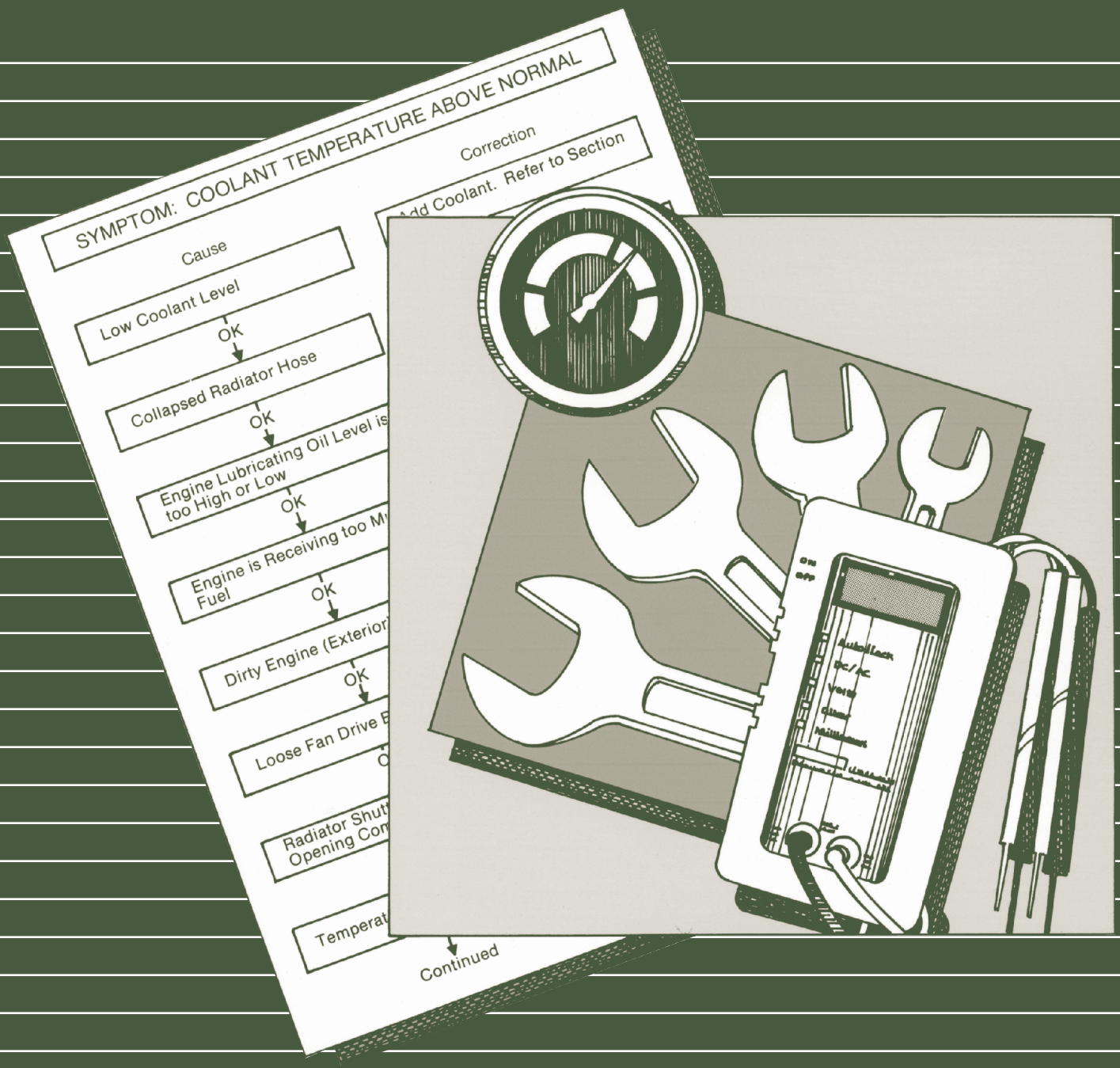
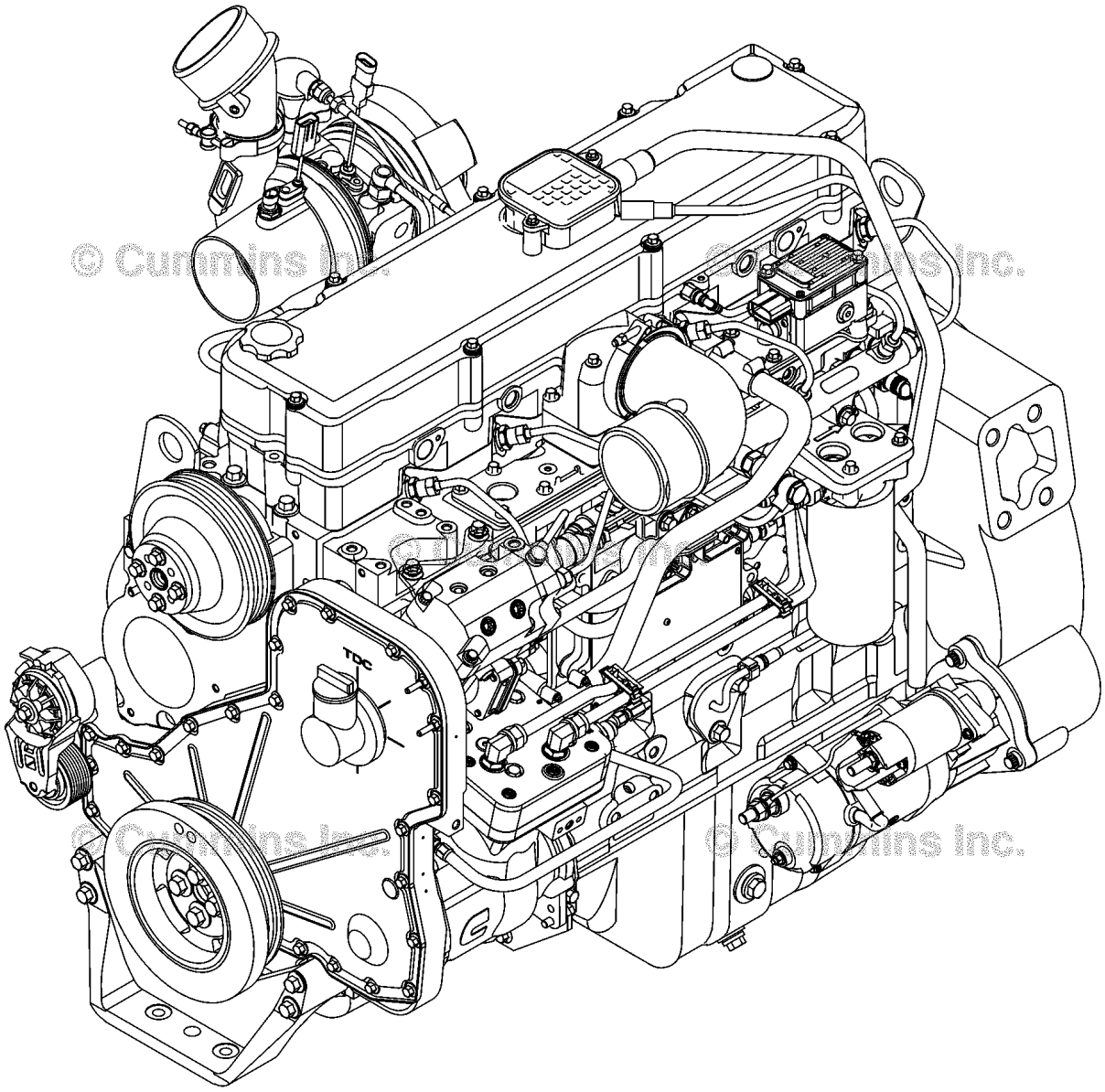
Troubleshooting and Repair Manual ISB, ISBe2, ISBe3, ISBe4, QSB4.5, QSB5.9, QSB6.7, ISC, QSC8.3, ISL, ISLe3, ISLe4, and QSL9, CM850 Electronic Control System Volume 1



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 1



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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.

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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.

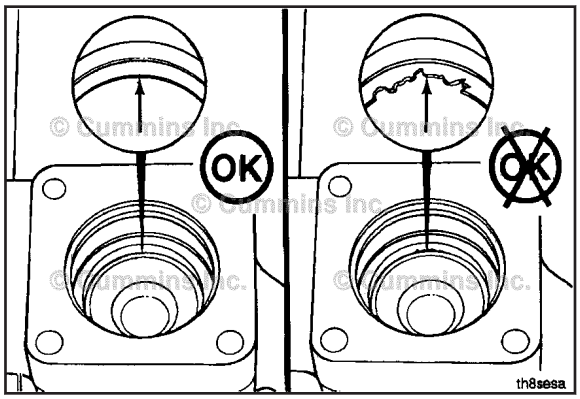
To reduce the risk of high voltage shock, always follow all warnings and service instructions. Always assume the vehicle and its high voltage system are energized, even if the engine is not running.

Approved high voltage insulated gloves are required for this procedure.

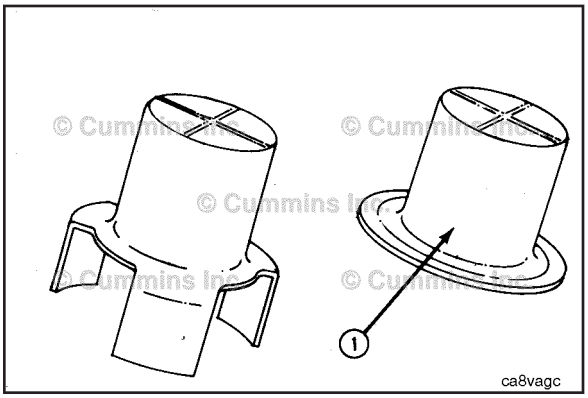
Illustrations

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 E - Engine and System Identification

Section Contents

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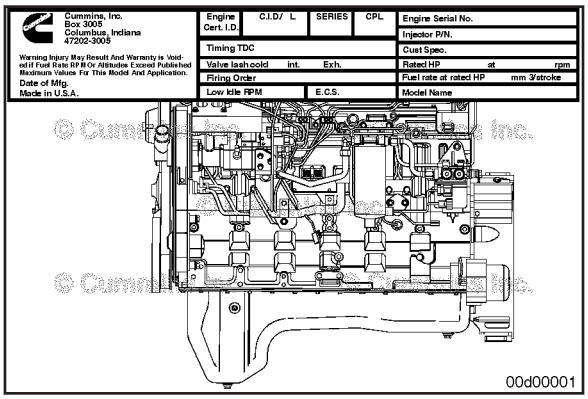
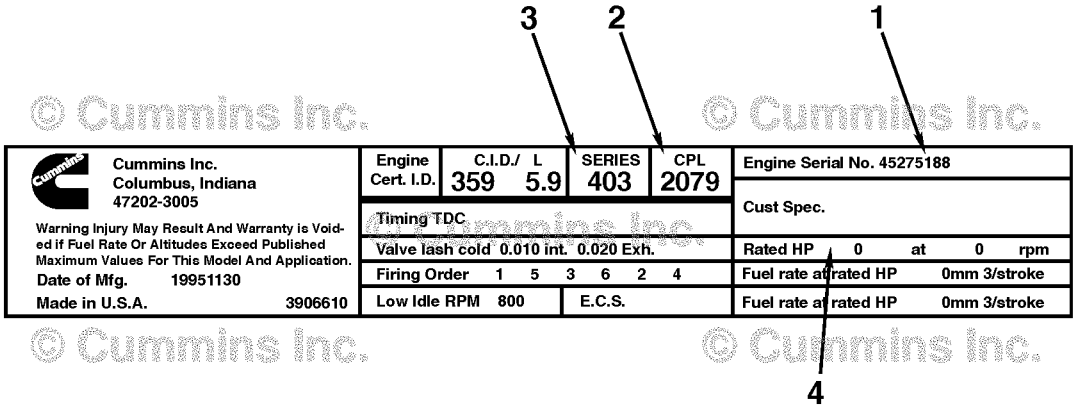
Engine Identification

Engine Dataplate

The engine dataplate provides important information about the engine. The engine serial number (ESN) and control part list (CPL) provide information for service andfor ordering parts. The engine dataplate **must not** be changed unless approved by Cummins Inc.





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Have the following engine data available when communicating with a Cummins® Authorized Repair Location:

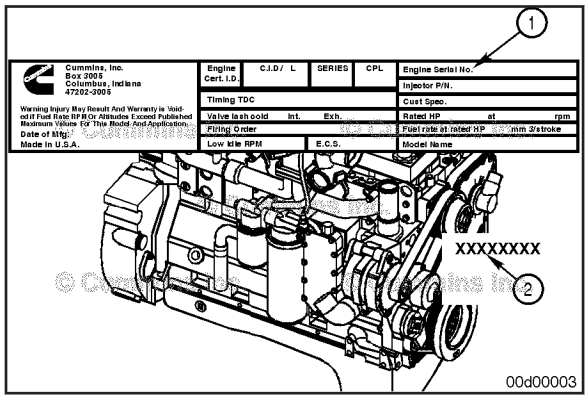
1 Engine serial number (ESN)

2 Control parts list (CPL) number

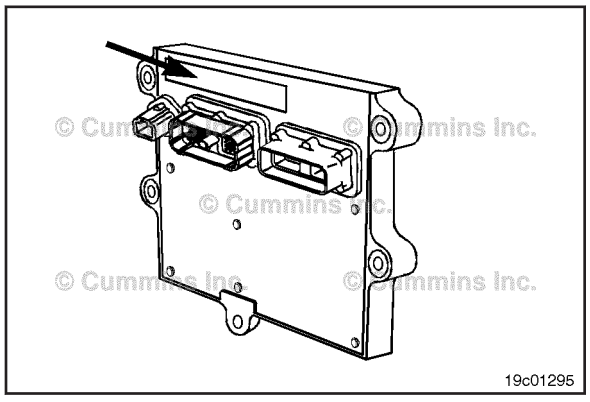
3 Model

4 Advertised horsepower and rpm.

NOTE: Depending on the manufacturing plant, calibration data may also be be found on the engine dataplate.



If the engine dataplate (1) is **not** readable, the ESN (2) can be found on the engine block, on top of the lubricating oil cooler housing. Additional engine information can be found on the electronic control module (ECM) dataplate.



ECM Dataplate

The ECM dataplate is located on the front of the ECM.

The following information is available on the ECM dataplate:

- ECM part number (PN)
- ECM serial number (SN)
- ECM date code (DC)
- Engine serial number (ESN)
- ECM code (identifies the software in the ECM).

NOTE: The presence of an ECM dataplate depends on the manufacturing plant and the date the engine was manufactured. If an ECM dataplate was **not** installed by the manufacturing plant, calibration data can be found on the engine dataplate.

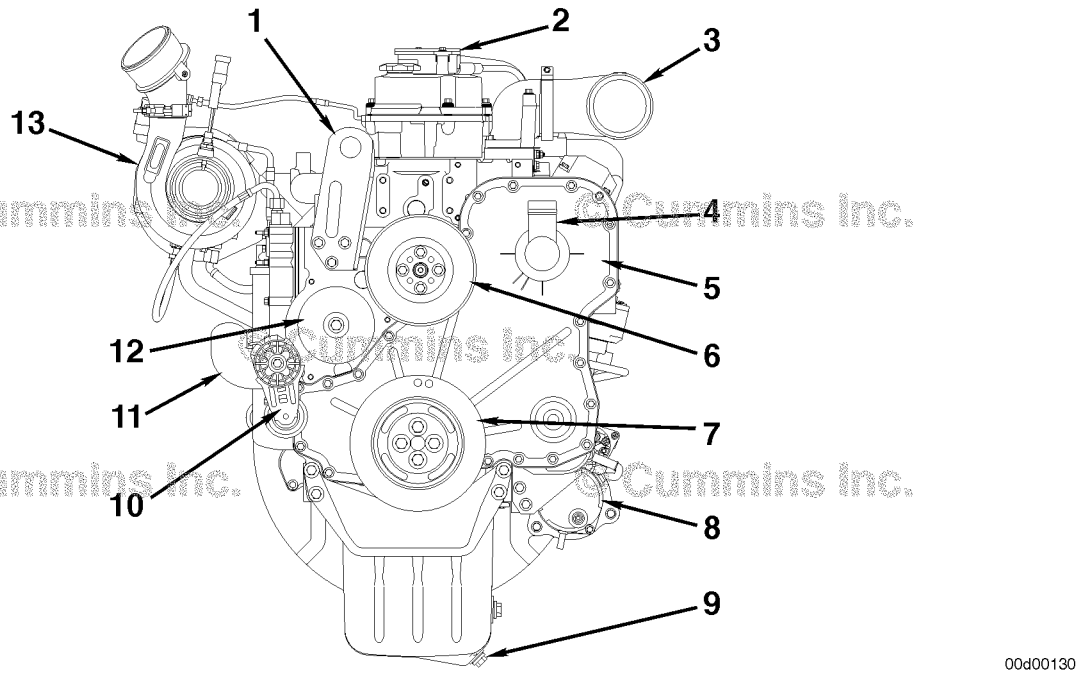
Engine Diagrams

Engine Views

With CM850

The following illustrations provide the locations of the major external engine components, filters, and other service and maintenance points. Some external components will be at different locations for different engine models.

NOTE: The illustrations are **only** a reference to show a typical engine.



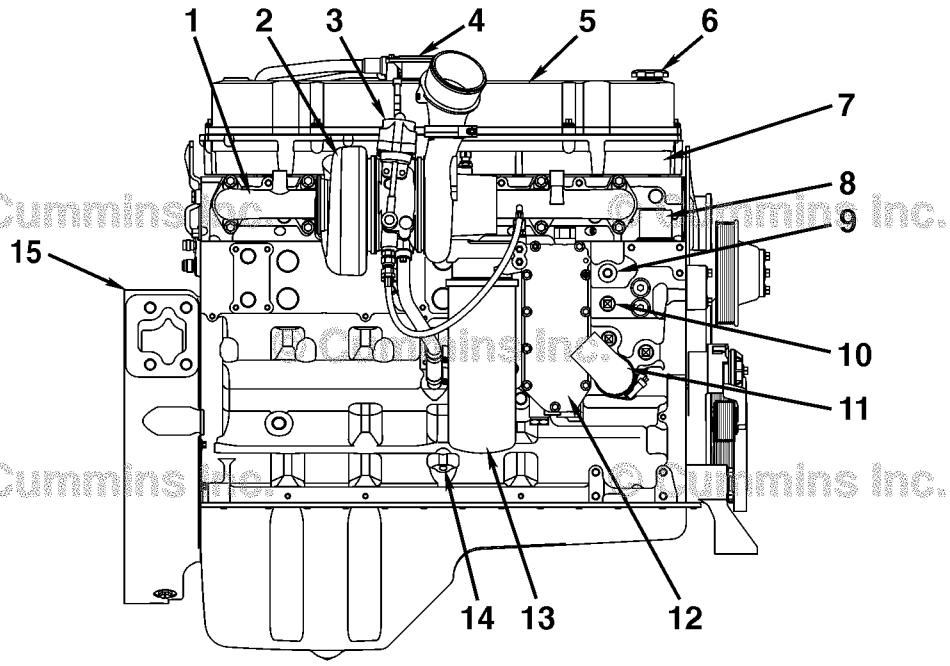
Front View (ISC, QSC8.3, ISL, and QSL9)

1 Engine lifting bracket
2 Crankcase breather
3 Air intake connection
4 Engine oil fill
5 Front gear cover
6 Fan pulley
7 Vibration Damper
8 Starter
9 Engine oil pan drain plug
10 Automatic belt tensioner
11 Coolant inlet connection
12 Water pump
13 Turbocharger (Variable Geometry Turbocharger shown)

Engine Diagrams

Engine Views

With CM850



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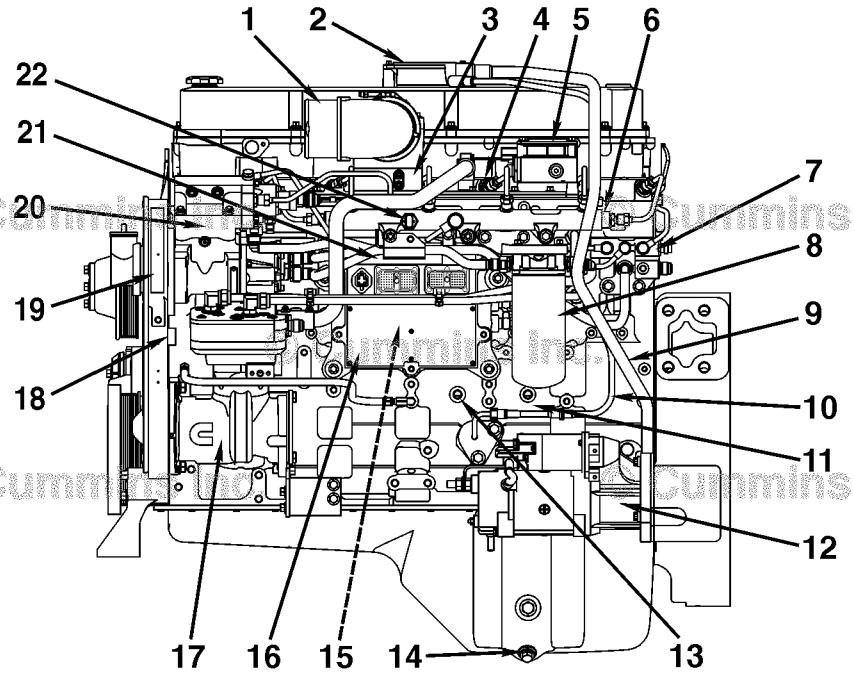
Exhaust Side View (ISC, QSC8.3, ISL, and QSL9)

1 Exhaust manifold
2 Turbocharger (variable geometry turbocharger shown)
3 Variable geometry turbocharger actuator
4 Crankcase breather
5 Rocker lever cover
6 Engine oil fill
7 Rocker lever housing
8 Coolant outlet connection
9 Coolant temperature sensor
10 Coolant heater port
11 Coolant inlet connection
12 Lubricating oil cooler
13 Lubricating oil filter
14 Dipstick location
15 Flywheel housing.

Engine Diagrams

Engine Views

With CM850



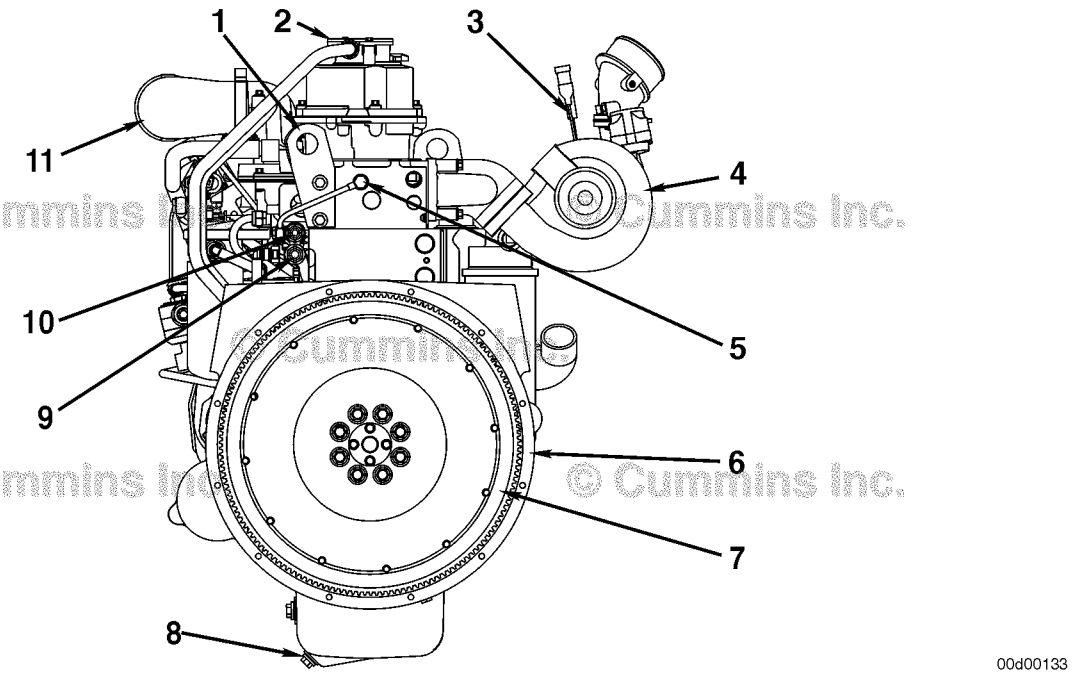
Intake Side View (ISC, QSC8.3, ISL, and QSL9)

1 Air intake connection
2 Crankcase breather
3 Intake air heater
4 Intake manifold pressure and temperature sensor
5 Turbocharger control valve
6 Fuel rail
7 Fuel drain manifold
8 Fuel filter
9 Crankcase breather draft tube
10 Crankcase breather oil drain tube
11 Crankshaft speed sensor
12 Starter
13 Lubricating oil pressure sensor
14 Engine oil drain plug
15 Fuel lift pump (behind ECM)
16 Electronic control module (ECM)
17 Air compressor
18 Camshaft speed sensor
19 Engine data plate
20 High-pressure fuel pump
21 Ambient air pressure sensor
22 Fuel rail pressure sensor.

Engine Diagrams

Engine Views

With CM850



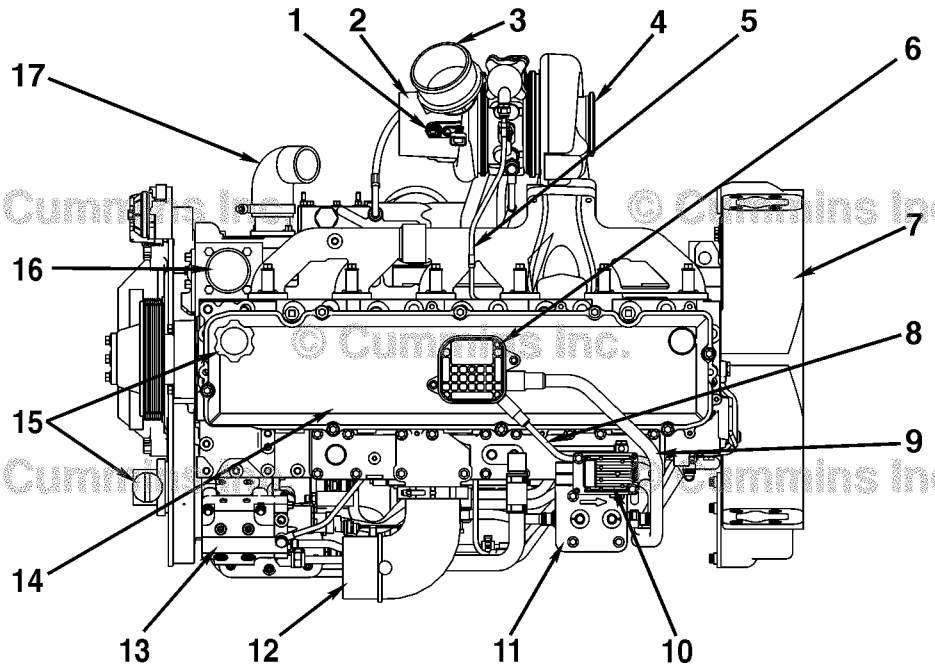
Rear View (ISC, QSC8.3, ISL, and QSL9)

1 Engine lifting bracket
2 Crankcase breather
3 Turbocharger speed sensor (**only** on variable geometry turbochargers)
4 Turbocharger (variable geometry turbocharger shown)
5 Injector drain line connection
6 Flywheel housing
7 Flywheel
8 Engine oil drain plug
9 OEM fuel supply line connection
10 OEM fuel drain line connection
11 Air intake connection.

Engine Diagrams

Engine Views

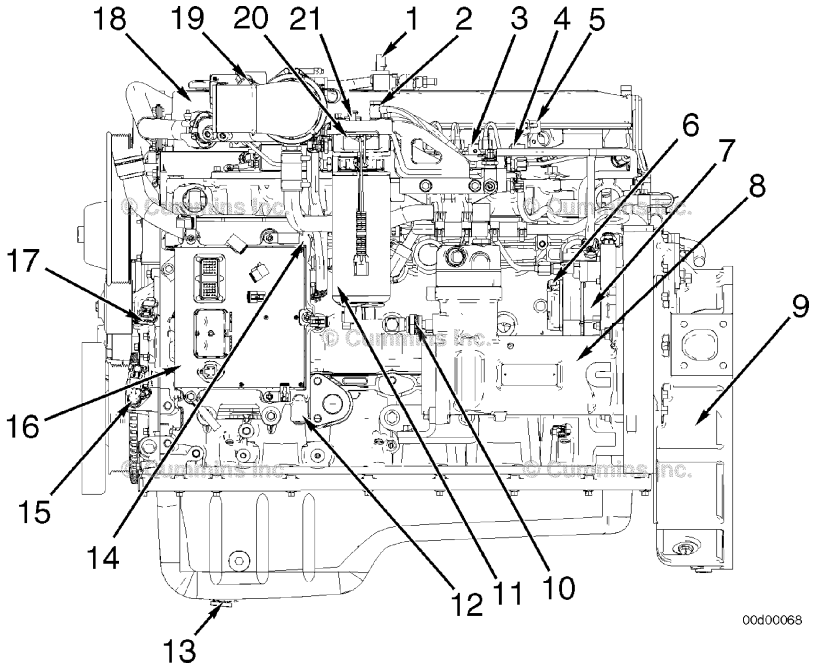
With CM850



Top View (ISC, QSC8.3, ISL, and QSL9)

1 Turbocharger compressor inlet temperature sensor
2 Turbocharger air inlet
3 Turbocharger air outlet
4 Turbocharger exhaust outlet
5 Turbocharger actuator air line
6 Crankcase breather
7 Flywheel housing
8 Crankcase breather oil drain tube
9 Crankcase breather draft tube
10 Turbocharger control valve
11 Fuel filter bracket
12 Air inlet connection
13 High-pressure fuel pump
14 Crankcase pressure sensor (**only** on recreational vehicles)
15 Engine oil fill
16 Coolant outlet connection
17 Coolant inlet connection.

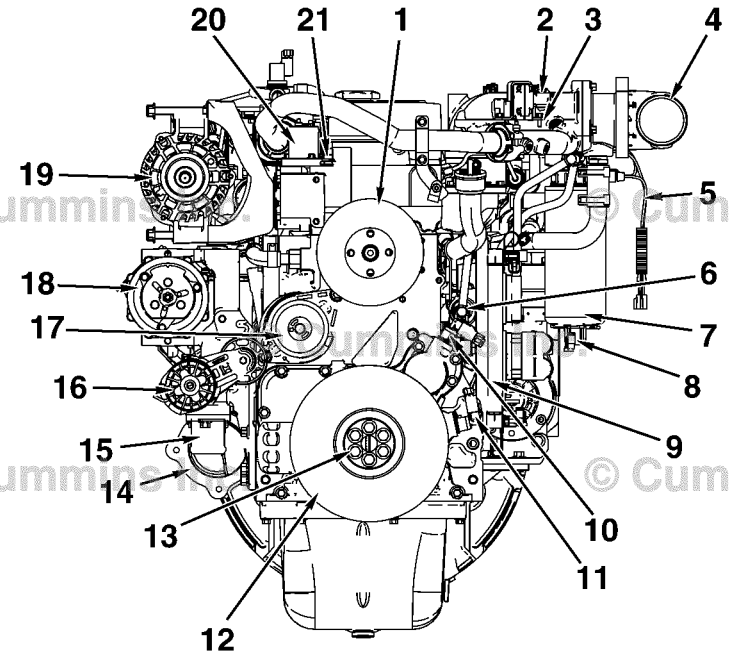
ISB



Intake Side View (CM850 Electronic Control Module)

1 Exhaust pressure sensor
2 Fuel rail pressure relief valve
3 Fuel rail
4 Intake manifold pressure sensor
5 Intake temperature sensor
6 Electronic fuel control (EFC) actuator
7 Bosch® fuel pump
8 Air compressor
9 Flywheel housing
10 Oil pressure switch
11 Fuel filter
12 Fuel inlet to cooling plate
13 Oil pan drain plug
14 Barometric pressure sensor
15 Engine speed sensor (crankshaft)
16 Electronic control module
17 Engine speed sensor (camshaft)
18 Air intake inlet
19 EGR temperature sensor
20 Fuel heater
21 Fuel rail pressure sensor.

ISB



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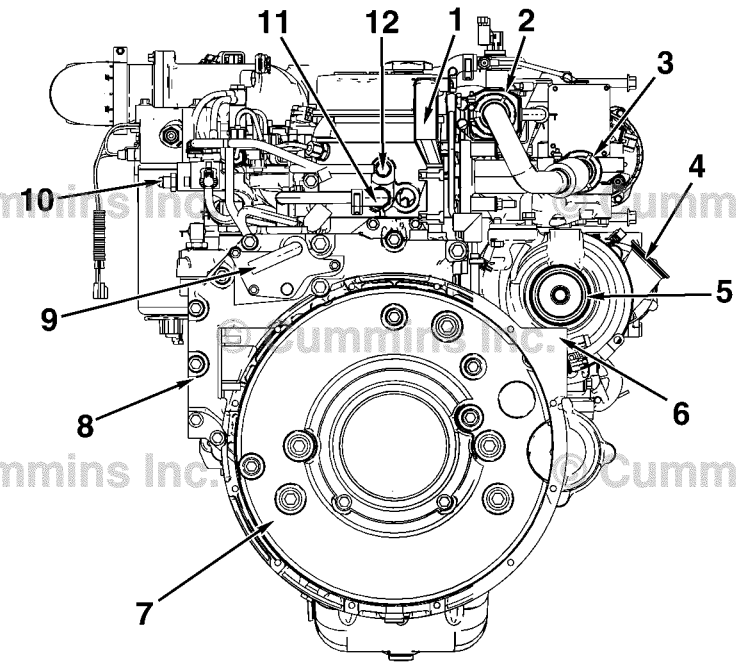
Front View (CM850 Electronic Control Module)

1 Fan drive
2 EGR differential pressure sensor
3 EGR temperature sensor
4 Air inlet
5 Fuel heater
6 Fuel lift pump
7 Fuel filter
8 Water-in-fuel sensor
9 Electronic control module
10 Engine speed sensor (camshaft)
11 Engine speed sensor (crankshaft)
12 Vibration damper
13 Fan or PTO drive flange mounting
14 Starter
15 Coolant inlet
16 Belt tensioner
17 Water pump
18 Freon compressor
19 Alternator
20 Coolant outlet
21 Coolant temperature sensor.

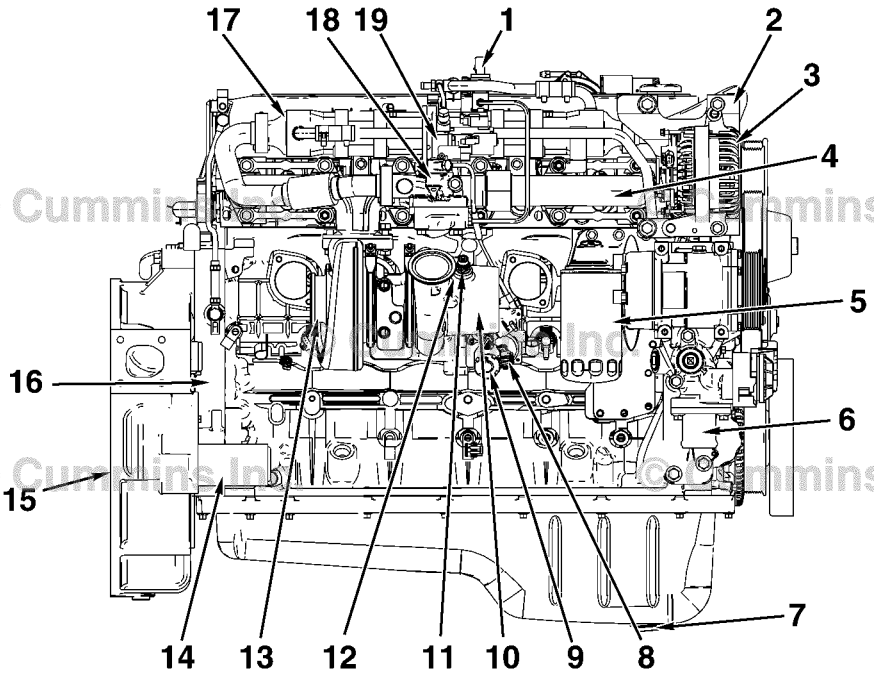
ISB



Rear View (CM850 Electronic Control Module)

1 Breather tube (valve cover to gear housing)
2 EGR cooler
3 EGR valve
4 Air outlet from turbocharger
5 Turbocharger exhaust outlet
6 Flywheel housing
7 Flywheel
8 Gear housing
9 Crankcase breather
10 Fuel out (return to tank)
11 Coolant connection for air compressor
12 Fuel return line.

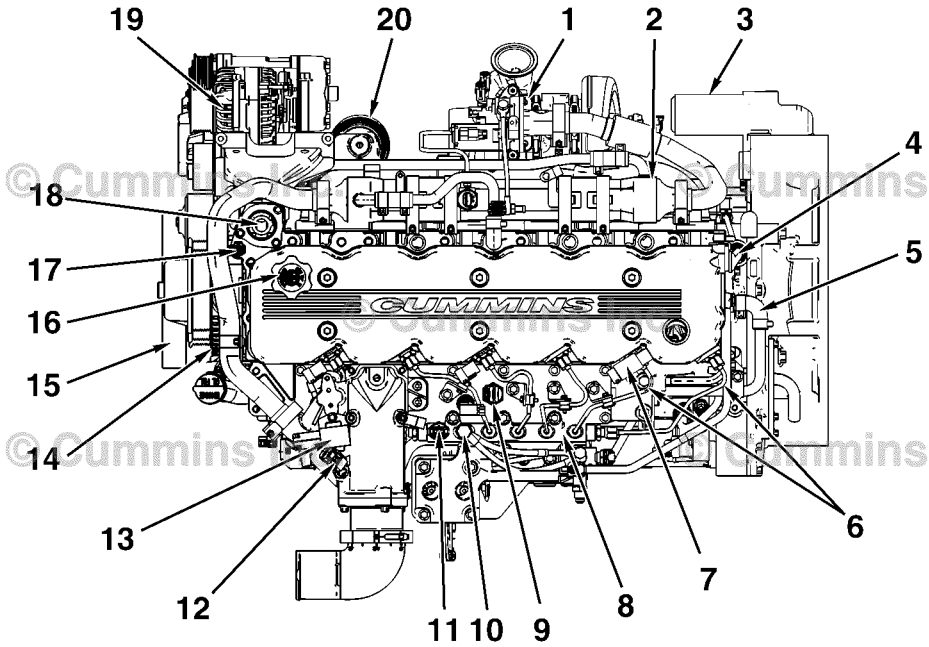
ISB



Exhaust Side View (CM850 Electronic Control Module)

1 Exhaust pressure sensor
2 Coolant outlet
3 Alternator
4 Exhaust manifold
5 Oil filter
6 Coolant inlet
7 Oil pan drain plug
8 Turbocharger position sensor
9 Turbocharger actuator
10 Turbocharger compressor inlet
11 Compressor inlet temperature sensor
12 Turbocharger speed sensor
13 Turbocharger exhaust outlet
14 Starter
15 Flywheel housing
16 Gear housing
17 EGR cooler
18 EGR valve
19 EGR actuator.

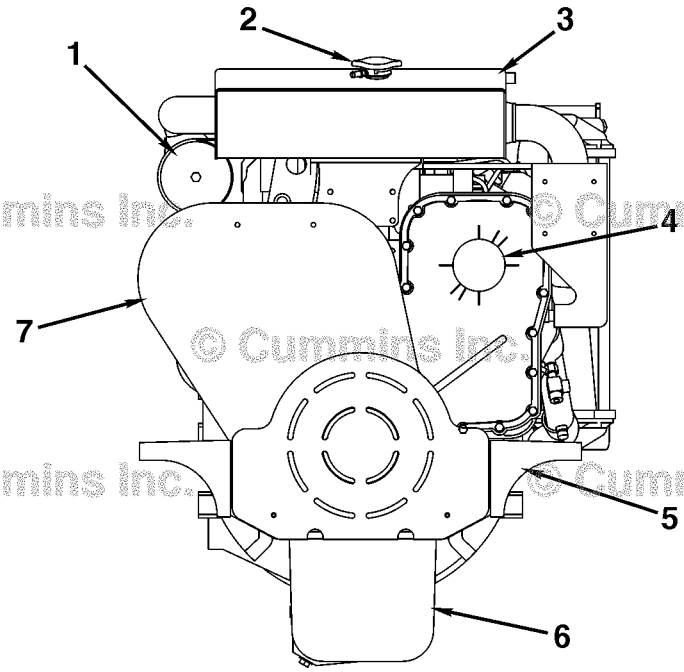
ISB



Top View (CM850 Electronic Control Module)

1 EGR valve
2 EGR cooler
3 Starter
4 Breather tube (valve cover to gear housing)
5 Air compressor cooling connection
6 High-pressure fuel lines
7 Intake temperature sensor
8 Fuel rail
9 Intake manifold pressure sensor
10 Fuel rail pressure relief valve
11 Fuel rail pressure sensor
12 EGR temperature sensor
13 EGR differential pressure sensor
14 Tone wheel
15 Vibration damper
16 Oil fill cap
17 Coolant temperature sensor
18 Coolant outlet
19 Alternator
20 Oil filter.

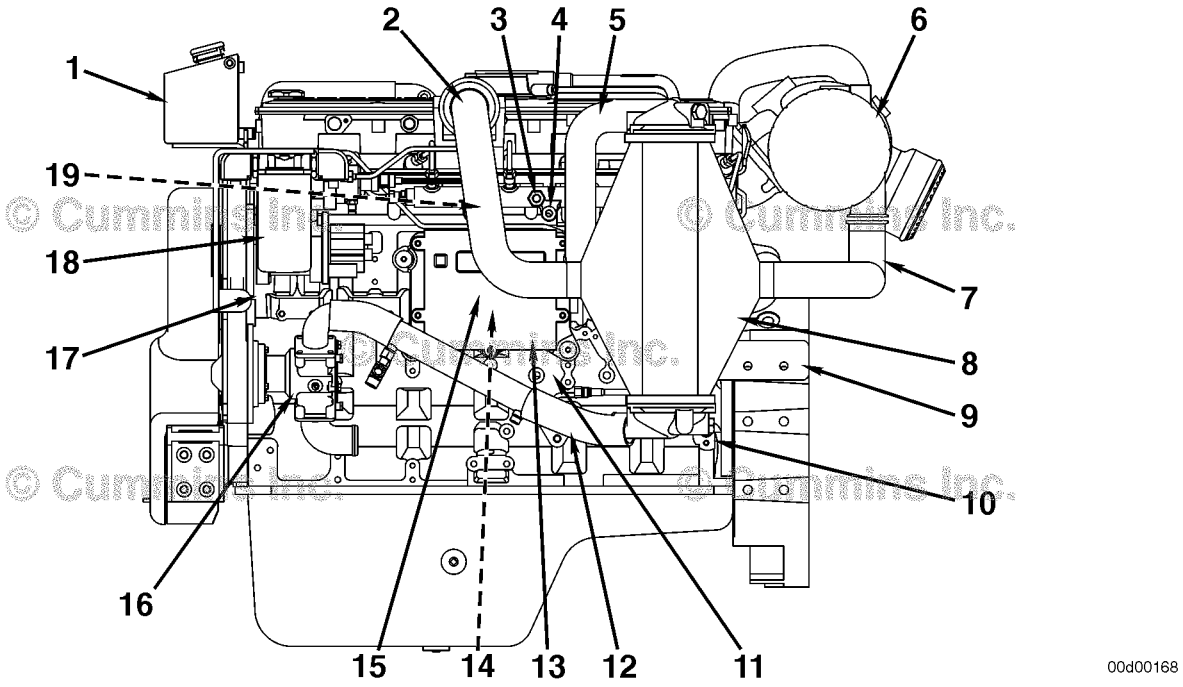
Marine Applications



QSL Front View (CM850 Electronic Control Module)

1 Heat exchanger
2 Coolant fill cap
3 Expansion tank
4 Timing case cover
5 Engine mounting bracket
6 Oil pan
7 Belt and fan guard.

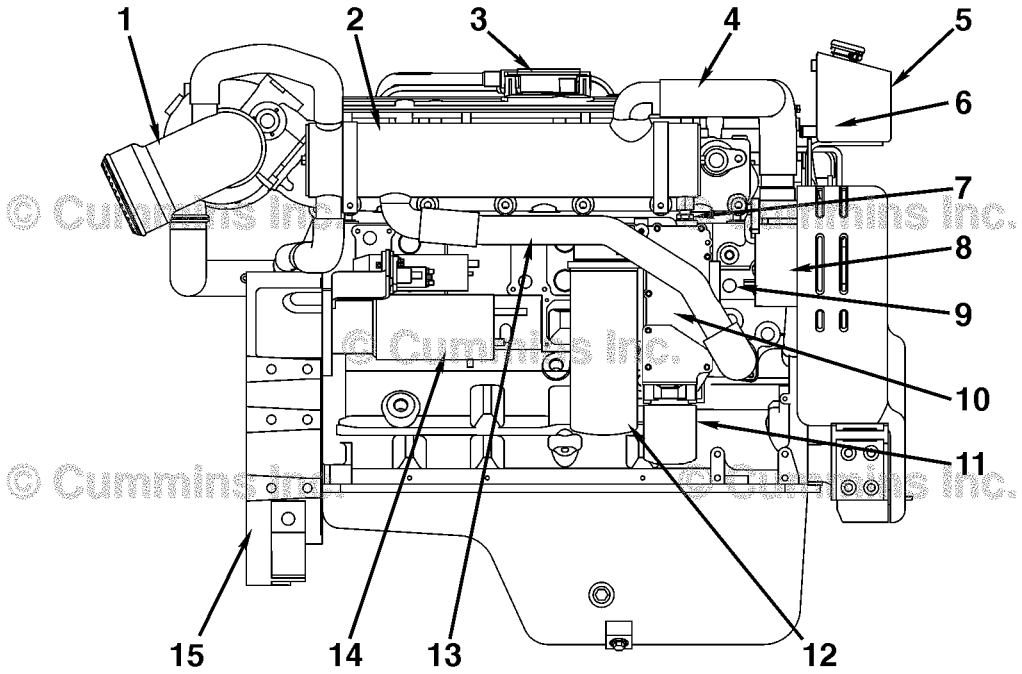
Marine Applications



QSL Port View (CM850 Electronic Control Module)

1 Expansion tank
2 Aftercooler air outlet
3 Intake manifold temperature sensor
4 Intake manifold pressure sensor
5 Aftercooler seawater outlet
6 Air cleaner or filter
7 Aftercooler air inlet
8 Aftercooler housing
9 SAE number 1 flywheel housing
10 Crankshaft speed sensor
11 Oil pressure sensor
12 Aftercooler seawater inlet
13 Engine control module (ECM)
14 Fuel lift pump (behind ECM)
15 SIM module
16 Seawater pump
17 Camshaft position sensor
18 Fuel filter
19 Fuel rail pressure sensor (behind aftercooler air outlet).

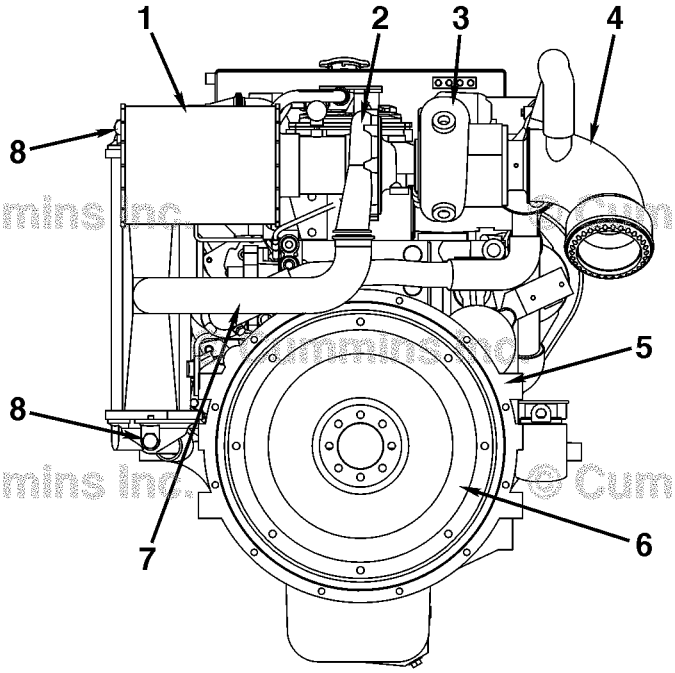
Marine Applications



QSL Starboard View (CM850 Electronic Control Module)

1 Water cooled exhaust elbow
2 Heat exchanger
3 Crankcase breather
4 Heat exchanger coolant inlet
5 Expansion tank
6 Coolant level sensor
7 Zinc anode
8 Alternator
9 Coolant temperature sensor
10 Lubricating oil cooler
11 Coolant filter
12 Lubricating oil filter
13 Heat exchanger coolant outlet
14 Starter motor
15 SAE number 1 flywheel housing.

Marine Applications



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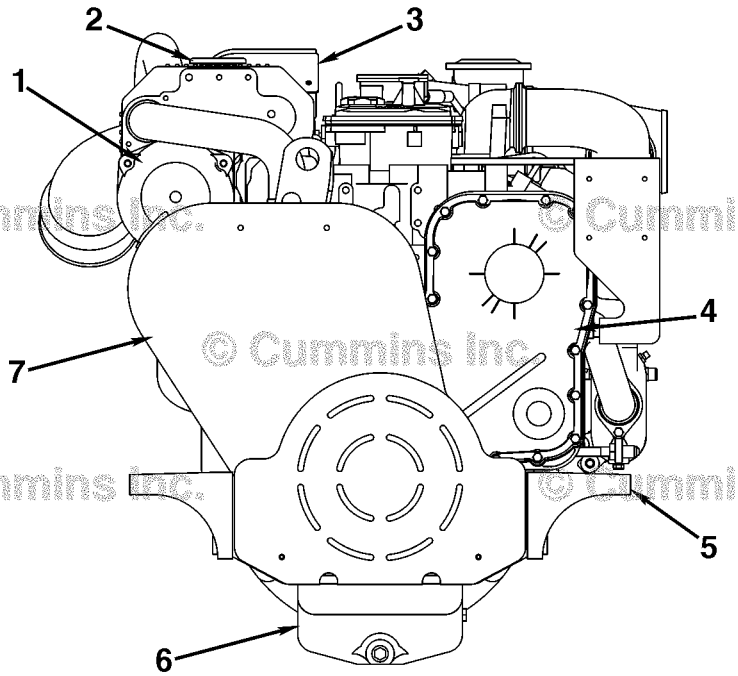
Rear View QSL (CM850 Electronic Control Module)

1 Air cleaner and filter
2 Turbocharger compressor side
3 Turbocharger exhaust turbine side
4 Water cooled exhaust elbow
5 SAE number 1 flywheel housing
6 Flywheel
7 Aftercooler air inlet
8 Aftercooler zinc anode.

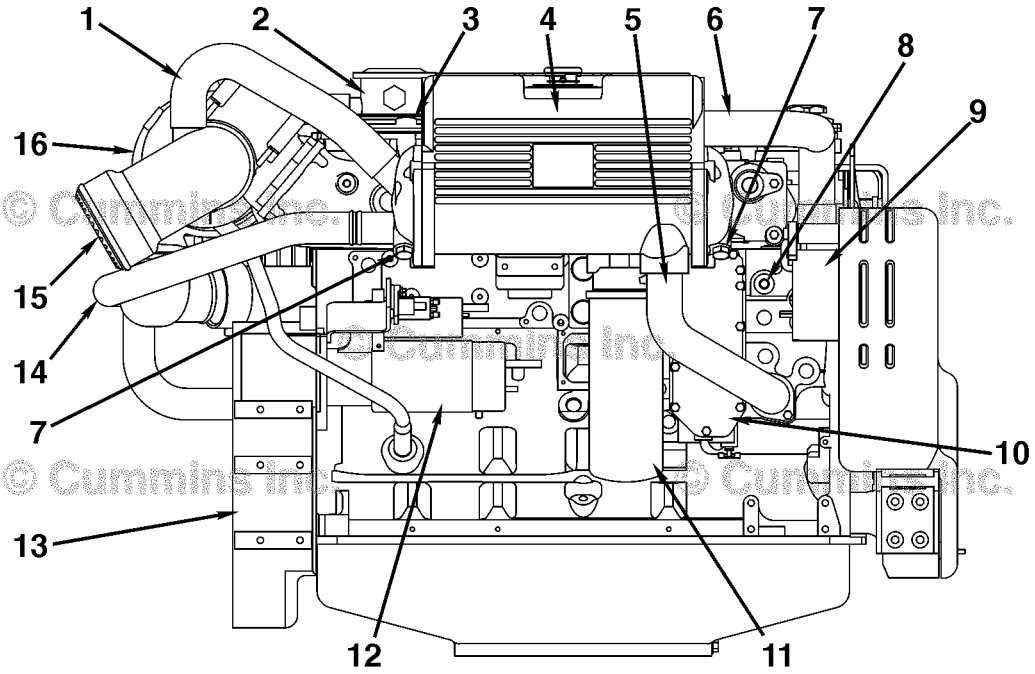
Marine Applications



Front View (QSC) (CM850 Electronic Control Module)

1 Heat exchanger
2 Coolant fill cap
3 Expansion tank
4 Timing case cover
5 Engine mounting bracket
6 Oil pan
7 Belt and pulley guard.

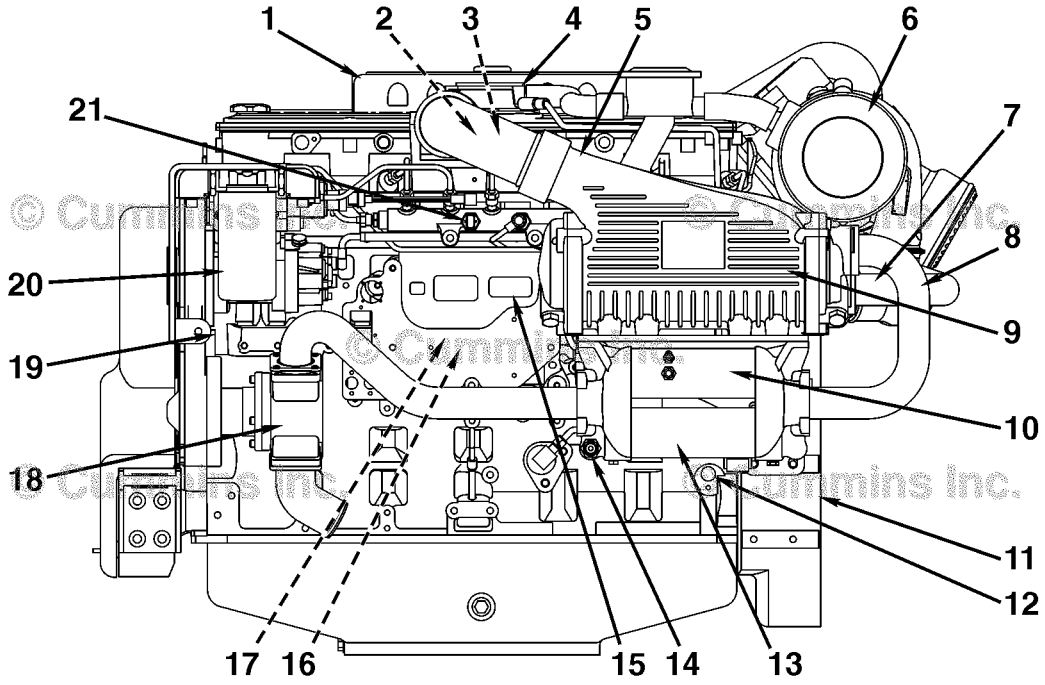
Marine Applications



QSC Starboard View (CM850 Electronic Control Module)

1 Seawater outlet from heat exchanger
2 Vacuum regulator for air filter
3 Coolant level sensor
4 Expansion tank
5 Coolant outlet from heat exchanger
6 Coolant inlet to heat exchanger
7 Zinc anodes
8 Coolant temperature sensor
9 Alternator
10 Lubricating oil cooler
11 Lubricating oil filter
12 Starter motor
13 SAE number 1 flywheel housing
14 Seawater inlet to heat exchanger
15 Exhaust elbow
16 Turbocharger.

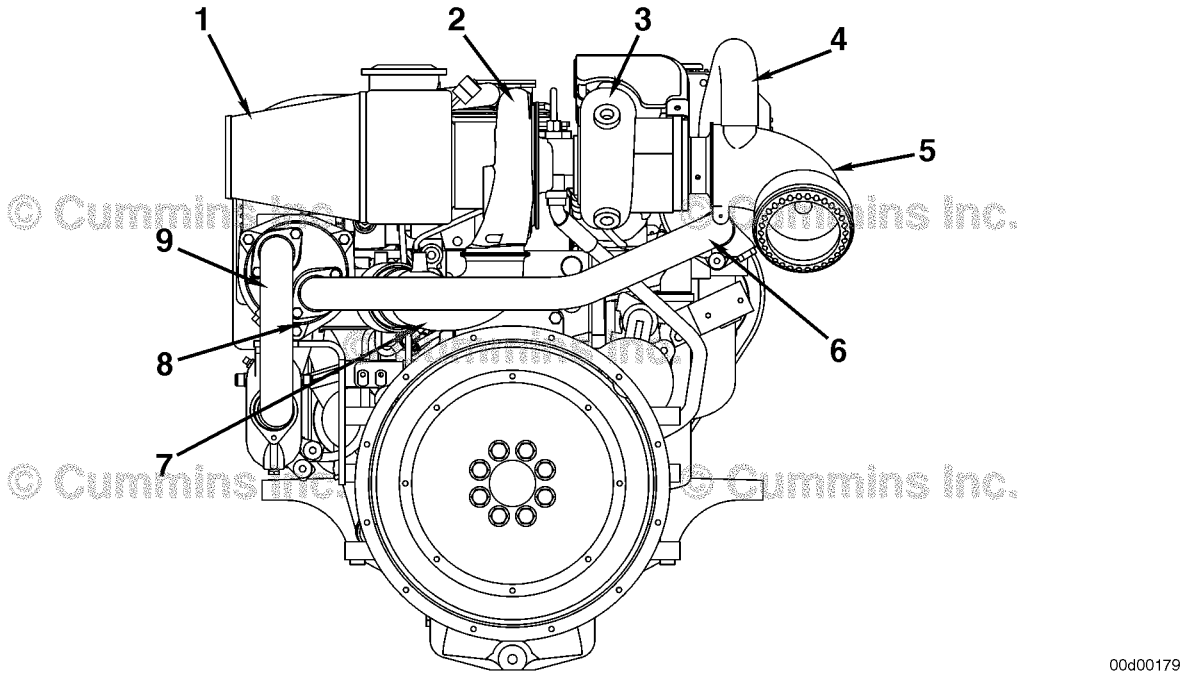
Marine Applications



QSC Port View (CM850 Electronic Control Module)

1 Expansion tank
2 Intake manifold temperature sensor (behind aftercooler air outlet)
3 Intake manifold pressure sensor (behind aftercooler air outlet
4 Crankcase breather
5 Aftercooler air outlet
6 Air cleaner or filter
7 Aftercooler seawater outlet
8 Aftercooler seawater inlet
9 Aftercooler housing
10 Fuel cooler
11 SAE number 1 flywheel housing
12 Crankshaft speed sensor
13 Gear cooler
14 Oil pressure sensor
15 Engine control module (ECM)
16 Fuel lift pump (behind ECM)
17 SIM module
18 Seawater Pump
19 Camshaft position sensor
20 Fuel filter
21 Fuel rail pressure sensor.

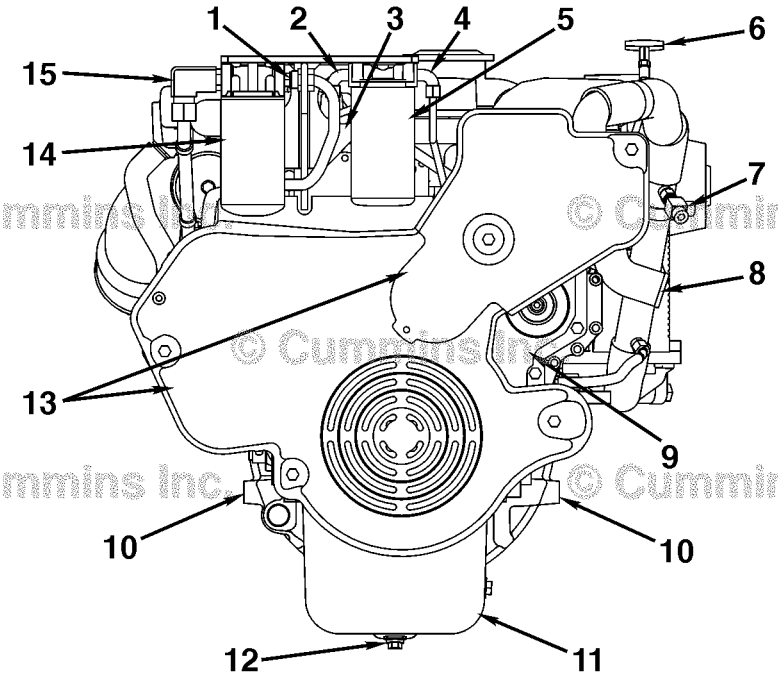
Marine Applications



QSC Rear View (CM850 Electronic Control Module)

1 Air cleaner or filter
2 Turbocharger compressor side
3 Turbocharger exhaust side
4 Heat exchanger seawater outlet
5 Seawater cooled exhaust elbow
6 Heat exchanger seawater inlet
7 Aftercooler air inlet
8 Aftercooler drain valve.
9 Aftercooler seawater inlet

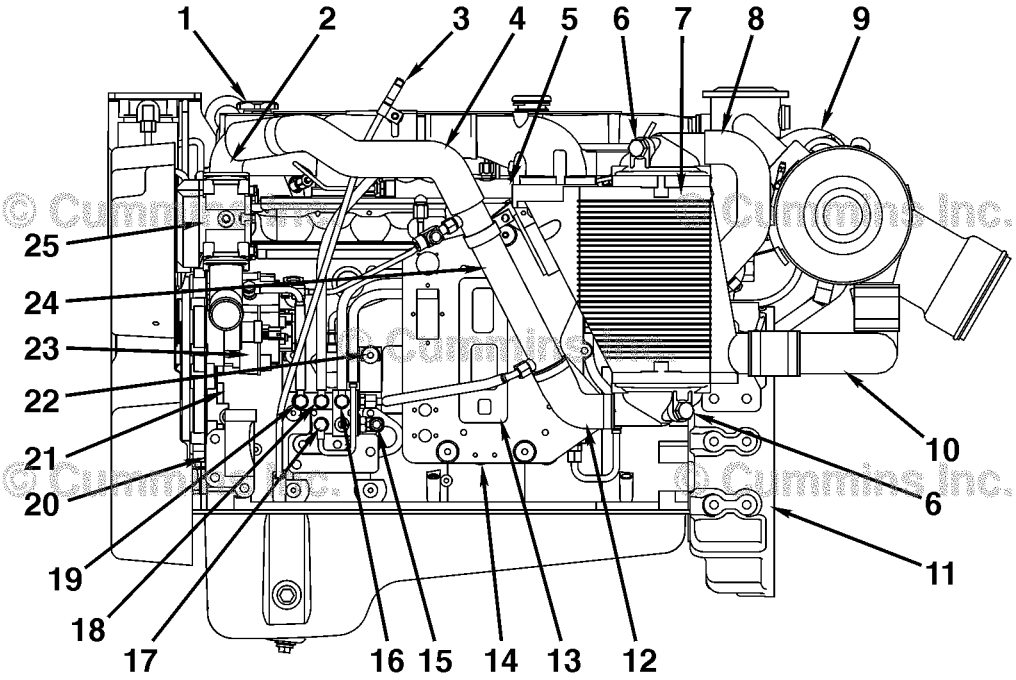
Marine Applications



QSB Front View (CM850 Electronic Control Module)

1 Lubricating oil filter head outlet
2 Fuel filter head outlet to high pressure fuel pump
3 Coolant temperature sensor
4 Fuel filter head inlet from lift pump
5 Fuel filter
6 Lubricating oil dipstick
7 Fuel return from fuel cooler to tank
8 Sea water pump inlet
9 Timing case cover
10 Mounting brackets
11 Oil pan
12 Lubricating oil drain
13 Belt and pulley guards
14 Lubricating oil filter
15 Lubricating oil filter head inlet.

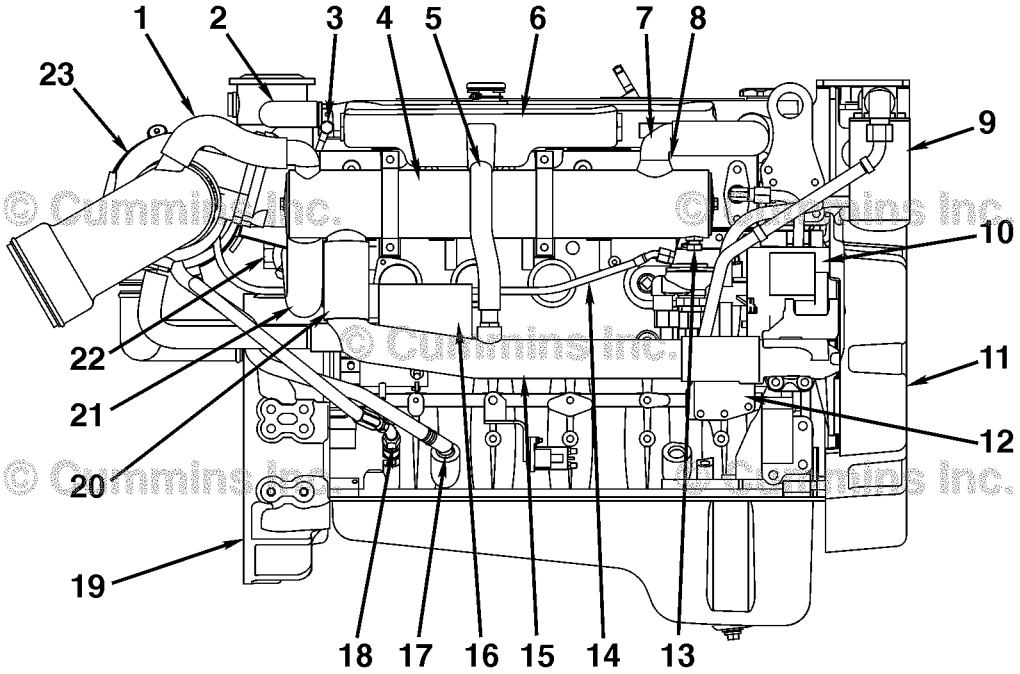
Marine Applications



QSB Port View (CM850 Electronic Control Module)

1 Engine oil fill
2 Sea water pump outlet
3 Lubricating oil level gauge
4 Sea water supply to fuel cooler
5 Intake manifold pressure and air temperature sensor
6 Aftercooler zinc anode (2)
7 Aftercooler housing
8 Aftercooler sea water outlet
9 Turbocharger
10 Aftercooler air inlet
11 Flywheel housing
12 Aftercooler sea water inlet
13 Electronic control module (ECM)
14 Fuel lift pump (behind ECM cooling plate)
15 Fuel inlet connection
16 Fuel return from injector
17 Fuel supply to lift pump
18 Fuel return from fuel rail pressure relief valve
19 Fuel return from high pressure fuel pump
20 Crankshaft speed sensor
21 Camshaft speed sensor
22 Oil pressure sensor
23 Fuel pump
24 Fuel cooler
25 Sea water pump.

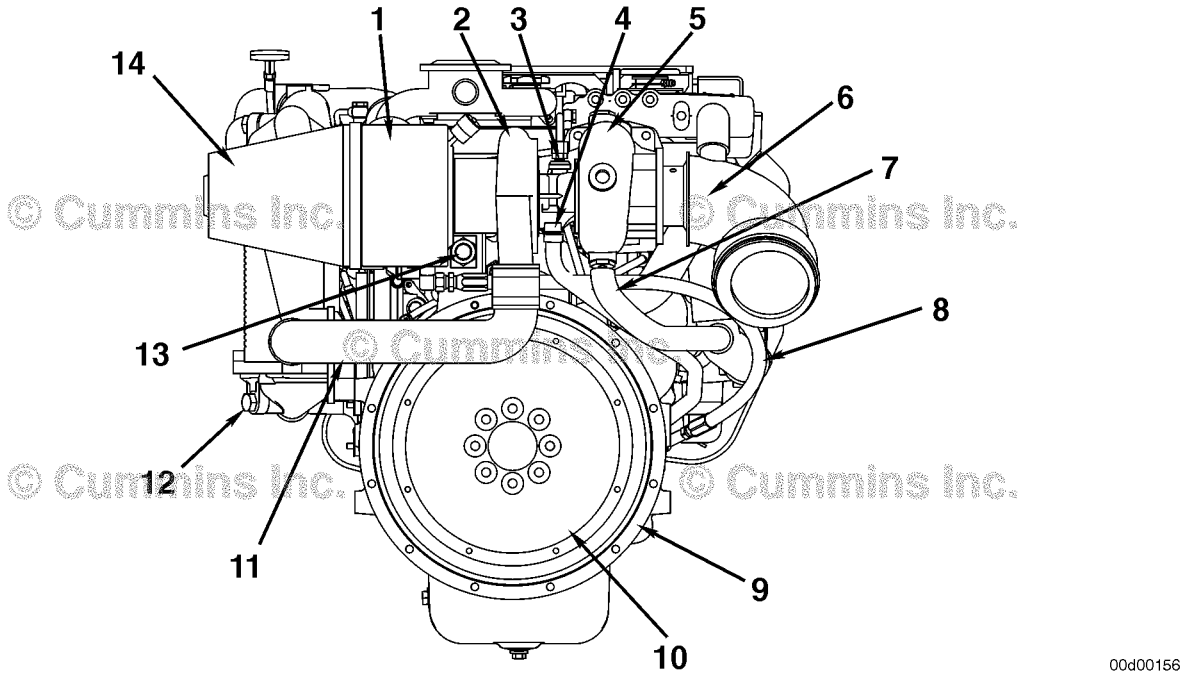
Marine Applications



QSB Starboard View (CM850 Electronic Control Module)

1 Sea water outlet
2 Closed crankcase breather system hose
3 Crankcase breather tube banjo connection
4 Heat exchanger
5 Engine coolant fill line
6 Expansion tank
7 Coolant level sensor
8 Heat exchanger engine coolant inlet
9 Lubricating oil filter
10 Alternator
11 Belt and pulley guard
12 Lubricating oil cooler
13 Zinc anode
14 Turbocharger oil supply line
15 Coolant return junction tube
16 Starting motor
17 Turbocharger oil drain line
18 Closed crankcase breather oil drain line
19 Flywheel housing
20 Heat exchanger engine coolant outlet
21 Heat exchanger sea water inlet
22 Marine gear oil cooler
23 Turbocharger

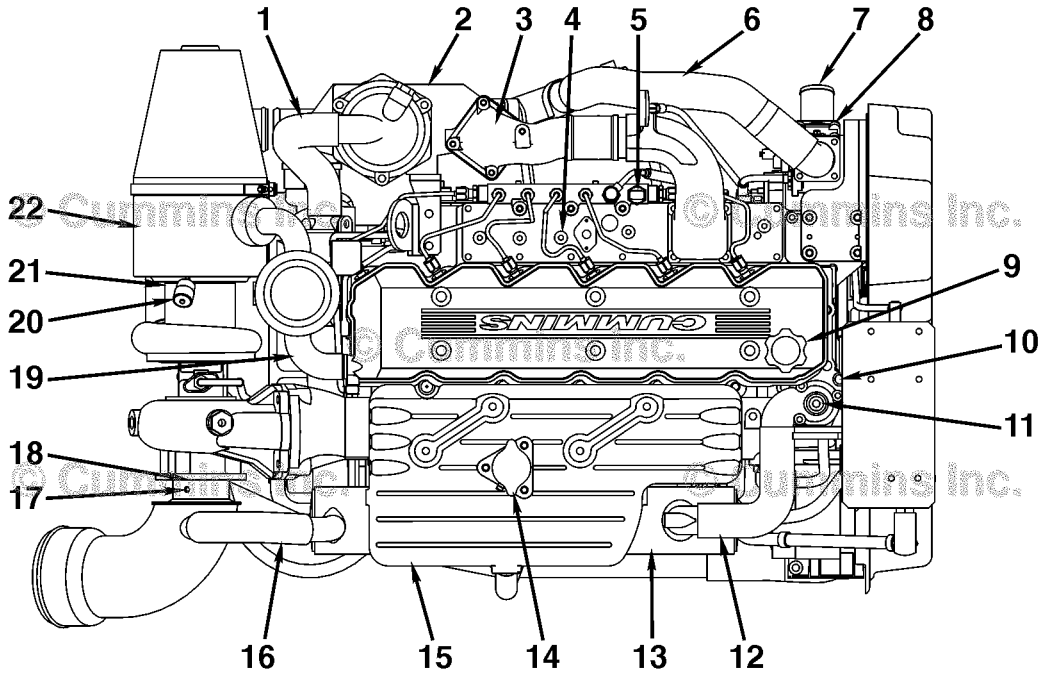
Marine Applications



QSB Rear View (CM850 Electronic Control Module)

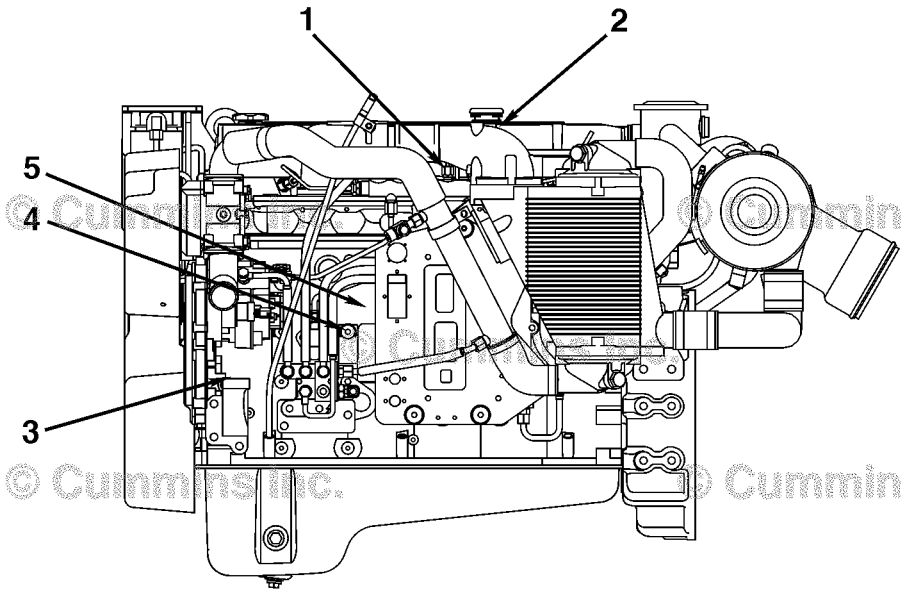
1 Closed crankcase breather system
2 Turbocharger, compressor side
3 Turbocharger oil supply
4 Turbocharger oil drain
5 Turbocharger, turbine side
6 Heat exchanger (behind exhaust outlet)
7 Turbocharger coolant outlet
8 Closed crankcase breather oil drain tube
9 Flywheel housing
10 Flywheel
11 Aftercooler air inlet
12 Aftercooler zinc anode
13 Marine gear oil cooler
14 Air cleaner and filter.

Marine Applications



QSB Top View (CM850 Electronic Control Module)

1 Aftercooler seawater outlet
2 Aftercooler housing
3 Intake air connection from aftercooler to intake manifold
4 Intake manifold pressure and temperature port
5 Fuel rail pressure sensor
6 Sea water supply to fuel cooler
7 Sea water pump inlet
8 Sea water pump
9 Engine oil fill
10 Coolant temperature sensor
11 Coolant pressure side vent petcock
12 Heat exchanger engine coolant inlet
13 Heat exchanger
14 Coolant fill neck
15 Expansion tank
16 Sea water outlet from heat exchanger
17 Exhaust temperature and back pressure port
18 Exhaust outlet connection
19 Closed crankcase breather blow-by connection
20 Air inlet restriction indicator
21 Air cleaner connection
22 Closed crankcase breather/air cleaner assembly.



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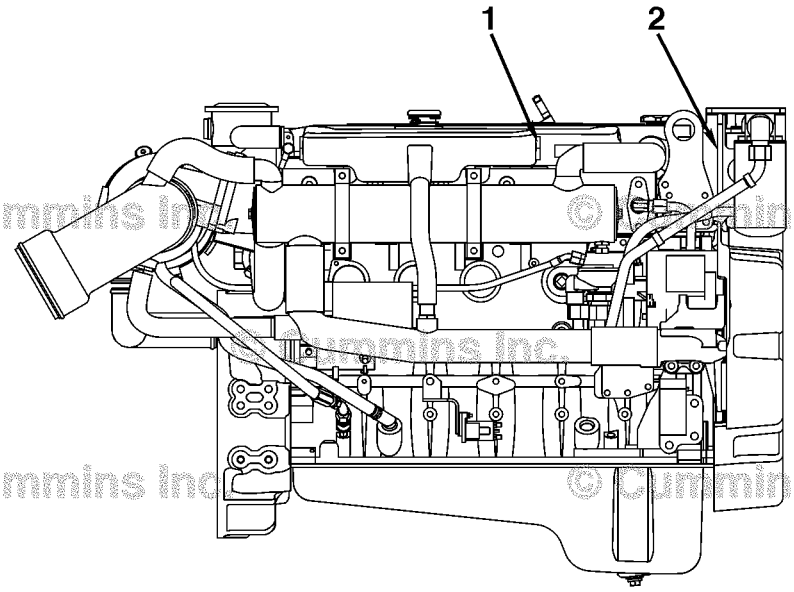
QSB5.9 Marine Sensors Port View

1 Rail fuel pressure sensor
2 Intake manifold pressure sensor
3 Engine position/speed sensor
4 Engine oil pressure sensor
5 Fuel lift pump - 12-VDC and 24-VDC (behind ECM cooling plate).



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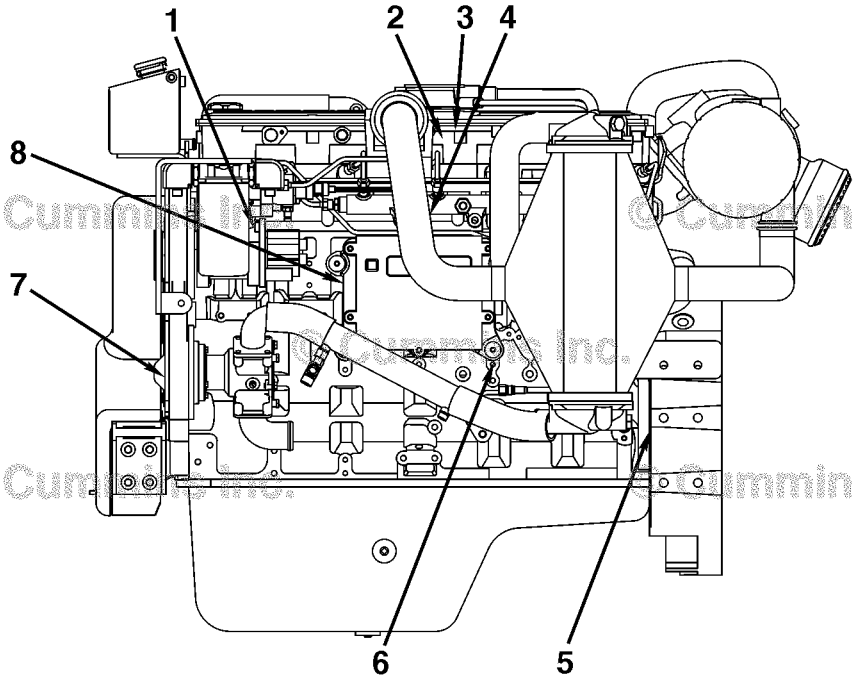
QSB5.9 Marine sensor Starboard View

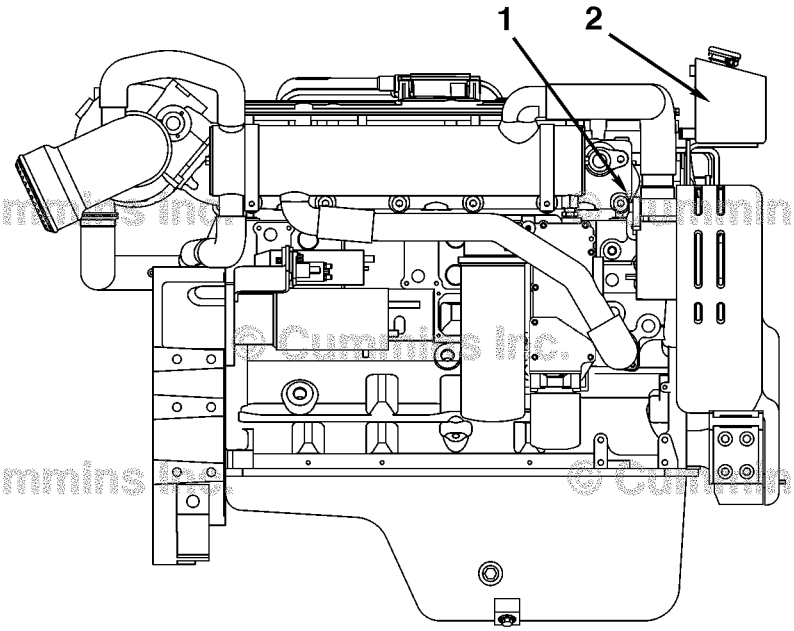
1 Coolant level sensor

2 Coolant temperature sensor.



QSL9 Marine Sensors Port View

1 Fuel pump actuator high pressure
2 Intake manifold temperature sensor
3 Intake manifold pressure sensor
4 Rail fuel pressure sensor
5 Crankshaft position sensor
6 Engine oil pressure sensor
7 Camshaft position sensor
8 Fuel lift pump - 12-VDC and 24-VDC (behind the ECM cooling plate)



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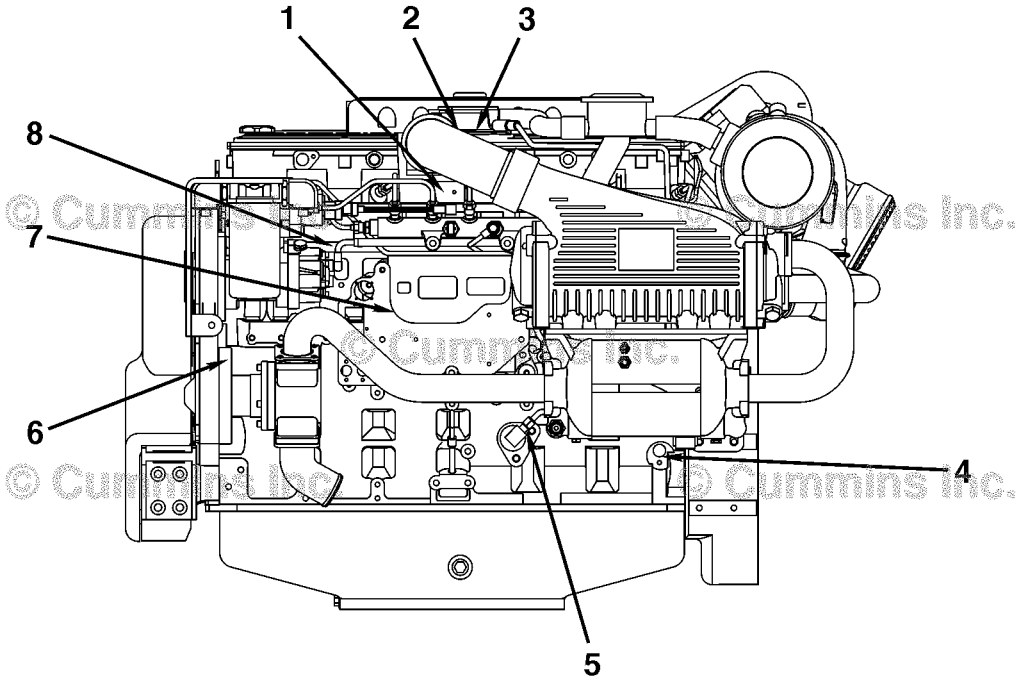
QSL9 Marine Sensors Starboard View

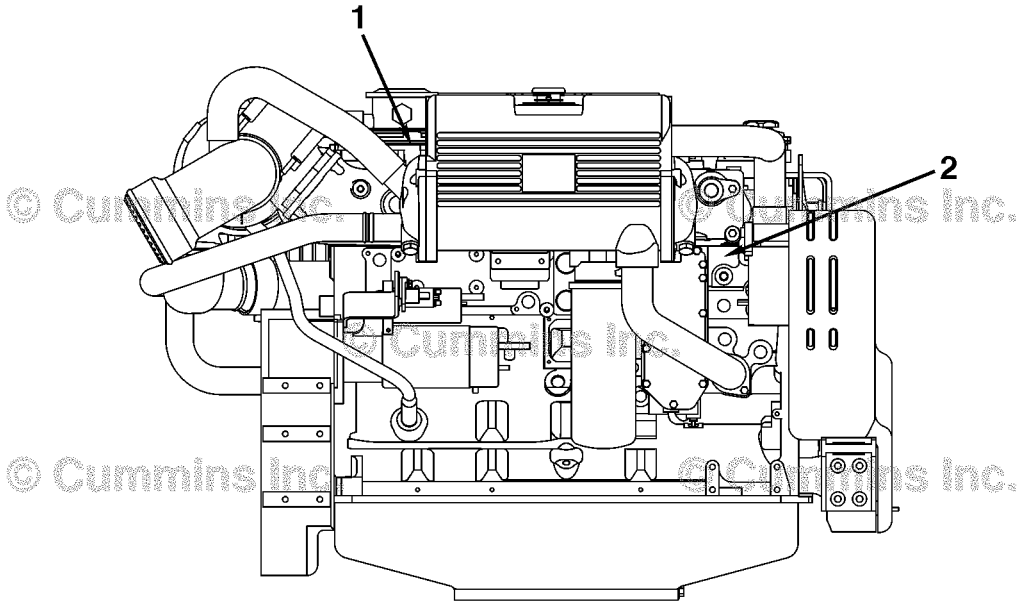
1 Coolant temperature sensor (behind alternator)

2 Coolant level sensor (rear of expansion tank).



QSC8.3 Sensors Port View

1 Rail fuel pressure sensor
2 Intake manifold pressure sensor (behind aftercooler air outlet)
3 Intake manifold temperature sensor (behind aftercooler air outlet)
4 Crankshaft position sensor
5 Engine oil pressure sensor
6 Camshaft position sensor (front gear housing)
7 Fuel lift pump - 12-VDC and 24-VDC (behind ECM cooling plate)
8 Fuel pump actuator, high pressure.



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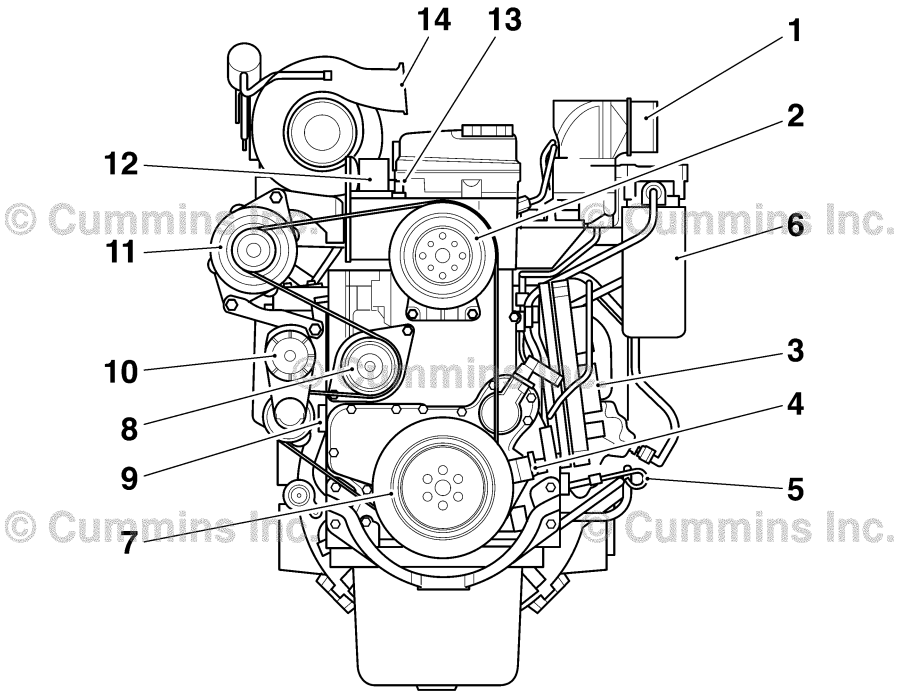
QSC8.3 Starboard View

1 Coolant level sensor (rear of expansion tank)

2 Coolant temperature sensor (behind alternator).

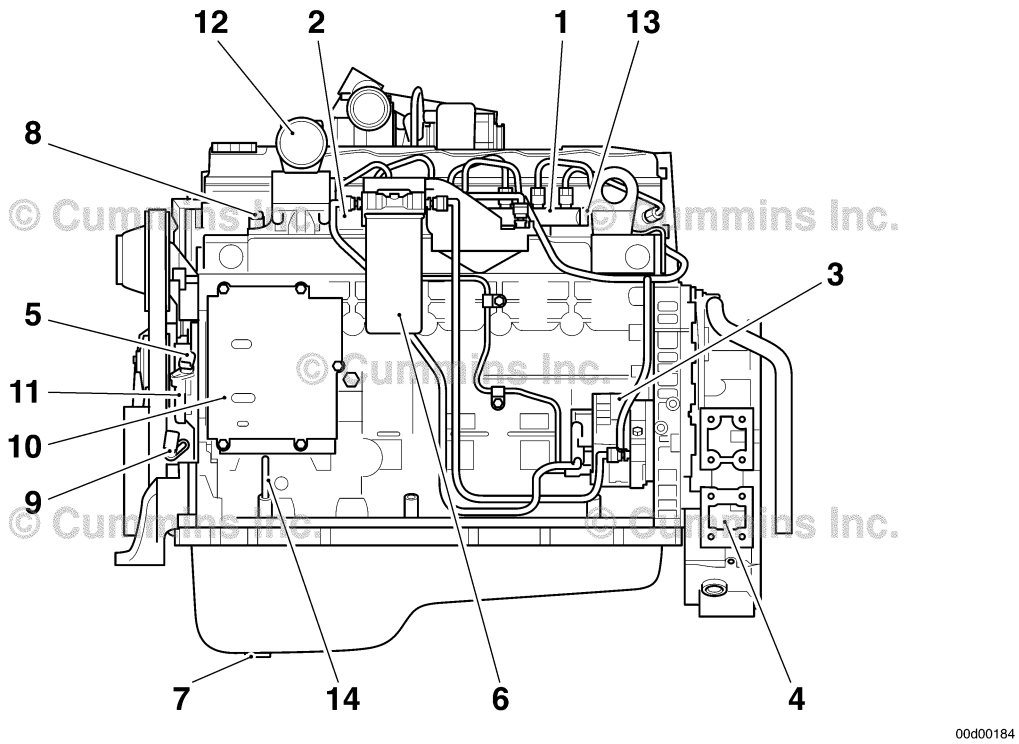
The following illustrations show the locations of the major external engine components, filters, and other service and maintenance points. Some external components will be at different locations for different engine models.

NOTE: The illustrations are **only** a reference to show a typical engine.



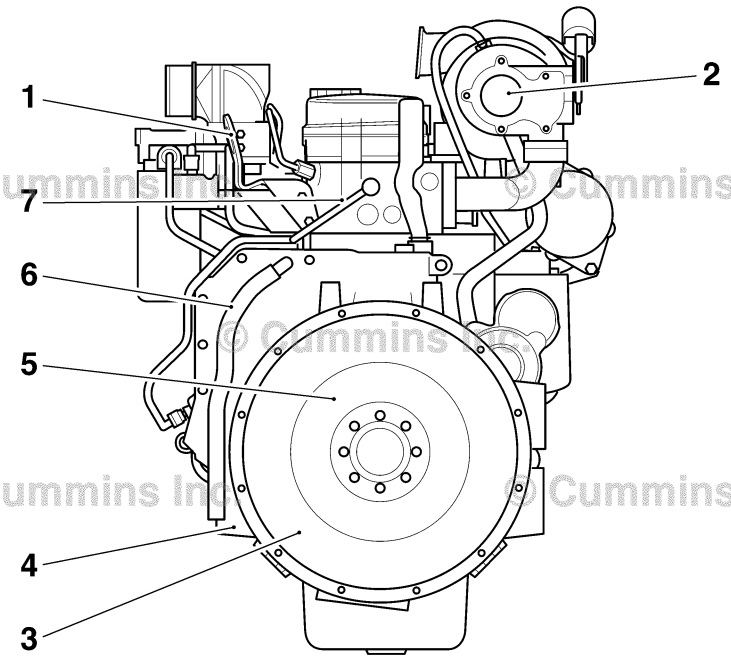
QSB 6.7 Engine - Front View

1 Air inlet
2 Fan drive
3 Electronic control module
4 Engine speed sensor (crankshaft)
5 Dipstick
6 Fuel filter
7 Vibration damper
8 Water pump
9 Starter
10 Belt tensioner
11 Alternator
12 Coolant outlet
13 Coolant temperature sensor
14 Turbocharger air outlet.



QSB 6.7 Engine - Left Side View

1 Fuel rail
2 Intake pressure and temperature sensor
3 Bosch™ fuel pump
4 Flywheel housing
5 Oil pressure switch
6 Fuel filter
7 Oil pan drain plug
8 Barometric pressure sensor
9 Engine speed sensor (crankshaft)
10 Electronic control module
11 Engine position sensor (camshaft)
12 Air intake inlet
13 Rail pressure sensor
14 Dipstick.



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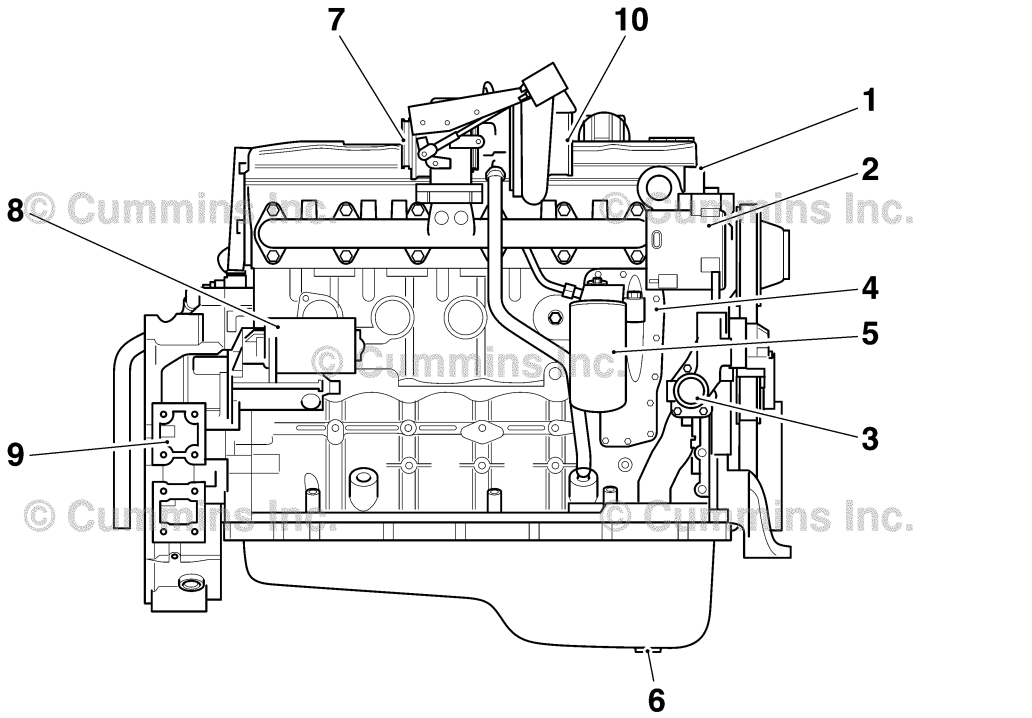
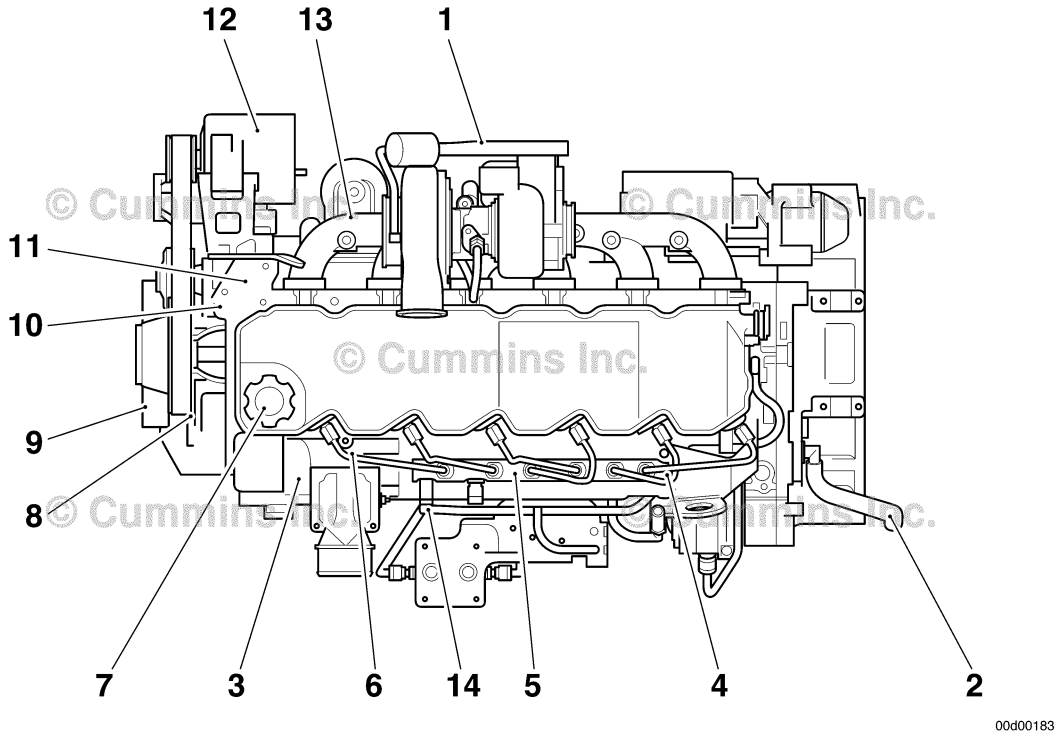
QSB 6.7 Engine - Rear View

1 Rear engine lifting bracket
2 Turbocharger exhaust outlet
3 Clutch mounting holes
4 Flywheel housing
5 Flywheel/flexplate
6 Crankcase breather tube
7 Injector drain line.



QSB 6.7 Engine - Right Side View

1 Coolant outlet
2 Alternator
3 Coolant inlet
4 Lubricating oil cooler
5 Oil filter
6 Oil pan drain plug
7 Turbocharger exhaust outlet
8 Starter
9 Flywheel housing
10 Turbocharger compressor inlet.



QSB 6.7 Engine - Top View

1 Turbocharger wastegate
2 Crankcase breather
3 Barometric pressure/temperature sensor
4 Fuel rail pressure sensor
5 Fuel rail
6 High-pressure fuel lines
7 Oil fill cap
8 Tone wheel
9 Vibration damper
10 Coolant temperature sensor
11 Coolant outlet
12 Alternator
13 Exhaust manifold
14 Rail pressure relief valve.

Notes

Section F - Familiarization

Section Contents

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Electronic Controlled Fuel System (101-007)

General Information

The ISC, ISL and ISLe3, with CM850 engine control module (ECM) is an electronically operated fuel control system that also provides many operator and vehicle features.

The base functions of the control system include fueling and timing control, limiting the engine speed operating range between the low and the high idle set points and reducing exhaust emissions while optimizing engine performance. The system also controls the engine brakes.

The control system uses inputs from the operator and its sensors to determine the fueling and timing required to operate at the desired engine speed at the required emissions level.

Engine Control Module Inputs

The engine control module (ECM) is the control center of the system. It processes all of the inputs and sends commands to the fuel system, vehicle and engine control devices.

The ECM performs diagnostic tests on most of its circuits and will activate a fault code if a problem is detected in one of these circuits. Along with the fault code identifying the problem, a snapshot of engine operating parameters at the time of fault activation is also stored in memory.

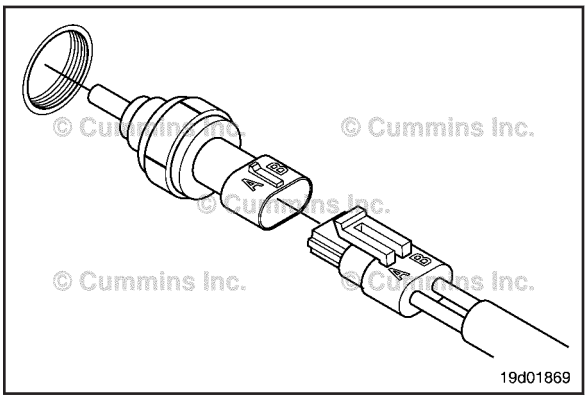
Active fault codes will cause a diagnostic lamp to activate to signal the driver.

The ECM can communicate with service tools and some other vehicle controllers (such as transmissions, ABS, ASR, electronic dash displays and so on) through the SAE J1939 data link or the SAE J1708 data link.

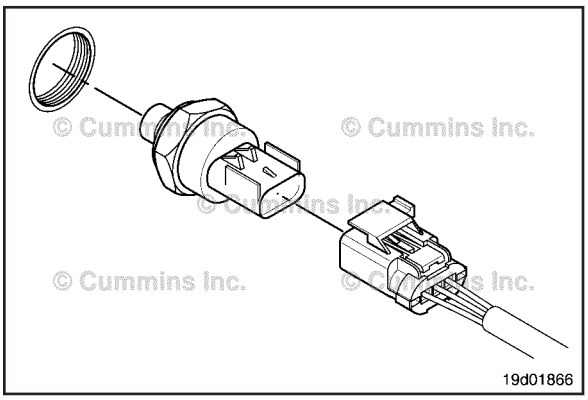
Some vehicles and equipment will have SAE J1939 networks on them that link many of the “smart” controllers together. Vehicle control devices can temporarily command engine speed or torque to perform one of its functions (that is, transmission shifting, anti-lock braking and so on).

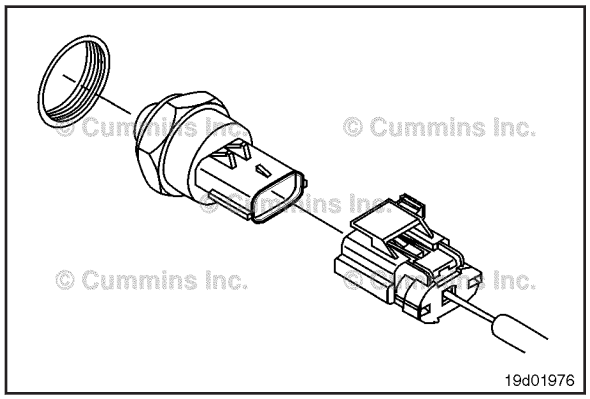
The control system utilizes a number of sensors to provide information on engine operating parameters. These sensors include:

- Engine coolant temperature sensor
- Intake manifold air temperature sensor

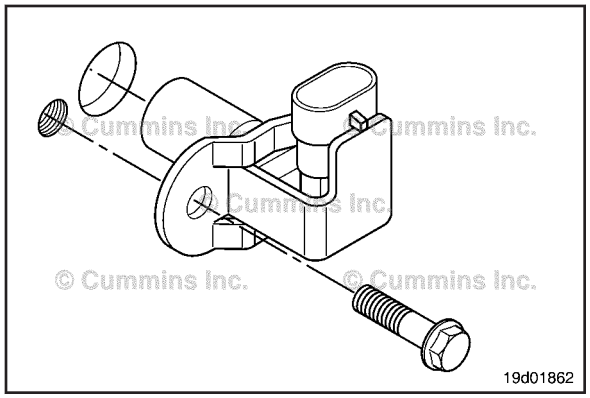


- Intake manifold pressure sensor

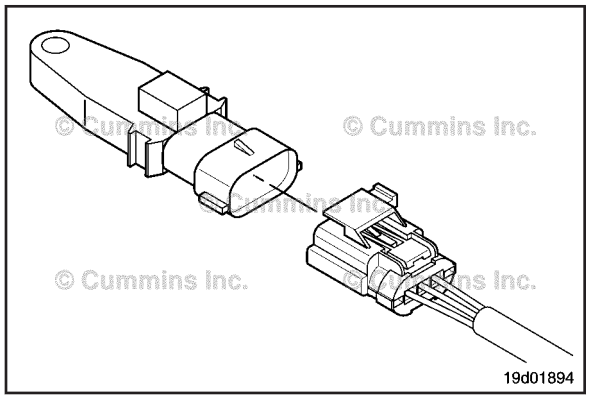




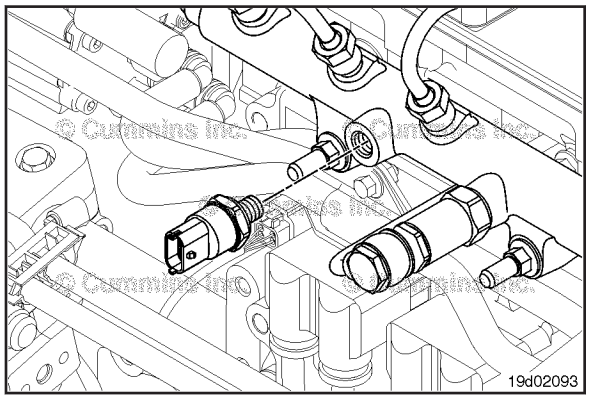
- Engine oil pressure sensor



- Engine speed (crankshaft position) sensor
- Camshaft position sensor

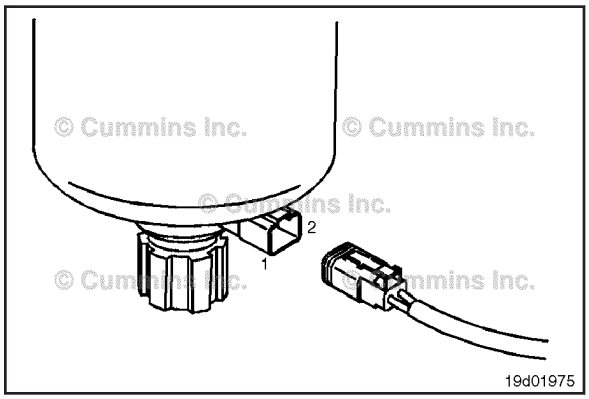


- Barometric pressure sensor

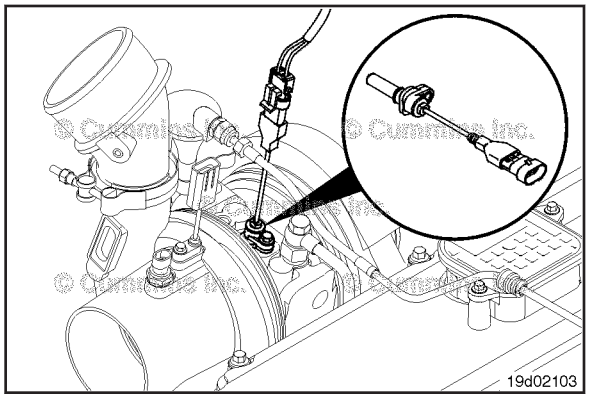


- Rail fuel pressure sensor

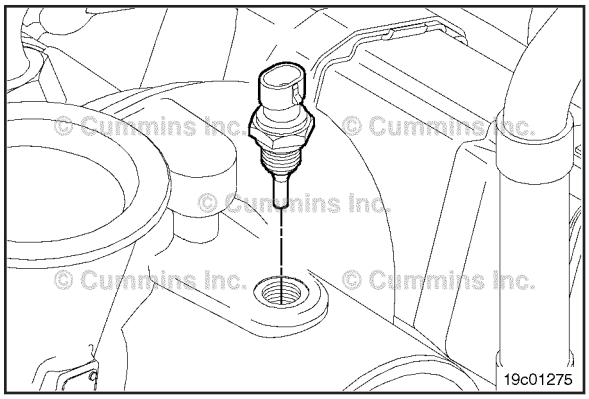
- Water-in-fuel sensor



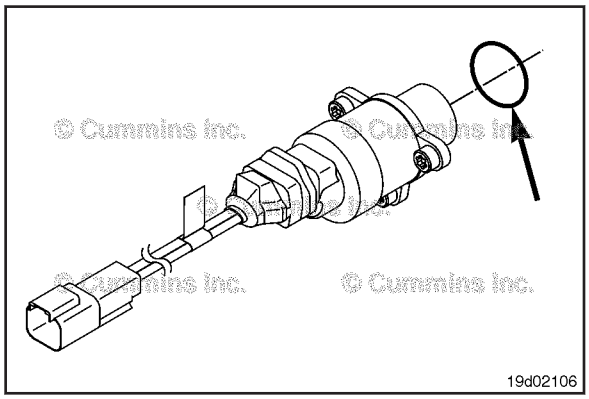
- Turbocharger speed sensor

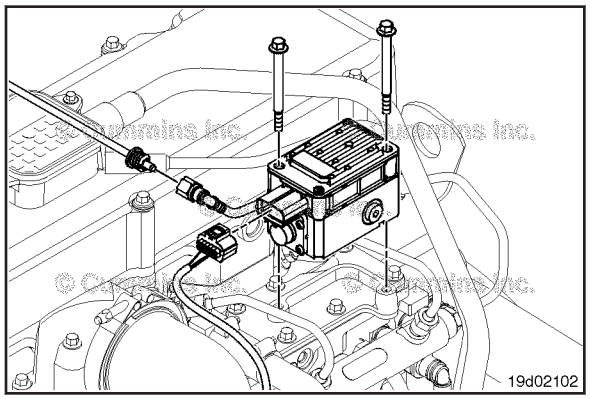


- Turbocharger compressor inlet air temperature sensor.



Fuel pump actuator

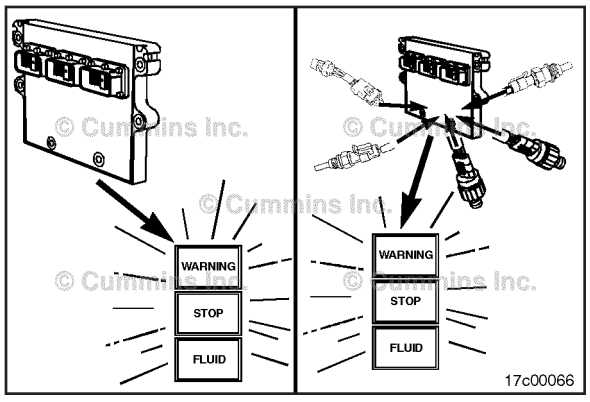




Turbocharger control valve

- Accelerator pedal/lever position sensor
- Idle validation switch
- Engine brake selector switches
- Engine coolant level sensor
- Vehicle speed sensors
- Feature control switches (i.e. cruise control switches)
- Fan control switch
- Air conditioner pressure switch
- Remote accelerator
- Remote PTO.

NOTE: These inputs are application dependent. Some applications will **not** use all of these inputs.



Diagnostic Fault Codes

The electronic engine control system can display and record certain detectable fault conditions. These failures are displayed as fault codes, which make troubleshooting easier. The fault codes are retained in the ECM.

There are two types of diagnostic codes:

- Engine electronic control system fault codes are to inform the operator that there is a problem with the control system that will require troubleshooting.
- Information and engine protection fault codes are to inform the operator that the control system has detected an engine condition outside the normal operating range.

All fault codes recorded will either be active (fault code is currently active on the engine) or inactive (fault code was active at some time, but is **not** currently active).

The “Stop” light is red and indicates the need to stop the engine as soon as it can be safely done. The engine **must** remain shutdown until the fault can be repaired.

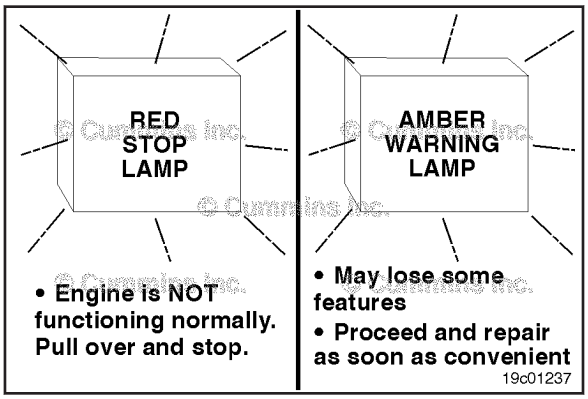
The “Warning” light is amber and indicates the need to repair the fault at the first available opportunity.

Maintenance type fault codes will flash the amber Warning light for 30 seconds after the keyswitch is turned to the ON position when one of the following occurs: maintenance is required (if Maintenance Monitor is turned on) or if water-in-fuel is detected.

If the Warning light flashes for 30 seconds at key-on and water is drained from the primary, water-separating filter, then the secondary filter **must** be replaced.

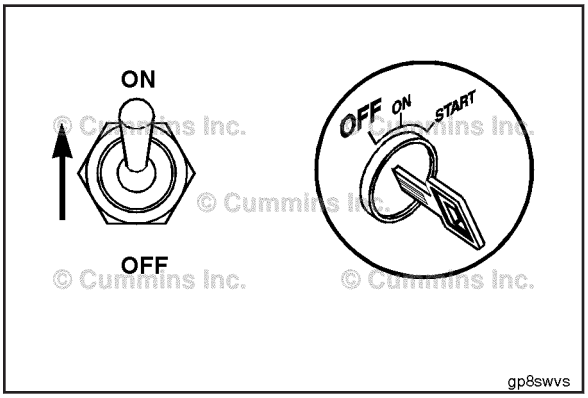
If the Water-In-Fuel lamp illuminates and water is drained from the primary, water-separating filter, then the secondary filter **must** be replaced.

NOTE: The names and colors of these lamps can vary with equipment manufacturer.



Fault codes can be accessed in at least two different ways; using the electronic service tool, or fault code flash out.

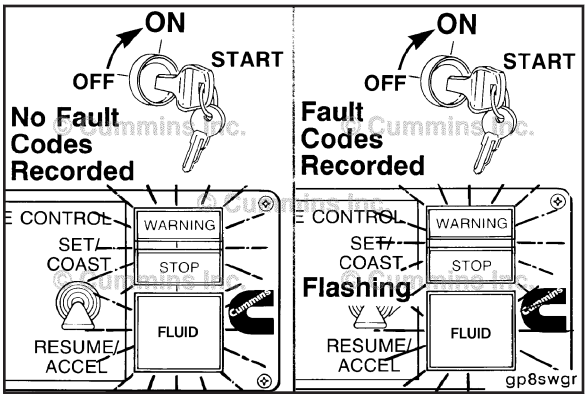
To check for active engine electronic fuel system and engine protection system fault codes, turn the keyswitch OFF and move the diagnostic switch to the ON position.

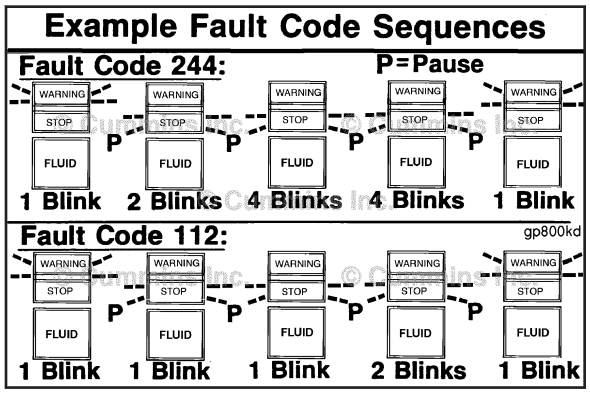


Turn the vehicle keyswitch to the ON position.

If no active fault codes are recorded, both lights will come on and stay on.

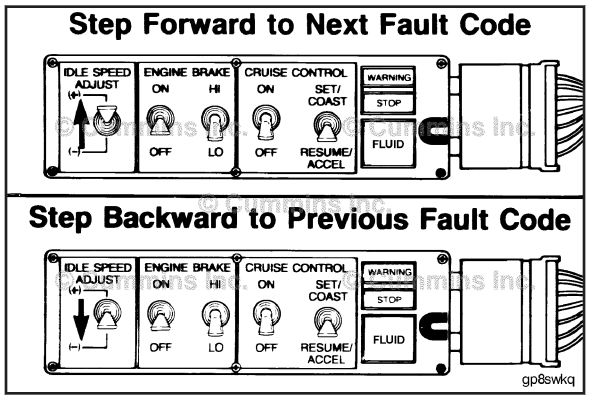
If active fault codes are recorded, both lights will come on momentarily then begin to flash the code of the recorded faults.





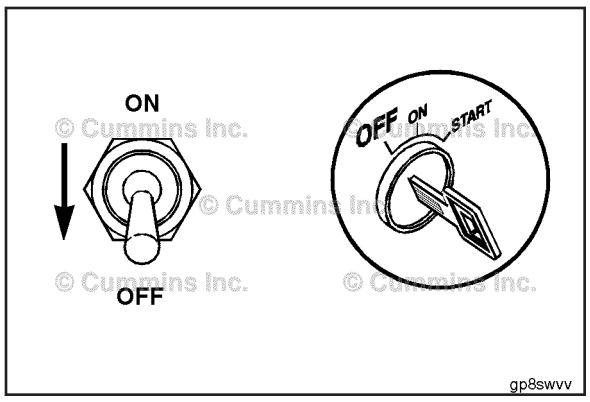
The fault code will flash in the following sequence:

- First, a WARNING (amber) light will flash.
- Then there will be a short one or two second pause after which the number of the recorded fault code will flash in STOP (red).
- There will be a one or two second pause between each number.
- When the number has finished flashing in red, an amber light will appear again.



The lights flash each fault code out three times before advancing to the next code. To skip to the next fault code, move the Increment/Decrement switch (if equipped) momentarily to the increment (+) position. You can go back to the previous fault code by momentarily moving the Increment/Decrement switch (if equipped) to the decrement (-) position. If only one active fault is recorded, the same fault code will continuously be displayed when either (+) or (-) switch is depressed.

The explanation and correction of the fault codes is in Section TF of this manual.



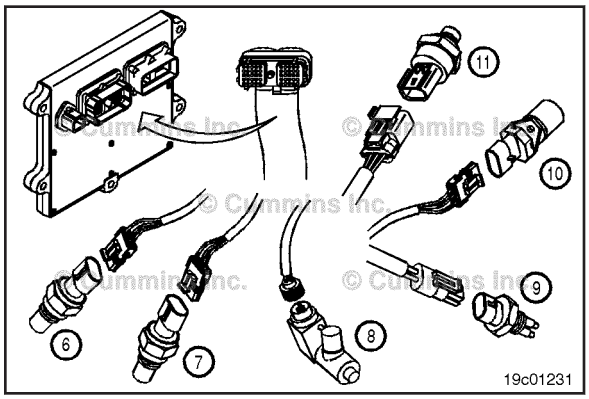
When **not** using the diagnostic system, turn off the diagnostic switch.

Engine Protection System

⚠CAUTION⚠
When the red STOP lamp is illuminated, the driver/ operator must pull to the side of the road, when it is safe to do so, to reduce the possibility of engine damage.

The ISC, ISL, and ISLe3 CM850 engines are equipped with an engine protection system. The system monitors critical engine temperatures and pressures, and will log diagnostic faults when an over or under normal condition occurs. If an out-of-range condition exists and engine derate action is to be initiated, the operator will be alerted by an in-cab Warning lamp. The Stop lamp will blink or flash when out-of-range conditions continue to worsen. The driver **must** pull to the side of the road, when it is safe to do so, to reduce the possibility of engine damage.

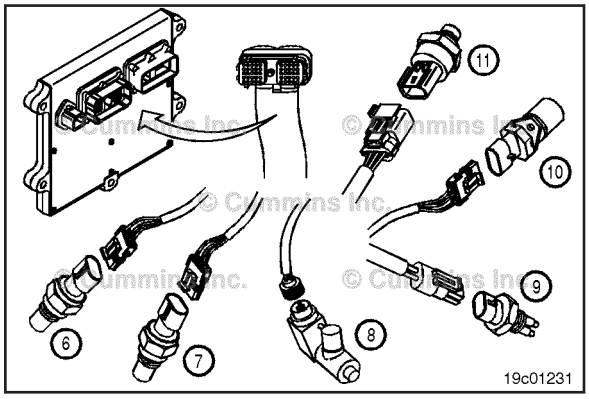
NOTE: Engine power and speed will gradually be reduced, depending on the level of severity of the observed condition. The engine protection system will **not** shut down the engine unless the engine protection shutdown feature has been enabled.



Fault Code Snapshot Data

When a diagnostic fault code is recorded in the ECM, the ECM input and output data is recorded from all sensors and switches. Snapshot data allows the relationships between ECM inputs and outputs to be viewed and used during troubleshooting.

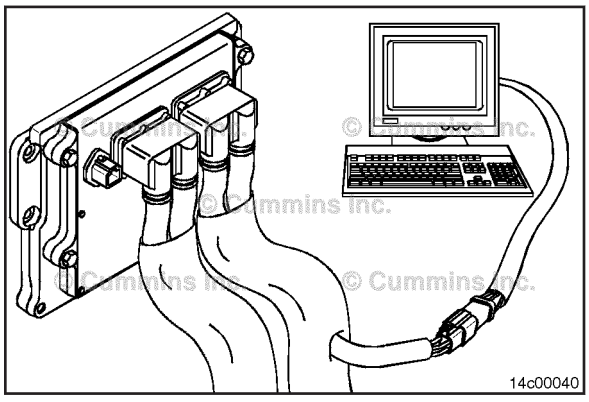
Fault code snapshot data can **only** be viewed using INSITE™.

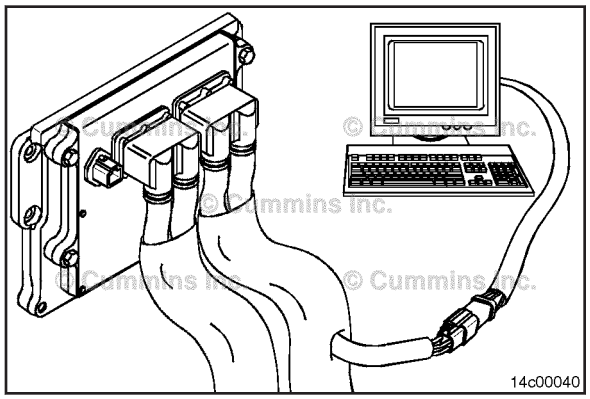


INSITE™ Electronic Service Tool Description

INSITE™ is a service tool for the electronic engine control system. Use INSITE™ to:

- Program customer specified information into the ECM (parameter and features)
- Aid in troubleshooting the engine
- Change the engine power or rated speed calibration
- Transfer new or update calibration files to the electronic engine control system (ECM)
- Create and view trip reports, etc.





INSITE™ Electronic Service Tool Monitor Mode

The INSITE™ monitor mode is a useful troubleshooting aid that displays the key ECM inputs and outputs. This feature can be used to spot constant or abnormally fluctuating values.

Service Tools and Hardware - Overview

General Information

Cummins Inc. produces many engines that are electronically controlled. These engines have special diagnostic requirements for the engine control module (ECM) in the system. To interface with the ECMs, electronic service tools, such as INSITE™ electronic service tool, have been developed.

INSITE™ electronic service tool interfaces with the electronic engines via a data link. A data link provides a means of transmitting and sorting electric signals, and consists of special electronic circuitry and electrical harnesses. Connection points from electronic service tools are also part of the data link. An OEM data link, if available, is provided by the OEM and consists of circuitry located in the OEM harness. An engine data link consists of circuitry located in the engine harness. Both engine and OEM data links alike are defined by standards written by the Society of Automotive Engineers (SAE). Cummins Inc. uses two such standards for electronic service tools. One is a combination of SAE J1587 and SAE J1708 and the other is SAE J1939. The J1939 data link is described in more detail in Procedure 019-165 in the appropriate engine service manual. The J1587/J1708 data link is described in more detail in Procedure 019-166 in the appropriate service manual, and is hereafter referred to as J1708 in this document. Engine data links (both J1939 and J1708) are discussed in more detail in Procedure 019-428 in the appropriate engine service manual.

INSITE™ Electronic Service Tool Description

General Information

INSITE™ electronic service tool is a Windows® based software application that works with Cummins® ECMs to diagnose and troubleshoot engine problems, store and analyze historical information about an engine, and to modify an engine's operating values. INSITE™ electronic service tool Professional also enables you to transfer calibrations to an ECM.

INSITE™ electronic service tool is used on an IBM® compatible personal computer (PC) that is attached to an ECM through an INLINE™, INLINE™ I, INLINE™ II_1, INLINE™ 4, INLINE™ 5, or INLINE™ 6 data link adapter kit.

NOTE: 1. The INLINE™ II adapter has become obsolete. It can be used with INSITE™, but technical support for this adapter is **not** available.

After registering a copy of INSITE™ electronic service tool and connecting to an ECM data source, INSITE™ electronic service tool enables you to retrieve present or recorded data about an engine, alter ECM settings, store data for viewing at a later time, analyze data to monitor and assess the operation of an engine, and view active or inactive engine fault codes.

INSITE™ electronic service tool is installed in the INTELECT™ folder on the hard drive of a personal computer. INSITE™ User's Manuals are available in the INTELECT™ and Manuals folder for specific Cummins® electronic engines. Additional information for service and support from a Cummins® distributor for INSITE™ electronic service tool questions is included in the front of the User's Manuals.

Different versions of INSITE™ electronic service tool may be available for use at one time, although some INSITE™ electronic service tool versions may **not** be compatible with some ECMs. ECM and INSITE™ electronic service tool compatibility information is available at the INSITE™ Product website. INSITE™ electronic service tool improvements are sometimes released as Feature Packs. The latest Feature Pack information for specific INSITE™ electronic service tool versions is also available at the INSITE™ Electronic Service Tool product website. It is important to maintain the INSITE™ electronic service tool with the latest versions and Feature Packs that become available.

INSITE™ electronic service tool can utilize either a communication port (COM port) or a Universal Serial Bus (USB) on the PC when communicating with an ECM. A COM port **must** be configured properly for INSITE™ electronic service tool to function correctly. It is possible for other software programs on the PC to take control of a COM port and prevent INSITE™ electronic service tool from accessing the COM port. Troubleshooting information for INSITE™ electronic service tool communication issues is available in the Base INSITE™ USER's Manual and also in the ECM No Communication Troubleshooting Tree on QuickServe™ Online or Intercept.

Initial Check

INSITE™

- In the main INSITE™ electronic service tool window, verify that the data link selected in the ECM Data Source Connection drop-down matches the data link hardware being used
- Verify that the correct INSITE™ version is installed. The INSITE™ version can be determined from the main INSITE™ electronic service tool window by selecting Help, About INSITE
- Verify that the infrared port is disabled so the serial port is **only** being used for ECM communications

- If you have the Palm Pilot Hot Sync Manager on a PC that **only** has one serial port, you **must** disable the Hot Sync Manager before connecting to an ECM.

Datalink Adapters

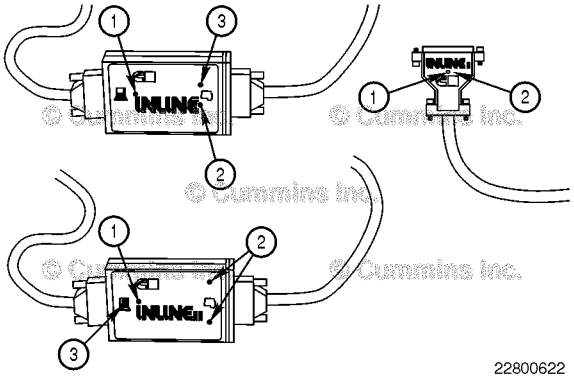
- Check the firmware version of the INLINE™ II_1, INLINE™ 4, INLINE™ 5, or INLINE™ 6 data link adapter to make sure it is the latest firmware version available
- Verify that the data link adapter being used is compatible with the data link wiring available on the engine or vehicle.

General Information

A data link adapter is a device that converts the J1708, or J1939 data link messages from the ECM into a message that a PC can process. Because INSITE™ electronic service tool is a PC based tool, a data link adapter is required to troubleshoot engines.

Cummins® Service Products offer the following data link adapter kits:

- INLINE™ adapter kit, Part Number 3163099
- INLINE™ I adapter kit, Part Number 3163583
- INLINE™ 6 adapter kit, Part Number 2892092.



Data Link Adapter Identification Diagram - INLINE™, INLINE™ I, AND INLINE™ II (see note 1).

1 Power light

2 Communication light

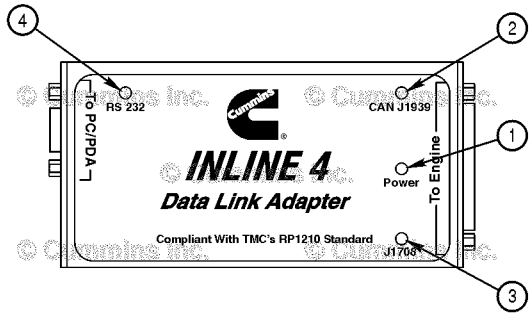
3 To PC light.

Power for the INLINE™ I data link adapter is provided by the personal computer via the serial cable being used in the communication setup. In Windows XP™, Windows Vista™, and Windows™ 7, the power light will **only** be illuminated while INSITE™ electronic service tool has the COM port initialized and will **not** remain illuminated after exiting INSITE™ electronic service tool.

Power for the INLINE™, INLINE™ II_1, INLINE™ 4, INLINE™ 5, and INLINE™6 data link adapters depends upon the communication setup in use. The 12 VDC power is supplied by the vehicle power system for the vehicle and engine communication setups. The 12 VDC power is supplied by an auxiliary power supply for the bench communication setup.

The INLINE™ and INLINE™ I data link adapters will **only** support J1708 data link protocols. The INLINE™ II_1, INLINE™ 4, INLINE™ 5, or INLINE™ 6 data link adapter will support either J1708 or J1939 protocol. When connecting with INSITE™ electronic service tool using an INLINE™ II_1, INLINE™ 4, INLINE™ 5, and INLINE™6, INSITE™ electronic service tool will attempt to establish communication with an ECM on J1939 first. If no communication is established on J1939, INSITE™ electronic service tool will then attempt to establish communication on J1708.

NOTE: 1. The INLINE™ II adapter has become obsolete. It can be used with INSITE™, but technical support for this adapter is **not** available.



Data link Adapter Identification Diagram - INLINE™ 4.

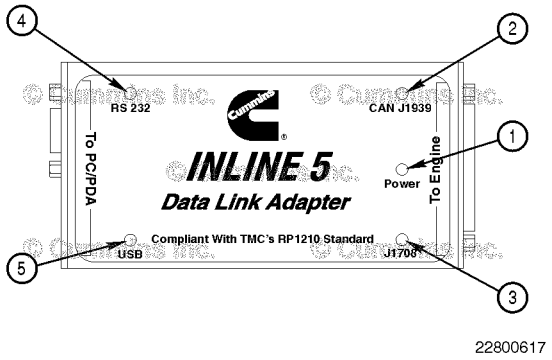
1 Power light

2 J1939 communication light

3 J1708 communication light

4 RS-232 to PC light.

The INLINE™ 4 is an RP1210A compliant data link adapter that will support both J1708, and J1939 protocol. RP1210A is an industry wide standard that defines data link message format for service tools. The INLINE™ 4 **must** be configured correctly within INSITE™ electronic service tool to define the COM port being used on the PC and the type of data link protocol that is available, J1708, J1939, or autodetect.



Datalink Adapter Identification Diagram - INLINE™ 5.

1 Power light

2 J1939 communication light

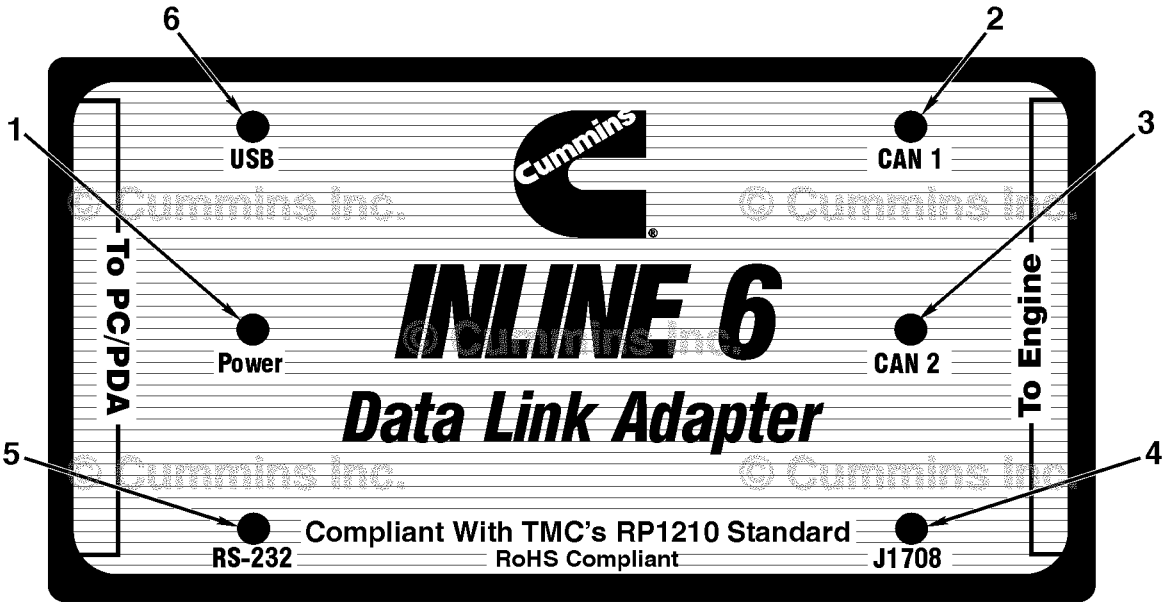
3 J1708 communication light

4 RS-232 to PC light

5 USB to PC light.

The INLINE™ 5 is an RP1210A compliant data link adapter that will support both J1708, and J1939 protocol. It can be used with either a COM port or USB port. The INLINE™ 5 **must** be configured correctly within INSITE™ electronic service tool to define the COM or USB port being used on the PC and the type of data link protocol that is available, J1708, or J193, or autodetect.

NOTE: 1. The INLINE™ II adapter has become obsolete. It can be used with INSITE™ electronic service tool, but technical support for this adapter is **not** available.



Data Link Adapter Identification Diagram - INLINE™ 6

1 Power light

2 CAN 1 communication light (J1939)

3 CAN 2 communication light (J1939)

4 J1708 communication

5 RS-232 to PC light

6 USB to PC light.

The INLINE™ 6 is an RP1210A compliant data link adapter that will support both J1708 and J1939 protocols. It can be used with either a COM port or USB port. The INLINE™ 6 **must** be configured correctly within INSITE™ electronic service tool to define the COM or USB port being used on the PC and the type of data link protocol that is available, J1708, J1939, or autodetect.

The INLINE™ II_1, INLINE™ 4, INLINE™ 5, and INLINE™ 6 data link adapters require firmware software in order to operate correctly. Firmware versions are updated periodically and **must** be uploaded into data link adapters when updates are released. The latest firmware version is always available on the most recent INCAL™ DVD-ROM as well as from the website http://inline.cummins.com.The firmware version for a data link adapter is displayed at the lower right corner on the main INSITE™ electronic service tool window when connected to an ECM. INSITE™ electronic service tool **must** be connected to an ECM in order for the firmware version to be displayed.

Setup

General Information

Communication with the ECM can be established at three basic locations:

- Bench communication setup
- Vehicle communication setup
- Engine communication setup.

The communication setups are described in more detail in the remainder of this procedure. Each location utilizes different data link adapter cables. All three locations require either a serial cable or USB cable (INLINE™ 5 **only**) to interface from the data link adapter to the PC.

The ECM on newer engines can support data link communication on the OEM data link through the OEM connector at the ECM. It can also support data link communication on the engine data link through the engine connector at the ECM. The wiring diagram for a specific engine and ECM **must** be consulted to determine if an ECM supports both OEM data link and engine data link communication.

For Midrange and Heavy Duty engines, the recommended communication setup, if available, is the Cummins Inc. bench communication setup which establishes communication directly to the ECM. The bench communication setup can support both J1708 and J1939 data link protocols, when used with ECMs that support both protocols.

For High Horsepower engines with multiple ECMs, the recommended communication setup is the engine communication setup through the 9-pin connector provided in the engine harness.

J1939 data link communication, if available, is preferred for transferring calibrations because of less interference from other data link devices such as traction control systems and electronic dashes. J1708 communication can require extra time to disable the OEM ECMs that are also communicating on the J1708 data link in order to avoid interference from those devices. Also, the J1939 information transfer rate is faster than J1708 and a calibration download will take less time to complete using J1939 communication compared to J1708 communication.

The functionality of a communication setup can be verified by testing the communication setup on a second ECM or vehicle, if available, or by completing the resistance checks defined for each setup type.

The following table summarizes the ECM communication setups.

Communication Setup	Data link Connection Location	Engine ECM Data link Source	Data link Protocols Supported
Bench	ECM connector	OEM	J1708, J1939
Vehicle 6 pin	Dash 6 pin connector	OEM	J1708
Vehicle 9 pin	Dash 9 pin connector	OEM	J1708, J1939[1]
Engine	Engine harness 3 pin connector	Engine	J1939
Engine	Engine harness 6 pin connector	Engine	J1708[2]
Engine	Engine harness 9 pin connector	Engine	J1939[3]

Notes:

1 The 9 pin connector **must** be fully wired to support J1939 protocol.

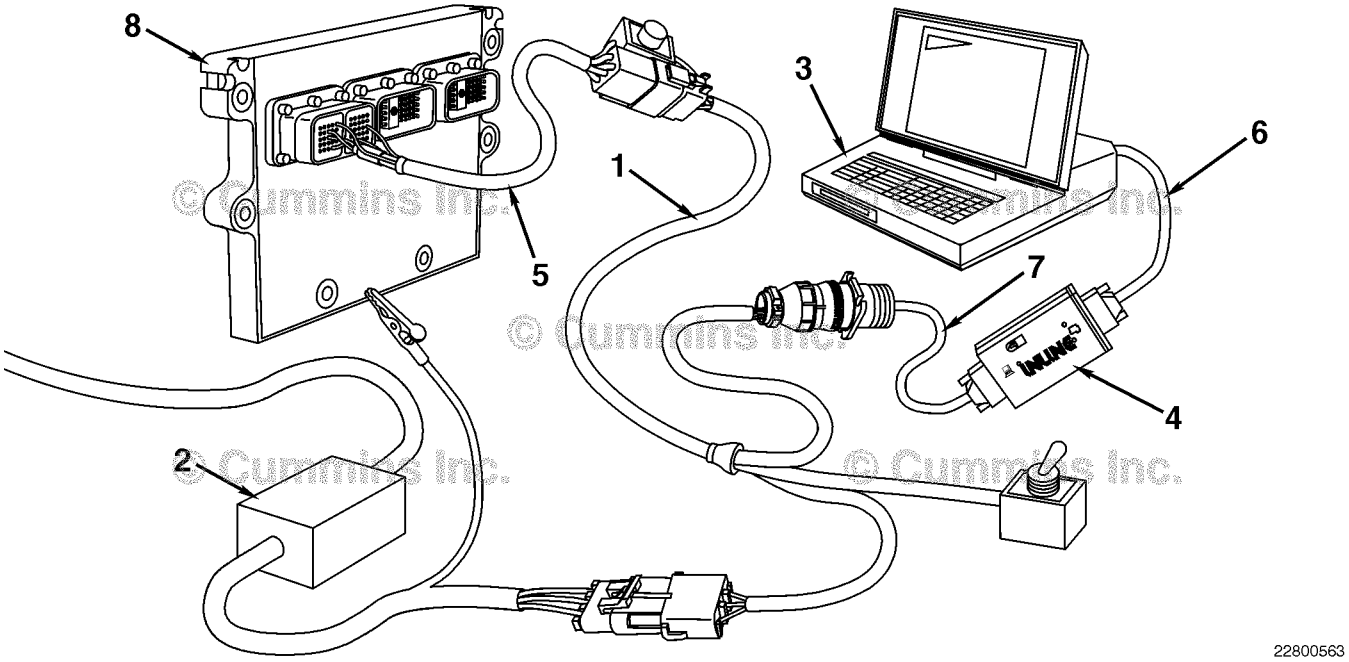
2 Available **only** on selected older engines.

3 Available **only** on selected High Horsepower engines.

Bench Communication Setup

The bench communication setup establishes communication directly with the ECM through the connector port on the ECM. An example of a bench communication setup is shown below.

The bench calibration harness (1) is common for most bench setups and can be used with the appropriate bench calibration cable (5) to communicate with various ECM's. A list of available bench calibration cables (5) for various ECM's is included in Bulletin 3377791, which is accessible on QuickServe™ Online. Proper function of the bench calibration harness (1) and bench calibration cable (5) can be verified by using the wiring diagrams provided to complete resistance checks.



Bench Communication Setup

1 Bench calibration harness, Part Number 3163151

2 Power supply[1]

3 PC with INSITE™ electronic service tool

4 Data link adapter

5 CM570 bench calibration cable, Part Number 3164789

6 PC Serial cable[2], Part Number 4918418.

7 Data link adapter cable, Part Number 3165159

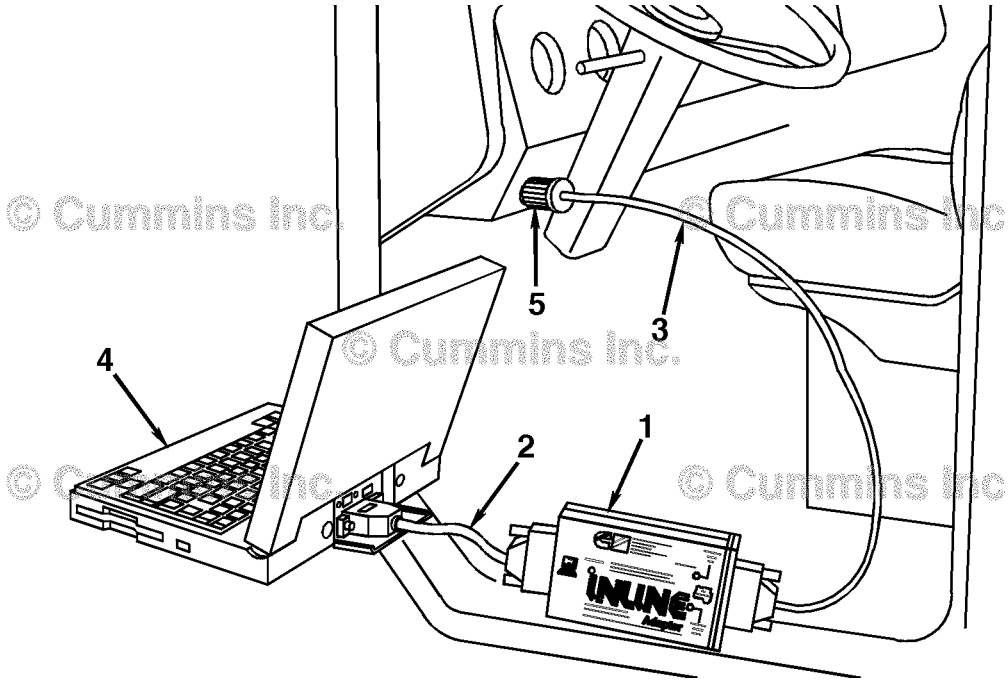
8 CM570 ECM (example).

NOTE: 1. See Bulletin 3377791 for part number.

NOTE: 2. USB cable, Part Number 4918591, can be used with the INLINE™ 4, INLINE™ 5, and INLINE™6.

Vehicle Communication Setup

An additional communication setup is a 9 pin or 6 pin Deutsch™ connection that is commonly located in the cab of a vehicle. The vehicle communication setup utilizes the OEM harness and connects to the ECM at the OEM connector port. A 9 pin connector in the cab, if fully wired, is capable of supporting both J1939, and J1708 protocol. Some OEMs place a 9 pin connector in the cab but do **not** provide wiring to support J1939 protocol. A 6 pin connector will **only** support J1708 protocol.



On Vehicle Communication Setup

1 Data link adapter

2 PC serial cable$_2$, Part Number 4918418.

3 Data link adapter cable$_1$

4 PC with INSITE™ electronic service tool

5 Vehicle data link adapter connector$_1$.

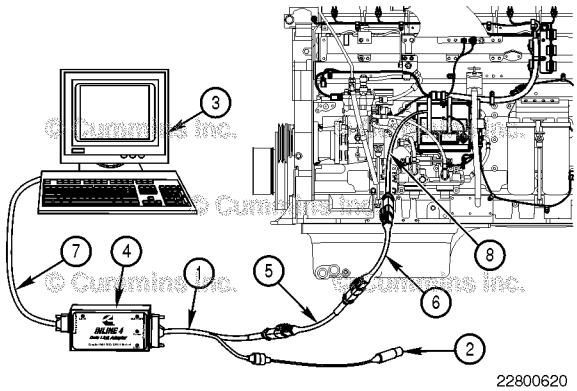
NOTE: 1. See Bulletin 3377791 for part number.

NOTE: 2. USB cable, Part Number 4918591, can be used with the INLINE™ 4, INLINE™ 5, and INLINE™6.

Engine Communication Setup

The engine communication setup utilizes the engine data link provided on the engine wiring harness. Depending upon the engine, the engine communication setup available on the engine harness can be a 3-pin Deutsch™ connector, a 6-pin Deutsch™ connector, or a 9-pin Deutsch™ connector.

A 3-pin Deutsch™ connector on the engine harness is available on newer engines and provides a connection point to the J1939 data link. A mini-backbone cable, which includes a 60 ohm resistor and a gender changer cable, may be required in order to connect to the ECM on the J1939 protocol. An auxiliary power supply is required for the data link adapter.



3-Pin Deutsch™ Connector

1 Data link cable$_1$

2 Power supply cable$_1$

3 PC with INSITE™ electronic service tool

4 Data link adapter

5 Gender changer cable, Part Number 3163597

6 Mini-backbone cable, Part Number 3163096

7 PC Serial cable[2], Part Number 4918418

8 Engine harness 3-pin connector, Part Number 3165141.

NOTE: 1. See Bulletin 3377791 for part number.

NOTE: 2. USB cable, Part Number 4918591, can be used with the INLINE™ 4, INLINE™ 5, and INLINE™6.

A 6-pin Deutsch™ connector is available on the engine harness for some older engines and provides a connection point to the engine J1939 data link. The 6-pin connector includes a power supply for the data link adapter.

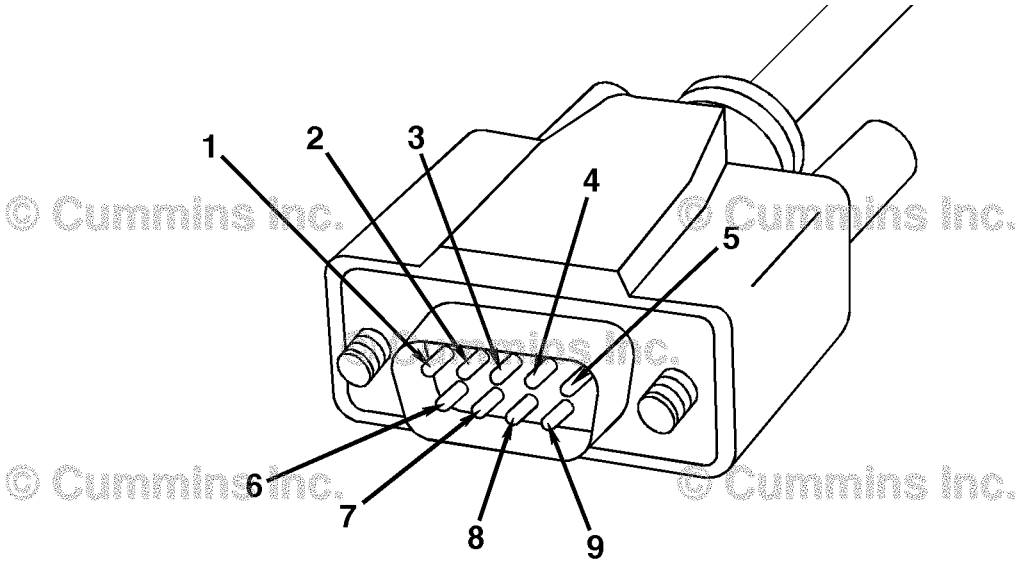
Resistance Check

General Information

A serial cable is required to interface from the data link adapter to the PC, or a USB cable can be used with an INLINE™ 5/6 data link adapter.

⚠CAUTION⚠

Use test lead, Part Number 3822758, and test lead, Part Number 3822917, to avoid the possibility of damage to the serial cable pins.



22800565

Serial Cable, Part Number 4918418

1 Open

2 Transmit data

3 Receive data

4 Data terminal ready (+5 VDC)

5 Signal ground

6 Open

7 Request to send (+5 VDC)

8 Clear to send

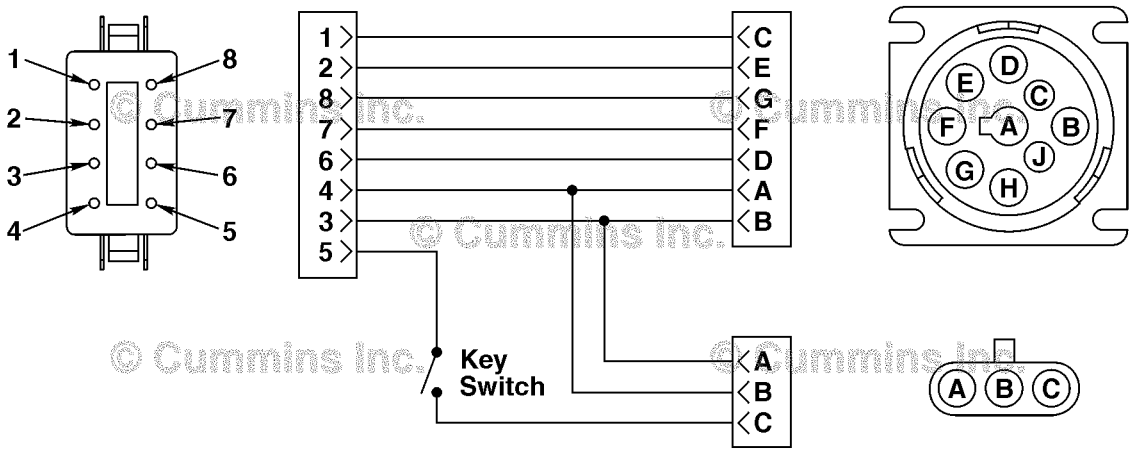
9 Open.

Insert a test lead into pin 1 of the female end of the serial cable, and connect it to the multimeter probe. Attach the other test lead to pin 1 of the male end of the serial cable, and connect it to the multimeter probe.

Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). Repeat the resistance measurement for pins 2 through 9. The multimeter **must** show a closed circuit (10 ohms or less) for each pin. If the circuit is **not** closed, replace the serial cable.

⚠CAUTION⚠

To avoid the possibility of damage to connector pins, use test lead, Part Number 3823993, on the 8-pin connector. Use test lead, Part Number 3823994, on the round 9-pin connector. Use test lead, Part Number 3824812, on the 3-pin connector.



22800618

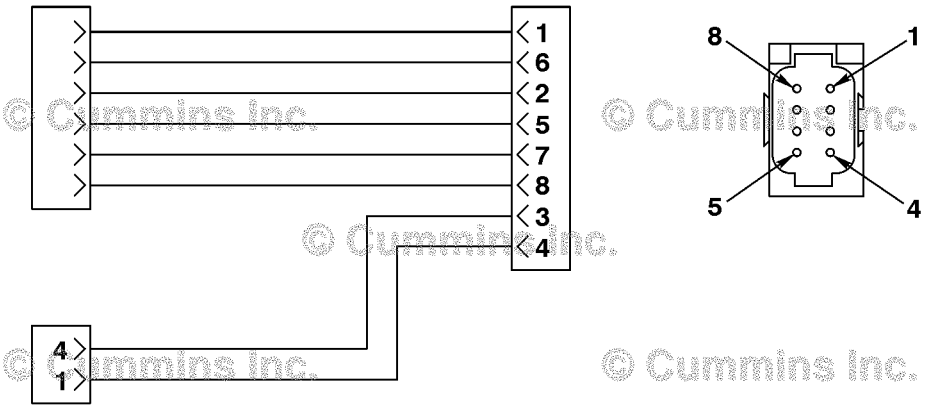
Bench Calibration Harness, Part Number 3163151

1 J1939 data link (+)
2 J1939 data link shield
3 Battery (+)
4 Battery (-)
5 Keyswitch
6 J1939 data link (-)
7 J1708 data link (+)
8 J1708 data link (-)

Measure the resistance from each pin in the 8-pin connector to be corresponding location in the 9-pin and/or 3 pin connector. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the bench calibration harness.

⚠CAUTION⚠

To avoid the possibility of damage to connector pins, use test lead, Part Number 382994, on the 8 pin connector. Determine the appropriate test lead needed for the ECM connector on the bench calibration cable.



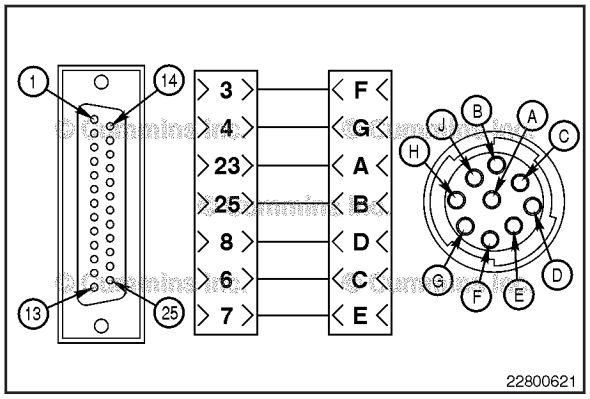
Bench Calibration Cable

1 J1939 data link (+)
2 J1939 data link shield
3 Battery (+)
4 Battery (-)
5 Keyswitch
6 J1939 data link (-)
7 J1708 data link (+)
8 J1708 data link (-).
9 ECM Connector (See wiring diagram for ECM connector pin identification).

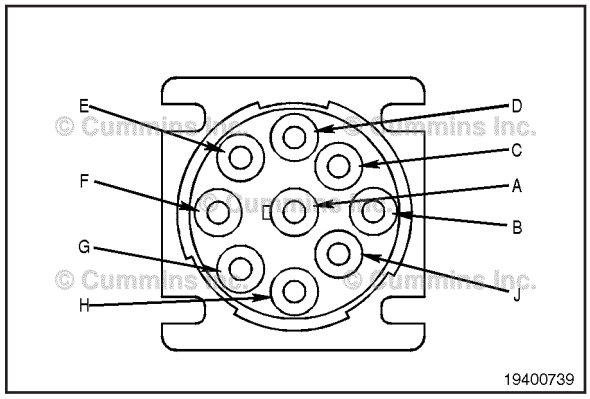
Measure the resistance from each pin in the 8 pin connector to the corresponding location in the ECM connector. See wiring diagram for the ECM for connector pin identification. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the bench calibration cable.

⚠CAUTION⚠

To avoid the possibility of damage to connector pins, use male test lead, Part Number 3823993, on the 9-pin Deutsch™ connector. Use male test lead, Part Number 3822758, on the 25-pin connector.



9-Pin Data link Cable, Part Number 3165159



9-Pin In-Cab Data link Connector

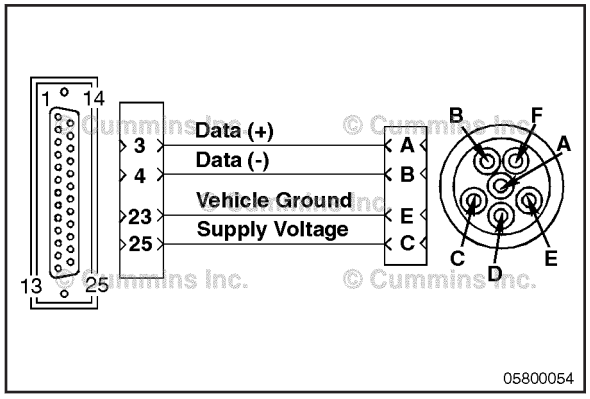
- A. Ground

- B. Battery (+)
- C. J1939 data link (+)
- D. J1939 data link (-)
- E. J1939 data link shield
- F. J1708 data link (+)
- G. J1708 data link (-)
- H. Open
- J. Open

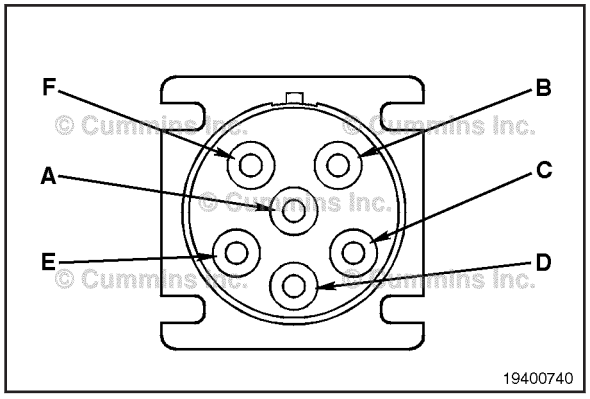
Measure the resistance from pins A, B, C, D, E, F, and G in the 9-pin connector to the corresponding location in the 25-pin connector as shown. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the data link cable.

⚠CAUTION⚠

To avoid the possibility of damage to connector pins, use male test lead, Part Number 3824811, on the 6-pin Deutsch™ connector. Use male test lead, Part Number 3822758, on the 25-pin connector.



6-Pin Data link Cable, Part Number 3165160



6-Pin In-Cab Data link Connector

A J1708 data link (+)

B J1708 data link (-)

C Battery (+)

D Open

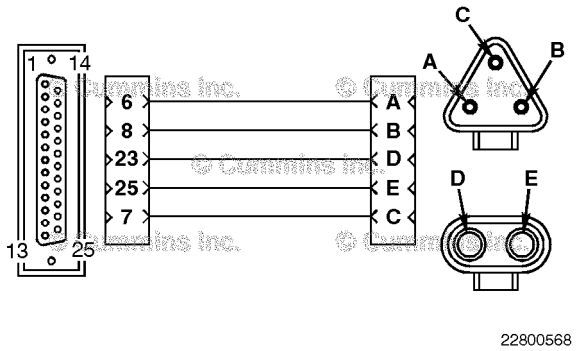
E Ground

F Open.

Measure the resistance from pins A, B, C, and E in the 6-pin connector to the corresponding location in the 25-pin connector as shown. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the data link cable.

⚠CAUTION⚠

To avoid the possibility of damage to the connector pins, use male test lead, Part Number 3822758, on the 25-pin connector. Use female test lead, Part Number 3823994, on the 3-pin connector. Use male test lead, Part Number 3822995, on the 2-pin power connector.

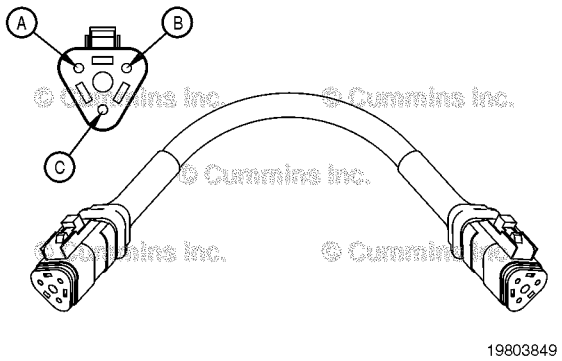


3-Pin Data link Cable, Part Number 3165141

Measure the resistance from pins A, B, and C in the 3-pin connector to the corresponding location in the 25-pin connector as shown. Measure the resistance from pins D and E in the 2-pin power supply connector to the corresponding location in the 5-pin connector as shown. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the data link cable.

⚠CAUTION⚠

To avoid the possibility of damage to connector pins, use two male test leads, Part Number 3823993, on each 3-pin connector.

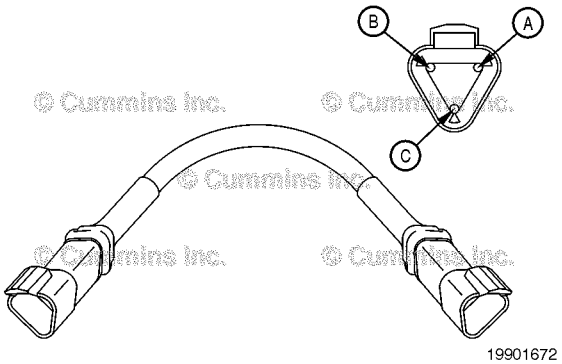


Mini Backbone Cable, Part Number 3163096

Measure the resistance from pin A in one end of the backbone cable to pin A in the opposite end of the backbone cable. Repeat for pins B and C. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the backbone cable. Measure the resistance across pins A and B at either end of the cable to measure the terminating resistance. The terminating resistance value **must** measure between 50-70 ohms.

⚠CAUTION⚠

To avoid the possibility of damage to connector pins, use two female test leads, Part Number 3823994, on each 3-pin connector.



Gender Changer Cable, Part Number 3163597

Measure the resistance from pin A in one end of the gender changer cable to pin A in the opposite end of the gender changer cable. Repeat for pins B and C. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the gender changer cable.

Notes

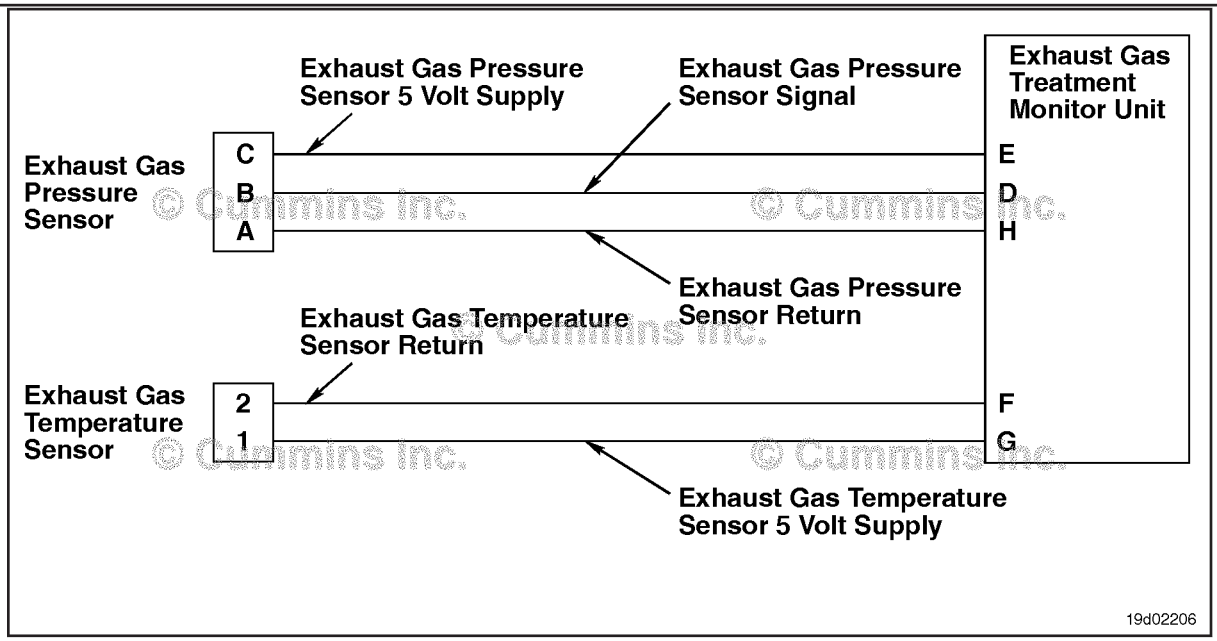
Section TF - Troubleshooting Fault Codes

Section Contents

Fault Code 0001

Exhaust Gas Pressure Sensor Number 1 Circuit - Voltage Above Normal, or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 0001 PID(P), SID(S): SPN: None FMI: Lamp: SRT:	Exhaust Gas Pressure Sensor Number 1 Circuit - Voltage Above Normal, or Shorted to High Source. High signal voltage detected at the Exhaust Gas Pressure Sensor circuit.	None on performance.



Exhaust Gas Pressure Sensor Number 1 Circuit

Circuit Description:

The exhaust gas pressure sensor provides the exhaust gas pressure to the exhaust gas treatment monitor unit through the exhaust gas treatment monitor harness.

Component Location:

The exhaust gas pressure sensor will be located near the inlet to the exhaust catalyst. The location will vary depending on application.

Shop Talk:

Possible causes of this fault code include:

- Open return circuit in the harness, connectors, or sensor
- Signal circuit shorted to sensor supply or battery voltage.

This fault code will **only** be present in the exhaust gas treatment monitor unit and will **not** be present in the engine electronic control module (ECM). The exhaust gas treatment fault code and maintenance lamps will both flash one time in sequence to alert the operator that this condition exists. The engine diagnostic lamps will **not** illuminate.

Refer to Troubleshooting Fault Code t05-0001

FAULT CODE 0001 - Exhaust Gas Pressure Sensor Number 1 Circuit - Voltage Above Normal, or Shorted to High Source

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the exhaust gas pressure sensor and circuit.**		
STEP 1A:	Inspect the exhaust gas pressure sensor and connector pins.	Dirty or damaged pins?	
STEP 1B:	Check the circuit response.	Fault Code 0001 inactive and Fault Code 0002 active?	
STEP 1C:	Check the sensor supply voltage and return circuit.	4.75 to 5.25 VDC?	
STEP 1D:	Check the fault code and verify sensor condition.	Fault Code 0001 present?	
STEP 2:	**Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.**		
STEP 2A:	Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.	Dirty or damaged pins?	
STEP 2B:	Check for an open circuit in the exhaust gas treatment monitor harness.	Less than 10 ohms?	
STEP 2C:	Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.	Greater than 100k ohms?	
STEP 2D:	Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.	Greater than 100 ohms?	
STEP 2E:	Check for fault code presence.	Fault Code 0001 present?	
STEP 3:	**Clear the fault code.**		
STEP 3A:	Disable the fault code.	Fault Code 0001 present?	

TROUBLESHOOTING STEP

STEP 1: Check the exhaust gas pressure sensor and circuit.

STEP 1A: Inspect the exhaust gas pressure sensor and connector pins.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Inspect the exhaust gas treatment monitor harness and exhaust gas pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A
	Dirty or damaged pins? **NO**	1B

STEP 1B: Check the circuit response.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the Exhaust Gas Treatment Monitor Unit using the Emissions Monitor Interface electronic service tool. • Start the engine and check for the appropriate circuit response after 30 seconds. • Use the Emissions Monitor Interface electronic service tool to read the fault codes.	Fault Code 0001 inactive and Fault Code 0002 active? **YES**	1D
	Fault Code 0001 inactive and Fault Code 0002 active? **NO**	2A

STEP 1C: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the SUPPLY voltage and RETURN circuit. • Measure the voltage between the exhaust gas pressure +5 volt SUPPLY pin and the exhaust gas pressure RETURN pin at the sensor connector of the exhaust gas treatment monitor harness.	4.75 to 5.25 VDC? **YES**	1D
	4.75 to 5.25 VDC? **NO**	2A

STEP 1D: Check the fault codes and verify sensor condition.

Condition:
- Turn keyswitch OFF
- Connect the exhaust gas pressure sensor to the exhaust gas treatment monitor harness
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the Exhaust Gas Treatment Monitor Unit using the Emissions Monitor Interface electronic service tool. • Start the engine and check for the appropriate circuit response after 30 seconds. • Use the Emissions Monitor Interface electronic service tool to read the fault codes.	Fault Code 0001 present? **YES** **Repair:** A damaged sensor has been detected. Replace the exhaust gas pressure sensor. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-039 in Section 11.	3A
	Fault Code 0001 present? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	3A

STEP 2: Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.

STEP 2A: Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.

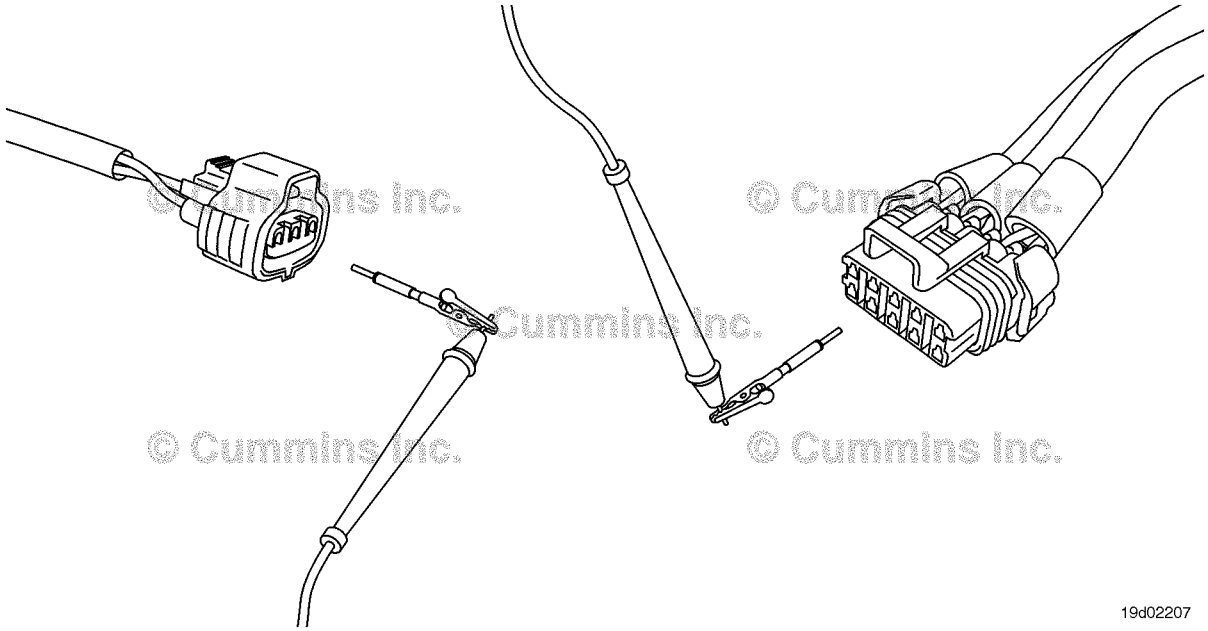
Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor unit from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Inspect the exhaust gas treatment monitor unit and exhaust gas treatment harness connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the exhaust gas treatment monitor unit connector or exhaust gas treatment monitor harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. • Refer to Procedure 011-038 in Section 11. • Refer to Procedure 011-035 in Section 11.	3A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check for an open circuit in the exhaust gas treatment monitor harness.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor unit from the exhaust gas treatment monitor harness
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness.

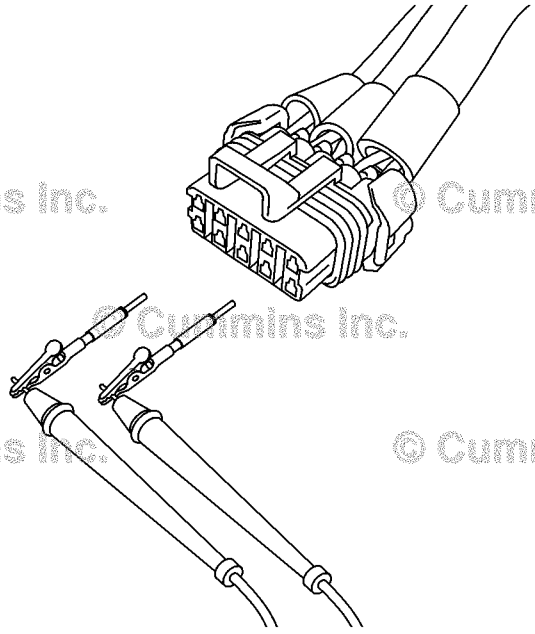
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector exhaust gas pressure RETURN pin and the exhaust gas treatment monitor harness exhaust gas pressure sensor connector RETURN pin. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	2C
	Less than 10 ohms? **NO** **Repair:** An open RETURN circuit has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



STEP 2C: Check for a pin to pin short circuit in the exhaust gas treatment monitor harness.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor harness from the exhaust gas treatment monitor unit connector
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness.

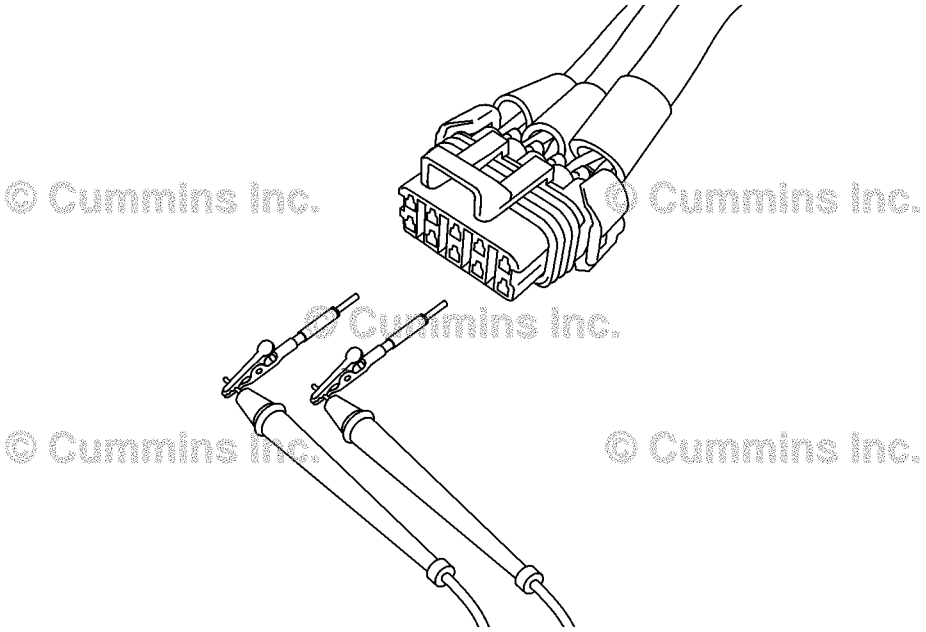
Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the exhaust gas pressure SIGNAL pin in the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector and all other pins in the exhaust gas treatment monitor harness connector. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	2D
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the pin to pin short circuit. Repair or replace the exhaust gas treatment monitor harness. Refer to Procedure 011-038 in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418.	3A



STEP 2D: Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor harness from the exhaust gas treatment monitor unit connector
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the exhaust gas pressure SUPPLY pin in the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector and all other pins in the exhaust gas treatment monitor harness connector. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	2E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SUPPLY line has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the pin-to-pin short circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



STEP 2E: Check for fault code presence.

Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the Exhaust Gas Treatment Monitor Unit using the Emissions Monitor Interface electronic service tool. • Start the engine and check for the appropriate circuit response after 30 seconds. • Use the Emissions Monitor Interface electronic service tool to read the fault codes.	Fault Code 0001 present? **YES** **Repair:** Replace the exhaust gas treatment monitor unit. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-035 in Section 11.	3A
	Fault Code 0001 present? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	3A

STEP 3: Clear the fault code.

STEP 3A: Disable the fault code.

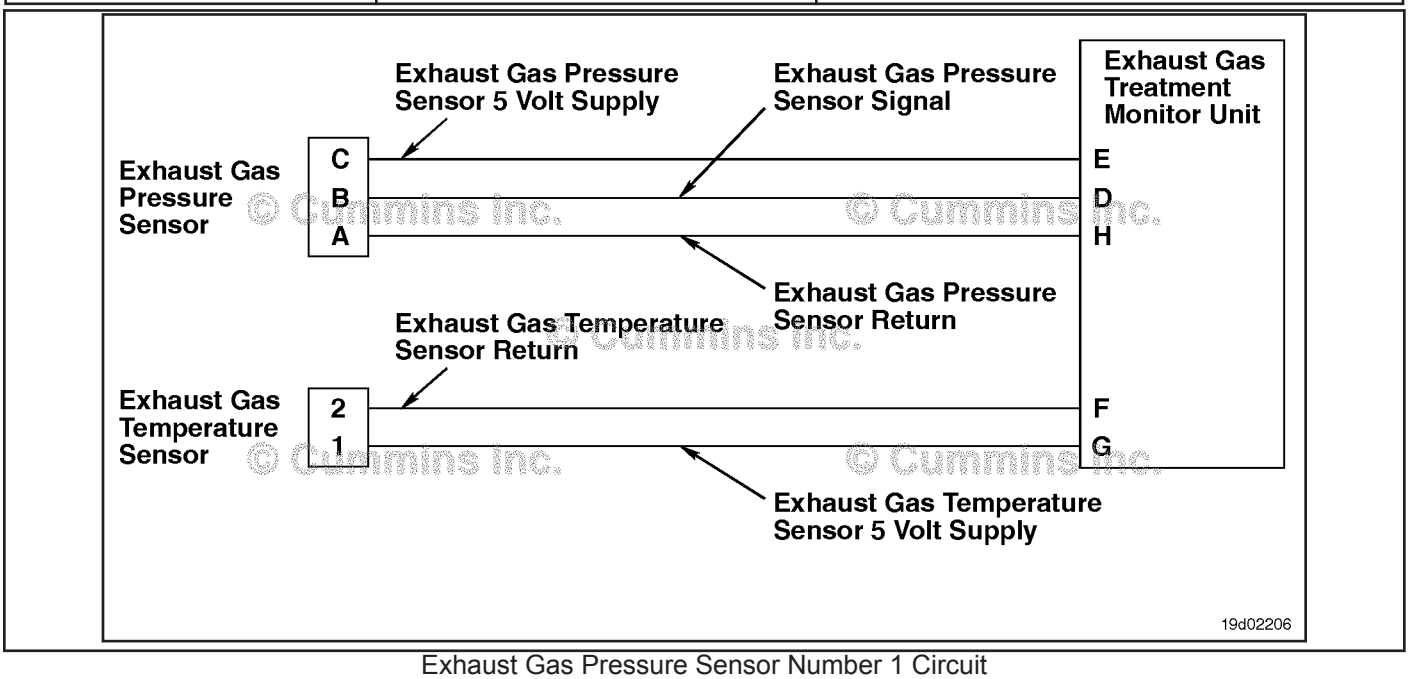
Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the fault codes using the Emissions Monitor Interface slectronic service tool. • Verify that the emission warning lamps flash twice to signify a reset. • Start the engine and let it idle for one minute.	Fault Code 0001 present? **YES**	1A
	Fault Code 0001 present? **NO**	Repair complete.

Fault Code 0002

Exhaust Gas Pressure Sensor Number 1 Circuit - Voltage Below Normal, or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 0002 PID(P), SID(S): SPN: None FMI: Lamp: SRT:	Exhaust Gas Pressure Sensor Number 1 Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage or open circuit detected at the Exhaust Gas Pressure Sensor circuit.	None on performance.



Exhaust Gas Pressure Sensor Number 1 Circuit

Circuit Description:

The exhaust gas pressure sensor provides the exhaust gas pressure to the exhaust gas treatment monitor unit through the exhaust gas treatment monitor harness.

Component Location:

The exhaust gas pressure sensor will be located near the inlet to the exhaust catalyst. The location will vary depending on application.

Shop Talk:

Possible causes of this fault code include:

- Signal circuit open or shorted to ground in the exhaust gas treatment monitor harness or exhaust gas pressure sensor.
- Supply line open or shorted to ground.

This fault code will **only** be present in the exhaust gas treatment monitor unit and will **not** be present in the engine electronic control module (ECM). The exhaust gas treatment fault code and maintenance lamps will both flash two times in sequence to alert the operator that this condition exists. The engine diagnostic lamps will **not** illuminate.

Refer to Troubleshooting Fault Code t05-0002

FAULT CODE 0002 - Exhaust Gas Pressure Sensor Number 1 Circuit - Voltage Below Normal, or Shorted to Low Source

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the exhaust gas pressure sensor and circuit.**		
STEP 1A:	Inspect the exhaust gas pressure sensor and connector pins.	Dirty or damaged pins?	
STEP 1B:	Check the sensor supply voltage and return circuit.	4.75 to 5.25 VDC?	
STEP 1C:	Check the circuit response.	Fault Code 0002 inactive and Fault Code 0001 active?	
STEP 1D:	Check the fault code and verify sensor condition.	Fault Code 0002 is active?	
STEP 2:	**Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.**		
STEP 2A:	Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.	Dirty or damaged pins?	
STEP 2B:	Check for an open circuit in the exhaust gas treatment monitor harness.	Less than 10 ohms?	
STEP 2C:	Check for an open circuit in the exhaust gas treatment monitor harness.	Less than 10 ohms?	
STEP 2D:	Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.	Greater than 100k ohms?	
STEP 2E:	Check for a pin short circuit to ground.	Greater than 100k ohms?	
STEP 2F:	Check for fault code presence.	Fault Code 0002 present?	
STEP 3:	**Clear the fault code.**		
STEP 3A:	Disable the fault code.	Fault Code 0002 present?	

TROUBLESHOOTING STEP

STEP 1: Check the exhaust gas pressure sensor and circuit.

STEP 1A: Inspect the exhaust gas pressure sensor and connector pins.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Inspect the exhaust gas treatment monitor harness and exhaust gas pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^e, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A
	Dirty or damaged pins? **NO**	1B

STEP 1B: Check the sensor supply voltage and return circuit.

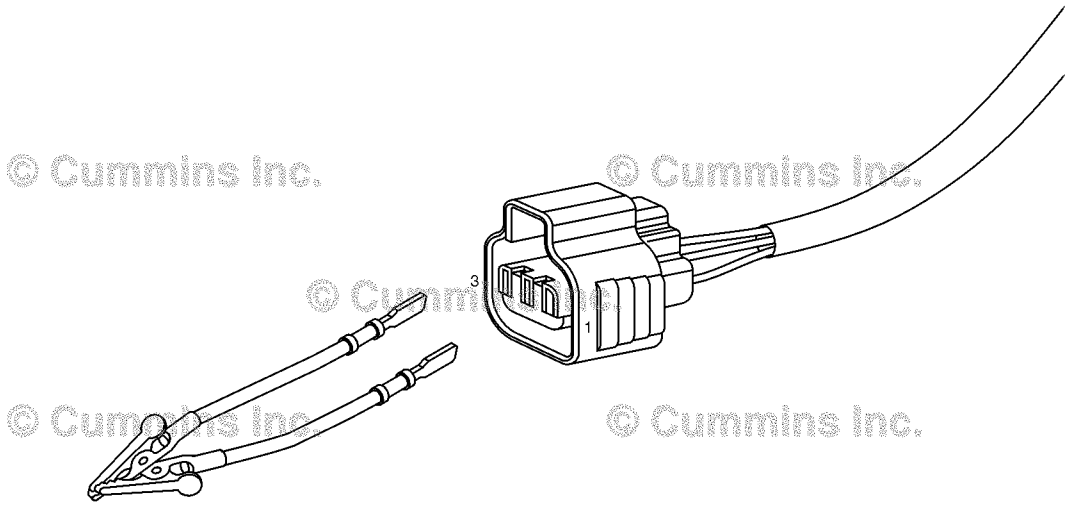
Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the SUPPLY voltage and RETURN circuit. • Measure the voltage between the exhaust gas pressure +5 volt SUPPLY pin and the exhaust gas pressure RETURN pin at the sensor connector of the exhaust gas treatment monitor harness.	4.75 to 5.25 VDC? **YES**	1C
	4.75 to 5.25 VDC? **NO**	2A

STEP 1C: Check the circuit response.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the Exhaust Gas Treatment Monitor Unit using the Emissions Monitor Interface electronic service tool. • Place a jumper wire between the exhaust gas pressure SUPPLY pin and the exhaust gas pressure SIGNAL pin at the exhaust gas pressure sensor connector of the exhaust gas treatment monitor harness. • Start the engine and check for the appropriate circuit response after 30 seconds. • Use the Emissions Monitor Interface electronic service tool to read the fault codes.	Fault Code 0002 inactive and Fault Code 0001 active? **YES**	1D
	Fault Code 0002 inactive and Fault Code 0001 active? **NO**	2A



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STEP 1D: Check the fault codes and verify sensor condition.

Condition:
- Turn keyswitch OFF
- Connect the exhaust gas pressure sensor to the exhaust gas treatment monitor harness
- Reset Emissions Gas Treatment Monitor
- Start engine
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use the Emissions Monitor Interface electronic service tool to read the fault codes.	Fault Code 0002 is active? **YES** **Repair:** A damaged sensor has been detected. Replace the exhaust gas pressure sensor. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-039 in Section 11.	3A
	Fault Code 0002 is active? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	3A

STEP 2: Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.

STEP 2A: Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.

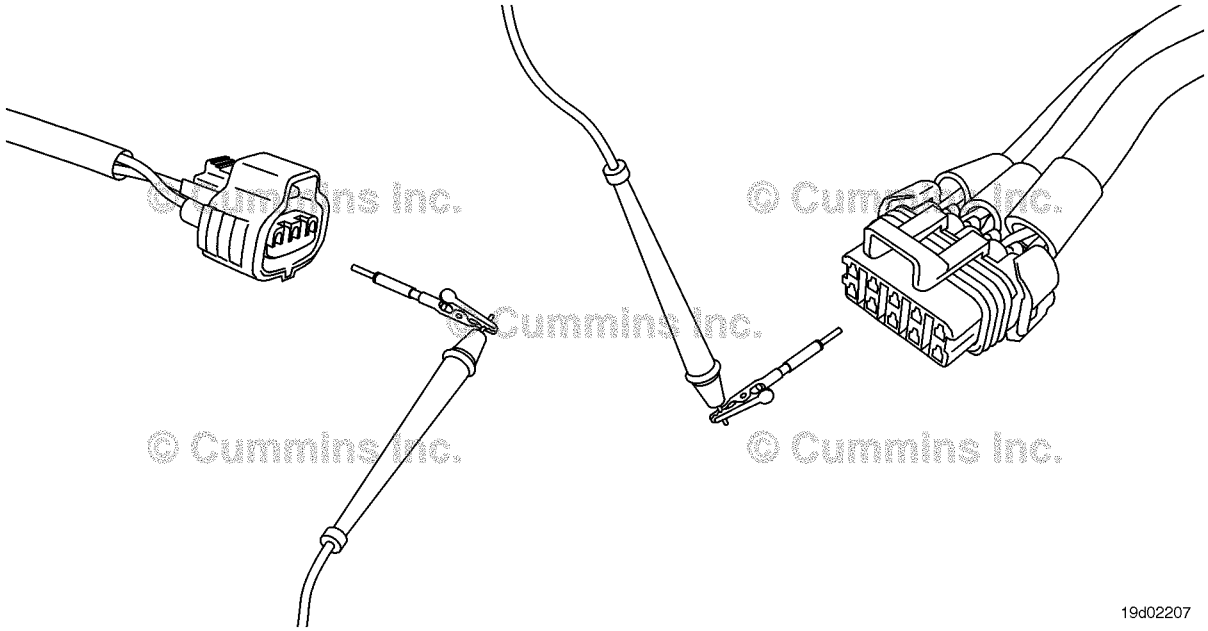
Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor unit from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Inspect theexhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the exhaust gas treatment monitor unit connector or exhaust gas treatment monitor harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Use the following procedure(s) in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. • Refer to Procedure 011-038 in Section 11. • Refer to Procedure 011-035 in Section 11.	3A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check for an open circuit in the exhaust gas treatment monitor harness.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor unit from the exhaust gas treatment monitor harness
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness.

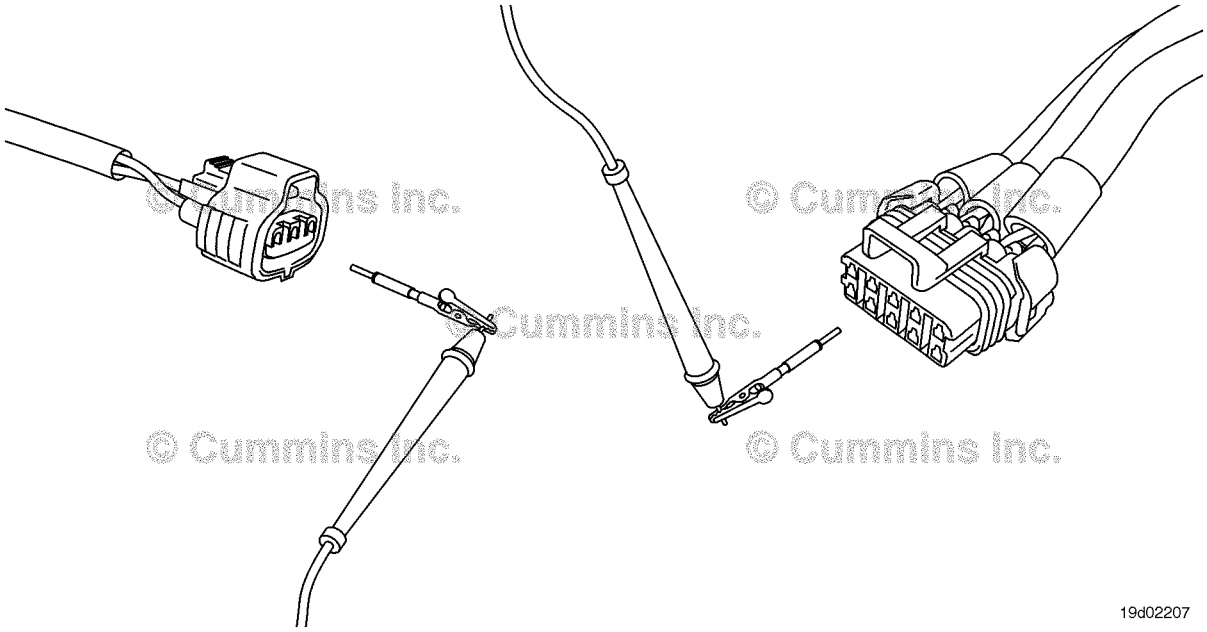
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector exhaust gas pressure SUPPLY pin and the exhaust gas treatment monitor harness exhaust gas pressure sensor connector SUPPLY pin. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	2C
	Less than 10 ohms? **NO** **Repair:** An open SUPPLY circuit has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



STEP 2C: Check for an open circuit in the exhaust gas treatment monitor harness.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor unit from the exhaust gas treatment monitor harness
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness.

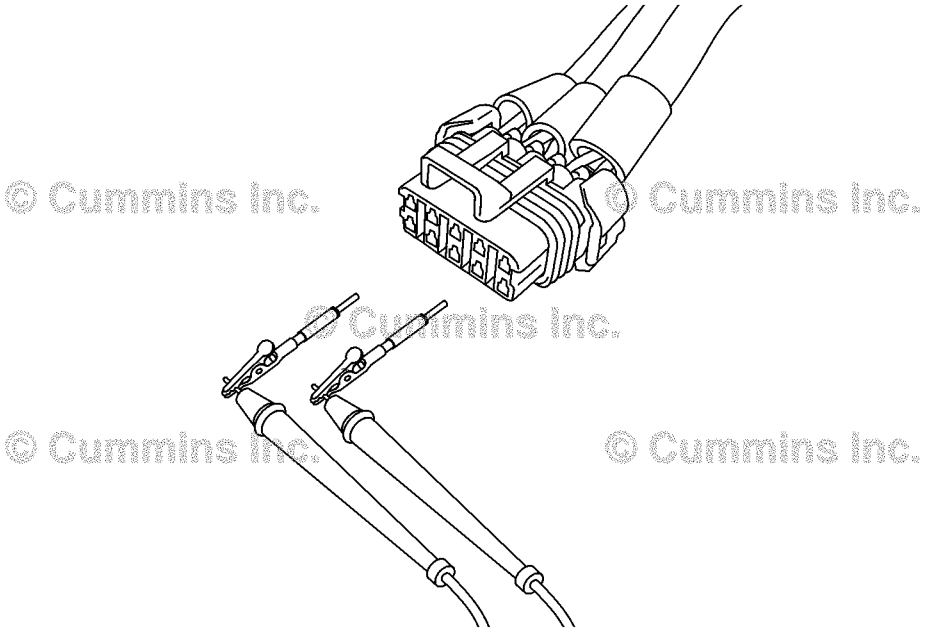
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector exhaust gas pressure SIGNAL pin and the exhaust gas treatment monitor harness exhaust gas pressure sensor connector SIGNAL pin. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	2D
	Less than 10 ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



STEP 2D: Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor harness from the exhaust gas treatment monitor unit connector
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness.

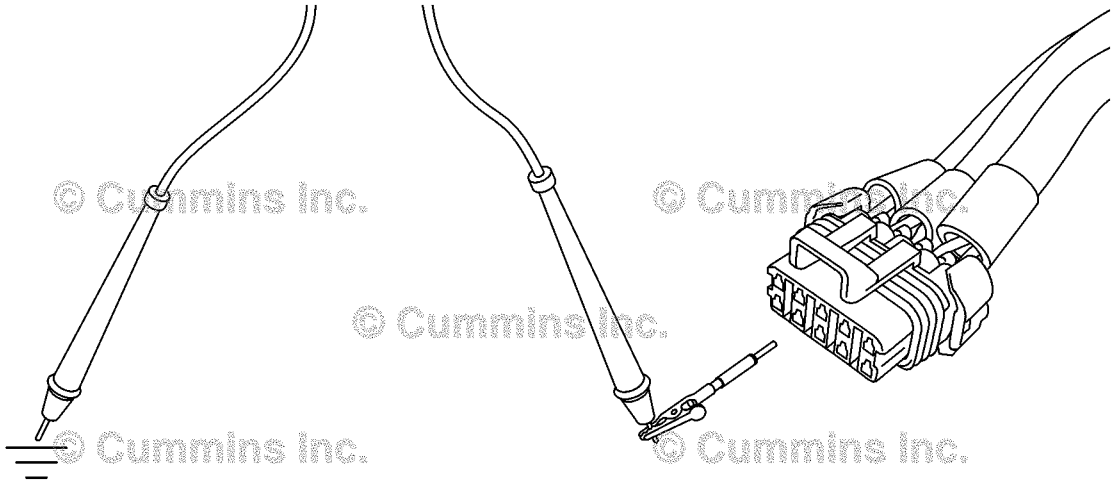
Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the exhaust gas pressure SIGNAL pin in the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector and all other pins in the exhaust gas treatment monitor harness connector. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	2E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the pin to pin short circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



STEP 2E: Check for a pin short circuit to ground

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor harness from the exhaust gas treatment monitor unit connector
- Disconnect the exhaust gas pressure sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Check for a pin-to-ground short. • Measure the resistance between the exhaust gas pressure SIGNAL pin in the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector and ground. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	2F
	Greater than 100k ohms? **NO** **Repair:** A pin-to-ground short circuit on the SIGNAL line has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the pin to pin short circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



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STEP 2F: Check for fault code presence.

Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the Exhaust Gas Treatment Monitor Unit using the Emissions Monitor Interface electronic service tool. • Start the engine and check for the appropriate circuit response after 30 seconds. • Use the Emissions Monitor Interface electronic service tool to read the fault codes.	Fault Code 0002 present? **YES** **Repair:** Replace the exhaust gas treatment monitor unit. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^e, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-035 in Section 11.	3A
	Fault Code 0002 present? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	3A

STEP 3: Clear the fault code.

STEP 3A: Disable the fault code.

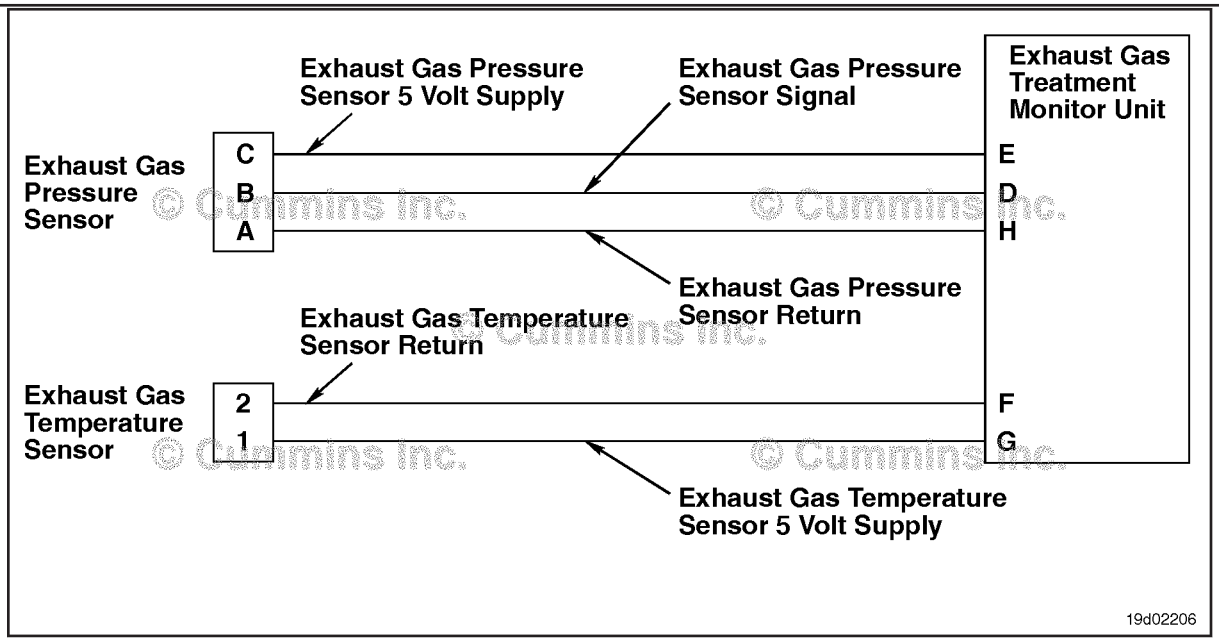
Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the fault codes using the Emissions Monitor Interface slectronic service tool. • Verify that the emission warning lamps flash twice to signify a reset. • Start the engine and let it idle for one minute.	Fault Code 0002 present? **YES**	1A
	Fault Code 0002 present? **NO**	Repair complete.

Fault Code 0003

Exhaust Gas Pressure Sensor Number 1 Circuit - Data Erratic, Intermittent, or Incorrect.

CODES	REASON	EFFECT
Fault Code: 0003 PID(P), SID(S): SPN: None FMI: Lamp: SRT:	Exhaust Gas Pressure Sensor Number 1 Circuit - Data Erratic, Intermittent, or Incorrect. The exhaust gas treatment monitor unit has detected that the exhaust gas pressure sensor number 1 is **not** changing.	None on performance.



Exhaust Gas Pressure Sensor Number 1 Circuit

Circuit Description:

The exhaust gas pressure sensor provides the exhaust gas pressure to the exhaust gas treatment monitor unit through the exhaust gas treatment monitor harness.

Component Location:

The exhaust gas pressure sensor will be located near the inlet to the exhaust catalyst. The location will vary depending on application.

Shop Talk:

This fault code is activated when the exhaust gas treatment monitor unit detects that the exhaust gas pressure signal value is **not** changing (ie, stuck in range). In order for this fault code to activate, the exhaust gas treatment monitor unit **must** detect that the exhaust gas pressure signal does **not** change during 30 minutes of engine operation where the exhaust gas temperature is above 250°C [482°F].

Possible causes of this fault code include:

- Faulty exhaust gas pressure sensor.

This fault code will **only** be present in the exhaust gas treatment monitor unit, and will **not** be present in the engine electronic control module (ECM). The exhaust gas treatment fault code and maintenance lamps will both flash three times in sequence to alert the operator that this condition exists. The engine diagnostic lamps will **not** illuminate.

Refer to Troubleshooting Fault Code t05-0003

FAULT CODE 0003 - Exhaust Gas Pressure Sensor Number 1 Circuit - Data Erratic, Intermittent, or Incorrect
TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Monitor the exhaust gas pressure**		
STEP 1A:	**Monitor the exhaust gas pressure.**	**Does the pressure reading change?**	
STEP 2:	**Clear the fault code.**		
STEP 2A:	**Disable the fault code.**	**Fault Code 0003 present?**	

TROUBLESHOOTING STEP

STEP 1: Monitor the exhaust gas pressure.
STEP 1A: Monitor the exhaust gas pressure.

Condition:
- Turn keyswitch OFF
- Connect the Emissions Monitor Interface electronic service tool
- Start the engine.

Action	Specification/Repair	Next Step
Monitor the exhaust gas pressure reading using the Emission Monitor Interface electronic service tool. • Operate the engine from low idle to high idle several times and verify that the pressure reading changes.	Does the pressure reading change? **YES**	No repair.
	Does the pressure reading change? **NO** **Repair:** A damaged connection has been detected in the sensor or harness connector or a damaged sensor has been detected. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-039 in Section 11.	2A

STEP 2: Clear the fault code.

STEP 2A: Disable the fault code.

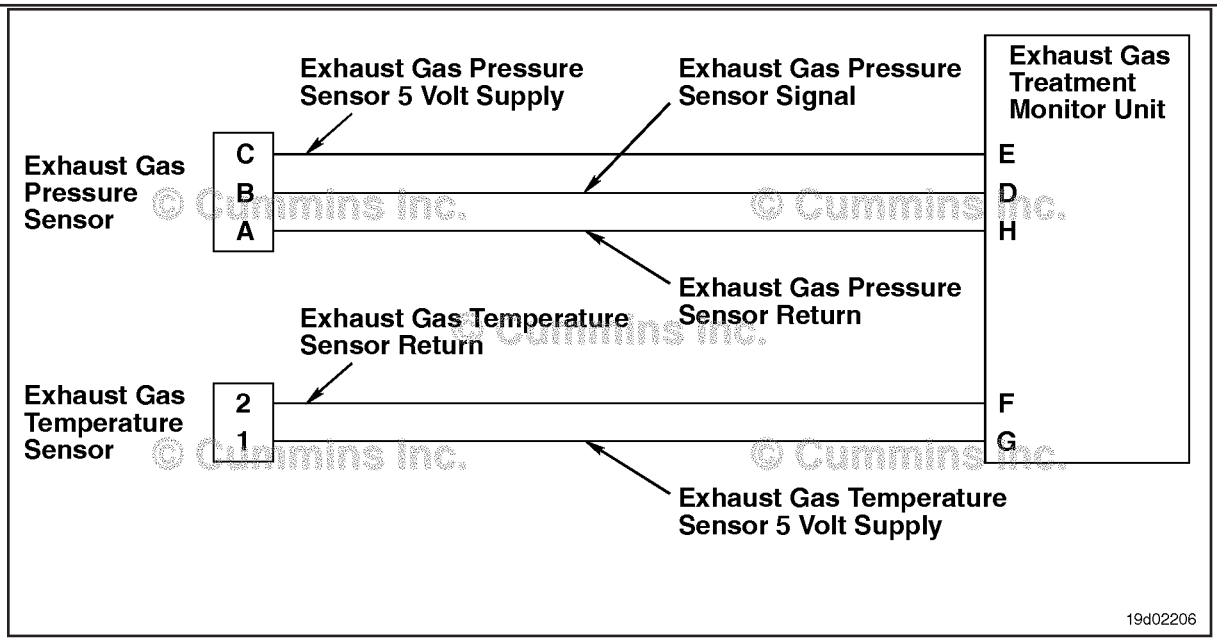
Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the fault codes using the Emissions Monitor Interface slectronic service tool. • Verify that the emission warning lamps flash twice to signify a reset. Note: The engine will need to be operated for at least thirty minutes with the exhaust gas temperature above 250°C [482°F] in order for this fault code to set. It is unlikely that this fault code will become active in the shop.	Fault Code 0003 present? **YES** **Repair:** Return to troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1A
	Fault Code 0003 present? **NO**	Repair complete.

Fault Code 0004

Exhaust Gas Temperature Sensor Number 1 Circuit - Data Erratic, Intermittent, or Incorrect.

CODES	REASON	EFFECT
Fault Code: 0004 PID(P), SID(S): SPN: None FMI: Lamp: SRT:	Exhaust Gas Temperature Sensor Number 1 Circuit - Data Erratic, Intermittent, or Incorrect. The exhaust gas treatment monitor unit has detected that the exhaust gas temperature sensor number 1 is **not** changing.	None on performance.



Exhaust Gas Temperature Sensor Number 1 Circuit

Circuit Description:

The exhaust gas temperature sensor provides the exhaust gas temperature to the exhaust gas treatment monitor unit through the exhaust gas treatment monitor harness.

Component Location:

The exhaust gas temperature sensor will be located near the inlet to the exhaust catalyst. The location will vary depending on application.

Shop Talk:

This fault code is activated when the exhaust gas treatment monitor unit detects that the exhaust gas temperature signal value is **not** changing (ie, stuck in range). In order for this fault code to activate, the exhaust gas treatment monitor unit **must** detect that the exhaust gas temperature is below 100°C [212°F] during one hour of continuous engine operation.

Possible causes of this fault code include:

- Faulty exhaust gas temperature sensor.

This fault code will **only** be present in the exhaust gas treatment monitor unit, and will **not** be present in the engine electronic control module (ECM). The exhaust gas treatment fault code and maintenance lamps will both flash four times in sequence to alert the operator that this condition exists. The engine diagnostic lamps will **not** illuminate.

Refer to Troubleshooting Fault Code t05-0004

FAULT CODE 0004 - Exhaust Gas Temperature Sensor Number 1 Circuit - Data Erratic, Intermittent, or Incorrect
TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Monitor the exhaust gas temperature**		
STEP 1A:	**Monitor the exhaust gas temperature.**	**Does the temperature reading change?**	
STEP 2:	**Clear the fault code.**		
STEP 2A:	**Disable the fault code.**	**Fault Code 0004 present?**	

TROUBLESHOOTING STEP

STEP 1: Monitor the exhaust gas temperature.
STEP 1A: Monitor the exhaust gas temperature.

Condition:
- Turn keyswitch OFF
- Connect the Emissions Monitor Interface electronic service tool
- Start the engine.

Action	Specification/Repair	Next Step
Monitor the exhaust gas temperature reading using the Emission Monitor Interface electronic service tool. • Operate the engine from low idle to high idle several times and verify that the temperature reading changes.	Does the temperature reading change? **YES**	No repair.
	Does the temperature reading change? **NO** **Repair:** A damaged connection has been detected in the sensor or harness connector or a damaged sensor has been detected. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-037 in Section 11.	2A

STEP 2: Clear the fault code.

STEP 2A: Disable the fault code.

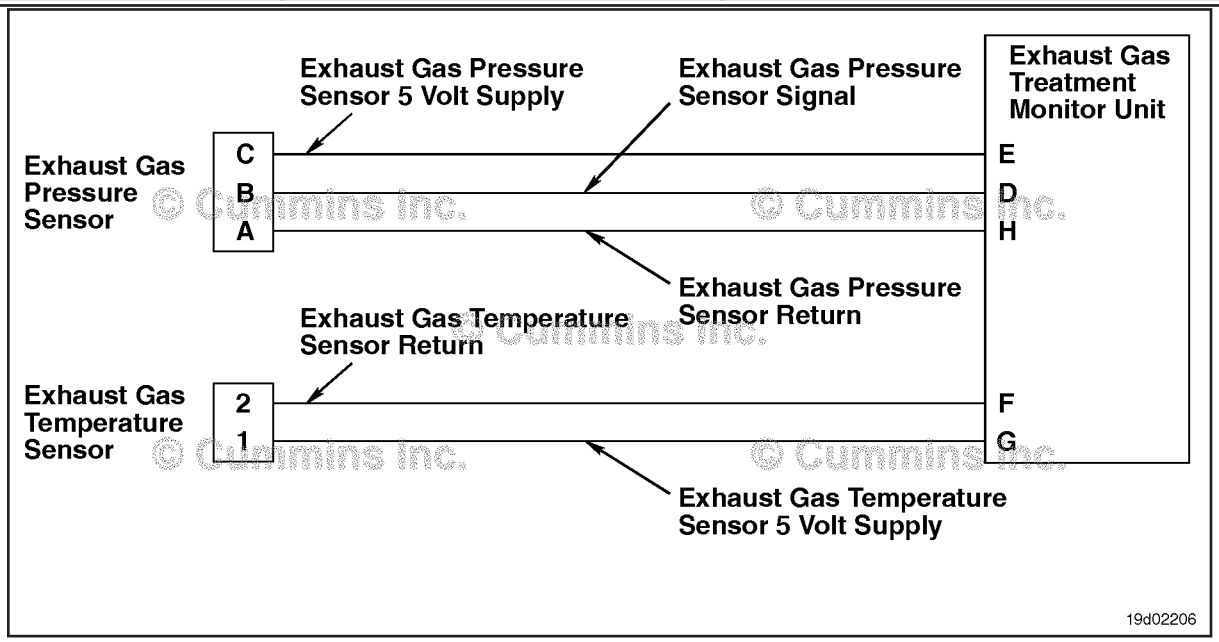
Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the fault codes using the Emissions Monitor Interface slectronic service tool. • Verify that the emission warning lamps flash twice to signify a reset. Note: The engine will need to be operated for at least one hour in order for this fault code to set. It is unlikely that this fault code will become active in the shop.	Fault Code 0004 present? **YES** **Repair:** Return to troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1A
	Fault Code 0004 present? **NO**	Repair complete.

Fault Code 0005

Exhaust Gas Temperature Sensor Number 1 Circuit - Voltage Below Normal, or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 0005 PID(P), SID(S): SPN: None FMI: Lamp: SRT:	Exhaust Gas Temperature Sensor Number 1 Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage or open circuit detected at the Exhaust Gas Temperature Sensor circuit.	None on performance.



Exhaust Gas Temperature Sensor Number 1 Circuit

Circuit Description:

The exhaust gas temperature sensor provides the exhaust gas temperature to the exhaust gas treatment monitor unit through the exhaust gas treatment monitor harness.

Component Location:

The exhaust gas temperature sensor will be located near the inlet to the exhaust catalyst. The location will vary depending on application.

Shop Talk:

Possible causes of this fault code include:

- Signal shorted to ground
- Signal shorted to return or ground in the sensor
- Open circuit on the signal wire
- Open return circuit in the harness, connector, or sensor.

This fault code will **only** be present in the exhaust gas treatment monitor unit and will **not** be present in the engine electronic control module (ECM). The exhaust gas treatment fault code and maintenance lamps will both flash five times in sequence to alert the operator that this condition exists. The engine diagnostic lamps will **not** illuminate.

Refer to Troubleshooting Fault Code t05-0005

FAULT CODE 0005 - Exhaust Gas Temperature Sensor Number 1 Circuit - Voltage Below Normal, or Shorted to Low Source

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the exhaust gas temperature sensor and circuit.**		
STEP 1A:	Inspect the exhaust gas temperature sensor and connector pins.	Dirty or damaged pins?	
STEP 1B:	Check the sensor resistance.	14k ohms to 250k ohms?	
STEP 2:	**Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.**		
STEP 2A:	Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.	Dirty or damaged pins?	
STEP 2B:	Check for an open circuit in the exhaust gas treatment monitor harness.	Less than 10 ohms?	
STEP 2C:	Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.	Greater than 100k ohms?	
STEP 2D:	Check for a pin short circuit to ground.	Greater than 100k ohms?	
STEP 2E:	Check for fault code presence.	Fault Code 0002 present?	
STEP 3:	**Clear the fault code.**		
STEP 3A:	Disable the fault code.	Fault Code 0002 present?	

TROUBLESHOOTING STEP

STEP 1: Check the exhaust gas temperature sensor and circuit.

STEP 1A: Inspect the exhaust gas temperature sensor and connector pins.

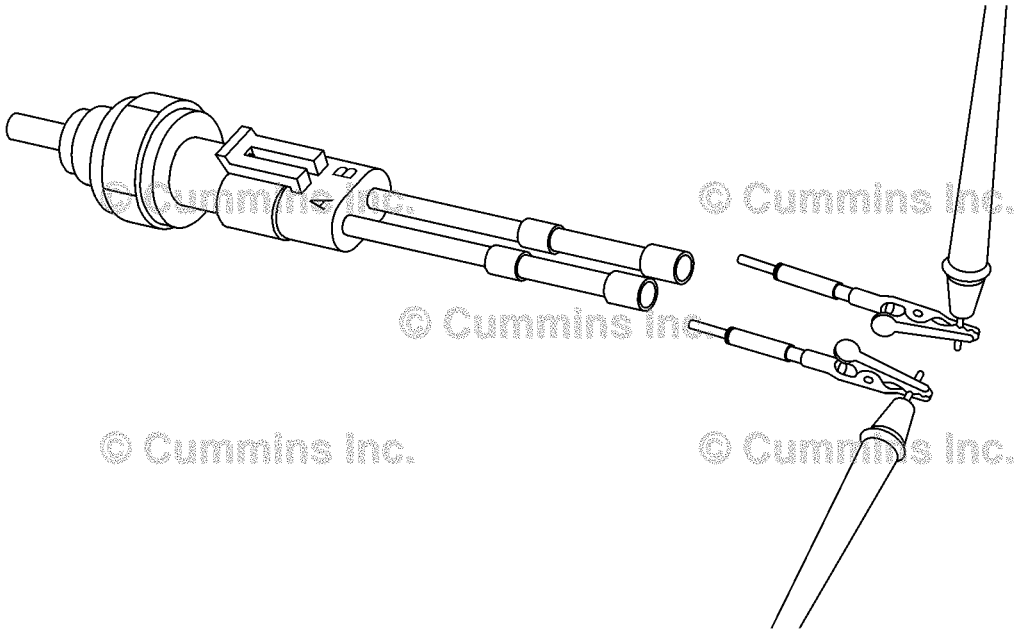
Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas temperature sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Inspect the exhaust gas treatment monitor harness and exhaust gas temperature sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A
	Dirty or damaged pins? **NO**	1B

STEP 1B: Check the sensor resistance.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas temperature sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Check the sensor resistance. • Measure the resistance between the SIGNAL pin and the RETURN pin at the exhaust gas temperature sensor connector.	14k ohms to 250k ohms? **YES**	2A
	14k ohms to 250k ohms? **NO** **Repair:** Replace the exhaust gas temperature sensor. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-037 in Section 11.	3A



STEP 2: Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.

STEP 2A: Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.

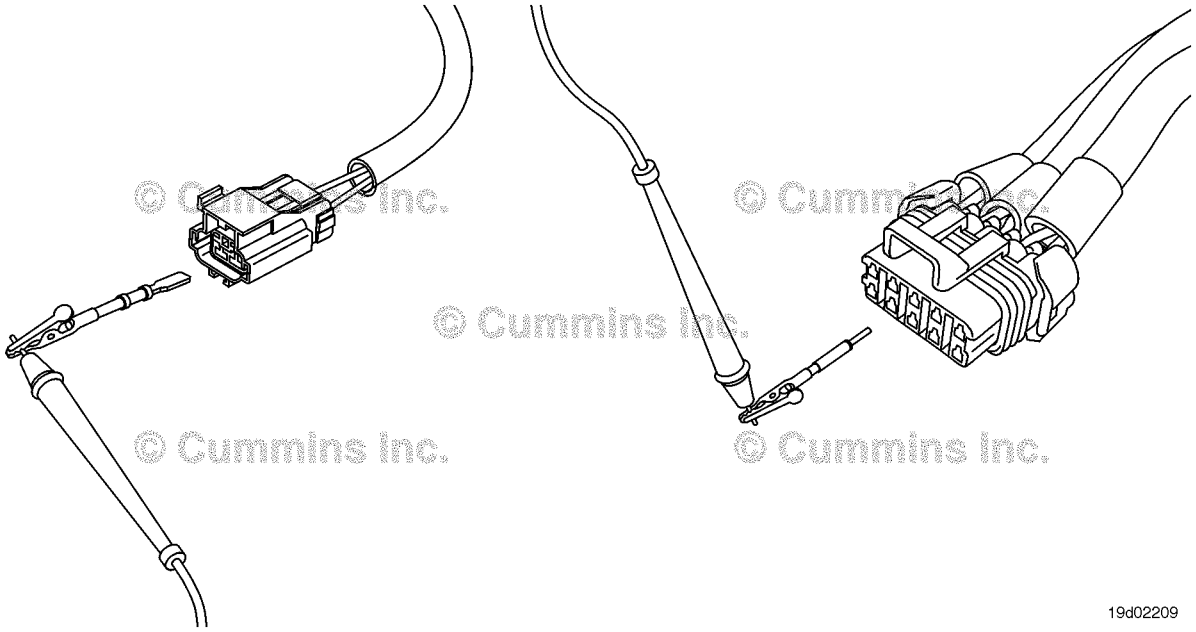
Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor unit from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the exhaust gas treatment monitor unit connector or exhaust gas treatment monitor harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Use the following procedure(s) in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. • Refer to Procedure 011-038 in Section 11. • Refer to Procedure 011-035 in Section 11.	3A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check for an open circuit in the exhaust gas treatment monitor harness.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment unit from the exhaust gas treatment monitor harness
- Disconnect the exhaust gas temperature sensor from the exhaust gas treatment monitor harness.

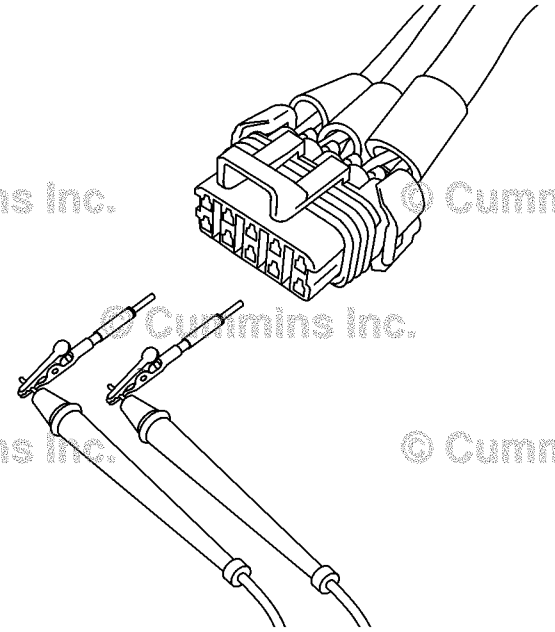
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector exhaust gas temperature sensor SIGNAL pin and the exhaust gas treatment monitor harness exhaust gas temperature sensor connector SIGNAL pin. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	2C
	Less than 10 ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^e, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



STEP 2C: Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor harness from the exhaust gas treatment monitor unit connector
- Disconnect the exhaust gas temperature sensor from the exhaust gas treatment monitor harness.

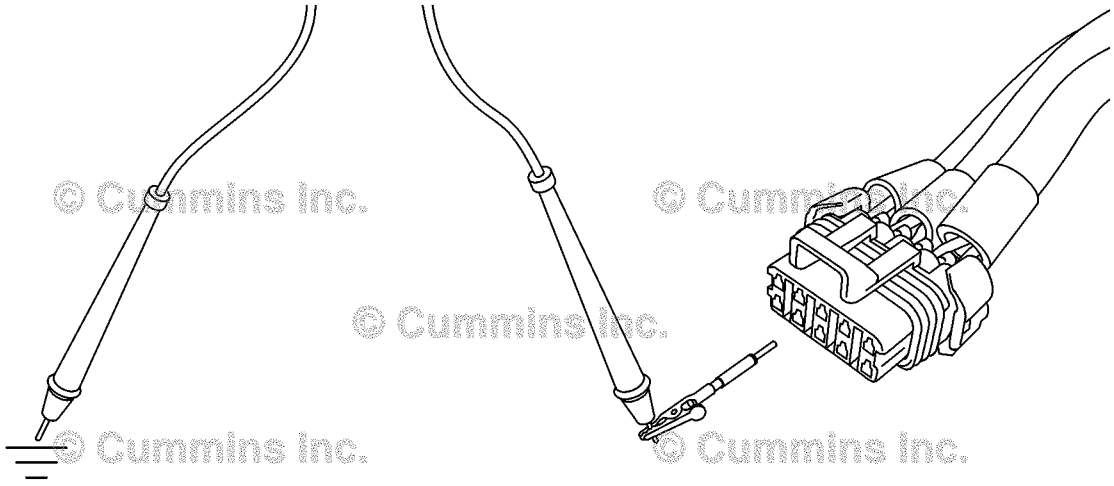
Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the exhaust gas temperature SIGNAL pin in the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector and all other pins in the exhaust gas treatment monitor connector. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	2D
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the pin-to-pin short circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



STEP 2D: Check for a pin short circuit to ground

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor harness from the exhaust gas treatment monitor unit connector
- Disconnect the exhaust gas temperature sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Check for a pin-to-ground short. • Measure the resistance between the exhaust gas temperature SIGNAL pin in the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector and ground. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	2E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-ground short circuit on the SIGNAL line has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the pin-to-ground short circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



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STEP 2E: Check for fault code presence.

Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the Exhaust Gas Treatment Monitor Unit using the Emissions Monitor Interface electronic service tool. • Start the engine and check for the appropriate circuit response after the engine has idled for five minutes. • Use the Emissions Monitor Interface electronic service tool to read the fault codes.	Fault Code 0005 present? **YES** **Repair:** Replace the exhaust gas treatment monitor unit. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^e, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-035 in Section 11.	3A
	Fault Code 0005 present? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	3A

STEP 3: Clear the fault code.

STEP 3A: Disable the fault code.

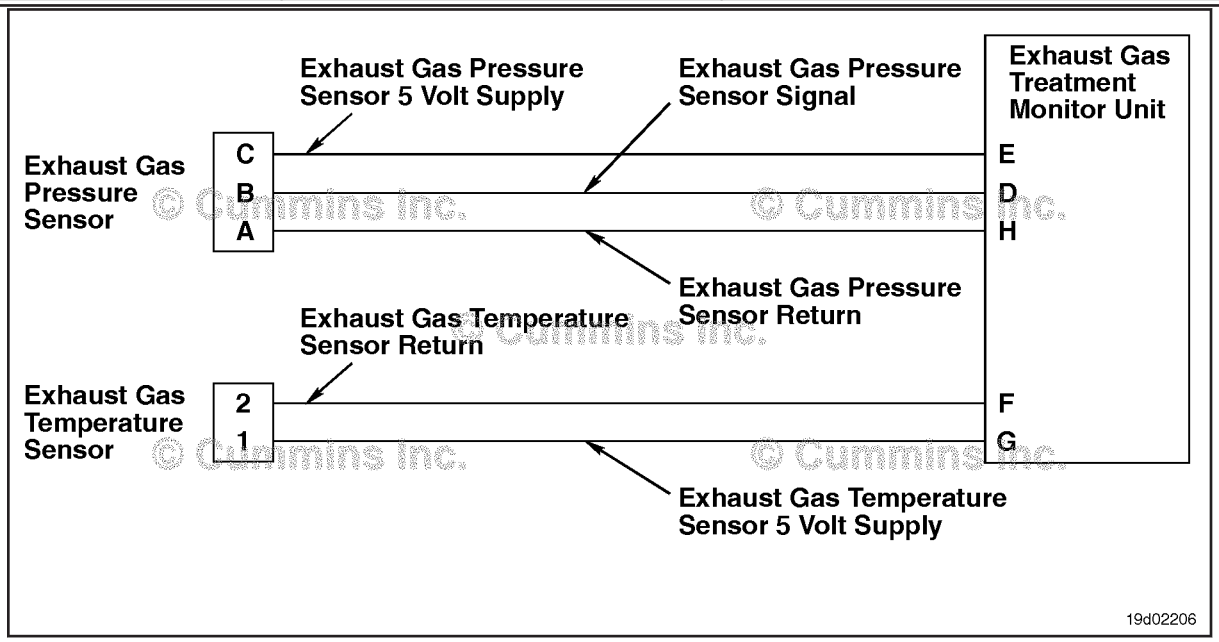
Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the fault codes using the Emissions Monitor Interface slectronic service tool. • Verify that the emission warning lamps flash twice to signify a reset. • Start the engine and let it idle for five minutes.	Fault Code 0005 present? **YES**	1A
	Fault Code 0005 present? **NO**	Repair complete.

Fault Code 0006

Exhaust Gas Temperature Sensor Number 1 Circuit - Voltage Above Normal, or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 0006 PID(P), SID(S): SPN: None FMI: Lamp: SRT:	Exhaust Gas Temperature Sensor Number 1 Circuit - Voltage Above Normal, or Shorted to High Source. High signal voltage or open circuit detected at the Exhaust Gas Temperature Sensor circuit.	None on performance.



Exhaust Gas Temperature Sensor Number 1 Circuit

Circuit Description:

The exhaust gas temperature sensor provides the exhaust gas temperature to the exhaust gas treatment monitor unit through the exhaust gas treatment monitor harness.

Component Location:

The exhaust gas temperature sensor will be located near the inlet to the exhaust catalyst. The location will vary depending on application.

Shop Talk:

Possible causes of this fault code include:

- Signal circuit shorted to a voltage source or a shorted sensor.

This fault code will **only** be present in the exhaust gas treatment monitor unit and will **not** be present in the engine electronic control module (ECM). The exhaust gas treatment fault code and maintenance lamps will both flash six times in sequence to alert the operator that this condition exists. The engine diagnostic lamps will **not** illuminate.

Refer to Troubleshooting Fault Code t05-0006

FAULT CODE 0006 - Exhaust Gas Temperature Sensor Number 1 Circuit - Voltage Above Normal, or Shorted to High Source

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the exhaust gas temperature sensor and circuit.**		
STEP 1A:	**Inspect the exhaust gas temperature sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 1B:	**Check the sensor resistance.**	**14k ohms to 250k ohms?**	
STEP 2:	**Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.**		
STEP 2A:	**Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.**	**Greater than 100k ohms?**	
STEP 2C:	**Check for fault code presence.**	**Fault Code 0002 present?**	
STEP 3:	**Clear the fault code.**		
STEP 3A:	**Disable the fault code.**	**Fault Code 0002 present?**	

TROUBLESHOOTING STEP

STEP 1: Check the exhaust gas temperature sensor and circuit.

STEP 1A: Inspect the exhaust gas temperature sensor and connector pins.

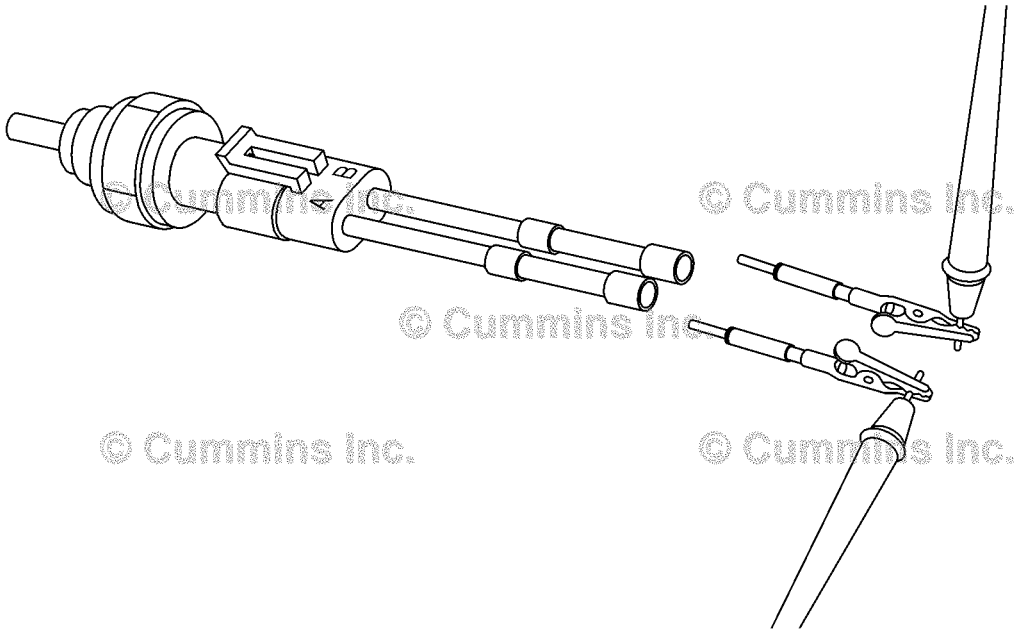
Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas temperature sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Inspect the exhaust gas treatment monitor harness and exhaust gas temperature sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^e, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A
	Dirty or damaged pins? **NO**	1B

STEP 1B: Check the sensor resistance.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas temperature sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Check the sensor resistance. • Measure the resistance between the SIGNAL pin and the RETURN pin at the exhaust gas temperature sensor connector.	14k ohms to 250k ohms? **YES**	2A
	14k ohms to 250k ohms? **NO** **Repair:** Replace the exhaust gas temperature sensor. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-037 in Section 11.	3A



STEP 2: Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.

STEP 2A: Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.

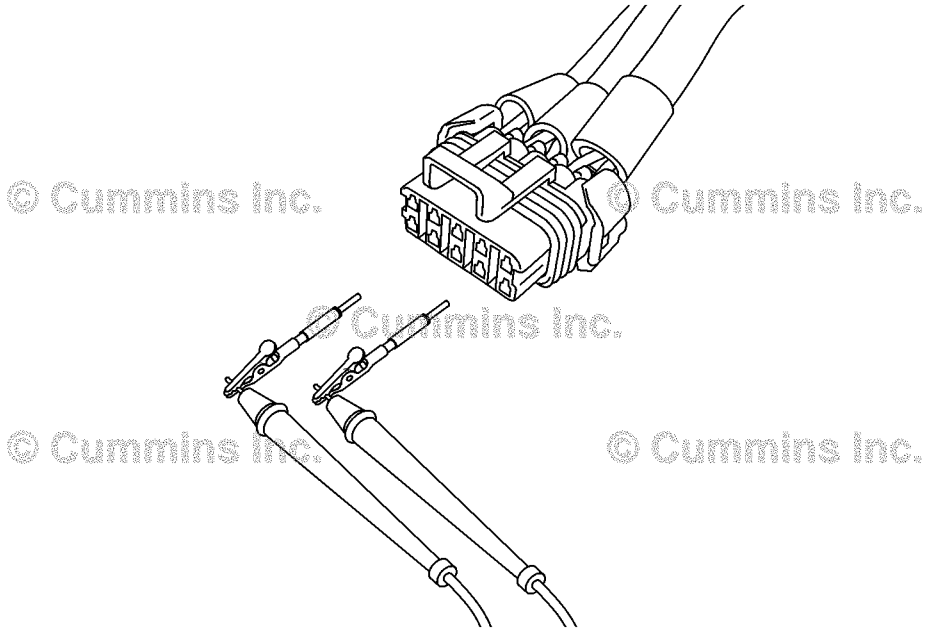
Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor unit from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Inspect theexhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the exhaust gas treatment monitor unit connector or exhaust gas treatment monitor harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. • Refer to Procedure 011-038 in Section 11. • Refer to Procedure 011-035 in Section 11.	3A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor harness from the exhaust gas treatment monitor unit connector
- Disconnect the exhaust gas temperature sensor from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the exhaust gas temperature sensor SIGNAL pin in the exhaust gas treatment monitor harness exhaust gas treatment monitor unit connector and all other pins in the exhaust gas treatment monitor unit connector. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	2D
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the exhaust gas treatment monitor harness. Troubleshoot each harness connected in series to determine which contains the pin-to-pin short circuit. Repair or replace the exhaust gas treatment monitor harness. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-038 in Section 11.	3A



STEP 2D: Check for fault code presence.

Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the Exhaust Gas Treatment Monitor Unit using the Emissions Monitor Interface electronic service tool. • Check for the appropriate circuit response after 30 seconds. • Use the Emissions Monitor Interface electronic service tool to read the fault codes.	Fault Code 0006 present? **YES** **Repair:** Replace the exhaust gas treatment monitor unit. Use the following procedure in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 011-035 in Section 11.	3A
	Fault Code 0006 present? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	3A

STEP 3: Clear the fault code.

STEP 3A: Disable the fault code.

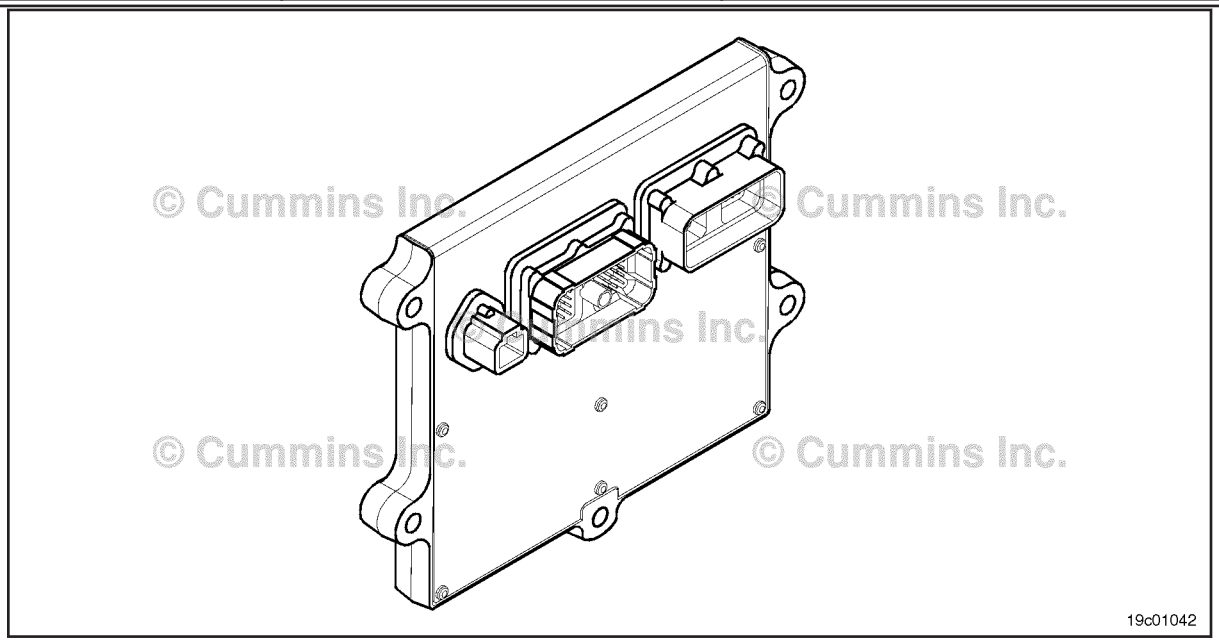
Condition:
- Connect all components
- Turn keyswitch ON
- Connect the Emissions Monitor Interface electronic service tool.

Action	Specification/Repair	Next Step
Reset the fault codes using the Emissions Monitor Interface slectronic service tool. • Verify that the emission warning lamps flash twice to signify a reset. • Start the engine and let it idle for one minute.	Fault Code 0006 present? **YES**	1A
	Fault Code 0006 present? **NO**	Repair complete.

Fault Code 111

Engine Control Module - Critical Internal Failure

CODES	REASON	EFFECT
Fault Code: 111 PID(P), SID(S): S254 SPN: 629 FMI: 12/12 Lamp: Red SRT:	Engine Control Module - critical internal failure. Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits.	Engine may **not** start.



ECM Microprocessor

Circuit Description:

The ECM is a computer that is responsible for engine control, diagnostics, and user features.

Component Location:

The ECM is located on the fuel system side of the engine. It is attached at the cylinder head between cylinders 2 and 3. Refer to Procedure 100–002 in Section E for a detailed component location view.

Shop Talk:

This fault code can **only** be caused by an internal ECM problem. Repairs are **not** possible for the ECM.

Refer to Troubleshooting Fault Code t05-111

FAULT CODE 111 - Engine Control Module - Critical Internal Failure

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.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the ECM**		
STEP 1A:	**Check the ECM**	**Fault Code 111 inactive?**	
STEP 1B:	**Check the inactive counts of Fault Code 111**	**Less than 3 counts?**	
STEP 2:	**Clear the fault codes**		
STEP 2A:	**Disable the fault code**	**Fault Code 111 inactive?**	
STEP 2B:	**Clear the inactive fault codes**	**All fault codes cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check the ECM

STEP 1A: Check the ECM

Condition:
- Connect all components

Action	Specification/Repair	Next Step
Check the ECM. • Turn the keyswitch OFF and wait 5 seconds. • Start the engine and let it idle for 1 minute.	Is Fault Code 111 inactive? **YES**	1B
	Is Fault Code 111 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	2A

STEP 1B: Check the inactive counts of Fault Code 111

Condition:
- Turn the keyswitch ON.

Action	Specification/Repair	Next Step
Check the inactive counts of Fault Code 111. • Use INSITE™ electronic service tool to read the inactive counts of Fault Code 111.	Are there less than 3 counts? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	2B
	Are there less than 3 counts? **NO**	2A

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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 111 inactive? **YES**	2B
	Fault Code 111 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a 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 components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 115

Engine Magnetic Crankshaft Speed/Position Lost Both of Two Signals - Data Erratic, Intermittent, or Incorrect

CODES	REASON	EFFECT
Fault Code: 115 PID(P), SID(S): P190 SPN: 612 FMI: 2 Lamp: Red SRT:	Engine Magnetic Crankshaft Speed/Position Lost Both of Two Signal - Data Erratic, Intermittent, or Incorrect. The ECM has detected that the primary engine speed sensor and the backup engine speed sensor signals are reversed.	Fueling to the injectors is disabled, and the engine can **not** be started.

Circuit Description:

The main engine speed sensor (crankshaft position sensor) and the backup engine speed sensor (camshaft position sensor) are connected to the engine wiring harness.

Component Location:

The main engine speed sensor (crankshaft position sensor) reads a tone wheel that is mounted to the front of the engine crankshaft. The backup engine speed sensor (camshaft position sensor) reads a tone wheel that is inside the front cover.

Shop Talk:

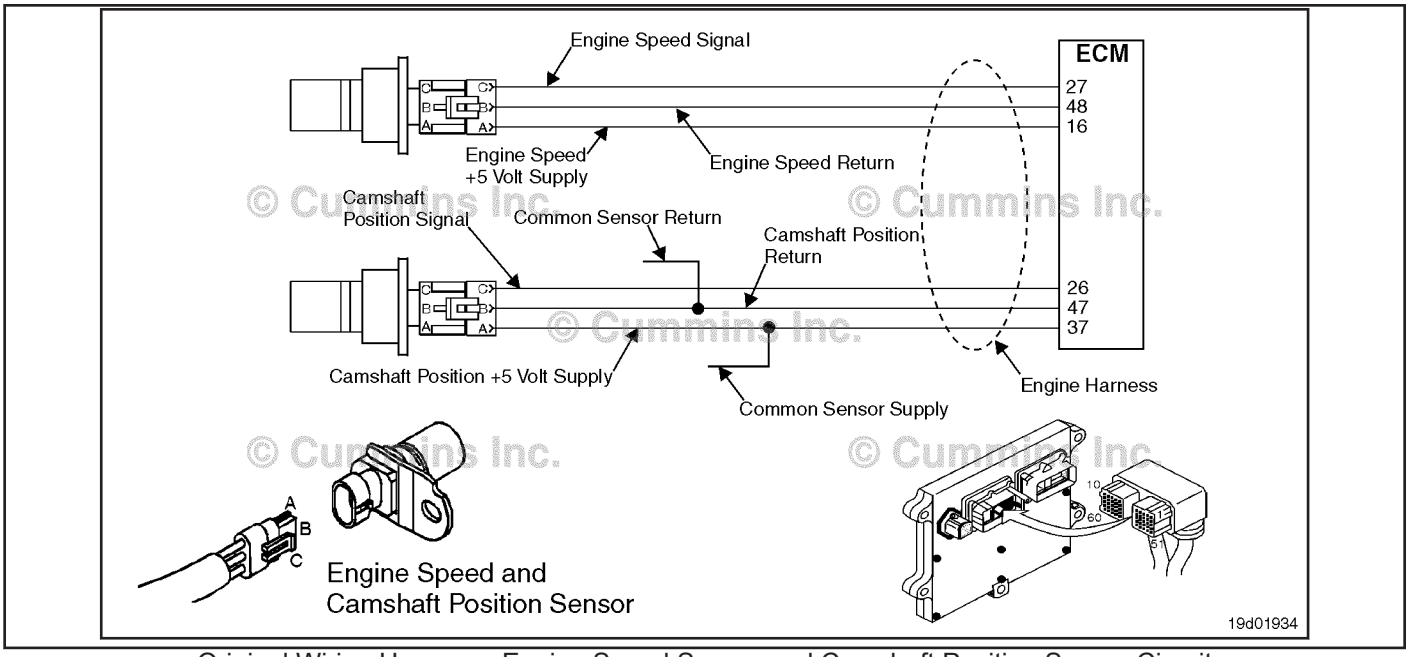
The main engine speed sensor (crankshaft position sensor) and the backup engine speed sensor (camshaft position sensor) are located in close proximity to one another. The same sensor is used in both locations. (Connector key is the same.) A P-clip on the engine wiring harness prohibits the harness connectors from being connected to the incorrect sensors. However, if the P-clip is omitted, it is possible to plug the wiring harness connectors into the incorrect sensors. If this occurs, the ECM will detect the problem and the engine will **not** start. Once the connector problem is corrected, the engine can be started and the fault code will become inactive.

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:

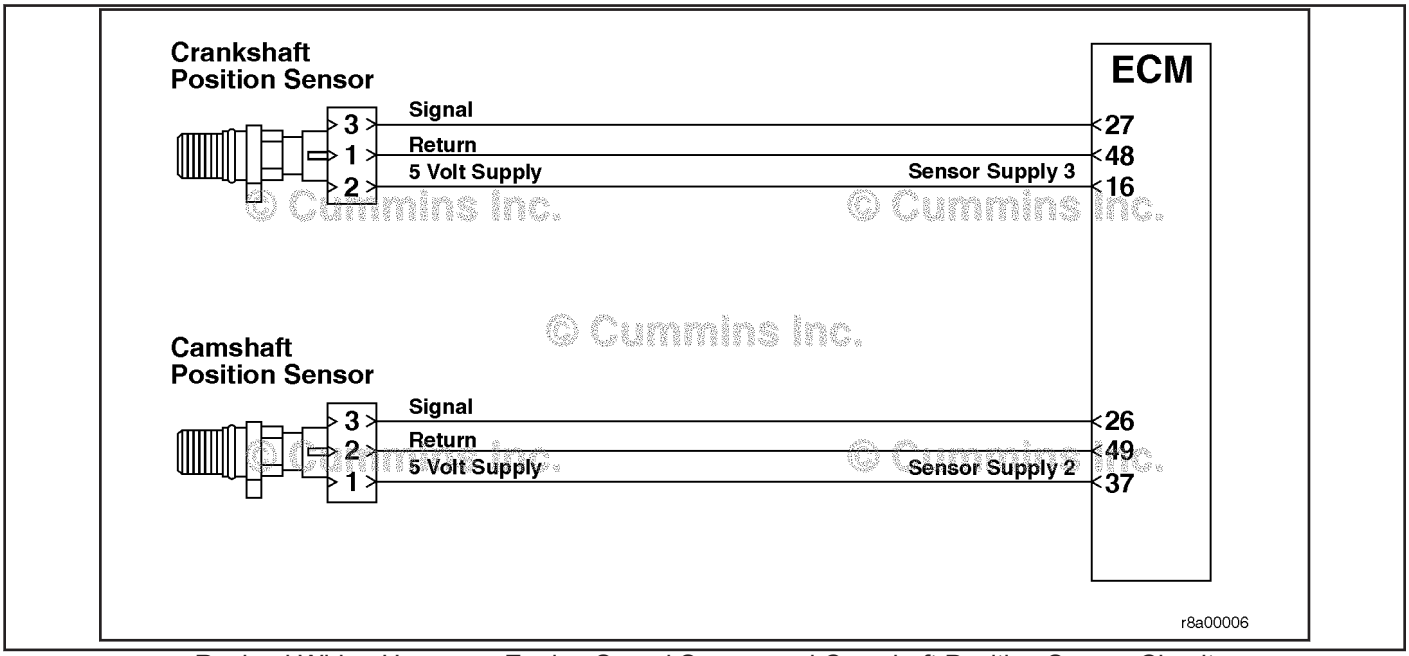
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin, and the camshaft position sensor RETURN pin
- Check for continuity between ECM 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 t05-115.

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Determine if Fault Code 115 becomes active during cranking.**	**Fault Code 115 becomes active during cranking?**	
STEP 1B:	**Inspect the engine harness.**	**Harness connectors connected to correct sensors?**	
STEP 2:	**Clear the fault codes.**		
STEP 2A:	**Disable the fault code.**	**Fault Code 115 inactive?**	
STEP 2B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Determine if Fault Code 115 becomes active during cranking.

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

Action	Specification/Repair	Next Step
Attempt to start the engine by engaging the starter for at least ten seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 115 becomes active during cranking? **YES**	1B
	Fault Code 115 becomes active during cranking? **NO**	2A

STEP 1B: Inspect the engine harness.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Inspect the engine harness connectors for correct connections. • Make sure that the main engine speed sensor (crankshaft position sensor) and the backup engine speed sensor (camshaft position sensor) are connected to the engine wiring harness correctly.	Harness connectors connected to correct sensors? **YES**	2A
	Harness connectors connected to correct sensors? **NO**	2A

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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 115 inactive? **YES**	2B
	Fault Code 115 inactive? **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. • Use INSITE™ electronic service tool to erase the inactive fault codes	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO**	Appropriate troubleshooting steps

Fault Code 122

Intake Manifold Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 122 PID(P), SID(S): P102 SPN: 102 FMI: 3/3 Lamp: Amber SRT:	Intake Manifold Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage detected at the intake manifold pressure circuit.	Automotive: Derate in power output of the engine. Marine: No engine protection for circuit or sensor failure.

Circuit Description:

The intake manifold pressure sensor monitors intake manifold pressure and passes information to the electronic control module (ECM) through the engine harness. If the intake manifold pressure becomes too high, it will cause a derate condition on automotive applications.

For marine applications, no derate condition occurs. There is no engine protection for a circuit or sensor failure.

Component Location:

The intake manifold pressure sensor is located in the air intake horn. Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

Shop Talk:

The intake manifold pressure 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 122, check for multiple faults.

Possible causes of this fault code include:

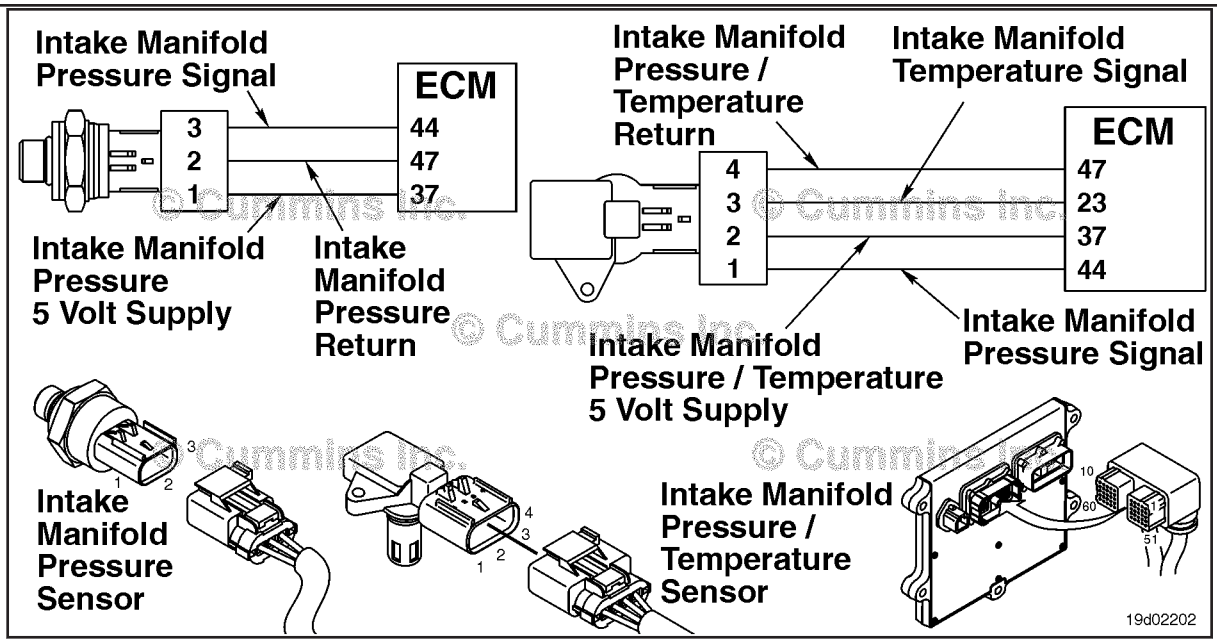
- Open return circuit in the engine harness, connectors, or sensor
- SIGNAL wire shorted to sensor supply or battery voltage.

The sensor return configuration for Euro 4 ISB engines has been changed for automotive wiring harnesses manufactured from February 2012 onwards. The new style wiring harnesses can be be identified using the method below:

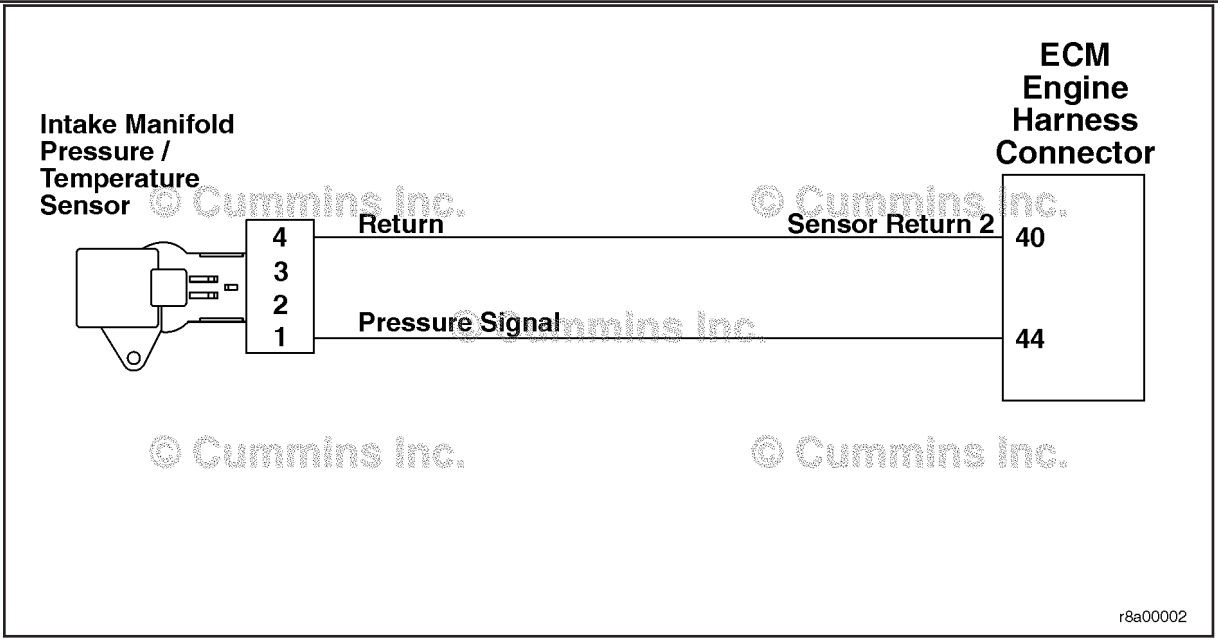
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM 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 - Intake Manifold Pressure Sensor Circuit



Revised Wiring Harness - Intake Manifold Pressure Sensor Circuit

Refer to Troubleshooting Fault Code t05-122.

FAULT CODE 122 - Intake Manifold 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.

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 122 inactive?	
STEP 2:	**Check the intake manifold pressure sensor and circuit**		
STEP 2A:	Inspect the intake manifold pressure sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the circuit response.	Fault Code 123 active and Fault Code 122 inactive?	
STEP 2C:	Check the sensor supply voltage and return circuit.	4.75 to 5.25 VDC?	
STEP 2D:	Check the fault codes and verify sensor condition.	Fault Code 122 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 engine control module response.	Fault Code 123 active and Fault Code 122 inactive?	
STEP 3A-2:	Check for an active fault code.	Fault Code 122 inactive?	
STEP 3B:	Inspect 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 to 5.25 VDC?	
STEP 3B-2:	Check for an active fault code.	Fault Code 122 inactive?	
STEP 4:	**Clear the fault code**		
STEP 4A:	Disable the fault code.	Fault Code 122 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 227 active? **YES**	Refer to Fault Code 227
	Fault Code 227 active? **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. • Use INSITE™ to read the fault codes.	Fault Code 122 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 122 inactive? **NO**	2A

STEP 2: Check the intake manifold pressure sensor and circuit

STEP 2A: Inspect the intake manifold pressure sensor and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold pressure sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and intake manifold pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins. • Wire insulation damage • Connector shell broken. • Damaged locking tab connector	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the circuit response.

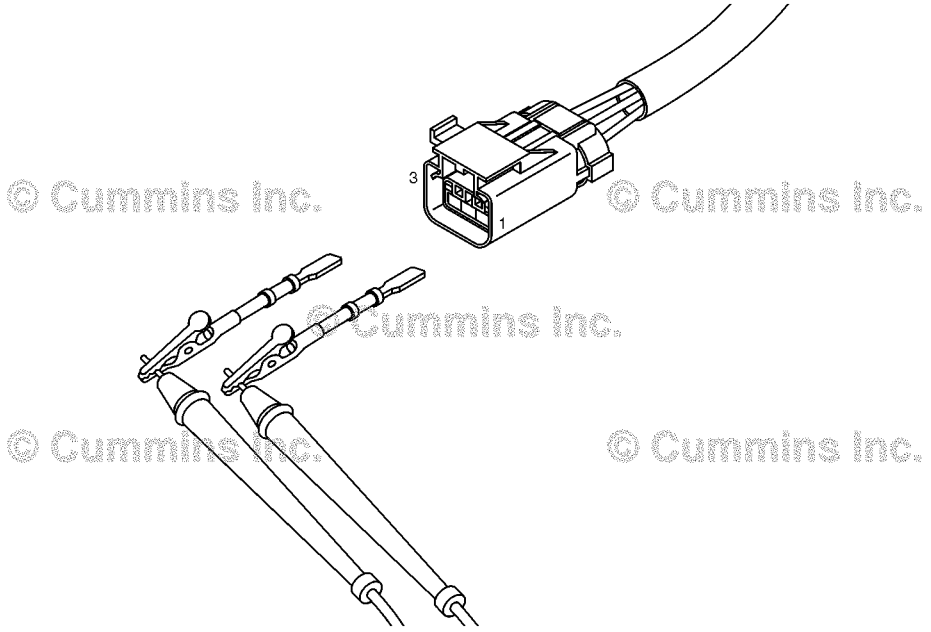
Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold pressure sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 123 active and Fault Code 122 inactive? **YES**	2C
	Fault Code 123 active and Fault Code 122 inactive? **NO**	3A

STEP 2C: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold pressure sensor from the engine harness.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the intake manifold pressure +5 volt SUPPLY pin to the intake manifold pressure RETURN pin at the sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	2D
	4.75 to 5.25 VDC? **NO**	3B



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

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 123 active? **YES** **Repair:** A damaged sensor has been detected. Replace the intake manifold pressure sensor. Refer to Procedure 019-061 in Section 19.	4A
	Fault Code 123 inactive? **NO** **Repair:** 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 the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins. • Wire insulation damage • Connector shell broken. • Damaged locking tab connector Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 123 active and Fault Code 122 inactive? **YES**	3A-2
	Fault Code 123 active and Fault Code 122 inactive? **NO** **Repair:** 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 for the appropriate circuit reaponse after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 122 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the failure.	4A
	Fault Code 122 inactive? **NO** **Repair:** A pin-to-pin short circuit has been detected on the signal line of the engine harness. 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.

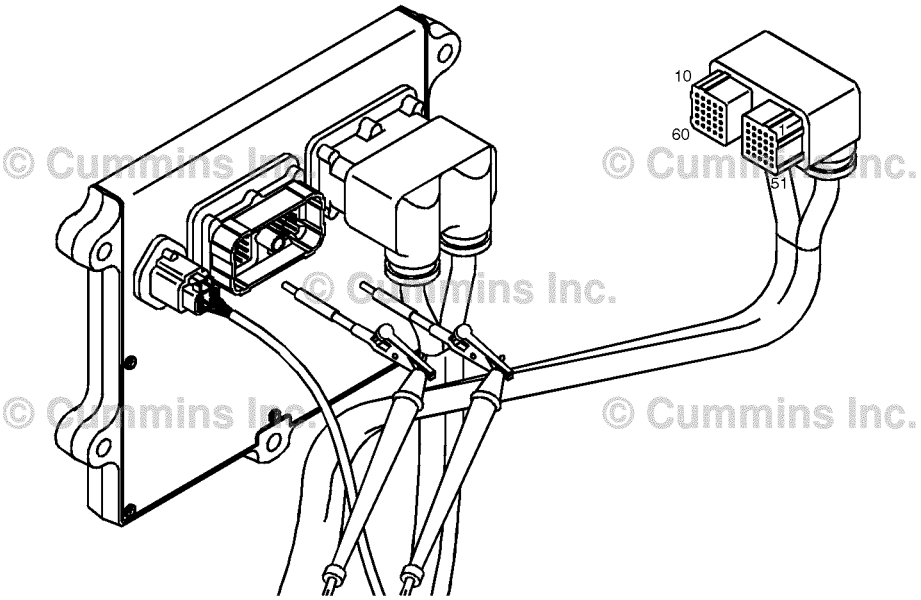
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins. • Wire insulation damage • Connector shell broken. • Damaged locking tab connector Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the intake manifold pressure +5 volt SUPPLY pin to the intake manifold pressure RETURN pin at the engine control module engine connector. Refer to the circuit diagram or the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	3B-2
	4.75 to 5.25 VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 122 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 122 inactive? **NO** **Repair:** An open RETURN circuit has been detected in the engine harness. 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 122 inactive? **YES**	4B
	Fault Code 122 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and rechecked.	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. • Use INSITE™ electronic service tool to read the fault codes.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO** **Repair:** Troubleshoot any remaining active fault codes.	Appropriate troubleshooting steps

Fault Code 123

Intake Manifold Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 123 PID(P), SID(S): P102 SPN: 102 FMI: 4/4 Lamp: Amber SRT:	Intake Manifold Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at the intake manifold pressure circuit.	Automotive: Derate in power output of the engine. Marine: None - No engine protection for circuit sensor failure.

Circuit Description:

The intake manifold pressure sensor monitors intake manifold pressure and passes information to the electronic control module (ECM) through the engine harness. On automotive applications, if the intake manifold pressure becomes too low, it will cause a derate condition.

For marine applications, no derate condition occurs. There is no engine protection for a circuit or sensor failure.

Component Location:

The intake manifold pressure sensor is located in the air intake horn. Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

Shop Talk:

The intake manifold pressure 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 123, check for multiple faults.

Possible causes of this fault code include:

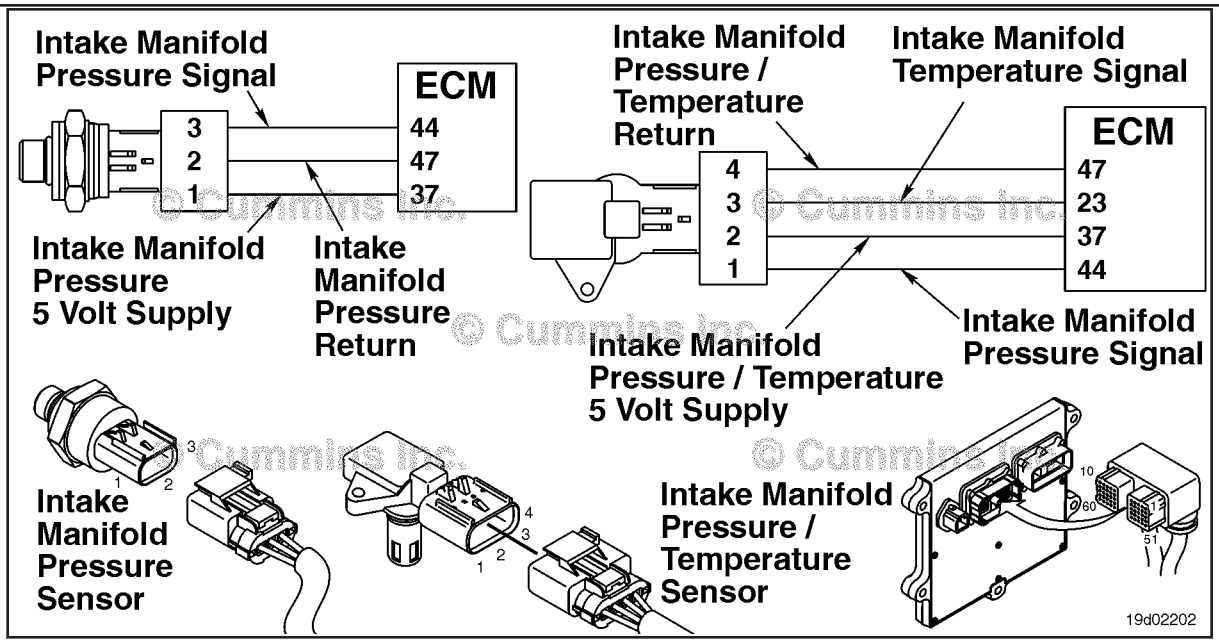
- Signal circuit open or shorted to ground in the engine harness or sensor
- SUPPLY line open or shorted to ground.

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:

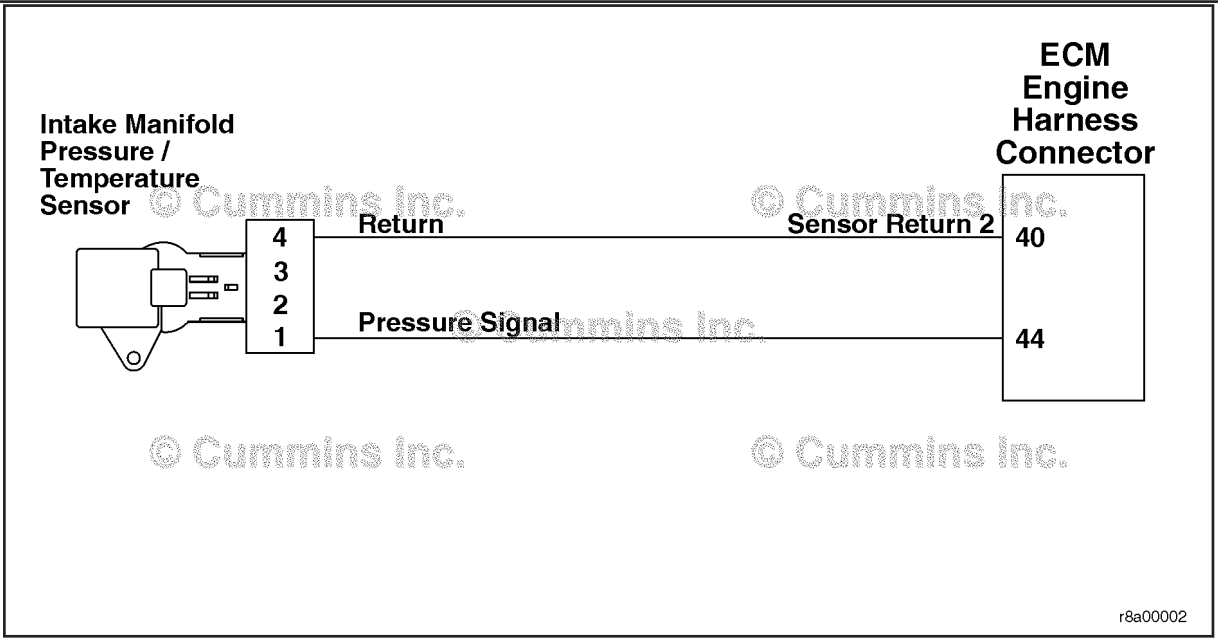
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin, and the camshaft position sensor RETURN pin
- Check for continuity between ECM 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 - Intake Manifold Pressure Sensor Circuit



Revised Wiring Harness - Intake Manifold Pressure Sensor Circuit

Refer to Troubleshooting Fault Code t05-123.

FAULT CODE 123 - Intake Manifold 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 3164596 - male Framatome test leadPart 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 123 inactive?**	
STEP 2:	**Check the intake manifold pressure sensor and circuit.**		
STEP 2A:	**Inspect the intake manifold pressure 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 122 active and Fault Code 123 inactive?**	
STEP 2D:	**Check the fault codes and verify sensor condition.**	**Fault Code 123 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 to 5.25 VDC?**	
STEP 3A-2:	**Check for an active fault code.**	**Fault Code 123 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 122 active and Fault Code 123 inactive?**	
STEP 3B-2:	**Check for an active fault code.**	**Fault Code 123 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 123 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. • Use INSITE™ to read the fault codes.	Fault Code 187 active? **YES**	Refer to Fault Code 187
	Fault Code 187 active? **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. • Use INSITE™ electronic service tool to erase the inactive fault codes.	Fault Code 123 inactive? **YES**	Use the following procedure for Inactive or Intermittent Fault codes. Refer to Procedure 019-362 in Section 19.
	Fault Code 123 inactive? **NO**	2A

STEP 2: Check the intake manifold pressure sensor and circuit.

STEP 2A: Inspect the intake manifold pressure sensor and connector pins.

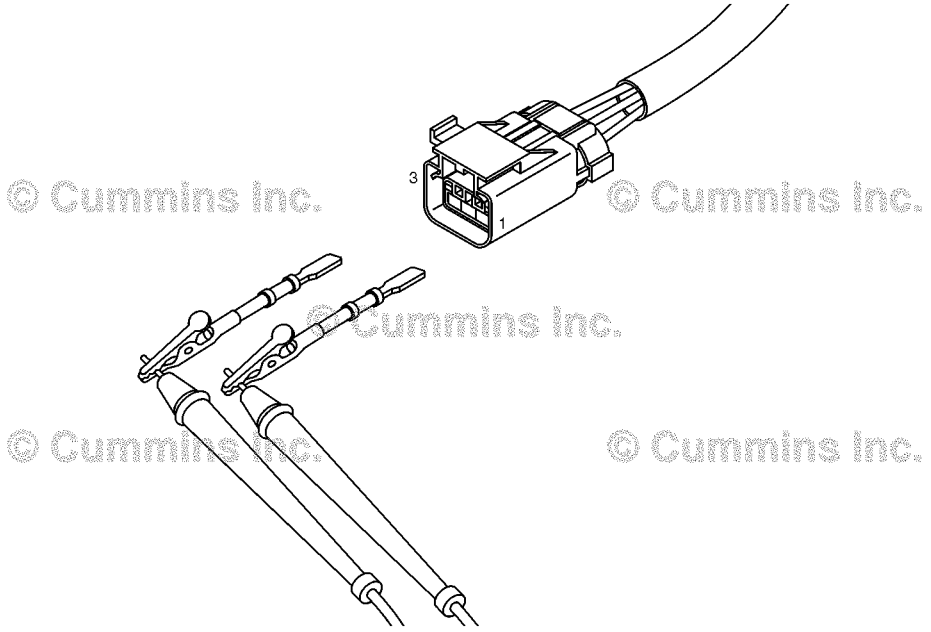
Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold pressure sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and intake manifold pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold pressure sensor from the engine harness.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the intake manifold pressure +5 volt SUPPLY pin to the intake manifold pressure RETURN pin at the sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	2C
	4.75 to 5.25 VDC? **NO**	3A



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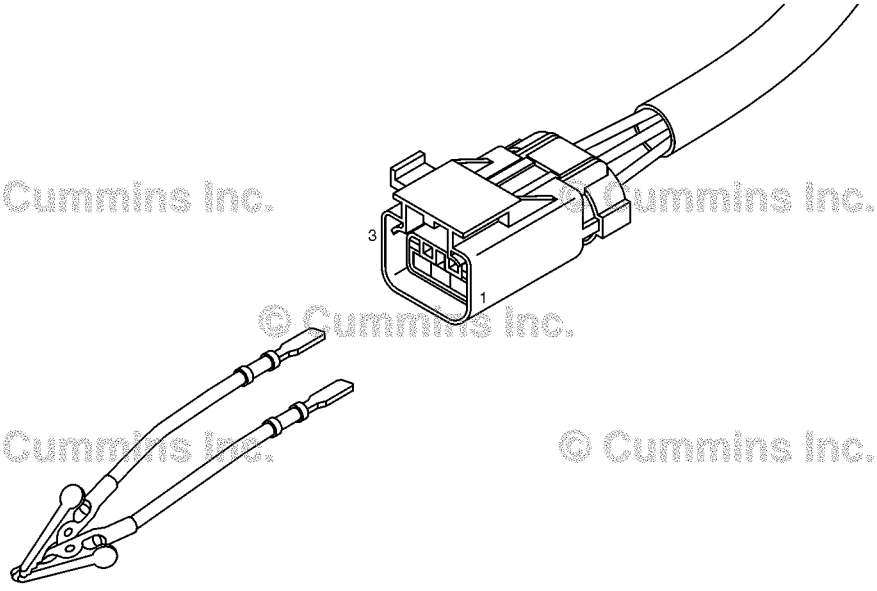
STEP 2C: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold 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 intake manifold pressure +5 volt SUPPLY pin and the intake manifold pressure SIGNAL pin at the intake manifold pressure sensor connector of the engine harness. Refer to the circuit diagram or the wiring diagram for connector pin identification. Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to erase the inactive fault codes.	Fault Code 122 active and Fault Code 123 inactive? **YES**	2D
	Fault Code 122 active and Fault Code 123 inactive? **NO**	3B



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

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold 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. • Use INSITE™ to erase the inactive fault codes.	Fault Code 123 active? **YES** **Repair:** A damaged sensor has been detected. Replace the intake manifold pressure sensor. Refer to Procedure 019-061 in Section 19.	4A
	Fault Code 123 active? **NO** **Repair:** None. The removal and installation of the connector corrected the failure.	4A

STEP 3: Check the engine control module and engine harness

STEP 3A: Inspect engine control module and engine harness connector pins.

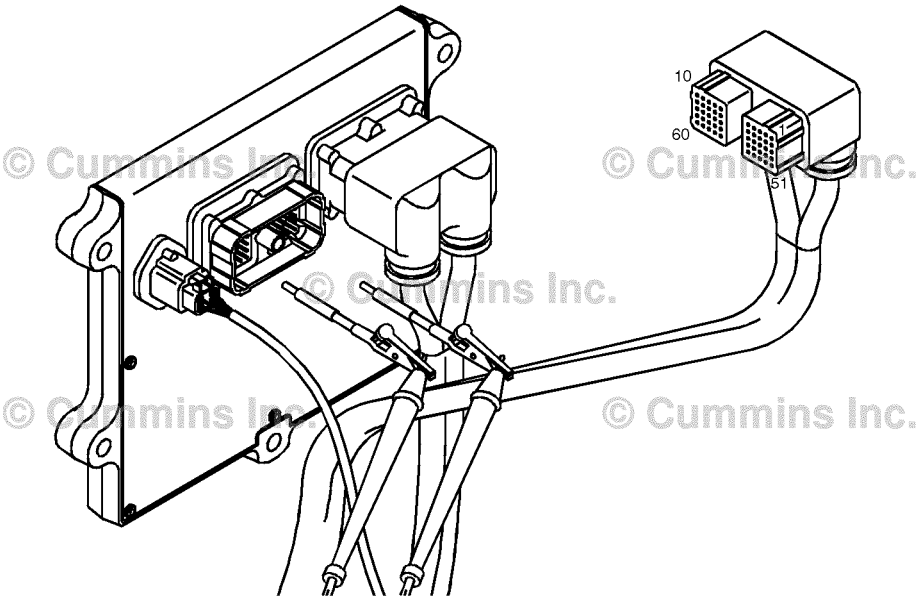
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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. • Measure the voltage from the intake manifold pressure +5 volt SUPPLY pin to the intake manifold pressure RETURN pin at the engine control module engine connector. Refer to the circuit diagram or the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	3A-2
	4.75 to 5.25 VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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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 for the appropriate circuit reaponse after 30 seconds. • Use INSITE™ electronic service tool to erase the inactive fault codes.	Fault Code 123 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 123 inactive? **NO** **Repair:** A open or shorted SUPPLY circuit has been detected in the engine harness. 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.

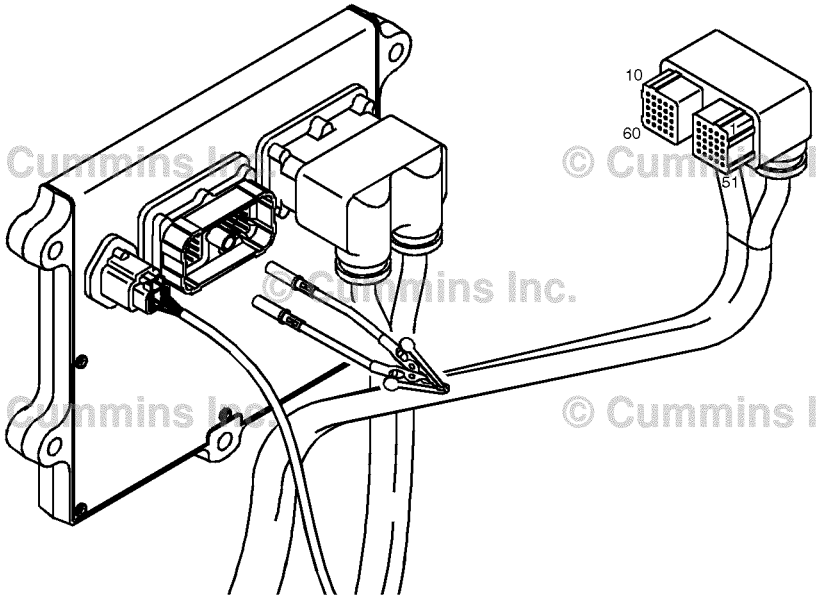
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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
Place a jumper wire between the intake manifold pressure +5 volt SUPPLY pin and the intake manifold pressure SIGNAL pin at the engine control module engine connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Check the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to erase the inactive fault codes.	Fault Code 122 active and Fault Code 123 inactive? **YES**	3B-2
	Fault Code 122 active and Fault Code 123 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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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. • Use INSITE™ electronic service tool to erase the inactive fault codes.	Fault Code 123 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 123 inactive? **NO** **Repair:** An open circuit or a pin to pin short circuit has been detected on the signal line of the engine harness. 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to erase the inactive fault codes.	Fault Code 123 inactive? **YES**	4B
	Fault Code 123 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and rechecked.	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. • Use INSITE™ electronic service tool to erase the inactive fault codes.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO** **Repair:** Troubleshoot any remaining active fault codes.	Appropriate troubleshooting steps

Fault Code 124

Intake Manifold 1 Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level

CODES	REASON	EFFECT
Fault Code: 124 PID(P), SID(S): P102 FMI: 0/16 Lamp: Amber SRT:	Intake Manifold 1 Pressure Sensor Circuit - Data Valid But Above Normal Operating Range - Moderately Severe Level. Intake manifold pressure has exceeded the maximum limit for the given engine rating.	Engine power derate.

Circuit Description:

The intake manifold pressure sensor is used by the ECM to monitor the engine intake manifold pressure.

Component Location:

Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

Shop Talk:

This fault code become active when the intake manifold pressure exceeds the maximum pressure limit for a given engine rating.

Possible causes:

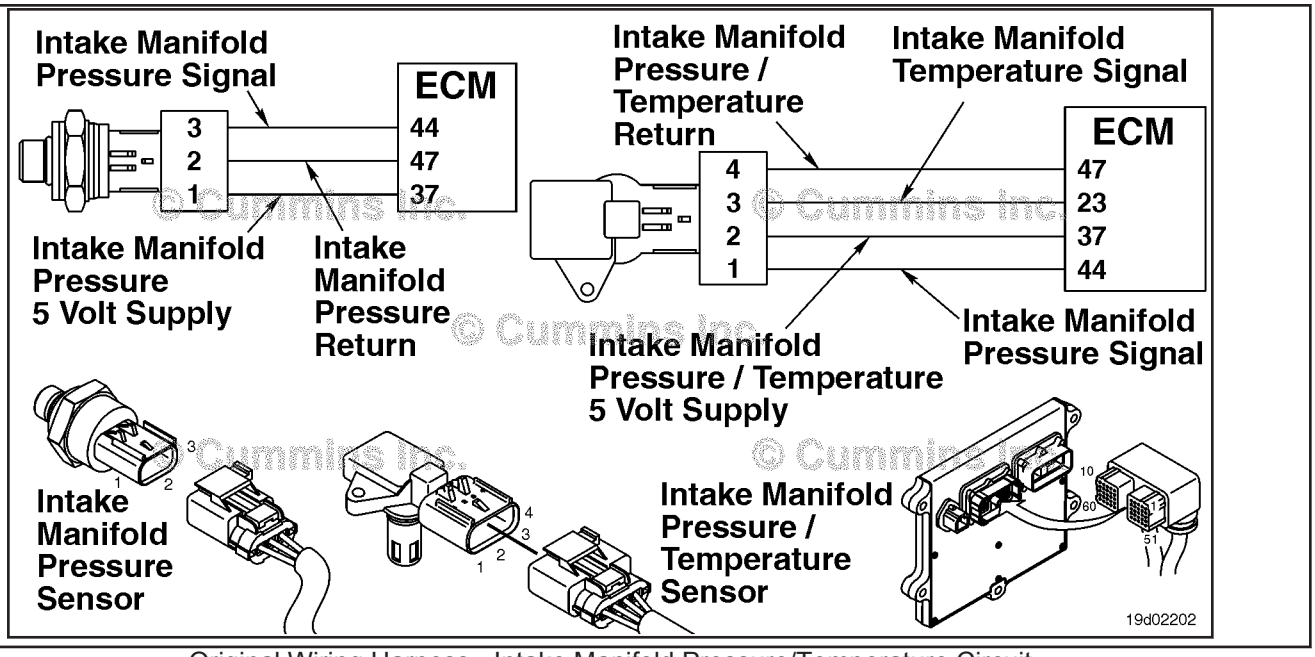
- Malfunctioning turbocharger wastegate
- Wastegate tampering
- Wrong turbocharger part
- Possible tampering of the fuel system or turbocharger system.

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:

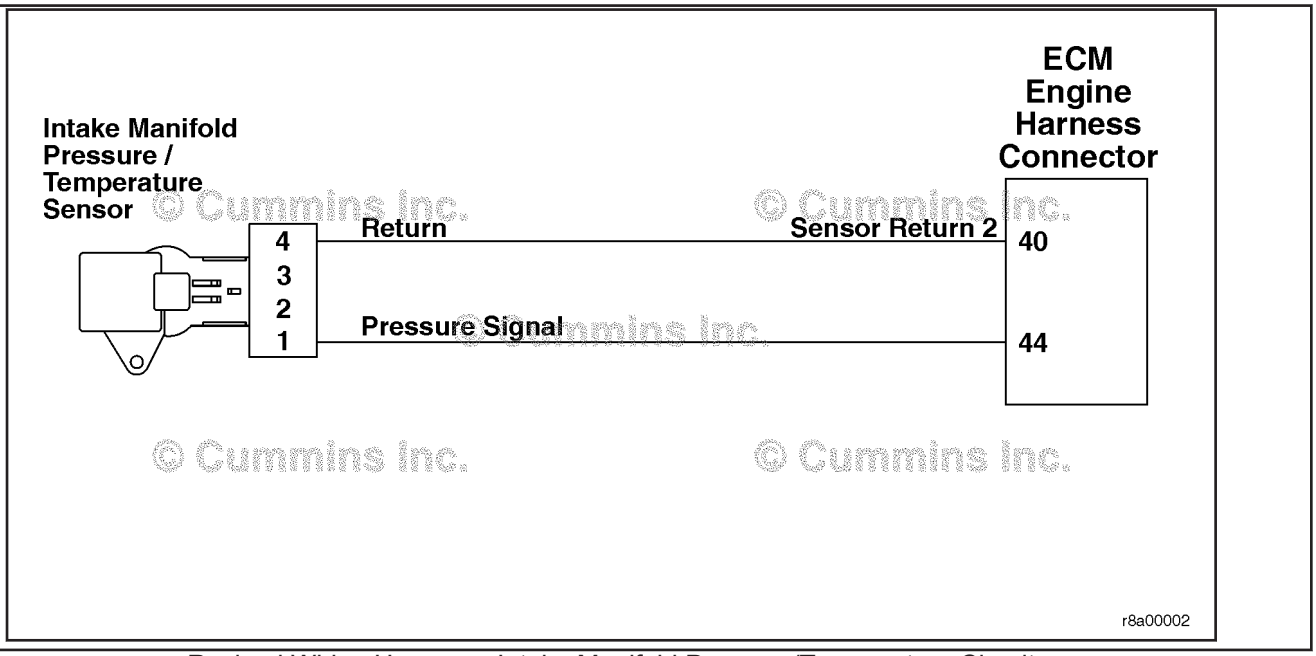
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM 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 - Intake Manifold Pressure/Temperature Circuit



Revised Wiring Harness - Intake Manifold Pressure/Temperature Circuit

Refer to Troubleshooting Fault Code t05-124.

FAULT CODE 124 - Intake Manifold 1 Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level

TROUBLESHOOTING SUMMARY

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 8 in Hg?**	
STEP 1B:	**Verify the sensor accuracy with a mechanical gauge.**	**Sensor reading is correct within 5 in Hg?**	
STEP 1C:	**Check the system for tampering.**	**Tampering detected?**	
STEP 2:	**Clear the fault code.**		
STEP 2A:	**Disable the fault code.**	**Fault Code 124 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 the sensor accuracy with INSITE™ electronic service tool. • Monitor Intake Manifold Pressure with INSITE™ electronic service tool with the keyswitch ON and the engine **not** running.	Value of Intake Manifold Pressure less than 8 in Hg? **YES**	1B
	Value of Intake Manifold Pressure less than 8 in Hg? **NO** **Repair:** 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. • Connect a mechanical intake manifold pressure gauge to the engine. • Use INSITE™ electronic service tool read the fault codes. • 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. Note: The engine may need to be loaded before the pressure readings can be compared.	Sensor reading is correct within 5 in Hg? **YES**	1C
	Sensor reading is correct within 5 in Hg? **NO** **Repair:** 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 for the following: • Turbocharger wastegate tampering. • Variable geometry turbocharger tampering. • Fuel system tampering. • Fuel system add-on electronic devices.	Tampering detected? **YES** **Repair:** Remove the tampering device.	2A
	Tampering detected? **NO**	Engine Performance Troubleshooting Tree

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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 124 inactive? **YES**	2B
	Fault Code 124 inactive? **NO**	1A

STEP 2B: Clear the inactive fault codes.

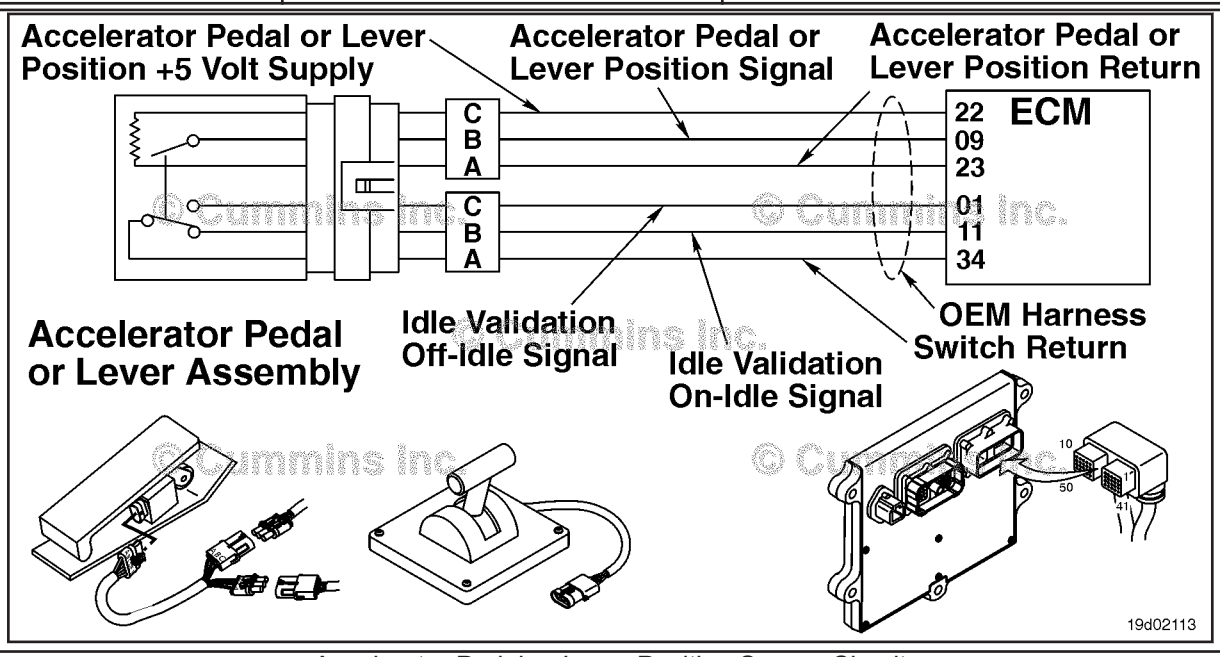
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 131

Accelerator Pedal or Lever Position Sensor Circuit - Shorted High

CODES	REASON	EFFECT
Fault Code: 131 PID(P), SID(S): P091 SPN: 91 FMI: 3/3 Lamp: Red SRT:	Accelerator Pedal or Lever Position Sensor Circuit - Shorted High. High voltage detected at accelerator pedal or lever position circuit.	Automotive: Severe derate in power output of the engine. Limp home capability **only**. Marine: Severe derate in engine speed. Limp home capability **only**.



Accelerator Pedal or Lever Position Sensor 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 +5 VDC Supply, Accelerator Pedal or Lever Position Return, and Accelerator Pedal or Lever Position Signal.

Component Location:

The accelerator pedal or lever position sensor is located on the accelerator pedal or lever. Refer to the OEM manual.

Shop Talk:

If troubleshooting an intermittent accelerator problem:

The accelerator pedal or lever position sensor 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 or lever position signal circuit shorted to battery or +5 VDC supply
- Open accelerator pedal or lever return circuit in the harness or connections
- Accelerator supply shorted to battery
- Failed accelerator pedal or lever position sensor.

NOTE: The three wires in the accelerator position sensor circuit **must** be twisted together.

Refer to Troubleshooting Fault Code t05-131

FAULT CODE 131 - Accelerator Pedal or Lever Position Sensor Circuit - Shorted High

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 3823996 - female Weather-Pack test leadPart 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 387 active?	
STEP 1B:	Check for an active fault code.	Fault Code 131 active?	
STEP 2:	**Check the accelerator pedal or lever position sensor circuit.**		
STEP 2A:	Inspect the accelerator pedal or lever position sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the accelerator pedal or lever position sensor supply voltage and return circuit.	4.75 to 5.25 VDC?	
STEP 2C:	Check the circuit response.	Fault Code 132 active and Fault Code 131 inactive?	
STEP 2D:	Check the fault codes and verify accelerator pedal or lever condition.	Fault Code 132 is active?	
STEP 3:	**Check the ECM and OEM harness.**		
STEP 3A:	Inspect ECM and OEM harness connector pins.	Dirty or damaged pins?	
STEP 3A-1:	Check for an open circuit in the OEM harness.	Less than 10 ohms?	
STEP 3A-2:	Check for a pin-to-pin short circuit in the OEM harness.	Greater than 100k ohms?	
STEP 3B:	Check for an inactive fault code.	Fault Code 131 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 131 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 387 active? **YES**	Fault Code 387
	Fault Code 387 active? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 131 active? **YES**	2A
	Fault Code 131 active? **NO**	Use the following procedure for an Inactive or Intermittent Fault Code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the accelerator pedal or lever position sensor and circuit.

STEP 2A: Inspect the accelerator pedal or lever position sensor and connector pins.

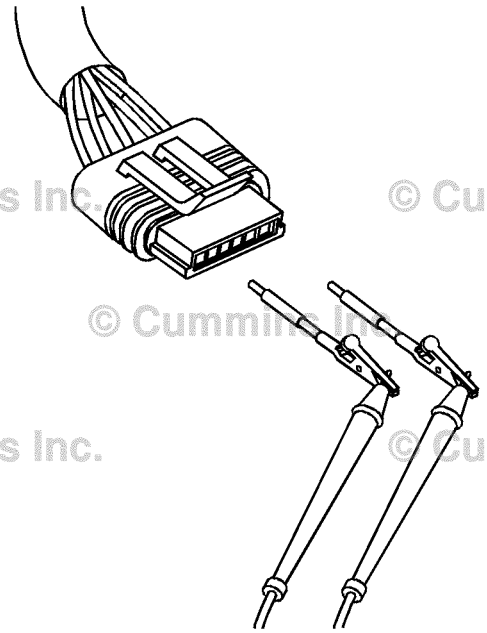
Condition:
- Turn keyswitch OFF.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pin • Connector shell broken • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the accelerator pedal or lever 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
Measure the voltage from the accelerator pedal or lever position sensor +5 VDC SUPPLY pin to the accelerator pedal or lever position sensor RETURN pin at the sensor connector of the OEM harness. Refer to the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	2C
	4.75 to 5.25 VDC? **NO**	3A



STEP 2C: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 132 active and Fault Code 131 inactive? **YES**	2D
	Fault Code 132 active and Fault Code 131 inactive? **NO**	3A

STEP 2D: Check the fault codes and verify accelerator pedal or lever condition.

Condition:
- Turn keyswitch OFF.
- Connect the accelerator pedal or lever to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. Use INSITE™ electronic service tool to read the fault codes.	Fault Code 132 is active? **YES** **Repair:** A damaged accelerator pedal or lever has been detected. Contact the appropriate OEM or dealership for repair instructions. Replace the accelerator pedal or lever. Refer to the OEM service manual.	4A
	Fault Code 132 is active? **NO** **Repair:** None. The removal and installation of the connector corrected the failure.	4A

STEP 3: Check the ECM and OEM harness.

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

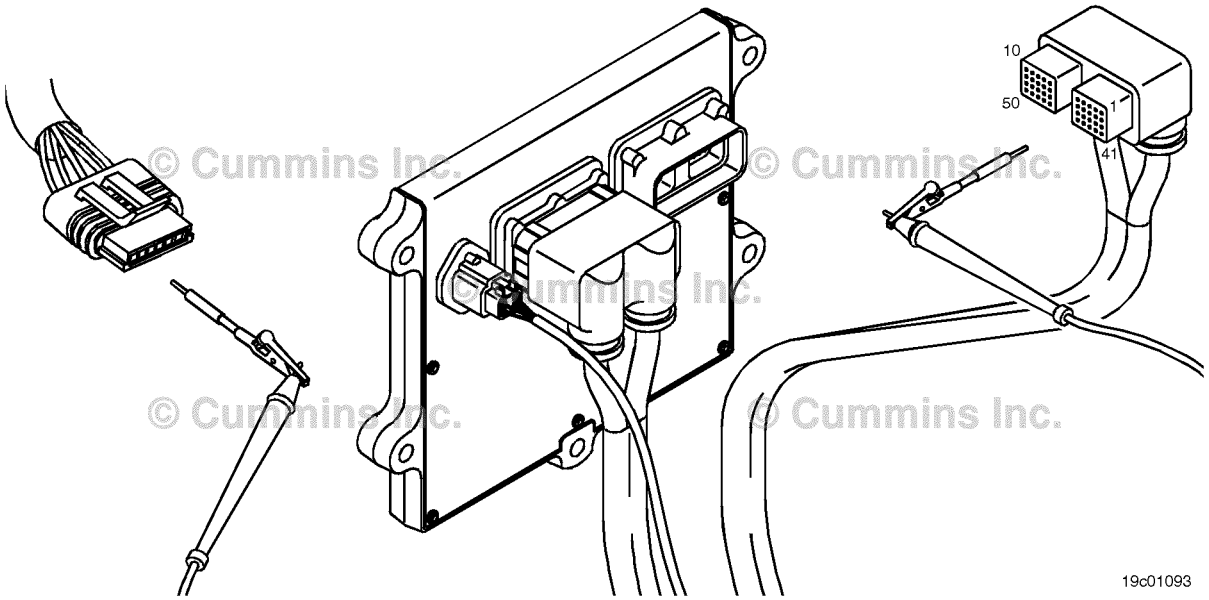
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pin • Connector shell broken • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the harness connector. Clean the connector and pins. 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? **NO**	3A-1

STEP 3A-1: Check for an open 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.

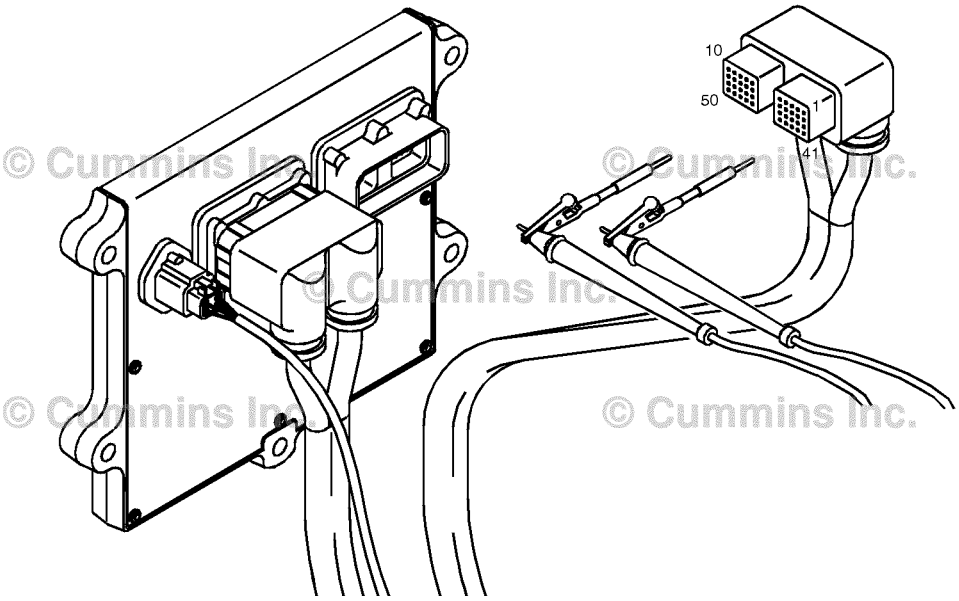
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector accelerator pedal or lever RETURN pin and the OEM harness accelerator pedal or lever RETURN pin. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3A-2
	Less than 10 ohms? **NO** **Repair:** An open RETURN circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3A-2: 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. • Measure the resistance between the accelerator pedal or lever SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3B
	Greater than 100k ohms? **NO** **Repair:** Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



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STEP 3B: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 131 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 131 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 131 inactive? **YES**	4B
	Fault Code 131 inactive? **NO** **Repair:** 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.

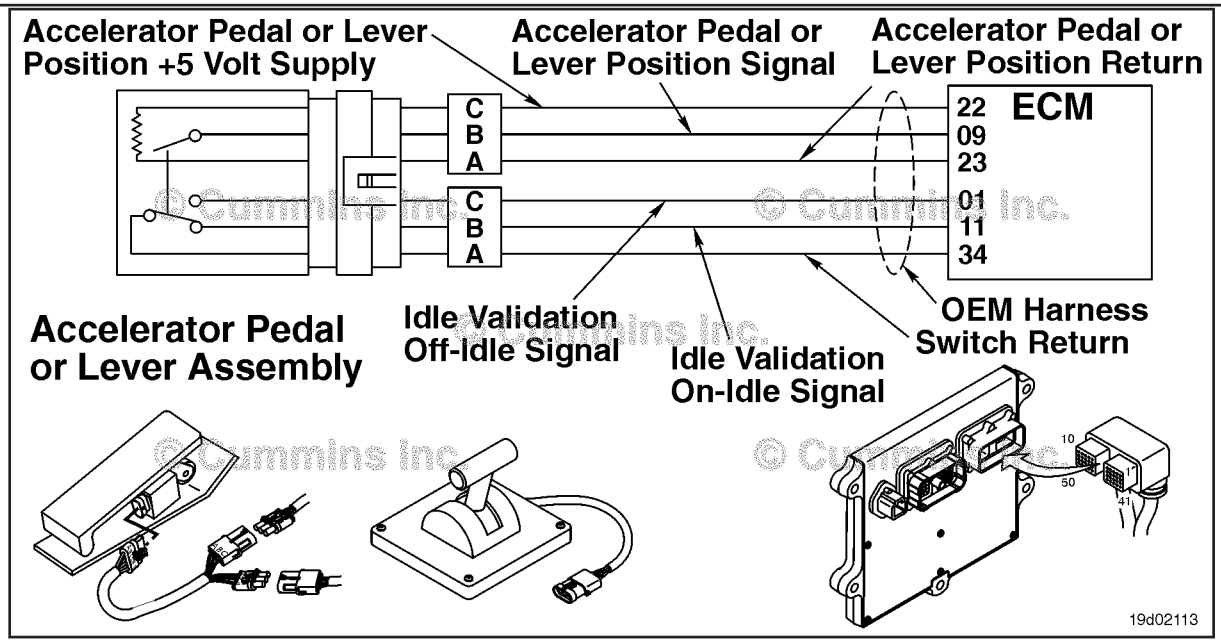
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 132

Accelerator Pedal or Lever Position Sensor Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 132 PID(P), SID(S): P091 SPN: 91 FMI: 4/4 Lamp: Red SRT:	Accelerator Pedal or Lever Position Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected at accelerator pedal or lever position signal circuit.	Automotive: Severe derate in power output of the engine. Limp home capability **only**. Marine: Severe derate in engine speed. Limp home capability **only**.



Accelerator Pedal or Lever Position Sensor 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.

Component Location:

The accelerator pedal or lever position sensor is mounted to the accelerator pedal or lever assembly. Refer to the OEM manual.

Shop Talk:

If troubleshooting an intermittent accelerator problem:

The accelerator pedal or lever position sensor signal voltage can be monitored with the INSITE™ electronic service tool, while flexing the harness to locate the intermittent connection. Intermittent connections will show up as abrupt changes in signal voltage displayed by INSITE™ electronic service tool.

Possible causes of this fault include:

- Accelerator pedal or lever position signal shorted to engine ground or return wires in the OEM harness or sensor.
- Failed accelerator pedal or lever 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 t05-132

FAULT CODE 132 - Accelerator Pedal or Lever Position 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 3823995 - male Weather-Pack test lead; Part Number 3823996 - female Weather-Pack test lead; 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 443 active?**	
STEP 1B:	**Check for an active fault code.**	**Fault Code 132 active?**	
STEP 2:	**Check the accelerator pedal or lever position sensor and circuit.**		
STEP 2A:	**Inspect the accelerator pedal or lever position sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the accelerator pedal or lever position sensor supply voltage and return circuit.**	**4.75 to 5.25 VDC?**	
STEP 2C:	**Check the circuit response.**	**Fault Code 131 active and Fault Code 132 inactive?**	
STEP 2D:	**Check the fault codes and verify accelerator pedal or lever condition.**	**Fault Code 132 is active?**	
STEP 3:	**Check the ECM and OEM harness.**		
STEP 3A:	**Inspect the ECM and OEM harness connector pins.**	**Dirty or damaged pins?**	
STEP 3A-1:	**Check for an open circuit in the OEM harness.**	**Less than 10 ohms?**	
STEP 3A-2:	**Check for an open circuit in the OEM harness.**	**Less than 10 ohms?**	
STEP 3A-3:	**Check for a pin-to-pin short circuit in the OEM harness.**	**Greater than 100k ohms?**	
STEP 3A-4:	**Check for a pin short circuit to ground in the OEM harness.**	**Greater than 100k ohms?**	
STEP 3B:	**Check for an inactive fault code.**	**Fault Code 132 inactive?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 132 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 443 active? **YES**	Fault Code 443
	Fault Code 443 active? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 132 active? **YES**	2A
	Fault Code 132 active? **NO**	Use the following procedure for an inactive or intermittent Fault Code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the accelerator pedal or lever position sensor and circuit.

STEP 2A: Inspect the accelerator pedal or lever position sensor and connector pins.

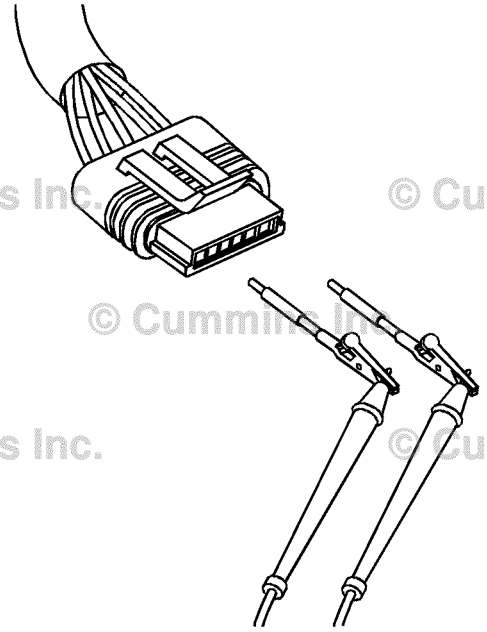
Condition:
- Turn keyswitch OFF.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pin • Connector shell broken • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A defective connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the accelerator pedal or lever position sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Measure the voltage from the accelerator pedal or lever position +5 VDC SUPPLY pin to the accelerator pedal or lever position RETURN pin at the sensor connector of the OEM harness. Refer to the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	2C
	4.75 to 5.25 VDC? **NO**	3A



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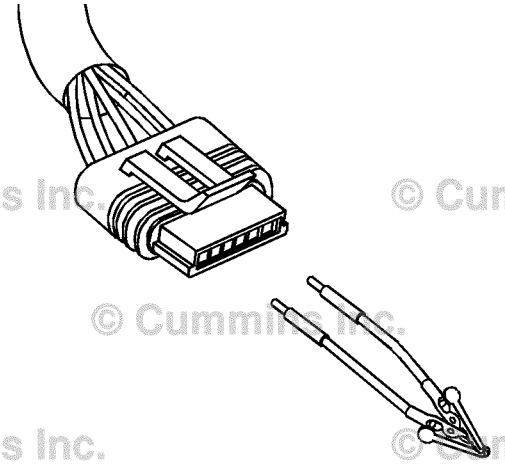
STEP 2C: Check the circuit response.

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
Place a jumper wire between the accelerator pedal or lever position +5 VDC SUPPLY pin and the accelerator pedal or lever position SIGNAL pin at the sensor connector of the OEM harness. • Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes. Refer to the wiring diagram for connector pin identification.	Fault Code 131 active and Fault Code 132 inactive? **YES**	2D
	Fault Code 131 active and Fault Code 132 inactive? **NO**	3A



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STEP 2D: Check the fault codes and verify accelerator pedal or lever condition.

Condition:
- Turn keyswitch OFF.
- Connect the accelerator pedal or lever to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 132 is active? **YES** **Repair:** A damaged accelerator pedal or lever has been detected. Contact the appropriate OEM or dealership for repair instructions. Replace the accelerator pedal or lever. Refer to the OEM service manual.	4A
	Fault Code 132 is active? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	4A

STEP 3: Check the ECM and OEM harness.

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

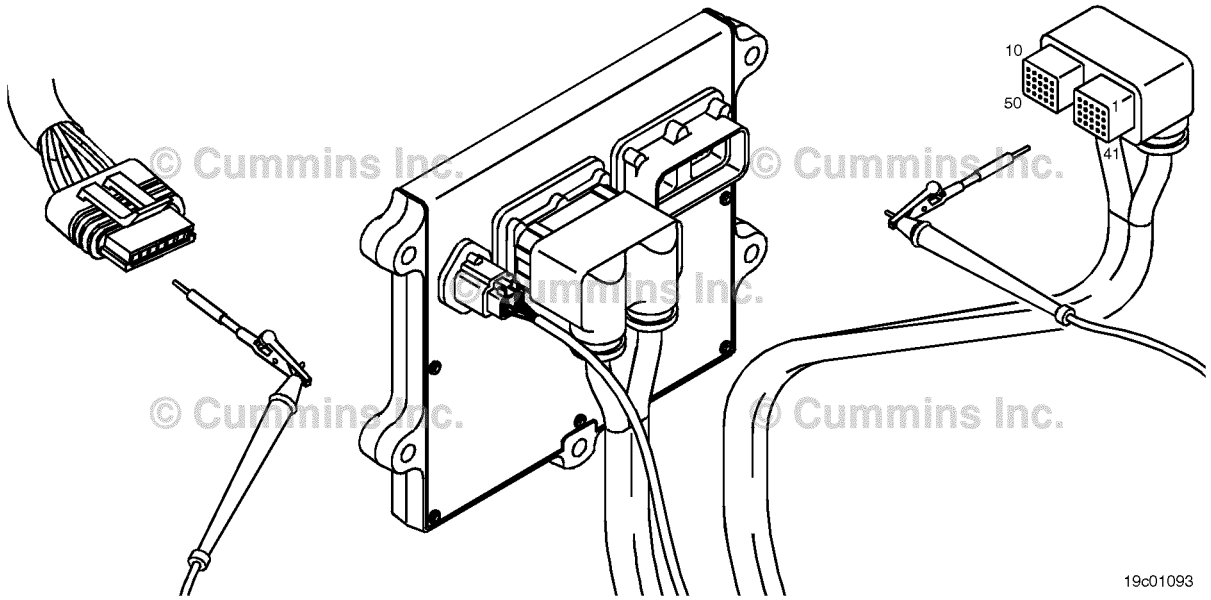
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pin • Connector shell broken • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A defective connection has been detected in the harness connector. Clean the connector and pins. 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? **NO**	3A-1

STEP 3A-1: Check for an open 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.

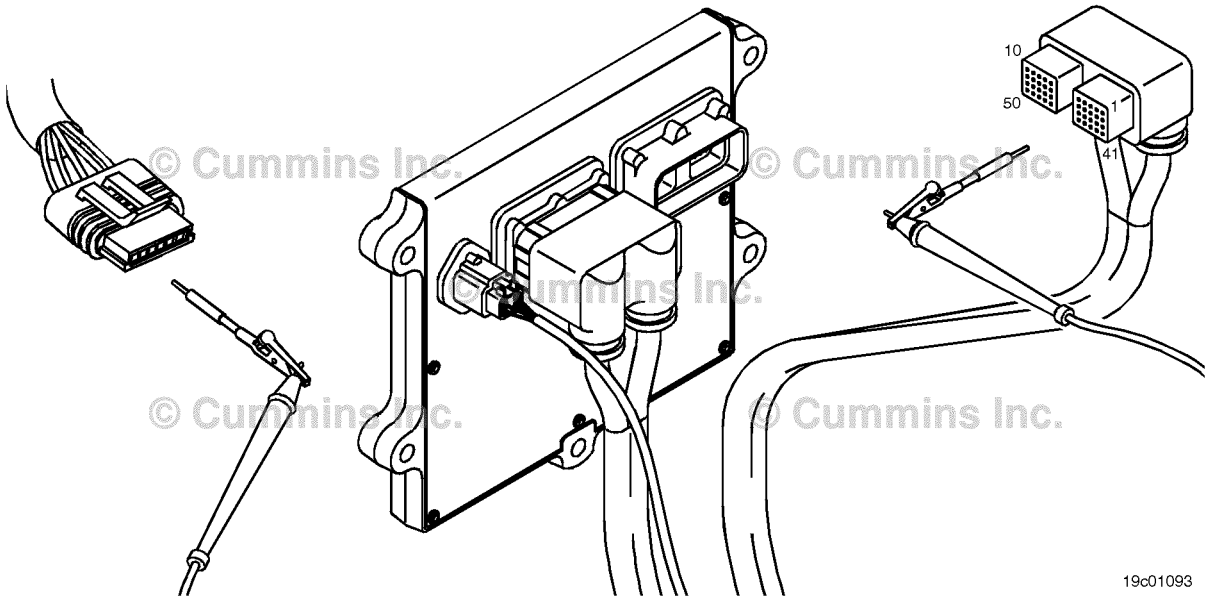
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector accelerator pedal or lever SUPPLY pin and the OEM harness accelerator pedal or lever connector SUPPLY pin. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3A-2
	Less than 10 ohms? **NO** **Repair:** An open SUPPLY circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3A-2: Check for an open circuit in the OEM harness.

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

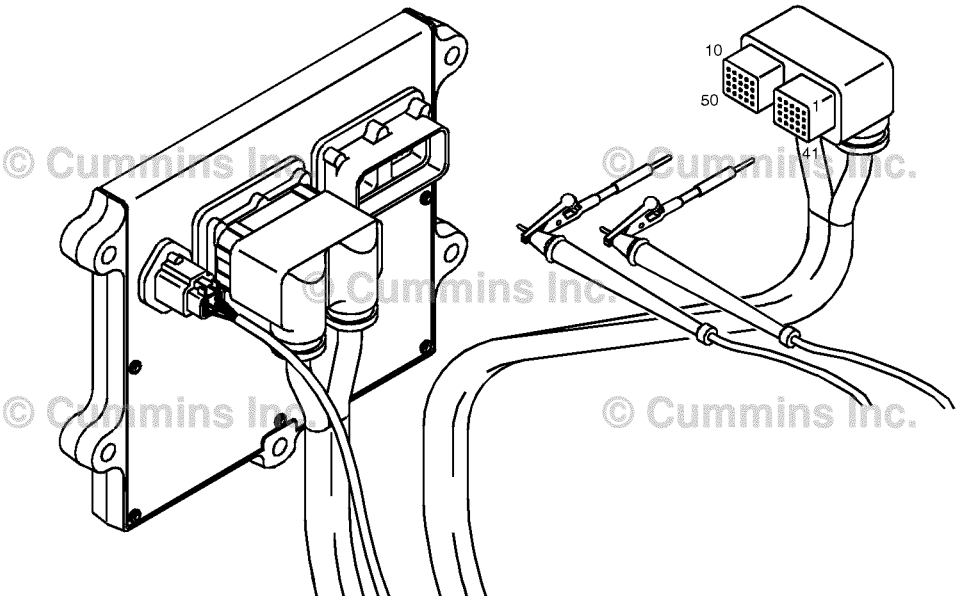
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector accelerator pedal or lever SIGNAL pin and the OEM harness accelerator pedal or lever connector SIGNAL pin. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3A-3
	Less than 10 ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3A-3: 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.

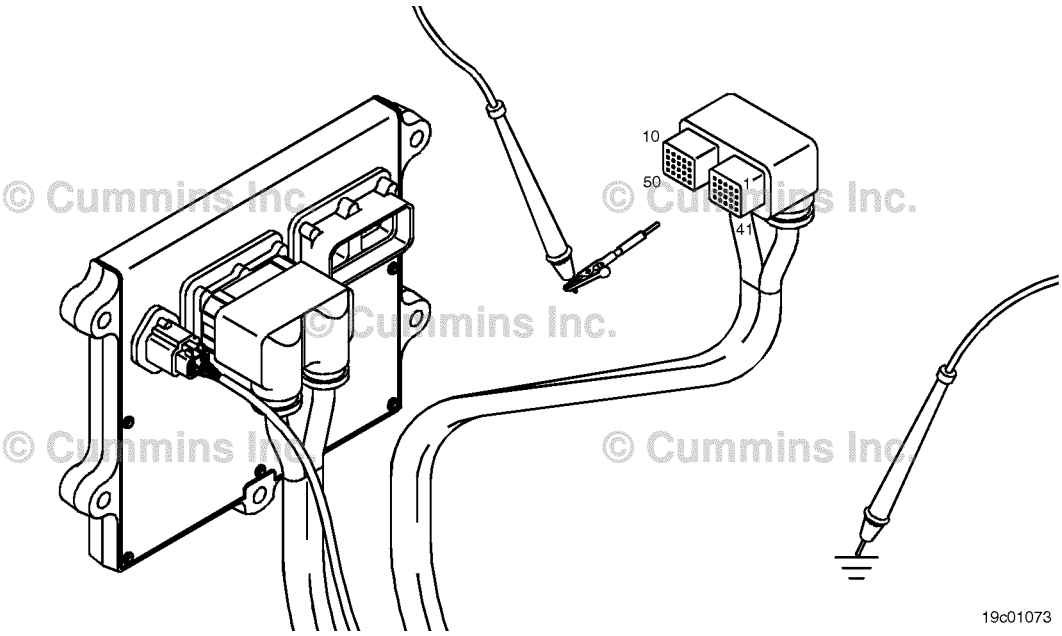
Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the accelerator pedal or lever SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3A-4
	Greater than 100k ohms? **NO** **Repair:** Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3A-4: 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
Check for a pin to ground short. • Measure the resistance between the accelerator pedal or lever SIGNAL pin in the OEM harness ECM connector and ground. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3B
	Greater than 100k ohms? **NO** **Repair:** A pin to ground short circuit on the SIGNAL line has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3B: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 132 inactive? **YES** **Repair:** The removal and installation of the connector corrected the fault.	4A
	Fault Code 132 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 132 inactive? **YES**	4B
	Fault Code 132 inactive? **NO** **Repair:** 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.

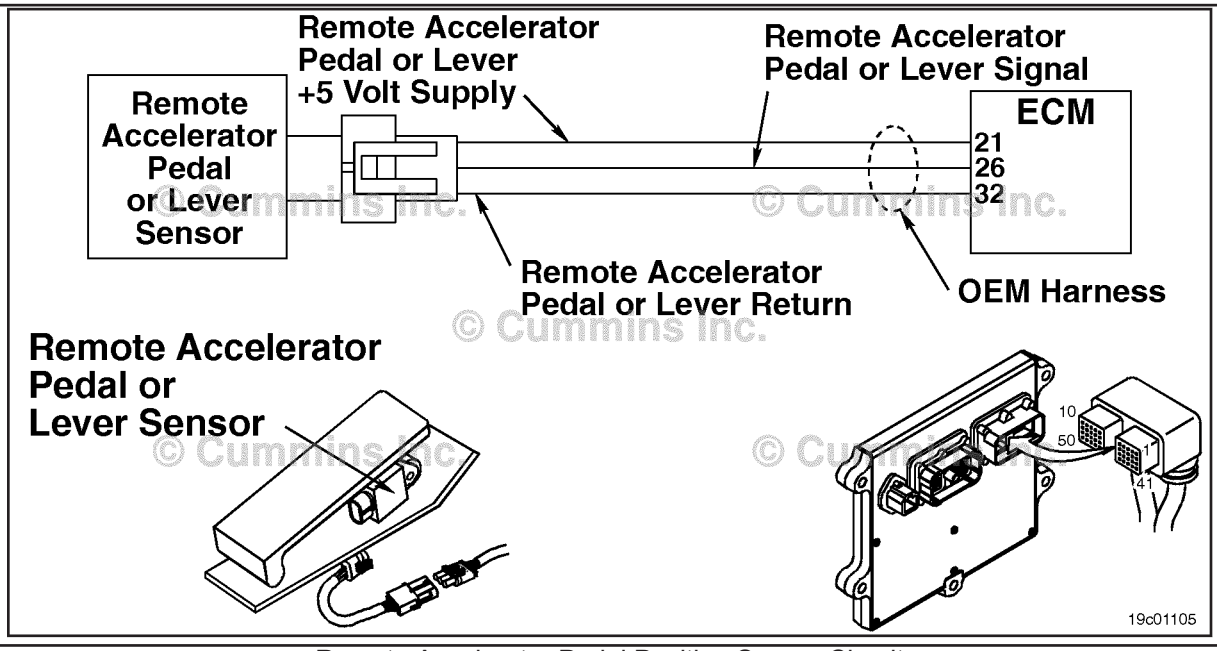
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 133

Remote Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage Above Normal, or shorted to High Source

CODES	REASON	EFFECT
Fault Code: 133 PID(P), SID(S): P029 SPN: 974 FMI: 3/3 Lamp: None SRT:	Remote Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage Above Normal, or shorted to High Source. High voltage detected at remote accelerator pedal position circuit.	Remote accelerator will not operate. Remote accelerator position will be set to zero percent.



Remote Accelerator Pedal Position Sensor Circuit

Circuit Description:

The remote accelerator pedal or lever provides the operators accelerator command to the electronic control module (ECM) through the OEM harness. The ECM uses this signal to determine the fueling command.

Component Location:

The remote accelerator pedal or lever location varies with each OEM. Refer to the OEM troubleshooting and repair manual.

Shop Talk:

If troubleshooting an intermittent accelerator problem:

The remote accelerator pedal or lever position sensor 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:

- Remote accelerator pedal or lever position signal circuit shorted to battery or +5 volt supply
- Open remote accelerator pedal or lever return circuit in the harness or connections
- Remote accelerator supply shorted to battery
- Failed remote accelerator pedal or lever position sensor.

Note: The three wires in the remote accelerator position sensor circuit **must** be twisted together.

Refer to Troubleshooting Fault Code t05-133

FAULT CODE 133 - Remote Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage Above Normal, or Shorted to High Source

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To avoid 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 3823996 - female Weather-Pack 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 sensor supply fault codes.	Fault Code 387 or 2185 active?	
STEP 1B:	Check for an active fault code.	Fault Code 133 active?	
STEP 2:	**Check the remote accelerator pedal or lever position sensor circuit.**		
STEP 2A:	Inspect the remote accelerator pedal or lever position sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the remote accelerator pedal or lever position sensor supply voltage and return circuit.	4.75 to 5.25 VDC?	
STEP 2C:	Check the circuit response.	Fault Code 134 active and Fault Code 133 inactive?	
STEP 2D:	Check the fault codes and verify accelerator pedal or lever condition.	Fault Code 134 is active?	
STEP 3:	**Check the ECM and OEM harness.**		
STEP 3A:	Inspect ECM and OEM harness connector pins.	Dirty or damaged pins?	
STEP 3A-1:	Check for an open circuit in the OEM harness.	Less than 10 ohms?	
STEP 3A-2:	Check for a pin-to-pin short circuit in the OEM harness.	Greater than 100k ohms?	
STEP 3B:	Check for an inactive fault code.	Fault Code 133 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 133 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 387 or 2185 active? **YES**	Fault Code 387 or 2185
	Fault Code 387 or 2185 active? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 133 active? **YES**	2A
	Fault Code 133 active? **NO**	Use the following procedure for an inactive or intermittent Fault Code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the remote accelerator pedal or lever position sensor and circuit.

STEP 2A: Inspect the remote accelerator pedal or lever position sensor and connector pins.

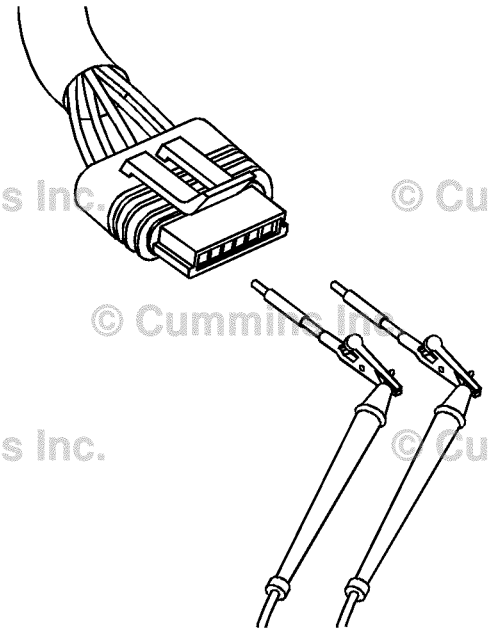
Condition:
- Turn keyswitch OFF.
- Disconnect the remote accelerator pedal or lever position sensor from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the remote accelerator pedal or lever position sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Measure the voltage from the remote accelerator pedal or lever position sensor +5 volt SUPPLY pin to the remote accelerator pedal or lever position sensor RETURN pin at the sensor connector of the OEM harness. Refer to the circuit diagram or the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	2C
	4.75 to 5.25 VDC? **NO**	3A



STEP 2C: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the remote 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 134 active and Fault Code 133 inactive? **YES**	2D
	Fault Code 134 active and Fault Code 133 inactive? **NO**	3A

STEP 2D: Check the fault codes and verify remote accelerator pedal or lever condition.

Condition:
- Turn keyswitch OFF.
- Connect the remote accelerator pedal or lever to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. Use INSITE™ electronic service tool to read the fault codes.	Fault Code 134 is active? **YES** **Repair:** A damaged remote accelerator pedal or lever has been detected. Contact the appropriate OEM or dealership for repair instructions. Replace the remote accelerator pedal or lever. Refer to the OEM service manual.	4A
	Fault Code 134 is active? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	4A

STEP 3: Check the ECM and OEM harness.

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

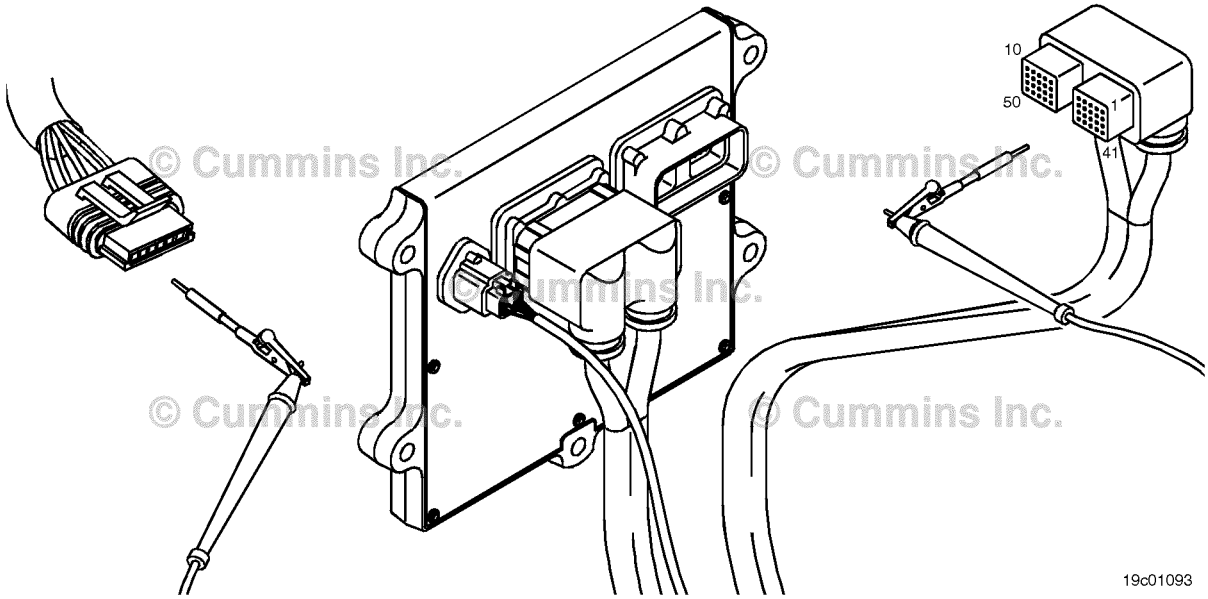
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. • Damaged locking tab connector	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the harness connector. Clean the connector and pins. 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? **NO**	3A-1

STEP 3A-1: Check for an open circuit in the OEM harness.

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

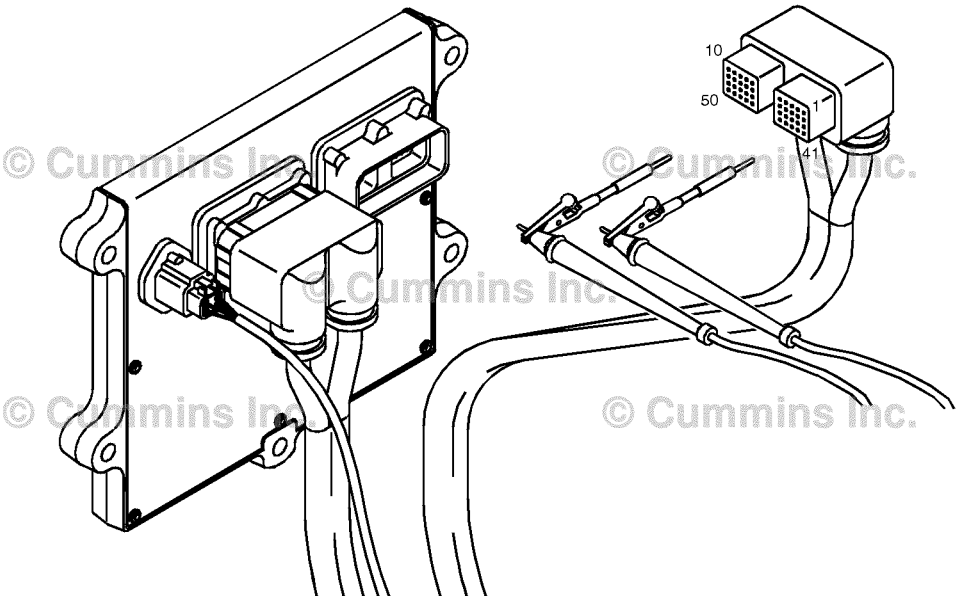
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector remote accelerator pedal or lever RETURN pin and the OEM harness remote accelerator pedal or lever RETURN pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3A-2
	Less than 10 ohms? **NO** **Repair:** An open RETURN circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3A-2: 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 remote accelerator pedal or lever position sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin to pin short. • Measure the resistance between the remote accelerator pedal or lever SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3B
	Greater than 100k ohms? **NO** **Repair:** Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3B: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 133 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 133 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 133 inactive? **YES**	4B
	Fault Code 133 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and rechecked.	1A

STEP 4B: Clear the inactive fault codes.

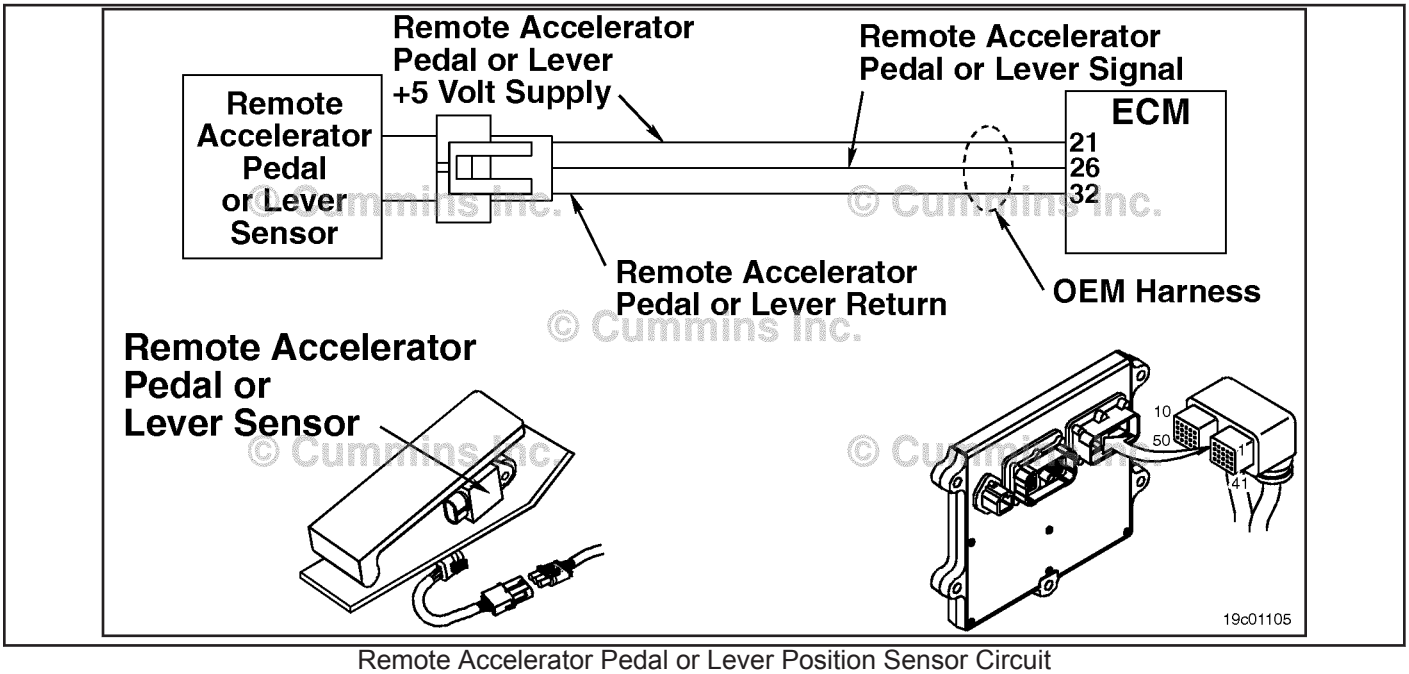
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 134

Remote Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage Below Normal, or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 134 PID(P), SID(S): P029 SPN: 974 FMI: 4/4 Lamp: Red SRT:	Remote Accelerator Pedal or Lever Position Sensor 1 Circuit - Voltage Below Normal, or Shorted to Low Source. Low voltage detected at remote accelerator pedal position signal.	Remote accelerator will **not** operate. Remote accelerator position will be set to zero percent.



Remote Accelerator Pedal or Lever Position Sensor Circuit

Circuit Description:

The remote accelerator pedal or lever provides the opertors accelerator command to the electronic control module (ECM) through the OEM harness. The ECM uses this signal to determine the fueling command.

Component Location:

The remote accelerator pedal or lever location varies with each OEM. Refer to the OEM service manual.

Shop Talk:

If troubleshooting an intermittent accelerator problem:

The remote accelerator pedal or lever position sensor signal voltage can be monitored with the INSITE™ electronic service tool, while flexing the harness to locate the intermittent connection. Intermittent connections will show up as abrupt changes in signal voltage displayed by INSITE™.

Possible causes of this fault include:

- Remote accelerator pedal or lever position signal shorted to engine ground or return wires in the OEM harness or sensor.
- Failed remote accelerator pedal or lever position sensor.
- Open circuit in the remote accelerator signal, supply, or return wire in the harness or connectors.

NOTE: The three wires in the remote accelerator position sensor circuit **must** be twisted together.

Refer to Troubleshooting Fault Code t05-134

FAULT CODE 134 - Remote Accelerator Pedal or Lever Position Sensor 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 3823995 - male Weather-Pack test lead; Part Number 3823996 - female Weather-Pack test lead; 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 443 or 2186 active?	
STEP 1B:	Check for an active fault code.	Fault Code 134 active?	
STEP 2:	**Check the remote accelerator pedal or lever position sensor and circuit.**		
STEP 2A:	Inspect the remote accelerator pedal or lever position sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the remote accelerator pedal or lever position sensor supply voltage and return circuit.	4.75 to 5.25 VDC?	
STEP 2C:	Check the circuit response.	Fault Code 133 active and Fault Code 134 inactive?	
STEP 2D:	Check the fault codes and verify remote accelerator pedal or lever condition.	Fault Code 134 is active?	
STEP 3:	**Check the ECM and OEM harness.**		
STEP 3A:	Inspect the ECM and OEM harness connector pins.	Dirty or damaged pins?	
STEP 3A-1:	Check for an open circuit in the OEM harness.	Less than 10 ohms?	
STEP 3A-2:	Check for an open circuit in the OEM harness.	Less than 10 ohms?	
STEP 3A-3:	Check for a pin-to-pin short circuit in the OEM harness.	Greater than 100k ohms?	
STEP 3A-4:	Check for a pin short circuit to ground in the OEM harness.	Greater than 100k ohms?	
STEP 3B:	Check for an inactive fault code.	Fault Code 134 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 134 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. • Use INSITE™ electronic service tool, read the fault codes.	Fault Code 443 or 2186 active? **YES**	Fault Code 443 or 2186
	Fault Code 443 or 2186 active? **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. • Use INSITE™ electronic service tool, read the fault codes.	Fault Code 134 active? **YES**	2A
	Fault Code 134 active? **NO**	Use the following procedure for an inactive or intermittent Fault Code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the remote accelerator pedal or lever position sensor and circuit.

STEP 2A: Inspect the remote accelerator pedal or lever position sensor and connector pins.

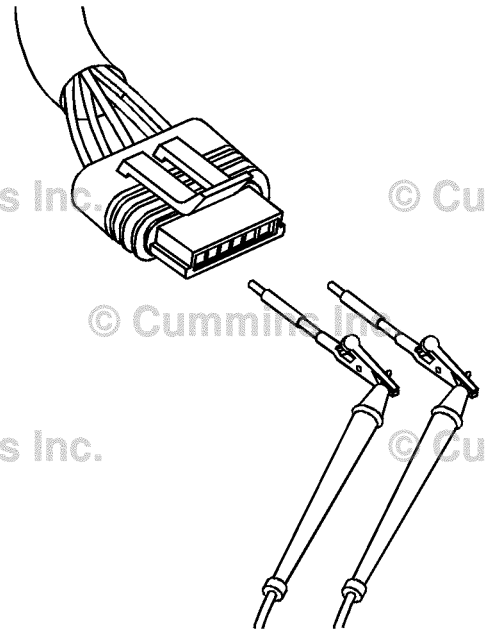
Condition:
- Turn keyswitch OFF.
- Disconnect the remote accelerator pedal or lever position sensor from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the remote accelerator pedal or lever position sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Measure the voltage from the accelerator pedal or lever position +5 volt SUPPLY pin to the accelerator pedal or lever position RETURN pin at the sensor connector of the OEM harness. Refer to the circuit diagram or the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	2C
	4.75 to 5.25 VDC? **NO**	3A



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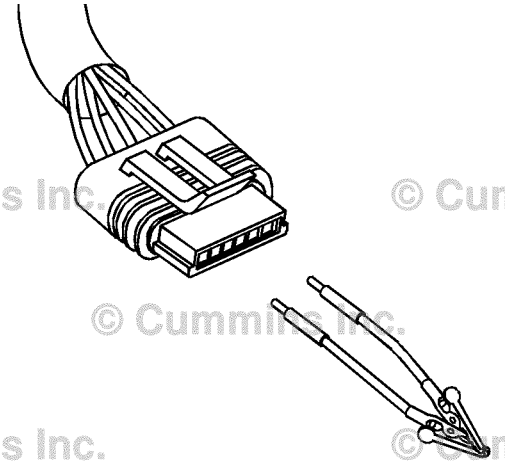
STEP 2C: Check the circuit response.

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

Action	Specification/Repair	Next Step
Place a jumper wire between the accelerator pedal or lever position +5 volt SUPPLY pin and the accelerator pedal or lever position SIGNAL pin at the sensor connector of the OEM harness. • Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool , read the fault codes. Refer to the circuit diagram or the wiring diagram for connector pin identification.	Fault Code 133 active and Fault Code 134 inactive? **YES**	2D
	Fault Code 133 active and Fault Code 134 inactive? **NO**	3A



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STEP 2D: Check the fault codes and verify remote accelerator pedal or lever condition.

Condition:
- Turn keyswitch OFF.
- Connect the remote accelerator pedal or lever to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 134 is active? **YES** **Repair:** A damaged remote accelerator pedal or lever has been detected. Contact the appropriate OEM or dealership for repair instructions. Replace the remote accelerator pedal or lever. Refer to the OEM service manual.	4A
	Fault Code 134 is active? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	4A

STEP 3: Check the ECM and OEM harness.

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

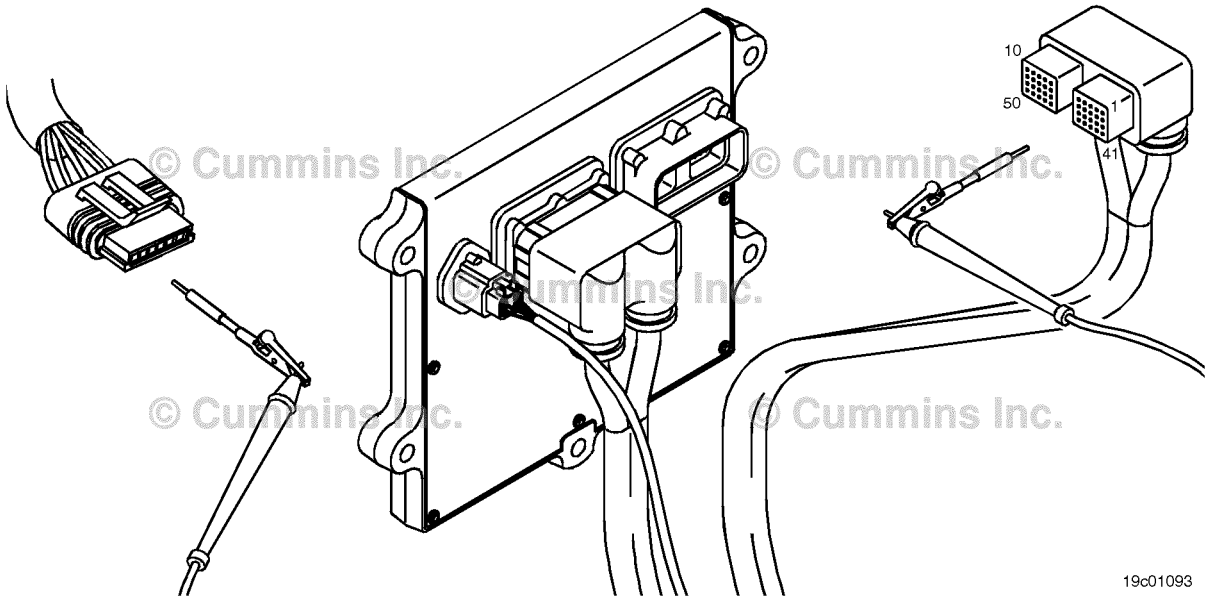
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the harness connector. Clean the connector and pins. 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? **NO**	3A-1

STEP 3A-1: Check for an open circuit in the OEM harness.

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

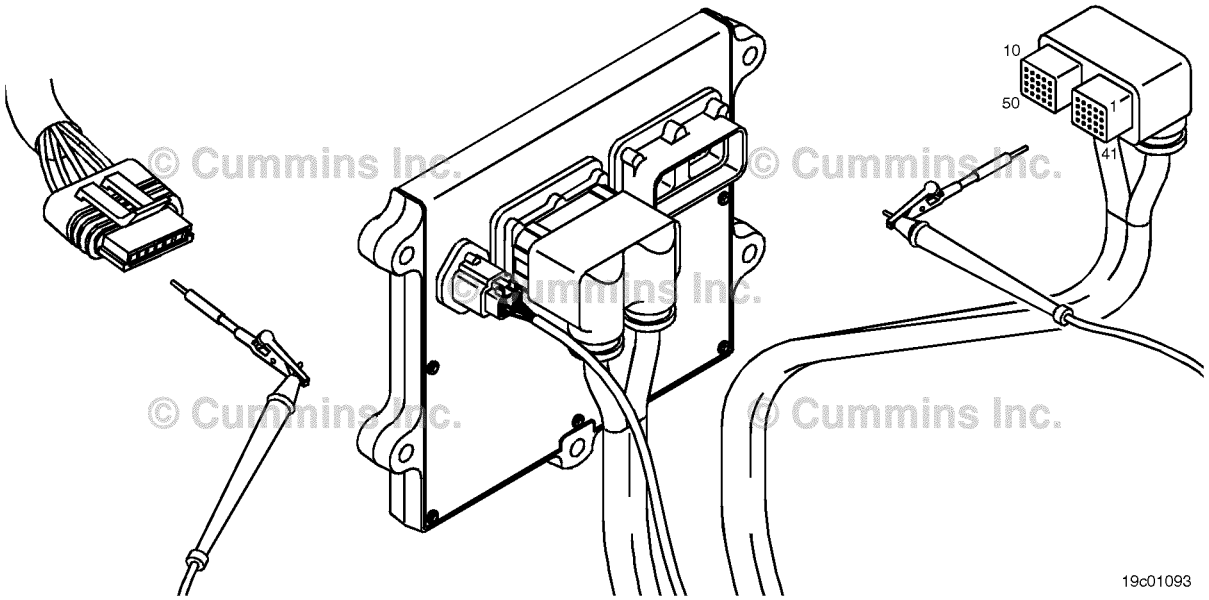
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector remote accelerator pedal or lever SUPPLY pin and the OEM harness remote accelerator pedal or lever connector SUPPLY pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3A-2
	Less than 10 ohms? **NO** **Repair:** An open SUPPLY circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3A-2: Check for an open circuit in the OEM harness.

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

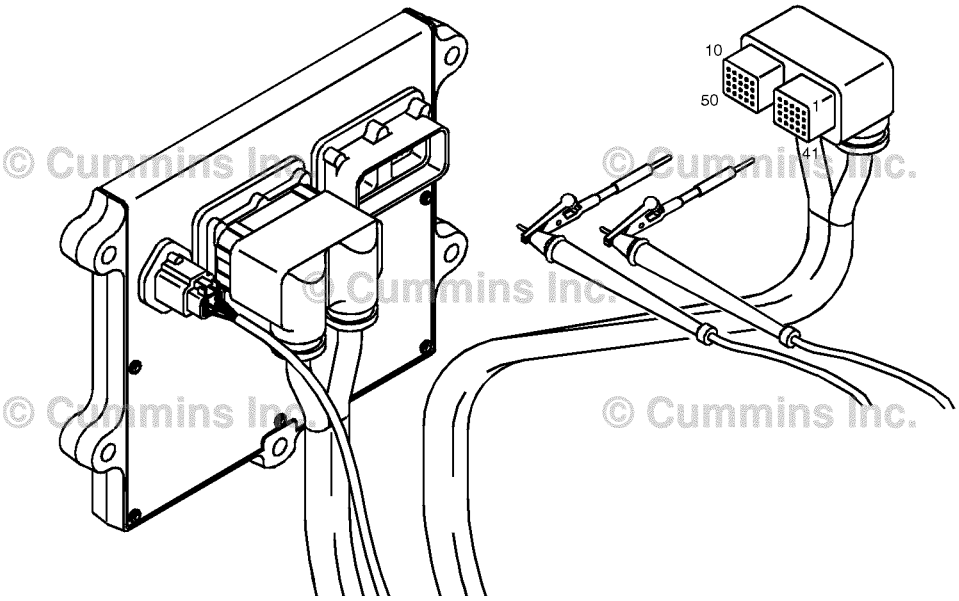
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector remote accelerator pedal or lever SIGNAL pin and the OEM harness remote accelerator pedal or lever connector SIGNAL pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3A-3
	Less than 10 ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3A-3: 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 remote accelerator pedal or lever position sensor from the OEM harness.

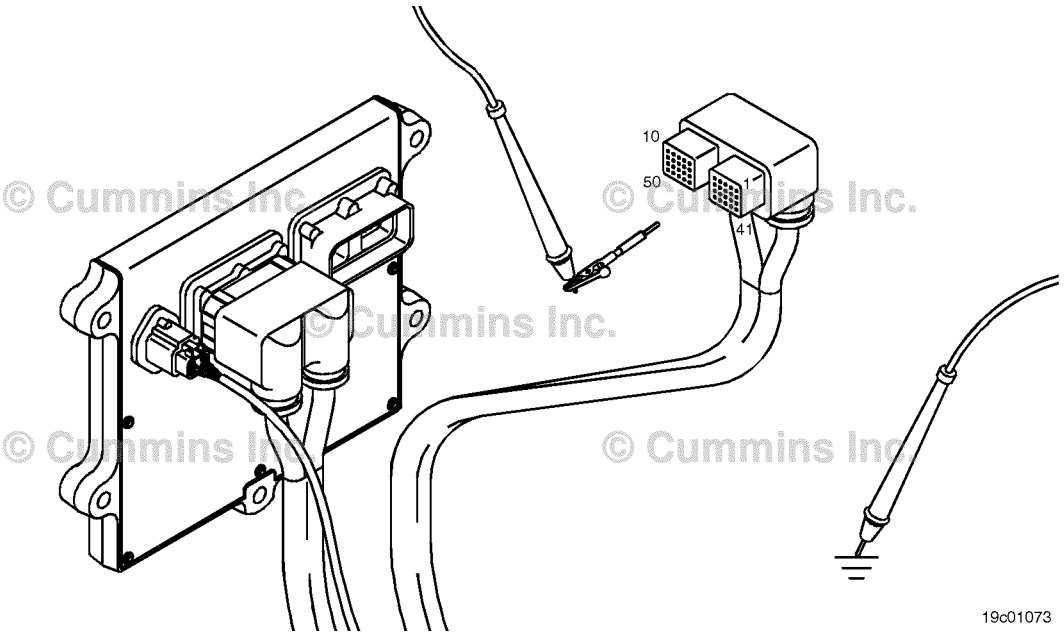
Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the remote accelerator pedal or lever SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3A-4
	Greater than 100k ohms? **NO** **Repair:** Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3A-4: 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 remote accelerator pedal or lever position sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin to ground short. • Measure the resistance between the remote accelerator pedal or lever SIGNAL pin in the OEM harness ECM connector and ground. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3B
	Greater than 100k ohms? **NO** **Repair:** A pin to ground short circuit on the SIGNAL line has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3B: 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. • Use INSITE™ to read the fault codes.	Fault Code 134 inactive? **YES** **Repair:** The removal and installation of the connector corrected the fault.	4A
	Fault Code 134 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool, verify that the fault code is inactive.	Fault Code 134 inactive? **YES**	4B
	Fault Code 134 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and rechecked.	1A

STEP 4B: Clear the inactive fault codes.

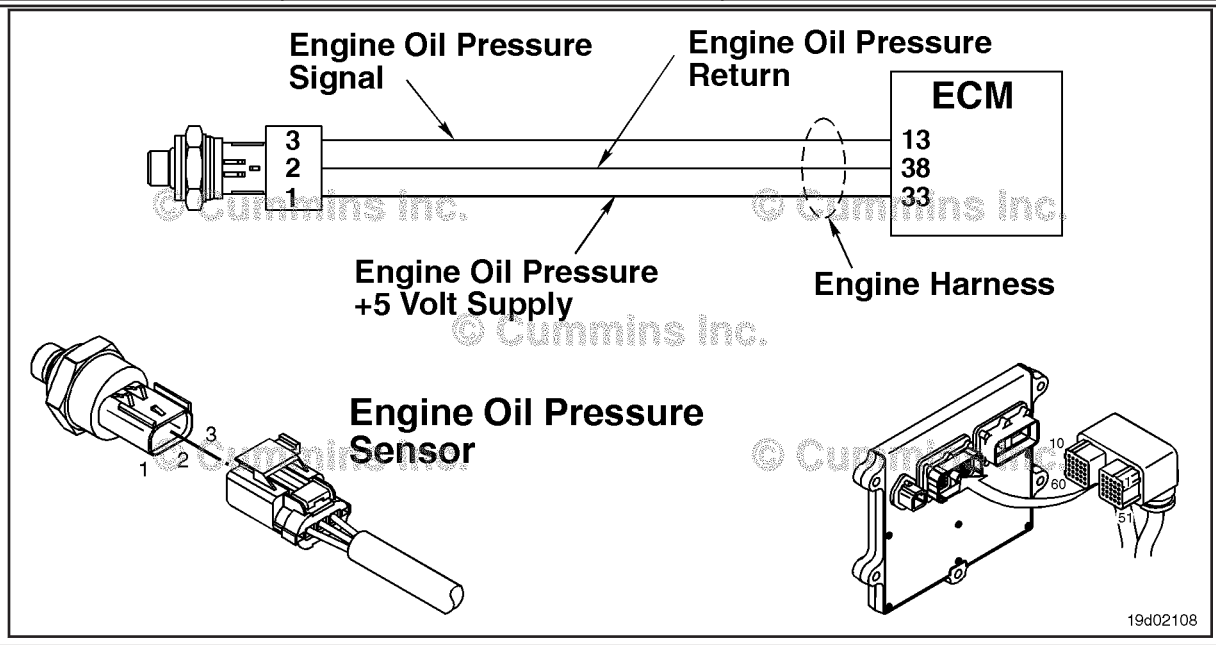
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 135 (Automotive Application)

Oil Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 135 PID(P), SID(S): P100 SPN: 100 FMI: 3 Lamp: Amber SRT:	Oil Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source. High signal voltage detected at the engine oil pressure circuit.	None on performance. No engine protection for oil pressure.



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. The ECM monitors the voltage on the signal pin and converts this to a pressure value.

Component Location:

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

Shop Talk:

The oil pressure 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 135, check for multiple faults.

Possible causes of this fault code include:

- Open return circuit in the harness, connectors, or sensor
- Signal circuit shorted to sensor supply or battery voltage.

Refer to Troubleshooting Fault Code t05-135

FAULT CODE 135 (Automotive Application) - Oil 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 3164596 - male Framatome 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 386 active?**	
STEP 1B:	**Check for an inactive fault code.**	**Fault Code 135 inactive?**	
STEP 2:	**Check the oil pressure sensor and circuit.**		
STEP 2A:	**Inspect the oil pressure sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the circuit response.**	**Fault Code 141 active and Fault Code 135 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 221 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 engine control module response.**	**Fault Code 141 active and Fault Code 135 inactive?**	
STEP 3A-2:	**Check for an active fault code.**	**Fault Code 135 inactive?**	
STEP 3B:	**Inspect 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 active fault code.**	**Fault Code 135 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 135 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 386 active? **YES**	Refer to Fault Code 386
	Fault Code 386 active? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 135 inactive? **NO**	2A

STEP 2: Check the oil pressure sensor and circuit.

STEP 2A: Inspect the oil pressure sensor and connector pins.

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

Action	Specification/Repair	Next Step
Inspect the engine harness and oil pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Dirt or debris in or on the connector pins • Missing or damaged connector seals • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the circuit response.

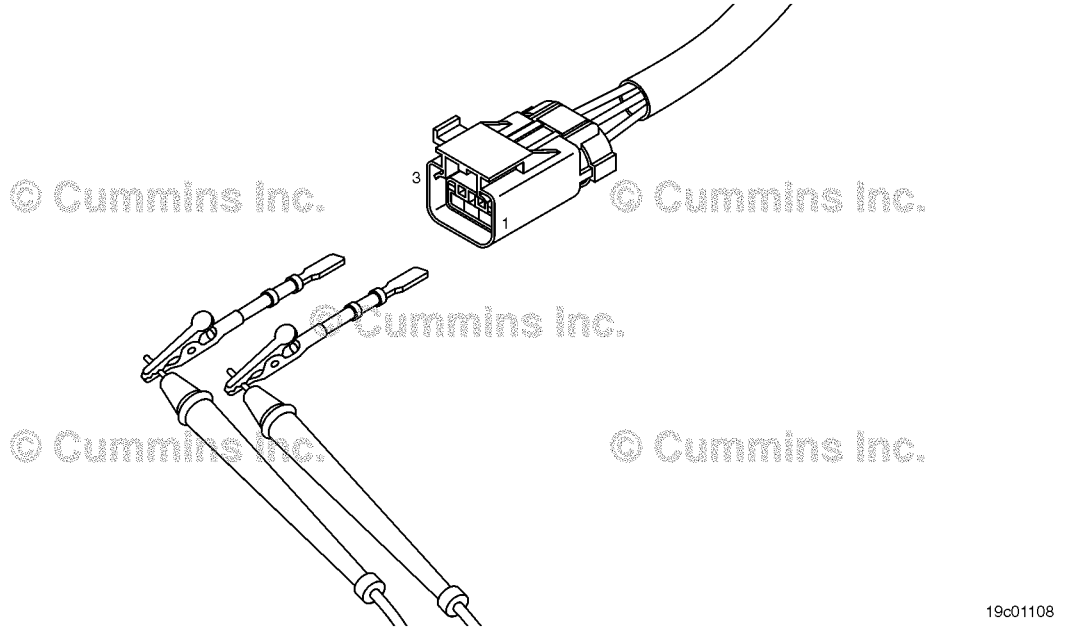
Condition:
- Turn keyswitch OFF.
- Disconnect the oil pressure sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 active and Fault Code 135 inactive? **YES**	2C
	Fault Code 141 active and Fault Code 135 inactive? **NO**	3A

STEP 2C: Check the sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the oil pressure +5 volt SUPPLY pin to the oil pressure RETURN pin at the sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	2D
	4.75-VDC to 5.25-VDC? **NO**	3B



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

Condition:
- Turn keyswitch OFF.
- Connect the oil pressure sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 active? **YES** **Repair:** A damaged sensor has been detected. Replace the oil pressure sensor. Refer to Procedure 019-066 in Section 19.	4A
	Fault Code 135 active? **NO** **Repair:** 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 the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Dirt or debris in or on the connector pins • Missing or damaged connector seals • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 active and Fault Code 135 inactive? **YES**	3A-2
	Fault Code 141 active and Fault Code 135 inactive? **NO** **Repair:** 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 for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 135 inactive? **NO** **Repair:** A pin-to-pin short circuit has been detected on the signal line of the engine harness. 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.

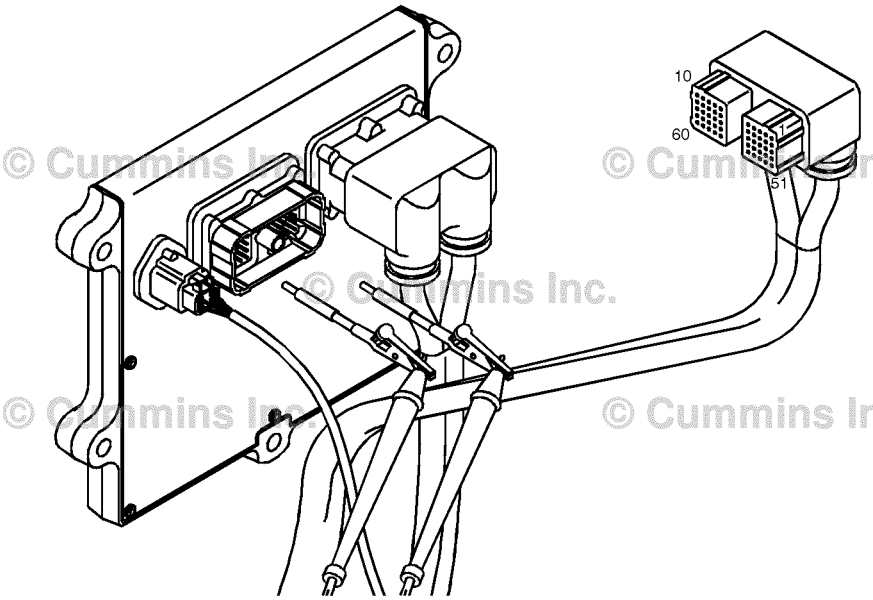
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Dirt or debris in or on the connector pins • Missing or damaged connector seals • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	3B-1

STEP 3B-1: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the engine control module engine connector.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the oil pressure +5 volt SUPPLY pin to the oil pressure RETURN pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	3B-2
	4.75-VDC to 5.25-VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 135 inactive? **NO** **Repair:** An open RETURN circuit has been detected in the engine harness. 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 135 inactive? **YES**	4B
	Fault Code 135 inactive? **NO** **Repair:** 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.

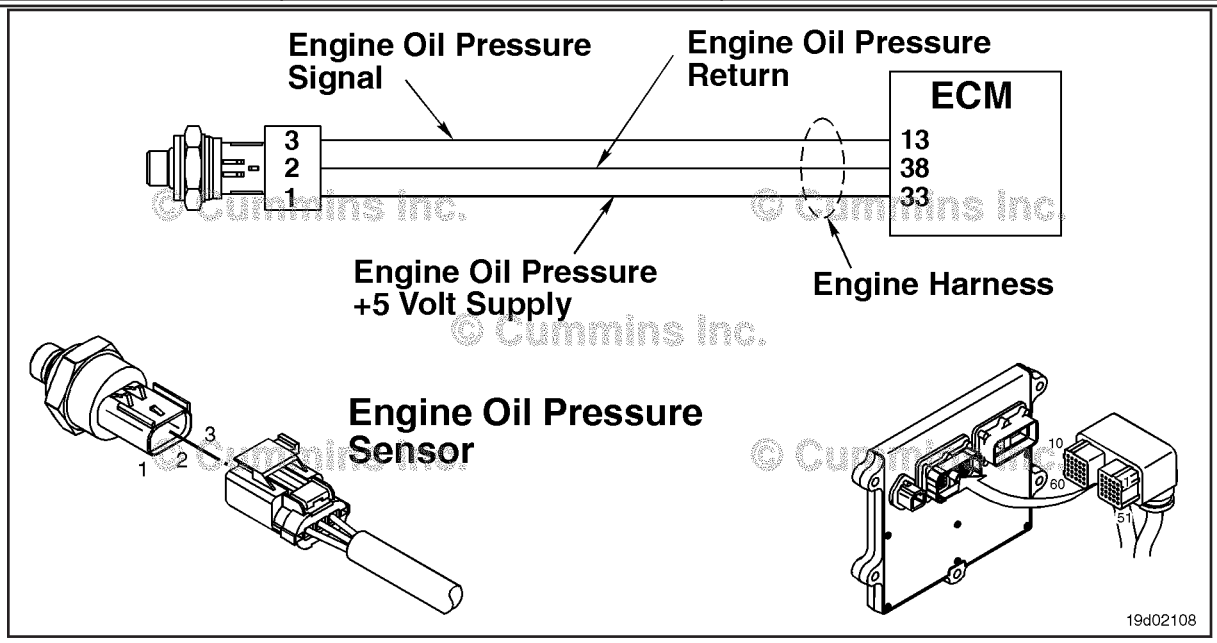
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 135 (Marine Applications)

Oil Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 135 PID(P), SID(S): P100 SPN: 100 FMI: 3 Lamp: Amber SRT:	Oil Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source. High signal voltage detected at the engine oil pressure circuit.	None. No engine protection for circuit or sensor failure.



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. The ECM monitors the voltage on the signal pin and converts this to a pressure value.

Component Location:

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

Shop Talk:

Possible causes of this fault code include:

- Open return circuit in the harness, connectors, or sensor
- Signal circuit shorted to sensor supply or battery voltage.

Refer to Troubleshooting Fault Code t05-135

FAULT CODE 135 (Marine Applications) - Oil 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 3164596 - male Framatome 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 135 inactive?	
STEP 2:	**Check the oil pressure sensor and circuit.**		
STEP 2A:	Inspect the oil pressure sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the circuit response.	Fault Code 141 active and Fault Code 135 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 221 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 engine control module response.	Fault Code 141 active and Fault Code 135 inactive?	
STEP 3A-2:	Check for an active fault code.	Fault Code 135 inactive?	
STEP 3B:	Inspect 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 active fault code.	Fault Code 135 inactive?	
STEP 4:	**Clear the fault code.**		
STEP 4A:	Disable the fault code.	Fault Code 135 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 135 inactive? **NO**	2A

STEP 2: Check the oil pressure sensor and circuit.

STEP 2A: Inspect the oil pressure sensor and connector pins.

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

Action	Specification/Repair	Next Step
Inspect the engine harness and oil pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Dirt or debris in or on the connector pins • Missing or damaged connector seals • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the circuit response.

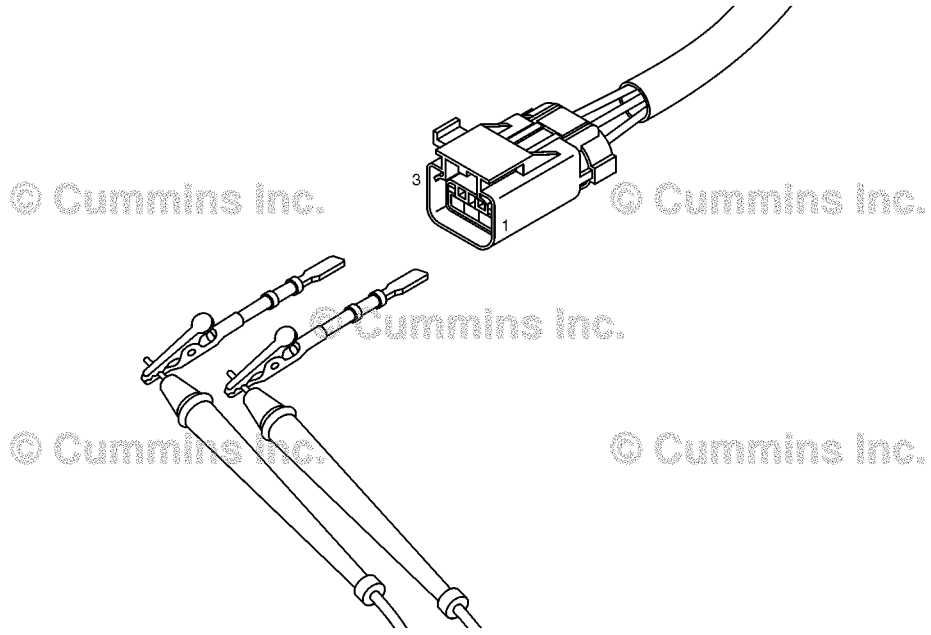
Condition:
- Turn keyswitch OFF.
- Disconnect the oil pressure sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 active and Fault Code 135 inactive? **YES**	2C
	Fault Code 141 active and Fault Code 135 inactive? **NO**	3A

STEP 2C: Check the sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the oil pressure +5 volt SUPPLY pin to the oil pressure RETURN pin at the sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	2D
	4.75-VDC to 5.25-VDC? **NO**	3B



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

Condition:
- Turn keyswitch OFF.
- Connect the oil pressure sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 active? **YES** **Repair:** A damaged sensor has been detected. Replace the oil pressure sensor. Refer to Procedure 019-066 in Section 19.	4A
	Fault Code 135 active? **NO** **Repair:** 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 the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Dirt or debris in or on the connector pins • Missing or damaged connector seals • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 active and Fault Code 135 inactive? **YES**	3A-2
	Fault Code 141 active and Fault Code 135 inactive? **NO** **Repair:** 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 for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 135 inactive? **NO** **Repair:** A pin-to-pin short circuit has been detected on the signal line of the engine harness. 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.

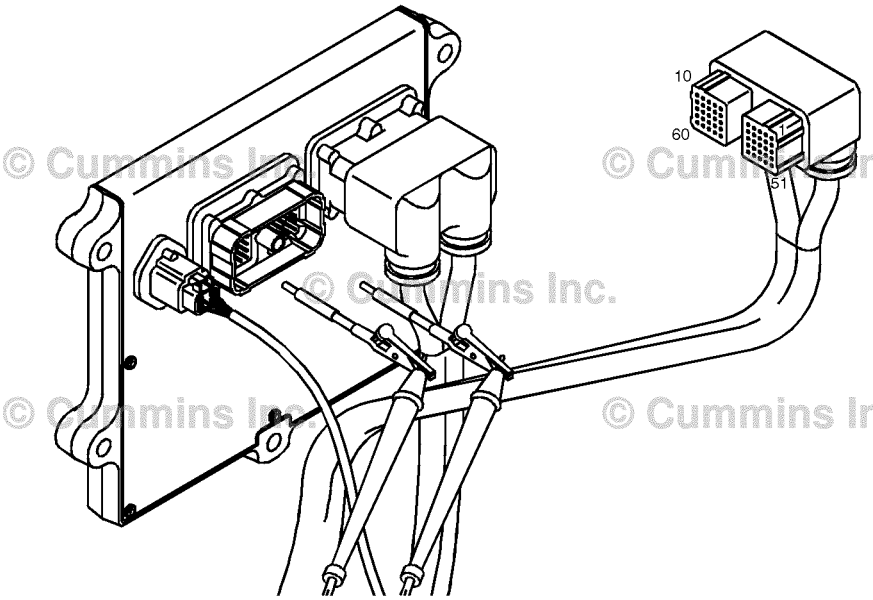
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Dirt or debris in or on the connector pins • Missing or damaged connector seals • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **NO**	3B-1

STEP 3B-1: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the engine control module engine connector.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the oil pressure +5 volt SUPPLY pin to the oil pressure RETURN pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	3B-2
	4.75-VDC to 5.25-VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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. • Use INSITE™ to read the fault codes.	Fault Code 135 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 135 inactive? **NO** **Repair:** An open RETURN circuit has been detected in the engine harness. 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 135 inactive? **YES**	4B
	Fault Code 135 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and rechecked.	1A

STEP 4B: Clear the inactive fault codes.

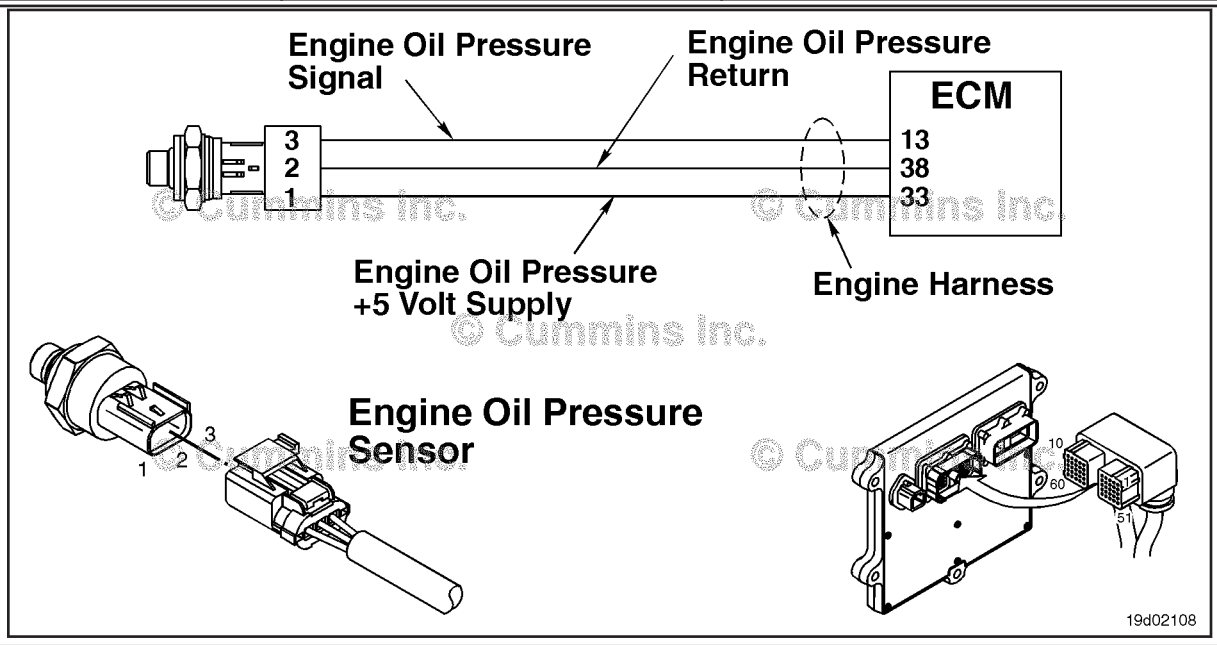
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 141 (Automotive Application)

Oil Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 141 PID(P), SID(S): P100 SPN: 100 FMI: 4/4 Lamp: Amber SRT:	Oil Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at the engine oil pressure circuit.	None on performance. No engine protection for oil pressure.



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. The ECM monitors the voltage on the signal pin and converts this to a pressure value.

Component Location:

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

Shop Talk:

The oil pressure 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 141, 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.

Refer to Troubleshooting Fault Code t05-141

FAULT CODE 141 (Automotive Application) - Oil 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 3164596 - male Framatome™ 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?**	
STEP 1B:	**Check for an inactive fault code.**	**Fault Code 141 inactive?**	
STEP 2:	**Check the oil pressure sensor and circuit.**		
STEP 2A:	**Inspect the oil 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 135 active and Fault Code 141 inactive?**	
STEP 2D:	**Check the fault codes and verify sensor condition.**	**Fault Code 141 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 active fault code.**	**Fault Code 141 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 135 active and Fault Code 141 inactive?**	
STEP 3B-2:	**Check for an active fault code.**	**Fault Code 141 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 141 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 352 active? **YES**	Refer to Fault Code 352
	Fault Code 352 active? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 141 inactive? **NO**	2A

STEP 2: Check the oil pressure sensor and circuit.

STEP 2A: Inspect the oil pressure sensor and connector pins.

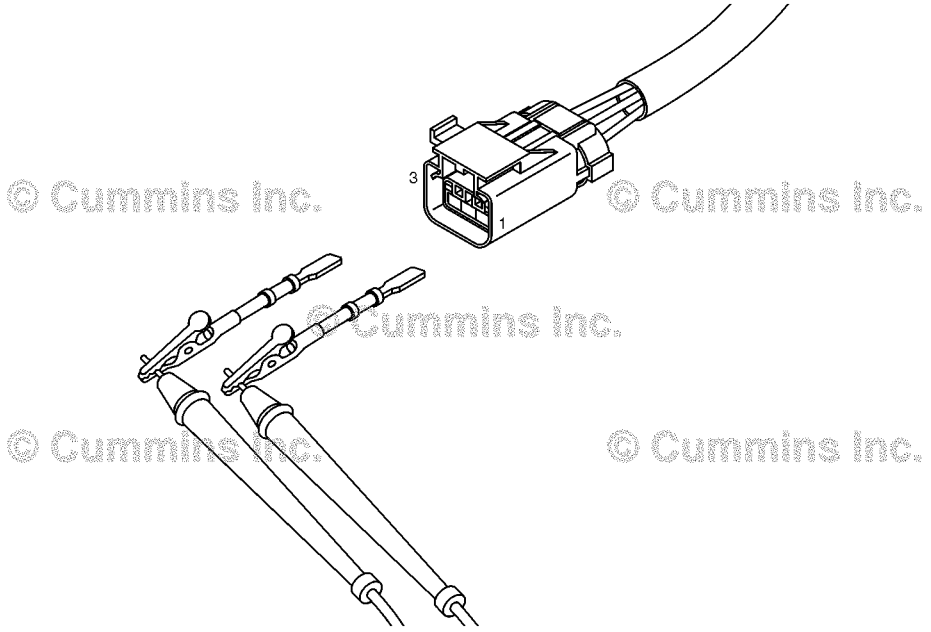
Condition:
- Turn keyswitch OFF.
- Disconnect the oil pressure sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and oil pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the oil pressure +5 volt SUPPLY pin to the oil pressure RETURN pin at the sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	2C
	4.75-VDC to 5.25-VDC? **NO**	3A



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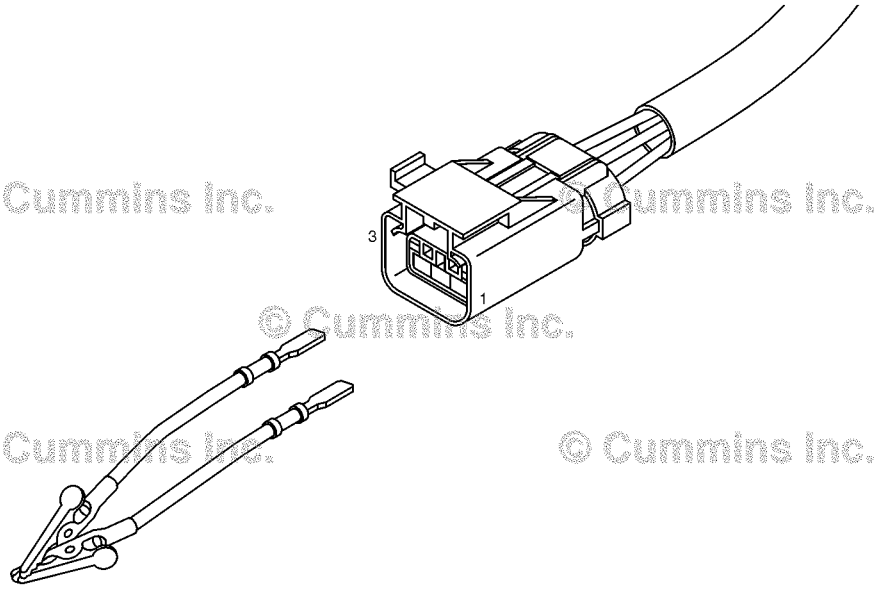
STEP 2C: Check the circuit response.

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

Action	Specification/Repair	Next Step
Check the circuit response. Place a jumper wire between the oil pressure +5 volt SUPPY pin and the oil pressure SIGNAL pin at the oil pressure sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification. Start and idle the engine for 1 minute with the oil temperature higher than 49°C [120°F]. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 active and Fault Code 141 inactive? **YES**	2D
	Fault Code 135 active and Fault Code 141 inactive? **NO**	3B



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

Condition:
- Turn keyswitch OFF.
- Connect the oil pressure sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 active? **YES** **Repair:** A damaged sensor has been detected. Replace the oil pressure sensor. Refer to Procedure 019-066 in Section 19.	4A
	Fault Code 141 active? **NO** **Repair:** 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.

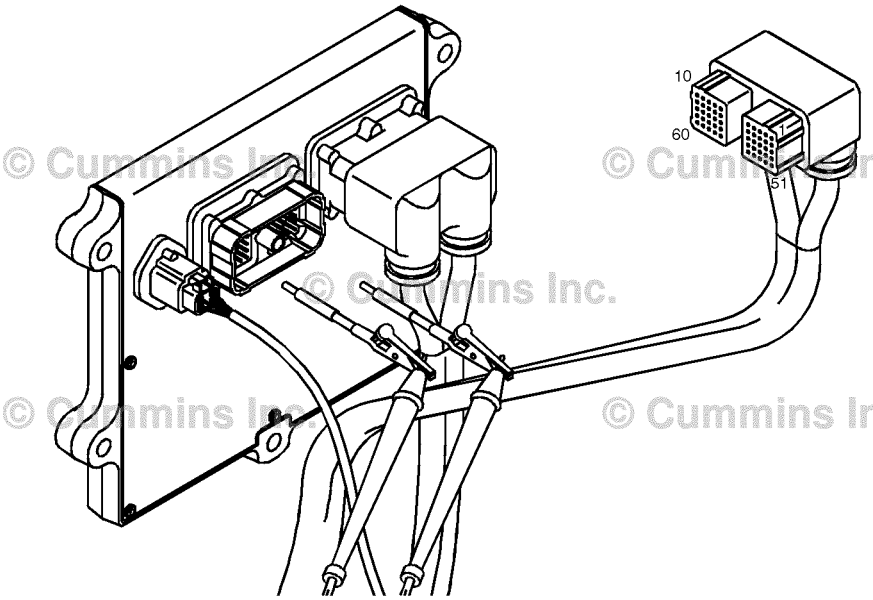
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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. • Measure the voltage from the oil pressure +5 volt SUPPLY pin to the oil pressure RETURN pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	3A-2
	4.75-VDC to 5.25-VDC? **NO** **Repair:** 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 for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 141 inactive? **NO** **Repair:** An open or shorted SUPPLY circuit has been detected in the engine harness. 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.

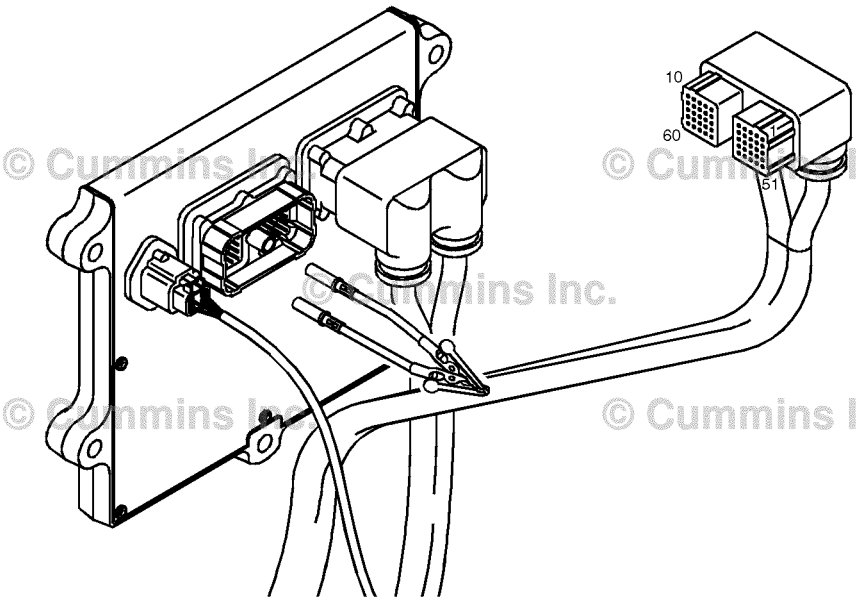
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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 ECM response. Place a jumper wire between the oil pressure +5 volt SUPPLY pin and the oil pressure SIGNAL pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification. Start and idle the engine for 1 minute with the oil temperature higher than 49°C [120°F]. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 active and Fault Code 141 inactive? **YES**	3B-2
	Fault Code 135 active and Fault Code 141 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 141 inactive? **NO** **Repair:** An open RETURN or a pin-to-pin short circuit has been detected on the signal line of the engine harness. 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 141 inactive? **YES**	4B
	Fault Code 141 inactive? **NO** **Repair:** 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.

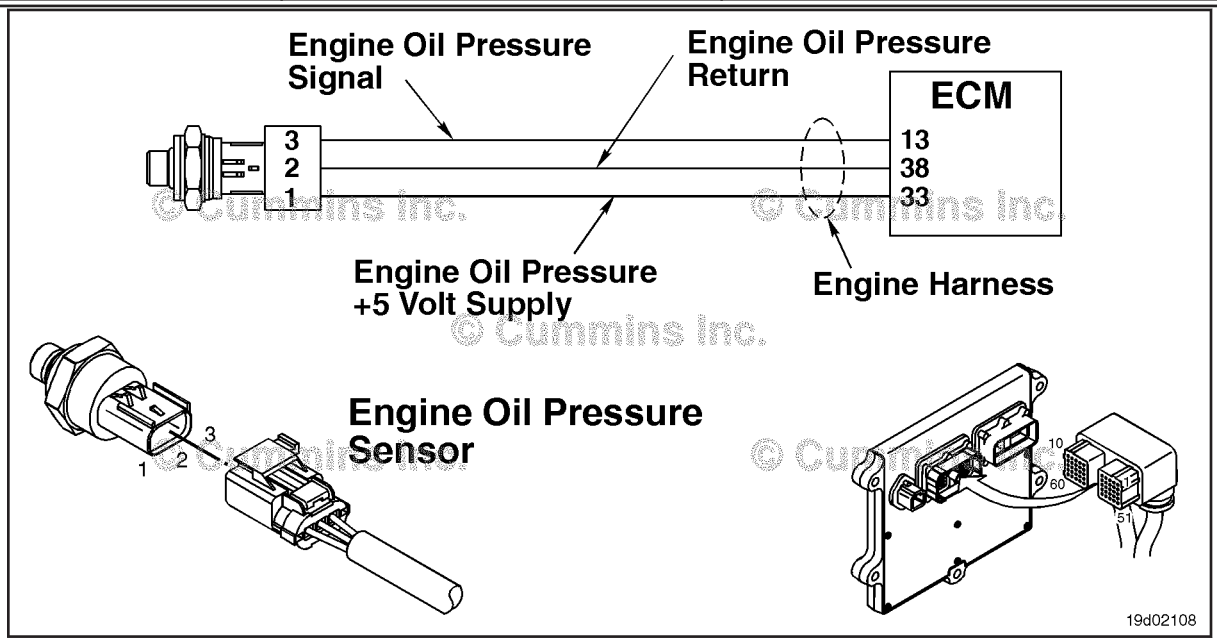
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 141 (Marine Applications)

Oil Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 141 PID(P), SID(S): P100 SPN: 100 FMI: 4/4 Lamp: Amber SRT:	Oil Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at the engine oil pressure circuit.	None. No engine protection for circuit or sensor failure.



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. The ECM monitors the voltage on the signal pin and converts this to a pressure value.

Component Location:

The engine oil pressure sensor is located on the left side of the engine block. Refer to Procedure 100-002 in Section E.

Shop Talk:

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.

Refer to Troubleshooting Fault Code t05-141

FAULT CODE 141 (Marine Applications) - Oil 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 3164596 - male Framatome™ 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 141 inactive?**	
STEP 2:	**Check the oil pressure sensor and circuit.**		
STEP 2A:	**Inspect the oil 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 135 active and Fault Code 141 inactive?**	
STEP 2D:	**Check the fault codes and verify sensor condition.**	**Fault Code 141 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 active fault code.**	**Fault Code 141 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 135 active and Fault Code 141 inactive?**	
STEP 3B-2:	**Check for an active fault code.**	**Fault Code 141 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 141 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. • Use INSITE™ to read the fault codes.	Fault Code 141 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 141 inactive? **NO**	2A

STEP 2: Check the oil pressure sensor and circuit.

STEP 2A: Inspect the oil pressure sensor and connector pins.

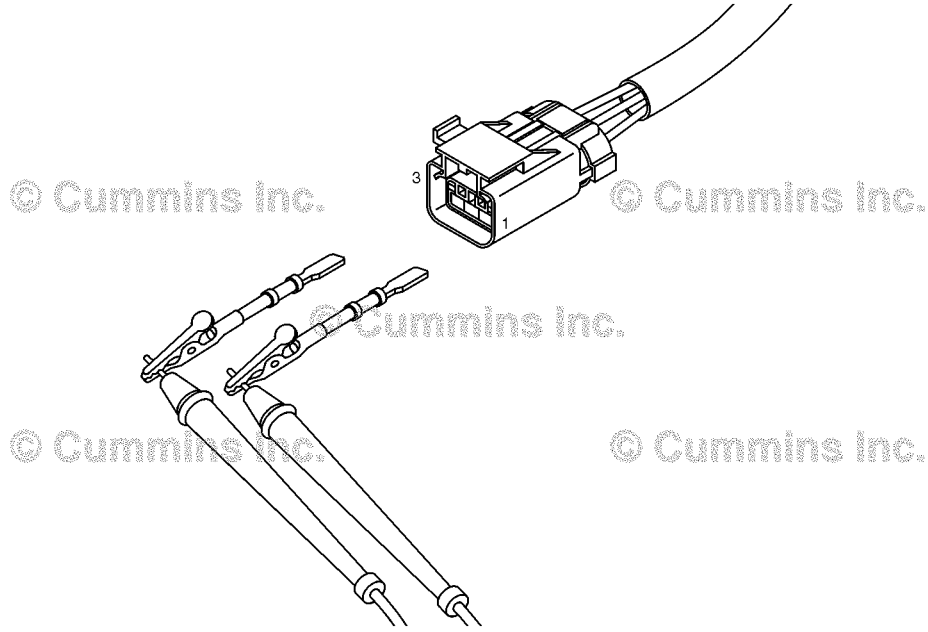
Condition:
- Turn keyswitch OFF.
- Disconnect the oil pressure sensor from the engine harness.

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

STEP 2B: Check the sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the oil pressure +5 volt SUPPLY pin to the oil pressure RETURN pin at the sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	2C
	4.75-VDC to 5.25-VDC? **NO**	3A



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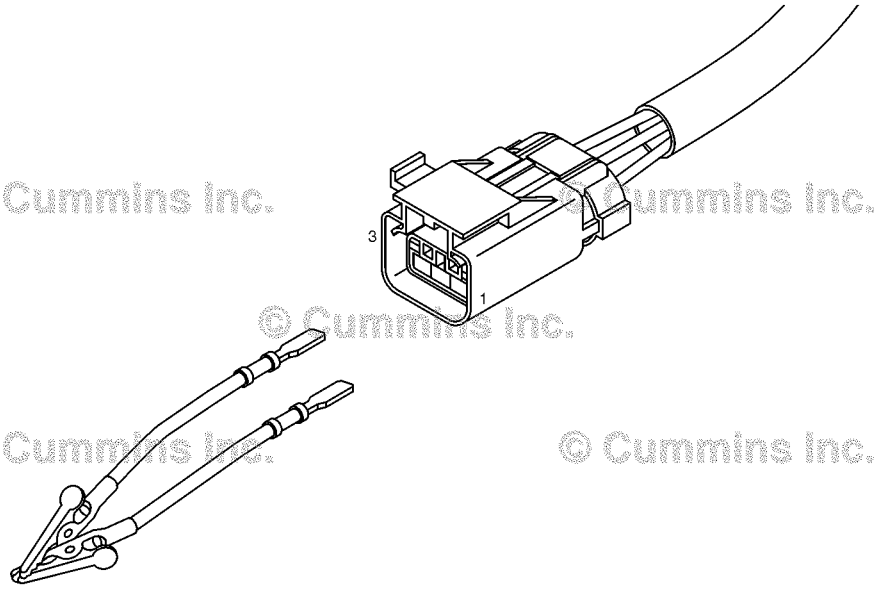
STEP 2C: Check the circuit response.

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

Action	Specification/Repair	Next Step
Check the circuit response. Place a jumper wire between the oil pressure +5 volt SUPPY pin and the oil pressure SIGNAL pin at the oil pressure sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification. Start and idle the engine for 1 minute with the oil temperature higher than 49°C [120°F]. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 active and Fault Code 141 inactive? **YES**	2D
	Fault Code 135 active and Fault Code 141 inactive? **NO**	3B



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

Condition:
- Turn keyswitch OFF.
- Connect the oil pressure sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 active? **YES** **Repair:** A damaged sensor has been detected. Replace the oil pressure sensor. Refer to Procedure 019-066 in Section 19.	4A
	Fault Code 141 active? **NO** **Repair:** 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.

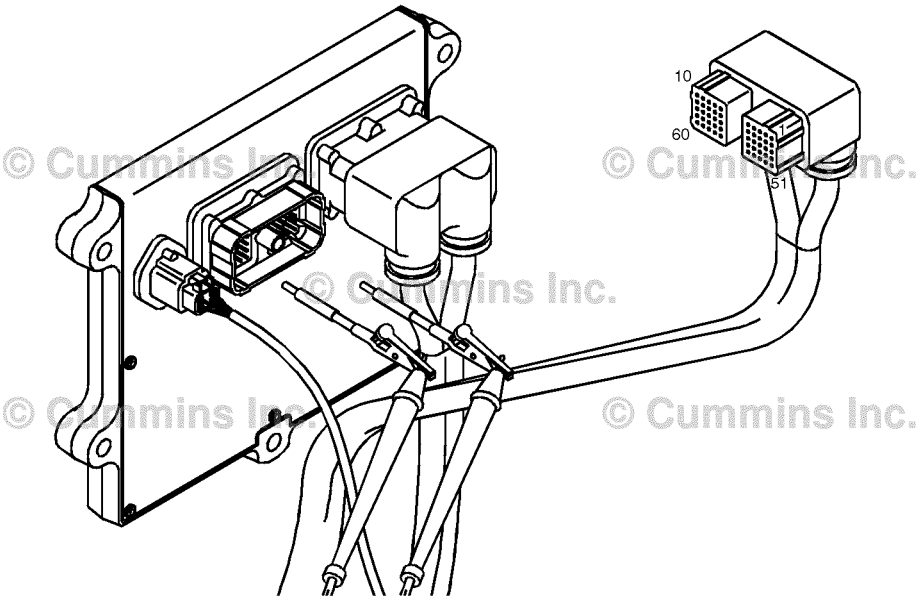
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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. • Measure the voltage from the oil pressure +5 volt SUPPLY pin to the oil pressure RETURN pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	3A-2
	4.75-VDC to 5.25-VDC? **NO** **Repair:** 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 for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 141 inactive? **NO** **Repair:** An open or shorted SUPPLY circuit has been detected in the engine harness. 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.

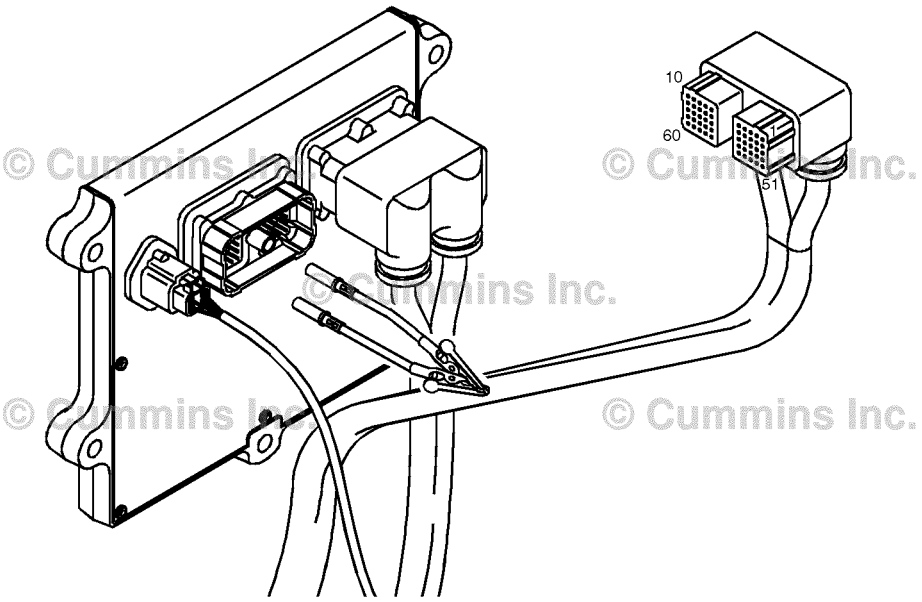
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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 ECM response. Place a jumper wire between the oil pressure +5 volt SUPPLY pin and the oil pressure SIGNAL pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification. Start and idle the engine for 1 minute with the oil temperature higher than 49°C [120°F]. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 active and Fault Code 141 inactive? **YES**	3B-2
	Fault Code 135 active and Fault Code 141 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 141 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the failure.	4A
	Fault Code 141 inactive? **NO** **Repair:** An open RETURN or a pin-to-pin short circuit has been detected on the signal line of the engine harness. 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 141 inactive? **YES**	4B
	Fault Code 141 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and rechecked.	1A

STEP 4B: Clear the inactive fault codes.

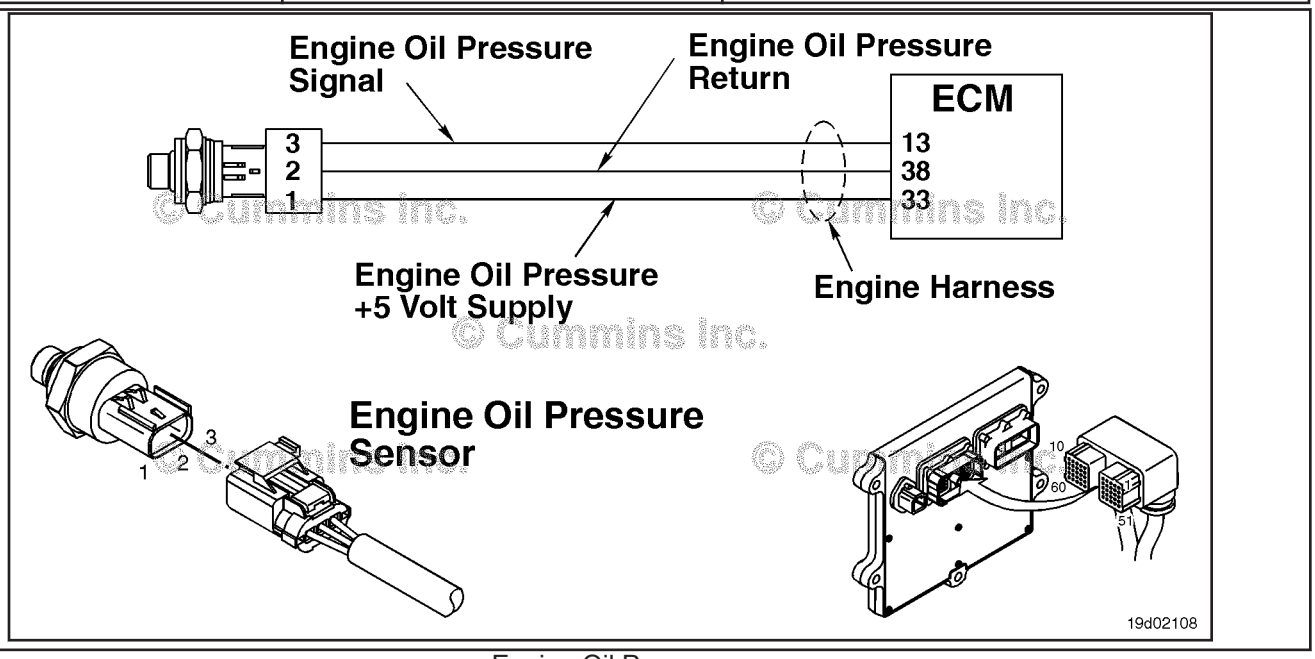
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 143 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine)

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

CODES	REASON	EFFECT
Fault Code: 143 PID(P), SID(S): P100 SPN: 100 FMI: 1/18 Lamp: Amber SRT:	Engine Oil Rifle Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level. Engine oil pressure signal indicates engine oil pressure is below the engine protection warning limit.	Automotive: None on performance. Marine: calibration dependent.



Engine Oil Pressure

Circuit Description:

The engine oil pressure sensor is used by the electronic control module (ECM) to monitor the lubricating oil pressure. The ECM monitors the voltage on the signal pin and converts this to a pressure value.

Component Location:

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

Refer to Troubleshooting Fault Code t05-143

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 143.	**Active or inactive counts of Fault Code 143?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 143.

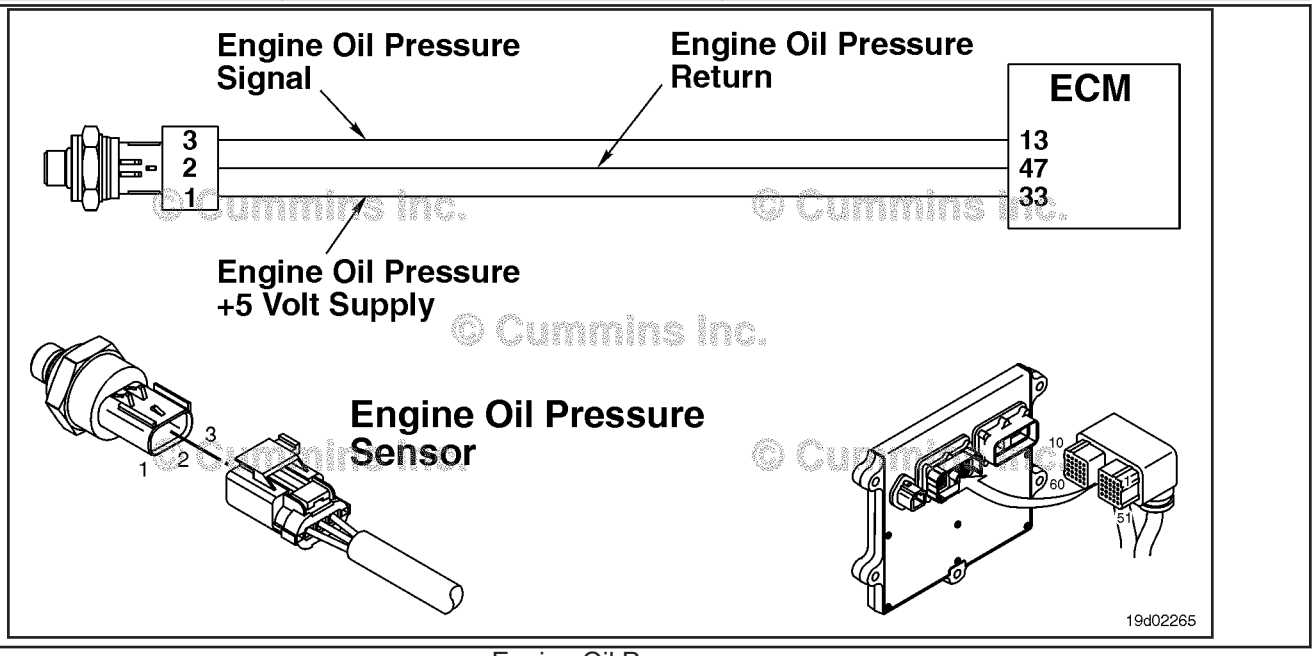
Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check the fault codes. • Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 143? **YES** **Repair:** Refer to the Lubricating Oil Pressure Below or Above Normal troubleshooting tree in Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418 or ISB^{e} and ISB (Common Rail Fuel System) Series Engines, Bulletin 4021271.	Appropriate troubleshooting symptom tree
	Active or inactive counts of Fault Code 143? **NO**	Repair complete

Fault Code 143 (QSB Marine Application)

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

CODES	REASON	EFFECT
Fault Code: 143 PID(P), SID(S): P100 SPN: 100 FMI: 1/18 Lamp: Amber SRT:	Engine Oil Rifle Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level. Engine oil pressure signal indicates engine oil pressure is below the engine protection warning limit.	Marine: calibration dependent.



Engine Oil Pressure

Circuit Description:

The engine oil pressure sensor is used by the electronic control module (ECM) to monitor the lubricating oil pressure. The ECM monitors the voltage on the signal pin and converts this to a pressure value.

Component Location:

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

Refer to Troubleshooting Fault Code t05-143

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 143.	**Active or inactive counts of Fault Code 143?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 143.

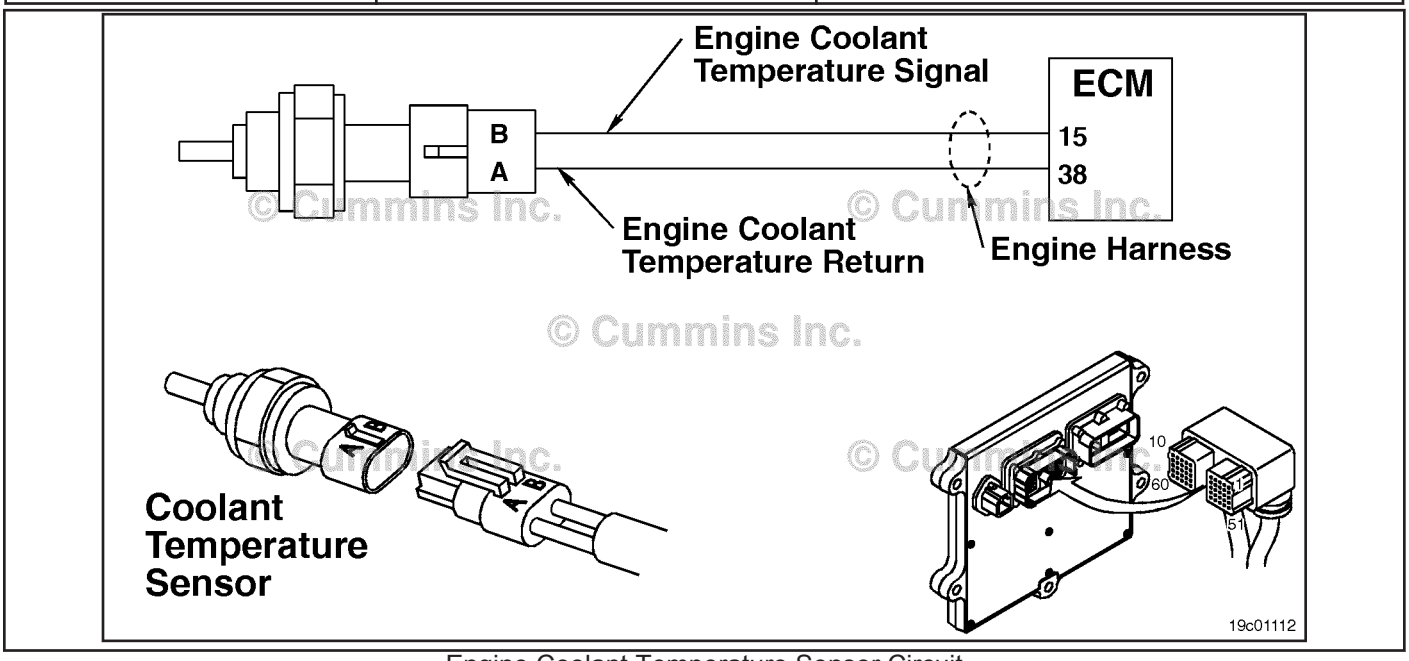
Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check the fault codes. • Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 143? **YES** **Repair:** Refer to the Lubricating Oil Pressure Below or Above Normal troubleshooting tree in Troubleshooting and Repair Manual, ISB^{e} and ISB (Common Rail Fuel System) Series Engines, Bulletin 4021271.	Appropriate troubleshooting symptom tree
	Active or inactive counts of Fault Code 143? **NO**	Repair complete

Fault Code 144 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine)

Engine Coolant Temperature 1 Sensor Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 144 PID(P), SID(S): P110 SPN: 110 FMI: 3/3 Lamp: Amber SRT:	Engine Coolant Temperature 1 Sensor Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage or open circuit detected at engine coolant temperature circuit.	Automotive: Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for engine coolant temperature. Marine: None, no engine protection for circuit or sensor failure.



Engine Coolant Temperature Sensor Circuit

Circuit Description:

The engine coolant temperature sensor is used by the electronic control module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is used by the ECM for the engine protection system, and engine emissions control.

Component Location:

The engine coolant temperature sensor is located on the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

Before troubleshooting Fault Code 144, check for multiple faults.

The engine coolant temperature sensor shares return wires in the engine harness with other sensors. An open 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.

Temperature (°C)	Temperature (°F)	Resistance (ohms)
0	32	30k to 37k
25	77	9.3k to 10.7k
50	122	3.2k to 3.8k
80	176	1.0k to 1.3k
95	203	700 to 800

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 t05-144

FAULT CODE 144 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine) - Engine Coolant Temperature 1 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 - Deutsch/AMP/Metri-Pack test lead and Part Number 3822917 - 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 144 inactive?**	
STEP 2:	**Check the engine coolant temperature sensor and circuit.**		
STEP 2A:	**Inspect the engine coolant temperature sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the sensor resistance.**	**180 ohms to 160k ohms?**	
STEP 2C:	**Check the fault codes and verify sensor condition.**	**Fault Code 144 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 145 active and Fault Code 144 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 144 inactive?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 144 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 144 inactive? **NO**	2A

STEP 2: Check the engine coolant temperature sensor and circuit.

STEP 2A: Inspect the engine coolant temperature sensor and connector pins.

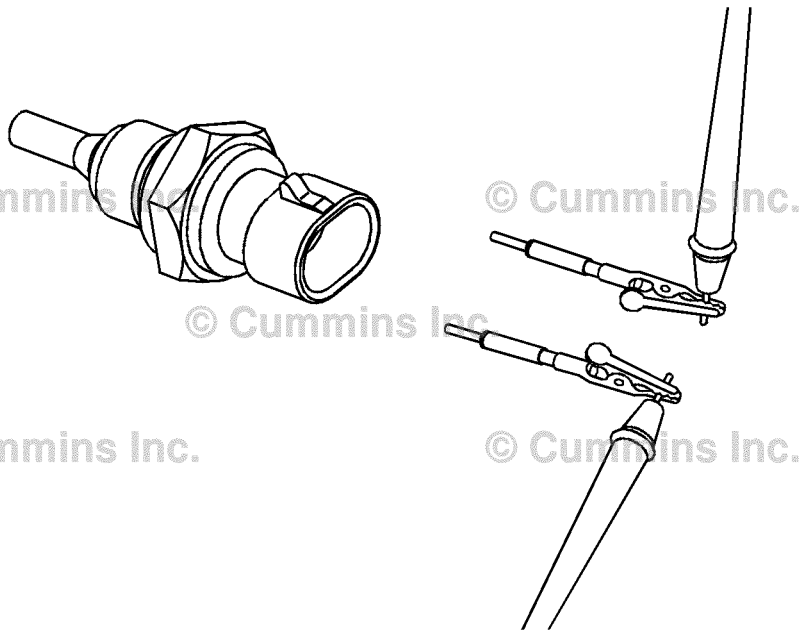
Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant temperature sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broke • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the sensor resistance.

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

Action	Specification/Repair	Next Step
Check the sensor resistance. • Measure the resistance between the engine coolant temperature sensor SIGNAL pin and engine coolant temperature sensor RETURN pin at the engine coolant temperature sensor. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	180 ohms to 160k ohms? **YES**	2C
	180 ohms to 160k ohms? **NO** **Repair:** Replace the engine coolant temperature sensor. Refer to Procedure 019-019 in Section 19.	4A



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

Condition:
- Turn keyswitch OFF.
- Connect the coolant 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 is active? **YES**	3A
	Fault Code 144 is active? **NO** **Repair:** 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.

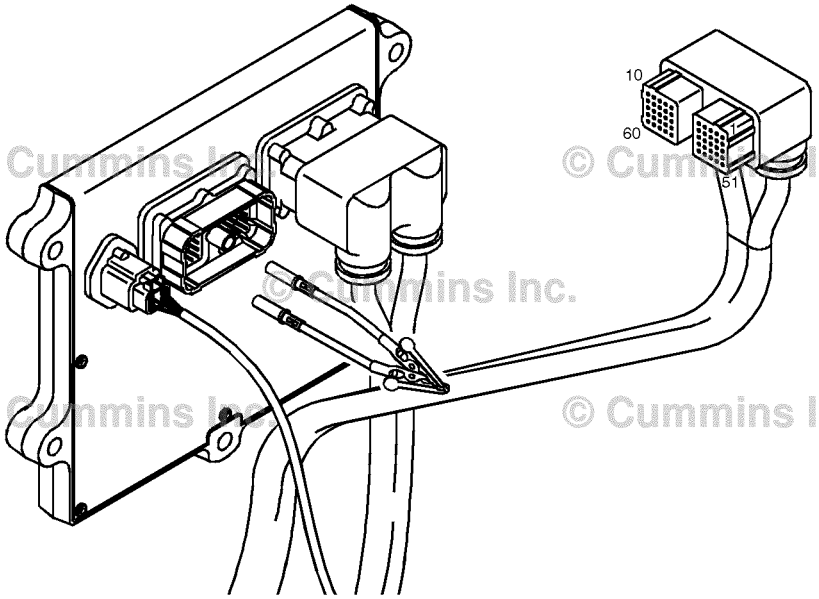
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell shroud broke • Damaged locking tab connector • Damage to wire or engine harness insulation. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or the engine harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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 coolant temperature sensor SIGNAL pin and coolant temperature sensor RETURN pin at the ECM connector. • Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes. Refer to the circuit diagram or wiring diagram for connector pin identification.	Fault Code 145 active and Fault Code 144 inactive? **YES**	3C
	Fault Code 145 active and Fault Code 144 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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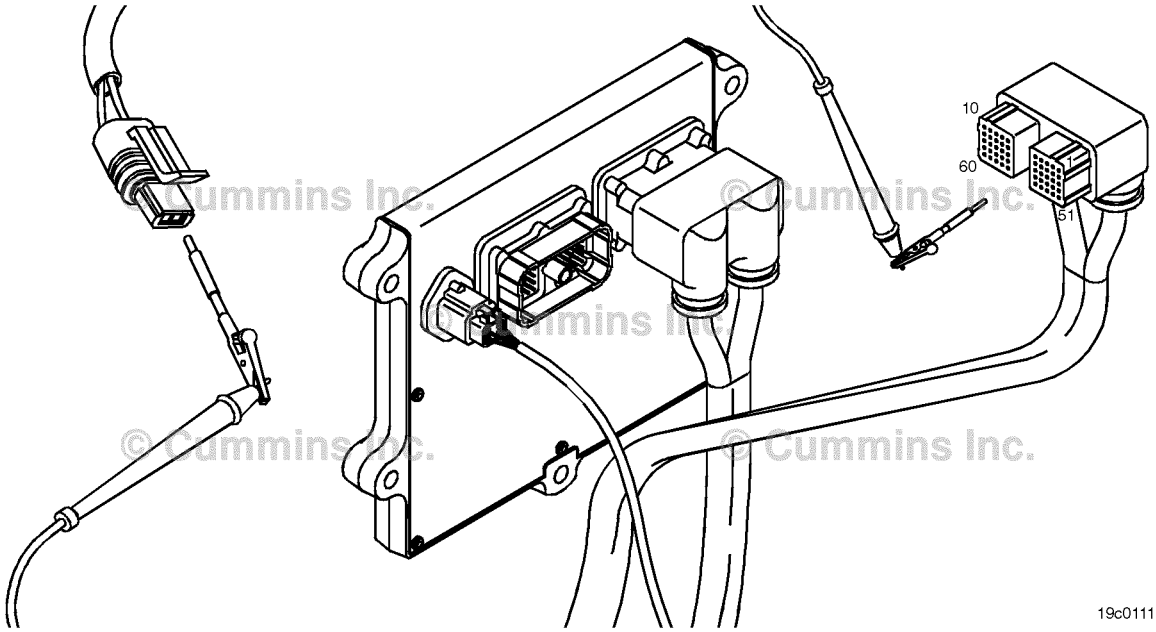
STEP 3C: Check for an open circuit in the engine harness.

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

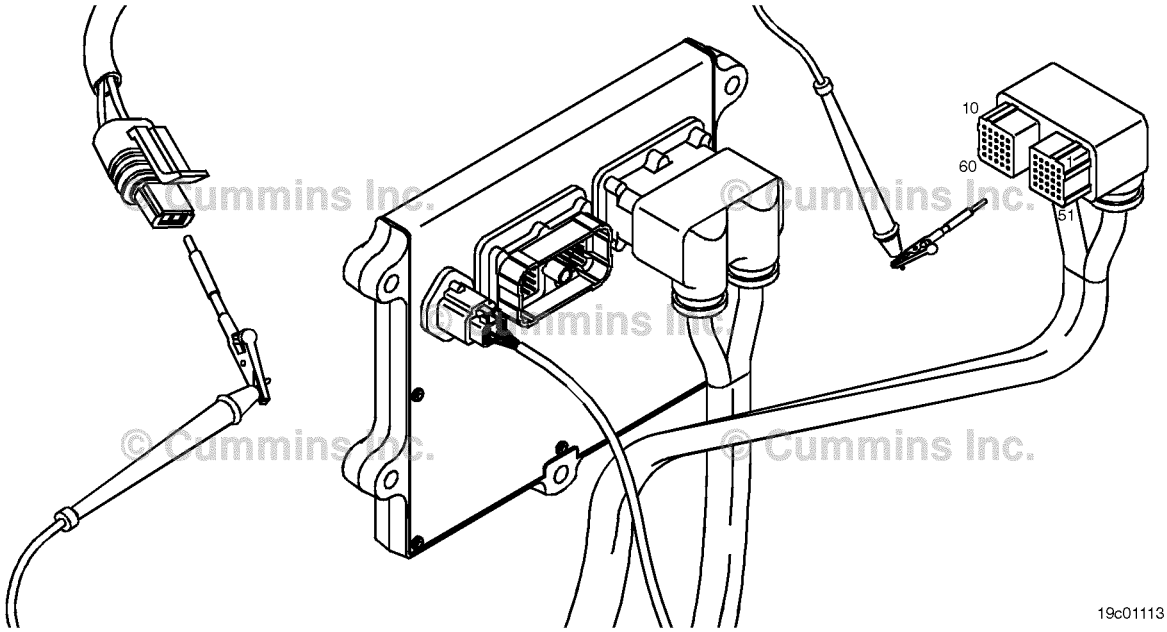
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the engine harness ECM connector engine coolant temperature sensor RETURN pin and the engine harness engine coolant temperature sensor connector RETURN pin. Refer to the circuit diagram or wiring diagram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

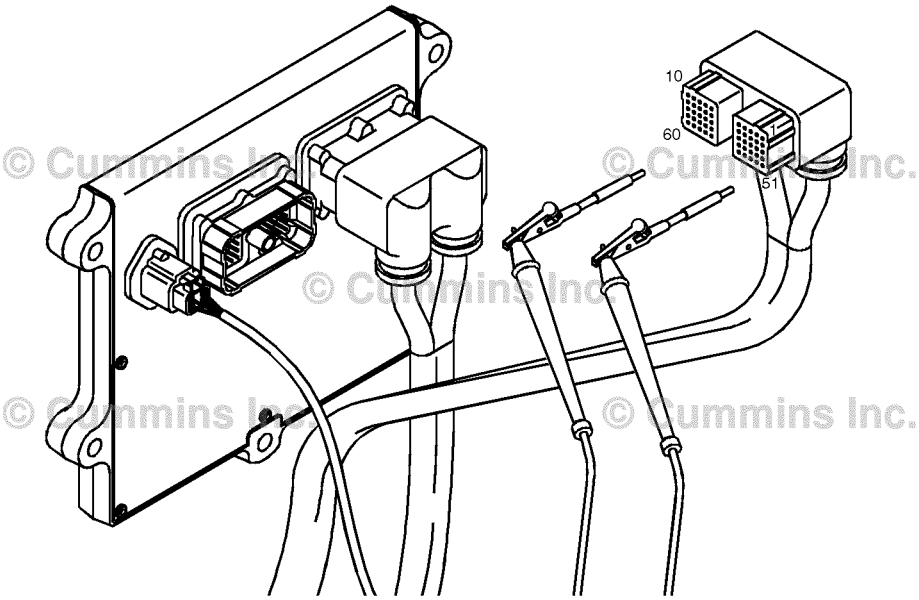
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the engine harness ECM connector engine coolant temperature sensor SIGNAL pin and the engine harness engine coolant temperature sensor connector SIGNAL pin. Refer to the circuit diagram or wiring diagram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

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the engine coolant temperature sensor SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 144 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 144 inactive? **YES**	4B
	Fault Code 144 inactive? **NO** **Repair:** 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.

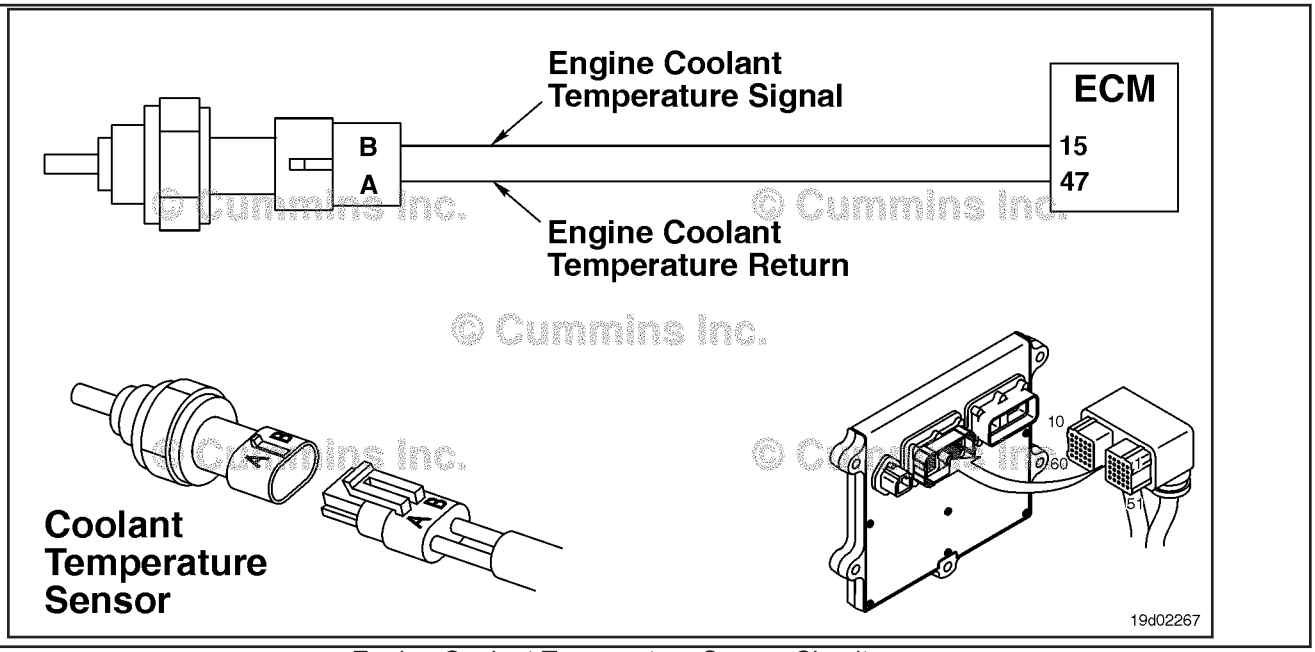
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 144 (QSB Marine Application)

Engine Coolant Temperature 1 Sensor Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 144 PID(P), SID(S): P110 SPN: 110 FMI: 3/3 Lamp: Amber SRT:	Engine Coolant Temperature 1 Sensor Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage or open circuit detected at engine coolant temperature circuit.	Marine: None, no engine protection for circuit or sensor failure.



Engine Coolant Temperature Sensor Circuit

Circuit Description:

The engine coolant temperature sensor is used by the electronic control module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is used by the ECM for the engine protection system, and engine emissions control.

Component Location:

The engine coolant temperature sensor is located on the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

Before troubleshooting Fault Code 144, check for multiple faults.

The engine coolant temperature sensor shares return wires in the engine harness with other sensors. An open 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.

Temperature (°C)	Temperature (°F)	Resistance (ohms)

0	32	30k to 37k
25	77	9.3k to 10.7k
50	122	3.2k to 3.8k
80	176	1.0k to 1.3k
95	203	700 to 800

Refer to Troubleshooting Fault Code t05-144

FAULT CODE 144 (QSB Marine Application) - Engine Coolant Temperature 1 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 - Deutsch/AMP/Metri-Pack test lead and Part Number 3822917 - 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 144 inactive?	
STEP 2:	**Check the engine coolant temperature sensor and circuit.**		
STEP 2A:	Inspect the engine coolant temperature sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the sensor resistance.	180 ohms to 160k ohms?	
STEP 2C:	Check the fault codes and verify sensor condition.	Fault Code 144 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 145 active and Fault Code 144 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 144 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 144 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 144 inactive? **NO**	2A

STEP 2: Check the engine coolant temperature sensor and circuit.

STEP 2A: Inspect the engine coolant temperature sensor and connector pins.

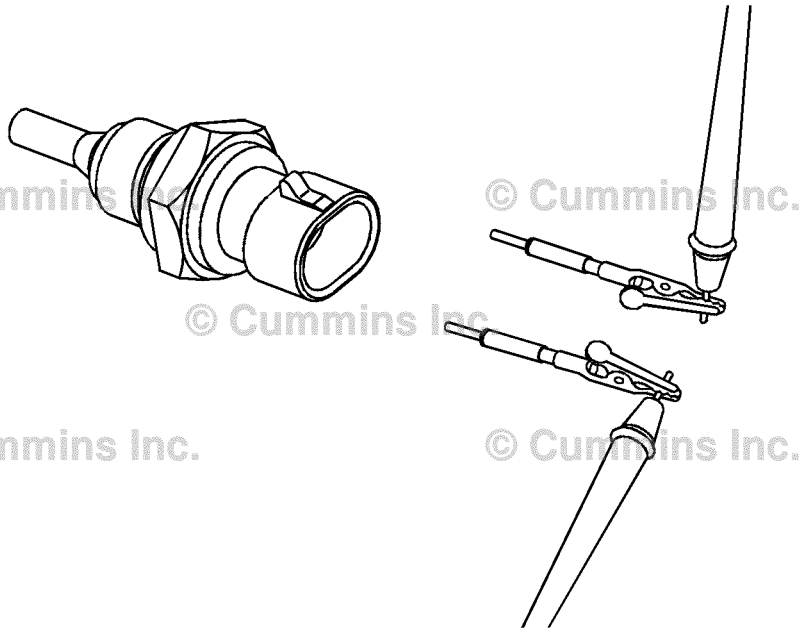
Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant temperature sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broke • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the sensor resistance.

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

Action	Specification/Repair	Next Step
Check the sensor resistance. • Measure the resistance between the engine coolant temperature sensor SIGNAL pin and engine coolant temperature sensor RETURN pin at the engine coolant temperature sensor. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	180 ohms to 160k ohms? **YES**	2C
	180 ohms to 160k ohms? **NO** **Repair:** Replace the engine coolant temperature sensor. Refer to Procedure 019-019 in Section 19.	4A



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

Condition:
- Turn keyswitch OFF.
- Connect the coolant 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 is active? **YES**	3A
	Fault Code 144 is active? **NO** **Repair:** 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.

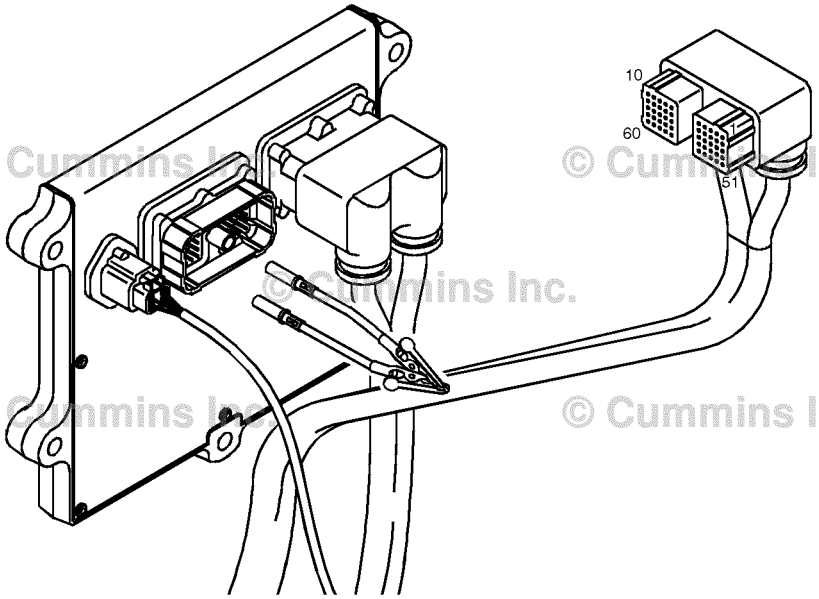
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell shroud broke • Damaged locking tab connector • Damage to wire or engine harness insulation. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or the engine harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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 coolant temperature sensor SIGNAL pin and coolant temperature sensor RETURN pin at the ECM connector. • Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes. Refer to the circuit diagram or wiring diagram for connector pin identification.	Fault Code 145 active and Fault Code 144 inactive? **YES**	3C
	Fault Code 145 active and Fault Code 144 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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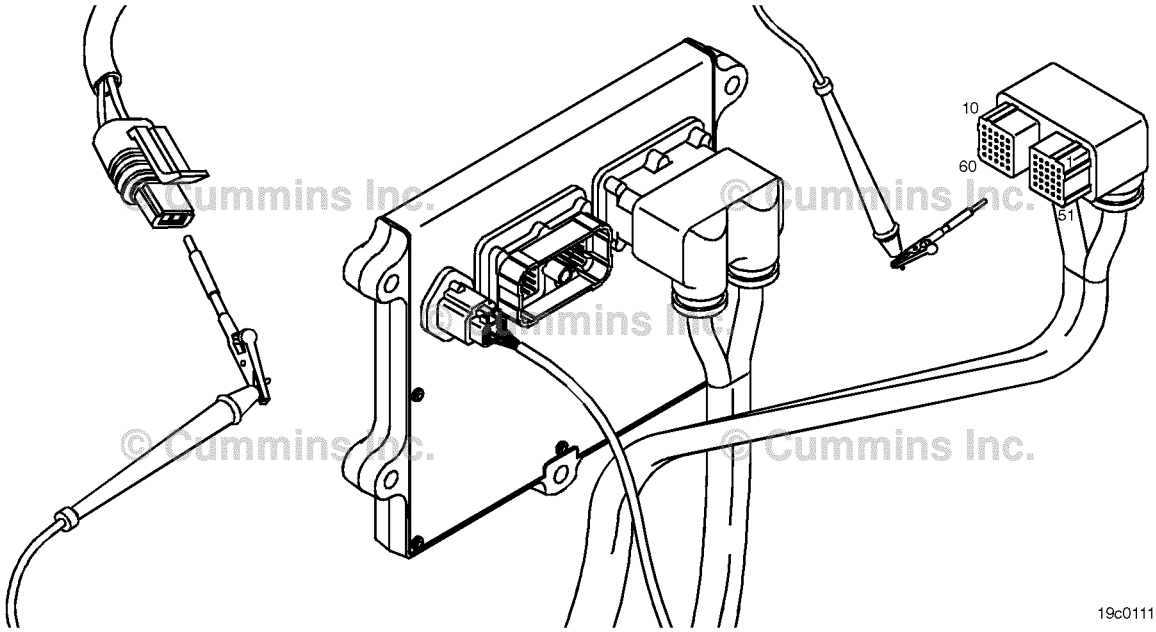
STEP 3C: Check for an open circuit in the engine harness.

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

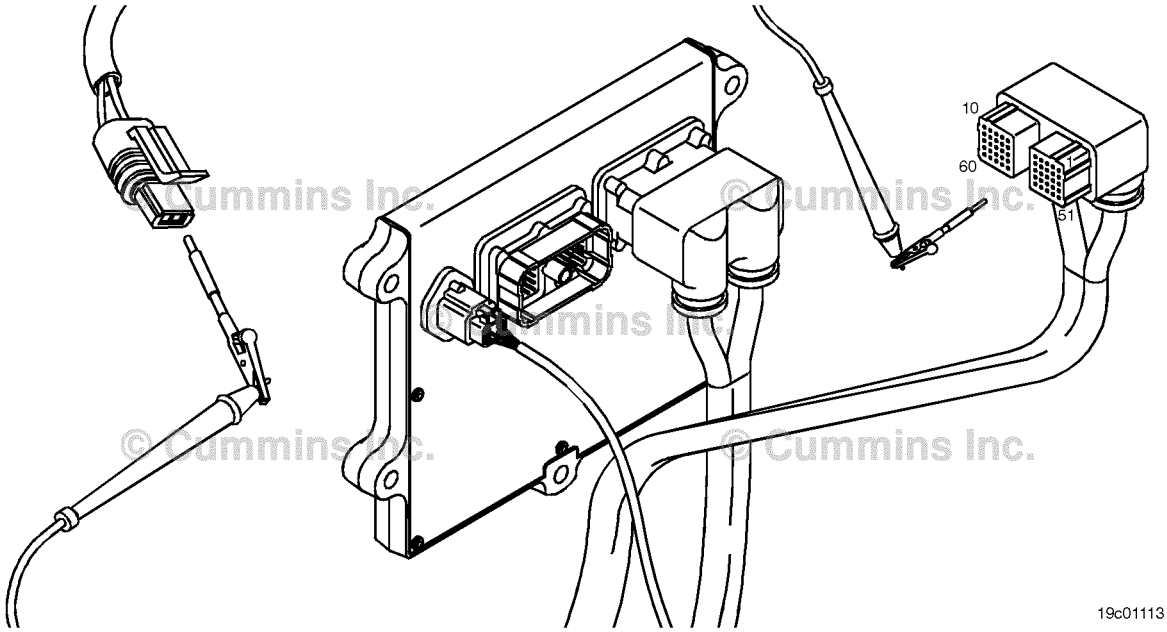
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the engine harness ECM connector engine coolant temperature sensor RETURN pin and the engine harness engine coolant temperature sensor connector RETURN pin. Refer to the circuit diagram or wiring diagram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

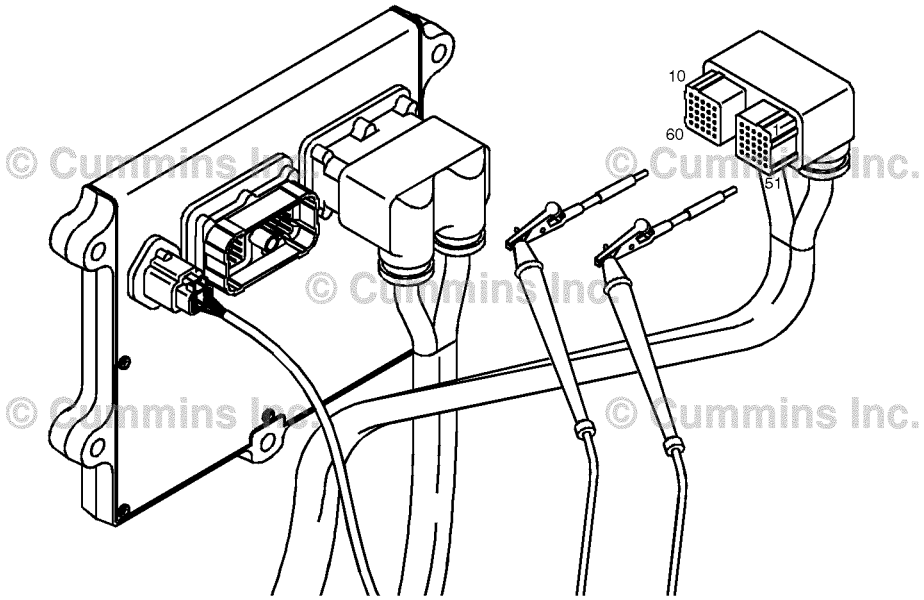
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the engine harness ECM connector engine coolant temperature sensor SIGNAL pin and the engine harness engine coolant temperature sensor connector SIGNAL pin. Refer to the circuit diagram or wiring diagram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

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the engine coolant temperature sensor SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 144 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 144 inactive? **YES**	4B
	Fault Code 144 inactive? **NO** **Repair:** 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.

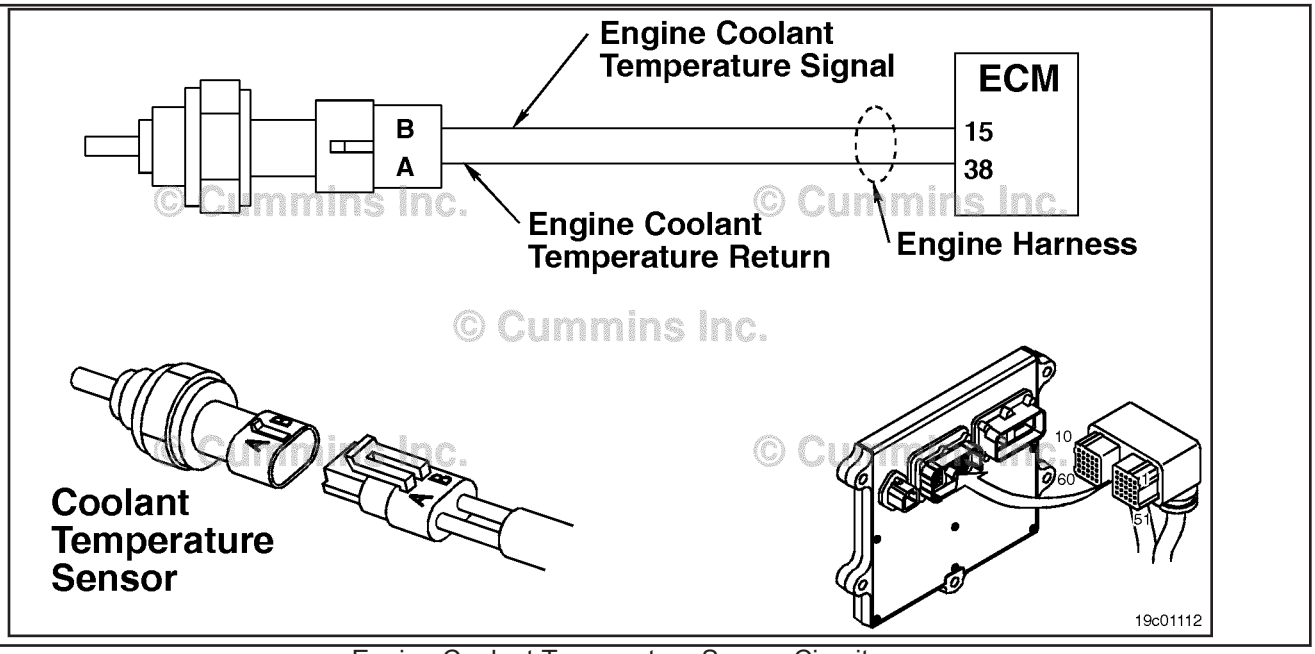
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 145 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine)

Engine Coolant Temperature 1 Sensor Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 145 PID(P), SID(S): P110 SPN: 110 FMI: 4/4 Lamp: Amber SRT:	Engine Coolant Temperature 1 Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at engine coolant temperature circuit.	Automotive: Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for engine coolant temperature. Marine: calibration dependent.



Engine Coolant Temperature Sensor Circuit

Circuit Description:

The engine coolant temperature sensor is used by the electronic control module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is used by the ECM for the engine protection system and engine emissions control.

Component Location:

The engine coolant temperature sensor is located on the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

The engine coolant temperature sensor shares return wires in the engine harness with other sensors. A shorted return can cause multiple fault codes to be active. Before troubleshooting Fault Code 145, check for multiple fault codes.

Possible causes of this fault code include:

- Signal shorted to ground in the harness.
- Signal shorted to return or ground in the sensor.

Temperature (°C)	Temperature (°F)	Resistance (ohms)

0	32	30k to 37k
25	77	9.3k to 10.7k
50	122	3.2k to 3.8k
80	176	1.0k to 1.3k
95	203	700 to 800

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 t05-145

FAULT CODE 145 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine) - Engine Coolant Temperature 1 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 145 inactive?	
STEP 2:	**Check the engine coolant temperature sensor and circuit.**		
STEP 2A:	Inspect the engine coolant temperature sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the circuit response.	Fault Code 144 active and Fault Code 145 inactive?	
STEP 2C:	Check the fault codes and verify sensor condition.	Fault Code 145 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 144 active and Fault Code 145 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 145 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 145 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 145 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 145 inactive? **NO**	2A

STEP 2: Check the engine coolant temperature sensor and circuit.

STEP 2A: Inspect the engine coolant temperature sensor and connector pins.

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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broke • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 active and Fault Code 145 inactive? **YES**	2C
	Fault Code 144 active and Fault Code 145 inactive? **NO**	3A

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

Condition:
- Turn keyswitch OFF.
- Connect the engine coolant 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 145 is active? **YES** **Repair:** A damaged sensor has been detected. Replace the engine coolant temperature sensor. Refer to Procedure 019-019 in Section 19.	4A
	Fault Code 145 active? **NO** **Repair:** 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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broke • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the harness connector. Clean the connector and pins. 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? **NO**	3B

STEP 3B: Check the ECM response.

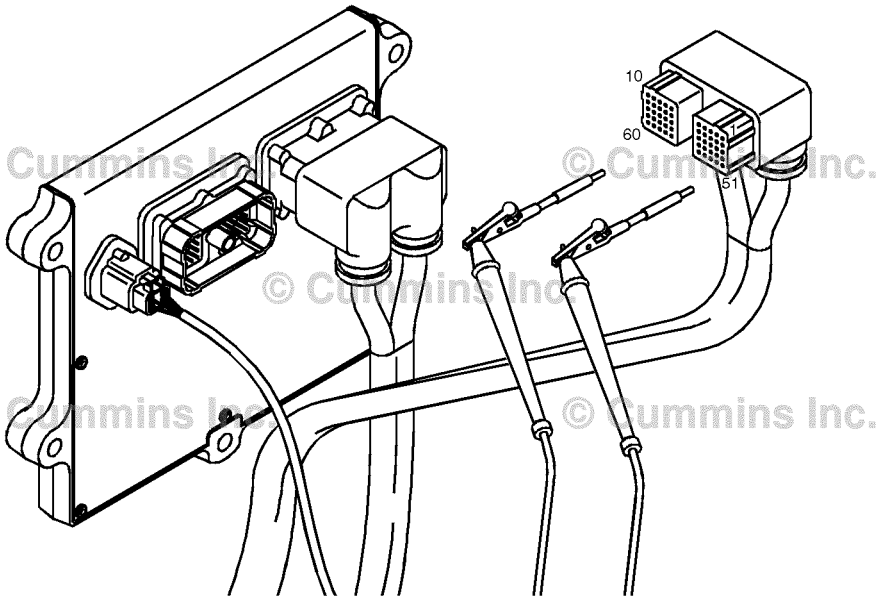
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 active and Fault Code 145 inactive? **YES**	3C
	Fault Code 144 active and Fault Code 145 inactive? **NO** **Repair:** 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 engine coolant temperature sensor from the engine harness.

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



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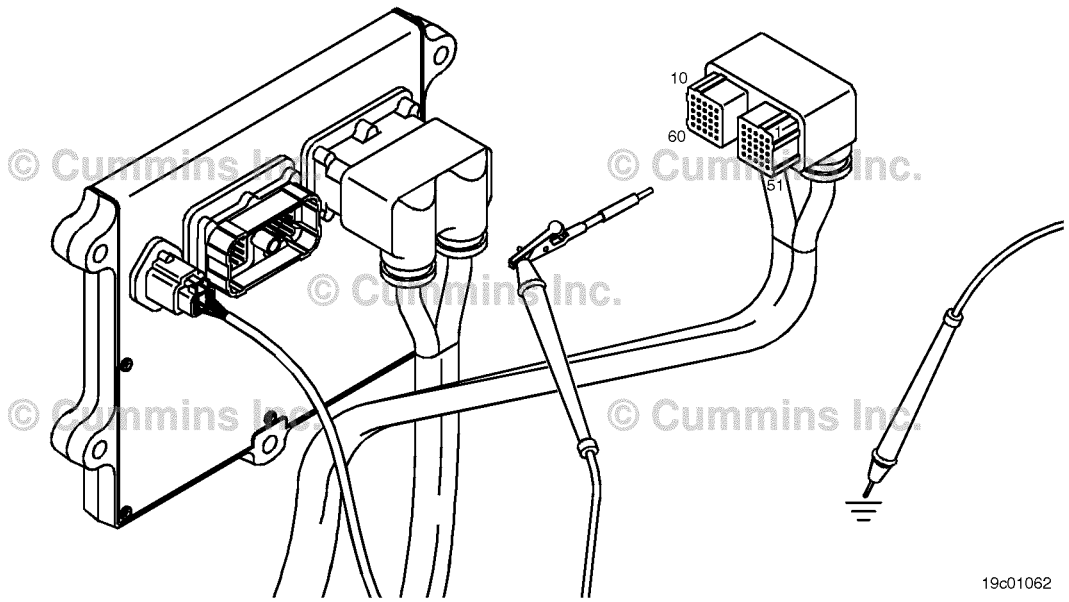
STEP 3D: Check for a pin short circuit to ground.

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

Action	Specification/Repair	Next Step
Check for a pin to ground short. • Measure the resistance between the engine coolant temperature sensor SIGNAL pin in the engine harness ECM connector and ground. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** A pin to ground short circuit on the SIGNAL line has been detected in the engine harness. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 145 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 145 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 145 inactive? **YES**	4B
	Fault Code 145 inactive? **NO** **Repair:** 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.

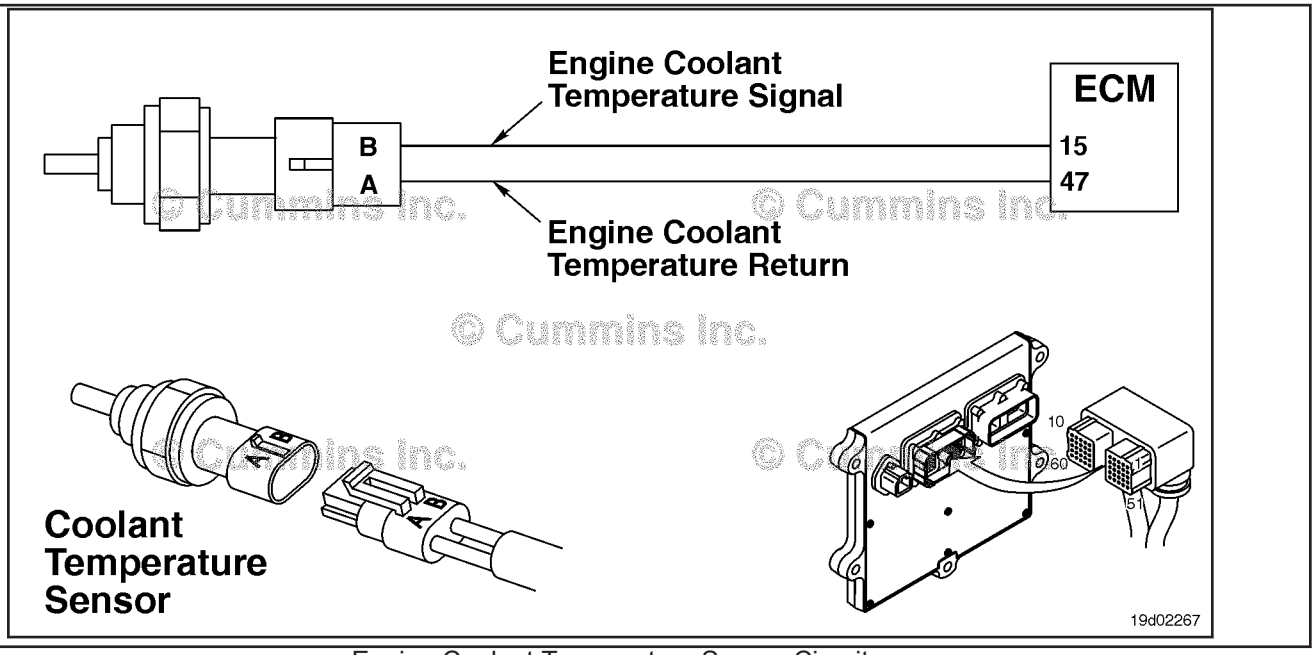
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 145 (QSB Marine Application)

Engine Coolant Temperature 1 Sensor Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 145 PID(P), SID(S): P110 SPN: 110 FMI: 4/4 Lamp: Amber SRT:	Engine Coolant Temperature 1 Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at engine coolant temperature circuit.	Marine: calibration dependent.



Engine Coolant Temperature Sensor Circuit

Circuit Description:

The engine coolant temperature sensor is used by the electronic control module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is used by the ECM for the engine protection system and engine emissions control.

Component Location:

The engine coolant temperature sensor is located on the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

The engine coolant temperature sensor shares return wires in the engine harness with other sensors. A shorted return can cause multiple fault codes to be active. Before troubleshooting Fault Code 145, check for multiple fault codes.

Possible causes of this fault code include:

- Signal shorted to ground in the harness.
- Signal shorted to return or ground in the sensor.

Temperature (°C)	Temperature (°F)	Resistance (ohms)
0	32	30k to 37k

25	77	9.3k to 10.7k
50	122	3.2k to 3.8k
80	176	1.0k to 1.3k
95	203	700 to 800

Refer to Troubleshooting Fault Code t05-145

FAULT CODE 145 (QSB Marine Application) - Engine Coolant Temperature 1 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 145 inactive?	
STEP 2:	**Check the engine coolant temperature sensor and circuit.**		
STEP 2A:	Inspect the engine coolant temperature sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the circuit response.	Fault Code 144 active and Fault Code 145 inactive?	
STEP 2C:	Check the fault codes and verify sensor condition.	Fault Code 145 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 144 active and Fault Code 145 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 145 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 145 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 145 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 145 inactive? **NO**	2A

STEP 2: Check the engine coolant temperature sensor and circuit.

STEP 2A: Inspect the engine coolant temperature sensor and connector pins.

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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broke • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 active and Fault Code 145 inactive? **YES**	2C
	Fault Code 144 active and Fault Code 145 inactive? **NO**	3A

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

Condition:
- Turn keyswitch OFF.
- Connect the engine coolant 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 145 is active? **YES** **Repair:** A damaged sensor has been detected. Replace the engine coolant temperature sensor. Refer to Procedure 019-019 in Section 19.	4A
	Fault Code 145 active? **NO** **Repair:** 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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broke • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the harness connector. Clean the connector and pins. 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? **NO**	3B

STEP 3B: Check the ECM response.

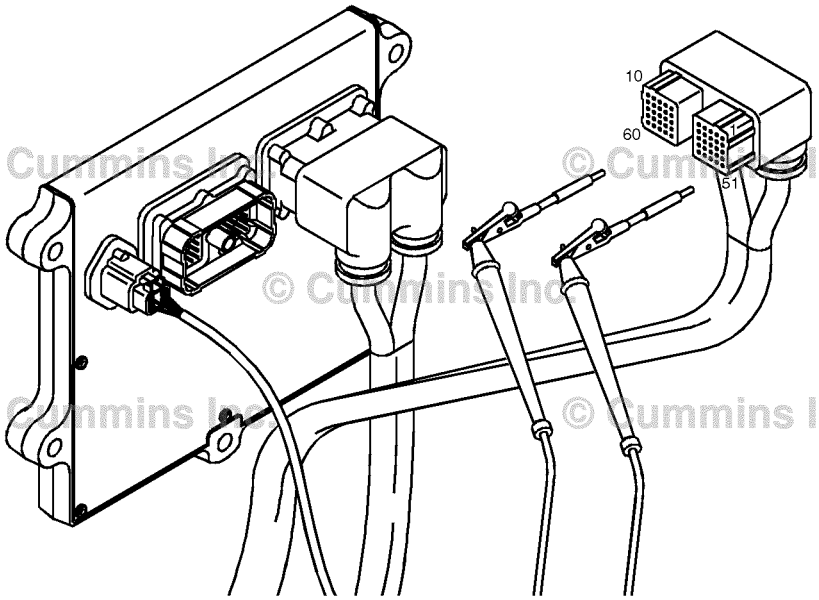
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 active and Fault Code 145 inactive? **YES**	3C
	Fault Code 144 active and Fault Code 145 inactive? **NO** **Repair:** 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 engine coolant temperature sensor from the engine harness.

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



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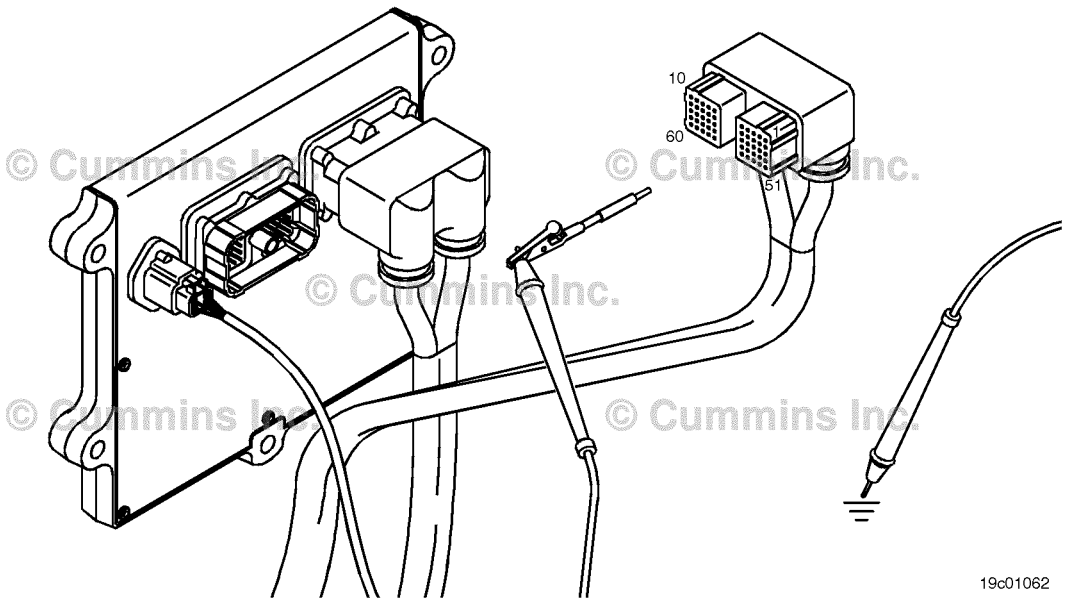
STEP 3D: Check for a pin short circuit to ground.

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

Action	Specification/Repair	Next Step
Check for a pin to ground short. • Measure the resistance between the engine coolant temperature sensor SIGNAL pin in the engine harness ECM connector and ground. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** A pin to ground short circuit on the SIGNAL line has been detected in the engine harness. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 145 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 145 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 145 inactive? **YES**	4B
	Fault Code 145 inactive? **NO** **Repair:** 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.

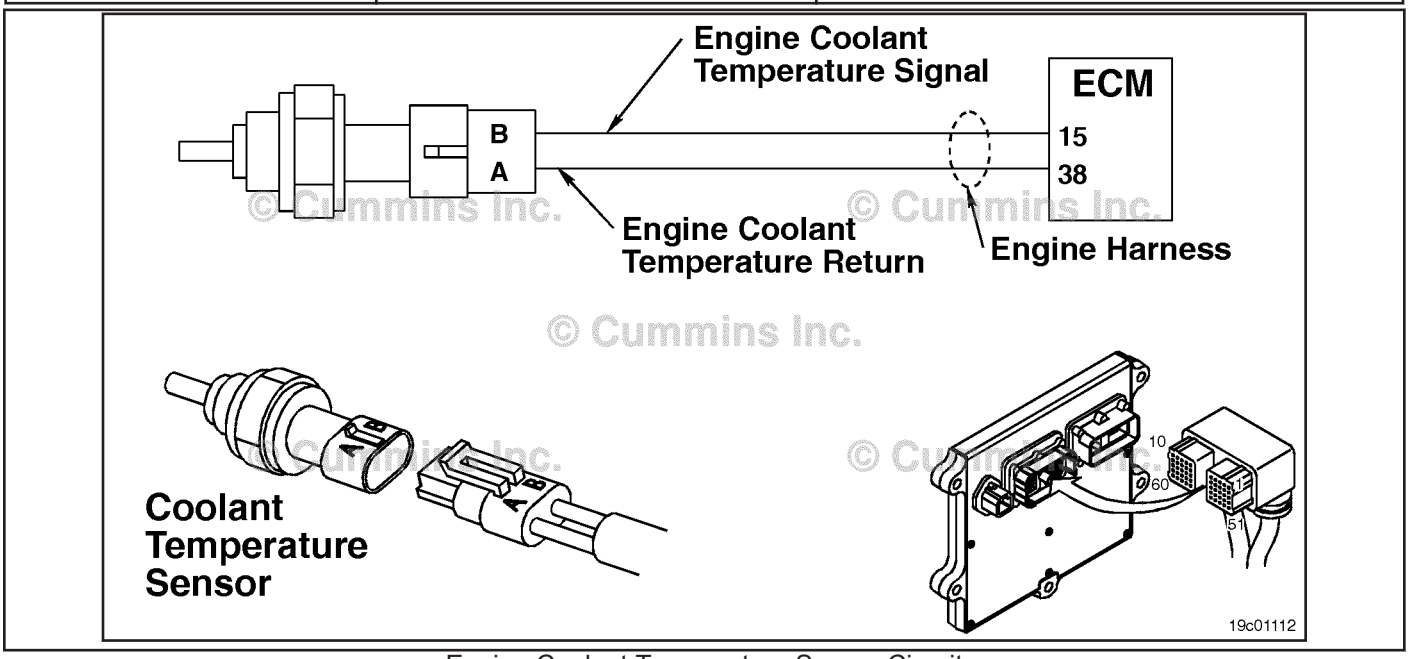
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 146 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine)

Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level

CODES	REASON	EFFECT
Fault Code: 146 PID(P), SID(S): P110 SPN: 110 FMI: 0/16 Lamp: Amber SRT:	Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level. Engine coolant temperature signal indicates engine coolant temperature is above engine protection warning limit.	Automotive: Progressive power derate increasing in severity from time of alert. Marine: calibration dependent.



Engine Coolant Temperature Sensor Circuit

Circuit Description:

The engine coolant temperature sensor is used by the Electronic Control Module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is used by the ECM for the engine protection system and engine emissions control.

Component Location:

The engine coolant temperature sensor is located on the exhaust side of the engine near the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

This fault code indicates that coolant temperature has exceeded the engine protection limits for high coolant temperature. Refer to Engine Coolant Temperature Above Normal symptom troubleshooting tree.

Refer to Troubleshooting Fault Code t05-146

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 146.	**Active or inactive counts of Fault Code 146?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 146.

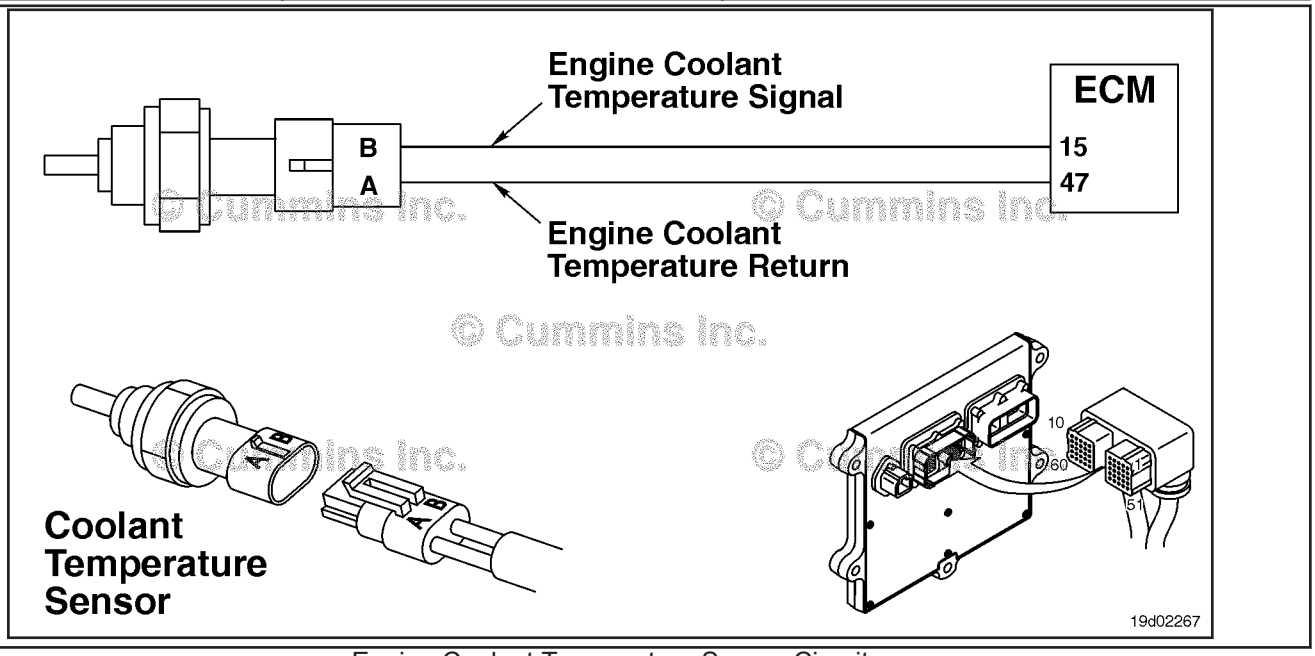
Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for Fault Code 146. • Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 146? **YES** **Repair:** Refer to the Engine Coolant Temperature Above Normal symptom tree in Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418 or ISB (Common Rail Fuel System) Series Engines, Bulletin 4021271.	Appropriate troubleshooting symptom tree
	Active or inactive counts of Fault Code 146? **NO**	Repair complete

Fault Code 146 (QSB Marine Application)

Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level

CODES	REASON	EFFECT
Fault Code: 146 PID(P), SID(S): P110 SPN: 110 FMI: 0/16 Lamp: Amber SRT:	Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level. Engine coolant temperature signal indicates engine coolant temperature is above engine protection warning limit.	Marine: calibration dependent.



Engine Coolant Temperature Sensor Circuit

Circuit Description:

The engine coolant temperature sensor is used by the Electronic Control Module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is used by the ECM for the engine protection system and engine emissions control.

Component Location:

The engine coolant temperature sensor is located on the exhaust side of the engine near the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

This fault code indicates that coolant temperature has exceeded the engine protection limits for high coolant temperature. Refer to Engine Coolant Temperature Above Normal symptom troubleshooting tree.

Refer to Troubleshooting Fault Code t05-146

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 146.	**Active or inactive counts of Fault Code 146?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 146.

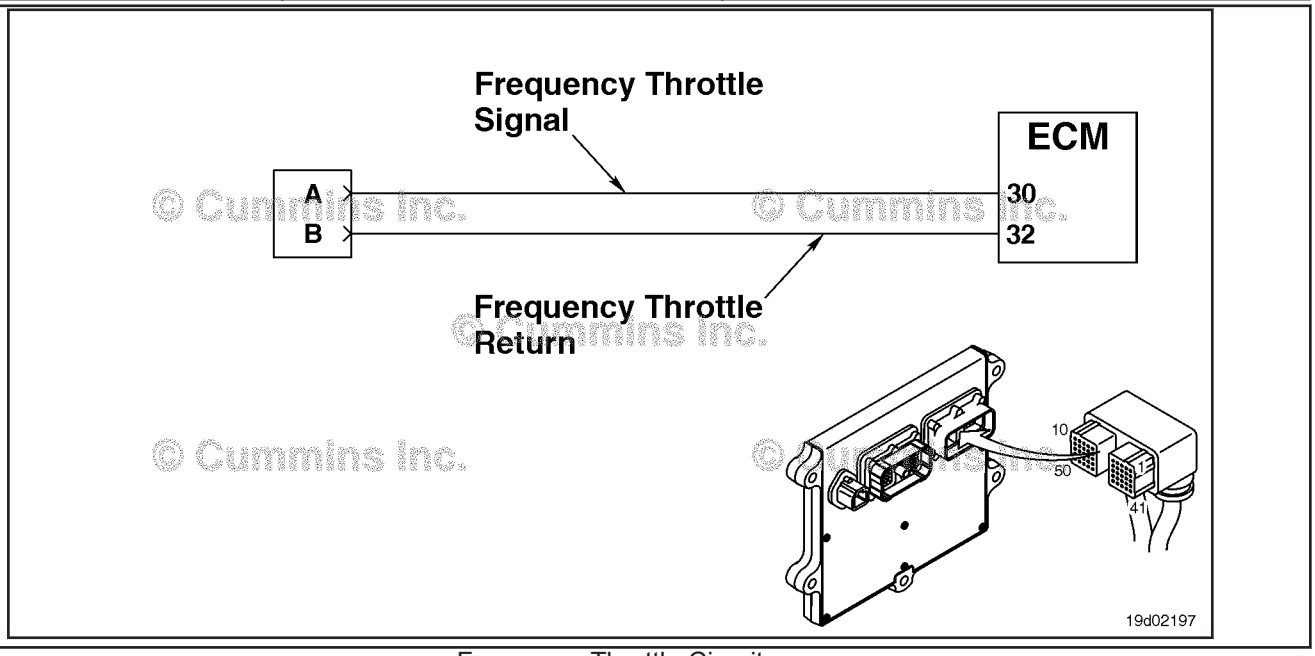
Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for Fault Code 146. • Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 146? **YES** **Repair:** Refer to the Engine Coolant Temperature Above Normal symptom tree in Troubleshooting and Repair Manual, ISB^{e} and ISB (Common Rail Fuel System) Series Engines, Bulletin 4021271.	Appropriate troubleshooting symptom tree
	Active or inactive counts of Fault Code 146? **NO**	Repair complete

Fault Code 147

Accelerator Pedal or Lever Position 1 Sensor Circuit Frequency - Data Valid but Below Normal Operational Range - Most Severe Level

CODES	REASON	EFFECT
Fault Code: 147 PID(P), SID(S): P091 FMI: 1 Lamp: Red SRT:	Accelerator Pedal or Lever Position 1 Sensor Circuit Frequency - Data Valid but Below Normal Operational Range - Most Severe Level. A frequency of less than 100 HZ has been detected at the frequency throttle input to the ECM.	Severe detate in power output of the engine. Limp home power **only**.



Frequency Throttle Circuit

Circuit Description:

This type of throttle interface is designed to accept a variable frequency signal as the throttle signal. An electronic component generates a square wave logic-level signal in which the frequency of the signal corresponds to a throttle command. The frequency values are established by the calibration in the electronic control module (ECM).

Component Location:

Throttle location varies with each OEM. Refer to the OEM troubleshooting and repair manual.

Shop Talk:

The frequency throttle can be used in conjunction with a voltage throttle or by itself.

Possible causes:

- Open circuit in the frequency throttle signal wire.
- Shorted to ground frequency throttle signal wire.
- Failed frequency throttle.
- Incorrect frequency throttle reference (input) voltage.

Refer to Troubleshooting Fault Code t05-147

FAULT CODE 147 Accelerator Pedal or Lever Position 1 Sensor Circuit Frequency - Data Valid But Below Normal Operational Range - Most Severe Level

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for inactive fault codes.**	**Fault Codes 147 inactive?**	
STEP 2:	**Check the frequency throttle and circuit.**		
STEP 2A:	**Inspect the frequency throttle and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check for a short to ground in the frequency throttle.**	**Greater than 100K ohms?**	
STEP 2C:	**Check for correct frequency throttle input voltage.**	**Voltage greater than OEM specifications?**	
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 harness.**	**Less than 10 ohms?**	
STEP 3C:	**Check for a pin short circuit to ground in the OEM harness.**	**Greater 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 an inactive fault code.**	**Fault Code 147 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault code 147 inactive?**	
STEP 4B:	**Clear the inactive fault codes.**	**All faults 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. • Using INSITE™ electronic service tool read the fault codes.	Fault Code 147 inactive? **YES**	Intermittent fault code troubleshooting tree.
	Fault Code 147 inactive? **NO**	2A

STEP 2: Check frequency throttle and circuit.

STEP 2A: Inspect the frequency throttle and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the frequency throttle and connector pins.

Action	Specification/Repair	Next Step
Inspect the OEM harness and frquency throttle connector pins for the following: • Corroded pins • Bent or broken pins. • Pushed back or expanded pins. • Wire insulation damaged. • Moisture in or on the connector. • Missing or damaged connector seals. • Connector shell broken. • Dirt or debris in or on the connector pins. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or has harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check for a short to ground in the frequency throttle.

Condition:
- Turn keyswitch OFF.
- Disconnect the frequency throttle from the OEM harness.

Action	Specification/Repair	Next Step
Check for a frequency throttle output short to ground. • Measure the resistance between the frequency throttle SIGNAL pin and ground at the frequency throttle connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	2C
	Greater than 100K ohms? **NO** **Repair:** A shorted frequency throttle has been detected. Repair or replace the frequency throttle. Refer to the OEM service manual.	4A

STEP 2C: Check for correct frequency throttle input voltage.

Condition:
- Turn keyswitch OFF.
- Disconnect the frequency throttle from the OEM harness.

Action	Specification/Repair	Next Step
Check the frequency throttle reference (input) voltage. • Measure frequency throttle reference (input) voltage. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Voltage greater than OEM specifications? **YES**	3A
	Voltage greater than OEM specifications? **NO** **Repair:** An incorrect reference (input) voltage to the frequency throttle has been detected. Repair or replace the frequency throttle reference (input) circuit. Refer to the OEM service manual.	4A

STEP 3: Check the ECM and OEM harness.

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

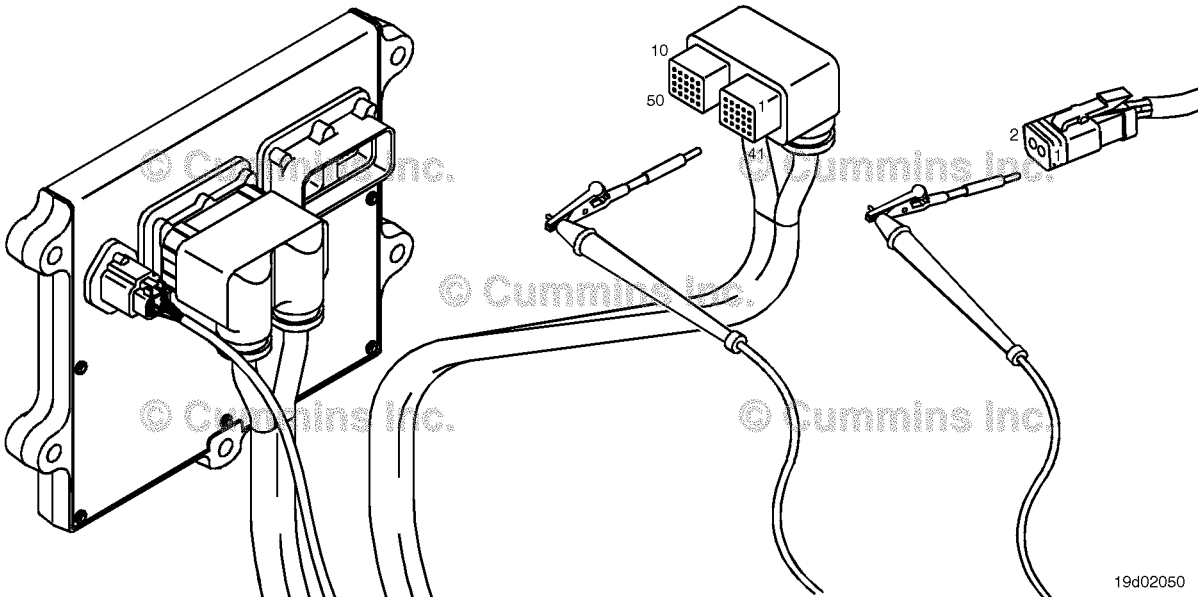
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Corroded pins. • Bent or broken pins. • Pushed back or expanded pins. • Wire insulation damaged. • Moisture in or on the connector. • Missing or damaged connector seals. • Connector shell broken. • Dirt or debris in or on the connector pins. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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 OEM harness from the frequency throttle.

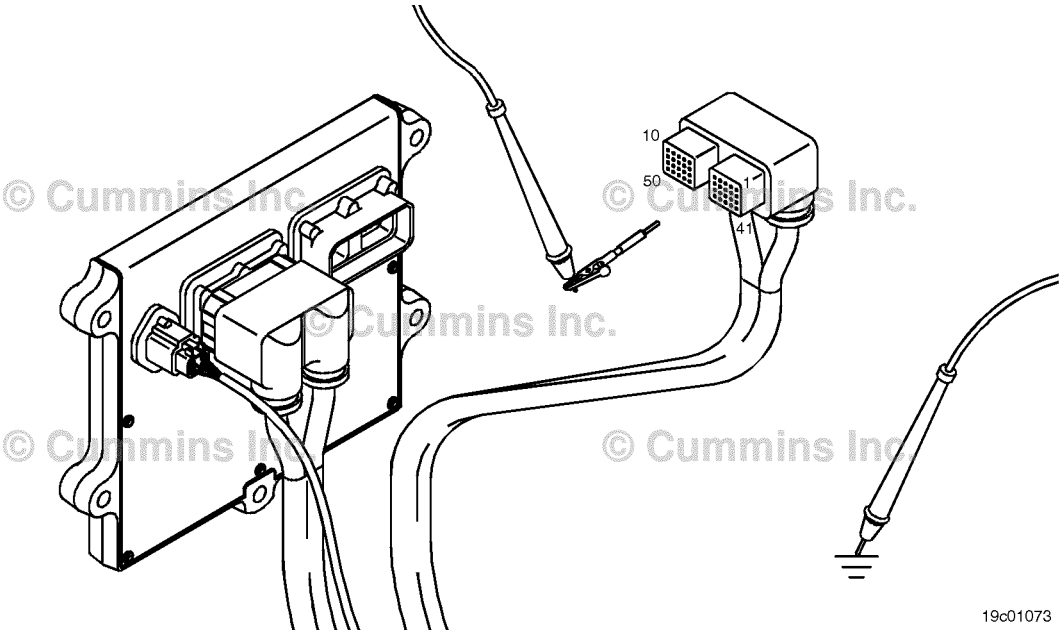
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector frequency throttle SIGNAL pin and the OEM harness frequency throttle connector SIGNAL pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3C
	Less than 10 ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open signal circuit. 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 in the OEM harness.

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

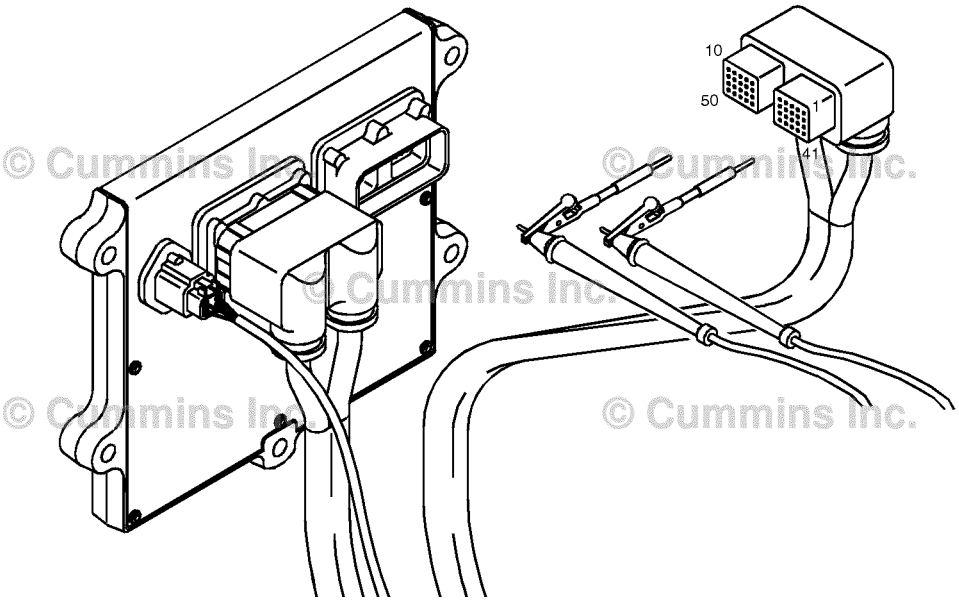
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector frequency throttle SIGNAL pin and engine block ground. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3D
	Greater than 100K ohms? **NO** **Repair:** An shorted to ground SIGNAL circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open signal circuit. 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.
- Disconnect the frequency throttle from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the OEM pressure SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3E
	Greater than 100K ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the pin-to-pin shorted signal circuit. 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. • Use INSITE™ electronic service tool read the fault codes.	Fault Code 147 inactive? **YES** **Repair:** None. The removal and reinstallation of the connector corrected the fault.	4A
	Fault Code 147 inactive? **NO** **Repair:** 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. • Start the engine and let idle for one minute. • Use INSITE™ electronic service tool, verify that the fault code is inactive.	Fault Code 147 inactive? **YES**	4B
	Fault Code 147 inactive? **NO**	1A

STEP 4B: Clear the inactive fault codes.

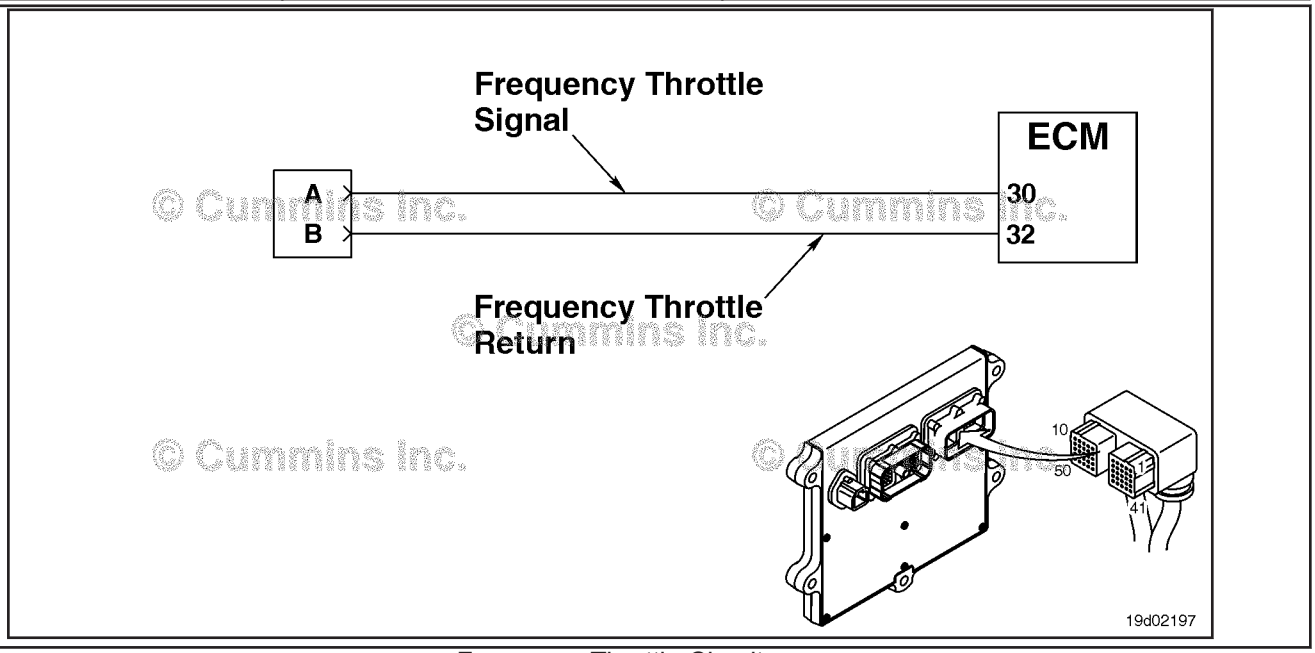
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 148

Accelerator Pedal or Lever Position Sensor 1 - Data Valid but Above Normal Operational Range - Most Severe Level

CODES	REASON	EFFECT
Fault Code: 148 PID(P), SID(S): P091 FMI: 0 Lamp: Red SRT:	Accelerator Pedal or Lever Position Sensor 1 - Data Valid but Above Normal Operational Range - Most Severe Level. A frequency of more than 1500 Hz has been detected at the frequency throttle input to the ECM.	Severe derate in power output of the engine. Limp home power **only**.



Frequency Throttle Circuit

Circuit Description:

This type of throttle interface is designed to accept a variable frequency signal as the throttle signal. An electronic component generates a square wave logic-level signal in which the frequency of the signal corresponds to a throttle command. The frequency values are established by the calibration in the ECM.

Component Location:

Throttle location varies with each OEM. Refer to the OEM troubleshooting and repair manual.

Shop Talk:

The frequency throttle can be used in conjunction with a voltage throttle or by itself.

Possible causes:

- Malfunctioning OEM Frequency Throttle
- Shorted signal wire to voltage source.

Refer to Troubleshooting Fault Code t05-148

FAULT CODE 148 - Accelerator Pedal or Lever Position Sensor 1 - Data Valid But Above Normal Operational Range - Most Severe Level

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for inactive fault codes.**	**Fault Code 148 inactive?**	
STEP 2:	**Check the frequency throttle and circuit.**		
STEP 2A:	**Inspect the frequency throttle and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the circuit response.**	**Fault Code 147 active and Fault Code 148 inactive?**	
STEP 2C:	**Check the fault codes and verify sensor condition.**	**Fault Code 148 is active?**	
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 an inactive fault code.**	**Fault Code 148 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 148 inactive?**	
STEP 4B:	**Clear the inactive fault codes.**	**All faults 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. • Use INSITE™ electronic service tool, read the fault codes.	Fault Code 148 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 148 inactive? **NO**	2A

STEP 2: Check the frequency throttle and circuit.

STEP 2A: Inspect the frequency throttle and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the frequency throttle from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and frequency throttle connector pins for the following: • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Wire insulation damaged • Moisture in or on the connector • Missing or damaged connector seals • Connector shell broken • Dirt or debris in or on the connector pins. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the frequency throttle from the OEM harness.
- Turn kesyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 147 active and Fault Code 148 inactive? **YES**	2C
	Fault Code 147 active and Fault Code 148 inactive? **NO**	3A

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

Condition:
- Turn keyswitch OFF.
- Connect the frequency throttle to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 148 is active? **YES** **Repair:** A damaged frequency throttle has been detected. Repair or replace the frequency throttle. Refer to OEM service manual.	4A
	Fault Code 148 is active? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	4A

STEP 3: Check the ECM and OEM harness.

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

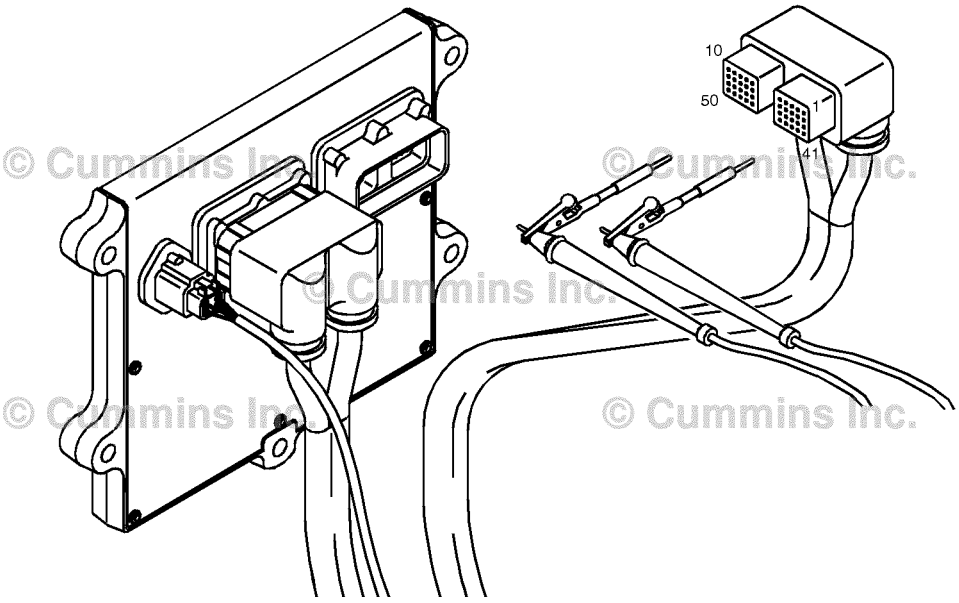
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Wire insulation damaged • Missing or damaged connector seals • Connector shell broken. • Dirt or debris in or on the connector pins. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged haness, connector or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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 frequency throttle from the OEM harnress.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the frequency throttle SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3C
	Greater the 100K ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the pin-to-pin shorted signal circuit. Repair or replace the OEM harness. Refer to Procedure 019-071 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. • Use INSITE electronic service tool to read the fault codes.	Fault Code 148 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 148 inactive? **NO** **Repair:** A damaged frequency throttle has been detected. Repair or replace the frequency throttle. 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool, verify that the fault code is inactive.	Fault Code 148 inactive? **YES**	4B
	Fault Code 148 inactive? **NO**	1A

STEP 4B: Clear the inactive fault codes.

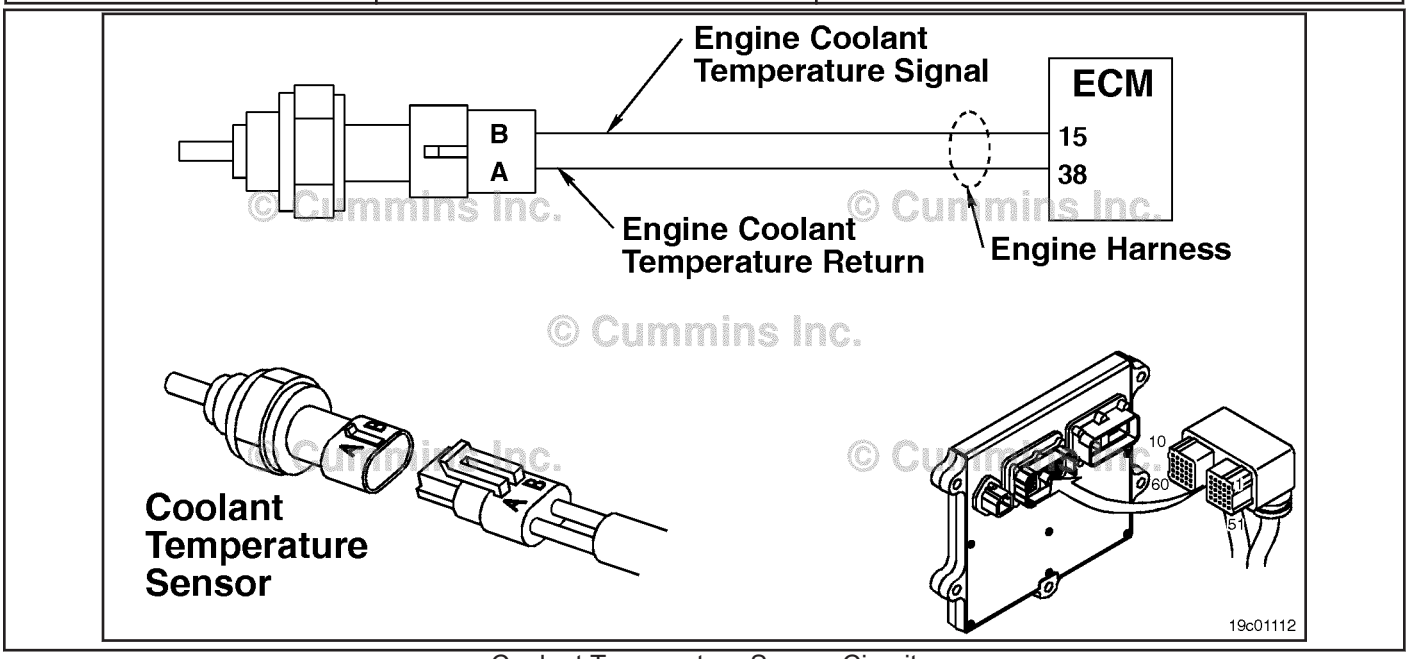
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 151 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine)

Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Most Severe Level

CODES	REASON	EFFECT
Fault Code: 151 PID(P), SID(S): P110 SPN: 110 FMI: 0/0 Lamp: Red SRT:	Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Most Severe Level. Engine coolant temperature signal indicates engine coolant temperature above engine protection critical limit.	Automotive: Progressive power derate increasing in severity from time of alert. If Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after red Stop lamp starts flashing. Marine: calibration dependent.



Coolant Temperature Sensor Circuit

Circuit Description:

The engine coolant temperature sensor is used by the electronic control module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is used by the ECM for the engine protection system and engine emission control.

Component Location:

The engine coolant temperature sensor is located on the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

This fault code indicates that coolant temperature has exceeded the engine protection limits for high coolant temperature. Refer to the Engine Coolant Temperature Above Normal symptom troubleshooting tree in Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418 or ISB^{e} and ISB (Common Rail Fuel System) Series Engines, Bulletin 4021271.

Refer to Troubleshooting Fault Code t05-151

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 151.	**Active or inactive counts of Fault Code 151?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 151.

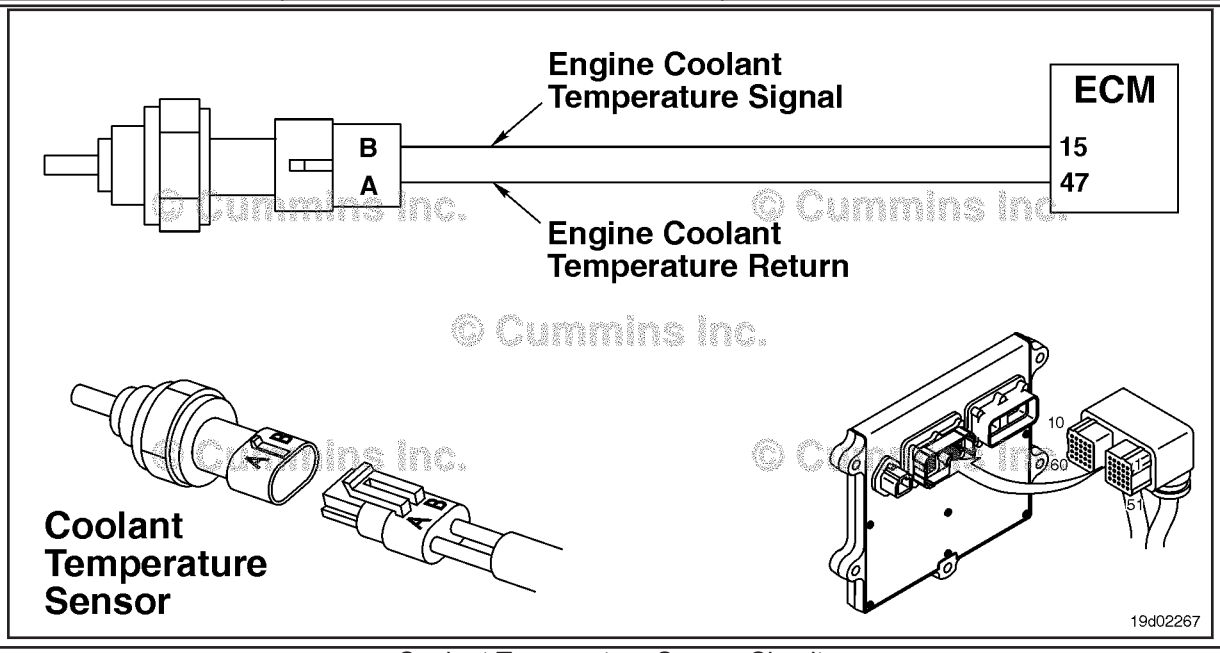
Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for fault codes. Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 151? **YES** **Repair:** Refer to the Engine Coolant Temperature Above Normal symptom troubleshooting tree in Troubleshooting and Repair Manual, ISB (Common Rail Fuel System) Series Engine, Bulletin 4021272 .	Appropriate troubleshooting symptom tree
	Active or inactive counts of Fault Code 151? **NO**	Repair complete

Fault Code 151 (QSB Marine Only)

Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Most Severe Level

CODES	REASON	EFFECT
Fault Code: 151 PID(P), SID(S): P110 SPN: 110 FMI: 0/0 Lamp: Red SRT:	Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Most Severe Level. Engine coolant temperature signal indicates engine coolant temperature above engine protection critical limit.	Marine: calibration dependent.



Coolant Temperature Sensor Circuit

Circuit Description:

The engine coolant temperature sensor is used by the electronic control module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is used by the ECM for the engine protection system and engine emission control.

Component Location:

The engine coolant temperature sensor is located on the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

This fault code indicates that coolant temperature has exceeded the engine protection limits for high coolant temperature. Refer to the Engine Coolant Temperature Above Normal symptom troubleshooting tree in Troubleshooting and Repair Manual, ISB^{e} and ISB (Common Rail Fuel System) Series Engine, Bulletin 4021272.

Refer to Troubleshooting Fault Code t05-151

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 151.	**Active or inactive counts of Fault Code 151?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 151.

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

Action	Specification/Repair	Next Step
Check for fault codes. Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 151? **YES** **Repair:** Refer to the Engine Coolant Temperature Above Normal symptom troubleshooting tree in Troubleshooting and Repair Manual, ISB^{e} and ISB (Common Rail Fuel System) Series Engine, Bulletin 4021272 .	Appropriate troubleshooting symptom tree
	Active or inactive counts of Fault Code 151? **NO**	Repair complete

Fault Code 153

Intake Manifold Air Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 153 PID(P), SID(S): P105 SPN: 105 FMI: 3/3 Lamp: Amber SRT:	Intake Manifold Air Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage detected at intake manifold air temperature circuit.	Possible white smoke. Fan will stay ON if controlled by the ECM. No engine protection for intake manifold air temperature. Marine: calibration dependent.

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. Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

Shop Talk:

The intake manifold air temperature sensor shares RETURN wires in the engine harness with other sensors. Opens and shorts in the engine harness can cause multiple fault codes to be active. Check active fault codes with multiple counts first.

Possible causes of this fault code include:

- Open return circuit in the harness, connectors, or sensor
- Open signal circuit or shorted to voltage source.

Temperature (°F)	Temperature (°C)	Resistance (ohms)
32	0	29k to 36k
77	25	9k to 11k
104	40	4.9k to 5.8k
212	100	600 to 700

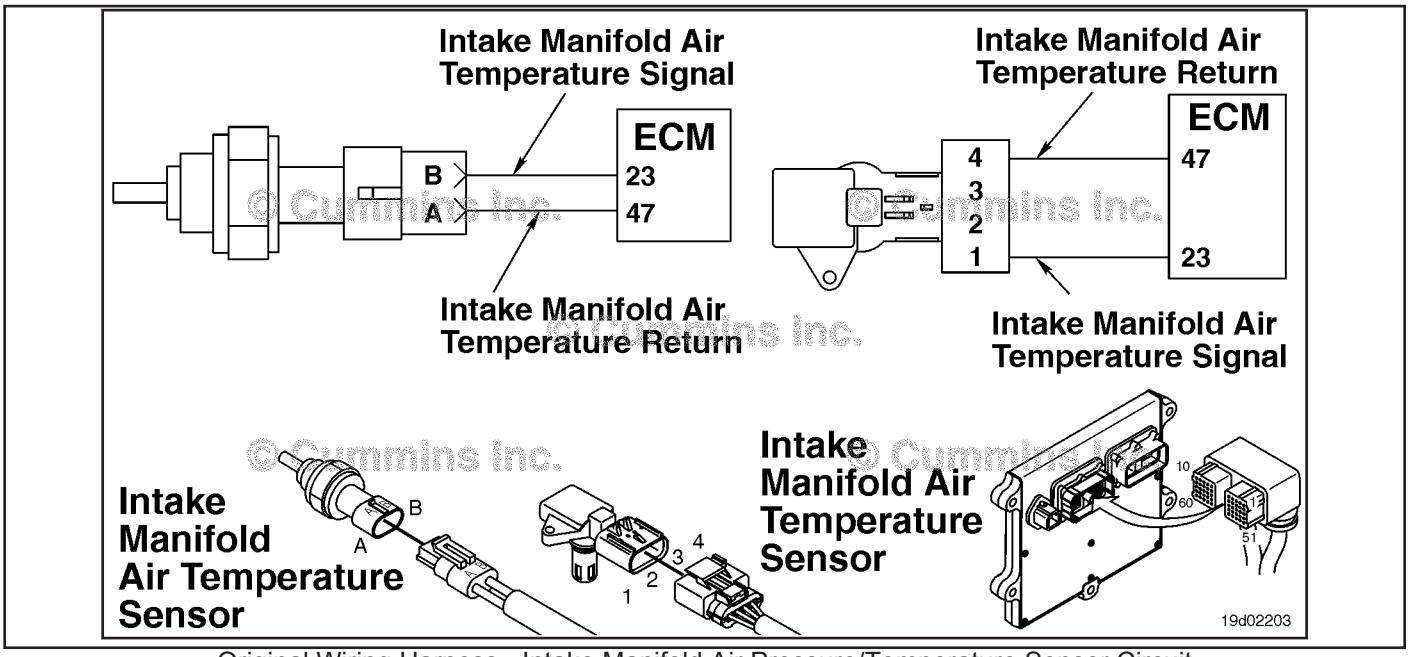
The sensor return configuration for Euro 4 ISB engines has been changed for automotive wiring harnesses manufactured from February 2012 onward. The new style wiring harnesses can be be identified using the method below:

- 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.

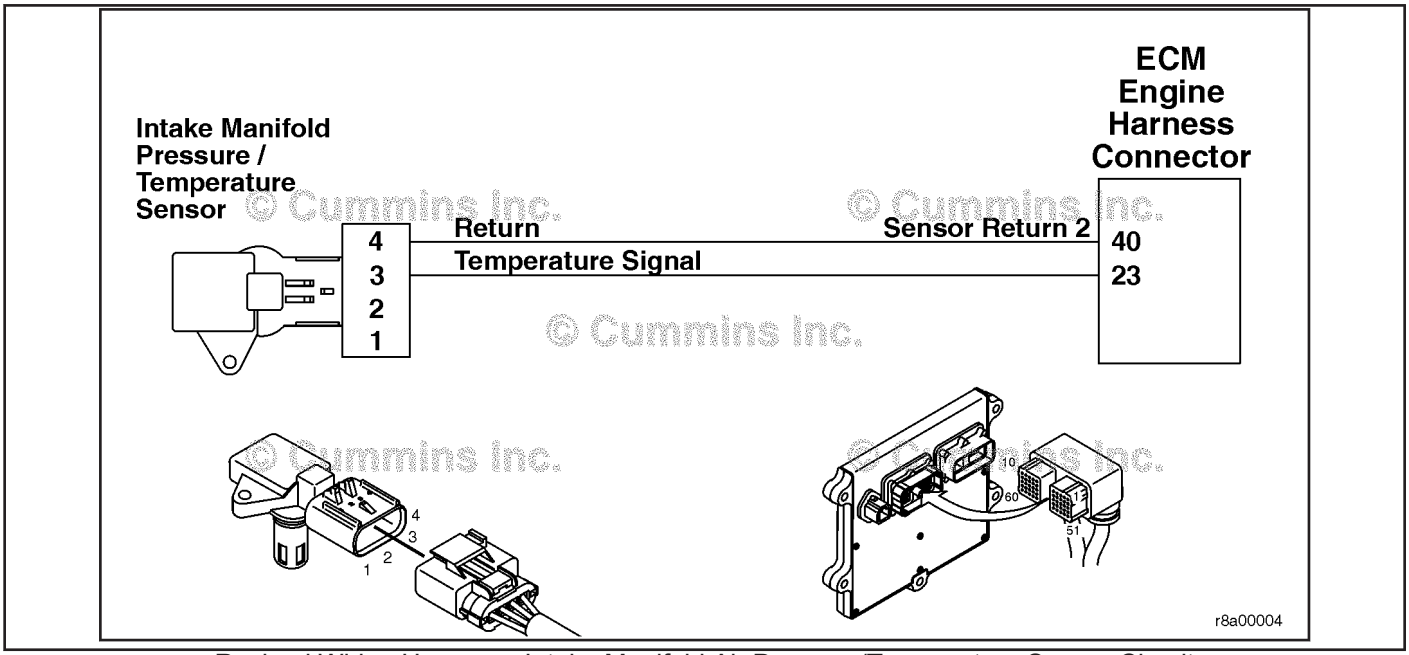
Engine Harnesses			
From	To	New Harness	Old Harness
Intake manifold pressure/ temperature sensor RETURN pin	Camshaft position sensor RETURN pin	Open circuit	Short circut

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 - Intake Manifold Air Pressure/Temperature Sensor Circuit



Revised Wiring Harness - Intake Manifold Air Pressure/Temperature Sensor Circuit

Refer to Troubleshooting Fault Code t05-153.

FAULT CODE 153 Intake Manifold Air Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source
TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

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

⚠CAUTION⚠

To reduce the possiblity 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 153 inactive?	
STEP 2:	**Check the intake manifold air temperature sensor and circuit.**		
STEP 2A:	Inspect the intake manifold air temperature sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the sensor resistance.	180 ohms to 160k ohms?	
STEP 2C:	Check the fault codes and verify sensor condition.	Fault Code 153 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 154 active and Fault Code 153 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 153 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 153 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. • Use INSITE™ to read the fault codes.	Fault Code 153 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 153 inactive? **NO**	2A

STEP 2: Check the intake manifold air temperature sensor and circuit.

STEP 2A: Inspect the intake manifold air temperature sensor and connector pins.

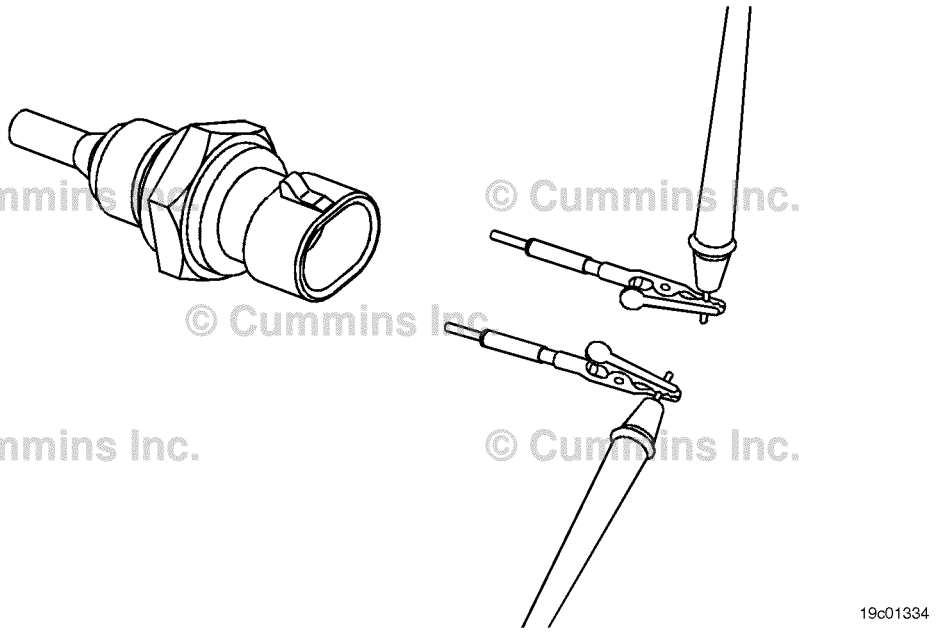
Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold air temperature sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the sensor resistance.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold air temperature sensor from the engine harness.

Action	Specification/Repair	Next Step
Check the sensor resistance. • Measure the resistance between the intake manifold air temperature sensor SIGNAL pin and intake manifold air temperature sensor RETURN pin at the intake manifold air temperature sensor. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	180 ohms to 160k ohms? **YES**	2C
	180 ohms to 160k ohms? **NO** **Repair:** Replace the intake manifold air temperature sensor. Refer to Procedure 019-059 in Section 19.	4A



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

Condition:
- Turn keyswitch OFF.
- Connect the intake manifold 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 153 is active? **YES**	3A
	Fault Code 153 is active? **NO** **Repair:** 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.

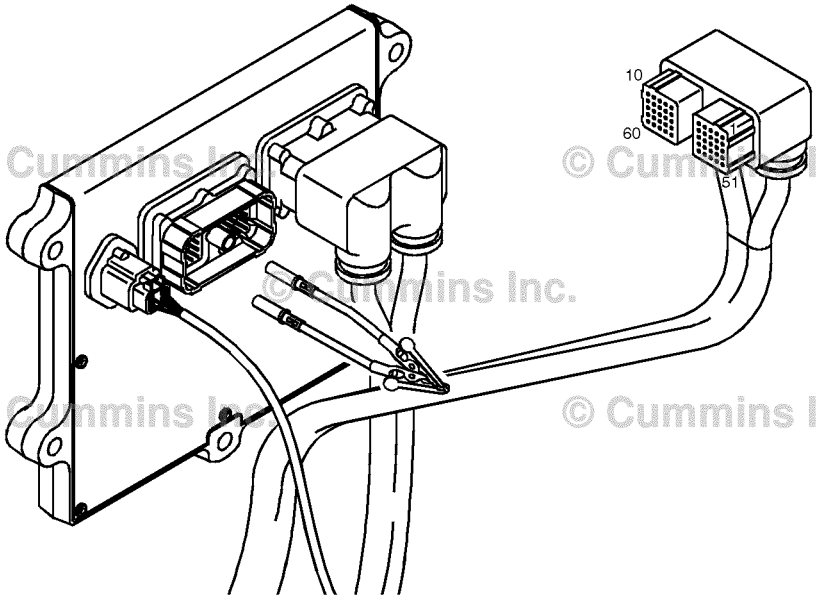
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or the engine harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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 intake manifold air temperature sensor SIGNAL pin and the intake manifold temperature sensor RETURN pin at the ECM connector. • Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes. Refer to the circuit dirgram or the wiring diagram for connector pin identification.	Fault Code 154 active and Fault Code 153 inactive? **YES**	3C
	Fault Code 154 active and Fault Code 153 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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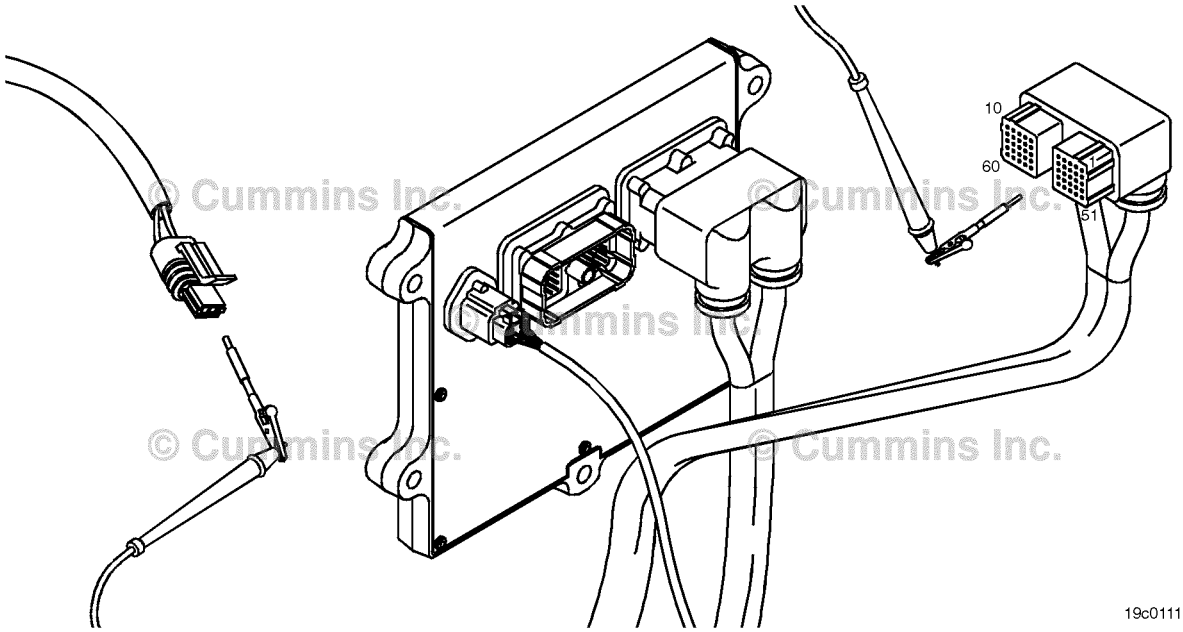
STEP 3C: Check for an open circuit in the engine harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the intake manifold air temperature sensor from the engine harness.

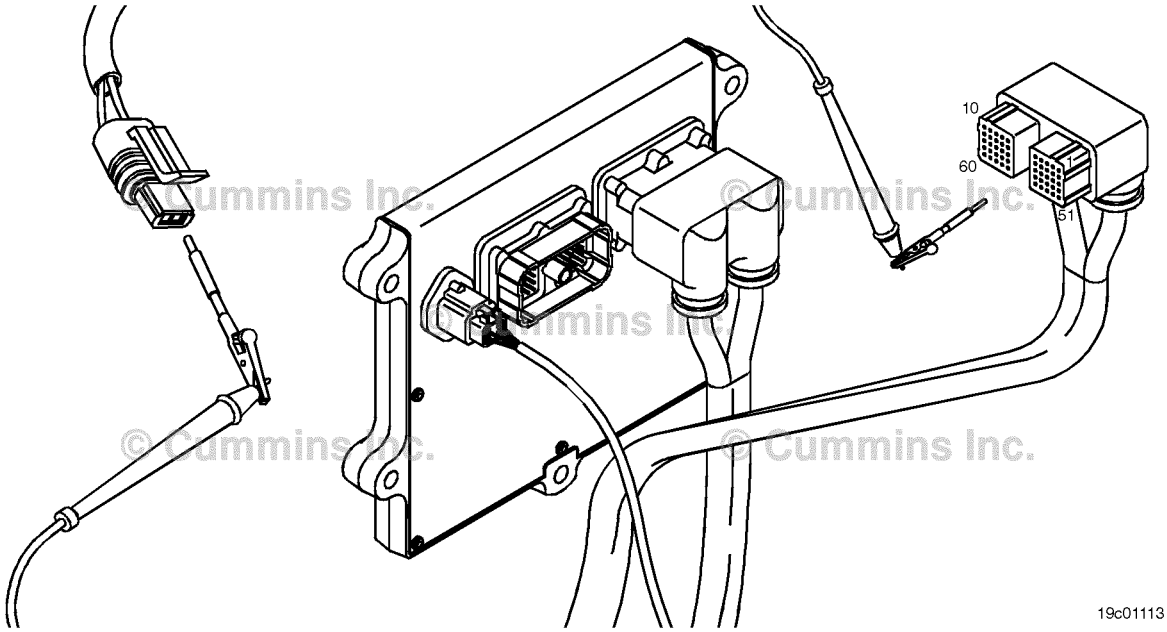
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the engine harness ECM connector intake manifold air temperature sensor RETURN pin and the engine harness intake manifold air temperature sensor connector RETURN pin. Refer to the circuit dirgram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3C-1
	Less than 10 ohms? **NO** **Repair:** An open RETURN circuit has been detected in the engine harness. 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 intake manifold air temperature sensor from the engine harness.

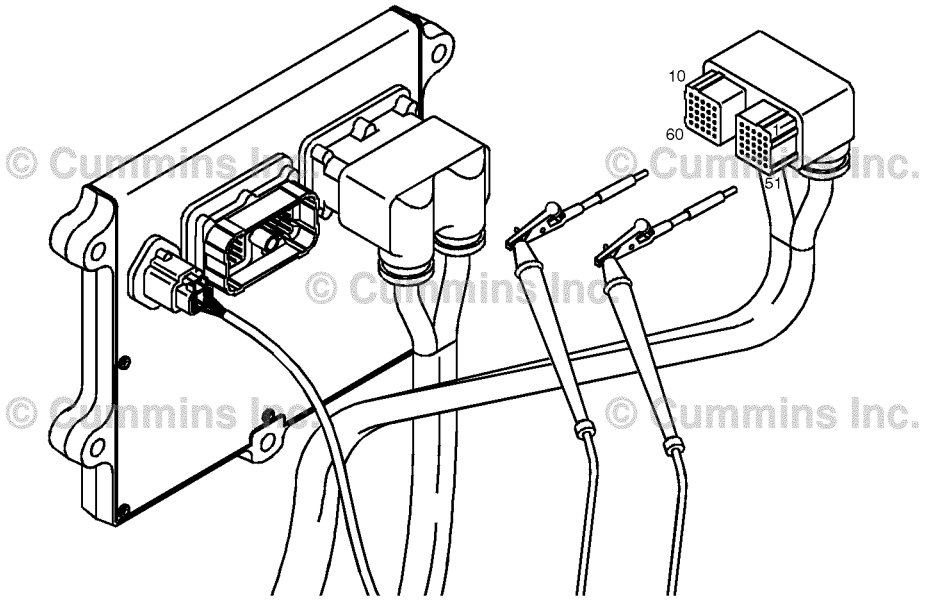
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the engine harness ECM connector intake manifold air temperature sensor SIGNAL pin and the engine harness intake manifold air temperature sensor connector SIGNAL pin. Refer to the circuit dirgram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3D
	Less than 10 ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the engine harness. 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 intake manifold air temperature sensor from the engine harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the engine coolant temperature sensor SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector. Refer to the circuit dirgram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 153 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 153 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 153 inactive? **YES**	4B
	Fault Code 153 inactive? **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. • Use INSITE™ electronic service tool to erase the inactive fault codes.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO**	Appropriate troubleshooting steps

Fault Code 154

Intake Manifold Air Pressure/Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 154 PID(P), SID(S): P105 SPN: 105 FMI: 4/4 Lamp: Amber SRT:	Intake Manifold Air Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at intake manifold air temperature circuit.	Posible white smoke. Fan will stay ON if controlled by the ECM. No engine protection for intake manifold air temperature. Marine: None - No engine protection for circuit or sensor failure.

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.

Component Location:

The intake manifold air 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 intake manifold temperature sensor shares RETURN wires in the engine harness with other sensors. Opens and shorts in the engine harness can cause multiple fault codes to be active. Check fault codes with multiple counts first.

Possible causes of this fault code include:

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

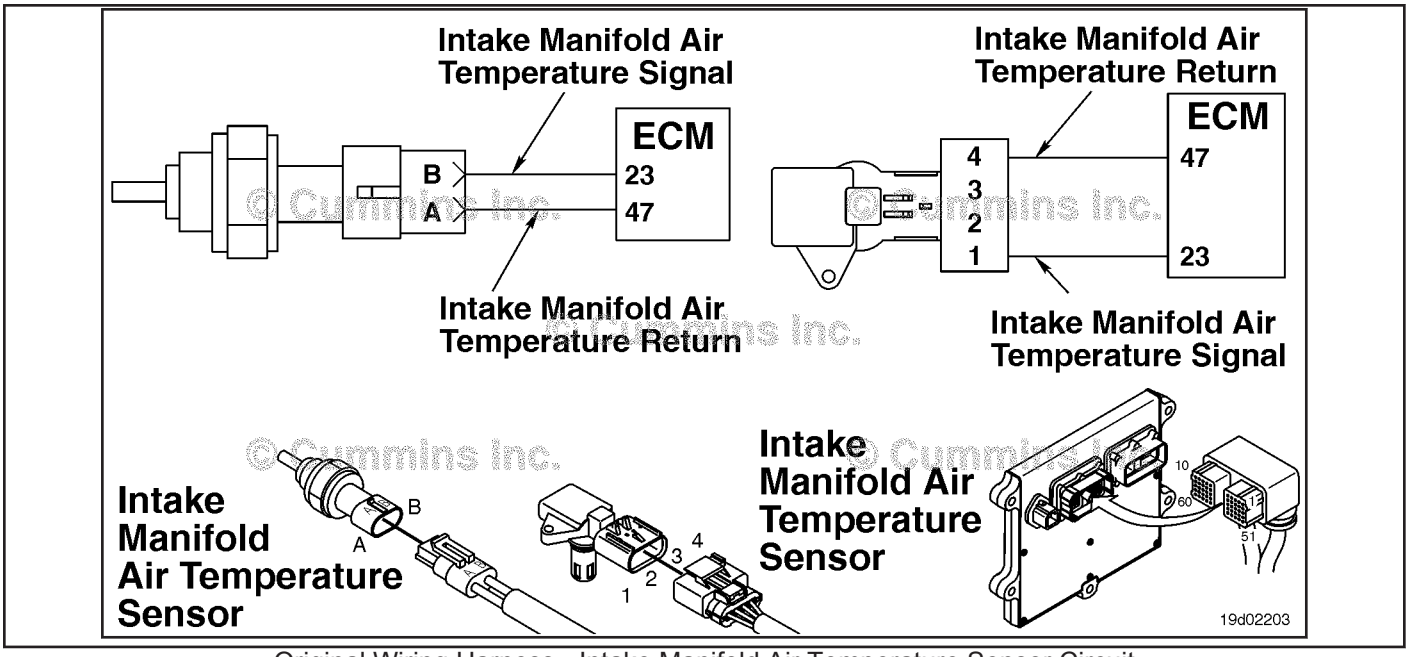
Temperature (°C)	Temperature (°F)	Resistance (ohms)
0	32	29k to 36k
25	77	9k to 11k
40	104	4.9k to 5.8k
100	212	600 to 700

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:

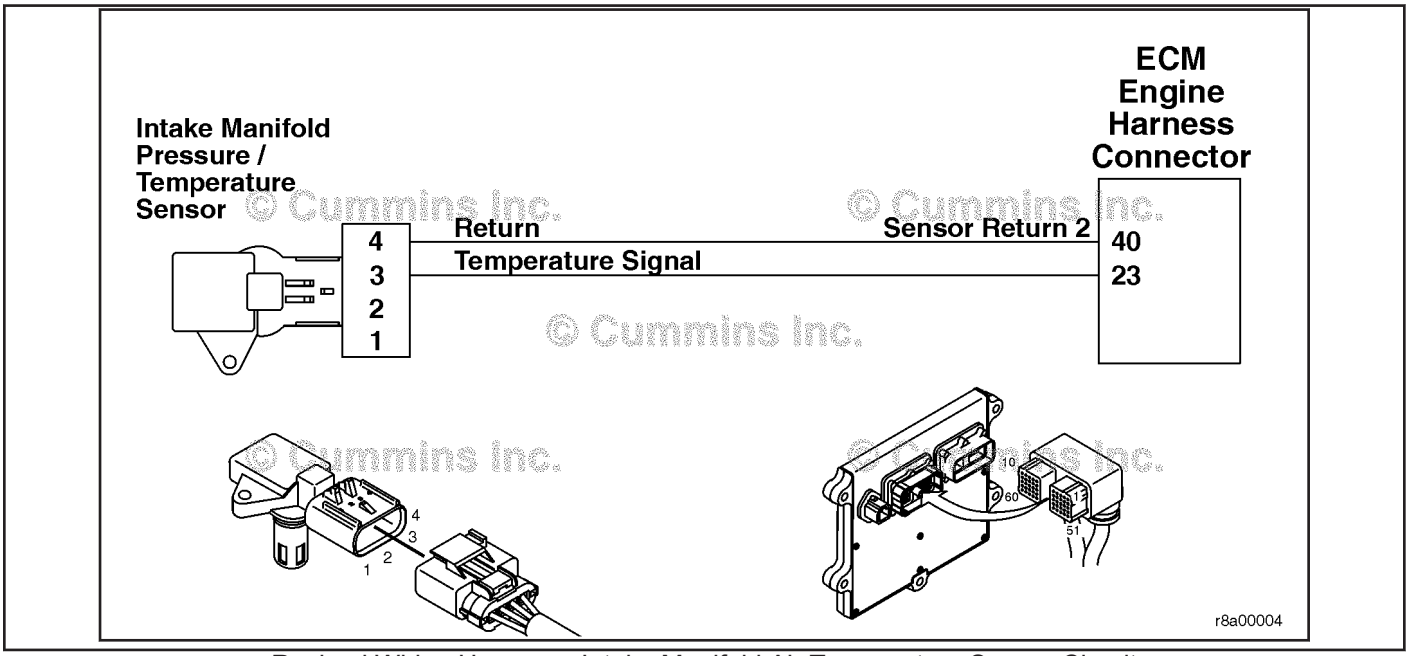
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM 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 - Intake Manifold Air Temperature Sensor Circuit



Revised Wiring Harness - Intake Manifold Air Temperature Sensor Circuit

Refer to Troubleshooting Fault Code t05-154.

FAULT CODE 154 - Intake Manifold Air Pressure/Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

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

⚠CAUTION⚠

To reduce the possiblity 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 154 inactive?	
STEP 2:	**Check the intake manifold air temperature sensor and circuit.**		
STEP 2A:	Inspect the intake manifold air temperature sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the circuit response.	Fault Code 153 active and Fault Code 154 inactive?	
STEP 2C:	Check the fault codes and verify sensor condition.	Fault Code 154 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 153 active and Fault Code 154 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 154 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 154 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 154 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 154 inactive? **NO**	2A

STEP 2: Check the intake manifold air temperature sensor and circuit.

STEP 2A: Inspect the intake manifold air temperature sensor and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold air temperature sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 153 active and Fault Code 154 inactive? **YES**	2C
	Fault Code 153 active and Fault Code 154 inactive? **NO**	3A

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

Condition:
- Turn keyswitch OFF.
- Connect the intake manifold 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 154 is active? **YES** **Repair:** A damaged sensor has been detected. Replace the intake manifold air temperature sensor. Refer to Procedure 019-059 in Section 19.	4A
	Fault Code 154 is active? **NO** **Repair:** 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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the harness connector. Clean the connector and pins. 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? **NO**	3B

STEP 3B: Check the ECM response.

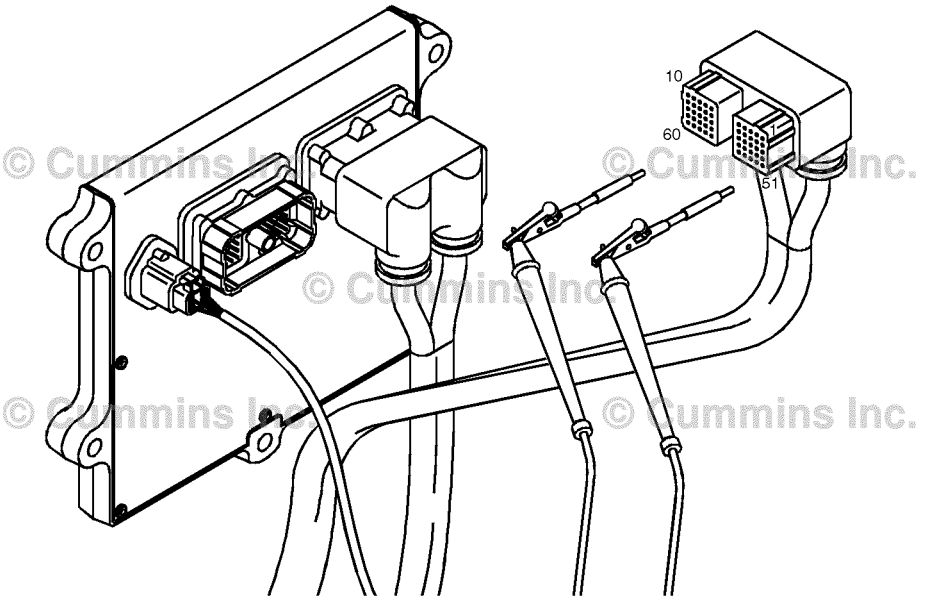
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 153 active and Fault Code 154 inactive? **YES**	3C
	Fault Code 153 active and Fault Code 154 inactive? **NO** **Repair:** 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 intake manifold air temperature sensor from the engine harness.

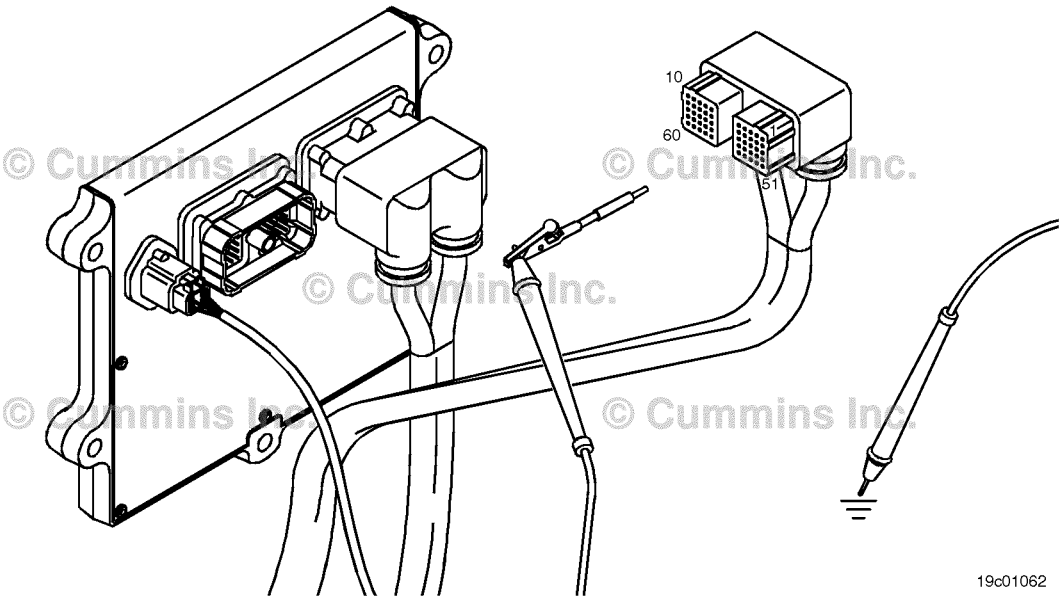
Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the intake manifold air temperature sensor SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3D
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the engine harness. 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 intake manifold air temperature sensor from the engine harness.

Action	Specification/Repair	Next Step
Check for a pin-to-ground short. • Measure the resistance between intake manifold air temperature sensor SIGNAL pin in the engine harness ECM connector and ground. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-ground short circuit on the SIGNAL line has been detected in the engine harness. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 154 is inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 154 is inactive? **NO** **Repair:** 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 154 inactive? **YES**	4B
	Fault Code 154 inactive? **NO** **Repair:** 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. • Use INSITE™ electronic service tool to erase the inactive fault codes.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO** **Repair:** Troubleshoot any remaining active fault codes.	Appropriate troubleshooting steps

Fault Code 155 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine)

Intake Manifold 1 Temperature - Data Valid But Above Normal Operating Range - Most Severe Level

CODES	REASON	EFFECT
Fault Code: 155 PID(P), SID(S): P105 SPN: 105 FMI: 0/0 Lamp: Red SRT:	Intake Manifold 1 Temperature - Data Valid But Above Normal Operating Range - Most Severe Level. Intake manifold air temperature signal indicates intake manifold air temperature above engine protection critical limit.	Automotive: Progressive power and derate increasing in severity from time of 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.

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. If engine protection is enabled, the engine will shut down 30 seconds after the red lamp starts flashing. No derate condition occurs for marine engines.

Component Location:

The intake manifold air 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 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:

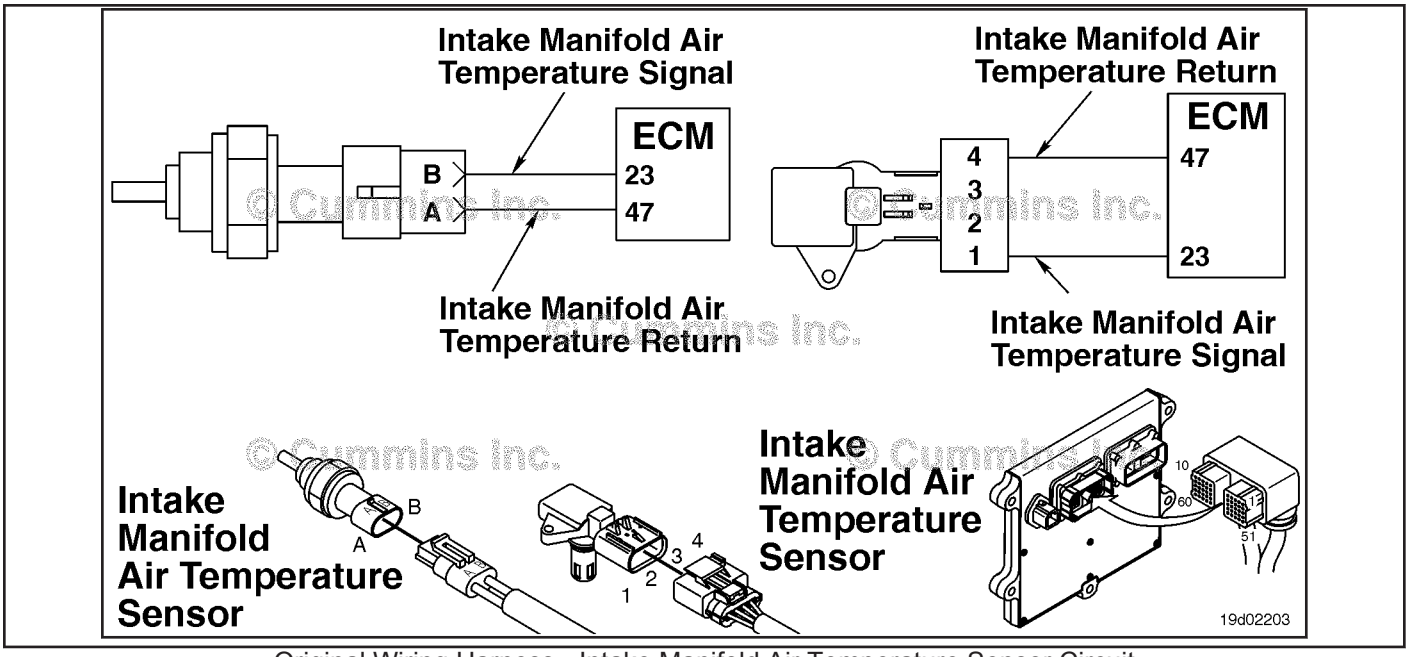
- Restricted air flow through the charge-air cooler
- Undersized charge-air cooler
- High turbocharger compressor outlet temperature
- For marine engines, verify the cooling water intake is **not** blocked or clogged with debris.

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:

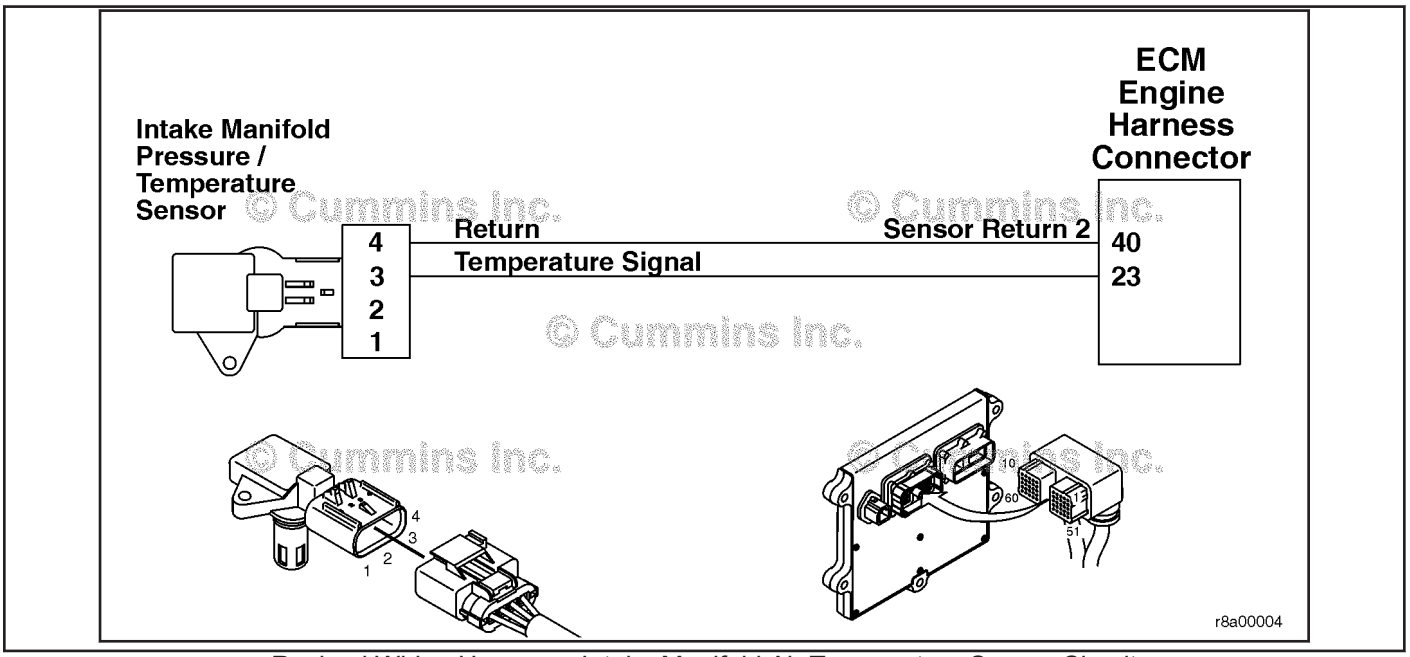
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM 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 - Intake Manifold Air Temperature Sensor Circuit



Revised Wiring Harness - Intake Manifold Air Temperature Sensor Circuit

Refer to Troubleshooting Fault Code t05-155.

FAULT CODE 155 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine) - Intake Manifold 1 Temperature - Data Valid But Above Normal Operating Range - Most Severe Level

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 155.	**Active or inactive counts of Fault Code 155?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault code.

STEP 1A: Check for Fault Code 155.

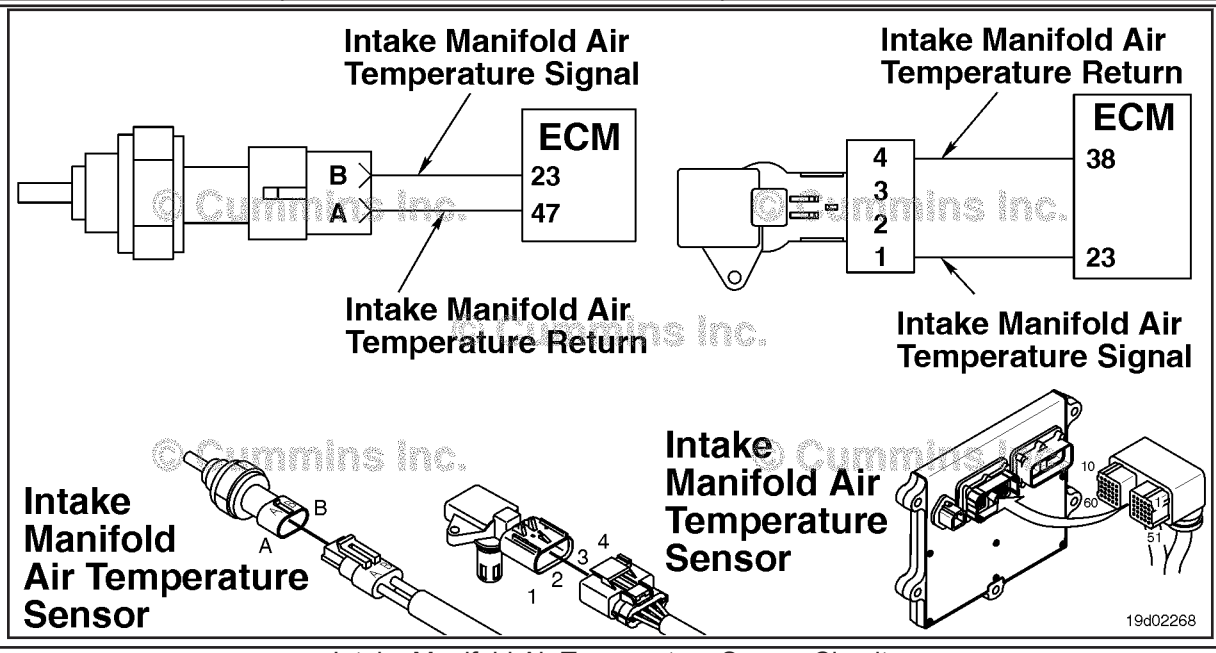
Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for Fault Code 155. • Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 155? **YES** **Repair:** Reference the Intake Manifold Air Temperature Above Specification symptom tree in the ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418 or ISB^{e} and ISB (Common Rail Fuel System) Series Engines, Bulletin 4021271.	Appropriate symptom troubleshooting tree
	Active or inactive counts of Fault Code 155? **NO**	Repair complete

Fault Code 155 (QSB Marine Application)

Intake Manifold 1 Temperature - Data Valid but Above Normal Operational Range - Most Severe Level

CODES	REASON	EFFECT
Fault Code: 155 PID(P), SID(S): P105 SPN: 105 FMI: 0/0 Lamp: Red SRT:	Intake Manifold 1 Temperature - Data Valid but Above Normal Operational Range - Most Severe Level. Intake manifold air temperature signal indicates intake manifold air temperature above engine protection critical limit.	Marine: Calibration dependent.



Intake Manifold Air Temperature Sensor Circuit

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. No derate condition occurs for marine engines.

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:

- Restricted air flow through the charge air cooler
- Undersized charge air cooler
- High turbocharger compressor outlet temperature
- For marine engines verify the cooling water intake is **not** blocked or clogged with debris.

Refer to Troubleshooting Fault Code t05-155

FAULT CODE 155 (QSB Marine Application) - Intake Manifold 1 Temperature - Data Valid but Above Normal Operational Range - Most Severe Level

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 155.	**Active or inactive counts of Fault Code 155?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault code.

STEP 1A: Check for Fault Code 155.

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

Action	Specification/Repair	Next Step
Check for Fault Code 155. • Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 155? **YES** **Repair:** Reference the Intake Manifold Air Temperature Above Specification symptom tree in the ISB^{e} and ISB (Common Rail Fuel System) Series Engines, Bulletin 4021271.	Appropriate symptom troubleshooting tree
	Active or inactive counts of Fault Code 155? **NO**	Repair complete

Fault Code 187 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine)

Sensor Supply Voltage Number 2 Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 187 PID(P), SID(S): S232 SPN: 1080 FMI: 4/4 Lamp: Amber SRT:	Sensor Supply Voltage Number 2 Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected at the sensor supply number 2 circuit.	Automotive: Engine power derate. Marine: None - No engine protection for circuit or sensor failure.

Circuit Description:

The sensor supply number 2 pin of the electronic control module (ECM) provides +5 VDC for the camshaft engine position sensor, intake manifold pressure sensor, and rail fuel pressure sensor.

Component Location:

The sensor supply number 2 is located in the ECM.

Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E.

Shop Talk:

Low voltage on the +5-VDC SUPPLY line can be caused by a short circuit to ground in a SUPPLY line, a short circuit between a SUPPLY line or a RETURN line, a malfunctioning sensor, or a malfunctioning 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 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 INSITE™ electronic service tool.
- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

OBD Information (Euro 4 Stage 1+ Certified Engines):

- The ECM illuminates the 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 MIL after one ignition cycle that the diagnostic runs and passes. The MIL lamp **cannot** be cleared using INSITE™ electronic service tool.
- The fault code will be cleared from memory after 400 days or 9600 hours of engine operation.

OBD Information (Euro 4 Stage 1 + Certified Engines):

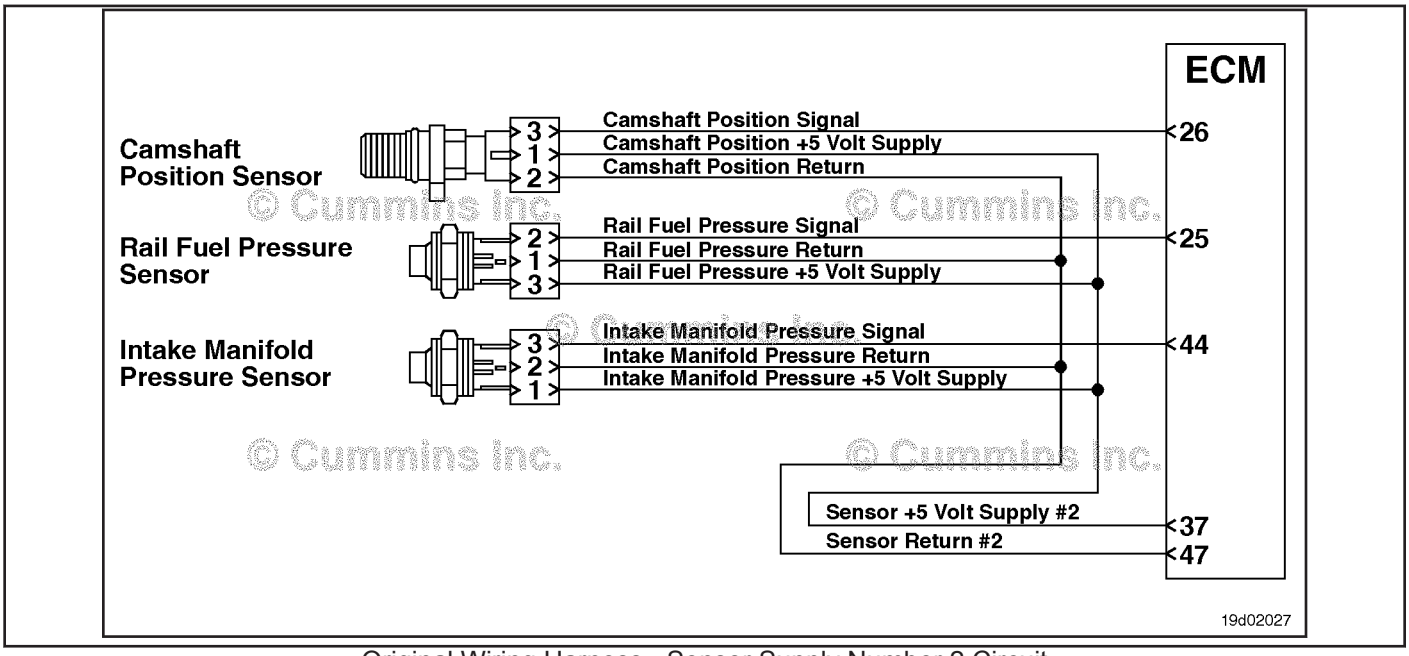
- The ECM illuminates the MIL when the diagnostic runs and fails.
- An engine torque derate will be activated after 50 hours of engine operation with the fault code active.
- The ECM turns OFF the MIL after one ignition cycle that the diagnostic runs and passes. The MIL lamp can **not** be cleared using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

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:

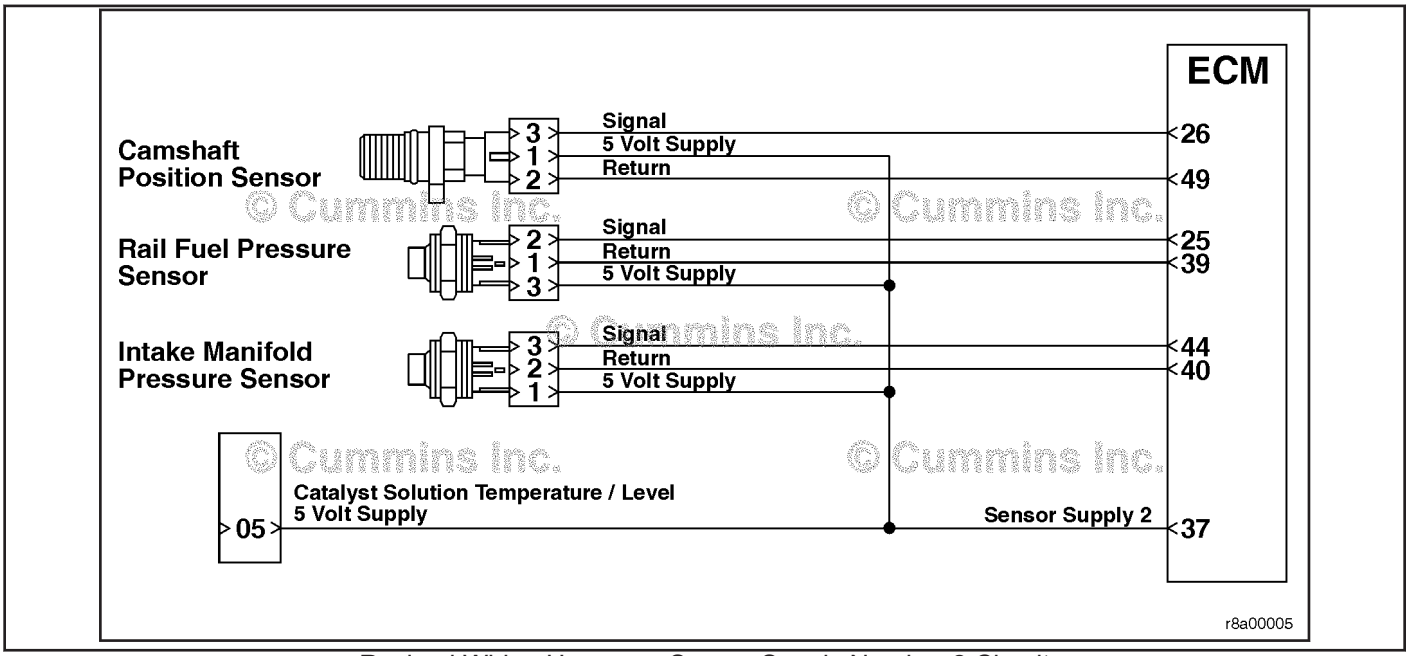
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM 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 - Sensor Supply Number 2 Circuit



Revised Wiring Harness - Sensor Supply Number 2 Circuit

Refer to Troubleshooting Fault Code t05-187.

FAULT CODE 187 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine) Sensor Supply Voltage Number 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 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; 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 an active fault code.**	**Fault Code 187 active?**	
STEP 2:	**Check the sensors and circuits connected to the sensor supply number 2 and return.**		
STEP 2A:	**Inspect the camshaft engine position sensor and circuit connected to the sensor supply number 2 and return.**	**Dirty or damaged pins?**	
STEP 2A-1:	**Check the circuit response.**	**Fault Code 187 active?**	
STEP 2B:	**Inspect the intake manifold pressure sensor and circuit connected to the sensor supply number 2 and return.**	**Dirty or damaged pins?**	
STEP 2B-1:	**Check the circuit response.**	**Fault Code 187 active?**	
STEP 2C:	**Check orientation of sensor connection**	**Is the sensor correctly installed?**	
STEP 2C-1:	**Inspect the rail fuel pressure sensor and circuit connected to the sensor supply number 2 and return.**	**Dirty or damaged pins?**	
STEP 2C-2:	**Check the circuit response.**	**Fault Code 187 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 187 active?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 187 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 187 active? **YES**	2A
	Fault Code 187 active? **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 number 2 and return.

STEP 2A: Inspect the camshaft engine position sensor and circuit connected to the sensor supply number 2 and return.

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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection had been detected in the sensor or harness connector. Repair the damaged pins. Repair or replace the engine harness, or replace the sensor, whichever has the damaged pins. Flush the dirt, debris, or moisture from the connector pins using electronic contact cleaner, Part Number 3822510. Install the appropriate connector seal if it is damaged or missing. • Repair the harness. Refer to Procedure 019-203 in Section 19. • Replace the harness. Refer to Procedure 019-043 in Section 19. • Replace the camshaft engine position sensor. Refer to Procedure 019-364 in Section 19.	4A
	Dirty or damaged pins? **NO**	2A-1

STEP 2A-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
Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 187 active? **YES**	2B
	Fault Code 187 active? **NO** **Repair:** Replace the camshaft engine position sensor. Refer to Procedure 019-063 in Section 19.	4A

STEP 2B: Inspect the intake manifold pressure sensor and circuit connected to the sensor supply number 2 and return.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold pressure sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection had been detected in the sensor or harness connector. Repair the damaged pins. Repair or replace the engine harness, or replace the sensor, whichever has the damaged pins. Flush the dirt, debris, or moisture from the connector pins using electronic contact cleaner, Part Number 3822510. Install the appropriate connector seal if it is damaged or missing. • Repair the harness. Refer to Procedure 019-203 in Section 19. • Replace the harness. Refer to Procedure 019-043 in Section 19. • Replace the intake manifold pressure sensor. Refer to Procedure 019-061 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B-1

STEP 2B-1: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 187 active? **YES**	2C
	Fault Code 187 active? **NO** **Repair:** Replace the intake manifold pressure sensor. Refer to Procedure 019-061 in Section 19.	4A

STEP 2C: Check orientation of connector.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Check for the appropriate orientation of rail fuel pressure sensor connector. • Note: The connector can be installed incorrectly rotated 180 degrees.	Is the sensor correctly installed? **YES**	2C-1
	Is the sensor correctly installed? **NO** **Repair:** Reorient connector.	4A

STEP 2C-1: Inspect the rail fuel pressure sensor and circuit connected to the sensor supply number 2 and return.

Condition:
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection had been detected in the sensor or harness connector. Repair the damaged pins. Repair or replace the engine harness, or replace the sensor, whichever has the damaged pins. Flush the dirt, debris, or moisture from the connector pins using electronic contact cleaner, Part Number 3822510. Install the appropriate connector seal if it is damaged or missing. • Repair the harness. Refer to Procedure 019-203 in Section 19. • Replace the harness. Refer to Procedure 019-043 in Section 19. • Replace the rail fuel pressure sensor. Refer to Procedure 019-115 in Section 19.	4A
	Dirty or damaged pins? **NO**	2C-2

STEP 2C-2: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 187 active? **YES**	3A
	Fault Code 187 active? **NO** **Repair:** Replace the rail fuel pressure sensor. Refer to Procedure 019-115 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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Refer to the circuit diagram or wiring diagram fro connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection had been detected in the sensor or harness connector. Repair the damaged pins. Repair or replace the engine harness, or replace the sensor, whichever has the damaged pins. Flush the dirt, debris, or moisture from the connector pins using electronic contact cleaner, Part Number 3822510. Install the appropriate connector seal if it is damaged or missing. • Repair the harness. Refer to Procedure 019-203 in Section 19. • Replace the harness. Refer to Procedure 019-043 in Section 19. • Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A
	Dirty or damaged pins? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 187 active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A
	Fault Code 187 active? **NO** **Repair:** 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.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 187 inactive? **YES**	4B
	Fault Code 187 inactive? **NO**	1A

STEP 4B: Clear the inactive fault codes.

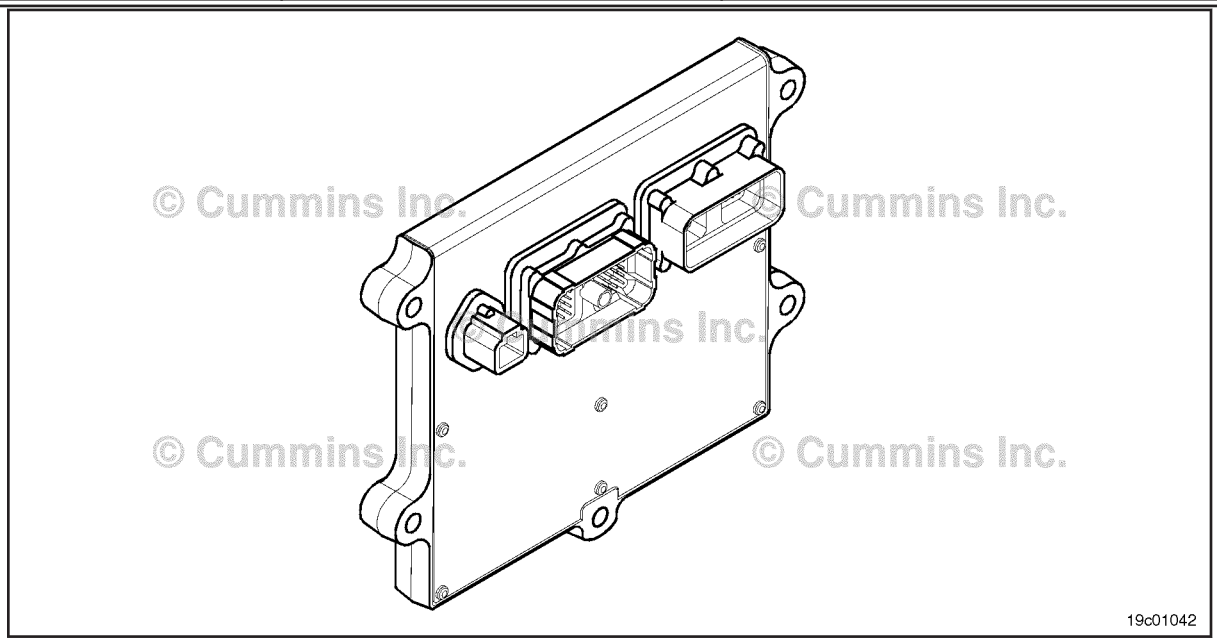
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 187 (QSB Marine Application)

Sensor Supply 2 Circuit - Voltage Below Normal, or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 187 PID(P), SID(S): S232 SPN: 1080 FMI: 4/4 Lamp: Amber SRT:	Sensor Supply 2 Circuit - Voltage Below Normal, or Shorted to Low Source. Low voltage detected at the sensor supply number 2 circuit.	Marine: None, no engine protection for circuit or sensor failure.



Sensor Supply Number 2 Circuit

Circuit Description:

The sensor supply number 2 pin of the electronic control module (ECM) provides +5 VDC for the intake manifold pressure sensor, and rail fuel pressure sensor.

Component Location:

The sensor supply number 2 is located in the ECM.

Refer to Procedure 100-002 for a detailed component location view of each sensor.

Shop Talk:

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

Refer to Troubleshooting Fault Code t05-187

FAULT CODE 187 (QSB Marine Application) Sensor Supply 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 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, 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 an active fault code.	Fault Code 187 active?	
STEP 2:	**Check the sensors and circuits connected to the sensor supply number 2 and return.**		
STEP 2A:	Inspect the rail fuel pressure sensor and circuit connected to the sensor supply number 2 and return.	Dirty or damaged pins?	
STEP 2A-1:	Check the circuit response.	Fault Code 187 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 187 active?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 187 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 187 active? **YES**	2A
	Fault Code 187 active? **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 number 2 and return.

STEP 2A: Inspect the intake manifold pressure sensor and circuit connected to the sensor supply number 2 and return.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold pressure sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2A-1

STEP 2A-1: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the intake manifold 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 187 active? **YES**	2B
	Fault Code 187 active? **NO** **Repair:** Replace the intake manifold pressure sensor. Refer to Procedure 019-061 in Section 19.	4A

STEP 2B: Inspect the rail fuel pressure sensor and circuit connected to the sensor supply number 2 and return.

Condition:
- Turn keyswitch OFF.
- Disconnect the rail fuel pressure sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B-1

STEP 2B-1: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 187 active? **YES**	3A
	Fault Code 187 active? **NO** **Repair:** Replace the rail fuel pressure sensor. Refer to Procedure 019-115 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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 187 active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A
	Fault Code 187 active? **NO** **Repair:** 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.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 187 inactive? **YES**	4B
	Fault Code 187 inactive? **NO** **Repair:** Return to the ttroubleshooting steps or contact a local Cummins® Authorized Repair Location of all steps have been completed and checked again.	1A

STEP 4B: Clear the inactive fault codes.

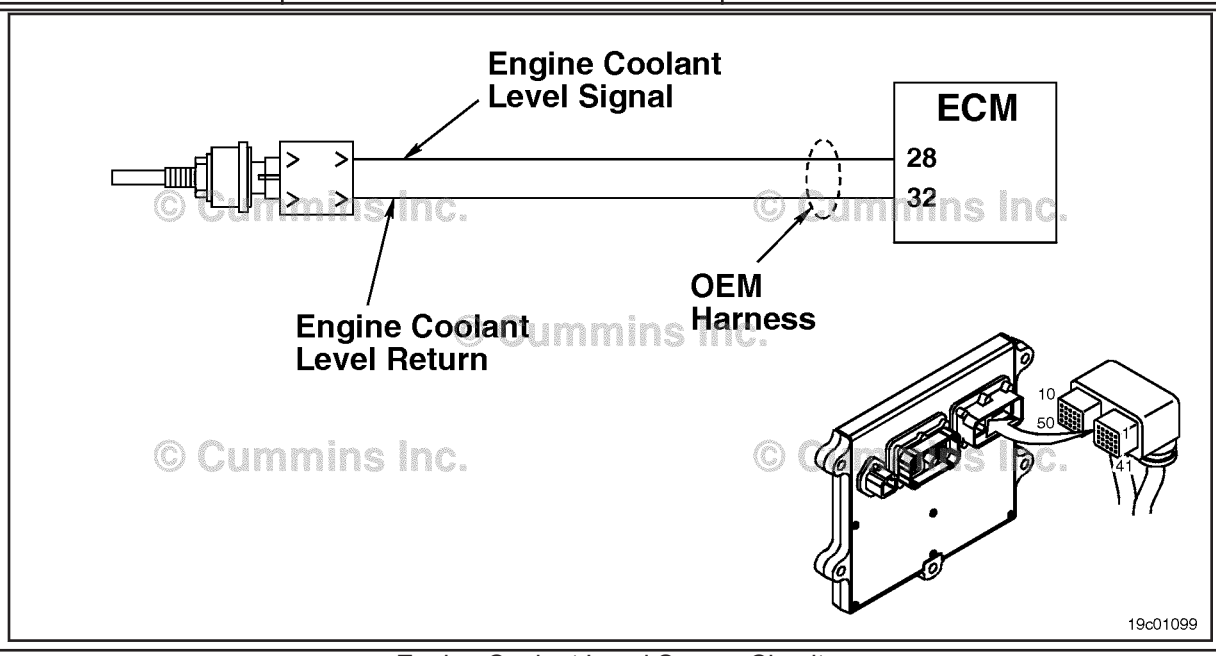
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 195 - Two Wire Sensor

Coolant Level Sensor 1 Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 195 PID(P), SID(S): P111 SPN: 111 FMI: 3/3 Lamp: Amber SRT:	Coolant Level Sensor 1 Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage detected at engine coolant level circuit.	Automotive: None on performance. Marine: None, no engine protection for circuit or sensor failure.



Engine Coolant Level Sensor Circuit

Circuit Description:

The engine coolant level sensor monitors the engine coolant level within the coolant system and passes information to the electronic control module (ECM) through the OEM harness.

Component Location:

The engine coolant level sensor is typically located in the radiator top tank or surge tank, for marine engines, it is located in the expansion tank. Refer to the OEM troubleshooting and repair manual for location.

Shop Talk:

Possible causes of 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 t05-195

FAULT CODE 195 - Two Wire Sensor - Coolant Level Sensor 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 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3164133 - 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 195 active?**	
STEP 2:	**Check the engine coolant level sensor and circuit.**		
STEP 2A:	**Inspect the engine coolant level sensor and connector and pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the sensor resistance.**	**Greater than 800k ohms?**	
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 3B-1:	**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 195 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 195 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 195 active? **YES**	2A
	Fault Code 195 active? **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 coolant level sensor and circuit.

STEP 2A: Inspect the engine coolant level sensor and connector pins.

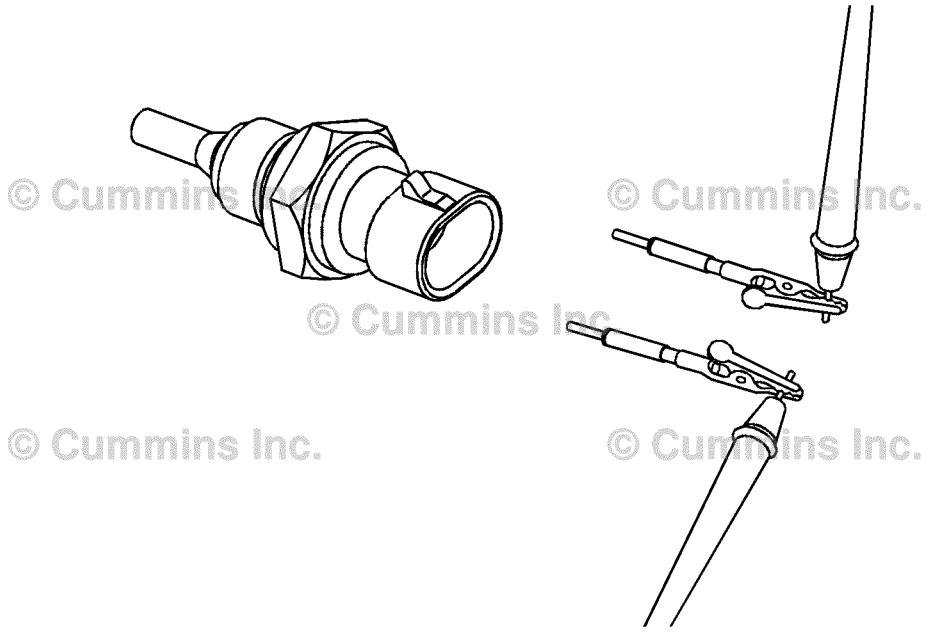
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and engine coolant level sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check the sensor resistance.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant level sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check the sensor resistance. • Measure the resistance between the engine coolant level SIGNAL pin and the engine coolant level RETURN pin at the engine coolant level sensor connector. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 800k ohms? **YES** **Repair:** Replace the engine coolant level sensor. Refer to Procedure 019-017 in Section 19.	4A
	Greater than 800k ohms? **NO**	3A



STEP 3: Check the ECM and OEM harness.

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

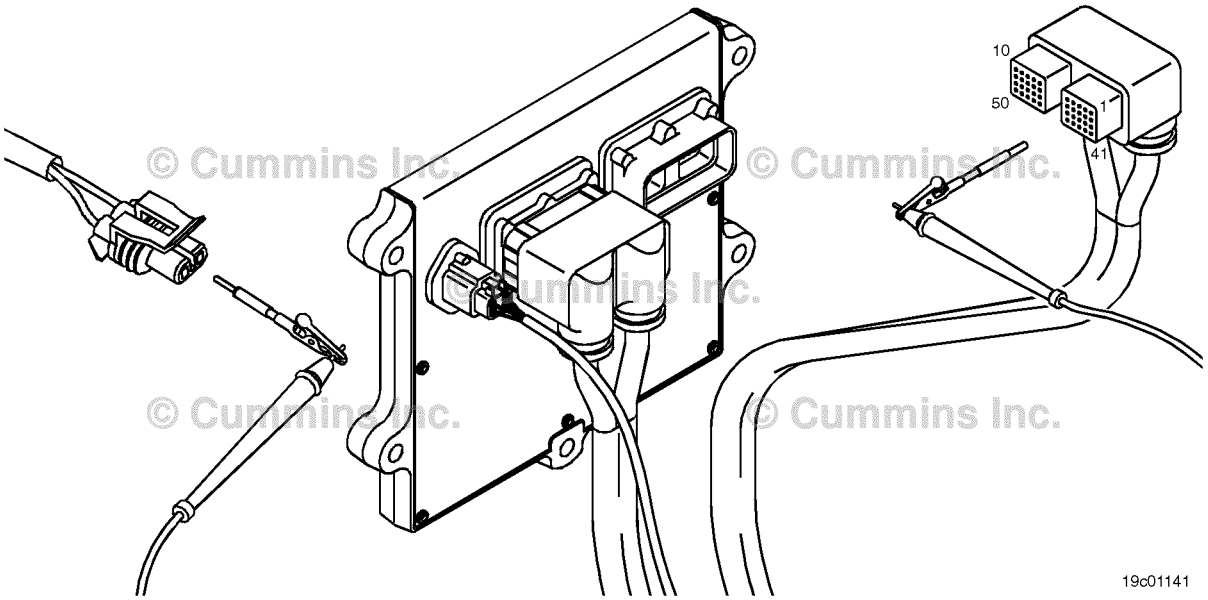
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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 engine coolant level sensor from the OEM harness.

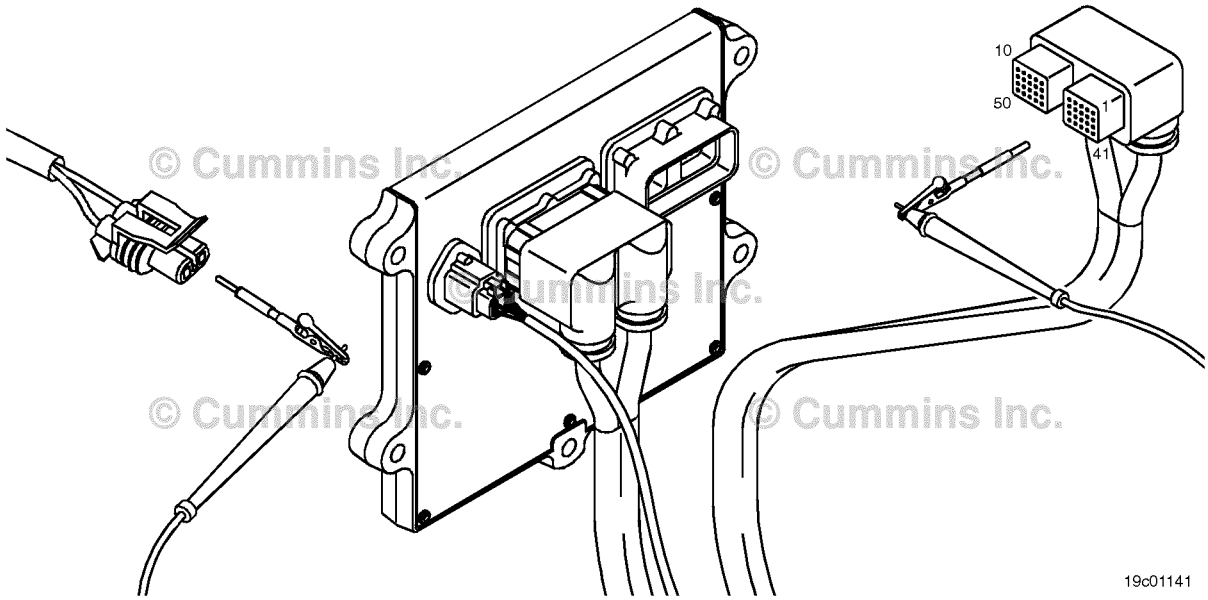
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector engine coolant level sensor RETURN pin and the OEM harness engine coolant level sensor connector RETURN pin. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3B-1
	Less than 10 ohms? **NO** **Repair:** An open RETURN circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3B-1: Check for an open circuit in the OEM harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the engine coolant level sensor from the OEM harness.

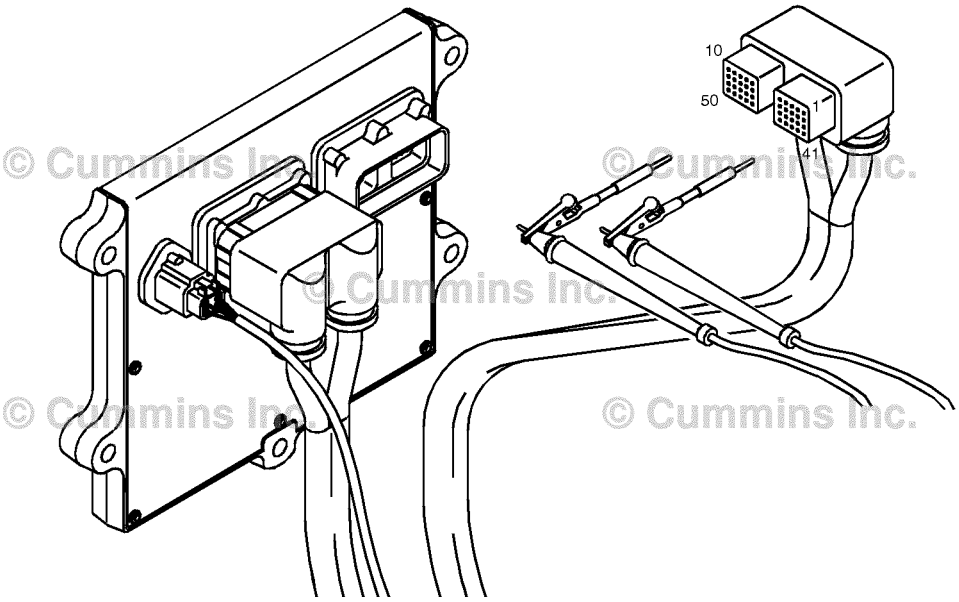
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector engine coolant level sensor SIGNAL pin and the engine coolant level sensor connector SIGNAL pin. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3C
	Less than 10 ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the OEM harness. 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 form the ECM.
- Disconnect the engine coolant level sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the engine coolant level SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM harness connector. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3D
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the OEM harness. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 195 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 195 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 195 inactive? **YES**	4B
	Fault Code 195 inactive? **NO** **Repair:** Return to the appropriate 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.

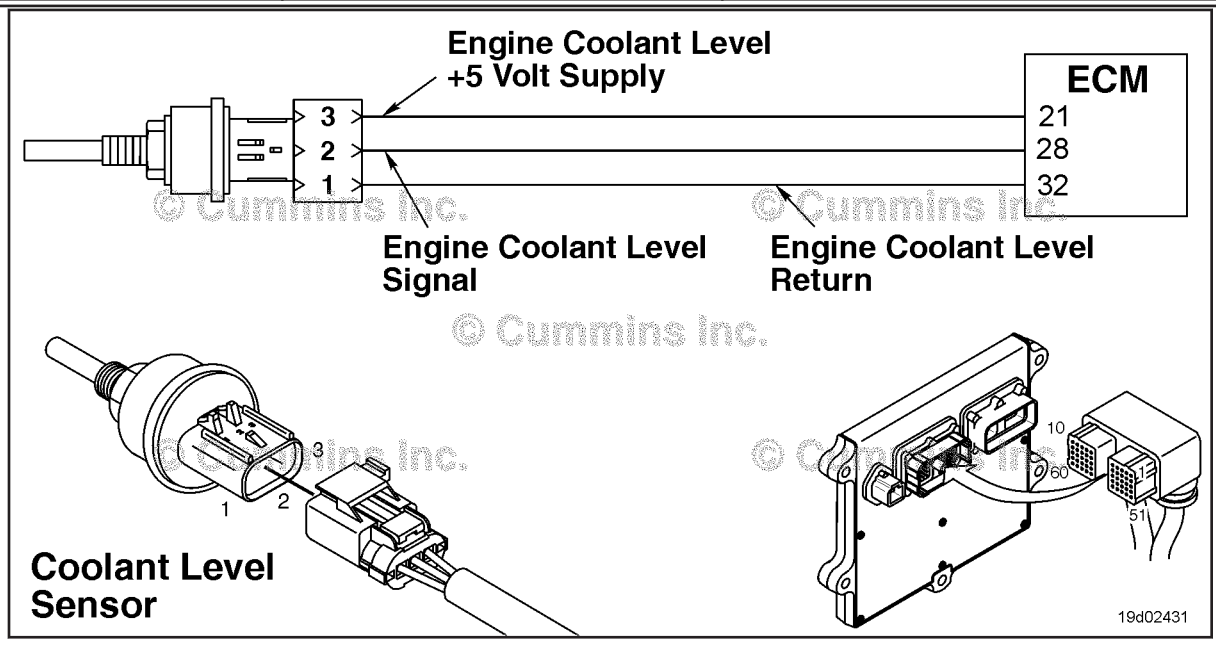
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 195 - Three Wire Sensor

Coolant Level Sensor 1 Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 195 PID(P), SID(S): P111 SPN: 111 FMI: 3/3 Lamp: Amber SRT:	Coolant Level Sensor 1 Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage detected at engine coolant level circuit.	None on performance.



Engine Coolant Level Sensor 1 Circuit

Circuit Description:

The electronic control module (ECM) supplies a 5 volt supply to the engine coolant level sensor using a common sensor supply circuit. The ECM also provides a ground on the sensor return circuit. The engine coolant level sensor provides a signal to the ECM on the engine coolant level sensor signal circuit. This sensor signal voltage changes based on the coolant level in the expansion tank.

Component Location:

The engine coolant level sensor is typically located in the radiator top tank or surge tank. Refer to the OEM troubleshooting and repair manual for location.

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 ECM detects that the coolant level signal voltage is greater than 4.5-VDC for more than 1 second.

Action Taken When the Fault Code is Active:

- The ECM illuminates the amber CHECK ENGINE light immediately when the diagnostic runs and fails.
- No engine protection will be available for low coolant level.

Conditions for Clearing the Fault Code:

The ECM will turn off the amber CHECK ENGINE light immediately after the diagnostic runs and passes.

Shop Talk:

Possible causes of this fault code include:

- Open return circuit in the engine harness, connectors, or sensor
- Signal circuit shorted to sensor supply or battery voltage
- Sensor supply circuit shorted to battery voltage.

Refer to Troubleshooting Fault Code t05-195

FAULT CODE 195 - Three Wire Sensor - Coolant Level Sensor 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 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3164133 - 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 386 active?	
STEP 1B:	Check for an inactive fault code.	Fault Code 195 inactive?	
STEP 2:	**Check the engine coolant level sensor and circuit.**		
STEP 2A:	Inspect the engine coolant level sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the circuit response	Fault Code 195 active and Fault Code 195 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 195 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 a pin-to-pin short circuit in the OEM harness.	Greater than 100k ohms?	
STEP 3E:	Check for an inactive fault code.	Fault Code 195 inactive?	
STEP 4:	**Clear the fault code.**		
STEP 4A:	Disable the fault code.	Fault Code 195 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 386 active? **YES**	Refer to Fault Code 386
	Fault Code 386 active? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 195 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 195 inactive? **NO**	2A

STEP 2: Check the engine coolant level sensor and circuit.

STEP 2A: Inspect the engine coolant level sensor and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant level sensor from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and engine coolant level sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the circuit response.

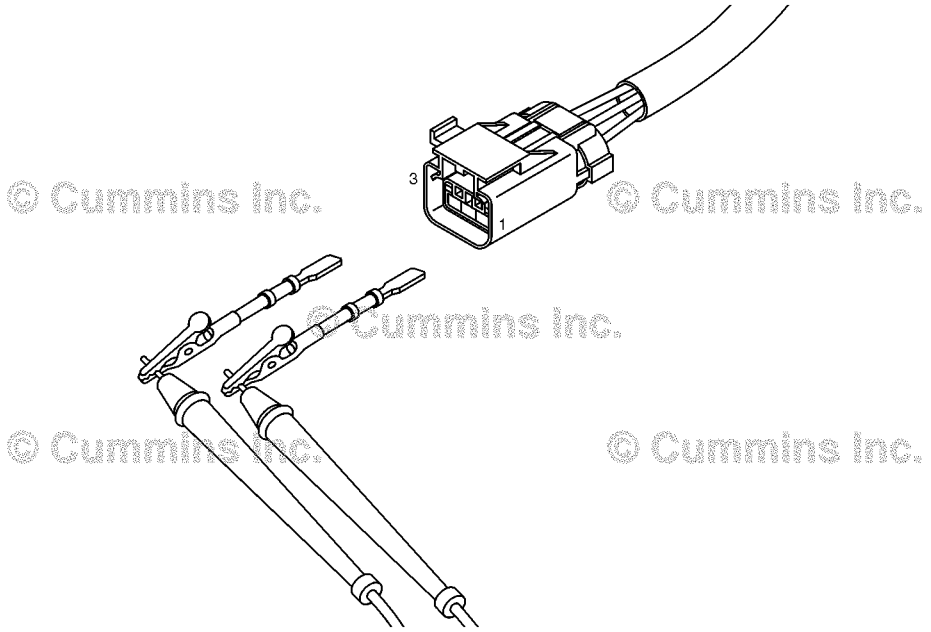
Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant level sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 196 active and Fault Code 195 inactive? **YES**	2C
	Fault Code 196 active and Fault Code 195 inactive? **NO**	3A

STEP 2C: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant level sensor from the OEM harness.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage between the engine coolant level sensor SUPPLY pin and the engine coolant level sensor RETURN pin at the engine coolant level sensor connector of the OEM harness. Refer to the circuit diagram or the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	2D
	4.75-VDC to 5.25-VDC? **NO**	3A



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

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

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 195 active? **YES** **Repair:** A damaged sensor has been detected. Replace the engine coolant level sensor. Refer to Procedure 019-017 in Section 19.	4A
	Fault Code 195 active? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	4A

STEP 3: Check the ECM and OEM harness.

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

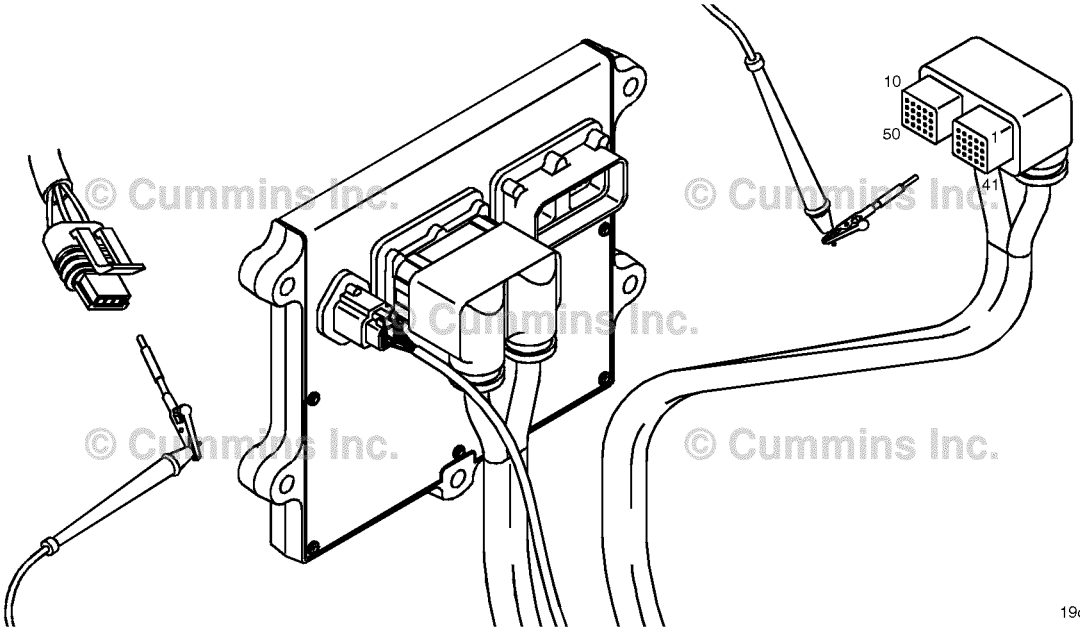
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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 engine coolant level sensor from the OEM harness.

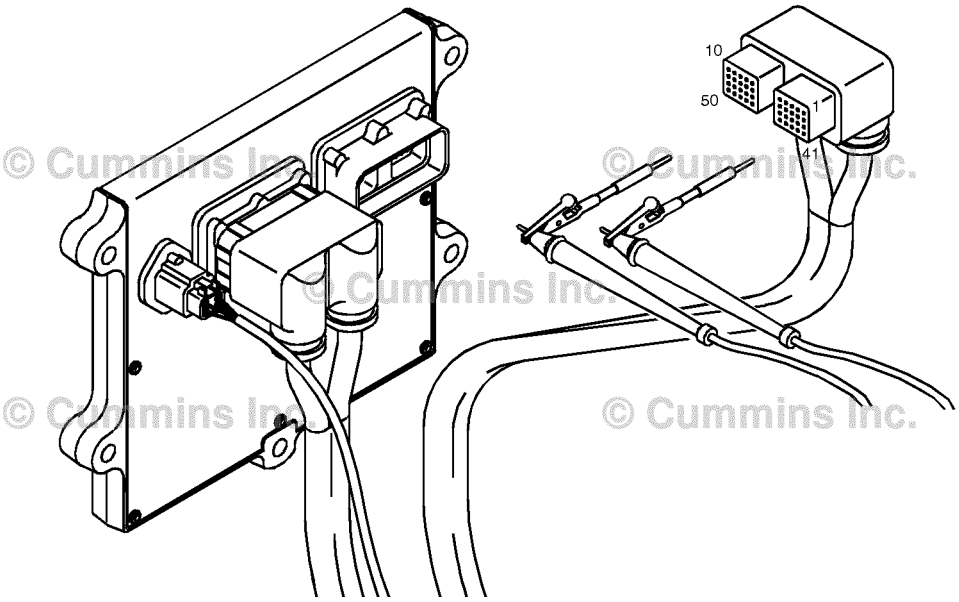
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector engine coolant level sensor RETURN pin and the OEM harness engine coolant level sensor connector RETURN pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3C
	Less than 10 ohms? **NO** **Repair:** An open RETURN circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. 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 engine coolant level sensor from the OEM harness.

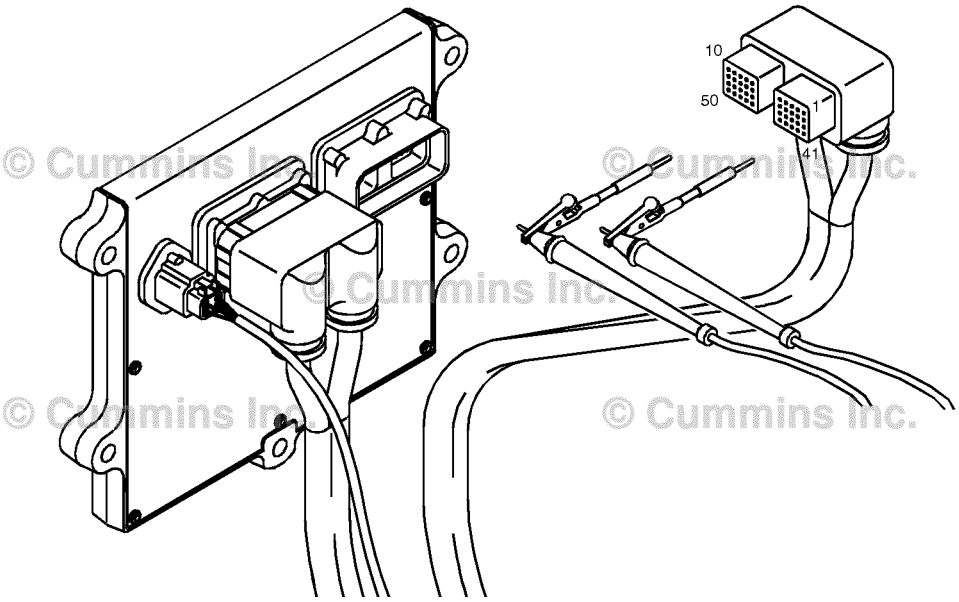
Action	Specification/Repair	Next Step
Check for a pin-to-pin short circuit. • Measure the resistance between the engine coolant level sensor SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM harness ECM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3D
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the OEM harness. 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 form the ECM connector.
- Disconnect the engine coolant level sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short circuit. • Measure the resistance between the engine coolant level sensor SUPPLY pin in the OEM harness ECM connector and all other pins in the OEM harness ECM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SUPPLY line has been detected in the OEM harness. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 195 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 195 inactive? **NO** **Repair:** Troubleshooting procedures need to be repeated from the beginning.	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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 195 inactive? **YES**	4B
	Fault Code 195 inactive? **NO** **Repair:** Return to the appropriate 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.

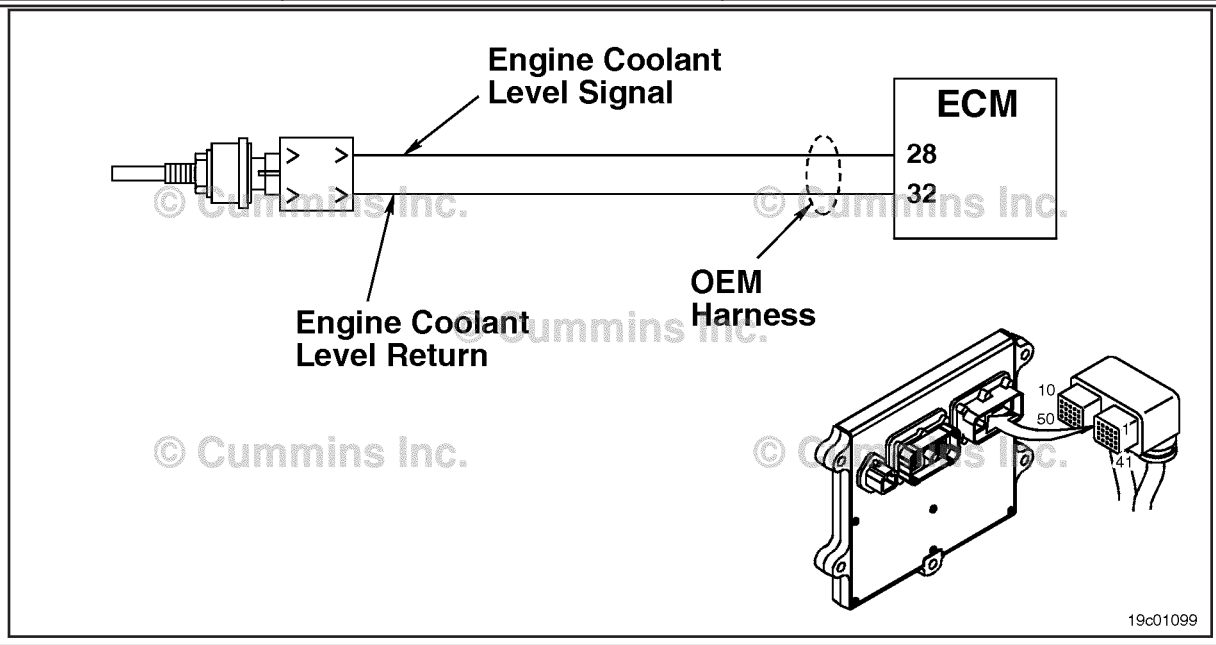
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 196 - Two Wire Sensor

Coolant Level Sensor 1 Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 196 PID(P), SID(S): P111 SPN: 111 FMI: 4/4 Lamp: Amber SRT:	Coolant Level Sensor 1 Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at the engine coolant level circuit.	None on performance.



Engine Coolant Level Sensor Circuit

Circuit Description:

The engine coolant level sensor monitors the engine coolant level within the coolant system and passes information to the electronic control module (ECM) through the OEM harness.

Component Location:

The engine coolant level sensor is typically located in the radiator top tank or surge tank. Refer to the OEM troubleshooting and repair manual for location.

Shop Talk:

Possible causes of this fault code include:

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

Refer to Troubleshooting Fault Code t05-196

FAULT CODE 196 - Two Wire Sensor - Coolant Level Sensor 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 196 active?**	
STEP 2:	**Check the engine coolant level sensor and circuit.**		
STEP 2A:	**Inspect the engine coolant level sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the circuit response.**	**Fault Code 195 active and Fault Code 196 inactive?**	
STEP 2C:	**Check the fault codes and verify sensor condition.**	**Fault Code 196 is active?**	
STEP 3:	**Check the 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 short circuit to ground in the OEM harness.**	**Greater than 100k ohms?**	
STEP 3D:	**Check for an inactive fault code.**	**Fault Code 196 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 196 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 196 active? **YES**	2A
	Fault Code 196 active? **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 coolant level sensor and circuit.

STEP 2A: Inspect the engine coolant level sensor and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant level sensor from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check the circuit response.

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

Action	Specification/Repair	Next Step
Check for an appropriate ECM response after 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 195 active and Fault Code 196 inactive? **YES**	2C
	Fault Code 195 active and Fault Code 196 inactive? **NO**	3A

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

Condition:
- Turn keyswitch OFF.
- Connect the engine coolant level sensor to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 196 is active? **YES** **Repair:** A damaged engine coolant level sensor has been detected. Replace the engine coolant level sensor. Refer to Procedure 019-017 in Section 19.	4A
	Fault Code 196 is active? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	4A

STEP 3: Check the OEM harness.

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

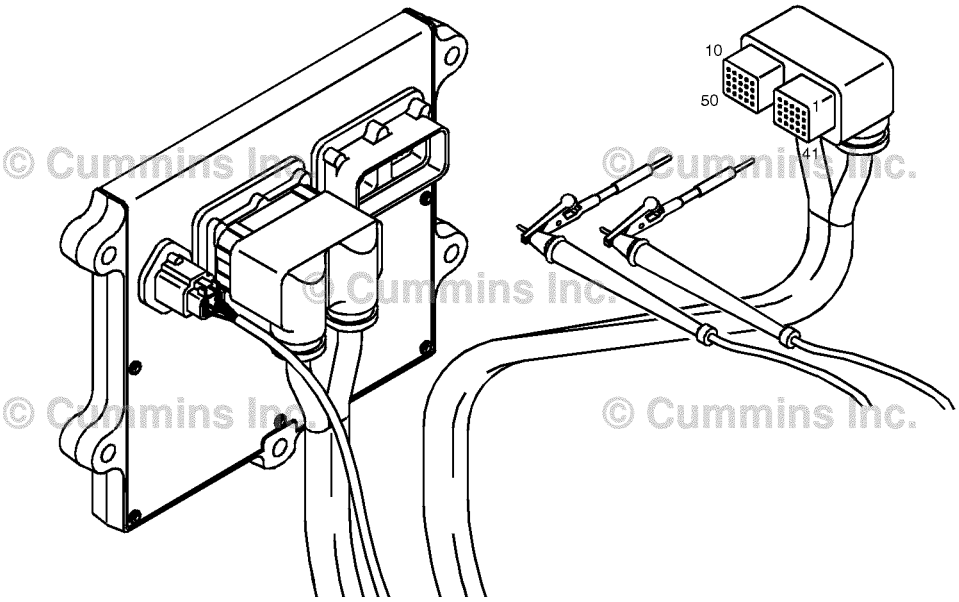
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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 engine coolant level sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance and check for a short circuit between the engine coolant level SIGNAL pin at the OEM harness ECM connector and all other pins in the connector. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3C
	Greater than 100k ohms? **NO** **Repair:** A short circuit between pins has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



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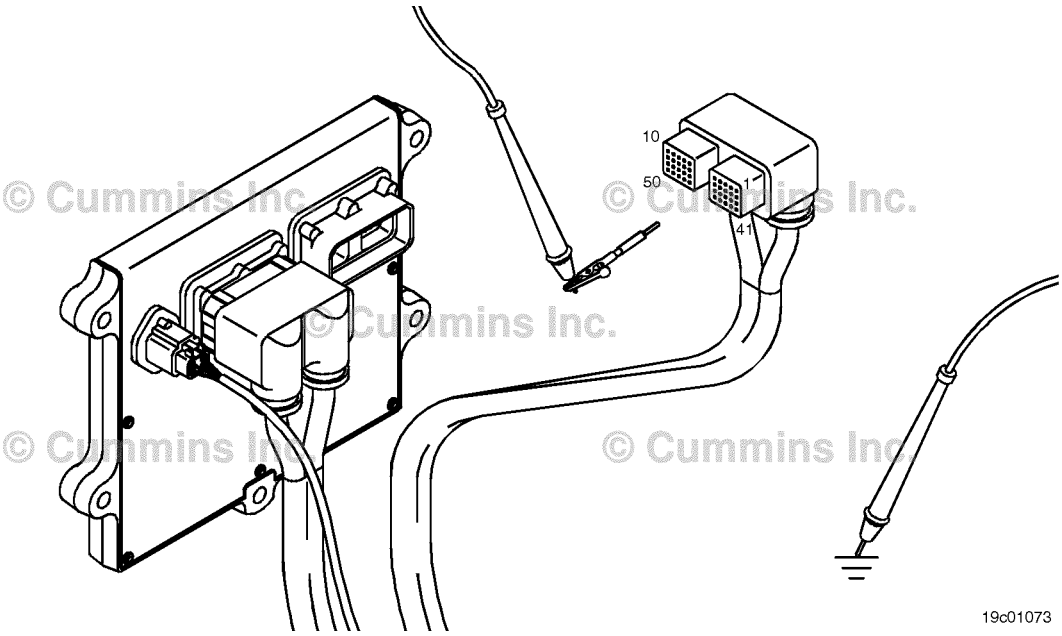
STEP 3C: Check for a pin short circuit to ground in the OEM harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the engine coolant level sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin short to ground. • Measure the resistance and check for a short circuit between the engine coolant level sensor SIGNAL pin at the OEM harness ECM connector and engine block ground. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3D
	Greater than 100k ohms? **NO** **Repair:** A short circuit to ground has been detected in the OEM harness. 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 ECM response after one minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 196 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 196 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool, verify that the fault code is inactive.	Fault Code 196 inactive? **YES**	4B
	Fault Code 196 inactive? **NO** **Repair:** 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.

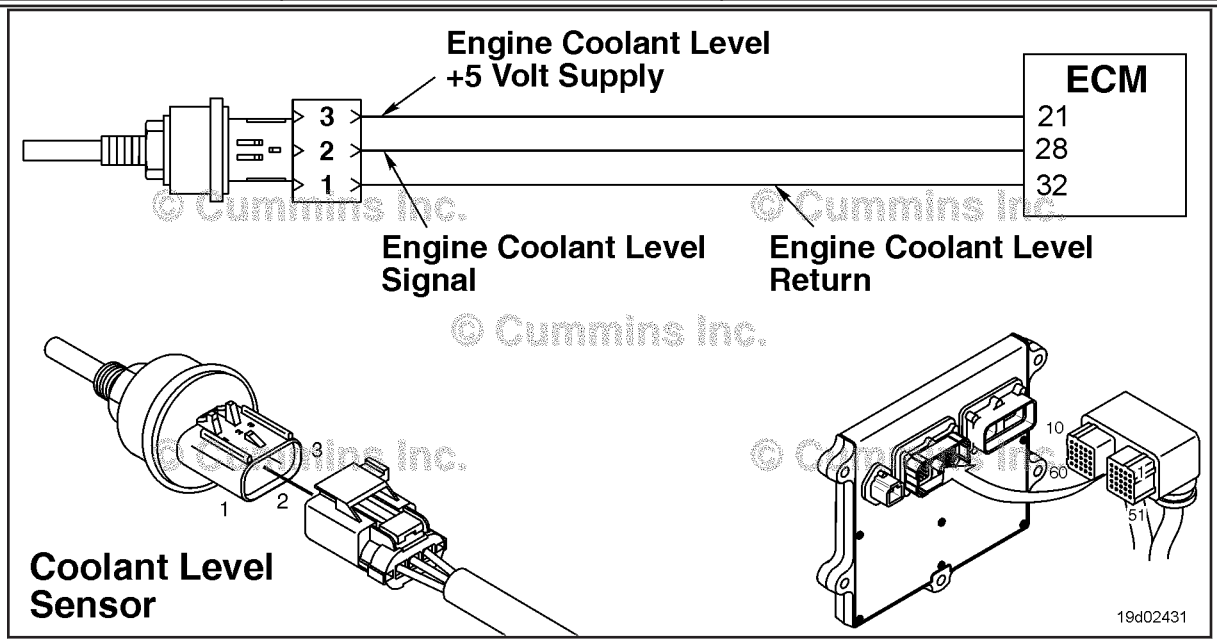
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 196 - Three Wire Sensor

Coolant Level Sensor 1 Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 196 PID(P), SID(S): P111 SPN: 111 FMI: 4/4 Lamp: Amber SRT:	Coolant Level Sensor 1 Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at engine coolant level circuit.	None on performance.



Coolant Level Sensor 1 Circuit

Circuit Description:

The electronic control module (ECM) provides a 5 volt supply to the engine coolant level sensor using a common sensor supply circuit. The ECM also provides a ground on the sensor return circuit. The engine coolant level sensor provides a signal to the ECM on the engine coolant level sensor SIGNAL circuit. This sensor signal voltage changes based on the coolant level in the expansion tank.

Component Location:

The engine coolant level sensor is typically located in the radiator top tank or surge tank. Refer to the OEM troubleshooting and repair manual for location.

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 the coolant level signal voltage is less than 0.5-VDC for more than 1 second.

Action Taken When the Fault Code is Active:

- The ECM illuminates the amber CHECK ENGINE light immediately when the diagnostic runs and fails.
- No engine protection will be available for low coolant level.

Conditions for Clearing the Fault Code:

The ECM will turn off the amber CHECK ENGINE light immediately after the diagnostic runs and passes.

Shop Talk:

Possible causes of this fault code include:

- Open SIGNAL circuit in the engine harness, connectors, or sensor
- Signal circuit shorted to ground in the engine harness, connector, or sensor
- Damaged sensor.

Refer to Troubleshooting Fault Code t05-196

FAULT CODE 196 - Three Wire Sensor - Coolant Level Sensor 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 3164133 - 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 352 active?	
STEP 1B:	Check for an inactive fault code.	Fault Code 196 inactive?	
STEP 2:	**Check the engine coolant level sensor and circuit.**		
STEP 2A:	Inspect the engine coolant level sensor and electrical connections.	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 195 active and Fault Code 196 inactive?	
STEP 2D:	Check the fault codes and verify sensor condition.	Fault Code 196 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.	Greater than 100k ohms.	
STEP 3F:	Check for an inactive fault code.	Fault Code 196 inactive?	
STEP 4:	**Clear the fault code.**		
STEP 4A:	Disable the fault code.	Fault Code 196 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 352 active? **YES**	Refer to Fault Code 352
	Fault Code 352 active? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 196 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 196 inactive? **NO**	2A

STEP 2: Check the engine coolant level sensor and circuit.

STEP 2A: Inspect the engine coolant level sensor and electrical connections.

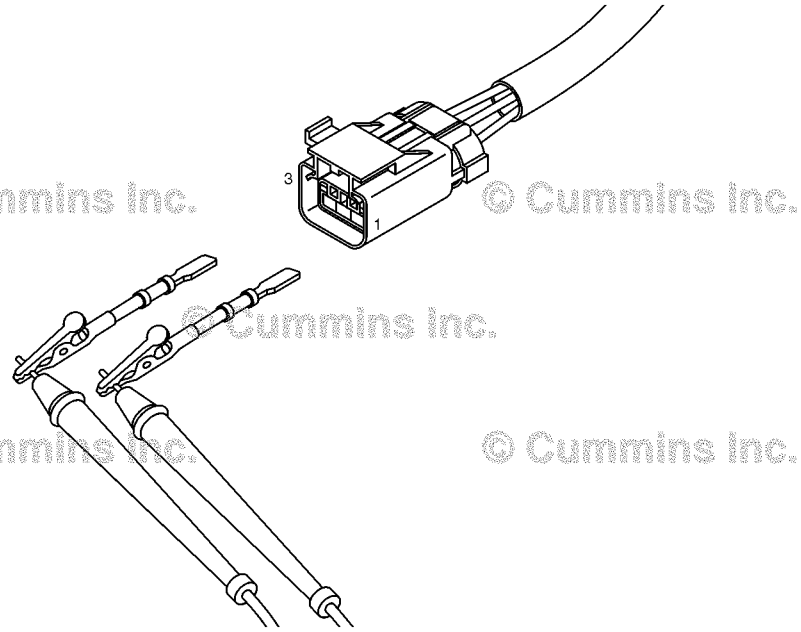
Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant level sensor from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and engine coolant level sensor connections for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant level sensor from the OEM harness.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage between the engine coolant level SUPPLY pin and the engine coolant level RETURN pin at the engine coolant level sensor connector of the OEM harness. Refer to the circuit diagram or the wiring diagram for connector pin identification.	4.75 to 5.25-VDC? **YES**	2C
	4.75 to 5.25-VDC? **NO**	3A



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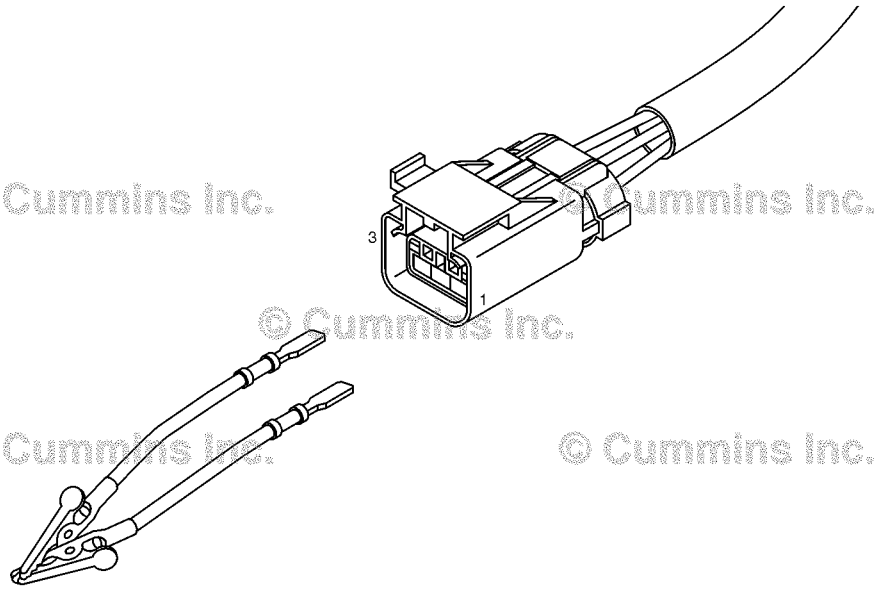
STEP 2C: Check the circuit response.

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

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Place a jumper wire between the engine coolant level sensor SUPPLY pin and the engine coolant level sensor SIGNAL pin at the engine coolant level sensor connector of the OEM harness. • Use INSITE™ electronic service tool to read the fault codes. Refer to the circuit diagram or wiring diagram for connector pin identification.	Fault Code 195 active and Fault Code 196 inactive? **YES**	2D
	Fault Code 195 active and Fault Code 196 inactive? **NO**	3A



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

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

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 196 active? **YES** **Repair:** A damaged sensor has been detected. Replace the engine coolant level sensor. Refer to Procedure 019-017 in Section 19.	4A
	Fault Code 196 active? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	4A

STEP 3: Check the ECM and OEM harness.

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

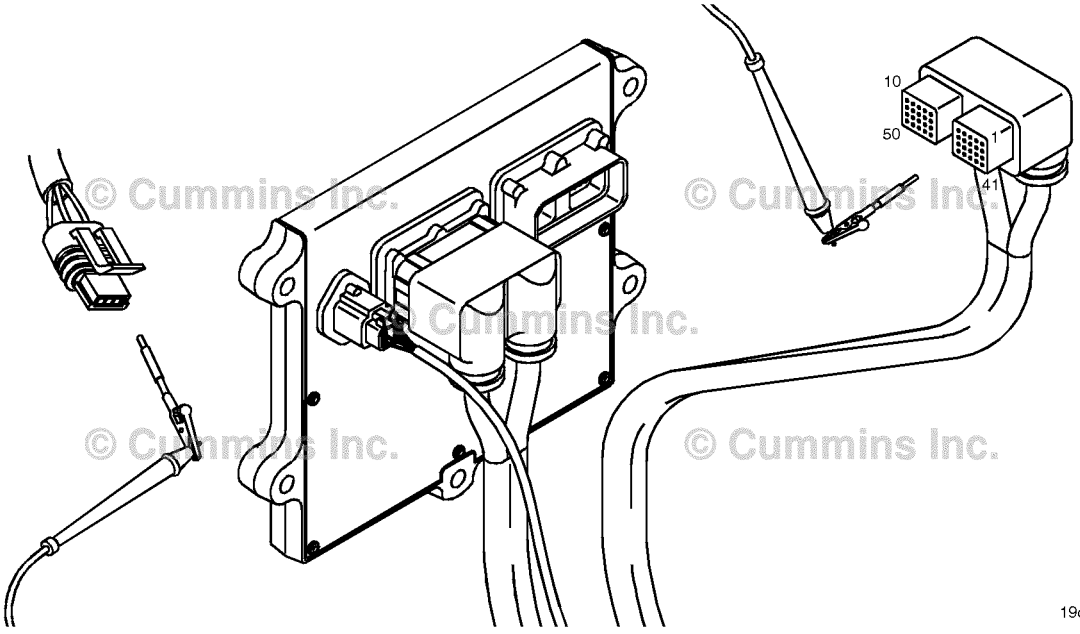
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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 engine coolant level sensor from the OEM harness.

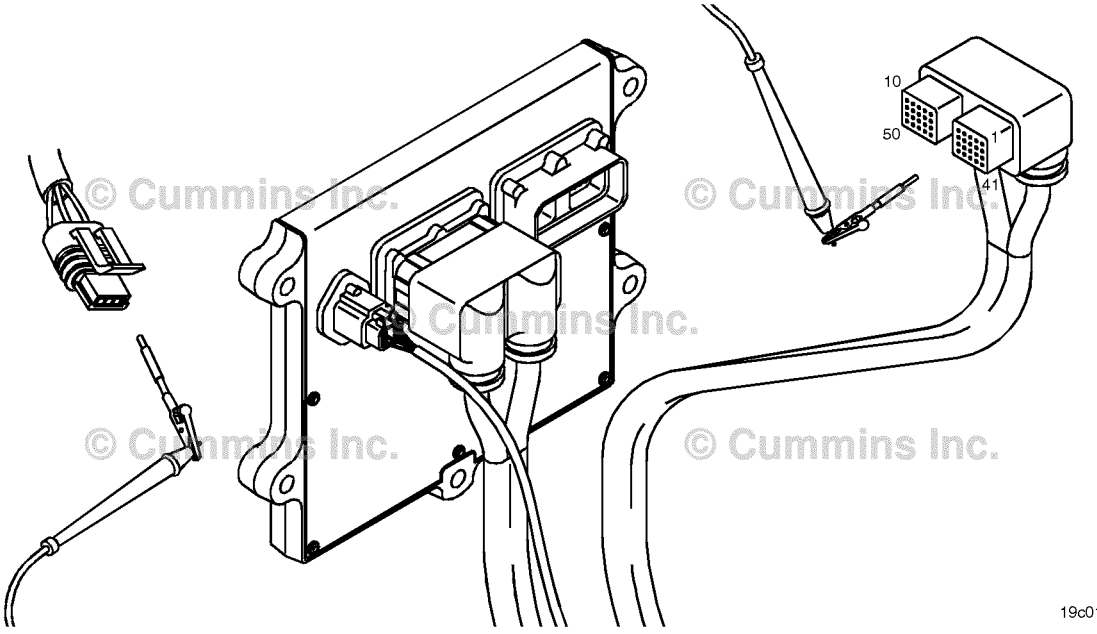
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector engine coolant level sensor SUPPLY pin and the OEM harness engine coolant level sensor connector SUPPLY pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3C
	Less than 10 ohms? **NO** **Repair:** An open SUPPLY circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. 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 engine coolant level sensor from the OEM harness.

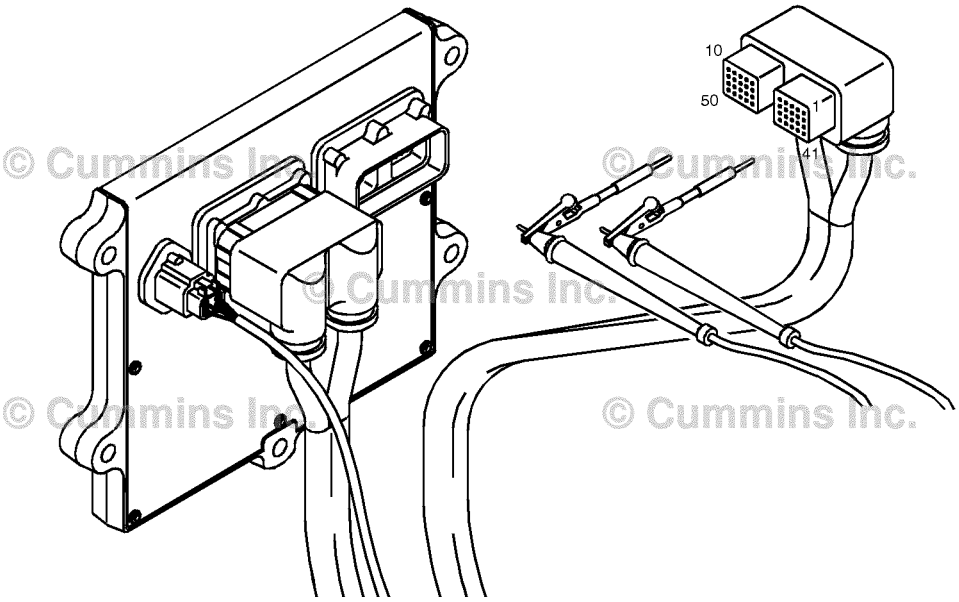
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector engine coolant level sensor SIGNAL pin and the OEM harness engine coolant level sensor connector SIGNAL pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10k ohms? **YES**	3D
	Less than 10k ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. 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 engine coolant level sensor from the OEM harness.

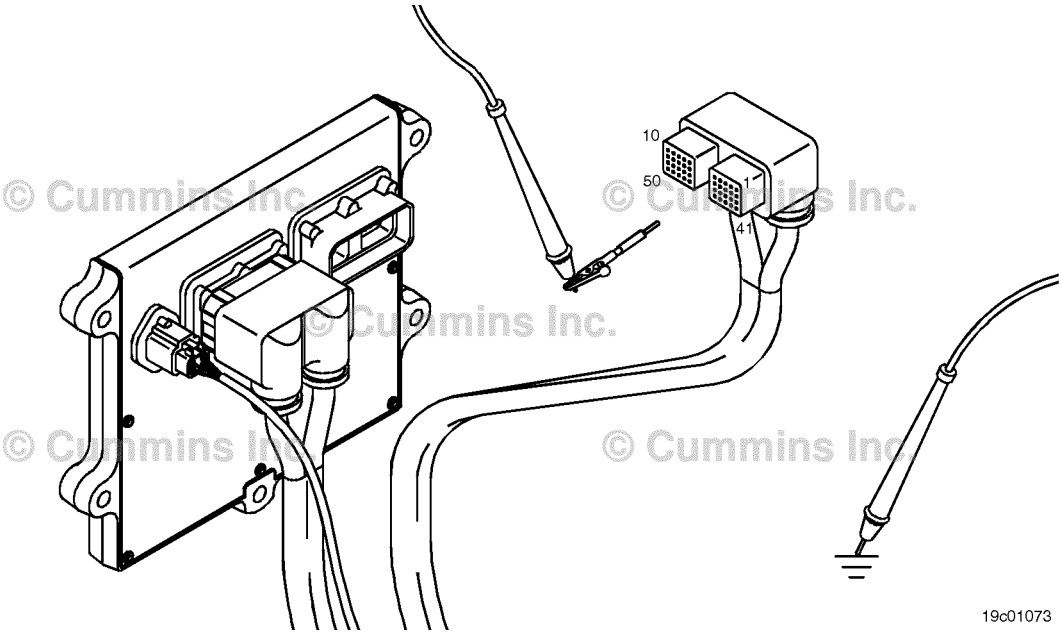
Action	Specification/Repair	Next Step
Check for a pin-to-pin short circuit. • Measure the resistance between the engine coolant level sensor SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM harness ECM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL wire has been detected in the OEM harness. 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.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.
- Disconnect the engine coolant level sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin-to-ground short circuit. • Measure the resistance between the engine coolant level sensor SIGNAL pin in the OEM harness ECM connector and ground. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3F
	Greater than 100k ohms? **NO** **Repair:** A pin-to-ground short circuit on the SIGNAL wire has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the shorted SIGNAL circuit to ground. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 196 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 196 inactive? **NO** **Repair:** 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.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 196 inactive? **YES**	4B
	Fault Code 196 inactive? **NO** **Repair:** 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.

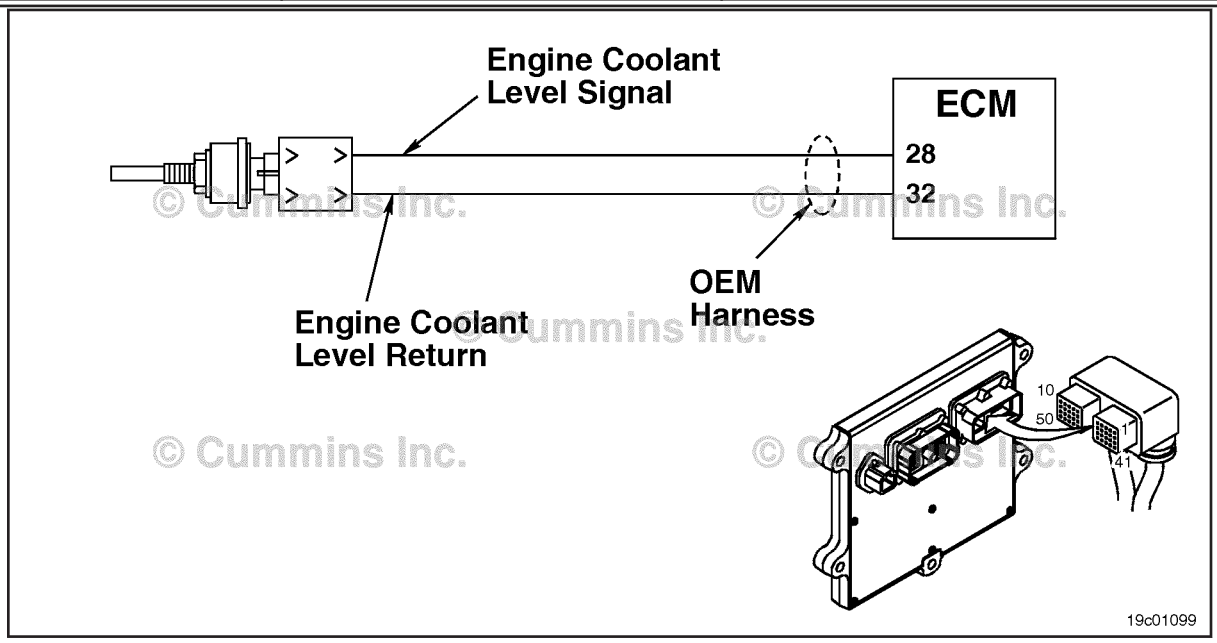
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 197

Coolant Level - Data Valid but Below Normal Operational Range - Moderately Severe Level

CODES	REASON	EFFECT
Fault Code: 197 PID(P), SID(S): P111 SPN: 111 FMI: 1/18 Lamp: Amber SRT:	Coolant Level - Data Valid but Below Normal Operational Range - Moderately Severe Level. Low engine coolant level detected.	None on performance.



Engine Coolant Level

Circuit Description:

The engine coolant level sensor monitors the engine coolant level within the coolant system and passes information to the electronic control module (ECM) through the OEM harness.

Component Location:

The engine coolant level sensor is typically located in the radiator top tank or surge tank. Refer to the OEM service manual for the location.

Shop Talk:

This fault code goes active when the coolant level inside the radiator top tank or surge tank drops below the sensor level. Fill the top tank with coolant.

Refer to Troubleshooting Fault Code t05-197

FAULT CODE 197 - Coolant Level - Data Valid but Below Normal Operational Range - Moderately Severe Level

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 197.	**Active or inactive counts of Fault Code 197?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 197.

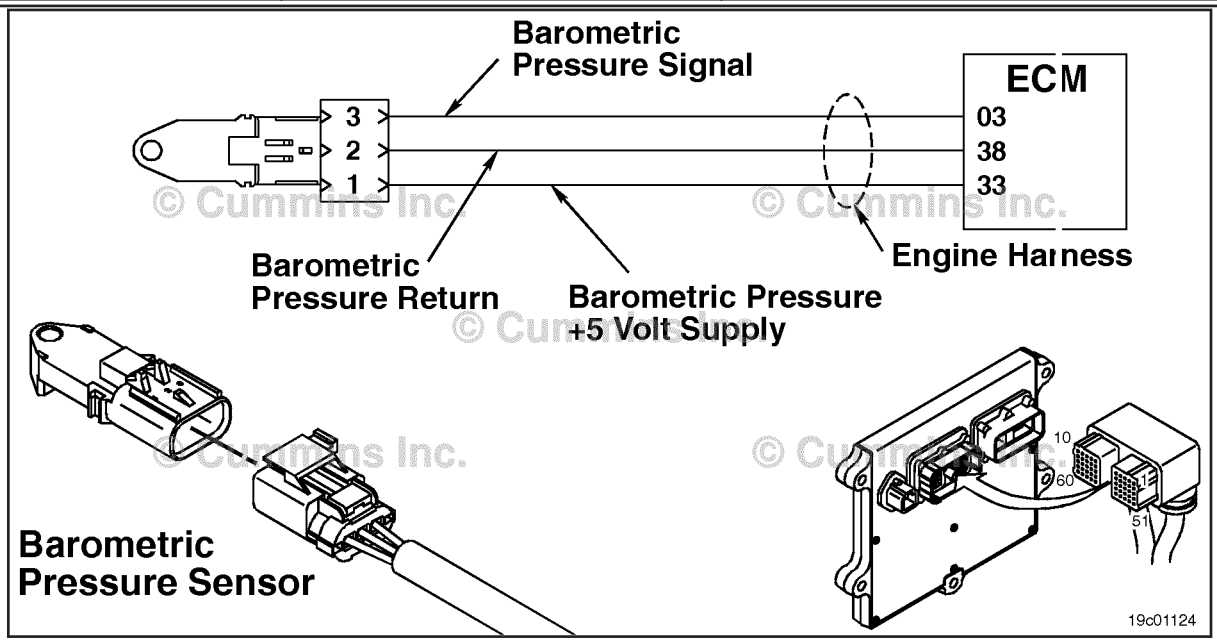
Condition:
- Turn keyswitch ON.
- Connect INSITE™ the electronic service tool.

Action	Specification/Repair	Next Step
Check for fault codes. • Use INSITE™ the electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 197? **YES** **Repair:** Add coolant to the engine. • Use the following procedure in the ISC, QSC8.3, ISL, and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418 or the ISB^{e} and ISB (Common Rail Fuel System) Series Engines, Bulletin 4021271. Refer to Procedure 008-018 in Section 8. If Fault Code 197 is active and the coolant level is **not** low, a malfunctioning coolant level sensor is a likely cause. Refer to the OEM service manual before replacing the coolant level sensor.	Repair complete.
	Active or inactive counts of Fault Code 197? **NO**	Repair complete

Fault Code 221

Barometric Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 221 PID(P), SID(S): P108 SPN: 108 FMI: 3/3 Lamp: Amber SRT:	Barometric Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage detected at barometric pressure circuit.	Engine power derate.



Barometric Pressure Sensor Circuit

Circuit Description:

The barometric pressure sensor is used by the ECM to monitor the barometric pressure. This value is one of many inputs used by the ECM to determine the correct air/fuel ratio for proper engine operation.

Component Location:

The barometric pressure sensor is mounted on the main branch of the engine harness near the ECM. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

Shop Talk:

The barometric pressure 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 221, check for multiple faults.

Possible causes of this fault code include:

- Open return circuit in the harness, connectors, or sensor
- Signal circuit shorted to sensor supply or battery voltage.

Operation below sea level:

- Note: If you have equipment that operates below sea level (such as in a mining operation) and your equipment continues to log Fault Code 221, contact Cummins® Service Engineering for the correct calibration.

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.

Refer to Troubleshooting Fault Code t05-221

FAULT CODE 221 - Barometric 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 3164596 - male Framatome™ 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 386 active?**	
STEP 1B:	**Check for an inactive fault code.**	**Fault Code 221 inactive?**	
STEP 2:	**Check the barometric pressure sensor and circuit.**		
STEP 2A:	**Inspect the barometric pressure sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the circuit response.**	**Fault Code 222 active and Fault Code 221 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 221 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 engine control module response.**	**Fault Code 222 active and Fault Code 221 inactive?**	
STEP 3A-2:	**Check for an active fault code.**	**Fault Code 221 inactive?**	
STEP 3B:	**Inspect 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 active fault code.**	**Fault Code 221 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 221 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 386 active? **YES**	Refer to Fault Code 386
	Fault Code 386 active? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 221 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 221 inactive? **NO**	2A

STEP 2: Check the barometric pressure sensor and circuit.

STEP 2A: Inspect the barometric pressure sensor and connector pins.

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

Action	Specification/Repair	Next Step
Inspect the engine harness and barometric pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the circuit response.

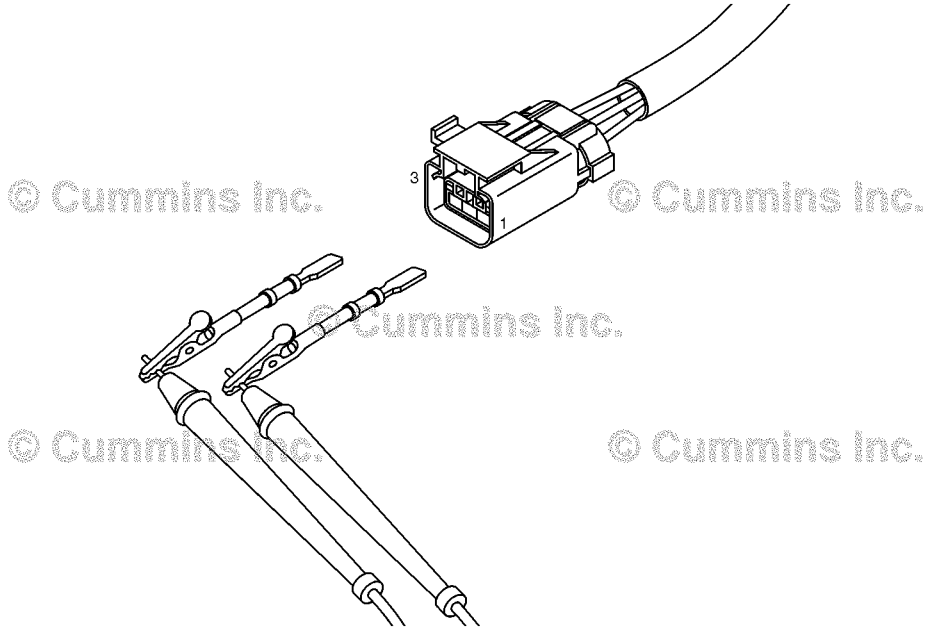
Condition:
- Turn keyswitch OFF
- Disconnect the barometric pressure sensor from the engine harness
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 222 active and Fault Code 221 inactive? **YES**	2C
	Fault Code 222 active and Fault Code 221 inactive? **NO**	3A

STEP 2C: Check the sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the barometric pressure +5 volt SUPPLY pin to the barometric pressure RETURN pin at the sensor connector of the engine harness. Refer to the circuit diagram or wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	2D
	4.75-VDC to 5.25-VDC? **NO**	3B



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

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

Action	Specification/Repair	Next Step
Check the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 221 active? **YES** **Repair:** A damaged sensor has been detected. Replace the barometric air pressure sensor. Refer to Procedure 019-004 in Section 19.	4A
	Fault Code 221 active? **NO** **Repair:** 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 the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. • Refer to Procedure 019-043 in Section 19. • Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A
	Dirty or damaged pins? **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
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 222 active and Fault Code 221 inactive? **YES**	3A-2
	Fault Code 222 active and Fault Code 221 inactive? **NO** **Repair:** 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 for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 221 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 221 inactive? **NO** **Repair:** A pin-to-pin short circuit has been detected on the signal line of the engine harness. 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.

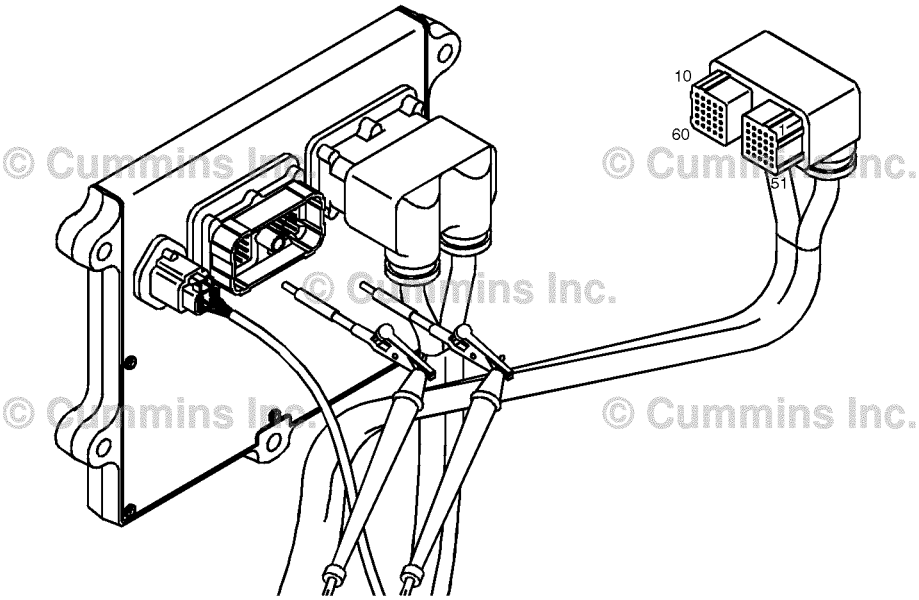
Condition:
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. • Refer to Procedure 019-043 in Section 19. • Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A
	Dirty or damaged pins? **NO**	3B-1

STEP 3B-1: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF
- Disconnect the engine harness from the engine control module engine connector
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the barometric pressure +5 volt SUPPLY pin to the barometric pressure RETURN pin at the engine control module engine connector. Refer to the circuit diagram or wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	3B-2
	4.75-VDC to 5.25-VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 221 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 221 inactive? **NO** **Repair:** An open RETURN circuit has been detected in the engine harness. 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 221 inactive? **YES**	4B
	Fault Code 221 inactive? **NO** **Repair:** 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.

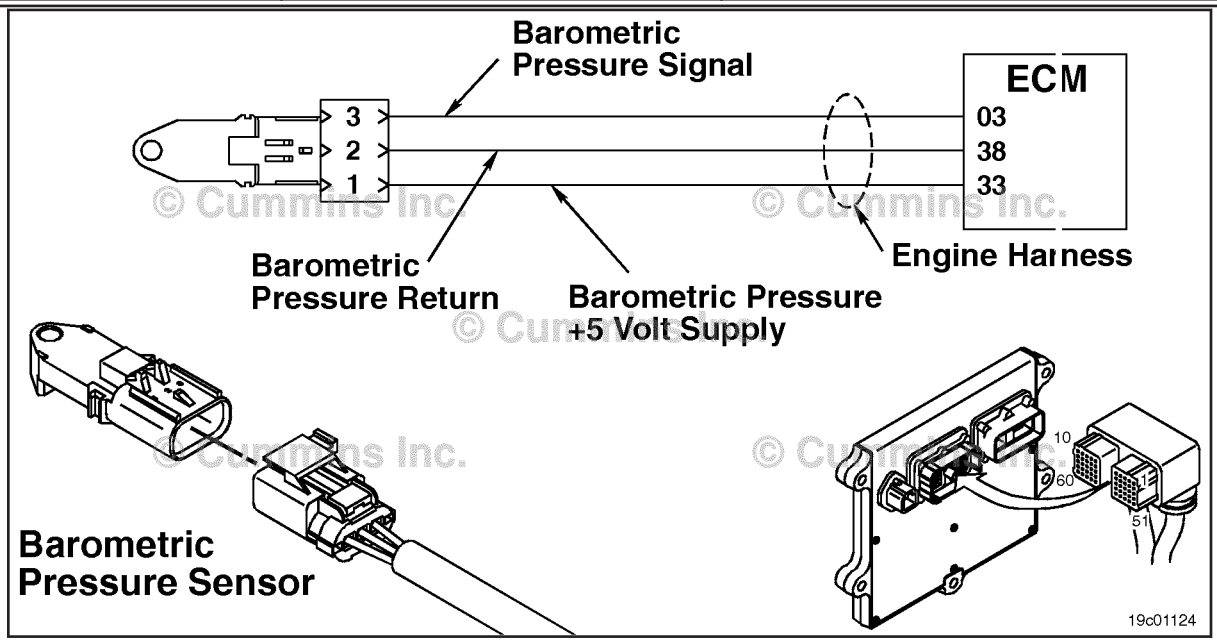
Condition:
- Connect all components
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

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

Fault Code 222

Barometric Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 222 PID(P), SID(S): P108 SPN: 108 FMI: 4/4 Lamp: Amber SRT:	Barometric Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at barometric pressure circuit.	Engine power derate.



Barometric Pressure Sensor Circuit

Circuit Description:

The barometric pressure sensor is used by the electronic control module (ECM) to monitor the barometric pressure. This value is one of many inputs used by the ECM to determine the correct air/fuel ratio for proper engine operation.

Component Location:

The barometric pressure sensor is mounted on the main branch of the engine harness near the ECM. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

The barometric pressure 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 222, 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 t05-222

FAULT CODE 222 - Barometric 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 3164596 - male Framatome test leadPart 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?**	
STEP 1B:	**Check for an inactive fault code.**	**Fault Code 222 inactive?**	
STEP 2:	**Check the barometric pressure sensor and circuit.**		
STEP 2A:	**Inspect the barometric 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 221 active and Fault Code 222 inactive?**	
STEP 2D:	**Check the fault codes and verify sensor condition.**	**Fault Code 222 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 active fault code.**	**Fault Code 222 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 221 active and Fault Code 222 inactive?**	
STEP 3B-2:	**Check for an active fault code.**	**Fault Code 222 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 222 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 352 active? **YES**	Refer to Fault Code 352
	Fault Code 352 active? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 222 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 222 inactive? **NO**	2A

STEP 2: Check the barometric pressure sensor and circuit.

STEP 2A: Inspect the barometric pressure sensor and connector pins.

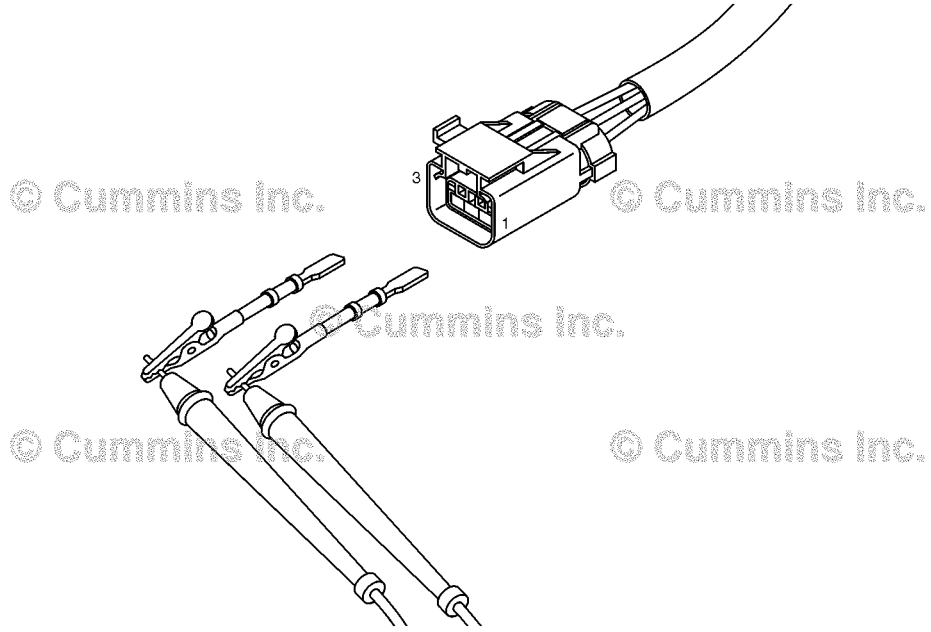
Condition:
- Turn keyswitch OFF.
- Disconnect the barometric pressure sensor from the engine harness.

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

STEP 2B: Check the sensor supply voltage and return circuit.

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

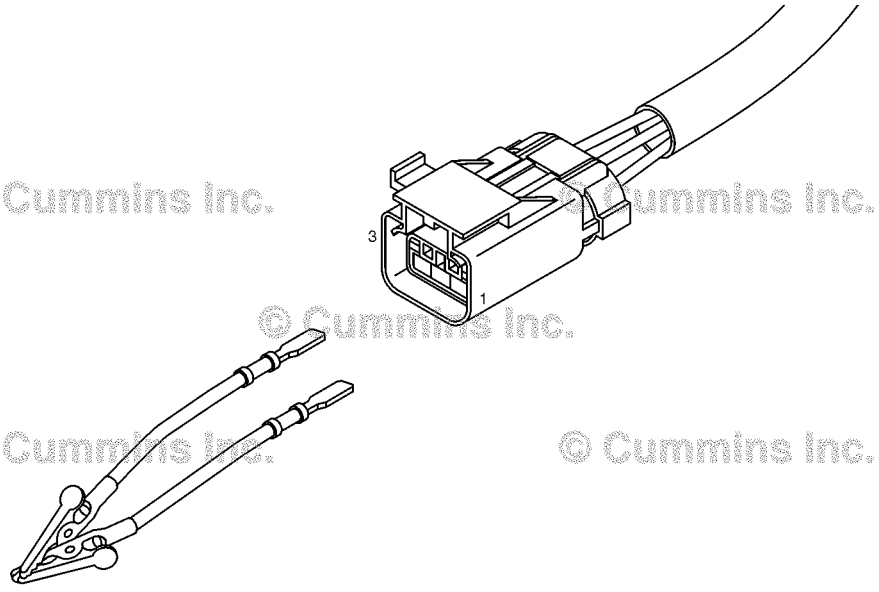
Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the barometric pressure +5 volt SUPPLY pin to the barometric pressure RETURN pin at the sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	2C
	4.75 to 5.25 VDC? **NO**	3A



STEP 2C: 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
Place a jumper wire between the barometric pressure +5 volt SUPPLY pin and the barometric pressure SIGNAL pin at the barometric pressure sensor connector of the engine harness. Refer to the wiring diagram for connector pin identification. Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 221 active and Fault Code 222 inactive? **YES**	2D
	Fault Code 221 active and Fault Code 222 inactive? **NO**	3B



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

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

Action	Specification/Repair	Next Step
Check the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 222 active? **YES** **Repair:** A damaged sensor has been detected. Replace the barometric pressure sensor. Refer to Procedure 019-004 in Section 19.	4A
	Fault Code 222 active? **NO** **Repair:** 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.

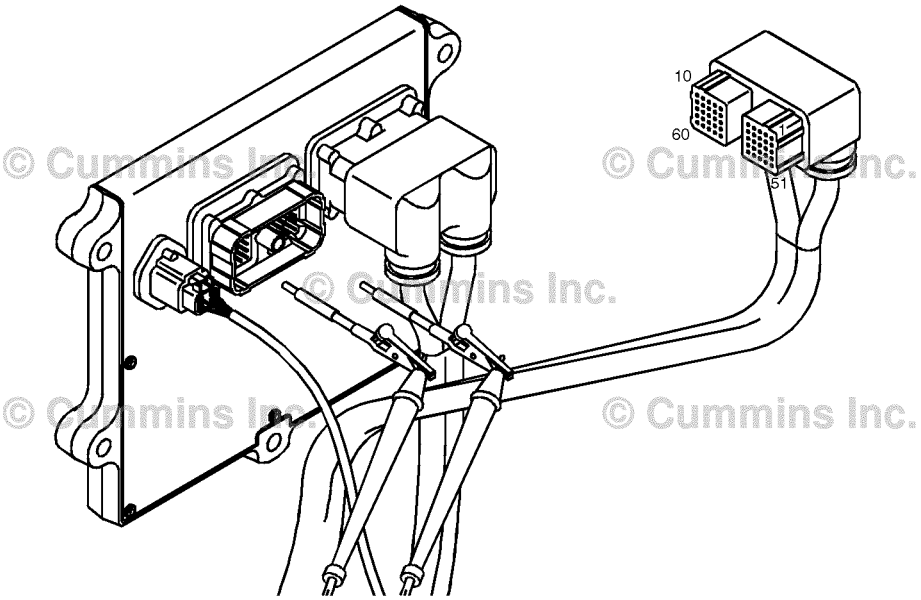
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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. • Measure the voltage from the barometric pressure +5 volt SUPPLY pin to the barometric pressure RETURN pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	3A-2
	4.75 to 5.25 VDC? **NO** **Repair:** 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 for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 222 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 222 inactive? **NO** **Repair:** An open or shorted SUPPLY circuit has been detected in the engine harness. 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.

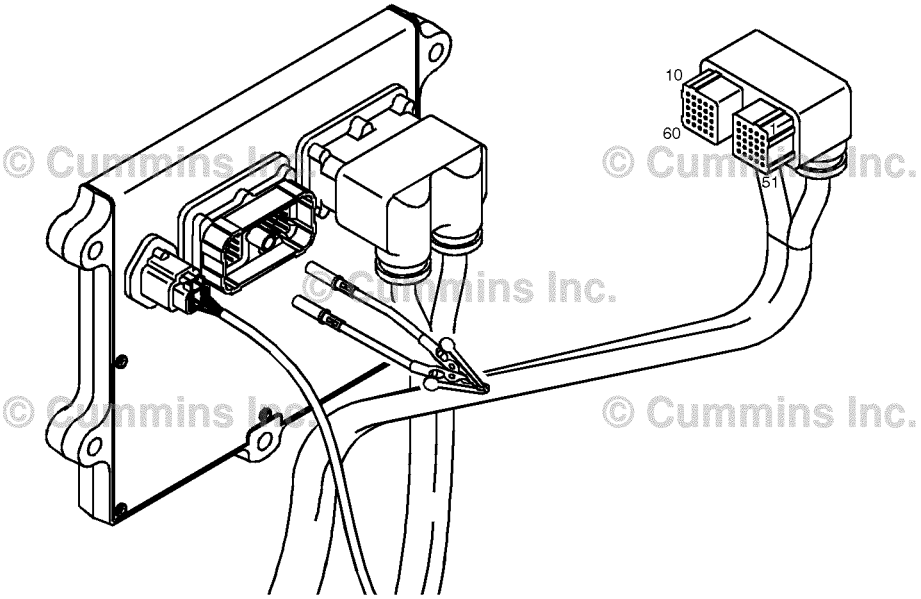
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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
Place a jumper wire between the barometric pressure +5 volt SUPPLY pin and the barometric pressure SIGNAL pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification. Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 221 active and Fault Code 222 inactive? **YES**	3B-2
	Fault Code 221 active and Fault Code 222 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 222 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 222 inactive? **NO** **Repair:** An open RETURN or a pin-to-pin short circuit has been detected on the signal line of the engine harness. 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 222 inactive? **YES**	4B
	Fault Code 222 inactive? **NO** **Repair:** 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.

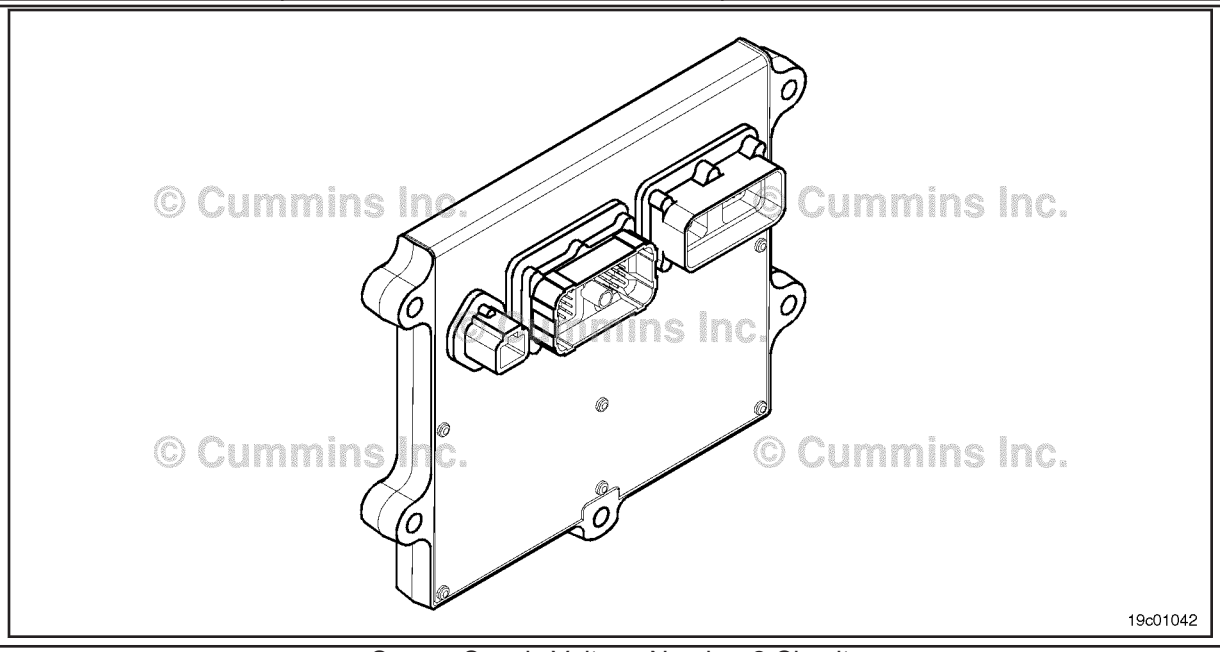
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 227 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine)

Sensor Supply 2 Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 227 PID(P), SID(S): S232 SPN: 1080 FMI: 3/3 Lamp: Amber SRT:	Sensor Supply 2 Circuit - Voltage Above Normal or Shorted to High Source. High voltage detected at sensor supply number 2 circuit.	Automotive application: Engine power derate. Marine application: None, no engine protection for circuit or sensor failure.



Sensor Supply Voltage Number 2 Circuit

Circuit Description:

The sensor supply number 2 pin of the electronic control module (ECM) provides +5 VDC for the camshaft engine position sensor, intake manifold pressure sensor, and rail fuel pressure sensor. ISB and QSB5.9 use a combined intake manifold pressure/temperature sensor.

Component Location:

Sensor supply voltage number 2 is located inside the ECM. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

High voltage on the +5 VDC supply line can be caused by a signal shorted to battery voltage in the engine harness or connectors, or a failed ECM.

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 t05-227

FAULT CODE 227 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial, and Marine) - Sensor Supply 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.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for an active fault code.**	**Fault Code 227 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 227 active?**	
STEP 3:	**Clear the fault codes.**		
STEP 3A:	**Disable the fault code.**	**Fault Code 227 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 227 active? **YES**	2A
	Fault Code 227 active? **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 sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broke • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 227 active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	3A
	Fault Code 227 active? **NO** **Repair:** Repair or replace the engine harness. Refer to Procedure 019-043 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 227 inactive? **YES**	3B
	Fault Code 227 inactive? **NO** **Repair:** 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.

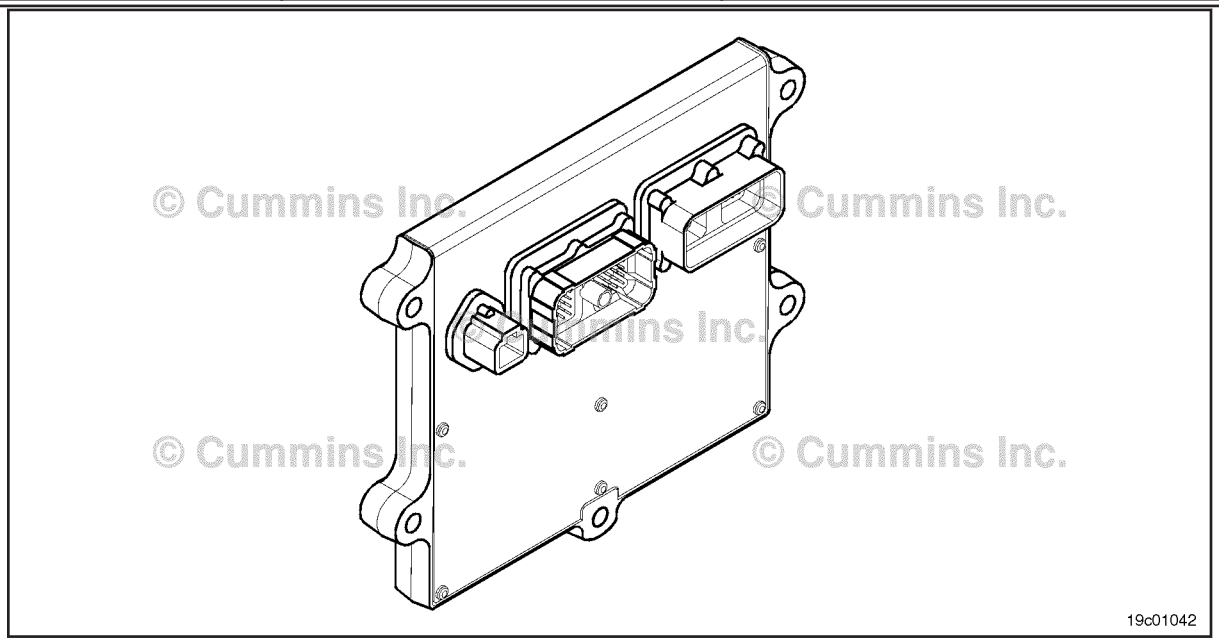
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 227 (QSB Marine Application)

Sensor Supply 2 Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 227 PID(P), SID(S): S232 SPN: 1080 FMI: 3/3 Lamp: Amber SRT:	Sensor Supply 2 Circuit - Voltage Above Normal or Shorted to High Source. High voltage detected at sensor supply number 2 circuit.	Marine application: None, no engine protection for circuit or sensor failure.



Sensor Supply Voltage Number 2 Circuit

Circuit Description:

The sensor supply number 2 pin of the electronic control module (ECM) provides +5 VDC for the intake manifold pressure sensor, and rail fuel pressure sensor. ISB and QSB5.9 use a combined intake manifold pressure/ temperature sensor.

Component Location:

Sensor supply voltage number 2 is located inside the ECM. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

High voltage on the +5 VDC supply line can be caused by a signal shorted to battery voltage in the engine harness or connectors, or a failed ECM.

Refer to Troubleshooting Fault Code t05-227

FAULT CODE 227 (QSB Marine Application) - Sensor Supply 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.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for an active fault code.**	**Fault Code 227 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 227 active?**	
STEP 3:	**Clear the fault codes.**		
STEP 3A:	**Disable the fault code.**	**Fault Code 227 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 227 active? **YES**	2A
	Fault Code 227 active? **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 sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broke • Wire insulation damage • Damaged locking tab connector.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 227 active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	3A
	Fault Code 227 active? **NO** **Repair:** Repair or replace the engine harness. Refer to Procedure 019-043 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 227 inactive? **YES**	3B
	Fault Code 227 inactive? **NO** **Repair:** 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. • Use INSITE™ electronic service tool to erase the inactive fault codes.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO** **Repair:** Troubleshoot any remaining active fault codes.	Appropriate troubleshooting steps

Fault Code 234 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial and Marine)

Engine Crankshaft Speed/Position - Data Valid But Above Normal Operating Range - Most Severe Level

CODES	REASON	EFFECT
Fault Code: 234 PID(P), SID(S): P190 SPN: 190 FMI: 0/0 Lamp: Red SRT:	Engine Crankshaft Speed/ Position - Data Valid But Above Normal Operating Range - Most Severe Level. Engine speed signal indicates engine speed above engine protection limit.	Fuel injection disabled until engine speed falls below the overspeed limit.

Circuit Description:

The crankshaft engine speed sensor and the camshaft engine position sensor provide engine speed and position information to the electronic control module (ECM) through the engine harness.

Component Location:

The crankshaft speed sensor is located on the intake side of the engine near the number 6 cylinder at the crankshaft centerline. 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. The camshaft speed sensor is located below the fuel pump in the back of the gear housing.

Shop Talk:

Possible causes of this fault code include:

- External fuel sources drawn into the intake air passage
- Reverse powering (motoring) of the engine
- Tampering of the engine speed/position sensors.

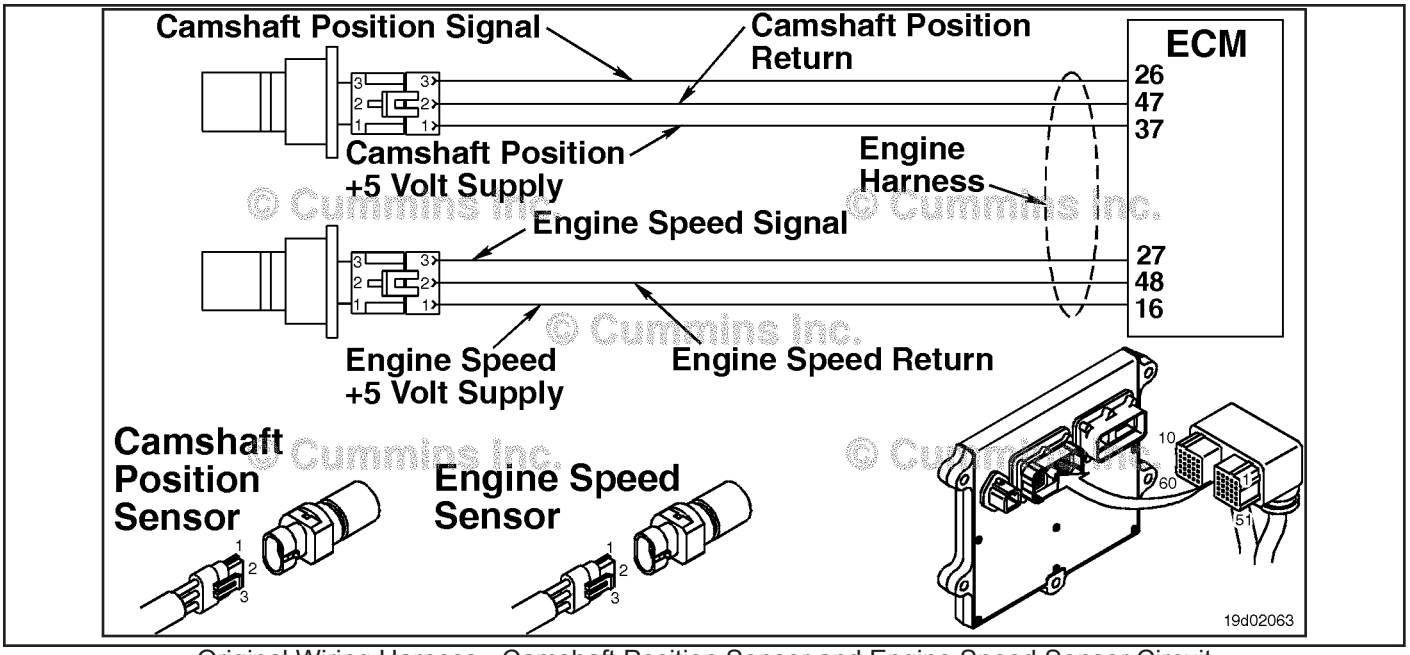
Inspect the intake manifold for sources of flammable vapors. Check the turbocharger seals to verify that there are no oil leaks. Inspect the engine speed/position sensors for damage or tampering.

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:

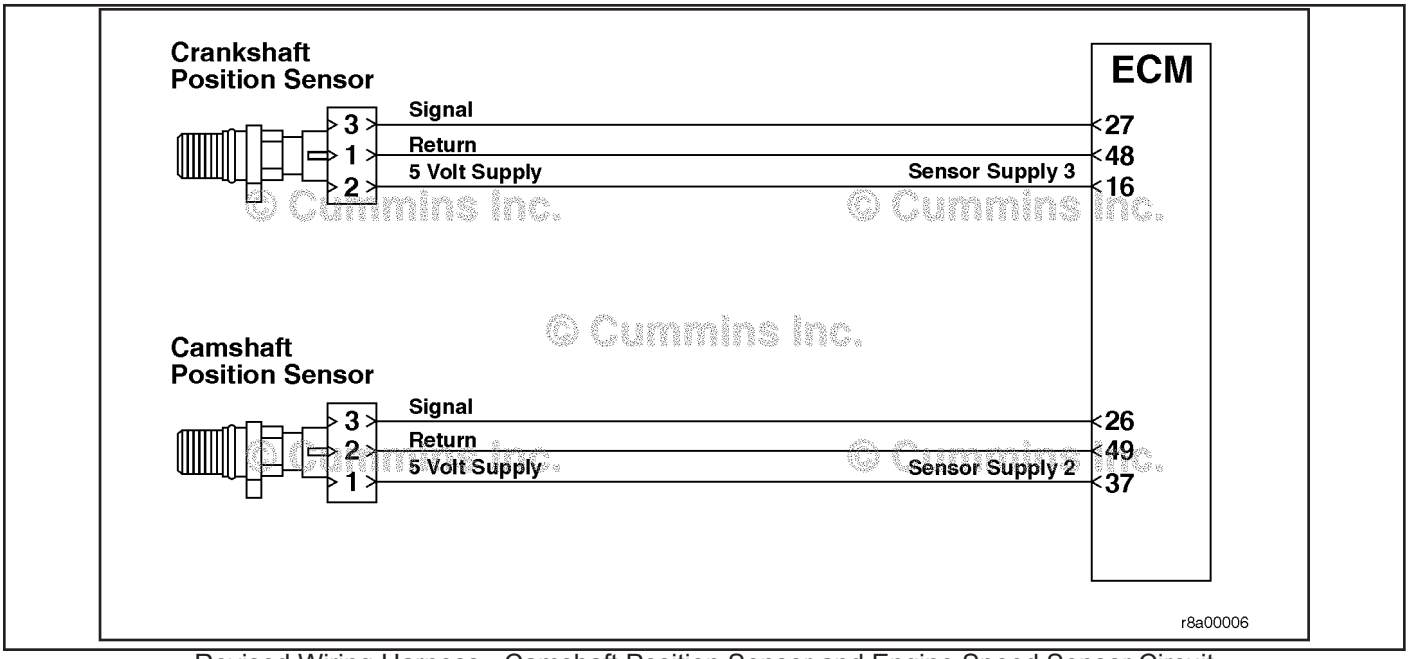
- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM 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 - Camshaft Position Sensor and Engine Speed Sensor Circuit



Revised Wiring Harness - Camshaft Position Sensor and Engine Speed Sensor Circuit

Refer to Troubleshooting Fault Code t05-234.

FAULT CODE 234 (ISB/QSB Automotive and Industrial, ISC/QSC/ISL/QSL Automotive, Industrial and Marine) - Engine Crankshaft Speed/Position - Data Valid But Above Normal Operating Range - Most Severe Level

TROUBLESHOOTING SUMMARY

⚠ WARNING ⚠

DO NOT OPERATE A DIESEL ENGINE WHERE THERE ARE OR CAN BE COMBUSTIBLE VAPORS. These vapors can be sucked through the air intake system and cause engine acceleration and overspeeding that can result in a fire, an explosion, and extensive property damage. Numerous safety devices are available, such as air intake shutoff devices, to minimize the risk of overspeeding where an engine, due to its application, might operate in a combustible environment, such as due to a fuel spill or gas leak. Remember, Cummins has no way of knowing the use you have for your engine. THE EQUIPMENT OWNER AND OPERATOR ARE RESPONSIBLE FOR SAFE OPERATION IN A HOSTILE ENVIRONMENT. CONSULT YOUR CUMMINS AUTHORIZED REPAIR LOCATION FOR FURTHER INFORMATION.

△ CAUTION △

If the engine speed stays above 3500 rpm, the engine must be shut off immediately or engine damage can occur.

△ CAUTION △

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

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Identify the reason for the overspeed.**		
STEP 1A:	Check for an alternate fuel source.	Alternate fuel source?	
STEP 1B:	Check the engine rpm with INSITE™ electronic service tool.	Correct rpm reading?	
STEP 1C:	Inspect the OEM harness and vehicle speed sensor connector pins.	Dirty or damaged pins?	
STEP 1D:	Check for an active fault at low engine rpm.	Inactive fault code at low rpm?	
STEP 1E:	Test the vehicle.	Fault Code 234 inactive?	
STEP 2:	**Clear the fault codes.**		
STEP 2A:	Disable the fault code.	Fault Code 234 inactive?	
STEP 2B:	Clear the inactive fault codes.	All fault codes cleared?	

TROUBLESHOOTING STEP

STEP 1: Identify the reason for the overspeed.

STEP 1A: Check for an alternate fuel source.

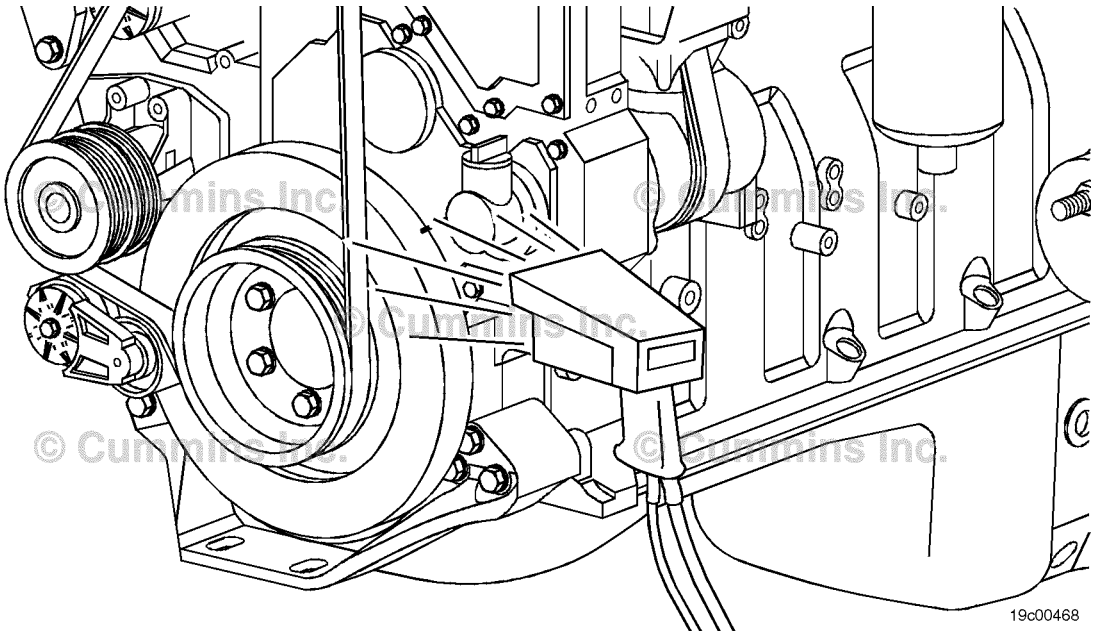
Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Check for an alternate fuel source. • Check if the driver reported a fuel-controlled event where the engine rapidly accelerated to or past 3400 rpm, followed by moderate deceleration to 3400 rpm.	Alternate fuel source? **YES** **Repair:** Locate any alternate fuel sources, such as operating the engine near flammable vapors, blown turbocharger seals, etc.	2A
	Alternate fuel source? **NO**	1B

STEP 1B: Check the engine rpm with INSITE™ electronic service tool.

Condition:
- Turn keyswitch ON.
- Engine is running.

Action	Specification/Repair	Next Step
Check the engine rpm with INSITE™ electronic service tool. NOTE: Compare the engine speed reading on INSITE™ electronic service tool to a mechanical tachometer or the dash tachometer.	Correct rpm reading? **YES**	1C
	Correct rpm reading? **NO** **Repair:** Inspect the crankshaft engine speed sensor and camshaft engine position sensor as outlined in Fault Code 689 and 778.	Fault Code 689 and 778



STEP 1C: Inspect the OEM harness and vehicle speed sensor connector pins.

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

Action	Specification/Repair	Next Step
Inspect the OEM harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19.	2A
	Dirty or damaged pins? **NO**	1D

STEP 1D: Check for an active fault at low engine rpm.

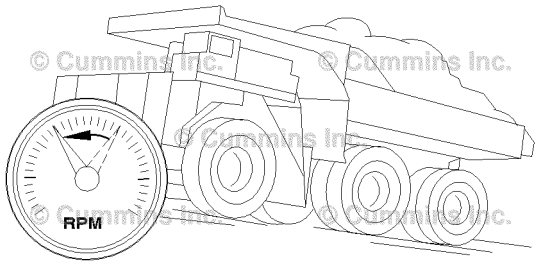
Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check for active Fault Code 234 when the engine is not running above 3200 rpm.	Inactive fault code at low rpm? **YES**	1E
	Inactive fault code at low rpm? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	2A

STEP 1E: Test the vehicle.

Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Test the vehicle in a road test or sea trail to check if the overspeed condition is still present. -	Fault Code 234 inactive? **YES**	2A
	Fault Code 234 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact your local Cummins® Authorized Repair Location if all the steps have been completed and checked again.	1A



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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. • Start the engine and let it idle for one minute. • Using INSITE™ electronic service tool, verify that the fault code is inactive.	Fault Code 234 inactive? **YES**	2B
	Fault Code 234 inactive? **NO**	1A

STEP 2B: Clear the inactive fault codes.

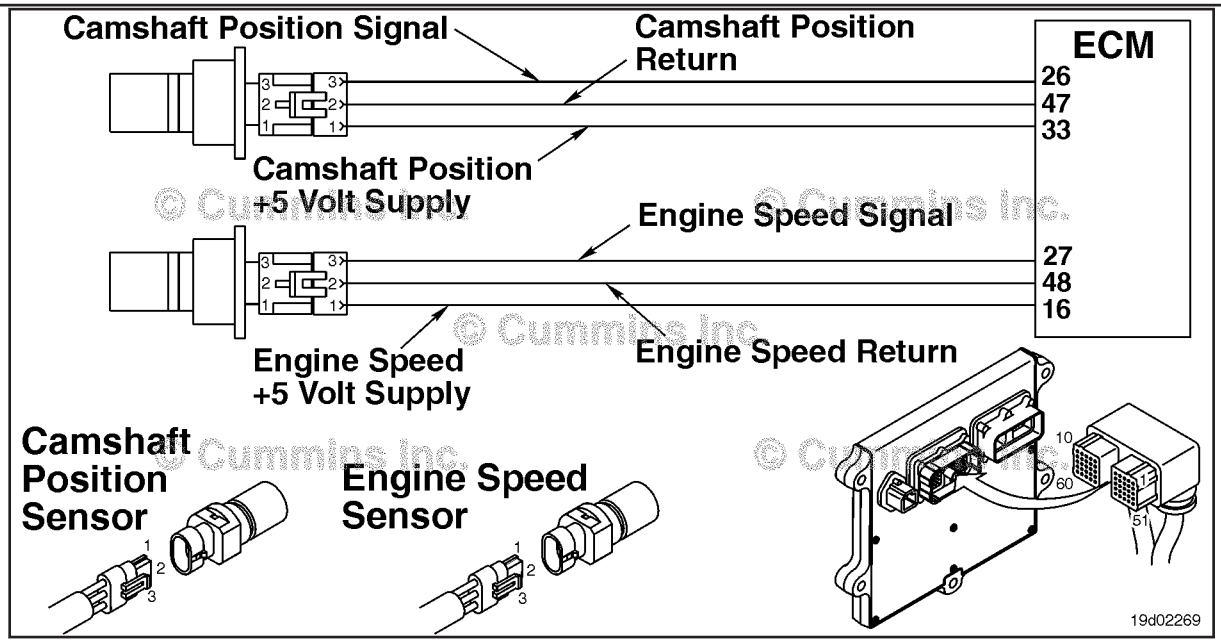
Condition:
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

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

Fault Code 234 (QSB Marine Application)

Engine Crankshaft Speed/Position - Data Valid but Above Normal Operational Range - Most Severe Level

CODES	REASON	EFFECT
Fault Code: 234 PID(P), SID(S): P190 SPN: 190 FMI: 0/0 Lamp: Red SRT:	Engine Crankshaft Speed/ Position - Data Valid but Above Normal Operational Range - Most Severe Level. Engine speed signal indicates engine speed above engine protection limit.	Fuel injection disabled until engine speed falls below the overspeed limit.



Camshaft Position Sensor and Engine Speed Sensor Circuit

Circuit Description:

The crankshaft engine speed sensor and the camshaft engine position sensor provide engine speed and position information to the Electronic Control Module (ECM) through the engine harness.

Component Location:

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. The camshaft speed sensor is located below the fuel pump in the back of the gear housing.

Shop Talk:

Possible causes of this fault code include:

- External fuel sources drawn into the intake air passage
- Reverse powering (motoring) of the engine
- Tampering of the engine speed/position sensors.

Inspect the intake manifold for sources of flammable vapors. Check the turbocharger seals to verify that there are no oil leaks. Inspect the engine speed/position sensors for damage or tampering.

Refer to Troubleshooting Fault Code t05-234

FAULT CODE 234 (QSB Marine Application) - Engine Crankshaft Speed/ Position - Data Valid but Above Normal Operational Range - Most Severe Level

TROUBLESHOOTING SUMMARY

⚠ WARNING ⚠

DO NOT OPERATE A DIESEL ENGINE WHERE THERE ARE OR CAN BE COMBUSTIBLE VAPORS. These vapors can be sucked through the air intake system and cause engine acceleration and overspeeding that can result in a fire, an explosion, and extensive property damage. Numerous safety devices are available, such as air intake shutoff devices, to minimize the risk of overspeeding where an engine, due to its application, might operate in a combustible environment, such as due to a fuel spill or gas leak. Remember, Cummins has no way of knowing the use you have for your engine. THE EQUIPMENT OWNER AND OPERATOR ARE RESPONSIBLE FOR SAFE OPERATION IN A HOSTILE ENVIRONMENT. CONSULT YOUR CUMMINS AUTHORIZED REPAIR LOCATION FOR FURTHER INFORMATION.

⚠ CAUTION ⚠

If the engine speed stays above 3500 rpm, the engine must be shut off immediately or engine damage can occur.

⚠ CAUTION ⚠

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

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Identify the reason for the overspeed.**		
STEP 1A:	**Check for proper operating conditions.**	**Engine motoring downhill?**	
STEP 1B:	**Check the engine rpm with INSITE™ electronic service tool.**	**Correct rpm reading?**	
STEP 1C:	**Inspect the OEM harness and vehicle speed sensor connector pins.**	**Dirty or damaged pins?**	
STEP 1D:	**Check for an active fault at low engine rpm.**	**Inactive fault code at low rpm?**	
STEP 1E:	**Test the vehicle.**	**Fault Code 234 inactive?**	
STEP 2:	**Clear the fault codes.**		
STEP 2A:	**Disable the fault code.**	**Fault Code 234 inactive?**	
STEP 2B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

TROUBLESHOOTING STEP

STEP 1: Identify the reason for the overspeed.

STEP 1A: Check for an alternate fuel source.

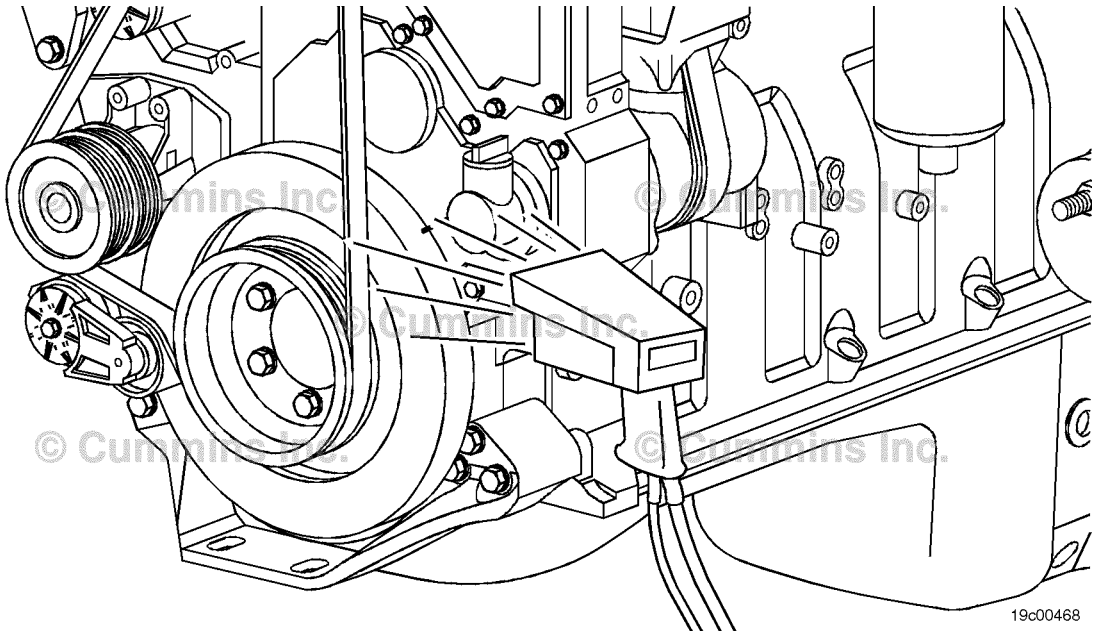
Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Check for an alternate fuel source. • Check if the driver reported a fuel-controlled event where the engine rapidly accelerated to or past 3400 rpm, followed by moderate deceleration to 3400 rpm.	Alternate fuel source? **YES** **Repair:** Locate any alternate fuel sources, such as operating the engine near flammable vapors, blown turbocharger seals, etc.	2A
	Alternate fuel source? **NO**	1B

STEP 1B: Check the engine rpm with INSITE™ electronic service tool.

Condition:
- Turn keyswitch ON.
- Engine is running.

Action	Specification/Repair	Next Step
Check the engine rpm with INSITE™ electronic service tool. NOTE: Compare the engine speed reading on INSITE™ electronic service tool to a mechanical tachometer or the dash tachometer.	Correct rpm reading? **YES**	1C
	Correct rpm reading? **NO** **Repair:** Inspect the crankshaft engine speed sensor and camshaft engine position sensor as outlined in Fault Codes 689 and 778.	Fault Codes 689 and 778



STEP 1C: Inspect the OEM harness and vehicle speed sensor connector pins.

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

Action	Specification/Repair	Next Step
Inspect the OEM harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19.	2A
	Dirty or damaged pins? **NO**	1D

STEP 1D: Check for an active fault at low engine rpm.

Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check for active Fault Code 234 when the engine is not running above 3200 rpm.	Inactive fault code at low rpm? **YES**	1E
	Inactive fault code at low rpm? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	2A

STEP 1E: Test the vehicle.

Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Test the vehicle in a sea trail to check if the overspeed condition is still present. -	Fault Code 234 inactive? **YES**	2A
	Fault Code 234 inactive? **NO** **Repair:** 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 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. • Start the engine and let it idle for one minute. • Using INSITE™ electronic service tool, verify that the fault code is inactive.	Fault Code 234 inactive? **YES**	2B
	Fault Code 234 inactive? **NO**	1A

STEP 2B: Clear the inactive fault codes.

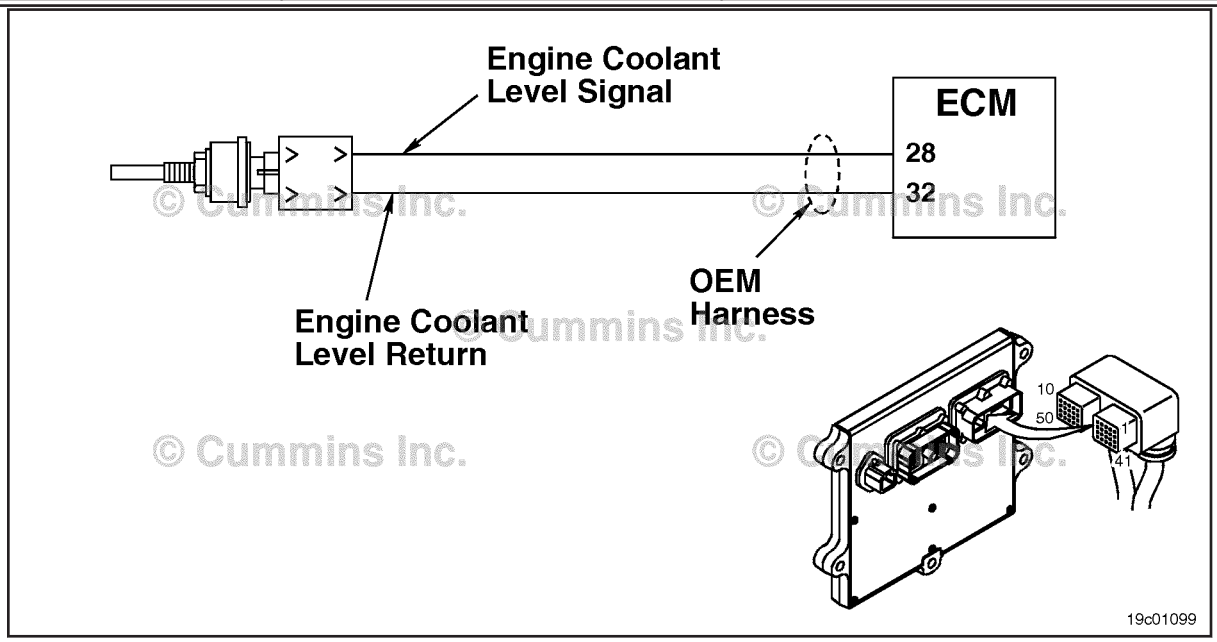
Condition:
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

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

Fault Code 235

Coolant Level - Data Valid but Below Normal Operational Range - Most Severe Level

CODES	REASON	EFFECT
Fault Code: 235 PID(P), SID(S): P111 SPN: 111 FMI: 1 Lamp: Amber SRT:	Coolant Level - Data Valid but Below Normal Operational Range - Most Severe Level. Low engine coolant level detected.	Progressive power derate increasing in severity from time of alert. If the Engine Protection Shutdown feature is enabled, the engine will shut down 30 seconds after Red Stop lamp starts flashing. Marine: None. No engine protection for sensor or circuit failure.



Engine Coolant Level

Circuit Description:

The engine coolant level sensor monitors the engine coolant level within the coolant system and passes information to the electronic control module (ECM) through the OEM harness.

Component Location:

The engine coolant level sensor is typically located in the radiator top tank or surge tank. Refer to the OEM troubleshooting and repair manual for the location.

Shop Talk:

This fault code goes active when the coolant level inside the radiator top tank or surge tank drops below the sensor level. Fill the top tank with coolant.

Refer to Troubleshooting Fault Code t05-235

Coolant Level Low - Data Valid But Below Normal Operating Range - Most Severe Level

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 235.	**Active or inactive counts of Fault Code 235?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 235.

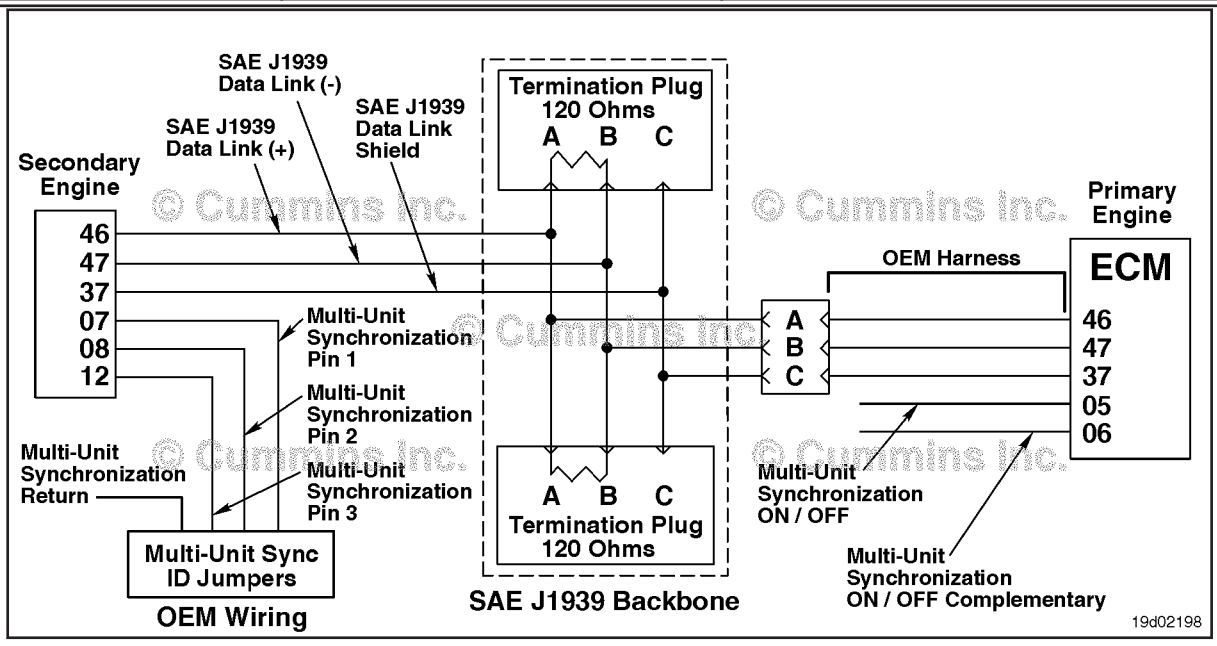
Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for fault codes. • Use INSITE™ electronic service tool, to read the fault codes.	Active or inactive counts of Fault Code 235? **YES** **Repair:** Add coolant to the engine. Use the following procedure in Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 008-018 in Section 8. Use the following procedure for Troubleshooting and Repair Manual, ISB^{e} and ISB (Common Rail Fuel System) Series Engines, Bulletin 4021271. Refer to Procedure 008-018 in Section 8. If Fault Code 235 is active and the coolant level is **not** low, a malfunctioning coolant level sensor is a likely cause. Refer to the OEM service manual before replacing the coolant level sensor.	Repair complete
	Active or inactive counts of Fault Code 235? **NO**	Repair complete

Fault Code 237

External Speed Command Input (Multiple Unit Synchronication) - Data Erratic, Intermittent, or Incorrect

CODES	REASON	EFFECT
Fault Code: 237 PID(P), SID(S): S030 SPN: 644 FMI: 2 Lamp: Amber SRT:	External Speed Command Input (Multiple Unit Synchronization) - Data Erratic, Intermittent, or Incorrect. The throttle input signal to the primary or secondary engine for multiple unit synchronization is less than 3 percent or more than 97 percent.	Primary or secondary engines may be shut down.



Multi-Unit synchronization

Circuit Description:

The primary engine broadcasts the engine speed control message over the J1939 datalink to all secondary engines. Jumper wires are used to configure an engine as a primary engine or as a secondary engine. **Only** one engine can be configured as the primary engine. Up to five engines can be configured as secondary engines on the same J1939 datalink.

Component Location:

The J1939 datalink connections are part of the OEM harness. Location of the J1939 harness will vary by the OEM. Refer to the OEM manual for specific component location.

The configuration of the three pins inputs to the electronic control module (ECM) on the OEM harness determines if an engine is a primary or secondary engine. To activate a pin, the pin **must** be grounded. To deactivate a pin, the pin **must** be open circuit.

Multi-Unit Number 3	Multi-Unit Number 2	Multi-Unit Number 1	Description
Inactive	Inactive	Inactive	Error Condition
Inactive	Inactive	Active	Primary
Inactive	Active	Inactive	Secondary 1

Multi-Unit Number 3	Multi-Unit Number 2	Multi-Unit Number 1	Description
Inactive	Active	Active	Secondary 2
Active	Inactive	Inactive	Secondary 3
Active	Inactive	Active	Secondary 4
Active	Active	Inactive	Secondary 5
Active	Active	Active	Error Condition

Refer to Troubleshooting Fault Code t05-237

FAULT CODE 237 - External Speed Command Input (Multiple Unit Synchronication) - Data Erratic, Intermittent, or Incorrect
TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Determine the engine configuration.**		
STEP 1A:	Check the engine configuration.	All engines configured correctly as either primary or secondary?	
STEP 2:	**Check the J1939 datalink harness.**		
STEP 2A:	Inspect the J1939 datalink harness and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check for an open or short circuit in the J1939 datalink harness.	Resistance between 50 and 70 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 a pin to pin short circuit in the OEM harness.	Greater then 100K ohms?	
STEP 3C:	Check for a short circuit to ground in the OEM harness.	Greater than 100K ohms for inactive pins and less than 10 ohms for active pins?	
STEP 3D:	Check for an open or short circuit in the ECM J1939 datalink harness.	Resistance between 50 to 70 ohms?	
STEP 3E:	Check for a short circuit in the ECM J1939 datalink harness.	Greater than 100K ohms?	
STEP 3F:	Check for an inactive fault code.	Fault Code 237 inactive?	
STEP 4:	**Clear the fault code.**		
STEP 4A:	Disable the fault code	Fault Code 237 inactive?	
STEP 4B:	Clear the inactive fault code	All faults cleared?	

TROUBLESHOOTING STEP

STEP 1: Determine the engine configuration.

STEP 1A: Check the engine configuration.

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

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool, to determine if all engines are configured correctly as either primary or secondary engines. • Use INSITE™ electronic service tool to monitor parameters for Multi-Unit Synchronization to determine the engine configuration.	All engine configured correctly as either primary or secondary? **YES**	2A
	All engine configured correctly as either primary or secondary? **NO** **Repair:** Check the Mult-Unit Synchronization switch configuration for correct setup.	4A

STEP 2: Check the J1939 datalink harness.

STEP 2A: Inspect the J1939 datalink harness and connector pins.

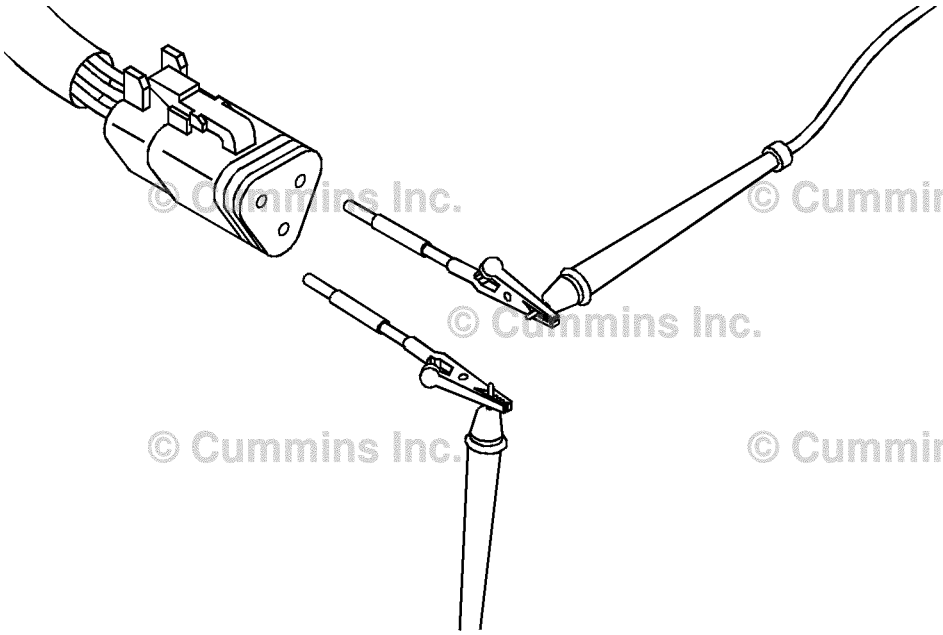
Condition:
- Turn keyswitch OFF.
- Disconnect the J1939 datalink interconnect between the primary and secondary ECM's.

Action	Specification/Repair	Next Step
Inspect the J1939 data link connector pins for the following: • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Wire insulation damaged • Moisture in or on the connector • Missing or damaged connector seals • Connector shell broken • Dirt or debris in or on the connector pins. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the J1939 data link harness.. Clean the connector and pins. Repair the damaged harness, connector or pins if possible.	4A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check for an open or short circuit in the J1939 datalink harness

Condition:
- Turn keyswitch OFF.
- Disconnect the J1939 interconnect between the primary and secondary ECM's

Action	Specification/Repair	Next Step
Check for an open or short circuit. • Measure the resistance between the SAE J1939 Datalink (+) wire and the SAE J1939 Datalink (-) wire on the service datalink connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Resistance between 50 to 70 ohms? **YES**	3A
	Resistance between 50 to 70 ohms? **NO** **Repair:** An open or short has been detected on the service datalink connector or harness connection to the J1939 datalink backbone. 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.

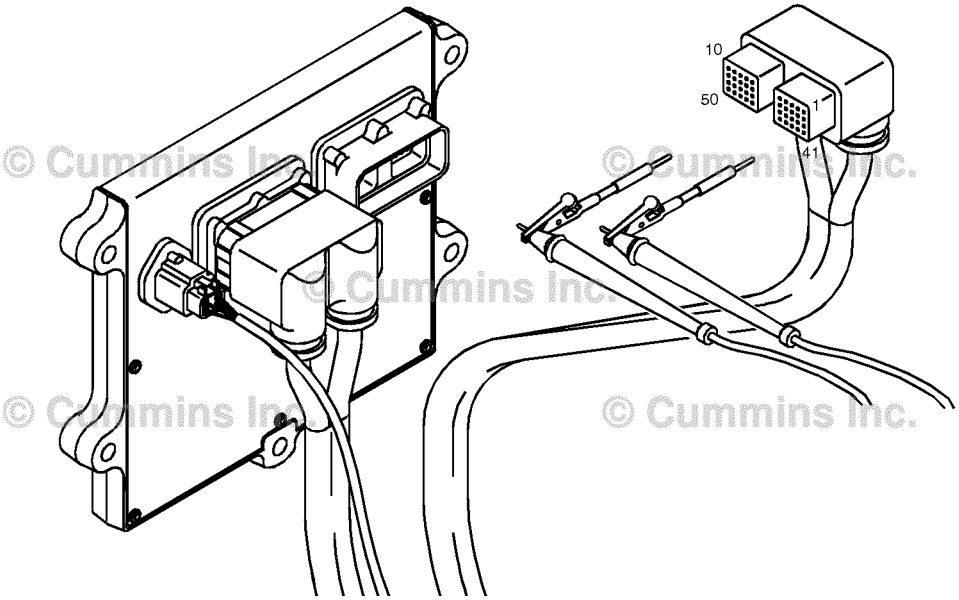
Condition:
- Turn keyswitch OFF.
- Disconnect the secondary engine OEM harness from the ECM.

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

STEP 3B: Check for a pin-to-pin short circuit in the OEM harness.

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

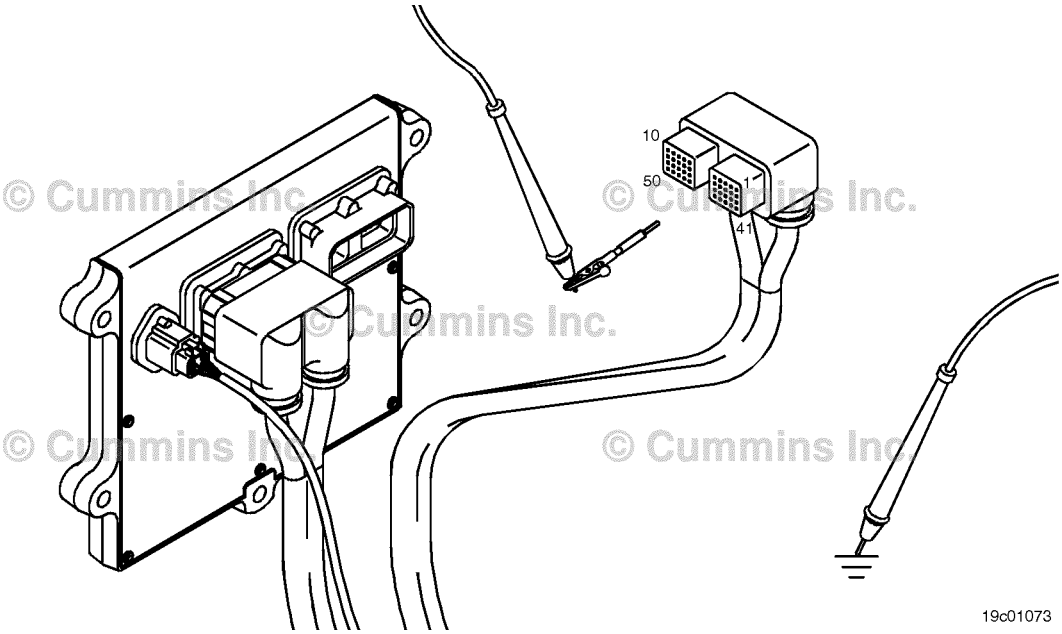
Action	Specification/Repair	Next Step
Check for a pin to pin short. • Measure the resistance between the Multi-Unit Synchronization ID Pin 1 in the OEM ECM connector and all other pins in the OEM connector. • Measure the resistance between the Multi-Unit Synchronization ID Pin 2 in the OEM ECM connector and all other pins in the OEM connector. • Measure the resistance between the Multi-Unit Synchronization ID Pin 3 in the OEM ECM connector and all other pins in the OEM connector. • Measure the resistance between the Multi-Unit Synchronization ON/OFF pin in the OEM ECM connector and all other pins in the OEM connector. NOTE: The Multi-Unit Synchronization switch **must** be in the OFF position for this check. • Measure the resistance between the Multi-Unit Synchronization ON/OFF Complimentary pin in the OEM ECM connector and all other pins in the OEM connector. Note: The Multi-Unit Synchronization switch **must** be in the ON position for this check. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3C
	Greater than 100K ohms? **NO** **Repair:** A pin-to-pin short circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3C: Check for a short circuit to ground in the OEM harness.

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

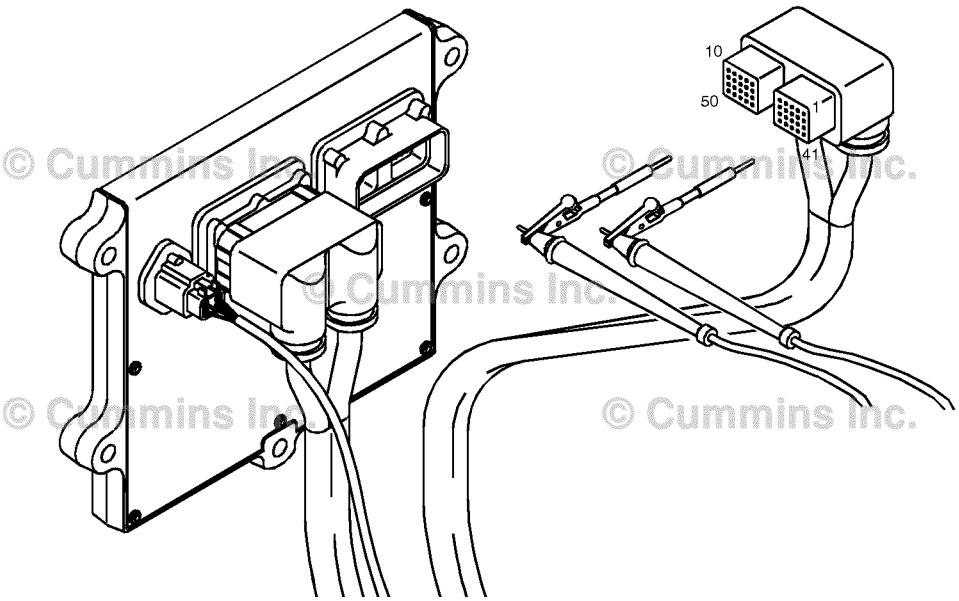
Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the Multi-Unit Synchronization ID Pin 1 in the OEM ECM connector and ground. • Measure the resistance between the Multi-Unit Synchronization ID Pin 2 in the OEM ECM connector and ground. • Measure the resistance between the Multi-Unit Synchronization ID Pin 3 in the OEM ECM connector and ground. • Measure the resistance between the Multi-Unit Synchronization ON/OFF Complimentary pin in the OEM ECM connector and ground. NOTE: Determine the location of Multi-Unit Synchronization switch before performing these steps. Pins in this check will either be shorted or open depending on the configuration of the Multi-Unit Synchronization switch. Refer to circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms for inactive pins and less than 10 ohms for active pins? **YES**	3D
	Greater than 100K ohms for inactive pins and less than 10 ohms for active pins? **NO** **Repair:** A short circuit to ground has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3D: Check for an open or short circuit in the ECM J1939 datalink harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the primary and secondary ECM's.

Action	Specification/Repair	Next Step
Check for an open or short curcuit. • Measure the resistance between the SAE J1939 Data Link (+) wire and the SAE J1939 Data Link (-) wire on the appropriate Cummins ECM OEM connection to the J1939 datalink harness connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Resistance between 50 and 70 ohms? **YES**	3E
	Resistance between 50 and 70 ohms? **NO** **Repair:** An open or short has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



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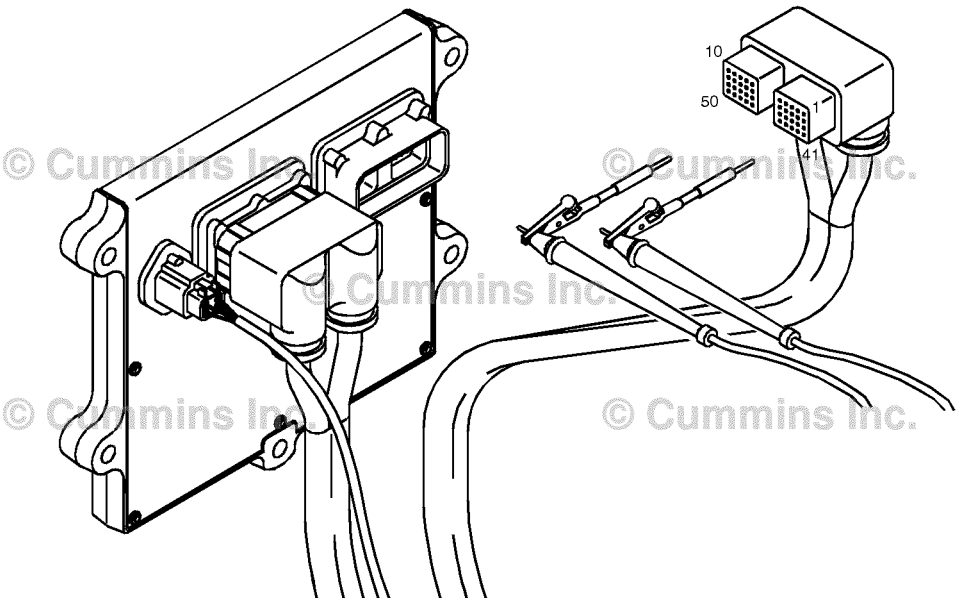
STEP 3E: Check for a short circuit in the ECM J1939 datalink harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the primary and secondary ECM's.

Action	Specification/Repair	Next Step
Check for a short circuit. • Measure the resistance and check for a short circuit between the SAE J1939 Data Link (+) wire and the SAE J1939 Data Link (-) wire on the appropriate Cummins ECM OEM connection to the J1939 datalink harness connector. NOTE: Disregard any resistance between 50 and 70 ohms between the SAE J1939 Data Link (-) pins. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3F
	Greater than 100K ohms? **NO** **Repair:** A short has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



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STEP 3F: Check for an inactive fault code.

Condition:
- Connect all components.
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Check the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool, to check the fault codes.	Fault Code 237 inactive? **YES** **Repair:** None. The removal and reinstallation of the connector corrected the fault.	4A
	Fault Code 237 inactive? **NO** **Repair:** A communication issue between the primary and secondary ECM's had been detected or a damaged ECM or calibration is causing the fault code.	Refer to the appropriate ECM No Communication symptom tree.

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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool, to verify that the fault code is inactive.	Fault Code 237 inactive? **YES**	4B
	Fault Code 237 inactive? **NO**	1A

STEP 4B: Clear the inactive fault code

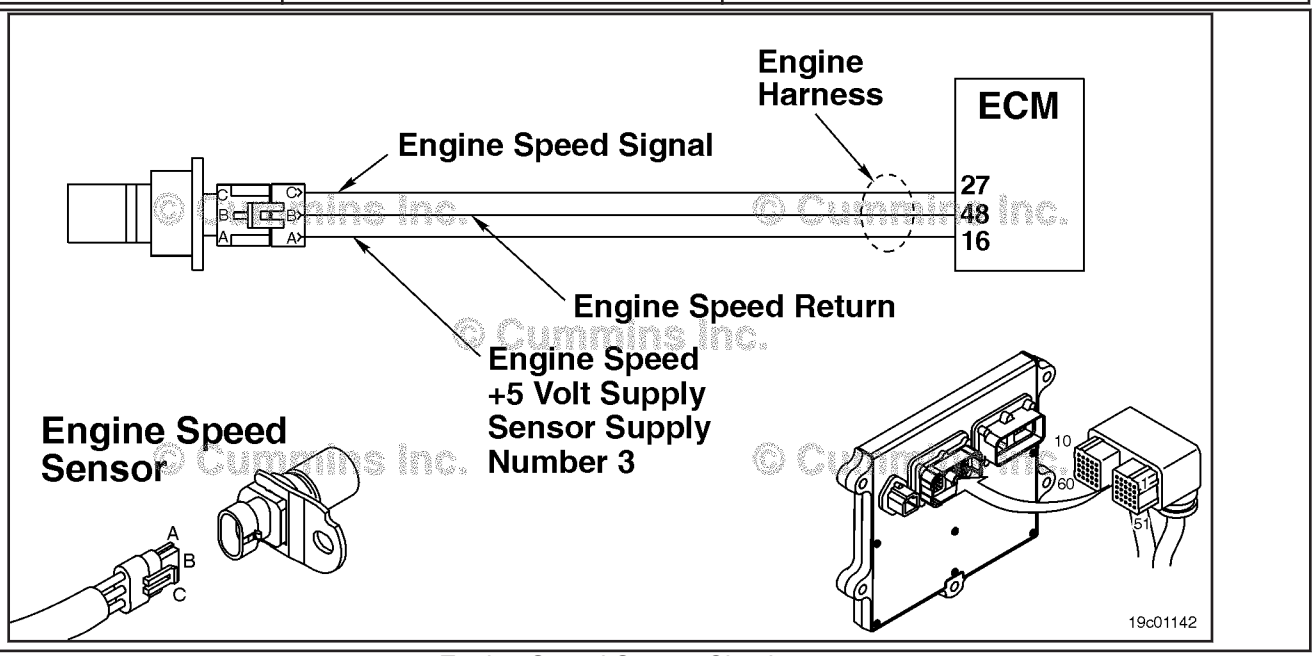
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 238

Sensor Supply 3 Circuit - Voltage Below Normal, or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 238 PID(P), SID(S): S232 SPN: 611 FMI: 4/4 Lamp: Amber SRT:	Sensor Supply 3 Circuit - Voltage Below Normal, or Shorted to Low Source. Low voltage detected on the +5 volt sensor supply circuit to the engine speed sensor.	Possible hard starting and rough running.



Engine Speed Sensor Circuit

Circuit Description:

The engine speed voltage supply provides +5 VDC for the engine speed sensor. If the supply wire to this sensor is damaged, the sensor will **not** work properly.

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. Refer to Procedure 100-002 for detailed component view location.

Shop Talk:

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

Refer to Troubleshooting Fault Code t05-238

FAULT CODE 238 - Sensor Supply 3 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 3164596 - male Framatome 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 238 active?**	
STEP 2:	**Check the engine speed sensor and circuit.**		
STEP 2A:	**Inspect the engine speed sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the circuit response.**	**Fault Code 238 active?**	
STEP 3:	**Check the engine harness.**		
STEP 3A:	**Inspect the engine harness and ECM connector pins.**	**Dirty or damaged pins?**	
STEP 3B:	**Check the circuit response.**	**Fault Code 238 active?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 238 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:
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check for an active fault code. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 238 active? **YES**	2A
	Fault Code 238 active? **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 speed sensor and circuit.

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

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

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

STEP 2B: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the 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 after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 238 active? **YES**	3A
	Fault Code 238 active? **NO** **Repair:** The engine speed sensor is internally shorted. Replace the engine speed sensor. Refer to Procedure 019-365 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 the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 238 active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A
	Fault Code 238 active? **NO** **Repair:** The engine speed sensor SUPPLY line has shorted to ground or a return wire. 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.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 238 inactive? **YES**	4B
	Fault Code 238 inactive? **NO**	1A

STEP 4B: Clear the inactive fault codes.

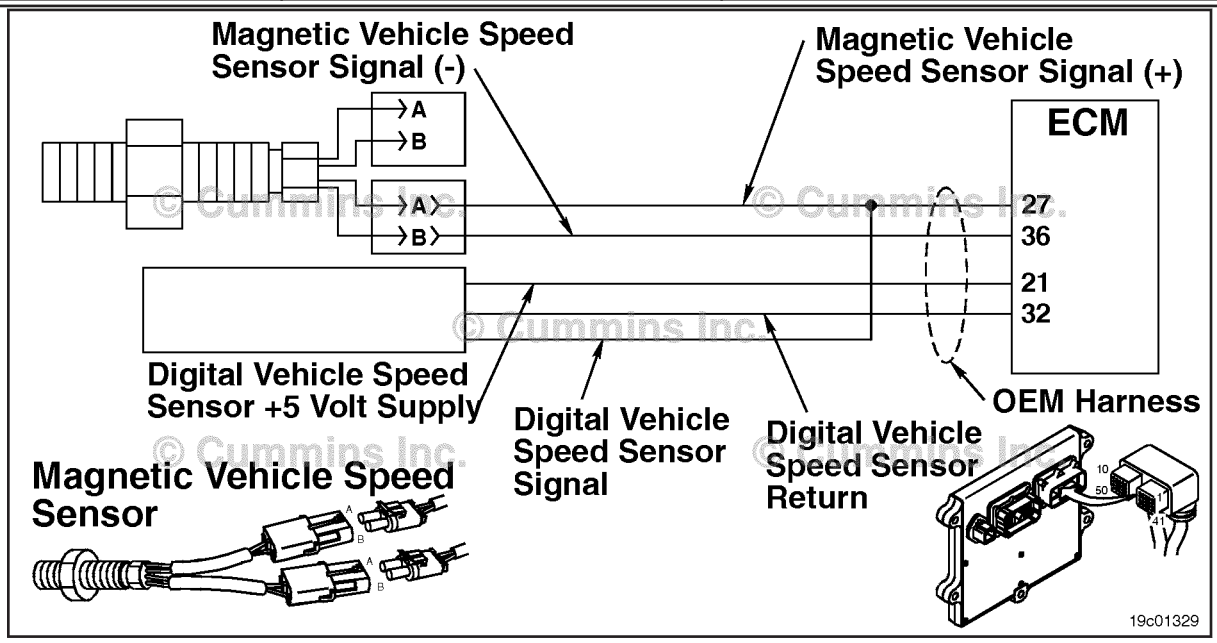
Condition:
- Connect all components.
- Turn keyswitch ON.

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

Fault Code 241

Vehicle Speed Sensor Circuit - Data Erratic, Intermittent or Incorrect

CODES	REASON	EFFECT
Fault Code: 241 PID(P), SID(S): P084 SPN: 84 FMI: 2/2 Lamp: Amber SRT:	Vehicle Speed Sensor Circuit - Data Erratic, Intermittent or Incorrect. The ECM lost the vehicle speed signal.	Engine speed limited to Maximum Engine Speed without VSS parameter value. Cruise control, Gear-Down Protection, and Road Speed Governor will **not** work.



Vehicle Speed Sensor Circuit

Circuit Description:

The vehicle speed sensor senses the speed of the tailshaft gear on the vehicle's transmission. This speed signal is then transmitted to the engine electronic control module (ECM) and converted into a vehicle speed.

Component Location:

The vehicle speed sensor is located in the rear of the vehicle transmission. Refer to the OEM troubleshooting and repair manual.

Shop Talk:

There are multiple types of vehicle speed sensors. Various types include magnetic pickup, data link, digital, and tachograph. Refer to your OEM for the specific type installed on the vehicle.

This fault is set active when the ECM loses a vehicle speed signal when other engine conditions indicate the vehicle is moving. The fault can also become active if there is a series of clutch, service brake or throttle movements with no vehicle movement. The fault is set inactive when the ECM receives a vehicle speed signal greater than zero.

Since the vehicle speed sensor is an OEM installed component, this troubleshooting procedure will **not** catch all failures of the circuit due to components **not** under Cummins Inc. control. Sensor resistance values, data link speed sensors and tachographs are **not** fully covered under this procedure. For more information on those components, please refer to the OEM troubleshooting and repair manual.

Refer to Troubleshooting Fault Code t05-241

FAULT CODE 241 - Vehicle Speed 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 possiblity 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 vehicle speed sensor setting in INSITE™ electronic service tool.**		
STEP 1A:	Verify that the vehicle speed sensor and the setting in INSITE™ electronic service tool match.	The setting in INSITE™ electronic service tool matches the speed sensor type on the vehicle?	
STEP 2:	**Check the OEM harness.**		
STEP 2A:	Inspect the OEM harness pins and the sensor connector pins.	Dirty or damaged pins?	
STEP 2B:	Inspect the OEM harness connector pins at the ECM.	Dirty or damaged pins?	
STEP 2C:	Check for an open circuit in the OEM harness.	Less than 10 ohms?	
STEP 2D:	Check for a short circuit to ground in the OEM harness.	More than 100k ohms?	
STEP 2E:	Check for a pin-to-pin short circuit in the OEM harness.	More than 100k ohms?	
STEP 3:	**Check for additional OEM devices.**		
STEP 3A:	Check the vehicle speed sensor circuit for additional devices.	Extra devices?	
STEP 3B:	Check for the gear slipping on the shaft.	Gear or tone wheel damaged or slips?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 241 inactive?	
STEP 4B:	Clear the inactive fault codes.	All fault codes cleared?	

TROUBLESHOOTING STEP

STEP 1: Check the vehicle speed sensor setting in INSITE™.

STEP 1A: Verify that the vehicle speed sensor and the setting in INSITE™ match.

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

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool, go to the Vehicle Speed Source feature under Adjustments, Features and Parameters. • Verify that the vehicle speed sensor type parameter in INSITE™ electronic service tool matches the physical sensor type on the vehicle.	The setting in INSITE™ electronic service tool matches the speed sensor type on the vehicle? **YES**	2A
	The setting in INSITE™ electronic service tool matches the speed sensor type on the vehicle? **NO** **Repair:** Change the setting in the ECM with INSITE™ electronic service tool to match the vehicle speed sensor type.	4A

STEP 2: Check the OEM harness.

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

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

Action	Specification/Repair	Next Step
Inspect the OEM harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

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

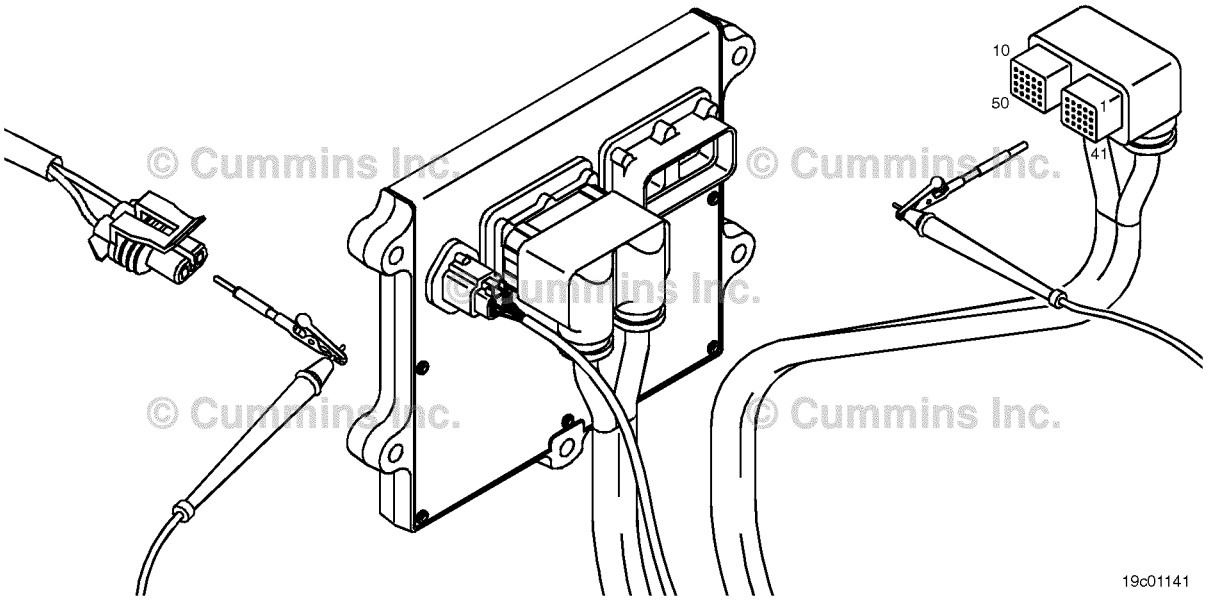
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and the ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2C

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

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

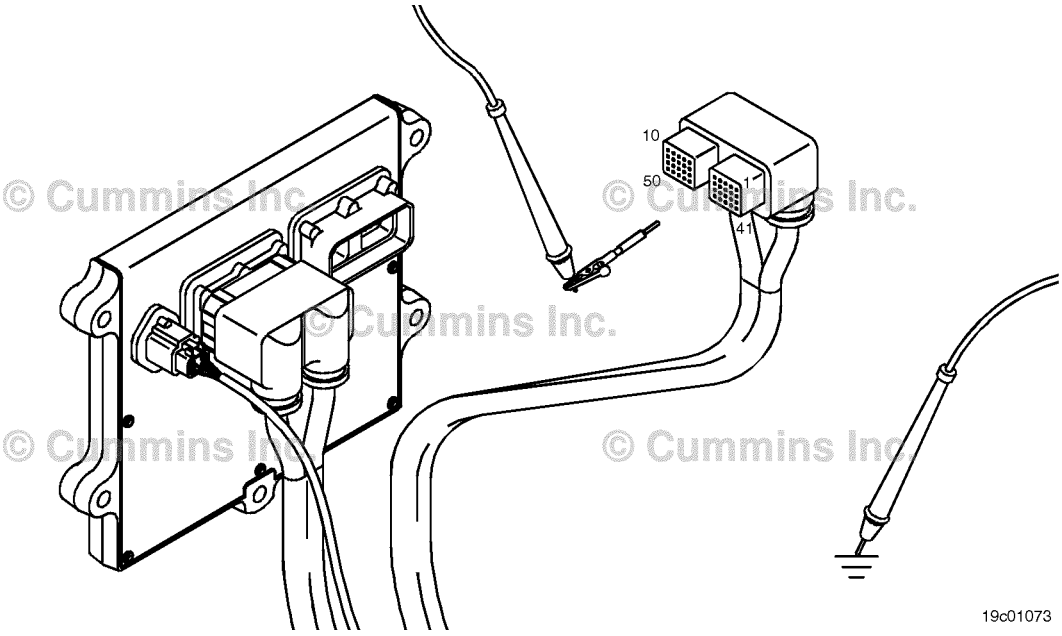
Action	Specification/Repair	Next Step
Use a multimeter, check for an open circuit in the OEM harness. • Measure the resistance of the magnetic vehicle speed sensor SIGNAL (+) wire between the OEM harness ECM connector and the OEM harness magnetic vehicle speed sensor connector. • Measure the resistance of the magnetic vehicle speed sensor SIGNAL (-) wire between the OEM harness ECM connector and the OEM harness magnetic vehicle speed sensor connector. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	2D
	Less than 10 ohms? **NO** **Repair:** An open circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 2D: Check for a short circuit to ground in the OEM harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness connector from the ECM.
- Disconnect the OEM harness from the vehicle speed sensor.

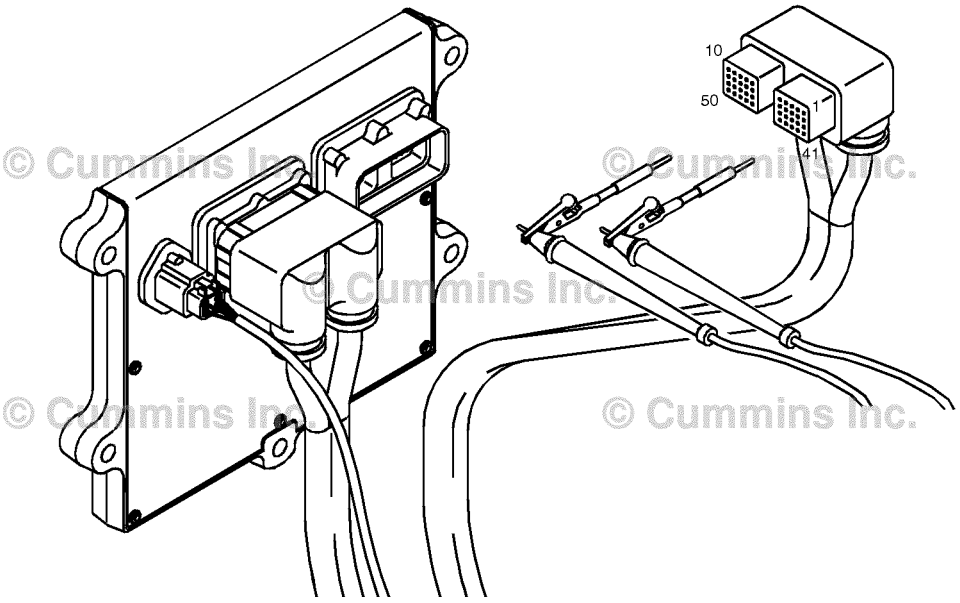
Action	Specification/Repair	Next Step
Check for a short circuit to ground on the magnetic vehicle speed sensor SIGNAL (+) and magnetic vehicle speed sensor SIGNAL (-) circuit in the OEM harness. • Measure the resistance between the magnetic vehicle speed sensor SIGNAL (+) at the ECM connector to engine block ground. • Measure the resistance between the magnetic vehicle speed sensor SIGNAL (-) at the ECM connector to engine block ground. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	More than 100k ohms? **YES**	2E
	More than 100k ohms? **NO** **Repair:** A short circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



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 OEM harness from the vehicle speed sensor.

Action	Specification/Repair	Next Step
Use a multimeter, check for a pin-to-pin short circuit in the OEM harness. • Measure the resistance and check for a short circuit between the magnetic vehicle speed sensor SIGNAL (+) pin at the OEM harness ECM connector and all other pins in the connector. • Measure the resistance and check for a short circuit between the magnetic vehicle speed sensor SIGNAL (-) pin at the OEM harness ECM connector and all other pins in the connector. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	More than 100k ohms? **YES**	3A
	More than 100k ohms? **NO** **Repair:** A short circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3: Check for additional OEM devices.

STEP 3A: Check the vehicle speed sensor circuit for additional devices.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Inspect the vehicle speed sensor circuit for any additional or extra devices that can interfere with the speed signal. -	Extra devices? **YES** **Repair:** Remove the device or contact an OEM representative.	4A
	Extra devices? **NO**	3B

STEP 3B: Check for the gear slipping on the shaft.

Condition:
- Turn keyswitch OFF.
- Remove the vehicle speed sensor from the transmission.

Action	Specification/Repair	Next Step
Inspect the gear or tone wheel on the rear of the transmission where the speed sensor picks up the speed signal. Make sure the gear or tone wheel is not damaged or slipping on the shaft. -	Gear or tone wheel damaged or slips? **YES** **Repair:** Refer to the OEM service manual to repair or replace the gear or tone wheel.	4A
	Gear or tone wheel damaged or slips? **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. • Start the engine and move the vehicle so that the ECM can read a vehicle speed. • Use INSITE™ electronic service tool to verify that Fault Code 241 is inactive.	Fault Code 241 inactive? **YES**	4B
	Fault Code 241 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact your local Cummins® Authorized Repair Location or OEM dealer if all the steps have been completed and checked again.	1A

STEP 4B: Clear the inactive fault codes.

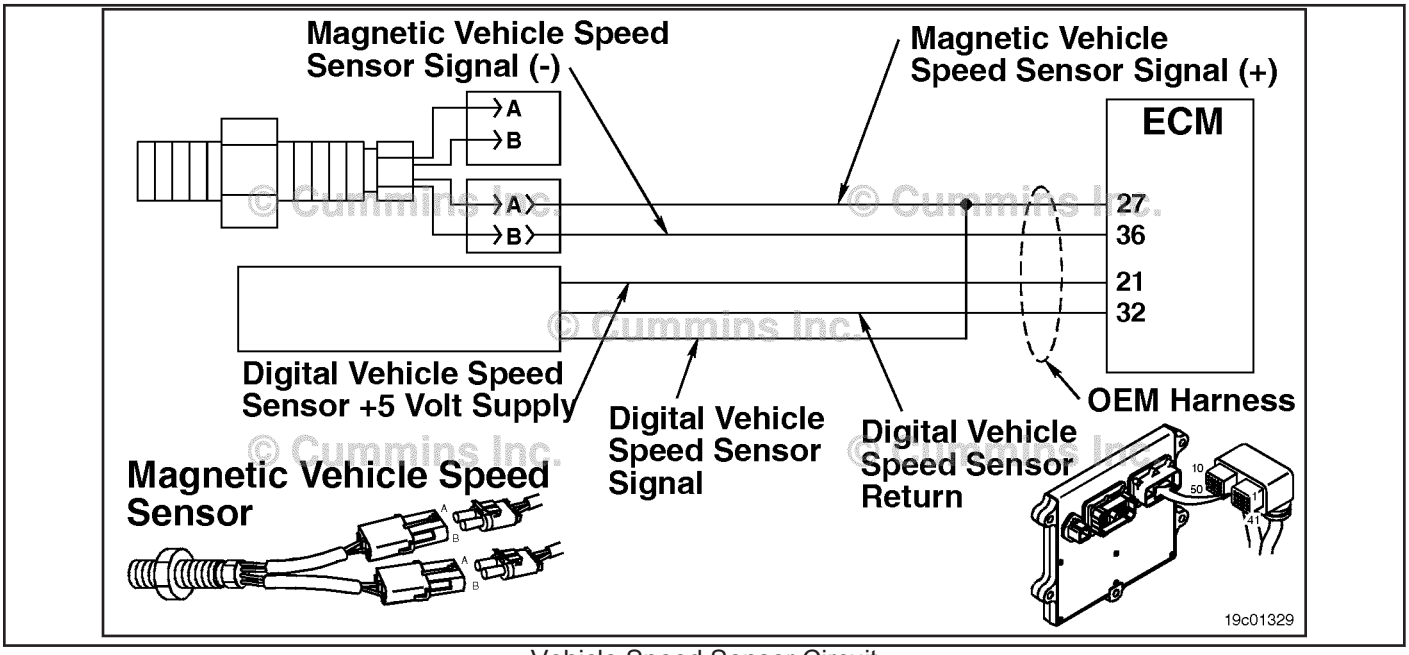
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 242

Vehicle Speed Sensor Circuit Tampering Has Been Detected - Abnormal Rate of Change

CODES	REASON	EFFECT
Fault Code: 242 PID(P), SID(S): P084 SPN: 84 FMI: 10/10 Lamp: Amber SRT:	Vehicle Speed Sensor Circuit Tampering Has Been Detected - Abnormal Rate of Change. Invalid or inappropriate vehicle speed signal. Signal indicates an intermittent connection or VSS tampering.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will **not** work.



Vehicle Speed Sensor Circuit

Circuit Description:

The vehicle speed sensor senses the speed of the tailshaft gear on the vehicle's transmission. This speed signal is then transmitted to the engine electronic control module (ECM) and converted into a vehicle speed.

Component Location:

The vehicle speed sensor is located in the rear of the vehicle transmission.

Shop Talk:

Verify that the feature settings for the vehicle speed sensor anti-tampering (Fault Code 242), application type and automatic transmission are set correctly. If any of these are set incorrectly for your specific vehicle and application, Fault Code 242 could occur erroneously.

Driving techniques such as driving for extended periods of time in lower gears can log Fault Code 242. Fault Code 242 can be logged if the driver attempts to defeat the road speed governor by repeatedly cycling the keyswitch.

Once the speed signal has been restored the fault code will go inactive once the keyswitch is on for 30 seconds and the ECM senses zero vehicle and engine speed.

Refer to Troubleshooting Fault Code t05-242

FAULT CODE 242 - Vehicle Speed Sensor Circuit Tampering Has Been Detected - Abnormal Rate of Change
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:	**Verify that the feature settings are correct.**		
STEP 1A:	Verify that the customer wants Vehicle Speed Anti-Tampering (Fault Code 242) enabled.	Customer wants Vehicle Speed Sensor Anti-Tampering enabled?	
STEP 1B:	Verify that the vehicle speed sensor and the setting in INSITE™ electronic service tool match.	The setting in INSITE™ electronic service tool matches the speed sensor type on the vehicle?	
STEP 1C:	Verify that the Anti-Tampering Sensitivity Level is set correctly for the application.	Sensitivity Level is set correctly?	
STEP 2:	**Look for signs or evidence of tampering.**		
STEP 2A:	Inspect the vehicle speed sensor.	Tampering, installed incorrectly or external device present?	
STEP 2B:	Check for open circuit in the OEM harness.	Less than 10 ohms?	
STEP 2C:	Check for short circuit to ground in the OEM harness.	More than 100k ohms?	
STEP 2D:	Check for a pin-to-pin short circuit in the OEM harness.	More than 100k ohms?	
STEP 3:	**Check the vehicle speed reporting.**		
STEP 3A:	Use INSITE™ electronic service tool to monitor the vehicle speed signal.	INSITE™ electronic service tool readout and the vehicle speedometer match?	
STEP 3B:	Verify the vehicle speed.	Vehicle speed is accurate?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault codes.	Fault Code 242 inactive?	
STEP 4B:	Clear the inactive fault codes.	All fault codes cleared?	

TROUBLESHOOTING STEP

STEP 1: Verify that the feature settings are correct.

STEP 1A: Verify that the customer wants Vehicle Speed Anti-Tampering (Fault Code 242) enabled.

Condition:

Action	Specification/Repair	Next Step
Verify that the customer wants Vehicle Speed Sensor Anti-Tampering feature enabled. -	Customer wants Vehicle Speed Sensor Anti-Tampering enabled? **YES**	1B
	Customer wants Vehicle Speed Sensor Anti-Tampering enabled? **NO** **Repair:** Use INSITE™ electronic service tool, disable the Vehicle Speed Sensor Anti-Tampering feature.	4A

STEP 1B: Verify that the vehicle speed sensor and the setting in INSITE™ electronic service tool match.

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

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool, go to the Vehicle Speed Source feature under Adjustments, Features and Parameters. • Verify that the Vehicle Speed Sensor Type parameter setting in INSITE™ electronic service tool matches the physical sensor type on the vehicle.	The setting in INSITE™ electronic service tool matches the speed sensor type on the vehicle? **YES**	1C
	The setting in INSITE™ electronic service tool matches the speed sensor type on the vehicle? **NO** **Repair:** Change the setting in the ECM with INSITE™ electronic service tool to match the vehicle speed sensor type.	4A

STEP 1C: Verify that the Anti-Tampering Sensitivity Level is set correctly for the application.

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

Action	Specification/Repair	Next Step
Verify that the Vehicle Speed Signal Tampering Sensitivity Level is set correctly for the application. • Use INSITE™ electronic service tool go to the Vehicle Speed Source feature under Adjustments, Features and Parameters. • Check the ECM setting for Vehicle Speed Signal Tampering Sensitivity Level.	Sensitivity Level is set correctly? **YES**	2A
	Sensitivity Level is set correctly? **NO** **Repair:** Use INSITE™ electronic service tool to set the Vehicle Speed Signal Tampering Sensitivity Level to the correct value for the vehicle.	4A

STEP 2: Look for signs or evidence of tampering.

STEP 2A: Inspect the vehicle speed sensor.

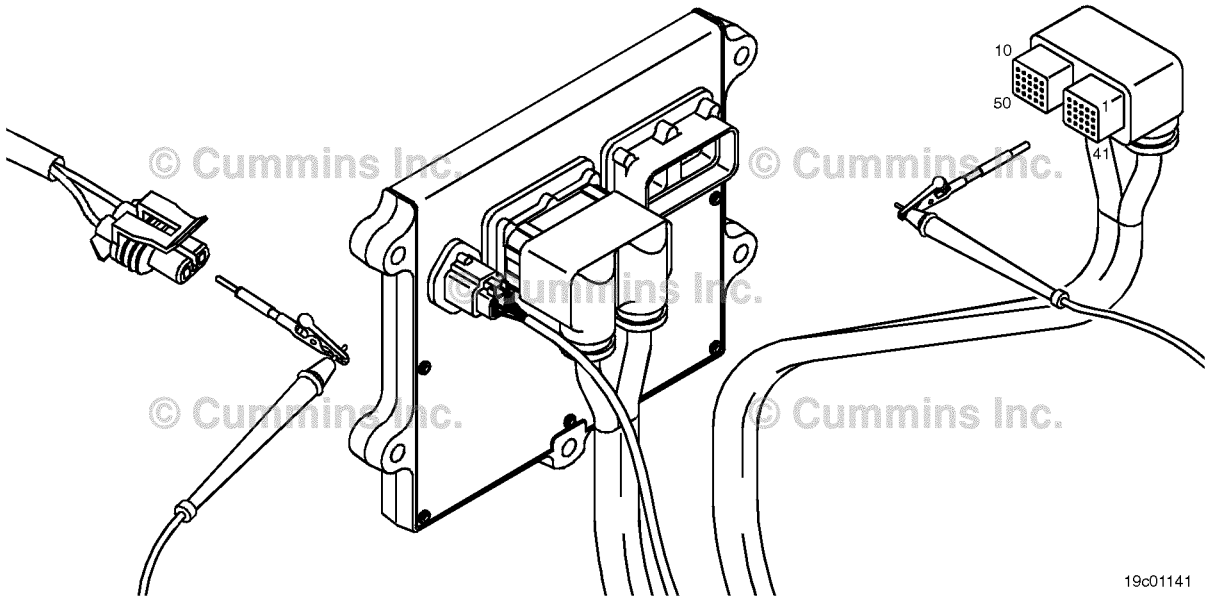
Condition:

Action	Specification/Repair	Next Step
Inspect the vehicle speed sensor for the following: • Improper mounting of the vehicle speed sensor • Vehicle speed sensor improperly connected to the OEM harness • Other external device connected in place of the vehicle speed sensor • Any evidence that tampering with the vehicle speed sensor has taken place.	Tampering, installed incorrectly, or external device present? **YES** **Repair:** Remove the tampering device. Install the sensor correctly or remove the external device.	4A
	Tampering, installed incorrectly. or external device present? **NO**	2B

STEP 2B: Check for open circuit in the OEM harness.

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

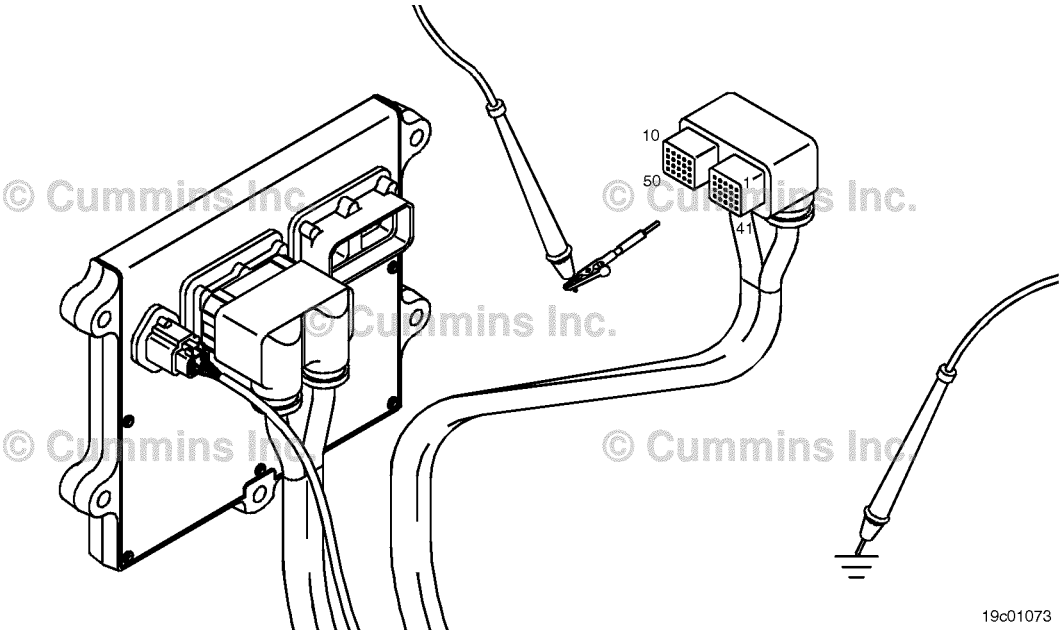
Action	Specification/Repair	Next Step
Using a multimeter, check for an open circuit in the OEM harness. • Measure the resistance of the magnetic vehicle speed sensor SIGNAL (+) wire between the OEM harness ECM connector and the OEM harness magnetic vehicle speed sensor connector. • Measure the resistance of the magnetic vehicle speed sensor SIGNAL (-) wire between the OEM harness ECM connector and the OEM harness magnetic vehicle speed sensor connector. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	2C
	Less than 10 ohms? **NO** **Repair:** An open circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 2C: Check for short circuit to ground in the OEM harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness connector from the ECM.
- Disconnect the OEM harness from the vehicle speed sensor.

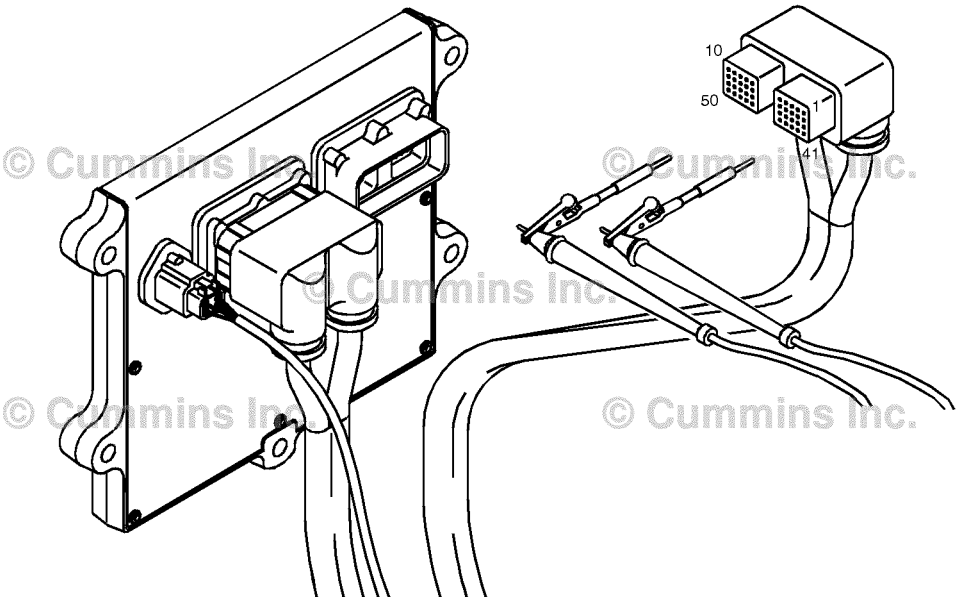
Action	Specification/Repair	Next Step
Check for a short circuit to ground on the magnetic vehicle speed sensor SIGNAL (+) and magnetic vehicle speed sensor SIGNAL (-) circuit in the OEM harness. • Measure the resistance between the magnetic vehicle speed sensor SIGNAL (+) pin at the ECM connector to engine block ground. • Measure the resistance between the magnetic vehicle speed sensor SIGNAL (-) pin at the ECM connector to engine block ground. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	More than 100k ohms? **YES**	2D
	More than 100k ohms? **NO** **Repair:** A short circuit has been detected in the OEM harness. 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 OEM harness.

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

Action	Specification/Repair	Next Step
Using a multimeter, check for a pin-to-pin short circuit in the OEM harness. • Measure the resistance and check for a short circuit between the magnetic vehicle speed sensor SIGNAL (+) pin at the OEM harness ECM connector and all other pins in the connector. • Measure the resistance and check for a short circuit between the magnetic vehicle speed sensor SIGNAL (-) pin at the OEM harness ECM connector and all other pins in the connector. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	More than 100k ohms? **YES**	3A
	More than 100k ohms? **NO** **Repair:** A short circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3: Check the vehicle speed reporting.

STEP 3A: Use INSITE™ electronic service tool to monitor the vehicle speed signal.

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

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to check the vehicle speed. • Verify that the vehicle speed is 0 when the vehicle is stationary and the engine is running. • Drive the vehicle or run on a chassis dynamometer. Compare the vehicle speed read by INSITE™ electronic service tool to the speedometer on the dash.	INSITE™ electronic service tool readout and the vehicle speedometer match? **YES**	3B
	INSITE™ electronic service tool readout and the vehicle speedometer match? **NO** **Repair:** Verify that the Tire Size, Rear Axle Ratio, and Tailshaft Gear Teeth parameters are set correct in the ECM.	4A

STEP 3B: Verify the vehicle speed.

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

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to verify that the speed reported is accurate or reasonable for the current gear. • (For example: 64 km/h [40 mph] in top gear is probably inaccurate data)	Vehicle speed is accurate? **YES**	4A
	Vehicle speed is accurate? **NO** **Repair:** Verify that the Tire Size, Rear Axle Ratio, and Tailshaft Gear Teeth parameters are set correct in the ECM.	4A

STEP 4: Clear the fault codes.

STEP 4A: Disable the fault code.

Condition:
- Connect all components.
- Turn keyswitch ON.
- Engine **not** running.
- Vehicle **not** moving.

Action	Specification/Repair	Next Step
Disable the fault code. • With the keyswitch ON and the vehicle stationary, wait 1 minute. • Use INSITE™ electronic service tool, verify that Fault Code 242 is inactive.	Fault Code 242 inactive? **YES**	4B
	Fault Code 242 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact your local Cummins® Authorized Repair Location or OEM dealer if all the steps have been completed and checked again.	1A

STEP 4B: Clear the inactive fault codes.

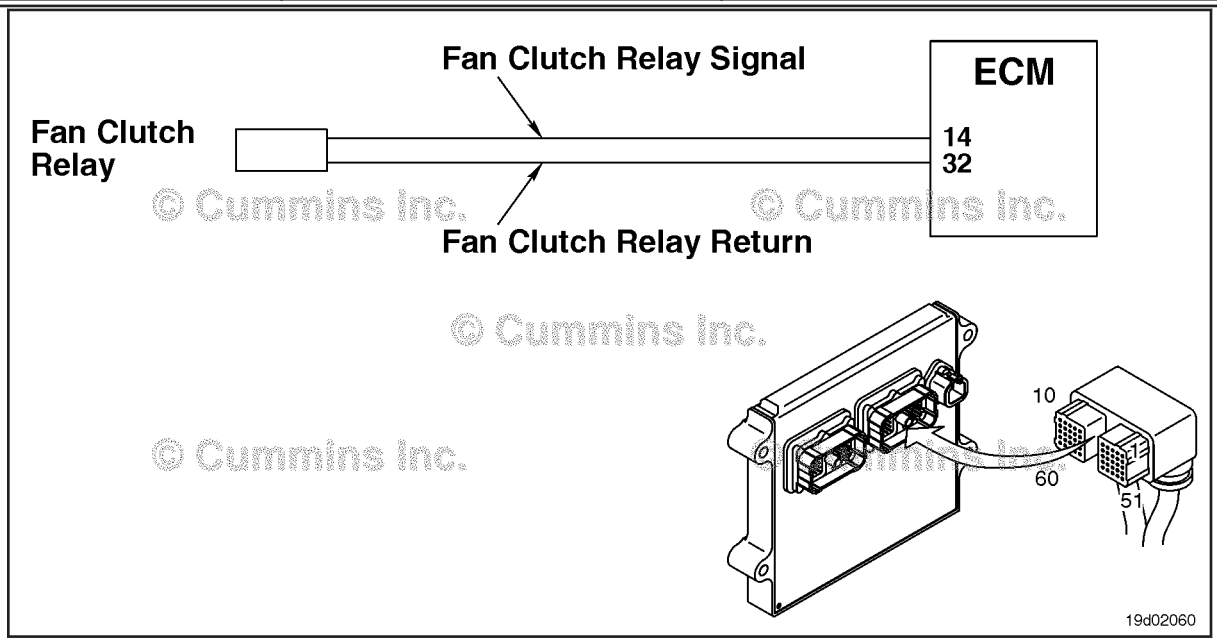
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 245

Fan Control Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 245 PID(P), SID(S): S033 SPN: 647 FMI: 4/4 Lamp: Amber SRT:	Fan Control Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at the fan control circuit when commanded on.	The fan can possibly stay on continuously or **not** run at all.



Fan Control Circuit

Circuit Description:

The electronic control module (ECM) provides a signal to the fan control solenoid to turn the engine fan on and off. There are two types of fans supported by this signal; variable speed and ON/OFF. The INSITE™ electronic service tool can be used to determine which fan type is currently set up for use. The fan 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 control solenoid location varies by OEM. Refer to the appropriate OEM service literature to determine the location.

Shop Talk:

The fan control logic can be adjusted with the INSITE™ electronic service tool. There are two choices: 12 or 24 VDC ON, or 0 VDC ON. For proper fan operation, the fan control logic setup with INSITE™ electronic service tool **must** match the hardware configuration on the vehicle.

This fault code is logged when the ECM commands 12 or 24 VDC to the fan control solenoid, but the voltage on the fan control signal circuit is less than 12 or 24 VDC. The low voltage on the signal circuit usually indicates a short circuit to ground in the harness or solenoid.

If Fault Code 245 is still active after completing the following troubleshooting steps, consult the OEM service literature for procedures to check the fan control circuit for a short circuit to ground.

Refer to Troubleshooting Fault Code t05-245

FAULT CODE 245 - Fan Control Circuit - Voltage Below Normal or Shorted to Low 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 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 245 active?**	
STEP 2:	**Check the fan control solenoid and circuit.**		
STEP 2A:	**Inspect the fan control solenoid and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check for an internal short in the fan control solenoid.**	**Within the OEM resistance specification?**	
STEP 2B-1:	**Check for a pin-to-ground short circuit in the fan control solenoid.**	**Greater than 100k ohms?**	
STEP 2C:	**Check the fan control solenoid diagnostic supply voltage and supply line.**	**Greater than +5-VDC?**	
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 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 245 inactive?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 245 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 245 active? **YES**	2A
	Fault Code 245 active? **NO**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the fan control solenoid and circuit.

STEP 2A: Inspect the fan control solenoid and connector pins.

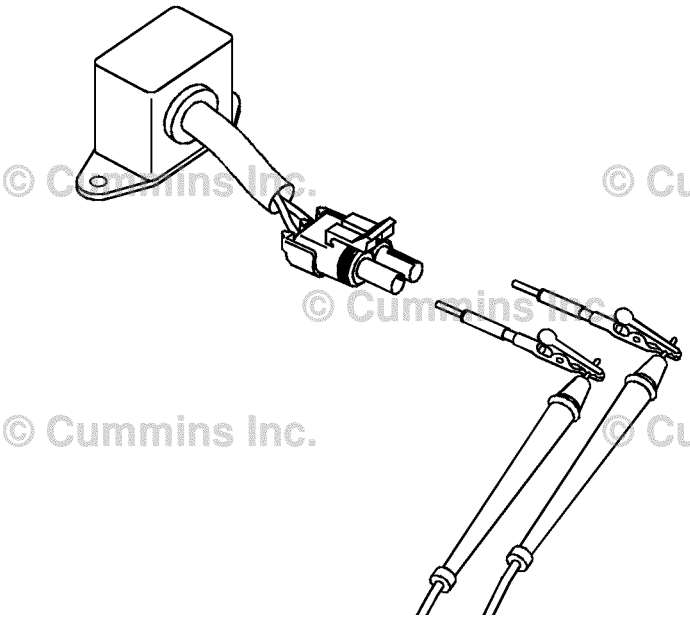
Condition:
- Turn keyswitch OFF.
- Disconnect the fan control solenoid from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the solenoid or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check for an internal short in the fan control solenoid.

Condition:
- Turn keyswitch OFF.
- Disconnect the fan control solenoid from the OEM harness.

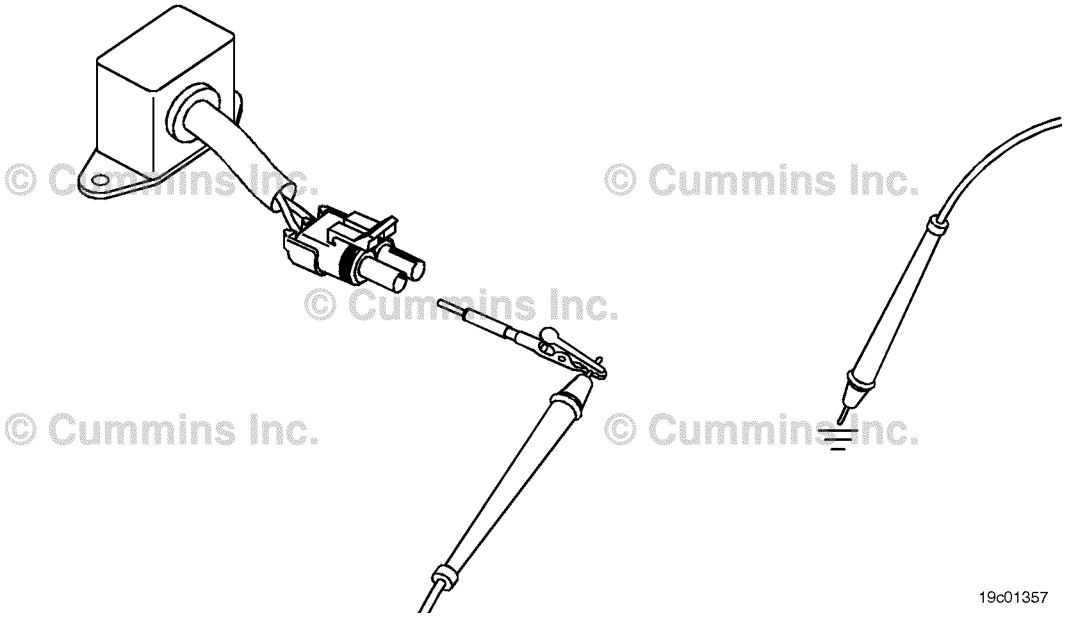
Action	Specification/Repair	Next Step
Check for low internal resistance of the fan control solenoid. • Use a multimeter, measure the resistance between the SIGNAL and RETURN pin of the fan control solenoid connector. Refer to the circuit diagram or wiring diagram for connector pin identification. Refer to the OEM service manual for resistance specifications. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Within the OEM resistance specification? **YES**	2B-1
	Within the OEM resistance specification? **NO** **Repair:** Replace the fan control solenoid. Refer to the OEM service manual.	4A



STEP 2B-1: Check for a pin-to-ground short circuit in the fan control solenoid.

Condition:
- Turn keyswitch OFF.
- Disconnect the fan control solenoid from the OEM harness.

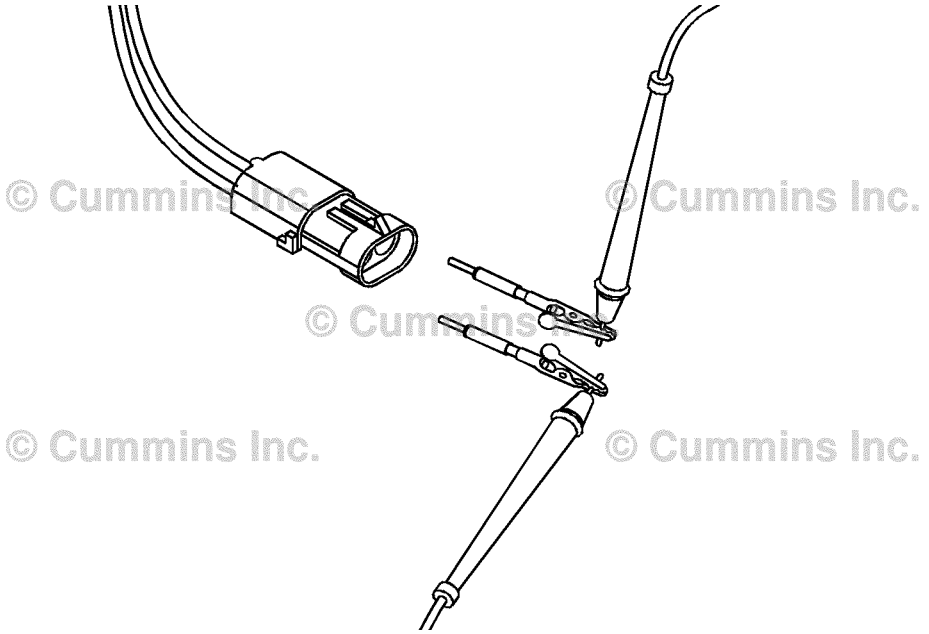
Action	Specification/Repair	Next Step
Short circuit on one connector pin-to-ground check: Measure the resistance and check for a short circuit between the following fan control solenoid connector pin and ground: • Fan control SIGNAL connector pin. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	2C
	Greater than 100k ohms? **NO** **Repair:** Replace the fan control solenoid. Refer to the OEM service manual.	4A



STEP 2C: Check the fan control solenoid diagnostic supply voltage and supply line.

Condition:
- Turn keyswitch OFF.
- Disconnect the fan control solenoid from the OEM harness.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Measure the voltage between the fan control SIGNAL pin and the fan control RETURN pin at the OEM harness actuator connector. Refer to the wiring diagram for connector pin identification.	Greater than +5-VDC? **YES**	3C
	Greater than +5-VDC? **NO**	3A



STEP 3: Check the ECM and OEM harness.

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

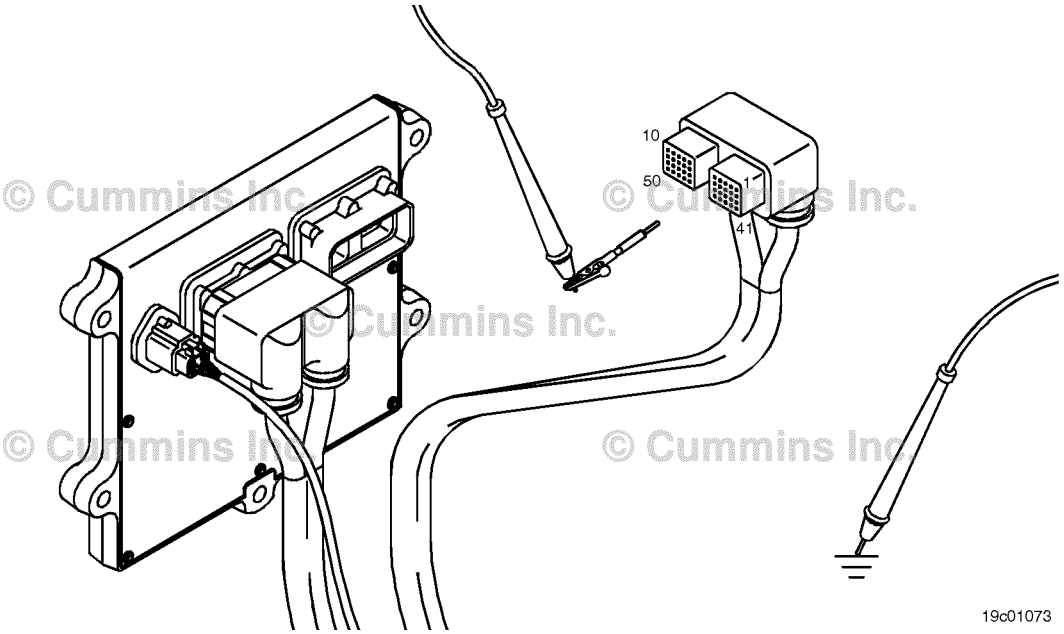
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

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

STEP 3B: 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 fan control solenoid from the OEM harness.

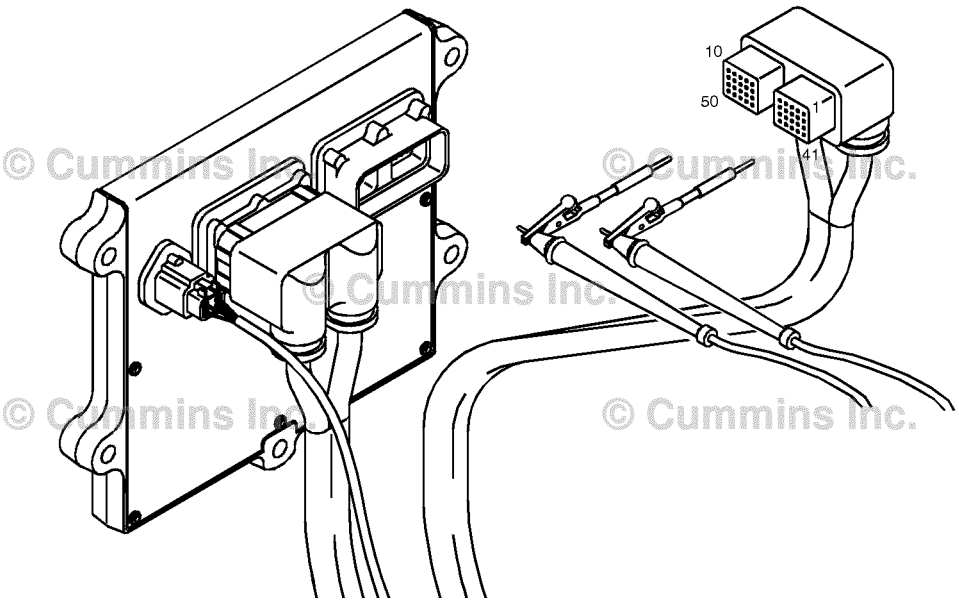
Action	Specification/Repair	Next Step
Short circuit on one connector - pin-to-ground check: • Measure the resistance and check for a short circuit between the fan control SIGNAL pin of the OEM harness ECM connector and engine block ground. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3C
	Greater than 100k ohms? **NO** **Repair:** 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 fan control solenoid from the OEM harness.

Action	Specification/Repair	Next Step
Check for a short circuit on one connector pin-to-pin check: • Measure the resistance and check for a short circuit between the fan control SIGNAL pin of the OEM harness ECM connector and all other pins in the connector. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3D
	Greater than 100k ohms? **NO** **Repair:** 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. Use INSITE™ electronic service tool to read the fault codes.	Fault Code 245 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 245 inactive? **NO** **Repair:** 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. • Disconnect the engine coolant temperature sensor from the engine harness. • Start the engine and let it idle for 1 minute. • Turn the keyswitch OFF, shutdown the engine. • Connect the engine coolant temperature sensor to the engine harness. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 245 inactive? **YES**	4B
	Fault Code 245 inactive? **NO** **Repair:** 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.

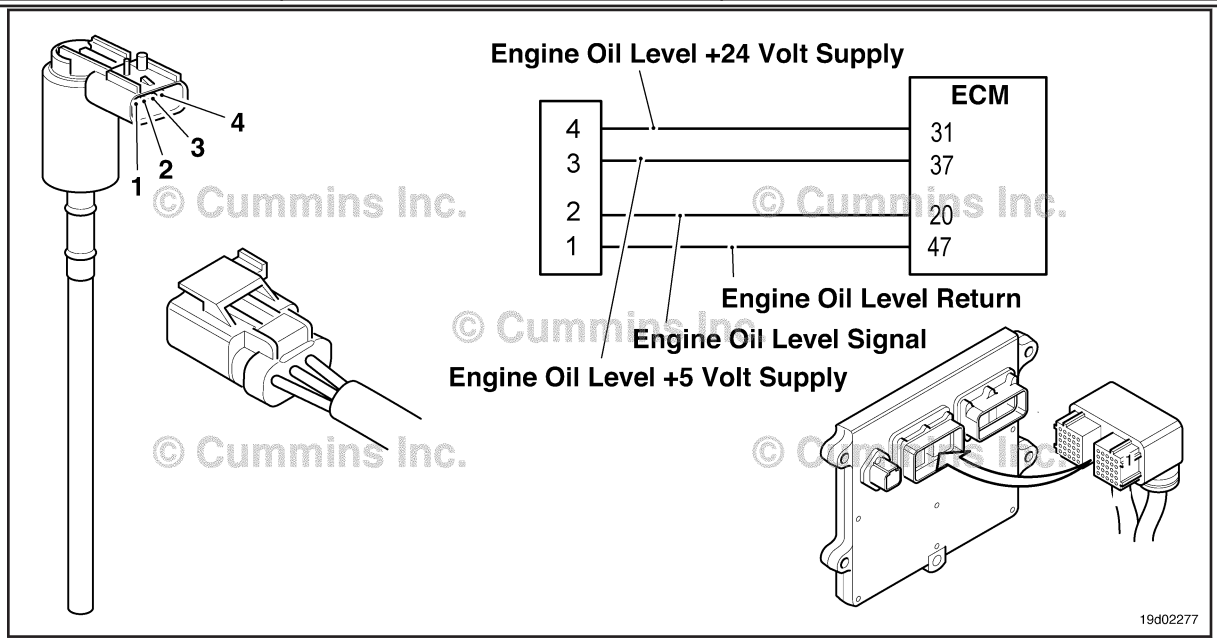
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 253

Engine Oil Level — Data Valid But Below Normal Operational Range — Most Severe Level

CODES	REASON	EFFECT
Fault Code: 253 PID(P), SID(S): P98 SPN: 98 FMI: 1 Lamp: Red SRT:	Engine Oil Level — Data Valid But Below Normal Operational Range — Most Severe Level. Very 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 253.

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 253 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 253 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 t05-253

Engine Oil Level - Data Valid but Below Normal Operating 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 253 active?**	
STEP 2:	**Check the engine lubricating oil level.**		
STEP 2A:	**Verify the engine lubricating oil level.**	**Engine lubricating oil level correct?**	
STEP 3:	**Clear the fault codes.**		
STEP 3A:	**Disable the fault codes.**	**Fault Code 253 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 INSITE™ electronic service tool.
- Turn keyswitch ON.
- Verify engine oil temperature is near ambient temperature.
- Make sure the vehicle is parked on level ground.

Action	Specification/Repair	Next Step
Read the fault codes. • Use INSITE™ electronic service too to read the fault codes.	Fault Code 253 active? **YES**	2A
	Fault Code 253 active? **NO**	2A

STEP 2: Check the engine lubricating oil level.

STEP 2A: Verify the engine lubricating oil level.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Verify the engine lubricating oil level using the oil dipstick.	Engine lubricating oil level correct? **YES** **Repair:** Replace the lubricating oil level sensor. Refer to Procedure 019-056 in Section 19.	3A
	Engine lubricating oil level correct? **NO** **Repair:** Low engine lubricating oil level has been detected. Add engine lubricating oil to the engine. • 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 007-037 in Section 7. • 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 007-037 in Section 7.	3A

STEP 3: Clear the fault codes

STEP 3A: Disable the fault codes.

Condition:
- Turn keyswitch OFF.
- Wait 30 seconds, and then turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Determine if fault 253 is inactive. Use INSITE™ electronic service tool to determine if Fault Code 253 is inactive.	Fault Code 253 inactive? **YES**	3B
	Fault Code 253 inactive? **NO** **Repair:** Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected.	1A

STEP 3B: Clear the inactive fault codes.

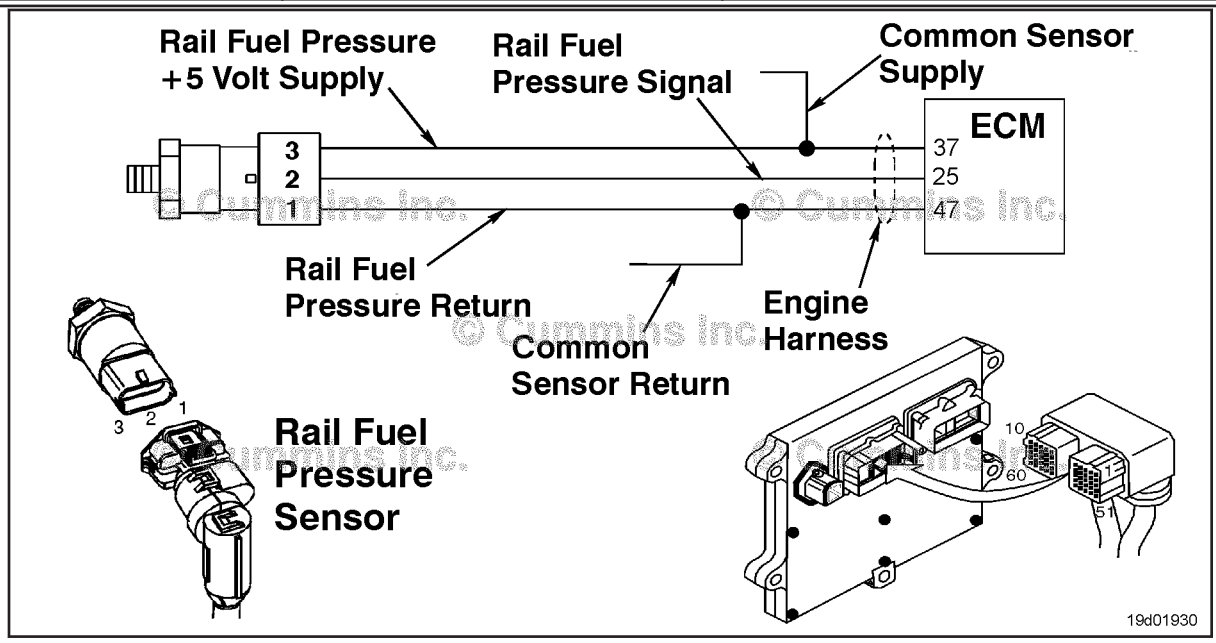
Condition:
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

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

Fault Code 268

Injector Metering Rail 1 Pressure - Data Erratic, Intermittent, or Incorrect

CODES	REASON	EFFECT
Fault Code: 268 PID(P), SID(S): P094 SPN: 94 FMI: 2 Lamp: Amber 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 Pressure Sensor Circuit

Circuit Description:

The fuel pressure sensor contains supply, signal, and return pins. The 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, backup engine position sensor.

Component Location:

The fuel pressure sensor is located in the rail fuel on the air intake side of the engine. See Procedure 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 ECM detects that 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 t05-268

FAULT CODE 268 - 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.**	**Fault Code 451 or 452 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 the ECM and engine harness connector pins.**	**Dirty or damaged pins?**	
STEP 3B:	**Clear the circuit response.**	**Fault Code 451 active?**	
STEP 3C:	**Clear the circuit response.**	**Fault Code 452 active?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 268 inactive?**	
STEP 4B:	**Clear the inactive fault codes.**	**All faults cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check the sensor circuit fault codes.

STEP 1A: Check for active Fault Codes 154 and 155.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Use INSITE™ electronic service tool, to read the fault codes.	Fault Codes 451 or 452 is active? **YES**	Appropriate troubleshooti ng tree.
	Fault Codes 451 or 452 is active? **NO**	2A

STEP 2: Check the rail fuel pressure sensor 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 rail fuel pressure sensor and connector pins. • Corroded pins. • Bent or broken pins. • Pushed back or expanded pins. • Wire insulation damaged. • Moisture in or on the connector. • Missing or damaged connector seals. • Connector shell broken. • Dirt of debris in or on the connector pins. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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. • Use the INSITE™ electronic service tool, to read the fault codes.	Fault Code 451 active? **YES**	2C
	Fault Code 451 active? **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 to the rail fuel pressure connector of the engine harness. See the circuit diagram or the wiring diagram for connector pin identification. Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 452 active? **YES** **Repair:** Replace the rail fuel pressure sensor. Refer to Procedure 019-115 in Section 19.	4A
	Fault Code 452 active? **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: • Corroded pins. • Bent or broken pins. • Pushed back or expanded pins. • Wire insulation damaged. • Moisture in or on the connector. • Missing or damaged connector seals. • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **NO**	3B

STEP 3B: Check the circuit response.

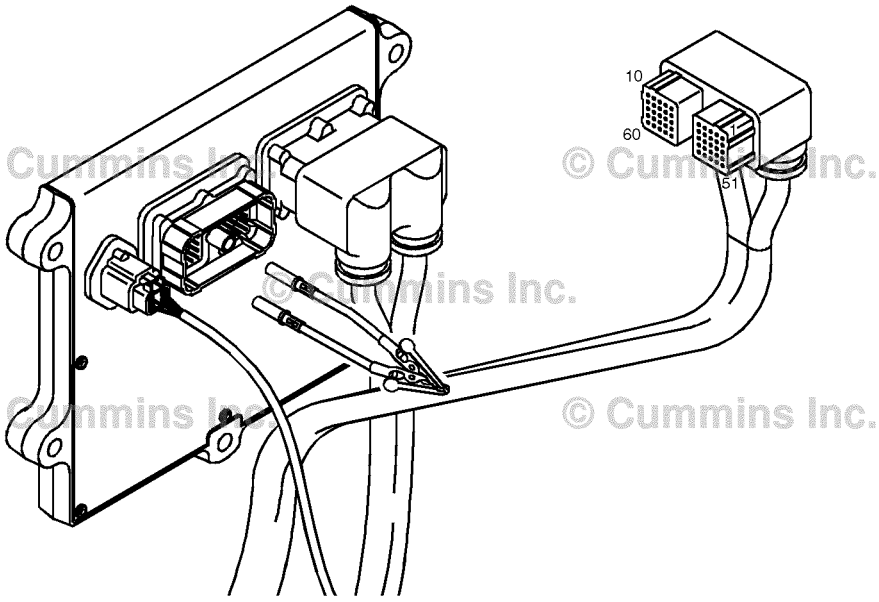
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropirate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 451 active? **YES**	3C
	Fault Code 451 active? **NO** **Repair:** 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
Place a jumper wire between the rail fuel pressure SIGNAL pin and rail fuel pressure RETURN pin at the engine control module engine connector. Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 452 active? **YES** **Repair:** High resistance or a short circuit has been detected in the engine harness. Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19.	4A
	Fault Code 452 active? **NO** **Repair:** 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
Diable the fault code. • Start the engine. • Operate the engine under light load for two minutes. • Use INSITE™ electronic service tool, to verify that the fault code is inactive.	Fault Code 268 inactive? **YES**	4B
	Fault Code 268 inactive? **NO**	1A

STEP 4B: Clear the inactive fault code.

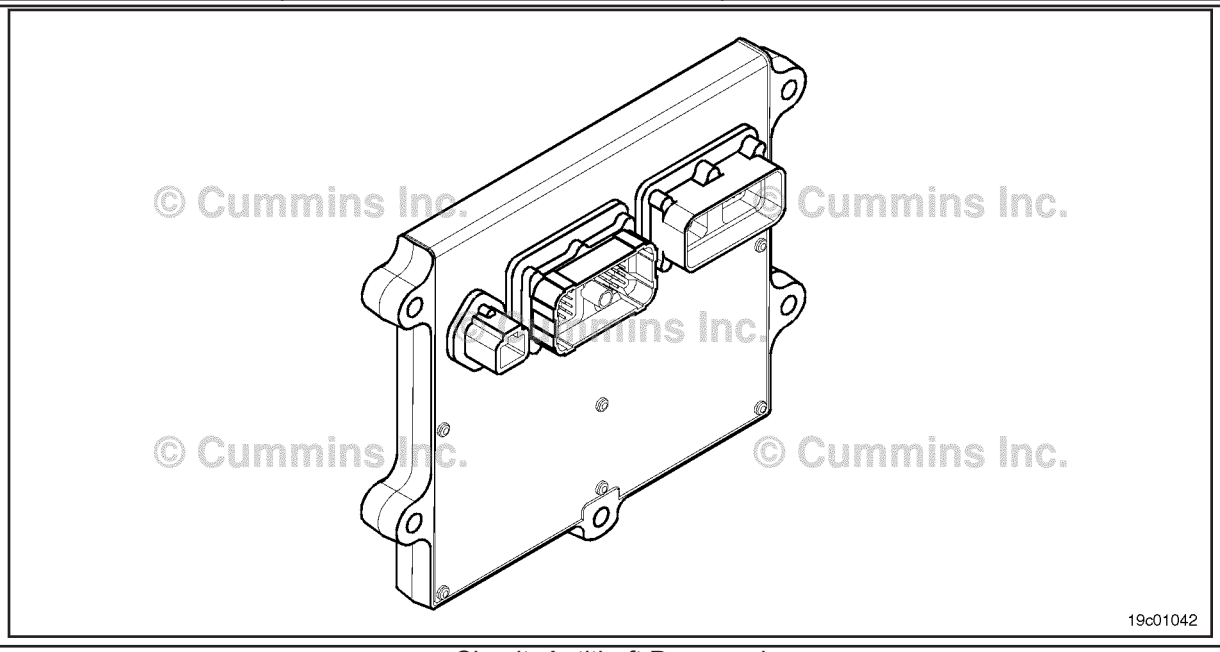
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Clear the inactive fault code. • Use INSITE™ electronic service tool, to erase the inactive fault code.	All faults cleared? **YES**	Repair complete.
	All faults cleared? **NO**	Appropriate troubleshooti ng steps.

Fault Code 269

Antitheft Password Valid Indicator — Data Erratic, Intermittent, or Incorrect

CODES	REASON	EFFECT
Fault Code: 269 PID(P), SID(S): S217 SPN: 1195 FMI: 2 Lamp: Red SRT:	Antitheft Password Valid Indicator — Data Erratic, Intermittent, or Incorrect. Engine ignition attempt without authorization from immobilizer anti-theft device.	The engine will not start.



Circuit: Antitheft Password

Circuit Description:

The immobilizer anti-theft device is connected to the primary engine Electronic Control Module (ECM) through a J1939 datalink network.

Messages sent from the immobilizer anti-theft device are received by the Cummins engine ECM and used for controlling the anti-theft features. The Cummins ECM and immobilizer anti-theft device **must** be configured properly so that proper operation of the multiplexed components will occur.

Component Location:

The engine ECM is located on the intake side of the engine. The J1939 datalink wiring and location of OEM installed J1939 devices varies by OEM. The immobilizer anti-theft device is installed by the OEM.

Shop Talk:

This fault code is active when the immobilizer anti-theft device has not been deactivated. The engine will not start until proper authorization has been activated.

On-Board Diagnostics (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 t05-269

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 269 is active?**	
STEP 2:	**Clear the fault codes.**		
STEP 2A:	**Disable the fault codes.**	**Fault code 269 inactive?**	
STEP 2B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Read for fault codes.

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

Action	Specification/Repair	Next Step
Check for the immobilizer anti-theft device fault codes. • Using INSITE™ electronic service tool read the fault codes.	Fault Codes 269 active? **YES** **Repair:** The immobilizer anti-theft device has not been deactivated. The engine will not start until proper authorization has been activated. Refer to OEM troubleshooting for immobilizer anti-theft device operation.	2A
	Fault Codes 269 active? **NO**	2A

STEP 2: Clear the fault codes.

STEP 2A: Disable the fault codes

Condition:
- Turn keyswitch OFF.
- Wait 30 seconds, and then turn the keyswitch on.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Dertermine if fault code 269 is inactive. • Use INSITE™ electronic service tool to determine if fault code 269 is inactive?	Is fault code 269 inactive? **YES**	2B
	Is fault code 269 inactive? **NO** **Repair:** Troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected.	1A

STEP 2B: Clear the inactive fault codes.

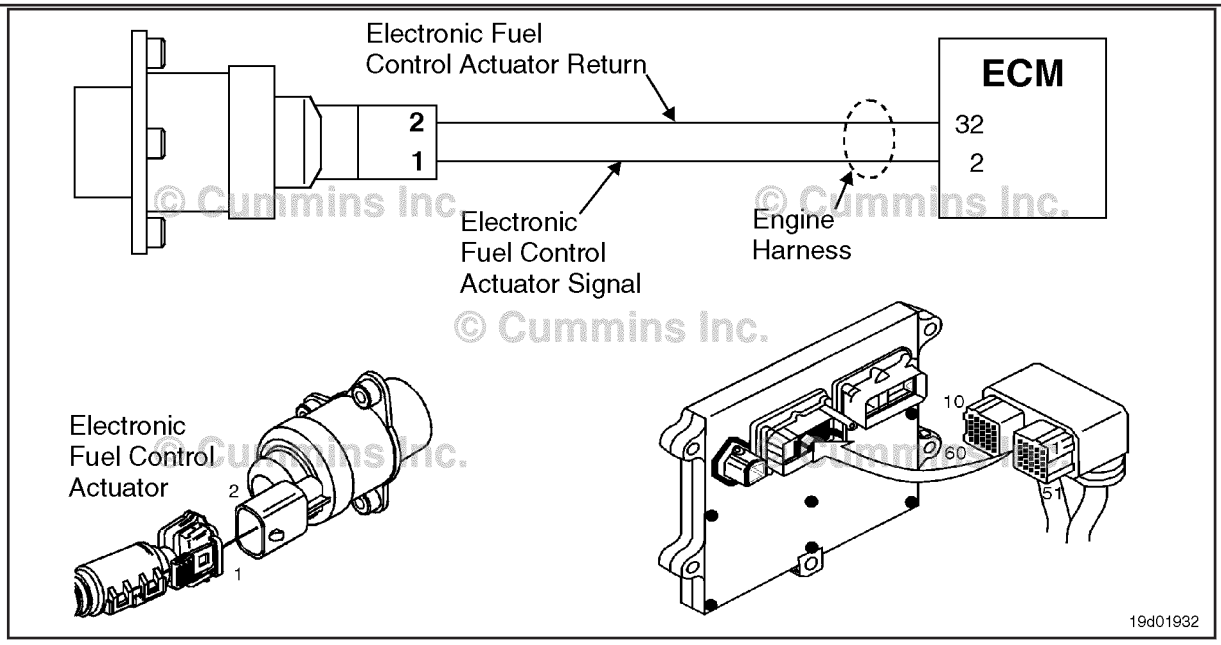
Condition:
- Connect all components.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Clear the inactive fault codes. • Using INSITE™ electronic service tool, erase all inactive fault codes.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO**	Appropriate troubleshooting steps

Fault Code 271 (ISB/QSB (Automotive and Industrial Application)

High Fuel Pressure Solenoid Valve Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 271 PID(P), SID(S): S126 SPN: 1347 FMI: 4 Lamp: Amber SRT:	High Fuel Pressure Solenoid Valve Circuit - Voltage Below Normal or Shorted to Low Source. Electronic fuel control actuator shorted low.	Engine will run poorly at idle. Engine will have low power. Fuel pressure will be higher than commanded.



Electronic Fuel Control Actuator Circuit

Circuit Description:

The circuit is a pulse width modulated (PWM) driver in the Electronic Control Module (ECM) that controls the electronic fuel control actuator. The actuator is grounded in the ECM. The actuator is normally open. Pulse width modulation (PWM) duty cycle to the electronic fuel control actuator depends on the difference between desired rail pressure and sensed rail pressure.

Component Location:

The electronic fuel control actuator is located on the engine-mounted fuel pump housing. The engine wiring harness and the ECM are other components in the circuit that can cause this fault code. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

This fault becomes active when the ECM detects a short circuit in the electronic fuel control actuator circuit. Causes for this fault code are short circuit to ground or low resistance (electronic fuel control actuator coil is shorted internally) in the circuit for the electronic fuel control actuator. When excessive current or a short circuit is detected, the ECM driver to the electronic fuel control actuator is turned off to protect the circuit. It is necessary to cycle the keyswitch off and then back on before the ECM will retest for the cause of the fault code. The ECM driver is activated at key-on; and if the cause is no longer present, the fault code will become inactive and can be cleared. If the fault code is intermittent, look for causes of an intermittent short to ground in the wiring harness or connectors.

Refer to Troubleshooting Fault Code t05-271

FAULT CODE 271 (ISB/QSB (Automotive and Industrial Application) - High Fuel Pressure Solenoid Valve 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 3164110 - male Bosch® test lead; Part Number 3164111 - 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 an active fault code.**	**Fault Code 271 active?**	
STEP 2:	**Check the electronic fuel control actuator and circuit.**		
STEP 2A:	**Inspect the electronic fuel control actuator and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check for a pin-to-ground short circuit in the electronic fuel control actuator.**	**Greater than 100k ohms?**	
STEP 2B-1:	**Check the ECM response.**	**Fault Code 271 inactive and Fault Code 272 active?**	
STEP 2B-2:	**Check the ECM response.**	**Fault Code 271 active and Fault Code 272 inactive?**	
STEP 2C:	**Check the electronic fuel control actuator diagnostic supply voltage and supply line.**	**Greater than 3.0 VDC?**	
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 electronic fuel control actuator diagnostic supply voltage.**	**Greater than 3.0 VDC?**	
STEP 3C:	**Check for a pin short circuit to ground in the engine harness.**	**Greater than 100k ohms?**	
STEP 3D:	**Check for a pin-to-pin short circuit in the engine harness.**	**Greater than 100k ohms?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 271 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 271 active? **YES**	2A
	Fault Code 271 active? **NO**	Inactive or Intermittent Fault Code, Refer to Procedure 019-362.

STEP 2: Check the electronic fuel control actuator and circuit.

STEP 2A: Inspect the electronic fuel control actuator and connector pins.

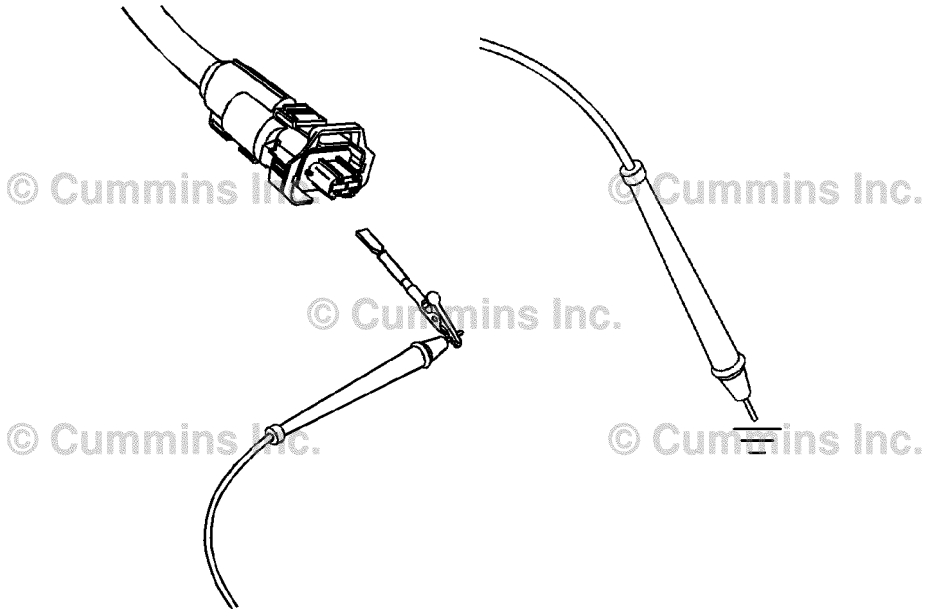
Condition:
- Turn keyswitch OFF.
- Disconnect the electronic fuel control actuator from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and actuator connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pin • Connector shell broke • Wire insulation damage • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check for a pin-to-ground short circuit in the electronic fuel control actuator.

Condition:
- Turn keyswitch OFF.
- Disconnect the electronic fuel control actuator from the engine harness.

Action	Specification/Repair	Next Step
Short circuit on one connector - pin-to-ground check: • Measure the resistance and check for a short circuit between the electronic fuel control actuator connector pin and ground: Electronic fuel control actuator SIGNAL connector pin. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	2B-1
	Greater than 100k ohms? **NO** **Repair:** Replace the high-pressure fuel pump. Use the following procedure in the ISB^{e} and ISB (Common Rail Fuel System) Series Engines Troubleshooting and Repair Manual, Bulletin 4021271. Refer to Procedure 005-016 in Section 5.	4A



STEP 2B-1: Check the ECM response.

Condition:
- Turn keyswitch OFF.
- Disconnect the electronic fuel control actuator from the engine harness.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the ECM response. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 271 inactive and Fault Code 272 active? **YES**	2B-2
	Fault Code 271 inactive and Fault Code 272 active? **NO**	2C

STEP 2B-2: Check the ECM response.

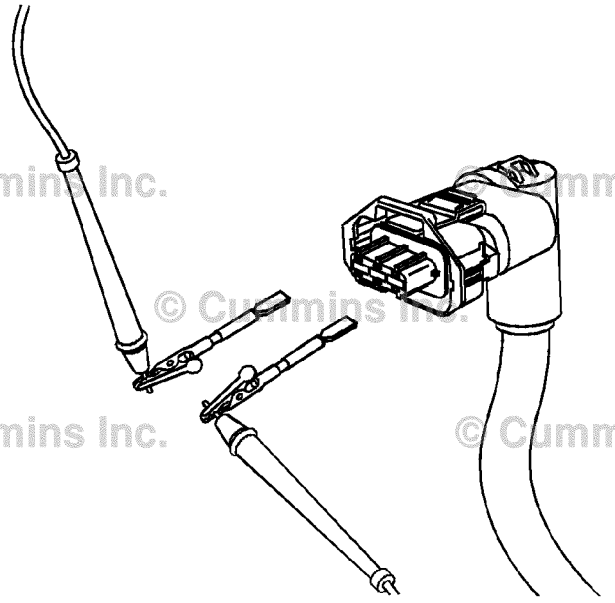
Condition:
- Turn keyswitch OFF.
- Reconnect the electronic fuel control actuator to the engine harness.
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the ECM response. • Use INSITE™ electronic service tool to read the fault codes. If Fault Code 271 is active whenever the electronic fuel control actuator is connected, the electronic fuel control actuator has a short circuit.	Fault Code 271 active and Fault Code 272 inactive? **YES**	4A
	Fault Code 271 active and Fault Code 272 inactive? **NO**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.

STEP 2C: Check the electronic fuel control actuator diagnostic supply voltage and supply line.

Condition:
- Turn keyswitch OFF.
- Disconnect the electronic fuel control actuator from the engine harness.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and supply line. • Measure the voltage between the electronic fuel control actuator SIGNAL pin and the Electronic fuel control actuator RETURN pin at the engine harness actuator connector.	Greater than 3.0 VDC? **YES**	3D
	Greater than 3.0 VDC? **NO**	3A



STEP 3: Check the ECM and engine harness.

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

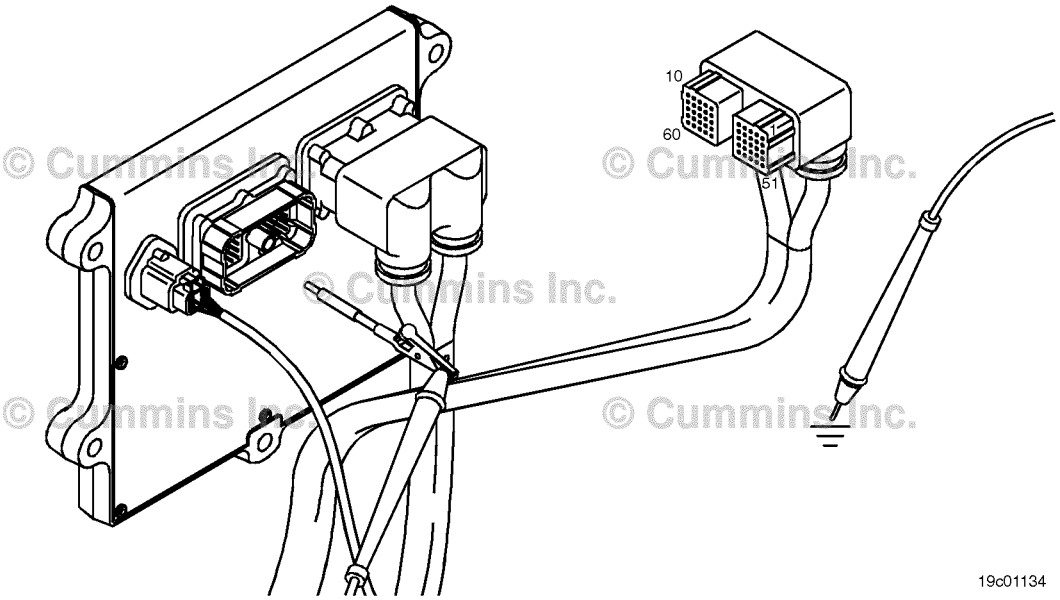
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

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

STEP 3B: Check the ECM electronic fuel control actuator diagnostic supply voltage.

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

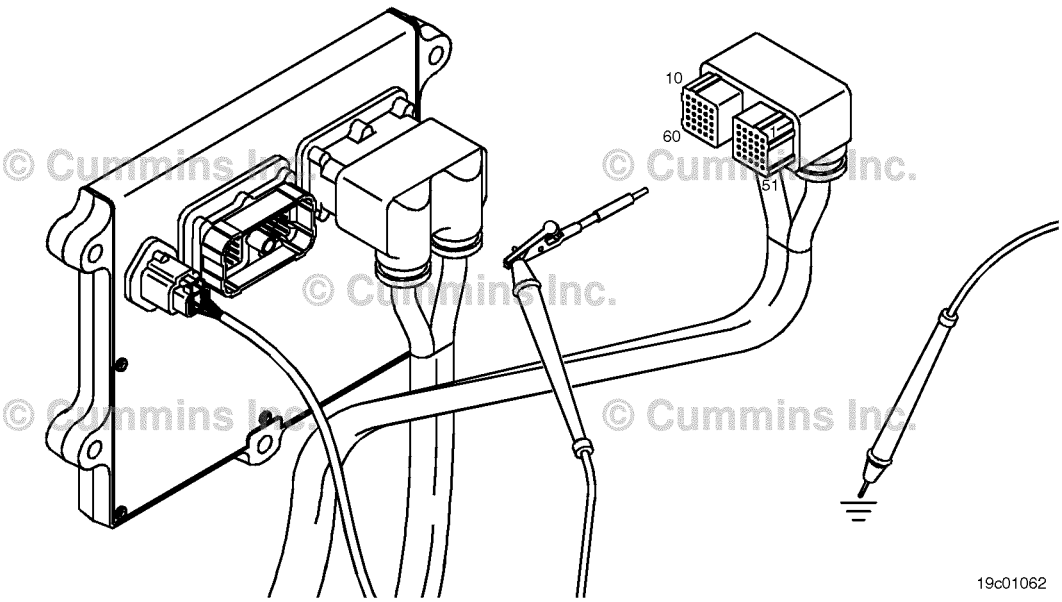
Action	Specification/Repair	Next Step
Check the supply voltage. • Measure the voltage between the electronic fuel control actuator SIGNAL pin at the engine harness connector ECM port and ground.	Greater than 3.0 VDC? **YES**	3C
	Greater than 3.0 VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



STEP 3C: Check for a pin short circuit to ground in the engine harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the electronic fuel control actuator from the engine harness.

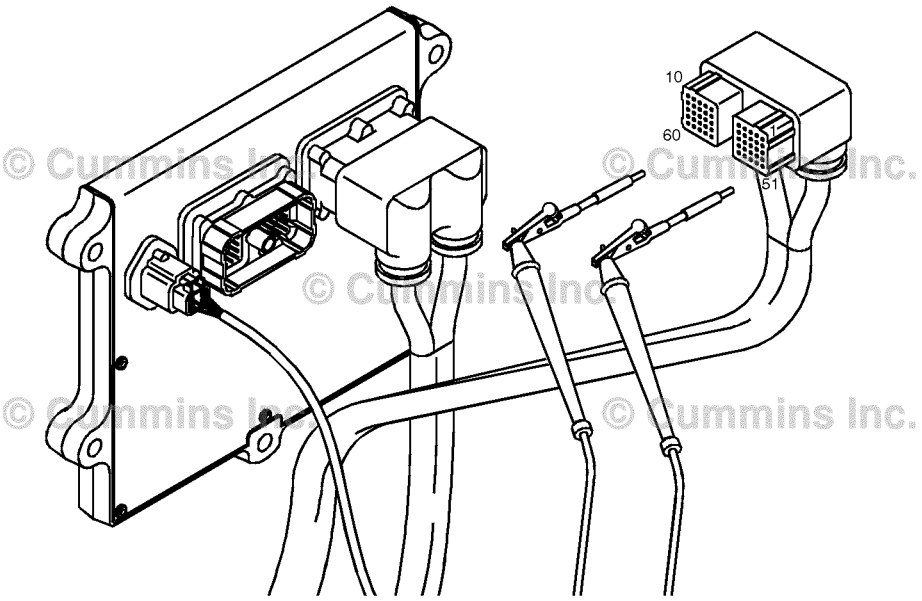
Action	Specification/Repair	Next Step
Short circuit on one connector - pin-to-ground check: • Measure the resistance and check for a short circuit between the following engine harness ECM connector pin and ground: Electronic fuel control actuator SIGNAL pin. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3D
	Greater than 100k ohms? **NO** **Repair:** Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 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 electronic fuel control actuator from the engine harness.

Action	Specification/Repair	Next Step
Short circuit on one connector - pin-to-pin check: • Measure the resistance and check for a short circuit between the following engine harness ECM connector pin and all other pins in the engine harness ECM connector: electronic fuel control actuator SIGNAL pin. Refer to the circuit diagram or wiring diagram for connector pin identification. For general resistance measurement techniques, refer to Resistance Measurements Using a Multimeter and Wiring Diagram, Refer to Procedure 019-360 .	Greater than 100k ohms? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A
	Greater than 100k ohms? **NO** **Repair:** 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.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 271 inactive? **YES**	4B
	Fault Code 271 inactive? **NO** **Repair:** Refer to the troubleshooting steps or contact a local Cummins® Authorized Repair location if all steps have been completed and rechecked.	1A

STEP 4B: Clear the inactive fault codes.

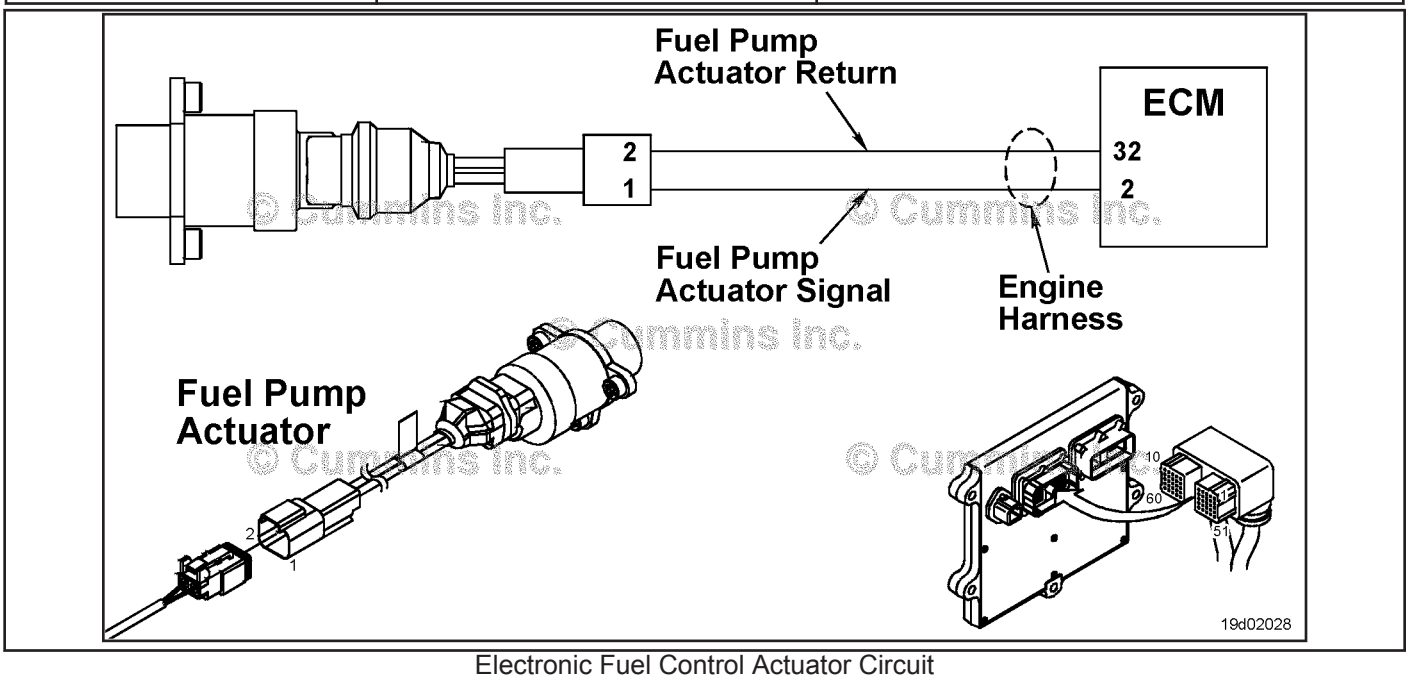
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 271 (ISC/QSC/ISL/QSL Automotive, Industrial, and Marine Application)

High Fuel Pressure Solenoid Valve Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 271 PID(P), SID(S): S126 SPN: 1347 FMI: 4 Lamp: Amber SRT:	High Fuel Pressure Solenoid Valve Circuit - Voltage Below Normal or Shorted to Low Source. Low signal voltage detected at the fuel pump actuator circuit.	Engine will run poorly at idle. Engine will have low power. Fuel pressure will be higher than commanded.



Electronic Fuel Control Actuator Circuit

Circuit Description:

The circuit is a pulse width modulated (PWM) driver in the Electronic Control Module (ECM) that controls the electronic fuel control actuator. The actuator is grounded in the ECM. The actuator is normally open. Pulse width modulation (PWM) duty cycle to the electronic fuel control actuator depends on the difference between desired rail pressure and sensed rail pressure.

Component Location:

The fuel pump actuator is located on the engine-mounted fuel pump. The engine siring harness and the ECM are other components in the circuit that can cause this fault code Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

This fault becomes active when the ECM detects a short circuit in the electronic fuel control actuator circuit. Causes for this fault code are short circuit to ground or low resistance (fuel control actuator coil is shorted internally) in the circuit for the fuel pump actuator. When excessive current or a short circuit is detected, the ECM driver to the fuel control actuator is turned off to protect the circuit. It is necessary to cycle the keyswitch off and then back on before the ECM will retest for the cause of the fault code. The ECM driver is reenabled at key-on; and if the cause is no longer present, the fault code will become inactive and can be cleared. If the fault code is intermittent, look for causes

of an intermittent short to ground in the wiring harness or connectors. Since the ISC and ISL engines utilize a 2-stage fuel rail pressure relief valve, failures to the fuel pump actuator will result in operation with the fuel rail pressure relief valve open. Extended operation with the fuel rail pressure relief valve open can damage the pressure relief valve.

Fault Code 2311 may have high counts if the fault condition is or was intermittent.

Refer to Troubleshooting Fault Code t05-271

FAULT CODE 271 (ISC/QSC/ISL/QSL Automotive, Industrial, and Marine Application) High Fuel Pressure Solenoid Valve 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 271 active?	
STEP 2:	**Check the fuel pump actuator and circuit.**		
STEP 2A:	Inspect the fuel pump actuator and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the circuit response.	Fault Code 272 is active and Fault Code 271 is inactive?	
STEP 2C:	Check the fault codes and verify sensor condition.	Fault Code 271 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 272 active and Fault Code 271 inactive	
STEP 3C:	Check for a pin short circuit to ground in the engine harness.	Greater than 100k ohms?	
STEP 3D:	Check for pin short circuit to ground.	Greater than 100k ohms?	
STEP 3E:	Check for an inactive fault code.	Fault Code 271 is inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 271 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 271 active? **YES**	2A
	Fault Code 271 active? **NO**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the fuel pump actuator and circuit.

STEP 2A: Inspect the fuel pump actuator and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the fuel pump actuator from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and actuator connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pin • Connector shell broke • Wire insulation damage • Damaged locking tab connector. NOTE: Inspect the pigtail wire harness as well as the engine harness for wire insulation damage that can cause a short circuit. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the fuel pump actuator 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 272 is active and Fault Code 271 is inactive? **YES**	2C
	Fault Code 272 is active and Fault Code 271 is inactive? **NO**	3A

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

Condition:
- Turn keyswitch OFF.
- Connect the fuel pump actuator 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 271 active? **YES** **Repair:** A damaged fuel pump actuator has been detected. Replace the fuel pump actuator. Refer to Procedure 019-117 in Section 19.	4A
	Fault Code 271 active? **NO** **Repair:** 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.

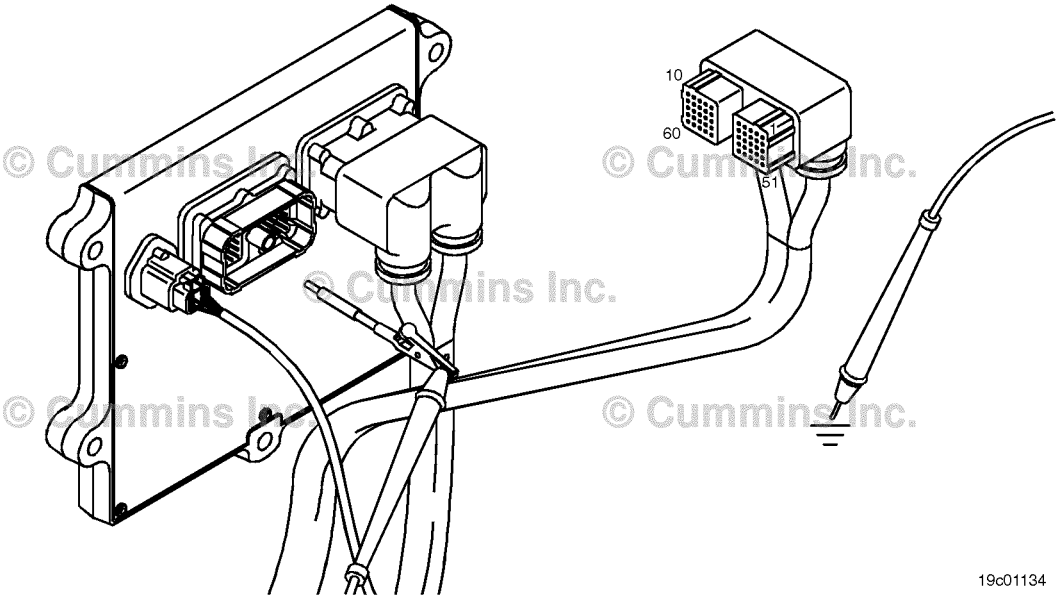
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pin • Connector shell broke • Wire insulation damage • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **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.

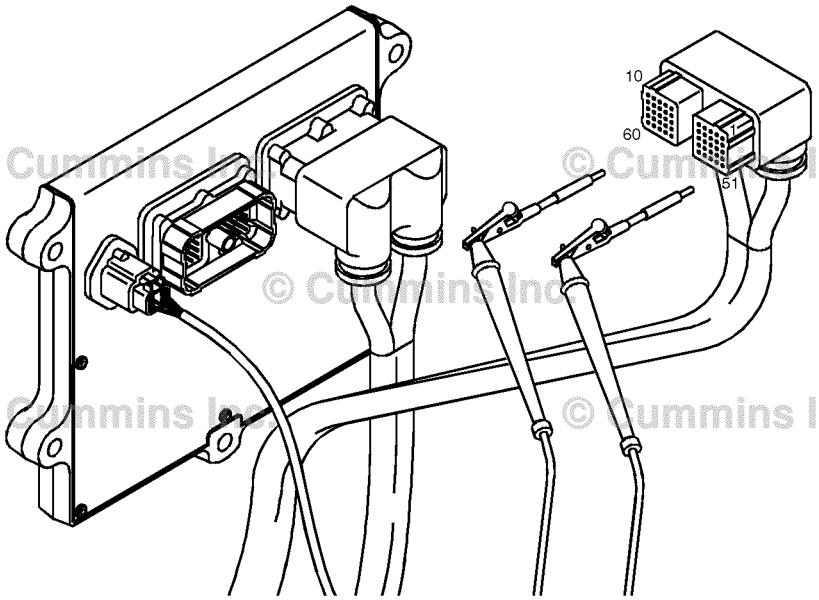
Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool, to read the fault codes.	Fault Code 272 active and Fault Code 271 inactive? **YES**	3C
	Fault Code 272 active and Fault Code 271 inactive? **NO** **Repair:** Replace 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 fuel pump actuator from the engine harness.

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



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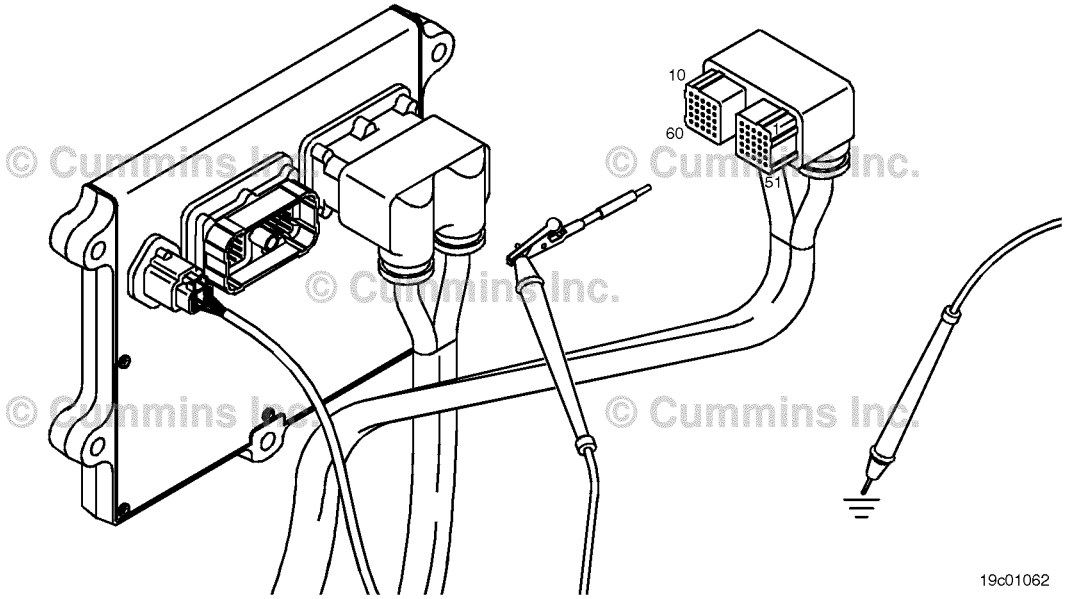
STEP 3D: Check for a pin short circuit to ground.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the fuel pump actuator from the engine harness.

Action	Specification/Repair	Next Step
Check for a pin-to-ground short. • Measure the resistance between the fuel pump actuator SIGNAL pin in the engine harness ECM connector and ground. • Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** A pin-to-ground short circuit on the SIGNAL line has been detected in the engine harness. 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. • Use INSITE™ electronic service tool , to read the fault code.	Fault Code 271 is inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	4A
	Fault Code 271 is inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 271 inactive? **YES**	4B
	Fault Code 271 inactive? **NO** **Repair:** 1A	1A

STEP 4B: Clear the inactive fault codes.

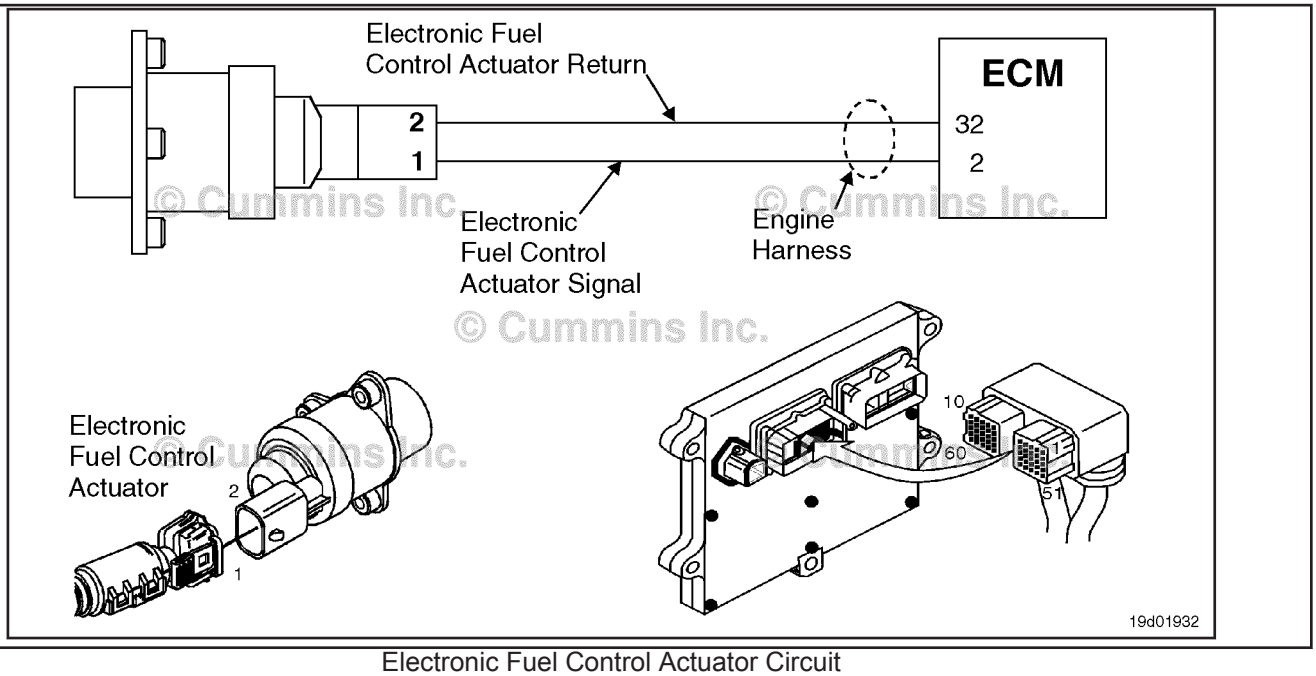
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 272 (ISB/QSB (Automotive and Industrial Application)

High Fuel Pressure Solenoid Valve Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 272 PID(P), SID(S): S126 SPN: 1347 FMI: 3 Lamp: Amber SRT:	High Fuel Pressure Solenoid Valve Circuit - Voltage Above Normal or Shorted to High Source. Electronic fuel control actuator shorted high.	Engine will run poorly but will be severely derated. Rail pressure will be higher than commanded.



Electronic Fuel Control Actuator Circuit

Circuit Description:

The circuit is a pulse width modulated (PWM) driver in the Electronic Control Module (ECM) that controls the electronic fuel control actuator. The actuator is grounded in the ECM. The actuator is a normally open. Pulse width modulation (PWM) duty cycle to the electronic fuel control actuator depends on the difference between desired rail pressure and sensed rail pressure. Duty cycle will also decrease (electronic fuel control actuator opens) as fueling increases.

Component Location:

The electronic fuel control actuator is located on engine-mounted fuel pump housing. The engine wiring harness and the ECM are other components in the circuit that can cause this fault code. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

This fault becomes active when the ECM detects an open in the electronic fuel control actuator circuit. Causes of this fault code are a short circuit to a positive voltage or an open circuit in the electronic fuel control actuator circuit. If there is high harness resistance, Fault Code 2311 could have high inactive counts. If the fault code is intermittent, look for causes of an intermittent open circuit such as loose pins and bad connections.

Refer to Troubleshooting Fault Code t05-272

FAULT CODE 272 (ISB/QSB (Automotive and Industrial)) - High Fuel Pressure Solenoid Valve 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 3164110 - male Bosch® test lead, Part Number 3164111 - 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 an active fault code.	Fault Code 272 active?	
STEP 2:	**Check the electronic fuel control actuator and circuit.**		
STEP 2A:	Inspect the electronic fuel control actuator and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check for an open circuit in the electronic fuel control actuator.	Between 0.1 and 5 ohms?	
STEP 2C:	Check the electronic fuel control actuator diagnostic supply voltage and return circuit.	Greater than 3.0-VDC?	
STEP 2D:	Check for an open circuit in the electronic fuel control actuator return circuit.	Less than 10 ohms?	
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 electronic fuel control actuator diagnostic supply voltage.	Greater than 3.0-VDC?	
STEP 3C:	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 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 272 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 272 active? **YES**	2A
	Fault Code 272 active? **NO**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the electronic fuel control actuator and circuit.

STEP 2A: Inspect the electronic fuel control actuator and connector pins.

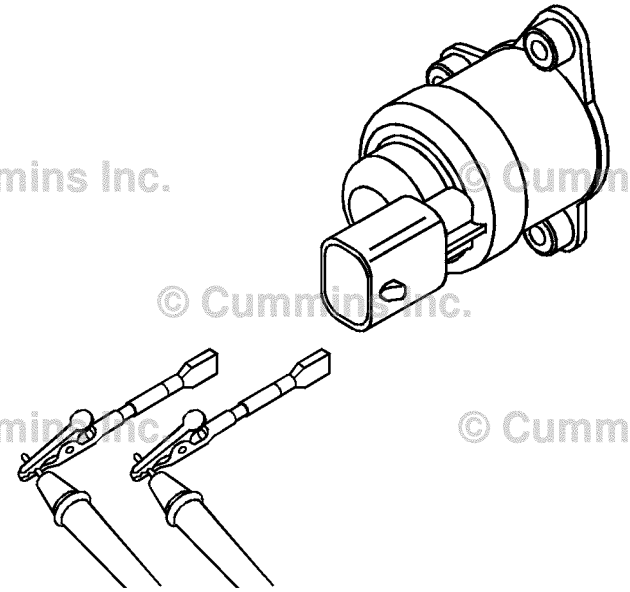
Condition:
- Turn keyswitch OFF.
- Disconnect the electronic fuel control actuator from the engine harness.

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

STEP 2B: Check for an open circuit in the electronic fuel control actuator.

Condition:
- Turn keyswitch OFF.
- Disconnect the electronic fuel control actuator from the engine harness.

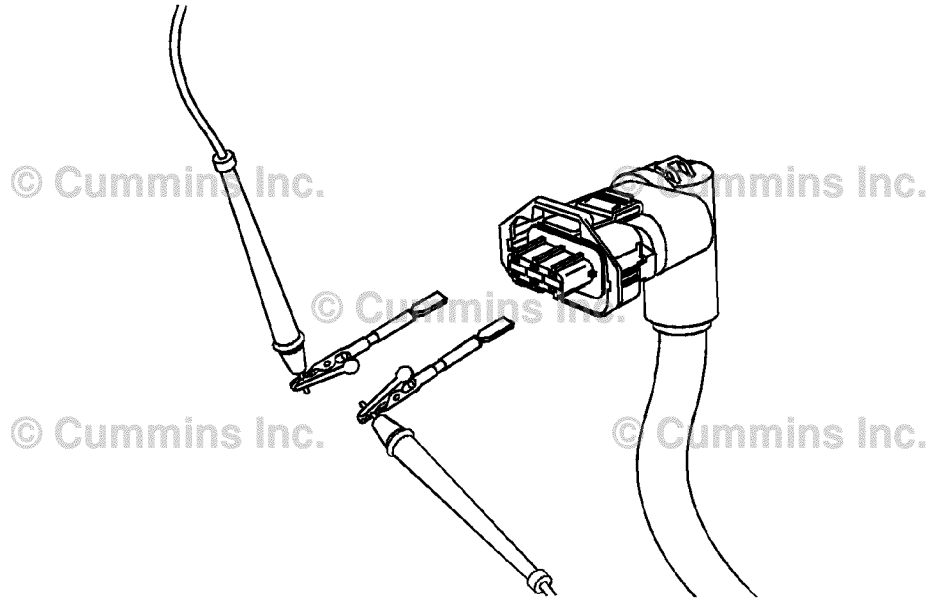
Action	Specification/Repair	Next Step
Check the actuator continuity for a pin-to-pin open circuit: • Measure the resistance and check for an open circuit between the electronic fuel control actuator SIGNAL pin and the electronic fuel control actuator RETURN pin. Reference the appropriate wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Between 0.1 and 5 ohms? **YES**	2C
	Between 0.1 and 5 ohms? **NO** **Repair:** Replace the high-pressure fuel pump. Use the following procedure in the ISB^{e} and ISB (Common Rail Fuel System) Series Engines Troubleshooting and Repair Manual, Bulletin 4021271. Refer to Procedure 005-016 in Section 5.	4A



STEP 2C: Check the electronic fuel control actuator diagnostic supply voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the electronic fuel control actuator from the engine harness.
- Turn keyswitch ON.

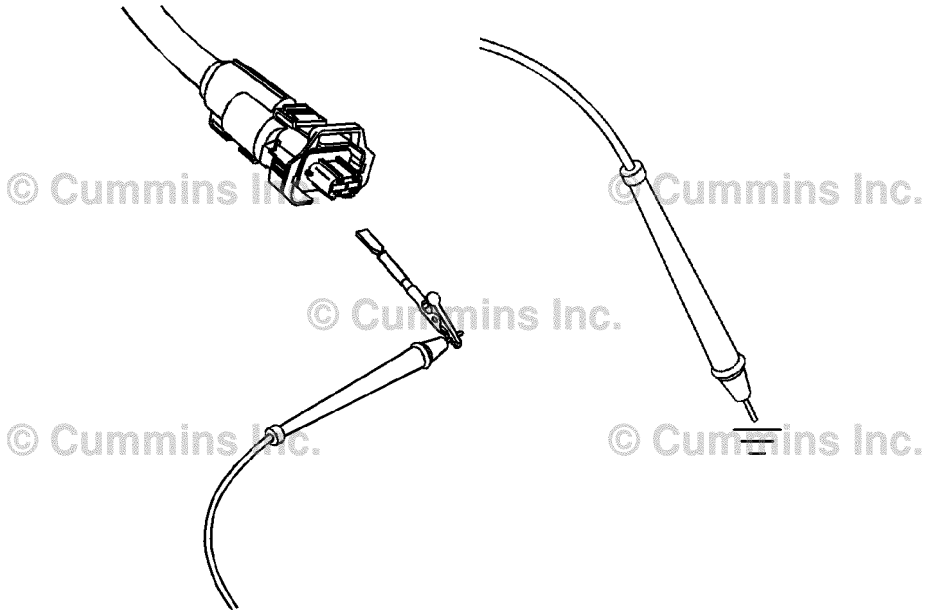
Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage between the electronic fuel control actuator SIGNAL pin and the electronic fuel control actuator RETURN pin at the engine harness actuator connector. Reference the appropriate wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 3.0-VDC? **YES**	3D
	Greater than 3.0-VDC? **NO**	2D



STEP 2D: Check for an open circuit in the electronic fuel control actuator return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the electronic fuel control actuator from the engine harness.

Action	Specification/Repair	Next Step
Harness connector pin-to-ground continuity check: • Measure the resistance between the engine harness electronic fuel control actuator RETURN pin and ground. Reference the appropriate wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3A
	Less than 10 ohms? **NO** **Repair:** Clean the connector and pins. Repair or replace the engine harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A



STEP 3: Check the ECM and engine harness.

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

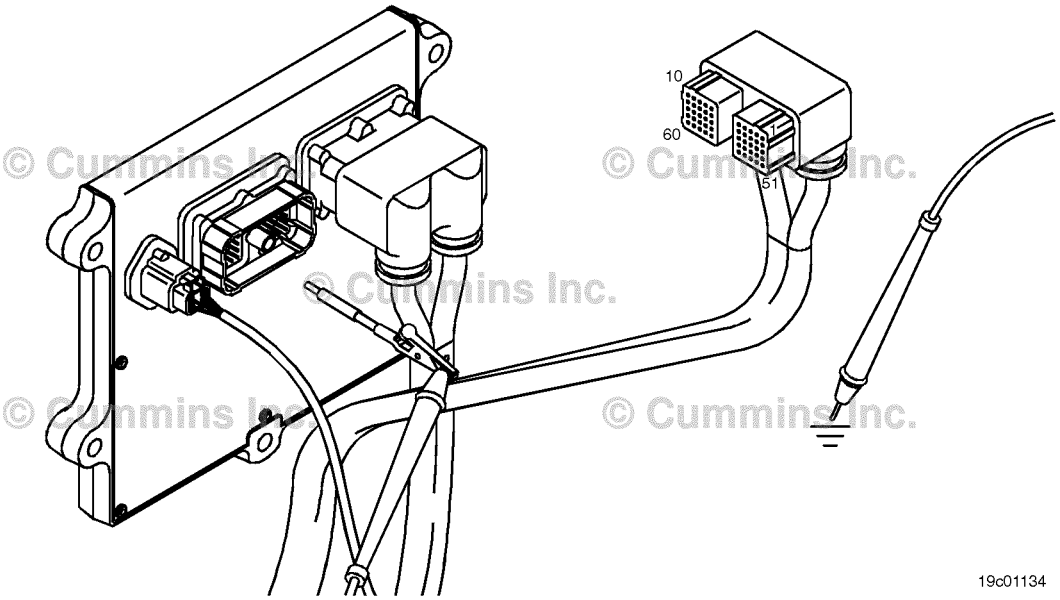
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

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

STEP 3B: Check the ECM electronic fuel control actuator diagnostic supply voltage.

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

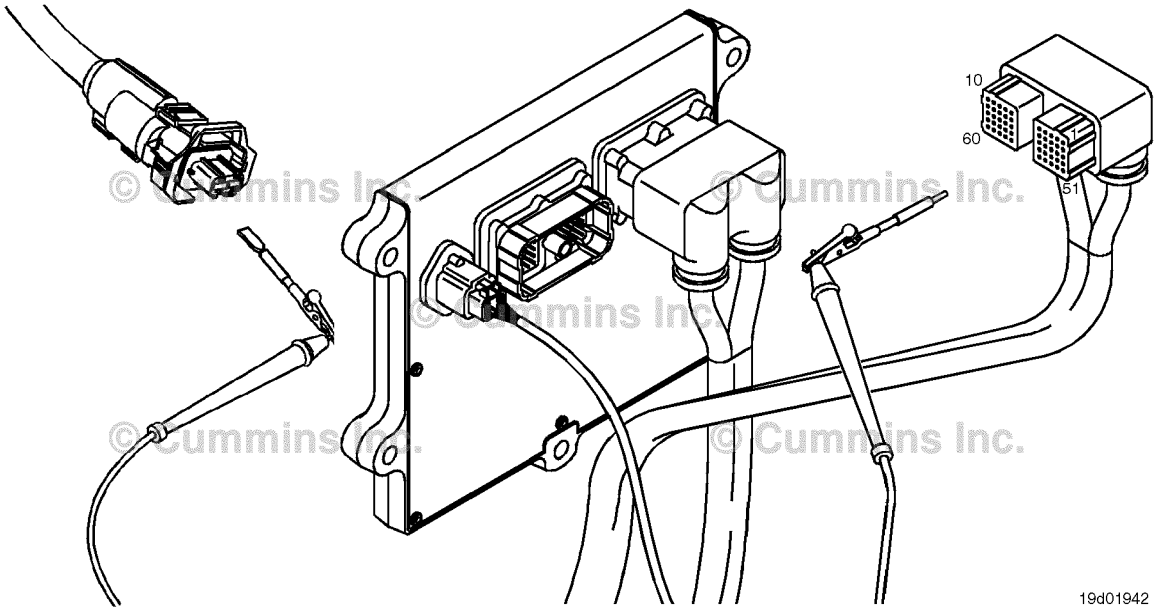
Action	Specification/Repair	Next Step
Check the supply voltage. • Measure the voltage between the electronic fuel control actuator SIGNAL pin at the engine harness connector ECM port and ground. Reference the appropriate wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 3.0-VDC? **YES**	3C
	Greater than 3.0-VDC? **NO** **Repair:** 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 electronic fuel control actuator from the engine harness.

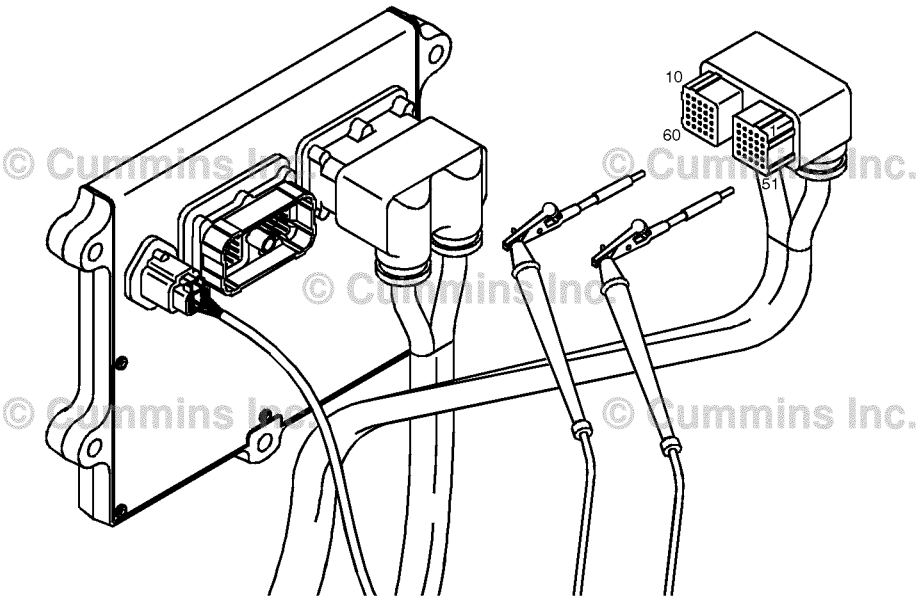
Action	Specification/Repair	Next Step
Check the harness connector continuity for a pin-to-pin open circuit: • Measure the resistance between the electronic fuel control actuator SIGNAL pin at the ECM connector of the engine harness and the electronic fuel control actuator SIGNAL pin at the electronic fuel control actuator connector of the engine harness. Reference the appropriate wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3D
	Less than 10 ohms? **NO** **Repair:** 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 electronic fuel control actuator from the engine harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short circuit. Measure the resistance and check for a short circuit between the following engine harness ECM connector pin and all other pins in the engine harness ECM connector: • Electronic fuel control actuator SIGNAL pin. Reference the appropriate wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A
	Greater than 100k ohms? **NO** **Repair:** 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.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 272 inactive? **YES**	4B
	Fault Code 272 inactive? **NO** **Repair:** 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.

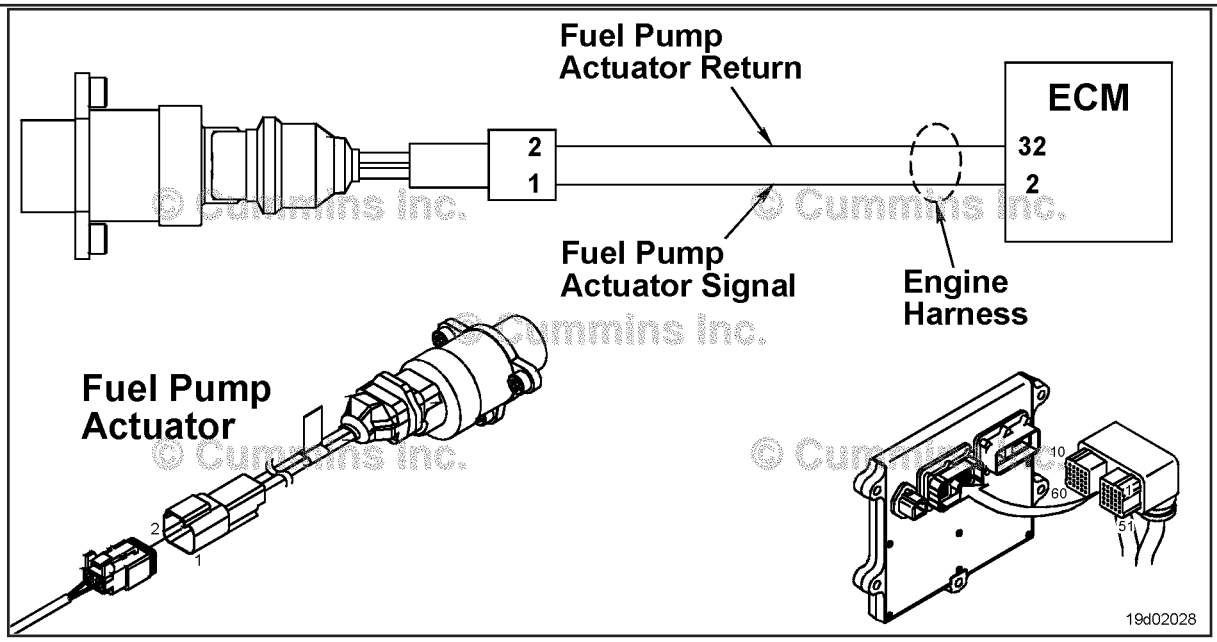
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Clear the inactive fault codes. • Use INSITE™ electronic service tool to erase the inactive fault codes .	All fault codes cleared? **YES**	Repair complete.
	All fault codes cleared? **NO** **Repair:** Troubleshoot any remaining active fault codes.	Go to the appropriate troubleshooti ng steps.

Fault Code 272 (ISC/QSC/ISL/QSL Automotive, Industrial, and Marine Application)

High Fuel Pressure Solenoid Valve Circuit - Voltage Above Normal or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 272 PID(P), SID(S): S126 SPN: 1347 FMI: 3 Lamp: Amber SRT:	High Fuel Pressure Solenoid Valve Circuit - Voltage Above Normal or Shorted to High Source. High signal voltage or open circuit detected at the fuel pump actuator circuit.	Engine will **not** run or engine will run poorly.



High Fuel Pressure Solenoid Valve Circuit

Circuit Description:

The circuit is a Pulse With Modulation (PWM) driver in the Electronic Control Module (ECM) that controls the fuel pump actuator. The actuator is grounded in the ECM. The actuator is normally open. PWM duty cycle to the fuel pump actuator depends on the difference between desired rail pressure and sensed rail pressure.

Component Location:

The fuel pump actuator is located on engine-mounted fuel pump housing. The engine wiring harness and the ECM are other components in the circuit that can cause this fault code. See Procedure Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

This fault becomes active when the ECM detects an open in the fuel pump actuator circuit. Causes of this fault code are a short circuit to a positive voltage or an open circuit in the fuel pump actuator circuit. If there is high harness resistance or an intermittent open circuit, Fault Code 2311 could have high inactive counts. If the fault code is intermittent, look for causes of an intermittent open circuit such as loose pins and bad connections. If the fault code is intermittent, look closely for loose wire connections at the ECM connector. Also, if the fault code is intermittent, wiggle the harness and the electronic fuel control.

Refer to Troubleshooting Fault Code t05-272

FAULT CODE 272 (ISC/QSC/ISL/QSL Automotive, Industrial, and Marine) - High Fuel Pressure Solenoid Valve 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 active fault code.	Fault Code 272 active?	
STEP 2:	**Check the fuel pump actuator and circuit.**		
STEP 2A:	Inspect the fuel pump actuator and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check for an open circuit in the fuel pump actuator.	Between 0.1 and 5 ohms?	
STEP 2C:	Check the fuel pump actuator diagnostic signal voltage and return circuit.	Greater than 3.0-VDC?	
STEP 2D:	Check for an open circuit in the fuel pump actuator return circuit.	Less than 10 ohms?	
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 fuel pump actuator diagnostic signal voltage.	Greater than 3.0-VDC?	
STEP 3C:	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 272 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 272 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 272 active? **YES**	2A
	Fault Code 272 active? **NO**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the fuel pump actuator and circuit.

STEP 2A: Inspect the fuel pump actuator and connector pins.

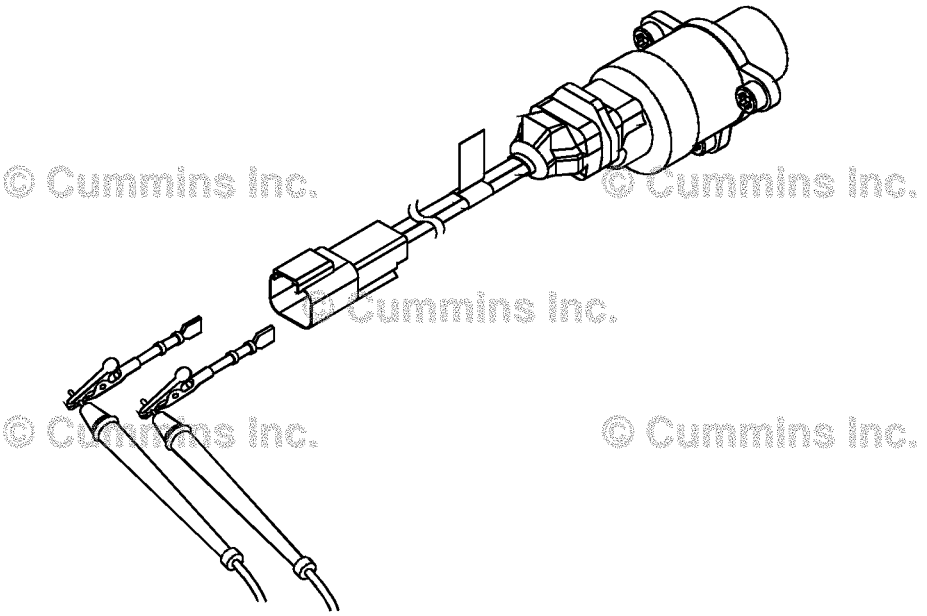
Condition:
- Turn keyswitch OFF.
- Disconnect the fuel pump actuator from the engine harness.

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

STEP 2B: Check for an open circuit in the fuel pump actuator.

Condition:
- Turn keyswitch OFF.
- Disconnect the fuel pump actuator from the engine harness.

Action	Specification/Repair	Next Step
Actuator continuity - pin-to-pin continuity check: • Measure the resistance and check for an open circuit between the fuel pump actuator SIGNAL pin and the fuel pump actuator RETURN pin. Refer to the wiring diagram for connector pin identification. Use the following procedures for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Between 0.1 and 5 ohms? **YES**	2C
	Between 0.1 and 5 ohms? **NO** **Repair:** Replace the fuel pump actuator. Refer to Procedure 019-117 in Section 19.	4A



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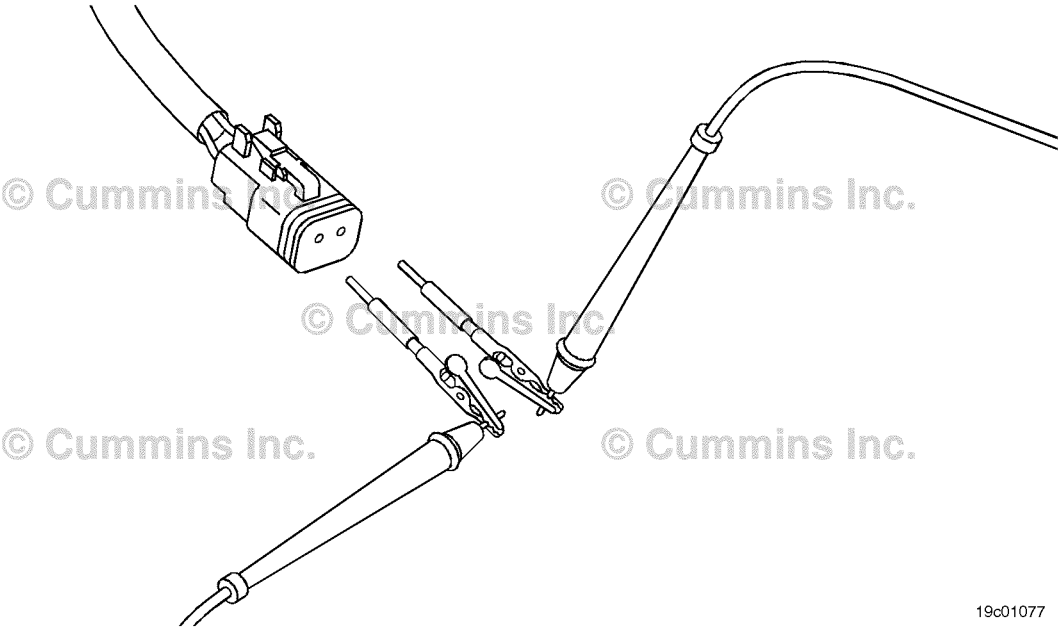
STEP 2C: Check the fuel pump actuator diagnostic signal voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the fuel pump actuator from the engine harness.
- Turn keyswitch ON.

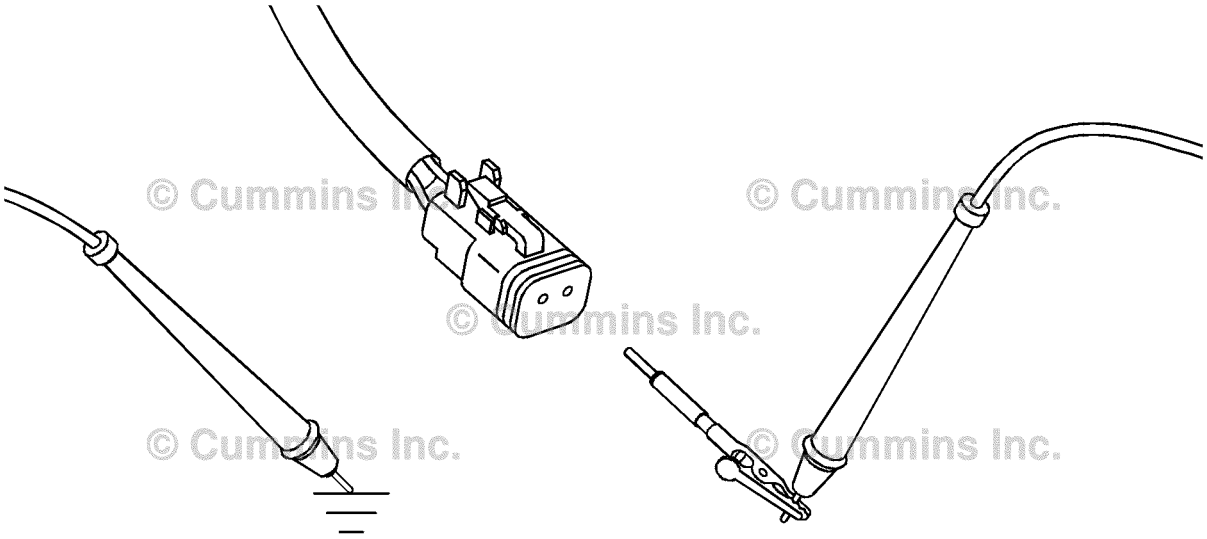
Action	Specification/Repair	Next Step
Check the signal voltage and return circuit. • Measure the voltage between the fuel pump actuator SIGNAL pin and the fuel pump actuator RETURN pin at the engine harness actuator connector. Refer to the appropriate wiring diagram for connector pin identification. Use the following procedures for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 3.0-VDC? **YES**	3D
	Greater than 3.0-VDC? **NO**	2D



STEP 2D: Check for an open circuit in the fuel pump actuator return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the fuel pump actuator from the engine harness.

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



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STEP 3: Check the ECM and engine harness.

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

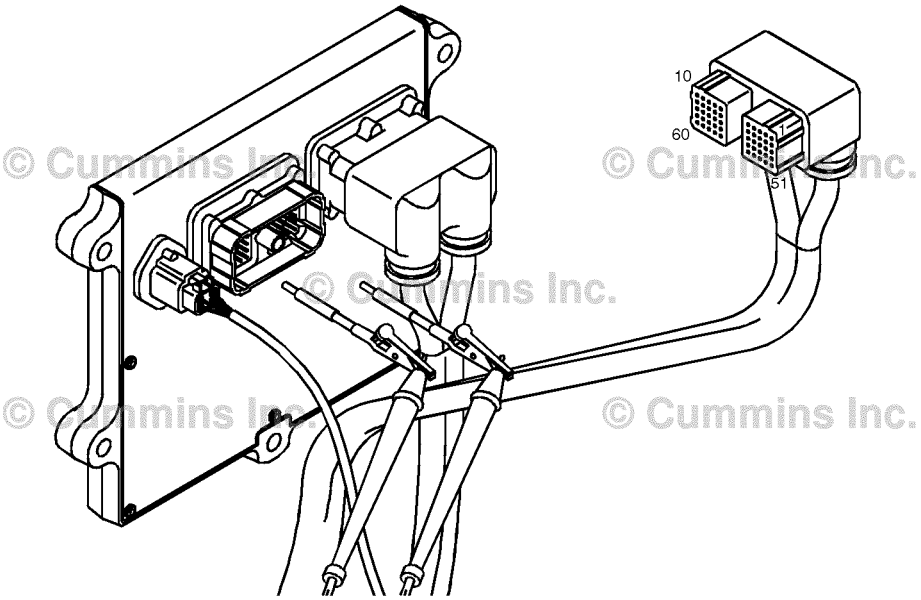
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

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

STEP 3B: Check the ECM fuel pump actuator diagnostic signal voltage.

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

Action	Specification/Repair	Next Step
Check the signal voltage. • Measure the voltage from the fuel pump actuator SIGNAL pin to the fuel pump actuator RETURN pin at the ECM connector. Refer to the appropriate wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 3.0-VDC? **YES**	3C
	Greater than 3.0-VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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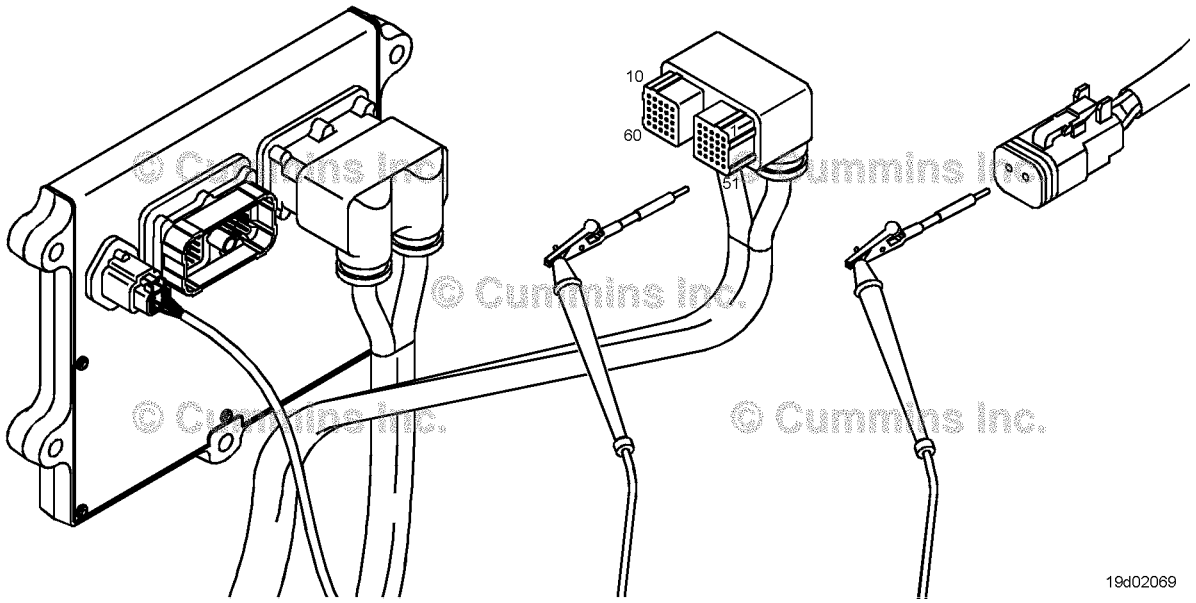
STEP 3C: Check for an open circuit in the engine harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the fuel pump actuator from the engine harness.

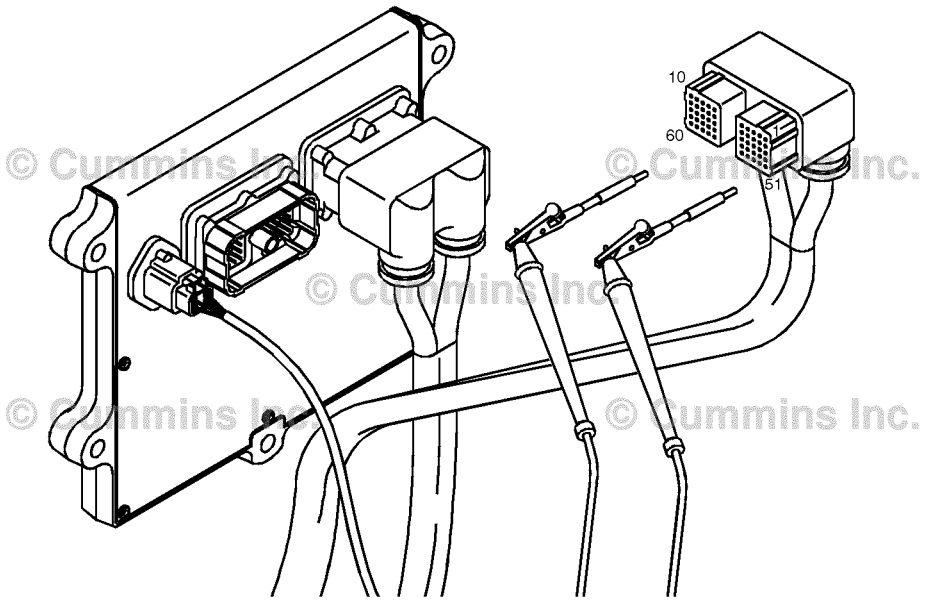
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the fuel pump actuator SIGNAL pin at the ECM connector of the engine harness and the fuel pump actuator SIGNAL pin at the fuel pump actuator connector of the engine harness. Refer to the appropriate wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3D
	Less than 10 ohms? **NO** **Repair:** 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 fuel pump actuator from the engine harness.

Action	Specification/Repair	Next Step
Check the engine harness continuity for a pin-to-pin short circuit: • Measure the resistance between the fuel pump actuator SIGNAL pin in the engine harness ECM connector and all other pins in the connector. Refer to the appropriate wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3E
	Greater than 100k ohms? **NO** **Repair:** 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 272 inactive? **YES** **Repair:** NOTE: The removal and installation of the connector corrected the failure.	4A
	Fault Code 272 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 272 inactive? **YES**	4B
	Fault Code 272 inactive? **NO**	1A

STEP 4B: Clear the inactive fault codes.

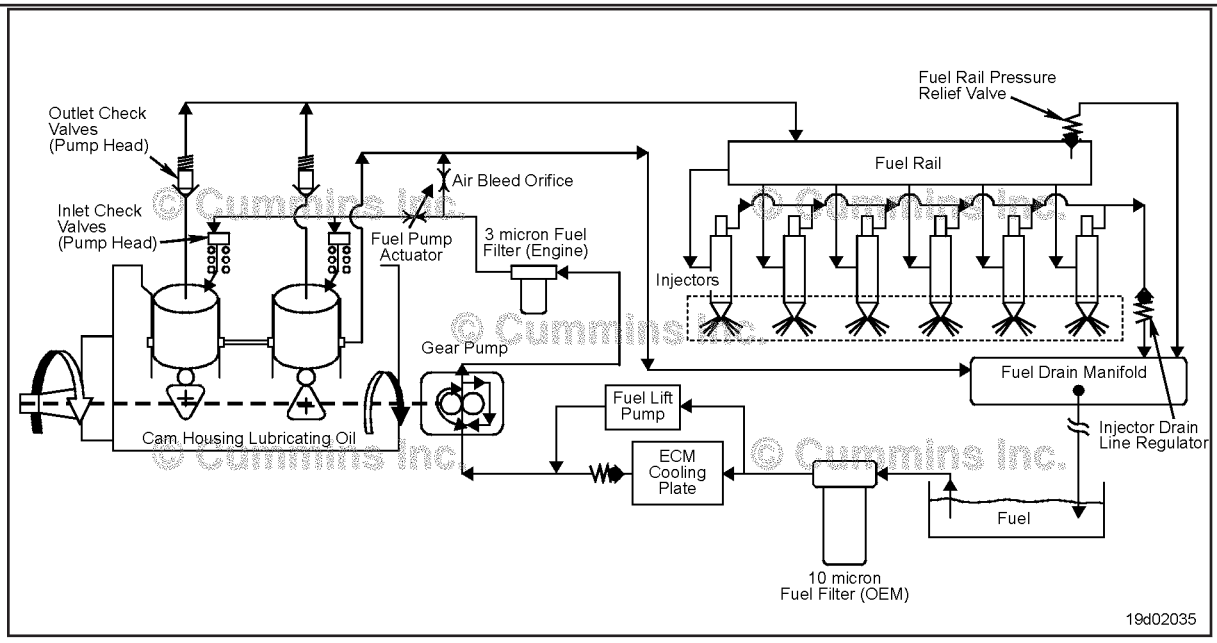
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Clear the inactive fault codes. • Use INSITE™ electronic service tool to erase the inactive fault codes.	All fault codes cleared? **YES**	Repair complete.
	All fault codes cleared? **NO**	Go to the appropriate troubleshooting steps.

Fault Code 275

Fuel Pumping Element Number 1 (Front) - Mechanical System Not Responding Properly or Out of Adjustment

CODES	REASON	EFFECT
Fault Code: 275 PID(P), SID(S): S126 SPN: 1347 FMI: 7 Lamp: Yellow SRT:	Fuel Pumping Element Number 1 (Front) - Mechanical System Not Responding Properly or Out of Adjustment.	Engine will **not** run or possible low power.



High Pressure Pump

Circuit Description:

The fuel pump contains two barrel and plunger assemblies; each barrel and plunger assembly utilizes an inlet and outlet check valve. Fuel at gear pump pressure is metered through the fuel pump actuator and unseats one of the two inlet check valves as the fuel at gear pump pressure enters the pumping chamber. As the pumping plunger begins its upward motion, the pressure in the pumping chamber increases rapidly and the inlet check valve is closed. As pressure reaches accumulator pressure, the outlet check valve is opened. As the plunger travels upward, fuel exits past the outlet check valve and pressurizes the fuel rail.

Component Location:

The fuel pump is located on the backside of the gear housing. The barrel and plunger and check valve assemblies are part of the fuel pump head sub-assembly.

Shop Talk:

Fault Code 275 will most likely come active while operating at a steady state loaded condition. At this condition commanded fuel pressures are highest and the pump's pressure balance is affected the most.

If a high pressure seal has failed, pump head drain flow will be excessive. If a seal failure has progressed far enough, the engine may **not** start because of an inability to develop fuel rail pressure.

If the engine will **not** start, there are two indications that the pump head has failed:

- The drain flow will be excessive. This can be measured while cranking the engine (refer to Troubleshooting and Repair Manual, ISC, QSC8.3, ISL, and QSL9 Series Engines, Bulletin 4021418).
- The pumping plungers are broken or mechanically stuck. This can be checked by visual inspection (refer to Troubleshooting and Repair Manual, ISC, QSC8.3, ISL, and QSL9 Series Engines, Bulletin 4021418).

A faulty fuel pressure sensor signal due to a damaged fuel pressure sensor signal wire will cause the fuel pressure sensor to be inconsistent. This condition can cause Fault Code 275 to become active on an intermittent basis.

Refer to Troubleshooting Fault Code t05-275

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for an active fault code.**	**Fault Code 275 has reoccurred at least 1 time during engine operation?**	
STEP 2:	**Check for air in fuel.**		
STEP 2A:	**Check for air in fuel.**	**Air in fuel?**	
STEP 3:	**Check the fuel pressure sensor connector.**		
STEP 3A:	**Inspect the fuel pressure sensor connector and wiring connections.**	**Dirty or damaged pins?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 275 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™ the electronic service tool.
- Clear all inactive fault codes.
- Operate the engine at the steady state loaded condition.

Action	Specification/Repair	Next Step
Check for fault codes. • Use INSITE™ the electronic service tool to read the fault codes.	Fault Code 275 has reoccurred at least 1 time during engine operation? **YES**	2A
	Fault Code 275 has reoccurred at least 1 time during engine operation? **NO**	3A

STEP 2: Check for air in fuel.

STEP 2A: Check for air in fuel.

Condition:
- Install a Compuchek® fitting at the outlet of the pressure side fuel filter.
- Start the engine and allow it to idle.
- Connect a test hose at the fuel filter head and run into a bucket.

Action	Specification/Repair	Next Step
Check for air in fuel as the engine idles. Perform the air in fuel test. 006-003 in Troubleshooting and Repair Manual, ISC, QSC8.3, ISL, and QSL9 Series Engines, Bulletin 4021418.	Air in fuel? **YES** **Repair:** The suction side fuel lines, suction filter, or tank pick-up is allowing air to enter fuel supply. Repair or replace the fuel lines, suction filter, or tank pick-up.	1A
	Air in fuel? **NO**	3A

STEP 3: Check the fuel pressure sensor connector.

STEP 3A: Inspect the fuel pressure sensor connector and wiring connections.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Inspect the fuel pressure sensor connector for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector. For general inspection techniques, refer to Component Connector and Pin Inspection, Refer to Procedure 019-361. Refer to the wiring diagram for connector pin identification. **NOTE:** A bad connection on the fuel pressure sensor or intermittent wiring connections can cause the signal reading to fluctuate and cause this fault code to become active on an intermittent basis.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connector, or pins if possible.	4A
	Dirty or damaged pins? **NO** **Repair:** Replace the fuel pump head. Refer to Procedure 005-227 in Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418.	4A

STEP 4: Clear the fault codes.

STEP 4A: Disable the fault code.

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

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for 1 minute. • Operate the engine at a steady-state loaded condition. • Use INSITE™ the electronic service tool to verify the fault code is inactive.	Fault Code 275 inactive? **YES**	4B
	Fault Code 275 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins Authorized Repair Location if all steps have been completed and rechecked.	1A

STEP 4B: Clear the inactive fault code.

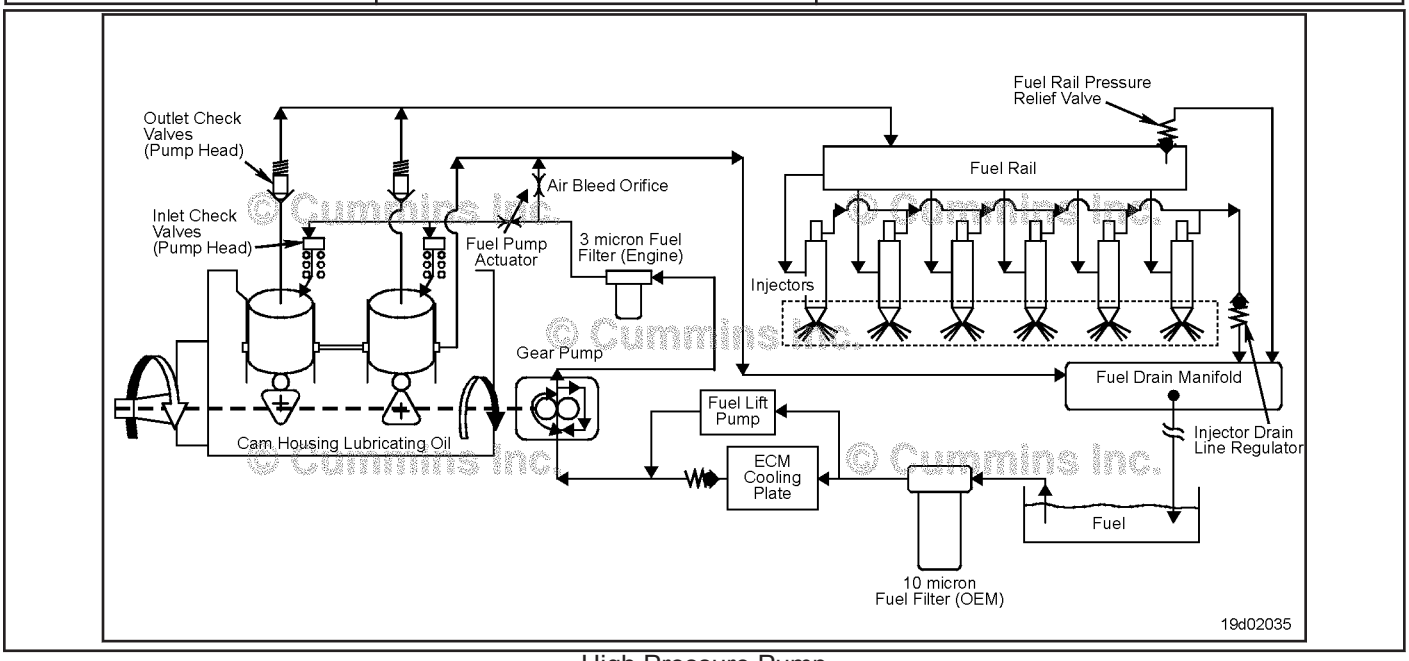
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ the electronic service tool.

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

Fault Code 281

Fuel Pump Pressurizing Assembly 1 - Mechanical System Not Responding Properly or Out of Adjustment

CODES	REASON	EFFECT
Fault Code: 281 PID(P), SID(S): S126 SPN: 1347 FMI: 7 Lamp: Amber SRT:	Fuel Pump Pressurizing Assembly 1 - Mechanical System Not Responding Properly or Out of Adjustment. A pumping imbalance between the front and rear pumping plungers has been detected.	Engine will **not** run or possible low power.



High Pressure Pump

Circuit Description:

The fuel pump contains two barrel and plunger assemblies; each barrel and plunger assembly utilizes an inlet and outlet check valve. Fuel at gear pump pressure is metered through the fuel pump actuator and unseats one of the two inlet check valves as the fuel at gear pump pressure enters the pumping chamber. As the pumping plunger begins its upward motion, the pressure in the pumping chamber increases rapidly and the inlet check valve is closed. As pressure reaches accumulator pressure, the outlet check valve is opened. As the plunger travels upward, fuel exits past the outlet check valve and pressurizes the fuel rail.

Component Location:

The fuel pump is located on the backside of the gear housing. The barrel and plunger and check valve assemblies are part of the fuel pump head sub-assembly.

Shop Talk:

Fault Code 281 will most likely come active while operating at a steady state loaded condition. At this condition commanded fuel pressures are highest and the pump's pressure balance is affected the most.

If a high pressure seal has failed, pump head drain flow will be excessive. If a seal failure has progressed far enough, the engine may **not** start because of an inability to develop fuel rail pressure.

If the engine will **not** start, there are two indications that the pump head has failed:

- The drain flow will be excessive. This can be measured while cranking the engine (refer to Troubleshooting and Repair Manual, ISC, QSC8.3, ISL, and QSL9 Series Engines, Bulletin 4021418).
- The pumping plungers are broken or mechanically stuck. This can be checked by visual inspection (refer to Troubleshooting and Repair Manual, ISC, QSC8.3, ISL, and QSL9 Series Engines, Bulletin 4021418).

A faulty fuel pressure sensor signal due to a damaged fuel pressure sensor signal wire will cause the fuel pressure sensor to be inconsistent. This condition can cause Fault Code 281 to become active on an intermittent basis.

Refer to Troubleshooting Fault Code t05-281

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for an active fault code.**	**Fault Code 281 has reoccurred at least one time during engine operation?**	
STEP 2:	**Check for air in fuel.**		
STEP 2A:	**Check for air in fuel.**	**Air in fuel?**	
STEP 3:	**Check the fuel pressure sensor connector.**		
STEP 3A:	**Inspect the fuel pressure sensor connector and wiring connections.**	**Dirty or damaged pins?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 281 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™ the electronic service tool.
- Clear all inactive fault codes.
- Operate the engine at the steady state loaded condition.

Action	Specification/Repair	Next Step
Check for fault codes. • Use INSITE™ the electronic service tool to read the fault codes.	Fault Code 281 has reoccurred at least one time during engine operation? **YES**	2A
	Fault Code 281 has reoccurred at least one time during engine operation? **NO**	3A

STEP 2: Check for air in fuel.

STEP 2A: Check for air in fuel.

Condition:
- Install a Compuchek® fitting at the outlet of the pressure side fuel filter.
- Start the engine and allow it to idle.
- Connect a test hose at the fuel filter head and run into a bucket.

Action	Specification/Repair	Next Step
Check for air in fuel as the engine idles. Perform the air in fuel test. 006-003 in Troubleshooting and Repair Manual, ISC, QSC8.3, ISL, and QSL9 Series Engines, Bulletin 4021418.	Air in fuel? **YES** **Repair:** The suction side fuel lines, suction filter, or tank pick-up is allowing air to enter fuel supply. Repair or replace the fuel lines, suction filter, or tank pick-up.	1A
	Air in fuel? **NO**	3A

STEP 3: Check the fuel pressure sensor connector.

STEP 3A: Inspect the fuel pressure sensor connector and wiring connections.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Inspect the fuel pressure sensor connector for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector. For general inspection techniques, refer to Component Connector and Pin Inspection, Refer to Procedure 019-361. Refer to the circuit diagram or the wiring diagram for connector pin identification. Note: A bad connection on the fuel pressure sensor or intermittent wiring connections can cause the signal reading to fluctuate and cause this fault code to become active on an intermittent basis.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connector, or pins if possible.	4A
	Dirty or damaged pins? **NO** **Repair:** Replace the fuel pump head. Refer to Procedure 005-227 in Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418.	4A

STEP 4: Clear the fault codes.

STEP 4A: Disable the fault code.

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

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for one minute. • Operate the engine at a steady-state loaded condition. • Use INSITE™ the electronic service tool to verify the fault code is inactive.	Fault Code 281 inactive? **YES**	4B
	Fault Code 281 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins Authorized Repair Location if all steps have been completed and rechecked.	1A

STEP 4B: Clear the inactive fault code.

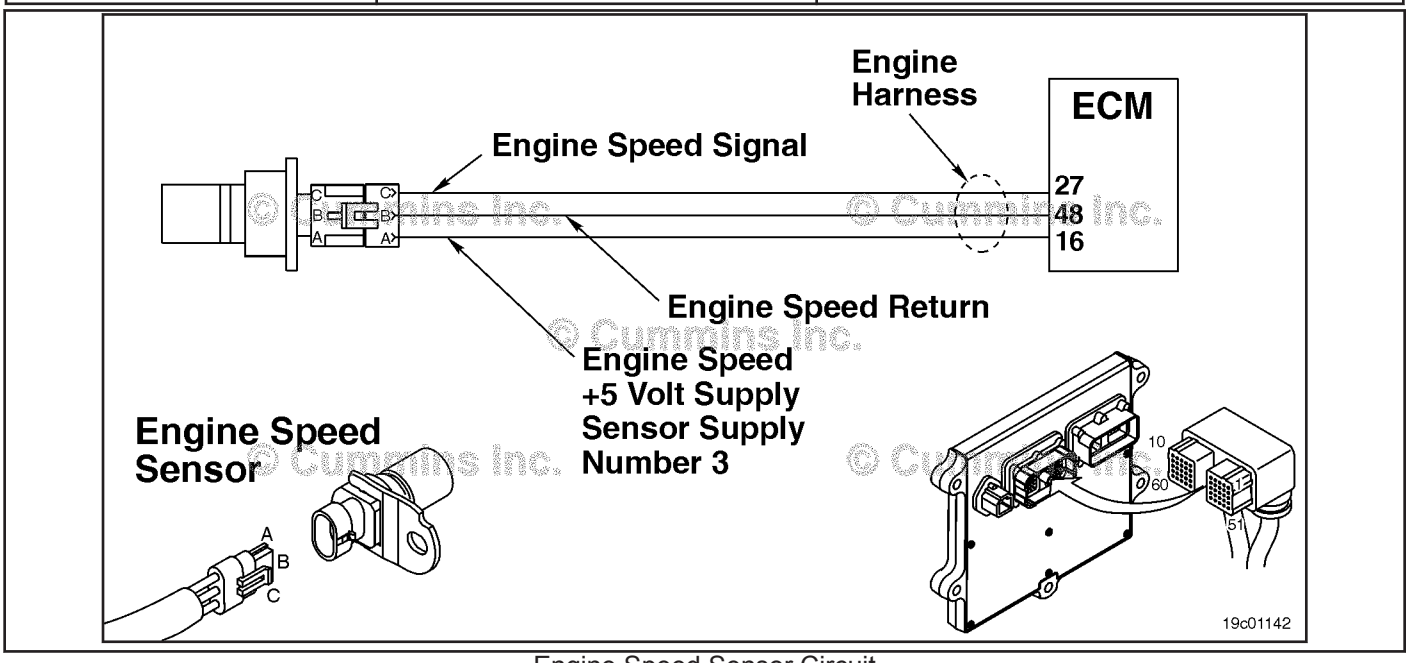
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ the electronic service tool.

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

Fault Code 284

Engine Speed/Position Sensor (Crankshaft) Supply Voltage Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 284 PID(P), SID(S): S221 SPN: 1043 FMI: 4/4 Lamp: Amber SRT:	Engine Speed/Position Sensor (Crankshaft) Supply Voltage Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected on the ECM voltage supply line to engine speed sensor.	Possible hard starting and rough running.



Engine Speed Sensor Circuit

Circuit Description:

The engine speed voltage supply provides +5 VDC for the engine speed sensor. If the supply wire to this sensor is damaged, the sensor will **not** work properly.

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. Refer to Procedure 100-002 for detailed component view location.

Shop Talk:

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

Refer to Troubleshooting Fault Code t05-284

FAULT CODE 284 - Engine Speed/Position Sensor (Crankshaft) 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 3164596 - male Framatome™ 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 284 active?**	
STEP 2:	**Check the engine speed sensor and circuit.**		
STEP 2A:	**Inspect the engine speed sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the circuit response.**	**Fault Code 284 active?**	
STEP 3:	**Check the engine harness.**		
STEP 3A:	**Inspect the engine harness and ECM connector pins.**	**Dirty or damaged pins?**	
STEP 3B:	**Check the circuit response.**	**Fault Code 284 active?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 284 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:
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check for an active fault code. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 284 active? **YES**	2A
	Fault Code 284 active? **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 speed sensor and circuit.

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

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

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

STEP 2B: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the 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 after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 284 active? **YES**	3A
	Fault Code 284 active? **NO** **Repair:** The engine speed sensor is internally shorted. Replace the engine speed sensor. Refer to Procedure 019-365 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 the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 284 active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A
	Fault Code 284 active? **NO** **Repair:** The engine speed sensor SUPPLY line has shorted to ground or a return wire. 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.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 284 inactive? **YES**	4B
	Fault Code 284 inactive? **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. • Use INSITE™ electronic service tool to erase the inactive fault codes.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO**	Appropriate troubleshooting steps

Fault Code 285

SAE J1939 Multiplexing PGN Timeout Error - Abnormal Update Rate

CODES	REASON	EFFECT
Fault Code: 285 PID(P), SID(S): S231 SPN: 639 FMI: 9 Lamp: Amber SRT:	SAE J1939 Multiplexing PGN Timeout Error - Abnormal Update Rate. The Cummins® ECM did **not** receive a multiplexed message from an OEM VECU or SIM within the time limit or did **not** receive it at all.	One or more multiplexed devices will **not** operate properly. One or more symptoms will occur.

Circuit Description:

Note: Any reference to VECU may be considered as SIM in marine applications.

Normally, switches, accelerators and other components are connected to the engine ECM directly through individual wires. Multiplexing allows those same components to be hard wired to an OEM Vehicle Electronic Control Unit (VECU) or Transmission ECU in the cab, or a System Integration Module (SIM) in marine applications. As a result, component values and states from components such as sensors, accelerators and switches can be transmitted from the OEM VECU or SIM to the Cummins® engine ECM over the SAE J1939 data link.

Messages sent from OEM VECUs or Transmission ECUs, or SIMs are received by the Cummins® engine ECM and used for controlling the engine. The Cummins® ECM and OEM VECUs **must** be configured properly, so that proper operation of the multiplexed components will occur.

Component Location:

The engine ECM is located on the intake side of the engine. Refer to Procedure 100-002 in Section E. The J1939 data link wiring and VECU location varies by OEM. The SIM is located on the engine, or in the Vessel Interface Panel (VIP) in marine applications.

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 does **not** receive a valid J1939 message from a multiplexed device for more than 1 second.

The ECM detects an open or short circuit condition in the J1939 data link harness.

Action Taken When the Fault Code is Active:

- The ECM illuminates the amber CHECK ENGINE light immediately when the diagnostic runs and fails.
- The ECM will use a default state as an input for the multiplexed device.

Conditions for Clearing the Fault Code:

The ECM will turn off the amber CHECK ENGINE light immediately after the diagnostic runs and passes.

Shop Talk:

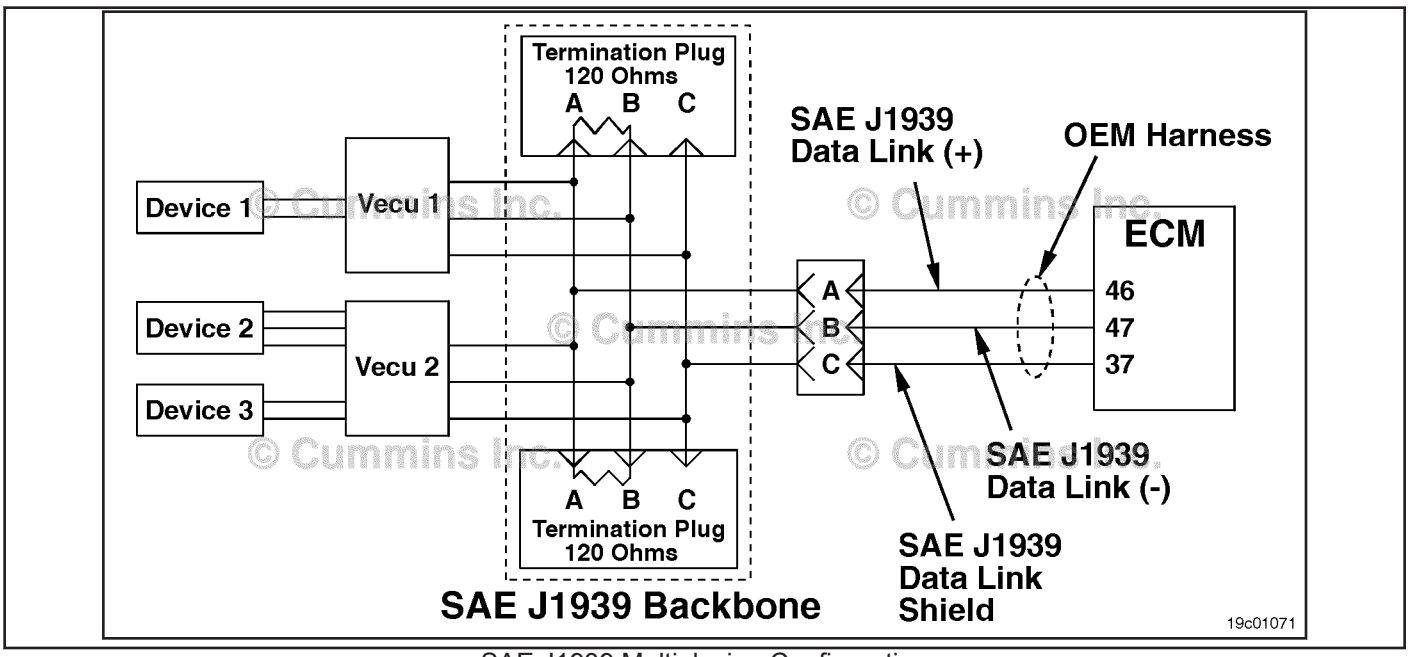
Verify the electronic control module (ECM) calibration is correct. Check the calibration revision history found on QuickServe™ Online for applicable fixes to the calibration stored in the ECM. If necessary, calibrate the ECM. Refer to Procedure 019-032 in Section 19.

When this fault code is active, some multiplexed devices may **not** function as desired.

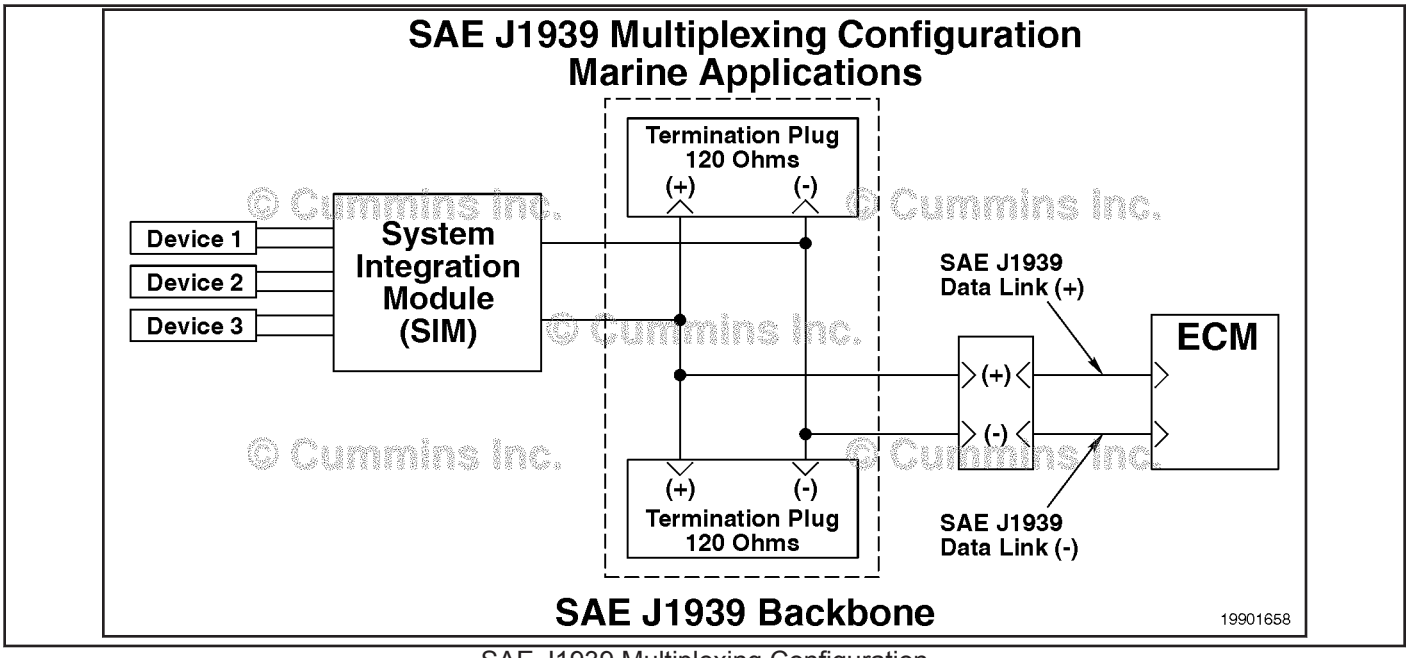
This fault can occur for the following reasons:

- When the ECM is set up properly (components enabled and OEM VECU source addressed correctly) to receive information from an OEM VECU, but the OEM VECU is actually transmitting a message that says that component is **not** available for multiplexing. This can be caused when a multiplexed component is enabled in the Cummins® ECM, but the OEM VECU source address of the VECU transmitting the component message is incorrect in the Cummins® ECM, or the OEM VECU is **not** set up to transmit the multiplexed component message.
- This fault can also be caused by a malfunctioning J1939 data link connection between the OEM VECU and Cummins® ECM, a malfunctioning connection between the component and the OEM VECU, malfunctioning OEM VECU or malfunctioning Cummins® ECM. It may be necessary to contact the OEM for proper multiplexing configuration.

It is possible to use INSITE™ electronic service tool to monitor multiplexed components.



SAE J1939 Multiplexing Configuration



SAE J1939 Multiplexing Configuration

Refer to Troubleshooting Fault Code t05-285

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check for ECM communication with INSITE™ electronic service tool.**		
STEP 1A:	Check for ECM communication with INSITE™ electronic service tool.	Is communication between the INSITE™ electronic service tooland the ECM possible?	
STEP 2:	**Check the fault codes.**		
STEP 2A:	Check for an active fault code.	Fault Code 285 is active?	
STEP 3:	**Check the OEM VECU and engine ECM for proper multiplexing configuration.**		
STEP 3A:	Determine which VECU multiplexed components (switches, accelerators, or sensors) are enabled for multiplexing over the J1939 data link to the engine ECM and compare to the engine ECM configuration.	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration?	
STEP 4:	**Check the service data link harness.**		
STEP 4A:	Inspect the service data link harness and connector pins.	Dirty or damaged pins?	
STEP 4B:	Check for an open or short circuit in the J1939 data link harness.	50 ohms to 70 ohms?	
STEP 5:	**Check the OEM harness.**		
STEP 5A:	Check the ECM and OEM harness connector pins.	Dirty or damaged pins?	
STEP 5B:	Check for an open or short circuit in the ECM J1939 data link harness.	50 ohms to 70 ohms?	
STEP 5C:	Check for a short circuit in the ECM J1939 data link harness.	Greater than 100k ohms?	
STEP 5D:	Check for an inactive fault code.	Fault Code 285 inactive?	
STEP 6:	**Clear the fault code.**		
STEP 6A:	Disable the fault code.	Fault Code 285 inactive?	
STEP 6B:	Clear the inactive fault codes.	All fault codes cleared?	

TROUBLESHOOTING STEP

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

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

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

Action	Specification/Repair	Next Step
Verify INSITE™ electronic service tool communication with the ECM.	Is communication between INSITE™ electronic service tool and the ECM possible? **YES**	2A
	Is communication between INSITE™ electronic service tool and the ECM possible? **NO**	4A

STEP 2: Check the fault codes.

STEP 2A: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 285 is active? **YES**	3A
	Fault Code 285 is active? **NO**	Refer to Procedure 019-362 in Section 19.

STEP 3: Check the OEM VECU and engine ECM for proper multiplexing configuration.

STEP 3A: Determine which VECU multiplexed components (switches, accelerators, or sensors) are enabled for multiplexing over the J1939 data link to the engine ECM and compare to the engine ECM configuration.

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

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool SAE J1939 Multiplexed Fault Data, located in Advanced ECM data, to determine which multiplexed component is causing the fault. If the status column indicates “Active” for a multiplexed component, check that the engine ECM multiplexed component enables and source addresses match the OEM VECU multiplexed component enables and source addresses. These components can be found under SAE J1939 Multiplexing in Features and Parameters. **Note:** Refer to Multiplexing Troubleshooting, Bulletin 4021378, for specific multiplexing configuration information for several OEMs. If the OEM is not listed in the bulletin, it will be necessary to contact the OEM for specific multiplexing information.	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration? **YES** **Repair:** An OEM issue has been detected. Contact the OEM for further repair instructions. It is still possible that there is a VECU, VECU setup, or VECU to data link connection issue.	6A
	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration? **NO** **Repair:** An incorrect setup has been detected in the Cummins® engine ECM. Enable the proper components for multiplexing on the applicable OEM application and make sure the OEM VECU source addresses for each component are correct.	6A

STEP 4: Check the service data link harness.

STEP 4A: Inspect the service data link harness and connector pins.

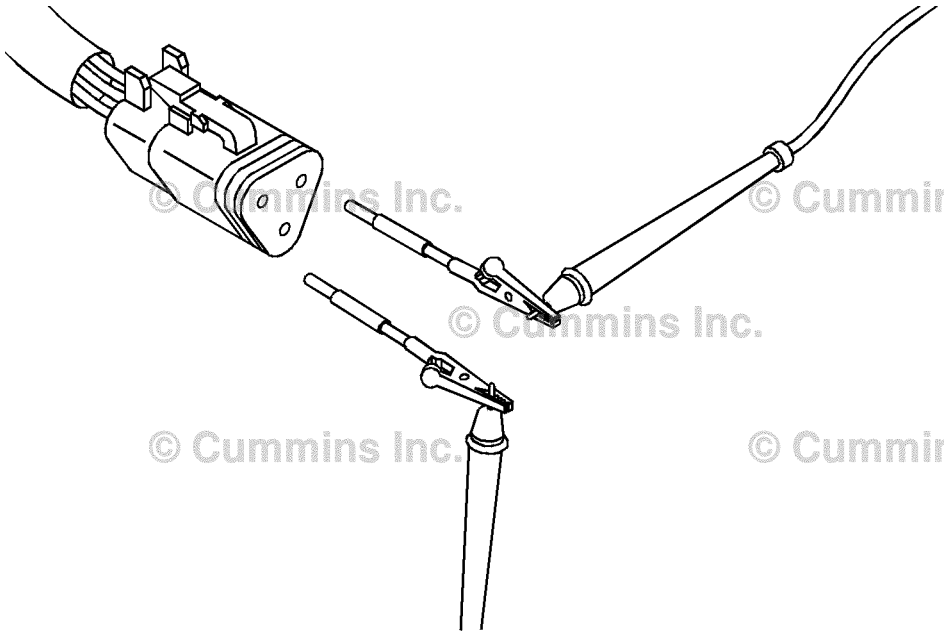
Condition:
- Turn keyswitch OFF.
- Disconnect the data link adapter from the service data link connector.

Action	Specification/Repair	Next Step
Inspect the service data link connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damaged • Damaged connector locking tab. Follow the general inspection techniques as described in the following procedure.Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the service data link cable. Clean the connector and pins. Repair the damaged harness, connector, or pins, if possible.	6A
	Dirty or damaged pins? **NO**	4B

STEP 4B: Check for an open or short circuit in the J1939 data link harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the data link adapter from the service data link connector.

Action	Specification/Repair	Next Step
Check for an open or short circuit. • Measure the resistance between the SAE J1939 data link (+) wire and the SAE J1939 data link (-) wire on the service data link connector. Refer to the circuit diagram or wiring diagram for connector pin identification. Follow the general resistance measurement techniques described in the following procedure and the wiring diagram. Refer to Procedure 019-360 in Section 19.	50 ohms to 70 ohms? **YES**	5A
	50 ohms to 70 ohms? **NO** **Repair:** An open or short has been detected on the service data link connector or harness connection to the J1939 data link backbone. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	6A



STEP 5: Check the OEM harness

STEP 5A: Check the ECM and OEM harness connector pins.

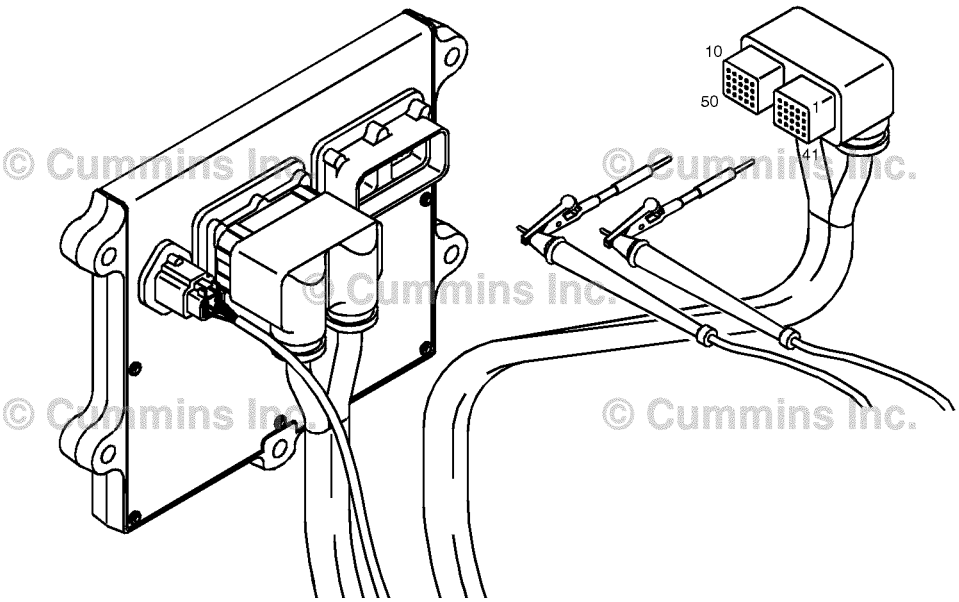
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the ECM data link harness connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken. • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection to the Cummins® ECM has been detected in the J1939 data link connector or harness. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible.	6A
Follow the general inspection techniques as described in the following procedure.Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **NO**	5B

STEP 5B: Check for an open or short circuit in the ECM J1939 data link harness.

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

Action	Specification/Repair	Next Step
Check for an open or short circuit. • Measure the resistance between the SAE J1939 data link (+) wire and the SAE J1939 data link (-) wire on the appropriate Cummins® ECM OEM connection to the J1939 data link harness connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Follow the general resistance measurement techniques described in the following procedure and the wiring diagram. Refer to Procedure 019-360 in Section 19.	50 ohms to 70 ohms? **YES**	5C
	50 ohms to 70 ohms? **NO** **Repair:** An open or short has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	6A



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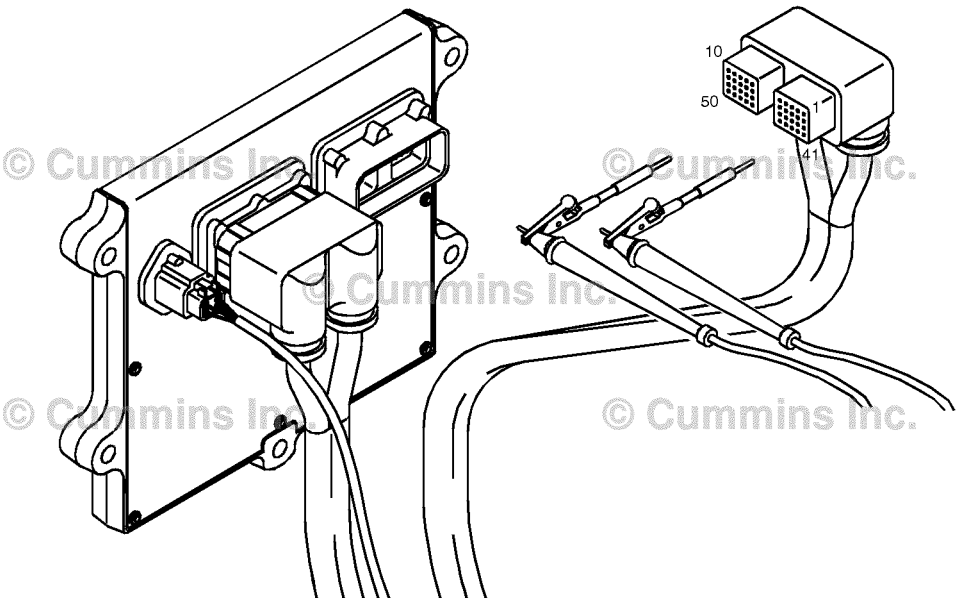
STEP 5C: Check for a short circuit in the ECM J1939 data link harness.

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

Action	Specification/Repair	Next Step
Check for a pin-to-pin short circuit. • Measure the resistance and check for a short circuit between the SAE J1939 data link (+) wire and the SAE J1939 data link (-) wire on the Cummins® ECM OEM connection to all other pins in the OEM connector. **NOTE:** Disregard any resistance between 50 and 70 ohms between the SAE J1939 data link (+) and the SAE J1939 data link (-) pins. Refer to the circuit diagram or wiring diagram for connector pin identification. Follow the general resistance measurement techniques described in the following procedure and the wiring diagram. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	5D
	Greater than 100k ohms? **NO** **Repair:** A short has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	6A



STEP 5D: 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. • Use INSITE™ electronic service tool.	Fault Code 285 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	6A
	Fault Code 285 inactive? **NO** **Repair:** A communication issue between the ECM and the data link, or a damaged ECM or calibration is causing the fault code.	Refer to the appropriate ECM No Communication symptom tree

STEP 6: Clear the fault code.

STEP 6A: Disable the fault code.

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

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 285 inactive? **YES**	6B
	Fault Code 285 inactive? **NO**	1A

STEP 6B: Clear the inactive fault code.

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

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

Fault Code 286

SAE J1939 Multiplexing Configuration Error - Out of Calibration

CODES	REASON	EFFECT
Fault Code: 286 PID(P), SID(S): S231 SPN: 639 FMI: 13 Lamp: Amber SRT:	SAE J1939 Multiplexing Configuration Error - Out of Calibration. The ECM expected information from a multiplexed device but **only** received a portion of the necessary information.	At least one multiplexed device will **not** operate properly.

Circuit Description:

Normally, switches, accelerators and other components are connected to the engine ECM directly through individual wires. Multiplexing allows those same components to be hard wired to an OEM Vehicle Electronic Control Unit (VECU) or Transmission ECU in the cab, or a System Intergration Module (SIM) in marine applications. Then component values and states from components such as sensors, accelerators and switches can be transmitted from the OEM VECU or SIM to the Cummins® engine ECM over the SAE J1939 data link.

Messages sent from OEM VECUs, Transmission ECUs. or SIM are received by the Cummins® engine ECM and used for controlling the engine. The Cummins® ECM and OEM VECU(s) **must** be configured properly so that proper operation of the multiplexed components will occur.

Component Location:

The engine ECM is located on the intake side of the engine. Refer to Procedure 100-002 in Section E.The J1939 data link wiring and VECU location varies by OEM. The SIM is located on the engine, or in the Vessel Interface Panel (VIP) in marine applications.

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 expects to receive a valid J1939 message from a multiplexed device for more than 1 second.

Action Taken When the Fault Code is Active:

- The ECM illuminates the amber CHECK ENGINE light immediately when the diagnostic runs and fails.
- The multiplexed device will **not** operate.

Conditions for Clearing the Fault Code:

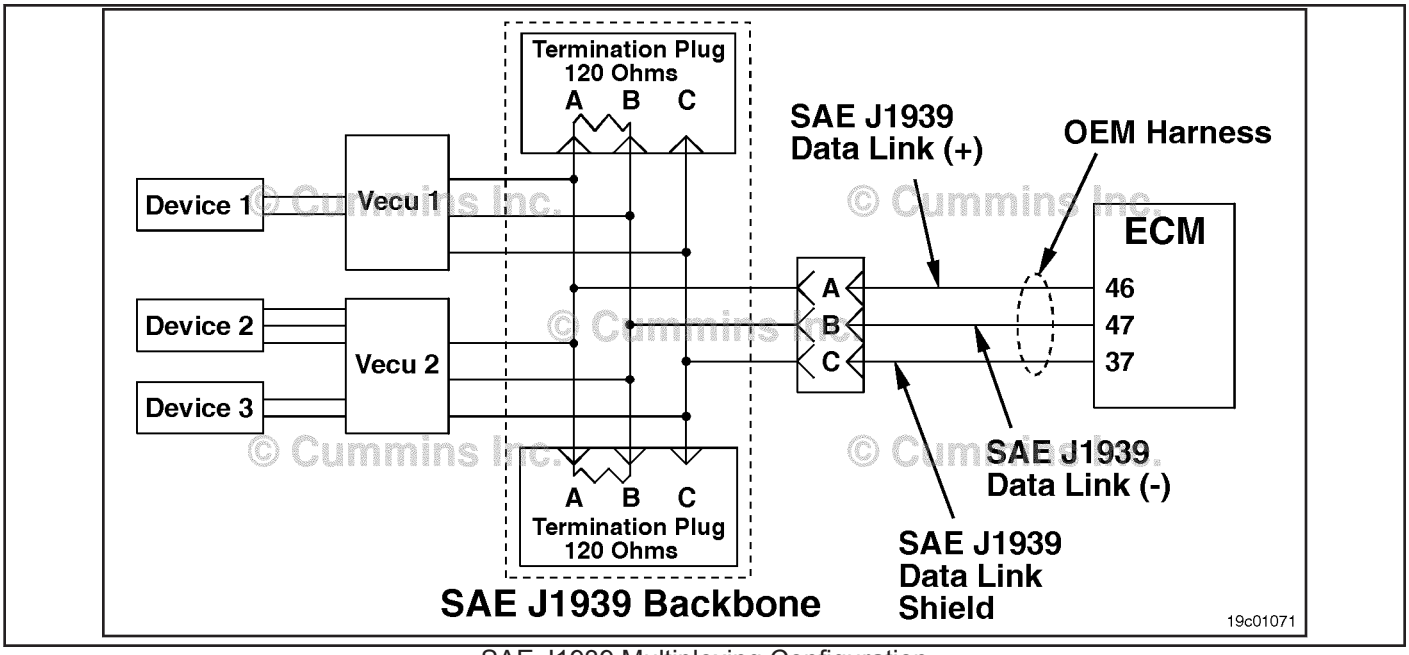
The ECM will turn off the amber CHECK ENGINE light immediately after the diagnostic runs and passes.

Shop Talk:

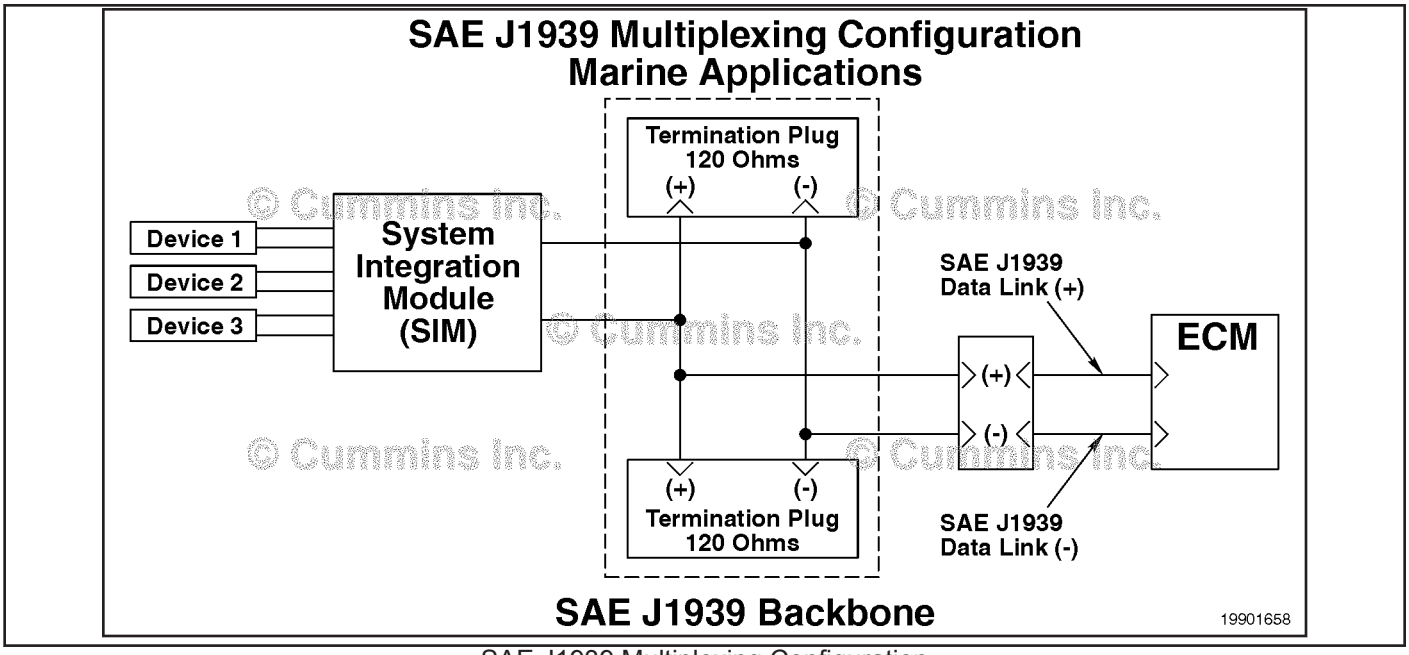
Verify the electronic control module (ECM) calibration is correct. Check the calibration revision history found on QuickServe™ Online for applicable fixes to the calibration stored in the ECM. If necessary, calibrate the ECM. Refer to Procedure 019-032 in Section 19.

This fault can occur when the ECM is set up properly (components enabled and OEM VECU source addressed correctly) to receive information from an OEM VECU, but the OEM VECU is actually transmitting a message that says that component is **not** available for multiplexing.

It is possible to use INSITE™ electronic service tool to monitor multiplexed components.



SAE J1939 Multiplexing Configuration



SAE J1939 Multiplexing Configuration

Refer to Troubleshooting Fault Code t05-286

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check for ECM communication with INSITE™ electronic service tool.**		
STEP 1A:	Check for ECM communication with INSITE™ electronic service tool.	Is communication between INSITE™ electronic service tool and the ECM possible?	
STEP 2:	**Check the fault codes.**		
STEP 2A:	Check for an active fault code.	Fault Code 286 is active?	
STEP 3:	**Check the OEM VECU and engine ECM for proper multiplexing configuration.**		
STEP 3A:	Determine which VECU multiplexed components (switches, accelerators, or sensors) are enabled for multiplexing over the J1939 data link to the engine ECM and compare to the engine ECM configuration.	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration?	
STEP 4:	**Check the service data link harness.**		
STEP 4A:	Inspect the service data link harness and connector pins.	Dirty or damaged pins?	
STEP 4B:	Check for an open or short circuit in the J1939 data link harness.	50 ohms to 70 ohms?	
STEP 5:	**Check the OEM harness.**		
STEP 5A:	Check the ECM and OEM harness connector pins.	Dirty or damaged pins?	
STEP 5B:	Check for an open or short circuit in the ECM J1939 data link harness.	50 ohms to 70 ohms?	
STEP 5C:	Check for a short circuit in the ECM J1939 data link harness.	Greater than 100k ohms?	
STEP 5D:	Check for an inactive fault code.	Fault Code 286 inactive?	
STEP 6:	**Clear the fault code.**		
STEP 6A:	Disable the fault code.	Fault Code 286inactive?	
STEP 6B:	Clear the inactive fault codes.	All faults cleared?	

TROUBLESHOOTING STEP

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

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

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

Action	Specification/Repair	Next Step
Verify INSITE™ electronic serivce tool communication with the ECM.	Is communication between INSITE™ electronic service tool and the ECM possible? **YES**	2A
	Is communication between INSITE™ electronic service tool and the ECM possible? **NO**	4A

STEP 2: Check the fault codes.

STEP 2A: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 286 is active? **YES**	3A
	Fault Code 286 is active? **NO**	Refer to Procedure 019-362 in Section 19.

STEP 3: Check the OEM VECU and engine ECM for proper multiplexing configuration.

STEP 3A: Determine which VECU multiplexed components (switches, accelerators, or sensors) are enabled for multiplexing over the J1939 data link to the engine ECM and compare to the engine ECM configuration.

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

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool SAE J1939 Multiplexed Fault Data, located in Advanced ECM data, to determine which multiplexed component is causing the fault. If the status column indicates “Active” for a multiplexed component, check that the engine ECM multiplexed component enables and source addresses match the OEM VECU multiplexed component enables and source addresses. These components can be found under SAE J1939 Multiplexing in Features and Parameters. **Note:** Refer to Multiplexing Troubleshooting, Bulletin 4021378, for specific multiplexing configuration information for several OEMs. If the OEM is not listed in the bulletin, it will be necessary to contact the OEM for specific multiplexing information.	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration? **YES** **Repair:** An OEM issue has been detected. Contact the OEM for further repair instructions. It is still possible that there is a VECU, VECU setup, or VECU to data link connection issue.	6A
	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration? **NO** **Repair:** An incorrect setup has been detected in the Cummins® engine ECM. Enable the proper components for multiplexing on the applicable OEM application and make sure the OEM VECU source addresses for each component are correct.	6A

STEP 4: Check the service data link harness.

STEP 4A: Inspect the service data link harness and connector pins.

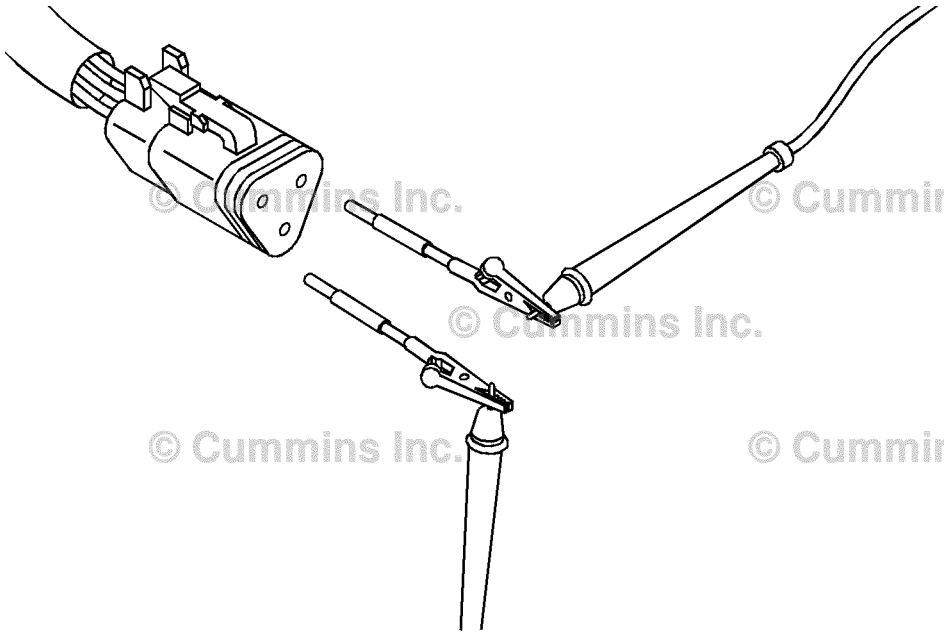
Condition:
- Turn keyswitch OFF.
- Disconnect the data link adapter from the service data link connector.

Action	Specification/Repair	Next Step
Inspect the service data link connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken. • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the service data link cable or connector. Clean the connector and pins. Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19.	6A
Refer to the circuit diagram or wiring diagram for component pin identification. Follow the general inspection techniques as described in the following procedure.Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **NO**	4B

STEP 4B: Check for an open or short circuit in the J1939 data link harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the data link adapter from the service data link connector.

Action	Specification/Repair	Next Step
Check for an open or short circuit. • Measure the resistance between the SAE J1939 data link (+) wire and the SAE J1939 data link (-) wire on the service data link connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Follow the general resistance measurement techniques described in the following procedure and the wiring diagram. Refer to Procedure 019-360 in Section 19.	50 ohms to 70 ohms? **YES**	5A
	50 ohms to 70 ohms? **NO** **Repair:** An open or short has been detected on the service data link connector or harness connection to the J1939 data link backbone. Repair or replace the data link harness. Refer to Procedure 019-071 in Section 19.	6A



STEP 5: Check the OEM harness.

STEP 5A: Check the ECM and OEM harness connector pins.

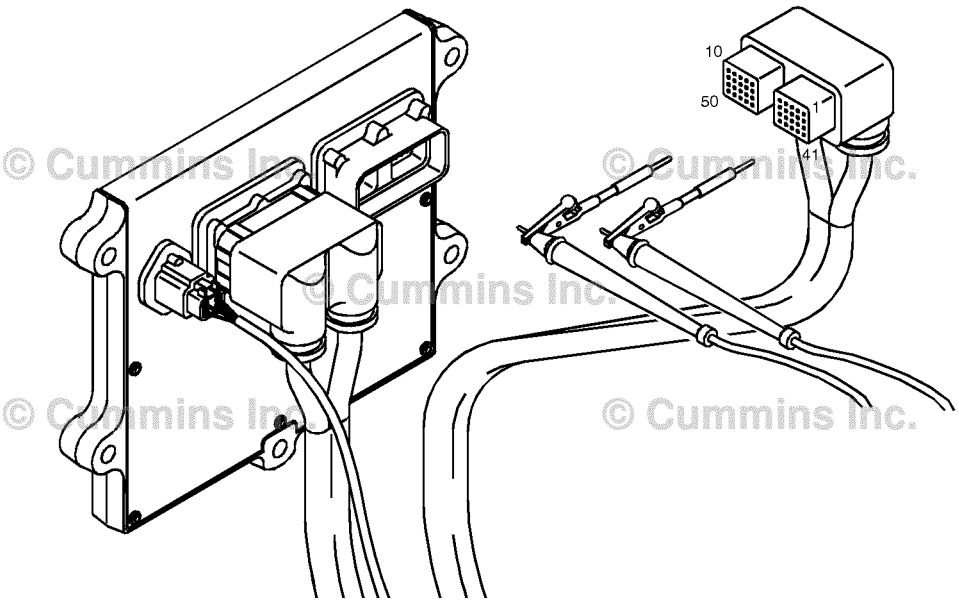
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the ECM data link harness connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken. • Wire insulation damage • Damaged locking tab. Refer to circuit diagram or wiring diagram for component pin inspection. Follow the general inspection techniques as described in the following procedure.Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection to the Cummins® ECM has been detected in the J1939 data link connector or harness. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19.	6A
	Dirty or damaged pins? **NO**	5B

STEP 5B: Check for an open or short circuit in the ECM J1939 data link harness.

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

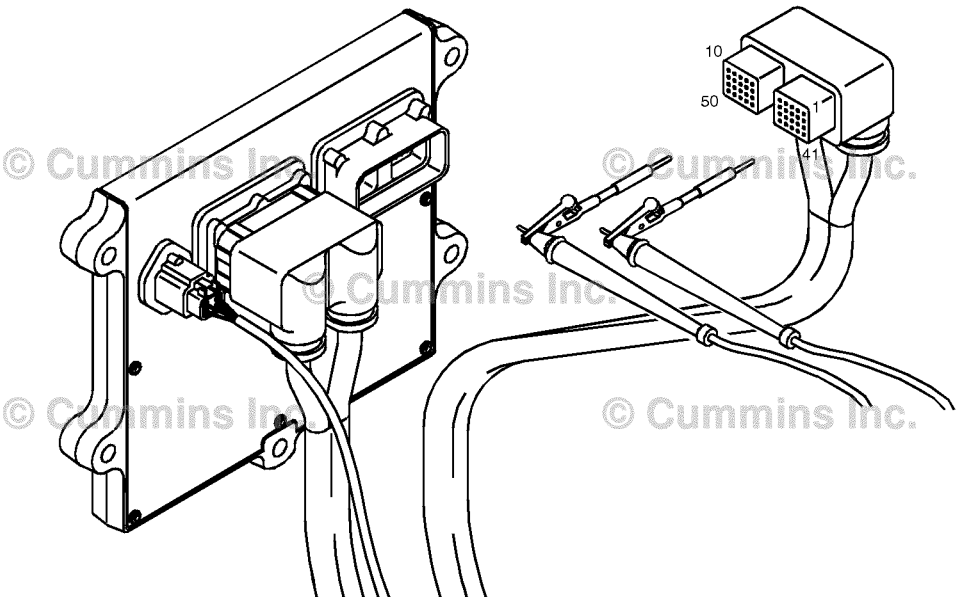
Action	Specification/Repair	Next Step
Check for an open or short circuit. • Measure the resistance between the SAE J1939 data link (+) wire and the SAE J1939 data link (-) wire on the appropriate Cummins® ECM OEM connection to the J1939 data link harness connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Follow the general resistance measurement techniques described in the following procedure and the wiring diagram. Refer to Procedure 019-360 in Section 19.	50 ohms to 70 ohms? **YES**	5C
	50 ohms to 70 ohms? **NO** **Repair:** An open or short has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	6A



STEP 5C: Check for a short circuit in the ECM J1939 data link harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the data link adapter from the service data link connector.

Action	Specification/Repair	Next Step
Check for a pin to pin short circuit. • Measure the resistance and check for a short circuit between the SAE J1939 data link (+) wire and the SAE J1939 data link (-) wire on the Cummins® ECM OEM connection to all other pins in the OEM connector. **NOTE:** Disregard any resistance between 50 and 70 ohms between the SAE J1939 data link (+) and the SAE J1939 data link (-) pins. Refer to the circuit diagram or the wiring diagram for connector pin identification. Follow the general resistance measurement techniques described in the following procedure and the wiring diagram. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	5D
	Greater than 100k ohms? **NO** **Repair:** A short has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	6A



STEP 5D: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 286 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	6A
	Fault Code 286 inactive? **NO** **Repair:** A communication issue between the ECM and the data link, or a damaged ECM or calibration is causing the fault code.	Refer to the appropriate ECM No Communication symptom tree

STEP 6: Clear the fault code.

STEP 6A: Disable the fault code.

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

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for 1 minute. • Using the INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 286 inactive? **YES**	6B
	Fault Code 286 inactive? **NO**	1A

STEP 6B: Clear the inactive fault code.

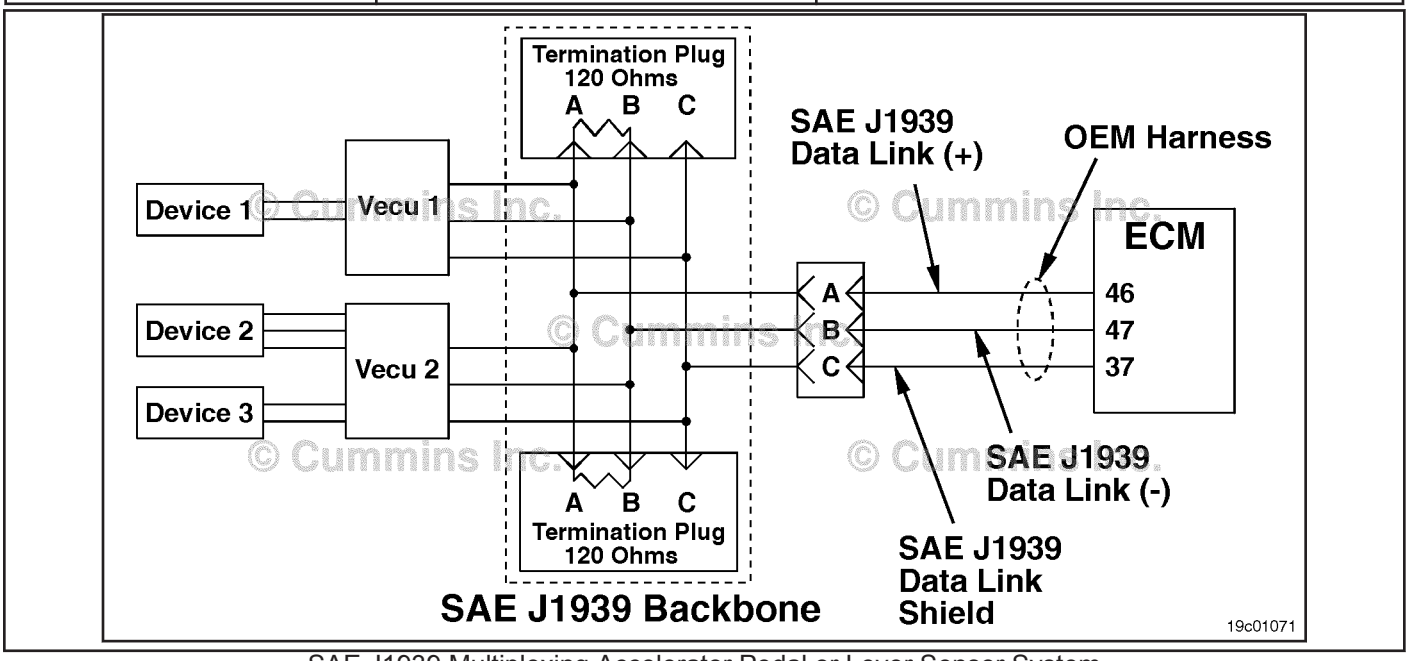
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 287

SAE J1939 Multiplexing Accelerator Pedal or Lever Sensor System Error - Received Network Data Error

CODES	REASON	EFFECT
Fault Code: 287 PID(P), SID(S): P91 SPN: 91 FMI: 19 Lamp: Red SRT:	SAE J1939 Multiplexing Accelerator Pedal or Lever Sensor System Error - Received Network Data Error. The OEM vehicle electronic control unit (VECU) detected a fault with its accelerator pedal.	Engine may **only** idle or engine will **not** accelerate to full speed.



SAE J1939 Multiplexing Accelerator Pedal or Lever Sensor System

Circuit Description:

Normally, switches, accelerators, and other components are connected to the engine ECM directly through individual wires. Multiplexing allows those same components to be hard wired to an OEM Vehicle Electronic Control Unit (VECU) or Transmission ECU in the cab. Then component values and states from components (such as sensors, accelerators, and switches) can be transmitted from the OEM VECU to the Cummins engine ECM over the SAE J1939 datalink.

Messages sent from OEM VECU's or Transmissions ECU's are received by the Cummins engine ECM and used for controlling the engine. The Cummins ECM and OEM VECU's **must** be configured properly so that proper operation of the multiplexed components will occur.

Component Location:

The engine ECM is located on the intake side of the engine. The J1939 datalink wiring and VECU location varies by OEM.

Shop Talk:

This fault can occur when the OEM VECU detects an error on the accelerator and or idle validation switch. The ECM has been set up properly (components enabled and OEM VECU source addressed correctly) to receive multiplexed

information for the idle validation switch states and accelerator position over the J1939 datalink from an OEM VECU, and the OEM VECU is transmitting the message for that component.

The three types of errors that can occur for this fault are:

- When the accelerator is depressed and the OEM VECU reads accelerator position as greater than 0%, but the idle validation switch indicates it is in the idle position. This fault status is transmitted to the Cummins ECM on the J1939 datalink, which causes this fault to occur in the Cummins ECM.
- When the accelerator is released and the OEM VECU reads accelerator position as 0%, but the idle validation switch indicates it is **not** in the idle position. This fault status is transmitted to the Cummins ECM on the J1939 datalink, which causes this fault to occur in the Cummins ECM.
- The OEM VECU determines that the accelerator signal line is shorted high or shorted low.

NOTE: It is still possible to get a Fault Code 285 or 286 if there is an incorrect setup in the OEM VECU or Cummins ECM, for other components, or the accelerator and idle validation switch, or if the datalink is damaged. OEM configurations **must** multiplex the accelerator and idle validation switch inputs together to allow the use of the J1939 multiplexing and limp home feature for these components. INSITE™ can be used to monitor multiplexed components.

Refer to Troubleshooting Fault Code t05-287

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for an active fault code.**	**Fault Code 287 is active?**	
STEP 2:	**Check the OEM VECU and engine ECM for proper multiplexing configuration.**		
STEP 2A:	**Determine which VECU multiplexed components (switches, accelerators, or sensors) are enabled for multiplexing over the J1939 datalink to the engine ECM and compare to the engine ECM configuration.**	**Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration?**	
STEP 3:	**Monitor the accelerator parameters with INSITE™ electronic service tool.**		
STEP 3A:	**Determine if the idle validation switch and or accelerator parameters are being received properly by the engine ECM.**	**Throttle Status/Idle Validation parameter displays released and Percent Throttle parameter displays a value of zero?**	
STEP 3B:	**Determine if the idle validation switch and or accelerator are being received properly by the engine ECM.**	**Throttle Status/Idle Validation parameter displays depressed and Percent Throttle parameter displays a value greater than zero?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 287 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. • Using INSITE™, read the fault codes.	Fault Code 287 is active? **YES**	2A
	Fault Code 287 is active? **NO**	Refer to Inactive or Intermittent Fault Code, Refer to Procedure 019-362.

STEP 2: Check the OEM VECU and engine ECM for proper multiplexing configuration.

STEP 2A: Determine which VECU multiplexed components (switches, accelerators, or sensors) are enabled for multiplexing over the J1939 datalink to the engine ECM and compare to the engine ECM configuration.

Condition:
- Determine proper OEM VECU multiplexing configuration component enables and OEM VECU source addresses from the appropriate OEM information, or from a saved job image.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check that the engine ECM multiplexed component enables and source addresses match the OEM VECU multiplexed component enables and source addresses.	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration? **YES**	3A
	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration? **NO** **Repair:** An incorrect setup has been detected in the Cummins ECM. Enable the proper components for multiplexing on the applicable OEM application and ensure the OEM VECU source addresses for each component are correct.	4A

STEP 3: Monitor the accelerator parameters with INSITE™ electronic service tool.

STEP 3A: Determine if the idle validation switch and or accelerator parameters are being received properly by the engine ECM.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Determine whether the idle validation switch and accelerator position sensor are multiplexed from the appropriate OEM.
- Ensure the accelerator is in the released position.

Action	Specification/Repair	Next Step
Monitor the following parameters in INSITE™ Monitor Mode: • Percent Throttle • Throttle Status/Idle Validation **NOTE:** Monitor parameters can possibly **not** appear in the electronic service tool exactly as listed above. When the throttle is released, the Throttle Status/ Idle Validation parameter **must** display “released” and Percent Throttle parameter **must** display a value of zero.	Throttle Status/Idle Validation parameter displays released and Percent Throttle parameter displays a value of zero? **YES**	3B
	Throttle Status/Idle Validation parameter displays released and Percent Throttle parameter displays a value of zero? **NO** **Repair:** There is an OEM issue with the accelerator or idle validation switch or OEM VECU. • Refer to the appropriate OEM for further instructions. • Refer to Procedure 019-054. • Refer to Procedure 019-085. • Refer to Procedure 019-086.	4A

STEP 3B: Determine if the idle validation switch and or accelerator are being received properly by the engine ECM.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Determine whether the idle validation switch is multiplexed with the accelerator position sensor from the appropriate OEM.
- Ensure the accelerator is in the depressed position.

Action	Specification/Repair	Next Step
Monitor the following parameters in INSITE™ Monitor Mode: • Percent Throttle • Throttle Status/Idle Validation When the throttle is depressed, the Throttle Status/Idle Validation parameter **must** display “depressed” and Percent Throttle parameter **must** display a value greater than zero.	Throttle Status/Idle Validation parameter displays depressed and Percent Throttle parameter displays a value greater than zero? **YES**	4A
	Throttle Status/Idle Validation parameter displays depressed and Percent Throttle parameter displays a value greater than zero? **NO** **Repair:** There is an OEM issue with the idle validation switch or the accelerator or with the OEM VECU. • Refer to the appropriate OEM for further instructions. • Refer to Procedure 019-054. • Refer to Procedure 019-085. • Refer to Procedure 019-086.	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. • Start the engine and let it idle for 1 minute. • Using the INSITE™, verify that the fault code is inactive.	Fault Code 287 inactive? **YES**	4B
	Fault Code 287 inactive? **NO**	1A

STEP 4B: Clear the inactive fault code.

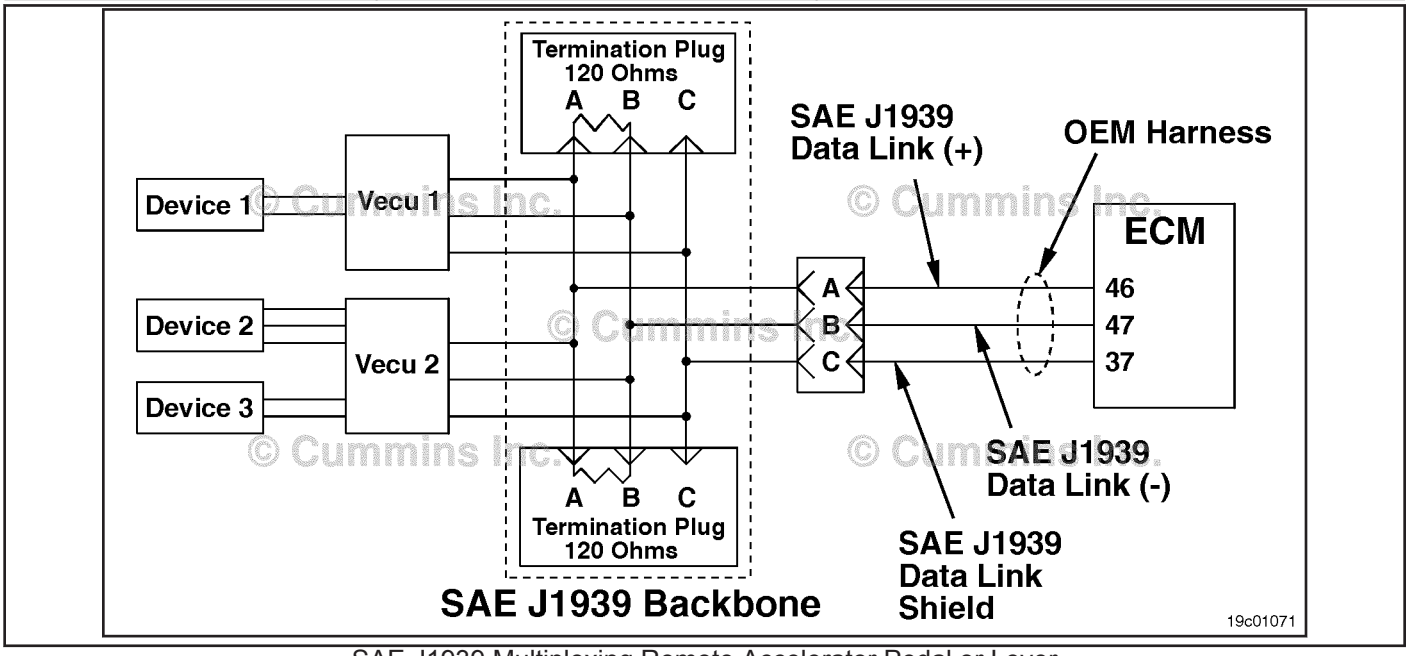
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using the INSITE™.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO**	Appropriate troubleshooting steps

Fault Code 288

SAE J1939 Multiplexing Remote Accelerator Pedal or Lever Data Error - Received Network Data Error

CODES	REASON	EFFECT
Fault Code: 288 PID(P), SID(S): P29 SPN: 974 FMI: 19 Lamp: Red SRT:	SAE J1939 Multiplexing Remote Accelerator Pedal or Lever Data Error - Received Network Data Error. The OEM vehicle electronic control unit (VECU) detected a fault with the remote accelerator.	The engine will **not** respond to the remote throttle. Engine may **only** idle. The primary or cab accelerator may be able to be used.



SAE J1939 Multiplexing Remote Accelerator Pedal or Lever

Circuit Description:

Normally, switches, accelerators, and other components are connected to the engine ECM directly through individual wires. Multiplexing allows those same components to be hard wired to an OEM Vehicle Electronic Control Unit (VECU) or Transmission ECU in the cab. Then component values and states from components (such as sensors, accelerators, and switches) can be transmitted from the OEM VECU to the Cummins engine ECM over the SAE J1939 datalink.

Messages sent from OEM VECU's or Transmissions ECU's are received by the Cummins engine ECM and used for controlling the engine. The Cummins ECM and OEM VECU's **must** be configured properly so that proper operation of the multiplexed components will occur.

Component Location:

The engine ECM is located on the intake side of the engine. The J1939 datalink wiring and VECU location varies by OEM.

Shop Talk:

This fault can occur when the OEM VECU detects an error on the remote throttle and or remote throttle enable switch. The ECM has been set up properly (components enabled and OEM VECU source addressed correctly) to receive multiplexed information for the remote throttle enable switch states and remote accelerator position over the J1939

datalink from an OEM VECU, and the OEM VECU is transmitting the message for that component. Most OEM's will **not** have the circuitry to detect a remote throttle switch error.

The two types of errors that can occur for this fault are:

- The OEM VECU determines that the remote throttle signal line is shorted high or shorted low. This fault status is transmitted to the Cummins ECM on the J1939 datalink, which causes this fault to occur in the Cummins ECM.
- When the remote throttle enable switch has a shorted high or shorted low error detected by the OEM VECU. This fault status is transmitted to the ECM on the J1939 datalink, which causes this fault to occur in the ECM. Most OEM's will **not** incorporate fault detection on a switch.

NOTE: It is still possible to get a Fault Code 285 or 286 if there is an incorrect setup in the OEM VECU or Cummins ECM for other components, or the remote throttle and remote throttle switch, or the datalink is damaged. OEM configurations **must** multiplex the remote throttle and remote throttle switch inputs together to allow the use of the J1939 multiplexing feature for these components. INSITE™ can be used to monitor multiplexed components.

Refer to Troubleshooting Fault Code t05-288

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for an active fault code.**	**Fault Code 288 is active?**	
STEP 2:	**Check the OEM VECU and engine ECM for proper multiplexing configuration.**		
STEP 2A:	**Determine which VECU multiplexed components (switches, accelerators, or sensors) are enabled for multiplexing over the J1939 datalink to the engine ECM and compare to the engine ECM configuration.**	**Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration?**	
STEP 3:	**Monitor the remote accelerator parameters with INSITE™ electronic service tool.**		
STEP 3A:	**Determine if the remote throttle switch and or remote accelerator parameters are being received properly by the engine ECM.**	**Remote Throttle Switch parameter displays ON and Percent Throttle parameter displays a value of zero?**	
STEP 3B:	**Determine if the remote throttle switch and or remote throttle parameters are being received properly by the engine ECM.**	**Remote Throttle Switch parameter displays ON and Percent Throttle parameter displays a value greater than zero?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 288 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. • Using INSITE™, read the fault codes.	Fault Code 288 is active? **YES**	2A
	Fault Code 288 is active? **NO**	Refer to Inactive or Intermittent Fault Code, Refer to Procedure 019-362.

STEP 2: Check the OEM VECU and engine ECM for proper multiplexing configuration.

STEP 2A: Determine which VECU multiplexed components (switches, accelerators, or sensors) are enabled for multiplexing over the SAE J1939 datalink to the engine ECM and compare to the engine ECM configuration.

Condition:
- Determine proper OEM VECU multiplexing configuration component enables and OEM VECU source addresses from the appropriate OEM information, or from a saved job image.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check that the engine ECM multiplexed component enables and source addresses match the OEM VECU multiplexed component enables and source addresses.	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration? **YES**	3A
	Does the ECM multiplexing configuration match the OEM VECU multiplexing configuration? **NO** **Repair:** An incorrect setup has been detected in the Cummins ECM. Enable the proper components for multiplexing on the applicable OEM application and ensure the OEM VECU source addresses for each component are correct.	4A

STEP 3: Monitor the remote accelerator parameters with INSITE™ electronic service tool.

STEP 3A: Determine if the remote throttle switch and or remote accelerator parameters are being received properly by the engine ECM.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Ensure the remote throttle switch is ON and the remote accelerator is in the released position.

Action	Specification/Repair	Next Step
Monitor the following parameters in INSITE™ Monitor Mode: • Percent Throttle • Remote Throttle Status/Idle Validation **NOTE:** Monitor parameters can possibly **not** appear in the electronic service tool exactly as listed above. When the remote throttle is released, the Remote Throttle Switch parameter **must** display ON and the Percent Throttle parameter **must** display a value of zero.	Remote Throttle Switch parameter displays ON and Percent Throttle parameter displays a value of zero? **YES**	3B
	Remote Throttle Switch parameter displays ON and Percent Throttle parameter displays a value of zero? **NO** **Repair:** There is an OEM issue with the remote throttle switch, the remote throttle, or with the OEM VECU. Refer to the appropriate OEM for further instructions.	4A

STEP 3B: Determine if the remote throttle switch and or remote throttle parameters are being received properly by the engine ECM.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Ensure the remote throttle switch is ON and the remote accelerator is in the depressed position.

Action	Specification/Repair	Next Step
Monitor the following parameters in INSITE™ Monitor Mode: • Percent Throttle • Remote Throttle Switch Status **NOTE:** Monitor parameters can possibly **not** appear in the electronic service tool exactly as shown above. When the remote throttle is depressed, the Remote Throttle Switch parameter **must** display ON and the Percent Throttle parameter **must** display a value greater than zero.	Remote Throttle Switch parameter displays ON and Percent Throttle parameter displays a value greater than zero? **YES**	4A
	Remote Throttle Switch parameter displays ON and Percent Throttle parameter displays a value greater than zero? **NO** **Repair:** There is an OEM issue with the remote throttle switch, or the remote throttle, or with the OEM VECU. Refer to the appropriate OEM for further instructions.	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. • Start the engine and let it idle for 1 minute. • Using the INSITE™, verify that the fault code is inactive.	Fault Code 288 inactive? **YES**	4B
	Fault Code 288 inactive? **NO**	1A

STEP 4B: Clear the inactive fault code.

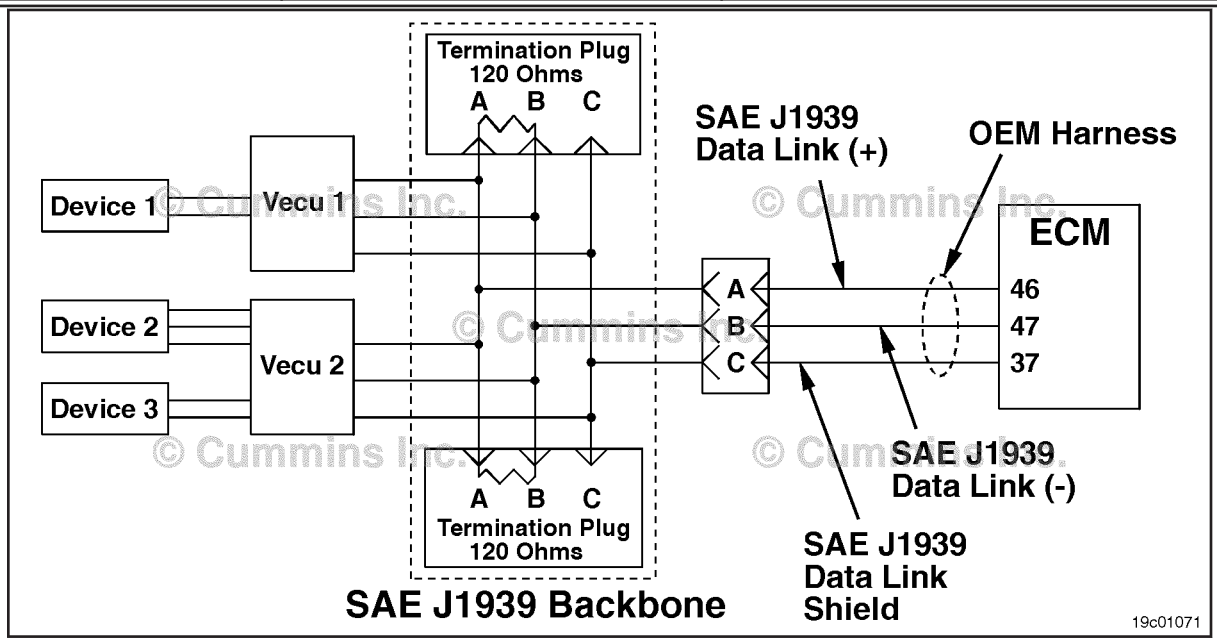
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using INSITE™.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO**	Appropriate troubleshooting steps

Fault Code 291

Proprietary Datalink Error (OEM/Vehicle Datalink) — Abnormal Update Rate.

CODES	REASON	EFFECT
Fault Code: 291 PID(P), SID(S): S248 SPN: 625 FMI: 9 Lamp: Red SRT:	Proprietary Datalink Error (OEM/ Vehicle Datalink) — Abnormal Update Rate. The ECM cannot communicate with the immobilizer anti-theft system.	The immobilizer anti-theft system will not operate properly. The engine may not start.



Circuit:

Circuit Description:

The immobilizer anti-theft device is connected to the primary engine Electronic Control Module (ECM) through a J1939 datalink network.

Messages sent from the immobilizer anti-theft device are received by the Cummins engine ECM and used for controlling the anti-theft features. The Cummins ECM and immobilizer anti-theft device **must** be configured properly so that proper operation of the multiplexed components will occur.

Component Location:

The engine ECM is located on the intake side of the engine. The J1939 datalink wiring and location of OEM installed J1939 devices varies by OEM.

Shop Talk:

This fault can occur for the following reasons:

- When the ECM is setup properly to receive information from an immobilizer anti-theft device, but the immobilizer anti-theft device may not actually be transmitting the message for that component. This can be caused when a multiplexed component is enabled in the Cummins ECM, but the immobilizer anti-theft device source address of the VECU transmitting the component message is incorrect in the Cummins ECM, or the immobilizer anti-theft device is not setup to transmit the multiplexed component message.
- This fault can be caused by a bad J1939 datalink connection between the immobilizer anti-theft device and Cummins ECM , a bad connection between the component and the immobilizer anti-theft device, bad immobilizer

anti-theft device or bad Cummins ECM. It may be necessary to contact the OEM for proper multiplexing configuration.

On-Board Diagnostics (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 t05-291

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 fault codes.**		
STEP 1A:	**Check for an active fault code.**	**Fault Code 291 is active?**	
STEP 2:	**Check the immobilizer anti-theft device for proper configuration.**		
STEP 2A:	**Determine if the immobilizer anti-theft device configured correctly.**	**The immobilizer anti-theft device is configured correctly.**	
STEP 3:	**Check the service datalink harness**		
STEP 3A:	**Inspect the immobilizer anti-theft device and connector pins.**	**Dirty or damaged pins?**	
STEP 3B:	**Check for an open or short circuit in the J1939 harness**	**Resistance between 50 and 70 ohms?**	
STEP 4:	**Check the OEM harness**		
STEP 4A:	**Check the ECM and OEM harness connector pins**	**Damaged or dirty pins?**	
STEP 4B:	**Check for an open or short circuit in the ECM J1939 datalink harness**	**Resistance between 50 and 70 ohms?**	
STEP 4C:	**Check for a short circuit in the ECM J1939 datalink harness**	**Greater than 100k ohms?**	
STEP 5:	**Clear the fault code.**		
STEP 5A:	**Disable the fault code.**	**Fault Code 291 inactive?**	
STEP 5B:	**Clear the inactive fault code.**	**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. • Use INSITE™ to read the fault codes.	Fault Code 291 is active? **YES**	2A
	Fault Code 291 is active? **NO**	Refer to Inactive or Intermittent Fault Code 019-362.

STEP 2: Check the immobilizer anti-theft device for proper configuration.

STEP 2A: Determine if the immobilizer anti-theft device is configured correctly.

Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the immobilzer anti-theft device for the following: • Correct power supply and ground connections • Proper connections to the J1939 datalink • Correct electronic configuration of the immobilizer anti-theft device.	The immobilizer anti-theft device is configured correctly? **YES**	3A
	The immobilizer anti-theft device is configured correctly? **NO** **Repair:** Refer to the immobilizer anti-theft installation instructions provided by the OEM.	Refer to OEM installation instructions.

STEP 3: Check the service datalink harness

STEP 3A: Inspect the immobilizer anti-theft device and connector pins

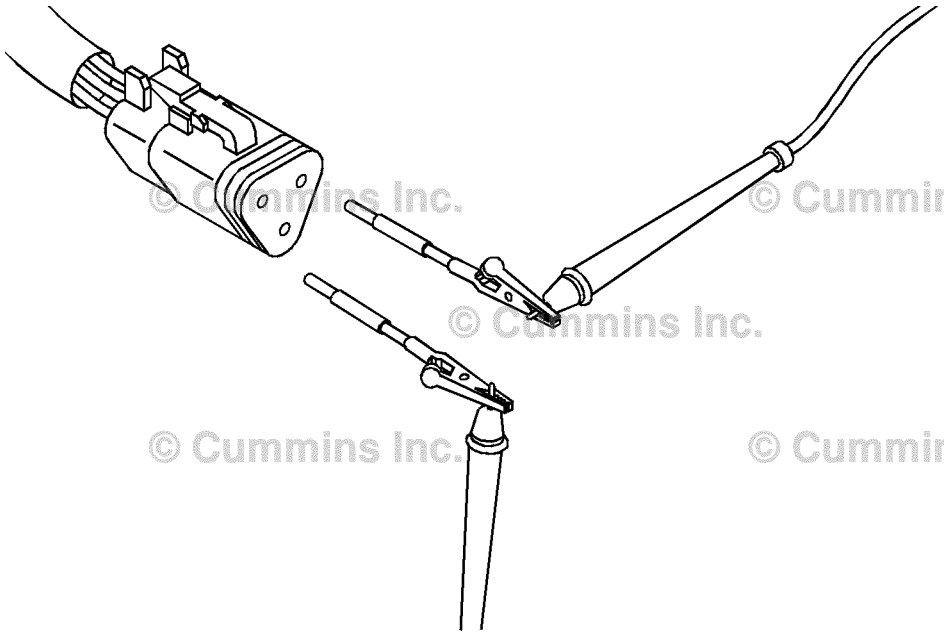
Condition:
- Turn keyswitch OFF.
- Disconnect the immobilizer anti-theft device from the J1939 datalink

Action	Specification/Repair	Next Step
Inspect the service data link connector pins for the following: • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins	Dirty or damaged pins? **YES** **Repair:** A defective connection has been detected in the service datalink cable. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible.	5A
	Dirty or damaged pins? **NO**	3B

STEP 3B: Check for an open or short circuit in the J1939 datalink harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the immobilizer anti-theft device from the J1939 datalink.

Action	Specification/Repair	Next Step
Check for an open or short circuit: • Measure the resistance between the SAE J1939 Data Link (+) wire and the SAE J1939 Data Link (-) wire on the service data link connector. Refer to the wiring diagram for connector pin identification. For general resistance measurement techniques, refer to the Resistance Measurements Using a Multimeter and Wiring Diagram, Procedure Refer to Procedure 019-360.	Resistance between 50 and 70 ohms? **YES**	4A
	Resistance between 50 and 70 ohms? **NO** **Repair:** An open or short has been detected on the service datalink connector or harness connection to the J1939 datalink backbone. Repair/replace the OEM harness 019-071.	5A



STEP 4: Check the OEM harness

STEP 4A: Check the ECM and OEM harness connector pins.

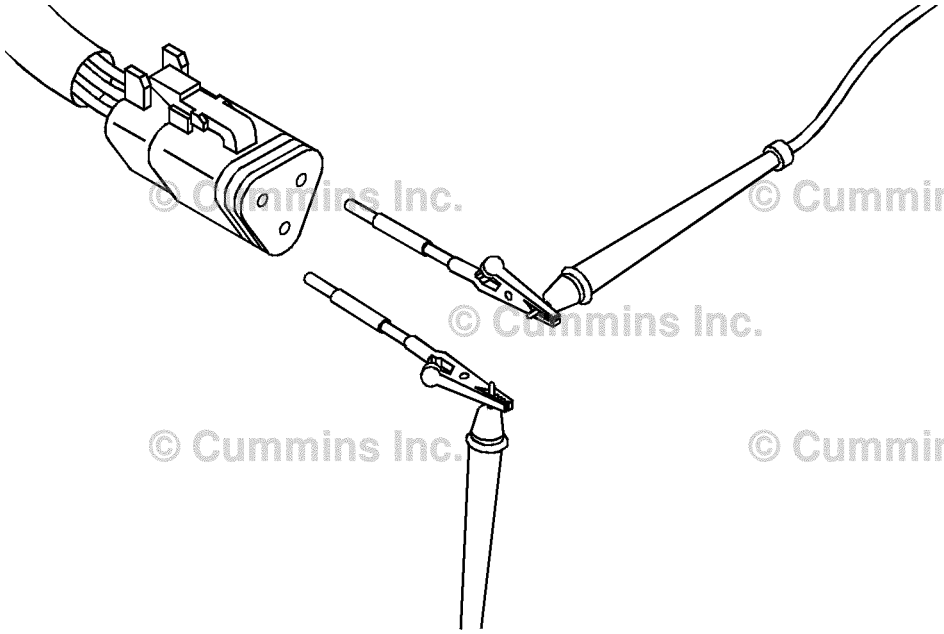
Condition:
- Turn keyswitch OFF
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the ECM data link harness connector pins for the following: • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins	Dirty or damaged pins? **YES** **Repair:** A defective connection to the Cummins ECM has been detected in the J1939 datalink connector or harness. Clean the connector and pins. Repair the damaged harness, connector or pins if possible.	5A
	Dirty or damaged pins? **NO**	4B

STEP 4B: Check for an open or short circuit in the ECM J1939 datalink harness

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

Action	Specification/Repair	Next Step
Check for an open or short circuit: • Measure the resistance between the SAE J1939 Data Link (+) wire and the SAE J1939 (-) wire on the appropriate Cummins ECM OEM connection to the J1939 datalink harness connector. Refer to the wiring diagram for connector pin identification. For general resistance measurement techniques, refer to the Resistance Measurements Using a Multimeter and Wiring Diagram, Procedure Refer to Procedure 019-360.	Resistance between 50 and 70 ohms? **YES**	4C
	Resistance between 50 and 70 ohms? **NO** **Repair:** An open or short has been detected in the OEM harness. Repair or replace the OEM harness. 019-071.	5A



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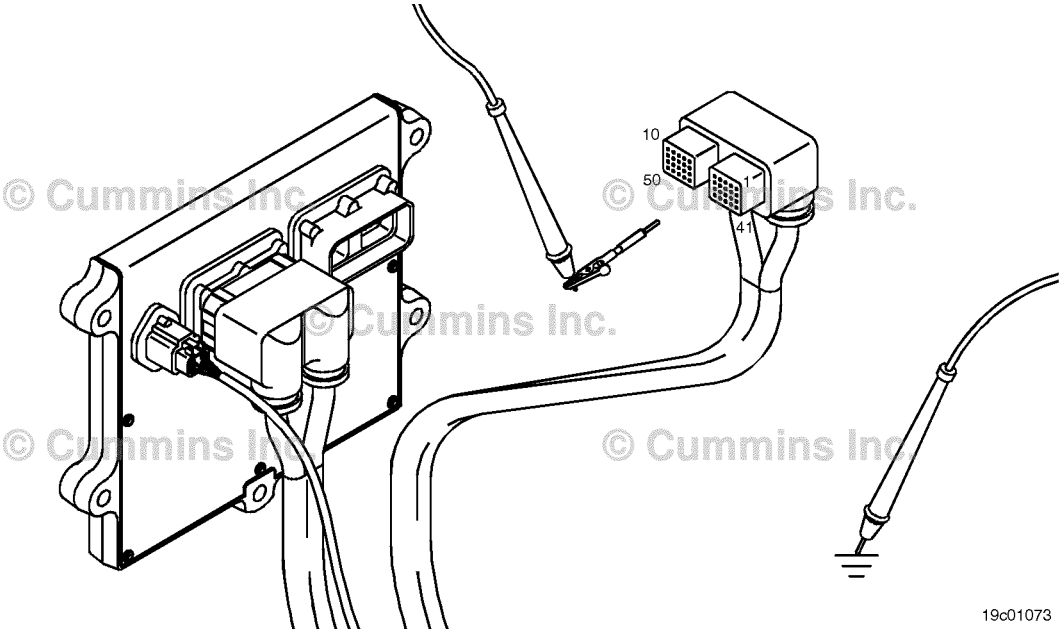
STEP 4C: Check for a short circuit in the ECM J1939 datalink harness

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

Action	Specification/Repair	Next Step
Check for a short circuit: • Measure the resistance and check for a short circuit between the SAE J1939 Data Link (+) wire and the SAE J1939 (-) wire on the appropriate Cummins ECM OEM connection to the J1939 datalink harness connector. Note: Disregard any resistance between 50 and 70 ohms between the SAE J1939 Data Link (+) and the SAE J1939 Data Link (-) pins. Refer to the wiring diagram for connector pin identification. For general resistance measurement techniques, refer to the Resistance Measurements Using a Multimeter and Wiring Diagram, Refer to Procedure 019-360.	Greater than 100k ohms? **YES**	Refer to the No Communication Symptom Tree.
	Greater than 100k ohms? **NO** **Repair:** A short has been detected in the OEM harness. Repair or replace the OEM harness. 019-071.	5A



STEP 5: Clear the fault code

STEP 1A: 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. • Start the engine and let it idle for 1 minute • Using INSITE™, verify that the fault code is inactive.	Fault Code 291 is inactive? **YES**	5B
	Fault Code 291 is inactive? **NO**	1A

STEP 5B: Clear the inactive fault code

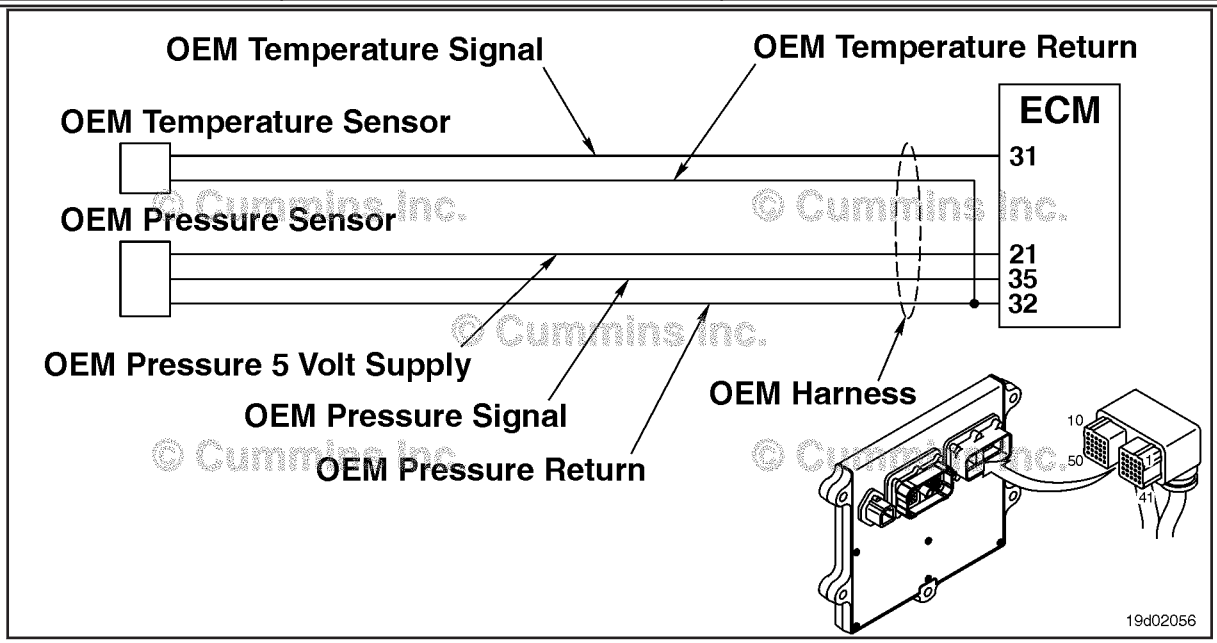
Condition:
- Connect all components
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using the INSITE™ electronic service tool.	All faults cleared? **YES**	Repair complete.
	All faults cleared? **NO**	Appropriate troubleshooting steps.

Fault Code 292

Auxiliary Temperature Sensor Input 1 - Special Instructions.

CODES	REASON	EFFECT
Fault Code: 292 PID(P), SID(S): P441 SPN: 441 FMI: 14 Lamp: Red SRT:	Auxiliary Temperature Sensor Input 1 - Special Instructions.	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 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 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 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 t05-292

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 292.	**Active or inactive counts of Fault Code 292?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 292.

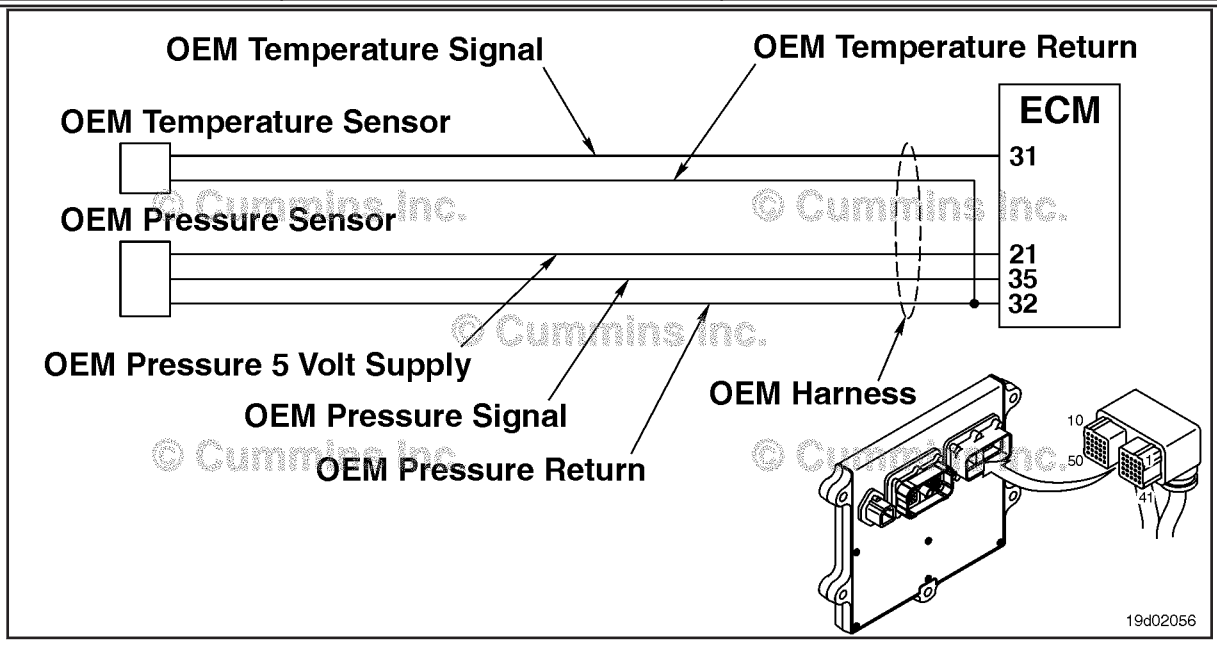
Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for an inactive fault code. • Using INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 292? **YES** **Repair:** 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 292? **NO**	Repair complete

Fault Code 293

Auxiliary Temperature Sensor Input 1 - Voltage Above Normal, or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 293 PID(P), SID(S): P441 SPN: 441 FMI: 3 Lamp: Amber SRT:	Auxiliary Temperature Sensor Input 1 - Voltage Above Normal, or Shorted to High Source. High signal voltage or open circuit detected at the OEM auxiliary temperature circuit.	None on performance.



Auxiliary Temperature Sensor Input 1 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.

Component Location:

The OEM temperature sensor input will vary depending on application. Refer to the OEM troubleshooting manual for sensor location.

Shop Talk:

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.

Refer to Troubleshooting Fault Code t05-293

FAULT CODE 293 - Auxiliary Temperature Sensor Input 1 - 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 293 is inactive?**	
STEP 2:	**Check the OEM temperature sensor and circuit.**		
STEP 2A:	**Inspect the OEM temperature sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the sensor resistance.**	**180 ohms to 160K 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 from an open circuit in the OEM harness.**	**Less than 10 ohms?**	
STEP 3B-1:	**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 293 inactive?**	
STEP 4:	**Clear the fault code**		
STEP 4A:	**Disable the fault code.**	**Fault Code 293 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 inactive fault code.

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

Action	Specification/Repair	Next Step
Check for an inactive fault code. • Use INSITE™ electronic service tool, to read the fault codes.	Fault Code 293 is inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 293 is inactive? **NO**	2A

STEP 2: Check the OEM temperature sensor and circuit.

STEP 2A: Inspect the OEM temperature sensor and connector pins.

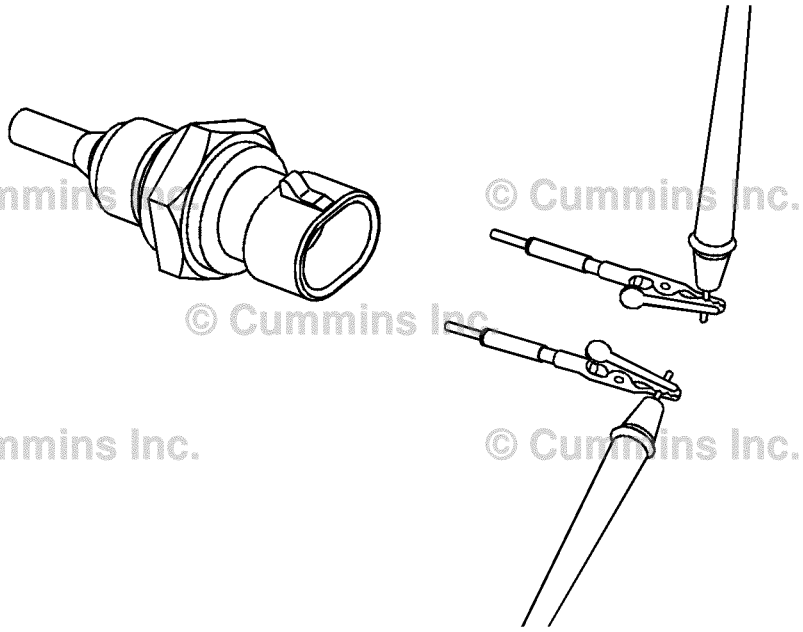
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM temperature sensor and connector pins.

Action	Specification/Repair	Next Step
Inspect the OEM harness and OEM temperature sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the sensor resistance.

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

Action	Specification/Repair	Next Step
Check the sensor resistance. • Measure the resistance between the SIGNAL pin and RETURN pin at the OEM temperature sensor connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	180 ohms to 160K ohms? Refer to OEM service manual for additional specifications. **YES**	3A
	180 ohms to 160K ohms? **NO** **Repair:** Replace the OEM temperature sensor. Refer to OEM service manual.	4A



STEP 3: Check the ECM and OEM harness.

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

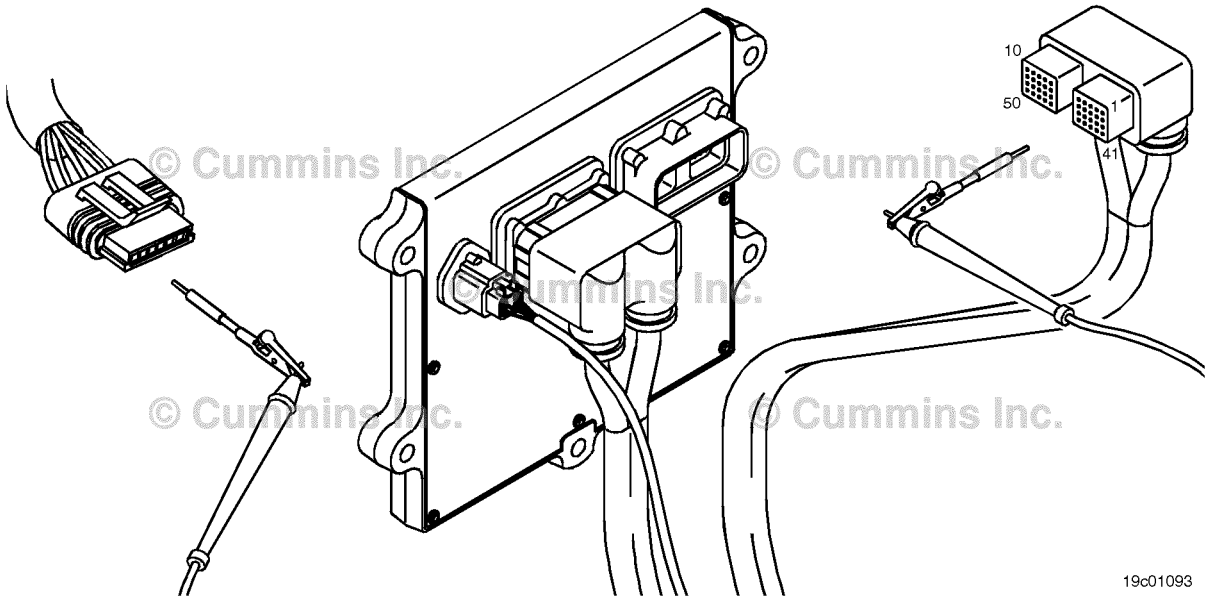
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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 OEM temperature sensor from the OEM harness.

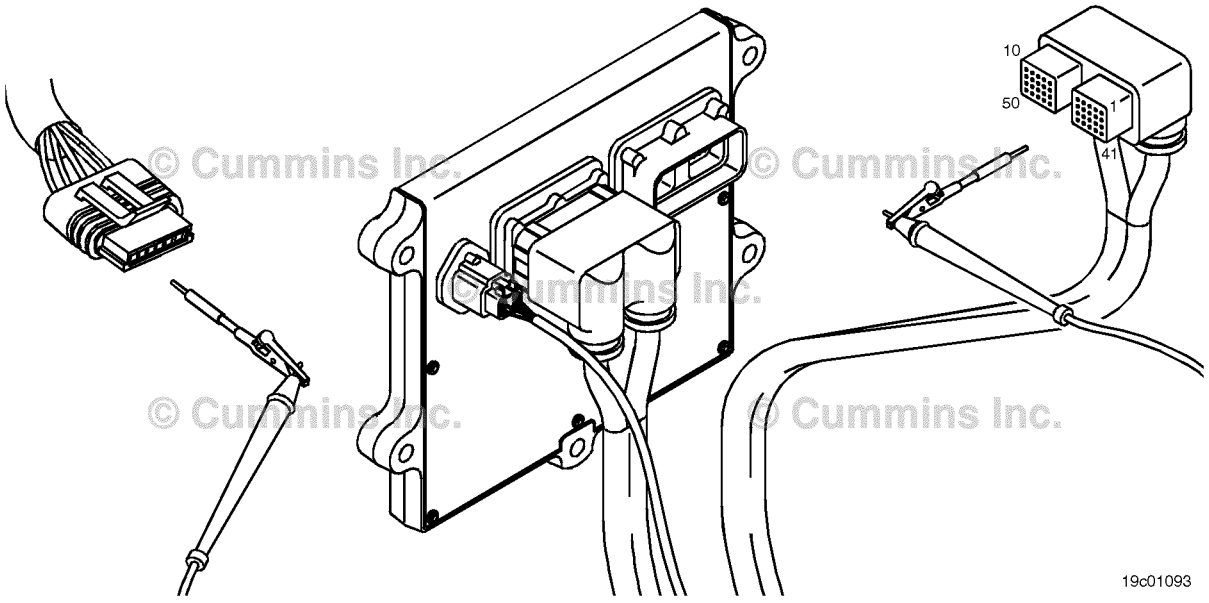
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector OEM temperature sensor RETURN pin and OEM harness OEM temperature sensor connector RETURN pin. Refer to the circuit diagram or the wiring diagram connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3B-1
	Less than 10 ohms? **NO** **Repair:** An open RETURN circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



STEP 3B-1: Check for an open circuit in the OEM harness.

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

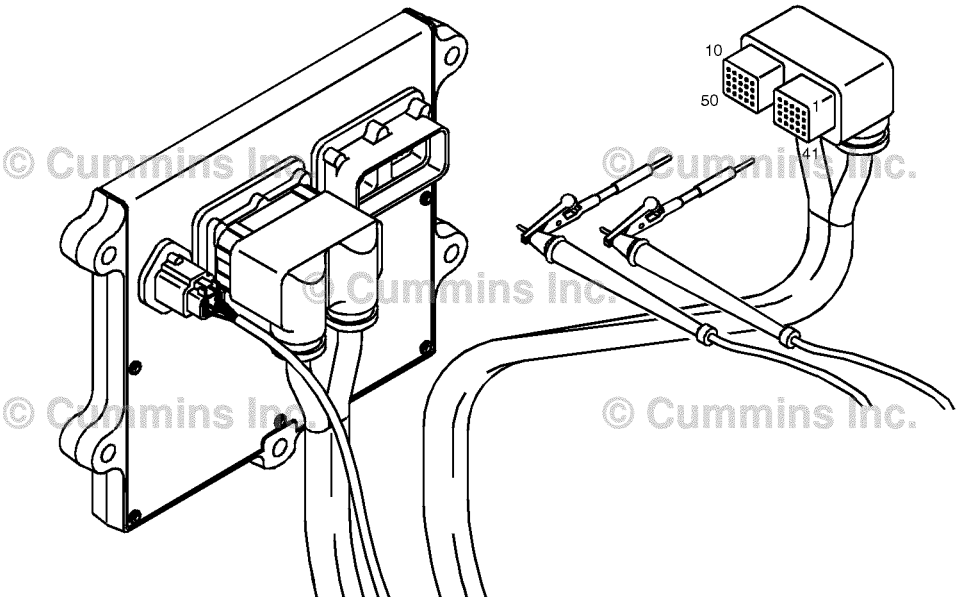
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector OEM temperature sensor SIGNAL pin and the OEM harness OEM temperature sensor connector SIGNAL pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3C
	Less than 10 ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. 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 OEM temperature sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the OEM temperature sensor SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM harness ECM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3D
	Greater than 100K ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the pin-to-pin shorted signal circuit. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 293 inactive? **YES** **Repair:** None. The removal and reinstallation of the connector corrected the fault.	4A
	Fault Code 293 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service too, to verify that the fault code is inactive.	Fault Code 293 inactive? **YES**	4B
	Fault Code 293 inactive? **NO**	1A

STEP 4B: Clear the inactive fault code.

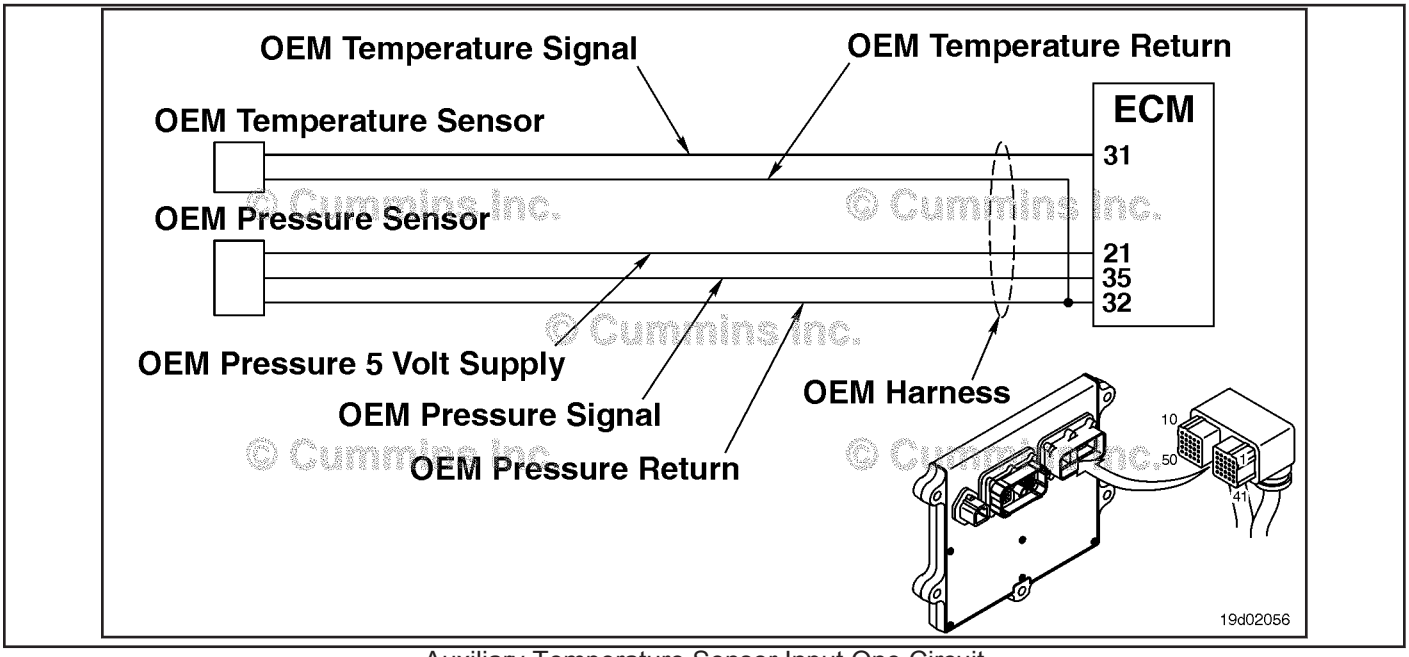
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 294

Auxiliary Temperature Sensor Input 1 Circuit - Voltage Below Normal, or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 294 PID(P), SID(S): P441 SPN: 441 FMI: 4 Lamp: Amber SRT:	Auxiliary Temperature Sensor Input 1 Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at OEM auxiliary temperature circuit.	None on performance.



Auxiliary Temperature Sensor Input One 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.

Component Location:

The OEM temperature sensor input will vary depending on application. Refer to the OEM troubleshooting manual for sensor location.

Shop Talk:

Possible causes of this fault code include:

- Signal shorted to ground in the harness.
- Signal shorted to return or ground in the sensor.

Refer to Troubleshooting Fault Code t05-294

FAULT CODE 294 - Auxiliary Temperature Sensor Input 1 Circuit - Voltage Below Normal, or Shorted to Low Source

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes**		
STEP 1A:	**Check for an inactive fault code.**	**Fault Code 294 is inactive?**	
STEP 2:	**Check the OEM temperature sensor and circuit.**		
STEP 2A:	**Inspect the OEM temperature sensor and connector pins.**	**Dirty or damage pins?**	
STEP 2B:	**Check the circuit response.**	**Fault Code 293 active and Fault Code 294 inactive?**	
STEP 2C:	**Check the fault codes and verify sensor condition.**	**Fault Code 294 is active?**	
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 then 100K ohms?**	
STEP 3D:	**Check for an inactive fault code.**	**Fault Code 294 is inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 294 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. • Use INSITE™ electronic service tool to read the fault code.	Fault Code 294 is inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 294 is inactive? **NO**	2A

STEP 2: Check the OEM temperature sensor and circuit.

STEP 2A: Inspect the OEM temperature sensor and connector pins.

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

Action	Specification/Repair	Next Step
Inspect the OEM harness and OEM temperature sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the circuit response.

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

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE electronic service tool, to read the fault codes.	Fault Code 293 active and Fault Code 294 inactive? **YES**	2C
	Fault Code 293 active and Fault Code 294 inactive? **NO**	3A

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

Condition:
- Use INSITE™ electronic service tool to read the fault codes.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use electronic service tool to read the fault codes.	Fault Code 294 is active? **YES** **Repair:** A damaged sensor has been detected. Replace the OEM temperature sensor. Refer to OEM service manual.	4A
	Fault Code 294 is active? **NO** **Repair:** None. The removal and reinstallation of the connector corrected the fault.	4A

STEP 3: Check the ECM and OEM harness.

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

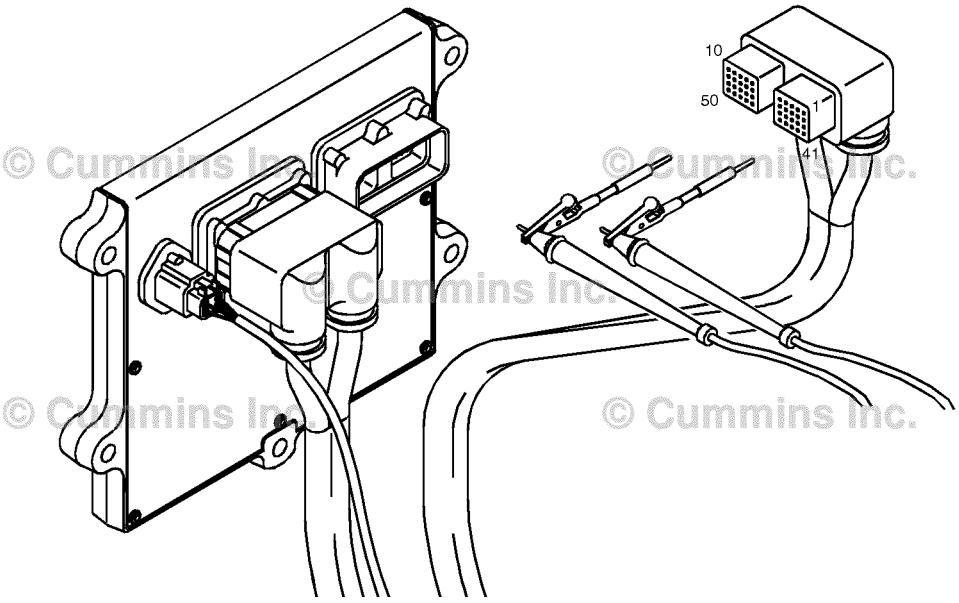
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM OEM connector.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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 OEM temperature sensor from the OEM harness.

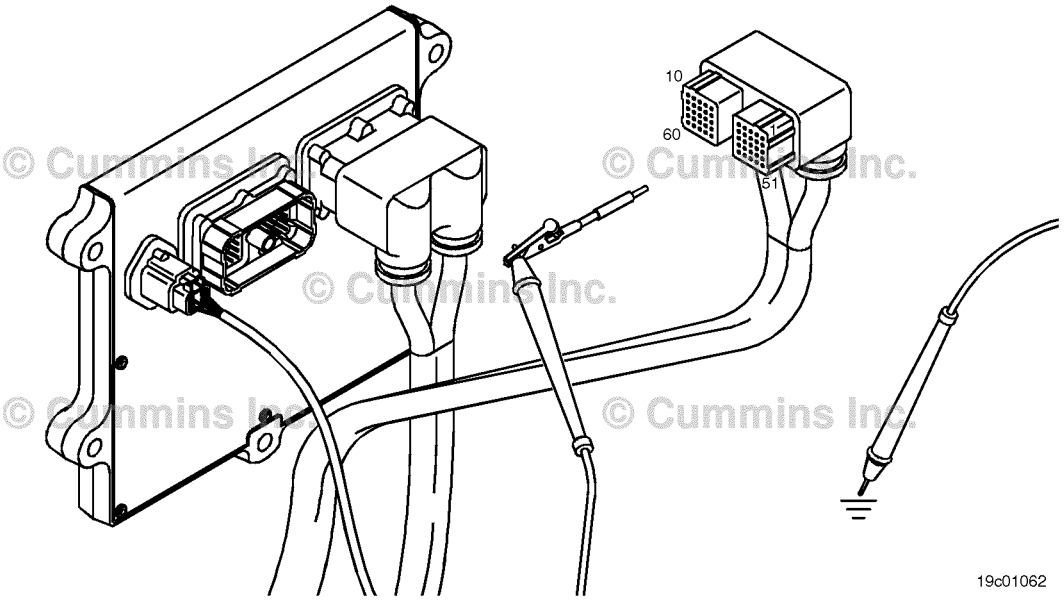
Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the OEM temperature SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector. Refer to the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3C
	Greater than 100K ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the pin-to-pin shorted signal circuit. 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 OEM temperature sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin to ground short. • Measure the resistance between the OEM temperature SIGNAL pin in the OEM harness ECM connector and ground. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3D
	Greater than 100K ohms? **NO** **Repair:** A pin-to-ground short circuit on the SIGNAL line has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the shorted signal circuit to ground. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 294 is inactive? **YES** **Repair:** None. The removal and reinstallation of the connector corrected the fault.	4A
	Fault Code 294 is inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 294 inactive? **YES**	4B
	Fault Code 294 inactive? **NO**	1A

STEP 4B: Clear the inactive fault codes.

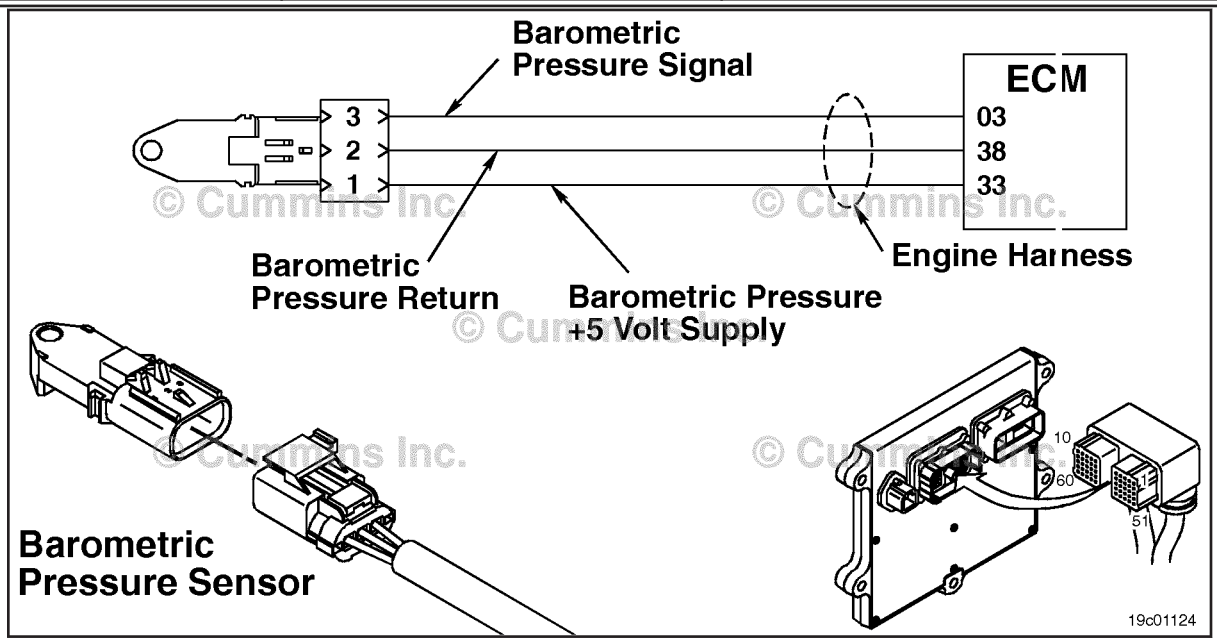
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 295

Barometric Pressure — Data Erratic, Intermittent, or Incorrect

CODES	REASON	EFFECT
Fault Code: 295 PID(P), SID(S): P108 SPN: 108 FMI: 2 Lamp: Amber SRT:	Barometric Pressure —Data Erratic, Intermittent, or Incorrect. The barometric air pressure sensor is reading an erratic value at initial key-on.	Engine power derate



Circuit:

Circuit Description:

The barometric pressure sensor is used by the electronic control module (ECM) to monitor the barometric pressure. This value is one of many inputs used by the ECM to determine the correct air/fuel ratio for proper engine operation.

Component Location:

The barometric pressure sensor is mounted on the main branch of the engine harness near the ECM. 100-002 (Engine Diagrams) in Section E for a detailed component location view.

Shop Talk:

The engine barometric pressure reading is compared to the other pressure sensor values at initial key-on. If the value of engine barometric pressure does not match the readings from pressure sensors within a pre-defined tolerance, this fault code is logged. To make the diagnostic run, turn the keyswitch on for 15 seconds before cranking the engine.

Possible causes of this fault code include:

- Stuck in-range barometric pressure sensor reading
- High resistance in the barometric pressure sensor signal or return lines
- Stuck in-range intake manifold pressure 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 cycles 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 t05-295

FAULT CODE 295 - Barometric Pressure - 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 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 221 or 222 active?**	
STEP 2:	**Check the barometric pressure sensor and circuit.**		
STEP 2A:	**Inspect the barometric pressure sensor and connector pins.**	**Dirty or damaged pins?**	
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 222 active?**	
STEP 3C:	**Check the circuit response.**	**Fault Code 221 active?**	
STEP 3D:	**Check the harness resistance.**	**Harness resistance less than 3 ohms?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Verify the repair.**	**INSITE™ electronic service tool reading within 102 mm Hg [4 in Hg] of local barometric pressure?**	
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 221 and 222.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Use INSITE™ electronic service tool to read the fault codes.	Fault Codes 221 or 222 active? **YES**	Go to the appropriate fault code troubleshooting tree.
	Fault Codes 221 or 222 active? **NO**	2A

STEP 2: Check the barometric pressure sensor and circuit.

STEP 2A: Inspect the barometric pressure sensor and connector pins.

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

Action	Specification/Repair	Next Step
Inspect the engine harness and barometric pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or the engine harness connector. Clean the connector and pins. 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? **NO**	3B

STEP 3B: Check the circuit response.

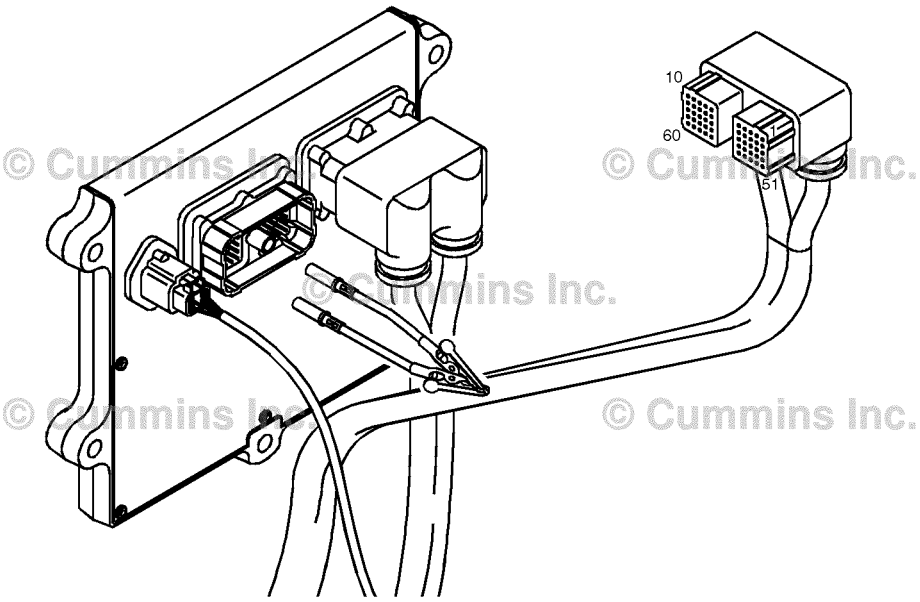
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 222 active? **YES**	3C
	Fault Code 222 active? **NO** **Repair:** 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 barometric pressure +5 volt SUPPLY pin and the barometric pressure SIGNAL pin at the engine control module engine connector. Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 221 active? **YES**	3D
	Fault Code 221 active? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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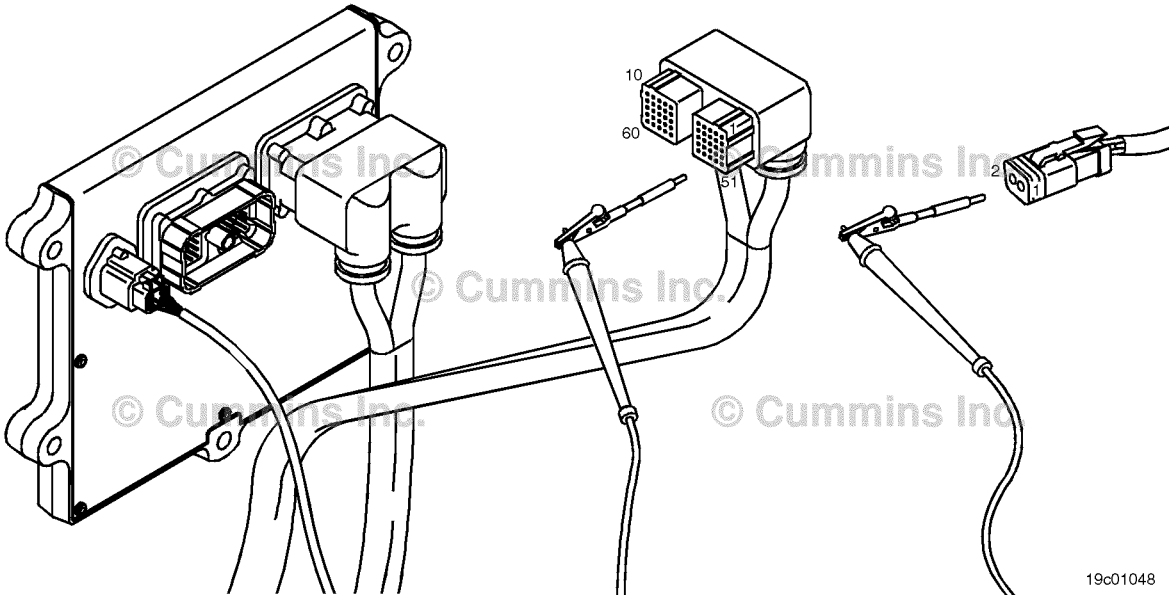
STEP 3D: Check the harness resistance.

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

Action	Specification/Repair	Next Step
Check the resistance of the engine harness signal and return wires. • Measure the resistance between the barometric pressure sensor SIGNAL pin at the barometric pressure sensor engine harness connector and the barometric pressure sensor SIGNAL pin at the ECM engine harness connector. • Measure the resistance between the barometric pressure sensor RETURN pin at the barometric pressure sensor engine harness connector and the barometric pressure sensor RETURN pin at the ECM engine harness connector. Refer to the circuit diagram of the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Harness resistance less than 3 ohms? **YES** **Repair:** An in-range failure of the barometric pressure sensor has been detected. Replace the barometric pressure sensor. Refer to Procedure 019-004 in Section 19.	4A
	Harness resistance less than 3 ohms? **NO** **Repair:** High resistance has been detected in the engine harness. Repair or replace the engine harness. Refer to Procedure 019-043 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™ electronic service tool Data Monitor/Logger. • Compare the INSITE™ electronic service tool reading for Barometric Air Pressure to the local barometric pressure. Use the following procedure for barometric pressure values at altitude. Refer to Procedure 018-028 in Section V.	INSITE™ electronic service tool reading within 102 mm Hg [4 in Hg] of local barometric pressure? **YES**	4B
	INSITE™ electronic service tool reading within 102 mm Hg [4 in Hg] of local barometric pressure? **NO**	1A

STEP 4B: Clear the fault codes.

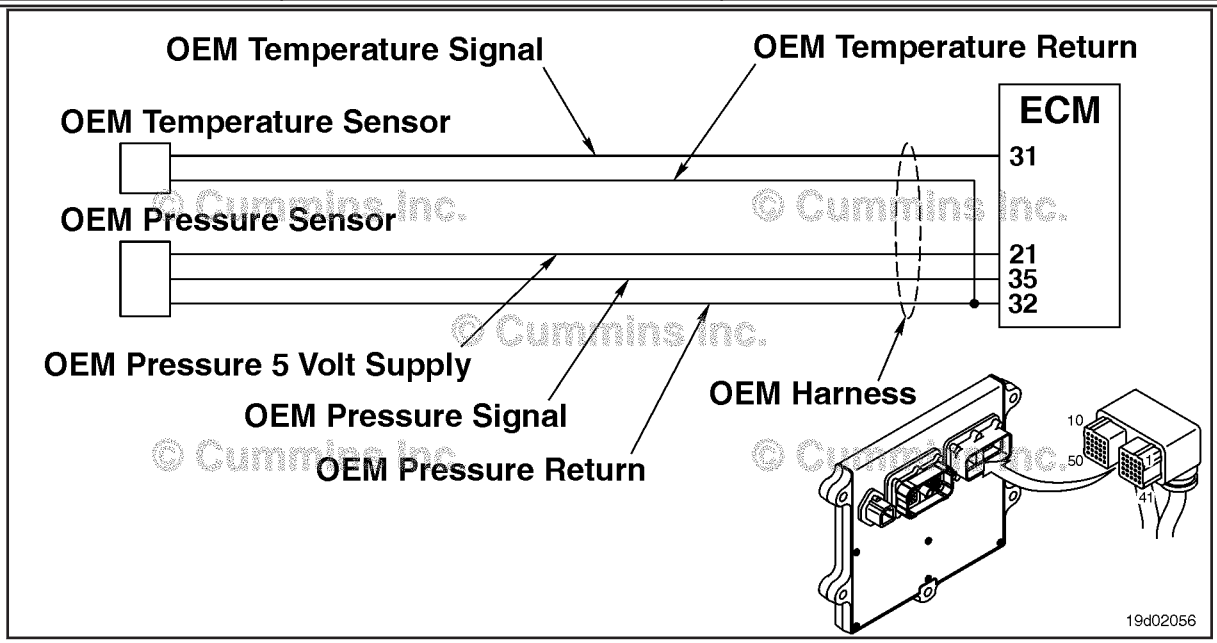
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Clear the fault codes. • Use INSITE™ electronic service tool to clear all active and inactive fault codes.	All fault codes cleared? **YES**	Repair complete.
	All fault codes cleared? **NO**	Go to the appropriate troubleshooti ng steps.

Fault Code 296a

Auxiliary Pressure Sensor Input 1 - Special Instructions

CODES	REASON	EFFECT
Fault Code: 296a PID(P), SID(S): P223 SPN: 1388 FMI: 14 Lamp: Red SRT:	Auxiliary Pressure Sensor Input 1 - Special Instructions	Possible engine power derate.



OEM Temperature/Pressure Sensor Circuit

Circuit Description:

The OEM has the option of wiring a pressure sensor input to the Cummins® ECM. A specific calibration is then created to recognize this pressure 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 sensor input will vary depending on application. Refer to the OEM troubleshooting and repair manual for sensor location.

Shop Talk:

This fault code is activated when the pressure 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 t05-296

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Check for Fault Code 296a.	**Active or inactive counts of Fault Code 296a?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 296a.

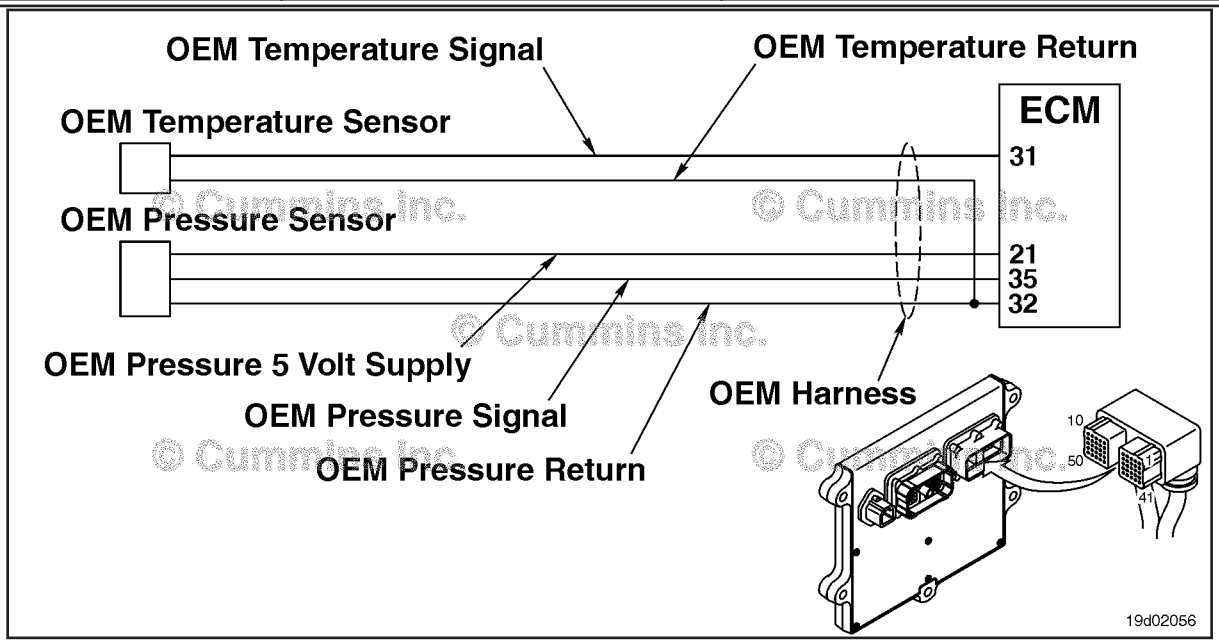
Condition:
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for an inactive fault code. • Use INSITE™ electronic service tool to read the fault codes.	Active or inactive counts of Fault Code 296a? **YES** **Repair:** The engine protection limit has been exceeded for the OEM supplied pressure input. Refer to the OEM troubleshooting and repair manual.	OEM troubleshooting manual
	Active or inactive counts of Fault Code 296a? **NO**	Repair complete

Fault Code 296lrv

Auxiliary Pressure Sensor Input 1 - Special Instructions

CODES	REASON	EFFECT
Fault Code: 296lrv PID(P), SID(S): 443 SPN: 1388 FMI: 14 Lamp: Red SRT:	Auxiliary Pressure Sensor Input 1 - Special Instructions	Engine power derate.



ISL Recreational Vehicles - Crankcase Pressure Sensor Circuit

Circuit Description:

The pressure inside the crankcase is measured by the crankcase pressure sensor. When the crankcase pressure sensor determines that the crankcase pressure is higher than normal, this fault code is logged.

Component Location:

The crankcase pressure sensor is located on the rocker cover, near the crankcase breather.

Conditions for Running the Diagnostics:

This diagnostic runs continuously when the engine is operating at any rpm range.

Conditions for Setting the Fault Codes:

The ECM detects that the crankcase pressure is greater than a calibrated value.

Action Taken When the Fault Code is Active:

- The ECM illuminates the red ENGINE light when the crankcase pressure limit is exceeded.

Conditions for Clearing the Fault Code:

The ECM will **not** turn off the red ENGINE light. The red light, derate, and fault code will **not** clear even after KEY OFF. It will **only** be reset by the INSITE™ electronic service tool or calibration.

Shop Talk:

Possible causes of this fault code include:

- Coolant in the oil
- Crankcase pressure sensor damage
- Plugged or restricted crankcase breather oil separator
- Plugged or restricted crankcase breather oil drain tube
- Plugged or restricted crankcase breather draft tube
- Scuffed piston and/or cylinder liner
- Damaged air compressor
- Damaged turbocharger.

It is important to check for plugged or restricted hoses, tubes, check valves, and filters in extreme cold ambient temperatures.

If Fault Code 296lrv becomes active before the maintenance interval is reached or as the result of a scuffed piston or cylinder liner, reference the Engine Noise Excessive - Connecting Rod Excessive troubleshooting symptom tree in the Troubleshooting and Repair Manual ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4, and QSL9 Engines, Bulletin 4021418.

Refer to Troubleshooting Fault Code t05-296 (ISL Recreational Vehicles).

Fault Code 296 (ISL Recreational Vehicles) - Auxiliary Pressure Sensor Input 1 - Special Instructions

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for active fault codes.**	**Fault Code 296lrv active?**	
STEP 2:	**Inspect the crankcase ventilation system.**		
STEP 2A:	**Verify pressure sensor accuracy.**	**Pressure reading 0 ± 0.28 kPa - G [0 ± 1.18 in H_2O]?**	
STEP 2B:	**Inspect the crankcase ventilation oil drain tubes, check valves, breather tubes.**	**Oil drain tubes, check valves, or breather tubes plugged?**	
STEP 2C:	**Coolant in the oil.**	**Coolant in the oil?**	
STEP 3:	**Check for piston and cylinder liner scuffing.**		
STEP 3A:	**Inspect the cylinder liners and piston skirts for scuffing.**	**Scratches or scuffs?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 296lrv inactive?**	
STEP 4B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for active fault codes.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 296lrv active? **YES**	2A
	Fault Code 296lrv active? **NO**	3A

STEP 2: Inspect the crankcase ventilation system.

STEP 2A: Verify pressure sensor accuracy.

Condition:
- Turn Keyswitch ON.
- Connect INSITE™ electronic service tool.
- Connect INSITE™ electronic service tool Monitor.
- Do **not** operate engine.

Action	Specification/Repair	Next Step
Verify pressure sensor accuracy. • Make sure the correct sensor part number is installed. • When checking the pressure sensor accuracy, make sure the engine is **not** running. • Monitor the crankcase pressure. • Use INSITE™ electronic service tool to measure crankcase pressure.	Is the pressure reading 0 ± 0.28 kPa - G [0 ± 1.13 in H_2O]? **YES**	2B
	Is the pressure reading 0 ± 0.28 kPa - G [0 ± 1.13 in H_2O]? **NO** **Repair:** Replace the crankcase pressure sensor. Refer to Procedure 019-445 in Section 19.	4A

STEP 2B: Inspect the crankcase ventilation oil drain tubes, check valves, breather tubes.

Condition:
- Turn keyswitch OFF.
- Do **not** operate engine.

Action	Specification/Repair	Next Step
Inspect the oil drain tubes, check valves, and breather tubes for plugging. Use the following procedures in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 003-001 in Section 3. Refer to Procedure 003-018 in Section 3.	Are the oil drain tubes, check valves, or breather tubes plugged? **YES** **Repair:** Clean or replace the crankcase ventilation oil drain tubes, check valves, and breather tubes. Use the following procedures in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 003-001 in Section 3. Refer to Procedure 003-018 in Section 3.	2C
	Are the oil drain tubes, check valves, or breather tubes plugged? **NO**	3A

STEP 2C: Check for coolant in the oil.

Condition:
- Turn keyswitch OFF.
- Do **not** operate engine.

Action	Specification/Repair	Next Step
Check for coolant in the oil. Use the following procedures in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 007-083 in Section 7.	Is coolant in the oil? **YES** **Repair:** If coolant is found in the oil, reference the Coolant in the Lubricating Oil troubleshooting symptom tree in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418.	4A
	Is coolant in the oil? **NO**	3A

STEP 3: Check for piston and cylinder liner scuffing.

STEP 3A: Inspect the cylinder liners and piston skirts for scuffing.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Inspect the cylinder liners and piston skirts for scuffing. • Inspect the cylinder liners, and piston skirts for scuffing. • Check for progressive damage. Use the following procedures in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 001-028 in Section 1. Refer to Procedure 002-004 in Section 2.	Are there scratches or scuffs? **YES** **Repair:** Replace the damaged power cylinder(s) and check for progressive damage. Replace all connecting rods, connecting rod bearings, and piston pins. Inspect the piston pin bores on any non damaged pistons. Use the following procedures in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. • Replace any piston **not** within specifications. If pistons are reusable, reuse the piston rings. Refer to Procedure 001-043 in Section 1. • Install all new connecting rods. Refer to Procedure 001-054 in Section 1. • Install all new connecting rod bearings. Refer to Procedure 001-005 in Section 1. • Install all new piston pins. Refer to Procedure 001-054 in Section 1.	4A
	Are there scratches or scuffs? **NO** **Repair:** Reference the Crankcase Gases (Blowby) Excessive troubleshooting symptom tree in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418.	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.
- Operate engine.

Action	Specification/Repair	Next Step
Disable the fault code. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 296lrv inactive? **YES**	4B
	Fault Code 296lrv inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all the steps have been completed and checked again.	2A

STEP 4B: Clear the inactive fault codes.

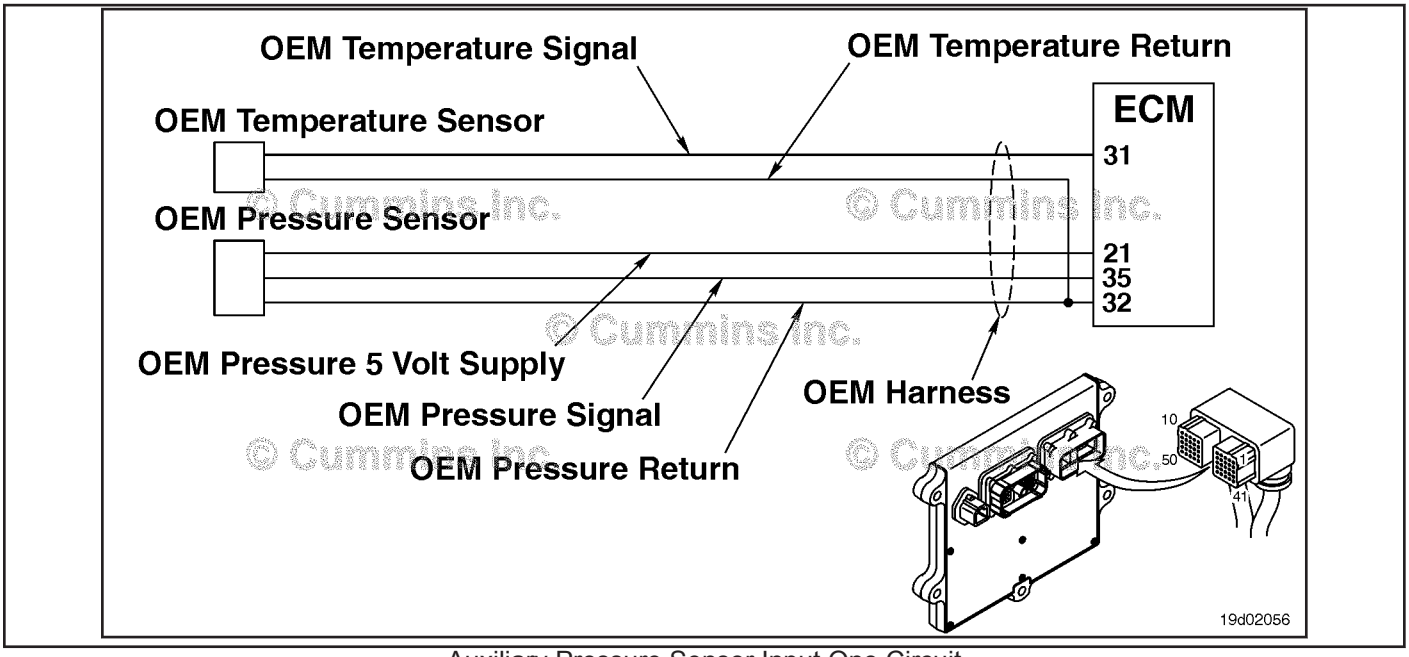
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 297

Auxiliary Pressure Sensor Input 1 Circuit - Voltage Above Normal, or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 297 PID(P), SID(S): P223 SPN: 1388 FMI: 3 Lamp: Amber SRT:	Auxiliary Pressure Sensor Input 1 Circuit - Voltage Above Normal, or Shorted to High Source. High signal voltage detected at the OEM pressure circuit.	None on performance.



Auxiliary Pressure Sensor Input One Circuit

Circuit Description:

The OEM has the option of wiring a pressure sensor input to the Cummins ECM. A specific calibration is then created to recognize this pressure sensor input.

Component Location:

The OEM pressure sensor input will vary depending on application. Refer to the OEM troubleshooting manual for sensor location.

Shop Talk:

Possible causes of this fault code include:

- Open return circuit in the harness, connectors, or sensor.
- signal circuit shorted to sensor supply or battery voltage.

Refer to Troubleshooting Fault Code t05-297

FAULT CODE 297 - Auxiliary Pressure Sensor Input 1 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 sensor supply or multiple fault codes.	Sensor Supply Fault Code 386 active?	
STEP 2:	**Check the OEM pressure sensor and circuit.**		
STEP 2A:	Inspect the OEM pressure sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the circuit response.	Fault Codes 298 active and Fault Code 297 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 297 is 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 a pin to pin short circuit in the OEM harness.	Greater than 100K ohms?	
STEP 3E:	Check for an inactive fault code.	Fault Code 297 inactive?	
STEP 4:	**Clear the fault code.**		
STEP 4A:	Disable the fault code.	Fault Code 297 inactive?	
STEP 4B:	Clear the inactive fault codes.	All faults cleared?	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for sensor supply or multiple fault codes.

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

Action	Specification/Repair	Next Step
Check for sensor supply fault codes. • Use INSITE™ electronic service tool, to read the fault codes.	Sensor supply Fault Code 386 active? **YES**	Refer to Fault Code 386 fault code troubleshooting.
	Sensor supply Fault Code 386 active? **NO**	2A

STEP 2: Check the OEM pressure sensor and circuit.

STEP 2A: Inspect the OEM pressure sensor and connector pins.

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

Action	Specification/Repair	Next Step
Inspect the OEM harness and OEM pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the circuit response.

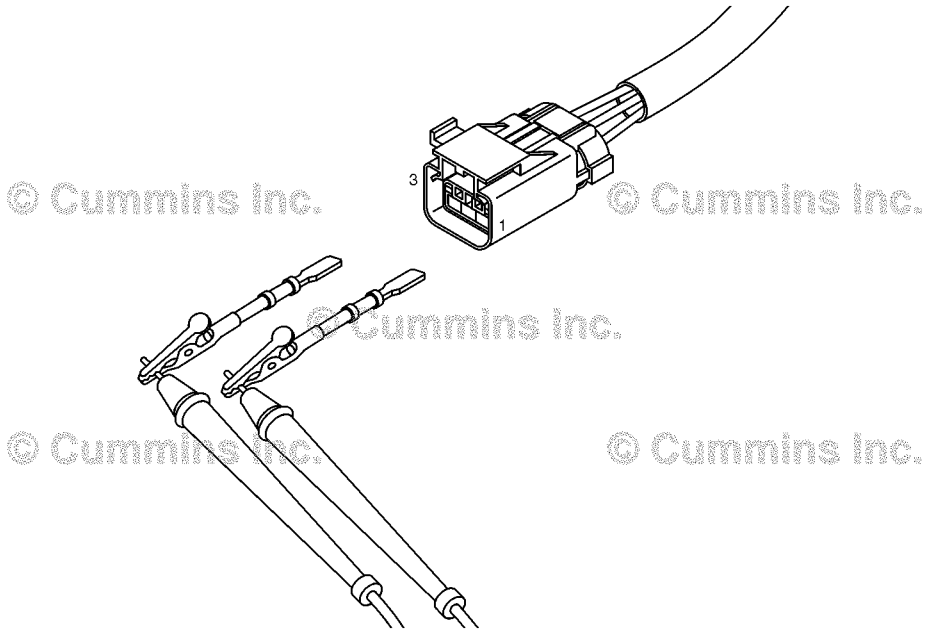
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM pressure sensor from the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 298 active and Fault Code 297 inactive? **YES**	2C
	Fault Code 298 active and Fault Code 297 inactive? **NO**	3A

STEP 2C: Check the sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage between the OEM Pressure +5 volt SUPPLY pin and the OEM pressure RETURN pin at the sensor connector of the OEM harness. Refer to the circuit diagram or the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	2D
	4.75-VDC to 5.25-VDC? **NO**	3A



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

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

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 297 is active? **YES** **Repair:** A damaged sensor has been detected. Replace the OEM pressure sensor. Refer to OEM service manual.	4A
	Fault Code 297 is active? **NO** **Repair:** None. The removal and reinstallation of the connector corrected the fault.	4A

STEP 3: Check the ECM and OEM harness.

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

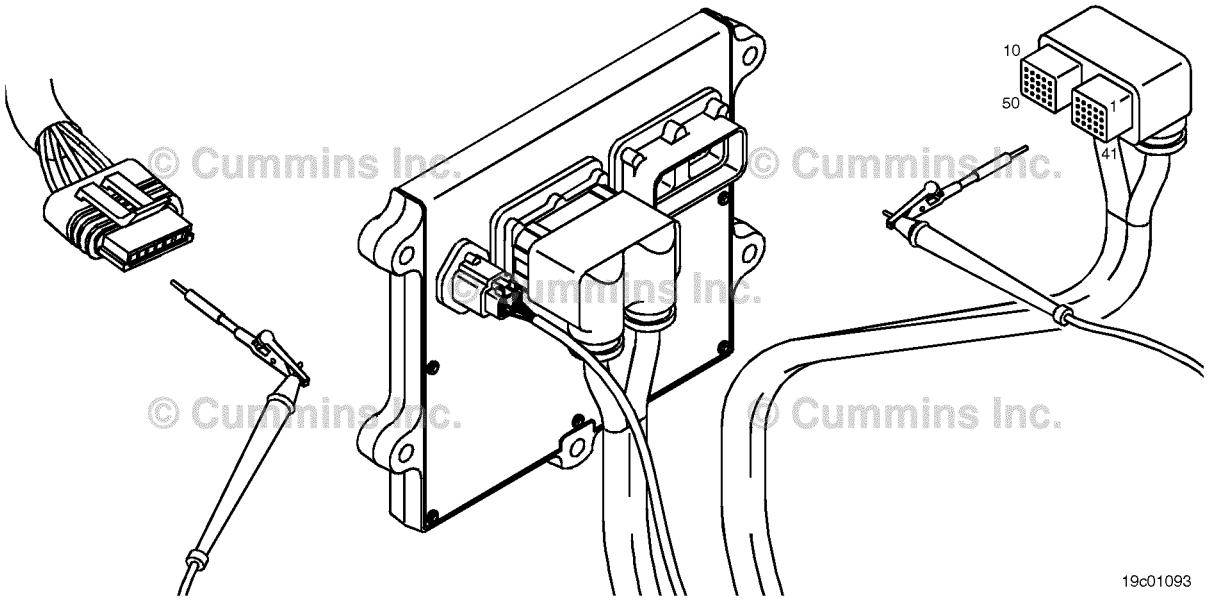
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the OEM hanress and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **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 OEM pressure sensor from the OEM harness.

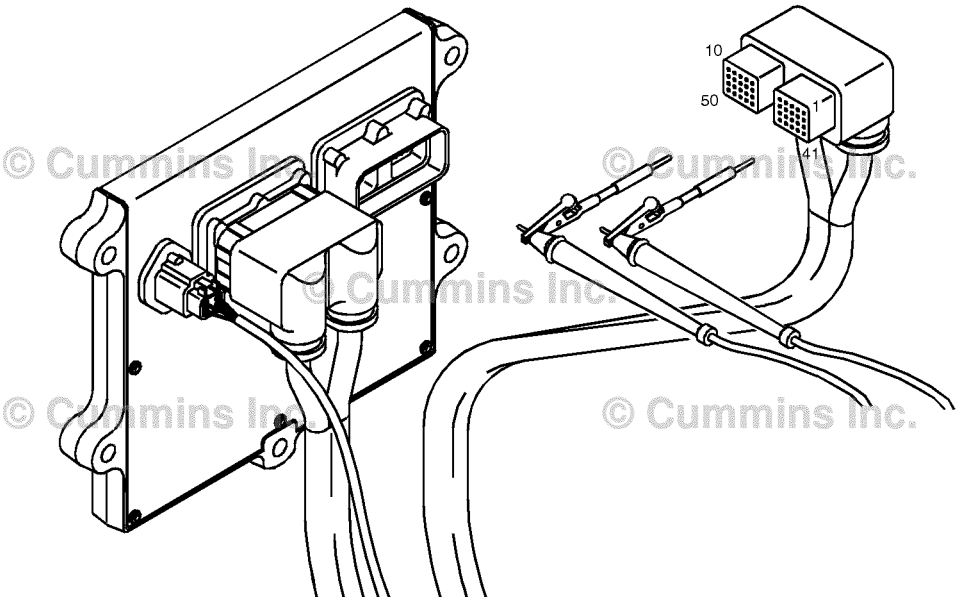
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector OEM pressure RETURN pin and the OEM harness OEM pressure sensor connector RETURN pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3C
	Less than 10 ohms? **NO** **Repair:** An open RETURN circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. 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 OEM pressure sensor from the OEM harness.

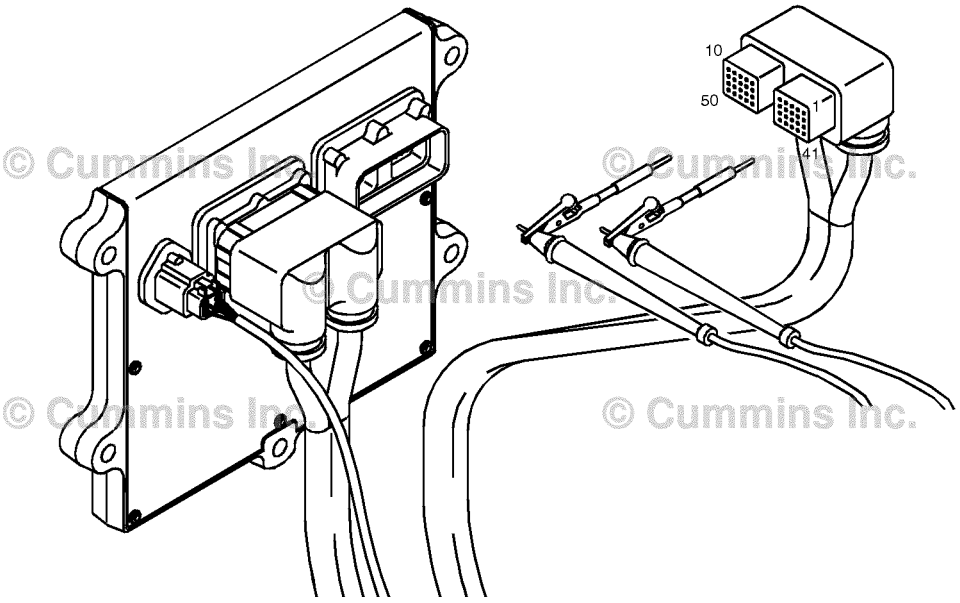
Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the OEM pressure SUPPLY pin in the OEM harness ECM connector and all other pins in the ECM OEM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3E
	Greater than 100K ohms? **NO** **Repair:** A pin-to-pin short circuit on the SUPPLY line has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the pin-to-pin shorted supply circuit. 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.
- Disconnect the OEM pressure sensor from the OEM harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the OEM pressure SUPPLY pin in the OEM harness ECM connector and all other pins in the ECM OEM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3E
	Greater than 100K ohms? **NO** **Repair:** A pin-to-pin short circuit on the SUPPLY line has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the shorted signal circuit to ground. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 297 inactive? **YES** **Repair:** None. The removal and reinstallation of the connector corrected the fault.	4A
	Fault Code 297 inactive? **NO** **Repair:** 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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 297 inactive? **YES**	4B
	Fault Code 297 inactive? **NO**	1A

STEP 4B: Clear the inactive fault codes.

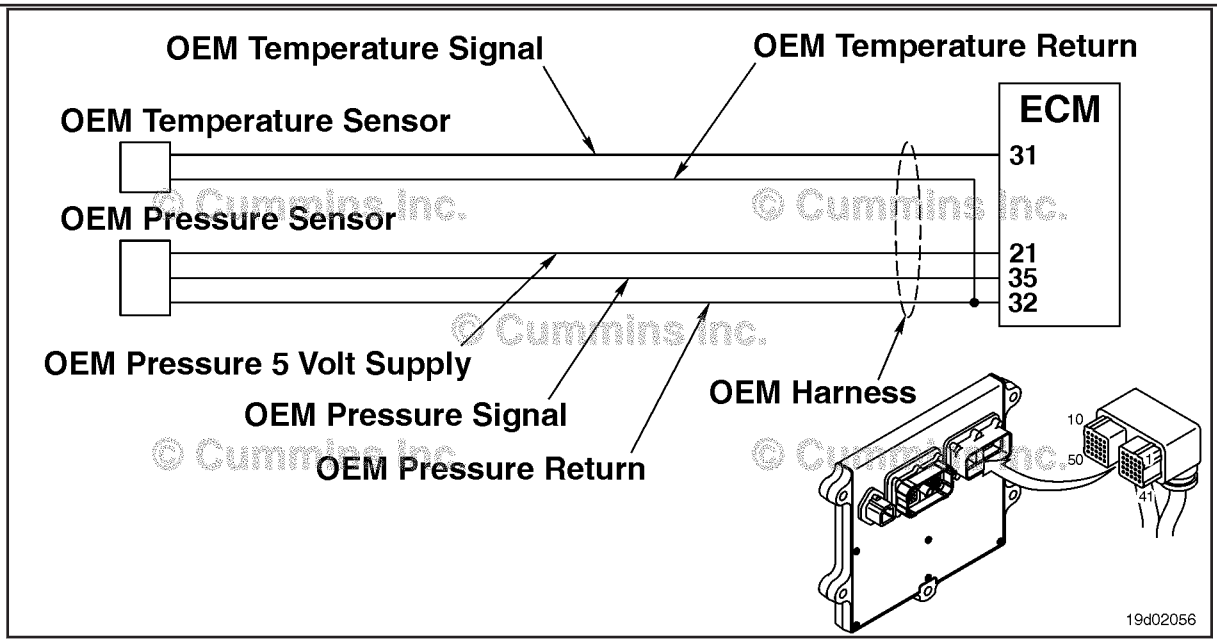
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable the fault code. • Use INSITE™ electronic service tool to erase the inactive fault codes.	All faults cleared? **YES**	Repair Complete.
	All faults cleared? **NO**	Appropriate troubleshooting steps.

Fault Code 298

Auxiliary Pressure Sensor Input 1 Circuit - Voltage Below Normal, or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 298 PID(P), SID(S): P223 SPN: 1388 FMI: 4 Lamp: Amber SRT:	Auxiliary Pressure Sensor Input 1 Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage or open circuit detected at the OEM pressure circuit.	None on performance.



Auxiliary Pressure Sensor Input One Circuit

Circuit Description:

The OEM has the option of wiring a pressure sensor input to the Cummins ECM. A specific calibration is then created to recognize this pressure sensor input.

Component Location:

The OEM pressure sensor input will vary depending on application. Refer to the OEM troubleshooting manual for sensor location.

Shop Talk:

Possible causes of this fault code include:

- Signal circuit open or shorted to ground in the OEM harness or sensor.
- Supply line open or shorted to ground.

Refer to Troubleshooting Fault Code t05-298

FAULT CODE 298 - Auxiliary Pressure Sensor Input 1 Circuit - Voltage Below Normal, or Shorted to Low Source

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	Check for sensor supply fault codes.	Fault Code Sensor Supply Fault Code 352 active?	
STEP 2:	**Check the OEM pressure sensor and circuit.**		
STEP 2A:	Inspect the OEM 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 297 active and Fault Code 298 inactive?	
STEP 2D:	Check the fault codes and verify sensor condition.	Fault Code 298 is active?	
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 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 short circuit to ground.	Greater than 100K ohms?	
STEP 3F:	Check for an inactive fault code.	Fault Code 298 inactive?	
STEP 4:	**Clear the fault code.**		
STEP 4A:	Disable the fault code.	Fault Code 298 inactive?	
STEP 4B:	Clear the inactive fault codes.	All faults 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. • Use INSITE™ electronic service to tool read the fault codes.	Fault Code Sensor Supply Fault Code 352 active? **YES**	Refer to Fault Code 352.
	Fault Code Sensor Supply Fault Code 352 active? **NO**	2A

STEP 2: Check the OEM pressure sensor and circuit.

STEP 2A: Inspect the OEM pressure sensor and connector pins.

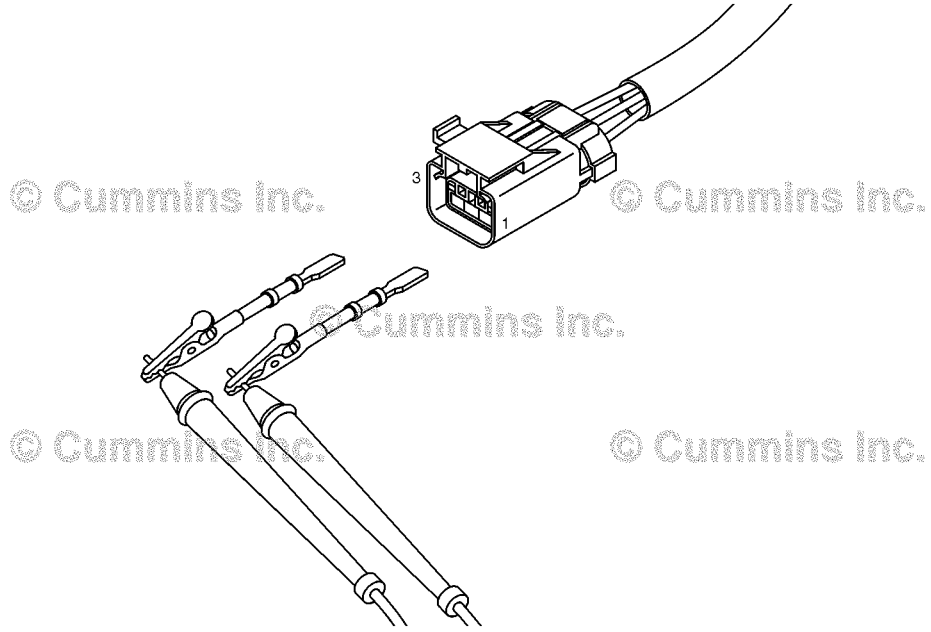
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM pressure sensor from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and OEM pressure sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. 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? **NO**	2B

STEP 2B: Check the sensor supply voltage and return circuit.

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

Action	Specification/Repair	Next Step
Check the supply voltage and retrun circuit. • Measure the voltage between the OEM Pressure +5 volt SUPPLY pin and the OEM pressure RETURN pin at the sensor connector of the OEM harness. Refer to the circuit diagram or the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	2C
	4/75-VDC to 5..25-VDC? **NO**	3A



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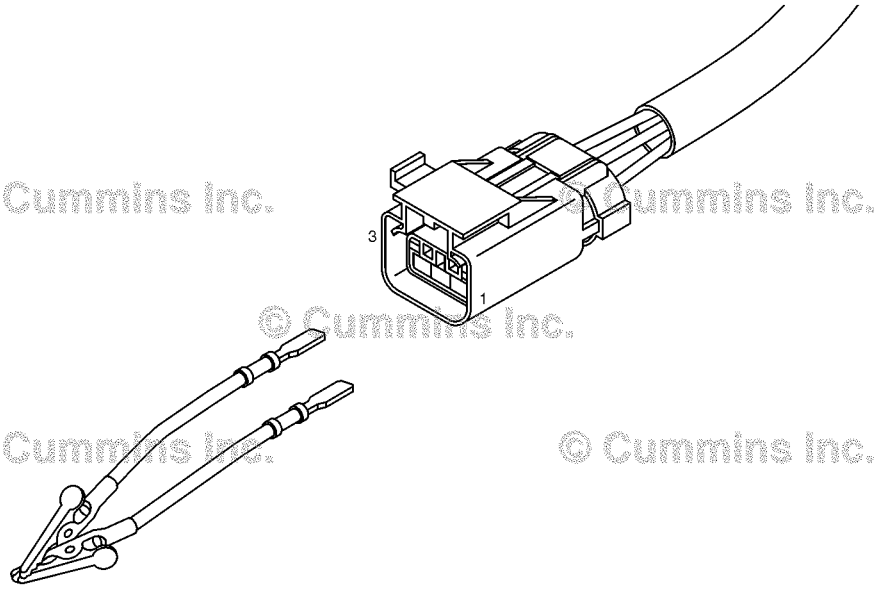
STEP 2C: Check the circuit response.

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
Place a jumper wire between the OEM pressure SUPPLY pin and the OEM pressure SIGNAL pin at the OEM pressure sensor connector of the OEM harness. Check for the appropriate circuit response after 30 seconds • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 297 active and Fault Code 298 inactive? **YES**	2D
	Fault Code 297 active and Fault Code 298 inactive? **NO**	3A



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

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

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 298 is active? **YES** **Repair:** A damaged sensor has been detected. Replace the OEM pressure sensor. Refer to OEM service manual.	4A
	Fault Code 298 is active? **NO** **Repair:** None. The removal and reinstallation of the connector corrected the fault.	4A

STEP 3: Check the ECM and OEM harness.

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

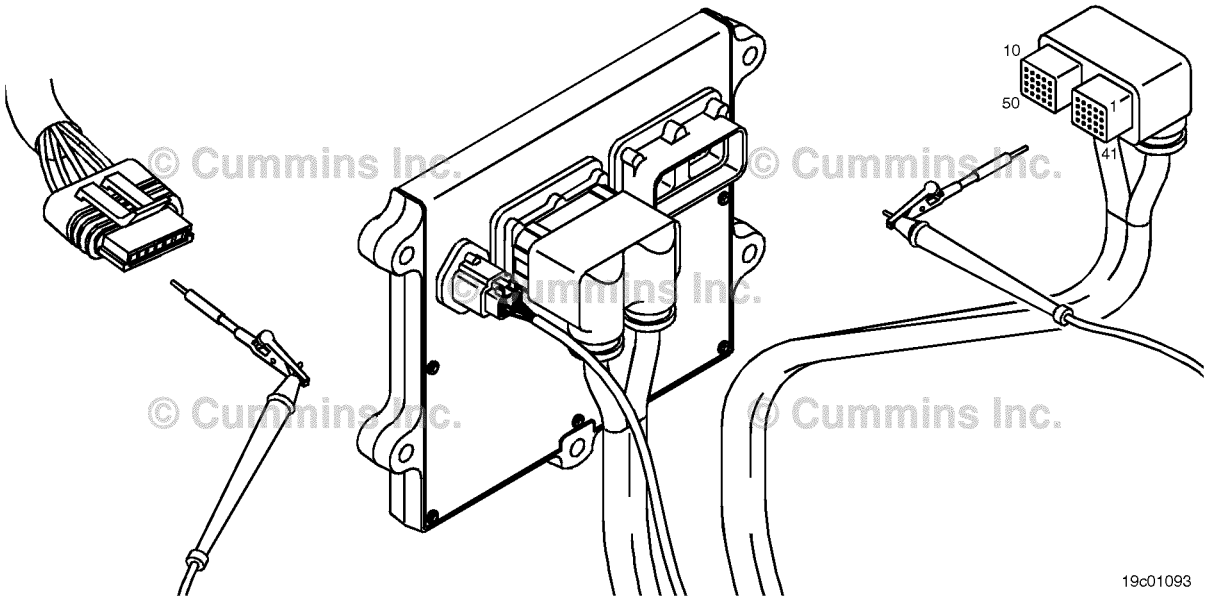
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the connector pins for the following:Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible.	4A
	Dirty or damaged pins? **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 OEM pressure sensor from the OEM harness.

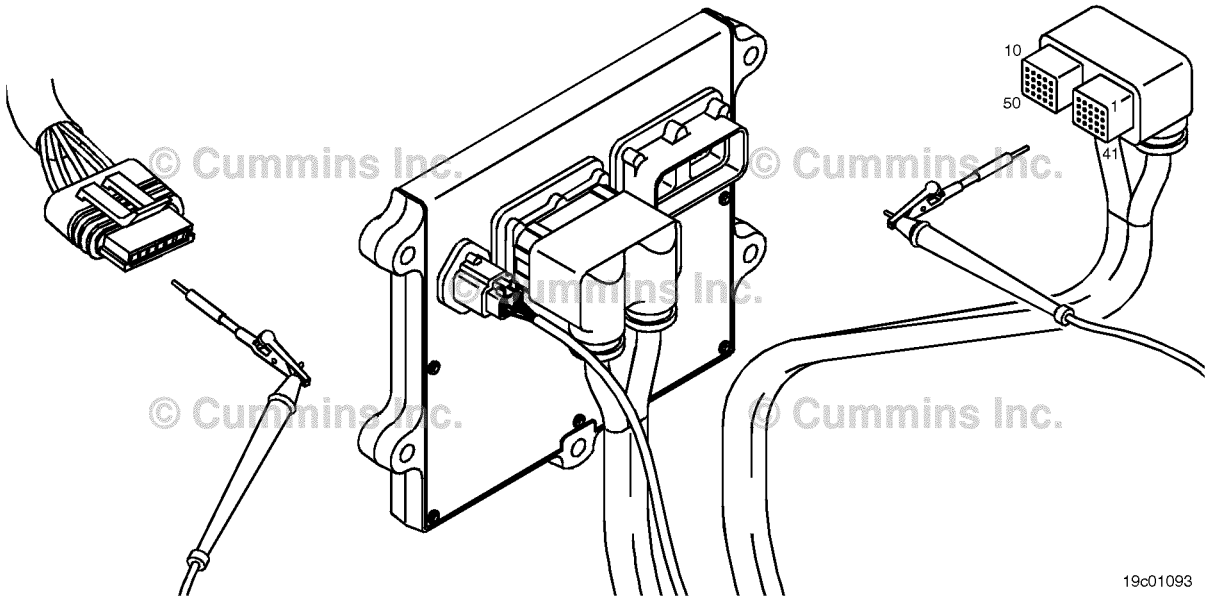
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector OEM pressure RETURN pin and the OEM harness OEM pressure sensor connector RETURN pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	3C
	Less than 10 ohms? **NO** **Repair:** An open RETURN circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open return circuit. 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 OEM pressure sensor from the OEM harness.

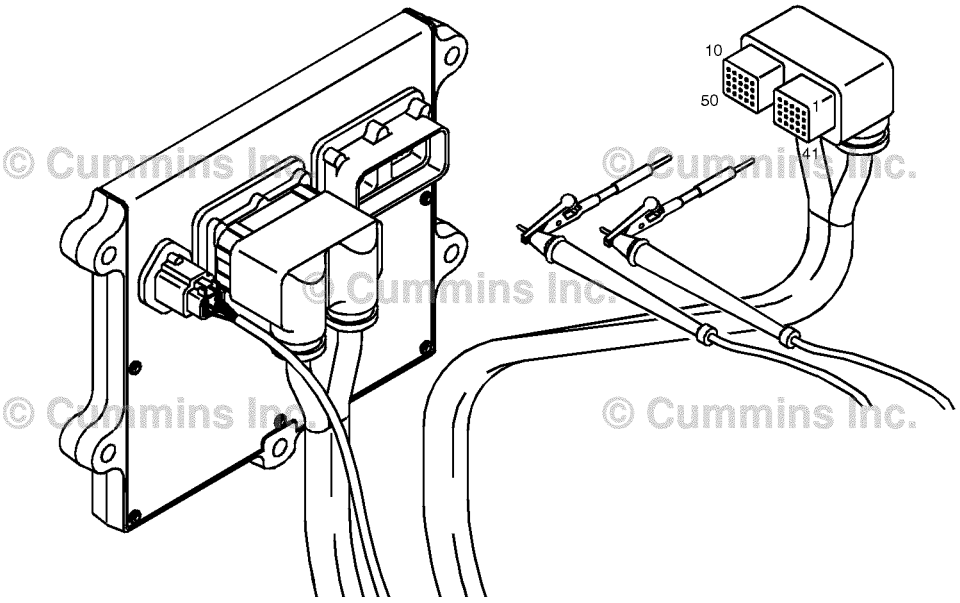
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the OEM harness ECM connector OEM pressure SIGNAL pin and the OEM harness OEM pressure sensor connector SIGNAL pin. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms **YES**	3D
	Less than 10 ohms? **NO** **Repair:** An open SIGNAL circuit has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the open signal circuit. 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 OEM pressure sensor from the OEM harness.

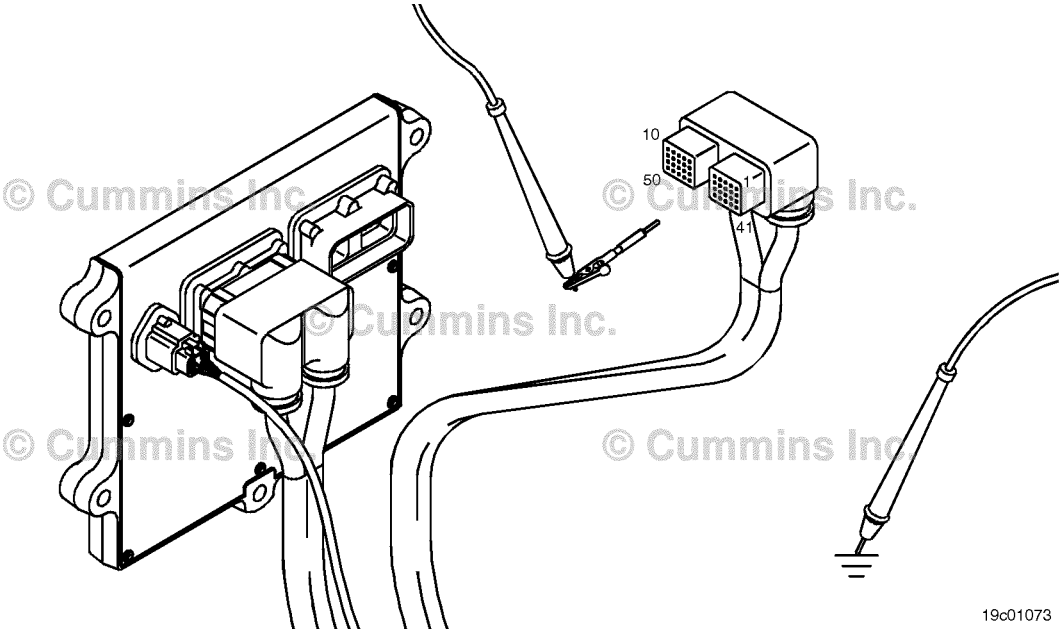
Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the OEM pressure SIGNAL pin in the OEM harness ECM connector and all other pins in the OEM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Grater than 100K ohms? **YES**	3E
	Greater than 100K ohms? **NO** **Repair:** A pin-to-pin short circuit on the SIGNAL line has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the pin to pin shorted signal circuit. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



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

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

Action	Specification/Repair	Next Step
Check for a pin-to-ground short. • Measure the resistance between the OEM pressure SIGNAL pin in the OEM harness ECM connector and ground. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3F
	Greater than 100K ohms? **NO** **Repair:** A pin-to-ground short circuit on the SIGNAL line has been detected in the OEM harness. Troubleshoot each harness connected in series to determine which contains the shorted signal circuit to ground. 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 298 inactive? **YES** **Repair:** None. The removal and reinstallation of the connector corrected the fault.	4A
	Fault Code 298 inactive? **NO** **Repair:** 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
Disabel the fault code. • Start the engine let it idle for one minute. • Use INSITE™ electronic service tool, to verify that the fault code is inactive.	Fault Code 298 inactive? **YES**	4B
	Fault Code 298 inactive? **NO**	1A

STEP 4B: Clear the inactive fault codes.

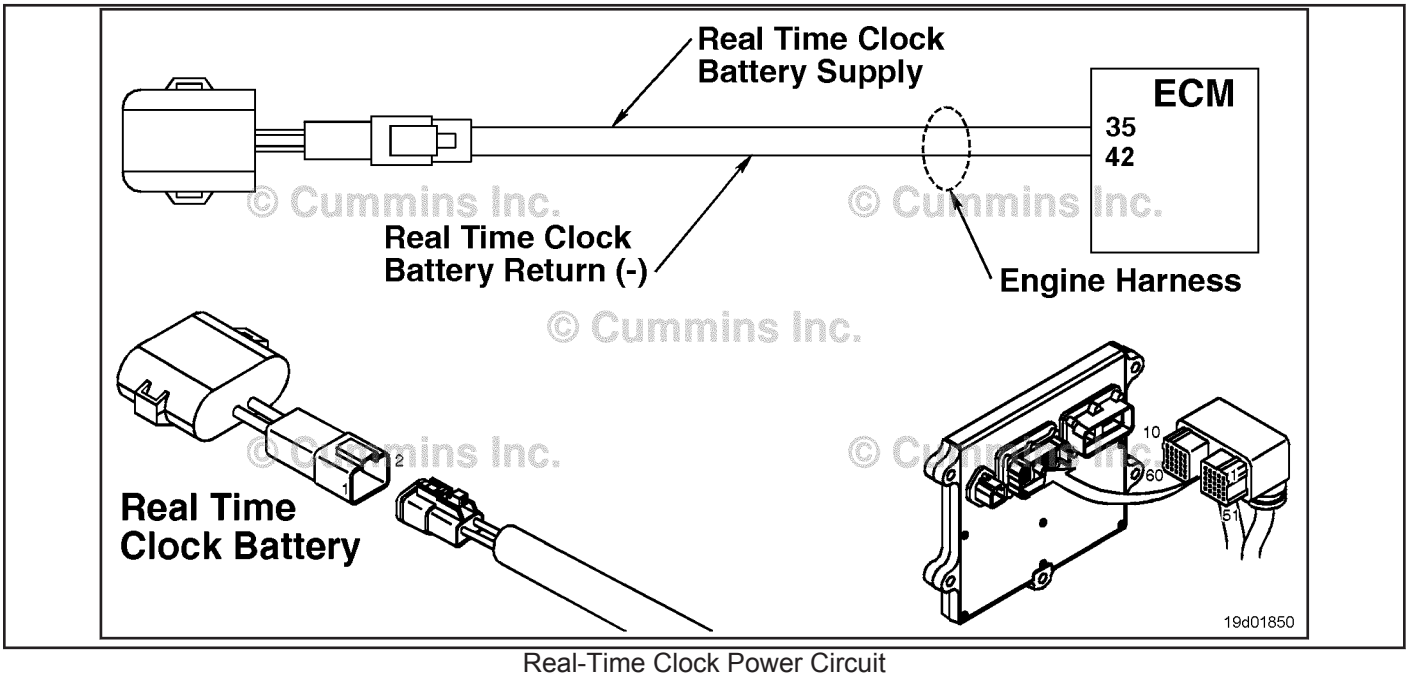
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 319

Real-Time Clock Power Interrupt - Data Erratic, Intermittent or Incorrect

CODES	REASON	EFFECT
Fault Code: 319 PID(P), SID(S): P251 SPN: 251 FMI: 2/2 Lamp: Amber (Maintenance Flashout) SRT:	Real-Time Clock Power Interrupt - Data Erratic, Intermittent or Incorrect. Real-time clock lost power.	None on performance. Data in the ECM will **not** have accurate time and date information.



Real-Time Clock Power Circuit

Circuit Description:

Under ordinary operating conditions, the real-time clock in the electronic control module (ECM) is powered by the vehicle's batteries. If battery power to the ECM is lost, then the real-time clock will be powered by a battery in the engine harness (if equipped).

Component Location:

The real-time clock battery is secured to the engine harness near the ECM. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

Shop Talk:

This fault indicates that the real-time clock in the ECM lost power. Possible causes for this fault are weak or failed real-time clock battery, failed wiring or connectors between the battery and ECM, or the engine is **not** equipped with a real-time clock battery and the vehicle battery power to the ECM is lost.

NOTE: If the Real Time Clock is supplied by the OEM via a CAN BUS and a battery backup is **not** used, then refer to the OEM wiring diagram. If this is the case, then check INSITE™ electronic service tool, “Advanced ECM Data - Real Time Clock Settings.” If the OEM supplies a Real Time Clock signal, then the address **must** be set according to the OEM wiring or the fault code will become active.

Refer to Troubleshooting Fault Code t05-319

FAULT CODE 319 - Real-Time Clock Power Interrupt - 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 No. 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part No. 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the real-time clock battery and connections.**		
STEP 1A:	Inspect the ECM and engine harness connector pins.	Dirty or damaged pins?	
STEP 1B:	Check the real-time clock battery voltage at the ECM harness connector.	Between 3.3 and 3.6-VDC?	
STEP 1B-1:	Inspect the real-time clock battery and engine wire harness connector pins.	Dirty or damaged pins?	
STEP 1B-2:	Check the real-time clock battery voltage at the battery module connector.	Between 3.3 and 3.6-VDC?	
STEP 2:	**Check the battery module harness.**		
STEP 2A:	Check for an open circuit in the engine harness.	Less than 10 ohms?	
STEP 2B:	Check for a short circuit in the engine harness.	More than 100k ohms?	
STEP 2C:	Check for a short circuit to ground.	More than 100k ohms?	
STEP 3:	**Clear the fault codes.**		
STEP 3A:	Disable the fault code.	Fault Code 319 inactive?	
STEP 3B:	Clear the inactive fault codes.	All fault codes cleared?	

TROUBLESHOOTING STEP

STEP 1: Check the real-time clock battery and connections.

STEP 1A: Inspect the ECM and engine harness connector pins.

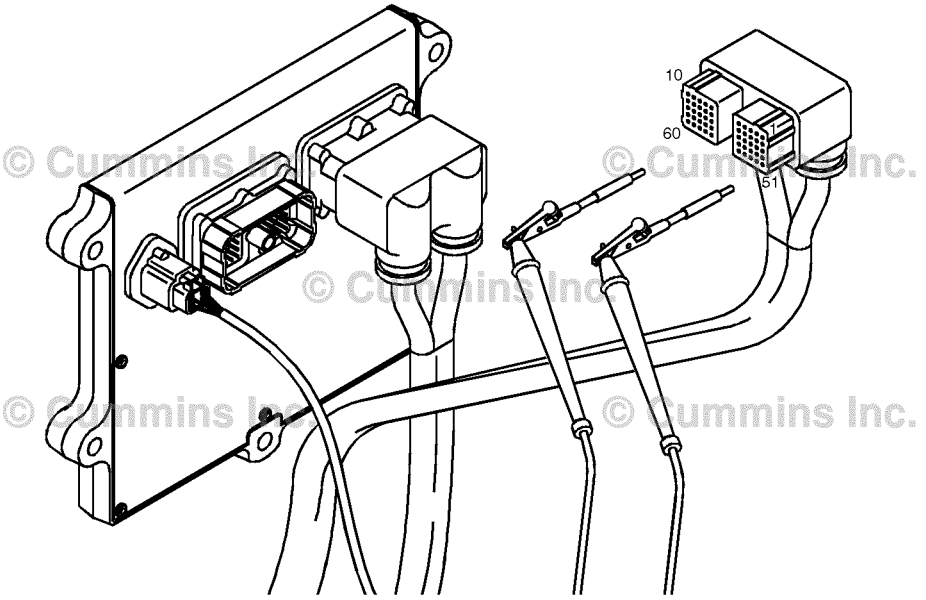
Condition:
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tabs. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor harness connector. • Flush the dirt, debris, or moisture from the connector pins. Use electronic cleaner, Part Number 3824510. • Install the appropriate connector seal if it is damaged or missing. • Repair the engine harness. Refer to Procedure 019-043 in Section 19.	3A
	Dirty or damaged pins? **NO**	1B

STEP 1B: Check the real-time clock battery voltage at the ECM harness connector.

Condition:
- Engine equipped with optional real-time clock battery
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Measure the voltage between the real-time clock battery SUPPLY pin and the real-time clock battery RETURN (-) pin at the ECM connector of the engine harness. Use the circuit diagram or the wiring diagram for connector pin identification.	Between 3.3 and 3.6-VDC? **YES**	3A
	Between 3.3 and 3.6-VDC? **NO**	1B-1



STEP 1B-1: Inspect the real-time clock battery and engine wire harness connector pins.

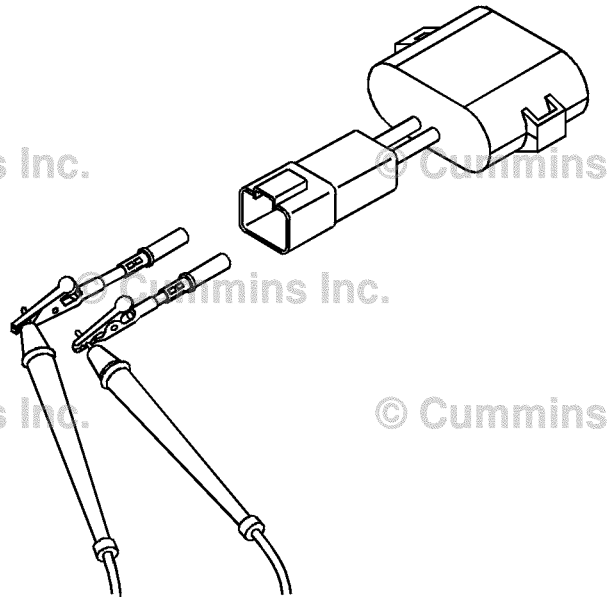
Condition:
- Turn keyswitch OFF
- Disconnect the real-time clock battery from the engine harness.

Action	Specification/Repair	Next Step
Inspect the real-time clock battery and engine harness connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tabs. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Repair or replace the real-time clock battery or engine harness. • Refer to Procedure 019-311 in Section 19 • Refer to Procedure Procedure 019-043 in Section 19.	3A
	Dirty or damaged pins? **NO**	1B-2

STEP 1B-2: Check the real-time clock battery voltage at the battery module connector.

Condition:
- Engine equipped with optional real-time clock battery
- Turn keyswitch OFF
- Disconnect the real-time clock battery from the engine harness.

Action	Specification/Repair	Next Step
Measure the voltage between the real-time clock battery SUPPLY pin and the real-time clock battery RETURN (-) pin at the real-time clock battery connector. Use the circuit diagram or the wiring diagram for connector pin identification.	Between 3.3 and 3.6-VDC? **YES**	2A
	Between 3.3 and 3.6-VDC? **NO** **Repair:** Replace the real-time clock battery. Refer to Procedure 019-311 in Section 19.	3A

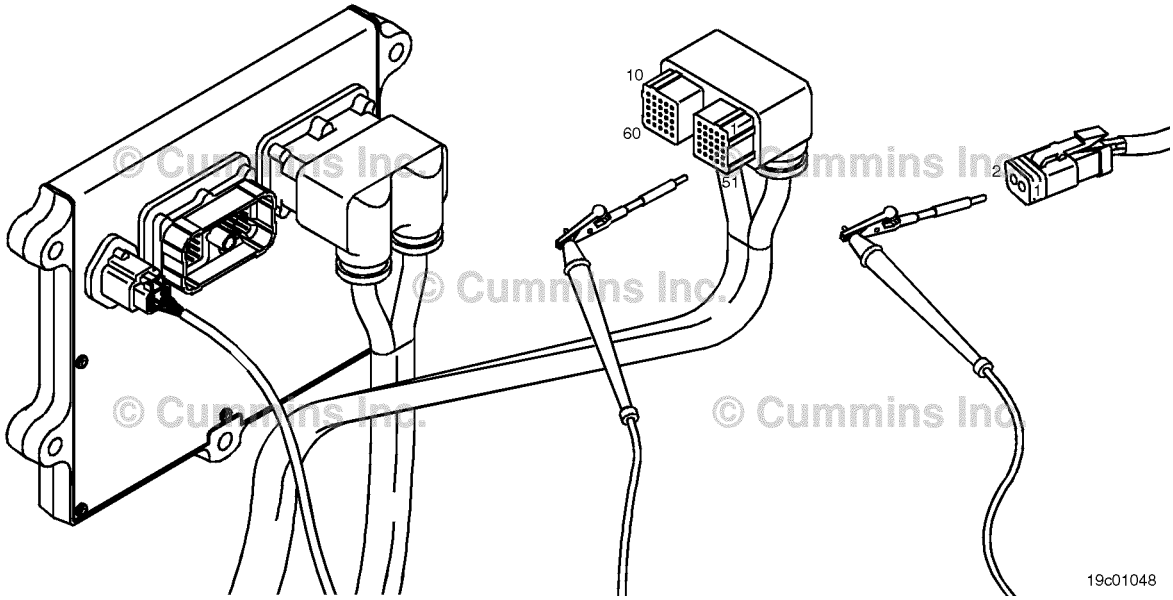


STEP 2: Check the battery module harness.

STEP 2A: Check for an open circuit in the engine harness.

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

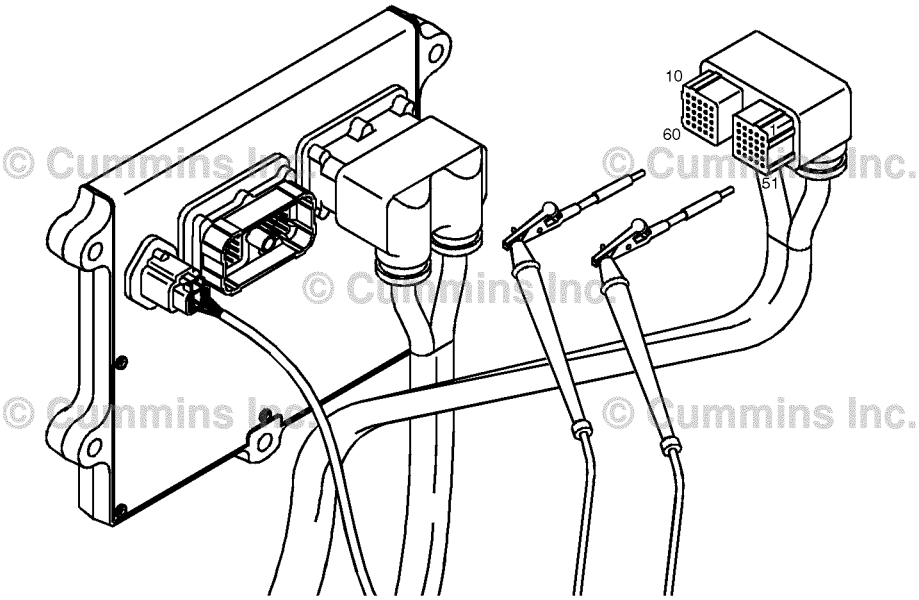
Action	Specification/Repair	Next Step
Measure the following resistance: • The resistance between the real-time clock battery SUPPLY pin at the battery connector of the engine harness to the real-time clock battery SUPPLY pin at the ECM harness connector • The resistance between the real-time clock battery RETURN (-) pin at the battery connector of the engine harness to the real-time clock battery RETURN (-) pin at the ECM harness connector. Use the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	2B
	Less than 10 ohms? **NO** **Repair:** An open circuit has been detected in the engine harness. Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19.	3A



STEP 2B: Check for a short circuit in the engine harness.

Condition:
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the real-time clock battery from the engine harness.

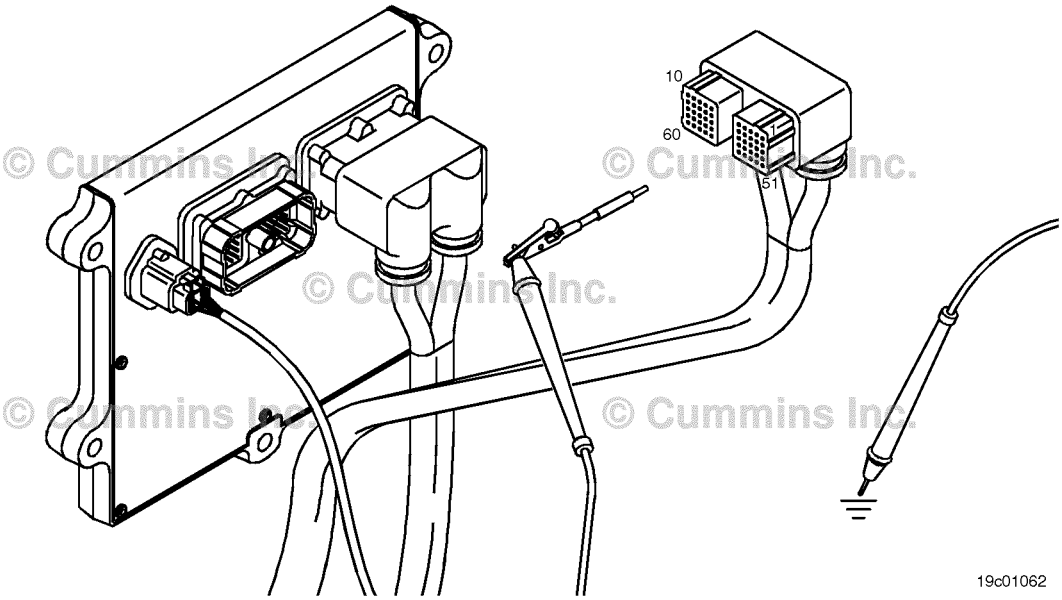
Action	Specification/Repair	Next Step
Use a multimeter, measure the resistance from the real-time clock battery SUPPLY pin at the ECM connector of the engine harness to all other pins in the connector. Use the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	More than 100k ohms? **YES**	2C
	More than 100k ohms? **NO** **Repair:** A short circuit has been detected in the engine harness. Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19.	3A



STEP 2C: Check for a short circuit to ground.

Condition:
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Disconnect the real-time clock battery from the engine harness.

Action	Specification/Repair	Next Step
Use a multimeter, measure the resistance from the real-time clock battery SUPPLY pin at the ECM connector of the engine harness to engine block ground. Use the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	More than 100k ohms? **YES**	3A
	More than 100k ohms? **NO** **Repair:** A short circuit has been detected in the engine harness. Repair or replace the engine harness. Refer to Procedure 019-043 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. • Use INSITE™ electronic service tool to set the real-time clock to the correct date and time. • Verify that Fault Code 319 is inactive.	Fault Code 319 inactive? **YES**	3B
	Fault Code 319 inactive? **NO** **Repair:** 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.

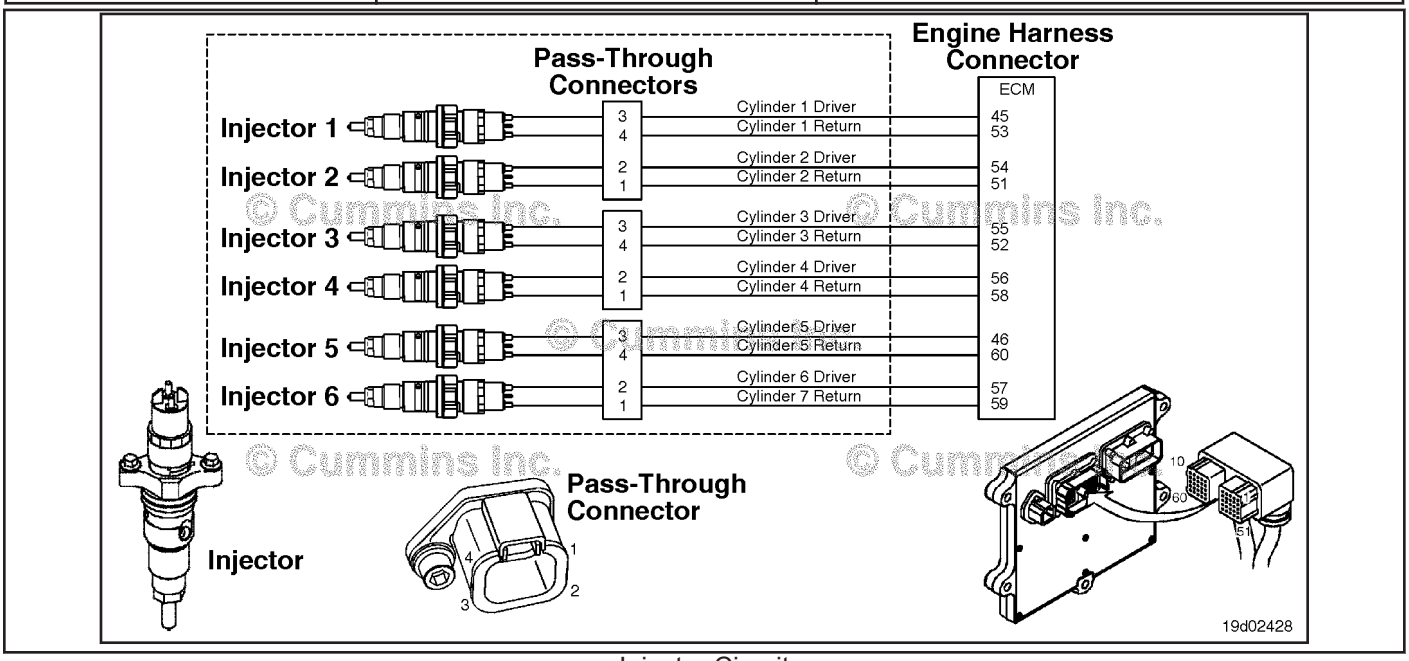
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 322

Injector Solenoid Driver Cylinder 1 Circuit - Current Below Normal or Open Circuit

CODES	REASON	EFFECT
Fault Code: 322 PID(P), SID(S): S001 SPN: 651 FMI: 5 Lamp: Amber SRT:	Injector Solenoid Driver Cylinder 1 Circuit - Current Below Normal or Open Circuit. High resistance or **no** current detected at number 1 injector driver or RETURN pin.	Engine can misfire or possibly run rough.



Injector Circuit

Circuit Description:

The injector solenoid valves control fueling quantity and injection timing. The engine control module (ECM) energizes the solenoid by closing a high-side and a low-side switch. There are two high-side switches and six low-side switches inside the ECM. The injectors for cylinders 1, 2, and 3 (front bank) share a single high-side switch that connects the injector circuit to the source of high voltage inside the ECM. Likewise, the injectors for cylinders 4, 5, and 6 (rear bank) also share a single high-side switch. Each injector circuit has a dedicated low-side switch that completes the circuit path to ground inside the ECM.

Component Location:

The engine harness connects the ECM to three injector circuit pass-through connectors that are located in the rocker housing. Internal injector harnesses are located under the valve cover and connect the injectors to the engine harness at the pass-through connectors. Each pass-through connector provides power and return to two injectors.

Shop Talk:

- Fault activation: The ECM senses current as each injector is actuated. If the ECM detects a persistent circuit error on an injector circuit, this fault will become active. If a circuit error is determined to cause excessive current, the ECM will disable the injection event for the faulty cylinders(s).
- Fault deactivation: The ECM will attempt to enable any disabled injector circuit whenever the engine is started and approximately once per minute while the engine is running. If an injector circuit fault is active and the faulty condition is repaired, the fault will become inactive once the engine is restarted or if the engine is permitted to idle for more than a minute.

- If a fault condition is intermittent and especially if more than one injector fault code is in the ECM memory, look for a wire harness that can short to components inside the rocker housing or for a short circuit to ground in the injector solenoid.
- If more than one injector fault code is occurring and the faults occur for injector circuits in the same bank, a short circuit exists.
- If the faults occur intermittently or faults occur, the engine can exhibit a misfire even if the injector circuit fault code does **not always** register. If a single cylinder exhibits misfires, look for an open circuit problem. If several cylinders on the same bank exhibit misfires, look for a short circuit anywhere in the bank of cylinders.

Causes of a single injector fault are:

- An open circuit in the engine harness(es) or injector solenoid
- High resistance in a single injector or injector solenoid
- Extremely low resistance in an injector solenoid (injector shorted internally but **not** to ground)
- Damaged ECM
- An intermittent short.

An intermittent short can result if the wiring harness insulation rubs through near a rocker lever. An intermittent short can cause a single injector fault code. For example, a short on the harness to cylinder number 1 causes a fault code for cylinder number 2 or cylinder number 3.

Causes of multiple injector fault codes in the same bank of injectors are:

- Short circuit in the engine harness(es) - either shorts to ground or to other wires in the engine harness
- Short circuit in any of the three injectors in the bank - shorts to ground
- Damaged ECM.

When looking for short circuits in the injector harnesses, pay particular attention to the wire insulation. Make sure there are **no** shorts to a rocker lever.

NOTE: Fault Code 951 (cylinder balance) can also be present due to this fault code.

Refer to Troubleshooting Fault Code t05-322.

FAULT CODE 322 - Injector Solenoid Driver Cylinder 1 Circuit - Current Below Normal or Open Circuit

TROUBLESHOOTING SUMMARY

⚠WARNING⚠

The injector solenoids receive high voltage when the engine is operating. To reduce the possibility of personal injury from electrical shock, do not wear jewelry or damp clothing, and do not touch the injector solenoids or the solenoid wires when the engine is operating.

⚠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 3164133 - male Deutsch™ test lead, Part Number 3164132 - female Deutsch™ 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 for active fault codes.**		
STEP 1A:	Read the fault codes with INSITE™ electronic service tool.	Fault Code 322 active?	
STEP 1B:	Read the fault codes with INSITE™ electronic service tool.	Fault Codes for other injectors on the same bank active?	
STEP 2:	**Check the injector and injector circuit for an open circuit.**		
STEP 2A:	Inspect the engine harness connections.	Connector properly connected?	
STEP 2B:	Inspect the engine harness and ECM connector pins.	Dirty or damaged pins?	
STEP 2C:	Check for an open circuit.	Less than 2 ohms?	
STEP 2C-1:	Check for high resistance or an open circuit in the injector solenoid and circuit.	Less than 2 ohms?	
STEP 2D:	Check for high resistance or an open circuit in the injector solenoid.	Fault code follow the injector?	
STEP 3:	**Check the engine harness.**		
STEP 3A:	Inspect the engine harness and injector pass-through connector pins.	Dirty or damaged pins?	
STEP 3B:	Check the injector harness circuits for short circuits to ground.	Greater than 100k ohms?	
STEP 3C:	Check the injector solenoids for short circuits to ground.	Greater than 100k ohms?	
STEP 4:	**Isolate the ECM or injector malfunction.**		
STEP 4A:	Check for active fault codes.	Same or multiple (same bank) injector fault codes active?	
STEP 4A-1:	Injector isolation.	Multiple (same bank) injector fault codes active?	

STEP 4A-2:	**Injector isolation.**	**Multiple (same bank) injector fault codes active?**
STEP 4A-3:	**Check for active fault codes.**	**Multiple (same bank) injector fault codes active?**

STEP 5: Clear the fault codes.

STEP 5A:	**Disable the fault code.**	**Same or multiple (same bank) injector fault codes active?**
STEP 5B:	**Clear the inactive fault codes.**	**All fault codes cleared?**

TROUBLESHOOTING STEP

STEP 1: Check for active fault codes.

STEP 1A: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 322 active? **YES**	1B
	Fault Code 322 active? **NO**	Refer to Procedure 019-362 in Section 19.

STEP 1B: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Read the fault codes. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Fault codes for other injectors on the same bank active? **YES**	3A
	Fault codes for other injectors on the same bank active? **NO**	2A

STEP 2: Check the injector and injector circuit for an open circuit.

STEP 2A: Inspect the engine harness connections.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Make sure the following engine harness connections are properly made: • Engine harness connected to the ECM • Engine harness connected to the injector pass-through connectors at the rocker housing.	Connectors properly connected? **YES**	2B
	Connectors properly connected? **NO** **Repair:** Install the engine harness connectors properly.	5A

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

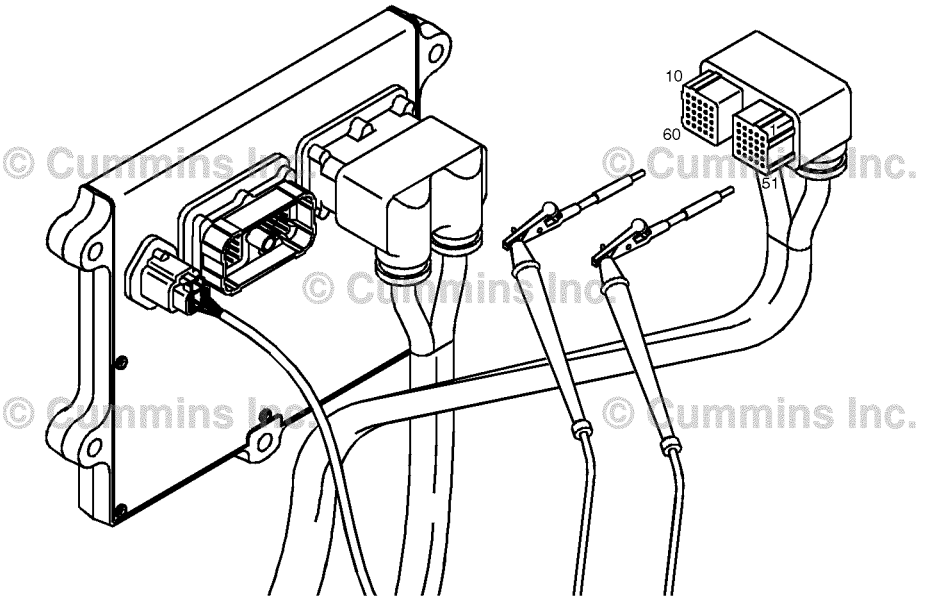
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Replace the engine harness. Refer to Procedure 019-043 in Section 19.	5A
Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **NO**	2C

STEP 2C: Check for an open circuit.

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

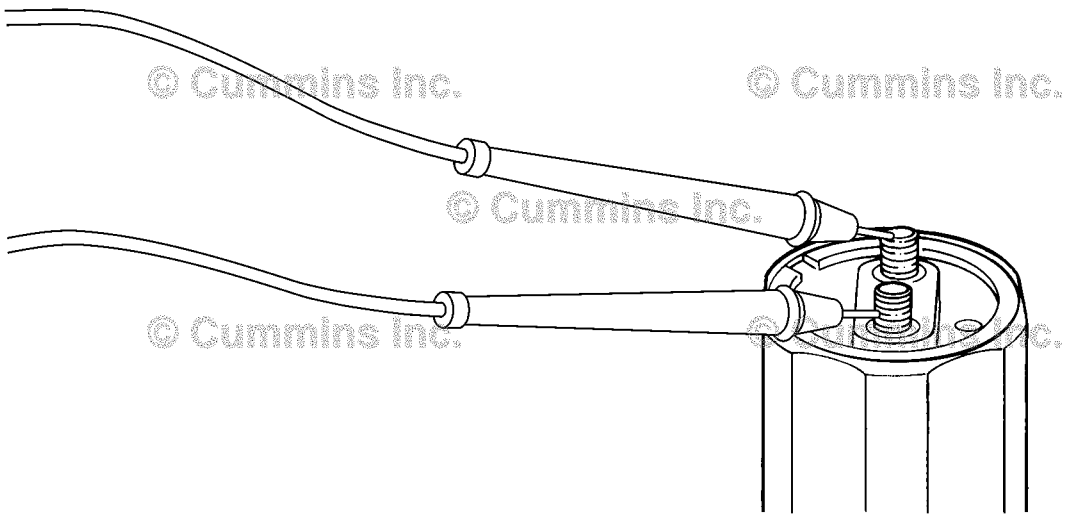
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 1 DRIVER pin and the cylinder number 1 RETURN pin on the harness. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 2 ohms? **YES**	2D
	Less than 2 ohms? **NO**	2C-1



STEP 2C-1: Check for high resistance or an open circuit in the injector solenoid and circuit.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 1 DRIVER pin and the cylinder number 1 RETURN pin on the injector solenoid. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Less than 2 ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for an open circuit. Repair or replace the damaged component.	5A
	Less than 2 ohms? **NO** **Repair:** Replace the injector. 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.	5A



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STEP 2D: Check for high resistance or an open circuit in the injector solenoid.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Remove the injector and swap it with an injector in another bank. Refer to Procedure 006-026 in Section 6. • Turn keyswitch ON. • Operate engine and let it idle. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Did the fault code follow the injector? **YES** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A
	Did the fault code follow the injector? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A

STEP 3: Check the engine harness.

STEP 3A: Inspect the engine harness and injector pass-through connector pins.

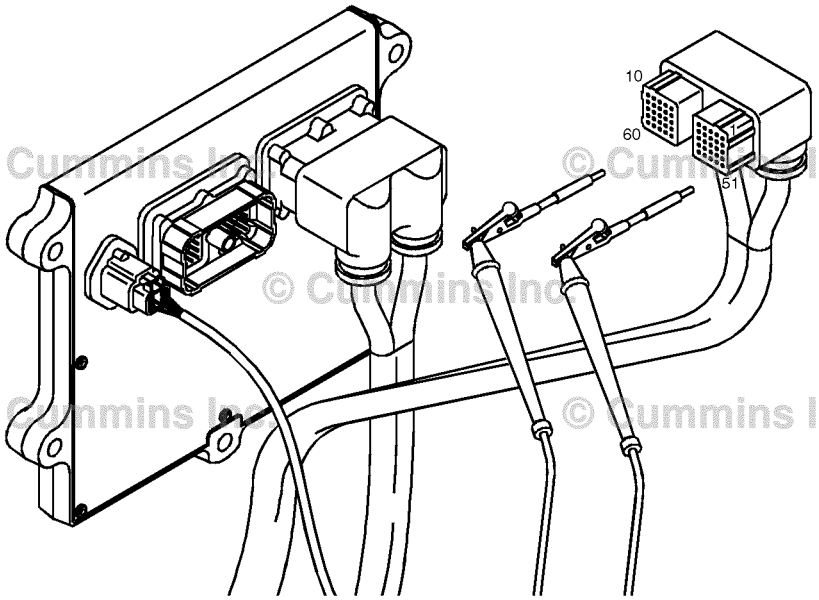
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Refer to Procedure 019-043 in Section 19.	5A
	Dirty or damaged pins? **NO**	3B

STEP 3B: Check the injector harness circuits for short circuits to ground.

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

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder number 1 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 2 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 3 SIGNAL pin and engine block ground. Refer to the circuit diagram or the wiring diagram for connector pin idenfication. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	4A
	Greater than 100k ohms? **NO**	3C



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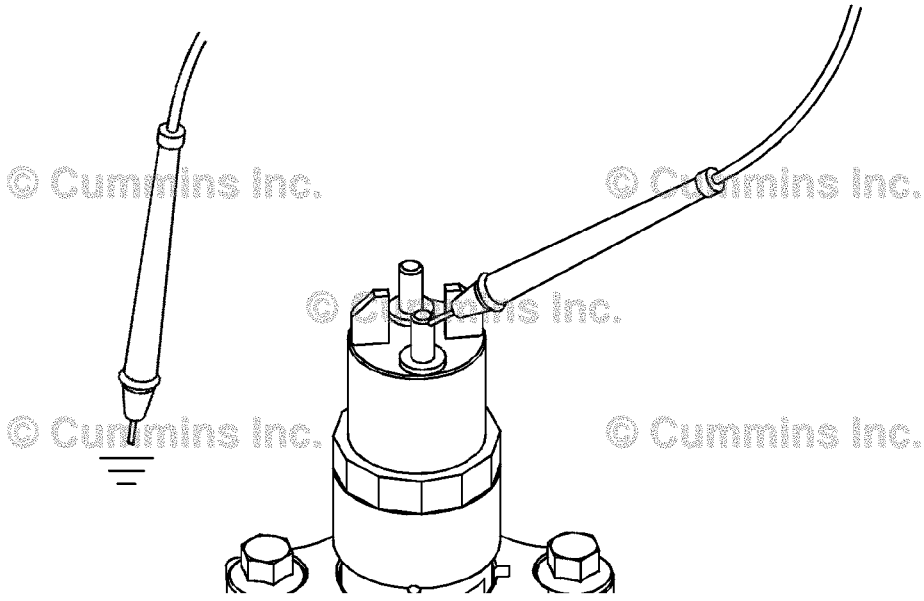
STEP 3C: Check the injector solenoids for short circuits to ground.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injectors being tested.

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder 1 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder 2 SIGNAL pin and engine block ground • Measure the resistance between the cylinder 3 SIGNAL pin and engine block ground. Reference the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for a short circuit. • Repair or replace the damaged component.	5A
	Greater than 100k ohms? **NO** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4: Isolate the ECM or injector malfunction.

STEP 4A: Check for active fault codes.

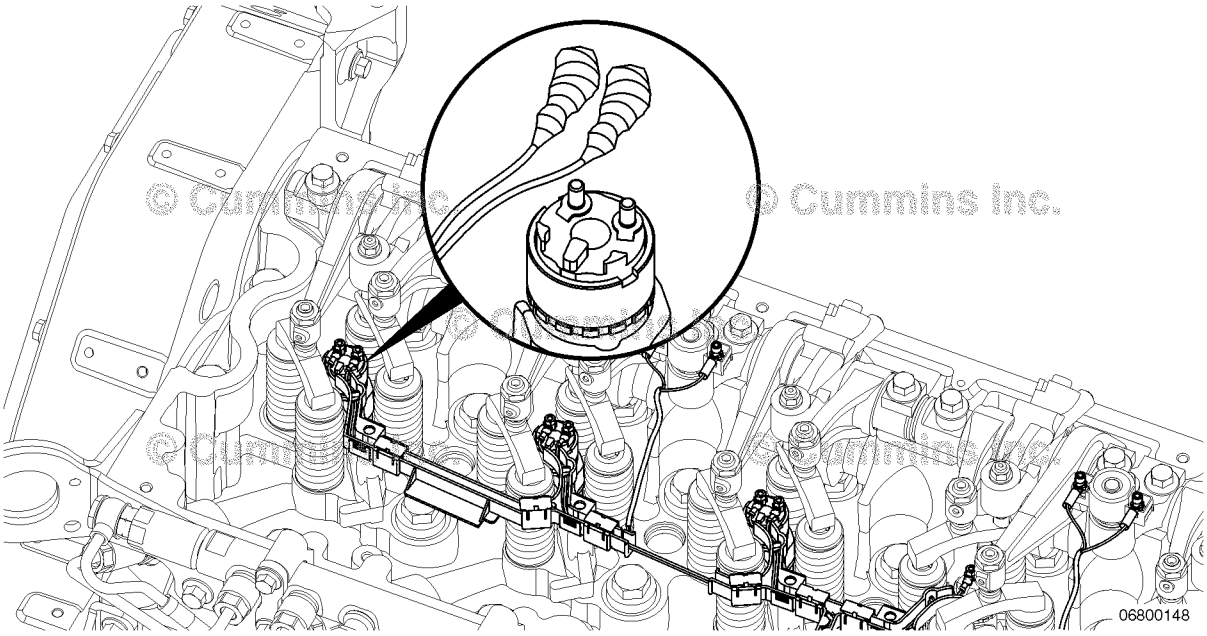
Condition:
- Connect all components.
- Place the rocker cover on the cylinder head and install the capscrews loosely so that the engine may run at idle.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes. Bank fault codes: • Bank 1 - Front Bank: Fault Codes 322, 324, and 331. • Bank 2 - Rear Bank: Fault Codes 323, 325, and 332.	Same or multiple (same bank) injector fault codes active? **YES**	4A-1
	Same or multiple (same bank) injector fault codes active? **NO**	5A

STEP 4A-1: Injector isolation.

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

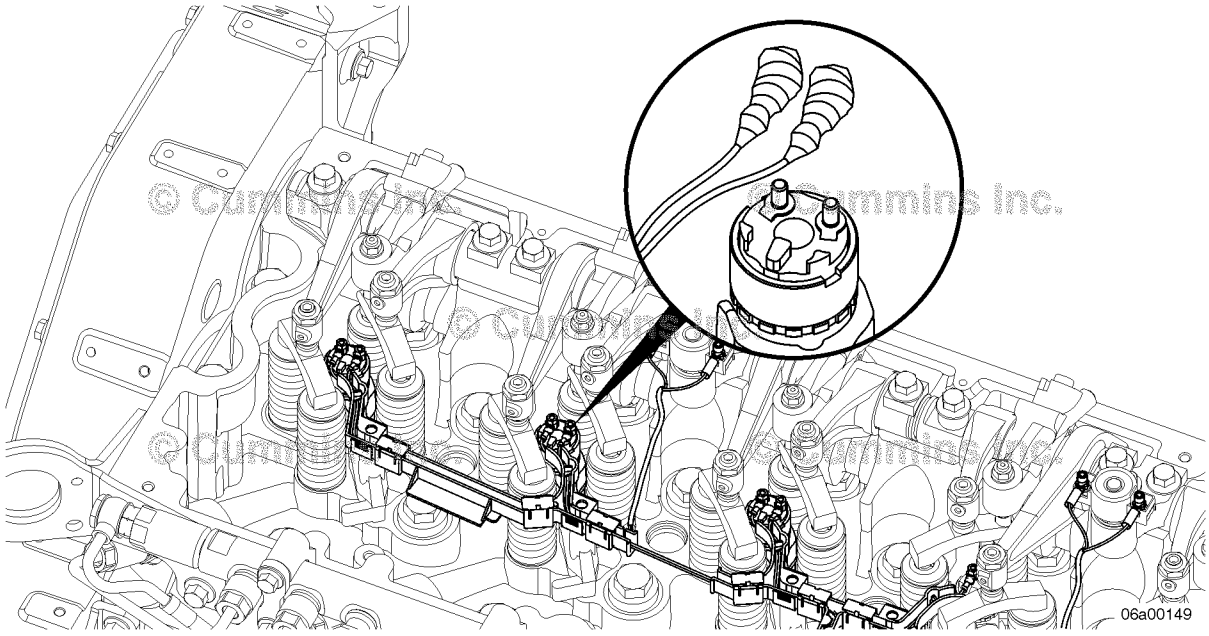
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Disconnect the injector wiring harness from injector number 1. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-2
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 1. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-2: Injector isolation.

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

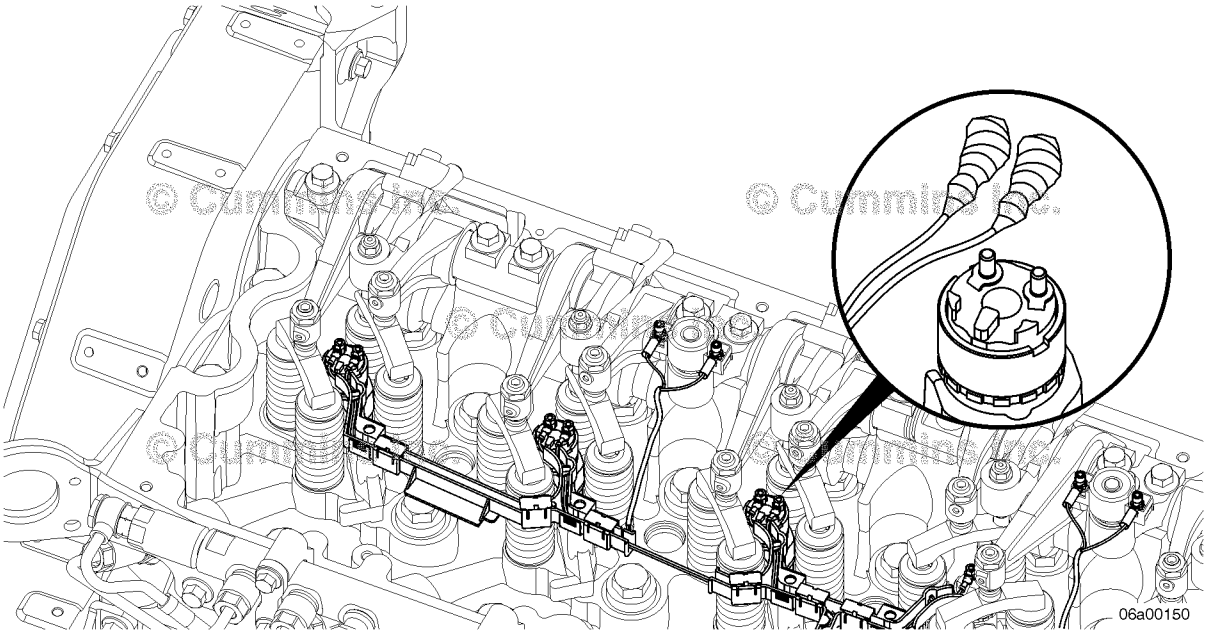
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 1. • Disconnect the injector wiring harness from injector number 2. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-3
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 2. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-3: Check for active fault codes.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 2. • Disconnect the injector wiring harness from injector number 3. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 3. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault codes are inactive.	Same or multiple (same bank) injector fault codes active? **YES** **Repair:** Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1B
	Same or multiple (same bank) injector fault codes active? **NO**	5B

STEP 5B: Clear the inactive fault codes.

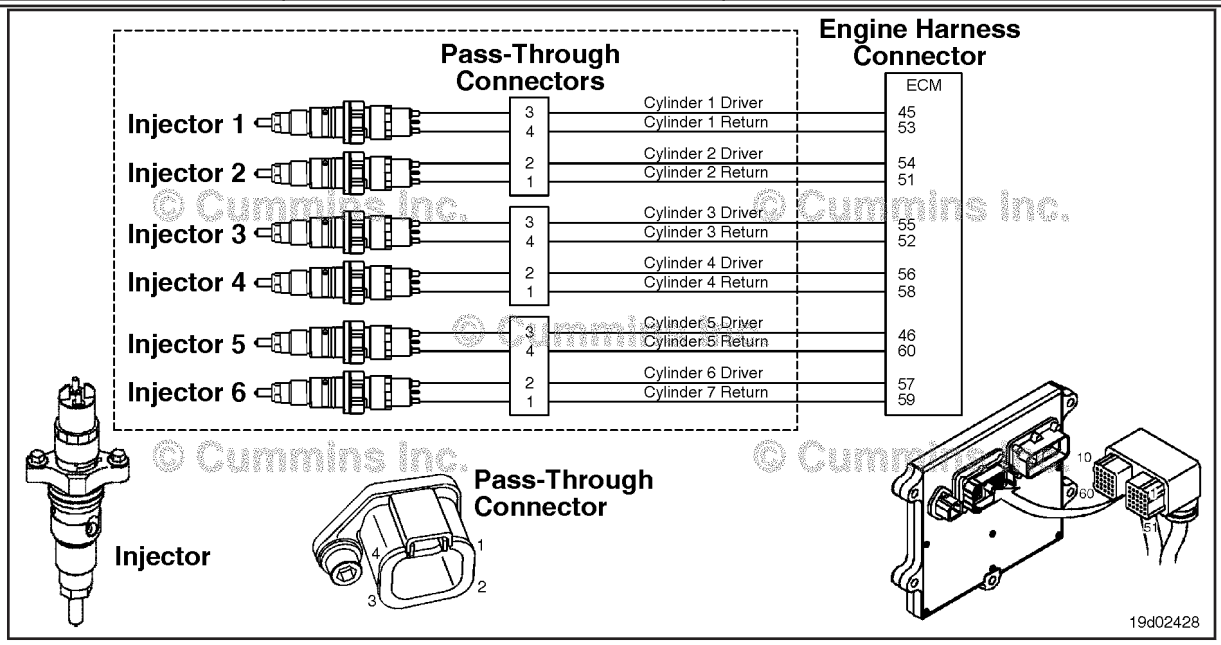
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 323

Injector Solenoid Driver Cylinder 5 Circuit - Current Below Normal or Open Circuit

CODES	REASON	EFFECT
Fault Code: 323 PID(P), SID(S): S005 SPN: 655 FMI: 5 Lamp: Amber SRT:	Injector Solenoid Driver Cylinder 5 Circuit - Current Below Normal or Open Circuit. High resistance or **no** current detected at number 5 injector driver or RETURN pin.	Engine can misfire or possibly run rough.



Injector Circuit

Circuit Description:

The injector solenoid valves control fueling quantity and injection timing. The engine control module (ECM) energizes the solenoid by closing a high-side and a low-side switch. There are two high-side switches and six low-side switches inside the ECM. The injectors for cylinders 1, 2, and 3 (front bank) share a single high-side switch that connects the injector circuit to the source of high voltage inside the ECM. Likewise, the injectors for cylinders 4, 5, and 6 (rear bank) also share a single high-side switch. Each injector circuit has a dedicated low-side switch that completes the circuit path to ground inside the ECM.

Component Location:

The engine harness connects the ECM to three injector circuit pass-through connectors that are located in the rocker housing. Internal injector harnesses are located under the valve cover and connect the injectors to the engine harness at the pass-through connectors. Each pass-through connector provides power and return to two injectors.

Shop Talk:

- Fault activation: The ECM senses current as each injector is actuated. If the ECM detects a persistent circuit error on an injector circuit, this fault will become active. If a circuit error is determined to cause excessive current, the ECM will disable the injection event for the faulty cylinders.
- Fault deactivation: The ECM will attempt to enable any disabled injector circuit whenever the engine is started and approximately once per minute while the engine is running. If an injector circuit fault is active and the faulty condition is repaired, the fault will become inactive once the engine is restarted or if the engine is permitted to idle for more than a minute.

- If a fault condition is intermittent and especially if more than one injector fault code is in the ECM memory, look for a wire harness that can short to components inside the rocker housing or a short to ground in the injector solenoid.
- If more than one injector fault code is occurring and the faults occur for injector circuits in the same bank, a short circuit exists.
- If the faults occur intermittently or faults occur, the engine can exhibit a misfire even if the injector circuit fault code does **not always** register. If a single cylinder exhibits misfires, look for an open circuit problem. If several cylinders on the same bank exhibit misfires, look for a short circuit anywhere in the bank of cylinders.

Causes of a single injector fault are:

- Open circuit in the engine harness(es) or injector solenoid
- High resistance in a single injector or injector solenoid
- Extremely low resistance in an injector solenoid (injector shorted internally but **not** to ground)
- Damaged ECM
- An intermittent short.

An intermittent short can result if the wiring harness insulation rubs through near a rocker lever. An intermittent short can cause a single injector fault code. For example, a short on the harness to cylinder number 1 causes a fault code for cylinder number 2 or cylinder number 3.

Causes of multiple injector fault codes in the same bank of injectors are:

- Short circuit in the engine harness(es) - either shorts to ground or to other wires in the engine harness
- Short circuit in any of the three injectors in the bank - shorts to ground
- Damaged ECM.

When looking for short circuits in the injector harnesses, pay particular attention to the wire insulation. Make sure there are **no** shorts to a rocker lever.

Note: Fault Code 951 (cylinder balance) can also be present due to this fault code.

Refer to Troubleshooting Fault Code t05-323.

FAULT CODE 323 - Injector Solenoid Driver Cylinder 5 Circuit - Current Below Normal or Open Circuit
TROUBLESHOOTING SUMMARY

⚠WARNING⚠

The injector solenoids receive high voltage when the engine is operating. To reduce the possibility of personal injury from electrical shock, do not wear jewelry or damp clothing, and do not touch the injector solenoids or the solenoid wires when the engine is operating.

⚠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 3164133 - male Deutsch™ test lead, Part Number 3164132 - female Deutsch™ 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 for active fault codes.**		
STEP 1A:	Read the fault codes with INSITE™ electronic service tool.	Fault Code 323 active?	
STEP 1B:	Read the fault codes with INSITE™ electronic service tool.	Fault Codes for other injectors on the same bank active?	
STEP 2:	**Check the injector and injector circuit for an open circuit.**		
STEP 2A:	Inspect the engine harness connections.	Connector properly connected?	
STEP 2B:	Inspect the engine harness and ECM connector pins.	Dirty or damaged pins?	
STEP 2C:	Check for an open circuit.	Less than 2 ohms?	
STEP 2C-1:	Check for high resistance or an open circuit in the injector solenoid and circuit.	Less than 2 ohms?	
STEP 2D:	Check for high resistance or an open circuit in the injector solenoid.	Fault code follow the injector?	
STEP 3:	**Check the engine harness.**		
STEP 3A:	Inspect the engine harness and injector pass-through connector pins.	Dirty or damaged pins?	
STEP 3B:	Check the injector harness circuits for short circuits to ground.	Greater than 100k ohms?	
STEP 3C:	Check the injector solenoids for short circuits to ground.	Greater than 100k ohms?	
STEP 4:	**Isolate the ECM or injector malfunction.**		
STEP 4A:	Check for active fault codes.	Same or multiple (same bank) injector fault codes active?	
STEP 4A-1:	Injector isolation.	Multiple (same bank) injector fault codes active?	

STEP 4A-2:	**Injector isolation.**	**Multiple (same bank) injector fault codes active?**
STEP 4A-3:	**Check for active fault codes.**	**Multiple (same bank) injector fault codes active?**

STEP 5: Clear the fault codes.

STEP 5A:	**Disable the fault code.**	**Same or multiple (same bank) injector fault codes active?**
STEP 5B:	**Clear the inactive fault codes.**	**All fault codes cleared?**

TROUBLESHOOTING STEP

STEP 1: Check for active fault codes.

STEP 1A: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 323 active? **YES**	1B
	Fault Code 323 active? **NO**	Refer to Procedure 019-362 in Section 19.

STEP 1B: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Read the fault codes. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Fault codes for other injectors on the same bank active? **YES**	3A
	Fault codes for other injectors on the same bank active? **NO**	2A

STEP 2: Check the injector and injector circuit for an open circuit.

STEP 2A: Inspect the engine harness connections.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Make sure the following engine harness connections are properly made: • Engine harness connected to the ECM • Engine harness connected to the injector pass-through connectors at the rocker housing.	Connectors properly connected? **YES**	2B
	Connectors properly connected? **NO** **Repair:** Install the engine harness connectors properly.	5A

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

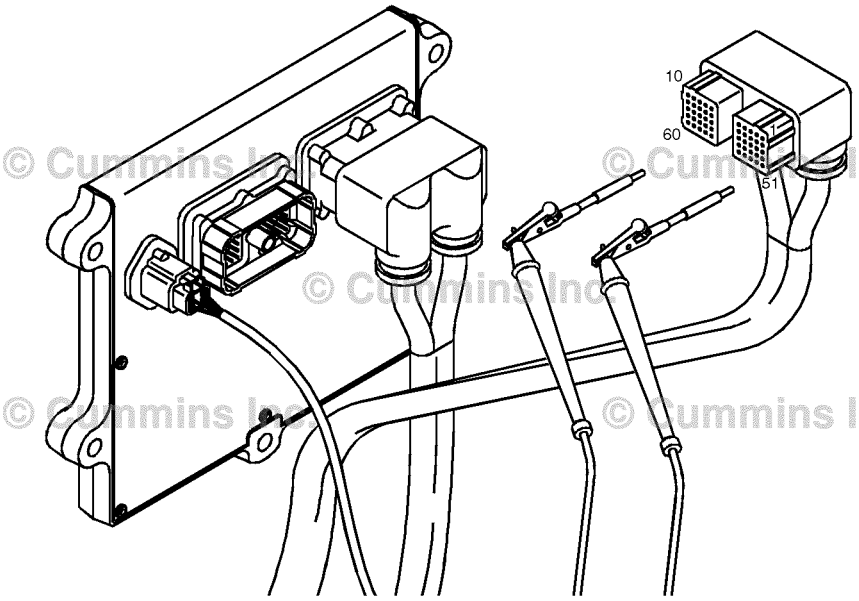
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Replace the engine harness. Refer to Procedure 019-043 in Section 19.	5A
Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **NO**	2C

STEP 2C: Check for an open circuit.

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

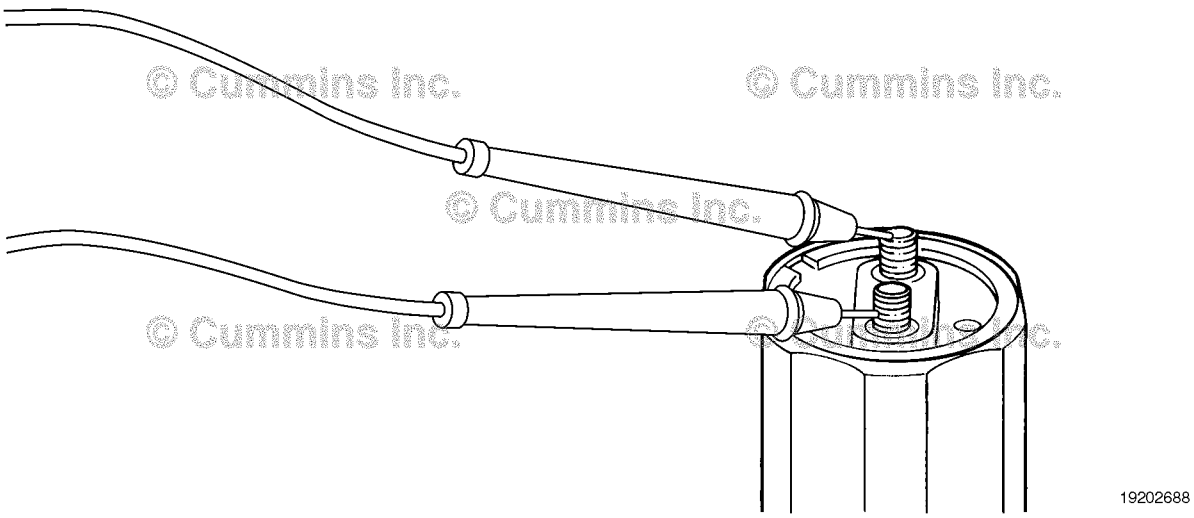
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 5 DRIVER pin and the cylinder number 5 RETURN pin on the harness. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 2 ohms? **YES**	2D
	Less than 2 ohms? **NO**	2C-1



STEP 2C-1: Check for high resistance or an open circuit in the injector solenoid and circuit.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 5 DRIVER pin and the cylinder number 5 RETURN pin on the injector solenoid. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Less than 2 ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for an open circuit. Repair or replace the damaged component.	5A
	Less than 2 ohms? **NO** **Repair:** Replace the injector. 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.	5A



STEP 2D: Check for high resistance or an open circuit in the injector solenoid.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Remove the injector and swap it with an injector in another bank. Refer to Procedure 006-026 in Section 6. • Turn keyswitch ON. • Operate engine and let it idle. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Did the fault code follow the injector? **YES** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A
	Did the fault code follow the injector? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A

STEP 3: Check the engine harness.

STEP 3A: Inspect the engine harness and injector pass-through connector pins.

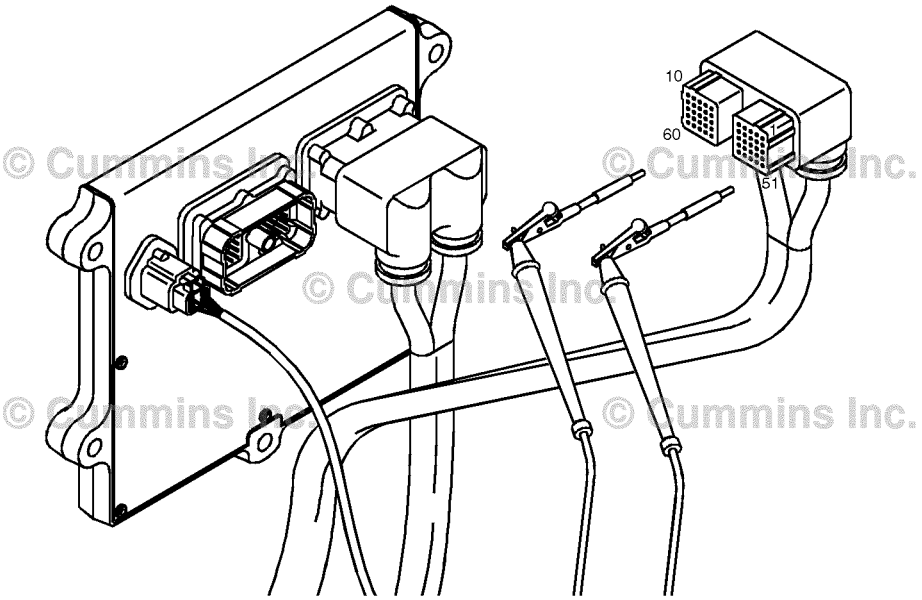
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Refer to Procedure 019-043 in Section 19.	5A
	Dirty or damaged pins? **NO**	3B

STEP 3B: Check the injector harness circuits for short circuits to ground.

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

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder number 4 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 5 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 6 SIGNAL pin and engine block ground. Refer to the circuit diagram or the wiring diagram for connector pin idenfication. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	4A
	Greater than 100k ohms? **NO**	3C



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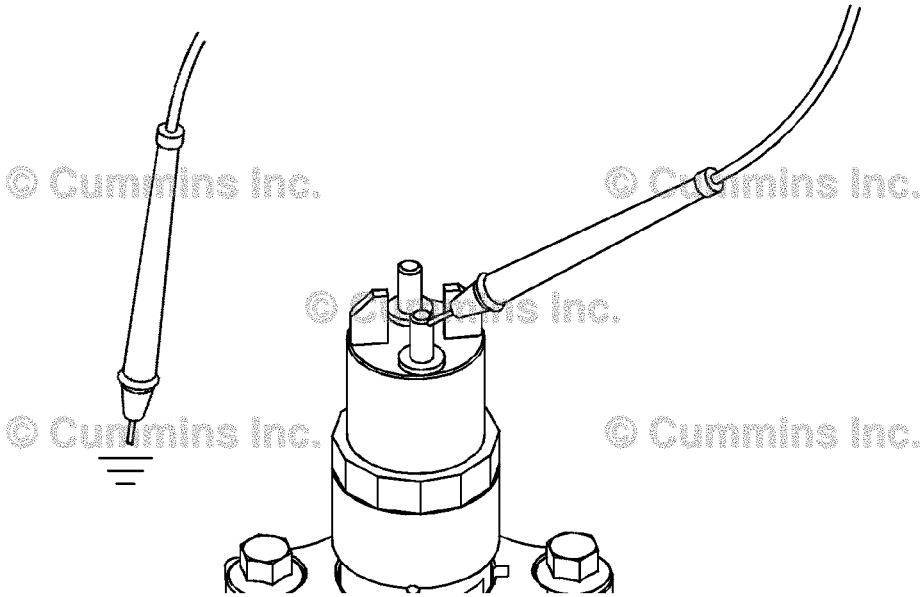
STEP 3C: Check the injector solenoids for short circuits to ground.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injectors being tested.

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder 4 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder 5 SIGNAL pin and engine block ground • Measure the resistance between the cylinder 6 SIGNAL pin and engine block ground. Reference the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for a short circuit. • Repair or replace the damaged component.	5A
	Greater than 100k ohms? **NO** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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STEP 4: Isolate the ECM or injector malfunction.

STEP 4A: Check for active fault codes.

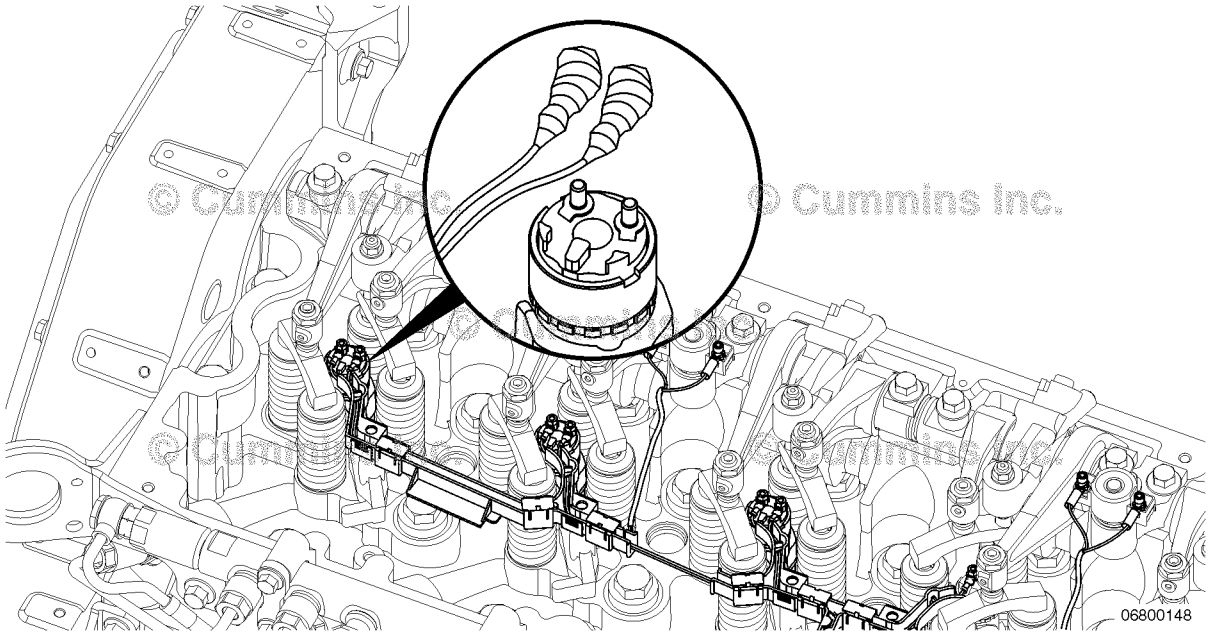
Condition:
- Connect all components.
- Place the rocker cover on the cylinder head and install the capscrews loosely so that the engine may run at idle.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes. Bank fault codes: • Bank 1 - Front Bank: Fault Codes 322, 324, and 331. • Bank 2 - Rear Bank: Fault Codes 323, 325, and 332.	Same or multiple (same bank) injector fault codes active? **YES**	4A-1
	Same or multiple (same bank) injector fault codes active? **NO**	5A

STEP 4A-1: Injector isolation.

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

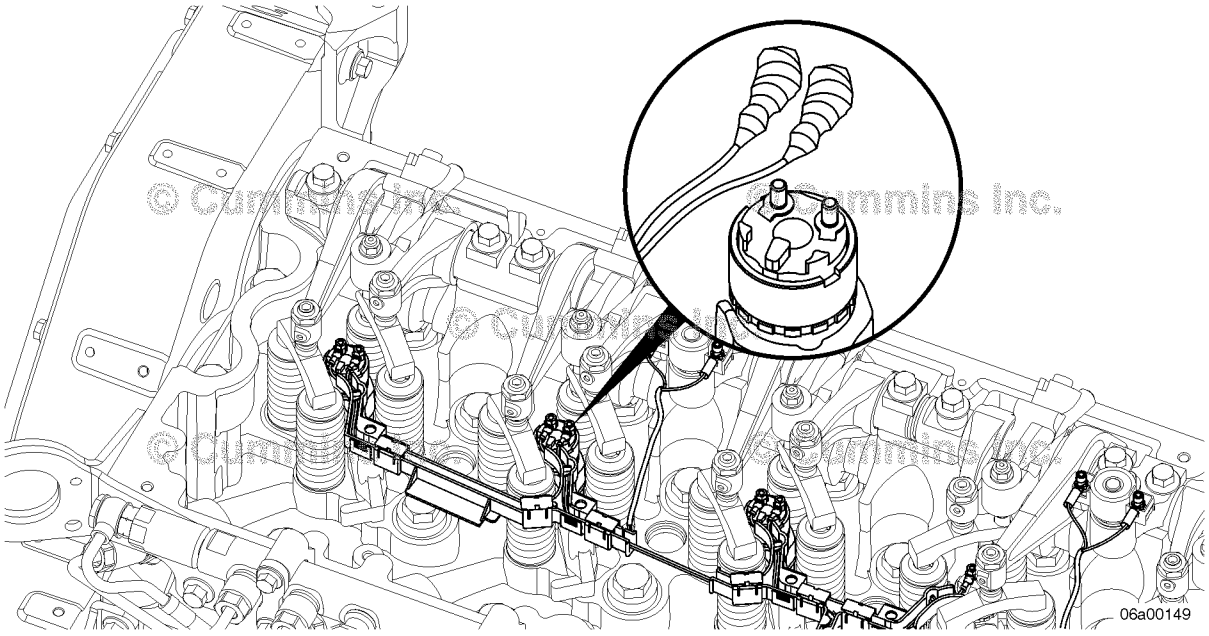
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Disconnect the injector wiring harness from injector number 4. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-2
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 4. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-2: Injector isolation.

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

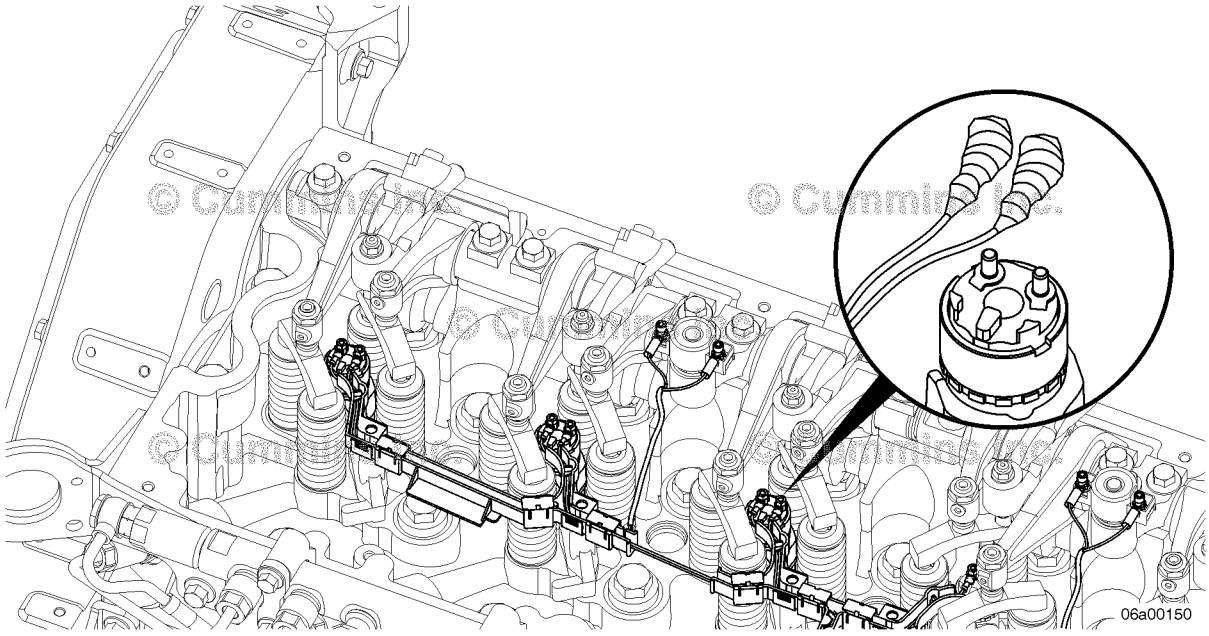
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 4. • Disconnect the injector wiring harness from injector number 5. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-3
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 5. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-3: Check for active fault codes.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 5. • Disconnect the injector wiring harness from injector number 6. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 6. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault codes are inactive.	Same or multiple (same bank) injector fault codes active? **YES** **Repair:** Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1B
	Same or multiple (same bank) injector fault codes active? **NO**	5B

STEP 5B: Clear the inactive fault codes.

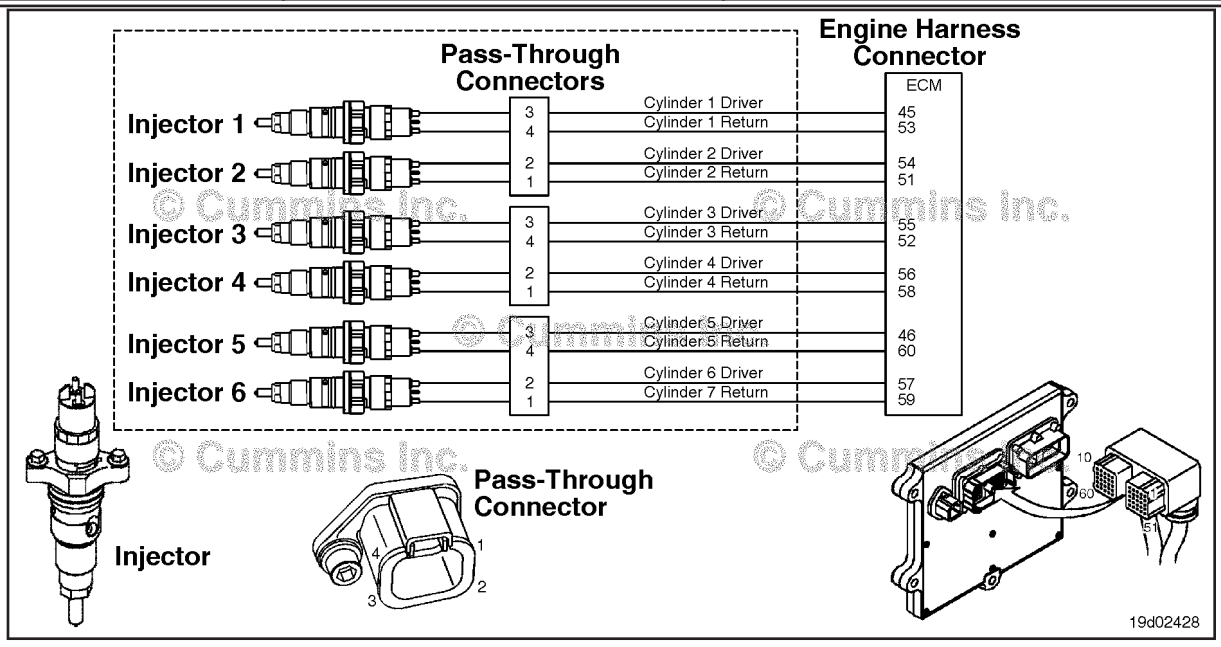
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 324

Injector Solenoid Driver Cylinder 3 Circuit - Current Below Normal or Open Circuit

CODES	REASON	EFFECT
Fault Code: 324 PID(P), SID(S): S003 SPN: 653 FMI: 5 Lamp: Amber SRT:	Injector Solenoid Driver Cylinder 3 Circuit - Current Below Normal or Open Circuit. High resistance or **no** current detected at number 3 injector or RETURN pin.	Engine can misfire or possibly run rough.



Injector Circuit

Circuit Description:

The injector solenoid valves control fueling quantity and injection timing. The engine control module (ECM) energizes the solenoid by closing a high-side and a low-side switch. There are two high-side switches and six low-side switches inside the ECM. The injectors for cylinders 1, 2, and 3 (front bank) share a single high-side switch that connects the injector circuit to the source of high voltage inside the ECM. Likewise, the injectors for cylinders 4, 5, and 6 (rear bank) also share a single high-side switch. Each injector circuit has a dedicated low-side switch that completes the circuit path to ground inside the ECM.

Component Location:

The engine harness connects the ECM to three injector circuit pass-through connectors that are located in the rocker housing. Internal injector harnesses are located under the valve cover and connect the injectors to the engine harness at the pass-through connectors. Each pass-through connector provides power and return to two injectors.

Shop Talk:

- Fault activation: The ECM senses current as each injector is actuated. If the ECM detects a persistent circuit error on an injector circuit, this fault will become active. If a circuit error is determined to cause excessive current, the ECM will disable the injection event for the faulty cylinders.
- Fault deactivation: The ECM will attempt to enable any disabled injector circuit whenever the engine is started and approximately once per minute while the engine is running. If an injector circuit fault is active and the faulty condition is repaired, the fault will become inactive once the engine is restarted or if the engine is permitted to idle for more than a minute.

- If a fault condition is intermittent and especially if more than one injector fault code is in the ECM memory, look for a wire harness that can short to components inside the rocker housing or a short circuit to ground in the injector solenoid.
- If more than one injector fault code is occurring and the faults occur for injector circuits in the same bank, a short circuit exists.
- If the faults occur intermittently or faults occur, the engine can exhibit a misfire even if the injector circuit fault code does **not always** register. If a single cylinder exhibits misfires, look for an open circuit problem. If several cylinders on the same bank exhibit misfires, look for a short circuit anywhere in the bank of cylinders.

Causes of a single injector fault are:

- Open circuit in the engine harness(es) or injector solenoid
- High resistance in a single injector or injector solenoid
- Extremely low resistance in an injector solenoid (injector shorted internally but **not** to ground)
- Damaged ECM.
- An intermittent short.

An intermittent short can result if the wiring harness insulation rubs through near a rocker lever. An intermittent short can cause a single injector fault code. For example, a short on the harness to cylinder number 1 causes a fault code for cylinder number 2 or cylinder number 3.

Causes of multiple injector fault codes in the same bank of injectors are:

- Short circuit in the engine harness(es) - either shorts to ground or to other wires in the engine harness
- Short circuit in any of the three injectors in the bank - shorts to ground
- Damaged ECM.

When looking for short circuits in the injector harnesses, pay particular attention to the wire insulation. Make sure there are **no** shorts to a rocker lever.

Note: Fault Code 951 (cylinder balance) can also be present due to this fault code.

Refer to Troubleshooting Fault Code t05-324.

FAULT CODE 324 - Injector Solenoid Driver Cylinder 3 Circuit - Current Below Normal or Open Circuit

TROUBLESHOOTING SUMMARY

⚠WARNING⚠

The injector solenoids receive high voltage when the engine is operating. To reduce the possibility of personal injury from electrical shock, do not wear jewelry or damp clothing, and do not touch the injector solenoids or the solenoid wires when the engine is operating.

⚠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 3164133 - male Deutsch™ test lead, Part Number 3164132 - female Deutsch™ 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 for active fault codes.**		
STEP 1A:	Read the fault codes with INSITE™ electronic service tool.	Fault Code 324 active?	
STEP 1B:	Read the fault codes with INSITE™ electronic service tool.	Fault Codes for other injectors on the same bank active?	
STEP 2:	**Check the injector and injector circuit for an open circuit.**		
STEP 2A:	Inspect the engine harness connections.	Connector properly connected?	
STEP 2B:	Inspect the engine harness and ECM connector pins.	Dirty or damaged pins?	
STEP 2C:	Check for an open circuit.	Less than 2 ohms?	
STEP 2C-1:	Check for high resistance or an open circuit in the injector solenoid and circuit.	Less than 2 ohms?	
STEP 2D:	Check for high resistance or an open circuit in the injector solenoid.	Fault code follow the injector?	
STEP 3:	**Check the engine harness.**		
STEP 3A:	Inspect the engine harness and injector pass-through connector pins.	Dirty or damaged pins?	
STEP 3B:	Check the injector harness circuits for short circuits to ground.	Greater than 100k ohms?	
STEP 3C:	Check the injector solenoids for short circuits to ground.	Greater than 100k ohms?	
STEP 4:	**Isolate the ECM or injector malfunction.**		
STEP 4A:	Check for active fault codes.	Same or multiple (same bank) injector fault codes active?	
STEP 4A-1:	Injector isolation.	Multiple (same bank) injector fault codes active?	

STEP 4A-2:	**Injector isolation.**	**Multiple (same bank) injector fault codes active?**
STEP 4A-3:	**Check for active fault codes.**	**Multiple (same bank) injector fault codes active?**

STEP 5: Clear the fault codes.

STEP 5A:	**Disable the fault code.**	**Same or multiple (same bank) injector fault codes active?**
STEP 5B:	**Clear the inactive fault codes.**	**All fault codes cleared?**

TROUBLESHOOTING STEP

STEP 1: Check for active fault codes.

STEP 1A: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 324 active? **YES**	1B
	Fault Code 324 active? **NO**	Refer to Procedure 019-362 in Section 19.

STEP 1B: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Read the fault codes. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Fault codes for other injectors on the same bank active? **YES**	3A
	Fault codes for other injectors on the same bank active? **NO**	2A

STEP 2: Check the injector and injector circuit for an open circuit.

STEP 2A: Inspect the engine harness connections.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Make sure the following engine harness connections are properly made: • Engine harness connected to the ECM • Engine harness connected to the injector pass-through connectors at the rocker housing.	Connectors properly connected? **YES**	2B
	Connectors properly connected? **NO** **Repair:** Install the engine harness connectors properly.	5A

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

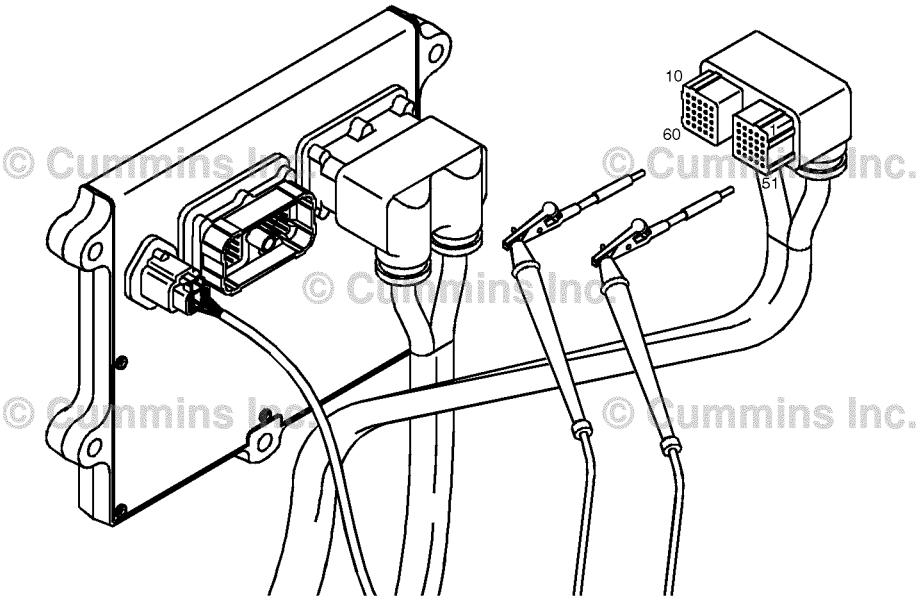
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Replace the engine harness. Refer to Procedure 019-043 in Section 19.	5A
Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **NO**	2C

STEP 2C: Check for an open circuit.

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

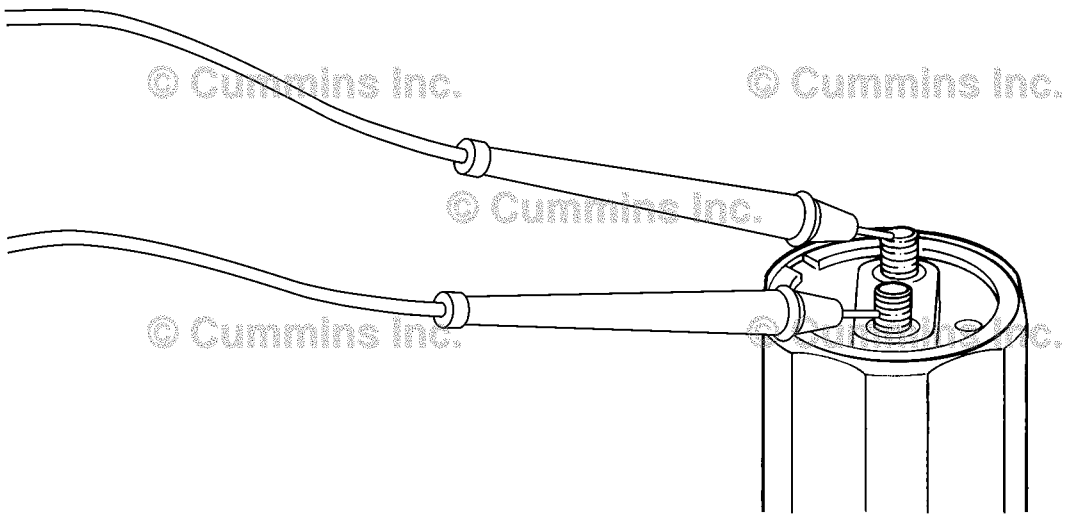
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 3 DRIVER pin and the cylinder number 3 RETURN pin on the harness. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 2 ohms? **YES**	2D
	Less than 2 ohms? **NO**	2C-1



STEP 2C-1: Check for high resistance or an open circuit in the injector solenoid and circuit.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 3 DRIVER pin and the cylinder number 3 RETURN pin on the injector solenoid. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Less than 2 ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for an open circuit. Repair or replace the damaged component.	5A
	Less than 2 ohms? **NO** **Repair:** Replace the injector. 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.	5A



STEP 2D: Check for high resistance or an open circuit in the injector solenoid.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Remove the injector and swap it with an injector in another bank. Refer to Procedure 006-026 in Section 6. • Turn keyswitch ON. • Operate engine and let it idle. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Did the fault code follow the injector? **YES** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A
	Did the fault code follow the injector? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A

STEP 3: Check the engine harness.

STEP 3A: Inspect the engine harness and injector pass-through connector pins.

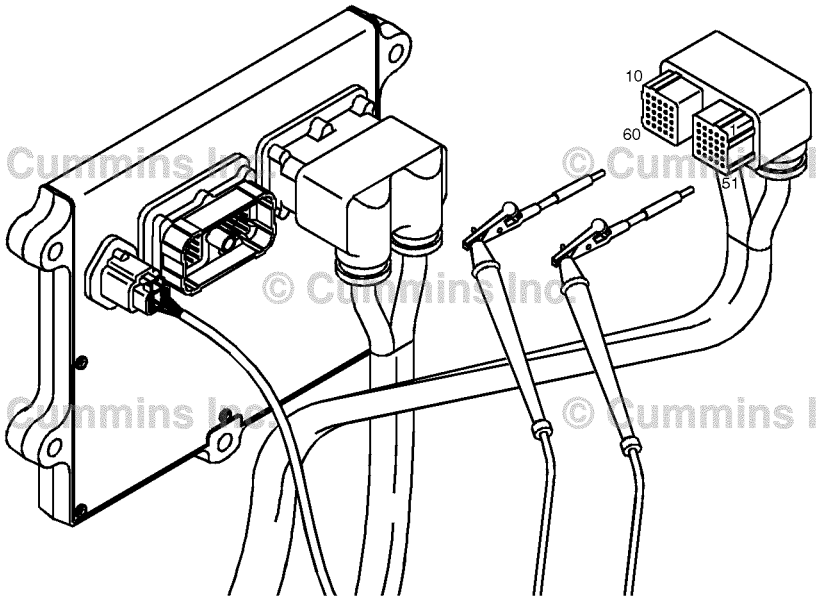
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Refer to Procedure 019-043 in Section 19.	5A
	Dirty or damaged pins? **NO**	3B

STEP 3B: Check the injector harness circuits for short circuits to ground.

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

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder number 1 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 2 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 3 SIGNAL pin and engine block ground. Refer to the circuit diagram or the wiring diagram for connector pin idenfication. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	4A
	Greater than 100k ohms? **NO**	3C



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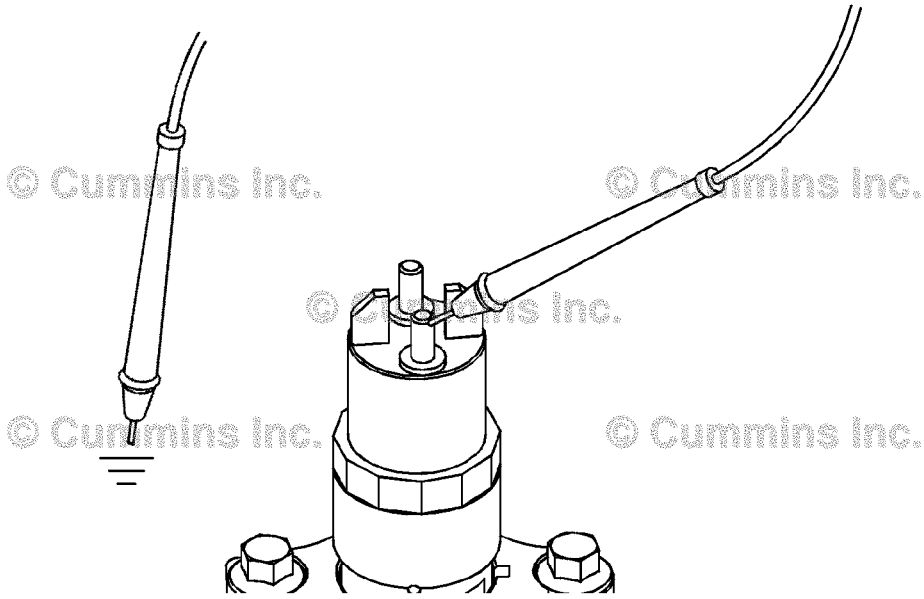
STEP 3C: Check the injector solenoids for short circuits to ground.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injectors being tested.

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder 1 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder 2 SIGNAL pin and engine block ground • Measure the resistance between the cylinder 3 SIGNAL pin and engine block ground. Reference the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for a short circuit. • Repair or replace the damaged component.	5A
	Greater than 100k ohms? **NO** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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STEP 4: Isolate the ECM or injector malfunction.

STEP 4A: Check for active fault codes.

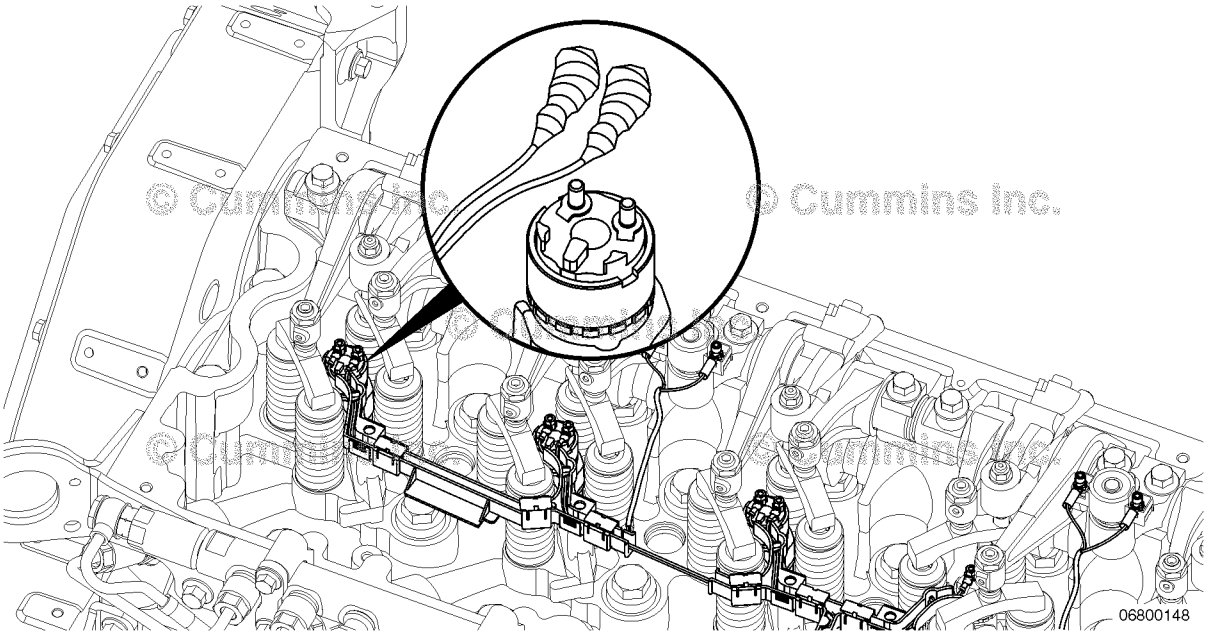
Condition:
- Connect all components.
- Place the rocker cover on the cylinder head and install the capscrews loosely so that the engine may run at idle.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes. Bank fault codes: • Bank 1 - Front Bank: Fault Codes 322, 324, and 331. • Bank 2 - Rear Bank: Fault Codes 323, 325, and 332.	Same or multiple (same bank) injector fault codes active? **YES**	4A-1
	Same or multiple (same bank) injector fault codes active? **NO**	5A

STEP 4A-1: Injector isolation.

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

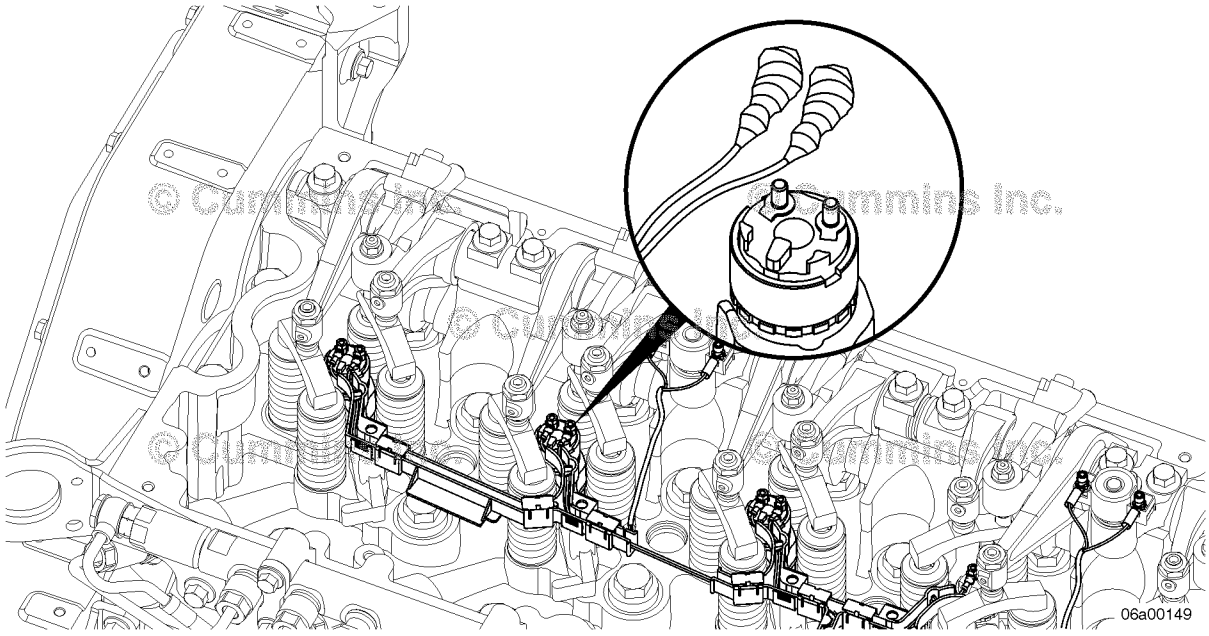
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Disconnect the injector wiring harness from injector number 1. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-2
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 1. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-2: Injector isolation.

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

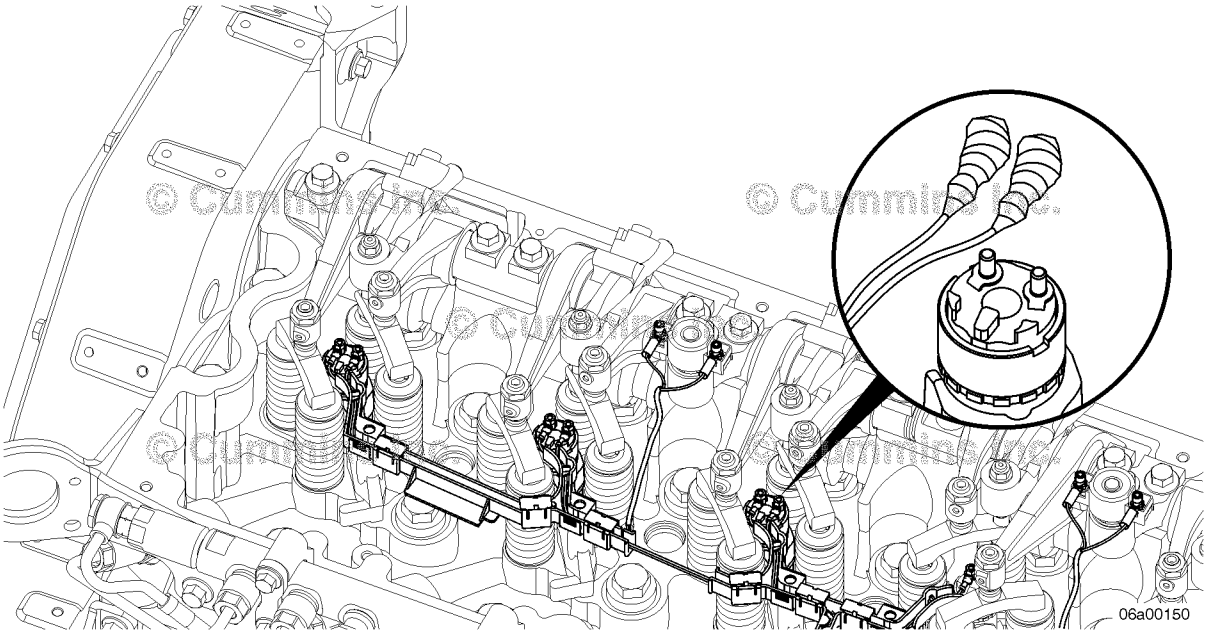
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 1. • Disconnect the injector wiring harness from injector number 2. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-3
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 2. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-3: Check for active fault codes.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 2. • Disconnect the injector wiring harness from injector number 3. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 3. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault codes are inactive.	Same or multiple (same bank) injector fault codes active? **YES** **Repair:** Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1B
	Same or multiple (same bank) injector fault codes active? **NO**	5B

STEP 5B: Clear the inactive fault codes.

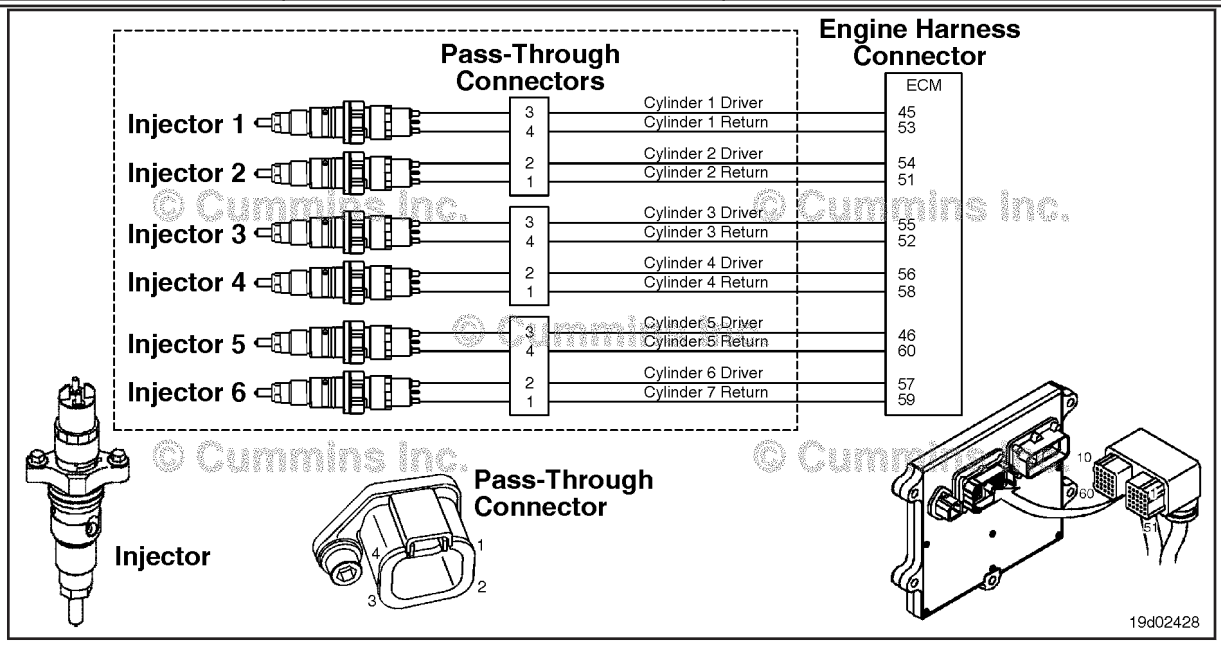
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 325

Injector Solenoid Driver Cylinder 6 Circuit - Current Below Normal or Open Circuit

CODES	REASON	EFFECT
Fault Code: 325 PID(P), SID(S): S006 SPN: 656 FMI: 5 Lamp: Amber SRT:	Injector Solenoid Driver Cylinder 6 Circuit - Current Below Normal or Open Circuit. High resistance or **no** current detected at number 6 injector driver or RETURN pin.	Engine can misfire or possibly run rough.



Injector Circuit

Circuit Description:

The injector solenoid valves control fueling quantity and injection timing. The engine control module (ECM) energizes the solenoid by closing a high-side and a low-side switch. There are two high-side switches and six low-side switches inside the ECM. The injectors for cylinders 1, 2, and 3 (front bank) share a single high-side switch that connects the injector circuit to the source of high voltage inside the ECM. Likewise, the injectors for cylinders 4, 5, and 6 (rear bank) also share a single high-side switch. Each injector circuit has a dedicated low-side switch that completes the circuit path to ground inside the ECM.

Component Location:

The engine harness connects the ECM to three injector circuit pass-through connectors that are located in the rocker housing. Internal injector harnesses are located under the valve cover and connect the injectors to the engine harness at the pass-through connectors. Each pass-through connector provides power and return to two injectors.

Shop Talk:

- Fault activation: The ECM senses current as each injector is actuated. If the ECM detects a persistent circuit error on an injector circuit, this fault will become active. If a circuit error is determined to cause excessive current, the ECM will disable the injection event for the faulty cylinders.
- Fault deactivation: The ECM will attempt to enable any disabled injector circuit whenever the engine is started and approximately once per minute while the engine is running. If an injector circuit fault is active and the faulty condition is repaired, the fault will become inactive once the engine is restarted or if the engine is permitted to idle for more than a minute.

- If a fault condition is intermittent and especially if more than one injector fault code is in the ECM memory, look for a wire harness that can short to components inside the rocker housing or a short circuit to ground in the injector solenoid.
- If more than one injector fault code is occurring and the faults occur for injector circuits in the same bank, a short circuit exists.
- If the faults occur intermittently or faults occur, the engine can exhibit a misfire even if the injector circuit fault code does **not always** register. If a single cylinder exhibits misfires, look for an open circuit problem. If several cylinders on the same bank exhibit misfires, look for a short circuit anywhere in the bank of cylinders.

Causes of a single injector fault are:

- Open circuit in the engine harness(es) or injector solenoid
- High resistance in a single injector or injector solenoid
- Extremely low resistance in an injector solenoid (injector shorted internally but **not** to ground)
- Damaged ECM.
- An intermittent short.

An intermittent short can result if the wiring harness insulation rubs through near a rocker lever. An intermittent short can cause a single injector fault code. For example, a short on the harness to cylinder number 1 causes a fault code for cylinder number 2 or cylinder number 3.

Causes of multiple injector fault codes in the same bank of injectors are:

- Short circuit in the engine harness(es) - either shorts to ground or to other wires in the engine harness
- Short circuit in any of the three injectors in the bank - shorts to ground
- Damaged ECM.

When looking for short circuits in the injector harnesses, pay particular attention to the wire insulation. Make sure there are **no** shorts to a rocker lever.

Note: Fault Code 951 (cylinder balance) can also be present due to this fault code.

Refer to Troubleshooting Fault Code t05-325.

FAULT CODE 325 - Injector Solenoid Driver Cylinder 6 Circuit - Current Below Normal or Open Circuit
TROUBLESHOOTING SUMMARY

⚠WARNING⚠

The injector solenoids receive high voltage when the engine is operating. To reduce the possibility of personal injury from electrical shock, do not wear jewelry or damp clothing, and do not touch the injector solenoids or the solenoid wires when the engine is operating.

⚠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 3164133 - male Deutsch™ test lead, Part Number 3164132 - female Deutsch™ 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 for active fault codes.**		
STEP 1A:	Read the fault codes with INSITE™ electronic service tool.	Fault Code 325 active?	
STEP 1B:	Read the fault codes with INSITE™ electronic service tool.	Fault Codes for other injectors on the same bank active?	
STEP 2:	**Check the injector and injector circuit for an open circuit.**		
STEP 2A:	Inspect the engine harness connections.	Connector properly connected?	
STEP 2B:	Inspect the engine harness and ECM connector pins.	Dirty or damaged pins?	
STEP 2C:	Check for an open circuit.	Less than 2 ohms?	
STEP 2C-1:	Check for high resistance or an open circuit in the injector solenoid and circuit.	Less than 2 ohms?	
STEP 2D:	Check for high resistance or an open circuit in the injector solenoid.	Fault code follow the injector?	
STEP 3:	**Check the engine harness.**		
STEP 3A:	Inspect the engine harness and injector pass-through connector pins.	Dirty or damaged pins?	
STEP 3B:	Check the injector harness circuits for short circuits to ground.	Greater than 100k ohms?	
STEP 3C:	Check the injector solenoids for short circuits to ground.	Greater than 100k ohms?	
STEP 4:	**Isolate the ECM or injector malfunction.**		
STEP 4A:	Check for active fault codes.	Same or multiple (same bank) injector fault codes active?	
STEP 4A-1:	Injector isolation.	Multiple (same bank) injector fault codes active?	

STEP 4A-2:	**Injector isolation.**	**Multiple (same bank) injector fault codes active?**
STEP 4A-3:	**Check for active fault codes.**	**Multiple (same bank) injector fault codes active?**

STEP 5: Clear the fault codes.

STEP 5A:	**Disable the fault code.**	**Same or multiple (same bank) injector fault codes active?**
STEP 5B:	**Clear the inactive fault codes.**	**All fault codes cleared?**

TROUBLESHOOTING STEP

STEP 1: Check for active fault codes.

STEP 1A: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 325 active? **YES**	1B
	Fault Code 325 active? **NO**	Refer to Procedure 019-362 in Section 19.

STEP 1B: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Read the fault codes. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Fault codes for other injectors on the same bank active? **YES**	3A
	Fault codes for other injectors on the same bank active? **NO**	2A

STEP 2: Check the injector and injector circuit for an open circuit.

STEP 2A: Inspect the engine harness connections.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Make sure the following engine harness connections are properly made: • Engine harness connected to the ECM • Engine harness connected to the injector pass-through connectors at the rocker housing.	Connectors properly connected? **YES**	2B
	Connectors properly connected? **NO** **Repair:** Install the engine harness connectors properly.	5A

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

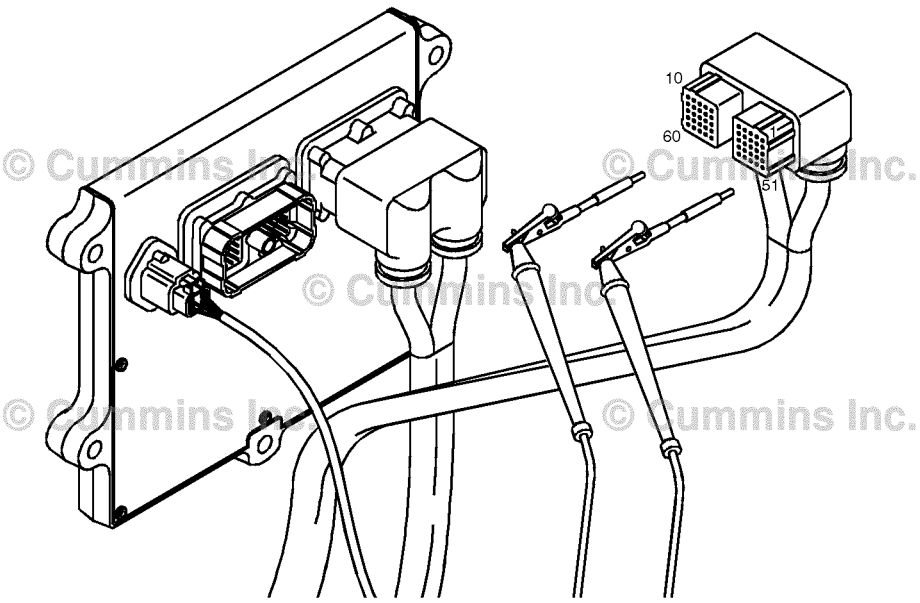
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Replace the engine harness. Refer to Procedure 019-043 in Section 19.	5A
Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **NO**	2C

STEP 2C: Check for an open circuit.

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

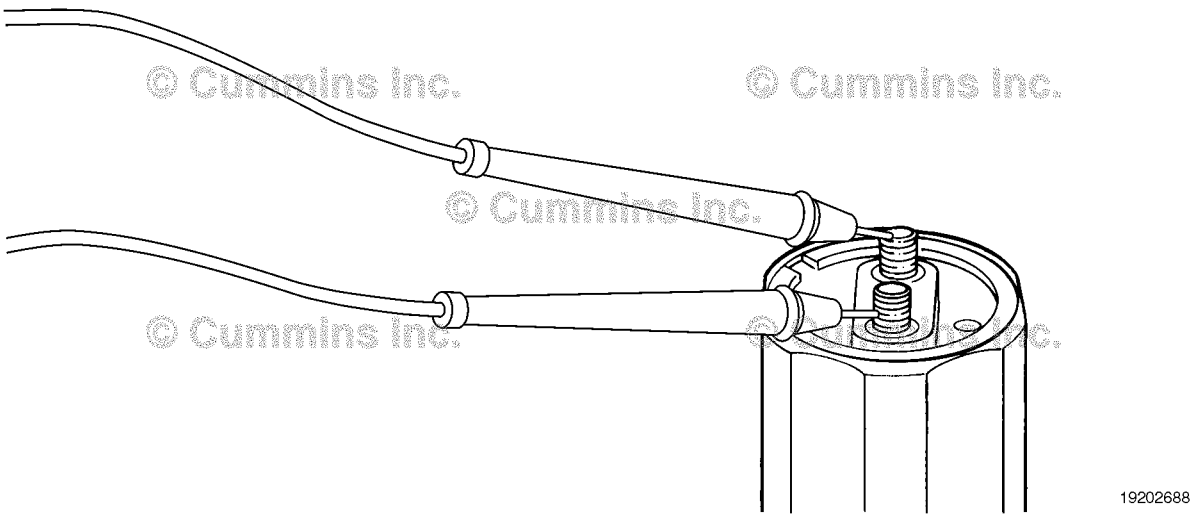
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 6 DRIVER pin and the cylinder number 6 RETURN pin on the harness. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 2 ohms? **YES**	2D
	Less than 2 ohms? **NO**	2C-1



STEP 2C-1: Check for high resistance or an open circuit in the injector solenoid and circuit.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 6 DRIVER pin and the cylinder number 6 RETURN pin on the injector solenoid. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Less than 2 ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for an open circuit. Repair or replace the damaged component.	5A
	Less than 2 ohms? **NO** **Repair:** Replace the injector. 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.	5A



STEP 2D: Check for high resistance or an open circuit in the injector solenoid.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Remove the injector and swap it with an injector in another bank. Refer to Procedure 006-026 in Section 6. • Turn keyswitch ON. • Operate engine and let it idle. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Did the fault code follow the injector? **YES** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A
	Did the fault code follow the injector? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A

STEP 3: Check the engine harness.

STEP 3A: Inspect the engine harness and injector pass-through connector pins.

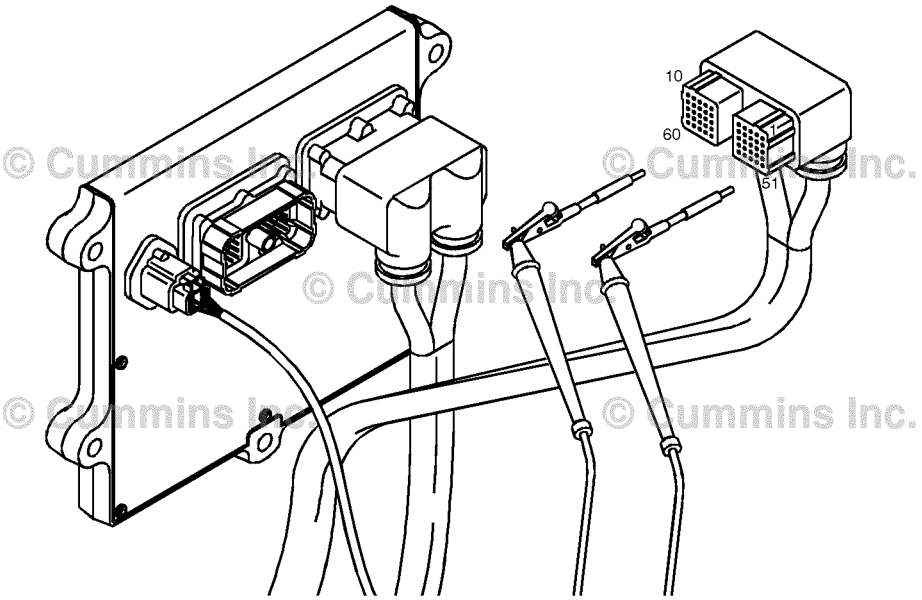
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Refer to Procedure 019-043 in Section 19.	5A
	Dirty or damaged pins? **NO**	3B

STEP 3B: Check the injector harness circuits for short circuits to ground.

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

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder number 4 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 5 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 6 SIGNAL pin and engine block ground. Refer to the circuit diagram or the wiring diagram for connector pin idenfication. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	4A
	Greater than 100k ohms? **NO**	3C



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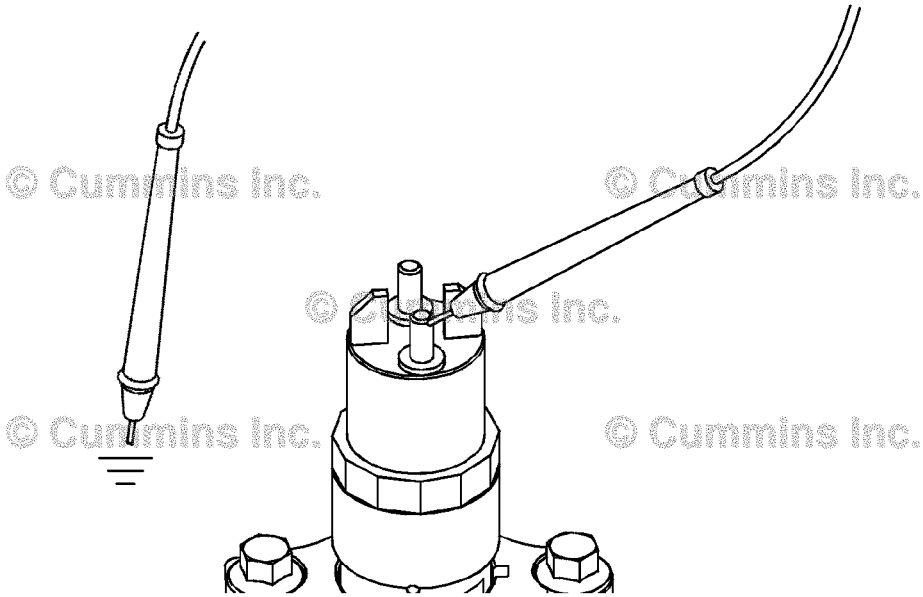
STEP 3C: Check the injector solenoids for short circuits to ground.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injectors being tested.

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder 4 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder 5 SIGNAL pin and engine block ground • Measure the resistance between the cylinder 6 SIGNAL pin and engine block ground. Reference the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for a short circuit. • Repair or replace the damaged component.	5A
	Greater than 100k ohms? **NO** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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STEP 4: Isolate the ECM or injector malfunction.

STEP 4A: Check for active fault codes.

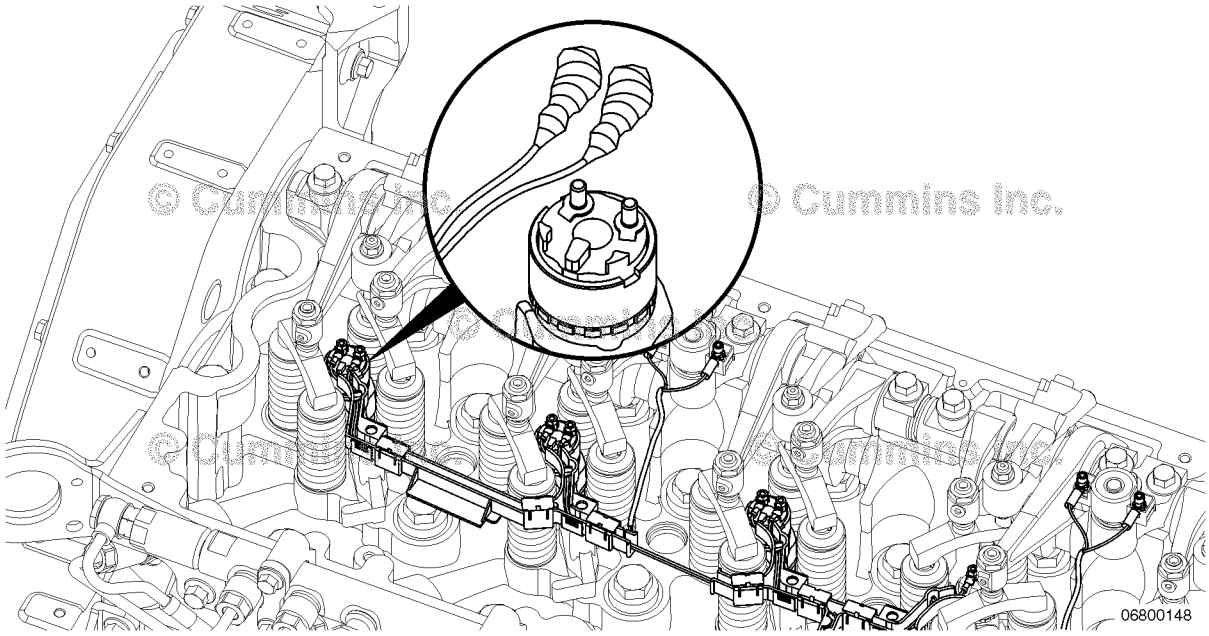
Condition:
- Connect all components.
- Place the rocker cover on the cylinder head and install the capscrews loosely so that the engine may run at idle.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes. Bank fault codes: • Bank 1 - Front Bank: Fault Codes 322, 324, and 331. • Bank 2 - Rear Bank: Fault Codes 323, 325, and 332.	Same or multiple (same bank) injector fault codes active? **YES**	4A-1
	Same or multiple (same bank) injector fault codes active? **NO**	5A

STEP 4A-1: Injector isolation.

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

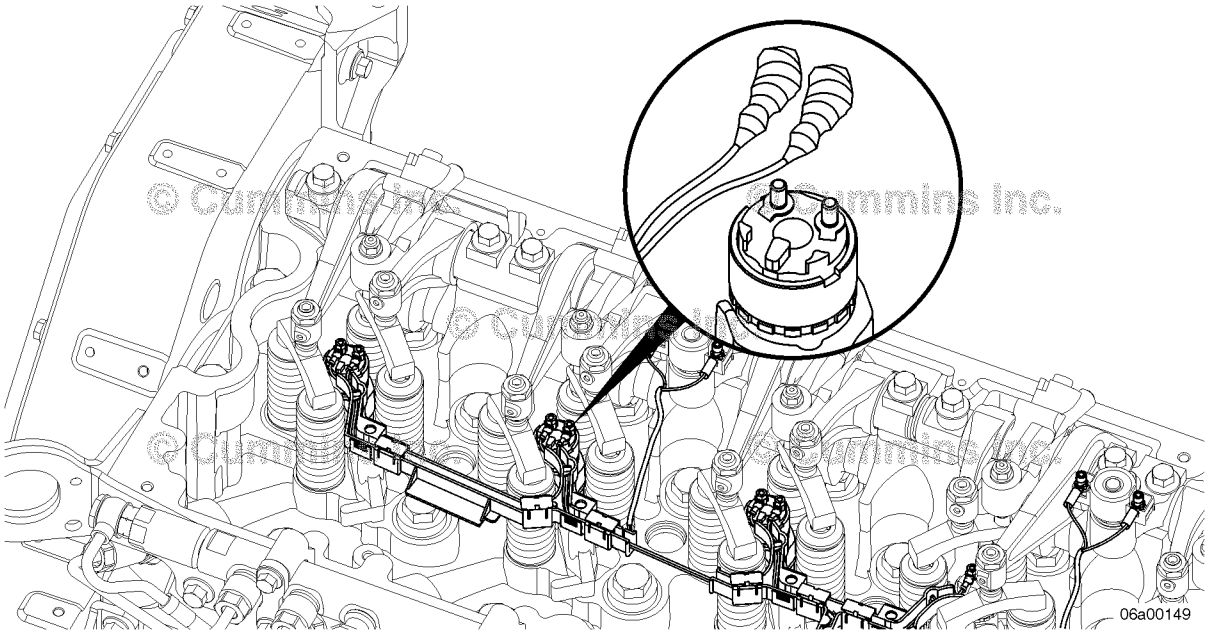
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Disconnect the injector wiring harness from injector number 4. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-2
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 4. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-2: Injector isolation.

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

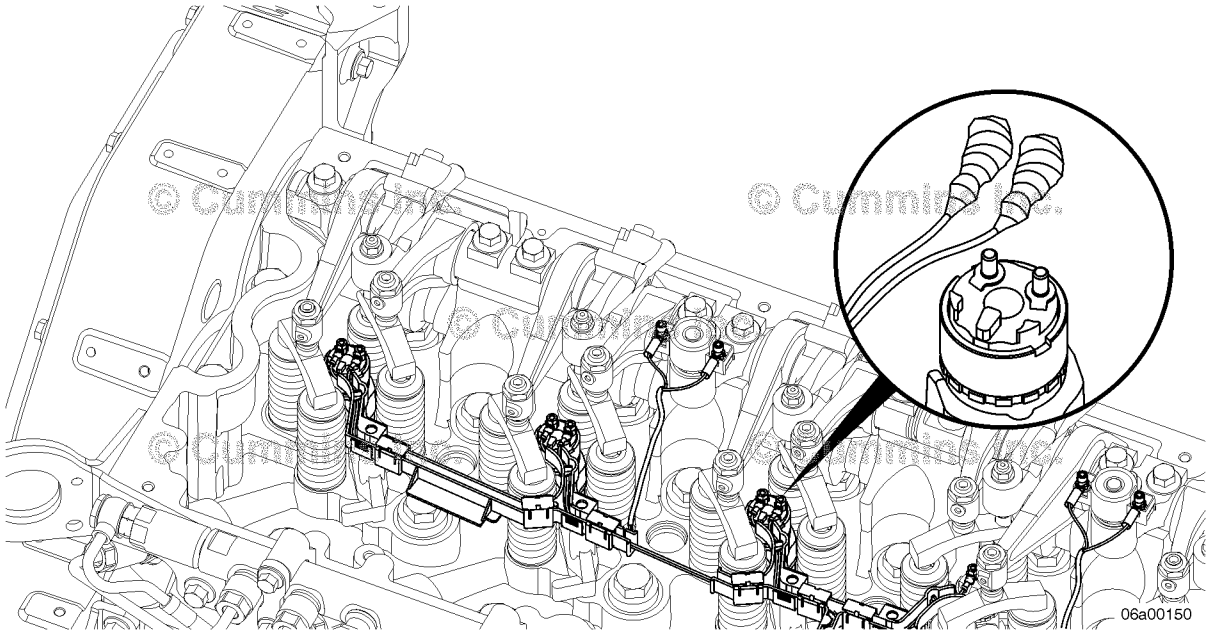
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 4. • Disconnect the injector wiring harness from injector number 5. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-3
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 5. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-3: Check for active fault codes.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 5. • Disconnect the injector wiring harness from injector number 6. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 6. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault codes are inactive.	Same or multiple (same bank) injector fault codes active? **YES** **Repair:** Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1B
	Same or multiple (same bank) injector fault codes active? **NO**	5B

STEP 5B: Clear the inactive fault codes.

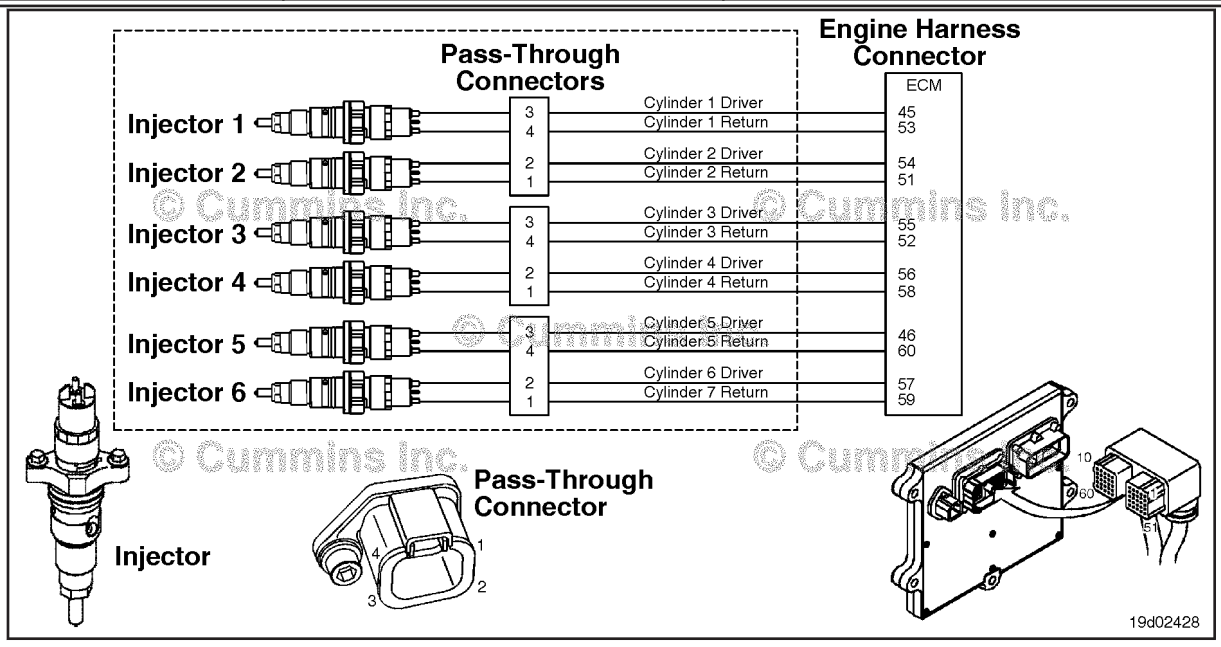
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 331

Injector Solenoid Driver Cylinder 2 Circuit - Current Below Normal or Open Circuit

CODES	REASON	EFFECT
Fault Code: 331 PID(P), SID(S): S002 SPN: 652 FMI: 5 Lamp: Amber SRT:	Injector Solenoid Driver Cylinder 2 Circuit - Current Below Normal or Open Circuit. High resistance or **no** current detected at number 2 injector driver or RETURN pin.	Engine can misfire or possibly run rough.



Injector Circuit

Circuit Description:

The injector solenoid valves control fueling quantity and injection timing. The engine control module (ECM) energizes the solenoid by closing a high-side and a low-side switch. There are two high-side switches and six low-side switches inside the ECM. The injectors for cylinders 1, 2, and 3 (front bank) share a single high-side switch that connects the injector circuit to the source of high voltage inside the ECM. Likewise, the injectors for cylinders 4, 5, and 6 (rear bank) also share a single high-side switch. Each injector circuit has a dedicated low-side switch that completes the circuit path to ground inside the ECM.

Component Location:

The engine harness connects the ECM to three injector circuit pass-through connectors that are located in the rocker housing. Internal injector harnesses are located under the valve cover and connect the injectors to the engine harness at the pass-through connectors. Each pass-through connector provides power and return to two injectors.

Shop Talk:

- Fault activation: The ECM senses current as each injector is actuated. If the ECM detects a persistent circuit error on an injector circuit, this fault will become active. If a circuit error is determined to cause excessive current, the ECM will disable the injection event for the faulty cylinders.
- Fault deactivation: The ECM will attempt to enable any disabled injector circuit whenever the engine is started and approximately once per minute while the engine is running. If an injector circuit fault is active and the faulty condition is repaired, the fault will become inactive once the engine is restarted or if the engine is permitted to idle for more than a minute.

- If a fault condition is intermittent and especially if more than one injector fault code is in the ECM memory, look for a wire harness that can short to components inside the rocker housing or a short circuit to ground in the injector solenoid.
- If more than one injector fault code is occurring and the faults occur for injector circuits in the same bank, a short circuit exists.
- If the faults occur intermittently or faults occur, the engine can exhibit a misfire even if the injector circuit fault code does **not always** register. If a single cylinder exhibits misfires, look for an open circuit problem. If several cylinders on the same bank exhibit misfires, look for a short circuit anywhere in the bank of cylinders.

Causes of a single injector fault are:

- Open circuit in the engine harness(es) or injector solenoid
- High resistance in a single injector or injector solenoid
- Extremely low resistance in an injector solenoid (injector shorted internally but **not** to ground)
- Damaged ECM.
- An intermittent short.

An intermittent short can result if the wiring harness insulation rubs through near a rocker lever. An intermittent short can cause a single injector fault code. For example, a short on the harness to cylinder number 1 causes a fault code for cylinder number 2 or cylinder number 3.

Causes of multiple injector fault codes in the same bank of injectors are:

- Short circuit in the engine harness(es) - either shorts to ground or to other wires in the engine harness
- Short circuit in any of the three injectors in the bank - shorts to ground
- Damaged ECM.

When looking for short circuits in the injector harnesses, pay particular attention to the wire insulation. Make sure there are **no** shorts to a rocker lever.

Note: Fault Code 951 (cylinder balance) can also be present due to this fault code.

Refer to Troubleshooting Fault Code t05-331.

FAULT CODE 331 - Injector Solenoid Driver Cylinder 2 Circuit - Current Below Normal or Open Circuit

TROUBLESHOOTING SUMMARY

⚠WARNING⚠

The injector solenoids receive high voltage when the engine is operating. To reduce the possibility of personal injury from electrical shock, do not wear jewelry or damp clothing, and do not touch the injector solenoids or the solenoid wires when the engine is operating.

⚠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 3164133 - male Deutsch™ test lead, Part Number 3164132 - female Deutsch™ 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 for active fault codes.**		
STEP 1A:	Read the fault codes with INSITE™ electronic service tool.	Fault Code 331 active?	
STEP 1B:	Read the fault codes with INSITE™ electronic service tool.	Fault Codes for other injectors on the same bank active?	
STEP 2:	**Check the injector and injector circuit for an open circuit.**		
STEP 2A:	Inspect the engine harness connections.	Connector properly connected?	
STEP 2B:	Inspect the engine harness and ECM connector pins.	Dirty or damaged pins?	
STEP 2C:	Check for an open circuit.	Less than 2 ohms?	
STEP 2C-1:	Check for high resistance or an open circuit in the injector solenoid and circuit.	Less than 2 ohms?	
STEP 2D:	Check for high resistance or an open circuit in the injector solenoid.	Fault code follow the injector?	
STEP 3:	**Check the engine harness.**		
STEP 3A:	Inspect the engine harness and injector pass-through connector pins.	Dirty or damaged pins?	
STEP 3B:	Check the injector harness circuits for short circuits to ground.	Greater than 100k ohms?	
STEP 3C:	Check the injector solenoids for short circuits to ground.	Greater than 100k ohms?	
STEP 4:	**Isolate the ECM or injector malfunction.**		
STEP 4A:	Check for active fault codes.	Same or multiple (same bank) injector fault codes active?	
STEP 4A-1:	Injector isolation.	Multiple (same bank) injector fault codes active?	

STEP 4A-2:	**Injector isolation.**	**Multiple (same bank) injector fault codes active?**
STEP 4A-3:	**Check for active fault codes.**	**Multiple (same bank) injector fault codes active?**

STEP 5: Clear the fault codes.

STEP 5A:	**Disable the fault code.**	**Same or multiple (same bank) injector fault codes active?**
STEP 5B:	**Clear the inactive fault codes.**	**All fault codes cleared?**

TROUBLESHOOTING STEP

STEP 1: Check for active fault codes.

STEP 1A: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 331 active? **YES**	1B
	Fault Code 331 active? **NO**	Refer to Procedure 019-362 in Section 19.

STEP 1B: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Read the fault codes. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Fault codes for other injectors on the same bank active? **YES**	3A
	Fault codes for other injectors on the same bank active? **NO**	2A

STEP 2: Check the injector and injector circuit for an open circuit.

STEP 2A: Inspect the engine harness connections.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Make sure the following engine harness connections are properly made: • Engine harness connected to the ECM • Engine harness connected to the injector pass-through connectors at the rocker housing.	Connectors properly connected? **YES**	2B
	Connectors properly connected? **NO** **Repair:** Install the engine harness connectors properly.	5A

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

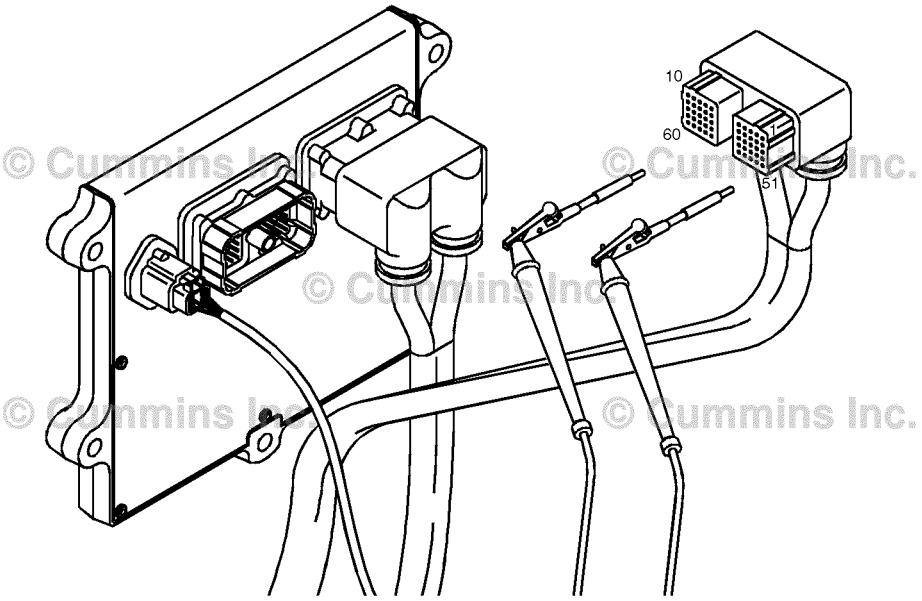
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Replace the engine harness. Refer to Procedure 019-043 in Section 19.	5A
Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **NO**	2C

STEP 2C: Check for an open circuit.

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

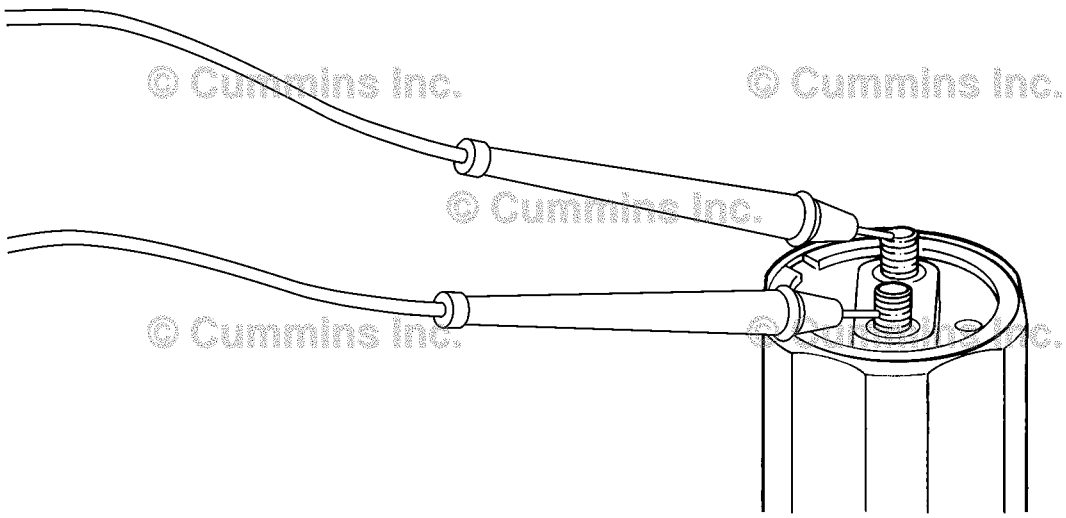
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 2 DRIVER pin and the cylinder number 2 RETURN pin on the harness. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 2 ohms? **YES**	2D
	Less than 2 ohms? **NO**	2C-1



STEP 2C-1: Check for high resistance or an open circuit in the injector solenoid and circuit.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 2 DRIVER pin and the cylinder number 2 RETURN pin on the injector solenoid. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Less than 2 ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for an open circuit. Repair or replace the damaged component.	5A
	Less than 2 ohms? **NO** **Repair:** Replace the injector. 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.	5A



STEP 2D: Check for high resistance or an open circuit in the injector solenoid.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Remove the injector and swap it with an injector in another bank. Refer to Procedure 006-026 in Section 6. • Turn keyswitch ON. • Operate engine and let it idle. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Did the fault code follow the injector? **YES** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A
	Did the fault code follow the injector? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A

STEP 3: Check the engine harness.

STEP 3A: Inspect the engine harness and injector pass-through connector pins.

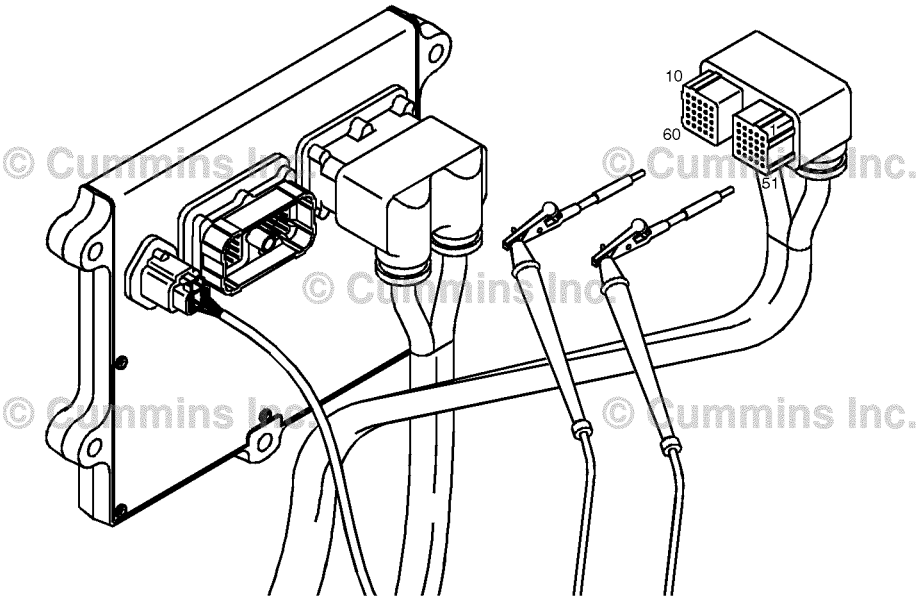
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Refer to Procedure 019-043 in Section 19.	5A
	Dirty or damaged pins? **NO**	3B

STEP 3B: Check the injector harness circuits for short circuits to ground.

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

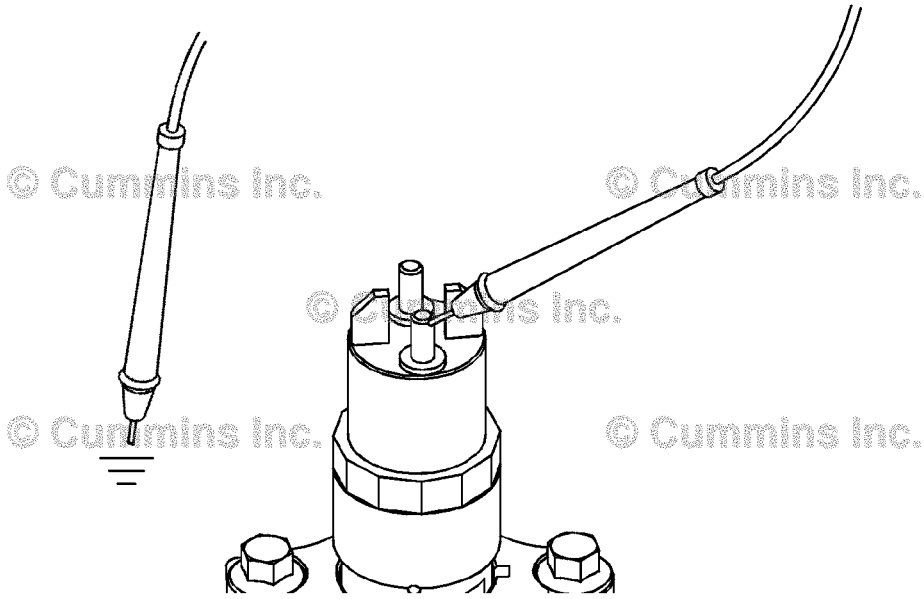
Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder number 1 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 2 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 3 SIGNAL pin and engine block ground. Refer to the circuit diagram or the wiring diagram for connector pin idenfication. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	4A
	Greater than 100k ohms? **NO**	3C



STEP 3C: Check the injector solenoids for short circuits to ground.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injectors being tested.

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder 1 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder 2 SIGNAL pin and engine block ground • Measure the resistance between the cylinder 3 SIGNAL pin and engine block ground. Reference the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for a short circuit. • Repair or replace the damaged component.	5A
	Greater than 100k ohms? **NO** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4: Isolate the ECM or injector malfunction.

STEP 4A: Check for active fault codes.

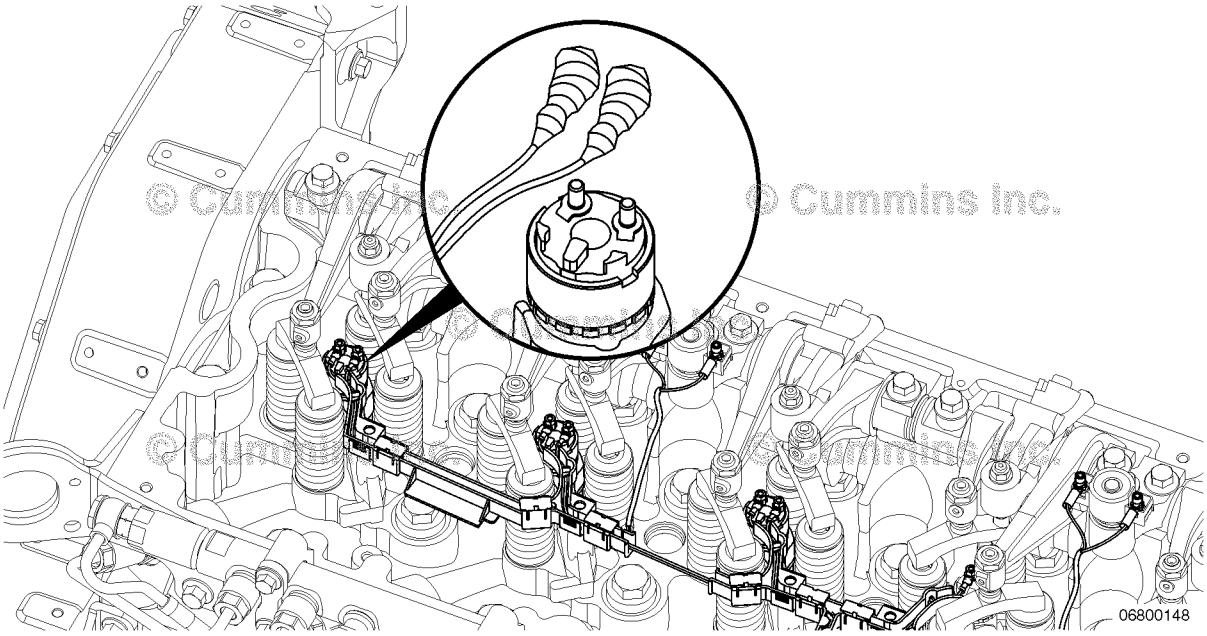
Condition:
- Connect all components.
- Place the rocker cover on the cylinder head and install the capscrews loosely so that the engine may run at idle.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes. Bank fault codes: • Bank 1 - Front Bank: Fault Codes 322, 324, and 331. • Bank 2 - Rear Bank: Fault Codes 323, 325, and 332.	Same or multiple (same bank) injector fault codes active? **YES**	4A-1
	Same or multiple (same bank) injector fault codes active? **NO**	5A

STEP 4A-1: Injector isolation.

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

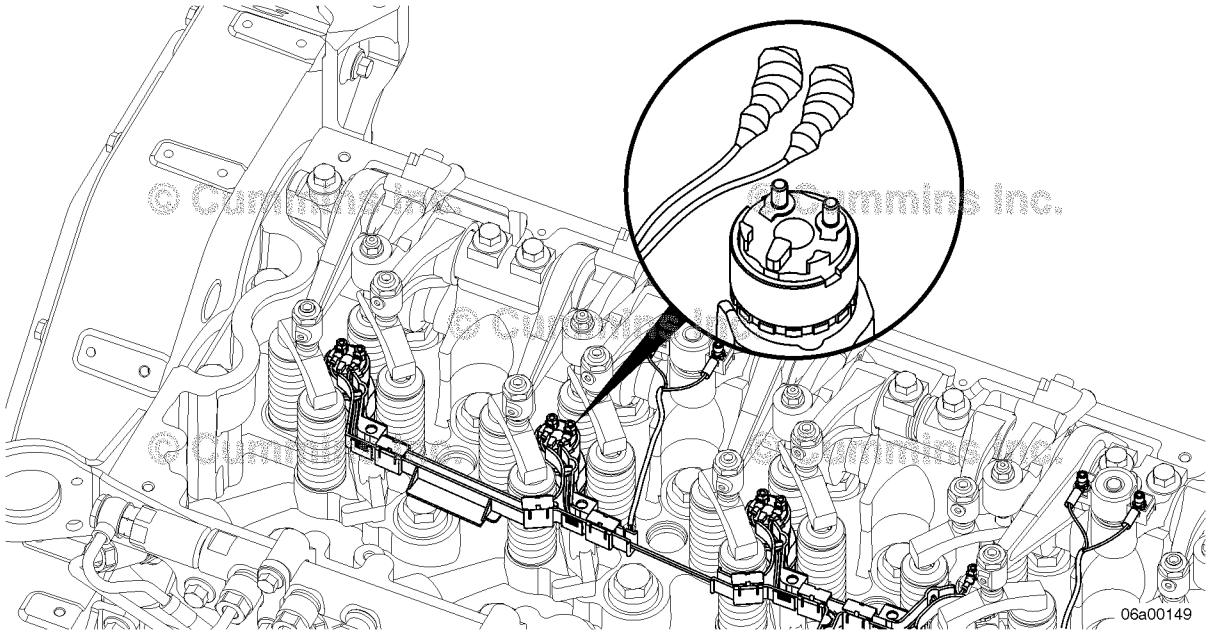
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Disconnect the injector wiring harness from injector number 1. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-2
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 1. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-2: Injector isolation.

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

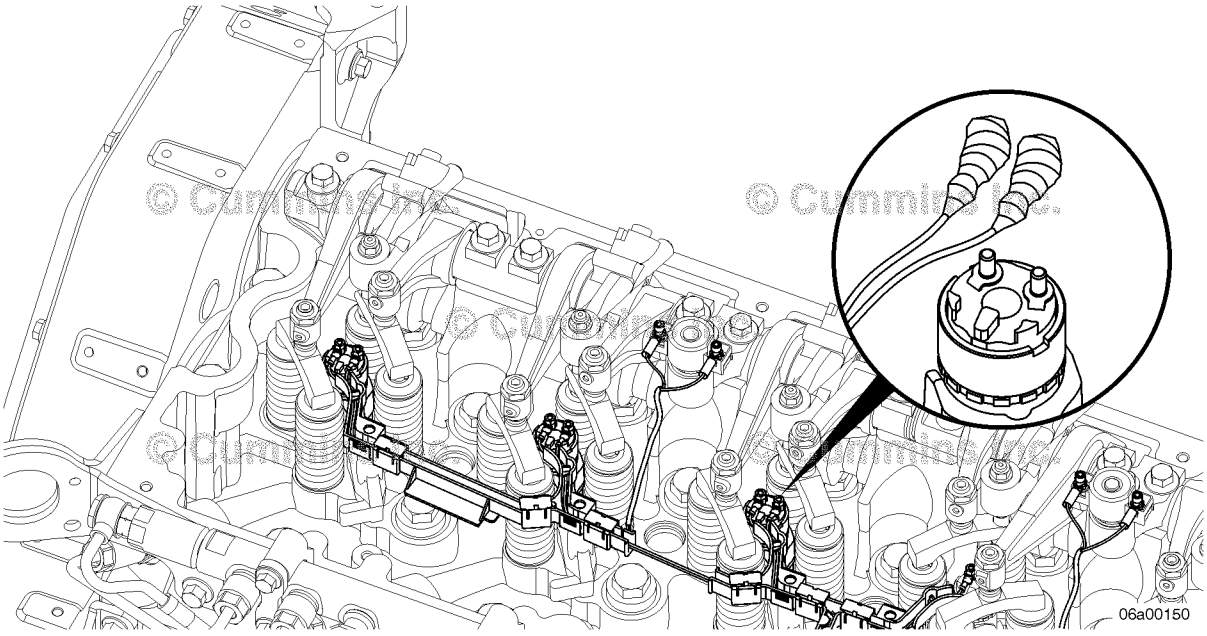
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 1. • Disconnect the injector wiring harness from injector number 2. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-3
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 2. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-3: Check for active fault codes.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 2. • Disconnect the injector wiring harness from injector number 3. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 3. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault codes are inactive.	Same or multiple (same bank) injector fault codes active? **YES** **Repair:** Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1B
	Same or multiple (same bank) injector fault codes active? **NO**	5B

STEP 5B: Clear the inactive fault codes.

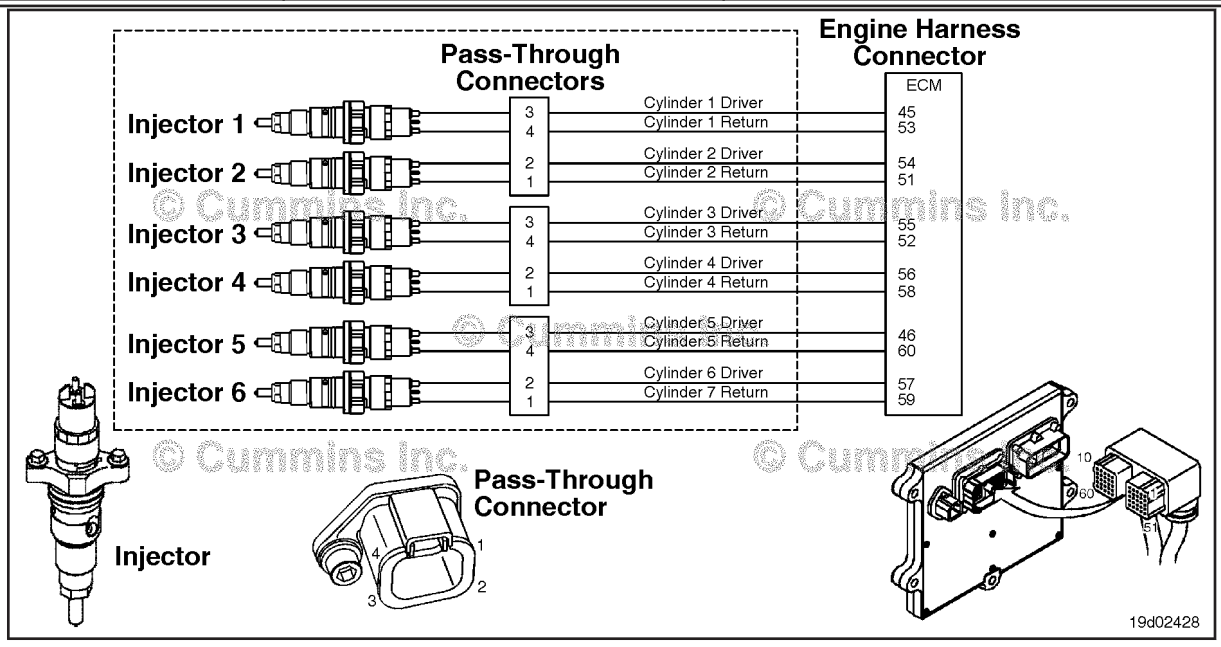
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 332

Injector Solenoid Driver Cylinder 4 Circuit - Current Below Normal or Open Circuit

CODES	REASON	EFFECT
Fault Code: 332 PID(P), SID(S): S004 SPN: 654 FMI: 5 Lamp: Amber SRT:	Injector Solenoid Driver Cylinder 4 Circuit - Current Below Normal or Open Circuit. High resistance or **no** current detected at number 4 injector driver or RETURN pin.	Engine can misfire or possibly run rough.



Injector Circuit

Circuit Description:

The injector solenoid valves control fueling quantity and injection timing. The engine control module (ECM) energizes the solenoid by closing a high-side and a low-side switch. There are two high-side switches and six low-side switches inside the ECM. The injectors for cylinders 1, 2, and 3 (front bank) share a single high-side switch that connects the injector circuit to the source of high voltage inside the ECM. Likewise, the injectors for cylinders 4, 5, and 6 (rear bank) also share a single high-side switch. Each injector circuit has a dedicated low-side switch that completes the circuit path to ground inside the ECM.

Component Location:

The engine harness connects the ECM to three injector circuit pass-through connectors that are located in the rocker housing. Internal injector harnesses are located under the valve cover and connect the injectors to the engine harness at the pass-through connectors. Each pass-through connector provides power and return to two injectors.

Shop Talk:

- Fault activation: The ECM senses current as each injector is actuated. If the ECM detects a persistent circuit error on an injector circuit, this fault will become active. If a circuit error is determined to cause excessive current, the ECM will disable the injection event for the faulty cylinders.
- Fault deactivation: The ECM will attempt to enable any disabled injector circuits whenever the engine is started and approximately once per minute while the engine is running. If an injector circuit fault is active and the faulty condition is repaired, the fault will become inactive once the engine is restarted or if the engine is permitted to idle for more than a minute.

- If a fault condition is intermittent and especially if more than one injector fault code is in the ECM memory, look for a wire harness that can short to components inside the rocker housing or a short circuit to ground in the injector solenoid.
- If more than one injector fault code is occurring and the faults occur for injector circuits in the same bank, a short circuit exists.
- If the faults occur intermittently or fault occurs, the engine can exhibit a misfire even if the injector circuit fault code does **not always** register. If a single cylinder exhibits misfires, look for an open circuit problem. If several cylinders on the same bank exhibit misfires, look for a short circuit anywhere in the bank of cylinders.

Causes of a single injector fault are:

- Open circuit in the engine harness(es) or injector solenoid
- High resistance in a single injector or injector solenoid
- Extremely low resistance in an injector solenoid (injector shorted internally but **not** to ground)
- Damaged ECM.
- An intermittent short.

An intermittent short can result if the wiring harness insulation rubs through near a rocker lever. An intermittent short can cause a single injector fault code. For example, a short on the harness to cylinder number 1 causes a fault code for cylinder number 2 or cylinder number 3.

Causes of multiple injector fault codes in the same bank of injectors are:

- Short circuit in the engine harness(es) - either shorts to ground or to other wires in the engine harness
- Short circuit in any of the three injectors in the bank - shorts to ground
- Damaged ECM.

When looking for short circuits in the injector harnesses, pay particular attention to the wire insulation. Make sure there are **no** shorts to a rocker lever.

Note: Fault Code 951 (cylinder balance) can also be present due to this fault code.

Refer to Troubleshooting Fault Code t05-332.

FAULT CODE 332 - Injector Solenoid Driver Cylinder 4 Circuit - Current Below Normal or Open Circuit
TROUBLESHOOTING SUMMARY

⚠WARNING⚠

The injector solenoids receive high voltage when the engine is operating. To reduce the possibility of personal injury from electrical shock, do not wear jewelry or damp clothing, and do not touch the injector solenoids or the solenoid wires when the engine is operating.

⚠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 3164133 - male Deutsch™ test lead, Part Number 3164132 - female Deutsch™ 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 for active fault codes.**		
STEP 1A:	Read the fault codes with INSITE™ electronic service tool.	Fault Code 332 active?	
STEP 1B:	Read the fault codes with INSITE™ electronic service tool.	Fault Codes for other injectors on the same bank active?	
STEP 2:	**Check the injector and injector circuit for an open circuit.**		
STEP 2A:	Inspect the engine harness connections.	Connector properly connected?	
STEP 2B:	Inspect the engine harness and ECM connector pins.	Dirty or damaged pins?	
STEP 2C:	Check for an open circuit.	Less than 2 ohms?	
STEP 2C-1:	Check for high resistance or an open circuit in the injector solenoid and circuit.	Less than 2 ohms?	
STEP 2D:	Check for high resistance or an open circuit in the injector solenoid.	Fault code follow the injector?	
STEP 3:	**Check the engine harness.**		
STEP 3A:	Inspect the engine harness and injector pass-through connector pins.	Dirty or damaged pins?	
STEP 3B:	Check the injector harness circuits for short circuits to ground.	Greater than 100k ohms?	
STEP 3C:	Check the injector solenoids for short circuits to ground.	Greater than 100k ohms?	
STEP 4:	**Isolate the ECM or injector malfunction.**		
STEP 4A:	Check for active fault codes.	Same or multiple (same bank) injector fault codes active?	
STEP 4A-1:	Injector isolation.	Multiple (same bank) injector fault codes active?	

STEP 4A-2:	**Injector isolation.**	**Multiple (same bank) injector fault codes active?**
STEP 4A-3:	**Check for active fault codes.**	**Multiple (same bank) injector fault codes active?**

STEP 5: Clear the fault codes.

STEP 5A:	**Disable the fault code.**	**Same or multiple (same bank) injector fault codes active?**
STEP 5B:	**Clear the inactive fault codes.**	**All fault codes cleared?**

TROUBLESHOOTING STEP

STEP 1: Check for active fault codes.

STEP 1A: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 332 active? **YES**	1B
	Fault Code 332 active? **NO**	Refer to Procedure 019-362 in Section 19.

STEP 1B: Read the fault codes with INSITE™ electronic service tool.

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

Action	Specification/Repair	Next Step
Read the fault codes. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Fault codes for other injectors on the same bank active? **YES**	3A
	Fault codes for other injectors on the same bank active? **NO**	2A

STEP 2: Check the injector and injector circuit for an open circuit.

STEP 2A: Inspect the engine harness connections.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Make sure the following engine harness connections are properly made: • Engine harness connected to the ECM • Engine harness connected to the injector pass-through connectors at the rocker housing.	Connectors properly connected? **YES**	2B
	Connectors properly connected? **NO** **Repair:** Install the engine harness connectors properly.	5A

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

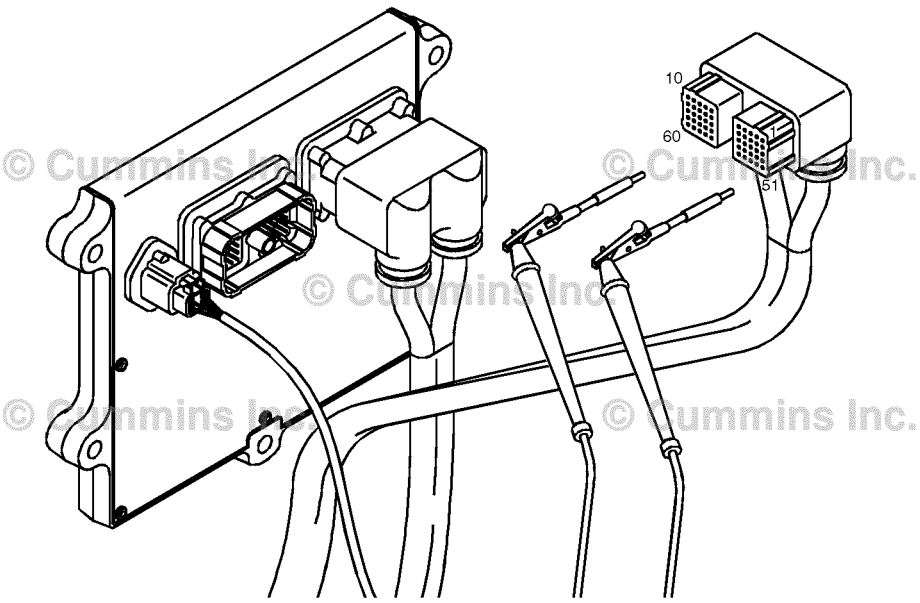
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Replace the engine harness. Refer to Procedure 019-043 in Section 19.	5A
Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **NO**	2C

STEP 2C: Check for an open circuit.

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

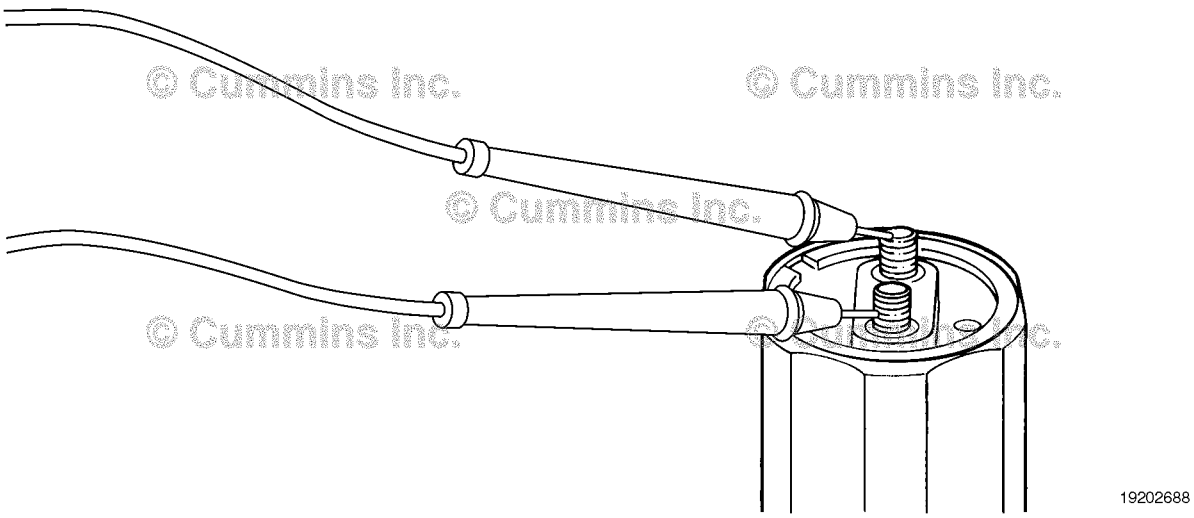
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 4 DRIVER pin and the cylinder number 4 RETURN pin on the harness. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 2 ohms? **YES**	2D
	Less than 2 ohms? **NO**	2C-1



STEP 2C-1: Check for high resistance or an open circuit in the injector solenoid and circuit.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the cylinder number 4 DRIVER pin and the cylinder number 4 RETURN pin on the injector solenoid. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Less than 2 ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for an open circuit. Repair or replace the damaged component.	5A
	Less than 2 ohms? **NO** **Repair:** Replace the injector. 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.	5A



STEP 2D: Check for high resistance or an open circuit in the injector solenoid.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Remove the injector and swap it with an injector in another bank. Refer to Procedure 006-026 in Section 6. • Turn keyswitch ON. • Operate engine and let it idle. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Did the fault code follow the injector? **YES** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A
	Did the fault code follow the injector? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A

STEP 3: Check the engine harness.

STEP 3A: Inspect the engine harness and injector pass-through connector pins.

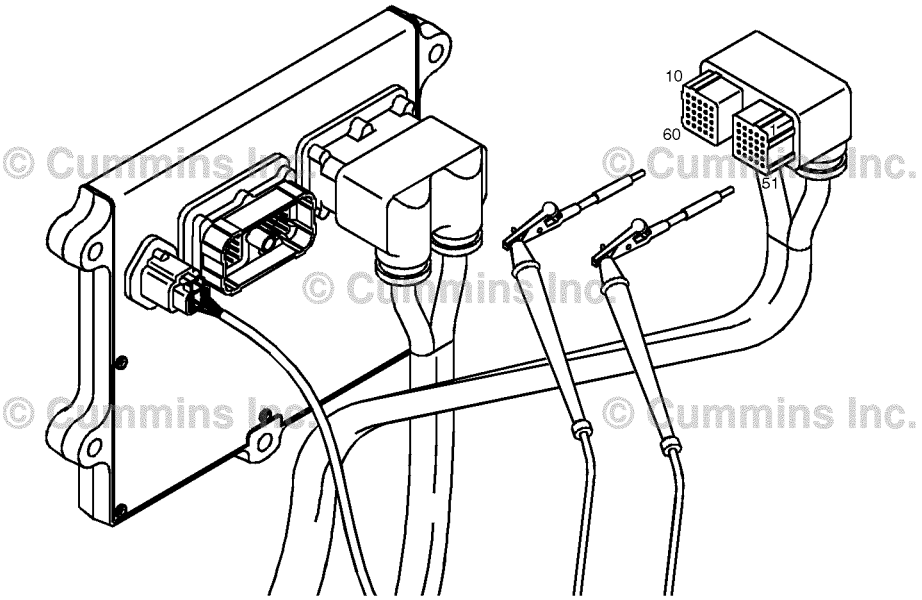
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Refer to Procedure 019-043 in Section 19.	5A
	Dirty or damaged pins? **NO**	3B

STEP 3B: Check the injector harness circuits for short circuits to ground.

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

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder number 4 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 5 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder number 6 SIGNAL pin and engine block ground. Refer to the circuit diagram or the wiring diagram for connector pin idenfication. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	4A
	Greater than 100k ohms? **NO**	3C



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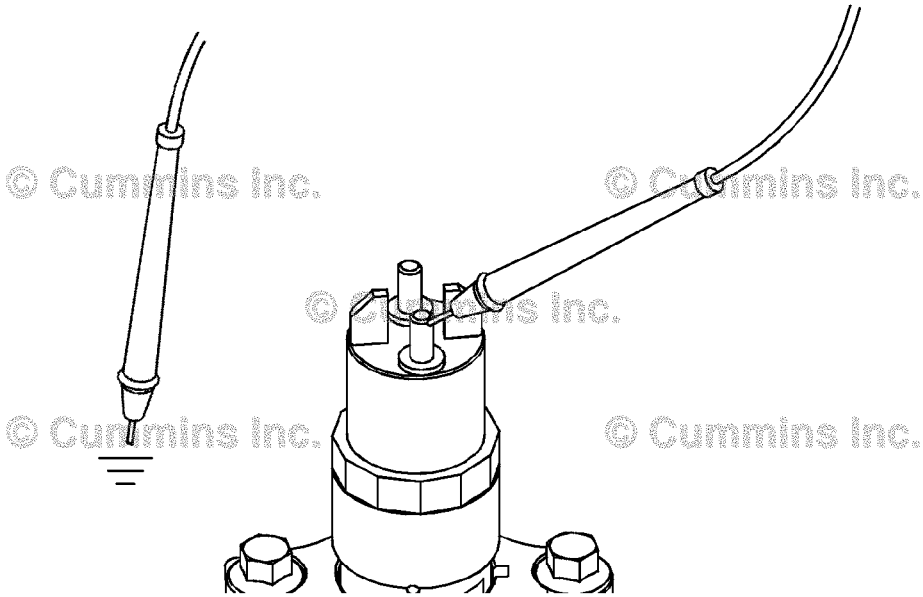
STEP 3C: Check the injector solenoids for short circuits to ground.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injectors being tested.

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder 4 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder 5 SIGNAL pin and engine block ground • Measure the resistance between the cylinder 6 SIGNAL pin and engine block ground. Reference the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for a short circuit. • Repair or replace the damaged component.	5A
	Greater than 100k ohms? **NO** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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STEP 4: Isolate the ECM or injector malfunction.

STEP 4A: Check for active fault codes.

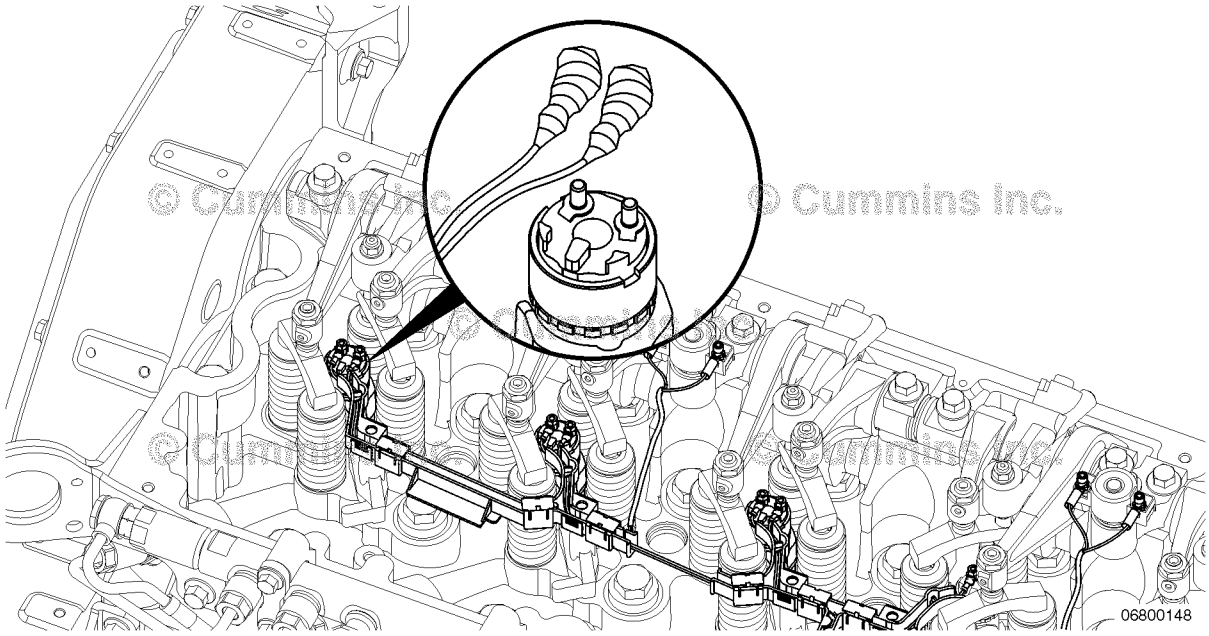
Condition:
- Connect all components.
- Place the rocker cover on the cylinder head and install the capscrews loosely so that the engine may run at idle.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes. Bank fault codes: • Bank 1 - Front Bank: Fault Codes 322, 324, and 331. • Bank 2 - Rear Bank: Fault Codes 323, 325, and 332.	Same or multiple (same bank) injector fault codes active? **YES**	4A-1
	Same or multiple (same bank) injector fault codes active? **NO**	5A

STEP 4A-1: Injector isolation.

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

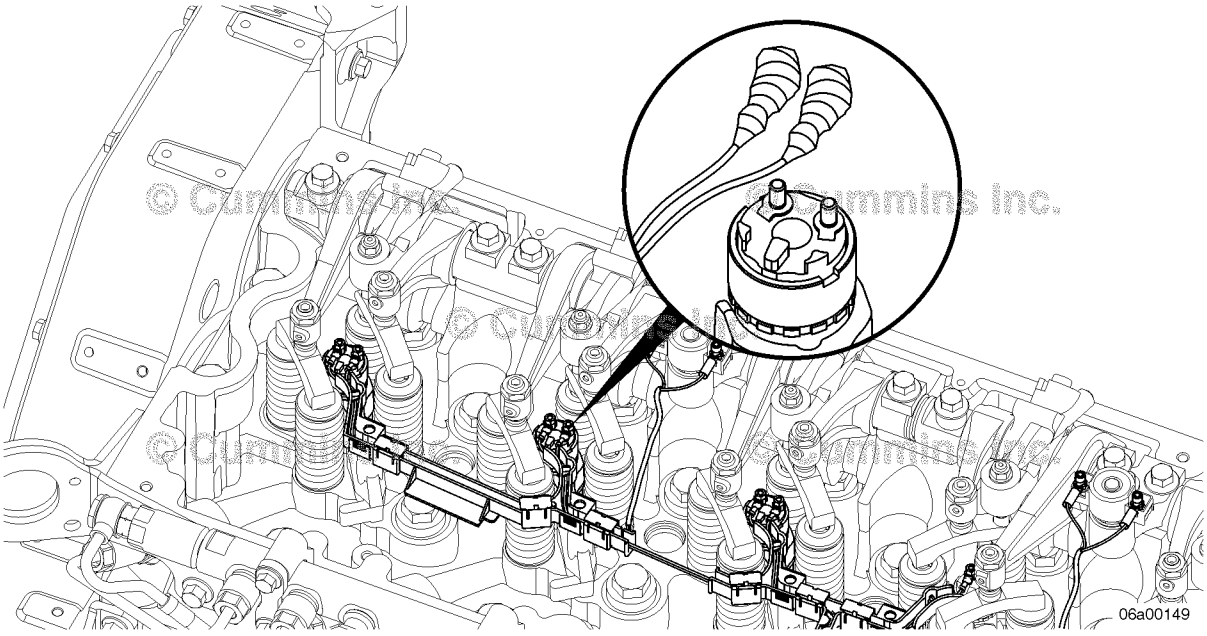
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Disconnect the injector wiring harness from injector number 4. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-2
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 4. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-2: Injector isolation.

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

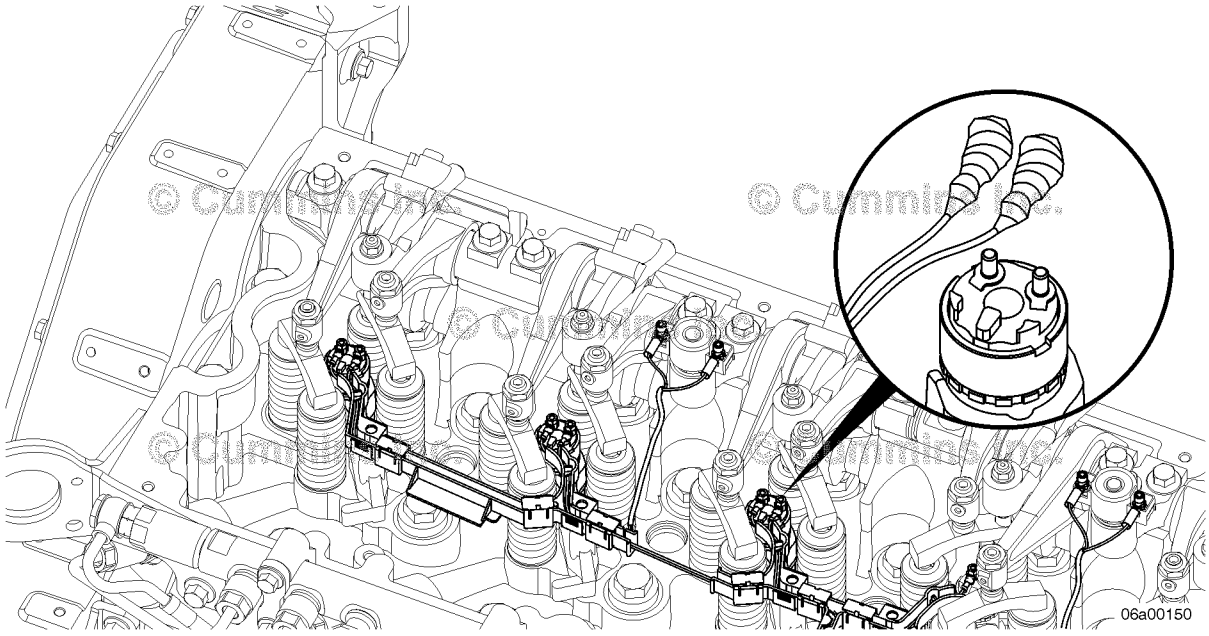
Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 4. • Disconnect the injector wiring harness from injector number 5. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-3
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 5. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



STEP 4A-3: Check for active fault codes.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Connect the injector wiring harness to injector 5. • Disconnect the injector wiring harness from injector number 6. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 6. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify that the fault codes are inactive.	Same or multiple (same bank) injector fault codes active? **YES** **Repair:** Return to the troubleshooting steps or contact a Cummins® Authorized Repair Location if all steps have been completed and checked again.	1B
	Same or multiple (same bank) injector fault codes active? **NO**	5B

STEP 5B: Clear the inactive fault codes.

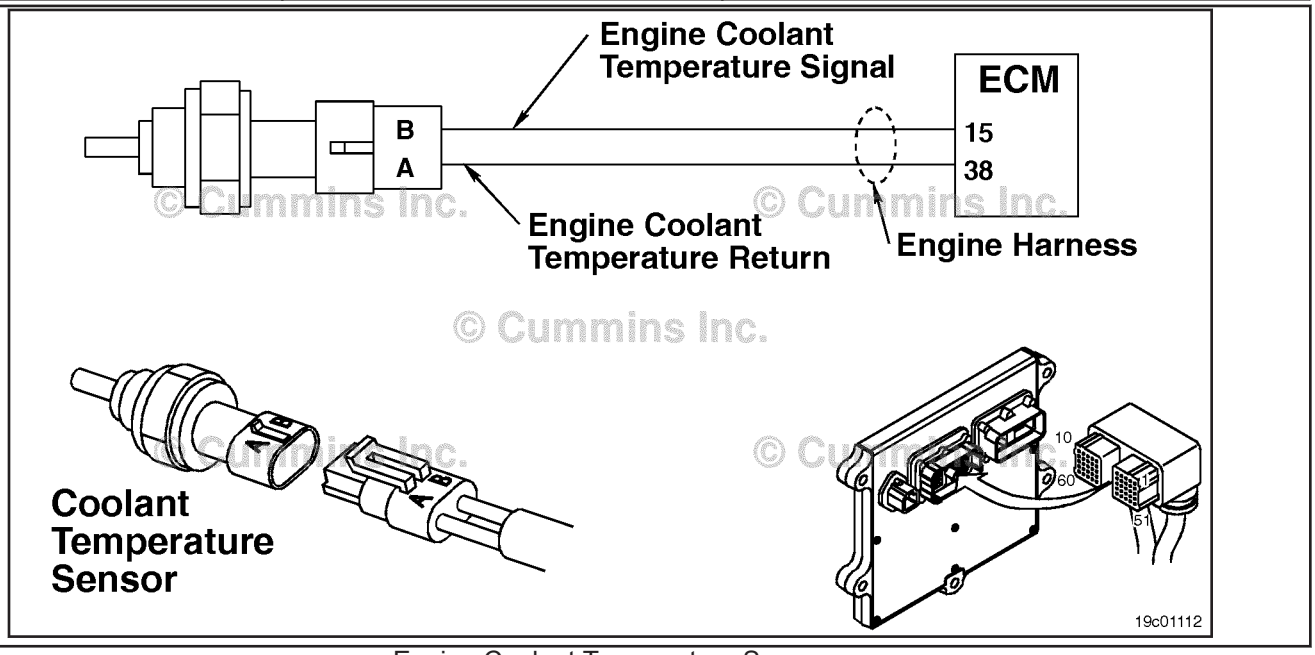
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 334

Engine Coolant Temperature - Data Erratic, Intermittent, or Incorrect

CODES	REASON	EFFECT
Fault Code: 334 PID(P), SID(S): P110 SPN: 110 FMI: 2 Lamp: Amber SRT:	Engine Coolant Temperature - Data Erratic, Intermittent, or Incorrect. The engine coolant temperature reading is **not** changed with engine operating conditions.	The ECM will estimate engine coolant temperature.



Engine Coolant Temperature Sensor

Circuit Description:

The engine coolant temperature sensor is used by the electronic control module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is use by the ECM for the engine protection system and engine emission control.

Component Location:

The engine coolant temperature sensor is located on the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

Two different failure modes of the engine coolant temperature sensor can trigger this fault code. The engine **must** be turned off for period of 8 hours before this diagnostic will run. When the keyswitch is turned ON after an 8 hour cold soak, engine coolant temperature is compared to intake manifold temperature. If coolant temperature is found to be higher than intake manifold temperature by a calibratable value, the fault code is logged. The diagnostic also checks to make sure that coolant temperature increases during the first 10 minutes of engine operation. If coolant temperature does **not** increase by a calibratable value, this fault code is logged.

Possible causes of this fault code include:

- Stuck in-range engine coolant temperature sensor.
- High resistance in the engine coolant temperature sensor signal or return lines.

On-Board Diagnostics (OBD) Information (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.
- 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 t05-334

FAULT CODE 334 - Engine Coolant Temperature - Data Erratic, Intermittent, or Incorrect

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check for sensor circuit fault codes.**		
STEP 1A:	**Check for Fault Code 144 and 145.**	**Fault Code 144 and 145 is active?**	
STEP 2:	**Check the thermostat.**		
STEP 2A:	**Check the thermostat.**	**Thermostat operate correctly?**	
STEP 3:	**Check the engine coolant temperature sensor and circuit.**		
STEP 3A:	**Inspect the engine coolant temperature sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 3B:	**Check the circuit response.**	**Fault Code 144 active?**	
STEP 3C:	**Check the circuit response.**	**Fault Code 145 active?**	
STEP 4:	**Check the engine control module (ECM) and engine harness.**		
STEP 4A:	**Inspect ECM and engine harness connector pins.**	**Dirty or damage pins?**	
STEP 4B:	**Check the circuit response.**	**Fault Code 144 active?**	
STEP 4C:	**Check the circuit response.**	**Fault Code 145 active?**	
STEP 5:	**Clear the fault code.**		
STEP 5A:	**Disable the fault code.**	**Fault Code 334 inactive?**	
STEP 5B:	**Clear the inactive fault codes.**	**All faults cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check for sensor circuit fault codes.

STEP 1A: Check for Fault Codes 144 and 145.

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

Action	Specification/Repair	Next Step
Check for active fault codes. • Use INSITE™ electronic service tool to read the fault codes	Fault Code 144 or 145 is active? **YES**	Fault Code 144 or 145 troubleshooting tree.
	Fault Code 144 or 145 is active? **NO**	2A

STEP 2: Check the thermostat.

STEP 2A: Check the thermostat

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Check the thermostat for correct operation. • For ISBe, ISB, and QSB5.9 (Common Rail Fuel System). Refer to Procedure 008-013 in Section 8. • For ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4, and QSL9 Engines. Refer to Procedure 008-013 in Section 8.	Thermostat operate correctly? **YES**	3A
	Thermostat operate correctly? **NO** **Repair:** Replace the thermostat. • For ISBe, ISB, and QSB5.9 (Common Rail Fuel System). Refer to Procedure 008-013 in Section 8. • For ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4, and QSL9 Engines. Refer to Procedure 008-013 in Section 8.	5A

STEP 3: Check the engine coolant temperature sensor and circuit.

STEP 3A: Inspect the engine coolant temperature sensor and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant temperature sensor and connector pins.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine coolant temperature sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-071 in Section 19.	5A
	Dirty or damaged pins? **NO**	3B

STEP 3B: Check the circuit response.

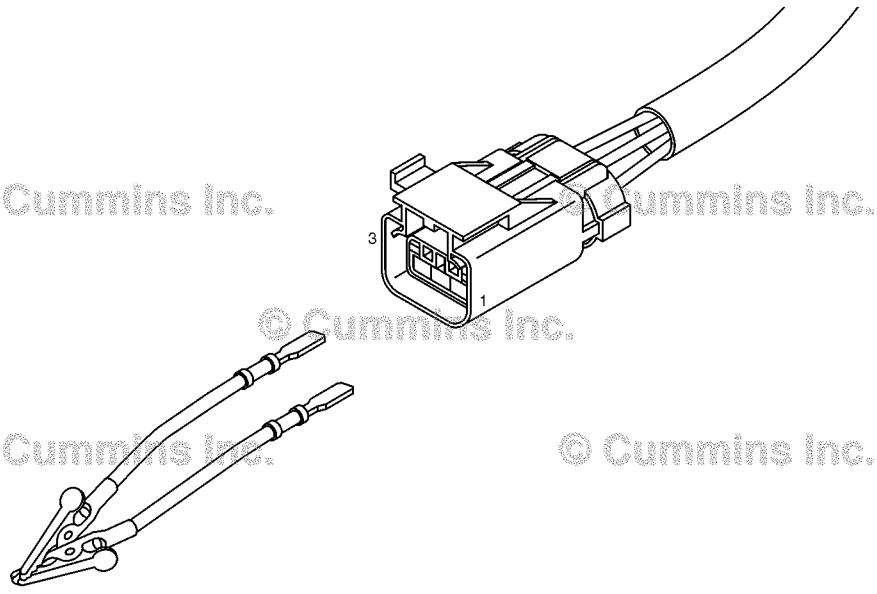
Condition:
- Turn keyswitch OFF.
- Disconnect the engine coolant temperature sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 active? **YES**	3C
	Fault Code 144 active? **NO**	4A

STEP 3C: 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
Place a jumper wire between the engine coolant temperature SIGNAL pin and the engine coolant temperature RETURN pin at the engine coolant temperature connector of the engine harness. Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 145 active? **YES** **Repair:** Replace the engine coolant temperature sensor. Refer to Procedure 019-019 in Section 19.	5A
	Fault Code 145 active? **NO**	4A



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STEP 4: Check the ECM and engine harness.

STEP 4A: 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: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	5A
	Dirty or damaged pins? **NO**	4B

STEP 4B: 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. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 144 active? **YES**	4C
	Fault Code 144 active? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A

STEP 4C: 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 coolant temperature SIGNAL pin and engine coolant temperature RETURN pin at the ECM engine connector. Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 145 active? **YES** **Repair:** High resistance or a short circuit has been detected in the engine harness. Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19.	5A
	Fault Code 145 active? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A

STEP 5: Clear the fault code.

STEP 5A: Disable the fault code.

Condition:
- Connect all components.
- Make sure coolant temperature is equal to ambient air temperature.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable the fault code. To allow this diagnostic to run, the keyswitch **must** be turned OFF for a minimum of 8 hours. This will allow the coolant temperature to stabilize down to ambient temperature. The engine **must** be started and warmed up to operating temperature before the fault code will be disabled. • Start the engine with coolant temperature near ambient air temperature. • Operate the engine until coolant temperature reaches thermostat opening temperature. • Use INSITE™ electronic service tool to verify that the fault code is inactive. Note: The coolant temperature **must** be equal to ambient air temperature before starting the engine.	Fault Code 334 inactive? **YES**	5B
	Fault Code 334 inactive? **NO**	1A

STEP 5B: Clear the inactive fault codes.

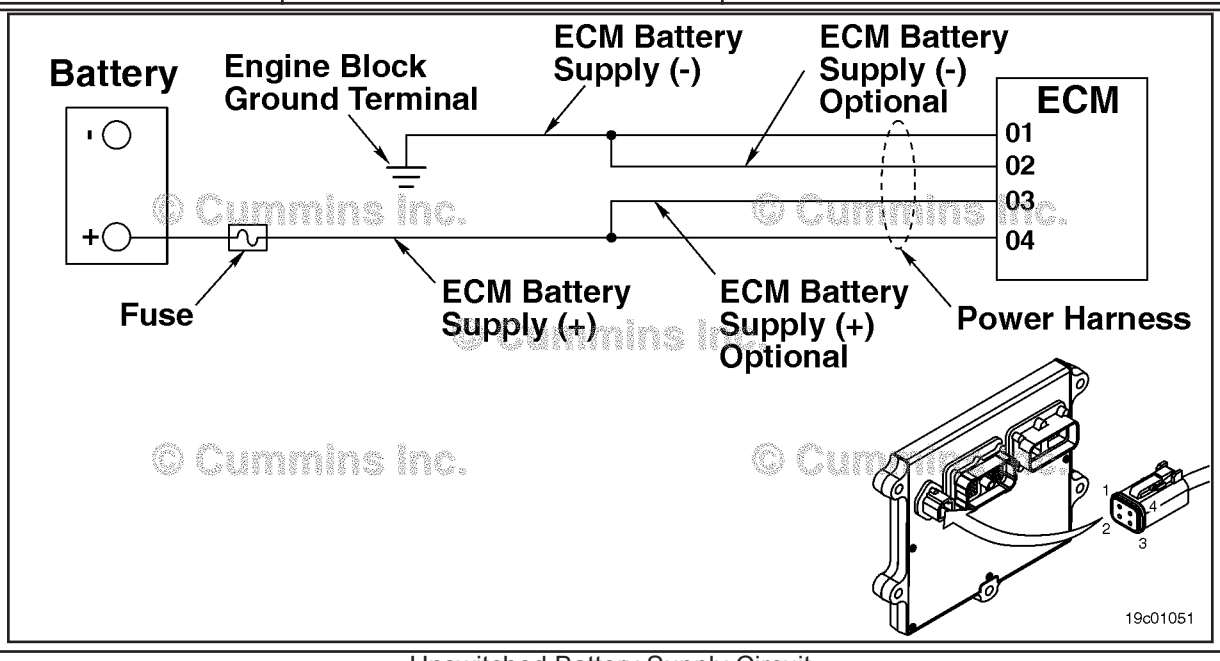
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Clear the inactive fault codes. • Use INSITE™ electronic service tool to clear the inactive fault codes.	All faults cleared? **YES**	Repair complete.
	All Faults cleared? **NO**	Appropriate troubleshooti ng steps.

Fault Code 341

Engine Control Module Data Lost - Data Erratic, Intermittent or Incorrect

CODES	REASON	EFFECT
Fault Code: 341 PID(P), SID(S): S253 SPN: 630 FMI: 2/2 Lamp: Amber SRT:	Engine Control Module Data Lost - Data Erratic, Intermittent or Incorrect. 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. In marine applications this is a 25 ampere fuse on 12 VDC systems and a 15 ampere fuse on 24 VDC 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. Pins 2 and 3 are optional circuits possibly **not** used by the OEM. In marine applications **only** circuits 1 and 3 are use for unswitched battery. Refer to the OEM circuit diagram or 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 t05-341

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 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:	**Clear the fault codes.**		
STEP 5A:	**Disable the fault code.**	**Fault Code 341 inactive?**	
STEP 5B:	**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 to read the fault codes.

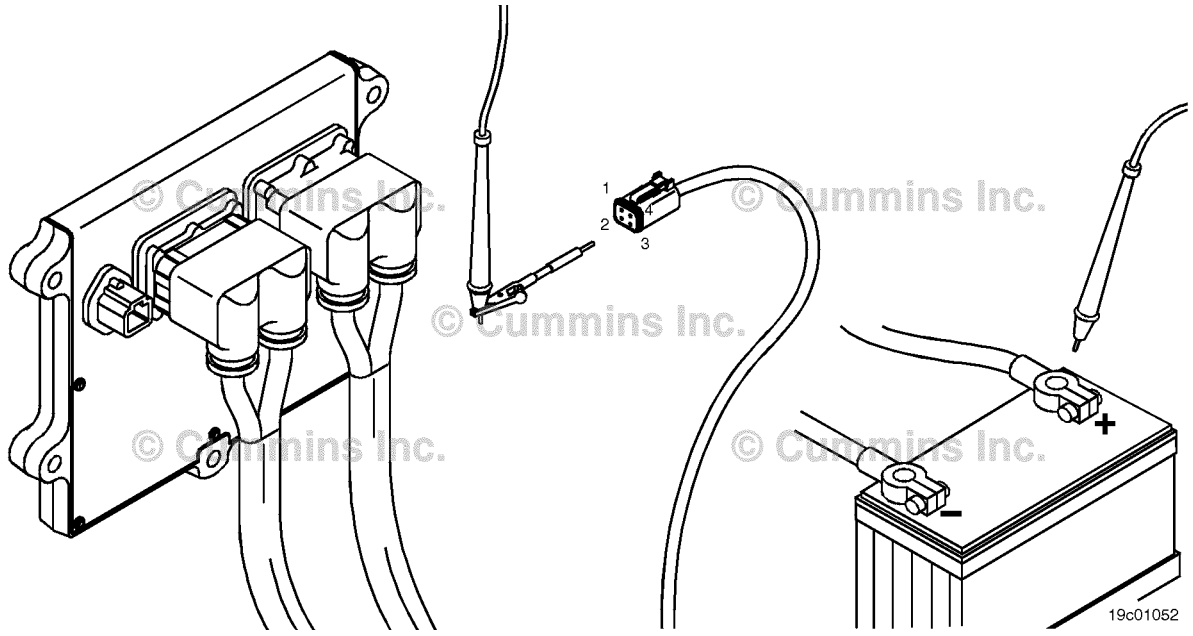
Action	Specification/Repair	Next Step
Check for an active fault code. • Use INSITE™ electronic service tool to read the fault codes.	Are other fault codes active? **YES** **Repair:** Troubleshoot the active fault codes.	Go to appropriate fault code troubleshooting tree.
	Are other fault codes active? **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.

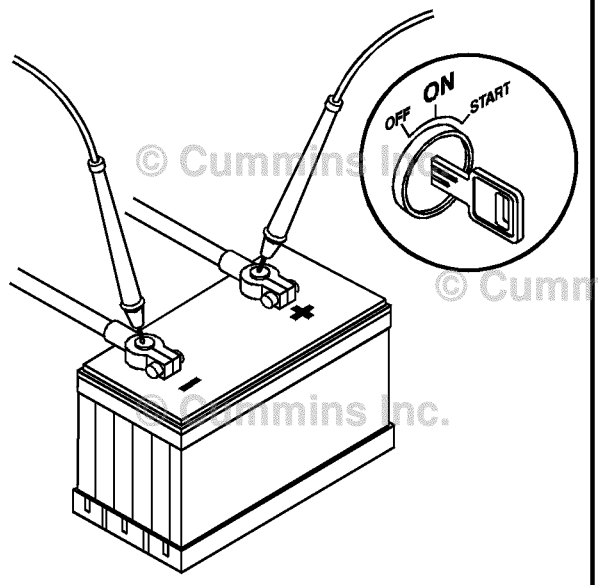
Action	Specification/Repair	Next Step
Check the resistance of the battery supply circuit. • Use a multimeter to measure the resistance between the ECM battery SUPPLY (+) pin of the power harness ECM connector and the positive (+) battery terminal. • Use a multimeter to measure the resistance between the ECM battery SUPPLY (-) pin of the power harness ECM connector and the engine block ground. Refer to the circuit diagram or wiring diagram for connector pin identification. 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? **YES**	2B
	Less than 10 ohms? **NO**	3A

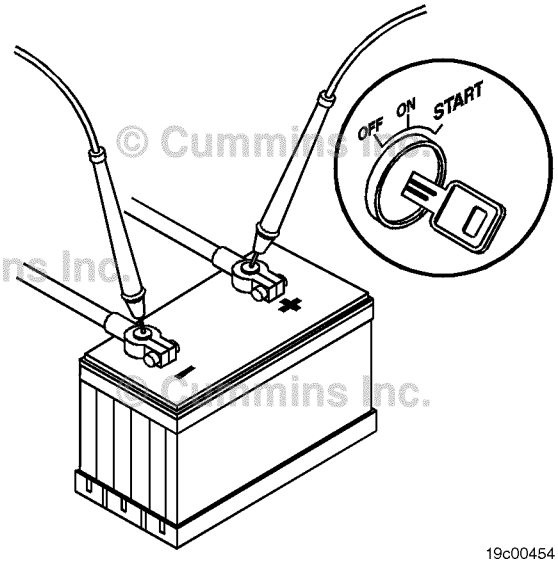


STEP 2B: Check the battery voltage.

Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the battery voltage. • 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)? **YES**	2C
	Normal conditions: At least (+) 12 VDC? (During cranking: At least (+) 6.2 VDC)? **NO** **Repair:** Charge or replace the battery. Refer to the OEM troubleshooting and repair manual.	5A





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STEP 2C: Check the battery connections.

Condition:
- Turn keyswitch OFF.

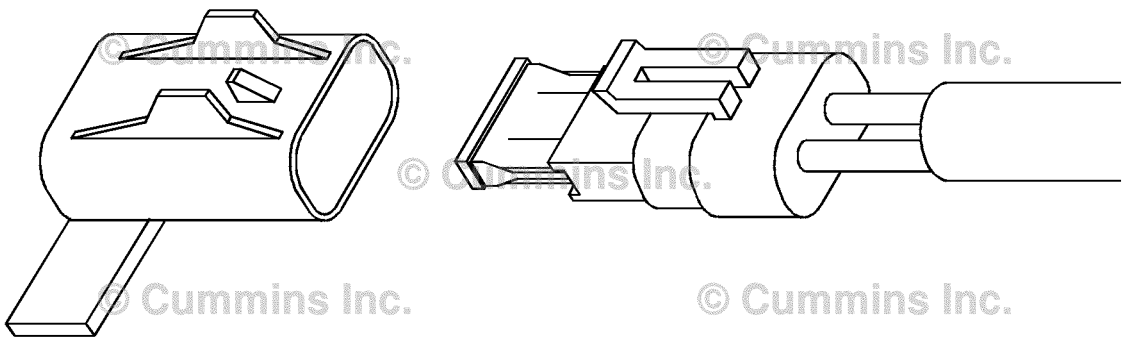
Action	Specification/Repair	Next Step
Check the battery connections. • Inspect the battery terminal connections.	Are connections tight and corrosion-free? **YES**	4A
	Are connections tight and corrosion-free? **NO** **Repair:** Tighten the loose connections and clean the terminals. Refer to the OEM troubleshooting 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? **YES**	3B
	Are fuses installed correctly? **NO** **Repair:** Install the fuses correctly. Refer to Procedure 019-198.	5A



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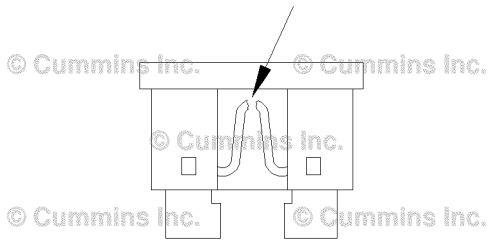
STEP 3B: Verify that the OEM fuses are not blown.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Verify that the OEM fuses are not blown.	Are any fuses blown? **YES** **Repair:** Replace the fuses.	5A
	Are any fuses blown? **NO** **Repair:** Repair or replace the OEM harness. Refer to Procedure 019-071.	5A



19800238

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. • 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? **YES** **Repair:** Repair or replace the damaged wiring.	5A
	Are any wires damaged? **NO** **Repair:** Verify the OEM power supply wiring to the Electronic Control Module (ECM) is correct. Refer to the Original Equipment Manufacturer (OEM) wiring diagram.	5A

STEP 5: Clear the fault codes.

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. • Turn keyswitch OFF and wait 30 seconds. • Turn keyswitch ON. • Use INSITE™ electronic service tool to verify Fault Code 341 is inactive.	Fault Code 341 inactive? **YES**	5B
	Fault Code 341 inactive? **NO** **Repair:** 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 5B: Clear the inactive fault codes.

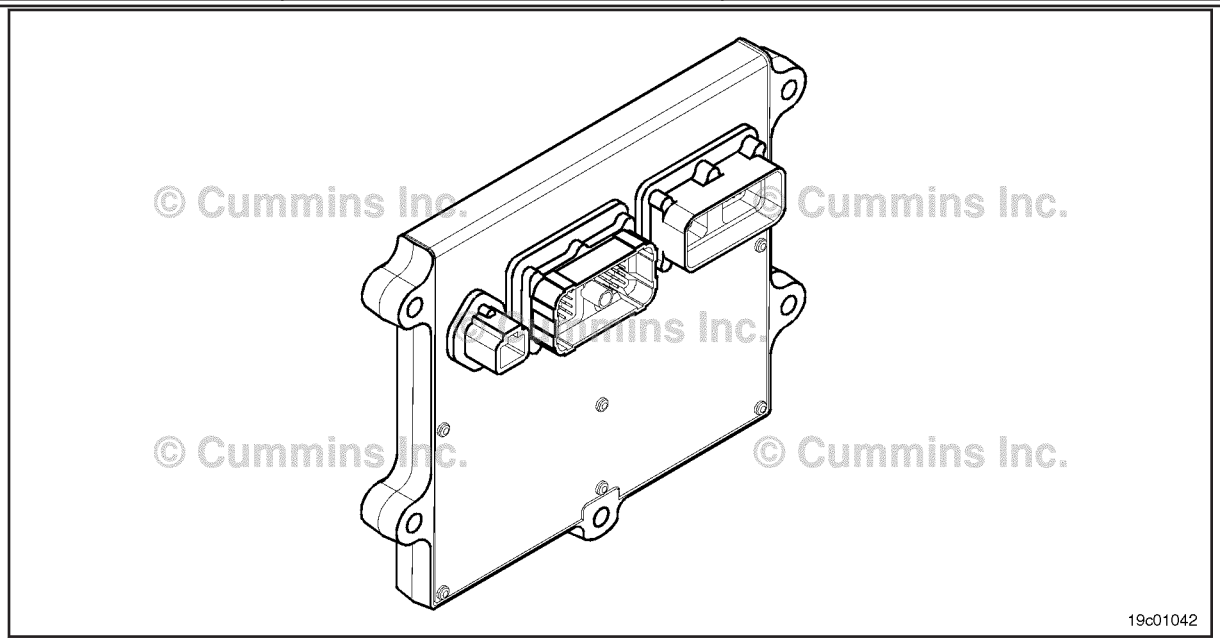
Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Fault Code 342

Electronic Calibration Code Incompatibility - Out of Calibration

CODES	REASON	EFFECT
Fault Code: 342 PID(P), SID(S): S253 SPN: 630 FMI: 13 Lamp: Red SRT:	Electronic Calibration Code Incompatibility - Out of Calibration. An incompatable calibration between the primary and secondary OEM installed ECM's has been detected.	None on performance.



Electronic Control Module

Circuit Description:

This fault code is logged when incompatibel calibrations between the primary and secondary OEM installed ECM' is detected. This fault code is specific to OEM installed ECM's and is **only** reported in the Cummins ECM for information purposes **only**.

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 incompatible calibrations between the primary and secondary OEM installed ECM's is detected The fault is **not** triggered by the Cummins installed engine 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 t05-342

TROUBLESHOOTING SUMMARY

STEPS **SPECIFICATIONS** **SRT CODE**

STEP 1: Check the fault codes.

STEP 1A: Check for active fault codes. **Fault Code 342 is active?**

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for active fault codes.

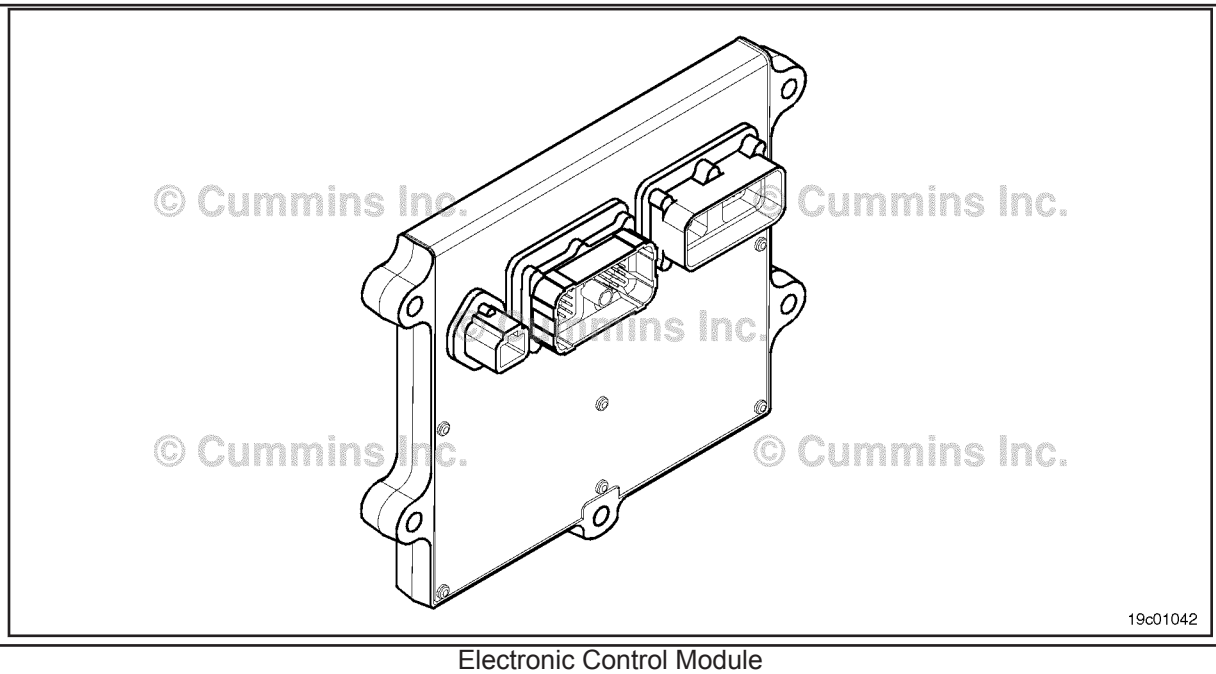
Condition:
- Turn keyswitch ON.
- Connect INSITE electronic service tool.

Action	Specification/Repair	Next Step
Check for active fault codes. • Use INSITE electronic service tool to read the fault codes.	Fault Code 342 is active? **YES** **Repair:** Incompatible calibrations have been detected in the OEM installed primary and secondary ECM's. Refer to the OEM troubleshooting manual.	OEM troubleshooting manual.
	Fault Code 342 is active? **NO**	Repair complete.

Fault Code 343

Engine Control Module Warning Internal Hardware Failure - Bad Intelligent Device or Component

CODES	REASON	EFFECT
Fault Code: 343 PID(P), SID(S): S254 SPN: 629 FMI: 12/12 Lamp: Amber SRT:	Engine Control Module Warning Internal Hardware Failure - Bad Intelligent Device or Component.	No performance effects or possible severe power derate.



Electronic Control Module

Circuit Description:

The ECM is a computer that is responsible for engine control, diagnostics, and user features.

Component Location:

The ECM is located on the fuel system side of the engine. Refer to Procedure 100-002 for a detailed component location view.

Shop Talk:

This fault code can **only** be caused by an internal ECM problem. Repairs are **not** possible for the ECM.

For Euro certified engines this fault code indicates that the Real Time Clock feature needs to re reset (if equipped).

Refer to Troubleshooting Fault Code t05-343

FAULT CODE 343 - Engine Control Module Warning Internal Hardware Failure - Bad Intelligent Device or Component

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

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

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the ECM.**		
STEP 1A:	**Reset the real time clock feature (Euro certified engines only).**	**Has real time clock feature been set correctly (if equipped)?**	
STEP 1B:	**Check the ECM.**	**Fault Code 343 active?**	
STEP 1C:	**Check the inactive counts of Fault Code 343.**	**Less than 3 counts?**	
STEP 2:	**Clear the fault codes.**		
STEP 2A:	**Disable the fault code.**	**Fault Code 343 inactive?**	
STEP 2B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check the ECM.

STEP 1A: Reset the real time clock feature (Euro certified engines only).

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

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to check Real Time Clock feature under Advanced ECM data. • If the feature is available, verify that the time is set correctly.	Has the Real Time Clock feature been set correctly (if equipped)? **YES**	1B
	Has the Real Time Clock feature been set correctly (if equipped)? **NO** **Repair:** Use INSITE™ electronic service tool to set the correct date and time for the Real Time Clock feature.	Repair Complete.

STEP 1B: Check the ECM.

Condition:
- Connect all components.

Action	Specification/Repair	Next Step
Check the ECM. • Turn keyswitch OFF and wait five seconds. • Start the engine and let it idle for one minute.	Is Fault Code 343 active? **YES** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	1C
	Is Fault Code 343 active? **NO**	2A

STEP 1C: Check the inactive counts of Fault Code 343.

Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the inactive counts of Fault Code 343. • Use INSITE™ electronic service tool to read the inactive counts of Fault Code 343.	Are there less than three counts? **YES**	2B
	Are there less than three counts? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	2A

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. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to verify that the fault code is inactive.	Fault Code 343 inactive? **YES**	2B
	Fault Code 343 inactive? **NO** **Repair:** 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 components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

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

Notes

Fault Codes

Index

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