Workshop Manual

EGC Diagnostics

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4.3GXi-F(F), 4.3OSi-F(F)
5.0GXi-F(F), 5.0OSi-F(F)
5.7Gi-F(F), 5.7GXi-G(F)
5.7OSi-E(F), 5.7OSXi-E(F)
8.1Gi-G(F), 8.1GXi-F(F), 8.1OSi-C(F)

Section 1: General Information

This service manual is divided into sections concerning various systems and assemblies. Refer to the **Contents** to locate the section covering the system or assembly requiring service. Each section title page has an additional listing that will describe the sections contents in more detail. Be sure to read the **Safety Section** at the end of this manual, and pay special attention to all safety warnings as they appear throughout the text. Since models are subject to change at any time, some photos may not depict actual product.

Good Service Practice

Service required for the engine and sterndrive is generally one of three kinds:

- **Normal care and maintenance** - which includes putting a new engine and stern drive into operation, storing, lubrication, and care under special operating conditions such as salt water and cold weather.
- **Operating malfunctions** - due to improper engine or drive mounting, propeller condition or size, boat condition, or the malfunction of some part of the engine. This includes engine servicing procedures to keep the engine in prime operating condition.
- **Complete disassembly and overhaul** - such as major service or rebuilding a unit.

It is important to determine before disassembly just what the trouble is and how to correct it quickly, with minimum expense to the owner.

When repairing an assembly, the most reliable way to ensure a good job is to do a complete overhaul on that assembly, rather than just to replace the bad part. Wear not readily apparent on other parts could cause malfunction soon after the repair job. Repair kits and seal kits contain all the parts needed to ensure a complete repair, to eliminate guesswork, and to save time.

Repair time can also be minimized by the use of special tools. Volvo Penta special tools are designed to perform service procedures unique to the product that cannot be completed using tools from other sources. They also speed repair work to help achieve service flat rate times. In some cases, the use of substitute tools can damage the part.

Preparation for Service

Proper preparation is extremely helpful for efficient service work. A clean work area at the start of each job will minimize tools and parts becoming misplaced. Clean an engine that is excessively dirty before work starts. Cleaning will occasionally uncover trouble sources. Obtain tools, instruments and parts needed for the job before work is started. Interrupting a job to locate special tools or repair kits is a needless delay.

⚠ **Caution!**

Use proper lifting and handling equipment. Working on stern drives without proper equipment can cause damage and personal injury.

Always use clean fresh fuel when testing engines. Troubles can often be traced to the use of old or dirty fuel.

Service Policy

It is a Volvo Penta policy to provide dealers with service knowledge so they can give professional service demanded by today's consumer. The Volvo Penta Training Centers, frequent mailing of Service Bulletins, Letters and Promotions, Special Tools, Partner Network, and this Service Manual represent the latest effort to assist dealers in giving consumers the best and most prompt service possible. If a service question does not appear to be answered in this manual, you are invited to contact the Volvo Penta Service Department by calling or through Partner Network for additional help. Always be sure to give complete information, including engine model number and serial number.

Replacement Parts

⚠ **Warning!**

When replacement parts are required, always use genuine Volvo Penta parts, or parts with equivalent characteristics, including type, strength, and material. Failure to do so may result in product malfunction and possible injury to the operator and/or passengers.

Parts Catalogs

Parts Catalogs and the electronic parts catalog (EPC) contain exploded views showing the correct assembly of all parts, as well as a complete listing of the parts for replacement. These catalogs are helpful as a reference during disassembly and reassembly, and are available from Partner Network and Volvo Penta Parts.

Special Service Tools

Volvo Penta has specially designed tools to simplify some of the disassembly and assembly operations. These tools are illustrated in this Service Manual, in many cases in actual use. All special tools can be ordered from Volvo Penta Parts. Individual purchasers of Service Manuals must order Special Tools through an authorized dealer.

Product References, Illustrations & Specifications

Volvo Penta reserves the right to make changes at anytime, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts at any time without incurring any obligation to equip same on models manufactured prior to date of such change. All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of printing. The right is reserved to make changes at anytime without notice.

All photographs and illustrations used in this manual may not depict actual models or equipment, but are intended as representative views for reference only. The continuing accuracy of this manual cannot be guaranteed.

The purpose of an engine tune-up is to restore power and performance that has been lost through wear, corrosion or deterioration of one or more parts or components. In the normal operation of an engine, these changes can take place gradually at a number of points, so that it is seldom advisable to attempt an improvement in performance by correction of one or two items only. Time will be saved and more lasting results will be obtained by following a definite and thorough procedure of analysis and correction of all items affecting power and performance.

Economical, trouble-free operation can better be ensured if a complete tune-up is performed once every year, preferably in the spring. Components that affect power and performance can be divided into three groups:

- Components affecting compression
- Components affecting ignition
- Components affecting fuel system

Tuning the Engine

Tune-up procedures should cover these groups in the order given. While the items affecting compression and ignition may be handled according to personal preference, correction of items in the fuel system group should not be attempted until all items affecting compression and ignition have been satisfactorily corrected. Most of the procedures for performing a complete engine tune-up will be covered in greater detail in this manual. This section will deal mainly with the order of procedures involved in tuning the engine.

Engine Compression Testing

During all work done around the engine, while the engine is running or being cranked, use extreme care to avoid getting fingers or clothing caught in any belts, pulleys, or other moving parts.

2. Visually inspect stern drive unit for leaks, missing parts or other obvious defects. **Replace deteriorated parts.**
3. Compression check: Proper compression is essential for good engine performance. An engine with low or uneven compression cannot be properly tuned.
   - Operate engine to normal operating temperature.

⚠ **Caution!**

Engine must not be started and run without water for cooling.

- Remove any foreign matter from around spark plugs by blowing out with compressed air.
- Remove and inspect all spark plugs. Install thread-type compression gauge in spark plug hole.
- Set the Volvo Penta Scan tool to “ECM TESTS” and select “COMPRESSION TEST” before cranking the engine.

⚠ **Caution!**

This test commands the ECM to disable all spark and fuel injector outputs. The test must be properly exited from the Scan Tool to re-enable normal spark and fuel operation. DO NOT perfrom this test in open water. Always perform this test dockside or on a trailer. The engine will be disabled until the test is properly exited.

If the scan tool is disconnected during the COMPRESSION TEST, the engine will remain disabled until the scan tool is reconnected and the COMPRESSION TEST mode is exited properly. Refer to the documentation that comes with the Scan tool for further information on Scan tool operation.

Test Conclusion

The indicated compression pressures are considered normal if the lowest reading cylinder is within 75% of the highest.

Example:

If the highest pressure reading was 140 PSI, 75% of 140 is 105. Therefore, any cylinder reading less than 105 PSI indicates an improperly seated valve, worn valve guides, piston, cylinder, or worn or broken piston rings. Any cylinder reading 105 PSI or greater is within specifications, and compression is considered normal.

If one or more cylinders read low, squirt approximately one tablespoon of engine oil on top of the pistons in the low reading cylinders. Repeat compression pressure check on the cylinders.

1. If compression improves considerably, the piston rings are at fault.
2. If compression does not improve, valves are sticking or seating poorly, or valve guides are worn.
3. If two adjacent cylinders indicate low compression pressures and squirting oil on the pistons does not increase the compression, the cause may be a cylinder head gasket leak between the cylinders. This problem could allow engine oil and/or coolant to enter the cylinders. It is recommended the following quick reference chart be used when checking cylinder compression pressures. The chart has been calculated so that the lowest reading number is 75% of the highest reading.

Table 1: Compression Pressure Limit

Max. PSI	Min. PSI	Max. PSI	Min. PSI	Max. PSI	Min. PSI	Max. PSI	Min. PSI
134	101	154	115	174	131	194	145
136	102	156	117	176	132	196	147
138	104	158	118	178	133	196	148
140	105	160	120	180	135	200	150
142	107	162	121	182	136	202	151
144	108	164	123	184	138	204	153
146	110	166	124	186	140	206	154
148	111	168	126	188	141	208	156
150	113	170	127	190	142	210	157
152	114	172	129	192	144	212	158

After checking cylinder compression, repairs should be made as necessary. Subsequent adjustments to an engine that does not have proper compression will not measurably improve performance or correct operational problems. After verifying compression, check ignition and fuel system components.

Ignition System Components

- Spark Plugs
- Spark Plug Leads
- Distributor Cap
- Rotor
- Ignition Coil
- High Tension Lead
- Ignition Switch
- Circuit Wiring and Connectors

Fuel System Components

- Fuel Tank Pickup and Screen

- Fuel Tank Vent
- Anti-Siphon Valve (if equipped)
- Fuel Octane and Quality
- Boat Fuel Lines and Valves
- External Engine Fuel Filter
- Fuel Pump(s) and Line
- Engine PCV Valve
- Flame Arrestor

All of the above listed components are not necessarily part of an engine tune-up, but must be considered when attempting to correct engine/boat performance problems. Repair or replace components only as required.

⚠ **Warning!**

Do not substitute automotive parts. Volvo Penta marine components meet U.S. Coast Guard regulations for external ignition proof operation and marine use. Volvo Penta marine components are specially designed not to cause ignition of fuel vapors in the bilge or engine compartment. The use of automotive parts can result in fire and explosion.

Intake Manifold Vacuum Testing

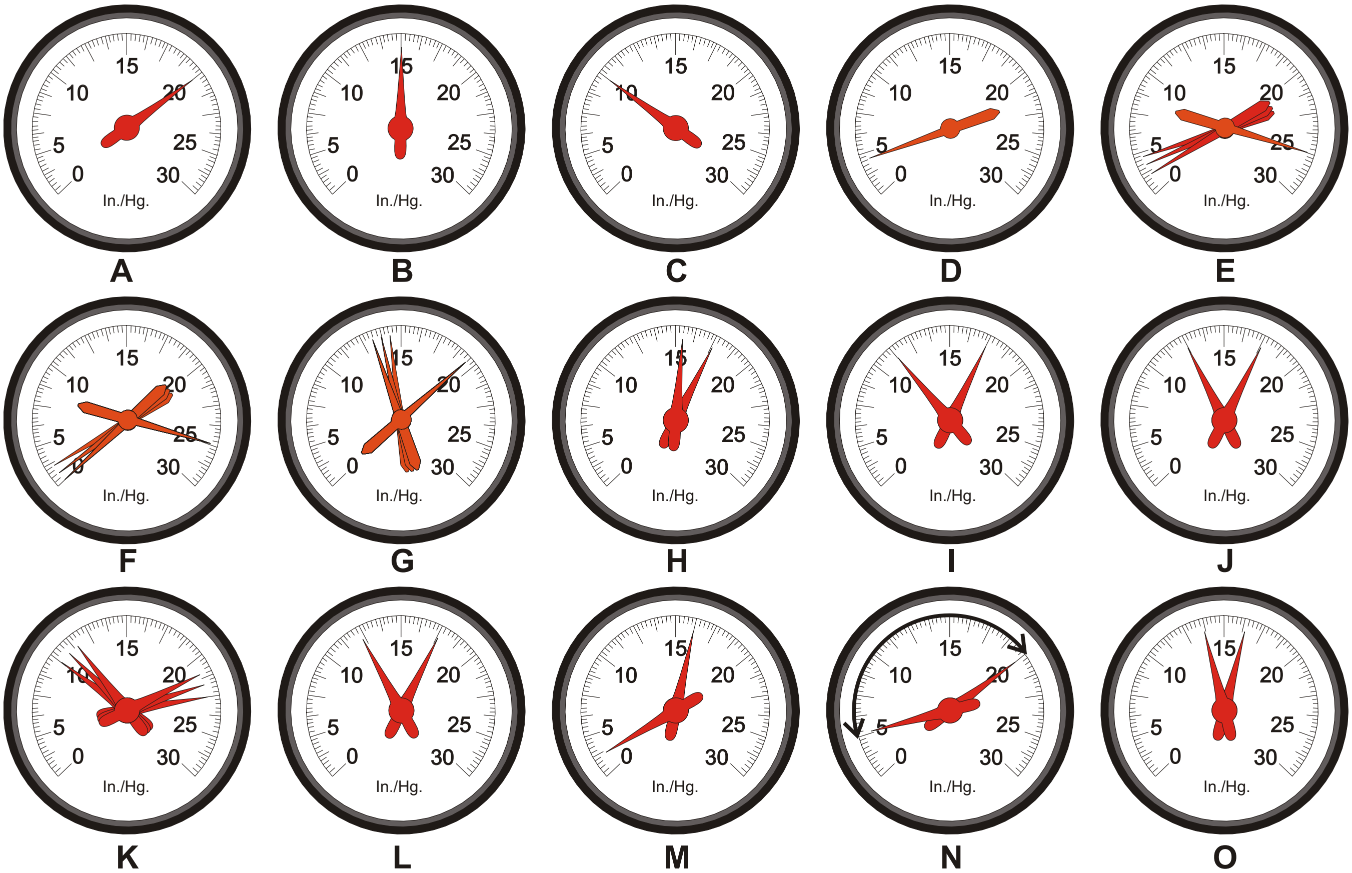
Test Procedures

1. Install a vacuum gauge to a good intake manifold source (usually at the PCV valve port), following the gauge manufacturer's instructions. Start and warm up the engine.
2. Observe the vacuum gauge while operating the engine over a range of engine speeds.

Test Results

1. A steady vacuum reading between 14 and 19in. Hg. (47-64 kPa) at idle indicates an engine in good mechanical condition.
2. A vacuum reading below 14 in. Hg. (47 kPa) at idle, indicates an engine that is not developing enough vacuum. Further testing for base mechanical problems is needed.
3. Possible causes of low intake manifold vacuum are late ignition timing, low compression, poor engine sealing, leaks at vacuum lines and connections or bad MAP sensor.
4. If the gauge fluctuates at idle, possible causes are sticking or leaking valves, or an ignition miss.
5. If the gauge fluctuates at idle but smooths out as engine RPM increases, check for bad valves or camshaft.
6. If the gauge fluctuates more with increases engine RPM, check for weak or broken valve springs, bad valves, ignition miss, or a leaking head gasket.
7. If the vacuum gauge fluctuates regularly with each engine cycle, check for a bad valve.

8. If the vacuum reading drops steadily as engine RPM increases, check the exhaust system between the engine and vertical drive for restrictions.
9. See table and chart below and on the following page for more information.



A	Normal at Idle	14-19 in. Hg. (47-64 kPa)
B	Late Ignition Timing	11-17 in. Hg. (37-57 kPa)
C	Late Valve Timing	8-15 in. Hg. (27-50 kPa).
D	Intake Leak	Low but steady reading
E	Normal Acceleration	Drops to 2 then rises to 25 when throttle is rapidly increased and decreased.
F	Worn Rings	Drops to 0, then rises to 22 when throttle is rapidly increased and decreased
G	Sticking Valve(s)	Normally steady, intermittently flicks downward approx. 4 in. Hg. (13 kPa) from highest level.
H	Leaking Valve	Drops 2 in. Hg. (6 kPa) from highest reading.
I	Burned or Warped Valve	Evenly spaced down-scale flicker approximately 5 in. Hg (17 kPa).
J	Worn Valve	Oscillates Approximately 4 in. Hg. (13 kPa).
K	Weak Valve Springs	Violent oscillations as RPM increases.
L	Improper Idle Mixture	Floats slowly between 13-17 in. Hg. (44-57 kPa)
M	Restricted Exhaust	Normal when first started. Drops to approx. 0 as RPM increases
N	Head Gasket Leak	Floats between 5-20 in. Hg. (17-68 kPa)
O	Defective Ignition Component	Slight float between 14-16 in. Hg. (47-54 kPa)

Gasoline Requirements

⚠ **DANGER!**

Gasoline is extremely flammable and highly explosive under certain conditions. Always stop engine and do not smoke or allow open flames or sparks near the boat when refuelling gas tanks. When filling the gas tank, ground the tank to the source of gasoline by holding the hose nozzle firmly against the side of the deck filler plate, or ground it in some other manner. This action prevents static electricity buildup which could cause sparks and ignite fuel vapors.

USE ONLY UNLEADED FUEL. Use lead-free gasoline with the following minimum or higher octane specification:

Inside the U.S.: (R+M)/2 (AKI) = 87
Outside the U.S.: (RON) = 90

If fuels with 89 AKI pump posted (93 RON) octane number or higher are used an increase in power can be expected with EFI models.

Premium fuels contain injector cleaners and other additives that protect the fuel system and provide optimum performance.

⚠ **Caution!**

Engine damage resulting from the use of gasoline with octane 86 AKI (89 RON) and lower is considered misuse of the engine and will void the engine warranty. *Volvo Penta* suggests the use of 89 AKI or higher fuels. These fuels have additives that are beneficial to maximum engine performance and long life of service components.

To prevent gum formation and corrosion in the fuel system, use a Marine Fuel Stabilizer in the gasoline.

Gasoline Containing Alcohol

Many brands of gasoline being sold today contain alcohol. Two commonly used alcohol additives are Ethanol (ethyl alcohol) and Methanol (methyl alcohol).

⚠ **Caution!**

Do not use any gasoline which contains Methanol (methyl alcohol).

See the boat's Operators Manual to determine if the boats fuel system is compatible with alcohol blended fuels. If it is, your engine may use gasoline blended with no more than 10% Ethanol (ethyl alcohol) meeting the minimum octane specification. **Do not use any gasoline which contains METHANOL (methyl alcohol).**

Continued use of **METHANOL** (methyl alcohol) fuel will cause serious damage to the fuel system.

If you use gasoline containing alcohol, be aware of the following:

- ïThe engine will operate leaner. This may cause engine problems such as vapor lock, low speed stalling, or hard starting.
- ïAlcohol blended fuels attract and hold moisture. Moisture can cause fuel tank corrosion. Inspect fuel tanks at least annually. Replace corroded or leaking fuel tanks.
- ïFrequently inspect non-metallic parts of fuel system and replace if excessively stiff, deteriorated or leaking.

Fuel leakage can contribute to a fire and/or explosion.

Crankcase Oil

Initial factory fill is a high quality motor oil for API Service SJ. During the break-in period (20 hours), frequently check the oil level. Somewhat higher oil consumption is normal until piston rings are seated. The oil level should be maintained in the safe range between the Add and Full marks on the dipstick. This range represents approximately 1 litre (1 quart). If it is necessary to add or change the motor oil, use a quality oil with API service category SJ.

At the end of the break-in period (20 hours), change the crankcase oil and replace the oil filter. Refer to **Lubrication and Inspection Chart** for recommended oil change intervals.

NOTE! The use of multi-viscosity oils, such as 10W-30 or 10W-40, is not recommended.

Draining and Filling the Engine Crankcase

If using Volvo Penta Premium Synthetic Engine Oil, drain and refill crankcase every 200 hours of operation or once a year, whichever occurs first.

If using oil other than Volvo Penta Premium Synthetic Engine Oil, drain and refill crankcase every 100 hours of operation or once a year, whichever occurs first.

⚠ **DANGER!**

To prevent fire and explosion, always make sure engine compartment is free of gasoline fumes before using any spark-producing tools such as the electric drill motor used with oil withdrawal pump kit.

Check the motor oil level frequently with the dipstick. When oil is to be changed, remove dipstick and withdraw oil from crankcase through withdrawal/dipstick tube. The oil withdrawal tube is provided so oil does not have to be drained into the bilge. Withdraw oil with a suction pump.

Fill the crankcase to the specified capacity with a quality motor oil labelled for service category SH. When changing motor oil, select from the following chart the SAE viscosity that matches the temperature range in which the boat will be operated. If it is necessary to add motor oil, use motor oil of the same viscosity.

Table 2: Temperature Viscosity Recommendations

If the lowest Anticipated Temperature is:	The Following SAE Viscosity Oils are Recommended
32° F (0° C) and above	SAE 30
0° F (-18° C) to 32° F (0° C)	SAE 20W-20
Below 0° F (-18° C)	SAE 10

NOTE! Disregard any reference to multi-viscosity oil printed on engine. Such reference is intended for automotive use only and not marine application.

⚠ **Caution!**

Do not fill above full mark. Overfilling results in high operating temperatures, foaming (air in oil), loss of power, and overall reduced engine life.

Table 3: Crankcase Capacities

Model	With Filter
Sterndrive	
4.3GXi/OSi	5.0 qts. (4.7 liters)
5.0GXi/OSi	5.5 qts. (5.2 liters)
5.7Gi/GXi/OSi/OSXi	5.5 qts. (5.2 liters)
8.1Gi/GXi	9.0 qts. (8.5 liters)
Inboards	
5.7GiI/GXiI	5.5 qts. (5.2 liters)
8.1GiI/GXiI	9.0 qts. (8.5 liters)

Oil Filter

Replace the oil filter whenever the motor oil is changed. This filter is a self-contained, screw-on type. To remove, unscrew filter canister counterclockwise and discard. When attaching a new filter, be sure the gasket is lightly lubricated with motor oil. Hand tighten only, run engine and check for leaks. Do not run engine without supplying cooling water. See *Parts Catalog* for model and filter requirements.

Maintain the level with Volvo Penta Power Trim/Tilt & Steering Fluid. Approved power steering fluids such as GM power steering fluid or Dexron II automatic transmission fluid can also be used. Do not overfill the pump reservoir.

Off-Season Storage

There are nine steps that must be completed for Off-Season Storage Preparation

When gasoline engines are removed from service for long periods (2 months or more), it is important that they are correctly stored or protected (internally). Today's gasoline blends are not as stable as in the past and consideration must be given if the fuel will not be used within a short time or if the engine is being placed in storage. Failure to properly stabilize the fuel can damage fuel system components and is not considered as warrantable.
Boat manufacturers should follow the gasoline storage mixture section for testing prior to shipment.

Note! Volvo Penta has discontinued the fuel stabilizer #3855832, a suitable replacement can be purchased locally at most automotive supply stores.

Limited Use If the vessels fuel within the tank(s) will not be consumed within a 30-day period from the time of filling, a gasoline fuel stabilizer must be added as per the manufacturers instructions. This will help prevent the fuel from breaking down and causing reduced engine performance or damage from uncontrolled combustion.

Storage If the boat is being placed into storage, a gasoline fuel stabilizer must be added to the tank(s) as per the manufacturers instructions. The amount of stabilizer required is determined by the quantity of fuel and the length of time it will be placed in storage. The maximum period that fuel can be stabilized is six months due to limitations of the stabilizers and fuels.

⚠ **DANGER!**

Any fuel leakage should be corrected immediately to prevent possible fire and/or explosion.

⚠ **Caution!**

Do not run engine out of fuel or run the electric fuel pumps dry more than 10 seconds. Running the electric fuel pumps dry will cause fuel pump damage.

Prepare a storage mixture

In addition to stabilization of the fuel, it is highly desirable to have the valves and cylinders coated with a light film of oil previously accomplished through fogging. Today's fuel injection manifolds are designed with a complex air channel design that will not allow the traditional fogging oils to be injected past the throttle plate while running. The oil will get stuck in the plenum and never reach the cylinders. Together with the stabilizer, two-cycle motor oil can be added to a fuel mixture for stabilization purposes.

- Using an outboard motor six-gallon fuel tank, add two-cycle motor oil at a ratio of 50:1 (one pint to 6 gallons) and stabilizer at one ounce per gallon (unless stated otherwise on the manufacturers label). Mix well.
- Disconnect boat fuel line at engine fuel pump. Attach the storage mixture fuel tank.
- Connect a suitable engine flush device if the boat is not in the water.

- Run the engine on the storage mixture for approximately 5 minutes at 1500 RPM. This will ensure that all fuel system and internal engine components are thoroughly protected. Do not operate the engine above 1500 RPM as the water pump demand may exceed the supply, damaging the pump.
- Reduce the engine speed to idle and stop the engine.
- Reconnect the fuel fitting and check for fuel leaks.

Electric Fuel Pumps and Fuel Cells

Regardless of the ratio of fuel stabilizer to fuel we use, the maximum recommended storage time for gasoline, according to STA-BIL, is six months. During final assembly testing at our Lexington factory, each engine is run on a fuel mix that is stabilized. Each engine is shut off without running the fuel pumps dry and the fuel system is sealed to prevent damage. With the delay in time between the product getting installed in a boat, shipped to you, sold and finally delivered; the six-month time frame can easily be exceeded.

Since delivering a quality, dependable product is one of our highest goals; we work closely with our suppliers to identify the root cause of failure on any parts returned for warranty credit. While there are certainly legitimate failures of fuel pumps, the major portion of them are returned to us due to varnished fuel from long term storage. We would like to offer some advice on dealing with these issues.

Stuck Pumps

If a fuel pump appears stuck and will not operate, you may try briefly reversing the polarity to the pump to turn it in the opposite direction. You should disconnect the electrical plug of one pump at a time on the fuel cell to determine which pump might have a problem.

Noisy Fuel Pumps

Electric pumps will often cavitate and become noisy if they are starving for fuel. On carbureted engines or low-pressure fuel cell pumps, check the fuel supply, quality of the fuel hose, anti-siphon valve, and filter before replacing the fuel pump.

A noisy high-pressure pump on a fuel cell may indicate a low fuel level in the reservoir. Check the fuel supply and low pressure pump operation to be sure the reservoir is receiving the correct volume of fuel. The same information would apply to engines with the earlier vapor separator tank design.

This information may help prevent the needless replacement of pumps in many cases and reduce the repair time for the boat owner.

Change Motor Oil and Oil Filter

- Engine should first be operated under load until oil is thoroughly warmed up. If oil is allowed to warm up before draining, a more complete draining will be accomplished. In addition, accumulated impurities will be held in suspension by the oil and be removed during draining operation.
- Remove motor oil by siphoning it out of oil withdrawal tube. Follow the procedure under **Draining and Filling the Engine Crankcase.**
- Install a new oil filter and fill crankcase with recommended oil.

⚠ **Caution!**

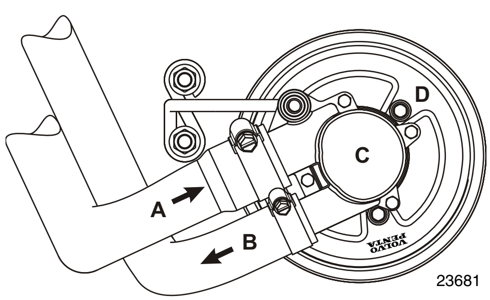
Sterndrive must be submerged in water or an accessory flushing adaptor must be used while operating engine. When using a flushing adaptor, remove propeller before starting engine to prevent accidental contact with rotating propeller.

- With sterndrive in full down position, run engine at a fast idle for a few minutes to distribute clean oil through engine.
- Shut off engine and check oil level. Check oil filter gasket for leaks. Add oil if necessary to bring oil level up to, but not over, the full mark.

Change Sterndrive Lubricant

Drain and refill with fresh Volvo Penta GL-5 Synthetic Gear Lubricant or Mobilube 1 SHC Fully Synthetic SAE 75W-90 (meeting or exceeding MIL-L-2105C or D, API GL-4 or 5) gear lubricant. Refer to Vertical Drive Service Manual.

Drain Cooling System



4.3GXi, 4.3OSi

When draining the cooling system, raise or lower the bow of the boat to position the engine in a level horizontal plane. This will provide complete drainage of the engine block and manifolds. If the bow is higher or lower that the stern, some water may be trapped in the engine block or manifolds.

Improper or incomplete draining may result in freeze damage to the engine, manifolds, sterndrive, or other components. Freeze damage is not covered under Volvo Penta's Limited Warranty.

Front

1. Remove inlet (A) and outlet (B) hoses from raw water pump and rotate engine with starter 1-2 revolutions. If engine starts to run, shut off immediately.

Caution!

Do not run engine without water. If engine starts with the water intake hose disconnected, shut off immediately. Allowing the engine to run without water will damage the engine and cooling components.

2. Disconnect the small water by-pass hose at the top of the thermostat housing.
3. Disconnect and drain large hose at the circulation pump.
4. Disconnect the fuel cell water discharge hose. Lower the hose into the bilge to allow draining. Blow out and remaining water with compressed air. Reconnect after draining is complete.

Port

5. Remove cylinder block drain plug. Clear hole with small wire to ensure complete drainage.
6. Remove exhaust manifold drain plug. Clear hole with small wire to ensure complete drainage.

Starboard

7. Remove cylinder block drain plug. Clear hole with small wire to ensure complete drainage.
8. Remove exhaust manifold drain plug. Clear hole with small wire to ensure complete drainage.
9. Reinstall drain plugs after draining is complete to keep the threads of the drain holes from corroding. It will be difficult to install the drain plugs if the plugs are left out over the winter.

5.0GXi, 5.0OSi, 5.7Gi, 5.7OSi, 5.7GXi, 5.7OSXi, 5.7GiI-F, 5.7GXiI-G

Front

1. Remove inlet (A) and outlet (B) hoses from raw water pump and rotate engine with starter 1-2 revolutions. If engine starts to run, shut off immediately.

⚠ **Caution!**

Do not run engine without water. If engine starts with the water intake hose disconnected, shut off immediately. Allowing the engine to run without water will damage the engine and cooling components.

2. Disconnect and drain large hose at the circulation pump.

Port

1. Remove cylinder block drain plug. Clear hole with small wire to ensure complete drainage.
2. Remove exhaust manifold drain plug located at the rear of the exhaust manifold. Clear hole with small wire to ensure complete drainage.

Starboard

1. Remove cylinder block drain plug. Clear hole with small wire to ensure complete drainage.
2. Remove exhaust manifold drain plug located at the rear of the exhaust manifold. Clear hole with small wire to ensure complete drainage.
3. Reinstall drain plugs after draining is complete to keep the threads of the drain holes from corroding. It will be difficult to install the drain plugs if the plugs are left out over the winter.

8.1Gi, 8.1GXi, 8.1OSi, 8.1GiI-G, 8.1GXiI-F

Front

1. Remove inlet (A) and outlet (B) hoses from raw water pump and rotate engine with starter 1-2 revolutions. If engine starts to run, shut off immediately.

⚠ **Caution!**

Do not run engine without water. If engine starts with intake hose disconnected, shut off immediately. Allowing the engine to run without water will damage the engine and cooling components.

2. Disconnect and drain large hose at the circulation pump.

Port

1. Remove cylinder block drain plug. Clear hole with small wire to ensure complete drainage.

2. Remove exhaust manifold drain plug located at the front of the port exhaust manifold, behind the power steering pump. Clear hole with small wire to ensure complete drainage.

Starboard

1. Remove cylinder block drain plug. Clear hole with small wire to ensure complete drainage.
2. Remove exhaust manifold drain plug located at the rear of the exhaust manifold. Clear hole with small wire to ensure complete drainage.
3. Reinstall drain plugs after draining is complete to keep the threads of the drain holes from corroding. It will be difficult to install the drain plugs if the plugs are left out over the winter.

Preparation for Boating After Storage

1. Install all drain plugs if they were left out during storage. Install cooling hoses and clamps. Check condition of hoses, manifold end caps and clamps. Connect hoses to engine and tighten clamps securely. Install boat drain plug, if removed.
2. Remove the distributor cap and rotor. Wipe the inside of the distributor cap dry with a clean cloth and spray with *Corrosion Spray*. Replace the rotor and cap.
3. Clean the battery terminals. With the ignition switch in the "OFF" position, install the battery and attach the battery cables. Spray terminals with Corrosion Spray.
4. **Open the fuel shut-off valve (if so equipped) and check all fuel line connections for leaks.**
5. Check the flame arrestor and clean if necessary. **Reinstall, make sure all parts are in place and tighten nut securely.**

⚠ **Warning!**

Do not place fingers in the throttle body on electronic throttle equipped engines. The throttle plate has a powerful motor that can cause severe injury if the ignition energized.

6. Make a thorough check of the boat and engine for loose or missing nuts and screws. Pump the bilge dry and air out the engine compartment.

⚠ **Danger!**

To prevent a possible explosion, operate the blower as recommended by the boat manufacturer before starting engine. If the boat is not equipped with a bilge blower, open engine cover or hatch prior to starting and leave open until after engine is running.

If operating boat in water, tie boat securely to dock to prevent forward or backward movement.

When using a flushing adaptor, remove the propeller before starting engine to prevent accidental contact with rotating propeller.

7. Test run engine: Launch boat or use a flushing adaptor installed on Sterndrive.

⚠ **Caution!**

Do not start engine out of water unless using a flushing adaptor. Always turn water on before starting engine. Control water pressure as full water pressure may cause damage to supply pump and engine.

8. With engine compartment open, start the engine. Monitor the voltmeter, oil pressure and water temperature gauges frequently to be sure all systems are operating properly. **Check for fuel, oil, and water leaks.**

Engine Break-in

All engines have been run for a short period of time as a final test at the factory. You must follow the Engine Break-In procedure during the first 20 hours of operation to ensure maximum performance and longest engine life.

NOTE!

To ensure proper lubrication during the break-in period, do not remove factory break-in oil until after the 20-hour break-in is completed.

First Two Hours

For the first five to ten minutes of operation, operate engine at a fast idle (above 1500 RPM). After engine has reached operating temperature, momentarily reduce engine speed, then increase engine speed, to assist break-in of piston rings and bearings.

During the remaining first two hours of operation, accelerate boat onto plane quickly and bring throttle back to maintain a planing attitude. During this period, vary the engine speed frequently by accelerating to approximately three-fourths throttle for two to three minutes, then back to minimum planing speed. Maintain planing attitude to avoid excessive engine load.

DO NOT RUN ENGINE AT A CONSTANT RPM FOR PROLONGED PERIODS OF TIME DURING THE BREAK-IN PERIOD.

Next Eight Hours

During next eight hours, continue to operate at approximately three-fourths throttle or less (minimum planing speed). Occasionally reduce throttle to idle speed for a cooling period. During this eight hours of operation it is permissible to operate at full throttle for periods of less than two minutes.

DO NOT RUN ENGINE AT A CONSTANT RPM FOR PROLONGED PERIODS OF TIME DURING THE BREAK-IN PERIOD.

Final Ten Hours

During the final ten hours of break-in, after warming engine to operating temperature, it is permissible to operate at full throttle for five to ten minutes at a time. Momentarily reduce then increase engine speed to assist break-in of rings and bearings. Occasionally reduce engine speed to idle to provide cooling periods.

DO NOT RUN ENGINE AT A CONSTANT RPM FOR PROLONGED PERIODS OF TIME DURING THE BREAK-IN PERIOD.

During break-in period, be particularly observant during initial running of engine, as follows:

1. Check crankcase oil level frequently. Maintain oil level in safe range, between “add” and “full” marks on dipstick.

NOTE! If you have a problem getting a good oil level reading on dipstick, rotate dipstick 180° in tube.

2. Watch oil pressure gauge. If indicator fluctuates whenever boat attitude (i.e. turning, climbing on plane, etc.) is changed, it may be the oil pickup screen is not covered with oil. Check crankcase dipstick, and add oil to crankcase if required. **DO NOT OVERFILL**. If oil level is correct and condition still exists, check for possible gauge or oil pump malfunction.

NOTE! Oil pressure will rise as RPM increases, and fall as RPM decreases. In addition, cold oil will generally show higher oil pressure for any specific RPM than hot oil. Both of these conditions reflect normal engine operation.

3. Watch engine temperature indicator to be sure there is proper water circulation.

⚠ **Caution**

Failure to follow the break-in procedure will void the engine warranty.

At end of break-in period (20 hours), change the motor oil and replace oil filter. Fill crankcase with recommended motor oil, See “Crankcase Oil” on page 9.

Operation After Break-in

After break-in, the engine can be operated at any RPM from idle to full throttle. However, cruising at 3600 RPM or less saves fuel, reduces noise, and prolongs engine life.

When starting a cold engine, always allow engine to warm up gradually. Never run engine at full throttle until engine is thoroughly warmed up. Be sure to check oil level frequently during the first 50 hours of operation, since oil consumption will be high until piston rings are properly seated.

Submerged Engine

Remove engine from water as quickly as possible.

It is imperative that all water is removed from the engine and immediately lubricate all internal parts. All electrical devices must also be dried and inspected for water damage. Delay in completing these actions may allow extensive engine damage.

Frequently check engine compartment for gasoline fumes and excessive water accumulation; water depth in bilge should be kept well below flywheel housing.

20-Hour Check

1. Change engine oil and oil filter.
2. Check power trim/tilt reservoir for proper fluid level.
3. Change fuel filter/water separator.
4. Check flame arrestor for proper mounting, cleanliness or damage.
5. Start engine and check complete fuel system for leaks.

6. Lubricate steering cable ram with Volvo Penta grease. Check power steering pump reservoir for correct fluid level on models equipped with power steering. Failure to properly lubricate the steering system could lead to loss of steering control.
7. Check shift system for proper adjustment and operation.
8. Inspect exhaust system. Tighten all hose clamps, and check for leaks.
9. Check tension on all drive belts.
10. Check all engine mount screws for tightness.
11. Check for any deficiencies, malfunctions, signs of abuse, etc. Correction of any problems at this time will prevent the worsening of a minor problem and help ensure a trouble-free boating season.
12. Check oil level in Sterndrive and add as necessary with GL-5 Synthetic Gear Lubricant or Mobilube 1 SHC Fully Synthetic SAE 75W-90 (meeting or exceeding MIL-L-2105C or D, API GL-4 or 5) gear lubricant.
13. Make sure engine can achieve maximum rated RPM. See engine specifications.

Belt Tension

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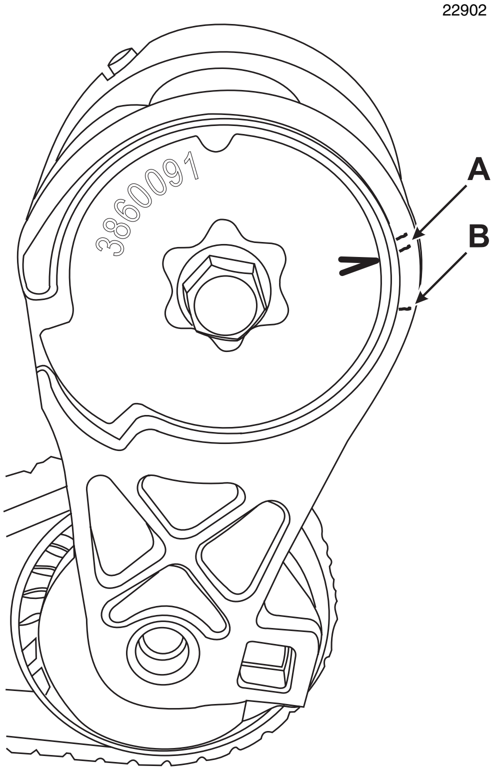


Serpentine belts are tensioned automatically and do not require adjustment. Replace when the tension indicator lines up with the single line on the housing (A).

The Volvo Penta serpentine belts are for heavy-duty marine use. DO NOT replace with automotive belts.

Positive Closed-Type Ventilation System

5.0L and 5.7L engines only

A malfunctioning closed crankcase ventilation system may be indicated by loping or rough engine idle. Do not attempt to compensate for this idle condition by disconnecting the crank-case ventilation system and making adjustments. The removal of the crankcase ventilation system from the engine will adversely affect fuel economy and engine ventilation with resultant shortening of engine life. To determine whether loping or rough idle condition is caused by a malfunctioning crankcase ventilation system, perform the following tests.

NOTE! 8.1 engines have an internal crankcase ventilation system and have no serviceable components.

NOTE! 4.3 engines do not have a PCV valve. The crankcase ventilation is provided by a fixed orifice located in the port valve cover and connected by a hose to the intake manifold.

With Engine Idling

1. Remove PCV valve from its mounting, but leave vacuum inlet side connected to hose. If the valve is functioning properly and not plugged, a hissing noise will be heard as air passes through valve. A strong vacuum will be felt when a finger is placed over valve inlet. Check for vacuum leaks in hose line and at all connections.
2. Reinstall PCV valve, then remove crankcase air inlet hose at flame arrestor connection. Loosely hold a small piece of stiff paper (such as a 3 x 5 memo card or parts tag card) over opening at end of inlet hose. After a minute or so, (to allow crankcase pressure to lower) the piece of paper should be sucked against hose opening with a noticeable force.

With Engine Stopped

Remove PCV valve from its mounting and shake it. A metallic clicking noise should be heard, indicating that valve parts are free, and not sticking.

If ventilation system passes these two tests, it can be considered functionally OK, and no further service is required. If it fails either test, replace PCV valve and repeat Engine Idling Test.

If system still does not pass test, clean ventilation system hoses and all passages to induction system in accordance with established procedures.

Servicing PCV Valve

⚠ **Caution!**

Do not attempt to clean crankcase ventilation regulator valve. It should be replaced.

Clean crankcase ventilation system connection(s) on intake manifold by probing with a flexible wire or bottle brush. Clean hoses, tubes and associated hardware with a low-volatility, petroleum-base solvent and dry with compressed air.

Troubleshooting - System Isolation

The following is to help you isolate a malfunction of one or possibly several systems. After determining which systems are related to the malfunction, refer to the individual system troubleshooting charts to isolate the specific cause.

Engine Does not Start	Cranking System	Engine should crank at specified RPM. If not, check for 1. Discharged or dead Battery 2. Loose or corroded connections 3. Cranking System Troubleshooting Chart in the Electrical Ignition/ Fuel Service Manual
	Ignition System	Must have good spark at spark plugs. If not, check the: 1. Distributor Cap 2. Coil and spark plug leads 3. Ignition timing 4. Automatic spark advance 5. Appropriate Ignition Troubleshooting Chart in the Electrical/Ignition/Fuel Service Manual.
	Fuel System	1. Fuel Tank, valves, and lines 2. Fuel pump and filter 3. Boat Fuel System Troubleshooting Chart 4. Engine Fuel System Troubleshooting Chart
Engine Runs Improperly		Check the following: 1. Compression 2. Ignition system 3. Fuel and injection system 4. Lubrication system 5. Cooling System 6. Sterndrive and propeller 7. PCV Valve 8. Engine Troubleshooting Guides

Engine Troubleshooting Guides

These guides were written to help you trace the symptoms of the trouble to the source, without having to read through and prove every possibility. Much of the information here will be familiar to well informed mechanics.

Also, many factors will seem insignificant but when you think of it, usually the toughest problem to troubleshoot is caused by the smallest error. The greatest aid to solving a service problem is information. Start gathering information from the boat operator and write it on his job card or work ticket. Find out pertinent facts, such as:

- When did this trouble start?
- How was the boat loaded?
- Did the trouble occur suddenly, or start gradually?

Analyze this information and try to match it to similar situations you have experienced in the past. Keep in mind the fundamental rules:

- COMPRESSION - Mixture inducted into cylinder and compressed.
- SPARK - Proper intensity at the proper time.
- FUEL - Proper mixture of air and fuel.

These are very old rules, but necessary for the engine to run. Use these charts and the service information they refer to. Do not try to remember tolerances, settings, measurements, etc., as they are written in the service manual. Leave your mind free to analyze the problem.

Following is a list of the troubleshooting guides which may be found on the pages indicated.

Engine Will Not Crank

Starter Circuit - Check:

- Battery condition: weak, dead, sulfated, bad cells
- Battery cables for loose or corroded connections
- Shorted or open ignition switch
- Starter motor and solenoid for shorts, grounds or open circuits
- Starter assist solenoid/starter relay
- Circuit breakers
- Wiring from battery to ignition switch
- See ***Electrical/Ignition/Fuel Service Manual***

Engine Cranks, But Will Not Start

Ignition Circuit - Check:

- Primary circuit wiring from ignition switch to ignition coil/ignition module
- Secondary circuit wiring from coil to spark plug
- Spark plugs for proper gap, fouling, burned electrodes, cracked or dirty insulator
- See ***Electrical/Ignition/Fuel Service Manual***
- Low battery voltage

Fuel System - Check:

- Quantity and condition of fuel in boat tank
- Operation and flow capacity of boat anti-siphon valve
- Fuel tank vent is unrestricted
- Fuel tank pick-up screen is clean
- Correct diameter/unrestricted boat fuel lines
- Fuel shutoff and multiple tank valves are open and operating properly
- Fuel pump vent hose for signs of fuel or oil that would indicate a fuel pump failure.
- Fuel pump/relay/circuit breaker operation
- External fuel filter
- See ***Electrical/Ignition/Fuel System Service Manual***

Cylinder Compression - Check

- Conduct test following procedure in this section, and compare readings to Compression Limit Chart.

Hard Starting - Cold Engine

Has Engine Always Done This? Check:

Ask these questions first:

1. Fuel tank antisiphon valve (if equipped)
2. Fuel lines for obstructions
3. For debris inside fuel tank
4. See ***Electrical/Ignition/Fuel System Service Manual***

Was Engine Used For A Long Time? Check:

1. For clean external fuel filters
2. Water in fuel due to condensation
3. Fuel quality deterioration
4. See *Electrical/Ignition/Fuel System Service Manual*

Is This A New Condition? Check:

1. Fuel tank antisiphon valve (if equipped)
2. Fuel system for leaks, dirt, or obstructions
3. Engine and ignition system
4. See ***Electrical/Ignition/Fuel System Service Manual***

Hard Starting - Hot Engine

Has Engine Always Done This? Check:

Ask these questions first:

1. Fuel tank antisiphon valve (if equipped)
2. See ***Electrical/Ignition/Fuel System Service Manual***

Is This A New Condition? Check:

1. Brand, type or octane of fuel
2. Spark plugs
3. Water in fuel
4. Condition of battery and cables
5. Starter motor for overheat damage

Did Engine Refuse To Start After Being Run? Check:

1. Ignition system primary circuit

Ignition coil(s)/ignition module

2. Engine timing
3. Fuel tank antisiphon valve (if equipped)
4. See ***Electrical/Ignition/Fuel System Service Manual***

Engine Runs Rough

If At Slow Speed - Check:

1. Fuel tank antisiphon valve (if equipped)
2. Idle speed
3. Engine timing and spark plugs
4. Fuel pressure
5. Water or contaminants in fuel
6. Manifold vacuum leak
7. See ***Electrical/Ignition/Fuel System Service Manual***

If At High Speed - Check:

1. Air leak on suction side of fuel system
2. Too low octane fuel
3. Ignition system secondary circuit
4. Engine timing
5. Fuel filter
6. Fuel pump pressure
7. Engine compression
8. Water or contaminants in fuel, water in cylinders
9. See Electrical/Ignition/ Fuel System Service Manual

Engine Noises and Vibrations

Valves - Hydraulic Lifters

1. Rapping only when starting (oil too heavy for prevailing weather, varnish on lifter, oil needs to be changed)
2. Intermittent rapping (leakage at lifter check ball)
3. Idle noise (excessive leak down rate, faulty check ball seat)
4. Generally noisy (excessive oil in crankcase, stuck lifter plunger)
5. Loud noise at operating temperature (scored lifter plunger, fast leak down rate, oil viscosity too light for prevailing weather or operating temperatures)
6. See appropriate Engine section

Ignition System (Ping or Knock)

1. Incorrect spark plugs
2. Incorrect spark plug wire routing
3. Use higher octane fuel
4. See Electrical/Ignition/Fuel Service Manual

Cooling System

1. Supply pump
2. Loose belts, pulleys

3. See ***Cooling System*** section

Mountings

1. Loose, broken or worn engine mounts
2. Loose lag screws holding mounts to stringer
3. Check engine alignment see *Removing and Installing Engine* section

Crankshaft Balancer or Flywheel

1. Loose bolt(s)

Alternator

1. Loose pulley, worn bearings
2. Loose mounting bolts

Sterndrive

1. Failed U-joints or gimbal bearing
2. Damaged internal drive components
3. Worn, bent or broken propeller hub or blades
4. Loose, worn or damaged engine coupler

Engine Overheats

1. Actual engine temperature by verifying with an accurate thermometer
2. Gauge operation and wiring circuit
3. Sending unit operation and wiring circuit
4. Supply pump, circulating pump and belt(s)
5. Water intake screens for blockage
6. Thermostat
7. Water supply hoses
8. Engine timing
9. Water leaks on pressure side of supply pump
10. Air leaks on suction side of supply pump
11. Engine compression

Engine Dies Out

Loss Of, Or Out Of, Fuel - Check:

1. Fuel gauge operation and wiring
2. Fuel level in tank
3. Water or debris in fuel
4. Fuel pickup tube and screen blockage
5. Fuel tank vent blockage
6. Plugged fuel filter
7. Air leak on suction side of fuel system
8. Fuel leak on pressure side of fuel system
9. Inoperative, restricted or incorrectly sized anti-siphon valve
10. Boat fuel lines too small in diameter
11. Fuel pump pressure and suction

12. See ***Electrical/Ignition/Fuel System Service Manual***

Loss Of Ignition - Check:

1. Primary and secondary ignition circuits
2. Ignition switch
3. Circuit breakers
4. Wiring between engine and dash
5. Main engine harness wiring
6. See ***Electrical/Ignition/Fuel Service Manual***

Engine Stops Or Dies Out Due To Seizure - Check:

1. Sterndrive for internal damage
2. Oil pressure gauge
3. Crankcase oil level
4. Water in engine or sterndrive oil
5. Temperature gauge and cooling system operation
6. Internal engine components as required

Engine Won't Reach Operating RPM

1. Fuel type or octane
2. Propeller pitch or diameter, damaged blades, slipping hub
3. Crankcase oil level
4. Marine growth on hull and drive
5. Wrong Sterndrive gear ratio
6. Operating at high altitude
7. Restricted air intake
8. Restricted exhaust outlets in engine, transom bracket or drive
9. Poor cylinder compression
10. Fuel pump pressure and vacuum
11. Boat overloaded, or load improperly placed
12. Engine overheating
13. Engine timing and ignition system operation
14. Remote control cables and linkage for proper attachment and travel

Defective Engine Lubricating System

Engine Components - Check:

1. Clogged or incorrect oil filter
2. Worn oil pump gears, cover or shaft
3. Worn or collapsed oil pump relief valve spring, or foreign material caught on valve seat
4. Oil pump relief valve plunger loose in cover
5. Damaged filter bypass grommet
6. Clogged oil pickup screen, broken tube or housing
7. Plugged crankshaft or blocked oil galleys

8. Dirty or defective hydraulic lifters, clogged push rod passages
9. Poor quality, incorrect viscosity or oil level
10. Incorrect hose routing on remote filter systems
11. Water in crankcase oil from condensation, defective head gasket, oil cooler, or cracked manifold/block water passages

Oil Pressure Warning System - Check:

1. Oil gauge/warning horn operation and wiring
2. Engine temperature
3. Oil pressure gauge and warning horn sender operation and wiring

Low Battery Voltage After Short Storage

Engine/Boat Components - Check:

1. All electrical accessories including ignition circuit off
2. Disconnect main battery negative cable from battery
3. Connect ammeter or voltmeter in series between negative battery cable and negative battery post
   - Meter reading of “0” indicates no draw, test battery and charging system
   - Meter movement no matter how slight indicates draw from battery
4. Disconnect main engine harness 10-Pin Connector
   - Meter drops back to “0”, problem caused by boat system, continue to isolate each boat electrical accessory until problem is found
   - Meter does not drop back to “0”, problem caused by engine electrical system, continue to isolate each engine electrical accessory until problem is found
5. Repair or replace components as necessary

Abbreviations

Table 4: Abbreviations used in this manual

BP	Barometric Pressure
CAN	Controller Area Network
CKP	Crankshaft Position Sensor
CMP	Camshaft Position Sensor
DBW	Drive-By-Wire
DTC	Diagnostic Trouble Code
DVOM	Digital Voltage and Ohm Meter
ECM	Engine Control Module
ECT	Engine Coolant Temperature Sensor
EGC	Electronic Gas Control System
EGT	Exhaust Gas Temperature
EPC	Electronic Parts Catalog
ET	Electronic Throttle
IAC	Idle Air Control Valve
IAT	Intake Air Temperature Sensor
IVS	Idle Validation Switch
KS	Knock Sensor
LED	Light Emitting Diode
MAP	Manifold Absolute Pressure
MIL	Malfunction Indicator Lamp
PWM	Pulse Width Modulated
TCP	Throttle Control Position Sensor
TPS	Throttle Position Sensor
OBD	On-board Diagnostics
DLC	Data Link Connector
MEFI	Marine Electronic Fuel Injection
IC	Ignition Control
ODM	Output Driver Module
EEPROM	Electrically Erasable Programmable Read-only Memory
EI	Electronic Ignition System
PFI	Port Fuel Injection
ICM	Ignition Control Module
COP	Internal Micro Processor
EVC	Electronic Vessel Control
A/D	Analog/Digital
T-MAP	Manifold Absolute Pressure / Manifold Air Temperature sensor
AC	Alternating Current

NOTES

Section 2: System Description

Visual / Physical Inspection

A careful visual and physical inspection must be performed as part of any diagnostic procedure. This can often lead to fixing a problem without further diagnostics. Inspect all vacuum hoses for correct routing, pinches, cracks or disconnects. Be sure to inspect hoses that are difficult to see. Inspect all the wires in the engine compartment for proper connections, burned or chafed spots, pinched wires or contact with sharp edges or hot manifolds. This visual/physical inspection is very important. It must be done carefully and thoroughly.

Basic Knowledge and Tools Required

To use this manual most effectively, a general understanding of basic electrical circuits and circuit testing tools is required. You should be familiar with wiring diagrams, the meaning of voltage, ohms, amps and the basic theories of electricity. You should also understand what happens if a circuit becomes open, shorted to ground or shorted to voltage.

To perform system diagnostics, several special tools and equipment are required. Please become acquainted with the tools and their use before attempting to diagnose the system. Special tools that are required for system service are illustrated in this section.

Electrostatic Discharge Damage

Electronic components used in control systems are often designed to carry very low voltage, and are very susceptible to damage caused by electrostatic discharge. It is possible for less than 100 volts of static electricity to cause damage to some electronic components. By comparison, it takes as much as 4,000 volts for a person to feel the zap of a static discharge.

There are several ways a person can become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a seat, in which a charge of as much as 25,000 volts can build up. Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off, leaving the person highly charged with the opposite polarity. Static charges of either type can cause damage. Therefore, it is important to use care when handling and testing electronic components.

Engine Wiring

When it is necessary to move any of the wiring, whether to lift wires away from their harnesses or move harnesses to reach some component, take care that all wiring is replaced in its original position and all harnesses are routed correctly. If clips or retainers break, replace them. Electrical problems can result from wiring or harnesses becoming loose and moving from their original positions, or from being rerouted.

Engine Control Module (ECM) Self-Diagnostics

The Engine Control Module (ECM) performs a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The ECM's language for communicating the source of a malfunction is a system of Diagnostic Trouble Codes (DTC's). The DTC's are two digit numbers that can range from 12 to 81. When a malfunction is detected by the ECM, a DTC is set and the Malfunction Indicator Lamp (MIL) is illuminated.

Malfunction Indicator Lamp (MIL)

The Malfunction Indicator Lamp (MIL) is part of the Diagnostic Trouble Code (DTC) tool, or it can be a dash mounted warning light on some applications.

- If present, it informs the operator that a problem has occurred and that the boat should be taken for service as soon as reasonably possible.
- It displays DTC's stored by the ECM which help the technician diagnose system problems.

As a bulb and system check, the light will come "ON" with the key "ON," engine "OFF." When the engine is started, the light will turn "OFF." If the light remains "ON," the self-diagnostic system has detected a problem. If the problem goes away, the light will go out in most cases after 10 seconds, but a DTC will remain stored in the ECM.

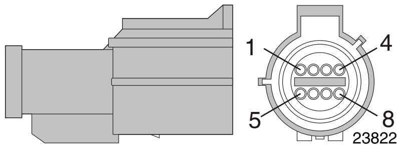
When the light remains "ON" while the engine is running, or when a malfunction is suspected due to a driveability problem, the "On-Board Diagnostic (OBD) System Check" must be performed as the first step. These checks will expose malfunctions which may not be detected if other diagnostics are performed prematurely.

Intermittent Malfunction Indicator Lamp (MIL)

In the case of an "intermittent" problem, the Malfunction Indicator Lamp (MIL) may light for 10 seconds, and then go out. However, the corresponding DTC will be stored in the memory of the ECM. When DTC's are set by an intermittent malfunction, they could be helpful in diagnosing the system.

If an intermittent DTC is cleared, it may or may not reset. If it is an intermittent failure, consult the "Diagnostic Aids" on the facing page of the corresponding DTC table. A physical inspection of the applicable sub-system most often will resolve the problem.

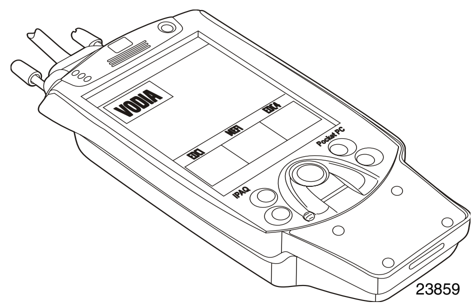
Reading Diagnostic Trouble Codes (DTC’s)



Data Link Connector

The provision for communicating with the ECM is the Data Link Connector (DLC). It is part of the engine wiring harness, and is a 8-pin connector, which is electrically connected to the ECM. It is used in the assembly plant to receive information in checking that the engine is operating properly before it leaves the plant. The DTC(s) stored in the ECM’s memory can be retrieved with several Diagnostic Trouble Code (DTC) tools listed below.

VODIA Scan Tool

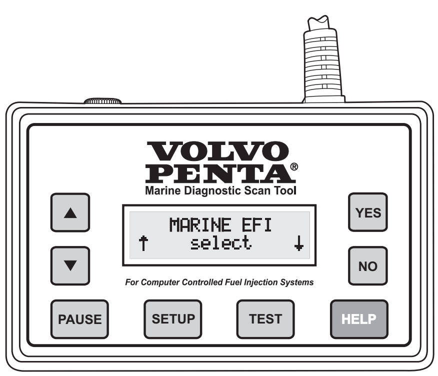


The VODIA tool is an advanced flexible diagnostic tool which is compatible with all Volvo Penta Gas and Diesel engines with electronic control systems, including the new EGC Control System. The VODIA tool is a full-feature scan tool which will read and record all vital engine parameters, read and reset fault codes, and perform engine tests. The tool will also allow access to EVC systems and links to the Volvo Penta Partner Network where updates can be downloaded online for future expansion.

The VODIA tool may only be ordered through the Volvo Penta Partner Network. From the home page, select Service/Warranty and then select VODIA from the menu. Detailed information and pricing may be found on the VODIA website.

Dealers who currently have a VODIA tool can order the connection cable for EGC engines (PN 3883170) from our Parts and Accessories department. The program itself is available for download to all registered users from the VODIA website on the Volvo Penta Partner Network.

Volvo Penta Marine Diagnostic Scan Tool (P/N 3851228)



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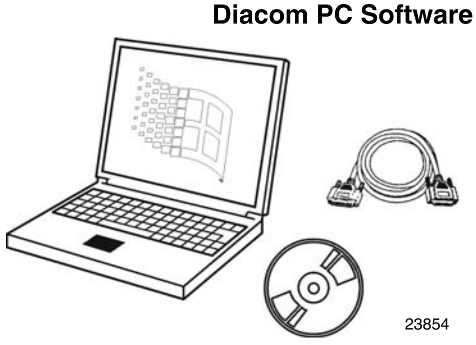
This full-function scan tool will:

- Provide complete access to all vital engine parameters.
- Read and reset fault codes.
- Perform output tests on EGC Control Systems.

The tool is also compatible with all GM based Volvo Penta EFI engines with MEFI 1, 3, 4, and 4B controls. The tool features an easy to use keypad and a high visibility two line text display. The kit includes connectors for EGC and MEFI engines, and a carrying case. Updates

Dealers who currently have earlier versions of this tool with the Techmate faceplate can obtain updated internal software and a connection cable by contacting Rinda Technologies, Chicago, IL, at (773) 736-6633 or by visiting http://www.rinda.com

Diacom PC Software



The Diacom program will provide full access to all vital engine parameters, read and reset fault codes, and perform output tests on EGC Control Systems. The program allows easy access to all vital engine parameters on Windows based PC’s. Fault codes can be read and reset, and output tests can be performed. The system can easily record and store test runs. Live or recorded readings may be graphed for analysis and can also be e-mailed to VPA Technical Assistance for review. The software is also compatible with all Volvo Penta General Motors based EFI engines with MEFI 1, 3, 4, and 4b controls. The kit includes connectors for EGC and MEFI engines and may be purchased directly by contacting Rinda Technologies, Chicago, IL, at (773) 736-6633 or by visiting http://www.rinda.com.

Updates

Dealers who currently have earlier versions of this software can obtain updated software and an EGC connection cable by contacting Rinda Technologies, Chicago, IL, at (773) 736-6633 or by visiting http://www.rinda.com.

Service Mode

When the Diagnotic tool is installed at the DLC and “service mode” or “ON” is selected, the system will enter what is called the “Service Mode.” In this mode, the ECM will:

- Display any stored DTC’s.
- The ignition timing is controlled to a fixed timing degree programmed in the ECM. This will allow base timing to be adjusted on distributor ignition engines.

Normal Mode

When the Diagnotic tool is in the “normal mode” or “OFF,” it has no affect on the engine operation.

On-Board Diagnostic (OBD) System Check

After the visual/physical inspection, the “On-Board Diagnostic (OBD) System Check” is the starting point for all diagnostic procedures.

The correct procedure to diagnose a problem is to follow two basic steps:

1. Are the on-board diagnostics working? This is determined by performing the “On-Board Diagnostic (OBD) System Check.” Since this is the starting point for the diagnostic procedures, always begin here. If the on-board diagnostics are not working, the OBD system check will lead to a diagnostic table to correct the problem. If the on-board diagnostics are working properly, the next step is:
2. Is there a DTC stored? If a DTC is stored, go directly to the number in the DTC table. This will determine if the fault is still present.

DLC Scan Tools

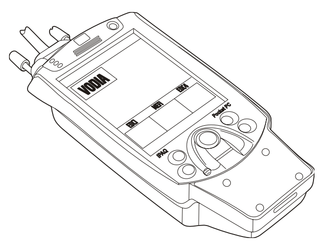
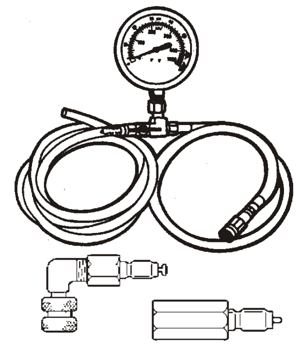
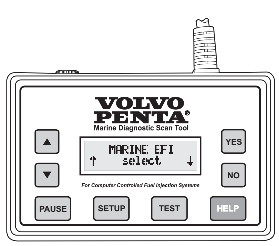
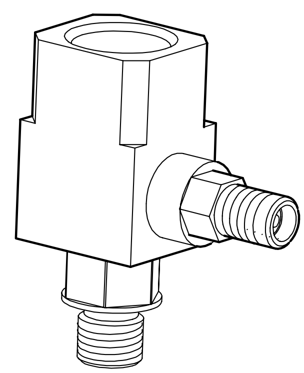
The ECM can communicate a variety of information through the DLC. This data is transmitted at a high frequency which requires a scan tool for interpretation.

With an understanding of the data which the scan tool displays, and knowledge of the circuits involved, the scan tool can be very useful in obtaining information which would be more difficult or impossible to obtain with other equipment.

A scan tool does not make the use of diagnostic tables unnecessary, nor do they indicate exactly where the problem is in a particular circuit. Tables are provided for the use of a scan tool.

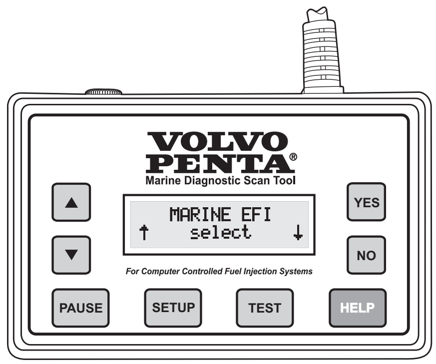
Special Tool and Equipment

Table 1: Special Tools and Equipment

Illustration	Tool Number/ Description	Illustration	Tool Number/ Description
	VODIA Scan Tool The VODIA tool is an advanced flexible diagnostic tool which is compatible with all Volvo Penta Gas and Diesel engines with electronic control systems, including the new EGC Control System. The VODIA tool is a full-feature scan tool which will read and record all vital engine parameters, read and reset fault codes, and perform engine tests.		Fuel Pressure Test Kit (PN 3855533) This kit includes adapter P/N 3862357 for attachment to the larger Schrader valves found on the high-pressure fuel rail on EGC engines, and the smaller Schrader valve adapter P/N 3855354 for low pressure test ports. Each adapter is also available individually.
	Volvo Penta Marine Diagnostic Scan Tool (P/N 3851228) The tool is also compatible with all GM based Volvo Penta EFI engines with MEFI 1, 3, 4, and 4B controls. The tool features an easy to use keypad and a high visibility two line text display. The kit includes connectors for EGC and MEFI engines, and a carrying case.		PN 3861684 Schrader adapter. For checking fuel pump pressure near the high pressure fuel pump (the valve is in the fuel rail)
	Diacom PC Software The Diacom program will provide full access to all vital engine parameters, read and reset fault codes, and perform output tests on EGC Control-Systems. The program allows easy access to all vital engine parameters on Windows based PC's.		

Notes

Section 3: Volvo Penta Diagnostic Scan Tool



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The Volvo Penta Diagnostic Scan tool is a multi-function device that is used as a scan tool and fuel injector tester. The scan tool supports all Volvo Penta/GM electronic fuel injection products and is software upgradable for future applications. In addition to the scan tool's functions, the tool also contains a programmable fuel injector tester that is compatable with most multi-port marine fuel injectors.

The tool automatically tailors its menu choices and available functions based on the type of ECM it detects on the engine. A flowchart of the menu choices and their functions are on following pages. Some functions and features may vary between similar ECM types. This variation is due to the way a particular ECM is programmed. Some ECM functions may have certain features enabled or disabled which will cause the scan tool to automatically adjust its menu and data display choices.

UP Button - Scrolls to next menu choice or use to increase a value

DOWN Button - Scrolls to previous menu choice or used to decrease value.

YES Button - Used to choose or activated menu options.

NO Button - Exits the current menu or test mode.

PAUSE Button - Stops information that is scrolling across the display.

SETUP Button - Displays scan tool setup option.

TEST Button - Used to activate outputs or pulse injectors depending on test mode.

HELP Button - Provides information on menu selections or engine parameters.

Scan Tool Compatibility

The Volvo Penta Diagnositc Scan tool is compatibile with all Volvo Penta/General Motors Marine Electronic Fuel Injection (MEFI) generations, and the Volvo Penta Electronic Gas Controller (EGC). Please note that other manufacturers products may also be compatable based on the software updates.

Setup

The setup function is accessible while in any of the scan tool's menus or while in the data scanning mode. Pressing the "SETUP" key causes the scan tool to suspend its current mode of operation and enter a special setup menu. The setup menu contains items that allow you to tailor various functions of the scan tool.

```
English / Metric
↑     select     ↓
```

ENGLISH / METRIC Mode changes related pressure, temperature and velocity to display in English or Metric units.

```
  GPH Scaling
↑    select    ↓
```

GPH Scaling - Affects the display of MEFI 1 and 2 fuel flow readings. Use scale 1 for all Volvo Penta engines.

```
  MAP Scaling
↑    select    ↓
```

MAP Scaling - only used on supercharged engines.

```
 Save Settings
↑    select    ↓
```

SAVE SETTINGS - Saves the changes made to the English/Metric, GPH Scaling, Screen Contrast, and Fuel Injector time settings to the scan tool's non-volitile memory. The selected settings are stored permanently and will automatically load each time the tool is turned ON. These settings will remain in effect until changed via the menus.

```
 Screen Adjust
↑    select    ↓
```

SCREEN ADJUST - Adjusts the scan tool's display contrast. The display's readability is affected by both ambient light and environmental temperature. Use the screen adjustment feature as necessary to produce suitable contrast for your operating environment.

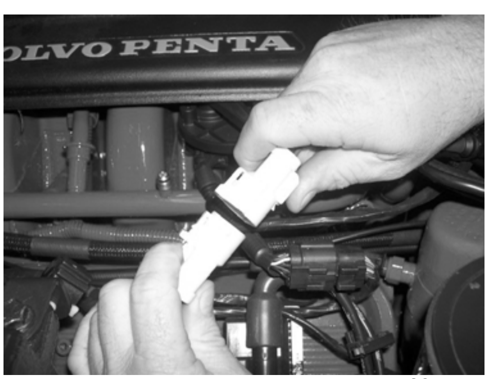
Connecting to the EGC System

The Volvo Penta Diagnostic Scan Tool has the ability to diagnose both singe and twin engine applicaitons. The connection and operation of the tool is simple and straightforwared.

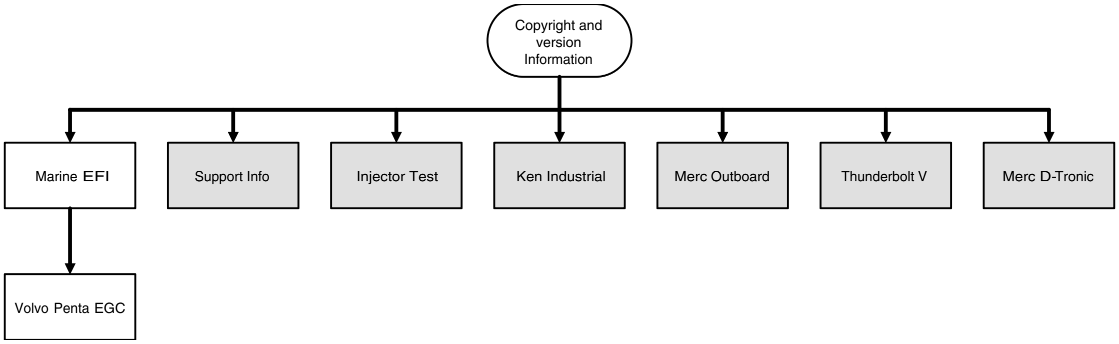
1. Locate and remove the EGC Diagnositc Link Connector (DLC). from its protective cover located on the starboard exhaust manifold fuse box mounting bracket.

DSCN 1985

2. With the ignition switch in the OFF position, and the EGC adapter installed on the Diagnostic Scan Tool, connect the Diagnostic Scan Tool to the engine's DLC.
3. With the Diagnostic Scan Tool connected, turn the ignition switch to the ON position. A series of screens will appear giving the version and copyright information. If no screens appear when the ignition switch is turned ON, check the connections at the DLC, the scan tool adaptor, main engine harness connector, battery power and ground connections to the engine.



DSCN 1995



4. After the Diagnositc Scan Tool displays its version and copyright information the “Marine EFI” operating mode is displayed by default. Press **YES** to select this mode.

Operation

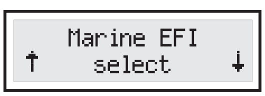
The ▲ and ▼ keys are used to access all menu choices thoughout the operation of the scan tool.

The **YES** key is used to select or activate the currently displayed menu item.

The **HELP** key provides information on current menu choices or items.

After the scan tool displays its initial opening messages, use the ▲ and ▼ to access one of the following operating modes, then press the **YES** key to select it.

Marine EFI - Selects troubleshooting diagnostics for Volvo Penta MEFI and EGC systems



Injector Test - Selects the injector tests.

Support Information - Selects the support and contact information for the vairous products.

Connecting to Twin Engine Systems

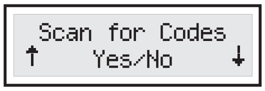
In a twin engine configuration, the ECM modules (one on each engine) may be electronically linked together through a master/slave wire connection. This connection allows the engines to communicate and diagnose either engine through one connection. In order for the Diagnostic Scan Tool to function properly in this mode, BOTH ignitions should be ON. It is not necessary to have both engines running, but both engines need to have the ignition turned ON.

The master/slave connection is highly recommended but not required and is usually installed by the boat manufacturer. If the master/slave connection is not installed, each engine needs to be diagnosed individually.

Obtaining Data

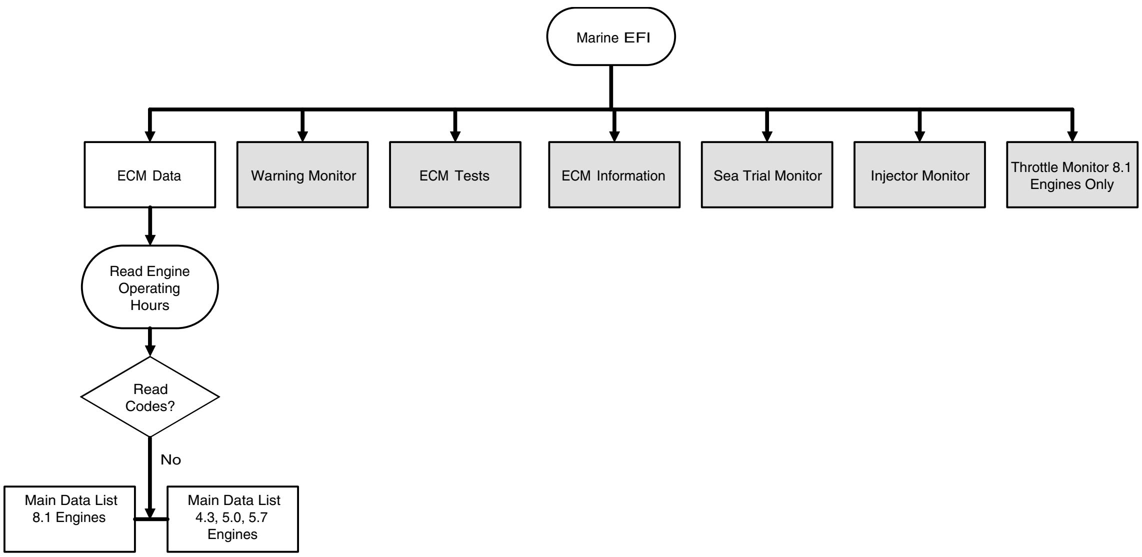
After selecting the “Marine EFI” function, the diagnostic scan tool will attempt to communicate and identify the ECM. After identification has been made, the diagnostic scan tool will display the type of ECM it has identified. The diagnostic scan tool will then display the "ECM Data" function.

Next, the diagnostic scan tool will provide "Engine Run Hours



Once the diagnostic scan tool has interrogated the ECM, it will ask if you would like to scan for codes. To scan for codes, press the ▲ button. To bypass this function press the ▼ button to continue to the "ECM Data" function.

ECM Data



After choosing the “ECM Data” function, you will be presented with a data list depending on which engine you are servicing. This function contains valuable information for determining the status of sensors in the engine.

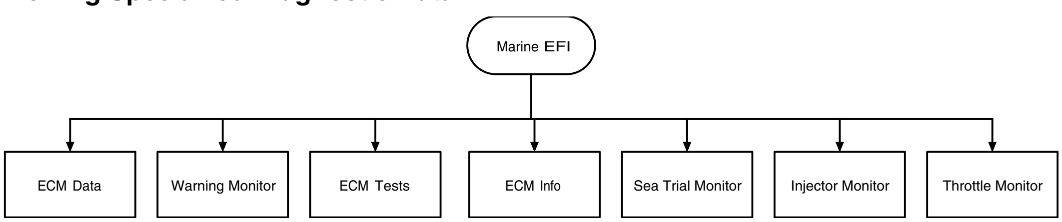
Main Data List
8.1 Engines

Engine Speed
Desired Idle Speed
Cam Retard
MAP Volts
Barometric Pressure
Manifold Pressure
Engine Load
Injector Pulse Width
TCP Actual %
TCP Commanded %
TP Actual %
ECT Volts
ECT Sensor Temp
IAT Volts
IAT Sensor Temp
Oil Pressure Volts
Oil Pressure
Oil Pressure Status
Ignition Switch Volts
Battery Volts
Spark Advance
Knock Intensity
Fuel Flow Rate
Trim Volts
EGT Switch Input
Warning Horn Status
MIL Status
Engine Derate 1
Engine Derate 2
Low Rev Limit
Fuel Relay Driver
Ignition Relay Driver
Horn Driver
MIL Driver
Tach Driver
Shift Interrupt Volts
Neutral Safety Switch
Dual Helm Input
Master/Slave Input
Engine Run State
Engine Starts
Operating Hours

Main Data List
4.3, 5.0, 5.7 Engines

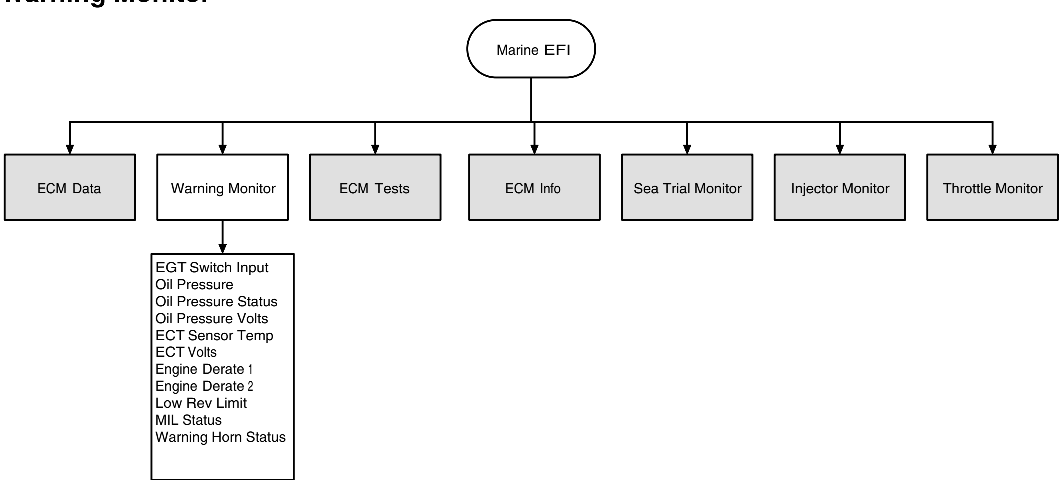
Engine Speed
Desired Idle Speed
IAC Position
Cam Retard
MAP Volts
Barometric Pressure
Manifold Volts
Engine Load
Injector Pulse Width
TP Volts
TP%
ECT Volts
ECT Sensor Temp
Oil Pressure Volts
Oil Pressure
Oil Pressure Status
Ignition Switch Volts
Battery Volts
Spark Advance
Knock Average Volts
Knock Retard
Octane Rating
Knock Intensity
Fuel Flow Rate
Trim Volts
EGT Switch Input
Warning Horn Status
MIL Status
Engine Derate 1
Engine Derate 2
Low Rev Limit
Fuel Pump Relay Driver
Ignition Relay Driver
Horn Driver
MIL Driver
Tach Driver
Shift Interrupt Volts
Neutral Safety Switch
Dual Help Input
Engine Run State
Engine Starts
Operating Hours

Viewing Speciaized Diagnostic Data



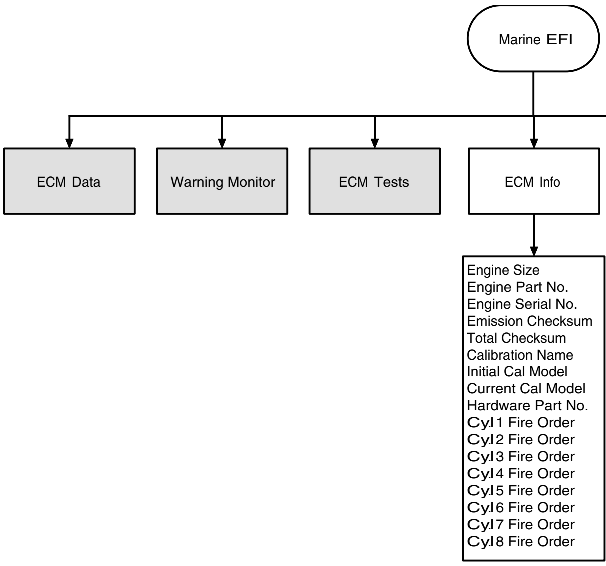
In addition to providing ECM Data as listed above, the diagnostic scan tool has access to more data which is taylored for specific purpose. This data is accessable from the Volvo Penta EGC main menu and are as follows.

Warning Monitor



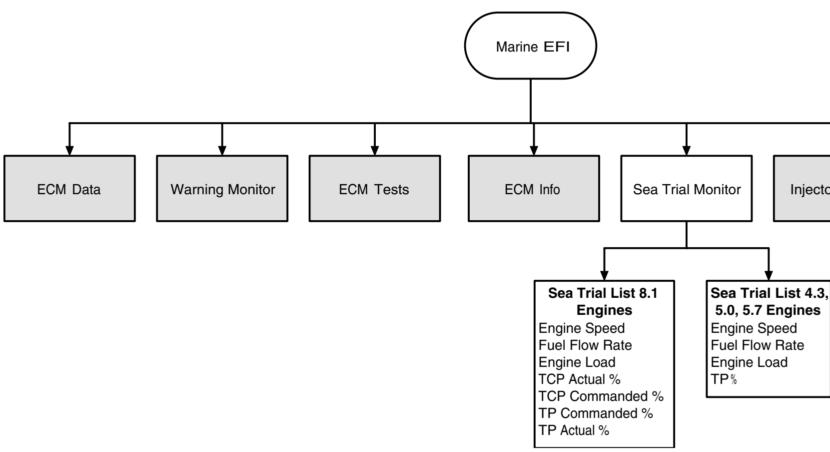
The items under this menu provde quick access to a subset of ECG parameters and status indicators that are considered critical system items. Items in this list provide important operating data such as oil pressure, engine temperature, MIL status and other critical engine functions.

ECM Info



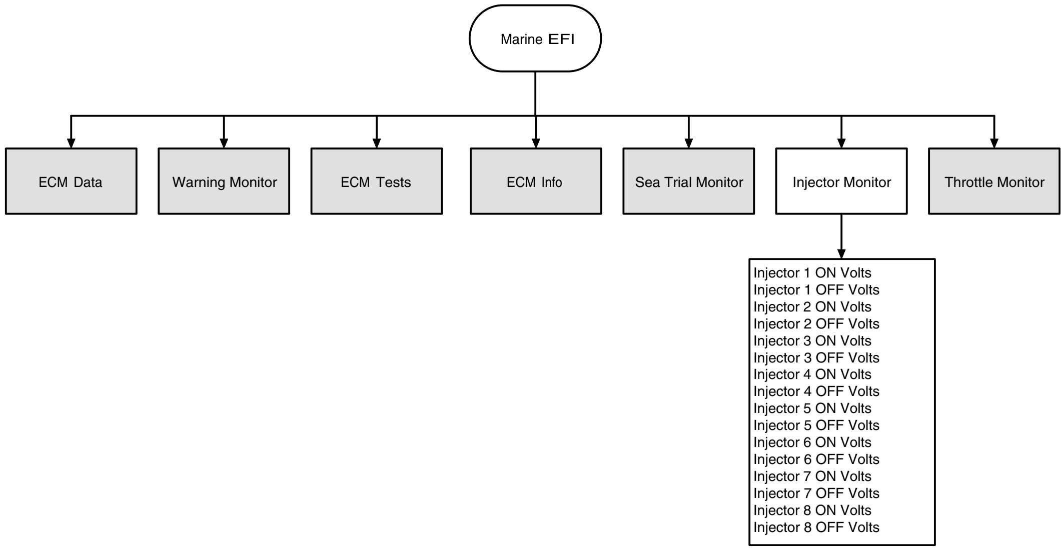
This list of menu items will allow the technician to see information about the the ECM version, serial number, calibration information related to the EGC module. This information is non-diagnostic in nature and includes hardware and software version numbers, calibration checksum, serial number and engine firing order data.

Sea Trial Monitor



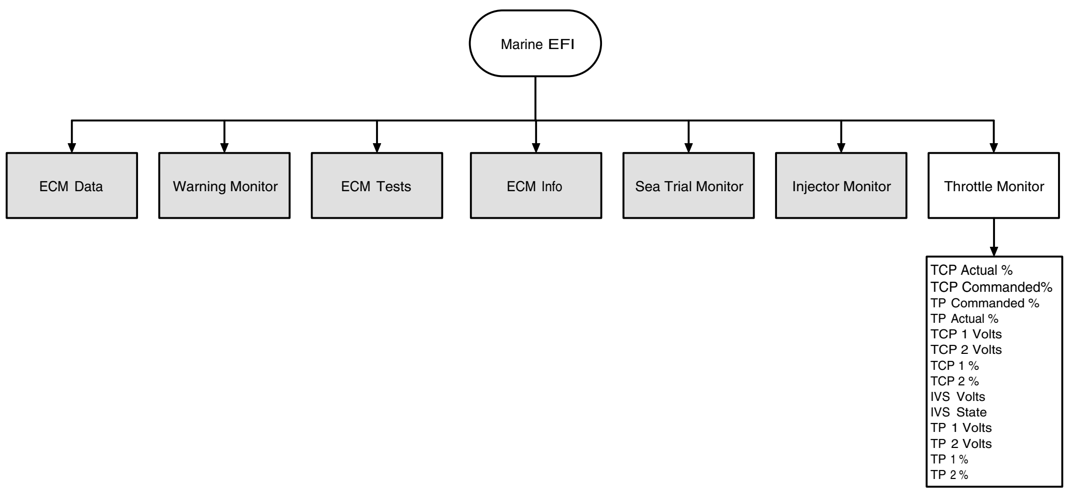
The Sea Trial Monitor menu includes a sit of engine parameters that are useful when performing boat tests. The parameters that are monitored include engine RPM, fuel flow rate, engine load and throttle position data.

Injector Monitor



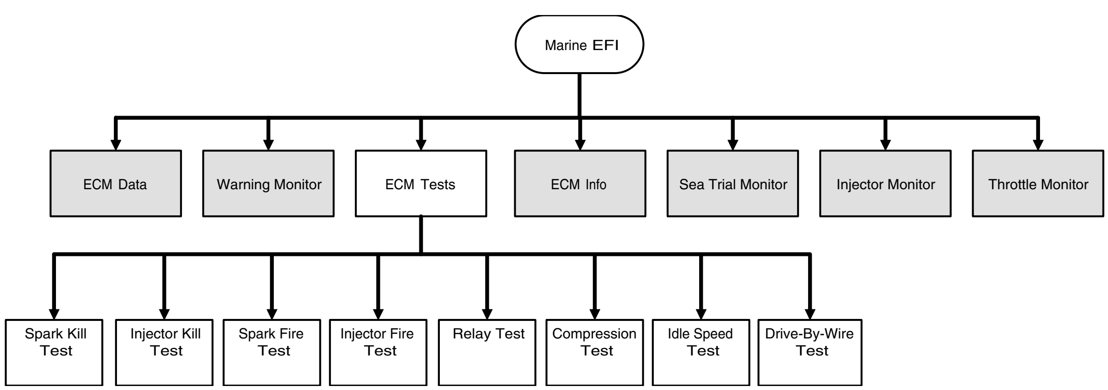
This menu will display the ON and OFF voltages for each injector driver. The technician can diagnose and isolate an injector that has an electricl problem by using this menu.

Throttle Monitor

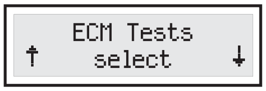


This function is reserved for engine equipped with Electronic Throttle Control (ETC). This menu will allow the technician to monitor throttle commands and throttle position and compare the two functions.

ECM Tests



The ECM Tests will let the technician access a variety of EGC funtion tests.



1. After selecting the “ECM Tests” menu from the diagnostic scan tool main EGC menu, you will be given the following options.
2. Use the ▲ and ▼ keys to select the desired function and then press the **YES** button to enter the desired function.

Spark Kill Test

This test allows individual spark outputs to be disabled. Perform this test under moderate load within an RPM range of 1000 to 2000 RPM. Running the engine under moderate load will allow you to audibly hear a drop in engine speed when the spark is disabled. When selecting this test, you will be prompted to select the spark output 1 through 8 to disable. The spark output follows the firing order, i.e. for the 8.1 engine spark output 1 = cylinder 1, spark output 2 = cylinder 8, spark output 3 = cylinder 7 etc... Use the ▲ and ▼ keys to select the desired spark output and then press TEST key to start the test. The test will run for approxomately 10 seconds.

NOTE! To abort the Spark Kill Test at any time, press and hold the NO key.

Injector Kill Test

Injector Kill Test This test allows individual fuel injectors to be disabled. This test should be performed with the engine under a moderate load within an RPM range of 1000 to 2000 rpm. Running the engine under a moderate load will allow you to audibly hear a drop in engine speed when the injector is disabled. Upon selecting this test you will be prompted to select the fuel injector, 1 thru 8, to disable. Injector numbers follow cylinder-firing order. Use the ▲ and ▼ keys to select the desired fuel injector and then press the TEST key to start the test. The test will run for approximately 10 seconds.

NOTE! To abort the Injector Kill test at any time, press and hold the scanner's NO key.

Spark Fire Test

This test allows individual spark outputs to be fired.

WARNING: Engine backfire and external flame can occur during this test. As a safety precaution, purge fuel vapors from the engine before proceeding. Do not remove the flame arrestor.

IMPORTANT! Before performing this test disconnect the engine's Crank Position Sensor.

NOTE! This test must be performed with Key-On and Engine Off.

Upon selecting this test you will be prompted to select the spark output to fire. Spark outputs follow cylinder firing order. Use the ▲ and ▼ keys to select the desired spark output and then press the TEST key to start the test. The test will run for approximately 10 seconds. Use an inductive pickup KV tester to verify the spark output's operation.

NOTE! To abort the Injector Kill test at any time, press and hold the scanner's NO key.

Injector Fire Test

This test allows individual fuel injectors to be pulsed. The test must be performed with Key ON / Engine OFF. This test is intended to be used for injector leak-down testing and it can assist in identifying clogged injectors. Use Fuel Pressure Test Kit (PN 3855533) in conjunction with this test.

After selecting this test you will first be prompted to select a fuel injector ON time. The ON time can be adjusted from I to 999 milliseconds. Use the ▲ and ▼ keys to set the injector ON time and then press the YES key to proceed to the test. Holding either the ▲ or ▼ key continuously for more than two seconds accelerates the injector ON time adjustment.

After setting the time and pressing YES you will be prompted to select the fuel injector to pulse. Use the ▲ and ▼ keys to select the desired fuel injector and then press the TEST key to activate the injector. The injector sequence follows the engine firing order, same as in the spark kill test.

NOTE! After the injector is pulsed you will be prompted to run then engine for a short period of time to clear out the unburned fuel from the cylinder. The test cannot be re-run unless this procedure is performed.

Relay Test

This test allows the EGC module's relay outputs to be activated. The test must be performed with Key ON / Engine OFF. After selecting this test you will be prompted to select either the Ignition Relay output or All Relays (including the Fuel Pump relay). Pressing the TEST key will activate the selected relay(s) for approximately two seconds.

Compression Test

The Compression Test is a special test mode that the EGC system provides to allow a technician to safely perform a cylinder compression check by disabling the ignition system and fuel system to prevent fuel and spark from being introduced into the engine compartment with the spark plugs removed.

⚠ **Warning! The fuel and ignition systems are disabled during this test, it should only be performed at the dock or on land. The test must be properly exited from the diagnostic scan tool in order to re-enable normal ignition and fuel system operation. If the diagnostic scan tool is diconnected from the engine during the Compression Test, the engine will remain in the disabled state. You must reconnect the diagnostic scan tool, re-enter the Compression Test mode and then properly exit the test.**

Idle Speed Test

This test is used to verify the operation of the engine's idle speed control system. This test must be performed with the engine idling, in neutral and at normal operating temperature. The test overrides the factory set engine idle speed and allows a technician to adjust the idle speed from 600 to 2000 RPM. After selecting the Idle Speed Test the scan tool will initially command the engine to idle at 700 RPM. Use the ▲ and ▼ keys to vary the commanded speed in 100-RPM increments.

NOTE! To stop the Idle Speed test at any time, press and hold the scanner's NO key.

Drive by Wire Test

This test is available only when connected to engines equipped with Electronic Throttle Control (ETC). The test checks the functionality of the ETC system by commanding the engine's throttle blade to track helm throttle control lever movements.

This test must be performed with Key ON Engine OFF. After selecting this test you will be prompted to move the helm throttle lever and observe movements of the engine throttle blade. The scan tool will also display the commanded Throttle Control Position percentage as well as the commanded Throttle Position percentage (percentage of throttle blade movement).

NOTE! To stop the Drive by Wire test at any time, press and hold the scanner's NO key.

Section 4: Symptoms

Before Using This Section

Before using this section you should have checked for Diagnostic Trouble Codes and determined that:

The ECM is operating correctly

There are no DTCs ative or stored.

Symptom

Verify the customer complaint, and locate the correct symptom in the table of contents. Check the items indicated under that symptom.

Visual / Physical Checks

Several of the symptom procedures call for a careful visual and physical check. The importance of this step cannot be stressed too strongly. I can lead to correcting a problem without further checks and save valuable time.

These check should include:

- ECM grounds and sensors for clean, tight connections and in their proper location.
- Vacuum hoses for splits, kinks, and connected properly. Check for any type of leak or restriction.
- Air leaks at the throttle body mounting area and intake manifold sealing surfaces.
- Ignition wires for cracking, hardness, proper routing and carbon tracking.
- Wiring for proper connections, pinches, and cuts. If wiring harness or connection repair is necessary, See *Wiring Harness Repair*.
- Moisture in primary or secondary ignition circuit connections
- Salt corrosion on electrical connections and exposed body linkages.

On-Board Diagnostics System Check (OBD)

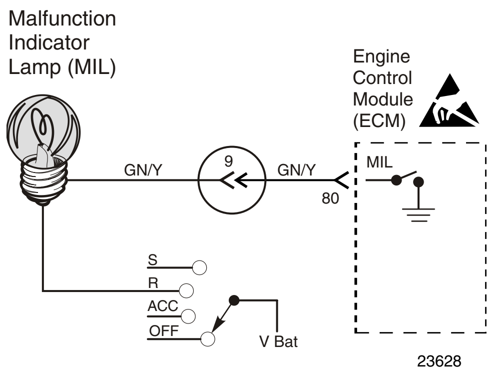
Malfunction Indicator Lamp (MIL)

Circuit Description

The Volvo Penta Fuel system is equipped with on-board diagnostics (OBD). The system has an optional dash mounted check engine light for the indication of system problems. Engine control system problems that affect emissions or driveability of the boat will set a diagnostic trouble code (DTC). The MIL lamp is powered from the ignition switch. The Engine Control Module (ECM) will provide a path to ground through pin 80 at the ECM and then via Pin 9 in the engine harness connector to illuminate the MIL lamp.

The MIL has the following functions:

1. Notifies the operator of a problem with the fuel system, ignition system, engine temperature, exhaust temperature, or oil pressure so the operator can arrange for service as soon as possible.
2. It will display DTC's that have been stored due to a system malfunction.



The lamp should illuminate when the key is in the run position, and the engine is not running. This feature verifies that the lamp is in proper working order.

If the lamp does not illuminate with the key ON/engine OFF, repair the lamp as soon as possible. Once the engine is in the run mode, the lamp should turn off. If the lamp illuminates while the engine is running a current DTC may be set. Always use the OBD system check chart to verify proper MIL operation before proceeding with a DTC repair

On-Board Diagnostics System Check (OBD)

Step	Action	Value(s)	Yes	No
1	• Key ON engine OFF Does MIL illuminate?		Go to step 2	Go to step 3
2	• Start the engine Does the MIL turn off		MIL is working properly. OBD system check is complete.	Go to step 10
3	• Key ON engine OFF. • Check for voltage between MIL power source and engine ground. Is voltage present?		Go to step 4	Repair MIL voltage source. Refer to the wiring diagram.
4	• Replace MIL Lamp. Did this solve the problem		Go to step 1	Go to step 5

On-Board Diagnostics System Check (OBD)

Step	Action	Value(s)	Yes	No
5	• Key OFF. • Disconnect the ECM wire harness connector. • Using DVOM, check for continuity between the MIL ground and the ECM terminal 80. Is there continuity?		Go to step 6	Go to step 8
6	• Inspect the MIL lamp socket, the ECM connector and ECM terminal 80 for damage, corrosion, or contamination. Was there a problem?		Repair the circuit as necessary. See *Wiring Harness Repair*.	Go to step 7
7	• Replace ECM. Is the replacement complete?		Go to step 1.	
8	• Back probe the MIL and ECM side of the ECM connector. • Using a DVOM, check for continuity through ECM connector pin #80 Is there continuity?		Go to step 9	Repair open circuit in the ECM connector.
9	• Inspect the MIL lamp socket, and ECM connector socket #80 for damage, corrosion, or contamination. Did you find a problem?		Repair the damaged socket or terminal as required. See *Wiring Harness Repair*.	Repair the open circuit as necessary. See *Wiring Harness Repair*.
10	• Active DTCs are stored in memory. Proceed with DTC diagnosis. If no active DTCs are found in memory, return to table 1, Step 11			
11	• Key OFF. • Disconnect the ECM wire harness connector. • Using a DVOM check for continuity between the ECM terminal 80 and battery voltage. Do you have continuity?		Repair the shorted ground circuit as necessary. See *Wiring Harness Repair.*	Go to step 7.

Preliminary and Intermittent Checks

Preliminary and Intermittent Checks

Checks	Action
Before Using this Section	Before using this section, you should have performed an OBD check and determined that: 1. The ECM and MIL are operating properly. 2. There are no DTCs stored. or a DTC exists but without a MIL. Several of the following symptom procedures call for a careful visual and physical check. The visual and physical checks are very important. The checks can lead to correcting a problem without further checks that may save valuable time.
Visual and Physical Checks	• Check all ECM system fuses and circuit breakers. • Check the ECM ground is clean, tight and in its proper location. • Check thoroughly for any type of leak or restriction. • Check for vacuum leaks at all the mounting areas of the intake manifold sealing surfaces, and vacuum hoses and connections. • Check the ignition wires for the following conditions: —Cracking —Hardness —Proper routing —Carbon tracking • Check the wiring harness for the following items: —Loose or disconnected sensors —Proper connections, pinches or cuts. • The following symptom tables contain groups of possible causes for each symptom. The order of these procedures are not important. If using the diagnostic readings do not indicate the problems, the proceed in logical order, easiest or most likely to cause the symptom first.
Preliminary Checks	• Refer to table 2 • Do not use the DTC tables. If a fault is intermittent, use of the DTC tables may result in the replacement of good parts.
Faulty Electrical Connections or Wiring	• Faulty electrical connections or wiring can cause most intermittent problems. • Check the suspected circuit for the following conditions: —Faulty fuse or circuit breaker —Connections poorly mated or misaligned —Terminals not fully seated in the connector (backed out) —Terminals not properly formed or damaged —Terminal to wires poorly connected —Terminal tension insufficient (loose in socket) • Carefully remove all the connector terminals in the problem circuit to ensure the proper contact tension. If necessary, replace all the connector terminals in the proper circuit to ensure proper contact tension. • Checking for poor terminal to wire connections requires removing the terminal for the connector body.

Preliminary and Intermittent Checks

Operational Test	If visual and physical checks do not reveal the cause of the problem, operate the boat with a diagnostic tool connected to the engine's Data Link Connector. When the problem occurs, an abnormal voltage or scan reading indicates the problem may be in that circuit.
Intermittent Malfunction Indicator Lamp	The following components can cause an intermittent MIL and no DTC(s): • Defective relay, ECM driven solenoid, or a switch that can cause electrical system interference. Normally, the problem will occur when the faulty component is operating. • The improper installation of electrical devices, such as pumps, bilge blowers, radios, etc. • The MIL circuit or diagnostic test terminal intermittently shorted to ground. • ECM grounds
DTC Memory	All DTCs are stored in EEPROM and are not erased unless intentionally erased using the diagnostic tools.

Hard Starting

Definition: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms section.
- Check the ECM grounds for being clean, tight and in the proper locations.
- Search Service Bulletins.

Sensor System

- Check the engine coolant temperature (ECT) sensor for being shifted in value. Connect a Scan tool. Compare the engine coolant temperature against the intake air temperature (IAT) on a cold engine. The ECT sensor and IAT sensor values should be within 3°C (5°F) of each other. If the ECT sensor is out of range with the IAT sensor, check the resistance of the ECT sensor. Replace the ECT sensor if the resistance is not within specification. If the sensor is within specification, check and repair the ECT signal circuit for high resistance.
- Check the camshaft position (CMP) sensor for proper mounting and or a bad connection. A long crank time occurs if the ECM does not receive a CMP signal.

Fuel System

- Check the fuel pump relay operation. The fuel pump should turn ON for 5 seconds when you turn ON the ignition.
- A faulty fuel pump check valve allows the fuel in the lines to drain back to the tank after the engine stops.
- Check for incorrect fuel pressure.
- Check for a restricted fuel filter.
- Check for a contaminated fuel condition.

Ignition System

- Check for proper ignition voltage output per manufacturers recommendations.
- Remove the spark plugs and check for the following:
  - Correct heat range
  - Wet plugs
  - Cracks
  - Wear
  - Improper gap
  - Burned electrodes
  - Heavy deposits
- Determine the cause of the fouling before replacing the spark plugs if the spark plugs are gas, coolant or oil fouled.
- Check for bare or shorted ignition wires.
- Check for loose ignition coil grounds.

Engine Mechanical

- Check for excessive oil in combustion chamber - Leaking valve seals.
- Check for low cylinder compression
- Check combustion chambers for excessive carbon buildup. Clean the chambers using top engine cleaner. Follow the instructions on the can.
- Inspect the following components for incorrect basic engine parts:
  - Cylinder Heads
  - Camshaft

    - Pistons, etc.
- Refer to the appropriate procedures in Engine Mechanical.

Surginig

Definition: Engine power variation under steady throttle or cruise. Feels like the boat speeds up and slows down with no change in throttle position.

NOTE! Make sure that the boat is checked in calm water. Light chop or small seas can produce a surging sensation.

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms section.
- Check the ECM grounds for being clean, tight and in the proper locations.
- Search Service Bulletins.

Fuel System

- Check for incorrect fuel pressure.
- Check for a restricted fuel filter.
- Check for a contaminated fuel condition.
- Check that each injector harness is connected to the correct injector or cylinder according to the firing order.
- Check the items that cause an engine to run rich long term.
- Check the items that cause an engine to run lean long term.

Ignition System

- Wet down the secondary ignition system with water from a spray bottle. Wetting down the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water
- Check for proper ignition voltage output per manufacturers recommendations.
- Remove the spark plugs and check for the following:
  - Correct heat range
  - Wet plugs
  - Cracks
  - Wear
  - Improper gap
  - Burned electrodes
  - Heavy deposits
- Determine the cause of the fouling before replacing the spark plugs if the spark plugs are gas, coolant or oil fouled.
- Check for bare or shorted ignition wires.
- Check for loose ignition coil grounds.

Engine Mechanical

- Ensure that the engine is not overheating, causing the engine to go into RPM reduction mode.

Additional

- Visually check the vacuum hoses for splits, kinks and proper connections and routing.

Hesitation, Sag or Stumble

Definition: Momentary lack of response as the throttle is increased. Can occur at any boat speed. Usually more pronounced when first trying to make the boat move, as from a stop. May cause the engine to stall if severe enough.

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms.
- Check the ECM grounds for being clean, tight and in the proper locations.
- Search for Service Bulletins.
- Remove the flame arrestor and check for dirt or for being restricted

Sensor/System

- Check the MAP sensor operation.
- Check the TP sensor operation.

Fuel System

- Check for incorrect fuel pressure.
- Check for a restricted fuel filter.
- Check for a contaminated fuel.
- Check the fuel injectors.
- Check the items that cause an engine to run rich long term.
- Check the items that cause an engine to run lean long term.
- Worn throttle linkage.

Ignition System

- Wet down the secondary ignition system with water from a spray bottle. Wetting down the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water.
- Check for proper ignition voltage output per manufacturers recommendations.
- Remove the spark plugs and check for the following:
- Correct heat range
- Wet plugs
- Cracks
- Wear
- Improper gap
- Burned electrodes
- Heavy deposits
- Determine the cause of the fouling before replacing the spark plugs if the spark plugs are gas, coolant or oil fouled.
- Check for bare or shorted ignition wires.
- Check for loose ignition coil grounds.

Addtional Checks

- Check the engine thermostat for proper operation and heat range.
- Check the alternator output voltage. Repair the charging system if the alternator output voltage is less than 12 volts or more than 16 volts.
- Throttle linkage for sticking, binding, or wear
- Intake Valves for deposits

Detonation/Spark Knock

Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms.
- Check the ECM grounds for clean, tight connectiona and in the proper locations.
- Search for Service Bulletins.
- If the scan tool readings are normal, refer to supporting text of the Diagnostic Check, and there are no engine mechanical faults, fill the fuel tank with a known high quality fuel that meets the boats minimum octane requirements. Refer to *Fuel System Specifications*. Test the boat and re-evaluate the performance.

Sensor/System

- Knock sensors connected and functioning.
- ECT - Refer to Diagnostics section.
- TP sensor for binding, sticking, or corrosion. Voltage should increase as throttle is moved to wide open throttle (WOT) on mechanical throttle engines.

Fuel System

- Check fuel quality and proper octane rating.
- Check for incorrect fuel pressure.
- Check for a restricted fuel filter.
- Check for a contaminated fuel condition.
- Check the items that cause an engine to run lean long term.

Ignition System

- Check the spark plugs for proper heat range.

Engine Cooling

- Check for obvious overheating problems.
- Insufficient coolant flow through the engine.
- Wrong or stuck thermostat.
- Inoperative water supply pump.

Engine Mechanical

- Low oil level
- Check for excessive oil in combustion chamber - Leaking valve seals.
- Check for low cylinder compression
- Check combustion chambers for excessive carbon buildup. Clean the chambers using top engine cleaner. Follow the instructions on the can.
- Camshaft timing
- Inspect the following components for incorrect basic engine parts:
  - Cylinder Heads
  - Camshaft
  - Pistons, etc.
- Refer to the appropriate procedures in *Engine Mechanical Workshop Manual.*

Lack of Power, Sluggish or Spongy

Definition: Engine delivers less than expected power. Little or no increase in speed when throttle is opened.

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms.
- Check the ECM grounds for being clean, tight and in the proper locations.
- Search for Service Bulletins.
- Remove the flame arrestor and check for dirt or for being restrict

Sensor/System

- Ensure that the engine is not going into RPM reduction mode.
- Use a diagnostic tool in to monitor the knock sensor system for excessive spark retard activity.

Fuel System

- Check for incorrect fuel pressure.
- Check for a restricted fuel filter.
- Check for contaminated fuel.
- Check the fuel injectors. Refer to Fuel Injector Test
- Check the items that cause an engine to run rich long term.
- Check the items that cause an engine to run lean long term.

Ignition System

- Wet down the secondary ignition system with water from a spray bottle. Wetting down the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water.
- Check for proper ignition voltage output per manufacturers recommendations.
- Remove the spark plugs and check for the following:
  - Correct heat range
  - Wet plugs
  - Cracks
  - Wear
  - Improper gap
  - Burned electrodes
  - Heavy deposits
- Determine the cause of the fouling before replacing the spark plugs if the spark plugs are gas, coolant or oil fouled.
- Check for bare or shorted ignition wires.
- Check for loose ignition coil grounds.

Engine Mechanical

- Restricted Exhaust
- Excessive oil in combustion chamber - Leaking valve seals.
- Low cylinder compression
- Combustion chambers for excessive carbon buildup. Clean the chambers using top engine cleaner. Follow the instructions on the can.
- Inspect the following components for incorrect basic engine parts:
  - Cylinder Heads
  - Camshaft
- Pistons, etc.Refer to the appropriate procedures in Engine Mechanical.

Addtional Checks

- Proper Alternator Output
- ECM grounds for clean tight connections and in their proper location.
- Dirty boat bottom from marine growth
- Propeller for proper pitch, size and condition

Cuts Out, Misses

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. This condition is not normally felt above 1,500 RPM. The exhaust has a steady spitting sound at idle or low speed.

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms.
- Check the ECM grounds for clean, tight connectiona and in the proper locations.
- Search for Service Bulletins.
- If the scan tool readings are normal, refer to supporting text of the Diagnostic Check, and there are no engine mechanical faults, fill the fuel tank with a known high quality fuel that meets the boat's minimum octane requirements. Refer to *Fuel System Specifications*. Test the boat and re-evaluate the performance.

Sensor/System

- TPS for open or grounded circuits

Fuel System

- Check for incorrect fuel pressure.
- Check for a restricted fuel filter.
- Check for a contaminated fuel condition.
- Check the items that cause an engine to run rich long term.
- Check the items that cause an engine to run lean long term.

Ignition System

- Wet down the secondary ignition system with water from a spray bottle. Wetting down the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water.
- Check for proper ignition voltage output.
- Remove the spark plugs and check for the following:
  - Correct heat range
  - Wet plugs
  - Cracks
  - Wear
  - Improper gap
  - Burned electrodes
  - Heavy deposits
- Determine the cause of the fouling before replacing the spark plugs if the spark plugs are gas, coolant or oil fouled.
- Check for bare or shorted ignition wires.
- Check for loose ignition coil grounds.
- Visually and physically inspect the secondary ignition for the following:
  - Ignition wires arcing to ground.
  - Ignition wires for proper engagement to spark plug and coil.
  - Ignition coils for cracks or carbon tracking.
  - Ignition wires for resistance, should not exceed 30,000 Ohms.

Engine Mechanical

- Check engine mechanical for the following:
  - Low compression.
  - Sticking or leaking valves.

Symptoms

- Worn camshaft lobes.
- Valve timing.
- Bent push rods.
- Worn rocker arms.
- Broken Valve Springs.
- Excessive oil in the combustion chamber.

Additional Checks

- Inspect the exhaust system for possible restriction.
- Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. A sudden increase in indicated RPM with little change in actual engine RPM change indicates EMI is present. Check for high voltage components near ignition control circuits if a problem exists.
- Check the exhaust manifold passages for casting flash.

Rough, Unstable, or Incorrect Idle; Stalling

Definition: Engine runs unevenly at idle. If severe, the engine may shake. Engine idle speed may vary in RPM (hunting). Either condition may be severe enough to stall the engine. Engine idles at incorrect speed

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms.
- Check the ECM grounds for being clean, tight and in the proper locations.
- Search for Service Bulletins.
- Remove the flame arrestor element and check for dirt or for restrictions.

Sensor/System

- Check the air intake system and crankcase for air leaks.
- Check the crankcase ventilation valve for proper operation(If equipped). Place a finger over the inlet hole in the valve end several times. The valve should snap back. If not, replace valve.
- Check the Cam sensor (CMP) for code.
- Check the idle air control (IAC) valve for proper operation for engines without electronic throttles.
- Use a diagnostic tool to monitor the knock sensor (KS) system for excessive spark retard activity.

Fuel System

- Check the fuel injectors. Refer to Fuel Injector Test.
- Check for incorrect fuel pressure.
- Check for a restricted fuel filter.
- Check for a contaminated fuel condition.
- Check that each injector harness is connected to the correct injector and cylinder.
- Check for foreign material accumulation in the throttle bore, coking on the throttle valve or on the throttle shaft. Also check for throttle body tampering.
- Check the items that cause an engine to run rich long term.
- Check the items that cause an engine to run lean long term.

Ignition System

- Wet down the secondary ignition system with water from a spray bottle. Wetting down the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water.
- Check for proper ignition voltage output.
- Remove the spark plugs and check for the following:
    - Correct heat range
    - Wet plugs
    - Cracks
    - Wear
    - Improper gap
    - Burned electrodes
    - Heavy deposits
- Determine the cause of the fouling before replacing the spark plugs if the spark plugs are gas, coolant or oil fouled.
- Check for bare or shorted ignition wires.
- Check for loose ignition coil grounds.
- Visually and physically inspect the secondary ignition for the following:
    - Ignition wires arcing to ground.
    - Ignition wires for proper engagement to spark plug and coil.
    - Ignition coils for cracks or carbon tracking.

  - Ignition wires for resistance, should not exceed 30,000 Ohms.

Engine Mechanical

- Check engine mechanical for the following:
  - Low compression
  - Sticking or leaking valves
  - Worn camshaft lobes
  - Valve timing
  - Bent push rods
  - Worn rocker arms
  - Broken Valve Springs
- Excessive oil in the combustion chamber - Leaking valve seals.
- Inspect the following components for incorrect basic engine parts:
  - Camshaft
  - Cylinder heads
  - Pistons, etc.
- Refer to the appropriate procedures in Engine Mechanical.

Additional Checks

- Inspect the exhaust system for possible restriction.
- Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. A sudden increase in indicated RPM with little change in actual engine RPM change indicates EMI is present.
- Check for high voltage components near ignition control circuits if a problem exists.
- Check for faulty motor mounts.
- Check the intake manifold and the exhaust manifold passages for casting flash.

Backfire

Definition: Fuel ignites in manifold making a loud popping noise.

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms.
- Check the ECM grounds for being clean, tight and in the proper locations.
- Search for Service Bulletins.

Fuel System

- Check for incorrect fuel pressure.
- Check for a restricted fuel filter.
- Check for a contaminated fuel condition.
- Check the fuel injectors. Refer to Fuel Injector Test.
- Check that each injector harness is connected to the correct injector and cylinder.

Sensor System

- Check the air intake system and crankcase for air leaks.
- Check the crankcase ventilation valve for proper operation (if equipped). Place a finger over the inlet hole in the valve end several times. The valve should snap back. If not, replace the valve.
- Use a scan to in order to monitor the knock sensor system for excessive spark retard activity.

Ignition System

- Wet down the secondary ignition system with water from a spray bottle. Wetting down the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water.
- Check for proper ignition voltage output.
- Remove the spark plugs and check for the following:
- Correct heat range
- Wet plugs
- Cracks
- Wear
- Improper gap
- Burned electrodes
- Heavy deposits
- Determine the cause of the fouling before replacing the spark plugs if the spark plugs are gas, coolant or oil fouled
- Check for bare or shorted ignition wires.·Check for loose ignition coil grounds.·Visually and physically inspect the secondary ignition for the following:·Ignition wires arcing to ground·Ignition wires for proper routing·Ignition coils for cracks or carbon tracking
- Engine Cooling·Check for restrictions to the water intake.·Check the engine thermostat for proper operation and for the correct heat range.

Engine Mechanical

- Check engine mechanical for the following:
  - Low compression
  - Sticking or leaking valves
  - Worn camshaft lobes
  - Valve timing
  - Bent pushrods
  - Worn rocker arms
  - Broken valve springs

  - Excessive oil in the combustion chamber - leaking valve seals
- Inspect the following components for incorrect basic engine parts:
  - Camshaft
  - Cylinder heads
  - Pistons, etc.

Additional

- Inspect the exhaust system for possible restriction.
- Electromagnectic interference (EMI) on the reference circuit can cause an engine miss condition. A sudden increase in indicated RPM with little change in actual engine RPM change indicates EMI is present. Check for high voltage components near ignition control circuits if a problem exists.
- Check intake and exhaust manifold passages for casting flash or debris.
- Visually and physically check the vacuum hoses for splits, kinks and proper connections and routing.

Dieseling, Run-On

Definition: Engine continues to run after key is turned OFF, but runs very rough. If the engine runs smooth, check the ignition switch and the ignition switch adjustment.

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms.
- Check the ECM grounds for being clean, tight and in the proper locations.
- Search for Service Bulletins.

Fuel System

- Inspect the injectors for a leaking condition.

Cooling System

- Faulty or incorrect thermostat.
- Engine overheating, resulting from cooling system restriction.

Poor Fuel Economy

Definition: Fuel economy, as measured by actual fuel used, is noticeably lower than expected. Also, fuel economy is noticeably lower than it was on this vessel at one time, as previously shown by actual measurement.

Preliminary

- See *Preliminary and Intermittent Checks* page 48 before starting in Symptoms.
- Check the ECM grounds for being clean, tight and in the proper locations.
- Search for Service Bulletins.
- Check how the boat is operated.
  - Are there excessive loads being carried or is the boat overloaded?
  - Is the acceleration rate too much, too often?
- Remove the flame arrestor element and check for dirt or for restrictions.

Fuel System

- Check the type, quality and alcohol content of the fuel. Oxygenated fuels have lower energy and may deliver reduced fuel economy.
- Check the fuel injectors. Refer to Fuel Injector Test.
- Check for incorrect fuel pressure.
- Check for a restricted fuel filter.
- Check for a contaminated fuel condition.
- Check that each injector harness is connected to the correct injector and cylinder.
- Check for foreign material accumulation in the throttle bore, coking on the throttle valve or on the throttle shaft. Also check for throttle body tampering.
- Check the items that cause an engine to run rich long term.

Sensor System

- Check the air intake system and crankcase for air leaks.
- Check the crankcase ventilation valve for proper operation (if equipped). Place a finger over the inlet hole in the valve end several times. The valve should snap back. If not, replace valve.
- Use a diagnostic tool to monitor the knock sensor (KS) system for excessive spark retard activity.

Ignition System

- Wet down the secondary ignition system with water from a spray bottle. Wetting down the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water.
- Check for proper ignition voltage output.
- Remove the spark plugs and check for the following:
  - Correct heat range
  - Wet plugs
  - Cracks
  - Wear
  - Improper gap
  - Burned electrodes
  - Heavy deposits
- Determine the cause of the fouling before replacing the spark plugs if the spark plugs are gas, coolant or oil fouled.
- Check for bare or shorted ignition wires.
- Check for loose ignition coil grounds.
- Visually and physically inspect the secondary ignition for the following:

- Ignition wires arcing to ground
- Ignition wires for proper engagement to spark plug and coil
- Ignition coils for cracks or carbon tracking

Engine Cooling

- Check for water flow restrictions.
- Check the engine thermostat for proper operation and for the correct heat range.

Engine Mechanical

- Check engine mechanical for the following:
  - Low compression
  - Sticking or leaking valves
  - Worn camshaft lobes
  - Valve timing
  - Bent push rods
  - Worn rocker arms
  - Broken Valve Springs
  - Excessive oil in the combustion chamber - Leaking valve seals.
- Inspect the following components for incorrect basic engine parts:
  - Camshaft
  - Cylinder heads
  - Pistons, etc.
- Refer to the appropriate procedures in Engine Mechanical.

Additional

- Inspect the exhaust system for possible restriction.
- Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. A sudden increase in indicated RPM with little change in actual engine RPM change indicates EMI is present. Check for high voltage components near ignition control circuits if a problem.·Check the intake manifold and the exhaust manifold passages for casting flash.
- Check for excessive drag on the boat (e.g. barnacles on bottom and sterndrive.

ECM Connector Identification

This chart is to further aid in diagnosis of symptoms.

4.3 Liter Engines

ECM Connector Identification 4.3 Liter

Pin	Color	Function
1		
2		
3		
4		
5	PU/LBL	IAC Coil B+
6	LBL/DBL	IAC Coil B-
7	LGN	MAP Signal
8		
9	DBL/OR	(TPS Signal All Others)
10		
11		
12		
13	W/OR	CAN 1 Termination +
14	BL/P	CAN 1 High +
15	BL/W	CAN 1 Low —
16		
17		
18		
19	LGN/R	5V ref # 1
20	SB/GN	Isolated Ground for Vref #1
21	PU/W	CKP Signal + (twisted pair)
22	W/PU	CKP Ground — (twisted pair)
23	GR/BN	CMP Signal +(twisted pair)
24	PU/OR	CMP Ground — (twisted pair)
25		
26		
27	SB/Y	Knock Sensor Signal (Port)
28	SB	Ground (Port KS)
29	SB/W	Knock Sensor Signal (Stbd)
30	SB	Ground (Stbd KS)
31	Y	IC Circuit
32		
33		
34		
35		
36		
37		

ECM Connector Identification 4.3 Liter

38		
39	Y/GR	IAT Signal
40	T/W	ECT Signal
41	T/R	Exhaust Temp Switches Input
42	P/LGN	Master/Slave Input
43		
44		
45	PU	Ignition Feed (Run, Start)
46	BN/W	Trim Position Sensor Signal
47	LGN/W	Shift Interrupt Input
48		
49		
50		
51		
52		
53	LBL	(OPS) Oil Pressure Sensor Signal
54	OR/LGN	Dual Helm Enable Input
55	DGN/Y	Serial Data Transmit
56	OR/Y	Serial Data Receive
57		
58	GR	Tach Output
59		
60	R/PU	Battery Feed 1
61	T/LBL	Injector Driver cylinder #1
62	GR/Y	Injector Driver cylinder #6
63	T/BN	Injector Driver cylinder #5
64	GR/W	Injector Driver cylinder #4
65	T/Y	Injector Driver cylinder #3
66	GR/OR	Injector Driver cylinder #2
67		
68		
69	SB	Power Ground
70		
71	W/LBL	Ignition Relay Driver
72		
73		
74		
75		
76	T/SB	Warning Horn Driver
77		
78		

ECM Connector Identification 4.3 Liter

79	R/PU	Battery Feed 2
80	GN/Y	MIL Driver (Malfunction Indicator Lamp)
81	SB	Power Ground
82	P/W	IAC Coil A +
83	T/OR	IAC Coil A —
84	LBL/W	Fuel Pump Relay Driver
85		
86	BN/W	Trim Gauge Driver
87	T	Coolant Temperature Gauge Driver
88	DBL	Oil Pressure Gauge Driver
89		
90		

5.0 and 5.7 Liter

ECM Connector Identification 5.0 and 5.7 Liter

Pin	Color	Function
1		
2		
3		
4		
5	PU/LBL	IAC Coil B+
6	LBL/DBL	(IAC Coil B —
7	LGN	MAP Signal
8		
9	DBL/OR	TPS Signal
10		
11		
12		
13	W/OR	CAN 1 Termination +
14	BL/P	CAN 1 High +
15	BL/W	CAN 1 Low —
16		
17		
18		
19	LGN/R	5V ref # 1
20	SB/GN	Isolated Ground for Vref #1
21	PU/W	CKP Signal (twisted pair)
22	W/PU	CKP Ground (twisted pair)
23	GR/BN	CMP Signal (twisted pair)
24	PU/OR	CMP Ground (twisted pair)
25		
26		
27	SB/Y	Knock Sensor Signal (Port)
28	SB	Ground (Port KS)
29	SB/W	Knock Sensor Signal (Stbd)
30	SB	Ground (Stbd KS)
31	Y	IC Circuit
32		
33		
34		
35		
36		
37		
38		
39	Y/GR	IAT Signal

ECM Connector Identification 5.0 and 5.7 Liter

40	T/W	ECT Signal
41	T/R	Exhaust Temp Switches Input
42	P/LGN	Master/Slave Input
43		
44		
45	PU	Ignition Feed (Run, Start)
46	BN/W	Trim Position Sensor Signal
47	LGN/W	Shift Interrupt Input
48		
49		
50		
51		
52		
53	LBL	(OPS) Oil Pressure Sensor Signal
54	OR/LGN	Dual Helm Enable Input
55	DGN/Y	Serial Data Transmit
56	OR/Y	Serial Data Receive
57		
58	GR	Tach Output
59		
60	R/PU	Battery Feed 1
61	T/LBL	Injector Driver Fire Order # 1
62	GR/BL	Injector Driver Fire Order # 8
63	GR/W	Injector Driver Fire Order # 4
64	T/Y	Injector Driver Fire Order # 3
65	GR/Y	Injector Driver Fire Order # 6
66	T/BR	Injector Driver Fire Order # 5
67	T/GR	Injector Driver Fire Order # 7
68	GR/O	Injector Driver Fire Order # 2
69	SB	Power Ground
70		
71	W/LBL	Ignition Relay Driver
72		
73		
74		
75		
76	T/SB	Warning Horn Driver
77		
78		
79	R/PU	Battery Feed 2
80	GN/Y	MIL Driver (Malfunction Indicator Lamp)

ECM Connector Identification 5.0 and 5.7 Liter

81	SB	Power Ground
82	P/W	IAC Coil A+
83	T/OR	IAC Coil A —
84	LBL/W	Fuel Pump Relay Driver
85		
86	BN/W	Trim Gauge Driver
87	T	Coolant Temperature Gauge Driver
88	DBL	Oil Pressure Gauge Driver
89		
90		

8.1 Liter

ECM Connector Identification 8.1 Liter

Pin	Color	Function
1		
2		
3		
4		
5	PU/LBL	TPS #1 Signal
6	LBL/DBL	TPS #2 Signal
7	LGN	MAP Signal
8		
9	DBL/OR	TCP #1 Signal
10	OR/SB	TCP #2 Signal
11		
12		
13	W/OR	CAN 1 Termination
14	BL/P	CAN 1 High
15	BL/W	CAN 1 Low
16	R/SB	CAN 2 Low
17	R/W	CAN 2 High
18	OR/W	CAN 2 Termination
19	LGN/R	5V ref # 1
20	SB/GN	Isolated Ground for Vref #1
21	PU/W	CKP Signal (twisted pair)
22	W/PU	CKP Ground (twisted pair)
23	GR/BN	CMP Signal (twisted pair)
24	PU/OR	CMP Ground (twisted pair)
25		
26		
27	SB/Y	Knock Sensor Signal (Port)
28	SB	Ground (Port KS)
29	SB/W	Knock Sensor Signal (Stbd)
30	SB	Ground (Stbd KS)
31	Y	Ignition Control cylinder #1
32	W/R	Ignition Control cylinder #8
33	W/GN	Ignition Control cylinder #7
34	Y/GN	Ignition Control cylinder #2
35	Y/W	Ignition Control cylinder #6
36	W/SB	Ignition Control cylinder #5
37	W/T	Ignition Control cylinder #4
38	Y/BL	Ignition Control cylinder #3
39	Y/GR	IAT Signal

ECM Connector Identification 8.1 Liter

40	T/W	ECT Signal
41	T/R	Exhaust Temp Switches Input
42	P/LGN	Master/Slave Input
43		
44		
45	PU	Ignition Feed (Run, Start)
46	BN/W	Trim Position Sensor Signal
47	LGN/W	Shift Interrupt Input
48	PU/Y	IVS (Idle Validation Switch) Input
49	LGN/PU	5V ref # 2
50	SB/LGN	Isolated Ground for Vref # 2
51		
52		
53	LBL	OPS Signal (Oil Pressure Sensor)
54	OR/LGN	Dual Helm Enable Input
55	DGN/Y	Serial Data Transmit
56	OR/Y	Serial Data Receive
57		
58	GR	Tach Output
59		
60	R/PU	Battery Feed 1
61	T/LBL	Injector Driver cylinder #1
62	GR/BL	Injector Driver cylinder #8
63	T/GN	Injector Driver cylinder #7
64	GR/O	Injector Driver cylinder #2
65	GR/Y	Injector Driver cylinder #6
66	T/BN	Injector Driver cylinder #5
67	GR/W	Injector Driver cylinder #4
68	T/Y	Injector Driver cylinder #3
69	SB	Power Ground
70		
71	W/LBL	Ignition Relay Driver
72		
73		
74		
75		
76	T/SB	Warning Horn Driver
77		
78		
79	R/PU	Battery Feed 2
80	GN/Y	MIL Driver (Malfunction Indicator Lamp)

ECM Connector Identification 8.1 Liter

81	SB	Power Ground
82	P/W	DBW + Drive By Wire Motor
83	T/OR	DBW — Drive By Wire Motor
84	LBL/W	Fuel Pump Relay Driver
85		
86	BN/W	Trim Gauge Driver
87	T	Coolant Temperature Gauge Driver
88	DBL	Oil Pressure Gauge Driver
89		
90		

Section 5: Diagnostics

Contents

DTC 0016 - Never Crank Synced At Start

SPN-636 FMI-8

Circuit Description

The crankshaft position sensor (CKP) is a magnetic transducer mounted on the engine block adjacent to a pulse wheel located on the crankshaft. It determines crankshaft position by monitoring the pulse wheel. The crankshaft position sensor is used to measure engine RPM and it is used in conjunction with the cam sensor (CMP) to synchronize the ignition system and fuel injectors.

The CKP sensor works in conjunction with a reluctor wheel. The CKP sensor has a 5 volt reference signal from the ECM, a ground circuit and a signal circuit. As the crankshaft rotates, the reluctor wheel teeth interrupt a magnetic field produced by a magnet within the sensor. The sensor's internal circuitry detects this and produces a 5 volt square wave which the ECM reads. The ECM uses this signal to accurately measure crankshaft velocity and piston location which is a variable used in order to control spark and fuel injection quantity and injection timing.

The ECM must see a valid crankshaft position signal while cranking before the engine starts. If no signal is present within 4 cranking revolutions, this fault will set. If there is no signal present, then code 0337, CKP signal loss sets. Code 0016 sets when any of the following conditions occur:

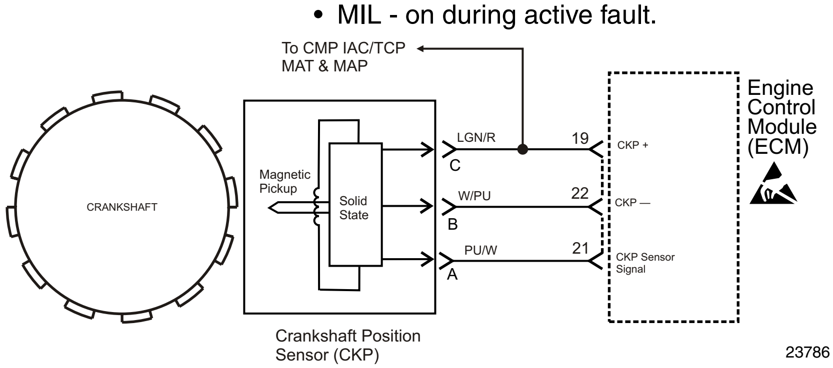
—The signal from the CKP is not the correct signal (i.e. it shows an incorrect number of reluctor wheel teeth) but a signal exists.

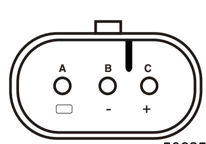
—The CMP signal is incorrect (i.e. wrong number of teeth) but a signal exists or...

—The CKP and CMP signals are correct but out of sequence. (i.e. timing chain has jumped teeth) AND this condition exists for 4 revolutions of the crankshaft WHILE cranking the engine.

Conditions for setting the DTC

- Crankshaft position sensor.
- Fault condition - 4 cranking revolutions without proper sync between the CKP and the CMP sensors and engine speed is greater than 90 RPM.
- MIL - on during active fault.





CKP Sensor Connection

Troubleshooting

If this code is present after engine repairs to the crankshaft, examine the reluctor wheel for damage or alignment.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check V REF

Disconnect CKP sensor. Check the LGN/R wire (pin-c) at the sensor for 5 volt Vref. Using DVOM connect to pin-C at the CKP connector and a known good engine ground. Does the voltage read approximately 5 volts?

YES: Go to *Check V REF power and ground* on this page

NO: Go to *Check CKP signal circuit for continuity* on this page

Check V REF power and ground

Connect a DVOM set to DC Volts between the B and C terminals of the CKP sensor connector. Does the voltage read approximately 5 volts?

YES: Replace CKP sensor

NO: Go to *Check CKP sensor ground circuit continuity* on this page

Check CKP sesnor connector

Check for corroded terminals or open wires if the resistance is much higher. Did you find a problem?

YES: Repair wiring as necessary.

NO: Go to *Check CKP signal circuit for continuity* on this page

Check CKP sensor ground circuit continuity

Check the W/PU wire at the sensor connector for ground. Connect a DVOM set to Ohms between the B terminal of the CKP sensor connector and engine ground. Is there approximately 4-5 Ohms?

YES: Go to *Check CKP signal circuit for continuity* on this page

NO: Repair wiring as necessary

Check CKP signal circuit for continuity

Check the PU/W wire pin-A between the Crank sensor connector and the ECM connector (pin-21) for continuity. Do you have continuity?

YES: Go to *Check the ECM ground terminals* on this page

NO: Repair wiring as necessary

Check the ECM ground terminals

Check that the ECM ground terminals are clean and tight. Did you find a problem?

YES: Repair wiring as necessary

NO: Go to *Check Crankshaft Position Sensor* on this page

Check Crankshaft Position Sensor

Place an DVOM set to Ohms across terminals B and C of the CKP sensor. The reading should be open (infinite resistance). Do you have infinite resistancee?

YES: Replace ECM

NO: Replace sensor if resistance is indicated.

DTC 0107 - MAP Low Voltage

SPN-106 FMI-4

Circuit Description

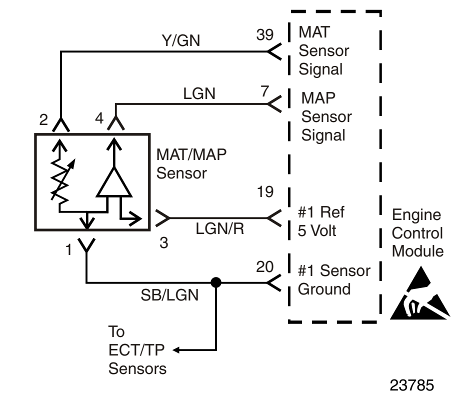
The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum).The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT). If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM. The MAP sensor voltage of 5 volts is delivered to the MAP sensor from ECM (pin-19) to terminal “C or 1” of the MAP sensor harness connector. Terminal “A” or “1” at the sensor is the sensor ground circuit for the MAP sensor and returns current back to (pin-20) of the ECM. The MAP signal terminal “B” or “4” returns a voltage signal back to the ECM proportional to what the manifold pressure is (i.e. low pressure [high vacuum] at idle equals low voltage, high pressure [low vacuum] at wide open throttle equals high voltage).

Diagnostic Aids

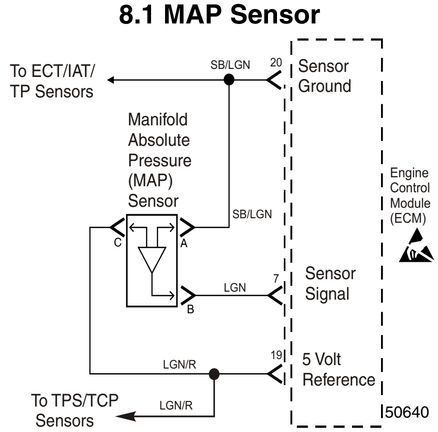
If the engine is running rough, unstable, or missing due to a suspected mechanical problem, vacuum leak or other issue causing misfire, these problems must be taken care before using the diagnostic table. Failure to follow this recommendation will result in a false MAP diagnostic and repair procedure. Condition for setting the DTC are:

- Check condition - during cranking or running.
- Fault condition -
  - 4.3, 5.0, and 5.7 engines -MAP voltage less than 0.05, throttle position greater than 2 percent, and engine speed is less than maximum RPM.
  - 8.1 engine - MAP voltage less than 0.10, throttle position greater than 2 percent, and engine speed is less than maximum RPM.
- MIL - on for remainder of key on cycle.
- Miscellaneous - fueling is based on RPM and TPS limp-home condition during this fault. The ECM does not derate the engine when this fault is active but there is a soft warning while the code is active.

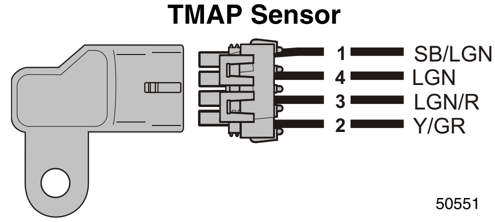
4.3, 5.0, 5.7 TMAP Sensor



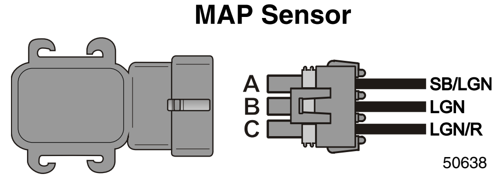
8.1 MAP Sensor



TMAP Sensor



MAP Sensor



Troubleshooting

The following items should be checked in sequence when diagnosing DTC0107.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check MAP Circuit.

Using diagnostic tool, view MAP volts. If MAP volts are less than 0.1 volts, the circuit is open.

- Disconnect the MAP sensor from the wiring harness.
- Using a jumper, connect the V REF (LGN/R wire), and MAP signal circuit (LGN wire) together at the MAP sensor connector.
- Key ON. Does the diagnostic tool should display MAP voltage of 4.5 volts or greater. If not, repair the circuit as necessary

Check MAP Sensor

- Remove MAP Sensor from intake manifold
- Connect vacuum pump to MAP sensor.
- Key ON, engine OFF.
- Apply vacuum to the sensor and compare voltage drop to table below. If voltage does not change or does not agree with the table, replace the sensor.

NOTE: The voltage drop is calculated by subtracting the signal voltage output from the no load voltage input from the sensor.

Applied Vacuum	**4.0** 101.6	**8.0** 203.2	**12.0** 304.8	**16.0** 406.4	**20.0** 508
8.1 Voltage Drop ± 0.1	**.73**	**1.44**	**2.16**	**2.88**	**3.60**
4.3, 5.0, 5.7 Voltage Drop ±0.1	**.6**	**1.1**	**1.7**	**2.2**	**2.8**

Check MAP Connector for Damage.

- Inspect MAP connector pins for corrosion, contamination or mechanical damage.

Check ECM Connectors for Damage.

- Inspect ECM connector and wire harness connector terminals for corrosion, contamination or mechanical damage.

DTC 0108 - MAP High Pressure

SPN-106 FMI-16

Circuit Description

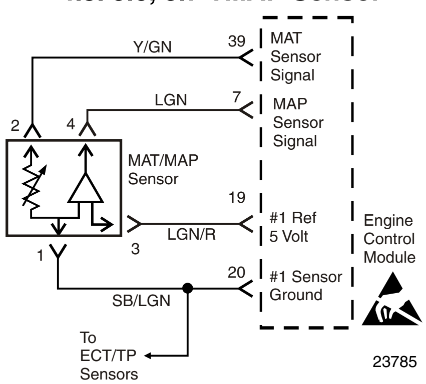
The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum).The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT). If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM. The MAP sensor voltage of 5 volts is delivered to the MAP sensor from ECM (pin-19) to terminal “C or 1” of the MAP sensor harness connector. Terminal “A” at the sensor is the sensor ground circuit for the MAP sensor and returns current back to (pin-20) of the ECM. The MAP signal terminal “B” returns a voltage signal back to the ECM proportional to what the manifold pressure is (i.e. low pressure [high vacuum] at idle equals low voltage, high pressure [low vacuum] at wide open throttle equals high voltage).

Diagnostic Aids

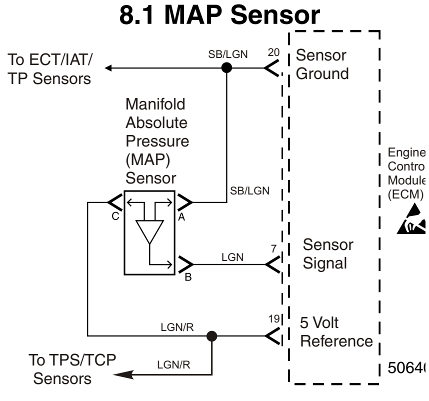
If the engine is running rough, unstable, or missing due to a suspected mechanical problem, vacuum leak or other issue causing misfire, these problems must be corrected before using the diagnostic table. Failure to follow this recommendation will result in a false MAP diagnostic and repair procedure. Conditions for setting the DTC are:

- Manifold absolute pressure too high during running.
- Check condition - engine speed is greater than 800 RPM, throttle command less than 10 percent, and steady MAP and TPS.
- Fault condition -
    - 8.1 engines - MAP greater than 14 psi, TPS less than 10 percent, and engine speed is greater than 1800 RPM.
    - 4.3, 5.0, 5.7 engines - MAP greater than 16 psi, TPS less than 10 percent, and engine speed is greater than 1800 RPM.
- MIL - on for remainder of key on cycle.
- Miscellaneous - fuel is based on RPM and TPS in limp-home condition during this fault.

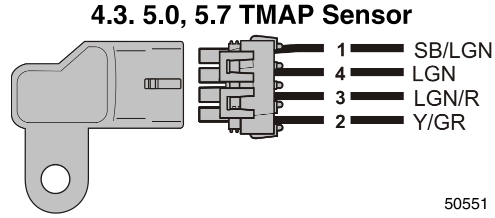
4.3. 5.0, 5.7 TMAP Sensor



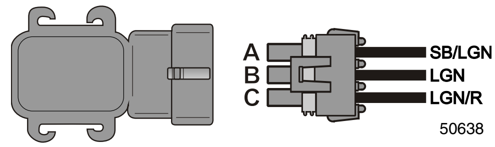
8.1 MAP Sensor



4.3. 5.0, 5.7 TMAP Sensor



8.1 MAP Sensor



Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0108

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check MAP Sensor circuit.

Key **OFF**. Disconnect the MAP sensor connector. Turn the key to the ON position. The diagnostic tool should display MAP pressure less than 0.5 volts. If the diagnostic tool displays MAP pressure more than 0.5 volts, the MAP signal circuit is shorted to voltage. Locate the short and repair as necessary.

Check MAP Sensor

Remove MAP sensor from intake manifold. Connect MAP sensor wiring harness connector. Connect a vacuum pump to the map sensor port. Key **ON**, engine **OFF**. Apply vacuum to the sensor and compare voltage drop to table below. If voltage does not change or does not agree with the table, replace sensor.

Applied Vacuum	**4.0** 101.6	**8.0** 203.2	**12.0** 304.8	**16.0** 406.4	**20.0** 508
8.1 Voltage Drop ± 0.1	**.73**	**1.44**	**2.16**	**2.88**	**3.60**
4.3, 5.0, 5.7 Voltage Drop ±0.1	**.6**	**1.1**	**1.7**	**2.2**	**2.8**

Check MAP Senor ground circuit

Key **ON**, engine **OFF**, disconnect MAP connector and measure between the 5 volt ref (LGN/R wire) and ground (SB/LGN wire) to ensure there is 5 volts in the wire (and not 12v). If 12v, the ground wire is shorted to power, repair as necessary. If 5v, then measure between the 5v ref (LGN/R wire) and sensor return (LGN wire) in the MAP connector. If voltmeter reads 0, repair open sensor return.

Check ECM connectors for damage.

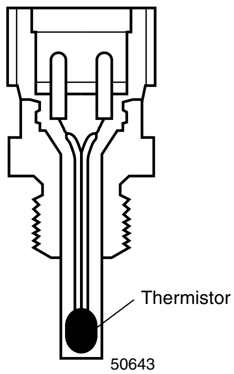
Key **OFF**. Disconnect ECM connector and inspect terminals for damage, corrosion or contamination.

DTC 0111 - IAT Higher Than Expected 1

SPN-105 FMI-15

Circuit Description

8.1 IAT Sensor

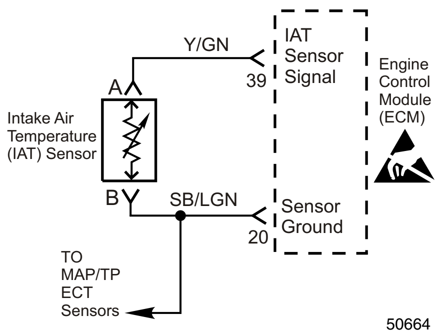


The Intake Air Temperature sensor is a negative temperature coefficient thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the total airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower voltage when the air is warm.

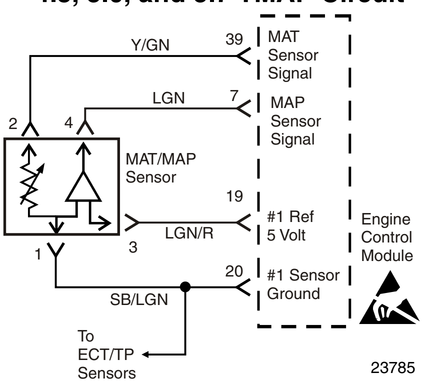
This fault will set if the Intake Air Temperature is greater than 71°C (160°F) and engine RPM is greater than 1500 for longer than 1 minute. The code will be erased from the ECM after 100 key cycles provided the code is not set again within the 100 cycles.

Conditions for setting the DTC

8.1 IAT Circuit



4.3, 5.0, and 5.7 TMAP Circuit



- Intake Air Temperature greater than 71°C (160°F) for more than 1 minute and engine RPM greater than 1500.

IAT Temperature vs. Resistance

8.1 IAT Sensor			4.3, 5.0 and 5.7 TMAP Sensor		
F°	Ohms	C°	F°	Ohms	C°
242.4	101	116.8	248	110	120
231.9	121	111	239	125	115
211.6	175	99.7	221	162	105
201.4	209	94.1	203	214	95
181.9	302	83.2	185	284	85
163.1	434	72.8	167	383	75
144.9	625	62.7	149	522	65
127.4	901	53	131	721	55
102.4	1,556	39.1	104	1,200	40
78.9	2,689	26	77	2,063	25
49.9	5,576	9.9	50	3,791	10
23.5	11,562	-4.7	23	7,419	-5
-5.7	28,770	-20.9	-4	15,614	-20
-21.2	49,715	-29.5	-22	26,854	-30
-30.8	71,589	-34.8	-31	35,763	-35
-40	99,301	-40	-40	48,153	-40

Troubleshooting

The following items should be checked in sequence when diagnosing DTC0111.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

If the code is inactive, check the current IAT output to determine if the sensor is giving appropriate readings for the current conditions. If the sensor is reading correctly go to the next step. If the sensor has incorrect readings,.

Verify code.

If the code is active, check the engine intake air temperature with a mechanical thermometer to verify the intake air temperature is below the values for setting DTC0111. If the engine intake temperature is below the specified values, go to the next step. If the engine air intake temperature exceeds the specified values, increase engine compartment ventilation until the engine compartment ambient air temperature is within limits.

Check the IAT sensor connector for damage.

Remove the IAT sensor connector and inspect the pins for damage or corrosion and the pins are not pushed out of the socket.

Check ECM connector for damage.

Remove the ECM connector and inspect the ECM and connector pins for damage or corrosion and are properly seated in position.

Check the IAT sensor.

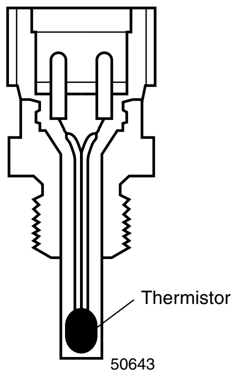
Remove and check the IAT sensor returns the values specified in the Temperature v. Resistance Table. If the sensor does not conform to the specified values, replace the sensor.

DTC 0112 - IAT Low Voltage

SPN-105 FMI-4

Circuit Description

8.1 MAT Sensor



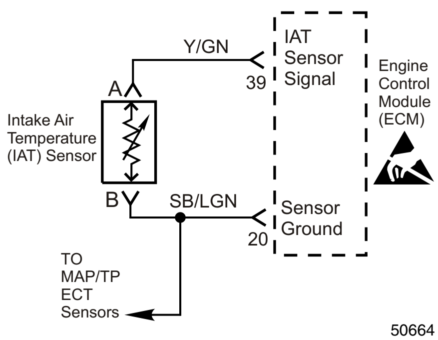
The MAT Intake Air Temperature sensor is a negative temperature coefficient thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the total airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower voltage when the air is warm.

The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow and influenced more by the ECT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the amount of airflow into the engine, and ignition timing.

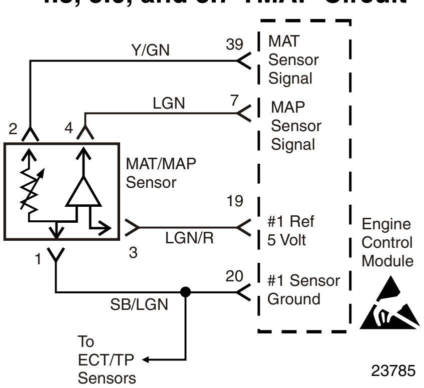
This fault will set if the signal voltage is less than 0.05 volts anytime the engine is cranking or running. The ECM will use the default value for the IAT sensor in the event of this fault. The code will be erased from the ECM after 100 key cycles provided the code is not set again within the 100 cycles.

Conditions for setting the DTC are:

8.1 MAT Circuit



4.3, 5.0, and 5.7 TMAP Circuit



- Intake air temperature reading does not change with engine operation.
- Check condition-engine running.
- Fault condition-IAT sensor voltage less than 0.05 volts for longer than 2 seconds with the engine running.
- MIL On during active fault and for 2 seconds after active fault.

IAT Temperature vs. Resistance

8.1 IAT Sensor				4.3, 5.0 and 5.7 TMAP Sensor		
F°	Ohms	C°		F°	Ohms	C°
242.4	101	116.8		248	110	120
231.9	121	111		239	125	115
211.6	175	99.7		221	162	105
201.4	209	94.1		203	214	95
181.9	302	83.2		185	284	85
163.1	434	72.8		167	383	75
144.9	625	62.7		149	522	65
127.4	901	53		131	721	55
102.4	1,556	39.1		104	1,200	40
78.9	2,689	26		77	2,063	25
49.9	5,576	9.9		50	3,791	10
23.5	11,562	-4.7		23	7,419	-5
-5.7	28,770	-20.9		-4	15,614	-20
-21.2	49,715	-29.5		-22	26,854	-30
-30.8	71,589	-34.8		-31	35,763	-35
-40	99,301	-40		-40	48,153	-40

Troubleshooting

If DTC-0642 is also set, repair this code before proceeding.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check IAT voltage

Key ON, engine OFF.

With the diagnostic tool connected and in ECM DATA mode, go to the IAT voltage screen. Does the IAT voltage 0.05 volts or less. If not the problem is intermittent. If the voltage is 0.05 volts or less, go to the next step.

Does the diagnostic tool display IAT voltage greater than 4.9 volts. If so the sensor signal circuit is shorted to engine ground or to sensor ground, or the ECM is faulty.

Check IAT sensor.

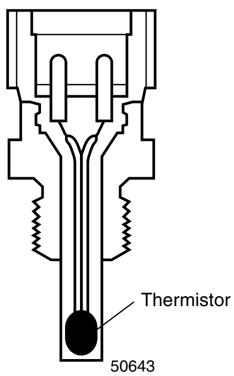
Using a DVOM, check the resistance between the two terminals of the IAT sensor. Compare the resistance readings to the table, if the resistance deviates more than 10% or is infinite (open) replace the sensor.

DTC 0113 - IAT High Voltage

SPN-105 FMI 3

Circuit Description

8.1 MAT Sensor



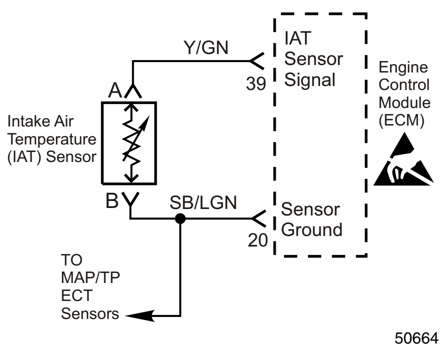
The MAT sensor is a negative temperature coefficient thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the injector pulse width and timing to the engine.

The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower voltage when the air is warm.

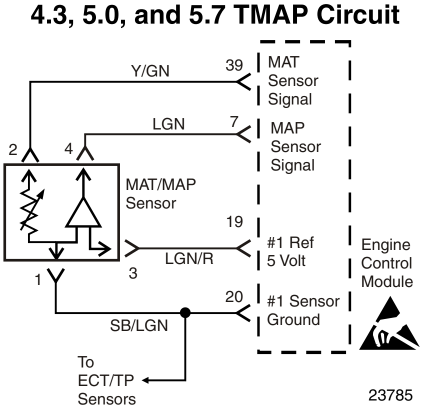
This fault will set if the signal voltage is more than 4.95 volts anytime the engine is running. The ECM will use a default value for the IAT sensor in the event of this fault. The diagnostic tool will display this default temperature value (110°F), however the diagnostic tool will always display the actual voltage from the IAT sensor while this code is active. The code will be erased from the ECM after approximately 100 key cycles provided the code is not set again within the 100 cycles.

Conditions for setting the DTC

8.1 IAT Circuit



4.3, 5.0, and 5.7 TMAP Circuit



Check condition-engine running.

Fault condition-IAT sensor voltage greater than 4.95 longer than 1 sec.

MIL On during active fault and for 2 seconds after active fault.

IAT Temperature vs. Resistance

8.1 IAT Sensor			4.3, 5.0 and 5.7 TMAP Sensor		
F°	Ohms	C°	F°	Ohms	C°
242.4	101	116.8	248	110	120
231.9	121	111	239	125	115
211.6	175	99.7	221	162	105
201.4	209	94.1	203	214	95
181.9	302	83.2	185	284	85
163.1	434	72.8	167	383	75
144.9	625	62.7	149	522	65
127.4	901	53	131	721	55
102.4	1,556	39.1	104	1,200	40
78.9	2,689	26	77	2,063	25
49.9	5,576	9.9	50	3,791	10
23.5	11,562	-4.7	23	7,419	-5
-5.7	28,770	-20.9	-4	15,614	-20
-21.2	49,715	-29.5	-22	26,854	-30
-30.8	71,589	-34.8	-31	35,763	-35
-40	99,301	-40	-40	48,153	-40

Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0113.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check for open IAT circuit.

Key ON, engine OFF, Does the diagnostic tool display a IAT voltage 4.95V or greater. If yes, continue to the next step. If no, problem is intermittent, See *Preliminary and Intermittent Checks* page 48.

Check for open IAT signal circuit.

Disconnect MAT connector. Measure volts between sensor signal wire and a known good engine ground, preferably the engine-grounding stud if accessible. Voltmeter should read 5 volts. If not, check for the following conditions

- If voltmeter reads 0, circuit is open or shorted to ground.
- If voltmeter reads higher than 5 volts (i.e. 6-7 volts), then circuit is shorted to battery voltage.

If either condition exists, repair circuit as necessary.

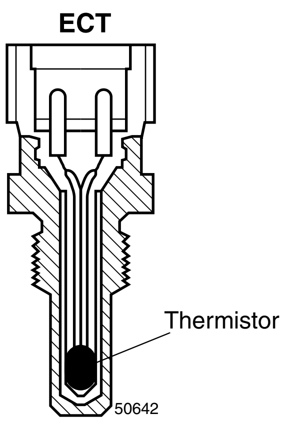
Check for IAT ground circuits.

Short signal wire to sensor return #1 in MAT connector. Check IAT voltage display on diagnostic tool. If voltage is 0, there is an open in the MAT sensor and the sensor should be replaced. If 5 volts then sensor return #1 is open and the circuit should be repaired.

DTC 0116 - ECT Higher Than Expected 1

SPN-110 FMI-15

Circuit Description



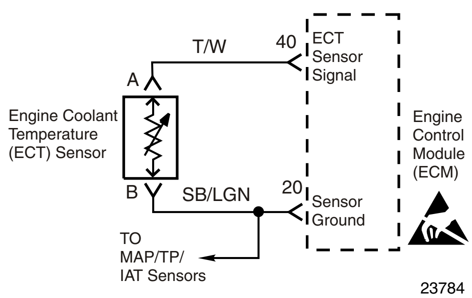
The engine coolant temperature (ECT) sensor is a temperature-sensitive resistor (Thermistor) located in the engine coolant jacket, near the thermostat. The ECT output is used drive the engine termperature gauge and for fuel injection pulse width calculation, and for engine protection. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

This fault will set in the event of an engine over temperature condition. When the coolant exceeds 87° C (190° F) and engine exceeds 500 RPM, this fault will set and the engine alarm will sound a soft warning one beep every 5 seconds and the MIL lamp will illuminate. During this fault, maximum throttle position is limited to 50% on engines equipped with electronic throttle.

Conditions for setting the DTC

- Engine coolant temperature.
- Check condition - engine running.
- Engine coolant temperature reading greater than 87°C (190° F) for longer than 1 minute and engine speed is greater than 500 RPM.
- Alarm will sound soft warning 1 beep every 5 seconds during active fault and MIL - will illuminate.

Diagnostic Aids



Possible causes for this code include the following items and should be checked as a preliminary inspection.

- Poor water flow through the cooling system on raw water cooled engines. Check for debris in or obstructions to the water intake. Check raw water pump impeller for wear or damage.
- Poor water flow through the heat exchanger, low water level in closed side of the closed circuit cooling system. Check for debris in or obstructions to the water intake. Check raw water pump impeller for wear or damage. Check circulating pump belt for slipping and proper tension.
- Too much current flow through ECT for a given temperature.

Table 1: Temperature vs. Resistance

C°	F°	Ohms	C°	F°	Ohms
100	212	177	20	68	3520
90	194	241	15	59	4450
80	176	332	10	50	5670
70	158	467	5	41	7280
60	140	667	0	32	9420
50	122	973	-5	23	12300
45	113	1118	-10	14	16180
40	104	1459	-15	5	21450
35	95	1802	-20	-4	28680
30	86	2238	-30	-22	52700
25	77	2796	-40	-40	100700

Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0116.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check engine temperature.

Diagnostic tool connected in ECT temperature mode. Drive the boat to simulate the conditions that set the code. Using a digital non-contact infrared thermometer, check the temperature of the thermostat housing and compare that reading to the ECT temperature displayed on the diagnostic scan tool. The two readings should be within ± 5°F (3° C) of each other.

- If the readings agree and the temperature is more than 190°F (87°C), the engine has insufficient water flow. Correct the water flow condition and retest.
- If the reading disagree and the temperature from the infrared thermometer is within limits, the ECT has excessive current flow (low circuit resistance), continue diagnostics of the ECT circuit.

Verify ECT function

Disconnect ECT wiring harness connector. Using DVOM check resistance in table for the current engine temperature. If temperature deviates more than 5%, replace ECT sensor.

Verify ECT circuit function.

Disconnect ECT wiring harness connector. Inspect the ECT wire harness connector terminals for damage, shorts, corrosion, or contamination

Using a jumper, connect the ECT signal (pin-A) at the ECT connector to engine ground. The ECT voltage should be 0.05 volts or less. If not go to next step.

Check ECT ground circuit.

Using a DVOM check for continuity between ECT sensor ground (pin-B) and ECM connector (pin-20). Do you have continuity between them? If not repair break in wiring. If there is continuity, go to the next step.

Check ECM connector for damage

Disconnect ECM wiring harness connector. Inspect ECM connector (pin-40 and 20) for damage corrosion, or contamination.

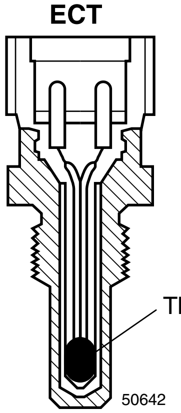
Check ECT signal circuit

Using DVOM, check for continuity between ECT connector signal (pin-A) and ECM connector terminal 40.

DTC 0117 - ECT Low Voltage

SPN-110 FMI-4

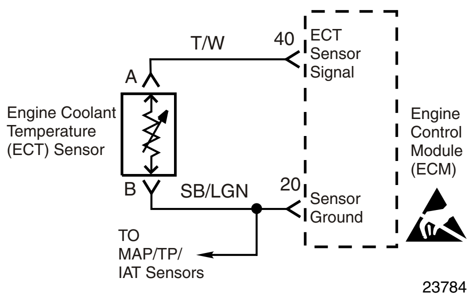
Circuit Description



The engine coolant temperature (ECT) sensor is a temperature-sensitive resistor (Thermistor) located in the engine coolant jacket, near the thermostat. The ECT output is used drive the engine termperature gauge and for fuel injection pulse width calculation, and to detect engine overheat conditions. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and the voltage is lower when the sensor is warm.

This fault will set if the signal voltage is less than 0.05 volts anytime the engine is running. The ECM will use a default temperature for the ECT sensor in the event of this fault.

Conditions for setting the DTC



- Engine coolant temperature.
- Check condition - engine stopped or running.
- Fault condition - ECT sensor voltage less than 0.05.
- MIL - on during active fault.

Table 2: Temperature vs. Resistance

C°	F°	Ohms	C°	F°	Ohms
100	212	177	20	68	3520
90	194	241	15	59	4450
80	176	332	10	50	5670
70	158	467	5	41	7280
60	140	667	0	32	9420
50	122	973	-5	23	12300
45	113	1118	-10	14	16180
40	104	1459	-15	5	21450
35	95	1802	-20	-4	28680
30	86	2238	-30	-22	52700
25	77	2796	-40	-40	100700

Troubleshooting

If DTC-0642 is also set, repair this code before proceeding.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check ECT circuit.

Diagnostic tool in ECT voltage mode. Key OFF. Disconnect ECT wiring harness connection. Key ON. Does diagnostic tool display voltage of 4.9 or greater?

YES: Replace ECT.

NO: Go to ***Check ECT signal circuit.*** **on this page.**

Check ECT signal circuit.

Disconnect ECM wiring harness connector. Using DVOM set for Ohms, check resistance between pin-40 at the ECM connector and a known good engine ground, preferably the engine grounding stud if accessible. Do you have continuity?

YES: Sensor signal circuit is shorted, repair circuit as necessary.

NO: Go to ***Check ECT circuit for short*** on this page

Check ECT circuit for short

Check between pin-40 and pin-20 at the ECM connector. Do you have continuity?

YES: Circuit is shorted, repair circuit as necessary

NO: Go to ***Check ECM connector*** **on this page**.

Check ECM connector

Check ECM connections for bend, corrosion, pushed out pins or other damage. Did you find a problem?

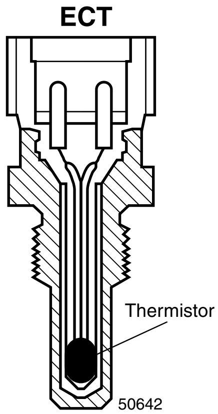
YES: Repair circuit as necessary

NO: Replace ECM

DTC 0118 - ECT High Voltage

SPN-110 FMI-3

Circuit Description

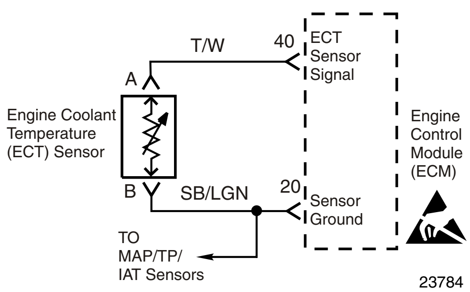


The engine coolant temperature (ECT) sensor is a temperature-sensitive resistor (Thermistor) located in the engine coolant jacket, near the thermostat. The ECT output is used drive the engine termperature gauge and for fuel injection pulse width calculation, and to detect engine overheat conditions. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and the voltage is lower when the sensor is warm.

The ECM sends 5 volts to the ECT and monitors the output voltage. If the ECM sees too much resistance (open circuit) the voltage will exceed the voltage threshold of 4.95 volts and set the code.

This code sets when there is an open circuit in the ECT circuitry i.e. the ECT sensor, the signal wire, or the ground #1 circuit.

Conditions for setting the DTC



- Open signal circuit
- Open sensor ground circuit
- Open internal ECT circuit.
- Check condition - engine stopped or running, depending on software version. Later versions of the software check this condition with engine stopped.
- Fault condition - ECT sensor voltage exceeds 4.95.
- MIL - on during active fault.

Table 3: Temperature vs. Resistance

C°	F°	Ohms	C°	F°	Ohms
100	212	177	20	68	3520
90	194	241	15	59	4450
80	176	332	10	50	5670
70	158	467	5	41	7280
60	140	667	0	32	9420
50	122	973	-5	23	12300
45	113	1118	-10	14	16180
40	104	1459	-15	5	21450
35	95	1802	-20	-4	28680
30	86	2238	-30	-22	52700
25	77	2796	-40	-40	100700

Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0118

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check ECT circuit

Turn ignition ON, engine OFF. Diagnostic tool connected and set for ECT volts mode. If diagnostic tool shows more than 4.95 volts, disconnect ECT connector. Using DVOM check voltage between terminals A and B on the ECT connector. If DVOM reads 5 volts, circuit is OK, replace ECT sensor.

If DVOM reads less than 5 volts or no volts, Go to ***Check ECT signal circuit*** on this page.

If DVOM reads 6-12 volts Go to ***Check ECT circuit for short to power*** on this page.

Check ECT circuit for short to power

If voltage is 6-12 volts, the signal circuit is shorted to power. Repair circuit as necessary. Check for damage to ECT sensor and ECM because of overvoltage condition.

Check ECT connector

Inspect the ECT wire harness connector terminals for damage, corrosion, or contamination.

Check ECT signal circuit

Key ON ECT disconnected, using DVOM check voltage on the signal wire (pin-A) at the ECT connctor and a known good engine ground, the engine ground stud is preferred if accessable.

If there is 5 volts present, Go to ***Check ECT ground circuit*** on this page.

If less than 5 volts or no volts, repair oprn ECT signal circuit

Check ECT ground circuit

Disconnect ECM connector. Using a DVOM check for continuity between ECT sensor ground (pin-B) and ECM connector (pin-20). Do you have continuity between them? If no continuity, repair ground circuit.

Check ECM connector

Inspect ECM connector pins 40 and 20 for damage corrosion, or contamination.

DTC 0121 - TPS 1 Lower Than TPS 2

SPN-51 FMI-1

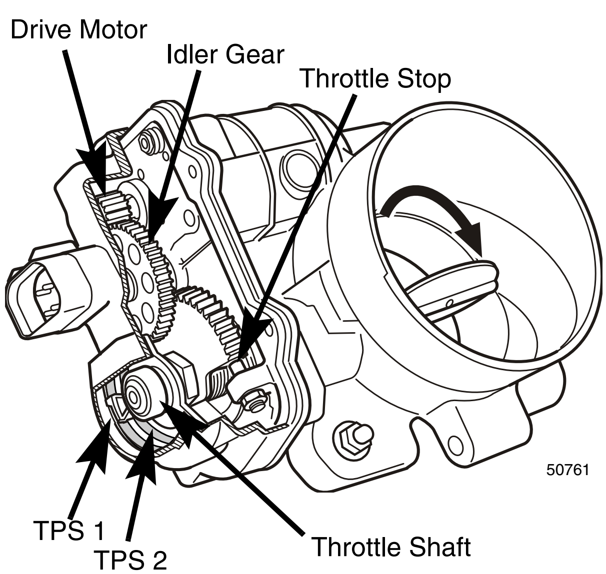
Circuit Description

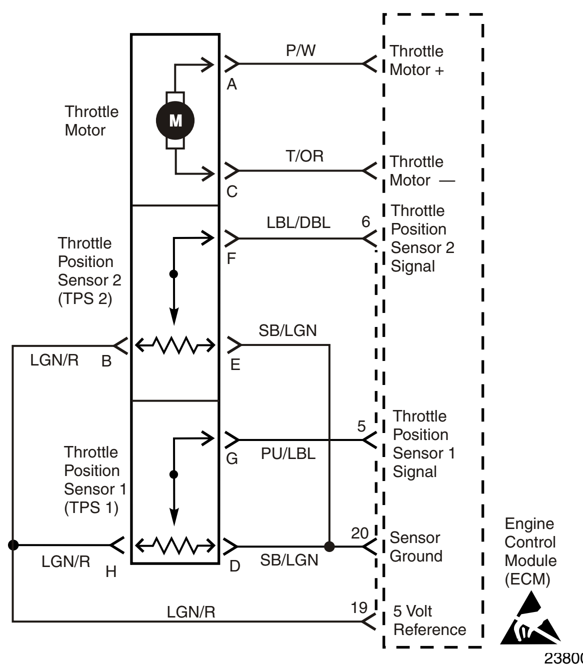
There are two throttle position sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read low voltage when closed and TPS 2 will read high voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

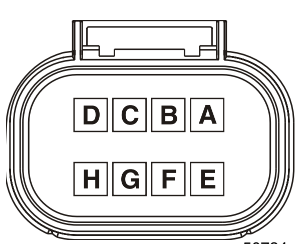
This fault will set if TPS 1 is 20% (or more) lower than TPS 2. At this point the throttle is considered to be out of specification or there is a problem with the TPS signal circuit. During this active fault the MIL light will be on and the engine will enable the low rev limit and forced idle.

Conditions for Setting DTC

- Fault condition TPS 1 is 20% lower than TPS 2
- Check condition Key ON
- MIL light on for remaining of key cycle
- Engine forced idle
- Engine low rev limit







Pin	Function
A	Throttle Motor +
B	5 V ref
C	Throttle Motor –
D	Ground

Pin	Function
E	Ground
F	TPS2
G	TPS1
H	5 V ref

Troubleshooting

If DTC-0642 is also set, repair this code before proceeding.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" then continue with this test but beware that the problem may be intermittent. If the TPS 1/2 differential step shows no problem, then the code is intermittent. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

TPS1 Lower than TPS 2

Key ON engine OFF. Diagnostic tool connected in DBW mode. Move the throttle through its full range. Is TPS 1 and TPS 2 position difference more than 20% at any time during throttle movement?

YES: Go to ***Check TPS1/2 Voltage*** **on this page**.

NO: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

Check TPS1/2 Voltage

Key OFF. Disconnect throttle body wiring harness connector. Key ON. Set diagnostic tool to throttle monitor mode. Is the voltage for both TPS 1 and TPS2 less than 0.1 Volts?

YES: Go to ***Check TPS1 5V ref*** on this page

NO: TPS shorted to voltage in harness, Go to ***Check TPS1 Continuity*** on this page

Check TPS1 5V ref

Key OFF. Disconnect throttle body connector. Diagnostic tool in Throttle Monitor mode. Key ON. Use a jumper wire and connect each TPS 1 (pin-G) and TPS 2 (pin-F) signals to the 5V ref (pin-H) at the throttle body connector. Observe TPS 1 voltage on the diagnostic tool. Does the diagnostic tool display TPS 1 or TPS 2 voltage over 4.9 volts when connected to the 5V ref?

YES: No problem with the 5V ref circuit, Replace throttle body

NO: Go to ***Check TPS1 Continuity*** **on this page.**

Check TPS1 Continuity

Disconnect the ECM wire harness connector. Using a DVOM, check the TPS 1 signal wire (pin-5) at the ECM wire harness connector and (pin-G) at the throttle body connector for continuity. Did you find a problem?

YES: Repair circuit as necessary.

NO: Faulty ECM.

DTC 0122 - TPS 1 Signal Voltage Low (ETC)

SPN-51 FMI-4

Circuit Description

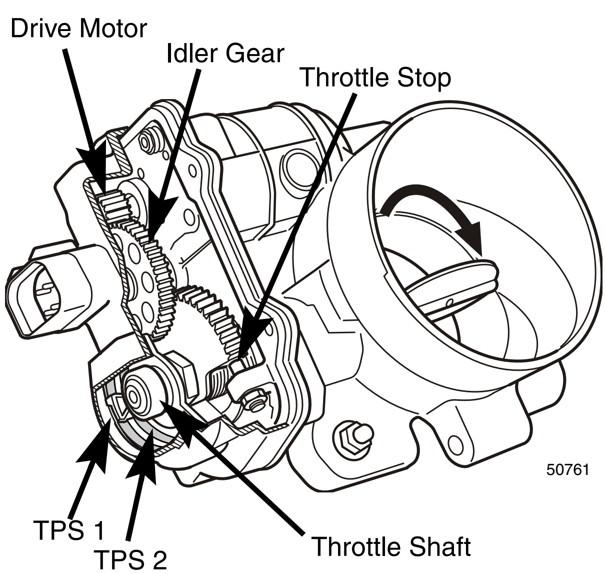
The electronic throttle has two counter acting throttle position sensors. Two sensors are used for improved safety and redundancy.

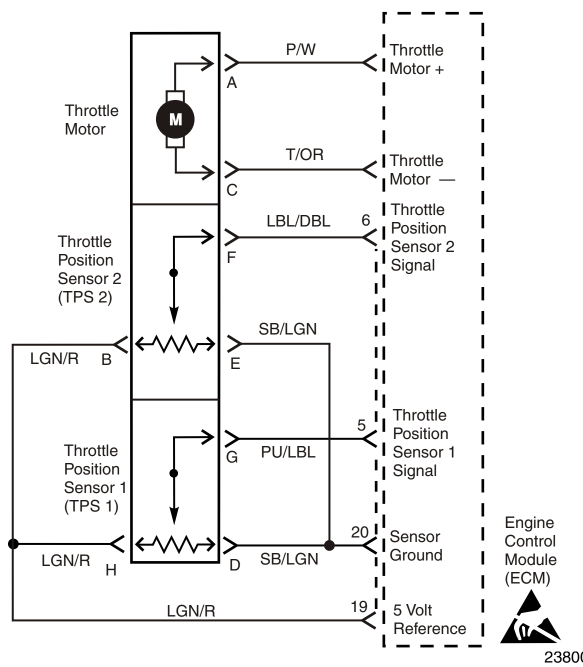
The throttle position sensor uses a variable resistor to determine signal voltage based on throttle plate position, and is located within the throttle. Less opening results in lower voltage and greater opening in higher voltage. The TPS value is used by the ECM to determine if the throttle is opening as commanded.

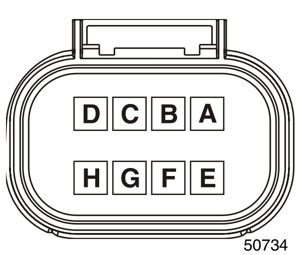
This fault will set if voltage is less than 0.2 volts at any operating condition while the engine is cranking or running. The engine will run in derate 2 provided there is no active DTCs for TPS2

Conditions for setting the DTC

- Throttle position sensor No. 1.
- Check condition - cranking or running.
- Fault condition - TPS sensor voltage less than 0.2.
- MIL - on during active fault.
- Engine derate 2.







Pin	Function
A	Throttle Motor +
B	5 V ref
C	Throttle Motor –
D	Ground

Pin	Function
E	Ground
F	TPS2
G	TPS1
H	5 V ref

Troubleshooting

If DTC-0642 is also set, repair this code before proceeding.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TPS1 Voltage

Key ON, engine OFF. Diagnostic tool connected in throttle monitor mode. Is TPS 1 voltage less than 0.2 volts with the throttle closed?

YES: Go to ***Check ECM 5V ref Circuit*** **on this page**.

NO: Intermittent problem. Go to ***Check Wiring Harness Connector and Terminals*** on this page.

Check Wiring Harness Connector and Terminals

Inspect the throttle wire harness connector terminals for damage, corrosion or contamination. Did you find the problem?

YES: Repair circuit as necessary.

NO: Go to ***Check TPS1 Signal Continuity*** on this page.

Check ECM 5V ref Circuit

Disconnect throttle body connector, Key ON. Using a DVOM measure the voltage between V REF (pin-H) and a good engine ground. Does it read approximately 5 volts?

YES: ECM and wiring OK. Go to ***Check TPS1 Signal Continuity*** on this page.

NO: Diagnose and repair 5V Ref #1 circuit problem.

Check TPS1 Signal Continuity

Key On, engine OFF. Using a jumper wire, jump between V REF (pin-H) and TPS1 signal (pin-G). Diagnostic tool in throttle monitor mode, read the voltage for TPS1 on the diagnostic tool. Did it change from 0 to 5 volts?

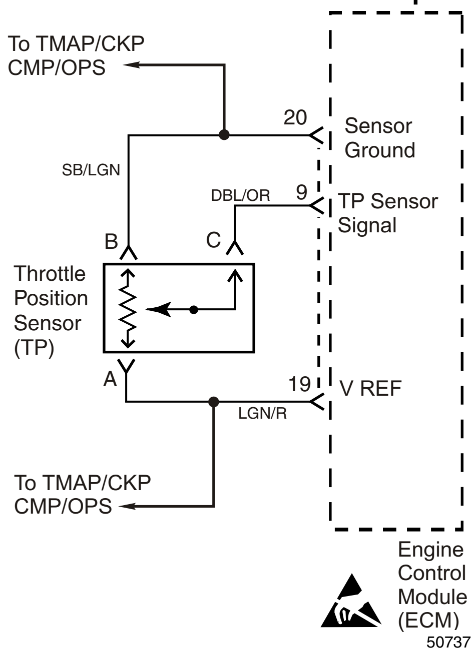
YES: Signal wire OK. Replace Throttle body

NO: Repair signal wire for open or short to ground (whichever condition exists).

DTC 0122 - TPS Signal Voltage Low (IAC)

SPN-51 FMI-4

Circuit Description



The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about 0.7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is used by the ECM to determine when to go into idle mode and only affects fuel delivery while TPS voltage is changing. Once TPS voltage stops changing the ECM relies on MAP to determine engine load, the TPS has no effect on fuel delivery.

The ECM supplies a 5 volt signal to the sensor from pin 19 to TP sensor connector terminal A. Terminal B to pin 20 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, to pin 9, according to where the throttle blades are positioned.

Diagnostic Aids

Check for the following conditions:

Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.

The scan tool reads throttle position in voltage and percentage relative to the throttle blade opening. With ignition “ON”, engine “OFF”, throttle blades closed (idle), the voltage should be 0.3-0.9 volts. The voltage should steadily increase as the throttle is moved toward Wide Open Throttle (WOT).

If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value. The ECM replaces the input with MAP and uses MAP changes to "see" a change in throttle position.

Conditions for setting the DTC

- Throttle position sensor malfunction or open 5V ref and/or signal circuit.
- Check condition - cranking or running.
- Fault condition - TPS sensor voltage less than 0.2.
- MIL - on during active fault.

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TPS Voltage

Key ON, engine OFF. Diagnostic tool connected in throttle monitor mode viewing TPS1 voltage. Is TPS voltage less than 0.2 volts with the throttle closed?

YES: Go to ***Check Wiring Harness Connector and Terminals*** **on this page**.

NO: Intermittent problem. Go to ***Check Wiring Harness Connector and Terminals*** on this page.

Check Wiring Harness Connector and Terminals

Inspect the TPS wire harness connector terminals for damage, corrosion or contamination. Did you find a problem?

YES: Repair circuit as necessary.

NO: Go to ***Check ECM 5V ref Circuit*** on this page.

Check ECM 5V ref Circuit

Key OFF. Disconnect the TPS wiring harness connector. Using a jumper, connect the 5-volt reference circuit (pin A) and TPS signal circuit (pin C) together at the TPS connector. Key ON. Does the diagnostic tool display TPS voltage of 4.0 volts or greater?

YES: TPS open circuit internally. Replace the TPS.

NO: Go to ***Check TPS1 Signal Continuity*** on this page.

Check TPS Signal Continuity

Key OFF. Disconnect ECM connector. Using a DVOM, check continuity between TPS signal (DBL/OR wire) at the TPS connector and ECM connector TPS signal (pin 9). Do you have continuity?

YES: Signal circuit OK. Go to ***Check 5V ref Continuity*** on this page

NO: Repair wiring as necessary.

Check 5V ref Continuity

Key OFF. Disconnect ECM connector. Using a DVOM, check continuity between 5V ref connector signal (pin H) and ECM connector (pin 19). Do you have continuity?

YES: Replace the ECM.

NO: Repair wiring as necessary.

DTC 0123 - TPS 1 Signal Voltage High (ETC)

SPN-51 FMI-3

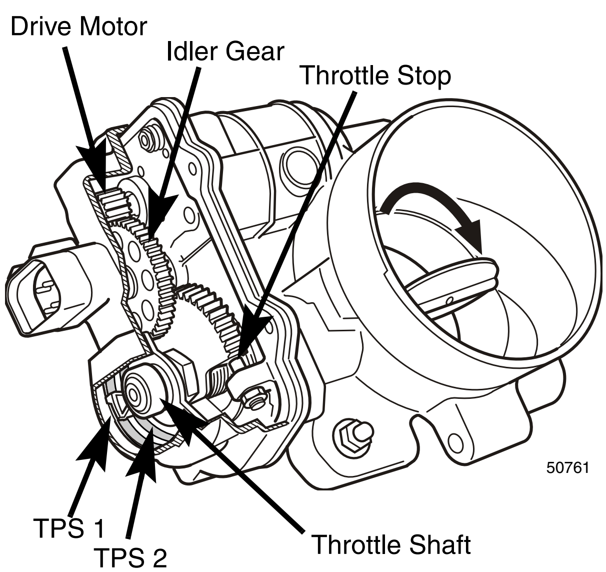
Circuit Description

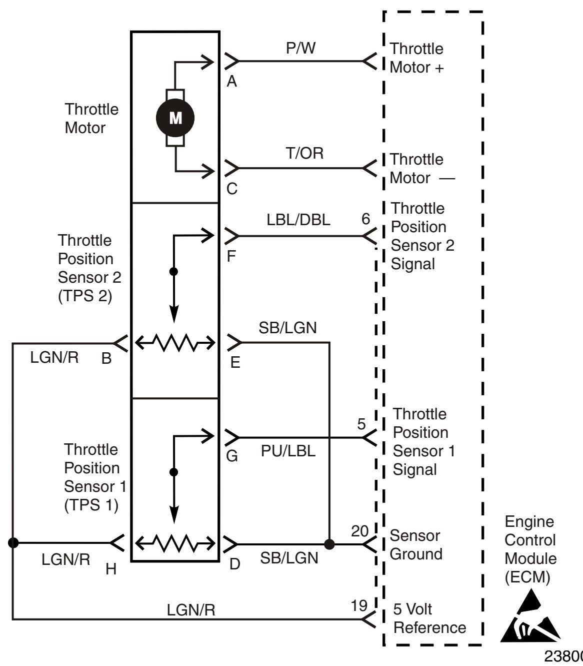
The electronic throttle has two counter acting throttle position sensors. Two sensors are used for improved safety and redundancy. The throttle position sensor uses a variable resistor to determine signal voltage based on throttle plate position, and is connected to the throttle shaft. Less opening results in lower TPS1voltage, and greater opening in higher TPS1 voltage.

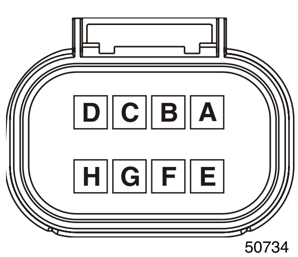
The TPS value is used by the ECM to determine if the throttle is opening as commanded. This fault will set if TPS1 voltage is above 4.8 volts at any operating condition while the engine is cranking or running.

Conditions for setting the DTC

- Throttle position sensor No. 1.
- Check condition - cranking or running.
- Fault condition - TPS sensor voltage exceeds 4.8.
- MIL - on during active fault.
- Hard warning buzzer
- Engine operates in derate 2.







Pin	Function
A	Throttle Motor +
B	5 V ref
C	Throttle Motor –
D	Ground

Pin	Function
E	Ground
F	TPS2
G	TPS1
H	5 V ref

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TPS1 Voltage

Key ON, engine OFF. Diagnostic tool connected in data mode. Does the diagnostic tool display TPS 1 voltage of 4.8 volts or greater with the throttle closed?

YES: Go to *Check 5V Reference 1 Circuit.* **on this page**

NO: Intermittent problem. Go to *Check Wiring Harness Connector and Terminals* on this page.

Check 5V Reference 1 Circuit.

Disconnect the throttle body connector and measure voltage between pin B (5V Ref #1) and a good engine ground. Does it measure approximately 5 volts?

YES: **Go to *Check TPS 1 operation* on this page.**

NO: **Repair 5V Ref #1 circuit for short to voltage.**

Check TPS 1 operation

With the throttle body still disconnected, key on, diagnostic tool connected in throttle monitor mode, read TPS1 voltage on the diagnostic tool. Does TPS1 volts read 0 volts?

YES: TPS 1 malfunction, replace throttle body.

NO: **Go to *Check Wiring Harness Connector and Terminals* on this page**

Check Wiring Harness Connector and Terminals

Inspect the throttle wire harness connector terminals for damage, corrosion or contamination. Did you find the problem?

YES: Repair circuit as necessary.

NO: **Go to *Check TPS1 Signal Continuity* on this page.**

Check TPS1 Signal Continuity

Key OFF. Disconnect ECM connector. Using a DVOM, check continuity between TPS 1 connector signal (pin G) and ECM connector TPS 1 signal (pin 5). Do you have continuity?

YES: Signal wire OK.

NO: Repair wiring as necessary.

Check 5V ref Continuity

Key OFF. Disconnect ECM connector. Using a DVOM, check continuity between 5V ref connector signal (pin H) and ECM connector (pin 19). Do you have continuity?

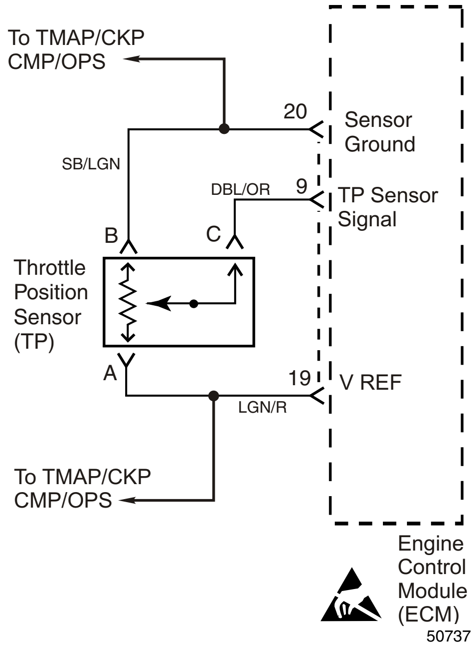
YES: Replace the ECM.

NO: Repair wiring as necessary.

DTC 0123 - TPS Signal Voltage High (IAC)

SPN-51 FMI-3

Circuit Description



The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about.7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor from pin 19 to TP sensor connector terminal A. Terminal B to pin 20 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, to pin 9, according to where the throttle blades are positioned.

Conditions for setting the DTC

- Throttle position sensor malfunction or wiring shorted to power.
- Check condition - cranking or running.
- Fault condition - TPS sensor voltage exceeds 4.8.
- MIL - on during active fault.

Diagnostic Aids

Check for the following conditions:

Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.

The diagnostic tool reads throttle position in voltage and percentage relative to the throttle blade opening. With ignition “ON”, engine “OFF”, throttle blades closed (idle), the voltage should be 0.3-0.9 volts. The voltage should steadily increase as the throttle is moved toward Wide Open Throttle (WOT).

If other DTCs are set, check for a short to ground in the V REF circuit.

If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

Troubleshooting

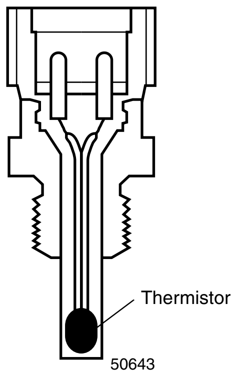
Check code is valid and active	Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.
Check TPS Voltage	Key ON, engine OFF. Diagnostic tool connected in data mode. Does the diagnostic tool display TPS voltage of 4.8 volts or greater with the throttle closed? **YES:** Go to ***Check TPS* on this page**. **NO:** Intermittent problem. Go to ***Check Wiring Harness Connector and Terminals*** on this page.
Check TPS	Disconnect TPS sensor wiring harness connector. Key ON, engine OFF. Does diagnostic tool display TPS voltage of 4.8 Volts. **YES:** Go to ***Check Wiring Harness Connector and Terminals*** on this page **NO:** TPS sensor shorted. Replace TPS sensor.
Check Wiring Harness Connector and Terminals	Inspect the TPS wire harness connector terminals for damage, corrosion or contamination. Did you find a problem? **YES:** Repair circuit as necessary. **NO:** Go to ***Check TPS1 Signal Continuity*** on this page.
Check TPS Signal Continuity	Key OFF. Disconnect ECM connector. Using a DVOM, check continuity between TPS connector signal (pin C) and ECM connector TPS signal (pin 9). Do you have continuity? **YES:** Signal wire OK. **NO:** Repair wiring as necessary.
Check 5V ref Continuity	Key OFF. Disconnect ECM connector. Using a DVOM, check continuity between 5V ref connector signal (pin A) and ECM connector (pin 19). Do you have continuity? **YES:** Replace the ECM. **NO:** Repair wiring as necessary.

DTC 0127 - IAT Higher Than Expected 2

SPN-105 FMI-0

Circuit Description

8.1 IAT Sensor

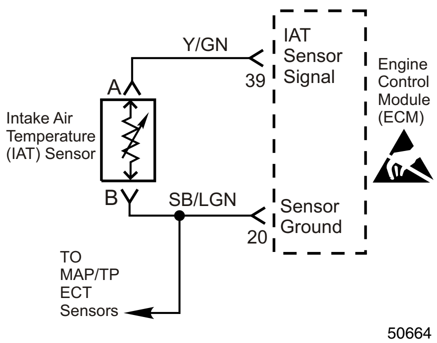


The Intake Air Temperature sensor is a negative temperature coefficient thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the total airflow injector pulse width and ignition timing for the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower voltage when the air is warm.

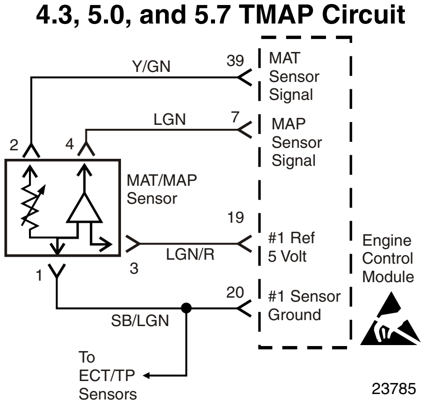
This fault will set if the Intake Air Temperature is greater than 79°C (175°F) and engine RPM is greater than 1500 for longer than 1 minute.

Conditions for setting the DTC

8.1 IAT Circuit



4.3, 5.0, and 5.7 TMAP Circuit



- Intake Air Temperature greater than 79°C (175°F) for more than 1 minute and engine RPM greater than 1500.

IAT Temperature vs. Resistance

8.1 IAT Sensor			4.3, 5.0 and 5.7 TMAP Sensor		
F°	Ohms	C°	F°	Ohms	C°
242.4	101	116.8	248	110	120
231.9	121	111	239	125	115
211.6	175	99.7	221	162	105
201.4	209	94.1	203	214	95
181.9	302	83.2	185	284	85
163.1	434	72.8	167	383	75
144.9	625	62.7	149	522	65
127.4	901	53	131	721	55
102.4	1,556	39.1	104	1,200	40
78.9	2,689	26	77	2,063	25
49.9	5,576	9.9	50	3,791	10
23.5	11,562	-4.7	23	7,419	-5
-5.7	28,770	-20.9	-4	15,614	-20
-21.2	49,715	-29.5	-22	26,854	-30
-30.8	71,589	-34.8	-31	35,763	-35
-40	99,301	-40	-40	48,153	-40

Troubleshooting

The following items should be checked in sequence when diagnosing DTC0127.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

If the code is inactive, check the current IAT output to determine if the sensor is giving appropriate readings for the current conditions. If the sensor is reading correctly go to the next step. If the sensor has incorrect readings,.

Check for other Codes.

This code will set for a very high intake temperature is detected. If the code is active, check for the presence of DTC-0111. and then check the engine intake air temperature with a mechanical thermometer to verify the intake air temperature is below the values for setting DTC0127. If the engine intake temperature is below the specified values, go to the next step. If the engine air intake temperature exceeds the specified values, increase engine compartment ventilation until the engine compartment ambient air temperature is within limits.

If DTC-0111 does not accompany DTC-0127, there is a malfunction in the ECM.

Check the IAT sensor connector for damage.

Remove the IAT sensor connector and inspect the pins for damage or corrosion and the pins are not pushed out of the socket.

Check ECM connector for damage.

Remove the ECM connector and inspect the ECM and connector pins for damage or corrosion and are properly seated in position.

Check the IAT sensor.

Remove and check the IAT sensor returns the values specified in the Temperature v. Resistance Table. If the sensor does not conform to the specified values, replace the sensor.

DTC 0129 - BP Low Pressure

SPN-108 FMI-1

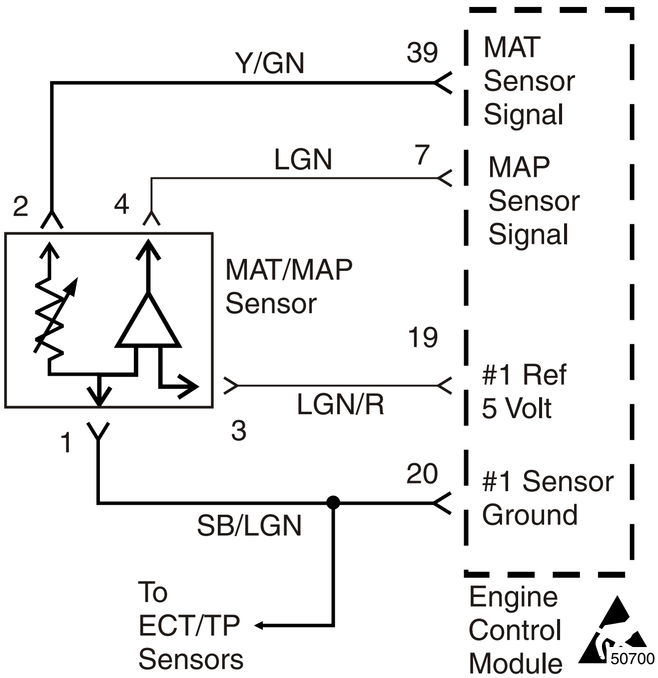
Circuit Description

The barometric pressure (BP) is estimated from the MAP/TMAP sensor. The barometric pressure value is used for fuel and airflow calculations. This fault sets in the event the BP value is out of the normal range.

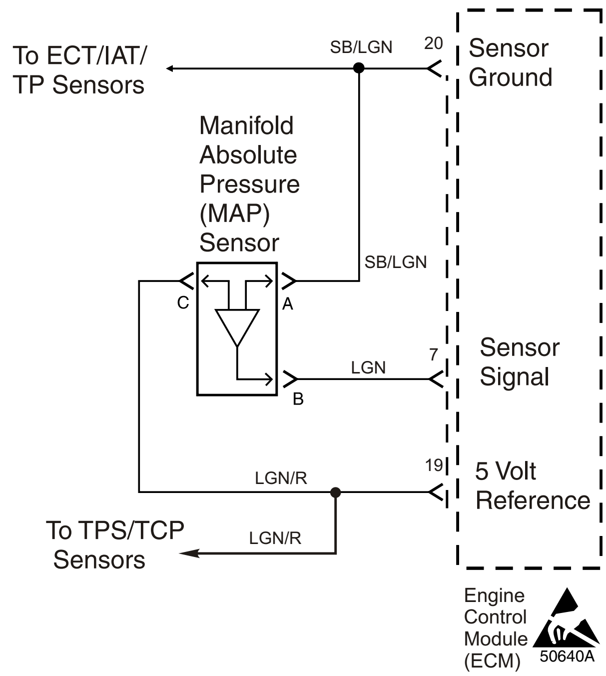
Conditions for setting the DTC

- Barometric pressure.
- Check condition - Engine Running.
- Fault condition - BP less than 8.3 psi.
- MIL - on for active fault and for 2 seconds after active fault.

4.3, 5.0, 5.7 TMAP Sensor



8.1 MAP Sensor



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Barometric pressure

Key ON, engine OFF. Diagnostic tool connected in "Engine Data" mode with Barometric Pressure PSI selected. Does the diagnostic tool display Barometric Pressure of 8.3 PSI or less?

YES: **Go to *Check MAP V REF circuit* on this page**

NO: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

Check MAP V REF circuit

Key ON. Using a voltmeter, measure the voltage between the V REF circuit (pin C on 8.1L, pin 3 all others) and a good engine ground. Does it measure approx 5 volts?

YES: Go to ***Check MAP signal circuit*** on this page

NO: Repair V REF circuit.

Check MAP signal circuit

Key ON, use an appropriate jumper and jump the V REF #1 circuit into the signal wire (pin B on 8.1L, pin 4 all others). Does the scan tool MAP voltage display approximately 5 volts?

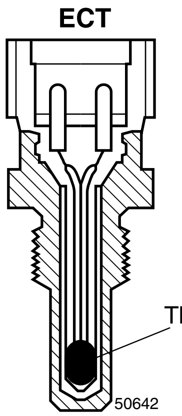
YES: Replace MAP sensor on 8.1 engines or TMAP sensor on all other engines.

NO: Repair MAP signal wire. If signal wire is not shorted to either ground (engine ground or sensor return #1 or #2) and is not open circuit, then check ECM connector for pin push out, damage or spreading. If no problem is found with connector, replace ECM.

DTC 0217 - ECT Higher Than Expected 2

SPN-110 FMI-15

Circuit Description



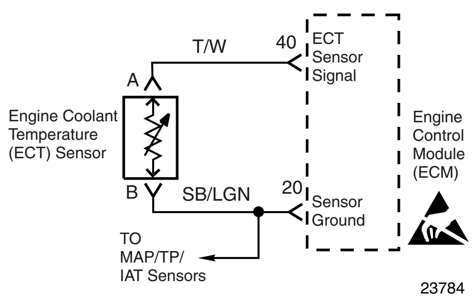
The engine coolant temperature (ECT) sensor is a temperature-sensitive resistor (Thermistor) located in the engine coolant jacket, near the thermostat. The ECT output is used drive the engine termperature gauge and for fuel injection pulse width calculation, and for engine protection. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

This fault will set in the event of an extreme or severe engine over temperature condition. When the coolant exceeds 96° C (205° F) and engine exceeds 500 RPM, this fault will set and the engine alarm will sound a hard warning one beep rapidly at ¼ second intervals and the MIL lamp will illuminate. On the 8.1L engines equipped with electronic throttle, the ECM will enable power derate 2 which limits the throttle to 30% throttle angle. On all other engines the, the RPM is limited to 2500.

Conditions for setting the DTC

- Engine coolant temperature.
- Check condition - engine running.
- Engine coolant temperature reading greater than 96°C (205° F) for longer than 1 minute and engine speed is greater than 500 RPM.
- Alarm will sound hard warning 1 beep every ¼ second during active fault and MIL will illuminate.

Diagnostic Aids



Possible causes for this code include the following items and should be checked as a preliminary inspection.

- Poor water flow through the cooling system on raw water cooled engines. Check for debris in or obstructions to the water intake. Check raw water pump impeller for wear or damage.
- Poor water flow through the heat exchanger, low water level in closed side of the closed circuit cooling system. Check for debris in or obstructions to the water intake. Check raw water pump impeller for wear or damage. Check circulating pump belt for slipping and proper tension.
- Too much current flow through ECT for a given temperature.

Table 4: Temperature vs. Resistance

C°	F°	Ohms	C°	F°	Ohms
100	212	177	20	68	3520
90	194	241	15	59	4450
80	176	332	10	50	5670
70	158	467	5	41	7280
60	140	667	0	32	9420
50	122	973	-5	23	12300
45	113	1118	-10	14	16180
40	104	1459	-15	5	21450
35	95	1802	-20	-4	28680
30	86	2238	-30	-22	52700
25	77	2796	-40	-40	100700

Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0217.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check engine temperature.

Diagnostic tool connected in ECT temperature mode. Drive the boat to simulate the conditions that set the code. Using a digital non-contact infrared thermometer, check the temperature of the thermostat housing at the ECT port and compare that reading to the ECT temperature displayed on the diagnostic scan tool. The two readings should be within ± 5°F (3°C) of each other.

If the readings agree and the temperature is more than 205°F (96°C), the engine has insufficient water flow. Correct the water flow condition and retest.

If the reading disagree and the temperature from the infrared thermometer is within engine operational limits, the ECT has excessive current flow (low circuit resistance), Go to ***Check ECT circuit*** on this page.

Check ECT circuit

Turn ignition ON, engine OFF. Diagnostic tool connected reading ECT volts. Disconnect the ECT and read ECT voltage on the scan tool. If the voltage is less than 4.99 volts, then there is current flow in the circuit. This means that either the circuit has a partial short to ground or the ECM has a partial short to ground internally. Check sensor internal resistance and replace sensor if low resistance is found.

DTC 0219 - Maximum Governor Speed Override

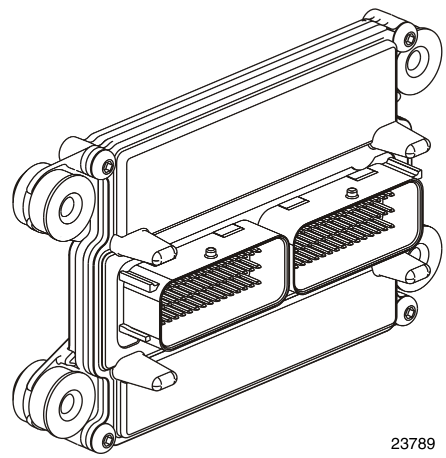
SPN-515 FMI-15

Circuit Description

This code is only used on 8.1 liter engines. This fault will set anytime engine RPM exceeds 5000 RPM or more for 2 seconds or longer continuously. When 5000 RPM is reached, the ECM will start closing the throttle to prevent and engine overrev condition. This is to help prevent engine or equipment damage. The MIL will be on during this active fault.

Conditions for setting the DTC

- Maximum governor speed override.
- Check condition - engine running.
- Fault condition - engine RPM greater than maximum rated for 2 seconds continuously
- MIL - on during active fault.



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Troubleshooting

NOTE: If any other DTCs are present, diagnose those first.

Check Propeller(s) Size

Check propeller pitch and size for correct size for the boat. Is propeller correctly sized for the boat?

YES: Go to ***Check Propeller Hub*** **on this page**

NO: **Replace propeller with the correct size for the engine load.**

Check Propeller Hub

Check propeller hub for slipping. Is the hub slipping?

YES: Replace or repair propeller.

NO: Go to ***Check ECM Part Number*** **on this page**

Check ECM Part Number

Check the part number on the ECM to ensure correct calibration is being used. Is the ECM part number correct?

YES Go to ***Check Throttle Operation*** **on this page**

NO: **Replace ECM with correct part number**

Check Throttle Operation

Check the mechanical operation of the throttle. Is the mechanical operation of the throttle OK?

YES: Go to ***Check for Vacuum Leak*** **on this page**

NO: **Correct mechanical operation of the throttle**

Check for Vacuum Leak

Check intake manifold and vacuum hoses for very large vacuum leaks. Did you find any vacuum leaks?

YES: Repair Vacuum leak

NO: **System OK.**

DTC 0221 - TPS 1 Higher Than TPS 2

SPN-51 FMI-1

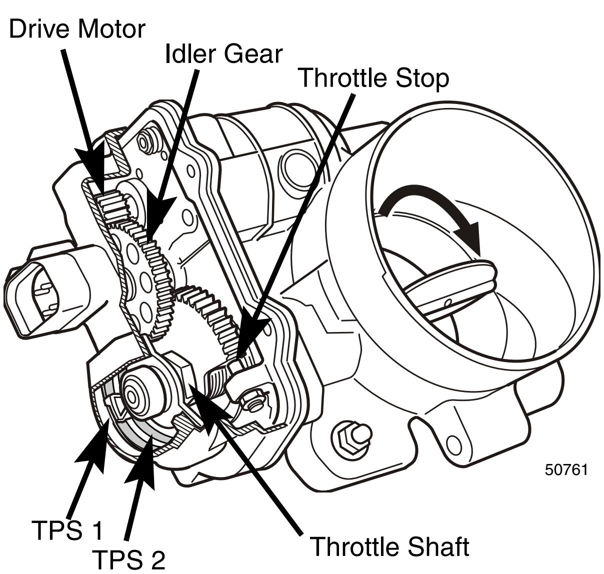
Circuit Description

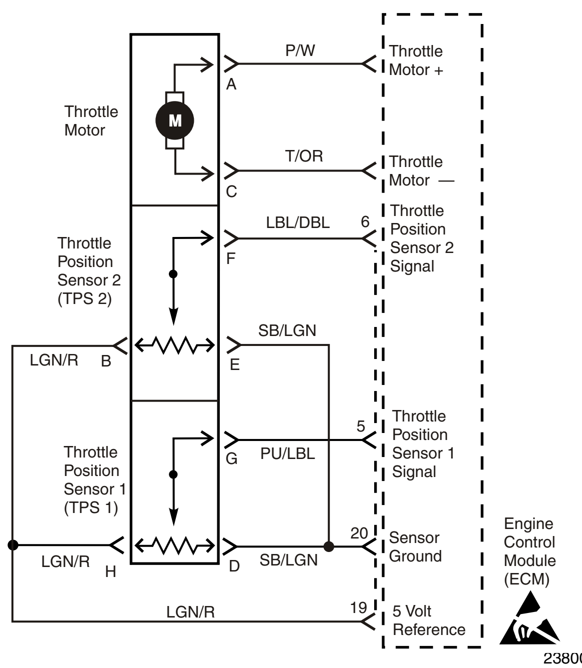
There are two throttle position sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read low voltage when closed and TPS 2 will read high voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

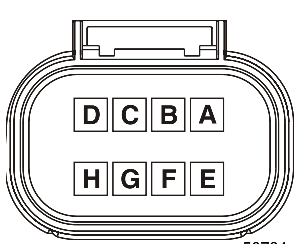
This fault will set if TPS 1 is 20% (or more) higher than TPS 2. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. During this active fault the MIL light will be on and the engine will enable the low rev limit and forced idle.

Conditions for Setting DTC

- Fault condition TPS 1 is 20% higher than TPS 2
- Check condition Key ON
- MIL light on for remaining of key cycle
- Engine in Derate 2
- Hard warning buzzer







Pin	Function
A	Throttle Motor +
B	5 V ref
C	Throttle Motor –
D	Ground

Pin	Function
E	Ground
F	TPS2
G	TPS1
H	5 V ref

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" then continue with this test but beware that the problem may be intermittent. If the TPS 1/2 differential step shows no problem, then the code is intermittent. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TPS 1/2 Differential

Key ON engine OFF. Diagnostic tool connected in throttle monitor mode. Is the difference between TPS 1 and TPS 2 greater than 20%?

YES: Go to ***Check TPS 1/2 Voltage*** on this page.

NO: Intermittent problem, See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TPS 1/2 Voltage

Key OFF. Disconnect throttle wiring harness connector. Key ON. Set diagnostic tool to throttle monitor mode. Is the voltage for both TPS 1 and TPS 2 less than 0.1 Volts?

YES: Go to ***Check TPS 5V ref*** on this page.

NO: Go to ***Check TPS signal circuit for short to power*** on this page.

Check TPS 5V ref

Key OFF. Diagnostic tool in Throttle Monitor mode. Key ON. Use a jumper wire and connect each TPS 1 (pin G) and TPS 2 (pin F) signals to the 5V ref (pin H) at the throttle body connector. Observe TPS 1 voltage on the diagnostic tool. Does the diagnostic tool display TPS 1 or TPS 2 voltage over 4.9 volts when connected to the 5V ref?

YES: Replace Throttle Body

NO: Go to ***Check TPS signal circuit for short to power*** on this page.

Check TPS signal circuit for short to power

Key ON, engine OFF. Using DVOM with one lead connected to a known good engine ground, problem terminal F and G of the throttle body connector. Does either wire show battery voltage?

YES: TPS signal wire shorted to power, repair wiring as necessary.

NO: Replace ECM

DTC 0222 - TPS 2 Low Voltage

SPN-520198 FMI-4

Circuit Description

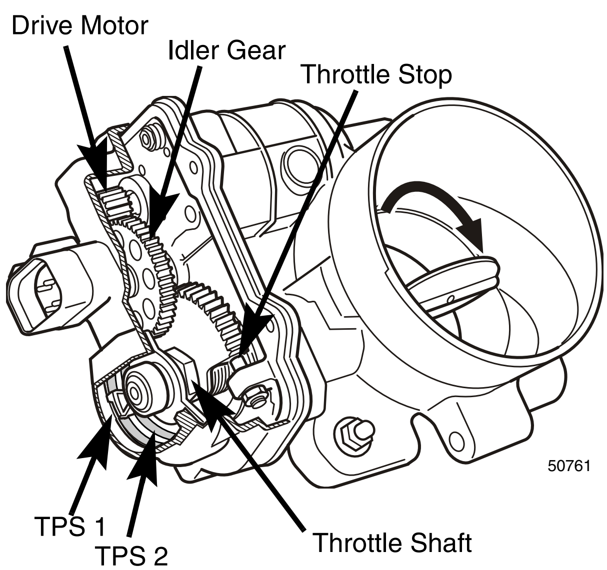
The electronic throttle has two counter acting throttle position sensors. Two sensors are used for improved safety and redundancy.

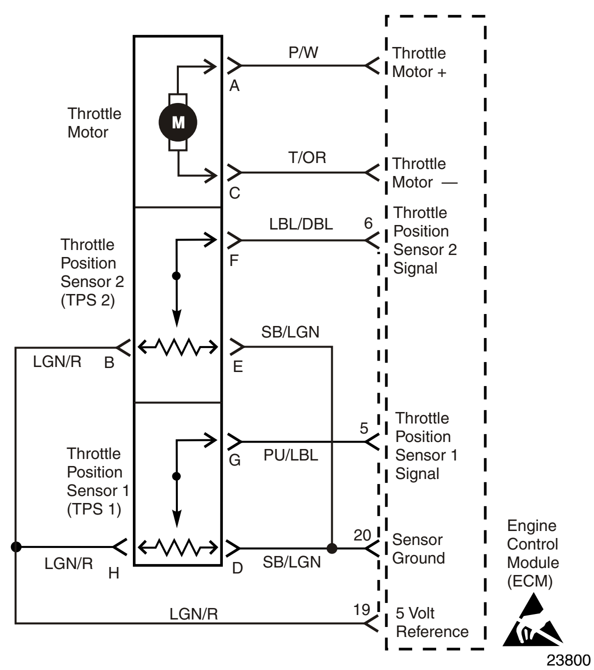
The throttle position sensor uses a variable resistor to determine signal voltage based on throttle plate position, and is located within the throttle. Less opening results in lower voltage, and greater opening in higher voltage. The TPS value is used by the ECM to determine if the throttle is opening as commanded.

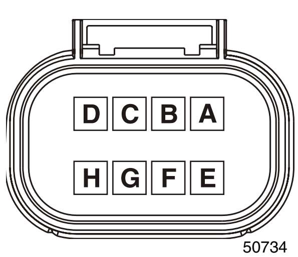
This fault will set if voltage is less than 0.2 volts at any operating condition while the engine is cranking or running. The engine will run in power derate 2 provided there is no active DTC for TPS1.

Conditions for setting the DTC

- Throttle position sensor No. 2.
- Check condition - cranking or running.
- Fault condition - TPS sensor voltage less than 0.2.
- MIL - on during active fault
- Engine derate 2







Pin	Function
A	Throttle Motor +
B	5 V ref
C	Throttle Motor –
D	Ground

Pin	Function
E	Ground
F	TPS2
G	TPS1
H	5 V ref

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TPS2 Voltage

Key ON, engine OFF. Diagnostic tool connected in throttle monitor mode. Is TPS 2 voltage less than 0.2 volts with the throttle closed?

YES: Go to ***Check ECM 5V ref Circuit*** **on this page**.

NO: Intermittent problem. Go to ***Check Wiring Harness Connector and Terminals*** on this page.

Check Wiring Harness Connector and Terminals

Inspect the throttle wire harness connector terminals for damage, corrosion or contamination. Did you find the problem?

YES: Repair circuit as necessary.

NO: Go to ***Check TPS1 Signal Continuity*** **on this page.**

Check ECM 5V ref Circuit

Disconnect throttle body connector, Key ON. Using a DVOM measure the voltage between pin B (5v Ref #2) and a good engine ground. Does it read approximately 5 volts?

YES: ECM and wiring OK. Go to ***Check TPS1 Signal Continuity*** on this page.

NO: Diagnose and repair 5V Ref #2 circuit problem.

Check TPS2 Signal Continuity

Key On, engine OFF. Using a jumper wire, jump between pin B (5v ref #2) and pin F (TPS2 signal). Diagnostic tool in throttle monitor mode, read the voltage for TPS2 on the diagnostic tool. Did it change from 0 to 5 volts?

YES: Signal wire OK. Replace Throttle body

NO: Repair signal wire for open or short to ground (whichever condition exists).

DTC 0223 - TPS 2 High Voltage

SPN-520198 FMI-3

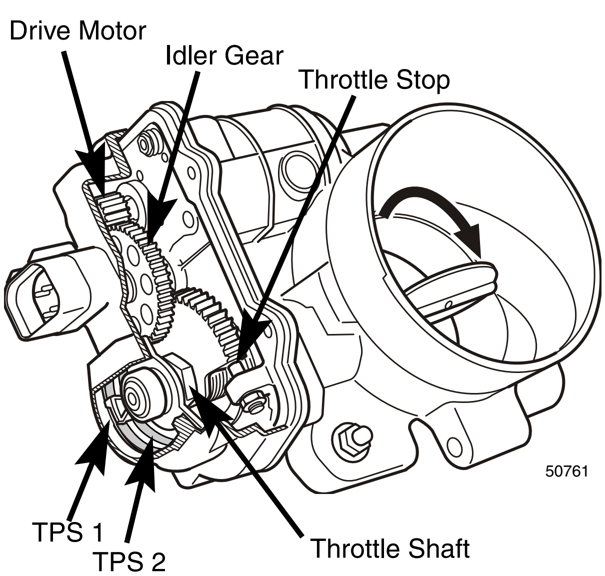
Circuit Description

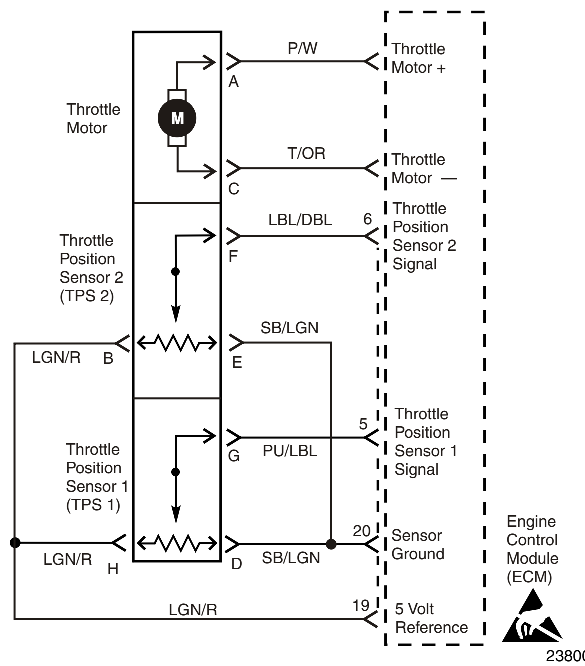
The electronic throttle has two counter acting throttle position sensors. Two sensors are used for improved safety and redundancy. The throttle position sensor uses a variable resistor to determine signal voltage based on throttle plate position, and is connected to the throttle shaft. Less opening results in lower TPS2 voltage, and greater opening in higher TPS2 voltage.

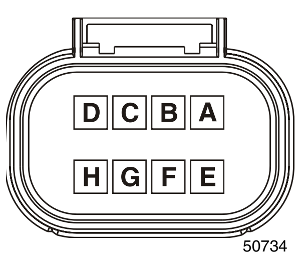
The TPS value is used by the ECM to determine if the throttle is opening as commanded. This fault will set if TPS2 voltage is above 4.8 volts at any operating condition while the engine is cranking or running.

Conditions for setting the DTC

- Throttle position sensor No. 2.
- Check condition - cranking or running.
- Fault condition - TPS sensor voltage exceeds 4.8.
- MIL - on during active fault.
- Hard warning buzzer
- Engine operates in derate 2.







Pin	Function
A	Throttle Motor +
B	5 V ref
C	Throttle Motor –
D	Ground

Pin	Function
E	Ground
F	TPS2
G	TPS1
H	5 V ref

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TPS 2 Voltage

Key ON, engine OFF. Diagnostic tool connected in data mode. Does the diagnostic tool display TPS 2 voltage of 4.8 volts or greater with the throttle closed?

YES: Go to ***Check 5V Reference 1 Circuit.*** **on this page**

NO: Intermittent problem. Go to ***Check Wiring Harness Connector and Terminals*** on this page.

Check V REF Circuit.

Disconnect the throttle body connector and measure voltage between pin H (V REF) and a good engine ground. Does it measure approximately 5 volts?

YES: Go to *Check TPS 1 operation* on this page.

NO: Repair V REF circuit for short to voltage.

Check TPS 2 operation

With the throttle body still disconnected, key on, diagnostic tool connected in throttle monitor mode, read TPS 2 voltage on the diagnostic tool. Does TPS 2 volts read 0 volts?

YES: TPS 2 malfunction, replace throttle body.

NO: Go to *Check Wiring Harness Connector and Terminals* on this page

Check Wiring Harness Connector and Terminals

Inspect the throttle wire harness connector terminals for damage, corrosion or contamination. Did you find the problem?

YES: Repair circuit as necessary.

NO: Go to *Check TPS1 Signal Continuity* on this page.

Check TPS 2 Signal Continuity

Key OFF. Disconnect ECM connector. Using a DVOM, check continuity between TPS 2 connector signal (pin F) and ECM connector TPS 2 signal (pin 6). Do you have continuity?

YES: Signal wire OK.

NO: Repair wiring as necessary.

Check V REF Continuity

Key OFF. Disconnect ECM connector. Using a DVOM, check continuity between V REF connector signal (pin H) and ECM connector (pin 19). Do you have continuity?

YES: Replace the ECM.

NO: Repair wiring as necessary.

DTC 0261 - Injector Driver 1 Open

SPN-651 FMI-5

Table 5: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This DTC will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

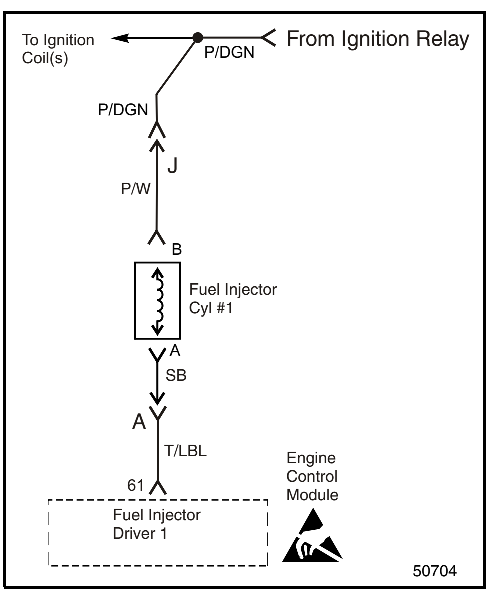
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, Preliminary and Intermittent Checks” on page 48.

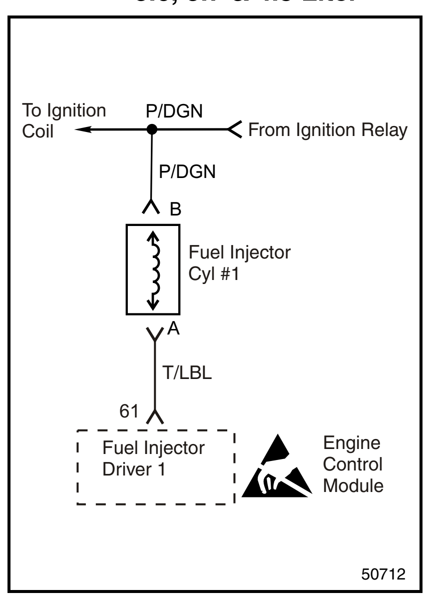
Conditions for Setting DTC

- Injector coil open or driver circuit shorted to ground.
- Check condition-Key ON and engine running.
- Fault condition-battery voltage at ECM greater than 9 volts and injector driver off voltage for this injector is less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

8.1 Liter



5.0, 5.7 & 4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0261

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key On - Engine Running ECM Data Mode. Clear system fault codes. View the "injector driver off volts" for the cylinder that has the DTC. Remember: "injector drivers" are listed in driver sequence order NOT cylinder number, See *Injector driver sequence* page 121.

- **Example: cylinder #3 injector on a 5.0L engine is the 4th cylinder in the driver sequence. In order to see the voltage on injector for cylinder #3 you need to view "Injector Driver #4 Off Voltage" Does DTC-reset with engine idling?**

YES **Go to *Check Injector for Open Coil* on this page**

NO **If voltage from "injector Driver off volts" is at 0 volts, problem is active, if voltage is close to system voltage displayed on other injector driver off voltages then problem is not active. Wiggle affected connectors while watching injector off voltage to determine if intermittent is in a connector. Now Go to *Check Injector Power Feed Circuit* on this page**

Check Injector Power Feed Circuit

Key OFF. Disconnect affected injector connector at the injector. Key ON. Check for battery voltage on the P/W wire at the injectore connector when the key is turned back on. There should be battery voltage there for 5 seconds at key on. Is there power present when the key is turned ON?

YES **Go to *Check Injector Driver to ECM Circuit.* on this page**

NO **Repair short to ground in harness or faulty ECM if shorted to analog ground and harness is OK**

Check Injector for Open Coil

Key Off. Disconnect harness connector from the #1 cylinder injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of16 Ohms or less?

YES **Go to *Check Injector Power Feed Circuit* on this page**

NO **Replace faulty injector.**

Check Injector Driver to ECM Circuit.

Disconnect the harness connector from the ECM. Using the DVOM measure the resistance from the injector connector to pin 16 on the harness connector. Does the DVOM display a resistance of 5.0 Ohms or less?

YES **Faulty connection at injector or ECM or Faulty ECM.**

NO **Repair open in harness.**

DTC 0264 - Injector Driver 2 Open

SPN-652 FMI-5

Table 6: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This DTC will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

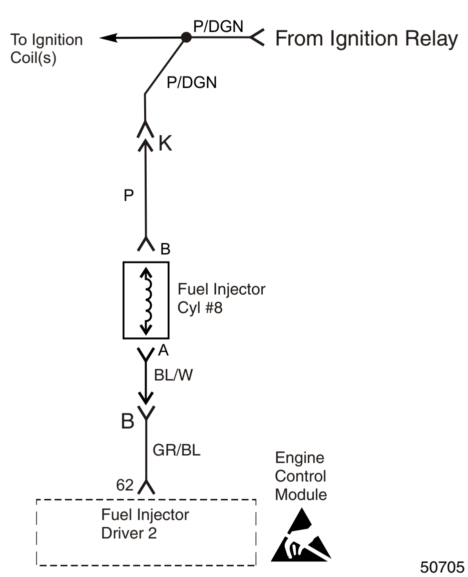
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, Preliminary and Intermittent Checks” on page 48.

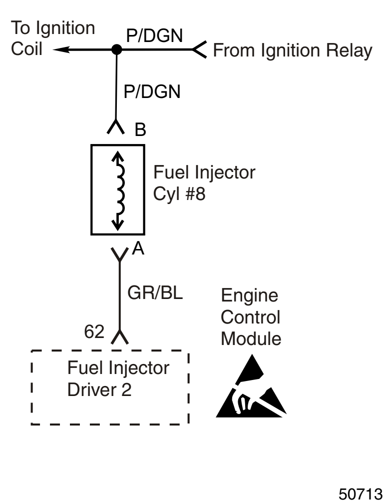
Conditions for Setting DTC

- Injector coil open or driver circuit shorted to ground.
- Check condition-Key ON and engine running.
- Fault condition-battery voltage at ECM greater than 9 volts and injector driver off voltage for this injector is less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

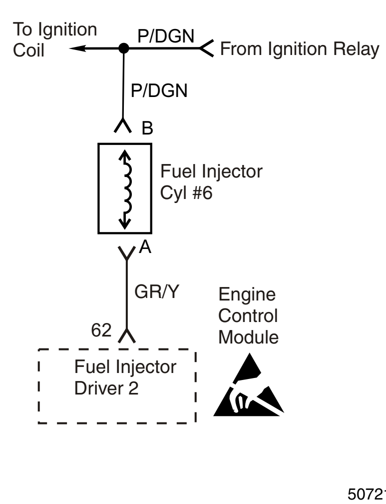
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0261

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key On - Engine Running ECM Data Mode. Clear system fault codes. View the "injector driver off volts" for the cylinder that has the DTC. Remember: "injector drivers" are listed in driver sequence order NOT cylinder number, See *Injector driver sequence* page 121.

- **Example:** cylinder #3 injector on a 5.0L engine is the 4th cylinder in the driver sequence. In order to see the voltage on injector for cylinder #3 you need to view "Injector Driver #4 Off Voltage" Does DTC-reset with engine idling?

YES Go to ***Check Injector for Open Coil*** **on this page**

NO If voltage from "injector Driver off volts" is at 0 volts, problem is active, if voltage is close to system voltage displayed on other injector driver off voltages then problem is not active. Wiggle affected connectors while watching injector off voltage to determine if intermittent is in a connector. Now Go to ***Check Injector Power Feed Circuit*** **on this page**

Check Injector Power Feed Circuit

Key OFF. Disconnect affected injector connector at the injector. Key ON. Check for battery voltage on the P/W wire at the injector connector when the key is turned back on. There should be battery voltage there for 5 seconds at key on. Is there power present when the key is turned ON?

YES Go to ***Check Injector Driver to ECM Circuit.*** **on this page**

NO Repair short to ground in harness or faulty ECM if shorted to analog ground and harness is OK

Check Injector for Open Coil

Key Off. Disconnect harness connector from the #1 cylinder injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of16 Ohms or less?

YES Go to ***Check Injector Power Feed Circuit*** **on this page**

NO Replace faulty injector.

Check Injector Driver to ECM Circuit.

Disconnect the harness connector from the ECM. Using the DVOM measure the resistance from the injector connector to pin 16 on the harness connector. Does the DVOM display a resistance of 5.0 Ohms or less?

YES Faulty connection at injector or ECM or Faulty ECM.

NO Repair open in harness.

DTC 0265 - Injector Driver 2 Shorted

SPN-652 FMI-6

Table 7: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

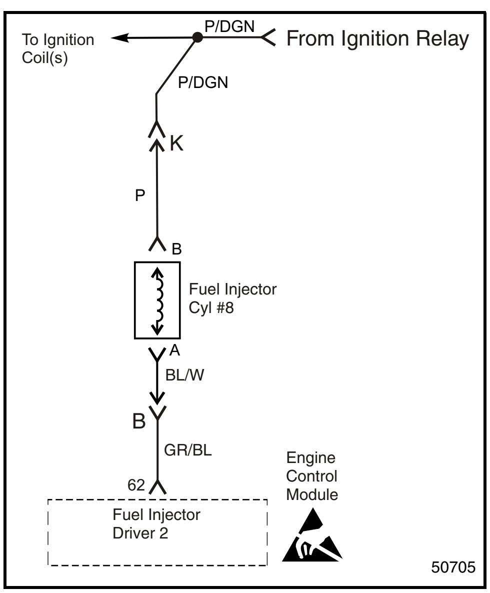
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

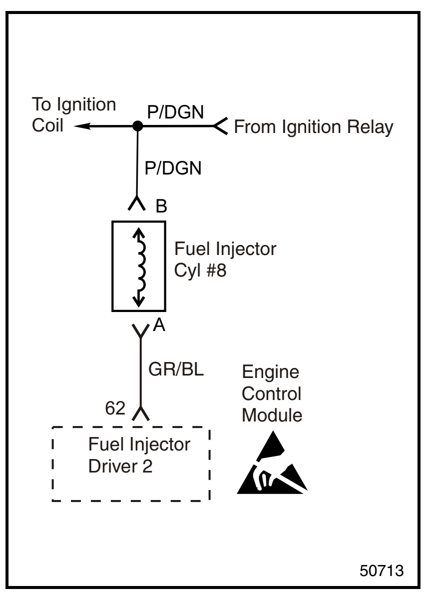
Conditions for Setting DTC

- Injector coil internally shorted or injector driver circuit shorted to voltage.
- Check condition - engine running.
- Fault condition-battery voltage at ECM less than 16 volts and injector low side less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

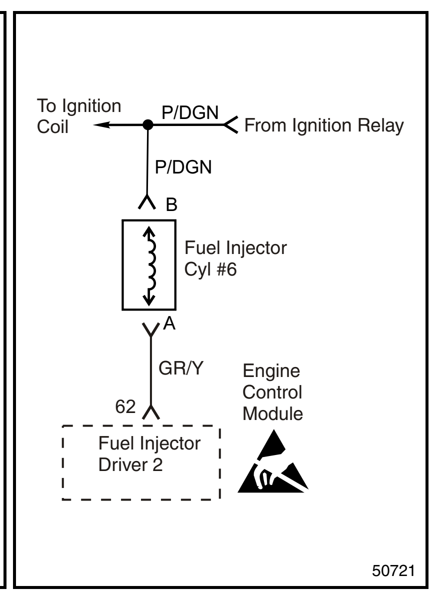
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0265

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key ON - engine running, diagnostic tool in ECM Data Mode. View "injector driver on voltage" for this injector. Is the voltage above 1 volt?

YES If voltage is above 1 volt, problem is active. **Go to *Check Injector for Open Coil* on this page**

NO If voltage is below 1 volt problem is intermittent. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NOTE: Injector drivers on the scan tool are in sequence. See *Injector driver sequence* page 121. for the corresponding cylinder number.

Check Injector for Shorted Coil

Key OFF. Disconnect harness connector from the #1 injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of 14 Ohms or more?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace the injector.

Check Injector Short to Power

Key ON. Disconnect the # 1 injector. Measure voltage between the T/LBL wire at the injector and a good ground. Is voltage 0.5 volts or greater.

YES Circuit is shorted to voltage either in the harness or inside the ECM. Repair short in harness or replace ECM

NO Replace faulty injector or faulty ECM

DTC 0267 - Injector Driver 3 Open

SPN-653 FMI-5

Table 8: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This DTC will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

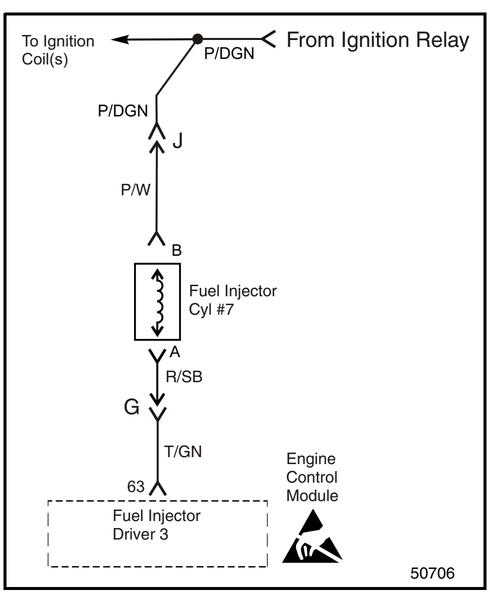
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, Preliminary and Intermittent Checks” on page 48.

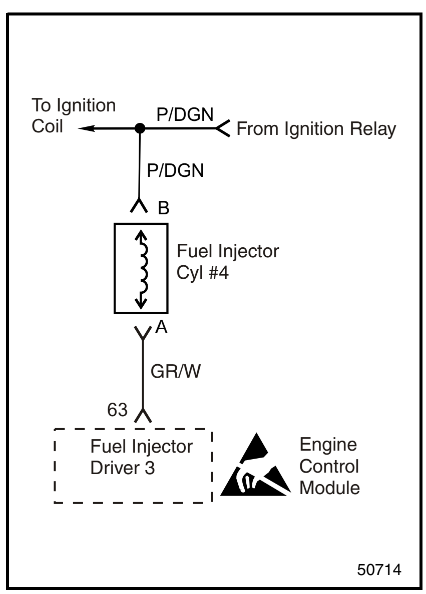
Conditions for Setting DTC

- Injector coil open or driver circuit shorted to ground.
- Check condition-Key ON and engine running.
- Fault condition-battery voltage at ECM greater than 9 volts and injector driver off voltage for this injector is less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

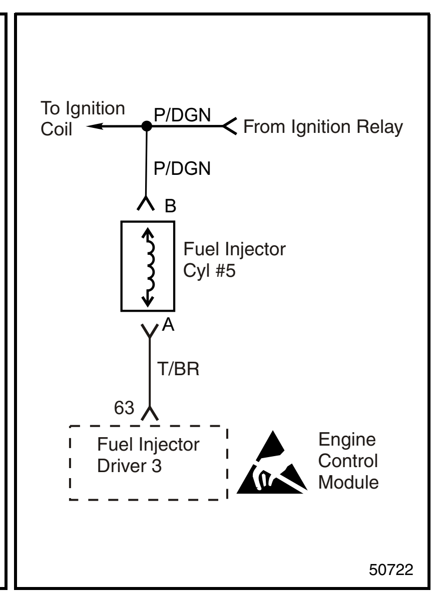
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0261

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key On - Engine Running ECM Data Mode. Clear system fault codes. View the "injector driver off volts" for the cylinder that has the DTC. Remember: "injector drivers" are listed in driver sequence order NOT cylinder number, See *Injector driver sequence* page 121.

- **Example:** cylinder #3 injector on a 5.0L engine is the 4th cylinder in the driver sequence. In order to see the voltage on injector for cylinder #3 you need to view "Injector Driver #4 Off Voltage" Does DTC-reset with engine idling?

YES Go to *Check Injector for Open Coil* **on this page**

NO If voltage from "injector Driver off volts" is at 0 volts, problem is active, if voltage is close to system voltage displayed on other injector driver off voltages then problem is not active. Wiggle affected connectors while watching injector off voltage to determine if intermittent is in a connector. Now Go to *Check Injector Power Feed Circuit* **on this page**

Check Injector Power Feed Circuit

Key OFF. Disconnect affected injector connector at the injector. Key ON. Check for battery voltage on the P/W wire at the injectore connector when the key is turned back on. There should be battery voltage there for 5 seconds at key on. Is there power present when the key is turned ON?

YES Go to *Check Injector Driver to ECM Circuit.* **on this page**

NO Repair short to ground in harness or faulty ECM if shorted to analog ground and harness is OK

Check Injector for Open Coil

Key Off. Disconnect harness connector from the #1 cylinder injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of16 Ohms or less?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace faulty injector.

Check Injector Driver to ECM Circuit.

Disconnect the harness connector from the ECM. Using the DVOM measure the resistance from the injector connector to pin 16 on the harness connector. Does the DVOM display a resistance of 5.0 Ohms or less?

YES Faulty connection at injector or ECM or Faulty ECM.

NO Repair open in harness.

DTC 0268 - Injector Driver 3 Shorted

SPN-651 FMI-6

Table 9: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

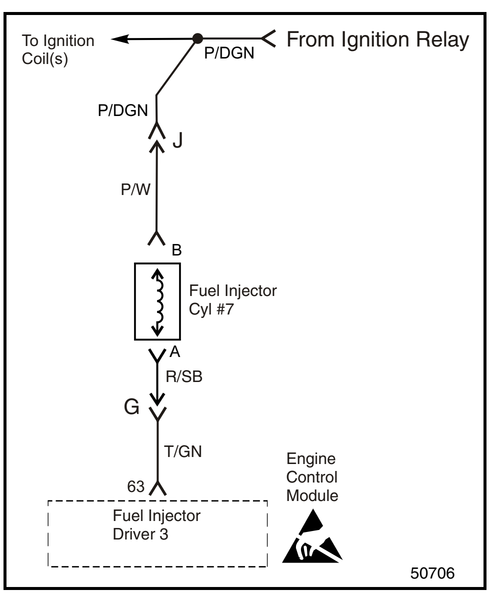
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

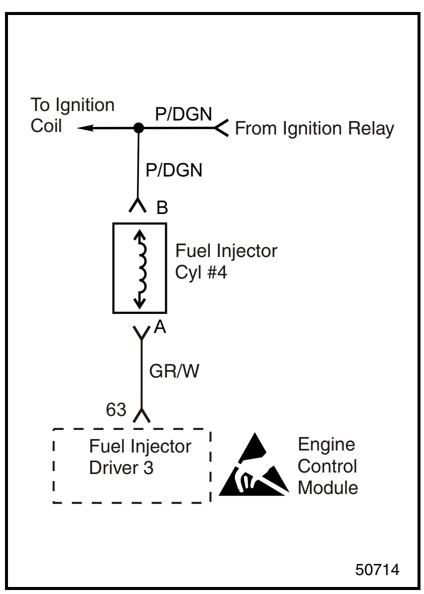
Conditions for Setting DTC

- Injector coil internally shorted or injector driver circuit shorted to voltage.
- Check condition - engine running.
- Fault condition-battery voltage at ECM less than 16 volts and injector low side less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

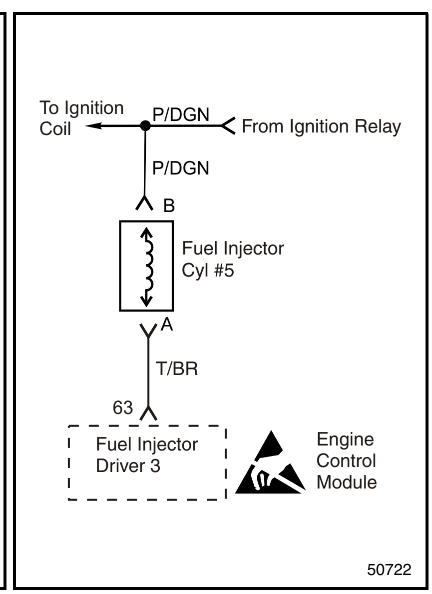
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0262

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key ON - engine running, diagnostic tool in ECM Data Mode. View "injector driver on voltage" for this injector. Is the voltage above 1 volt?

YES If voltage is above 1 volt, problem is active. **Go to *Check Injector for Open Coil* on this page**

NO If voltage is below 1 volt problem is intermittent. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NOTE: Injector drivers on the scan tool are in sequence. See *Injector driver sequence* page 121. for the corresponding cylinder number.

Check Injector for Shorted Coil

Key OFF. Disconnect harness connector from the #1 injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of 14 Ohms or more?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace the injector.

Check Injector Short to Power

Key ON. Disconnect the # 1 injector. Measure voltage between the T/LBL wire at the injector and a good ground. Is voltage 0.5 volts or greater.

YES Circuit is shorted to voltage either in the harness or inside the ECM. Repair short in harness or replace ECM

NO Replace faulty injector or faulty ECM

DTC 0270 - Injector Driver 4 Open

SPN-654 FMI-5

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This DTC will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

Table 10: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

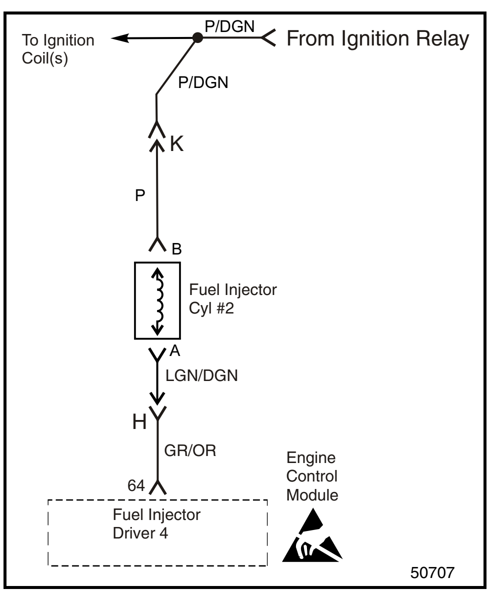
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, Preliminary and Intermittent Checks" on page 48.

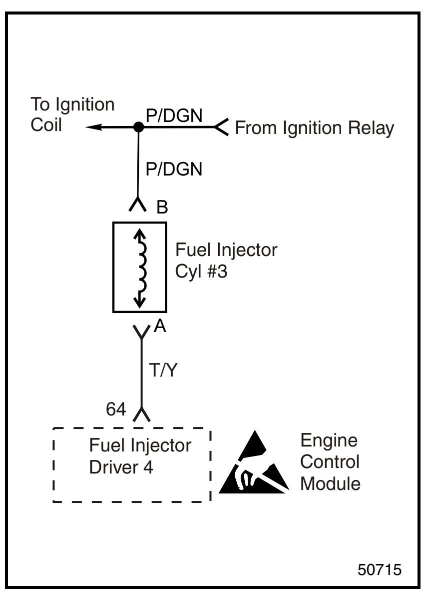
Conditions for Setting DTC

- Injector coil open or driver circuit shorted to ground.
- Check condition-Key ON and engine running.
- Fault condition-battery voltage at ECM greater than 9 volts and injector driver off voltage for this injector is less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

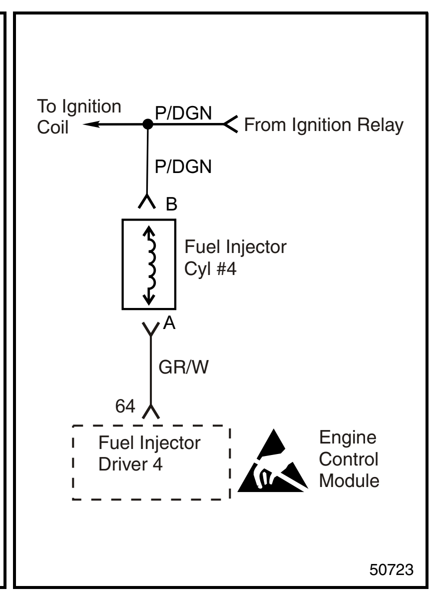
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0261

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key On - Engine Running ECM Data Mode. Clear system fault codes. View the "injector driver off volts" for the cylinder that has the DTC. Remember: "injector drivers" are listed in driver sequence order NOT cylinder number, See *Injector driver sequence* page 121.

- **Example:** cylinder #3 injector on a 5.0L engine is the 4th cylinder in the driver sequence. In order to see the voltage on injector for cylinder #3 you need to view "Injector Driver #4 Off Voltage" Does DTC-reset with engine idling?

YES Go to *Check Injector for Open Coil* **on this page**

NO If voltage from "injector Driver off volts" is at 0 volts, problem is active, if voltage is close to system voltage displayed on other injector driver off voltages then problem is not active. Wiggle affected connectors while watching injector off voltage to determine if intermittent is in a connector. Now Go to *Check Injector Power Feed Circuit* **on this page**

Check Injector Power Feed Circuit

Key OFF. Disconnect affected injector connector at the injector. Key ON. Check for battery voltage on the P/W wire at the injectore connector when the key is turned back on. There should be battery voltage there for 5 seconds at key on. Is there power present when the key is turned ON?

YES Go to *Check Injector Driver to ECM Circuit.* **on this page**

NO Repair short to ground in harness or faulty ECM if shorted to analog ground and harness is OK

Check Injector for Open Coil

Key Off. Disconnect harness connector from the #1 cylinder injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of16 Ohms or less?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace faulty injector.

Check Injector Driver to ECM Circuit.

Disconnect the harness connector from the ECM. Using the DVOM measure the resistance from the injector connector to pin 16 on the harness connector. Does the DVOM display a resistance of 5.0 Ohms or less?

YES Faulty connection at injector or ECM or Faulty ECM.

NO Repair open in harness.

DTC 0271 - Injector Driver 4 Shorted

SPN-654 FMI-6

Table 11: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

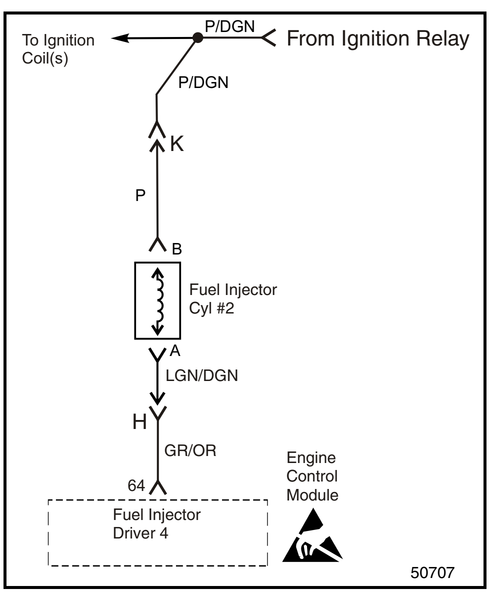
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

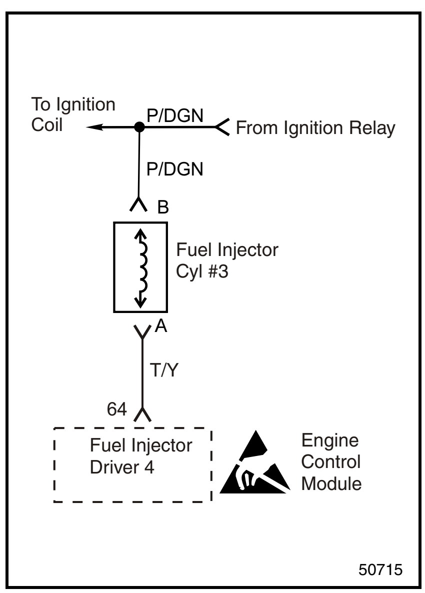
Conditions for Setting DTC

- Injector coil internally shorted or injector driver circuit shorted to voltage.
- Check condition - engine running.
- Fault condition-battery voltage at ECM less than 16 volts and injector low side less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

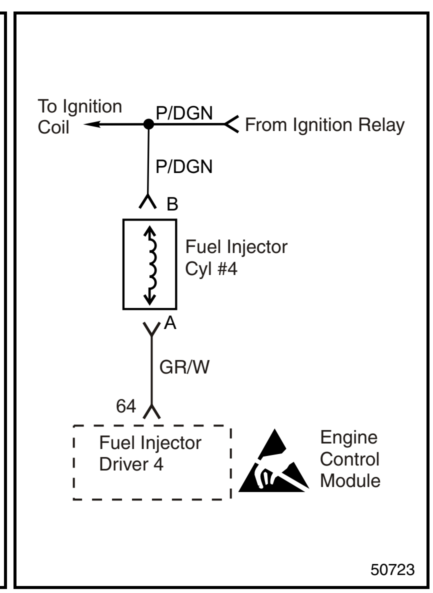
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0262

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key ON - engine running, diagnostic tool in ECM Data Mode. View "injector driver on voltage" for this injector. Is the voltage above 1 volt?

YES If voltage is above 1 volt, problem is active. **Go to *Check Injector for Open Coil* on this page**

NO If voltage is below 1 volt problem is intermittent. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NOTE: Injector drivers on the scan tool are in sequence. See *Injector driver sequence* page 121. for the corresponding cylinder number.

Check Injector for Shorted Coil

Key OFF. Disconnect harness connector from the #1 injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of 14 Ohms or more?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace the injector.

Check Injector Short to Power

Key ON. Disconnect the # 1 injector. Measure voltage between the T/LBL wire at the injector and a good ground. Is voltage 0.5 volts or greater.

YES Circuit is shorted to voltage either in the harness or inside the ECM. Repair short in harness or replace ECM

NO Replace faulty injector or faulty ECM

DTC 0273 - Injector Driver 5 Open

SPN-655 FMI-5

Table 12: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This DTC will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

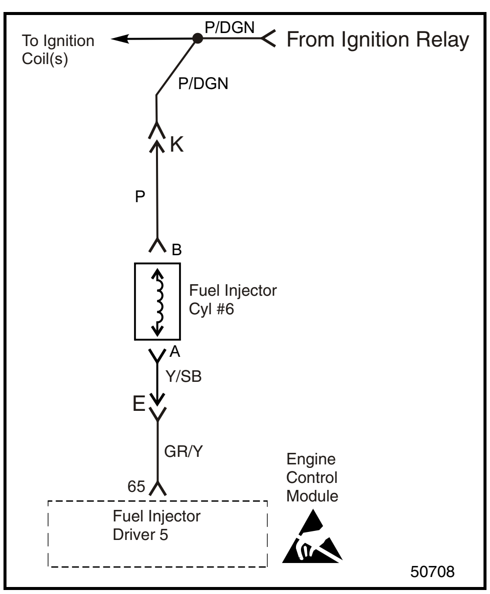
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, Preliminary and Intermittent Checks” on page 48.

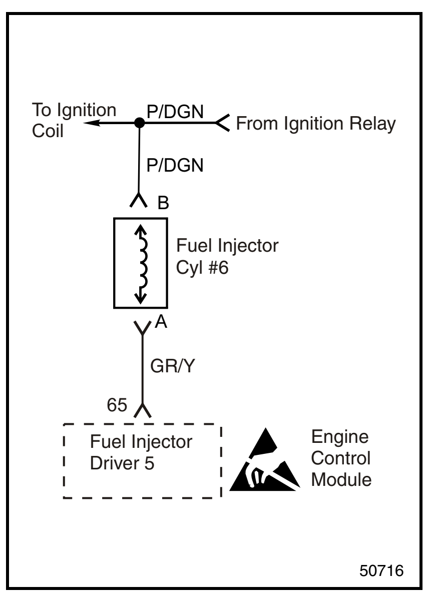
Conditions for Setting DTC

- Injector coil open or driver circuit shorted to ground.
- Check condition-Key ON and engine running.
- Fault condition-battery voltage at ECM greater than 9 volts and injector driver off voltage for this injector is less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

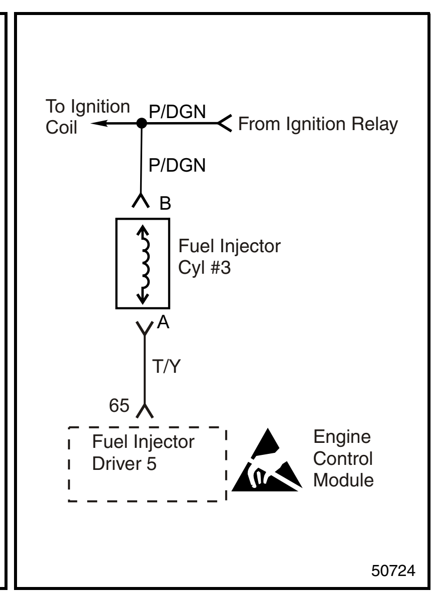
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0261

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key On - Engine Running ECM Data Mode. Clear system fault codes. View the "injector driver off volts" for the cylinder that has the DTC. Remember: "injector drivers" are listed in driver sequence order NOT cylinder number, See *Injector driver sequence* page 121.

- **Example:** cylinder #3 injector on a 5.0L engine is the 4th cylinder in the driver sequence. In order to see the voltage on injector for cylinder #3 you need to view "Injector Driver #4 Off Voltage" Does DTC-reset with engine idling?

YES Go to *Check Injector for Open Coil* **on this page**

NO If voltage from "injector Driver off volts" is at 0 volts, problem is active, if voltage is close to system voltage displayed on other injector driver off voltages then problem is not active. Wiggle affected connectors while watching injector off voltage to determine if intermittent is in a connector. Now Go to *Check Injector Power Feed Circuit* **on this page**

Check Injector Power Feed Circuit

Key OFF. Disconnect affected injector connector at the injector. Key ON. Check for battery voltage on the P/W wire at the injectore connector when the key is turned back on. There should be battery voltage there for 5 seconds at key on. Is there power present when the key is turned ON?

YES Go to *Check Injector Driver to ECM Circuit.* **on this page**

NO Repair short to ground in harness or faulty ECM if shorted to analog ground and harness is OK

Check Injector for Open Coil

Key Off. Disconnect harness connector from the #1 cylinder injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of16 Ohms or less?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace faulty injector.

Check Injector Driver to ECM Circuit.

Disconnect the harness connector from the ECM. Using the DVOM measure the resistance from the injector connector to pin 16 on the harness connector. Does the DVOM display a resistance of 5.0 Ohms or less?

YES Faulty connection at injector or ECM or Faulty ECM.

NO Repair open in harness.

DTC 0274 - Injector Driver 5 Shorted

SPN-654 FMI-6

Table 13: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

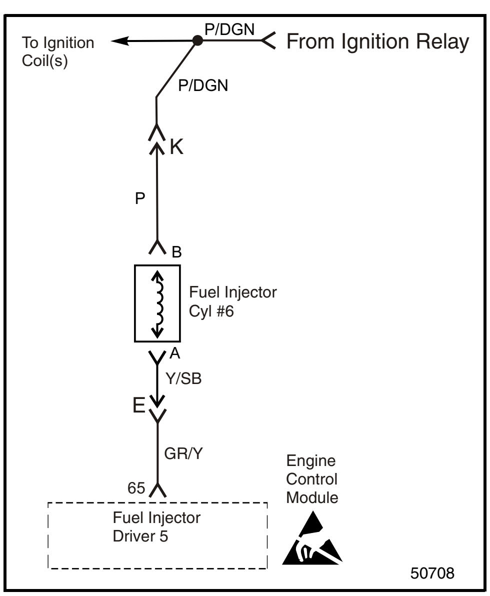
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

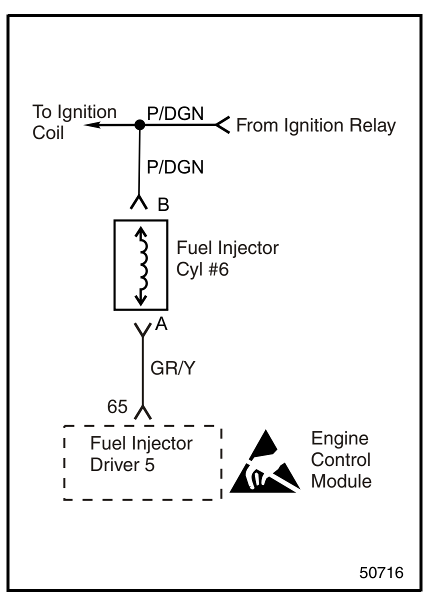
Conditions for Setting DTC

- Injector coil internally shorted or injector driver circuit shorted to voltage.
- Check condition - engine running.
- Fault condition-battery voltage at ECM less than 16 volts and injector low side less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

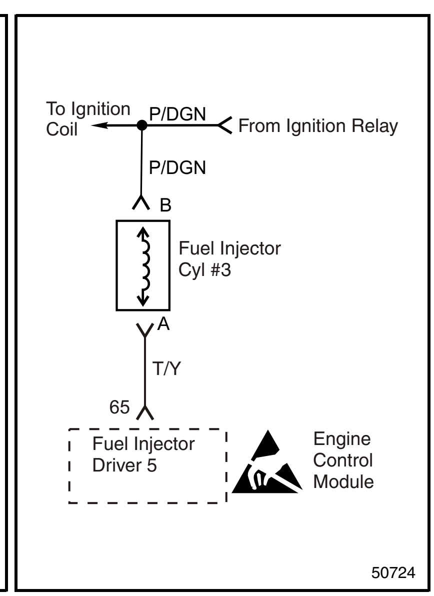
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0262

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key ON - engine running, diagnostic tool in ECM Data Mode. View "injector driver on voltage" for this injector. Is the voltage above 1 volt?

YES If voltage is above 1 volt, problem is active. **Go to *Check Injector for Open Coil* on this page**

NO If voltage is below 1 volt problem is intermittent. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NOTE: Injector drivers on the scan tool are in sequence. See *Injector driver sequence* page 121. for the corresponding cylinder number.

Check Injector for Shorted Coil

Key OFF. Disconnect harness connector from the #1 injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of 14 Ohms or more?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace the injector.

Check Injector Short to Power

Key ON. Disconnect the # 1 injector. Measure voltage between the T/LBL wire at the injector and a good ground. Is voltage 0.5 volts or greater.

YES Circuit is shorted to voltage either in the harness or inside the ECM. Repair short in harness or replace ECM

NO Replace faulty injector or faulty ECM

DTC 0276 - Injector Driver 6 Open

SPN-656 FMI-5

Table 14: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This DTC will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

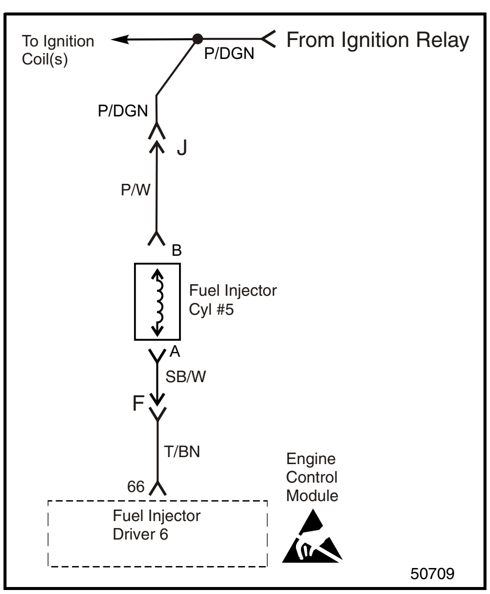
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, Preliminary and Intermittent Checks" on page 48.

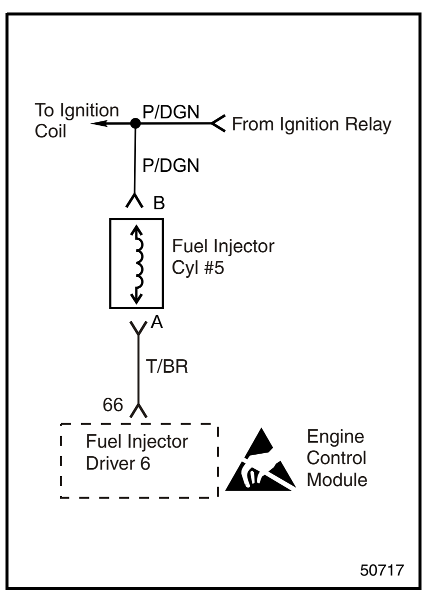
Conditions for Setting DTC

- Injector coil open or driver circuit shorted to ground.
- Check condition-Key ON and engine running.
- Fault condition-battery voltage at ECM greater than 9 volts and injector driver off voltage for this injector is less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

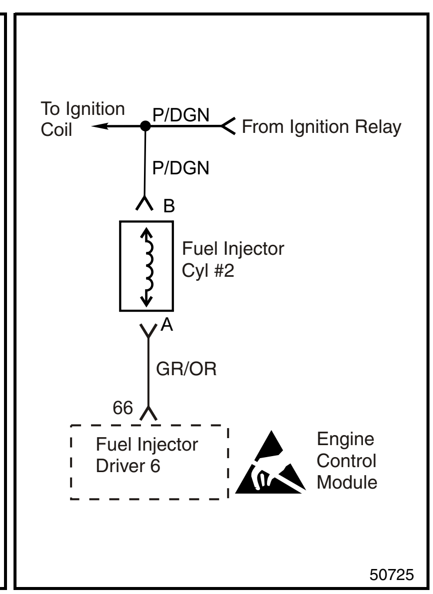
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0261

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key On - Engine Running ECM Data Mode. Clear system fault codes. View the "injector driver off volts" for the cylinder that has the DTC. Remember: "injector drivers" are listed in driver sequence order NOT cylinder number, See *Injector driver sequence* page 121.

- **Example:** cylinder #3 injector on a 5.0L engine is the 4th cylinder in the driver sequence. In order to see the voltage on injector for cylinder #3 you need to view "Injector Driver #4 Off Voltage" Does DTC-reset with engine idling?

YES Go to *Check Injector for Open Coil* **on this page**

NO If voltage from "injector Driver off volts" is at 0 volts, problem is active, if voltage is close to system voltage displayed on other injector driver off voltages then problem is not active. Wiggle affected connectors while watching injector off voltage to determine if intermittent is in a connector. Now Go to *Check Injector Power Feed Circuit* **on this page**

Check Injector Power Feed Circuit

Key OFF. Disconnect affected injector connector at the injector. Key ON. Check for battery voltage on the P/W wire at the injectore connector when the key is turned back on. There should be battery voltage there for 5 seconds at key on. Is there power present when the key is turned ON?

YES Go to *Check Injector Driver to ECM Circuit.* **on this page**

NO Repair short to ground in harness or faulty ECM if shorted to analog ground and harness is OK

Check Injector for Open Coil

Key Off. Disconnect harness connector from the #1 cylinder injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of16 Ohms or less?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace faulty injector.

Check Injector Driver to ECM Circuit.

Disconnect the harness connector from the ECM. Using the DVOM measure the resistance from the injector connector to pin 16 on the harness connector. Does the DVOM display a resistance of 5.0 Ohms or less?

YES Faulty connection at injector or ECM or Faulty ECM.

NO Repair open in harness.

DTC 0277 - Injector Driver 6 Shorted

SPN-654 FMI-6

Table 15: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

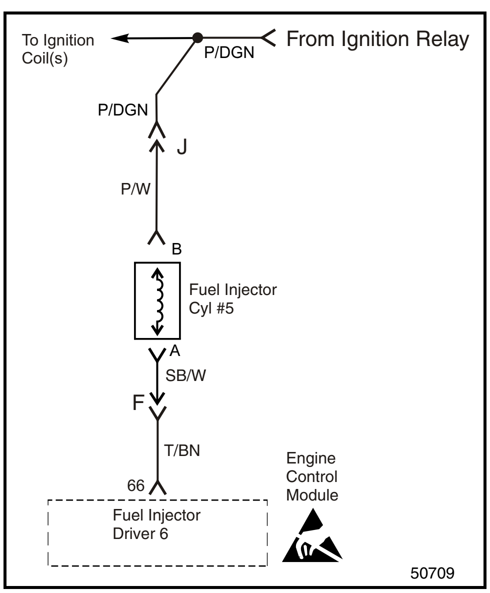
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*” on page 48” in Section 4

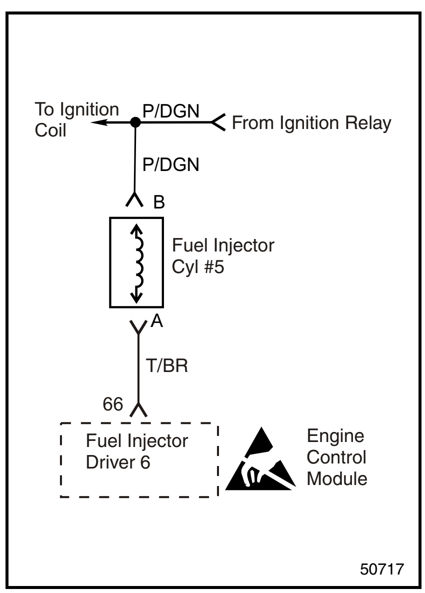
Conditions for Setting DTC

- Injector coil internally shorted or injector driver circuit shorted to voltage.
- Check condition - engine running.
- Fault condition-battery voltage at ECM less than 16 volts and injector low side less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

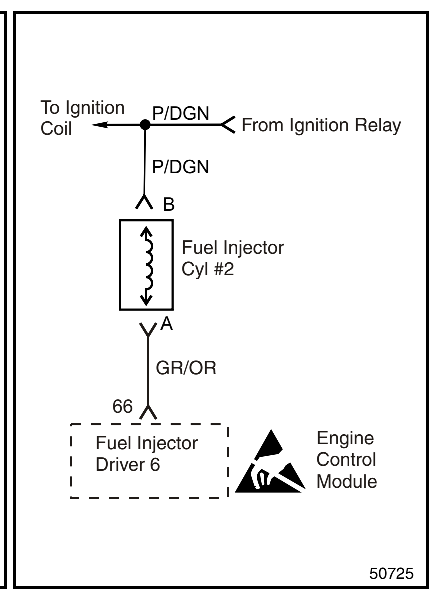
8.1 Liter



5.0 & 5.7 Liter



4.3 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0262

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key ON - engine running, diagnostic tool in ECM Data Mode. View "injector driver on voltage" for this injector. Is the voltage above 1 volt?

YES If voltage is above 1 volt, problem is active. **Go to *Check Injector for Open Coil* on this page**

NO If voltage is below 1 volt problem is intermittent. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NOTE: Injector drivers on the scan tool are in sequence. See *Injector driver sequence* page 121. for the corresponding cylinder number.

Check Injector for Shorted Coil

Key OFF. Disconnect harness connector from the #1 injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of 14 Ohms or more?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace the injector.

Check Injector Short to Power

Key ON. Disconnect the # 1 injector. Measure voltage between the T/LBL wire at the injector and a good ground. Is voltage 0.5 volts or greater.

YES Circuit is shorted to voltage either in the harness or inside the ECM. Repair short in harness or replace ECM

NO Replace faulty injector or faulty ECM

DTC 0279 - Injector Driver 7 Open

SPN-657 FMI-5

Table 16: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This DTC will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

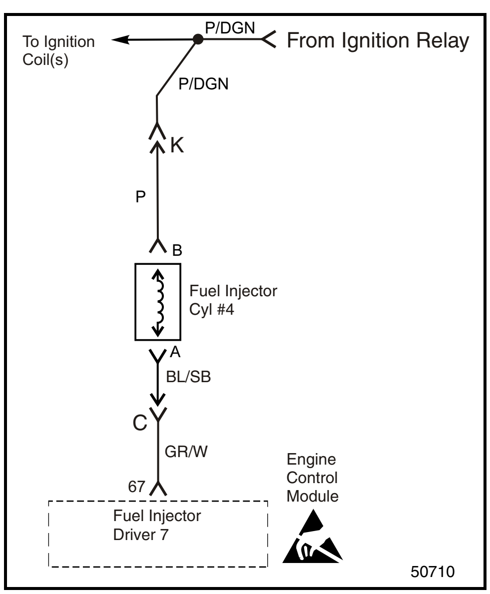
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, Preliminary and Intermittent Checks" on page 48.

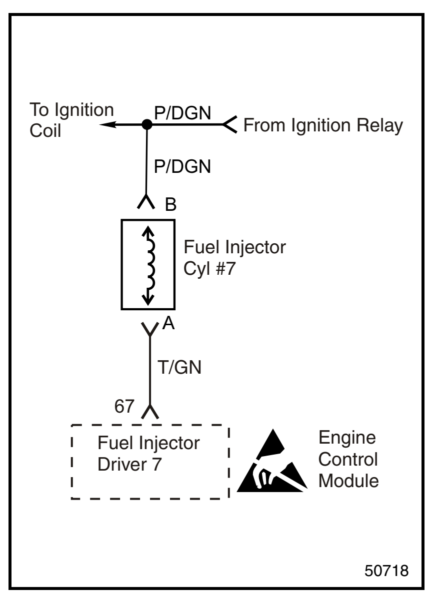
Conditions for Setting DTC

- Injector coil open or driver circuit shorted to ground.
- Check condition-Key ON and engine running.
- Fault condition-battery voltage at ECM greater than 9 volts and injector driver off voltage for this injector is less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

8.1 Liter



5.0 & 5.7 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0261

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key On - Engine Running ECM Data Mode. Clear system fault codes. View the "injector driver off volts" for the cylinder that has the DTC. Remember: "injector drivers" are listed in driver sequence order NOT cylinder number, See *Injector driver sequence* page 121.

- **Example:** cylinder #3 injector on a 5.0L engine is the 4th cylinder in the driver sequence. In order to see the voltage on injector for cylinder #3 you need to view "Injector Driver #4 Off Voltage" Does DTC-reset with engine idling?

YES Go to *Check Injector for Open Coil* **on this page**

NO If voltage from "injector Driver off volts" is at 0 volts, problem is active, if voltage is close to system voltage displayed on other injector driver off voltages then problem is not active. Wiggle affected connectors while watching injector off voltage to determine if intermittent is in a connector. Now Go to *Check Injector Power Feed Circuit* **on this page**

Check Injector Power Feed Circuit

Key OFF. Disconnect affected injector connector at the injector. Key ON. Check for battery voltage on the P/W wire at the injectore connector when the key is turned back on. There should be battery voltage there for 5 seconds at key on. Is there power present when the key is turned ON?

YES Go to *Check Injector Driver to ECM Circuit.* **on this page**

NO Repair short to ground in harness or faulty ECM if shorted to analog ground and harness is OK

Check Injector for Open Coil

Key Off. Disconnect harness connector from the #1 cylinder injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of16 Ohms or less?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace faulty injector.

Check Injector Driver to ECM Circuit.

Disconnect the harness connector from the ECM. Using the DVOM measure the resistance from the injector connector to pin 16 on the harness connector. Does the DVOM display a resistance of 5.0 Ohms or less?

YES Faulty connection at injector or ECM or Faulty ECM.

NO Repair open in harness.

DTC 0280 - Injector Driver 7 Shorted

SPN-654 FMI-6

Table 17: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

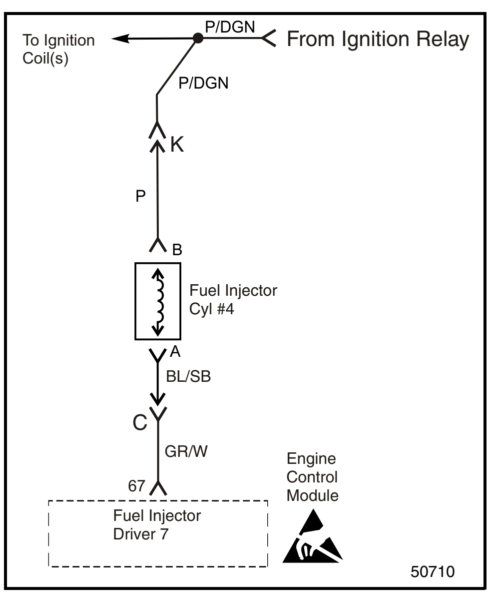
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

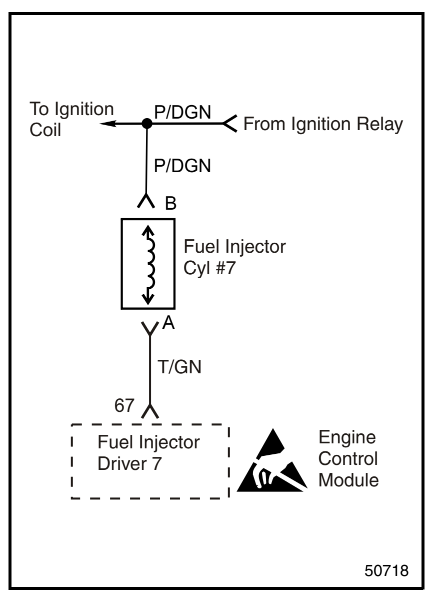
Conditions for Setting DTC

- Injector coil internally shorted or injector driver circuit shorted to voltage.
- Check condition - engine running.
- Fault condition-battery voltage at ECM less than 16 volts and injector low side less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

8.1 Liter



5.0 & 5.7 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0262

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key ON - engine running, diagnostic tool in ECM Data Mode. View "injector driver on voltage" for this injector. Is the voltage above 1 volt?

YES If voltage is above 1 volt, problem is active. **Go to *Check Injector for Open Coil* on this page**

NO If voltage is below 1 volt problem is intermittent. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NOTE: Injector drivers on the scan tool are in sequence. See *Injector driver sequence* page 121. for the corresponding cylinder number.

Check Injector for Shorted Coil

Key OFF. Disconnect harness connector from the #1 injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of 14 Ohms or more?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace the injector.

Check Injector Short to Power

Key ON. Disconnect the # 1 injector. Measure voltage between the T/LBL wire at the injector and a good ground. Is voltage 0.5 volts or greater.

YES Circuit is shorted to voltage either in the harness or inside the ECM. Repair short in harness or replace ECM

NO Replace faulty injector or faulty ECM

DTC 0282 - Injector Driver 8 Open

SPN-658 FMI-5

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This DTC will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

Table 18: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

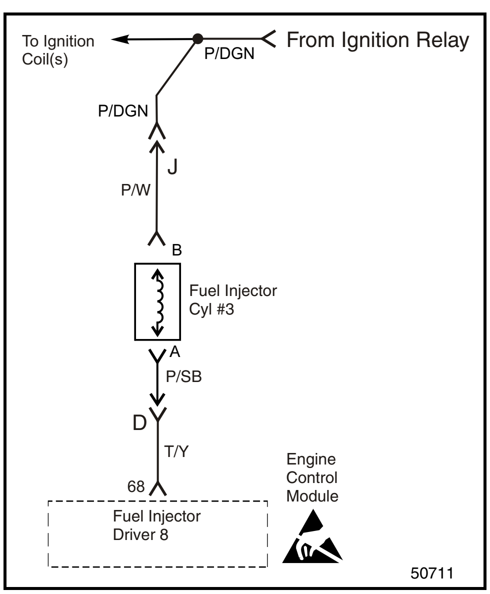
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, Preliminary and Intermittent Checks” on page 48.

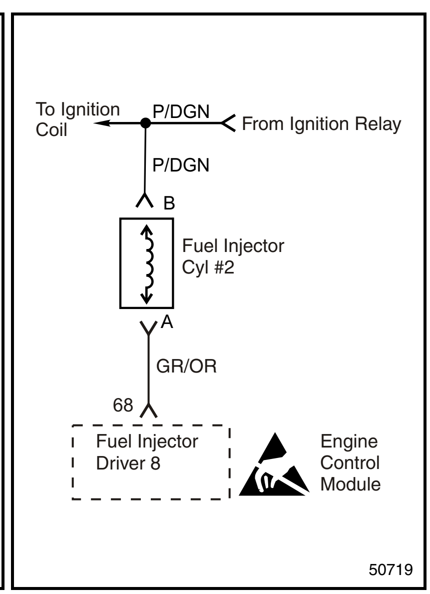
Conditions for Setting DTC

- Injector coil open or driver circuit shorted to ground.
- Check condition-Key ON and engine running.
- Fault condition-battery voltage at ECM greater than 9 volts and injector driver off voltage for this injector is less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

8.1 Liter



5.0 & 5.7 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0261

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key On - Engine Running ECM Data Mode. Clear system fault codes. View the "injector driver off volts" for the cylinder that has the DTC. Remember: "injector drivers" are listed in driver sequence order NOT cylinder number, See *Injector driver sequence* page 121.

- **Example:** cylinder #3 injector on a 5.0L engine is the 4th cylinder in the driver sequence. In order to see the voltage on injector for cylinder #3 you need to view "Injector Driver #4 Off Voltage" Does DTC-reset with engine idling?

YES Go to *Check Injector for Open Coil* **on this page**

NO If voltage from "injector Driver off volts" is at 0 volts, problem is active, if voltage is close to system voltage displayed on other injector driver off voltages then problem is not active. Wiggle affected connectors while watching injector off voltage to determine if intermittent is in a connector. Now Go to *Check Injector Power Feed Circuit* **on this page**

Check Injector Power Feed Circuit

Key OFF. Disconnect affected injector connector at the injector. Key ON. Check for battery voltage on the P/W wire at the injectore connector when the key is turned back on. There should be battery voltage there for 5 seconds at key on. Is there power present when the key is turned ON?

YES Go to *Check Injector Driver to ECM Circuit.* **on this page**

NO Repair short to ground in harness or faulty ECM if shorted to analog ground and harness is OK

Check Injector for Open Coil

Key Off. Disconnect harness connector from the #1 cylinder injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of16 Ohms or less?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace faulty injector.

Check Injector Driver to ECM Circuit.

Disconnect the harness connector from the ECM. Using the DVOM measure the resistance from the injector connector to pin 16 on the harness connector. Does the DVOM display a resistance of 5.0 Ohms or less?

YES Faulty connection at injector or ECM or Faulty ECM.

NO Repair open in harness.

DTC 0283 - Injector Driver 8 Shorted

SPN-654 FMI-6

Table 19: Injector driver sequence

Injector Driver	Engine Cylinder		
	8.1L	5.7L 5.0L	4.3L
1	1	1	1
2	8	8	6
3	7	4	5
4	2	3	4
5	6	6	3
6	5	5	2
7	4	7	—
8	3	2	—

Circuit Description

The Engine Control Module (ECM) controls the fuel injector drivers. Ignition voltage is supplied to all the injectors via the Ignition Relay (R5) in the fuse and relay power center. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a low side driver in the ECM. The injector drivers are in sequential order from 1-8. Depending on which engine is being serviced, the same injector driver will control a different cylinder depending on where in the firing order the injector driver is located. See the injector driver sequence table for the firing sequence

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

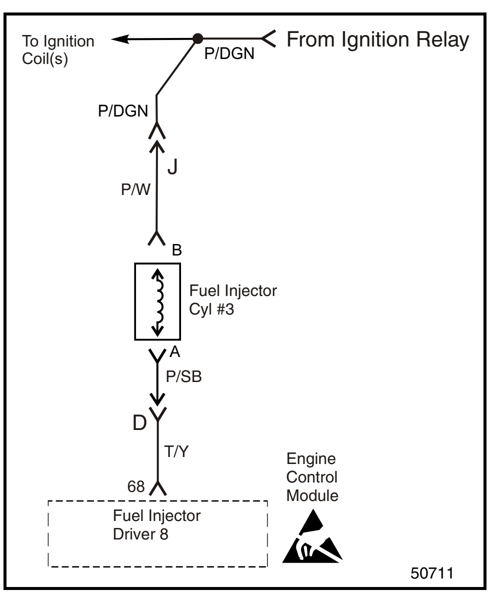
Diagnostic Aids

Performing a fuel injector coil test may help isolate an intermittent condition. If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

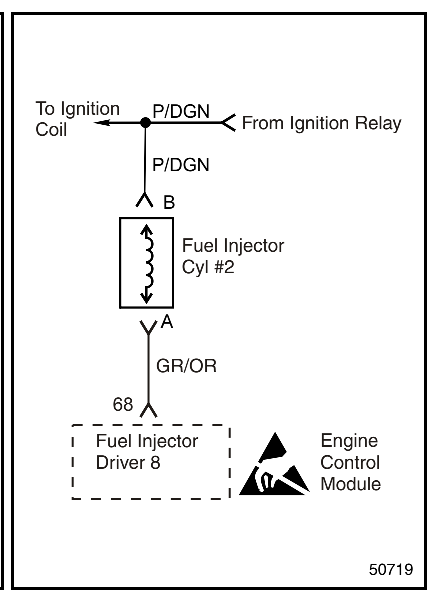
Conditions for Setting DTC

- Injector coil internally shorted or injector driver circuit shorted to voltage.
- Check condition - engine running.
- Fault condition-battery voltage at ECM less than 16 volts and injector low side less than 4 volts for 10 injector firings.
- MIL-on for active fault and for 5 seconds after active fault.

8.1 Liter



5.0 & 5.7 Liter



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0262

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Injector Coil for Intermittent

Key ON - engine running, diagnostic tool in ECM Data Mode. View "injector driver on voltage" for this injector. Is the voltage above 1 volt?

YES If voltage is above 1 volt, problem is active. **Go to *Check Injector for Open Coil* on this page**

NO If voltage is below 1 volt problem is intermittent. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NOTE: Injector drivers on the scan tool are in sequence. See *Injector driver sequence* page 121. for the corresponding cylinder number.

Check Injector for Shorted Coil

Key OFF. Disconnect harness connector from the #1 injector. Using a high impedance DVOM measure the resistance between pins on the injector. Does the DVOM display a resistance of 14 Ohms or more?

YES Go to *Check Injector Power Feed Circuit* **on this page**

NO Replace the injector.

Check Injector Short to Power

Key ON. Disconnect the # 1 injector. Measure voltage between the T/LBL wire at the injector and a good ground. Is voltage 0.5 volts or greater.

YES Circuit is shorted to voltage either in the harness or inside the ECM. Repair short in harness or replace ECM

NO Replace faulty injector or faulty ECM

DTC 0326 - Knock 1 Excessive Signal

SPN-731 FMI-2

Circuit Description

The ECM uses the Knock Sensors to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 0326 will set if either knock sensor output is greater than 4.5 volts and the MAP is less than 8 psi (16.288 in.Hg) and spark retard is at maximum.

Conditions For Setting DTC

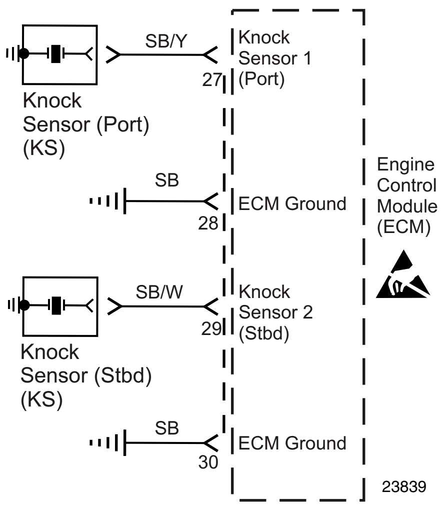
- Knock Sensor Open
- Check condition - Engine running under load
- Fault condition - Knock sensor 1 indicated excessive signal
- Corrective actions - illuminate MIL

Diagnostic Aids

Check for the following conditions:

9. Loose knock sensor in the engine block.

If the knock sensor wires are routed too close to the secondary ignition wire, the ECM may see the interference as an excessive knock signal, resulting in false timing retard and setting this DTC.



Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0326.

Verify condition

Drive boat under load while viewing KS average volts and knock intensity. When both increase greatly, disconnect #1 KS and briefly run boat to see if condition continues. Does knock sensor voltage still increase with #1 KS disconnected?

YES: Defective sensor, replace sensor.

NO: Go to *Check KS signal circuit* **on this page**

Check KS signal circuit

Key ON, Engine OFF. Run Mode ="Stopped". Using DVOM, check the voltage potential between knock 1 and Vbat. Is Voltage >80% of Vbat?

YES: Go to *Check ECM connector* **on this page**

NO: **Possible defective sensor, replace sensor or intermittent fault, *See Preliminary and Intermittent Checks*" on page 48" in Section 4**

Check ECM connector

Disconnect the wire harness connector at the ECM. Using a DVOM, check for continuity on pin 27 (SB/Y wire) and the knock sensor connector. Do you have continuity?

YES: Replace ECM

NO: Faulty wiring harness, repair wiring as necessary

DTC 0327 - Knock Sensor 1 Open

SPN-731 FMI-4

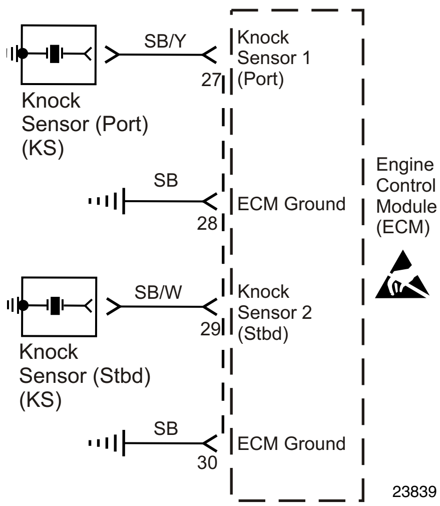
Circuit Description

The ECM uses the Knock Sensors to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM.

Knock Sensor input is monitored for DTCs with the engine at normal operating temperature, engine speed above 3000 RPM, and throttle open (10 psi MAP or above). Once this criteria is met it will take 3 seconds for the DTC to set

10. DTC 0327 will set only if the ECM does not see any activity on the KS circuit.

Diagnostic Aids



Check for the following conditions:

1. Poor connection a the ECM
   - Open signal or KS ground circuits.
   - Circuit resistance.
   - Inspect the harness connections for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection or corrosion.
2. Damaged harness
   - Inspect the wiring harness for damage
3. Non functioning knock sensor
4. Loose or improperly mounted knock sensor in the engine block.
5. Poor connection at the knock sensor.

Troubleshooting

Check code is valid and active

Drive boat under load while viewing KS average volts and knock intensity. Does knock sensor voltage increase?

YES: **Intermittent problem, See *Preliminary and Intermittent Checks*" on page 48" in Section 4**

NO: Go to *Check KS signal circuit for damage* **on this page**

Check KS signal circuit for damage

Check the Knock Sensor signal circuit for any damaged, corroded or contaminated terminals. Was a problem found?

YES: Repair wiring as necessary.

NO: Go to *Check KS circuit continuity* **on this page**

Check KS circuit continuity

Disconnect ECM connector. Using DVOM, check continuity between ECM connector terminal 27 and terminal 28. Is there continuity?

YES: Repair wiring as necessary.

NO: Go to *Check Knock Sensor* **on this page**

Check Knock Sensor

Remove Knock Sensor from engine. Using a DVOM set for AC volts, connect one test lead to the Knock Sensor output terminal. Hold the other lead to the mounting threads. Use a small piece of metal e.g. a bolt or similar metal object, lightly tap on the threaded end of the Knock Sensor. Does the Knock Sensor produce any AC voltage?

YES: Replace ECM

NO: Replace Knock Sensor

DTC 0331 - Knock 2 Excessive Signal

SPN-731 FMI-2

Circuit Description

The ECM uses the Knock Sensors to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 0331 will set if either knock sensor output is greater than 4.5 volts and the MAP is less than 8 psi (16.288 in.Hg) and spark retard is at maximum.

Conditions For Setting DTC

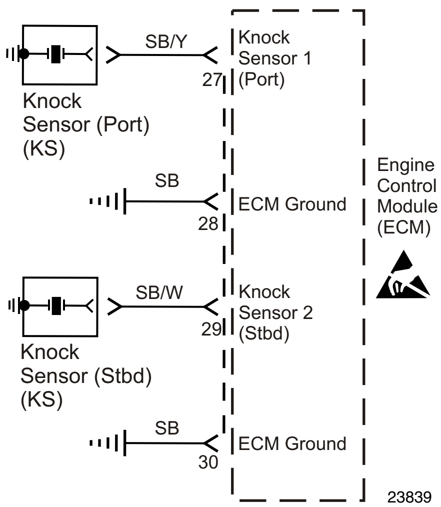
- Knock Sensor Open
- Check condition - Engine ON
- Fault condition - Knock sensor 2 indicated excessive signal
- Corrective actions - illuminate MIL

Diagnostic Aids

Check for the following conditions:

6. Loose knock sensor in the engine block.

If the knock sensor wires are routed too close to the secondary ignition wire, the ECM may see the interference as an excessive knock signal, resulting in false timing retard and setting this DTC.



Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0326.

Verify condition

Drive boat under load while viewing KS average volts and knock intensity. When both increase greatly, disconnect #2 KS and briefly run boat to see if condition continues. Does knock sensor voltage still increase with #2 KS disconnected?

YES: Defective sensor, replace sensor.

YES: Go to *Check KS signal circuit* **on this page**

Check KS signal circuit

Key ON, Engine OFF. Run Mode ="Stopped". Using DVOM, check the voltage potential between knock 2 and Vbat. Is Voltage >80% of Vbat?

YES: Go to *Check ECM connector* **on this page**

NO: Possible defective sensor, replace sensor or intermittent fault, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

Check ECM connector

Disconnect the wire harness connector at the ECM. Using a DVOM, check for continuity on pin 29 (SB/W wire) and the knock sensor connector. Do you have continuity?

YES: Replace ECM

NO: Faulty wiring harness, repair as necessary

DTC 0332 - Knock Sensor 2 Open

SPN-520197 FMI-4

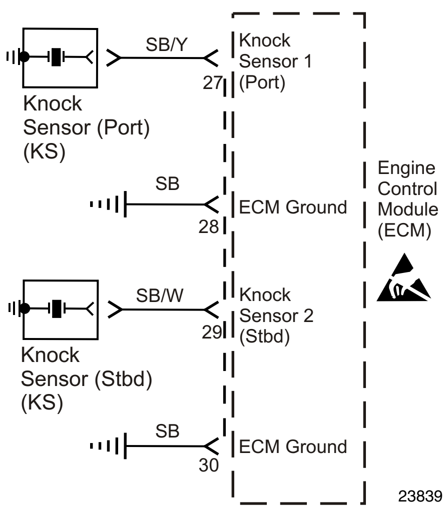
Circuit Description

The ECM uses the Knock Sensors to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM.

Knock Sensor input is monitored for DTCs with the engine at normal operating temperature, engine speed above 3000 RPM, and throttle open (10 psi MAP or above). Once this criteria is met it will take 3 seconds for the DTC to set

Note: DTC 0332 will set only if the ECM does not see any activity on the KS circuit.

Diagnostic Aids



Check for the following conditions:

1. Poor connection a the ECM
   - Open signal or KS ground circuits.
   - Circuit resistance.
   - Inspect the harness connections for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection or corrosion.
2. Damaged harness
   - Inspect the wiring harness for damage
3. Non functioning knock sensor
4. Loose or improperly mounted knock sensor in the engine block.
5. Poor connection at the knock sensor.

Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0332

Check code is valid and active

Drive boat under load while viewing KS average volts and knock intensity. Does knock sensor voltage increase?

YES: Intermittent problem, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Go to *Check KS signal circuit for damage* **on this page**

Check KS signal circuit for damage

Check the Knock Sensor signal circuit for any damaged, corroded or contaminated terminals. Was a problem found?

YES: Repair circuit as necessary.

NO: Go to *Check KS circuit continuity* **on this page**

Check KS circuit continuity

Disconnect ECM connector. Using DVOM, check continuity between ECM connector terminal 27 and terminal 28. Is there continuity?

YES: Repair the circuit as necessary.

NO: Go to *Check Knock Sensor* **on this page**

Check Knock Sensor

Remove Knock Sensor from engine. Using a DVOM set for AC volts, connect one test lead to the Knock Sensor output terminal. Hold the other lead to the mounting threads. Use a small piece of metal e.g. a bolt or similar metal object, lightly tap on the threaded end of the Knock Sensor. Does the Knock Sensor produce any AC voltage?

YES: Replace ECM

NO: Replace Knock Sensor

DTC 0336 - Crank Sync Noise

SPN-636 FMI-2

Circuit Description

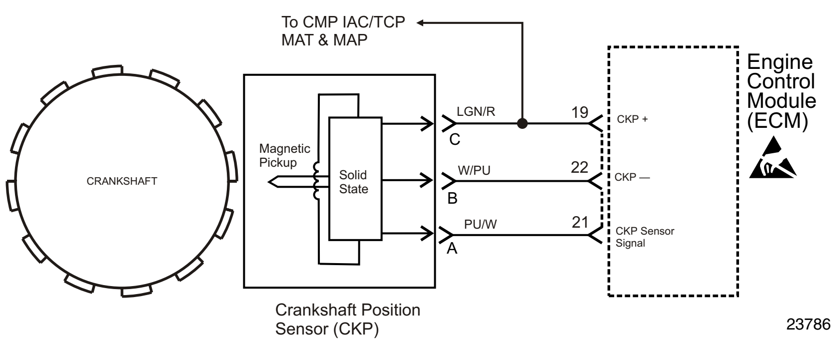
The crankshaft position sensor (CKP) is a magnetic transducer mounted on the engine block adjacent to a pulse wheel located on the crankshaft. It determines crankshaft position by monitoring the pulse wheel. The crankshaft position sensor is used to measure engine RPM and it is used in conjunction with the cam sensor (CMP) to synchronize the ignition system and fuel injectors.

The CKP sensor works in conjunction with a reluctor wheel. The CKP sensor has a 5 volt reference signal from the ECM, a ground circuit and a signal circuit. As the crankshaft rotates, the reluctor wheel teeth interrupt a magnetic field produced by a magnet within the sensor. The sensor's internal circuitry detects this and produces a 5 volt square wave which the ECM reads. The ECM uses this signal to accurately measure crankshaft velocity and piston location which is a variable used in order to control spark and fuel injection quantity and injection timing.

The crankshaft position sensor (CKP) is used to measure engine RPM and its signal is used to synchronize the ignition and fuel systems. The ECM must see a valid crankshaft position signal while running. If no signal is present for 800 ms or longer, this fault will set.

Conditions for setting the DTC

- Crankshaft position sensor.
- Check condition - engine running.
- Fault condition - 1 invalid crank re-sync.
- MIL - on during active fault and for 10 seconds after active fault.



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0336.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Wiring

Check the wiring and electrical connections between the ECM and the crankshaft position sensor. Check the CKP sensor wire routing is not in close proximity to secondary ignition leads. Is the wiring OK?

YES Check the following components are functioning properly; system ground, crankshaft sensor, crankshaft trigger wheel and ECM

NO Repair wiring harness.

DTC 0337 - Crankshaft Sensor Loss

SPN-636 FMI-4

Circuit Description

The CKP sensor works in conjunction with a 24X reluctor wheel for 8.1 engines, 4X reluctor wheel for 5.0 and 5.7 engines and 3X for 4.3 engines. The CKP sensor has a 5 volt reference power supply, a ground reference and a signal circuit.

As the crankshaft rotates, the reluctor wheel interrupts a magnetic field produced by a magnet within the sensor. The sensor's internal circuitry detects this and produces a signal which the ECM reads. The ECM uses this signal to accurately measure crankshaft velocity which is a variable used in order to detect misfire, and control spark and fuel.

Diagnostic Aids

Check for the following conditions:

1. Poor connection in harness; inspect the harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
2. Crankshaft reluctor wheel damaged or improper installation.
3. Excessive air gap between the CKP sensor and the reluctor.
4. Excessive crankshaft end play.
   - Excessive crankshaft end play causes the CKP sensor reluctor wheel to move out of alignment with the CKP sensor. This could result in any one of the following conditions.

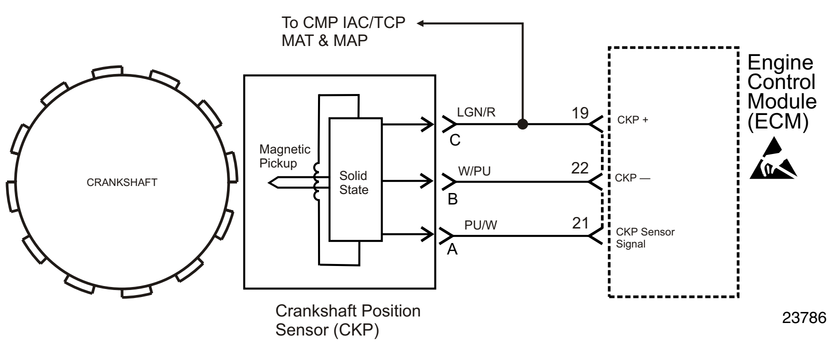
     —A no start

     —A start and stall

     —Erratic performance

Conditions for setting the DTC

- Crankshaft position sensor.
- Check condition - engine running.
- MIL - on during active fault and for 10 seconds after active fault.



Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0337

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check ECM Ground

Check that the ECM ground terminals are clean and tight. Are the ground terminals clean and tight.

YES Go to *Check CKP 5V Ref Circuit* **on this page**

NO Repair circuit as necessary

Check CKP 5V Ref Circuit

Key ON and engine OFF. Disconnect the CMP sensor connector. Using a DVOM, check for voltage at the CKP sensor connector pin A and engine ground. Do you have voltage?

YES Go to *Check CKP Ground Circuit* **on this page**

NO Repair circuit as necessary.

Check CKP Ground Circuit

Key OFF. Disconnect ECM connector. Using a DVOM, check for continuity between CKP connector pin C and ECM connector pin 21. Do you have continuity between them?

YES Go to *Check CKP Signal Circuit* **on this page**

NO Repair circuit as necessary.

Check CKP Signal Circuit

Using a DVOM, check for continuity between CKP connector pin B and ECM connector pin 22. Do you have continuity between them?

YES Go to *Check CKP Connector* **on this page**

NO Repair circuit as necessary.

Check CKP Connector

Inspect the CKP connector terminals for damage, corrosion or contamination. Is the connector damaged?

YES Repair connector or replace wiring harness as necessary.

NO Go to *Check ECM Connector* **on this page**

Check ECM Connector

Inspect the ECM connector terminals 21, 22, and 20 for damage, corrosion or contamination. Is the ECM connector damaged, corroded or contaminated?

YES Repair connector or replace wiring harness as necessary.

NO Go to *Check Crankshaft Position Sensor* **on this page**

Check Crankshaft Position Sensor

Place an DVOM set to Ohms across terminals B and C of the CKP sensor. The reading should be open (infinite resistance). Replace sensor if resistance is indicated.

DTC 0341 - Camshaft Sensor Noise

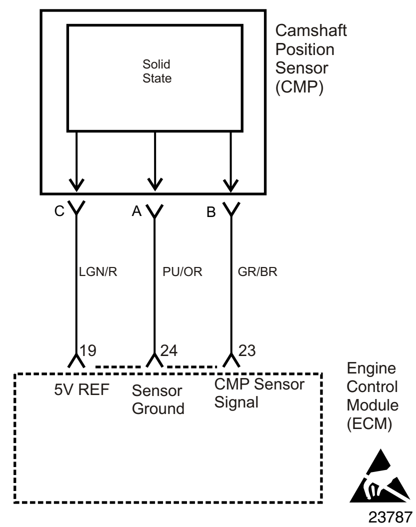
SPN-723 FMI-2

Circuit Description

The camshaft position sensor (CMP) is used to synchronize the fuel and ignition systems. This fault will set if the ECM detects erroneous pulses from the camshaft position sensor (CMP) causing invalid cam re-sync.

Conditions for setting the DTC

- Camshaft position sensor.
- Check condition - engine cranking or running.
- Fault condition - one invalid cam re-sync.
- MIL - on for active fault and for 10 seconds after active fault.



Troubleshooting

The following items should be checked in sequence when diagnosing DTC-0341.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check CMP wire routing

Check the CMP sensor wire routing is not in close proximity to secondary ignition leads. Did you find a problem?

YES: Reroute any secondary wires away from CMP circuit wires.

NO: Go to *Check ECM ground* **on this page**

Check ECM ground

Check that the ECM ground terminals are clean and tight. Are the ground terminals clean and tight?

YES: Go to *Check CMP V REF* **on this page**

NO: Clean and tighten ground terminals.

Check CMP V REF

Key ON and engine OFF. Disconnect the CMP sensor connector. Using a DVOM, check for voltage at the CMP sensor connector pin A and engine ground. Do you have voltage?

YES: Go to *Check CMP ground circuit wire* **on this page**

NO: Repair wiring as necessary.

Check CMP ground circuit wire

Key OFF. Disconnect ECM connector. Using a DVOM, check for continuity between CMP connector pin B and ECM connector pin 24. Do you have continuity between them?

YES: Go to *Check CMP signal circuit wire* **on this page**

NO: Repair wiring as required.

Check CMP signal circuit wire

Using a DVOM, check for continuity between CMP connector pin C and ECM connector pin 23. Do you have continuity between them?

YES: Go to *Check CMP connector* **on this page**

NO: Repair wiring as required.

Check CMP connector

Inspect the CMP connector terminals for damage, corrosion or contamination. Did you find a problem?

YES: Repair wiring as required.

NO: Go to *Check ECM connector for damage* **on this page**

Check ECM connector for damage

Inspect the ECM connector terminals 23, 24, and 19 for damage, corrosion or contamination. Did you find a problem?

YES: Repair or replace wiring harness as required.

NO: Replace CMP sensor. Pay special attention to the CMP sensor reluctor wheel inspection. Check the wiring and electrical connections between the ECM and the camshaft position sensor.

DTC 0342 - Camshaft Sensor Loss

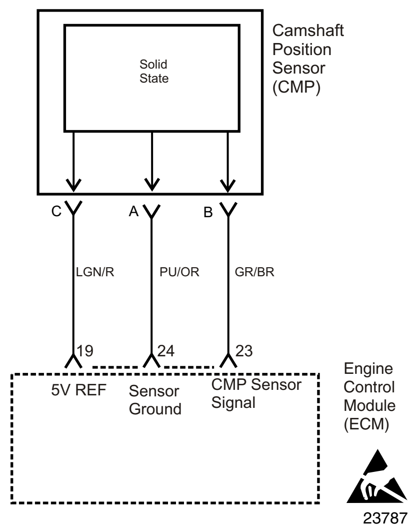
SPN-723 FMI-4

Circuit Description

The camshaft position sensor (CMP) is used to synchronize the fuel and ignition systems. This fault will set if the ECM does not detect a cam pulse in 3 engine cycles whenever the engine is cranking or running. The engine will not run with this fault present.

Conditions for setting the DTC

- Camshaft position sensor.
- Check condition - engine cranking or running.
- Fault condition - no cam pulse in 3 engine cycles.
- MIL - on for active fault and for 10 seconds after active fault.



Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0342

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check ECM Ground

Check that the ECM ground terminals are clean and tight. Are the ground terminals clean and tight.

YES Go to *Check CKP 5V Ref Circuit* **on this page**

NO Repair as necessary

Check CMP 5V Ref Circuit

Key ON and engine OFF. Disconnect the CMP sensor connector. Using a DVOM, check for voltage at the CMP sensor connector pin A and engine ground. Do you have voltage?

YES Go to *Check CKP Ground Circuit* **on this page**

NO Repair circuit as necessary.

Check CMP Ground Circuit

Key ON. Disconnect ECM connector. Measure voltage between pin A (5v Ref #1) and pin B (CMP ground). Does the voltmeter read 5 volts?

YES Go to *Check CKP Signal Circuit* **on this page**

NO Open ground, repair circuit as necessary.

Check CMP Signal Circuit

Disconnect ECM. Using a DVOM, check for continuity between Pin C and pins 20, 50, 69 and 81. Do you have continuity between pin C and any of the other pins?

YES Go to *Check CKP Connector* **on this page**

NO Circuit shorted, repair circuit as necessary.

Check CMP Connector

Inspect the CMP connector terminals for damage, corrosion or contamination. Is the connector damaged?

YES Repair connector or replace wiring harness as necessary.

NO Go to *Check ECM Connector* **on this page**

Check ECM Connector

Inspect the ECM connector terminals 23, 22, and 20 for damage, corrosion or contamination. Is the ECM connector damaged, corroded or contaminated?

YES Repair connector or replace wiring harness as necessary.

NO Replace Camshaft sensor.

DTC 0508 - IAC Ground Short

SPN-520201 FMI-6

Circuit Description

The ECM controls idle speed to a calibrated desired RPM based on sensor inputs and actual engine RPM. The ECM uses four 2 circuits (A and B) with 4 wires to move the Idle Air Control (IAC) valve. The movement of the IAC valve varies the amount of air flow bypassing the throttle plates. The ECM controls idle speed by determining the position of the IAC valve.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness. Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Check for vacuum leaks, disconnected or brittle vacuum hoses, cuts, etc. Examine manifold and throttle body gaskets for proper seal. Check for cracked intake manifold.
- Check for poor connections, opens or short to grounds in circuits 5, 6, 82, and 83. This may result in improper idle control.
- An IAC valve which is “frozen” and will not respond to the ECM, a throttle stop screw which has been tampered with, or a damaged throttle body or linkage may cause improper idle.

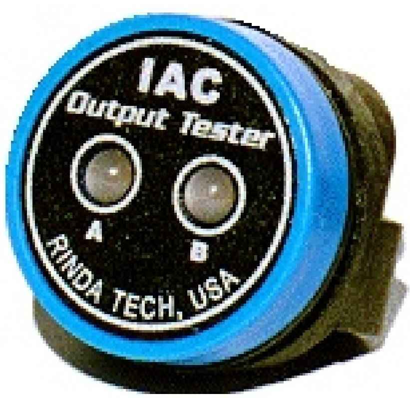
Rinda IAC signal tester P/N 94016 available from Rinda Technologies, www.rinda.com,

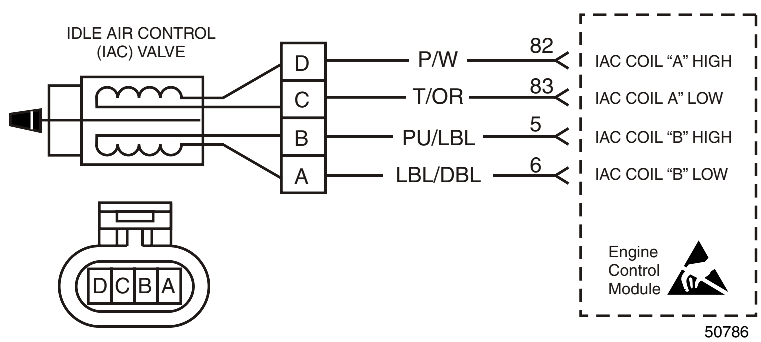
Rinda Technologies Inc.

4563 N. Elston Ave.

Chicago, IL 60630

Tel: 773-736-6633





Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0508

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

⚠ **Caution! Always connect water to the engine before starting. Running the engine without water can damage the water pump or engine.**

Test IAC valve

Ignition OFF for 10 seconds. Disconnect IAC harness connector Restart the engine and record the RPM Is the RPM higher than the first recorded RPM by more than 200 RPM?

YES: Go to *Confirm IAC valve test* **on this page**

NO: Go to *Check IAC circuit.* **on this page**

Confirm IAC valve test

Reinstall the IAC harness connector. Does the idle speed return within 75 RPM of the original recorded RPM within 30 seconds?

YES: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NO: Go to *Check IAC circuit.* **on this page**

Check IAC circuit.

Ignition OFF for 10 seconds. Disconnect IAC harness connector. Connect Rinda IAC tester P/N 94016 to IAC wiring harness connector. Key ON, engine OFF. Does the tester indicate the output for both drivers are good?

YES: Replace IAC valve

NO: Go to *Check IAC circuit for grounding* **on this page**

Check IAC circuit for grounding

Engine OFF. Disconnect ECM connector. With IAC disconnected, use a DVOM to check for continuity between the IAC connector pins and a known good engine ground. Do any of the circuits have continuity?

YES: Repair circuit as necessary

NO: Replace ECM

DTC 0509 - IAC Coil Open/Short

SPN-520201 FMI-5

Circuit Description

The ECM controls idle speed to a calibrated desired RPM based on sensor inputs and actual engine RPM. The ECM uses four 2 circuits (A and B) with 4 wires to move the Idle Air Control (IAC) valve. The movement of the IAC valve varies the amount of air flow bypassing the throttle plates. The ECM controls idle speed by determining the position of the IAC valve.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness. Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Check for vacuum leaks, disconnected or brittle vacuum hoses, cuts, etc. Examine manifold and throttle body gaskets for proper seal. Check for cracked intake manifold.
- Check for poor connections, opens or short to grounds in circuits 5, 6, 82, and 83. This may result in improper idle control.
- An IAC valve which is “frozen” and will not respond to the ECM, a throttle stop screw which has been tampered with, or a damaged throttle body or linkage may cause improper idle.

Rinda IAC signal tester P/N 94016 available from Rinda Technologies, www.rinda.com,

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4563 N. Elston Ave.

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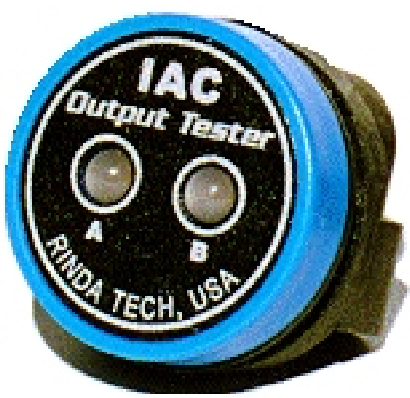
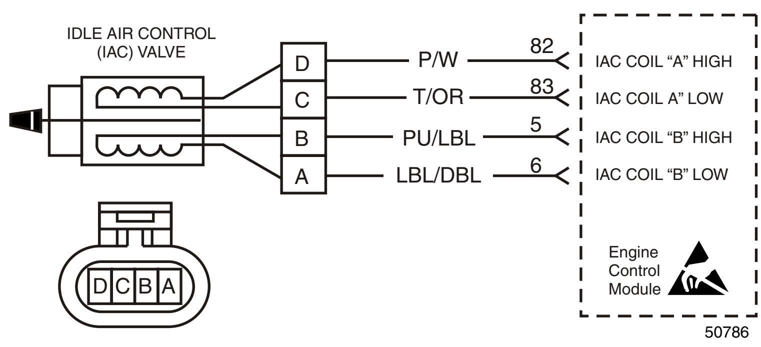




Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Test IAC valve

Ignition OFF for 10 seconds. Disconnect IAC harness connector Restart the engine and record the RPM Is the RPM higher than the first recorded RPM by more than 200 RPM?

YES: Go to *Confirm IAC valve test* **on this page**

NO: Go to *Check IAC circuit.* **on this page**

Confirm IAC valve test

Reinstall the IAC harness connector. Does the idle speed return within 75 RPM of the original recorded RPM within 30 seconds?

YES: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NO: Go to *Check IAC circuit.* **on this page**

Check IAC circuit.

Disconnect the ECM connector. Key ON. With a voltmeter connected to a good ground, check all IAC circuits at the IAC connector for voltage. Does the tester indicate voltage?

YES: Replace engine harness

NO: Replace ECM and retest.

DTC 0522 - Oil Pressure Sender Low Voltage

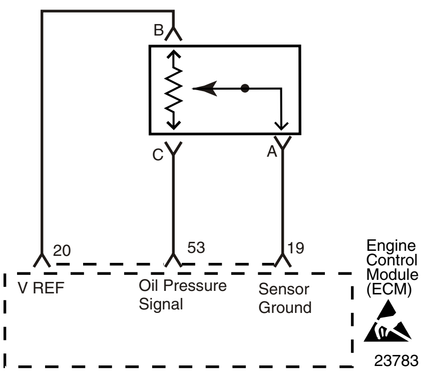
SPN-100 FMI-4

Circuit Description

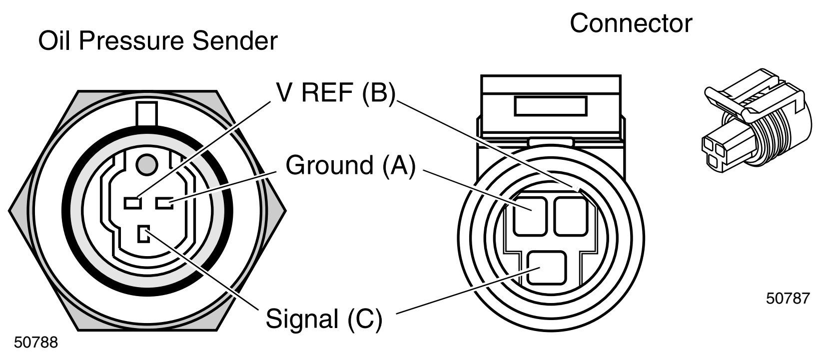
The oil pressure sensor is used to communicate a low oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM uses an analog voltage input with an internal 5-volt reference. If the oil pressure circuit is grounded, the input voltage will be near zero. If it is open, the input will be near 5 volts. Low OPS voltage is equal to low oil pressure. High OPS voltage is equal to high oil pressure. The ECM will turn on the alarm to alert the operator in the event of this fault to help prevent possible damage.

An oil pressure sender low voltage fault will set if the sensor voltage is less than 0.2 volts longer than 2 seconds. Conditions that will normally cause this code are a shorted or partially shorted 5-volt reference circuit, and/or a shorted oil pressure sensor signal wire to ground.

Conditions for setting the DTC



- Engine oil pressure sender voltage low.
- Check condition - stopped, sender reference less than 0.2 volts.
- Fault condition - shorted circuit/voltage low.
- MIL - on during active fault and for 3 seconds after active fault.
- Soft Warning - on during active fault.



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check OPS voltage

Key ON, Engine OFF. Diagnostic tool connected in oil pressure voltage mode. Observe OPS voltage. Does the diagnostic tool display OPS voltage of 0.2 volts or less?

YES: **Go to *Check OPS sensor* on this page**

NO: Problem is intermittent, **See *Preliminary and Intermittent Checks*" on page 48" in Section 4**

Check OPS sensor

Key ON. Disconnect the OPS wiring harness connector at the oil pressure sensor. Measure voltage between the V REF (pin-B) feed at the OPS connector and a known good engine ground. Does the diagnostic tool display OPS voltage of approximately 5 volts?

YES: OPS sensor shorted internally, replace OPS sensor.

NO: Go to *Check OPS signal circuit* **on this page.**

Check OPS signal circuit

Using DVOM, check for continuity between the OPS signal wire and a known good engine ground. Do you have continuity?

YES: Signal circuit shorted to ground, repair circuit as necessary.

NO: ECM not functioning properly, replace ECM

DTC 0523 - Oil Pressure Sender High Voltage

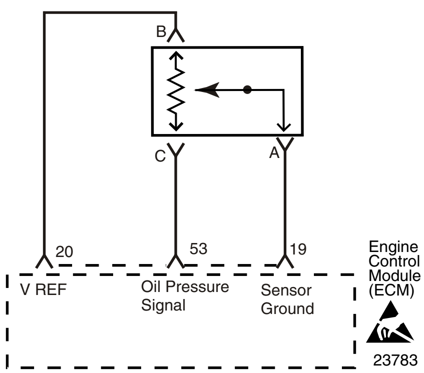
SPN-100 FMI-3

Circuit Description

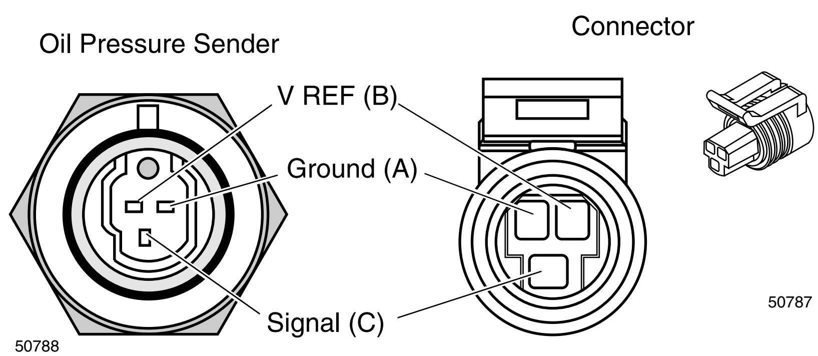
The oil pressure sensor is used to communicate a low oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM uses an analog voltage input with an internal 5-volt reference. If the oil pressure circuit is grounded, the input voltage will be near zero. If it is open, the input will be near 5 volts. Low OPS voltage is equal to low oil pressure. High OPS voltage is equal to high oil pressure. The ECM will turn on the alarm to alert the operator in the event of this fault to help prevent possible damage.

An oil pressure sender high voltage fault will set if the sensor voltage exceeds 4.8 volts longer than 2 seconds. This is usually a result of an open signal circuit in the OPS, or an open ground circuit. This code will be accompanied by 112 psi oil pressure reading on the oil pressure gage key ON engine OFF.

Conditions for setting the DTC



- Engine oil pressure sender voltage high.
- Check condition - sender reference greater than 4.8 volts.
- Fault condition - open circuit/voltage high.
- MIL - on during active fault and for 3 seconds after active fault.
- Soft Warning - on during active fault



Troubleshooting.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*” on page 48” in Section 4.

Check OPS circuit voltage

Key ON, Engine OFF. diagnostic tool connected in Oil Pressure Volts mode. Observe OPS voltage. Does the diagnostic tool display OPS voltages of 4.8 volts or more?

YES: Go to *Check OPS V REF circuit* **on this page**

NO: Problem is intermittent, **See *Preliminary and Intermittent Checks*” on page 48” in Section 4**

Check OPS V REF circuit

Key ON. Using a DVOM set to DC volts, measure the voltage between the OPS signal wire at the OPS connector (pin-B) and a known good engine ground. Do you have voltage?

YES: Go to *Check OPS signal circuit for open* **on this page**

NO:

Check OPS signal circuit for open

Key ON, using a fused jumper wire connect the OPS signal wire to the sensor ground circuit in the OPS connector. View OPS voltage on the scan tool. Did the voltage drop to 0?

YES: Replace OPS sensor

NO: **Repair circuit as necessary.**

Check OPS V REF for continuity

Key OFF, disconnect ECM. Using DVOM, check continuity between OPS V REF terminal at the OPS connector and (pin-53) on the ECM connector. Do you have continuity?

YES: Replace ECM

NO: Repair wiring as necessary

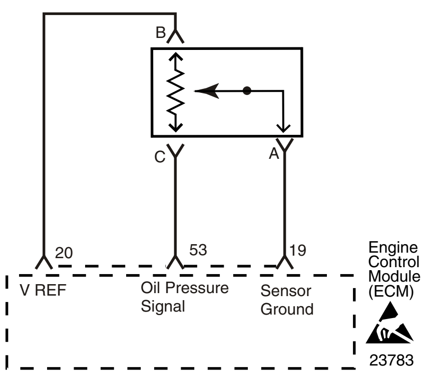
DTC 0524 - Low Oil Pressure

SPN-100 FMI-1

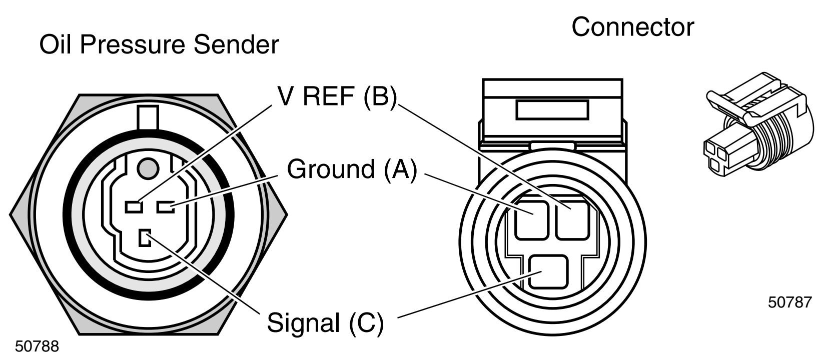
Circuit Description

The oil pressure sensor is used to communicate a low oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM uses an analog voltage input with an internal 5-volt reference. If the oil pressure circuit is grounded, the input voltage will be near zero. If it is open, the input will be near 5 volts. Low OPS voltage is equal to low oil pressure. High OPS voltage is equal to high oil pressure. The ECM will turn on the alarm to alert the operator in the event of this fault to help prevent possible damage.

Conditions for setting the DTC



- Check condition - engine running for 30 seconds and engine speed is greater than 550 RPM.
- Fault condition - Engine oil pressure below 5 psi for 30 seconds or longer.
- MIL - on during active fault and for 3 seconds after active fault.
- 8.1 Engines - Low rev limit
- All other engines - Power Derate 2.



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Verify oil pressure

Verify the engine has adequate oil pressure with a mechanical pressure gauge before proceeding.Does the engine have low oil pressure?

YES: Repair the faulty lubricating system.

NO: Go to *Check OPS sensor* on this page

Check OPS sensor

Key ON, Engine ON. Diagnostic tool connected in Oil Pressure psi mode. Slowly increase engine RPM to 1000 while observing oil pressure. Does the diagnostic tool display OPS of 5 psi or less?

YES: Go to *Check OPS Circuit* **on this page.**

NO: Problem is intermittent. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4.**

Check OPS Circuit

Disconnect OPS sensor and check connector for corrosion at the V REF (pin B). If none found then view OPS voltage with the scan tool. Does the OPS voltage read above 4.5 volts?

YES: Replace OPS sensor

NO: Go to *Check for signal circuit for partial short to ground* **on this page**

Check for signal circuit for partial short to ground

Key OFF. Disconnect ECM connector. Using DVOM, check continuity between OPS connector signal pin C and ECM connector pin 20, 50 and 69. Do you have continuity?

YES: Repair the circuit that has continuity.

NO: Replace ECM

DTC 0562 - System Voltage Low

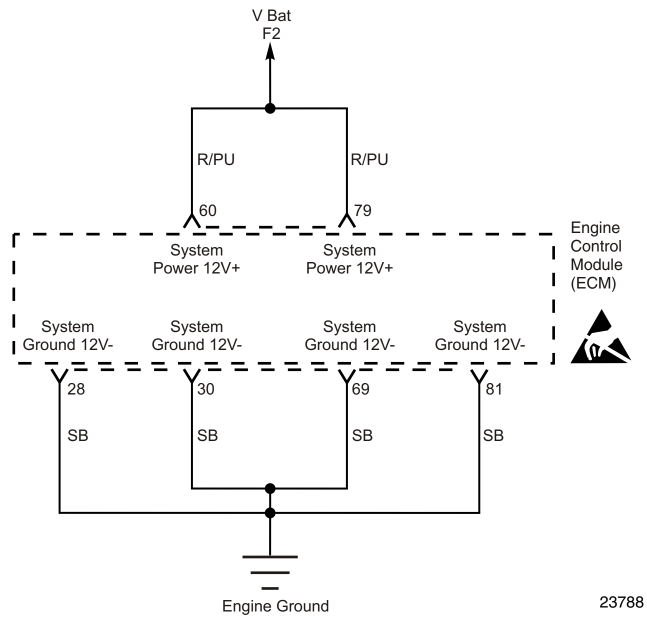
SPN-168 FMI-17

Circuit Description

The battery voltage powers the ECM and must be measured to correctly operate injector drivers, fuel trim valves and ignition coils. This fault will set if the ECM detects system voltage less than 11.0 volts for 30 seconds or longer while the alternator should be charging.

Conditions for setting the DTC

- System voltage to ECM.
- Check condition - key ON and engine speed greater than 500 RPM.
- Fault condition - battery voltage at ECM less than 11.0 volts continuously for 30 seconds.
- MIL - on for active fault and for 10 seconds after active fault.



Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0562

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check battery power output to ECM

Key On engine running. Diagnostic tool connected in ECM Data Mode. Does diagnostic tool display system voltage greater than 11.0 volts?

YES: Go to *Check ECM power circuits* on this page

NO: Repair charging problem.

Check ECM power circuits

Back probe ECM connector pins 60 and 79. Measure voltage with DVOM between each pin and engine ground. Is the voltage greater than 11.0 volts?

YES: Go to *Check ECM grounds* **on this page**

NO: Repair ECM power circuit. Refer to engine wiring diagrams for the model engine being serviced.

Check ECM grounds

Back probe ECM connector pins 28, 30, 69, and 81. Measure voltage with DVOM between each pin and battery voltage. Is the voltage greater than 11.0 volts?

YES: Intermittent problem, Check battery and engine and ECM-grounds. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NO: Repair ECM ground circuit. Refer to engine wiring diagrams for the model engine being serviced.

DTC 0563 - System Voltage High

SPN-168 FMI-15

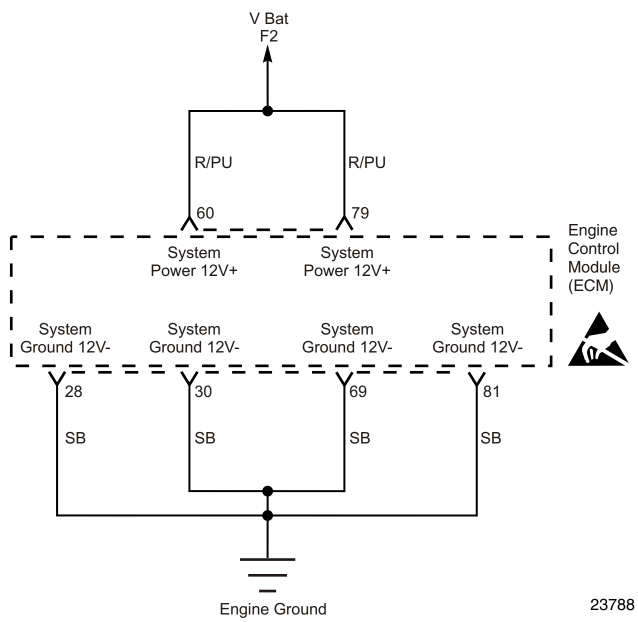
Circuit Description

The battery voltage powers the ECM and must be measured to correctly operate injector drivers, trim valves and ignition coils.

This fault will set if the ECM detects voltage greater than 16 volts for 3 seconds at anytime the engine is cranking or running. The ECM will shut down with internal protection if the system voltage exceeds 26 volts. The ECM fuse will then open.

Conditions for setting the DTC

- System voltage to ECM.
- Check condition - cranking or running.
- Fault condition - switched battery voltage at ECM greater than 16 volts for 3 seconds.
- MIL - on for active fault and for 5 seconds after active fault.



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check system voltage

Key ON engine running. Diagnostic tool connected in ECM Data Mode. Run engine greater than 1500 RPM. Does the diagnostic tool display voltage greater than 16 volts?

YES: Repair charging system problem. Refer to the "*Electrical, Carburetor, and Ignition Workshop Manual"* for further diagnostic information on the charging system.

NO: Go to *Check voltage at the battery* on this page

Check voltage at the battery

Check voltage at battery terminals with DVOM, with engine speed greater than 1500 RPM. Is it greater than 16 volts?

YES: Repair the charging system. Refer to the "Electrical, Carburetor, and Ignition Workshop Manual" for further diagnostic information on the charging system.

NO: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

DTC 0601 - Flash Checksum Invalid

SPN-628 FMI-13

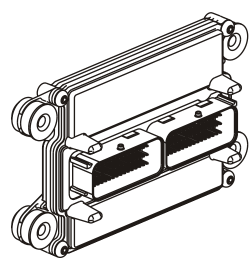
Circuit Description

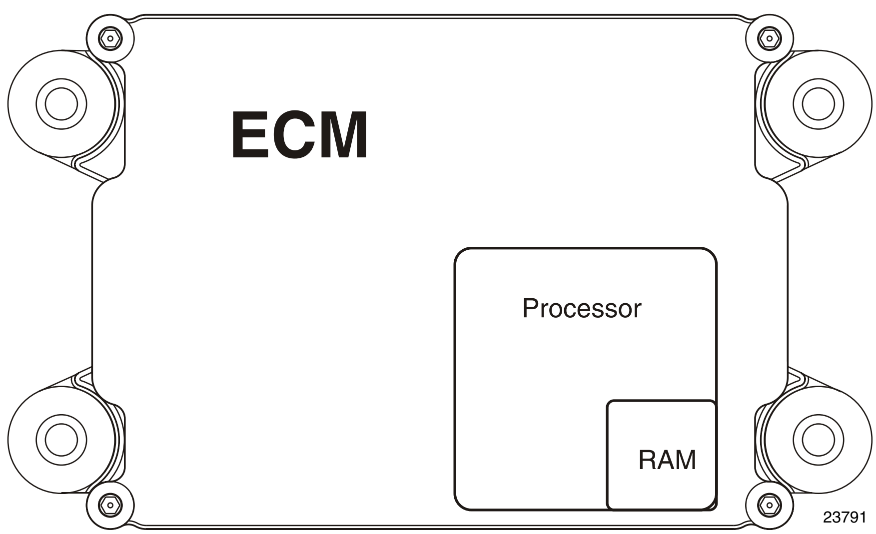
The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, power derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 30 percent on electronic throttle engines. On IAC engines, the RPM is limited to 2500 RPM. This is enforced until the fault is manually cleared.

Conditions for setting the DTC

- Electronic control module.
- Check condition - key ON.
- Fault condition - internal microprocessor error.
- MIL - on until code is cleared by technician.
- Power derate - level 2 until fault is cleared manually.





Troubleshooting.

Verify Code

Key ON and engine running. Diagnostic tool connected in ECM data mode. Clear fault codea. Does DTC 0601 reoccur with the engine idling?

YES: Replace ECM

NO: Intermittent problem, Go to *Check Power and Grounds* on this page.

Check Power and Grounds

Check all ECM power and ground circuits. Refer to the Wiring Diagrams for the model engine being serviced. Are the power and ground circuits OK?

YES: Replace the ECM.

NO: Repair the circuit as necessary.

DTC 0604 - RAM Failure

SPN-630 FMI-12

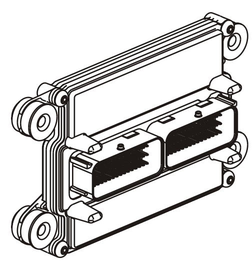
Circuit Description

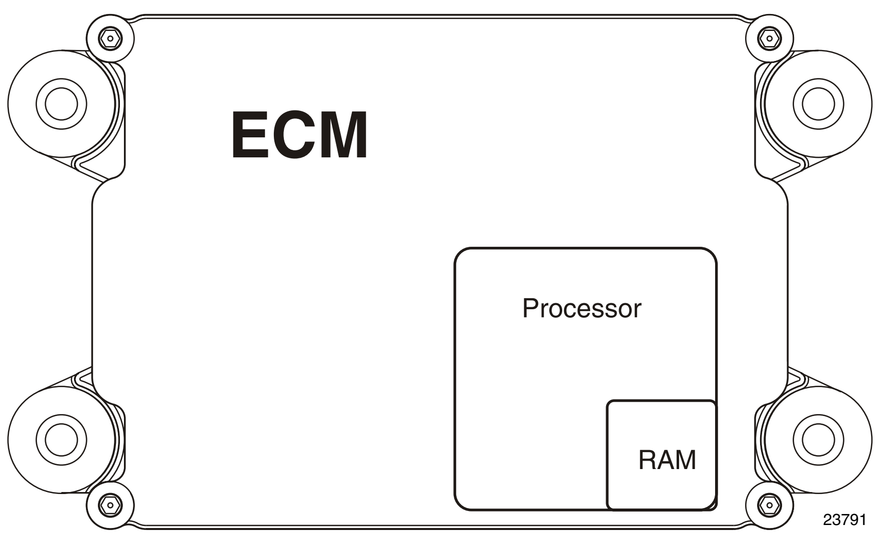
Random access memory (RAM) is located within the microprocessor that can be read from or written to at any time. The system fault codes and the adaptive learn table are among the data stored in RAM.

During this active fault, power derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 30 percent on electronic throttle engines. On IAC engines, the RPM is limited to 2500 RPM. This is enforced until the fault is manually cleared.

Conditions for setting the DTC

- Random access memory.
- Check condition - key ON.
- Fault condition - internal ECM memory access failure.
- MIL - on until fault is cleared.
- Power derate - level 2 enforced.





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Troubleshooting.

Verify Code

Key ON and engine running. Diagnostic tool connected in ECM data mode. Clear fault codea. Does DTC 0604 reoccur with the engine idling?

YES: Replace ECM

NO: Intermittent problem, Go to *Check Power and Grounds* on this page.

Check Power and Grounds

Check all ECM power and ground circuits. Refer to the Wiring Diagrams for the model engine being serviced. Are the power and ground circuits OK?

YES: Replace the ECM.

NO: Repair the circuit as necessary.

DTC 0606 - COP Failure

SPN-629 FMI-31

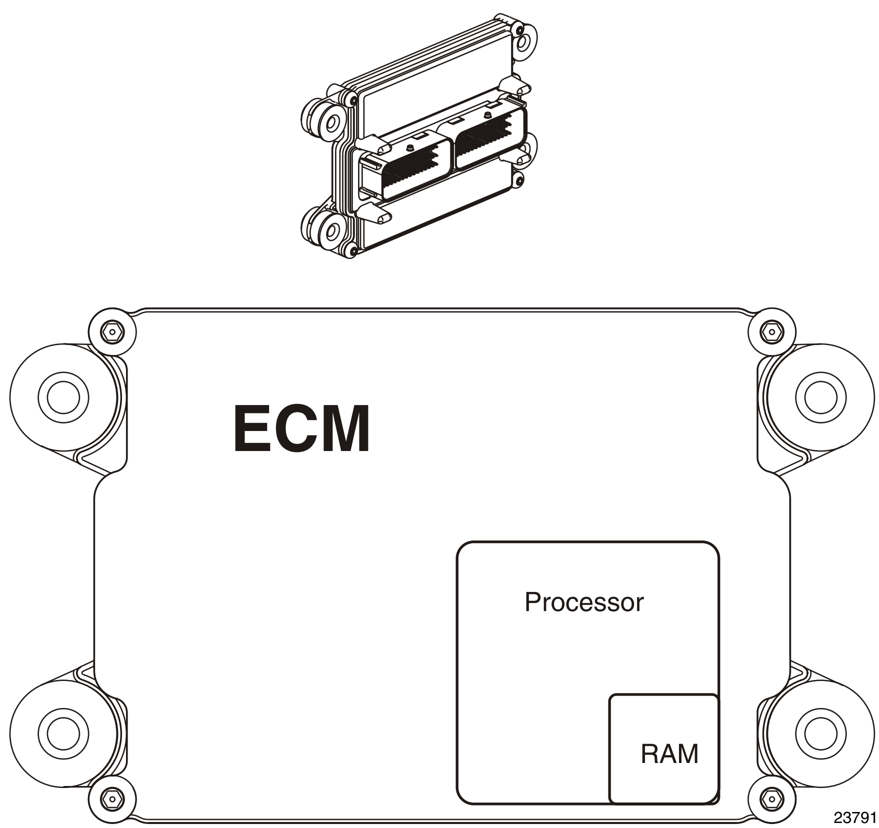
Circuit Description

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared.

During this active fault, power derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 30 percent on electronic throttle engines. On IAC engines, the RPM is limited to 2500 RPM. This is enforced until the fault is manually cleared.

Conditions for setting the DTC

- Electronic control module.
- Check condition - key ON.
- Fault condition - internal microprocessor error.
- MIL - on until code is cleared by technician.
- Power derate - level 2 until fault is cleared manually.



Troubleshooting.

Verify Code

Key ON and engine running. Diagnostic tool connected in ECM data mode. Clear fault codea. Does DTC 0606 reoccur with the engine idling?

YES: Replace ECM

NO: Intermittent problem, Go to *Check Power and Grounds* on this page.

Check Power and Grounds

Check all ECM power and ground circuits. Refer to the Wiring Diagrams for the model engine being serviced. Are the power and ground circuits OK?

YES: Replace the ECM.

NO: Repair the circuit as necessary.

DTC 0627 - Fuel Pump Relay Coil Open

SPN-1348 FMI-5

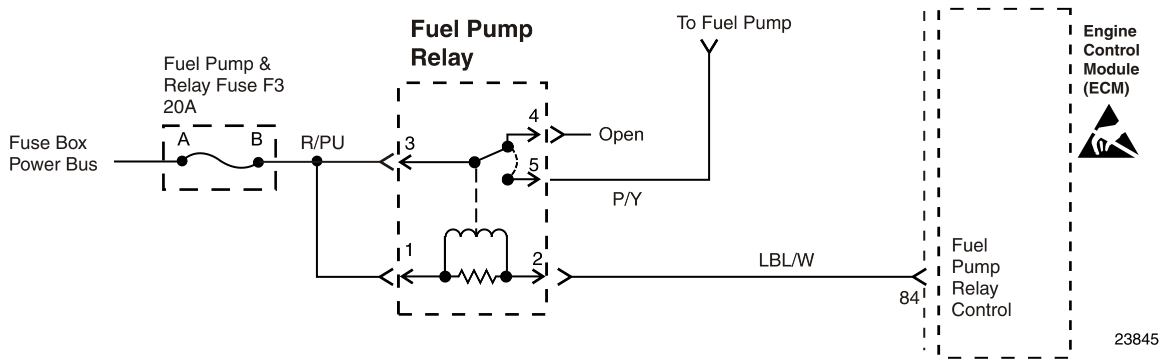
Circuit Description

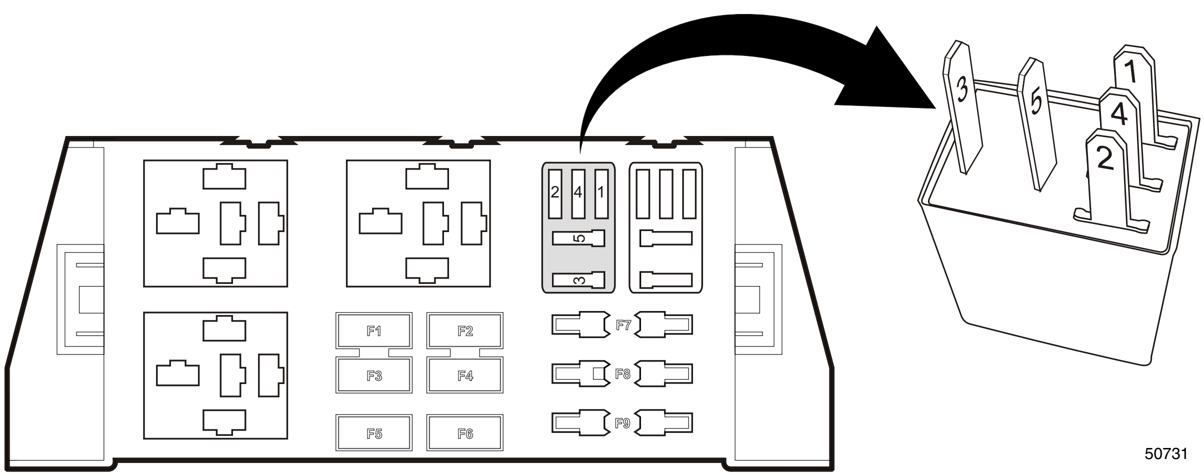
The Engine Control Module (ECM) controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the controlled component. This driver has a fault line which the ECM monitors. When the ECM commands the relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM commands the relay OFF, the voltage should be high, near battery voltage. If the fault detection circuit senses a voltage other than what the ECM expects, the fault line status changes causing a DTC to set.

The relay controls the high current flow to the fuel pumps. This allows the ECM driver to only have to control the relatively low current used by the relay.

Diagnostic Aids

If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*” on page 48” in Section 4.





Troubleshooting

The following items should be checked in sequence when diagnosing DTC 0627

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Relay

Ignition OFF. Diagnostic tool connected in ECM Tests Mode - Relay Test. Turn ignition ON, engine OFF. Command the relay ON and OFF. Does the relay turn ON and OFF when commanded?

YES: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NO: Go to *Check Relay Power Feed Circuit* **on this page**

Check Relay Power Feed Circuit

Using a test lamp connected to a known good engine ground, probe the relay socket (pin 1) of fuel pump relay power feed circuit. Is the test lamp illuminated?

YES: Circuit functioning normally, Check Relay Current Draw" on page 188" in section 5

NO: **Repair circuit as necessary. Check fuel pump relay fuse.**

Check Relay Current Draw

Ignition OFF, disconnect ECM connector. Install a 5 amp fused jumper wire from a known good engine ground to the control circuit of the ECM connector pin 84. Ignition ON, engine OFF. Using DVOM on the 40 amp scale, measure the current from the relay control circuit in the ECM connector to ground for 2 minutes. Is the current draw less than 0.75A?

Important! If the DVOM goes to 0 during the current draw test, replace the relay.

YES: Go to *Check Relay Ground Circuit* **on this page**

NO: **Replace Relay**

Check Relay Ground Circuit

Ignition OFF. Remove the fuel pump relay from the Fuse and Relay center. Using DVOM, measure the resistance from the relay control circuit pin 2 in the fuel pump relay socket and pin 84 in the ECM harness connector. Does the DVOM display infinite resistance?

YES: **Circit is open, repair as necessary**

NO: Go to *Check Relay Control Circuit* **on this page**

Check Relay Control Circuit

Ignition OFF. Reconnect ECM connector. With the fuel pump relay removed, connect a test lamp between the fuel pump relay control circuit pin 2 and the fuel pump relay feed circuit pin 1 in the fuel pump relay socket. Turn ignition ON, engine OFF. Using the diagnostic tool, command the relay ON and OFF. Does the test lamp turn ON and OFF when commanded?

YES: **Circuit is intermittent,** See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NO: **Replace ECM**

DTC 0628 - Fuel Pump Relay Control Ground Short

SPN-1348 FMI-4

Circuit Description

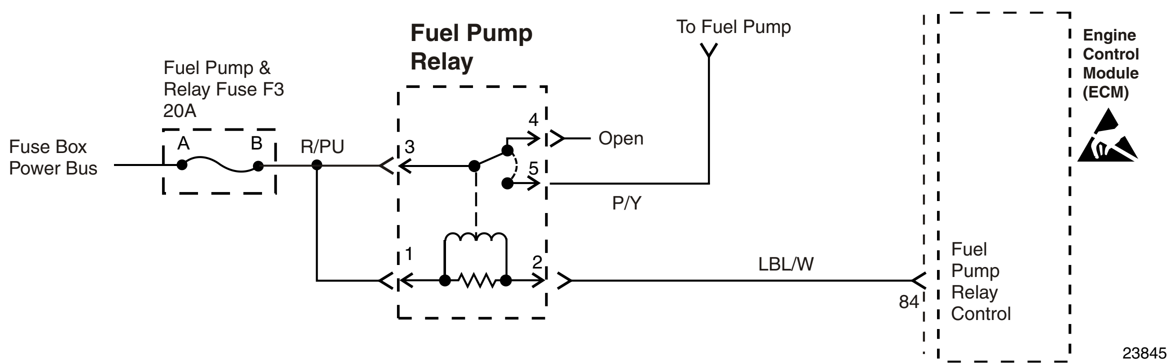
The Engine Control Module (ECM) controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the controlled component. This driver has a fault line which the ECM monitors. When the ECM commands the relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM commands the relay OFF, the voltage should be high, near battery voltage. If the fault detection circuit senses a voltage other than what the ECM expects, the fault line status changes causing a DTC to set.

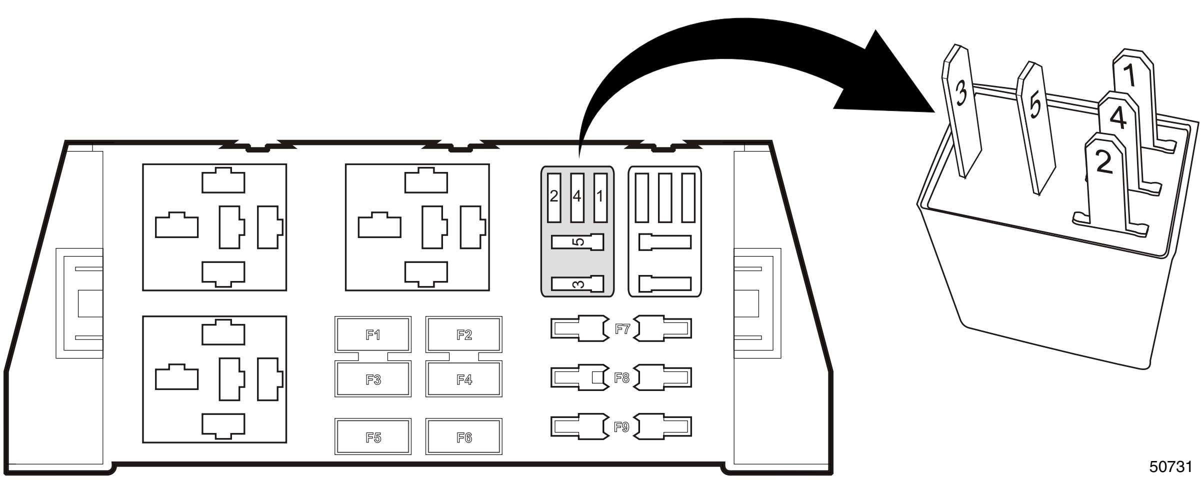
The relay controls the high current flow to the fuel pumps. This allows the ECM driver to only have to control the relatively low current used by the relay.

Diagnostic Aids

If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

During this condition, the ECM will see 0 Volts on the control circuit indicating the current is flowing directly to ground. The diagnostics are designed to locate the short to ground.





Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Relay Operation

Ignition OFF. Diagnostic tool connected in ECM Test Mode - Relay Test. Turn ignition ON, engine OFF. Command the relay ON and OFF. Does the relay turn ON and OFF when commanded?

YES: **Intermittent problem, See *Preliminary and Intermittent Checks*" on page 48" in Section 4**

NO: Go to *Check Relay Feed and Control Circuit* **on this page**

Check Relay Feed and Control Circuit

Ignition OFF. Connect a test lamp between the fuel pump relay control circuit pin 2 and the fuel pump relay feed circuit pin 1 in the fuel pump relay socket. Turn ignition ON, engine OFF. Using the diagnostic tool, command the relay ON and OFF. Does the test lamp turn ON and OFF when commanded?

YES: **Fuel pump relay defective, replace relay.**

NO: Go to *Check Relay Power Circuit* **on this page**

Check Relay Power Circuit

Remove fuel pump relay, using a test lamp connected to a known good engine ground, probe the relay socket (pin 1) of fuel pump relay power feed circuit. Is the test lamp illuminated?

YES: Go to *Check Relay Power Feed Circuit* **on this page**

NO: **Repair circuit as necessary. Check fuel pump relay fuse F3.**

Check Relay Control Circuit

Ignition OFF. Remove the fuel pump relay from the Fuse and Relay center. Disconnect ECM connector, Using DVOM, measure the resistance from the relay control circuit pin 84 in the ECM harness connector to ground. Does the DVOM display infinite resistance?

YES: **Replace ECM**

NO: **Circuit shorted to ground, repair wiring as necessary.**

DTC 0629 - Fuel Pump Relay Coil Short to Power

SPN-1348 FMI-3

Circuit Description

The Engine Control Module (ECM) controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the controlled component. This driver has a fault line which the ECM monitors. When the ECM commands the relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM commands the relay OFF, the voltage should be high, near battery voltage. If the fault detection circuit senses a voltage other than what the ECM expects, the fault line status changes causing a DTC to set.

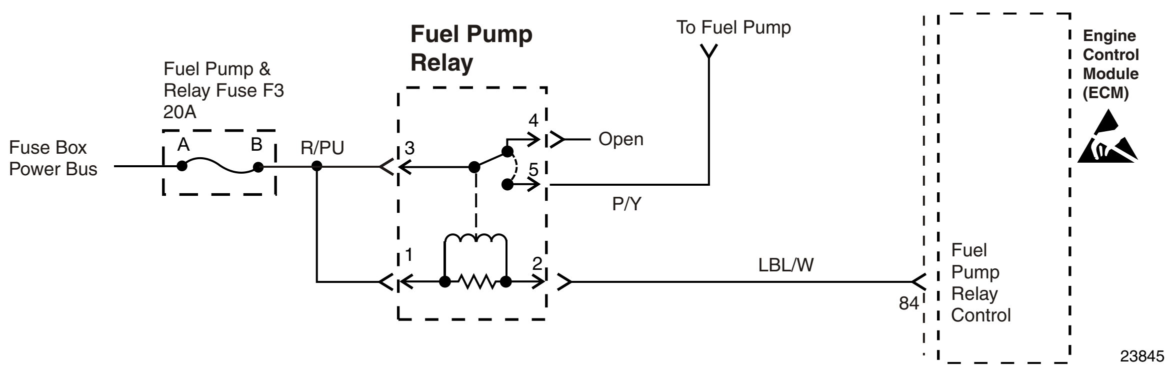
The relay controls the high current flow to the fuel pumps. This allows the ECM driver to only have to control the relatively low current used by the relay.

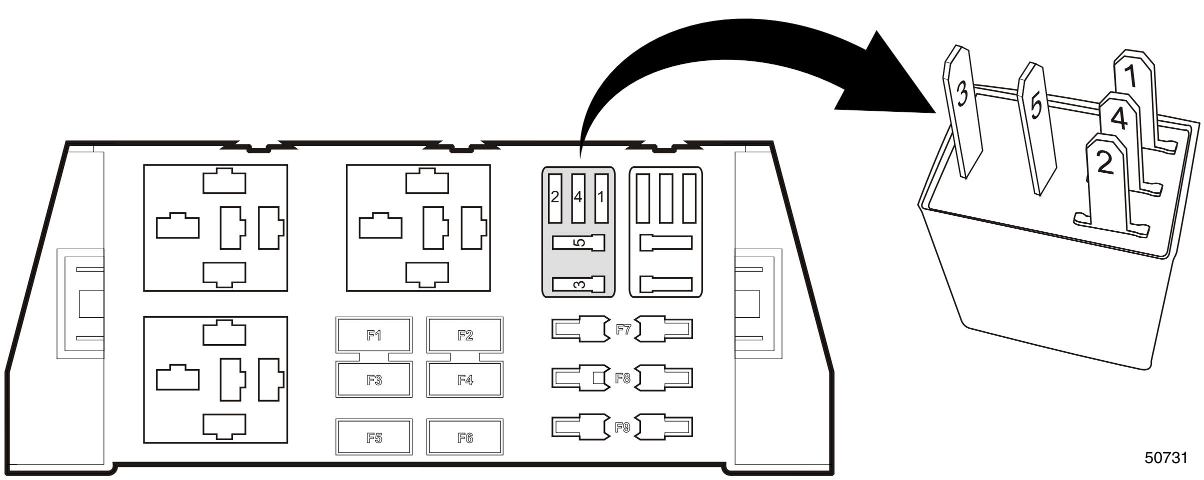
Diagnostic Aids

If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

The ECM monitors the amount of voltage on the control circuit for this DTC. Whe the ECM senses full battery voltage for 10 samples, it will set DTC 0629.

A shorted control coil or shorted control circuit wire (LBL/W) to battery volage are two possibilites for setting this DTC.





Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Relay

Ignition OFF. Diagnostic tool connected in ECM Tests Mode - Relay Test. Turn ignition ON, engine OFF. Command the relay ON and OFF. Does the relay turn ON and OFF when commanded?

YES: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NO: Go to *Check Control Circuit Function* **on this page**

Check Control Circuit Function

Ignition OFF. Disconnect the ECM connector. Ignition ON, engine OFF. Using a fused jumper wire connected to a known good engine ground, momentarily probe the relay control circuit in the ECM pin 84 of the harness connector. Does the relay turn ON when the circuit is grounded and OFF when the circuit is opened?

YES: Go to *Check Relay Current Draw* on this page

NO: Go to *Check Relay Ground Circuit* on this page

Check Relay Current Draw

Ignition OFF Disconnect ECM connector. Install a 5 amp fused jumper wire from a known good engine ground to the control circuit and the ECM connector pin 84. Ignition ON, engine OFF. Using DVOM on the 40 amp scale, measure the current from the relay control circuit in the ECM connector to ground for 2 minutes. Does the current draw measure less than 0.75A?

Important! If the DVOM goes to 0 during the current draw test, replace the relay.

YES: Replace fuel pump relay.

NO: Go to *Check Relay Ground Circuit* on this page

Check Relay Ground Circuit

Ignition OFF. Connect a test lamp between the fuel pump relay control circuit pin 2 and the fuel pump relay and a known good engine ground. Turn ignition ON, engine OFF. Does the test lamp turn ON?

YES: Control wire shorted to power. Repair circuit as necessary

NO: Go to *Check Relay Power Circuit* on this page

Check Relay Power Circuit

Using a test lamp connected to a known good engine ground, probe the ignition feed circuit in the fuse and relay box, on the coil side of the fuel pump relay (pin 1). Is the test lamp illuminated?

YES: Replace ECM

NO: Check fuse F3.

DTC 0642 - V REF #1 Voltage Low (ETC)

SPN-1079 FMI-4

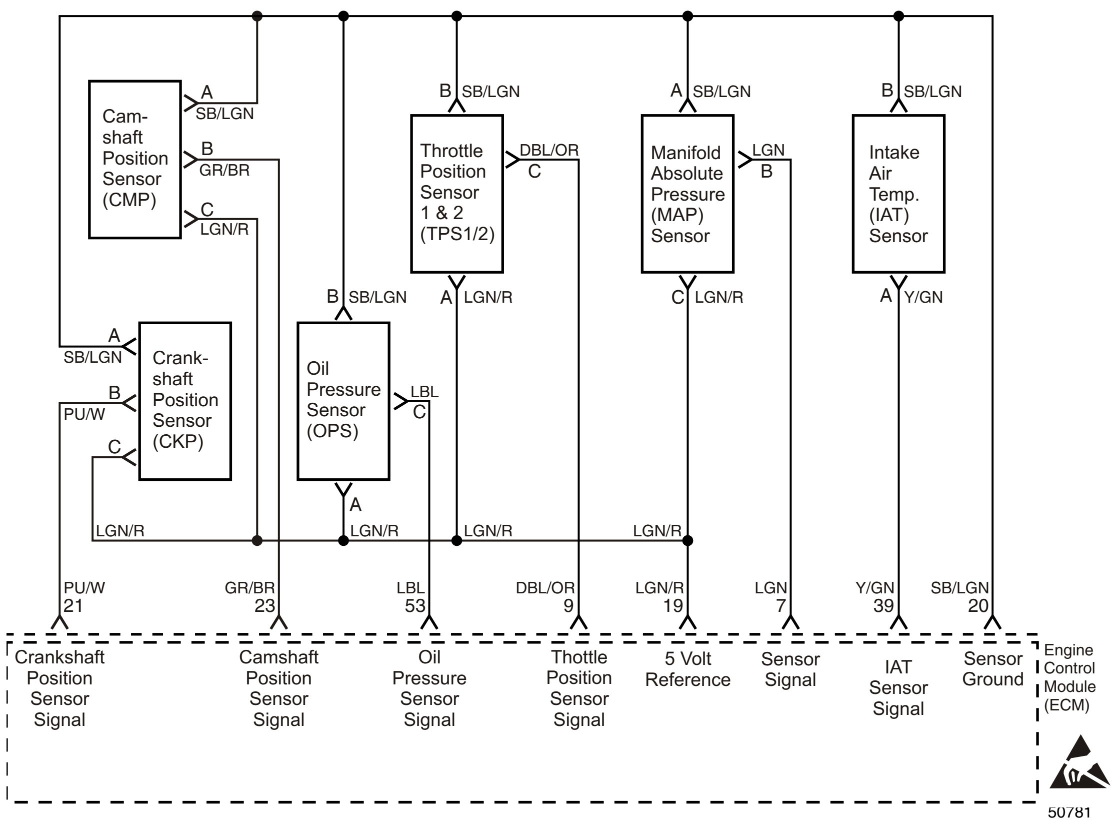
Circuit Description

The VREF 5-volt supply powers the MAP (or TMAP), OPS, CKP, CMP, TPS1, TPS2, and TCP1. The accuracy of the 5-volt supply is very important to the accuracy of the sensors and is therefore controlled by the ECM. The ECM monitors the 5-volt supply to determine if it is overloaded, shorted, or otherwise out of specification.

This fault will set if the 5-volt reference is below 4.6 volts.

Conditions for setting the DTC

- External 5V reference.
- Fault condition - 5V reference voltage lower than 4.6 volts.
- MIL - on during active fault and for 2 seconds after active fault.



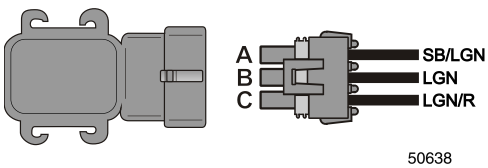
Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

NOTE! If this code is active and not intermittent, it is highly likely that you will see error codes for the following components: MAP, OPS, CKP, CMP, TPS1, TPS2, and TCP1.

Verify V REF is Low



Key ON, engine OFF. Disconnect the MAP sensor. Using a DVOM set to VDC, connect to a known good engine ground and probe the V REF wire (LGN/R, pin-C). Does the DVOM register below 4.6V?

YES: Go to *Check for Faulty Component on this page*

NO: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check for Faulty Component

While continuing to monitor the DVOM voltage reading through the MAP sensor V REF wire, disconnect each sensor (below) one at a time. If the voltage jumps back up to the 5V range, the last component removed may be faulty.

- OPS, CKP, CMP, TPS1, TCP1

Did removing any of the components cause the voltage to jump to the 5V range?

YES: Inspect the V REF supply wire leads for shorts before replacing the sensor.

NO: Go to *Check for V REF Continuity on this page*

Check for V REF Continuity

Remove the ECM connector. Set the DVOM to Ohms and monitor for continuity between the V REF wire and engine ground. Do you have continuity to engine ground?

YES: Repair wiring as necessary.

NO: Replace the ECM.

DTC 0642 - V REF Voltage Low (IAC)

SPN-1079 FMI-4

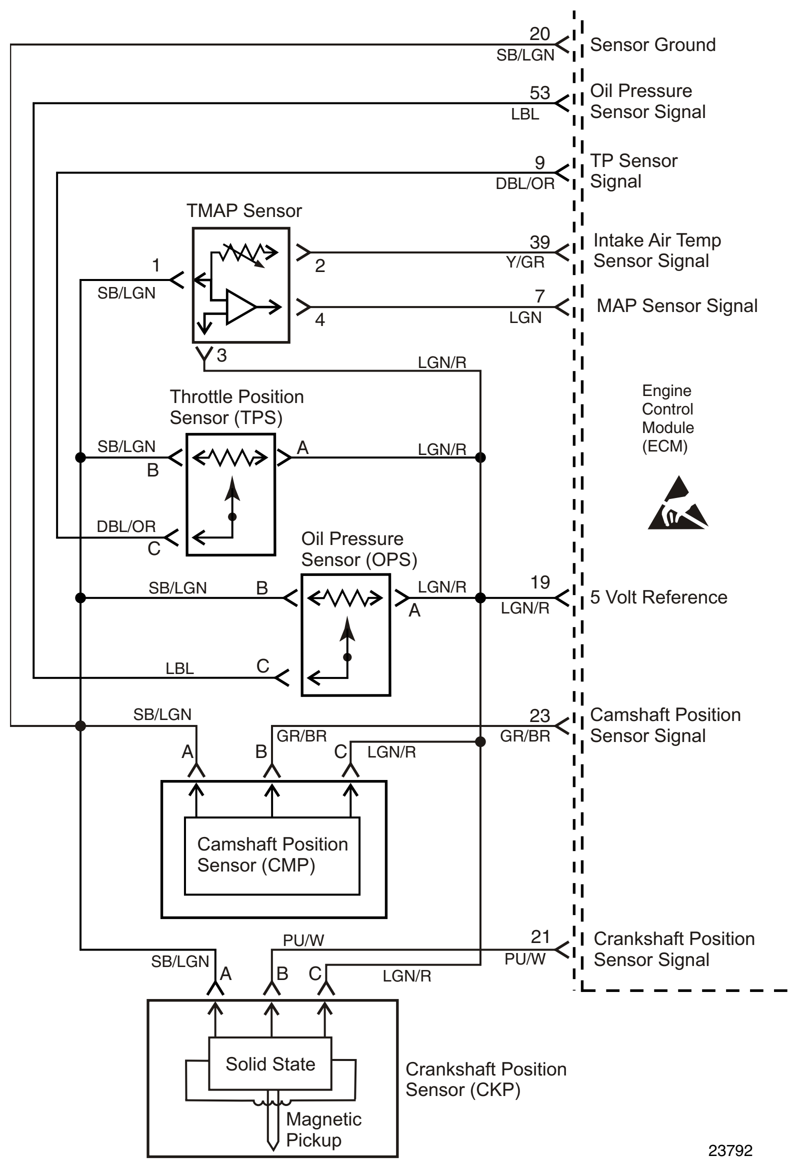
Circuit Description

The VREF 5-volt supply powers the MAP (or TMAP), OPS, CKP, CMP, TPS1, TPS2, and TCP1. The accuracy of the 5-volt supply is very important to the accuracy of the sensors and is therefore controlled by the ECM. The ECM monitors the 5-volt supply to determine if it is overloaded, shorted, or otherwise out of specification.

This fault will set if the 5-volt reference is below 4.6 volts.

Conditions for setting the DTC

- External 5V reference.
- Fault condition - 5V reference voltage lower than 4.6 volts.
- MIL - on during active fault and for 2 seconds after active fault.



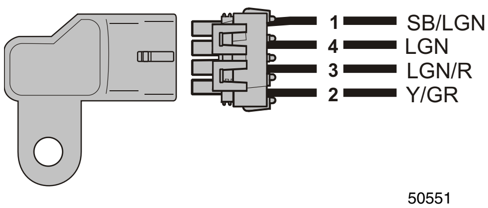
Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

NOTE! If this code is active and not intermittent, it is highly likely that you will see error codes for the following components: TMAP, OPS, CKP, CMP, TPS1, TPS2, and TCP1.

Verify 5V REF is Low



Key ON, engine OFF. Disconnect the TMAP sensor. Using a DVOM set to VDC, connect to a known good engine ground and probe the 5V REF wire (LGN/R, pin-3). Does the DVOM register below 4.6V?

YES: Go to *Check for Faulty Component on this page*

NO: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check for Faulty Component

While continuing to monitor the DVOM voltage reading through the TMAP sensor 5V REF wire, disconnect each sensor (below) one at a time. If the voltage jumps back up to the 5V range, the last component removed may be faulty.

- OPS, CKP, CMP, TPS1, TCP1

Did removing any of the components cause the voltage to jump to the 5V range?

YES: Inspect the 5V REF supply wire leads for shorts before replacing the sensor.

NO: Go to *Check for V REF Continuity on this page*

Check for 5V REF Continuity

Remove the ECM connector. Set the DVOM to Ohms and monitor for continuity between the 5V REF and engine ground. Do you have continuity to engine ground?

YES: Repair wiring as necessary.

NO: Replace the ECM.

DTC 0642 - V REF Voltage Low (IAC)

SPN-1079 FMI-4

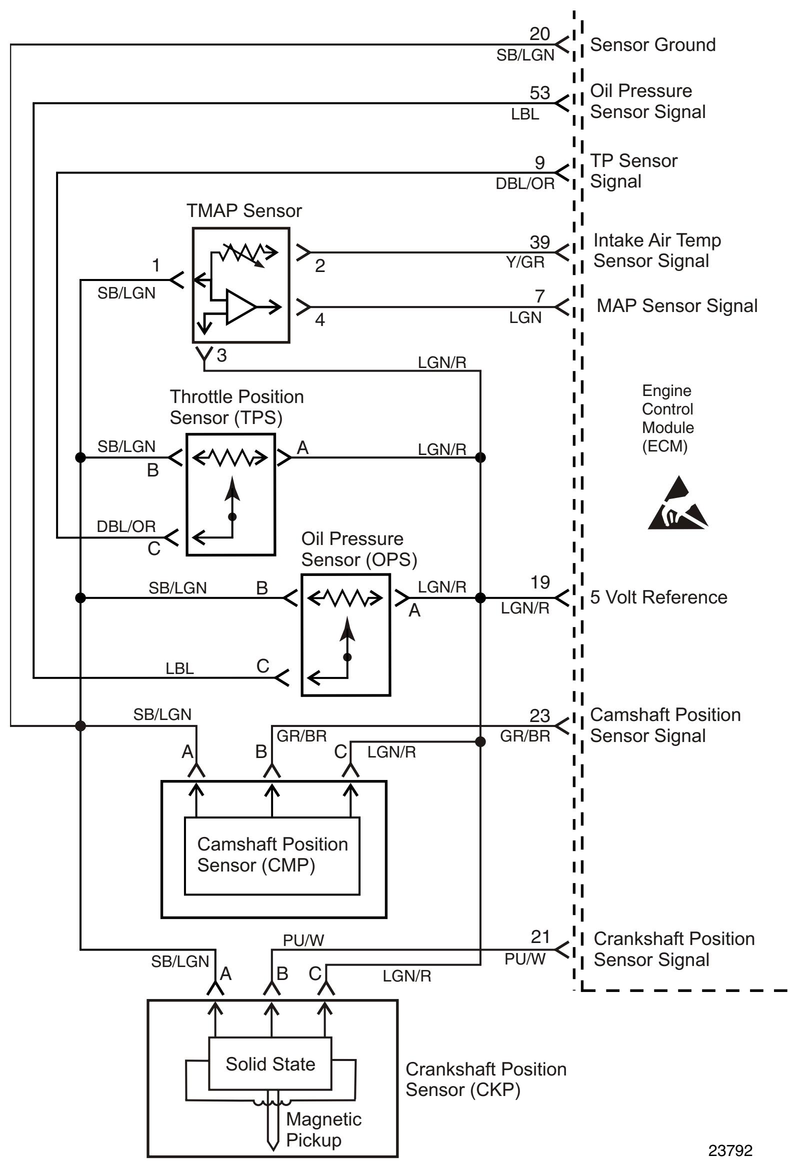
Circuit Description

The VREF 5-volt supply powers the MAP (or TMAP), OPS, CKP, CMP, TPS1, TPS2, and TCP1. The accuracy of the 5-volt supply is very important to the accuracy of the sensors and is therefore controlled by the ECM. The ECM monitors the 5-volt supply to determine if it is overloaded, shorted, or otherwise out of specification.

This fault will set if the 5-volt reference is below 4.6 volts.

Conditions for setting the DTC

- External 5V reference.
- Fault condition - 5V reference voltage lower than 4.6 volts.
- MIL - on during active fault and for 2 seconds after active fault.



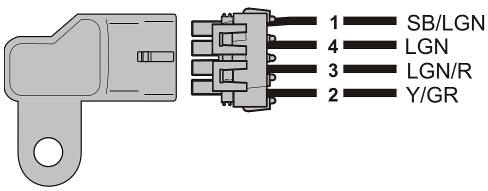
Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

NOTE! If this code is active and not intermittent, it is highly likely that you will see error codes for the following components: TMAP, OPS, CKP, CMP, TPS1, TPS2, and TCP1.

Verify 5V REF is Low



Key ON, engine OFF. Disconnect the TMAP sensor. Using a DVOM set to VDC, connect to a known good engine ground and probe the 5V REF wire (LGN/R, pin-3). Does the DVOM register below 4.6V?

YES: Go to *Check for Faulty Component on this page*

NO: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check for Faulty Component

While continuing to monitor the DVOM voltage reading through the TMAP sensor 5V REF wire, disconnect each sensor (below) one at a time. If the voltage jumps back up to the 5V range, the last component removed may be faulty.

- OPS, CKP, CMP, TPS1, TCP1

Did removing any of the components cause the voltage to jump to the 5V range?

YES: Inspect the 5V REF supply wire leads for shorts before replacing the sensor.

NO: Go to *Check for V REF Continuity on this page*

Check for 5V REF Continuity

Remove the ECM connector. Set the DVOM to Ohms and monitor for continuity between the 5V REF and engine ground. Do you have continuity to engine ground?

YES: Repair wiring as necessary.

NO: Replace the ECM.

DTC 0643 - V REF #1 Voltage High (ETC)

SPN-1079 FMI-3

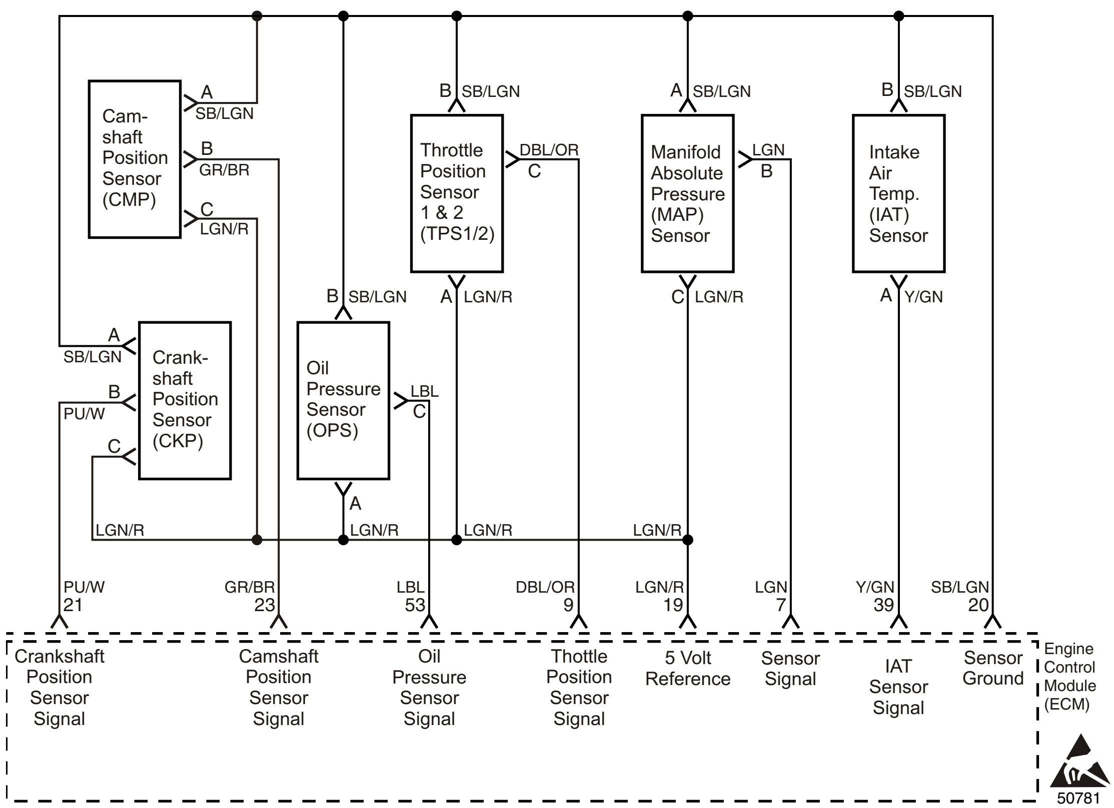
Circuit Description

The VREF 5-volt supply powers the MAP (or TMAP), OPS, CKP, CMP, TPS1, TPS2, and TCP1. The accuracy of the 5-volt supply is very important to the accuracy of the sensors and is therefore controlled by the ECM. The ECM monitors the 5-volt supply to determine if it is overloaded, shorted, or otherwise out of specification.

This fault will set if the 5V reference is above 5.4 volts.

Conditions for Setting the DTC

- External 5V reference.
- Check condition - cranking with battery voltage greater than 8 volts or engine running.
- Fault condition - 5V reference voltage higher than 5.4 volts.
- MIL - on during active fault and for 2 seconds after active fault.

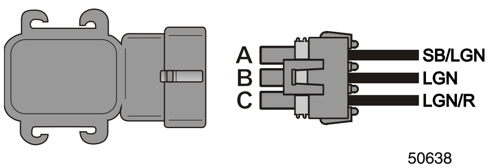


Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*” on page 48” in Section 4.

Verify V REF is High



Key ON, engine OFF. Disconnect the MAP sensor. Using a DVOM set to VDC, connect to a known good engine ground and probe the V REF wire (LGN/R, pin-C). Does the DVOM register above 5.4V?

YES: Go to *Check for Faulty Component on this page*

NO: Intermittent problem. See *Preliminary and Intermittent Checks*” on page 48” in Section 4.

Check for Short to Power

Remove the ECM connector. Key ON, engine OFF. Set the DVOM to VDC and check voltage between the V REF (LGN/R, pin-C) and a known good engine ground. Do you have more than 5.4V?

YES: Repair wiring as necessary.

NO: Replace the ECM.

DTC 0643 - V REF Voltage High (IAC)

SPN-1079 FMI-3

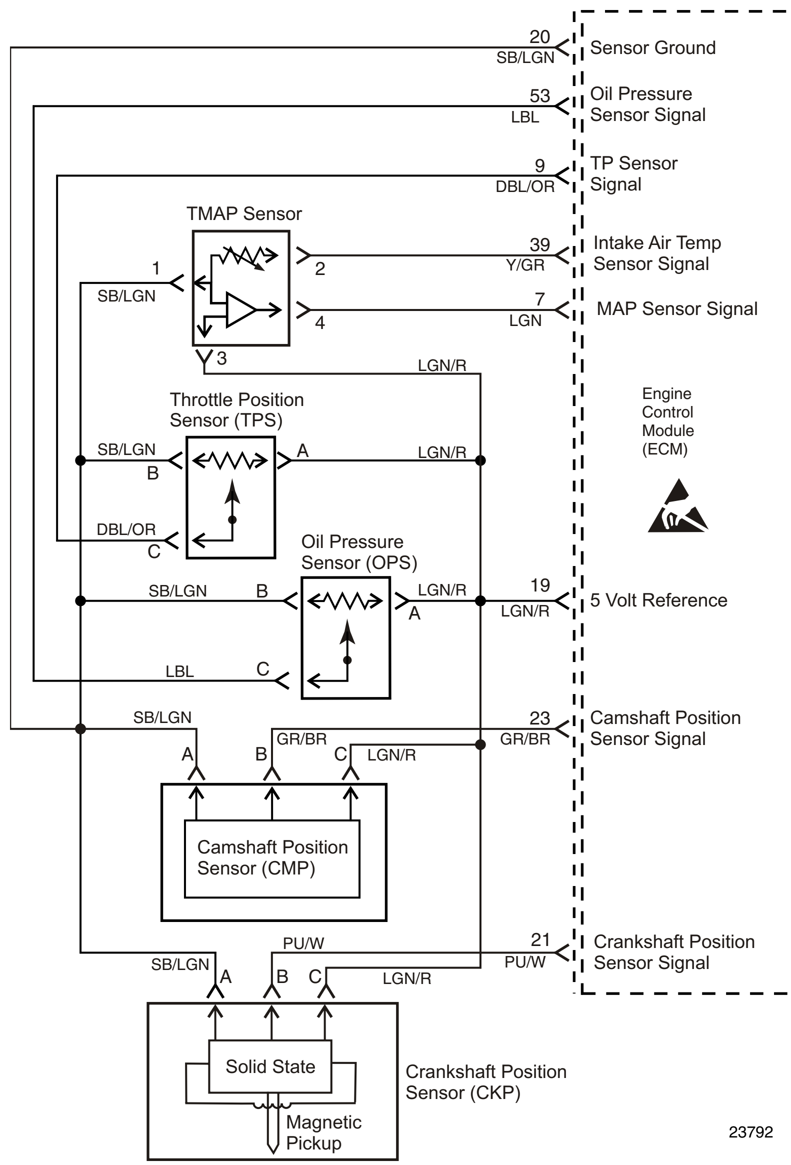
Circuit Description

The VREF 5-volt supply powers the MAP (or TMAP), OPS, CKP, CMP, TPS1, TPS2, and TCP1. The accuracy of the 5-volt supply is very important to the accuracy of the sensors and is therefore controlled by the ECM. The ECM monitors the 5-volt supply to determine if it is overloaded, shorted, or otherwise out of specification.

This fault will set if the 5V reference is above 5.4 volts.

Conditions for setting the DTC

- External 5V reference.
- Check condition - cranking with battery voltage greater than 8 volts or engine running.
- Fault condition - 5V reference voltage higher than 5.4 volts.
- MIL - on during active fault and for 2 seconds after active fault.

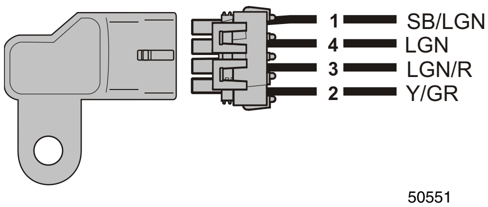


Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Verify 5V REF is High



Key ON, engine OFF. Disconnect the TMAP sensor. Using a DVOM set to VDC, connect to a known good engine ground and probe the 5V REF wire (LGN/R, pin-3). Does the DVOM register above 5.4V?

YES: Go to *Check for Faulty Component on this page*

NO: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check for Short to Power

Remove the ECM connector. Key ON, engine OFF. Set the DVOM to VDC and check voltage between the 5V REF (LGN/R, pin-3) and a known good engine ground. Do you have more than 5.4V?

YES: Repair wiring as necessary.

NO: Replace the ECM.

DTC 0652 - V REF #2 Voltage Low

SPN-1080 FMI-4

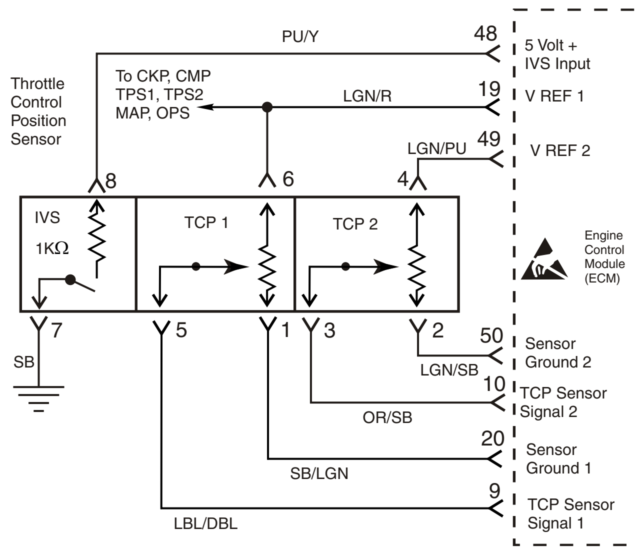
Circuit Description

The 5-volt VREF #2 is a dedicated supply voltage to power the TCP 2 sensor for redundancy. The accuracy of the 5-volt supply is very important to the accuracy of the sensor and is therefore controlled by the ECM. The ECM monitors the 5V supply to determine if the sensor is overloaded, shorted, or otherwise out of specification.

This fault will set if the 5V reference is below 3 volts.

Conditions for Setting the DTC

- External 5V reference.
- Fault condition - 5V reference voltage less than 3 volts.
- MIL - on during active fault and for 2 seconds after active fault.



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Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Verify V REF #2 is Low

Key ON, engine OFF. Disconnect the TCP connector. Using a DVOM set to VDC, connect to a known good engine ground and probe the 5V REF 2 wire (LGN/PU, pin-4). Does the DVOM register 5.0V?

YES: Replace the TCP sensor.

NO: Go to *Check for V REF Continuity on this page*

Check for V REF Continuity

Disconnect the ECM connector. Using a DVOM set to Ohms, connect to a known good engine ground and probe the 5V REF 2 wire (LGN/PU, pin-4). Does the DVOM show continuity?

YES: Repair wiring as necessary.

NO: Replace the ECM.

DTC 0653 - V REF #2 Voltage High

SPN-1080 FMI-3

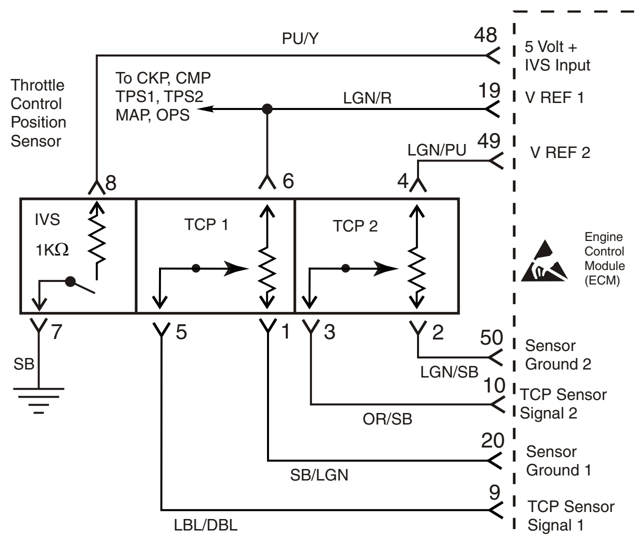
Circuit Description

The 5-volt VREF #2 is a dedicated supply voltage to power the TCP 2 sensor for redundancy. The accuracy of the 5-volt supply is very important to the accuracy of the sensor and is therefore controlled by the ECM. The ECM monitors the 5V supply to determine if the sensor is overloaded, shorted, or otherwise out of specification.

This fault will set if the 5V reference is above 5.4 volts.

Conditions for Setting the DTC

- External 5V reference.
- Check condition - cranking with battery voltage greater than 8 volts or engine running.
- Fault condition - 5V reference voltage higher than 5.4 volts.
- MIL - on during active fault and for 2 seconds after active fault.



23798

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Verify 5V REF #2 is High

Key ON, engine OFF. Disconnect the TCP connector. Using a DVOM set to VDC, connect to a known good engine ground and probe the 5V REF 2 wire (LGN/PU, pin-4). Does the DVOM show greater than 5.4V?

YES: Go to *Check for Faulty Component on this page*

NO: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4

Check for Short to Power

Remove the ECM connector. Set the DVOM to VDC and check voltage between the 5V REF 2 wire (LGN/PU, pin-4) and a known good engine ground. Do you have more than 5.4V?

YES: Repair wiring as necessary.

NO: Replace the ECM.

DTC 0685 - Ignition Relay Coil Open

SPN-1485 FMI-5

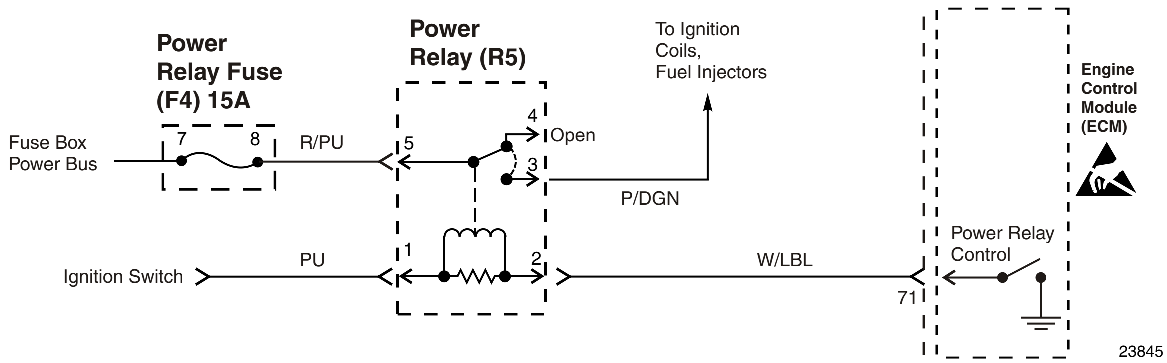
Circuit Description

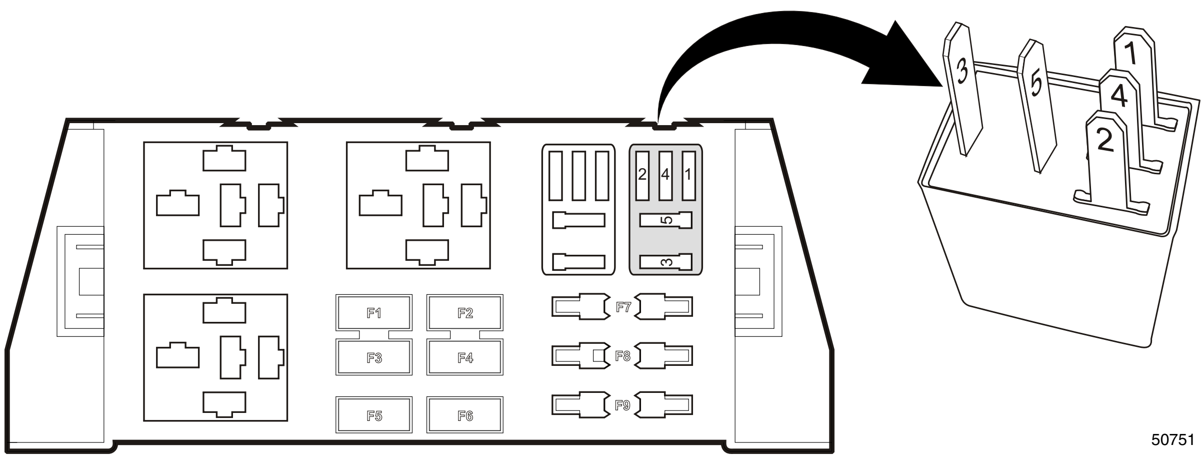
The Engine Control Module (ECM) controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the controlled component. This driver has a fault line which the ECM monitors. When the ECM commands the relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM commands the relay OFF, the voltage should be high, near battery voltage. If the fault detection circuit senses a voltage other than what the ECM expects, the fault line status changes causing a DTC to set.

The relay controls the high current flow to the ignition coils. This allows the ECM driver to only have to control the relatively low current used by the relay.

Diagnostic Aids

If the condition is suspected to be intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4.





Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Relay

Ignition OFF. Diagnostic tool connected in ECM Tests Mode - Relay Test. Turn ignition ON, engine OFF. Command the relay ON and OFF. Does the relay turn ON and OFF when commanded?

YES: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4.**

NO: Go to *Check Relay Control Circuit* **on this page.**

Important! If ECM doesn't command the relay ON and OFF, replace the ECM.

Check Relay Control Circuit

Ignition OFF. With the ignition relay removed, connect a test lamp between the ignition relay control circuit (pin 2) and the ignition relay feed circuit (pin 1) in the ignition relay socket. Turn ignition ON, engine OFF. Using the diagnostic tool, command the relay ON and OFF. Does the test lamp turn ON and OFF when commanded?

YES: **Circuit is intermittent,** See *Preliminary and Intermittent Checks*" **on page 48" in Section 4.**

NO: Go to *Check Relay Power Feed Circuit* **on this page.**

Check Relay Power Feed Circuit

Using a test lamp connected to a known good engine ground, probe the relay socket (pin 1) of ignition relay power feed circuit. Is the test lamp illuminated?

YES: Circuit functioning normally, Go to *Check Relay Current Draw* **on this page**.

NO: Repair circuit as necessary. Check ignition relay fuse.

Check Relay Current Draw

Install relay. Ignition OFF, disconnect ECM connector. Install a 5 amp fused jumper wire from a known good engine ground to the control circuit of the ECM connector pin 71. Ignition ON, engine OFF. Using DVOM on the 40 amp scale, measure the current from the relay control circuit in the ECM connector to ground for 2 minutes. Is the current draw less than 0.09A?

YES: Go to *Check Relay Ground Circuit* **on this page.**

NO: Replace Relay.

Important! If the DVOM goes to 0 during the current draw test, replace the relay. Check the resistance of the relay between pin 1 and pin 2; if resistance is other than 104 Ohms ±10%, replace the relay.

Check Relay Ground Circuit

Ignition OFF. Remove the ignition relay from the Fuse and Relay center. Using DVOM, measure the resistance from the relay control circuit (pin 2) in the ignition relay socket and pin 71 in the ECM harness connector. Does the DVOM display near zero or no resistance?

YES: Replace ECM.

NO: Circuit is open. Repair as necessary.

DTC 0686 - Ignition Relay Control Ground Short

SPN-1485 FMI-4

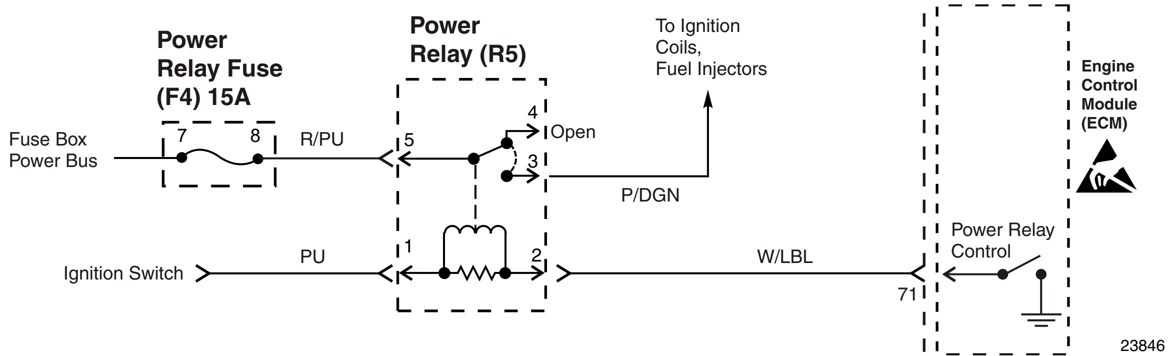
Circuit Description

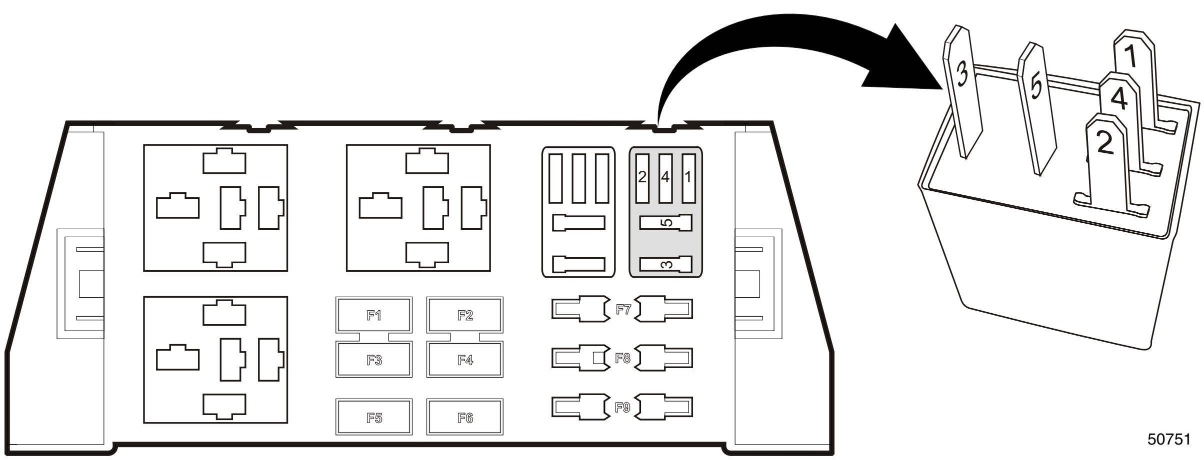
The Engine Control Module (ECM) controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the controlled component. This driver has a fault line which the ECM monitors. When the ECM commands the relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM commands the relay OFF, the voltage should be high, near battery voltage. If the fault detection circuit senses a voltage other than what the ECM expects, the fault line status changes causing a DTC to set.

The relay controls the high current flow to the ignition coils. This allows the ECM driver to only have to control the relatively low current used by the relay.

Diagnostic Aids

If the condition is suspected to be intermittent, see Preliminary and Intermittent Checks" on page 48" in section 4.





Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Relay Operation

Ignition OFF. Diagnostic tool connected in ECM Test Mode - Relay Test. Turn ignition ON, engine OFF. Command the relay ON and OFF. Does the relay turn ON and OFF when commanded?

YES: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

NO: Go to *Check Relay Feed and Control Circuit* on this page.

Check Relay Feed and Control Circuit

Ignition OFF. Connect a test lamp between the ignition relay control circuit pin 2 and the ignition relay feed circuit pin 1 in the ignition relay socket. Turn ignition ON, engine OFF. Using the diagnostic tool, command the relay ON and OFF. Does the test lamp turn ON and OFF when commanded?

YES: Ignition relay defective. Replace relay.

NO: Go to *Check Relay Power Circuit* on this page.

Check Relay Power Circuit

Remove ignition relay, using a test lamp connected to a known good engine ground, probe the relay socket (pin 1) of ignition relay power feed circuit. Is the test lamp illuminated?

YES: Go to *Check Relay Power Feed Circuit* on this page.

NO: Repair circuit as necessary. Check ignition relay fuse F4.

Check Relay Control Circuit

Ignition OFF. Remove the ignition relay from the Fuse and Relay center. Disconnect ECM connector, Using DVOM, measure the resistance from the relay control circuit pin 71 in the ECM harness connector to ground. Does the DVOM display infinite resistance?

YES: Replace ECM.

NO: Circuit shorted to ground. Repair wiring as necessary.

DTC 0687 - Ignition Relay Coil Short to Power

SPN-1485 FMI-3

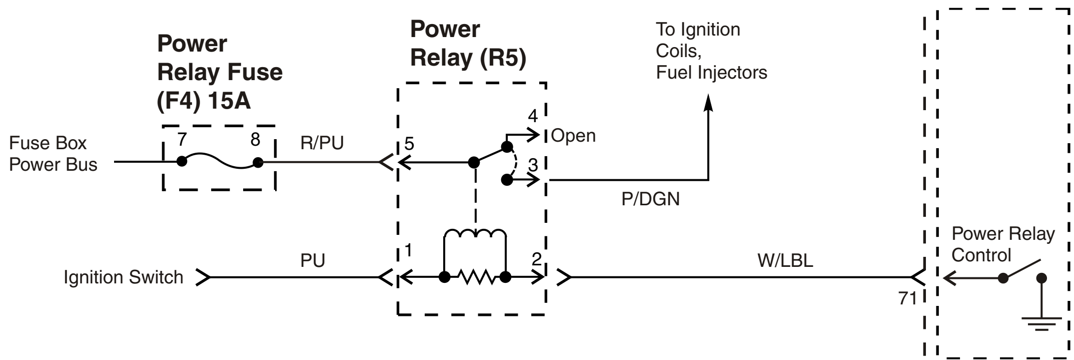
Circuit Description

The Engine Control Module (ECM) controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the controlled component. This driver has a fault line which the ECM monitors. When the ECM commands the relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM commands the relay OFF, the voltage should be high, near battery voltage. If the fault detection circuit senses a voltage other than what the ECM expects, the fault line status changes causing a DTC to set.

The relay controls the high current flow to the ignition coils. This allows the ECM driver to only have to control the relatively low current used by the relay.

Diagnostic Aids

If the condition is suspected to be intermittent, see Preliminary and Intermittent Checks" on page 48" in section 4.



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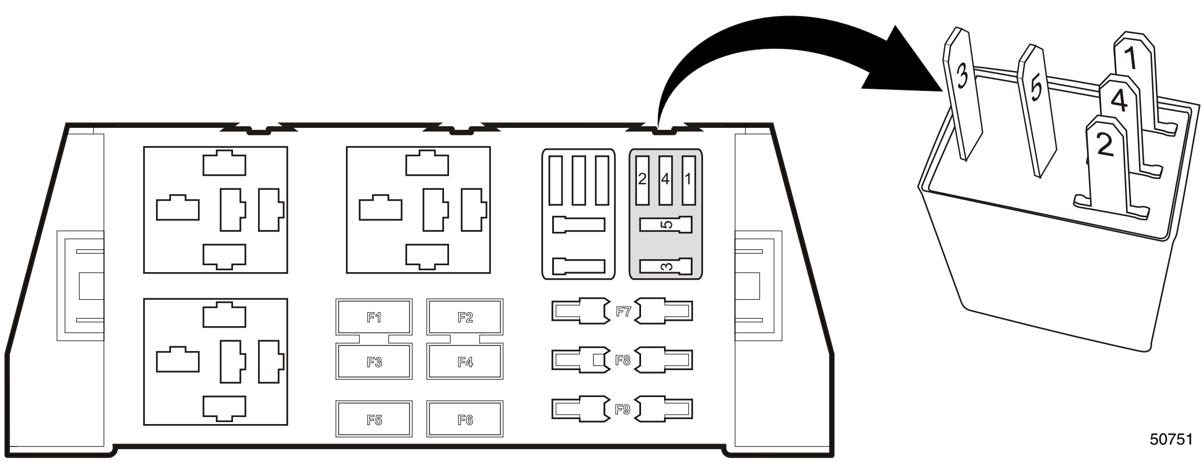

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Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Relay

Ignition OFF. Diagnostic tool connected in ECM Tests Mode - Relay Test. Turn ignition ON, engine OFF. Command the relay ON and OFF. Does the relay turn ON and OFF when commanded?

YES: Intermittent problem, See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

NO: Go to *Check Control Circuit Function* on this page.

Check Control Circuit Function

Ignition OFF. Disconnect the ECM connector. Ignition ON, engine OFF. Using a fused jumper wire connected to a known good engine ground, momentarily probe the relay control circuit in the ECM pin 71 of the harness connector. Does the relay turn ON when the circuit is grounded and OFF when the circuit is opened?

YES: Go to *Check Relay Current Draw* on this page.

NO: Go to *Check Relay Ground Circuit* on this page.

Check Relay Current Draw

Ignition OFF Disconnect ECM connector. Install a 5 amp fused jumper wire from a known good engine ground to the control circuit and the ECM connector pin 71. Ignition ON, engine OFF. Using DVOM on the 40 amp scale, measure the current from the relay control circuit in the ECM connector to ground for 2 minutes. Does the current draw measure less than 0.09A?

Important! If the DVOM goes to 0 during the current draw test, replace the relay.

YES: Replace ignition relay.

NO: Go to *Check Relay Ground Circuit* on this page.

Check Relay Ground Circuit

Ignition OFF. Connect a test lamp between the ignition relay control circuit pin 2 on the ignition relay and a known good engine ground. Turn ignition ON, engine OFF. Does the test lamp turn ON?

YES: Control wire shorted to power. Repair circuit as necessary.

NO: Go to *Check Relay Power Circuit* on this page.

Check Relay Power Circuit

Using a test lamp connected to a known good engine ground, probe the ignition feed circuit in the fuse and relay box, on the coil side of the ignition relay (pin 1). Is the test lamp illuminated?

YES: Replace ECM.

NO: Check fuse F4.

DTC 1111 - Fuel Rev Limit

SPN-515 FMI-16

Circuit Description

This fault will set anytime engine RPM exceeds maximum rated by 200 RPM or more for 2 seconds or longer continuously. When these conditions are met, the ECM shuts off the fuel injectors. This is to help prevent engine or equipment damage. The MIL will be on during this active fault. This fault will also have DTC 0219 Maximum Govenor Speed Override set on 8.1 engines with electronic throttle.

Conditions for setting the DTC

- Fuel rev limit.
- Check condition - engine running.
- Fault condition - engine RPM greater than maximum rated by 200 RPM or more for 2 seconds or longer continuously.
- MIL - on during active fault.
- DTC 0219 Maximum Govenor Speed Override set

Table 20: Max RPM

Engine Model	Maximum RPM
4.3 GXi	4800
5.0 GXi	5000
5.7 Gi/GXi	5200
8.1 Gi	4600
8.1 GXi	5000

Trobleshooting

NOTE: If any other DTCs are present, diagnose those first.

Check Propeller(s) Size

Check propeller pitch and size for correct size for the boat. Is propeller correctly sized for the boat?

YES: Go to *Check Propeller Hub* **on this page**

NO: Replace propeller with the correct size for the engine load.

Check Propller Hub

Check propller hub for slipping. Is the hub slipping?

YES: Replace or repair propeller.

NO: Go to *Check ECM Part Number* **on this page**

Check ECM Part Number

Check the part number on the ECM to ensure correct calibration is being used. Is the ECM part number correct?

YES Go to *Check Throttle Operation* **on this page**

NO: Replace ECM with correct part number

Check Throttle Operation

Check the mechanical operation of the throttle. Is the mechanical operation of the throttle OK?

YES: Go to *Check for Vacuum Leak* **on this page**

NO: Correct mechanical operation of the throttle

Check for Vacuum Leak

Check intake manifold and vacuum hoses for very large vacuum leaks. Did you find any vacuum leaks?

YES: Repair Vacuum leak

NO: System OK.

DTC 1112 - Spark Rev Limit

SPN-515 FMI-0

Circuit Description

This fault will set anytime engine RPM exceeds maximum rated by 400 RPM or more for 2 seconds or longer continuously. When these conditions are met, the ECM will shut off spark to the engine. This is to help prevent engine or equipment damage. The MIL will be on during this active fault. Code [1]DTC 0219 and DTC 1111 will accompany this code.

Conditions for setting the DTC

- Spark rev limit is reached.
- Check condition - engine running.
- Fault condition - engine RPM greater than maximum rated by 400 RPM or more for 2 seconds or longer continuously.
- MIL - on during active fault.
- Codes [1]DTC 0219 and DTC 1111 will also set.

Table 21: Max RPM

Engine Model	Maximum RPM
4.3 GXi	4800
5.0 GXi	5000
5.7 Gi/GXi	5200
8.1 Gi	4600
8.1 GXi	5000

1. 8.1 liter engines equpped with electronic throttle.

Trobleshooting

NOTE: If any other DTCs are present, diagnose those first.

Check Propeller(s) Size

Check propeller pitch and size for correct size for the boat. Is propeller correctly sized for the boat?

YES: Go to *Check Propeller Hub* **on this page**

NO: Replace propeller with the correct size for the engine load.

Check Propller Hub

Check propller hub for slipping. Is the hub slipping?

YES: Replace or repair propeller.

NO: Go to *Check ECM Part Number* **on this page**

Check ECM Part Number

Check the part number on the ECM to ensure correct calibration is being used. Is the ECM part number correct?

YES Go to *Check Throttle Operation* **on this page**

NO: Replace ECM with correct part number

Check Throttle Operation

Check the mechanical operation of the throttle. Is the mechanical operation of the throttle OK?

YES: Go to *Check for Vacuum Leak* **on this page**

NO: Correct mechanical operation of the throttle

Check for Vacuum Leak

Check intake manifold and vacuum hoses for very large vacuum leaks. Did you find any vacuum leaks?

YES: Repair Vacuum leak

NO: System OK.

DTC 1121 - TCP 1/2 Simultaneous Voltages Out-of-Range

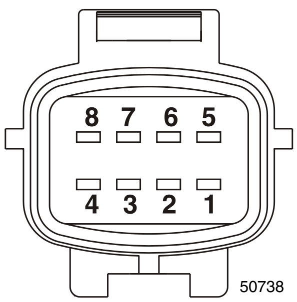
SPN-91 FMI-31

Circuit Description

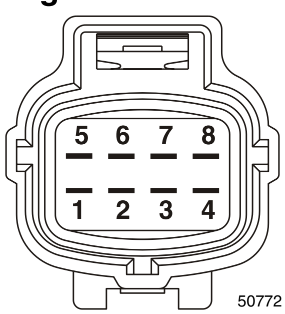
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault indicates that the two TCP percentages correlate and register an off-idle condition but the IVS state reads at idle throughout entire operating range. When this fault occurs, the MIL will be illuminated, the buzzer will sound a hard warning and forced idle will be enforced.

TCP Harness Connector



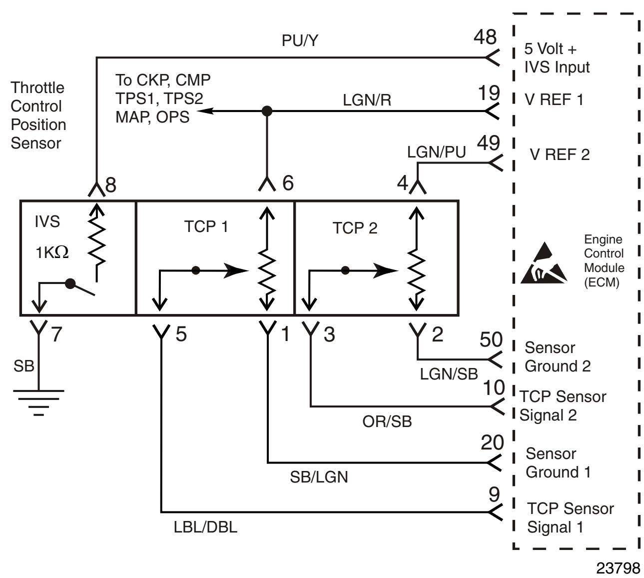
Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input

Conditions for Setting DTC

- TCP sensor with dual sensors and IVS.
- Check Condition- Key On, Engine On
- Fault Condition- TCP 1% is approximately that of TCP2% and both are greater than TCP idle valid%, and IVS= At Idle
- Illuminate MIL, hard warning and forced idle



Troubleshooting

For TCP 1 Out-of-Range, See *DTC 2122 - TCP 1 High Voltage* page 195., and DTC 2123 - TCP 1 Low Voltage” on page 197

For TCP 2 Out-of-Range See *DTC 2127 - TCP 2 Low Voltage* page 204., and DTC 2128 - TCP 2 High Voltage” on page 207.

DTC 1122 - TCP 1 and TCP 2 Do Not Match or IVS

SPN-520199 FMI-11

Circuit Description

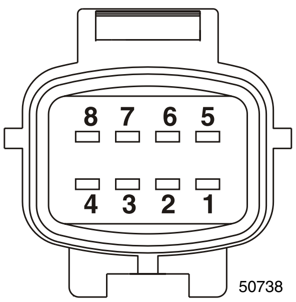
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

9. This fault is only applicable with dual potentiometer and single IVS sensors and indicates that the two TCP percentages correlate and register an off-idle condition but the IVS state reads at idle throughout entire operating range.

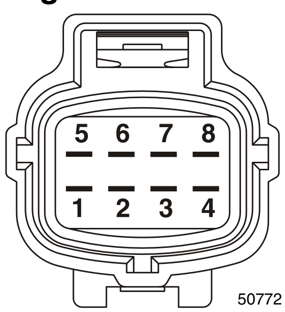
Conditions for Setting DTC

- Electronic throttle control position (TCP) sensor.
- Check Condition- Key On, Engine On
- Fault Condition- TCP 1% is approximately 20% different than TCP2% and both are greater than TCP idle valid%, and IVS= At Idle
- Corrective Action(s)- Illuminate MIL, sound audible warning and power derate, low rev limit, or forced idle

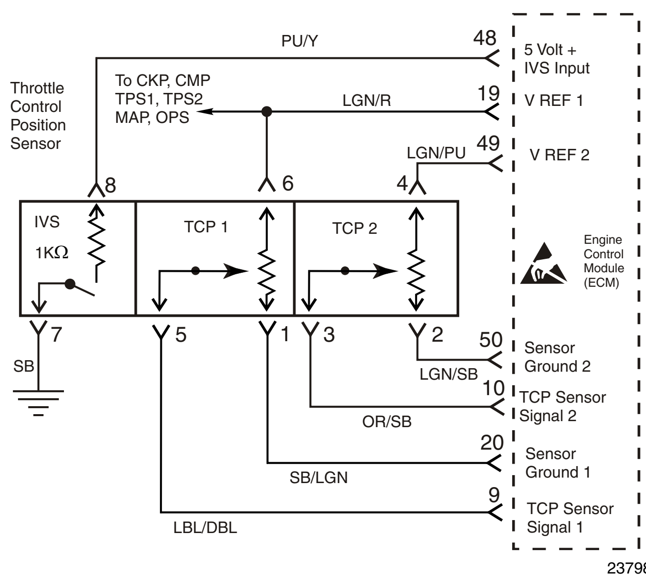
TCP Harness Connector



Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input



Troubleshooting

For TCP 1 and TCP 2 Do Not Match

See *DTC 2121 - TCP 1 Lower Than TCP 2* page 193., and DTC 2126 - TCP 1 Higher Than TCP 2” on page 197.

For TCP 1 and TCP 2 Do Not Match IVS

See *DTC 2115 - TCP 1 Higher Than IVS limit* page 187., and DTC 2116 - TCP 2 Higher Than IVS Limit” on page 189.

DTC 1511 - Trim Sender Voltage High (2-Wire)

SPN-520202 FMI-3

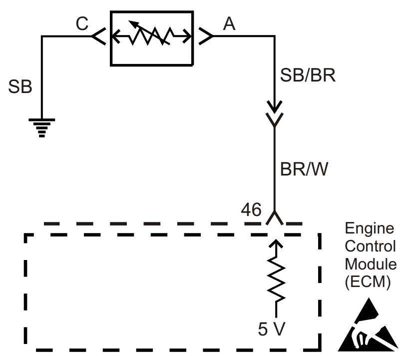
Note: If the trim sender is a three wire type trim sender See *DTC 1511 - Trim Sender Voltage High (3-Wire)* page 149.

Circuit Description

The sterndrive 2 wire trim sending unit circuit sends a 5 volt reference signal from the ECM to the sending unit on the transom shield. The circuit is internal to the ECM and is connected in parallel with the regulated 5 VDC power supply so that when no load is connected to the circuit the feedback voltage is equal to 5 VDC. This fault is active when the voltage feedback from the sensor is above 1.4 volts.

⚠ Important! Disregard this code if the boat is equipped with a digital trim gauge system.

Conditions for setting DTC



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- Sterndrive Analog Trim Sensor (2 wire)
- Check Condition- Key On, Engine OFF
- Fault Condition- Trim sending unit voltage higher than expected

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Trim Sender Circuit voltage

Key ON engine OFF, diagnostic tool connected in ECM Data mode, go to Trim Volts. Does the diagnostic tool show more than 1.4 volts?

YES: Go to *Check Trim Sender Circuit for open* on this page

NO: Go to *Check Trim Sender* on this page

Check Trim Sender Circuit for open

Disconnect trim sender connector at the engine wiring harness. Using a jumper wire, connect the trim sender signal terminal (BR/W wire) and the ground terminal (SB wire) together. Does the diagnostic tool indicate approximately 5 volts when the trim sender is disconnected and go to zero volts when the terminals are connected together?

YES: Go to *Check Trim Sender* on this page

NO: Go to *Check Trim Sender V REF* on this page

Check Trim Sender

Using a DVOM set to Ohms, connect to the SB/BR wire and the SB wire on the trim sender wire connector. Cycle the drive full up or full down while monitoring the ohmmeter. Does the circuit show open at any time during the trim cycle?

YES: Replace Trim Sender

NO: Go to *Check Trim Sender Circuit Continuity* on this page

Check Trim Sender V REF

Key ON engine OFF. Using a DVOM set to VDC, measure voltage between the V REF wire (BR/W) on the engine harness trim connector and a known good engine ground. Does DVOM display approximately 5.0 volts?

YES: Go to *Check Trim Sender Circuit Ground* on this page

NO: Go to *Check Trim Sender Circuit Continuity* on this page

Check Trim Sender Circuit Ground

Using DVOM set to Ohms, check for resistance between the SB wire on the engine harness trim connector and a known good engine ground. Do you have continuity?

YES: Go to *Check Trim Sender Circuit Continuity* on this page

NO: Repair wiring as necessary

Check Trim Sender Circuit Continuity

Disconnect ECM, Using DVOM set for Ohms, check for resistance between pin-46 in the ECM connector and the BR/W wire on the engine harness trim connector. Do you have continuity?

YES: Replace ECM

NO: Repair wiring as necessary.

DTC 1511 - Trim Sender Voltage High (3-Wire)

SPN-520202 FMI-3

Circuit Description

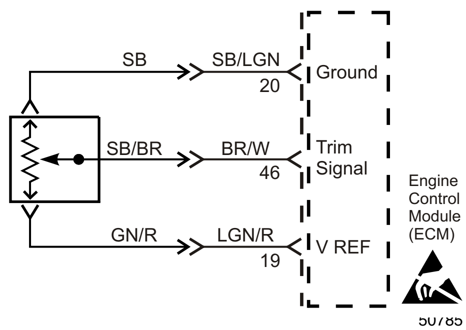
The sterndrive trim sending unit circuit sends a 5 volt reference signal from the ECM to the sending unit on the transom shield. The circuit is internal to the ECM and is connected in parallel with the regulated 5 VDC power supply so that when no load is connected to the circuit the feedback voltage is equal to 5 VDC. This fault is active when the voltage feedback from the sensor is above 1.4 volts.

NOTE! If other ground circuit related codes exist (i.e. OPS, MAP or TMAP, MAT, CKP, or CMP), carry out diagnostics and repair those faults first before addressing DTC-1511.

Important! Disregard this code if the boat is equipped with a digital trim system.

Conditions for setting DTC

- Sterndrive Analog Trim Sensor (3 wire)
- Check Condition- Key On, Engine Off
- Fault Condition- Trim sending unit voltage higher than expected



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Trim Signal Voltage

Key ON, engine OFF. Disconnect trim sender. Using a DVOM set to VDC, probe trim signal wire (BR/W) on the engine harness while connected to a known good engine ground. Does the DVOM display 5.0V?

YES: Go to *Check Trim Signal Circuit on this page*

NO: Repair wiring as necessary.

Check Trim Signal Circuit

Key ON, engine OFF. Diagnostic tool connected in Trim Volts display mode. Using a jumper wire, short the trim signal wire (BR/W) on the engine harness to a known good engine ground. Does the diagnostic tool show 0V?

YES: Go to *Check Ground Circuit on this page*

NO: Go to *Check Trim Signal for Short to Power on this page*

Check Ground Circuit

Using a jumper wire, short the trim signal wire (BR/W) to the trim ground wire (SB/LGN) on the engine harness. Does the diagnostic tool show 0V?

YES: Replace trim sender.

NO: Go to *Check Ground Wire for Short to Power on this page*

Check Trim Signal for Short to Power

Disconnect the ECM connector. Using a DVOM set to VDC, probe trim signal wire (BR/W) on the engine harness while connected to a known good engine ground. Does the DVOM display greater than 5.0V?

YES: Repair wiring as necessary.

NO: Replace ECM.

Check Ground Wire for Short to Power

Disconnect the ECM connector. Using a DVOM set to VDC, probe trim ground wire (SB/LGN) on the engine harness while connected to a known good engine ground. Does the DVOM display greater than 5.0V?

YES: Repair wiring as necessary.

NO: Replace ECM.

DTC 1611 - 5V 1/2 Simultaneous Out-of-Range

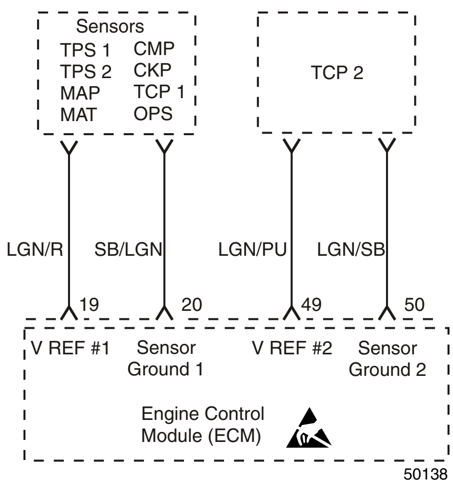
SPN-1079 FMI-31

Circuit Description

V REF #1 is a regulated 5 VDC output that supplies power to sensors and actuators. This power is generally supplied, but is not limited to hall-effect sensors, potentiometers, switches, and pressure transducers. V REF #2 is a low-current 5 VDC power supply intended solely for powering the potentiometer used for the electronic throttle control and is required for redundancy. High accuracy of the power supplies are essential to ensure proper signal scaling. Both power supplies have a feedback voltage that is monitored by the ECM to determine if the output is overloaded, shorted, or otherwise out of specification.

This fault indicates that both power supply feedback voltages are out-of-range as defined in the calibration and will only activate on electronic throttle (ETC) applications. The camshaft and crankshaft position sensors are powered by V REF #1 and my cause engine stalling due to the loss of synchronization. This fault will usually accompany multiple faults of the CMP, CKP, MAP, MAT, TCP1 and TPS1 sensors.

Conditions for setting DTC



- Powered sensors and TCP 2
- Check Condition – Engine on
- Fault Condition – High or low voltage feedback on both V REF #1 and V REF #2 out of limits.
- Action – Illuminate MIL, Buzzer Hard Warning, Low Rev Limit, and Forced Idle are enforced.

Diagnotic Aids

This code will be accompanied by other codes depending on the condition of V REF #1 and V REF #2. The accompanying codes will determine how to correct the fault.

Troubleshooting

For V REF #1 Low Voltage	Go to *DTC 0642 - V REF #1 Voltage Low (ETC)* page 121
For V REF #1 High Voltage	Go to *DTC 0643 - V REF #1 Voltage High (ETC)* page 125
For V REF #2 Low Voltage	Go to *DTC 0652 - V REF #2 Voltage Low* page 129.
For V REF #2 High Voltage	Go to *DTC 0653 - V REF #2 Voltage High* page 131.

DTC 1612 - RTI 1 Loss

SPN-629 FMI-31

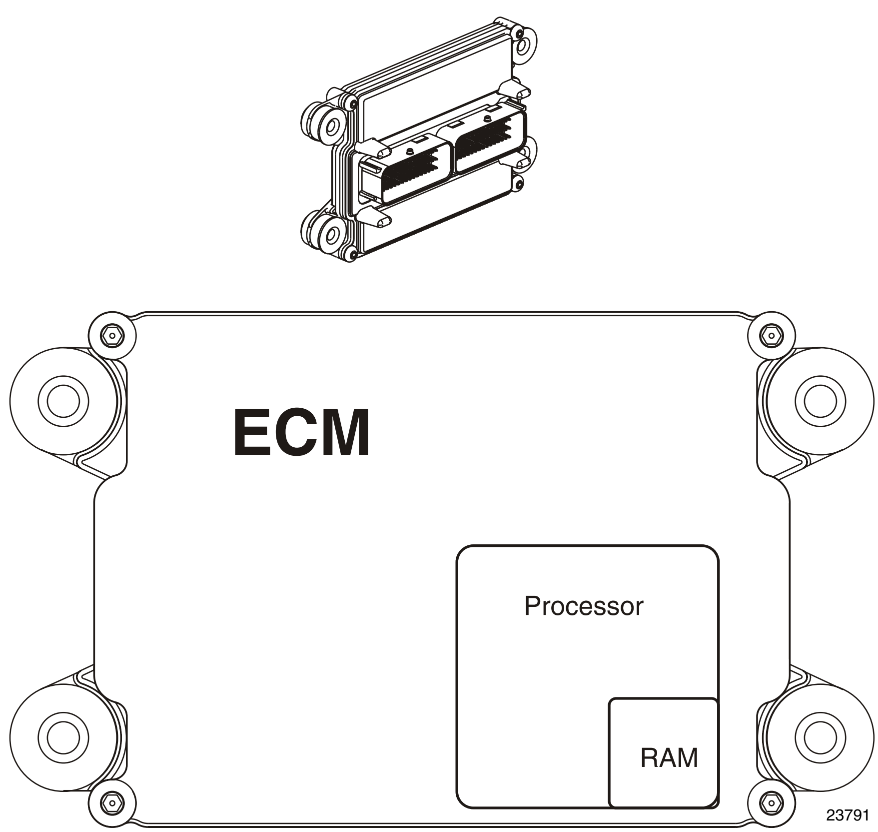
Circuit Description

The ECM runs checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, low rev limit and forced idle will be enforced. When this is enforced, the engine will only run at idle to allow boat manuvering. This is enforced until the fault is manually cleared.

Conditions for setting the DTC

- Electronic control module.
- Check condition - key ON.
- Fault condition - internal microprocessor error.
- MIL - on until code is cleared by technician.
- Low rev limit and forced idle until fault is cleared manually



23791

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check DTC does not reset

Key ON and engine running. Diagnostic tool connected in ECM Data Mode. Clear system fault code. Does DTC 1612 reset with the engine idling?

YES: Fault intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Go to *Check power and grounds* **on this page**

Check power and grounds

Check all ECM power and ground circuits. Refer to Wiring Diagrams for the engine model being serviced. Are the power and ground circuits OK?

YES: Replace ECM with known good ECM and retest.

NO: Repair wiring as necessary and retest.

DTC 1613 - RTI 2 Loss

SPN-629 FMI-31

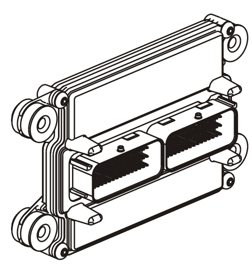
Circuit Description

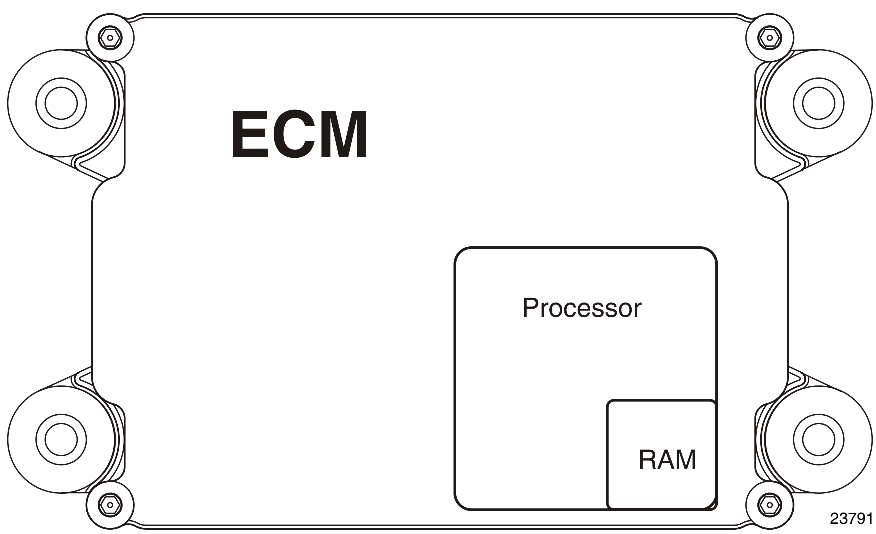
The ECM runs checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, low rev limit and forced idle will be enforced. When this is enforced, the engine will only run at idle to allow boat manuvering. This is enforced until the fault is manually cleared.

Conditions for setting the DTC

- Electronic control module.
- Check condition - key ON.
- Fault condition - internal microprocessor error.
- MIL - on until code is cleared by technician.
- Low rev limit and forced idle until fault is cleared manually





23791

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check DTC does not reset

Key ON and engine running. Diagnostic tool connected in ECM Data Mode. Clear system fault code. Does DTC 1613 reset with the engine idling?

YES: Fault intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Go to *Check power and grounds* **on this page**

Check power and grounds

Check all ECM power and ground circuits. Refer to Wiring Diagrams for the engine model being serviced. Are the power and ground circuits OK?

YES: Replace ECM with known good ECM and retest.

NO: Repair wiring as necessary and retest.

DTC 1614 - RTI 3 Loss

SPN-629 FMI-31

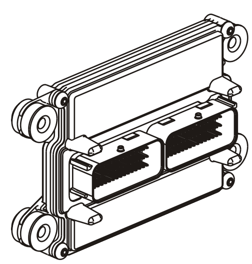
Circuit Description

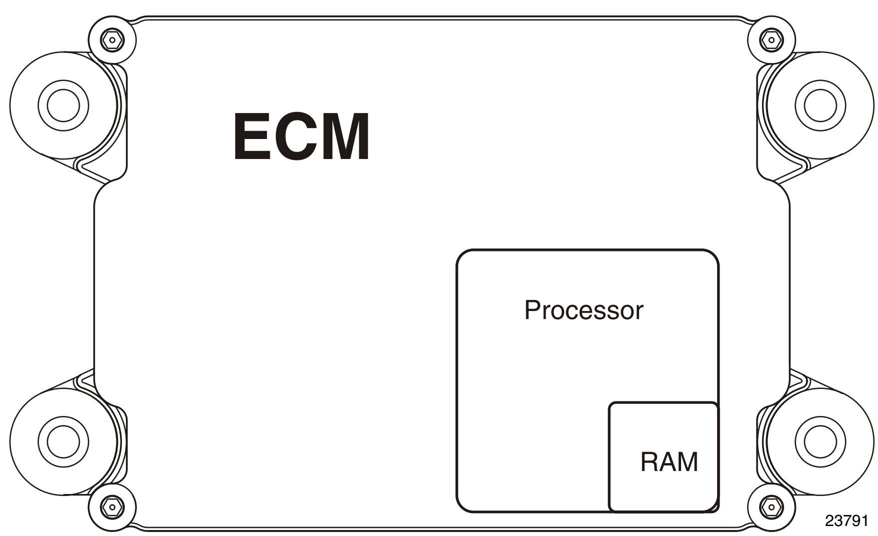
The ECM runs checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, low rev limit and forced idle will be enforced. When this is enforced, the engine will only run at idle to allow boat manuvering. This is enforced until the fault is manually cleared.

Conditions for setting the DTC

- Electronic control module.
- Check condition - key ON.
- Fault condition - internal microprocessor error.
- MIL - on until code is cleared by technician.
- Low rev limit and forced idle until fault is cleared manually





Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check DTC does not reset

Key ON and engine running. Diagnostic tool connected in ECM Data Mode. Clear system fault code. Does DTC 1614 reset with the engine idling?

YES: Fault intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Go to *Check power and grounds* **on this page**

Check power and grounds

Check all ECM power and ground circuits. Refer to Wiring Diagrams for the engine model being serviced. Are the power and ground circuits OK?

YES: Replace ECM with known good ECM and retest.

NO: Repair wiring as necessary and retest.

DTC 1615 - A/D Loss

SPN-629 FMI-31

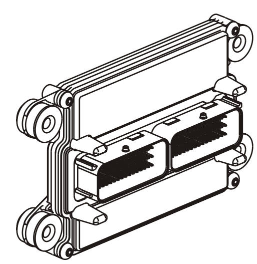
Circuit Description

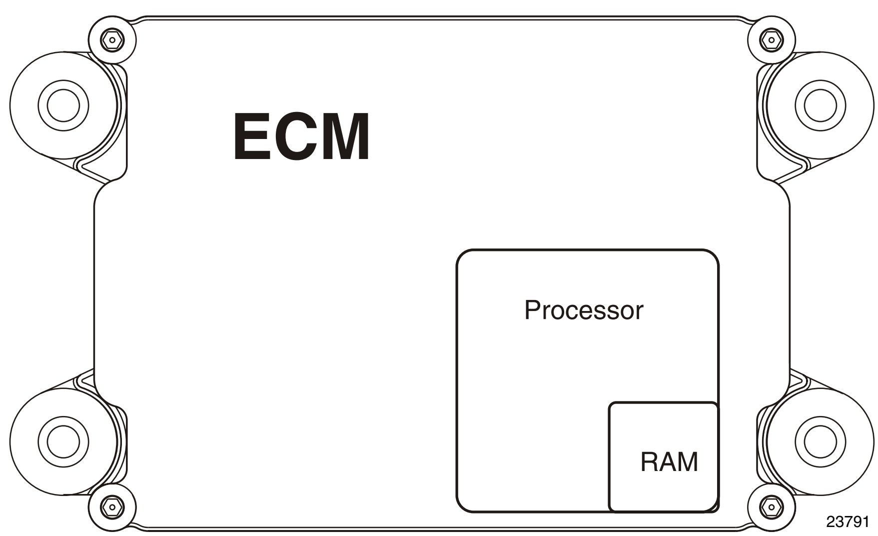
The ECM runs checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, low rev limit and forced idle will be enforced. When this is enforced, the engine will only run at idle to allow boat manuvering. This is enforced until the fault is manually cleared.

Conditions for setting the DTC

- Electronic control module.
- Check condition - key ON.
- Fault condition - internal microprocessor error.
- MIL - on until code is cleared by technician.
- Low rev limit and forced idle until fault is cleared manually





Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check DTC does not reset

Key ON and engine running. Diagnostic tool connected in ECM Data Mode. Clear system fault code. Does DTC 1615 reset with the engine idling?

YES: Fault intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Go to *Check power and grounds* **on this page**

Check power and grounds

Check all ECM power and ground circuits. Refer to Wiring Diagrams for the engine model being serviced. Are the power and ground circuits OK?

YES: Replace ECM with known good ECM and retest.

NO: Repair wiring as necessary and retest.

DTC 1616 - Invalid Interrupt

SPN-629 FMI-31

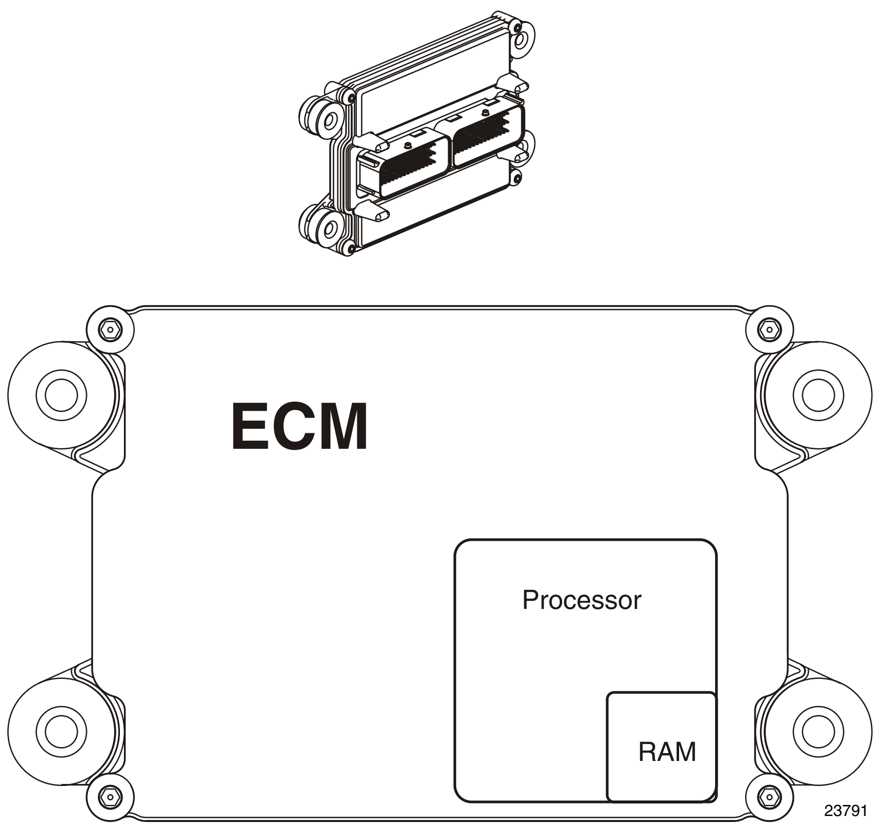
Circuit Description

The ECM runs checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, low rev limit and forced idle will be enforced. When this is enforced, the engine will only run at idle to allow boat manuvering. This is enforced until the fault is manually cleared.

Conditions for setting the DTC

- Electronic control module.
- Check condition - key ON.
- Fault condition - internal microprocessor error.
- MIL - on until code is cleared by technician.
- Low rev limit and forced idle until fault is cleared manually



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check DTC does not reset

Key ON and engine running. Diagnostic tool connected in ECM Data Mode. Clear system fault code. Does DTC 1616 reset with the engine idling?

YES: Fault intermittent, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Go to *Check power and grounds* **on this page**

Check power and grounds

Check all ECM power and ground circuits. Refer to Wiring Diagrams for the engine model being serviced. Are the power and ground circuits OK?

YES: Replace ECM with known good ECM and retest.

NO: Repair wiring as necessary and retest.

DTC 1628 - CAN Address Conflict Failure

SPN-639 FMI-1

Circuit Description

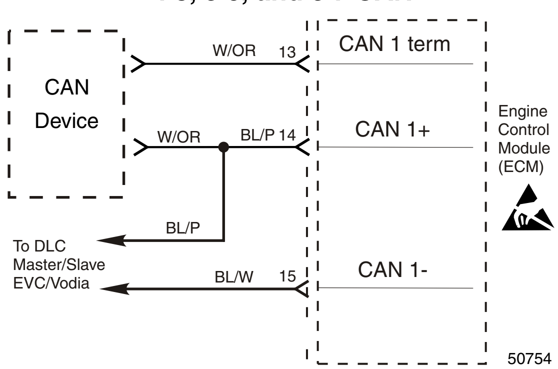
The controller area network serves as a communication portal between intelligent devices. These devices may be–but are not limited to–other engine ECM's (slave), diagnostic tools, "smart" gauges, "smart" sensors, powertrain control units, vehicle controllers, actuators, etc. The network permits several devices to communicate with each other receiving and broadcasting commands as programmed. This type of network allows devices to be added to an entire system through only two conductors and permits all other devices to broadcast and receive commands to and from the device when properly commanded. CAN1 is used for general network communication including gauge display, diagnostic tool communication, and other general 3rd party traffic. CAN2 is reserved solely for engine control (engine synchronization, throttle control, vehicle controller commands, etc.) and is limited to Volvo Penta ETC engines only.

This fault indicates that there are two (2) or more devices on the network that use the same source address.

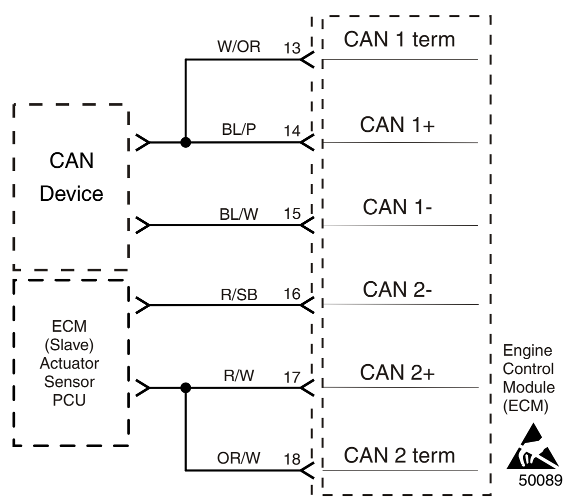
Conditions for Setting DTC

- CAN device(s)
- Check Condition- Key On, Engine on
- Fault Condition- two or more devices on the network that contain the same SA
- Corrective Action(s)- Sound audible warning or illuminate secondary warning lamp
- Non-emissions related fault

4.3, 5.0, and 5.7 CAN



8.1 CAN



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Verify that DTC 1628 is Active

Connect diagnostic tool. Key ON, engine running. Set diagnostic tool to "Run Mode"= Running. Is there more than one engine on the CAN?

YES: Go to *Disconnect Secondary Engine* **on this page.**

NO: Go to *Disconnect One Device* **on this page.**

Disconnect Secondary Engine

Key OFF. Disconnect the second engine from the network. Key ON. Does the diagnostic tool indicate DTC 1628 still active?

YES: Go to *Disconnect One Device* **on this page.**

NO: Configure secondary engine as slave. Reconnect engine to the network.

Disconnect One Device

Key OFF. Disconnect one (1) device from the CAN. Wait three (3) seconds. Key ON. Does diagnostic tool indicate DTC 1628 still active?

YES: Repeat this step.

NO: Remove last device that set the DTC 1628 Code. Contact device manufacturer to request an alternate SA.

DTC 1631 - Water Temperature Gauge Open/Short to Ground

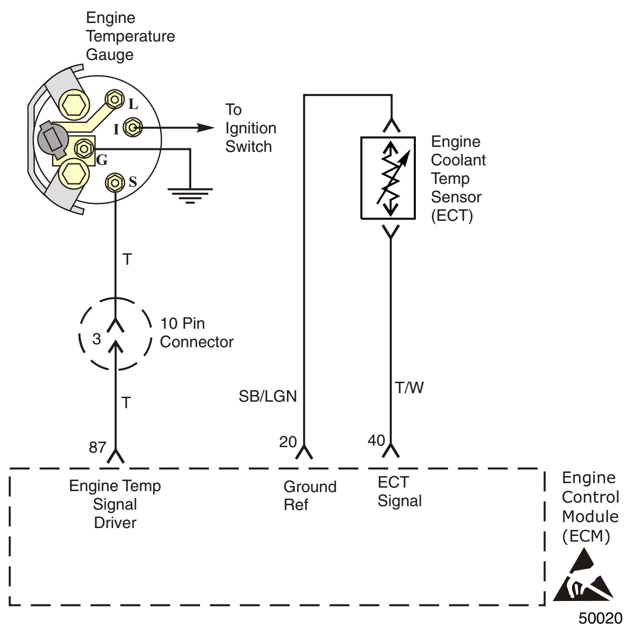
SPN-697 FMI-5

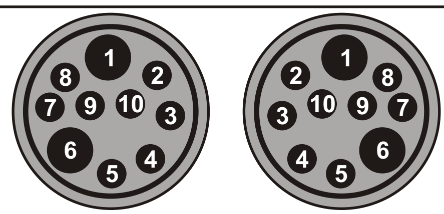
Circuit Description

The Water Temperature gauge signal sent from the sending unit to the ECM where it is interpreted and then sent to the gage signal wire.

Conditions for setting DTC

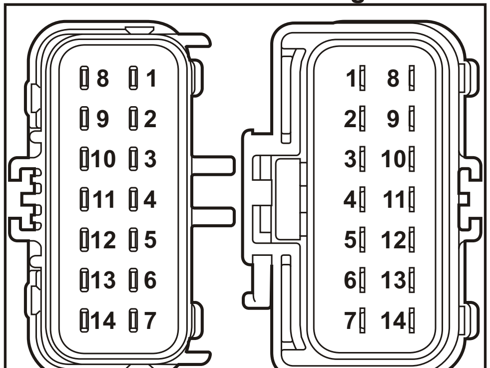
- Analog gauge, proportional actuator, on-off device
- Check Condition- Key-ON, Engine Running
- Fault Condition- Output circuit open or shorted to ground
- Corrective Action(s)- Trigger buzzer/secondary warning device





10 Pin Connectors

Extension Engine



14 Pin Connectors 50755

Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Extension Cable for Open

Disconnect the extension cable from the engine harness connector. Using a DVOM set to Ohms, probe the signal wire pin-3 of the extension cable connector to the signal wire (Tan) connection on the temperature gauge. Do you have continuity?

YES: Go to *Check Engine Harness for Open on this page*

NO: Repair wiring as necessary.

Check Engine Harness for Open

Disconnect the ECM connector. Using a DVOM set to Ohms, probe ECM connector pin-87 to signal wire pin-3 of the engine harness connector. Do you have continuity?

YES: Go to *Check Extension Cable for Ground on this page*

NO: Repair wiring as necessary.

Check Extension Cable for Ground

Disconnect the signal wire (Tan) from the temperature gauge. Using a DVOM set to Ohms, probe the signal wire pin-3 of the extension cable connector to a known good ground on the control panel. Do you have continuity?

YES: Repair wiring as necessary.

NO: Go to *Check Engine Harness for Ground on this page*

Check Engine Harness for Ground

Using a DVOM set to Ohms, probe the signal wire (pin-3 on engine harness connector or pin-87 on ECM connector) by grounding to a known good engine ground. Do you have continuity?

YES: Repair wiring as necessary.

NO: Replace ECM.

DTC 1631 - Water Temperature Gauge Open/Short to Ground

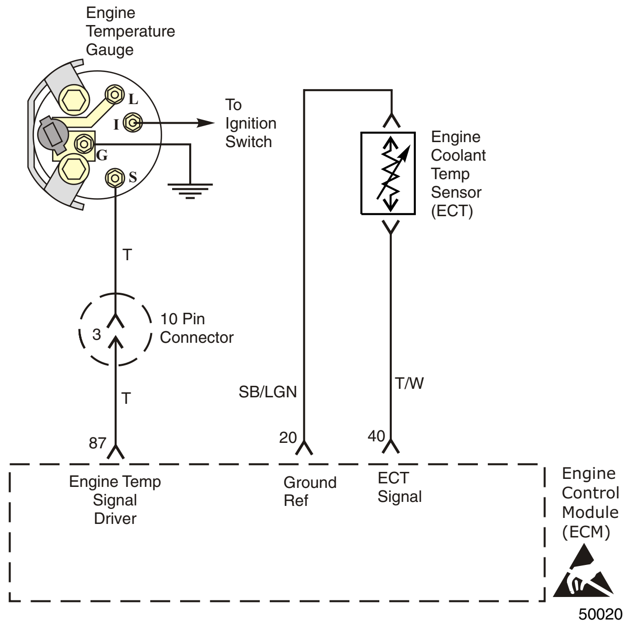
SPN-697 FMI-5

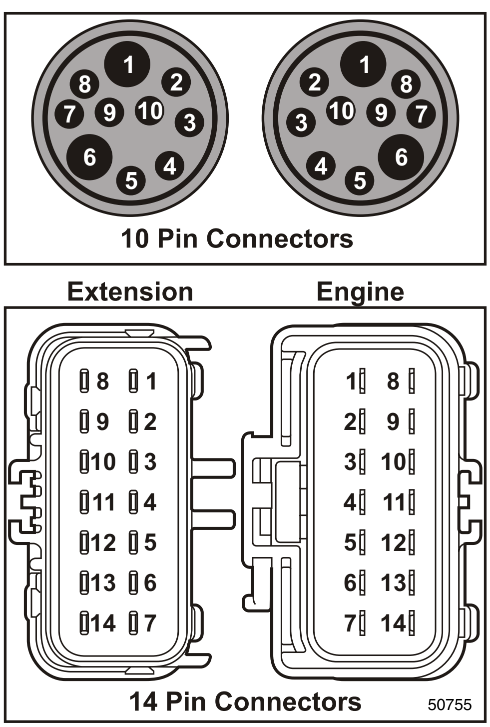
Circuit Description

The Water Temperature gauge signal sent from the sending unit to the ECM where it is interpreted and then sent to the gage signal wire.

Conditions for setting DTC

- Analog gauge, proportional actuator, on-off device
- Check Condition- Key-ON, Engine Running
- Fault Condition- Output circuit open or shorted to ground
- Corrective Action(s)- Trigger buzzer/secondary warning device





Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Extension Cable for Open

Disconnect the extension cable from the engine harness connector. Using a DVOM set to Ohms, probe the signal wire pin-3 of the extension cable connector to the signal wire (Tan) connection on the temperature gauge. Do you have continuity?

YES: Go to *Check Engine Harness for Open on this page*

NO: Repair wiring as necessary.

Check Engine Harness for Open

Disconnect the ECM connector. Using a DVOM set to Ohms, probe ECM connector pin-87 to signal wire pin-3 of the engine harness connector. Do you have continuity?

YES: Go to *Check Extension Cable for Ground on this page*

NO: Repair wiring as necessary.

Check Extension Cable for Ground

Disconnect the signal wire (Tan) from the temperature gauge. Using a DVOM set to Ohms, probe the signal wire pin-3 of the extension cable connector to a known good ground on the control panel. Do you have continuity?

YES: Repair wiring as necessary.

NO: Go to *Check Engine Harness for Ground on this page*

Check Engine Harness for Ground

Using a DVOM set to Ohms, probe the signal wire (pin-3 on engine harness connector or pin-87 on ECM connector) by grounding to a known good engine ground. Do you have continuity?

YES: Repair wiring as necessary.

NO: Replace ECM.

DTC 1632 - Water Temperature Gauge Short to Power

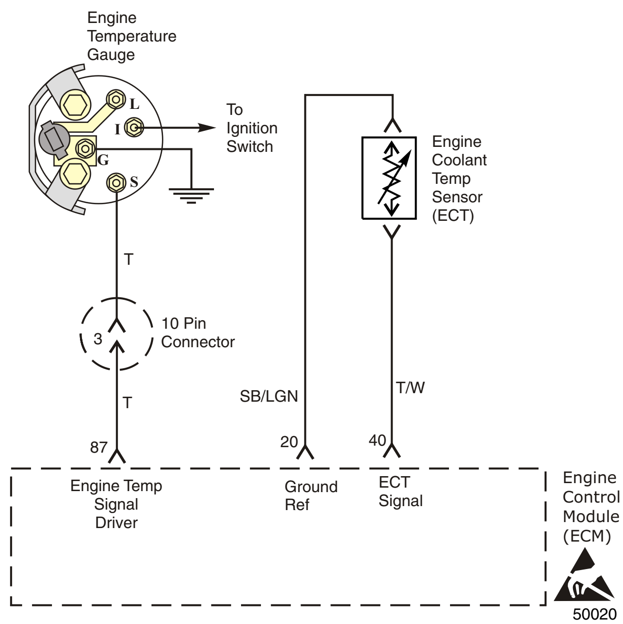
SPN-697 FMI-6

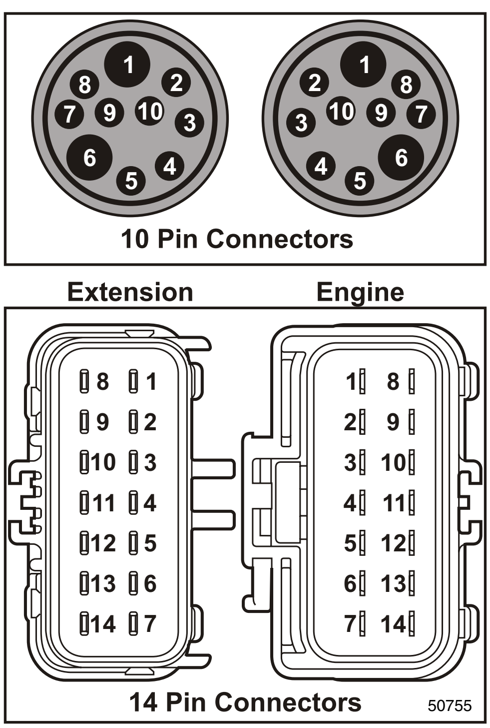
Circuit Description

The Water Temperature gauge signal sent from the sending unit to the ECM where it is interpreted and then sent to the gage signal wire.

Conditions for setting DTC

- Analog gauge, proportional actuator, on-off device
- Check Condition- Key-ON, Engine Running
- Fault Condition- output circuit shorted to power.
- Corrective Action(s)- Trigger buzzer/secondary warning device





Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Signal Circuit for Short to Power

Disconnect the signal wire (Tan) connection from the temperature gauge. Using a DVOM set to VDC, probe the signal wire (Tan) using a known good engine ground. Does the DVOM read battery voltage?

YES: Go to *Check Engine Harness for Short to Power on this page*

NO: Replace temperature gauge.

Check Engine Harness for Short to Power

Disconnect the extension harness connector from the engine harness. Using a DVOM set to VDC, probe the signal wire (pin-3) on the engine harness using a known good engine ground. Does the DVOM read battery voltage?

YES: Repair the engine harness wiring as necessary.

NO: Repair the extension harness wiring as necessary.

DTC 1633 - Oil Pressure Gauge Open / Short to Ground

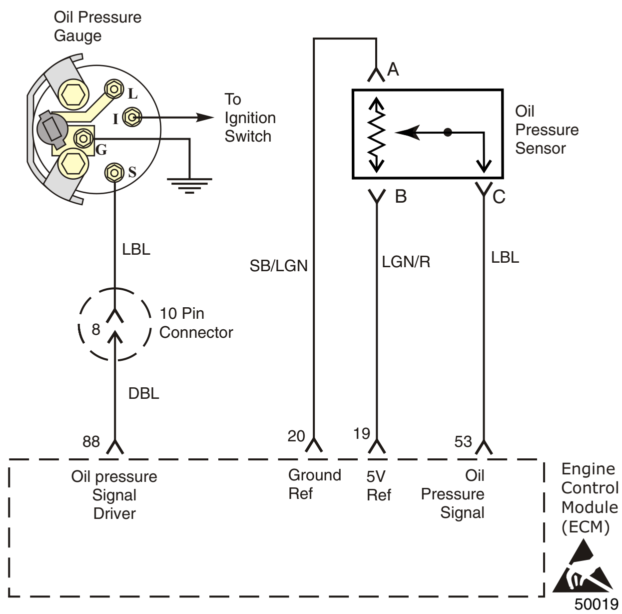
SPN-698 FMI-5

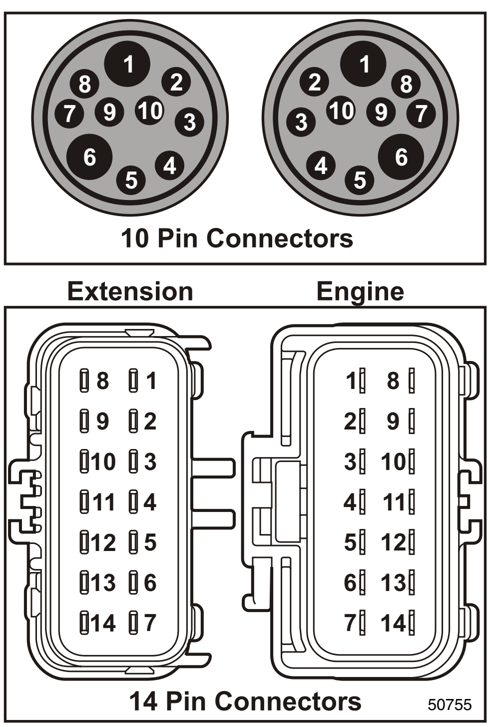
Circuit Description

The oil pressure gauge signal sent from the sending unit to the ECM where it is interpreted and then sent to the gage signal wire.

Conditions for setting DTC

- Analog gauge, proportional actuator, on-off device
- Check Condition- Key-ON, Engine Running
- Fault Condition- Output circuit open or shorted to ground
- Corrective Action(s)- Trigger buzzer/secondary warning device





Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Extension Cable for Open

Disconnect the extension cable from the engine harness connector. Using a DVOM set to Ohms, probe the signal wire pin-8 of the extension cable connector to the signal wire (DBL) connection on the oil pressure gauge. Do you have continuity?

YES: Go to *Check Engine Harness for Open on this page*

NO: Repair wiring as necessary.

Check Engine Harness for Open

Disconnect the ECM connector. Using a DVOM set to Ohms, probe ECM connector pin-88 to signal wire pin-8 of the engine harness connector. Do you have continuity?

YES: Go to *Check Extension Cable for Ground on this page*

NO: Repair wiring as necessary.

Check Extension Cable for Ground

Disconnect the signal wire (DBL) from the oil pressure gauge. Using a DVOM set to Ohms, probe the signal wire pin-8 of the extension cable connector to a known good ground on the control panel. Do you have continuity?

YES: Repair wiring as necessary.

NO: Go to *Check Engine Harness for Ground on this page*

Check Engine Harness for Ground

Using a DVOM set to Ohms, probe the signal wire (pin-8 on engine harness connector or pin-88 on ECM connector) by grounding to a known good engine ground. Do you have continuity?

YES: Repair wiring as necessary.

NO: Replace ECM.

DTC 1634 - Oil Pressure Gauge Short to Power

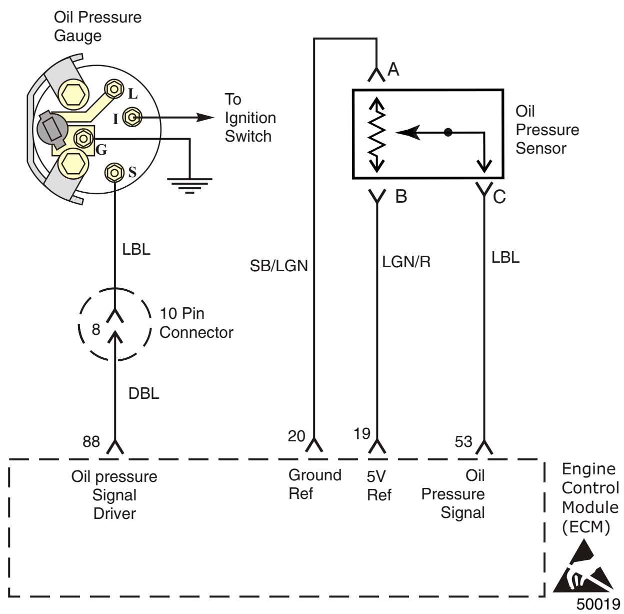
SPN-698 FMI-6

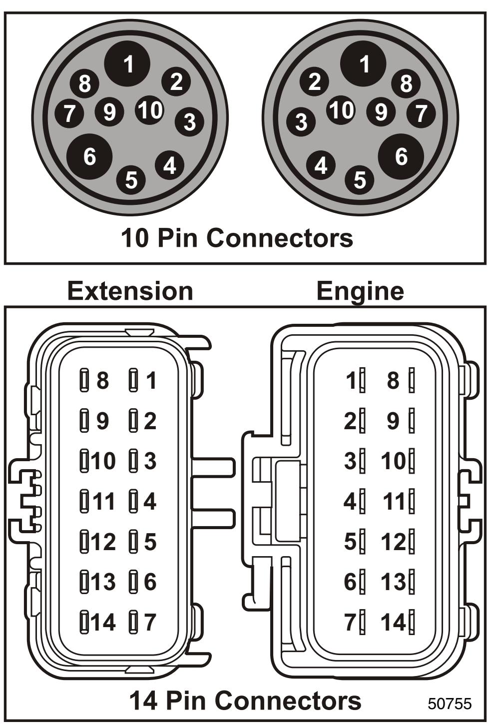
Circuit Description

The oil pressure gauge signal sent from the sending unit to the ECM where it is interpreted and then sent to the gage signal wire.

Conditions for setting DTC

- Analog gauge, proportional actuator, on-off device
- Check Condition- Key-ON, Engine Running
- Fault Condition- output circuit shorted to power.
- Corrective Action(s)- Trigger buzzer/secondary warning device.





Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Signal Circuit for Short to Power

Disconnect the signal wire (DBL) connection from the oil pressure gauge. Using a DVOM set to VAC, probe the signal wire (DBL) using a known good engine ground. Does the DVOM read battery voltage?

YES: Go to *Check Engine Harness for Short to Power on this page*

NO: Replace oil pressure gauge.

Check Engine Harness for Short to Power

Disconnect the extension harness connector from the engine harness. Using a DVOM set to VAC, probe the signal wire (pin-8) on the engine harness using a known good engine ground. Does the DVOM read battery voltage?

YES: Repair the engine harness wiring as necessary.

NO: Repair the extension harness wiring as necessary.

DTC 1635 - Trim Position Gauge Open / Short to Ground

SPN-699 FMI-5

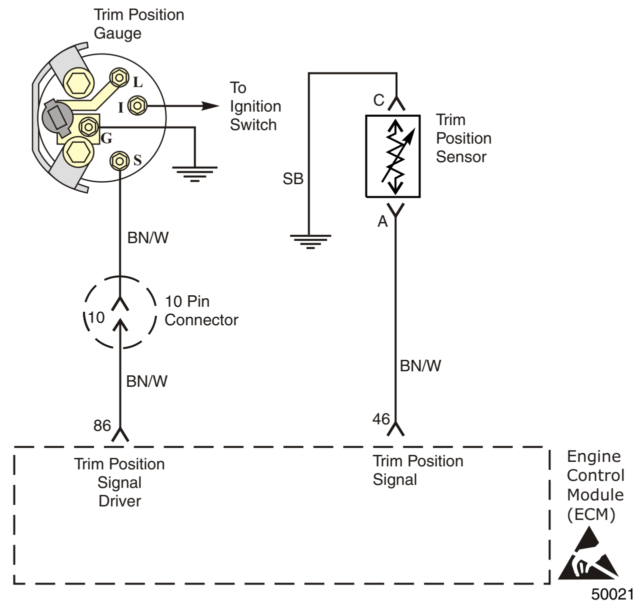
Circuit Description

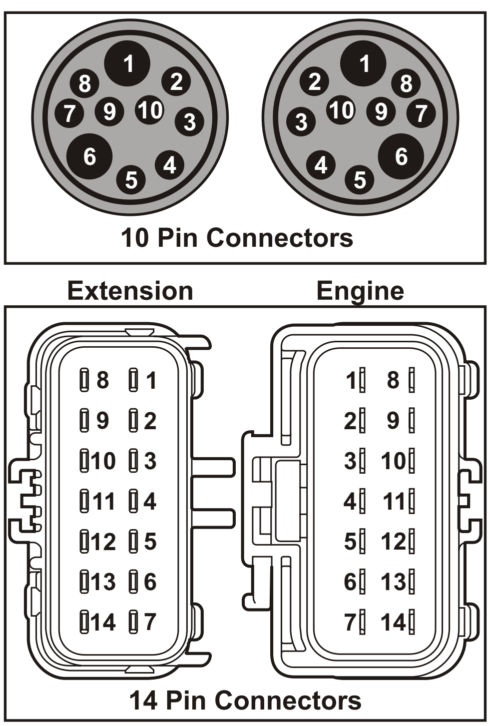
The trim position gauge signal sent from the sending unit to the ECM where it is relayed to the gage signal wire.

Important! Disregard this code if the boat is equipped with a digital trim gauge.

Conditions for setting DTC

- Analog gauge, proportional actuator, on-off device
- Check Condition- Key-ON, Engine Running
- Fault Condition- Output circuit open or shorted to ground
- Corrective Action(s)- Trigger buzzer/secondary warning device





Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Extension Cable for Open

Disconnect the extension cable from the engine harness connector. Using a DVOM set to Ohms, probe the signal wire pin-10 of the extension cable connector to the signal wire (BR/W) connection on the trim gauge. Do you have continuity?

YES: Go to *Check Engine Harness for Open on this page*

NO: Repair wiring as necessary.

Check Engine Harness for Open

Disconnect the ECM connector. Using a DVOM set to Ohms, probe ECM connector pin-86 to signal wire pin-10 of the engine harness connector. Do you have continuity?

YES: Go to *Check Extension Cable for Ground on this page*

NO: Repair wiring as necessary.

Check Extension Cable for Ground

Disconnect the signal wire (BR/W) from the trim gauge. Using a DVOM set to Ohms, probe the signal wire pin-10 of the extension cable connector to a known good ground on the control panel. Do you have continuity?

YES: Repair wiring as necessary.

NO: Go to *Check Engine Harness for Ground on this page*

Check Engine Harness for Ground

Using a DVOM set to Ohms, probe the signal wire (pin-10 on engine harness connector or pin-86 on ECM connector) by grounding to a known good engine ground. Do you have continuity?

YES: Repair wiring as necessary.

NO: Replace ECM.

DTC 1636 - Trim Position Gauge Short to Power

SPN-699 FMI-6

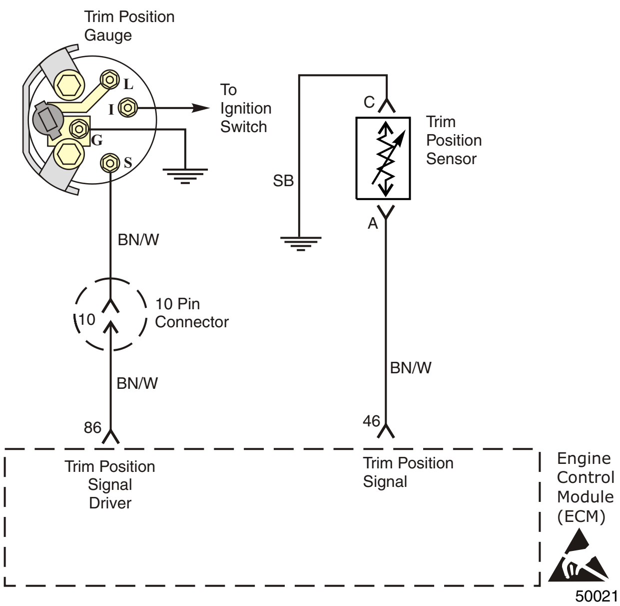
Circuit Description

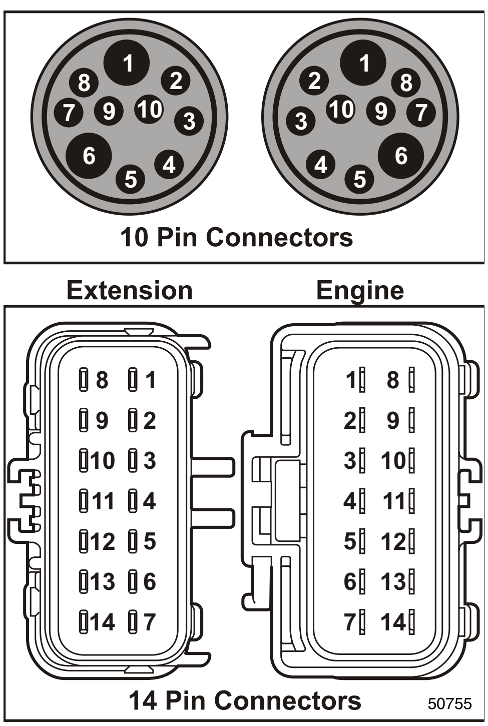
The trim position gauge signal sent from the sending unit to the ECM where it is relayed to the gage signal wire.

Important! Disregard this code if the boat is equipped with a digital trim gauge.

Conditions for setting DTC

- Analog gauge, proportional actuator, on-off device
- Check Condition- Key-ON, Engine Running
- Fault Condition- Output circuit shorted power
- Corrective Action(s)- Trigger buzzer/secondary warning device





Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Signal Circuit for Short to Power

Disconnect the signal wire (BR/W) connection from the trim gauge. Using a DVOM set to VAC, probe the signal wire (BR/W) using a known good engine ground. Does the DVOM read battery voltage?

YES: Go to *Check Engine Harness for Short to Power on this page*

NO: Replace trim gauge.

Check Engine Harness for Short to Power

Disconnect the extension harness connector from the engine harness. Using a DVOM set to VAC, probe the signal wire (pin-10) on the engine harness using a known good engine ground. Does the DVOM read battery voltage?

YES: Repair the engine harness wiring as necessary.

NO: Repair the extension harness wiring as necessary.

DTC 1641 - Buzzer Control Ground Short

SPN-920 FMI-4

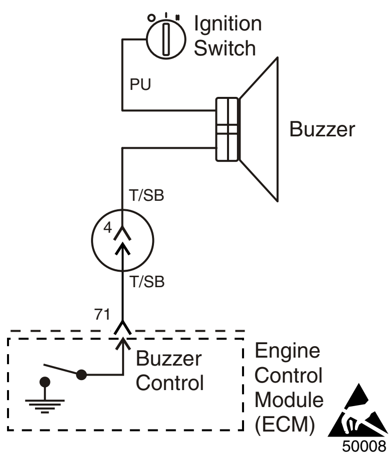
Circuit Description

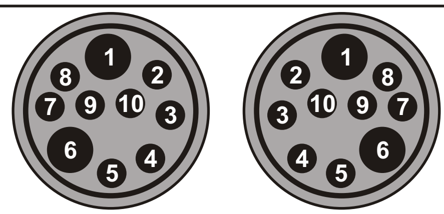
The buzzer is energized from ignition switch at the instrument panel. It is energized whenever the ignition key is turned to the ON position. The buzzer circuit is driven through pin 4 of the main engine harness connector (10 pin) located on the starboard rear of the engine. The control for the circuit is an ECM driver that grounds pin 76 at the ECM which completes the circuit and turns the buzzer on. The ECM will activate the buzzer for three beeps during key ON cycle as a test.

Any time the ECM detects a soft warning or a hard warning, the ECM actuates the buzzer driver. When a soft warning is indicated, the ECM will turn the buzzer on for 500ms and off 5000ms. When a hard warning is indicated, the ECM will turn the buzzer on for 500ms and off for 250ms.

Conditions for Setting DTC

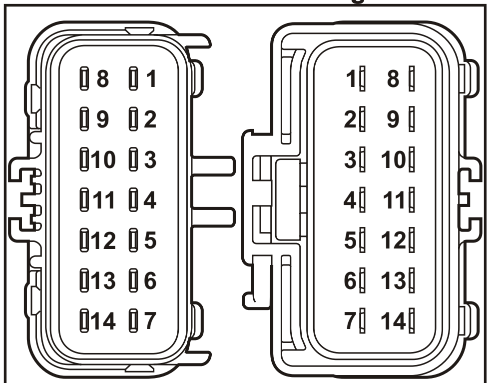
- Check condition - Key ON
- Buzzer on continuously
- No soft or hard warning active
- MIL - active during active fault and for 2 seconds after active fault.





10 Pin Connectors

Extension Engine



14 Pin Connectors 50755

Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Extension Harness for Short

Disconnect extension connector from engine harness. Using a DVOM connected to a known good engine ground, probe terminal 4 (T/SB wire) of the extension harness connector. Do you have continuity?

YES: Repair harness wiring as necessary.

NO: Go to *Check Engine Harness Circuit* on this page.

Check Engine Harness Circuit

Using a DVOM connected to a known good engine ground, probe terminal 4 (T/SB wire) of the engine harness connector. Do you have continuity?

YES: Repair harness wiring as necessary.

NO: Go to *Check Engine Harness for Short* on this page.

Check Engine Harness for Short

Disconnect the EMC connector. Using a DVOM connected to a known good engine ground, probe terminal 4 (T/SB wire) of the engine harness connector. Do you have continuity?

YES: Repair harness wiring as necessary.

NO: Replace ECM.

DTC 1642 - Buzzer Open

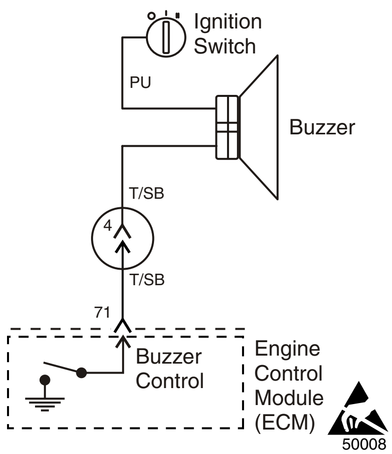
SPN-920 FMI-5

Circuit Description

The buzzer is energized from ignition switch at the instrument panel. It is energized whenever the ignition key is turned to the ON position. The buzzer circuit is driven through pin 4 of the main engine harness connector located on the starboard rear of the engine. The control for the circuit is an ECM driver that grounds pin 76 at the ECM which completes the circuit and turns the buzzer on. The ECM will activate the buzzer for three beeps during key ON cycle as a test.

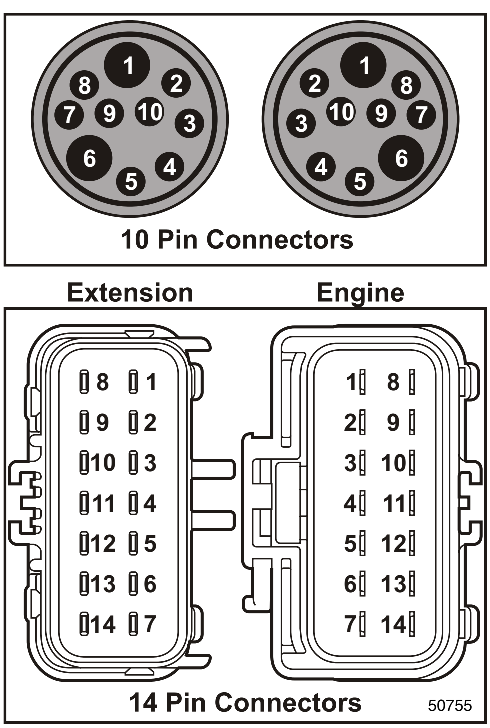
Any time the ECM detects a soft warning or a hard warning, the ECM actuates the buzzer driver. When a soft warning is indicated, the ECM will turn the buzzer on for 500ms and off 5000ms. When a hard warning is indicated, the ECM will turn the buzzer on for 500ms and off for 250ms.

Conditions for Setting DTC



- Check condition - Key ON
- Buzzer inoperative
- No soft or hard warning active
- MIL - active during active fault and for 2 seconds after active fault.

Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –



Troubleshooting

Check code is valid and active	Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.
Check for Power to Buzzer	Key ON, engine OFF. Using a test light connected to a known good ground, probe power side of buzzer (PU wire). Does light illuminate? **YES: Go to *Check Buzzer* on this page.** **NO:** Repair power side wiring as necessary.
Check Buzzer	Key ON, engine OFF. Connect one end of a jumper wire to a known good ground. Attach other end to signal side of the buzzer (T/SB wire). Does buzzer sound? **YES: Go to *Check Continuity of Extension Cable* on this page.** **NO:** Replace buzzer.
Check Continuity of Extension Cable	Disconnect boat wiring harness connector from the engine connector. Using a DVOM set to Ohms, probe terminal 4 on the extension harness to signal wire on buzzer. Is there continuity? **YES: Go to *Check Buzzer Connection* on this page.** **NO:** Repair extension harness as necessary.
Check Buzzer Connection	Check buzzer connection on signal side (T/SB wire) for loose connection, corrosion, and damage. Is there a problem with the connection? **YES:** Repair connection as necessary. **NO:** Go to *Check Continuity of Buzzer Signal Wire on Engine Harness* **on this page.**
Check Continuity of Buzzer Signal Wire on Engine Harness	Disconnect ECM connector. Using a DVOM set to Ohms, probe terminal 4 (T/SB wire) of engine connector to pin-76 of the EVC connector. Is there continuity? **YES:** Go to *Check ECM Pin-76* **on this page.** **NO:** Repair wiring as necessary.
Check ECM Pin-76	Check ECM connector pin-76 to see if it is loose, corroded or damaged. Also check pin-76 on ECM to see if it is loose, corroded or damaged. Is there a problem with either pin? **YES:** Repair as necessary. **NO:** Replace ECM.

DTC 1643 - Buzzer Control Short to Power

SPN-920 FMI-3

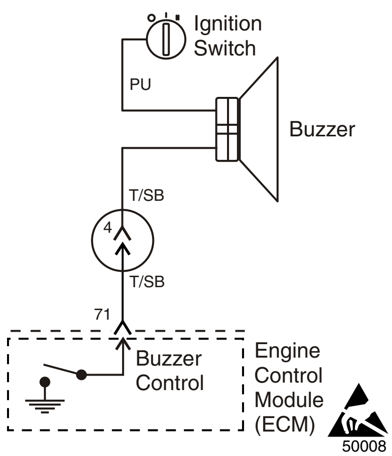
Circuit Description

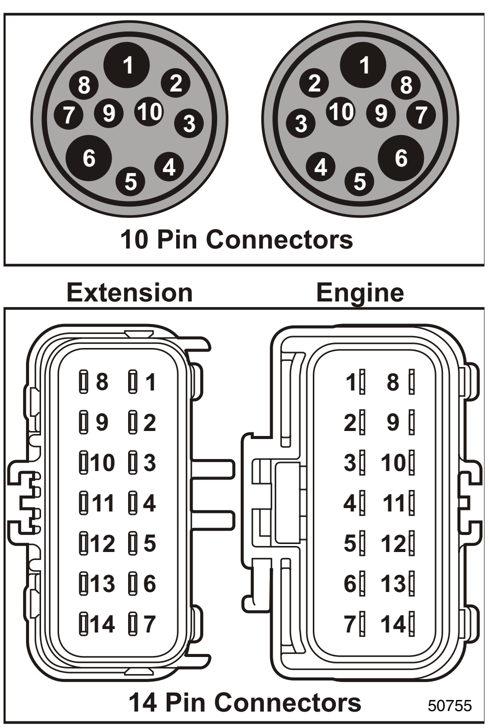
The buzzer is energized from ignition switch at the instrument panel. It is energized whenever the ignition key is turned to the ON position. The buzzer circuit is driven through pin 4 of the main engine harness connector (10 pin) located on the starboard rear of the engine. The control for the circuit is an ECM driver that grounds pin 76 at the ECM which completes the circuit and turns the buzzer on. The ECM will activate the buzzer for three beeps during key ON cycle as a test.

Any time the ECM detects a soft warning or a hard warning, the ECM actuates the buzzer driver. When a soft warning is indicated, the ECM will turn the buzzer on for 500ms and off 5000ms. When a hard warning is indicated, the ECM will turn the buzzer on for 500ms and off for 250ms.

Conditions for Setting DTC

- Check condition - Key ON
- Buzzer on continuously
- No soft or hard warning active
- MIL - active during active fault and for 2 seconds after active fault.





Pin	Color	Function
1	Solid Black	Ground
2	Gray	Tachometer
3	Tan	Water Temperature
4	Tan/Solid Black	Buzzer
5	Purple	Ignition
6	Red/Purple	Switched Power
7	Yellow/Red	Start
8	Dark Blue	Oil Pressure
9	Green/Yellow	MIL
10	Brown/White	Trim Gauge
11	–	–
12	–	–
13	Blue/Pink	CAN 1 +
14	Blue/White	CAN 1 –

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Extension Harness for Short

Disconnect extension connector from engine harness. Using a DVOM set to VDC and connected to a known good engine ground, probe terminal 4 (T/SB wire) of the extension harness connector. Do you have 12 Volts?

YES: Go to *Check Buzzer for Resistance on this page*.

NO: Go to *Check Engine Harness for Short on this page*.

Check Buzzer for Resistance

Disconnect buzzer signal and power wires. Using a DVOM set to Ohms, measure resistance across buzzer. Is resistance 0 Ohms?

YES: Replace buzzer.

NO: Repair harness wiring as necessary.

Check Engine Harness for Short

Using a DVOM set to VDC and connected to a known good engine ground, probe terminal 4 (T/SB wire) of the engine harness connector. Do you have 12 Volts?

YES: Repair harness wiring as necessary.

NO: Replace ECM.

DTC 2111 - Throttle Unable To Close

SPN-51 FMI-7

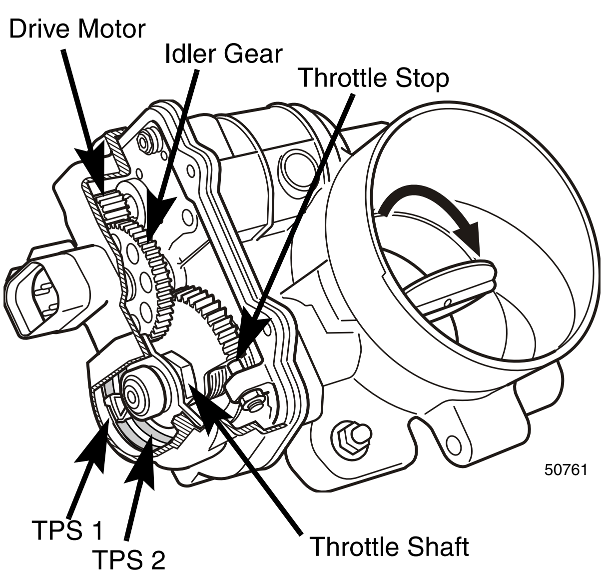
Circuit Description

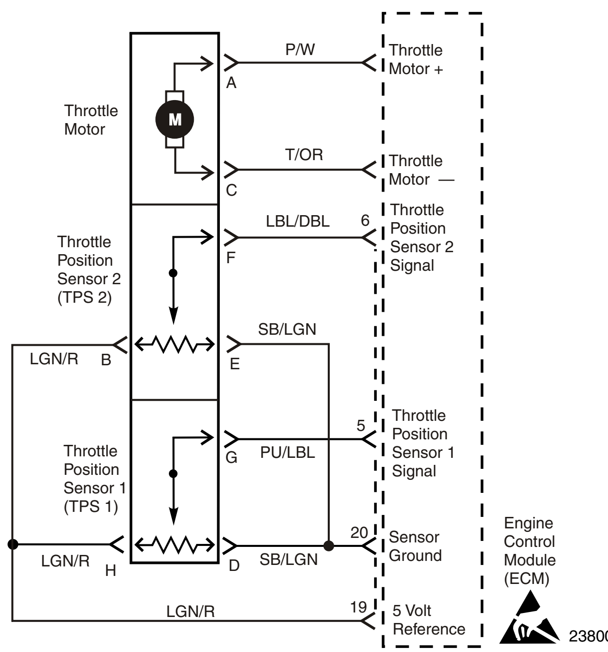
There are 2 throttle position sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

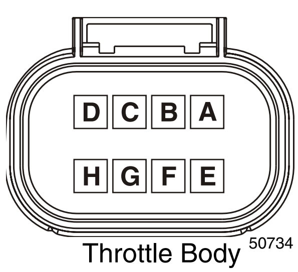
This fault will set if the throttle command is 20 percent less than the actual throttle position. During this active fault the MIL light will be on and forced idle mode will be activated.

Conditions for setting the DTC

- Throttle position sensor.
- Check condition - cranking or running.
- Fault condition - throttle command is 20 percent less than throttle position for 200ms or longer.
- MIL - on during active fault.
- Low rev limit enforced.
- Forced idle enforced.







Pin	Function
A	DBW +
B	5 V ref
C	DBW –
D	Ground

Pin	Function
E	Ground
F	TPS2
G	TPS1
H	5 V ref

Troubleshooting

If DTC-0121, 0122, 0123, 0221, 0222, 0223, or any other DTCs related to TPS are present, repair these codes before proceeding.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Throttle Operation

Key ON, engine OFF. Diagnostic tool connected in drive by wire (DBW) test mode. Advance throttle until the throttle command is 100%. Does the throttle plate fully open?

YES: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NO: Go to *Check for Foreign Objects in Throttle Bore* on this page

Check for Foreign Objects in Throttle Bore

Check throttle bore for foreign object that may be restricting throttle movement. Did you find a problem?

⚠ **Warning! Disconnect Throttle body wiring harness connector before attempting to remove any objects from the throttle plate area. Do not reach into the throttle plate area with fingers. Serious injury or amputation could occur if throttle plate is energized with fingers in the throttle plate area.**

YES: Remove foreign object.

NO: Go to *Check ECT connector* on this page

Check ECT connector

Check throttle connector terminals for damage, corrosion, or contamination. Did you find a problem?

YES: Repair as necessary

NO: Go to *Check drive motor circuit* on this page

Check drive motor circuit

Key ON engine OFF. Disconnect ECT wiring harness connector. Using DVOM, check for battery voltage on ECT connector pin-A and pin-C.Do you have battery voltage at both pins.

YES: Go to *Check drive motor (+) circuit continuity* on this page

NO: Repair open circuit.

Check drive motor (+) circuit continuity

Key OFF. Disconnect ECM connector. Using DVOM, check for continuity between throttle connector drive motor wire pin-A and ECM connector pin-82. Do you have continuity with no resistance?

YES: Go to *Check drive motor (—) circuit continuity* on this page

NO: Repair wiring as necessary.

Check drive motor (—) circuit continuity

Using DVOM, check for continuity between throttle connector drive motor wire pin-C and ECM connector pin-83. Do you have continuity?

YES: Replace Throttle body.

NO: Repair wiring as necessary.

DTC 2112 - Throttle Unable To Open

SPN-51 FMI-7

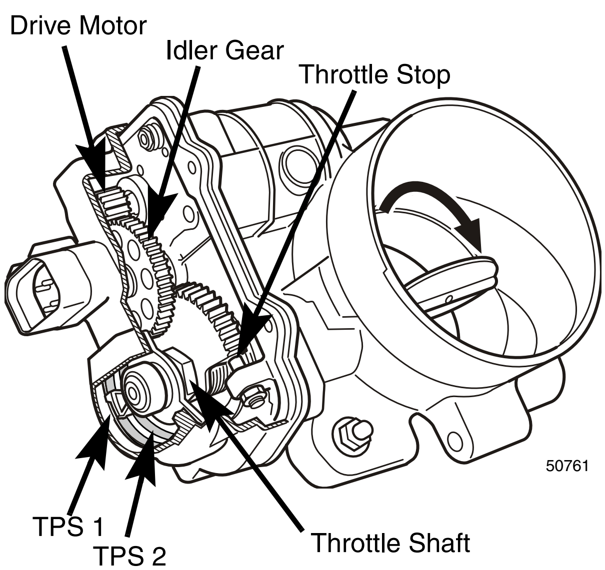
Circuit Description

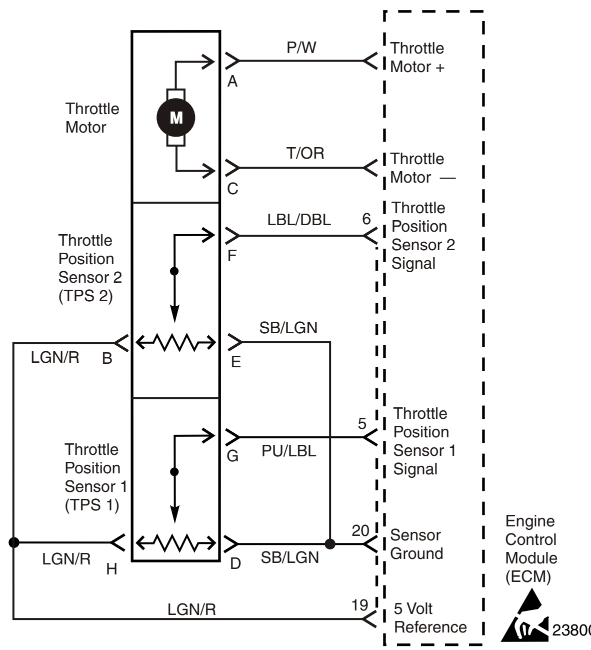
There are 2 throttle position sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

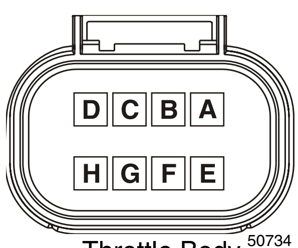
This fault will set if the throttle command is 20 percent or more than the actual throttle position. During this active fault the MIL light will be on and the engine will run in forced idle mode.

Conditions for setting the DTC

- Throttle position sensor.
- Check condition - cranking or running.
- Fault condition - throttle command is 20 percent more than actual throttle position.
- MIL - on during active fault.
- Engine forced idle enforced.







Throttle Body

Pin	Function
A	DBW +
B	5 V ref
C	DBW –
D	Ground

Pin	Function
E	Ground
F	TPS2
G	TPS1
H	5 V ref

Troubleshooting

If DTC-0121, 0122, 0123, 0221, 0222, 0223, or any other DTCs related to TPS are present, repair these codes before proceeding.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check Throttle Operation

Key ON, engine OFF. Diagnostic tool connected in drive by wire (DBW) test mode. Advance throttle until the throttle command is 100%. Does the throttle plate fully open?

YES: Intermittent problem, See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

NO: Go to *Check for Foreign Objects in Throttle Bore* on this page

Check for Foreign Objects in Throttle Bore

Check throttle bore for foreign object that may be restricting throttle movement. Did you find a problem?

⚠ **Warning! Disconnect Throttle body wiring harness connector before attempting to remove any objects from the throttle plate area. Do not reach into the throttle plate area with fingers. Serious injury or amputation could occur if throttle plate is energized with fingers in the throttle plate area.**

YES: Remove foreign object.

NO: Go to *Check ECT connector* on this page

Check ECT connector

Check throttle connector terminals for damage, corrosion, or contamination. Did you find a problem?

YES: Repair as necessary

NO: Go to *Check drive motor circuit* on this page

Check drive motor circuit

Key ON engine OFF. Disconnect ECT wiring harness connector. Using DVOM, check for battery voltage on ECT connector pin-A and pin-C.Do you have battery voltage at both pins.

YES: Go to *Check drive motor (+) circuit continuity* on this page

NO: Repair open circuit.

Check drive motor (+) circuit continuity

Key OFF. Disconnect ECM connector. Using DVOM, check for continuity between throttle connector drive motor wire pin-A and ECM connector pin-82. Do you have continuity with no resistance?

YES: Go to *Check drive motor (—) circuit continuity* on this page

NO: Repair wiring as necessary.

Check drive motor (—) circuit continuity

Using DVOM, check for continuity between throttle connector drive motor wire pin-C and ECM connector pin-83. Do you have continuity?

YES: Replace Throttle body.

NO: Repair wiring as necessary.

DTC 2115 - TCP 1 Higher Than IVS limit

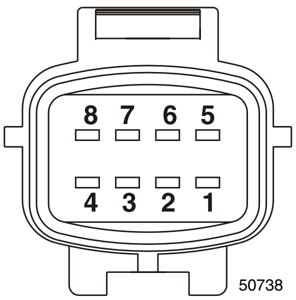
SPN-91 FMI-0

Circuit Description

The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

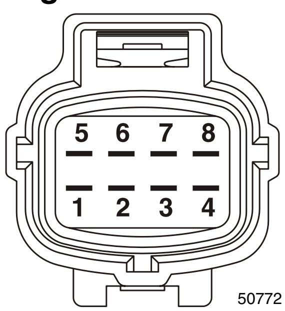
This fault will set if the IVS is at idle (open) and the TCP 1 voltage is greater than 1.2 volts. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced and the buzzer will give soft warning. When these are enforced the maximum throttle position is 30%. The Low Rev Limit and Power Derate are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.

TCP Harness Connector



50738

Engine Connector

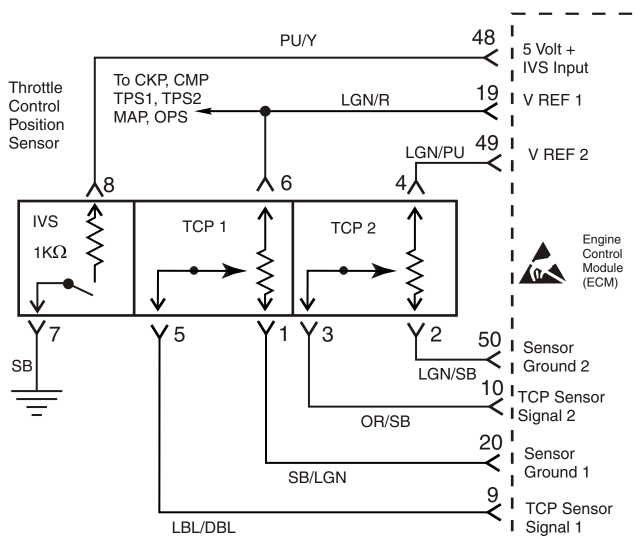


50772

Pin	Function
9	Ground 1
10	Ground 2
11	TCP 2
12	V REF 2
13	TCP 1
14	V REF
15	IVS Ground
16	IVS 5V+ Input

Conditions for Setting DTC

- Throttle Control Position Sensor/Idle Validation Switch
- Check Condition-Engine Cranking or Running
- Fault Condition-IVS at idle and TCP 1 voltage greater than 1.2 volts
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycle
- Alarm sounds soft warning, power derate (level 2) and low rev limit enforced for remainder of key-on cycle



23798

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check IVS state at idle

Key ON and engine OFF. Diagnostic tool connected in Throttle Monitor Mode. Does the diagnostic tool display IVS "Idle" with the throttle fully open.

YES: Open circuit. Go to *Check IVS circuit* on this page

NO: Go to *Check IVS operation* on this page

Check IVS circuit

Key OFF. Disconnect TCP wire harness connector. Key On. Does the diagnostic tool display IVS "Idle"?

YES: Replace TCP sensor

NO: Go to *Check IVS signal for short to ground* on this page

Check IVS operation

Key OFF. Reconnect TCP wire harness connector. Key ON. Advance throttle until TCP 1 is between 1.1 and 1.3 volts. Does the diagnostic tool display IVS "Idle"?

YES: Replace TCP sensor

NO: Intermittent problem, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

Check IVS circuit continuity

Disconnect ECM wire harness connector and TCP wire harness connector. Using DVOM probe pin-8 of the TCP engine wire harness connector and pin-48 of the ECM wire harness connector. Do you have continuity?

YES: Go to *Check IVS ground circuit* on this page

NO: Open circuit, repair wiring as required

Check IVS ground circuit

Using DVOM probe pin-7 of the TCP engine wire harness connector and a known good engine ground. Do you have continuity?

YES: Replace ECM

NO: Open circuit, repair wiring as required

Check IVS signal for short to ground

Using DVOM probe pin-8 of the TCP wire harness connector and a known good engine ground. Do you have continuity

YES: IVS signal circuit is shorted to ground. Repair wiring as required

NO: Circuit OK, replace ECM

DTC 2116 - TCP 2 Higher Than IVS Limit

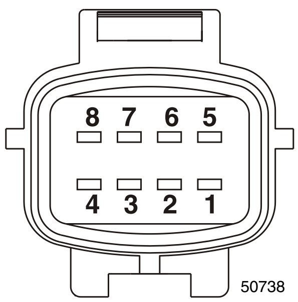
SPN-29 FMI-0

Circuit Description

The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault will set if the IVS is at idle (open) and the TCP 2 voltage is greater than 0.5 volts. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced. When these are enforced the maximum throttle position is 30%. The Low Rev Limit and Power Derate are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.

TCP Harness Connector



Engine Connector

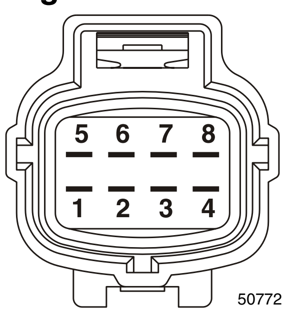
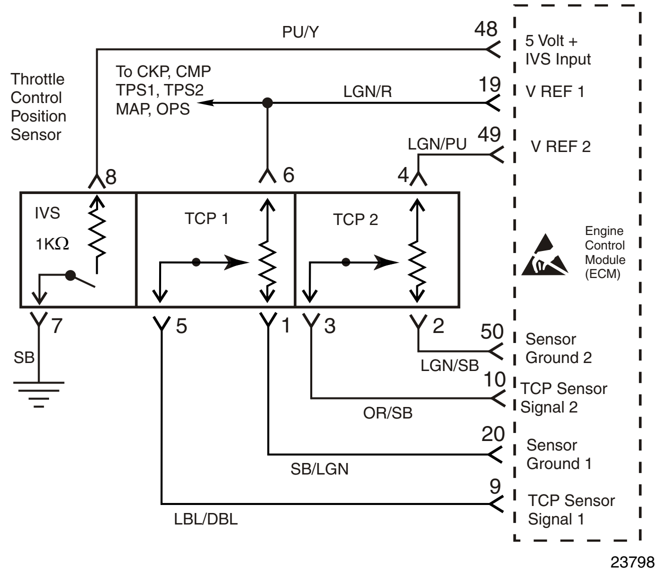


Table 22:

Pin	Function
17	Ground 1
18	Ground 2
19	TCP 2
20	V REF 2
21	TCP 1
22	V REF
23	IVS Ground
24	IVS 5V+ Input

Conditions for Setting DTC

- Throttle Control Position Sensor/Idle Validation Switch.
- Check Condition-Engine Cranking or Running.
- Fault Condition-IVS at idle and TCP 2 voltage greater than 0.5 volts.
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycle.
- Power Derate (level 2) and Low Rev Limit enforced for remainder of key-on cycle.



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check IVS state at idle

Key ON and engine OFF. Diagnostic tool connected in Throttle Monitor Mode. Does the diagnostic tool display IVS "Idle" with the throttle fully open.

YES: Open circuit. Go to *Check IVS circuit* on this page

NO: Go to *Check IVS operation* on this page

Check IVS circuit

Key OFF. Disconnect TCP wire harness connector. Key On. Does the diagnostic tool display IVS "Idle"?

YES: Replace TCP sensor

NO: Go to *Check IVS signal for short to ground* on this page

Check IVS operation

Key OFF. Reconnect TCP wire harness connector. Key ON. Advance throttle until TCP 2 is between 0.5 and 0.65 volts. Does the diagnostic tool display IVS "Idle"?

YES: Replace TCP sensor

NO: Intermittent problem, See *Preliminary and Intermittent Checks*" on page 48" in Section 4

Check IVS circuit continuity

Disconnect ECM wire harness connector and TCP wire harness connector. Using DVOM probe pin-8 of the TCP engine wire harness connector and pin-48 of the ECM wire harness connector. Do you have continuity?

YES: Go to *Check IVS ground circuit* on this page

NO: Open circuit, repair wiring as required

Check IVS ground circuit

Using DVOM probe pin-7 of the TCP engine wire harness connector and a known good engine ground. Do you have continuity?

YES: Replace ECM

NO: Open circuit, repair wiring as required

Check IVS signal for short to ground

Using DVOM probe pin-8 of the TCP wire harness connector and a known good engine ground. Do you have continuity

YES: IVS signal circuit is shorted to ground. Repair wiring as required

NO: Circuit OK, replace ECM

DTC 2120 - TCP 1 Invalid Voltage, TCP 2 Disagrees with IVS

SPN-520199 FMI-11

Circuit Description

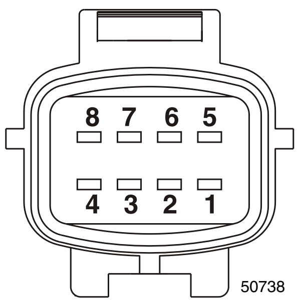
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault is only applicable with dual potentiometer and single IVS sensors and indicates that the two TCP percentages correlate and register an off-idle condition but the IVS state reads at idle throughout entire operating range.

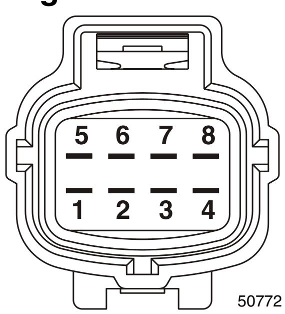
Conditions for Setting DTC

- Electronic throttle control position (TCP) sensor.
- Check Condition- Key On, Engine On
- Fault Condition- TCP 1% is approximately 20% different than TCP2% and both are greater than TCP idle valid%, and IVS= At Idle
- Corrective Action(s)- Illuminate MIL, sound audible warning and power derate, low rev limit, or forced idle

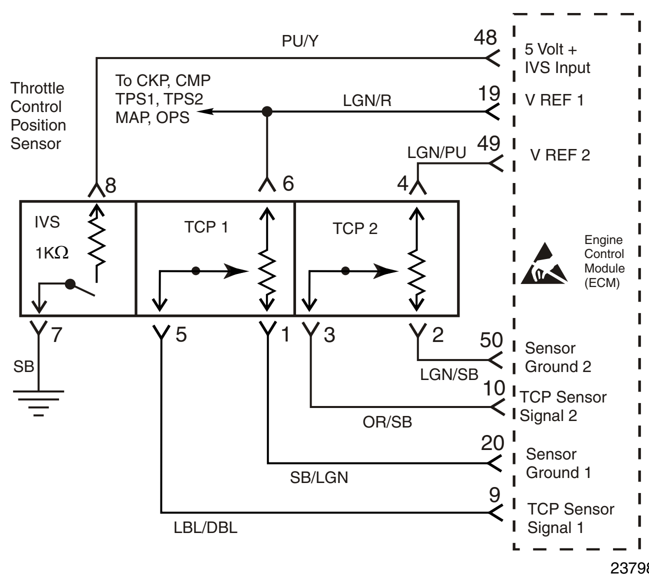
TCP Harness Connector



Engine Connector



Pin	Function
25	Ground 1
26	Ground 2
27	TCP 2
28	V REF 2
29	TCP 1
30	V REF
31	IVS Ground
32	IVS 5V+ Input



Troubleshooting

For TCP 1 Out-of-Range	See *DTC 2122 - TCP 1 High Voltage* page 195., and DTC 2123 - TCP 1 Low Voltage" on page 197.
For TCP 2 Disagrees with IVS	See *DTC 2116 - TCP 2 Higher Than IVS Limit* page 189., and DTC 2140 - TCP 2 Lower Than IVS Limit" on page 215.

DTC 2121 - TCP 1 Lower Than TCP 2

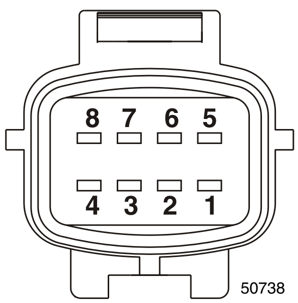
SPN-91 FMI-18

Circuit Description

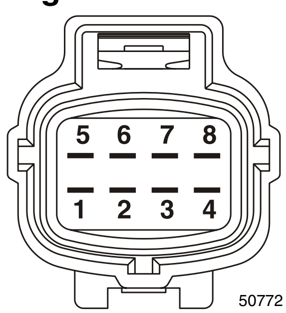
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault will set if throttle control position sensor 1 is 20% lower than throttle control position sensor 2. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced. When these are enforced the maximum throttle position is 30% and engine RPM is limited. The Low Rev Limit and Power Derate are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.

TCP Harness Connector



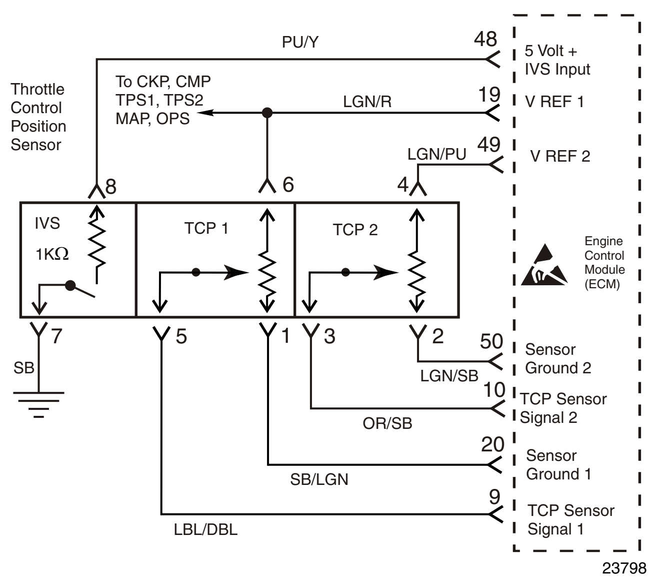
Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input

Conditions for setting DTC

- Check Condition - Key ON, Engine OFF
- Fault Condition - TCP 1 voltage lower than TCP 2 by more than 20%
- Power Derate level 2 and Low Rev Limit enforced
- MIL flash at 2Hz cycles during and after active fault for remainder of key cycle
- Alarm - Soft Warning during active fault



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check for other DTCs

Key ON - engine ON. Diagnostic tool connected. Operate engine at idle. Scan for diagnostic codes. Does the diagnostic tool show DTC 642, 643, 652, or 653?

YES: Go to the diagnostic for this code before proceeding

NO: Go to *Check TCP position at idle* on this page

Check TCP position at idle

Key ON - engine OFF. Diagnostic tool connected in Throttle Monitor Mode. Does the diagnostic tool show TCP1 and TCP2 percentages within 20% with TCP at the fully closed position (idle).

YES: Go to *Check TCP sensor sweep* on this page

NO: Go to *Check V REF supply voltage* on this page

Check TCP sensor sweep

Open the TCP sensor to the wide open position. Does the diagnostic tool show TCP 1 and TCP 2 at full scale and within 20%?

YES: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Replace TCP sensor

Check V REF supply voltage

Disconnect TCP connector.Using a DVOM set for DC volts, measure the voltage on V REF (pin-6) and V REF 2 (pin-4). Is the voltage approximately 5 VDC on each TCP?

YES: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Go to *Check V REF circuit continuity* on this page

Check V REF circuit continuity

Disconnect ECM wiring harness connector. Check continuity between pin-6 at the TCP connector and pin-19 at the ECM connector for V REF and pin-4 at the TCP connector and pin-49 at the ECM connector for V REF 2. Do you have continuity on both circuits?

YES: Replace ECM

NO: Repair the affected circuit.

DTC 2122 - TCP 1 High Voltage

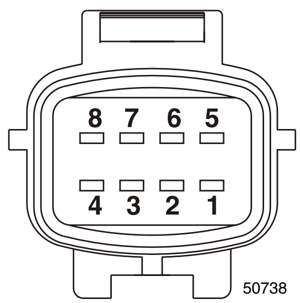
SPN-91 FMI-3

Circuit Description

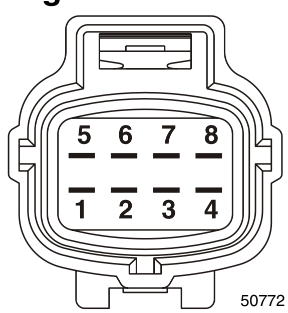
The engine load request to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates 2 potentiometers with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to engine ground through a 1000 ohm resistor when the throttle is advanced more than the idle position.

This fault will set if TCP 1 voltage is over 4.8 volts at any operating condition while the key is ON. If the voltage exceeds 4.8, then TCP is considered to be out of specifications. At this point the ECM has lost throttle input request redundancy from the TCP, and must therefore enforce the power derate (level 2). When this is enforced, the maximum throttle plate opening is 30 percent. The power derate is enforced for the remainder of the key ON cycle. Power derate is still enforced if the active fault is no longer present; the MIL light will flash at 2 Hz for the remainder of the key ON cycle and the warning horn will sound a soft warning as long as the code is active. This is a reminder that the power derate is still enforced.

TCP Harness Connector



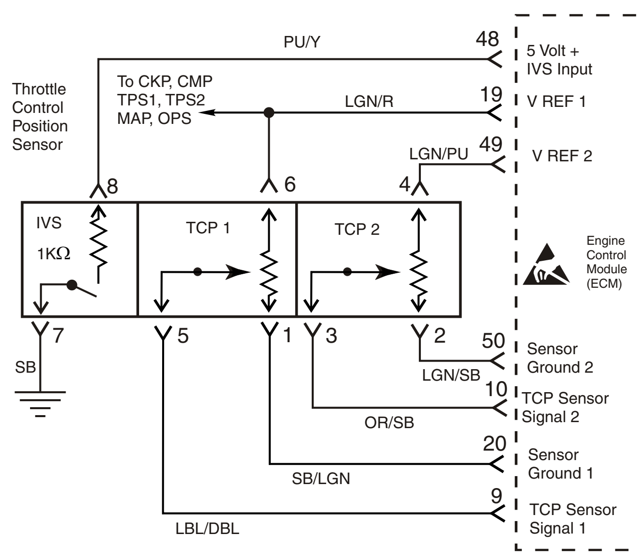
Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input

Conditions for setting the DTC

- Throttle control position.
- Check condition - key ON.
- Fault condition - TCP1 sensor voltage exceeds 4.8.
- MIL - on during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key ON cycle.
- Power derate - (level 2) limit enforced.



Troubleshooting

Check code is valid and active	Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.
Check TCP1 Voltage at Idle	Key ON and engine OFF. Diagnostic tool connected in ECM Data Mode with TCP1 voltage displayed. Does the diagnostic tool display TCP1 voltage of 4.8 volts or greater with the throttle in idle position? **YES:** Go to *Check TCP connector* on this page **NO:** Go to *Check TCP1 Voltage During Acceleration* on this page
Check TCP1 Voltage During Acceleration	Slowly increase throttle while observing TCP 1 voltage. Does the diagnostic tool show TCP1 voltage ever greater than 4.8 volts? **YES:** Go to *Check TCP 1 ground circuit* on this page **NO:** Intermittent problem, See *Preliminary and Intermittent Checks*" on page 48" in Section 4.
Check TCP connector	Key OFF. Disconnect TCP connector. Inspect connector wire terminals for damage, corrosion or contamination. Did you find a problem? **YES:** Repair terminals as required. **NO:** Go to *Check V REF circuit.* on this page
Check V REF circuit.	Key ON. Using DVOM, check voltage between V REF, pin-6 at the TCP connector, and a known good engine ground. Do you have approximately 5 volts? **YES:** Go to *Check TCP 1 ground circuit* on this page **NO:** Go to *Check ECM connector* on this page
Check TCP 1 ground circuit	Test the TCP 1 sensor connector ground circuit pin-1 (SB/LGN) with a test light connected to battery voltage. Does the light come on? **YES:** Go to *Check for short to power on TCP 1 signal circuit* on this page **NO:** Replace TCP sensor.
Check for short to power on TCP 1 signal circuit	Using a DVOM check for voltage at the ECM wiring harness connector between ECM TCP 1 signal pin-5 (LBL/DBL) and engine ground. Do you have voltage between them? **YES:** Repair wiring short to power **NO:** Go to *Check ECM connector* on this page
Check ECM connector	Key OFF. Disconnect ECM wire harness connector. Inspect the ECM wire harness connector terminals for damage, corrosion or contamination. Did you find a problem? **YES:** Repair damaged connector as required **NO:** Replace ECM

DTC 2123 - TCP 1 Low Voltage

SPN-91 FMI-4

Circuit Description

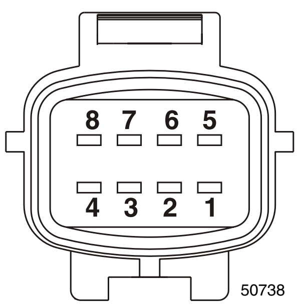
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault will set if voltage is less than 0.2 volts at any operating condition while the key is ON. If the voltage is less than 0.2 volts, then TCP is considered to be out of specifications. At this point the ECM does not have a valid signal, and must therefore enforce the power derate (level 2). When this is enforced, the maximum throttle position is 30 percent. The power derate is enforced for the remainder of the key ON cycle. Power derate is still enforced if the active fault is no longer present; the MIL light will flash at 2 Hz for the remainder of the key ON cycle. This is a reminder that the power derate is still enforced.

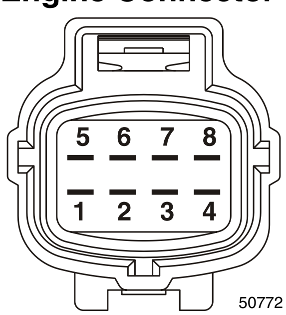
Conditions for setting the DTC

- Check condition - key ON.
- Fault condition - TCP 1 sensor voltage less than 0.2V.
- MIL - on during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key ON cycle.
- Power derate - level 2 enforced.

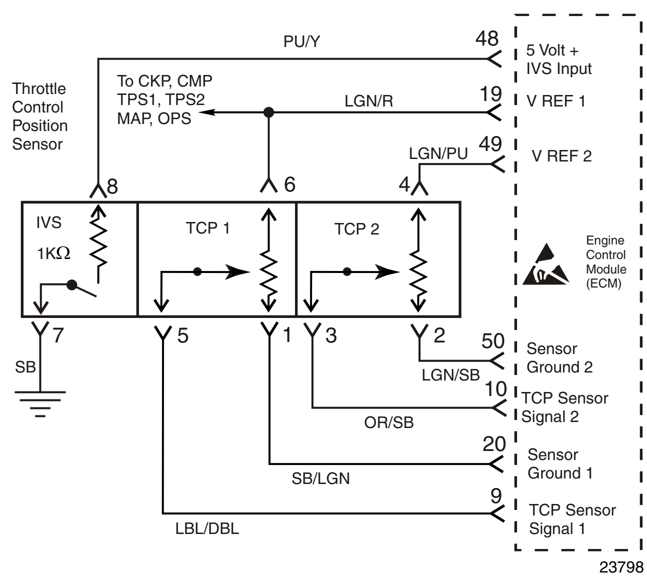
TCP Harness Connector



Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input



Troubleshooting

Note! If DTC-0642 is present, repair this code before proceeding.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TCP1 Voltage at Idle

Key ON and engine OFF. Diagnostic tool connected in Throttle Monitor Mode set for TCP 1 volts. Does the diagnostic tool display TCP 1 voltage of 0.2 volts or less with the TCP sensor in idle position?

YES: Go to *Check TCP connector* on this page

NO: Go to *Check TCP1 Voltage During Acceleration* on this page

Check TCP1 Voltage During Acceleration

Slowly accelerate the throttle while observing TCP 1 voltage. Does the diagnostic tool TCP 1 voltage ever drop below 0.2 volts during full sweep of the sensor?

YES: Defective TCP sensor. Replace TCP sensor.

NO: Intermittent problem. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

Check TCP connector

Key OFF. Disconnect TCP sensor connector. Inspect connector and wire terminals for damage, corrosion or contamination. Did you find a problem?

YES: Repair as necessary

NO: Go to *Check V REF* on this page

Check V REF

Key ON. Using a DVOM, check for voltage at the TCP sensor connector between V REF (pin 6) and a known good engine ground. Do you have approximately 5 volts?

YES: Go to *Check Signal Circuit* on this page

NO: Go to *Check V REF Circuit Continuity* on this page

Check Signal Circuit

Key OFF. Jumper the V REF circuit pin-6 and TCP signal circuit pin-5 together. Key ON. Does diagnostic tool display 4.8 volts or greater?

YES: Signal circuit OK.

NO: Go to *Check ECM Connector for Damage* on this page

Check ECM Connector for Damage

Inspect ECM connector terminals for damage, corrosion, or contamination. Did you find a problem?

YES: Repair as necessary.

NO: Go to *Check V REF Circuit Continuity* on this page

Check V REF Circuit Continuity

Key OFF. Disconnect ECM wire harness connector. Using DVOM, check for continuity between TCP sensor connector V REF pin-6 and ECM connector V REF pin-19. Do you have continuity between them?

YES: Go to *Check V REF for Short to Ground* on this page

NO: Repair circuit as necessary

Check V REF for Short to Ground

Using a DVOM, check for continuity between ECM V REF pin-19 and engine ground. Do you have continuity between them?

YES: Repair circuit as necessary

NO: Go to *Check TCP 1 Signal Circuit for Continuity* on this page

Check TCP 1 Signal Circuit for Continuity

Key OFF. Using DVOM, check for continuity between TCP 1 signal pin-5 and ECM connector TCP 1 signal pin-9. Do you have continuity?

YES: Go to *Check TCP 1 Signal for Short to Ground* on this page

NO: Repair wiring as necessary.

Check TCP 1 Signal for Short to Ground

Using DVOM, check for continuity between ECM connector TCP 1 signal pin-9 and engine ground. Do you have continuity?

YES: Replace ECM

NO: Repair wiring as necessary

DTC 2125 - TCP 2 Invalid Voltage, TCP 1 Disagrees with IVS

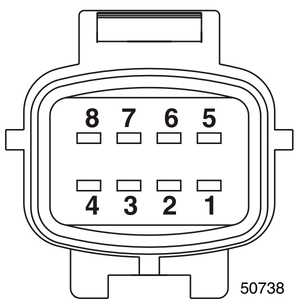
SPN-520199 FMI-11

Circuit Description

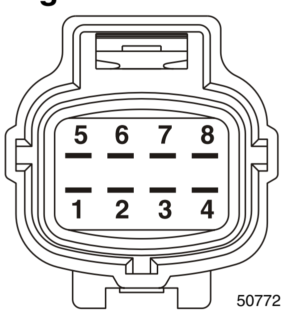
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault is only applicable with dual potentiometer and single IVS sensors and indicates that the two TCP percentages correlate and register an off-idle condition but the IVS state reads at idle throughout entire operating range.

TCP Harness Connector



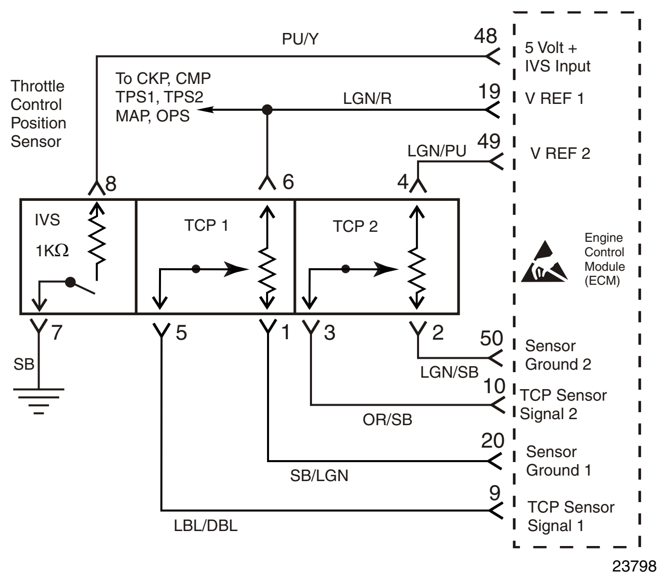
Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input

Conditions for Setting DTC

- Electronic throttle control position (TCP) sensor.
- Check Condition- Key On, Engine On
- Fault Condition- TCP 1% is approximately of TCP2% and both are greater than TCP idle valid%, and IVS= At Idle
- Corrective Action(s)- Illuminate MIL, sound audible warning and power derate, low rev limit, or forced idle



For TCP 2 Out-of-Range,

See *DTC 2127 - TCP 2 Low Voltage* page 204., and DTC 2128 - TCP 2 High Voltage” on page 207.

For TCP 1 Disagrees with IVS

See *DTC 2115 - TCP 1 Higher Than IVS limit* page 187., and DTC 2139 - TCP 1 Lower Than IVS limit” on page 215.

DTC 2126 - TCP 1 Higher Than TCP 2

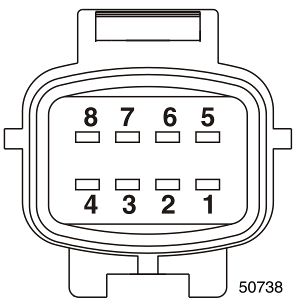
SPN-91 FMI-16

Circuit Description

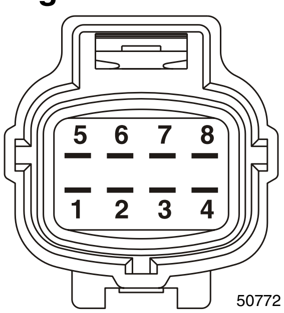
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault will set if throttle control position sensor 1 is 20% higher than throttle control position sensor 2. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced. When these are enforced the maximum throttle position is 30% and engine RPM is limited. The Low Rev Limit and Power Derate are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.

TCP Harness Connector



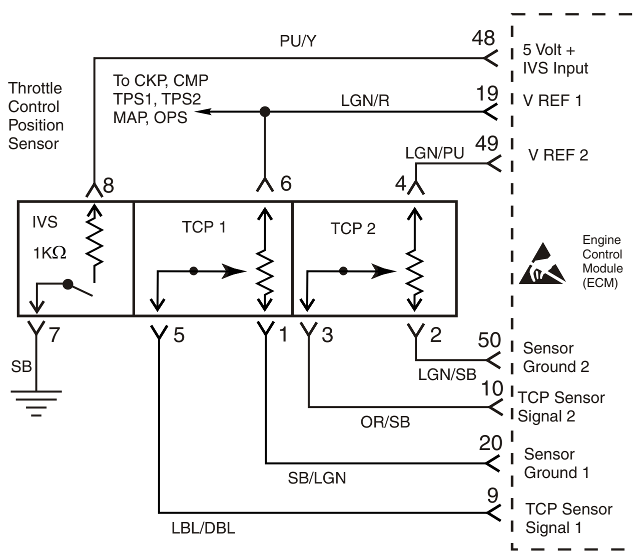
Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input

Conditions for setting DTC

- Check Condition - Key ON, Engine OFF
- Fault Condition - TCP 1 voltage higher than TCP 2 by more than 20%
- Power Derate level 2 and Low Rev Limit enforced
- MIL flash at 2Hz cycles during and after active fault for remainder of key cycle
- Alarm - Soft Warning during active fault



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check for other DTCs

Key ON - engine ON. Diagnostic tool connected. Operate engine at idle. Scan for diagnostic codes. Does the diagnostic tool show DTC 642, 643, 652, or 653?

YES: Go to the diagnostic for this code before proceeding

NO: Go to *Check TCP position at idle* on this page

Check TCP position at idle

Key ON - engine OFF. Diagnostic tool connected in Throttle Monitor Mode. Does the diagnostic tool show TCP1 and TCP2 percentages within 20% with TCP at the fully closed position (idle).

YES: Go to *Check TCP sensor sweep* on this page

NO: Go to *Check V REF supply voltage* on this page

Check TCP sensor sweep

Open the TCP sensor to the wide open position. Does the diagnostic tool show TCP 1 and TCP 2 at full scale and within 20%?

YES: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Replace TCP sensor

Check V REF supply voltage

Disconnect TCP connector.Using a DVOM set for DC volts, measure the voltage on V REF (pin-6) and V REF 2 (pin-4). Is the voltage approximately 5 VDC on each TCP?

YES: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Go to *Check V REF circuit continuity* on this page

Check V REF circuit continuity

Disconnect ECM wiring harness connector. Check continuity between pin-6 at the TCP connector and pin-19 at the ECM connector for V REF and pin-4 at the TCP connector and pin-49 at the ECM connector for V REF 2. Do you have continuity on both circuits?

YES: Replace ECM

NO: Repair the affected circuit.

DTC 2127 - TCP 2 Low Voltage

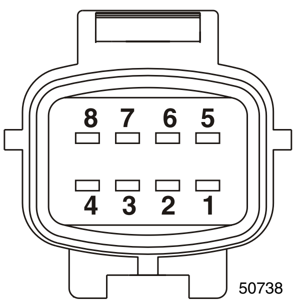
SPN-29 FMI-4

Circuit Description

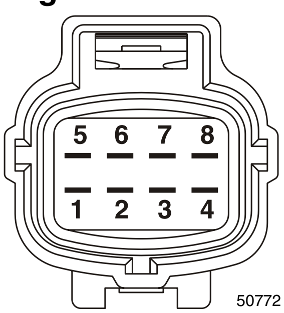
The engine load request to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates 2 potentiometers with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to engine ground through a 1000 ohm resistor when the throttle is advanced more than the idle position.

This fault will set if voltage is less than 0.090 volts at any operating condition while the key is ON. If the voltage is less than 0.090 volts, then TCP 2 is considered to be out of specifications. At this point the ECM does not have a valid signal, and must therefore enforce the power derate (level 2). When this is enforced, the maximum throttle position is 30 percent. The power derate is enforced for the remainder of the key ON cycle. Power derate is still enforced if the active fault is no longer present; the MIL light will flash at 2 Hz for the remainder of the key ON cycle. This is a reminder that the power derate is still enforced.

TCP Harness Connector



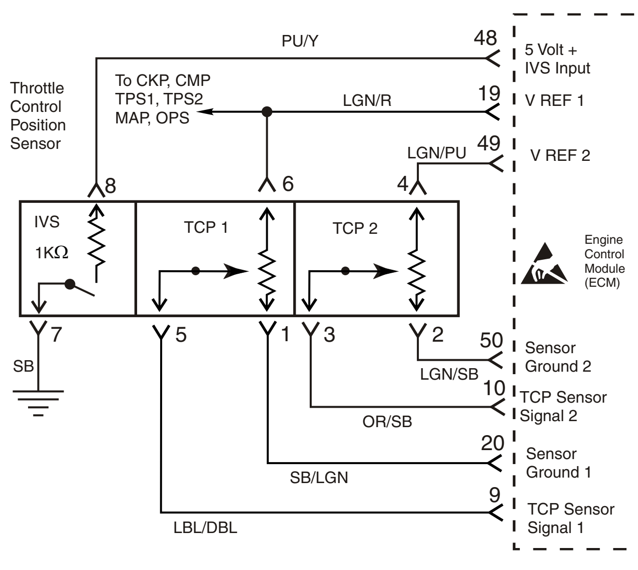
Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input

Conditions for setting the DTC

- Check condition - key ON.
- Fault condition - TCP 2 sensor voltage less than 0.090 volts.
- MIL - on during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key ON cycle.
- Power derate - level 2 enforced.



Troubleshooting

If DTC-0652 is set, repair this code before proceeding.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TCP1 Voltage at Idle

Key ON and engine OFF. Diagnostic tool connected in Throttle Monitor Mode set for TCP 2 volts. Does the diagnostic tool display TCP 2 voltage of 0.090 volts or less with the TCP sensor in idle position?

YES: Go to *Check TCP connector* on this page

NO: Go to *Check TCP1 Voltage During Acceleration* on this page

Check TCP2 Voltage During Acceleration

Slowly accelerate the throttle while observing TCP 2 voltage. Does the diagnostic tool TCP 2 voltage ever drop below 0.090 volts during full sweep of the sensor?

YES: Defective TCP sensor. Replace TCP sensor.

NO: Intermittent problem. See *Preliminary and Intermittent Checks*" **on page 48" in Section 4**

Check TCP connector

Key OFF. Disconnect TCP sensor connector. Inspect connector and wire terminals for damage, corrosion or contamination. Did you find a problem?

YES: Repair as necessary

NO: Go to *Check V REF* on this page

Check V REF 2

Key ON. Using a DVOM, check for voltage at the TCP sensor connector between V REF 2 (pin-4) and a known good engine ground. Do you have approximately 5 volts?

YES: Go to *Check Signal Circuit* on this page

NO: Go to *Check V REF Circuit Continuity* on this page

Check Signal Circuit

Key OFF. Jumper the V REF 2 circuit (pin-4) and TCP signal circuit (pin-3) together. Key ON. Does diagnostic tool display 4.8 volts or greater?

YES: Signal circuit OK.

NO: Go to *Check ECM Connector for Damage* on this page

Check ECM Connector for Damage

Inspect ECM connector terminals for damage, corrosion, or contamination. Did you find a problem?

YES: Repair as necessary.

NO: Go to *Check V REF Circuit Continuity* on this page

Check V REF 2 Circuit Continuity

Key OFF. Disconnect ECM wire harness connector. Using DVOM, check for continuity between TCP sensor connector V REF (pin-4) and ECM connector V REF 2 (pin-49). Do you have continuity between them?

YES: Go to *Check V REF for Short to Ground* on this page

NO: Repair circuit as necessary

Check V REF 2 for Short to Ground

Using a DVOM, check for continuity between ECM V REF 2 (pin-49) and engine ground. Do you have continuity between them?

YES: Repair circuit as necessary

NO: Go to *Check TCP 1 Signal Circuit for Continuity* on this page

Check TCP 2 Signal Circuit for Continuity

Key OFF. Using DVOM, check for continuity between TCP 2 signal (pin-3) and ECM connector TCP 2 signal (pin-10). Do you have continuity?

YES: Go to *Check TCP 1 Signal for Short to Ground* on this page

NO: **Repair wiring as necessary.**

Check TCP 2 Signal for Short to Ground

Using DVOM, check for continuity between ECM connector TCP 2 signal (pin-10) and engine ground. Do you have continuity?

YES: Replace ECM

NO: Repair wiring as necessary

DTC 2128 - TCP 2 High Voltage

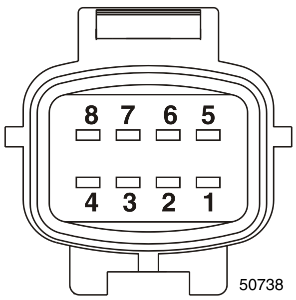
SPN-29 FMI-3

Circuit Description

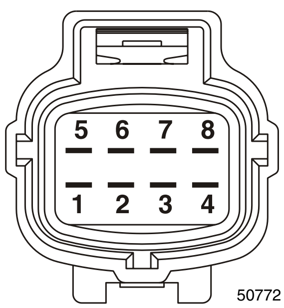
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault will set if TCP 2 voltage is over 2.7 volts at any operating condition while the key is ON. If the voltage exceeds 2.7, then TCP is considered to be out of specifications. At this point the ECM has lost throttle input request redundancy from the TCP, and must therefore enforce the power derate (level 2). When this is enforced, the maximum throttle plate opening is 30 percent. The power derate is enforced for the remainder of the key ON cycle. Power derate is still enforced if the active fault is no longer present; the MIL light will flash at 2 Hz for the remainder of the key ON cycle and the warning horn will sound a soft warning as long as the code is active. This is a reminder that the power derate is still enforced.

TCP Harness Connector



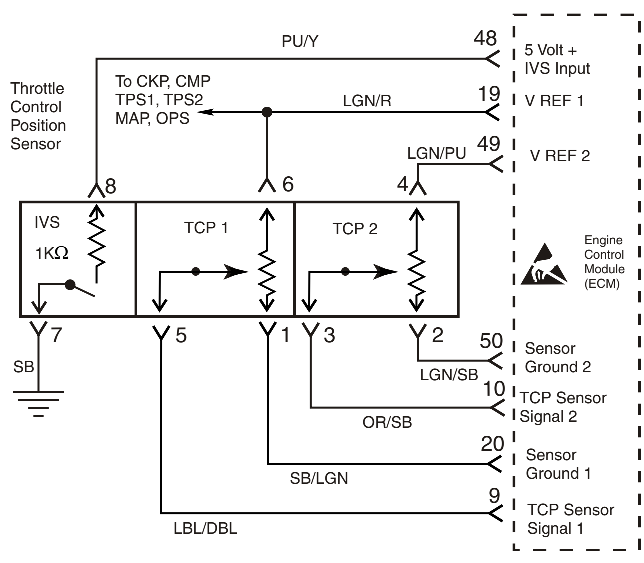
Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input

Conditions for setting the DTC

- Throttle control position.
- Check condition - key ON.
- Fault condition - TCP 2 sensor voltage exceeds 2.7.
- MIL - on during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key ON cycle.
- Power derate - (level 2) limit enforced.



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TCP 2 Voltage at Idle

Key ON and engine OFF. Diagnostic tool connected in ECM Data Mode with TCP 2 voltage displayed. Does the diagnostic tool display TCP 2 voltage of 2.7 volts or greater with the throttle in idle position?

YES: Go to *Check TCP connector* on this page

NO: Go to *Check TCP1 Voltage During Acceleration* on this page

Check TCP 2 Voltage During Acceleration

Slowly increase throttle while observing TCP 2 voltage. Does the diagnostic tool ever show TCP 2 voltage greater than 2.7 volts?

YES: Go to *Check TCP 1 ground circuit* on this page

NO: Intermittent problem, See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check TCP connector

Key OFF. Disconnect TCP connector. Inspect connector wire terminals for damage, corrosion or contamination. Did you find a problem?

YES: Repair terminals as required.

NO: Go to *Check V REF circuit.* on this page

Check V REF circuit

Key ON. Using DVOM, check voltage between V REF, pin-4 at the TCP connector, and a known good engine ground. Do you have approximately 5 volts?

YES: Go to *Check TCP 1 ground circuit* on this page

NO: Go to *Check ECM connector* on this page

Check TCP 2 ground circuit

Test the TCP 2 sensor connector ground circuit pin-2 (LGN/SB) with a test light connected to battery voltage. Does the light come on?

YES: Go to *Check for short to power on TCP 1 signal circuit* on this page

NO: Circuit OK, replace TCP sensor.

Check continuity on TCP 2 signal circuit

Using a DVOM check for continuity at the ECM wiring harness connector between ECM TCP 2 signal pin-3 (OR/SB) and ECM connector pin-10. Do you have continuity?

YES: Repair wiring as required

NO: Go to *Check ECM connector* on this page

Check ECM connector

Key OFF. Disconnect ECM wire harness connector. Inspect the ECM wire harness connector terminals for damage, corrosion or contamination. Did you find a problem?

YES: Repair damaged connector as required

NO: Replace ECM

DTC 2130 - IVS Stuck At-Idle TCP 1/2 Match

SPN-558 FMI-5

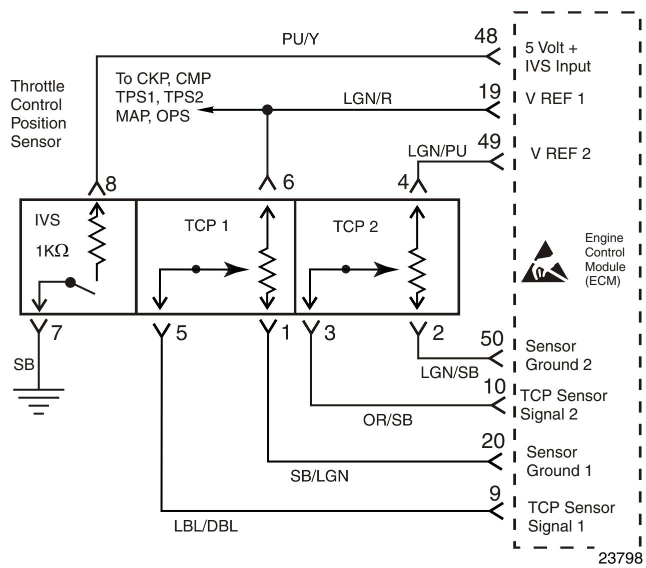
Circuit Description

The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

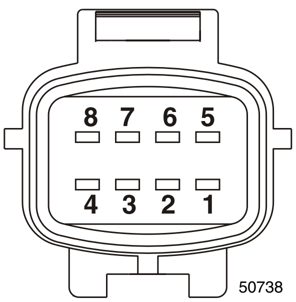
This fault indicates that the two TCP percentages correlate and register an off-idle condition but the IVS state remains at idle throughout entire operating range.

Conditions for Setting DTC

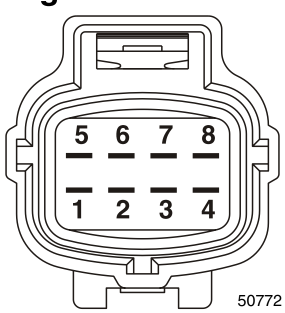
- Electronic throttle control position (TCP) sensor.
- Check Condition- Key On, Engine On
- Fault Condition- TCP 1% and TCP2% are within normal parameters and both are greater than TCP idle valid%, and IVS= At Idle
- Corrective Action(s)- Illuminate MIL, sound audible warning and power derate, low rev limit, or forced idle



TCP Harness Connector



Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input

Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check IVS operation

Key ON, engine ON. Connect diagnostic tool in Throttle Monitor mode. Operate engine at idle in neutral. Increase TCP sensor until TCP is 1% greater than idle validation%.

⚠ **Caution! This will cause the engine to accelerate. DO NOT exceed 10% TCP.**

Is IVS state "Off Idle"?

YES: Intermittent problem. See *Preliminary and Intermittent Checks*" on page 48" in Section 4

NO: Go to *Check TCP connector* on this page

Check TCP connector

Disconnect TCP connector. Check connector for loose, or broken pins. Check connector for corrosion or other damage. Did you find a problem?

YES: **Repair connector as required**

NO: Go to *Check IVS resistance* on this page

Check IVS resistance

Key OFF - engine OFF. Move TCP sensor to Wide Open Throttle position and hold open. Using DVOM measure the resistance between IVS input signal (pin-8) and IVS ground (pin-7) at the TCP connector. Is the resistance 1K ohms or greater?

YES: Go to *Check IVS supply voltage* on this page

NO: Replace TCP sensor

Check IVS supply voltage

Key ON. Using DVOM, check voltage between pin-8 of the TCP engine harness connector and a known good engine ground. Do you have approximately 5 volts.

YES: Go to *Check for IVS ground resistance* on this page

NO: Go to *Check TCP input circuit continuity* on this page

Check for IVS ground resistance

Using DVOM, Check wiring between IVS ground (pin 7) on the engine connector and a known good engine ground. Is there any resistance measured?

YES: Repair wiring as required.

NO: Go to *Check TCP input circuit continuity* on this page

Check TCP input circuit continuity

Key OFF, disconnect ECM. Using DVOM set for continuity, check for continuity between pin-8 at the TCP engine harness connector and pin-48 at the ECM wiring harness connector. Do you have continuity?

YES: Replace ECM

NO: Repair wiring as required.

DTC 2131 - IVS Stuck Off-Idle

SPN-558 FMI-6

Circuit Description

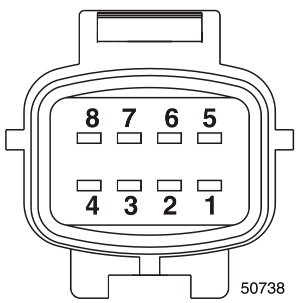
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault is only applicable with dual potentiometer and single IVS sensors and indicates that the two TCP percentages correlate and register an off-idle condition but the IVS state reads at idle throughout entire operating range.

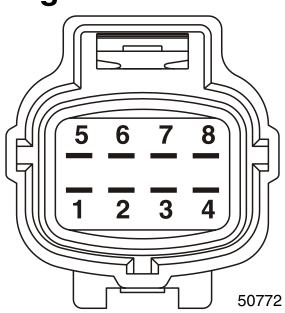
Conditions for Setting DTC

- Electronic throttle control position (TCP) sensor.
- Check Condition- Key On, Engine On
- Fault Condition- TCP 1% is approximately of TCP2% and both are greater than TCP idle valid%, and IVS= OFF Idle
- Corrective Action(s)- Illuminate MIL, sound audible warning and power derate, low rev limit, or forced idle

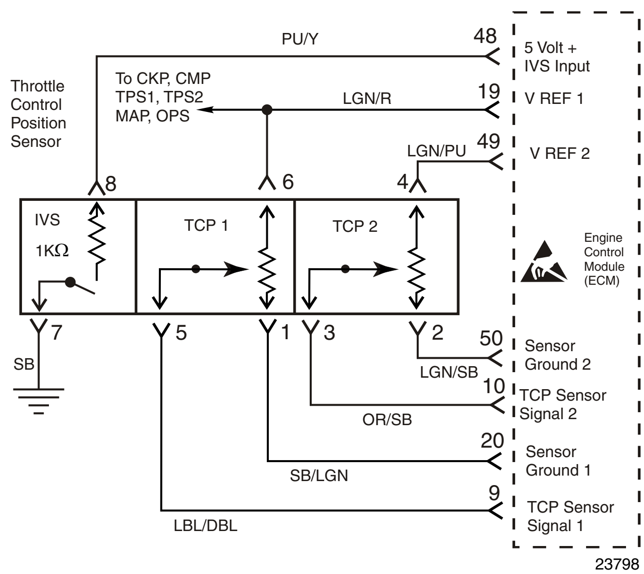
TCP Harness Connector



Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check throttle cable position

Connect diagnostic tool and set for Throttle Monitor Mode. Key ON - engine ON. Operate engine at idle in neutral. Ensure the sensor is securely mounted to throttle bracket. **Ensure the throttle cable is not holding TCP sensor open** and TCP sensor is in the fully closed throttle position. Does diagnostic tool still indicate DTC 2131?

YES: Go to *Check IVS supply for short to ground* on this page

NO: Adjust throttle cable to allow TCP sensor to close fully

Check IVS supply for short to ground

Disconnect ECM Using DVOM connected to a known good engine ground, check for continuity between pin-8 of the TCP engine harness connector. Do you have continuity

YES: Supply circuit shorted to ground, repair wiring as required.

NO: Replace TCP sensor

DTC 2135 - TPS 1/2 Simultaneous Voltages Out-of-Range

SPN-51 FMI-31

Circuit Description

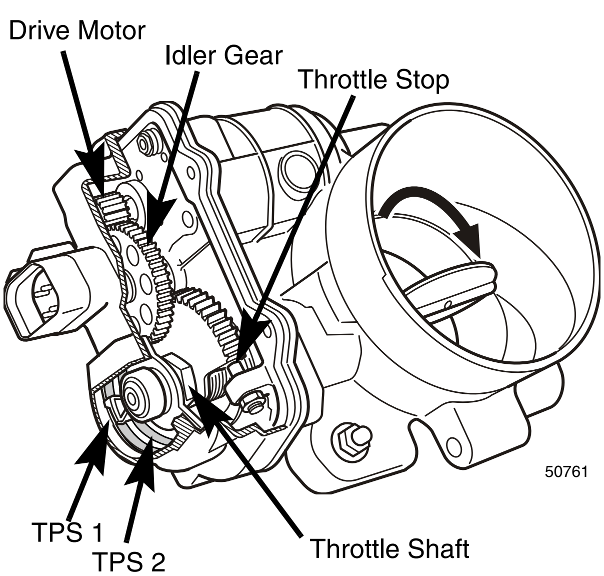
There are 2 throttle position sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

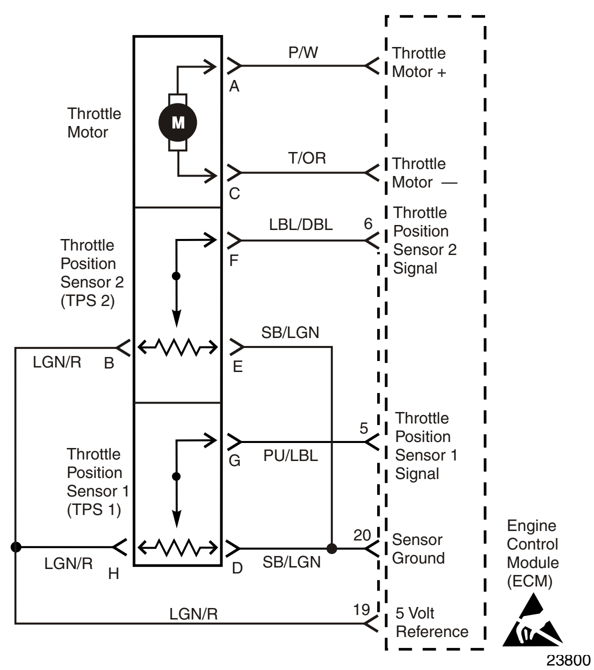
This fault will set if the throttle position and redundancy is lost. During this active fault the MIL light will be on and **Engine Shutdown** be activated.

NOTE! This is the only DTC that will command engine shutdown.

Conditions for setting the DTC

- Throttle position sensor 1 and 2.
- Check condition - cranking.
- Fault condition - Throttle position on TPS 1 and TPS 2 are greater than 4.8 volts or less than.2 volts.
- MIL - on during active fault.
- Hard warning buzzer.
- **Engine Shutdown**.





Pin	Function
A	Throttle Motor +
B	5 V ref
C	Throttle Motor –
D	Ground

Pin	Function
E	Ground
F	TPS2
G	TPS1
H	5 V ref

Troubleshooting

See Diagnostic Information	DTC 0123 - TPS 1 Signal Voltage High (ETC)” on page 29, DTC 0122 - TPS 1 Signal Voltage Low (ETC)” on page 25, DTC 0223 - TPS 2 High Voltage” on page 45, and DTC 0222 - TPS 2 Low Voltage” on page 43

DTC 2139 - TCP 1 Lower Than IVS limit

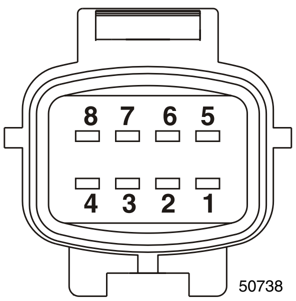
SPN-91 FMI-1

Circuit Description

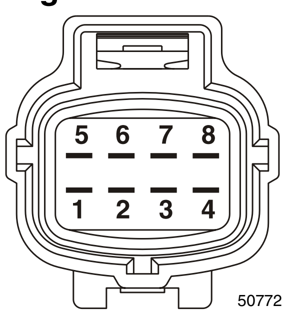
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault will set if the IVS is at idle (open) and the TCP 1 voltage is less than 0.6 volts. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced. When these are enforced the maximum throttle position is 30%. The Low Rev Limit and Power Derate are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.

TCP Harness Connector



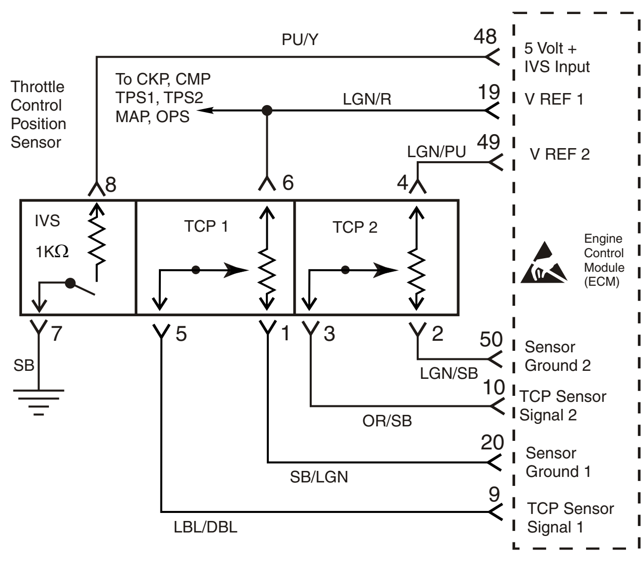
Engine Connector



Pin	Function
1	Ground 1
2	Ground 2
3	TCP 2
4	V REF 2
5	TCP 1
6	V REF
7	IVS Ground
8	IVS 5V+ Input

Conditions for setting DTC

- Check Condition-Engine Cranking or Running
- Fault Condition-IVS off-idle and TCP voltage less than 0.6 volts
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for remainder of key-on cycle
- Power Derate (level 2) enforced for remainder of key-on cycle



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check IVS state at idle

Key ON and engine OFF. Diagnostic tool connected in Throttle Monitor Mode. Does the diagnostic tool display IVS "Off Idle" with the throttle fully closed?

YES: Go to *Check IVS circuit* on this page

NO: Intermittent problem,See *Preliminary and Intermittent Checks*" on page 48" in Section 4

Check IVS circuit

Key OFF. Disconnect TCP wire harness connector. Using a jumper wire, connect IVS signal wire (pin-8) and IVS ground (pin-7) together. Key On. Does the diagnostic tool display IVS "Idle"?

YES: Replace TCP sensor

NO: Go to *Check IVS for short to ground* on this page

Check IVS for short to ground

Disconnect ECM wire harness connector. Using DVOM probe pin-8 of the TCP engine wire harness connector and a known good engine ground. Do you have continuity?

YES: Repair wiring as necessary

NO: Replace ECM

DTC 2140 - TCP 2 Lower Than IVS Limit

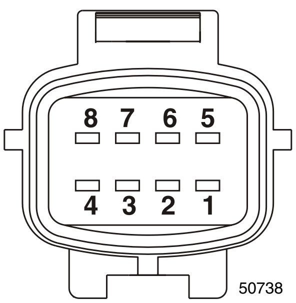
SPN-29 FMI-1

Circuit Description

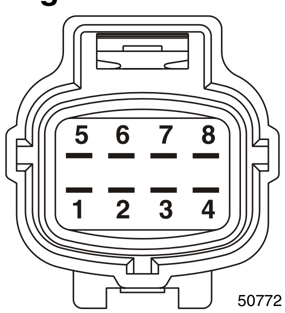
The engine load command to the ECM is determined by operator advance of the Throttle Control Position sensor (TCP). The ECM monitors the TCP and controls the throttle to maintain the commanded power level. Because a problem with the TCP signal can result in a higher or lower power than intended by the operator, the TCP used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the throttle is advanced more than the idle position.

This fault will set if the IVS is at idle (open) and the TCP 2 voltage is less than 0.6 volts. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced. When these are enforced the maximum throttle position is 30%. The Low Rev Limit and Power Derate are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.

TCP Harness Connector



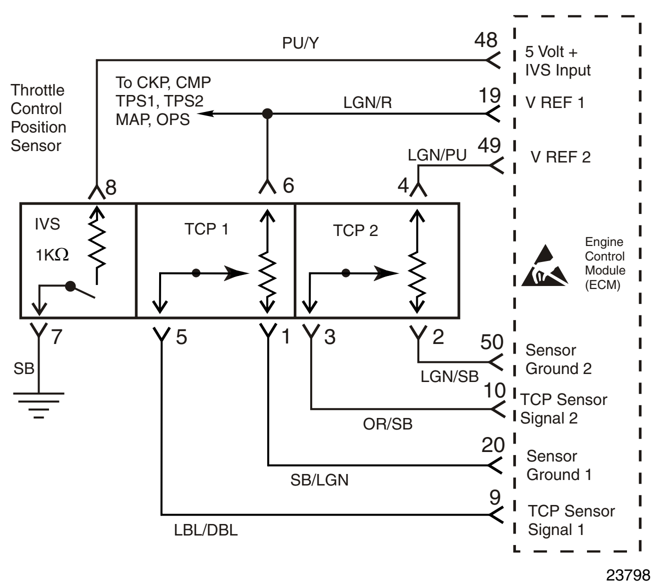
Engine Connector



Pin	Function
9	Ground 1
10	Ground 2
11	TCP 2
12	5 V ref 2
13	TCP 1
14	5 V ref 1
15	IVS Ground
16	IVS 5V+ Input

Conditions for setting DTC

- Throttle Control Position Sensor/Idle Validation Switch
- Check Condition-Engine Cranking or Running
- Fault Condition-IVS off-idle and TCP voltage less than 0.6 volts
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for remainder of key-on cycle
- Power Derate (level 2) and Low Rev Limit enforced for remainder of key-on cycle



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check IVS state at idle

Key ON and engine OFF. Diagnostic tool connected in Throttle Monitor Mode. Does the diagnostic tool display IVS "Off Idle" with the throttle fully closed?

YES: Go to *Check IVS circuit* on this page

NO: Intermittent problem,See *Preliminary and Intermittent Checks*" on page 48" in Section 4

Check IVS circuit

Key OFF. Disconnect TCP wire harness connector. Using a jumper wire, connect IVS signal wire (pin 8) and IVS ground (pin-7) together. Key On. Does the diagnostic tool display IVS "Idle"?

YES: Replace TCP sensor

NO: Go to *Check IVS for short to ground* on this page

Check IVS for short to ground

Disconnect ECM wire harness connector. Using DVOM probe pin-8 of the TCP engine wire harness connector and a known good engine ground. Do you have continuity?

YES: Repair wiring as necessary

NO: Replace ECM

DTC 2229 - BP High Pressure

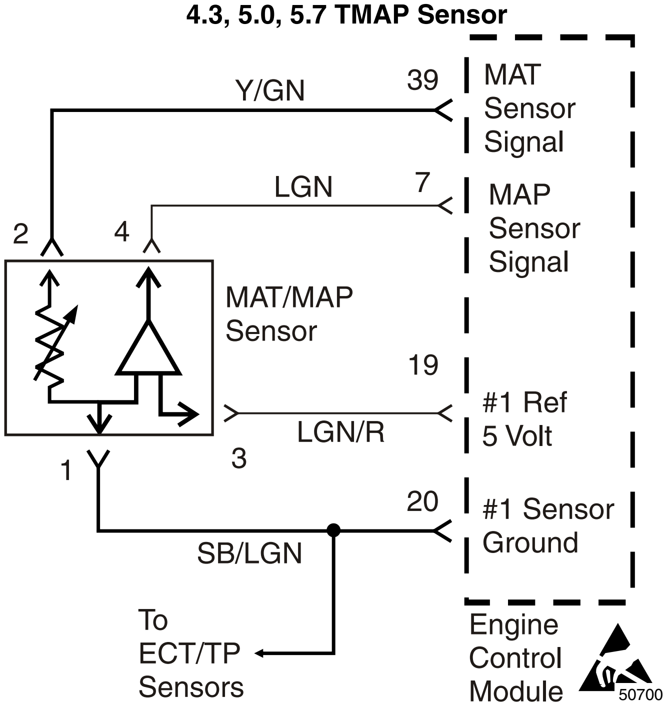
SPN-108 FMI-0

Circuit Description The barometric pressure (BP) is estimated from the TMAP sensor. The barometric pressure value is used for fuel and airflow calculations. This fault sets in the event the BP value is out of the normal range.

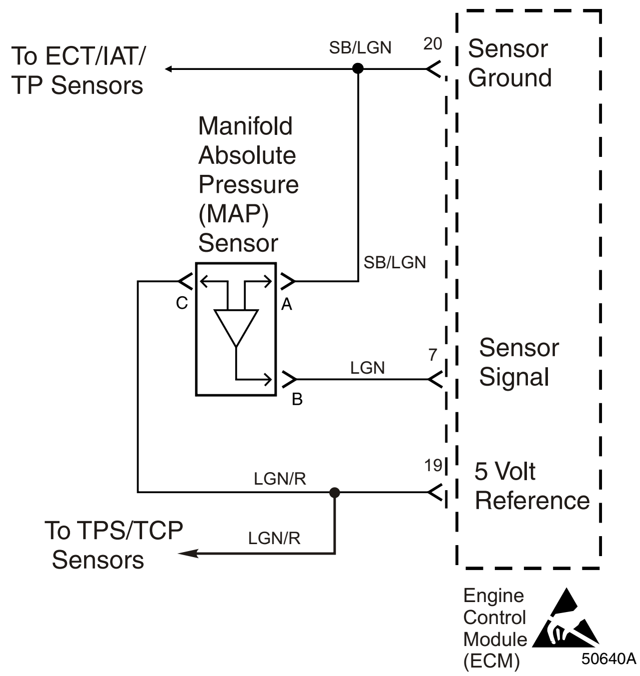
Conditions for setting the DTC

- Barometric pressure.
- Check condition - key ON.
- Fault condition - BP greater than 16 psi.
- MIL - on for active fault and for 2 seconds after active fault.

4.3, 5.0, 5.7 TMAP Sensor



8.1 MAP Sensor



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check baro pressure

Key ON, engine OFF. Diagnostic tool connected in ECM Data Mode. Does diagnostic tool display MAP pressure of 16 PSI or greater?

YES: Replace sensor.

NO: Intermittent problem,

DTC 2428 - EGT Temperature High

SPN-520203 FMI-0

Circuit Description

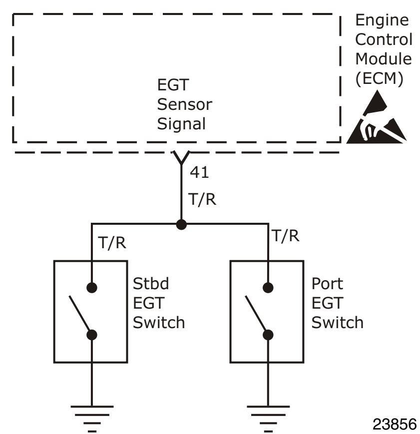
The Exhaust Gas Temperature switch is a normally open switch that has a bimetal strip designed to close when the exhaust manifold reaches 130°C (267°F). It is designed to give the operator an warning that the water flow has been interrupted to the engine before engine damage can occur.

When DTC 2428 is activated, the buzzer will sound for 500ms and off for 250ms. On the 8.1L engines equipped with electronic throttle, the ECM will enable power derate 2 which limits the throttle to 30% throttle angle. The code is permanently stored in memory of the ECM.

The code will be active during the condition and for 15 seconds after the manifold temperature has lowered.

Conditions for setting DTC

- MIL light on
- Buzzer on for 500ms off 250ms
- Check condition cranking or running
- Exhaust manifold temperature above 130°C (267°F ± 10°F) and engine running for more than 15 seconds.



Troubleshooting

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Verify code

Using a infrared thermometer, verify the exhaust manifold is actually reaching 130°C (267°F). Is the manifold temperature 130°C (267°F)?

YES: Repair cooling system.

NO: Go to *Check EGT sensors* **on this page**.

Check EGT sensors

Disconnect both EGT switches. Using DVOM, probe the EGT terminals and a known good engine ground. Do you have continuity?

YES: Replace EGT sensor.

NO: Go to *Check EGT circuit* **on this page**

Check EGT circuit

Disconnect ECM wire harness connector. Using a DVOM, connect probe to a known good engine ground and exhaust manifold temperature circuits. Do you have continuity?

YES: Repair circuit as necessary.

NO: Replace ECM.

DTC 2618 - Tachometer Output Ground Short

SPN-645 FMI-4

Circuit Description

The tachometer is driven by a signal generated from the ECM. The ECM receives an input signal from the crankshaft sensor (CKP) which is a magneto resistive type sensor.

4.3, 5.0, and 5.7 engines

The 4.3, 5.0 and 5.7 engine CKP sensors are three wire sensors based on the magneto resistive principle. A magneto resistive sensor uses two magnetic pickups between a permanent magnet. A reluctor wheel passes the magnets the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The ECM supplies a V REF, and signal circuit to the CKP sensor. The sensor returns a digital ON/OFF pulse 3 times per crankshaft revolution for the V6 engine, 4 times for the V8 engine. The CKP sensor reads the crankshaft mounted reluctor wheel to identify pairs of cylinders at top dead center (TDC).

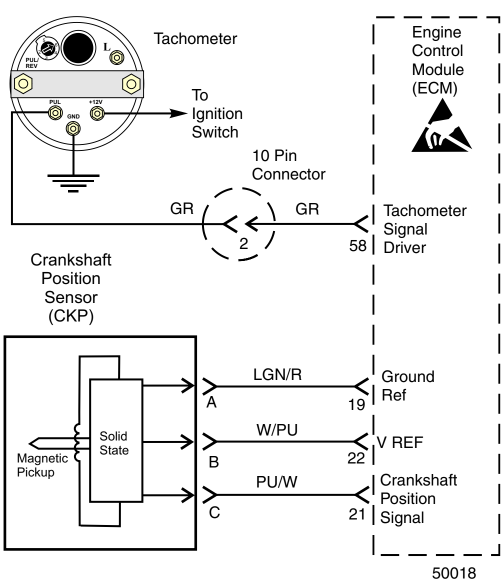
8.1 engines

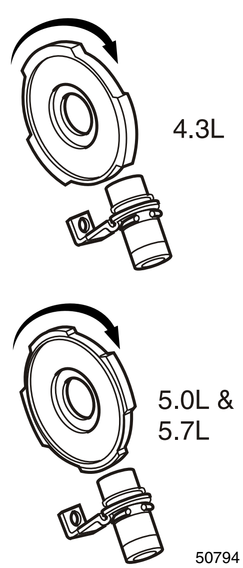
The 8.1 sensor works in conjunction with a 24X reluctor wheel mounted on the crankshaft. The 24X reluctor wheel uses 2 different width notches that are 15 degrees apart. This pulse width encoded pattern allows cylinder identification within 90 degrees of crankshaft rotation. The reluctor wheel also has dual track notches that are 180 degrees out of phase. This allows for quicker starts and accuracy. The CKP sensor also outputs a 4X signal to the ECM to drive the tachometer. All CKP signals are output as a digital waveform. The ECM outputs the tachometer signal from pin 58 in the ECM wire harness connector to the number 2 pin of the Main engine wire harness connector (10 pin) and then it is carried forward to the tachometer via a gray wire.

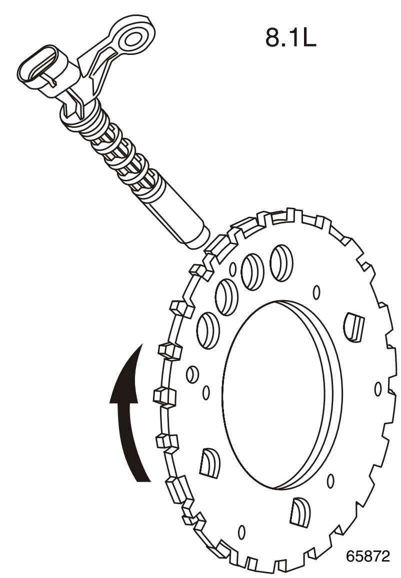
The ECM monitors the amount of voltage that is coming from the tachometer and sets DTC 2618 if the voltage is outside the set parameters.

Conditions for setting DTC

- Tachometer Installed
- Check Condition- Key On, Engine On
- Fault Condition- ECM tachometer output shorted to ground
- Corrective Action(s)- Buzzer soft warning and illuminate MIL







Troubleshooting

The following diagnostics will help diagnose DTC 2618 as well as an inoperative tachometer.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Verify ECM output

Key ON engine running in neutral at idle. Diagnostic tool in ECM Data mode, go to Engine RPM. Does the ECM show engine RPM on the diagnostic tool?

YES: Go to *Check Tach Signal Continuity to Ground* on this page

NO: Replace ECM

Check tach output

Reconnect ECM wiring harness. Key ON - engine running. Run Mode= "Running." Operate engine at idle in neutral. Using DVOM, measure the frequency between tach signal and ground. Is the ECM frequency output between the tach and ground stable and within ± 10% of calculated frequency?

Frequency Calculation

$$\frac{C}{2} \times \frac{N}{60} = \text{Hz}$$

N=engine speed in RPM.

C= number of engine cylinders.

YES: Faulty tach. Replace tach. OR Intermittent short in wiring harness. Go to *Check Tach Signal Continuity to Ground* on this page

NO: Replace ECM

Check Tach Signal Continuity to Ground

Key OFF. Disconnect ECM wiring harness connector. Using DVOM, check for continuity between the tach signal wire at the tach and a known good engine ground. Do you have continuity?

YES: Repair wiring as necessary

NO: Replace ECM

DTC 2619 - Tachometer Output Short to Power

SPN-645 FMI-3

Circuit Description

The tachometer is driven by a signal generated from the ECM. The ECM receives an input signal from the crankshaft sensor (CKP) which is a magneto resistive type sensor.

4.3, 5.0, and 5.7 engines

The 4.3, 5.0 and 5.7 engine CKP sensors are three wire sensors based on the magneto resistive principle. A magneto resistive sensor uses two magnetic pickups between a permanent magnet. A reluctor wheel passes the magnets the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The ECM supplies a V REF, and signal circuit to the CKP sensor. The sensor returns a digital ON/OFF pulse 3 times per crankshaft revolution for the V6 engine, 4 times for the V8 engine. The CKP sensor reads the crankshaft mounted reluctor wheel to identify pairs of cylinders at top dead center (TDC).

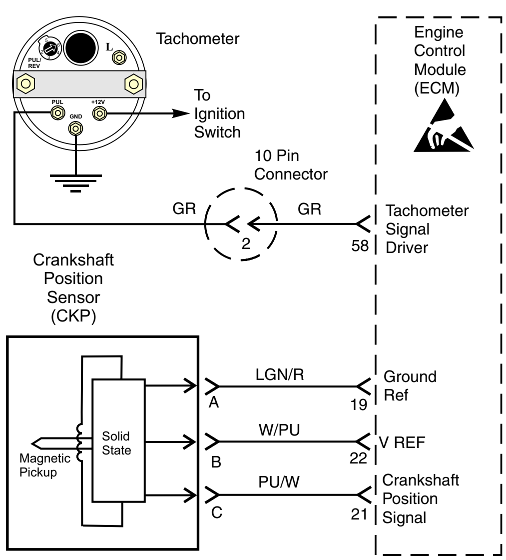
8.1 engines

The 8.1 sensor works in conjunction with a 24X reluctor wheel mounted on the crankshaft. The 24X reluctor wheel uses 2 different width notches that are 15 degrees apart. This pulse width encoded pattern allows cylinder identification within 90 degrees of crankshaft rotation. The reluctor wheel also has dual track notches that are 180 degrees out of phase. This allows for quicker starts and accuracy. The CKP sensor also outputs a 4X signal to the ECM to drive the tachometer. All CKP signals are output as a digital waveform. The ECM outputs the tachometer signal from pin 58 in the ECM wire harness connector to the number 2 pin of the Main engine wire harness connector (10 pin) and then it is carried forward to the tachometer via a gray wire.

The ECM monitors the amount of voltage that is coming from the tachometer and sets DTC 2619 if the voltage is outside the set parameters.

Conditions for setting DTC

- Tachometer Installed
- Check Condition- Key On, Engine On
- Fault Condition- ECM tachometer output shorted to ground
- Corrective Action(s)- Buzzer soft warning and illuminate MIL



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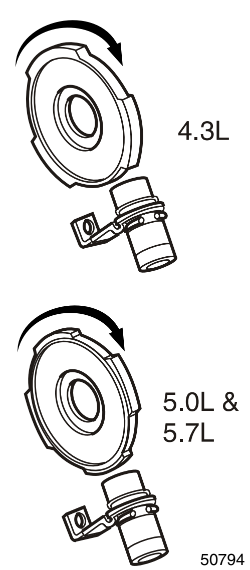

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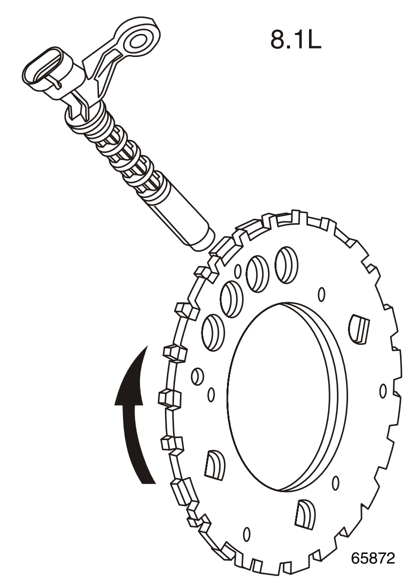

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Troubleshooting

The following diagnostics will help diagnose DTC 2619 as well as an erratic or inoperative tachometer.

Check code is valid and active

Connect the diagnostic tool to the DLC and verify that the code is present and not intermittent. Check the "starts since code last set" counter. It should be at 0. If the start counter is higher than 0, then the code is an intermittent code. See *Preliminary and Intermittent Checks*" on page 48" in Section 4.

Check for voltage on tach signal circuit

Key OFF. Disconnect ECM wiring harness connector. Using DVOM, check the voltage between the signal wire at the tach and a known good ground. Is the voltage greater than 1VDC?

YES: Repair short to power in wiring harness

NO: Go to *Check tach output* on this page

Check tach output

Reconnect ECM wiring harness. Key ON - engine running. Operate engine at idle in neutral. Using DVOM, measure the frequency between tach signal and ground. Is the ECM frequency output between the tach and ground stable and within ± 10% of calculated frequency.

Frequency Calculation

$$\frac{C}{2} \text{ X } \frac{N}{60} = \text{Hz}$$

N=engine speed in RPM.

C= number of engine cylinders.

YES: Faulty tach. Replace tach, or Intermittent short in wiring harness.

NO: Replace ECM

Section 6: ECM Limits

The following charts are the limit criteria used by the ECM to set Diagnositc Trouble Codes. The table is formatted to allow you to determine if the code is valid based on the limit criteria set in the programming used by the ECM.

DTC: Diagnostic Trouble Code number

Value : Temperature, RPMs, pressure, volts etc...

Greater than >: Amount greater than the limit value to set the DTC.

Less than <: Amount less than the limit value required to set the DTC.

Limit : Threshold limit used by the ECM to set or remove a DTC

Latch: Amount of time, or units required for the engine to operate when the threshold has been reached to set an active DTC.

Unlatch: Amount of time or units required for the engine to operatore while below the threashold to remove an active DTC.

Example: DTC 0108 MAP High Pressure - the engine is operating with a MAP pressure greater than 14 psi, and the Throttle Position is less than 10% wide open throttle, and the engine speed is greather than 1800 RPM for longer than 2 seconds.

In order for the engine to unlatch DTC 0108 which will make the code inactive, the engine must operate less than 12 psi with the throttle position less than 10% of wide open throttle and the engine speed needs to be greater than 1800 rpm

Table 1: Limits

MAP					
DTC	**Value**		**Limit**	**Latch**	**Unlatch**
0108	Map Pressure	>	14 psia	**2 sec.**	**4 sec**
	TPS	<	10%		
	RPM	>	1800		
	Unlatch Pressure	<	12 psia		
0107	Map Voltage	<	0.100	**0.5 sec**	**2 sec**
	TPS	>	2%		
	RPM	<	7000		
	Unlatch Voltage	>	0.500		
ECT					
0118	ECT voltage	>	4.950	**1 sec**	**2 sec**
0117	ECT voltage	<	0.050		
0116	ECT temperature	>	190°F	**60 sec**	**15 sec**
	RPM	>	500		

Table 1: Limits

0217	ECT temperature	>	205°F	**10 sec**	**15 sec**
	RPM	>	500		
IAT					
0113	IAT voltage	>	4.95	**1 sec**	**2 sec**
0112	IAT voltage	<	0.050		
0111	IAT temperature	>	180°F	**60 sec**	**15 sec**
	RPM	>	1500		
0127	IAT temperature	>	175°F	**120 sec**	**15 sec**
EGT					
2428	EGT temperature	>	175°F	**30 sec**	**15 sec**
BP					
0129	BP pressure	<	8.30 psi	**1 sec**	**2 sec**
Knock					
0327 0332	Knock 1/2 sensor input voltage	<	0.100	**3 sec**	**1 sec**
	RPM	>	3000		
	MAP	>	10 psi		
0326 0331	Knock 1/2 sensor input voltage	>	4.500		
	MAP	<	8 psi		
Battery Voltage					
0563	Volts	>	15	**3 sec**	**5 sec**
0562	Volts	<	11	**30 sec**	**10 sec**
	RPM	>	500		
5V External					
0643	5V external 1 high voltage	>	5.40	**1 sec**	**2 sec**
0642	5 Volts external 1 low voltage	<	4.60	**1 sec**	**2 sec**
0653	5 Volts external 2 high voltage	>	5.40		
0652	5 Volts external 2 low voltage	<	4.60		
1611	5 Volts ext 1/2 simultaneous out-of-range high votage	>	5.40		
	5 Volts ext 1/2 simultaneous out-of-range low votage	<	4.60		
TPS					
0123	TPS 1 High Voltage	>	4.80	**0.500 sec**	**2 sec**
0122	TPS 1 Low Voltage	<	0.200		**3 sec**
0223	TPS 2 High Voltage	>	4.80		**2 sec**
0222	TPS 2 Low Voltage	<	0.200		**3 sec**
0221	TPS 1 Voltage Higher than TPS 2 Voltage	>	20% differential	**1 sec**	**2 sec**
0121	TPS 1 Voltage Lower than TPS 2 Voltage	<	-20% differential		

Table 1: Limits

2112	Unable to reach higher TPS	>	20% differential between target TPS v Actual TPS	**1 sec**	**0.500 sec**
2111	Unable to reach lower TPS	<	-20% dfferential between target TPS v Actual TPS		
	Battery Voltage	>	Greater than 9 but less than 16		
TPS					
0123	TPS 1 High Voltage	>	4.80	**0.500 sec**	**2 sec**
0122	TPS 1 Low Voltage	<	0.200		**3 sec**
0223	TPS 2 High Voltage	>	4.80		**2 sec**
0222	TPS 2 Low Voltage	<	0.200		**3 sec**
0221	TPS 1 Voltage Higher than TPS 2 Voltage	>	20% differential	**1 sec**	**2 sec**
0121	TPS 1 Voltage Lower than TPS 2 Voltage	<	-20% differential		
2112	Unable to reach higher TPS	>	20% differential between target TPS v Actual TPS	**1 sec**	**0.500 sec**
2111	Unable to reach lower TPS	<	-20% dfferential between target TPS v Actual TPS		
	Battery Voltage	>	Greater than 9 but less than 16		
TCP					
2122	TCP 1 High Voltage	>	4.80	**0.500 sec**	**2 sec**
2123	TCP 1 Low Voltage	<	0.200		
2128	TCP 2 High Voltage	>	2.70		
2127	TCP 2 Low Voltage	<	0.090		
2115	TCP 1 Higher than IVS limit	>	IVS at idle when TCP 1 is greater than 0.90 volts.		
2139	TCP 1 Lower than IVS limit	<	IVS is off idle when TCP 1 is less than 0.60 volts, or IVS off idle if TCP 1 is at idle fault and TCP 1 < TCP 2 learned idle + 0.100 volts		
2116	TCP 2 Higher than EVS limit	>	IVS at idle whe TCP 2 is greater than 0.500 volts.		
2140	TCP 2 Lower than IVS limit	<	IVS off idle when TCP 2 is less than 0.270 volts, or IVS off idle if TCP 2 is at idle fault and TCP2 is less than TCP 2 learned idle + 0.100 volts		
2126	TCP 1 higher than TCP 2	>	TCP 1 % > TCP 2 % by 20%	**1 sec**	**2 sec**
2121	TCP 1 lower than TCP 2	<	TCP 1 % > TCP 2 % by -20%		

Table 1: Limits

2130	IVS stuck at idle TCP 1/2 match		Uses same parameters as individual TCP 1/2 IVS fault detection above.	**0.500 sec**	**2 sec**
2131	IVS stuck off idle, TCP 1/2 match.				
1121	TCP 1/2 simultaneous voltage out-of-range.		Uses same parameters as individual TCP 1/2 fault detection above.		
2120	TCP 1 invalid voltage and TCP 2 disagrees with with IVS		Uses same parameters as individual TCP 1/2 IVS fault detection above.		
2125	TCP 2 invalid voltage and TCP 1 disagrees with IVS				
1122	TCP 1/2 do not match each other or the IVS		Uses same parameters as individual TCP 1/2 fault detection above.		
Auxilary Analog Inputs					
1511	AUX analog PU1 High	>	1.400 volts	**10 sec**	**2 sec**
Engine Speed					
0219	Max govern speed override	>	5100 RPM	**2 sec**	**1 sec**
1111	Fuel rev limit	>	5200 RPM	**0.100 sec**	**0.500 sec**
1112	Spark rev limit	>	5400 RPM	**0.300 sec**	**1 sec**
Oil Pressure					
0524	Oil Pressure	<	5 psi and > 550 RPM	**30 sec**	**3 sec**
0523	Oil Pressure sender high voltage	>	4.8 volts	**1 sec**	**2 sec**
0522	Oil Pressure sender low voltage	<	0.200 volts		
Fuel Injectors					
0262	#1 Injector coil shorted	>	4.0 volts and battery voltage > 16 volts	**10 samples**	**5 samples**
0265	#2 Injector coil shorted	>			
0268	#3 Injector coil shorted	>			
0271	#4 Injector coil shorted	>			
0274	#5 Injector coil shorted	>			
0277	#6 Injector coil shorted	>			
0280	#7 Injector coil shorted	>			
0283	#8 Injector coil shorted	>			
Fuel Pump Relay Control/Coil					
0628	Fuel pump relay control ground short			**10 samples**	**5 samples**
0627	Fuel pump relay coil open				
0629	fuel pump relay coil shor to power				
Ignition Relay Control/Coil					
0686	Ignition relay control ground short			**10 samples**	**5 samples**
0685	Ignition relay coil open				
0687	Ignition relay short to power				
Starter Relay Control/Coil					

Table 1: Limits

0616	Starter relay control ground short			**10 samples**	**5 samples**
0615	Starter relay coil open				
0617	Starter relay short to power				
Buzzer Control					
1641	Buzzer control ground short			**10 samples**	**5 samples**
1642	Buzzer open				
1643	buzzer control short to power				
TACH output					
2618	Tach output ground short				
2619	tach output short to po				
Gauge Low Side Diagnostics					
1631	Water Temperature gauge open/short to ground	<	Low side feedback < 5% of battery voltage, and duty-cycle < 5%	**2 sec**	**0.500 sec**
1632	Water Temperature gauge short to power	>	Low side feedback > 90% of battery voltage, and duty-cycle > 75%		
1633	Oil pressure gauge open/short to ground	<	Low side feedback < 5% of battery voltage, and duty-cycle < 5%		
1634	Oil pressure gauge short to power	>	Low side feedback > 90% of battery voltage, and duty-cycle > 75%		
1635	Trim position gauge open/ short to ground	<	Low side feedback < 5% of battery voltage, and duty-cycle < 5%		
1636	Trim positon gauge short to power	>	Low side feedback > 90% of battery voltage, and duty-cycle > 75%		
Cam/Crank Sensors					
0342	Camshaft sensor loss		No cam pulse in 2 cycles and 100 RPM	**0.100 sec**	**10 sec**
0337	Crankshaft sensor loss	>	Cam pulse without crankshaft activity for 3 cam pulses	**0.100 sec**	**N/A**
0341	Camshaft sync noise	>	1 invalid cam re-syncs within 700 ms	**1 sec**	**10 sec**
0336	Crankshaft sync noise		1 invalid crank re-sync withing 800 ms		
0018	Never crank synced at start	>	4 cranking revs without sync and 90 RPM.	**1 sec**	**N/A**

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