a short circuit between the supply line and return circuit, a failed accelerator, or a failed ECM power supply.

## Refer to Troubleshooting Fault Code t05-443

# FAULT CODE 443 - Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Fault Code 443 active?** | |
| **STEP 2:** | **Check the sensors and circuits connected to the sensor supply and return.** | | |
| **STEP 2A:** | **Inspect the accelerator pedal or lever position sensor and circuit connected to the sensor supply and return** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault Code 443 active?** | |
| **STEP 3:** | **Check the ECM and OEM harness.** | | |
| **STEP 3A:** | **Inspect the ECM and OEM harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check for a pin-to-pin short circuit in the OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 3B-1:** | **Check for a pin short circuit to ground in the OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 443 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 443 active?<br>**YES** | 2A |
| | Fault Code 443 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check the sensors and circuits connected to the sensor supply and return.

**STEP 2A: Inspect the accelerator pedal or lever position sensor and circuit connected to the sensor supply and return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 443 active?<br>**YES** | 3A |
| | Fault Code 443 active?<br>**NO**<br>**Repair:**<br>Replace the accelerator pedal or lever position sensor. Refer to the OEM service manual. | 4A |

## STEP 3: Check the ECM and OEM harness.

**STEP 3A: Inspect the ECM and OEM harness connector pins.**

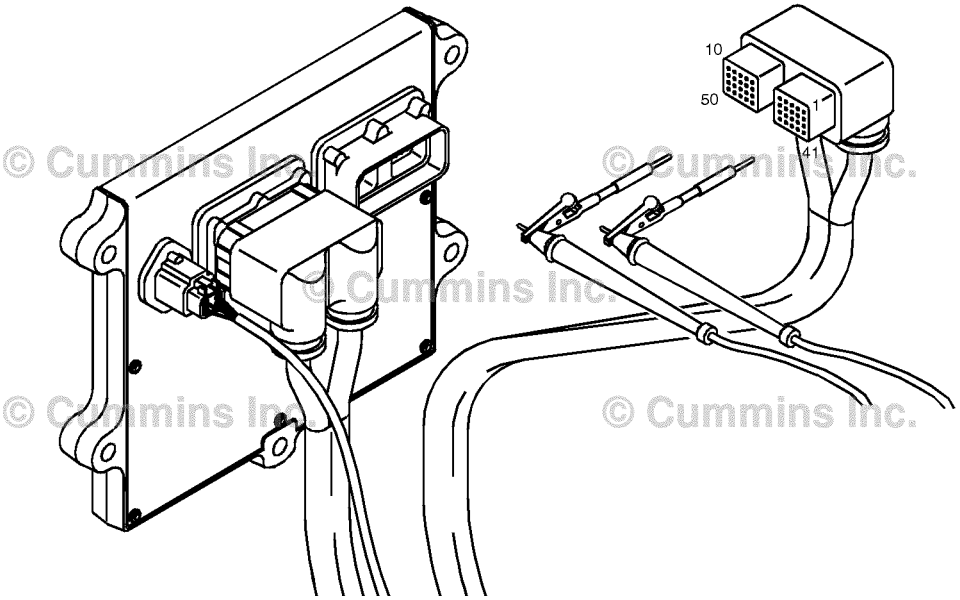
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.

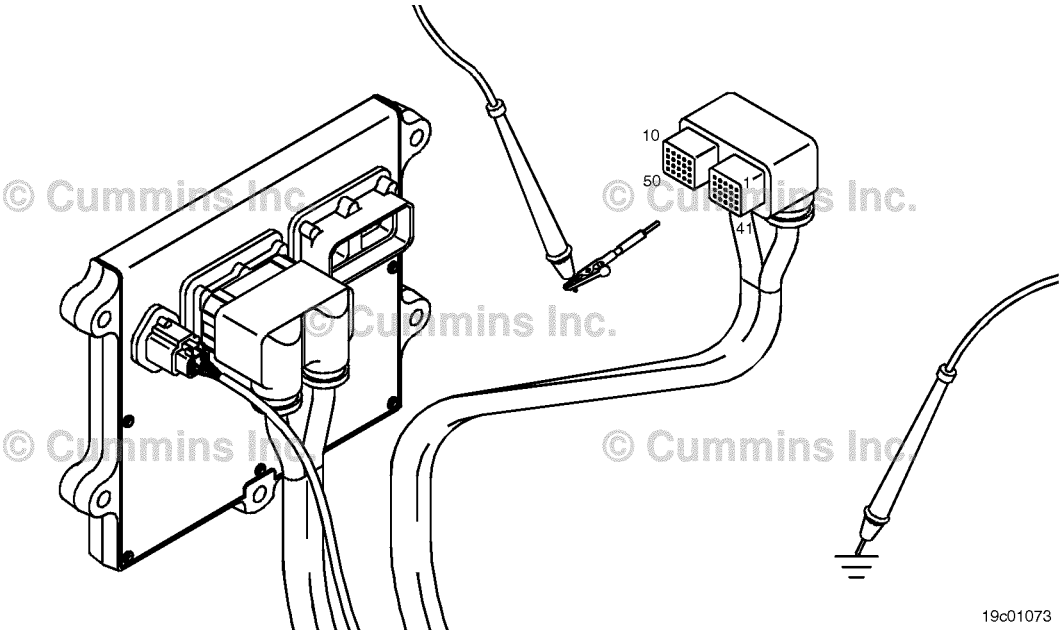
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short circuit on one connector.<br>Measure the resistance and check for a short circuit between the following OEM harness ECM connector pin and all other pins in the connector:<br>• Accelerator pedal or lever position +5-VDC SUPPLY pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3B-1 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3B-1: Check for a pin short circuit to ground in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on one connector - pin to ground check:<br>Measure the resistance and check for a short circuit between the following OEM harness ECM connector pin and ground:<br>• Accelerator pedal or lever position +5-VDC SUPPLY pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 4A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 443 inactive?<br>**YES** | 4B |
| | Fault Code 443 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 4B: Clear the inactive fault codes.

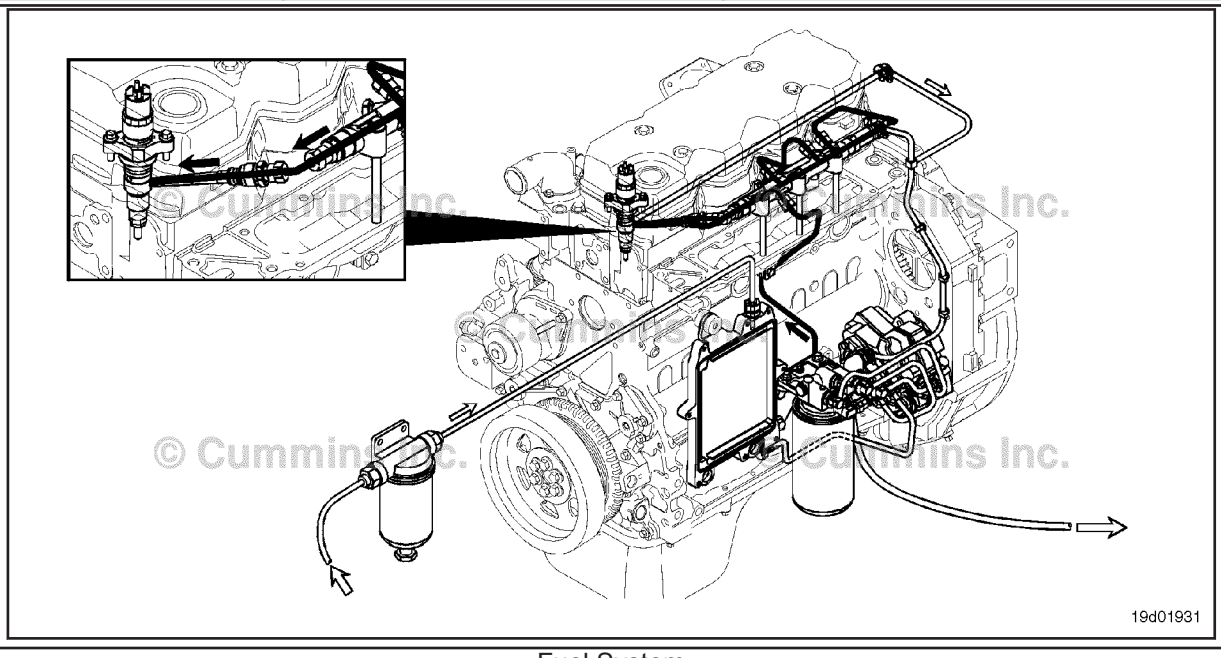
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes . | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooti ng steps |

# Fault Code 449 (ISB/QSB Automotive and Industrial Application)

## Injector Metering Rail Number 1 Pressure - Data Valid But Above Normal Operating Range - Most Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 449<br>PID(P), SID(S): P94<br>SPN: 157<br>FMI: 0<br>Lamp: Amber<br>SRT: | Injector Metering Rail Number 1 Pressure - Data Valid But Above Normal Operating Range - Most Severe Level. The ECM has detected that fuel pressure in the rail fuel is higher than the commanded pressure. | None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is reduced. |




Fuel System

**Circuit Description:**

The electronic control module (ECM) monitors engine-operating conditions, including the reading of rail fuel pressure, and changes the flow command to either increase (OPEN the electric fuel control valve) or decrease (CLOSE the electric fuel control valve) the fuel supply to the high-pressure pump.

**Component Location:**

The electric fuel control valve is installed on the high-pressure fuel pump.

**Shop Talk:**

Fault Code 449 is activated when the sensed rail fuel pressure reaches the opening pressure of the rail fuel pressure relief valve. Sensed pressure has exceeded system target range.

An electric fuel control actuator with excessive leakage will result in high rail fuel pressures at idle or light load, and Fault Code 449 can possibly be logged. A restriction in the fuel-drain-to-tank return line can prevent unneeded fuel from exiting the high-pressure fuel pump. This excess drain fuel can enter the pumping chamber and pressurize the rail. Check the fuel drain line restriction. High resistance or an open circuit in the electric fuel control actuator can cause this fault to log (though Fault Codes 272 and 2311 will become active in these cases). Air in the fuel can result in pressure changes that would cause this fault to log very high. High lift pump delivery pressure could cause this fault to log, as could tampering with the rail fuel pressure sensor.

## Refer to Troubleshooting Fault Code t05-449

# FAULT CODE 449 (ISB/QSB Automotive and Industrial Application) - Injector Metering Rail Number 1 Pressure - Data Valid But Above Normal Operating Range - Most Severe Level

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A :** | **Read the fault codes.** | **Fault Code 271, 272, or 2311 inactive?** | |
| **STEP 2:** | **Check the rail fuel pressure sensor.** | | |
| **STEP 2A:** | **Verify that the rail fuel pressure sensor reads inrange.** | **Pressure = 0 ±40 bar?** | |
| **STEP 3:** | **Check the operation of the low-pressure fuel system.** | | |
| **STEP 3A:** | **Check for air in fuel.** | **Air present?** | |
| **STEP 3B:** | **Check for excessive lift pump fuel pressure.** | **Less than 20 psi?** | |
| **STEP 4:** | **Check for fuel return drain line restriction.** | | |
| **STEP 4A:** | **Check the fuel return drain line for excessive restriction.** | **Less than 2.7 psi?** | |
| **STEP 5:** | **Check for damage to the fuel rail pressure relief valve.** | | |
| **STEP 5A:** | **Check for leakage from the fuel rail pressure relief valve.** | **Fuel return within specification?** | |
| **STEP 6:** | **Clear the fault codes.** | | |
| **STEP 6A:** | **Disable the fault code.** | **Fault codes inactive?** | |
| **STEP 6B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to read the fault codes.<br>• Check for fault codes related to the electronic fuel control actuator shorted low or high. | Fault Code 271, 272, or 2311 inactive?<br>**YES** | 2A |
| | Fault Code 271, 272, or 2311 inactive?<br>**NO**<br>**Repair:**<br>Troubleshoot applicable fault codes for electronic fuel control actuator. | Applicable Fault Code 271, 272, or 2311 |

## STEP 2: Check the rail fuel pressure sensor.

### STEP 2A: Verify that the rail fuel pressure sensor reads inrange.

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use INSITE™ electronic service tool to read the rail fuel pressure. | Pressure = 0 ±40 bar?<br>**YES** | 3A |
| | Pressure = 0 ±40 bar?<br>**NO**<br>**Repair:**<br>Replace the sensor or repair the engine harness.<br>• Refer to Procedure 019-115 in Section 19.<br>• Refer to Procedure 019-360 in Section 19. | 6A |

## STEP 3: Check the operation of the low-pressure fuel system.

### STEP 3A: Check for air in fuel.

**Condition:**
- Connect a test hose at the fuel filter head inlet and run hose into a bucket.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for air in fuel as lift pump runs.<br>• Perform the air-in-fuel test. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-003 in Section 6. | Air present?<br>**YES**<br>**Repair:**<br>Repair the cause of the air in the fuel.<br>Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-003 in Section 6. | 4A |
| | Air present?<br>**NO** | 3B |

**STEP 3B: Check for excessive lift pump fuel pressure.**

**Condition:**
- Connect a test hose at the fuel filter head inlet and run hose into a bucket.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for excessive lift pump fuel pressure.<br>• Install a pressure gauge at the outlet port of the fuel filter head using an MI0 Compuchek™ fitting, Part Number 3824842.<br>• Start the engine and let it idle.<br>• Measure the pressure at the fuel filter head outlet. | Less than 20 psi?<br>**YES** | 5A |
| | Less than 20 psi?<br>**NO**<br>**Repair:**<br>The internal pressure regulator has failed.<br>Replace the electric fuel lift pump.<br>Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 005-045 in Section 5. | 6A |

## STEP 4: Check for fuel return drain line restriction.

**STEP 4A: Check the fuel return drain line for excessive restriction.**

**Condition:**
- Install a pressure gauge in the fuel return line banjo bolt at the high-pressure fuel pump drain manifold.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the fuel return drain line for excessive restriction.<br>• Operate the engine at high idle speed.<br>• Measure the fuel return drain line restriction.<br>• Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-012 in Section 6. | Less than 2.7 psi?<br>**YES**<br>**Repair:**<br>Replace the electronic fuel control valve. Refer to Procedure 019-102 in Section 19. | 5A |
| | Less than 2.7 psi?<br>**NO**<br>**Repair:**<br>Repair or replace the fuel return drain line.<br>Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-013 in Section 6. | 5A |

## STEP 5: Check for damage to the fuel rail pressure relief valve.

### STEP 5A: Check for leakage from the fuel pressure relief valve.

**Condition:**
- Turn keyswitch OFF.
- Install test fittings to measure the fuel return from the fuel rail pressure relief valve.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for leakage from the fuel rail pressure relief valve.<br>NOTE: Excessive fuel rail pressure can possibly cause damage to the fuel rail pressure relief valve.<br>• Install test fittings to measure the fuel return.<br>• Follow the test outlined in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-061 in Section 6. | Fuel return within specification?<br>**YES**<br>**Repair:**<br>Replace the high-pressure fuel pump.<br>Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 005-016 in Section 5. | 6A |
| | Fuel return within specification?<br>**NO**<br>**Repair:**<br>Replace the fuel rail pressure relief valve.<br>Use the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-061 in Section 6. | 6A |

## STEP 6: Clear the fault codes.

### STEP 6A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Verify that fault codes are inactive. | Fault codes inactive?<br>**YES** | 6B |
| | Fault codes inactive?<br>**NO** | 1A |

**STEP 6B: Clear the inactive fault codes.**

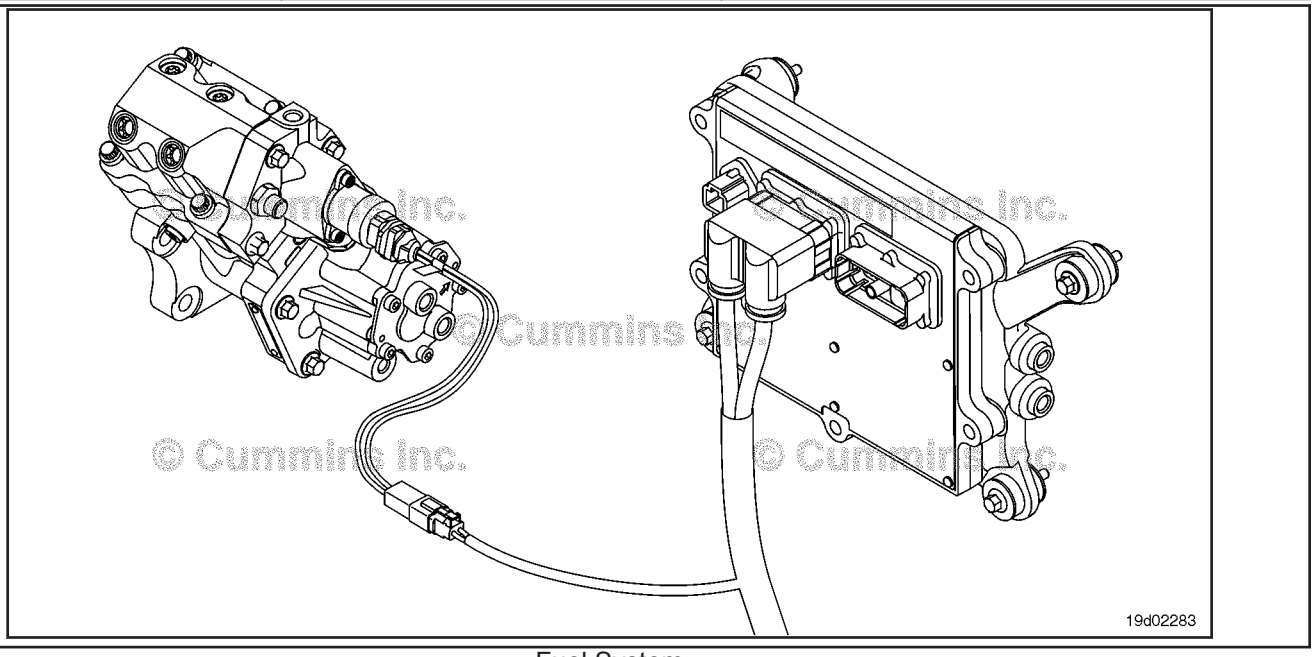
**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool, to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 449 (ISC/QSC/ISL/QSL Automotive, Industrial, and Marine Applications)

## Injector Metering Rail Number 1 Pressure - Data Valid But Above Normal Operating Range - Most Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 449<br>PID(P), SID(S): P94<br>SPN: 157<br>FMI: 0<br>Lamp: Amber<br>SRT: | Injector Metering Rail Number 1 Pressure - Data Valid But Above Normal Operating Range - Most Severe Level. Fuel pressure signal indicates that fuel pressure has exceeded the maximum limit for the given engine rating. | None or possible power interruption associated with dump valve reset. |




Fuel System

**Circuit Description:**

The electronic control module (ECM) monitors engine-operating conditions, including the reading of rail fuel pressure, and changes the flow command to either increase (OPEN the fuel pump actuator) or decrease (CLOSE the fuel pump actuator) the fuel supply to the high-pressure pump.

**Component Location:**

The fuel pump actuator is installed on the high-pressure fuel pump.

**Shop Talk:**

Fault Code 449 is activated when the sensed rail fuel pressure exceeds the opening pressure of the rail fuel pressure relief valve.

In normal engine operation the ECM calibration varies the flow command to the fuel pump actuator to achieve the correct fuel rail pressure. System failures that cause loss of pressure control can cause the fuel rail pressure relief valve to open. The fuel rail pressure relief valve acts to protect the high pressure components from over-pressurization. If the ECM detects that the fuel rail pressure relief valve is open without a detection of a fuel pump actuator circuit error, Fault Code 449 will become active.

On certain applications, the ECM will try to reset automatically causing a momentary loss of power for less than one second.

Conditions that can cause Fault Code 449:

- Purging air through the fuel system can cause a pressure overshoot, therefore causing Fault Code 449 to log.
- Sustained periods of very low pressure under load followed by pressure recovery overshoot. This can be caused by high restriction due to plugged filters.
- A tampered fuel pressure sensor that reads low, a biased pressure sensor, or a poor electrical connection.
- If an intermittent electrical circuit problem, of the fuel pump actuator circuit, exists it is possible for Fault Code 449 to become active then inactive during normal engine operation. ECM Fault Code 2311 is designed to detect electrical circuit issues with the actuator. Therefore, it is **only** necessary to look for bad connectors or harness issues for Fault Code 449 if no other fault codes exist.
- Other conditions include faulty ECM wiring harness such as poor grounds, battery voltage spikes, electrical noise, low alternator output, and large disturbances of battery voltage, as when jump starting the vehicle.

## Refer to Troubleshooting Fault Code t05-449

# FAULT CODE 449 (ISC/QSC/ISL/QSL Automotive, Industrial, and Marine Applications) - Injector Metering Rail Number 1 Pressure - Data Valid But Above Normal Operating Range - Most Severe Level

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A : | Read the fault codes. | Are Fault Code(s) 271, 272, 2311, or 1117 active or high inactive counts? | |
| **STEP 2:** | **Check for air in the fuel.** | | |
| STEP 2A: | Check for air in fuel. | Air in the fuel? | |
| **STEP 3:** | **Check the low pressure fuel system.** | | |
| STEP 3A: | Measure the gear pump pressure at the outlet of the pressure side fuel filter. | Is gear pump pressure low? | |
| STEP 3B: | Measure the pressure at the inlet to the pressure side fuel filter. | Is filter restriction high? | |
| STEP 3C: | Measure the inlet restriction at the gear pump inlet. | Is the gear pump inlet restriction to high? | |
| STEP 3D: | Measure the inlet restriction at the OEM connection point. | Is OEM inlet restriction to high? | |
| STEP 3E: | Check for a restriction at the OEM connection point. | Debris or damage? | |
| **STEP 4:** | **Check the rail fuel pressure sensor.** | | |
| STEP 4A: | Verify the rail fuel pressure sensor reads in-range. | Is the pressure 0 ± 40 bar [0 ± 580 psi]? | |
| STEP 4B: | Inspect the fuel pressure sensor signal wire and connector pins. | Dirty or damaged pins? | |
| **STEP 5:** | **Check customer complaints.** | | |
| STEP 5A: | Check customer complaints. | Does the engine start and stall or surge at idle? | |
| **STEP 6:** | **Check the fuel pump actuator.** | | |
| STEP 6A: | Check the fuel pump actuator and harness connector pins. | Dirty or damaged pins? | |
| STEP 6B: | Inspect the fuel pump actuator for damage. | Are the o-rings on the fuel pump actuator damaged? | |
| STEP 6C: | Monitor the fuel rail pressure at idle. | Does measured fuel rail pressure deviate more than 200 bar [2901 psi] and surge at idle? | |
| **STEP 7:** | **Check the ECM to ground strap.** | | |
| STEP 7A: | Inspect the ECM to ground strap. | Is the ECM to ground strap missing or have the connections degraded? | |
| **STEP 8:** | **Clear the fault codes.** | | |
| STEP 8A: | Disable the fault code. | Fault codes inactive? | |

**STEP 8B:** **Clear the inactive fault codes.** **All fault codes cleared?**

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to read the fault codes.<br>• Check for fault codes related to the fuel pump actuator shorted low or high. | Are Fault Code(s) 271, 272, 2311, or 1117 active or high inactive counts?<br>**YES** | Appropriate Troubleshooting Tree |
| | Are Fault Code(s) 271, 272, 2311, or 1117 active or high inactive counts?<br>**NO** | 2A |

### STEP 2: Check for air in the fuel.

**STEP 2A: Check for air in the fuel.**

**Condition:**
- Turn keyswitch ON.

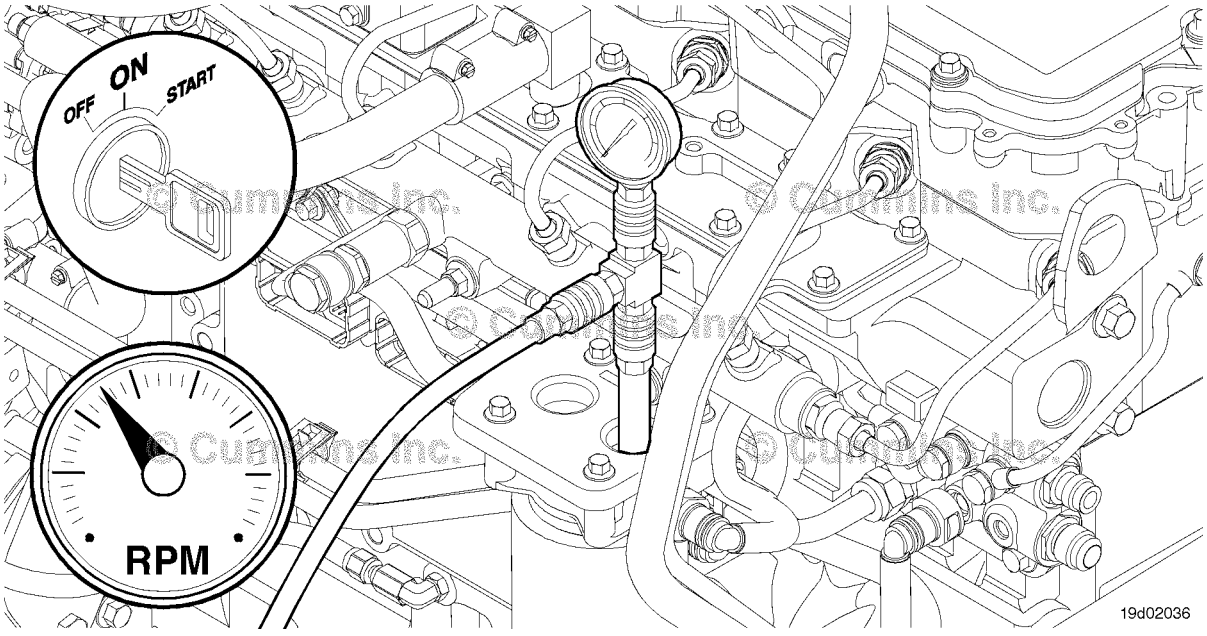
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for air in the fuel. | Air in the fuel?<br>**YES**<br>**Repair:**<br>Air detected<br>Correct the source of the air leak. Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe4, and QSL9 Engines Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-003 in Section 6. | Appropriate Troubleshooting Tree |
| | Air in the fuel?<br>**NO** | 3A |

## STEP 3: Check the low pressure fuel system.

### STEP 3A: Measure the gear pump pressure at the outlet of the pressure side fuel filter.

**Condition:**
- Turn keyswitch OFF.
- Connect the diagnostic fittings.
- Turn keyswitch ON.

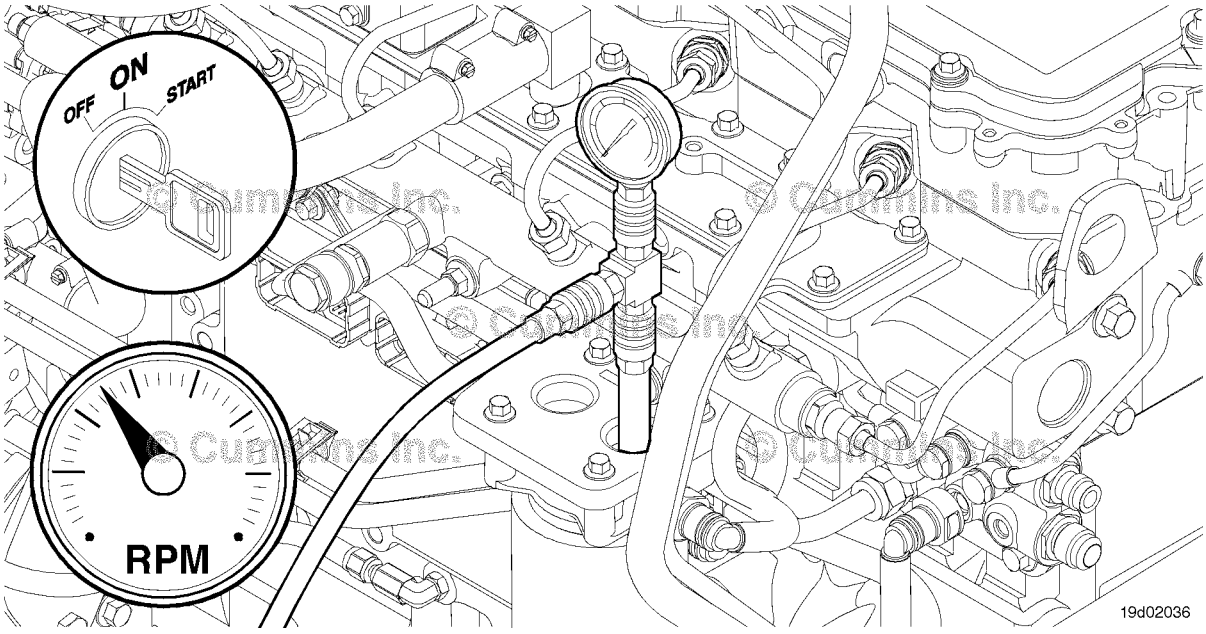
| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the pressure at the outlet of the pressure side fuel filter.<br>• Install a T-fitting at the outlet of the pressure side fuel filter.<br>• Install a diagnostic fuel line at the T-fitting with an orifice of 0.109 cm [0.043 in].<br>• Install a 0 to 1379 kPa [0 to 200 psi] pressure gauge at the T-fitting.<br>• Start the engine.<br>• Measure gear pump pressure at high idle.<br>Minimum gear pump pressure at high idle engine speed 483 kPa [70 psi].<br>Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4, and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 005-025 in Setion 5. | Is gear pump pressure low?<br>**YES** | 3B |
| | Is gear pump pressure low?<br>**NO** | 4A |



**STEP 3B: Measure the pressure at the inlet to the pressure side fuel filter.**

**Condition:**
- Turn keyswitch OFF.
- Connect the diagnostic fittings.
- Turn keyswitch ON.

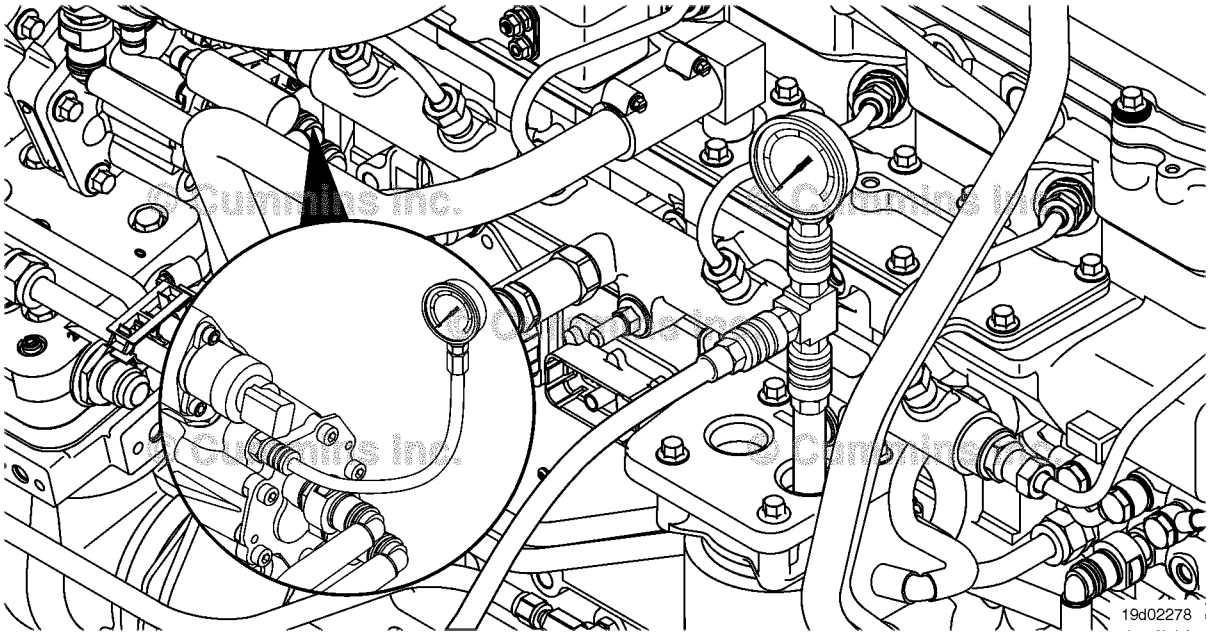
| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the pressure at the inlet to the pressure side fuel filter.<br>• Install a T-fitting at the outlet of the pressure side fuel filter.<br>• Install a diagnostic fuel line at the T-fitting with an orifice of 0.109 cm [0.043 in]. Run the output of this fuel line into a collection device or the vehicle's fuel tank.<br>• Install a 0 to 1379 kPa [0 to 200 psi] pressure gauge at the T-fitting.<br>• Install a 0 to 1379 kPa [0 to 200 psi] pressure gauge at the inlet of the pressure side fuel filter.<br>• Start the engine.<br>• Measure gear pump pressure at high idle.<br>Maximum fuel filter pressure drop 138 kPa [20 psi].<br>Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4, and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 005-025 in Section 5. | Is filter restriction high?<br>**YES**<br>**Repair:**<br>The fuel filter is plugged.<br>Replace the pressure side fuel filter.<br>Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe4, and QSL9 Engines Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-015 in Section 6. | 8A |
| | Is filter restriction high?<br>**NO** | 3C |



**STEP 3C: Measure the inlet restriction at the gear pump inlet.**

**Condition:**
- Turn keyswitch OFF.
- Connect the diagnostic fittings.
- Turn keyswitch ON.

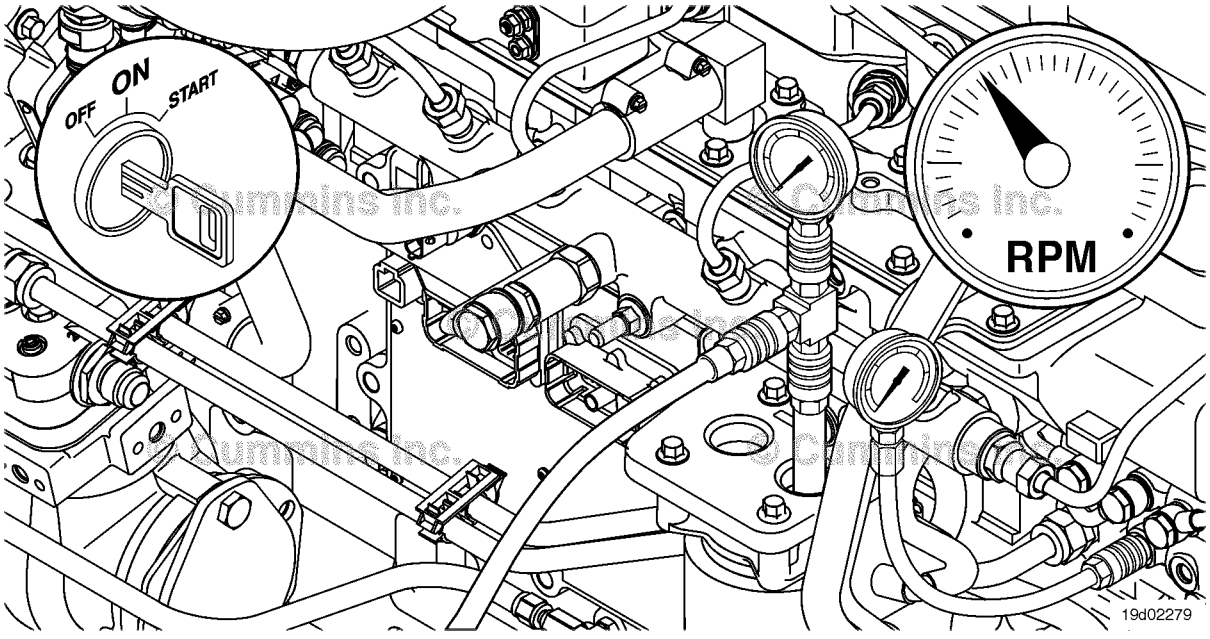
| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the inlet resriction.<br>• Install a diagnostic fitting at the inlet to the fuel gear pump.<br>• Install a 0 to 762 mm-Hg [0 to 30 in-Hg] vacuum gauge at the inlet to the gear pump.<br>• Install a M10 standard thread o-ring diagnostic fitting at the pressure side fuel filter outlet port.<br>• Operate the engine at high idle no load and measure the restriction at the inlet to the gear pump.<br>If the engine will **not** start or the engine starts and stalls, be sure the fuel is primed to the gear pump. This test is **only** valid if the engine is running.<br>Maximum gear pump inlet restriction 254 mm-Hg [10 in-Hg].<br>Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe4, and QSL9 Engines Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-020 in Section 6. | Is the gear pump inlet restriction too high?<br>**YES** | 3D |
| | Is the gear pump inlet restriction too high?<br>**NO**<br>**Repair:**<br>Replace the gear pump.<br>Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe4, and QSL9 Engines Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 005-025 in Section 5. | 8A |



**STEP 3D: Measure the inlet restriction at the OEM connection point.**

**Condition:**
- Turn keyswitch OFF.
- Connect the diagnostic fittings.
- Turn keyswitch ON.

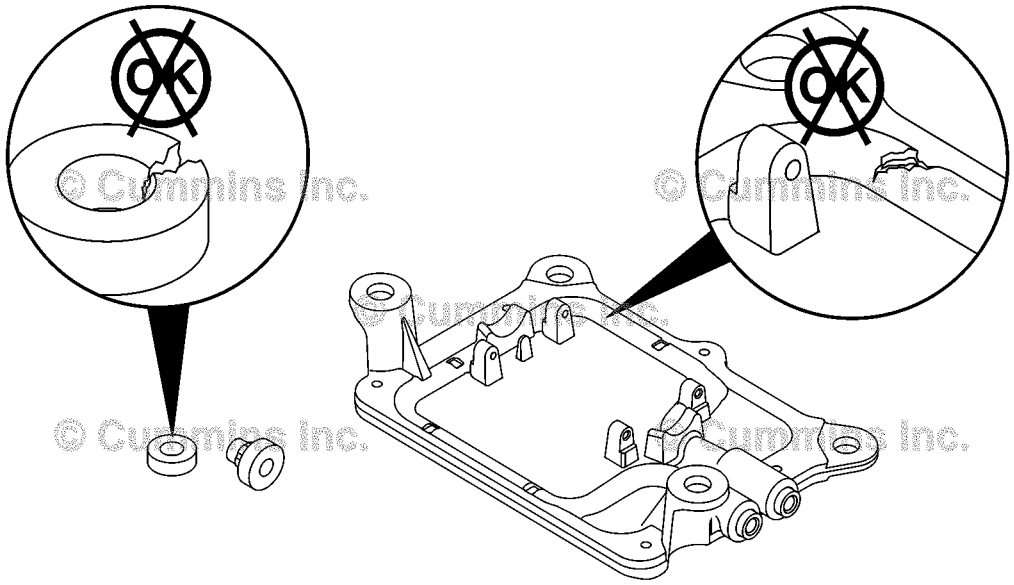
| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the inlet restriction.<br>• Install a 0 to 762 mm-Hg [0 to 30 in-Hg] vacuum gauge at the OEM connection point.<br>• Install a M10 standard thread o-ring diagnostic fitting at the pressure side fuel filter outlet port.<br>• Install a diagnostic fitting at the pressure side outlet port with an orifice of 0.109 cm [0.043 in].<br>• Operate the engine at high idle no load and measure the restriction at the inlet to the gear pump.<br>If the engine will **not** start or the engine starts and stalls, be sure the fuel is primed to the gear pump. This test is **only** valid if the engine is running.<br>Maximum OEM inlet restriction 203 mm-Hg [8 in-Hg].<br>Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe4, and QSL9 Engines Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-020 in Section 6. | Is OEM inlet restriction too high?<br>**YES**<br>**Repair:**<br>A fuel restriction exists upstream of the OEM connection point.<br>Refer to the OEM service manual. | Appropriate Troubleshooting Manual |
| | Is OEM inlet restriction too high?<br>**NO** | 3E |



**STEP 3E: Check for a restriction at the OEM connection point.**

**Condition:**

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the ECM cooling plate and check valve.<br>Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe4, and QSL9 Engines Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-006 in Section 6. | Debris or damage?<br>**YES**<br>**Repair:**<br>Clean or replace the ECM cooling plate.<br>Clean or replace the check valve. | 8A |
| | Debris or damage?<br>**NO** | 4A |

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## STEP 4: Check the rail fuel pressure sensor.

### STEP 4A: Verify the rail fuel pressure sensor reads in-range.

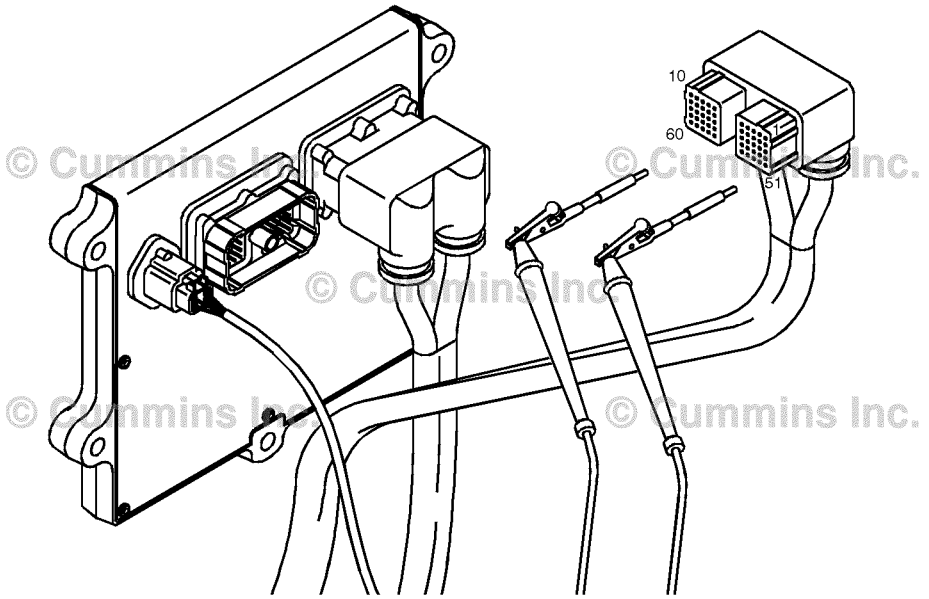
**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify the sensor reads in-range. | Is the pressure 0 ± 40 bar [ 0 ± 580 psi]?<br>**YES** | 4B |
| | Is the pressure 0 ± 40 bar [ 0 ± 580 psi]?<br>**NO**<br>**Repair:**<br>The fuel pressure sensor is incorrectly reading a fuel pressure.<br>Replace the rail fuel pressure sensor.<br>Refer to Procedure 019-115 in Section 19. | 8A |

**STEP 4B: Inspect the fuel pressure sensor signal wire and connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect ECM from engine harness

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the fuel pressure sensor signal wire and connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins. Refer to Procedure 019-043 in Section 19. | 8A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 5A |



## STEP 5: Check customer complaints.

### STEP 5A: Check customer complaints.

| Condition: | | |
|---|---|---|
| **Action** | **Specification/Repair** | **Next Step** |
| Interview the customer or driver.<br>- | Does the engine start and stall or surge at idle?<br>**YES** | 6A |
| | Does the engine start and stall or surge at idle?<br>**NO** | 7A |

## STEP 6: Check the fuel pump actuator.

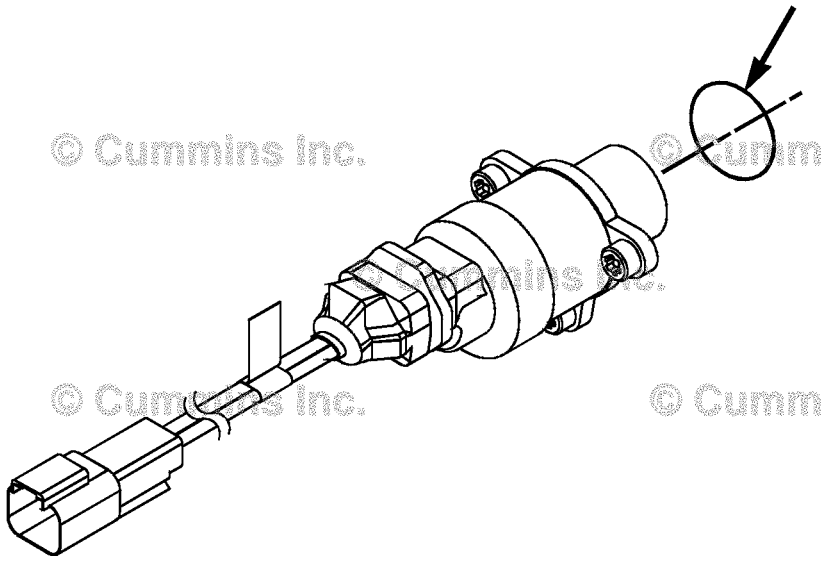
### STEP 6A: Check the fuel pump actuator and harness connector pins.

| **Condition:**<br>• Turn keyswitch OFF.<br>• Disconnect the fuel pump actuator from the engine harness. | | |
|---|---|---|
| **Action** | **Specification/Repair** | **Next Step** |
| Inspect the fuel pump actuator, pigtail wires, and harness connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Repair the connector and pins. Repair the damaged harness, connectors, or pins. Refer to Procedure 019-043 in Section 19. | 8A |
| | Dirty or damaged pins?<br>**NO** | 6B |

**STEP 6B: Inspect the fuel pump actuator for damage.**

**Condition:**
- Turn keyswitch OFF.
- Remove the fuel pump actuator.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the fuel pump actuator o-rings for damage. | Are the o-rings on the fuel pump actuator damaged?<br>**YES**<br>**Repair:**<br>Replace the fuel pump actuator o-rings. Refer to Procedure 019-117 in Section 19. | 8A |
| | Are the o-rings on the fuel pump actuator damaged?<br>**NO** | 6C |

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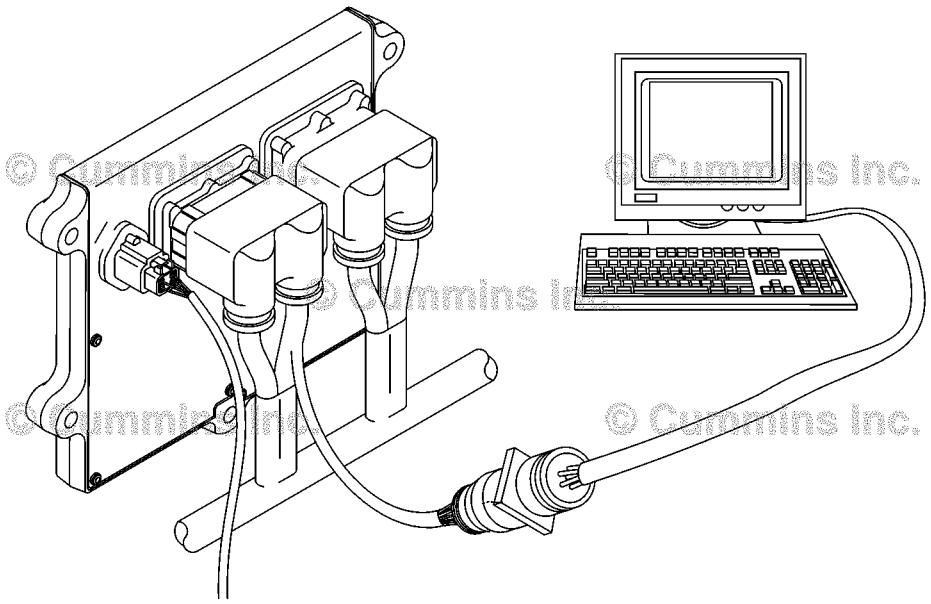
**STEP 6C: Monitor the fuel rail pressure at idle.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Start the engine.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Run the engine at idle for at least one minute to purge air induced from previous steps.<br>• Use INSITE™ electronic service tool, to monitor commanded fuel rail pressure and measured fuel rail pressure. | Does measured fuel rail pressure deviate more than 200 bar [2901 psi] and surge at idle?<br>**YES**<br>**Repair:**<br>Replace the fuel pump actuator. Refer to Procedure 019-117 in Section 19. | 8A |
| | Does measured fuel rail pressure deviate more than 200 bar [2901 psi] and surge at idle?<br>**NO** | 7A |

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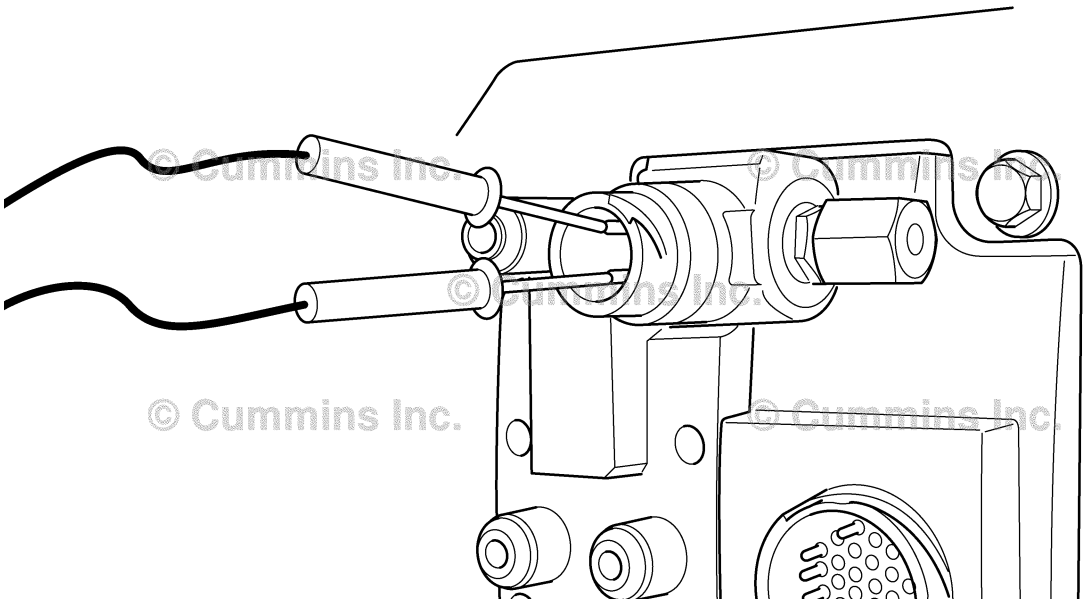
## STEP 7: Check the ECM to ground strap.

### STEP 7A: Inspect the ECM to ground strap.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Run the engine at idle for at least one minute to purge air induced from previous steps.<br>• Check the ground from the ECM to the block. Refer to Procedure 019-008 in Section 19.<br>• Check ground connections from block to battery (-) negative. | Is the ECM to ground strap missing or have the connections degraded?<br>**YES**<br>**Repair:**<br>Repair missing or degraded ground connections. | 8A |
| | Is the ECM to ground strap missing or have the connections degraded?<br>**NO**<br>**Repair:**<br>Contact a Cummins® Authorized Repair Location. | 8A |



## STEP 8: Clear the fault codes.

### STEP 8A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify the fault codes are inactive. | Fault codes inactive?<br>**YES** | 8B |
| | Fault codes inactive?<br>**NO** | 1A |

### STEP 8B: Clear the inactive fault codes.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 451

## Injector Metering Rail Number 1 Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 451<br>PID(P), SID(S): P157<br>SPN: 157<br>FMI: 3<br>Lamp: Amber<br>SRT: | Injector Metering Rail Number 1 Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage detected at rail fuel pressure sensor circuit. | Automotive: Power and/or speed derate.<br>Marine: None. |

**Circuit Description:**

The fuel pressure sensor is used by the electronic control module (ECM) to monitor the fuel pressure in the fuel rail. The sensor gets +5-VDC from the ECM and is grounded by a RETURN pin. A third pin is the SIGNAL pin. The power and RETURN pins are shared with other devices on the engine.

**Component Location:**

The fuel pressure sensor is installed in the fuel rail. Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

**Shop Talk:**

This fault code will become active if there is an open circuit on any of the three pins (+5 volt SUPPLY, SIGNAL, and RETURN) that connect the sensor or the ECM to the wiring harness. This fault will also be active if the SIGNAL wire is shorted to a source of voltage. This fault code will become inactive any time the keyswitch is ON and the signal returns to a valid in-range voltage.

Causes for this fault code include:

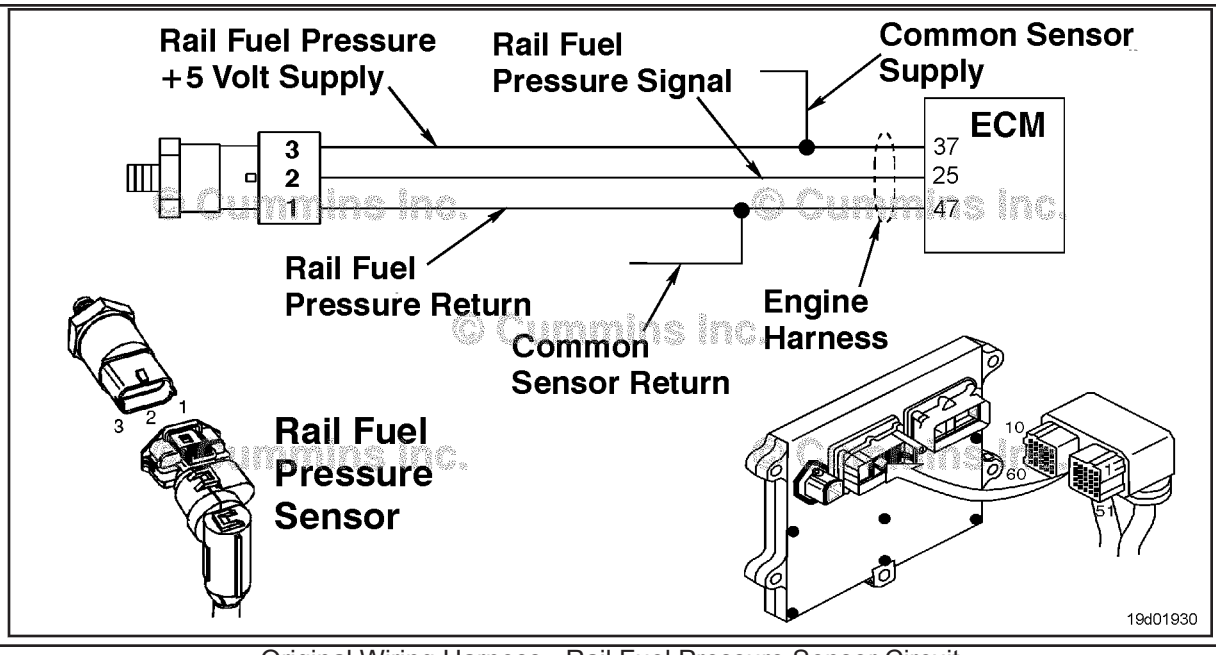
- Voltage (+5-VDC or higher shorted to the SIGNAL wire)
- Open circuit on the SIGNAL wire
- Open circuit on the +5-VDC SUPPLY wire
- Open circuit on the RETURN wire
- Damaged sensor
- Malfunctioning ECM.

The sensor return configuration for Euro 4 ISB engines has been changed for automotive wiring harnesses manufactured from February 2012 onward. The new style wiring harnesses can be be identified using the method below:

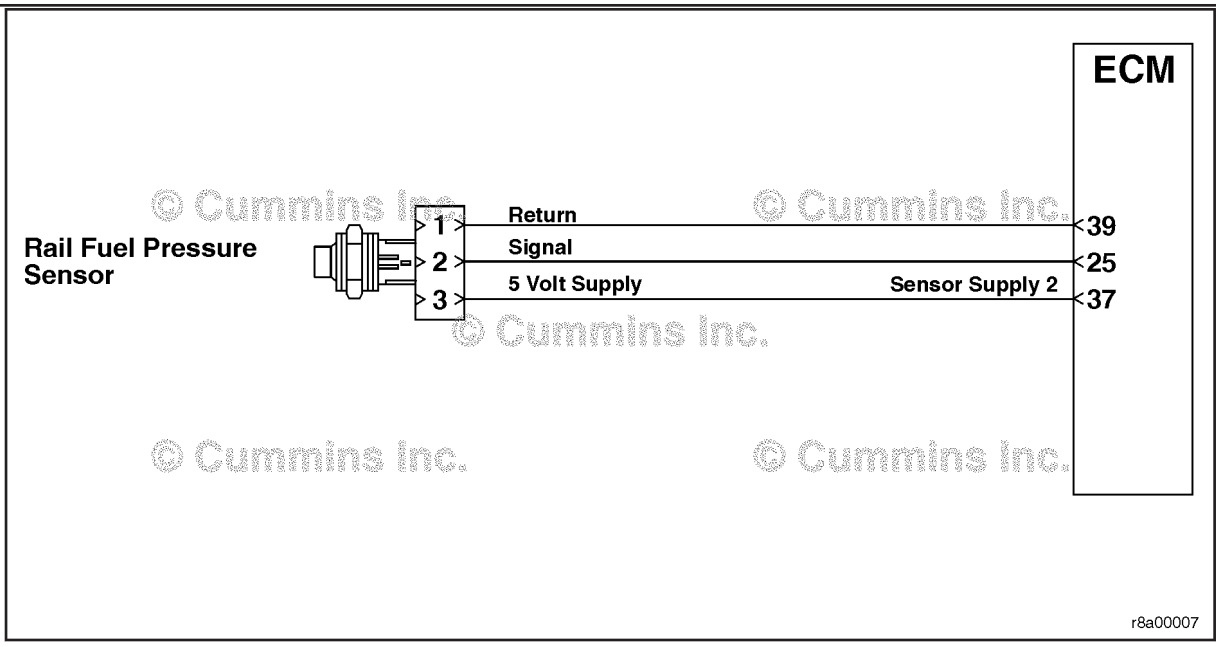
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM pin 47 and the camshaft position sensor RETURN pin
- Use the table below to determine which harness is fitted to the engine.

| Engine Harnesses | | | |
|---|---|---|---|
| From | To | New Harness | Old Harness |
| Intake manifold pressure/ temperature sensor RETURN pin | Camshaft position sensor RETURN pin | Open circuit | Short circut |
| ECM pin 47 | Camshaft position sensor RETURN pin | Open circuit | Short circuit |

NOTE: QSB engines, all C series engines, and all L series engines are **not** affected by this change.




Original Wiring Harness - Rail Fuel Pressure Sensor Circuit




Original Wiring Harness - Rail Fuel Pressure Sensor Circuit

**Refer to Troubleshooting Fault Code t05-451.**

# FAULT CODE 451 - Injector Metering Rail Number 1 Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3164111 - male Bosch™ test lead, Part Number 3164110 - female Bosch™ test lead, Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead, and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for sensor supply fault codes.** | **Fault Code 227 active?** | |
| **STEP 1B:** | **Check for an inactive fault code.** | **Fault Code 451 inactive?** | |
| **STEP 2:** | **Check the rail fuel pressure sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the rail fuel pressure sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault Code 452 active and Fault Code 451 inactive?** | |
| **STEP 2C:** | **Check the sensor supply voltage and return circuit.** | **4.75-VDC to 5.25-VDC?** | |
| **STEP 2D:** | **Check the fault codes and verify sensor condition.** | **Fault Code 451 active?** | |
| **STEP 3:** | **Check the engine control module and engine harness.** | | |
| **STEP 3A:** | **Inspect the engine control module and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3A-1:** | **Check the engine control module response.** | **Fault Code 452 active and Fault Code 451 inactive?** | |
| **STEP 3A-2:** | **Check for an inactive fault code.** | **Fault Code 451 inactive?** | |
| **STEP 3B:** | **Inspect the engine control module and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B-1:** | **Check the sensor supply voltage and return circuit.** | **4.75-VDC to 5.25-VDC?** | |
| **STEP 3B-2:** | **Check for an inactive fault code.** | **Fault Code 451 inactive?** | |
| **STEP 4:** | **Clear the fault code.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 451 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for sensor supply fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for sensor supply fault codes.<br>• Use INSITE™ electronic service to read the fault codes. | Fault Code 227 active?<br>**YES** | Appropriate troubleshooti ng tree |
| | Fault Code 227 active?<br>**NO** | 1B |

**STEP 1B: Check for an inactive fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 451 inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 451 inactive?<br>**NO** | 2A |

## STEP 2: Check the rail fuel pressure sensor and circuit.

### STEP 2A: Inspect the rail fuel pressure sensor and connector pins.

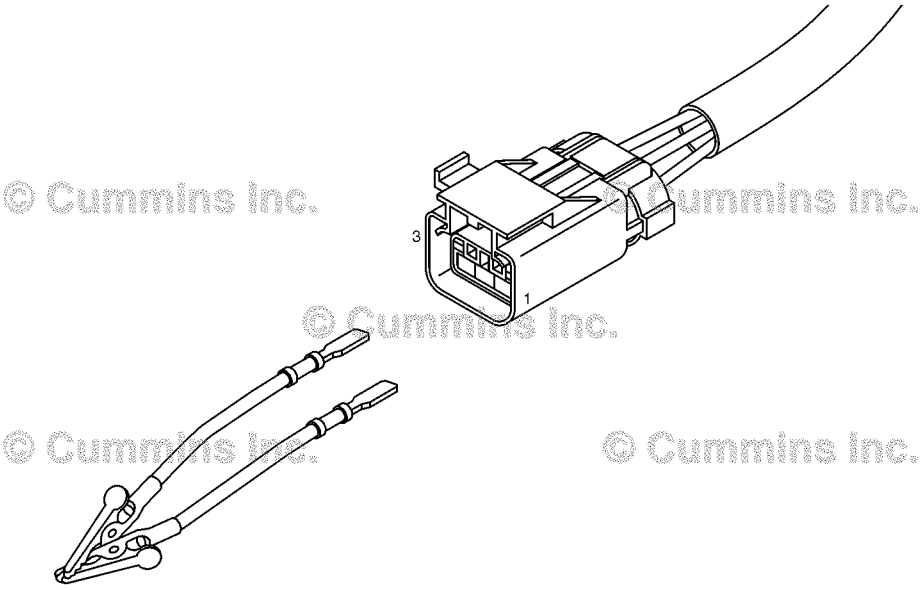
**Condition:**
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and rail fuel pressure sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris on or in the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the rail fuel pressure RETURN pin and the rail fuel pressure SIGNAL pin at the rail fuel pressure sensor connector of the engine harness.<br>Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes.<br>Refer to the wiring diagram for connector pin identification. | Fault Code 452 active and Fault Code 451 inactive?<br>**YES** | 2C |
| | Fault Code 452 active and Fault Code 451 inactive?<br>**NO** | 3A |

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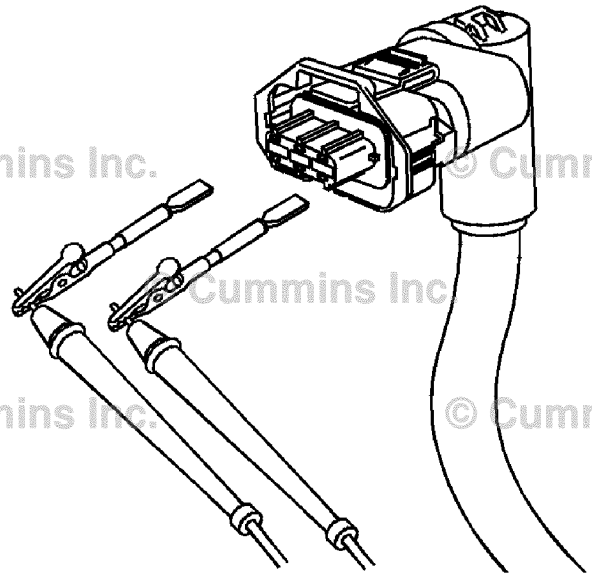
**STEP 2C: Check the sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the supply voltage and return circuit.<br>• Measure the voltage from the rail fuel pressure +5 volt SUPPLY pin to the rail fuel pressure RETURN pin at the sensor connector of the engine harness.<br>Refer to the wiring diagram for connector pin identification. | 4.75_VDC to 5.25-VDC?<br>**YES** | 2D |
| | 4.75-VDC to 5.25-VDC?<br>**NO** | 3B |





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**STEP 2D: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF.
- Connect the rail fuel pressure sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 451 is active?<br>**YES**<br>**Repair:**<br>A damaged sensor has been detected.<br>Replace the rail fuel pressure sensor. Refer to Procedure 019-115 in Section 19. | 4A |
| | Fault Code 451 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the engine control module and engine harness.

**STEP 3A: Inspect the engine control module and engine harness connector pins.**

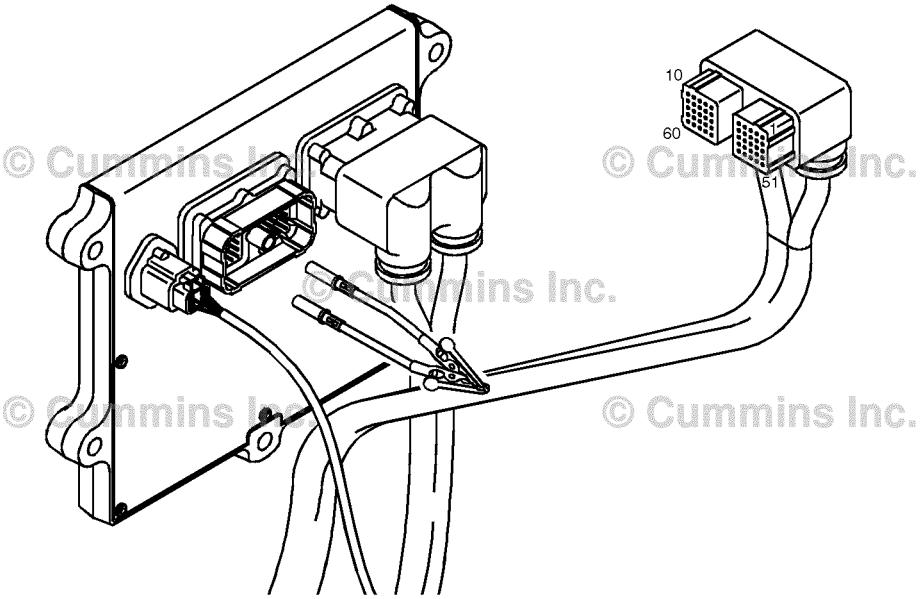
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and engine control module engine connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris on or in the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the engine control module engine connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3A-1 |

**STEP 3A-1: Check the engine control module response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the rail fuel pressure +5 volt SUPPLY pin and the rail fuel pressure SIGNAL pin at the ECM engine connector.<br>Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes.<br>Refer to the wiring diagram for connector pin identification. | Fault Code 452 active and Fault Code 451 inactive?<br>**YES** | 3A-2 |
| | Fault Code 452 active and Fault Code 451 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



**STEP 3A-2: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 451 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Fault Code 451 inactive?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit has been detected on the signal line of the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

**STEP 3B: Inspect the engine control module and engine harness connector pins.**

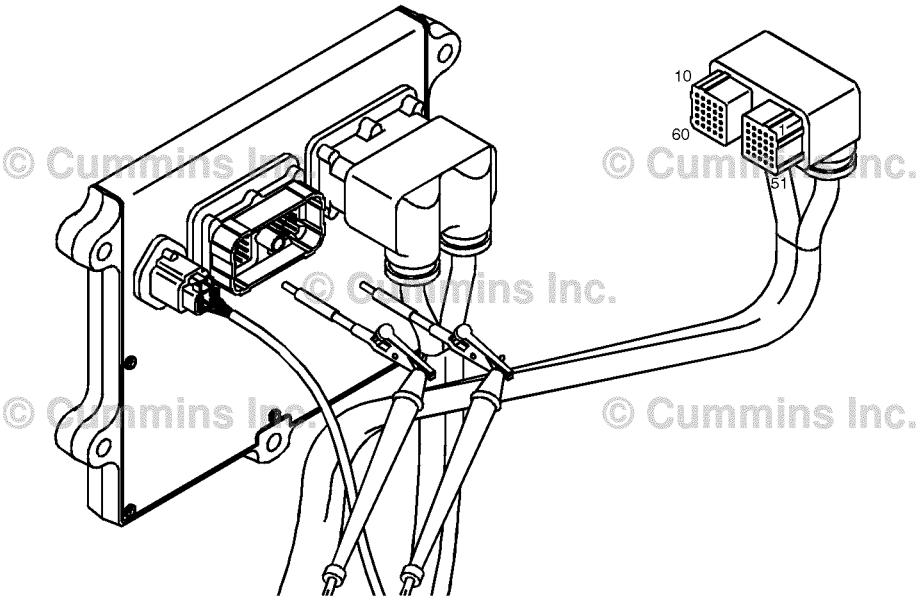
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and engine control module engine connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris on or in the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the engine control module engine connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B-1 |

**STEP 3B-1: Check the sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the supply voltage and return circuit.<br>• Measure the voltage from the rail fuel pressure +5 volt SUPPLY pin to the rail fuel pressure RETURN pin at the ECM engine harness connector.<br>Refer to the wiring diagram for connector pin identification. | 4.75-VDC to 5.25-VDC?<br>**YES** | 3B-2 |
| | 4.75-VDC to 5.25-VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



**STEP 3B-2: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 451 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Fault Code 451 inactive?<br>**NO**<br>**Repair:**<br>An open RETURN circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 451 inactive?<br>**YES** | 4B |
| | Fault Code 451 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 452

## Injector Metering Rail Number 1 Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 452<br>PID(P), SID(S): P157<br>SPN: 157<br>FMI: 4<br>Lamp: Amber<br>SRT: | Injector Metering Rail Number 1 Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at the rail fuel pressure sensor circuit. | Automotive: Power and/or speed derate.<br>Marine: None. |

**Circuit Description:**

The fuel pressure sensor is used by the electronic control module (ECM) to monitor the fuel pressure in the fuel rail. The sensor gets +5 VDC from the ECM and is grounded by a RETURN pin. A third pin is the SIGNAL pin. The power and RETURN pins are shared with other devices on the engine.

**Component Location:**

The fuel pressure sensor is installed in the fuel rail. Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

**Shop Talk:**

This fault code will become inactive any time the keyswitch is ON and the SIGNAL pin voltage of the ECM is too low. This can be caused by a short circuit to ground on the +5-VDC SUPPLY or SIGNAL wire. This fault will also become active if a device that is powered by the common +5-VDC power supply is shorted to ground. This fault code will become inactive any time the keyswitch is ON and the signal returns to a valid in-range voltage.

Causes for this fault code include:

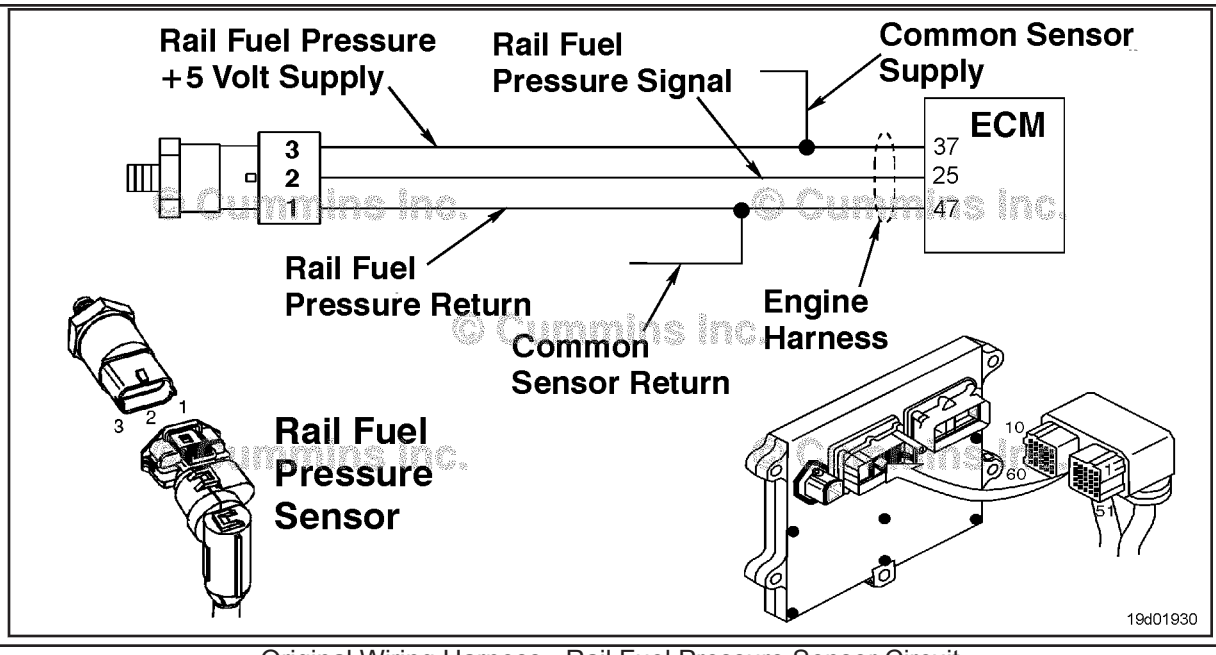
- Engine harness: the SUPPLY or SIGNAL wire is shorted to ground
- Other components: any component connected to the common power supply is shorted to ground
- Damaged sensor
- Damaged ECM.

The sensor return configuration for Euro 4 ISB engines has been changed for automotive wiring harnesses manufactured from February 2012 onward. The new style wiring harnesses can be be identified using the method below:

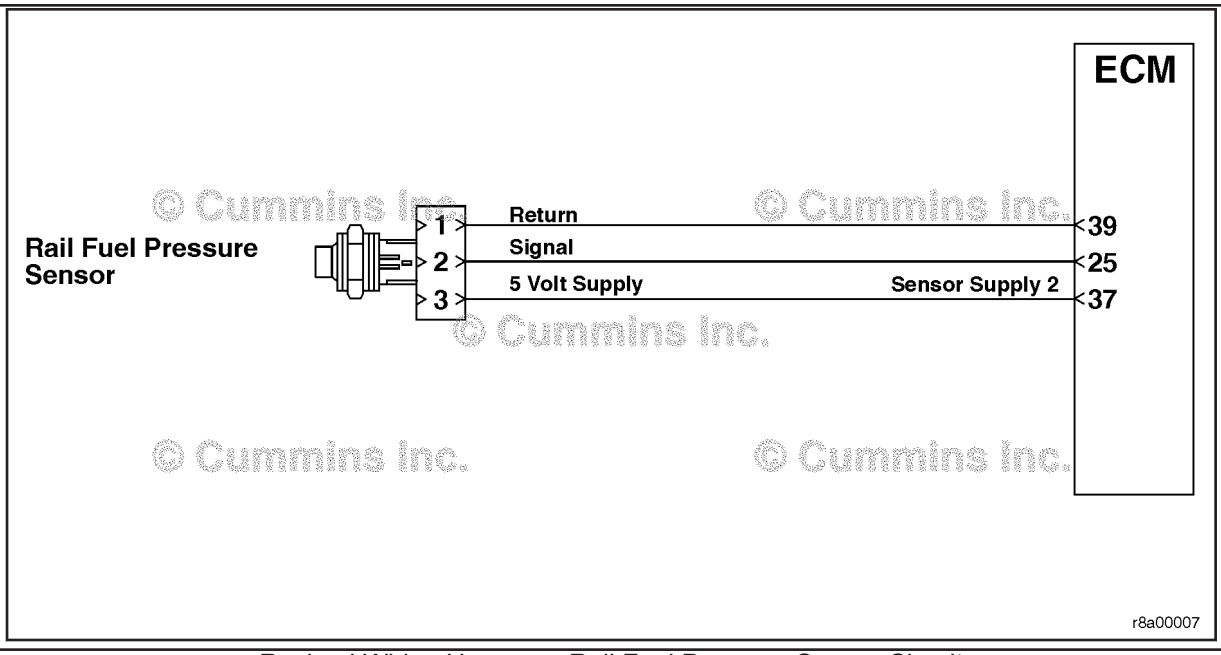
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM pin 47 and the camshaft position sensor RETURN pin
- Use the table below to determine which harness is fitted to the engine.

| Engine Harnesses | | | |
|---|---|---|---|
| From | To | New Harness | Old Harness |
| Intake manifold pressure/ temperature sensor RETURN pin | Camshaft position sensor RETURN pin | Open circuit | Short circut |
| ECM pin 47 | Camshaft position sensor RETURN pin | Open circuit | Short circuit |

NOTE: QSB engines, all C series engines, and all L series engines are **not** affected by this change.




Original Wiring Harness - Rail Fuel Pressure Sensor Circuit




Revised Wiring Harness - Rail Fuel Pressure Sensor Circuit

**Refer to Troubleshooting Fault Code t05-452.**

# FAULT CODE 452 - Injector Metering Rail Number 1 Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3164111 - male Bosch™ test lead, Part Number 3164110 - female Bosch™ test lead, Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead, and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for sensor supply fault codes.** | **Fault Code 187 active?** | |
| **STEP 1B:** | **Check for an inactive fault code.** | **Fault Code 452 is inactive?** | |
| **STEP 2:** | **Check the rail fuel pressure sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the rail fuel pressure sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the sensor supply voltage and return circuit.** | **4.75-VDC to 5.25-VDC?** | |
| **STEP 2C:** | **Check the circuit response.** | **Fault Code 451 active and Fault Code 452 inactive?** | |
| **STEP 2D:** | **Check the fault codes and verify sensor condition.** | **Fault Code 452 is active?** | |
| **STEP 3:** | **Check the engine control module and engine harness.** | | |
| **STEP 3A:** | **Inspect engine control module and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3A-1:** | **Check the sensor supply voltage and return circuit.** | **4.75-VDC to 5.25-VDC?** | |
| **STEP 3A-2:** | **Check for an inactive fault code.** | **Fault Code 452 inactive?** | |
| **STEP 3B:** | **Inspect engine control module and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B-1:** | **Check the engine control module response.** | **Fault Code 451 active and Fault Code 452 inactive?** | |
| **STEP 3B-2:** | **Check for an inactive fault code.** | **Fault Code 452 inactive?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 452 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for sensor supply fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for sensor supply fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 187 active?<br>**YES** | Appropriate troubleshooti ng tree |
| | Fault Code 187 active?<br>**NO** | 1B |

**STEP 1B: Check for an inactive fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic serive tool to read the fault codes. | Fault Code 452 is inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 452 is inactive?<br>**NO** | 2A |

## STEP 2: Check the rail fuel pressure sensor and circuit.

### STEP 2A: Inspect the rail fuel pressure sensor and connector pins.

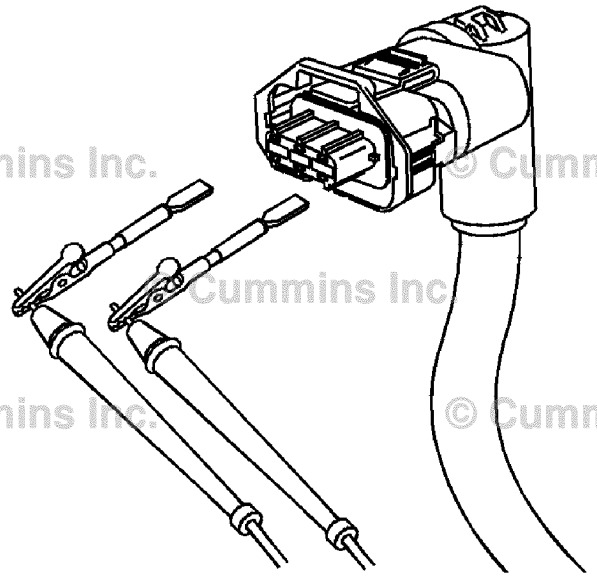
**Condition:**
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and rail fuel pressure sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the supply voltage and return circuit.<br>• Measure the voltage from the rail fuel pressure +5 volt SUPPLY pin to the rail fuel pressure RETURN pin at the sensor connector of the engine harness.<br>Refer to the wiring diagram for connector pin identification. | 4.75-VDC to 5.25-VDC?<br>**YES** | 2C |
| | 4.75-VDC to 5.25-VDC?<br>**NO** | 3A |






**STEP 2C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 451 active and Fault Code 452 inactive?<br>**YES** | 2D |
| | Fault Code 451 active and Fault Code 452 inactive?<br>**NO** | 3B |

**STEP 2D: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF.
- Connect the rail fuel pressure sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 452 is active?<br>**YES**<br>**Repair:**<br>A damaged sensor has been detected.<br>Replace the rail fuel pressure sensor. Refer to Procedure 019-115 in Section 19. | 4A |
| | Fault Code 452 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the engine control module and engine harness.

**STEP 3A: Inspect engine control module and engine harness connector pins.**

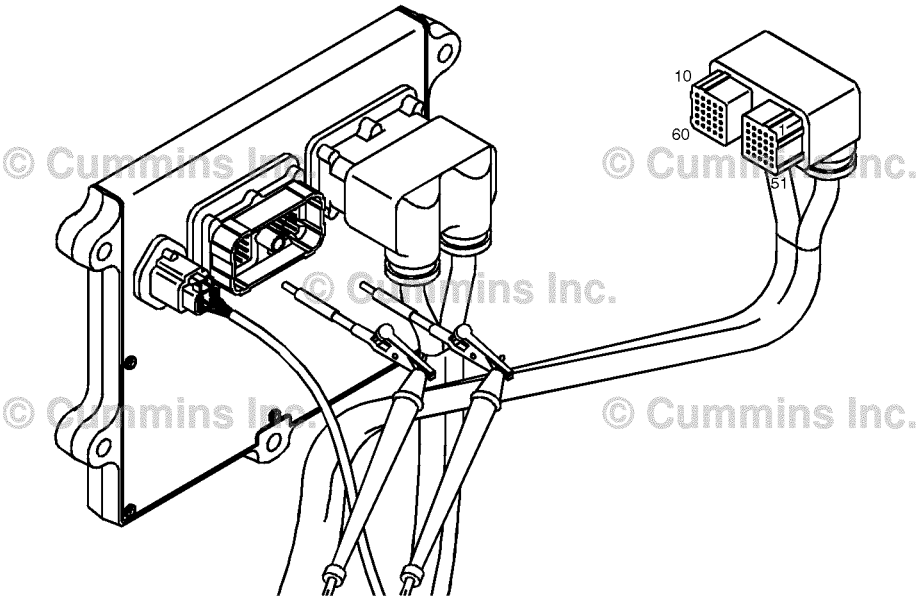
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect theengine harness and engine control module engine connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the engine control module engine connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3A-1 |

**STEP 3A-1: Check the sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the supply voltage and return circuit.<br>• Measure the voltage from the rail fuel pressure +5 volt SUPPLY pin to the rail fuel pressure RETURN pin at the ECM engine connector.<br>Refer to the wiring diagram for connector pin identification. | 4.75-VDC to 5.25-VDC?<br>**YES** | 3A-2 |
| | 4.75-VDC to 5.25-VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



**STEP 3A-2: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 452 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the failure. | 4A |
| | Fault Code 452 inactive?<br>**NO**<br>**Repair:**<br>An open or shorted SUPPLY circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

**STEP 3B: Inspect engine control module and engine harness connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and engine control module engine connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the engine control module engine connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B-1 |

**STEP 3B-1: Check the engine control module response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 451 active and Fault Code 452 inactive?<br>**YES** | 3B-2 |
| | Fault Code 451 active and Fault Code 452 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3B-2: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 452 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the failure. | 4A |
| | Fault Code 452 inactive?<br>**NO**<br>**Repair:**<br>An open return circuit or a pin-to-pin short circuit has been detected on the signal line of the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 452 inactive?<br>**YES** | 4B |
| | Fault Code 452 inactive?<br>**NO** | 1A |

### STEP 4B: Clear the inactive fault codes.

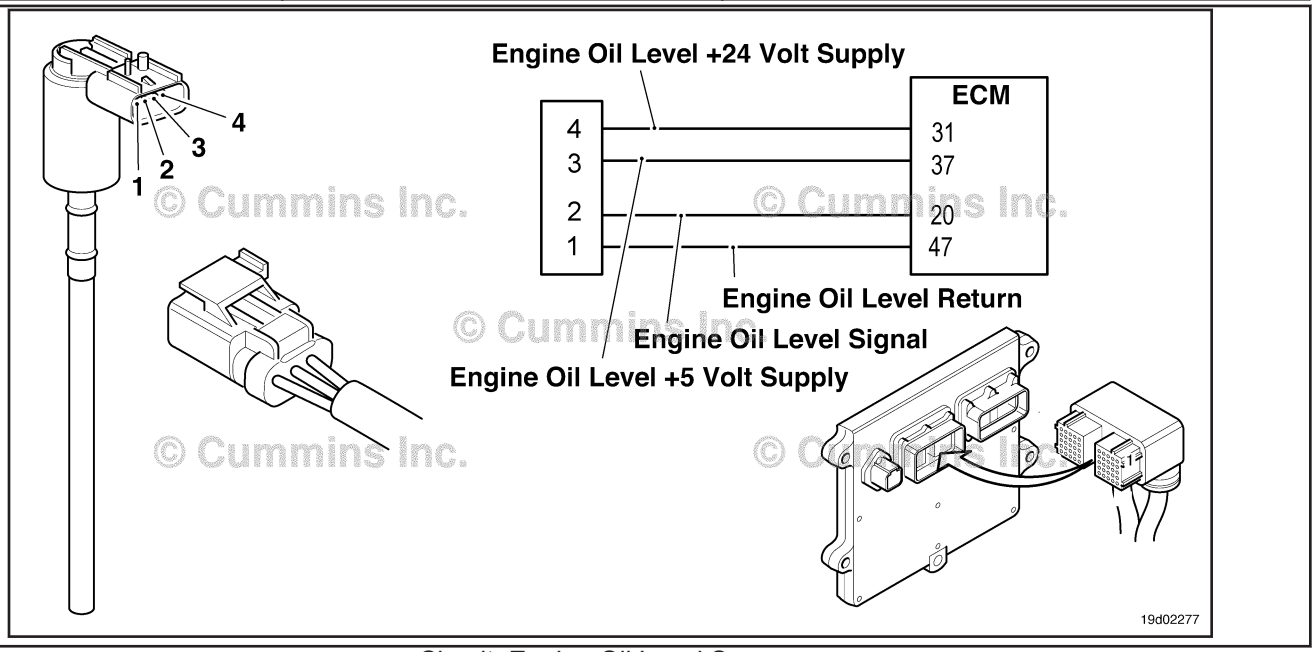
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 471

## Engine Oil Level — Data Valid But Below Normal Operational Range — Least Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 471<br>PID(P), SID(S): P98<br>SPN: 98<br>FMI: 1/17<br>Lamp: Maintenance<br>SRT: | Engine Oil Level — Data Valid But Below Normal Operational Range — Least Severe Level. Low oil level has been detected by the oil level sensor. | The engine may derate. Possible low oil pressure, possible severe engine damage. |




Circuit: Engine Oil Level Sensor.

**Circuit Description:**

An algorithm in the ECM calibration monitors engine oil level while the ECM is keyed on and no engine speed is detected. If the engine oil level falls below a certain threshold, the ECM will activate Fault 471, as well as the maintenance lamp. The maintenance lamp will flash only during a keyon event.

**Component Location:**

The engine oil level sensor is located on the engine oil dipstick, on the air intake side of the engine. 100-002 (Engine Diagrams) in section E for further details on dipstick location.

**Shop Talk:**

If inactive counts of Fault 471 are logged in the ECM, it could be possible that the engine was running or keyed on while tilted at an angle severe enough to cause this fault to be triggered.

Other causes of fault code 471 may include:

- The engine may not have been filled to proper capacity during the most recent oil change
- External engine oil leaks (oil leaking onto the ground)
- Internal engine oil leaks (oil leaking into the fuel system or cooling system)
- High engine oil consumption/power cylinder failure (check for abnormally high blowby when the engine is loaded).

On-Board Diagnostic (OBD) Information:

- The ECM illuminates the appropriate amber or red fault lamp when the diagnostic runs and fails

- The ECM turns off the appropriate fault lamp when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-471

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement:Part Number 3822758 - male Deutsch/AMP/Metri-Pack test leadPart Number 3822917 - female Deutsch/AMP/Metri-Pack test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Read the fault codes** | **Fault Code 471 active?** | |
| **STEP 2:** | **Clear the fault codes.** | | |
| **STEP 2A:** | **Disable the fault codes.** | **Fault Code 471 inactive?** | |
| **STEP 2B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.
- Engine oil temperature near ambient temperature.
- Make sure the vehicle is parked on level ground.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>• Use INSITE™ to read the fault codes. | Fault Code 471 active?<br>**YES**<br>**Repair:**<br>Low engine lubricating oil level has been detected.<br>Add engine lubricating oil to the engine.<br>007-037. | 2A |
| | Fault Code 471 active?<br>**NO** | 2A |

## STEP 2: Clear the fault codes

### STEP 2A: Disable the fault codes.

**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute<br>• Using INSITE™, verify that the fault code is inactive. | Is fault 471 inactive?<br>**YES** | 2B |
| | Is fault 471 inactive?<br>**NO** | 1A |

### STEP 2B: Clear the inactive fault codes.

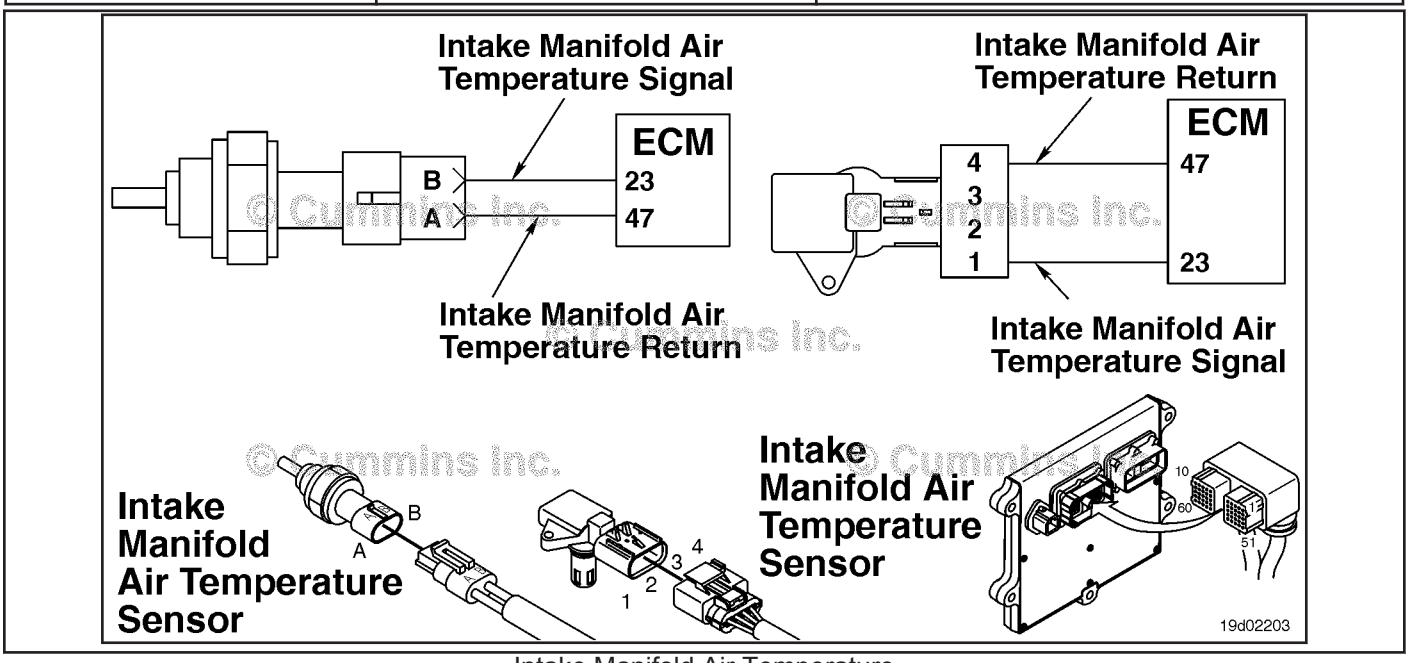
**Condition:**
- Connect all components
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Erase the inactive fault codes using INSITE™. | All fault codes cleared?<br>**YES** | Repair complete. |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps. |

# Fault Code 488

## Intake Manifold 1 Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 488<br>PID(P), SID(S): P105<br>SPN: 105<br>FMI: 0/16<br>Lamp: Amber<br>SRT: | Intake Manifold 1 Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level. Intake manifold air temperature signal indicates intake manifold air temperature above engine protection warning limit. | Progressive power derate increasing in severity from time of alert. |




Intake Manifold Air Temperature

**Circuit Description:**

The intake manifold air temperature sensor monitors intake manifold air temperature and passes information to the electronic control module (ECM) through the engine harness. If the intake manifold air temperature becomes too high, it will cause a derate condition.

**Component Location:**

The intake manifold air temperature sensor is located in the air intake manifold. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

The intake manifold air temperature sensor measures the temperature of the charge-air as it passes through the intake manifold. Possible causes of this fault code include:

- Plugged charge air cooler fins
- Restricted airflow through the charge air cooler
- Undersized charge air cooler
- High turbocharger compressor outlet temperature.

## Refer to Troubleshooting Fault Code t05-488

## TROUBLESHOOTING SUMMARY

| STEPS | SPECIFICATIONS | SRT CODE |
|---|---|---|
| **STEP 1: Check the fault codes.** | | |
| **STEP 1A: Check for Fault Code488.** | **Active or inactive counts of Fault Codes 488?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 488.**

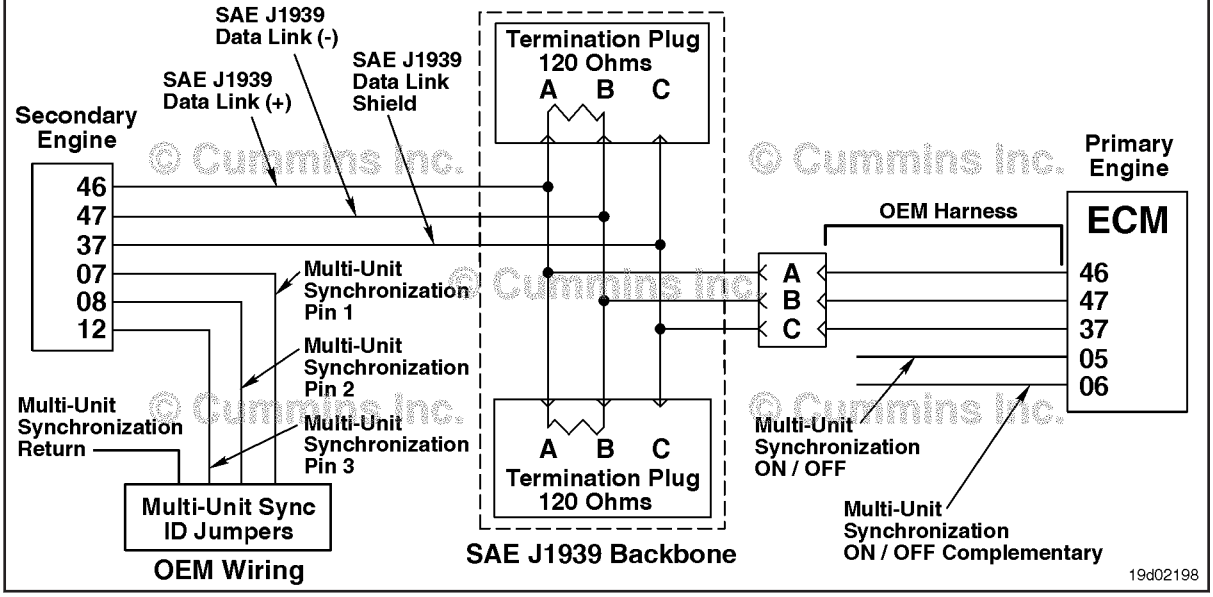
**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or inactive counts of Fault Codes 488?<br>**YES**<br>**Repair:**<br>Refer to the Intake Manifold Air Temperature Above Specification symptom tree. | Appropriate troubleshooting symptom tree |
| | Active or inactive counts of Fault Codes 488?<br>**NO** | Repair complete |

# Fault Code 497

## Multiple Unit Synchronization Switch - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 497<br>PID(P), SID(S): S114<br>SPN: 1137<br>FMI: 2<br>Lamp: Amber<br>SRT: | Multiple Unit Synchronization Switch - Data Erratic, Intermittent, or Incorrect. Multi-Unit synchronous ON/OFF switch and Multi-Unit synchronous complimentary ON/OFF switch have different values in the ECM. | Multi-Unit synchronization feature is disabled. |




Multi-Unit Synchronization

**Circuit Description:**

The multi-unit synchronization feature uses an ON/OFF switch and a complementary switch. The complementary switch is used by the ECM to determine the type of coupling (hard or soft) to use between multiple engines when multi-unit synchronization switch is engaged.

**Component Location:**

The multi-unit synchronization switch is mounted by the OEM. Refer to the OEM manual for specific switch location.

**Shop Talk:**

The multi-unit synchronization feature allows two or more engines to be controlled by a single throttle signal and run at a similar speed. There is three engine configurations available with this feature: soft-coupled, hard-coupled, and soft-coupled marine.

The soft-coupled configuration has all secondary engines in parallel with each other. The primary engine outputs a throttle signal to all secondary engines. This setup allows all engines to remain running if a secondary engine stops

The hard-coupled configuration has the primary and all secondary engines in series with each other. The primary engine outputs a throttle signal, which is received by the first secondary engine. This secondary engine then outputs the throttle signal the next secondary engine in the series. This process repeats until the primary engine receives the throttle signal.

The soft-coupled mare configuration has all secondary engines in parallel with each other. The primary engine outputs a throttle signal on the J1939 datalink to all secondary engines.

## Refer to Troubleshooting Fault Code t05-497

# FAULT CODE 497 - Multiple Unit Synchronization Switch - Data Erratic, Intermittent, or Incorrect
## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for an inactive fault code. | Fault Code 497 is inactive? | |
| **STEP 2:** | **Check the OEM switch circuit.** | | |
| STEP 2A: | Inspect the OEM switch. | Dirty or damaged pins? | |
| STEP 2B: | Check the OEM switch. | Is the multi-unit synchronization switch and the multi-unit synchronization complementary switch operating correctly? | |
| **STEP 3:** | **Check the ECM and OEM harness.** | | |
| STEP 3A: | Inspect ECM and OEM harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check for a pin-to-pin short circuit in the OEM harness. | Greater than 100K ohms? | |
| STEP 3C: | Check for a pin short circuit to ground. | Greater than 100K ohms? | |
| STEP 3D: | Check for an open circuit in the OEM harness. | Less than 10 ohms? | |
| STEP 3E: | Check for an inactive fault code. | Fault Code 497 inactive? | |
| **STEP 4:** | **Clear the fault code.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 497 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All faults cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

#### STEP 1A: Check for an inactive fault code.

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 497 is inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 497 is inactive?<br>**NO** | 2A |

### STEP 2: Check the OEM switch circuit.

#### STEP 2A: Inspect the OEM switch.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the multi-unit synchronization switch from the OEM harness.
- Disconnect the multi-unit synchronization complementary switch fro the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the multi-unit synchronization switch, multi-unit synchronization complementary switch, and OEM harness connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the switch or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the OEM switch.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the multi-unit synchronization switch from the OEM harness.
- Disconnect the multi-unit synchronization complementary switch from the harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the functionality of the multi-unit synchronization switch and the multi-unit synchronization complementary switch.<br>Use the following procedure for troubleshooting information for the multi-unit synchronization switch. Refer to Procedure 019-270 in Section 19. | Is the multi-unit synchronization switch and the multi-unit synchronization complementary switch operating correctly?<br>**YES** | 3A |
| | Is the multi-unit synchronization switch and the multi-unit synchronization complementary switch operating correctly?<br>**NO**<br>**Repair:**<br>Replace the multi-unit synchronization switch or the multi-unit synchronization complementary switch. Refer to the OEM service manual. | 4A |

## STEP 3: Check the ECM and OEM harness.

**STEP 3A: Inspect ECM and OEM harness connector pins.**

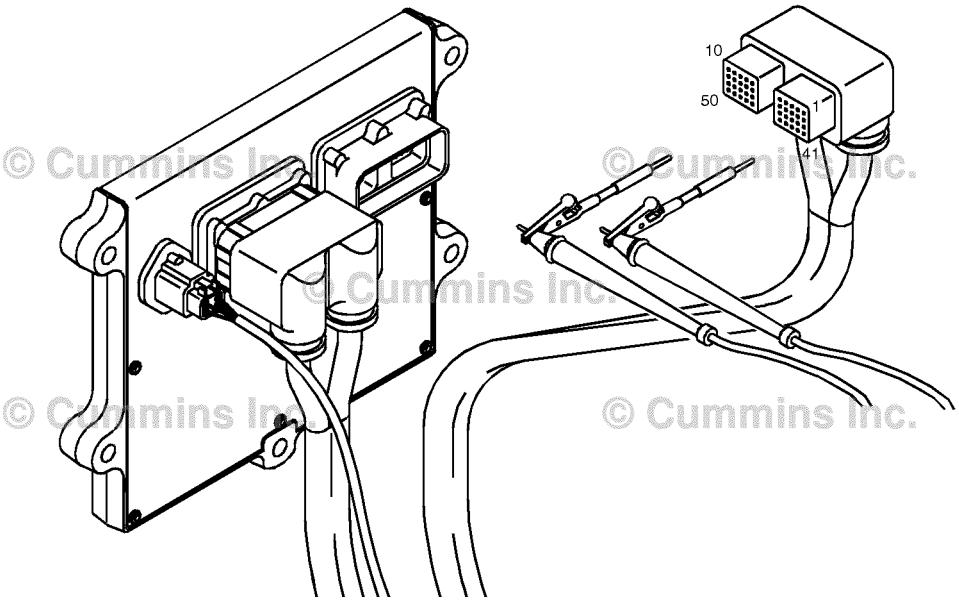
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible.<br>Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the multi-unit synchronization switch from the harness.

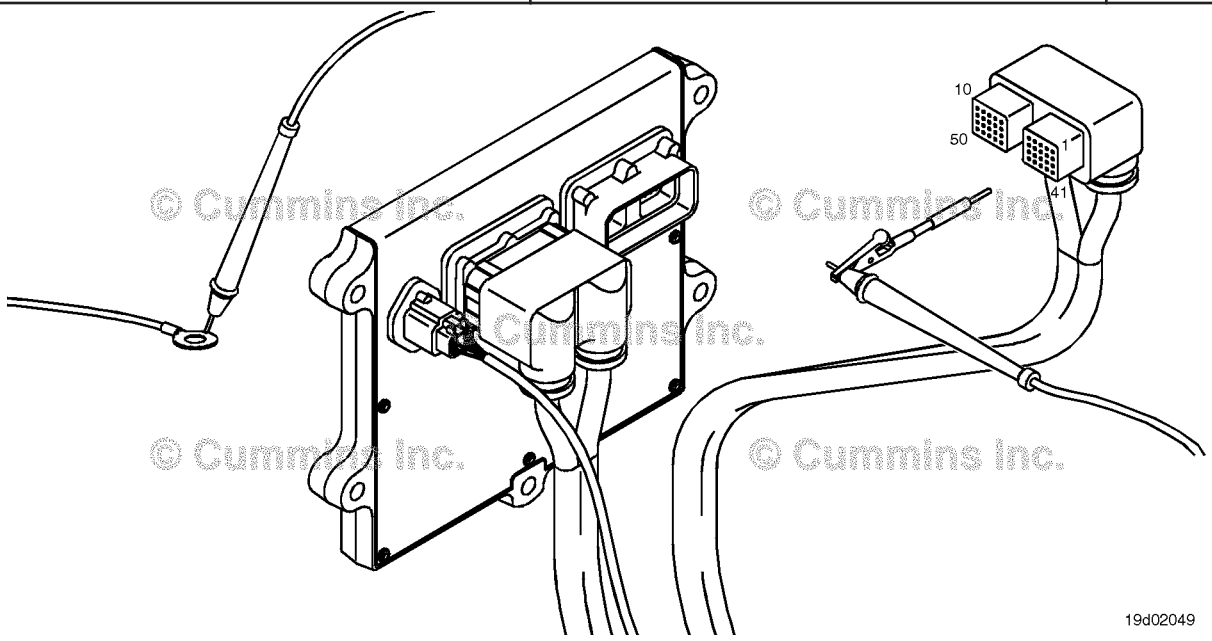
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the multi-unit synchronization switch pin in the OEM harness ECM connector and all other pins in the OEM connector.<br>• Measure the resistance between the multi-unit synchronization complimentary switch pin in the OEM harness ECM connector and all other pins in the OEM connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3C |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a pin short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from ECM.
- Disconnect the multi-unit synchronization switch from the OEM harness.
- Disconnect the multi-unit synchronization complimentary switch from the OEM harness.

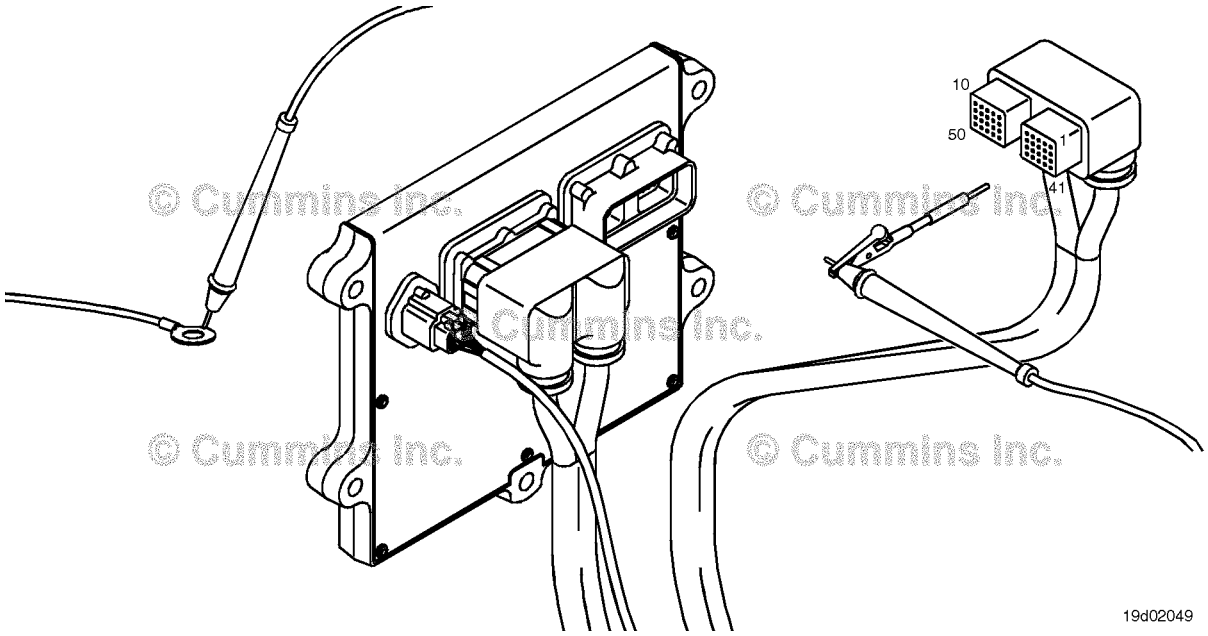
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-ground short.<br>• Measure the resistance between the multi-unit synchronization switch pin in the OEM harness ECM connector and ground.<br>• Measure the resistance between the multi-unit synchronization complementary switch pin in the OEM harness ECM connector and ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3D |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-ground short circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check for an open circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the multi-unit synchronization complimentary switch from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-ground short.<br>• Measure the resistance between the OEM harness ECM connector multi-unit synchronization switch pin and the OEM harness multi-unit synchronization switch pin.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3E |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open circuit has been detectd in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool, read the fault codes. | Fault Code 497 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and reinstallation of the connector corrected the fault. | 4A |
| | Fault Code 497 inactive?<br>**NO**<br>**Repair:**<br>Refer to OEM service manual. | 4A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Use INSITE™ electronic service tool and verify that the fault code is inactive. | Fault Code 497 inactive?<br>**YES** | 4B |
| | Fautl Code 497 inactive?<br>**NO** | 1A |

**STEP 4B: Cleqar the inactive fault codes.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All faults cleared?<br>**YES** | Repair complete. |
| | All fault cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 498

## Engine Oil Level Sensor Circuit - Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 498<br>PID(P), SID(S): P98<br>SPN: 98<br>FMI: 3<br>Lamp: Amber<br>SRT: | Engine Oil Level Sensor Circuit - Voltage Above Normal or Shorted to High Source. The engine oil level sensor has detected an internal failure. | Oil level sensor operation will be disabled. |

**Circuit Description:**

The oil level sensor will monitor the oil fluid level in the oil pan at key-on. The oil level sensor will **not** monitor the oil level after the engine is started or when the engine speed is greater than 0 rpm. During the engine key-on, if the oil level sensor detects a critical low oil level, then the amber CHECK ENGINE light will blink for 30 seconds and a fault code will be logged. If an operator observes a blinking amber CHECK ENGINE light at key-on, the operator **must** check the engine oil level with the manual dipstick.

The oil level sensor provides the electronic control module (ECM) with a pulse width modulated (PWM) signal. Within this signal, the oil level sensor transmits the engine oil level reading, oil temperature, and fault code information from the oil level sensor.

**Component Location:**

The oil level sensor is located on the left side of the engine on the front oil dipstick port. Refer to Procedure 100-002 for a detailed component location view.

**Conditions for Running the Diagnostics:**

This diagnostic runs continuously when the keyswitch is in the ON position or when the engine is running.

**Conditions for Setting the Fault Codes:**

The oil level sensor has detected an internal short or open circuit.

**Action Taken When the Fault Code is Active:**

- The ECM illuminates the amber CHECK ENGINE light immediately when the diagnostic runs and fails.
- The oil level sensor operation will be disabled.

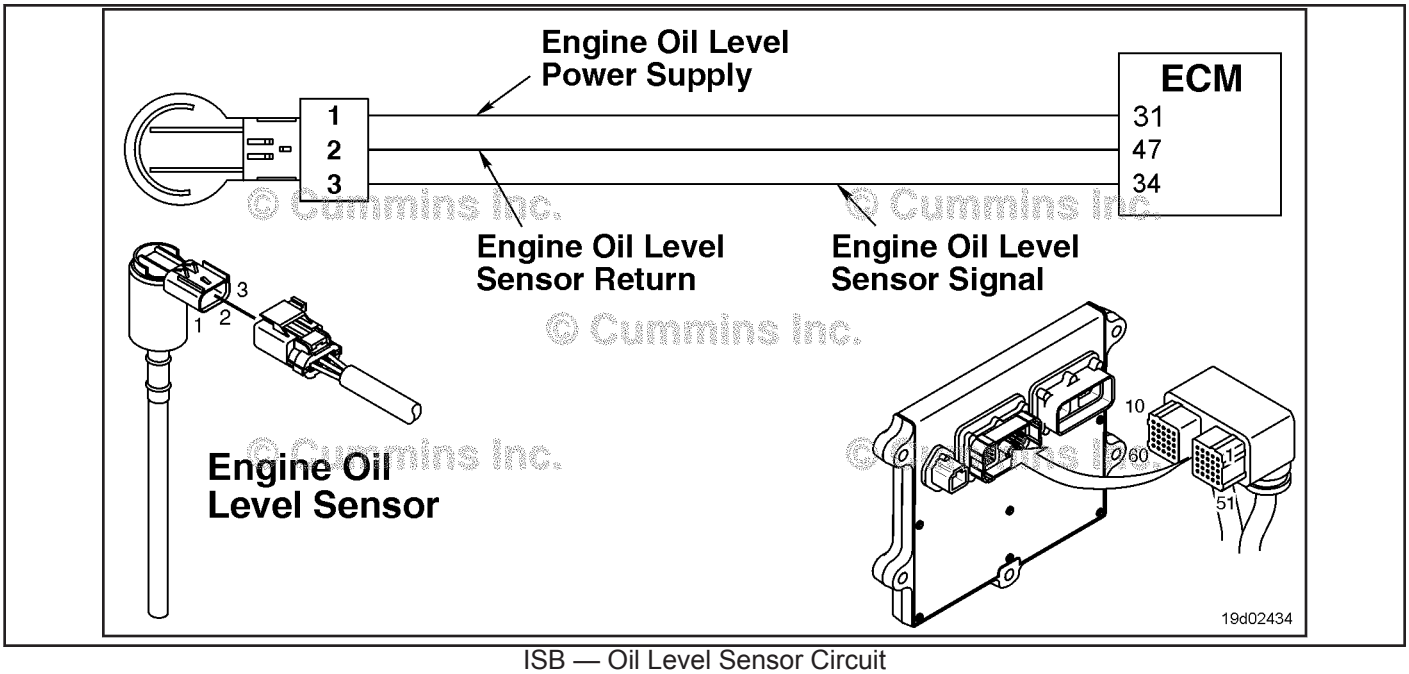
**Conditions for Clearing the Fault Code:**

The ECM will turn off the amber CHECK ENGINE light and enable oil level sensor operation immediately after a valid PWM signal is received from the oil level sensor.

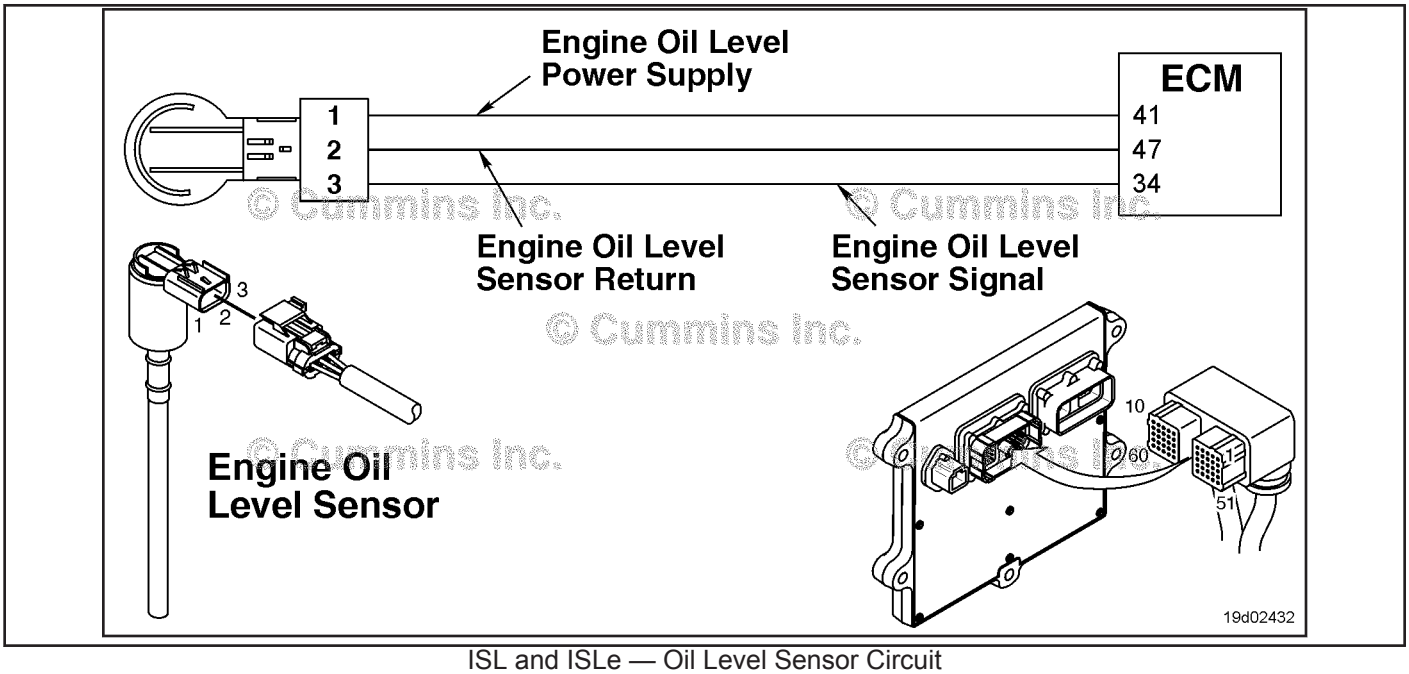
**Shop Talk:**

Possible causes of this fault code include:

- Open or short circuit internally to the oil level sensor
- A malfunctioning oil level sensor.




ISB — Oil Level Sensor Circuit




ISL and ISLe — Oil Level Sensor Circuit

**Refer to Troubleshooting Fault Code t05-498**

# FAULT CODE 498 - Engine Oil Level Sensor Circuit - Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for inactive fault codes.** | **Fault Code 498 inactive?** | |
| **STEP 2:** | **Check the oil level sensor.** | | |
| **STEP 2A:** | **Inspect the oil level sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Inspect the oil level sensor.** | **Damage found to the oil level sensor body or connector?** | |
| **STEP 2C:** | **Check the fault codes.** | **Fault Code 498 active?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 498 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for inactive fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for inactive fault codes.<br>• Use INSITE™ electronic service tool to read the fault code. | Fault Code 498 inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 498 inactive?<br>**NO** | 2A |

## STEP 2: Check the oil level sensor.

### STEP 2A: Inspect the oil level sensor and connector pins.

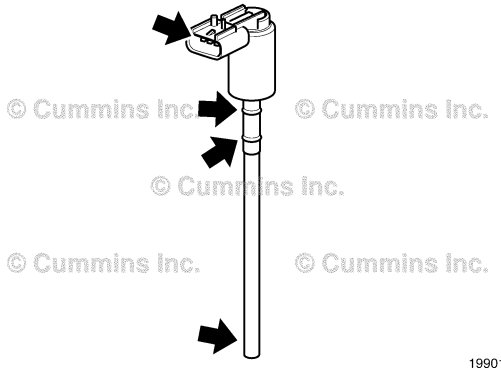
**Condition:**
- Turn keyswitch OFF.
- Disconnect the oil level

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and oil level sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible.<br>Refer to Procedure 019-043 in Section 19. | 3A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

### STEP 2B: Inspect the oil level sensor.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the oil level sensor from the engine harness.
- Remove the engine oil level sensor. Refer to Procedure 019-056 in Section 19.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Visually inspect the lubricating oil level sensor for damage to the wiring or body.<br>• Inspect the o-rings for damage. | Damage found to the oil level sensor body or connector?<br>**YES**<br>**Repair:**<br>Replace the oil level sensor. Refer to Procedure 019-056 in Section 19. | 3A |
| | Damage found to the oil level sensor body or connector?<br>**NO** | 2C |



**STEP 2C: Check the fault codes.**

**Condition:**
- Turn keyswitch OFF.
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 498 active?<br>**YES**<br>**Repair:**<br>Replace the oil level sensor. Refer to Procedure 019-056 in Section 19. | 3A |
| | Fault Code 498 active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 3A |

## STEP 3: Clear the fault code.

**STEP 3A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 498 inactive?<br>**YES** | 3B |
| | Fault Code 498 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all the steps have been completed and checked again. | 1A |

**STEP 3B: Clear the inactive fault codes.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting charts |

# Fault Code 499

## Engine Oil Level Sensor Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 499<br>PID(P), SID(S): P98<br>SPN: 98<br>FMI: 4<br>Lamp: Amber<br>SRT: | Engine Oil Level Sensor Circuit - Voltage Below Normal or Shorted to Low Source. The engine oil level sensor has detected an internal failure. | Oil level sensor operation will be disabled. |

**Circuit Description:**

The oil level sensor will monitor the oil fluid level in the oil pan at key-on. The oil level sensor will **not** monitor the oil level after the engine is started or when the engine speed is greater than 0 rpm. During the engine key-on, if the oil level sensor detects a critical low oil level, then the amber CHECK ENGINE light will blink for 30 seconds and a fault code will be logged. If an operator observes a blinking amber CHECK ENGINE light at key-on, the operator **must** check the engine oil level with the manual dipstick.

The oil level sensor provides the electronic control module (ECM) with a pulse width modulated (PWM) signal. Within this signal, the oil level sensor transmits the engine oil level reading, oil temperature, and fault code information from the oil level sensor.

**Component Location:**

The oil level sensor is located on the left side of the engine on the front oil dipstick port. Refer to Procedure 100-002 for a detailed component location view.

**Conditions for Running the Diagnostics:**

This diagnostic runs continuously when the keyswitch is in the ON position or when the engine is running.

**Conditions for Setting the Fault Codes:**

The oil level sensor has detected an internal short or open circuit.

**Action Taken When the Fault Code is Active:**

- The ECM illuminates the amber CHECK ENGINE light immediately when the diagnostic runs and fails.
- The oil level sensor operation will be disabled.

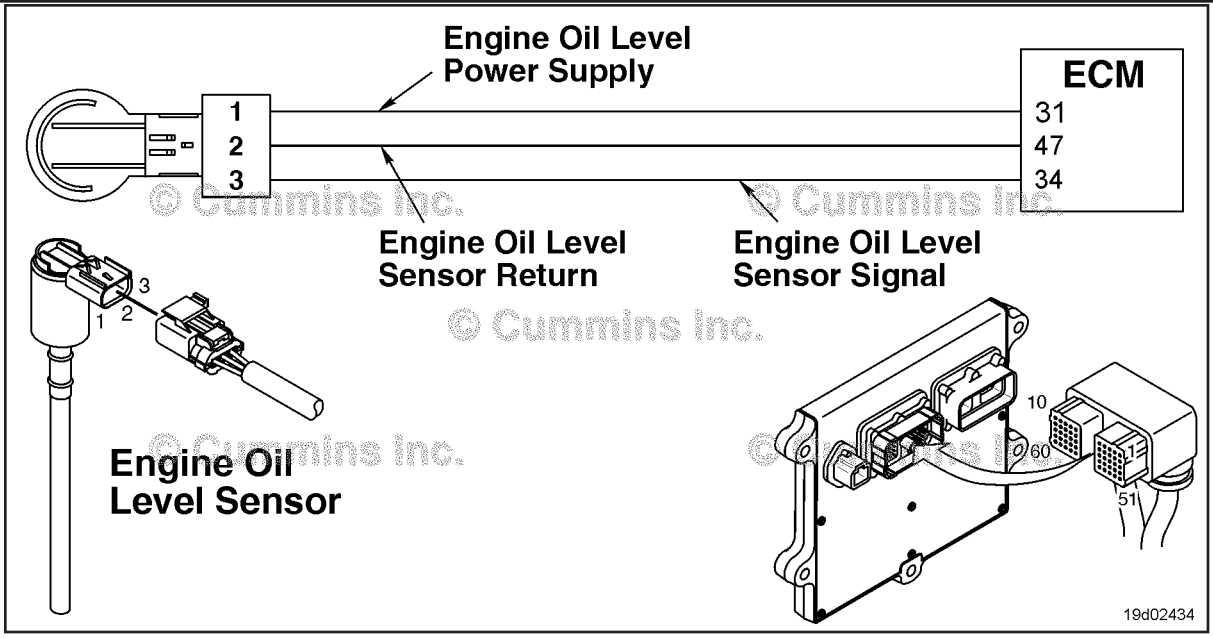
**Conditions for Clearing the Fault Code:**

The ECM will turn off the amber CHECK ENGINE light and enable oil level sensor operation immediately after a valid PWM signal is received from the oil level sensor.

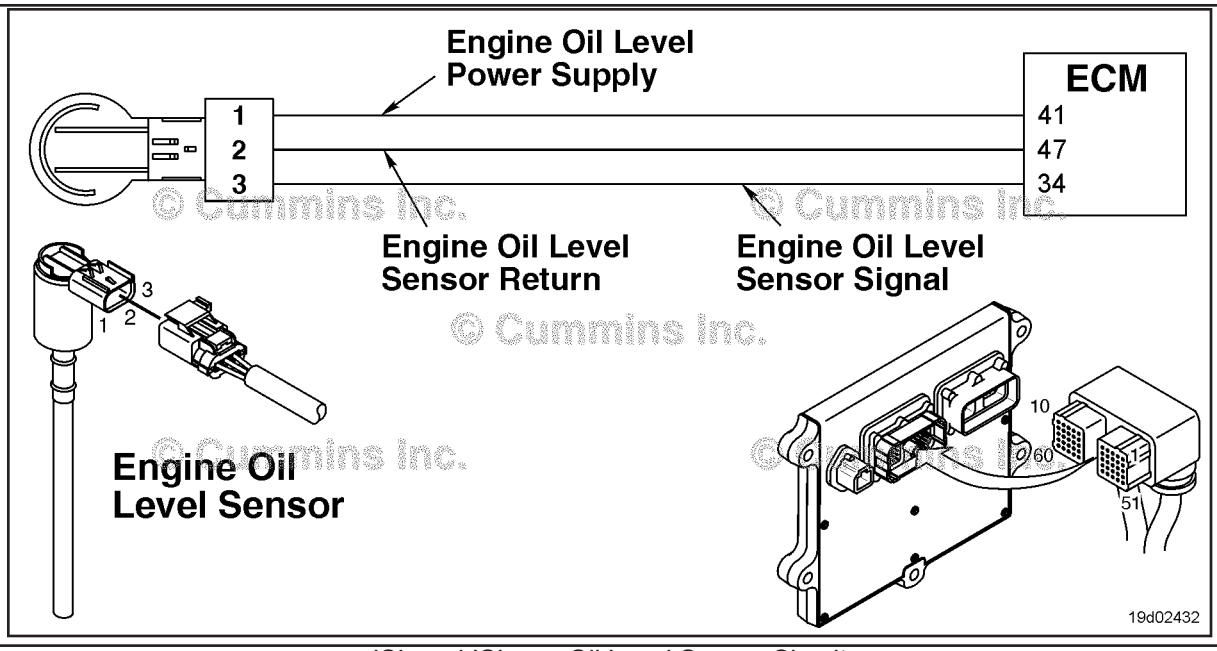
**Shop Talk:**

Possible causes of this fault code include:

- Open or short circuit internally to the oil level sensor
- A failed oil level sensor
- An open circuit in the oil level sensor circuit.




ISB — Oil Level Sensor Circuit




ISL and ISLe — Oil Level Sensor Circuit

**Refer to Troubleshooting Fault Code t05-499**

# FAULT CODE 499 - Engine Oil Level Sensor Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for inactive fault codes. | Fault Code 499 inactive? | |
| **STEP 2:** | **Check the oil level sensor.** | | |
| STEP 2A: | Inspect the oil level sensor and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Inspect the oil level sensor. | Damage found to the oil level sensor body or connector? | |
| STEP 2C: | Check the voltage to the engine oil level sensor. | Voltage is equal to battery voltage? | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| STEP 3A: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 3A-1: | Check the engine oil level sensor voltage at the ECM | Voltage is greater than or equal to battery voltage? | |
| STEP 3A-2: | Check the battery supply voltage to the ECM | Voltage is equal to battery voltage? | |
| STEP 3B: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 3B-1: | Check for an open in the engine harness. | Resistance less than 10 ohms? | |
| STEP 3B-2: | Check for a short circuit in the engine harness. | Resistance greater than 100k ohms? | |
| STEP 3B-3: | Check for a short circuit to ground in the engine harness. | Resistance greater than 100k ohms? | |
| STEP 3B-4: | Check the fault codes. | Fault code 499 is active? | |
| **STEP 4:** | **Clear the fault code.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 499 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for inactive fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for inactive fault codes.<br>• Use INSITE™ electronic service tool to read the fault code. | Fault Code 499 inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 499 inactive?<br>**NO** | 2A |

### STEP 2: Check the oil level sensor.

**STEP 2A: Inspect the oil level sensor and connector pins.**

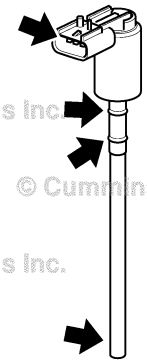
**Condition:**
- Turn keyswitch OFF.
- Disconnect the oil level

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and oil level sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 3A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Inspect the oil level sensor.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the oil level sensor from the engine harness.
- Remove the engine oil level sensor. Refer to Procedure 019-056 in Section 19.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Visually inspect the lubricating oil level sensor for damage to the wiring or body.<br>• Inspect the o-rings for damage. | Damage found to the oil level sensor body or connector?<br>**YES**<br>**Repair:**<br>Replace the oil level sensor. Refer to Procedure 019-056 in Section 19. | 3A |
| | Damage found to the oil level sensor body or connector?<br>**NO** | 2C |





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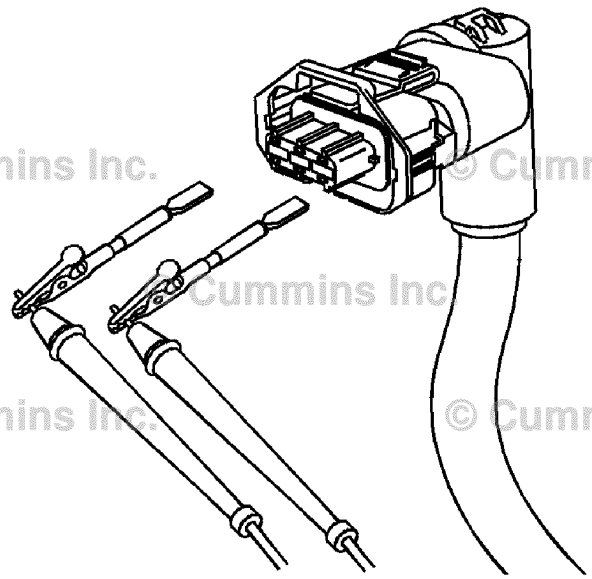
**STEP 2C: Check the voltage to the engine oil level sensor.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the oil level sensor from the engine harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the power supply and return circuit to the engine oil sensor.<br>• Measure the voltage between engine oil level supply circuit and the engine oil level return circuit at the engine harness connector of the oil level sensor.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Voltage is equal to battery voltage?<br>**YES** | 3B |
| | Voltage is equal to battery voltage?<br>**NO** | 3A |



## STEP 3: Check the ECM and engine harness.

### STEP 3A: Inspect ECM and engine harness connector pins.

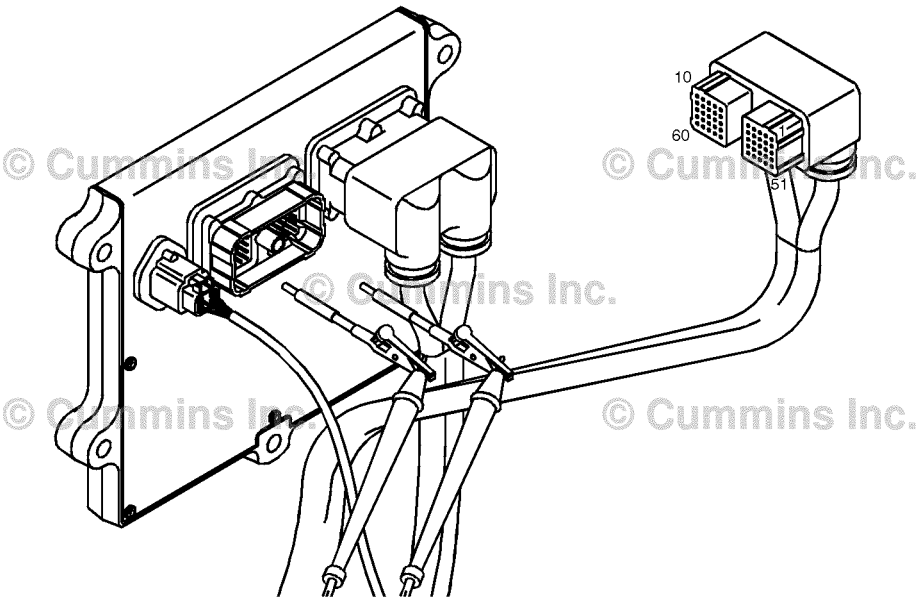
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3A-1 |

**STEP 3A-1: Check the engine oil level sensor voltage at the ECM.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.

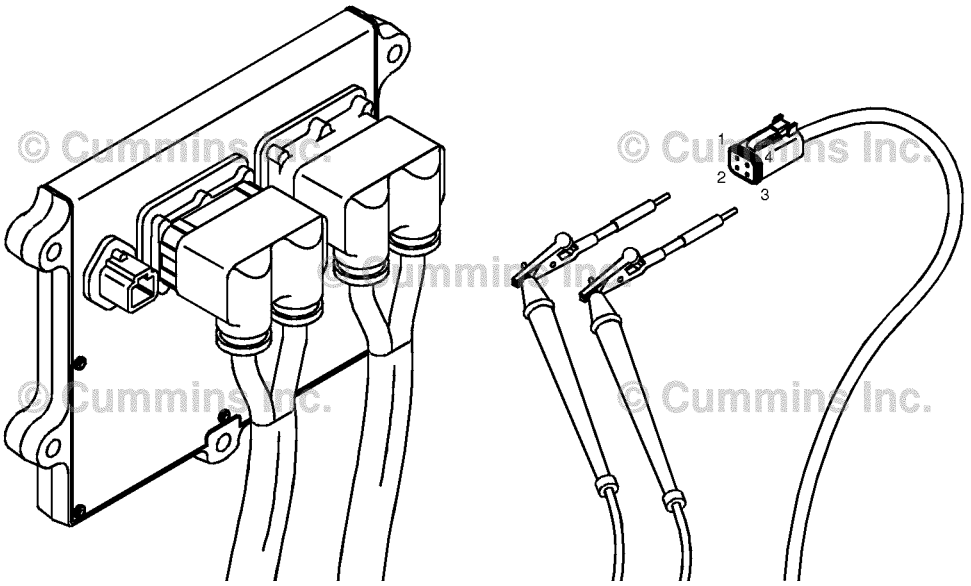
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the power supply and return circuit to the engine oil level sensor.<br>• Measure the voltage between engine oil level sensor power supply circuit and engine oil level sensor return circuit at the ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Voltage is greater than or equal to battery voltage?<br>**YES**<br>**Repair:**<br>An open circuit in the engine oil level sensor power supply or return circuit has been detected in the engine harness.<br>Replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |
| | Voltage is greater than or equal to battery voltage?<br>**NO** | 3A-2 |



**STEP 3A-2: Check the battery supply voltage to the ECM.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness from the ECM.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the power supply and return circuit to the ECM.<br>• Measure the voltage between the ECM power supply circuit and the ECM return circuit at the OEM power harness connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Voltage is equal to battery voltage?<br>**YES**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |
| | Voltage is equal to battery voltage?<br>**NO**<br>**Repair:**<br>Low voltage has been detected at the ECM power connector.<br>Check the battery voltage and the OEM wiring between the battery and ECM power harness connector. | 4A |



**STEP 3B: Inspect ECM and engine harness connector pins.**

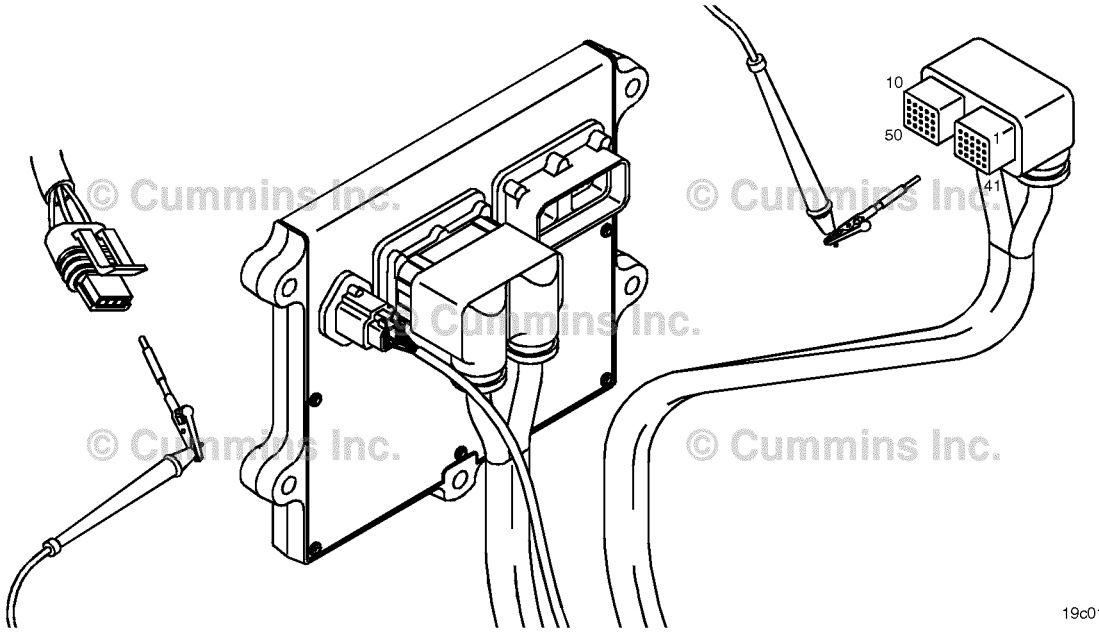
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B-1 |

**STEP 3B-1: Check for an open in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine oil level sensor from the engine harness.
- Disconnect the engine harness from the ECM.

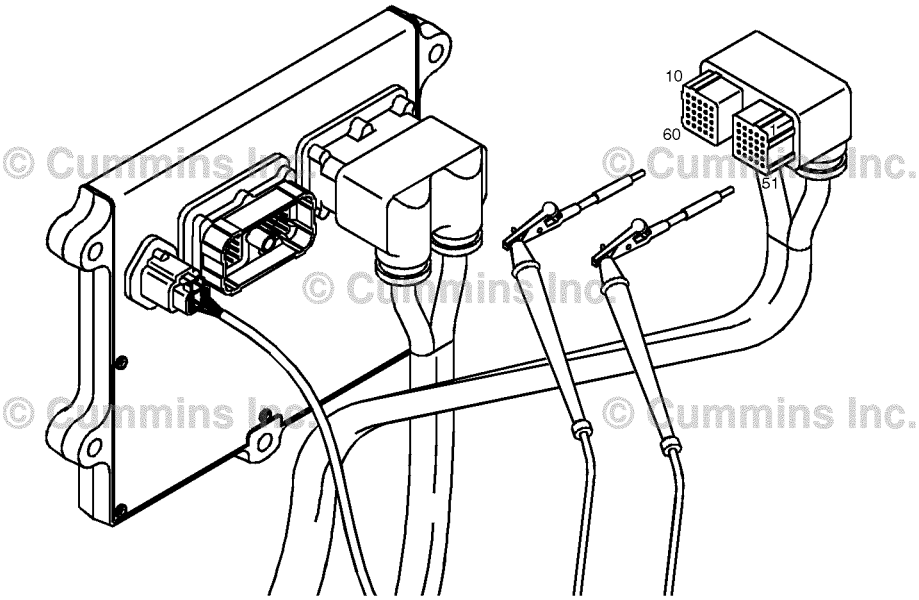
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit in the engine harness.<br>• Measure the resistance between the engine oil level sensor signal wire at the engine oil level sensor engine harness connector and the engine oil level sensor signal wire at the ECM engine harness connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Resistance less than 10 ohms?<br>**YES** | 3B-2 |
| | Resistance less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open circuit has been detected in the engine harness.<br>Replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3B-2: Check for a short circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine oil level sensor from the engine harness.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit in the engine harness.<br>• Measure the resistance between the engine oil level sensor wire at the ECM engine harness connector and all other pins in the connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Resistance greater than 100k ohms?<br>**YES** | 3B-3 |
| | Resistance greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A short circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



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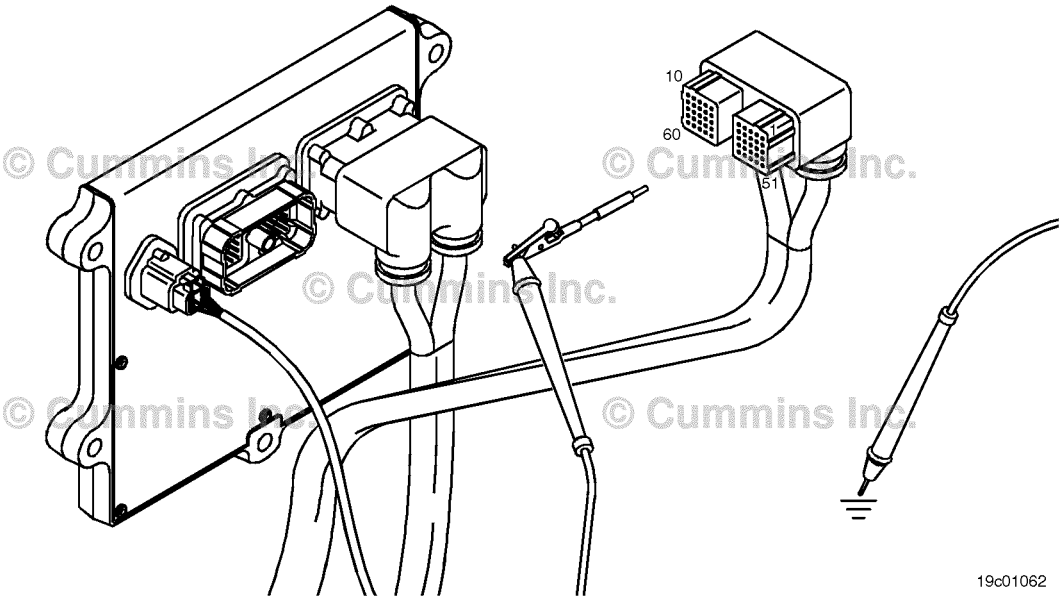
**STEP 3B-3: Check for a short circuit to ground in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine oil level sensor from the engine harness.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground in the engine harness.<br>• Measure the resistance between the engine oil level sensor wire at the ECM engine harness connector and ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Resistance greater than 100k ohms?<br>**YES** | 3B-4 |
| | Resistance greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A short circuit to ground has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3B-4: Check the fault codes.**

**Condition:**
- Turn keyswitch OFF.
- Connect the engine harness to the ECM.
- Connect the engine oil level sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool read the fault codes. | Fault code 499 is active?<br>**YES**<br>**Repair:**<br>The engine oil level sensor is shorted internally.<br>Replace the engine oil level sensor. Refer to Procedure 019-056 in Section 19. | 4A |
| | Fault code 499 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 499 inactive?<br>**YES** | 4B |
| | Fault Code 499 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

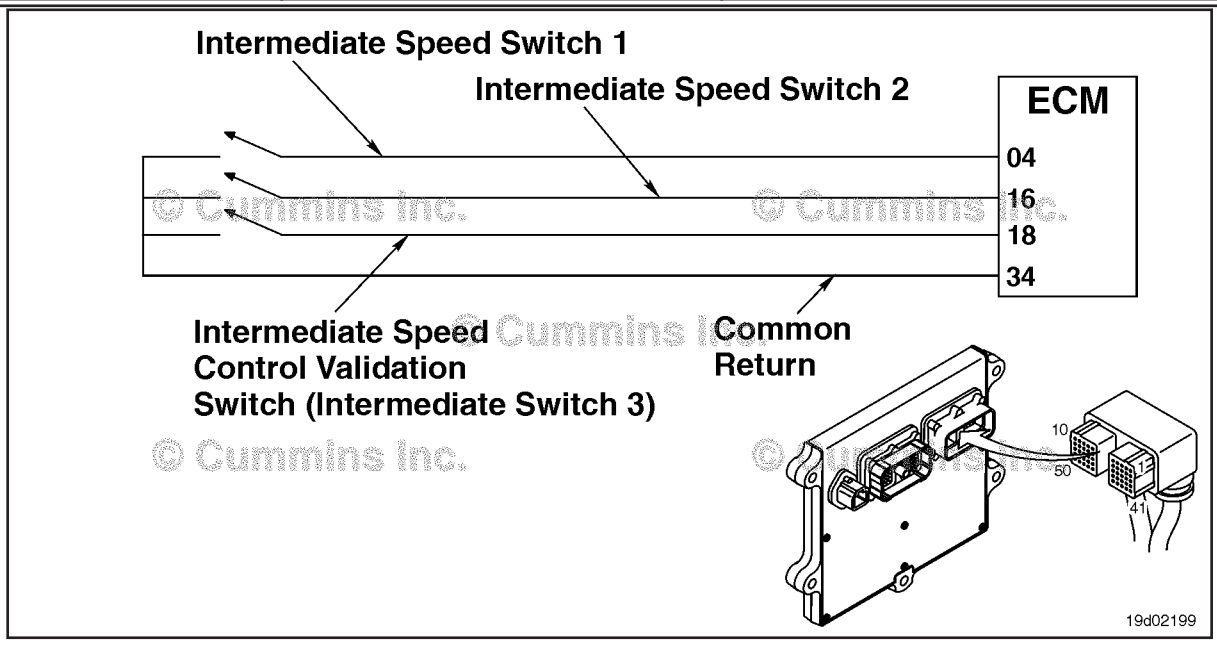
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting charts |

# Fault Code 523

## Auxiliary Intermediate (PTO) Speed Switch Validation - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 523<br>PID(P), SID(S): P089<br>SPN: 611<br>FMI: 2<br>Lamp: Amber<br>SRT: | Auxiliary Intermediate (PTO) Speed Switch Validation - Data Erratic, Intermittent, or Incorrect. The position of the intermediate speed control switch 1 does **not** match the position of the intermediate speed control validation switch. | Intermediate speed control switch may **not** operate correctly. |




Intermediate Speed Control Switch Configuration

**Circuit Description:**

Up to three Intermediate Speed Control set speeds (1,2,3) can be selected, depending on OEM availability. A multi-position switch or three individual switches must be installed by the OEM to support this feature.

**Component Location:**

The Intermediate Speed Control (PTO) switch is mounted by the OEM, usually inside the cab of the vehicle or externally as a speed control switch.

**Shop Talk:**

When activated by switch or hand throttle, the Intermediate Speed Control feature governs engine speed to the corresponding preset speed. The three preset speeds can be adjusted with an increment or decrement switch but can not exceed the low or high idle governor engine speed limits.

If Intermediate Speed Control validation is being use, Intermediate Speed Control Switched Set Speed Three will be used as the validation input.

## Refer to Troubleshooting Fault Code t05-523

# FAULT CODE 523 - Auxiliary Intermediate Power Take-Off (PTO) Speed Switch Validation - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for an inactive fault code. | Fault Code 523 is inactive? | |
| **STEP 2:** | **Check the original equipment manufacturer (OEM) switch circuit.** | | |
| STEP 2A: | Inspect the OEM switch. | Dirty or damaged pins? | |
| STEP 2B: | Check the intermediate speed control switch 1. | Intermediate speed control switch 1 is operating correctly? | |
| STEP 2C: | Check the intermediate speed control validation switch. | Intermediate speed control validation switch operating correctly? | |
| **STEP 3:** | **Check the engine control module (ECM) and OEM harness.** | | |
| STEP 3A: | Inspect ECM and OEM harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check for a pin-to-pin short circuit in the OEM harness. | Greater than 100K ohms? | |
| STEP 3C: | Check for a pin short circuit to ground. | Greater than 100K ohms? | |
| STEP 3D: | Check for an open circuit in the OEM harness. | Less than 10 ohms? | |
| STEP 3E: | Check for an inactive fault code. | Fault Code 523 inactive? | |
| **STEP 4:** | **Clear the fault code.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 523 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All faults cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

#### STEP 1A: Check for an inactive fault code.

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use electronic service tool to read the fault codes. | Fault Code 523 is inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 523 is inactive?<br>**NO** | 2A |

### STEP 2: Check the OEM switch circuit.

#### STEP 2A: Inspect the OEM switch.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the intermediate speed control switch 1 from the OEM harness.
- Disconnect the intermediate speed control validation switch from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the intermediate speed control switch 1, intermediate speed control validation switch, and OEM harness connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the switch or harness connector.<br>Clean the connector and pins.<br>Repair the damage harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the intermediate speed control switch 1.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the intermediate speed control switch 1 for the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the functionality of the intermediate speed control switch.<br>Use the following procedure for troubleshooting information for the intermediate speed control switch. Refer to Procedure 019-107 in Section 19. | Intermediate speed control switch 1 is operating correctly?<br>**YES** | 2C |
| | Intermediate speed control switch 1 is operating correctly?<br>**NO**<br>**Repair:**<br>Replace the intermediate speed control switch. Refer to the OEM service manual. | 4A |

**STEP 2C: Check the intermediate speed control validation switch.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the intermediate speed control validation switch from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the functionality of the intermediate speed control validation switch.<br>Use the following procedure for troubleshooting information for the intermediate speed control switch. Refer to Procedure 019-107 in Section 19. | Intermediate speed control switch 1 is operating correctly?<br>**YES** | 3A |
| | Intermediate speed control switch 1 is operating correctly?<br>**NO**<br>**Repair:**<br>Replace the intermediate speed control switch. Refer to the OEM service manual. | 4A |

## STEP 3: Check the ECM and OEM harness.

### STEP 3A: Inspect ECM and OEM harness connector pins.

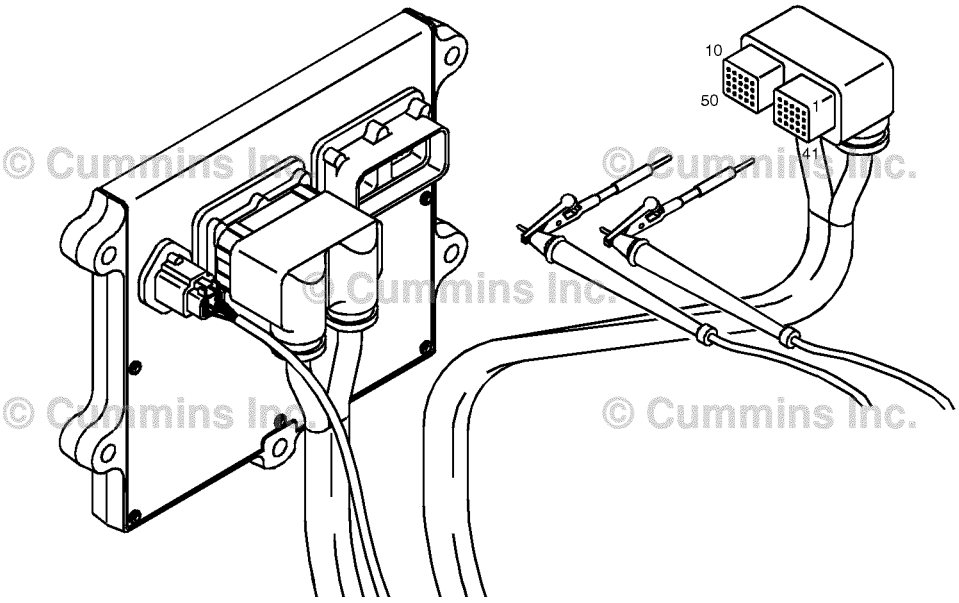
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the intermediate speed control switch 1 from the OEM harness.
- Disconnect the intermediate speed control validation switch from the OEM harness.

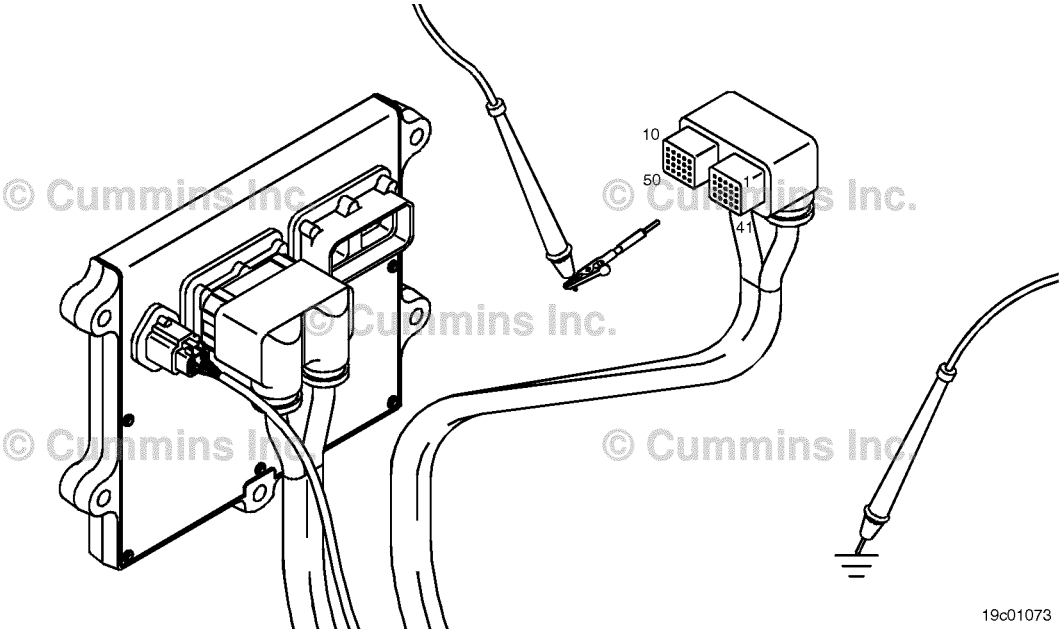
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the intermediate speed control switch 1 pin in the OEM harness ECM connector and all other pins in the OEM connector.<br>• Measure the resistance between the intermediate speed control validation switch pin in the OEM harness ECM connector and all other pins in the OEM connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3D |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a pin short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the intermediate speed control switch 1 from the OEM harness.
- Disconnect the intermediate speed control validation switch from the OEM harness.

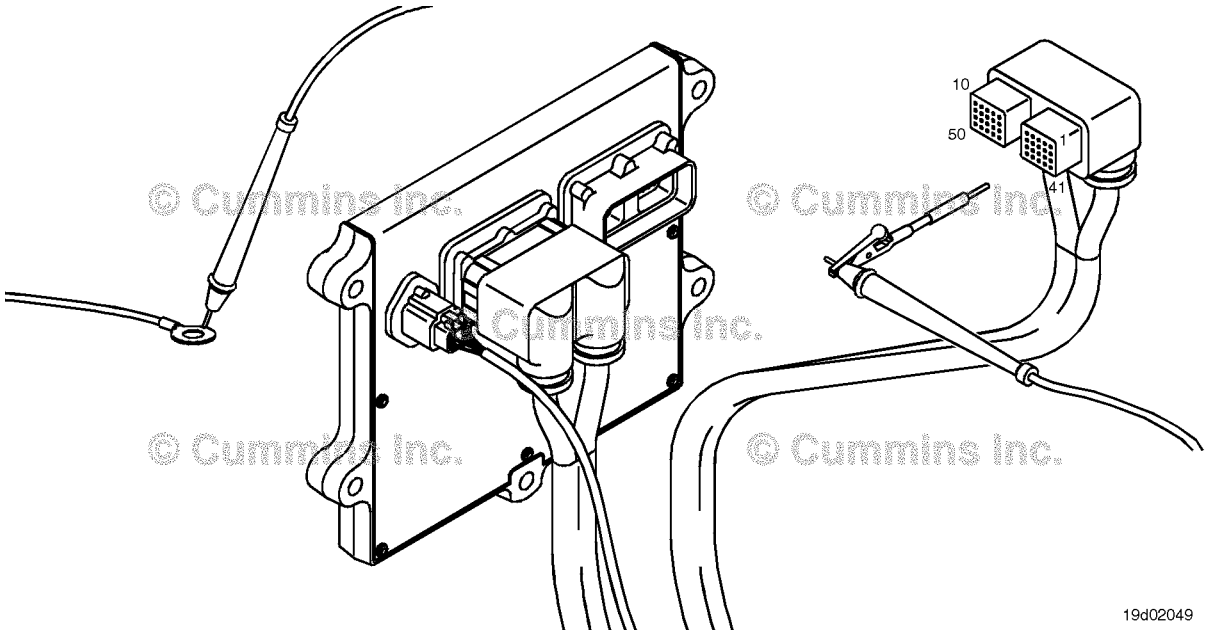
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-ground short.<br>• Measure the resistance between the intermediate speed control switch 1 pin in the OEM harness ECM connector and ground.<br>• Measure the resistance between the intermediated speed control validation switch pin in the OEM harness ECM connector and ground.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3E |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-ground short circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check for an open circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the intermediate speed control switch 1 from the OEM harness.
- Disconnect the intermediate speed control validation switch from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the OEM harness ECM connector intermediate speed control switch 1 pin and the OEM harness intermediate speed control switch 1 pin.<br>• Measure the resistance between the OEM harness ECM connector intermediated speed control validation pin and the OEM harness intermediated speed control validation switch pin.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3F |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>Engine specific condition/action text.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 523 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and reinstallation of the connector corrected the fault. | 4A |
| | Fault Code 523 inactive?<br>**NO**<br>**Repair:**<br>Refer to OEM service manual. | 4A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 523 inactive?<br>**YES** | 4B |
| | Fault Code 523 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

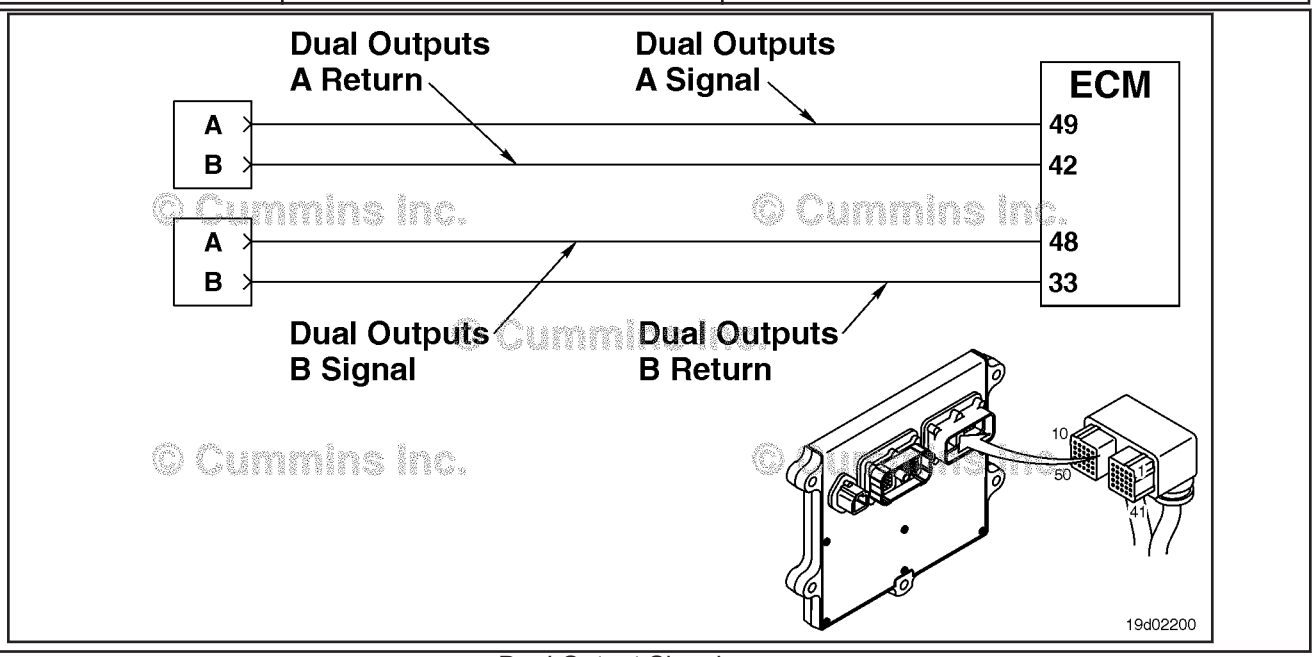
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool .

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault code.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All faults cleared?<br>**YES** | Repair complete. |
| | All faults cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 527

## Auxiliary Input/Output 2 Circuit Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 527<br>PID(P), SID(S): S154<br>SPN: 702<br>FMI: 3<br>Lamp: Amber<br>SRT: | Auxiliary Input/Output 2 Circuit Voltage Above Normal or Shorted to High Source. High signal voltage or open circuit has been detected at the auxiliary input and output 2 circuit. | None on performance |




Dual Output Signal

**Circuit Description:**

The electronic control module (ECM) provides a signal to the OEM output control solenoid to turn the OEM supplied accessory on and off. The OEM output control circuit varies by OEM. Certain OEM's may use a solenoid return that is wired to the ECM or may use a return that goes to engine block or chassis ground.

**Component Location:**

The OEM out solenoid location varies by OEM. Refer to the appropriate OEM service literature to determine the location.

**Shop Talk:**

The ECM monitors the voltage level on this circuit. When the ECM commands the OEM output signal low, it expects the voltage level to be approximately zero volts. If it detects a high voltage, this fault is recorded. If Fault Code 527 is still active after completing the following troubleshooting steps, consult the OEM service literature for procedures to check the OEM output device for an open circuit or short to ground. Possible causes of this fault include:

- Open circuit in the engine harness or OEM output control solenoid
- Short circuit to voltage source in the OEM harness
- Failed ECM.

## Refer to Troubleshooting Fault Code t05-527

# FAULT CODE 527 - Auxiliary Input/Output 2 Circuit Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes** | | |
| STEP 1A: | Check for an inactive fault code. | Fault Code 527 is inactive? | |
| **STEP 2:** | **Check the OEM output control solenoid and circuit.** | | |
| STEP 2A: | Inspect the OEM output control solenoid and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check for an open circuit in the OEM output control solenoid. | Less than 100 ohms? | |
| STEP 2C: | Check the OEM output control solenoid diagnostic supply voltage, supply line and return circuit. | Greater the 3.75-VDC? | |
| STEP 2D: | Check for an open circuit in the OEM output control solenoid circuit. | Less than 10 ohms? | |
| **STEP 3:** | **Check the ECM and OEM harness.** | | |
| STEP 3A: | Inspect ECM and OEM harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check for an open circuit in the OEM output control signal circuit. | Less than 10 ohms? | |
| STEP 3C: | Check for a pin to pin short circuit in the OEM harness. | Greater than 100K ohms? | |
| STEP 3D: | Check for an inactive fault code. | Fault Code 527 inactive? | |
| **STEP 4:** | **Clear the fault code.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 527 Inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All faults cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

#### STEP 1A: Check for an inactive fault code.

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 527 is inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 527 is inactive?<br>**NO** | 2A |

### STEP 2: Check the OEM output control solenoid and circuit.

#### STEP 2A: Inspect the OEM output control solenoid and connector pins.

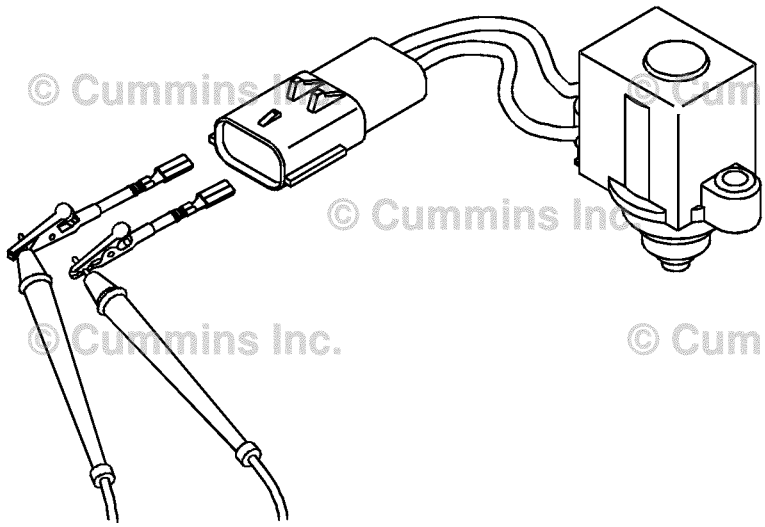
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM output control solenoid from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM output control harness and OEM output control solenoid connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check for an open circuit in the OEM output control solenoid.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM output control solenoid from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check OEM output control solenoid resistance.<br>• Measure the resistance between the OEM output control solenoid SIGNAL pin and the OEM output control solenoid RETURN pin at the OEM output control solenoid connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification. | Less than 100 ohms?<br>**YES** | 2C |
| | Less than 100 ohms?<br>**NO**<br>**Repair:**<br>An open circuit in the OEM output control solenoid has been detected.<br>Replace the OEM output control solenoid Refer to the OEM service manual. | 4A |

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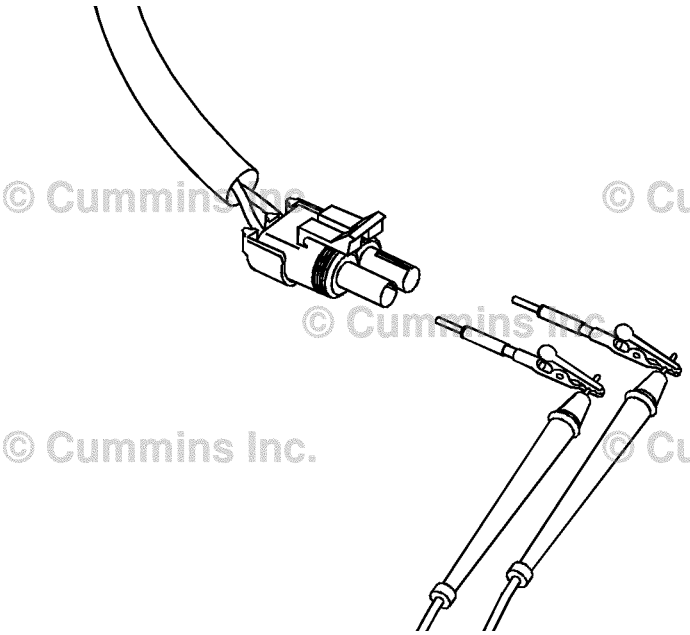
**STEP 2C: Check the OEM output control solenoid diagnostic supply voltage, supply line and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM output control solenoid from the OEM harness.
- Turn keyswitch ON.

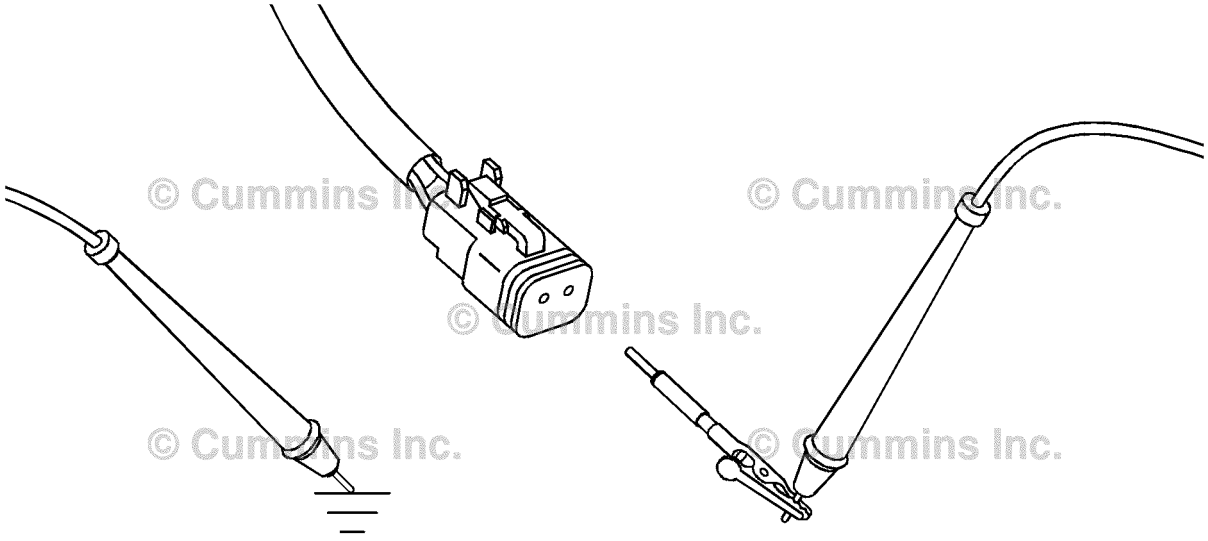
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the OEM output control solenoid diagnostic supply voltage and retrun circuit.<br>• Measure the voltage between the OEM output control solenoid SIGNAL pin and the OEM output control solenoid RETURN pin at the OEM output control solenoid connector of the OEM harness. | Greater than 3.75-VDC?<br>**YES** | 3C |
| | Greater the 3.75-VDC?<br>**NO** | 2D |



**STEP 2D: Check for an open circuit in the OEM output control solenoid circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM output control solenoid from the OEM output control harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the OEM output control solenoid RETURN pin in the engine harness and ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3A |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open circuit on the RETURN wire has been detected. Refer to the OEM circuit diagram or wiring diagram for RETURN wire configuration.<br>If the RETURN is wired to the ECM, repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.<br>If the RETURN wire is grounded to the chassis or engine block ground, repair the source of the failed connection.<br>Clean, repair, or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 3: Check the ECM and OEM harness.

### STEP 3A: Inspect ECM and OEM harness connector pins.

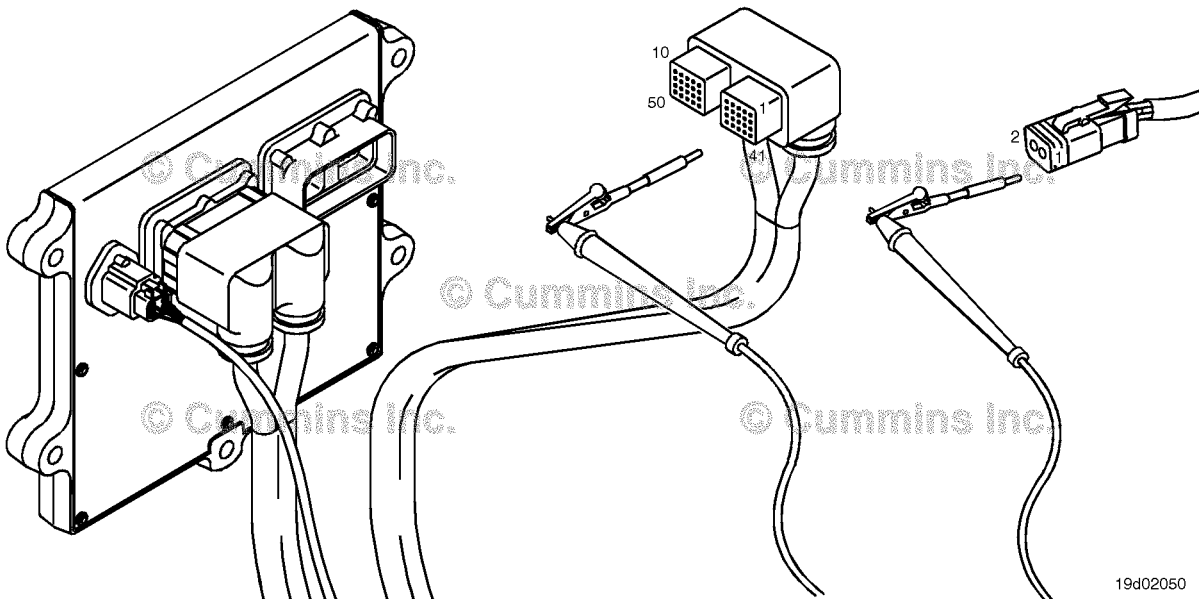
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the OEM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for an open circuit in the OEM output control signal circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the OEM output control solenoid from the OEM harness.

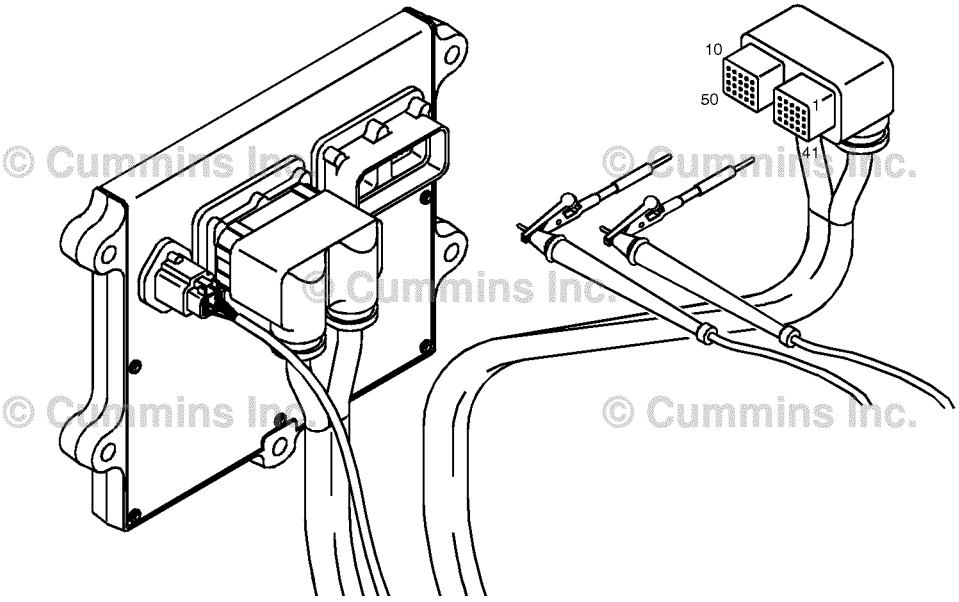
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the OEM harness ECM OEM output control solenoid SIGNAL pin and the OEM harness OEM output control solenoid connector SIGNAL pin.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohm?<br>**YES** | 3C |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open OEM control output solenoid SIGNAL circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the OEM output control solenoid from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the OEM output control solenoid SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3D |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the OEM output control solenoid SIGNAL line has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault code 527 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and reinstallation of the connector corrected the fault. | 4A |
| | Fault Code 527 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 527 inactive?<br>**YES** | 4B |
| | Fault Code 527 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

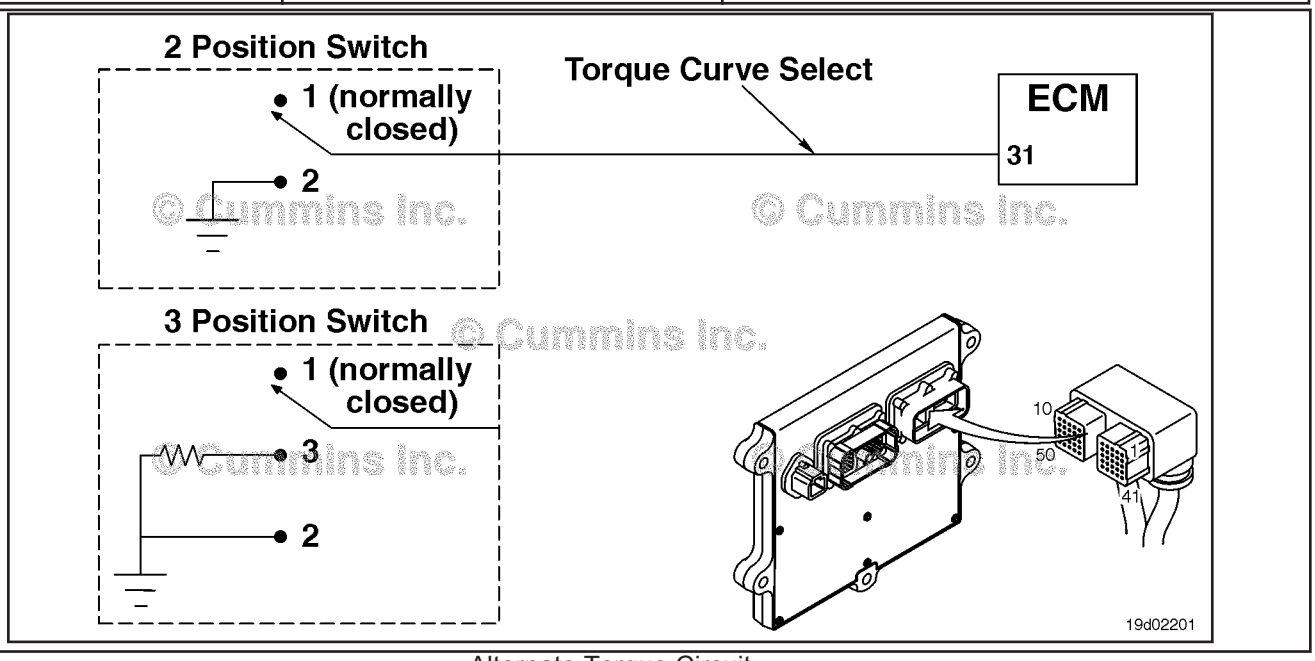
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All faults cleared?<br>**YES** | Repair complete. |
| | All faults cleared?<br>**NO** | Appropriate troubleshooting steps. |

# Fault Code 528

## Auxiliary Alternate Torque Validation Switch - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 528<br>PID(P), SID(S): P093<br>SPN: 093<br>FMI: 2<br>Lamp: Amber<br>SRT: | Auxiliary Alternate Torque Validation Switch - Data Erratic, Intermittent, or Incorrect. An error has been detected in the alternate torque switch circuit. | Torque curve setting defaults to default curve. |



Alternate Torque Circuit

**Circuit Description:**

The torque curve switch circuit allows the operator to select from up to three preprogrammed torque curves using a two- or three-position switch, depending on which the original equipment manufacturer (OEM) has provided.

**Component Location:**

The location of the torque curve switch circuit varies with each OEM and equipment model. Refer to the OEM manual.

**Shop Talk:**

The switch can be monitored for proper operation in INSITE™ electronic service tool. If the switch is changing state correctly on the service tool, then the problem does **not** lie in the switch circuit. The three position-switch has three states:

- Position 1 - open
- Position 2 - closed
- Position 3 - 1500 ohm resistance

The two position-switch has two states:

- Position 1 - open
- Position 2 - closed

## Refer to Troubleshooting Fault Code t05-528

# FAULT CODE 528 - Auxiliary Alternate Torque Validation Switch - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an inactive fault code.** | **Fault Code 528 is inactive?** | |
| **STEP 2:** | **Check the OEM switch circuit.** | | |
| **STEP 2A:** | **Inspect the OEM switch.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the OEM switch.** | **Alternate torque switch operating correctly?** | |
| **STEP 3:** | **Check the ECM and OEM harness.** | | |
| **STEP 3A:** | **Inspect ECM and OEM harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check for a pin-to-pin short circuit in the OEM harness.** | **Greater than 100K ohms?** | |
| **STEP 3C:** | **Check for a pin short circuit to ground.** | **Greater than 100K ohms?** | |
| **STEP 3D:** | **Check for an open circuit in the OEM harness.** | **Less than 10 ohms?** | |
| **STEP 3E:** | **Check for an inactive fault code.** | **Fault Code 528 inactive?** | |
| **STEP 4:** | **Clear the fault code.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 528 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an inactive fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 528 is inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault code 528 is inactive?<br>**NO** | 2A |

## STEP 2: Check the OEM switch circuit.

### STEP 2A: Inspect the OEM switch.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the Alternate Torque Switch from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the Alternater Torque Switch and OEM harness connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the switch or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

### STEP 2B: Check the OEM switch.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the Alternate Torque Switch from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the functionality of the Alternate Torque Switch.<br><br>Use the following procedure for troubleshooting information for the alternate torque switch. Refer to Procedure 019-136 in Section 19. | Alternate torque switch operating correctly?<br>**YES** | 3A |
| | Alternate torque switch operating correctly?<br>**NO**<br>**Repair:**<br>Replace the alternate torque switch. Refer to OEM service manual. | 4A |

## STEP 3: Check the ECM and OEM harness.

### STEP 3A: Inspect ECM and OEM harness connector pins.

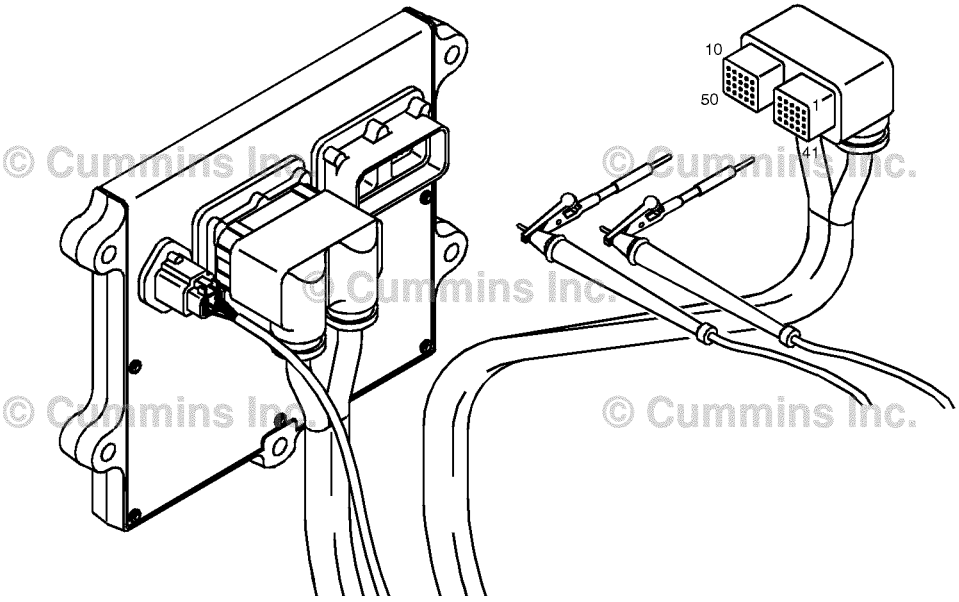
**Condition:**
- Turn keyswitch OFF,
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damage pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness connector or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the alternate torque switch from the OEM harness.

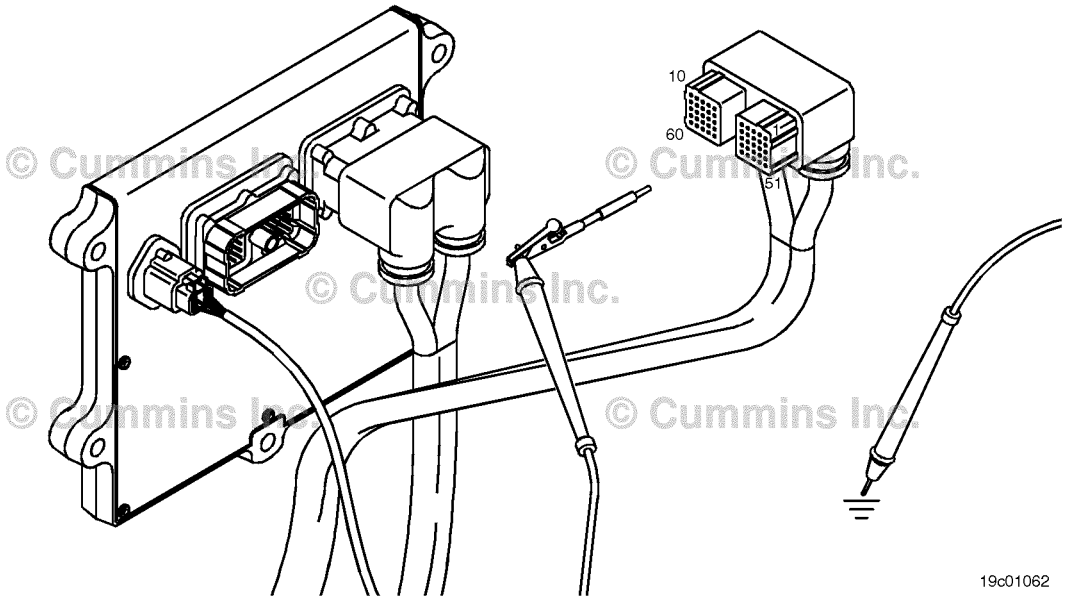
| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Measure the resistance between the alternate torque switch pin in the OEM harness ECM connector and all other pins in the OEM connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3C |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the alternate torque switch circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a pin short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from ECM.
- Disconnect the alternate torque switch from the OEM harness.

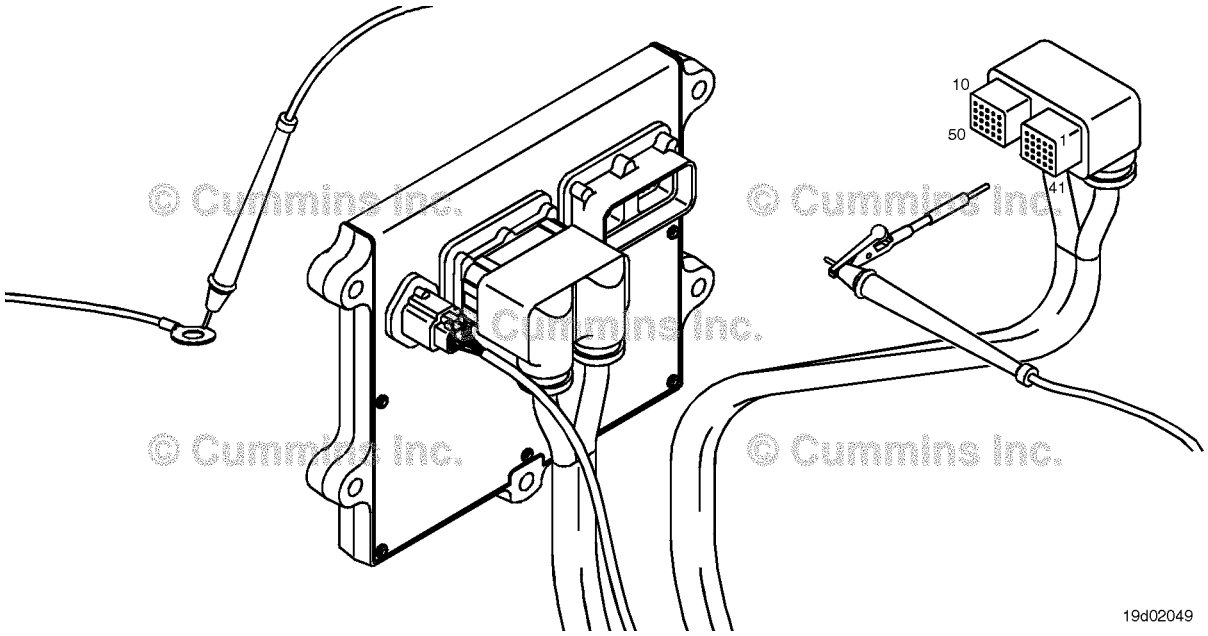
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-ground short.<br>• Measure the resistance between the alternate torque switch pin in the OEM harness ECM connector and ground.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3D |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-ground short circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check for an open circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the alternate torque switch from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the OEM harness ECM connector alternate torque switch pin and the OEM harness alternate torque switch pin.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3E |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 528 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and reinstallation of the connector corrected the fault. | 4A |
| | Fault Code 528 inactive?<br>**NO**<br>**Repair:**<br>Refer to OEM service manual. | 4A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 528 inactive?<br>**YES** | 4B |
| | Fault Code 528 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

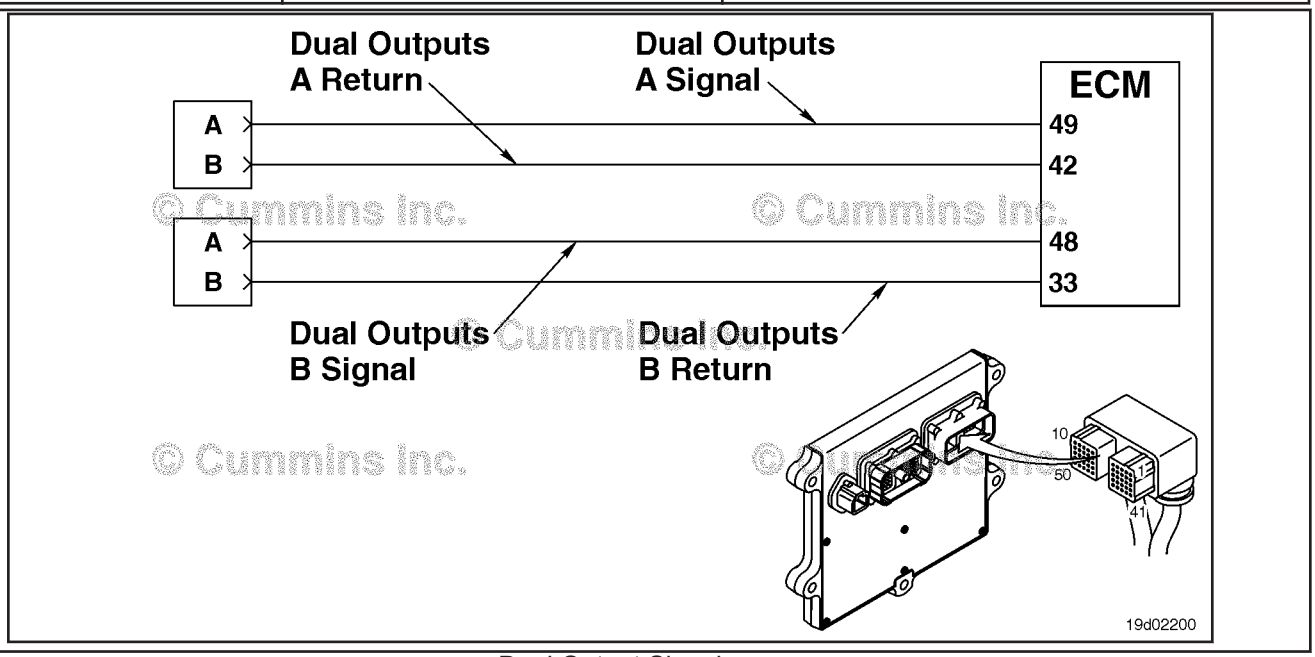
**Condition:**
- Components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All faults cleared?<br>**YES** | Repair complete. |
| | All faults cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 529

## Auxiliary Input/Output 3 Circuit - Voltage Above Normal, or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 529<br>PID(P), SID(S): S051<br>SPN: 703<br>FMI: 3<br>Lamp: Amber<br>SRT: | Auxiliary Input/Output 3 Circuit - Voltage Above Normal, or Shorted to High Source. High signal voltage has been detected at the auxiliary input/output 3 circuit. | None on performance. |




Dual Output Signal

**Circuit Description:**

The electronic control module (ECM) provides a signal to the OEM output control solenoid to turn the OEM supplied accessory on and off. The OEM output control circuit varies by OEM. Certain OEM's may use a solenoid return that is wired to the ECM or may use a return that goes to engine block or chassis ground.

**Component Location:**

The OEM output solenoid location varies by OEM. Refer to appropriate OEM service literature to determine the location.

**Shop Talk:**

The ECM monitors the voltage level on this circuit. When the ECM commands the OEM output signal low, it expects the voltage level to be approximately zero volts. If it detects a high voltage, this fault is recorded. If Fault Code 529 is still active after completing the following troubleshooting steps, consult the OEM service literature for procedures to check the OEM output device for an open circuit or short to ground. Possible causes of this fault include:

- Open circuit in the engine harness or OEM output control solenoid
- Short circuit to voltage source in the OEM harness
- Failed ECM.

## Refer to Troubleshooting Fault Code t05-529

# FAULT CODE 529 - Auxiliary Input/Output 3 Circuit - Voltage Above Normal, or Shorted to High Source

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for an inactive fault code. | Fault Code 529 inactive? | |
| **STEP 2:** | **Check the OEM output control solenoid and circuit.** | | |
| STEP 2A: | Inspect the OEM output control solenoid and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check for an open circuit in the OEM output control solenoid. | Less than 100 ohms? | |
| STEP 2C: | Check the OEM output control solenoid diagnostic supply voltage, supply line and return circuit. | Greater than 3.75-VDC? | |
| STEP 2D: | Check for an open circuit in the OEM output control solenoid circuit. | Less than 10 ohms? | |
| **STEP 3:** | **Check the ECM and OEM harness.** | | |
| STEP 3A: | Inspect ECM and OEM harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check for an open circuit in the OEM output control signal circuit. | Less than 10 ohms? | |
| STEP 3C: | Check for a pin to pin short circuit in the OEM harness. | Greater than 100K ohms? | |
| STEP 3D: | Check for an inactive fault code. | Fault Code 529 inactive? | |
| **STEP 4:** | **Clear the fault code.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 529 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All faults cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

#### STEP 1A: Check for an inactive fault code.

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool. | Fault Code 529 is inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 529 is inactive?<br>**NO** | 2A |

### STEP 2: Check the OEM output control solenoid and circuit.

#### STEP 2A: Inspect the OEM output control solenoid and connector pins.

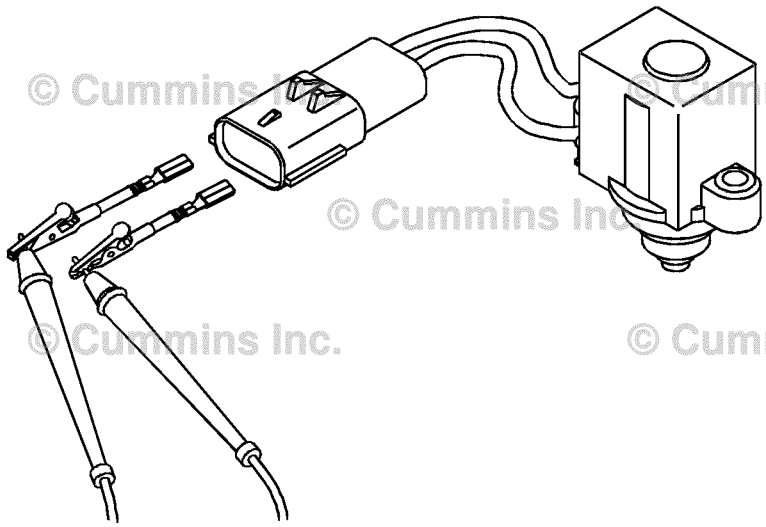
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM output control solenoid from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM output control solenoid and connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damage pins?<br>**NO** | 2B |

**STEP 2B: Check for an open circuit in the OEM output control solenoid.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM output control solenoid from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check OEM output control solenoid resistance.<br>• Measure the resistance between the OEM output control solenoid SIGNAL pin and the OEM output control solenoid RETURN pin at the OEM output control solenoid connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 100 ohms?<br>**YES** | 2C |
| | Less than 100 ohms?<br>**NO**<br>**Repair:**<br>An open circuit in the OEM output control solenoid has been detected.<br>Replace the OEM output control solenoid. Refer to the OEM service manual. | 4A |

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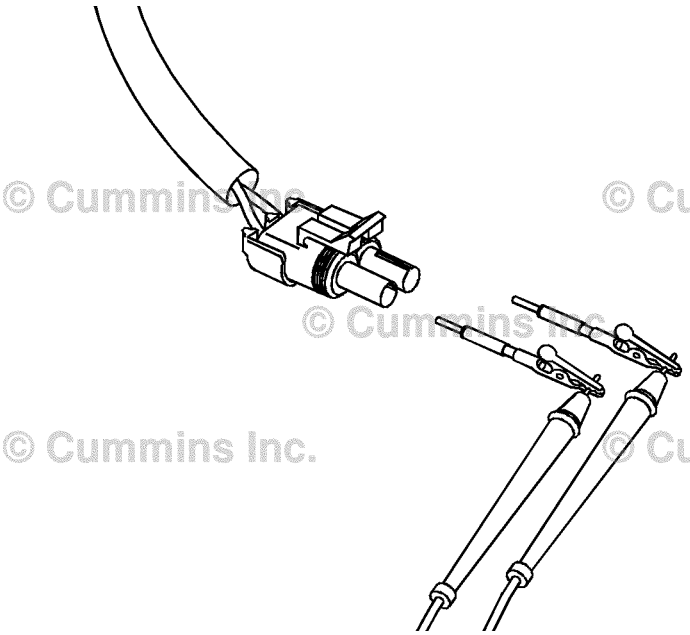
**STEP 2C: Check the OEM output control solenoid diagnostic supply voltage, supply line and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM output control solenoid from the OEM harness.
- Turn keyswitch ON.

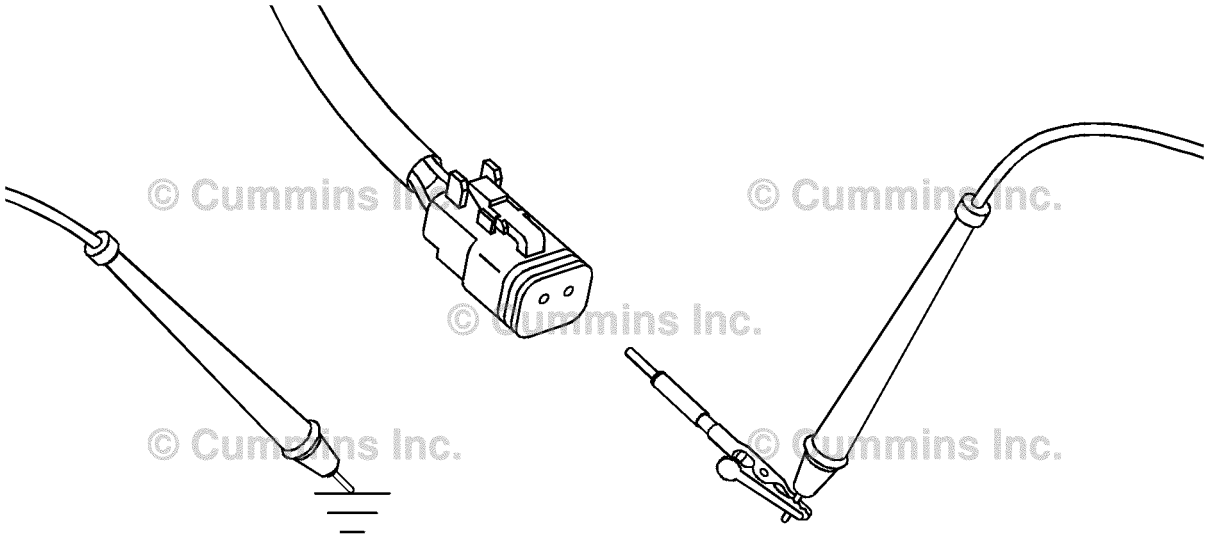
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the OEM output control solenoid diagnostic supply voltage and return circuit.<br>• Measure the voltage between the OEM output control solenoid SIGNAL pin and the OEM output control solenoid RETURN pin at the OEM output control solenoid connector of the OEM harness. | Greater than 3.75-VDC?<br>**YES** | 3C |
| | Greater than 3.75-VDC?<br>**NO** | 2D |



**STEP 2D: Check for an open circuit in the OEM output control solenoid circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM output control solenoid from the OEM output control harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the OEM output control solenoid diagnostic supply voltage and return circuit.<br>• Measure the resistance between the OEM output control solenoid RETURN pin in the engine harness and ground.<br>Refer to the circuit diagram or the wiring diagram for the connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3A |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open circuit on the RETURN wire has been detected. Refer to the OEM wiring diagram for RETURN wire configuration.<br>IF the RETURN is wired to the ECM, repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.<br>If the RETURN wire is grounded to the chassis or engine block ground, repair the source of the failed connection.<br>Clean, repair, or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 3: Check the ECM and OEM harness.

### STEP 3A: Inspect ECM and OEM harness connector pins.

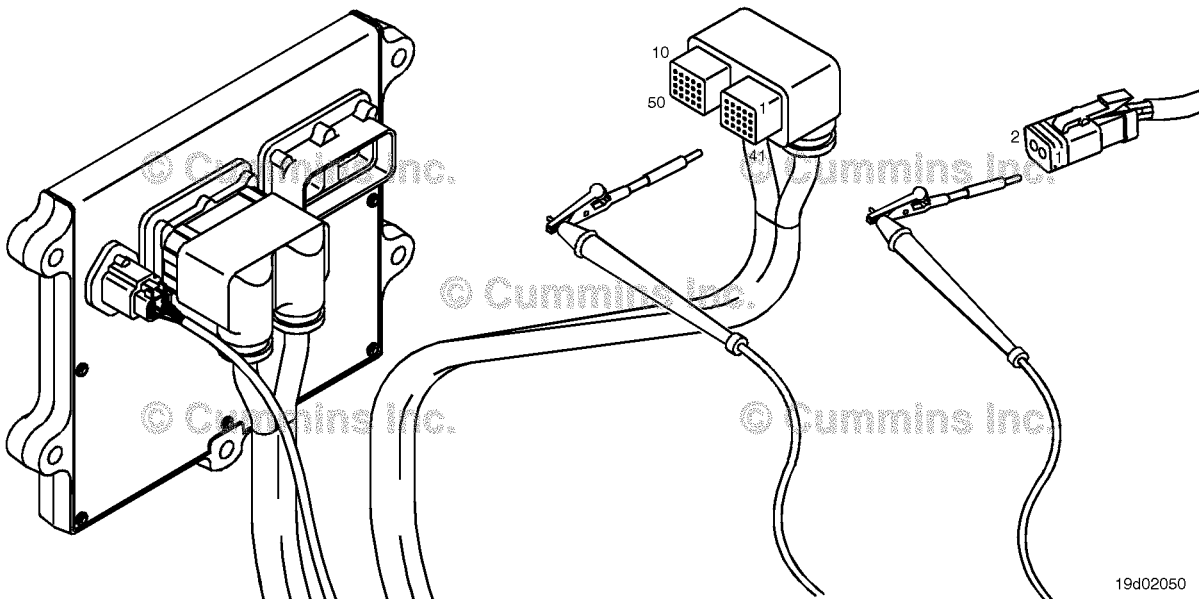
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the ECM and OEM harness connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for an open circuit in the OEM output control signal circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the OEM output control solenoid from the OEM harness.

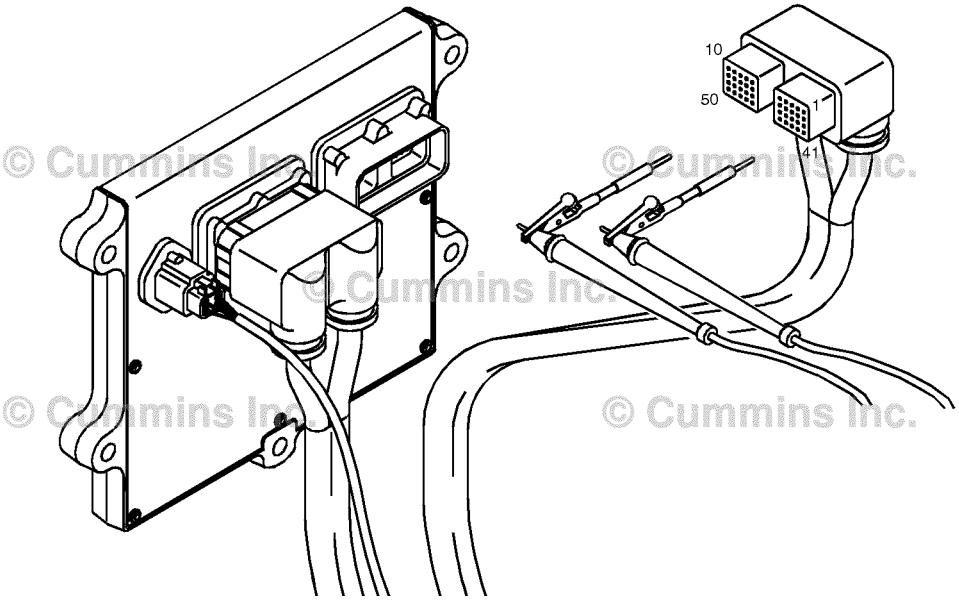
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the OEM harness ECM OEM output control solenoid SIGNAL pin and the OEM harness OEM output control solenoid connector SIGNAL pin.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open OEM control output solenoid SIGNAL circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the OEM output control solenoid from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the OEM output control solenoid SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3D |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the OEM output control solenoid SIGNAL line has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 529 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the problem. | 4A |
| | Fault Code 529 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault code.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 529 inactive?<br>**YES** | 4B |
| | Fault Code 529 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

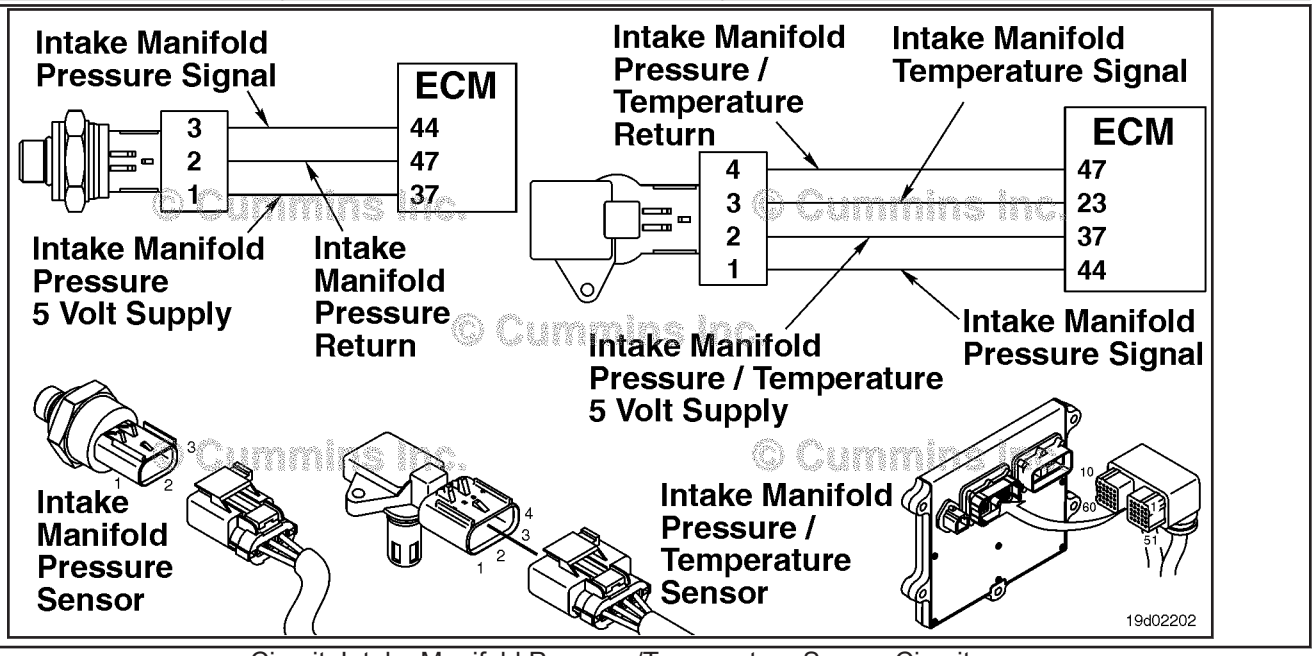
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clar the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault cleared?<br>**YES** | Repair complete. |
| | All faults cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 545

## Turbocharger 1 Wastegate Control — Mechanical System Not Responding Properly or Out of Adjustment

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 545<br>PID(P), SID(S): S032<br>SPN: 1188<br>FMI: 7<br>Lamp: Amber<br>SRT: | Turbocharger 1 Wastegate Control — Mechanical System Not Responding Properly or Out of Adjustment. Intake manifold pressure has exceeded the maximum limit for the given engine rating. | Engine power derate. |




Circuit: Intake Manifold Pressure/Temperature Sensor Circuit

**Circuit Description:**

The intake manifold pressure sensor is used by the ECM to monitor the engine intake manifold pressure.

**Component Location:**

100-002 (Engine Diagrams) in Section E for a detailed component location view.

**Shop Talk:**

This fault code become active when the intake manifold pressure exceeds the maximum pressure limit for a given engine rating.

Possible causes:

- Malfunctioning turbocharger wastegate
- Wastegate tampering
- Wrong turbocharger part
- Possible tampering of the fuel system or turbocharger system.

On-Board Diagnostics (OBD) Information:

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-545

# FAULT CODE 545 - Turbocharger 1 Wastegate Control - Mechanical System Not Responding Properly or Out of Adjustment

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the sensor accuracy.** | | |
| **STEP 1A:** | **Verify the sensor accuracy with INSITE™ electronic service tool.** | **Value of intake manifold pressure is less than 203 mm Hg [8 in Hg]?** | |
| **STEP 1B:** | **Verify the sensor accuracy with a mechanical gauge.** | **Sensor reading is correct within 127 mm Hg [5 in Hg]?** | |
| **STEP 1C:** | **Check the system for tampering.** | **Tampering detected?** | |
| **STEP 1D:** | **Check the turbocharger wastegate operation.** | **Turbocharger wastegate operating properly?** | |
| **STEP 2:** | **Clear the fault code.** | | |
| **STEP 2A:** | **Disable the fault codes.** | **Fault code 545 inactive?** | |
| **STEP 2B:** | **Clear the inactive fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the sensor accuracy.

**STEP 1A: Verify the sensor accuracy with INSITE™ electronic service tool.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify sensor accuracy with INSITE™ electronic service tool.<br>• Monitor the intake manifold pressure with INSITE™ electronic service tool with the keyswitch on and the engine **not** running. | Value of the intake manifold pressure is less than 203 mm Hg [8 in Hg]?<br>**YES** | 1B |
| | Value of the intake manifold pressure is less than 203 mm Hg [8 in Hg]?<br>**NO**<br>**Repair:**<br>Replace the intake manifold pressure sensor. Refer to Procedure 019-061 in Section 19. | Repair Complete. |

**STEP 1B: Verify the sensor accuracy with a mechanical gauge.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Start the engine.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify the sensor accuracy with a mechanical gauge.<br>• Connect a mechanical intake manifold pressure gauge to the engine<br>• Using INSITE™ electronic service tool read the fault codes<br>• Start the engine, and compare the intake manifold pressure reading on the service tool monitor screen to the reading on the mechanical intake manifold pressure gauge.<br>Note: The engine may need to be loaded before the pressure readings can be compared. | Sensor reading is within 127 mm Hg [5 in Hg]?<br>**YES** | 1C |
| | Sensor reading is within 127 mm Hg [5 in Hg]?<br>**NO**<br>**Repair:**<br>Replace the intake manifold pressure sensor. Refer to Procedure 019-061 in Section 19. | 2A |

**STEP 1C: Check the system for tampering.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the turbocharger and fuel system fior the following:<br>• Turbocharger wastegate tampering<br>• Variable geometry turbocharger tampering<br>• Fuel system tampering<br>• Fuel system add-on electronic devices. | Tampering detected?<br>**YES**<br>**Repair:**<br>Remove the tampering device. | 2A |
| | Tampering detected?<br>**NO** | 1D |

**STEP 1D: Check the turbocharger wastegate operation.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the wastegate actuator for proper operation.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 010-050 in Section 10.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 010-050 in Section 10. | Turbocharger wastegate operating properly?<br>**YES** | 2A |
| | Turbocharger wastegate operating properly?<br>**NO**<br>**Repair:**<br>Replace the turbocharger wastegate actuator.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 010-050 in Section 10.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 010-050 in Section 10. | 2A |

## STEP 2: Clear the fault code.

**STEP 2A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault code 545 inactive?<br>**YES** | 2B |
| | Fault code 545 inactive?<br>**NO** | 1A |

**STEP 2B: Clear the inactive fault codes.**

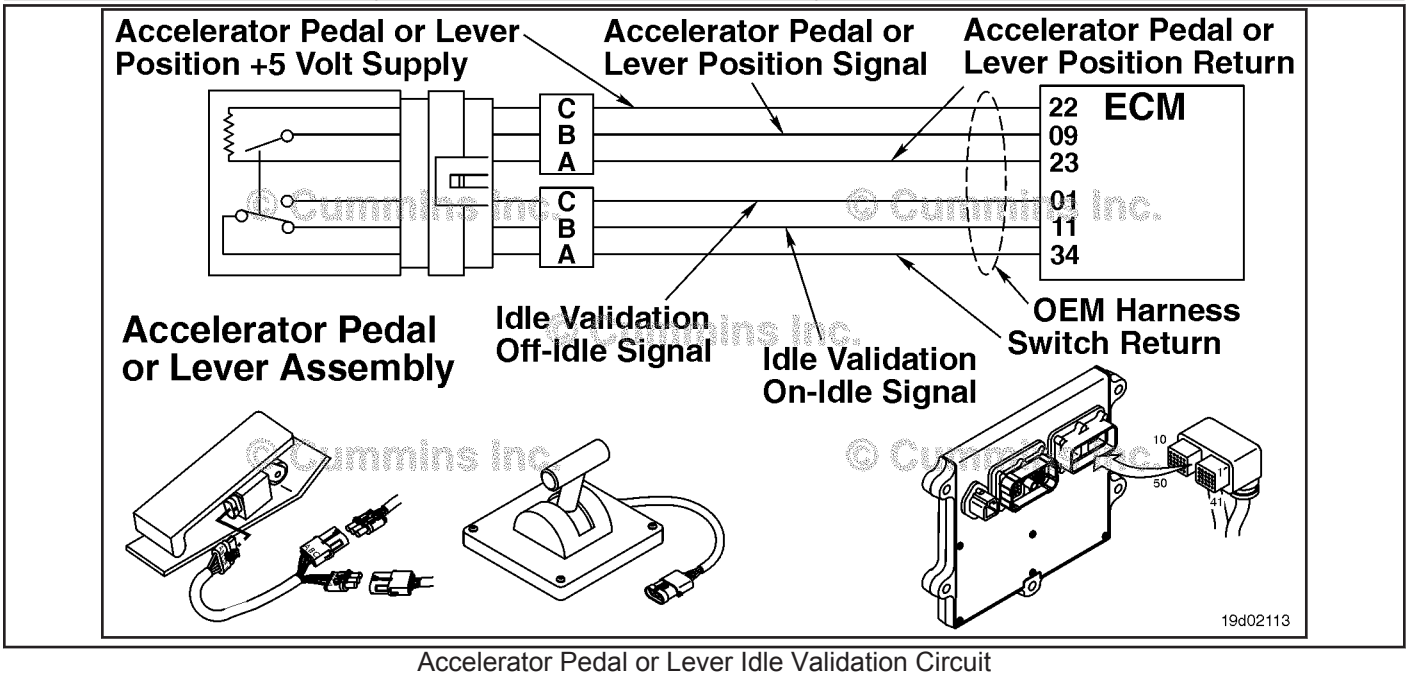
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 551 (ISS)

## Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 551<br>PID(P), SID(S): S230<br>SPN: 558<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source. No voltage detected simultaneously on both the idle validation and off-idle and on-idle switches. | Automotive: Engine will **only** idle.<br>Marine: Severe derate in engine speed. Limp home capability **only**. |




Accelerator Pedal or Lever Idle Validation Circuit

**Circuit Description:**

The idle validation switch is used by the electronic control module (ECM) to indicate when the accelerator pedal or lever is released (on-idle) or depressed (off-idle). The switch is adjusted by the accelerator pedal or lever manufacturers to switch from on-idle to off-idle at the correct accelerator pedal or lever position. The switch return is a shared return with other OEM cab switches.

**Component Location:**

The integrated sensor switch (ISS) is located on the accelerator pedal or lever assembly.

**Shop Talk:**

- This fault code is usually caused by a short circuit to ground in the harness, an uncalibrated accelerator pedal or lever assembly, or a miswired idle validation switch.
- When installing a new accelerator pedal or lever assembly, it **must** be calibrated before operating the engine. To calibrate, turn the keyswitch to the ON position, and fully depress and release the pedal or lever three times.

## Refer to Troubleshooting Fault Code t05-551

# FAULT CODE 551 (ISS) - Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠ WARNING ⚠**

**On Automotive applications, set the service brake using the trailer brake hand valve. Make sure there is enough air pressure to activate the brake pressure switch. Securely chock the wheels. Truck movement during troubleshooting can cause severe equipment damage, personal injury, or death.**

**⚠ CAUTION ⚠**

**To avoid damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠ CAUTION ⚠**

**To avoid pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3823995 - male Weather-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the ISS.** | | |
| STEP 1A: | Inspect the ISS and connector pins. | Dirty or damaged pins? | |
| STEP 1B: | Check the ISS for a short circuit from pin to pin. | Greater than 100k ohms? | |
| **STEP 2:** | **Check the OEM harness.** | | |
| STEP 2A: | Check the OEM harness for a short circuit to ground. | Greater than 4.0-VDC? | |
| STEP 2A-1: | Inspect the OEM harness and ECM connector pins. | Dirty or damaged pins? | |
| STEP 2A-2: | Check the OEM harness for a short circuit to return. | Greater than 100k ohms? | |
| STEP 2A-3: | Check the OEM harness for a short circuit to ground. | Greater than 100k ohms? | |
| STEP 2A-4: | Check for a pin-to-pin short circuit in the OEM harness. | Greater than 100k ohms? | |
| STEP 2A-5: | Check the ECM voltage. | Greater than 4.0-VDC? | |
| STEP 2B: | Check for a pin-to-pin short circuit in the OEM harness. | Greater than 100k ohms? | |
| **STEP 3:** | **Clear the fault codes.** | | |
| STEP 3A: | Disable the fault code. | Fault Code 551 inactive? | |
| STEP 3B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the ISS.

**STEP 1A: Inspect the ISS from the connector pins.**

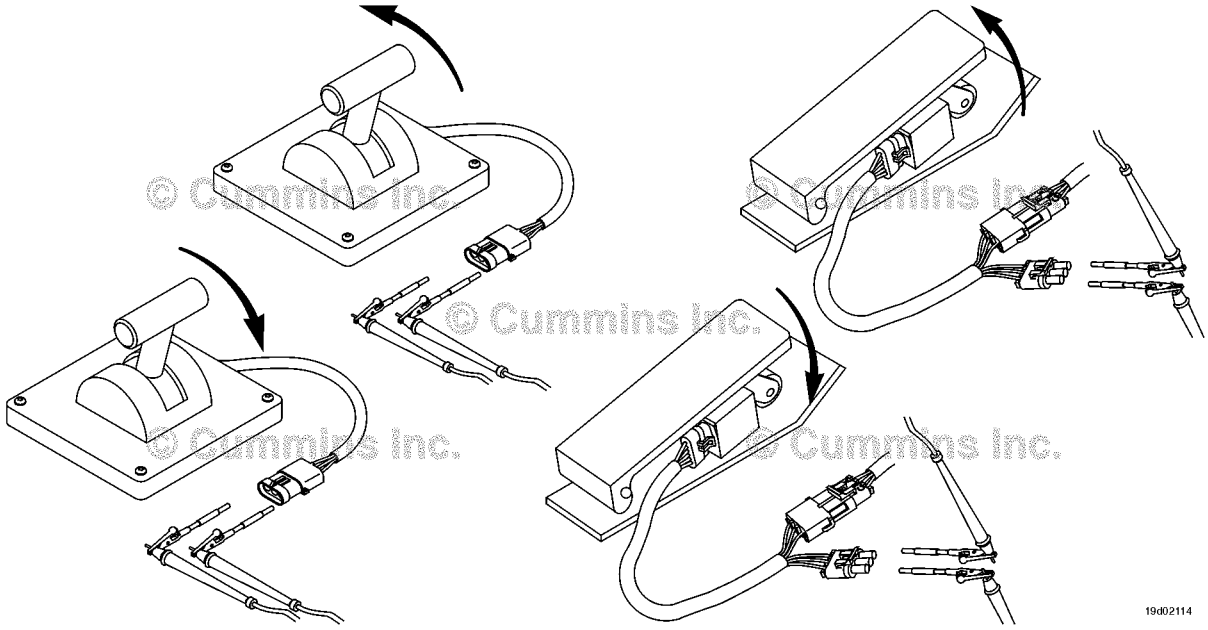
**Condition:**
- Turn keyswitch OFF.
- Disconnect the ISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ISS connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 1B |

**STEP 1B: Check the ISS for a short circuit from pin to pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the ISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin and idle validation off-idle SIGNAL pin at the switch connector with the pedal or lever released and depressed.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Replace the ISS switch. Refer to the OEM service manual. | 3A |

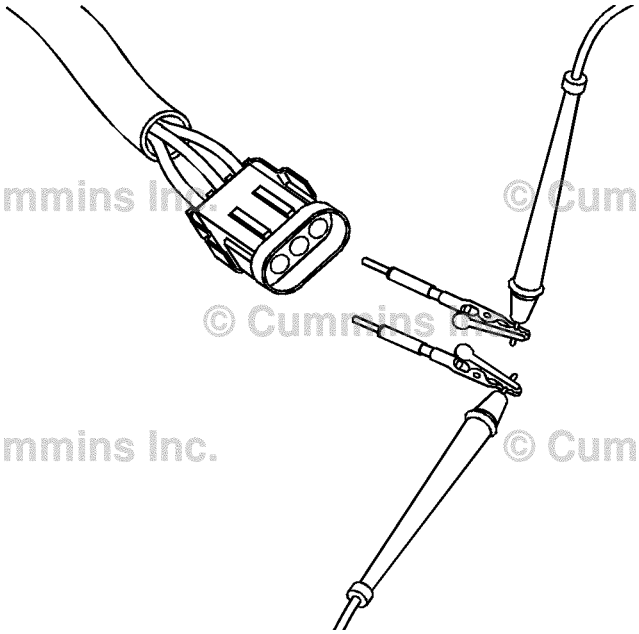


## STEP 2: Check the OEM harness.

### STEP 2A: Check the OEM harness for a short circuit to ground.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the ISS from the OEM harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the voltage from the idle validation on-idle SIGNAL pin in the ISS connector of the OEM harness to the switch RETURN pin in the ISS connector of the OEM harness.<br>• Measure the voltage from the idle validation off-idle SIGNAL pin in the ISS connector of the OEM harness to the switch RETURN pin in the ISS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | Greater than 4.0-VDC?<br>**YES** | 2B |
| | Greater than 4.0-VDC?<br>**NO** | 2A-1 |



**STEP 2A-1: Inspect the OEM harness and ECM connector pins.**

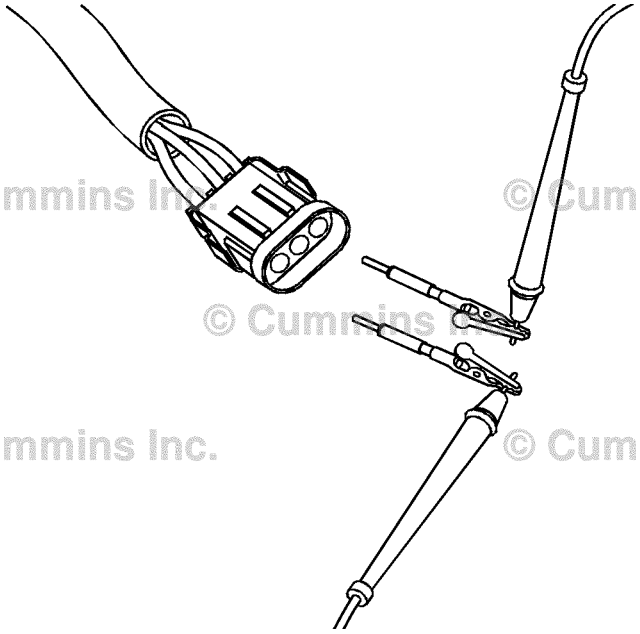
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, of pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 2A-2 |

**STEP 2A-2: Check the OEM harness for a short circuit to return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the ISS from the OEM harness.
- Disconnect the OEM harness from the ECM.

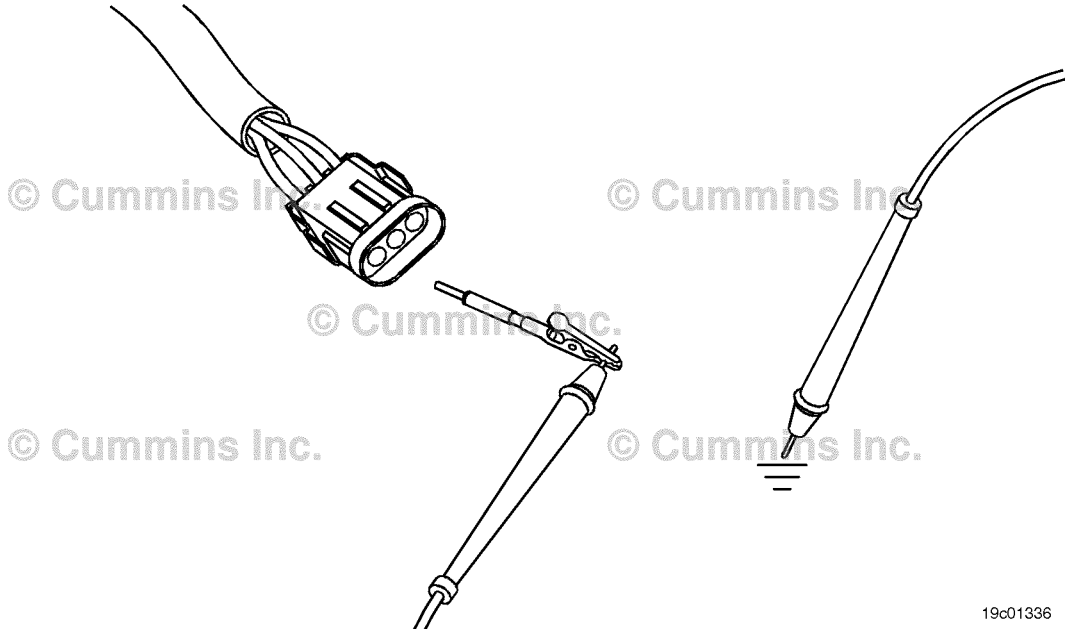
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to return.<br>• Measure the resistance from the idle validation on-idle SIGNAL pin in the ISS connector of the OEM harness to the switch RETURN pin in the ISS connector of the OEM harness.<br>• Measure the resistance from the idle validation off-idle SIGNAL pin in the ISS connector of the OEM harness to the switch RETURN pin in the ISS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A-3 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2A-3: Check the OEM harness for a short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the ISS from the OEM harness.

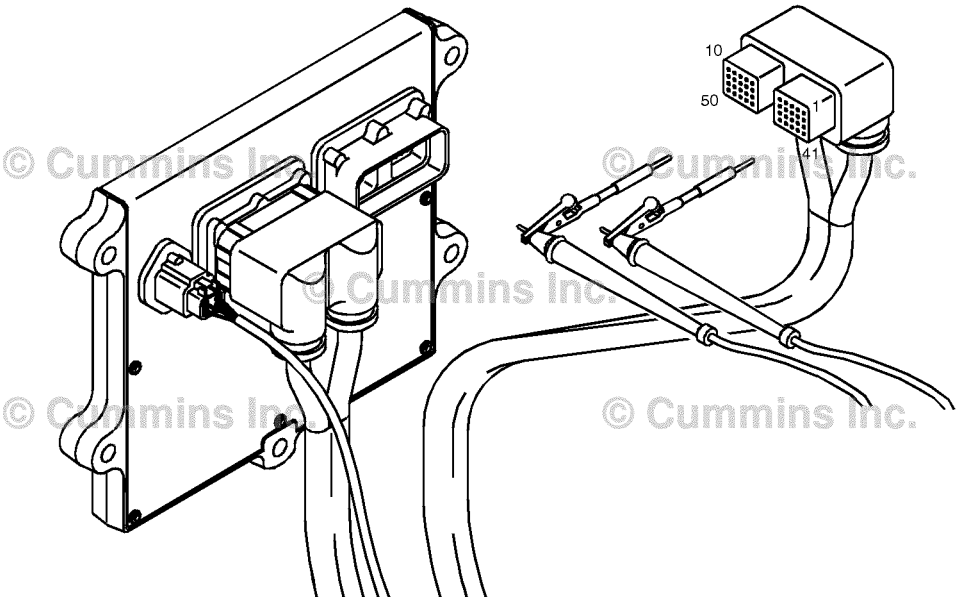
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin at the ISS connector of the OEM harness and engine block ground.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin at the ISS connector of the OEM harness and engine block ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A-4 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2A-4: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the ISS from the OEM harness.

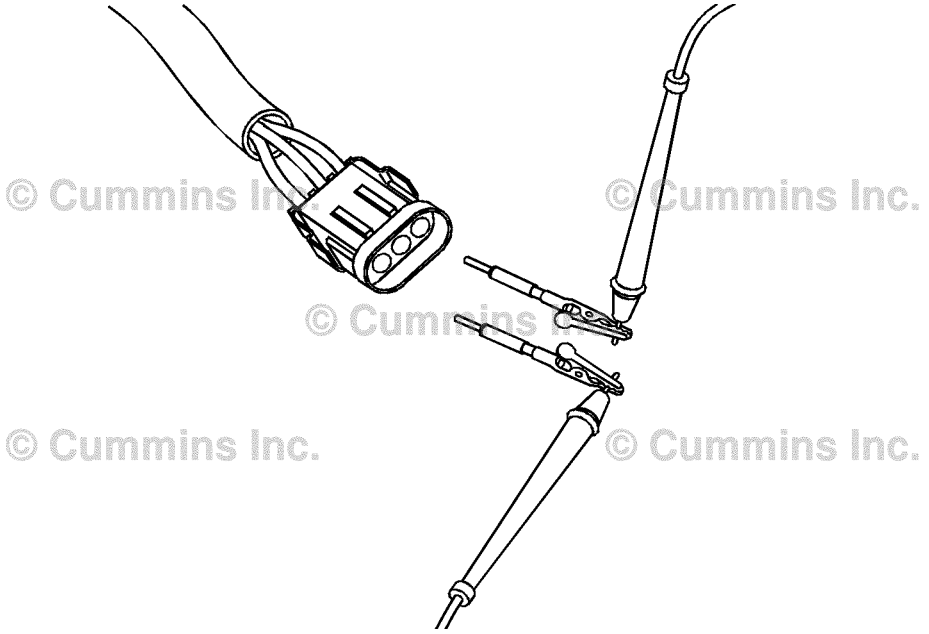
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin at the ECM connector of the OEM harness and all other pins in the connector.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin at the ECM connector of the OEM harness and all other pins in the connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A-5 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2A-5: Check the ECM voltage.**

**Condition:**
- Turn keyswitch OFF.
- Connect the OEM harness to the ECM.
- Disconnect the ISS from the OEM harness.
- Turn keyswitch ON.

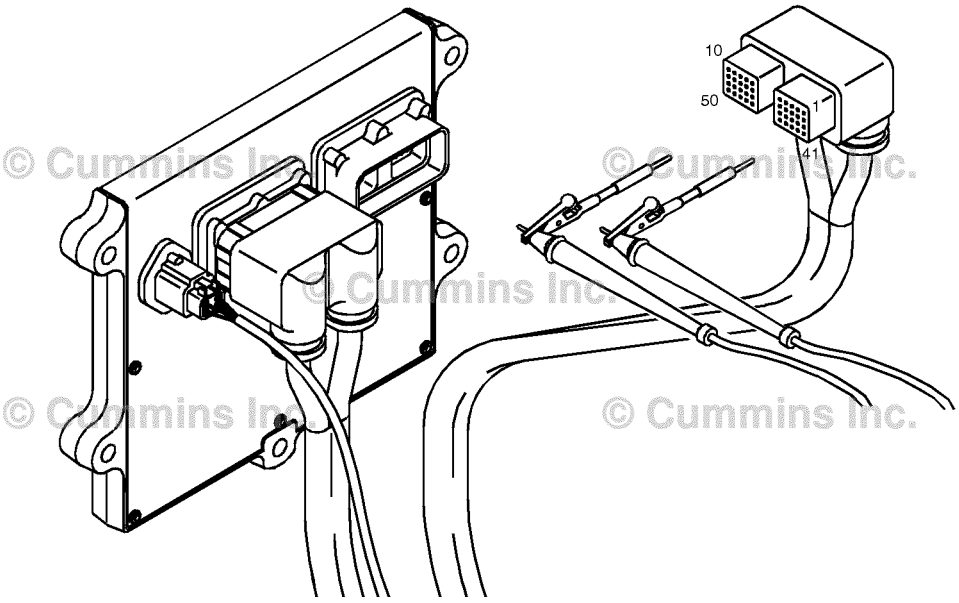
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the ECM voltage.<br>• Measure the voltage between the idle validation on-idle SIGNAL pin in the ISS connector of the OEM harness to the switch RETURN pin in the ISS connector of the OEM harness.<br>• Measure the voltage between the idle validation off-idle SIGNAL pin in the ISS connector of the OEM harness to the switch RETURN pin in the ISS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | Greater than 4.0-VDC?<br>**YES**<br>**Repair:**<br>Replace the ISS. Refer to the OEM service manual. | 3A |
| | Greater than 4.0-VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | Repair complete |



**STEP 2B: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the ISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin in the OEM harness.<br>• Measure the resistance and check for a short circuit between the idle validation on-idle SIGNAL pin and all other pins in the OEM harness ECM connector.<br>• Measure the resistance and check for a short circuit between the idle validation off-idle SIGNAL pin and all other pins in the OEM harness ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the ISS. Refer to the OEM service manual. | 3A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Turn the keyswitch ON and completely depress and release the accelerator pedal or lever three times.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify Fault Code 551 code is inactive. | Fault Code 551 inactive?<br>**YES** | 3B |
| | Fault Code 551 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair location if all steps have been completed and checked again. | 1A |

### STEP 3B: Clear the inactive fault codes.

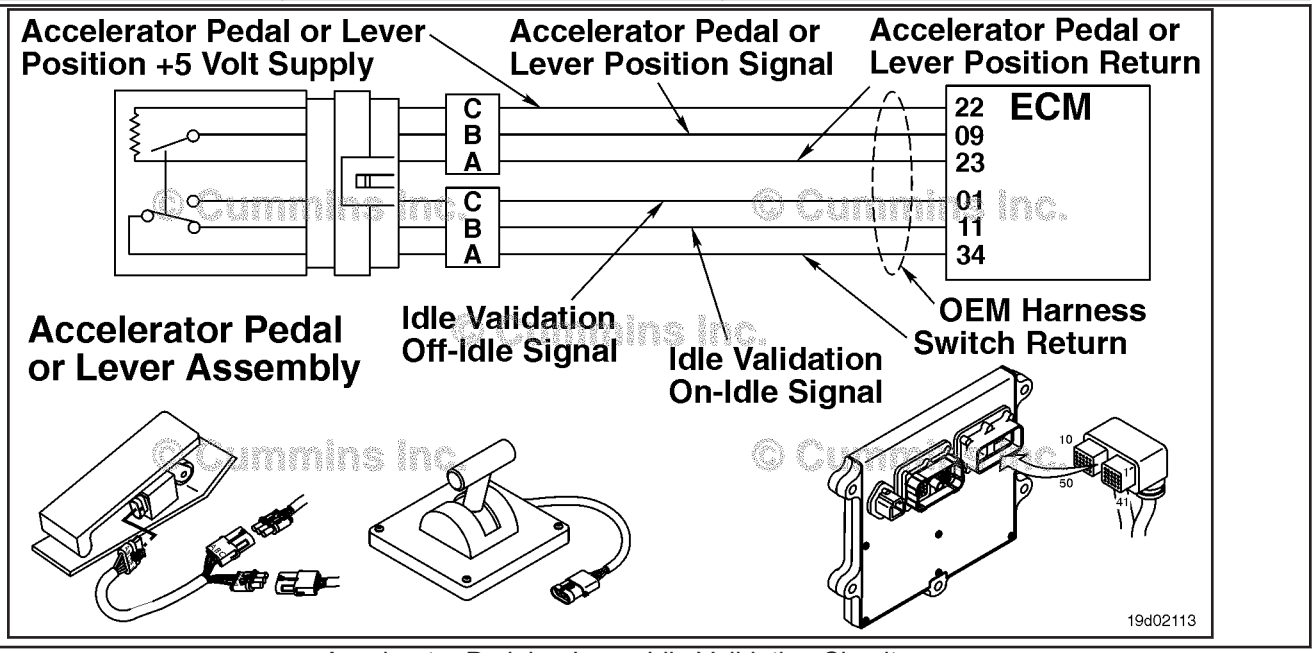
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service to erase the fault codes. | All fault codes cleared?<br>**YES** | Repair Complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 551 (NISS)

## Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 551<br>PID(P), SID(S): S230<br>SPN: 558<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source. No voltage detected simultaneously on both the idle validation off-idle and on-idle circuits. | Automotive: Engine will **only** idle.<br>Marine: Severe derate in engine speed. Limp home capability **only**. |




Accelerator Pedal or Lever Idle Validation Circuit

**Circuit Description:**

The idle validation switch is used by the electronic control module (ECM) to indicate when the accelerator pedal or lever is released (on-idle) or depressed (off-idle). The switch is adjusted by the accelerator pedal or lever manufacturers to switch from on-idle to off-idle at the correct accelerator pedal or lever position. The switch return is a shared return with other OEM cab switches.

**Component Location:**

The nonintegrated sensor switch (NISS) is located on the accelerator pedal or lever assembly.

**Shop Talk:**

- This fault code is usually caused by a short circuit to ground in the harness, an uncalibrated accelerator pedal or lever assembly, or a miswired idle validation switch.
- When installing a new accelerator pedal or lever assembly, it **must** be calibrated before operating the engine. To calibrate, turn the keyswitch to the ON position and fully depress and release the pedal or lever three times.

## Refer to Troubleshooting Fault Code t05-551

# FAULT CODE 551 (NISS) - Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠ WARNING ⚠**

**On Automotive applications, set the service brake using the trailer brake hand valve. Make sure there is enough air pressure to activate the brake pressure switch. Securely chock the wheels. Truck movement during troubleshooting can cause severe equipment damage, personal injury, or death.**

**⚠ CAUTION ⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠ CAUTION ⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3823995 - male Weather-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the NISS.** | | |
| **STEP 1A:** | **Inspect the NISS and harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 1B:** | **Check the NISS for a short circuit from pin to pin.** | **Greater than 100k ohms?** | |
| **STEP 2:** | **Check the OEM harness.** | | |
| **STEP 2A:** | **Check the OEM harness for a short circuit to ground.** | **Greater than 4.0-VDC?** | |
| **STEP 2A-1:** | **Inspect the OEM harness and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2A-2:** | **Check the OEM harness for a short circuit to return.** | **Greater than 100k ohms?** | |
| **STEP 2A-3:** | **Check the OEM harness for a short circuit to ground.** | **Greater than 100k ohms?** | |
| **STEP 2A-4:** | **Check for a pin-to-pin short circuit in the OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 2A-5:** | **Check the ECM voltage.** | **Greater than 4.0-VDC?** | |
| **STEP 2B:** | **Check for a pin-to-pin short circuit in the OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 3:** | **Clear the fault codes.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 551 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the NISS.

**STEP 1A: Inspect the NISS and connector pins.**

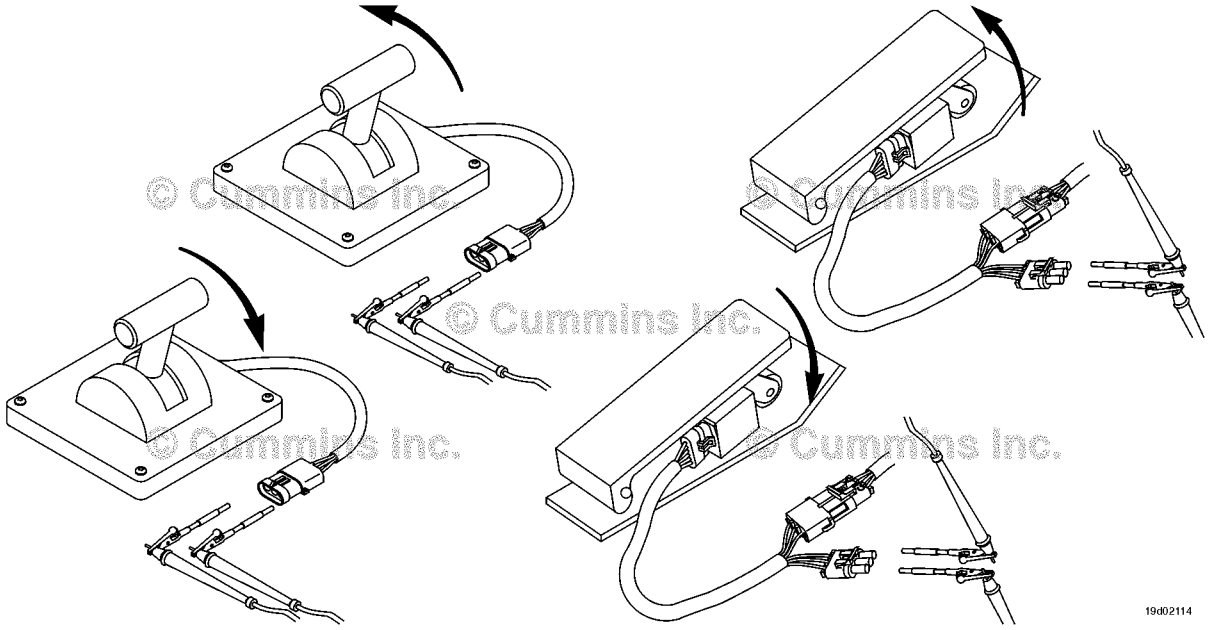
**Condition:**
- Turn keyswitch OFF.
- Disconnect the NISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and NISS from the OEM harness connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 1B |

**STEP 1B: Check the NISS for a short circuit from pin to pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the NISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin and the idle validation off-idle SIGNAL pin at the switch connector with the pedal or lever released and depressed.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Replace the NISS. Refer to the OEM service manual. | 3A |

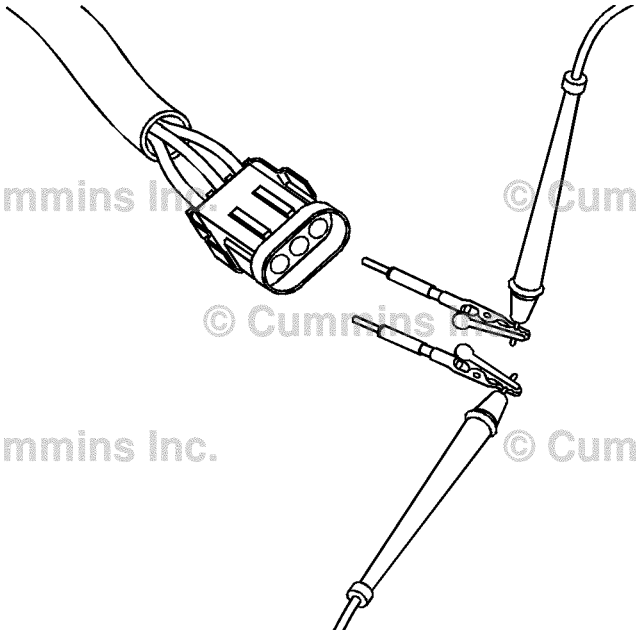


## STEP 2: Check the OEM harness.

### STEP 2A: Check the OEM harness for a short circuit to ground.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the NISS from the OEM harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the voltage from the idle validation on-idle SIGNAL pin in the NISS connector of the OEM harness to the switch RETURN pin in the NISS connector of the OEM harness.<br>• Measure the voltage from the idle validation off-idle SIGNAL pin in the NISS connector of the OEM harness to the switch RETURN pin in the NISS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | Greater than 4.0-VDC?<br>**YES** | 2B |
| | Greater than 4.0-VDC?<br>**NO** | 2A-1 |



**STEP 2A-1: Inspect the OEM harness and ECM connector pins.**

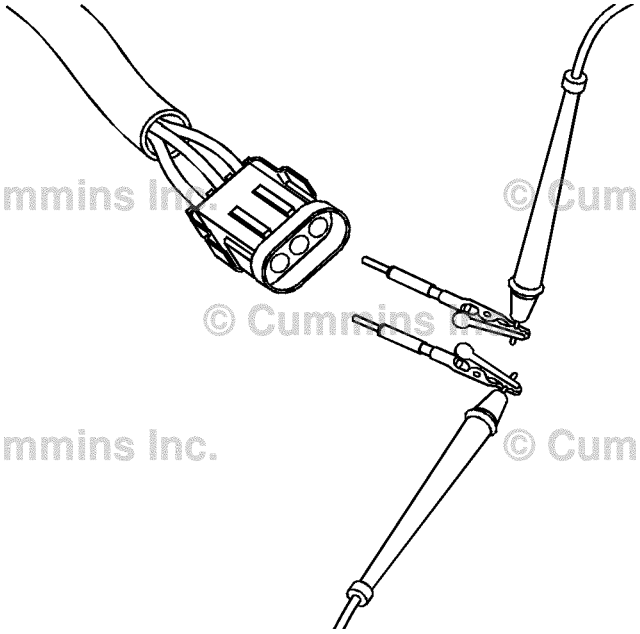
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 2A-2 |

**STEP 2A-2: Check the OEM harness for a short circuit to return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the NISS from the OEM harness.
- Disconnect the OEM harness from the ECM.

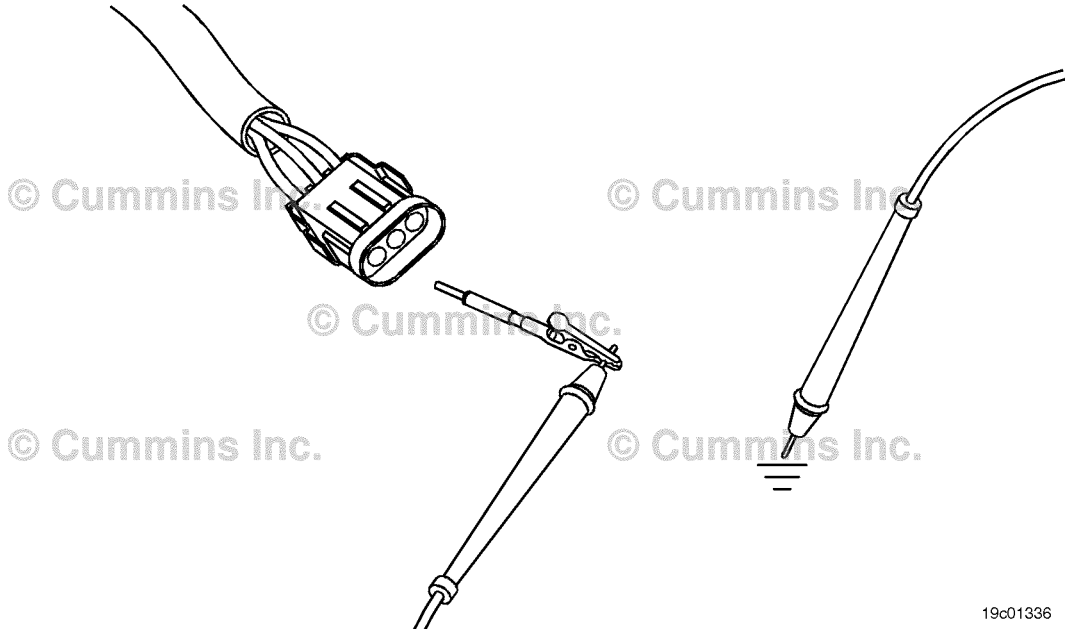
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to return.<br>• Measure the resistance from the idle validation on-idle SIGNAL pin in the NISS connector of the OEM harness to the switch RETURN pin in the NISS connector of the OEM harness.<br>• Measure the resistance from the idle validation off-idle SIGNAL pin in the NISS connector of the OEM harness to the switch RETURN pin in the NISS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A-3 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2A-3: Check the OEM harness for a short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the NISS from the OEM harness.

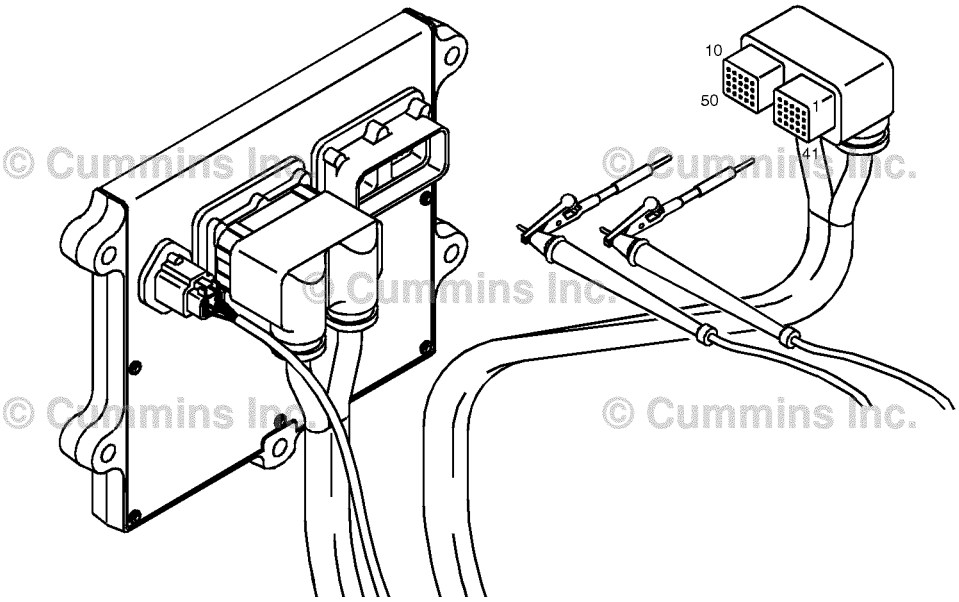
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin at the NISS connector of the OEM harness and engine block ground.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin at the NISS connector of the OEM harness and engine block ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A-4 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2A-4: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the NISS from the OEM harness.

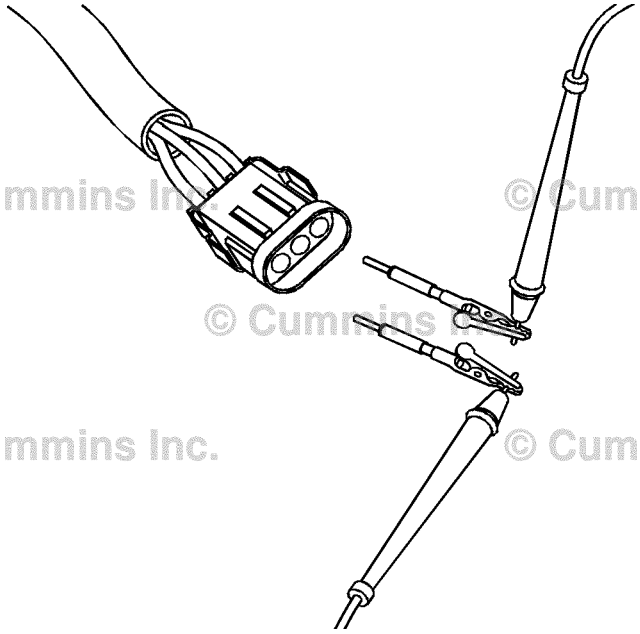
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin at the ECM connector of the OEM harness and all other pins in the connector.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin at the ECM connector of the OEM harness and all other pins in the connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A-5 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2A-5: Check the ECM voltage.**

**Condition:**
- Turn keyswitch OFF.
- Connect the OEM harness to the ECM.
- Disconnect the NISS from the OEM harness.
- Turn keyswitch ON.

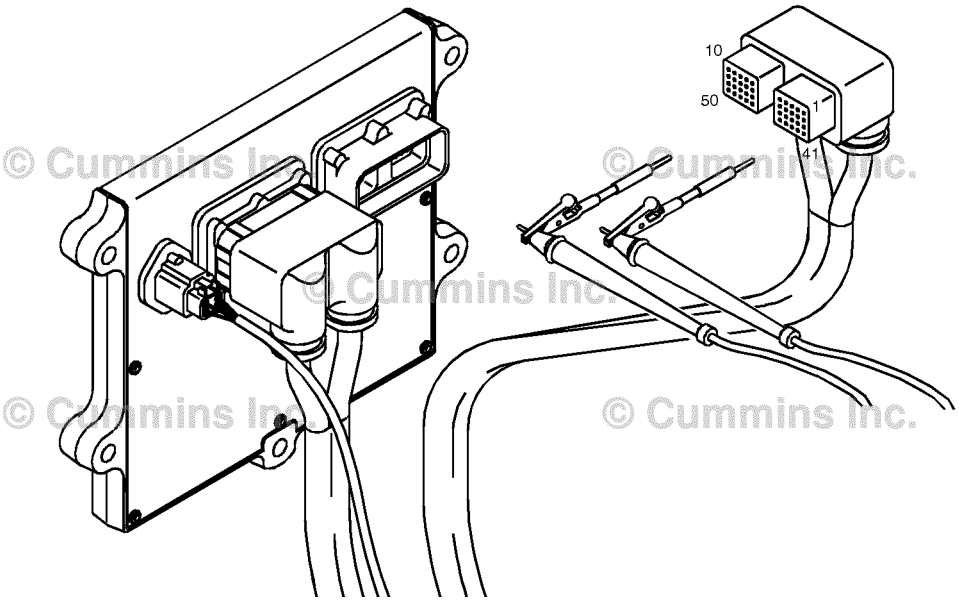
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the voltage between the idle validation on-idle SIGNAL pin in the NISS connector of the OEM harness to the switch RETURN pin in the NISS connector of the OEM harness.<br>• Measure the voltage between the idle validation off-idle SIGNAL pin in the NISS connector of the OEM harness to the switch RETURN pin in the NISS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | Greater than 4.0-VDC?<br>**YES**<br>**Repair:**<br>Replace the NISS. Refer to the OEM service manual. | 3A |
| | Greater than 4.0-VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | Repair Complete |



**STEP 2B: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the NISS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin in the OEM harness.<br>• Measure the resistance and check for a short circuit between the idle validation on-idle SIGNAL pin and all other pins in the OEM harness ECM connector.<br>• Measure the resistance and check for a short circuit between the idle validation off-idle SIGNAL pin and all other pins in the OEM harness ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Turn the keyswitch ON and completely depress and release the accelerator pedal or lever three times.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that Fault Code 551 is inactive. | Fault Code 551 inactive?<br>**YES** | 3B |
| | Fault Code 551 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair location if all steps have been completed and checked again. | 1A |

### STEP 3B: Clear the inactive fault codes.

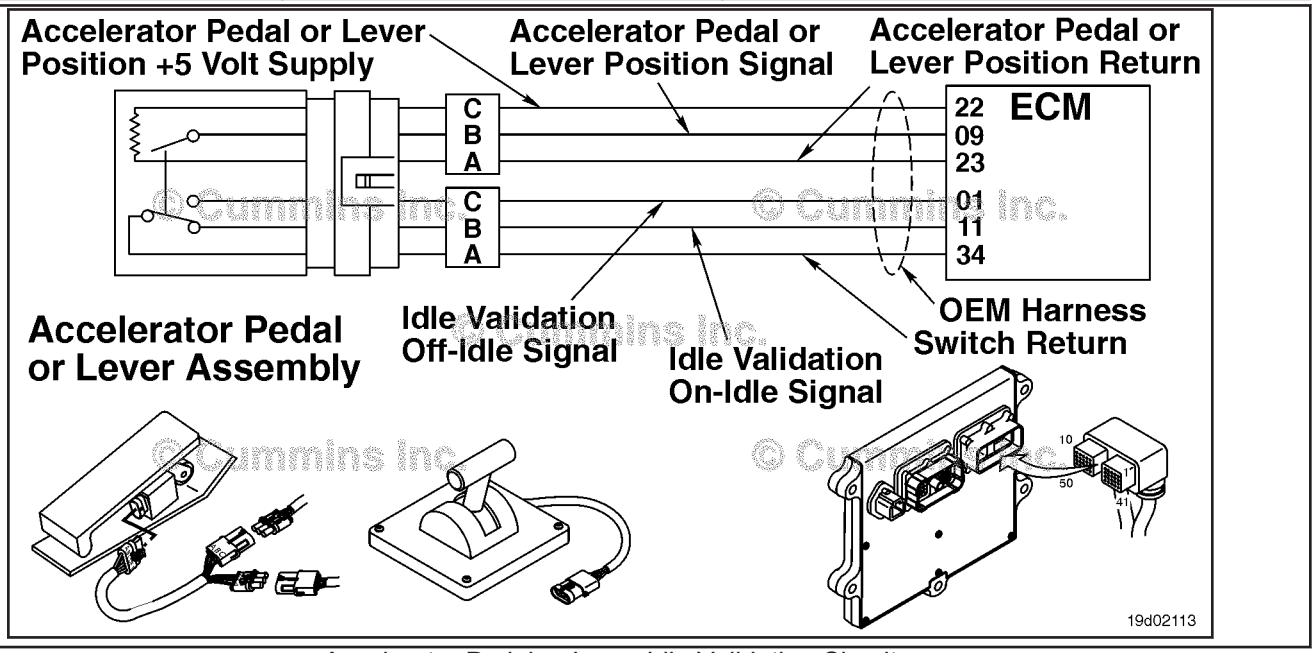
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair Complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 551 (SSS)

## Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 551<br>PID(P), SID(S): S230<br>SPN: 558<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source. No voltage detected simultaneously on both the idle validation off-idle and on-idle circuits. | Automotive: Engine will **only** idle.<br>Marine: Severe derate in engine speed. Limp home capability **only**. |




Accelerator Pedal or Lever Idle Validation Circuit

**Circuit Description:**

The idle validation switch is used by the electronic control module (ECM) to indicate when the accelerator pedal or lever is released (on-idle) or depressed (off-idle). The switch is adjusted by the accelerator pedal or lever manufacturers to switch from on-idle to off-idle at the correct accelerator pedal or lever position. The switch return is a shared return with other OEM cab switches.

**Component Location:**

The solid state sensor switch (SSS) is located on the accelerator pedal or lever assembly.

**Shop Talk:**

- This fault code is usually caused by a short circuit to ground in the harness, an uncalibrated accelerator pedal or lever assembly, or a miswired idle validation switch.
- When installing a new accelerator pedal or lever assembly, it **must** be calibrated before operating the engine. To calibrate, turn the keyswitch to the ON position, and fully depress and release the pedal or lever three times.

## Refer to Troubleshooting Fault Code t05-551

# FAULT CODE 551 (SSS) - Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠ WARNING ⚠**

**On Automotive applications, set the service brake using the trailer brake hand valve. Make sure there is enough air pressure to activate the brake pressure switch. Securely chock the wheels. Truck movement during troubleshooting can cause severe equipment damage, personal injury, or death.**

**⚠ CAUTION ⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠ CAUTION ⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3823995 - male Weather-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the SSS.** | | |
| **STEP 1A:** | Inspect the SSS and harness connector pins. | Dirty or damaged pins? | |
| **STEP 1B:** | Check the SSS for a short circuit from pin to pin. | Greater than 100k ohms? | |
| **STEP 2:** | **Check the OEM harness.** | | |
| **STEP 2A:** | Check the OEM harness for a short circuit to ground. | Greater than 4.0-VDC? | |
| **STEP 2A-1:** | Inspect the OEM harness and ECM connector pins. | Dirty or damaged pins? | |
| **STEP 2A-2:** | Check the OEM harness for a short circuit to return. | Greater than 100k ohms? | |
| **STEP 2A-3:** | Check the OEM harness for a short circuit to ground. | Greater than 100k ohms? | |
| **STEP 2A-4:** | Check for a short circuit from pin to pin in the OEM harness. | Greater than 100k ohms? | |
| **STEP 2A-5:** | Check the ECM voltage. | Greater than 4.0-VDC? | |
| **STEP 2B:** | Check for a pin-to-pin short circuit in the OEM harness. | More than 100k ohms. | |
| **STEP 3:** | **Clear the fault codes.** | | |
| **STEP 3A:** | Disable the fault code. | Fault Code 551 inactive? | |
| **STEP 3B:** | Clear the inactive fault code. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the SSS.

**STEP 1A: Inspect the SSS and connector pins.**

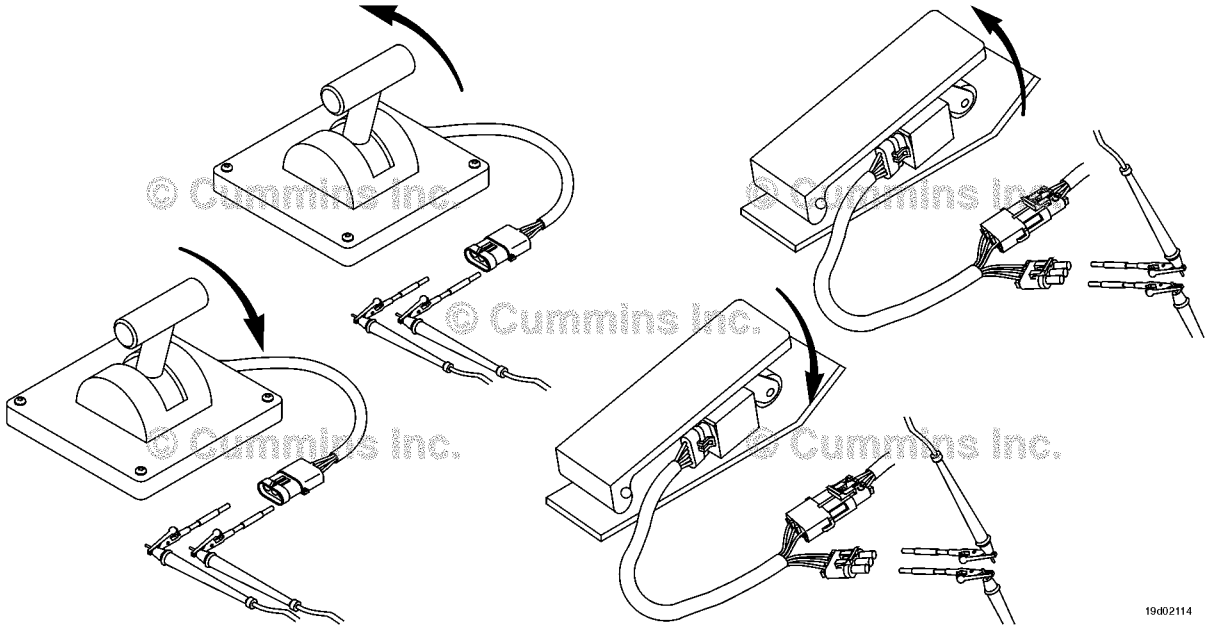
**Condition:**
- Turn keyswitch OFF.
- Disconnect the SSS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and SSS connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 1B |

**STEP 1B: Check the SSS for a short circuit from pin to pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the SSS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin and idle validation off-idle SIGNAL pin at the switch connector with the pedal or lever released and depressed.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Replace the SSS. Refer to the OEM service manual. | 3A |

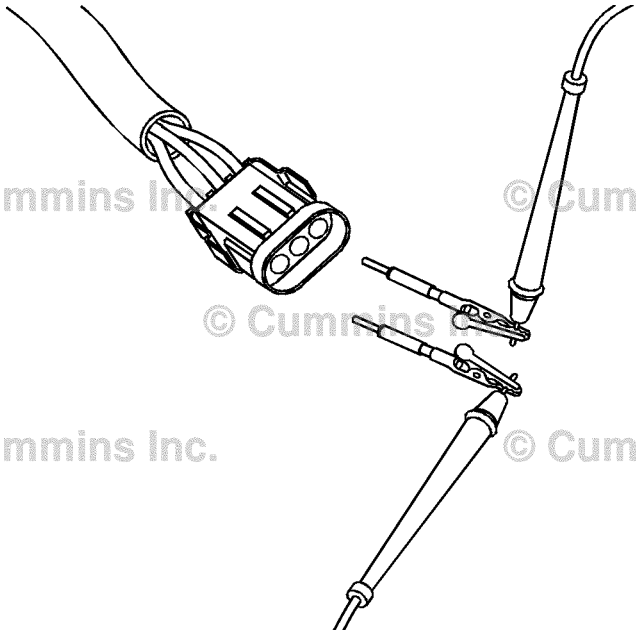


## STEP 2: Check the OEM harness.

### STEP 2A: Check the OEM harness for a short circuit to ground.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the SSS from the OEM harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the voltage from the idle validation on-idle SIGNAL pin in the SSS connector of the OEM harness to the switch RETURN pin in the SSS connector of the OEM harness.<br>• Measure the voltage from the idle validation off-idle SIGNAL pin in the SSS connector of the OEM harness to the switch RETURN pin in the SSS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | Greater than 4.0-VDC?<br>**YES** | 2B |
| | Greater than 4.0-VDC?<br>**NO** | 2A-1 |



**STEP 2A-1: Inspect the OEM harness and ECM connector pins.**

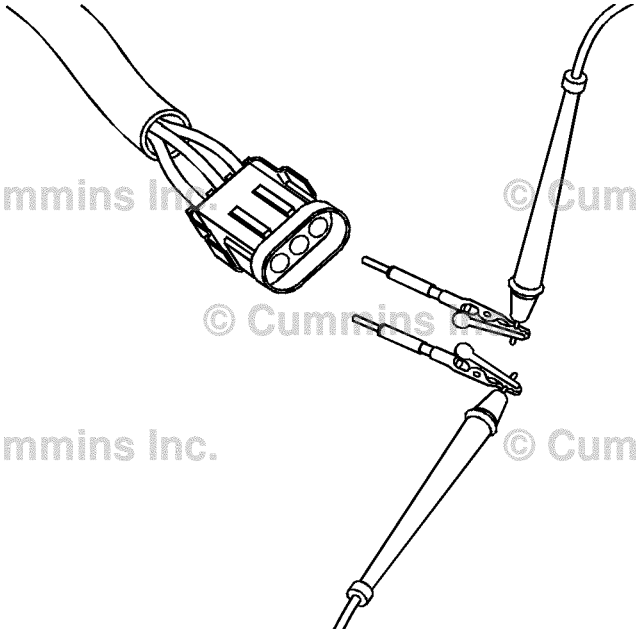
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 3A |
| | Dirty or damaged pins?<br>**NO** | 2A-2 |

**STEP 2A-2: Check the OEM harness for a short circuit to return.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the SSS from the OEM harness.
- Disconnect the OEM harness from the ECM.

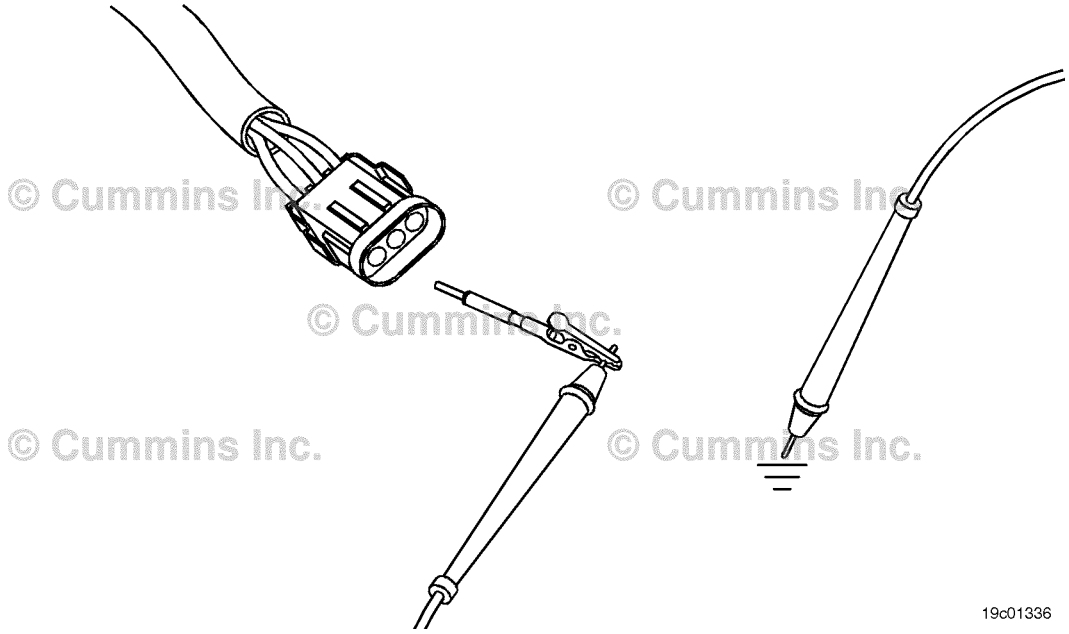
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to return.<br>• Measure the resistance from the idle validation on-idle SIGNAL pin in the SSS connector of the OEM harness to the switch RETURN pin in the SSS connector of the OEM harness.<br>• Measure the resistance from the idle validation off-idle SIGNAL pin in the SSS connector of the OEM harness to the switch RETURN pin in the SSS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A-3 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | Repair Complete |



**STEP 2A-3: Check the OEM harness for a short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the SSS from the OEM harness.

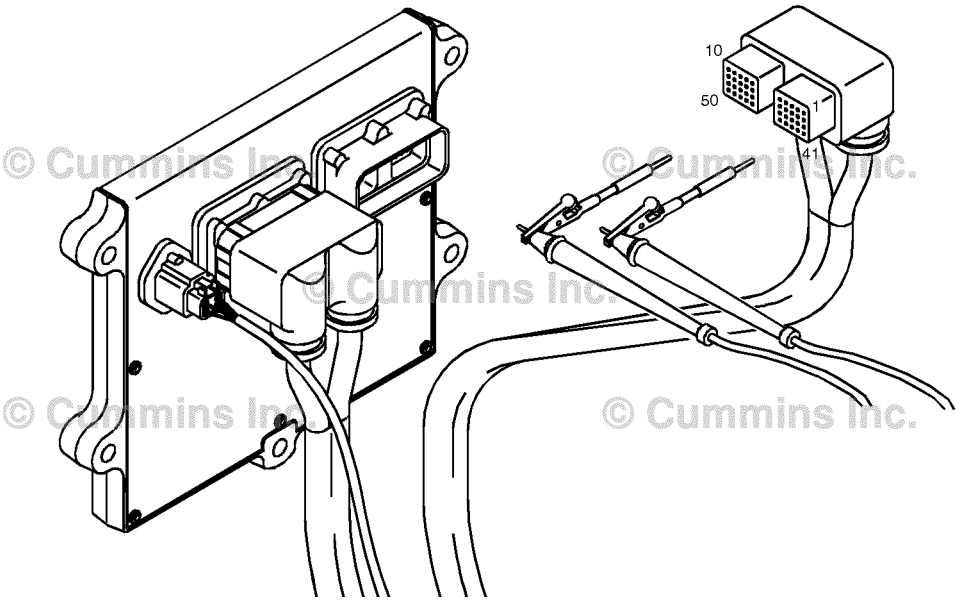
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the resistance between the idle validation on-idle SIGNAL pin at the SSS connector of the OEM harness and engine block ground.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin at the SSS connector of the OEM harness and engine block ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2A-4 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2A-4: Check for a short circuit from pin to pin in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the SSS from the OEM harness.

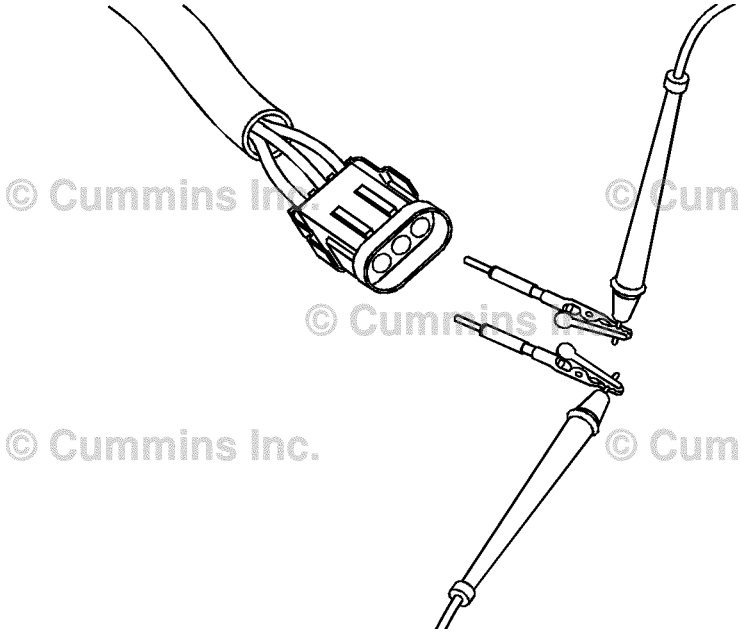
| Action | Specification/Repair | Next Step |
|---|---|---|
| Short circuit on one connector - pin-to-pin check:<br>• Measure the resistance between the idle validation on-idle SIGNAL pin at the ECM connector of the OEM harness and all other pins in the connector.<br>• Measure the resistance between the idle validation off-idle SIGNAL pin at the ECM connector of the OEM harness and all other pins in the connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the SSS. | 2A-5 |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2A-5: Check the ECM voltage.**

**Condition:**
- Turn keyswitch OFF.
- Connect the OEM harness to the ECM.
- Disconnect the SSS from the OEM harness.
- Turn keyswitch ON.

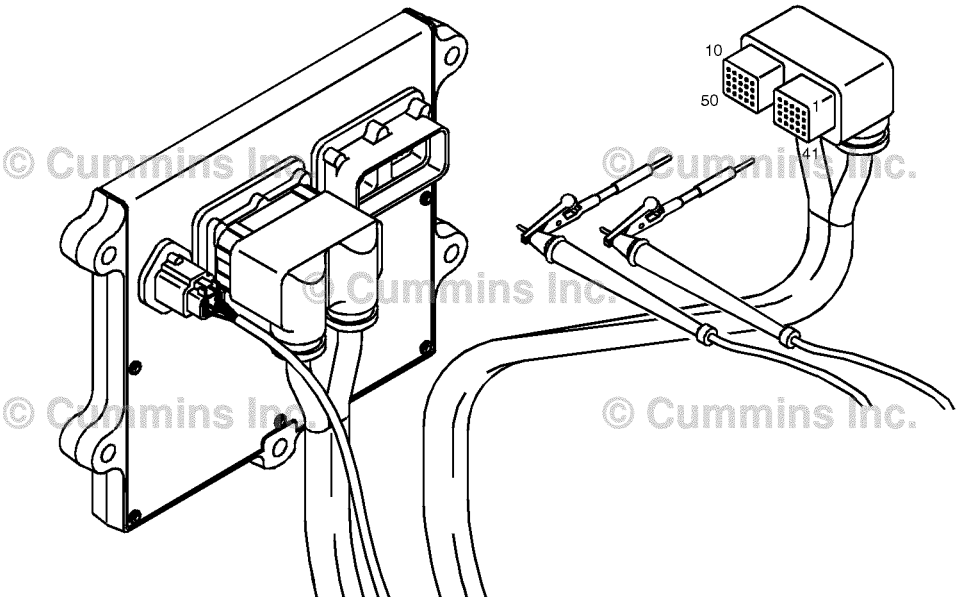
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the voltage between the idle validation on-idle SIGNAL pin in the SSS connector of the OEM harness to the switch RETURN pin in the SSS connector of the OEM harness.<br>• Measure the voltage between the idle validation off-idle SIGNAL pin in the SSS connector of the OEM harness to the switch RETURN pin in the SSS connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | Greater than 4.0-VDC?<br>**YES**<br>**Repair:**<br>Replace the SSS. Refer to the OEM service manual. | 3A |
| | Greater than 4.0-VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | Repair Complete |



**STEP 2B: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the SSS from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin in the OEM harenss.<br>• Measure the resistance and check for a short circuit between the idle validation on-idle SIGNAL pin and all other pins in the OEM harness ECM connector.<br>• Measure the resistance and check for a short circuit between the idle validation off-idle SIGNAL pin and all other pins in the OEM harness ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the SSS. Refer to the OEM service manual. | 3A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Turn the keyswitch ON and completely depress and release the accelerator pedal or lever three times.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that Fault Code 551 is inactive. | Fault Code 551 inactive?<br>**YES** | 3B |
| | Fault Code 551 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair location if all steps have been completed and checked again. | 1A |

### STEP 3B: Clear the inactive fault codes.

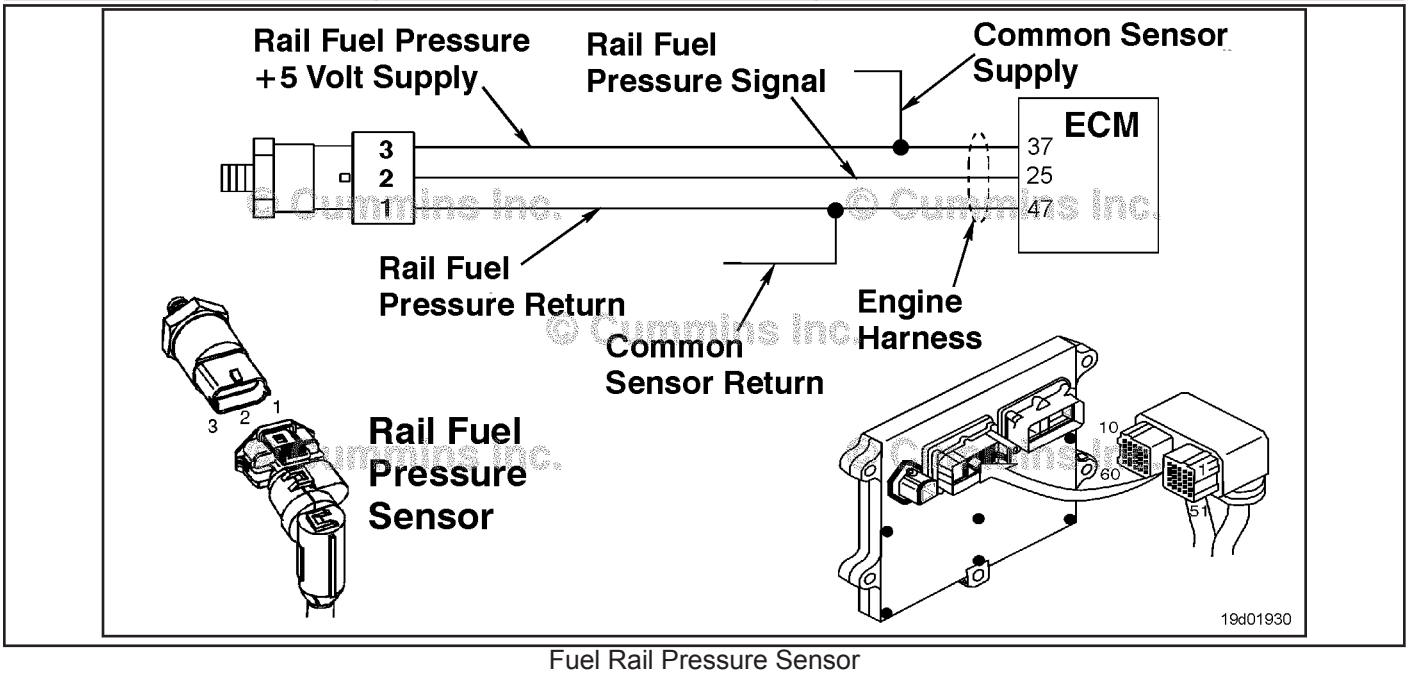
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair Complete. |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 553

## Injector Metering Rail 1 Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 553<br>PID(P), SID(S): P157<br>SPN: 157<br>FMI: 0/16<br>Lamp: Amber<br>SRT: | Injector Metering Rail 1 Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level. The ECM has detected that fuel pressure is higher than commanded pressure. | None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is reduced. |



Fuel Rail Pressure Sensor

**Circuit Description:**

The electronic control module (ECM) monitors engine operating conditions, including the reading of fuel rail pressure, and changes the flow command to either increase (open the fuel pump actuator) or decrease (close the fuel pump actuator) the fuel supply to the high pressure pump.

**Component Location:**

The fuel pump actuator is installed in the adapter on the back of the high-pressure pump.

**Shop Talk:**

A fuel pump actuator with excessive leakage or a damaged inboard o-ring will result in high fuel rail pressures at idle or light load.

If the fuel pump actuator exhibits excessive leakage, it is possible that the fuel rail pressure will reach the opening pressure of the fuel rail pressure relief valve and Fault Code 449 may also become active.

## Refer to Troubleshooting Fault Code t05-553

# FAULT CODE 553 - Injector Metering Rail 1 Pressure - Data Valid But Above Normal Operational Range - Moderately Severe Level

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for fuel pump actuator fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fault Codes 271, 272, 1117, or 2311 active or high inactive counts?** | |
| **STEP 2:** | **Check the rail fuel pressure sensor.** | | |
| **STEP 2A:** | **Monitor rail pressure with INSITE™ electronic service tool.** | **Is the fuel rail pressure 0 ± 43 bar [0 ± 624 psi]?** | |
| **STEP 3:** | **Check drain line restriction** | | |
| **STEP 3A:** | **Check drain line restriction.** | **Fuel drain line restriction is within the specifications outlined in Procedure 006-012?** | |
| **STEP 4:** | **Check the low pressure fuel system.** | | |
| **STEP 4A:** | **Check for excessive supply pump fuel pressure.** | **Is pressure greater than 1207 kPa [175 psi]?** | |
| **STEP 4B:** | **Check the fuel pump actuator.** | **Is the inboard o-ring cut or shaved?** | |
| **STEP 5:** | **Clear the fault code.** | | |
| **STEP 5A:** | **Disable the fault code.** | **Fault Code 553 inactive?** | |
| **STEP 5B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for fuel pump actuator fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 271, 272, 1117, or 2311 active or high inactive counts?<br>**YES** | Appropriate troubleshooti ng tree |
| | Fault Code 271, 272, 1117, or 2311 active or high inactive counts?<br>**NO** | 2A |

## STEP 2: Check the rail fuel pressure sensor.

### STEP 2A: Verify rail fuel pressure sensor accuracy.

**Condition:**
- Turn keyswitch ON
- Connect INSITE™ electronic service tool
- Run INSITE™ electronic service tool monitor
- Engine **not** running.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify rail fuel pressure sensor accuracy.<br>• Make sure the correct sensor part number is installed in the high-pressure fuel rail.<br>Monitor the fuel rail pressure.<br>• Use INSITE™ electronic service tool to measure fuel rail pressure. | Is the fuel pressure 0 ± 43 bar [0 ± 624 psi]?<br>**YES** | 3A |
| | Is the fuel pressure 0 ± 43 bar [0 ± 624 psi]?<br>**NO**<br>**Repair:**<br>Replace the rail fuel pressure sensor. Refer to Procedure 019-115 in Section 19. | 5A |

## STEP 3: Check drain line restriction.

### STEP 3A: Check drain line restriction.

**Condition:**
- Turn keyswitch ON
- Engine running.

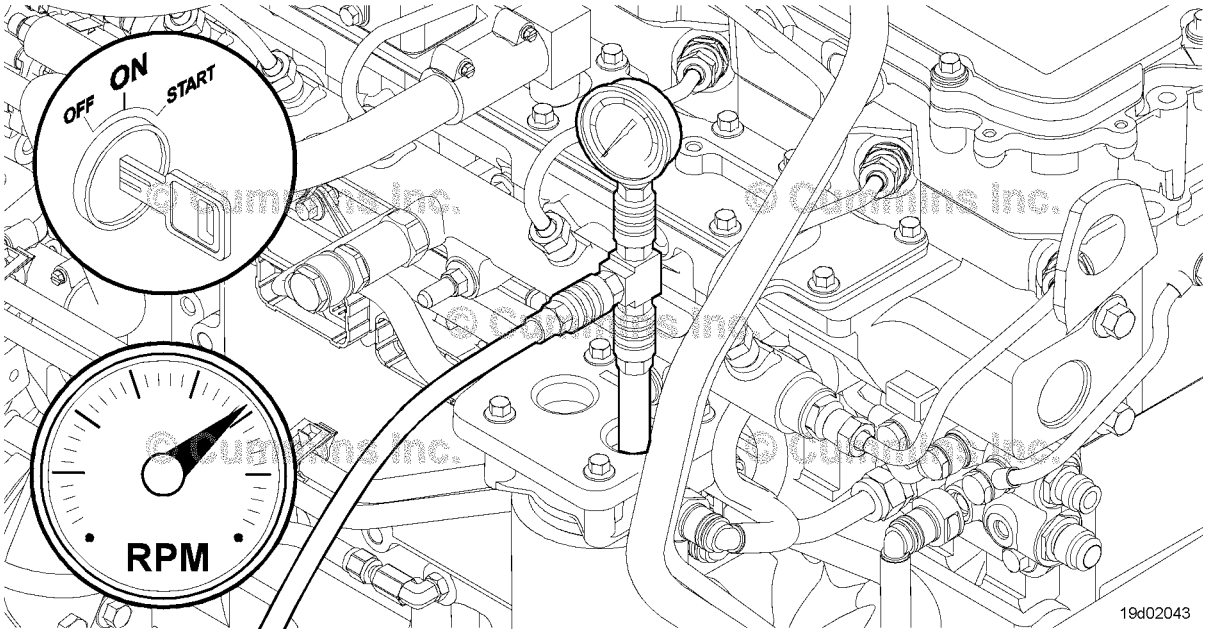
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for excessive fuel drain line restriction.<br>• Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-012 in Section 6.<br>• Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-012 in Section 6. | Fuel drain line restriction is within the specifications outlined in Procedure 006-012?<br>**YES** | 4A |
| | Fuel drain line restriction is within the specifications outlined in Procedure 006-012?<br>**NO**<br>**Repair:**<br>Repair the source of the high fuel drain line restriction.<br>• Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-012 in Section 6.<br>• Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-012 in Section 6. | 5A |

## STEP 4: Check the low pressure fuel system.

### STEP 4A: Check for excessive supply pump fuel pressure.

**Condition:**
- Engine running.

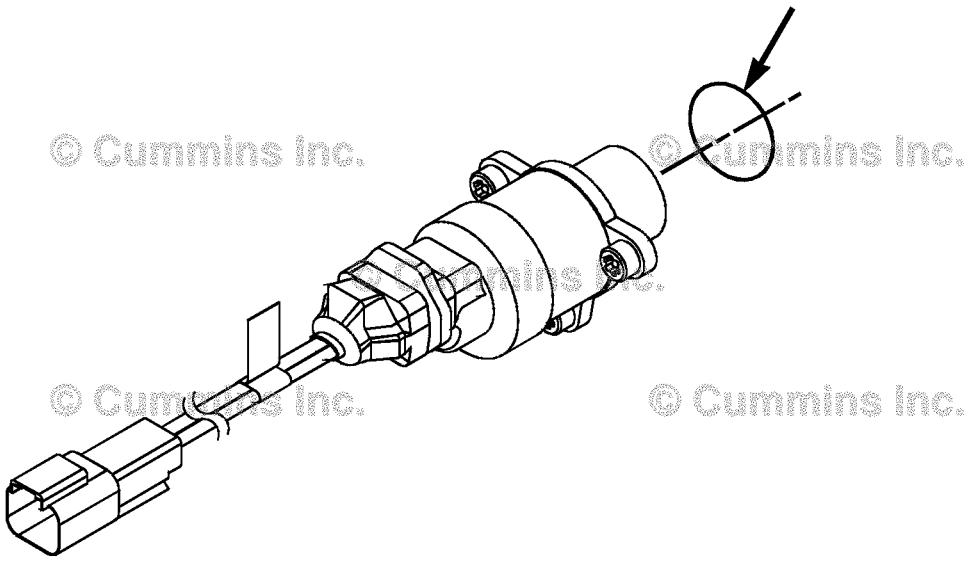
| Action | Specification/Repair | Next Step |
|---|---|---|
| Install an M10 standard thread o-ring diagnostic fitting, Part Number 3824842, at the pressure-side fuel filter outlet port.<br>Install a 0 to 2068 kPa [0 to 300 psi] pressure gauge at the outlet of the pressure side filter.<br>• Operate the engine at idle and measure the pressure at the gear pump outlet.<br>Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 005-025 in Section 5. | Is pressure greater than 1207 kPa [175 psi]?<br>**YES**<br>**Repair:**<br>Replace the fuel gear pump assembly. | 5A |
| | Is pressure greater than 1207 kPa [175 psi]?<br>**NO** | 4B |



**STEP 4B: Check the fuel pump actuator.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the fuel pump actuator.<br>Remove the fuel pump actuator. Refer to Procedure 019-117 in Section 19.<br>• Inspect the fuel pump actuator inboard o-ring. If this o-ring is cut or shaved, fuel may be permitted to bypass the fuel pump actuator and enter the high-pressure pump. | Is the inboard o-ring cut or shaved?<br>**YES**<br>**Repair:**<br>Replace the damaged o-ring. | 5A |
| | Is the inboard o-ring cut or shaved?<br>**NO**<br>**Repair:**<br>Replace the fuel pump actuator. Refer to Procedure 019-117 in Section 19. | 5A |



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## STEP 5: Clear the fault code.

**STEP 5A: Disable the fault code.**

**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let if idle for one minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 553 inactive?<br>**YES** | 5B |
| | Fault Code 553 inactive?<br>**NO** | 1A |

**STEP 5B: Clear the inactive fault codes.**

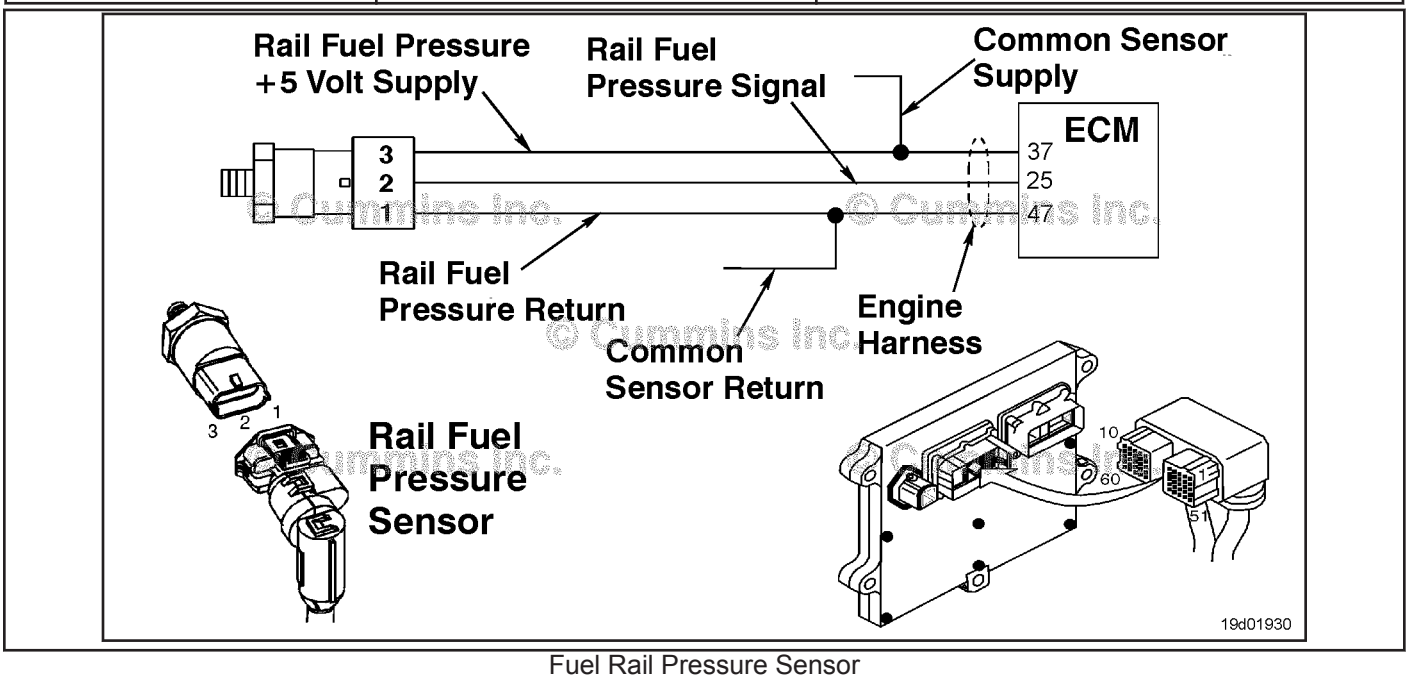
**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 554

## Injector Metering Rail 1 Pressure - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 554<br>PID(P), SID(S): P157<br>SPN: 157<br>FMI: 2<br>Lamp: Amber<br>SRT: | Injector Metering Rail 1 Pressure - Data Erratic, Intermittent, or Incorrect. the ECM has detected that the fuel pressure signal is **not** changing. | The ECM will estimate fuel pressure and power is reduced. |




Fuel Rail Pressure Sensor

**Circuit Description:**

The fuel pressure sensor contains supply, signal, and return pins. The electronic control module (ECM) provides +5 VDC to the fuel pressure sensor. This +5 VDC power supply is a shared supply. Other sensors on this circuit are the intake manifold pressure sensor and backup engine position sensor.

**Component Location:**

The fuel pressure sensor is located in the rail fuel on the air intake side of the engine. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code can become active any time the engine is loaded and the electronic control module (ECM) detects the fuel pressure in the rail fuel is not changing. This fault code will become inactive whenever the ECM is powered down or if the ECM detects that the engine is loaded and the fuel pressure is changing normally. If there are many inactive counts of this fault code or if the fault is not repeatable, look for signs of tampering to the fuel pressure sensor circuit. If the fault code occurs intermittently (can not be reproduced during a road test), then inspect each of the following for poor connections or damage:

- Intake manifold pressure sensor
- Backup engine position sensor
- Fuel pressure sensor.

## Refer to Troubleshooting Fault Code t05-554

# FAULT CODE 554 - Injector Metering Rail 1 Pressure - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for sensor circuit fault codes.** | | |
| **STEP 1A:** | **Check for Fault Codes 451 and 452** | **Fault Code 451 or 452 is active?** | |
| **STEP 2:** | **Check the rail fuel pressure sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the rail fuel pressure sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault Code 451 active?** | |
| **STEP 2C:** | **Check the circuit response.** | **Fault Code 452 active?** | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| **STEP 3A:** | **Inspect CM and engine harness connector pins.** | **Dirty or damaged pin?** | |
| **STEP 3B:** | **Check the circuit response.** | **Fault Code 451 active?** | |
| **STEP 3C:** | **Check the circuit response.** | **Fault Code 452 active?** | |
| **STEP 4:** | **Clear the fault code.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 554 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for sensor circuit fault codes.

**STEP 1A: Check for Fault Codes 451 and 452.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 451 or 452 is active?<br>**YES** | Appropriate troubleshooting tree. |
| | Fault Code 451 or 452 is active?<br>**NO** | 2A |

## STEP 2: Check the rail fuel pressure sensor and circuit.

### STEP 2A: Inspect the rail fuel pressure sensor and connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and rail fuel pressure sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

### STEP 2B: Check the circuit response.

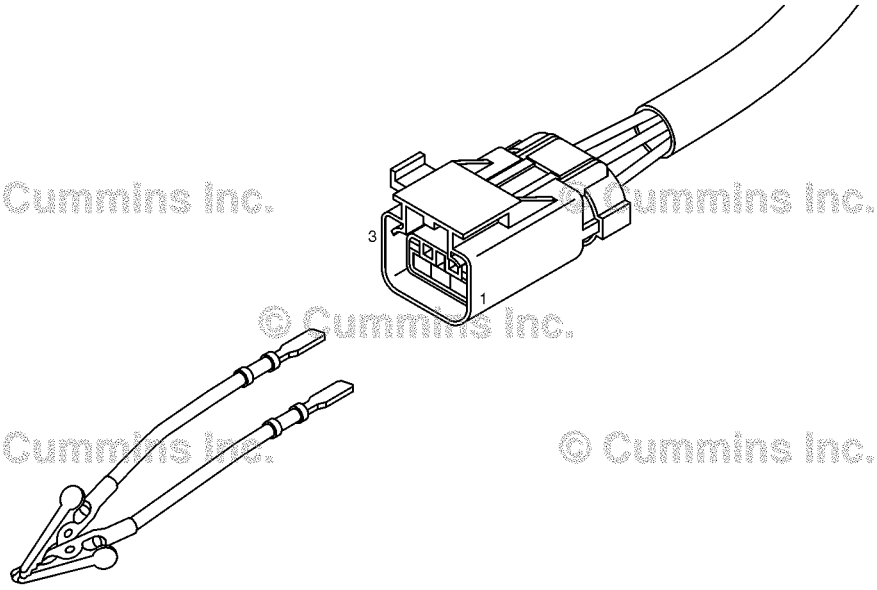
**Condition:**
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 451 active?<br>**YES** | 2C |
| | Fault Code 451 active?<br>**NO** | 3A |

**STEP 2C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the rail fuel pressure signal pin and the rail fuel pressure return pin at the rail fuel pressure connector of the engine harness.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 452 active?<br>**YES**<br>**Repair:**<br>Replace the rail fuel pressure sensor. Refer to Procedure 019-115 in Section 19. | 4A |
| | Fault Code 452 active?<br>**NO** | 3A |

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## STEP 3: Check the ECM and engine harness.

### STEP 3A: Inspect ECM and engine harness connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

### STEP 3B: Check the circuit response.

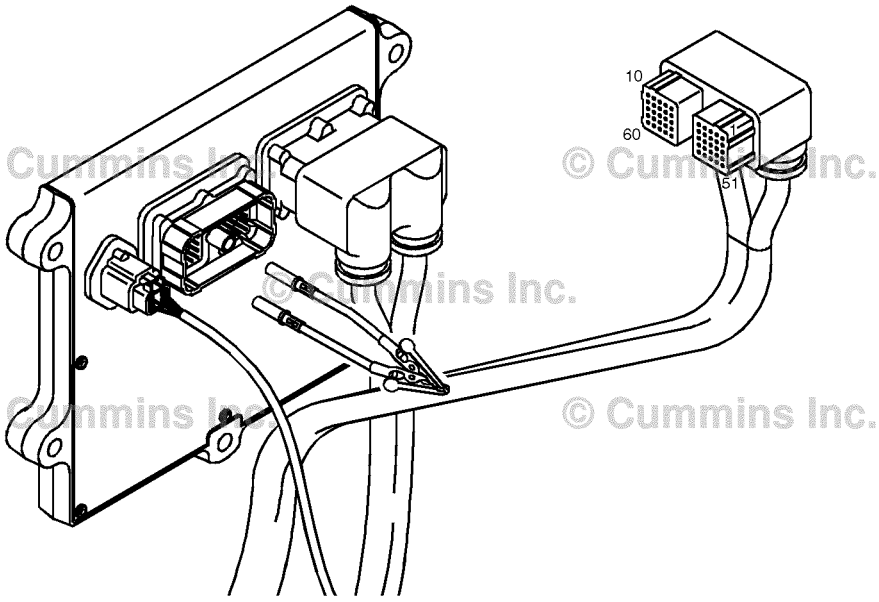
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 451 active?<br>**YES** | 3C |
| | Fault code 451 active?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the rail fule parssure SIGNAL pin and rail fuel pressure RETURN pin at the engine control module engine connector.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 452 active?<br>**YES**<br>**Repair:**<br>High resistance or a short circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |
| | Fault Code 452 active?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



## STEP 4: Clear the fault code.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine.<br>• Operate the engine under light load for two minutes.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 554 inactive?<br>**YES** | 4B |
| | Fault Code 554 inactive?<br>**NO** | 1A |

### STEP 3B: Clear the inactive fault codes.

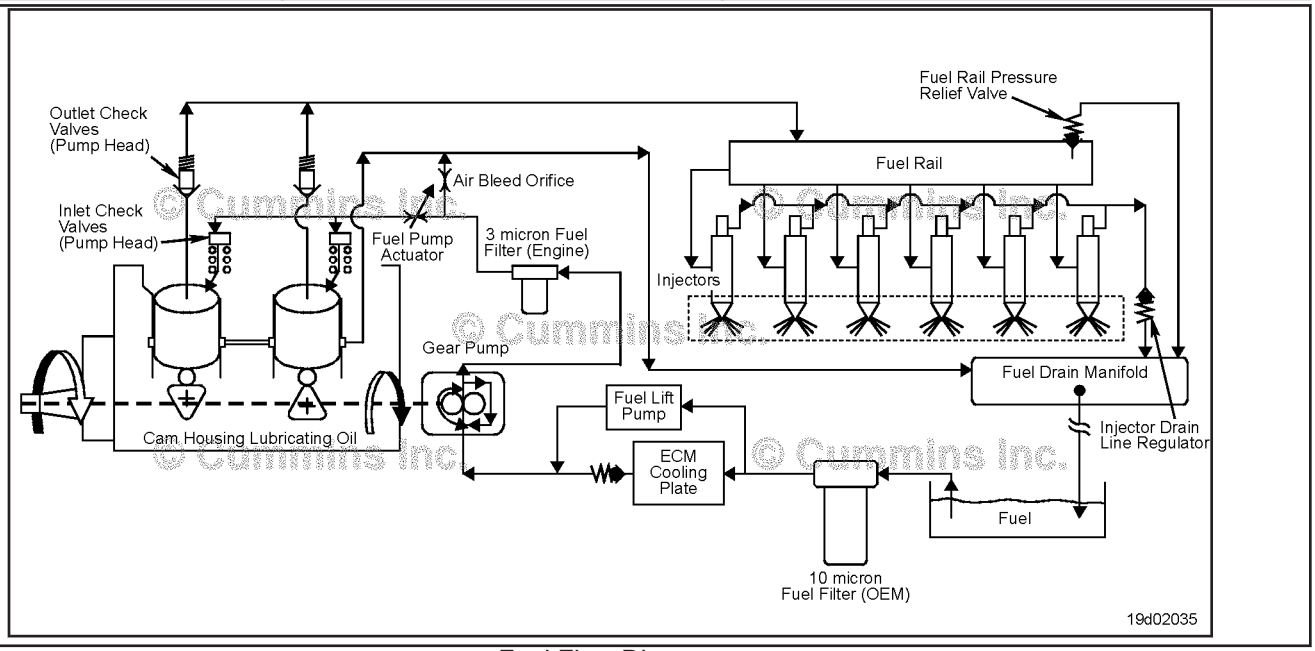
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All faults cleared?<br>**YES** | Repair complete. |
| | All faults cleared?<br>**NO** | Appropriate troubleshooting steps. |

# Fault Code 559 (ISB/QSB Automotive, Marine or Industrial Application)

## Fuel Pump Delivery Pressure Low - Data Valid but Below Normal Operational Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 559<br>PID(P), SID(S): P157<br>SPN: 157<br>FMI: 1/18<br>Lamp: Amber<br>SRT: | Fuel Pump Delivery Pressure Low - Data Valid but Below Normal Operational Range - Moderately Severe Level. The ECM has detected that fuel pressure is lower than commanded pressure. | Possibly hard to start, low power, or engine smoke. Engine can possibly **not** start. |




Fuel Flow Diagram

**Circuit Description:**

The fuel pressure control loop relies on fuel pressure supplied to the high-pressure pump by the electric lift pump and low-pressure pump. The ECM monitors rail fuel pressure and engine operating conditions and changes the flow command to maintain the proper rail fuel pressure. Changes to the flow command result in opening (or closing) of the electronic fuel control actuator to supply more (or less) fuel to the high-pressure pump.

The fuel flow circuit includes, in the following order of fuel flow:

- Fuel tank
- OEM fuel supply line
- OEM 300-micron filter
- ECM cooling plate
- Electric lift pump
- Fuel filter
- Gear pump
- Electronic fuel control actuator
- High-pressure fuel pump
- Rail fuel (includes fuel pressure relief dump valve and pressure sensor)
- High-pressure fuel lines
- High-pressure fuel connectors
- Injectors
- Return to tank.

**Component Location:**

The fuel pump is located at the rear of the engine, on the intake side of the engine. Use the foolowing procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

**Shop Talk:**

Causes of this fault code include the following:

- High inlet restriction
- Excessive air in fuel
- Loss of fuel prime during cranking
- Plugged fuel filter
- Low lift pump pressure
- Stuck or restricted electronic fuel control actuator
- System return (excessive return flow from the injector, high-pressure pump, or rail pressure relief valve)
- Tampering.

If the drain line is restricted completely, the high pressure fuel pump will be damaged, causing internal leakage. Prior to pump damage, fault codes indicative of a drain line restriction will occur. Following the damage, these fault codes will go inactive and Fault Code 559, which is indicative of leakage, will be active. If troubleshooting Fault Code 559 results in replacement of the pump and there are inactive counts of Fault Codes 553 or 449, the fuel drain line **must** be inspected and the fuel drain line restriction measured. This is to reduce the possibility of repeat high pressure pump damage.

## Refer to Troubleshooting Fault Code t05-559b

# FAULT CODE 559 (ISB/QSB Automotive, Marine or Industrial Application) - Fuel Pump Delivery Pressure Low - Data Valid But Below Normal Operating Range - Moderately Severe Level

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Read the fault codes. | Fault Code 2266 or 1911 active or high inactive counts? | |
| **STEP 2:** | **Check the operation of the low-pressure fuel system.** | | |
| STEP 2A: | Check for adequate fuel supply. | Equipment/vehicle has an adequate fuel supply? | |
| STEP 2B: | Check for an external fuel leak. | Fuel leaks present? | |
| **STEP 3:** | **Low pressure system checks.** | | |
| STEP 3A: | Measure the inlet restriction. | Inlet restriction meets specification? | |
| STEP 3B: | Check for electric lift pump. | Engine has an electrical lift pump? | |
| STEP 3C: | Measure the lift pump fuel flow. | Lift pump meets minimum specifications? | |
| STEP 3D: | Check for air in the fuel. | Air in the fuel? | |
| **STEP 4:** | **Check the fuel filter restriction.** | | |
| STEP 4A: | Measure the pressure drop across the fuel filter. | Drop in pressure meets specification? | |
| STEP 4B: | Measure the fuel filter outlet pressure. | Fuel filter outlet pressure meets specification? | |
| **STEP 5:** | **Check the high-pressure fuel system.** | | |
| STEP 5A: | Check for leakage from the fuel rail pressure relief valve. | Fuel return with specification? | |
| STEP 5B: | Check for excessive fuel return leakage from the high-pressure fuel system, injectors, and high-pressure connectors. | Fuel leakage within specification? | |
| STEP 5B-1: | Check the high-pressure connector (HPC) torque. | Injector high-pressure connector torque meets specifications? | |
| STEP 5B-2: | Check for individual leaking injectors. | One injector able to be identified to be causing the excessive return flow? | |
| STEP 5C: | Check for excessive fuel return from the high-pressure fuel pump. | Fuel return with specification? | |
| **STEP 6:** | **Clear the fault codes.** | | |
| STEP 6A: | Disable the fault code. | Fault codes inactive? | |
| STEP 6B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 2266 or 1911 active or high inactive counts?<br>**YES** | Troubleshoot applicable fault codes |
| | Fault Code 2266 or 1911 active or high inactive counts?<br>**NO** | 2A |

### STEP 2: Check the operation of the low-pressure fuel system.

**STEP 2A: Check for adequate fuel supply.**

**Condition:**
- Turn keyswitch ON.
- Turn engine OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for adequate fuel supply<br>• Do **not** rely on the vehicle's fuel gauge. Verify there is fuel in the tank.<br>• Check the equipment/vehicle fuel gauge.<br>• Inspect the fuel tank if there is any doubt about the accuracy of the fuel gauge. | Equipment/vehicle has an adequate fuel supply?<br>**YES** | 2B |
| | Equipment/vehicle has an adequate fuel supply?<br>**NO**<br>**Repair:**<br>Add fuel to the fuel tank or perform repairs to the vehicle's tank or fuel gauge. | 6A |

**STEP 2B: Check for an external fuel leak.**

**Condition:**
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for external fuel leaks.<br>• Start the engine and let it idle.<br>• Inspect for external fuel leaks. | Fuel leaks present?<br>**YES**<br>**Repair:**<br>Locate and repair the source of the external fuel leak. | 6A |
| | Fuel leaks present?<br>**NO** | 3A |

## STEP 3: Low pressure system checks.

**STEP 3A: Measure inlet restriction.**

**Condition:**
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the inlet restriction.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-020 in Section 6. | Inlet restriction meets specification?<br>**YES** | 3B |
| | Inlet restriction meets specification?<br>**NO**<br>**Repair:**<br>The inlet restriction may be caused by a dirty OEM fuel filter, a bent fuel line, or debris in fuel tank. Identify and repair the cause of the inlet restriction. | 6A |

**STEP 3B: Check for electric lift pump.**

**Condition:**
- Turn keyswitch OFF.
- Engine OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Determine if the engine is equipped with an electrical lift pump. | Engine has an electrical lift pump?<br>**YES** | 3C |
| | Engine has an electrical lift pump?<br>**NO** | 3D |

**STEP 3C: Measure the lift pump fuel flow.**

**Condition:**
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the lift pump fuel flow.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271, for measuring the lift pump flow. Refer to Procedure 005-045 in Section 5. | Lift pump meets minimum specifications?<br>**YES** | 3D |
| | Lift pump meets minimum specifications?<br>**NO**<br>**Repair:**<br>Replace the electric fuel lift pump.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 005-045 in Section 5. | 6A |

**STEP 3D: Check for air in the fuel.**

**Condition:**
- Turn keyswitch ON.
- Operate engine.

This test can **not** be performed if the engine will **not** start. If the engine will **not** start, proceed to the next step.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for air in the fuel.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271, for checking for air in the fuel. Refer to Procedure 006-003 in Section 6. | Air in the fuel?<br>**YES**<br>**Repair:**<br>Address the source of air.<br>A few bubbles exiting the line during the test is expected.<br>A foamy appearance is an indication of a leak that allows air to enter, a severe inlet restriction that causes cavitation, or a system that is **not** yet primed. The source of air entry can be isolated to one of the following locations:<br>• Suction fuel lines<br>• OEM fuel lines<br>• Suction-side fuel filter assemblies<br>• Stand-pipes in the fuel tank(s). | 6A |
| | Air in the fuel?<br>**NO** | 4A |

## STEP 4: Check the fuel filter restriction.

### STEP 4A: Measure the pressure drop across the fuel filter.

**Condition:**
- Turn keyswitch ON.
- Run the engine at rated condition.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the pressure drop across the fuel filter.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-015 in Section 6. | Drop in pressure meets specification?<br>**YES** | 4B |
| | Drop in pressure meets specification?<br>**NO**<br>**Repair:**<br>Replace the pressure-side filter and verify the pressure side fuel lines are **not** restricted. | 6A |

### STEP 4B: Measure the fuel filter outlet pressure.

**Condition:**
- Turn keyswitch ON.
- Run the engine at rated condition.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify the fuel filter outlet pressure measured in the previous step meets specification.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-015 in Section 6. | Fuel filter outlet pressure meets specification?<br>**YES** | 5A |
| | Fuel filter outlet pressure meets specification?<br>**NO**<br>**Repair:**<br>Replace the high-pressure pump. | 6A |

## STEP 5: Check the high-pressure fuel system.

### STEP 5A: Check for leakage from the fuel rail pressure relief valve.

**Condition:**
- Turn keyswitch OFF.
- Install test fittings to measure the fuel return from the fuel rail pressure relief valve.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for leakage from the fuel rail pressure relief valve.<br>• Install test fittings to measure the fuel return.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure Procedure 006-061 in Section 6. | Fuel return within specification?<br>**YES** | 5B |
| | Fuel return within specification?<br>**NO**<br>**Repair:**<br>Replace the rail fuel pressure relief valve.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure Procedure 006-061 in Section 6. | 6A |

### STEP 5B: Check for excessive fuel return leakage from the high-pressure fuel system, injector, and high-pressure connectors.

**Condition:**
- Turn keyswitch OFF.
- Install test fittings to measure the fuel return from the injectors and high-pressure connectors.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for excessive fuel leakage from the injectors and high-pressure connectors.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6. | Fuel leakage within specification?<br>**YES** | 5C |
| | Fuel leakage within specification?<br>**NO** | 5B-1 |

**STEP 5B-1: Check the high-pressure connector (HPC) torque.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the injector high-pressure connector torque.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-052 in Section 6. | Injector high-pressure connector torque meets specifications?<br>**YES** | 5B-2 |
| | Injector high-pressure connector torque meets specifications?<br>**NO**<br>**Repair:**<br>Tighten the injector high-pressure connector.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-052 in Section 6.<br>Check the injector return flow again. | 5B |

**STEP 5B-2: Check for individual leaking injectors.**

**Condition:**
- Turn keyswitch ON.
- Operate the engine at idle.
- Make sure INSITE™ electronic service tool Fuel System Leakage Test is ACTIVE.

This test can be performed if the engine will **not** start.

If the engine will **not** start, perform this test while cranking the engine.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a fuel leak at individual injectors.<br>• Cap off each injector, one at a time, with the injector leakage isolation tool. The service tool **must** be installed with the engine OFF.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6. | One injector able to be identified to be causing the excessive return flow?<br>**YES**<br>**Repair:**<br>Replace the injector for the cylinder that is causing the high injector return flow.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6. | 6A |
| | One injector able to be identified to be causing the excessive return flow?<br>**NO**<br>**Repair:**<br>Cap off additional injectors to identify the source of high injector return flow. Replace the injector for the cylinder(s) causing the high injector return flow.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6. | 5B |

**STEP 5C: Check for excessive fuel return from the high-pressure fuel pump.**

**Condition:**
- Turn keyswitch OFF.
- Install test fittings to measure the fuel return from the high-pressure fuel pump.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for excessive fuel return from the high-pressure fuel pump.<br>• Install test fittings to measure the fuel return from the fuel pump.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 005-016 in Section 5. | Fuel return within specification?<br>**YES** | 6A |
| | Fuel return within specification?<br>**NO**<br>**Repair:**<br>Replace the high-pressure fuel pump.<br>• Reference the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 005-016 in Section 5. | 6A |

## STEP 6: Clear the fault codes.

**STEP 6A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Verify the fault codes are inactive. | Fault codes inactive?<br>**YES** | 6B |
| | Fault codes inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

**STEP 6B: Clear the inactive fault codes.**

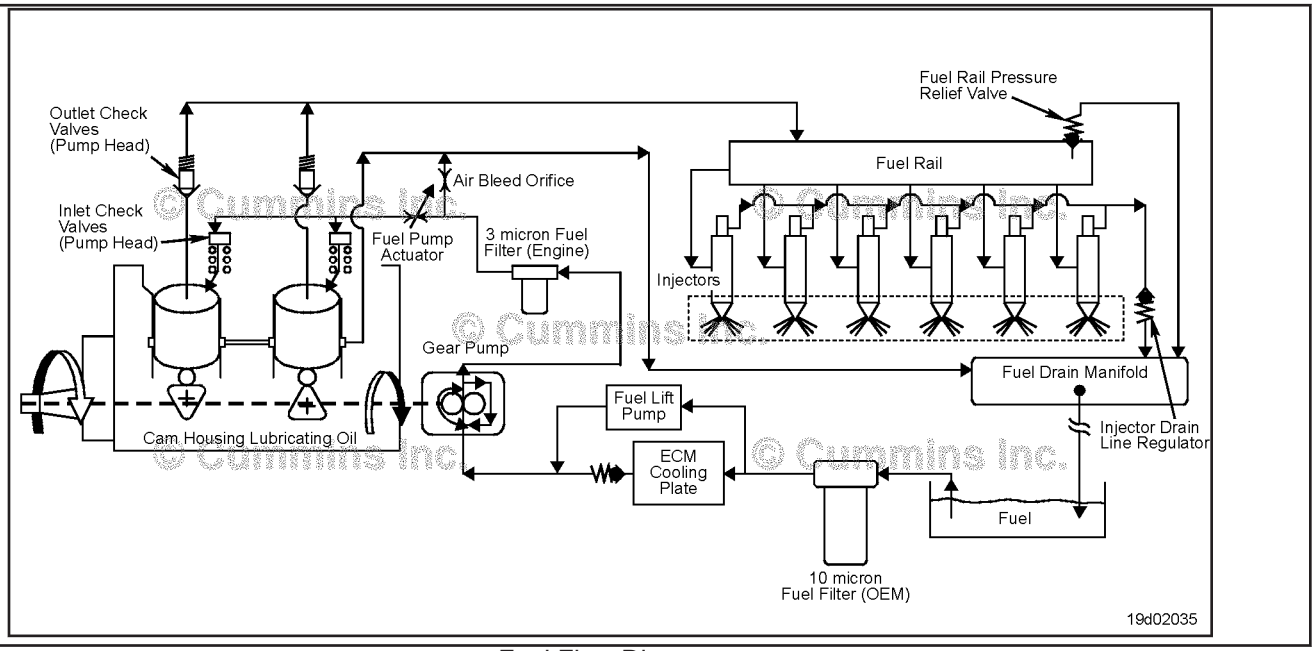
**Condition:**
- Connect all components.
- Perform a 15 to 20 minute road test or run the engine on the dynamometer.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 559 (ISC/QSC/ISL/QSL Automotive, Industrial, or Marine Application)

## Injector Metering Rail 1 Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 559<br>PID(P), SID(S): P94<br>SPN: 94<br>FMI: 0/18<br>Lamp: Yellow<br>SRT: | Injector Metering Rail 1 Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level. The ECM has detected that fuel pressure is lower than commanded pressure. | Possibly hard to start, low power, or engine smoke. |




Fuel Flow Diagram

**Circuit Description:**

The pressure control loop relies on fuel pressure supplied to the high-pressure pump by the fuel gear pump. The electronic control module (ECM) monitors rail fuel pressure and engine operating conditions and changes the flow command to maintain the proper rail fuel pressure. Changes to the flow command result in opening (or closing) of the fuel pump actuator to supply more (or less) fuel to the high-pressure pump.

The fuel flow circuit includes, in the following order:

- OEM fuel tank
- OEM fuel supply line
- Water stripping fuel filter (10 micron, water stripping, suction side fuel filter)
- Engine mounted OEM fuel connection
- Fuel supply tube to ECM cooling plate
- ECM cooling plate
- Fuel supply tube to the low-pressure gear pump
- Fuel supply tube to the pressure-side fuel filter
- Primary fuel filter (3 micron pressure-side fuel filter)
- Fuel supply tube to the high-pressure pump
- High-pressure pump
- High-pressure system (including fuel rail and fuel rail pressure relief valve), injectors, and high-pressure lines.

**Component Location:**

The high-pressure fuel pump is mounted to the gear housing on the intake side of the engine. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

**Shop Talk:**

The troubleshooting steps for Fault Code 559 and Fault Code 2215 are the same.

For all active and non-active Fault Code 559 troubleshooting, reference Fault Code 2215 troubleshooting tree.

## Refer to Troubleshooting Fault Code t05-559

## TROUBLESHOOTING SUMMARY

| STEPS | SPECIFICATIONS | SRT CODE |
|---|---|---|
| **STEP 1: Check the fault codes.** | | |
| **STEP 1A: Read the fault codes.** | **Fault Code 559 active or has high inactive counts?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

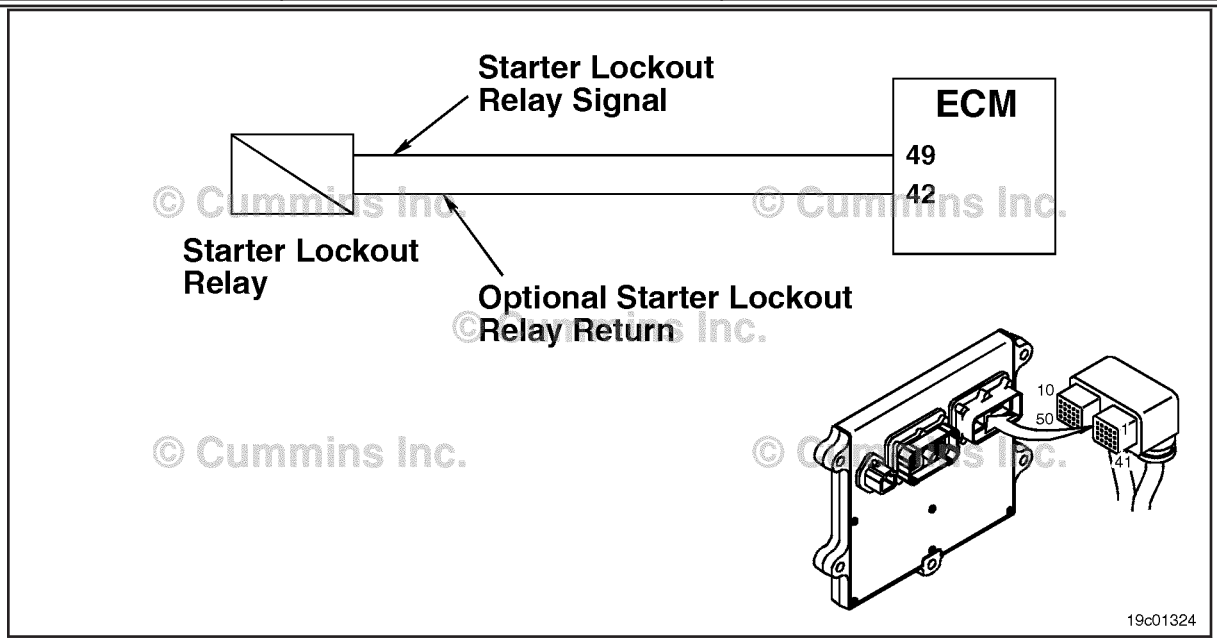
**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 559 is active or has high inactive counts?<br>**YES** | Go to Fault Code 2215 troubleshooting tree. |
| | Fault Code 559 is active or has high inactive counts?<br>**NO** | Repair complete |

# Fault Code 584

## Starter Relay Circuit - Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 584<br>PID(P), SID(S): S39<br>SPN: 677<br>FMI: 3/3<br>Lamp: Amber<br>SRT: | Starter Relay Circuit - Voltage Above Normal or Shorted to High Source. Open circuit or high voltage detected at starter lockout circuit. | Either the engine will **not** start or the engine will **not** have starter lockout protection. |




Starter Relay Circuit

**Circuit Description:**

The starter lockout relay is controlled by the ECM through the starter lockout relay signal circuit. The relay prevents the starter from being engaged when the engine is running. The relay return circuit is dependent on OEM wiring. It may be wired back to the ECM on some vehicles or wired to chassis or block ground on others. Consult the OEM wiring diagram for return circuit details.

**Component Location:**

The starter lockout relay is installed by the vehicle OEM. Refer to the OEM service manual for exact location.

**Shop Talk:**

The ECM monitors the voltage level on this circuit. If it detects a voltage when the signal is commanded off, it records this fault code.This fault can be caused by:

- Open circuit in the starter lockout relay, OEM harness, or connectors
- Short circuit to a voltage source in the OEM harness or relay.

## Refer to Troubleshooting Fault Code t05-584

# FAULT CODE 584 - Starter Relay Circuit - Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an inactive fault code.** | **Fault Code 584 active?** | |
| **STEP 2:** | **Check the starter lockout relay circuit.** | | |
| **STEP 2A:** | **Inspect the starter lockout relay and connector pins.** | | |
| **STEP 2B:** | **Check the resistance of the starter lockout relay.** | **Less than 10k ohms?** | |
| **STEP 2C:** | **Check for an open circuit in the starter lockout relay return circuit.** | **Less than 10 ohms?** | |
| **STEP 3:** | **Check the ECM and OEM harness.** | | |
| **STEP 3A:** | **Inspect ECM and OEM harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check for an open circuit in OEM harness.** | **Less than 10 ohms?** | |
| **STEP 3C:** | **Check for a pin-to-pin short circuit in the OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 3D:** | **Check for an inactive fault code.** | **Fault Code 584 inactive?** | |
| **STEP 4:** | **Clear the fault codes** | | |
| **STEP 4A:** | **Disable the fault code** | **Fault Code 584 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an inactive fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 584 inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 584 inactive?<br>**NO** | 2A |

### STEP 2: Check the starter lockout relay circuit.

**STEP 2A: Inspect the starter lockout relay and connector pins.**

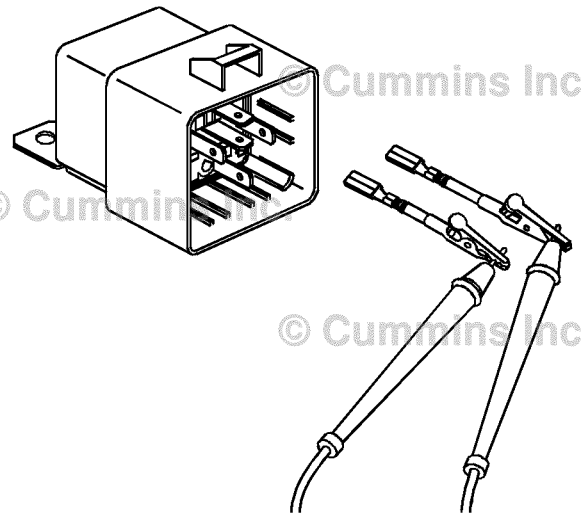
**Condition:**
- Turn keyswitch OFF.
- Disconnect the starter relay from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM starter relay and connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the resistance of the starter lockout relay.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the starter lockout relay from the OEM harness.

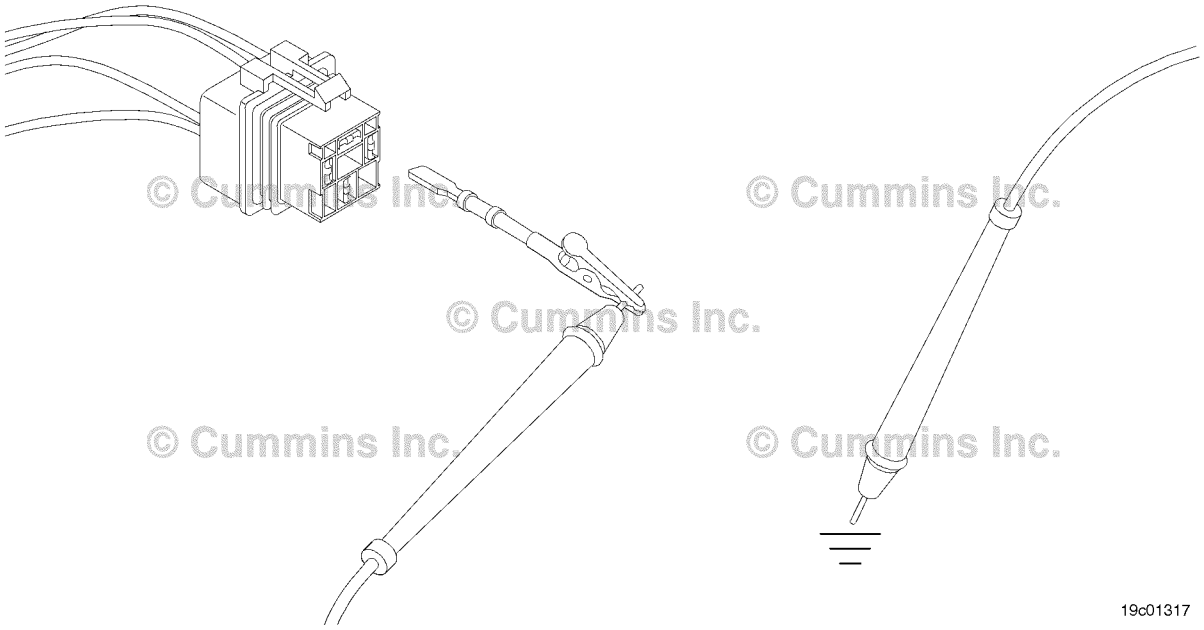
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the starter lockout relay resistance.<br>• Measure the resistance between the starter lockout relay SIGNAL pin and the starter lockout relay RETURN pin.<br>Refer to the OEM wiring diagram for starter relay pin configuration.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10k ohms?<br>**YES** | 2C |
| | Less than 10k ohms?<br>**NO**<br>**Repair:**<br>Replace the starter lockout relay. Refer to the OEM service manual. | 4A |



**STEP 2C: Check for an open circuit in the starter lockout relay return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the starter lockout relay from the OEM harness.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the starter lockout relay RETURN pin at the starter lockout relay connector to ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3A |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open circuit on the RETURN wire has been detected. Refer to the OEM wiring diagram for RETURN wire configuration.<br>If the RETURN is wired to the ECM, repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.<br>If the RETURN wire is grounded to the chassis or engine block ground, repair the source of the failed connection.<br>Clean, repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 3: Check the ECM and OEM harness.

### STEP 3A: Inspect ECM and OEM harness connector pins.

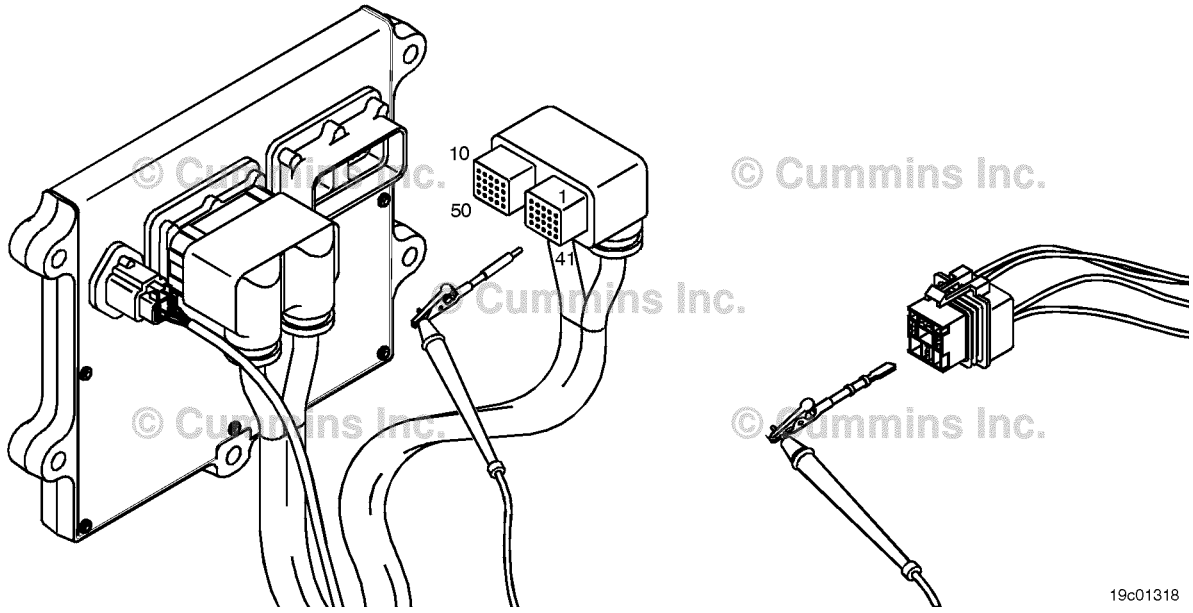
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for an open circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the starter lockout relay from the OEM harness.

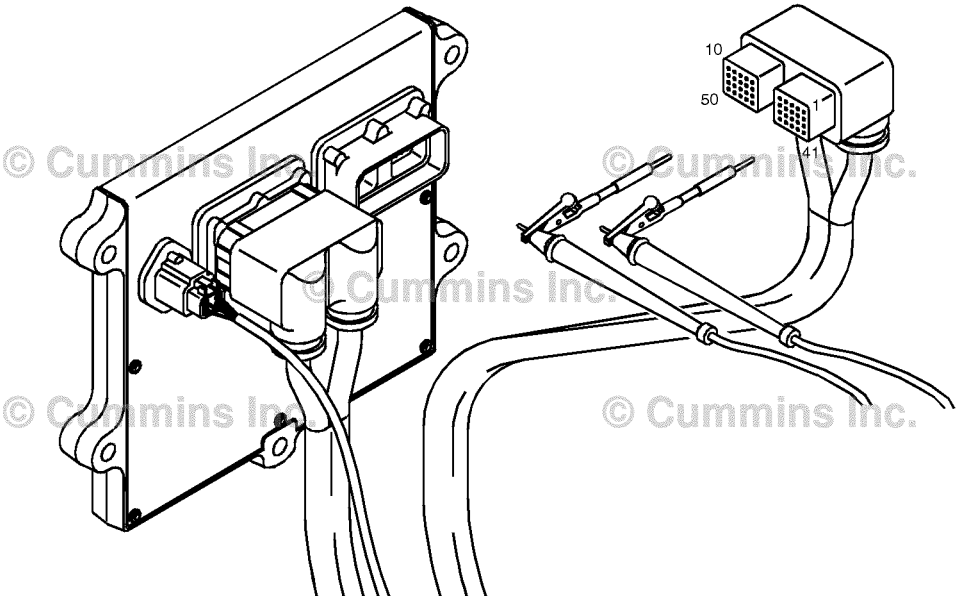
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the starter lockout relay SIGNAL pin at the starter lockout relay connector and the starter lockout relay SIGNAL pin at the OEM harness ECM connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open circuit in the starter lockout relay SIGNAL line has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the starter lockout relay from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the starter lockout relay SIGNAL pin in the OEM ECM connector and all other pins in the OEM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the output device driver SIGNAL line has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 584 inactive?<br>**YES**<br>**Repair:**<br>None.<br>The removal and installation of the connector corrected the fault. | 4A |
| | Fault Code 584 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 584 inactive?<br>**YES** | 4B |
| | Fault Code 584 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

**STEP 4B: Clear the inactive fault codes.**

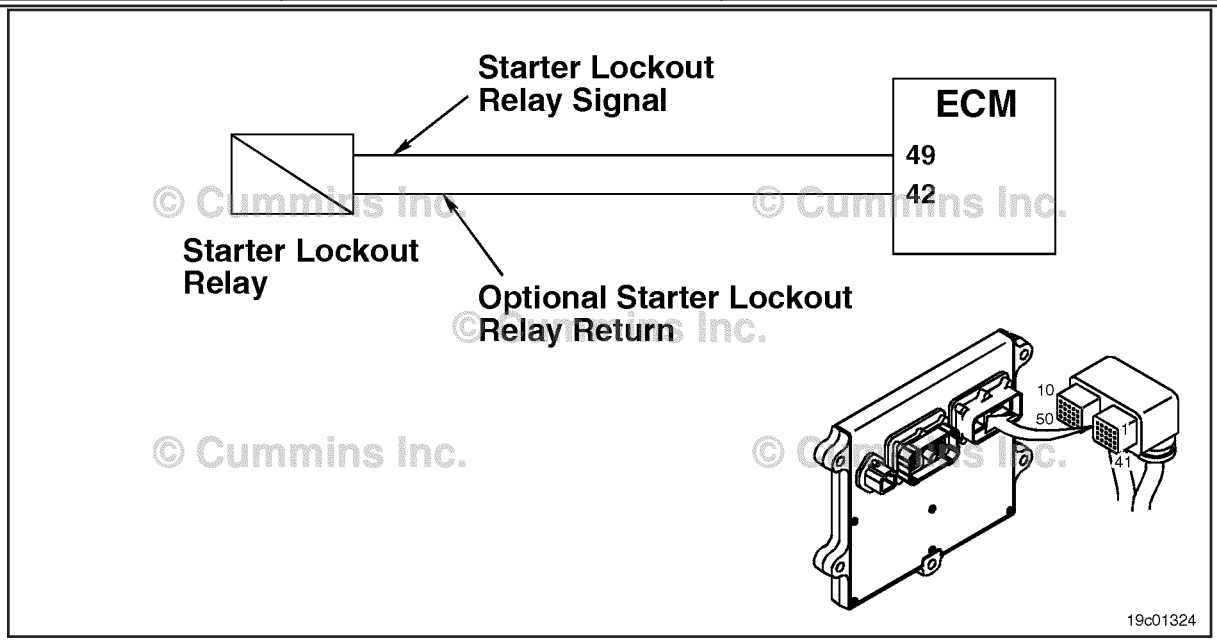
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool, to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 585

## Starter Relay Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 585<br>PID(P), SID(S): S39<br>SPN: 677<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Starter Relay Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected at starter lockout circuit. | The engine will **not** have starter lockout protection. |




Starter Relay Circuit

**Circuit Description:**

The starter lockout relay is controlled by the electronic control module (ECM) through the starter lockout relay signal circuit. The relay prevents the starter from being engaged when the engine is running. The relay return circuit is dependent on OEM wiring. It may be wired back to the ECM on some vehicles or wired to chassis or block ground on others. Consult the OEM wiring diagram for return circuit details.

**Component Location:**

The starter lockout relay is installed by the vehicle OEM. Refer to OEM service manual for exact location.

**Shop Talk:**

The ECM monitors the voltage level on this circuit. If it detects a low voltage when the signal is commanded on, it records this fault code. This fault code can be caused by a short circuit to ground in the starter lockout relay, OEM harness, or connectors.

## Refer to Troubleshooting Fault Code t05-585

# FAULT CODE 585 - Starter Relay Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for an active fault code. | Fault Code 585 active? | |
| **STEP 2:** | **Check starter lockout relay and circuit.** | | |
| STEP 2A: | Inspect starter relay and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the starter lockout relay resistance. | Greater than 6 ohms? | |
| STEP 2B-1: | Check for a pin to ground short circuit in the starter lockout relay. | Greater than 100k ohms? | |
| STEP 2C: | Check the starter lockout relay diagnostic supply voltage, supply line and return circuit. | Greater than 3.75-VDC? | |
| **STEP 3:** | **Check the OEM harness.** | | |
| STEP 3A: | Inspect ECM and OEM harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check for a short circuit to ground in the OEM harness. | Greater than 100k ohms? | |
| STEP 3C: | Check for a pin-to-pin short circuit in the OEM harness. | Greater than 100k ohms? | |
| STEP 3D: | Check for an inactive fault code. | Fault Code 585 is inactive? | |
| **STEP 4:** | **Clear the fault codes.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 585 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All faults cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 585 active?<br>**YES** | 2A |
| | Fault Code 585 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check starter lockout relay and circuit.

**STEP 2A: Inspect starter relay and connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the starter relay from the OEM harness.

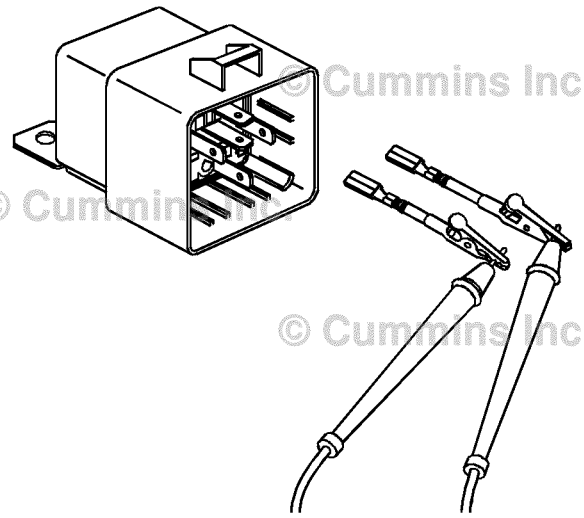
| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM starter relay and connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the starter lockout relay resistance.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the starter lockout relay from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the resistance of the relay coil and check for low resistance between the starter lockout relay SIGNAL pin and the relay RETURN pin.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 6 ohms?<br>**YES** | 2B-1 |
| | Greater than 6 ohms?<br>**NO**<br>**Repair:**<br>Replace the starter lockout relay. Refer to the OEM service manual. | 4A |





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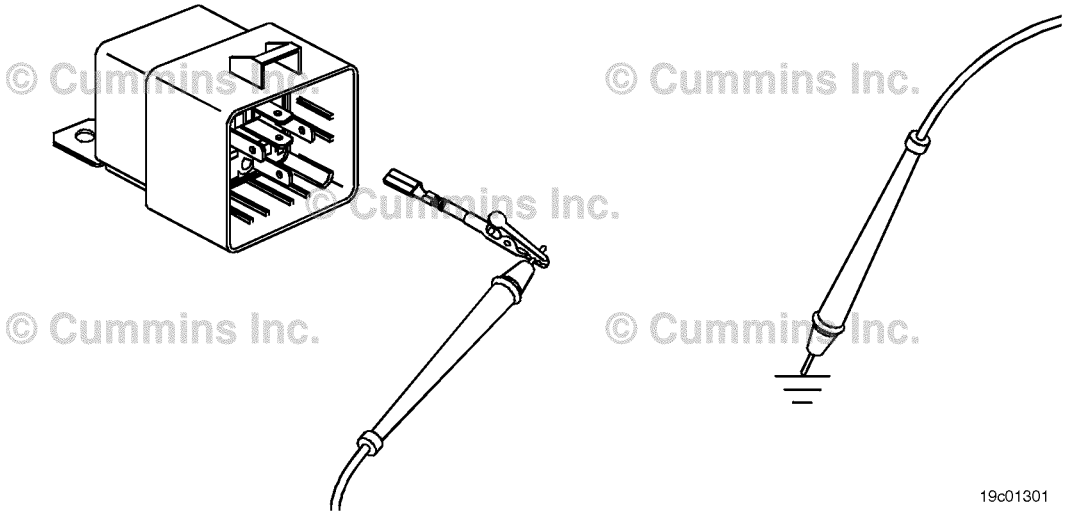
**STEP 2B-1: Check for a pin to ground short circuit in the starter lockout relay.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the starter lockout relay from the OEM harness.

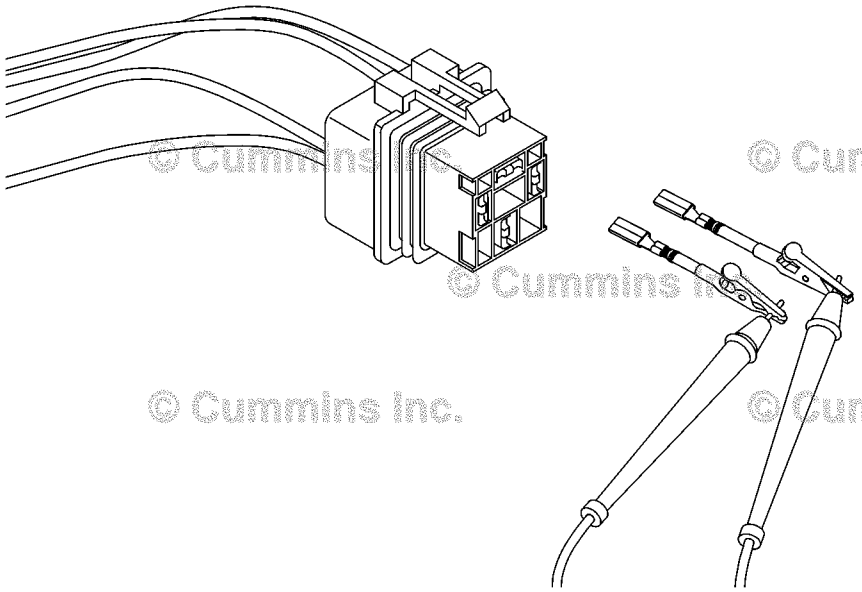
| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the resistance and check for a short circuit between the starter lockout relay SIGNAL pin and ground.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2C |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Replace the starter lockout relay. Refer to the OEM service manual. | 4A |



**STEP 2C: Check the starter lockout relay diagnostic supply voltage, supply line and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the starter lockout relay from the OEM harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the starter lockout relay diagnostic supply voltage and return circuit.<br>• Measure the voltage between the starter lockout relay SIGNAL pin and the starter lockout relay RETURN pin at the starter lockout relay connector of the OEM harness. | Greater than 3.75-VDC?<br>**YES** | 3C |
| | Greater than 3.75-VDC?<br>**NO** | 3A |



## STEP 3: Check the OEM harness.

### STEP 3A: Inspect ECM and OEM harness connector pins.

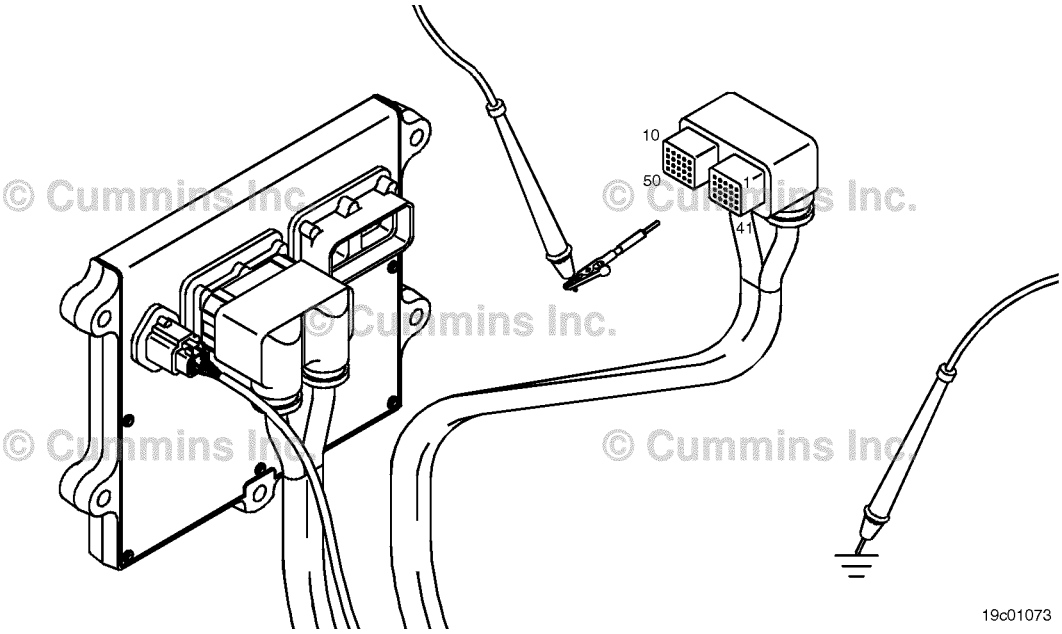
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for a short circuit to ground in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the starter lockout relay from the OEM harness.
- Disconnect the OEM harness from the ECM.

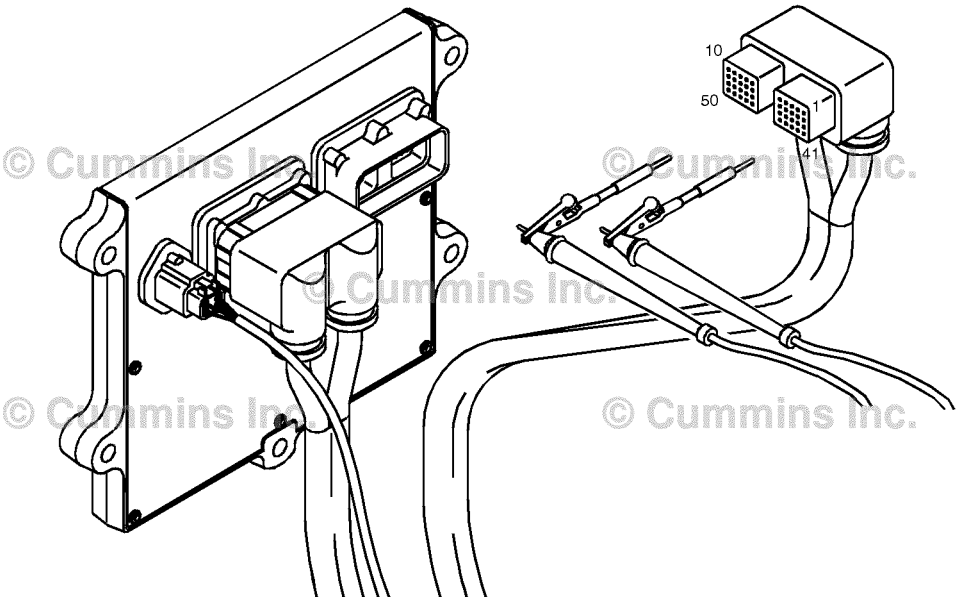
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground in the OEM harness.<br>• Measure the resistance between the starter lockout relay SIGNAL pin in the OEM harness ECM connector and ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3C |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the starter lockout relay from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the resistance and check for a short circuit between the starter lockout relay SIGNAL pin and all other pins in the OEM harness ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



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**STEP 3D: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 585 is inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector correct the fault. | 4A |
| | Fault Code 585 is inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 585 inactive?<br>**YES** | 4B |
| | Fault Code 585 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

**STEP 4B: Clear the inactive fault codes.**

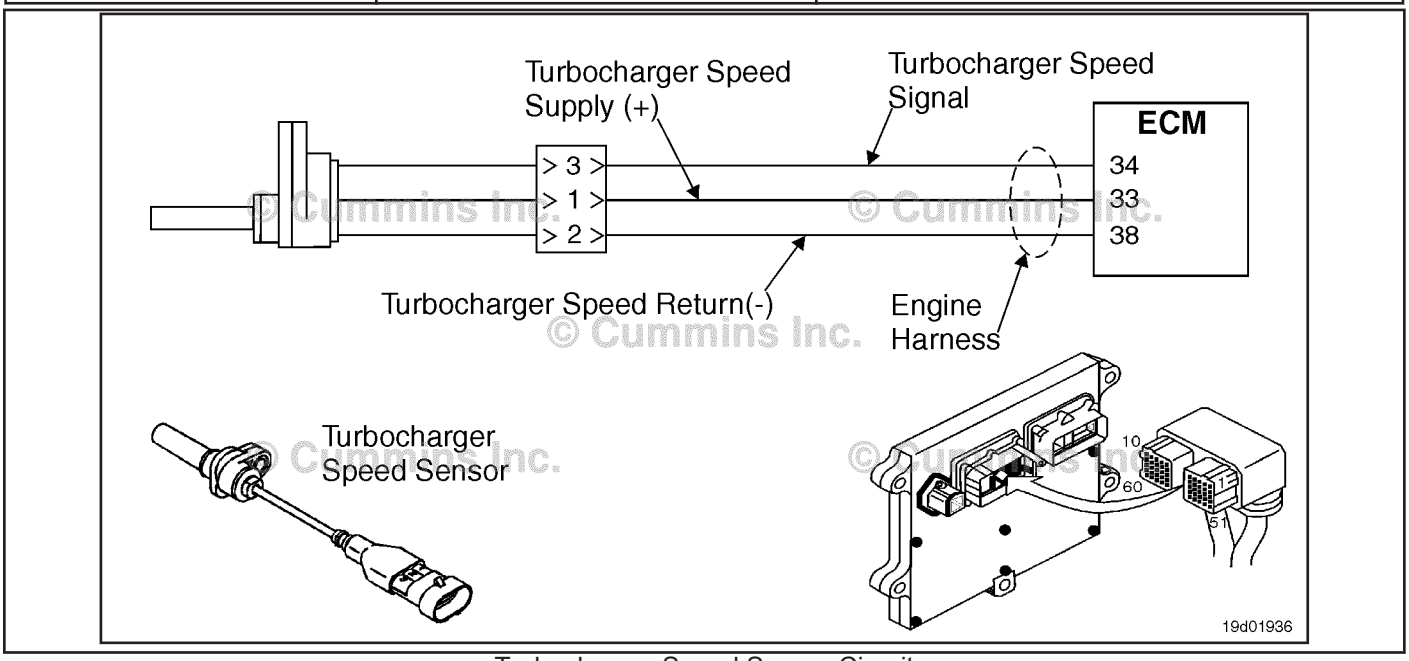
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 595 (ISB/QSB Automotive or Industrial Application)

## Turbocharger Number 1 Speed High - Warning Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 595<br>PID(P), SID(S): P103<br>SPN: 103<br>FMI: 0<br>Lamp: Amber<br>SRT: | Turbocharger Number 1 speed high - warning level. High turbocharger speed has been detected. | Engine power derate. The ECM uses an estimated turbocharger speed. |




Turbocharger Speed Sensor Circuit

**Circuit Description:**

The electronic control module (ECM) provides +5 VDC to the turbocharger speed sensor signal pin. Circuitry inside the turbocharger speed sensor detects the movement of the turbocharger compressor blades and produces a speed signal. This signal is used by the ECM for engine controls.

**Component Location:**

The turbocharger speed sensor is located in the turbocharger compressor housing. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code becomes inactive at key-on or any time the ECM detects a valid turbocharger speed signal. One cause of this fault code is high-frequency electrical noise. If the fault occurs intermittently, check the circuit and the sensor pigtail connector for opens or short circuits.

## Refer to Troubleshooting Fault Code t05-595

# FAULT CODE 595 (ISB/QSB Automotive or Industrial Application) - Turbocharger Number 1 Speed High - Warning Level

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for sensor supply fault codes.** | **Fault Code 352 active or has inactive counts?** | |
| **STEP 1B:** | **Check for an active fault code.** | **Fault Code 595 active?** | |
| **STEP 2:** | **Check the sensor and engine harness.** | | |
| **STEP 2A:** | **Inspect the engine harness and sensor harness connector pins.** | **Dirty or damaged pins or damaged components?** | |
| **STEP 2B:** | **Check for an open circuit.** | **Less than 10 ohms?** | |
| **STEP 2C:** | **Check for a short circuit to ground.** | **Greater than 100k ohms?** | |
| **STEP 2D:** | **Check for a short circuit from pin to pin.** | **Greater than 100k ohms?** | |
| **STEP 3:** | **Check the circuit response.** | | |
| **STEP 3A:** | **Check for an active fault code.** | **Fault Code 595 active?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 595 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for sensor supply fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for sensor supply fault codes.<br>• Use INSITE™ electronic service tool, to read the fault codes. | Fault Code 352 active or has inactive counts?<br>**YES** | Fault Code 352 |
| | Fault Code 352 active or has inactive counts?<br>**NO** | 1B |

**STEP 1B: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Start the engine and let it idle for one minute.<br>• Use the accelerator pedal to accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>• Use INSITE™ electronic service tool, to read the fault codes. | Fault Code 595 active?<br>**YES** | 2A |
| | Fault Code 595 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

## STEP 2: Check the sensor and engine harness.

**STEP 2A: Inspect the engine harness and sensor harness connector pins.**

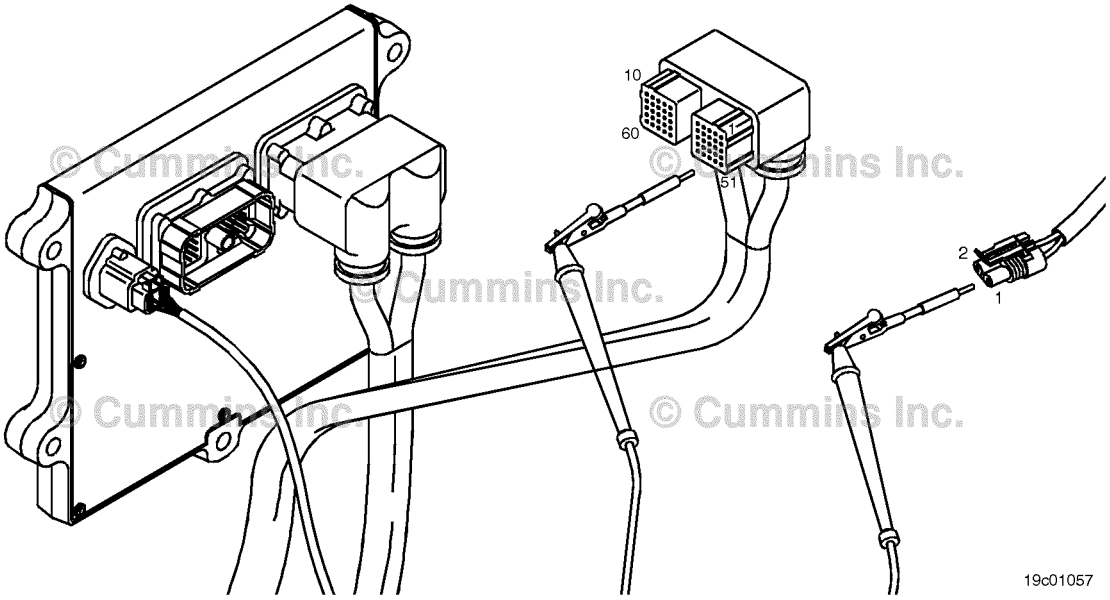
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the turbocharger speed sensor.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the sensor connector, the engine harness connector, and the sensor pigtail harness connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins or damaged components?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins or damaged components?<br>**NO** | 2B |

**STEP 2B: Check for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the turbocharger speed sensor.
- Disconnect the engine harness from the ECM.

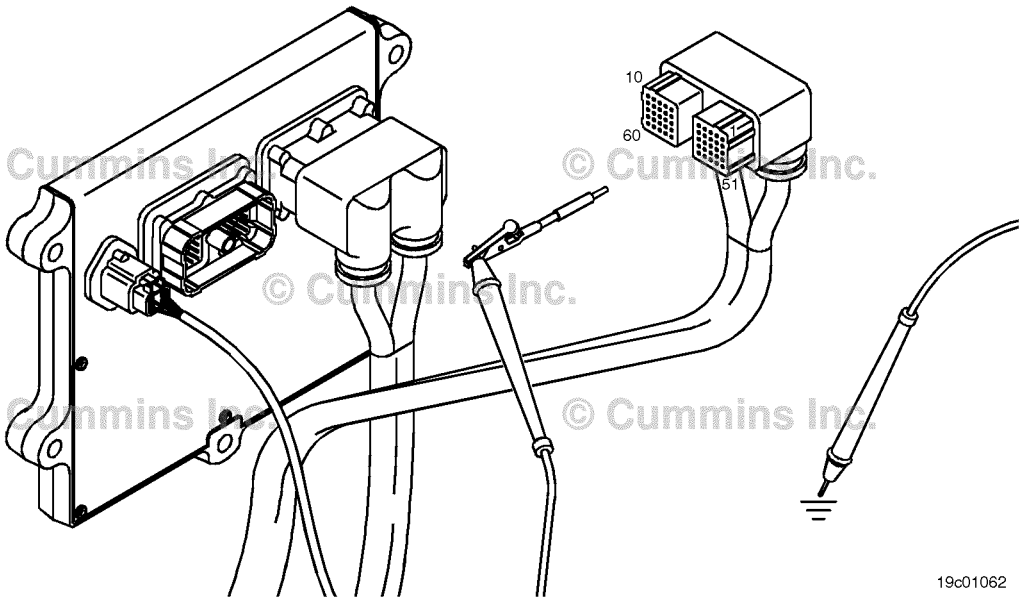
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the Turbocharger Speed 5-VDC SUPPLY pin at the ECM connector of the engine harness and the Turbocharger Speed 5-VDC SUPPLY pin at the sensor harness connector of the engine harness.<br>• Measure the resistance between the Turbocharger Speed SIGNAL pin at the ECM connector of the engine harness and the Turbocharger Speed SIGNAL pin at the sensor harness connector of the engine harness.<br>• Measure the resistance between the Turbocharger Speed RETURN pin at the ECM connector of the engine harness and the Turbocharger Speed RETURN pin at the sensor harness connector of the engine harness.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2C |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 2C: Check for a short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the turbocharger speed sensor.
- Disconnect the engine harness from the ECM.

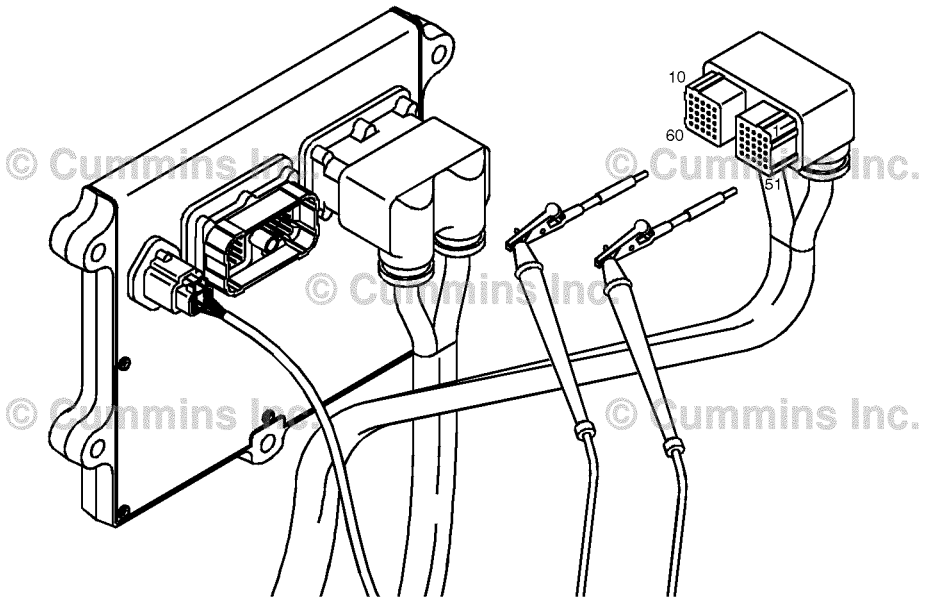
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the resistance between the Turbocharger Speed 5-VDC SUPPLY pin at the ECM connector of the engine harness and engine block ground.<br>• Measure the resistance between the Turbocharger Speed SIGNAL pin at the ECM connector of the engine harness and engine block ground.<br>• Measure the resistance between the Turbocharger Speed RETURN pin at the ECM connector of the engine harness and engine block ground.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 2D: Check for a short circuit from pin to pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the turbocharger speed sensor.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin-to-pin.<br>• Measure the resistance between the Turbocharger Speed 5-VDC SUPPLY pin at the ECM connector of the engine harness and all other pins in the connector.<br>• Measure the resistance between the Turbocharger Speed SIGNAL pin at the ECM connector of the engine harness and all other pins in the connector.<br>• Measure the resistance between the Turbocharger Speed RETURN pin at the ECM connector of the engine harness and all other pins in the connector.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



## STEP 3: Check the circuit response.

### STEP 3A: Check for an active fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Start the engine and let it idle for one minute.<br>• Use the accelerator pedal to accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 595 active?<br>**YES**<br>**Repair:**<br>Replace the turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. | 4A |
| | Fault Code 595 active?<br>**NO** | 4A |

## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use the accelerator pedal to accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>NOTE: This step applies even if maximum engine speed without vehicle speed sensor limits the engine speed.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 595 inactive?<br>**YES** | 4B |
| | Fault Code 595 inactive?<br>**NO** | 1A |

### STEP 4B: Clear the inactive fault codes.

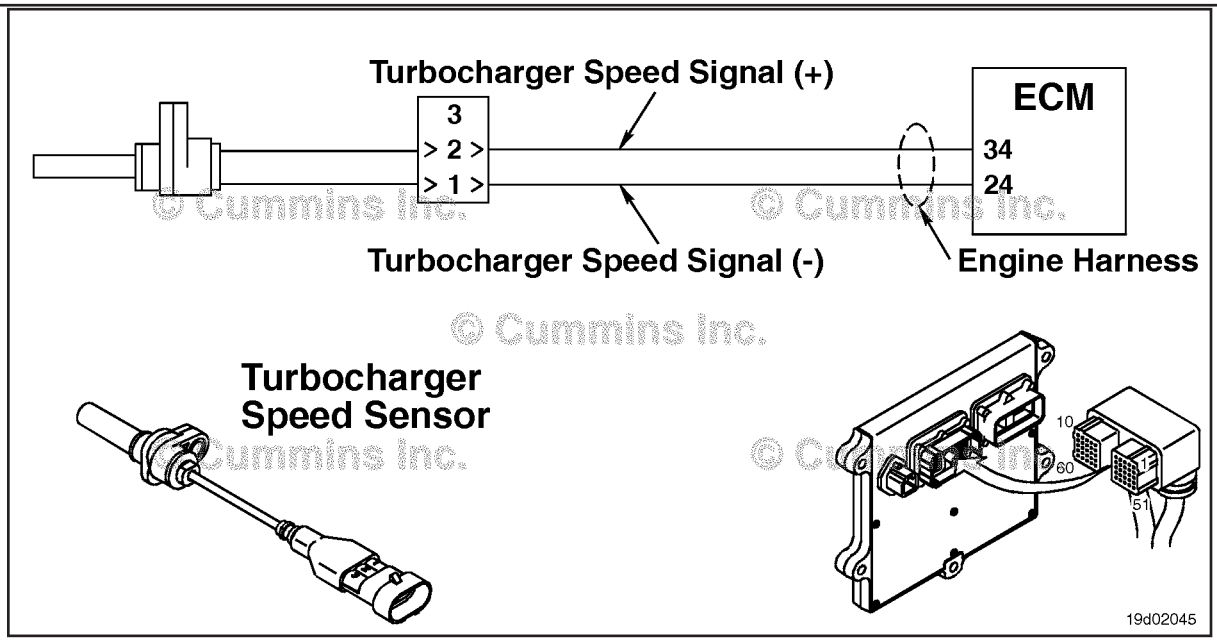
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 595 (ISC/QSC/ISL/QSL Automotive, Industrial, or Marine Application)

## Turbocharger Number 1 Speed High - Data Valid but Above Normal Operational Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 595<br>PID(P), SID(S): P103<br>SPN: 103<br>FMI: 0/16<br>Lamp: Amber<br>SRT: | Turbocharger Number 1 Speed High - Data Valid but Above Normal Operational Range - Moderately Severe Level. High turbocharger speed has been detected. | Engine power derate. The ECM uses an estimated turbocharger speed. |




Turbocharger Number 1 Speed High Circuit

**Circuit Description:**

The turbocharger speed sensor is a variable reluctance speed sensor. It consists of a coil of wire and an iron core. The target on the turbocharger shaft is a ground flat in the center of the shaft.

**Component Location:**

The turbocharger speed sensor is mounted in the center housing of the turbocharger. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault can come active any time the key is on and the electronic control module (ECM) detects turbocharger speed greater than a calibration limit. This fault can be caused by failures in the following components:

- Turbocharger speed sensor
- Engine harness
- ECM power supply or grounds
- Electronic vehicle accessories which emit excessive electromagnetic interference.

This fault becomes inactive any time the ECM detects a valid turbocharger speed.

If the fault occurs intermittently:

- Look for causes of intermittent open circuit or short circuits in the turbocharger speed sensor circuit (including the speed sensor pigtail connector).
- Look for sources of electronic noise such as poorly installed vehicle electronic components.
- Ensure that vehicle chassis grounds are in good condition.
- Ensure that the ECM power supply and ground circuits are in good condition and that this power supply is **not** shared with other vehicle electronics.

## Refer to Troubleshooting Fault Code t05-595

# FAULT CODE 595 (ISC/QSC/ISL/QSL Automotive, Industrial, or Marine Application) - Turbocharger Number 1 Speed High - Data Valid but Above Normal Operational Range - Moderately Severe Level

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To avoid damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To avoid pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Cannon™/Metri-Pack™ test lead and Part Number 3822917 female Deutsch™/AMP™/Cannon™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for intermittent fault condition.** | | |
| STEP 1A: | Operate the engine at idle and high idle to check for fault activation. | Does Fault Code 595 come active during engine operation? | |
| **STEP 2:** | **Check for a damaged turbocharger speed sensor.** | | |
| STEP 2A: | Inspect the engine harness connector to the turbocharger speed sensor. | Is the connector or pigtail harness damaged? | |
| STEP 2B: | Measure the turbocharger speed sensor resistance. | Between 600 and 1600 ohms? | |
| STEP 2C: | Check for a short circuit to ground in the turbocharger speed sensor. | Greater than 100k ohms? | |
| **STEP 3:** | **Check the engine harness.** | | |
| STEP 3A: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins or connector? | |
| STEP 3B: | Check the turbocharger speed sensor circuit continuity. | Resistance within 10 ohms of the sensor resistance? | |
| STEP 3C: | Check for a short to ground in the engine harness. | Greater than 100k ohms? | |
| STEP 3D: | Check for a pin to pin short in the engine harness. | Greater than 100k ohms? | |
| **STEP 4:** | **Connect all components and determine if the fault code reoccurs.** | | |
| STEP 4A: | Operate the engine at idle and high idle to check for fault activation. | Does Fault Code 595 come active during engine operation? | |
| **STEP 5:** | **Clear the fault codes.** | | |
| STEP 5A: | Disable the fault code. | Fault Code 595 inactive? | |
| STEP 5B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check for intermittent fault condition.

**STEP 1A: Operate the engine at idle and high idle to check for fault activation.**

**Condition:**
- Connect INSITE™ electronic service tool and clear inactive fault codes.
- Start the engine.
- Use INSITE™ electronic service tool to read the fault codes.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Using the accelerator pedal, accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>- | Does Fault Code 595 come active during engine operation?<br>**YES** | 2A |
| | Does Fault Code 595 come active during engine operation?<br>**NO**<br>**Repair:**<br>An intermittent fault condition exists. The problem may be with the turbocharger speed sensor circuit; however, the intermittent fault condition may be due to electrical noise that is caused by other devices or faulty grounds. | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

### STEP 2: Check for a damged turbocharger speed sensor.

**STEP 2A: Inspect the engine harness connector to the turbocharger speed sensor.**

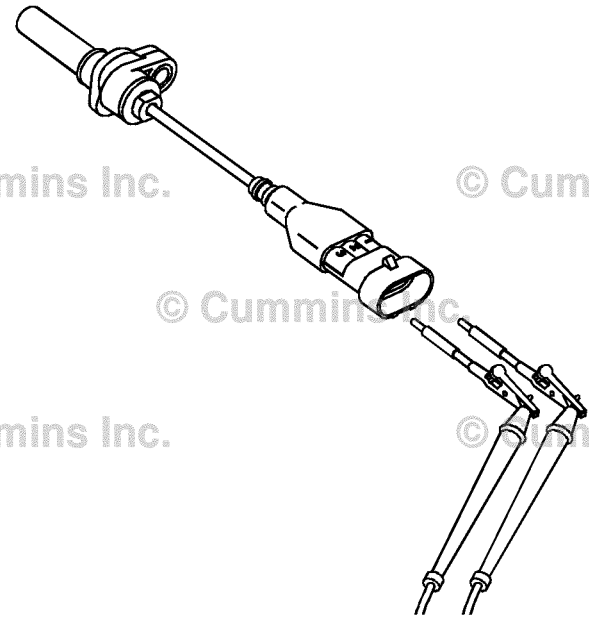
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the turbocharger speed sensor.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the turbocharger speed sensor connector, the engine harness connector, and the turbocharger speed sensor pigtail harness connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Is the connector or pigtail harness damaged?<br>**YES**<br>**Repair:**<br>Repair or replace the damaged connector or turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. | 5A |
| | Is the connector or pigtail harness damaged?<br>**NO** | 2B |

**STEP 2B: Measure the turbocharger speed sensor resistance.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger speed sensor from the engine harness.

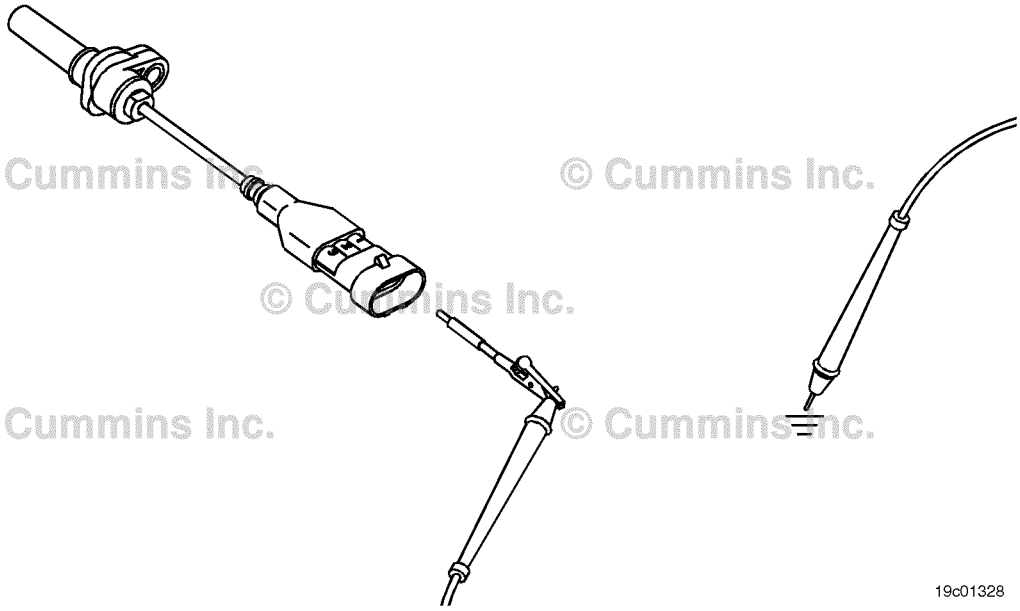
| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance from the turbocharger speed SIGNAL (+) pin to the turbocharger speed RETURN (-) pin at the sensor.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Between 600 and 1600 ohms?<br>**YES** | 2C |
| | Between 600 and 1600 ohms?<br>**NO**<br>**Repair:**<br>The turbocharger speed sensor is damaged.<br>Replace the turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. | 5A |



**STEP 2C: Check for a short circuit to ground in the turbocharger speed sensor.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger speed sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance from the turbocharger speed SIGNAL (+) pin on the sensor to the engine block ground.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>The turbocharger speed sensor is shorted to ground.<br>Replace the turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. | 5A |



## STEP 3: Check the engine harness.

### STEP 3A: Inspect the ECM and engine harness connector pins.

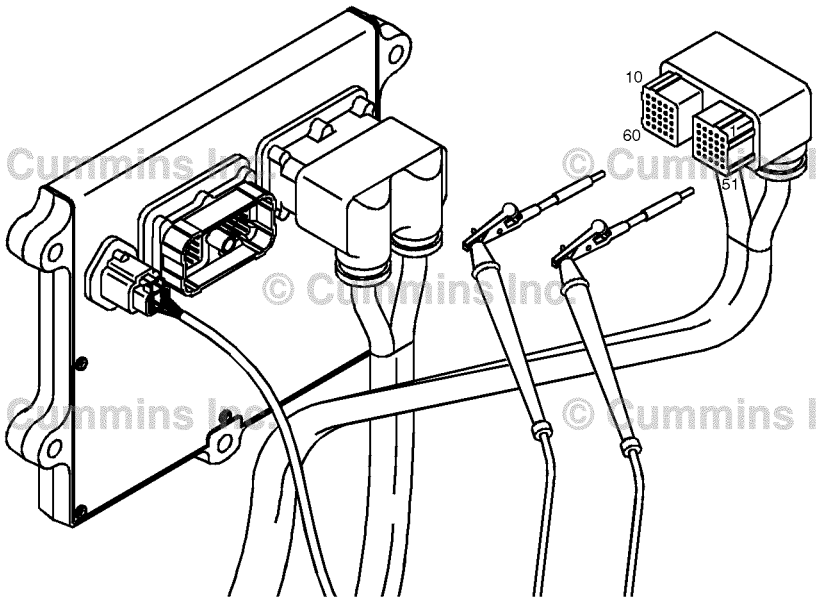
**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Disconnect the engine harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins or connector?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins, if possible.<br>Refer to Procedure 019-043 in Section 19. | 5A |
| | Dirty or damaged pins or connector?<br>**NO** | 3B |

**STEP 3B: Check the turbocharger speed sensor circuit continuity.**

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Disconnect the engine harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance from the turbocharger speed SIGNAL (+) pin at the engine harness ECM connector to the turbocharger speed RETURN (-) pin at the engine harness ECM connector.<br>Note: The resistance of the turbocharger speed sensor circuit **must not** be more than 10 ohms greater than the resistance of the turbocharger speed sensor. The turbocharger speed sensor resistance value was read in Step 2B.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Resistance within 10 ohms of sensor resistance?<br>**YES** | 3C |
| | Resistance within 10 ohms of sensor resistance?<br>**NO**<br>**Repair:**<br>There is high resistance or an open circuit in the engine harness or turbocharger speed sensor connector. Otherwise, there is a low resistance (short) across the sensor input pins.<br>Repair or replace the engine harness or connector(s). Refer to Procedure 019-043 in Section 19. | 5A |



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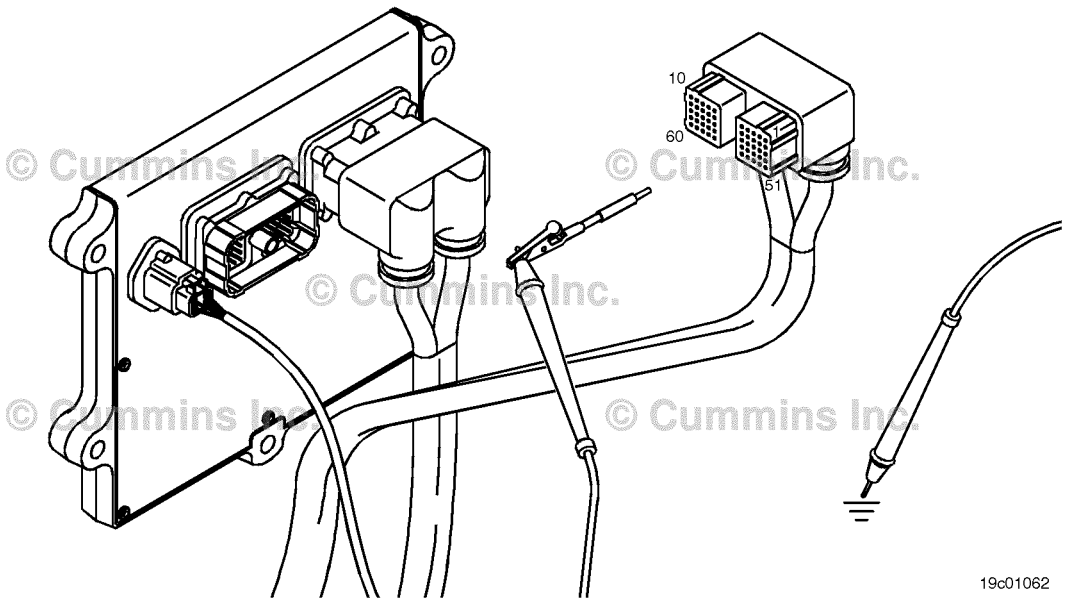
**STEP 3C: Check for a short to ground in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Disconnect the engine harness connector from the ECM.

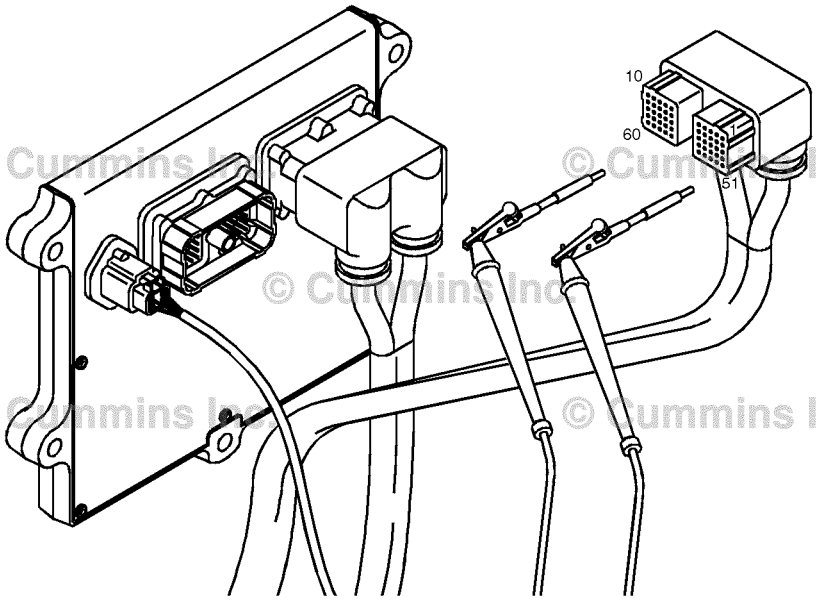
| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance from the turbocharger speed SIGNAL (+) pin at the engine harness ECM connector to engine block ground.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>There is a short to ground in the turbocharger speed sensor circuit. Inspect the engine harness for a short to ground.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 5A |



**STEP 3D: Check for a pin-to-pin short in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Disconnect the engine harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance from the turbocharger speed SIGNAL (+) pin of the engine harness ECM connector to all other pins in the connector except the turbocharger speed RETURN (-) pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 4A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>There is a short between pins of the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 5A |

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## STEP 4: Connect all components and determine if the fault code reoccurs.

### STEP 4A: Operate the engine at idle and high idle to check for fault activation.

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Connect the engine harness to the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Operate the engine at idle.<br>• Using the accelerator pedal, accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>Note: This step applies even if maximum engine speed without vehicle speed sensor limits the engine speed. | Does Fault Code 595 come active during engine operation?<br>**YES**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 5A |
| | Does Fault Code 595 come active during engine operation?<br>**NO**<br>**Repair:**<br>An intermittent fault condition exists. The problem may exist in the turbocharger speed sensor circuit or it may exist with other vehicle electronic components. The problem may have been corrected when the harness connections were re-engaged.<br>Be certain that the ECM and chassis grounds are in good condition. | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

## STEP 5: Clear the fault codes.

### STEP 5A: Disable the fault code.

**Condition:**
- Turn keyswitch OFF.
- Connect turbocharger speed sensor to the engine harness.
- Connect the engine harness to the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Using the accelerator pedal, accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>Note: This step applies even if maximum engine speed without vehicle speed sensor limits the engine speed. | Fault Code 595 inactive?<br>**YES** | 5B |
| | Fault Code 595 inactive?<br>**NO** | 1A |

**STEP 5B: Clear the inactive fault codes.**

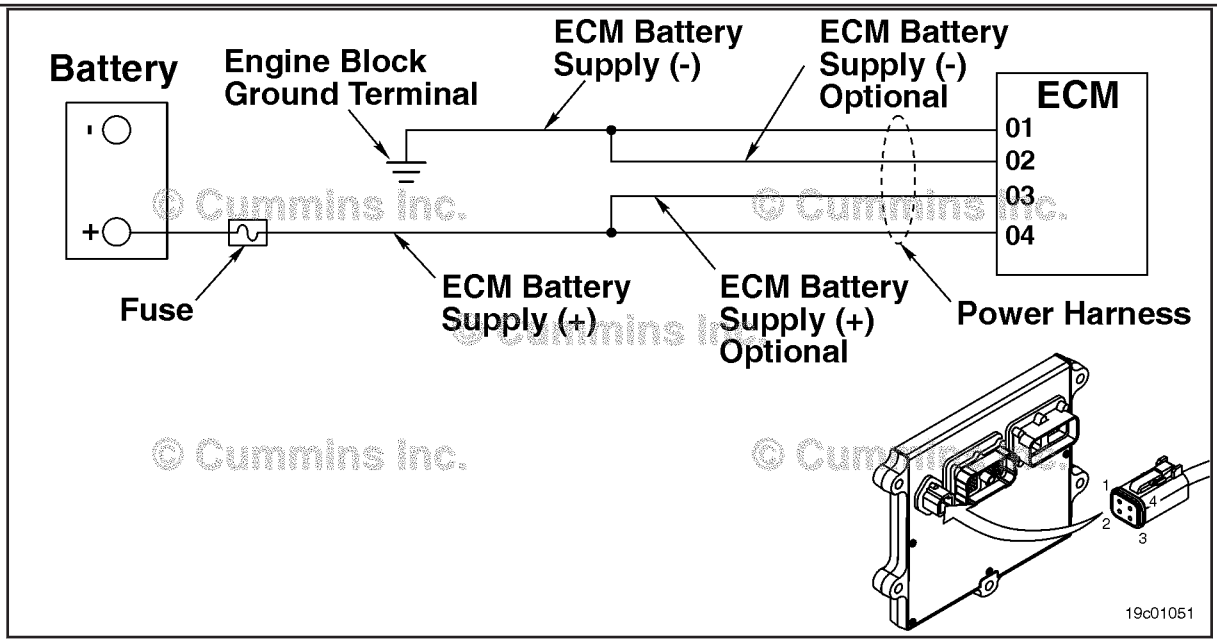
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 596

## Electrical Charging System Voltage High - Data Valid But Above Normal Operating Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 596<br>PID(P), SID(S): P167<br>SPN: 167<br>FMI: 0/16<br>Lamp: Amber<br>SRT: | Electrical Charging System Voltage High - Data Valid But Above Normal Operating Range - Moderately Severe Level. High battery voltage detected by the battery voltage monitor feature. | Amber warning lamp illuminated until high battery voltage condition is corrected. |




Battery Voltage Monitor Circuit

**Circuit Description:**

The electronic control module (ECM) receives constant voltage from the batteries through the unswitched battery wires that are connected directly to the positive (+) battery post. The ECM receives switched battery input through the vehicle keyswitch wire when the vehicle keyswitch is turned ON.

**Component Location:**

The ECM is connected to the battery by the ECM power harness. This direct link provides a constant power supply for the ECM. The location of the battery will vary with the OEM. Refer to the OEM service manual for the battery location.

**Shop Talk:**

This fault code is part of the Alternator Failure Warning feature. The ECM can increase idle speed and deactivate the idle decrement switch if idle speedup is enabled. View the Alternator Failure Warning feature settings using the INSITE™ electronic service tool. Disabling the Alternator Failure Warning feature will also disable this fault code.

Make sure the ECM battery supply (+) is coming directly from the battery and **not** the starter.

Possible causes of this fault code:

- Overcharged batteries caused by a malfunctioning alternator or regulator.

## Refer to Troubleshooting Fault Code t05-596

# FAULT CODE 596 - Electrical Charging System Voltage High - Data Valid But Above Normal Operating Range - Moderately Severe Level

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the equipment battery system.** | | |
| **STEP 1A:** | **Inspect the battery cable and alternator connections.** | **Damaged connections?** | |
| **STEP 1B:** | **Check the battery voltage.** | **Are the voltages at least (+) 12-VDC under normal conditions and at least (+) 6.2-VDC during cranking?** | |
| **STEP 2:** | **Check the charging system.** | | |
| **STEP 2A:** | **Inspect the alternator.** | **Alternator charging within OEM specifications?** | |
| **STEP 3:** | **Clear the fault codes.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 596 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the equipment battery system.

**STEP 1A: Inspect the battery cable and alternator connections.**

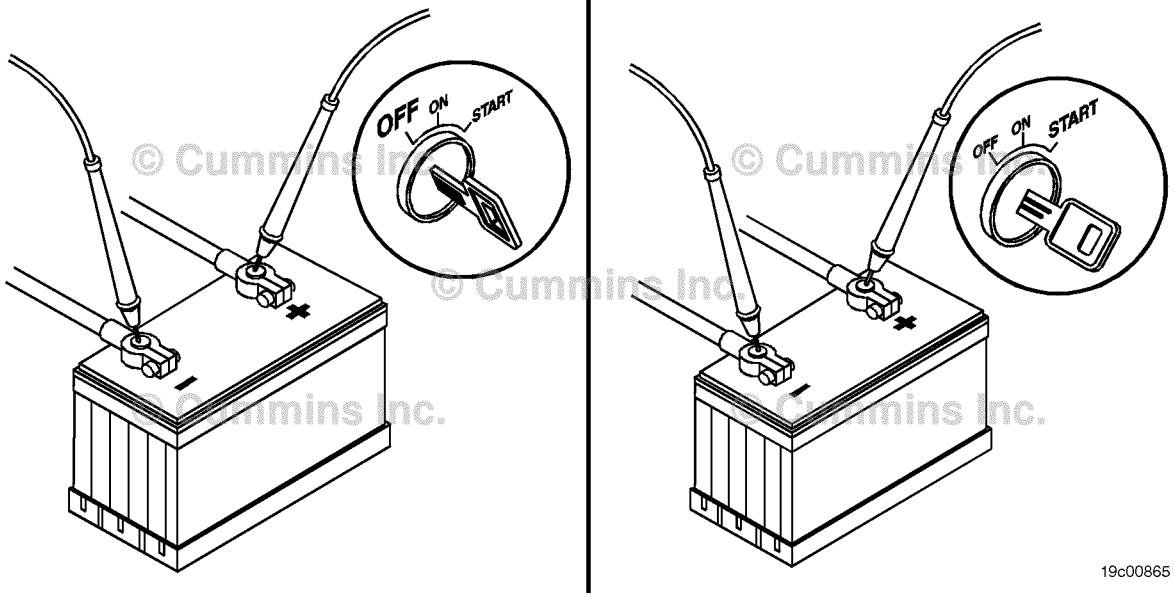
**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the battery cable and alternator connections for the following:<br>• Corrosion<br>• Loose connection. | Damaged connections?<br>**YES**<br>**Repair:**<br>Repair the damaged connections.Tighten the battery connections and clean the battery terminals. Refer to the OEM service manual. | 3A |
| | Damaged connections?<br>**NO** | 1B |

**STEP 1B: Check the battery voltage.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Measure the battery voltage from the positive (+) terminal to the negative (−) terminal.<br>• Measure the battery voltage from the positive (+) terminal to the negative (−) terminal while trying to start the engine. | Are the voltages at least (+) 12-VDC under normal conditions and at least (+) 6.2-VDC during cranking?<br>**YES** | 2A |
| | Are the voltages at least (+) 12-VDC under normal conditions and at least (+) 6.2-VDC during cranking?<br>**NO**<br>**Repair:**<br>Charge or replace the battery. Refer to the OEM service manual. | 3A |

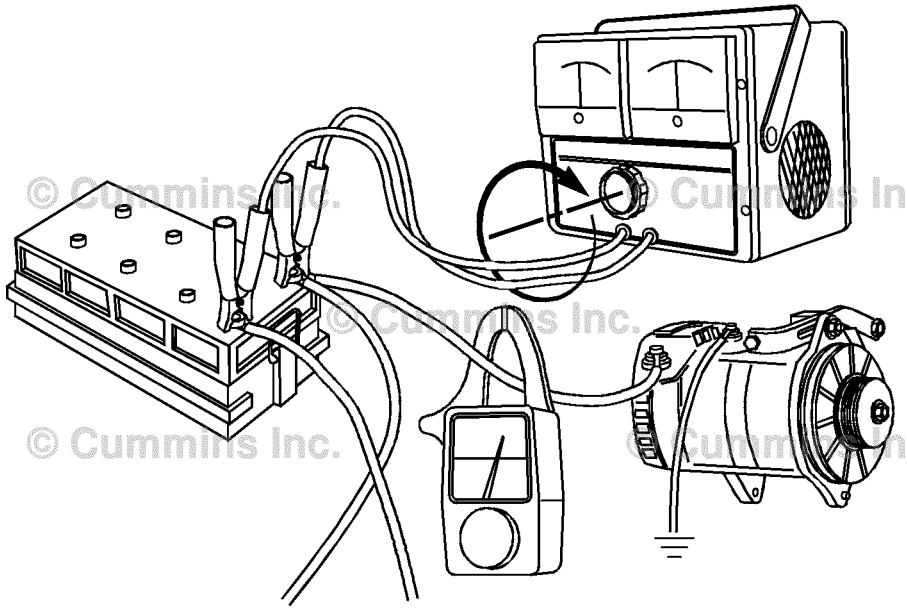


## STEP 2: Check the charging system.

### STEP 2A: Inspect the alternator.

**Condition:**
- Turn keyswitch OFF.
- Use OEM ammeter or install an ammeter between the alternator and the battery.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the charging rate of the alternator.<br>• Start the engine and check the alternator's charging rate (amps).<br>NOTE: It will probably be necessary to place a load on the batteries to measure the alternator output properly. | Is the alternator charging within OEM specifications?<br>**YES** | 3A |
| | Is the alternator charging within OEM specifications?<br>**NO**<br>**Repair:**<br>Repair or replace the alternator, regulator, and/or OEM wiring to the alternator. Refer to the OEM service manual. | 3A |

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## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it run for 10 minutes.<br>• Use INSITE™ electronic service tool to verify that Fault Code 596 is inactive. | Fault Code 596 inactive?<br>**YES** | 3B |
| | Fault Code 596 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact your local Cummins® Authorized Repair Location if all the steps have been completed and checked again. | 1A |

### STEP 3B: Clear the inactive fault codes.

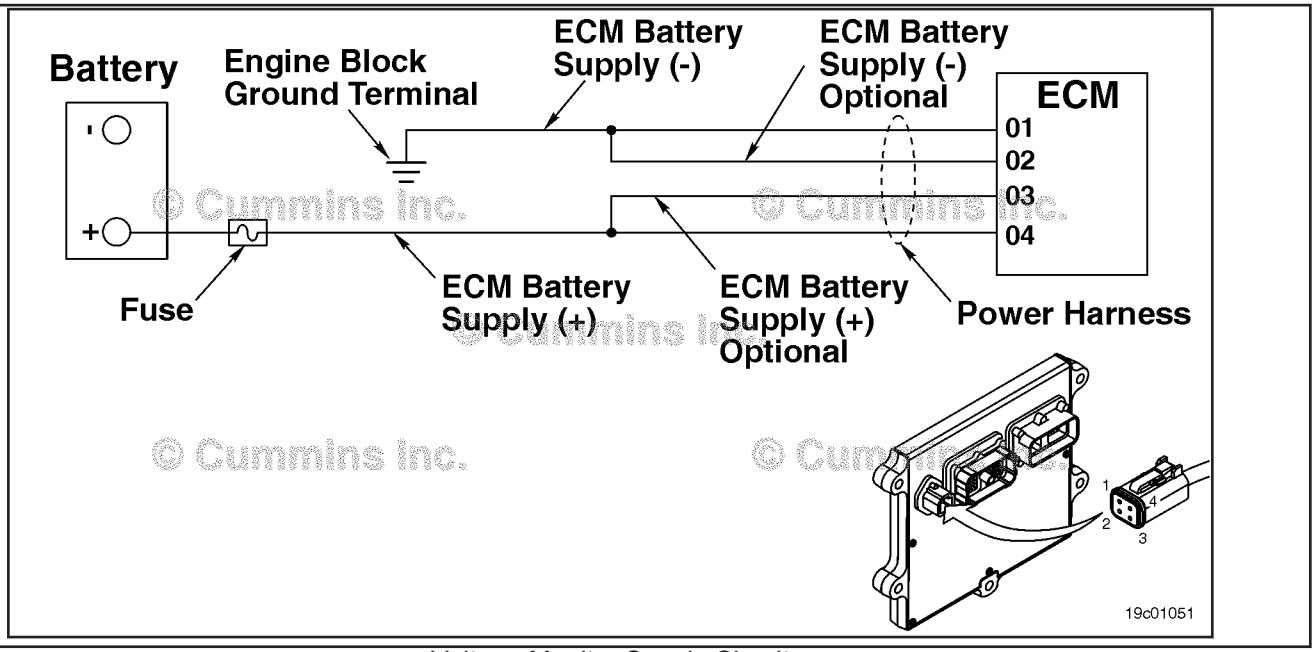
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooti ng steps |

# Fault Code 597

## Electrical Charging System Voltage Low - Data Valid But Below Normal Operating Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 597<br>PID(P), SID(S): P167<br>SPN: 167<br>FMI: 1/18<br>Lamp: Amber<br>SRT: | Electrical Charging System Voltage Low - Data Valid But Below Normal Operating Range - Moderately Severe Level. Low battery voltage detected by the battery voltage monitor feature. | Amber lamp will light until low battery voltage condition is corrected. |




Voltage Monitor Supply Circuit

**Circuit Description:**

The electronic control module (ECM) receives constant voltage from the batteries through the unswitched battery wires that are connected directly to the positive (+) battery post. The ECM receives switched battery input through the vehicle keyswitch wire when the vehicle keyswitch is turned ON.

**Component Location:**

The ECM is connected to the battery by the ECM power harness. This direct link provides a constant power supply for the ECM. The location of the battery will vary with the OEM. Refer to the OEM service manual for the battery location.

**Shop Talk:**

This fault code is part of the Alternator Failure Warning feature. The ECM can increase idle speed and deactivate the idle decrement switch if Idle Speedup is enabled. View the Alternator Failure Warning feature settings with INSITE™ electronic service tool. Disabling the Alternator Failure Warning feature will also disable this fault code.

Make sure the ECM unswitched battery supply is coming directly from the battery and **not** the starter.

Possible causes of this fault:

- Undercharged batteries caused by a malfunctioning alternator or regulator.
- High-current devices on the vehicle such as citizens band radio amplifiers, numerous exterior lights, or other accessories.

## Refer to Troubleshooting Fault Code t05-597

# FAULT CODE 597 - Electrical Charging System Voltage Low - Data Valid But Below Normal Operating Range - Moderately Severe Level

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use these test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the equipment battery system.** | | |
| STEP 1A: | Inspect the battery cable and alternator connections. | Any damaged connections? | |
| STEP 1B: | Check the battery voltage. | Is the battery voltage at least (+) 12-VDC under normal conditions and at least (+) 6.2-VDC during cranking? | |
| **STEP 2:** | **Check the alternator and power harness.** | | |
| STEP 2A: | Inspect the alternator. | Alternator charging within OEM specifications? | |
| STEP 2B: | Check for an open circuit in the unswitched battery supply circuit. | Less than 10 ohms? | |
| STEP 2C: | Check for a short circuit. | More than 100k ohms? | |
| STEP 2D: | Check the add-on or accessory wiring at the positive (+) terminal of the battery. | No damaged wires? | |
| STEP 2E: | Check for a pin-to-pin short circuit in the power harness. | More than 100k ohms? | |
| **STEP 3:** | **Clear the fault codes.** | | |
| STEP 3A: | Disable the fault code. | Fault Code 597 inactive? | |
| STEP 3B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the equipment battery system.

**STEP 1A: Inspect the battery cable and alternator connections.**

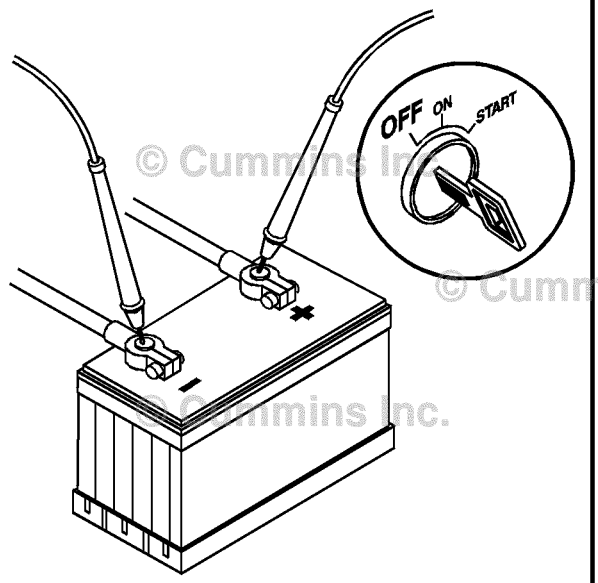
**Condition:**
- Turn keyswitch OFF.

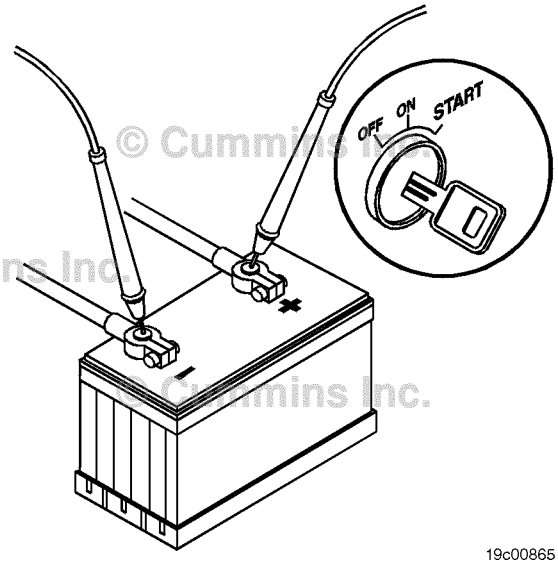
| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the battery cable and alternator connections for the following:<br>• Corrosion<br>• Loose connection. | Any damaged connections?<br>**YES**<br>**Repair:**<br>Repair the damaged connections.<br>Tighten the battery connections and clean the battery terminals. Refer to the OEM service manual. | 3A |
| | Any damaged connections?<br>**NO** | 1B |

**STEP 1B: Check the battery voltage.**

**Condition:**
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Place the positive (+) probe of the multimeter on the positive battery terminal. Touch the negative (-) probe of the multimeter to the negative battery terminal while trying to start the engine. | Is the battery voltage at least (+) 12-VDC under normal conditions and at least (+) 6.2-VDC during cranking?<br>**YES** | 2A |
| | Is the battery voltage at least (+) 12-VDC under normal conditions and at least (+) 6.2-VDC during cranking?<br>**NO**<br>**Repair:**<br>Charge or replace the battery.<br>Refer to the OEM service manual. | 3A |

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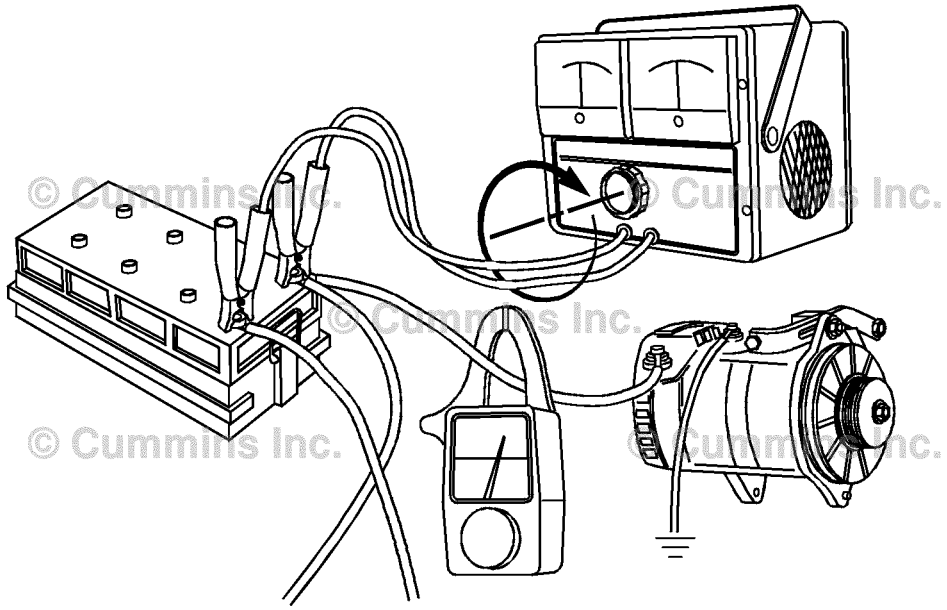
## STEP 2: Check the alternator and power harness.

### STEP 2A: Inspect the alternator.

**Condition:**
- Turn keyswitch OFF.
- Use the OEM ammeter or install an ammeter between the alternator and the battery.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the charging rate of the alternator.<br>• Start the engine and check the alternator's charging rate (amps).<br>NOTE: It will probably be necessary to place a load on the batteries to measure the alternator output properly. | Is the alternator charging within OEM specifications?<br>**YES** | 2B |
| | Is the alternator charging within OEM specifications?<br>**NO**<br>**Repair:**<br>Repair or replace the alternator and/or OEM wiring to the alternator. Refer to the OEM service manual. | 3A |

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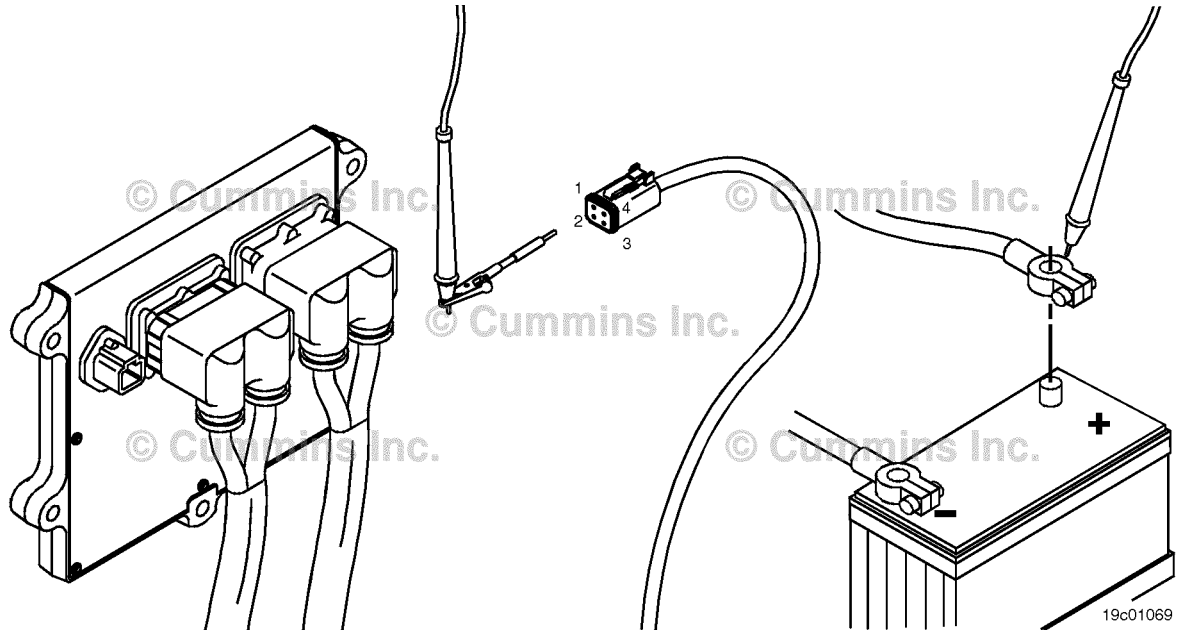
**STEP 2B: Check for an open circuit in the unswitched battery supply circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the power harness connector from the ECM.
- Disconnect the positive battery cable from the battery.

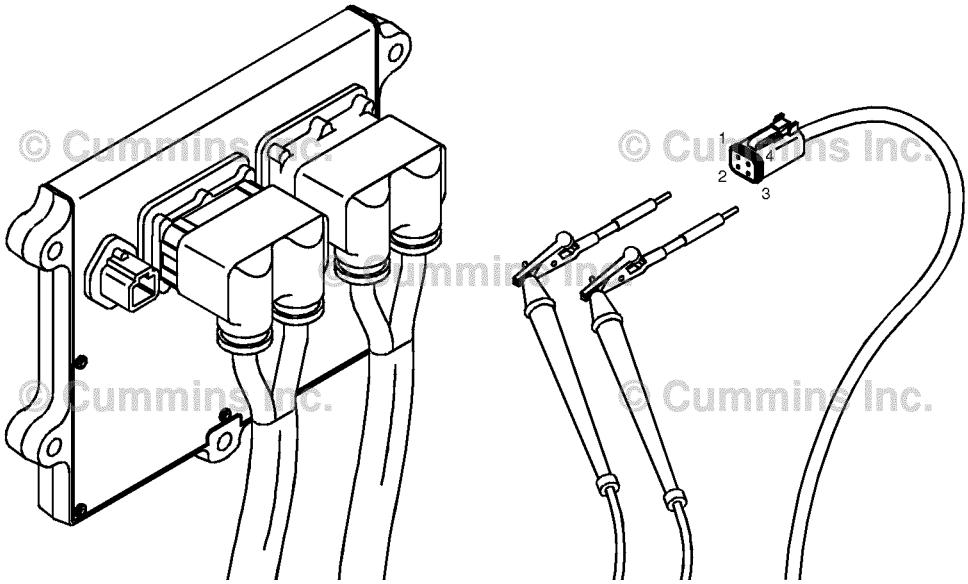
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit in the unswitched battery supply circuit.<br>• Using a multimeter, measure the resistance between the ECM battery SUPPLY (+) pins of the OEM power harness ECM connector and the positive (+) battery terminal.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2C |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the battery harness. Refer to the OEM service manual. | 3A |



**STEP 2C: Check for a short circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the power harness connector from the ECM.
- Disconnect the positive (+) battery cable from the battery.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit.<br>• Using a multimeter, measure the resistance between the ECM battery SUPPLY (+) pins and the ECM battery SUPPLY (-) pins of the ECM power harness connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | More than 100k ohms?<br>**YES** | 2D |
| | More than 100k ohms?<br>**NO**<br>**Repair:**<br>A short circuit has been detected in the OEM power harness.<br>Repair or replace the OEM power harness. Refer to Procedure 019-071 in Section 19. | 3A |




**STEP 2D: Check the add-on or accessory wiring at the positive (+) terminal of the battery.**

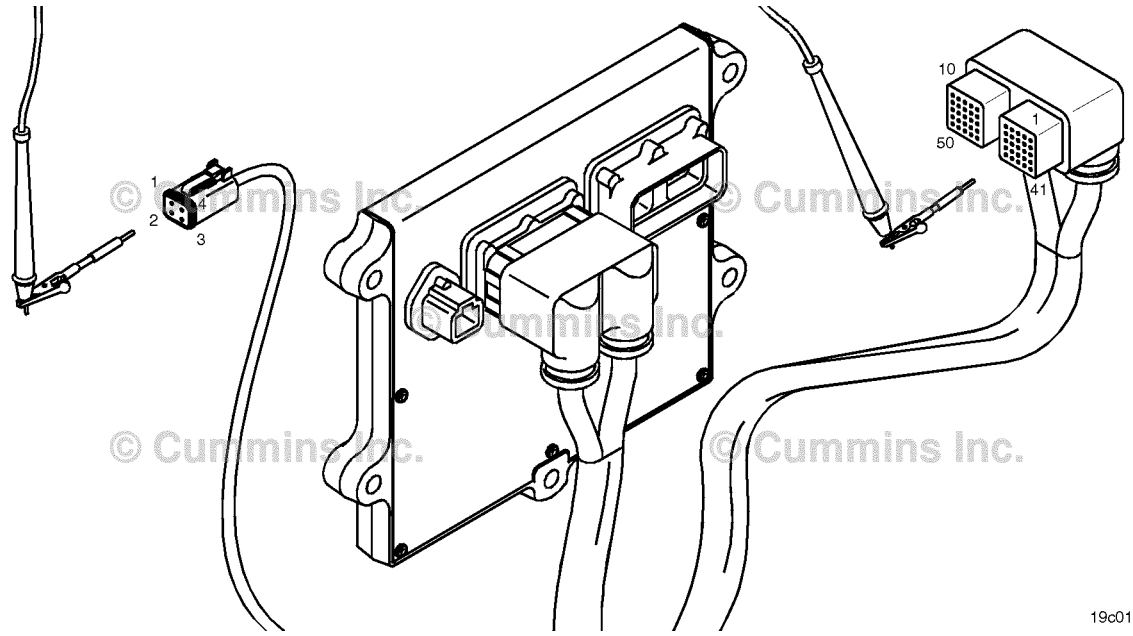
**Condition:**
- Turn keyswitch OFF

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the add-on or accessory wiring at the positive (+) terminal of the battery.<br>• Starting at the positive (+) terminal, follow any add-on or accessory wiring and examine the wire(s) for damaged insulation or installation error that can cause a short circuit in the supply wire to the engine block. | Any damaged wires?<br>**YES**<br>**Repair:**<br>Repair the damaged wiring. | 2E |
| | Any damaged wires?<br>**NO** | 3A |

**STEP 2E: Check for a short circuit in the power harness**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness connector from the ECM
- Disconnect the positive (+) battery cable from the battery.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use a multimeter to measure the resistance between the ECM Battery SUPPLY (+) pins in the OEM power harness connector to all pins in the OEM harness ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | More than 100k ohms?<br>**YES** | 3A |
| | More than 100k ohms?<br>**NO**<br>**Repair:**<br>A short circuit has been detected in the OEM power harness.<br>Repair or replace the OEM power harness. Refer to Procedure 019-071 in Section 19. | 3A |



## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it run for 10 minutes.<br>• Use INSITE™ electronic service tool to verify that Fault Code 597 is inactive. | Fault Code 597 inactive?<br>**YES** | 3B |
| | Fault Code 597 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact your local Cummins® Authorized Repair Location if all the steps have been completed and checked a second time. | 1A |

### STEP 3B: Clear the inactive fault codes.

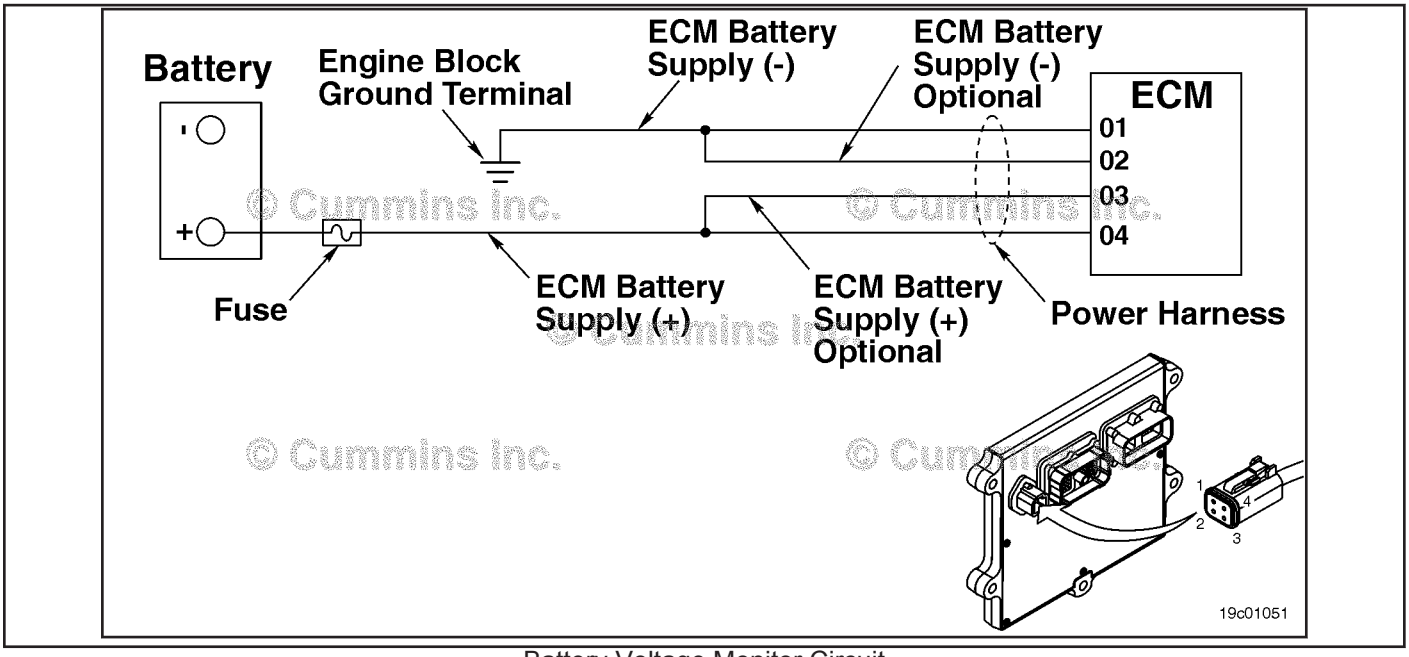
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes | Appropriate troubleshooti ng steps |

# Fault Code 598

## Electrical Charging System Voltage Low - Data Valid But Below Normal Operating Range - Most Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 598<br>PID(P), SID(S): P167<br>SPN: 167<br>FMI: 1/1<br>Lamp: Red<br>SRT: | Electrical Charging System Voltage Low - Data Valid But Below Normal Operating Range - Most Severe Level. Very low battery voltage detected by the battery voltage monitor feature. | Red lamp illuminated until very low battery voltage condition is corrected. |




Battery Voltage Monitor Circuit

**Circuit Description:**

The electronic control module (ECM) receives constant voltage from the batteries through the unswitched battery wires that are connected directly to the positive (+) battery post. The ECM receives switched battery input through the vehicle keyswitch wire when the vehicle keyswitch is turned ON.

**Component Location:**

The ECM is connected to the battery by the OEM harness. This direct link provides a constant power supply for the ECM. The location of the battery will vary with the OEM. Refer to the OEM service manual for the battery location.

**Shop Talk:**

This fault code is part of the Alternator Failure Warning feature. The ECM can increase idle speed and deactivate idle the decrement switch if Idle Speedup is enabled. View the Alternator Failure Warning feature settings with INSITE™ electronic service tool. Disabling the Alternator Failure Warning feature will also disable this fault code.

Make sure the ECM battery supply (+) is coming directly from the battery and **not** the starter.

Possible causes of this fault code:

- Undercharged batteries caused by a malfunctioning alternator or regulator.

## Refer to Troubleshooting Fault Code t05-598

# FAULT CODE 598 - Electrical Charging System Voltage Low - Data Valid But Below Normal Operating Range - Most Severe Level

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the equipment battery system.** | | |
| STEP 1A: | Inspect the battery cable and alternator connections. | Damaged connections? | |
| STEP 1B: | Check the battery voltage. | Are the voltages at least (+) 12-VDC during normal conditions and at least (+) 6.2-VDC during cranking? | |
| **STEP 2:** | **Check the alternator and OEM harness.** | | |
| STEP 2A: | Inspect the alternator. | Alternator charging within OEM specifications? | |
| STEP 2B: | Inspect the battery power connector. | Dirty or damaged pins? | |
| STEP 2C: | Check for an open circuit in the unswitched battery supply circuit. | Less than 10 ohms? | |
| STEP 2D: | Check for a pin-to-pin short circuit in the power harness. | More than 100k ohms? | |
| STEP 2E: | Check the add-on or accessory wiring at the positive (+) terminal of the battery. | Damaged wires? | |
| **STEP 3:** | **Clear the fault codes.** | | |
| STEP 3A: | Disable the fault code. | Fault Code 598 inactive? | |
| STEP 3B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the equipment battery system.

**STEP 1A: Inspect the battery cable and alternator connections.**

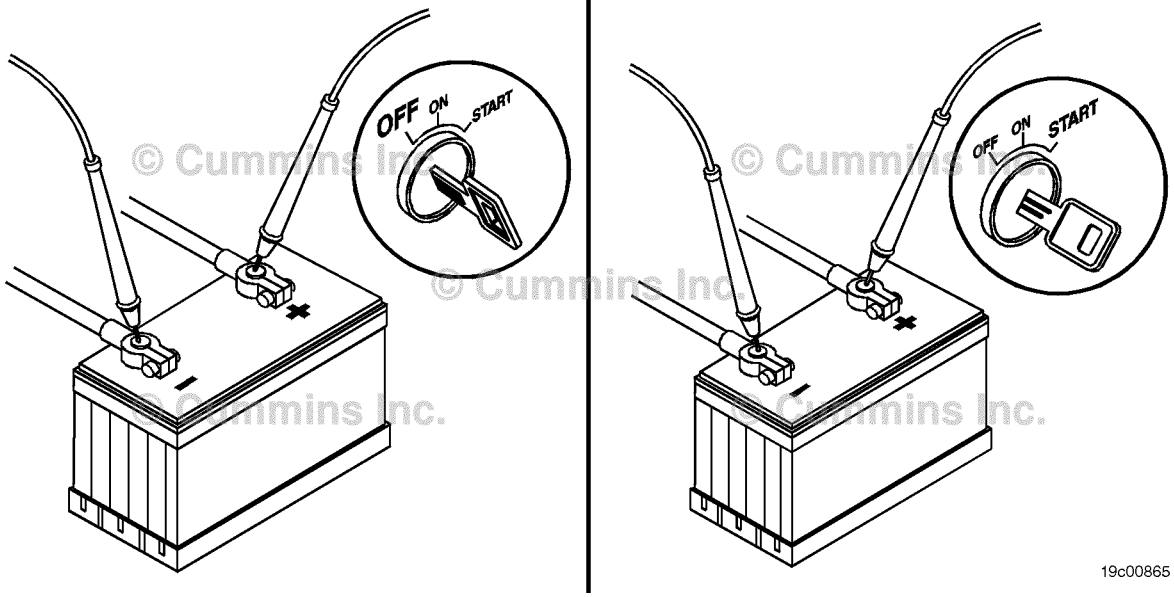
**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the battery cable and alternator connections for the following:<br>• Corrosion<br>• Loose connection. | Damaged connections?<br>**YES**<br>**Repair:**<br>Repair the damaged connections.<br>Tighten the battery connections and clean the battery terminals.<br>Refer to the OEM service manual. | 3A |
| | Damaged connections?<br>**NO** | 1B |

**STEP 1B: Check the battery voltage.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Measure the battery voltage from the positive (+) terminal to the negative (−) terminal.<br>• Measure the battery voltage from the positive (+) terminal to the negative (−) terminal while trying to start the engine. | Are the voltages at least (+) 12-VDC during normal conditions and at least (+) 6.2-VDC during cranking?<br>**YES** | 2A |
| | Are the voltages at least (+) 12-VDC during normal conditions and at least (+) 6.2-VDC during cranking?<br>**NO**<br>**Repair:**<br>Charge or replace the battery. Refer to the OEM service manual. | 3A |

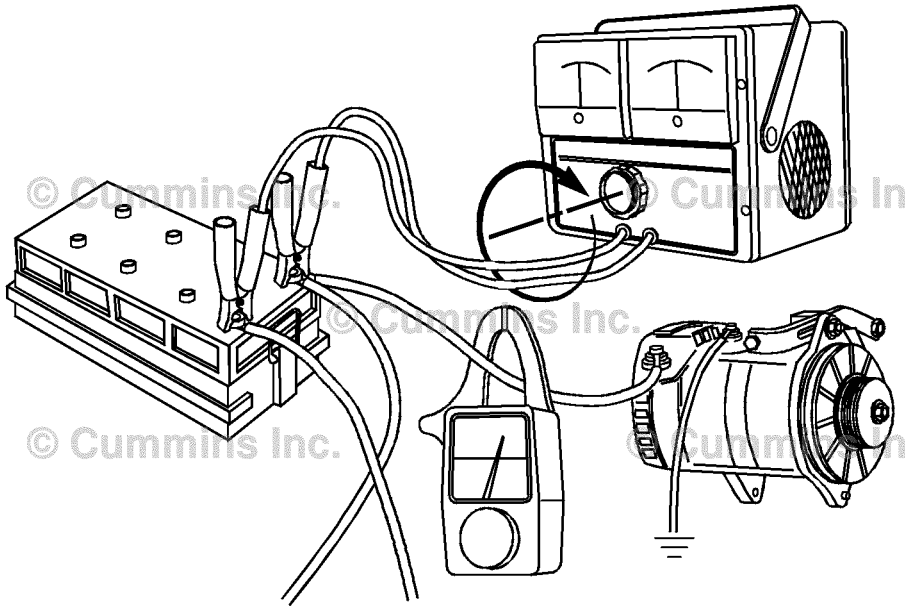


## STEP 2: Check the alternator and OEM harness.

### STEP 2A: Inspect the alternator.

**Condition:**
- Turn keyswitch OFF.
- Use OEM ammeter or install an ammeter between the alternator and the battery.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the charging rate of the alternator.<br>• Start the engine and check the alternator's charging rate (amps).<br>NOTE: It will probably be necessary to place a load on the batteries to measure the alternator output properly. | Is the alternator charging within OEM specifications?<br>**YES** | 2B |
| | Is the alternator charging within OEM specifications?<br>**NO**<br>**Repair:**<br>Repair or replace the alternator and/or OEM wiring to the alternator. Refer to the OEM service manual. | 3A |

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**STEP 2B: Inspect the battery power connector.**

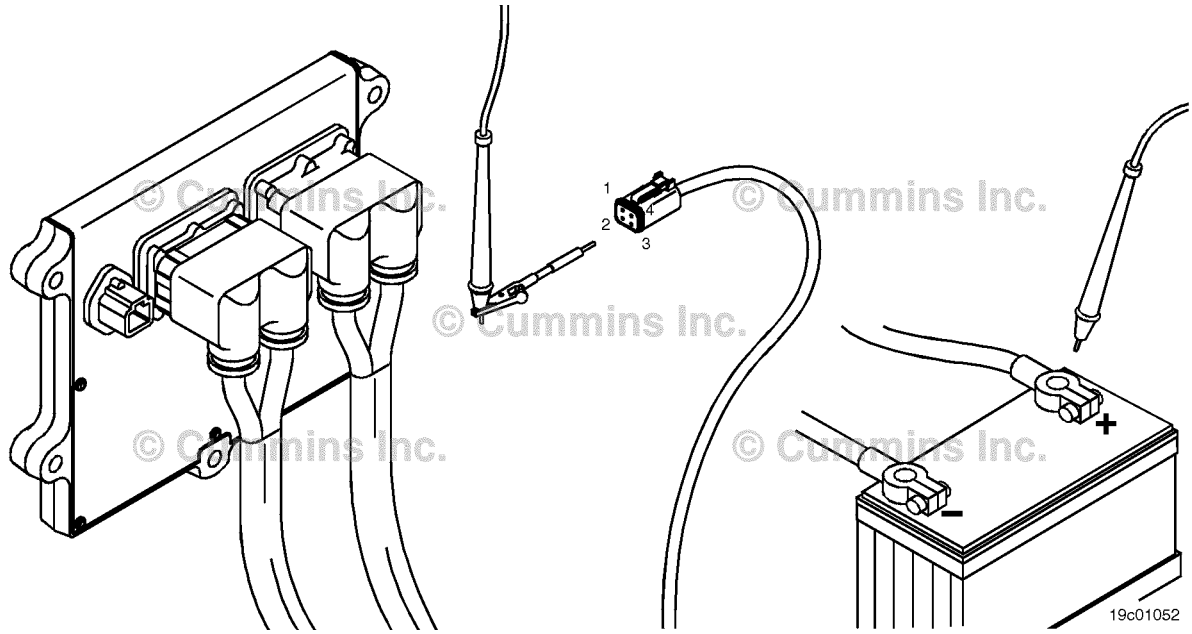
**Condition:**
- Turn keyswitch OFF.
- Disconnect the power harness from the battery at the power connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the battery power connector on both the battery side and the harness side for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pin<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged locking tab connector. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Repair the battery power connector. Refer to the OEM service manual for location and procedure.<br>• Flush the dirt, debris, or moisture from the connector pins using electrical contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing. | 3A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2C |

**STEP 2C: Check for an open circuit in the unswitched battery supply circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness connector from the ECM.

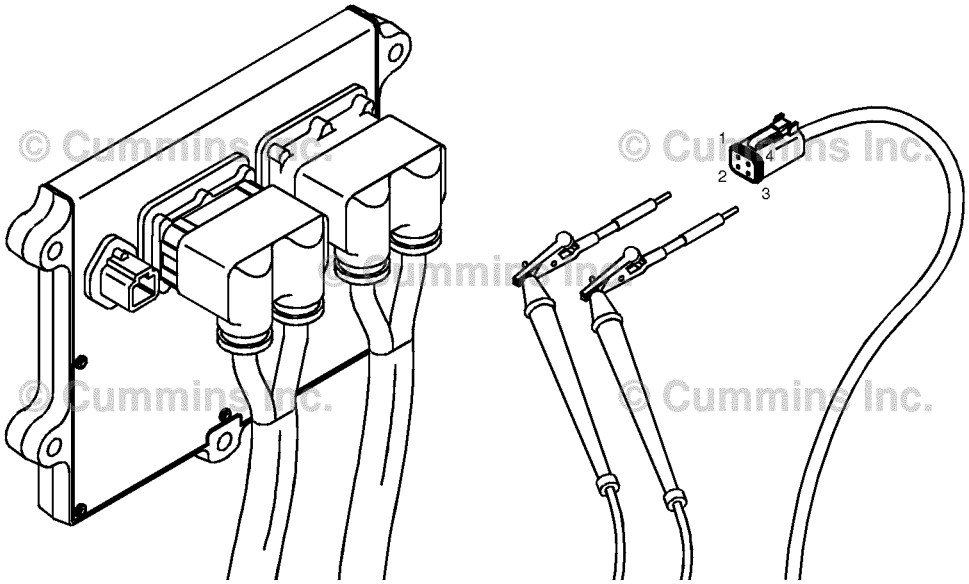
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance of the ECM battery supply (+) circuit between the OEM power harness connector and the positive (+) terminal of the battery.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |



**STEP 2D: Check for a pin-to-pin short circuit in the power harness**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the power harness connector from the ECM.
- Disconnect the positive battery cable from the battery.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the resistance and check for a short circuit between the ECM battery supply (+) pins and all other pins of the power harness connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | More than 100k ohms?<br>**YES** | 2E |
| | More than 100k ohms?<br>**NO**<br>**Repair:**<br>A short circuit has been detected in the OEM power harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 3A |




**STEP 2E: Check the add-on or accessory wiring at the positive (+) terminal of the battery.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the add-on or accessory wiring at the positive (+) terminal of the battery.<br>• Starting at the positive (+) terminal, follow any add-on or accessory wiring and examine the wire(s) for damaged insulation or installation error that can cause a short circuit at supply wire to the engine block ground. | Damaged wires?<br>**YES**<br>**Repair:**<br>Repair the damaged wiring. | 3A |
| | Damaged wires?<br>**NO** | 3A |

## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it run for 10 minutes.<br>• Turn keyswitch ON.<br>• Use INSITE™ electronic service tool to verify that Fault Code 598 is inactive. | Fault Code 598 inactive?<br>**YES** | 3B |
| | Fault Code 598 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact your local Cummins® Authorized Repair Location if all the steps have been completed and checked again. | 1A |

### STEP 3B: Clear the inactive fault codes.

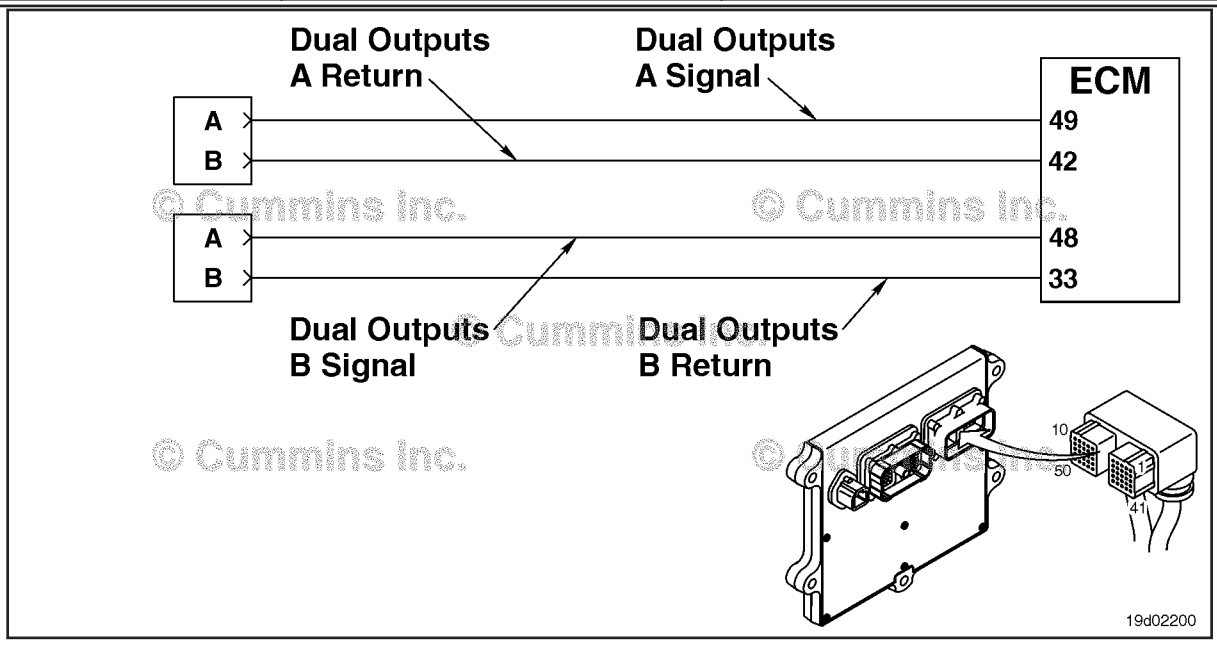
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 599

## Auxiliary Commanded Dual Output Shutdown - Special Instructions

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 599<br>PID(P), SID(S): S025<br>SPN: 640<br>FMI: 14<br>Lamp: Red<br>SRT: | Auxiliary Commanded Dual Output Shutdown - Special Instructions. The engine protection limit has been exceeded for the dual outputs calibrated limits. | Engine will shut down. |




Dual Outputs Circuit

**Circuit Description:**

Dual outputs based on sensed parameters provide up to two independent switched outputs for OEM use. The state of each switched output can be determined by different inputs to the electronic control module (ECM) depending on the engine platform. The ECM can provide different outputs to OEM devices if any of the inputs are above or below calibrated thresholds. Each switched output is independent of the other with respect to control parameter input and threshold settings.

**Component Location:**

The dual outputs features are OEM dependent. Refer to OEM troubleshooting information for component location.

**Shop Talk:**

This fault code is activated when one of the OEM defined inputs has exceeded a calibratible limit. The triggers for shutdown are OEM dependent.

## Refer to Troubleshooting Fault Code t05-599

## TROUBLESHOOTING SUMMARY

| STEPS | SPECIFICATIONS | SRT CODE |
|---|---|---|
| **STEP 1: Check the fault codes.** | | |
| **STEP 1A: Check for Fault Code 599.** | **Active or inactive counts of Fault Code 599?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 599.**

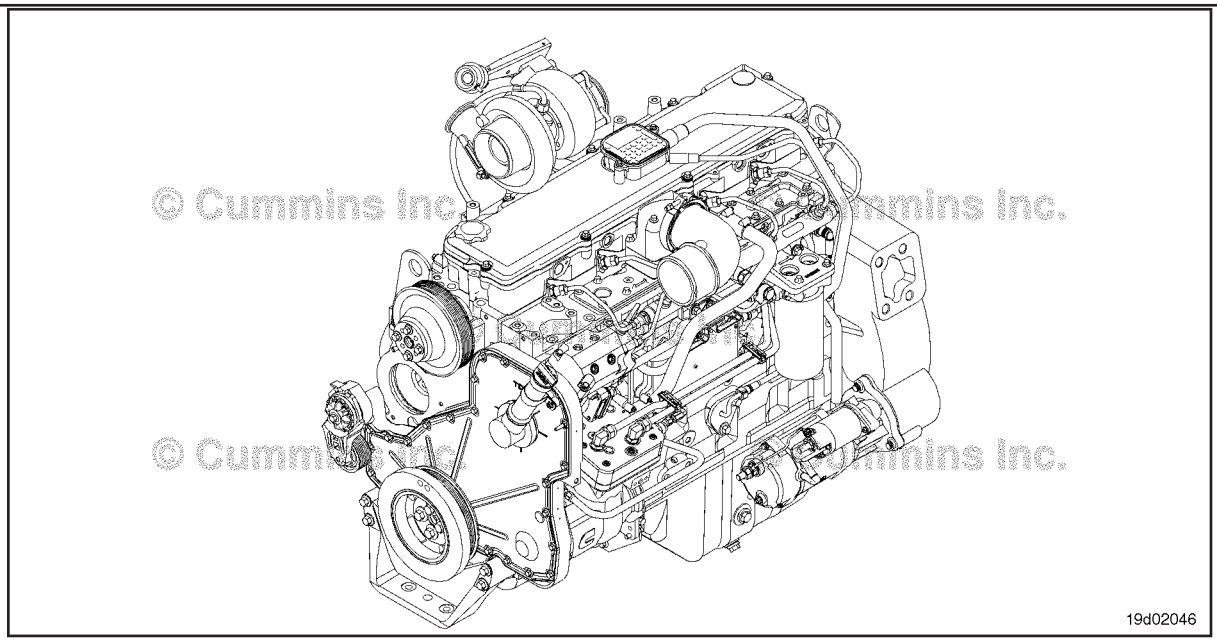
**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or inactive counts of Fault Code 599?<br>**YES**<br>**Repair:**<br>The engine protection limit has been exceeded or the OEM supplied auxiliary device. Refer to the OEM troubleshooting manual. | OEM troubleshooting manual. |
| | Active or inactive counts of Fault Code 599?<br>**NO** | Repair complete. |

# Fault Code 649

## Change Lubricating Oil and Filter - Condition Exists

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 649<br>PID(P), SID(S): S153<br>SPN: 1378<br>FMI: 11/31<br>Lamp: Amber (Maintenance Flashout)<br>SRT: | Change Lubricating Oil and Filter - Condition Exists. Change engine oil and filter. | None on performance; maintenance reminder **only**. |




**Circuit Description:**

The ECM informs the driver of a maintenance event by using the Maintenance Monitor feature's lubrication oil drain limits.

**Component Location:**

The oil filter is located on the exhaust side of the engine, and the oil fill port varies by application. Refer to Procedure 100-002 for a detailed component location for the oil filter and refer to the OEM manual for the location of the oil fill port.

**Shop Talk:**

This fault code will **only** become active if the maintenance monitor is enabled in INSITE™. Make sure that the oil and filter are changed before clearing the fault.

## Refer to Troubleshooting Fault Code t05-649

# FAULT CODE 649 - Change Lubricating Oil and Filter - Condition Exists

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for Fault Code 649.** | **Fault Code 649 active?** | |
| **STEP 2:** | **Clear the fault codes.** | | |
| **STEP 2A:** | **Disable the fault code.** | **Fault Code 649 inactive?** | |
| **STEP 2B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 649.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for Fault Code 649.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 649 active?<br>**YES**<br>**Repair:**<br>Change the engine lubricating oil and filter.<br>Reset the maintenance monitor using the INSITE™ electronic service tool. | 2A |
| | Fault Code 649 active?<br>**NO** | 2A |

## STEP 2: Clear the fault codes.

### STEP 2A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Use INSITE™ electronic service tool to reset the maintenance monitor.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive.<br>NOTE: The maintenance monitor can also be reset manually. | Fault Code 649 inactive?<br>**YES** | 2B |
| | Fault Code 649 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 2B: Clear the inactive fault codes.

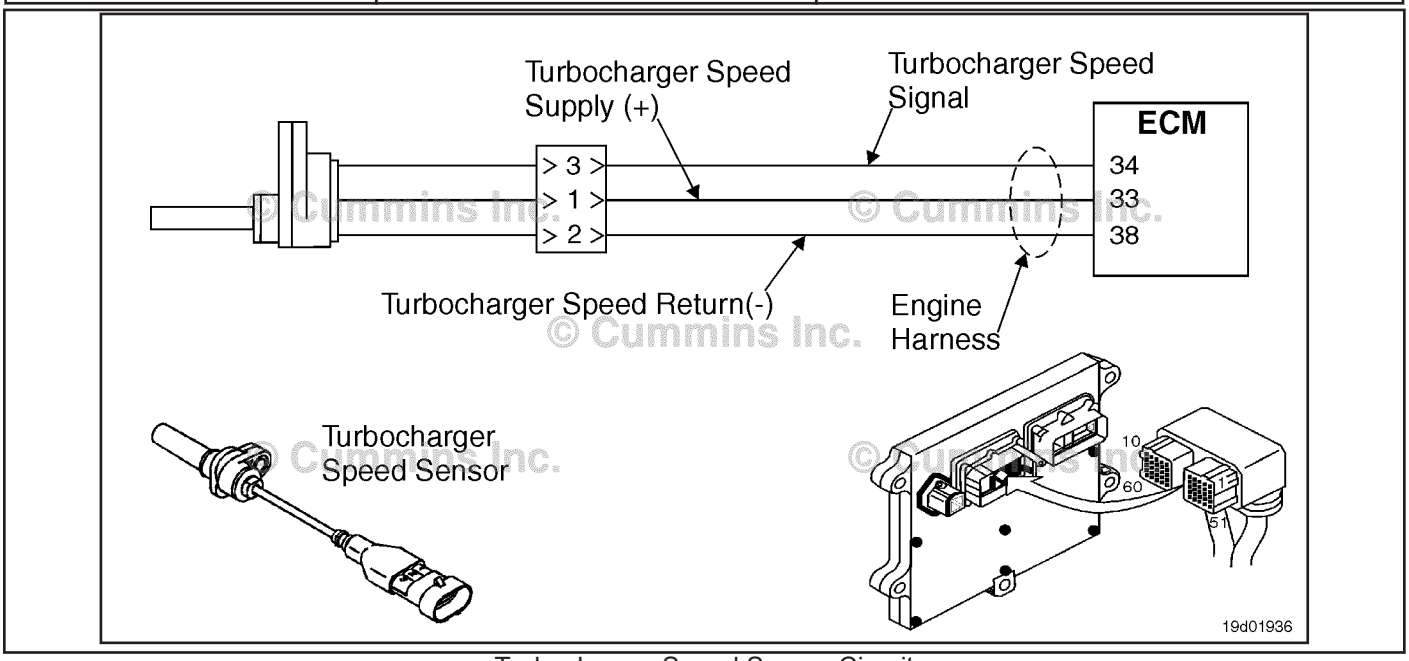
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 687 (ISB/QSB Automotive or Industrial Application)

## Turbocharger Speed Sensor - Below Normal Operating Range

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 687<br>PID(P), SID(S): P103<br>SPN: 103<br>FMI: 18<br>Lamp: Amber<br>SRT: | Turbocharger number 1 speed low - warning level. Low turbocharger speed detected by the ECM. | Engine power derate. The ECM uses estimated turbocharger speed. |




Turbocharger Speed Sensor Circuit

**Circuit Description:**

The electronic control module (ECM) provides +5 VDC to the turbocharger speed sensor signal pin. Circuitry inside the turbocharger speed sensor detects the movement of the turbocharger compressor blades and produces a speed signal. This signal is used by the ECM for engine controls.

**Component Location:**

The turbocharger speed sensor is located in the turbocharger compressor housing. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault will become active if the engine is running and the ECM detects boost pressure and engine speed but no turbocharger speed signal. Possible causes of this fault:

- Turbocharger speed sensor failure
- Engine harness failure
- ECM failure.

This fault becomes inactive at key-on or any time the speed signal from the turbocharger speed sensor returns. If the fault occurs intermittently, Fault Code 2345 can also be in the ECM memory. Look for causes of intermittent open circuit or short circuits in the turbocharger speed sensor circuit (including the speed sensor pigtail connector).

## Refer to Troubleshooting Fault Code t05-687

# FAULT CODE 687 (ISB/QSB Automotive or Industrial Application) - Turbocharger Speed Sensor - Below Normal Operating Range

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for sensor supply fault codes. | Fault Code 352 active or has inactive counts? | |
| STEP 1B: | Check for an active fault code. | Fault Code 687 active? | |
| **STEP 2:** | **Check the turbocharger speed sensor and circuit.** | | |
| STEP 2A: | Inspect the turbocharger speed sensor and harness connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the sensor supply voltage and return circuit at the harness. | 4.75 to 5.25 VDC? | |
| STEP 2C: | Check the sensor supply voltage and return circuit at the ECM. | 4.75 to 5.25 VDC? | |
| STEP 2D: | Check for an open circuit. | Less than 10 ohms? | |
| STEP 2E: | Check for a short circuit to ground. | Greater than 100k ohms? | |
| STEP 2F: | Check for a short circuit from pin to pin. | Greater than 100k ohms? | |
| **STEP 3:** | **Clear the fault codes.** | | |
| STEP 3A: | Disable the fault code. | Fault Code 687 inactive? | |
| STEP 3B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for sensor supply fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for sensor supply fault codes.<br>• Use INSITE™ electronic service tool, read the fault codes. | Fault Code 352 active or has inactive counts?<br>**YES** | Fault Code 352 |
| | Fault Code 352 active or has inactive counts?<br>**NO** | 1B |

**STEP 1B: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Start the engine and let it idle for one minute.<br>• Use the accelerator pedal, accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>• Return engine speed to idle.<br>• Use INSITE™ electronic service tool, read the fault codes.<br>NOTE: This step applies even if maximum engine speed without vehicle speed sensor limits the engine speed. | Fault Code 687 active?<br>**YES** | 2A |
| | Fault Code 687 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

## STEP 2: Check the turbocharger speed sensor and circuit.

### STEP 2A: Inspect the turbocharger speed sensor and harness connector pins.

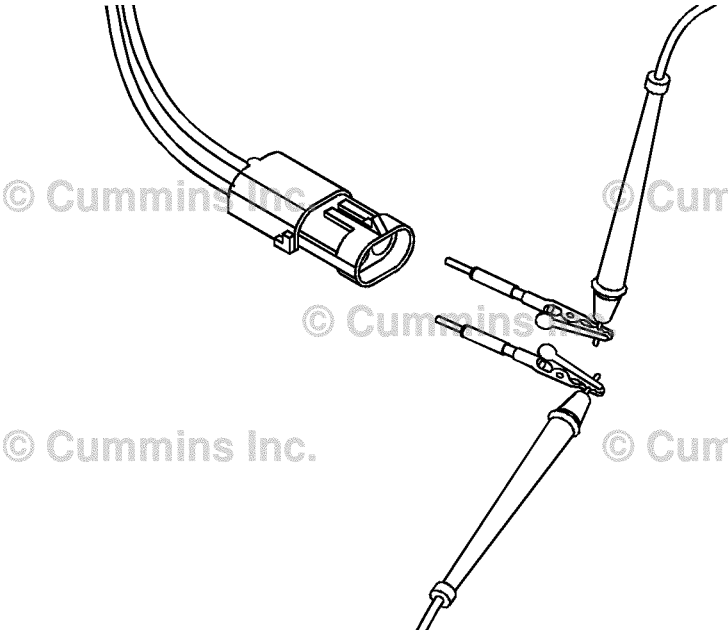
**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger speed sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and turbocharger speed sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broke<br>• Wire insulation damage<br>• Damaged locking tab connector.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.<br><br>NOTE: The turbocharger speed sensor has a “pigtail” connection. Closely inspect this electrical connection for signs of damage to the wire insulation. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the sensor supply voltage and return circuit at the harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the turbocharger speed sensor.
- Turn keyswitch ON.

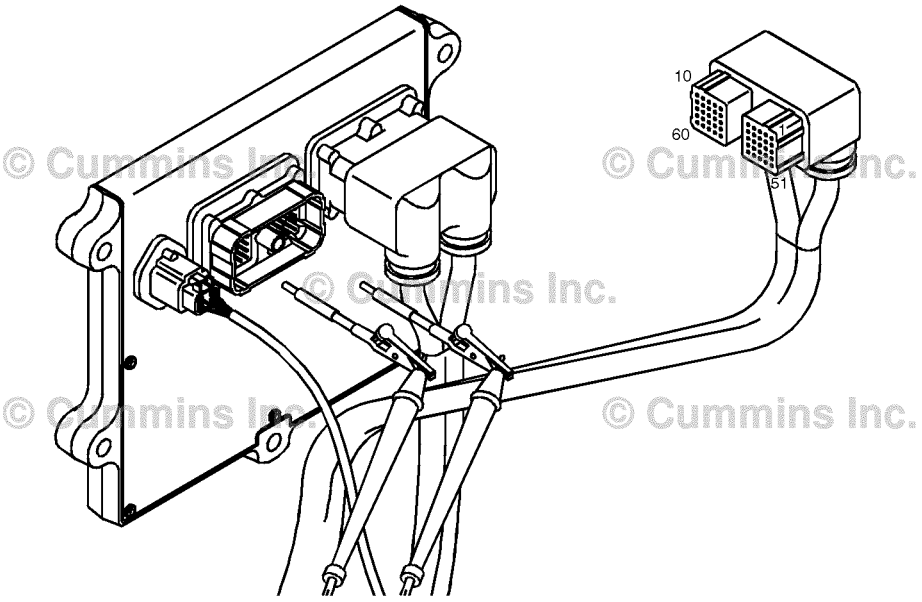
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the sensor supply voltage and return circuit.<br>• Measure the voltage between the turbocharger speed +5 VDC SUPPLY pin and the turbocharger speed RETURN pin at the sensor connector of the engine harness. | 4.75 to 5.25 VDC?<br>**YES** | 2D |
| | 4.75 to 5.25 VDC?<br>**NO** | 2C |



**STEP 2C: Check the sensor supply voltage and return circuit at the ECM.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.

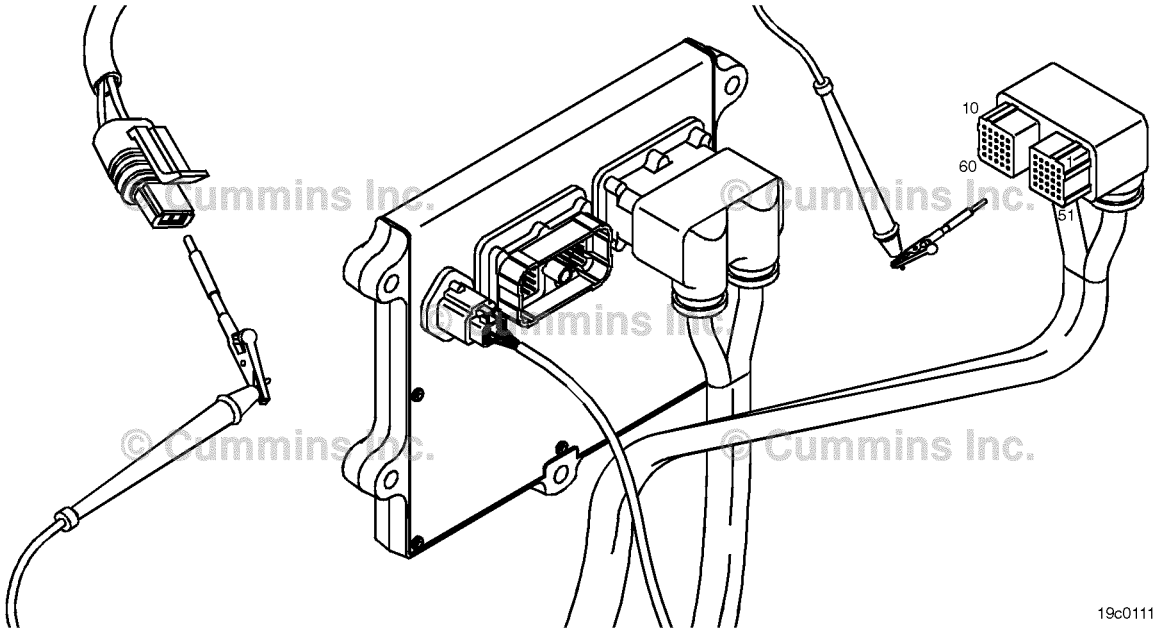
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the sensor supply voltage and return circuit at the ECM.<br>• Measure the voltage between the turbocharger speed +5 VDC SUPPLY pin and the turbocharger speed RETURN pin at the ECM port.<br><br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | 4.75 to 5.25 VDC?<br>**YES**<br>**Repair:**<br>Repair or replace the engine harness. | 3A |
| | 4.75 to 5.25 VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 3A |



**STEP 2D: Check for an open circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the turbocharger speed sensor from the engine harness.

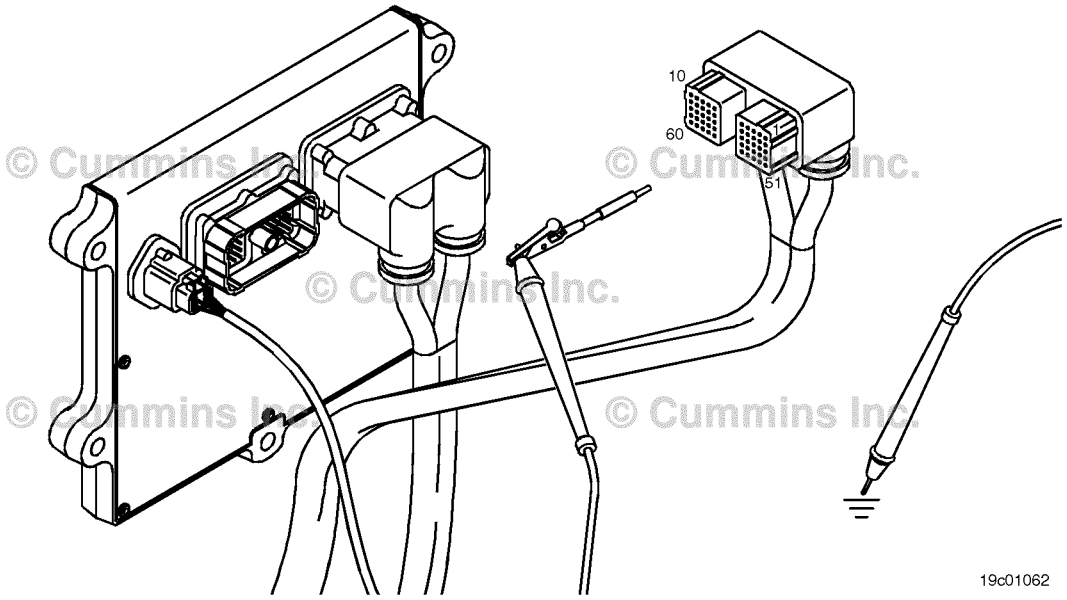
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the turbocharger speed SIGNAL pin at the ECM connector of the engine harness and the turbocharger speed SIGNAL pin at the turbocharger speed sensor connector of the engine harness.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 2E |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the engine harness. | 3A |



**STEP 2E: Check for a short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger speed sensor from the engine harness.
- Disconnect the engine harness from the ECM.

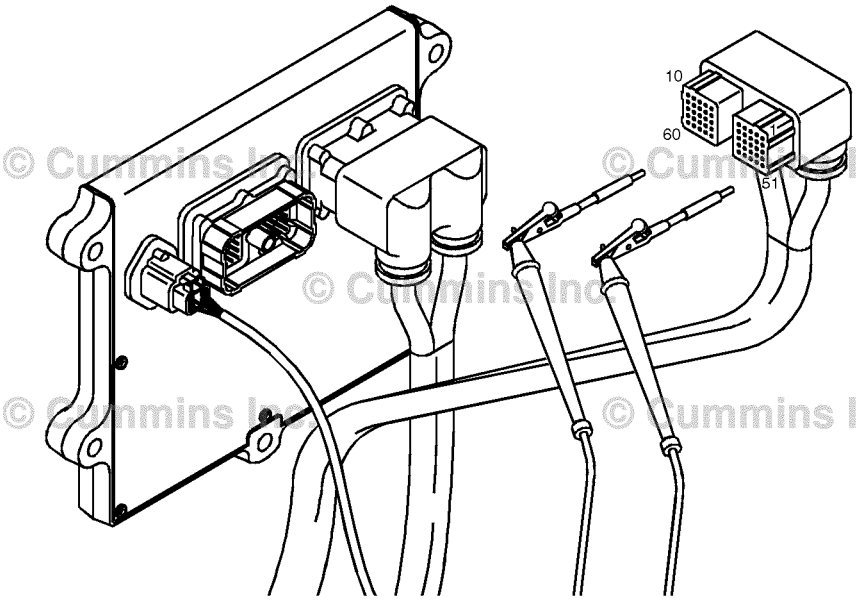
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the resistance between the turbocharger speed SIGNAL pin at the ECM connector of the engine harness and engine block ground.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 2F |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the engine harness. | 3A |



**STEP 2F: Check for a short circuit from pin to pin.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger speed sensor from the engine harness.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit from pin to pin.<br>• Measure the resistance between the turbocharger speed SIGNAL pin and all other pins at the ECM connector of the engine harness.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Replace the turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. | 3A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the engine harness. | 3A |



## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use the accelerator pedal, accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>• Return engine speed to idle.<br>• Use INSITE™ electronic service tool, read the fault codes.<br>NOTE: This step applies even if maximum engine speed without vehicle speed sensor limits the engine speed. | Fault Code 687 inactive?<br>**YES** | 3B |
| | Fault Code 687 inactive?<br>**NO** | 1A |

### STEP 3B: Clear the inactive fault codes.

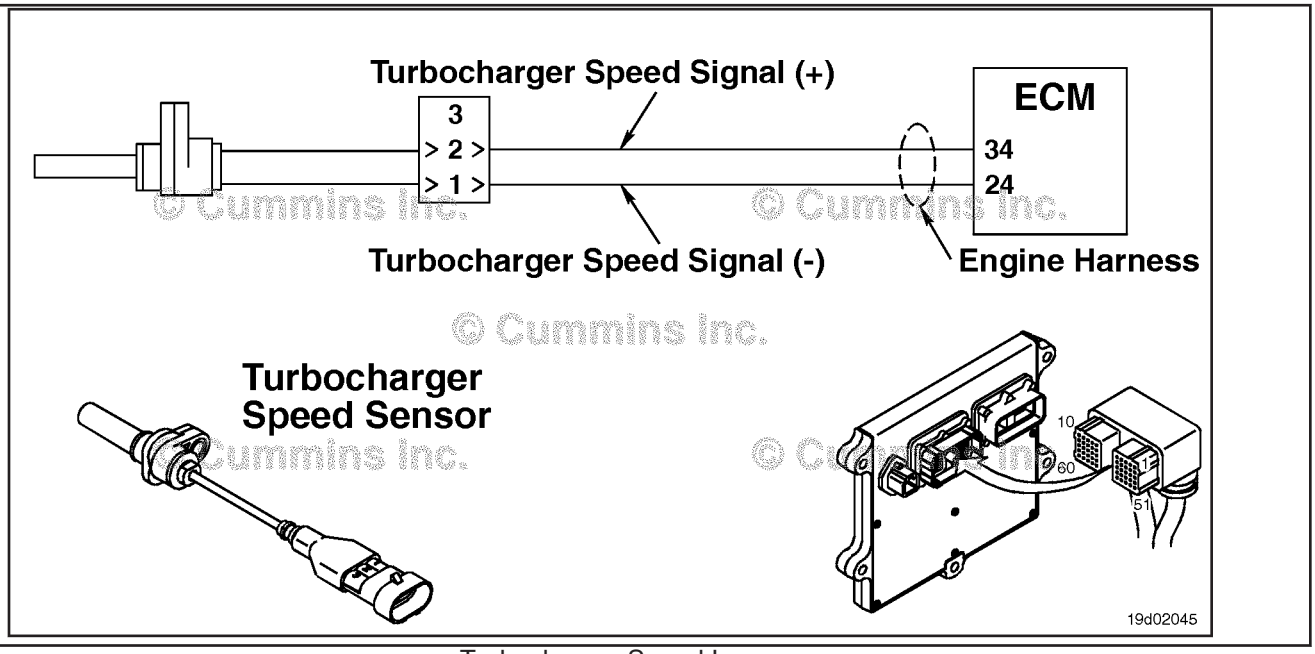
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 687 (ISC/QSC/ISL/QSL Automotive, Industrial, or Marine Application)

## Turbocharger Number 1 Speed Low - Data Valid but Below Normal Operational Range - Moderately Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 687<br>PID(P), SID(S): P103<br>SPN: 103<br>FMI: 1/18<br>Lamp: Amber<br>SRT: | Turbocharger Number 1 Speed Low - Data Valid but Below Normal Operational Range - Moderately Severe Level. Low turbocharger speed detected by the ECM. | Engine power derate. The ECM uses an estimated turbocharger speed. |




Turbocharger Speed Low

**Circuit Description:**

The turbocharger speed sensor is a variable reluctance speed sensor. It consists of a coil of wire and an iron core. A signal is generated as the turbocharger shaft spins. The target on the turbocharger shaft is a ground flat in the center of the shaft.

**Component Location:**

The turbocharger speed sensor is mounted in the center housing of the turbocharger.

**Shop Talk:**

This fault may come active if the electronic control module (ECM) senses boost pressure and engine speed while at the same time a turbocharger speed signal is **not** present.

Items that can fail and cause this fault code include:

- Turbocharger speed sensor
- Engine harness
- Barometric pressure sensor
- Intake manifold pressure sensor
- ECM.

This fault becomes inactive any time the speed signal from the turbocharger speed sensor returns.

If the fault occurs intermittently, look for causes of intermittent open circuit or short circuits in the turbocharger speed sensor circuit (including the speed sensor pigtail connector).

## Refer to Troubleshooting Fault Code t05-687

# FAULT CODE 687 (ISC/QSC/ISL/QSL Automotive, Industrial, or Marine Application) - Turbocharger Number 1 Speed Low - Data Valid but Below Normal Operational Range - Moderately Severe Level

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Cannon™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Cannon™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for barometric pressure or intake manifold pressure sensor faults.** | | |
| STEP 1A: | Read the fault codes with INSITE™ electronic service tool. | Fault Codes 122, 123, 221, or 222 active? | |
| **STEP 2:** | **Check for intermittent fault condition.** | | |
| STEP 2A: | Operate the engine and confirm that the turbocharger speed fault comes active. | Did Fault Code 687 come active during engine operation? | |
| **STEP 3:** | **Check for a failed turbocharger speed sensor.** | | |
| STEP 3A: | Inspect the engine harness connector to the turbocharger speed sensor. | Is the connector or pigtail harness damaged? | |
| STEP 3B: | Measure the turbocharger speed sensor resistance. | Between 600 and 1600 ohms? | |
| STEP 3C: | Check for a short circuit to ground in the turbocharger speed sensor. | Greater than 100k ohms? | |
| **STEP 4:** | **Check the engine harness.** | | |
| STEP 4A: | Inspect the ECM and engine harness connector pins. | Is the engine harness connector damaged? | |
| STEP 4B: | Check the turbocharger speed sensor circuit continuity. | Within 10 ohms of sensor resistance? | |
| STEP 4C: | Check for a short to ground in the engine harness. | Greater than 100k ohms? | |
| STEP 4D: | Check for a pin-to-pin short in the engine harness. | Greater than 100k ohms? | |
| **STEP 5:** | **Check the ECM.** | | |
| STEP 5A: | Connect all components and determine if the fault code reoccurs. | Did Fault Code 687 come active during engine operation? | |
| **STEP 6:** | **Clear the fault codes.** | | |
| STEP 6A: | Disable the fault code. | Fault Code 687 inactive? | |
| STEP 6B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check for barometric pressure or intake manifold pressure sensor faults.

**STEP 1A: Read the fault codes with INSITE™ electronic service tool.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes with INSITE™ electronic service tool. | Fault Codes 122, 123, 221, or 222 active?<br>**YES** | Appropriate fault code troubleshooti ng tree |
| | Fault Codes 122, 123, 221, or 222 active?<br>**NO** | 2A |

### STEP 2: Check for intermittent fault condition.

**STEP 2A: Operate the engine and confirm that the turbocharger speed fault comes active.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Clear the inactive fault codes.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Start the engine.<br>• Use the accelerator pedal, accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>• Return the engine speed to idle.<br>• Use INSITE™ electronic service tool, read the fault codes.<br>NOTE: This step is valid even if maximum engine speed, without vehicle speed sensor, limits the engine speed. | Did Fault Code 687 come active during engine operation?<br>**YES** | 3A |
| | Did Fault Code 687 come active during engine operation?<br>**NO**<br>**Repair:**<br>An intermittent fault conditions exists. | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

## STEP 3: Check for a failed turbocharger speed sensor.

### STEP 3A: Inspect the engine harness connector to the turbocharger speed sensor.

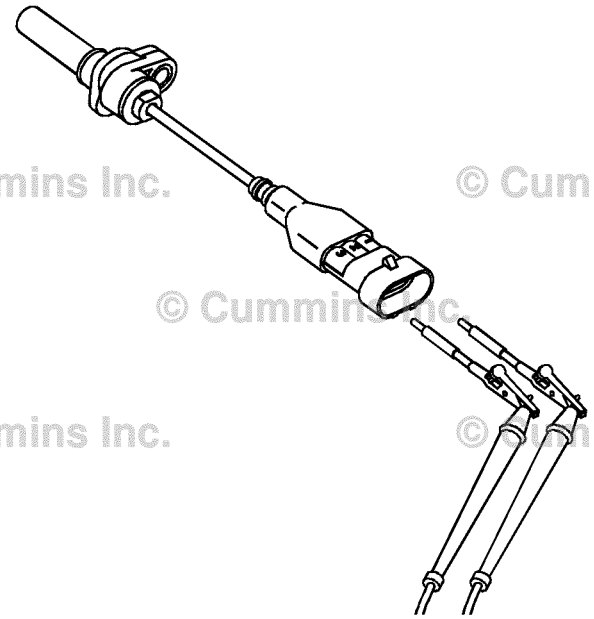
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the turbocharger speed sensor.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect theturbocharger speed sensor connector, the engine harness connector, and the turbocharger speed sensor pigtail harness? connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Is the connector pigtail harness damaged?<br>**YES**<br>**Repair:**<br>Repair or replace the damaged connector or turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. | 6A |
| | Is the connector pigtail harness damaged?<br>**NO** | 3B |

**STEP 3B: Measure the turbocharger speed sensor resistance.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger speed sensor from the engine harness.

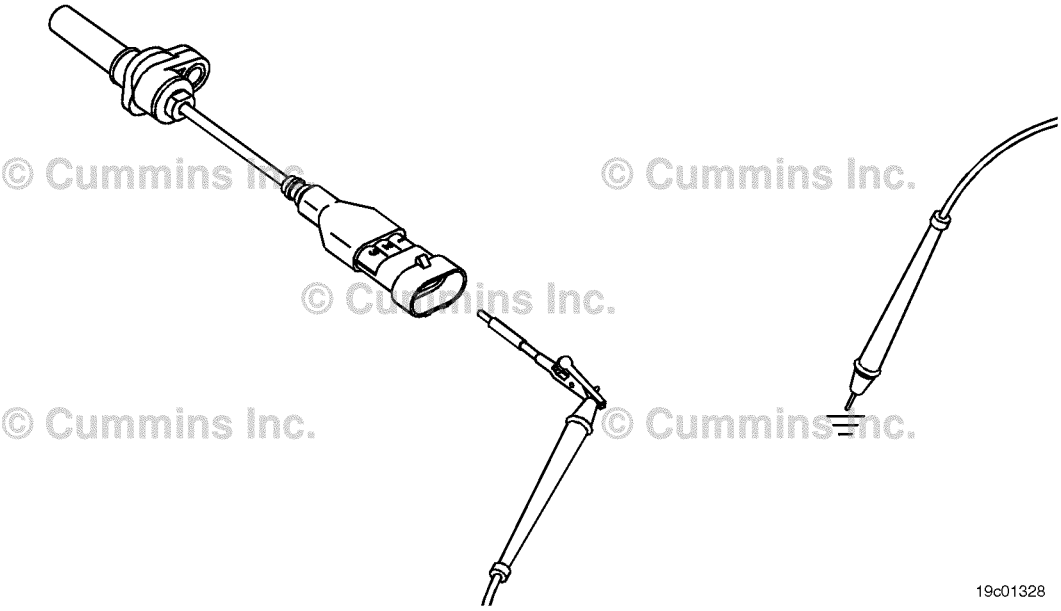
| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance from the turbocharger speed SIGNAL (+) pin to the turbocharger speed SIGNAL (-) pin at the sensor.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Between 600 and 1600 ohms?<br>**YES** | 3C |
| | Between 600 and 1600 ohms?<br>**NO**<br>**Repair:**<br>The turbocharger speed sensor is damaged.<br>Replace the turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. | 6A |



**STEP 3C: Check for a short circuit to ground in the turbocharger speed sensor.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger speed sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance from the turbocharger speed SIGNAL (+) pin at the sensor to engine block ground.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 4A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>The turbocharger speed sensor is shorted to ground.<br>Replace the turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. | 6A |



## STEP 4: Check the engine harness.

### STEP 4A: Inspect the ECM and engine harness connector pins.

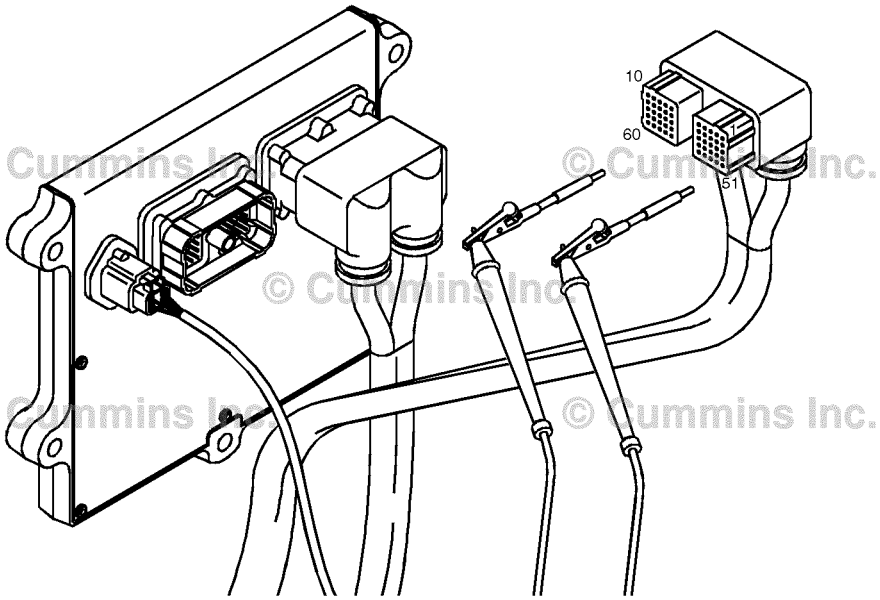
**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Disconnect the engine harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness ECM connector for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Is the engine harness connector damaged?<br>**YES**<br>**Repair:**<br>Repair or replace the engine harness connector. Refer to Procedure 019-043 in Section 19. | 6A |
| | Is the engine harness connector damaged?<br>**NO** | 4B |

**STEP 4B: Check the turbocharger speed sensor circuit continuity.**

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Disconnect the engine harness connector from the ECM.

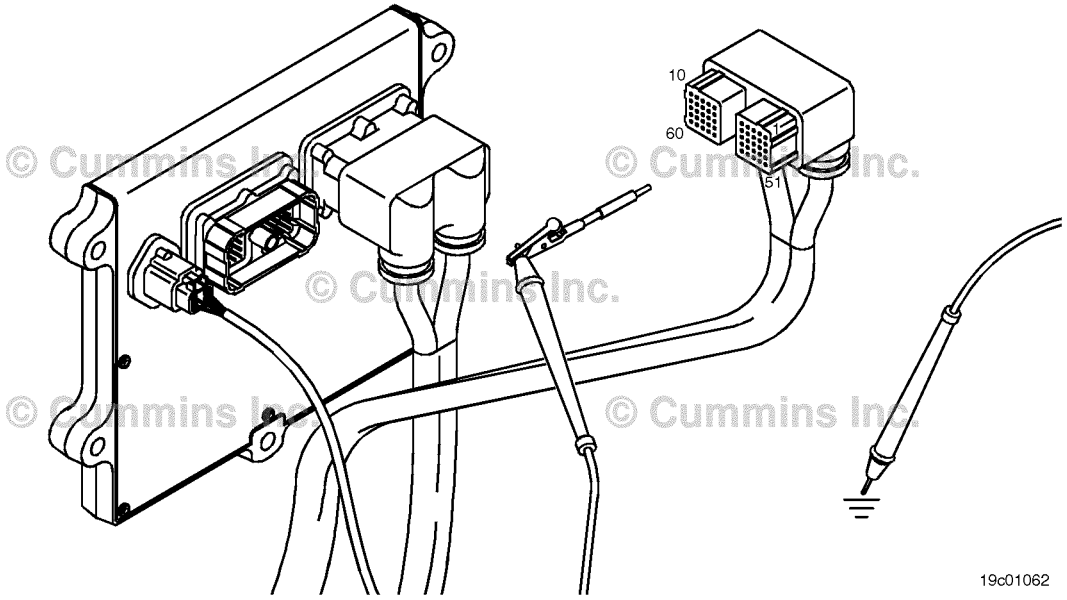
| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance form the turbocharger speed SIGNAL (+) pin of the engine harness ECM connector to the turbocharger speed SIGNAL (-) pin of the engine harness ECM connector.<br>NOTE: The resistance of the turbocharger speed sensor circuit resistance should be no more than 10 ohms greater than the resistance of the turbocharger speed sensor. The turbocharger speed sensor resistance value was read in Step 3B.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Within 10 ohms of sensor resistance?<br>**YES** | 4C |
| | Within 10 ohms of sensor resistance?<br>**NO**<br>**Repair:**<br>There is high resistance or an open circuit in the engine harness or turbocharger speed sensor connector.<br>Repair or replace the engine harness or connector(s). Refer to Procedure 019-043 in Section 19. | 6A |



**STEP 4C: Check for a short to ground in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Disconnect the engine harness connector from the ECM.

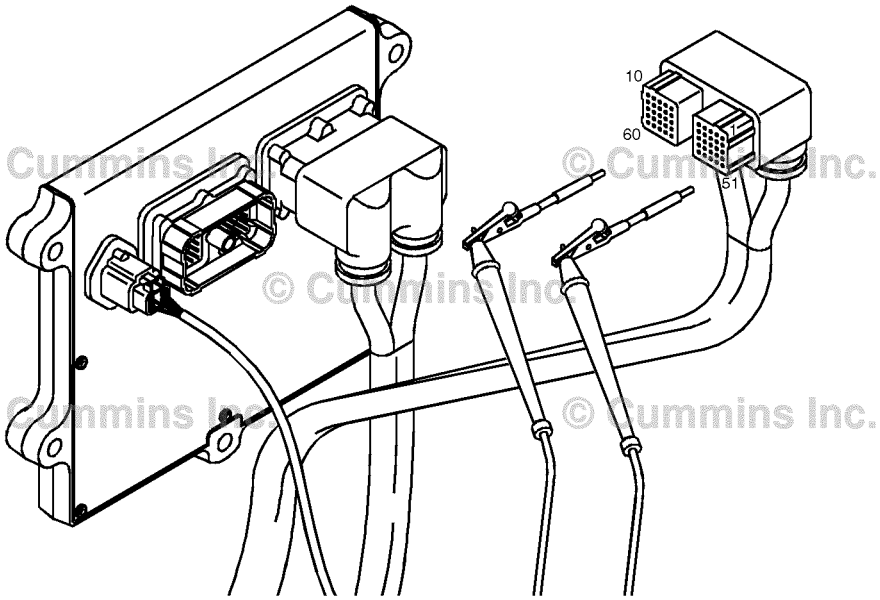
| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance from the turbocharger speed SIGNAL (+) pin of the engine harness ECM connector to engine block ground.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 4D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>There is a short to ground in the turbocharger speed sensor circuit. Inspect the engine harness for a short to ground.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 6A |



**STEP 4D: Check for a pin-to-pin short in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Disconnect the engine harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Using a multimeter, measure the resistance from the turbocharger speed SIGNAL (+) pin of the engine harness ECM connector to all other pins in the connector except turbocharger speed SIGNAL (-) pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 5A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Inspect the engine harness for a short between two pins.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 6A |



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## STEP 5: Check the ECM.

### STEP 5A: Connect all components and determine if the fault code reoccurs.

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Connect the engine harness to the ECM.
- Turn keyswitch ON.
- Start the engine.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Operate the engine at idle.<br>• Use the accelerator pedal, accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>• Return the engine speed to idle speed.<br>• Use INSITE™ electronic service tool, read the fault codes.<br>NOTE: This step applies even if maximum engine speed, without vehicle speed sensor, limits the engine speed. | Did Fault Code 687 come active during engine operation?<br>**YES** | 6A |
| | Did Fault Code 687 come active during engine operation?<br>**NO**<br>**Repair:**<br>The faulty condition was repaired when the components were reconnected. | 6A |

## STEP 6: Clear the fault codes.

### STEP 6A: Disable the fault code.

**Condition:**
- Turn the keyswitch OFF.
- Connect the turbocharger speed sensor to the engine harness.
- Connect the engine harness to the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Start the engine.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Using the accelerator pedal, accelerate the engine speed to high idle (100 percent) and hold the engine speed at high idle for at least 20 seconds.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive.<br>NOTE: This step applies even if maximum engine speed, without vehicle speed sensor, limits the engine speed. | Fault Code 687 inactive?<br>**YES** | 6B |
| | Fault Code 687 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair location if all steps have been completed and checked a second time. | 1A |

**STEP 6B: Clear the inactive fault codes.**

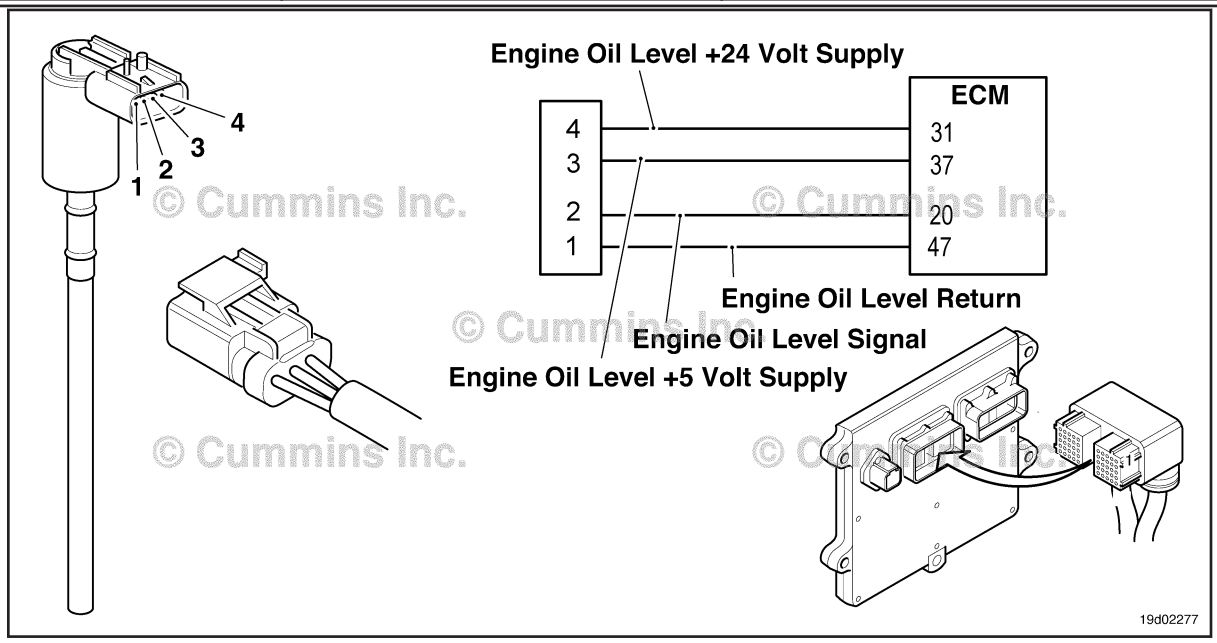
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool erase the inactive fault codes . | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 688

## Engine Oil Level — Data Valid But Above Normal Operational Range — Most Severe Level

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 688<br>PID(P), SID(S): P98<br>SPN: 98<br>FMI: 0<br>Lamp: Red<br>SRT: | Engine Oil Level — Data Valid But Above Normal Operational Range — Most Severe Level. High oil level has been detected by the oil level sensor. | Possible low power, excessive smoke, oil dilution, contamination, or severe engine damage. The engine may derate. |




Circuit: Engine Oil Level Sensor.

**Circuit Description:**

An algorithm in the ECM calibration monitors engine oil level while the ECM is keyed on and no engine speed is detected. If the engine oil level exceeds a certain threshold, the ECM will activate Fault 688.

**Component Location:**

The engine oil level sensor is located on the engine oil dipstick, on the air intake side of the engine. 100-002 (Engine Diagrams) in section E for further details on dipstick location.

**Shop Talk:**

Fault code 688 indicates that the oil level in the engine is much higher than the recommended oil level.

Other causes of fault code 688 may include:

- The engine may have been overfilled with oil during the most recent oil change
- The fuel system may be leaking into the lube oil system. (Check for fuel system faults or use fluorescent fuel system dye to identify leaks)
- The cooling system may be leaking into the lube oil system. (Check for coolant in the oil).

On-Board Diagnostic (OBD) Information:

- The ECM illuminates the appropriate amber or red fault lamp when the diagnostic runs and fails
- The ECM turns off the appropriate fault lamp when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-688

# FAULT CODE 688 - Engine Oil Level — Data Valid But Above Normal Operational Range — Most Severe Level

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Read the fault codes** | **Fault Code 688 active?** | |
| **STEP 2:** | **Clear the fault codes.** | | |
| **STEP 2A:** | **Disable the fault codes.** | **Fault Code 688 inactive?** | |
| **STEP 2B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.
- Engine oil temperature near ambient temperature.
- Make sure the vehicle is parked on level ground.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>• Use INSITE™ to read the fault codes. | Fault Code 688 active?<br>**YES**<br>**Repair:**<br>High engine lubricating oil level has been detected.<br>Correct the engine lubricating oil level condition. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 007-037 in Section 7. | 2A |
| | Fault Code 688 active?<br>**NO** | 2A |

## STEP 2: Clear the fault codes

### STEP 2A: Disable the fault codes.

**Condition:**
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Is fault 688 inactive?<br>**YES** | 2B |
| | Is fault 688 inactive?<br>**NO** | 1A |

### STEP 2B: Clear the inactive fault codes.

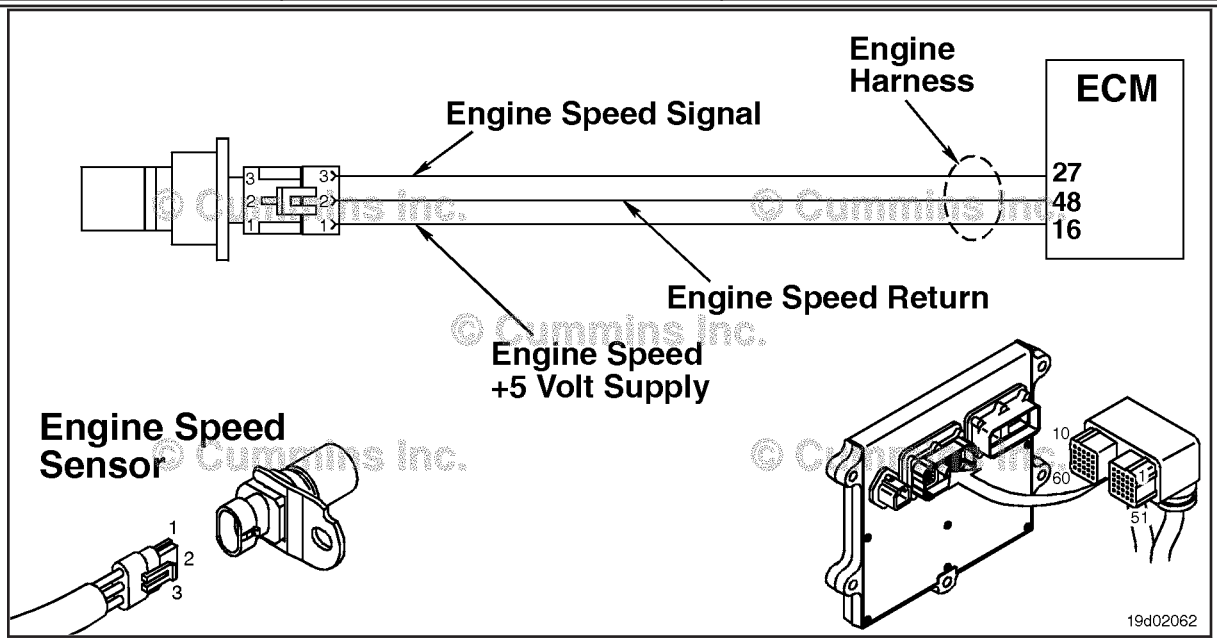
**Condition:**
- Connect all components
- Connect INSITE™ electronic service tool
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete. |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps. |

# Fault Code 689

## Engine Crankshaft Speed/Position - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 689<br>PID(P), SID(S): P190<br>SPN: 190<br>FMI: 2/2<br>Lamp: Amber<br>SRT: | Engine Crankshaft Speed/ Position - Data Erratic, Intermittent, or Incorrect. Loss of signal from crankshaft sensor. | Engine can run rough. Possibly poor starting capability. Engine runs using backup speed sensor. Engine power is reduced. |




Crankshaft Engine Speed Sensor Circuit

**Circuit Description:**

The crankshaft engine speed sensor provides engine speed information to the electronic control module (ECM). The sensor is powered by +5 volts. The sensor generates the signal by sensing the movement of target teeth machined into a tone wheel that is mounted to the crankshaft.

**Component Location:**

The engine speed sensor is located on the intake side of the engine between number 5 and number 6 cylinders at the crankshaft level. For ISB and QSB5.9 the crankshaft engine speed sensor is located on the intake side of the engine behind the vibration damper near the tone wheel. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code is recorded when the electronic control module (ECM) does **not** receive a signal from the crankshaft engine speed sensor, or the signal it receives is degraded.

Possible causes of this fault code include:

- Open circuit on the supply, signal, or return circuits in the sensor, engine harness, or ECM
- Short circuits to ground or return circuits in the sensor, engine harness, or ECM
- Short circuits to a voltage source in the sensor, engine harness, or ECM
- Damage to the sensor target teeth or tone wheel.

INSITE™ electronic service tool monitor parameter associated with this fault code and sensor include:

- Engine speed sensor state.

If this fault code occurs intermittently, look closely for causes of intermittent harness connections such as loose or worn pins in the engine harness connectors.

## Refer to Troubleshooting Fault Code t05-689

# FAULT CODE 689 - Engine Crankshaft Speed/Position - Data Erratic, Intermittent, or Incorrect
## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**
**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**
**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead, Part Number 3164596 - male Framatome™ test lead, and Part Number 3164597 - female Framatome™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for sensor supply fault codes.** | **Fault Code 284 active?** | |
| **STEP 1B:** | **Check for an active fault code.** | **Fault Code 689 active?** | |
| **STEP 2:** | **Check the crankshaft engine speed sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the crankshaft engine speed sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the sensor supply voltage and return circuit.** | **4.75-VDC to 5.25-VDC?** | |
| **STEP 2C:** | **Check the circuit response.** | **Crankshaft engine speed sensor state equals low?** | |
| **STEP 2C-1:** | **Check the circuit response.** | **Crankshaft engine speed sensor state equals high?** | |
| **STEP 2C-2:** | **Inspect the crankshaft engine speed sensor.** | **Damaged sensor tip?** | |
| **STEP 2C-3:** | **Check the circuit response.** | **Crankshaft engine speed sensor state transitions from high to low or low to high, or the state shows triggered?** | |
| **STEP 2C-4:** | **Verify adequate crankshaft engine speed sensor air gap.** | **Crankshaft engine speed sensor transitions from high to low or low to high, or the state shows triggered?** | |
| **STEP 2D:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2E:** | **Check the ECM response.** | **Monitor crankshaft engine speed sensor state equals low?** | |
| **STEP 2E-1:** | **Check the ECM response.** | **Monitor crankshaft engine speed sensor state equals high?** | |
| **STEP 3:** | **Check the ECM.** | | |
| **STEP 3A:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check the ECM sensor supply voltage and return circuit.** | **4.75-VDC to 5.25-VDC?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 689 inactive?** | |

**STEP 4B:** **Clear the inactive fault codes.** **All fault codes cleared?**

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for sensor supply fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for sensor supply fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 284 active?<br>**YES** | Fault Code 284 |
| | Fault Code 284 active?<br>**NO** | 1B |

**STEP 1B: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Start the engine and let it idle for one minute.<br>• While engine idles, monitor the fault code status.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 689 active?<br>**YES** | 2A |
| | Fault Code 689 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

## STEP 2: Check the crankshaft engine speed sensor and circuit.

### STEP 2A: Inspect the sensor and connector pins.

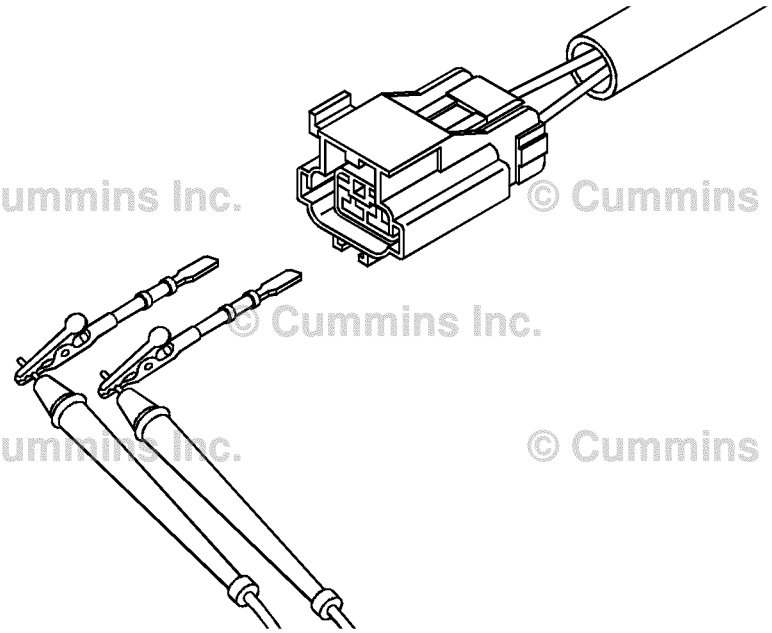
**Condition:**
- Turn keyswitch OFF.
- Disconnect the crankshaft engine speed sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty of damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the crankshaft engine speed sensor from the engine harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the voltage at the sensor connector.<br>Measure the voltage between the crankshaft engine speed SUPPLY pin and the crankshaft engine speed RETURN pin at the sensor connector of the engine harness. | 4.75-VDC to 5.25-VDC?<br>**YES** | 2C |
| | 4.75-VDC to 5.25-VDC?<br>**NO** | 3A |




**STEP 2C: Check the circuit response.**

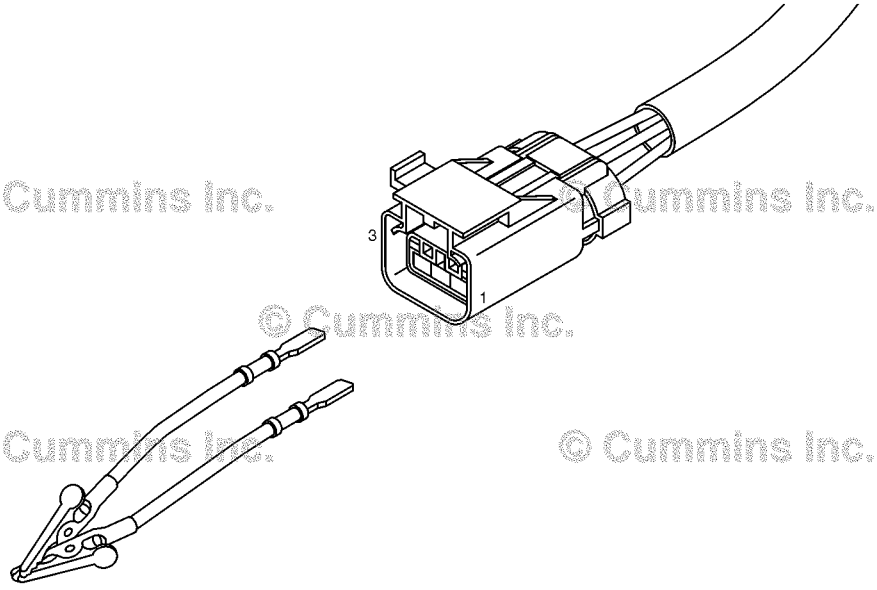
**Condition:**
- Turn keyswitch OFF.
- Disconnect the crankshaft engine speed sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response.<br>• Read the crankshaft engine speed sensor state using the INSITE™ electronic service tool monitor mode. | Crankshaft engine speed sensor state equals low?<br>**YES** | 2C-1 |
| | Crankshaft engine speed sensor state equals low?<br>**NO** | 2D |

**STEP 2C-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the crankshaft engine speed sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the crankshaft engine speed SUPPLY pin and the crankshaft engine speed SIGNAL pin at the sensor connector of the engine harness. Check for the appropriate ECM response.<br>• Read the crankshaft engine speed sensor state using the INSITE™ electronic service tool monitor mode.<br>Refer to the circuit diagram or wiring diagram for connector pin identification. | Crankshaft engine speed sensor state equals high?<br>**YES** | 2C-2 |
| | Crankshaft engine speed sensor state equals high?<br>**NO** | 2D |



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**STEP 2C-2: Inspect the crankshaft engine speed sensor.**

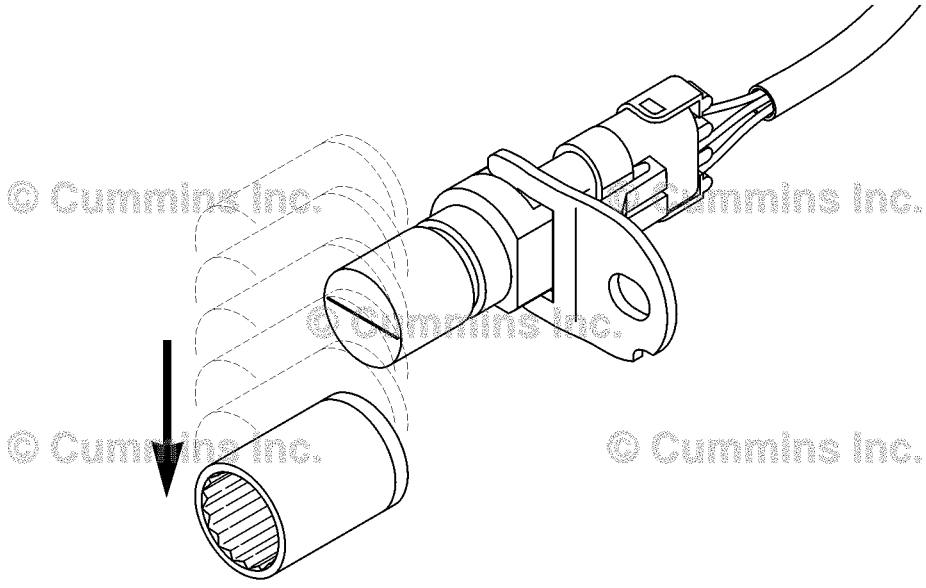
**Condition:**
- Turn keyswitch OFF.
- Remove the crankshaft engine speed sensor from the engine. Refer to Procedure 019-365 in Section 19.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the crankshaft engine speed sensor for the following:<br>• Damaged sensor tip<br>• Physical signs of the sensor touching the speed or speed teeth. | Damaged sensor tip?<br>**YES**<br>**Repair:**<br>Replace the crankshaft engine speed sensor. Refer to Procedure 019-365 in Section 19. | 4A |
| | Damaged sensor tip?<br>**NO** | 2C-3 |

**STEP 2C-3: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Remove the crankshaft engine speed sensor from the engine. Refer to Procedure 019-365 in Section 19.
- Make sure the crankshaft engine speed sensor is connected to the harness.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use the ratchet drive side of the socket tool that was used to remove the sensor from the engine, place it flush on the sensor so that the edge of the socket is on the edge of the sensor. Slowly slide the socket in a perpendicular direction to the marked line on the sensor or in a perpendicular direction to the mounting bracket of the sensor. Inspect for the following:<br>Check for the appropriate response.<br>• Read the crankshaft engine speed sensor state using INSITE™ electronic service tool monitor mode. | Crankshaft engine speed sensor state transitions from high to low or low to high, or the state shows triggered?<br>**YES** | 2C-4 |
| | Crankshaft engine speed sensor state transitions from high to low, or low to high, or the state shows triggered?<br>**NO**<br>**Repair:**<br>Replace the crankshaft engine speed sensor. Refer to Procedure 019-365 in Section 19. | 4A |

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**STEP 2C-4: Verify adequate crankshaft engine speed sensor air gap.**

**Condition:**
- Turn keyswitch ON.
- Install the crankshaft engine speed sensor to the engine. Refer to Procedure 019-365 in Section 19.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Momentarily engage the starter but do not start the engine. Repeat this as many times as necessary. Monitor the crankshaft engine speed sensor state of the crankshaft engine speed sensor for the following:<br>• Change of state from high to low or low to high, or the state shows triggered. | Crankshaft engine speed sensor transitions from high to low or low to high, or the state shows triggered?<br>**YES** | 4A |
| | Crankshaft engine speed sensor transitions from high to low or low to high, or the state shows triggered?<br>**NO**<br>**Repair:**<br>Inspect the crankshaft tone wheel for damage or spinning.<br>Refer to the appropriate base engine troubleshooting and repair manual for the repair or replacement. | 4A |

**STEP 2D: Inspect the ECM and engine harness connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2E |

**STEP 2E: Check the ECM response.**

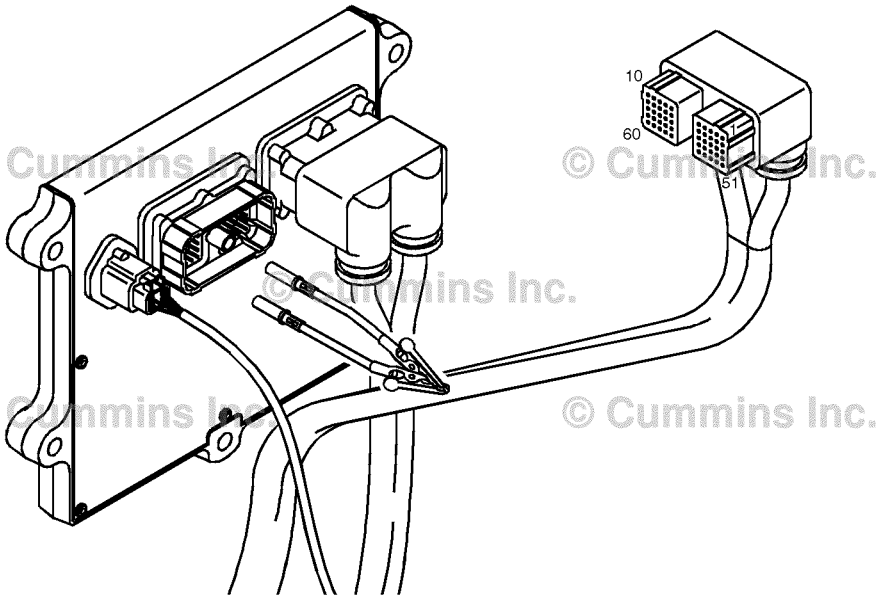
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response.<br>• Read the crankshaft engine speed sensor state using the INSITE™ electronic service tool monitor mode. | Monitor crankshaft engine speed sensor state equals low?<br>**YES** | 2E-1 |
| | Monitor crankshaft engine speed sensor state equals low?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 2E-1: Check the ECM response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the crankshaft engine speed SUPPLY pin and the crankshaft engine speed SIGNAL pin at the ECM port.<br>Check for the appropriate ECM response.<br>• Read the crankshaft engine speed sensor state using the INSITE™ electronic service tool monitor mode.<br>Refer to the circuit diagram or wiring diagram for connector pin identification. | Monitor crankshaft engine speed sensor state equals high?<br>**YES**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |
| | Monitor crankshaft engine speed sensor state equals high?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



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## STEP 3: Check the ECM.

### STEP 3A: Inspect the ECM and engine harness connector pins.

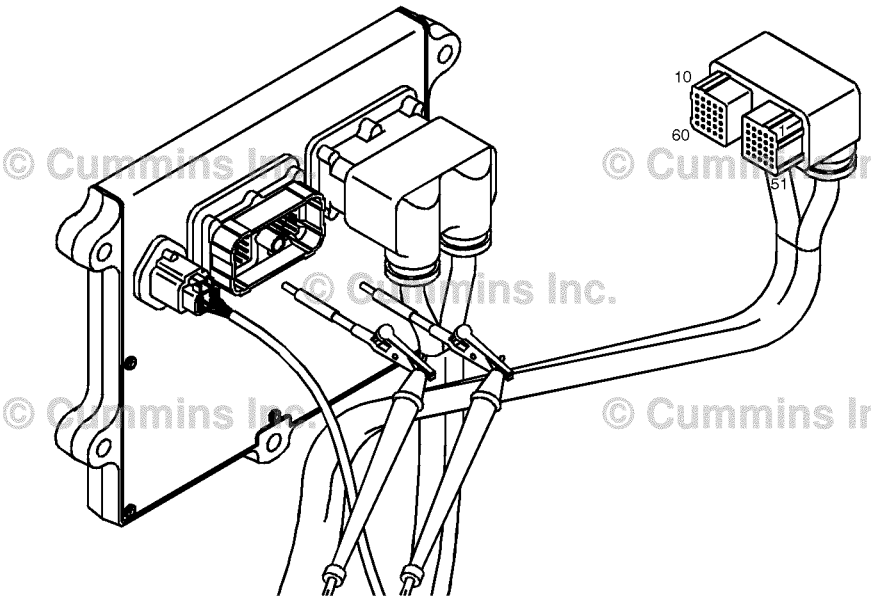
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the ECM and engine harness connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check the ECM sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the voltage between the crankshaft engine speed SUPPLY pin and the crankshaft engine speed RETURN pin at the ECM engine harness port.<br>Refer to the circuit diagram or wiring diagram for connector pin identification. | 4.75-VDC to 5.25-VDC?<br>**YES**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Setion 19. | 4A |
| | 4.75-VDC to 5.25-VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |




## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 689 inactive?<br>**YES** | 4B |
| | Fault Code 689 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

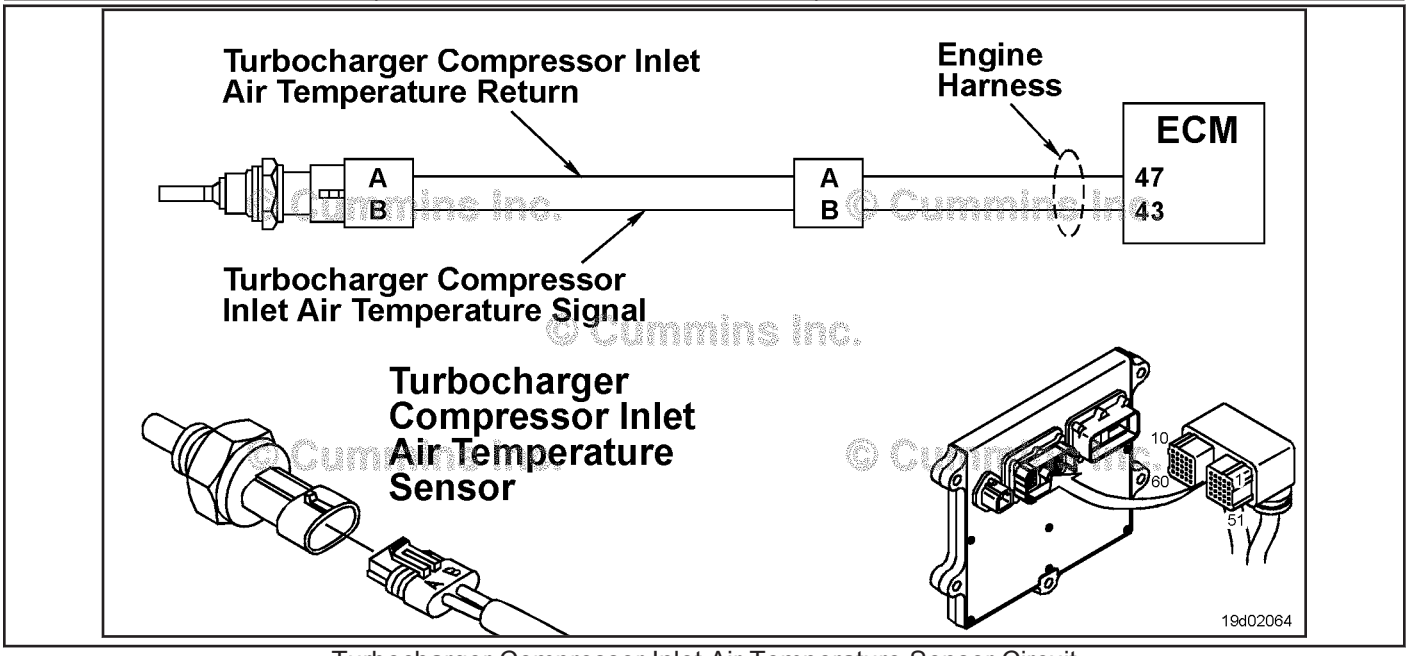
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 691

## Turbocharger #1 Compressor Inlet Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 691<br>PID(P), SID(S):<br>SPN: 1172<br>FMI: 3/3<br>Lamp: Amber<br>SRT: | Turbocharger Number 1 Compressor Inlet Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage detected at the turbocharger compressor inlet air temperature circuit. | Engine power derate. |



Turbocharger Compressor Inlet Air Temperature Sensor Circuit

**Circuit Description:**

The turbocharger compressor inlet air temperature sensor is used by the ECM to monitor the temperature of the intake air temperature coming into the turbocharger. The ECM monitors the voltage on the signal pin and converts this to a temperature value. This temperature is one of many inputs used by the ECM to control engine operation and emissions.

**Component Location:**

The turbocharger compressor inlet air temperature sensor is located in the compressor casing of the turbocharger. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

The turbocharger inlet air temperature sensor shares return wires in the engine harness with other sensors. An open return can cause multiple fault codes to be active. Before troubleshooting Fault Code 691, check for multiple fault codes. An extension harness between the main engine harness and the turbocharger compressor inlet temperature sensor may be used depending on the turbocharger arrangement.

Possible causes of this fault code:

- Open return circuit in the harness, connectors, or sensor

- Open signal circuit or short circuit to a voltage source
- Failed sensor.

The resistance of the sensor varies with temperature. The sensor resistance should conform to the values in the table shown below.

| Temperature (°F) | Temperature (°C) | Resistance (ohms) |
|---|---|---|
| 14 | -10 | 49k to 62k |
| 32 | 0 | 29k to 36k |
| 68 | 20 | 11k to 14k |
| 104 | 40 | 4.9k to 5.8k |
| 158 | 70 | 1.6k to 1.9k |

## Refer to Troubleshooting Fault Code t05-691

# FAULT CODE 691 - Turbocharger #1 Compressor Inlet Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for an inactive fault code. | Fault Code 691 inactive? | |
| **STEP 2:** | **Check the turbocharger compressor inlet air temperature sensor and circuit.** | | |
| STEP 2A: | Inspect the turbocharger compressor inlet air temperature sensor and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the sensor resistance. | 250 ohms to 380k ohms? | |
| STEP 2C: | Check the fault codes and verify sensor condition. | Fault Code 691 is active? | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| STEP 3A: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check the ECM response | Fault Code 692 active and Fault Code 691 inactive? | |
| STEP 3C: | Check for an open circuit in the engine harness. | Less than 10 ohms? | |
| STEP 3C-1: | Check for an open circuit in the engine harness. | Less than 10 ohms? | |
| STEP 3D: | Check for a pin-to-pin short circuit in the engine harness. | Greater than 100k ohms? | |
| STEP 3E: | Check for an inactive fault code. | Fault Code 691 inactive? | |
| **STEP 4:** | **Clear the fault codes.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 691 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

#### STEP 1A: Check for an inactive fault code.

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool, read the fault codes. | Fault Code 691 inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 691 inactive?<br>**NO** | 2A |

### STEP 2: Check the turbocharger compressor inlet air temperature sensor and circuit.

#### STEP 2A: Inspect the turbocharger compressor inlet air temperature sensor and connector pins.

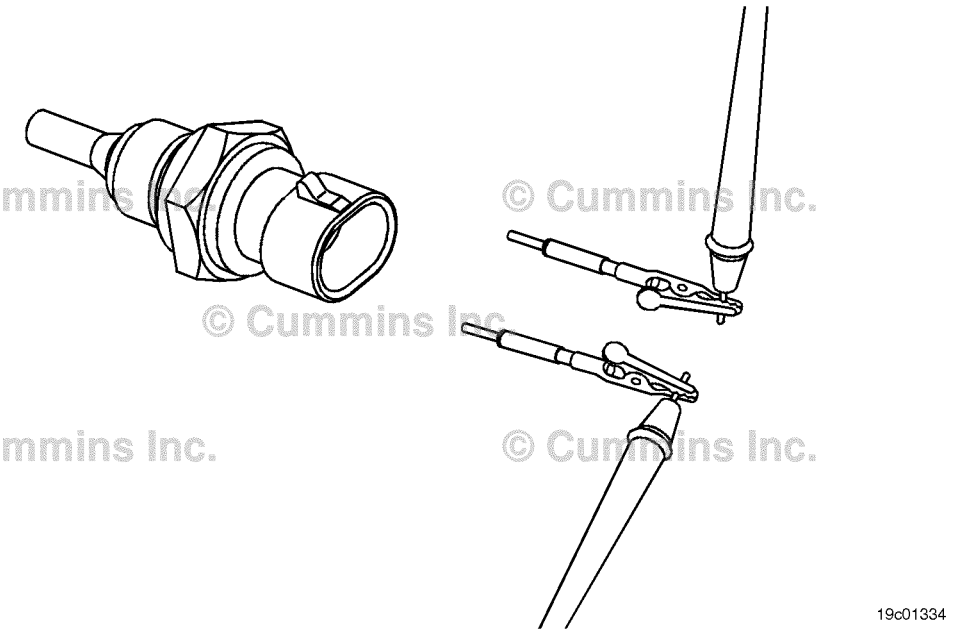
**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger compressor inlet air temperature sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor? connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A defective connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the sensor resistance.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger compressor inlet air temperature sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the sensor resistance.<br>• Measure the resistance between the turbocharger compressor inlet air temperature sensor SIGNAL pin and the turbocharger compressor inlet air temperature sensor RETURN pin at the turbocharger compressor inlet air temperature sensor.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | 250 ohms to 380k ohms?<br>**YES** | 2C |
| | 250 ohms to 380k ohms?<br>**NO**<br>**Repair:**<br>Replace the turbocharger compressor inlet air temperature sensor. Refer to Procedure 019-395 in Section 19. | 4A |



**STEP 2C: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger compressor inlet air temperature sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool, to read the fault codes. | Fault Code 691 is active?<br>**YES** | 3A |
| | Fault Code 691 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the ECM and engine harness.

**STEP 3A: Inspect the ECM and engine harness connector pins.**

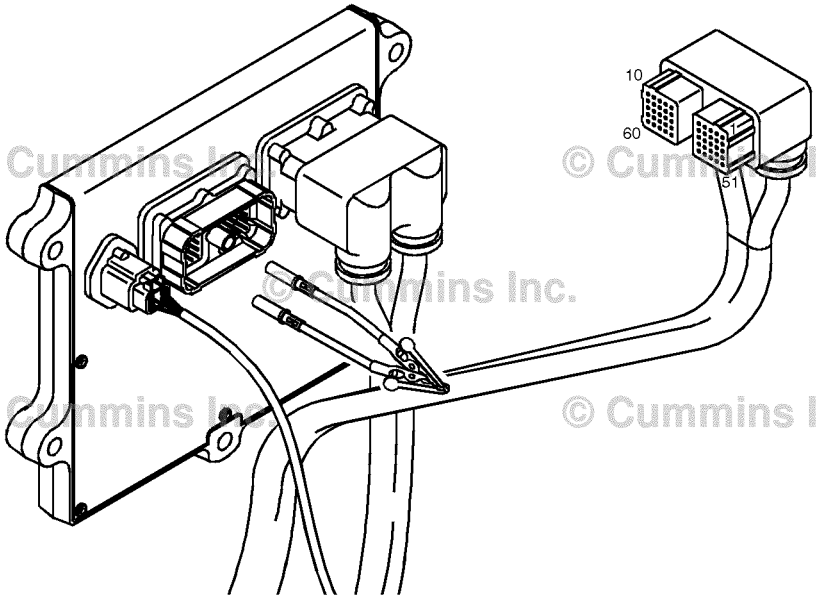
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or the engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check the ECM response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the turbocharger compressor inlet air temperature sensor SIGNAL pin and the turbocharger compressor inlet air temperature sensor RETURN pin at the ECM connector.<br>Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 692 active and Fault Code 691 inactive?<br>**YES** | 3C |
| | Fault Code 692 active and Fault Code 691 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



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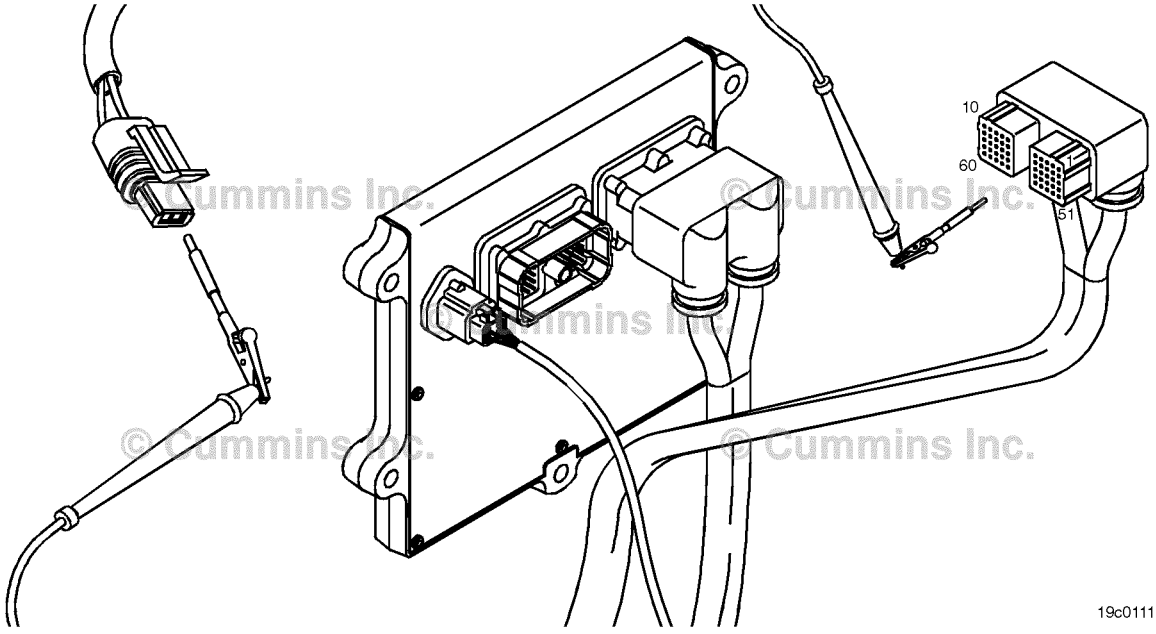
**STEP 3C: Check for an open circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the turbocharger compressor inlet air temperature sensor from the engine harness.

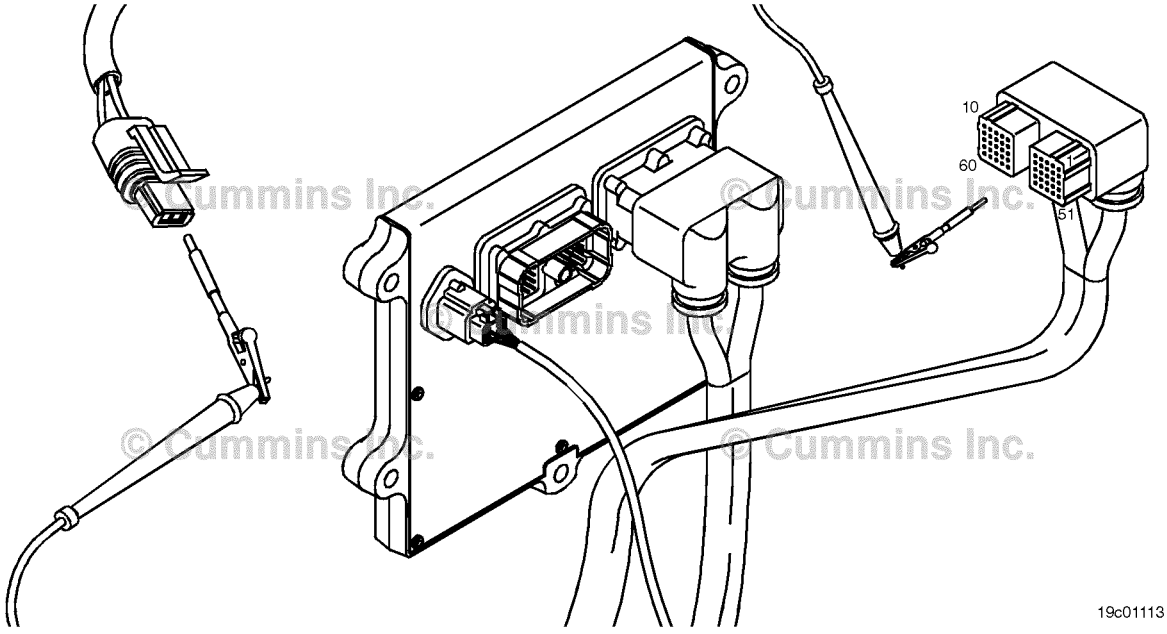
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the engine harness ECM connector turbocharger compressor inlet air temperature sensor RETURN pin and the engine harness turbocharger compressor inlet air temperature sensor connector RETURN pin.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C-1 |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open RETURN circuit has been detected in the engine harness.<br>Troubleshoot each harness connected in series to determine which contains the open return.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3C-1: Check for an open circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the turbocharger compressor inlet air temperature sensor from the engine harness.

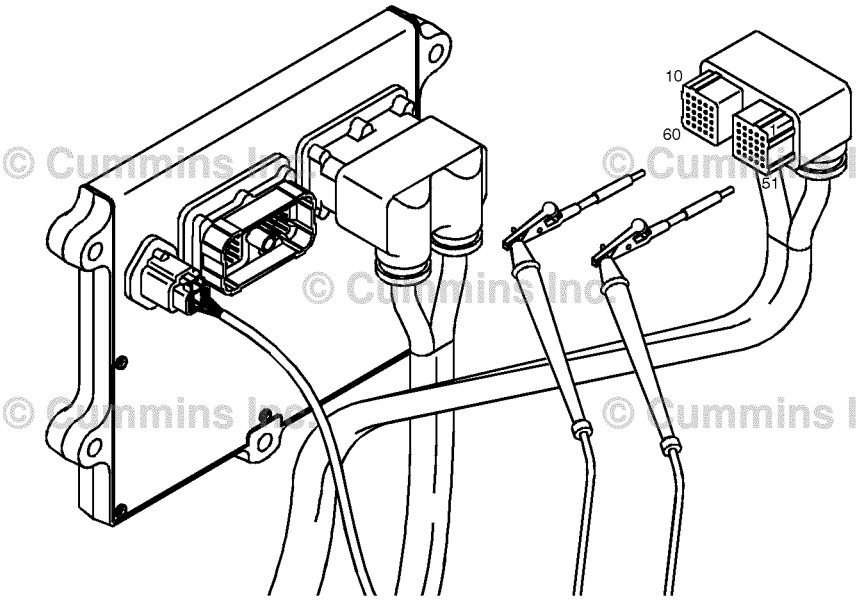
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the engine harness ECM connector compressor inlet air temperature sensor SIGNAL pin and the engine harness turbocharger compressor inlet air temperature sensor connector SIGNAL pin.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open SIGNAL circuit has been detected in the engine harness.<br>Troubleshoot each harness connected in series to determine which contains the pin-to-pin shorted signal circuit.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3D: Check for a pin-to-pin short circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the turbocharger compressor inlet air temperature sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the turbocharger compressor inlet air temperature sensor SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3E |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness.<br>Troubleshoot each harness connected in series to determine which contains the pin-to-pin shorted signal circuit.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool , read the fault codes. | Fault Code 691 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Fault Code 691 inactive?<br>**NO**<br>**Repair:**<br>Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. | 1A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 691 inactive?<br>**YES** | 4B |
| | Fault Code 691 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

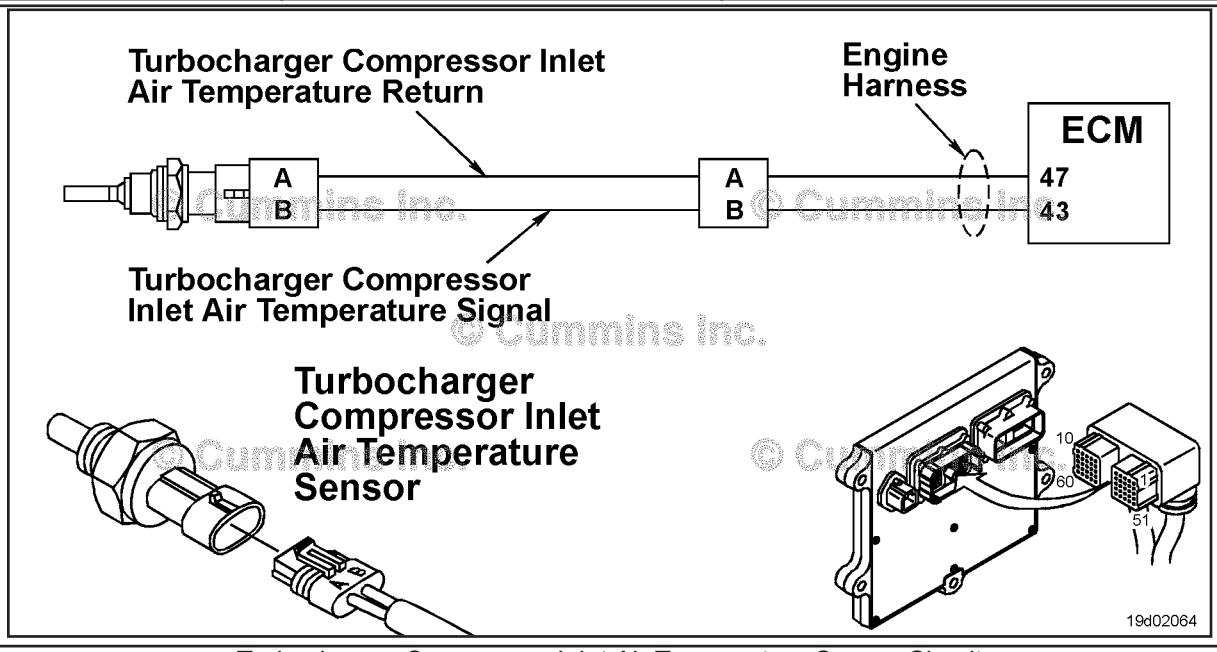
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 692

## Turbocharger Number 1 Compressor Inlet Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 692<br>PID(P), SID(S):<br>SPN: 1172<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Turbocharger Number 1 Compressor Inlet Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at the turbocharger compressor inlet air temperature sensor circuit. | Engine power derate. |




Turbocharger Compressor Inlet Air Temperature Sensor Circuit

**Circuit Description:**

The turbocharger compressor inlet air temperature sensor is used by the electronic control module (ECM) to monitor the temperature of the intake air temperature coming into the turbocharger. The ECM monitors the voltage on the signal pin and converts this to a temperature value. This temperature is one of many inputs used by the ECM to control engine operation and emissions.

**Component Location:**

The turbocharger compressor inlet air temperature sensor is located in the compressor casing of the turbocharger. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

An extension harness between the main engine harness and the turbocharger compressor inlet temperature sensor may be used depending on the turbocharger arrangement.

Possible causes of this fault code:

- Signal circuit shorted to ground in the harness
- Signal circuit shorted to return or ground in the sensor
- Failed sensor.

The resistance of the sensor varies with temperature. The sensor resistance should conform to the values in the table shown below.

| Temperature (°C) | Temperature (°F) | Resistance (ohms) |
|---|---|---|
| -10 | 14 | 49k to 62k |
| 0 | 32 | 29k to 36k |
| 20 | 68 | 11k to 14k |
| 40 | 104 | 4.9k to 5.8k |
| 70 | 158 | 1.6k to 1.9k |

## Refer to Troubleshooting Fault Code t05-692

# FAULT CODE 692 - Turbocharger Number 1 Compressor Inlet Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for an inactive fault code. | Fault Code 692 inactive? | |
| **STEP 2:** | **Check the turbocharger compressor inlet air temperature sensor and circuit.** | | |
| STEP 2A: | Inspect the turbocharger compressor inlet air temperature sensor and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the circuit response. | Fault Code 691 active and Fault Code 692 inactive? | |
| STEP 2C: | Check the fault codes and verify sensor condition. | Fault Code 692 is active? | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| STEP 3A: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check the ECM response. | Fault Code 691 active and Fault Code 692 inactive? | |
| STEP 3C: | Check for a pin-to-pin short circuit in the engine harness. | Greater than 100k ohms? | |
| STEP 3D: | Check for a pin short circuit to ground. | Greater than 100k ohms? | |
| STEP 3E: | Check for an inactive fault code. | Fault Code 692 is inactive? | |
| **STEP 4:** | **Clear the fault codes.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 692 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an inactive fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 692 inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 692 inactive?<br>**NO** | 2A |

### STEP 2: Check the turbocharger compressor inlet air temperature sensor and circuit.

**STEP 2A: Inspect the turbocharger compressor inlet air temperature sensor and connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger compressor inlet air temperature sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger compressor inlet air temperature sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 691 active and Fault Code 692 inactive?<br>**YES** | 2C |
| | Fault Code 691 active and Fault Code 692 inactive?<br>**NO** | 3A |

**STEP 2C: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF.
- Connect the turbocharger compressor inlet air temperature sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 692 is active?<br>**YES**<br>**Repair:**<br>A damaged sensor has been detected.<br>Replace the turbocharger compressor inlet air temperature sensor. Refer to Procedure 019-395 in Section 19. | 4A |
| | Fault Code 692 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the ECM and engine harness.

### STEP 3A: Inspect the ECM and engine harness connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 3B |

### STEP 3B: Check the ECM response.

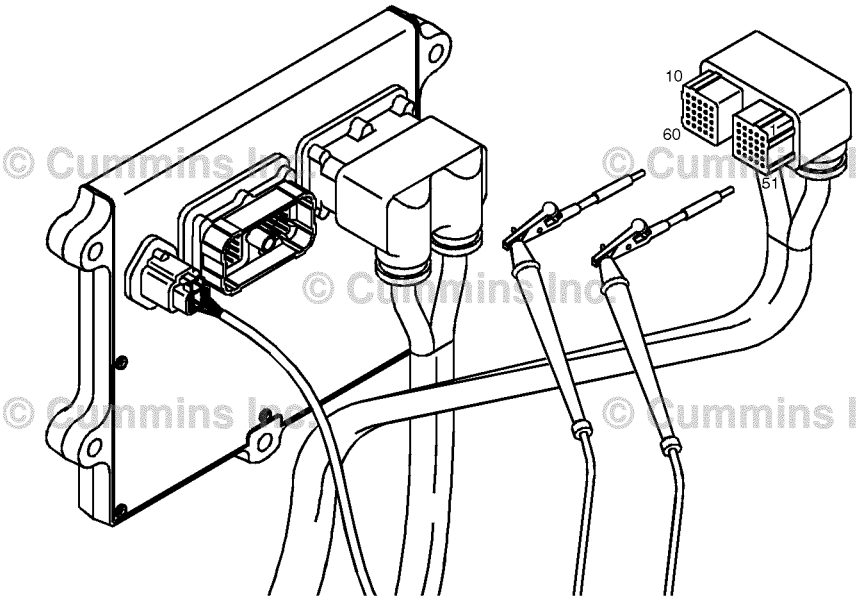
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 691 active and Fault Code 692 inactive?<br>**YES** | 3C |
| | Fault Code 691 active and Fault Code 692 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check for a pin-to-pin short circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the turbocharger compressor inlet air temperature sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the turbocharger compressor inlet air temperature SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness.<br>Troubleshoot each harness connected in series to determine which contains the pin-to-pin shorted signal circuit.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



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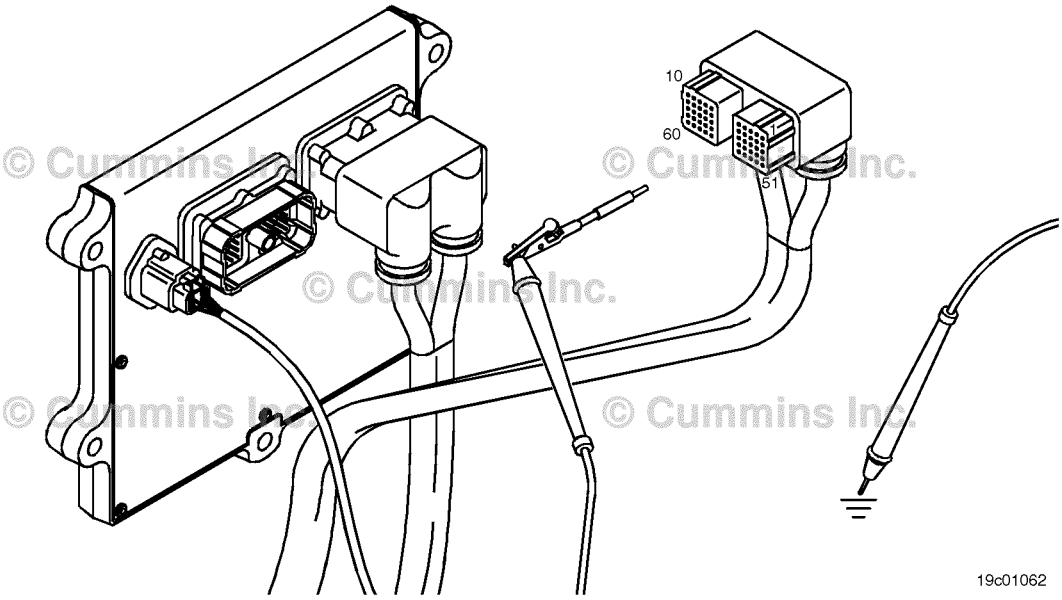
**STEP 3D: Check for a pin short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the turbocharger compressor inlet air temperature sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-ground short.<br>• Measure the resistance between the turbocharger compressor inlet air temperature sensor SIGNAL pin in the engine harness ECM connector and ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3E |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-ground short circuit on the SIGNAL line has been detected in the engine harness.<br>Troubleshoot each harness connected in series to determine which contains the shorted signal circuit to ground.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 692 is inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Fault Code 692 is inactive?<br>**NO**<br>**Repair:**<br>Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. | 1A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 692 inactive?<br>**YES** | 4B |
| | Fault Code 692 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair location if all steps have been completed and checked again. | 1A |

**STEP 4B: Clear the inactive fault codes.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 731 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, or Marine)

## Engine Speed Sensor/Position Camshaft and Crankshaft Misalignment - Mechanical System Not Responding Properly or Out of Adjustment

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 731<br>PID(P), SID(S): S064<br>SPN: 723<br>FMI: 7/7<br>Lamp: Amber<br>SRT: | Engine Speed Sensor/Position Camshaft and Crankshaft Misalignment - Mechanical System Not Responding Properly or Out of Adjustment. Mechanical misalignment between the crankshaft and camshaft engine speed sensors. | Engine will operate derated. Excessive smoke, hard start, and rough idle possible. |

**Circuit Description:**

The engine speed sensor and camshaft position sensor provide an engine speed and position signal to the electronic control module (ECM) through the engine harness.

**Component Location:**

Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

**Shop Talk:**

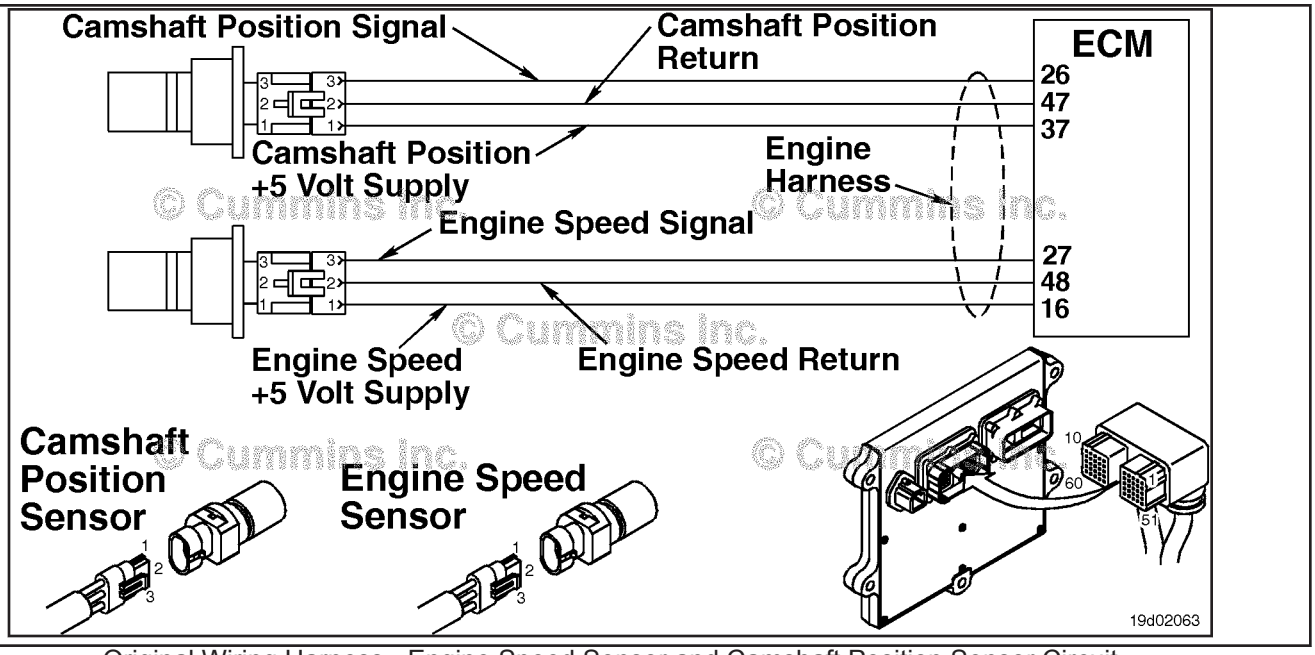
This fault will become active anytime the ECM receives a signal from both the primary EPS (crankshaft sensor) and the backup EPS (camshaft sensor), and the ECM determines that the camshaft and crankshaft signals are **not** in the correct phase. If this fault code is active immediately following a repair that included camshaft removal, it is likely that the camshaft gear was installed incorrectly and is **not** timed correctly.

The sensor return configuration for Euro 4 ISB engines has been changed for automotive wiring harnesses manufactured from February 2012 onward. The new style wiring harnesses can be be identified using the method below:

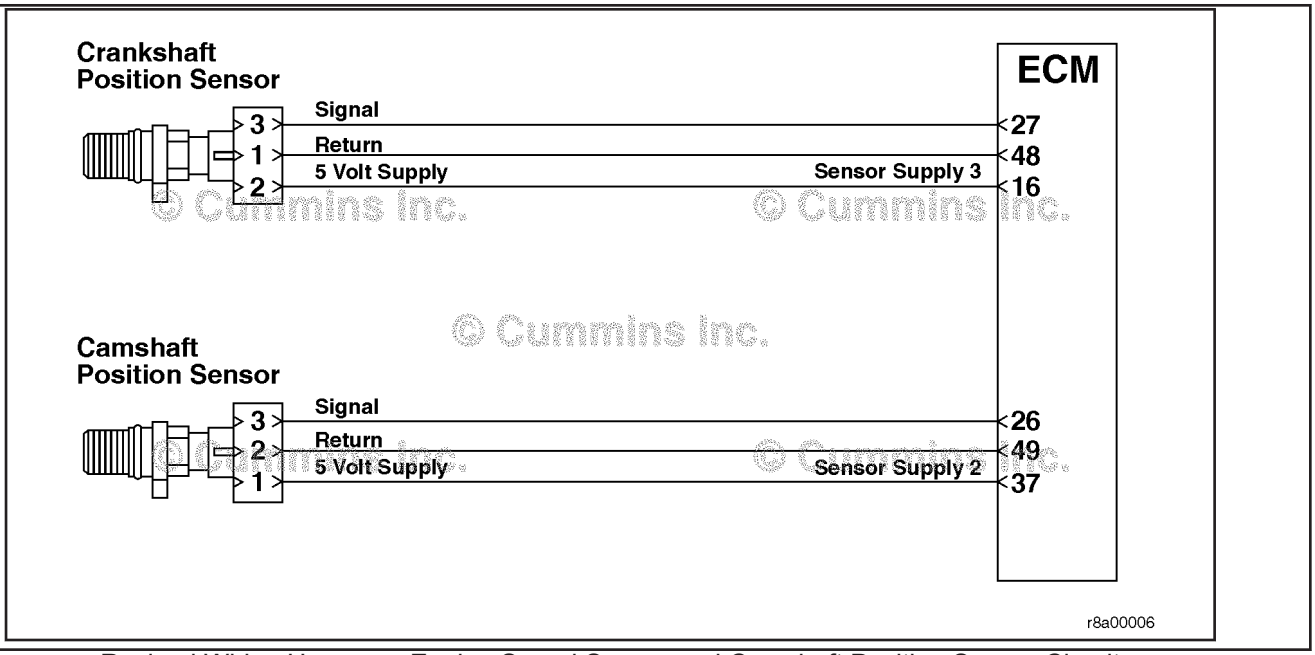
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM pin 47 and the camshaft position sensor RETURN pin
- Use the table below to determine which harness is fitted to the engine.

| Engine Harnesses | | | |
|---|---|---|---|
| From | To | New Harness | Old Harness |
| Intake manifold pressure/ temperature sensor RETURN pin | Camshaft position sensor RETURN pin | Open circuit | Short circut |
| ECM pin 47 | Camshaft position sensor RETURN pin | Open circuit | Short circuit |

NOTE: QSB engines, all C series engines, and all L series engines are **not** affected by this change.




Original Wiring Harness - Engine Speed Sensor and Camshaft Position Sensor Circuit




Revised Wiring Harness - Engine Speed Sensor and Camshaft Position Sensor Circuit

**Refer to Troubleshooting Fault Code t05-731.**

# FAULT CODE 731b - Engine Speed Sensor/Position Camshaft and Crankshaft Misalignment - Mechanical System Not Responding Properly or Out of Adjustment

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for multiple fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fault Code 731 the only active fault?** | |
| **STEP 2:** | **Inspect the tone wheels and speed/position sensors.** | | |
| **STEP 2A:** | **Inspect the engine speed and position sensors for damage.** | **Any damage?** | |
| **STEP 2B:** | **Inspect the tone wheels for any damage.** | **Any damage?** | |
| **STEP 3:** | **Inspect the engine and vehicle grounding.** | | |
| **STEP 3A:** | **Inspect the engine block, starter, alternator, chassis, and battery grounds.** | **All grounds present, properly grounded, free of corrosion, and tight?** | |
| **STEP 4:** | **Check for correct engine static timing.** | | |
| **STEP 4A:** | **Check static timing.** | **Camshaft and crankshaft timing marks properly aligned at top dead center?** | |
| **STEP 5:** | **Clear the fault code.** | | |
| **STEP 5A:** | **Disable the fault code.** | **Fault Code 731 inactive?** | |
| **STEP 5B:** | **Clear the fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for multiple fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>Use INSITE™ electronic service tool to read the fault codes. | Is fault code 731 the **only** active fault?<br>**YES** | 2A |
| | Is fault code 731 the **only** active fault?<br>**NO**<br>**Repair:**<br>Troubleshoot any other active faults before continuing with this tree. | Appropriate fault code troubleshooting tree. |

## STEP 2: Inspect the tone wheels and speed/position sensors.

### STEP 2A: Inspect the engine speed and position sensors for damage.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect for damage.<br>• Inspect the engine and position sensors for damage. | Any damage?<br>**YES**<br>**Repair:**<br>Replace the camshaft position sensor. Refer to Procedure 019-363 in Section 19.<br>Replace the crankshaft position sensor. Refer to Procedure 019-365 in Section 19. | 5A |
| | Any damage?<br>**NO** | 2B |

**STEP 2B: Inspect the tone wheels for any damage.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect for damage.<br>Inspect the crankshaft and camshaft tone wheels for damage. | Any damage?<br>**YES**<br>**Repair:**<br>Replace the tone wheel.<br>Replace the camshaft position sensor. Refer to Procedure 019-363 in Section 19.<br>Replace the crankshaft position sensor. Refer to Procedure 019-365 in Section 19.<br>Replace the tone wheel.<br>• For ISC, QSC8.3, ISL, and QSL9 engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 001-008 in Section 1.<br>• For ISB and QSB engines, use the following procedure in theISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 001-008 in Section 1.<br>• For ISC, QSC8.3, ISL, and QSL9 engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 001-016 in Section 1.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 001-016 in Section 1. | 5A |
| | Any damage?<br>**NO** | 3A |

## STEP 3: Inspect the engine and vehicle grounding.

### STEP 3A: Inspect the engine block, starter, alternator, chassis, and battery grounds.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine and vehicle grounding.<br>• Check all engine, starter, alternator, chassis, and battery grounds.<br>• Verify all grounds are present and properly grounded.<br>• Verify all connections are free of corrosion and tight. | Are all grounds present, properly grounded, free of corrosion, and tight?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Are all grounds present, properly grounded, free of corrosion, and tight?<br>**NO**<br>**Repair:**<br>Replace, tighten, or clean the ground wires or connections. | 5A |

## STEP 4: Check for correct engine static timing.

### STEP 4A: Check static timing.

**Condition:**
- Remove the gear cover.
- Rotate the engine to TDC for the number 1 cylinder and verify that the camshaft and crankshaft gear timing marks are properly aligned.
- For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bullein 4021418. Refer to Procedure 001-008 in Section 1.
- For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 001-008 in Section 1.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the timing.<br>Inspect the engine static timing. | Are the camshaft and crankshaft timing marks properly aligned at TDC?<br>**YES** | 5A |
| | Are the camshaft and crankshaft timing marks properly aligned at TDC?<br>**NO**<br>**Repair:**<br>Remove and install camshaft to properly align timing marks at TDC. | 5A |

## STEP 5: Clear the fault code.

### STEP 5A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that Fault Code 731 is inactive. | Fault Code 731 inactive?<br>**YES** | 5B |
| | Fault Code 731 inactive?<br>**NO**<br>**Repair:**<br>Note: Crankshaft gear slippage can be caused by excessive hydraulic loads on the gear train. Check and correct any excessive hydraulic loading condition on the vehicle.<br>Replace the crankshaft assembly if all steps have been completed and checked again. | 1A |

### STEP 5B: Clear the fault codes.

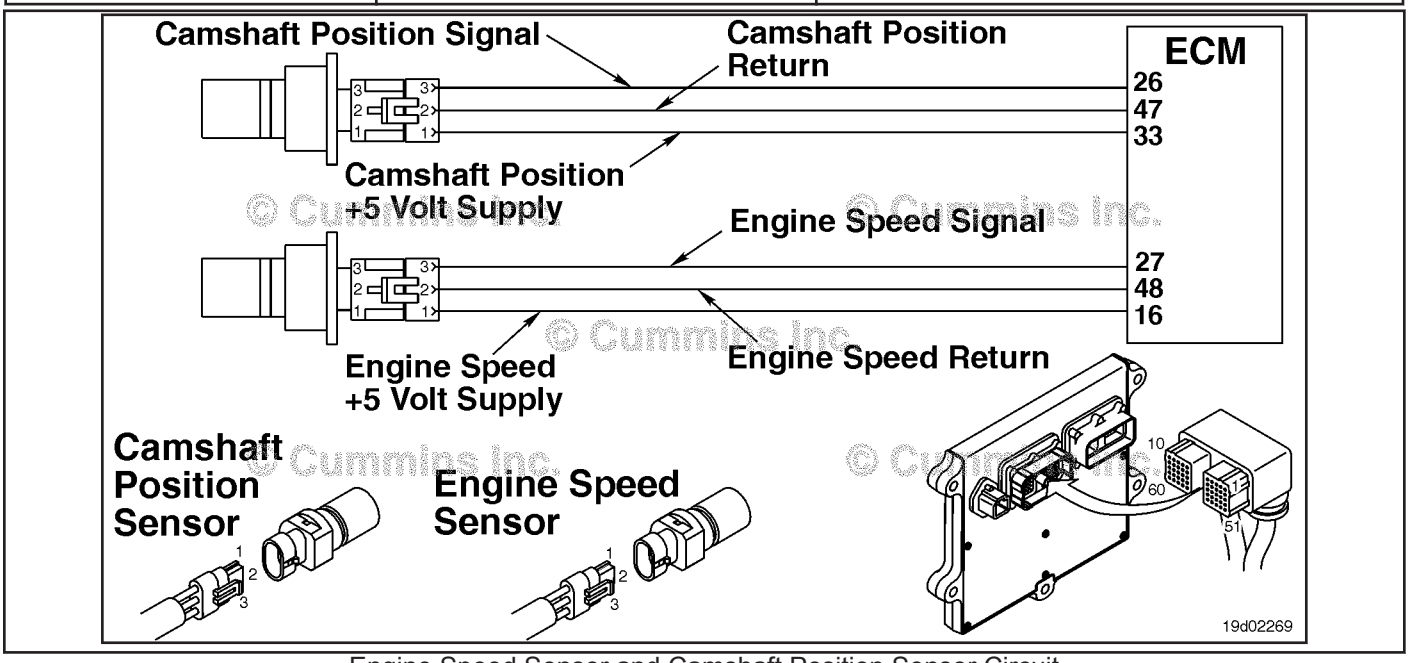
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair Complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 731 (QSB Marine Application)

## Engine Speed Sensor/Position Camshaft and Crankshaft Misalignment - Mechanical System Not Responding Properly or Out of Adjustment

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 731<br>PID(P), SID(S): S064<br>SPN: 723<br>FMI: 7/7<br>Lamp: Amber<br>SRT: | Engine Speed Sensor/Position Camshaft and Crankshaft Misalignment - Mechanical System Not Responding Properly or Out of Adjustment. Mechanical misalignment between the crankshaft and camshaft engine speed sensors. | Engine will run derated. Excessive smoke, hard start, and rough idle possible. |




Engine Speed Sensor and Camshaft Position Sensor Circuit

**Circuit Description:**

The engine speed sensor and camshaft position sensor provide an engine speed and position signal to the electronic control module (ECM) through the engine harness.

**Component Location:**

Refer to Procedure 100-002 (Engine Views) in Section E for a detailed component location view.

**Shop Talk:**

This fault will become active anytime the ECM receives a signal from both the primary EPS (crankshaft sensor) and the backup EPS (camshaft sensor), and the ECM determines that the camshaft and crankshaft signals are **not** in the correct phase. If this fault code is active immediately following a repair that includes camshaft removal, it is likely that the camshaft gear was installed incorrectly and is **not** timed correctly.

## Refer to Troubleshooting Fault Code t05-731

# FAULT CODE 731 (QSB Marine Application) - Engine Speed Sensor/Position Camshaft and Crankshaft Misalignment - Mechanical System Not Responding Properly or Out of Adjustment

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for multiple fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fault Code 731 the only active fault?** | |
| **STEP 2:** | **Inspect the tone wheels and speed/position sensors.** | | |
| **STEP 2A:** | **Inspect the engine speed and position sensors for damage.** | **Any damage?** | |
| **STEP 2B:** | **Inspect the tone wheels for any damage.** | **Any damage?** | |
| **STEP 3:** | **Inspect the engine and vehicle grounding.** | | |
| **STEP 3A:** | **Inspect the engine block, starter, alternator, chassis, and battery grounds.** | **Are all grounds present, properly grounded, free of corrosion, and tight?** | |
| **STEP 4:** | **Check for correct engine static timing.** | | |
| **STEP 4A:** | **Check static timing.** | **Camshaft and crankshaft timing marks properly aligned at top dead center?** | |
| **STEP 5:** | **Clear the fault code.** | | |
| **STEP 5A:** | **Disable the fault code.** | **Fault Code 731 inactive?** | |
| **STEP 5B:** | **Clear the fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for multiple fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>Use INSITE™ electronic service tool to read the fault codes. | Is fault code 731 the **only** active fault?<br>**YES** | 2A |
| | Is fault code 731 the **only** active fault?<br>**NO**<br>**Repair:**<br>Troubleshoot any other active faults before continuing with this tree. | Appropriate fault code troubleshooting tree. |

## STEP 2: Inspect the tone wheels and speed/position sensors.

### STEP 2A: Inspect the engine speed and position sensors for damage.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect for damage.<br>Inspect the engine and position sensors for damage. | Any damage?<br>**YES**<br>**Repair:**<br>Replace the position or speed sensor. Replace the camshaft position sensor. Refer to Procedure 019-363 in Section 19.<br>Replace the crankshaft position sensor. Refer to Procedure 019-365 in Section 19. | 5A |
| | Any damage?<br>**NO** | 2B |

**STEP 2B: Inspect the tone wheels for any damage.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect for damage.<br>Inspect the crankshaft and camshaft tone wheels for damage. | Any damage?<br>**YES**<br>**Repair:**<br>Replace the tone wheel.<br>Replace the camshaft position sensor. Refer to Procedure 019-363 in Section 19.<br>Replace the crankshaft position sensor. Refer to Procedure 019-365 in Section 19.<br>• For ISC, QSC, ISL, and QSL9 engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 001-008 in Section 1.<br>• For ISB, ISBe, and QSB engines use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 001-008 in Section 1.<br>• For ISC, QSC8.3, ISL, and QSL9 engines use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 001-016 in Section 1.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 001-016 Section 1. | 5A |
| | Any damage?<br>**NO** | 3A |

## STEP 3: Inspect the engine and vehicle grounding.

### STEP 3A: Inspect the engine block, starter, alternator, chassis, and battery grounds.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine and vehicle grounding.<br>• Check all engine, starter, alternator, chassis, and battery grounds.<br>• Verify all grounds are present and properly grounded.<br>• Verify all connections are free of corrosion and tight. | Are all grounds present, properly grounded, free of corrosion, and tight?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Are all grounds present, properly grounded, free of corrosion, and tight?<br>**NO**<br>**Repair:**<br>Replace, tighten, or clean the ground wires or connections. | 5A |

## STEP 4: Check for correct engine static timing.

### STEP 4A: Check static timing.

**Condition:**
- Remove the gear cover.
- Rotate the engine to TDC for the number 1 cylinder and verify that the camshaft and crankshaft gear timing marks are properly aligned. For ISC, QSC, ISL, and QSL9 engines use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 001-008 in Section 1. For ISB, ISBe, and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 001-008 in Section 1.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the timing.<br>Inspect the engine static timing. | Are the camshaft and crankshaft timing marks properly aligned at TDC?<br>**YES** | 5A |
| | Are the camshaft and crankshaft timing marks properly aligned at TDC?<br>**NO**<br>**Repair:**<br>Remove and install camshaft to properly align timing marks at TDC. | 5A |

## STEP 5: Clear the fault code.

### STEP 5A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that Fault Code 731 is inactive. | Fault Code 731 inactive?<br>**YES** | 5B |
| | Fault Code 731 inactive?<br>**NO**<br>**Repair:**<br>Note: Crankshaft gear slippage can be caused by excessive hydraulic loads on the gear train. Check and correct any excessive hydraulic loading condition on the vehicle.<br>Replace the crankshaft assembly if all steps have been completed and checked again. | 1A |

### STEP 5B: Clear the fault codes.

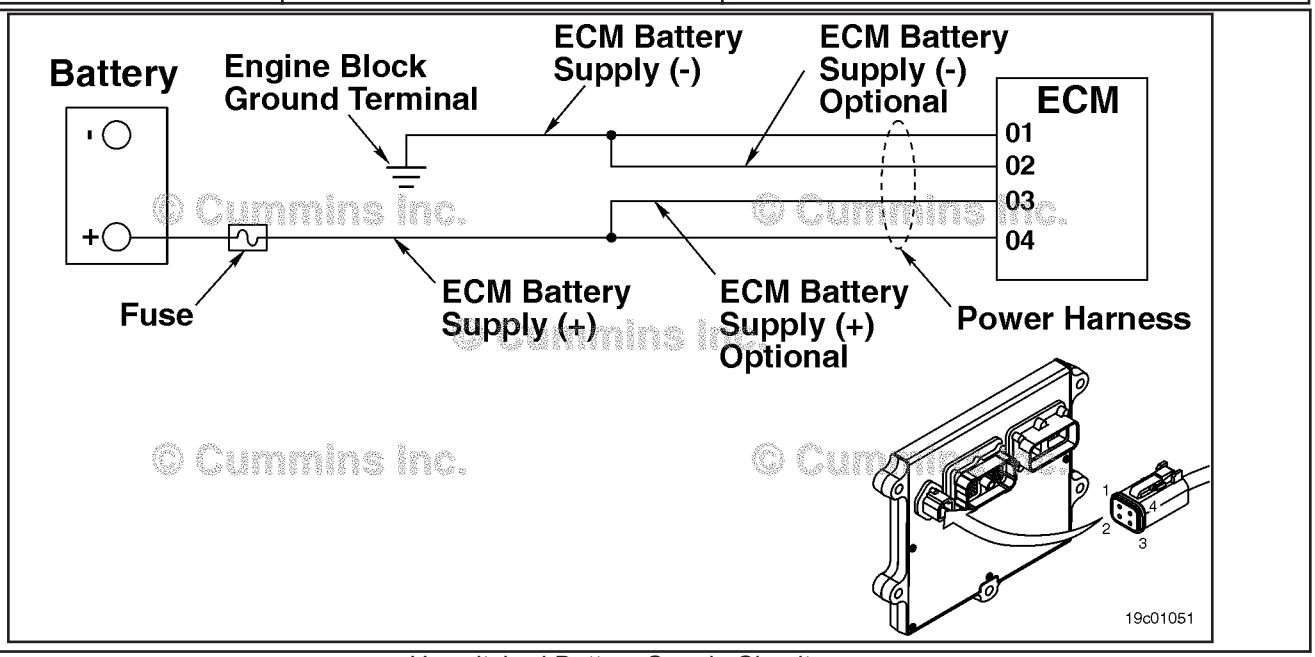
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair Complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 757

## Electronic Control Module Data Lost - Condition Exists

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 757<br>PID(P), SID(S): None<br>SPN: 611<br>FMI: 11/31<br>Lamp: Amber<br>SRT: | Engine Control Module Data Lost - Condition Exits. Severe loss of data from the ECM. | Possible no noticeable performance effects, engine dying or hard starting. Fault information, trip information, and maintenance monitor data can be inaccurate. |




Unswitched Battery Supply Circuit

**Circuit Description:**

The Electronic Control Module (ECM) receives constant voltage from the batteries through the unswitched battery wires that are connected directly to the positive (+) battery post. There is a single 30-ampere fuse in the unswitched battery wires to protect the engine harness from overheating. The ECM receives switched battery input through the vehicle keyswitch wire when the vehicle keyswitch is turned on. The battery return wires are connected directly to the negative (-) battery post. Pins 2 and 3 are optional circuits possibly **not** used by the OEM. Refer to the OEM wiring diagram for detailed information on these circuit.

**Component Location:**

The ECM is located on the left side of the engine, near the front of the engine. The ECM is connected to the battery by the ECM power harness. This direct link provides a constant power supply for the ECM. The location of the battery will vary with the OEM. Refer to the OEM troubleshooting and repair manual.

## Refer to Troubleshooting Fault Code t05-757

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement:Part No. 3822758 - male Deutsch/AMP/Metri-Pack test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an active fault code.** | **Are other fault codes active?** | |
| **STEP 2:** | **Check the batteries and the power harness connector.** | | |
| **STEP 2A:** | **Check the resistance of the battery supply circuit.** | **Less than 10 ohms?** | |
| **STEP 2B:** | **Check the battery voltage.** | **Normal conditions: At least (+) 12 VDC? (During cranking: At least (+) 6.2 VDC)?** | |
| **STEP 2C:** | **Check the battery connections.** | **Connections are tight and corrosion-free?** | |
| **STEP 3:** | **Check the OEM fuses.** | | |
| **STEP 3A:** | **Verify that the OEM fuses are installed correctly.** | **Fuses installed correctly?** | |
| **STEP 3B:** | **Verify that the OEM fuses are not blown.** | **Fuses not blown?** | |
| **STEP 4:** | **Check the power connector.** | | |
| **STEP 4A:** | **Check the add-on or the accessory wiring at the positive (+) terminal of the battery.** | **No damaged wires?** | |
| **STEP 5:** | **Recalibrate the ECM.** | | |
| **STEP 5A:** | **Recalibrate the ECM.** | **Fault Code 757 inactive?** | |
| **STEP 6:** | **Clear the fault codes.** | | |
| **STEP 6A:** | **Disable the fault code.** | **Fault Code 757 inactive?** | |
| **STEP 6B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

# TROUBLESHOOTING STEP

## STEP 1: Check the fault codes.

### STEP 1A: Check for an active fault code.

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ the electronic service tool to read the fault codes.

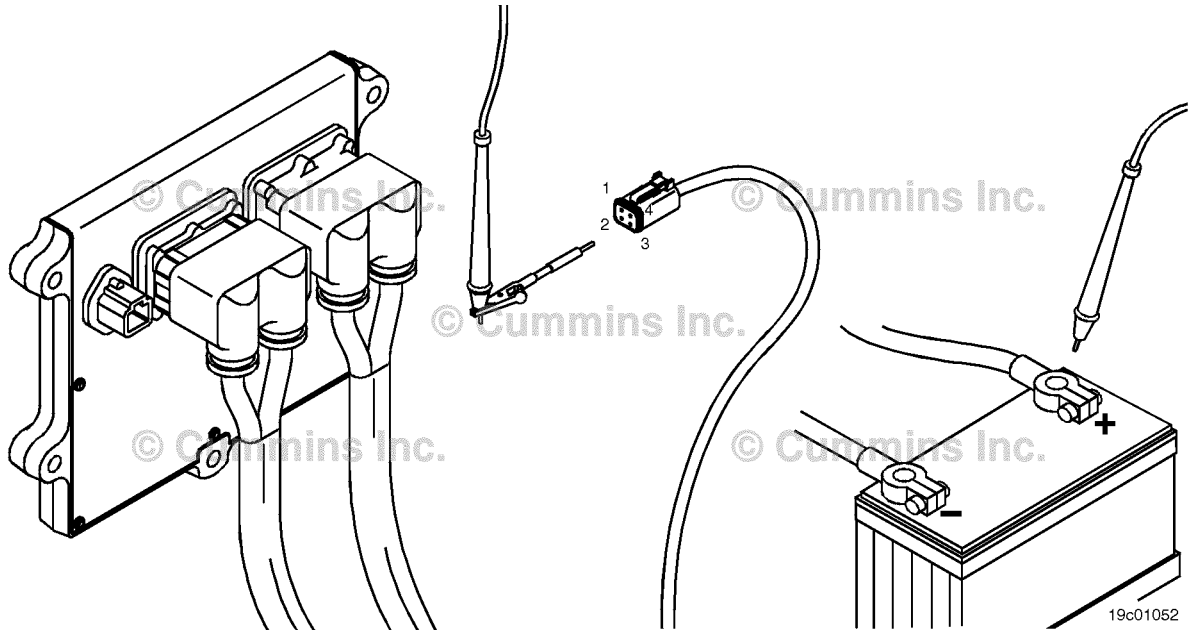
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ the electronic service tool to read the fault codes. | Are other fault codes active?<br>**YES**<br>**Repair:**<br>Troubleshoot the active fault codes. | Go to appropriate fault code troubleshooting tree. |
| | Are other fault codes active?<br>**NO** | 2A |

## STEP 2: Check the batteries and the power connector.

### STEP 2A: Check the resistance of the battery supply circuit.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the power harness connector from the ECM.

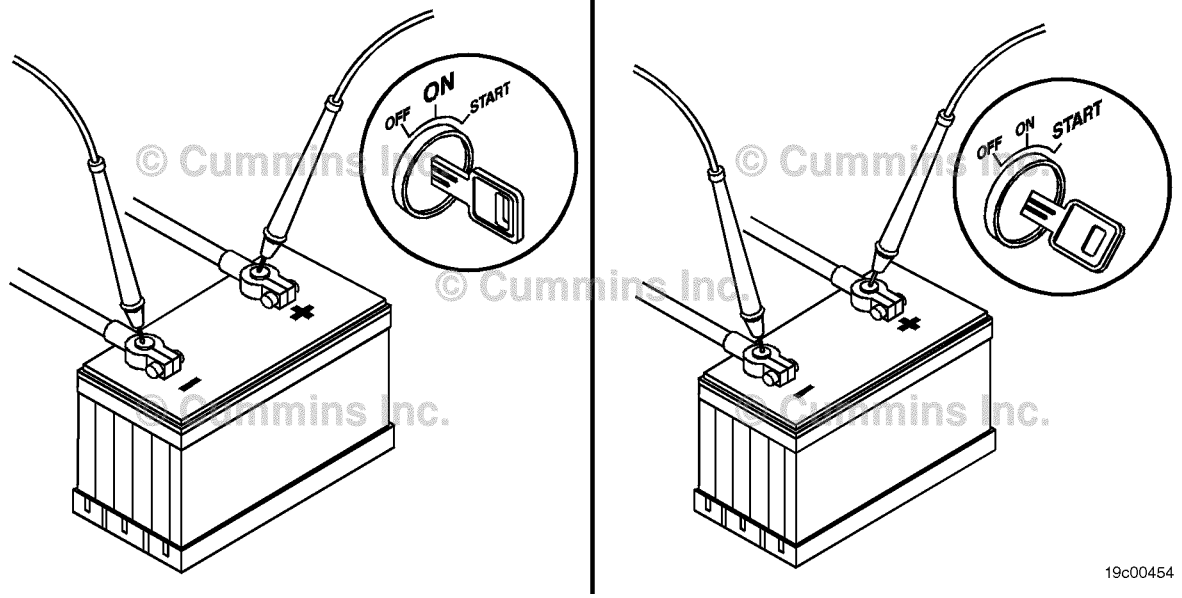
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the resistance of the battery supply circuit.<br>• Use a multimeter to measure the resistance between the ECM battery SUPPLY (+) pin of the power harness ECM connector and the positive (+) battery terminal.<br>• Use a multimeter to measure the resistance between the ECM battery SUPPLY (-) pin of the power harness ECM connector and the engine block ground.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>For general resistance measurement techniques, refer to the Resistance Measurements Using a Multimeter and Wiring Diagram, Refer to Procedure 019-360. | Less than 10 ohms?<br>**YES** | 2B |
| | Less than 10 ohms?<br>**NO** | 3A |



**STEP 2B: Check the battery voltage.**

**Condition:**
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Place the positive (+) probe of the multimeter on the positive battery terminal. Touch the negative (-) probe of the multimeter to the negative battery terminal while trying to start the engine. | Normal conditions: At least (+) 12 VDC? (During cranking: At least (+) 6.2 VDC)?<br>**YES** | 2C |
| | Normal conditions: At least (+) 12 VDC? (During cranking: At least (+) 6.2 VDC)?<br>**NO**<br>**Repair:**<br>Charge or replace the battery.<br>Refer to the OEM troubleshooting and repair manual. | 5A |



**STEP 2C: Check the battery connections.**

**Condition:**
- Turn keyswitch OFF.

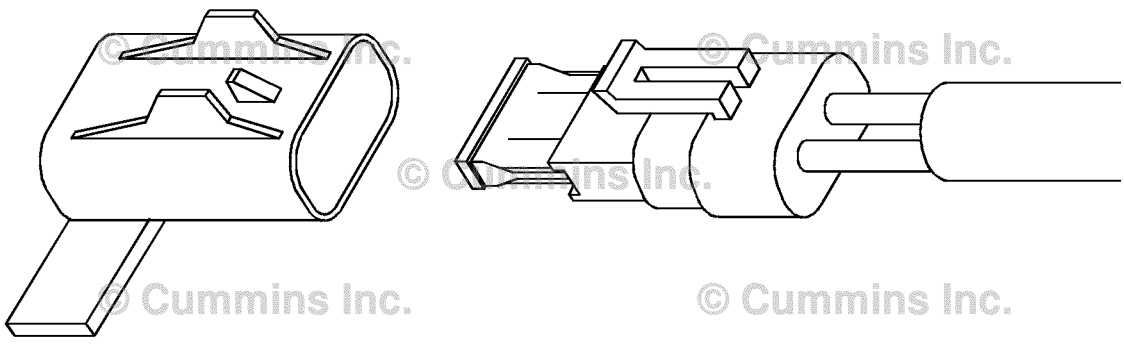
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery connections.<br>• Inspect the battery terminal connections. | Are connections tight and corrosion-free?<br>**YES** | 4A |
| | Are connections tight and corrosion-free?<br>**NO**<br>**Repair:**<br>Tighten the loose connections and clean the terminals.<br>Refer to the OEM troubleshooting and repair manual. | 5A |

## STEP 3: Check the OEM fuses.

**STEP 3A: Verify that the OEM fuses are installed correctly.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM fuses for correct installation. | Are fuses installed correctly?<br>**YES** | 3B |
| | Are fuses installed correctly?<br>**NO**<br>**Repair:**<br>Install the fuses correctly.<br>Refer to Procedure 019-198. | 5A |

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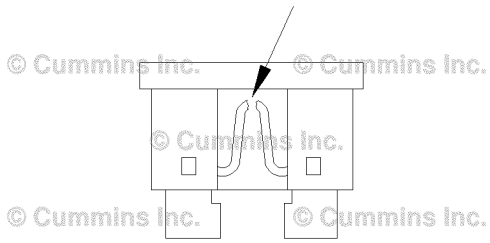
**STEP 3B: Verify that the OEM fuses are not blown.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify that the OEM fuses are not blown. | Are any fuses blown?<br>**YES**<br>**Repair:**<br>Replace the fuses. | 5A |
| | Are any fuses blown?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness.<br>Refer to Procedure 019-071. | 5A |

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## STEP 4: Check the power connector.

**STEP 4A: Check the add-on or the accessory wiring at positive (+) terminal of the battery.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the add-on or the accessory wiring at positive (+) terminal of the battery.<br>• Starting at the positive (+) terminal, follow any add-on or accessory wiring and examine wire(s) for damaged insulation or an installation error that can cause the supply wire to be shorted to the engine block. | Are any wires damaged?<br>**YES**<br>**Repair:**<br>Repair or replace the damaged wiring. | 6A |
| | Are any wires damaged?<br>**NO** | 5A |

## STEP 5: Recalibrate the ECM.

### STEP 5A: Recalibrate the ECM.

**Condition:**
- Connect all components.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Recalibrate the ECM.<br>• Use INSITE™ electronic service tool to calibrate the ECM. | Is Fault Code 757 inactive?<br>**YES** | 6A |
| | Is Fault Code 757 inactive?<br>**NO** | 6A |

## STEP 6: Clear the fault codes.

### STEP 6A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ the electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Turn keyswitch OFF and wait 30 seconds.<br>• Turn keyswitch ON. | Fault Code 757 inactive?<br>**YES** | 6B |
| | Fault Code 757 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact your local Cummins Authorized Repair Location if all the steps have been completed and checked again. | 1A |

### STEP 6B: Clear the inactive fault codes.

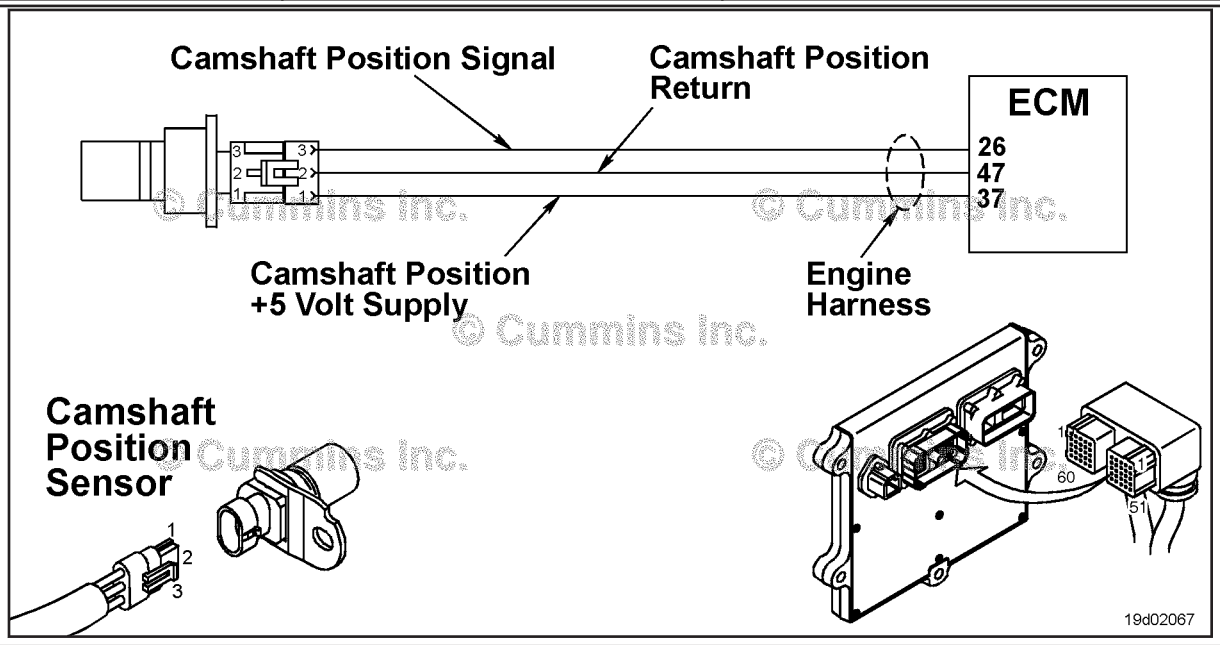
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ the electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ the electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes | Appropriate troubleshooting steps |

# Fault Code 778

## Engine Speed Sensor (Camshaft) Error - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 778<br>PID(P), SID(S): S064<br>SPN: 723<br>FMI: 2<br>Lamp: Amber<br>SRT: | Engine Speed Sensor (Camshaft) Error - Data Erratic, Intermittent, or Incorrect. The ECM has detected an error in the camshaft position sensor signal. | Possible poor starting. Engine power derate. |




Camshaft Engine Position Sensor Circuit

**Circuit Description:**

The camshaft engine position sensor provides engine position information to the electronic control module (ECM). The sensor is powered by (+) 5-VDC. The sensor generates the signal by sensing the movement of target teeth machined into a tone wheel that is mounted to the camshaft.

**Component Location:**

The camshaft position sensor is located below the fuel pump in the back of the gear housing.

**Shop Talk:**

This fault is recorded when the ECM does **not** receive a signal from the camshaft position sensor or the signal the ECM receives is degraded.

Possible causes of this fault code include:

- Open circuit on the supply, signal, or return circuits in the sensor, engine harness, or ECM
- Short circuits to ground or return circuits in the sensor, engine harness, or ECM
- Short circuits to voltage source in the sensor, engine harness, or ECM.

INSITE™ electronic service tool monitor parameters associated with this fault code and sensor include:

- Camshaft engine position sensor state
- Damage to the sensor target teeth or tone wheel.

If this fault code occurs intermittently, look closely for causes of intermittent harness connections such as loose or worn pins in the engine harness connectors.

If this fault code occurs intermittently, Fault Code 2322 will also be active or have high counts.

## Refer to Troubleshooting Fault Code t05-778

# FAULT CODE 778 - Engine Speed Sensor (Camshaft) Error - Data Erratic, Intermittent, or Incorrect
## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead, Part Number 3164596 - male Framatome™ test lead, and Part Number 3164597 - female Framatome™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for sensor supply fault codes. | Fault Code 187 or 227 active? | |
| STEP 1B: | Check for an active fault code. | Fault Code 778 active? | |
| **STEP 2:** | **Check the camshaft engine position sensor and circuit.** | | |
| STEP 2A: | Inspect the camshaft engine position sensor and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the sensor supply voltage and return circuit. | 4.75-VDC to 5.25-VDC? | |
| STEP 2C: | Check the circuit response. | Camshaft engine position sensor state equals low? | |
| STEP 2C-1: | Check the circuit response. | Camshaft engine position sensor state equals high? | |
| STEP 2C-2: | Inspect the camshaft engine position sensor. | Damaged sensor tip? | |
| STEP 2C-3: | Check the circuit response. | Camshaft engine position sensor state transitions from high to low, or low to high, or the state shows triggered? | |
| STEP 2C-4: | Inspect the camshaft gear teeth, air gap, and target wheel. | Is the air gap within specifications? | |
| STEP 2D: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 2E: | Check the ECM response. | Monitor camshaft position sensor state equals low? | |
| STEP 2E-1: | Check the ECM response. | Camshaft engine position sensor state equals high? | |
| **STEP 3:** | **Check the ECM.** | | |
| STEP 3A: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check the ECM sensor supply voltage and return circuit. | 4.75-VDC to 5.25-VDC? | |
| **STEP 4:** | **Check ECM calibration and clear fault codes.** | | |
| STEP 4A: | Check if an ECM calibration update is available. | If a calibration update for this fault code is available, does the | |

| | | |
|---|---|---|
| | | **ECM contain that revision or higher?** |
| **STEP 4B:** | **Disable the fault code.** | **Fault code inactive?** |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for sensor supply fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for sensor supply fault codes.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 187 or 227 active?<br>**YES** | Fault Code 187 or 227 |
| | Fault Code 187 or 227 active?<br>**NO** | 1B |

**STEP 1B: Check for an active fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 778 active?<br>**YES** | 2A |
| | Fault Code 778 active?<br>**NO** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |

## STEP 2: Check the camshaft engine position sensor and circuit.

### STEP 2A: Inspect the sensor and connector pins.

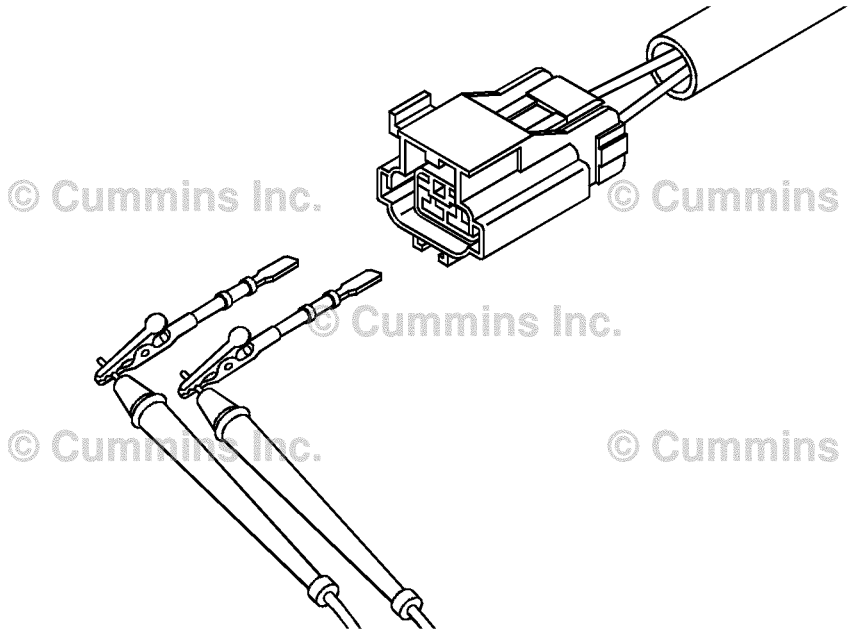
**Condition:**
- Turn keyswitch OFF.
- Disconnect the camshaft engine position sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris on or in the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the camshaft engine position sensor from the engine harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the sensor supply voltage and return circuit.<br>Measure the voltage between the camshaft position +5-VDC SUPPLY pin and the camshaft position RETURN pin at the sensor connector of the engine harness. | 4.75-VDC to 5.25-VDC?<br>**YES** | 2C |
| | 4.75-VDC to 5.25-VDC?<br>**NO** | 3A |






**STEP 2C: Check the circuit response.**

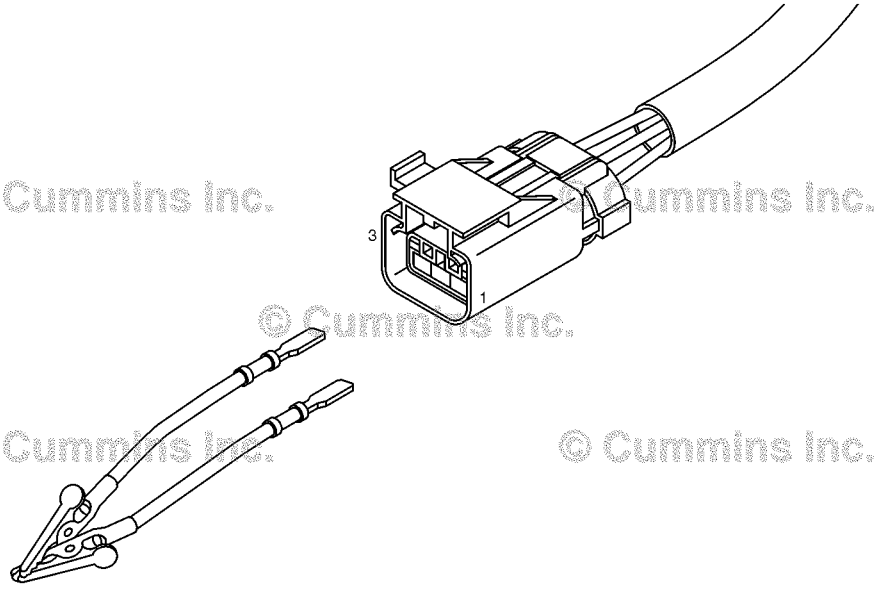
**Condition:**
- Turn keyswitch OFF.
- Disconnect the camshaft engine position sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response.<br>• Read the camshaft engine position sensor state. Use INSITE™ electronic service tool monitor mode. | Camshaft engine position sensor state equals low?<br>**YES** | 2C-1 |
| | Camshaft engine position sensor state equals low?<br>**NO** | 2D |

**STEP 2C-1: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the camshaft engine position sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the camshaft position +5-VDC SUPPLY pin and the camshaft engine position SIGNAL pin at the sensor connector of the engine harness.<br>• Check for the appropriate ECM response.<br>• Read the camshaft position sensor state. Use INSITE™ electronic service tool monitor mode.<br>Refer to the wiring diagram for connector pin identification. | Camshaft engine position sensor state equals high?<br>**YES** | 2C-2 |
| | Camshaft engine position sensor state equals high?<br>**NO** | 2D |

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**STEP 2C-2: Inspect the camshaft engine position sensor.**

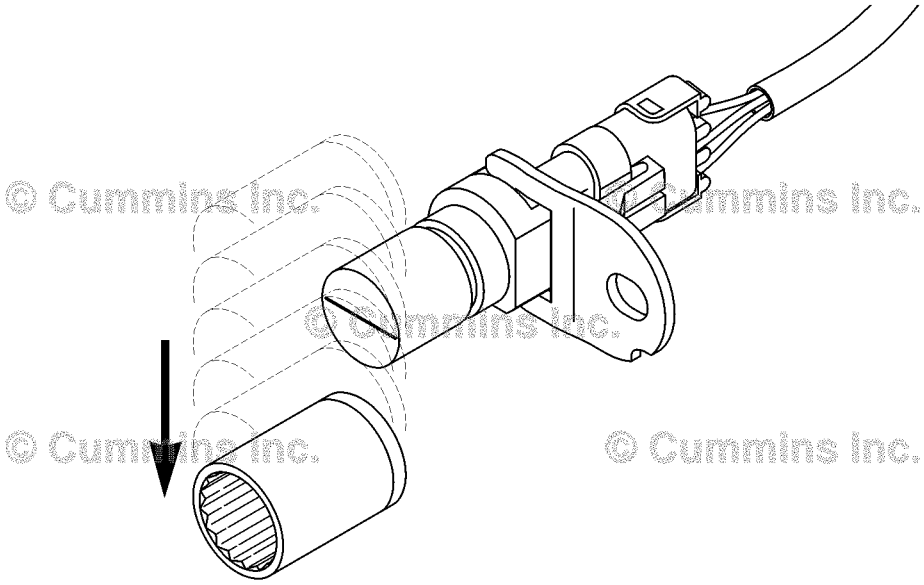
**Condition:**
- Turn keyswitch OFF.
- Remove the camshaft engine position sensor from the engine. Refer to Procedure 019-363 in Section 19.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the camshaft engine position sensor for the following:<br>• Damaged sensor tip<br>• Physical signs of the sensor touching the speed or position teeth. | Damaged sensor tip?<br>**YES**<br>**Repair:**<br>Replace the camshaft engine position sensor. Refer to Procedure 019-363 in Section 19. | 4A |
| | Damaged sensor tip?<br>**NO** | 2C-3 |

**STEP 2C-3: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Remove the camshaft engine position sensor from the engine. Refer to Procedure 019-363 in Section 19.
- Ensure the camshaft engine position sensor is connected to the harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the circuit response.<br>Note: Use the ratchet drive side of the socket tool that was used to remove the sensor from the engine, place it flush on the sensor so that the edge of the socket is on the edge of the sensor. Slowly slide the socket in a perpendicular direction to the marked line on the sensor or in a perpendicular direction to the mounting bracket of the sensor.<br>Inspect for the following:<br>• Check for the appropriate ECM response<br>• Read the camshaft engine position sensor state. Use INSITE™ electronic service tool monitor mode. | Camshaft engine position sensor state transitions from high to low, or low to high, or the state shows triggered?<br>**YES** | 2C-4 |
| | Camshaft engine position sensor state transitions from high to low, or low to high, or the state shows triggered?<br>**NO**<br>**Repair:**<br>Replace the camshaft engine position sensor. Refer to Procedure 019-363 in Section 19. | 4A |

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**STEP 2C-4: Inspect the camshaft gear teeth, air gap, and target wheel.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the camshaft gear teeth for damage or a loose camshaft gear condition.<br>For ISB engines, use the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271.<br>For ISC or ISL engines, use the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4, and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418.<br>Inspect the air gap.<br>• Remove the secondary engine speed sensor (camshaft sensor) from the gear housing and measure the air gap at several points in the crankshaft revolution. Refer to Procedure 019-363 in Section 19.<br>Air gap specifications:<br>• Minimum air gap: 0.96 mm [0.038 in]<br>• Maximum air gap: 2.25 mm [0.089 in]<br>• Maximum target runout: 0.5 mm [0.02 in] | Is the air gap within specifications?<br>**YES** | 2D |
| | Is the air gap within specifications?<br>**NO**<br>**Repair:**<br>Replace or shim the sensor if the air gap is out of specification.<br>If the target runout is excessive:<br>For engines with machined speed sensor targets, replace the camshaft gear.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manua, Bulletin 4021271. Refer to Procedure 001-012 in Section 1.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 001-012 in Section 1.<br>For engines with bolt on speed sensor targets, replace the bolt on the timing plate.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manua, Bulletin 4021271. Refer to Procedure 001-013 in Section 1.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 001-013 in Section 1. | 4A |

**STEP 2D: Inspect the ECM and engine harness connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris on or in the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2E |

**STEP 2E: Check the ECM response.**

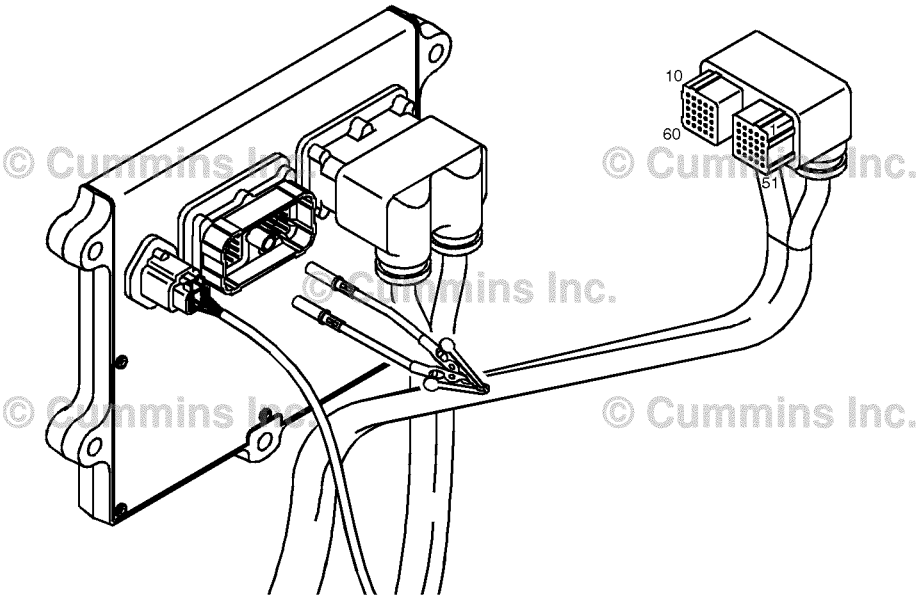
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response.<br>• Read the camshaft engine position sensor state. Use INSITE™ electronic service tool monitor mode. | Monitor camshaft engine position sensor state equals low?<br>**YES** | 2E-1 |
| | Monitor camshaft engine position sensor state equals low?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 2E-1: Check the ECM response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the camshaft position +5-VDC SUPPLY pin and the camshaft position SIGNAL pin at the ECM port.<br>Check for the appropriate ECM response.<br>• Read the camshaft engine position sensor state. Use INSITE™ electronic service tool monitor mode.<br>Refer to the wiring diagram for connector pin identification. | Monitor camshaft engine position sensor state equals high?<br>**YES**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |
| | Monitor camshaft engine position sensor state equals high?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



## STEP 3: Check the ECM.

### STEP 3A: Inspect the ECM and engine harness connector pins.

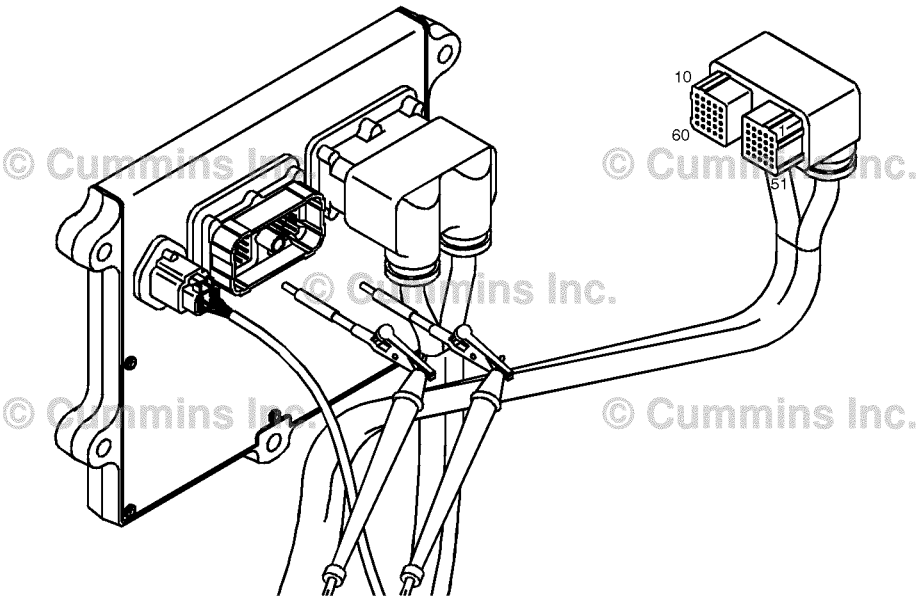
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris on or in the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check the ECM sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the voltage from the camshaft position +5-VDC SUPPLY pin to the camshaft position RETURN pin at the ECM port.<br>Refer to the wiring diagram for connector pin identification. | 4.75-VDC to 5.25-VDC?<br>**YES**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |
| | 4.75-VDC to 5.25-VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

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## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 778 inactive?<br>**YES** | 4B |
| | Fault Code 778 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

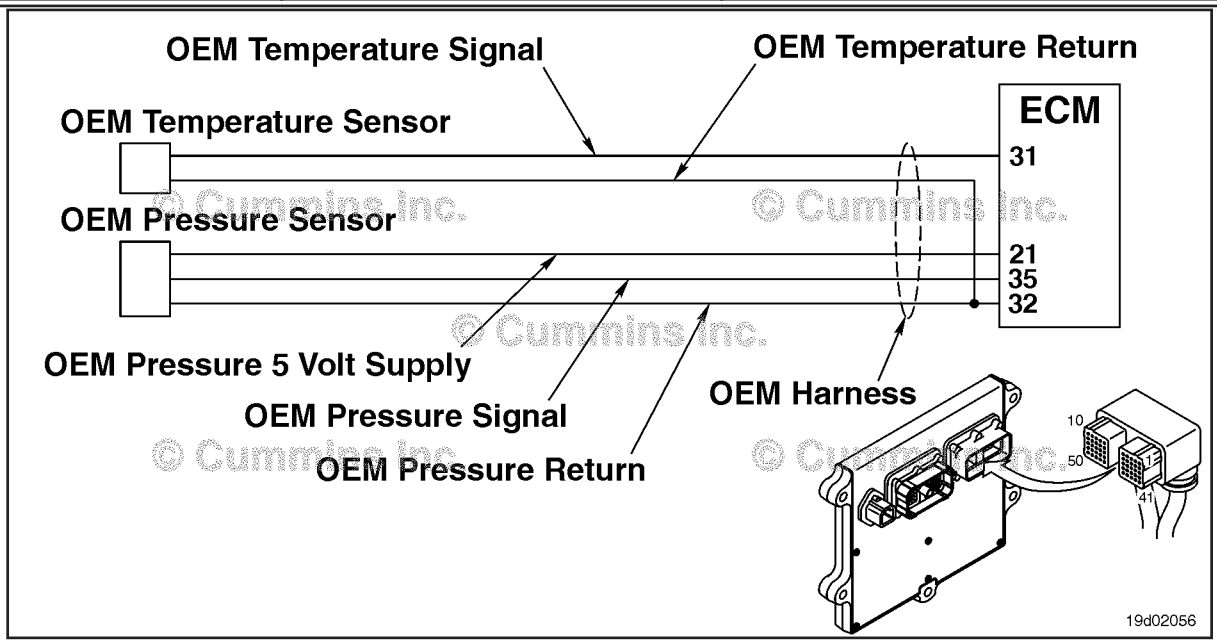
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 779

## Auxiliary Equipment Sensor Input #3 (OEM Switch) - Root Cause Not Known

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 779<br>PID(P), SID(S): S051<br>SPN: 703<br>FMI: 11<br>Lamp: Amber<br>SRT: | Auxiliary Equipment Sensor Input #3 (OEM Switch) - Root Cause Not Known. | Possible engine power derate. |



OEM Temperature/Pressure Sensor Circuit

**Circuit Description:**

The OEM has the option of wiring a pressure or temperature sensor input to the Cummins ECM. A specific calibration is then created to recognize this pressure or temperature sensor input. This fault code is activated when the pressure or temperature input from the OEM sensor exceeds the engine protection limit defined by the OEM. Depending on OEM requirements, an Engine Protection derate may be associated with this fault code.

**Component Location:**

The OEM pressure or temperature sensor input will vary depending on application. Refer to the OEM troubleshooting manual for sensor location.

**Shop Talk:**

This fault code is activated when the pressure or temperature input from the OEM sensor exceeds the engine protection limit defined by the OEM. An engine power derate is possible depending on the OEM application.

## Refer to Troubleshooting Fault Code t05-779

## TROUBLESHOOTING SUMMARY

| STEPS | SPECIFICATIONS | SRT CODE |
|---|---|---|
| **STEP 1: Check the fault codes.** | | |
| **STEP 1A: Check for Fault Code 779.** | **Active or inactive counts of Fault Code 779?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 779.**

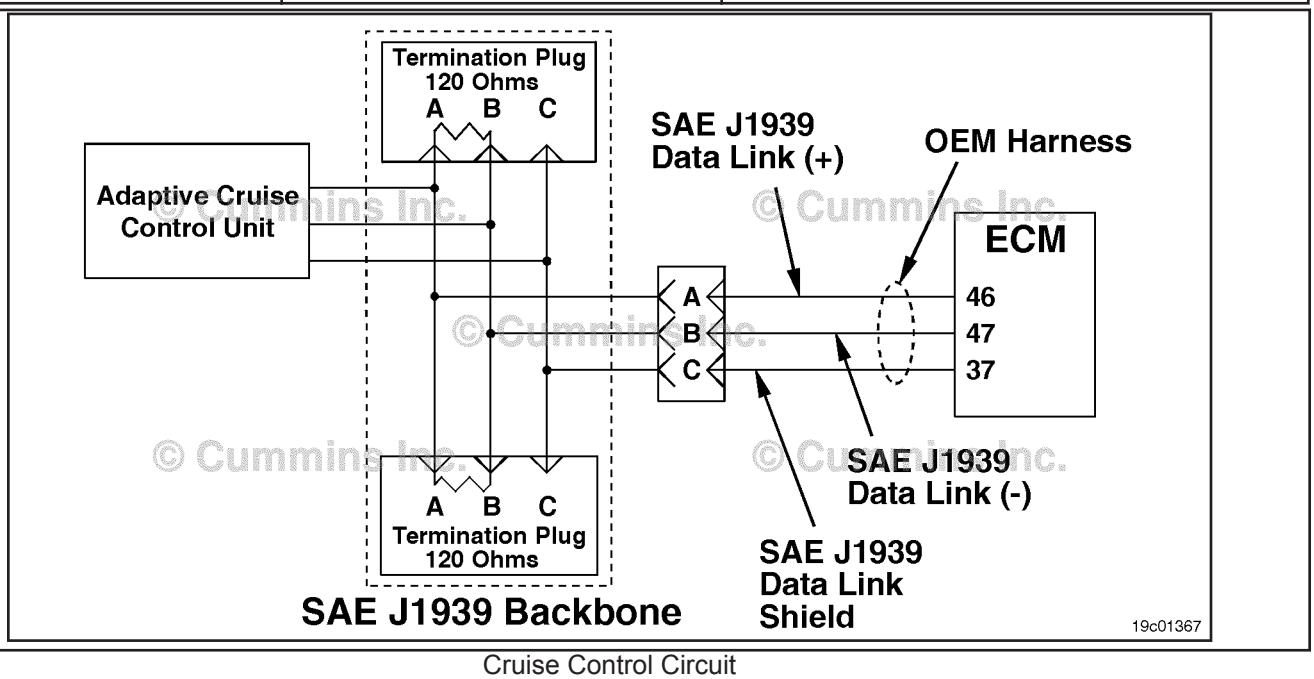
**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Using INSITE™, read the fault codes. | Active or inactive counts of Fault Code 779?<br>**YES**<br>**Repair:**<br>The engine protection limit has been exceeded for the OEM supplied pressure or temperature input. Refer to the OEM troubleshooting manual. | OEM troubleshooting manual |
| | Active or inactive counts of Fault Code 779?<br>**NO** | Repair complete |

# Fault Code 784

## Adaptive Cruise Control - Error

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 784<br>PID(P), SID(S):<br>SPN: 1590<br>FMI: 2<br>Lamp: None<br>SRT: | Loss of communication with adaptive cruise control. The ECM triggers this fault when the "heartbeat" signal from the data bus is **not** received. | Adaptive cruise control will **not** operate. Cruise control possibly will **not** operate properly. |




Cruise Control Circuit

**Circuit Description:**

The adaptive cruise control unit communicates with the electronic control module (ECM), sending and receiving vehicle speed control messages through the SAE J1939 data link.

**Component Location:**

The adaptive cruise control is a feature in INSITE™ electronic service tool. Refer to the OEM troubleshooting and repair manual for Adaptive Cruise Control Hardware.

**Shop Talk:**

Two conditions can cause this problem:

- The adaptive cruise hardware is **not** installed on the vehicle and the adaptive cruise feature has been enabled.
- The broadcast signal from the adaptive cruise is **not** being received. Refer to the OEM troubleshooting and repair manual and the Adaptive Cruise Hardware Manual.

## Refer to Troubleshooting Fault Code t05-784

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement:Part Number 3163151 - Electronic Control Module (ECM) Bench Calibration HarnessPart Number 3164185 - ECM Bench Calibration Adapter Cable.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for adaptive cruise control hardware.** | | |
| **STEP 1A:** | **Check for correct hardware.** | **Is adaptive cruise hardware installed on the vehicle?** | |
| **STEP 2:** | **Check SAE J1939 communications.** | | |
| **STEP 2A:** | **Check for ECM communication with INSITE™ electronic service tool.** | **Does INSITE™ electronic service tool communicate with the ECM?** | |
| **STEP 2B:** | **Inspect the OEM harness and ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2C:** | **Check ECM communication with the ECM bench calibration harness.** | **Does INSITE™ electronic service tool communicate with the ECM?** | |
| **STEP 3:** | **Clear the fault codes.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 784 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for adaptive cruise control hardware.

**STEP 1A: Check for correct hardware.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the hardware.<br>• Verify that the adaptive cruise hardware is installed on the vehicle. | Is adaptive cruise hardware installed on the vehicle?<br>**YES** | 2A |
| | Is adaptive cruise hardware installed on the vehicle?<br>**NO**<br>**Repair:**<br>Use INSITE™ electronic service tool, disable the adaptive cruise feature. | 3A |

## STEP 2: Check SAE J1939 communications.

### STEP 2A: Check for ECM communication with INSITE™ electronic service tool.

**Condition:**
- Turn keyswitch ON.
- Connect the INLINE™ II data link adapter to the vehicle SAE J1939 data link diagnostic connector.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Using INSITE™, electronic service tool attempt to communicate with ECM.<br>• Start INSITE™ electronic service tool.<br>• Select INSITE™ electronic service tool II (J1939) ECM connection. | Does INSITE™ electronic service tool communicate with the ECM?<br>**YES**<br>**Repair:**<br>The ECM SAE J1939 data link circuit is functioning properly. | Refer to the OEM troubleshooting and repair manual for information on troubleshooting the adaptive cruise control unit and the vehicle SAE J1939 network |
| | Does INSITE™ electronic service tool communicate with the ECM?<br>**NO** | 2B |

### STEP 2B: Inspect the OEM harness and ECM connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector seals.<br>For general inspection techniques, refer to Component Connector and Pin Inspection, Refer to Procedure 019-361. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins, if possible.<br>Refer to the Resistance Measurements Using a Multimeter and Wiring Diagram, Refer to Procedure 019-360. | 3A |
| | Dirty or damaged pins?<br>**NO** | 2C |

**STEP 2C: Check ECM communication with the ECM bench calibration harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Connect the ECM bench calibration harness to the ECM.
- Connect INLINE™ II data link adapter to the ECM bench calibration harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use INSITE™, electronic service tool attempt to communicate with the ECM.<br>• Start INSITE™ electronic service tool electronic service tool and connect to the ECM with an INLINE™ II (J1939) ECM connection. | Does INSITE™ electronic service tool communicate with the ECM?<br>**YES**<br>**Repair:**<br>INSITE™ electronic service tool is able to communicate with the ECM. This indicates that the ECM SAE J1939 data link circuit is functioning properly. | Refer to the OEM troubleshooting and repair manual for troubleshooting the vehicle SAE J1939 circuit and devices |
| | Does INSITE™ electronic service tool communicate with the ECM?<br>**NO** | Refer to the Communication Error - Electronic Service Tool or Control Device troubleshooting symptom tree. |

## STEP 3: Clear the fault codes.

**STEP 3A: Disable the fault code.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool, verify that the fault code is inactive. | Fault Code 784 inactive?<br>**YES** | 3B |
| | Fault Code 784 inactive?<br>**NO** | 1A |

**STEP 3B: Clear the inactive codes.**

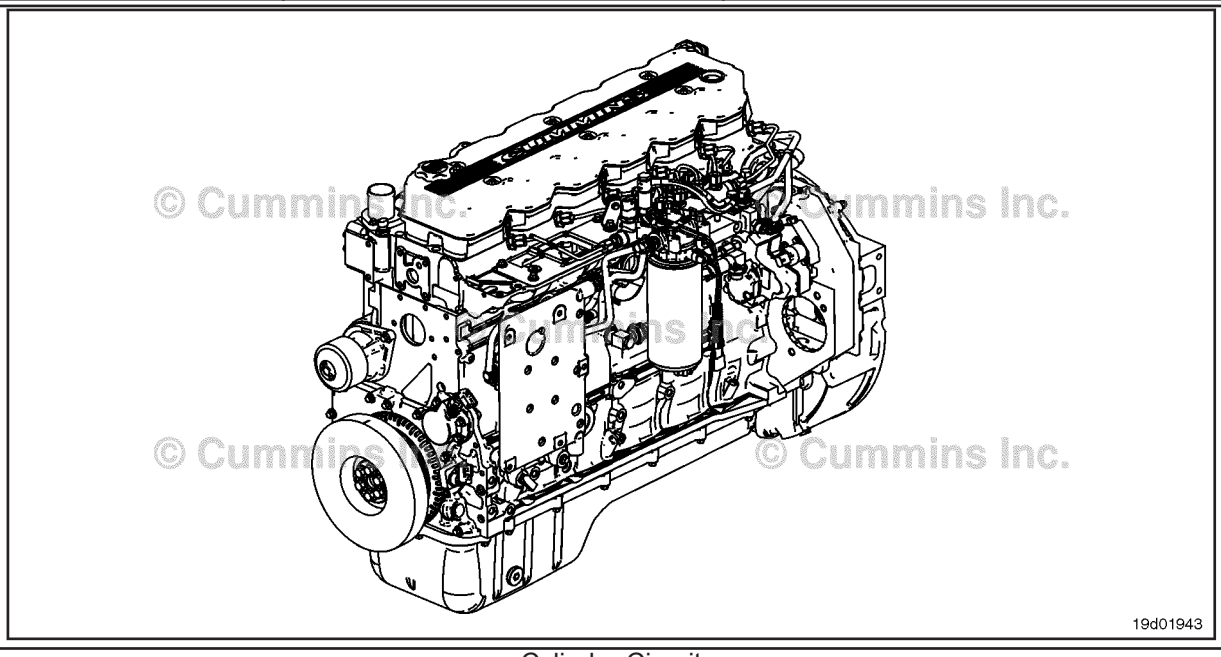
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool, erase the inactive fault codes . | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooti ng steps |

# Fault Code 951

## Cylinder Power Imbalance Detected

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 951<br>PID(P), SID(S): P166<br>SPN: 166<br>FMI: 2<br>Lamp: None<br>SRT: | Cylinder power imbalance between cylinders. A power imbalance between cylinders was detected by the ECM. | Possible low power, rough idle, or misfire. |




Cylinder Circuit

**Circuit Description:**

An algorithm in the electronic control module (ECM) calibration monitors engine speed as each injector fires while the engine is at idle. If a cylinder has high or low contribution to engine speed, this fault will become active. The intention of this fault is to assist in troubleshooting performance complaints such as engine misfire and low power. A fault lamp does **not** illuminate while this fault code is active.

**Component Location:**

The ECM is located on the intake side of the engine, below the air horn. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

If Fault Code 951 is inactive in the ECM memory and there is no complaint such as “low power” or “engine misfire,” it is possible that an intermittent event such as air entering the fuel system following a filter change caused the fault. Inactive counts of Fault Code 951 should be disregarded unless other performance symptoms are present.

Causes of cylinder imbalance can include:

- Faulty engine brakes (look for brakes out of adjustment or oil supplied to brake actuator when brakes are off)
- Valve lash out of adjustment (compare actual valve lash to the reset limits)
- Cylinder failure (check for high blowby when the engine is loaded)
- Valve failure or valve held open (listen for intake valve “chirping” noise in the intake)
- Cylinder head or gasket failure (look for signs of oil, coolant, or casting flash in the intake or exhaust passages)

- Extreme camshaft wear (inspect the camshaft lobes for wear)
- Extra, missing, or damaged sealing washer under an injector
- Extremely damaged HPC/injector interface (examine the high-pressure fuel connector at the injector end); this problem will also cause excessive fuel return and Fault Code 2292/2216
- Injector failures (“swap” injectors to see if the problem “follows” the indicated injector).

## Refer to Troubleshooting Fault Code t05-951

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for multiple fuel system fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fuel system component fault codes active or have accumulated inactive counts?** | |
| **STEP 2:** | **Perform diagnostic tests.** | | |
| **STEP 2A:** | **Perform the cylinder cutout test and/or the automated cylinder balance diagnostic test.** | **All cylinders test okay?** | |
| **STEP 3:** | **Clear the fault codes.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 951 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for multiple fuel system fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fault codes.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool read the fault codes. | Fuel system component fault codes active or have accumulated inactive counts?<br>**YES**<br>**Repair:**<br>Troubleshoot full system component fault codes. | Appropriate fault code troubleshooti ng tree |
| | Fuel system component fault codes active or have accumulated inactive counts?<br>Troubleshoot active fault codes first.<br>**NO** | 2A |

## STEP 2: Perform diagnostic tests.

### STEP 2A: Perform the cylinder cutout test and/or the automated cylinder balance diagnostic test.

**Condition:**
- Turn keyswitch ON.
- Allow the engine to run at idle speed.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use the automated cylinder balance diagnostic test to determine the power contribution of each cylinder. | All cylinders test okay?<br>**YES** | 3A |
| | All cylinders test okay?<br>**NO**<br>**Repair:**<br>Failure of cylinder test can be due to faulty engine brakes, valve lash out of adjustment, cylinder failure, valve failure, cylinder head or gasket failure, extreme camshaft wear, or injector failure.<br>Investigate, diagnose, and correct the condition of the applicable component that is possibly out of adjustment or malfunctioning. “Swap” injectors between cylinders to see whether or **not** the problem follows that injector. | Troubleshooting and Repair Manual, ISB$^{e}$, ISB, and QSB5.9 (Common Rail Fuel System), Bulletin 4021271. |

## STEP 3: Clear the fault codes.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Verify that the fault code is inactive. | Fault Code 951 inactive?<br>**YES** | 3B |
| | Fault Code 951 inactive?<br>**NO** | 1A |

**STEP 3B: Clear the inactive fault codes.**

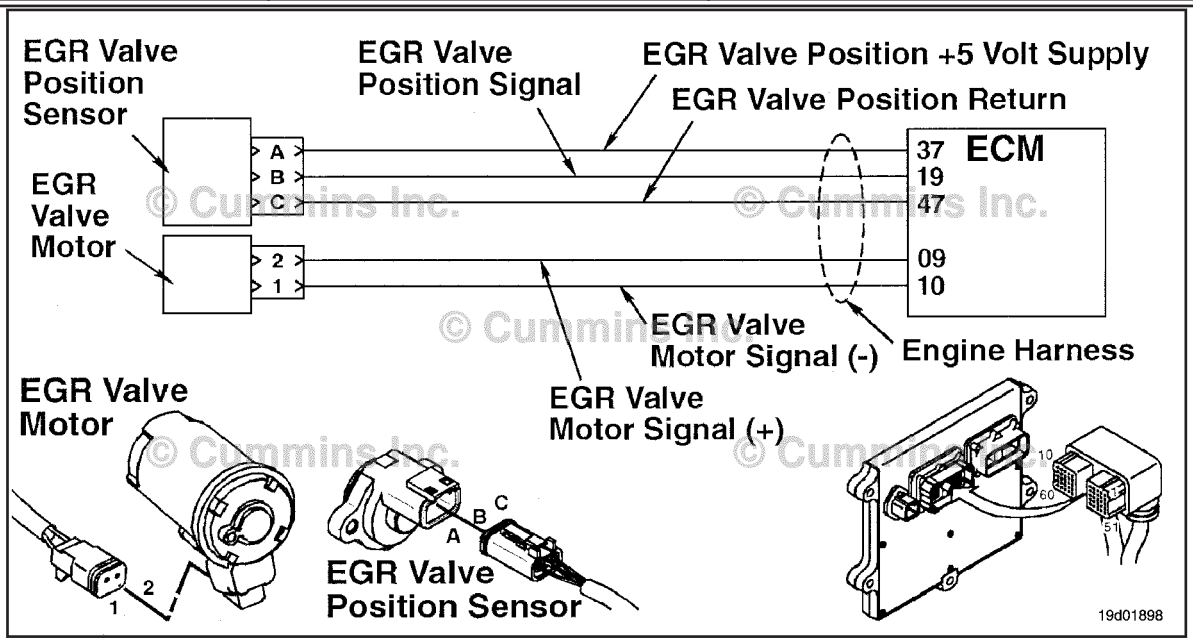
**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 957

## EGR Valve Position - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 957<br>PID(P), SID(S): P27<br>SPN: 27<br>FMI: 2<br>Lamp: Amber<br>SRT: | EGR Valve Position - Data erratic, intermittent, or incorrect. Intermittent EGR position information is being received by the electronic control module (ECM). | Possible low power. EGR valve will be closed. |




EGR Valve Position Circuit

**Circuit Description:**

The EGR valve position sensor outputs a voltage signal to the ECM. The ECM converts this signal into a percentage value, 0 to 100 percent, indicating EGR valve position. A fully open valve is equivalent to 100 percent.

**Component Location:**

The EGR valve position sensor is located on the EGR valve assembly. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code is caused by an internal failure of the EGR valve position sensor. This failure causes erratic readings of EGR valve position. The troubleshooting information for fault code 957 is the same as fault code 1228. Refer to fault code 1228 for the fault code troubleshooting information.

## Refer to Troubleshooting Fault Code t05-957

## TROUBLESHOOTING SUMMARY

| STEPS | SPECIFICATIONS | SRT CODE |
|---|---|---|
| **STEP 1: Check the fault codes.** | | |
| **STEP 1A: Check for an active fault code.** | **Fault code 957 is active?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

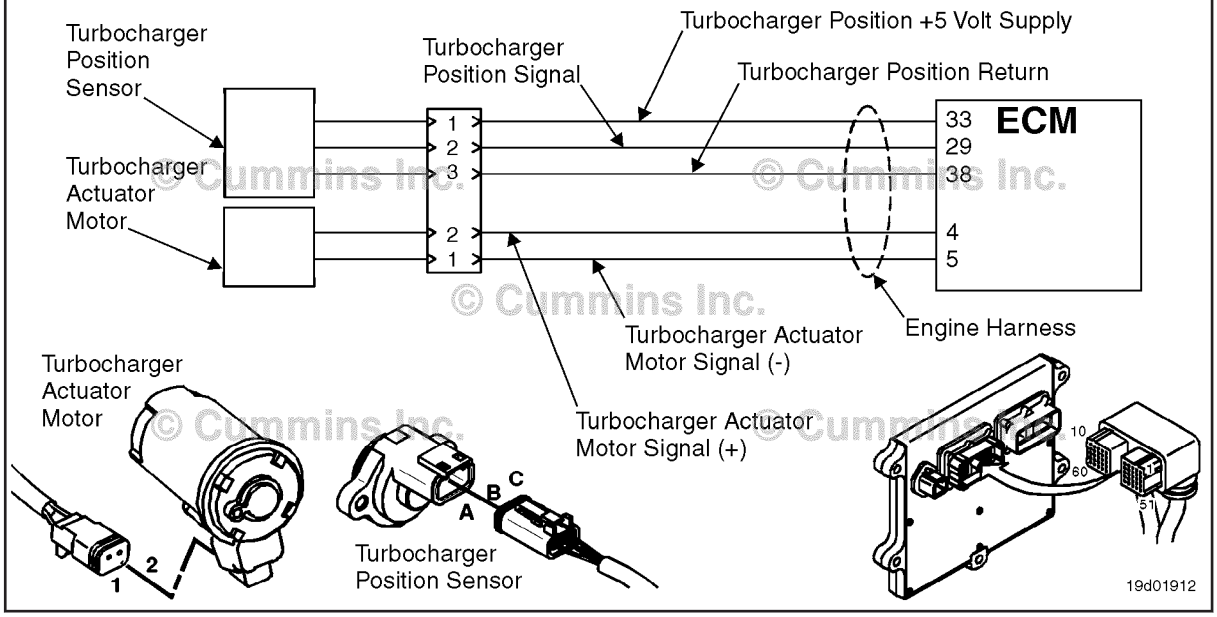
**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault code 957 is active?<br>**YES** | Refer to fault code 1228. |
| | Fault code 957 is active?<br>**NO** | Repair Complete |

# Fault Code 958

## VGT Position Sensor - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 958<br>PID(P), SID(S): P27<br>SPN: 2795<br>FMI: 2<br>Lamp: Amber<br>SRT: | VGT Position Sensor - Data erratic, intermittent, or incorrect. Intermittent variable geometry turbocharger (VGT) position information is being received by the electronic control module (ECM). | Possible low power. Power to the turbocharger actuator will be limited. |




Variable Geometry Turbocharger (VGT) Position Sensor Circuit

**Circuit Description:**

The turbocharger position sensor outputs a voltage signal to the ECM. The ECM converts this signal into a percentage value, 0 to 100 percent, indicating turbocharger position. A fully closed turbocharger actuator is equivalent to 100 percent.

**Component Location:**

The turbocharger position sensor is located on the variable geometry turbocharger (VGT) actuator assembly. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code is caused by an internal failure of the variable geometry turbocharger (VGT) position sensor. This failure causes erratic readings of the variable geometry turbocharger (VGT) position. The troubleshooting information for fault code 958 is the same as fault code 1229. Refer to fault code 1229 for the fault code troubleshooting information.

## Refer to Troubleshooting Fault Code t05-958

## TROUBLESHOOTING SUMMARY

| STEPS | SPECIFICATIONS | SRT CODE |
|---|---|---|
| **STEP 1: Check the fault codes.** | | |
| **STEP 1A: Check for an active fault code.** | **Fault code 958 is active?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

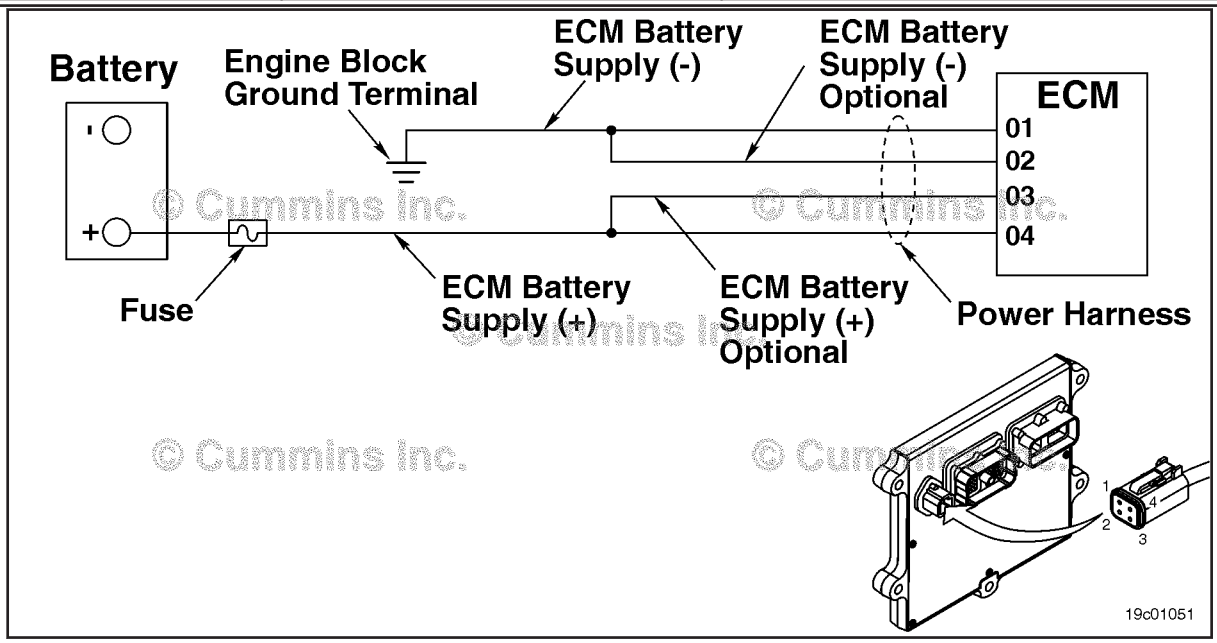
**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault code 958 is active?<br>**YES** | Refer to fault code 1229. |
| | Fault code 958 is active?<br>**NO** | Repair Complete |

# Fault Code 1117 Automotive Application

## Power Lost Without Ignition Off - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1117<br>PID(P), SID(S): S251<br>SPN: 627<br>FMI: 2/2<br>Lamp: None<br>SRT: | Power Lost Without Ignition Off - Data Erratic, Intermittent, or Incorrect. Supply voltage to the ECM fell below 6.2-VDC momentarily, or the ECM was **not** allowed to power down correctly (retain battery voltage for 30 seconds after key OFF). | Possible no noticeable performance effects or engine dying or hard starting. Fault information, trip information, and maintenance monitor data can be inaccurate. |





Unswitched Battery Supply

**Circuit Description:**

The ECM receives constant voltage from the batteries through the unswitched battery wires that are connected directly to the positive (+) battery post. The ECM receives switched battery input through the vehicle keyswitch wire when the vehicle keyswitch is turned ON.

**Component Location:**

The ECM is connected to the battery by the OEM power harness through the ECM battery supply stub. This provides a constant power supply for the ECM. The location of the battery will vary with the OEM. Refer to the OEM service manual.

**Shop Talk:**

This fault is set active if the ECM battery supply voltage drops below + 6.2-VDC while the keyswitch is in the ON position.

Make sure the ECM unswitched battery supply is coming directly from the battery and **not** the starter. If unswitched power is coming from the starter, it is possible for the battery voltage to drop low enough during cranking to set this fault active.

Where the fault code is inactive, familiarize yourself with the vehicle shut down practices used by the operator. For example, if there are controls inside the cab that can interrupt the (ECM) power supply (before the end of the 30

second power down process after key OFF), these should be considered as a potential cause when the fault code is being addressed. This should be explained to the operator.

This fault can also be caused by resistance in the ECM battery supply (+) or (-) circuits. Resistance in these circuits can cause the voltage level at the ECM input to drop low enough to set Fault Code 1117 active.

This fault can also be caused by a short to ground in the injector wiring harness. Check to be sure the injector wires are oriented so that they will **not** interfere with a rocker lever or other components in the overhead system. Keep in mind that certain operating conditions can cause the rocker levers to operate outside their normal range of motion.

This fault code can also be caused by noise transmitted over the J1587 or J1939 data links. The transmitted noise can cause a momentary interruption in the ECM power, which causes Fault Code 1117 to log. During troubleshooting, isolate the engine from the chassis to determine if any of the data links are conducting noise to the engine.

## Refer to Troubleshooting Fault Code t05-1117

# FAULT CODE 1117 Automotive Application - Power Lost Without Ignition Off - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3164133 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for fault codes.** | | |
| **STEP 1A:** | **Check for multiple fault codes.** | **Active or inactive Fault Code 2362 and/or 2363?** | |
| **STEP 2:** | **Check the batteries and the power connector.** | | |
| **STEP 2A:** | **Check the batteries and the power connector.** | **Connections tight and corrosion-free?** | |
| **STEP 2B:** | **Check the battery voltage.** | **Normal conditions: At least + 12-VDC [+ 24-VDC with 24 volt system]; During cranking: At least + 6.2-VDC?** | |
| **STEP 3:** | **Check the OEM power harness.** | | |
| **STEP 3A:** | **Inspect the harness and the ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check for an open circuit in the battery power circuit.** | **At least + 10-VDC [+ 20-VDC for a 24 volt system]?** | |
| **STEP 3B-1:** | **Verify that the OEM fuse is installed correctly.** | **Is fuse installed correctly?** | |
| **STEP 3B-2:** | **Check if the OEM fuse is blown.** | **Is fuse blown?** | |
| **STEP 3B-3:** | **Check the add-on or accessory wiring at the (+) terminal of the battery.** | **Any damaged wires?** | |
| **STEP 3C:** | **Check the resistance of the battery supply circuit.** | **Less than 1.0 ohms?** | |
| **STEP 3D:** | **Check the keyswitch input-to-ECM wire.** | **Keyswitch input wire interrupted?** | |
| **STEP 3E:** | **Check the keyswitch input circuit.** | **Less than 5 ohms?** | |
| **STEP 4:** | **Check the engine wiring harness, solenoid, and injector circuits.** | | |
| **STEP 4A:** | **Check for signal voltage.** | **Greater than 3.75-VDC?** | |
| **STEP 4A-1:** | **Check the engine harness and the ECM connector pins.** | **Dirty or damaged pins?** | |
| **STEP 4A-2:** | **Check for a signal short to ground at the ECM.** | **Greater than 3.75-VDC?** | |
| **STEP 4B:** | **Check for a short to ground.** | **More than 100k ohms?** | |

| | | |
|---|---|---|
| **STEP 4C:** | **Check the engine brake solenoids for a short to ground.** | **5 ohms or greater?** |
| **STEP 4D:** | **Inspect the injector pass-through connector pins.** | **Dirty or damaged pins or damaged wire insulation?** |
| **STEP 4E:** | **Check the injector harness circuits for short circuits to ground.** | **Greater than 1k ohms?** |
| **STEP 4F:** | **Check the injector solenoids for short circuits to ground.** | **Greater than 100k ohms?** |

## STEP 5: Clear the fault codes.

| | | |
|---|---|---|
| **STEP 5A:** | **Disable the fault code.** | **Fault Code 1117 inactive?** |
| **STEP 5B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** |

## TROUBLESHOOTING STEP

## STEP 1: Check for fault codes.

**STEP 1A: Check for multiple fault codes.**

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

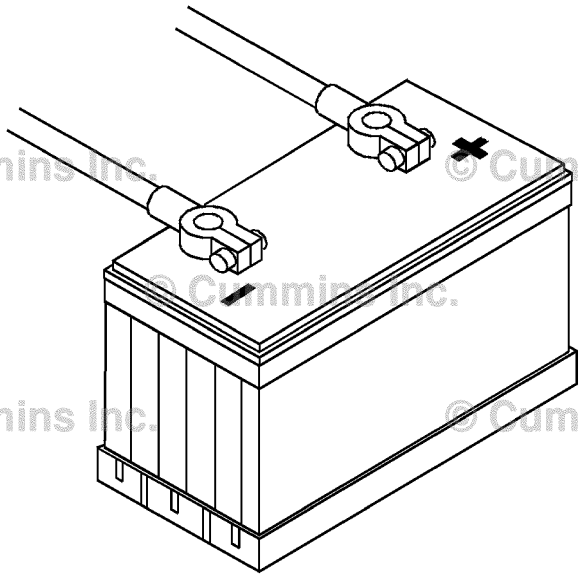
| Action | Specification/Repair | Next Step |
|---|---|---|
| Are the following fault codes active or inactive?<br>• Fault Code 2362 (Engine Brake Solenoid Signal Number 1 Circuit)?<br>• Fault Code 2363 (Engine Brake Solenoid Signal Number 2 Circuit)? | Active or inactive Fault Code 2362 and/or 2363?<br>**YES**<br>**Repair:**<br>Perform troubleshooting for Fault Code 2362 or 2363. | Fault Codes 2362 or 2363 |
| | Active or inactive Fault Code 2362 and/or 2363?<br>**NO** | 2A |

## STEP 2: Check the batteries and the power connector.

### STEP 2A: Check the batteries and the power connector.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery connections.<br>• Check the battery terminal connections. | Connections tight and corrosion-free?<br>**YES** | 2B |
| | Connections tight and corrosion-free?<br>**NO**<br>**Repair:**<br>Tighten the connections.<br>Tighten the loose connections and clean the terminals. Refer to the OEM service manual. | 5A |



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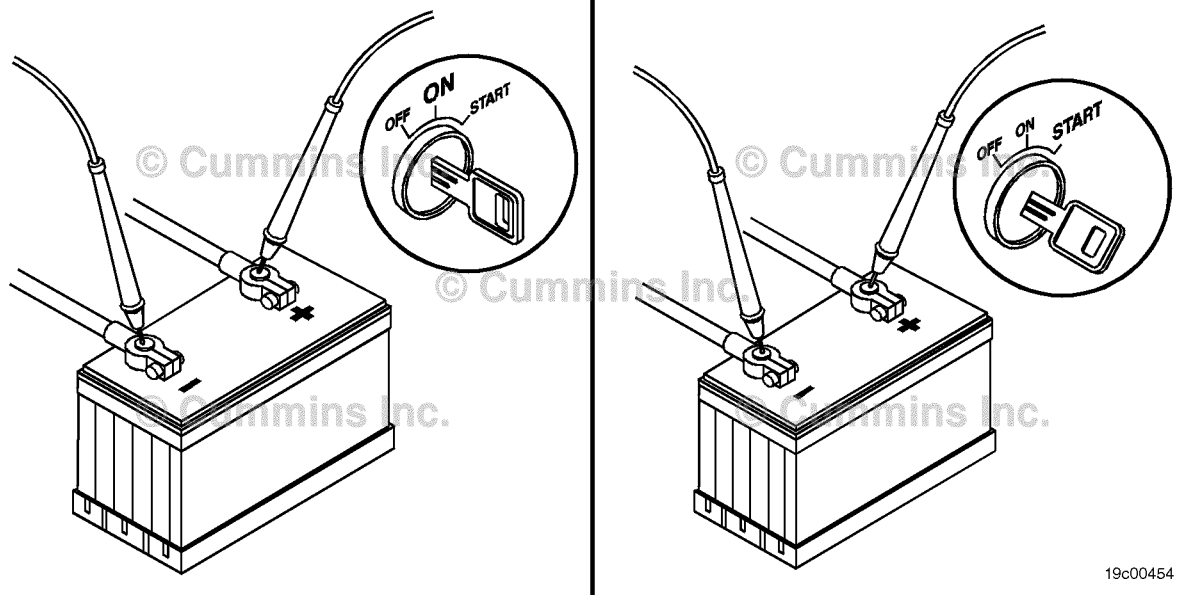
**STEP 2B: Check the battery voltage.**

**Condition:**
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Place the positive (+) probe of the multimeter on the positive battery terminal and touch the negative (-) probe to the negative battery terminal while trying to start the engine. | Normal conditions: At least + 12-VDC [+ 24-VDC with 24 volt system]; During cranking: At least + 6.2-VDC?<br>**YES** | 3A |
| | Normal conditions: At least + 12-VDC [+ 24-VDC with 24 volt system]; During cranking: At least + 6.2-VDC?<br>**NO**<br>**Repair:**<br>Charge or replace the battery. Refer to the OEM service manual. | 5A |



## STEP 3: Check the OEM power harness.

### STEP 3A: Inspect the harness and the ECM connector pins.

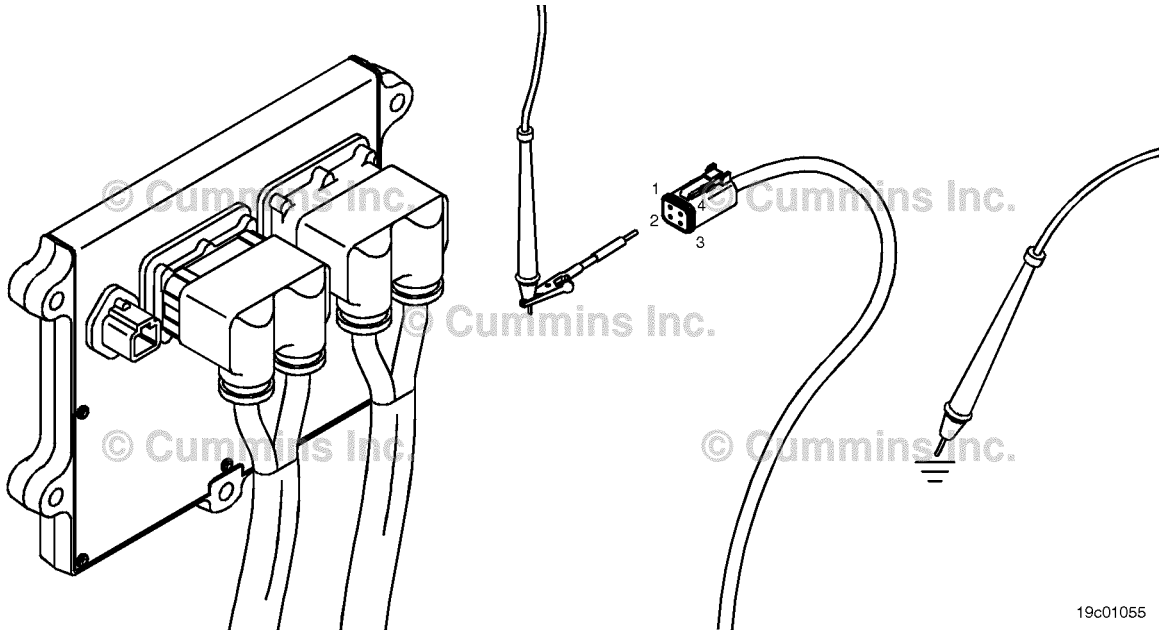
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness connector from the ECM

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the harness and the ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>Repair the damaged pins. Repair or replace the engine harness or replace the ECM, whichever has the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins, use electronic contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Repair the engine harness. Refer to Procedure 019-204 in Section 19.<br>Replace the engine harness. Refer to Procedure 019-043 in Section 19.<br>Replace the ECM. Refer to Procedure 019-031 in Section 19.<br>Replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 5A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for an open circuit in the battery power circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness ECM battery supply stub from the ECM.

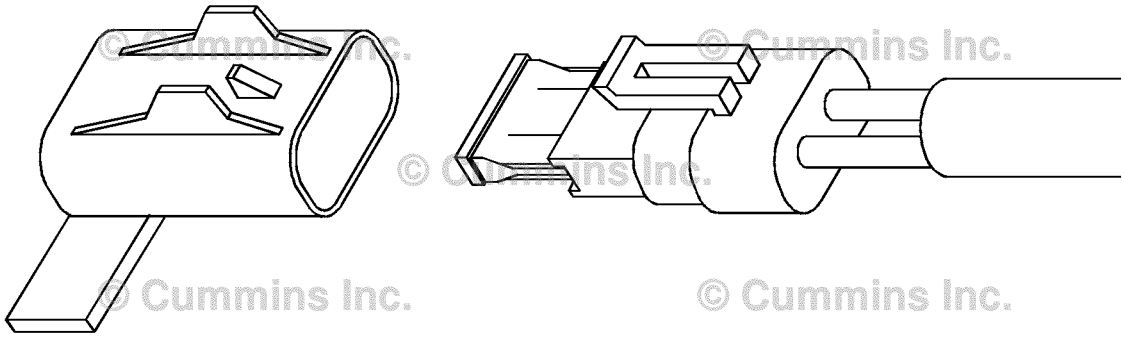
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit in the battery power circuits.<br>• Use a multimeter to measure the voltage from the ECM battery SUPPLY (+) pin of the engine harness ECM battery supply stub connector and engine block ground.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification. | At least + 10-VDC [+ 20-VDC for a 24 volt system]?<br>**YES** | 3C |
| | At least + 10-VDC [+ 20-VDC for a 24 volt system]?<br>**NO** | 3B-1 |



**STEP 3B-1: Verify that the OEM fuse is installed correctly.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM fuse for correct installation.<br>- | Is fuse installed correctly?<br>**YES** | 3B-2 |
| | Is fuse installed correctly?<br>**NO**<br>**Repair:**<br>Install the fuse correctly. Refer to Procedure 019-198 in Section 19. | 5A |

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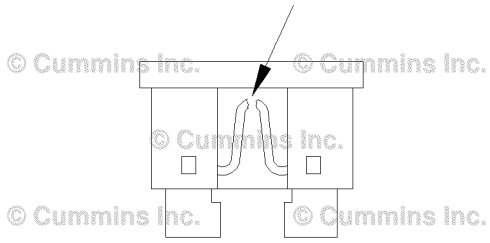
**STEP 3B-2: Check if the OEM fuse is blown.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify that the OEM fuse is not blown.<br>- | Is fuse blown?<br>**YES**<br>**Repair:**<br>Locate the short circuit.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.<br>Replace the blown fuse(s). Refer to Procedure 019-198 in Section 19. | 5A |
| | Is fuse blown?<br>**NO** | 3B-3 |



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**STEP 3B-3: Check the add-on or the accessory wiring at the (+) terminal of the battery.**

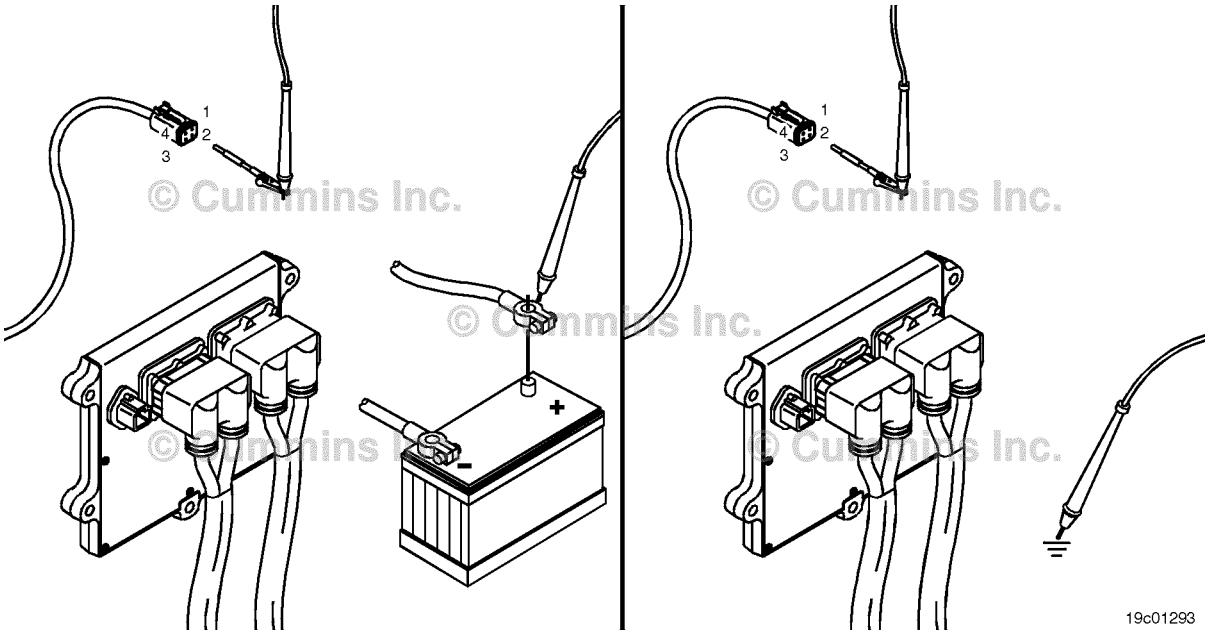
**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the add-on or the accessory wiring at the (+) terminal of the battery.<br>• Starting at the (+) terminal, follow any add-on or accessory wiring and examine wire(s) for damaged insulation or an installation error that can cause the supply wire to be shorted to the engine block. | Any damaged wires?<br>**YES**<br>**Repair:**<br>Repair or replace the damaged wiring. | 5A |
| | Any damaged wires?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM power harness from the OEM power connector to the batteries. | 5A |

**STEP 3C: Check the resistance of the battery supply circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness ECM battery supply stub from the ECM.
- Disconnect the positive terminal from the battery.
- Digital multimeter set to low resistance mode and calibrated to zero.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the resistance of the battery supply circuit.<br>• Measure the resistance between the ECM battery SUPPLY (+) pin of the engine harness ECM battery supply stub connector and the positive battery connector.<br>• Measure the resistance between the ECM battery SUPPLY (-) pin of the engine harness ECM battery supply stub connector and the negative battery connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>NOTE: Since the battery supply circuit resistance is normally very low, it is necessary to use a digital multimeter calibrated to zero on the low resistance setting to accurately measure the circuit resistance.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 1.0 ohms?<br>**YES** | 3D |
| | Less than 1.0 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the ECM power harness. Refer to Procedure 019-071 in Section 19. | 5A |



**STEP 3D: Check the keyswitch input-to-ECM wire.**

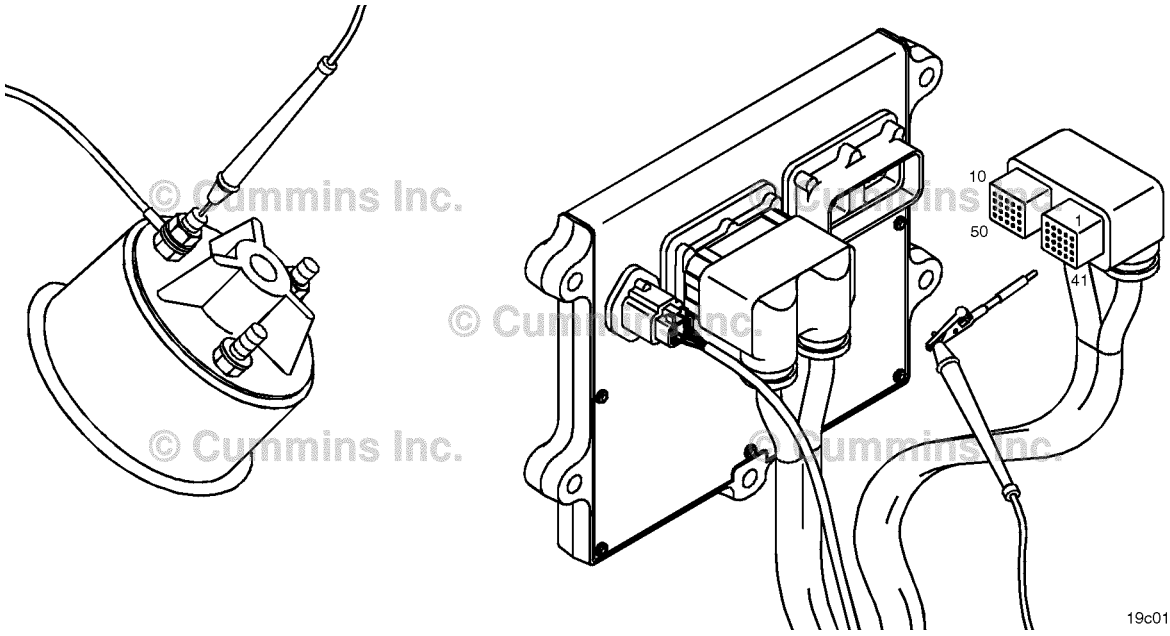
**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the keyswitch input wire from the keyswitch ignition post in the keyswitch assembly to the ECM to make sure there are no interruptions in the wire, such as solenoids or relays.<br>- | Keyswitch input wire interrupted?<br>**YES**<br>**Repair:**<br>Correct the wiring so the wire is uninterrupted. | 5A |
| | Keyswitch input wire interrupted?<br>**NO** | 3E |

**STEP 3E: Check the keyswitch input circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness connector from the ECM

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the keyswitch input circuit.<br>• Measure the resistance from the keyswitch ignition post in the keyswitch assembly to keyswitch input SIGNAL pin of the OEM harness connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 5 ohms?<br>**YES** | 4A |
| | Less than 5 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 5A |

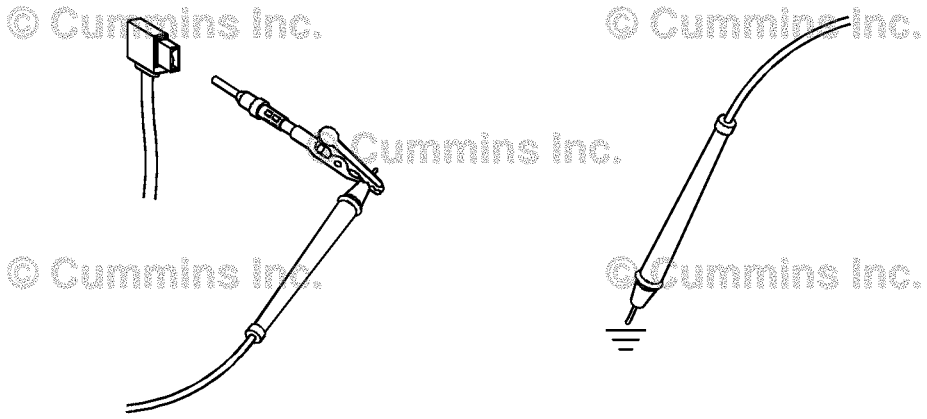


## STEP 4: Check the engine wiring harness, solenoid, and injector circuits.

### STEP 4A: Check for signal voltage.

**Condition:**
- Turn keyswitch OFF.
- Remove the rocker lever cover. Use the following procedure in the ISC, QSC8.3, ISL and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 003-011 Section 11.
- Disconnect the engine harness from the engine brake connector.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Use a multimeter to measure the voltage from the engine brake solenoid SIGNAL Number 1 pin of the engine harness to the engine block ground.<br>• Use a multimeter to measure the voltage from the engine brake solenoid SIGNAL Number 2 pin of the engine harness to the engine block ground.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification. | Greater than 3.75-VDC?<br>**YES** | 4B |
| | Greater than 3.75-VDC?<br>**NO** | 4A-1 |

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**STEP 4A-1: Check the engine harness and the ECM connector pins.**

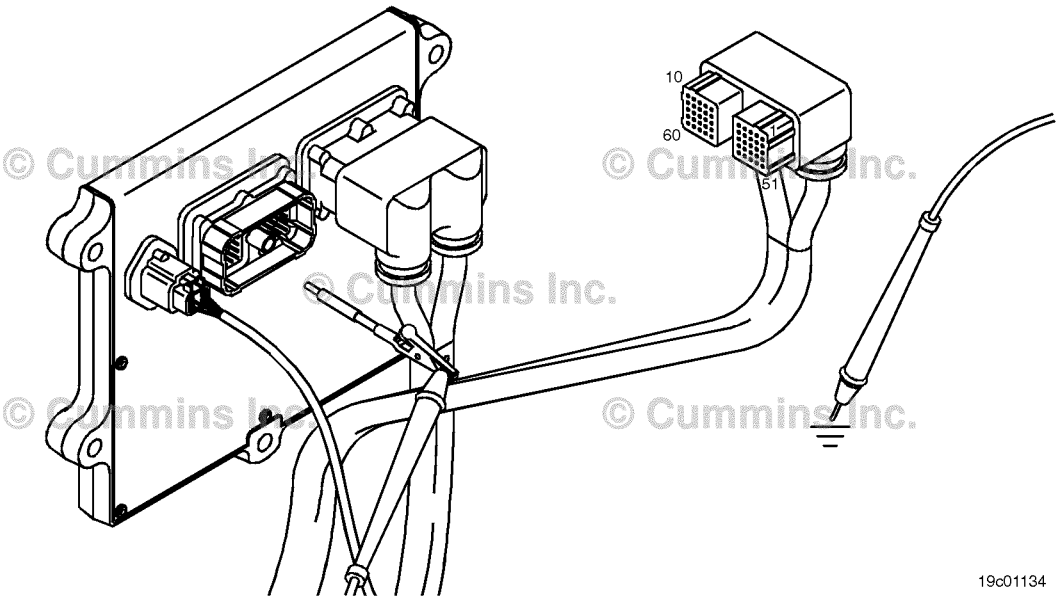
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br><br>Repair the damaged pins. Repair or replace the engine harness or replace the ECM, whichever has the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins, use electronic contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br><br>Repair the engine harness. Refer to Procedure 019-204 in Section 19.<br><br>Replace the engine harness. Refer to Procedure 019-043 in Section 19.<br><br>Replace the ECM. Refer to Procedure 019-031 in Section 19.<br><br>Replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 5A |
| | Dirty or damaged pins?<br>**NO** | 4A-2 |

**STEP 4A-2: Check for a signal short to ground at the ECM.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.
- Turn keyswitch ON.

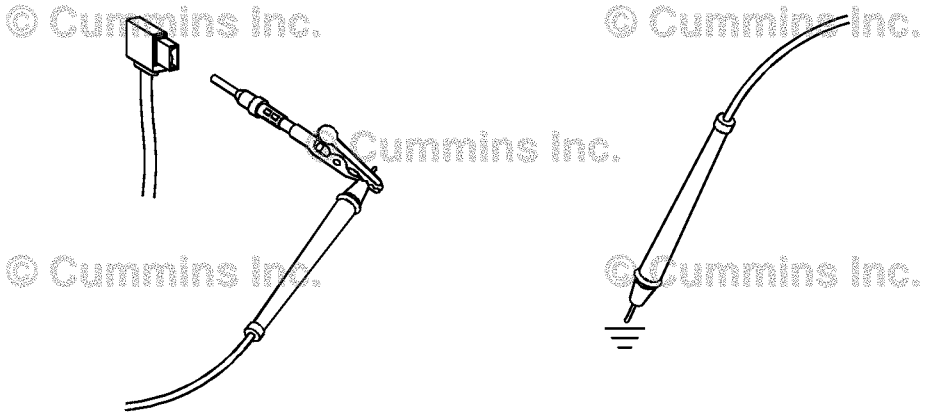
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short to ground.<br>• Use a multimeter to measure the voltage from the engine brake solenoid SIGNAL 1 pin of the ECM port to engine block ground.<br>• Use a multimeter to measure the voltage from the engine brake solenoid SIGNAL 2 pin of the ECM port to engine block ground. | Greater than 3.75-VDC?<br>**YES**<br>**Repair:**<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 5A |
| Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 3.75-VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 5A |



**STEP 4B: Check for a short to ground.**

**Condition:**
- Turn keyswitch OFF.
- Remove the rocker lever cover. Use the following procedure in the Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 003-011 in Section 3.
- Disconnect the engine harness from the engine brake connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short to ground.<br>• Use a multimeter to measure the resistance from the engine brake solenoid SIGNAL Number 1 pin of the engine brake connector to engine block ground.<br>• Use a multimeter to measure the resistance from the engine brake solenoid SIGNAL Number 2 pin of the engine brake connector to engine block ground.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | More than 100k ohms?<br>**YES** | 5A |
| | More than 100k ohms?<br>**NO**<br>**Repair:**<br>A short circuit to ground in the engine brake circuit has been detected in the engine harness.<br>Troubleshoot each harness connected in series to determine which contains the short circuit to ground.<br>Refer to Procedure 019-043 in Section 19. | 4C |

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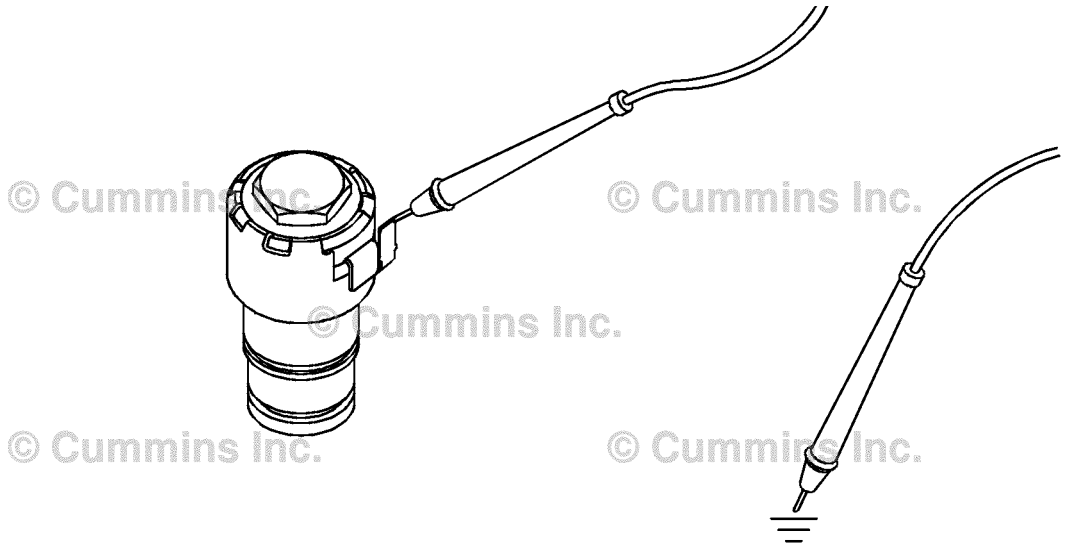
**STEP 4C: Check the engine brake solenoids for a short to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the engine brake connector.
- Remove the engine valve cover.
- Disconnect the engine brake wiring harness from solenoid number 1 and 2.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the resistance of solenoid number 1 and number 2.<br>• Use a multimeter to measure the resistance of solenoid number 1 terminal of the engine brake solenoid to the engine block ground.<br>• Use a multimeter to measure the resistance of solenoid number 2 terminal of the engine brake solenoid to the engine block ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | 5 ohms or greater?<br>**YES** | 4D |
| | 5 ohms or greater?<br>**NO**<br>**Repair:**<br>Replace the engine brake solenoid. Use the following procedure in the Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 020-012 in Section 20. | 5A |

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**STEP 4D: Inspect the injector pass-through connector pins.**

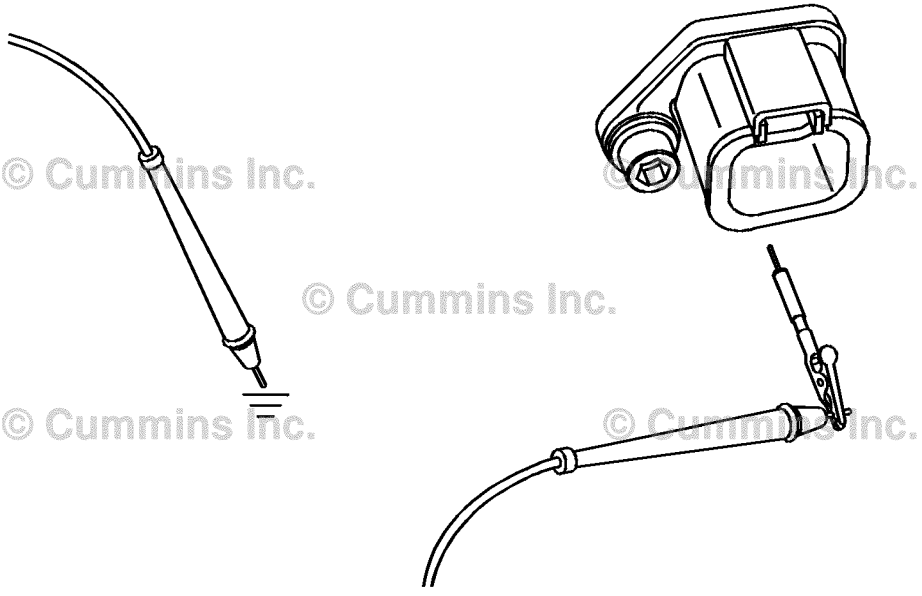
**Condition:**
- Turn the keyswitch OFF.
- Disconnect the engine harness from the injector pass-through connectors corresponding to the cylinders that are on the front and rear bank.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the injector pass-through connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins or damaged wire insulation?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the injector circuit.<br>Repair or replace the injector harness or pass-through connector.<br>• Flush the dirt, debris, or moisture from the connector pins. Use electronic contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Replace the injector harness pass-through connector. Refer to Procedure 019-206 in Section 19.<br>For wire insulation damage, replace the injector harness. Refer to Procedure 019-063 in Section 19. | 5A |
| | Dirty or damaged pins or damaged wire insulation?<br>**NO** | 4E |

**STEP 4E: Check the injector harness circuits for short circuits to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect all injector pass-through connectors corresponding to the cylinders that are on the front and rear bank.

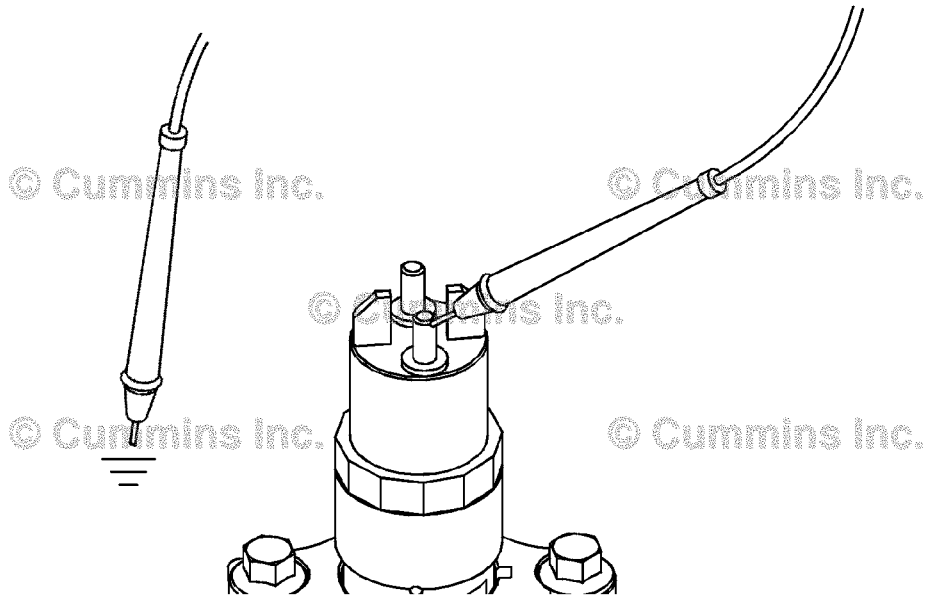
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the resistance between the cylinder number 1 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 2 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 3 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 4 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 5 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 6 DRIVER pin and engine block ground.<br>Use a wiring diagram for pin identification and the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 1k ohms?<br>**YES** | 5A |
| | Greater than 1k ohms?<br>**NO** | 4F |



**STEP 4F: Check the injector solenoids for short circuits to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect all injector pass-through connectors from the engine harness.
- Disconnect the injector harness from the injectors being tested.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a short circuit to ground.<br>• Measure the resistance between the cylinder number 1 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 2 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 3 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 4 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 5 DRIVER pin and engine block ground.<br>• Measure the resistance between the cylinder number 6 DRIVER pin and engine block ground.<br>Use a wiring diagram for pin identification and the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>Repair or replace the injector harness. Refer to Procedure 019-063 in Section 19. | 5A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Replace the injector(s).<br>• For ISC, QSC, and ISL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6.<br>• For ISB engines, use the following procedure in the ISB, ISBe, QSB (Common Rail Fuel System) Engines, Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6. | 5A |



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## STEP 5: Clear the fault codes.

### STEP 5A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine, and let it idle for 1 minute.<br>• Turn keyswitch to OFF position for 30 seconds.<br>• Turn keyswitch ON.<br>• Use INSITE™ electronic service tool to verify Fault Code 1117 is inactive.<br>NOTE: For Fault Code 1117 to become inactive, the ECM **must** go through one complete shutdown. | Fault Code 1117 inactive?<br>**YES** | 5B |
| | Fault Code 1117 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 5B: Clear the inactive fault codes.

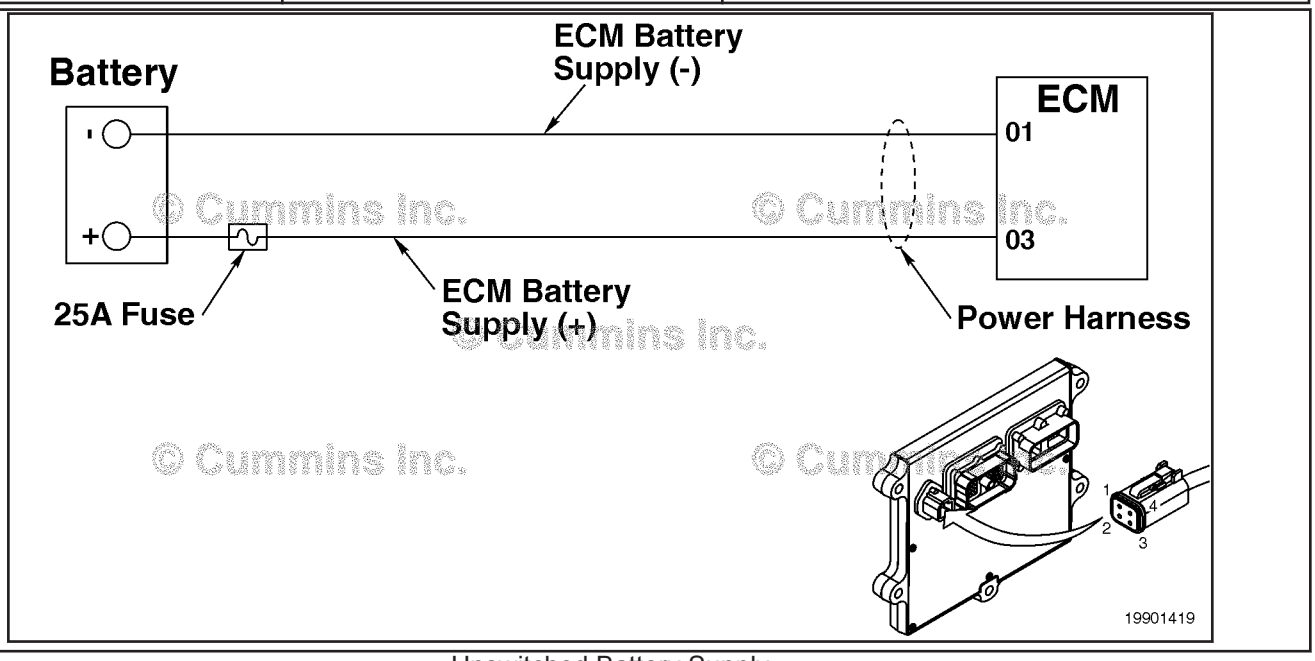
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 1117 (Marine Application)

## Power Lost without Ignition Off - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1117<br>PID(P), SID(S): S251<br>SPN: 627<br>FMI: 2/2<br>Lamp: None<br>SRT: | Power Lost without Ignition Off - Data Erratic, Intermittent, or Incorrect. Supply voltage to the ECM fell below +6.2-VDC momentarily, or the ECM was **not** allowed to power down correctly (retain battery voltage for 30 seconds after key OFF). | Possible no noticeable performance effects or engine dying or hard starting. Fault information, trip information, and maintenance monitor data can be inaccurate. |




Unswitched Battery Supply

**Circuit Description:**

The electronic control module (ECM) receives constant voltage from the batteries through the unswitched battery wires that are connected directly to the positive (+) battery post. The ECM receives switched battery input through the vehicle keyswitch wire when the vehicle keyswitch is turned ON.

**Component Location:**

The ECM is connected to the battery by the original equipment manufacturer (OEM) power harness through the ECM battery supply stub. This provides a constant power supply for the ECM. The location of the battery will vary with the OEM. Refer to the OEM service manual.

**Shop Talk:**

This fault is set active if the ECM battery supply voltage drops below +6.2-VDC while the keyswitch is in the ON position.

Make sure the ECM unswitched battery supply is coming directly from the battery and **not** the starter. If unswitched power is coming from the starter, it is possible for the battery voltage to drop low enough during cranking to set this fault active.

Where the fault code is inactive, familiarize yourself with the vehicle shutdown practices used by the operator. For example, if there are controls inside the cab that can interrupt the (ECM) power supply (before the end of the 30

second power down process after key OFF), these should be considered as a potential cause when the fault code is being addressed. This should be explained to the operator.

This fault can also be caused by resistance in the ECM battery supply (+) or (-) circuits. Resistance in these circuits can cause the voltage level at the ECM input to drop low enough to set Fault Code 1117 active.

This fault can also be caused by a short to ground in the injector wiring harness. Check to be sure the injector wires are oriented so that they will **not** interfere with a rocker lever or other components in the overhead system. Keep in mind that certain operating conditions could cause the rocker levers to operate outside their normal range of motion.

This fault code can also be caused by noise transmitted over the J1587 or J1939 data links. The transmitted noise can cause a momentary interruption in the ECM power, which causes Fault Code 1117 to log. During troubleshooting, isolate the engine from the vessel to determine if any of the data links are conducting noise to the engine.

## Refer to Troubleshooting Fault Code t05-1117

# FAULT CODE 1117 (Marine Application) - Power Lost without Ignition Off - Data Erratic, Intermittent, or Incorrect
## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3164133 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the batteries and the power connector.** | | |
| STEP 1A: | Check the batteries and the power connector. | Connections tight and corrosion-free? | |
| STEP 1B: | Check the battery voltage. | Normal conditions: At least + 12-VDC [+ 24-VDC with 24 volt system]; During cranking: At least + 6.2-VDC? | |
| **STEP 2:** | **Check the OEM power harness.** | | |
| STEP 2A: | Inspect the harness and the ECM connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check for an open circuit in the battery power circuit. | At least + 10-VDC [+ 20-VDC for a 24 volt system]? | |
| STEP 2B-1: | Verify that the OEM fuse is installed correctly. | Is fuse installed correctly? | |
| STEP 2B-2: | Check if the OEM fuse is blown. | Is fuse blown? | |
| STEP 2B-3: | Check the add-on or accessory wiring at the (+) terminal of the battery. | Any damaged wires? | |
| STEP 2C: | Check the resistance of the battery supply circuit. | Less than 1.0 ohm? | |
| STEP 2D: | Check the keyswitch input-to-ECM wire. | Keyswitch input wire interrupted? | |
| STEP 2E: | Check the keyswitch input circuit. | Less than 5 ohms? | |
| **STEP 3:** | **Check the engine wiring harness.** | | |
| STEP 3A: | Check the engine harness and the ECM connector pins. | Dirty or damaged pins? | |
| **STEP 4:** | **Clear the fault codes.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 1117 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All fault codes cleared? | |

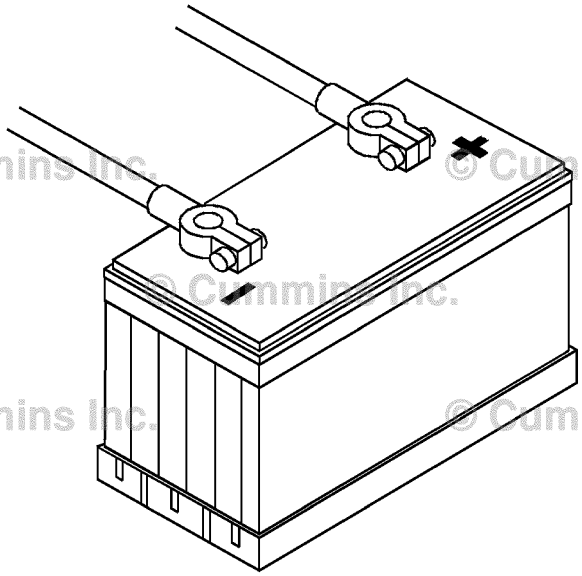
## TROUBLESHOOTING STEP

### STEP 1: Check the batteries and the power connector.

**STEP 1A: Check the batteries and the power connector.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery connections.<br>• Check the battery terminal connections. | Connections tight and corrosion-free?<br>**YES** | 1B |
| | Connections tight and corrosion-free?<br>**NO**<br>**Repair:**<br>Tighten the connections.<br>Tighten the loose connections and clean the terminals. Refer to the OEM service manual. | 4A |



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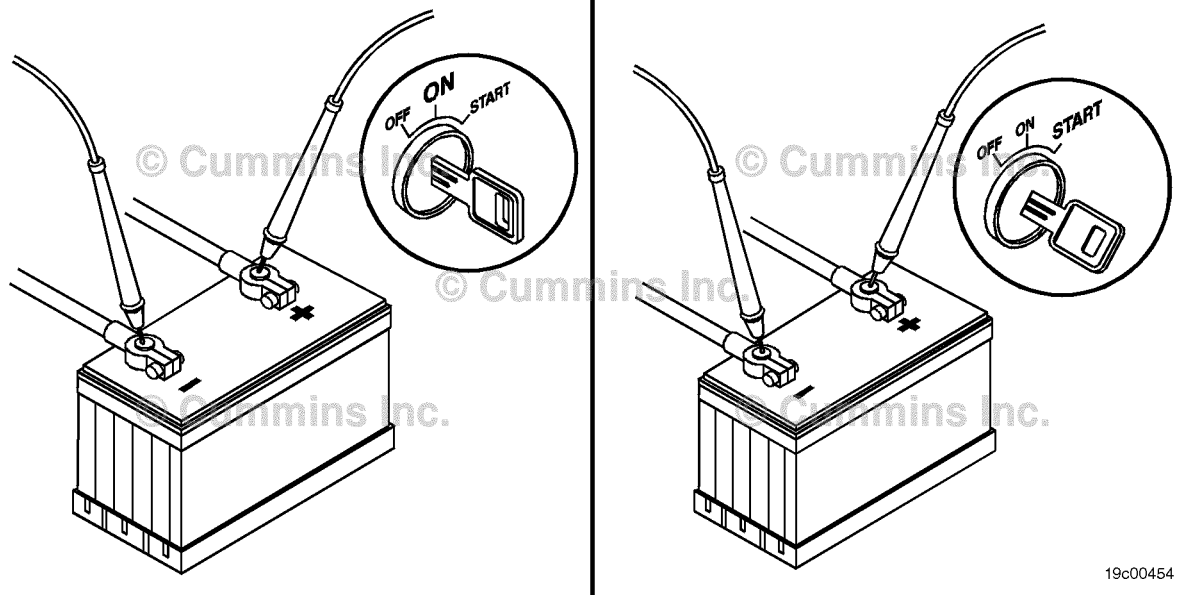
**STEP 1B: Check the battery voltage.**

**Condition:**
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the battery voltage.<br>• Place the positive (+) probe of the multimeter on the positive battery terminal and touch the negative (-) probe to the negative battery terminal while trying to start the engine. | Normal conditions: At least + 12-VDC [+ 24-VDC with 24 volt system]; During cranking: At least + 6.2-VDC?<br>**YES** | 2A |
| | Normal conditions: At least + 12-VDC [+ 24-VDC with 24 volt system]; During cranking: At least + 6.2-VDC?<br>**NO**<br>**Repair:**<br>Charge or replace the battery.<br>Refer to the OEM service manual. | 4A |



## STEP 2: Check the OEM power harness.

### STEP 2A: Inspect the harness and the ECM connector pins.

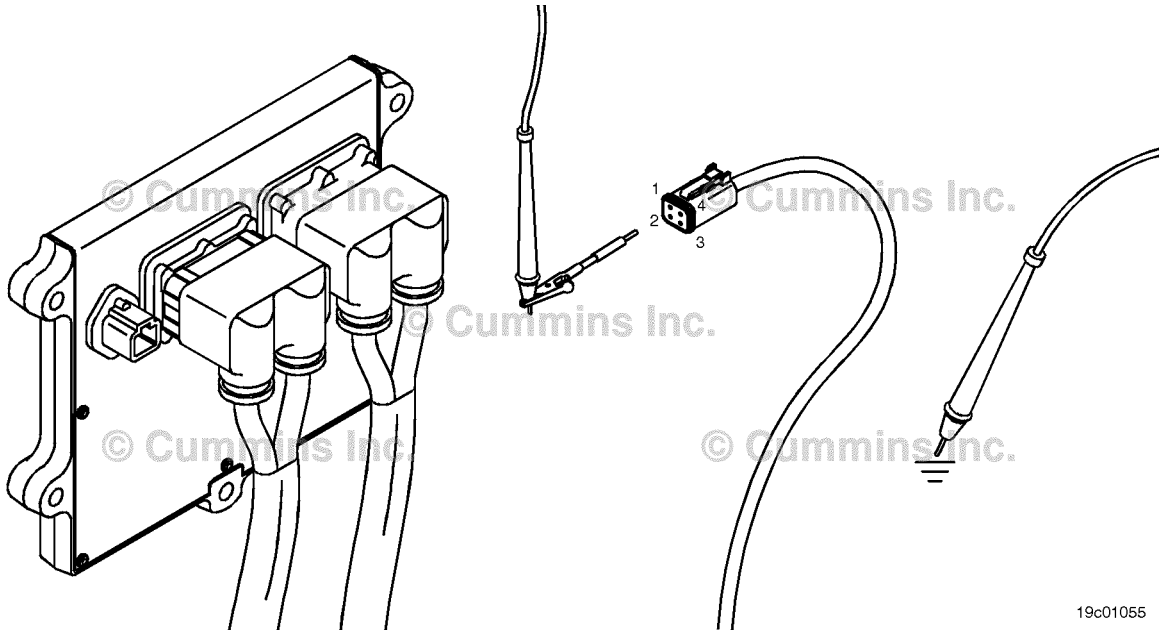
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM power harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the harness and the ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>Repair the damaged pins. Repair or replace the engine harness or replace the ECM, whichever has the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins, use electronic contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br>Repair the engine harness. Refer to Procedure 019-204 in Section 19.<br>Replace the engine harness. Refer to Procedure 019-043 in Section 19.<br>Replace the ECM. Refer to Procedure 019-031 in Section 19.<br>Replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check for an open circuit in the battery power circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness ECM battery supply stub from the ECM.

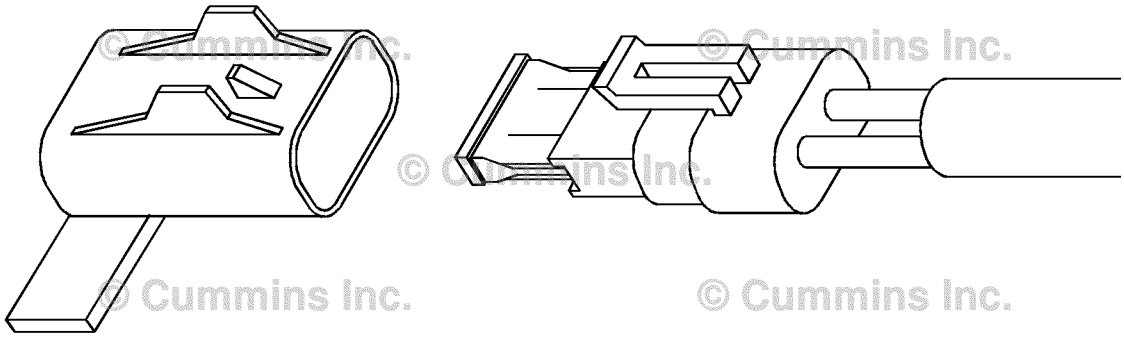
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit in the battery power circuits.<br>• Use a multimeter to measure the voltage from the ECM battery supply (+) pin of the engine harness ECM battery supply stub connector and engine block ground.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification. | At least + 10-VDC [+ 20-VDC for a 24 volt system]?<br>**YES** | 2C |
| | At least + 10-VDC [+ 20-VDC for a 24 volt system]?<br>**NO** | 2B-1 |



**STEP 2B-1: Verify that the OEM fuse is installed correctly.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM fuse for correct installation. | Is fuse installed correctly?<br>**YES** | 2B-2 |
| | Is fuse installed correctly?<br>**NO**<br>**Repair:**<br>Install the fuse correctly. Refer to Procedure 019-198 in Section 19. | 4A |



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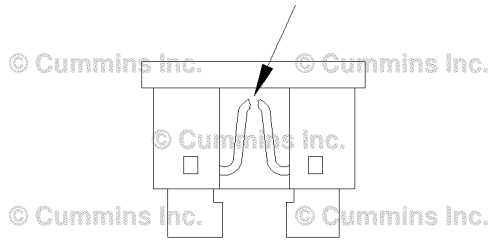
**STEP 2B-2: Check if the OEM fuse is blown.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify that the OEM fuse is not blown.<br>- | Is fuse blown?<br>**YES**<br>**Repair:**<br>Locate the short circuit.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.<br>Replace the blown fuse(s). Refer to Procedure 019-198 in Section 19. | 4A |
| | Is fuse blown?<br>**NO** | 2B-3 |



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**STEP 2B-3: Check the add-on or the accessory wiring at the (+) terminal of the battery.**

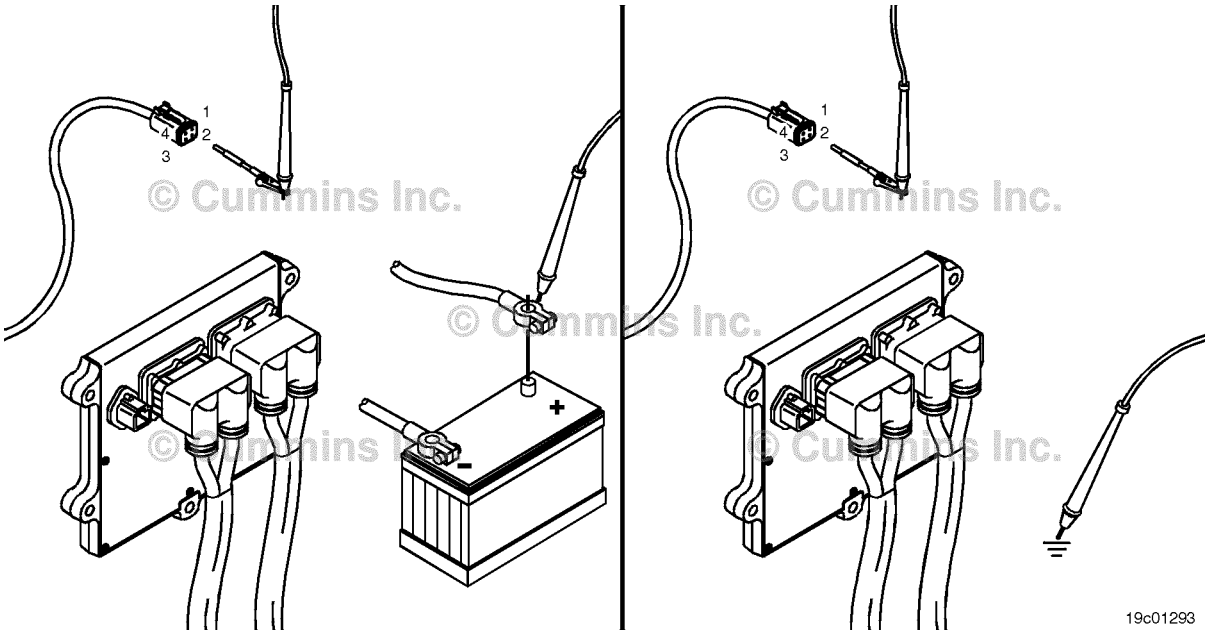
**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the add-on or the accessory wiring at the (+) terminal of the battery.<br>• Starting at the (+) terminal, follow any add-on or accessory wiring and examine wire(s) for damaged insulation or an installation error that can cause the supply wire to be shorted to the engine block. | Any damaged wires?<br>**YES**<br>**Repair:**<br>Repair or replace the damaged wiring. | 4A |
| | Any damaged wires?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM power harness from the OEM power connector to the batteries. | 4A |

**STEP 2C: Check the resistance of the battery supply circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness ECM battery supply stub from the ECM.
- Disconnect the positive terminal from the battery.
- Digital multimeter set to low resistance mode and calibrated to zero.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the resistance of the battery supply circuit.<br>• Measure the resistance between the ECM battery SUPPLY (+) pin of the engine harness ECM battery supply stub connector and the positive battery connector.<br>• Measure the resistance between the ECM battery SUPPLY (-) pin of the engine harness ECM battery supply stub connector and the negative battery connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>NOTE: Since the battery supply circuit resistance is normally very low, it is necessary to use a digital multimeter calibrated to zero on the low resistance setting to accurately measure the circuit resistance.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 1.0 ohm?<br>**YES** | 2D |
| | Less than 1.0 ohm?<br>**NO**<br>**Repair:**<br>Repair or replace the ECM power harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 2D: Check the keyswitch input-to-ECM wire.**

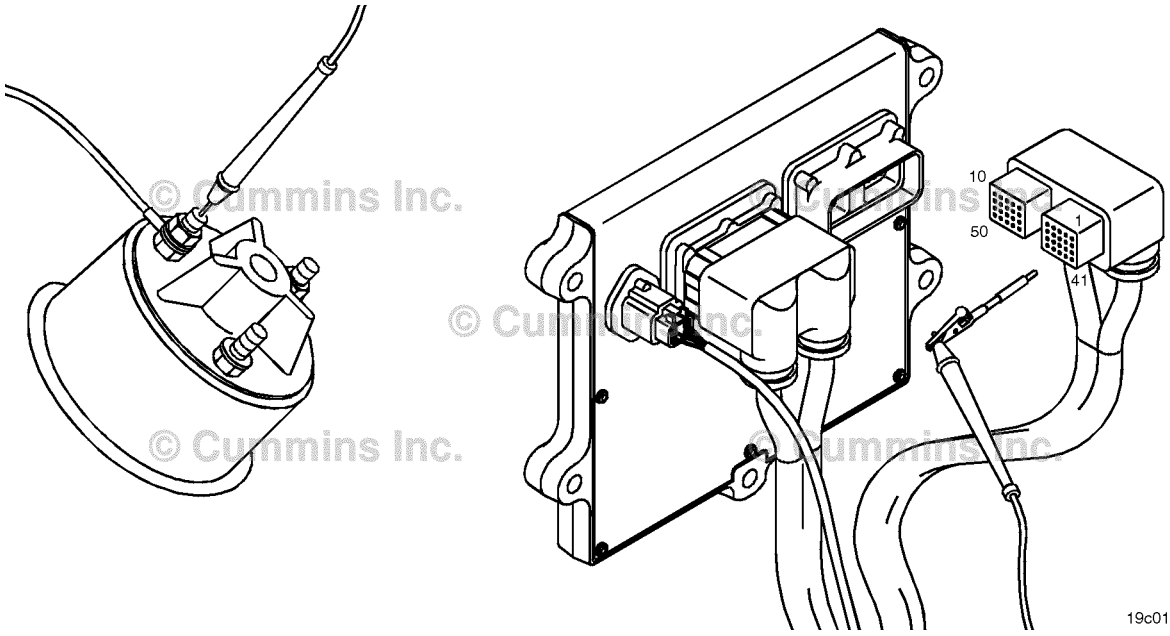
**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the keyswitch input wire from the keyswitch ignition post in the keyswitch assembly to the ECM to make sure there are no interruptions in the wire, such as solenoids or relays.<br>- | Keyswitch input wire interrupted?<br>**YES**<br>**Repair:**<br>Correct the wiring so the wire is uninterrupted. | 4A |
| | Keyswitch input wire interrupted?<br>**NO** | 2E |

**STEP 2E: Check the keyswitch input circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness connector from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the keyswitch input circuit.<br>• Measure the resistance from the keyswitch ignition post in the keyswitch assembly to keyswitch input SIGNAL pin of the OEM harness connector.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 5 ohms?<br>**YES** | 3A |
| | Less than 5 ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 3: Check the engine wiring harness.

### STEP 3A: Check the engine harness and the ECM connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the engine harness and ECM connector pins for the following.<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br><br>Repair the damaged pins. Repair or replace the engine harness or replace the ECM, whichever has the damaged pins.<br>• Flush the dirt, debris, or moisture from the connector pins, use electronic contact cleaner, Part Number 3824510.<br>• Install the appropriate connector seal if it is damaged or missing.<br><br>Repair the engine harness. Refer to Procedure 019-204 in Section 19.<br><br>Replace the engine harness. Refer to Procedure 019-043 in Section 19.<br><br>Replace the ECM. Refer to Procedure 019-031 in Section 19.<br><br>Replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 4A |

## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine, and let it idle for 1 minute.<br>• Turn the keyswitch to the OFF position for 30 seconds.<br>• Turn the keyswitch ON.<br>• Use INSITE™ to verify Fault Code 1117 is inactive.<br><br>NOTE: For Fault Code 1117 to become inactive, the ECM **must** go through one complete shutdown. | Fault Code 1117 inactive?<br>**YES** | 4B |
| | Fault Code 1117 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a Cummins® Authorized Repair location if all steps have been completed and checked again. | 1 |

**STEP 4B: Clear the inactive fault codes.**

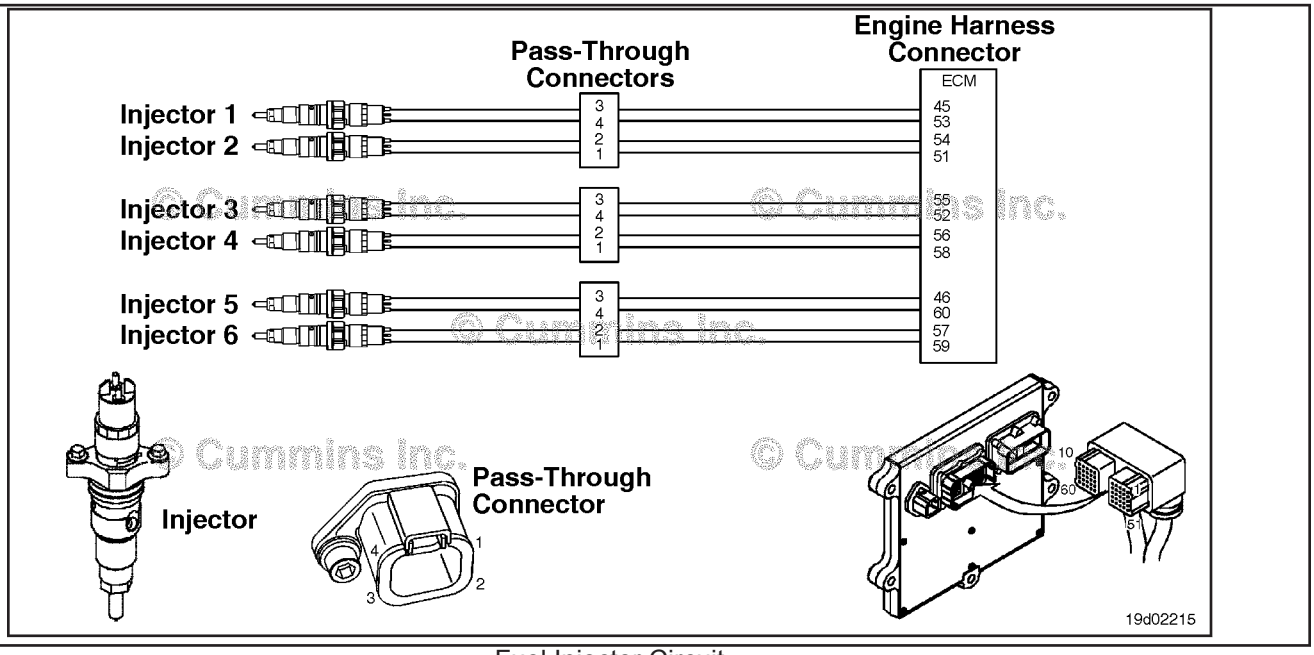
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 1139

## Injector Solenoid Driver Cylinder 1 - Mechanical System Not Responding Properly or Out of Adjustment

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1139<br>PID(P), SID(S): S001<br>SPN: 651<br>FMI: 7<br>Lamp: Amber<br>SRT: | Injector Solenoid Driver Cylinder 1 - Mechanical System Not Responding Properly or Out of Adjustment. Unintended fueling detected in cylinder number 1. | Engine will shut down. |




Fuel Injector Circuit

**Circuit Description:**

The electronic control module (ECM) can detect when unintended fuel injection occurs by monitoring fuel rail pressure and engine speed. This fault code is logged when the ECM determines that unintended fuel injection has occurred.

**Component Location:**

The fuel injector is located in the cylinder head. 100-002 for a detailed component location view.

**Shop Talk:**

This fault code can be caused by a failed or damaged injector causing continuous injection into the cylinder. Progressive cylinder damage may occur if the engine is operated for an extended period of time with this condition. If a failed injector is found to be the cause of this fault code, the cylinder liner and piston **must** be inspected for progressive damage.

If an injector nozzle is fractured or stuck, continuous fueling will ocur in that cylinder. If this condition occurs, the engine will typically die and **not** start. There will be exhaust smoke during cranking and no fuel rail pressure will be developed during cranking. Fault Code 2215 will be active during cranking if this condition exists.

## Refer to Troubleshooting Fault Code t05-1139

# FAULT CODE 1139 - Injector Solenoid Driver Cylinder 1 - Mechanical System Not Responding Properly or Out of Adjustment

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for Fault Code 1139.** | **Active or high inactive counts of Fault Code 1139 and loud engine knock occurs?** | |
| **STEP 2:** | **Check the fuel system.** | | |
| **STEP 2A:** | **Check for a stuck open injector.** | **Does the engine knock go away and Fault Code 1139 is inactive?** | |
| **STEP 2A-1:** | **Check for progressive cylinder damage.** | **Crankcase blowby measurement exceeds the specified limit?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 1139 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 1139.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or high inactive counts of Fault Code 1139 and a loud engine knock occurs?<br>**YES** | 2A |
| | Active or high inactive counts of Fault Code 1139 and a loud engine knock occurs?<br>**NO** | 3A |

## STEP 2: Check the fuel system.

### STEP 2A: Check for a stuck open injector.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a stuck open injector.<br>Use the fuel system leak tester blocking tool, part number 3164325, to block the fuel flow going to injector number 1.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6.<br>Start the engine and idle for one minute. | Does the engine knock go away and Fault Code 1139 is inactive?<br>**YES**<br>**Repair:**<br>A stuck open injector nozzle has been detected.<br>Replace the fuel injector.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 2A-1 |
| | Does the engine knock go away and Fault Code 1139 is inactive?<br>**NO** | Refer to Engine Noise symptom tree |

### STEP 2A-1: Check for progressive cylinder damage.

**Condition:**
- Turn keyswitch OFF.
- Measure the engine crankcase blowby. For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 014-010 in Section 14. For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 014-010 in Section 14.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Progressive engine damage is possible due to the damaged injector.<br>• Check for progressive damage<br>• Measure engine crankcase blowby. | Crankcase blowby measurement exceeds the specified limit?<br>**YES**<br>**Repair:**<br>Inspect for progressive engine damage. | 3A |
| | Crankcase blowby measurement exceeds the specified limit?<br>**NO** | 3A |

## STEP 3: Clear the fault code.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 1139 inactive?<br>**YES** | 3B |
| | Fault Code 1139 inactive?<br>**NO** | 1A |

### STEP 3B: Clear the inactive fault codes.

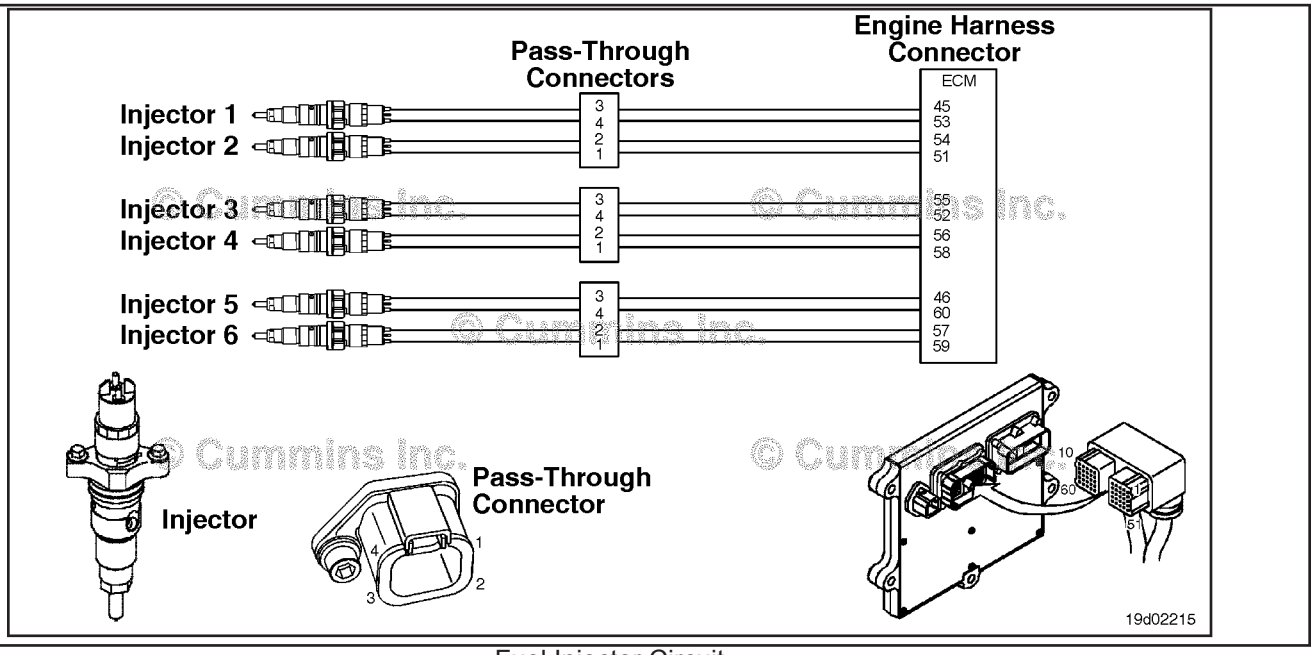
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 1141

## Injector Solenoid Driver Cylinder 2 - Mechanical System Not Responding Properly or Out of Adjustment

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1141<br>PID(P), SID(S): S002<br>SPN: 652<br>FMI: 7<br>Lamp: Amber<br>SRT: | Injector Solenoid Driver Cylinder 2 - Mechanical System Not Responding Properly or Out of Adjustment. Unintended fueling detected in cylinder number 2. | Engine will shut down. |




Fuel Injector Circuit

**Circuit Description:**

The electronic control module (ECM) can detect when unintended fuel injection occurs by monitoring fuel rail pressure and engine speed. This fault code is logged when the ECM determines that unintended fuel injection has occurred.

**Component Location:**

The fuel injector is located in the cylinder head. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code can be caused by a failed or damaged injector causing continuous injection into the cylinder. Progressive cylinder damage may occur if the engine is operated for an extended period of time with this condition. If a failed injector is found to be the cause of this fault code, the cylinder liner and piston **must** be inspected for progressive damage.

If an injector nozzle is fractured or stuck, continuous fueling will occur in that cylinder. If this condition occurs, the engine will typically die and **not** start. There will be exhaust smoke during cranking and no fuel rail pressure will be developed during cranking. Fault Code 2215 will be active during cranking if this condition exists.

## Refer to Troubleshooting Fault Code t05-1141

# FAULT CODE 1141 - Injector Solenoid Driver Cylinder 2 - Mechanical System Not Responding Properly or Out of Adjustment

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for Fault Code 1141.** | **Active or high inactive counts of Fault Code 1141 and loud engine knock occurs?** | |
| **STEP 2:** | **Check the fuel system.** | | |
| **STEP 2A:** | **Check for a stuck open injector.** | **Does the engine knock go away and Fault Code 1141 is inactive?** | |
| **STEP 2A-1:** | **Check for progressive cylinder damage.** | **Crankcase blowby measurement exceeds the specified limit?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 1141 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 1141.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or high inactive counts of Fault Code 1141 and a loud engine knock occurs?<br>**YES** | 2A |
| | Active or high inactive counts of Fault Code 1141 and a loud engine knock occurs?<br>**NO** | 3A |

## STEP 2: Check the fuel system.

### STEP 2A: Check for a stuck open injector.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a stuck open injector.<br>Using the fuel system leak tester blocking tool, part number 3164325, block the fuel flow going to injector number 2.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6.<br>• Start the engine and idle for one minute. | Does the engine knock go away and Fault Code 1141 is inactive?<br>**YES**<br>**Repair:**<br>A stuck open injector nozzle has been detected.<br>Replace the fuel injector. For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6. For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 2A-1 |
| | Does the engine knock go away and Fault Code 1141 is inactive?<br>**NO** | See Engine Noise symptom tree |

### STEP 2A-1: Check for progressive cylinder damage.

**Condition:**
- Turn keyswitch OFF.
- Measure the engine crankcase blowby. For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 014-010 in Section 14. For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 014-010 in Section 14.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Progressive engine damage is possible due to the failed injector.<br>• Check for progressive damage<br>• Measure engine crankcase blowby. | Crankcase blowby measurement exceeds the specified limit?<br>**YES**<br>**Repair:**<br>Inspect for progressive engine damage. | 3A |
| | Crankcase blowby measurement exceeds the specified limit?<br>**NO** | 3A |

## STEP 3: Clear the fault code.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 1141 inactive?<br>**YES** | 3B |
| | Fault Code 1141 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 3B: Clear the inactive fault codes.

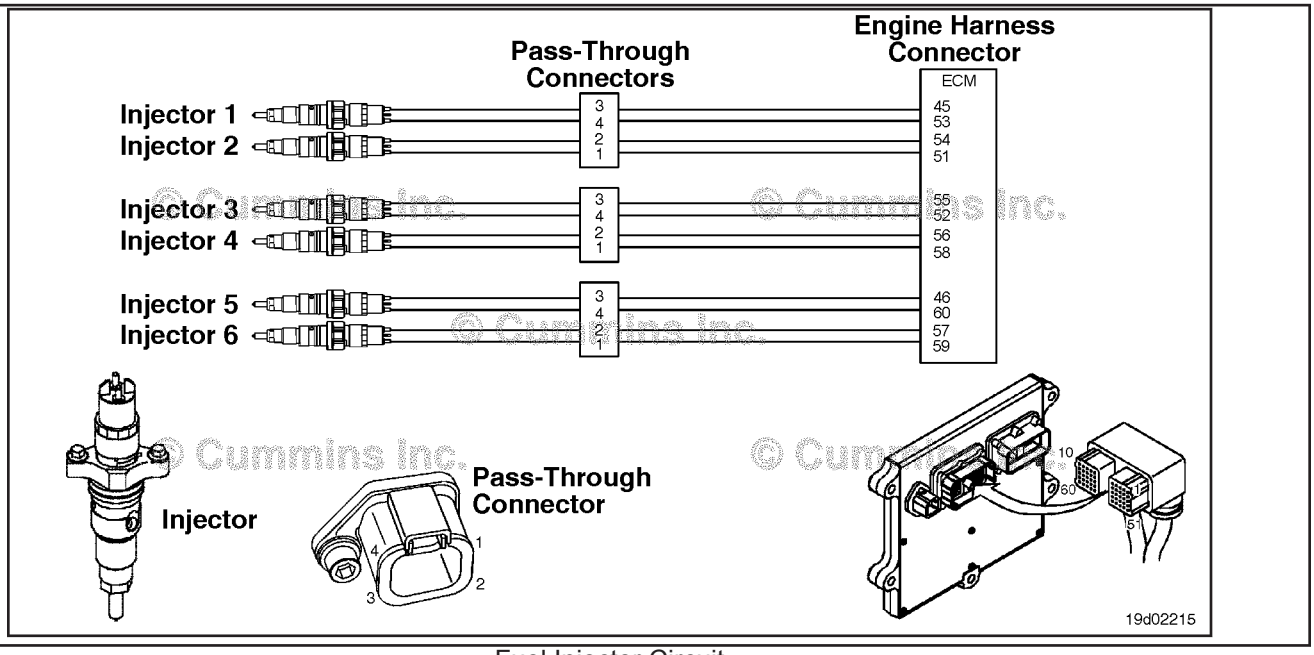
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 1142

## Injector Solenoid Driver Cylinder 3 - Mechanical System Not Responding Properly or Out of Adjustment

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1142<br>PID(P), SID(S): S003<br>SPN: 653<br>FMI: 7<br>Lamp: Amber<br>SRT: | Injector Solenoid Driver Cylinder 3 - Mechanical System Not Responding Properly or Out of Adjustment. Unintended fueling detected in cylinder number 3. | Engine will shut down. |




Fuel Injector Circuit

**Circuit Description:**

The electronic control module (ECM) can detect when unintended fuel injection occurs by monitoring fuel rail pressure and engine speed. This fault code is logged when the ECM determines that unintended fuel injection has occurred.

**Component Location:**

The fuel injector is located in the cylinder head. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code can be caused by a failed or damaged injector causing continuous injection into the cylinder. Progressive cylinder damage may occur if the engine is operated for an extended period of time with this condition. If a failed injector is found to be the cause of this fault code, the cylinder liner and piston **must** be inspected for progressive damage.

If an injector nozzle is fractured or stuck, continuous fueling will occur in that cylinder. If this condition occurs, the engine will typically die and **not** start. There will be exhaust smoke during cranking and no fuel rail pressure will be developed during cranking. Fault Code 2215 will be active during cranking if this condition exists.

## Refer to Troubleshooting Fault Code t05-1142

# FAULT CODE 1142 - Injector Solenoid Driver Cylinder 3 - Mechanical System Not Responding Properly or Out of Adjustment

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for Fault Code 1142.** | **Active or high inactive counts of Fault Code 1142 and loud engine knock occurs?** | |
| **STEP 2:** | **Check the fuel system.** | | |
| **STEP 2A:** | **Check for a stuck open injector.** | **Does the engine knock go away and Fault Code 1142 is inactive?** | |
| **STEP 2A-1:** | **Check for progressive cylinder damage.** | **Crankcase blowby measurement exceeds the specified limit?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 1142 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 1142.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or high inactive counts of Fault Code 1142 and a loud engine knock occurs?<br>**YES** | 2A |
| | Active or high inactive counts of Fault Code 1142 and a loud engine knock occurs?<br>**NO** | 3A |

## STEP 2: Check the fuel system.

### STEP 2A: Check for a stuck open injector.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a stuck open injector.<br>Using the fuel system leak tester blocking tool, part number 3164325, block the fuel flow going to injector number 3.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6.<br>• Start the engine and idle for one minute. | Does the engine knock go away and Fault Code 1142 is inactive?<br>**YES**<br>**Repair:**<br>A stuck open injector nozzle has been detected.<br>Replace the fuel injector.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 2A-1 |
| | Does the engine knock go away and Fault Code 1142 is inactive?<br>**NO** | Refer to Engine Noise symptom tree |

### STEP 2A-1: Check for progressive cylinder damage.

**Condition:**
- Turn keyswitch OFF.
- Measure the engine crankcase blowby. For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 014-010 in Section 14. For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 014-010 in Section 14.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Progressive engine damage is possible due to the damaged injector.<br>• Check for progressive damage<br>• Measure engine crankcase blowby. | Crankcase blowby measurement exceeds the specified limit?<br>**YES**<br>**Repair:**<br>Inspect for progressive engine damage. | 3A |
| | Crankcase blowby measurement exceeds the specified limit?<br>**NO** | 3A |

## STEP 3: Clear the fault code.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 1142 inactive?<br>**YES** | 3B |
| | Fault Code 1142 inactive?<br>**NO** | 1A |

### STEP 3B: Clear the inactive fault codes.

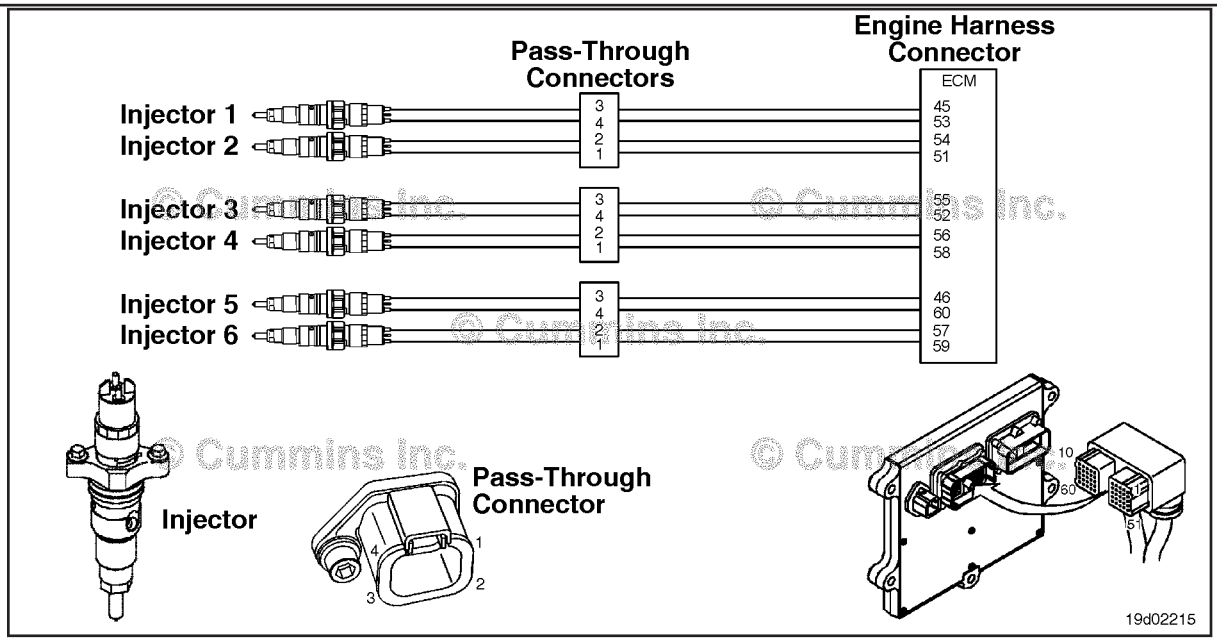
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 1143

## Injector Solenoid Driver Cylinder 4 - Mechanical System Not Responding Properly or Out of Adjustment

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1143<br>PID(P), SID(S): S004<br>SPN: 654<br>FMI: 7<br>Lamp: Amber<br>SRT: | Injector Solenoid Driver Cylinder 4 - Mechanical System Not Responding Properly or Out of Adjustment. Unintended fueling detected in cylinder number 4. | Engine will shut down. |




Fuel Injector Circuit

**Circuit Description:**

The electronic control module (ECM) can detect when unintended fuel injection occurs by monitoring fuel rail pressure and engine speed. This fault code is logged when the ECM determines that unintended fuel injection has occurred.

**Component Location:**

The fuel injector is located in the cylinder head. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code can be caused by a failed or damaged injector causing continuous injection into the cylinder. Progressive cylinder damage may occur if the engine is operated for an extended period of time with this condition. If a failed injector is found to be the cause of this fault code, the cylinder liner and piston **must** be inspected for progressive damage.

If an injector nozzle is fractured or stuck, continuous fueling will occur in that cylinder. If this condition occurs, the engine will typically die and **not** start. There will be exhaust smoke during cranking and no fuel rail pressure will be developed during cranking. Fault Code 2215 will be active during cranking if this condition exists.

## Refer to Troubleshooting Fault Code t05-1143

# FAULT CODE 1143 - Injector Solenoid Driver Cylinder 4 - Mechanical System Not Responding Properly or Out of Adjustment

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for Fault Code 1143.** | **Active or high inactive counts of Fault Code 1143 and loud engine knock occurs?** | |
| **STEP 2:** | **Check the fuel system.** | | |
| **STEP 2A:** | **Check for a stuck open injector.** | **Does the engine knock go away and Fault Code 1143 is inactive?** | |
| **STEP 2A-1:** | **Check for progressive cylinder damage.** | **Crankcase blowby measurement exceeds the specified limit?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 1143 inactive?** | |
| **STEP 3B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 1143.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or high inactive counts of Fault Code 1143 and a loud engine knock occurs?<br>**YES** | 2A |
| | Active or high inactive counts of Fault Code 1143 and a loud engine knock occurs?<br>**NO** | 3A |

## STEP 2: Check the fuel system.

### STEP 2A: Check for a stuck open injector.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a stuck open injector.<br>Using the fuel system leak tester blocking tool, part number 3164325, block the fuel flow going to injector number 4.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6.<br>• Start the engine and idle for one minute. | Does the engine knock go away and Fault Code 1143 is inactive?<br>**YES**<br>**Repair:**<br>A stuck open injector nozzle has been detected.<br>Replace the fuel injector. For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6. For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 2A-1 |
| | Does the engine knock go away and Fault Code 1143 is inactive?<br>**NO** | Refer to Engine Noise symptom tree |

### STEP 2A-1: Check for progressive cylinder damage.

**Condition:**
- Turn keyswitch OFF.
- Measure the engine crankcase blowby.
- For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 014-010 in Section 14.
- For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 014-010 in Section 14.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Progressive engine damage is possible due to the damaged injector.<br>• Check for progressive damage<br>• Measure engine crankcase blowby. | Crankcase blowby measurement exceeds the specified limit?<br>**YES**<br>**Repair:**<br>Inspect for progressive engine damage. | 3A |
| | Crankcase blowby measurement exceeds the specified limit?<br>**NO** | 3A |

## STEP 3: Clear the fault code.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 1143 inactive?<br>**YES** | 3B |
| | Fault Code 1143 inactive?<br>**NO** | 1A |

### STEP 3B: Clear the inactive fault codes.

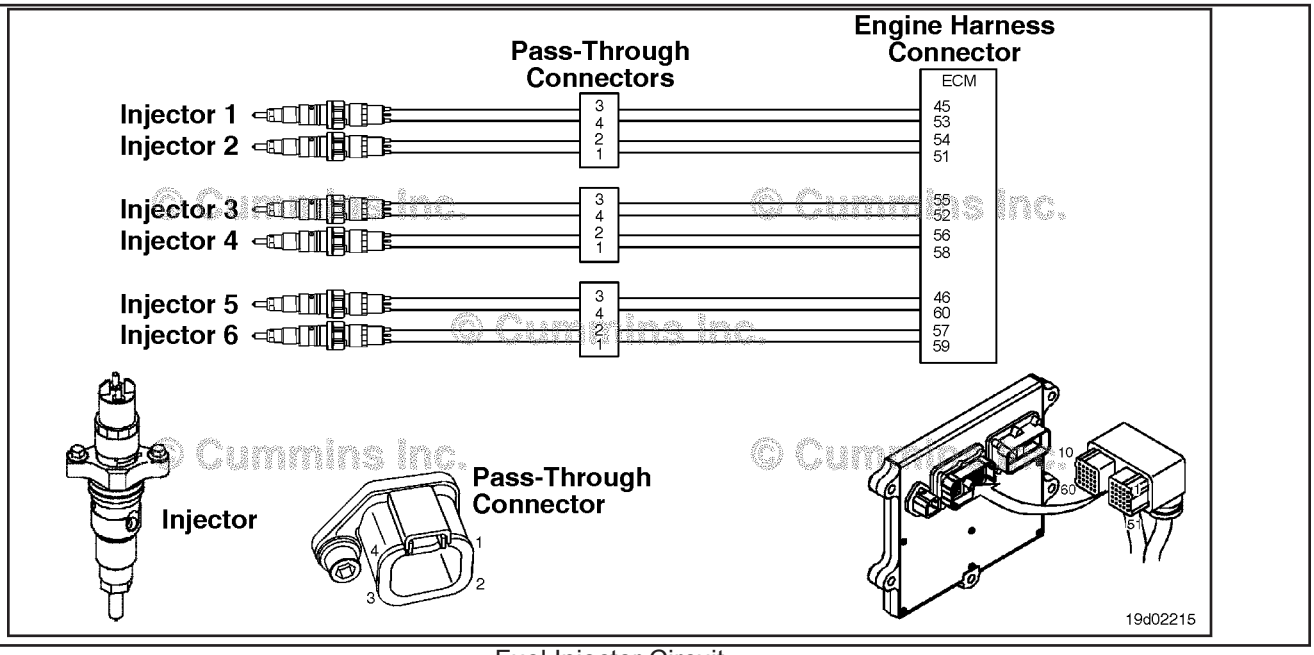
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 1144

## Injector Solenoid Driver Cylinder 5 - Mechanical System Not Responding Properly or Out of Adjustment

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1144<br>PID(P), SID(S): S005<br>SPN: 655<br>FMI: 7<br>Lamp: Amber<br>SRT: | Injector Solenoid Driver Cylinder 5 - Mechanical System **Not** Responding Properly or Out of Adjustment. Unintended fueling detected in cylinder Number 5. | Engine will shut down. |




Fuel Injector Circuit

**Circuit Description:**

The electronic control module (ECM) can detect when unintended fuel injection occurs by monitoring fuel rail pressure and engine speed. This fault code is logged when the ECM determines that unintended fuel injection has occurred.

**Component Location:**

The fuel injector is located in the cylinder head. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code can be caused by a failed or damaged injector causing continuous injection. If an injector nozzle is fractured or stuck open, continuous fueling will occur in that cylinder. If this condition occurs, an audible engine knock will be present, and the engine may stall and **not** start. In addition, low fuel rail pressure and excessive exhaust smoke will be present during cranking conditions. If a failed injector is found to be the cause of this fault code, progressive damage to the combustion chamber may have occurred.

## Refer to Troubleshooting Fault Code t05-1144

# FAULT CODE 1144 - Injector Solenoid Driver Cylinder 5 - Mechanical System Not Responding Properly or Out of Adjustment

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for Fault Code 1144.** | **Active or high inactive counts of Fault Code 1144, excessive exhaust smoke, and loud engine knock occurs?** | |
| **STEP 2:** | **Check the fuel system.** | | |
| **STEP 2A:** | **Check for a stuck open injector.** | **Does the engine knock, and excessive exhaust smoke go away and Fault Code 1144 is inactive?** | |
| **STEP 2A-1:** | **Check for progressive cylinder damage. Measure engine crankcase blowby.** | **Is the crankcase blowby measurement within the specified limit?** | |
| **STEP 3:** | **Reset the fault code.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 1144 inactive?** | |
| **STEP 3B:** | **Reset the inactive fault codes.** | **All fault codes reset?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 1144.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or high inactive counts of Fault Code 1144, excessive exhaust smoke, and loud engine knock occurs?<br>**YES** | 2A |
| | Active or high inactive counts of Fault Code 1144, excessive exhaust smoke, and loud engine knock occurs?<br>**NO** | 3A |

## STEP 2: Check the fuel system.

### STEP 2A: Check for a stuck open injector.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a stuck open injector.<br>Using the fuel system leak tester blocking tool, Part Number 3164325, block the fuel flow going to injector Number 5.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6.<br>• Start the engine and idle for one minute. | Does the engine knock and excessive exhaust smoke go away and Fault Code 1144 is inactive?<br>**YES**<br>**Repair:**<br>A stuck open injector nozzle has been detected.<br>Replace the fuel injector. For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6. For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 2A-1 |
| | Does the engine knock, and excessive exhaust smoke go away and Fault Code 1144 is inactive?<br>**NO** | Refer to Engine Noise symptom tree |

### STEP 2A-1: Check for progressive cylinder damage.

**Condition:**
- Turn keyswitch OFF.
- Measure the engine crankcase blowby. For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 014-010 in Section 14. For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 014-010 in Section 14.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Progressive engine damage is possible due to the damaged injector.<br>• Check for progressive damage<br>• Measure engine crankcase blowby. | Crankcase blowby measurement exceeds the specified limit?<br>**YES**<br>**Repair:**<br>Inspect for progressive damage. | 3A |
| | Crankcase blowby measurement exceeds the specified limit?<br>**NO** | 3A |

## STEP 3: Reset the fault code.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 1144 inactive?<br>**YES** | 3B |
| | Fault Code 1144 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair location if all steps have been completed and checked again. | 1A |

### STEP 3B: Reset the inactive fault codes.

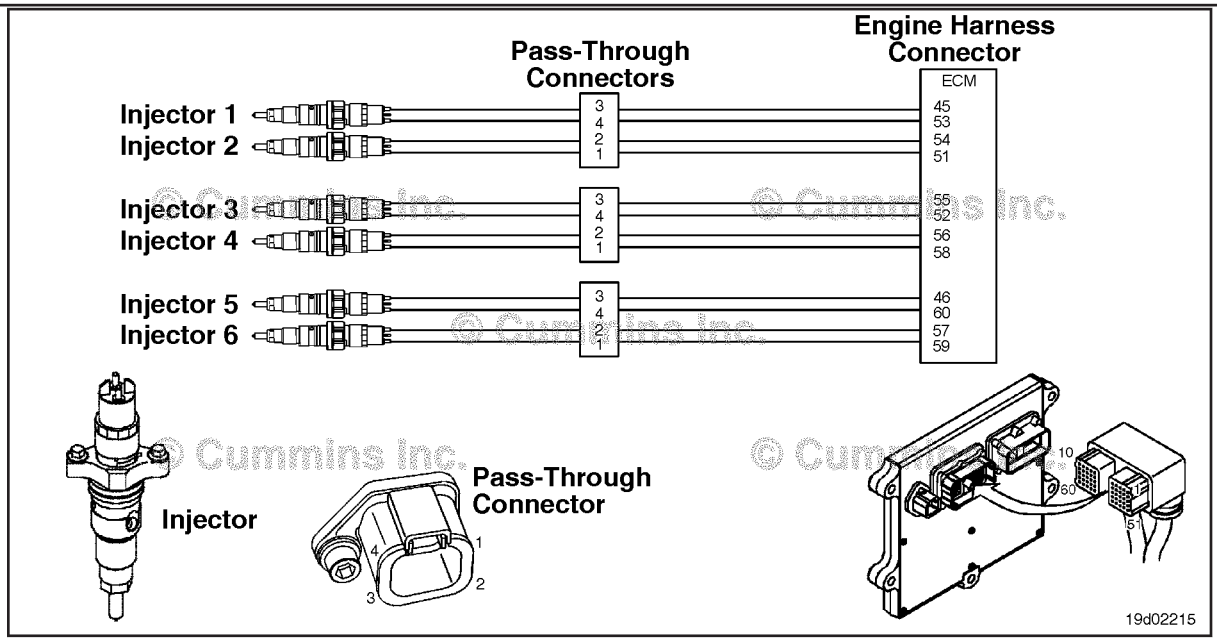
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Reset the inactive fault codes.<br>• Use the INSITE™ electronic service tool to reset the inactive fault codes. | All fault codes reset?<br>**YES** | Repair complete |
| | All fault codes reset?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 1145

## Injector Solenoid Driver Cylinder 6 - Mechanical System Not Responding Properly or Out of Adjustment

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1145<br>PID(P), SID(S): S006<br>SPN: 656<br>FMI: 7<br>Lamp: Amber<br>SRT: | Injector Solenoid Driver Cylinder 6 - Mechanical System Not Responding Properly or Out of Adjustment. Unintended fueling detected in cylinder Number 6. | Engine will shut down. |




Fuel Injector Circuit

**Circuit Description:**

The electronic control module (ECM) can detect when unintended fuel injection occurs by monitoring fuel rail pressure and engine speed. This fault code is logged when the ECM determines that unintended fuel injection has occurred.

**Component Location:**

The fuel injector is located in the cylinder head. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code can be caused by a failed or damaged injector causing continuous injection. If an injector nozzle is fractured or stuck open, continuous fueling will occur in that cylinder. If this condition occurs, an audible engine knock will be present, and the engine may stall and **not** start. In addition, low fuel rail pressure and excessive exhaust smoke will be present during cranking conditions. If a failed injector is found to be the cause of this fault code, progressive damage to the combustion chamber may have occurred.

## Refer to Troubleshooting Fault Code t05-1145

# FAULT CODE 1145 - Injector Solenoid Driver Cylinder 6 - Mechanical System Not Responding Properly or Out of Adjustment

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for Fault Code 1145.** | **Active or high inactive counts of Fault Code 1145, excessive exhaust smoke, and loud engine knock occurs?** | |
| **STEP 2:** | **Check the fuel system.** | | |
| **STEP 2A:** | **Check for a stuck open injector.** | **Does the engine knock, and excessive exhaust smoke go away and Fault Code 1145 is inactive?** | |
| **STEP 2A-1:** | **Check for progressive cylinder damage. Measure engine crankcase blowby.** | **Is the crankcase blowby measurement within the specified limit?** | |
| **STEP 3:** | **Reset the fault code.** | | |
| **STEP 3A:** | **Disable the fault code.** | **Fault Code 1145 inactive?** | |
| **STEP 3B:** | **Reset the inactive fault codes.** | **All fault codes reset?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 1145.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or high inactive counts of Fault Code 1145, excessive exhaust smoke, and loud engine knock occurs?<br>**YES** | 2A |
| | Active or high inactive counts of Fault Code 1145, excessive exhaust smoke, and loud engine knock occurs?<br>**NO** | 3A |

## STEP 2: Check the fuel system.

### STEP 2A: Check for a stuck open injector.

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a stuck open injector.<br>Use fuel system leak tester blocking tool, Part Number 3164325, to block the fuel flow going to injector Number 6.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6.<br>• Start the engine and idle for one minute. | Does the engine knock and excessive exhaust smoke go away and Fault Code 1145 is inactive?<br>**YES**<br>**Repair:**<br>A stuck open injector nozzle has been detected.<br>Replace the fuel injector. For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6. For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 2A-1 |
| | Does the engine knock, and excessive exhaust smoke go away and Fault Code 1145 is inactive?<br>**NO** | Refer to Engine Noise symptom tree |

### STEP 2A-1: Check for progressive cylinder damage.

**Condition:**
- Turn keyswitch OFF.
- Measure the engine crankcase blowby. For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 014-010 in Section 14. For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 014-010 in Section 14.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Progressive engine damage is possible due to the damaged injector.<br>• Check for progressive damage<br>• Measure engine crankcase blowby. | Crankcase blowby measurement exceeds the specified limit?<br>**YES**<br>**Repair:**<br>Inspect for progressive damage. | 3A |
| | Crankcase blowby measurement exceeds the specified limit?<br>**NO** | 3A |

## STEP 3: Reset the fault code.

### STEP 3A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 1145 inactive?<br>**YES** | 3B |
| | Fault Code 1145 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |

### STEP 3B: Reset the inactive fault codes.

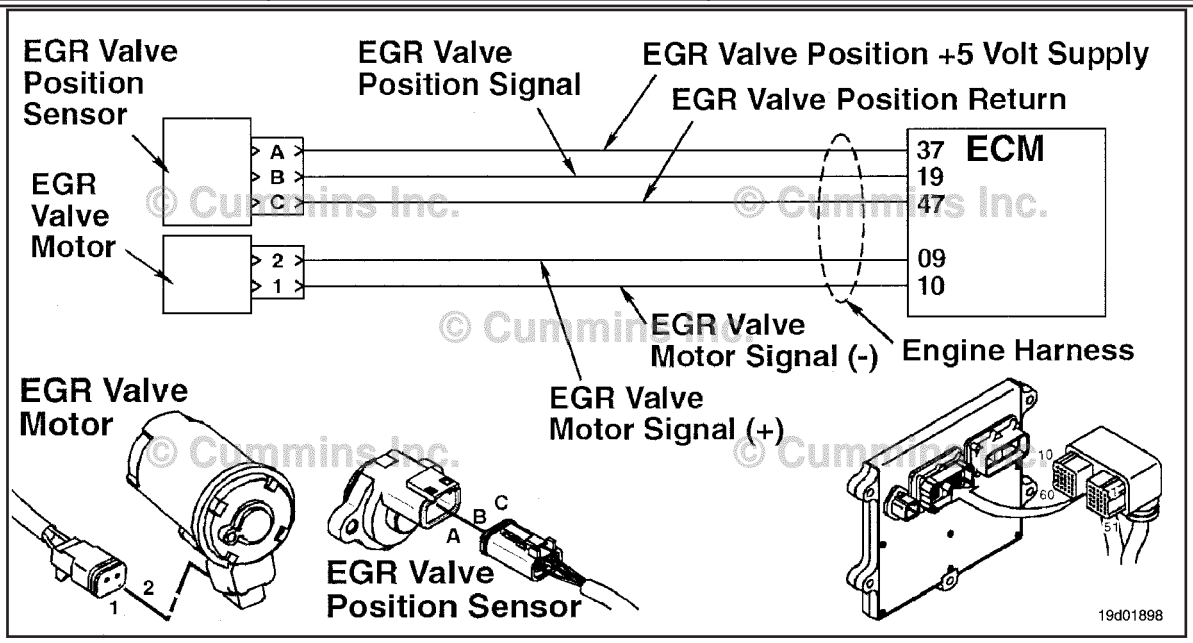
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Reset the inactive fault codes.<br>• Use INSITE™ electronic service tool to reset the inactive fault codes. | All fault codes reset?<br>**YES** | Repair complete |
| | All fault codes reset?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 1228

## EGR Valve Position - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1228<br>PID(P), SID(S): P27<br>SPN: 27<br>FMI: 2/2<br>Lamp: Amber<br>SRT: | EGR Valve Position - Data erratic, intermittent, or incorrect. Intermittent EGR position information is being received by the electronic control module (ECM). | Possible low power. EGR valve will be closed. |




EGR Valve Position Sensor Circuit

**Circuit Description:**

The EGR valve position sensor outputs a voltage signal to the electronic control module (ECM). The ECM converts this signal into a percentage value, 0 to 100 percent, indicating EGR valve position. A fully open valve is equivalent to 100 percent.

**Component Location:**

The EGR valve position sensor is located on the EGR valve assembly. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code is caused by an internal failure of the EGR valve position sensor. This failure causes erratic readings of EGR valve position.

## Refer to Troubleshooting Fault Code t05-1228

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Read the fault codes.** | | |
| **STEP 1A:** | **Check for fault codes.** | **Other active or inactive fault codes?** | |
| **STEP 1B:** | **Check for Fault Code 1228.** | **Active or inactive counts of Fault Code 1228?** | |
| **STEP 2:** | **Clear the fault codes.** | | |
| **STEP 2A:** | **Disable the fault codes.** | **Fault Code 1228 inactive?** | |
| **STEP 2B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Read the fault codes.

**STEP 1A: Check for fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use INSITE™ electronic service tool to read the fault codes. | Other active or inactive fault codes?<br>**YES** | Troubleshoot other fault codes |
| | Other active or inactive fault codes?<br>**NO** | 1B |

**STEP 1B: Check for Fault Code 1228.**

**Condition:**
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use INSITE™ electronic service tool to read the fault codes. | Active or inactive counts of Fault Code 1228?<br>**YES**<br>**Repair:**<br>Replace the EGR position sensor. Refer to Procedure 019-372. | 2A |
| | Active or inactive counts of Fault Code 1228?<br>**NO** | 2A |

## STEP 2: Clear the fault codes.

### STEP 2A: Disable the fault codes.

**Condition:**
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Start the engine and let it idle for one minute.<br>• Use INSITE™ electronic service tool to verify Fault Code 1228 is inactive. | Fault Code 1228 inactive?<br>**YES** | 2B |
| | Fault Code 1228 inactive?<br>**NO** | 1A |

### STEP 2B: Clear the inactive fault codes.

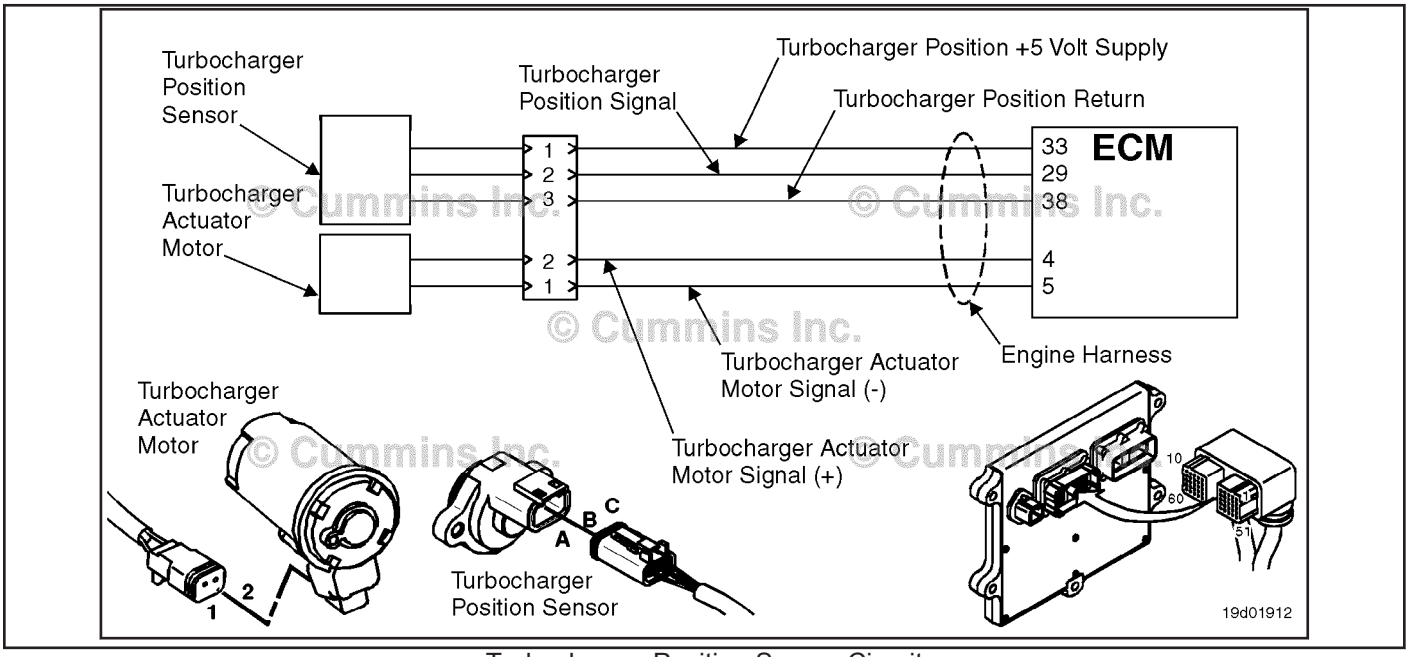
**Condition:**
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Erase the inactive fault codes using INSITE™ electronic service tool. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooting steps |

# Fault Code 1229

## VGT Position Sensor - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1229<br>PID(P), SID(S): S27<br>SPN: 2795<br>FMI: 2/2<br>Lamp: Amber<br>SRT: | VGT Position Sensor - Data erratic, intermittent, or incorrect. Intermittent variable geometry turbocharger (VGT) position information is being received by the electronic control module (ECM). | Possible low power. Power to the turbocharger actuator will be limited. |




Turbocharger Position Sensor Circuit

**Circuit Description:**

The turbocharger position sensor outputs a voltage signal to the ECM. The ECM converts this signal into a percentage value, 0 to 100 percent, indicating turbocharger position. A fully closed turbocharger actuataor is equivalent to 100 percent.

**Component Location:**

The turbocharger position sensor is located on the variable geometry turbocharger (VGT) actuator assembly. Refer to Procedure 100-002 for a detailed component location view.

**Shop Talk:**

This fault code is caused by an internal failure of the variable geometry turbocharger (VGT) position sensor. This failure causes erratic readings of variable geometry turbocharger (VGT) position.

## Refer to Troubleshooting Fault Code t05-1229

# FAULT CODE 1229 - VGT Position Sensor - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Read the fault codes.** | | |
| **STEP 1A:** | **Check for fault codes.** | **Other active or inactive fault codes?** | |
| **STEP 1B:** | **Check for Fault Code 1229.** | **Fault Code 1229 active?** | |
| **STEP 2:** | **Check the turbocharger position sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the turbocharger position sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault Code 2382 active?** | |
| **STEP 2C:** | **Check the circuit response.** | **Fault Code 2381 active?** | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| **STEP 3A:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Clear the circuit response.** | **Fault Code 2382 active?** | |
| **STEP 3C:** | **Clear the circuit response.** | **Fault Code 2381 active?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault codes.** | **Fault Code 1229 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Read the fault codes.

#### STEP 1A: Check for fault codes.

**Condition:**
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use INSITE™ electronic service tool to read the fault codes. | Other active or inactive fault codes? **YES** | Troubleshoot other fault codes |
| | Other active or inactive fault codes? **NO** | 1B |

**STEP 1B: Check for Fault Code 1229.**

**Condition:**
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1229 active?<br>**YES** | 2A |
| | Fault Code 1229 active?<br>**NO** | 4A |

## STEP 2: Check the turbocharger position sensor circuit.

**STEP 2A: Inspect the turbocharger position sensor and connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger position sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the turbocharger position sensor and connector pins.<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger position sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use the INSITE™ electronic service tool to read the fault codes. | Fault Code 2382 active?<br>**YES** | 2C |
| | Fault Code 2382 active?<br>**NO** | 3A |

**STEP 2C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the turbocharger position sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Install a jumper wire between the turbocharger position +5-VDC SUPPLY pin and the turbocharger position SIGNAL pin at the sensor connector of the engine harness.<br>See the circuit diagram or the wiring diagram for connector pin identification.<br>Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 2381 active?<br>**YES**<br>**Repair:**<br>Replace the turbocharger position sensor. Refer to Procedure 019-405 in Section 19. | 4A |
| | Fault Code 2381 active?<br>**NO** | 3A |

## STEP 3: Check the ECM and engine harness.

**STEP 3A: Inspect the ECM and engine harness connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 2382 active?<br>**YES** | 3C |
| | Fault Code 2382 active?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Install a jumper wire between the turbocharger position +5-VDC SUPPLY pin and the turbocharger position SIGNAL pin at the engine control module engine connector.<br>Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 2381 active?<br>**YES**<br>**Repair:**<br>High resistance or a short circuit has been detected in the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |
| | Fault Code 2381 active?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

## STEP 4: Clear the fault codes.

### STEP 4A: Disable the fault codes.

**Condition:**
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 1229 inactive?<br>**YES** | 4B |
| | Fault Code 1229 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® authorized repair location if all steps have been completed and checked again. | 1A |

### STEP 4B: Clear the inactive fault codes.

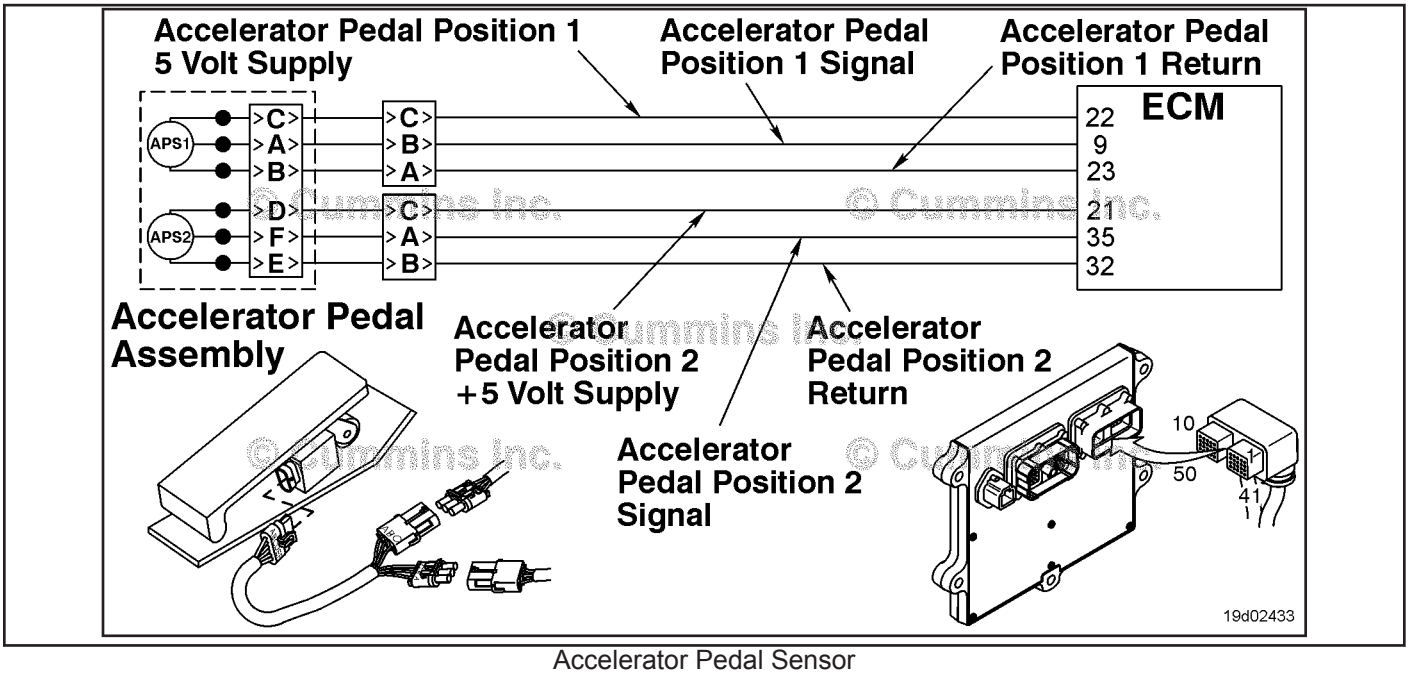
**Condition:**
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO**<br>**Repair:**<br>Troubleshoot any remaining active fault codes. | Appropriate troubleshooti ng steps |

# Fault Code 1239

## Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Above Normal or Shorted to High Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1239<br>PID(P), SID(S):<br>SPN: 2623<br>FMI: 3/3<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Above Normal or Shorted to High Source. High voltage detected at accelerator pedal position number 2 signal circuit. | Severe derate in power output of the engine. Limp home power **only**. |




Accelerator Pedal Sensor

**Circuit Description:**

The accelerator position sensor is a hall-effect sensor attached to the accelerator pedal. The accelerator position sensor varies the signal voltage to the electronic control module (ECM) as the accelerator pedal is depressed and released. Low signal voltage is received by the ECM when the accelerator pedal is at 0 percent. A high signal voltage is received by the ECM when the accelerator pedal is at 100 percent. The accelerator pedal position circuit contains an accelerator pedal position 5 volt supply, accelerator pedal position return, and accelerator pedal position signal.

The accelerator pedal contains two position sensors. These position sensors are used to measure the throttle position. Both position sensors receive a 5 volt supply from the ECM. A corresponding signal voltage based on the position of the accelerator pedal is then received from the ECM. The signal voltage for accelerator position 1 is twice as much as the signal voltage from the accelerator position 2.

When the ECM senses a signal voltage lower than the normal operating range of the sensor, this fault code is set.

**Component Location:**

The accelerator pedal position sensor is located on the accelerator pedal. Refer to the original equipment manufacturer (OEM) troubleshooting and repair manual.

**Shop Talk:**

Newer engines use two throttle position sensors to determine the throttle position. Older throttle pedals used a single throttle position sensor and an idle validation switch. If Fault Codes 132 and 1241 are active when the accelerator

pedal is in the idle position and Fault Code 132 goes inactive and Fault Code 1239 goes active when the throttle is depressed, the incorrect throttle pedal has been installed in the vehicle. A throttle pedal with two acceleration position sensors should be installed.

If troubleshooting an intermittent accelerator problem, the accelerator pedal position sensor 2 signal voltage can be monitored with the INSITE™ electronic service tool, while flexing the harness to locate the intermittent connection.

Possible causes of this fault include:

- Accelerator pedal position 2 signal circuit shorted to battery or 5 volt supply.
- Open accelerator pedal return circuit in the harness or connections.
- Accelerator supply shorted to battery.
- Failed accelerator pedal position sensor.

**Note:** The three wires in the accelerator position sensor circuit **must** be twisted together.

## Refer to Troubleshooting Fault Code t05-1239

# FAULT CODE 1239 - Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Above Normal or Shorted to High Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for sensor supply fault codes.** | **Fault Code 1695 active?** | |
| **STEP 2:** | **Check the accelerator pedal position sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the accelerator pedal position sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the accelerator pedal position sensor supply voltage and return circuit.** | **4.75 to 5.25 VDC?** | |
| **STEP 2C:** | **Check the circuit response.** | **Fault Code 1241 active and Fault Code 1239 inactive?** | |
| **STEP 2D:** | **Check the fault codes and verify accelerator pedal condition.** | **Fault Code 1239 active?** | |
| **STEP 3:** | **Check the ECM and OEM harness.** | | |
| **STEP 3A:** | **Inspect the ECM and OEM harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check for an open circuit in the OEM harness.** | **Less than 10 ohms?** | |
| **STEP 3C:** | **Check for a pin-to-pin short circuit in the OEM harness.** | **Greater than 100k ohms?** | |
| **STEP 3D:** | **Check for an inactive fault code.** | **Fault Code 1239 inactive?** | |
| **STEP 4:** | **Clear the fault code.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 1239 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for sensor supply fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1695 active?<br>**YES** | Fault Code 1695 |
| | Fault Code 1695 active?<br>**NO** | 2A |

### STEP 2: Check the accelerator pedal position sensor and circuit.

**STEP 2A: Inspect the accelerator pedal position sensor and connector pins.**

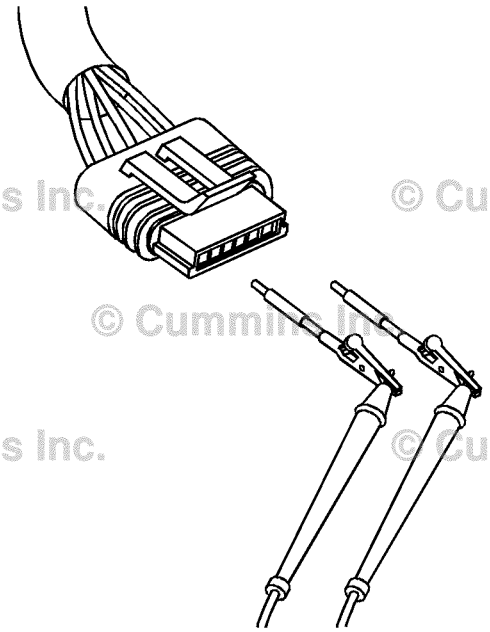
**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and exhaust gas temperature 1 sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A defective connection has been detected in the sensor connector or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the accelerator pedal position sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the accelerator pedal supply voltage.<br>• Measure the voltage from the accelerator pedal position sensor 5 volt SUPPLY pin to the accelerator pedal position sensor RETURN pin at the sensor connector of the OEM harness.<br>Refer to the circuit diagram or the wiring diagram for connector pin identification. | 4.75-VDC to 5.25-VDC?<br>**YES** | 2C |
| | 4.75-VDC to 5.25-VDC?<br>**NO** | 3A |






**STEP 2C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1241 active and Fault Code 1239 inactive?<br>**YES** | 2D |
| | Fault Code 1241 active and Fault Code 1239 inactive?<br>**NO** | 3A |

**STEP 2D: Check the fault codes and verify accelerator pedal condition.**

**Condition:**
- Turn keyswitch OFF.
- Connect the accelerator pedal to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1239 active?<br>**YES**<br>**Repair:**<br>A damaged accelerator pedal has been detected. Contact the appropriate OEM or dealership for repair instructions.<br>Replace the accelerator pedal. Refer to the OEM service manual. | 4A |
| | Fault Code 1239 active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the problem. | 4A |

## STEP 3: Check the ECM and OEM harness.

**STEP 3A: Inspect the ECM and OEM harness connector pins.**

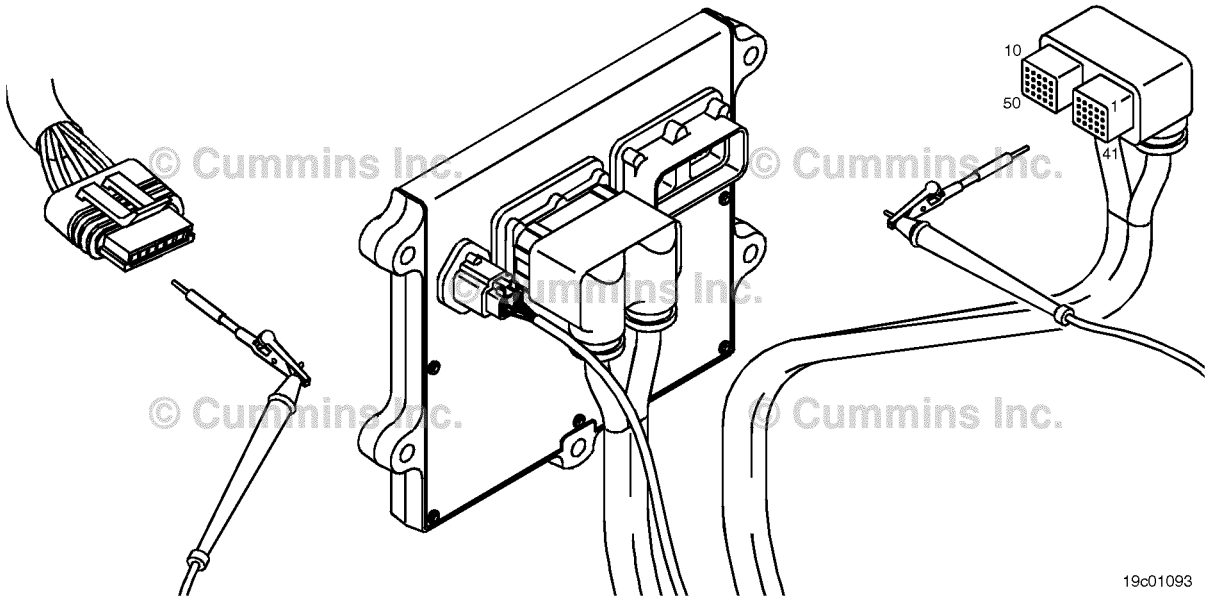
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for an open circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the accelerator pedal position sensor from the OEM harness.

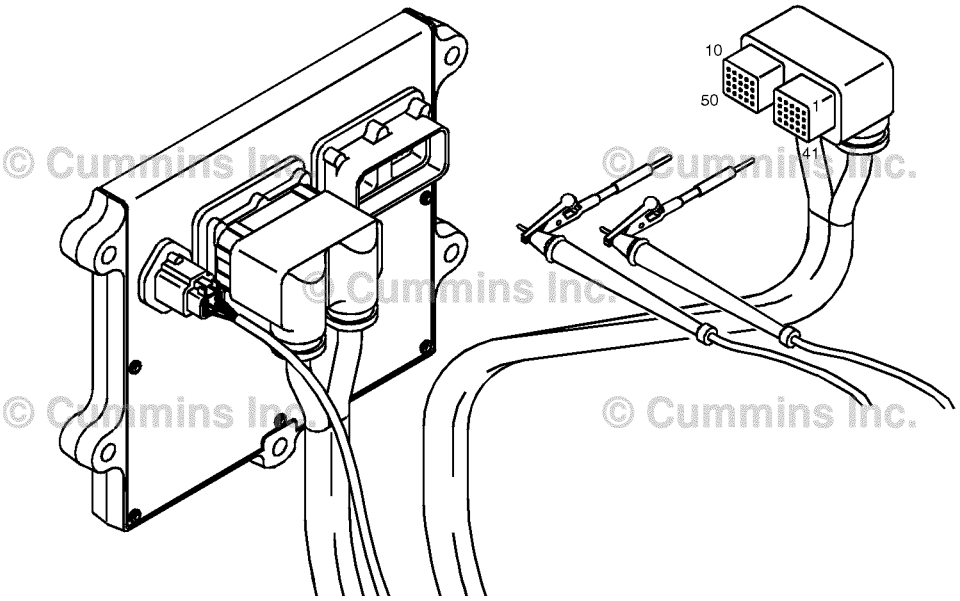
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the OEM harness ECM connector accelerator pedal RETURN pin and the OEM harness accelerator pedal RETURN pin.<br>Refer to the circuit diagram and the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open RETURN circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the accelerator pedal position sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short circuit.<br>• Measure the resistance between the accelerator pedal SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3D |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |

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**STEP 3D: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1239 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the problem. | 4A |
| | Fault Code 1239 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 1239 inactive?<br>**YES** | 4B |
| | Fault Code 1239 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all the steps have been completed and checked again. | 1A |

**STEP 4B: Clear the inactive fault codes.**

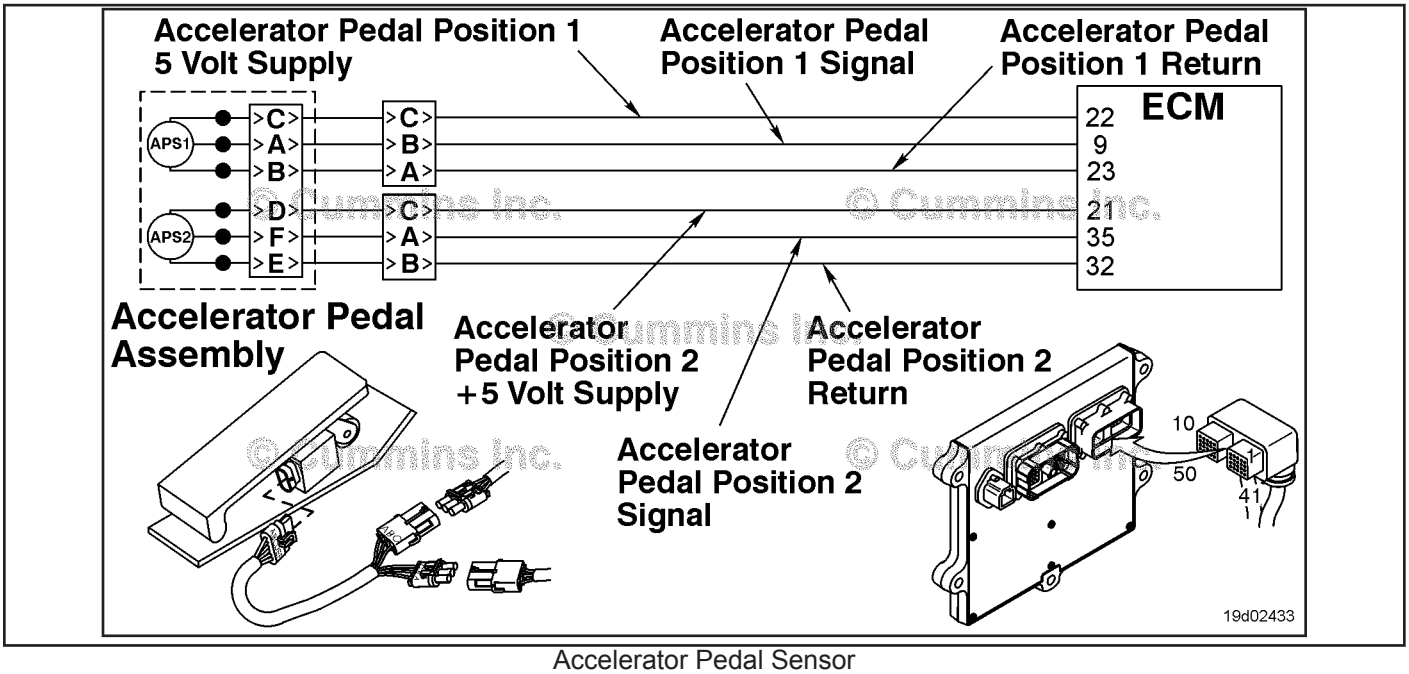
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooti ng steps |

# Fault Code 1241

## Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Below Normal or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1241<br>PID(P), SID(S): None<br>SPN: 2623<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected at accelerator pedal position number 2 signal circuit. | Severe derate in power output of the engine. Limp home power **only**. |




Accelerator Pedal Sensor

**Circuit Description:**

The accelerator position sensor is a hall-effect sensor attached to the accelerator pedal. The accelerator position sensor varies the signal voltage to the electronic control module (ECM) as the accelerator pedal is depressed and released. Low signal voltage is received by the ECM when the accelerator pedal at 0 percent. A high signal voltage is received by the ECM when the accelerator pedal is at 100 percent. The accelerator pedal position circuit contains an accelerator pedal position 5 volt supply, accelerator pedal position return, and accelerator pedal position signal.

The accelerator pedal contains two position sensors. These position sensors are used to measure the throttle position. Both position sensors receive a 5 volt supply from the ECM. A corresponding signal voltage based on the position of the accelerator pedal is then received from the ECM. The signal voltage for accelerator position 1 is twice as much as the signal voltage from accelerator position 2. When the ECM senses a signal voltage lower than the normal operating range of the sensor, this fault code is set.

**Component Location:**

The accelerator pedal position sensor is located on the accelerator pedal. Refer to the OEM troubleshooting and repair manual.

**Shop Talk:**

Newer engines use two throttle position sensors to determine the throttle position. Older throttle pedals used a single throttle position sensor and an idle validation switch. If Fault Codes 132 and 1241 are active when the accelerator

pedal is in the idle position and Fault Code 132 goes inactive and Fault Code 1239 goes active when the throttle is depressed, the incorrect throttle pedal has been installed in the vehicle. A throttle pedal with two acceleration position sensors should be installed.

If troubleshooting an intermittent accelerator problem, the accelerator pedal position sensor 2 signal voltage can be monitored with the INSITE™ electronic service tool, while flexing the harness to locate the intermittent connection.

Possible causes of this fault include:

- Accelerator pedal position signal shorted to engine ground or return wires in the OEM harness or sensor
- Malfunctioning accelerator pedal position sensor
- Open circuit in the accelerator signal, supply, or return wire in the harness or connectors.

**Note:** The three wires in the accelerator position sensor circuit **must** be twisted together.

## Refer to Troubleshooting Fault Code t05-1241

# FAULT CODE 1241 - Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Below Normal or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for sensor supply fault codes. | Fault Code 1696 active? | |
| **STEP 2:** | **Check the accelerator pedal position sensor and circuit.** | | |
| STEP 2A: | Inspect the accelerator pedal position sensor and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the accelerator pedal position sensor supply voltage and return circuit. | 4.75-VDC to 5.25-VDC? | |
| STEP 2C: | Check the circuit response. | Fault Code 1239 active and Fault Code 1241 inactive? | |
| STEP 2D: | Check the fault codes and verify accelerator pedal condition. | Fault Code 1241 active? | |
| **STEP 3:** | **Check the ECM and OEM harness.** | | |
| STEP 3A: | Inspect the ECM and OEM harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check for an open circuit in the OEM harness. | Less than 10 ohms? | |
| STEP 3C: | Check for an open circuit in the OEM harness. | Less than 10 ohms? | |
| STEP 3D: | Check for a pin-to-pin short circuit in the OEM harness. | Greater than 100k ohms? | |
| STEP 3E: | Check for a pin-to-ground short circuit in the OEM harness. | Greater than 100k ohms? | |
| STEP 3F: | Check for an inactive fault code. | Fault Code 1241 inactive? | |
| **STEP 4:** | **Clear the fault code.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 1241 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for sensor supply fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1696 active?<br>**YES** | Fault Code 1696 |
| | Fault Code 1696 active?<br>**NO** | 2A |

### STEP 2: Check the accelerator pedal position sensor and circuit.

**STEP 2A: Inspect the accelerator pedal position sensor and connector pins.**

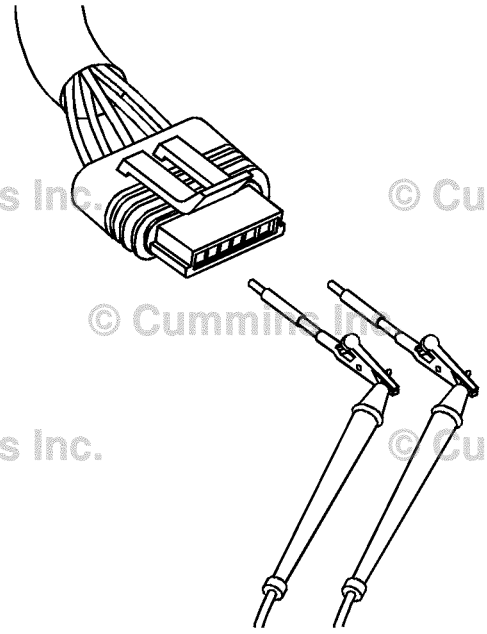
**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and accelerator pedal position sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the accelerator pedal position sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.
- Turn keyswitch ON.

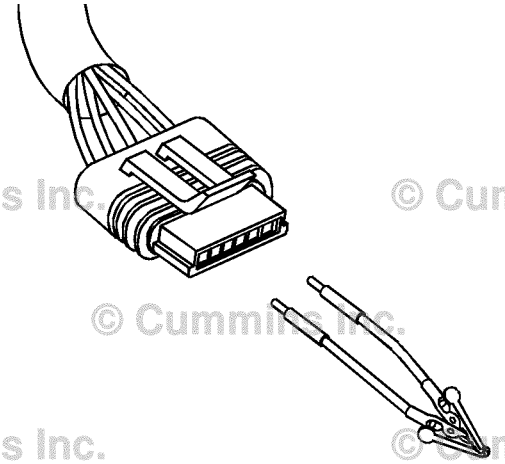
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the accelerator pedal position sensor supply voltage.<br>• Measure the voltage from the accelerator pedal position sensor 5 volt SUPPLY pin to the accelerator pedal position sensor RETURN pin at the sensor connector of the OEM harness.<br>Refer to the circuit diagram or wiring diagram for connector pin identification. | 4.75-VDC to 5.25-VDC?<br>**YES** | 2C |
| | 4.75-VDC to 5.25-VDC?<br>**NO** | 3A |



**STEP 2C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Place a jumper wire between the accelerator pedal position +5-VDC SUPPLY pin and the accelerator pedal position SIGNAL pin at the sensor connector of the OEM harness.<br>• Use INSITE™ electronic service tool to read the fault codes.<br>Refer to the circuit diagram or wiring diagram for connector pin identification. | Fault Code 1239 active and Fault Code 1241 inactive?<br>**YES** | 2D |
| | Fault Code 1239 active and Fault Code 1241 inactive?<br>**NO** | 3A |





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**STEP 2D: Check the fault codes and verify accelerator pedal condition.**

**Condition:**
- Turn keyswitch OFF.
- Connect the accelerator pedal to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1241 active?<br>**YES**<br>**Repair:**<br>A damaged accelerator pedal has been detected. Contact the appropriate OEM or dealership for repair instructions.<br>Replace the accelerator pedal. Refer to the OEM service manual. | 4A |
| | Fault Code 1241 active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the problem. | 4A |

## STEP 3: Check the ECM and OEM harness.

**STEP 3A: Inspect the ECM and OEM harness connector pins.**

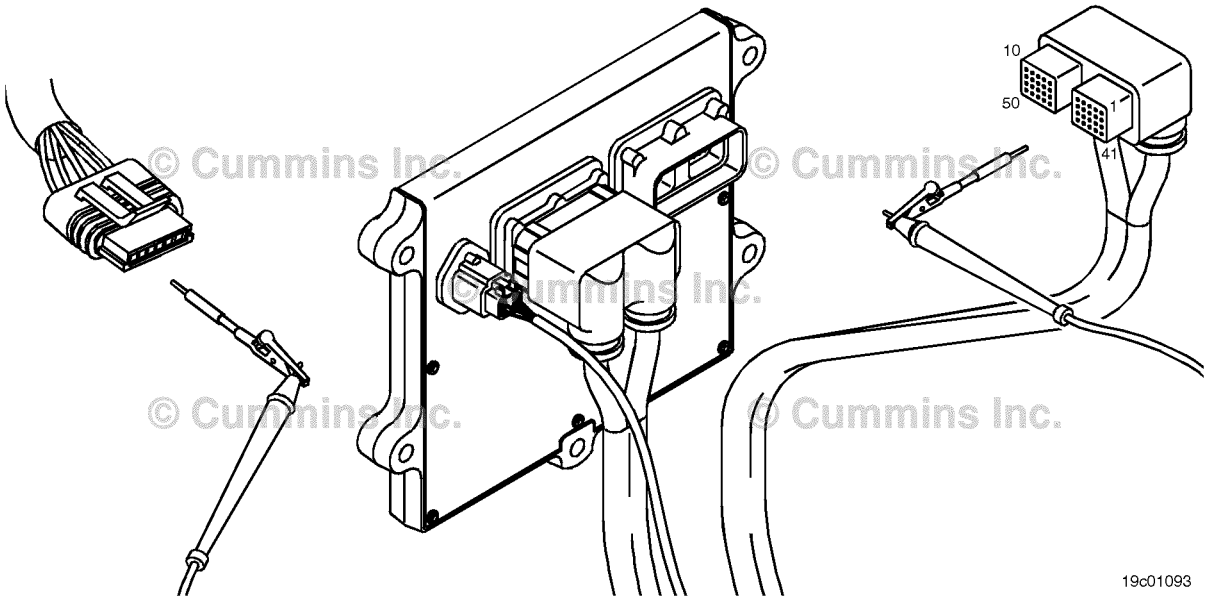
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for an open circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the accelerator pedal position sensor from the OEM harness.

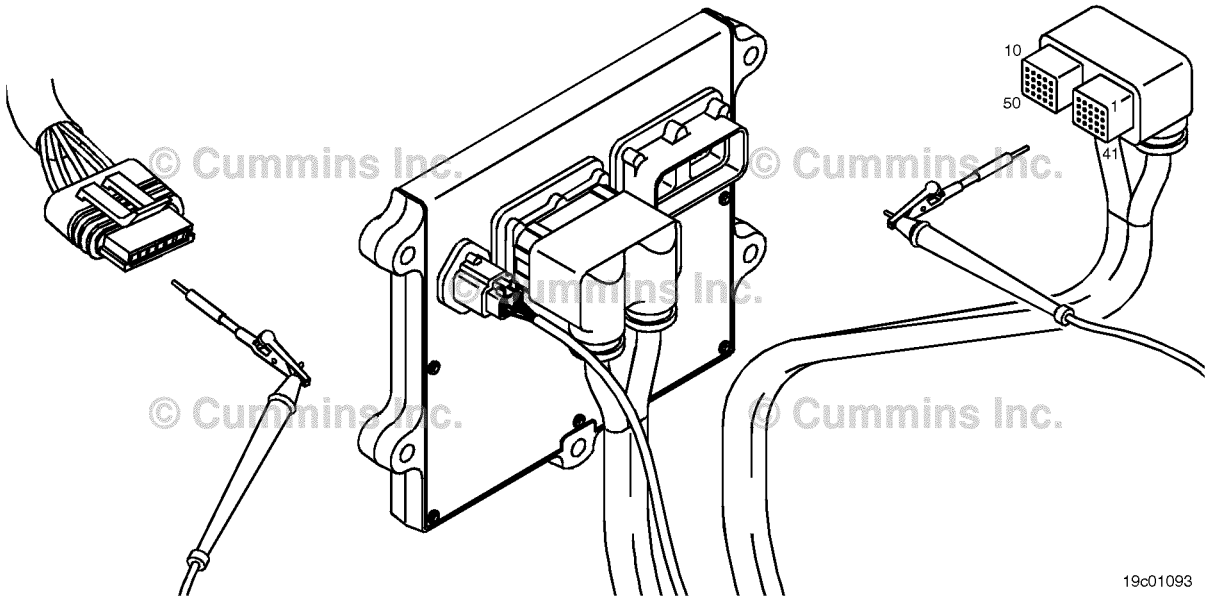
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the OEM harness ECM connector accelerator pedal SUPPLY pin and the OEM harness accelerator pedal connector SUPPLY pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open SUPPLY circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for an open circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the accelerator pedal from the OEM harness.

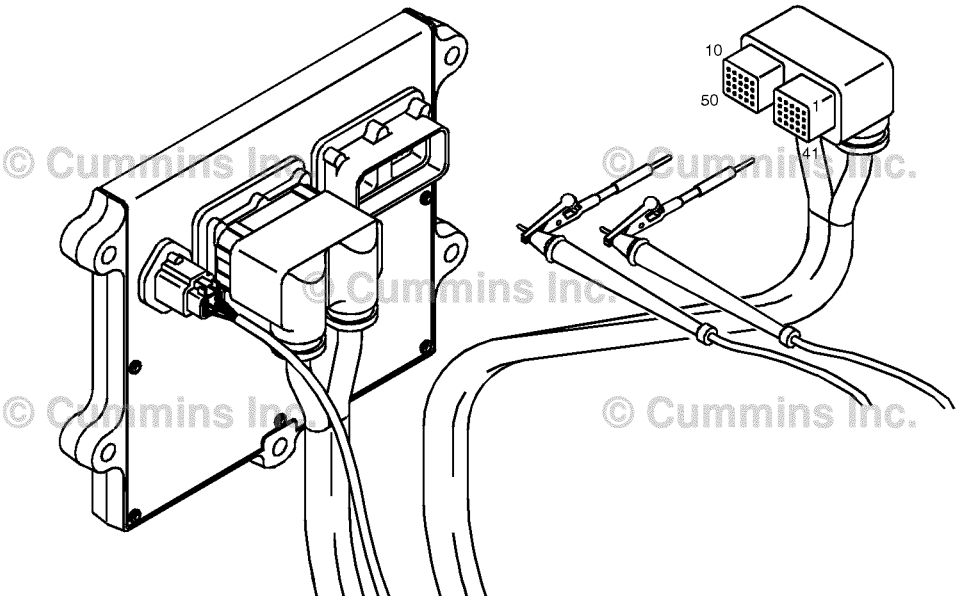
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the OEM harness ECM connector accelerator pedal SIGNAL pin and the OEM harness accelerator pedal connector SIGNAL pin.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open SIGNAL circuit has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3D: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the accelerator pedal from the OEM harness.

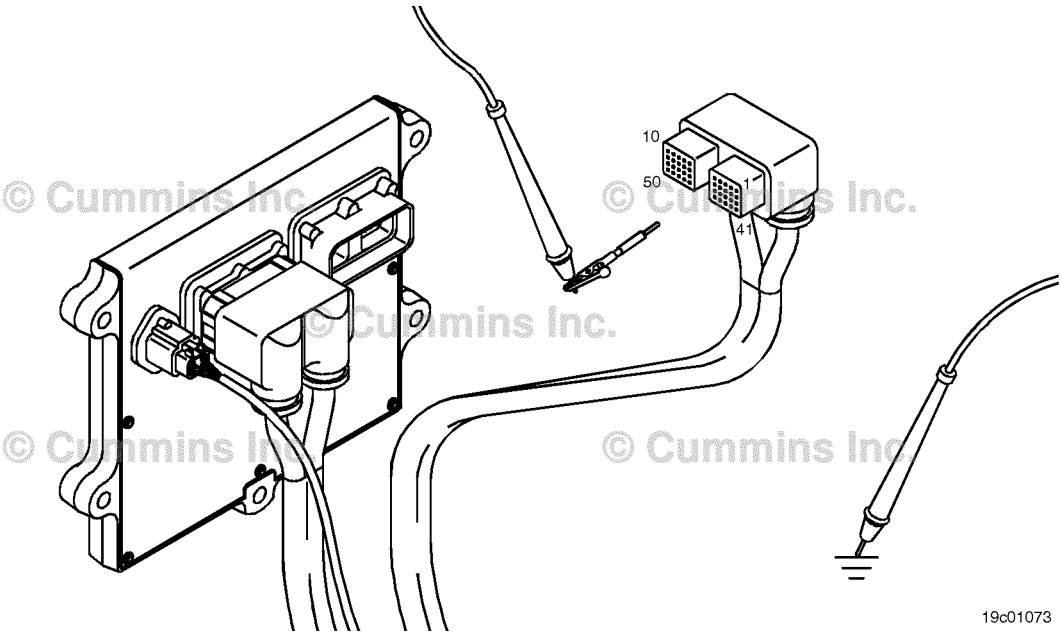
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short circuit.<br>• Measure the resistance between the accelerator pedal SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM harness ECM connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3E |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3E: Check for a pin-to-ground short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the accelerator pedal from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-ground short circuit.<br>• Measure the resistance between the accelerator pedal SIGNAL pin in the OEM harness ECM connector and ground.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3F |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-ground short circuit on the SIGNAL wire has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3F: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1241 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the problem. | 4A |
| | Fault Code 1241 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 1241 inactive?<br>**YES** | 4B |
| | Fault Code 1241 inactive?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all the steps have been completed and checked again. | 1A |

**STEP 4B: Clear the inactive fault codes.**

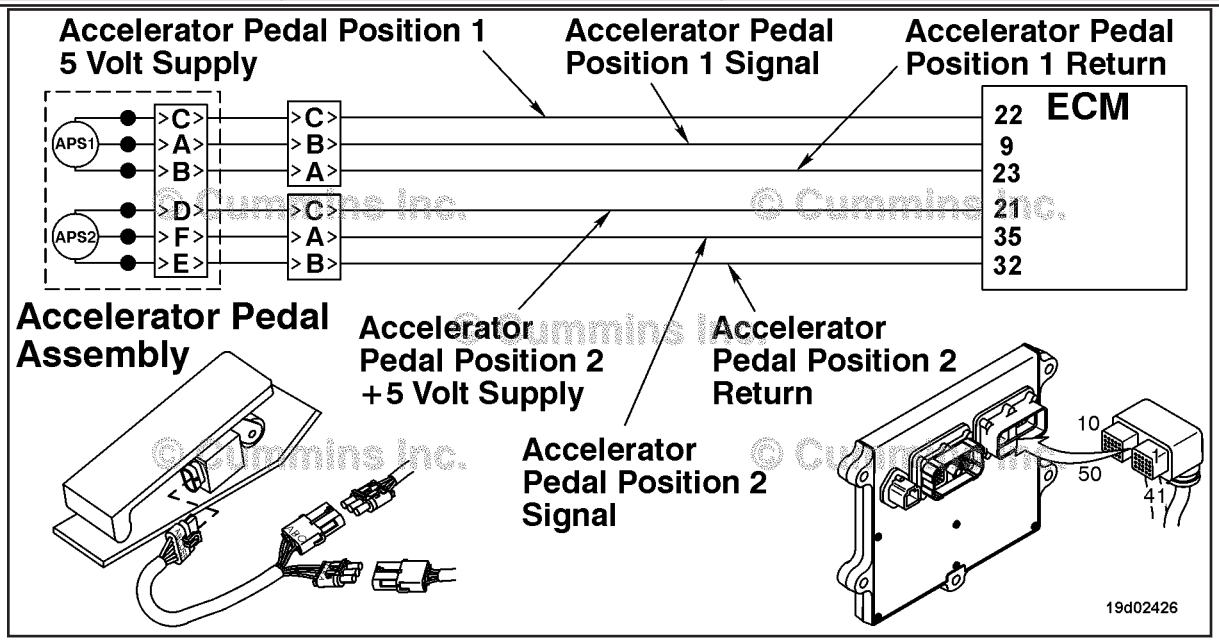
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 1242

## Accelerator Pedal or Lever Position Sensor Number 1 and Number 2 - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1242<br>PID(P), SID(S):<br>SPN: 091<br>FMI: 2/2<br>Lamp: Red<br>SRT: | Accelerator Pedal or Lever Position Sensor Number 1 and Number 2 - Data Erratic, Intermittent, or Incorrect. Accelerator position sensors numbers 1 and 2 are reading different values. | The engine will **only** idle. |




Accelerator Pedal Sensor

**Circuit Description:**

The accelerator position sensor is a hall-effect sensor attached to the accelerator pedal. The accelerator position sensor varies the signal voltage to the electronic control module (ECM) as the accelerator pedal is depressed and released. Low signal voltage is received by the ECM when the accelerator pedal is at 0 percent. A high signal voltage is received by the ECM when the accelerator pedal is at 100 percent. The accelerator pedal position circuit contains an accelerator pedal position 5 volt supply, accelerator pedal position return, and accelerator pedal position signal.

The accelerator pedal contains two position sensors. These position sensors are used to measure the throttle position. Both position sensors receive a 5 volt supply from the ECM. A corresponding signal voltage based on the position of the accelerator pedal is then received from the ECM. The signal voltage for accelerator position number 1 is twice as much as the signal voltage from accelerator position number 2.

**Component Location:**

The accelerator pedal position sensor is located on the accelerator pedal. Refer to the original equipment manufacturer (OEM) troubleshooting and repair manual.

**Shop Talk:**

Newer engines use two throttle position sensors to determine the throttle position. Older throttle pedals used a single throttle position sensor and an idle validation switch. If Fault Codes 132 and 1241 are active when the accelerator

pedal is in the idle position and Fault Code 132 goes inactive and Fault Code 1239 goes active when the throttle is depressed, the incorrect throttle pedal has been installed in the vehicle. A throttle pedal with two acceleration position sensors should be installed.

This fault code becomes active when the accelerator position sensor number 1 and accelerator position sensor number 2 are **not** reading the same value.

Possible causes of the fault include:

- Failed accelerator pedal position sensor 1 or failed accelerator pedal position sensor number 2.
- Accelerator pedal position sensor number 1 and accelerator pedal position sensor number 2 signal wires are shorted.

## Refer to Troubleshooting Fault Code t05-1242

# FAULT CODE 1242 - Accelerator Pedal or Lever Position Sensor Number 1 and Number 2 - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check the fault codes. | Fault Codes 131, 132, 1239, or 1241 active? | |
| **STEP 2:** | **Check the accelerator pedal position sensor readings.** | | |
| STEP 2A: | Inspect the accelerator pedal position sensor and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the circuit response. | Fault Codes 132 and 1241 both active? | |
| STEP 2C: | Check the accelerator pedal position number 1 sensor supply and return circuit. | 4.75-VDC to 5.25-VDC? | |
| STEP 2D: | Check the accelerator pedal position number 2 sensor supply and return circuit. | 4.75-VDC to 5.25-VDC? | |
| STEP 2E: | Check the fault codes. | Fault Codes 1242 active? | |
| **STEP 3:** | **Check the ECM and OEM harness.** | | |
| STEP 3A: | Inspect the ECM and OEM harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check for a pin-to-pin short circuit in the OEM harness. | Greater than 100k ohms? | |
| STEP 3C: | Check for a pin-to-pin short circuit in the OEM harness. | Greater than 100k ohms? | |
| **STEP 4:** | **Clear the fault code.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 1242 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check the fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Codes 131, 132, 1239, or 1241 active?<br>**YES** | Appropriate fault code troubleshooting tree |
| | Fault Codes 131, 132, 1239, or 1241 active?<br>**NO** | 2A |

### STEP 2: Check the accelerator pedal position sensor readings.

**STEP 2A: Inspect the accelerator pedal position sensor and connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness and accelerator pedal sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

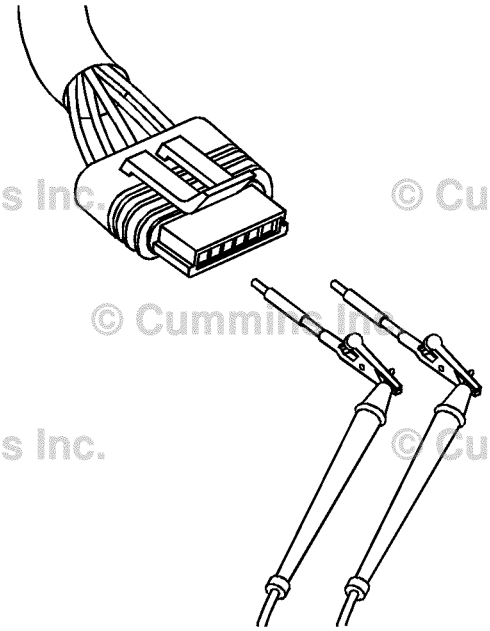
**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault codes 132 and 1241 are both active?<br>**YES** | 2C |
| | Fault codes 132 and 1241 are both active?<br>**NO**<br>**Repair:**<br>If fault code 132 did **not** go active, follow fault code 132 troubleshooting tree.<br>If fault code 1241 did **not** go active, follow fault code 1241 troubleshooting tree. | Appropriate fault code troubleshooting tree. |

**STEP 2C: Check the accelerator pedal position number 1 sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.
- Turn keyswitch ON.

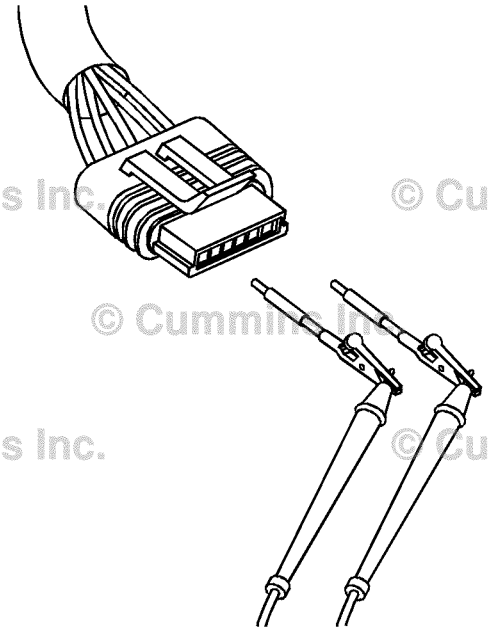
| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the voltage from the accelerator from the pedal position number 1 sensor +5 volt SUPPLY pin to the accelerator pedal position number 1 sensor RETURN pin at the sensor connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | 4.75-VDC to 5.25-VDC?<br>**YES** | 2D |
| | 4.75-VDC to 5.25-VDC?<br>**NO**<br>**Repair:**<br>Low sensor supply voltage has been detected.<br>Refer to fault code 132 troubleshooting tree. | Fault code 132 troubleshooting tree. |



**STEP 2D: Check the accelerator pedal position number 2 sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the accelerator pedal position sensor from the OEM harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Measure the voltage from the accelerator from the pedal position number 2 sensor +5 volt SUPPLY pin to the accelerator pedal position number 2 sensor RETURN pin at the sensor connector of the OEM harness.<br>Refer to the wiring diagram for connector pin identification. | 4.75-VDC to 5.25-VDC?<br>**YES** | 2E |
| | 4.75-VDC to 5.25-VDC?<br>**NO**<br>**Repair:**<br>Low sensor supply voltage has been detected.<br>Refer to fault code 1241 troubleshooting tree. | Fault code 1241 troubleshooting tree. |





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**STEP 2E: Check the fault codes.**

**Condition:**
- Turn keyswitch OFF.
- Connect the accelerator pedal position sensor to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Fully depress and release the accelerator pedal 3 times.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault code 1242 is inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |
| | Fault code 1242 is inactive?<br>**NO** | 3A |

## STEP 3: Check the ECM and OEM harness.

**STEP 3A: Inspect the ECM and OEM harness connector pins.**

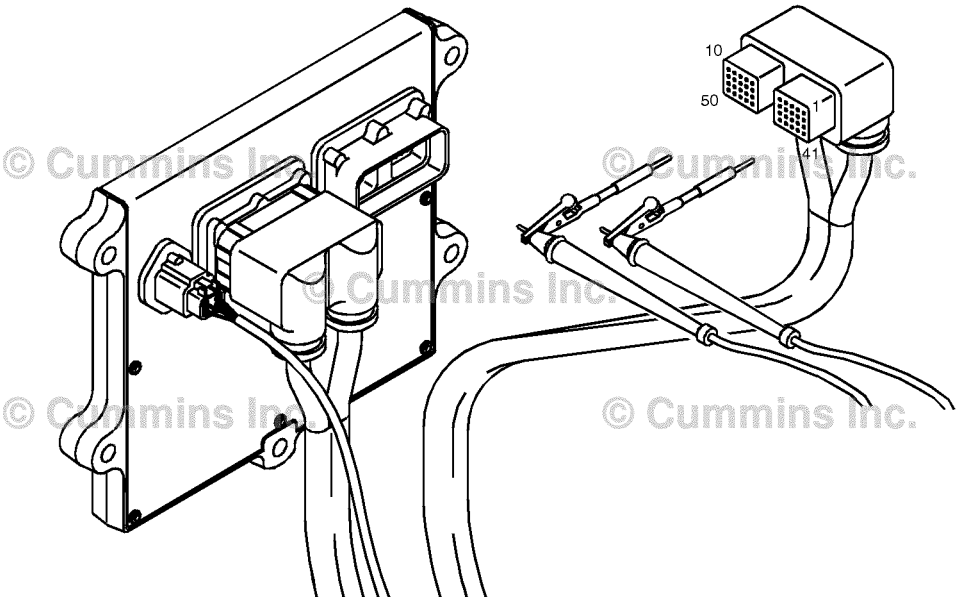
**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the OEM harness ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM or OEM harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the accelerator pedal from the OEM harness.

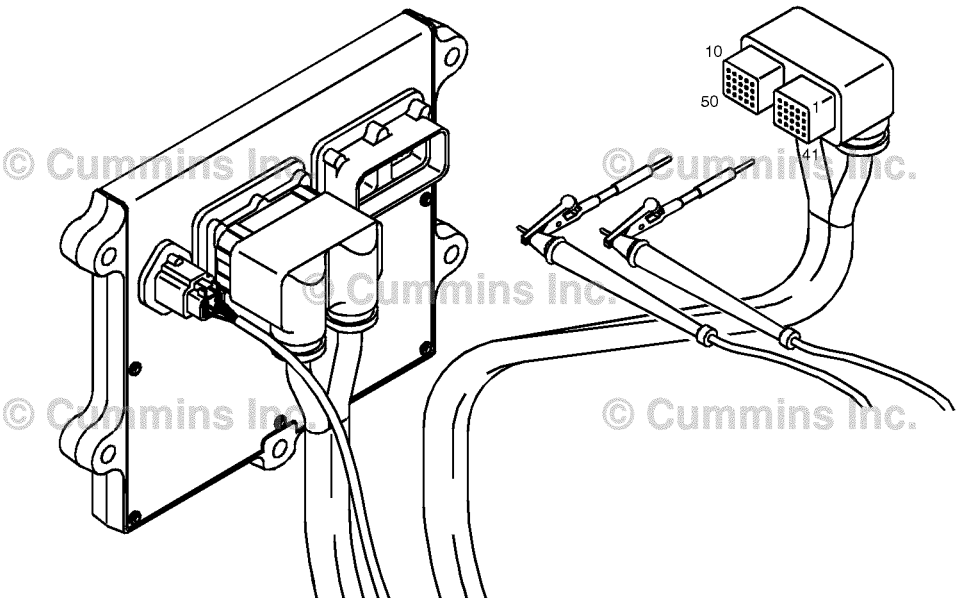
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short circuit.<br>• Measure the resistance between the accelerator position number 1 sensor SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM harness ECM connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3C |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the SIGNAL wire has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



**STEP 3C: Check for a pin-to-pin short circuit in the OEM harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the accelerator pedal from the OEM harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short circuit.<br>• Measure the resistance between the accelerator position number 2 sensor SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM harness ECM connector.<br>Refer to the circuit diagram or wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES**<br>**Repair:**<br>A damaged accelerator pedal has been detected. Contact the appropriate OEM or dealership for repair instructions.<br>Replace the accelerator pedal.<br>Refer to the OEM service manual. | 4A |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the SIGNAL wire has been detected in the OEM harness.<br>Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. | 4A |



## STEP 4: Clear the fault code.

### STEP 4A: Disable the fault code.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Fully depress and release the accelerator pedal 3 times.<br>• Use INSITE™ electronic service tool to verify that the fault code is inactive. | Fault Code 1242 inactive?<br>**YES** | 4B |
| | Fault Code 1242 inactive?<br>**NO** | 1A |

### STEP 4B: Clear the inactive fault codes.

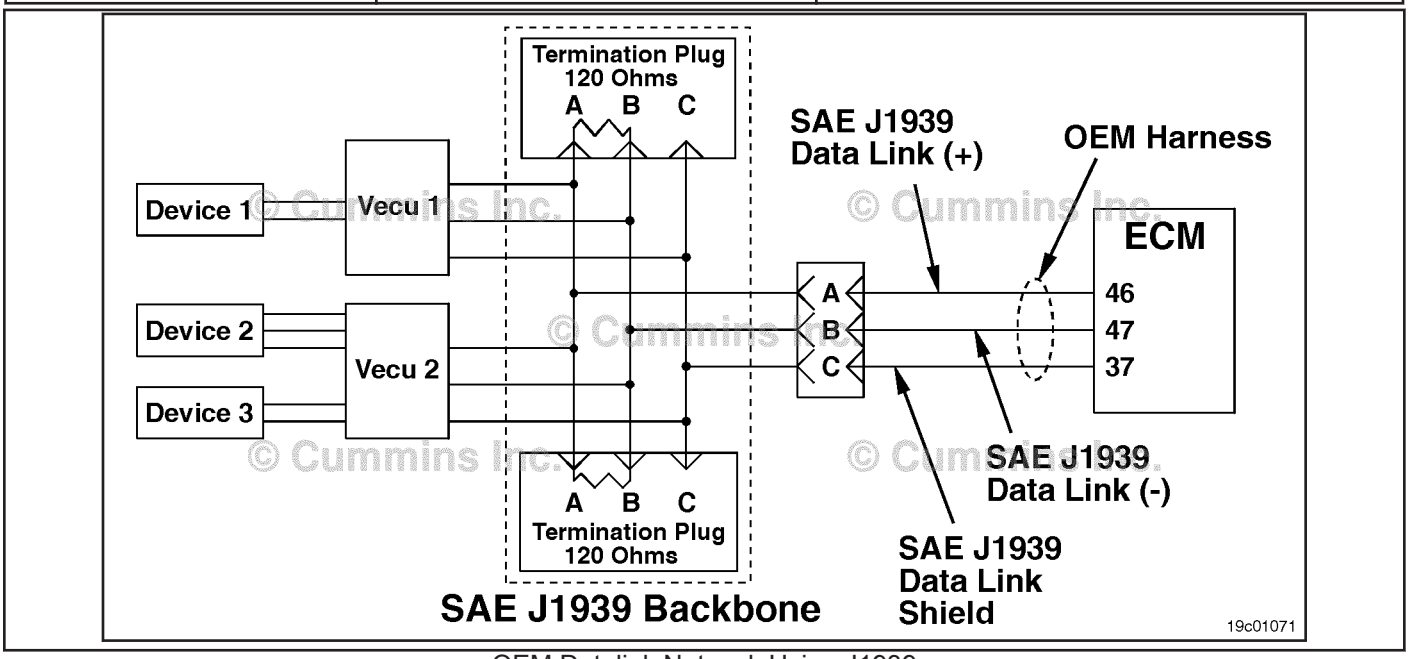
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to clear the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 1633

## Komnet Datalink Cannot Transmit - Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1633<br>PID(P), SID(S): None<br>SPN: 625<br>FMI: 2<br>Lamp: Amber<br>SRT: | Komnet Datalink Cannot Transmit - Data Erratic, Intermittent, or Incorrect. Communications within the OEM datalink network is intermittent. | None on performance. |




OEM Datalink Network Using J1939

**Circuit Description:**

The Cummins electronic control module (ECM) communicates to the OEM data link network using the J1939 data link protocol.

**Component Location:**

Refer to OEM troubleshooting for the location of the OEM installed primary and secondary ECM's.

**Shop Talk:**

This fault code is logged when J1939 data link communications between the OEM installed ECM's and the Cummins engine ECM is intermittent. This fault is **not** triggered by the Cummins installed ECM and is **only** stored as an information fault code. Do **not** recalibrate or change the Cummins ECM for this fault code.

## Refer to Troubleshooting Fault Code t05-1633

## TROUBLESHOOTING SUMMARY

| STEPS | SPECIFICATIONS | SRT CODE |
|---|---|---|
| **STEP 1: Check the fault codes.** | | |
| **STEP 1A: Check for an active fault code.** | **Fault Code 1633 is active?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an active fault code.**

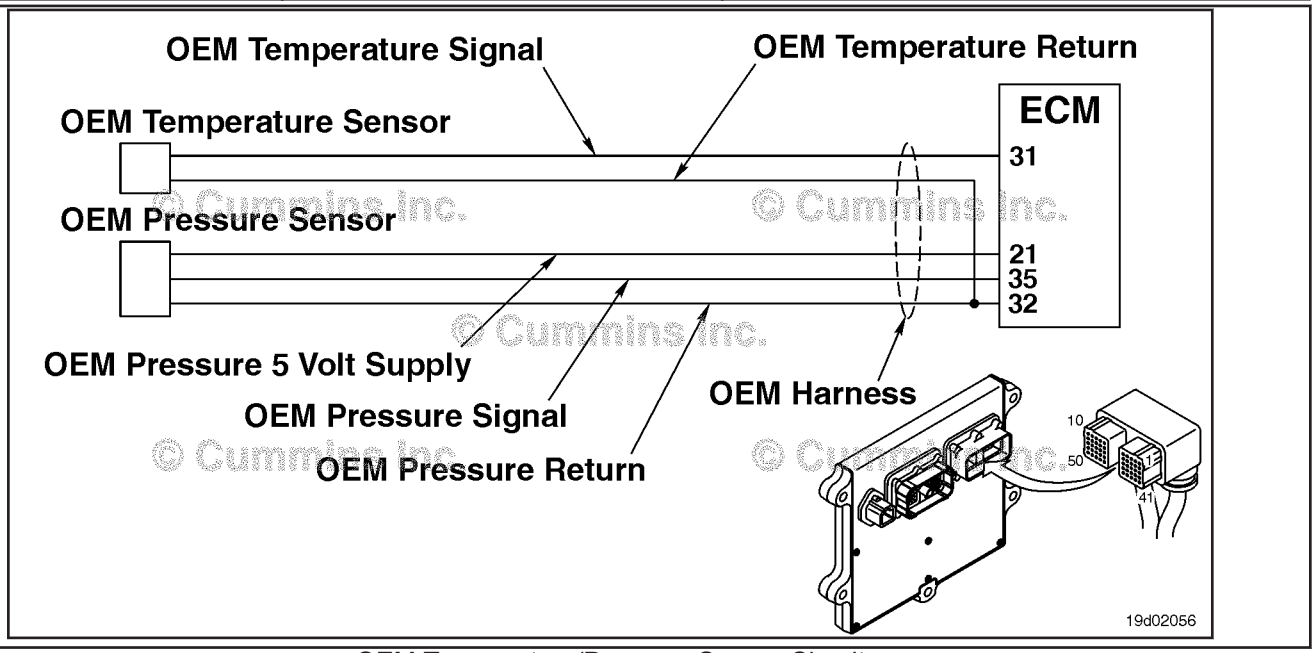
**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1633 is active?<br>**YES**<br>**Repair:**<br>A error has been detected in the OEM data link.<br>Refer to the OEM troubleshooting manual for more information. | Repair complete. |
| | Fault Code 1633 is active?<br>**NO** | Repair complete. |

# Fault Code 1639

## Auxiliary Equipment Sensor Input Number 3 (OEM Switch) - Root Cause Not Known

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1639<br>PID(P), SID(S): S051<br>SPN: 703<br>FMI: 11<br>Lamp: None<br>SRT: | Auxiliary Equipment Sensor Input Number 3 (OEM Switch) - Root Cause Not Known. | Possible engine power derate. |



OEM Temperature/Pressure Sensor Circuit

**Circuit Description:**

The OEM has the option of wiring a temperature sensor input to the Cummins ECM. A specific calibration is then created to recognize this temperature sensor input. This fault code is activated when the temperature input from the OEM sensor exceeds the engine protection limit defined by the OEM. Depending on OEM requirements, an Engine Protection derate may be associated with this fault code.

**Component Location:**

The OEM pressure or temperature sensor input will vary depending on application. Refer to the OEM troubleshooting manual for sensor location.

**Shop Talk:**

This fault code is activated when the maximum inlet temperature or inlet pressure of a third party after-treatment system has exceeded the maximum allowable limits. A power derate may or may not be associated with this fault code.

## Refer to Troubleshooting Fault Code t05-1639

## TROUBLESHOOTING SUMMARY

| STEPS | SPECIFICATIONS | SRT CODE |
|---|---|---|
| **STEP 1: Check the fault codes.** | | |
| **STEP 1A: Check for Fault Code 1639.** | **Active or inactive counts of Fault Code 1639?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for Fault Code 1639.**

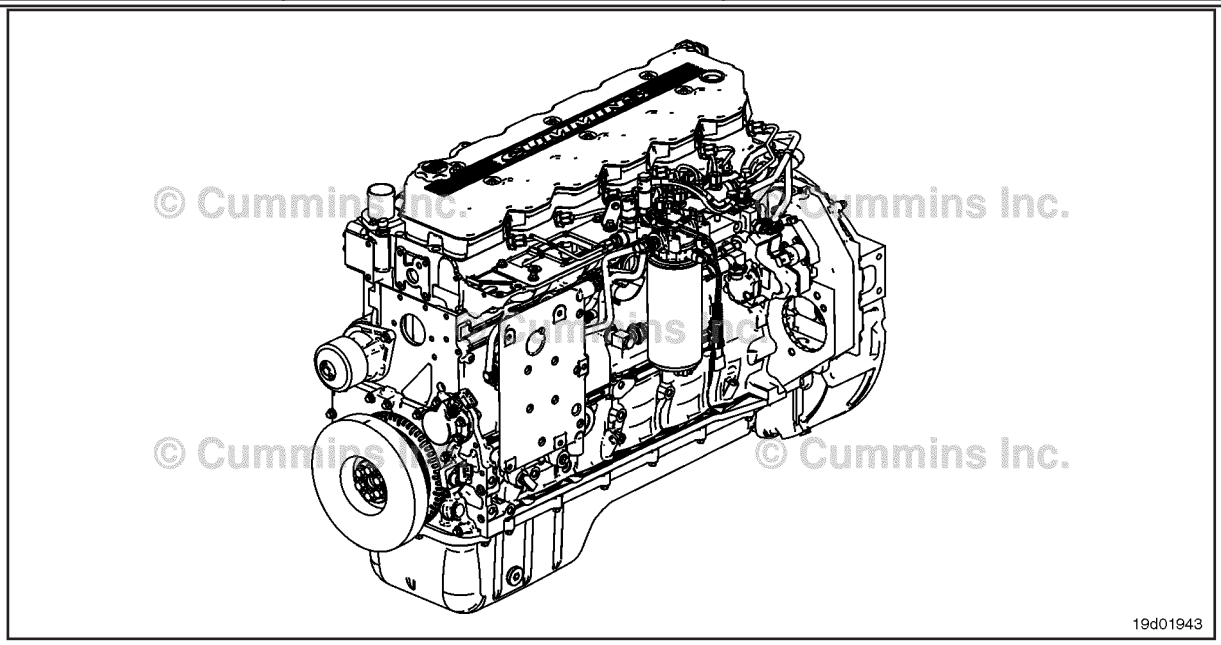
**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Active or inactive counts of Fault Code 1639?<br>**YES**<br>**Repair:**<br>The maximum inlet temperate or inlet pressure for the Exhaust Gas Filter has been exceeded.<br>Refer to Exhaust Gas Filter troubleshooting. | Exhaust Gas Filter Troubleshooting. |
| | Active or inactive counts of Fault Code 1639?<br>**NO** | Repair complete |

# Fault Code 1654

## Engine Misfire Cylinder 1 - Condition Exists.

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1654<br>PID(P), SID(S):<br>SPN: 1323<br>FMI: 11/31<br>Lamp: Amber<br>SRT: | Engine Misfire Cylinder 1-Condition Exists. Engine misfire has been detected in cylinder number 1. | Possible low power, rough idle, or misfire. |




Circuit

**Circuit Description:**

An algorithm in the ECM calibration monitors engine speed as each injector fires while the engine is at idle. If a cylinder has high or low contribution to engine speed, this fault will become active. The intention of this fault is to assist in troubleshooting performance complaints such as engine misfire and low power.

**Component Location:**

The ECM is located on the intake side of the engine. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

**Shop Talk:**

If Fault Code 1654 is inactive in the ECM memory and there is no complaint such as “low power” or “engine misfire”, it is possible that an intermittent event such as air entering the fuel system following a filter change caused the fault. Inactive counts of Fault Code 1654 should be disregarded unless other performance symptoms are present. The engine coolant temperature **must** be greater than 71°C [160°F] before this diagnostic will run.

Causes of cylinder misfire can include:

- Valve lash out of specification (compare actual valve lash to reset limits)
- Cylinder failure (check for high blowby when the engine is loaded)
- Valve failure or valve held open (listen for intake valve “chirping” noise in the intake)
- Cylinder head or gasket failure (look for signs of oil, coolant, or casting flash in the intake or exhaust passages)
- Extreme camshaft wear (inspect the camshaft lobes for wear)

- Extra, missing, or damaged sealing washer under an injector
- Injector failures (“swap” injectors to see if the problem “follows” the indicated injector).
- Check air compressor timing (if engine has had fault since new or has had a recent air compressor replacement.)
- For 6 cylinder ISBe4 automatic transmission applications: Check “On-Board Diagnostic (OBD) misfire alternate gains” setting in the features and parameters screen in INSITE™ electronic service tool. If the vehicle is fitted with a Voith transmission, this should be set to 2. All others are set to 1.

On-Board Diagnostic Information:

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails
- The ECM turns OFF the MIL after 3 consecutive ignition cycles, with the engine running for at least 10 seconds, that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared, use the INSITE™ electronic service tool
- The fault code will be cleared from the memory after 40 consecutive drive cycles when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-1654

# FAULT CODE 1654 - Engine Misfire Cylinder 1 - Condition Exists

## TROUBLESHOOTING SUMMARY

**CAUTION**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**CAUTION**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fuel system related fault codes active or have accumulated inactive counts?** | |
| **STEP 1B:** | **Check for cylinder misfire.** | **Cylinder misfire detected?** | |
| **STEP 2:** | **Perform diagnostic tests.** | | |
| **STEP 2A:** | **Perform the cylinder cutout test.** | **Cylinder misfire detected and isolated to injector?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Verify the repair** | **Cylinder misfire present?** | |
| **STEP 3B:** | **Clear the fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fuel system fault codes.<br>• Start the engine and let it idle for 1 minute<br>• Use INSITE™ electronic service tool to read the fault codes. | Fuel system related fault codes active or have accumulated inactive counts?<br>**YES** | Appropriate fault code troubleshooti ng tree. |
| | Fuel system related fault codes active or have accumulated inactive counts?<br>**NO** | 1B |

**STEP 1B: Check for cylinder misfire.**

**Condition:**
- Turn keyswitch ON.
- Start the engine and run at low idle.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for smoke, engine stumble, rough idle or misfire.<br>• Check for black or white smoke, engine stumble, rough idle or misfire at low idle, high idle, and during snap throttle accelerations. | Cylinder misfire detected?<br>**YES** | 2A |
| | Cylinder misfire detected?<br>**NO** | 3A |

## STEP 2: Perform diagnostic tests.

**STEP 2A: Perform the cylinder cutout test**

**Condition:**
- Turn the keyswitch ON
- Allow the engine to run at idle speed
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Determine if cylinder number 1 injector is misfiring.<br>• Use INSITE™ electronic service tool Cylinder Cutout Test to determine if the cylinder number 1 injector is misfiring. | Cylinder misfire detected and isolated to the injector?<br>**YES**<br>**Repair:**<br>A damaged injector has been detected.<br>Replace the cylinder number 1 injector.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 3A |
| | Cylinder misfire detected and isolated to the injector?<br>**NO**<br>**Repair:**<br>Check for other sources of cylinder misfire such as valve lash out of adjustment, cylinder damage, valve damage, cylinder head or gasket damage, extreme camshaft wear, or mistimed air compressor. | Appropriate troubleshooting procedures. |

## STEP 3: Clear the fault code.

### STEP 3A: Verify the repair.

**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify cylinder misfire is no longer present.<br>• Start the engine and verify the cylinder misfire is no longer present. | Cylinder misfire is present?<br>**YES**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |
| | Cylinder misfire is present?<br>**NO** | 3B |

### STEP 3B: Clear the fault codes.

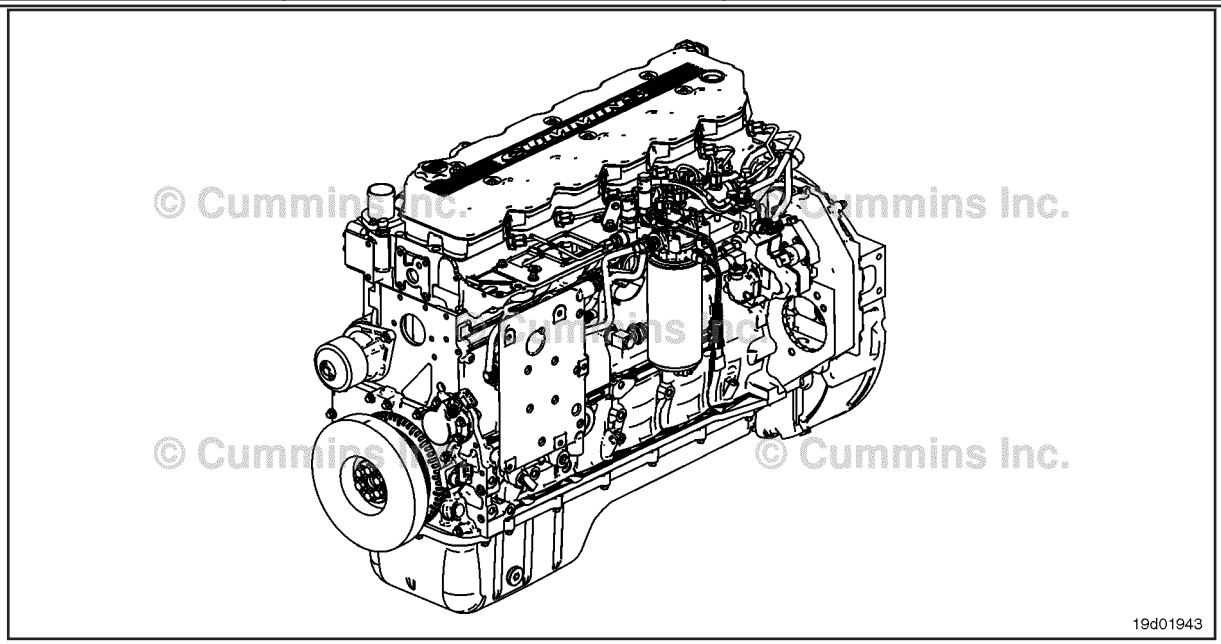
**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to clear all active and inactive fault codes. | All faults cleared?<br>**YES** | Repair complete |
| | All faults cleared?<br>**NO** | Appropriate troubleshooting steps. |

# Fault Code 1655

## Engine Misfire Cylinder 2 - Condition Exists.

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1655<br>PID(P), SID(S):<br>SPN: 1324<br>FMI: 11/31<br>Lamp: Amber<br>SRT: | Engine Misfire Cylinder 2 - Condition Exists. Engine misfire has been detected in cylinder number 2. | Possible low power, rough idle, or misfire. |




Circuit

**Circuit Description:**

An algorithm in the ECM calibration monitors engine speed as each injector fires while the engine is at idle. If a cylinder has high or low contribution to engine speed, this fault will become active. The intention of this fault is to assist in troubleshooting performance complaints such as engine misfire and low power.

**Component Location:**

The ECM is located on the intake side of the engine. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

**Shop Talk:**

If Fault Code 1655 is inactive in the ECM memory and there is no complaint such as “low power” or “engine misfire”, it is possible that an intermittent event such as air entering the fuel system following a filter change caused the fault. Inactive counts of Fault Code 1655 should be disregarded unless other performance symptoms are present. The engine coolant temperature must be greater than 71°C [160°F] before this diagnostic will run.

Causes of cylinder misfire can include:

- Valve lash out of specification (compare actual valve lash to reset limits)
- Cylinder failure (check for high blowby when the engine is loaded)
- Valve failure or valve held open (listen for intake valve “chirping” noise in the intake)
- Cylinder head or gasket failure (look for signs of oil, coolant, or casting flash in the intake or exhaust passages)
- Extreme camshaft wear (inspect the camshaft lobes for wear)

- Extra, missing, or damaged sealing washer under an injector
- Injector failures (“swap” injectors to see if the problem “follows” the indicated injector).
- Check air compressor timing (if engine has had fault since new or has had a recent air compressor replacement.)
- For 6 cylinder ISBe4 automatic transmission applications: Check “On-Board Diagnostic (OBD) misfire alternate gains” setting in the features and parameters screen in INSITE™ electronic service tool. If the vehicle is fitted with a Voith transmission, this should be set to 2. All others are set to 1.

On-Board Diagnostic Information:

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails
- The ECM turns OFF the MIL after 3 consecutive ignition cycles, with the engine running for at least 10 seconds, that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared, use the INSITE™ electronic service tool
- The fault code will be cleared from the memory after 40 consecutive drive cycles when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-1655

# FAULT CODE 1655 - Engine Misfire Cylinder 2 - Condition Exists

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fuel system related fault codes active or have accumulated inactive counts?** | |
| **STEP 1B:** | **Check for cylinder misfire.** | **Cylinder misfire detected?** | |
| **STEP 2:** | **Perform diagnostic tests.** | | |
| **STEP 2A:** | **Perform the cylinder cutout test.** | **Cylinder misfire detected and isolated to injector?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Verify the repair** | **Cylinder misfire present?** | |
| **STEP 3B:** | **Clear the fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fuel system fault codes.<br>• Start the engine and let it idle for 1 minute<br>• Use INSITE™ electronic service tool to read the fault codes. | Fuel system related fault codes active or have accumulated inactive counts?<br>**YES** | Appropriate fault code troubleshooting tree. |
| | Fuel system related fault codes active or have accumulated inactive counts?<br>**NO** | 1B |

**STEP 1B: Check for cylinder misfire.**

**Condition:**
- Turn keyswitch ON.
- Start the engine and run at low idle.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for smoke, engine stumble, rough idle or misfire.<br>• Check for black or white smoke, engine stumble, rough idle or misfire at low idle, high idle and during snap throttle accelerations. | Cylinder misfire detected?<br>**YES** | 2A |
| | Cylinder misfire detected?<br>**NO** | 3A |

## STEP 2: Perform diagnostic tests.

**STEP 2A: Perform the cylinder cutout test**

**Condition:**
- Turn the keyswitch ON
- Allow the engine to run at idle speed
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Determine if cylinder number 2 injector is misfiring.<br>• Use the INSITE™ electronic service tool Cylinder Cutout Test to determine if the cylinder number 2 injector is misfiring. | Cylinder misfire detected and isolated to the injector?<br>**YES**<br>**Repair:**<br>A damaged injector has been detected.<br>Replace the cylinder number 2 injector.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 3A |
| | Cylinder misfire detected and isolated to the injector?<br>**NO**<br>**Repair:**<br>Check for other sources of cylinder misfire such as: valve lash out of adjustment, cylinder damage, valve damage, cylinder head or gasket damage, extreme camshaft wear, or mis-timed air compressor. | Appropriate troubleshooting procedures. |

## STEP 3: Clear the fault code.

### STEP 3A: Verify the repair.

**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify cylinder misfire is no longer present.<br>• Start the engine and verify the cylinder misfire is no longer present. | Cylinder misfire is present?<br>**YES**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |
| | Cylinder misfire is present?<br>**NO** | 3B |

### STEP 3B: Clear the fault codes.

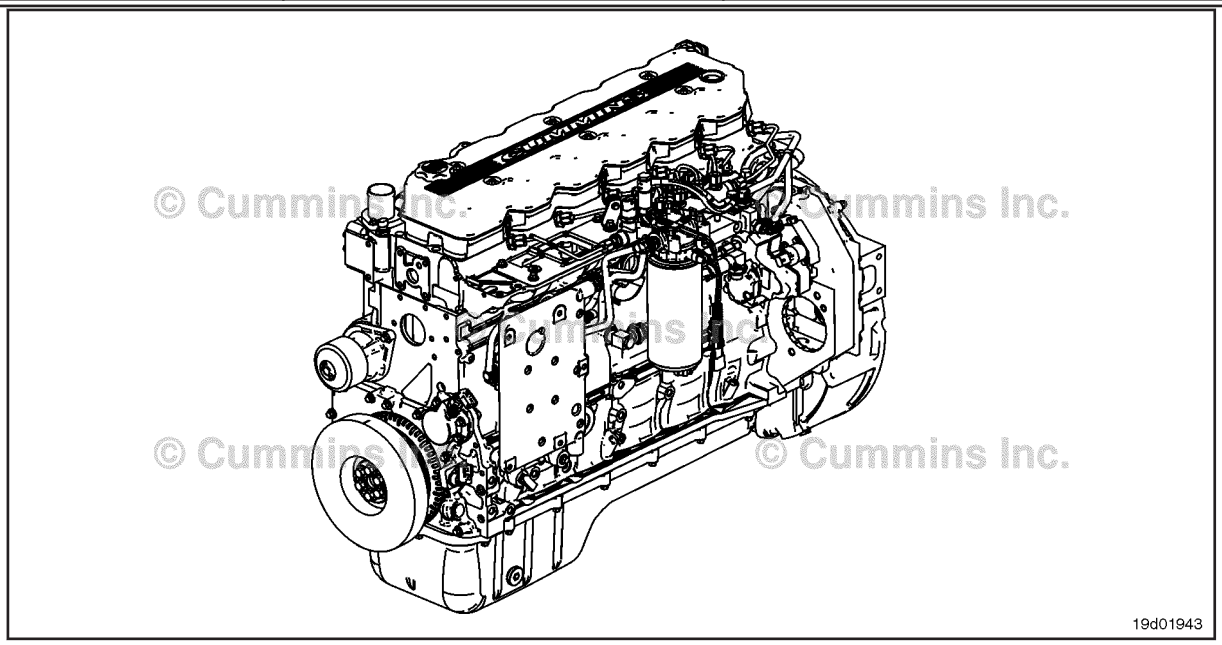
**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to clear all active and inactive fault codes. | All faults cleared?<br>**YES** | Repair complete. |
| | All faults cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 1656

## Engine Misfire Cylinder 3 - Condition Exists.

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1656<br>PID(P), SID(S):<br>SPN: 1325<br>FMI: 11/31<br>Lamp: Amber<br>SRT: | Engine Misfire Cylinder 3 - Condition Exists. Engine misfire has been detected in cylinder number 3. | Possible low power, rough idle, or misfire. |




Circuit

**Circuit Description:**

An algorithm in the ECM calibration monitors engine speed as each injector fires while the engine is at idle. If a cylinder has high or low contribution to engine speed, this fault will become active. The intention of this fault is to assist in troubleshooting performance complaints such as engine misfire and low power.

**Component Location:**

The ECM is located on the intake side of the engine. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

**Shop Talk:**

If Fault Code 1656 is inactive in the ECM memory and there is no complaint such as “low power” or “engine misfire”, it is possible that an intermittent event such as air entering the fuel system following a filter change caused the fault. Inactive counts of Fault Code 1656 should be disregarded unless other performance symptoms are present. The engine coolant temperature must be greater than 71°C [160°F] before this diagnostic will run.

Causes of cylinder misfire can include:

- Valve lash out of specification (compare actual valve lash to reset limits)
- Cylinder failure (check for high blowby when the engine is loaded)
- Valve failure or valve held open (listen for intake valve “chirping” noise in the intake)
- Cylinder head or gasket failure (look for signs of oil, coolant, or casting flash in the intake or exhaust passages)
- Extreme camshaft wear (inspect the camshaft lobes for wear)

- Extra, missing, or damaged sealing washer under an injector
- Injector failures (“swap” injectors to see if the problem “follows” the indicated injector).
- Check air compressor timing (if engine has had fault since new or has had a recent air compressor replacement.)
- For 6 cylinder ISBe4 automatic transmission applications: Check “On-Board Diagnostic (OBD) misfire alternate gains” setting in the features and parameters screen in INSITE™ electronic service tool. If the vehicle is fitted with a Voith transmission, this should be set to 2. All others are set to 1.

On-Board Diagnostic Information:

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails
- The ECM turns OFF the MIL after 3 consecutive ignition cycles, with the engine running for at least 10 seconds, that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared, use the INSITE™ electronic service tool
- The fault code will be cleared from the memory after 40 consecutive drive cycles when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-1656

# FAULT CODE 1656 - Engine Misfire Cylinder 3 - Condition Exists

## TROUBLESHOOTING SUMMARY

**CAUTION**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**CAUTION**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fuel system related fault codes active or have accumulated inactive counts?** | |
| **STEP 1B:** | **Check for cylinder misfire.** | **Cylinder misfire detected?** | |
| **STEP 2:** | **Perform diagnostic tests.** | | |
| **STEP 2A:** | **Perform the cylinder cutout test.** | **Cylinder misfire detected and isolated to injector?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Verify the repair** | **Cylinder misfire present?** | |
| **STEP 3B:** | **Clear the fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fuel system fault codes.<br>• Start the engine and let it idle for 1 minute<br>• Use INSITE™ electronic service tool to read the fault codes. | Fuel system related fault codes active or have accumulated inactive counts?<br>**YES** | Appropriate fault code troubleshooti ng tree. |
| | Fuel system related fault codes active or have accumulated inactive counts?<br>**NO** | 1B |

**STEP 1B: Check for cylinder misfire.**

**Condition:**
- Turn keyswitch ON.
- Start the engine and run at low idle.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for smoke, engine stumble, rough idle or misfire.<br>• Check for black or white smoke, engine stumble, rough idle or misfire at low idle, high idle and during snap throttle accelerations. | Cylinder misfire detected?<br>**YES** | 2A |
| | Cylinder misfire detected?<br>**NO** | 3A |

## STEP 2: Perform diagnostic tests.

**STEP 2A: Perform the cylinder cutout test**

**Condition:**
- Turn the keyswitch ON
- Allow the engine to run at idle speed
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Determine if cylinder number 3 injector is misfiring.<br>• Use INSITE™ electronic service tool Cylinder Cutout Test to determine if the cylinder number 3 injector is misfiring. | Cylinder misfire detected and isolated to the injector?<br>**YES**<br>**Repair:**<br>A damaged injector has been detected.<br>Replace the cylinder number 3 injector.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 3A |
| | Cylinder misfire detected and isolated to the injector?<br>**NO**<br>**Repair:**<br>Check for other sources of cylinder misfire such as valve lash out of adjustment, cylinder damage, valve damage, cylinder head or gasket damage, extreme camshaft wear, or mistimed air compressor. | Appropriate troubleshooting procedures. |

## STEP 3: Clear the fault code.

### STEP 3A: Verify the repair.

**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify cylinder misfire is no longer present.<br>• Start the engine and verify the cylinder misfire is no longer present. | Cylinder misfire is present?<br>**YES**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |
| | Cylinder misfire is present?<br>**NO** | 3B |

### STEP 3B: Clear the fault codes.

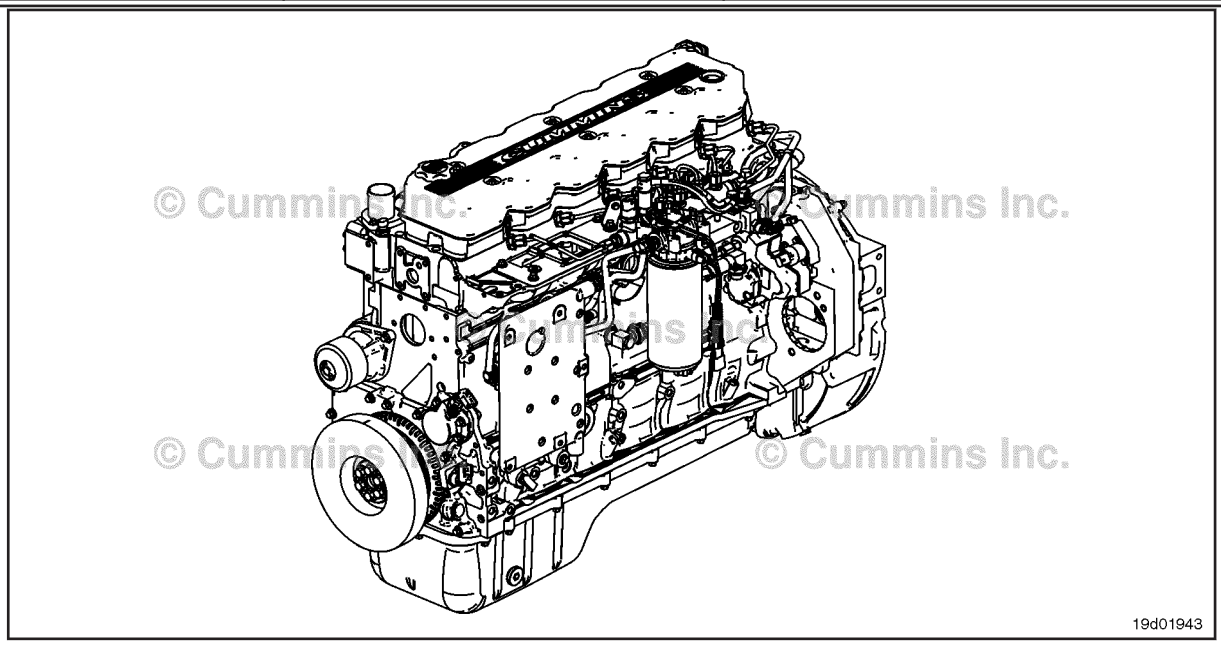
**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to clear all active and inactive fault codes. | All faults cleared?<br>**YES** | Repair complete |
| | All faults cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 1657

## Engine Misfire Cylinder 4 - Condition Exists.

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1657<br>PID(P), SID(S):<br>SPN: 1326<br>FMI: 11/31<br>Lamp: Amber<br>SRT: | Engine Misfire Cylinder 4 - Condition Exists. Engine misfire has been detected in cylinder number 4. | Possible low power, rough idle, or misfire. |




Circuit

**Circuit Description:**

An algorithm in the ECM calibration monitors engine speed as each injector fires while the engine is at idle. If a cylinder has high or low contribution to engine speed, this fault will become active. The intention of this fault is to assist in troubleshooting performance complaints such as engine misfire and low power.

**Component Location:**

The ECM is located on the intake side of the engine. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

**Shop Talk:**

If Fault Code 1657 is inactive in the ECM memory and there is no complaint such as “low power” or “engine misfire”, it is possible that an intermittent event such as air entering the fuel system following a filter change caused the fault. Inactive counts of Fault Code 1657 should be disregarded unless other performance symptoms are present. The engine coolant temperature must be greater than 71°C [160°F] before this diagnostic will run.

Causes of cylinder misfire can include:

- Valve lash out of specification (compare actual valve lash to reset limits)
- Cylinder failure (check for high blowby when the engine is loaded)
- Valve failure or valve held open (listen for intake valve “chirping” noise in the intake)
- Cylinder head or gasket failure (look for signs of oil, coolant, or casting flash in the intake or exhaust passages)
- Extreme camshaft wear (inspect the camshaft lobes for wear)

- Extra, missing, or damaged sealing washer under an injector
- Injector failures (“swap” injectors to see if the problem “follows” the indicated injector).
- Check air compressor timing (if engine has had fault since new or has had a recent air compressor replacement.)
- For 6 cylinder ISBe4 automatic transmission applications: Check “On-Board Diagnostic (OBD) misfire alternate gains” setting in the features and parameters screen in INSITE™ electronic service tool. If the vehicle is fitted with a Voith transmission, this should be set to 2. All others are set to 1.

On-Board Diagnostic Information:

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails
- The ECM turns OFF the MIL after 3 consecutive ignition cycles, with the engine running for at least 10 seconds, that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared, use the INSITE™ service tool
- The fault code will be cleared from the memory after 40 consecutive drive cycles when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-1657

# FAULT CODE 1657 - Engine Misfire Cylinder 4 - Condition Exists

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fuel system related fault codes active or have accumulated inactive counts?** | |
| **STEP 1B:** | **Check for cylinder misfire.** | **Cylinder misfire detected?** | |
| **STEP 2:** | **Perform diagnostic tests.** | | |
| **STEP 2A:** | **Perform the cylinder cutout test.** | **Cylinder misfire detected and isolated to injector?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Verify the repair** | **Cylinder misfire present?** | |
| **STEP 3B:** | **Clear the fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fuel system fault codes.<br>• Start the engine and let it idle for 1 minute<br>• Use INSITE™ electronic service tool to read the fault codes. | Fuel system related fault codes active or have accumulated inactive counts?<br>**YES** | Appropriate fault code troubleshooting tree. |
| | Fuel system related fault codes active or have accumulated inactive counts?<br>**NO** | 1B |

**STEP 1B: Check for cylinder misfire.**

**Condition:**
- Turn keyswitch ON.
- Start the engine and run at low idle.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for smoke, engine stumble, rough idle or misfire.<br>• Check for black or white smoke, engine stumble, rough idle or misfire at low idle, high idle and during snap throttle accelerations. | Cylinder misfire detected?<br>**YES** | 2A |
| | Cylinder misfire detected?<br>**NO** | 3A |

## STEP 2: Perform diagnostic tests.

**STEP 2A: Perform the cylinder cutout test**

**Condition:**
- Turn the keyswitch ON
- Allow the engine to run at idle speed
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Determine if cylinder number 4 injector is misfiring.<br>• Use INSITE™ electronic service tool Cylinder Cutout Test to determine if the cylinder number 4 injector is misfiring. | Cylinder misfire detected and isolated to the injector?<br>**YES**<br>**Repair:**<br>A damaged injector has been detected<br>Replace the cylinder number 4 injector.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 3A |
| | Cylinder misfire detected and isolated to the injector?<br>**NO**<br>**Repair:**<br>Check for other sources of cylinder misfire such as valve lash out of adjustment, cylinder damage, valve damage, cylinder head or gasket damage, extreme camshaft wear, or mistimed air compressor. | Appropriate troubleshooting procedures. |

## STEP 3: Clear the fault code.

### STEP 3A: Verify the repair.

**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify cylinder misfire is no longer present.<br>• Start the engine and verify the cylinder misfire is no longer present. | Cylinder misfire is present?<br>**YES**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |
| | Cylinder misfire is present?<br>**NO** | 3B |

### STEP 3B: Clear the fault codes.

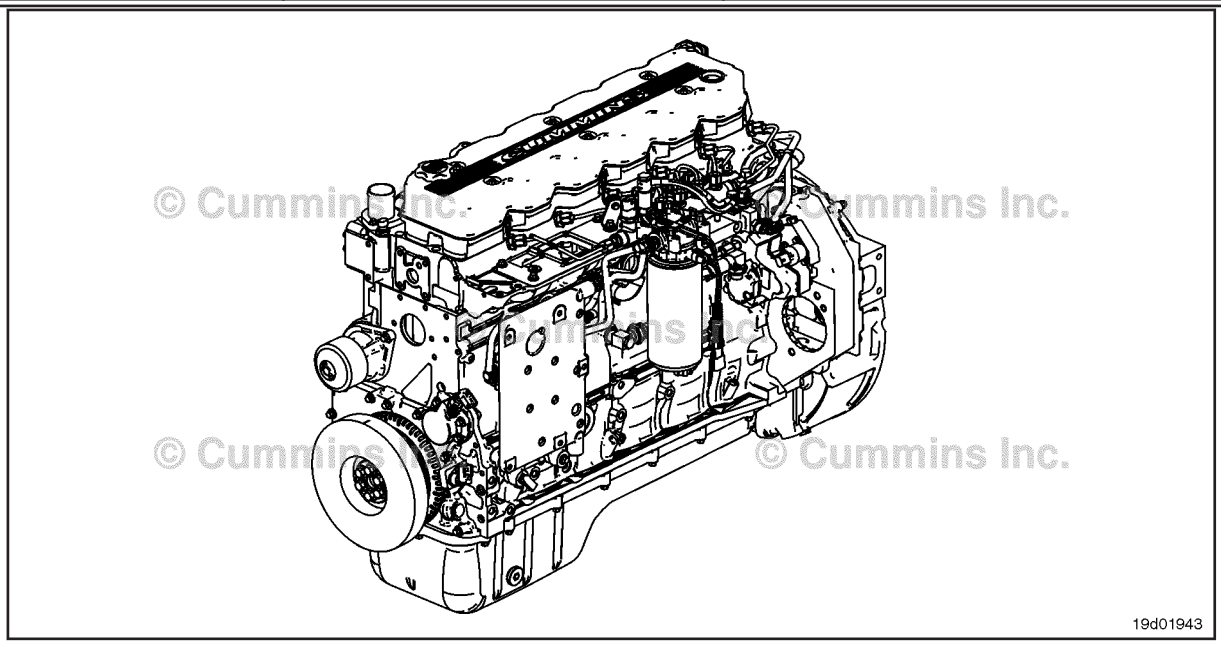
**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to clear all active and inactive fault codes. | All faults cleared?<br>**YES** | Repair complete |
| | All faults cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 1658

## Engine Misfire Cylinder 5 - Condition Exists.

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1658<br>PID(P), SID(S):<br>SPN: 1327<br>FMI: 11/31<br>Lamp: Amber<br>SRT: | Engine Misfire Cylinder 5 - Condition Exists. Engine misfire has been detected in cylinder number 5. | Possible low power, rough idle, or misfire. |




Circuit

**Circuit Description:**

An algorithm in the ECM calibration monitors engine speed as each injector fires while the engine is at idle. If a cylinder has high or low contribution to engine speed, this fault will become active. The intention of this fault is to assist in troubleshooting performance complaints such as engine misfire and low power.

**Component Location:**

The ECM is located on the intake side of the engine. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

**Shop Talk:**

If Fault Code 1658 is inactive in the ECM memory and there is no complaint such as “low power” or “engine misfire”, it is possible that an intermittent event such as air entering the fuel system following a filter change caused the fault. Inactive counts of Fault Code 1658 should be disregarded unless other performance symptoms are present. The engine coolant temperature must be greater than 71°C [160°F] before this diagnostic will run.

Causes of cylinder misfire can include:

- Valve lash out of specification (compare actual valve lash to reset limits)
- Cylinder failure (check for high blowby when the engine is loaded)
- Valve failure or valve held open (listen for intake valve “chirping” noise in the intake)
- Cylinder head or gasket failure (look for signs of oil, coolant, or casting flash in the intake or exhaust passages)
- Extreme camshaft wear (inspect the camshaft lobes for wear)

- Extra, missing, or damaged sealing washer under an injector
- Injector failures (“swap” injectors to see if the problem “follows” the indicated injector).
- Check air compressor timing (if engine has had fault since new or has had a recent air compressor replacement.)
- For 6 cylinder ISBe4 automatic transmission applications: Check “On-Board Diagnostic (OBD) misfire alternate gains” setting in the features and parameters screen in INSITE™ electronic service tool. If the vehicle is fitted with a Voith transmission, this should be set to 2. All others are set to 1.

On-Board Diagnostic Information:

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails
- The ECM turns OFF the MIL after 3 consecutive ignition cycles, with the engine running for at least 10 seconds, that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared, use the INSITE™ electronic service tool
- The fault code will be cleared from the memory after 40 consecutive drive cycles when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-1658

# FAULT CODE 1658 - Engine Misfire Cylinder 5 - Condition Exists

## TROUBLESHOOTING SUMMARY

**CAUTION**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**CAUTION**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fuel system related fault codes active or have accumulated inactive counts?** | |
| **STEP 1B:** | **Check for cylinder misfire.** | **Cylinder misfire detected?** | |
| **STEP 2:** | **Perform diagnostic tests.** | | |
| **STEP 2A:** | **Perform the cylinder cutout test.** | **Cylinder misfire detected and isolated to injector?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Verify the repair** | **Cylinder misfire present?** | |
| **STEP 3B:** | **Clear the fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fuel system fault codes.<br>• Start the engine and let it idle for 1 minute<br>• Use INSITE™ electronic service tool to read the fault codes. | Fuel system related fault codes active or have accumulated inactive counts?<br>**YES** | Appropriate fault code troubleshooti ng tree. |
| | Fuel system related fault codes active or have accumulated inactive counts?<br>**NO** | 1B |

**STEP 1B: Check for cylinder misfire.**

**Condition:**
- Turn keyswitch ON.
- Start the engine and run at low idle.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for smoke, engine stumble, rough idle or misfire.<br>• Check for black or white smoke, engine stumble, rough idle or misfire at low idle, high idle and during snap throttle accelerations. | Cylinder misfire detected?<br>**YES** | 2A |
| | Cylinder misfire detected?<br>**NO** | 3A |

## STEP 2: Perform diagnostic tests.

**STEP 2A: Perform the cylinder cutout test**

**Condition:**
- Turn the keyswitch ON
- Allow the engine to run at idle speed
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Determine if cylinder number 5 injector is misfiring.<br>• Use INSITE™ electronic service tool Cylinder Cutout Test to determine if the cylinder number 5 injector is misfiring. | Cylinder misfire detected and isolated to the injector?<br>**YES**<br>**Repair:**<br>A damaged injector has been detected<br>Replace the cylinder number 5 injector.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 3A |
| | Cylinder misfire detected and isolated to the injector?<br>**NO**<br>**Repair:**<br>Check for other sources of cylinder misfire such as valve lash out of adjustment, cylinder damage, valve damage, cylinder head or gasket damage, extreme camshaft wear, or mistimed air compressor. | Appropriate troubleshooting procedures. |

## STEP 3: Clear the fault code.

### STEP 3A: Verify the repair.

**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify cylinder misfire is no longer present.<br>• Start the engine and verify the cylinder misfire is no longer present. | Cylinder misfire is present?<br>**YES** | 1A |
| | Cylinder misfire is present?<br>**NO**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 3B |

### STEP 3B: Clear the fault codes.

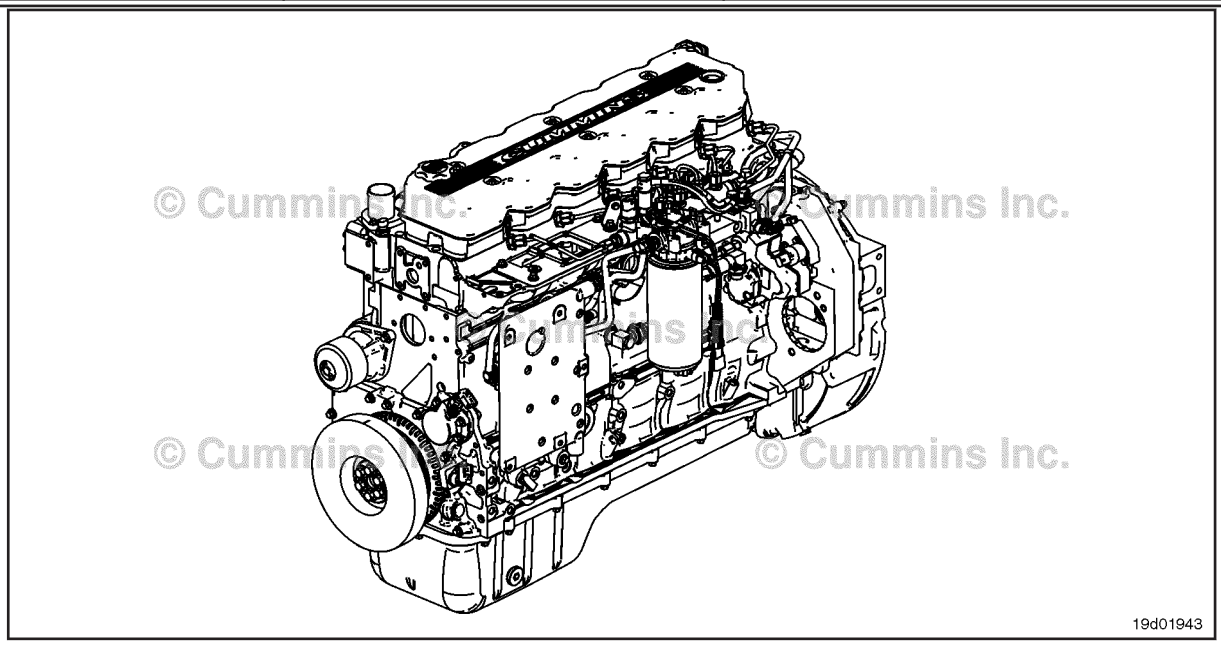
**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to clear all active and inactive fault codes. | All faults cleared?<br>**YES** | Repair complete? |
| | All faults cleared?<br>**NO** | Appropriate troubleshooting steps. |

# Fault Code 1659

## Engine Misfire Cylinder 6 - Condition Exists.

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1659<br>PID(P), SID(S):<br>SPN: 1328<br>FMI: 11/31<br>Lamp: Amber<br>SRT: | Engine Misfire Cylinder 6 - Condition Exists. Engine misfire has been detected in cylinder number 6. | Possible low power, rough idle, or misfire. |




Circuit

**Circuit Description:**

An algorithm in the ECM calibration monitors engine speed as each injector fires while the engine is at idle. If a cylinder has high or low contribution to engine speed, this fault will become active. The intention of this fault is to assist in troubleshooting performance complaints such as engine misfire and low power.

**Component Location:**

The ECM is located on the intake side of the engine. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

**Shop Talk:**

If Fault Code 1659 is inactive in the ECM memory and there is no complaint such as “low power” or “engine misfire”, it is possible that an intermittent event such as air entering the fuel system following a filter change caused the fault. Inactive counts of Fault Code 1659 should be disregarded unless other performance symptoms are present. The engine coolant temperature must be greater than 71°C [160°F] before this diagnostic will run.

Causes of cylinder misfire can include:

- Valve lash out of specification (compare actual valve lash to reset limits)
- Cylinder failure (check for high blowby when the engine is loaded)
- Valve failure or valve held open (listen for intake valve “chirping” noise in the intake)
- Cylinder head or gasket failure (look for signs of oil, coolant, or casting flash in the intake or exhaust passages)
- Extreme camshaft wear (inspect the camshaft lobes for wear)

- Extra, missing, or damaged sealing washer under an injector
- Injector failures (“swap” injectors to see if the problem “follows” the indicated injector).
- Check air compressor timing (if engine has had fault since new or has had a recent air compressor replacement.)
- For 6 cylinder ISBe4 automatic transmission applications: Check “On-Board Diagnostic (OBD) Misfire alternate gains” setting in the features and parameters screen in INSITE™ electronic service tool. If the vehicle is fitted with a Voith transmission, this should be set to 2. All others are set to 1.

On-Board Diagnostic Information:

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails
- The ECM turns OFF the MIL after 3 consecutive ignition cycles, with the engine running for at least 10 seconds, that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared, use the INSITE™ service tool
- The fault code will be cleared from the memory after 40 consecutive drive cycles when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-1659

# FAULT CODE 1659 - Engine Misfire Cylinder 6 - Condition Exists

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Read the fault codes.** | **Fuel system related fault codes active or have accumulated inactive counts?** | |
| **STEP 1B:** | **Check for cylinder misfire.** | **Cylinder misfire detected?** | |
| **STEP 2:** | **Perform diagnostic tests.** | | |
| **STEP 2A:** | **Perform the cylinder cutout test.** | **Cylinder misfire detected and isolated to injector?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Verify the repair** | **Cylinder misfire present?** | |
| **STEP 3B:** | **Clear the fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Read the fault codes.**

**Condition:**
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Read the fuel system fault codes.<br>• Start the engine and let it idle for 1 minute<br>• Use INSITE™ electronic service tool to read the fault codes. | Fuel system related fault codes active or have accumulated inactive counts?<br>**YES** | Appropriate fault code troubleshooting tree. |
| | Fuel system related fault codes active or have accumulated inactive counts?<br>**NO** | 1B |

**STEP 1B: Check for cylinder misfire.**

**Condition:**
- Turn keyswitch ON.
- Start the engine and run at low idle.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for smoke, engine stumble, rough idle or misfire.<br>• Check for black or white smoke, engine stumble, rough idle or misfire at low idle, high idle, and during snap throttle accelerations. | Cylinder misfire detected?<br>**YES** | 2A |
| | Cylinder misfire detected?<br>**NO** | 3A |

## STEP 2: Perform diagnostic tests.

**STEP 2A: Perform the cylinder cutout test**

**Condition:**
- Turn the keyswitch ON
- Allow the engine to run at idle speed
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Determine if the cylinder number 6 injector is misfiring.<br>• Use INSITE™ electronic service tool Cylinder Cutout Test to determine if the cylinder number 6 injector is misfiring. | Cylinder misfire detected and isolated to the injector?<br>**YES**<br>**Repair:**<br>A damaged injector has been detected.<br>Replace the cylinder number 6 injector.<br>• For ISB and QSB engines, use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.<br>• For ISC, QSC, ISL, and QSL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. | 3A |
| | Cylinder misfire detected and isolated to the injector?<br>**NO**<br>**Repair:**<br>Check for other sources of cylinder misfire such as valve lash out of adjustment, cylinder damage, valve damage, cylinder head or gasket damage, extreme camshaft wear, or mistimed air compressor. | Appropriate troubleshooting procedures. |

## STEP 3: Clear the fault code.

### STEP 3A: Verify the repair.

**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Verify cylinder misfire is no longer present.<br>• Start the engine and verify the cylinder misfire is no longer present. | Cylinder misfire is present?<br>**YES**<br>**Repair:**<br>Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and checked again. | 1A |
| | Cylinder misfire is present?<br>**NO** | 3B |

### STEP 3B: Clear the fault codes.

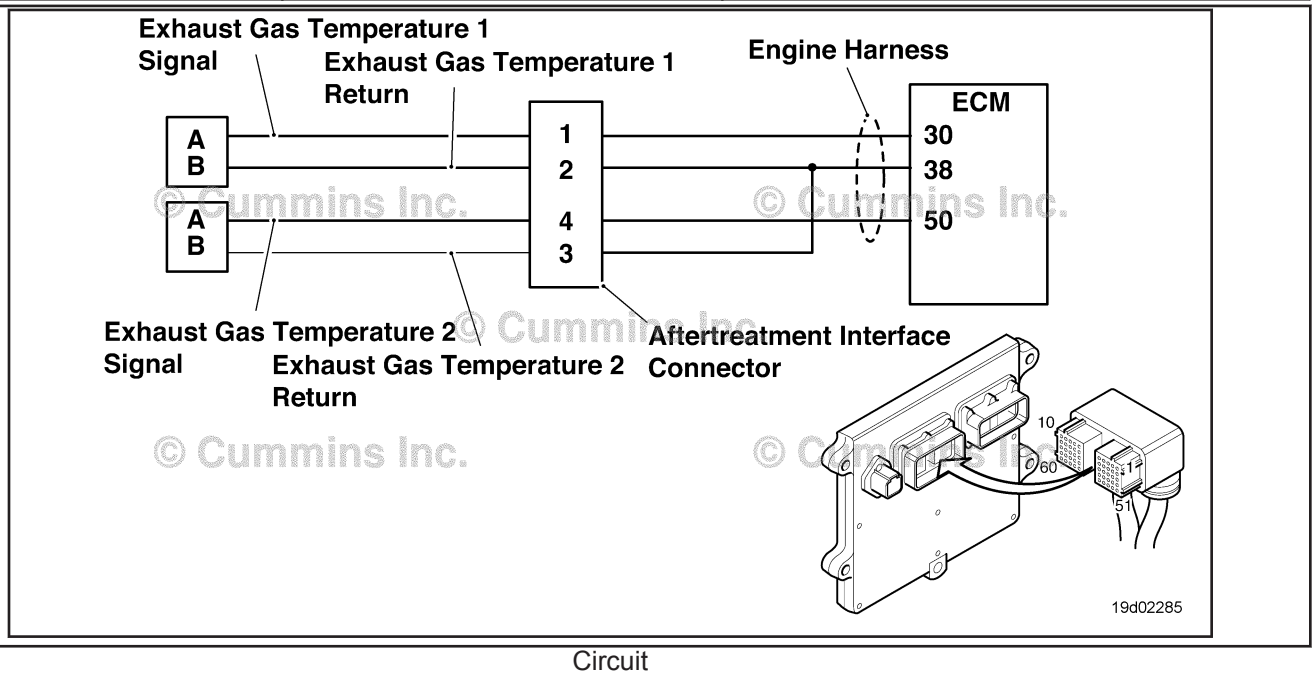
**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to clear all active and inactive fault codes. | All faults cleared?<br>**YES** | Repair complete |
| | All faults cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 1663

## Catalyst Inlet Temperature Sensor Swapped with Outlet - Condition Exists.

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1663<br>PID(P), SID(S):<br>SPN: 3241<br>FMI: 11/31<br>Lamp: Amber<br>SRT: | Catalyst Inlet Temperature Sensor Swapped with Outlet — Condition Exists. The inlet and outlet catalyst temperature sensor connections are swapped. | Catalyst solution injection into the aftertreatment system is disabled. |




Circuit

**Circuit Description:**

The catalyst temperature sensors are used to monitor the temperatures of the exhaust gas entering and exiting the catalyst.

**Component Location:**

The inlet and exhaust temperature sensors are located in the aftertreatment system. The inlet temperature sensor is located before the catalyst and the exhaust temperature sensor is located at the outlet of the exhaust.

**Shop Talk:**

Both inlet and outlet exhaust gas temperature sensors have the same part number, so it is possible to get the sensors connected backwards to the engine harness. This fault code is activated when the ECM determines that the temperature reading from the inlet and outlet sensors are reading backwards. The most likely cause of this fault code is that the inlet and exhaust temperature sensor connectors are swapped at the engine harness. Disconnect the inlet and outlet temperature sensors from the engine harness and swap the connectors. The catalyst temperature sensors must be reading ambient temperature and the engine **must** be off for a period of eight hours before this diagnostic will run.

On-Board Diagnostic (OBD) Information:

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails
- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool

- The fault code will be cleared from the memory after 40 consecutive drive cycles when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-1663

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement:Part Number 3822758 - male Deutsch/AMP/Metri-Pack test leadPart Number 3822917 - female Deutsch/AMP/Metri-Pack test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for sensor circuit fault codes.** | | |
| **STEP 1A:** | **Check for fault codes.** | **Fault code 1674, 1675, 1676, 1655, 1666, or 1667 active?** | |
| **STEP 2:** | **Check the temperature sensor configuration.** | | |
| **STEP 2A:** | **Check the circuit response.** | **Fault code 1675 active?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault code 1676 active?** | |
| **STEP 3:** | **Clear the fault code.** | | |
| **STEP 3A:** | **Clear the fault codes.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for sensor circuit fault codes.

**STEP 1A: Check for fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Using INSITE™ electronic service tool read the fault codes. | Fault code 1674, 1675, 1676, 1665, 1666, or 1667 active?<br>**YES** | Appropriate fault code troubleshooti ng tree. |
| | Fault code 1674, 1675, 1676, 1665, 1666, or 1667 active?<br>**NO** | 2A |

## STEP 2: Check the temperature sensor configuration.

### STEP 2A: Check the circuit response.

**Condition:**
- Turn the keyswitch OFF
- Disconnect the engine exhaust gas temperature 1 sensor (catalyst inlet) from the engine harness.
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ to read the fault codes. | Fault code 1666 active?<br>**YES**<br>**Repair:**<br>The catalyst inlet and catalyst exhaust temperature sensor readings are swapped.<br>Swap the wiring harness connections to the exhaust gas temperature 1 sensor and catalyst exhaust temperature sensor. | 3A |
| | Fault code 1666 active?<br>**NO** | 2B |

### STEP 2B: Check the circuit response.

**Condition:**
- Turn the keyswitch OFF
- Disconnect the engine exhaust gas temperature 2 sensor (catalyst inlet) from the engine harness.
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ to read the fault codes. | Fault code 1675 active?<br>**YES**<br>**Repair:**<br>The catalyst inlet and catalyst exhaust temperature sensor readings are swapped.<br>Swap the wiring harness connections to the exhaust gas temperature 1 (catalyst inlet) sensor and exhaust gas temperature 2 (catalyst outlet) temperature sensor. | 3A |
| | Fault code 1675 active?<br>**NO** | 3A |

## STEP 3: Clear the fault code.

### STEP 3A: Clear the fault codes.

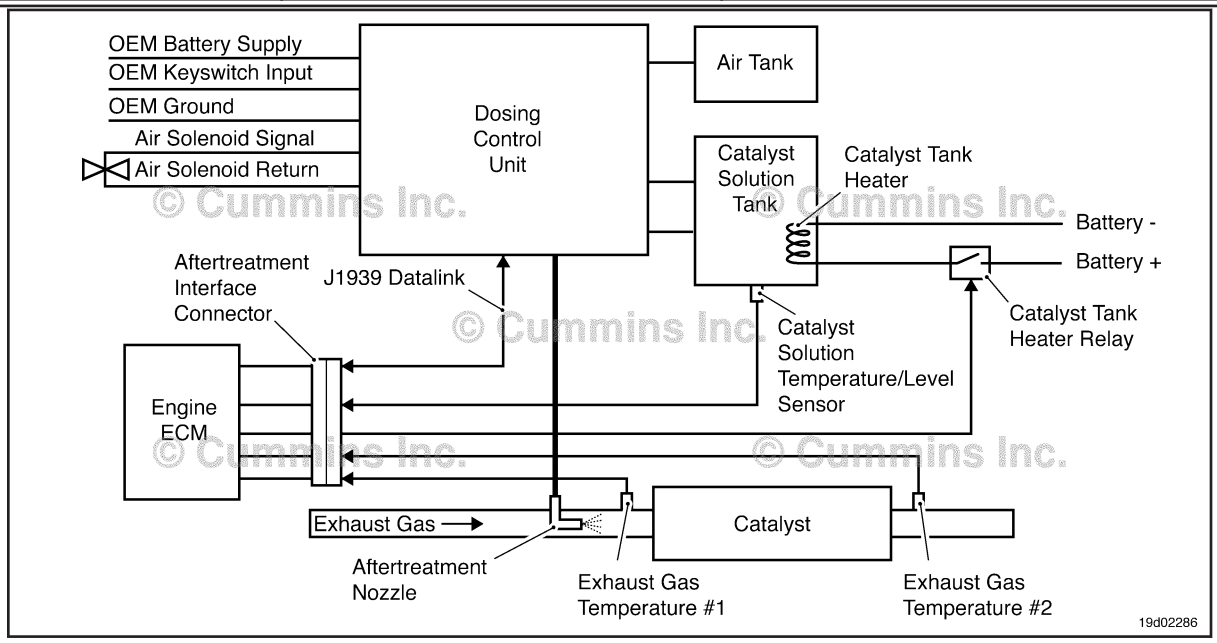
**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Using INSITE™ electronic service tool, erase all active and inactive fault codes. | All faults cleared?<br>**YES** | Repair complete. |
| | All faults cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 1664

## Catalyst Missing - Condition Exists.

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1664<br>PID(P), SID(S):<br>SPN: 3050<br>FMI: 11/31<br>Lamp: Amber<br>SRT: | Catalyst Missing — Condition Exists. The aftertreatment catalyst in the exhaust system is **not** present. | Catalyst solution injection into the aftertreatment system is disabled. |




Circuit: Aftertreatment Control System

**Circuit Description:**

The catalyst is monitored by inlet and outlet temperature sensors that are located in the aftertreatment system. The inlet temperature sensor is located before the catalyst and the outlet temperature sensor is located at the outlet of the catalyst system.

**Component Location:**

The catalyst is located in the exhaust system. The location of the catalyst may vary depending on the OEM.

**Shop Talk:**

This fault code becomes active when the inlet and outlet temperature sensors do **not** detect the presence of a catalyst in the aftertreatment system. This can be caused by tampering with the catalyst system, the catalyst has been removed from the vehicle, or a failed catalyst. The catalyst temperature sensors **must** be reading ambient temperature and the engine **must** be off for a period of eight hours before this diagnostic will run. If the catalyst temperature is above 100°F [38°C], or the catalyst temperature sensors have a difference of more than 10°F or 5.5°C the diagnostics will **not** run.

Possible causes of this fault include:

- Incorrect calibration revision on INCAL CD
- Tampering with catalyst system, removal of catalyst from vehicle, or failed catalyst.

On-Board Diagnostic (OBD) Information:

- The ECM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool
- The fault code will be cleared from the memory after 40 consecutive drive cycles when the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-1664

# FAULT CODE 1664 - Catalyst Missing - Condition Exists
## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**
**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**
**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for sensor circuit fault codes.** | | |
| **STEP 1A:** | **Check for fault codes.** | **Fault code 1663, 1674, 1675, 1676, 1665, 1666, or 1667 active?** | |
| **STEP 1B:** | **Check for the presence of a catalyst.** | **Catalyst present in aftertreatment system?** | |
| **STEP 1C:** | **Inspect the aftertreatment system.** | **Damage or tampering found in aftertreatment system?** | |
| **STEP 2:** | **Clear the fault code.** | | |
| **STEP 2A:** | **Verify the repair.** | **Catalyst Inlet Temperature and Catalyst Outlet Temperature reading within 10°F or 5.5°C of each other, at ambient temperature, after an 8 hour soak?** | |
| **STEP 2B:** | **Clear the fault code.** | **All faults cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for sensor circuit fault codes.
**STEP 1A: Check for fault codes.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for active fault codes.<br>• Using INSITE™ electronic service tool read the fault codes. | Fault code 1663, 1674, 1675, 1676, 1665, 1666, or 1667 active?<br>**YES** | Appropriate fault code troubleshooting tree. |
| | Fault code 1663, 1674, 1675, 1676, 1665, 1666, or 1667 active?<br>**NO** | 1B |

**STEP 1B: Check for presence of a catalyst.**

**Condition:**
- Turn keyswitch OFF.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect for presence of catalyst.<br>• Inspect for the presence of the catalyst in the exhaust system. | Is the catalyst present in the aftertreatment system?<br>**YES** | 1C |
| | Is the catalyst present in the aftertreatment system?<br>**NO**<br>**Repair:**<br>Install the proper catalyst for the application.<br>Refer to the OEM service manual. | 2A |

**STEP 1C: Inspect the aftertreatment system.**

**Condition:**
- Turn keyswitch OFF.
- Remove the catalyst from the exhaust system.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the catalyst.<br>• Inspect the catalyst for cracks or contamination. | Damage or tampering found in the catalyst system?<br>**YES**<br>**Repair:**<br>Install the proper catalyst for the application.<br>Refer to the OEM service manual. | 2A |
| | Damage or tampering found in the catalyst system?<br>**NO** | 2A |

## STEP 2: Clear the fault code.

### STEP 2A: Verify the repair.

**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Compare INSITE™ electronic service tool reading for Catalyst Inlet Temperature and Catalyst Outlet Temperature.<br>• Start the INSITE™ Data Monitor/Logger and compare the INSITE™ electronic service tool reading for Catalyst Inlet Temperature and Catalyst Outlet Temperature. | Catalyst Inlet Temperature and Catalyst Outlet Temperature within 10°F or 5.5°C of each other, at ambient temperature, after an 8 hour soak?<br>**YES** | 2B |
| | Catalyst Inlet Temperature and Catalyst Outlet Temperature within 10°F or 5.5°C of each other, at ambient temperature, after an 8 hour soak?<br>**NO** | 1A |

### STEP 2B: Clear the fault codes.

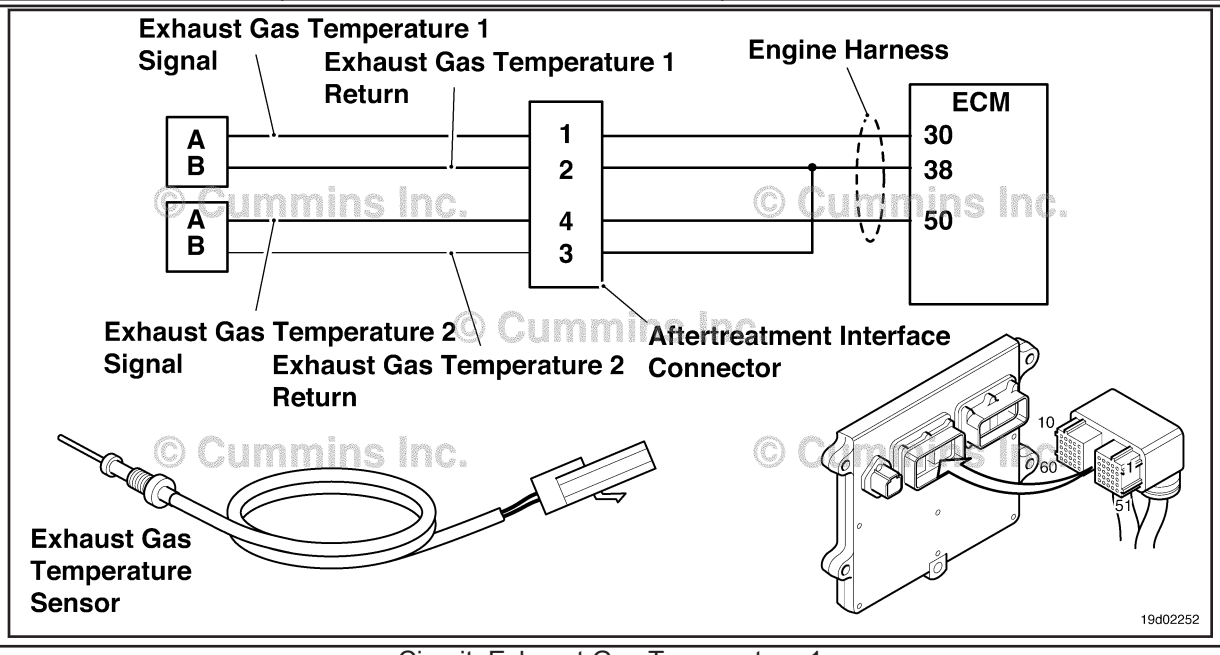
**Condition:**
- Connect all components
- Turn the keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to erase all active and inactive fault codes. | All faults cleared?<br>**YES** | Repair complete. |
| | All faults cleared?<br>**NO** | Appropriate troubleshooti ng steps. |

# Fault Code 1665

## Exhaust Gas Temperature 1 Circuit — Voltage Below Normal, or Shorted to Low Source.

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1665<br>PID(P), SID(S):<br>SPN: 3241<br>FMI: 4<br>Lamp: Amber<br>SRT: | Exhaust Gas Temperature 1 Circuit — Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at the catalyst inlet temperature sensor circuit. | Default temperature used for catalyst inlet temperature. |




Circuit: Exhaust Gas Temperature 1

**Circuit Description:**

The catalyst inlet temperature sensor is used by the electronic control module (ECM) to monitor the engine exhaust temperature entering the catalyst unit. The ECM monitors the voltage on the signal pin and converts this to a temperature value.

**Component Location:**

The catalyst inlet temperature sensor is located in the aftertreatment system. It is located between the turbocharger outlet and the catalyst unit inlet in the exhaust system.

**Shop Talk:**

The catalyst inlet temperature sensor shares return wires in the engine harness with other sensors. A shorted return can cause multiple fault codes to be active.

Possible causes of this fault code include:

- Signal shorted to ground in the harness
- Signal shorted to return or ground in the sensor

On-Board Diagnostics (OBD) Information (Euro 4 Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool.

- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

On-Board Diagnostics (OBD) Information (Euro 4 Stage 1+ Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- An engine torque derate will be activated after 50 hours of engine operation with the fault code active.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 1 ignition cycle that the diagnostic runs and does **not** fail. The MIL lamp **cannot** be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 400 days or 9600 hours of engine operation.

## Refer to Troubleshooting Fault Code t05-1665

# FAULT CODE 1665 - Exhaust Gas Temperature 1 Circuit - Voltage Below Normal, or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for an inactive fault code. | Fault Code 1665 inactive? | |
| **STEP 2:** | **Check the exhaust gas temperature #1 sensor and circuit.** | | |
| STEP 2A: | Inspect the exhaust gas temperature #1 sensor and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the circuit response. | Fault Code 1666 active and fault code 1665 inactive? | |
| STEP 2C: | Check the fault codes and verify sensor condition. | Fault Code 1665 is active? | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| STEP 3A: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 3B: | Check the circuit response. | Fault Code 1666 active and Fault Code 1665 inactive? | |
| STEP 3C: | Check for a pin to pin short circuit in the engine harness. | Greater than 100K ohms? | |
| STEP 3D: | Check for a pin short circuit to ground. | Greater than 100K ohms? | |
| STEP 3E: | Check for an inactive fault code. | Fault Code 1665 inactive? | |
| **STEP 4:** | **Clear the fault codes.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 1665 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

**STEP 1A: Check for an inactive fault code.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1665 inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 1665 inactive?<br>**NO** | 2A |

### STEP 2: Check the exhaust gas temperature #1 sensor and circuit.

**STEP 2A: Inspect the exhaust gas temperature #1 sensor and connector pins.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and exhaust gas temperature #1 sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault code 1666 active and fault code 1665 inactive?<br>**YES** | 2C |
| | Fault code 1666 active and fault code 1665 inactive?<br>**NO** | 3A |

**STEP 2C: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF.
- Connect the exhaust gas temperature #1 sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1665 is active?<br>**YES**<br>**Repair:**<br>Replace the exhaust gas temperature #1 sensor. Refer to Procedure 019-013 in Section 19. | 4A |
| | Fault Code 1665 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the fault. | 4A |

## STEP 3: Check the ECM and engine harness.

### STEP 3A: Inspect the ECM and engine harness connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or the engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

### STEP 3B: Check the circuit response.

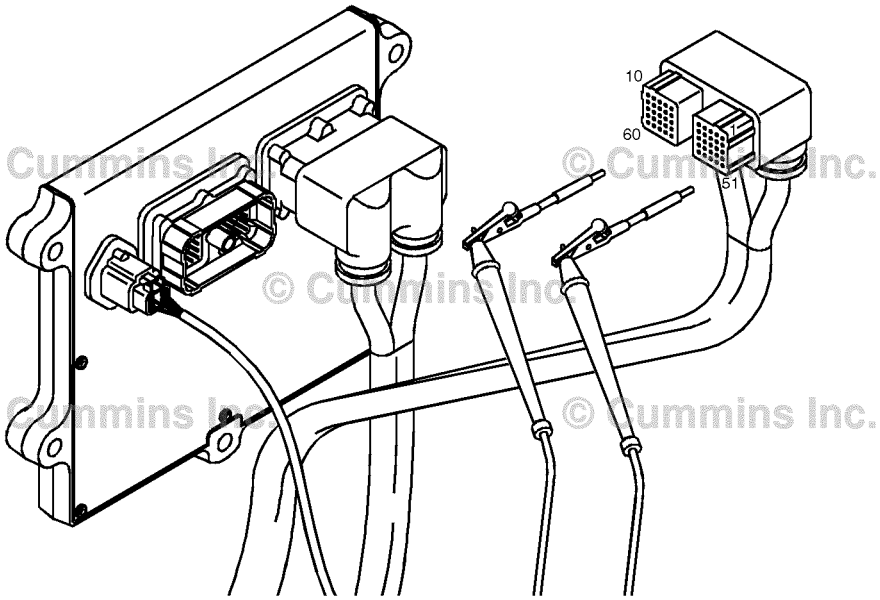
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1666 is active and Fault Code 1665 is inactive?<br>**YES** | 3C |
| | Fault Code 1666 is active and Fault Code 1665 is inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

**STEP 3C: Check for a pin to pin short circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.

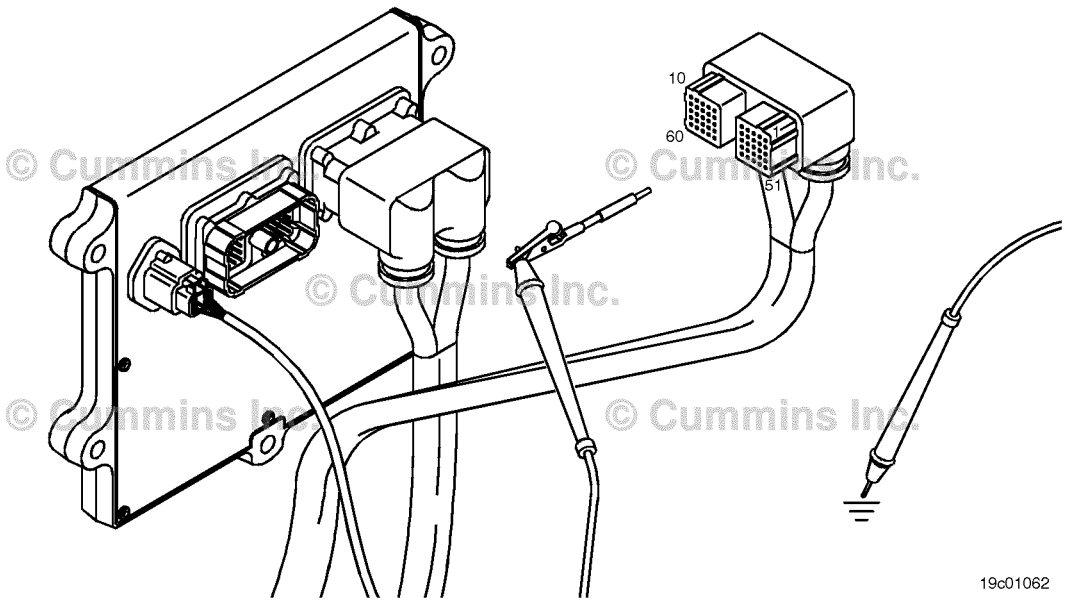
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the exhaust gas temperature #1 sensor SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3D |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3D: Check for a pin short circuit to ground.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-ground short.<br>• Measure the resistance between the exhaust gas temperature #1 sensor SIGNAL pin in the engine harness ECM connector and ground.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100k ohms?<br>**YES** | 3E |
| | Greater than 100k ohms?<br>**NO**<br>**Repair:**<br>A pin-to-ground short circuit on the SIGNAL line has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1665 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the problem. | 4A |
| | Fault Code 1665 inactive?<br>**NO**<br>**Repair:**<br>Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. | 1A |

## STEP 4: Clear the fault codes.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 1665 inactive?<br>**YES** | 4B |
| | Fault Code 1665 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

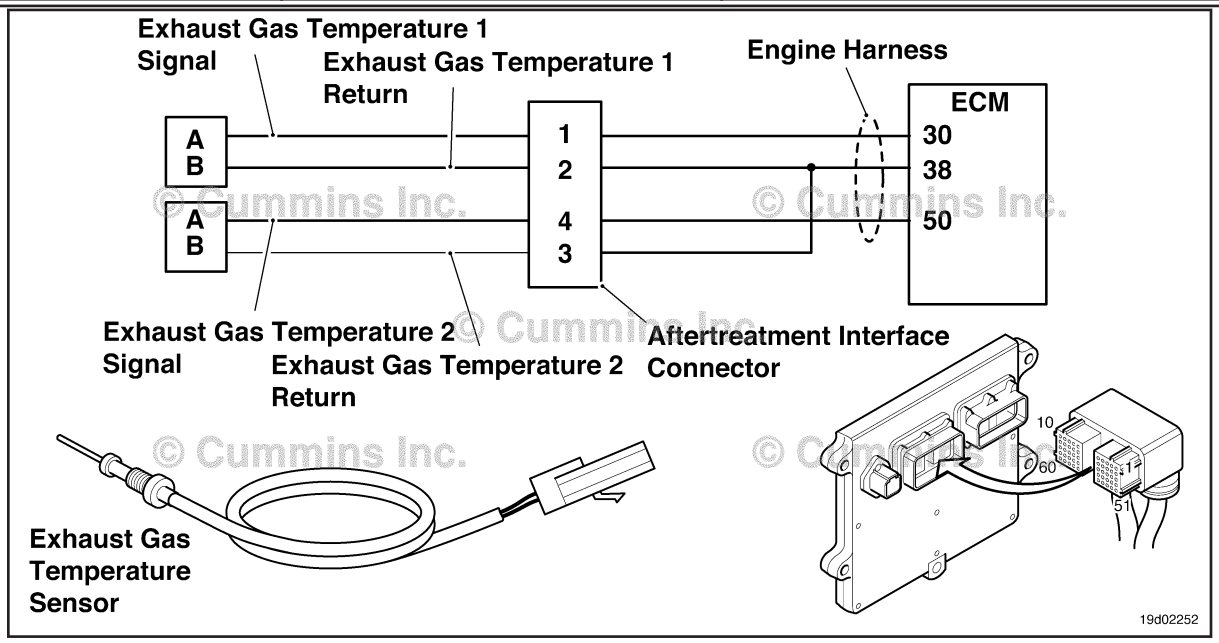
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 1666

## Exhaust Gas Temperature 1 Circuit — Voltage Above Normal, or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1666<br>PID(P), SID(S):<br>SPN: 3241<br>FMI: 3<br>Lamp: Amber<br>SRT: | Exhaust Gas Temperature 1 Circuit — Voltage Above Normal, or Shorted to Low Source. High signal voltage detected at the catalyst inlet temperature sensor circuit | Default temperature used for catalyst inlet temperature. |




Circuit: Exhaust Gas Temperature 1

**Circuit Description:**

The catalyst inlet temperature sensor is used by the electronic control module (ECM) to monitor the engine exhaust temperature entering the catalyst unit. The ECM monitors the voltage on the signal pin and converts this to a temperature value.

**Component Location:**

The catalyst inlet temperature sensor is located in the aftertreatment system. It is located between the turbocharger outlet and the catalyst unit inlet in the exhaust system.

**Shop Talk:**

Catalyst inlet temperature sensor shares return wires in the engine harness with other sensors. A shorted return can cause multiple fault codes to be active.

Possible causes of this fault code include:

- Open return circuit in the harness, connectors, or sensor.
- Open signal circuit or shorted to a voltage source.

On-Board Diagnostics (OBD) Information (Euro 4 Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool.

- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

On-Board Diagnostics (OBD) Information (Euro 4 Stage 1+ Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- An engine torque derate will be activated after 50 hours of engine operation with the fault code active.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 1 ignition cycle that the diagnostic runs and does **not** fail. The MIL lamp **cannot** be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 400 days or 9600 hours of engine operation.

## Refer to Troubleshooting Fault Code t05-1666

# FAULT CODE 1666 - Exhaust Gas Temperature 1 Circuit - Voltage Above Normal, or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| **STEP 1A:** | **Check for an inactive fault code.** | **Fault Code 1666 inactive?** | |
| **STEP 2:** | **Check the exhaust gas temperature #1 sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the exhaust gas temperature #1 sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault Code 1665 is active and fault code 1666 is inactive?** | |
| **STEP 2C:** | **Check the fault codes and verify sensor condition.** | **Fault Code 1666 is active?** | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| **STEP 3A:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check the circuit response.** | **Fault Code 1665 is active and Fault Code 1666 is inactive?** | |
| **STEP 3C:** | **Check for an open circuit in the engine harness.** | **Less than 10 ohms?** | |
| **STEP 3C-1:** | **Check for an open circuit in the engine harness.** | **Less than 10 ohms?** | |
| **STEP 3D:** | **Check for a pin to pin short circuit in the engine harness.** | **Greater than 100K ohms?** | |
| **STEP 3E:** | **Check for an inactive fault code.** | **Fault Code 1666 inactive?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Disable the fault code.** | **Fault Code 1666 inactive?** | |
| **STEP 4B:** | **Clear the inactive fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes.

#### STEP 1A: Check for an inactive fault code.

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1666 inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 1666 inactive?<br>**NO** | 2A |

### STEP 2: Check the exhaust gas temperature #1 sensor and circuit.

#### STEP 2A: Inspect the exhaust gas temperature #1 sensor and connector pins.

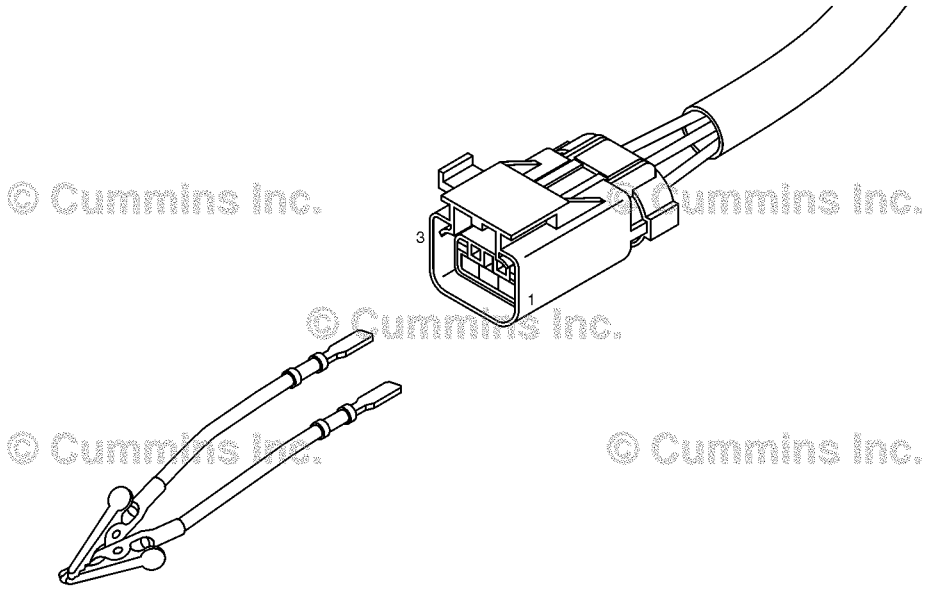
**Condition:**
- Turn keyswitch OFF.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and exhaust gas temperature #1 sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the exhaust gas temperatue #1 SIGNAL pin and the exhaust gas temperature #1 RETURN pin at the sensor connector of the engine harness.<br>• Refer to the wiring diagram for connector pin identification. | Fault Code 1665 is active and fault code 1666 is inactive?<br>**YES** | 2C |
| | Fault Code 1665 is active and fault code 1666 is inactive?<br>**NO** | 3A |

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**STEP 2C: Check the fault codes and verify sensor condition.**

**Condition:**
- Turn keyswitch OFF.
- Connect the exhaust gas temperature #1 sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1666 is active?<br>**YES**<br>**Repair:**<br>A damaged exhaust gas temperature #1 sensor has been detected.<br>Replace the exhaust gas temperature #1 sensor. Refer to Procedure 019-013 in Section 19. | 4A |
| | Fault Code 1666 is active?<br>**NO**<br>**Repair:**<br>None. The removal and installation of the connector corrected the problem. | 4A |

## STEP 3: Check the ECM and engine harness.

**STEP 3A: Inspect the ECM and engine harness connector pins.**

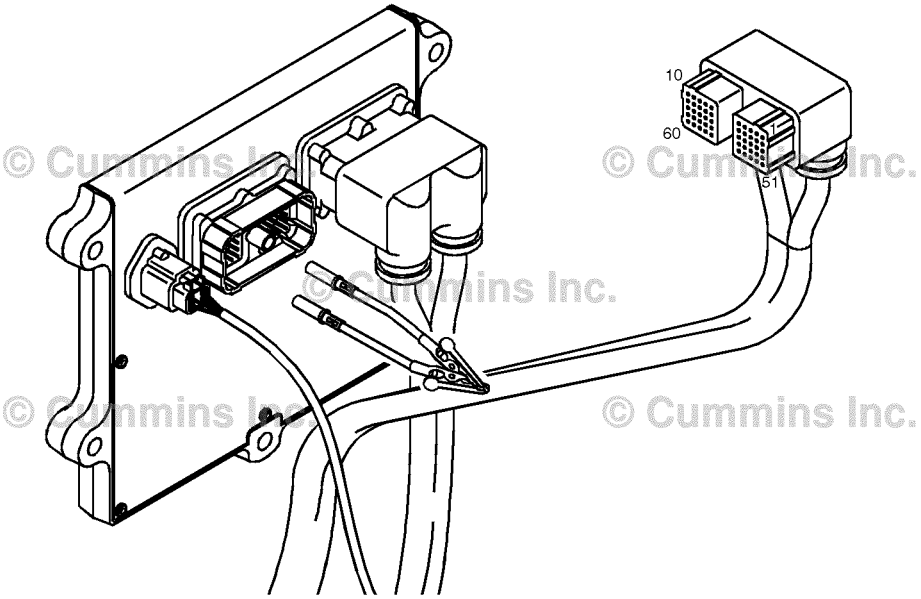
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or the engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

**STEP 3B: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

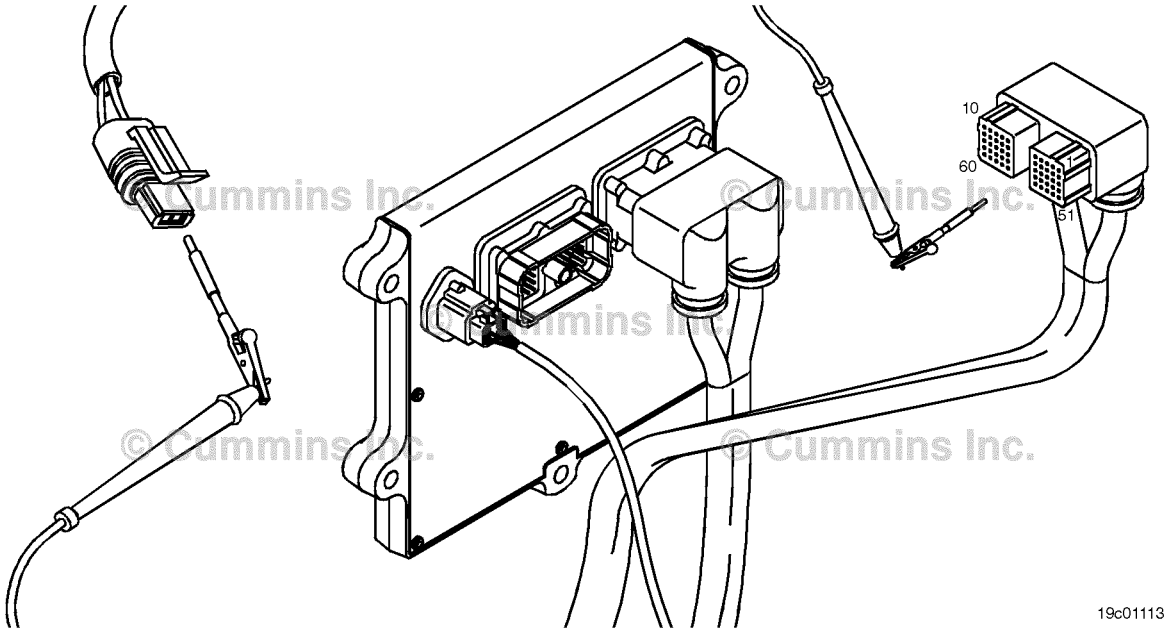
| Action | Specification/Repair | Next Step |
|---|---|---|
| Place a jumper wire between the exhaust gas temperature #1 sensor SIGNAL pin and the exhaust gas temperature #1 sensor RETURN pin at the ECM connector.<br>• Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes.<br>Refer to the wiring diagram for connector pin identification. | Fault Code 1665 active and Fault Code 1666 is inactive?<br>**YES** | 3C |
| | Fault Code 1665 active and Fault Code 1666 is inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



**STEP 3C: Check for an open circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.

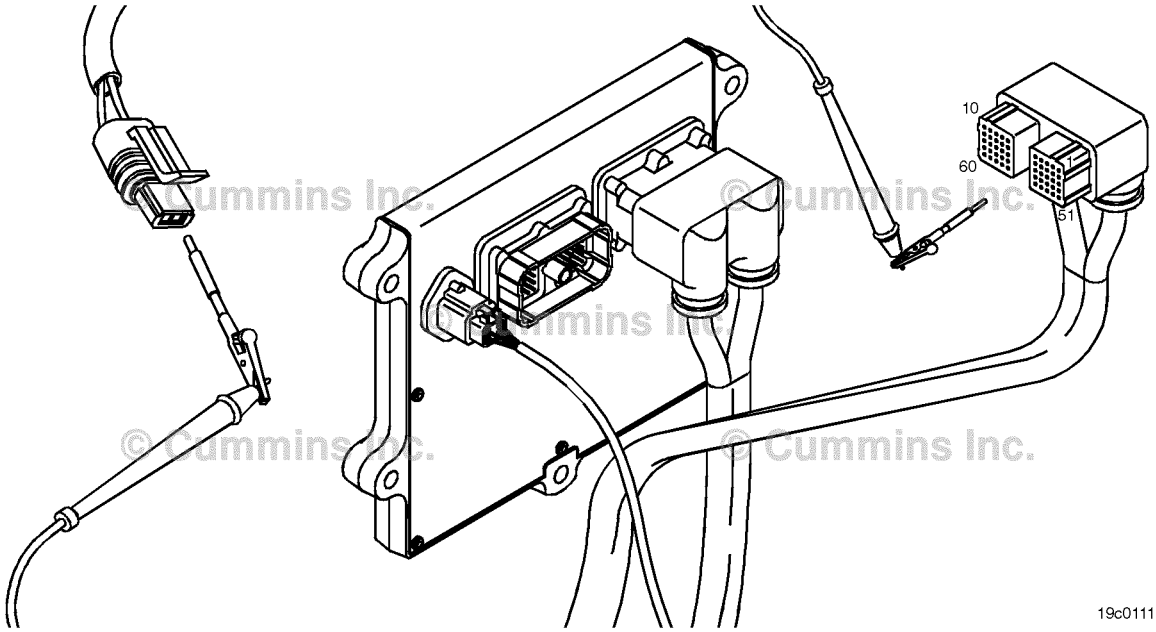
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the engine harness ECM connector exhaust gas temperature #1 sensor RETURN pin and the engine harness exhaust gas temperature #1 sensor connector RETURN pin.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3C-1 |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open RETURN circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3C-1: Check for an open circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.

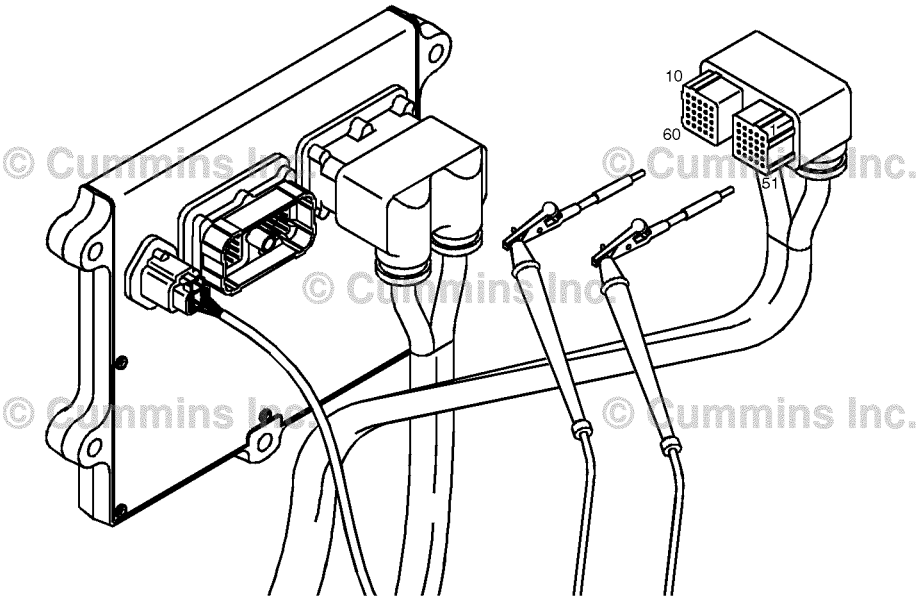
| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an open circuit.<br>• Measure the resistance between the engine harness ECM connector exhaust gas temperature #1 sensor SIGNAL pin and the engine harness exhaust gas temperature #1 sensor connector SIGNAL pin.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Less than 10 ohms?<br>**YES** | 3D |
| | Less than 10 ohms?<br>**NO**<br>**Repair:**<br>An open SIGNAL circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |



**STEP 3D: Check for a pin to pin short circuit in the engine harness.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for a pin-to-pin short.<br>• Measure the resistance between the exhaust gas temperature #1 sensor SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector.<br>Refer to the wiring diagram for connector pin identification.<br>Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. | Greater than 100K ohms?<br>**YES** | 3E |
| | Greater than 100K ohms?<br>**NO**<br>**Repair:**<br>A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

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**STEP 3E: Check for an inactive fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ to read the fault codes. | Fault Code 1666 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and installation of the connector corrected the problem. | 4A |
| | Fault Code 1666 inactive?<br>**NO**<br>**Repair:**<br>Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. | 1A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 1666 inactive?<br>**YES** | 4B |
| | Fault Code 1666 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

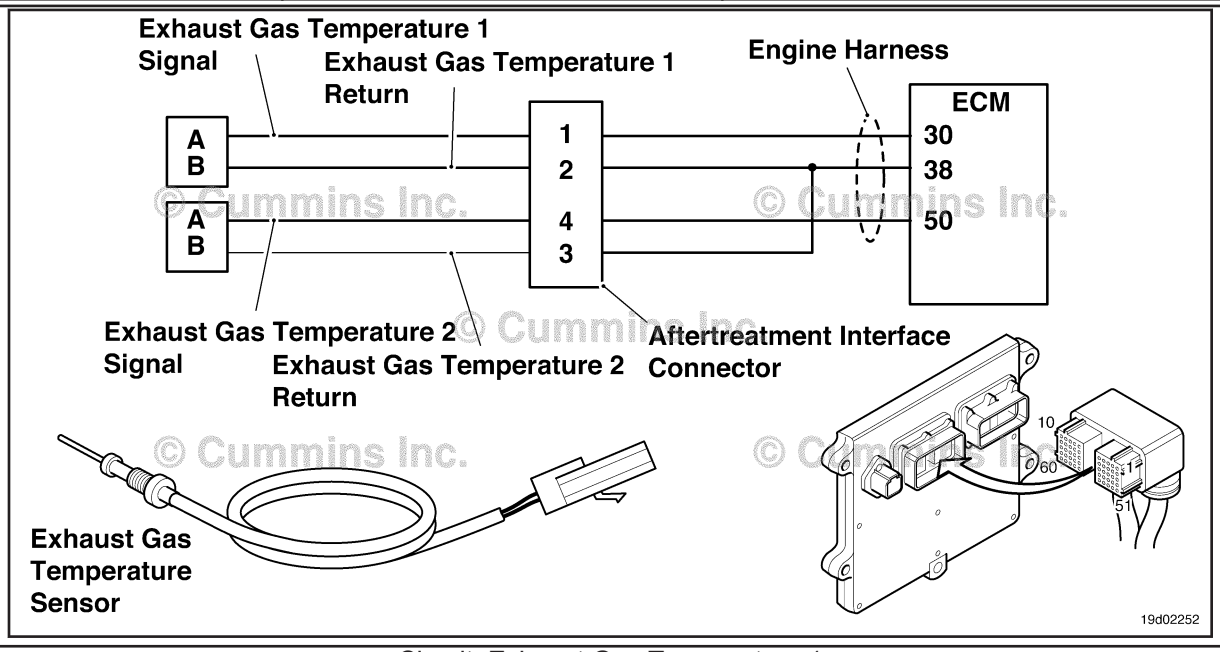
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Using INSITE™ electronic service tool erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooti ng steps |

# Fault Code 1667

## Exhaust Gas Temperature 1 — Data Erratic, Intermittent, or Incorrect

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1667<br>PID(P), SID(S):<br>SPN: 3241<br>FMI: 2<br>Lamp: Amber<br>SRT: | Exhaust Gas Temperature 1 — Data Erratic, Intermittent, or Incorrect. The exhaust gas temperature #1 sensor is not changing with engine operating conditions. | Default temperature value used for exhaust gas temperature #1. |




Circuit: Exhaust Gas Temperature 1

**Circuit Description:**

The exhaust gas temperature #1 sensor is used by the electronic control module (ECM) to monitor the engine exhaust temperature entering the catalyst unit. The ECM monitors the voltage on the signal pin and converts this to a temperature value.

**Component Location:**

The exhaust gas temperature #1 sensor is located in the aftertreatment system. It is located between the turbocharger outlet and the catalyst unit inlet in the exhaust system.

**Shop Talk:**

This diagnostic runs when the exhaust gas temperature sensors are compared to other engine temperatures during engine operation. The engine coolant temperature **must** be above 140°F before the diagnostic will run. If the value of the exhaust gas temperature #1 does **not** match the engine operating conditions, this fault code is logged.

Possible causes of this fault code include:

- Stuck in-range exhaust gas temperature #1 sensor
- High resistance in the exhaust gas temperature #1 sensor signal or return lines.

On-Board Diagnostics (OBD) Information:

- The ECM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.

- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

## Refer to Troubleshooting Fault Code t05-1667

# FAULT CODE 1667 - Exhaust Gas Temperature 1 - Data Erratic, Intermittent, or Incorrect

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check for sensor circuit fault codes.** | | |
| **STEP 1A:** | **Check for Fault Codes 1665 and 1666.** | **Fault Code 1665 or 1666 is active?** | |
| **STEP 2:** | **Check the exhaust gas temperature #1 sensor and circuit.** | | |
| **STEP 2A:** | **Inspect the exhaust gas temperature #1 sensor and connector pins.** | **Dirty or damaged pins?** | |
| **STEP 2B:** | **Check the circuit response.** | **Fault Code 1666 active?** | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| **STEP 3A:** | **Inspect the ECM and engine harness connector pins.** | **Dirty or damaged pins?** | |
| **STEP 3B:** | **Check the circuit response.** | **Fault Code 1666 active?** | |
| **STEP 4:** | **Clear the fault codes.** | | |
| **STEP 4A:** | **Verify the repair** | **Catalyst Inlet Temperature and Catalyst Outlet Temperature reading within 13.9°C or 25°F of each other?** | |
| **STEP 4B:** | **Clear the fault codes.** | **All fault codes cleared?** | |

## TROUBLESHOOTING STEP

### STEP 1: Check for sensor circuit fault codes.

**STEP 1A: Check for fault codes 1665 and 1666.**

**Condition:**
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for an active fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1665 or 1666 is active?<br>**YES** | Fault Code 1665 or 1666 troubleshooting tree. |
| | Fault Code 1665 or 1666 is active?<br>**NO** | 2A |

## STEP 2: Check the exhaust gas temperature #1 sensor and circuit.

### STEP 2A: Inspect the exhaust gas temperature #1 sensor and connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the exhaust gas temperature #1sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and exhaust gas temperature #1 sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 2B |

### STEP 2B: Check the circuit response.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine coolant temperature **must** be above 60°C [140°F].

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate ECM response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault code 1666 active?<br>**YES** | 3A |
| | Fault code 1666 active?<br>**NO**<br>**Repair:**<br>Replace the exhaust gas temperature #1 sensor. Refer to Procedure 019-013 in Section 19. | 4A |

## STEP 3: Check the ECM and engine harness.

### STEP 3A: Inspect the ECM and engine harness connector pins.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br><br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the ECM connector or the engine harness connector.<br>Clean the connector and pins. Repair the damaged harness, connector, or pins if possible.<br>Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B |

### STEP 3B: Check the circuit response.

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Engine coolant temperature **must** be above 60°C [140°F].

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1666 is active?<br>**YES**<br>**Repair:**<br>High resistance or a short circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |
| | Fault Code 1666 is active?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |

## STEP 4: Clear the fault code.

### STEP 4A: Verify the repair.

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Start the INSITE™ Data Monitor/Logger.<br>• Compare the INSITE™ electronic service tool reading for Catalyst Inlet Temperature and Catalyst Outlet Temperature. | Catalyst Inlet Temperature and Catalyst Outlet Temperature reading within 13.9°C or 25°F of each other?<br>**YES** | 4B |
| | Catalyst Inlet Temperature and Catalyst Outlet Temperature reading within 13.9°C or 25°F of each other?<br>**NO** | 1A |

### STEP 4B: Clear the fault codes.

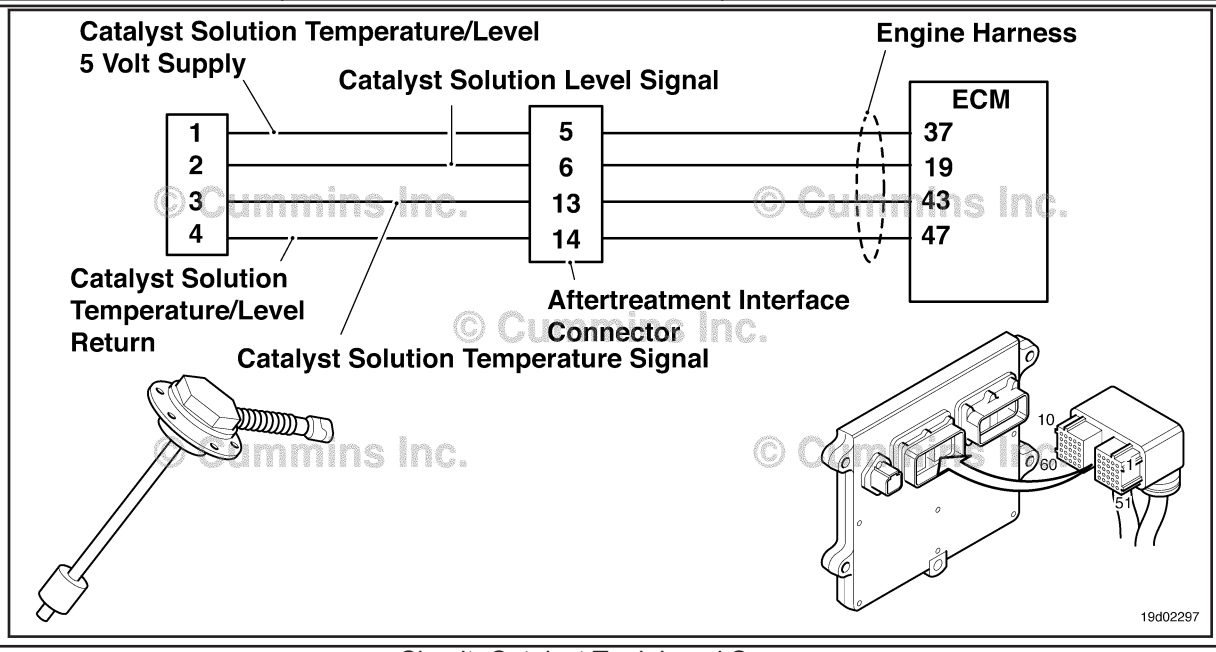
**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the fault codes.<br>• Use INSITE™ electronic service tool to erase all active and inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Fault Code 1668

## Catalyst Tank Level Sensor Circuit — Voltage Below Normal, or Shorted to Low Source

| CODES | REASON | EFFECT |
|---|---|---|
| Fault Code: 1668<br>PID(P), SID(S):<br>SPN: 1761<br>FMI: 4/4<br>Lamp: Amber<br>SRT: | Catalyst Tank Level Sensor Circuit — Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at the catalyst tank level sensor circuit. | Catalyst solution injection into the aftertreatment system is disabled. |




Circuit: Catalyst Tank Level Sensor.

**Circuit Description:**

The catalyst tank level sensor is used to monitor the catalyst solution level inside the catalyst tank. The catalyst tanks level sensor is a combination sensor with the catalyst solution temperature sensor. The level and temperature sensors share a common return circuit.

**Component Location:**

The catalyst tank level sensor is located in the catalyst solution tank. Location of the tank and level sensor is OEM dependent.

**Shop Talk:**

The catalyst tank level sensor shares supply and return wires in the engine harness with other sensors. Opens and shorts in the engine harness can cause multiple fault codes to be active.

Before troubleshooting Fault Code 1668, check for multiple faults.

Possible causes of this fault code include:

- Signal circuit open or shorted to ground in the engine harness or sensor
- Supply line open or shorted to ground.

On-Board Diagnostics (OBD) Information (Euro 4 Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

On-Board Diagnostics (OBD) Information (Euro 4 Stage 1+ Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- An engine torque derate will be activated after 50 hours of engine operation with the fault code active.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 1 ignition cycle that the diagnostic runs and does **not** fail. The MIL lamp **cannot** be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 400 days or 9600 hours of engine operation.

## Refer to Troubleshooting Fault Code t05-1668

# FAULT CODE 1668 - Catalyst Tank Level Sensor Circuit - Voltage Below Normal, or Shorted to Low Source

## TROUBLESHOOTING SUMMARY

**⚠CAUTION⚠**

**To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**

**⚠CAUTION⚠**

**To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.**

| STEPS | | SPECIFICATIONS | SRT CODE |
|---|---|---|---|
| **STEP 1:** | **Check the fault codes.** | | |
| STEP 1A: | Check for sensor supply fault codes. | Fault Code 187 active? | |
| STEP 1B: | Check for an inactive fault code. | Fault Code 1668 inactive? | |
| **STEP 2:** | **Check the catalyst tank level sensor and circuit.** | | |
| STEP 2A: | Inspect the catalyst tank level sensor and connector pins. | Dirty or damaged pins? | |
| STEP 2B: | Check the sensor supply voltage and return circuit. | 4.75 to 5.25 VDC? | |
| STEP 2C: | Check the circuit response. | Fault Code 1669 active and fault code 1668 inactive? | |
| STEP 2D: | Check the fault codes and verify sensor condition. | Fault code 1668 active? | |
| **STEP 3:** | **Check the ECM and engine harness.** | | |
| STEP 3A: | Inspect the ECM and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 3A-1: | Check the sensor supply voltage and return circuit. | 4.75 to 5.25 VDC? | |
| STEP 3A-2: | Check for an active fault code. | Fault Code 1668 inactive? | |
| STEP 3B: | Inspect engine control module and engine harness connector pins. | Dirty or damaged pins? | |
| STEP 3B-1: | Check the engine control module response. | Fault Code 1669 active and fault code 1668 inactive? | |
| STEP 3B-2: | Check for an active fault code. | Fault Code 1668 inactive? | |
| **STEP 4:** | **Clear the fault codes.** | | |
| STEP 4A: | Disable the fault code. | Fault Code 1668 inactive? | |
| STEP 4B: | Clear the inactive fault codes. | All fault codes cleared? | |

## TROUBLESHOOTING STEP

### STEP 1: Check the fault codes

**STEP 1A: Check for sensor supply fault codes.**

**Condition:**
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for sensor supply fault codes.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 187 active?<br>**YES** | Refer to Fault Code 187 |
| | Fault Code 187 active?<br>**NO** | 1B |

**STEP 1B: Check for an inactive fault code.**

**Condition:**
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for inactive fault code.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1668 is inactive?<br>**YES** | Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19. |
| | Fault Code 1668 is inactive?<br>**NO** | 2A |

## STEP 2: Check the catalyst tank level sensor and circuit.

### STEP 2A: Inspect the catalyst tank level sensor and connector pins.

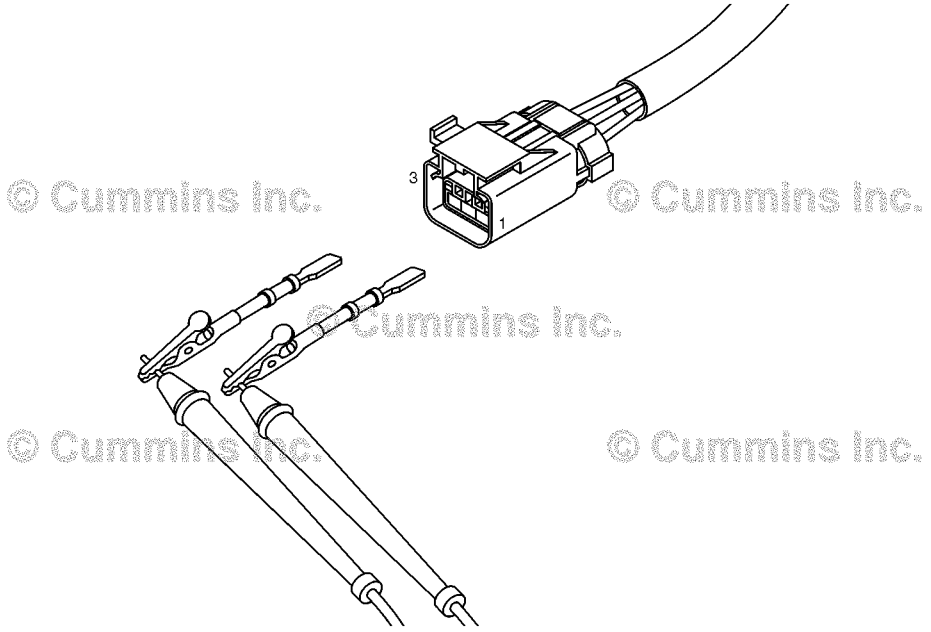
**Condition:**
- Turn keyswitch OFF.
- Disconnect the catalyst tank level sensor from the engine harness.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and catalyst tank level sensor connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the sensor or harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 2B |

**STEP 2B: Check the sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the catalyst tank level sensor from the engine harness.
- Turn keyswitch ON.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the supply voltage and return circuit.<br>• Measure the voltage from the CATALYST TANK LEVEL +5 VDC SUPPLY pin to the CATALYST TANK LEVEL RETURN pin at the sensor connector of the engine harness.<br>Refer to the wiring diagram for connector pin identification. | 4.75 to 5.25 VDC?<br>**YES** | 2C |
| | 4.75 to 5.25 VDC?<br>**NO** | 3A |



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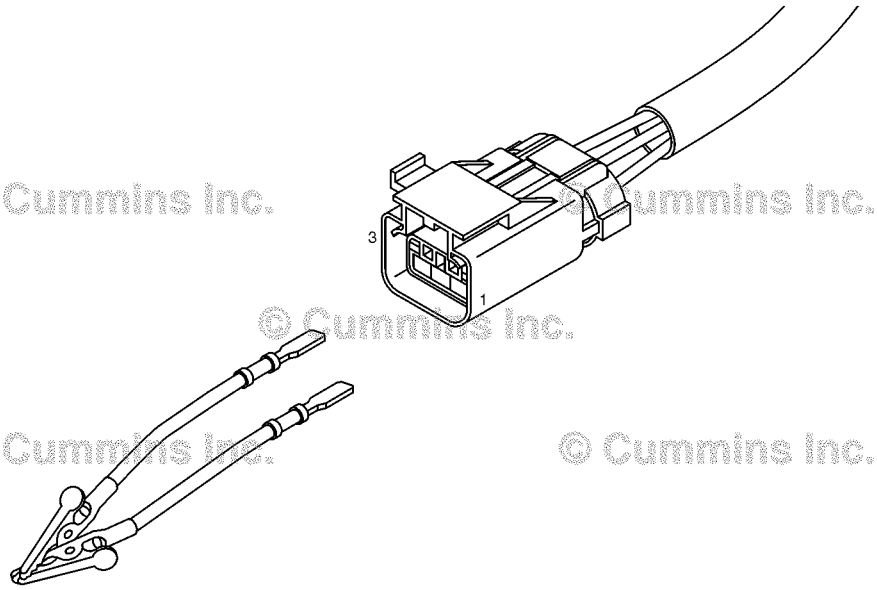
**STEP 2C: Check the circuit response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the catalyst tank level sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the appropriate circuit response after 30 seconds.<br>• Place a jumper wire between the CATALYST TANK LEVEL +5 VDC SUPPLY pin and the CATALYST TANK LEVEL SIGNAL pin at the catalyst tank level sensor connector of the engine harness.<br>• Using INSITE™ electronic service tool read the fault codes. | Fault Code 1669 active and Fault Code 1668 inactive?<br>**YES** | 2D |
| | Fault Code 1669 active and Fault Code 1668 inactive?<br>**NO** | 3B |

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**STEP 2D: Check the fault codes and verify sensor condition**

**Condition:**
- Turn keyswitch OFF.
- Connect the catalyst tank level sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the approriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault code 1668 is active?<br>**YES**<br>**Repair:**<br>A damaged sensor has been detected.<br>Replace the catalyst tank level sensor. Refer to OEM service manual. | 4A |
| | Fault code 1668 is active?<br>**NO**<br>**Repair:**<br>None. The removal and reinstallation of the connector corrected the problem. | 4A |

## STEP 3: Check the ECM and engine harness.

**STEP 3A: Inspect the ECM and engine harness connector pins.**

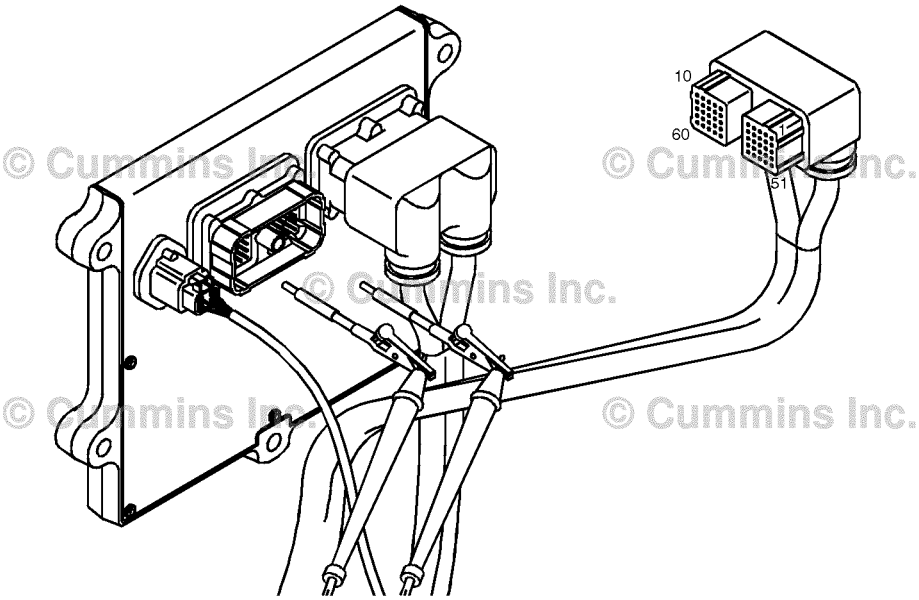
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Inspect the engine harness and ECM engine connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A defective connection has been detected in the ECM connector or the engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**NO** | 3A-1 |

**STEP 3A-1: Check the sensor supply voltage and return circuit.**

**Condition:**
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Turn keyswitch ON

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the supply voltage and return circuit.<br>• Measure the voltage from the CATALYST TANK LEVEL +5 VDC SUPPLY pin to the CATALYST TANK LEVEL RETURN pin at the engine control module engine connector.<br>Refer to the wiring diagram for connector pin identification. | 4.75 to 5.25 VDC?<br>**YES** | 3A-2 |
| | 4.75 to 5.25 VDC?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |



**STEP 3A-2: Check for an active fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool read the fault codes. | Fault Code 1668 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and reinstallation of the connector corrected the problem. | 4A |
| | Fault Code 1668 active?<br>**NO**<br>**Repair:**<br>An open or shorted SUPPLY circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

**STEP 3B: Inspect engine control module and engine harness connector pins.**

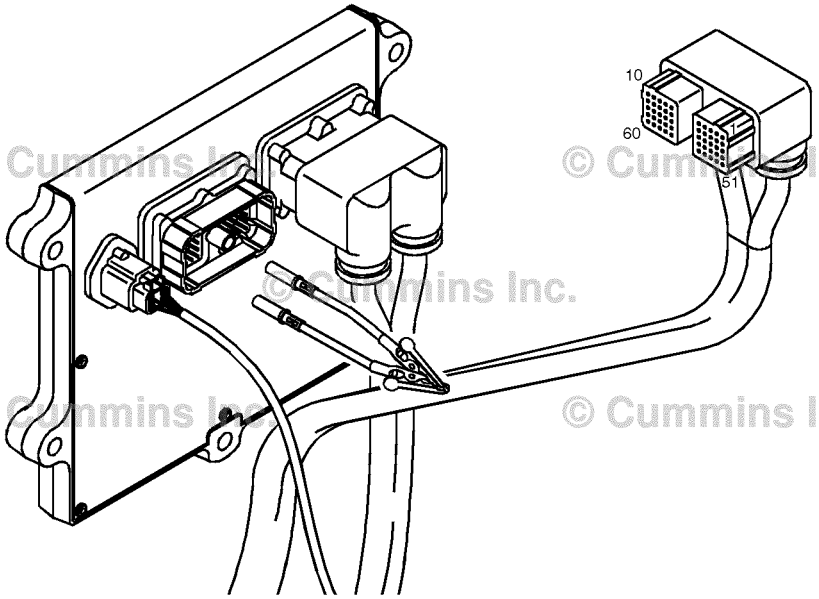
**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

| Action | Specification/Repair | Next Step |
|---|---|---|
| :Inspect the engine harness and engine control module engine connector pins for the following:<br>• Loose connector<br>• Corroded pins<br>• Bent or broken pins<br>• Pushed back or expanded pins<br>• Moisture in or on the connector<br>• Missing or damaged connector seals<br>• Dirt or debris in or on the connector pins<br>• Connector shell broken<br>• Wire insulation damage<br>• Damaged connector locking tab.<br>Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. | Dirty or damaged pins?<br>**YES**<br>**Repair:**<br>A damaged connection has been detected in the engine control module engine connector or engine harness connector.<br>Clean the connector and pins.<br>Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-043 in Section 19. | 4A |
| | Dirty or damaged pins?<br>**NO** | 3B-1 |

**STEP 3B-1: Check the engine control module response.**

**Condition:**
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check the appropriate circuit response after 30 seconds.<br>• Place a jumper wire between the CATALYST TANK LEVEL +5 VDC SUPPLY pin and the CATALYST TANK LEVEL SIGNAL pin at the engine control module engine connector.<br>• Using INSITE™ electronic service tool read the fault codes. | Fault Code 1669 active and Fault Fode 1668 inactive?<br>**YES** | 3B-2 |
| | Fault Code 1669 active and Fault Fode 1668 inactive?<br>**NO**<br>**Repair:**<br>Replace the ECM. Refer to Procedure 019-031 in Section 19. | 4A |




19c01111

**STEP 3B-2: Check for an active fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Check for the appropriate circuit response after 30 seconds.<br>• Use INSITE™ electronic service tool to read the fault codes. | Fault Code 1668 inactive?<br>**YES**<br>**Repair:**<br>None. The removal and reinstallation of the connector corrected the problem. | 4A |
| | Fault Code 1668 inactive?<br>**NO**<br>**Repair:**<br>An open circuit or pin-to-pin short circuit has been detected in the engine harness.<br>Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. | 4A |

## STEP 4: Clear the fault code.

**STEP 4A: Disable the fault code.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Disable the fault code.<br>• Start the engine and let it idle for 1 minute.<br>• Use INSITE™ electronic service tool to verify the fault code is inactive. | Fault Code 1668 inactive?<br>**YES** | 4B |
| | Fault Code 1668 inactive?<br>**NO** | 1A |

**STEP 4B: Clear the inactive fault codes.**

**Condition:**
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

| Action | Specification/Repair | Next Step |
|---|---|---|
| Clear the inactive fault codes.<br>• Use INSITE™ electronic service tool to erase the inactive fault codes. | All fault codes cleared?<br>**YES** | Repair complete |
| | All fault codes cleared?<br>**NO** | Appropriate troubleshooting steps |

# Notes

## Fault Codes

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