

POWERTECH® 8.1L Natural Gas Engines

With Level 8 Electronic Fuel Systems

TECHNICAL MANUAL POWERTECH® 8.1L Natural Gas Engines With Level 8 Electronic Fuel Systems

CTM300 18NOV03 (ENGLISH)

For complete service information also see:

**POWERTECH® 8.1L
Natural Gas Engines Repair CTM87**

John Deere Power Systems
LITHO IN USA

Introduction

Foreword

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.



CAUTION: This is the safety-alert symbol. When you see this symbol on the machine or in this manual, be alert to the potential for personal injury.

Use this component technical manual in conjunction with the engine repair manual (for 6081 CNG engines use CTM87) and the respective machine technical manual. See the repair manual for information on component removal and installation. See the machine technical manual for information on gaining access to the components.

This manual is divided into two parts: theory of operation and diagnostics. The theory of operation section contains information that explains how the engine subsystems operate. The diagnostics section helps identify the cause of engine problems.

Applicable special tools needed to do the job, specifications, and helpful reference materials are covered in separate groups toward the end of this manual.

Fundamental service information is available from other sources covering basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic type of failures and their causes.

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Operation and Diagnostics

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Handle Fluids Safely—Avoid Fires

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.



TS227 -JUN-23AUG88

DX,FLAME -19-29SEP98-1/1

Handle Compressed Natural Gas (CNG) Safely

Handle natural gas with care; it is highly flammable. Do NOT smoke while working on or around natural gas equipment.

Natural gas fumes may cause sickness or death. Work in well ventilated area.

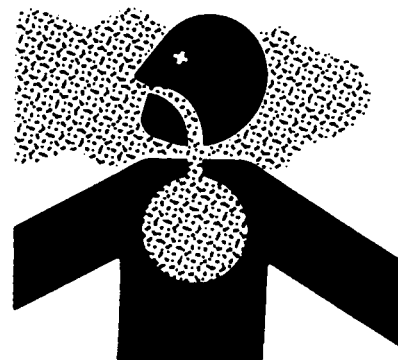
Shut off natural gas supply before servicing equipment.

Have a manual valve installed away from the engine to shut off gas supply in case of an emergency.

Prevent fires by keeping machine clean of accumulated trash, grease, and debris.



TS227 -JUN-23AUG88



TS220 -JUN-23AUG88

RG,RG34710,3002 -19-02AUG01-1/1

00 2 Service Cooling System Safely

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.



DX,RCAP -19-04JUN90-1/1

TS281 -UN-23AUG88

Prevent Battery Explosions

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).



DX,SPARKS -19-03MAR93-1/1

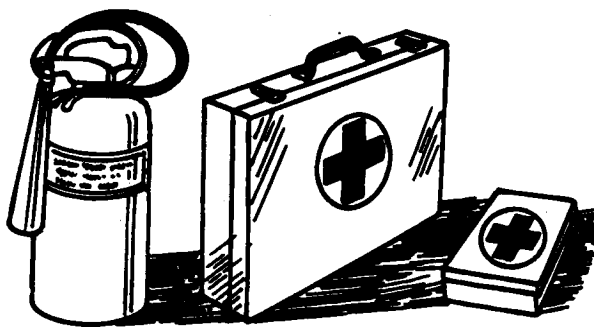
TS204 -UN-23AUG88

Prepare for Emergencies

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



DX,FIRE2 -19-03MAR93-1/1

TS291 -UN-23AUG88

Handling Batteries Safely



CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded (-) battery clamp first and replace it last.



CAUTION: Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

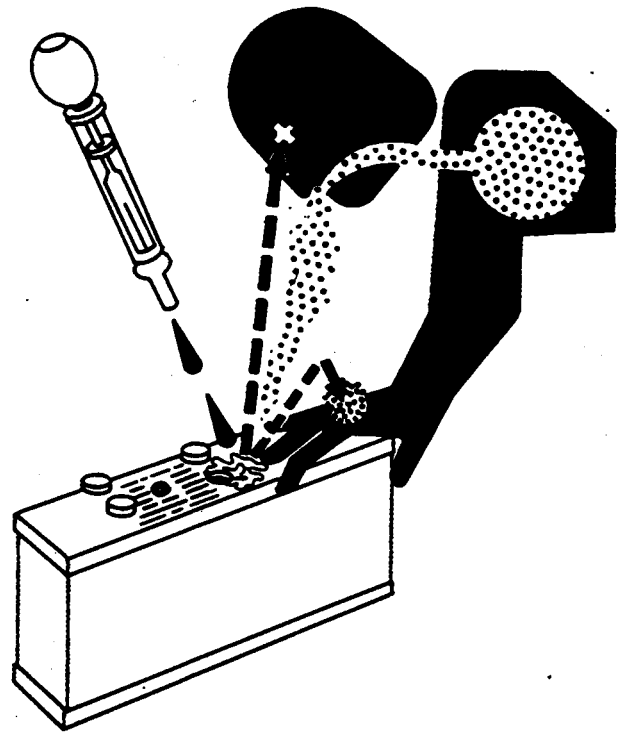
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 quarts).
3. Get medical attention immediately.



WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

TS204 -UN-23AUG88

TS203 -UN-23AUG88

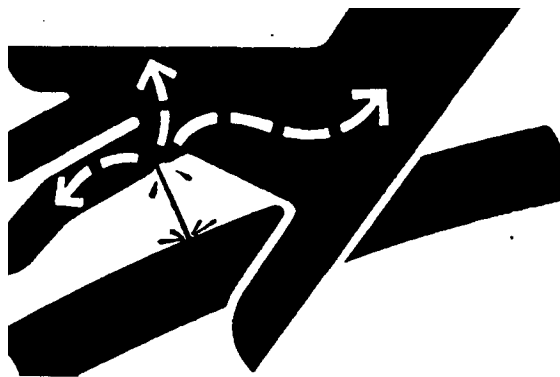
Avoid High-Pressure Fluids

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.



X9811 -UN-23AUG88

DX,FLUID -19-03MAR93-1/1

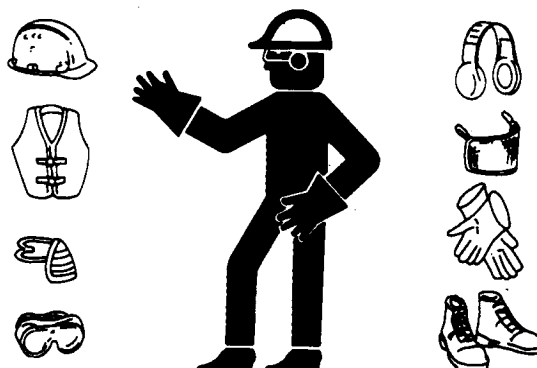
Wear Protective Clothing

Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



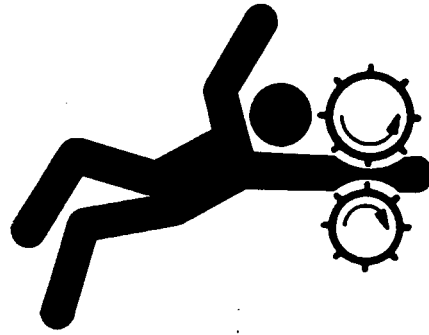
TS206 -UN-23AUG88

DX,WEAR -19-10SEP90-1/1

Service Machines Safely

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



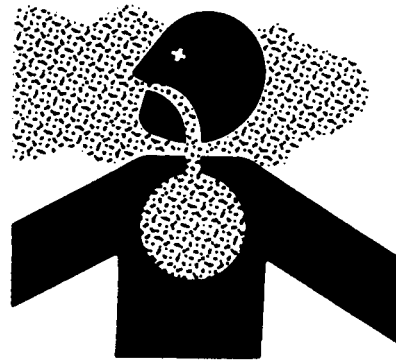
TS228 -JUN-23AUG88

DX, LOOSE -19-04JUN90-1/1

Work In Ventilated Area

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.



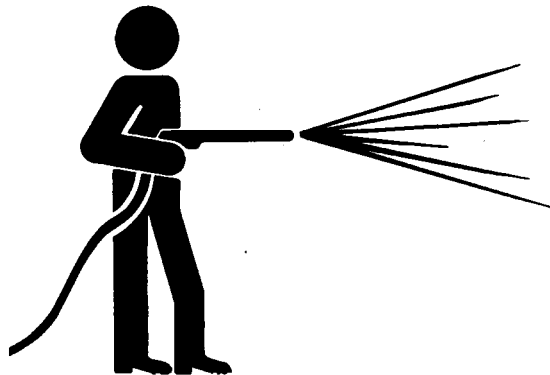
TS220 -JUN-23AUG88

DX, AIR -19-17FEB99-1/1

Work in Clean Area

Before starting a job:

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



T6642EJ -JUN-18OCT88

DX, CLEAN -19-04JUN90-1/1

Remove Paint Before Welding or Heating

Avoid potentially toxic fumes and dust.

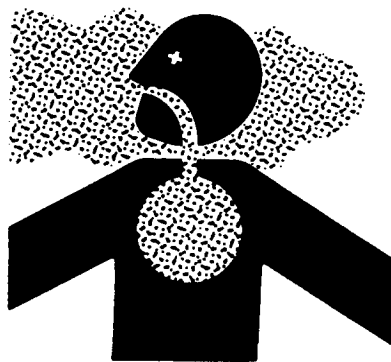
Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

- Remove paint a minimum of 76 mm (3 in.) from area to be affected by heating.
- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

Do all work in an area that is ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.



TS220 -UN-23AUG88

DX,PAINT -19-22OCT99-1/1

Avoid Heating Near Pressurized Fluid Lines

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.



TS953 -UN-15MAY90

DX,TORCH -19-03MAR93-1/1

Illuminate Work Area Safely

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



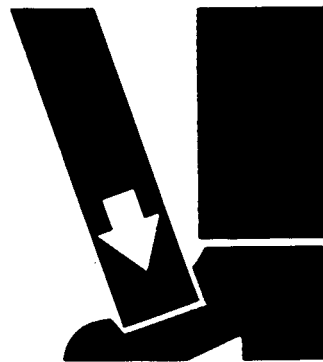
TS223 -UN-23AUG88

DX,LIGHT -19-04JUN90-1/1

Use Proper Lifting Equipment

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.



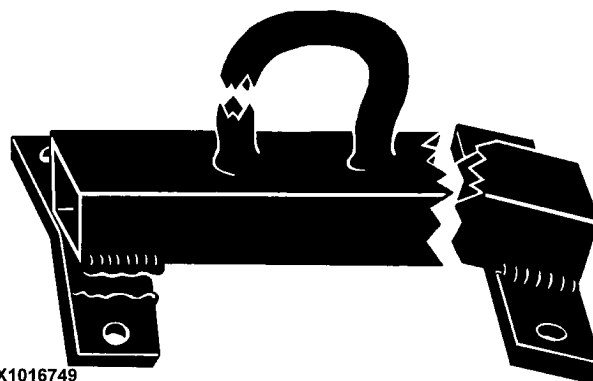
TS226 -UN-23AUG88

DX,LIFT -19-04JUN90-1/1

Construct Dealer-Made Tools Safely

Faulty or broken tools can result in serious injury. When constructing tools, use proper, quality materials, and good workmanship.

Do not weld tools unless you have the proper equipment and experience to perform the job.



LX1016749

LX1016749 -UN-01JUL97

DX,SAFE,TOOLS -19-10OCT97-1/1

Practice Safe Maintenance

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust machine while it is moving. Keep hands, feet, and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow machine to cool.

Securely support any machine elements that must be raised for service work.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. Remove any buildup of grease, oil, or debris.

On self-propelled equipment, disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

On towed implements, disconnect wiring harnesses from tractor before servicing electrical system components or welding on machine.



TS218 -UN-23AUG88

DX,SERV -19-17FEB99-1/1

Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.



TS779 -UN-08NOV89

DX,REPAIR -19-17FEB99-1/1

Dispose of Waste Properly

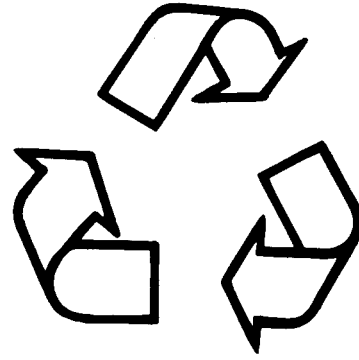
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.



TS1133 -UN-26NOV90

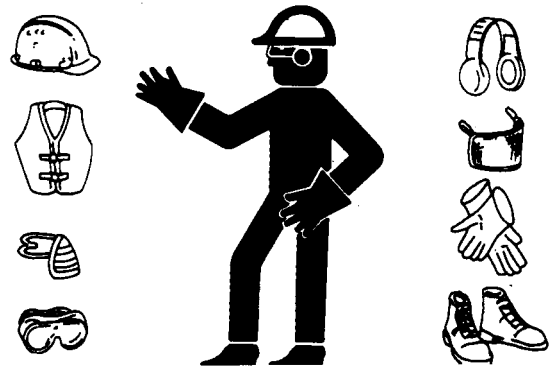
DX,DRAIN -19-03MAR93-1/1

Service Compressed Natural Gas (CNG) Systems Safely

Improper installation, service, or operation of CNG storage and delivery components can result in fire, explosion, and/or serious injury.

See ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 of this manual before servicing the CNG fuel system.

Relieve CNG fuel system pressure before working on the system. Properly tighten connections and check for leaks before pressurizing the CNG fuel system.



TS206 -UN-23AUG88

RG,RG34710,3019 -19-02AUG01-1/1

Protect Against High Pressure

CNG fuel systems operate at high pressures. DO NOT disassemble or remove any CNG fuel system components under pressure. Explosive separation of components, and the escaping natural gas can cause serious injury.

Relieve CNG fuel system pressure before disconnecting any fuel system component.



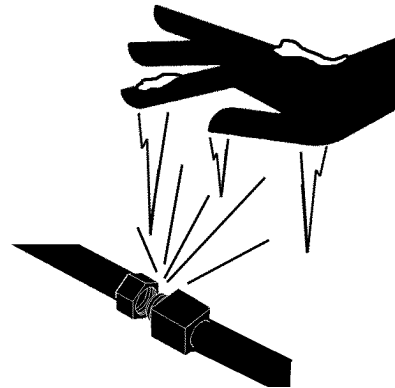
TS265 -UN-23AUG88

RG, RG34710, 3020 -19-02AUG01-1/1

Protect Against Extremely Cold CNG Leakage

Gas escaping from the CNG fuel system is very cold. Frostbite and skin damage can occur from contact with cold escaping gas or surrounding components.

Inspect for leaks by spraying a soap and water solution on joints, fittings, and other areas. Look for bubbles that indicate leakage from the system.



RG8110 -UN-20AUG98

RG, RG34710, 3021 -19-02AUG01-1/1

Live With Safety

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.



TS231 -19-07OCT88

DX, LIVE -19-25SEP92-1/1

General Engine Operation

The 6081 Natural Gas engine is a vertical stroke, in-line, valve-in-head, 6-cylinder engine. The firing order is 1-5-3-6-2-4.

Each engine is turbocharged. Operated by exhaust gases, the turbocharger compresses intake air from the air cleaner and routes it through the mixing elbow and intake manifold to each cylinder's combustion chamber. The turbocharger's wastegate is controlled by the electronic control unit (ECU) and has liquid cooled center housing.

An air-to-air aftercooler cools the turbocharger compressor discharge air by routing it through a heat exchanger (mounted beside the radiator) before it enters the intake manifold. The heat exchanger uses no liquid coolant, but relies on air flow to cool the charge air.

The camshaft and followers are made of chilled iron. The cam lobes are individually flame hardened to provide excellent wear characteristics. Spherically ground followers riding on tapered cam lobes help insure positive follower rotation. The camshaft has two different nose diameters to accommodate a pressed on timing wheel and a pressed on cam gear. The timing wheel is on the inside, and is used in conjunction with the camshaft position sensor to measure engine speed and to determine engine position.

Intake and exhaust valves are operated by cam followers, push rods, and rocker arm assembly. Cylinder head has replaceable inserts and valves, and has intake/exhaust valve stem seals.

The crankshaft is a one-piece, heat treated, dynamically balanced steel forging which rotates in replaceable two-piece main bearings. The rear thrust bearing has a flange on each side to reduce crankshaft deflection and to limit end play during high load operation.

Cylinder liners are of a wet sleeve, flanged, and centrifugally cast design. O-rings are used to seal the connection between cylinder block and liners. Liners are induction hardened and are individually replaceable.

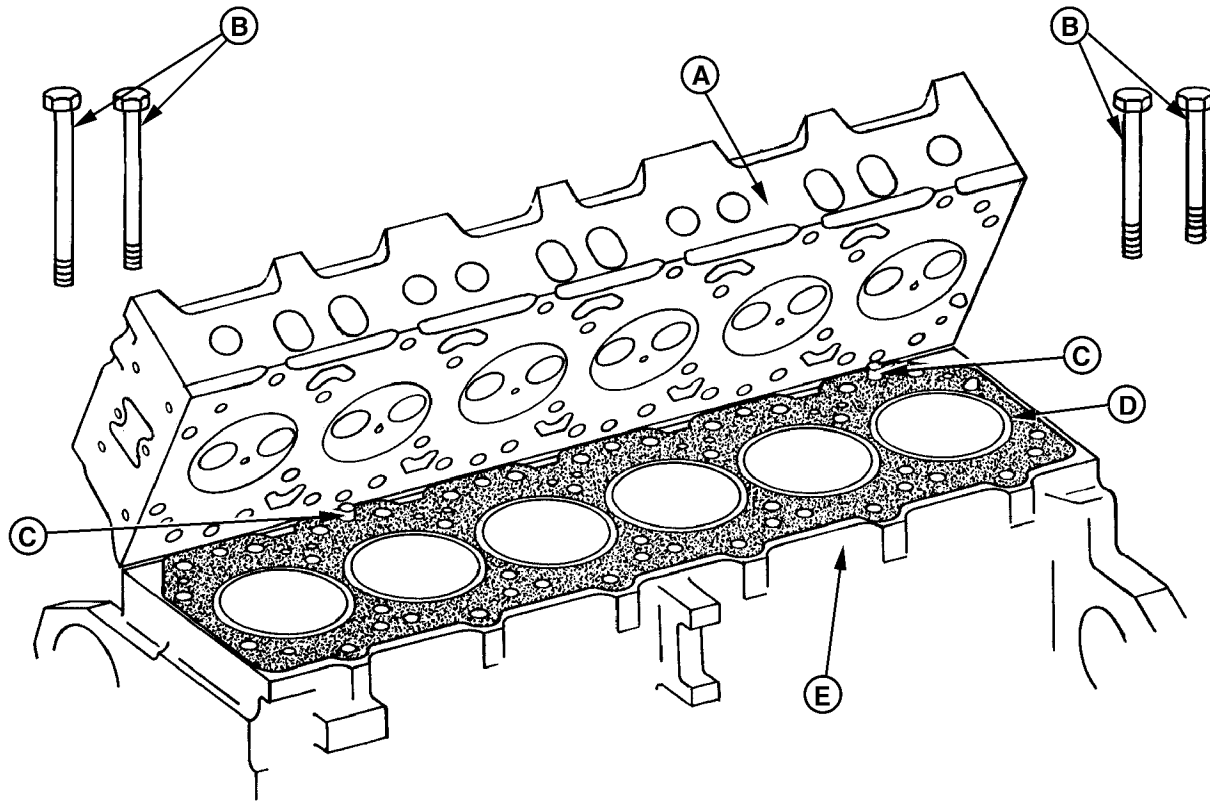
Pistons are constructed of high-silicone aluminum alloy. A "cereal bowl" shaped piston crown lowers the compression ratio to 11:1 compared to the diesel engine and provides a compact, high efficiency combustion chamber that promotes lean-burn combustion. The piston utilizes a three ring design. The top ring is a compression ring, the second ring is used for both compression and oil scrapping, and the lower ring is an oil control ring. A double Ni-Resist ring carrier is cast integrally in the piston to greatly improve the life of the piston ring grooves.

The highly polished, hardened piston pins are fully-floating and held in position by means of snap rings. Spray jets (piston cooling orifices) in the cylinder block direct pressurized oil to lubricate piston pins and cool pistons.

Connecting rods are of forged steel and have replaceable bushing and bearing inserts. They are weight controlled (by machining) on both ends to minimize engine vibration.

RG41221,000001E -19-08JUL03-1/1

Head Gasket Joint Construction and Operation

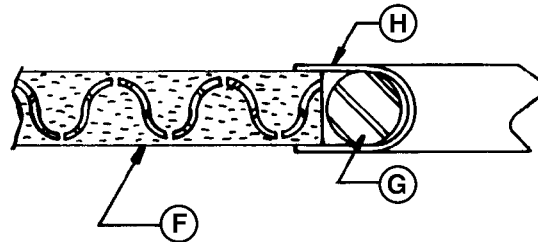


NOTE: The drawings for Head Gasket Joint Construction and Operation represent the 6081 CNG engine.

The head gasket joint consists of:

- Cylinder head gasket
- Cylinder head (A)
- Cylinder head cap screws (B)
- Cylinder liners (D)
- Cylinder block (E)

Refer to text on next page.



- A—Cylinder Head
- B—Cylinder Head Cap Screws
- C—Dowel Pins
- D—Cylinder Liners
- E—Cylinder Block
- F—Gasket Body
- G—Fire Ring Combustion Seal
- H—Stainless Steel Flange

RG6447 -JUN-26NOV97

RG6430 -JUN-03NOV97

Continued on next page

RG, RG34710, 3024 -19-14SEP01-1/2

The head gasket must be an air-tight seal between cylinder liners and cylinder head that can withstand the temperatures and pressures of the combustion process. The gasket must also form a liquid-tight seal between the cylinder head and the cylinder block to retain coolant and oil in their respective passages. The gasket is constructed of thin, formed sheets of steel-inserted, non-asbestos material (F). The surface of gasket is treated to improve liquid sealing and anti-stick characteristics. A firing ring combustion seal (G) is located at each cylinder bore and is held in place by a U-shaped stainless steel flange (H).

The cylinder head and block must be flat to provide an even clamping pressure over the entire surface of the gasket, and must have the proper surface finish to keep gasket material from moving in the joint. Dowels (C) are used to properly locate head gasket on block.

The cylinder liners must protrude evenly from the top of the cylinder block to the specified amount to provide adequate clamping force on firing ring of each cylinder.

The cap screws must be proper length, made of proper material, and be tightened to the proper torque in order to provide an adequate clamp load between other joint components.

Each of the above components contributes to the integrity of the head gasket joint. If any of these components do not conform to specifications, gasket joint may fail resulting in combustion leaks, coolant leaks, or oil leaks.

Failure of head gasket and mating parts may occur when coolant and oil temperatures become excessive, or when abnormally high combustion temperatures and pressures persist.

RG, RG34710, 3024 -19-14SEP01-2/2



RG41221,0000015 -19-14SEP01-1/2

A—Oil Pump
 B—Oil Cooler
 C—Oil Cooler Bypass Valve
 D—Oil Filter Bypass Valve
 E—Oil Pressure Regulating Valve Housing
 F—Oil Pressure Regulating Valve

G—Oil Filter Base
 H—Crankshaft Main Bearing
 I—Piston Cooling Orifices
 J—Camshaft Bushings
 K—Connecting Rod Bearings
 L—Main Oil Gallery

M—Drill Oil Passage
 N—Rocker Arm Shaft
 O—Turbocharger Lube Line
 P—Turbocharger Oil Return
 Q—Camshaft Followers
 R—Return Oil

S—Medium Oil Pressure
 T—High Oil Pressure
 U—Non-Cooled Oil
 V—Cooled Oil
 W—Non-Filtered Oil
 X—Filtered Oil

The engine lubrication system consists of a crank-driven oil pump (A), oil cooler (B), oil cooler bypass valve (C), oil filter, oil filter bypass valve (D) and oil pressure regulating valve (F).

Oil is drawn up from the sump, through the oil pump, and into the oil cooler. Oil proceeds through the oil cooler where it exchanges heat with the engine coolant. The oil cooler housing has an oil cooler bypass valve used to bypass the cooler if a restriction is found and the pressure increases. Oil goes to the oil filter base (G) which houses the oil filter and oil filter bypass valve. Oil passes through the oil filter, unless high restriction is sensed in which case the oil filter is bypassed.

The oil then moves to the oil pressure regulating valve housing (E) where the regulating valve regulates the main oil gallery (L) pressure and permits excess to be returned to the sump. After flowing past the regulating valve, cooled, clean pressurized oil is supplied to the main oil gallery for distribution to the crankshaft main bearings (H) and piston cooling orifices (I) through drilled passages in the cylinder block.

The main bearings work to send oil to the camshaft bushings (J) while passages in the crankshaft allow pressurized oil to also lubricate the connecting rod bearings (K). The piston cooling orifices direct oil onto the piston crown and piston/wrist pin assembly.

Oil from the camshaft bushing travels through drilled passages in the camshaft nose to lubricate the camshaft thrust washer and front drive train.

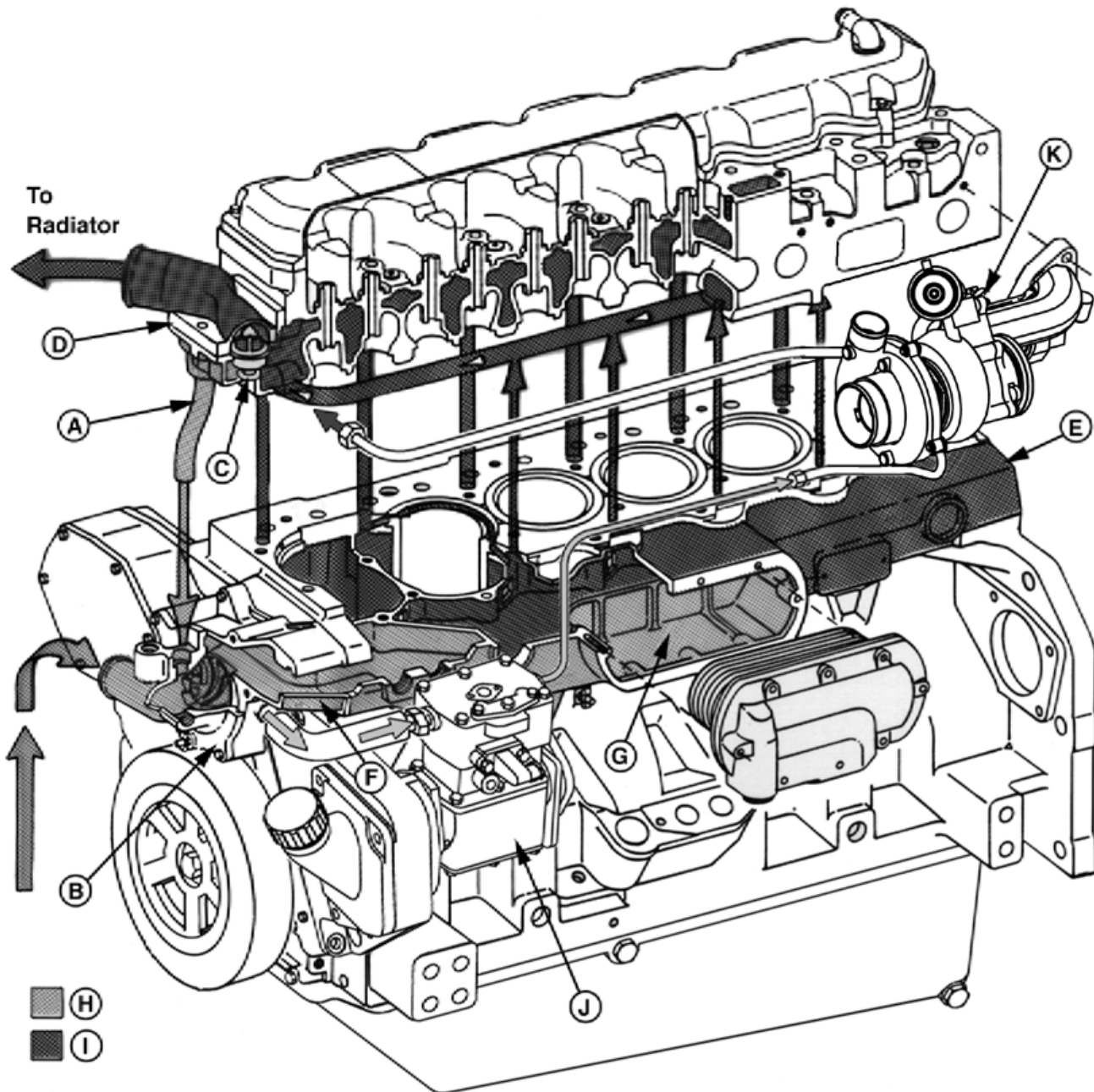
Oil from the rear camshaft bushing feeds through drilled passages (M) in the cylinder block and cylinder head into passages in the rocker arm shaft (N), which in turn provide oil to the other valve train components as well as the camshaft followers (Q).

Some oil is routed from the top of the oil filter base through an external line (O) to the turbocharger and is returned to the cylinder block crankcase through another external line.

The air compressor is pressure lubed by way of an external line which taps into the main oil gallery.

RG41221_0000015 -19-14SEP01-2/2

Cooling System Operation



A—Coolant Bypass Tube
B—Coolant Pump
C—Thermostats (2 used)

D—Thermostat Housing
E—Coolant Manifold
F—Inlet Manifold

G—Engine Oil Cooler
H—Low Temperature
I—High Temperature Engine Coolant

J—Air Compressor
K—Turbocharger

The cooling system consists of a conventional radiator, cooling fan, coolant pump (B), thermostats (C),

thermostat housing (D), and cylinder block with coolant cavities.

RG11908 -JUN-08JUL02

Continued on next page

RG41221,0000016 -19-14SEP01-1/2

The pump draws coolant from the bottom of the radiator and discharges it through the lower inlet manifold (F) on the left-hand side of the engine block. The inlet directs coolant to the engine oil cooler (G) and provides the cooling capability from the coolant flow around it. Coolant passes through the oil cooler cavity and enters the upper coolant manifold. At this time, the coolant flow will move in one of four directions. Each cylinder is unitized and has a separate flow circuit.

The main coolant passage flows through a rectangular port and around the cylinder liner, then exists the block through a vertical passage into the right-hand side of the cylinder head.

The second circuit involves flowing coolant from the upper coolant manifold through a small vertical passage onto the left-hand side of the cylinder head.

The third circuit is called the "directed cooling" system. Coolant flows through a small port and into a groove at the top of the cylinder liner. Coolant passes around a

groove in the liner, and exists into the vertical passage of the main circuit, then into the right-hand side of the cylinder head.

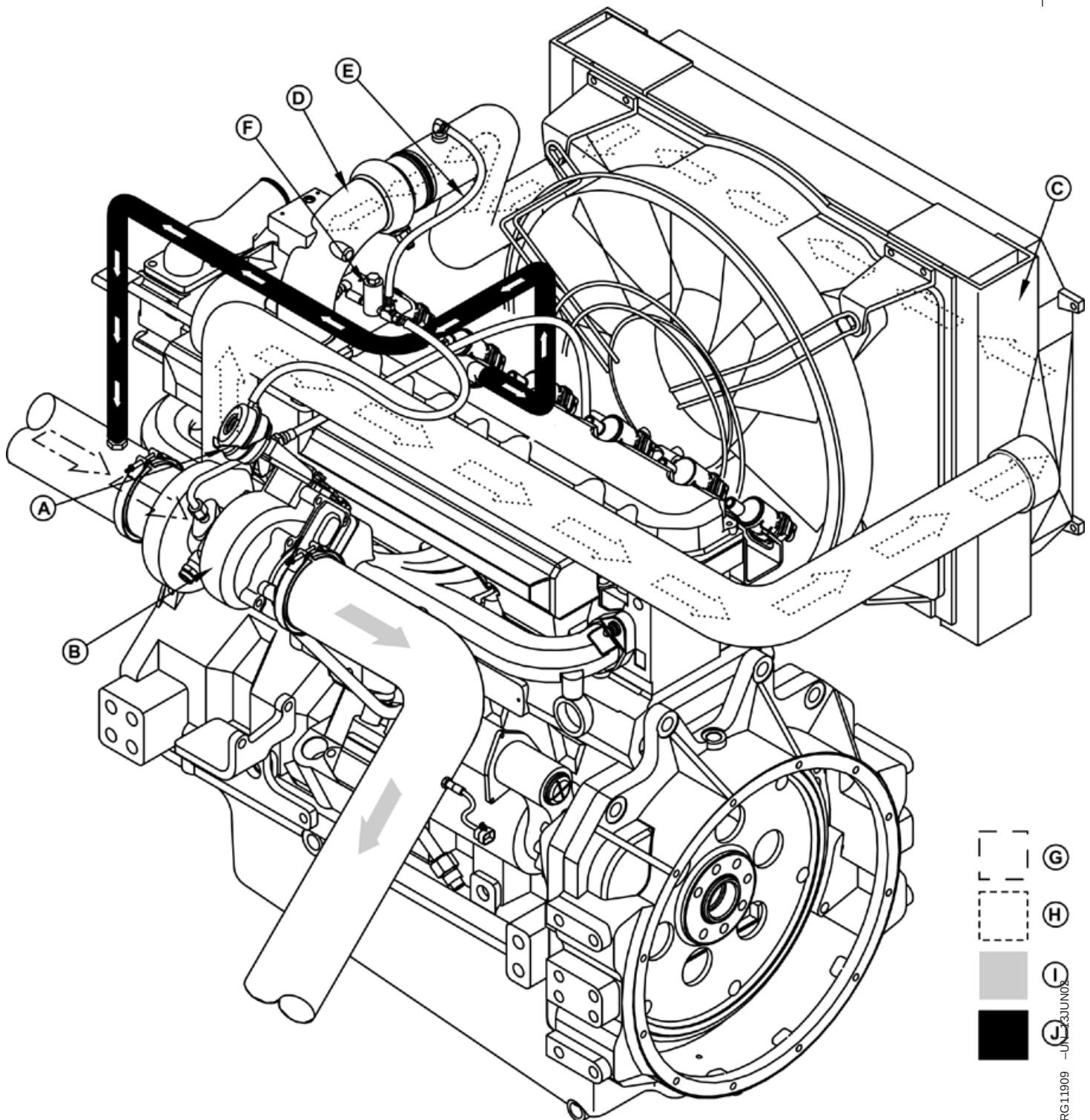
The fourth circuit flows coolant from the coolant manifold, into the air compressor (J), from the compressor, into the turbo, and from the turbocharger (K) to the thermostat housing. Coolant also runs to the fuel pressure regulator, which in some applications is remote from the engine.

Once the coolant is in the cylinder head, all flow is towards the front. Coolant passes into the thermostat housing, past the two open thermostats (engine at normal operating temperature), and then returns to the radiator.

If the thermostats are closed (during warm-up periods), coolant is directed back to the pump through the bypass tube (A) to be recirculated. This provides a faster and more uniform warm-up. Some coolant passes through the bypass tube even while the thermostats are open.

RG41221,0000016 -19-14SEP01-2/2

Intake and Exhaust System Operation



A—Wastegate
B—Turbocharger
C—Air-to-Air Aftercooler

D—Air/fuel Mixing Elbow
E—Intake Air routed to operate
Wastegate

F—Wastegate Actuator
G—Clean Air
H—Charged Air

I—Exhaust Air
J—Crankcase Blow By Air

Continued on next page

RG41221,000001D -19-08JUL03-1/2

Engine suction draws dust-laden outside air through an air inlet stack into the air cleaner. Air is filtered through dry-type primary and secondary filter elements in the air cleaner canister. Clean air (G) travels through the intake air hose to the turbocharger (B), this charged air (H) goes through the air-to-air aftercooler (C), through the air/fuel mixing elbow (D), and into the intake manifold.

Exhaust (I), as it is expelled out of the exhaust manifold, drives the turbocharger to deliver a larger quantity of air to meet the engine requirements than what could be delivered under naturally aspirated (non-turbocharged) conditions.

The air-to-air aftercooler cools the turbocharger compressor discharge air by routing it through a heat exchanger before it enters the engine. The heat

exchanger uses no coolant but relies on air flow to cool the charge air. Excessive crankcase pressure is released through a breather tube, and it runs into the intake air pipe before the turbocharger.

Prior to the mixing elbow, cool, charged air (J) is routed to control the wastegate (A). When the wastegate actuator (F) is not electronically powered, this air is routed to open the wastegate, allowing exhaust air to bypass the turbine wheel in the turbocharger. This limits the turbocharger's shaft speed which controls the boost pressure. When the wastegate actuator is powered, this air is routed out the vent. The valve allows the system to develop peak charge-air pressures for maximum engine boost response while eliminating the chance of excessive manifold pressure (over-boost) at high speeds or loads.

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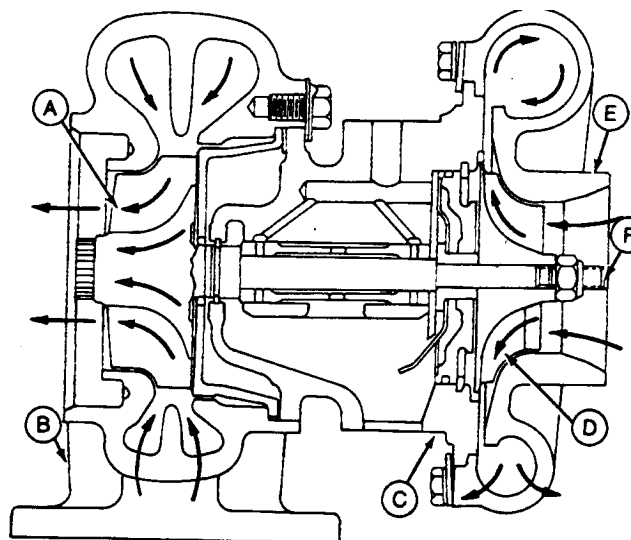
Turbocharger Operation

The turbocharger, which is basically an air pump that is driven by exhaust gases, allows the engine to produce added power without increasing displacement.

Exhaust gases from the engine pass through the turbine housing (B) causing the turbine wheel (A) to rotate before it is discarded into the atmosphere. The turbine wheels are mounted on the shaft (F) to drive the compressor wheel (D) which is also mounted on the shaft.

As the compressor wheel rotates in the compressor housing (E), an increased volume of (compressed) inlet air is drawn into the housing and delivered to the air-to-air aftercooler.

All rotating components of the turbocharger are lubricated within the center housing (C).



- A—Turbine Wheel
- B—Turbine Housing
- C—Center Housing
- D—Compressor Wheel
- E—Compressor Housing
- F—Shaft

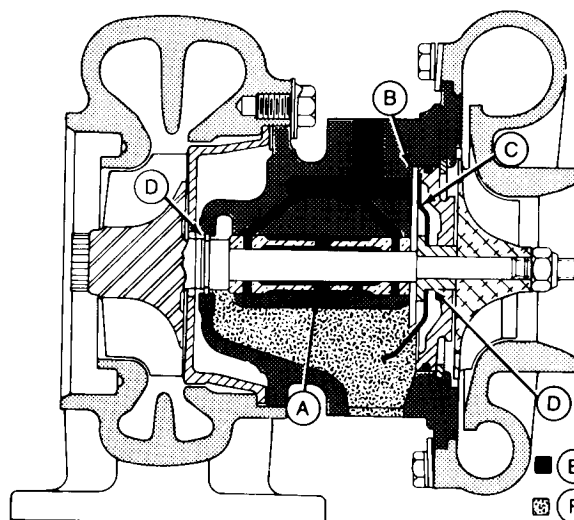
R28273 -UN-14DEC88

RG41221.0000018 -19-14SEP01-1/2

How the Turbocharger is Lubricated

Engine oil under pressure from the lubrication system is pumped through a passage in the bearing housing and is directed to the bearing (A), thrust plate (B), and thrust sleeve (C). Oil is sealed from the compressor and turbine by a piston ring (D) at both ends of bearing housing.

The turbocharger contains a single floating bearing. This bearing has a clearance between the bearing OD and the housing wall as well as clearance between the bearing ID and the shaft OD. These clearances are lubricated by the oil supply and the bearings are protected by a cushion of oil. Discharge oil drains by gravity from the bearing housing to the engine crankcase.

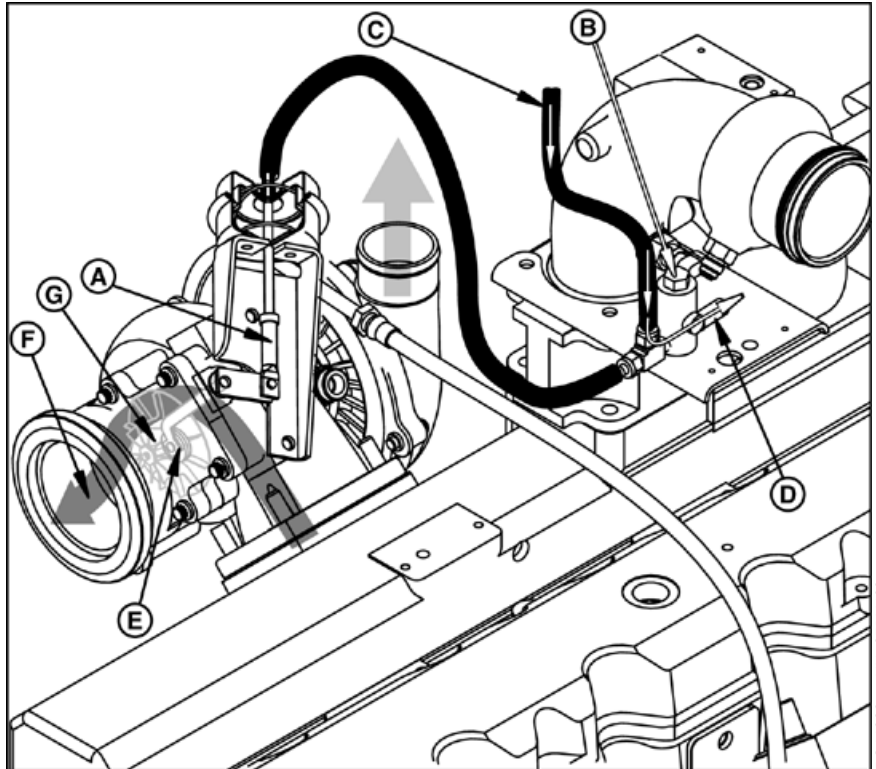


- A—Bearing
- B—Thrust Plate
- C—Thrust Sleeve
- D—Piston Ring
- E—Pressure Oil
- F—Discharge Oil

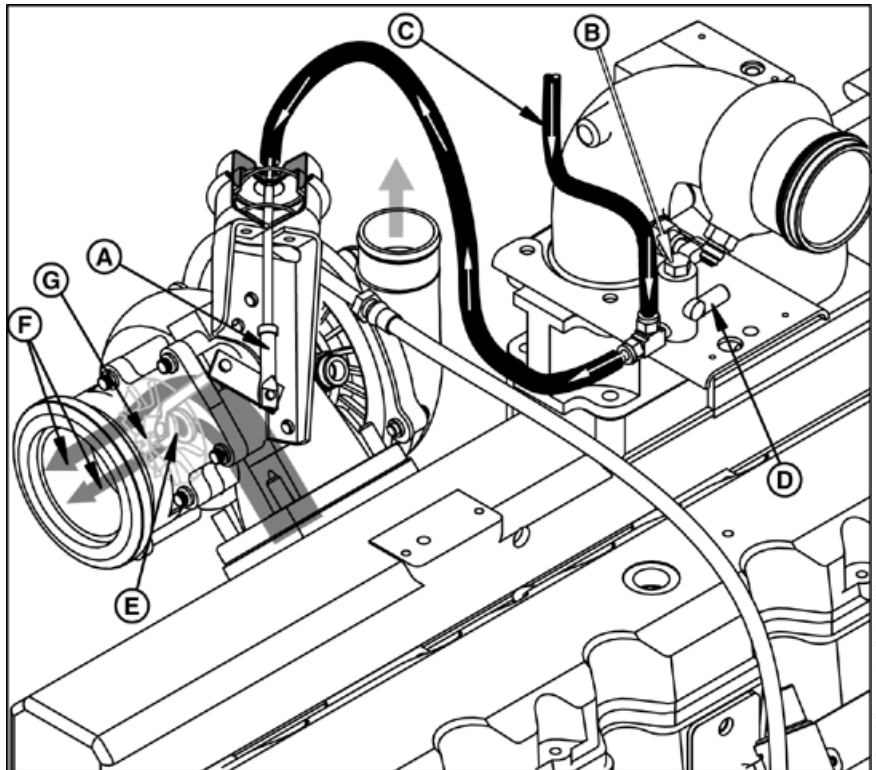
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RG41221.0000018 -19-14SEP01-2/2

Wastegate Operation



Wastegate Closed (Solenoid Energized)



Wastegate Open (Solenoid Unenergized)

Continued on next page

RG41221,000001C -19-14SEP01-1/2

A—Wastegate Actuator
B—Wastegate Control Solenoid

C—Pre-throttle Air Pressure
D—Vent

E—Turbocharger Turbine Wheel

F—Exhaust Air
G—Wastegate Valve

The opening and closing of the wastegate actuator (A) is indirectly controlled by the wastegate control solenoid (B). The ECU reads manifold absolute pressure (MAP), engine speed, and foot pedal position with respect to one another to help control the wastegate solenoid. If the MAP is too high with respect to the commanded value sent by the foot pedal for a certain engine speed, the ECU will then cut electrical power to the wastegate control solenoid which will reduce boost.

When the wastegate solenoid is energized, pre-throttle intake air pressure (C) is allowed to exit out of the vent

(D). Because the pressure is released through the vent, the wastegate actuator keeps the wastegate valve (G) closed and maximum boost can be developed.

When the wastegate solenoid is not powered, pre-throttle intake air pressure is not allowed to exit out of the vent. Because of this, air pressure exerts force onto the wastegate actuator. This actuator moves the wastegate control valve which allows some exhaust air (F) to bypass the turbine wheel (E) of the turbocharger. This reduces boost by reducing turbine speed.

RG41221,000001C -19-14SEP01-2/2

This technical diagram illustrates the exploded view of a 6-cylinder engine assembly. The components are labeled as follows:

- A**: Points to the crankshaft, which is the central rotating shaft of the engine.
- B**: Points to the main bearing cap, which supports the crankshaft.
- C**: Points to the connecting rod, which links the piston to the crankshaft.
- D**: Points to the piston and piston pin assembly, which converts the combustion pressure into mechanical work.
- E**: Points to the cylinder block, which houses the cylinders and the crankshaft.
- F**: Points to the cylinder head, which covers the top of the cylinders.
- G**: Points to the valve train mechanism, which controls the intake and exhaust valves.

RG11910 -UN-04JUN02

RG41221,0000019 -19-14SEP01-1/2

A—Fuel Filter

B—Low Pressure Lock-Off
Solenoid

C—Natural Gas Temperature
(NGT) Sensor

D—Natural Gas Pressure
(NGP) Sensor

E—Metering Block Outlet Port

F—Fuel Injectors

G—Mixing Elbow

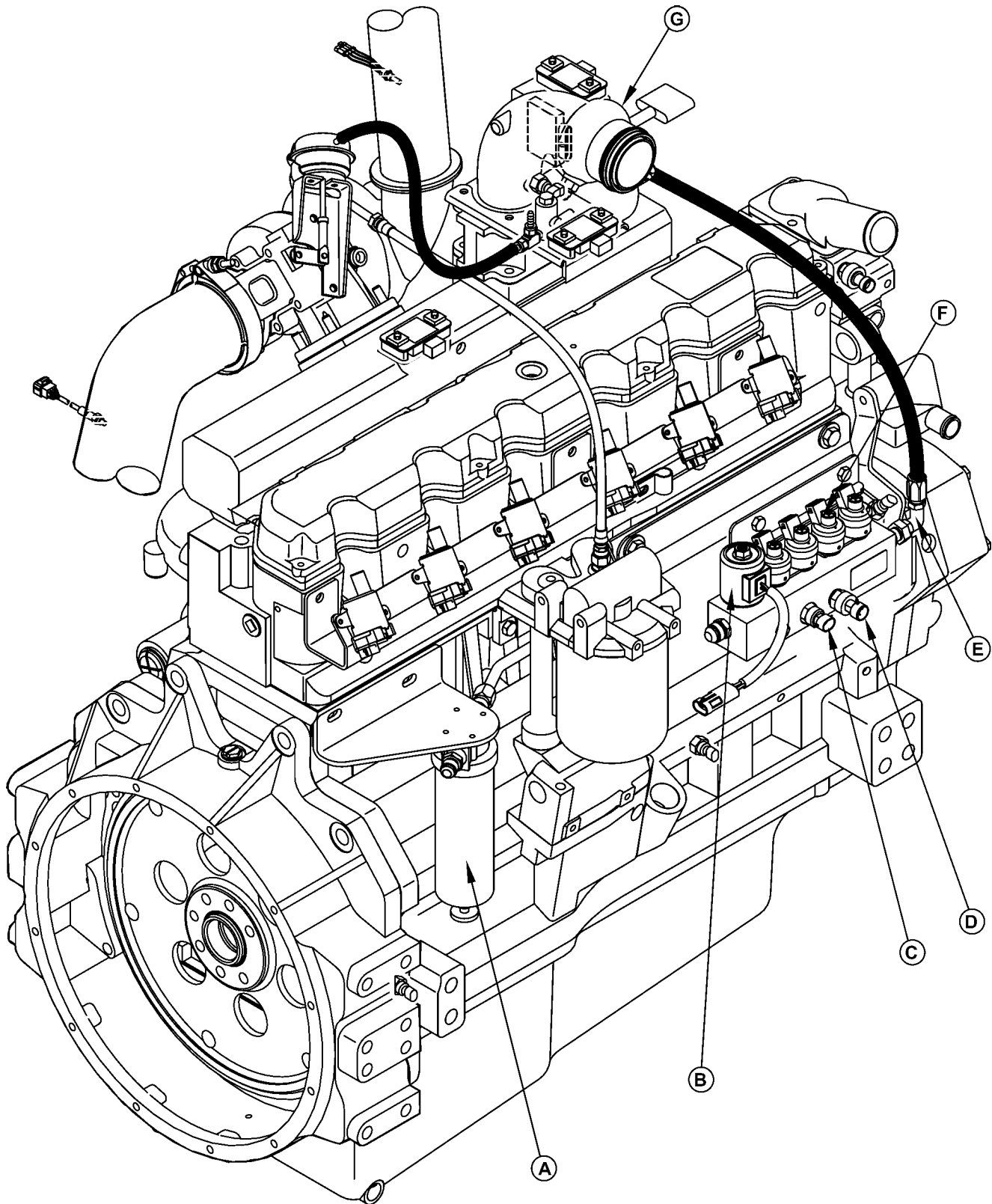
CNG fuel is supplied to the fuel pressure regulator inlet at pressures up to 3600 psi (24,825 kPa) (248 bar). Fuel is then reduced by a single stage diaphragm design pressure regulator to approximately 115 psi (800 kPa) (8.0 bar). The fuel pressure regulator is remote mounted in the engine compartment. The regulator is heated by engine coolant and a regulator pressure relief vent is connected to the vehicle vent to protect against over-pressure problems. Fuel is then routed through the fuel filter (A), and on to the metering block. Fuel is then delivered to the engine by eight electrically pulsed injectors (F) located on the fuel metering block. The ECU controls the “on” time (pulse width) of each injector to deliver the correct amount of fuel to the engine. A common outlet port (E) from the

metering valve provides fuel to a fuel/air mixer (G) located upstream of the throttle body.

Natural gas pressure (NGP) sensor (D) and natural gas temperature (NGT) sensor (C) are located at the metering valve so the ECU can adjust the injector pulse width to compensate for variations in natural gas density. Also located on the fuel metering block is an ECU controlled lock-off solenoid (B). The lock-off solenoid will stop the flow of fuel upstream of the injectors. The lock off solenoid controls a normally closed valve that opens when the ECU energizes it. The lock off solenoid will be closed anytime the ignition is OFF or is ON but hasn't been in the crank position for 16 seconds.

RG41221,0000019 -19-14SEP01-2/2

Fuel Control System Operation - Liquid Natural Gas



RG13011 -UN-08AUG03

Continued on next page

RG41221.000016D -19-16JUN03-1/2

A—Fuel Filter

B—Low Pressure Lock-Off
SolenoidC—Natural Gas Temperature
(NGT) SensorD—Natural Gas Pressure
(NGP) Sensor

E—Metering Block Outlet Port

F—Fuel Injectors (4)

G—Mixing Elbow

LNG fuel exits the fuel tank in a liquid form at pressures between 90-115 psia (620-800 kPa) (6.2-8.0 bar). The liquid gas travels through a heat exchanger to convert the liquid state into a gaseous state. The heat exchanger uses engine coolant to vaporize the liquid fuel and turn it into a gas. From the heat exchanger, fuel is routed through the Overpressure Regulator located between the heat exchanger and fuel filter. This regulates the pressure of the fuel to normal engine operating pressures.

Once the fuel at the desired pressure, it is routed through the fuel filter (A), and on to the metering block. Fuel is then delivered to the engine by four electrically pulsed injectors (F) located on the fuel metering block. The ECU controls the “on” time (pulse width) of each injector to deliver the correct amount of fuel to the

engine. A common outlet port (E) from the metering valve provides fuel to a fuel/air mixer (G) located upstream of the throttle body.

The ECU uses a natural gas Pressure (NGP) sensor (D) and a natural gas temperature (NGT) sensor (C) to calculate fuel density at the metering block. Based on the density, the ECU adjusts the injector pulse-width to compensate the amount of fuel delivered to the engine. Also located on the fuel metering block is an ECU controlled lock-off solenoid (B). The lock-off solenoid controls a normally closed valve that opens when the ECU energizes it. The lock-off solenoid will be closed anytime the ignition is OFF or is ON but hasn't been in the crank position for 16 seconds. This stops fuel flow upstream of the injectors.

RG41221,000016D -19-16JUN03-2/2

Fuel Control Modes

After the engine is first started, for the first 30-60 seconds of run time, the ECU operates in open loop. During open loop fuel control, fueling rate is determined by ECU calibration based on measurements of MAP, RPM, TCT, ECT, and UTP. This is speed density fuel control.

Fuel delivery accuracy is improved when the system operates in closed loop. After the engine has been running for about 30-60 sec, the ECU changes from open loop fuel control to closed loop fuel control. Closed loop provides the ability for the ECU to correct for gas composition variation and for changing operating conditions. Using a universal exhaust gas oxygen (UEGO) sensor, the ECU is able to measure the amount of oxygen in the exhaust. From the oxygen measurement, the ECU can determine the air/fuel ratio, then adjust the amount of fuel delivered until the optimum air/fuel ratio is achieved. The closed loop multiplier number is the percent increase or decrease from the base mass fuel flow the ECU delivered in order to achieve the optimum air/fuel ratio. Typical

corrections under normal operating conditions will be +/- 10%.

The adaptive learn acts as a fuel correction memory. The adaptive learn is enabled when the engine reaches operating temperature and is in closed loop fueling control. The adaptive learn function maintains a table where each cell of the table represents a different combination of engine speed (RPM) and engine load (MAP). Each time the closed loop correction is "successful" in achieving the optimum air/fuel ratio for a certain engine speed and MAP, the adaptive learn stores that fuel correction in a cell. The next time the engine operates at that same engine speed and MAP, the fuel correction stored in that cell is used. If the engine has a tendency to run slightly lean, the adaptive learn multiplier number will be positive. If the engine has a tendency to run slightly rich, the adaptive learn multiplier number will be negative. Under normal operating conditions, the system will operate in closed loop + adaptive fuel control mode.

RG41221,000001A -19-14SEP01-1/1

Theory of Lean-Burn Engines

A stoichiometric combustion engine burns an air/fuel mixture which contains just enough air to theoretically burn all of the fuel. A lean-burn combustion engine burns an air/fuel mixture which contains more air than is theoretically needed to completely burn the fuel.

The excess air in lean-burn combustion results in a more complete combustion than what is achievable in a stoichiometric engine. This complete combustion yields lower emissions of hydrocarbon (HC) and carbon monoxide (CO) and decreases fuel consumption. In addition, lean air/fuel mixtures burn at a lower temperature resulting in less formation of oxides of nitrogen (NOx) emissions.

The lower temperature combustion of a lean-burn engine results in less thermal energy loss through the cylinder walls, yielding a greater thermal efficiency. A lower combustion temperature also reduces the thermal stress on components exposed to combustion such as the exhaust valves.

The amount of energy in a lean mixture is less than the amount of energy in the same volume of a

stoichiometric mixture. However, the 6081HFN04 engine has a turbocharger and aftercooler that increases the density of the air/fuel mixture and allows the engine to develop a high power output.

Lean air/fuel mixtures don't ignite as readily as stoichiometric mixtures; therefore, a lean-burn engine ignition system must be powerful, and the air and fuel must be mixed thoroughly. The CNG engines thoroughly mix the air and fuel in a mixing elbow, upstream of the throttle. Ignition is accomplished using a high power inductive ignition system with one coil per cylinder to provide a high energy, long duration spark.

Accurate control of the air/fuel ratio in a lean-burn engine is extremely important. If the mixture is too rich, the advantages of lean-burn will be lost. If the mixture is too lean, the mixture will not ignite and a misfire will result. The CNG engine accurately controls the air/fuel ratio using a closed loop, adaptive learn, electronic fuel injection system to deliver a precise amount of natural gas to the engine.

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High Pressure Fuel Supply System Storage and Routing - Compressed Natural Gas

The Compressed Natural Gas (CNG) fuel for the engine is stored in high strength aluminum, fiberglass reinforced tanks (A). CNG is stored in the tanks up to 3600 psi (24,825 kPa) (248 bar).

Each tank includes a manual shut-off valve containing a pressure relief valve (B) designed to vent at either high pressure or high temperature. Each tanks' relief valve is plumbed into a common vent pipe (C) that routes out of the vehicle.

CNG flows out of the individual tanks, and into a high pressure rated, stainless steel common fuel line (D). The fuel lines are joined by high pressure rated stainless steel compression fittings. Any tank with its shut off valve open feeds fuel into the common fuel line. With its shut off valve closed, the tank doesn't feed the common line, but the valve's tee is exposed to common line high pressure.

The common fuel line flows into a high pressure lock-off (E) and a coalescing filter (F). From there, fuel flows to the fuel pressure regulator. The pressure regulator drops fuel pressure to approximately 115

psig (800 kPa) (8.0 bar). From the regulator, fuel flows to the fuel metering block containing a low pressure lock-off solenoid activated by the ignition switch, the engine Electronic Control Unit (ECU), and the fire suppression system.

During refilling, fuel is routed through a filter then back flows into the common fuel line and into any tank with an open shut off valve. A pressure gauge (G) plumbed into the filler assembly measures common fuel line pressure.

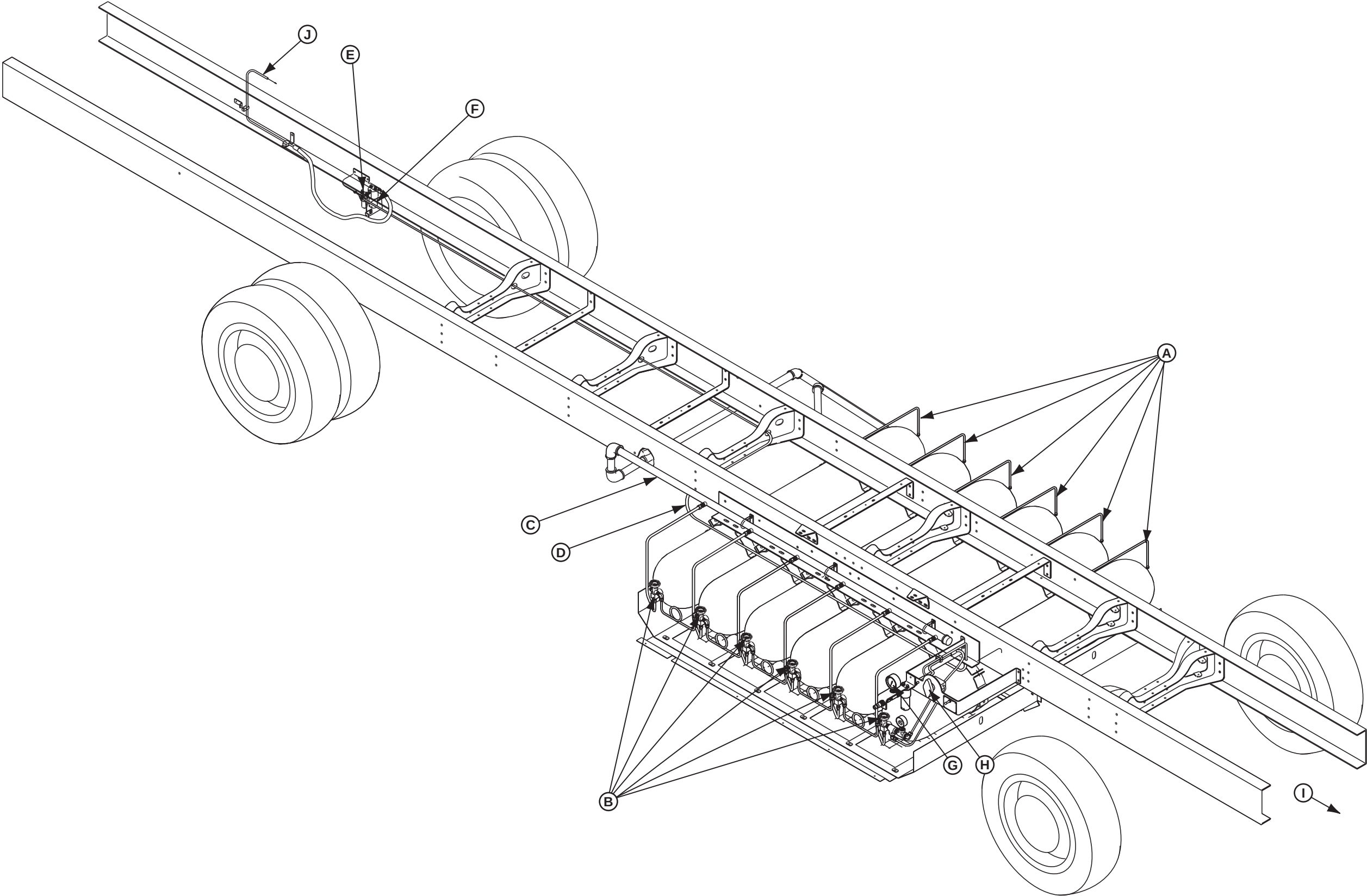
A 1/4-turn shut-off valve (H) near the filler assembly shuts off fuel flow to the common fuel line.

The fuel gauge on the dash of the vehicle is operated by the engine ECU. The ECU measures fuel pressure on the fuel pressure regulator with the Natural Gas Tank Pressure (NGTP) sensor and fuel temperature with the Natural Gas Tank Temperature (NGTT) sensor on the common fuel line, then calculates CNG fuel volume and operates the fuel gauge accordingly. The ECU won't sense any CNG in a tank with a closed shut off valve.

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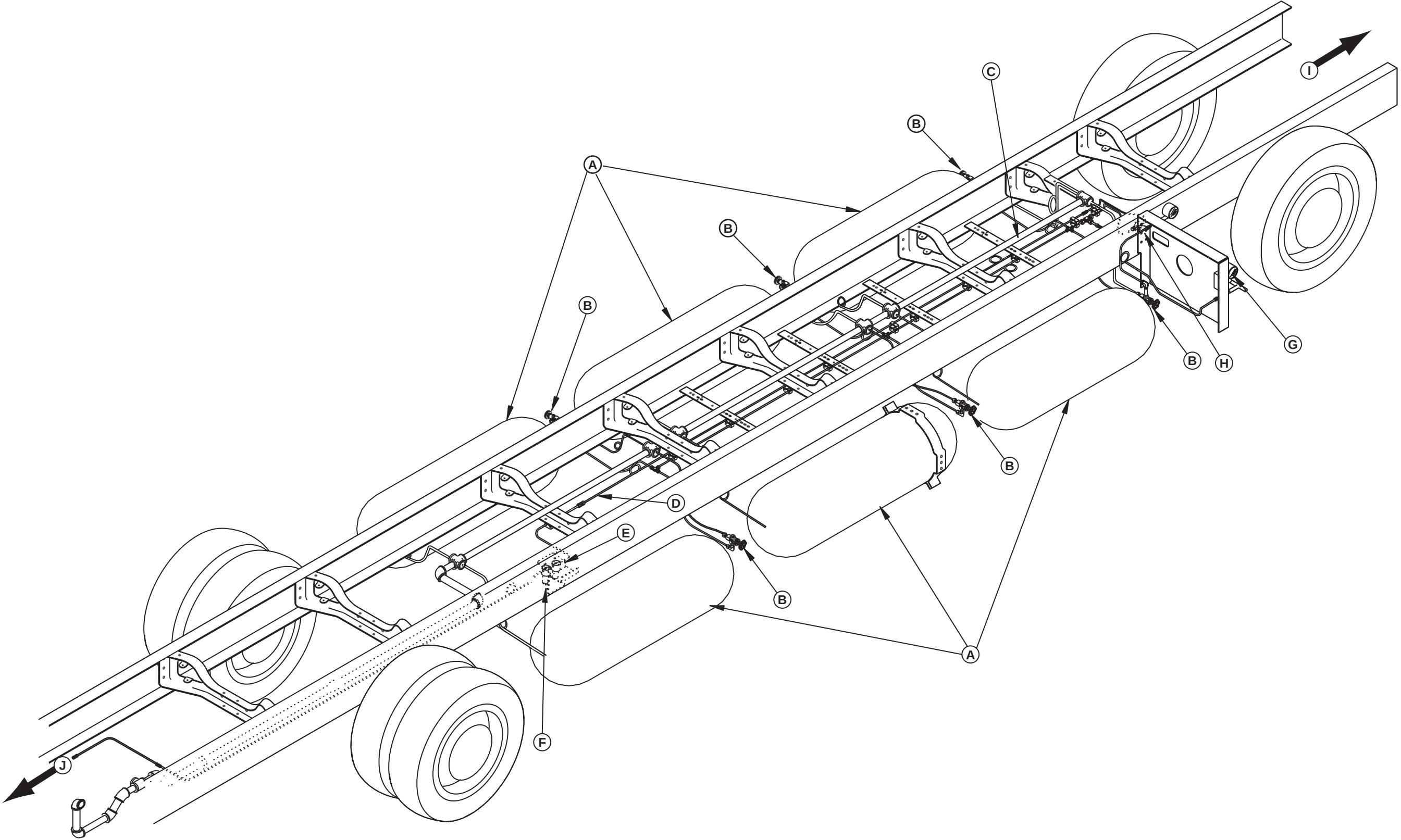


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RG41221,000001B -19-08JUL03-2/5

A—Compressed Natural Gas Tanks B—Pressure Relief Valve				C—Common Vent Pipe D—Common Fuel Line E—High Pressure Lock-Off	F—Coalescing Filter G—Pressure Gauge	H—1/4-Turn Shut-Off Valve I—Front of chassis	100 23
NOTE: Some buses may have the fuel regulator located away from the engine. Not all				applications will have the same configuration for fuel tanks.			
Continued on next page				RG41221.000001B -19-08JUL03-3/5			

RG8109 -UN-08JUN99



A—Compressed Natural Gas Tanks	C—Common Vent Pipe	F—Coalescing Filter	H—1/4-Turn Shut-Off Valve
B—Pressure Relief Valve	D—Common Fuel Line	G—Pressure Gauge	I—Front of chassis
E—High Pressure Lock-Off			

NOTE: Some buses may have the fuel regulator located away from the engine. Not all

applications will have the same configuration for fuel tanks.

High Pressure Fuel Supply System Storage and Routing - Liquid Natural Gas

Liquid Natural Gas (LNG) is stored in cryogenic containers. Cryogenic containers are specially insulated tanks required to keep the LNG temperature around -220°F (-104°C) without the use of refrigerants. LNG fuel is also required to be stored at very low pressures, 90 psia (620 kPa) (6.2 bar).

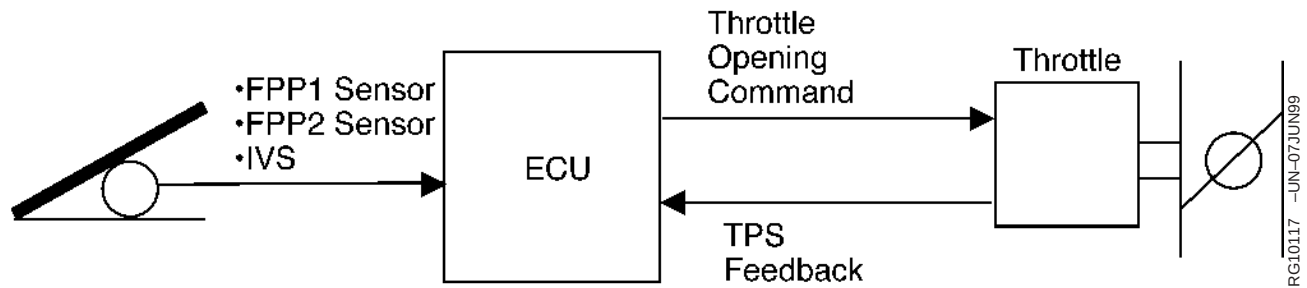
Each tank includes the following components:

Fuel Shut-off Valve	Used to stop the flow of gas to the engine during service and maintenance. This valve is normally open during normal engine operation.
Excess Flow Valve	Used to stop the flow of fuel in situations where overfueling occurs. If fuel flow exceeds the setpoint value, the valve closes for engine protection purposes.
Vapor Shutoff Valve	Used to relieve tank pressure during service or maintenance on tank. Valve is normally shut during engine operation.
Pressure Control Regulator	Used to reduce fuel tank pressure during normal operation. When the fuel pressure exceeds the setpoint, the valve opens and fuel flow escapes the tank.
Primary Relief Valve	Vents excess pressure to atmosphere.
Secondary Relief Valve	Backup to the Primary Relief Valve.

LNG flows out of the storage tank, and into heat exchanger. The heat exchanger warms the liquid natural gas to convert into a vapor. The heat exchanger uses engine coolant to warm the gas. The warm gas then travels through the Overpressure Regulator. Here the gas pressure is set to normal engine operating pressure.

Once the fuel is at the desired pressure, it is routed into a coalescing filter. Filtered fuel flows to the fuel metering block containing a low pressure lock-off solenoid activated by the ignition switch, the engine Electronic Control Unit (ECU), and the fire suppression system.

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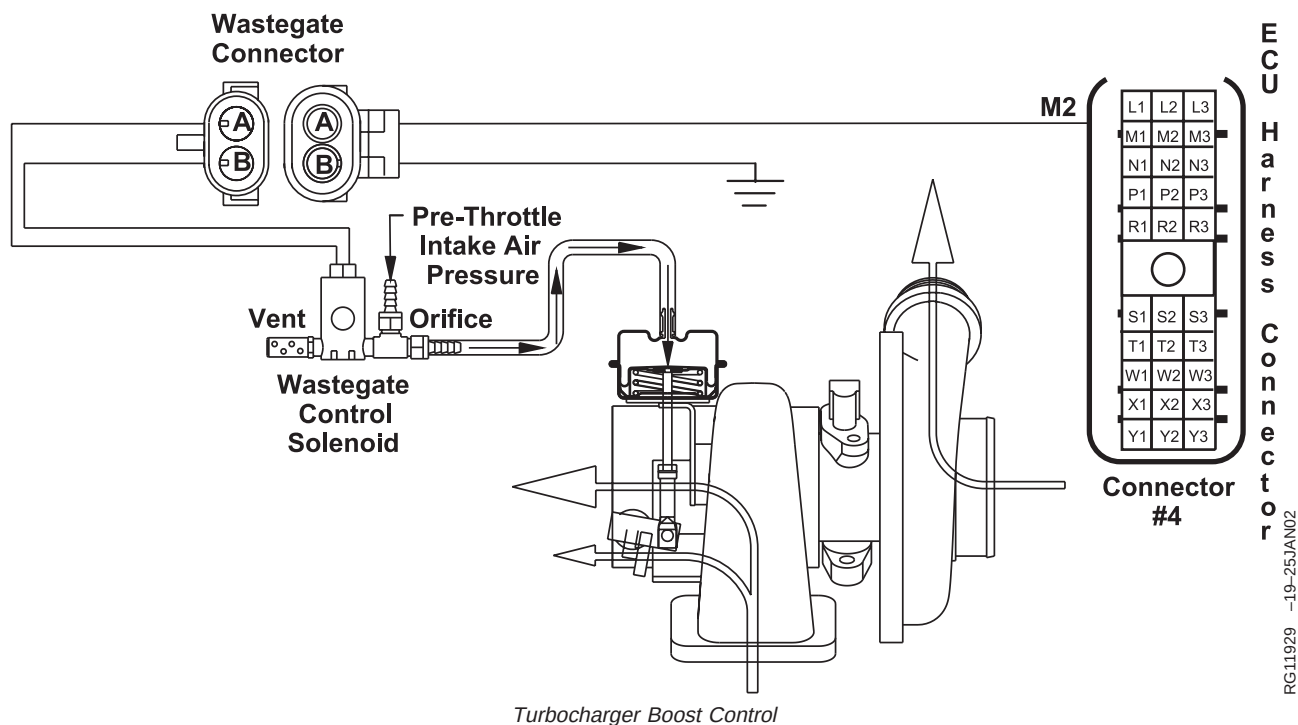
Air Control

Power output of a spark ignited natural gas engine is controlled by varying the airflow to the engine. More airflow results in more power. The ECU controls engine airflow by commanding both throttle opening and turbocharger boost level. John Deere CNG applications have a throttle that is a drive-by wire electronically controlled throttle/actuator. The ECU provides a pulse width modulated (PWM) signal to command throttle opening based on the foot pedal

position (FPP) input from the driver. The throttle is configured for min/max governing, and is designed so that no separate idle-air bypass is needed. The min/max governor is typical for a spark ignited engine and provides NO fast idle regulations. Attempting to run the engine at high idle similar to a diesel engine can result in damage to engine control components and base engine components. A switch on the dash is provided for fast idle operation.

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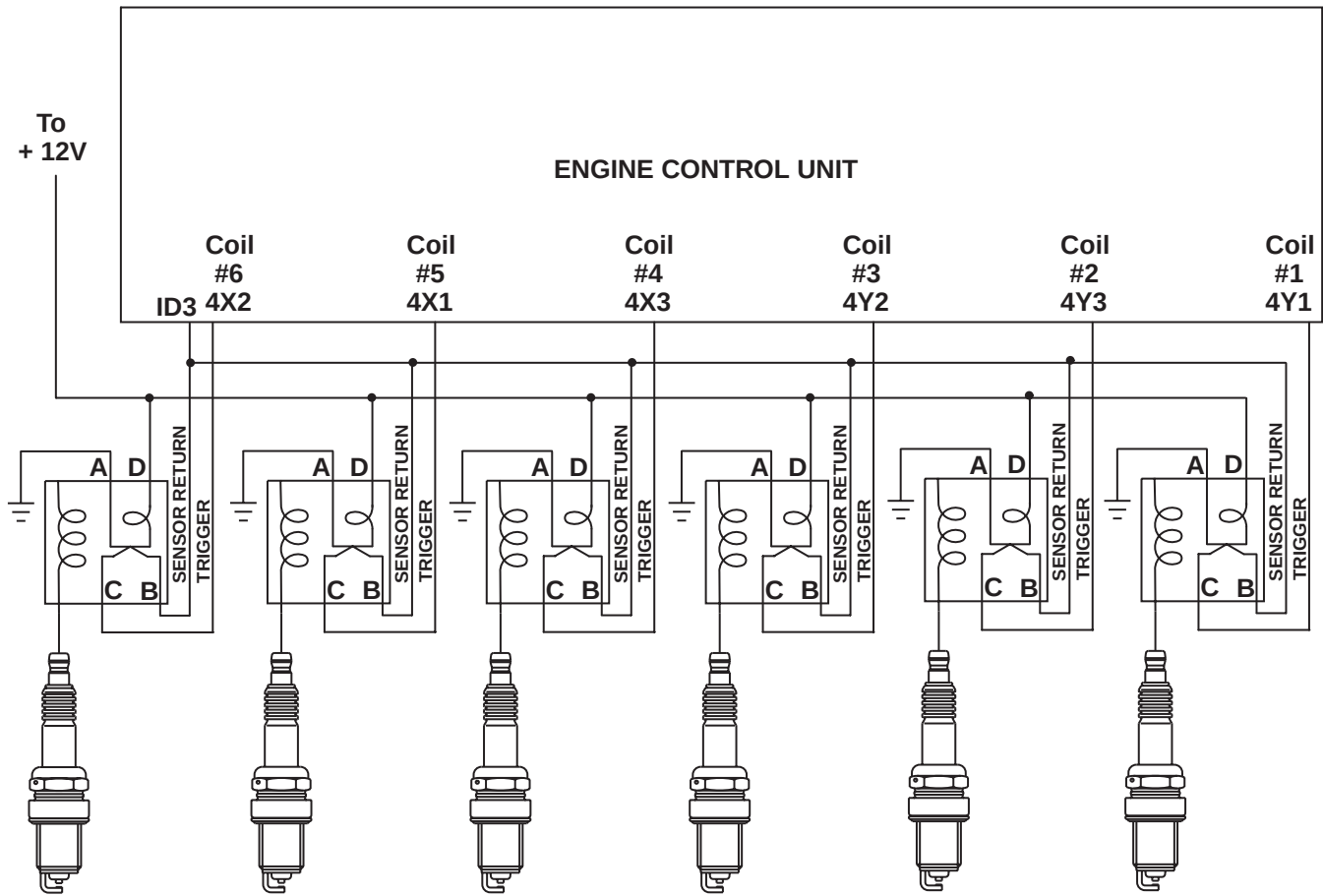
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Turbocharger boost control is achieved by using a turbo with a conventional diaphragm wastegate actuator and a pulse width modulated (PWM) wastegate control solenoid. The ECU controls the amount of boost that the turbocharger is allowed to generate by sending a PWM signal to the wastegate solenoid. The wastegate control solenoid routes pre-throttle intake air pressure to either the wastegate diaphragm or to a vent.

When the solenoid is energized, pressure is routed to the vent, spring force holds the wastegate closed and the turbo generates maximum boost. When the solenoid is not energized, pressure is routed to the wastegate diaphragm, overcoming spring force, opening the wastegate, causing the turbo to generate minimum boost. An internal foot pedal position (FPP)/engine speed table is used to control the boost at each condition.

Ignition Control



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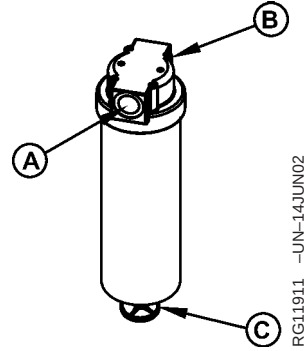
The JDNG Ignition Control system uses a direct single-fire, one coil-per-cylinder, inductive ignition system. The spark timing is controlled by the ECU based on engine speed, MAP and ECT. The ECU monitors the crankshaft position and camshaft position sensor inputs to determine engine speed and engine position, determines the desired timing advance, and

calculates which cylinder needs to fire next. The ECU then sends a trigger signal to the correct ignition coil to create the spark needed to start burning the fuel. The ECU monitors the trigger wire to make sure the signal being sent out is correct. For further information on the ignition coil, see **IGNITION COIL OPERATION** later in this Group.

RG41221,0000020 -19-08JUL03-1/1

Fuel Filter Operation

The final filter uses a grade 6 coalescing element to remove oil contamination as small as 0.3 to 0.6 microns from the fuel. Fuel enters the filter at the fuel inlet (A), flows through the filter element, and out the fuel outlet (B) to the fuel metering block. Fuel flows through the inner element and out to the canister. All of the oil contaminants that are filtered out of the fuel settle to the bottom of the filter element, form into a liquid state, and drain out the element to the bottom of the canister. To relieve pressure from gas lines and drain oil from the filter, open the drain valve (C) on the bottom of the canister.



CNG Fuel Filter

- A—Fuel Inlet
- B—Fuel Outlet
- C—Drain Valve

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Fuel Metering Block Operation - Compressed Natural Gas

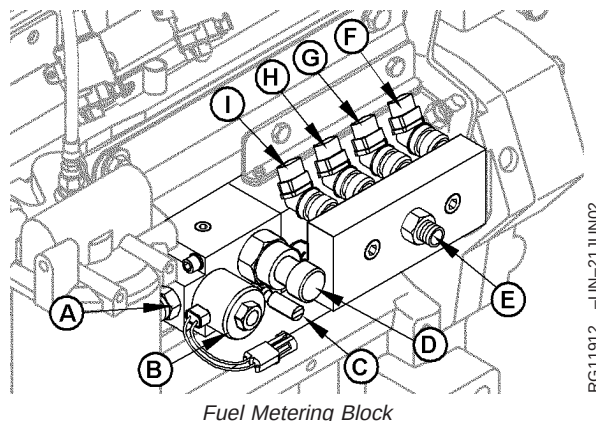
Filtered fuel enters the fuel metering block at the fuel inlet (A). If the low pressure lock-off solenoid (B) is energized, the fuel will flow into the upper manifold and on to each injector. The ECU sends a signal to each of the eight injectors commanding them to inject the fuel by lifting the needle and allowing the fuel to flow through the injector and into the lower manifold.

The low pressure lock-off solenoid is a normally closed valve that opens when the ECU energizes it. The lock-off solenoid will be closed anytime the ignition is OFF or is ON but has not been in the cranking position for 16 seconds. The upper manifold houses the diagnostic port (Schrader valve), the NGP (natural gas pressure) sensor (D), the NGT (natural gas temperature) sensor (C) and the inlet to all of the injectors.

The Schrader valve is used to check natural gas pressure prior to injection with a manual gauge (manuals gauges read about 15 psi less than the electronic sensors). If the injectors are sticky or dirty, the Schrader valve is also used to clean the injectors. For more information on cleaning the injectors, see ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual.

The natural gas pressure and natural gas temperature sensors are used to measure the pressure and temperature of the natural gas in the metering block prior to injection. The ECU calculates fuel density from these readings to control the amount of fuel flowing through the injectors. For further information on the natural gas pressure sensor, see MEASURING PRESSURE or for further information on the natural gas temperature sensor see MEASURING TEMPERATURE both later in this Group.

The fuel metering block is mounted in a horizontal position. There are four injectors on the top and four on the bottom. All of the odd numbered injectors are on the top side of the metering block. Injector #1 (F) is the top front injector. The even numbered injectors start with Injector #2 on the bottom front directly below Injector #1.



Fuel Metering Block

- A—Fuel Inlet
- B—Low Pressure Lock-Off Solenoid
- C—Natural Gas Temperature Sensor
- D—Natural Gas Pressure Sensor
- E—Fuel Outlet
- F—Injectors #1
- G—Injectors #3
- H—Injectors #5
- I—Injectors #7

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Fuel Metering Block Operation - Liquid Natural Gas

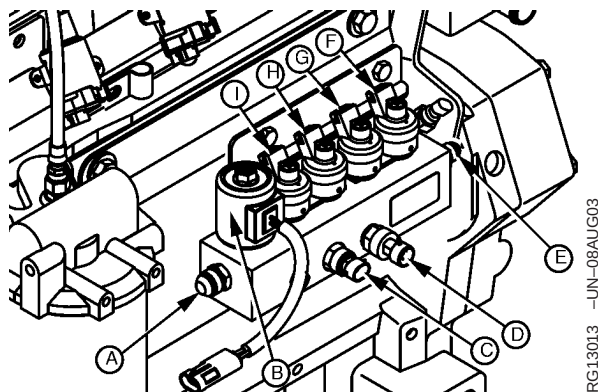
Filtered fuel enters the fuel metering block at the fuel inlet (A). If the low pressure lock-off solenoid (B) is energized, the fuel will flow into the manifold and on to each injector. The ECU sends a signal to each of the four injectors commanding them to inject the fuel by lifting the needle and allowing the fuel to flow through the injector and back into the manifold.

The low pressure lock-off solenoid is a normally closed valve that opens when the ECU energizes it. The lock-off solenoid will be closed anytime the ignition is OFF or is ON but has not been in the cranking position for 16 seconds. The manifold also houses the diagnostic port, the NGP (natural gas pressure) sensor (D), the NGT (natural gas temperature) sensor (C) and the inlet to all of the injectors.

A diagnostic port, located on the bottom of the manifold, is used to check natural gas pressure prior to injection with a manual gauge. If the injectors are sticky or dirty, the diagnostic port is also used to clean the injectors. For more information on cleaning the injectors, see ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual.

The natural gas pressure and natural gas temperature sensors are used to measure the pressure and temperature of the natural gas in the metering block prior to injection. The ECU calculates fuel density from these readings to control the amount of fuel flowing through the injectors. For further information on the natural gas pressure sensor, see MEASURING PRESSURE or for further information on the natural gas temperature sensor see MEASURING TEMPERATURE both later in this Group.

The fuel metering block is mounted in a horizontal position. There are four injectors. Injector #1 (F) is the top front injector.



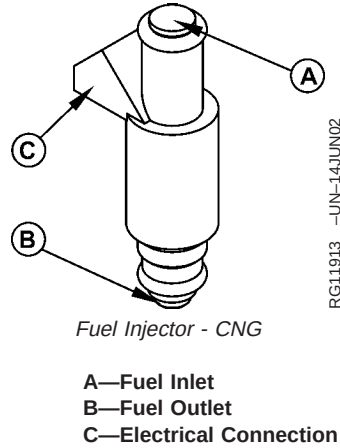
- A—Fuel Inlet
- B—Low Pressure Lock-Off Solenoid
- C—Natural Gas Temperature Sensor
- D—Natural Gas Pressure Sensor
- E—Fuel Outlet
- F—Injectors #1
- G—Injectors #2
- H—Injectors #3
- I—Injectors #4

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Fuel Injector Operation - Compressed Natural Gas

The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU for fuel metering purposes. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. Fuel enters the fuel inlet (A) on the top of the injector and receives a PWM signal from the ECU at the electrical connection (C). When the injector is energized, the needle valve inside the injector opens to allow the fuel to exit.

On CNG engines, injector #1 is located on the top front position of the fuel metering block. For further metering block and injector location information, see FUEL METERING BLOCK OPERATION - COMPRESSED NATURAL GAS earlier in this Group.

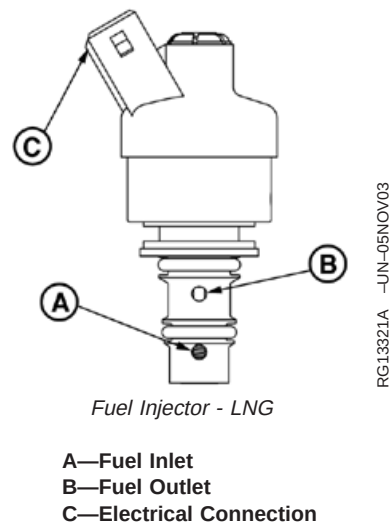


RG41221,0000023 -19-14SEP01-1/1

Fuel Injector Operation - Liquid Natural Gas

The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU for fuel metering purposes. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. Fuel enters the fuel inlet (A) on the bottom of the injector and receives a PWM signal from the ECU at the electrical connection (C). When the injector is energized, the needle valve inside the injector opens to allow the fuel to exit through the fuel outlet (B).

On LNG engines, injector #1 is located on the top front position of the fuel metering block. For further metering block and injector location information, see FUEL METERING BLOCK OPERATION - LIQUID NATURAL GAS earlier in this Group.

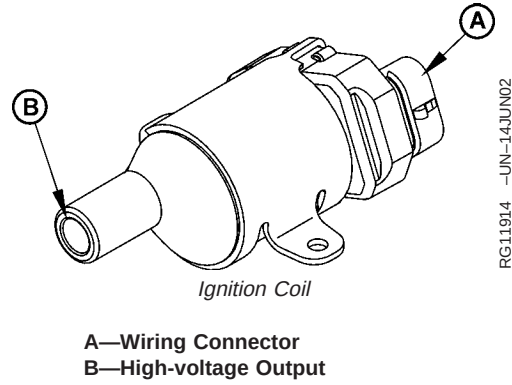


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Ignition Coil Operation

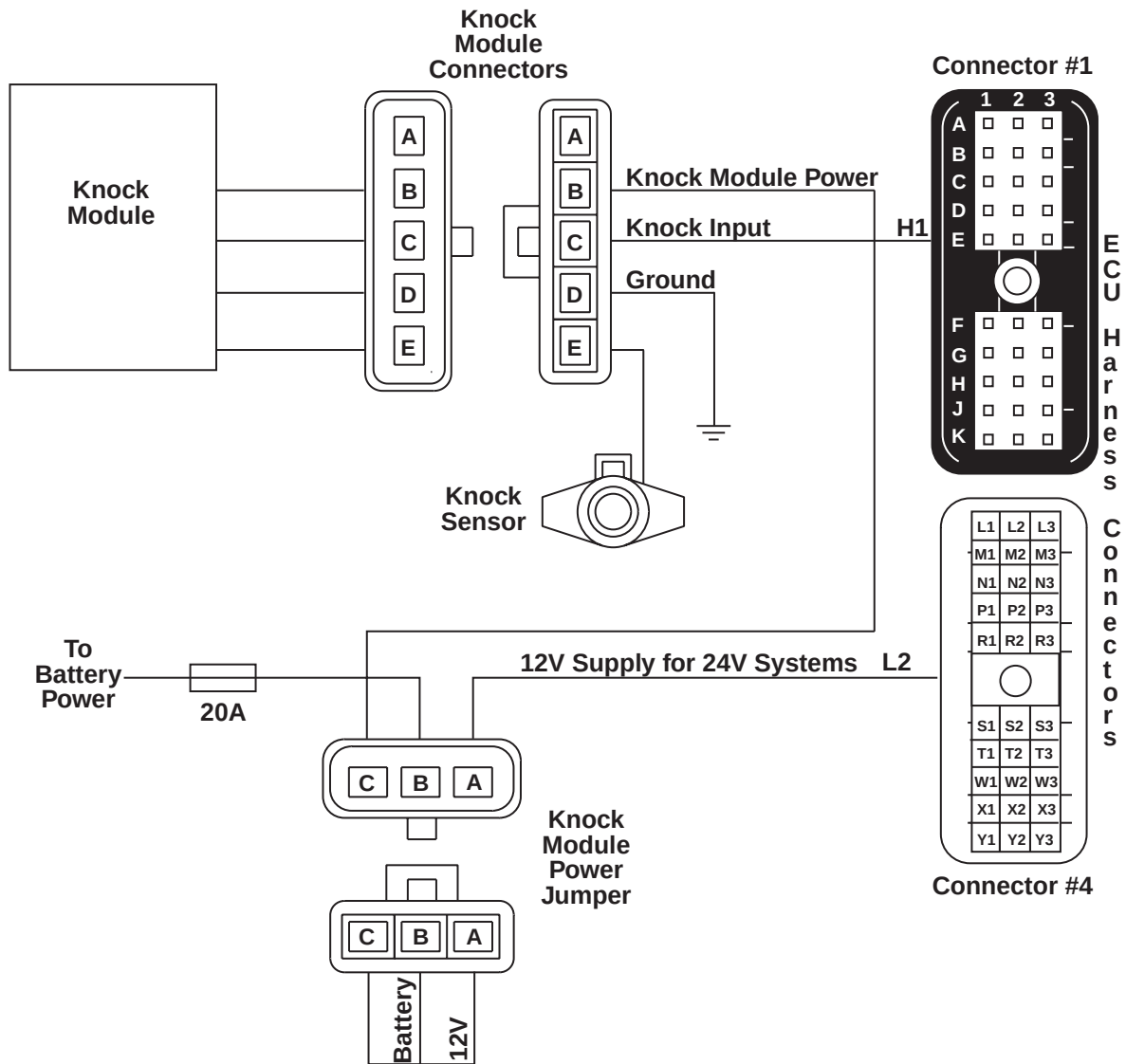
The ignition coils are used to provide a spark to ignite the fuel in each cylinder. The wiring connector (A) supplies power, ground, and the trigger signal to the ignition coil. The ignition coil is a transformer consisting of two wire coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let each coil know when that cylinder will fire. The amount of time the trigger is energized is the dwell time. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil through the output (B), through the spark plug wire, and to the spark plug. The spark plug uses this voltage to create a spark. This spark ignites the gas in each cylinder for injection to occur.

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.



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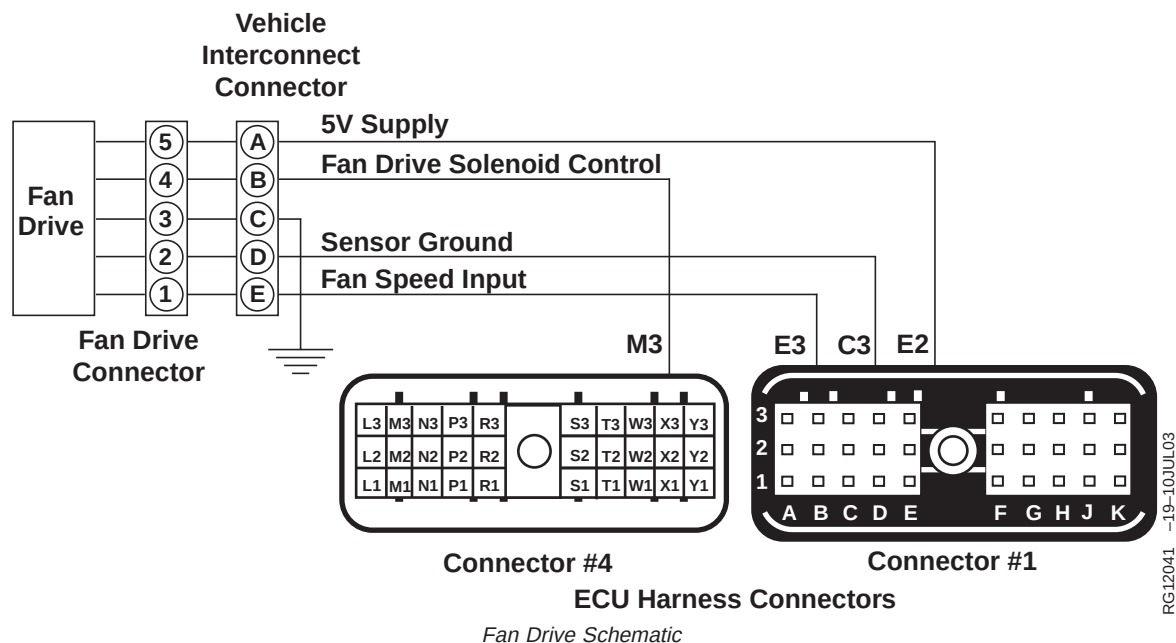
Knock Module Operation



The knock module is used to supply the ECU information pertaining to the current status of knock. The knock module receives a pulse width modulated (PWM) signal from the knock sensor. As the severity of knock increases, the PWM signal on-time increases. The knock module supplies a constant 12 volts to the ECU. When the knock severity is high enough, the module will short the signal to ground telling the ECU that knock has been detected. The ECU can then retard the engine to compensate for the knock.

The knock module is powered by a 12 volt supply on all application. On 12 volt electrical systems, the knock module receives battery voltage through the power jumper from the battery. On 24 volt electrical systems, the ECU supplies the power jumper with a 12 volt supply.

Vistronic Fan Drive Operation



Fan Drive Schematic

The vistronic fan is used to help cool the engine. The ECU monitors throttle charge temperature (TCT), engine coolant temperature (ECT), and the transmission sump temperature to drive the speed of the fan. As the temperatures become excessive, the ECU commands the fan drive to run at a higher speed. The ECU sends a PWM signal on the fan drive solenoid control wire to energize the fan and control

the speed. As the temperatures change, the ECU will vary the PWM signal to increase or decrease the speed of the fan.

Some applications use the hall effect sensor internal to the fan drive. This allows the ECU to monitor and determine if there are any significant differences between desired and actual fan speed.

RG41221,0000026 -19-14SEP01-1/1

Electronic Engine Controls Definition of Terms**DEFINITION OF TERMS**

Actuator	A device controlled by the ECU to perform a certain function.
Adaptive Learn	Adaptive learn is a function of the control system that helps to optimize engine operation by acting as a fuel correction memory. When the ECU commands a fuel quantity that is successful in achieving the desired air/fuel ratio, (measured with the UEGO sensor) the adaptive learn function "remembers" that fuel quantity and uses it in the future.
AL_Mult	Adaptive learn multiplier. The adaptive learn multiplier is a correction to the fuel delivery which is expressed as a percentage (%) and stored in the ECU's memory.
Analog	Signal which has a continuous range of possible voltages. Usually 0 to 5 or 0 to 12 volt signals.
BAP	Barometric Air Pressure. The pressure of the outside air.
Batt	Battery voltage.
Boost	Pressure in the intake tract just before the throttle body.
CAM	Camshaft Position Sensor
Closed Loop	The control system has two operating modes: open loop and closed loop. During closed loop mode, the ECU uses the UEGO sensor to determine the air/fuel ratio, then adjusts the amount of fuel delivered to the engine until the desired air/fuel ratio is achieved.
CL_Mult	Closed loop multiplier. The closed loop multiplier is a fast acting adjustment to the fuel delivery based on feedback from the UEGO. The closed loop multiplier is expressed as a percentage (%) and is not stored in the ECU's memory.
CEL	"Check Engine" Light.
CNG	Compressed Natural Gas.
DTC	Diagnostic Trouble Code. A code which is stored in the ECU's memory when the ECU detects a problem in the electronic engine control system.
DST	Diagnostic Scan Tool. The tool used to read and clear DTCs, read sensor and actuator data, and perform special tests.
Digital	A signal which consists of only two-volt levels — usually 0 volts and +5 volts.
EBP	Exhaust Back Pressure (sensor). Measures the pressure in the exhaust system downstream of the turbocharger.
ECT	Engine Coolant Temperature (sensor). Measures the temperature of the engine coolant.
ECU	Electronic Control Unit. The computer which controls the fuel, air, and ignition systems on the engine.
FPP1	Foot Pedal Position 1 (Sensor 1). Measures the position of the operator's foot pedal.
FPP2	Foot Pedal Position 2 (Sensor 2). Measures the position of the operator's foot pedal.
FPP3	Foot Pedal Position 3 (Sensor 3). Measures the position of the operator's foot pedal.
FPP4	Foot Pedal Position 4 (Sensor 4). Measures the position of the operator's foot pedal.
IVS	Idle Validation Switch. Switch to validate that no force is applied to the foot pedal.

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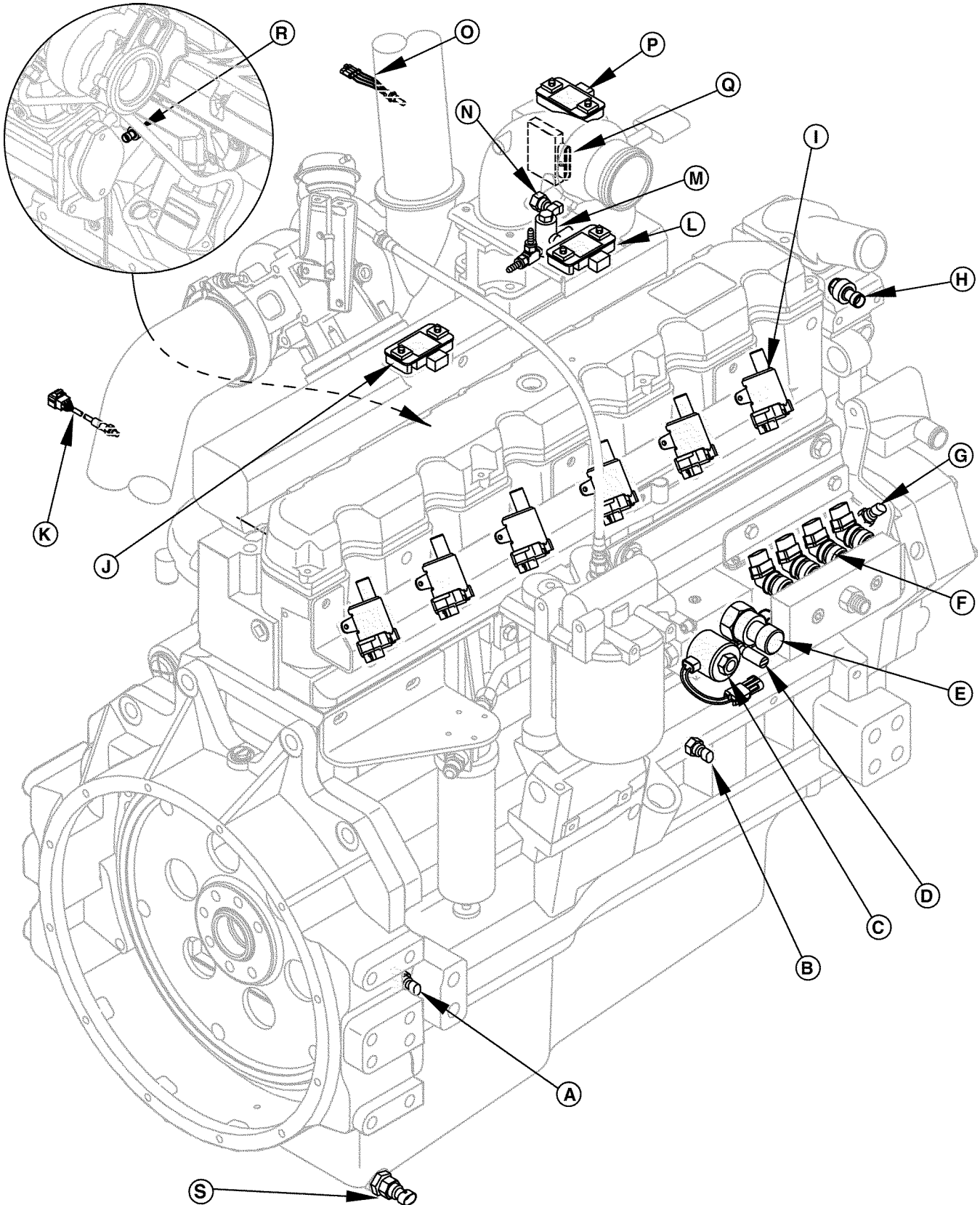
RG41221,0000027 -19-14SEP01-1/2

DEFINITION OF TERMS

LNG	Liquid Natural Gas
MAP	Manifold Absolute Pressure (sensor). Measures the pressure of the air in the intake manifold.
TCT	Throttle Charge Temperature (sensor). Measures the temperature of the air in the intake manifold.
NGP	Natural Gas Pressure (sensor). Measures the pressure of the natural gas in the metering block.
NGT	Natural Gas Temperature (sensor). Measures the temperature of the natural gas in the metering block.
NGTP	Natural Gas Tank Pressure (sensor). Measures the pressure of the natural gas in the fuel storage tanks. The NGTP sensor is located on the fuel pressure regulator.
NGTT	Natural Gas Tank Temperature (sensor). Measures the temperature of the natural gas in the fuel storage tanks.
Open Loop	The control system has two operating modes: open loop and closed loop. Before the engine is up to operating temperature and during several other special conditions, the control system operates in open loop mode. During open loop mode, the ECU commands fuel delivery based on engine data and information from several sensors.
PWM	Pulse Width Modulation. A digital signal (not analog) which consists of a pulse generated at a fixed frequency. When an actuator is controlled by a PWM signal, the on time of the signal is increased or decreased (modulated) to increase or decrease the output of the actuator.
Sensor	Devices used by the ECU to monitor various engine parameters.
TPS	Throttle Position Sensor is located inside the throttle. The throttle position sensor measures the opening of the throttle.
UEGO	Universal Exhaust Gas Oxygen (sensor). The UEGO sensor determines the air-fuel ratio of the engine by measuring the oxygen content of the exhaust gas.
UEGOH	UEGO Heater. A component of the UEGO sensor.
UEGOP	UEGO Pump cell. A component of the UEGO sensor.
UEGOR	UEGO Calibration Resistor. A component of the UEGO sensor.
UEGOS	UEGO Sense cell. A component of the UEGO sensor.

RG41221,0000027 -19-14SEP01-2/2

Electronic Engine Control System Overview



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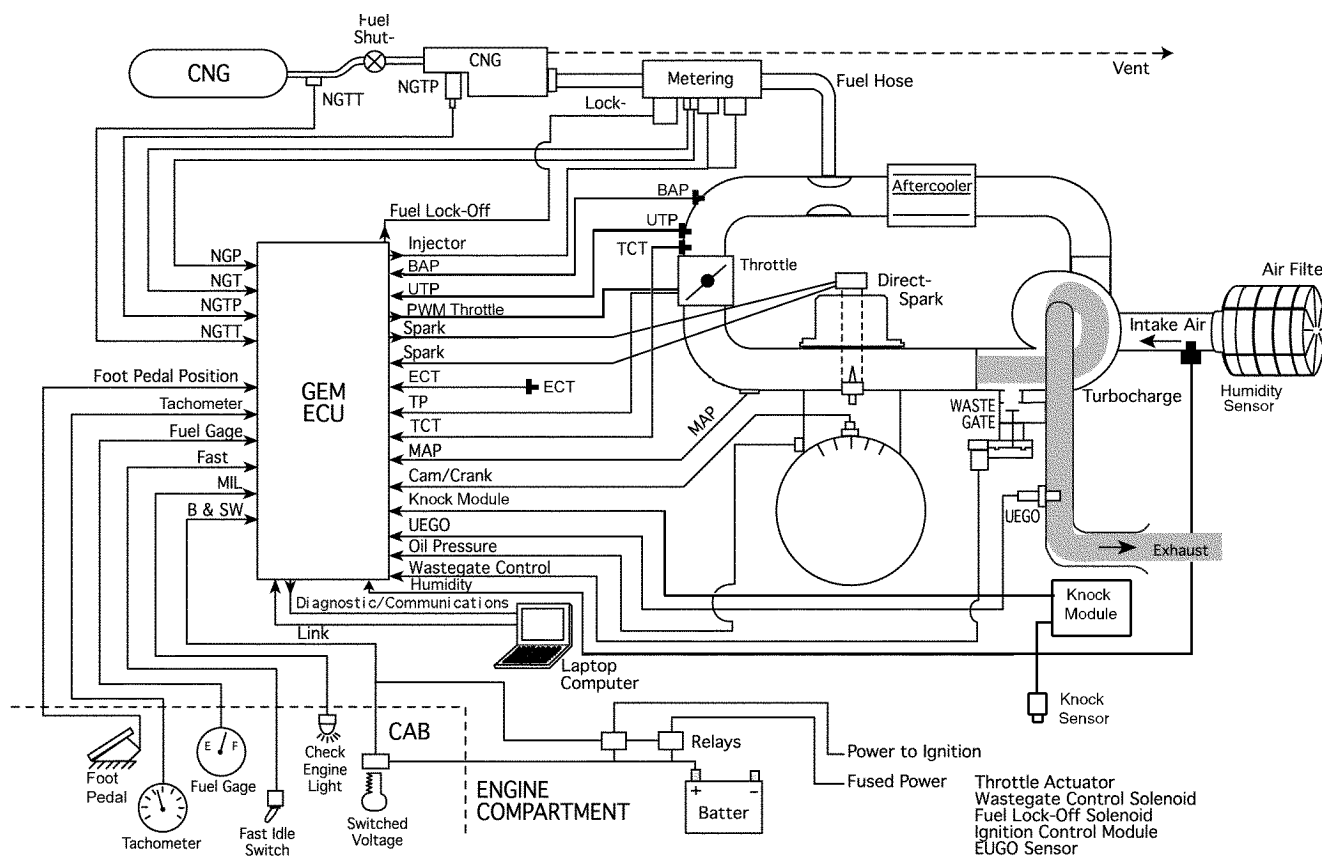
RG41221.0000378 -19-10JUL03-1/2

RG11919 -UN-08AUG03

A—Crankshaft Position Sensor	F—Injectors (8)	K—UEGO Sensor	P—Upstream Throttle Pressure Sensor
B—Oil Pressure Sensor	G—Camshaft Position Sensor	L—Barometric Air Pressure	Q—Knock Module
C—Low Pressure Lock-Off	H—Engine Coolant Temperature Sensor	M—Wastegate Control Solenoid	R—Knock Sensor
D—Natural Gas Temperature Sensor	I—Ignition Coil (6)	N—Throttle Charge Temperature Sensor	S—Oil Temperature Sensor
E—Natural Gas Pressure Sensor	J—Manifold Absolute Pressure Sensor	O—Humidity/Inlet Air Temperature Sensor	

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Electronic Engine Control System Overview - Continued



Electronic HFN04 Engine Controls System Overview

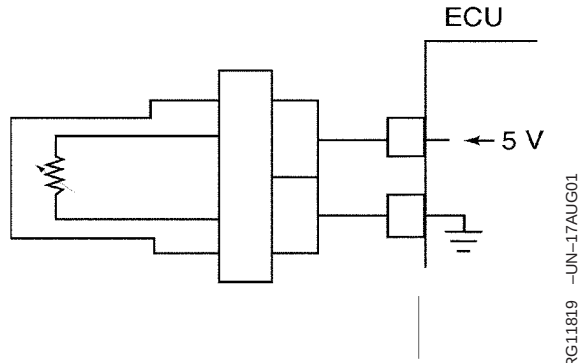
The John Deere 6081 CNG engines use the John Deere Level 8 control system to optimize exhaust emissions, driveability, and fuel economy. The system controls engine airflow, engine fuel delivery and ignition spark timing and provides self-diagnosis capabilities. In order to determine the optimum airflow, fuel delivery and spark timing, the system uses

sensors to monitor performance characteristics such as manifold air pressure, engine coolant temperature, universal exhaust gas oxygen, etc. The system ECU makes decisions based on the monitored parameters and controls the pulse width modulated (PWM) Throttle, the electrically pulsed fuel injectors and the ignition coils.

RG41221.0000028 -19-14SEP01-1/1

Measuring Temperature

The Engine Coolant Temperature (ECT), Throttle Charge Temperature (TCT), Natural Gas Temperature (NGT), Natural Gas Tank Temperature (NGTT), and the Inlet Air Temperature sensors are thermistors (temperature sensitive variable resistors). The sensors' resistance goes down as the temperature that it is exposed to goes up (negative temperature coefficient). The Engine Control Unit (ECU) sends 5 volts to the sensor, monitors the voltage drop across the sensor, and compares the voltage drop to preprogrammed values in the ECU's memory in order to determine temperature.



RG11819 -UN-17AUG01

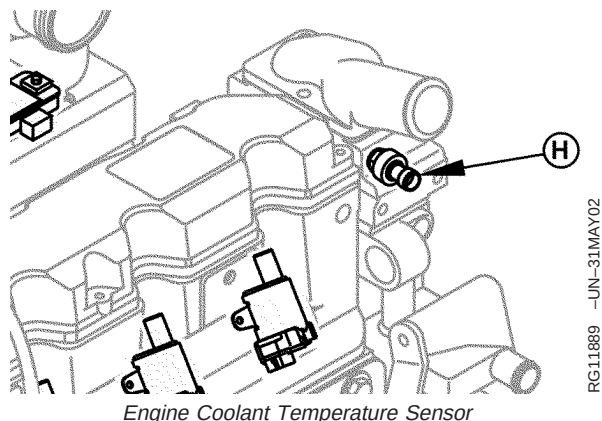
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RG41221,0000029 -19-08JUL03-1/8

Engine Coolant Temperature (ECT) Sensor

The ECT sensor is located in the thermostat housing. The ECU monitors engine coolant temperature for:

- Calculating engine airflow
- Calculating fan speed
- Low idle speeds
- Running in closed loop
- Fuel at start up
- Engine Protection purposes. For more information in engine protection and derate programs, see ENGINE PROTECTION or DERATE PROGRAMS later in this Group.



Engine Coolant Level Sensor

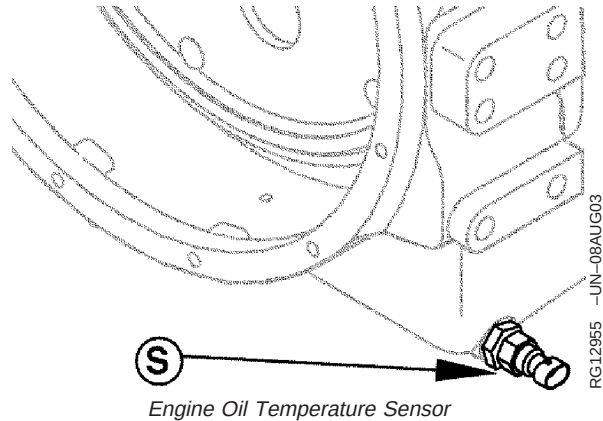
Some applications use a coolant level sensor along with the ECT sensor. This sensor is optional and the location can vary dependent on the application. The most common location is in the engine coolant overflow (surge) tank. The Coolant Level sensor is a two wire sensor; one wire connects to the input probe and the other to the brass housing as a ground. The coolant is used as an conductor between the input and the ground. This causes the input to be shorted to ground causing a very low voltage back to the coolant level module. When the coolant level drops and the sensor is no longer submerged, the input is no longer shorted to ground and the voltage goes high. The Coolant Level Module sends a 0 volt or 5 volt signal to the ECU depending on the input it receives from the sensor. When the ECU senses a 5 volt signal from the module, it knows that either the coolant level has dropped or there is a wiring problem between the ECU and the module.

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RG41221,0000029 -19-08JUL03-2/8

Engine Oil Temperature Sensor

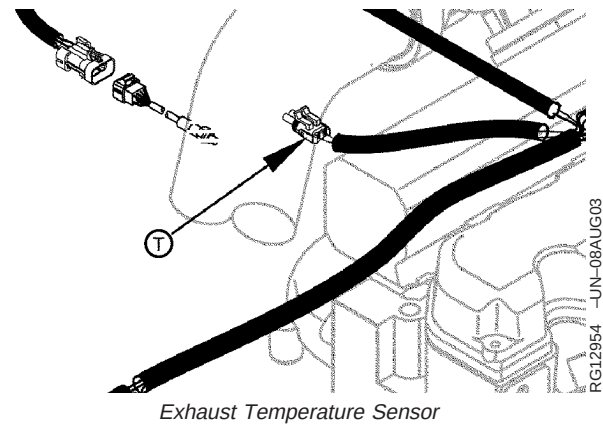
The engine oil temperature sensor is an optional sensor located in the oil pan. Depending on the application, the oil pan design and location of the sensor in the oil pan can vary. This sensor is used to measure the temperature of the oil in the oil pan. The ECU uses this information for engine protection purposes. For more information in engine protection and derate programs, see ENGINE PROTECTION or DERATE PROGRAMS later in this Group.



RG41221,0000029 -19-08JUL03-3/8

Exhaust Temperature Sensor

The exhaust temperature sensor is an optional sensor located in or after the catalyst of the muffler. The ECU uses this sensor to measure the exhaust temperature to determine if all of the fuel is being burned. Unburned fuel will result in high exhaust temperature. The ECU monitors exhaust temperature for engine protection purposes. For more information in engine protection and derate programs, see ENGINE PROTECTION or DERATE PROGRAMS later in this Group.

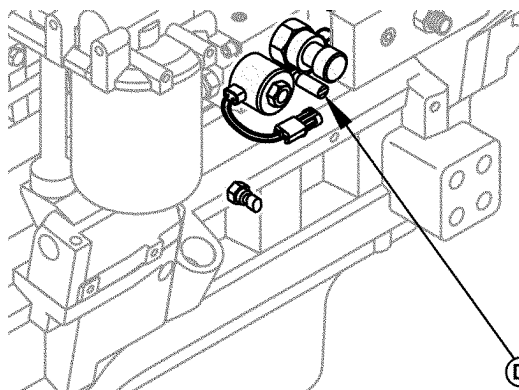


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RG41221,0000029 -19-08JUL03-4/8

Natural Gas Temperature (NGT) Sensor

The NGT sensor is located on the fuel metering block and is used to measure the natural gas temperature prior to injection. The ECU uses this sensor in conjunction with the Natural Gas Pressure sensor to calculate the density of the natural gas at the injectors. The ECU uses this information to determine the length of time each injector should be turned on.



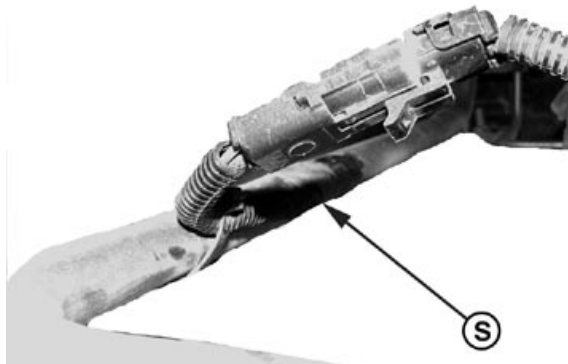
Natural Gas Temperature Sensor

RG11891 -JUN-31MAY02

RG41221,0000029 -19-08JUL03-5/8

Natural Gas Tank Temperature (NGTT) Sensor

The NGTT sensor is an optional sensor that is located on the main fuel line between the storage tanks and the high pressure fuel regulator. This sensor is used to measure the natural gas temperature as it leaves the storage tanks. The ECU uses this sensor in conjunction with the Natural Gas Tank Pressure sensor to calculate the amount of fuel in the storage tanks. The ECU then transfers this information to the fuel gauge on the dash of the vehicle.



Natural Gas Tank Temperature

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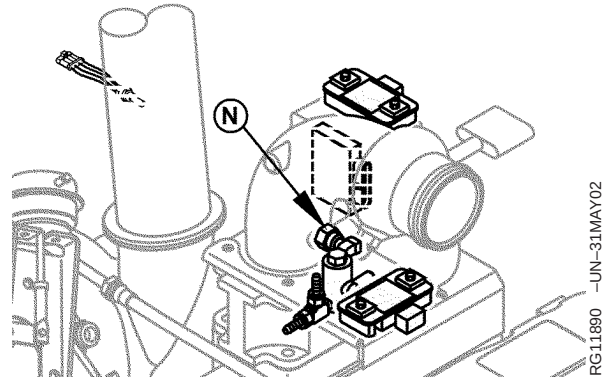
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RG41221,0000029 -19-08JUL03-6/8

Throttle Charge Temperature (TCT) Sensor

The TCT sensor is located above the throttle plate on the mixing elbow and is used to measure the throttle charge temperature. The ECU uses throttle charge temperature to calculate the mass of the air flowing into the engine. The ECU uses the mass of this air flow for:

- Calculating throttle charge temperature
- Calculating fan speed
- Engine Protection purposes. For more information in engine protection and derate programs, see ENGINE PROTECTION or DERATE PROGRAMS later in this Group.

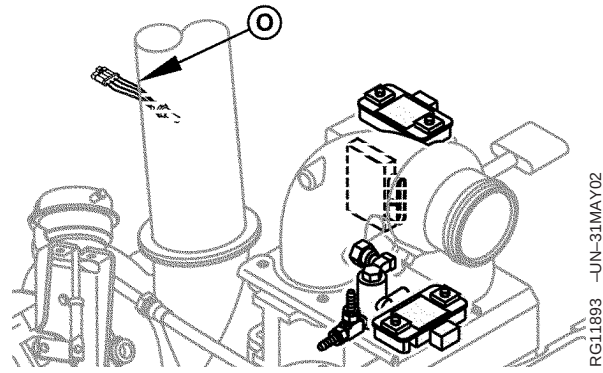


Throttle Charge Temperature Sensor

RG41221,0000029 -19-08JUL03-7/8

Humidity/Inlet Air Temperature Sensor

The Humidity/Inlet Air Temperature sensor is located above the crankcase vent in the air intake line. There are two main functions of this sensor; measure the temperature and the moisture of the inlet air. The ECU uses this sensor to calculate air density for mass air flow and specific humidity. The ECU uses the air flow calculations to help aid in fueling for consistent engine performance in moist areas. Spark timing is also affected by the air flow and relies on this sensor for engine performance.

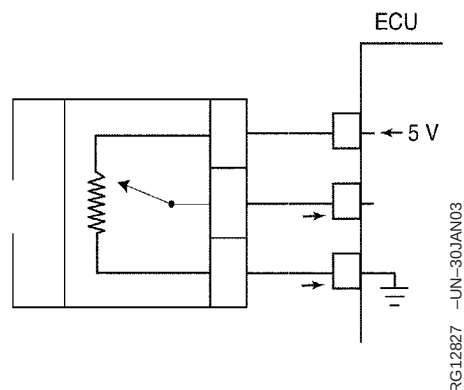


Humidity/Inlet Air Temperature Sensor

RG41221,0000029 -19-08JUL03-8/8

Measuring Pressure

The system's pressure sensors are 3 wire variable resistors. As the pressure changes, sensor resistance changes. The ECU sends a 5 volt reference voltage to the sensor, monitors the voltage returning on the sensor signal wire, and compares the voltage drop to preprogrammed values in the ECU's memory to determine pressure.

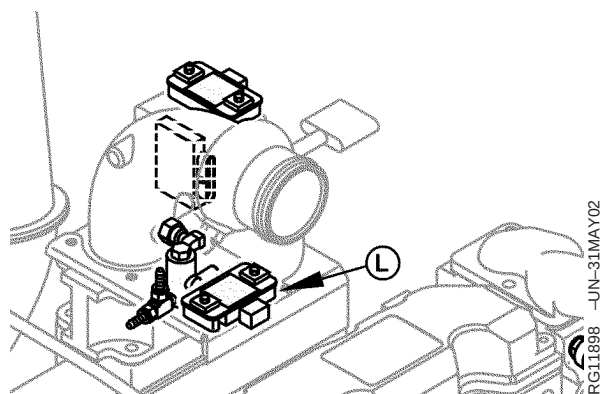


Pressure Sensor Schematic

RG41221,000002A -19-08JUL03-1/7

Barometric Air Pressure (BAP) Sensor

The BAP sensor is located on the base of the mixing elbow. The ECU uses barometric air pressure to measure the air pressure inside the engine compartment. The BAP sensor along with the humidity sensor are used to calculate specific humidity. The ECU also uses this sensor to calculate what the exhaust back pressure should be. At Key ON, engine OFF, the ECU does a cross check between the BAP, MAP and UTP sensors. At this time, all of the sensors should be the same. Under light load conditions, BAP and UTP should be very close.



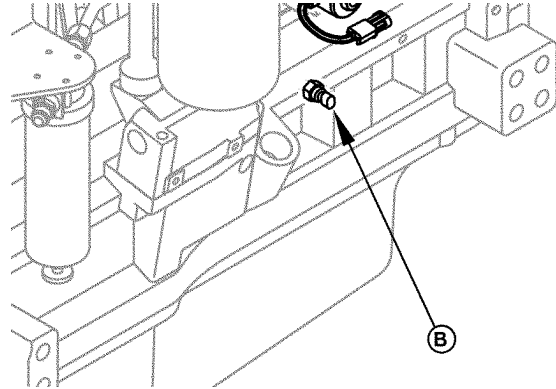
Barometric Air Pressure Sensor

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RG41221,000002A -19-08JUL03-2/7

Engine Oil Pressure Sensor

The oil pressure sensor is located in the main engine galley of the block. This sensor is used to supply the operator with the oil pressure measurement and for engine protection purposes. For more information in engine protection and derate programs, see ENGINE PROTECTION or DERATE PROGRAMS later in this Group.



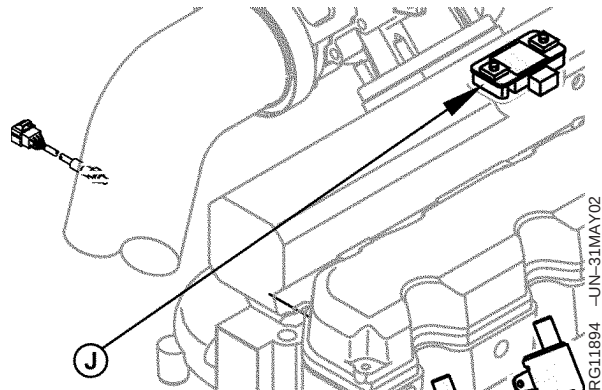
Engine Oil Pressure Sensor

RG11895 -UN-31MAY02

RG41221,000002A -19-08JUL03-3/7

Manifold Absolute Pressure (MAP) Sensor

The MAP sensor is located on the intake manifold. The ECU uses manifold absolute pressure to help calculate the amount of airflow into the engine. The MAP sensor also supplies the ECU with a direct measurement of turbo boost to help control the wastegate. At Key ON, engine OFF, the ECU does a cross check between the BAP, MAP and UTP sensors. At this time, all of the sensors should be the same.



Manifold Absolute Pressure Sensor

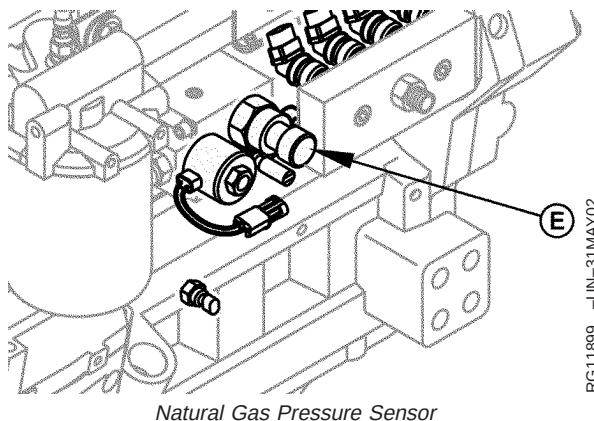
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RG41221,000002A -19-08JUL03-4/7

Natural Gas Pressure (NGP) Sensor

The NGP sensor is located on the fuel metering block and is used to measure the natural gas pressure prior to injection. The ECU uses this sensor in conjunction with the Natural Gas Temperature sensor to calculate the density of the natural gas at the injectors. The ECU uses this information to determine the length of time each injector should be turned on.

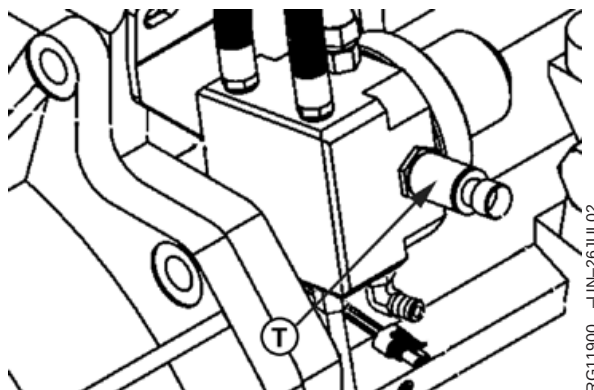


Natural Gas Pressure Sensor

RG41221,000002A -19-08JUL03-5/7

Natural Gas Tank Pressure (NGTP) Sensor

The NGTP sensor is located on the high pressure side of the fuel pressure regulator and is used to measure the natural gas pressure as it leaves the fuel tanks. Exact location varies per application. The ECU uses this sensor in conjunction with the Natural Gas Tank Temperature sensor to calculate the amount of fuel in the storage tanks. The ECU then transfers this information to the fuel gauge on the dash of the vehicle.



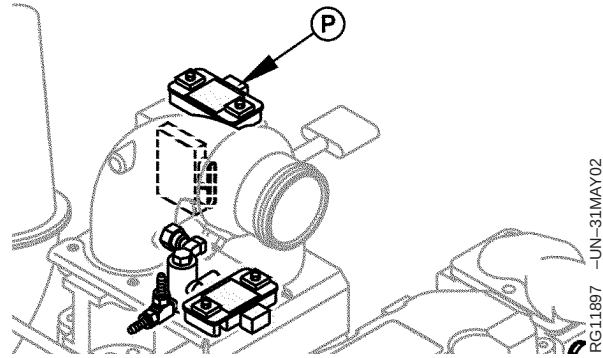
Natural Gas Tank Pressure Sensor

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RG41221,000002A -19-08JUL03-6/7

Upstream Throttle Pressure (UTP) Sensor

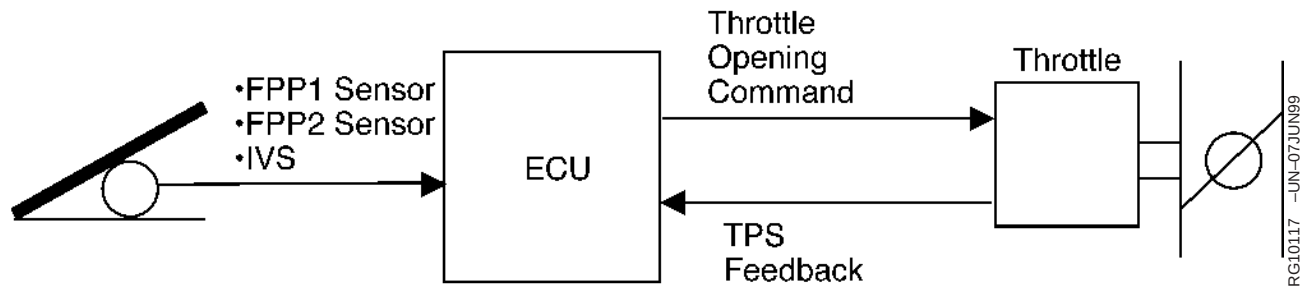
The UTP sensor is located on the mixing elbow. The ECU uses upstream throttle pressure to measure air pressure above the throttle plate. The ECU uses this information along with inputs from the manifold absolute pressure sensor and throttle position sensor to control turbo boost levels. At Key ON, engine OFF, the ECU does a cross check between the BAP, MAP and UTP sensors. At this time, all of the sensors should be the same. Under light load conditions, BAP and UTP should be very close.



Upstream Throttle Pressure Sensor

RG41221,000002A -19-08JUL03-7/7

Throttle Operation



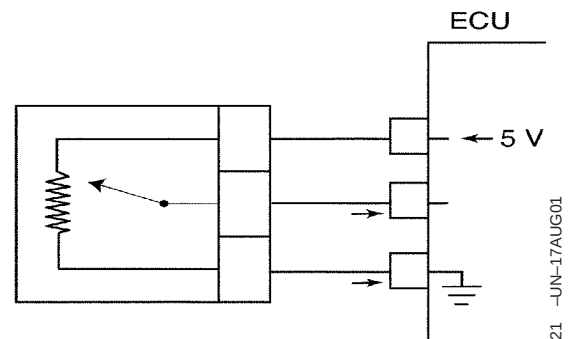
As the foot pedal is depressed, a foot pedal position (FPP) sensor sends a signal to the ECU. The ECU uses this signal to communicate to the throttle for throttle position. The throttle has a throttle position sensor (TPS) that reads the input from the ECU and

opens the throttle to the commanded position. TPS send a signal (TPS feedback) back to the ECU verifying that the throttle has opened to the commanded position.

RG41221,000002C -19-14SEP01-1/1

Measuring Throttle Position

The throttle position sensor (TPS) uses a variable resistor (potentiometers) to measure the position of the throttle. The resistance of the sensor varies depending on sensor position. A moveable center contact (wiper) slides along a wire-wound resistor as sensor position is changed. The ECU sends a 5 V reference voltage into the sensor, the voltage value returning to the ECU on the sensor signal wire varies depending on sensor position. The ECU monitors the voltage on the sensor signal wire and translates this voltage reading to sensor position.



Position Sensor Schematic

Throttle Position Sensor (TPS)

The TPS is located inside the throttle and is used to determine if the throttle is opening as commanded. This allows the user to compare the actual throttle position versus the commanded throttle position.

RG41221,000002B -19-11JUN03-1/1

Foot Pedal Operation

The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity.

Some applications use two foot pedals. If two foot pedals are used, they are designated as "Primary" and "Secondary".

Primary Foot Pedal

The primary foot pedal is standard on all vehicles. This foot pedal contains the foot pedal position 1 (FPP1) sensor, foot pedal position 2 (FPP2) sensor, and the primary foot pedal idle validation switch.

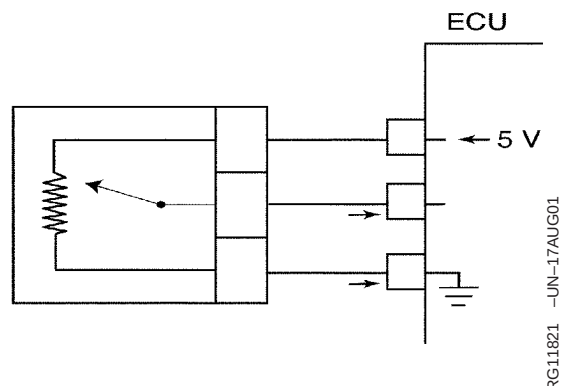
Secondary Foot Pedal

The secondary foot pedal is an option on some vehicles. This foot pedal contains the foot pedal position 3 (FPP3) sensor, foot pedal position 4 (FPP4) sensor, and the secondary foot pedal idle validation switch.

RG41221,000016C -19-08JUL03-1/1

Measuring Foot Pedal Position

The foot pedal position sensors use a variable resistor (potentiometer) to measure the position of the foot pedal. The resistance of these sensors vary depending on sensor position. A moveable center contact (wiper) slides along a wire-wound resistor as sensor position is changed. The ECU sends a 5 V reference voltage into the sensor, the voltage value returning to the ECU on the sensor signal wire varies depending on sensor position. The ECU monitors the voltage on the sensor signal wire and translates this voltage reading to sensor position. The idle validation switch on the primary foot pedal helps to validate that the FPP1 and FPP2 sensors are accurate. The idle validation switch on the secondary foot pedal helps to validate that the FPP3 and FPP4 sensors are accurate.



Position Sensor Schematic

Foot Pedal Position 1 (FPP1)

The FPP1 sensor is located inside the primary foot pedal. When the foot pedal is depressed, the sensor sends a signal telling the ECU the operator's desired engine load. FPP2 is a back up sensor used to send the signal to the ECU if FPP1 fails for any reason.

Foot Pedal Position 2 (FPP2)

The FPP2 sensor is located inside the primary foot pedal. When the foot pedal is depressed, the sensor sends a signal telling the ECU the operator's desired engine load. FPP2 is a back up sensor used to send the signal to the ECU only if FPP1 fails.

Foot Pedal Position 3 (FPP3)

The FPP3 sensor is located inside the secondary foot pedal. When the foot pedal is depressed, the sensor sends a signal telling the ECU the operator's desired engine load. FPP4 is a back up sensor used to send the signal to the ECU if FPP3 fails for any reason.

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RG41221,000016A -19-08JUL03-1/2

Foot Pedal Position 4 (FPP4)

The FPP4 sensor is located inside the secondary foot pedal. When the foot pedal is depressed, the sensor sends a signal telling the ECU the operator's desired engine load. FPP3 is a back up sensor used to send the signal to the ECU only if FPP4 fails.

Primary Foot Pedal Idle Validation Switch (IVS)

The IVS is located inside the primary foot pedal. The IVS is used to determine whether engine is at idle when it should or should not be according to the positions shown by both FPP1 and FPP2 voltage.

Secondary Foot Pedal Idle Validation Switch (IVS)

The IVS is located inside the secondary foot pedal. The IVS is used to determine whether engine is at idle when it should or should not be according to the positions shown by both FPP3 and FPP4 voltage.

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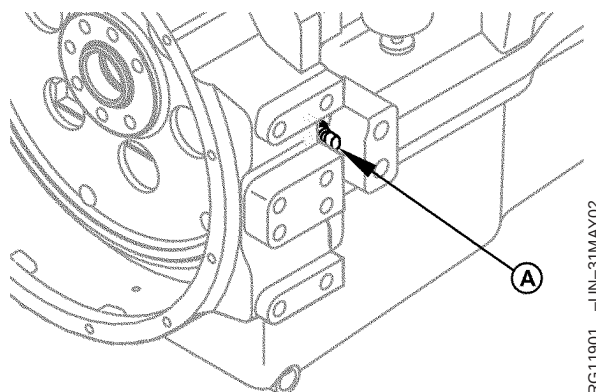
Measuring Engine Speed

Both the crankshaft position sensor and the camshaft position sensor operate by detecting notches on their corresponding gear/timing wheel. When a tooth/notch on the gear/timing wheel is directly under the sensor, a voltage is induced. The sensors use an internal magnet to create this voltage signal from the teeth on their respective gear/timing wheel. The magnetic field is pulled towards the gear/timing wheel as the teeth pass directly under the sensor. As the root diameter (area between teeth) pass the sensor, the magnetic field moves back toward the sensor. This creates the voltage signal that the ECU monitors for timing and speed. When a notch (one or more missing teeth) passes under the sensor, the pattern of the signal changes. By monitoring these changes in the signal, the ECU calculates the speed and the cylinder number that is ready for injection. The ECU monitors both of these sensors to verify that they are in time with each other.

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Crankshaft Position Sensor

The crankshaft position sensor is located on the rear of the engine. It is an inductive type pickup sensor that detects a notch on the oil pump drive gear. The ECU uses the crankshaft position input to determine engine speed and timing. The oil pump drive gear is composed of 72 evenly spaced teeth with 2 partially ground off teeth. The ground off teeth help the ECU determine when cylinder #1 is at Top-Dead-Center (TDC).



Crankshaft Position Sensor

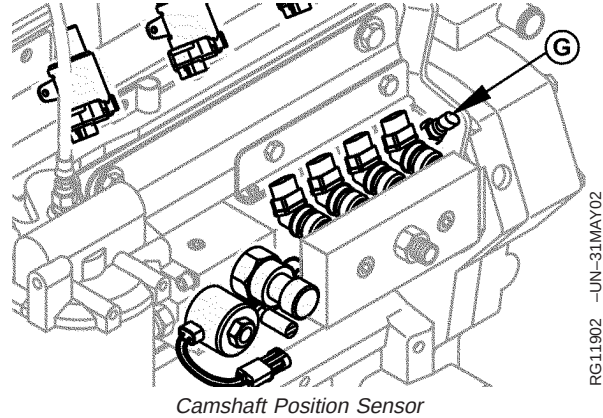
RG11901 -UN-31MAY02

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Camshaft Position Sensor

The camshaft position sensor is located on the front of the engine. It is an inductive type pickup sensor that detects notches on the cam gear. The ECU uses the camshaft position sensor to determine engine speed, and to determine when each cylinder is at TDC at the end of the compression stroke. The ECU needs this information in order to fire the correct coil at the correct time. The ECU monitors the voltage that is created by the cam position sensor when a tooth on the cam timing wheel passes under it. The camshaft timing wheel has 6 evenly spaced teeth with one additional tooth. When this extra tooth passes under the camshaft position sensor, the ECU then "knows" that cylinder number 1 is at TDC at the end of the compression stroke. The next notch will then indicate when the next cylinder in the firing order (cylinder number 5) is at TDC at the end of compression.



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Engine Airflow Measurement

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The system determines engine airflow using the speed-density strategy. Base airflow is calculated using engine speed, manifold absolute pressure (MAP), and engine volumetric efficiency. Engine volumetric efficiency is calibrated for the engine, then corrected for varying throttle charge temperature (TCT), engine coolant temperature (ECT), and upstream throttle pressure (UTP).

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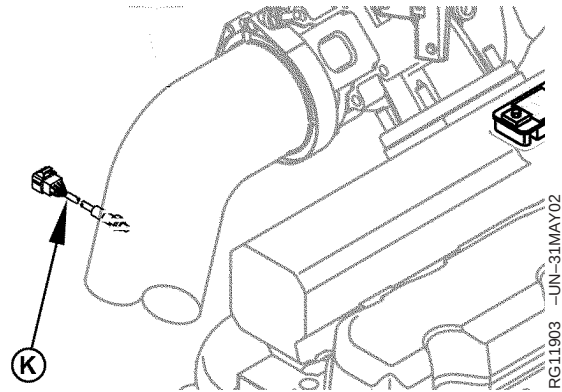
Universal Exhaust Gas Oxygen (UEGO) Sensor

When the engine is operating in closed loop, the Universal Exhaust Gas Oxygen sensor measures the amount of oxygen in the exhaust gas. The amount of free oxygen in the exhaust is directly related to the air/fuel ratio. A rich mixture results in little free oxygen; most of it is consumed during combustion. A lean mixture results in considerable free oxygen because all of the oxygen is not consumed during combustion. The ECU uses the oxygen measurement to determine the correct amount of fuel delivery.

The UEGO sensor is composed of a pump cell, a sense cell, a heater and a calibration resistor. The sense cell works similar to a standard automotive oxygen sensor where little sensed oxygen (rich condition) causes a relative high voltage (above 450 millivolts). Higher concentrations of oxygen (lean condition) cause a relative low voltage (below 450 millivolts). The sense cell uses ambient air outside the exhaust system for comparing the oxygen content in the exhaust.

The pump cell works to keep the sense cell at 450 millivolts or stoichiometric. By varying the current to the pumping cell, the pump cell can either pump oxygen into or out of the sense cell. If the exhaust gas is lean in the sense cell, the pump cell current is increased to pump oxygen away from the sense cell and into the ambient air cell. If the exhaust gas is rich, less current is supplied to allow more oxygen to flow from the ambient air cell into the sense cell. The ECU monitors the amount of voltage required by the pump cell to create the desired reading in the sense cell.

The UEGO heater is used to create the heat required for the sense and pump cell to operate correctly. When the temperature is too cold, the engine will run in "Open Loop" and will not record any data in the Adaptive Learn table.



Universal Exhaust Gas Oxygen Sensor

Continued on next page

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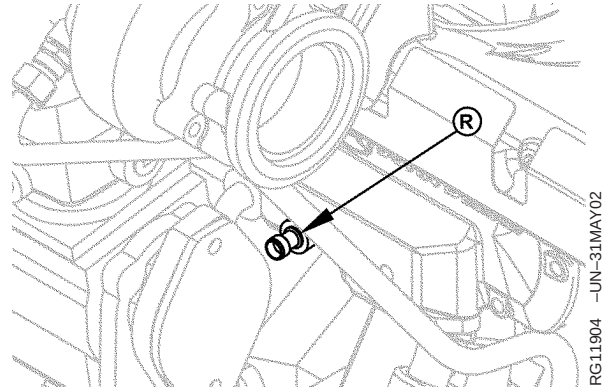
The calibration resistor provides a correction multiplier value which is designed to make each individual sensor appear like a sensor with a “nominal calibration characteristic. The UEGO calibration resistor allows the ECU to “fine tune” it’s oxygen measurement calibration when a UEGO sensor is changed.

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Knock Sensor

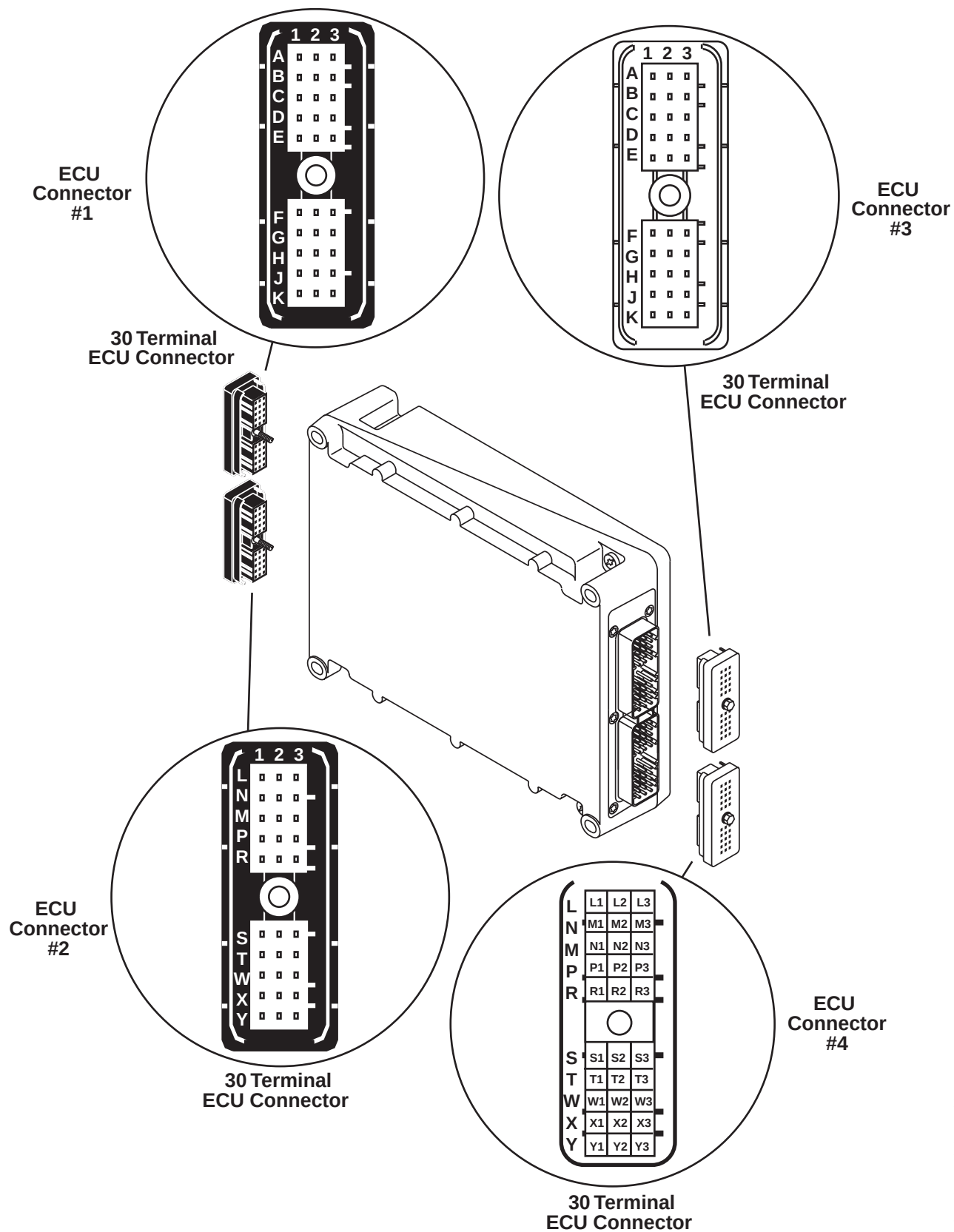
The knock sensor is located behind the compressor housing and is used to determine normal engine combustion. Normally this sensor has no effect on normal engine operation. The knock is used to reduce the risk of engine failure or damage due to poor fuel quality or excessive throttle charge temperatures.

The knock sensor is a resonant band pass filter that is very sensitive around 5.8 kHz. The knock module receives a pulse width modulated (PWM) signal from the knock sensor. The signal received is dependent on the amount of knock that is sensed on the engine. As the severity of knock increases, the PWM signal on-time increases. The knock module then translates the PWM signal into a comparative one-shot type signal (0 volts or 12 volts) to the ECU. The ECU uses this information to determine if the engine is seeing knock. Depending on the amount of knock, the ECU retards timing to compensate for the condition causing knock.



Knock Sensor

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Engine Control Unit (ECU)

Level 8 Engine Control Unit

Continued on next page

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RG11905 -19-25JAN02

The electronic control unit (ECU) is the “brains” of the control system. The ECU performs the following functions:

- Converts the electrical signals from all the various sensors into digital signals
- Makes decisions on the best airflow, fuel flow and ignition timing based on information from the various sensors
- Performs “self diagnosis” on the control system
- Stores fault codes in its memory

The ECU is divided into the following subsystems:

Analog/Digital Converters

This part of the ECU converts the electrical signals from the various sensors into digital signals that the central processing unit (CPU) can use.

Central Processing Unit

The central processing unit (CPU) performs the mathematical computations and logical functions that are necessary in controlling air, fuel, and ignition. The CPU commands closed loop operation and controls the “self diagnostic” system.

Memory

Random Access Memory - RAM: The RAM is like the working desk top of the ECU. Data from the various sensors and the results of various calculations are

temporarily stored in RAM. Information in RAM is lost when battery voltage to the ECU is removed.

Read Only Memory - ROM: The ROM contains programmed information. Information in ROM can only be read, not changed. ROM information is retained when battery voltage is removed.

Programmable Read Only Memory - PROM: The PROM contains information programmed in at the factory including engine calibration data, transmission information and axle ratio. Information in the PROM is retained when battery voltage is removed.

Connectors

There are four 30 way connectors for the Level 8 ECU. Depending on the application, the engine harness will be equipped with two of the four connectors.

ECU Connector	Color/Letters	Harness	Function
Connector #1	Black A-K	Engine	Components located on the engine only.
Connector #2	Black L-Y	Vehicle	Components located on the vehicle only.
Connector #3	White A-K	Vehicle	Components located on the vehicle only.
Connector #4	White L-Y	Engine	Components located on the engine only.

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Controlled Area Network (CAN)

Controlled Area Network (CAN) is used to allow communication between 2 or more controllers on the same machine/vehicle. All of the controllers that are required to communicate over CAN are connected together using wires that form a bus. J1939 is an SAE standard that utilizes CAN.

Just about any type of information can be communicated over the CAN bus. This information includes part numbers, serial numbers, engine speed, temperatures, pressures, fan speeds, ect. The Level 8 control system uses the bus for communication between other control system controllers.

CAN also allows diagnostic software like the Diagnostic Scan Tool (DST) and SERVICE ADVISOR™ to communicate with the engine controller. All of the information viewed through the software is transferred via the CAN Bus.

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Engine Protection

Engine protection is necessary to prevent damage to an engine. There are three different engine protection programs available in Engine Control Units (ECUs):

- **No Protection** — The ECU does not have the software to derate or shut the engine down. It is the responsibility of the operator to react to warning light(s) on their application. Derating or shutting the engine down may be necessary depending on the Diagnostic Trouble Code (DTC) that is set. Refer to the operator's manual to identify this information for a given application.
- **Engine Protection WITHOUT Shutdown** — The ECU has the capability to derate an engine. It is the responsibility of the operator to react to warning light(s) on their application to identify if it is necessary to shut the engine down. Refer to the operator's manual to retrieve this information for a given application. A Diagnostic Trouble Code (DTC) always accompanies a fuel derate. See DERATE SPECIFICATIONS in Group 198 later in this manual for derate specifications.
- **Engine Protection with Shutdown** — The ECU will derate the engine for given DTCs. If a DTC that

requires shutdown is set, the ECU will severely derate the engine and shut the engine down in 30 seconds. If the problem is corrected within the 30 second delay period, the power will increase at a particular rate until full power is reached. A Diagnostic Trouble Code (DTC) always accompanies a fuel derate. See DERATE SPECIFICATIONS in Group 198 later in this manual for derate specifications.

SHUTDOWN OVERRIDE

NOTE: Holding the shutdown override switch continuously "ON" will not reset the 30 second timer.

The engine protection shutdowns can be overridden for 30 seconds at a time. This can be used to move a vehicle to a safe location. Each time the switch is pushed, the shutdown timer is reset to 30 seconds, and the engine will run in a derated power mode.

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Derate Programs

The Electronic Control Unit (ECU) will derate the amount of fuel that is delivered to the engine when sensor inputs exceed normal operating ranges. A Diagnostic Trouble Code (DTC) always accompanies a fuel derate. See DERATE SPECIFICATIONS in Group 198 later in this manual for derate specifications.

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Engine Control Unit (ECU) Self-Diagnosis

The Engine Control Unit (ECU) has the ability to detect problems internally and in the electronic control system. This includes determining if any sensor input voltages are too high or too low. If the ECU detects a problem with the electronic control system, a Diagnostic Trouble Code (DTC) specific to the failed system will be stored in the ECU's memory.

There are two types of DTCs:

- Active
- Stored

Active DTCs indicate that the failure is occurring. These type of failures are sometimes called "hard" failures.

Stored DTCs indicate that a failure has occurred in the past, but is not currently occurring. This type of DTC can be caused by an "intermittent" failure. These could be problems such as a bad connection or a wire intermittently shorting to ground.

There are several different methods for displaying both stored and active DTCs from the ECU.

NOTE: If the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™ is used to read a sensor voltage and calculated value, and there is an active DTC for that sensor, the calculated value for that sensor will be the "limp home" value and the voltage will be the actual sensor voltage. Use the voltage during diagnostics unless otherwise directed by a diagnostic chart.

SPN/FMI CODES

SPN/FMI codes are written from the SAE J1939 standard as a two part code. The first part is called the Suspect Parameter Number (SPN). Typically, it contains between 2 and 4 digits. The SPN identifies the system or the component that has the failure; for example SPN 110 indicates a failure in the engine

coolant temperature circuit. The second part of the code is called the Failure Mode Identifier (FMI) code. The FMI contains 2 digits. The FMI identifies the type of failure that has occurred; for example FMI 3 indicates value above normal. In order to determine the exact failure, both the SPN and FMI are required. Combining SPN 110 with FMI 3 yields engine coolant temperature input voltage high.

On all applications with the Level 8 Engine Control Unit (ECU), the ECU transmits SPN/FMI codes over the Controller Area Network (CAN). This allows for service tools such as the DST, SERVICE ADVISOR™, and the Diagnostic Gauge to display active and stored DTCs. When using DST or SERVICE ADVISOR™ the codes will be displayed in a 000000.00 format. For example, SPN 110 FMI 3 will be displayed as 000110.03.

INDICATOR LAMPS

There are three available indicator lights available for the Level 8 Electronic Control System. Depending on the severity of the diagnostic trouble code one or more of the indicator lamps will set.

- **Warning Light:** A warning light will illuminate when a diagnostic trouble code sets that should not harm the engine. This is to let the operator know that something is wrong and they need to have it looked at as soon as they can.
- **Malfunction Light:** A malfunction light will illuminate when a diagnostic trouble code sets that should not harm the engine, but could effect emissions. This code should be repaired as soon as possible to keep the engine emission certified and running at its maximum performance.
- **Stop Light:** A stop light will illuminate when a diagnostic trouble code sets that can cause serious damage to the engine. The engine should be shut down as soon as this light appears.

CLEARING STORED DTCs

Stored DTCs can be cleared through the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™. If the DST or SERVICE ADVISOR™ is unavailable, refer to the

vehicle machine manual to determine how to clear the code reader.

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About This Group

This section of the manual contains necessary information for observable diagnostics and fuel-related test procedures. Use this information in conjunction with the 6081 Compressed Natural Gas Engines Repair Manual (CTM 87). Group 105 is divided into two areas: diagnosing malfunctions and test procedures. The diagnosing malfunctions area is further divided into the following headings, containing the following observable symptoms:

NOTE: Follow the diagnostic procedure of an active or stored DTC before pursuing any observable diagnostic procedure.

- E1 - Engine Cranks/Won't Start
- E2 - Engine Misfires/Runs Irregularly
- E3 - Engine Does Not Develop Full Power
- E4 - Engine Won't Idle (Not Missing/Running Rough)
- E6 - Engine Will Not Crank
- E8 - Abnormal Engine Noise

- F1 - Natural Gas Pressure Check
- F2 - Ignition System Check
- F3 - Fuel Injector Diagnostic Check
- F4 - High Fuel Consumption Check

- D1 - ECU Does Not Communicate With DST or SERVICE ADVISOR™
- D2 - Diagnostic Gauge Does Not Communicate With ECU

Procedures for diagnosing some of the above symptoms are formatted such that a test or repair is recommended, then based on the results another test or repair is recommended. Other symptoms are formatted in a symptom - problem - solution format. In these symptoms, the problems are arranged in the most likely or easiest to check first. Symptoms arranged in both formats refer to testing procedures in the second part of this section. The second part of this section contains the following testing procedures:

- Testing Procedures:
 - Diagnosing Turbocharger Malfunctions
 - Diagnosing Head Gasket Joint Failures
 - Head Gasket Inspection and Repair Sequence
 - Diagnosing Lubrication System Malfunctions
 - Diagnosing Cooling System Malfunctions
 - Test Engine Compression Pressure
 - Check Engine Oil Pressure

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E1 - Engine Cranks/Won't Start

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E1 - Engine Cranks/Won't Start Diagnostic Procedure

NOTE: This procedure applies to engines with John Deere Control Units (ECUs). This procedure should be used if engine cranking speed is OK, but engine will not start, or only starts after prolonged cranking. If engine will not crank, determine problem in the starting and charging system. See STARTING AND CHARGING SYSTEM DIAGNOSTICS in Group 110 later in this manual.

-- -1/1

① E1 - Preliminary Check

1. Ensure that the main fuel shut-off valve is OPEN.
2. Ensure that at least one fuel tank's shut-off valve is OPEN.
3. Ensure that fuel tanks have fuel in them.

No problems found:
GO TO ②

Problem found:
Repair and retest

-- -1/1

② Active DTC Test

1. Connect the DST or SERVICE ADVISOR™ For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 115 later in this manual.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software.
4. Crank engine for 15 seconds.
5. Read DTCs using DST or SERVICE ADVISOR™ while cranking engine.

No active DTCs:
GO TO ③

Active DTC(s) present:
Diagnose active DTCs first.
If any DTCs have a SPN of 636 or 637, go to those first.

Can't communicate with ECU:
See D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ later in this Group.

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-- -1/1

③ Throttle Test	1. Start cranking engine 2. While cranking engine, use diagnostic software to read Throttle Position Sensor Command and Throttle Position Sensor Feedback.	TPS Command and TPS Feedback are between 30-45%: GO TO ④ TPS Command and TPS Feedback not between 30-45%: Faulty Throttle -- -1/1
④ Natural Gas Pressure Test	1. Ignition ON 2. Using the ECU diagnostic software, read Natural Gas Pressure during the first 16 seconds the ignition is ON. Compare reading to specification below: Specification CNG - Natural Gas Pressure (Absolute) for 250 HP Engines—Pressure..... 110-155 psia (760-1070 kPa) (7.6-10.7 bar) CNG - Natural Gas Pressure (Absolute) for 275 and 280 HP Engines—Pressure 120-155 psia (830-1070 kPa) (8.3-10.7 bar) LNG - Natural Gas Pressure (Absolute) for all engines—Pressure..... 90-115 psia (620-793 kPa) (6.2-7.9 bar)	Pressure within spec: GO TO ⑥ Pressure above spec: GO TO ⑤ Pressure below spec: See F1 - NATURAL GAS PRESSURE CHECK later in this Group. -- -1/1
⑤ Fuel Regulator Test	1. Ignition OFF 2. Bleed pressure from metering block. • On CNG engines, remove cap on Schrader Valve and bleed pressure. • On LNG engines, loosen plug next to temperature sensor on the metering block until all gas has escaped. Tighten plug. 3. Ignition ON, engine OFF 4. Using the ECU diagnostic software, read Natural Gas Pressure during the first 16 seconds the ignition is ON. Compare reading to specification below: Specification CNG - Natural Gas Pressure (Absolute) for 250 HP Engines—Pressure..... 110-155 psia (760-1070 kPa) (7.6-10.7 bar) CNG - Natural Gas Pressure (Absolute) for 275 and 280 HP Engines—Pressure 120-155 psia (830-1070 kPa) (8.3-10.7 bar) LNG - Natural Gas Pressure (Absolute) for all engines—Pressure..... 90-115 psia (620-793 kPa) (6.2-7.9 bar)	Pressure within spec: GO TO ⑥ Pressure above spec: Faulty fuel regulator. Replace and retest. -- -1/1

6 Injector Clean Test

NOTE: Do not actually disassemble fuel lines or use cleaning solution. Only pulsate the injectors.

1. Using the ECU diagnostic software, run the injector clean (Do NOT actually clean the injectors with cleaner) for 30-45 seconds.
2. Try starting engine.

Engine does not start:
GO TO 7

Engine starts:
Injector(s) are sticking.
Clean injectors using
JT07281 Injector
Accessory Kit, JT07282
Fuel Injector Cleaner, and
JT07283 Pro Inject-R
Kleen. See ENGINE
TEST INSTRUCTIONS —
INJECTOR CLEANING in
Group 115 later in this
manual.

-- -1/1

7 Injector Leak Test

An injector that leaks could cause the intake manifold to fill with a noncombustible mixture. Prolonged cranking is required to clear the noncombustible mixture from the intake manifold.

1. Let vehicle sit for at least 5 minutes with engine OFF.
2. Disconnect fuel line that connects the fuel metering block to mixing elbow at the mixing elbow.
3. Place disconnected side of fuel line in container of water.
4. Watch container of water for gas bubbles.
5. Reinstall fuel line to mixing elbow and tighten to specification.

Specification

Mixing Elbow Inlet Line—Torque 20 lb-ft (27N•m)

Minimal bubbles present:
See F3 - FUEL
INJECTOR DIAGNOSTIC
CHECK later in this
Group.

Bubbles are present:
See F2 - IGNITION
SYSTEM TEST later in
this Group.

-- -1/1

E2 - Engine Misfires/Runs Irregularly

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E2 - Engine Misfires/Runs Irregularly Diagnostic Procedure

-- -1/1

❶ E2 - Preliminary Check	Before using this diagnostic procedure, check for the following that could cause or be mistaken as miss/rough running: 1. Check intake manifold air leaks. 2. Check for engine mechanical problems. 3. Verify transmission is NOT rapidly shifting back and forth. 4. Check to see if engine accessories such as AC is cycling ON and OFF. 5. Check for electromagnetic interference (EMI) from improperly installed radios, ect.	No problems found: GO TO ❷ Problem found: Repair and retest
❷ Active DTC Test	1. Connect the DST or SERVICE ADVISOR™ For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 115 later in this manual. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software. 4. Ignition ON, engine running 5. Read DTCs using DST or SERVICE ADVISOR™.	No active DTCs: GO TO ❸ Active DTC(s) present: Diagnose active DTCs first.
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❸ Rough Idle Test	Ignition ON, engine idling	Running rough: GO TO ❹ Not running rough: GO TO ❹

-- -1/1

Engine Diagnostic and Testing Procedures

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4 Engine Load Test

1. Ignition ON, engine running
2. Run engine under heavy load.
3. Increase load until engine misfires or runs irregularly.

Running rough:
GO TO 5

Not running rough:
No problem found. Verify complaint and try to reproduce conditions of the miss/rough running complaint.

-- -1/1

5 Active DTC Test

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 115 later in this manual.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software.
4. Ignition ON, engine running
5. Read DTCs using DST or SERVICE ADVISOR™.

No active DTCs:
GO TO 6

Active DTC(s) present:
Diagnose active DTCs.

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-- -1/1

6 Wastegate Control Test

1. Ignition OFF
2. Disconnect the wastegate control solenoid connector.
3. Using a multimeter, measure resistance between both terminals in the wastegate control solenoid connector on the wastegate.

Between 15-21 ohms:
GO TO 7

Below 15 ohms or above 21 ohms:
Faulty wastegate control solenoid.

-- -1/1

7 Wastegate System Check

1. Verify the wastegate solenoid pressure supply hose is not damaged or restricted.
2. Verify wastegate mechanical components are in good condition.

Wastegate System OK:
GO TO 8

Wastegate System not OK:
Repair faulty components and retest.

-- -1/1

8 Throttle Test	1. Ignition ON, engine running 2. Using the ECU diagnostic software, watch Throttle Position Sensor Command and Throttle Position Sensor Feedback. <i>NOTE: It is recommended to create a recording using the ECU diagnostic software while slowly depressing the foot pedal. This will eliminate the possibility of over-revving the engine for a long period of time. Over-revving the engine can cause internal engine failures.</i> 3. Slowly move foot pedal from idle position to fully depressed while watching TPS parameters.	TPS Feedback and TPS Command within 7% of each other: GO TO 9 TPS Feedback and TPS Command more than 7% of each other: Replace throttle and retest. -- -1/1
9 Spark Cutout Test	1. Ignition ON, engine running 2. Using the ECU diagnostic software, run the Spark Cutout Test for each coil. See ENGINE TEST INSTRUCTIONS - SPARK CUTOFF TEST in Group 115 later in this manual. <i>NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.</i>	All coils firing: GO TO 10 One or more coils not firing: See F2 - IGNITION SYSTEM TEST later in this Group. -- -1/1
10 Injector Cutout Test	1. Ignition ON, engine running 2. Using the ECU diagnostic software, run the Injector Cutout Test for each injector. See ENGINE TEST INSTRUCTIONS - INJECTOR CUTOFF TEST in Group 115 later in this manual.	All injectors working properly: GO TO 11 One or more injectors faulty: See F3 - FUEL INJECTOR DIAGNOSTIC CHECK later in this Group. -- -1/1
11 Injector Clean Test	Clean injectors using JT07281 Injector Accessory Kit, JT07282 Fuel Injector Cleaner, and JT07283 Pro Inject-R Kleen. See ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual.	Engine runs smooth: Engine is fixed. Engine still misses/runs rough: Check for leaks in the intake manifold gasket. -- -1/1

E3 - Engine Does Not Develop Full Power

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E3 - Engine Does Not Develop Full Power Diagnostic Procedure

-- -1/1

① Preliminary Check	Before using this diagnostic procedure, check for a dirty or restricted air filter.	Air filter clean: GO TO ② Dirty/restricted air filter: Replace air filter and retest. -- -1/1
② Active DTC Test	1. Connect the DST or SERVICE ADVISOR™ For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 115 later in this manual. 2. Drive vehicle and attempt to recreate conditions of low power complaint. 3. Start the ECU diagnostic software. 4. Ignition ON, engine idling 5. Read DTCs using DST or SERVICE ADVISOR™.	No active DTCs: GO TO ③ Active DTC(s) present: Diagnose active DTCs first.
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③ Foot Pedal Test	1. Ignition ON, engine OFF 2. Fully depress the foot pedal. 3. Using the ECU diagnostic software, read the Primary Foot Pedal Position.	FPP 97% or greater: GO TO ④ FPP below 97%: Foot pedal is not extending to its full range. -- -1/1
④ Throttle Test	1. Run engine at conditions that low power occurred. 2. Using the ECU diagnostic software, read the difference between Throttle Position Sensor Command and Throttle Position Sensor Feedback.	TPS Feedback and TPS Command within 7% of each other: GO TO ⑤ TPS Feedback and TPS Command more than 7% of each other: Faulty throttle. Replace and retest. -- -1/1

5 Wastegate Control Test	1. Ignition OFF 2. Disconnect the wastegate control solenoid connector. 3. Using a multimeter, measure resistance between both terminals in the wastegate control solenoid connector on the wastegate.	Between 15-21 ohms: GO TO 6 Below 15 ohms or above 21 ohms: Faulty wastegate control solenoid. ---1/1
6 Wastegate System Check	1. Verify the wastegate solenoid pressure supply hose is not damaged or restricted. 2. Verify wastegate mechanical components are in good condition.	Wastegate System OK: GO TO 7 Wastegate System not OK: Repair faulty components and retest. ---1/1
7 Spark Cutout Test	1. Ignition ON, engine running 2. Using the ECU diagnostic software, run the Spark Cutout Test for each coil. See ENGINE TEST INSTRUCTIONS - SPARK CUTOUT TEST in Group 115 later in this manual. <i>NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.</i>	All spark plugs firing: GO TO 8 One or more spark plugs not firing: See F2 - IGNITION SYSTEM TEST later in this Group. ---1/1
8 Injector Cutout Test	1. Ignition ON, engine running 2. Using the ECU diagnostic software, run the Injector Cutout Test for each injector. See ENGINE TEST INSTRUCTIONS - INJECTOR CUTOUT TEST in Group 115 later in this manual.	All injectors working properly: GO TO 9 One or more injectors faulty: See F3 - FUEL INJECTOR DIAGNOSTIC CHECK later in this Group. ---1/1

Engine Diagnostic and Testing Procedures

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10

9 Injector Clean Test

Clean injectors using JT07281 Injector Accessory Kit, JT07282 Fuel Injector Cleaner, and JT07283 Pro Inject-R Kleen. See ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual.

Engine still misses/runs rough:
GO TO 10

Engine runs smooth:
Engine is fixed.

-- -1/1

10 Intake Manifold Test

Check the intake manifold gasket for air leaks.

No leaks found:
See F1 - NATURAL GAS PRESSURE CHECK later in this Group.

Leaks found:
Repair and retest.

-- -1/1

E4 - Engine Won't Idle (Not Missing/Running Rough)

RG41221,0000035 -19-08JUL03-1/1

E4 - Engine Won't Idle (Not Missing/Running Rough) Diagnostic Procedure

-- -1/1

① Active DTC Test

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 115 later in this manual.
2. Ignition ON, engine OFF
3. Start ECU diagnostic software.
4. Ignition ON, engine idling
5. Read DTCs using DST or SERVICE ADVISOR™.

No active DTCs:
GO TO ②

Active DTC(s) present:
Diagnose active DTCs first.

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-- -1/1

② Fast Idle Switch Test

1. Ignition ON, engine running
2. If vehicle is equipped with a fast idle switch, make sure that the switch is in the OFF position.
3. Using the ECU diagnostic software, read Fast Idle Active Status.

Idle reads OFF:
GO TO ③

Idle reads ON:
Faulty fast idle switch.
OR
Faulty wiring to the fast idle switch.

-- -1/1

③ Foot Pedal Selection Check

Some applications use multiple foot pedals. If this application has more than one foot pedal, verify the position of the foot pedal selection switch.

Primary Foot Pedal is selected:
GO TO ④

Secondary Foot Pedal is selected:
GO TO ⑤

-- -1/1

④ Primary Foot Pedal Test

1. Ignition ON, engine OFF
2. Foot pedal in idle position.
3. Using the ECU diagnostic software, read Foot Pedal Position 1 Input Voltage, Foot Pedal Position 2 Input Voltage and Primary Foot Pedal Idle Validation Switch Status.

**FPP1 is 0.3-0.5 V
AND
FPP2 is 0.3-0.6 V
AND
IVS status is ON
GO TO ⑥**

**FPP1 is NOT 0.3-0.5 V
OR
FPP2 is NOT 0.3-0.6 V
OR
IVS status is OFF**
Faulty wiring for FPP1,
FPP2, or IVS
OR
Faulty foot pedal
OR
Faulty ECU connection

-- -1/1

⑤ Secondary Foot Pedal Test

1. Ignition ON, engine OFF
2. Foot pedal in idle position.
3. Using the ECU diagnostic software, read Foot Pedal Position 3 Input Voltage, Foot Pedal Position 4 Input Voltage and Secondary Foot Pedal Idle Validation Switch Status.

**FPP3 is 0.3-0.5 V
AND
FPP4 is 0.3-0.6 V
AND
IVS status is ON
GO TO ⑥**

**FPP3 is NOT 0.3-0.5 V
OR
FPP4 is NOT 0.3-0.6 V
OR
IVS status is OFF**
Faulty wiring for FPP3,
FPP4, or IVS
OR
Faulty secondary foot
pedal
OR
Faulty ECU connection

-- -1/1

⑥ Throttle Test

1. Ignition ON, engine running
2. Using the ECU diagnostic software, watch TPS Command and TPS Feedback.
3. Slowly move the selected foot pedal from idle position to fully depressed while watching the TPS parameters.

**TPS Feedback and TPS
Command within 7% of
each other:**
Plugged or dirty MAP
sensor
OR
Faulty ECU

**TPS Feedback and TPS
Command more than
7% of each other:**
Replace throttle and
retest.

-- -1/1

E8 - Abnormal Engine Noise

Symptom	Problem	Solution
E8 - Abnormal Engine Noise	Worn main or connecting rod bearings	Determine bearing clearance. See CYLINDER BLOCK, LINERS, PISTONS, AND RODS SPECIFICATIONS in Group 010 or CRANKSHAFT , MAIN BEARINGS, AND FLYWHEEL SPECIFICATIONS in Group 015 of 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).
	Excessive crankshaft end play	Check crankshaft end play. See CHECK CRANKSHAFT END PLAY in Group 015 of 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).
	Loose main bearing caps	Check bearing clearance; replace bearings and bearing cap screws as required. See CRANKSHAFT , MAIN BEARINGS, AND FLYWHEEL SPECIFICATIONS in Group 015 of 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).
	Worn connecting rod bushings and piston pins	Inspect piston pins and bushings. See INSPECT PISTON PINS AND BUSHINGS in Group 010 of 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).
	Scored pistons	Inspect pistons. See PRELIMINARY LINER, PISTON, AND ROD CHECKS in Group 010 of 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).

Continued on next page

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Symptom	Problem	Solution
	Worn timing gears or excess back lash	Check timing gear back lash. See CHECK CAMSHAFT END PLAY AND MEASURE GEAR BACKLASH in Group 016 of 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).
	Excessive valve clearance	Check and adjust valve clearance. See CHECK AND ADJUST VALVE CLEARANCE in Group 005 of the 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).
	Worn camshaft	Inspect camshaft. See VISUALLY INSPECT CAMSHAFT in Group 016 of 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).
	Worn rocker arm shaft(s)	Inspect rocker arm shafts. See DISASSEMBLE AND INSPECT ROCKER ARM SHAFT ASSEMBLY in Group 005 of 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).
	Insufficient engine lubrication	See DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS later in this Group.
	Turbocharger noise	See TURBOCHARGER SEVEN-STEP INSPECTION in Group 030 in 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).

RG41221.0000038 -19-14SEP01-2/2

F1 - Natural Gas Pressure Check

RG41221,0000039 -19-08JUL03-1/1

F1 - Natural Gas Pressure Check Diagnostic Procedure

NOTE: This diagnostic procedure should only be used when referred to by another diagnostic procedure.

-- 1/1

❶ F1 - Preliminary Check	Check for the following that could cause low natural gas pressures at the fuel metering block: 1. Ensure main fuel shut-off valve is OPEN. 2. Ensure that at least one fuel tank's shut-off valve is OPEN. 3. Ensure fuel tanks have fuel in them.	No problems found: GO TO ❷ Problem found: Repair and retest

-- 1/1

❷ Active DTC Test	1. Connect the DST or SERVICE ADVISOR™ For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 115 later in this manual. 2. Ignition ON, engine running/cranking 3. Start the ECU diagnostic software. 4. Ignition ON, engine idling/cranking 5. Read DTCs using DST or SERVICE ADVISOR™.	No active DTCs: GO TO ❸ Active DTC(s) present: Diagnose active DTCs first.

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-- 1/1

❸ Natural Gas Pressure Test	1. Ignition ON, engine running or cranking 2. Using the ECU diagnostic software, read Natural Gas Pressure during the first 16 seconds the ignition is ON. Compare reading to specification below: Specification Natural Gas Pressure (Absolute) for 250 HP Engines—Pressure 110-155 psia (760-1070 kPa) (7.6-10.7 bar) Natural Gas Pressure (Absolute) for 275 and 280 HP Engines—Pressure 120-155 psia (830-1070 kPa) (8.3-10.7 bar)	Pressure below spec: GO TO ❹ Pressure within spec: Adequate fuel pressure at the fuel metering block.

-- 1/1

Engine Diagnostic and Testing Procedures

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④ Natural Gas Pressure Gauge Test

1. Ignition OFF
2. Remove cap from Schrader valve on fuel metering block.
3. Connect a 0-200 psi pressure gauge to the Schrader valve.
4. Ignition ON, engine running or cranking
5. Read pressure on gauge. Compare reading to specification below:

Specification

Natural Gas Pressure (Gauge) for 250
HP Engines—Pressure 95-140 psig (655-1070 kPa) (6.5-10.7
bar)

Natural Gas Pressure (Gauge) for 275
and 280 HP Engines—Pressure 105-140 psia (725-1070 kPa) (7.2-10.7
bar)

Pressure below spec:
GO TO ⑤

Pressure within spec:
Faulty natural gas
pressure sensor.
Replace and retest.

-- -1/1

⑤ Natural Gas Tank Pressure Test

1. Ignition ON, engine OFF
2. Using the ECU diagnostic software, read the Natural Gas Tank Pressure parameter.

Above 300 psia (2070 kPa)
(20.7 bar):
GO TO ⑥

300 psia (2070 kPa)
(20.7 bar) or less:
Restriction in fuel line
between fuel tanks and
fuel regulator
OR
Faulty high pressure
lock-off

-- -1/1

⑥ Restricted Fuel Line Test

- Look for a restricted fuel line(s) between the fuel regulator and the fuel metering block.

No restriction found:
GO TO ⑦

Restriction found:
Repair fuel line and
retest.

-- -1/1

⑦ Fuel Filter Test

1. Ignition OFF
2. Open drain valve on bottom of fuel filter to relieve pressure in gas lines.
3. Unscrew fuel filter canister from the filter base.
4. Observe the fuel filter element.

Filter element clean:
GO TO ⑧

**Filter element dirty or
plugged:**
Replace filter element
and retest.

-- -1/1

⑧ Low Pressure
Lock-Off Stuck Shut
Test

- 1. Ignition OFF
- 2. Turn off natural gas supply at 1/4 turn shut-off valve.
- 3. Disconnect low pressure lock-off solenoid connector.
- 4. Remove nut (J) and spacer (I) from solenoid.
- 5. Remove solenoid (H). If solenoid does not pull off, rotate solenoid side to side while pulling outward.
- 6. Remove valve housing (G) from fuel metering block.
- 7. Remove parts (A-E) from valve housing.
- 8. Install empty valve housing on fuel metering block. Tighten to specification.

Specification

Valve Housing to Metering Block—
Torque 5 lb-ft (62 lb-in) (7 N•m)

- 9. Install solenoid and spacer. Tighten to specification.

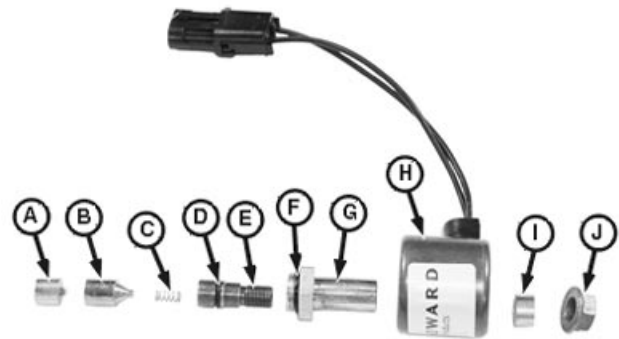
Specification

Lock-off Solenoid Assembly—Torque 5 lb-ft (62 lb-in) (7 N•m)

- 10. Reconnect low pressure lock-off solenoid electrical connector.
- 11. Open 1/4 turn shut-off valve.
- 12. Start engine and read Natural Gas Pressure using the ECU diagnostic software.
Compare reading to specification below:

Specification

Natural Gas Pressure (Absolute) for 250
HP Engines—Pressure 110-155 psia (760-1070 kPa) (7.6-10.7
bar)
Natural Gas Pressure (Absolute) for 275
and 280 HP Engines—Pressure 120-155 psia (830-1070 kPa) (8.3-10.7
bar)



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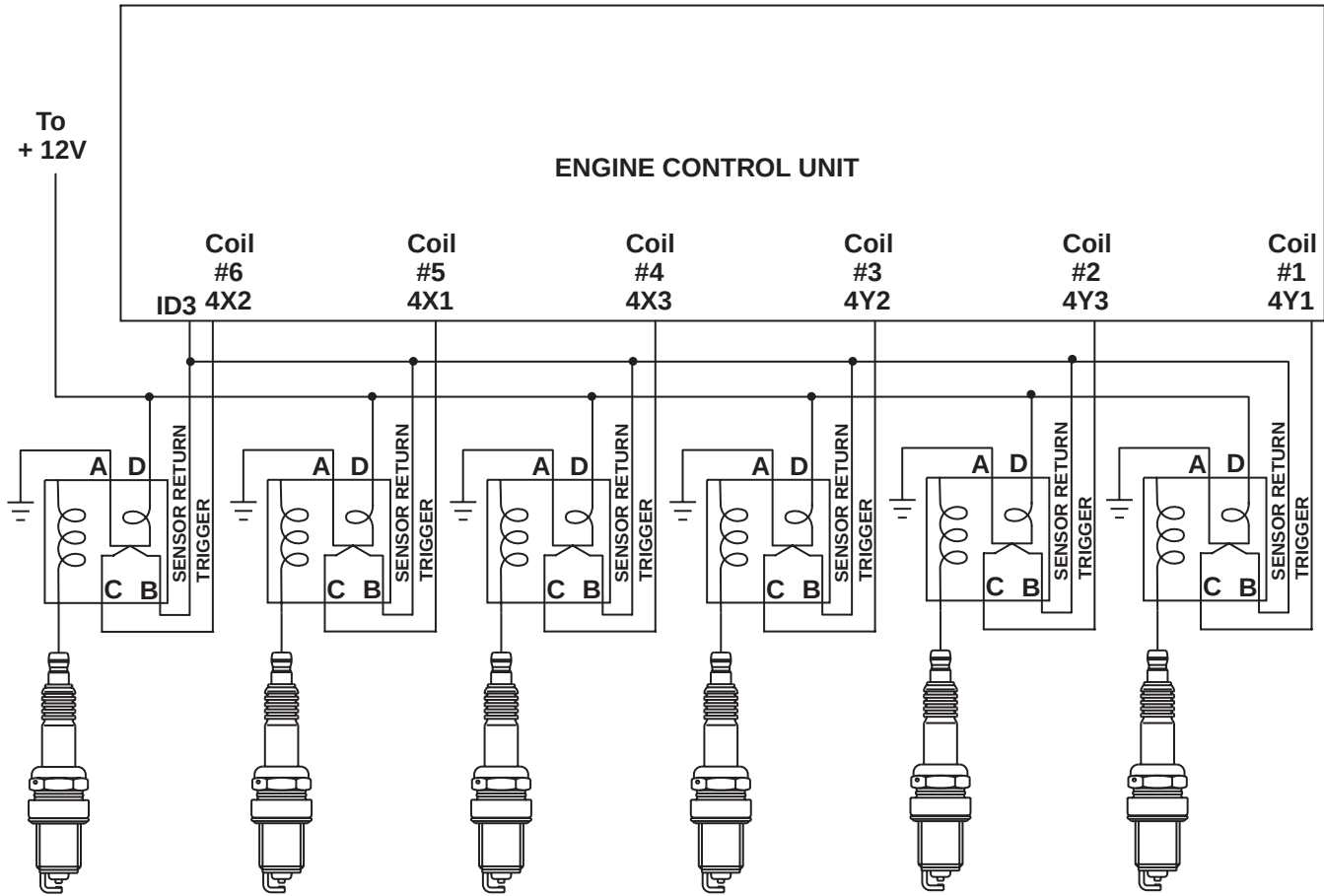
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A—Bottom Plunger
B—Top Plunger
C—Spring
D—O-Ring
E—Valve Stem
F—O-Ring
G—Valve Housing
H—Solenoid
I—Spacer
J—Nut

Pressure below spec:
Faulty high pressure fuel
regulator.
Replace and retest.

Pressure within spec:
Faulty plunger in low
pressure lock-off.
Replace low pressure
lock-off and retest.

F2 - Ignition System Check



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RG41221,000003A -19-14SEP01-1/1

F2 - Ignition System Check

RG41221,0000005 -19-08JUL03-1/1

F2 - Ignition System Check Diagnostic Procedure

NOTE: This diagnostic procedure should only be used when referred to by another diagnostic procedure.

-- -1/1

❶ Spark Cutout Test

NOTE: If another diagnostic procedure has already completed the Spark Cutout Test, GO TO ❷. Otherwise start at step ❶.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 160 later in this manual.
2. Ignition ON, engine running
3. Start the ECU diagnostic software
4. Using the ECU diagnostic software, run the Spark Cutout Test for each injector. See ENGINE TEST INSTRUCTIONS - SPARK CUTOFF TEST in Group 115 later in this manual.

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.

All coil firing properly:
No ignition coil problems found.

One or more coils faulty:
GO TO ❷

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-- -1/1

❷ Ignition Coil Power Test

1. Ignition OFF
2. Disconnect all 6 of the ignition coil connectors.
3. Ignition ON, engine OFF
4. Probe the ignition coil #1 power terminal (terminal D) on the engine harness with a test light connected to a good chassis ground.
5. Repeat step 4 for the rest of the ignition coils (2-6).

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.

Light ON for all coils:
GO TO ❸

Light OFF for one or more coils:
Open or short in coil power wire.
OR
Faulty fuse F04
OR
Faulty relay K03

-- -1/1

Engine Diagnostic and Testing Procedures

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③ Ignition Coil Ground Test

1. All of the ignition coil connectors still disconnected.
 2. Ignition ON, engine OFF
 3. Probe the ignition coil #1 ground terminal (terminal A) on the engine harness with a test light connected to battery voltage.
 4. Repeat step 3 for the rest of the ignition coils (2-6).
- NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.*

Light ON for all coils:
GO TO ④

Light OFF for one or more coils:
Open in ground wire.
Repair and retest.

-- -1/1

④ Sensor Ground Test

1. All of the ignition coil connectors still disconnected.
 2. Ignition ON, engine OFF
 3. Probe the ignition coil #1 sensor ground terminal (terminal B) on the engine harness with a test light connected to battery voltage.
 4. Repeat step 3 for the rest of the ignition coils (2-6).
- NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.*

Light ON for all coils:
GO TO ⑤

Light OFF for one or more coils:
Open in sensor ground wire.
Repair and retest.

-- -1/1

⑤ Spark Test

1. Ignition OFF
 2. Remove spark plug wire from the spark plug.
 3. Install JT07285 - Electronic Ignition Spark Tester to the spark plug wire.
 4. Hook clamp onto a good chassis ground.
 5. Crank engine while watching the spark tester.
 6. Repeat steps 2-5 for each of the other ignition coils.
- NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.*

Spark on all cylinders:
GO TO ⑥

No spark on one or more cylinders:
Faulty spark plug boot
OR
Faulty ignition coil
OR
Faulty ECU connection
OR
Faulty ECU

-- -1/1

⑥ Spark Plug Test

1. Ignition OFF
 2. Clean all dirt and debris from around the spark plugs.
 3. Remove one spark plug.
 4. Clean and check the spark plug gap. See CLEANING AND ADJUSTING SPARK PLUG GAP in Group 045 of 8.1 L Compressed Natural Gas Engines Repair Manual (CTM 87).
 5. Repeat steps 2-4 for the remaining 5 spark plugs.
- NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.*

Spark plug clean and gap correct:
Faulty ignition coil

Spark plug dirty:
Clean or replace spark plug.

Spark plug gap is incorrect:
Adjust the gap or replace spark plug.

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F3 - Fuel Injector Diagnostic Check

RG41221,000003B -19-14SEP01-1/1

F3 - Fuel Injector Diagnostic Check

NOTE: This diagnostic procedure should only be used when referred to by another diagnostic procedure.

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❶ Injector Cutout Test

NOTE: If another diagnostic procedure has already completed the Injector Cutout Test, GO TO ❷. Otherwise start at step ❶.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 160 later in this manual.
2. Ignition ON, engine running
3. Start the ECU diagnostic software
4. Using the ECU diagnostic software, run the Injector Cutout Test for each injector. See ENGINE TEST INSTRUCTIONS - INJECTOR CUTOUT TEST in Group 115 later in this manual.

All injectors working properly:
No injector problems found.

One or more injectors faulty:
GO TO ❷

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❷ Injector Resistance Test

1. Ignition OFF
2. Disconnect engine wiring harness connector from injector(s) that were determined faulty in step 1.
3. Disconnect engine wiring harness connector from one injector the was determined to be working fine in step 1.
4. Using a multimeter, measure the resistance across the following:
 - Both terminals on the good injector.
 - Both terminals on the determined faulty injector.

NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the affects of temperature. At 68°F (20°C) injector resistance is 4.6 ohms ±0.5 ohms.

Difference between measurements 1.0 ohms or less:
There is no problem with the injectors. Return to the diagnostic procedure that referred you to this procedure.

Difference between measurements greater than 1.0 ohms:
Faulty injector.
Replace and retest.

-- -1/1

F4 - High Fuel Consumption Check

RG41221,0000168 -19-29MAY03-1/1

F4 - High Fuel Consumption Check

NOTE: Some vehicles use a multiple high pressure lock-off system. For these vehicles, a diagnostic trouble code may not always catch failed high pressure lock-off valves.

-- -1/1

① Multiple High Pressure Lock-Off Check

Check the vehicle's fuel system for multiple high pressure lock-offs.

One high pressure lock-off:
GO TO ②

More than one high pressure lock-off:
GO TO ③

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② Fuel Tank Shut-off Valve Check

Ensure that shut-off valve on each fuel tank is open.

One or more shut-off valves closed:
Open all shut-off valves and recheck fuel consumption.

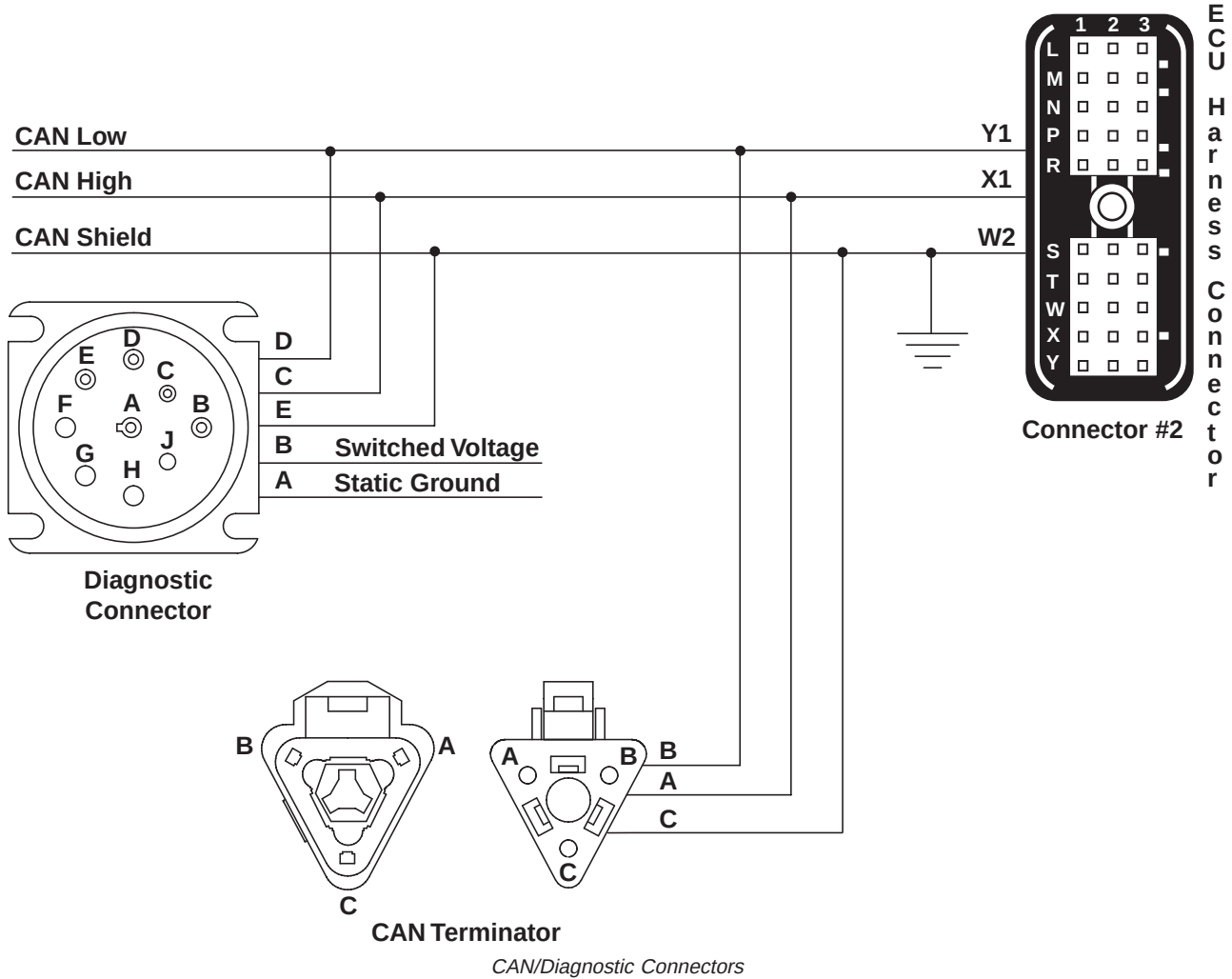
All shut-off valves open:
Fuel system is functioning correctly.

-- -1/1

③ High Pressure Lock-Off Test	 CAUTION: Do NOT open and close fuel tank shut-off valves while engine is running. 1. Ignition OFF 2. Close all fuel tank shut-off valves at each individual fuel tank. 3. Run engine until all fuel in lines is consumed and engine dies. 4. Ignition OFF 5. Open one fuel tank shut-off valve. 6. Ignition ON, run engine for 2 minutes 7. Ignition OFF 8. Close the fuel tank shut-off valve. 9. Run engine until all fuel in lines is consumed and engine dies. 10. Ignition OFF 11. Open one fuel tank shut-off valve on a different fuel tank. 12. Ignition ON, run engine for 2 minutes 13. Repeat steps 7-12 for the remaining fuel tanks.	Engine starts and runs on each individual tank: No fuel system problems found. Engine does not start and run for one or more individual tanks: Faulty high pressure lock-off valve on fuel tank(s) that did not provide fuel to the engine.	105 25

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D1 - ECU Does Not Communicate With DST or SERVICE ADVISOR™



RG11865 -19-22JUL02

This diagnostic procedure should be used if communication between the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™ and the Engine

Control Unit (ECU) cannot be established. For more information on CAN, see CONTROLLED AREA NETWORK (CAN) in Group 100 earlier in this manual.

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RG41221,000003C -19-14SEP01-1/1

D1 - ECU Does Not Communicate With DST or SERVICE ADVISOR™

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RG41221,0000252 -19-18SEP01-1/1

D1 - ECU Does Not Communicate With DST or SERVICE ADVISOR™ Diagnostic Procedure

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use the JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, diagnostic connector, and the CAN terminator connector looking for dirty damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty Connections Found:
Repair connections and retest.

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❷ Intermittent Fault Test

NOTE: For wiring information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 115 later in this manual.
2. Make sure all communication cables are properly connected
3. Ignition ON, engine OFF
4. Start the ECU diagnostic software

Can't communicate with ECU:
GO TO ❸

Communicates with ECU:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS later in this Group.

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Engine Diagnostic and Testing Procedures

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③ Sensor Voltage Test

NOTE: For wiring information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information.

1. Ignition OFF
2. Disconnect any one of the following:
 - NGT sensor
 - TCT sensor
 - ECT sensor
- For sensor location, see ELECTRONIC ENGINE CONTROL SYSTEM OVERVIEW earlier in this Group.
3. Ignition ON
4. Using a multimeter, measure the voltage between both terminals of the selected sensor harness connector.

4.5 volts or above:
GO TO ⑤

Below 4.5 volts:
GO TO ④

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④ Power Supply Test

NOTE: For wiring information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information.

1. Ignition OFF
2. Disconnect ECU connector #3 (white A-K)..
3. Ignition ON
4. Using a multimeter, measure the voltage between a good chassis ground and switched voltage (terminal D1) in the ECU connector #3 on the vehicle harness.

10.0 volts or above:
Faulty ECU power fuse
OR
Faulty ECU power wiring
OR
Faulty ECU.

Below 10.0 volts:
Key-on signal wire
shorted to ground
OR
Faulty ignition switch
OR
Faulty key-on power fuse.

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⑤ PDM Power Light Test

NOTE: For wiring information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information.

1. Ignition ON
2. Note power light on the PDM.

Power light is Green:
GO TO ⑧

Power light is Red or OFF:
GO TO ⑥

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Engine Diagnostic and Testing Procedures

⑥ Open in Diagnostic Connector Ground Wire Test	1. Ignition OFF 2. Disconnect the diagnostic cable from the diagnostic connector on main harness. 3. Using a multimeter, measure voltage between the ground terminal and the power terminal (terminals A and B) in the diagnostic connector on the main harness.	Substantially less than battery voltage: GO TO ⑦ At or near battery voltage: Faulty diagnostic cable between diagnostic connector and PDM OR Faulty Parallel Data Module (PDM) -- -1/1

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⑦ Harness Power and Ground Wire Test	<i>NOTE: For wiring information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information.</i> 1. Ignition OFF 2. Diagnostic cable still disconnected from the diagnostic connector on main harness. 3. Probe terminal A in diagnostic connector with test light connected to battery voltage.	Light ON: Open or short to ground in diagnostic connector power wire. Light OFF: Open in diagnostic connector ground wire.

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⑧ Open in Harness Circuit Test	<i>NOTE: For wiring information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #2 (black L-Y) and the diagnostic cable from the diagnostic connector. 3. Using a multimeter, measure resistance between: • Terminal D in the diagnostic connector and terminal Y1 in the ECU connector #2 on the vehicle harness. • Terminal C in the diagnostic connector and terminal X1 in the ECU connector #2 on the vehicle harness.	All measurements 5 ohms or less: GO TO ⑨ One or more measurements greater than 5 ohms: Open in harness circuit OR Connector terminals in wrong position.

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Engine Diagnostic and Testing Procedures

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9 CAN Resistance Check

NOTE: For wiring information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information.

1. Ignition OFF
2. ECU and diagnostic connectors still disconnected.
3. Using a multimeter, measure resistance between terminals C and D in the diagnostic connector on the vehicle harness.

Between 45 - 75 ohms:
GO TO **10**

Less than 45 ohms or greater than 75 ohms:
Faulty or missing CAN terminator connector(s).
OR
Open or short in CAN wiring harness

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10 CAN High and Low Voltage Test

NOTE: For wiring information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information.

1. Ignition OFF
2. Reconnect ECU connector #2.
3. Ignition ON
4. Using a multimeter, measure voltage between a good chassis ground and:
 - Terminal C in the diagnostic connector.
 - Terminal D in the diagnostic connector.

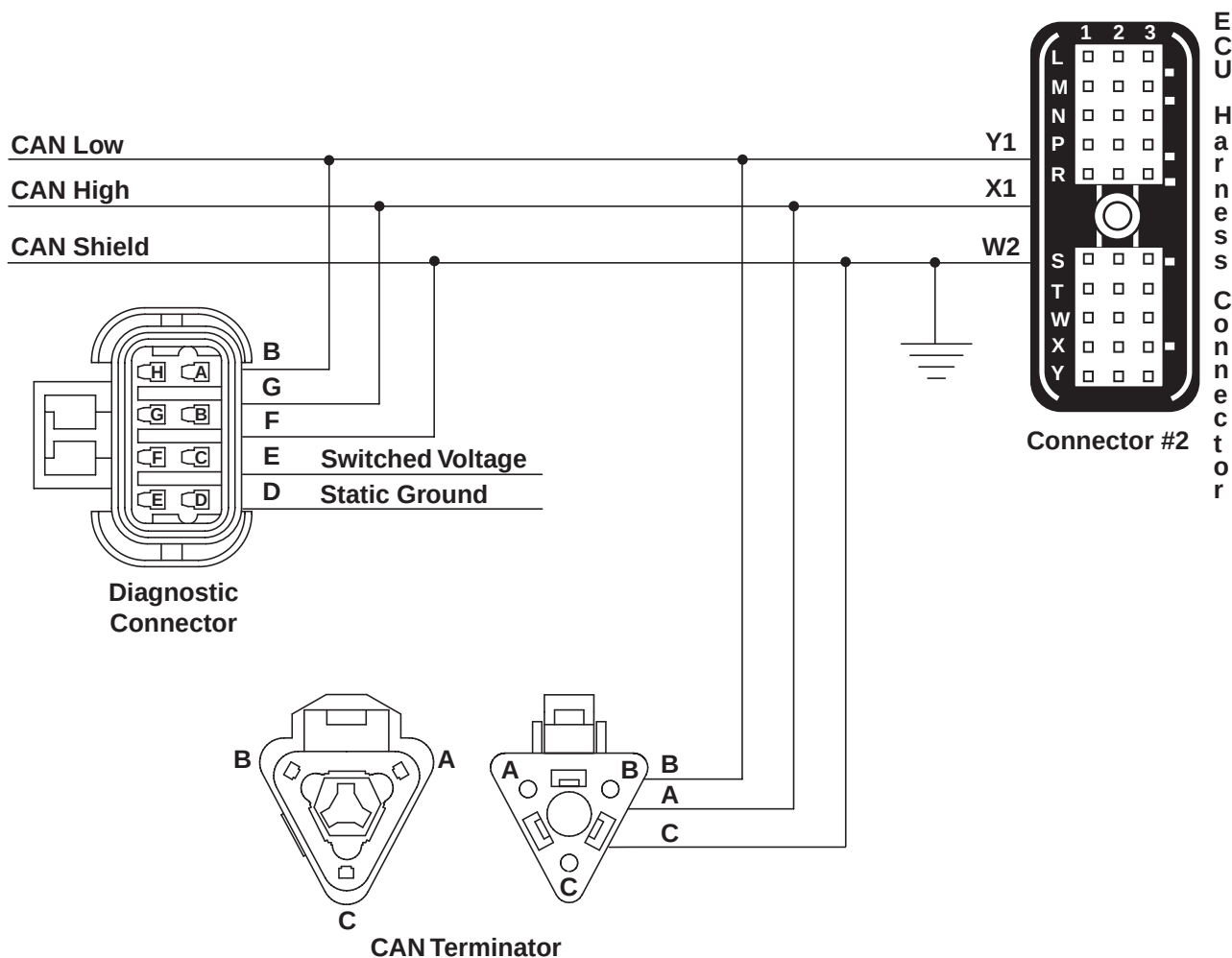
Both measurements between 1.5 - 3.5 volts:
Faulty ECU/Cab Harness connection
OR
Faulty diagnostic cable
OR
Faulty diagnostic connector
OR
Faulty Parallel Port Data Module (PDM)
OR
Faulty diagnostic software/computer configuration
OR
Faulty ECU

Either measurement less than 1.5 volts or greater than 3.5 volts:
CAN wiring shorted to ground or voltage
OR
Faulty ECU.

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D2 - Diagnostic Gauge Does Not Communicate With ECU



NOTE: For more information on CAN, see *CONTROLLED AREA NETWORK (CAN)* in Group 100 earlier in this manual.

Internal Diagnostic Gauge Errors

- The D2 - Diagnostic Gauge Does Not Communicate With ECU diagnostic procedure should be followed if

the diagnostic gauge shows the following error codes or it can not communicate with the ECU:

- EE-error
- ACP-Err/No Addr
- ACP-Err/Bus EP
- ACP-Err/Bus Error

RG11930 -19-29JUL02

RG41221,000003E -19-14SEP01-1/1

D2 - Diagnostic Gauge Does Not Communicate With ECU

RG41221,0000375 -19-08JUL03-1/1

D2 - Diagnostic Gauge Does Not Communicate With ECU Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use the JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, diagnostic gauge connector, and the CAN terminator connector looking for dirty damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connection and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.</i> 1. Ignition OFF 2. Ignition ON 3. Look for error message on diagnostic gauge.	Error or no power found in diagnostic gauge: GO TO ❸ No error found and power present in diagnostic gauge: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

-- -1/1

Engine Diagnostic and Testing Procedures

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③ Sensor Voltage Test	<i>NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.</i> - Ignition OFF - Disconnect any of the following: - Throttle Charge Temperature sensor - Natural Gas Temperature sensor - Engine Coolant Temperature sensor - Ignition ON - Using a multimeter, measure the voltage between both terminals of the selected sensor harness connector.	4.5 V or above: GO TO ⑤ Below 4.5 V: GO TO ④ -- -1/1
④ Power Supply Test	<i>NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.</i> - Ignition OFF - Disconnect ECU connector #3 (white A-K). - Ignition ON - Using a multimeter, measure the voltage between a good chassis ground and switched voltage (terminal D1) in the ECU connector #3 on the vehicle harness.	10.0 V or above: Faulty ECU power wiring OR Faulty ECU Below 10.0 V: Faulty ECU power fuse OR Key-on signal wire open or short to ground OR Faulty ignition switch OR Faulty key-on power fuse -- -1/1
⑤ Diagnostic Gauge Power Test	<i>NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.</i> - Ignition ON - View diagnostic gauge	Gauge has power: GO TO ⑧ Gauge does not have power: GO TO ⑥ -- -1/1
⑥ Open in Diagnostic Gauge Connector Ground Wire Test	<i>NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.</i> - Ignition OFF - Disconnect the diagnostic gauge connector. - Ignition ON, engine OFF - Using a multimeter, measure voltage between the switched voltage terminal and the ground terminal (terminal D and E) in the diagnostic gauge connector on the engine harness.	Substantially less than battery voltage: GO TO ⑦ At or near battery voltage: Faulty diagnostic connector OR Faulty diagnostic cable OR Faulty Parallel Data Module (PDM) -- -1/1

Engine Diagnostic and Testing Procedures

7 Open in Diagnostic Gauge Connector Power Wire Test	<i>NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.</i> 1. Ignition OFF 2. Disconnect diagnostic cable from diagnostic connector. 3. Probe terminal D in the diagnostic gauge connector with a test light connected to battery voltage.	Light ON: Open or short to ground in diagnostic gauge switched power wire. Light ON: Open in diagnostic gauge connector ground wire -- -1/1
8 Open in Harness Circuit Test	<i>NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #2 (black L-Y) and the diagnostic gauge from the diagnostic connector. 3. Using a multimeter, measure resistance on the harness end of both connectors between: • Terminal B in the diagnostic gauge connector and terminal Y1 in the ECU connector. • Terminal G in the diagnostic gauge connector and terminal X1 in the ECU connector.	All measurements 5 ohms or less: GO TO 9 One or more measurements greater than 5 ohms: Open in harness circuit OR Connector terminals in wrong position -- -1/1
9 CAN Resistance Test	<i>NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.</i> 1. Ignition OFF 2. Both ECU connector #2 (black L-Y) and the diagnostic gauge still disconnected. 3. Using a multimeter, measure resistance between terminals B and G in the harness end of the diagnostic connector.	Between 45-75 ohms: GO TO 10 Less than 45 or greater than 75 ohms: Faulty or missing CAN terminator connector(s) OR Open or short in CAN wiring harness -- -1/1

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10 CAN High and Low Voltage Test

NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.

1. Ignition OFF
2. Reconnect ECU connector.
3. Ignition ON
4. Using a multimeter, measure voltage between a good chassis ground and:
 - Terminal B in the diagnostic gauge connector
 - Terminal G in the diagnostic gauge connector

Both measurements between 1.5 - 3.5 V:
Faulty ECU connection
OR
Faulty diagnostic gauge connection
OR
Faulty diagnostic software/computer configuration
OR
Faulty ECU

Either measurement less than 1.5 V or greater than 3.5 V:
CAN wiring shorted to ground or power
OR
Faulty ECU

Diagnosing Turbocharger Malfunctions

Before replacing the turbocharger, determine what caused the failure of the defective unit, and correct the condition. This will prevent an immediate repeat failure of the replacement unit.

Noise or Vibration¹

- Bearings not lubricated (insufficient oil pressure).
- Air leak in engine intake or exhaust manifold.
- Improper clearance between turbine wheel and turbine housing.
- Broken blades (or other wheel failures).

Engine Will Not Deliver Rated Power

- Clogged manifold system.
- Foreign material lodged in compressor, impeller, or turbine.
- Excessive dirt build-up in compressor.
- Leak in engine intake and exhaust manifold.
- Rotating assembly bearing failure.
- Damaged compressor or turbine blades.

Oil on Compressor Wheel or in Compressor Housing (Oil Being Pushed or Pulled Through Center Housing)

- Excessive crankcase pressure.

- Air intake restriction.
- Drain tube restriction.
- Excessive crankcase vent oil carry over.

Oil in Manifold or Dripping from Housing

- Excessive crankcase pressure.
- Air intake restriction.
- Drain restriction.
- Damaged or worn journal bearings.
- Unbalance of rotating assembly.
- Damage to turbine or compressor wheel or blade.
- Dirt or carbon build-up on wheel or blade.
- Bearing wear.
- Oil starvation or insufficient lubrication.
- Shaft seals worn.

Turbine Wheel Drag

- Carbon build-up behind turbine wheel caused by cooked oil or combustion deposits.
- Dirt build-up behind compressor wheel caused by air intake leaks.
- Bearing seizure or dirty, worn bearings caused by excessive temperatures, unbalanced wheel, dirty oil, oil starvation, or insufficient lubrication.

¹ Do not confuse the whine heard during run down with noise which indicates a bearing failure.

Diagnosing Head Gasket Joint Failures

Head gasket failures generally fall into three categories:

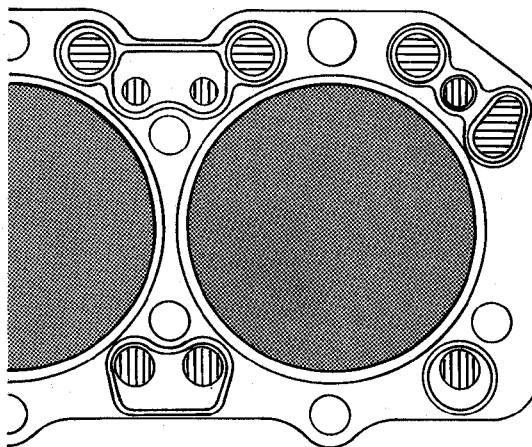
- Combustion seal leakage.
- Coolant seal leakage.
- Oil seal leakage.

Combustion seal leakage failures occur when combustion gases escape between cylinder head and head gasket combustion flange, or between combustion flange and cylinder liner. Leaking combustion gases may vent to an adjacent cylinder, to a coolant or oil passage, or externally.

Coolant or oil seal leakage failures occur when oil or coolant escapes between cylinder head and gasket body, or between cylinder block and gasket body. The oil or coolant may leak to an adjacent coolant or oil passage, or externally. Since oil and coolant passages are primarily on right hand (camshaft) side of engine, fluid leaks are most likely to occur in that area.

Follow these diagnostic procedures when a head gasket joint failure occurs, or is suspected.

1. Before starting of disassembling engine, conduct a visual inspection of vehicle, and note any of the following:
 - Oil or coolant in head gasket seam, or on adjacent surfaces. Especially right rear corner of gasket joint.
 - Displacement of gasket from normal position.
 - Discoloration from combustion gas leakage.
 - Leaking radiator, overflow tank, or hoses.
 - Leaking coolant from coolant pump weep hole.
 - Damaged or incorrect radiator, fan, or shroud.
 - Obstructed air flow or coolant flow.
 - Worn or slipping belts.
 - Damaged or incorrect pressure cap.
 - Presence of oil in coolant.
 - Low coolant levels.
 - Improper coolant.
 - Unusually high or low oil levels.
 - Oil degradation, dilution, or contamination.
 - Unburned fuel or coolant in exhaust system.



- A—Combustion Sealing Areas
 B—Oil Sealing Areas (Push Rod)
 C—Coolant Sealing Areas
 D—Cylinder Head Cap Screws

RG6449 -UN-26NOV97

2. Obtain coolant and oil samples for further analysis.
3. Start and warm up engine if it can be safely operated. Examine all potential leakage areas again as outlined previously. Using appropriate test and measurement equipment, check for the following:
 - Excessive raw fuel, or moisture in exhaust system.
 - Rough, irregular exhaust sound, or misfiring.
 - Air bubbles, gas entrapment in radiator or overflow tank.
 - Loss of coolant from overflow.
 - Excessive cooling system pressure.
 - Coolant overheating.
 - Low coolant flow.
4. Shut engine down. Recheck crankcase, radiator, and overflow tank for any significant differences in fluid levels, viscosity, or appearance.
5. Compare your observations from above steps with the following diagnostic charts. If diagnostic evaluations and observations provide conclusive evidence of combustion gas, coolant, or oil leakage from head gasket joint, the cylinder head must be removed for inspection and repair of gasket joint components.

Combustion Seal Leakage

Symptoms:

- Exhaust from head gasket crevice
- Air bubbles in radiator/overflow tank
- Coolant discharge from overflow tube
- Engine overheating
- Power loss
- Engine runs rough
- White exhaust smoke
- Gasket section dislodged, missing (blown)
- Coolant in cylinder
- Coolant in crankcase oil
- Low coolant level

Possible Causes:

- Insufficient liner standout
- Excessive liner standout differential between cylinders

- Low head bolt clamping loads
- Rough/damaged liner flange surface
- Cracked/deformed gasket combustion flange
- Out-of-flat/damaged/rough cylinder head surface
- Missing/mislocated gasket fire ring
- Block cracked in liner support area
- Hydraulic or mechanical disturbance of combustion seal

NOTE: Cracked cylinder head or liners may also allow combustion gas leakage into coolant.

Coolant Seal Leakage

Symptoms:

- Coolant discharge from head gasket crevice
- Coolant in crankcase oil
- Low coolant level
- High oil level
- Coolant discharge from crankcase vent

Possible Causes:

- Excessive liner standout
- Excessive liner standout differential between cylinders
- Low head bolt clamping loads
- Out-of-flat/damaged/rough block surface
- Out-of-flat/damaged/rough cylinder head surface
- Oil or coolant overheating
- Cracks/creases in gasket body surfaces
- Damaged/voids in elastomer beading

NOTE: Cracked cylinder head, liners, liner packings, defective oil cooler or aftercooler may also allow coolant leakage into crankcase.

Oil Seal Leakage

Symptoms:

- Oil discharge from head gasket crevice
- Oil in coolant
- Low crankcase oil level
- Reduced oil to rocker arms (noisy)

Possible Causes:

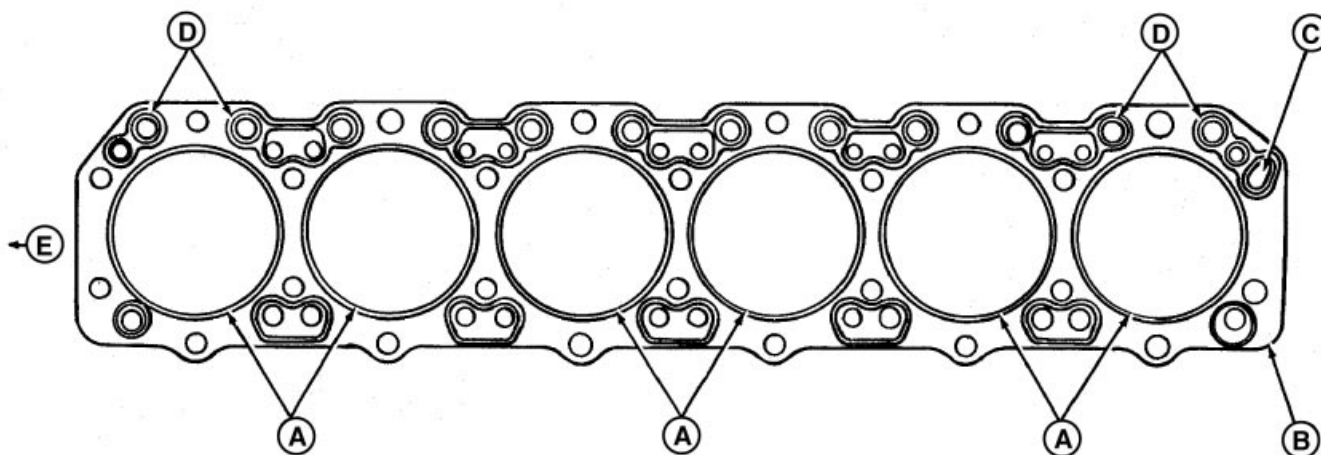
- Excessive liner standout

- Excessive liner standout differential between cylinders
- Low head bolt clamping loads
- Out-of-flat/damaged/rough block surface
- Out-of-flat/damaged/rough cylinder head surface
- Oil or coolant overheating
- Cracks/creases in gasket body surfaces
- Damage/voids in elastomer beading
- Damaged/missing O-ring seal at oil port to rocker arms

NOTE: Defective oil cooler may also allow oil leakage into coolant.

RG41221,0000040 -19-08JUL03-4/4

Head Gasket Inspection and Repair Sequence



RG6448 -UN-26NOV97

A—Combustion Seals
(Flanges)

B—Gasket Body
C—Rocker Arm Oil Port

D—Elastomer Beading Strips

E—Front of Engine

NOTE: The drawing for Head Gasket Inspection and Repair Sequence represent a 6081 CNG engine.

The following inspection procedures are recommended whenever a head gasket joint failure occurs, or when joint disassembly takes place.

1. Review historical data relating to machine operation, maintenance and repair, along with diagnostic observations. Note all areas requiring further inspection and analysis.
2. Remove rocker arm cover and check for presence of coolant in the oil.
3. Record head cap screws torques prior to removal. Upon removal, check cap screw length differences.
4. Remove cylinder head using appropriate lifting devices to prevent handling damage to head gasket. See REMOVE CYLINDER HEAD in Group 05 of CTM87 for 6081 CNG engines.
5. Observe surfaces of removed head gasket.
6. Examine combustion seals (A) for the following:
 - Flange severed/expanded/cracked/deformed.
 - Adjacent body area burned/eroded.
 - Fire ring severed/displaced/missing.
 - Flange sealing pattern eccentric/contains voids.
 - Discoloration of flange and adjacent body areas.
 - Flange surfaces rough/abraded/channelled.
7. Examine gasket body (B) for the following:
 - Combustion gas erosion paths or soot deposits originating at combustion seals.
 - Extreme discoloration/hardening/embrittlement in localized areas.
 - O-ring seal missing/damaged in port area (C).
 - Elastomer missing/damaged in port areas (D).
 - Oil or coolant paths from port areas.
 - Localized areas of low compression.
6. Before cleaning components, inspect head, block, and liners for evidence of combustion gas and fluid leakage. Inspect cylinder and valve ports for unusual deposits.
7. Clean block, head, liners, and cap screws. (See INSPECT AND CLEAN CYLINDER HEAD in Group 05 of CTM87 for 6081 CNG engines.)

Continued on next page

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8. Proceed with the following dimensional checks and visual inspections:

- Cylinder Head (See INSPECT AND CLEAN CYLINDER HEAD in Group 05 of CTM87 for 6081 CNG engines.)
 - Check surface flatness/finish.
 - Inspect for surface damage.
 - Check cylinder head thickness, if resurfacing.
- Cylinder Block and Liners (assembled and clamped) (See MEASURE CYLINDER LINER STANDOUT (HEIGHT ABOVE BLOCK) in Group 10 in CTM87 for 6081 CNG engines.)
 - Check liner standout at four places on each liner.
 - Check liner standout difference between cylinders.
- Cylinder Block (See INSPECT AND CLEAN CYLINDER BLOCK in Group 10 of CTM87 for 6081 CNG engines.)
 - Check surface flatness/finish.
 - Inspect for surface damage.
 - Check liner counterbore depth (if liner is removed).
 - Check top deck to crankshaft centerline dimension.

- Inspect cap screw bosses, must be clean/intact.

- Cylinder Liner (See VISUALLY INSPECT CYLINDER LINERS in Group 10 of CTM87 for 6081 CNG engines.)
 - Check liner flange flatness/finish.
 - Check liner flange thickness (if liner is removed).
 - Inspect flange for damage.
- Cylinder Head Cap Screws (See CTM87 for 6081 CNG engines.)
 - Inspect for corrosion damage.
 - Inspect condition of threads.
 - Inspect for straitness.
 - Check length.

9. When inspections and measurements have been completed, determine most probable causes of joint failure. Make all necessary repairs to joint components and cooling system.

10. Reassemble the engine according to procedures and specifications in COMPLETE FINAL ASSEMBLY of Group 10 and other Groups of CTM87 for 6081 CNG engines or in COMPLETE FINAL ASSEMBLY of Group 10 and other Groups of CTM146 for 6068 CNG engines.

RG41221,0000041 –19–14SEP01–2/2

Diagnosing Lubrication System Malfunctions

Symptom	Problem	Solution
Engine Oil Pressure Low	Low crankcase oil level	Fill crankcase to proper level.
	Incorrect oil	Drain crankcase and refill with proper grade and viscosity oil. See NATURAL GAS ENGINE OIL in Group 02 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).
	Plugged oil filter	Change oil and filter.
	Excessive Oil Temperature	Remove and inspect engine oil cooler. See REMOVE, INSPECT, AND INSTALL ENGINE OIL COOLER in Group 20 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).
	Faulty oil pressure regulating valve	Remove and inspect oil pressure regulating valve. See REMOVE, INSPECT, AND INSTALL OIL PRESSURE REGULATING VALVE, OIL FILTER BYPASS VALVE, AND OIL COOLER BYPASS VALVE in Group 20 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).
	Excessive main or connecting rod bearing clearance	Determine bearing clearance. See CHECK MAIN BEARING OIL CLEARANCE in Group 15 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).
	Plugged oil pump screen	Remove oil pan and clean screen. See REMOVE AND INSTALL ENGINE OIL PAN in Group 20 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).
	Faulty or missing piston cooling orifice	Check piston cooling orifice.

Continued on next page

RG41221,0000042 -19-14SEP01-1/2

Symptom	Problem	Solution
Engine Oil Pressure High	Incorrect oil	Drain crankcase and refill with proper grade and viscosity oil. See NATURAL GAS ENGINE OIL in Group 02 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).
	Plugged oil line(s)	Remove and replace plugged line(s).
	Plugged oil filter	Remove and replace oil filter.
	Faulty oil pressure regulating valve	Remove and inspect oil pressure regulating valve. See REMOVE, INSPECT, AND INSTALL OIL PRESSURE REGULATING VALVE, OIL FILTER BYPASS VALVE, AND OIL COOLER BYPASS VALVE in Group 20 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).
Oil Sludge and Dilution		
• Improper operation and servicing. • Coolant leakage into lubrication system. • Incomplete combustion. • Excessive oil consumption.		
Low Oil Pressure at Slow Idle		
• Bypass oil check valve failure.		

RG41221_0000042 -19-14SEP01-2/2

Diagnosing Cooling System Malfunctions

Symptom	Problem	Solution
Engine Coolant Temperature Above Normal	Low coolant level	Add coolant to proper level.
	Dirty or plugged radiator	Drain and flush radiator.
	Engine Overload	Reduce engine load.
	Loose or faulty fan belt	Replace or tighten fan belt as needed.
	Faulty Thermostat	Test thermostat opening temperature. See REMOVE AND TEST THERMOSTATS in Group 25 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).
	Faulty Coolant Pump	Remove and inspect coolant pump. See REMOVE COOLANT PUMP ASSEMBLY and VISUALLY INSPECT COOLANT PUMP in Group 25 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).
	Defective head gasket	Inspect/replace head gasket. See HEAD GASKET INSPECTION AND REPAIR SEQUENCE in Group 105 earlier in this manual.
Low Coolant Level	Corroded coolant passages	Clean or replace passages as necessary.
	Improper maintenance	Service regularly.
	Improper operation	Use correct vehicle for correct application.
	Damaged radiator	Repair or replace radiator.
	Coolant pump leakage	Seal ring or pump shaft worn.
	Faulty radiator cap	Replace radiator cap.

Test Engine Compression Pressure

IMPORTANT: Compression pressures are affected by the cranking speed of the engine. Before beginning test, insure that batteries are fully charged and spark plug area is thoroughly cleaned.

1. Start engine and run at rated speed until engine is running at normal operating temperature. (From a cold start, operate engine 10-15 minutes.)
2. Disconnect the 2-way electrical connection to the low-pressure lock-off solenoid (B).
3. Clean all dirt and debris from around the spark plugs.
4. Remove all spark plugs. See REMOVE AND INSTALL SPARK PLUGS in Group 45 of 6081 Compressed Natural Gas Engines - Repair (CTM87).

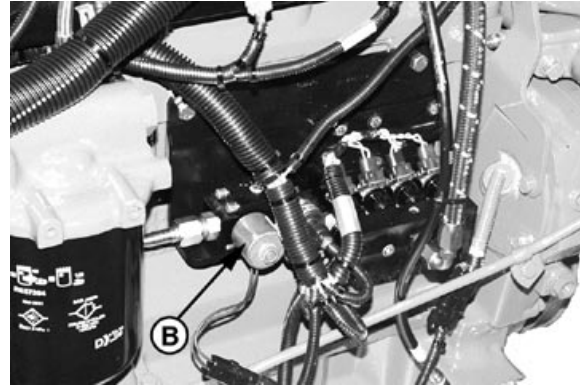
IMPORTANT: Inspect O-ring on JDG814 Compression Test Adapter (C) before measuring compression on each cylinder. Replace O-ring as needed.

5. Install JDG814 Compression Test Adapter (C) into the spark plug bore and tighten to specification.

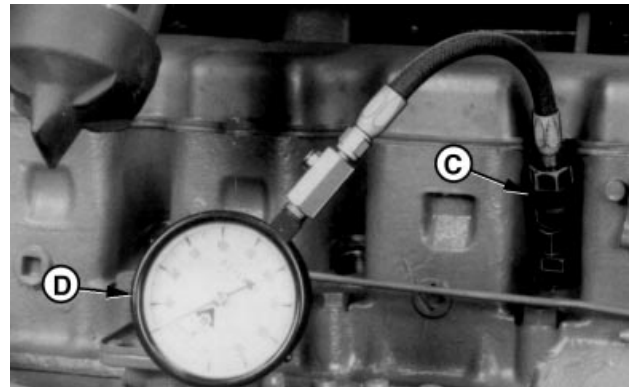
Specification

Compression Test Adapter—
Torque 7 N•m (5 lb-ft)

6. Connect JT01682 Gauge and Hose Assembly (D) to adapter.
7. Disconnect ECU connector #3 (white A-K).
8. Remove the Electronic Throttle. See REMOVE AND INSTALL ELECTRONIC THROTTLE AND THROTTLE POSITION SENSOR in Group 45 of 6081 Compressed Natural Gas Engines - Repair (CTM87).
9. Crank engine over at 275-325 rpm cranking speed and record compression readings.



RG12544B -UN-24JUL02



RG11221 -UN-25AUG00

B—Low Pressure Lock-Off Solenoid
C—Compression Test Adapter
D—Gauge and Hose Assembly

Continued on next page

RG41221,0000044 -19-14SEP01-1/2

Specification

Compression Pressure (Wide
Open Throttle)—6081 CNG
(10.5:1 C/R)..... 155–185 psig (1070–1275 kPa)
(10.7–13.0 bar)

NOTE: Specified pressure was taken at 183 m (600 ft) above sea level. A 3.6 percent reduction in gauge pressure will result for each additional 300 m (1000 ft) rise in altitude.

10. If pressure is much lower than shown, remove gauge and apply oil to ring area of piston through spark plug bore. Do not use too much oil and do not get oil on the valves.

11. Crank engine over and record compression readings again.

If pressure is higher than 185 psig (1275 kPa) (13.0 bar), worn or stuck rings are indicated. Either replace piston rings or install new piston and liner sets as needed. Refer to CTM87 for 6081 CNG engines.

If pressure is below 155 psig (1070 kPa) (10.7 bar), it is possible that valves are worn or sticking. Recondition cylinder as needed. Refer to CTM87 for 6081 CNG engines.

12. Measure compression pressure in all remaining cylinders and compare readings. Recondition cylinders and valves, or replace rings and liners, as required.

RG41221,0000044 –19–14SEP01–2/2

Check Engine Oil Pressure

1. Check engine crankcase oil level. Adjust if necessary.
2. Check overall condition of oil (viscosity, presence of coolant, ect.). Change engine oil and replace oil filter if necessary.
3. Remove pipe plug from main oil galley using JDG782 Oil Galley Plug Tool.
4. Install No. 0070 (D1) Fitting, No. 2106 (19-HP) Hose, and JT05472¹ Gauge (or equivalent).

IMPORTANT: To achieve an accurate oil pressure reading, warm up engine to 105°C (220°F).

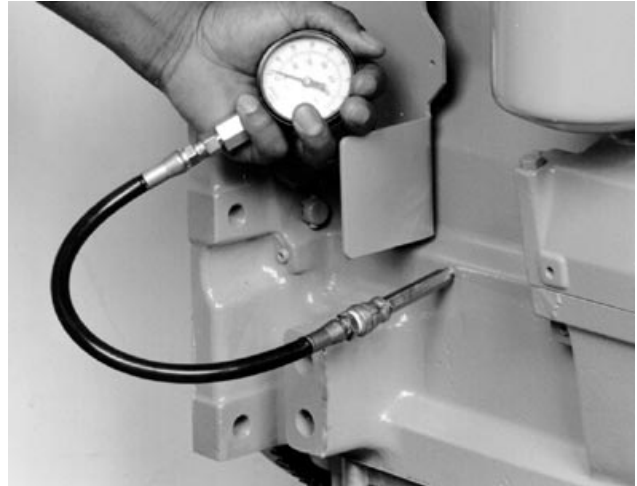
5. Start engine, run at speeds given below, measure oil pressure, and compare readings.

Specification

Minimum No Load at 750 rpm
(Idle)—Pressure..... 20 psig (140 kPa) (1.4 bar)
Maximum Full Load at 2200 rpm
(Rated Speed)—Pressure 58 psig (400 kPa) (4.0 bar)

6. If engine oil pressure is outside of the specification, see DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS earlier in this Group.

NOTE: The oil pressure regulating valve is designed so that adjustment of oil pressure should not be required.



RG7067 -JUN-20AUG98

¹Part of JT05470 (D15027NU) Universal Pressure Test Kit

Starting and Charging System Handling Precautions



CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded (-) battery clamp first and replace it last.



TS204 -JUN-23AUG88

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RG41221,0000010 -19-14SEP01-1/1

Starting and Charging System Diagnostics

Symptom	Problem	Solution
Low Battery Charge	Excessive engine idling	Idle engine only when necessary.
	Lights or accessories left on	Be sure all electrical switches are off before leaving vehicle.
	Continuous drain on battery	Check for current leakage on dirty battery top.
		Check for excessive parasitic drain on the battery by measuring current draw with ignition and all accessories off. If excessive draw is measured, remove fuses in fuse panel one at a time until circuit with excessive draw is located.
		See "Low Charging System Voltage Output" below.
Low Charging System Voltage Output	Faulty charging system output	Replace battery.
	Defective battery	Replace battery.
	Slipping drive belt	Adjust belt tension.
	Faulty voltage regulator	Replace voltage regulator.
	Defective diodes	Replace diodes.
	Defective electrical windings in alternator	Repair or replace alternator windings.
High Charging System Voltage Output	Excessively worn or sticking brushes	Repair or replace alternator brushes.
	Faulty voltage regulator	Replace voltage regulator.

Continued on next page

RG41221,0000011 -19-14SEP01-1/2

Symptom	Problem	Solution
Noisy Alternator	Defective or badly worn drive belt.	Replace drive belt.
	Worn or defective bearings	Replace alternator bearings.
	Loose mounting or loose pulley drive	Tighten mounting and pulley.
	Misaligned drive belt or pulley	Check pulley condition, align if necessary.
Sluggish Starter Operation	Low battery charge	Recharge battery. If battery does not respond to charging, install a new one.
	Dirty battery cable connection(s)	Inspect all battery cable connections, and clean if necessary.
	Defective starter	Replace starter.
	Extremely cold weather	Warm-up battery before starting engine.
	Too-high engine oil viscosity	Drain oil and replace with recommended viscosity oil.
Starter Will Not Operate	Low battery charge	Recharge battery. If battery does not respond to charging, install a new one.
	Defective or nonfunctional neutral safety switch	Repair problem with neutral safety switch.
	Dirty battery cable connection(s)	Inspect all battery cable connections, and clean if necessary.
	Defective starter solenoid	Replace solenoid.
	Faulty starter	Repair or replace starter.
	Defective start circuit	Check wiring, fuses, and relays.

RG41221,0000011 -19-14SEP01-2/2

Electrical Concepts

Tests will include making measurements of voltage and resistance and making checks for open circuits and short circuits. An understanding of the following concepts is required to use the diagnostic procedures:

- Voltage (volts):
- Current (amps):
- Resistance (ohms):
- Open Circuit:
- Short Circuit:

RG41221,0000012 -19-14SEP01-1/1

Using a Multimeter

It is recommended that a digital multimeter (JT07306 or equivalent with an analog display) be used to make the required measurements in the diagnostic procedures. A knowledge of the operation of the particular meter used is assumed.

Instructions for measuring voltages take the following form:

- Measure voltage from Point A (+) to Point (B) (-)

In this example, the positive test lead from the volt-ohm input of the meter should be connected to Point A and the negative test lead from the common input of the meter should be connected to Point B.

Unless otherwise stated, all voltage measurements are direct current (D.C.).

In making a resistance measurement, be careful to use the correct resistance range on the meter. Disconnect appropriate connectors or turn off key switch, as directed by diagnostic procedures later in this group.

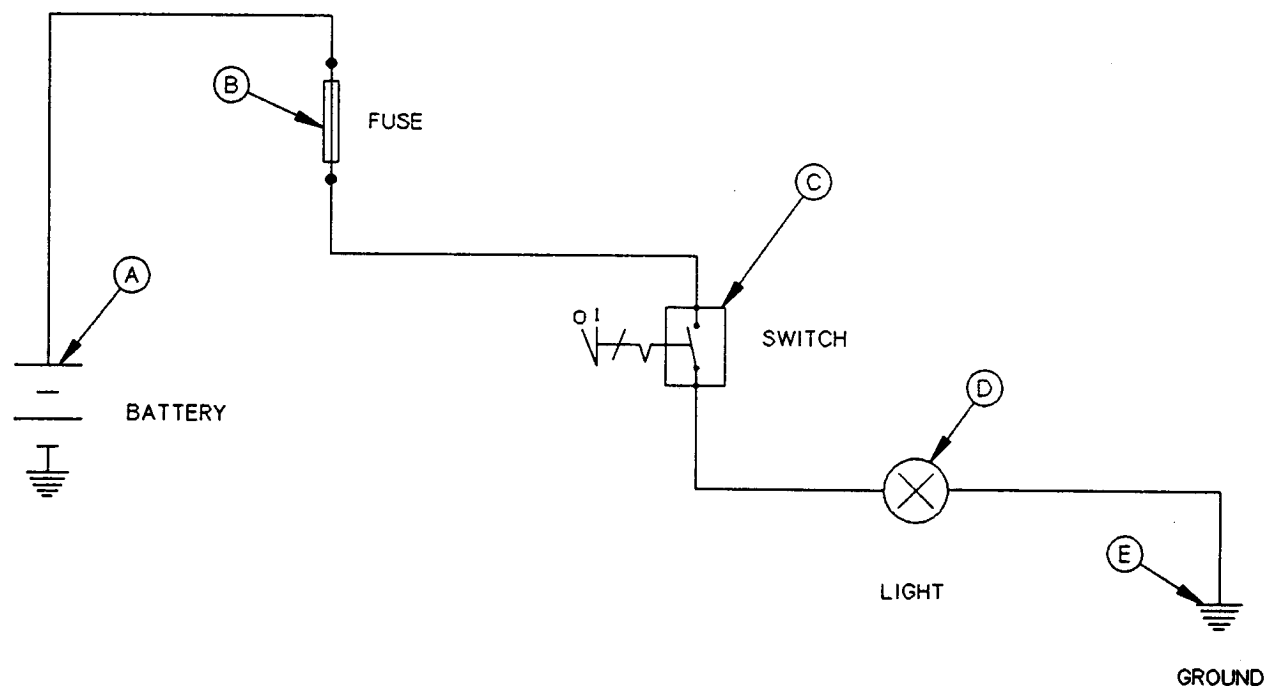


Digital Multimeter

RG11126 -UN-19JUN00

RG41221,000003D -19-14SEP01-1/1

Electrical System Basic Information



T7713AD (CV)

A—Battery
B—Fuse

C—Switch

D—Light

E—Ground

Electrical Circuit Malfunctions

1. There are four common circuit malfunctions

- High-Resistance Circuit
- Open Circuit
- Grounded Circuit
- Shorted Circuit

2. Three sections in a simple circuit where these malfunctions can occur;

- Before the controlling switch (C).
- Between the controlling switch and before the component, light (D).

- After the component.

Component malfunctions can easily be confused with circuit malfunctions. Therefore, care must be exercised when isolating the cause of the problem.

Example: Light does not operate or is dim when switch is turned ON, until switch connector is disconnected and reconnected.

Reason: High resistance caused by a dirty switch connector, caused a voltage drop which prevented the proper amount of current from flowing to the light.

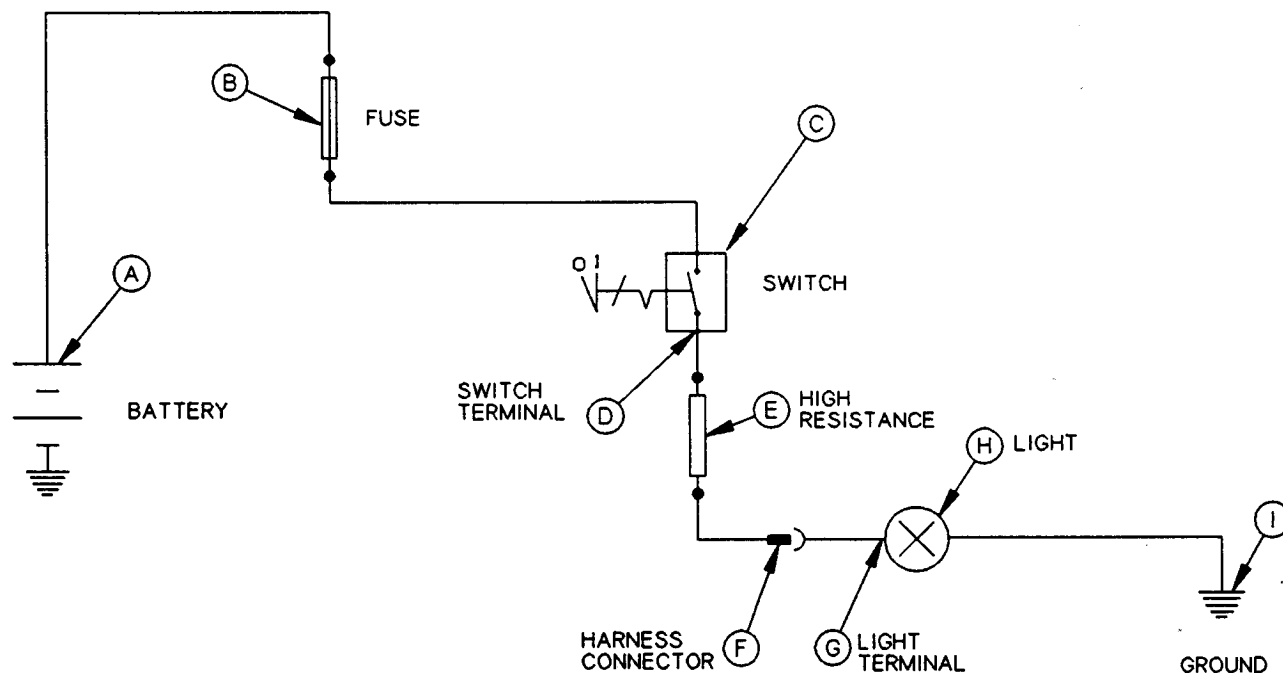
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NOTE: For accurate resistance readings, touch the two probes together while noting the measurement. Subtract this value from all resistance values measured.

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High Resistance Circuit



T7713AG (CV)

A—Battery
B—Fuse
C—Switch

D—Switch Terminal High
Resistance

F—Harness Connector
G—Light Terminal

H—Light
I—Ground

A high resistance circuit can result in slow, dim or no component operation.

Examples: Loose, corroded, dirty or oily terminals.
Wire size too small. Strands broken inside the wire.
Poor ground connection to frame.

To locate the cause of high resistance.

With switch (C) ON, check for battery voltage between switch and ground (I) at an easily accessible location, like harness connector (F).

If less than battery voltage is measured, check again closer to switch.

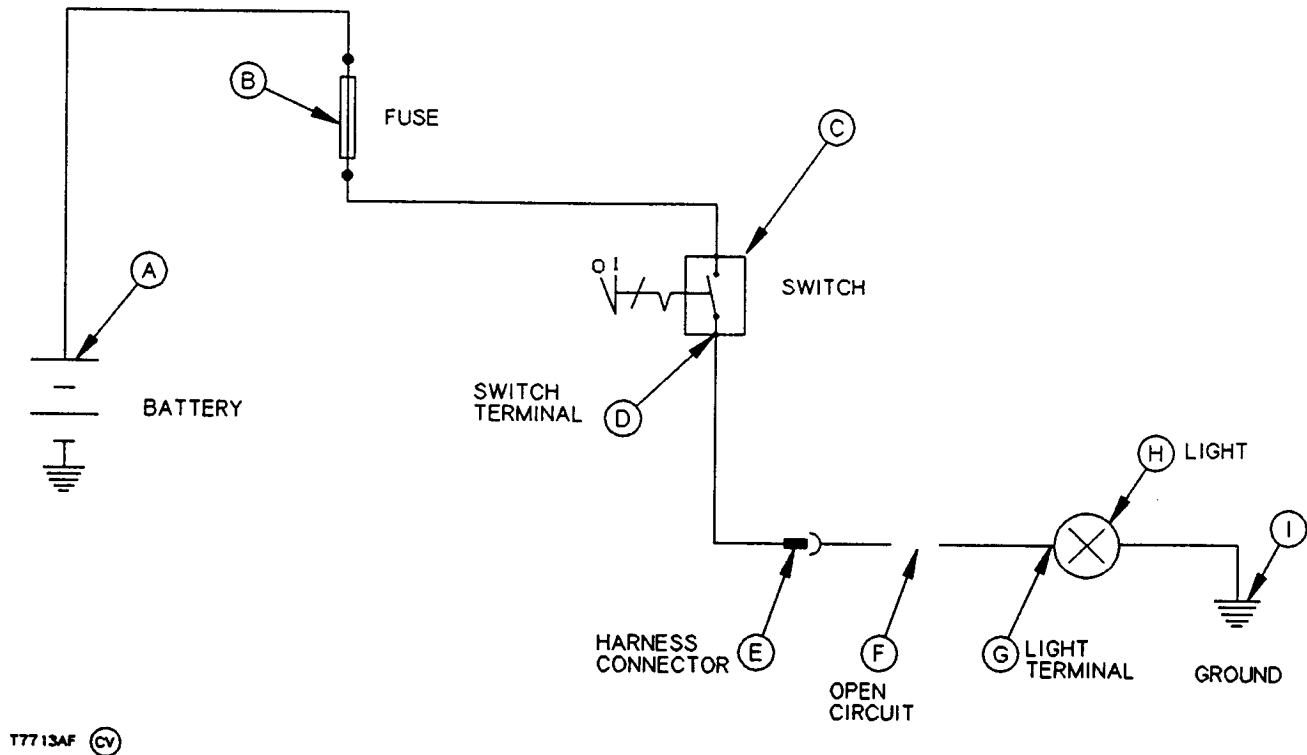
If battery voltage is measured, check closer to ground to locate point of voltage drop. The example shows high resistance (E) between switch and harness connector.

Repair circuit as required. In the example, strands were broken inside the wire, replace that section of wire.

Repeat check-out procedure after repair.

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Open Circuit



A—Battery
B—Fuse
C—Switch

D—Switch Terminal
E—Harness Connector

F—Open Circuit
G—Light Terminal

H—Light
I—Ground

An open circuit will result in no components operating. Fuse may or may not be blown.

Example: Broken wire, disconnected component terminal, pins inside a connector not making contact, blown fuse, open circuit breaker, failed switch or component, or a disconnected ground wire.

To locate a open circuit:

Check fuse. If blown, replace and operate circuit. If fuse blows a second time, continue check.

With switch (C) ON, check for battery voltage at switch terminal (D).

If no voltage is measured, check switch, fuse, and wiring to battery.

If battery voltage is measured, check for voltage closer to ground at harness connector (E).

If no voltage is measured, wire may be broken between switch and connector.

If battery voltage is measured, inspect connector pins. If pins are OK check for voltage at light terminal (G).

In the example, zero voltage will be measured at light terminal, indicating a broken wire between harness connector and light terminal.

If battery voltage had been measured, the next check for voltage would be at ground connection (I).

Normal measured voltage at a ground connection should be 0.0 to 0.5 volts.

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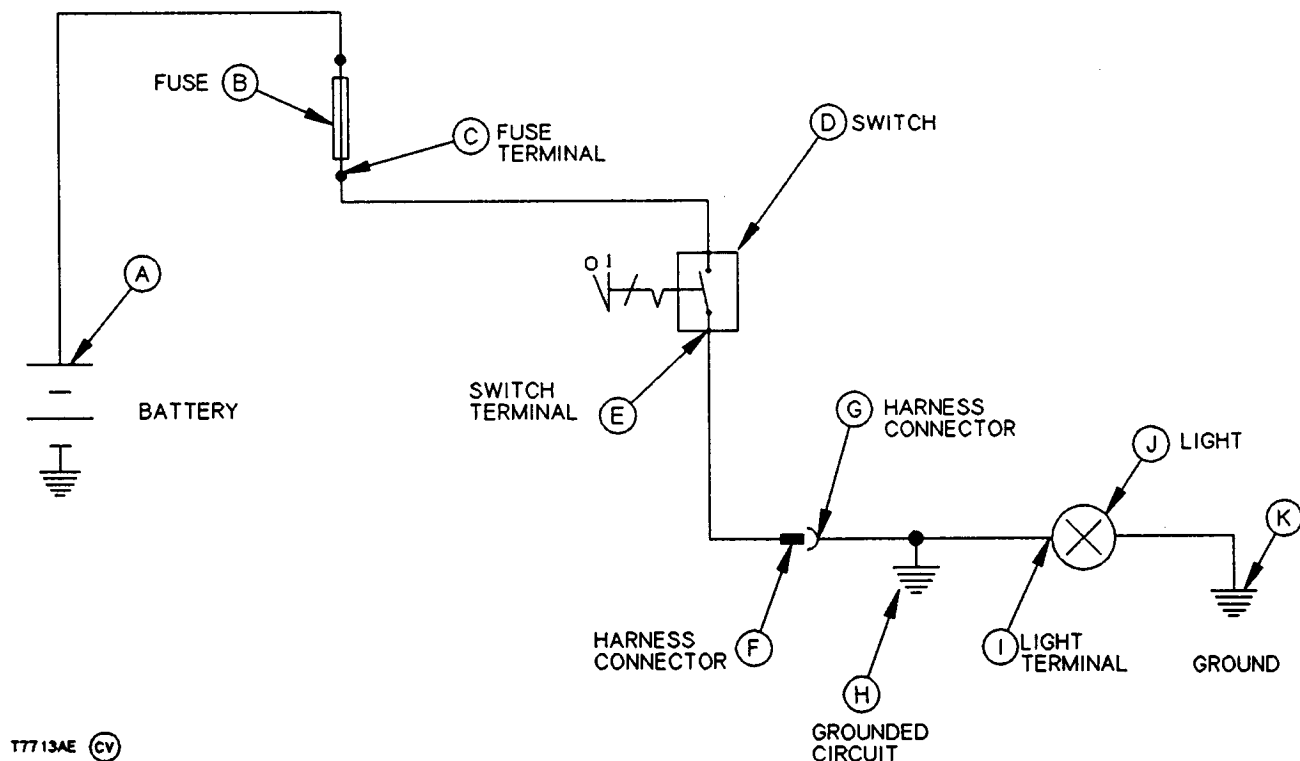
RG41221,000004A -19-14SEP01-1/2

If battery voltage is measured, poor connection to frame or broken wire is indicated.

When problem is located, repair as needed then repeat last check.

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Grounded Circuit

T7713AE (CV)

T7713AE -19-27FEB92

A—Battery
B—Fuse
C—Fuse Terminal

D—Switch
E—Switch Terminal
F—Harness Connector

G—Harness Connector
H—Grounded Circuit
I—Light Terminal

J—Light
K—Ground

If no component operates, the fuse is blown and replacement fuses blow immediately or the circuit breaker is open and reopens when reset, a grounded circuit exists. (Example: power wire contacting frame or other metal component). A wire may be pinched or insulation may be worn from a wire.

To isolate the location of a grounded circuit:

If circuit is grounded between battery and fuse, wire will be burned and circuit will be open, fuse will not be blown.

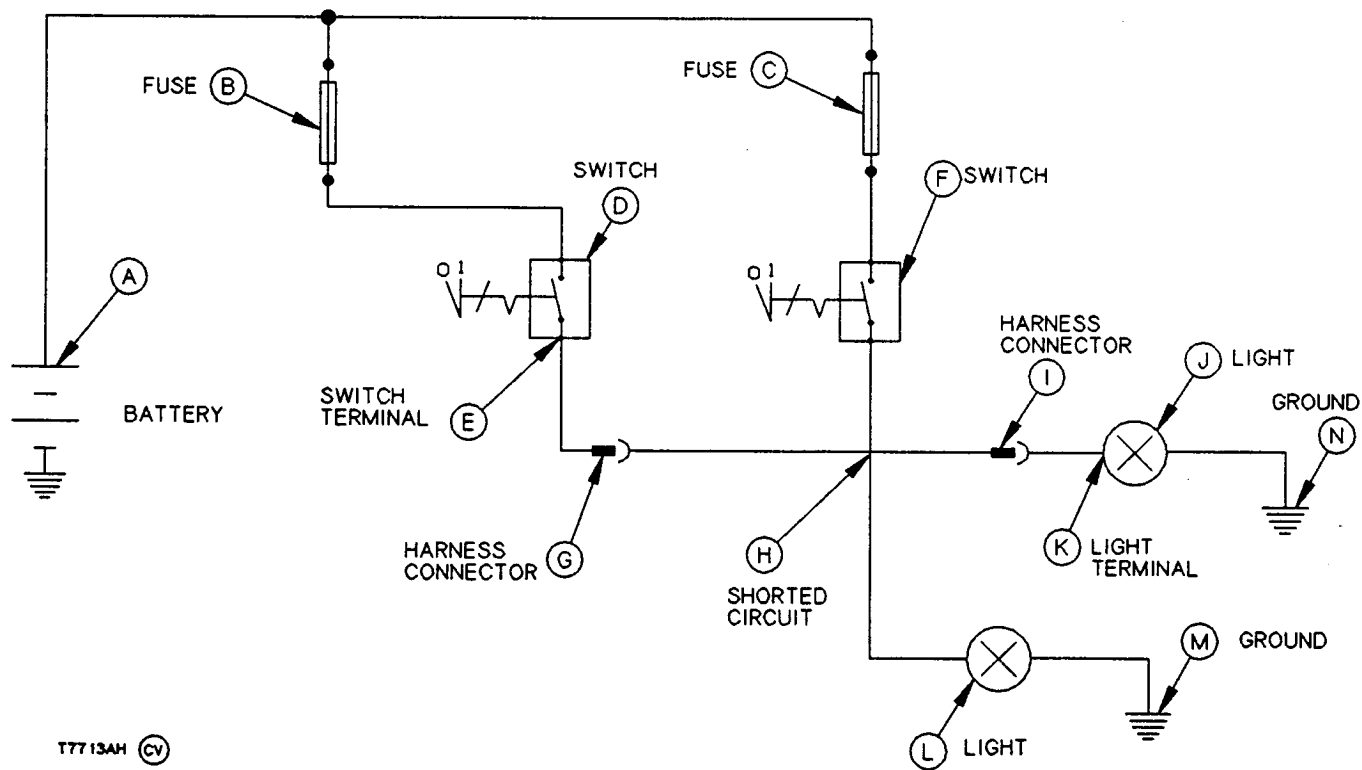
If fuse is blown, remove fuse from circuit, disconnect circuit near its center, such as harness connector (F), turn switch (D) ON, check for continuity to ground at harness connector (F). This will check harness from harness connector to fuse.

If continuity to ground is measured, there is a pinched or bare wire between fuse (B) and harness connector (F).

If continuity to ground does not exist, disconnect ground (K) from frame. Measure continuity to ground at harness connector (G). This checks harness from harness connector to ground terminal. In the example continuity to ground will exist because circuit is grounded (wire is pinched) at (H).

If continuity exists, disconnect circuit at light terminal (I) and measure continuity to ground on light terminal. This checks harness from light to ground terminal. In the example continuity will not exist, indicating a grounded circuit between the light and harness connector (G). Repeat check-out procedure after repair.

Shorted Circuit



A—Battery
B—Fuse
C—Fuse
D—Switch

E—Switch Terminal
F—Switch
G—Harness Connector
H—Shorted Circuit

I—Harness Connector
J—Light
K—Light Terminal

L—Light
M—Ground
N—Ground

A shorted circuit causes components in separate circuits to operate when a switch in either circuit is turned ON. (Example: two harnesses rubbing together until insulation is worn through allowing bare wires to touch). Components can also become shorted. However, shorted components will usually blow the fuse.

To locate a shorted circuit:

Turn switch (F) ON then OFF, turn switch (D) ON then OFF, both lights (J and L) will be ON when either switch (D or F) is ON.

Turn switch (F) ON. Both lights (J and L) will be ON, only light (L) should be ON.

Disconnect wire from switch component that should not be ON. In the example, disconnect wire from terminal (E) at switch (D). Light (J) remains ON.

Disconnect circuit at convenient places like harness connectors (G, I) and light terminal (K) until light (J) goes OFF.

The shorted circuit will be between the last two places the circuit was disconnected. In the example, it is between harness connectors (G and I). Light (J) will go OFF when harness connector (I) is disconnected. Inspect harness between connectors (G and I).

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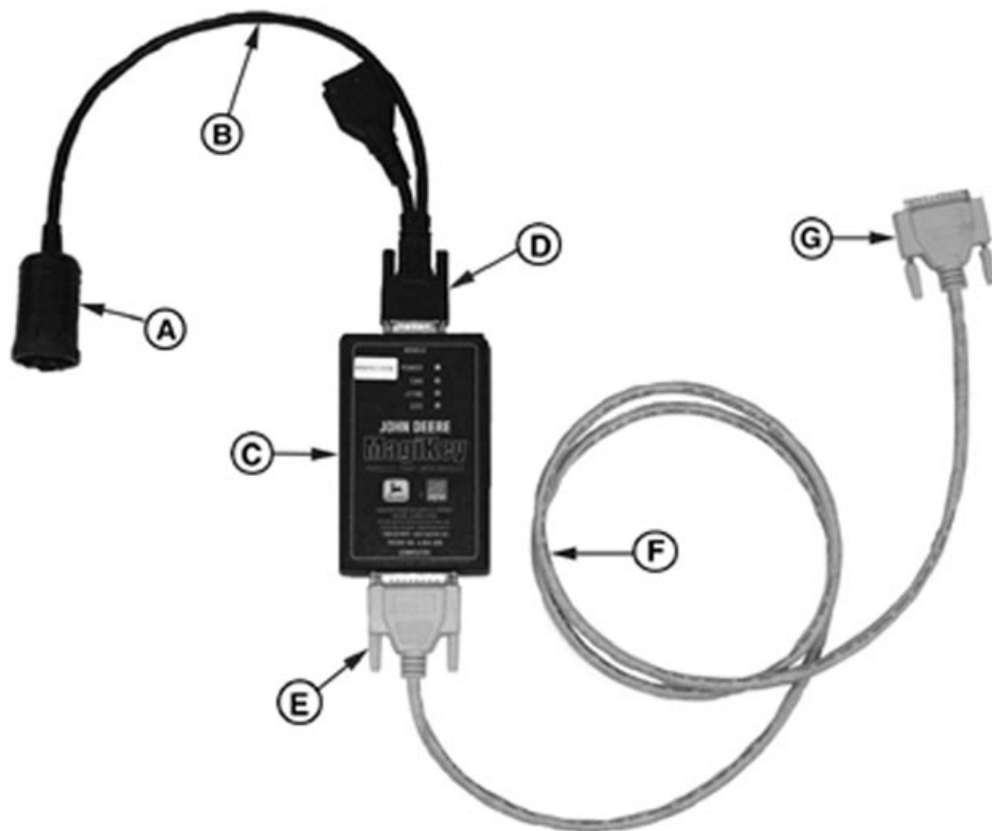
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Repair or replace wires and harnesses as needed.
Install tie bands and clamps on harnesses as required
to prevent future failures.

Repeat check-out procedure after repair.

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Connecting to Diagnostic Scan Tool (DST) or SERVICE ADVISOR™

RG11737A -UN-18MAY01

Connecting to the DST or SERVICE ADVISOR™

A—Diagnostic Connector Mate C—MagiKey E—25 Pin MagiKey Connector G—PC Connector
 B—John Deere Controller Cable D—26 Pin MagiKey Connector F—PC Cable

DS10023 ECU Communication Hardware Kit or JDIS121 - ECU Communication Hardware Kit is required to connect the DST or SERVICE ADVISOR™ to the ECU. Please refer to your John Deere Dealer website for obtaining the latest version of software and information on the hardware kit.

The diagnostic connector is a black, circular connector with a square mounting flange and a dust cap. There are nine available pins. Depending on application, the location of the diagnostic connector may vary. See the application/vehicle manual for exact location.

1. Locate diagnostic connector and remove dust cap.

2. Connect John Deere Controller Cable (B) to the diagnostic connector on the engine harness using the diagnostic connector mate (A).
3. Connect the other end of the John Deere Controller Cable (B) to the MagiKey (C) module at the 26 pin MagiKey connector (D).
4. Connect the PC cable (F) to the MagiKey (C) module at the 25 pin MagiKey connector (E).
5. Connect the PC cable (F) to the computer with the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™ installed through the PC connector (G).
6. Key ON, engine off or running, verify that power light on MagiKey is illuminated green.

7. Start the diagnostic software and select the appropriate application.
8. Connect to the application. The CAN light on the MagiKey should illuminate red when the connection to the ECU is made.
9. If DST or SERVICE ADVISOR™ does not connect see D1 - ECU DOES NOT COMMUNICATE WITH

- DST OR SERVICE ADVISOR™ DIAGNOSTIC PROCEDURE in Group 150 of this manual.
10. Replace the dust cap on the diagnostic connector when finished.

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Data Parameter Description

Following is a list of the data parameters that can be read on the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™. The DST consists of a Windows ('95 or '98 or 2000) or NT compatible computer and the associated hardware. Included in the list below is a brief description of each parameter, the range of possible readings, and each parameter's unit of measurement.

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Continued on next page

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Parameter	Units	Description
A/C Status	N/A ^a	Displays the active status if the air conditioning unit.
Active Foot Pedal Control	N/A ^a	The foot pedal that is currently selected to operate the vehicle on applications that use more than one foot pedal.
Adaptive Learn Multiplier	%	Adaptive learn multiplier is a correction to the fuel delivery which is expressed as a percentage (%) and stored in the ECU's memory.
Barometric Air Pressure	psia (kPa)	The pressure of the air outside.
Barometric Air Pressure Input Voltage	volts	The voltage coming from the Barometric Air Pressure sensor to the ECU. This voltage represents a specific pressure that the ECU will use and display.
Battery Voltage	volts	Switched battery voltage may vary depending on application.
Brake Switch Status	N/A ^a	This tells the ECU if the brake switch is ON or OFF.
Camshaft Improper Pattern Indicator	%	A "0" reading means that there is NO improper pattern. Between 0—100, the camshaft pattern becomes progressively more improper. When 100 is reached, a trouble code is thrown.
Camshaft Position Input Noise Indicator	%	A "0" reading means that there is NO noise. Between 0—100, camshaft noise becomes progressively worse. When 100 is reached, a trouble code is thrown.
Camshaft Position Sensor Speed	rpm	The speed of the camshaft timing wheel.
Camshaft Position Status	N/A ^a	When status is 15, the ECU is receiving ALL of the signal. When the status is below 15, it means that the ECU is not receiving all of the signal.
Closed Loop Multiplier	%	The closed loop multiplier is a fast acting adjustment to the fuel delivery based on feedback from the UEGO. The closed loop multiplier is expressed as a percentage (%) and is not stored in the ECU's memory.
Control Mode	N/A ^a	State the engine is running in, closed loop or open loop.
Crankshaft Position Improper Pattern Indicator	%	A "0" reading means that there is NO improper pattern. Between 0—100, the crank pattern becomes progressively more improper. When 100 is reached, a trouble code is thrown.
Crankshaft Position Input Noise Indicator	%	A "0" reading means that there is NO noise. Between 0—100, crank noise becomes progressively worse. When 100 is reached, a trouble code is thrown.
Crankshaft Position Sensor Speed	rpm	The speed of the oil pump drive gear.
Crankshaft Position Status	N/A ^a	When status is 15, the ECU is receiving ALL of the signal. When the status is below 15, it means that the ECU is not receiving all of the signal.
Cruise Accelerate Switch	N/A ^a	The cruise accelerate function has been activated. This should increase the speed at which cruise is set.
Cruise Brake Switch	N/A ^a	The cruise brake function has been activated. This will cancel the cruise when the brake is applied until operator resumes operation.
Cruise Clutch Switch	N/A ^a	The cruise clutch function has been activated. This will cancel the cruise when the clutch is applied until operator resumes operation.
Cruise Coast Switch	N/A ^a	The cruise coast function has been activated. This should decrease the speed at which cruise is set.
Cruise Control Active	N/A ^a	Confirms that cruise is ON/OFF depending on the operators command.
Cruise Control State	N/A ^a	Confirms that the function chosen by the operator is activated: hold, accelerate, coast, resume, set, throttle override.
Cruise Control On/Off Switch	N/A ^a	The operator has turn the cruise ON/OFF.
^a N/A = Not Applicable		

Parameter	Units	Description
Cruise Resume Switch	N/A ^a	The cruise resume function has been activated. This will reset the cruise to the speed at which cruise was at prior to using the brake or clutch.
Cruise Set Switch	N/A ^a	The cruise set function has been activated. This should lock the current engine speed in when switch is activated.
Current Throttle Source	N/A ^a	Displays the current source for controlling the throttle.
Door Interlock Switch	N/A ^a	This tells the ECU if the door is open or closed.
ECU Boot Block Part Number	N/A ^a	Part number for the Engine Control Unit (ECU) boot block.
ECU Configuration File Part Number	N/A ^a	Part number for the configuration file in the ECU.
ECU EOL Data Part Number	N/A ^a	Part number for the data programmed into the ECU at the end of the assembly line. EOL = End of Line
ECU Part Number	N/A ^a	Part number for the Engine Control Unit (ECU) hardware.
ECU Serial Number	N/A ^a	Serial number for the Engine Control Unit (ECU).
ECU Software Assembly Part Number	N/A ^a	Part number for the Engine Control Unit (ECU) software assembly.
ECU Software Part Number	N/A ^a	Part number for the Engine Control Unit (ECU) operating software.
Elevated Idle 1	N/A ^a	Displays the status of the elevated idle 1 switch. Either ON or OFF.
Elevated Idle 2	N/A ^a	Displays the status of the elevated idle 2 switch. Either ON or OFF.
Engine Coolant Temperature	°F (°C)	The temperature of the engine's coolant.
Engine Coolant Temperature Input Voltage	volts	The voltage coming from the Engine Coolant Temperature sensor to the ECU. This voltage represents a specific temperature that the ECU will use and display.
Engine Hourmeter	hr -min- sec	Total hours the ECU has run on an engine.
Engine Load at Current Speed	%	Percentage of load on the engine at a given speed.
Engine Model Number	N/A ^a	The model number for the engine.
Engine Oil Pressure	psig (kPa)	The pressure of the engine's oil.
Engine Oil Pressure Input Voltage	volts	The voltage coming from the Engine Oil Pressure sensor to the ECU. This voltage represents a specific pressure that the ECU will use and display.
Engine Oil Temperature	°F (°C)	The temperature of the engine's oil.
Engine Oil Temperature Input Voltage	volts	The voltage coming from the Engine Oil Temperature sensor to the ECU. This voltage represents a specific temperature that the ECU will use and display.
Engine Serial Number	N/A ^a	Serial number for this specific engine.
Engine Speed	rpm	The speed that the crankshaft sensor detects the oil pump drive gear is moving.
Exhaust Temperature	°F (°C)	The temperature of the engine's exhaust.
Exhaust Temperature Input Voltage	volts	The voltage coming from the Exhaust Temperature sensor to the ECU. This voltage represents a specific temperature that the ECU will use and display.
Fan Signal	%	The ECU sends a pulse width modulated signal to the fan drive to control the fan speed. 100% is the highest speed.
^a N/A = Not Applicable		

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Parameter	Units	Description
Foot Pedal Position 1 (FPP1) Voltage	volts	The voltage coming from the FPP1 sensor in the foot pedal to the ECU. This voltage represents the position of the foot pedal.
Foot Pedal Position	%	The position of the foot pedal in percent depressed.
Foot Pedal Position 2 (FPP2) Voltage	volts	The voltage coming from the FPP2 sensor in the foot pedal to the ECU. This voltage represents the position of the foot pedal.
Foot Pedal Position 3 (FPP3) Voltage	volts	The voltage coming from the FPP2 sensor in the foot pedal to the ECU. This voltage represents the position of the foot pedal.
Foot Pedal Position 4 (FPP4) Voltage	volts	The voltage coming from the FPP2 sensor in the foot pedal to the ECU. This voltage represents the position of the foot pedal.
Fuel Gauge	%	Displays the percent of fuel remaining in the fuel tank.
Fuel System Part Number	N/A ^a	The part number for the fuel system used on this engine.
Fuel System Serial Number	N/A ^a	The serial number for the fuel system used on this engine.
Governor Reference Speed	rpm	The reference to engine speed on the governor.
Humidity Input Voltage	volts	The voltage coming from the Humidity sensor to the ECU. This voltage is used to calculate specific humidity.
Inlet Air Temperature	°F (°C)	The temperature of the air entering the engine.
Inlet Air Temperature Voltage	volts	The voltage coming from the Inlet Air Temperature sensor to the ECU. This voltage represents a specific temperature.
Injector Pulse Width	ms	Rate that the ECU is pulsing the injectors.
Knock Factor	%	The amount of knock that the engine is producing under the current running condition.
Knock Supply Voltage	volts	Voltage that the ECU supplies the knock sensor.
Manifold Absolute Pressure - Actual	psia (kPa)	The actual boost pressure the engine is producing.
Manifold Absolute Pressure - Desired	psia (kPa)	The desired boost pressure the ECU is commanding the engine to produce.
Manifold Absolute Pressure Input Voltage	volts	The voltage coming from the Manifold Absolute Pressure sensor to the ECU. This voltage represents a specific pressure that the ECU will use and display.
Natural Gas Pressure	psia (kPa)	The pressure of the natural gas at the inlet of the fuel metering block.
Natural Gas Pressure Input Voltage	volts	The voltage coming from the Natural Gas Pressure sensor to the ECU. This voltage represents a specific pressure that the ECU will use and display.
Natural Gas Tank Pressure	psia (kPa)	The pressure of the natural gas at the inlet of the fuel regulator.
Natural Gas Tank Pressure Input Voltage	volts	The voltage coming from the Natural Gas Tank Pressure sensor to the ECU. This voltage represents a specific pressure that the ECU will use to calculate the amount of fuel remaining in the tank.
Natural Gas Tank Temperature	°F (°C)	The temperature of the natural gas in the fuel tanks.
Natural Gas Tank Temperature Input Voltage	volts	The voltage coming from the Natural Gas Tank Temperature sensor to the ECU. This voltage represents a specific temperature that the ECU will use to calculate the amount of fuel remaining in the tank.
Natural Gas Temperature	°F (°C)	The temperature of the natural gas at the inlet of the fuel metering block.
Natural Gas Temperature Input Voltage	volts	The voltage coming from the Natural Gas Temperature sensor to the ECU. This voltage represents a specific temperature that the ECU will use and display.
^a N/A = Not Applicable		

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Parameter	Units	Description
Option Assembly Part Number	N/A ^a	Part number that describes all of the options on the entire vehicle. This includes the Performance Option Part Number and the Vehicle Option Part Number.
Performance Option Part Number	N/A ^a	These are the engine performance specific options related to power and torque.
Phi - Actual	N/A ^a	The actual equivalence ratio the engine is running at.
Phi - Desired	N/A ^a	ECU commanded equivalence ratio for the engine to produce.
Primary Foot Pedal Idle Validation Switch Status	N/A ^a	This switch tells the ECU if the engine is in the idle position or using the primary foot pedal to control engine speed.
Secondary Foot Pedal Idle Validation Switch Status	N/A ^a	This switch tells the ECU if the engine is in the idle position or using the secondary foot pedal to control engine speed.
Sensor 1 Supply Voltage	volts	Voltage that the ECU supplies sensors.
Sensor 2 Supply Voltage	volts	Voltage that the ECU supplies sensors.
Sensor 3 Supply Voltage	volts	Voltage that the ECU supplies the sensors.
Specific Humidity	g H2O/kg air	The humidity in the air outside.
Throttle Charge Temperature	°F (°C)	The temperature of the air prior to entering the throttle.
Throttle Charge Temperature Input Voltage	volts	The voltage coming from the Throttle Charge Temperature sensor to the ECU. This voltage represents a specific temperature that the ECU will use and display.
Throttle Limit	N/A ^a	Determine if some other feature on the engine is active that does not allow the foot pedal to function.
Throttle Position Sensor (TPS) Command	%	The position that the ECU is commanding the throttle to open in order to meet the required operating conditions.
Throttle Position Sensor (TPS) Feedback	%	The position that the throttle actually opened. The ECU receives the feedback to verify the throttle is operating correctly.
Throttle Position Sensor (TPS) Voltage	volts	The voltage coming from the Throttle Position sensor on the feedback wire to the ECU. This voltage represents the current throttle position.
Torque Curve Number	N/A ^a	On some applications, the ECU limits the max fuel on multiple torque curves. This displays the torque curve the ECU is currently using to limit maximum fuel. Definition of the possible torque curves is found in Group 198 Specifications.
Total Fuel Consumption	L gal	Total amount of fuel used through the life of the engine.
Transmission Current Gear	N/A ^a	This is the current gear that the transmission is operating in.
Transmission Sump Temperature	°F (°C)	The temperature of the transmission sump. This is used to control the fan speed.
UEGO Calibration Resistor Voltage	volts	The voltage coming from the UEGO sensor to the ECU.
UEGO Pump Actual Impedance	ohms	The actual opposition of flow in the UEGO Pump circuit.
UEGO Pump Desired Impedance	ohms	The desired opposition of flow in the UEGO Pump circuit.
UEGO Heater Duty Cycle	%	Rate the ECU is running the UEGO Heater.
UEGO Pump Cell Current	amps	The current that the ECU reads on the Pump Cell wire.
UEGO Pump Cell Voltage	volts	The ECU sends voltage to the UEGO sensor to pump the correct amount of oxygen into the system to create the desired oxygen content.
UEGO Reference Voltage	volts	Voltage used as a reference point for measuring pump cell voltage and sense voltage.
^a N/A = Not Applicable		

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Parameter	Units	Description
UEGO Sense Voltage	volts	The voltage coming from the UEGO sensor to the ECU. This voltage represents the amount of oxygen in th exhaust.
Upstream Throttle Pressure - Actual	psia (kPa)	The actual pressure of the air above the throttle plate.
Upstream Throttle Pressure - Desired	psia (kPa)	The pressure of the air above the throttle plate that the ECU is commanding.
Upstream Throttle Pressure Input Voltage	volts	The voltage coming from the Upstream Throttle Pressure sensor to the ECU. This voltage represents the pressure that the ECU uses and displays.
Vehicle Option Part Number	N/A ^a	These are the vehicle specific options for the engine like fuel derates, shutdowns, sensor thresholds, ect.
Vehicle Serial Number	N/A ^a	The serial number for the vehicle that this engine is located in.
^a N/A = Not Applicable		

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Engine Test Instructions — Spark Cutout Test

For instructions on connection the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.

The Spark Cutout Test is used to aid in identifying an ignition coil that is having a problem or to help in diagnosing mechanical or intermittent problems. During this test, the Engine Control Unit (ECU) will disable one ignition coil that the technician selects. This test can be performed while operating the vehicle under the conditions that the problem occurs. If the spark test is selected with the engine running below 1000 rpm, the test will run for 15 seconds then automatically reenables the coil. If the Spark Cutout Test is selected with the engine running above 1000 rpm, the test will run for 5 seconds.

The Spark Cutout Test can not determine if an engine is producing low power. This test is only a guide to help determine if there is a problem with an ignition coil.

Before executing the Spark Cutout Test

- Warm engine to normal operating temperature.
- Check for and Diagnostic Trouble Codes (DTCs) Using the ECU diagnostic software. If there are any DTCs present, they must be repaired prior to running the test.

NOTE: The ECU will not allow the test to run if there are any active DTCs.

- Ensure that the battery and starter are in good working condition.

Performing the Spark Cutout Test

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC

SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.

2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Check for active DTCs. If there are active DTCs, diagnose them first.
5. Ignition ON, engine idling or running under conditions that problem occurred.
6. Select the Engine Test tab on DST or Special Function/Test from the from the Readings menu on SERVICE ADVISOR™.
7. Select the Spark Cutout Test from the DST or SERVICE ADVISOR™.
8. Follow the instructions given by the DST or SERVICE ADVISOR™.
9. Select the coil to be disabled (coil number is the actual coil number/cylinder number starting with #1 at the water pump side of the engine and not the firing order number). Only valid numbers are 1-6.
10. Test will run for 5 or 15 seconds depending on engine speed unless stopped by user.
11. Use the data and observations to help diagnose the problem. For a good coil, the data should do the following. When a coil is cut out, operator should be able to feel and hear the engine speed decrease. The higher the speed, more obvious it is. If there is no change when the coil is disabled, that cylinder is not contributing and a problem with the ignition system exists. See F2 - IGNITION SYSTEM TEST in Group 105 earlier in this manual.

Spark Cutout Parameters Below 1000 RPM

Parameter	Value at Idle
Test Status	Spark Cutout Test
Engine Speed	Should see slight drop when coil is cutout.
TPS Command	This value should remain steady.
Injector Pulse Width	Value should have a minimal decrease.
Closed Loop Multiplier	Value should go negative and drop.

NOTE: It is recommended that the test be run at least 3 times to ensure repeatability, accurate results.

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order.

Spark Cutout Parameters 1000 RPM or Above

Parameter	Value at Idle
Test Status	Spark Cutout Test
Engine Speed	Should see drop when coil is cutout.
TPS Command	This value should increase.
Injector Pulse Width	Value should have a minimal decrease.
Closed Loop Multiplier	Value should go negative and drop.

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Engine Test Instructions — Injector Cutout Test

For instructions on connection the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.

The Injector Cutout Test is used to aid in identifying an injector that is having a problem or to help in diagnosing mechanical or intermittent problems. During this test, the Engine Control Unit (ECU) will disable one injector that the technician selects. This test can be performed while operating the vehicle under the conditions that the problem occurs. If the injector cutout test is selected with the engine running below 1000 rpm, the minimum throttle command will lock into the position it was in when the test was selected. If the Injector Cutout Test is selected with the engine running above 1000 rpm, the throttle will continue to operate normally.

The Injector Cutout Test can not determine if an engine is producing low power. This test is only a guide to help determine if there is a problem with an individual injector.

Before executing the Injector Cutout Test

- Warm engine to normal operating temperature.
- Check for and Diagnostic Trouble Codes (DTCs) Using the ECU diagnostic software. If there are any DTCs present, they must be repaired prior to running the test.

NOTE: The ECU will not allow the test to run if there are any active DTCs.

- Ensure that the battery and starter are in good working condition.

Performing the Injector Cutout Test

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Check for active DTCs. If there are active DTCs, diagnose them first.
5. Ignition ON, engine idling or running under conditions that problem occurred.
6. Select the Engine Test tab on DST or Special Function/Test from the from the Readings menu on SERVICE ADVISOR™.

IMPORTANT: Failure to install cap will result in pressure regulator failure.

7. Select the Injector Cutout Test from the DST or SERVICE ADVISOR™.
8. Follow the instructions given by the DST or SERVICE ADVISOR™.
9. Select the injector to be disabled (injector number is the actual injector number and not the firing order number). Only valid numbers are 1-8 on CNG engines and 1-4 on LNG engines.
10. Test will run for 5 or 15 seconds depending on engine speed, unless stopped by user.

11. Use the data and observations to help diagnose the problem. For a good injector, the data should do the following. When an injector is cutout, operator should be able to feel and hear the engine speed decrease. The higher the speed, more obvious it is. If there is no change when the injector is disabled, that injector is not contributing and a problem with that injector exists. See F3 - FUEL INJECTOR DIAGNOSTIC CHECK in Group 105 earlier in this manual.

Injector Cutout Parameters Below 1000 RPM	
Parameter	Value
Test Status	Injector Cutout Test
Engine Speed	Should drop when injector is cutout but will recovery quickly.
TPS Command	This value should remain steady.
Injector Pulse Width	Value should have a minimal increase.
Closed Loop Multiplier	Value should have a minimal increase.

Injector Cutout Parameters 1000 RPM or Above	
Parameter	Value
Test Status	Injector Cutout Test
Engine Speed	Should drop when injector is cutout but will recovery quickly.
TPS Command	This value should increase.
Injector Pulse Width	This value should increase.
Closed Loop Multiplier	Value should go negative and then level off.

NOTE: *It is recommended that the test be run at least 3 times to ensure repeatability, accurate results.*

RG41221,0000050 -19-14SEP01-2/2

Engine Test Instructions — Injector Cleaning

Handle Compressed Natural Gas (CNG) Safely

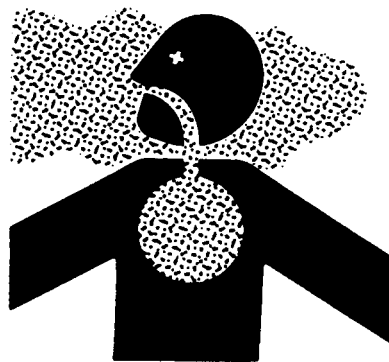


CAUTION: Handle Compressed Natural Gas (CNG) safely. CNG is methane (natural gas) stored at high pressure. It spreads into air quickly.

Natural gas fumes can cause sickness or death. Always work in a well ventilated area.

Do not smoke when refueling or working on or around natural gas vehicles or equipment.

Keep natural gas vehicles away from sparks, flames, and electrical devices in operation, especially if you suspect a natural gas leak.



TS220 -UN-23AUG88

RG41221,0000328 -19-01FEB02-1/8

Service Compressed Natural Gas (CNG) Systems Safely



CAUTION: Service Compressed Natural Gas (CNG) systems safely. Improper installation, service, or operation of CNG storage and delivery components can result in fire, explosion, and/or serious injury.

Relieve CNG fuel system pressure before working on the system. Properly tighten connections and check for leaks before pressurizing the CNG fuel system.



TS227 -UN-23AUG88

Continued on next page

RG41221,0000328 -19-01FEB02-2/8

Protect Against High Pressures



CAUTION: Protect against high pressure. CNG fuel systems operate at high pressures. **DO NOT** disassemble or remove any CNG fuel system components under pressure. Explosive separation of components, and the escaping natural gas can cause serious injury.

Relieve CNG fuel system pressure before disconnecting any fuel system component.



TS265 -UN-23AUG88

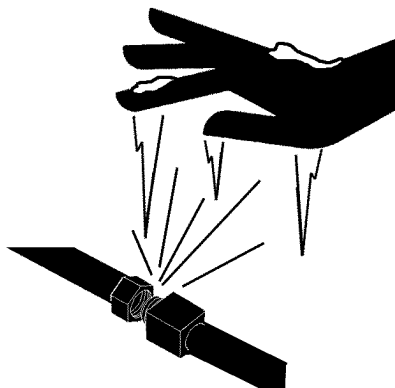
Continued on next page

RG41221,0000328 -19-01FEB02-3/8

Protect Against Extremely Cold CNG Leakage

! **CAUTION:** Protect against extremely cold CNG leakage. Gas escaping from the CNG fuel system is very cold. Frostbite and skin damage can occur for contact with cold escaping gas or surrounding components.

Inspect for leaks by spraying a soap and water solution on joints, fittings, and other areas. Look for bubbles that indicate leakage from the system.



RG8110 -UN-20AUG98

For instructions on connection the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.

Injector cleaning is used to clean sticky injectors. This test mode causes the injectors to be pulsed continuously for the purpose of cleaning injectors. This test should only be run when a diagnostic procedure recommends doing so.

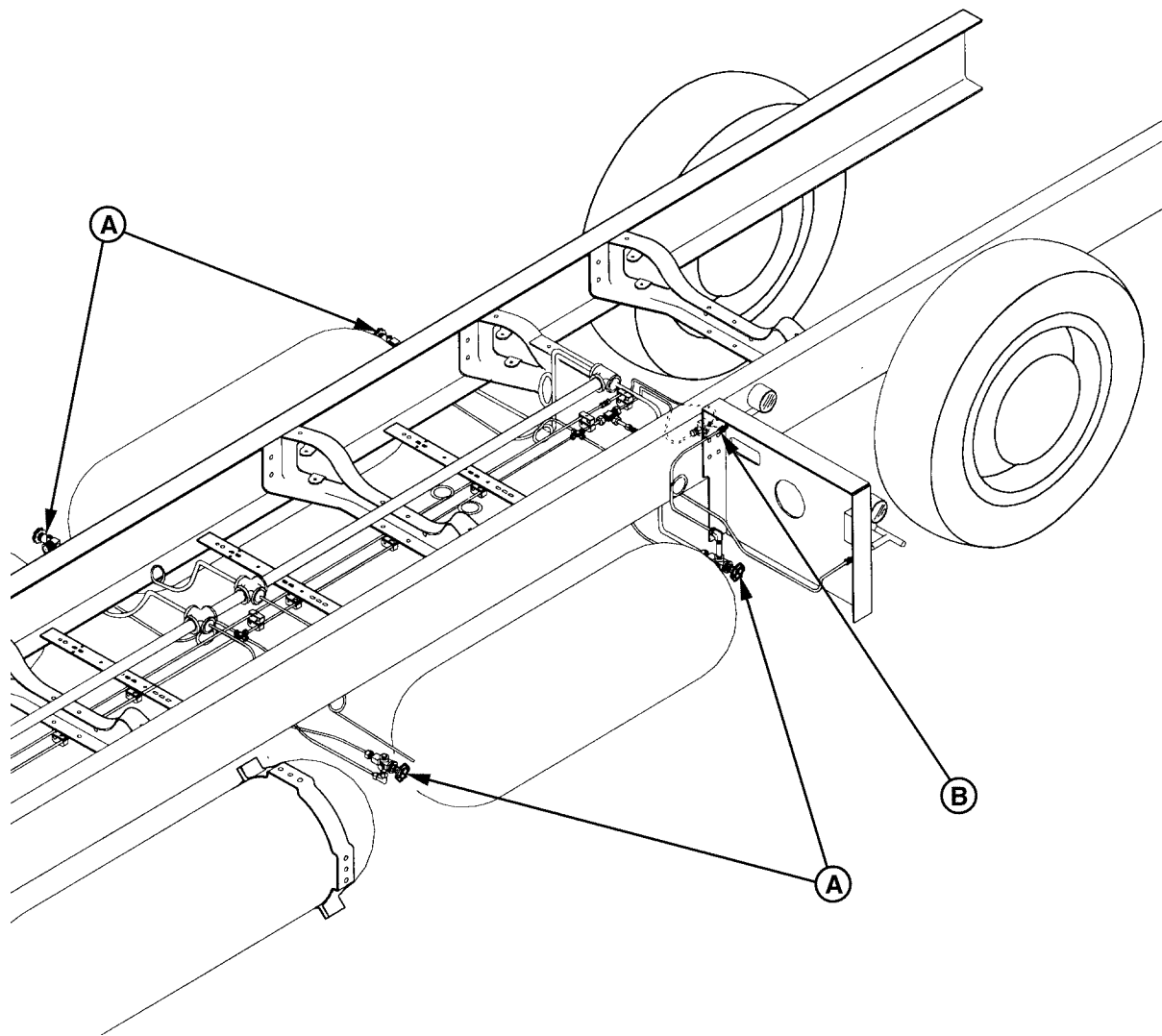
The diagnostic software will not allow this test mode to be selected if the engine is running. To select this test mode the ignition must be ON and the engine must be OFF.

To clean the injectors, perform the following procedures:

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Continued on next page

RG41221,0000328 -19-01FEB02-4/8



RG8140 -UN-20AUG98

A—Fuel Cylinder Manual
Shutoff Valve

B—1/4-turn Shutoff Valve

Performing the Injector Clean Test

IMPORTANT: Always relieve the natural gas pressure by closing each fuel cylinder manual shutoff valve (A). **DO NOT** relieve the natural gas pressure by closing the 1/4-turn valve (B).

NOTE: The illustration above is a typical CNG bus application and does not show all of the shutoff valves. Refer to vehicle operator's manual to help locate all fuel cylinder shutoff valves.

NOTE: The valve is closed when turned fully clockwise viewed from the top, and open when turned counterclockwise viewed from the top.

1. Close **ALL** fuel cylinder manual shutoff valves (A).
2. Start engine. If engine will not start go to step 3. If the engine **WILL** start, let it run until it dies from running out of fuel. Make sure pressure is completely relieved by attempting to start engine several more times. Proceed to step 4.

Continued on next page

RG41221,0000328 -19-01FEB02-5/8

3. If the engine **WILL NOT** start and run, make sure the vehicle is outside, away from heat, flames, or sparks. Slowly loosen the hose from the fuel metering block inlet fitting (A) just until escaping gas is heard. Let fuel escape until fuel pressure is completely relieved.
4. Disconnect the fuel hose (A) from the inlet of the metering block.
5. Inspect the O-ring on the fuel metering block inlet fitting for nicks or other damage. Replace if necessary with O-ring included in part number JT07281 Injector Cleaner Accessory Kit.
6. Apply a thin coating of O-ring lubricant or lithium-based grease to the O-ring on the fuel metering block inlet fitting.
7. Install cap from part number JT07281 Injector Cleaner Accessory Kit on the fuel metering block inlet fitting and tighten to specification.

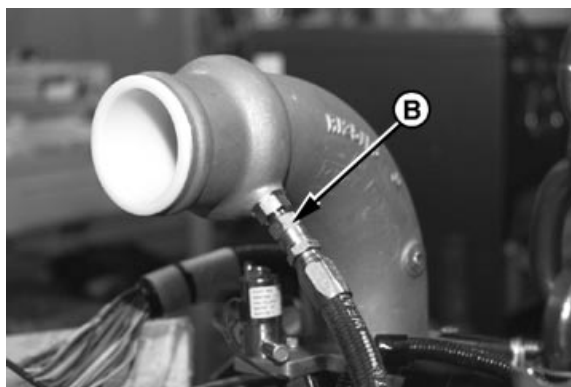
Specification

Fuel Metering Block Inlet
Connector—Torque 20 lb-ft (27N•m)

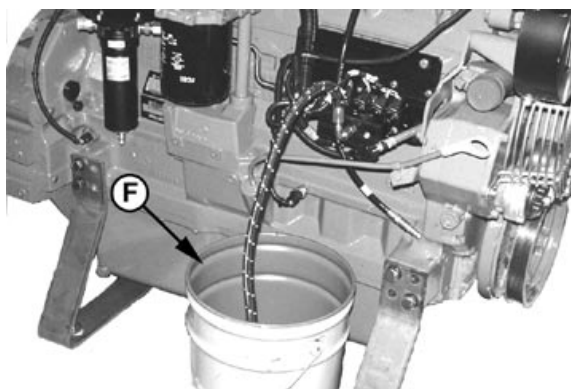
8. Disconnect the hose from the mixing elbow at (B).
9. Direct end of hose into a suitable container (F).
10. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
11. Ignition ON, engine OFF
12. Start the ECU diagnostic software.



RG12544A —UN-24JUL02



RG8073 —UN-20AUG98



RG12543A —UN-24JUL02

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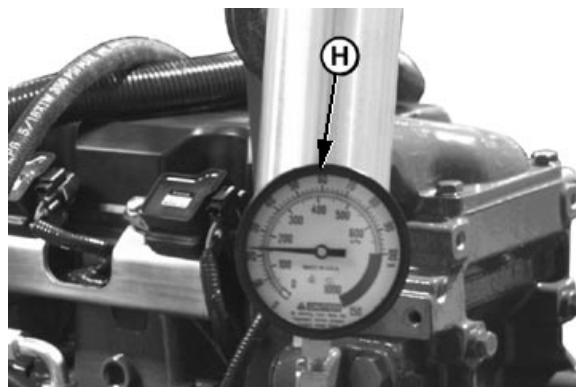
Continued on next page

RG41221,0000328 —19-01FEB02-6/8

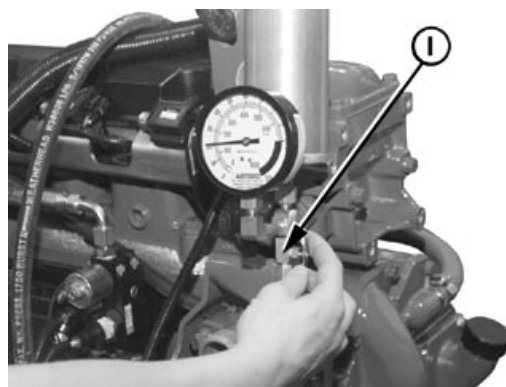
13. Using the metering block adapter from part number JT07281 Injector Cleaner Accessory Kit, connect part number JT07282 Fuel Injector Cleaner to the diagnostic port (G) located on the fuel metering block according to the instructions included with the Fuel Injector Cleaner Kit.
14. Adjust the canister pressure regulator (H) to 20-25 psi (140-173 kPa) (1.4-1.73 bar).
15. Open the valve (I) on the bottom of the canister.
16. Select the Engine Test tab on DST or Special Function/Test from the from the Readings menu on SERVICE ADVISOR™.
17. Select Injector Clean Test.
18. After all of the cleaning fluid has passed through the metering valve, stop the diagnostic software by pressing the Abort button. Adjust the canister pressure regulator to 70 psi (485 kPa) (4.9 bar). Restart the diagnostic software in the Injector Clean mode and allow air to flow through the valve for an additional 10 minutes to remove any remaining cleaning fluid.
19. Ignition OFF
20. Disconnect the injector cleaning equipment from the fuel metering block according to the instructions included with the injector cleaning equipment.
21. Replace the cap screw plug in the fuel metering block.
22. Disconnect the diagnostic cable.
23. Inspect the O-ring on the mixing elbow fitting for nicks or other damage. Replace if necessary with O-ring included in part number JT07281 Injector Cleaner Accessory Kit.
24. Apply a thin coating of O-ring lubricant or lithium-based grease to the O-ring on the mixing elbow fitting.



RG12545A -UN-24JUL02



RG11227 -UN-25AUG00



RG11228 -UN-25AUG00

25. Reconnect the hose to the mixing elbow and tighten to specification.

Specification

Mixing Elbow Inlet Line—Torque 20 lb-ft (27N•m)

26. Remove the cap from the metering valve inlet fitting.
27. Inspect the O-ring on the metering valve inlet fitting for nicks or other damage. Replace if necessary with O-ring included in part number JT07281 Injector Cleaner Accessory Kit.
28. Apply a thin coating of O-ring lubricant or lithium-based grease to the O-ring on the metering valve inlet fitting.
29. Reconnect the hose to the metering valve inlet and tighten to specification.

Specification

Metering Valve Inlet Line—

Torque 20 lb-ft (27N•m)

30. Open fuel cylinder manual shutoff valves.
31. Start engine.
32. With the engine idling, use a non-ammonia soap solution and wet the fitting and hose inlet to the mixing elbow and the fitting and hose at the inlet of the fuel metering block. If bubbles form, the fuel line or fitting is leaking.
33. If a leak is detected, inspect lines and fittings for loose or damaged connections. Also check for damaged or missing O-rings.
34. Repair and repeat procedure until no leaks are detected.

RG41221,0000328 -19-01FEB02-8/8

Reprogramming Engine Control Unit (ECU)

John Deere Ag and Construction dealers are able to reprogram ECUs using SERVICE ADVISOR™. See REPROGRAMMING ENGINE CONTROL UNIT USING SERVICE ADVISOR later in this Group.

OEM Distributors are able to reprogram ECUs using Diagnostic Scan Tool (DST). See REPROGRAMMING ENGINE CONTROL UNIT USING DST later in this Group.

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RG41221,0000092 -19-04NOV02-1/1

John Deere Trimmable Options

Trimmable options are features that can be turned ON or Off during an ECU programming cycle. These features will customize an engine for each individual customer. Not all engines have the trim feature.

To update trimmable features, download the software payload file and start the programming sequence through the service tool. The trim page automatically appears if the payload has trim incorporated.

For more information help select the correct option, use the help documentation available in each section of the trim page.

RG41221,0000169 -19-30MAY03-1/1

Downloading Payload File For DST

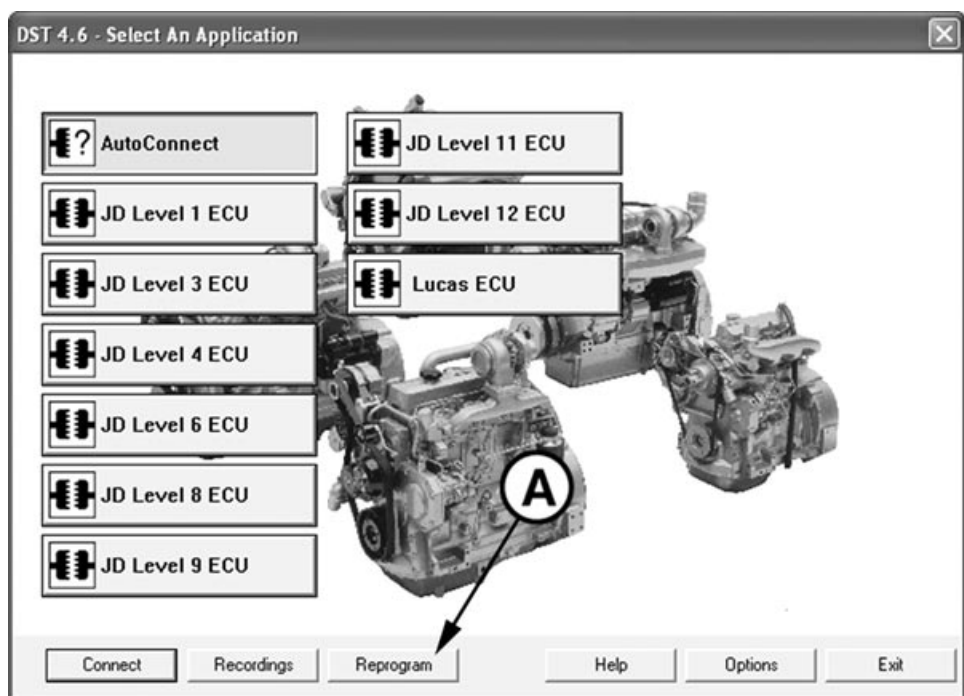
IMPORTANT: Diagnostic Scan Tool (DST) Version 4.6 or later must be installed prior to performing the following instructions.

IMPORTANT: The Engine Serial Number (ESN) for the engine that this instruction is to be performed on is required for downloading the proper payload file.

NOTE: An Internet connection will be needed for steps 1 - 12.

1. Start DST version 4.6.

RG41221,0000097 -19-04NOV03-1/10



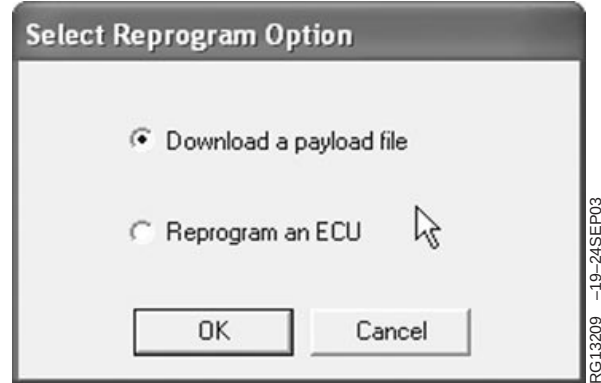
DST Main Menu

2. Select the Reprogram button (A).

Continued on next page

RG41221,0000097 -19-04NOV03-2/10

3. Select "Download a payload file" (C) from the Select Reprogram Option menu.
4. Log into the John Deere system using you User ID and Password.



Reprogram Option

RG41221,0000097 -19-04NOV03-3/10

Menu	Description	Action
HELP	The ECU Software Delivery System (SDS) is designed to support remote programming of ECUs. To download an ECU payload, click on the Download button.	Download
LOG OFF		✓
SDS HOME	A valid license is required to program an ECU. To validate an existing license or get a new license, click the License button.	License
		✓

(B)

RG12629 -19-19SEP02

Obtaining Valid License

Menu	Description
HELP	License information required for programming an ECU is being validated. Please wait...
LOG OFF	
SDS HOME	

RG12630 -19-19SEP02

Validating License

NOTE: Steps 5 – 7 only need to be completed the first time this instruction is performed.

permissions. Click on "License"(B). A screen will appear while validating license.

5. A license file is required for each computer that will reprogram ECUs. Download the license file to gain

Continued on next page

RG41221,0000097 -19-04NOV03-4/10

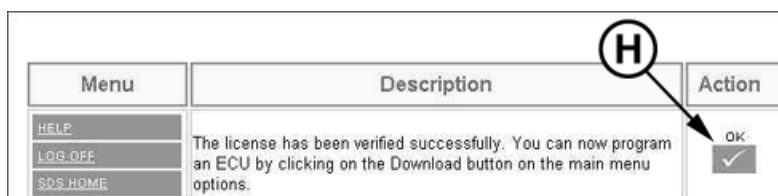


RG12613 -19-20SEP02

Grant Always Screen

6. Click on “Grant Always” (G).

RG41221,0000097 -19-04NOV03-5/10

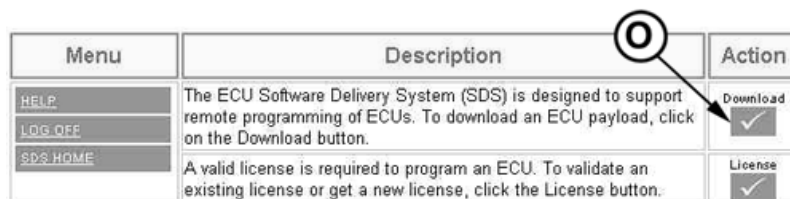


RG12631 -19-19SEP02

Verification Successful

7. Click “OK” (H) when license verification has completed.

RG41221,0000097 -19-04NOV03-6/10



RG12579 -19-06SEP02

8. Click on “Download” button (O). A screen will appear as the system verifies that a valid license file is present.

Continued on next page

RG41221,0000097 -19-04NOV03-7/10

Menu	Description	
HELP	Type of Electronic Control Unit (ECU):	E04 - Left Control Unit 2
LOG OFF		EHC - Power Reverser Transmission
SDS HOME		Engine
		EPC - Electronic Power Quad Transmission - EPQT
		HYD - Flex Hydraulic Control #1

RG12632 -19-19SEP02

Selecting Engine for ECU Type

9. Scroll down and click on "Engine" (P).

RG41221.0000097 -19-04NOV03-8/10

Menu	Description	Action
HELP	Engine Serial Number: (e.g. RG6081H144792)	Download ☒
LOG OFF	Replacing the ECU?: (if so, enter the new, replacement ECU serial number e.g. 110112)	
SDS HOME	☐ Yes	

RG12618 -19-18SEP02

Enter Engine Serial Number (ESN)

10. Click once in the ESN text box (Q) so the cursor is in the box. Type in the ESN into the text field. If you are replacing the current ECU, GO TO 9. If

you are reprogramming the existing ECU, click "Download" (R) and GO TO 11.

Continued on next page

RG41221.0000097 -19-04NOV03-9/10

Menu	Description		Action
HELP	Engine Serial Number:?	RG6081H200029	Download 
LOG OFF	Replacing the ECU?:?	☒	
SDS HOME	(if so, enter the new, replacement ECU serial number e.g. 110112)	110112	

RG12701A -19-14OCT02

Replacing ECU

11. If the current machine is being replaced, check the "Replacing the ECU" box (E).

12. Enter in the new ECU's serial number (F) located on the ECU label and click "Download".

NOTE: Sometimes the original ECU will not be available for reprogramming. When a new ECU is being programmed to replace the current ECU, the software will tie the engine serial number to the new ECU serial number.

13. Watch for a box to flash on the screen. After this disappears, the payload has been downloaded. To verify that the payload has been successfully download, look in the C: SDS payloadsn ECU folder.

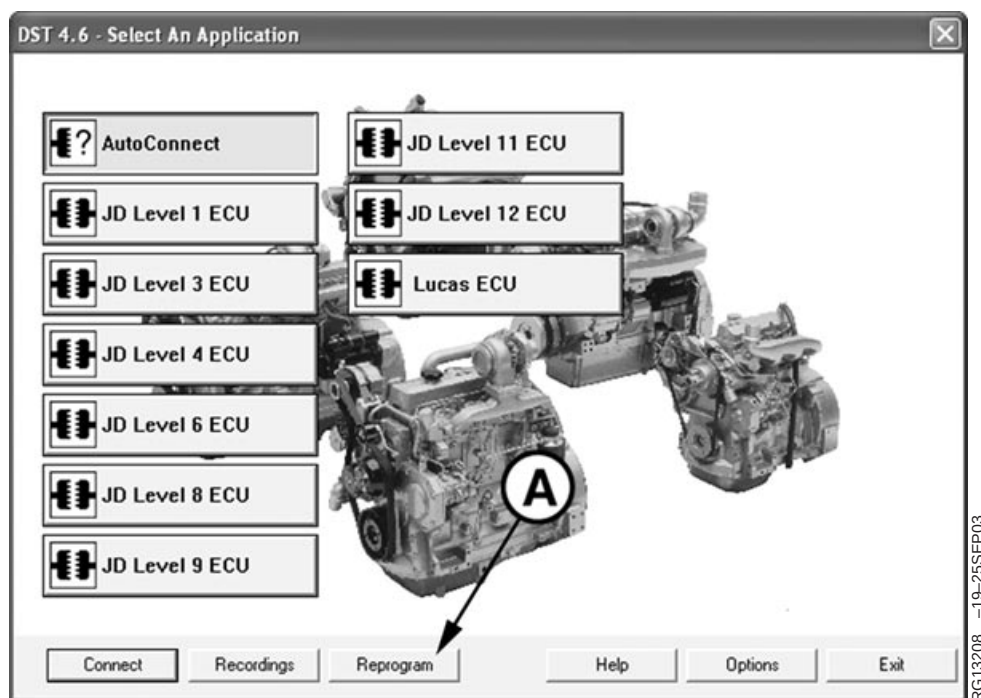
RG41221,0000097 -19-04NOV03-10/10

Reprogramming Engine Control Unit (ECU) With DST

NOTE: Internet connection is not required to program an engine control unit.

1. **Ignition ON, engine OFF.**
2. Connect computer with DST to the Diagnostic Connector on the engine.

RG41221,0000098 –19-04NOV03-1/8



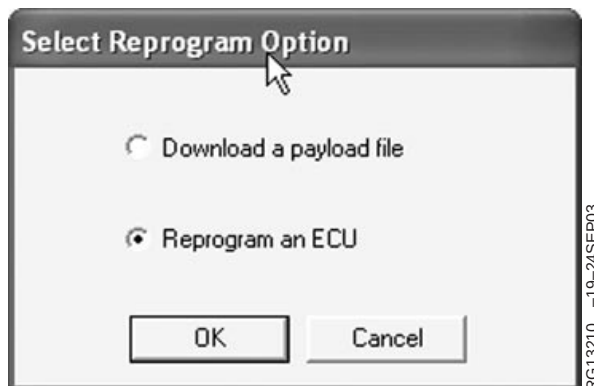
DST Main Menu

3. Start the DST software. Click on “Reprogram JD” (A).

Continued on next page

RG41221,0000098 –19-04NOV03-2/8

4. Select the "Reprogram an ECU" option from the Select Reprogram Option menu.

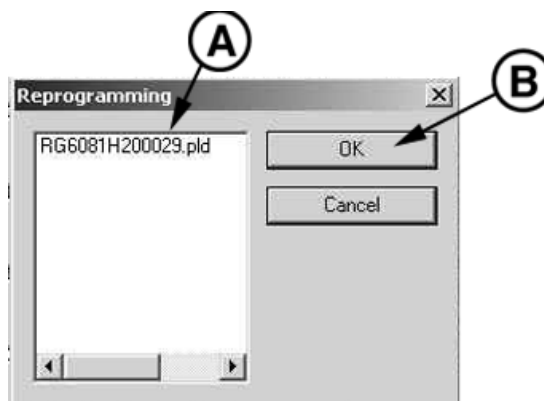


Reprogram Option

RG41221,0000098 -19-04NOV03-3/8

5. Click on the proper payload (A) and click OK (B).

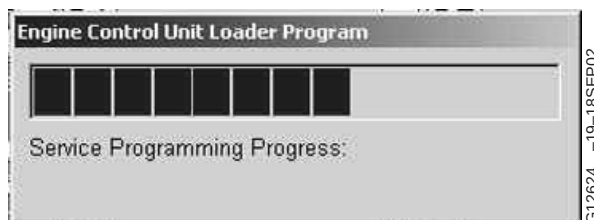
NOTE: If the engine serial number is missing from the Reprogramming box, run the ServiceProgrammingPayloadPath.reg file in the C:\MPST\IDST folder. Then start this procedure over by downloading the payload again.



Selecting Payload file for Reprogramming

RG41221,0000098 -19-04NOV03-4/8

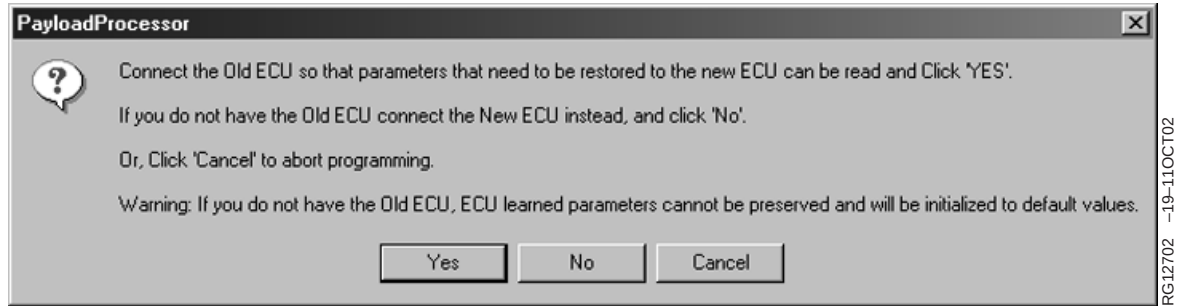
6. A progress bar will appear while reprogramming the ECU. If the engine is equipped with warning alarms, these may come on while in process of reprogramming and should be ignored.



Status Bar

Continued on next page

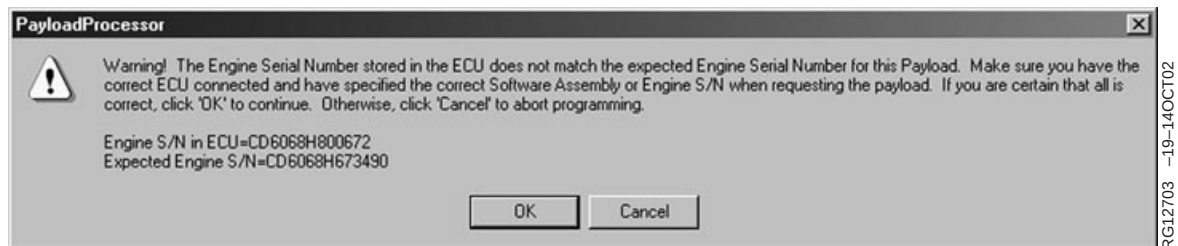
RG41221,0000098 -19-04NOV03-5/8



7. If the ECU is being replaced, the above message will appear. If you have the old ECU, connect to it

and click YES. If the old ECU is not available, click NO.

RG41221,0000098 -19-04NOV03-6/8



8. If the ECU is being replaced, the software will notice that the engine serial number does not match the ECU serial number. This message lets

the user know that the ECU expects a different engine serial number to match its ECU serial number. Click "OK" to continue.

RG41221,0000098 -19-04NOV03-7/8

9. When reprogramming the ECU has been successfully completed, the Payload Processor window will appear. Click "OK".
10. Disconnect computer from diagnostic connector and start engine to ensure proper operation.
11. A return file is generated every time a reprogramming sequence has been completed. This return file will automatically upload to the system the next time you download a payload.



Payload Processor Completed

IMPORTANT: If these steps do not work, please submit a John Deere DTAC case.

RG41221,0000098 -19-04NOV03-8/8

Downloading Payload File For SERVICE ADVISOR™

NOTE: An Internet connection will be needed for steps 1 - 16.

1. Start SERVICE ADVISOR™

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RG41221,0000094 -19-18NOV03-1/15

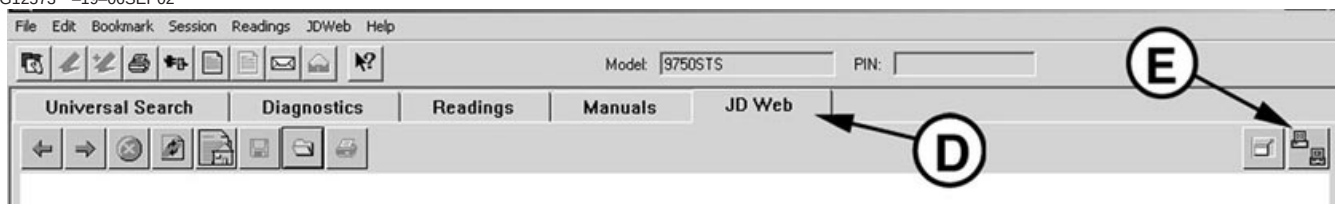


RG13332 -19-18NOV03

2. Select vehicle model (A) with the proper serial number range or if PIN is known select the PIN tab and enter PIN number. Click OK.

RG41221,0000094 -19-18NOV03-2/15

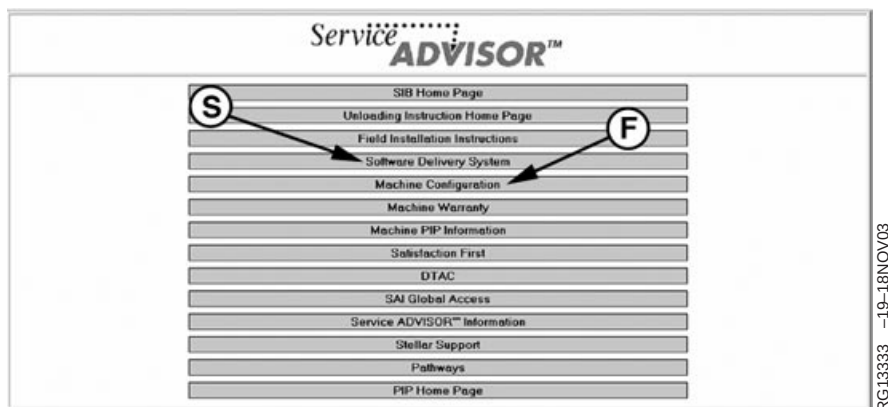
RG12573 -19-06SEP02



3. Click on "JD Web" tab (D). In the upper right hand corner click on "Connect to Network" button (E). Select network connection type and click OK.

Continued on next page

RG41221,0000094 -19-18NOV03-3/15



RG13333 -19-18NOV03

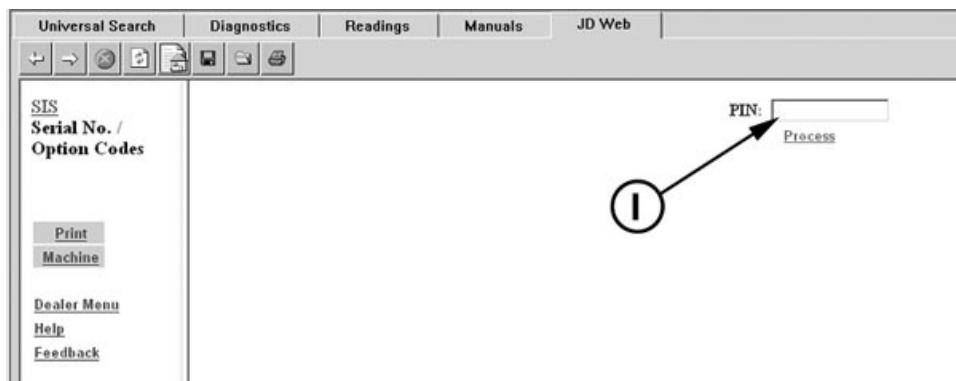
NOTE: Menu options may vary on the SERVICE ADVISOR™ menu.

to step 9. If only the PIN number is available, click on "Machine Configuration" (F) button.

- If the Engine Serial number (ESN) is available click on "Software Delivery System" button (S) and skip

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RG41221,0000094 -19-18NOV03-4/15

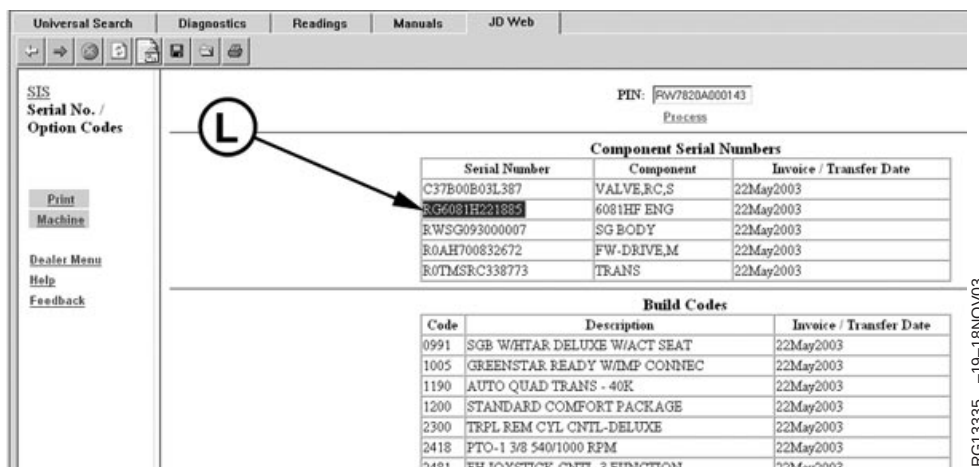


RG13334 -19-18NOV03

- Enter PIN number (I) if not already filled in, and select "Process". Equipment detail information for this vehicle will appear on the screen.

Continued on next page

RG41221,0000094 -19-18NOV03-5/15



Universal Search | Diagnostics | Readings | Manuals | JD Web

SIS
Serial No. /
Option Codes

Print
Machine

Dealer Menu
Help
Feedback

PIN: RW7820A000143
Process

Serial Number	Component	Invoice / Transfer Date
C37B00B03L387	VALVE,R,C,S	22May2003
RG6081H221885	6081HF ENG	22May2003
RWSG093000007	SG BODY	22May2003
R0AH700832672	FW-DRIVE,M	22May2003
R0TMSRC338773	TRANS	22May2003

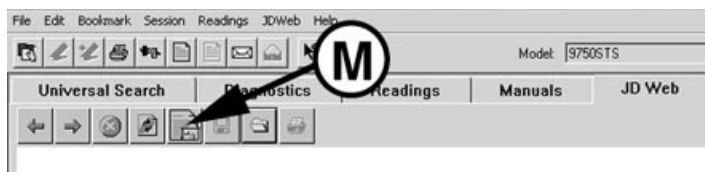
Code	Description	Invoice / Transfer Date
0991	SGB W/HTR DELUXE W/ACT SEAT	22May2003
1005	GREENSTAR READY W/IMP CONNEX	22May2003
1190	AUTO QUAD TRANS - 40K	22May2003
1200	STANDARD COMFORT PACKAGE	22May2003
2300	TRPL REM CYL CNTL-DELUXE	22May2003
2418	PTO-1 3/8 540/1000 RPM	22May2003

RG13335 -19-18NOV03

6. Hold left mouse button down and drag across the ESN (L) so that it is highlighted. Press the "Ctrl" key and the "C" key simultaneously to copy the ESN.

RG41221,0000094 -19-18NOV03-6/15

RG12577 -19-06SEP02



File Edit Bookmark Session Readings JDWeb Help

Model: 9750STS

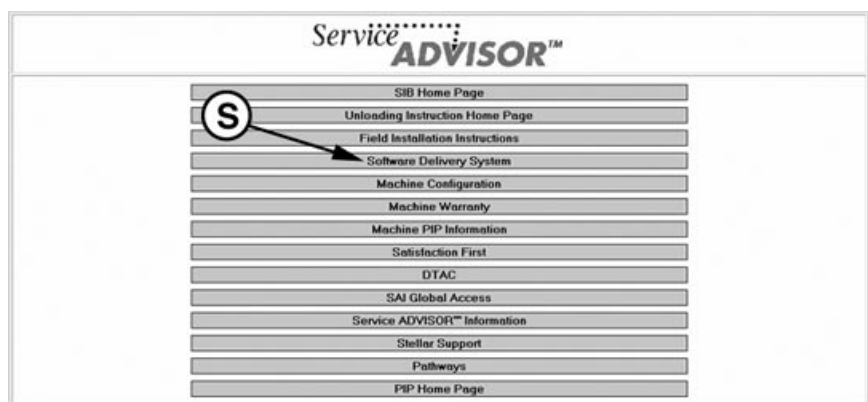
Universal Search | Diagnostics | Readings | Manuals | JD Web

M

7. Click on the "Home" button (M) within SERVICE ADVISOR™ to go back to the menu.

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RG41221,0000094 -19-18NOV03-7/15



Service ADVISOR™

S

- SIB Home Page
- Unloading Instruction Home Page
- Field Installation Instructions
- Software Delivery System
- Machine Configuration
- Machine Warranty
- Machine PIP Information
- Satisfaction First
- DTAC
- SAI Global Access
- Service ADVISOR™ Information
- Stellar Support
- Pathways
- PIP Home Page

RG13336 -19-18NOV03

8. Click on "Software Delivery System" button (S).
Login if necessary.

Continued on next page

RG41221,0000094 -19-18NOV03-8/15

SDS - Software Delivery System

Menu	Description	Action
HELP	The ECU Software Delivery System (SDS) is designed to support remote programming of ECUs. To download an ECU payload, click on the Download button.	Download
LOG OFF		☒
SDS HOME	A valid license is required to program an ECU. To validate an existing license or get a new license, click the License button.	License
Service ADVISOR™		☒

(B)

RG12612 -19-06SEP02

Obtaining Valid License

SDS - Software Delivery System

Menu	Description
HELP	License information required for programming an ECU is being validated. Please wait...
LOG OFF	
SDS HOME	
Service ADVISOR™	

RG12614 -19-06SEP02

Validating License

SDS - Software Delivery System

Menu	Description	Action
HELP	The ECU Software Delivery System (SDS) is designed to support remote programming of ECUs. To download an ECU payload, click on the Download button.	Download
LOG OFF		
SDS HOME		
Service ADVISOR™		

(O)

RG12616 -19-06SEP02

Figure B

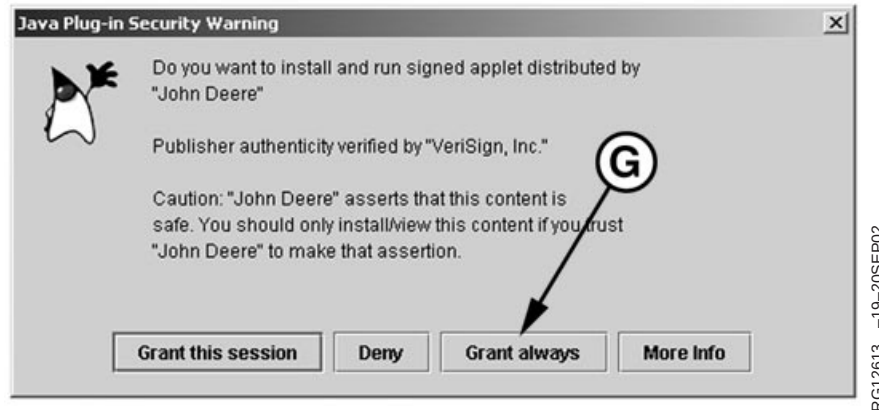
NOTE: Steps 9 - 11 only need to be completed the first time this instruction is performed.

9. A license file is required for each computer that will reprogram ECUs. Download the license file to gain

permissions. Click on "License" (B). A screen will appear while validating license. If the screen appears as "Figure B" allowing the option to download, click "Download" (O) and skip to Step 13.

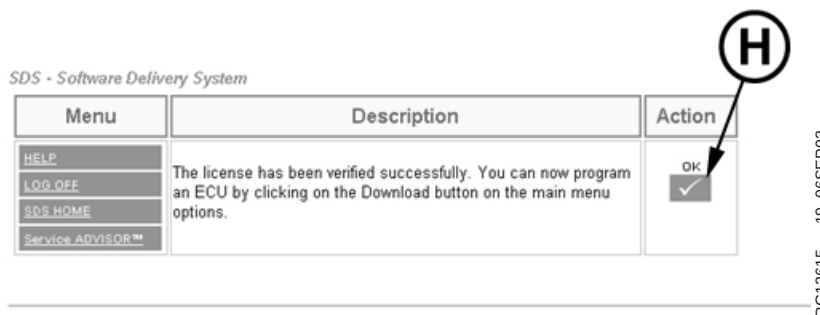
Continued on next page

RG41221,0000094 -19-18NOV03-9/15



10. Click on “Grant Always” (G).

RG41221,0000094 -19-18NOV03-10/15



11. Click “OK” (H) when license verification has been completed.

Continued on next page

RG41221,0000094 -19-18NOV03-11/15

Menu	Description	Action
HELP	The ECU Software Delivery System (SDS) is designed to support remote programming of ECUs. To download an ECU payload, click on the Download button.	Download
LOG OFF		☒
SDS HOME	A valid license is required to program an ECU. To validate an existing license or get a new license, click the License button.	License
		☒

RG12579 -19-06SEP02

12. Click on "Download" button (O). A screen will appear as the system verifies that a valid license file is present.

RG41221,0000094 -19-18NOV03-12/15

SDS - Software Delivery System

Menu	Description
HELP	Type of Electronic Control Unit (ECU): CAS - Active Seat for EPQ transmission E04 - Left Hand Armrest Control EHC - Power Reverser Transmission Engine EPQ - Electronic Power Quad Transmission - EPQT
LOG OFF	
SDS HOME	
Service ADVISOR?	

RG12580 -19-06SEP02

13. Scroll down and click on "Engine" (P).

RG41221,0000094 -19-18NOV03-13/15

SDS - Software Delivery System

Menu	Description	Action
HELP	Engine Serial Number: (e.g. 4792)	Download
LOG OFF		
SDS HOME	Replacing the ECU? (if so, enter the new, replacement ECU serial number e.g. 110112)	☒
Service ADVISOR?	(e.g. 4792) Undo Cut Copy Paste Delete Select All	

RG12581 -19-06SEP02

14. Click once in the ESN text box (Q) so the cursor is in the box. Type in the ESN or Right click and select "Paste" to copy the ESN into the text field.

If you are replacing the ECU, go to step 15. If you are reprogramming the existing ECU, click "Download" (R) and go to step 17.

Continued on next page

RG41221,0000094 -19-18NOV03-14/15

Menu	Description		Action
HELP	Engine Serial Number:?	RG6081H200029	Download 
LOG OFF	Replacing the ECU?:?	☒	
SDS HOME	(if so, enter the new, replacement ECU serial number e.g. 110112)	110112	

RG12701A -19-14OCT02

Replacing ECU

15. If the current machine ECU is being replaced, check the "Replacing the ECU" box (E).

IMPORTANT: Service ADVISOR™ software must be closed and reopened prior to programming the ECU.

NOTE: Sometimes the original ECU will not be available for reprogramming. When a new ECU is being programmed to replace the current ECU, the software will tie the engine serial number to the new ECU serial number.

17. After downloading the ECU payload to the computer, exit SERVICE ADVISOR™

16. Enter in the new ECU's serial number (F) located on the ECU label and click "Download".

SERVICE ADVISOR is a trademark of Deere & Company

RG41221.0000094 -19-18NOV03-15/15

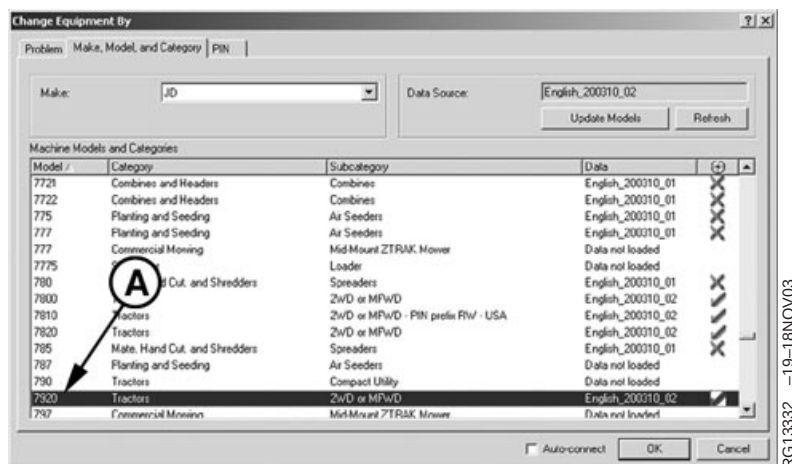
Reprogramming Engine Control Unit (ECU) With SERVICE ADVISOR™

IMPORTANT: Ignition ON, engine OFF.

Connect computer with SERVICE ADVISOR™ to the Diagnostic Connector in the cab or on the engine.

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RG41221.0000099 -19-18NOV03-1/7



NOTE: Internet connection is not required to program an engine control unit.

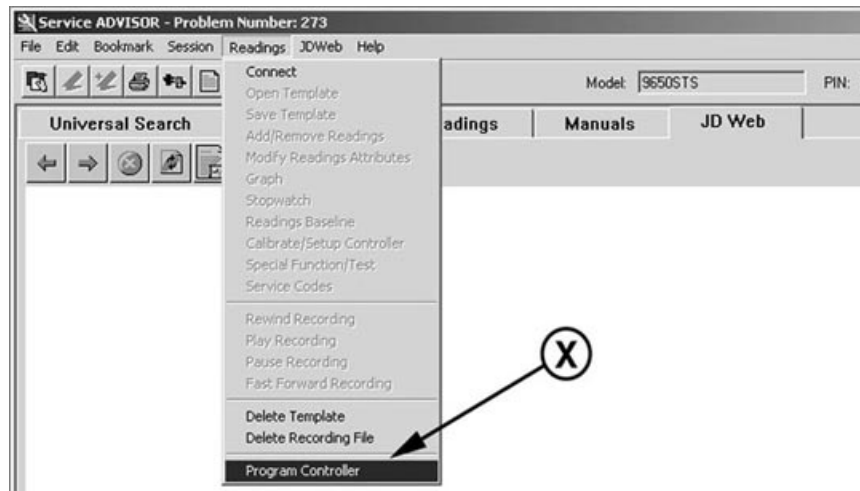
known select the PIN tab and enter PIN number. Click OK.

1. Start SERVICE ADVISOR™. Select vehicle model (A) with the proper serial number range or if PIN is

SERVICE ADVISOR is a trademark of Deere & Company

Continued on next page

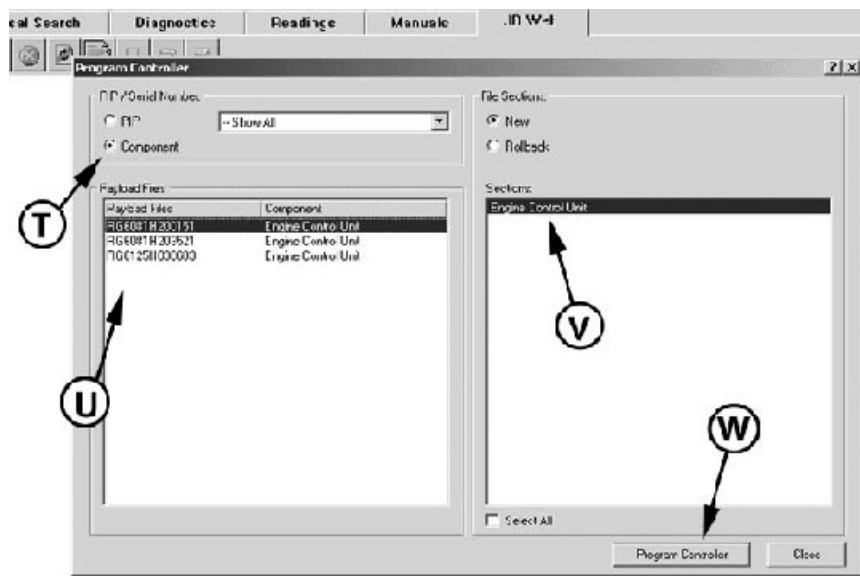
RG41221.0000099 -19-18NOV03-2/7



RG12582 -19-06SEP02

2. Click on "Readings" pull down menu and select "Program Controller" (X).

RG41221,0000099 -19-18NOV03-3/7



RG12583 -19-06SEP02

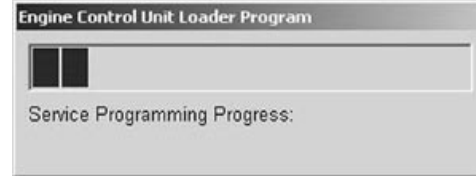
3. Select radio button for "Component" (T). Select the proper payload file for engine ECU (U).
4. Click once on "Engine Control Unit" (V) and click on "Program Controller" (W).

Continued on next page

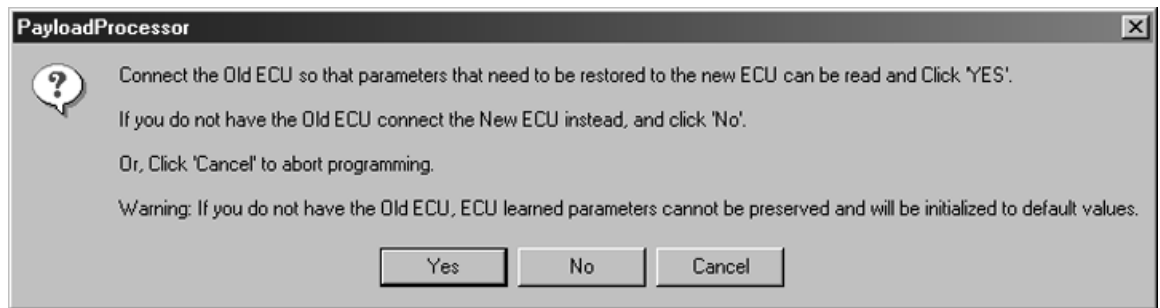
RG41221,0000099 -19-18NOV03-4/7

5. A progress bar will appear while reprogramming the ECU. The engine warning light may come on and a warning may sound while in process of reprogramming and should be ignored.

RG12584 -19-06SEP02



RG41221,0000099 -19-18NOV03-5/7

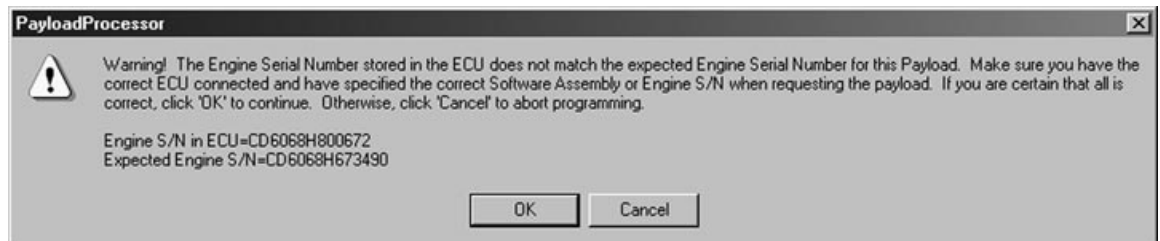


RG12702 -19-11OCT02

6. If the ECU is being replaced, the above message will appear. If you have the old ECU, connect to it

and click YES. If the old ECU is not available, click NO.

RG41221,0000099 -19-18NOV03-6/7



RG12703 -19-14OCT02

7. If the ECU is being replaced, the software will notice that the engine serial number does not match the ECU serial number. This message lets the user know that the ECU expects a different engine serial number to match its ECU serial number. Click "OK" to continue.

8. Disconnect computer from diagnostic connector and start vehicle to ensure proper operation.

RG41221,0000099 -19-18NOV03-7/7

Diagnostic Trouble Codes (DTCs)

There are several different methods of displaying both stored and active DTCs from the ECU.

SPN/FMI CODES

SPN/FMI codes are written from the SAE J1939 standard as a two part code. The first part is called the Suspect Parameter Number (SPN). Typically, it contains between 2 and 4 digits. The SPN identifies the system or the component that has the failure; for example SPN 110 indicates a failure in the engine coolant temperature circuit. The second part of the code is called the Failure Mode Identifier (FMI) code. The FMI contains 2 digits. The FMI identifies the type of failure that has occurred; for example FMI 3 indicates value above normal. In order to determine the exact failure, both the SPN and FMI are required. Combining SPN 110 with FMI 3 yields engine coolant temperature input voltage high.

On all applications with the Level 8 Engine Control Unit (ECU), the ECU transmits SPN/FMI codes over the Controller Area Network (CAN). This allows for service tools such as the DST, SERVICE ADVISOR™, and the Diagnostic Gauge to display active and stored DTCs. When using DST or SERVICE ADVISOR™ the codes will be displayed in a 000000.00 format. For example, SPN 110 FMI 3 will be displayed as 000110.03.

INDICATOR LAMPS

There are three available indicator lights available for the Level 8 Electronic Control System. Depending on the severity of the diagnostic trouble code one or more of the indicator lamps will set.

- **Warning Light:** A warning light will illuminate when a diagnostic trouble code sets that should not harm the engine. This is to let the operator know that something is wrong and they need to have it looked at as soon as they can.
- **Malfunction Light:** A malfunction light will illuminate when a diagnostic trouble code sets that should not harm the engine, but could effect emissions. This code should be repaired as soon as possible to keep the engine emission certified and running at its maximum performance.
- **Stop Light:** A stop light will illuminate when a diagnostic trouble code sets that can cause serious damage to the engine. The engine should be shut down as soon as this light appears.

CLEARING STORED DTCs

Stored DTCs can be cleared through the Diagnostic Scan Tool (DST), or SERVICE ADVISOR™.

For a list of all of the Diagnostic Trouble Codes, see LISTING OF DIAGNOSTIC TROUBLE CODES (DTCs) ON ECU later in this Group.

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SERVICE ADVISOR

RG41221,0000057 -19-08JUL03-1/1

Blinking DTCs

NOTE: Read through this entire procedure before starting. The blink sequence will occur too fast to allow reading step-by-step once the codes start to blink.

When there is no ECU diagnostic software available to read the Diagnostic Trouble Codes (DTCs), the technician should use this procedure to blink out any DTCs present in the ECU.

1. Ignition ON, engine OFF
2. Cycle the foot pedal from 0% to 100% three time within a three second interval.
3. The malfunction light will begin to flash.
4. The Fault Lamp will begin to flash a code number. For example, flash three times...short pause...flash two times...long pause. This example is code 32.
5. The ECU begins the flashing sequence by flashing a code 32, this indicates the start of blinking active codes. If there are any active DTCs, the ECU will flash it's 2-digit number or 3-digit number. If there is more than one active DTC, the ECU will flash each code in numerical order. If there are no active DTCs, the Fault Lamp will flash a code 88.

6. Following the active codes, the Fault Lamp will flash a code 33, this indicates the start of blinking stored codes. If there are any stored DTCs, the Fault Lamp will flash it's 3-digit number. If there is more than one stored DTC, the ECU will flash each code in numerical order. If there are no stored DTCs, the Fault Lamp will flash a code 88.

7. Once complete, the above sequence will be repeated.

8. As an example, if an engine had an active DTC 152 and stored DTC 053, the flashing sequence would be:

- flash three times...short pause
- flash two times...long pause
- flash one time...short pause
- flash five times...short pause
- flash two times...long pause
- flash three times...short pause
- flash three times...long pause
- long pause
- flash five times...short pause
- flash three times

NOTE: For the list of Blink Codes, see LISTING OF BLINK CODES ON ECU later in this Group.

RG41221,00000FB -19-12FEB03-1/1

Diagnostic System

The John Deere natural gas engine control system has self-diagnostic capabilities. Most problems that affect emissions or driveability of the vehicle will set a Diagnostic Trouble Code (DTC). The ECU will store that DTC in memory and illuminate the "Check Engine" Light (CEL) located on the dash of the vehicle.

Diagnostic Trouble Codes (DTCs)

Diagnostic Trouble Codes (DTCs) indicate that the ECU has detected a problem in some area of the electronic engine control system. The DTCs are output according to the SAE J1939 standard as a two part code. The first part is a six-digit Suspect Parameter Number (SPN) followed by a two-digit Failure Mode Identifier (FMI) code. In order to determine the exact failure, both parts (SPN and FMI) of the code are needed. The SPN identifies the system or the component that has the failure; for example SPN 110 indicates a failure in the engine coolant temperature circuit. The FMI identifies the type of failure that has occurred; for example FMI 3 indicates value above normal. Combining SPN 110 with FMI 3 yields engine coolant temperature input voltage high.

On all applications with the Level 8 Engine Control Unit (ECU), the ECU transmits SPN/FMI codes over the Controller Area Network (CAN). This allows for service tools such as the DST, SERVICE ADVISOR™, and the Diagnostic Gauge to display active and stored DTCs. When using DST or SERVICE ADVISOR™ the codes will be displayed in a 000000.00 format. For example, SPN 110 FMI 3 will be displayed as 000110.03.

If a sensor or wiring fails and a DTC is active for that sensor, the ECU will use a substitute "limp home" value in its calculations to continue engine operation.

NOTE: *If the DST is used to read a sensor voltage and calculated value, and there is a current DTC for that sensor, the calculated value for that sensor will be the "limp home" value and the voltage will be the actual sensor voltage. Use the voltage during diagnostics unless otherwise directed by a diagnostic chart.*

Some failures that set DTCs are "intermittent" failures. These could be problems such as a bad connection or a wire intermittently shorting to ground. Some intermittent DTCs will cause the CEL to turn on then turn off when the DTC "goes away". Other intermittent failures that could seriously affect engine operation will cause the CEL to be on and remain on until the ignition is shut off even though the problem may have "gone away". In either case the DTC will be stored in memory.

Other failures are "hard" failures. During this type of failure a DTC will be set, the CEL will be on and remain on until the problem is fixed.

CLEARING STORED DTCs

Stored DTCs can be cleared through the OEM instrument panel, through the Diagnostic Scan Tool (DST), or SERVICE ADVISOR™.

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SERVICE ADVISOR

RG41221,0000058 -19-14SEP01-1/1

Listing of Diagnostic Trouble Codes (DTCs) on ECU**DTC's Listing in Ascending SPN/FMI Codes**

SPN	FMI	Definition
000028	02	Secondary Foot Pedal Idle Validation Switch Invalid
	03	Foot Pedal Position 4 Input Voltage High
	04	Foot Pedal Position 4 Input Voltage Low
	07	Foot Pedal Position 4 and Idle Validation Switch Mismatch
	13	Foot Pedal Position 4 Learned Value Error
000029	03	Foot Pedal Position 3 Input Voltage High
	04	Foot Pedal Position 3 Input Voltage Low
	07	Foot Pedal Position 3 and Idle Validation Switch Mismatch
	13	Foot Pedal Position 3 Learned Value Error
	14	Foot Pedal Position 3 and Foot Pedal Position 4 Mismatch
000051	02	Throttle Position Invalid
	03	Throttle Position Sensor Feedback Voltage High
	04	Throttle Position Sensor Feedback Voltage Low
	07	Throttle Position Sensor Command/Feedback Out of Sync
000091	02	Foot Pedal Invalid
	03	Foot Pedal Position 1 Input Voltage High
	04	Foot Pedal Position 1 Input Voltage Low
	07	Foot Pedal Position 1 and IVS Mismatch
	13	Foot Pedal Position 1 Learned Value Error
000100	14	Foot Pedal Position 1 and Foot Pedal Position 2 Mismatch
	01	Engine Oil Pressure Extremely Low
	03	Engine Oil Pressure Input Voltage High
	04	Engine Oil Pressure Input Voltage Low
	16	Engine Oil Pressure Moderately High
000102	18	Engine Oil Pressure Moderately Low
	02	Manifold Absolute Pressure Cross Check Invalid
	03	Manifold Absolute Pressure Input Voltage High
000105	04	Manifold Absolute Pressure Input Voltage Low
	00	Throttle Charge Temperature Extremely High
	03	Throttle Charge Temperature Input Voltage High
	04	Throttle Charge Temperature Input Voltage Low
	16	Throttle Charge Temperature Moderately High
000108	02	Barometric Air Pressure Cross Check Invalid
	03	Barometric Air Pressure Input Voltage High
	04	Barometric Air Pressure Input Voltage Low
000110	00	Engine Coolant Temperature Extremely High
	03	Engine Coolant Temperature Input Voltage High
	04	Engine Coolant Temperature Input Voltage Low
	15	Engine Coolant Temperature High Least Severe
	16	Engine Coolant Temperature Moderately High
000111	01	Engine Coolant Level Low
000158	02	Intermittent Loss of ECU Power
000159	03	Natural Gas Pressure Input Voltage High
	04	Natural Gas Pressure Input Voltage Low
	16	Natural Gas Pressure Higher Than Expected
	18	Natural Gas Pressure Lower Than Expected
000172	03	Inlet Air Temperature Input Voltage High
	04	Inlet Air Temperature Input Voltage Low
000173	00	Exhaust Temperature Extremely High
	03	Exhaust Temperature Input Voltage High
	04	Exhaust Temperature Input Voltage Low

Continued on next page

RG41221.0000059 -19-08JUL03-1/3

SPN	FMI	Definition
	16	Exhaust Temperature Moderately High
000174	03	Natural Gas Temperature Input Voltage High
	04	Natural Gas Temperature Input Voltage Low
	18	Natural Gas Temperature Lower Than Expected
000175	00	Engine Oil Temperature Extremely High
	03	Engine Oil Temperature Input Voltage High
	04	Engine Oil Temperature Input Voltage Low
	16	Engine Oil Temperature Moderately High
000191	02	Vehicle Driveshaft Speed Invalid
	09	Vehicle Driveshaft Speed Invalid
000523	09	Gear Selection Invalid
000558	02	Primary Foot Pedal Idle Validation Switch Invalid
000620	03	Sensor Supply 3 Voltage High
	04	Sensor Supply 3 Voltage Low
000627	16	ECU Power Supply Voltage Higher Than Expected
	18	ECU Power Supply Voltage Lower Than Expected
000632	07	High Pressure Fuel Regulator Invalid
000636	02	Camshaft Position Sensor Input Noise
	08	Camshaft Position Sensor Input Missing
	10	Camshaft Position Sensor Input Pattern Error
000637	02	Crankshaft Position Sensor Input Noise
	07	Crankshaft Position/Camshaft Position Out of Sync
	08	Crankshaft Position Sensor Input Missing
	10	Crankshaft Position Sensor Input Pattern Error
000639	13	CAN Bus Error
000646	02	Wastegate Control Failure
000651	05	Injector #1 Circuit Open
	06	Injector #1 Circuit Shorted
000652	05	Injector #2 Circuit Open
	06	Injector #2 Circuit Shorted
000653	05	Injector #3 Circuit Open
	06	Injector #3 Circuit Shorted
000654	05	Injector #4 Circuit Open
	06	Injector #4 Circuit Shorted
000655	05	Injector #5 Circuit Open
	06	Injector #5 Circuit Shorted
000656	05	Injector #6 Circuit Open
	06	Injector #6 Circuit Shorted
000657	05	Injector #7 Circuit Open
	06	Injector #7 Circuit Shorted
000658	05	Injector #8 Circuit Open
	06	Injector #8 Circuit Shorted
000724	02	UEGO Sensor Failure
	13	UEGO Sensor Calibration Error
000731	00	Knock Retard Limit Reached
	02	Knock Signal Invalid
	04	Knock Sensor Input Voltage Low
	16	Knock Sensor Error
000970	31	External Shutdown - Auxiliary Request
001079	03	Sensor Supply 1 Voltage High
	04	Sensor Supply 1 Voltage Low
001080	03	Sensor Supply 2 Voltage High
	04	Sensor Supply 2 Voltage Low
001109	31	Engine Protection Shutdown Warning

Continued on next page

RG41221,0000059 -19-08JUL03-2/3

SPN	FMI	Definition
001110	31	Engine Protection Shutdown
001119	00	Exhaust Extremely Lean
	01	Exhaust Extremely Rich
	16	Exhaust Moderately Lean
	18	Exhaust Moderately Rich
001268	03	Ignition Coil #1 Input Voltage High
	04	Ignition Coil #1 Input Voltage Low
001269	03	Ignition Coil #2 Input Voltage High
	04	Ignition Coil #2 Input Voltage Low
001270	03	Ignition Coil #3 Input Voltage High
	04	Ignition Coil #3 Input Voltage Low
001271	03	Ignition Coil #4 Input Voltage High
	04	Ignition Coil #4 Input Voltage Low
001272	03	Ignition Coil #5 Input Voltage High
	04	Ignition Coil #5 Input Voltage Low
001273	03	Ignition Coil #6 Input Voltage High
	04	Ignition Coil #6 Input Voltage Low
001569	31	Fuel Derate
299745	03	Humidity Sensor Input Voltage High
	04	Humidity Sensor Input Voltage Low
299747	02	Low Pressure Lock-Off Signal Invalid
	07	Low Pressure Lock-Off Leak
299748	02	High Pressure Lock-Off Signal Invalid
299752	03	Foot Pedal Position 2 Input Voltage High
	04	Foot Pedal Position 2 Input Voltage Low
	07	Foot Pedal Position 2 and IVS Mismatch
	13	Foot Pedal Position 2 Learned Value Error
524275	03	Knock Supply Voltage High
	04	Knock Supply Voltage Low
524280	03	Natural Gas Tank Temperature Input Voltage High
	04	Natural Gas Tank Temperature Input Voltage Low
524281	03	Natural Gas Tank Pressure Input Voltage High
	04	Natural Gas Tank Pressure Input Voltage Low
	18	Natural Gas Tank Pressure Lower Than Expected
524282	02	Upstream Throttle Pressure Cross Check Invalid
	03	Upstream Throttle Pressure Input Voltage High
	04	Upstream Throttle Pressure Input Voltage Low
524283	03	UEGO Sense Cell Voltage High
	04	UEGO Sense Cell Voltage Low
524284	03	UEGO Calibration Resistor Voltage High
	04	UEGO Calibration Resistor Voltage Low
524285	03	UEGO Reference Voltage High
	04	UEGO Reference Voltage Low
524286	02	UEGO Heater Drive Failure
524287	03	UEGO Pump Cell Voltage High
	04	UEGO Pump Cell Voltage Low

RG41221.0000059 -19-08JUL03-3/3

Listing of Blink Codes on ECU

DTC's Listing in Ascending Blink Code Order

Blink Codes	SPN	FMI	Definition
011	299752	03	Foot Pedal Position 2 Input Voltage High
012	299752	04	Foot Pedal Position 2 Input Voltage Low
013	299752	07	Foot Pedal Position 2 and IVS Mismatch
014	299752	13	Foot Pedal Position 2 Learned Value Error
015	524282	03	Upstream Throttle Pressure Input Voltage High
016	524275	03	Knock Supply Voltage High
017	524275	04	Knock Supply Voltage Low
018	524282	04	Upstream Throttle Pressure Input Voltage Low
019	000029	04	Foot Pedal Position 3 Input Voltage Low
021	524280	03	Natural Gas Tank Temperature Input Voltage High
022	524280	04	Natural Gas Tank Temperature Input Voltage Low
023	000191	09	Vehicle Driveshaft Speed Invalid
024	524281	03	Natural Gas Tank Pressure Input Voltage High
025	524281	04	Natural Gas Tank Pressure Input Voltage Low
026	524281	18	Natural Gas Tank Pressure Lower Than Expected
027	000523	09	Gear Selection Invalid
028	000028	04	Foot Pedal Position 4 Input Voltage Low
029	000029	03	Foot Pedal Position 3 Input Voltage High
031	524282	02	Upstream Throttle Pressure Cross Check Invalid
032	N/A ^a	N/A ^a	When reading blink codes, signifies the start of active codes.
033	N/A ^a	N/A ^a	When reading blink codes, signifies the start of stored codes.
035	000028	03	Foot Pedal Position 4 Input Voltage High
036	000173	04	Exhaust Temperature Input Voltage Low
037	000173	03	Exhaust Temperature Input Voltage High
038	000175	04	Engine Oil Temperature Input Voltage Low
039	000175	03	Engine Oil Temperature Input Voltage High
041	001109	31	Engine Protection Shutdown Warning
042	000029	14	Foot Pedal Position 3 and Foot Pedal Position 4 Mismatch
043	001119	00	Exhaust Extremely Lean
044	001119	01	Exhaust Extremely Rich
045	001119	16	Exhaust Moderately Lean
046	001119	18	Exhaust Moderately Rich
048	000100	16	Engine Oil Pressure Moderately High
049	000028	02	Secondary Foot Pedal Idle Validation Switch Invalid
051	524283	03	UEGO Sense Cell Voltage High
052	524283	04	UEGO Sense Cell Voltage Low
053	524284	03	UEGO Calibration Resistor Voltage High
054	524284	04	UEGO Calibration Resistor Voltage Low
055	524285	03	UEGO Reference Voltage High
056	524285	04	UEGO Reference Voltage Low
057	524286	02	UEGO Heater Drive Failure
058	524287	03	UEGO Pump Cell Voltage High
059	524287	04	UEGO Pump Cell Voltage Low
061	001079	03	Sensor Supply 1 Voltage High
062	001079	04	Sensor Supply 1 Voltage Low
063	001080	03	Sensor Supply 2 Voltage High
064	001080	04	Sensor Supply 2 Voltage Low
066	001110	31	Engine Protection Shutdown
068	000029	07	Foot Pedal Position 3 and Idle Validation Switch Mismatch

^aNot Applicable

Continued on next page

RG41221,00000FA -19-08JUL03-1/4

Blink Codes	SPN	FMI	Definition
069	000028	07	Foot Pedal Position 4 and Idle Validation Switch Mismatch
071	001268	03	Ignition Coil #1 Input Voltage High
072	001268	04	Ignition Coil #1 Input Voltage Low
073	001269	03	Ignition Coil #2 Input Voltage High
074	001269	04	Ignition Coil #2 Input Voltage Low
075	001270	03	Ignition Coil #3 Input Voltage High
076	001270	04	Ignition Coil #3 Input Voltage Low
077	001271	03	Ignition Coil #4 Input Voltage High
078	001271	04	Ignition Coil #4 Input Voltage Low
081	001272	03	Ignition Coil #5 Input Voltage High
081	000029	13	Foot Pedal Position 3 Learned Value Error
082	001272	04	Ignition Coil #5 Input Voltage Low
083	001273	03	Ignition Coil #6 Input Voltage High
084	001273	04	Ignition Coil #6 Input Voltage Low
086	001569	31	Fuel Derate
087	000028	13	Foot Pedal Position 4 Learned Value Error
088	N/A ^a	N/A ^a	When reading blink codes, signifies that no codes are in the buffer.
089	000029	14	Foot Pedal Position 3 and Foot Pedal Position 4 Mismatch.
091	299745	03	Humidity Sensor Input Voltage High
092	299745	04	Humidity Sensor Input Voltage Low
094	299747	02	Low Pressure Lock-Off Signal Invalid
095	299747	07	Low Pressure Lock-Off Leak
097	299748	02	High Pressure Lock-Off Signal Invalid
099	000029	14	Foot Pedal Position 3 and Foot Pedal Position 4 Mismatch
111	000051	02	Throttle Position Invalid
112	000051	03	Throttle Position Sensor Feedback Voltage High
113	000051	04	Throttle Position Sensor Feedback Voltage Low
114	000051	07	Throttle Position Sensor Command/Feedback Out of Sync
116	000173	16	Exhaust Temperature Moderately High
117	000191	02	Vehicle Driveshaft Speed Invalid
117	000084	02	Vehicle Speed Missing
118	000970	31	External Shutdown - Auxiliary Request
119	000173	00	Exhaust Temperature Extremely High
121	000091	02	Foot Pedal Invalid
122	000091	03	Foot Pedal Position 1 Input Voltage High
123	000091	04	Foot Pedal Position 1 Input Voltage Low
124	000091	07	Foot Pedal Position 1 and IVS Mismatch
125	000091	13	Foot Pedal Position 1 Learned Value Error
126	000091	14	Foot Pedal Position 1 and Foot Pedal Position 2 Mismatch
128	000175	16	Engine Oil Temperature Moderately High
129	000175	00	Engine Oil Temperature Extremely High
131	000100	01	Engine Oil Pressure Extremely Low
132	000100	03	Engine Oil Pressure Input Voltage High
133	000100	04	Engine Oil Pressure Input Voltage Low
134	000100	18	Engine Oil Pressure Moderately Low
136	000102	02	Manifold Absolute Pressure Cross Check Invalid
137	000102	03	Manifold Absolute Pressure Input Voltage High
138	000102	04	Manifold Absolute Pressure Input Voltage Low
141	000105	00	Throttle Charge Temperature Extremely High
142	000105	03	Throttle Charge Temperature Input Voltage High
143	000105	04	Throttle Charge Temperature Input Voltage Low
144	000105	16	Throttle Charge Temperature Moderately High
146	000108	02	Barometric Air Pressure Cross Check Invalid

^aNot Applicable

Blink Codes	SPN	FMI	Definition
147	000108	03	Barometric Air Pressure Input Voltage High
148	000108	04	Barometric Air Pressure Input Voltage Low
151	000110	00	Engine Coolant Temperature Extremely High
152	000110	03	Engine Coolant Temperature Input Voltage High
153	000110	04	Engine Coolant Temperature Input Voltage Low
154	000110	15	Engine Coolant Temperature High Least Severe
155	000110	16	Engine Coolant Temperature Moderately High
157	000111	01	Engine Coolant Level Low
161	000158	02	Intermittent Loss of ECU Power
163	000159	03	Natural Gas Pressure Input Voltage High
164	000159	04	Natural Gas Pressure Input Voltage Low
165	000159	16	Natural Gas Pressure Higher Than Expected
166	000159	18	Natural Gas Pressure Lower Than Expected
171	000172	03	Inlet Air Temperature Input Voltage High
172	000172	04	Inlet Air Temperature Input Voltage Low
174	000174	03	Natural Gas Temperature Input Voltage High
175	000174	04	Natural Gas Temperature Input Voltage Low
176	000174	18	Natural Gas Temperature Lower Than Expected
178	000558	02	Primary Foot Pedal Idle Validation Switch Invalid
181	000620	03	Sensor Supply 3 Voltage High
182	000620	04	Sensor Supply 3 Voltage Low
184	000627	16	ECU Power Supply Voltage Higher Than Expected
185	000627	18	ECU Power Supply Voltage Lower Than Expected
187	000632	07	High Pressure Fuel Regulator Invalid
191	000636	02	Camshaft Position Sensor Input Noise
192	000636	08	Camshaft Position Sensor Input Missing
193	000636	10	Camshaft Position Sensor Input Pattern Error
194	000637	02	Crankshaft Position Sensor Input Noise
195	000637	07	Crankshaft Position/Camshaft Position Out of Sync
196	000637	08	Crankshaft Position Sensor Input Missing
197	000637	10	Crankshaft Position Sensor Input Pattern Error
211	000639	13	CAN Bus Error
213	000646	02	Wastegate Control Failure
221	000651	05	Injector #1 Circuit Open
222	000651	06	Injector #1 Circuit Shorted
223	000652	05	Injector #2 Circuit Open
224	000652	06	Injector #2 Circuit Shorted
225	000653	05	Injector #3 Circuit Open
226	000653	06	Injector #3 Circuit Shorted
227	000654	05	Injector #4 Circuit Open
228	000654	06	Injector #4 Circuit Shorted
231	000655	05	Injector #5 Circuit Open
232	000655	06	Injector #5 Circuit Shorted
233	000656	05	Injector #6 Circuit Open
234	000656	06	Injector #6 Circuit Shorted
235	000657	05	Injector #7 Circuit Open
236	000657	06	Injector #7 Circuit Shorted
237	000658	05	Injector #8 Circuit Open
238	000658	06	Injector #8 Circuit Shorted
241	000724	02	UEGO Sensor Failure
242	000724	13	UEGO Sensor Calibration Error
251	000731	00	Knock Retard Limit Reached
252	000731	02	Knock Signal Invalid

Continued on next page

RG41221,00000FA -19-08JUL03-3/4

Electronic Engine Controls Diagnostics

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Blink Codes	SPN	FMI	Definition
253	000731	04	Knock Sensor Input Voltage Low
254	000731	16	Knock Sensor Error

RG41221,00000FA -19-08JUL03-4/4

Diagnostic Procedure

Diagnosis of the electronic control system should be performed according to the following procedure:

1. Make sure all engine mechanical and other systems not related to the electronic control system are operating properly.
2. Read and record DTC(s).
3. Go to the diagnostic chart that corresponds to the DTC(s) present.

NOTE: If more than one DTC is present, go to the chart corresponding to the lowest number DTC and diagnose that problem to correction unless directed to do otherwise.

4. If no DTC(s) are present, proceed to the appropriate symptom for observable diagnostic charts in Group 105.
5. After any repairs are made, recheck to make sure all DTCs have been eliminated.

NOTE: After using the DST or SERVICE ADVISOR™, always replace the dust cover on the diagnostic connector.

IMPORTANT: Care should be used during diagnostic procedures to avoid damaging the terminals of connectors, sensors, and actuators. Probes should not be poked into or around the terminals or damage will result. Probes should only be touched against the terminals to make measurements. It is recommended that JT07328 Connector Adapter Test Kit be used to make measurements in connectors, sensors, and actuators. These adapters will ensure that terminal damage does not occur.

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RG41221,000005B -19-14SEP01-1/1

INTERMITTENT FAULT DIAGNOSTICS

Intermittent faults are problems that periodically “go away”. A problem such as a loose terminal that intermittently doesn’t make contact is a likely cause of an intermittent fault. Other intermittent faults may be set only under certain operating conditions such as heavy load, extended idle, etc. When diagnosing intermittent faults, take special note of the condition of wiring and connectors since a high percentage of intermittent problems originate here. Check for loose, dirty, or disconnected connectors. Inspect the wiring routing looking for possible shorts caused by contact with external parts (for example, rubbing against sharp sheet metal edges). Inspect the connector vicinity looking for wires that have pulled out of connector terminals, damaged connectors, poorly positioned terminals, and corroded or damaged terminals. Look for broken wires, damaged splices, and wire-to-wire shorts. Use good judgement if component replacement is thought to be required.

NOTE: The ECU is the component LEAST likely to fail.

Suggestions for diagnosing intermittent faults:

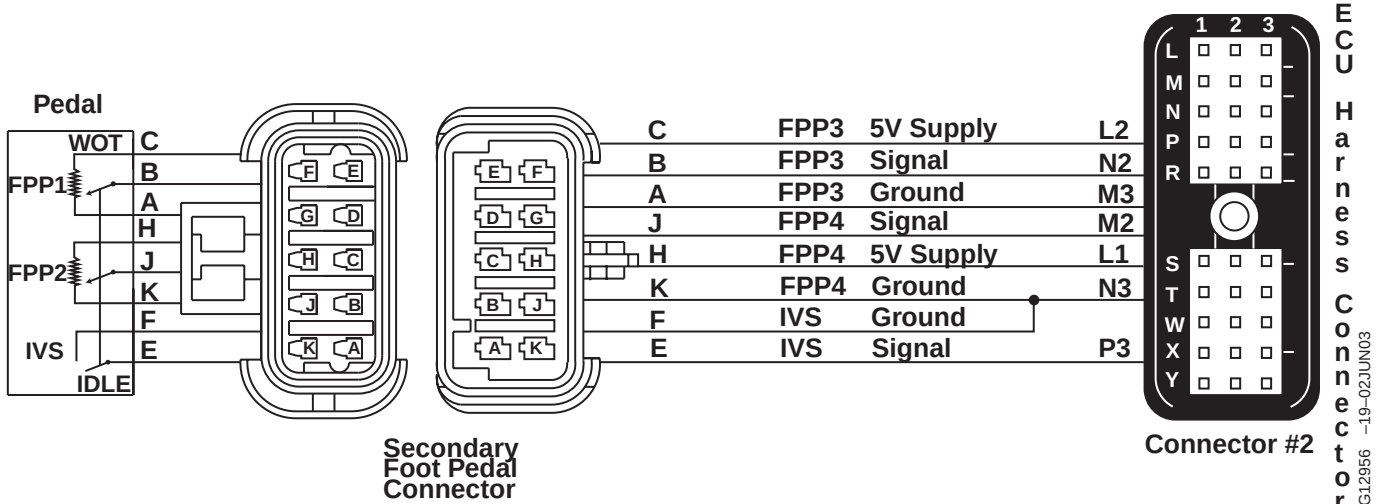
- If diagnostic chart indicates that the problem is intermittent, try to reproduce the operating conditions that were present when the DTC set. The Diagnostic Scan Tool (DST) or SERVICE ADVISOR™ can be used to help locate intermittent problems, as it

includes a function called Recording. The Recording function permits the recording of data parameter values during a diagnostic session. If a DTC sets during a certain diagnostic session, the parameters can be played back and observed to see what each parameter’s value was when the DTC occurred.

- If a faulty connection or wire is suspected to be the cause of the intermittent problem: clear DTCs, then check the connection or wire by wiggling it while watching the DST or SERVICE ADVISOR™ to see if the fault resets.
- To check the connection between the harness and a sensor or the harness and the ECU, use JT07328 Connector Adapter Test Kit. Insert the male end of the appropriate test adapter into the female end of the ECU or sensor connector terminal. There should be moderate resistance when the test adapter is inserted into the terminal. If the connection is loose, replace the female terminal.

Possible Causes of Intermittent Faults:

- Faulty connection between sensor or actuator and harness.
- Faulty contact between terminals in connector.
- Faulty terminal/wire connection.
- Electromagnetic interference (EMI) from an improperly installed 2-way radio, etc. can cause faulty signals to be sent to the ECU.
- Faulty ground feedback problems.

000028.02 — Secondary Foot Pedal Idle Validation Switch Invalid

NOTE: Some applications have an option for two foot pedal assemblies. If this code sets, use the following diagnostics for the secondary foot pedal.

Foot Pedal Position (FPP) Sensor

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000028.02 will set if:

- ECU detects a secondary foot pedal position of 2% or less **AND** an idle validation switch status of OFF **OR**

ECU detects a secondary foot pedal position of 27% or more **AND** an idle validation switch status of ON

If DTC 000028.02 sets, the following will occur:

- Adaptive learn disabled for remainder of key-on cycle
- Depending on whether or not there are other fault codes, one of the following will occur:
 - No change in driveability
 - Reduced engine power and degraded driveability
- If the ECU cannot validate any of the three signals (FPP3, FPP4, or IVS) on the secondary foot pedal, the ECU will limit the engine to low idle.
- ECU will set a SOLID Warning light.

RG41221,0000138 -19-20MAY03-1/1

000028.02 — Secondary Foot Pedal Idle Validation Switch Invalid

The secondary foot pedal position sensors and the idle validation switch do not agree on foot pedal position.

RG41221,0000174 -19-08JUL03-1/1

000028.02 Foot Pedal Invalid Diagnostic Procedure

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000028.02 SECONDARY FOOT PEDAL IDLE VALIDATION SWITCH INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000028.02 SECONDARY FOOT PEDAL IDLE VALIDATION SWITCH INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Secondary foot pedal in the idle position, using DST or SERVICE ADVISOR™ read Secondary Foot Pedal Idle Validation Switch Status. 7. Move foot pedal through full travel while using DST or SERVICE ADVISOR™ to read Secondary Foot Pedal Idle Validation Switch Status.	IVS status is OFF at idle: GO TO ❸ IVS status is ON when foot pedal is depressed: GO TO ❹ IVS status is ON at idle and OFF at full depression: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ IVS Signal Circuit Shorted Test

NOTE: For wiring and theory of operation information, see DTC 000028.02 SECONDARY FOOT PEDAL IDLE VALIDATION SWITCH INVALID supporting information.

1. Ignition OFF
2. Disconnect the secondary foot pedal connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read Secondary Foot Pedal Idle Validation Switch Status.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

IVS is OFF:

Short to ground in IVS signal circuit
OR
Faulty ECU connection
OR
Faulty ECU

IVS is ON:

Faulty idle validation switch.
Replace foot pedal and retest.

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④ IVS Test

NOTE: For wiring and theory of operation information, see DTC 000028.02 SECONDARY FOOT PEDAL IDLE VALIDATION SWITCH INVALID supporting information.

1. Ignition OFF
2. Disconnect secondary foot pedal connector from vehicle harness.
3. Install a jumper wire between the IVS signal terminal and the IVS ground terminal (terminals E and F) in the foot pedal connector on the vehicle harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read the Secondary Foot Pedal Idle Validation Switch Status.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

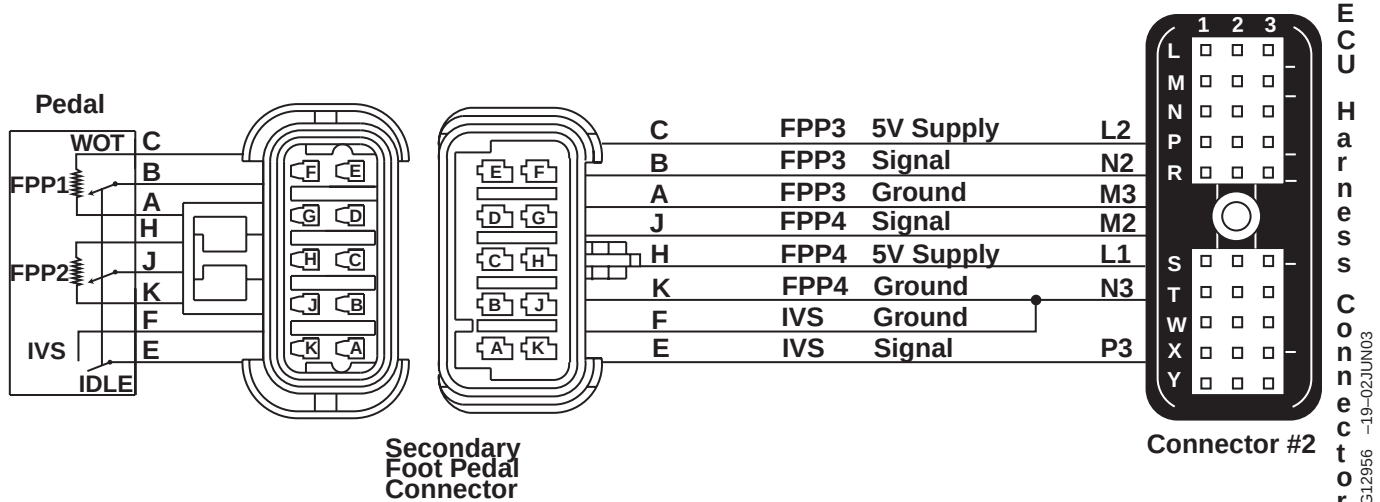
**IVS is ON:
GO TO ⑤****IVS is OFF:**

Faulty idle validation switch.
Replace foot pedal and retest.

-- -1/1

5 IVS Signal Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000028.02 SECONDARY FOOT PEDAL IDLE VALIDATION SWITCH INVALID supporting information.</i> 1. Ignition OFF 2. Remove jumper wires 3. Install a jumper wire between the IVS signal terminal (terminal E) in the foot pedal connector on the vehicle harness and a good chassis ground. 4. Ignition ON, engine OFF 5. Using the ECU diagnostic software, read the Secondary Foot Pedal Idle Validation Switch Status.	IVS is ON: Open in IVS signal circuit OR Faulty ECU connection OR Faulty ECU IVS is OFF: Open in IVS ground circuit OR Faulty foot pedal connection	115 65

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000028.03 — Foot Pedal Position 4 Input Voltage High**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000028.03 will set if:

- FPP4 input voltage exceeds a maximum voltage threshold of 4.9 volts. This voltage corresponds to a position that is higher than what is physically possible for the foot pedal.

If DTC 000028.03 sets, the following will occur:

- Foot Pedal Position 4 Input Voltage will default to 0 volts.
- The ECU will use the foot pedal position 3 sensor signal.
- DTC 001079.03 may also be present.
- ECU will set a SOLID Warning light.

RG41221,000013A -19-27MAY03-1/1

000028.03 — Foot Pedal Position 4 Input Voltage High

FPP4 input voltage exceeds a maximum voltage threshold.

RG41221,000013C -19-08JUL03-1/1

000028.03 Foot Pedal Position 4 Input Voltage High Diagnostic Procedure

NOTE: If DTC 000028.03 is accompanied with 001079.03, diagnose 001079.03 first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

-- -1/1

❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000028.03 FOOT PEDAL POSITION 4 INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

② DTC Test

NOTE: For wiring and theory of operation information, see DTC 000028.03 FOOT PEDAL POSITION 4 INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000028.03 reoccurs:
GO TO **④**

000028.03 doesn't reoccur:
GO TO **③**

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③ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000028.03 FOOT PEDAL POSITION 4 INPUT VOLTAGE HIGH supporting information.

1. Ignition ON, engine OFF
2. Diagnostic software still communicating with ECU.
3. Make note of any DTCs, then clear all DTCs.
4. Slowly depress secondary foot pedal through full travel and back to idle several times.
5. Using the ECU diagnostic software, read DTCs.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

000028.03 reoccurs:

Faulty foot pedal connection
OR
Faulty FPP1 sensor.
Replace foot pedal and retest.

000028.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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④ FPP4 Signal Shorted Test

NOTE: For wiring and theory of operation information, see DTC 000028.03 FOOT PEDAL POSITION 4 INPUT VOLTAGE HIGH supporting information.

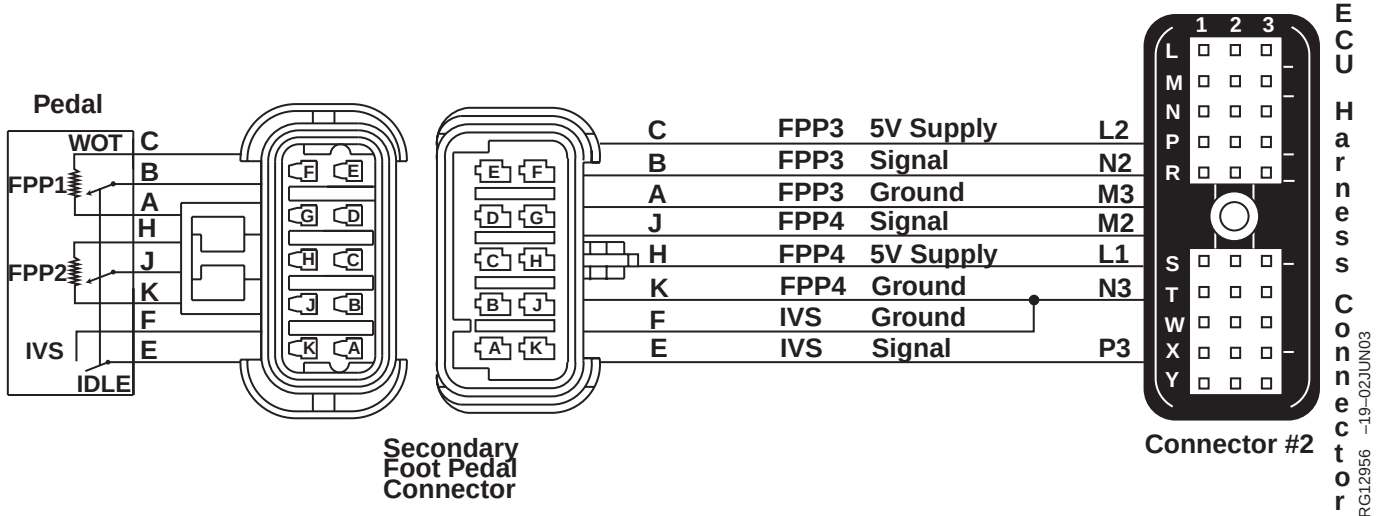
1. Ignition OFF
2. Disconnect secondary foot pedal connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read DTCs.

000028.04 occurs:
GO TO **⑤**

000028.04 doesn't occur:
Short to voltage in FPP4 sensor signal circuit
OR
Faulty ECU connection
OR
Faulty ECU

-- -1/1

5 FPP4 Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation information, see DTC 000028.03 FOOT PEDAL POSITION 4 INPUT VOLTAGE HIGH supporting information.</i> 1. Secondary foot pedal connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the FPP4 sensor ground (terminal K) of the foot pedal connector on the vehicle harness with a test light connected to battery voltage. <i>NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.</i>	Light ON: Faulty FPP4 sensor OR Faulty ECU connection OR Faulty ECU Light OFF: Open in FPP4 sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1	115 69

000028.04 — Foot Pedal Position 4 Input Voltage Low**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000028.04 will set if:

- FPP4 input voltage drops below 0.2 volts. This voltage corresponds to a position that is lower than what is physically possible for the foot pedal.

If DTC 000028.04 sets, the following will occur:

- Foot Pedal Position 4 Input Voltage will default to 0 volts.
- The ECU will use the foot pedal position 3 sensor signal.
- DTC 001079.04 may also be present.
- ECU will set a SOLID Warning light.

RG41221,000013D -19-27MAY03-1/1

000028.04 — Foot Pedal Position 4 Input Voltage Low

FPP4 input voltage below the minimum voltage threshold.

RG41221,000013E -19-08JUL03-1/1

000028.04 Foot Pedal Position 4 Input Voltage Low Diagnostic Procedure

NOTE: If DTC 000028.04 is accompanied with 001079.04, diagnose 001079.04 first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000028.04 FOOT PEDAL POSITION 4 INPUT VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

2 DTC Test

NOTE: For wiring and theory of operation information, see DTC 000028.04 FOOT PEDAL POSITION 4 INPUT VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000028.04 reoccurs:
GO TO **4**

000028.04 doesn't reoccur:
GO TO **3**

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3 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000028.04 FOOT PEDAL POSITION 4 INPUT VOLTAGE LOW supporting information.

1. Ignition ON, engine OFF
2. Slowly depress secondary foot pedal through full travel.
3. Using the ECU diagnostic software, read DTCs.

000028.04 reoccurs:
GO TO **4**

000028.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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4 FPP4 Sensor Ground Wire Test

NOTE: For wiring and theory of operation information, see DTC 000028.04 FOOT PEDAL POSITION 4 INPUT VOLTAGE LOW supporting information.

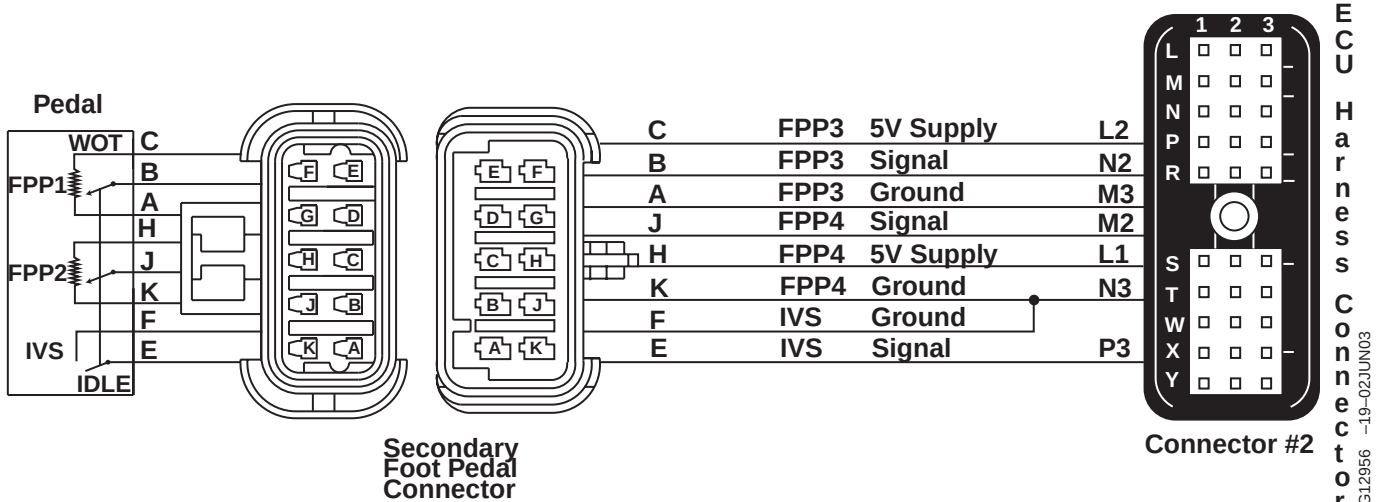
1. Ignition OFF
2. Disconnect the secondary foot pedal connector.
3. Ignition ON, engine OFF
4. Probe the FPP4 sensor ground wire (terminal K) of the foot pedal connector on the vehicle harness with a test light connected to battery voltage.

Light ON:
GO TO **5**

Light OFF:
Open in FPP4 sensor ground circuit
OR
Faulty ECU connection
OR
Faulty ECU

-- -1/1

5 FPP4 5V Supply Test	<i>NOTE: For wiring and theory of operation information, see DTC 000028.04 FOOT PEDAL POSITION 4 INPUT VOLTAGE LOW supporting information.</i> 1. Secondary foot pedal connector still disconnected. 2. Ignition ON, engine OFF 3. Using a multimeter, measure voltage between the 5V supply (terminal H) of the foot pedal connector on the vehicle harness and a good chassis ground.	4.0 - 6.0 volts: GO TO 6 Below 4.0 volts: Open in FPP4 sensor 5V supply circuit OR Short to ground in FPP4 sensor 5V supply circuit OR Faulty ECU connection OR Faulty ECU -- -1/1	115 73
6 FPP4 Signal Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000028.04 FOOT PEDAL POSITION 4 INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Secondary foot pedal connector still disconnected. 3. Disconnect ECU connector #2 (black L-Y). 4. Using a multimeter, measure resistance between terminal M2 in the ECU connector and terminal J in the foot pedal connector on the vehicle harness. <i>NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.</i>	5 ohms or less: Faulty foot pedal connection OR Faulty foot pedal Greater than 5 ohms: Short to ground in FPP4 signal wire OR Faulty ECU connection OR Faulty ECU -- -1/1	

000028.07 — Foot Pedal Position 4 and Idle Validation Switch Mismatch**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000028.07 will set if:

- Idle Validation Switch in ON when Foot Pedal Position 4 Input Voltage is 1.35 volts or more.
- Idle Validation Switch in OFF when Foot Pedal Position 4 Input Voltage is 0.1 volts or more.

If DTC 000028.07 sets, the following will occur:

- The ECU will use the foot pedal position sensor 3 signal.
- DTC 000028.02, 000028.03, or 000028.04 may also be present.
- ECU will set a SOLID Warning light.

RG41221,000013F -19-27MAY03-1/1

000028.07 — Foot Pedal Position 4 and Idle Validation Switch Mismatch

The foot pedal position 4 input voltage disagrees with the idle validation switch.

RG41221,0000140 -19-08JUL03-1/1

000028.07 Foot Pedal Position 4 Input Voltage and Idle Validation Switch Mismatch Diagnostic Procedure

NOTE: If DTC 000028.07 is accompanied with 000028.02, 000028.03, or 000028.04, diagnose them first.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000028.07 FOOT PEDAL POSITION 4 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

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❷ DTC Test

NOTE: For wiring and theory of operation information, see DTC 000028.07 FOOT PEDAL POSITION 4 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Slowly depress secondary foot pedal through full travel a couple of times.
7. Read DTCs using DST or SERVICE ADVISOR™.

Only 000028.07 reoccurs:
GO TO ❸

000028.02, 000028.03, or 000028.04 reoccurs:
Follow that diagnostic procedure.

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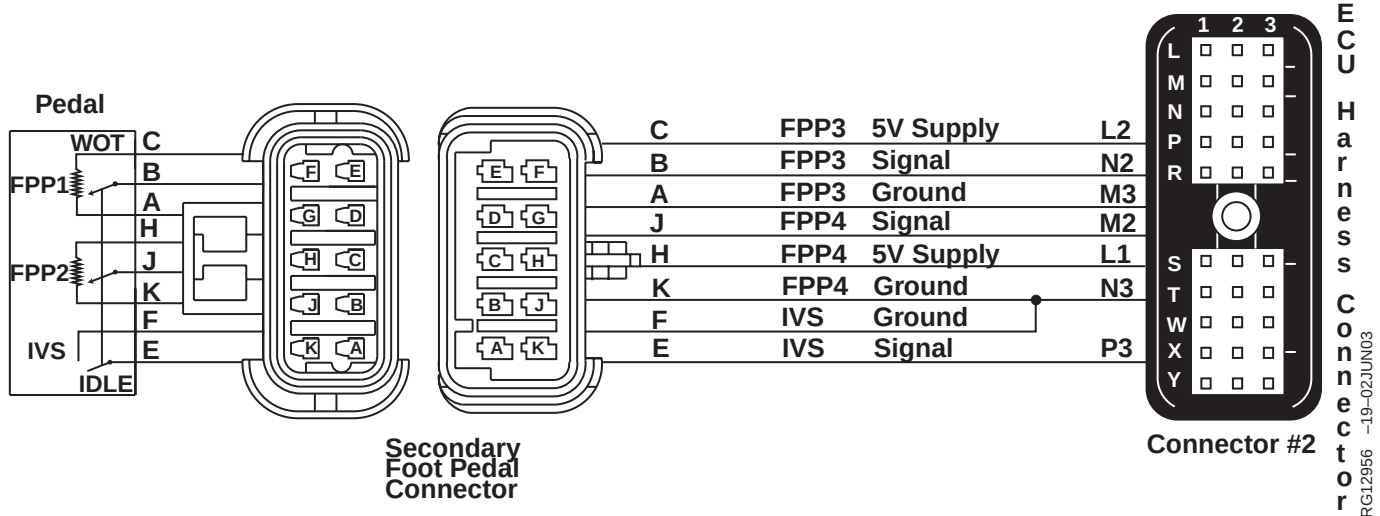
③ Foot Pedal Position 1
Sensor Wiring Check

NOTE: For wiring and theory of operation information, see DTC 000028.07 FOOT PEDAL POSITION 4 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the secondary foot pedal connector.
3. Using a multimeter, measure resistance between the following:
 - Terminal L1 in the ECU connector and terminal H in the foot pedal connector on the vehicle harness.
 - Terminal M2 in the ECU connector and terminal J in the foot pedal connector on the vehicle harness.
 - Terminal N3 in the ECU connector and terminal K in the foot pedal connector on the vehicle harness.

All measurements 5 ohms or less:
Faulty foot pedal.
Replace and retest.

Any measurement greater than 5 ohms less:
Short in wire that produces high resistance.

000028.13 — Foot Pedal Position 4 Learned Value Error**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000028.13 will set if:

- The foot pedal position 4 voltage exceeds the upper learned value or drops below the lower learned value.
 - Foot pedal position 4 voltage exceeds 4.6 volts.
 - Foot pedal position 4 voltage drops below 0.2 volts.

If DTC 000028.13 sets, the following will occur:

- The ECU will use the foot pedal position sensor 3 signal.
- Learned value is reset after key cycle.
- DTC 000028.02, 000028.03, or 000028.04 may also be present.
- ECU will set a SOLID Warning light.

000028.13 — Foot Pedal Position 4 Learned Value Error

The foot pedal position 1 voltage exceeds the upper learned value or drops below the lower learned value.

RG41221,0000142 -19-08JUL03-1/1

000028.13 Foot Pedal Position 4 Learned Value Error Diagnostic Procedure

NOTE: If DTC 000028.13 is accompanied with 000028.02, 000028.03, or 000028.04, diagnose them first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000028.13 FOOT PEDAL POSITION 4 LEARNED VALUE ERROR supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ DTC Test	<i>NOTE: For wiring and theory of operation information, see DTC 000028.13 FOOT PEDAL POSITION 4 LEARNED VALUE ERROR supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Slowly depress secondary foot pedal through full travel a couple of times. 7. Read DTCs using DST or SERVICE ADVISOR™.	000028.13 reoccurs: GO TO ❸ 000028.13 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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**③ Foot Pedal Position 4
Sensor Wiring Check**

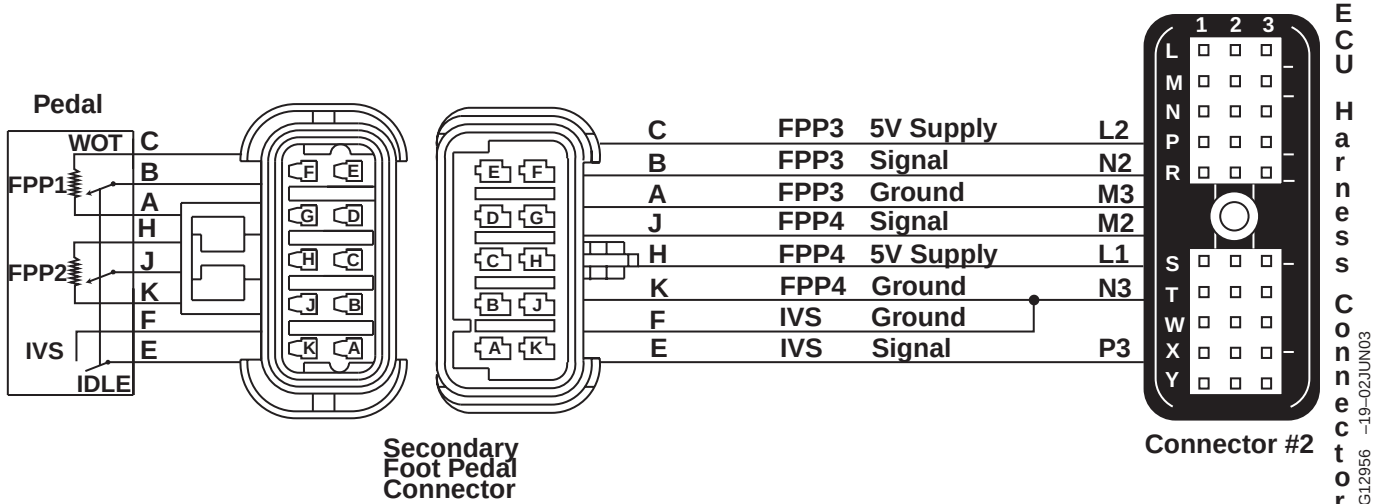
*NOTE: For wiring and theory of operation information, see DTC 000028.13 FOOT
PEDAL POSITION 4 LEARNED VALUE ERROR supporting information.*

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the secondary foot pedal connector.
3. Using a multimeter, measure resistance between the following:
 - Terminal L1 in the ECU connector and terminal H in the foot pedal connector on the vehicle harness.
 - Terminal M2 in the ECU connector and terminal J in the foot pedal connector on the vehicle harness.
 - Terminal N3 in the ECU connector and terminal K in the foot pedal connector on the vehicle harness.

**All measurements 5
ohms or less:**
Faulty foot pedal.
Replace and retest.

**Any measurement
greater than 5 ohms
less:**
Short in wire that
produces high resistance.

-- -1/1

000029.03 — Foot Pedal Position 3 Input Voltage High**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000029.03 will set if:

- FPP3 input voltage exceeds a maximum voltage threshold of 4.9 volts. This voltage corresponds to a position that is higher than what is physically possible for the foot pedal.

If DTC 000029.03 sets, the following will occur:

- Foot Pedal Position 3 Input Voltage will default to 0 volts.
- The ECU will use the foot pedal position 4 sensor signal.
- DTC 001080.03 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000143 -19-28MAY03-1/1

000029.03 — Foot Pedal Position 3 Input Voltage High

FPP3 input voltage exceeds a maximum voltage threshold.

RG41221,0000144 -19-08JUL03-1/1

000029.03 Foot Pedal Position 3 Input Voltage High Diagnostic Procedure

NOTE: If DTC 000029.03 is accompanied with 001080.03, diagnose 001080.03 first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000029.03 FOOT PEDAL POSITION 3 INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

2 DTC Test

NOTE: For wiring and theory of operation information, see DTC 000029.03 FOOT PEDAL POSITION 3 INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000029.03 reoccurs:
GO TO **4**

000029.03 doesn't reoccur:
GO TO **3**

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3 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000029.03 FOOT PEDAL POSITION 3 INPUT VOLTAGE HIGH supporting information.

1. Ignition ON, engine OFF
2. Diagnostic software still communicating with ECU.
3. Make note of any DTCs, then clear all DTCs.
4. Slowly depress secondary foot pedal through full travel and back to idle several times.
5. Using the ECU diagnostic software, read DTCs.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

000029.03 reoccurs:

Faulty foot pedal connection
OR
Faulty FPP3 sensor.
Replace foot pedal and retest.

000029.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

-- -1/1

4 FPP3 Signal Shorted Test

NOTE: For wiring and theory of operation information, see DTC 000029.03 FOOT PEDAL POSITION 3 INPUT VOLTAGE HIGH supporting information.

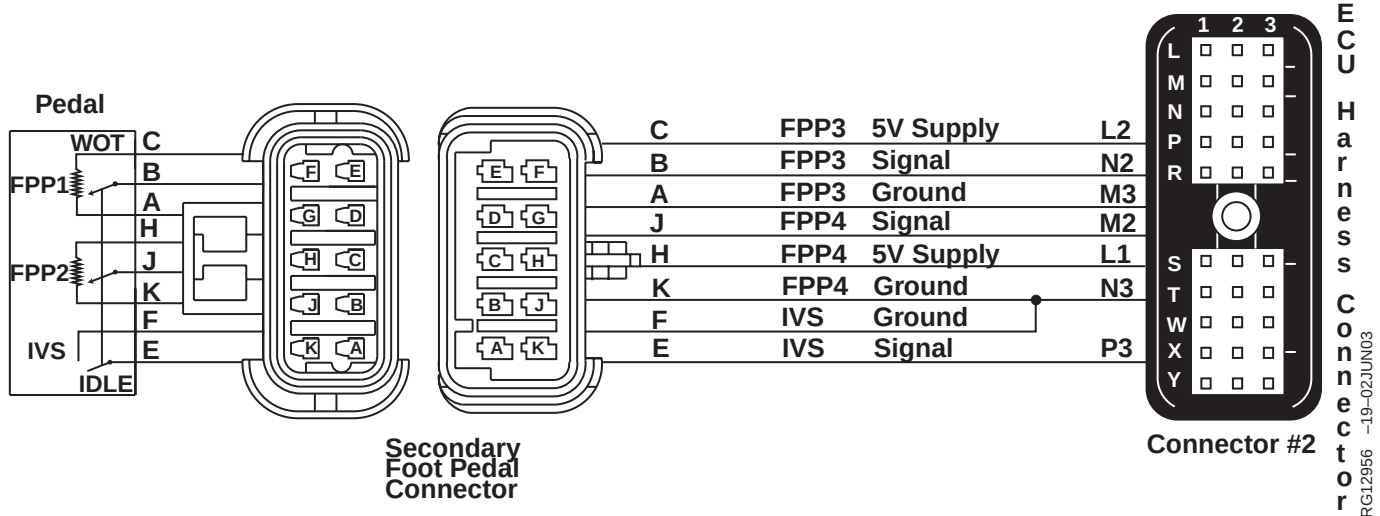
1. Ignition OFF
2. Disconnect secondary foot pedal connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read DTCs.

000029.04 occurs:
GO TO **5**

000029.04 doesn't occur:
Short to voltage in FPP3 sensor signal circuit
OR
Faulty ECU connection
OR
Faulty ECU

-- -1/1

5 FPP3 Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation information, see DTC 000029.03 FOOT PEDAL POSITION 3 INPUT VOLTAGE HIGH supporting information.</i> 1. Secondary foot pedal connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the FPP4 sensor ground (terminal K) of the foot pedal connector on the vehicle harness with a test light connected to battery voltage. <i>NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.</i>	Light ON: Faulty FPP3 sensor OR Faulty ECU connection OR Faulty ECU Light OFF: Open in FPP3 sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1	115 85

000029.04 — Foot Pedal Position 3 Input Voltage Low**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000029.04 will set if:

- FPP3 input voltage drops below 0.2 volts. This voltage corresponds to a position that is lower than what is physically possible for the foot pedal.

If DTC 000029.04 sets, the following will occur:

- Foot Pedal Position 3 Input Voltage will default to 0 volts.
- The ECU will use the foot pedal position 4 sensor signal.
- DTC 001080.04 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000145 -19-28MAY03-1/1

000029.04 — Foot Pedal Position 3 Input Voltage Low

FPP3 input voltage below the minimum voltage threshold.

RG41221,0000146 -19-08JUL03-1/1

000029.04 Foot Pedal Position 3 Input Voltage Low Diagnostic Procedure

NOTE: If DTC 000029.04 is accompanied with 001080.04, diagnose 001080.04 first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

-- -1/1

❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000029.04 FOOT PEDAL POSITION 3 INPUT VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

2 DTC Test

NOTE: For wiring and theory of operation information, see DTC 000029.04 FOOT PEDAL POSITION 3 INPUT VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000029.04 reoccurs:
GO TO **4**

000029.04 doesn't reoccur:
GO TO **3**

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3 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000029.04 FOOT PEDAL POSITION 3 INPUT VOLTAGE LOW supporting information.

1. Ignition ON, engine OFF
2. Slowly depress secondary foot pedal through full travel.
3. Using the ECU diagnostic software, read DTCs.

000029.04 reoccurs:
GO TO **4**

000029.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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4 FPP3 Sensor Ground Wire Test

NOTE: For wiring and theory of operation information, see DTC 000029.04 FOOT PEDAL POSITION 3 INPUT VOLTAGE LOW supporting information.

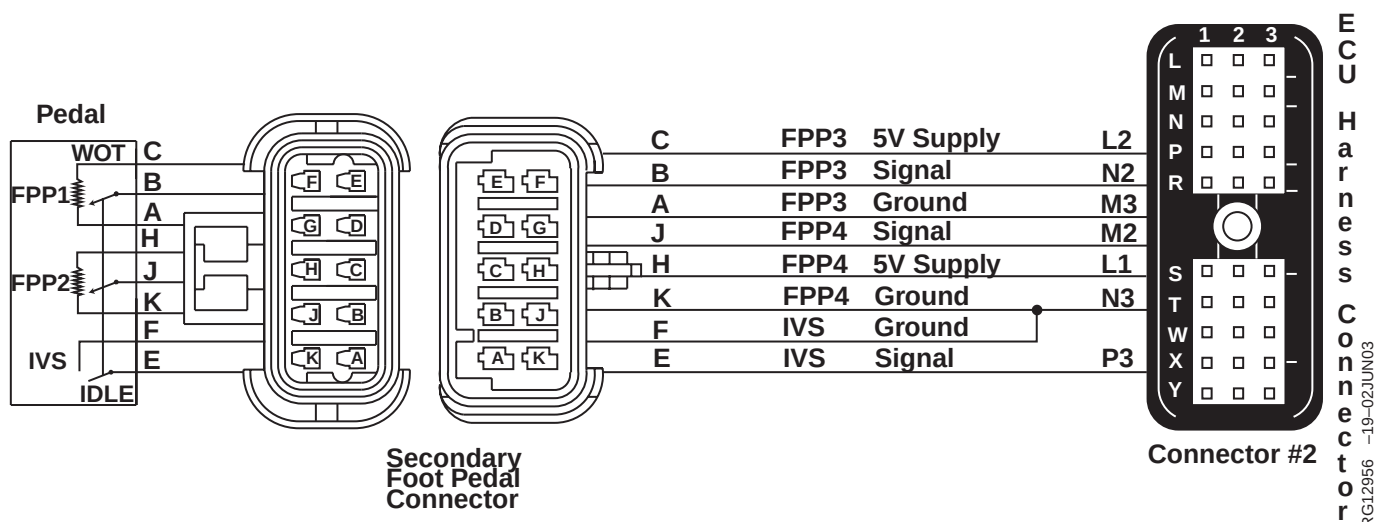
1. Ignition OFF
2. Disconnect the secondary foot pedal connector.
3. Ignition ON, engine OFF
4. Probe the FPP3 sensor ground wire (terminal A) of the foot pedal connector on the vehicle harness with a test light connected to battery voltage.

Light ON:
GO TO **5**

Light OFF:
Open in FPP3 sensor ground circuit
OR
Faulty ECU connection
OR
Faulty ECU

-- -1/1

5 FPP3 5V Supply Test	<i>NOTE: For wiring and theory of operation information, see DTC 000029.04 FOOT PEDAL POSITION 3 INPUT VOLTAGE LOW supporting information.</i> 1. Secondary foot pedal connector still disconnected. 2. Ignition ON, engine OFF 3. Using a multimeter, measure voltage between the 5V supply (terminal C) of the foot pedal connector on the vehicle harness and a good chassis ground.	4.0 - 6.0 volts: GO TO 6 Below 4.0 volts: Open in FPP3 sensor 5V supply circuit OR Short to ground in FPP3 sensor 5V supply circuit OR Faulty ECU connection OR Faulty ECU -- -1/1	115 89
6 FPP3 Signal Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000029.04 FOOT PEDAL POSITION 3 INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Foot pedal connector still disconnected. 3. Disconnect ECU connector #2 (black L-Y). 4. Using a multimeter, measure resistance between terminal N2 in the ECU connector and terminal B in the foot pedal connector on the vehicle harness. <i>NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.</i>	5 ohms or less: Faulty foot pedal connection OR Faulty foot pedal Greater than 5 ohms: Short to ground in FPP3 signal wire OR Faulty ECU connection OR Faulty ECU -- -1/1	

000029.07 — Foot Pedal Position 3 and Idle Validation Switch Mismatch**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000029.07 will set if:

- Idle Validation Switch in ON when Foot Pedal Position 3 Input Voltage is 1.35 volts or more.
- Idle Validation Switch in OFF when Foot Pedal Position 3 Input Voltage is 0.1 volts or more.

If DTC 000029.07 sets, the following will occur:

- The ECU will use the foot pedal position sensor 4 signal.
- DTC 000028.02, 000029.03, or 000029.04 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000147 -19-28MAY03-1/1

000029.07 — Foot Pedal Position 3 and Idle Validation Switch Mismatch

The foot pedal position 3 input voltage disagrees with the idle validation switch.

RG41221,0000148 -19-08JUL03-1/1

000029.07 Foot Pedal Position 3 Input Voltage and Idle Validation Switch Mismatch Diagnostic Procedure

NOTE: If DTC 000029.07 is accompanied with 000028.02, 000029.03, or 000029.04, diagnose them first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000029.07 FOOT PEDAL POSITION 3 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ DTC Test	<i>NOTE: For wiring and theory of operation information, see DTC 000029.07 FOOT PEDAL POSITION 3 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Slowly depress secondary foot pedal through full travel a couple of times. 7. Read DTCs using DST or SERVICE ADVISOR™.	Only 000029.07 reoccurs: GO TO ❸ 000028.02, 000029.03, or 000029.04 reoccurs: Follow that diagnostic procedure.

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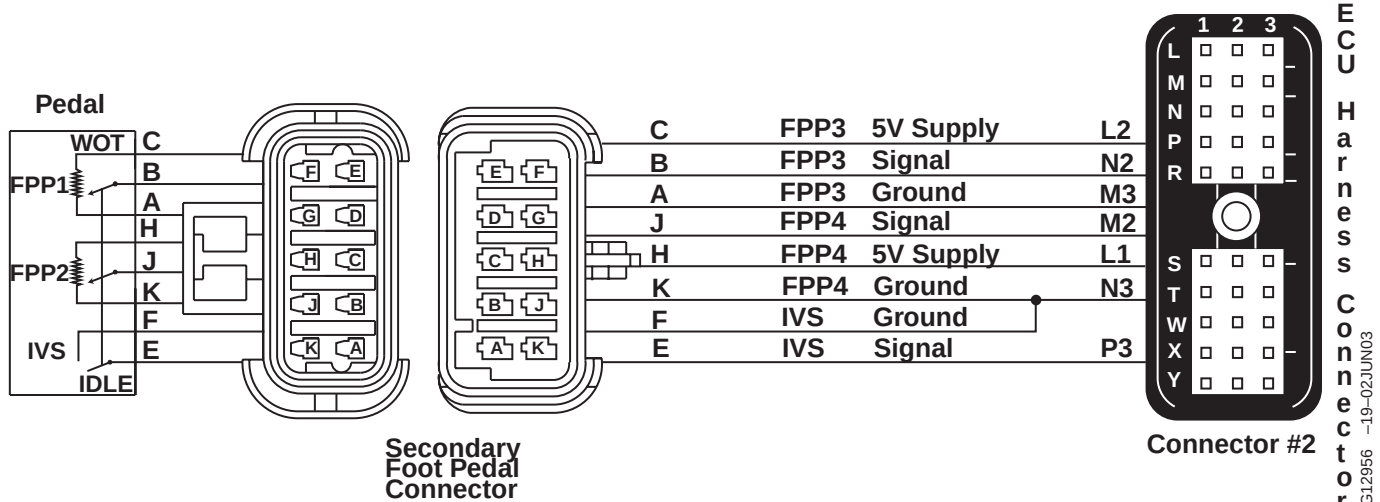
**③ Foot Pedal Position 3
Sensor Wiring Check**

NOTE: For wiring and theory of operation information, see DTC 000029.07 FOOT PEDAL POSITION 3 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the secondary foot pedal connector.
3. Using a multimeter, measure resistance between the following:
 - Terminal L2 in the ECU connector and terminal C in the foot pedal connector on the vehicle harness.
 - Terminal N2 in the ECU connector and terminal B in the foot pedal connector on the vehicle harness.
 - Terminal M3 in the ECU connector and terminal A in the foot pedal connector on the vehicle harness.

All measurements 5 ohms or less:
Faulty foot pedal.
Replace and retest.

Any measurement greater than 5 ohms less:
Short in wire that produces high resistance.

000029.13 — Foot Pedal Position 3 Learned Value Error**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000029.13 will set if:

- The foot pedal position 3 voltage exceeds the upper learned value or drops below the lower learned value.
 - Foot pedal position 3 voltage exceeds 4.6 volts.
 - Foot pedal position 3 voltage drops below 0.2 volts.

If DTC 000029.13 sets, the following will occur:

- The ECU will use the foot pedal position sensor 4 signal.
- Learned value is reset after key cycle.
- DTC 000028.02, 000029.03, or 000029.04 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000149 -19-28MAY03-1/1

000029.13 — Foot Pedal Position 3 Learned Value Error

The foot pedal position 3 voltage exceeds the upper learned value or drops below the lower learned value.

RG41221,000014A -19-28MAY03-1/1

000029.13 Foot Pedal Position 3 Learned Value Error Diagnostic Procedure

NOTE: If DTC 000029.13 is accompanied with 000028.02, 000029.03, or 000029.04, diagnose them first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000029.13 FOOT PEDAL POSITION 3 LEARNED VALUE ERROR supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ DTC Test	<i>NOTE: For wiring and theory of operation information, see DTC 000029.13 FOOT PEDAL POSITION 3 LEARNED VALUE ERROR supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Slowly depress secondary foot pedal through full travel a couple of times. 7. Read DTCs using DST or SERVICE ADVISOR™.	000029.13 reoccurs: GO TO ❸ 000029.13 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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**③ Foot Pedal Position 3
Sensor Wiring Check**

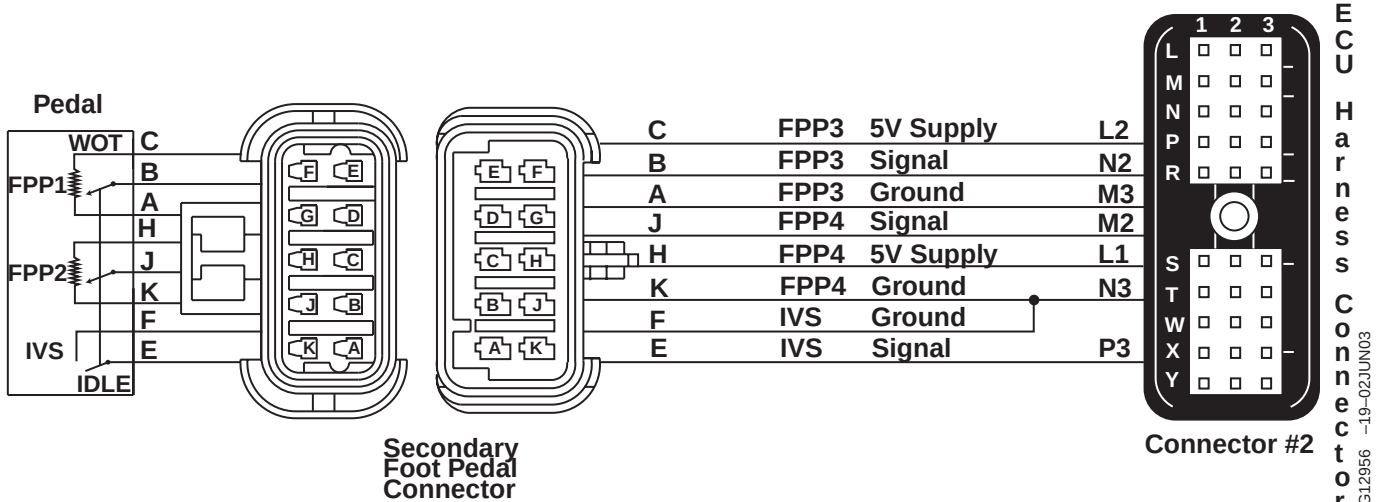
*NOTE: For wiring and theory of operation information, see DTC 000029.13 FOOT
PEDAL POSITION 3 LEARNED VALUE ERROR supporting information.*

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the secondary foot pedal connector.
3. Using a multimeter, measure resistance between the following:
 - Terminal L2 in the ECU connector and terminal C in the foot pedal connector on the vehicle harness.
 - Terminal N2 in the ECU connector and terminal B in the foot pedal connector on the vehicle harness.
 - Terminal M3 in the ECU connector and terminal A in the foot pedal connector on the vehicle harness.

**All measurements 5
ohms or less:**
Faulty foot pedal.
Replace and retest.

**Any measurement
greater than 5 ohms
less:**
Short in wire that
produces high resistance.

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000029.14 — Foot Pedal Position 3 and Foot Pedal Position 4 Mismatch**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000029.14 will set if:

- The absolute value of $|FPP3 \text{ volts} - FPP4 \text{ volts}|$ is greater than or equal to 1.5 volts.
- The absolute value of $|FPP3 \text{ volts} - FPP4 \text{ volts}|$ is less than or equal to 0.05 volts when FPP3 volts is greater than 3 volts.

NOTE: The absolute value of any number is that number. This means the absolute value of -6 is 6. For example: FPP3 volts is 1.3V and FPP4 volts is 2.9V. $|1.3 - 2.9| = |-1.6|$ or 1.6. This example would set 000091.14.

If DTC 000029.14 sets, the following will occur:

- DTC 000028.02, 000029.03, or 000029.04 may also be present.
- ECU will set a SOLID Warning light.

000029.14 — Foot Pedal Position 3 and Foot Pedal Position 4 Mismatch

The absolute value of |FPP3 volts - FPP4 volts| is out of specification.

RG41221,000014C -19-28MAY03-1/1

000091.14 Foot Pedal Position 1 and Foot Pedal Position 2 Mismatch Diagnostic Procedure

NOTE: If DTC 000029.14 is accompanied with 000028.02, 000029.03, or 000029.04, diagnose them first.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000029.14 FOOT PEDAL POSITION 3 AND FOOT PEDAL POSITION 4 MISMATCH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the secondary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

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❷ DTC Test

NOTE: For wiring and theory of operation information, see DTC 000029.14 FOOT PEDAL POSITION 3 AND FOOT PEDAL POSITION 4 MISMATCH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Slowly depress secondary foot pedal through full travel a couple of times.
7. Read DTCs using DST or SERVICE ADVISOR™.

000029.14 reoccurs:
GO TO ❸

000029.14 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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**③ Foot Pedal Position
Sensor Wiring Check**

NOTE: For wiring and theory of operation information, see DTC 000029.14 FOOT PEDAL POSITION 3 AND FOOT PEDAL POSITION 4 MISMATCH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the secondary foot pedal connector.
3. Using a multimeter, measure resistance between the following:
 - Terminal L2 in the ECU connector and terminal C in the foot pedal connector on the vehicle harness.
 - Terminal N2 in the ECU connector and terminal B in the foot pedal connector on the vehicle harness.
 - Terminal M3 in the ECU connector and terminal A in the foot pedal connector on the vehicle harness.
 - Terminal M2 in the ECU connector and terminal J in the foot pedal connector on the vehicle harness.
 - Terminal L1 in the ECU connector and terminal H in the foot pedal connector on the vehicle harness.
 - Terminal N3 in the ECU connector and terminal K in the foot pedal connector on the vehicle harness.
 - Terminal N3 in the ECU connector and terminal F in the foot pedal connector on the vehicle harness.
 - Terminal P3 in the ECU connector and terminal E in the foot pedal connector on the vehicle harness.

All measurements 5 ohms or less:

Faulty foot pedal.
Replace and retest.

Any measurement greater than 5 ohms less:

Short in wire that produces high resistance.

000051.02 — Throttle Position Invalid

ECU commands a manifold absolute pressure that the engine does not produce.

RG41221.0000350 -19-06MAY02-1/1

000051.02 Throttle Position Invalid Diagnostic Procedure

NOTE: If DTC 000051.02 is accompanied with 000102.02 diagnose 000051.02 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000051.02 THROTTLE POSITION INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the throttle connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.02 THROTTLE POSITION INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Ignition ON, engine running under load 5. Using DST or SERVICE ADVISOR™, read Manifold Absolute Pressure - Actual and Manifold Absolute Pressure - Desired.	Actual and Desired are greater than 10% different: GO TO ❸ Actual and Desired are within 10% of each other: Problem is intermittent. If no other codes are present. see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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Electronic Engine Controls Diagnostics

115 ,104	③ Air Leak Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.02 THROTTLE POSITION INVALID supporting information.</i> Check for any signs of air leaks on the intake manifold.	No air leaks: GO TO ④ Air leak(s) found: Repair air leak and retest. -- -1/1
	④ Throttle Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.02 THROTTLE POSITION INVALID supporting information.</i> 1. Ignition ON, engine running 2. Using the ECU diagnostic software, watch Throttle Position Sensor Command and Throttle Position Feedback. 3. Slowly move the foot pedal from idle position to fully depressed while watching the TPS parameters.	TPS Feedback and TPS Command within 7% of each other: Faulty MAP sensor. OR Faulty ECU TPS Feedback and TPS Command more than 7% of each other: Faulty throttle -- -1/1

000051.03 — Throttle Position Feedback Voltage High

TPS feedback voltage exceeds a maximum voltage threshold.

RG41221,0000298 -19-19SEP01-1/1

000051.03 Throttle Position Feedback Voltage High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000051.03 THROTTLE POSITION FEEDBACK VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the throttle connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.03 THROTTLE POSITION FEEDBACK VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine OFF 6. Read DTCs using DST or SERVICE ADVISOR™.	000051.03 reoccurs: GO TO ❸ 000051.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 ,108	③ TPS Feedback Shorted Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.03 THROTTLE POSITION FEEDBACK VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect the throttle connector. 3. Ignition ON, engine OFF 4. Using the ECU diagnostic software, read Throttle Position Sensor Voltage.	0.1 V or below: GO TO ④ Above 0.1 V Short to voltage in TPS Feedback circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ TPS Return Circuit Open Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.03 THROTTLE POSITION FEEDBACK VOLTAGE HIGH supporting information.</i> 1. Throttle connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the TPS sensor return terminal (terminal 3) of the throttle connector on the engine harness with a test light connected to battery voltage.	Light ON: Faulty throttle connection OR Faulty throttle actuator ground OR Faulty throttle Light OFF: Open in TPS sensor return circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

000051.04 — Throttle Position Feedback Voltage Low

TPS feedback voltage drops below the minimum voltage threshold.

RG41221,0000299 -19-19SEP01-1/1

000051.04 Throttle Position Feedback Voltage Low Diagnostic Procedure

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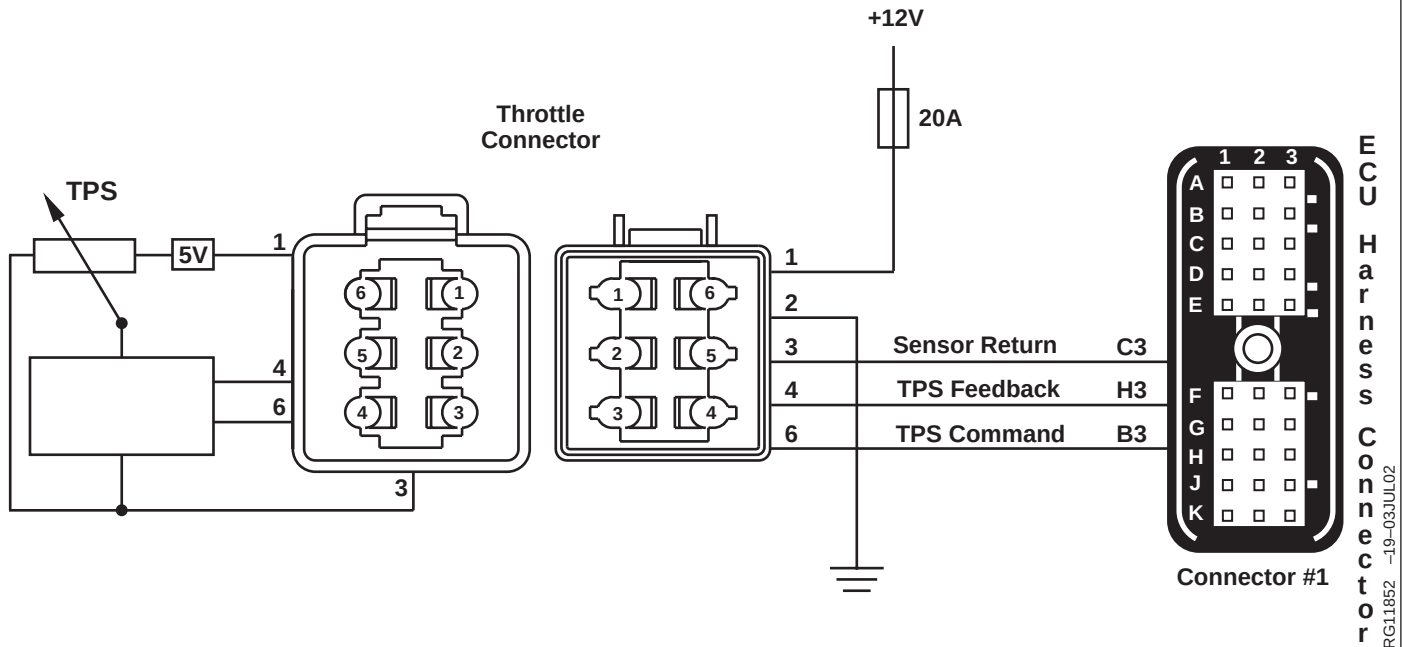
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000051.04 THROTTLE POSITION FEEDBACK VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.04 THROTTLE POSITION FEEDBACK VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000051.04 reoccurs: GO TO ❸ 000051.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 ,112	③ TPS Feedback Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.04 THROTTLE POSITION FEEDBACK VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Disconnect the throttle connector and ECU connector #1 (black A-K). 3. Using a multimeter, measure the resistance between terminal H3 in the ECU connector and terminal 4 in the throttle connector on the engine harness.	5 ohms or less: GO TO ④ Greater than 5 ohms: Open in TPS Feedback circuit OR Short in TPS Feedback circuit -- -1/1
	④ TPS Voltage Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.04 THROTTLE POSITION FEEDBACK VOLTAGE LOW supporting information.</i> 1. Throttle connector still disconnected. 2. Ignition OFF 3. Probe the TPS 12V supply terminal (terminal 1) of the throttle connector on the engine harness with a test light connected to a good chassis ground.	Light ON: Open in TPS sensor ground OR Faulty throttle connection OR Faulty ECU connection OR Faulty throttle OR Faulty ECU Light OFF: Open in 12V supply circuit OR Faulty throttle connector -- -1/1

000051.07 — Throttle Position Sensor Command/Feedback Out of Sync**Throttle Position Sensor (TPS)**

- The throttle position sensor (TPS) is a variable resistor (potentiometer) used to measure throttle opening. The TPS is located inside the throttle body. The throttle receives a +12V signal and steps the voltage down to +5V through a transformer. The TPS Feedback voltage varies with throttle position. Less throttle opening results in lower feedback voltage; greater throttle opening results in higher feedback voltage. The ECU sends the TPS Command and then compares it to the TPS Feedback to verify throttle operation. For further throttle position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000051.07 will set if:

- The ECU detects TPS Feedback is 20% above or below TPS Command.

If DTC 000051.07 sets, the following will occur:

- ECU will cut fuel to the engine to limit engine speed to 1400 rpm.
- ECU will set a SOLID STOP light.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

000051.07 — Throttle Position Sensor Command/Feedback Out of Sync115
115

The ECU detects TPS Feedback is 20% above or below TPS Command.

RG41221,000029A -19-19SEP01-1/1

000051.07 Throttle Position Sensor Command/Feedback Out of Sync Diagnostic Procedure

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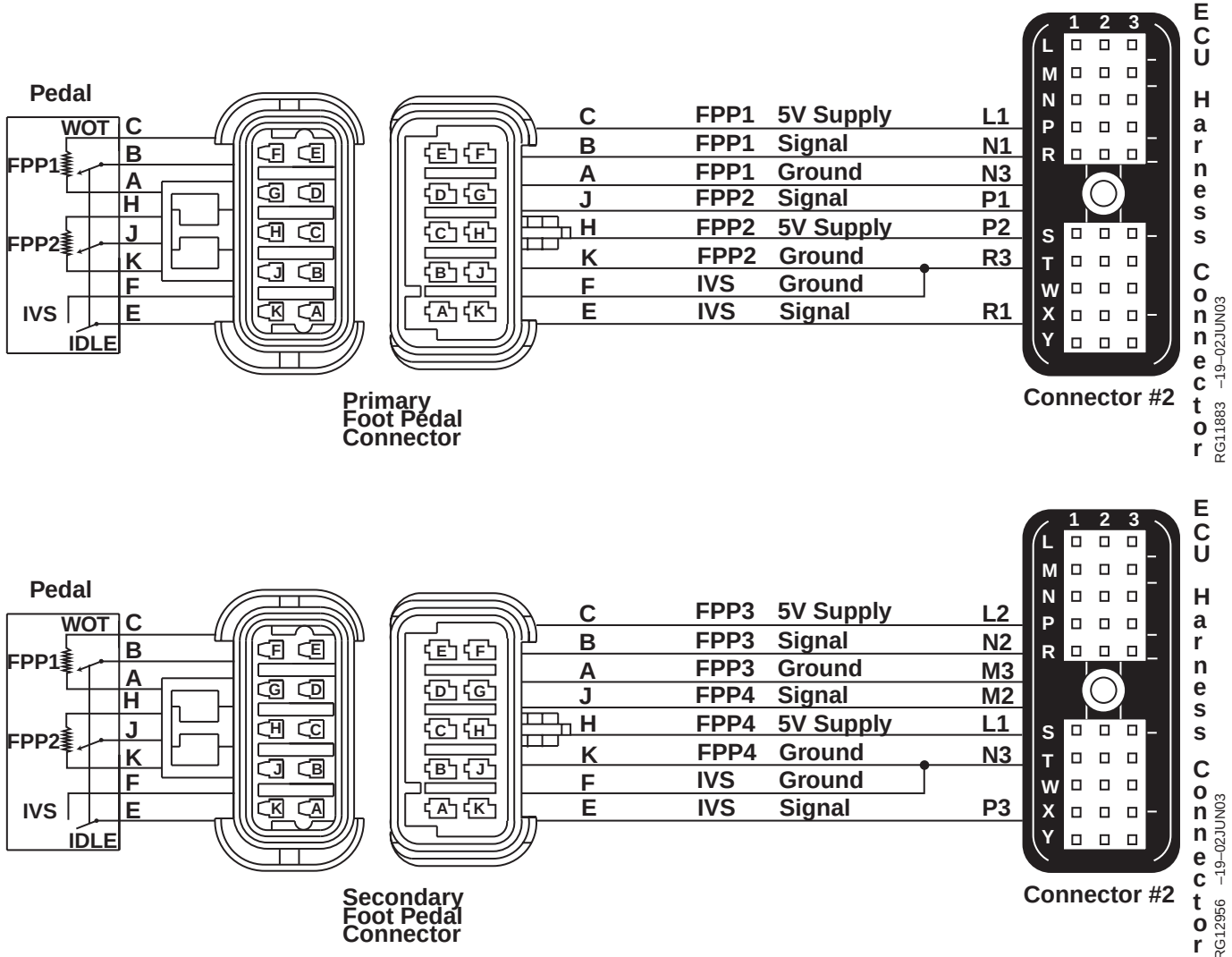
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000051.07 THROTTLE POSITION SENSOR COMMAND/FEEDBACK OUT OF SYNC supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the throttle connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.07 THROTTLE POSITION SENSOR COMMAND/FEEDBACK OUT OF SYNC supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000051.07 reoccurs: GO TO ❸ 000051.07 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 116	③ TPS Command Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.07 THROTTLE POSITION SENSOR COMMAND/FEEDBACK OUT OF SYNC supporting information.</i> 1. Ignition OFF 2. Disconnect the throttle connector and ECU connector #1 (black A-K). 3. Using a multimeter, measure resistance between terminal B3 in the ECU connector and terminal 6 in the throttle connector on the engine harness.	5 ohms or less: GO TO ④ Greater than 5 ohms: Open in TPS Command circuit OR Short in TPS Command circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ TPS Feedback Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000051.07 THROTTLE POSITION SENSOR COMMAND/FEEDBACK OUT OF SYNC supporting information.</i> 1. Ignition OFF 2. Throttle connector and ECU connector #1 (black A-K) still disconnected. 3. Using a multimeter, measure resistance between terminal H3 in the ECU connector and terminal 4 in the throttle connector on the engine harness.	5 ohms or less: Faulty throttle. Replace and retest. Greater than 5 ohms: Open in TPS Feedback circuit OR Short in TPS Feedback circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

000091.02 — Foot Pedal Invalid**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000091.02 will set if:

- FPP1 and FPP2 input voltages are not in range with each other.
- FPP3 and FPP4 input voltages are not in range with each other.
- ECU does not detect a signal coming from the primary foot pedal.
- ECU does not detect a signal coming from the secondary foot pedal.

If DTC 000091.02 sets, the following will occur:

- Foot pedal will be disabled and engine will run at 0% foot pedal position.

Continued on next page

RG41221.0000372 -19-08JUL03-1/2

- DTC 000091.03, 000091.04, 000091.07, 000091.13, 000091.14, 000558.02, 299752.03, 299752.04, 299752.07, or 299752.13 may also be present while using the primary foot pedal.
- DTC 000028.02, 000028.03, 000028.04, 000028.07, 000028.13, 000029.03, 000029.04, 000029.07,

- 000029.13 or 000029.14 may also be present while using the secondary foot pedal.
- ECU will set a SOLID Warning light.

115
,119

RG41221,0000372 -19-08JUL03-2/2

000091.02 — Foot Pedal Invalid

The foot pedal position sensor's input voltages are not in range with each other or the ECU does not detect a signal coming from the foot pedal.

RG41221,0000376 -19-13MAY02-1/1

000091.02 Foot Pedal Invalid Diagnostic Procedure

NOTE: If DTC 000091.02 is accompanied with any of the following DTCs, diagnose them first:

- 000028.02
- 000028.03
- 000028.04
- 000028.07
- 000028.13
- 000029.03
- 000029.04
- 000029.07
- 000029.13
- 000029.14
- 000091.03
- 000091.04
- 000091.07
- 000091.13
- 000091.14
- 000558.02
- 299752.03
- 299752.04
- 299752.07
- 299752.13

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

-- -1/1

❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000091.02 FOOT PEDAL INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the active foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s). 115 121
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000091.02 FOOT PEDAL INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Slowly depress the active foot pedal through full travel. 7. Read DTCs using DST or SERVICE ADVISOR™.	Only 000091.02 reoccurs: GO TO ❸ Other foot pedal DTC(s) and 000091.02 reoccurs: Diagnose other foot pedal related DTC(s) first. 000091.02 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.
<i>SERVICE ADVISOR is a trademark of Deere & Company</i>		
❸ Foot Pedal Selection Check	<i>NOTE: For wiring and theory of operation information, see DTC 000091.02 FOOT PEDAL INVALID supporting information.</i> Some applications use multiple foot pedals. If this application has more than one foot pedal, verify the position of the foot pedal selection switch.	Primary Foot Pedal is selected: GO TO ❹ Secondary Foot Pedal is selected: GO TO ❺

④ Primary Foot Pedal Wiring Test

NOTE: For wiring and theory of operation information, see DTC 000091.02 FOOT PEDAL INVALID supporting information.

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the primary foot pedal connectors.
3. Using a multimeter, measure resistance between the following terminals:
 - Terminal A in the primary foot pedal connector and terminal N3 in the ECU connector #2.
 - Terminal B in the primary foot pedal connector and terminal N1 in the ECU connector #2.
 - Terminal C in the primary foot pedal connector and terminal L1 in the ECU connector #2.
 - Terminal E in the primary foot pedal connector and terminal R1 in the ECU connector #2.
 - Terminal F in the primary foot pedal connector and terminal R3 in the ECU connector #2.
 - Terminal H in the primary foot pedal connector and terminal P2 in the ECU connector #2.
 - Terminal J in the primary foot pedal connector and terminal P1 in the ECU connector #2.
 - Terminal K in the primary foot pedal connector and terminal R3 in the ECU connector #2.

All measurements 5 ohms or less:

Faulty primary foot pedal. Replace and retest.

One or more measurement above 5 ohms:

Short in wire that high resistance.

-- -1/1

⑤ Secondary Foot Pedal Wiring Test

NOTE: For wiring and theory of operation information, see DTC 000091.02 FOOT PEDAL INVALID supporting information.

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the secondary foot pedal connectors.
3. Using a multimeter, measure resistance between the following terminals:
 - Terminal A in the primary foot pedal connector and terminal M3 in the ECU connector #2.
 - Terminal B in the primary foot pedal connector and terminal N2 in the ECU connector #2.
 - Terminal C in the primary foot pedal connector and terminal L2 in the ECU connector #2.
 - Terminal E in the primary foot pedal connector and terminal P3 in the ECU connector #2.
 - Terminal F in the primary foot pedal connector and terminal N3 in the ECU connector #2.
 - Terminal H in the primary foot pedal connector and terminal L1 in the ECU connector #2.
 - Terminal J in the primary foot pedal connector and terminal M2 in the ECU connector #2.
 - Terminal K in the primary foot pedal connector and terminal N3 in the ECU connector #2.

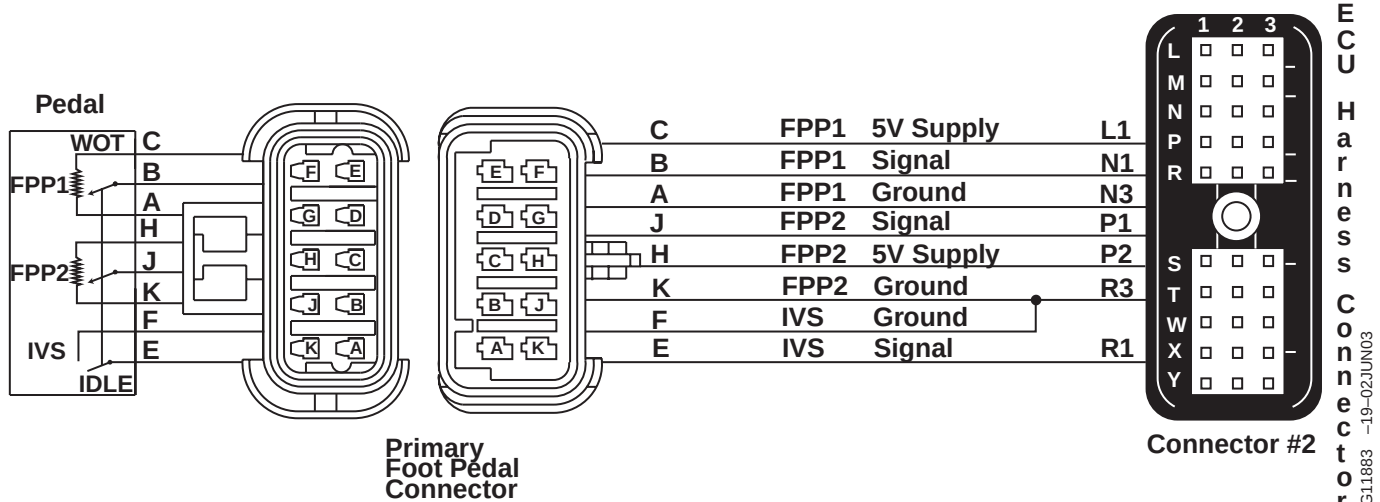
All measurements 5 ohms or less:

Faulty secondary foot pedal. Replace and retest.

One or more measurement above 5 ohms:

Short in wire that high resistance.

-- -1/1

000091.03 — Foot Pedal Position 1 Input Voltage High**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000091.03 will set if:

- FPP1 input voltage exceeds a maximum voltage threshold of 4.9 volts. This voltage corresponds to a position that is higher than what is physically possible for the foot pedal.

If DTC 000091.03 sets, the following will occur:

- Foot Pedal Position 1 Input Voltage will default to 0 volts.
- The ECU will use the foot pedal position 2 sensor signal.
- DTC 001079.03 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000062 -19-14SEP01-1/1

000091.03 — Foot Pedal Position 1 Input Voltage High

FPP1 input voltage exceeds a maximum voltage threshold.

RG41221.000007E -19-02OCT01-1/1

000091.03 Foot Pedal Position 1 Input Voltage High Diagnostic Procedure

NOTE: If DTC 000091.03 is accompanied with 001079.03, diagnose 001079.03 first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000091.03 FOOT PEDAL POSITION 1 INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the primary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

2 DTC Test

NOTE: For wiring and theory of operation information, see DTC 000091.03 FOOT PEDAL POSITION 1 INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000091.03 reoccurs:
GO TO **4**

000091.03 doesn't reoccur:
GO TO **3**

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3 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000091.03 FOOT PEDAL POSITION 1 INPUT VOLTAGE HIGH supporting information.

1. Ignition ON, engine OFF
2. Diagnostic software still communicating with ECU.
3. Make note of any DTCs, then clear all DTCs.
4. Slowly depress primary foot pedal through full travel and back to idle several times.
5. Using the ECU diagnostic software, read DTCs.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

000091.03 reoccurs:
Faulty foot pedal connection
OR
Faulty FPP1 sensor.
Replace foot pedal and retest.

000091.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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4 FPP1 Signal Shorted Test

NOTE: For wiring and theory of operation information, see DTC 000091.03 FOOT PEDAL POSITION 1 INPUT VOLTAGE HIGH supporting information.

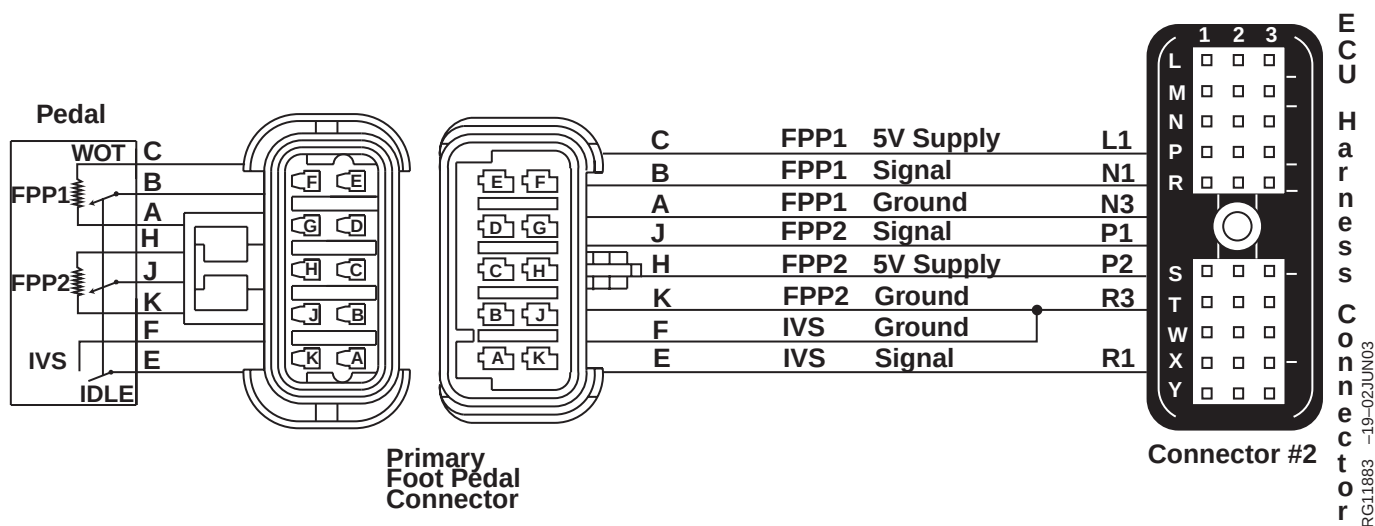
1. Ignition OFF
2. Disconnect primary foot pedal connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read DTCs.

000091.04 occurs:
GO TO **5**

000091.04 doesn't occur:
Short to voltage in FPP1 sensor signal circuit
OR
Faulty ECU connection
OR
Faulty ECU

-- -1/1

5 FPP1 Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation information, see DTC 000091.03 FOOT PEDAL POSITION 1 INPUT VOLTAGE HIGH supporting information.</i> 1. Primary foot pedal connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the FPP1 sensor ground (terminal A) of the foot pedal connector on the vehicle harness with a test light connected to battery voltage. <i>NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.</i>	Light ON: Faulty FPP1 sensor OR Faulty ECU connection OR Faulty ECU Light OFF: Open in FPP1 sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1	115 ,127

000091.04 — Foot Pedal Position 1 Input Voltage Low**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000091.04 will set if:

- FPP1 input voltage drops below 0.2 volts. This voltage corresponds to a position that is lower than what is physically possible for the foot pedal.

If DTC 000091.04 sets, the following will occur:

- Foot Pedal Position 1 Input Voltage will default to 0 volts.
- The ECU will use the foot pedal position 2 sensor signal.
- DTC 001079.04 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000063 -19-14SEP01-1/1

000091.04 — Foot Pedal Position 1 Input Voltage Low

FPP1 input voltage below the minimum voltage threshold.

RG41221,00002BD -19-01OCT01-1/1

000091.04 Foot Pedal Position 1 Input Voltage Low Diagnostic Procedure

NOTE: If DTC 000091.04 is accompanied with 001079.04, diagnose 001079.04 first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000091.04 FOOT PEDAL POSITION 1 INPUT VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the primary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

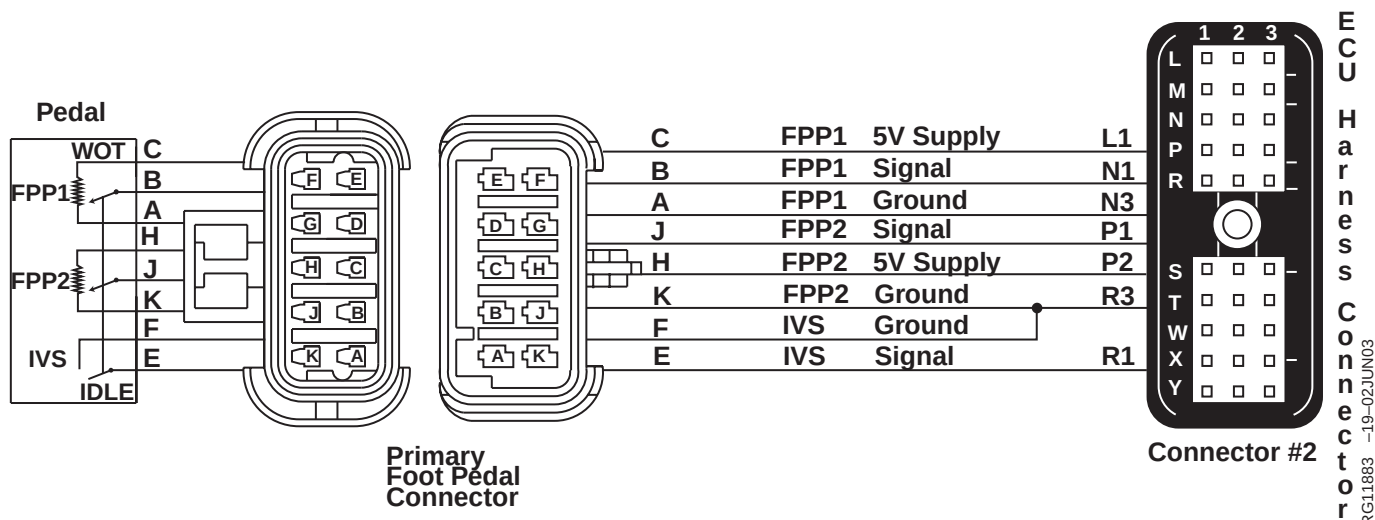
No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

115 ,130 ② DTC Test	<i>NOTE: For wiring and theory of operation information, see DTC 000091.04 FOOT PEDAL POSITION 1 INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000091.04 reoccurs: GO TO ④ 000091.04 doesn't reoccur: GO TO ③
<i>SERVICE ADVISOR is a trademark of Deere & Company</i> -- -1/1		
③ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000091.04 FOOT PEDAL POSITION 1 INPUT VOLTAGE LOW supporting information.</i> 1. Ignition ON, engine OFF 2. Slowly depress primary foot pedal through full travel. 3. Using the ECU diagnostic software, read DTCs.	000091.04 reoccurs: GO TO ④ 000091.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. -- -1/1
④ FPP1 Sensor Ground Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000091.04 FOOT PEDAL POSITION 1 INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Disconnect the primary foot pedal connector. 3. Ignition ON, engine OFF 4. Probe the FPP1 sensor ground wire (terminal A) of the primary foot pedal connector on the vehicle harness with a test light connected to battery voltage.	Light ON: GO TO ⑤ Light OFF: Open in FPP1 sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

5 FPP1 5V Supply Test	<i>NOTE: For wiring and theory of operation information, see DTC 000091.04 FOOT PEDAL POSITION 1 INPUT VOLTAGE LOW supporting information.</i> 1. Primary foot pedal connector still disconnected. 2. Ignition ON, engine OFF 3. Using a multimeter, measure voltage between the 5V supply (terminal C) of the foot pedal connector on the vehicle harness and a good chassis ground.	4.0 - 6.0 volts: GO TO 6 Below 4.0 volts: Open in FPP1 sensor 5V supply circuit OR Short to ground in FPP1 sensor 5V supply circuit OR Faulty ECU connection OR Faulty ECU -- -1/1	115 ,131
6 FPP1 Signal Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000091.04 FOOT PEDAL POSITION 1 INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Primary foot pedal connector still disconnected. 3. Disconnect ECU connector #2 (black L-Y). 4. Using a multimeter, measure resistance between terminal N1 in the ECU connector and terminal B in the foot pedal connector on the vehicle harness. <i>NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.</i>	5 ohms or less: Faulty foot pedal connection OR Faulty foot pedal Greater than 5 ohms: Short to ground in FPP1 signal wire OR Faulty ECU connection OR Faulty ECU -- -1/1	

000091.07 — Foot Pedal Position 1 Input Voltage and Idle Validation Switch Mismatch**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000091.07 will set if:

- Idle Validation Switch in ON when Foot Pedal Position 1 Input Voltage is 1.35 volts or more.
- Idle Validation Switch in OFF when Foot Pedal Position 1 Input Voltage is 0.1 volts or more.

If DTC 000091.07 sets, the following will occur:

- The ECU will use the foot pedal position sensor 2 signal.
- DTC 000091.03, 000091.04, or 000558.02 may also be present.
- ECU will set a SOLID Warning light.

RG41221_000008C -19-01NOV02-1/1

000091.07 — Foot Pedal Position 1 Input Voltage and Idle Validation Switch Mismatch

The foot pedal position 1 input voltage disagrees with the idle validation switch.

RG41221,000008D -19-01NOV02-1/1

000091.07 Foot Pedal Position 1 Input Voltage and Idle Validation Switch Mismatch Diagnostic Procedure

NOTE: If DTC 000091.07 is accompanied with 000091.03, 000091.04, or 000558.02, diagnose them first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000091.07 FOOT PEDAL POSITION 1 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the primary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

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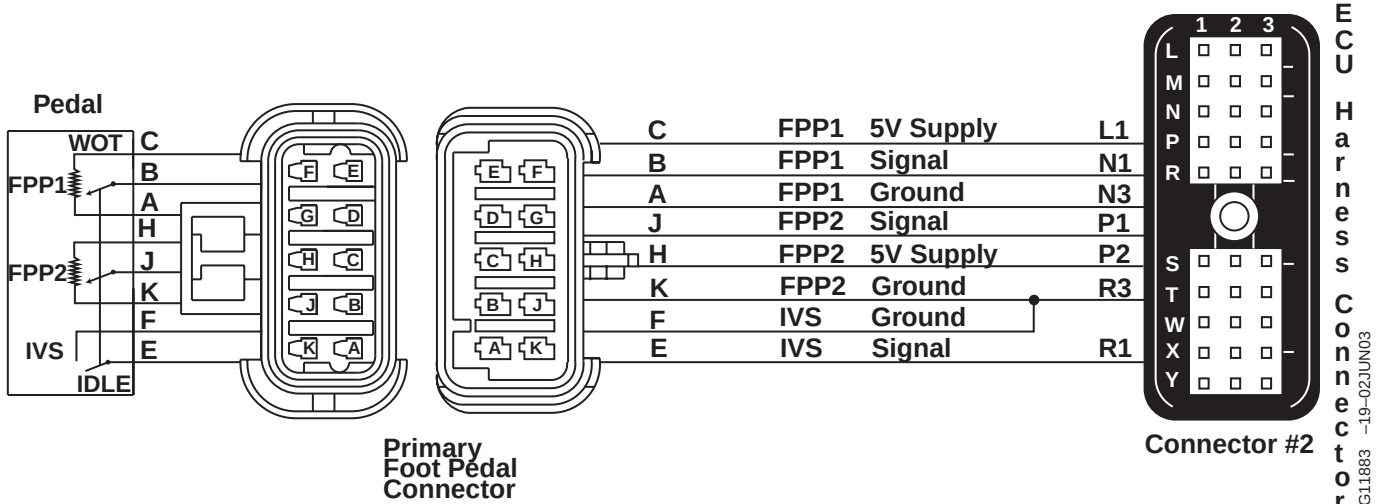
115 ,134 ② DTC Test	<i>NOTE: For wiring and theory of operation information, see DTC 000091.07 FOOT PEDAL POSITION 1 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Slowly depress primary foot pedal through full travel a couple of times. 7. Read DTCs using DST or SERVICE ADVISOR™.	Only 000091.07 reoccurs: GO TO ③ 000091.03, 000091.04, or 000558.02 reoccurs: Follow that diagnostic procedure.

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③ Foot Pedal Position 1 Sensor Wiring Check	<i>NOTE: For wiring and theory of operation information, see DTC 000091.07 FOOT PEDAL POSITION 1 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #2 (black L-Y) and the primary foot pedal connector. 3. Using a multimeter, measure resistance between the following: • Terminal L1 in the ECU connector and terminal C in the foot pedal connector on the vehicle harness. • Terminal N1 in the ECU connector and terminal B in the foot pedal connector on the vehicle harness. • Terminal N3 in the ECU connector and terminal A in the foot pedal connector on the vehicle harness.	All measurements 5 ohms or less: Faulty foot pedal. Replace and retest. Any measurement greater than 5 ohms less: Short in wire that produces high resistance.

-- -1/1

000091.13 — Foot Pedal Position 1 Learned Value Error**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000091.13 will set if:

- The foot pedal position 1 voltage exceeds the upper learned value or drops below the lower learned value.
 - Foot pedal position 1 voltage exceeds 4.6 volts.
 - Foot pedal position 1 voltage drops below 0.2 volts.

If DTC 000091.13 sets, the following will occur:

- The ECU will use the foot pedal position sensor 2 signal.
- Learned value is reset after key cycle.
- DTC 000091.03, 000091.04, or 000558.02 may also be present.
- ECU will set a SOLID Warning light.

000091.13 — Foot Pedal Position 1 Learned Value Error

The foot pedal position 1 voltage exceeds the upper learned value or drops below the lower learned value.

RG41221,000008F -19-01NOV02-1/1

000091.13 Foot Pedal Position 1 Learned Value Error Diagnostic Procedure

NOTE: If DTC 000091.13 is accompanied with 000091.03, 000091.04, or 000558.02, diagnose them first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000091.13 FOOT PEDAL POSITION 1 LEARNED VALUE ERROR supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the primary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

② DTC Test

NOTE: For wiring and theory of operation information, see DTC 000091.13 FOOT PEDAL POSITION 1 LEARNED VALUE ERROR supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Slowly depress primary foot pedal through full travel a couple of times.
7. Read DTCs using DST or SERVICE ADVISOR™.

000091.13 reoccurs:
GO TO ③

000091.13 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Foot Pedal Position 1 Sensor Wiring Check

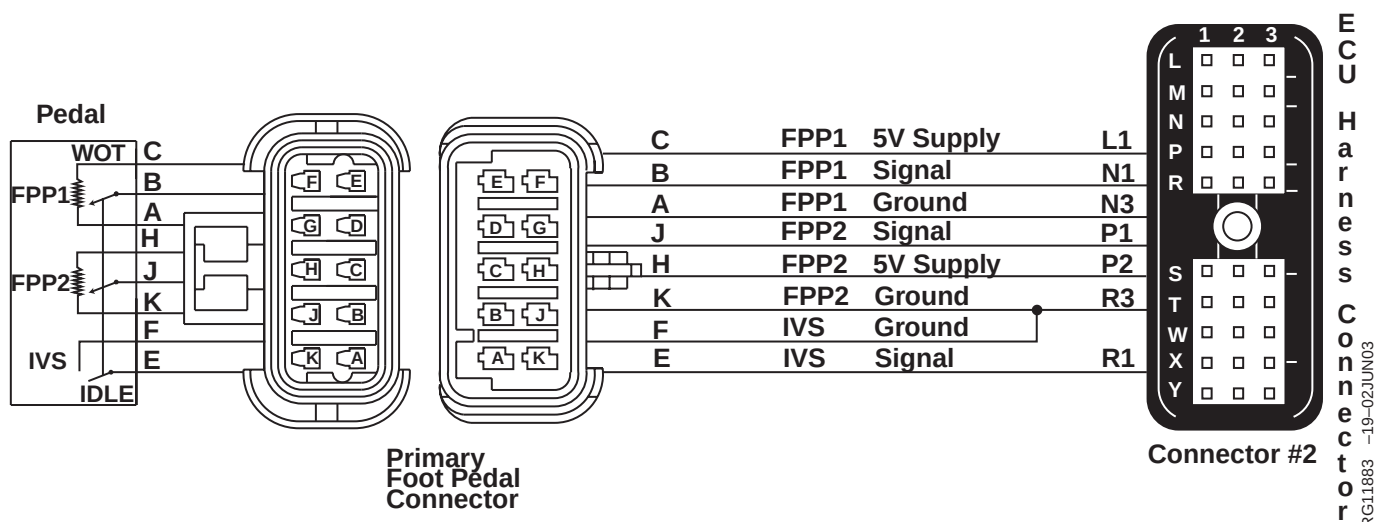
NOTE: For wiring and theory of operation information, see DTC 000091.13 FOOT PEDAL POSITION 1 LEARNED VALUE ERROR supporting information.

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the primary foot pedal connector.
3. Using a multimeter, measure resistance between the following:
 - Terminal L1 in the ECU connector and terminal C in the foot pedal connector on the vehicle harness.
 - Terminal N1 in the ECU connector and terminal B in the foot pedal connector on the vehicle harness.
 - Terminal N3 in the ECU connector and terminal A in the foot pedal connector on the vehicle harness.

All measurements 5 ohms or less:
Faulty foot pedal.
Replace and retest.

Any measurement greater than 5 ohms less:
Short in wire that produces high resistance.

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000091.14 — Foot Pedal Position 1 and Foot Pedal Position 2 Mismatch**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000091.14 will set if:

- The absolute value of |FPP1 volts - FPP2 volts| is greater than or equal to 1.5 volts.
- The absolute value of |FPP1 volts - FPP2 volts| is less than or equal to 0.05 volts when FPP1 volts is greater than 3 volts.

NOTE: The absolute value of any number is that number. This means the absolute value of |-6| is 6. For example: FPP1 volts is 1.3V and FPP2 volts is 2.9V. $|1.3 - 2.9| = |-1.6|$ or 1.6. This example would set 000091.14.

If DTC 000091.14 sets, the following will occur:

- DTC 000091.03, 000091.04, or 000558.02 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000090 -19-01NOV02-1/1

000091.14 — Foot Pedal Position 1 and Foot Pedal Position 2 Mismatch115
141

The absolute value of |FPP1 volts - FPP2 volts| is out of specification.

RG41221,0000091 -19-01NOV02-1/1

000091.14 Foot Pedal Position 1 and Foot Pedal Position 2 Mismatch Diagnostic Procedure

NOTE: If DTC 000091.04 is accompanied with 000091.03, 000091.04, or 000558.02, diagnose them first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000091.14 FOOT PEDAL POSITION 1 AND FOOT PEDAL POSITION 2 MISMATCH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the primary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

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② DTC Test

NOTE: For wiring and theory of operation information, see DTC 000091.14 FOOT PEDAL POSITION 1 AND FOOT PEDAL POSITION 2 MISMATCH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Slowly depress primary foot pedal through full travel a couple of times.
7. Read DTCs using DST or SERVICE ADVISOR™.

000091.14 reoccurs:
GO TO ③

000091.14 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Foot Pedal Position Sensor Wiring Check

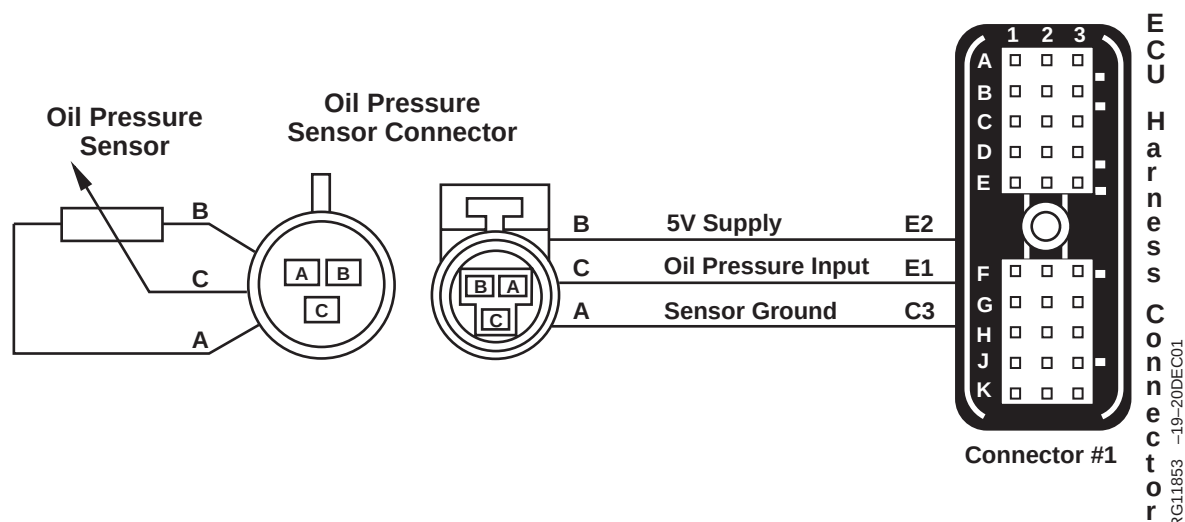
NOTE: For wiring and theory of operation information, see DTC 000091.14 FOOT PEDAL POSITION 1 AND FOOT PEDAL POSITION 2 MISMATCH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the primary foot pedal connector.
3. Using a multimeter, measure resistance between the following:
 - Terminal L1 in the ECU connector and terminal C in the foot pedal connector on the vehicle harness.
 - Terminal N1 in the ECU connector and terminal B in the foot pedal connector on the vehicle harness.
 - Terminal N3 in the ECU connector and terminal A in the foot pedal connector on the vehicle harness.
 - Terminal P1 in the ECU connector and terminal J in the foot pedal connector on the vehicle harness.
 - Terminal P2 in the ECU connector and terminal H in the foot pedal connector on the vehicle harness.
 - Terminal R3 in the ECU connector and terminal K in the foot pedal connector on the vehicle harness.
 - Terminal R3 in the ECU connector and terminal F in the foot pedal connector on the vehicle harness.
 - Terminal R1 in the ECU connector and terminal E in the foot pedal connector on the vehicle harness.

All measurements 5 ohms or less:
Faulty foot pedal.
Replace and retest.

Any measurement greater than 5 ohms less:
Short in wire that produces high resistance.

-- -1/1

000100.01 — Engine Oil Pressure Extremely Low**Oil Pressure Sensor**

- The oil pressure sensor is a pressure transducer connected to the main oil gallery or oil cooler. The oil pressure input voltage varies as oil pressure varies. As engine oil pressure increases, the oil pressure sensor input voltage increases. The ECU monitors oil pressure in order to protect the engine in case of a low oil pressure condition. For further oil pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000100.01 will set if:

- The ECU senses an oil pressure below the derate value set point. The derate value set point is dependent on engine speed.

If DTC 000100.01 sets, the following will occur:

- Engine protection is disabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - With Shutdown Feature: The derate will go into effect when the code is set and the engine will shut down after 30 seconds.
 - Will derate the engine 40% per minute to a maximum derate of 60%. When engine oil pressure rises above the derate value set point, power will be increased 20% per minute until either full power is reached or the derate value set point is surpassed again.
- DTC 001569.31 and DTC 000100.018 will also be present.
- If shutdown feature is available, DTC 001110.31 will also be present.
- ECU will set a SOLID STOP light.

RG41221,0000064 -19-14SEP01-1/1

000100.01 — Engine Oil Pressure Extremely Low115
145

The ECU senses an oil pressure below the derate value set point.

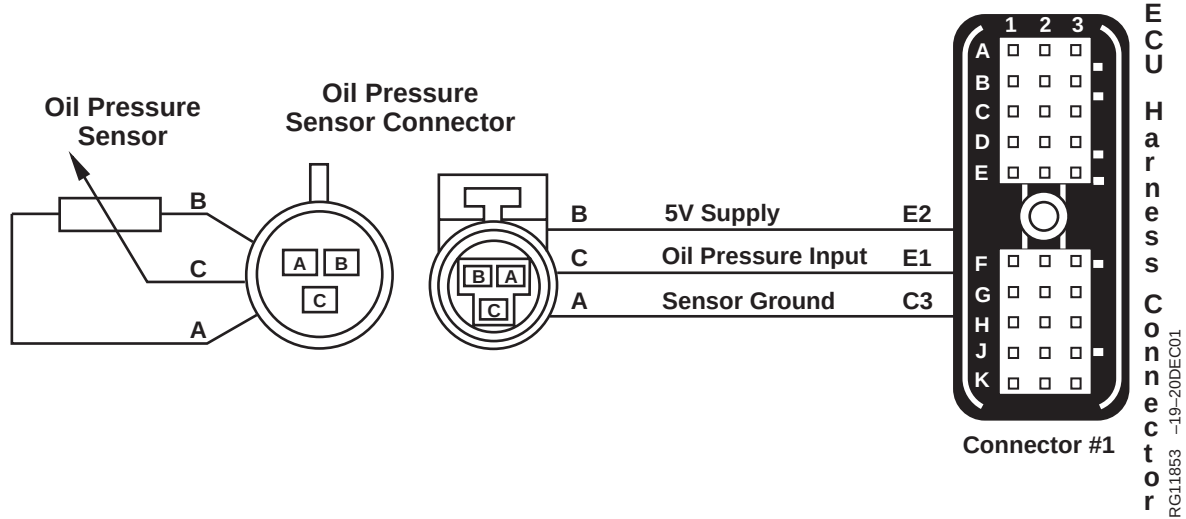
RG41221.000029C -19-19SEP01-1/1

000100.01 Engine Oil Pressure Extremely Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation, see DTC 000100.01 ENGINE OIL PRESSURE EXTREMELY LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the engine oil pressure sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Oil Pressure Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.01 ENGINE OIL PRESSURE EXTREMELY LOW supporting information.</i> Under the conditions where DTC 000100.01 occurs, measure engine oil pressure. See CHECK ENGINE OIL PRESSURE in Group 105 earlier in this manual.	Oil pressure below specification: See DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS in Group 105 earlier in this manual. Oil pressure within specification: Verify that oil pressure sensor 5 V supply, input, and ground circuits are OK. If oil pressure sensor circuits are OK, replace oil pressure sensor and retest

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000100.03 — Engine Oil Pressure Input Voltage High**Oil Pressure Sensor**

- The oil pressure sensor is a pressure transducer connected to the main oil gallery or oil cooler. The oil pressure input voltage varies as oil pressure varies. As engine oil pressure increases, the oil pressure sensor input voltage increases. The ECU monitors oil pressure in order to protect the engine in case of a low oil pressure condition. For further oil pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000100.03 will set if:

- The oil pressure input voltage exceeds 4.9 volts. This voltage corresponds to an oil pressure that is higher than what is physically possible for oil pressure.

If DTC 000100.03 sets, the following will occur:

- ECU uses a default oil pressure of 72.5 psig (500 kPa) (5.0 bar).
- ECU's low oil pressure engine protection feature disabled.
- DTC 000620.03 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000065 -19-14SEP01-1/1

000100.03 — Engine Oil Pressure Input Voltage High

The oil pressure input voltage exceeds the sensor's high voltage specification.

RG41221,000029B -19-19SEP01-1/1

000100.03 Engine Oil Pressure Input Voltage High Diagnostic Procedure

NOTE: If DTC 000100.03 is accompanied with 000620.03, diagnose 000620.03 first.

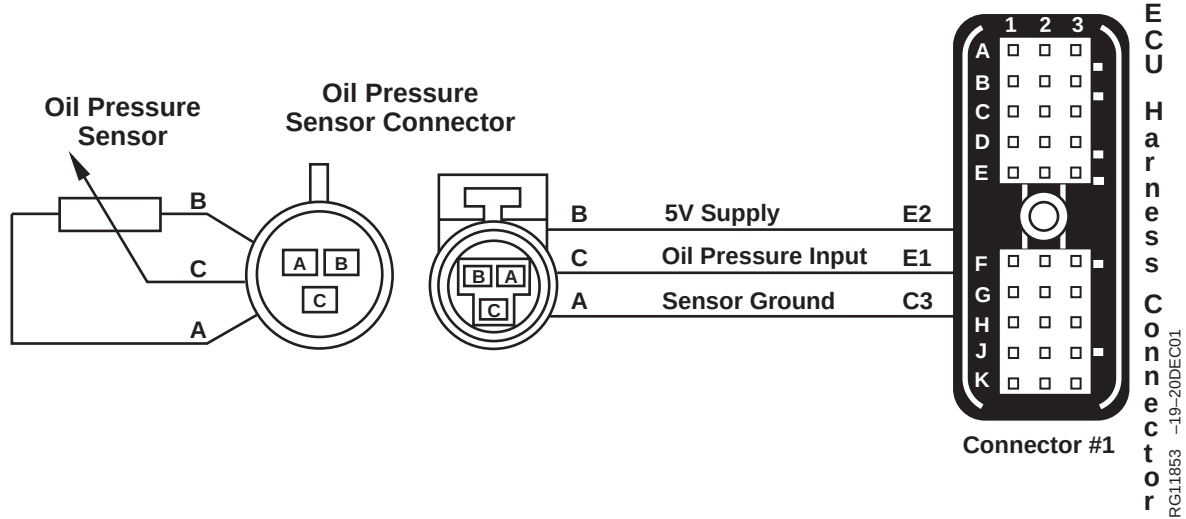
-- -1/1

❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation, see DTC 000100.03 ENGINE OIL PRESSURE INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the engine oil pressure sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.03 ENGINE OIL PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000100.03 reoccurs: GO TO ❸ 000100.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 ,148	③ Oil Pressure Input Shorted Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.03 ENGINE OIL PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect oil pressure sensor connector. 3. Ignition ON, engine OFF 4. Using the ECU diagnostic software, read Engine Oil Pressure Input Voltage	Below 0.2 V: GO TO ④ 0.2 V or greater: Short to voltage in oil pressure sensor input circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ Oil Pressure Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.03 ENGINE OIL PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Oil Pressure sensor connector still disconnected. 2. Ignition ON, engine OFF 3. Probe oil pressure sensor ground terminal (terminal A) in the oil pressure sensor connector on the engine harness with a test light connected to battery voltage.	Light ON: Faulty oil pressure sensor OR Faulty ECU connection OR Faulty ECU. Light OFF: Open in oil pressure sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

000100.04 — Engine Oil Pressure Input Voltage Low**Oil Pressure Sensor**

- The oil pressure sensor is a pressure transducer connected to the main oil gallery or oil cooler. The oil pressure input voltage varies as oil pressure varies. As engine oil pressure increases, the oil pressure sensor input voltage increases. The ECU monitors oil pressure in order to protect the engine in case of a low oil pressure condition. For further oil pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000100.04 will set if:

- The oil pressure input voltage drops below 0.2 volts. This voltage corresponds to an oil pressure that is lower than what is physically possible for oil pressure.

If DTC 000100.04 sets, the following will occur:

- ECU uses a default oil pressure of 72.5 psig (500 kPa) (5.0 bar).
- ECU's low oil pressure engine protection feature disabled.
- DTC 000620.04 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000066 -19-14SEP01-1/1

000100.04 — Engine Oil Pressure Input Voltage Low

The oil pressure input voltage drops below the sensor's low voltage specification.

RG41221.000029D -19-19SEP01-1/1

000100.04 Oil Pressure Input Voltage Low Diagnostic Procedure

NOTE: If DTC 000100.04 is accompanied with 000620.04, diagnose 000620.04 first.

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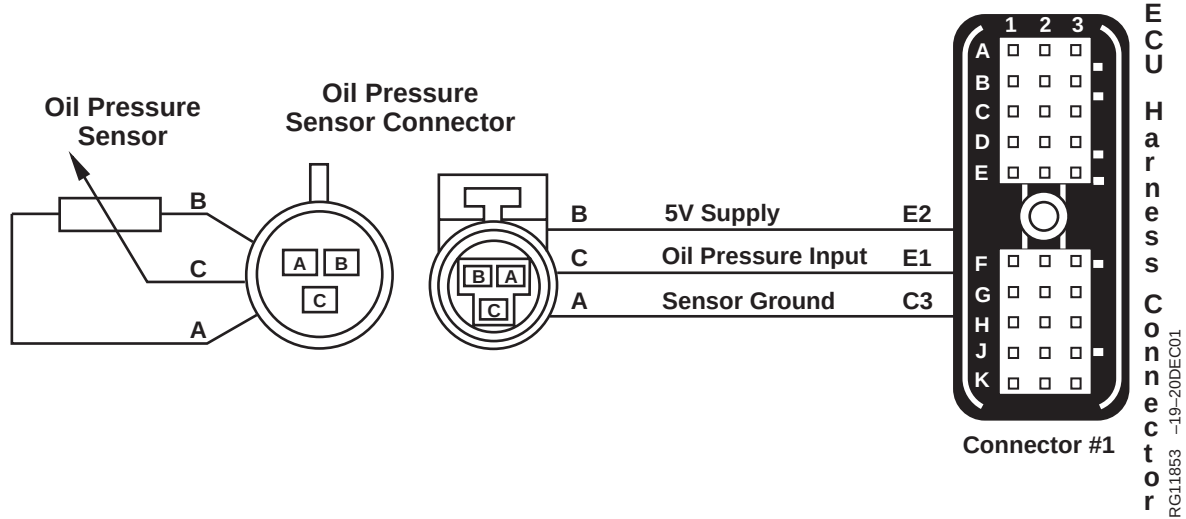
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the engine oil pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000100.04 reoccurs: GO TO ❸ 000100.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 ,152	③ Oil Pressure Sensor and Connector Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Disconnect oil pressure sensor connector. 3. Install a jumper wire between oil pressure sensor 5 V supply and input terminals (terminals B and C) in oil pressure sensor connector on the engine harness. 4. Ignition ON, engine OFF 5. Using the ECU diagnostic software, read Engine Oil Pressure Input Voltage.	Below 4.9 V: GO TO ④ 4.9 V or greater: Faulty oil pressure sensor connection OR Faulty oil pressure sensor -- -1/1
	④ Oil Pressure 5V Supply Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Remove jumper wire 3. Ignition ON, engine OFF 4. Using a multimeter, measure voltage between the 5 V supply (terminal B) of the oil pressure sensor connector on the engine harness and a good chassis ground.	4.0 - 6.0 volts: Open in oil pressure sensor input circuit OR Short to ground in oil pressure sensor input circuit OR Faulty ECU connection OR Faulty ECU Below 4.0 volts: Open in oil pressure sensor 5 V supply circuit OR Short to ground in oil pressure sensor 5 V supply circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

000100.16 — Engine Oil Pressure Moderately High**Oil Pressure Sensor**

- The oil pressure sensor is a pressure transducer connected to the main oil gallery or oil cooler. The oil pressure input voltage varies as oil pressure varies. As engine oil pressure increases, the oil pressure sensor input voltage increases. The ECU monitors oil pressure in order to protect the engine in case of a low oil pressure condition. For further oil pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000100.16 will set if:

- The ECU senses an oil pressure above 72.5 psig (500 kPa) (5.0 bar) when the engine speed at 0 rpm.

If DTC 000100.16 sets, the following will occur:

- ECU will set a SOLID Warning light.

RG41221,0000161 -19-29MAY03-1/1

000100.16 — Engine Oil Pressure Moderately High

The ECU senses an oil pressure above 72.5 psig (500 kPa) (5.0 bar) when the engine speed at 0 rpm.

RG41221.0000162 -19-29MAY03-1/1

000100.16 Engine Oil Pressure Moderately High Diagnostic Procedure

NOTE: If DTC 000100.16 is accompanied with 000100.03 or 000100.04, diagnose them first.

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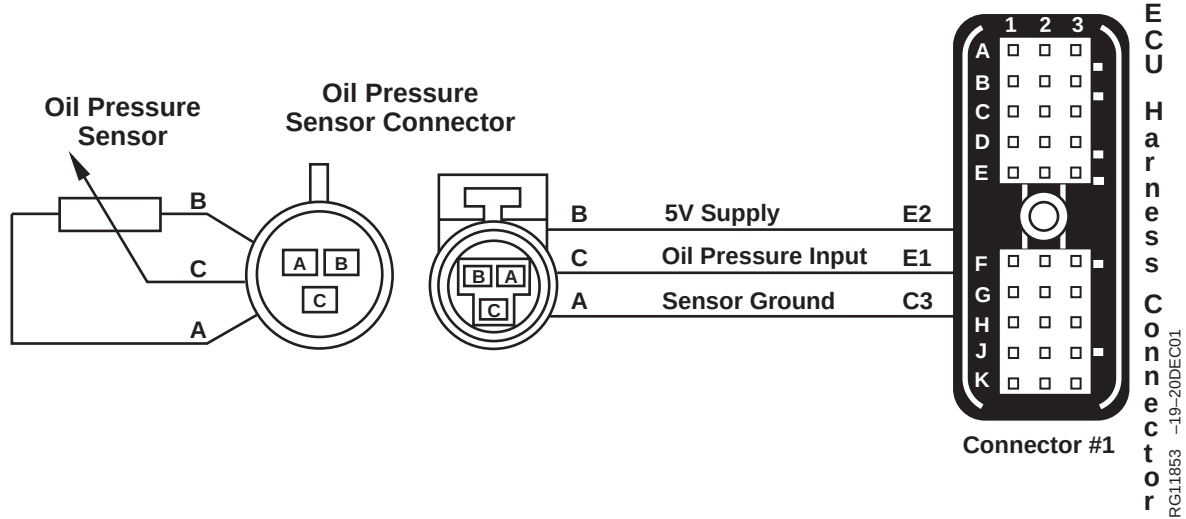
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation, see DTC 000100.16 ENGINE OIL PRESSURE MODERATELY HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the engine oil pressure sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.16 ENGINE OIL PRESSURE MODERATELY HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine OFF 6. Read DTCs using DST or SERVICE ADVISOR™.	000100.16 reoccurs: GO TO ❸ 000100.16 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 156 ③ Oil Pressure Input Wire Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.16 ENGINE OIL PRESSURE MODERATELY HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect oil pressure sensor connector. 3. Disconnect ECU connector #1 (black A-K). 4. Using a multimeter, measure resistance between input terminal (terminal E1) and all other terminals in ECU connector #1 on the engine harness.	All measurements greater than 5 ohms: GO TO ④ Any measurement 5 ohms or less: Oil pressure input wire shorted to wire with low resistance. -- -1/1
④ Oil Pressure 5V Supply Wire Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.16 ENGINE OIL PRESSURE MODERATELY HIGH supporting information.</i> 1. Ignition OFF 2. ECU connector #1 (black A-K) and oil pressure sensor connectors still disconnected. 3. Using a multimeter, measure resistance between 5V supply terminal (terminal E2) and all other terminals in ECU connector #1 on the engine harness.	All measurements greater than 5 ohms: GO TO ⑤ Any measurement 5 ohms or less: Oil pressure 5V supply wire shorted to wire with low resistance. -- -1/1
⑤ Oil Pressure Ground Wire Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.16 ENGINE OIL PRESSURE MODERATELY HIGH supporting information.</i> 1. Ignition OFF 2. ECU connector #1 (black A-K) and oil pressure sensor connectors still disconnected. 3. Using a multimeter, measure resistance between the sensor ground terminal (terminal C3) and all other terminals in ECU connector #1 on the engine harness.	All measurements greater than 5 ohms: GO TO ⑥ Any measurement 5 ohms or less: Oil pressure sensor ground wire shorted to wire with low resistance. -- -1/1
⑥ Oil Pressure Ground Wire Test	<i>NOTE: For wiring and theory of operation, see DTC 000100.16 ENGINE OIL PRESSURE MODERATELY HIGH supporting information.</i> 1. Ignition OFF 2. ECU connector #1 (black A-K) and oil pressure sensor connectors still disconnected. 3. Using a multimeter, measure resistance between the sensor ground terminal (terminal C3) in ECU connector #1 and the ground terminal (terminal A) in the oil pressure sensor connector on the engine harness.	5 ohms or less: Faulty oil pressure sensor Replace and retest. Greater than 5 ohms: Short or open in wire that had resistance higher than 5 ohms. -- -1/1

000100.18 — Engine Oil Pressure Moderately Low**Oil Pressure Sensor**

- The oil pressure sensor is a pressure transducer connected to the main oil gallery or oil cooler. The oil pressure input voltage varies as oil pressure varies. As engine oil pressure increases, the oil pressure sensor input voltage increases. The ECU monitors oil pressure in order to protect the engine in case of a low oil pressure condition. For further oil pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000100.18 will set if:

- The ECU senses an oil pressure below the warning value set point. The warning value set point is dependent on engine speed.

If DTC 000100.18 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 2% per minute to a maximum derate of 10%. When engine oil pressure rises above the derate value set point, power will be increased 2% per minute until either full power is reached or if the derate value set point is surpassed again.
- DTC 001569.31 will also be present.
- ECU will set a SOLID Warning light.

RG41221,0000067 -19-14SEP01-1/1

000100.18 — 000100.18 Engine Oil Pressure Moderately Low115
159

The ECU senses an oil pressure below the warning value set point.

RG41221.000029E -19-19SEP01-1/1

000100.18 Engine Oil Pressure Moderately Low Diagnostic Procedure

-- -1/1

❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation, see DTC 000100.18 ENGINE OIL PRESSURE MODERATELY LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the engine oil pressure sensor connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

❷ Oil Pressure Test

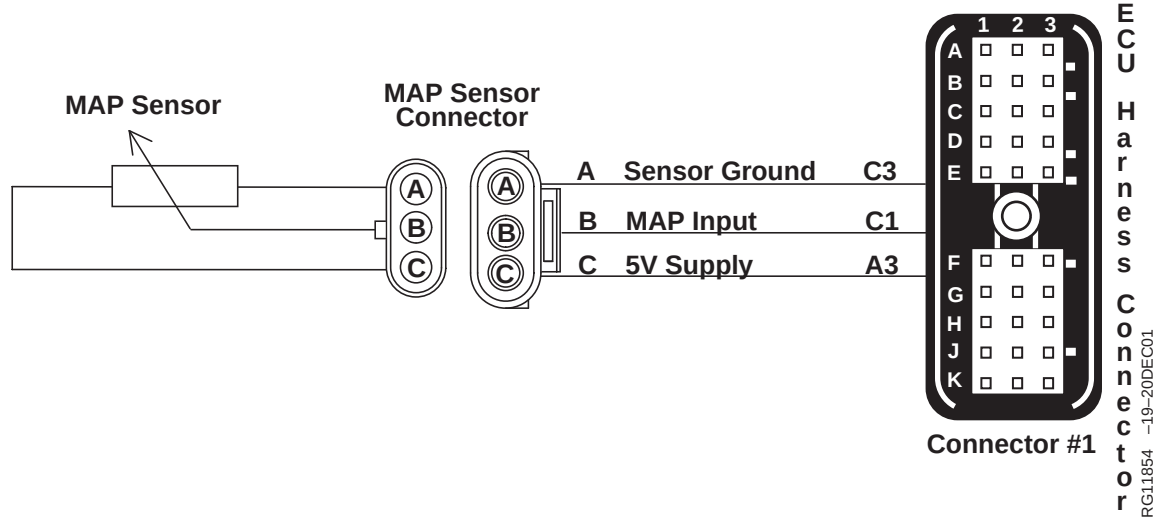
NOTE: For wiring and theory of operation, see DTC 000100.18 ENGINE OIL PRESSURE MODERATELY LOW supporting information.

Under the conditions where DTC 000100.18 occurs, measure engine oil pressure. See CHECK ENGINE OIL PRESSURE in Group 105 earlier in this manual.

Oil pressure below specification:
See DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS in Group 105 earlier in this manual.

Oil pressure within specification:
Verify that oil pressure sensor 5 V supply, input, and ground circuits are OK. If oil pressure sensor circuits are OK, replace oil pressure sensor and retest

-- -1/1

000102.02 — Manifold Absolute Pressure Cross Check Invalid**Manifold Absolute Pressure (MAP) Sensor**

- The Manifold Absolute Pressure (MAP) sensor is a pressure transducer located in the intake manifold. It is used to measure air pressure in the intake manifold. The ECU uses the MAP sensor in conjunction with several other sensors to determine the airflow rate to the engine. The MAP signal varies as intake manifold pressure varies. High pressures result in higher voltages; lower pressures result in lower voltages. For further MAP sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000102.02 will set if:

- The ECU does a cross check between the MAP sensor, the BAP sensor, and the UTP sensor during

start up and then randomly as the engine is running. If the ECU senses any of the following this code will set:

- ECU senses a manifold absolute pressure lower than the upstream throttle pressure when ECU is commanding higher boost.
- ECU senses a manifold absolute pressure that is in range, but not possible for the commanded engine performance.

If DTC 000102.02 sets, the following will occur:

- Engine may run rough and unstable.
- Engine will be less responsive with low power.
- Adaptive Learn will be disabled until DTC is fixed.
- DTC 000051.02, 000102.04, 001119.01, or 001119.18 may also be present.
- ECU will set a SOLID Warning light.

RG41221,0000068 -19-14SEP01-1/1

000102.02 — Manifold Absolute Pressure Cross Check Invalid

Cross check shows MAP is out of specification with BAP and UTP.

RG41221,000029F -19-19SEP01-1/1

000102.02 Manifold Absolute Pressure Cross Check Invalid Diagnostic Procedure

NOTE: If DTC 000102.02 is accompanied with 000051.02, 000102.04, 001119.01, or 001119.18, diagnose them first.

-- -1/1

❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000102.02 MANIFOLD ABSOLUTE PRESSURE CROSS CHECK INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the manifold absolute pressure sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000102.02 MANIFOLD ABSOLUTE PRESSURE CROSS CHECK INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000102.02 reoccurs: GO TO ❸ 000102.02 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

-- -1/1

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③ MAP Input Wire Shorted Test

NOTE: For wiring and theory of operation information, see DTC 000102.02 MANIFOLD ABSOLUTE PRESSURE CROSS CHECK INVALID supporting information.

1. Ignition OFF
2. Disconnect MAP sensor connector.
3. Disconnect ECU connector #1 (black A-K).
4. Using a multimeter, measure resistance between the following terminals:
 - Terminal C1 in the ECU connector and terminal B in the MAP sensor connector on the engine harness.
 - Terminal C3 in the ECU connector and terminal A in the MAP sensor connector on the engine harness.
 - Terminal A3 in the ECU connector and terminal C in the MAP sensor connector on the engine harness.

All measurements 5 ohms or less:
GO TO **④**

Any measurement(s) greater than 5 ohms:
Short or open in wire that had resistance greater than 5 ohms.

-- -1/1

④ MAP Sensor Test

NOTE: For wiring and theory of operation information, see DTC 000102.02 MANIFOLD ABSOLUTE PRESSURE CROSS CHECK INVALID supporting information.

1. Ignition ON, engine running under conditions that sets code
2. Using the ECU diagnostic software read Manifold Absolute Pressure - Actual and Manifold Absolute Pressure Input Voltage. Use the following table for the voltage range at specific pressures.

Pressure	Voltage
5.8 psia (40 kPa) (0.4 bar)	0.5 to 0.75 volts
10.3 psia (71 kPa) (0.7 bar)	1.06 to 1.20 volts
35 psia (240 kPa) (2.4 bar)	3.82 to 3.95 volts
44 psia (304 kPa) (3.0 bar)	4.78 to 5.0 volts

NOTE: If exact voltage is not included in table, see if relationship between Pressure and Voltage are similar to the table.

Voltage within specification:
GO TO **⑤**

Voltage out of specification:
Faulty MAP sensor
Replace and retest.

-- -1/1

⑤ Throttle Test

NOTE: For wiring and theory of operation information, see DTC 000102.02 MANIFOLD ABSOLUTE PRESSURE CROSS CHECK INVALID supporting information.

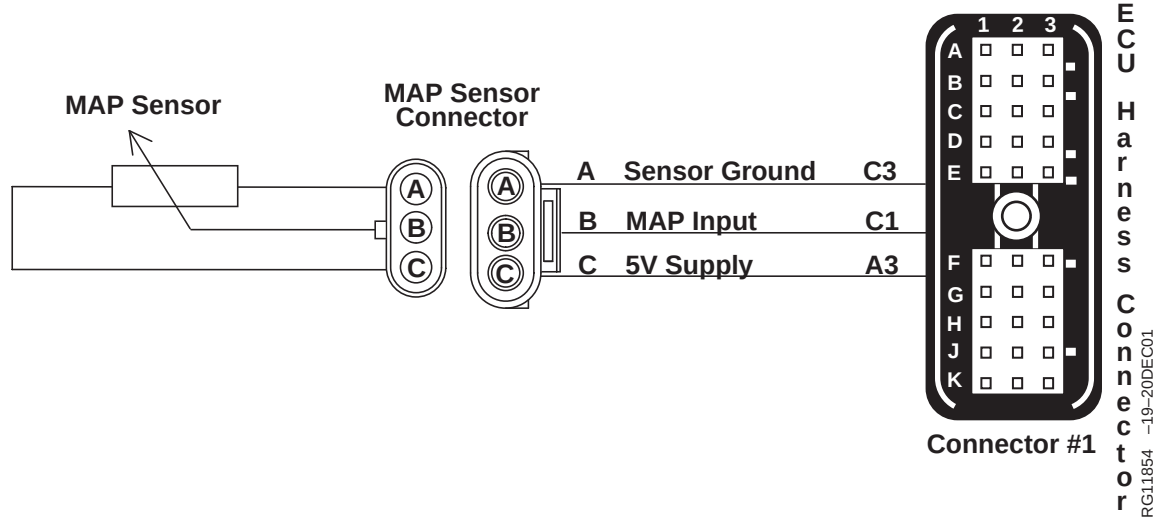
1. Ignition ON, engine running
2. Using the ECU diagnostic software, watch Throttle Position Sensor Command and Throttle Position Sensor Feedback parameters.
3. Slowly move the foot pedal from idle position to fully depressed while watching the TPS parameters.

TPS Feedback and TPS Command within 7% of each other:
GO TO **⑥**

TPS Feedback and TPS Command more than within 7% different:
Faulty throttle.
Replace and retest.

-- -1/1

⑥ Air Leak Test:	<i>NOTE: For wiring and theory of operation information, see DTC 000102.02 MANIFOLD ABSOLUTE PRESSURE CROSS CHECK INVALID supporting information.</i> Check for any signs of air leaks on the intake manifold.	No air leaks: Faulty MAP sensor. Replace and retest. Air leak(s) found: Repair air leak and retest. -- -1/1

000102.03 — Manifold Absolute Pressure Input Voltage High**Manifold Absolute Pressure (MAP) Sensor**

- The Manifold Absolute Pressure (MAP) sensor is a pressure transducer located in the intake manifold. It is used to measure air pressure in the intake manifold. The ECU uses the MAP sensor in conjunction with several other sensors to determine the airflow rate to the engine. The MAP signal varies as intake manifold pressure varies. High pressures result in higher voltages; lower pressures result in lower voltages. For further MAP sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000102.03 will set if:

- The manifold absolute pressure input voltage exceeds 4.9 volts. This voltage corresponds to a manifold absolute pressure that is higher than what is physically possible for manifold pressure.

If DTC 000102.03 sets, the following will occur:

- ECU uses BAP and UTP to calculate what MAP should be and uses this value until the code is repaired.
- DTC 001080.03 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000069 -19-14SEP01-1/1

000102.03 — Manifold Absolute Pressure Input Voltage High

The manifold absolute pressure input voltage exceeds the sensor's high voltage specification.

RG41221,00002A0 -19-19SEP01-1/1

000102.03 Manifold Absolute Pressure Input Voltage High Diagnostic Procedure

NOTE: If DTC 000102.03 is accompanied with 001080.03, diagnose 001080.03 first.

-- -1/1

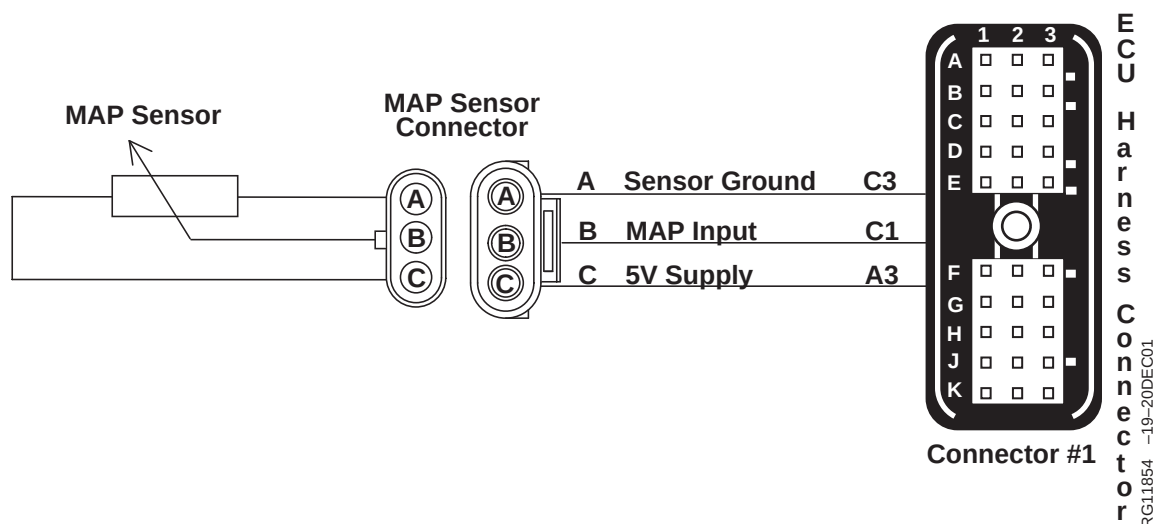
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000102.03 MANIFOLD ABSOLUTE PRESSURE INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the manifold absolute pressure sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000102.03 MANIFOLD ABSOLUTE PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000102.03 reoccurs: GO TO ❸ 000102.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 ,166	③ MAP Input Shorted Test	<i>NOTE: For wiring and theory of operation information, see DTC 000102.03 MANIFOLD ABSOLUTE PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect MAP sensor connector 3. Ignition ON, engine OFF 4. Using the ECU diagnostic software, read Manifold Absolute Pressure Input Voltage.	Below 0.2 V: GO TO ④ 0.2 V or greater: Short to voltage in MAP input circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ MAP Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation information, see DTC 000102.03 MANIFOLD ABSOLUTE PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. MAP sensor connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the MAP sensor ground terminal (terminal A) of the MAP connector on the engine harness with the test light connected to battery voltage.	Light ON: Faulty MAP sensor OR Faulty ECU connection OR Faulty ECU Light OFF: Open in MAP sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

000102.04 — Manifold Absolute Pressure Input Voltage Low**Manifold Absolute Pressure (MAP) Sensor**

- The Manifold Absolute Pressure (MAP) sensor is a pressure transducer located in the intake manifold. It is used to measure air pressure in the intake manifold. The ECU uses the MAP sensor in conjunction with several other sensors to determine the airflow rate to the engine. The MAP signal varies as intake manifold pressure varies. High pressures result in higher voltages; lower pressures result in lower voltages. For further MAP sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000102.04 will set if:

- The manifold absolute pressure input voltage drops below 0.2 volts. This voltage corresponds to a manifold absolute pressure that is lower than what is physically possible for manifold pressure.

If DTC 000102.04 sets, the following will occur:

- ECU uses BAP and UTP to calculate what MAP should be and uses this value until the code is repaired.
- DTC 000102.02, 001080.04, and 524282.02 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,000006A -19-14SEP01-1/1

000102.04 — Manifold Absolute Pressure Input Voltage Low

The manifold absolute pressure input voltage drops below the sensor's low voltage specification.

RG41221,00002A1 -19-19SEP01-1/1

000102.04 Manifold Absolute Pressure Input Voltage Low Diagnostic Procedure

NOTE: If DTC 000102.04 is accompanied with 001080.04, diagnose 001080.04 first.

NOTE: If DTC 000102.04 is accompanied with 000102.02 or 524282.02, diagnose 000102.04 first.

-- -1/1

❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000102.04 MANIFOLD ABSOLUTE PRESSURE INPUT VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the manifold absolute pressure sensor connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

② Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000102.04 MANIFOLD ABSOLUTE PRESSURE INPUT VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000102.04 reoccurs:
GO TO ③

000102.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ MAP Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 000102.04 MANIFOLD ABSOLUTE PRESSURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect the MAP sensor connector
3. Install a jumper wire between the MAP sensor 5V supply and the input terminals (terminals B and C) in the MAP sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Manifold Absolute Pressure Input Voltage.

Below 4.9 V:
GO TO ④

4.9 V or greater:
Faulty MAP sensor connection
OR
Faulty MAP sensor

-- -1/1

④ MAP 5V Supply Test

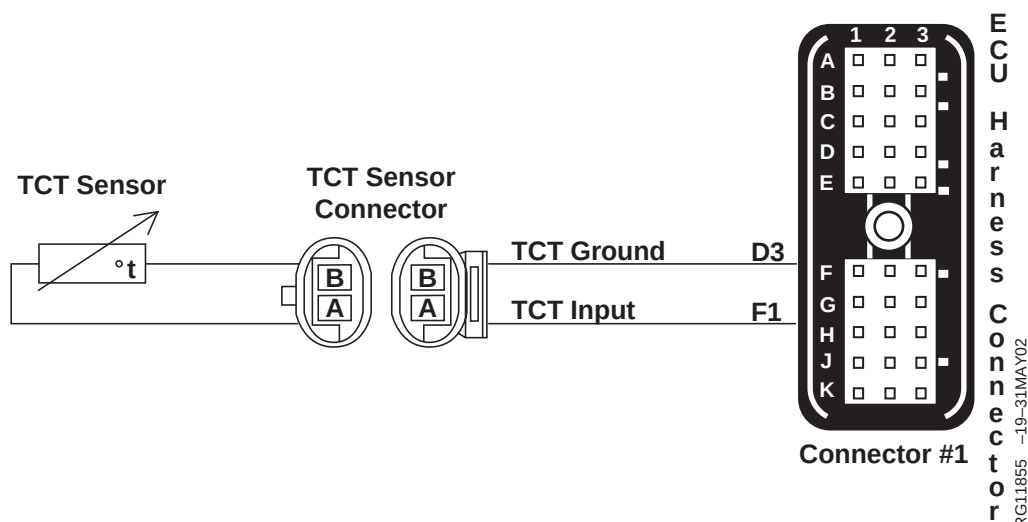
NOTE: For wiring and theory of operation information, see DTC 000102.04 MANIFOLD ABSOLUTE PRESSURE INPUT VOLTAGE LOW supporting information,

1. Ignition OFF
2. Remove the jumper wire
3. Ignition ON, engine OFF
4. Using a multimeter, measure voltage between the MAP 5V supply (terminal C) of the MAP sensor connector on the engine harness and a good chassis ground.

4.0 - 6.0 volts:
Open in MAP sensor input circuit
OR
Short to ground in input circuit
OR
Faulty ECU connection
OR
Faulty ECU

Below 4.0 volts:
Open in MAP sensor 5V supply circuit
OR
Short to ground in MAP sensor 5V supply circuit
OR
Faulty ECU connection
OR
Faulty ECU

-- -1/1

000105.00 — Throttle Charge Temperature Extremely High**Throttle Charge Temperature (TCT) Sensor**

- The Throttle Charge Temperature (TCT) sensor is a thermistor (temperature sensitive resistor) mounted on the mixing elbow. The TCT sensor is used to measure the temperature of the intake air. The TCT sensor's variable resistance causes the input voltage to the ECU to vary. Higher temperatures result in lower TCT input voltages to the ECU; lower temperatures result in higher voltages. For further TCT sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000105.00 will set if:

- The ECU senses a throttle charge temperature above the warning value set point in the ECU. The maximum value set point is 165°F (74°C).

If DTC 000105.00 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When TCT drops back below the maximum value set point, power will be increased 30% per minute until either full power is reached or if the maximum value set point is surpassed again.
- DTC 001569.31 and DTC 000105.16 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000373 -19-08MAY02-1/1

000105.00 — Throttle Charge Temperature Extremely High

The ECU senses a throttle charge temperature above the warning value set point.

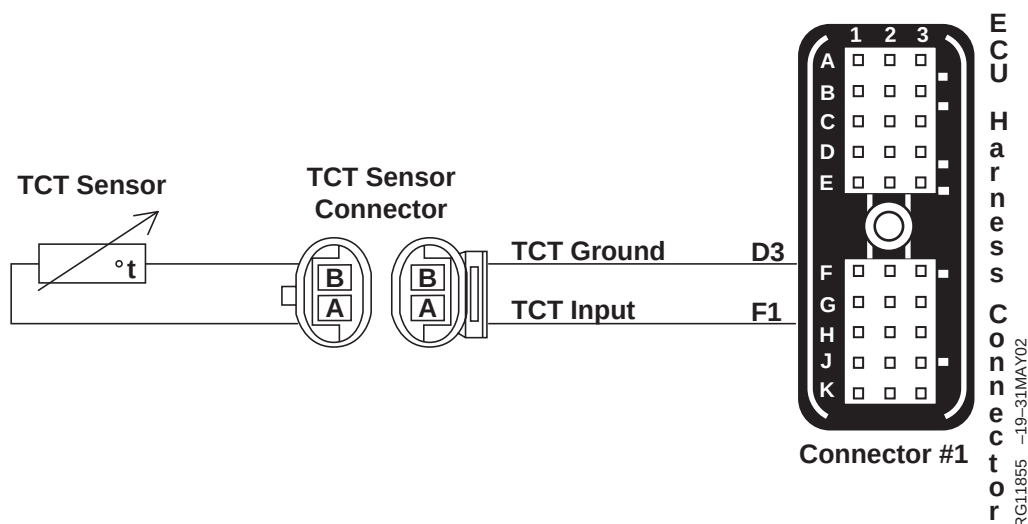
RG41221.0000374 -19-08MAY02-1/1

000105.00 Throttle Charge Temperature Extremely High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000105.00 THROTTLE CHARGE TEMPERATURE EXTREMELY HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the TCT sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Failures Causing High TCT Check	<i>NOTE: For wiring and theory of operation information, see DTC 000105.00 THROTTLE CHARGE TEMPERATURE EXTREMELY HIGH supporting information.</i> Check the following items that can cause high throttle charge temperature: • Excessively high ambient air temperature. • Restricted, dirty, or damaged charge air cooler. • Loose cooling fan belt. • Malfunctioning cooling fan. • Restricted or damaged intake air piping. • Damaged cooling fan shroud.	Cause of high TCT located: Repair problem and retest. No cause of high TCT temp located: Verify that TCT sensor input and ground circuits are OK. If TCT sensor circuits are OK, replace TCT sensor and retest.

-- -1/1

000105.03 — Throttle Charge Temperature Input Voltage High**Throttle Charge Temperature (TCT) Sensor**

- The Throttle Charge Temperature (TCT) sensor is a thermistor (temperature sensitive resistor) mounted on the mixing elbow. The TCT sensor is used to measure the temperature of the intake air. The TCT sensor's variable resistance causes the input voltage to the ECU to vary. Higher temperatures result in lower TCT input voltages to the ECU; lower temperatures result in higher voltages. For further TCT sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000105.03 will set if:

- The TCT input voltage exceeds 4.9 volts. This voltage corresponds to a temperature that is lower than what is physically possible for throttle charge temperature.

If DTC 000105.03 sets, the following will occur:

- ECU will default to a TCT value of 122°F (50°C).
- ECU's high throttle charge temperature engine protection feature disabled.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,000006B -19-14SEP01-1/1

000105.03 — Throttle Charge Temperature Input Voltage High

The TCT input voltage exceeds the sensor's high voltage specification.

RG41221.00002A2 -19-19SEP01-1/1

000105.03 Throttle Charge Temperature Input Voltage High Diagnostic Procedure

NOTE: The Throttle Charge Temperature, Engine Coolant Temperature, Exhaust Temperature, Natural Gas Temperature, and the Engine Oil Temperature sensors all share a common sensor ground to the ECU. If DTC 000110.03, 000173.03, 000174.03, and 000175.03 are also present, look for an open in the sensor ground wire.

-- -1/1

❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000105.03 THROTTLE CHARGE TEMPERATURE INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the TCT sensor connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

-- -1/1

2 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000105.03 THROTTLE CHARGE TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine OFF
6. Read DTCs using DST or SERVICE ADVISOR™.

000105.03 reoccurs:
GO TO **3**

000105.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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3 TCT Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 000105.03 THROTTLE CHARGE TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect TCT sensor connector
3. Install a jumper wire between both terminals in the TCT sensor harness connector
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Throttle Charge Temperature Input Voltage

Above 0.1 V:
GO TO **4**

0.1 V or below:
Faulty TCT sensor connection
OR
Faulty TCT sensor

-- -1/1

4 TCT Sensor Open Ground Circuit Test

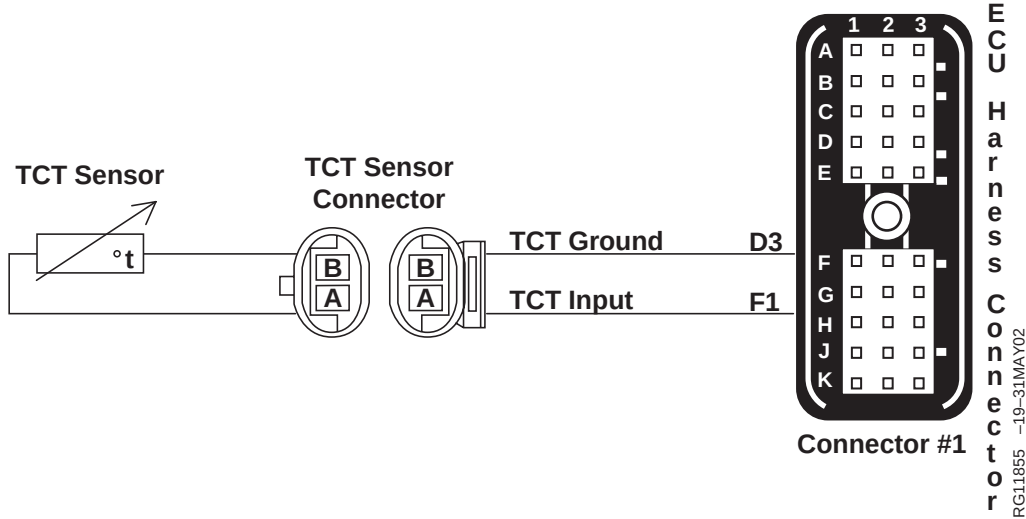
NOTE: For wiring and theory of operation information, see DTC 000105.03 THROTTLE CHARGE TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Remove jumper wire between both terminals.
3. Install jumper wire between TCT sensor harness connector input terminal (terminal A) of TCT sensor harness connector and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Throttle Charge Temperature Input Voltage

Above 0.1 V:
Open in TCT sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

0.1 V or below:
Open in TCT sensor ground circuit
OR
Faulty ECU connection
OR
Faulty ECU

-- -1/1

000105.04 — Throttle Charge Temperature Input Voltage Low**Throttle Charge Temperature (TCT) Sensor**

- The Throttle Charge Temperature (TCT) sensor is a thermistor (temperature sensitive resistor) mounted on the mixing elbow. The TCT sensor is used to measure the temperature of the intake air. The TCT sensor's variable resistance causes the input voltage to the ECU to vary. Higher temperatures result in lower TCT input voltages to the ECU; lower temperatures result in higher voltages. For further TCT sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000105.04 will set if:

- The TCT input voltage drops below 0.1 volts. This voltage corresponds to a temperature that is higher than what is physically possible for manifold air.

If DTC 000105.04 sets, the following will occur:

- ECU will default to a TCT value of 122°F (50°C).
- ECU's high throttle charge temperature engine protection feature disabled.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,000006C -19-14SEP01-1/1

000105.04 — Throttle Charge Temperature Input Voltage Low

The TCT input voltage drops below the sensor's low voltage specification.

RG41221,00002A3 -19-19SEP01-1/1

000105.04 Throttle Charge Temperature Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000105.04 THROTTLE CHARGE TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the TCT sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000105.04 THROTTLE CHARGE TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine OFF 6. Read DTCs using DST or SERVICE ADVISOR™.	000105.04 reoccurs: GO TO ❸ 000105.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115
,180

③ TCT Sensor Test

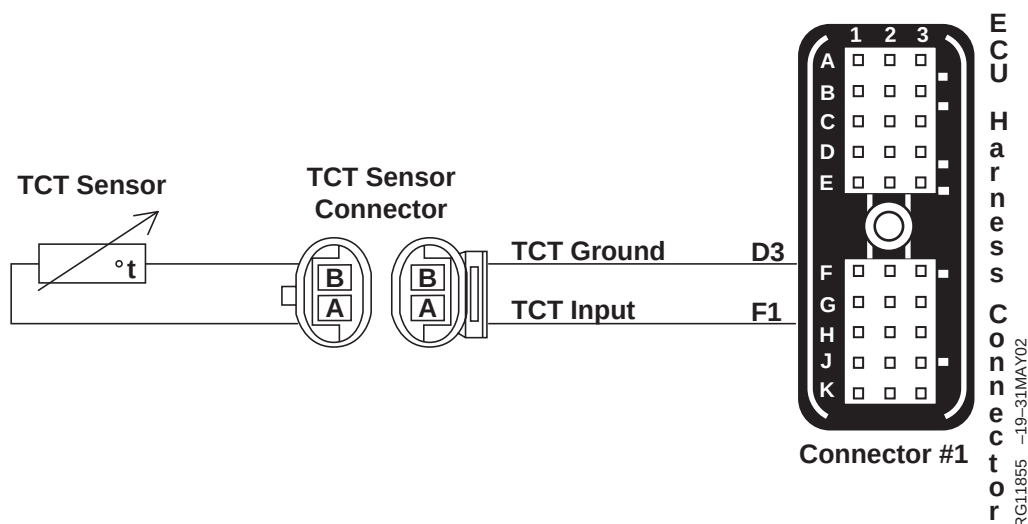
NOTE: For wiring and theory of operation information, see DTC 000105.04 THROTTLE CHARGE TEMPERATURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect TCT sensor connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read Throttle Charge Temperature Input Voltage

Below 4.9 V:
Short to ground in TCT sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

4.9 V or greater:
Faulty TCT sensor connection
OR
Faulty TCT sensor

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000105.16 — Throttle Charge Temperature Moderately High**Throttle Charge Temperature (TCT) Sensor**

- The Throttle Charge Temperature (TCT) sensor is a thermistor (temperature sensitive resistor) mounted on the mixing elbow. The TCT sensor is used to measure the temperature of the intake air. The TCT sensor's variable resistance causes the input voltage to the ECU to vary. Higher temperatures result in lower TCT input voltages to the ECU; lower temperatures result in higher voltages. For further TCT sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000105.16 will set if:

- The ECU senses a throttle charge temperature above the warning value set point in the ECU. The maximum value set point is 154°F (68°C).

If DTC 000105.16 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 15% per minute to a maximum derate of 15%. When TCT drops back below the maximum value set point, power will be increased 15% per minute until either full power is reached or if the maximum value set point is surpassed again.
- DTC 001569.31 will also be present.
- ECU will set a SOLID Warning light.

RG41221,000006E -19-14SEP01-1/1

000105.16 — Throttle Charge Temperature Moderately High

The ECU senses a throttle charge temperature above the warning value set point.

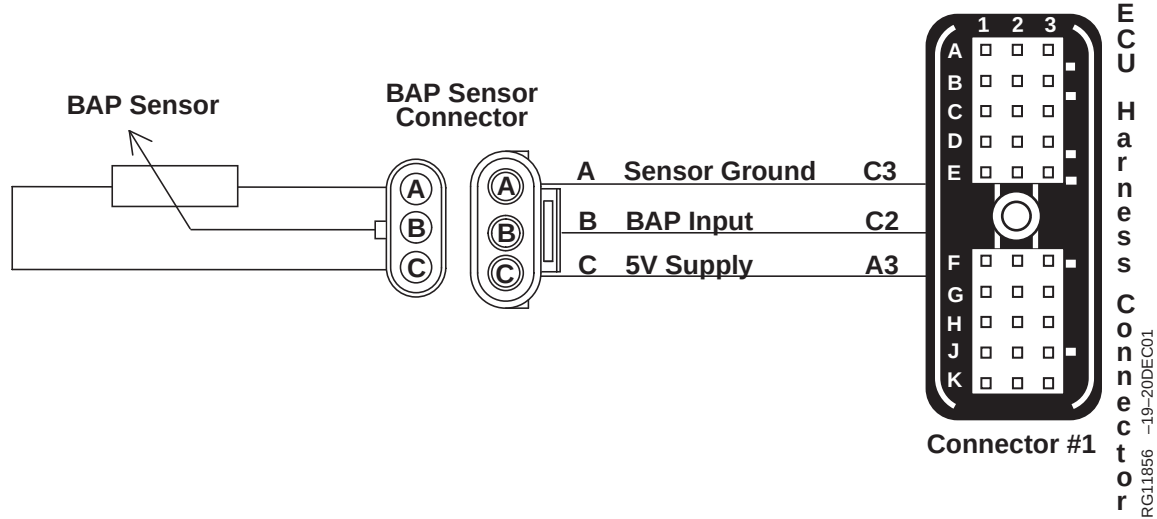
RG41221.00002A4 -19-19SEP01-1/1

000105.16 Throttle Charge Temperature Moderately High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000105.16 THROTTLE CHARGE TEMPERATURE MODERATELY HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the TCT sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Failures Causing High TCT Check	<i>NOTE: For wiring and theory of operation information, see DTC 000105.16 THROTTLE CHARGE TEMPERATURE MODERATELY HIGH supporting information.</i> Check the following items that can cause high throttle charge temperature: • Excessively high ambient air temperature. • Restricted, dirty, or damaged charge air cooler. • Loose cooling fan belt. • Malfunctioning cooling fan. • Restricted or damaged intake air piping. • Damaged cooling fan shroud.	Cause of high TCT located: Repair problem and retest. No cause of high TCT temp located: Verify that TCT sensor input and ground circuits are OK. If TCT sensor circuits are OK, replace TCT sensor and retest.

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000108.02 — Barometric Air Pressure Cross Check Invalid**Barometric Air Pressure (BAP) Sensor**

- The Barometric Air Pressure sensor is a pressure transducer mounted on the base of the mixing elbow. The BAP sensor is used to measure the pressure of the air inside the engine compartment. The BAP input voltage varies as the pressure varies. Higher air pressures result in higher BAP input voltages to the ECU; lower pressures result in lower voltages. The ECU monitors barometric air pressure along with the humidity sensor to calculate absolute humidity. For further BAP sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000108.02 will set if:

- The ECU does a cross check between the MAP sensor, the BAP sensor, and the UTP sensor during key ON. DTC 000108.02 will set if the ECU senses barometric air pressure that is not possible with the current MAP and UTP readings.

If DTC 000108.02 sets, the following will occur:

- The ECU will use the upstream throttle pressure value when there is no boost to calculate the barometric air pressure.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,000006F -19-14SEP01-1/1

000108.02 — Barometric Air Pressure Cross Check Invalid

Cross check shows BAP is out of specification with MAP and UTP.

RG41221,0000080 -19-04OCT01-1/1

000108.02 Barometric Air Pressure Cross Check Invalid Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000108.02 BAROMETRIC AIR PRESSURE CROSS CHECK INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the BAP sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000108.02 BAROMETRIC AIR PRESSURE CROSS CHECK INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000108.02 reoccurs: GO TO ❸ 000108.02 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ BAP Wiring Test

NOTE: For wiring and theory of operation information, see DTC 000108.02 BAROMETRIC AIR PRESSURE CROSS CHECK INVALID supporting information.

1. Ignition OFF
2. Disconnect the BAP connector.
3. Disconnect ECU connector #1 (black A-K).
4. Using a multimeter, measure resistance between the following terminals:
 - Terminal C2 in the ECU connector and terminal B in the BAP sensor connector on the engine harness.
 - Terminal C3 in the ECU connector and terminal A in the BAP sensor connector on the engine harness.
 - Terminal A3 in the ECU connector and terminal C in the BAP sensor connector on the engine harness.

All measurements 5 ohms or less:
GO TO **④**

One or more measurements greater than 5 ohms:
Short or open in wire that had a resistance greater than 5 ohms.

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④ BAP Sensor Test

NOTE: For wiring and theory of operation information, see DTC 000108.02 BAROMETRIC AIR PRESSURE CROSS CHECK INVALID supporting information.

1. Ignition ON, engine running under condition that set code
2. Using the ECU diagnostic software read Barometric Air Pressure and Barometric Air Pressure Input Voltage. Use the following table for the voltage range at specific pressures.

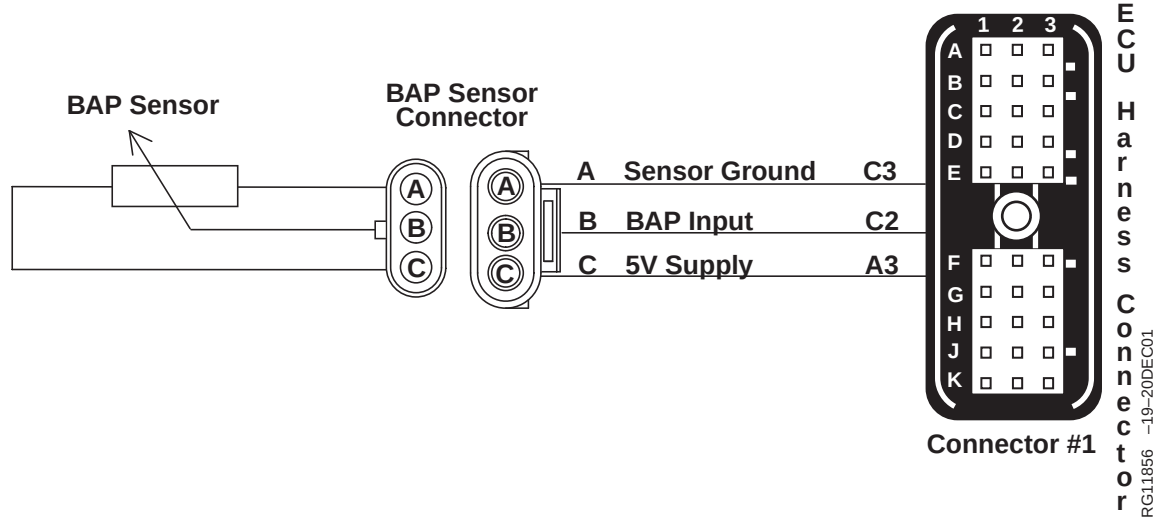
Pressure	Voltage
2.2 psia (15 kPa) (0.15 bar)	0.1 to 0.4 volts
5.8 psia (40 kPa) (0.4 bar)	1.5 to 1.7 volts
13.6 psia (94 kPa) (0.9 bar)	4.4 to 4.6 volts
14.8 psia (102 kPa) (1.0 bar)	4.8 to 5.1 volts

NOTE: If exact voltage is not included in table, see if relationship between Pressure and Voltage are similar to the table.

Voltage within specification:
Faulty ECU connection
OR
Faulty ECU

Voltage out of specification:
Faulty BAP sensor.

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000108.03 — Barometric Air Pressure Input Voltage High**Barometric Air Pressure (BAP) Sensor**

- The Barometric Air Pressure sensor is a pressure transducer mounted on the base of the mixing elbow. The BAP sensor is used to measure the pressure of the air inside the engine compartment. The BAP input voltage varies as the pressure varies. Higher air pressures result in higher BAP input voltages to the ECU; lower pressures result in lower voltages. The ECU monitors barometric air pressure along with the humidity sensor to calculate absolute humidity. For further BAP sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000108.03 will set if:

- BAP input voltage exceeds a maximum voltage threshold of 4.9 volts. This voltage corresponds to a pressure that is higher than what is physically possible for barometric air pressure.

If DTC 000108.03 sets, the following will occur:

- The ECU will use a default Barometric Air Pressure of 14.2 psia (98 kPa) (1.0 bar) until the engine has reached 0 boost pressure. Then the ECU will use the Upstream Throttle Pressure value.
- DTC 001080.03 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000070 -19-14SEP01-1/1

000108.03 — Barometric Air Pressure Input Voltage High

BAP input voltage exceeds the sensor's high voltage specification.

RG41221,0000081 -19-04OCT01-1/1

000108.03 Barometric Air Pressure Input Voltage High Diagnostic Procedure

NOTE: If DTC 000108.03 is accompanied with 001080.03, diagnose 001080.03 first.

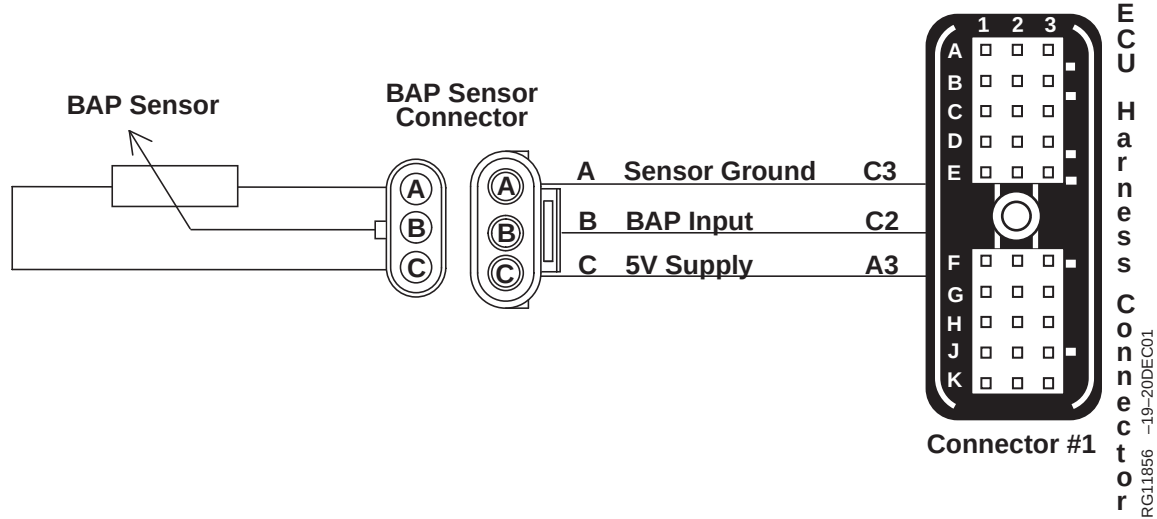
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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000108.03 BAROMETRIC AIR PRESSURE INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the BAP sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000108.03 BAROMETRIC AIR PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000108.03 reoccurs: GO TO ❸ 000108.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 ,190	③ BAP Input Shorted Test	<i>NOTE: For wiring and theory of operation information, see DTC 000108.03 BAROMETRIC AIR PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect the BAP sensor connector. 3. Ignition ON, engine OFF 4. Using the ECU diagnostic software, read Barometric Air Pressure Input Voltage.	Below 0.2 V: GO TO ④ 0.2 V or greater: Short to voltage in BAP input circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ BAP Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation information, see DTC 000108.03 BAROMETRIC AIR PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. BAP sensor connector still disconnected. 2. Ignition ON, engine OFF 3. Probe BAP sensor ground terminal (terminal A) in th BAP sensor connector on the engine harness with a test light connected to battery voltage	LIGHT ON: Faulty BAP sensor OR Faulty ECU connection OR Faulty ECU LIGHT OFF: Open in BAP sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

000108.04 — Barometric Air Pressure Input Voltage Low**Barometric Air Pressure (BAP) Sensor**

- The Barometric Air Pressure sensor is a pressure transducer mounted on the base of the mixing elbow. The BAP sensor is used to measure the pressure of the air inside the engine compartment. The BAP input voltage varies as the pressure varies. Higher air pressures result in higher BAP input voltages to the ECU; lower pressures result in lower voltages. The ECU monitors barometric air pressure along with the humidity sensor to calculate absolute humidity. For further BAP sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000108.04 will set if:

- BAP input voltage drops below 0.2 volts. This voltage corresponds to a pressure that is lower than what is physically possible for BAP.

If DTC 000108.04 sets, the following will occur:

- The ECU will use a default Barometric Air Pressure of 14.2 psia (98 kPa) (1.0 bar) until the engine has reached 0 boost pressure. Then the ECU will use the Upstream Throttle Pressure value.
- DTC 001080.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000071 -19-14SEP01-1/1

000108.04 — Barometric Air Pressure Input Voltage Low

BAP input voltage drops below the sensor's low voltage specification.

RG41221,0000082 -19-04OCT01-1/1

000108.04 Barometric Air Pressure Input Voltage Low Diagnostic Procedure

NOTE: If DTC 000108.04 is accompanied with 001080.04, diagnose 001080.04 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000108.04 BAROMETRIC AIR PRESSURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the BAP sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000108.04 BAROMETRIC AIR PRESSURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000108.04 reoccurs: GO TO ❸ 000108.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ BAP Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 000108.04 BAROMETRIC AIR PRESSURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect the BAP sensor connector.
3. Install a jumper wire between the BAP 5V supply and the input terminals (terminals B and C) in the sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Barometric Air Pressure Input Voltage.

Below 4.9 V:
GO TO **④**

4.9 V or greater:
Faulty BAP sensor connection
OR
Faulty BAP sensor

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④ BAP 5V Supply Test

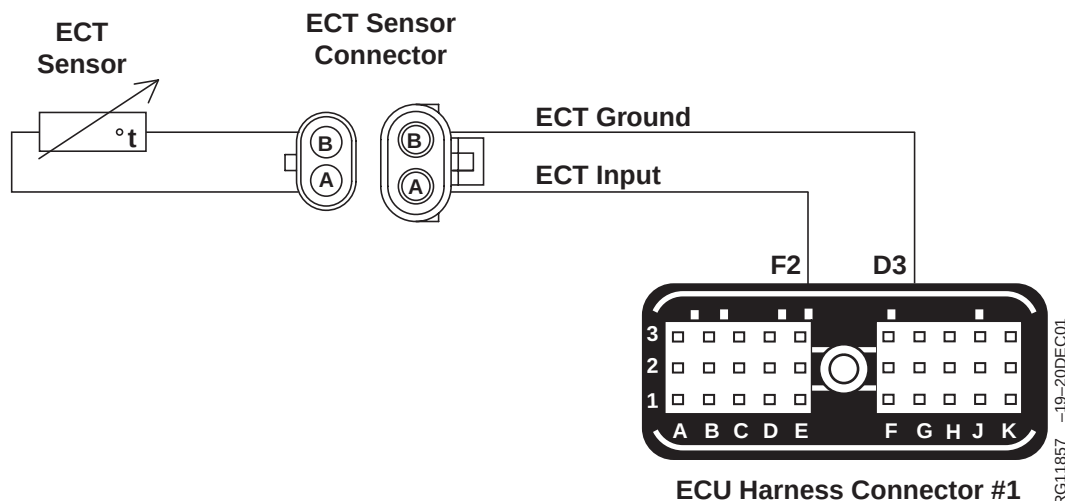
NOTE: For wiring and theory of operation information, see DTC 000108.04 BAROMETRIC AIR PRESSURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Remove the jumper wire
3. Ignition ON, engine OFF
4. Using a multimeter, measure voltage between the 5V supply (terminal C) of the BAP sensor connector on the engine harness and a good chassis ground.

4.0-6.0 volts:
Open in BAP sensor input circuit
OR
Short to ground in BAP sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

Below 4.0 volts:
Open in BAP 5V supply circuit
OR
Short to ground in BAP sensor 5V supply circuit
OR
Faulty ECU connection
OR
Faulty ECU

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000110.00 — Engine Coolant Temperature Extremely High**Engine Coolant Temperature (ECT) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000110.00 will set if:

- The ECU senses a coolant temperature above 239°F (115°C).

If DTC 000110.00 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - With Shutdown Feature: The derate will go into effect when the code is set and the engine will shut down after 30 seconds.
 - Will derate the engine 40% per minute to a maximum derate of 60%. When engine coolant temperature drops back below the maximum value set point, power will be increased 40% per minute until either full power is reached or if the maximum value set point is surpassed again.
- DTC 001569.31, DTC 000110.15, and DTC 000110.16 will also be present.
- If shutdown feature is available, DTC 001110.31 will also be present.
- ECU will set a SOLID STOP light.

RG41221,0000072 -19-14SEP01-1/1

000110.00 — Engine Coolant Temperature Extremely High

The ECU senses a coolant temperature above specification.

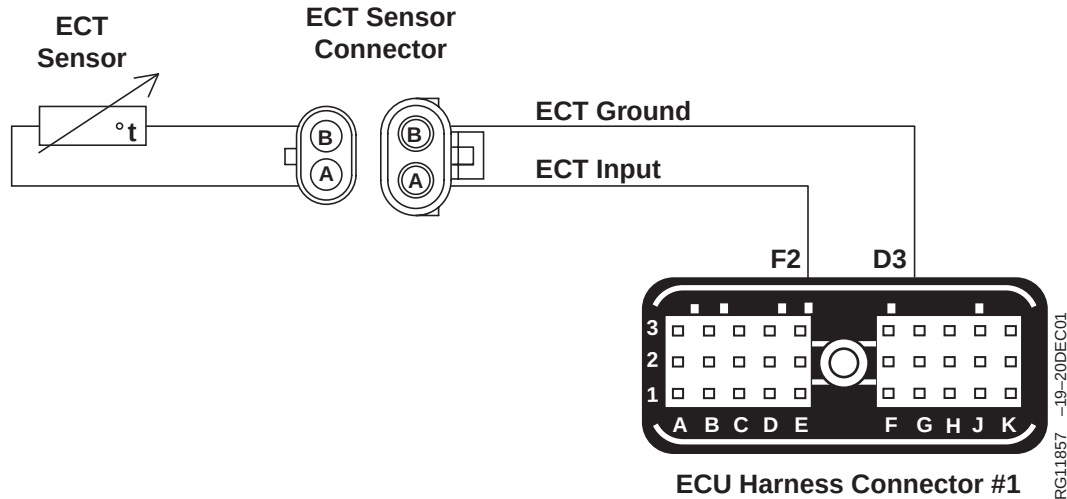
RG41221,00002A5 -19-19SEP01-1/1

000110.00 Engine Coolant Temperature Extremely High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000110.00 ENGINE COOLANT TEMPERATURE EXTREMELY HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ ECT Sensor and Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000110.00 ENGINE COOLANT TEMPERATURE EXTREMELY HIGH supporting information.</i> Under the conditions where DTC 000110.00 occurs, using a temperature gauge, verify that engine coolant temperature is above extremely high specification.	Temperature above specification: Engine overheating problem. See DIAGNOSING COOLING SYSTEM MALFUNCTIONS in Group 105 earlier in this manual. Temperature significantly less than specification: Verify that ECT sensor input and ground circuits are OK. If ECT sensor circuits are OK, replace ECT sensor and retest.

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000110.03 — Engine Coolant Temperature Input Voltage High**Engine Coolant Temperature (ECT) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000110.03 will set if:

- ECT input voltage exceeds a maximum voltage threshold of 4.9 volts. This voltage corresponds to a temperature that is lower than what is physically possible for ECT.

If DTC 000110.03 sets, the following will occur:

- The ECU will use a default engine coolant temperature of 203°F (95°C).
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

000110.03 — Engine Coolant Temperature Input Voltage High

ECT input voltage exceeds the sensor's high voltage specification.

RG41221.00002A6 -19-19SEP01-1/1

000110.03 Engine Coolant Temperature Input Voltage High Diagnostic Procedure

NOTE: The Throttle Charge Temperature, Engine Coolant Temperature, Exhaust Temperature, Natural Gas Temperature, and the Engine Oil Temperature sensors all share a common sensor ground to the ECU. If DTC 000105.03, 000173.03, 000174.03, and 000175.03 are also present, look for an open in the sensor ground wire.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000110.03 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair faulty connection(s).

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② Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000110.03 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000110.03 reoccurs:
GO TO ③

000110.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ ECT Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 000110.03 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect ECT sensor connector.
3. Install a jumper wire between both terminals in the ECT sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Engine Coolant Temperature Input Voltage.

Above 0.1 V:
GO TO ④

0.1 V or below:
Faulty ECT sensor connection
OR
Faulty ECT sensor

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④ ECT Open Ground Circuit Test

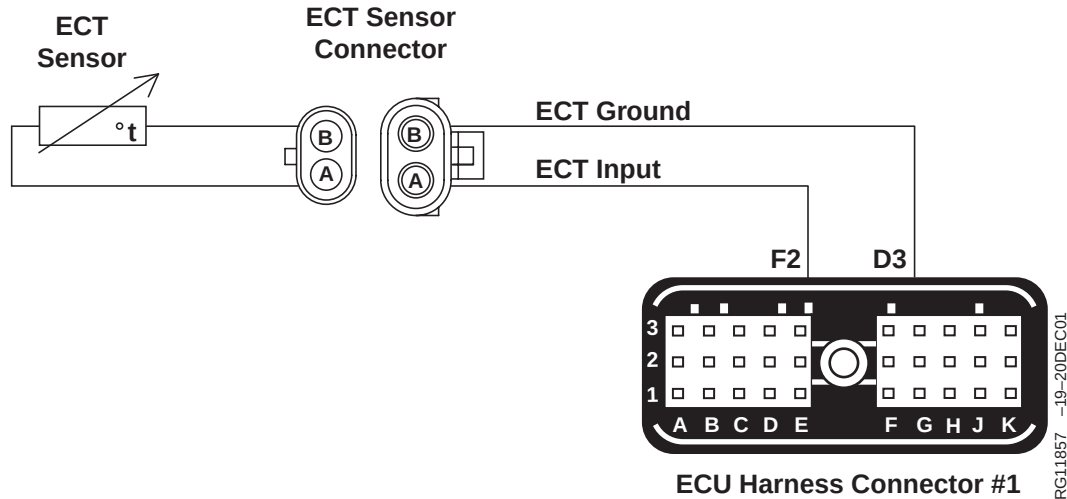
NOTE: For wiring and theory of operation information, see DTC 000110.03 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Remove jumper wire between both terminals.
3. Install jumper wire between the input terminal (terminal A) in the ECT sensor connector on the engine harness and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Engine Coolant Temperature Input Voltage.

Above 0.1 V:
Open in ECT input sensor circuit
OR
Faulty ECU connection
OR
Faulty ECU

0.1 V or below:
Open in ECT sensor ground circuit
OR
Faulty ECU connection
OR
Faulty ECU

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000110.04 — Engine Coolant Temperature Input Voltage Low**Engine Coolant Temperature (ECT) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000110.04 will set if:

- ECT input voltage drops below 0.1 volts. This voltage corresponds to a temperature that is higher than what is physically possible for ECT.

If DTC 000110.04 sets, the following will occur:

- The ECU will use a default engine coolant temperature of 203°F (95°C).
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000074 -19-14SEP01-1/1

000110.04 — Engine Coolant Temperature Input Voltage Low

ECT input voltage drops below the sensor's low voltage specification.

RG41221,00002A7 -19-19SEP01-1/1

000110.04 Engine Coolant Temperature Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000110.04 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000110.04 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine OFF or running 6. Read DTCs using DST or SERVICE ADVISOR™.	000110.04 reoccurs: GO TO ❸ 000110.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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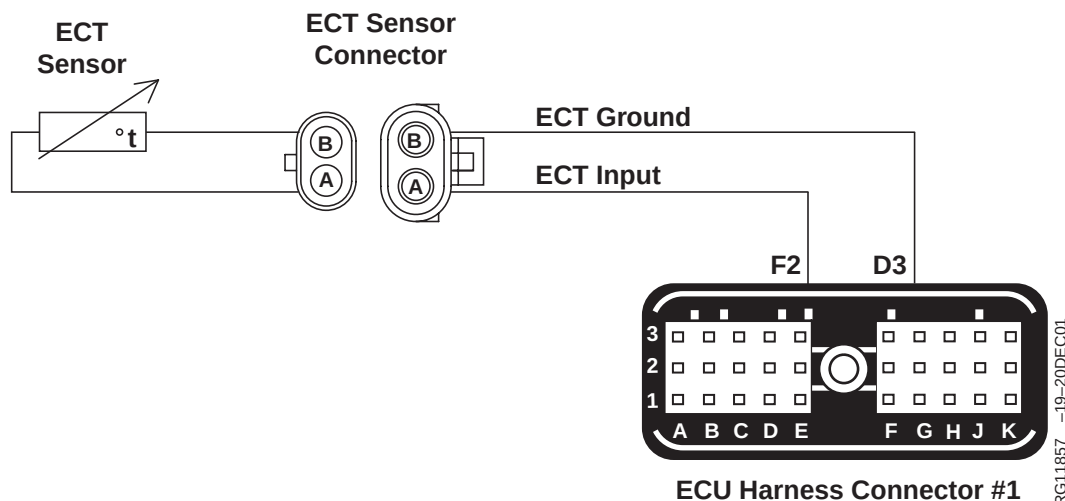
③ ECT Sensor Test

NOTE: For wiring and theory of operation information, see DTC 000110.04 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect ECT sensor connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read Engine Coolant Temperature Input Voltage.

Below 4.9 V:
Short to ground in ECT sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

4.9 V or greater:
Faulty ECT sensor connection
OR
Faulty ECT sensor

000110.15 — Engine Coolant Temperature High Least Severe**Engine Coolant Temperature (ECT) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000110.15 will set if:

- The ECU senses a coolant temperature above 221°F (105°C).

If DTC 000110.15 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 2% per minute to a maximum derate of 10%. When engine coolant temperature drops back below the maximum value set point, power will be increased 2% per minute until either full power is reached or if the maximum value set point is surpassed again.
- DTC 001569.31 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000075 -19-14SEP01-1/1

000110.15 — Engine Coolant Temperature High Least Severe

The ECU senses a coolant temperature above specification.

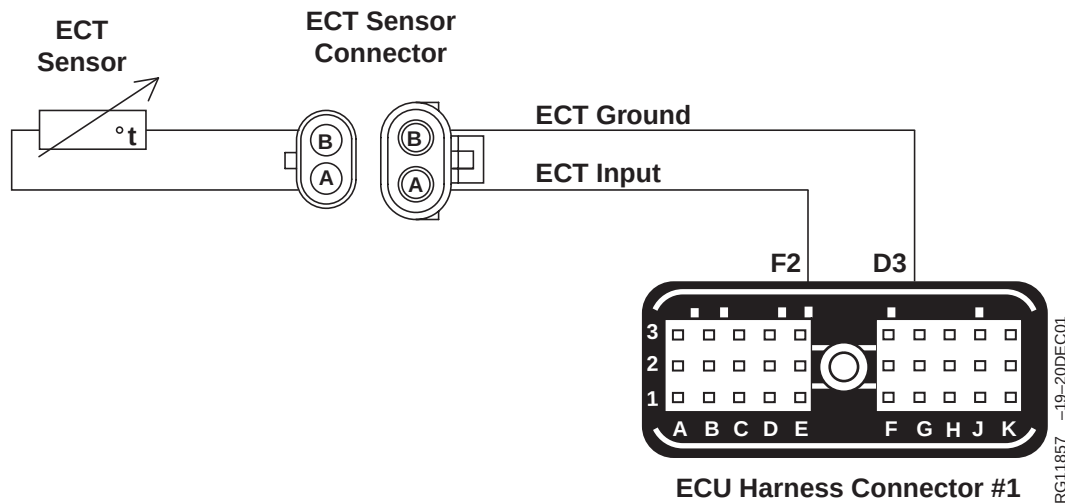
RG41221,00002A8 -19-19SEP01-1/1

000110.15 Engine Coolant Temperature Moderately High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000110.15 ENGINE COOLANT TEMPERATURE HIGH LEAST SEVERE supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ ECT Sensor and Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000110.15 ENGINE COOLANT TEMPERATURE HIGH LEAST SEVERE supporting information.</i> Under the conditions where DTC 000110.15 occurs, using a temperature gauge, verify that engine coolant temperature is above the moderately high specification.	Temperature above specification: Engine overheating problem. See DIAGNOSING COOLING SYSTEM MALFUNCTIONS in Group 105 earlier in this manual. Temperature significantly less than specification: Verify that ECT sensor input and ground circuits are OK. If ECT sensor circuits are OK, replace ECT sensor and retest.

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000110.16 — Engine Coolant Temperature Moderately High**Engine Coolant Temperature (ECT) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000110.16 will set if:

- The ECU senses a coolant temperature above 230°F (110°C).

If DTC 000110.16 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 20% per minute to a maximum derate of 40%. When engine coolant temperature drops back below the maximum value set point, power will be increased 20% per minute until either full power is reached or if the maximum value set point is surpassed again.
- DTC 001569.31 and DTC 000110.15 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000076 -19-14SEP01-1/1

000110.16 — Engine Coolant Temperature Moderately High

The ECU senses a coolant temperature above specification.

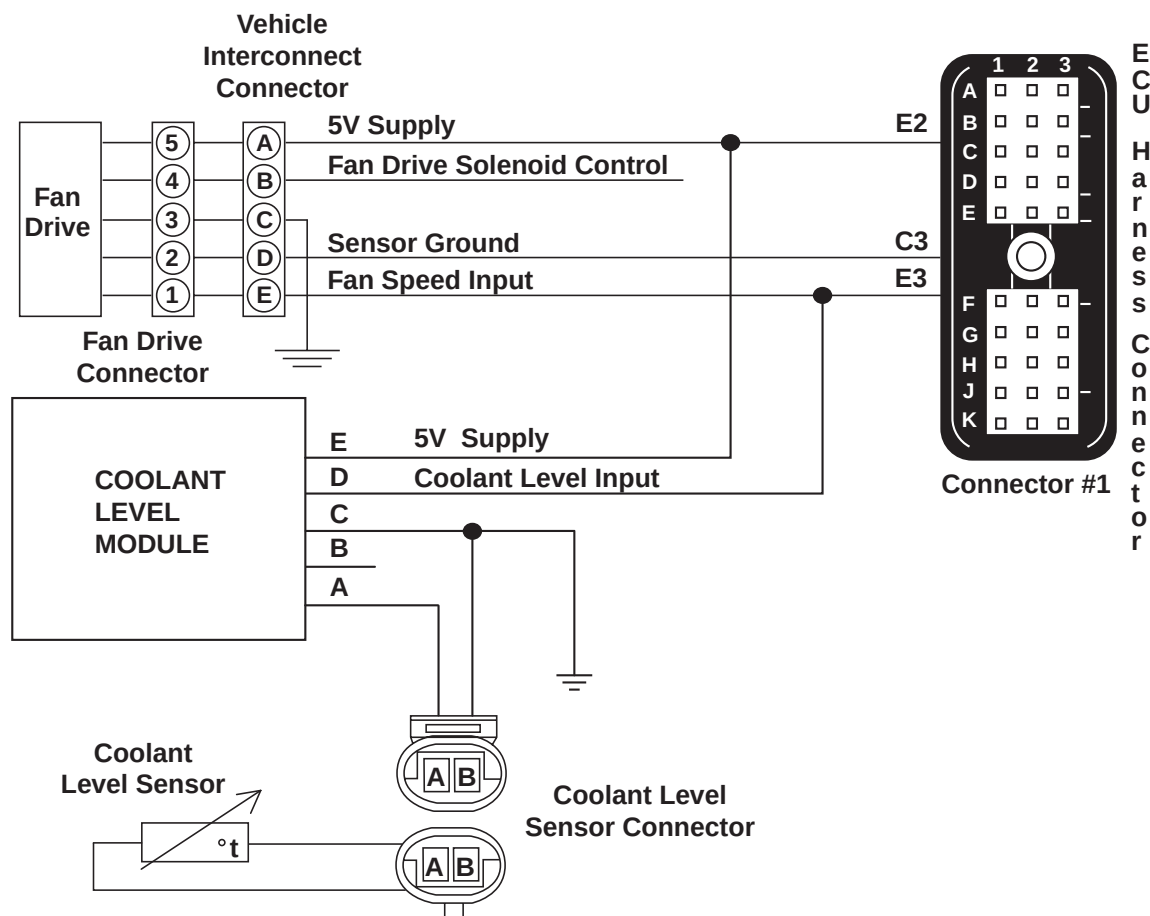
RG41221,00002A9 -19-19SEP01-1/1

000110.16 Engine Coolant Temperature Moderately High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000110.16 ENGINE COOLANT TEMPERATURE MODERATELY HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ ECT Sensor and Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000110.16 ENGINE COOLANT TEMPERATURE MODERATELY HIGH supporting information.</i> Under the conditions where DTC 000110.16 occurs, using a temperature gauge, verify that engine coolant temperature is above the moderately high specification.	Temperature above specification: Engine overheating problem. See DIAGNOSING COOLING SYSTEM MALFUNCTIONS in Group 105 earlier in this manual. Temperature significantly less than specification: Verify that ECT sensor input and ground circuits are OK. If ECT sensor circuits are OK, replace ECT sensor and retest.

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000111.01 — Engine Coolant Level Low

RG11906 -19-10JUL03

Coolant Level Sensor

- The Coolant Level sensor is a two wire sensor; one wire connects to the input probe and the other to the brass housing as a ground. The coolant is used as a conductor between the input and the ground. When the coolant level drops and the sensor is no longer submerged, the circuit is broken and the voltage goes high. The Coolant Level Module sends a 0 volt or 5 volt signal to the ECU. Under normal operation, the ECU will see 0 volts. For further coolant level sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000111.01 will set if:

- The ECU senses 5 volts on the coolant level input wire. This is caused by low coolant level or an open or short in the input wire.

If DTC 000111.01 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - With Shutdown Feature: The derate will go into effect when the code is set and the engine will shut down after 30 seconds.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When engine coolant level rises above the minimum value set point, power will be increased 30% per minute until either full power is reached or if the minimum value set point is surpassed again.
- DTC 001569.31 will also be present.
- If shutdown feature is available, DTC 001110.31 will also be present.
- DTC 000110.00, 15, and or 16 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

000111.01 — Engine Coolant Level Low

Engine coolant level drops below specification.

RG41221.0000358 -19-07MAY02-1/1

000111.01 Engine Coolant Level Low Diagnostic Procedure

NOTE: If DTC 000111.01 is accompanied with 000110.00, 000110.15, and 000110.16, diagnose 000111.01 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000111.01 ENGINE COOLANT LEVEL LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the engine coolant level sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).

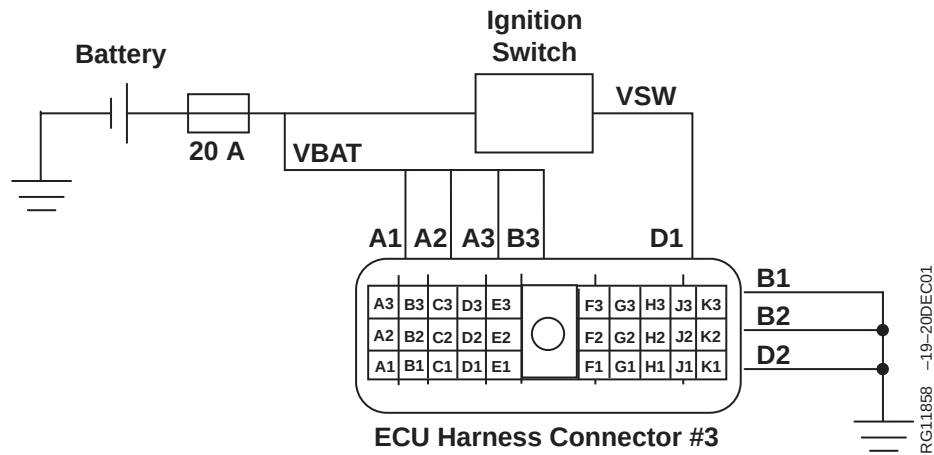
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❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000111.01 ENGINE COOLANT LEVEL LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™	000111.01 reoccurs: GO TO ❸ 000111.01 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 212 ③ Coolant Level Module Check	<i>NOTE: For wiring and theory of operation information, see DTC 000111.01 ENGINE COOLANT LEVEL LOW supporting information.</i> Check to see if coolant level module has been installed on engine. If module is not present, verify that a jumper wire has been installed between terminals D and E on the fan drive connector on the engine harness.	Coolant level module or jumper wire present: GO TO ④ Neither coolant level module or jumper wire present: Install jumper wire in the fan drive connector on the engine harness. -- -1/1
④ Coolant Level Test	<i>NOTE: For wiring and theory of operation information, see DTC 000111.01 ENGINE COOLANT LEVEL LOW supporting information.</i>  CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely. Check coolant level.	Coolant level OK: GO TO ⑤ Coolant level low: Determine and repair cause of low coolant level, refill engine with correct amount of coolant, and retest. -- -1/1
⑤ Coolant Level Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000111.01 ENGINE COOLANT LEVEL LOW supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #1 (black A-K), the coolant level module connector, and the coolant level sensor. 3. Using a multimeter, measure resistance between the following terminals: • Terminal A in the coolant level module connector and terminal A in the coolant level sensor connector. • Terminal B in the coolant level sensor connector and a good chassis ground. • Terminal C in the coolant level module connector and a good chassis ground. • Terminal D of the coolant level module connector and terminal E3 in the ECU connector. • Terminal E of the coolant level module connector and terminal E2 in the ECU connector.	All measurements 5 ohms or less: Faulty coolant level sensor OR Faulty coolant level module. Any measurement(s) greater than 5 ohms: Short or open in wire that had a resistance greater than 5 ohms. -- -1/1

000158.02 — Intermittent Loss of ECU Power**ECU Power Supply:**

- Power is supplied to the ECU through terminal D1 in the ECU connector #3.

DTC 000158.02 will set if:

- The ECU detects an intermittent loss of power supply.

If DTC 000158.02 sets, the following will occur:

- The ECU does not alter the engine operation when 000158.02 occurs.
- Engine may run rough or die if power loss is for too long.
- ECU will set a SOLID Warning light.

RG41221,0000077 -19-14SEP01-1/1

000158.02 — Intermittent Loss of ECU Power

The ECU detects an intermittent loss of power supply.

RG41221,00002C2 -19-07DEC01-1/1

000158.02 Intermittent Loss of ECU Power Diagnostic Procedure

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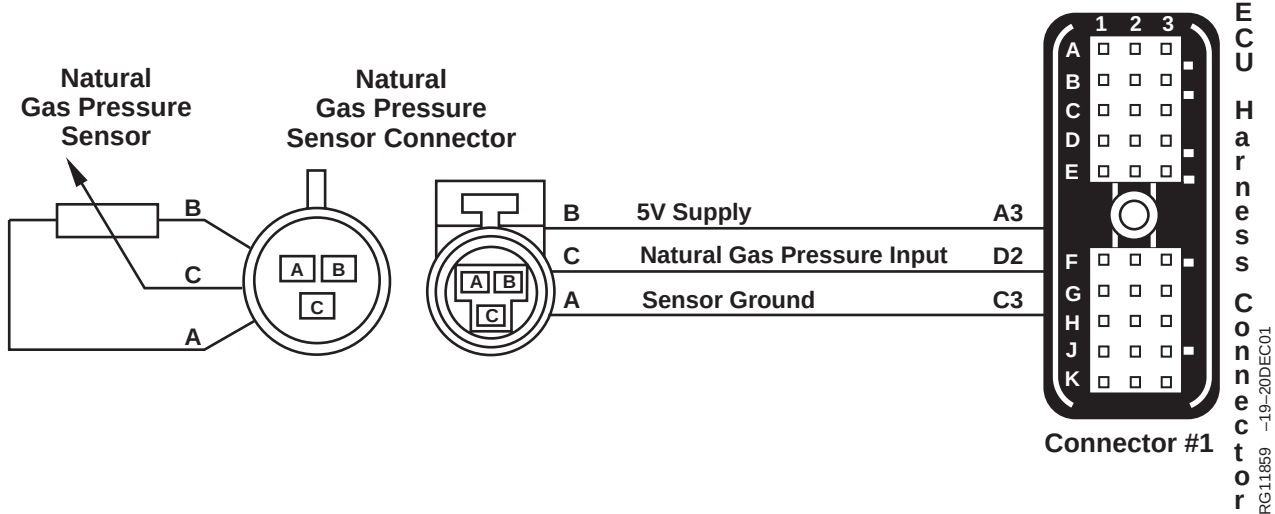
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000158.02 INTERMITTENT LOSS OF ECU POWER supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, battery, and ground connections looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000158.02 INTERMITTENT LOSS OF ECU POWER supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000158.02 reoccurs: GO TO ❸ 000158.02 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 216 ③ Battery Voltage Test	<i>NOTE: For wiring and theory of operation information, see DTC 000158.02 INTERMITTENT LOSS OF ECU POWER supporting information.</i> Using a multimeter, measure voltage between the positive and negative battery terminals.	At or near rated battery voltage: GO TO ④ Below rated battery voltage: Faulty battery or charging system. -- -1/1
④ ECU Open Power Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000158.02 INTERMITTENT LOSS OF ECU POWER supporting information.</i> 1. Ignition OFF 2. Disconnect the 30 way ECU connector #3 (white connector A-K). 3. Using a multimeter, measure voltage between a good chassis ground and the following terminals: • Terminal A1 of the ECU connector #3 on the vehicle harness • Terminal A2 of the ECU connector #3 on the vehicle harness • Terminal A3 of the ECU connector #3 on the vehicle harness • Terminal B3 of the ECU connector #3 on the vehicle harness	All measurements at or near battery voltage: GO TO ⑤ Any measurement substantially less than battery voltage: Faulty ECU power supply fuse OR Faulty ECU connection OR Open or short in ECU power circuit -- -1/1
⑤ ECU Ground Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000158.02 INTERMITTENT LOSS OF ECU POWER supporting information.</i> 1. Ignition OFF 2. ECU connector #3 (white connector A-K) still disconnected. 3. Using a multimeter, measure voltage between the positive battery terminal and the following terminals: • Terminal B1 of the ECU connector #3 on the vehicle harness • Terminal B2 of the ECU connector #3 on the vehicle harness • Terminal D2 of the ECU connector #3 on the vehicle harness	All measurements at or near battery voltage: GO TO ⑥ Any measurement substantially less than battery voltage: Faulty ECU connection OR Open or short in ECU power circuit -- -1/1
⑥ ECU Switched Power Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000158.02 INTERMITTENT LOSS OF ECU POWER supporting information.</i> 1. Ignition OFF 2. ECU connector #3 (white connector A-K) still disconnected. 3. Ignition ON, engine OFF 4. Using a multimeter, measure voltage between the ECU switched power terminal (terminal D1) in the ECU connector #3 on the vehicle harness and a good chassis ground.	At or near battery voltage: Faulty ECU Substantially less than battery voltage: Faulty ECU connection OR Open or short in ECU switched power circuit -- -1/1

000159.03 — Natural Gas Pressure Input Voltage High**Natural Gas Pressure (NGP) Sensor:**

- The Natural Gas Pressure sensor is a pressure transducer mounted on the fuel metering block. It is used to measure the regulated gas pressure prior to injection. The NGP signal voltage varies as the fuel pressure in the metering block varies. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further natural gas pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000159.03 will set if:

- NGP input voltage exceeds a maximum voltage threshold of 4.9 volts. This voltage corresponds to a pressure that is higher than what is physically possible for NGP.

If DTC 000159.03 sets, the following will occur:

- The ECU will use a default natural gas pressure of 135 psia (931 kPa) (9.30 bar)
- DTC 1080.03 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000078 -19-14SEP01-1/1

000159.03 — Natural Gas Pressure Input Voltage High

NGP input voltage exceeds the sensor's high voltage specification.

RG41221,0000083 -19-04OCT01-1/1

000159.03 Natural Gas Pressure Input Voltage High Diagnostic Procedure

NOTE: If DTC 000159.03 is accompanied with 001080.03, diagnose 001080.03 first.

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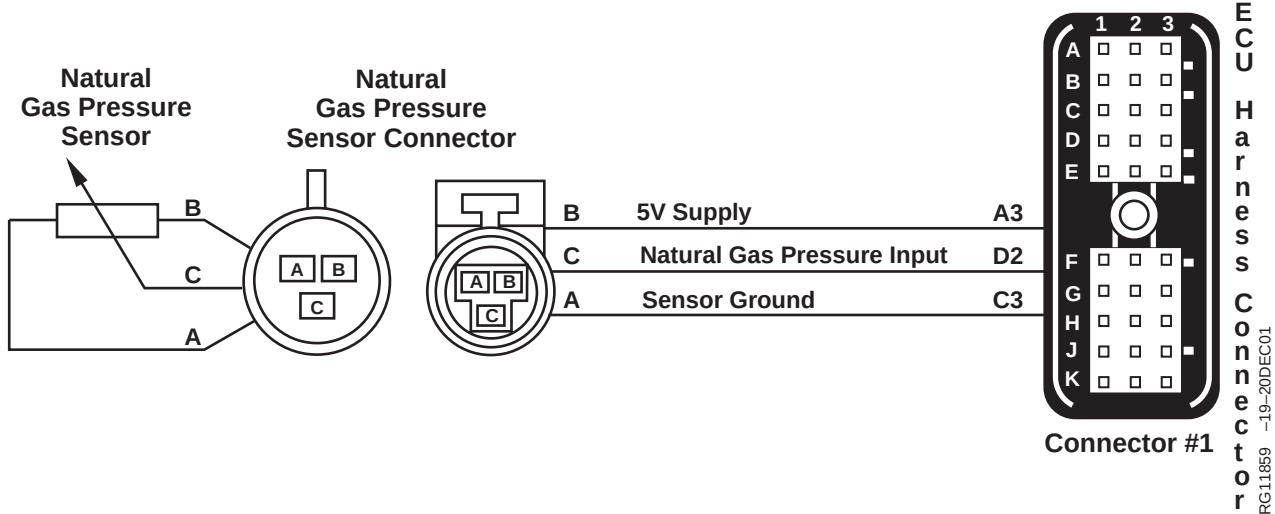
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000159.03 NATURAL GAS PRESSURE INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000159.03 NATURAL GAS PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000159.03 reoccurs: GO TO ❸ 000159.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 220	③ NGP Input Shorted Test	<i>NOTE: For wiring and theory of operation information, see DTC 000159.03 NATURAL GAS PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect the NGP sensor connector. 3. Ignition ON, engine OFF 4. Using the ECU diagnostic software, read Natural Gas Pressure Input Voltage.	Below 0.2 V: GO TO ④ 0.2 V or greater: Short to voltage in NGP input circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ NGP Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation information, see DTC 000159.03 NATURAL GAS PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. NGP sensor connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the NGP sensor ground (terminal A) of the NGP sensor connector on the engine harness with a test light connected to battery voltage.	Light ON: Faulty NGP sensor OR Faulty ECU connection OR Faulty ECU Light OFF: Open in NGP sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

000159.04 — Natural Gas Pressure Input Voltage Low**Natural Gas Pressure (NGP) Sensor:**

- The Natural Gas Pressure sensor is a pressure transducer mounted on the fuel metering block. It is used to measure the regulated gas pressure prior to injection. The NGP signal voltage varies as the fuel pressure in the metering block varies. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further natural gas pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000159.04 will set if:

- NGP input voltage drops below 0.2 volts. This voltage corresponds to a pressure that is lower than what is physically possible for NGP.

If DTC 000159.04 sets, the following will occur:

- The ECU will use a default natural gas pressure of 135 psia (931 kPa) (9.30 bar).
- DTC 1080.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

000159.04 — Natural Gas Pressure Input Voltage Low

NGP input voltage drops below sensor's low voltage specification.

RG41221,0000084 -19-04OCT01-1/1

000159.04 Natural Gas Pressure Input Voltage Low Diagnostic Procedure

NOTE: If DTC 000159.04 is accompanied with 001080.04, diagnose 001080.04 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000159.04 NATURAL GAS PRESSURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000159.04 NATURAL GAS PRESSURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000159.04 reoccurs: GO TO ❸ 000159.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ NGP Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 000159.04 NATURAL GAS PRESSURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect the NGP sensor connector.
3. Install a jumper wire between the NGP 5V supply and input terminals (terminals B and C) in the sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Natural Gas Pressure Input Voltage.

Below 4.9 V:
GO TO **④**

4.9 V or greater:
Faulty NGP sensor connection
OR
Faulty NGP sensor

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④ NGP 5V Supply Test

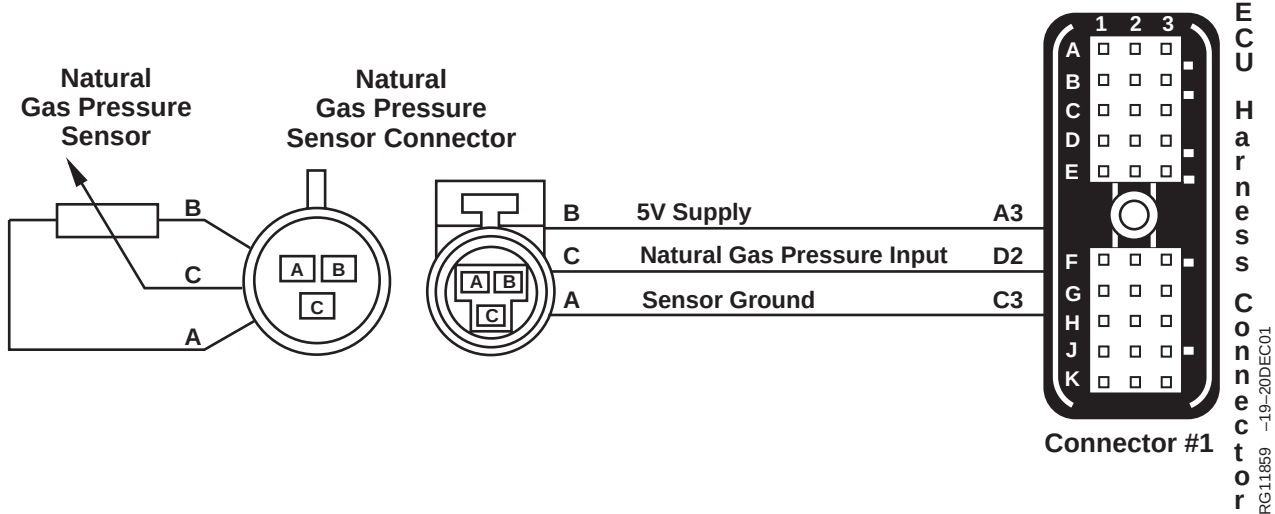
NOTE: For wiring and theory of operation information, see DTC 000159.04 NATURAL GAS PRESSURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Remove the jumper wire
3. Ignition ON, engine OFF
4. Using a multimeter, measure voltage between the 5V supply (terminal B) of the NGP sensor connector on the engine harness and a good chassis ground.

4.0 - 6.0 volts:
Open in NGP sensor input circuit
OR
Short to ground in NGP sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

Below 4.0 volts:
Open in NGP sensor 5V supply circuit
OR
Short to ground in NGP sensor 5V supply circuit
OR
Faulty ECU connection
OR
Faulty ECU

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000159.16 — Natural Gas Pressure Higher Than Expected**Natural Gas Pressure (NGP) Sensor:**

- The Natural Gas Pressure sensor is a pressure transducer mounted on the fuel metering block. It is used to measure the regulated gas pressure prior to injection. The NGP signal voltage varies as the fuel pressure in the metering block varies. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further natural gas pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000159.16 will set if:

- The ECU senses a natural gas pressure above the warning value set point in the ECU. The maximum value set point for CNG is 201 psia (1385 kPa) (13.8 bar). The maximum value set point for LNG is 130 psia (895 kPa) (9.0 bar).

If DTC 000159.16 sets, the following will occur:

- Adaptive Learn will be disabled until DTC is fixed.
- ECU will set a SOLID Warning light.

RG41221,000007A -19-14SEP01-1/1

000159.16 — Natural Gas Pressure Higher Than Expected

The ECU senses a natural gas pressure above the warning value set point.

RG41221,0000085 -19-04OCT01-1/1

000159.16 Natural Gas Pressure Higher Than Expected Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000159.16 NATURAL GAS PRESSURE HIGHER THAN EXPECTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000159.16 NATURAL GAS PRESSURE HIGHER THAN EXPECTED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Using DST or SERVICE ADVISOR™, read Natural Gas Pressure.	201 psia (1385 kPa) (13.8 bar) or greater: GO TO ❸ Below 201 psia (1385 kPa) (13.8 bar): Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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228

③ Natural Gas Pressure
Test

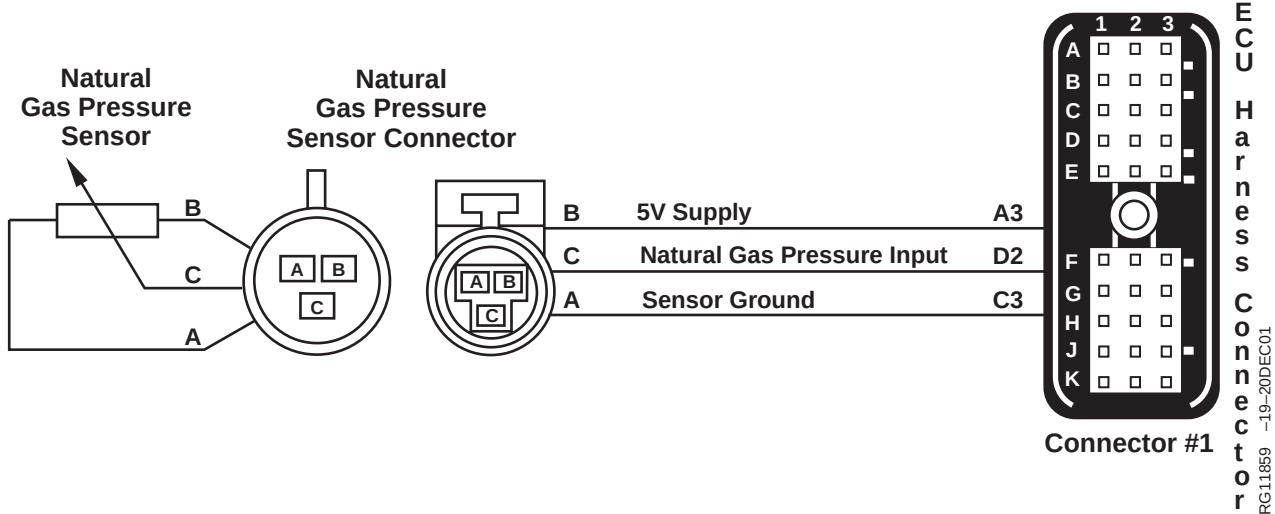
NOTE: For wiring and theory of operation information, see DTC 000159.16 NATURAL GAS PRESSURE HIGHER THAN EXPECTED supporting information.

1. Ignition OFF
2. Let engine sit for 5 minutes to relieve all pressure.
3. Connect pressure gauge to Schrader valve on fuel metering block.
4. Start engine and run at low idle.
5. Read pressure gauge.

**186 psig (1285 kPa)
(12.8 bar) or greater:**
Faulty fuel regulator

**Below 186 psig (1285
kPa) (12.8 bar):**
Faulty NGP sensor
connection
OR
Faulty NGP sensor

-- -1/1

000159.18 — Natural Gas Pressure Lower Than Expected**Natural Gas Pressure (NGP) Sensor:**

- The Natural Gas Pressure sensor is a pressure transducer mounted on the fuel metering block. It is used to measure the regulated gas pressure prior to injection. The NGP signal voltage varies as the fuel pressure in the metering block varies. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further natural gas pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 000159.18 will set if:

- The ECU senses a natural gas pressure below the warning value set point in the ECU. The minimum value set point specifications are as follows:

Specification

250 HP Engines Low Natural Gas Pressure Set Point—	
Pressure.....	105 psia (724 kPa) (7.2 bar)
275 and 280 HP Engines Low Natural Gas Pressure Set Point—	
Pressure.....	120 psia (827 kPa) (8.2 bar)
All LNG Engines Low Natural Gas Pressure Set Point—	
Pressure.....	80 psia (550 kPa) (5.5 bar)

If DTC 000159.18 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When natural gas pressure increases above the minimum value set point, power will be increased 30% per minute until either full power is reached or if the minimum value set point is surpassed again.
- Adaptive Learn will be disabled until DTC is fixed.
- DTC 001569.31 will also be present.
- DTC 001119.00 and 001119.016 may also be present. If 001119.00 is also active, derate will be more severe.
- DTC 000632.07 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

000159.18 — Natural Gas Pressure Lower Than Expected

The ECU senses a natural gas pressure below the warning value set point.

RG41221.0000086 -19-04OCT01-1/1

000159.18 Natural Gas Pressure Lower Than Expected Diagnostic Procedure

NOTE: If DTC 000159.18 is accompanied with 000632.07, 001119.00, 001119.16, or 001569.31, diagnose 000159.18 first.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000159.18 NATURAL GAS PRESSURE LOWER THAN EXPECTED supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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② Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000159.18 NATURAL GAS PRESSURE LOWER THAN EXPECTED supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Using DST or SERVICE ADVISOR™, read Natural Gas Pressure during the first 16 seconds the ignition is ON. Compare reading to specification.

Specification

Natural Gas Pressure (Absolute) for 250
HP Engines—Pressure 110-155 psia (760-1070 kPa) (7.6-10.7
bar)

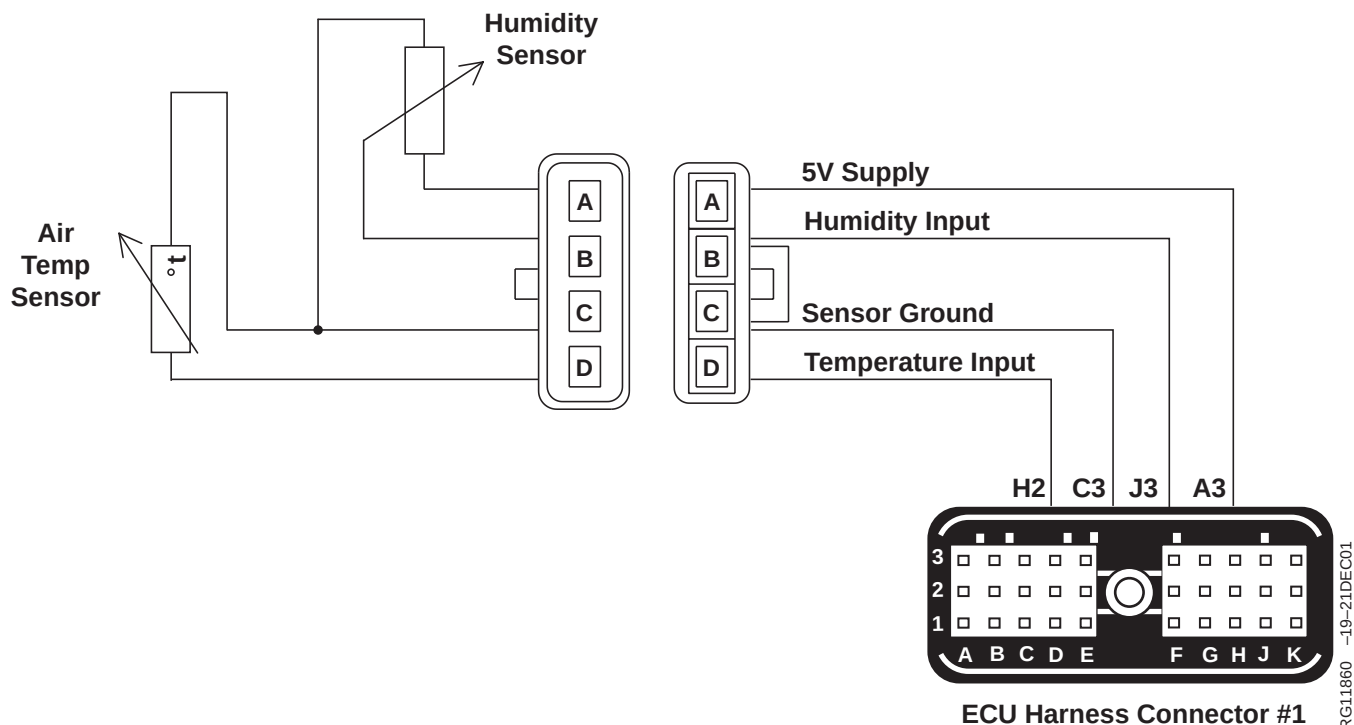
Natural Gas Pressure (Absolute) for 275
and 280 HP Engines—Pressure 120-155 psia (830-1070 kPa) (8.3-10.7
bar)

Pressure below spec:

See F1 - NATURAL GAS PRESSURE CHECK in Group 105 earlier in this manual.

Pressure within spec:

Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

000172.03 — Inlet Air Temperature Input Voltage High**Inlet Air Temperature Sensor:**

- The Inlet Air Temperature sensor is a thermistor (temperature sensitive resistor) mounted on the inlet air tube upstream of the crankcase vent between the air cleaner and the turbocharger. The ECU uses the inlet air temperature and the humidity sensor to calculate the specific humidity. The inlet air temperature sensor's variable resistance causes the input voltage to the ECU to vary. Higher temperatures result in lower voltages to the ECU; lower temperatures result in higher voltages. For further inlet air temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000172.03 will set if:

- The inlet air temperature input voltage exceeds 4.9 volts. This voltage corresponds to a temperature that is lower than what is physically possible for inlet air temperature.

If DTC 000172.03 sets, the following will occur:

- ECU will default specific humidity to 12g H₂O/kg air.
- Depending on the actual humidity in your location, there may be a slight increase or decrease in power.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,000007C -19-14SEP01-1/1

000172.03 — Inlet Air Temperature Input Voltage High

The inlet air temperature input voltage exceeds the sensor's high voltage specification.

RG41221,00002C3 -19-07DEC01-1/1

000172.03 Inlet Air Temperature Input Voltage High Diagnostic Procedure

NOTE: Through diagnosing this DTC, 299745.03 and/or 299745.04 may also occur. These codes relate to the humidity sensor which shares the same connector as the inlet air temperature sensor. Through disconnecting the sensor connector the above codes may set. Once 000172.03 has been repaired and all connections are made, the humidity sensor codes should also clear. If codes do not clear, go to corresponding diagnostic procedure.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000172.03 INLET AIR TEMPERATURE INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the inlet air temperature/humidity sensor connector, looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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② Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000172.03 INLET AIR TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000172.03 reoccurs:
GO TO ③

000172.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Inlet Air Temperature Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 000172.03 INLET AIR TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect inlet air temperature sensor connector.
3. Install a jumper wire between the input terminal and the sensor ground terminal (terminals C and D) in the inlet air temperature sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Inlet Air Temperature Voltage.

Above 0.5 V:
GO TO ④

0.5 V or below:
Faulty inlet air temperature sensor connection
OR
Faulty inlet air temperature sensor

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④ Inlet Air Temperature Open Ground Circuit Test

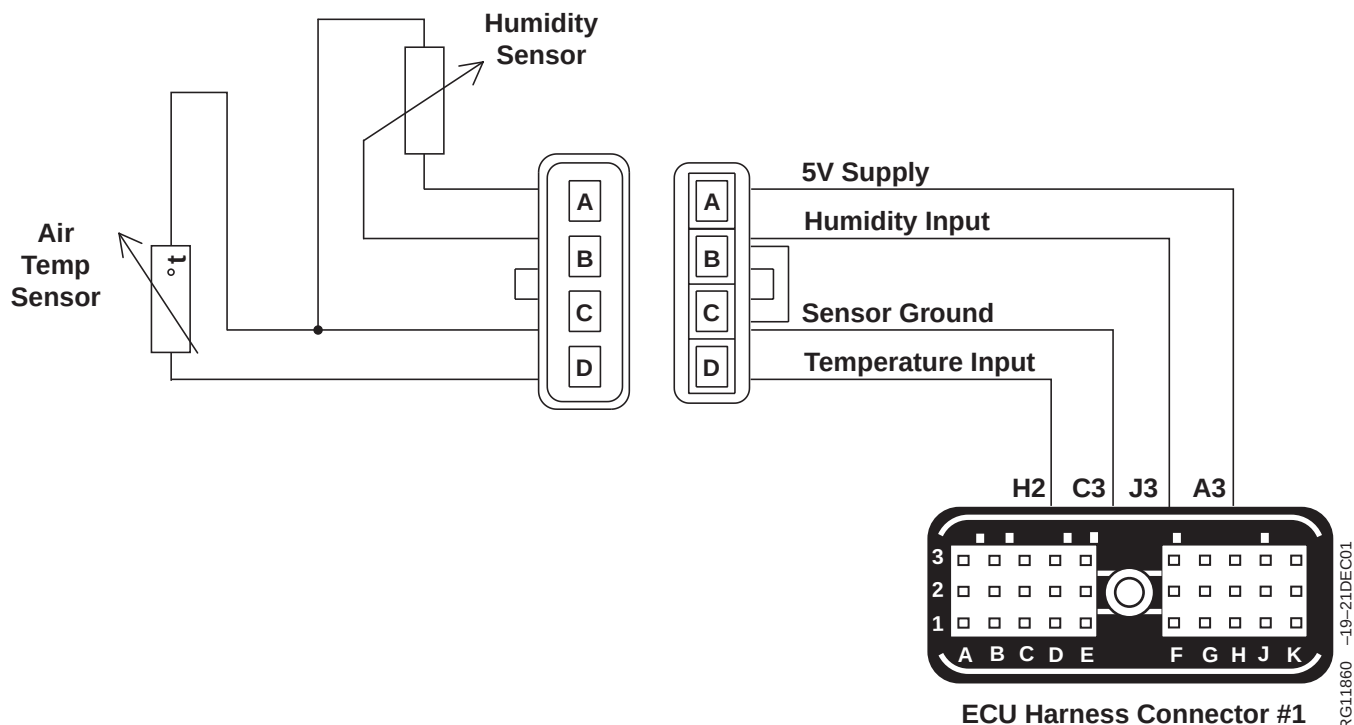
NOTE: For wiring and theory of operation information, see DTC 000172.03 INLET AIR TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Remove jumper wire between both terminals.
3. Install jumper wire between the input terminal (terminal D) on the inlet air temperature sensor connector on the engine harness and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Inlet Air Temperature Voltage.

Above 0.5 V:
Open in inlet air temperature input circuit
OR
Faulty ECU connection
OR
Faulty ECU

0.5 V or below:
Open in inlet air temperature sensor ground circuit
OR
Faulty ECU connection
OR
Faulty ECU

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000172.04 — Inlet Air Temperature Input Voltage Low**Inlet Air Temperature Sensor:**

- The Inlet Air Temperature sensor is a thermistor (temperature sensitive resistor) mounted on the inlet air tube upstream of the crankcase vent between the air cleaner and the turbocharger. The ECU uses the inlet air temperature and the humidity sensor to calculate the specific humidity. The inlet air temperature sensor's variable resistance causes the input voltage to the ECU to vary. Higher temperatures result in lower voltages to the ECU; lower temperatures result in higher voltages. For further inlet air temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000172.04 will set if:

- The inlet air temperature input voltage drops below 0.5 volts. This voltage corresponds to a temperature that is higher than what is physically possible for inlet air temperature.

If DTC 000172.04 sets, the following will occur:

- ECU will default specific humidity to 12g H₂O/kg air.
- Depending on the actual humidity in your location, there may be a slight increase or decrease in power.
- Inlet Air Temperature input voltage will default to 0 volts.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000253 -19-19SEP01-1/1

000172.04 — Inlet Air Temperature Input Voltage Low

The inlet air temperature input voltage drops below the sensor's low voltage specification.

RG41221,00002C4 -19-10DEC01-1/1

000172.04 Inlet Air Temperature Input Voltage Low Diagnostic Procedure

NOTE: Through diagnosing this DTC, 299745.04 and/or 299745.04 may also occur. These codes relate to the humidity sensor which shares the same connector as the inlet air temperature sensor. Through disconnecting the sensor connector the above codes may set. Once 000172.04 has been repaired and all connections are made, the humidity sensor codes should also clear. If codes do not clear, go to corresponding diagnostic procedure.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000172.04 INLET AIR TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the inlet air temperature/humidity sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.

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② Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000172.04 INLET AIR TEMPERATURE INPUT VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine OFF or running
6. Read DTCs using DST or SERVICE ADVISOR™.

000172.04 reoccurs:
GO TO ③

000172.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Inlet Air Temperature Sensor Test

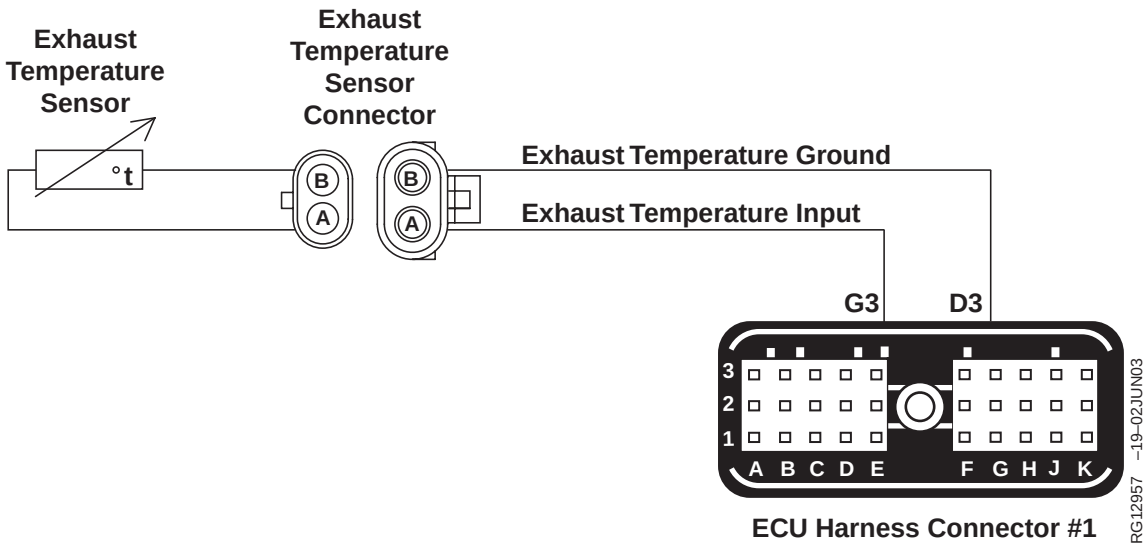
NOTE: For wiring and theory of operation information, see DTC 000172.04 INLET AIR TEMPERATURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect the inlet air temperature sensor connector on the engine harness.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read Inlet Air Temperature Voltage.

Below 4.9 V:
Short to ground in inlet air temperature input circuit
OR
Faulty ECU connection
OR
Faulty ECU

4.9 V or greater:
Faulty inlet air temperature sensor connector
OR
Faulty inlet air temperature sensor

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000173.00 — Exhaust Temperature Extremely High**Exhaust Temperature Sensor:**

- The Exhaust Temperature sensor is a thermistor (temperature sensitive variable resistor) located in or after the catalyst of the muffler. The ECU uses this sensor to measure the exhaust temperature to determine if all of the fuel is being burned. Unburned fuel will result in high exhaust temperature. The Exhaust Temperature sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further exhaust temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000173.00 will set if:

- The ECU senses an exhaust temperature above 1337°F (725°C).

If DTC 000173.00 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - With Shutdown Feature: The derate will go into effect when the code is set and the engine will shut down after 30 seconds.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When engine coolant temperature drops back below the maximum value set point, power will be increased 30% per minute until either full power is reached or if the maximum value set point is surpassed again.
- DTC 001569.31 and DTC 000173.16 will also be present.
- If shutdown feature is enabled, DTC 001109.31 and DTC 001110.31 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID STOP light if shutdown feature is enabled.

RG41221,000014D -19-28MAY03-1/1

000173.00 — Exhaust Temperature Extremely High

The ECU senses an exhaust temperature above specification.

RG41221,000014E -19-28MAY03-1/1

000173.00 Exhaust Temperature Extremely High Diagnostic Procedure

NOTE: If DTC 000173.00 is accompanied with 001119.01 or 001119.18, diagnose them first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000173.00 EXHAUST TEMPERATURE EXTREMELY HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the exhaust temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Spark Cutout Test	<i>NOTE: For wiring and theory of operation information, see DTC 000173.00 EXHAUST TEMPERATURE EXTREMELY HIGH supporting information.</i> 1. Ignition ON, engine running 2. Using the ECU diagnostic software, run the Spark Cutout Test for each coil. See ENGINE TEST INSTRUCTIONS - SPARK CUTOUT TEST in Group 115 later in this manual.	All coils firing: GO TO ❸ One or more coils not firing: See F2 - IGNITION SYSTEM TEST later in this Group.

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③ Injector Cutout Test

NOTE: For wiring and theory of operation information, see DTC 000173.00 EXHAUST TEMPERATURE EXTREMELY HIGH supporting information.

Using the ECU diagnostic software, run the Injector Cutout Test. See ENGINE TEST INSTRUCTIONS — INJECTOR CUTOUT TEST earlier in this Group.

Injectors working properly:
GO TO **④**

Faulty injector(s):
See F3 - FUEL INJECTOR DIAGNOSTIC CHECK in Group 105 earlier in this manual.

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④ Injector Clean Test

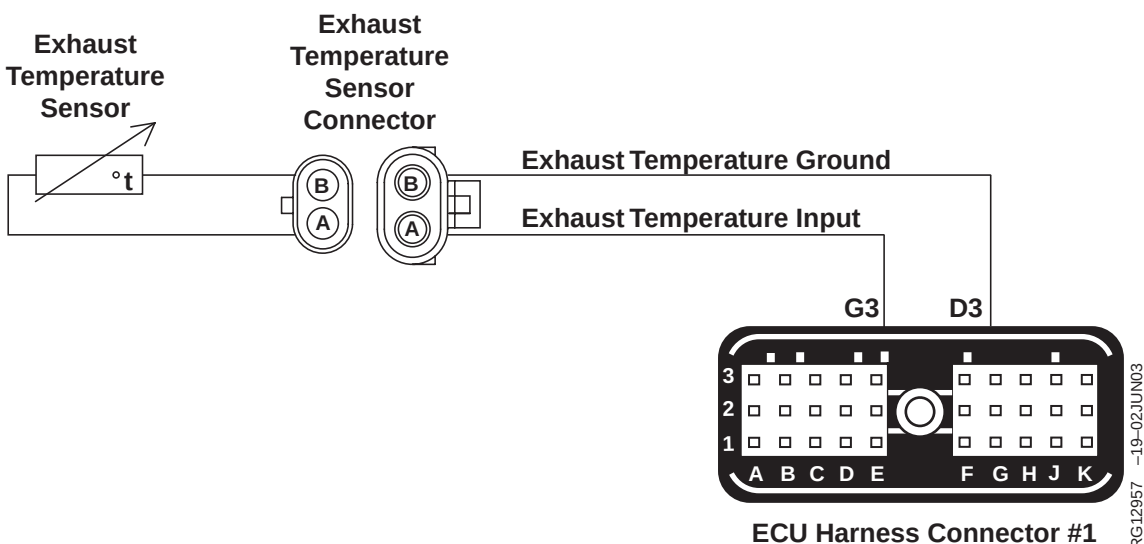
NOTE: For wiring and theory of operation information, see DTC 000173.00 EXHAUST TEMPERATURE EXTREMELY HIGH supporting information.

1. Clean injectors using JT07281 Injector Accessory Kit, JT07282 Fuel Injector Cleaner, and JT07283 Pro Inject-R Kleen. See ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual.
2. Run engine under conditions that caused DTC 000173.00 to set.

000173.00 doesn't reoccur:
Engine is fixed.

000173.00 reoccurs:
Verify that Exhaust Temperature sensor input and ground circuit are OK.
If Exhaust Temperature sensor circuits are OK, replace the sensor and retest.

-- -1/1

000173.03 — Exhaust Temperature Input Voltage High**Exhaust Temperature Sensor:**

- The Exhaust Temperature sensor is a thermistor (temperature sensitive variable resistor) located in or after the catalyst of the muffler. The ECU uses this sensor to measure the exhaust temperature to determine if all of the fuel is being burned. Unburned fuel will result in high exhaust temperature. The Exhaust Temperature sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further exhaust temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000173.03 will set if:

- The exhaust temperature sensor input voltage exceeds 4.9 volts. This voltage corresponds to a temperature that is lower than what is physically possible for exhaust temperature.

If DTC 000173.03 sets, the following will occur:

- The ECU will use a default exhaust temperature of 572°F (300°C).
- ECU will set a SOLID Warning light.

RG41221,0000152 -19-28MAY03-1/1

000173.03 — Exhaust Temperature Input Voltage High

Exhaust temperature input voltage exceeds the sensor's high voltage specification.

RG41221.0000153 -19-28MAY03-1/1

000173.03 Exhaust Temperature Input Voltage High Diagnostic Procedure

NOTE: The Throttle Charge Temperature, Engine Coolant Temperature, Exhaust Temperature, Natural Gas Temperature, and the Engine Oil Temperature sensors all share a common sensor ground to the ECU. If DTC 000105.03, 000110.03, 000174.03, and 000175.03 are also present, look for an open in the sensor ground wire.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000173.03 EXHAUST TEMPERATURE INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the exhaust temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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② Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000173.03 EXHAUST TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000173.03 reoccurs:
GO TO ③

000173.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Exhaust Temperature Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 000173.03 EXHAUST TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect the exhaust temperature sensor.
3. Install a jumper wire between both terminals in the exhaust temperature sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Exhaust Temperature Input Voltage.

Above 0.1 V:
GO TO ④

0.1 V or below:
Faulty exhaust temperature sensor connector
OR
Faulty exhaust temperature sensor

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④ Exhaust Temperature Ground Circuit Test

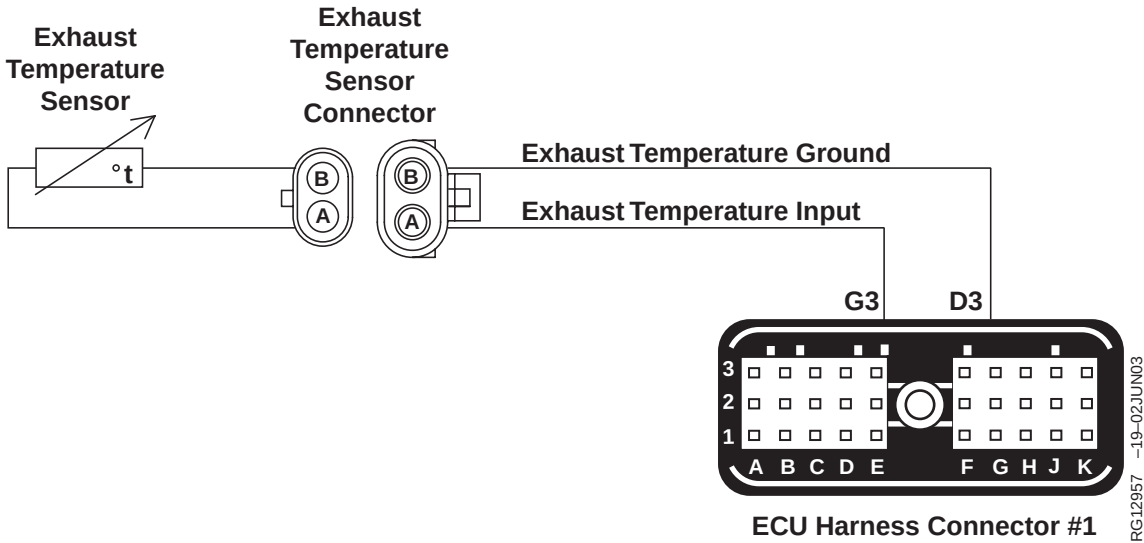
NOTE: For wiring and theory of operation information, see DTC 000173.03 EXHAUST TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Remove jumper wire between both terminals.
3. Install jumper wire between the input terminal (terminal A) in the exhaust temperature sensor connector on the engine harness and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Exhaust Temperature Input Voltage.

Above 0.1 V:
Open in exhaust temperature sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

0.1 V or below:
Open in exhaust temperature sensor ground circuit
OR
Faulty ECU connector
OR
Faulty ECU

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000173.04 — Exhaust Temperature Input Voltage Low**Exhaust Temperature Sensor:**

- The Exhaust Temperature sensor is a thermistor (temperature sensitive variable resistor) located in or after the catalyst of the muffler. The ECU uses this sensor to measure the exhaust temperature to determine if all of the fuel is being burned. Unburned fuel will result in high exhaust temperature. The Exhaust Temperature sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further exhaust temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000173.04 will set if:

- The exhaust temperature sensor input voltage drops below 0.1 volts. This voltage corresponds to a temperature that is higher than what is physically possible for exhaust temperature.

If DTC 000173.04 sets, the following will occur:

- The ECU will use a default exhaust temperature of 572°F (300°C).
- ECU will set a SOLID Warning light.

RG41221,0000151 -19-28MAY03-1/1

000173.04 — Exhaust Temperature Input Voltage Low

Exhaust temperature input voltage drops below the sensor's low voltage specification.

RG41221,0000154 -19-28MAY03-1/1

000173.04 Exhaust Temperature Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000173.04 EXHAUST TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the exhaust temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000173.04 EXHAUST TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000173.04 reoccurs: GO TO ❸ 000173.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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**③ Exhaust Temperature
Sensor Test**

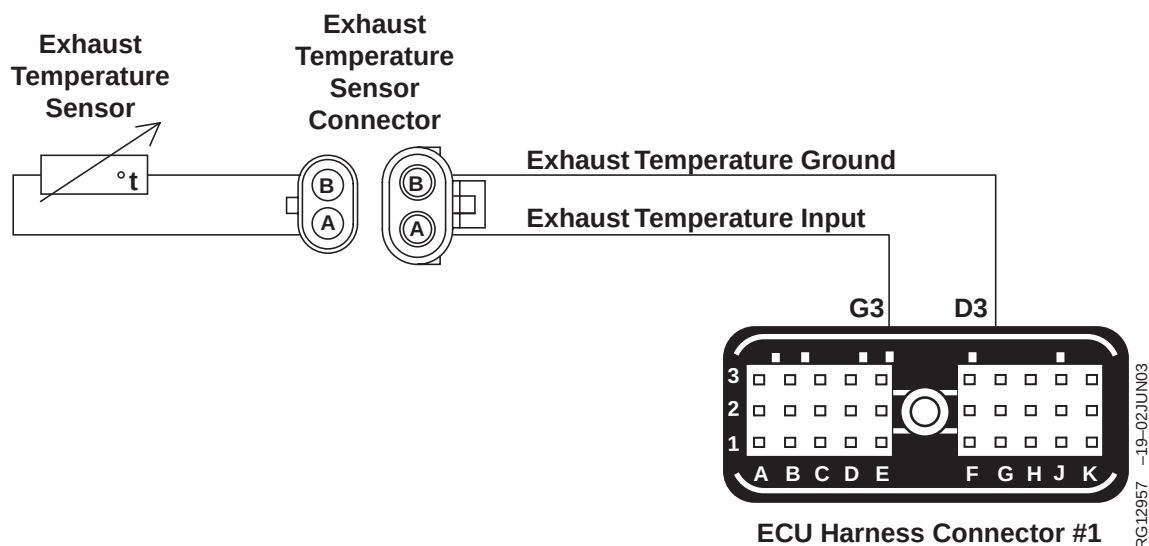
*NOTE: For wiring and theory of operation information, see DTC 000173.04 EXHAUST
TEMPERATURE INPUT VOLTAGE LOW supporting information.*

1. Ignition OFF
2. Disconnect exhaust temperature sensor connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read Exhaust Temperature Input Voltage.

Below 4.9 V:
Short to ground in
exhaust temperature
sensor input circuit
OR
Faulty ECU connections
OR
Faulty ECU

4.9 V or greater:
Faulty exhaust
temperature sensor
connections
OR
Faulty exhaust
temperature sensor

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000173.16 — Exhaust Temperature Moderately High**Exhaust Temperature Sensor:**

- The Exhaust Temperature sensor is a thermistor (temperature sensitive variable resistor) located in or after the catalyst of the muffler. The ECU uses this sensor to measure the exhaust temperature to determine if all of the fuel is being burned. Unburned fuel will result in high exhaust temperature. The Exhaust Temperature sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further exhaust temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000173.16 will set if:

- The ECU senses an exhaust temperature above 1247°F (675°C).

If DTC 000173.16 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 2% per minute to a maximum derate of 10%. When engine coolant temperature drops back below the maximum value set point, power will be increased 2% per minute until either full power is reached or if the maximum value set point is surpassed again.
- DTC 001569.31 will also be present.
- ECU will set a SOLID Warning light.

RG41221,0000150 -19-28MAY03-1/1

000173.16 — Exhaust Temperature Moderately High

The ECU senses an exhaust temperature above specification.

RG41221.0000155 -19-28MAY03-1/1

000173.16 Exhaust Temperature Moderately High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000173.16 EXHAUST TEMPERATURE MODERATELY HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the exhaust temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Spark Cutout Test	<i>NOTE: For wiring and theory of operation information, see DTC 000173.16 EXHAUST TEMPERATURE MODERATELY HIGH supporting information.</i> 1. Ignition ON, engine running 2. Using the ECU diagnostic software, run the Spark Cutout Test for each coil. See ENGINE TEST INSTRUCTIONS - SPARK CUTOFF TEST in Group 115 later in this manual.	All coils firing: GO TO ❸ One or more coils not firing: See F2 - IGNITION SYSTEM TEST later in this Group.

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③ Injector Cutout Test

NOTE: For wiring and theory of operation information, see DTC 000173.16 EXHAUST TEMPERATURE MODERATELY HIGH supporting information.

Using the ECU diagnostic software, run the Injector Cutout Test. See ENGINE TEST INSTRUCTIONS — INJECTOR CUTOUT TEST earlier in this Group.

Injectors working properly:
GO TO **④**

Faulty injector(s):
See F3 - FUEL INJECTOR DIAGNOSTIC CHECK in Group 105 earlier in this manual.

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④ Injector Clean Test

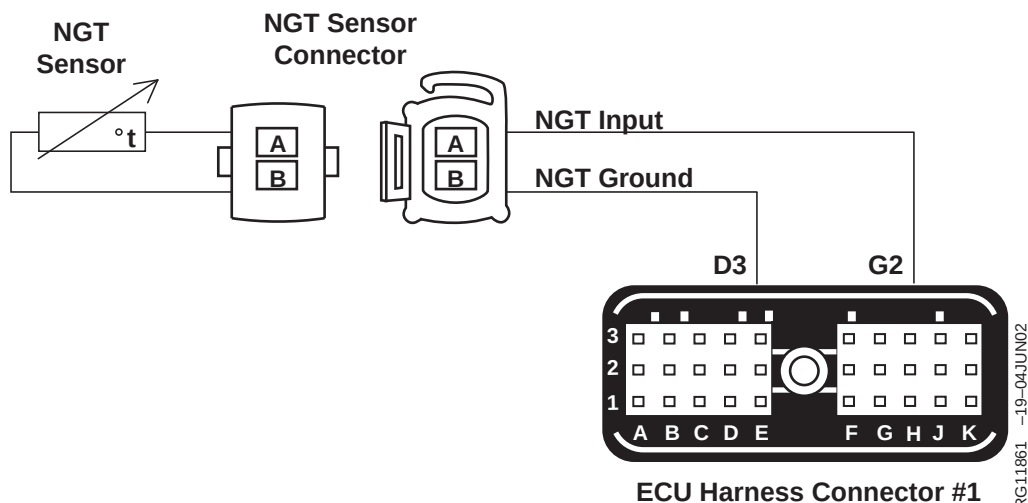
NOTE: For wiring and theory of operation information, see DTC 000173.16 EXHAUST TEMPERATURE MODERATELY HIGH supporting information.

1. Clean injectors using JT07281 Injector Accessory Kit, JT07282 Fuel Injector Cleaner, and JT07283 Pro Inject-R Kleen. See ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual.
2. Run engine under conditions that caused DTC 000173.00 to set.

000173.00 doesn't reoccur:
Engine is fixed.

000173.00 reoccurs:
Verify that Exhaust Temperature sensor input and ground circuit are OK.
If Exhaust Temperature sensor circuits are OK, replace the sensor and retest.

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000174.03 — Natural Gas Temperature Input Voltage High**Natural Gas Temperature (NGT) Sensor:**

- The Natural Gas Temperature sensor is a thermistor (temperature sensitive variable resistor) located on the fuel metering block. It is used to measure the temperature of the fuel prior to injection. The NGT sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further natural gas temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000174.03 will set if:

- The natural gas temperature sensor input voltage exceeds 4.9 volts. This voltage corresponds to a temperature that is lower than what is physically possible for natural gas temperature.

If DTC 000174.03 sets, the following will occur:

- The ECU will default to a natural gas temperature value of 68°F (20°C).
- Adaptive Learn will be disabled for the remainder of key cycle.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000254 -19-19SEP01-1/1

000174.03 — Natural Gas Temperature Input Voltage High

The natural gas temperature input voltage exceeds the sensor's high voltage specification.

RG41221.0000087 -19-04OCT01-1/1

000174.03 Natural Gas Temperature Input Voltage High Diagnostic Procedure

NOTE: The Throttle Charge Temperature, Engine Coolant Temperature, Exhaust Temperature, Natural Gas Temperature, and the Engine Oil Temperature sensors all share a common sensor ground to the ECU. If DTC 000105.03, 000110.03, 000173.03, and 000175.03 are also present, look for an open in the sensor ground wire.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000174.03 NATURAL GAS TEMPERATURE INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.

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② Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000174.03 NATURAL GAS TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000174.03 reoccurs:
GO TO ③

000174.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ NGT Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 000174.03 NATURAL GAS TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect NGT sensor connector
3. Install a jumper wire between both terminals in the NGT sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Natural Gas Temperature Input Voltage.

Above 0.1 V:
GO TO ④

0.1 V or below:
Faulty NGT sensor connection
OR
Faulty NGT sensor

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④ NGT Open Ground Circuit Test

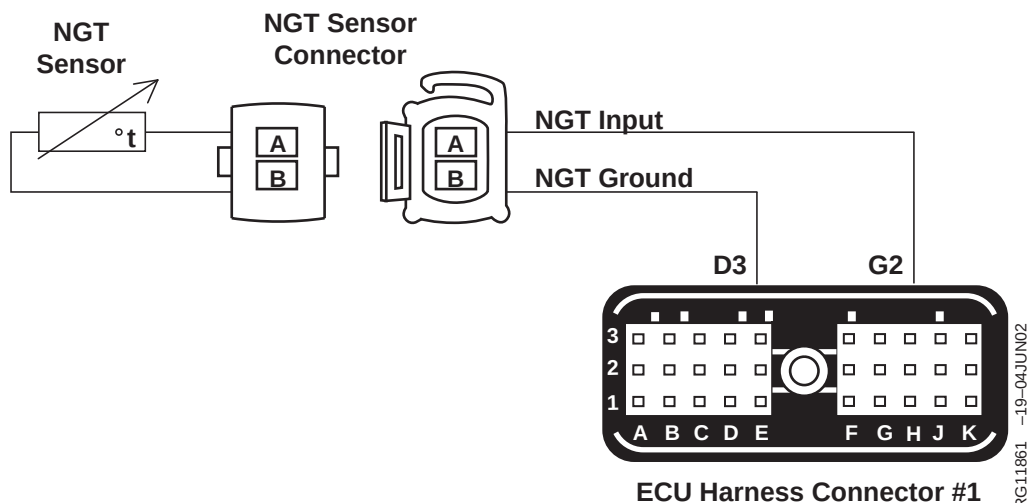
NOTE: For wiring and theory of operation information, see DTC 000174.03 NATURAL GAS TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Remove jumper wire
3. Install jumper wire between NGT sensor connector input terminal (terminal A) on the engine harness and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Natural Gas Temperature Input Voltage.

Above 0.1 V:
Open in NGT sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

0.1 V or below:
Open in NGT sensor ground circuit
OR
Faulty ECU connection
OR
Faulty ECU

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000174.04 — Natural Gas Temperature Input Voltage Low**Natural Gas Temperature (NGT) Sensor:**

- The Natural Gas Temperature sensor is a thermistor (temperature sensitive variable resistor) located on the fuel metering block. It is used to measure the temperature of the fuel prior to injection. The NGT sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further natural gas temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000174.04 will set if:

- The natural gas temperature sensor input voltage drops below 0.1 volts. This voltage corresponds to a temperature that is higher than what is physically possible for natural gas temperature.

If DTC 000174.04 sets, the following will occur:

- The ECU will default to a natural gas temperature value of 68°F (20°C).
- Adaptive Learn will be disabled for the remainder of key cycle.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

000174.04 — Natural Gas Temperature Input Voltage Low

The natural gas temperature input voltage drops below the sensor's low voltage specification.

RG41221,0000088 -19-04OCT01-1/1

000174.04 Natural Gas Temperature Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000174.04 NATURAL GAS TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000174.04 NATURAL GAS TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000174.04 reoccurs: GO TO ❸ 000174.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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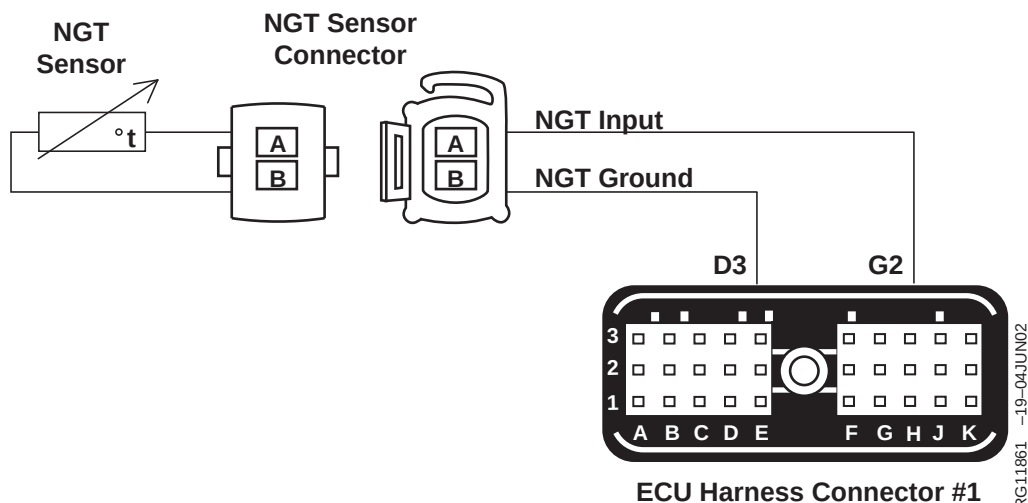
③ NGT Sensor Test

NOTE: For wiring and theory of operation information, see DTC 000174.04 NATURAL GAS TEMPERATURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect NGT sensor connector
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read Natural Gas Temperature Input Voltage.

Below 4.9 V:
Short to ground in NGT sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

4.9 V or greater:
Faulty NGT sensor connector
OR
Faulty NGT sensor

000174.18 — Natural Gas Temperature Lower Than Expected**Natural Gas Temperature (NGT) Sensor:**

- The Natural Gas Temperature sensor is a thermistor (temperature sensitive variable resistor) located on the fuel metering block. It is used to measure the temperature of the fuel prior to injection. The NGT sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further natural gas temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000174.18 will set if:

- The ECU senses a natural gas temperature below 0°F (-18°C) when engine coolant temperature is above 158°F (70°C).

If DTC 000174.18 sets, the following will occur:

- Adaptive Learn will be disabled for the remainder of the key cycle.
- DTC 001119.00 and 001119.16 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

000174.18 — Natural Gas Temperature Lower Than Expected

The ECU senses a natural gas temperature below specification.

RG41221,000035E -19-07MAY02-1/1

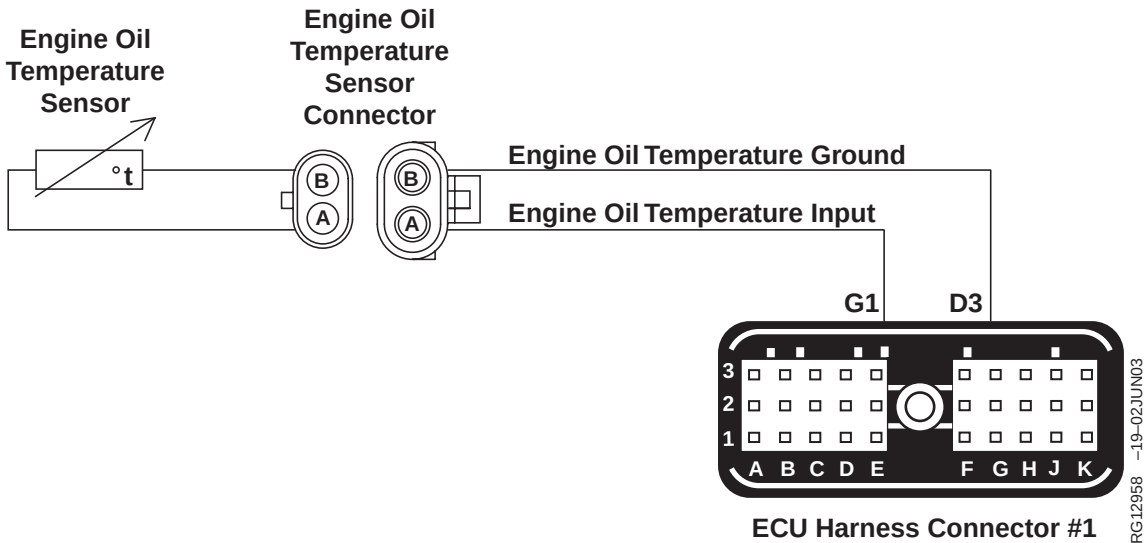
000174.18 Natural Gas Temperature Lower Than Expected Diagnostic Procedure

NOTE: If DTC 000174.18 is accompanied with 001119.00 and 001119.16, diagnose them first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000174.18 NATURAL GAS TEMPERATURE LOWER THAN EXPECTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Natural Gas Temperature Component Test	<i>NOTE: For wiring and theory of operation information, see DTC 000174.18 NATURAL GAS TEMPERATURE LOWER THAN EXPECTED supporting information.</i> Check the following that could cause natural gas temperatures to be lower than expected. • Gas Temperature Thermostat: If the thermostat that controls the gas temperature out of the heat exchanger fails closed, 000174.18 will occur. • Coolant Lines: If coolant lines to the heat exchanger become plugged or restricted, 000174.18 will occur. • Heat Exchanger: If the heat exchanger is full of sediment or contaminant in the coolant passages, 000174.18 will occur. • Ground Problems: ECU grounds must be a good battery ground. Faulty grounds may cause 000174.18 will occur as well as may other unrelated problems. • NGT Sensor: If no other problems are found, replace the NGT sensor and retest.	

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000175.00 — Engine Oil Temperature Extremely High**Engine Oil Temperature Sensor:**

- The Engine Oil Temperature sensor is a thermistor (temperature sensitive variable resistor) located in the oil pan. The Engine Oil Temperature sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further engine oil temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000175.00 will set if:

- The ECU senses an oil temperature above 275°F (135°C).

If DTC 000175.00 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - With Shutdown Feature: The derate will go into effect when the code is set and the engine will shut down after 30 seconds.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When engine coolant temperature drops back below the maximum value set point, power will be increased 30% per minute until either full power is reached or if the maximum value set point is surpassed again.
- DTC 001569.31 and DTC 000175.16 will also be present.
- If shutdown feature is enabled, DTC 001109.31 and DTC 001110.31 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID STOP light if shutdown feature is enabled.

RG41221.0000156 -19-08JUL03-1/1

000175.00 — Engine Oil Temperature Extremely High

The ECU senses an oil temperature above specification.

RG41221,0000158 -19-28MAY03-1/1

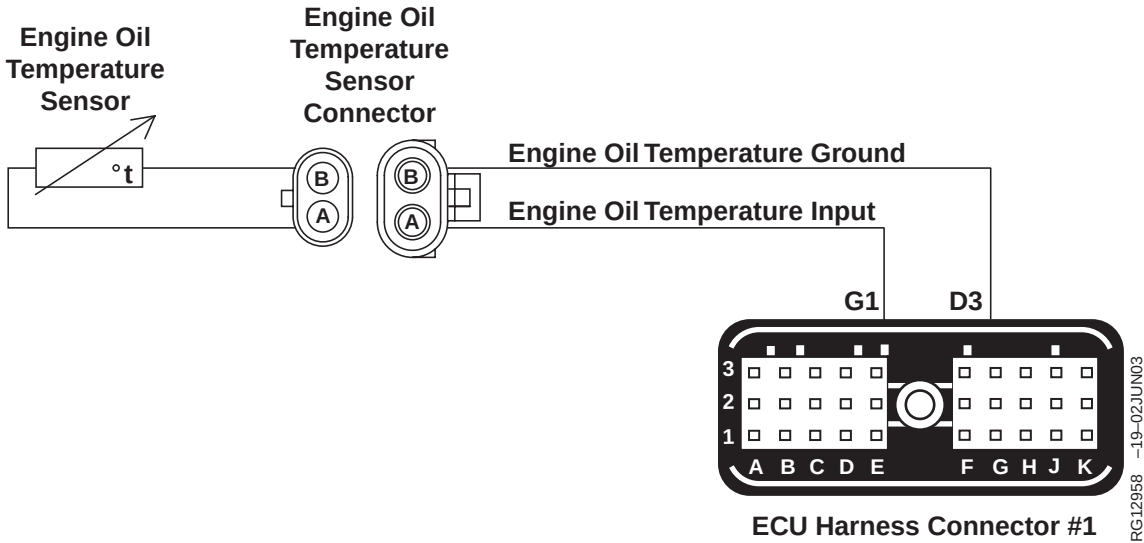
000175.00 Engine Oil Temperature Extremely High Diagnostic Procedure

NOTE: If DTC 000175.00 is accompanied with an Engine Coolant Temperature DTC, diagnose the Engine Coolant Temperature DTC first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000175.00 ENGINE OIL TEMPERATURE EXTREMELY HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the engine oil temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Oil Level Check	<i>NOTE: For wiring and theory of operation information, see DTC 000175.00 ENGINE OIL TEMPERATURE EXTREMELY HIGH supporting information.</i> Measure the oil level and verify that the level is not low.	Proper oil level: GO TO ❸ Low oil level: Add the correct amount of oil and retest.
❸ Oil Cooler Check	<i>NOTE: For wiring and theory of operation information, see DTC 000175.00 ENGINE OIL TEMPERATURE EXTREMELY HIGH supporting information.</i> Remove and inspect engine oil cooler. See REMOVE, INSPECT, AND INSTALL ENGINE OIL COOLER in Group 20 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).	Oil cooler OK: Faulty oil temperature sensor. Replace and retest. Faulty oil cooler: Replace oil cooler and retest.

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000175.03 — Engine Oil Temperature Input Voltage High**Engine Oil Temperature Sensor:**

- The Engine Oil Temperature sensor is a thermistor (temperature sensitive variable resistor) located in the oil pan. The Engine Oil Temperature sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further engine oil temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000175.03 will set if:

- The engine oil temperature sensor input voltage exceeds 4.9 volts. This voltage corresponds to a temperature that is lower than what is physically possible for engine oil temperature.

If DTC 000175.03 sets, the following will occur:

- The ECU will set a default engine oil temperature of 212°F (100°C).
- ECU will set a SOLID Warning light.

000175.03 — Engine Oil Temperature Input Voltage High

Engine oil temperature input voltage exceeds the sensor's high voltage specification.

RG41221,000015B -19-28MAY03-1/1

000175.03 Engine Oil Temperature Input Voltage High Diagnostic Procedure

NOTE: The Throttle Charge Temperature, Engine Coolant Temperature, Exhaust Temperature, Natural Gas Temperature, and the Engine Oil Temperature sensors all share a common sensor ground to the ECU. If DTC 000105.03, 000110.03, 000173.03, and 000174.03 are also present, look for an open in the sensor ground wire.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000175.03 ENGINE OIL TEMPERATURE INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the engine oil temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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2 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000175.03 ENGINE OIL TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000175.03 reoccurs:
GO TO **3**

000175.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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3 Engine Oil Temperature Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 000175.03 ENGINE OIL TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect the engine oil temperature sensor.
3. Install a jumper wire between both terminals in the engine oil temperature sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Engine Oil Temperature Input Voltage.

Above 0.1 V:
GO TO **4**

0.1 V or below:
Faulty engine oil temperature sensor connector
OR
Faulty engine oil temperature sensor

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4 Engine Oil Temperature Ground Circuit Test

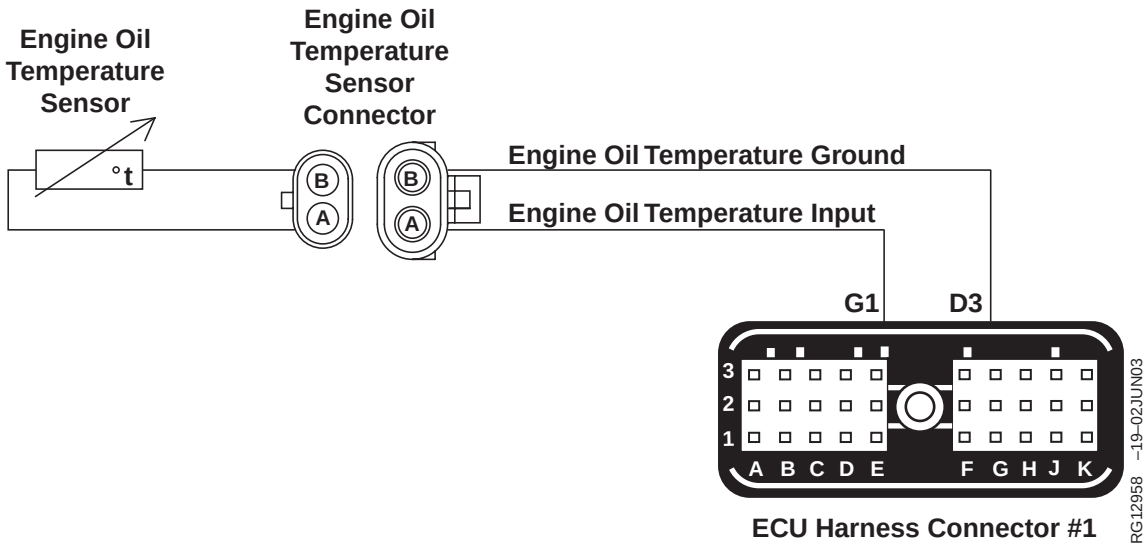
NOTE: For wiring and theory of operation information, see DTC 000175.03 ENGINE OIL TEMPERATURE INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Remove jumper wire between both terminals.
3. Install jumper wire between the input terminal (terminal A) in the engine oil temperature sensor connector on the engine harness and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Engine Oil Temperature Input Voltage.

Above 0.1 V:
Open in engine oil temperature sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

0.1 V or below:
Open in engine oil temperature sensor ground circuit
OR
Faulty ECU connector
OR
Faulty ECU

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000175.04 — Engine Oil Temperature Input Voltage Low**Engine Oil Temperature Sensor:**

- The Engine Oil Temperature sensor is a thermistor (temperature sensitive variable resistor) located in the oil pan. The Engine Oil Temperature sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further engine oil temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000175.04 will set if:

- The engine oil temperature sensor input voltage drops below 0.3 volts. This voltage corresponds to a temperature that is higher than what is physically possible for engine oil temperature.

If DTC 000175.04 sets, the following will occur:

- The ECU will set a default engine oil temperature of 212°F (100°C).
- ECU will set a SOLID Warning light.

RG41221_000015C -19-28MAY03-1/1

000175.04 — Engine Oil Temperature Input Voltage Low

Engine oil temperature input voltage drops below the sensor's low voltage specification.

RG41221,000015D -19-28MAY03-1/1

000175.04 Engine Oil Temperature Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000175.04 ENGINE OIL TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the engine oil temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000175.04 ENGINE OIL TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000175.04 reoccurs: GO TO ❸ 000175.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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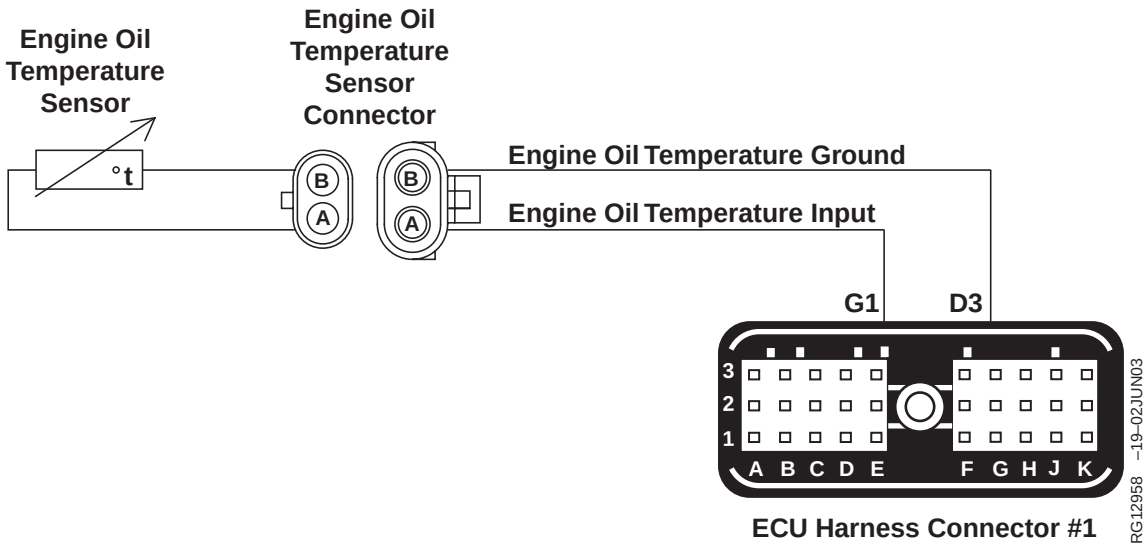
③ Engine Oil
Temperature Sensor
Test

NOTE: For wiring and theory of operation information, see DTC 000175.04 ENGINE OIL TEMPERATURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect engine oil temperature sensor connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read Engine Oil Temperature Input Voltage.

Below 4.9 V:
Short to ground in engine oil temperature sensor input circuit
OR
Faulty ECU connections
OR
Faulty ECU

4.9 V or greater:
Faulty engine oil temperature sensor connections
OR
Faulty engine oil temperature sensor

000175.16 — Engine Oil Temperature Moderately High**Engine Oil Temperature Sensor:**

- The Engine Oil Temperature sensor is a thermistor (temperature sensitive variable resistor) located in the oil pan. The Engine Oil Temperature sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further engine oil temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 000175.16 will set if:

- The ECU senses an oil temperature above 257°F (125°C).

If DTC 000175.16 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 2% per minute to a maximum derate of 10%. When engine coolant temperature drops back below the maximum value set point, power will be increased 2% per minute until either full power is reached or if the maximum value set point is surpassed again.
- DTC 001569.31 will also be present.
- ECU will set a SOLID Warning light.

RG41221,000015F -19-28MAY03-1/1

000175.16 — Engine Oil Temperature Moderately High

The ECU senses an oil temperature above specification.

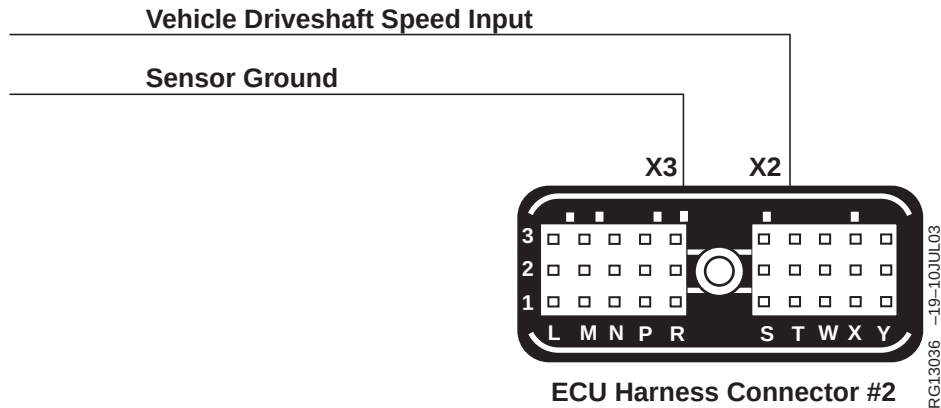
RG41221,0000160 -19-28MAY03-1/1

000175.16 Engine Oil Temperature Moderately High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000175.16 ENGINE OIL TEMPERATURE MODERATELY HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the engine oil temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Oil Level Check	<i>NOTE: For wiring and theory of operation information, see DTC 000175.16 ENGINE OIL TEMPERATURE MODERATELY HIGH supporting information.</i> Measure the oil level and verify that the level is not low.	Proper oil level: GO TO ❸ Low oil level: Add the correct amount of oil and retest.
❸ Oil Cooler Check	<i>NOTE: For wiring and theory of operation information, see DTC 000175.16 ENGINE OIL TEMPERATURE MODERATELY HIGH supporting information.</i> Remove and inspect engine oil cooler. See REMOVE, INSPECT, AND INSTALL ENGINE OIL COOLER in Group 20 in 8.1L Compressed Natural Gas Base Engine Manual (CTM87).	Oil cooler OK: Faulty oil temperature sensor. Replace and retest. Faulty oil cooler: Replace oil cooler and retest.

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000191.02 — Vehicle Driveshaft Speed Invalid**Vehicle Speed Sensor**

- The vehicle speed sensor is an inductive type sensor that is mounted on the transmission output shaft. As teeth on the gear/timing wheel rotate past the sensor, AC signals are generated. The frequency of these signals are proportional to the wheel speed. The signal from the sensor is sent to the transmission controller. The ECU receives the vehicle speed signal from the transmission controller in order to display vehicle speed to the operator.

DTC 000191.02 will set if:

- The ECU does not receive the vehicle speed signal from the transmission controller.

If DTC 000191.02 sets, the following will occur:

- Speedometer will be disabled.
- Cruise control will be disabled.
- ECU will set a SOLID Warning light.

RG41221,0000163 -19-29MAY03-1/1

000191.02 — Vehicle Driveshaft Speed Invalid

The ECU does not receive the vehicle speed signal from the transmission controller.

RG41221,0000173 -19-08JUL03-1/1

000191.02 Vehicle Driveshaft Speed Invalid Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000191.02 VEHICLE DRIVESHAFT SPEED INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the transmission controller connectors, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000191.02 VEHICLE DRIVESHAFT SPEED INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Ignition ON, engine running 5. Drive the vehicle to create vehicle speed. 6. Read the speedometer.	No vehicle speed: GO TO ❸ Vehicle speed occurs and looks realistic: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Vehicle Driveshaft
Speed Wiring Check

NOTE: For wiring and theory of operation information, see DTC 000191.02 VEHICLE DRIVESHAFT SPEED INVALID supporting information.

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the transmission controller connectors.
3. Using a multimeter, measure resistance between the following terminals
 - Vehicle Driveshaft Speed Input wire (terminal X2) in the ECU connector and the corresponding terminal in the transmission connector.
 - Vehicle Driveshaft Speed Ground wire (terminal X3) in the ECU connector and the corresponding terminal in the transmission connector.

All measurements 5 ohms or less:

Faulty vehicle driveshaft speed sensor wiring

OR

Faulty vehicle driveshaft speed sensor

OR

Faulty transmission controller

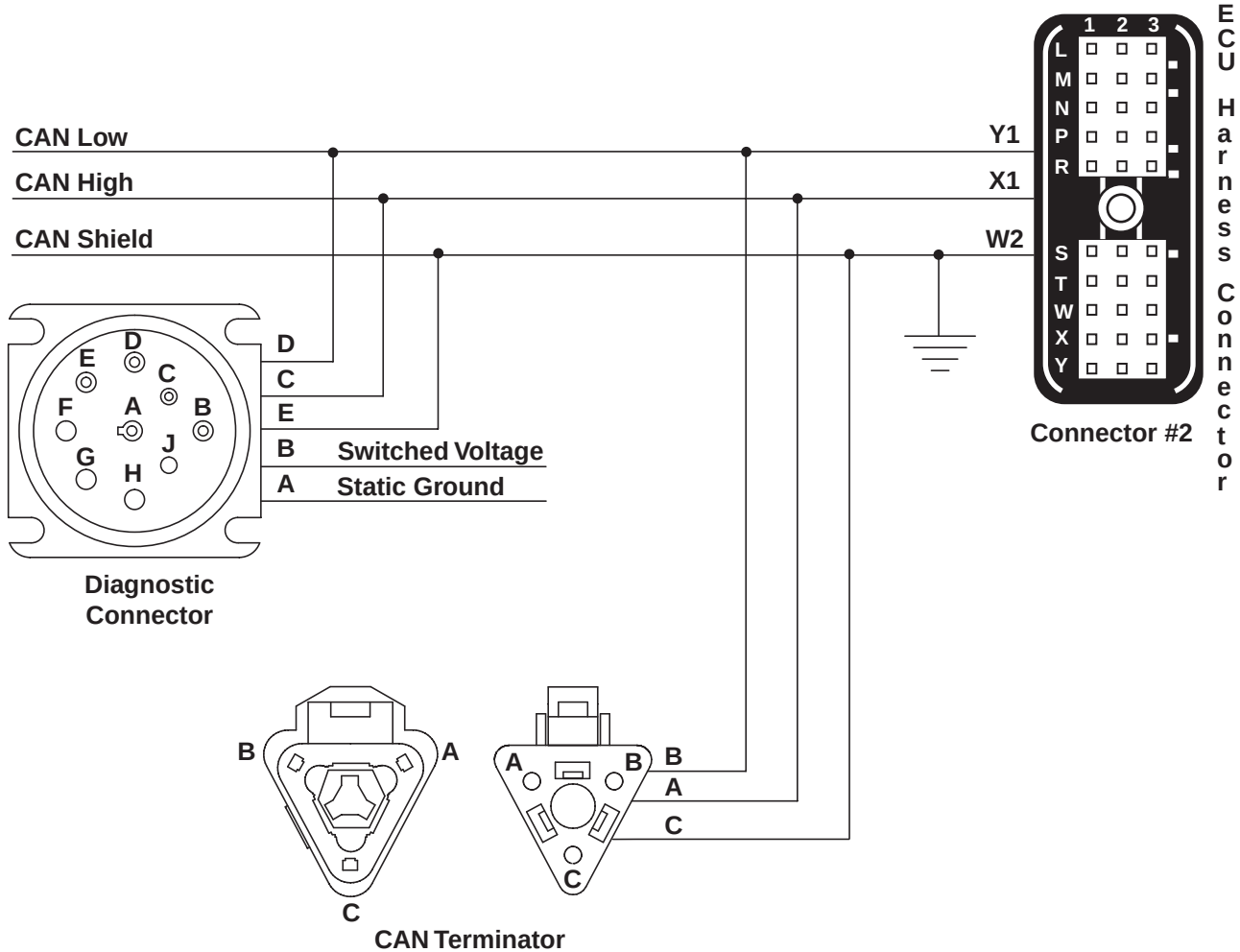
OR

Faulty ECU

Any measurement(s) greater than 5 ohms:

Short or open in wire that had resistance greater than 5 ohms.

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000191.09 — Vehicle Driveshaft Speed Invalid

RG11865 -19-22JUL02

Vehicle Speed Sensor

- The vehicle speed sensor is an inductive type sensor that is mounted on the transmission output shaft. As teeth on the gear/timing wheel rotate past the sensor, AC signals are generated. The frequency of these signals are proportional to the wheel speed. The signal from the sensor is sent to the transmission controller. The ECU receives the vehicle speed signal from the transmission controller over the CAN Bus in order to display vehicle speed to the operator.

DTC 000191.09 will set if:

- The ECU does not receive the vehicle speed signal from the transmission controller.

If DTC 000191.09 sets, the following will occur:

- Speedometer will be disabled.
- Cruise control will be disabled.
- 000639.13 may also be present.
- ECU will set a SOLID Warning light.

000191.09 — Vehicle Driveshaft Speed Invalid

The ECU does not receive the vehicle speed signal from the transmission controller.

RG41221,000007D -19-02OCT01-1/1

000191.09 Vehicle Driveshaft Speed Invalid Diagnostic Procedure

NOTE: If DTC 000191.09 is accompanied with 000639.13, diagnose that code first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000191.09 VEHICLE DRIVESHAFT SPEED INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the transmission controller connectors, the vehicle speed sensor connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair faulty connection(s).
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000191.09 VEHICLE DRIVESHAFT SPEED INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Ignition ON, engine running 5. Drive the vehicle to create vehicle speed. 6. Read the speedometer.	No vehicle speed: GO TO ❸ Vehicle speed occurs and looks realistic: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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**③ Transmission
Controller Test**

NOTE: For wiring and theory of operation information, see DTC 000191.09 VEHICLE DRIVESHAFT SPEED INVALID supporting information.

Check the following that could cause the vehicle speed signal to be missing:

1. Check the transmission controller for related codes. If codes exist, diagnose them.
2. Check the wiring to the vehicle speed sensor.
3. Check the vehicle speed sensor.

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000523.09 — Gear Selection Invalid

The ECU does not receive vehicle gear selection information or it is invalid.

Gear Selection

- The transmission controller transmits the vehicle gear selection to the ECU over the CAN bus. The ECU uses this information to verify the transmission is in neutral. Several features on the vehicle application need to have the transmission in neutral to function.

DTC 000523.09 will set if:

- The ECU does not receive vehicle gear selection information.
- The ECU was programmed incorrectly (trimmable option was selected that should not be).

If DTC 000523.09 sets, the following will occur:

- If the vehicle requires the transmission to be in neutral for certain options to function correctly, these options will be disabled.

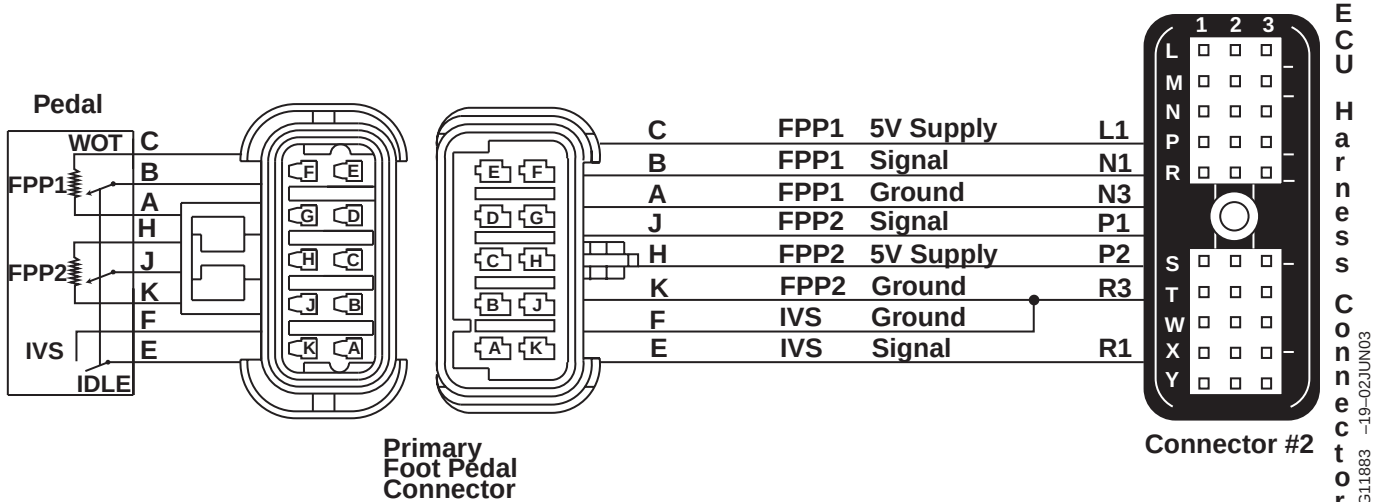
- DTC 000639.13 may also be present. If 000639.13 is present, diagnose it first.

If DTC 000523.09 sets:

- Using the DST or SERVICE ADVISOR™, monitor DTCs on the active code display parameter. If DTC 000639.13 also occurs, see DTC 000639.13 CAN BUS ERROR DIAGNOSTIC PROCEDURE later in this Group.
- If one of the following trim options were selected during reprogramming accidentally, reprogram ECU:
 - Enable Elevated Idle Neutral/Park Interlock
 - Enable Neutral/Park Interlock for Remote Throttle or Dual Foot Pedal
- Check to see if any other controllers on the machine have any active or stored CAN or vehicle related DTCs. If they do, go to the appropriate diagnostic procedure.
- If no other stored or active CAN or vehicle related DTCs are found, replace ECU and retest.

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RG41221.0000166 -19-08JUL03-1/1

000558.02 — Primary Foot Pedal Idle Validation Switch Invalid**Idle Validation Switch (IVS)**

- The foot pedal assembly contains an Idle Validation Switch (IVS) and two independent Foot Pedal Position (FPP) sensors. When the foot pedal is in the idle position, the IVS is open; giving the ECU an IVS status of "ON". When the foot pedal is depressed more than idle, the switch contacts close, grounding the IVS and giving the ECU an IVS status of "OFF". The IVS status is compared to the two FPP sensor signals to determine each signal's validity. For further idle validation switch information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 000558.02 will set if:

- ECU detects a primary foot pedal position of 2% or less **AND** an idle validation switch status of OFF

OR

ECU detects a primary foot pedal position of 27% or more **AND** an idle validation switch status of ON

If DTC 000558.02 sets, the following will occur:

- Adaptive learn disabled for remainder of key-on cycle
- Depending on whether or not there are other fault codes, one of the following will occur:
 - No change in driveability
 - Reduced engine power and degraded driveability
- If the ECU cannot validate any of the three signals (FPP1, FPP2, or IVS) the ECU will limit the engine to low idle.
- ECU will set a SOLID Warning light.

000558.02 — Primary Foot Pedal Idle Validation Switch Invalid

The primary foot pedal position and the idle validation switch do not agree on their current locations.

RG41221,0000089 -19-05OCT01-1/1

000558.02 Primary Foot Pedal Idle Validation Switch Invalid Diagnostic Procedure

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000558.02 IDLE VALIDATION SWITCH INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the primary foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000558.02 PRIMARY FOOT PEDAL IDLE VALIDATION SWITCH INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Primary foot pedal in the idle position, using DST or SERVICE ADVISOR™ read Primary Foot Pedal Idle Validation Switch Status. 7. Move foot pedal through full travel while using DST or SERVICE ADVISOR™ to read Primary Foot Pedal Idle Validation Switch Status.	IVS status is OFF at idle: GO TO ❸ IVS status is ON when foot pedal is depressed: GO TO ❹ IVS status is ON at idle and OFF at full depression: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ IVS Signal Circuit Shorted Test

NOTE: For wiring and theory of operation information, see DTC 000558.02 IDLE VALIDATION SWITCH INVALID supporting information.

1. Ignition OFF
2. Disconnect the primary foot pedal connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read Primary Foot Pedal Idle Validation Switch Status.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

IVS is OFF:

Short to ground in IVS signal circuit
OR
Faulty ECU connection
OR
Faulty ECU

IVS is ON:

Faulty idle validation switch.
Replace primary foot pedal and retest.

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④ IVS Test

NOTE: For wiring and theory of operation information, see DTC 000558.02 IDLE VALIDATION SWITCH INVALID supporting information.

1. Ignition OFF
2. Disconnect primary foot pedal connector from vehicle harness.
3. Install a jumper wire between the IVS signal terminal and the IVS ground terminal (terminals E and F) in the primary foot pedal connector on the vehicle harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read the Primary Foot Pedal Idle Validation Switch Status.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

**IVS is ON:
GO TO ⑤****IVS is OFF:**

Faulty idle validation switch.
Replace primary foot pedal and retest.

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⑤ IVS Signal Circuit Test

NOTE: For wiring and theory of operation information, see DTC 000558.02 IDLE VALIDATION SWITCH INVALID supporting information.

1. Ignition OFF
2. Remove jumper wires
3. Install a jumper wire between the IVS signal terminal (terminal E) in the primary foot pedal connector on the vehicle harness and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read the Primary Foot Pedal Idle Validation Switch Status.

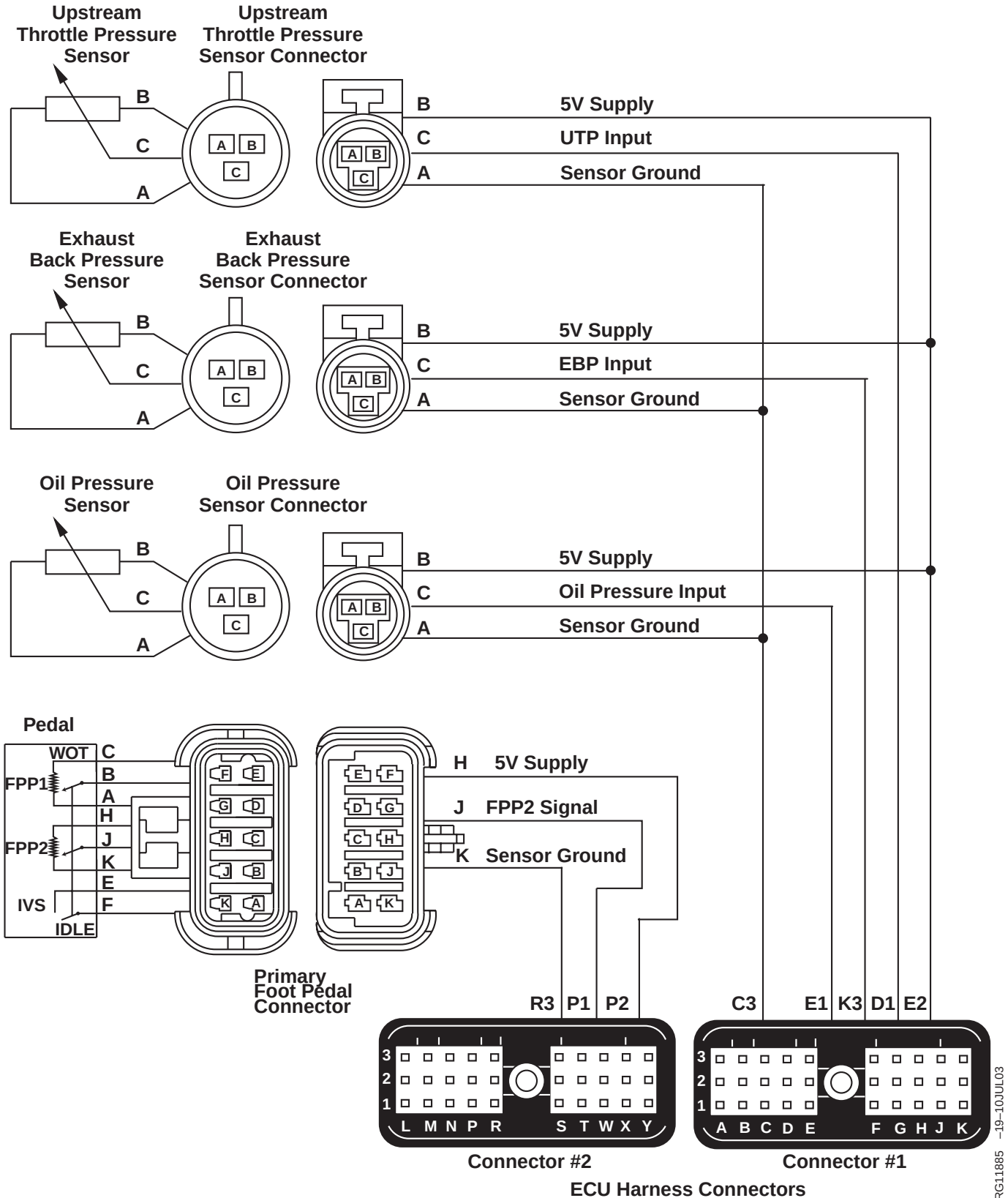
IVS is ON:

Open in IVS signal circuit
OR
Faulty ECU connection
OR
Faulty ECU

IVS is OFF:

Open in IVS ground circuit
OR
Faulty primary foot pedal connection

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000620.03 — Sensor Supply 3 Voltage High

Continued on next page

RG41221,0000258 -19-19SEP01-1/2

Sensor Supply Voltage

- The ECU supplies voltage to a few different sensors depending on application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

Sensor Supply 3

- Sensor Supply 3 supplies 5 volts to the following:
 - Upstream Throttle Pressure Sensor
 - Exhaust Back Pressure Sensor
 - Oil Pressure Sensor

– Foot Pedal 2 Sensor

DTC 000620.03 will set if:

- The ECU detects a supply voltage greater than 5.5 volts on the ECU 5 volt supply 3 circuit.

If DTC 000620.03 sets, the following will occur:

- Depending on the number of components the ECU is supplying 5 volts to, and the cause of the fault, engine operation may not be affected, or there may be problems with the sensors supplied 5 volts by the ECU.
- DTC 000100.03, 299752.03, and 524282.03 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000258 –19–19SEP01–2/2

000620.03 — Sensor Supply 3 Voltage High

The ECU detects a voltage above specification on the ECU 5 volt sensor supply circuit.

RG41221,00002AD -19-19SEP01-1/1

000620.03 Sensor Supply 3 Voltage High Diagnostic Procedure

NOTE: If DTC 000620.03 is accompanied with 000100.03, 299752.03, and 524282.03, diagnose 000620.03 first.

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❶ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000620.03 SENSOR SUPPLY 3 VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000620.03 reoccurs:
GO TO ❸

000620.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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❷ Short in 5V Supply Circuit Test

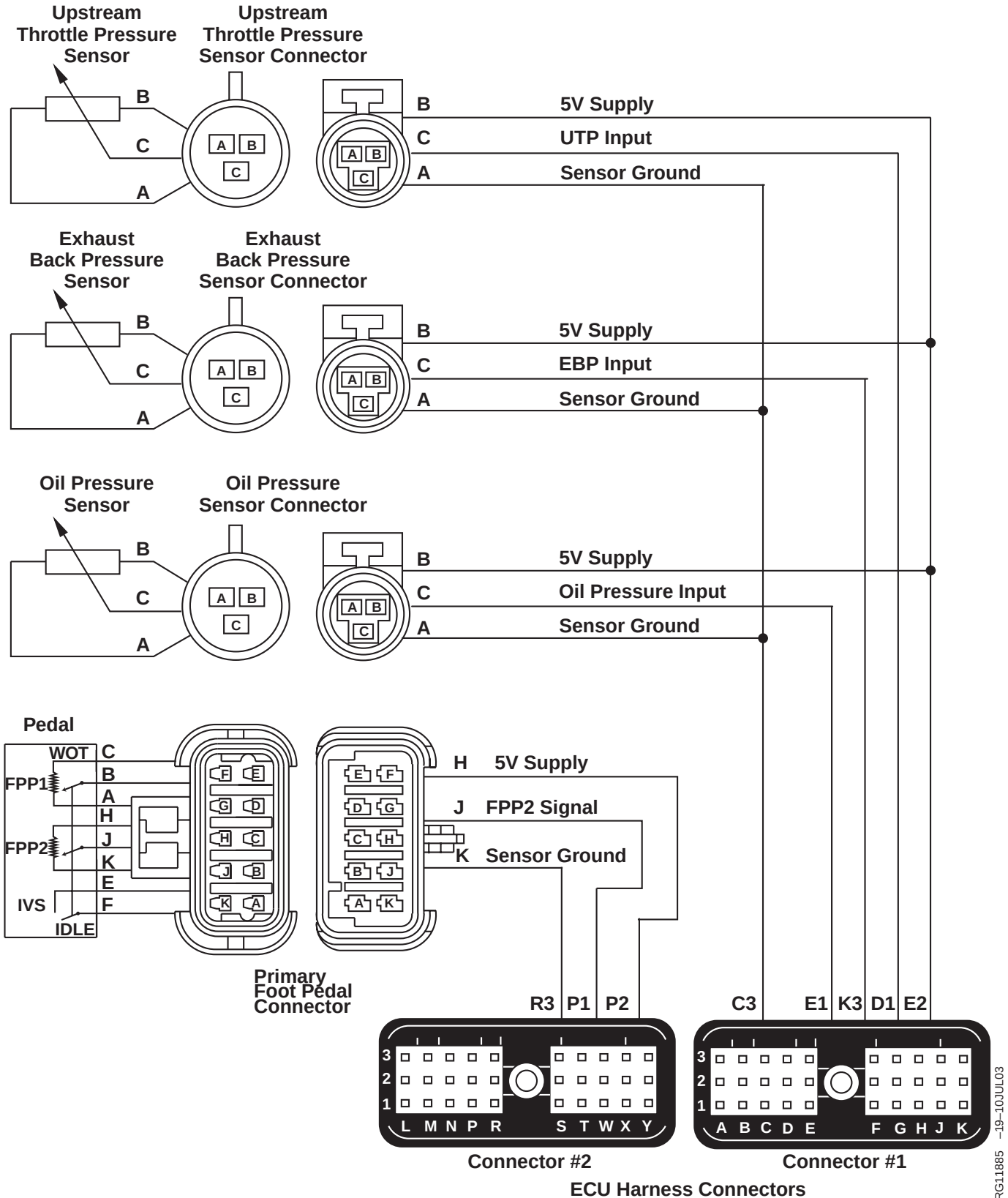
NOTE: For wiring and theory of operation information, see DTC 000620.03 SENSOR SUPPLY 3 VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect all 4 ECU connectors from the ECU.
3. Using a multimeter, measure resistance between the following terminals:
 - Terminal E2 in the ECU connector #1 on the engine harness and all of the other terminals in ECU connector #1 and ECU connector #4.
 - Terminal P2 in the ECU connector #2 on the vehicle harness and all of the other terminals in ECU connector #2 and ECU connector #3.

Greater than 20k ohms on all measurements:
Faulty ECU connection
OR
Faulty ECU

Any measurement 20k ohms or less:
Sensor 5V supply circuit shorted to power supply wire in ECU harness.

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000620.04 — Sensor Supply 3 Voltage Low

Sensor Supply Voltage

- The ECU supplies voltage to a few different sensors depending on application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

Sensor Supply 3

- Sensor Supply 3 supplies 5 volts to the following:
 - Upstream Throttle Pressure Sensor
 - Exhaust Back Pressure Sensor
 - Oil Pressure Sensor

- Foot Pedal 2 Sensor

DTC 000620.04 will set if:

- The ECU detects a voltage less than 4.5 volts on the ECU 5 volt supply 3 circuit.

If DTC 000620.04 sets, the following will occur:

- Depending on the number of components the ECU is supplying 5 volts to, and the cause of the fault, engine operation may not be affected, or there may be problems with the sensors supplied 5 volts by the ECU.
- DTC 000100.04, 299752.04, and 524282.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000259 –19–19SEP01–2/2

000620.04 — Sensor Supply 3 Voltage Low

The ECU detects a voltage below specification on the ECU 5 volt sensor supply circuit.

RG41221,00002AE -19-19SEP01-1/1

000620.04 Sensor Supply 3 Voltage Low Diagnostic Procedure

NOTE: If DTC 000620.04 is accompanied with 000100.04, 299752.04, and 524282.04, diagnose 000620.04 first.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000620.04 SENSOR SUPPLY 3 VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and all of the sensor connectors using this 5 volt supply looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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② Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000620.04 SENSOR SUPPLY 3 VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of all active DTCs, then clear all DTCs. 5. Ignition OFF 6. Disconnect all of the components that are supplied 5 volts by terminal E2 in the ECU connector #1 on the engine harness and terminal P2 in the ECU connector #2 on the vehicle harness. See DTC 000620.04 SENSOR SUPPLY 3 VOLTAGE LOW supporting information for a list of all of the components. 7. Ignition ON, engine running 8. Read DTCs using DST or SERVICE ADVISOR™.	000620.04 reoccurs: GO TO ③ 000620.04 doesn't reoccur: GO TO ④	115 ,301
<i>SERVICE ADVISOR is a trademark of Deere & Company</i> -- -1/1			
③ 5V Supply Circuit Shorted to Ground Test	<i>NOTE: For wiring and theory of operation information, see DTC 000620.04 SENSOR SUPPLY 3 VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Disconnect all 4 ECU connectors from the ECU. 3. Using a multimeter, measure resistance between: • Terminal E2 in the ECU connector #1 on the engine harness and: – Terminal C3 in ECU connector #1 – Terminal D3 in ECU connector #1 – Terminal B1 in ECU connector #3 – Terminal B2 in ECU connector #3 – Terminal D2 in ECU connector #3 • Terminal P2 in the ECU connector #2 on the vehicle harness and: – Terminal M3 in ECU connector #2 – Terminal N3 in ECU connector #2 – Terminal B1 in ECU connector #3 – Terminal B2 in ECU connector #3 – Terminal D2 in ECU connector #3	Greater than 20k ohms on all measurements: Faulty ECU connection OR Faulty ECU Any measurement 20k ohms or less: Sensor 5V supply circuit shorted to ground circuit. -- -1/1	

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4 Faulty Sensor Test

NOTE: For wiring and theory of operation information, see DTC 000620.04 SENSOR SUPPLY 3 VOLTAGE LOW supporting information.

1. Ignition ON, engine OFF
2. Reconnect all of the component connectors one at a time checking for 000620.04 to reoccur after each connection is made.

NOTE: Be sure to "Get Codes" after every connection to refresh the list of active codes.

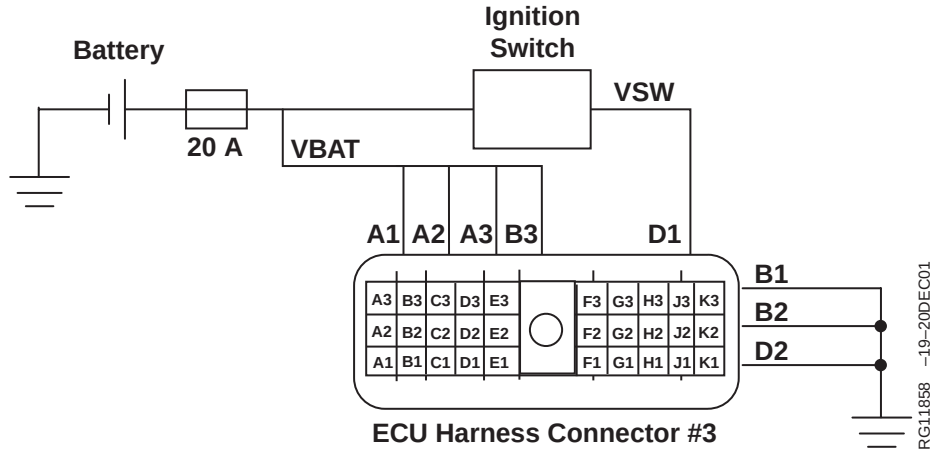
000620.04 reoccurs:

Sensor that caused 000620.04 to reoccur when it was reconnected is faulty.
Replace sensor and retest.

000620.04 doesn't reoccur:

Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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000627.16 — ECU Power Supply Voltage Higher Than Expected**System Voltage to ECU**

- Battery voltage powers the ECU and is measured so that the ECU can compensate for variations in battery voltage as it controls the output device drivers.

If DTC 000627.16 sets, the following will occur:

- Adaptive learn is disabled for remainder of key-ON cycle
- ECU will set a SOLID Warning light.

DTC 000627.16 will set if:

- The ECU detects a voltage greater than 36 volts for 1 second on one or more of the ECU voltage wires anytime the engine is cranking or running.

RG41221,000035F -19-07MAY02-1/1

000627.16 — ECU Power Supply Voltage Higher Than Expected

The ECU detects a voltage above specification on one or more of the ECU voltage wires anytime the engine is cranking or running.

RG41221.0000360 -19-07MAY02-1/1

000627.16 ECU Power Supply Voltage Higher Than Expected Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000627.16 ECU POWER SUPPLY VOLTAGE HIGHER THAN EXPECTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000627.16 ECU POWER SUPPLY VOLTAGE HIGHER THAN EXPECTED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine running at 1500 rpm 3. Start the ECU diagnostic software 4. Using the ECU diagnostic software, read Battery Voltage.	Above 36 V: GO TO ❸ 36 V or below: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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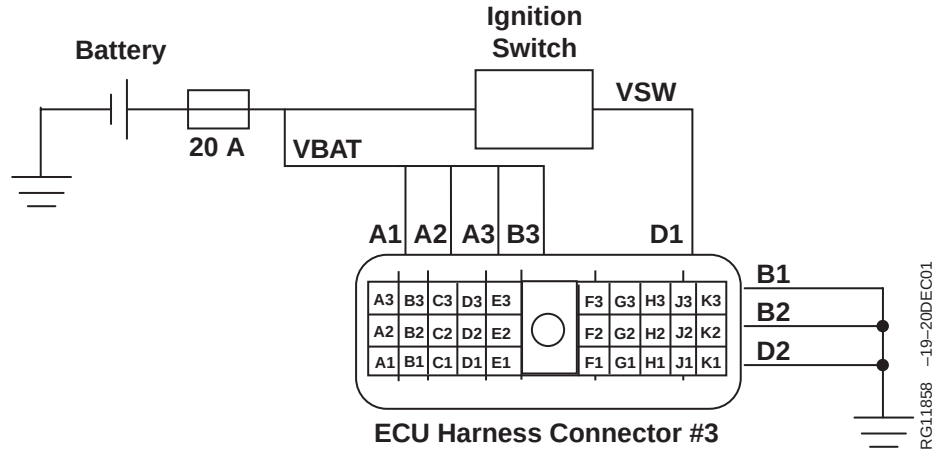
③ Battery Voltage Test

NOTE: For wiring and theory of operation information, see DTC 000627.16 ECU POWER SUPPLY VOLTAGE HIGHER THAN EXPECTED supporting information.

1. Ignition ON, engine running at 1500 rpm
2. Using a multimeter, measure voltage across the positive and negative battery terminals.

Above 36 V:
Faulty charging system.
See STARTING AND CHARGING SYSTEM DIAGNOSTICS in Section 110 earlier in this manual.

36 V or below:
Faulty ECU

000627.18 — ECU Power Supply Voltage Lower Than Expected**System Voltage to ECU**

- Battery voltage powers the ECU and is measured so that the ECU can compensate for variations in battery voltage as it controls the output device drivers.

If DTC 000627.18 sets, the following will occur:

- Adaptive learn is disabled for remainder of key-ON cycle
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

DTC 000627.18 will set if:

- The ECU detects a voltage less than 6 volts for 1 second on one of the ECU voltage wires anytime when engine speed is greater than 1200 rpm.

RG41221,0000361 -19-07MAY02-1/1

000627.18 — ECU Power Supply Voltage Lower Than Expected

The ECU detects a voltage below specification on one of the ECU voltage wires anytime when engine speed is above 1200 rpm.

RG41221,0000362 -19-07MAY02-1/1

000627.18 ECU Power Supply Voltage Lower Than Expected Diagnostic Procedure

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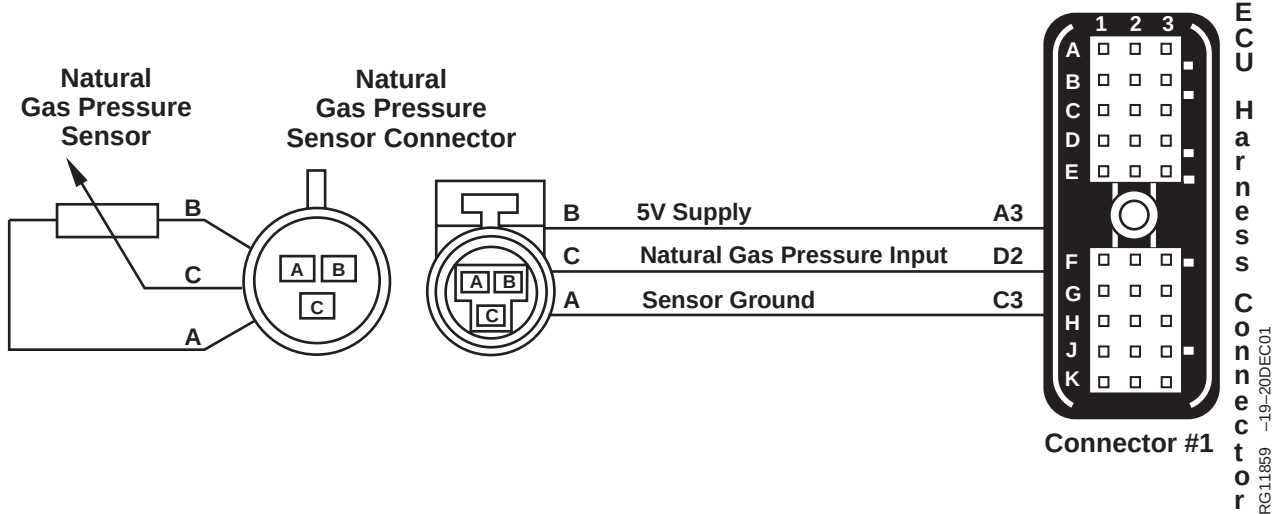
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000627.18 ECU POWER SUPPLY VOLTAGE LOWER THAN EXPECTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000627.18 ECU POWER SUPPLY VOLTAGE LOWER THAN EXPECTED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine running at low idle 3. Start the ECU diagnostic software 4. Using the ECU diagnostic software, read Battery Voltage.	Below 6.0 V: GO TO ❸ 6.0 V or greater: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 ,310	③ Battery Voltage Test	<i>NOTE: For wiring and theory of operation information, see DTC 000627.18 ECU POWER SUPPLY VOLTAGE LOWER THAN EXPECTED supporting information.</i> 1. Ignition ON, engine running at low idle 2. Using a multimeter, measure voltage across the positive and negative battery terminals.	6.0 V or greater: GO TO ④ Below 6.0 V: Faulty charging system. See STARTING AND CHARGING SYSTEM DIAGNOSTICS in Section 110 earlier in this manual. -- -1/1
	④ ECU Power Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000627.18 ECU POWER SUPPLY VOLTAGE LOWER THAN EXPECTED supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #3 (white A-K) on the vehicle harness. 3. Ignition ON, engine OFF 4. Using a multimeter, measure voltage between terminal a good chassis ground and the following terminal: • A1 in ECU connector #3 on the vehicle harness • A2 in ECU connector #3 on the vehicle harness • A3 in ECU connector #3 on the vehicle harness • B3 in ECU connector #3 on the vehicle harness • D1 in ECU connector #3 on the vehicle harness	6.0 V or greater: GO TO ⑤ Below 6.0 V: Open or short to ground in the ECU switched power circuit -- -1/1
	⑤ ECU Ground Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000627.18 ECU POWER SUPPLY VOLTAGE LOWER THAN EXPECTED supporting information.</i> 1. Ignition OFF 2. ECU connector #3 (white A-K) still disconnected. 3. Ignition ON, engine OFF 4. Using a multimeter, measure voltage between terminal A1 in ECU connector #3 on the vehicle harness and the following terminals: • Terminal B1 in the ECU connector #3 • Terminal B2 in the ECU connector #3 • Terminal D2 in the ECU connector #3	6.0 V or greater on all measurements: Faulty ECU Below 6.0 V on any measurement: Open in ground circuit that showed low voltage -- -1/1

000632.07 — High Pressure Fuel Regulator Invalid**High Pressure Fuel Regulator**

- The high pressure fuel regulator is remote mounted in the engine compartment. Location may vary depending on application. High pressure fuel from the fuel tanks flow into the fuel regulator and the pressure is reduced to engine operating gas pressure. Fuel is then filtered and flows through the low pressure lock-off valve at the inlet of the fuel metering block.

If DTC 000632.07 sets, the following will occur:

- ECU will shut the high pressure lock-off valve.
- ECU will shut the low pressure lock-off valve.
- The engine will die due to lack of fuel from the shut-off valves closing.
- DTC 159.18 may also be present.
- ECU will set a SOLID STOP light.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

DTC 000632.07 will set if:

- The ECU detects natural gas pressure that exceeds 189 psia (1300 kPa) (13.0 bar) at the natural gas pressure sensor on the fuel metering block.

RG41221,0000021 -19-20AUG02-1/1

000632.07 — High Pressure Fuel Regulator Invalid

The ECU detects natural gas pressure above specification at the fuel metering block

RG41221.0000022 -19-20AUG02-1/1

000632.07 High Pressure Fuel Regulator Invalid Diagnostic Procedure

NOTE: If DTC 000632.07 is accompanied with 000159.18, diagnose 000159.18 first.

IMPORTANT: Do NOT disconnect the Natural Gas Pressure Sensor connector any time the ignition switch is in the ON position. This will allow high pressure gas into the low pressure system and engine damage will occur.

-- -1/1

① Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000632.07 HIGH PRESSURE FUEL REGULATOR INVALID supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of all DTCs, then clear all DTCs
5. Ignition ON, engine OFF
6. Read DTCs using DST or SERVICE ADVISOR™.

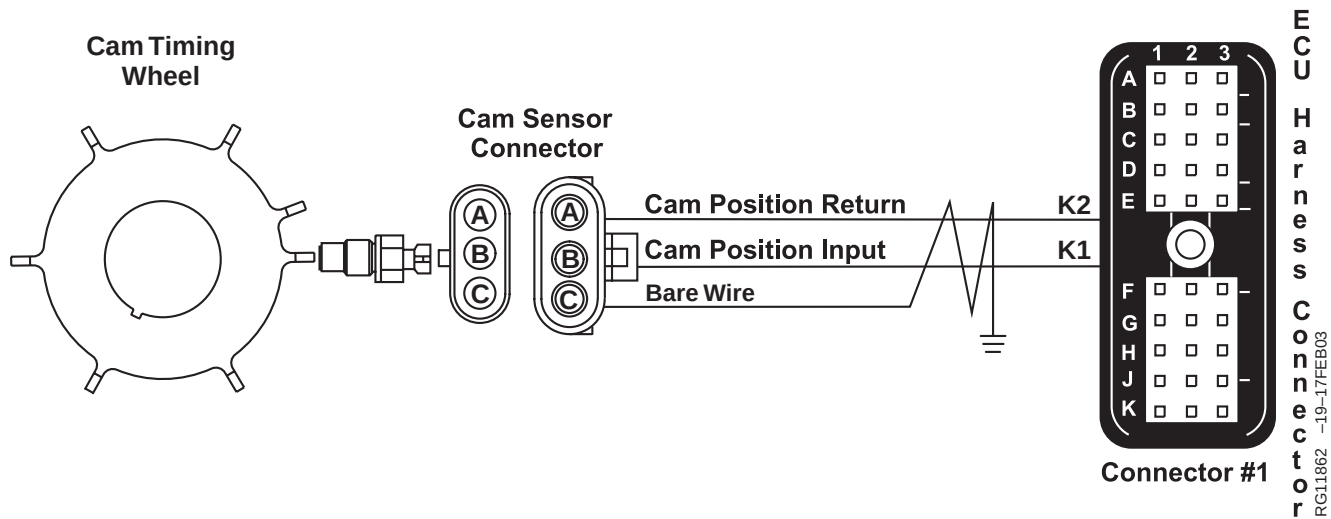
000632.07 reoccurs:
GO TO ②

000632.07 does not reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group

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115 314	② High Pressure Fuel Regulator Test	<i>NOTE: For wiring and theory of operation information, see DTC 000632.07 HIGH PRESSURE FUEL REGULATOR INVALID supporting information.</i> 1. Ignition OFF 2. Remove cap from Schrader valve on fuel metering block. 3. Connect a 0-200 psi pressure gauge to the Schrader valve. 4. Ignition ON, engine OFF 5. Using the pressure gauge, read the Natural Gas Pressure as soon as the ignition switch is turned ON.	Below 174 psig (1200 kPa) (12.0 bar): GO TO ③ 174 psig (1200 kPa) (12.0 bar) or greater: Faulty high pressure fuel regulator. Replace and retest. -- -1/1
	③ Natural Gas Pressure Sensor Test	<i>NOTE: For wiring and theory of operation information, see DTC 000632.07 HIGH PRESSURE FUEL REGULATOR INVALID supporting information.</i> 1. Ignition OFF IMPORTANT: Do NOT turn ignition switch ON while connector is disconnected. This will allow high pressure gas into the low pressure system and engine damage will occur. 2. Disconnect the natural gas pressure sensor connector. 3. Using a multimeter, measure resistance between the following terminals: • Terminal A in the natural gas pressure sensor connector and terminal C3 in ECU connector #1 (black A-K) on the engine harness. • Terminal B in the natural gas pressure sensor connector and terminal A3 in ECU connector #1 (black A-K) on the engine harness. • Terminal C in the natural gas pressure sensor connector and terminal D2 in ECU connector #1 (black A-K) on the engine harness.	5 ohms or less on all measurements: Faulty natural gas pressure sensor. Greater than 5 ohms on any measurement(s): Short in wire that had high resistance. -- -1/1

000636.02 — Camshaft Position Sensor Input Noise**Camshaft Position Sensor**

- The camshaft position sensor is located on the front of the engine between the fuel metering block and the timing gear cover. It is an inductive type pickup sensor that detects teeth on the cam timing wheel. The ECU uses the cam input to determine cylinder identification so that it can fire the correct coil. The cam timing wheel is composed of 6 evenly spaced teeth with one additional tooth. The ECU uses the additional tooth to determine cylinder #1 is approaching Top-Dead-Center (TDC). For further camshaft position sensor information, see MEASURING ENGINE SPEED in Group 100 earlier in this manual.

DTC 000636.02 will set if:

- The ECU detects excessive noise (extra pulses) on the camshaft position sensor input.

If DTC 000636.02 sets, the following will occur:

- If a crankshaft position sensor trouble code accompanies DTC 000636.02, the engine will die and won't restart until at least the camshaft position sensor code is repaired.
- ECU will use only the crankshaft position sensor input to determine piston position and engine speed.
- The moment that the trouble code sets, the engine may hesitate or die.
- If the engine is not running when the cam signal is lost, the engine will not start.
- ECU will set a SOLID Malfunction light.

RG41221,000025F -19-08MAY02-1/1

000636.02 — Camshaft Position Sensor Input Noise

The ECU detects excessive noise (extra pulses) on the camshaft position sensor input.

RG41221,00002AF -19-08MAY02-1/1

000636.02 Camshaft Position Sensor Input Noise Diagnostic Procedure

-- -1/1

❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000636.02 CAMSHAFT POSITION SENSOR INPUT NOISE supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the camshaft position sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000636.02 CAMSHAFT POSITION SENSOR INPUT NOISE supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of all DTCs, then clear all DTCs 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000636.02 reoccurs: GO TO ❸ 000636.02 does not reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group

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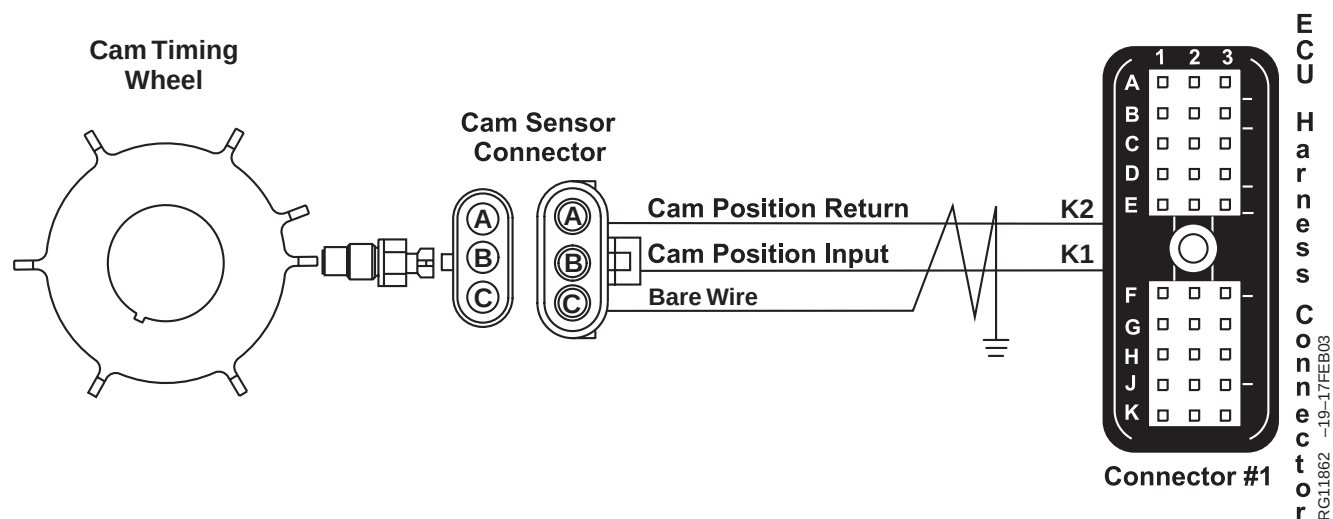
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③ Noise Detection Test

NOTE: For wiring and theory of operation information, see DTC 000636.02 CAMSHAFT POSITION SENSOR INPUT NOISE supporting information.

1. 000636.02 is most likely caused by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical ground or power connections anywhere on the machine. Things to check:
 - All harness connectors.
 - Alternator connections.
 - Chassis ground connections, battery ground connection.
 - Corrosion, dirt, or paint can cause intermittent and "noisy" connections.
 - Check the wiring for intermittent open and short circuits; particularly the camshaft sensor wiring.
 - Check wiring for proper pin location in the high pressure pump speed sensor and ECU connectors.
2. Other possible causes of 000636.02:
 - Electromagnetic interference (EMI) from an incorrectly installed 2-way radio.
 - Interference from some radar source.
 - Possible burrs on the high pressure pump timing wheel notches, should be clean, square edges.

Problem found:
Repair and retest.

000636.08 — Camshaft Position Sensor Input Missing**Camshaft Position Sensor**

- The camshaft position sensor is located on the front of the engine between the fuel metering block and the timing gear cover. It is an inductive type pickup sensor that detects teeth on the cam timing wheel. The ECU uses the cam input to determine cylinder identification so that it can fire the correct coil. The cam timing wheel is composed of 6 evenly spaced teeth with one additional tooth. The ECU uses the additional tooth to determine cylinder #1 is approaching Top-Dead-Center (TDC). For further camshaft position sensor information, see MEASURING ENGINE SPEED in Group 100 earlier in this manual.

DTC 000636.08 will set if:

- The ECU does not detect the camshaft position sensor input.

If DTC 000636.08 sets, the following will occur:

- If a crankshaft position sensor trouble code accompanies DTC 000636.08, the engine will die and won't restart until at least the camshaft sensor code is repaired.
- ECU will use only the crankshaft position sensor input to determine piston position and engine speed.
- The moment that the trouble code sets, the engine may hesitate or die.
- If the engine is not running when the camshaft signal is lost, the engine will not start.
- ECU will set a SOLID Malfunction light.

RG41221,0000260 -19-08MAY02-1/1

000636.08 — Camshaft Position Sensor Input Missing

The ECU does not detect the camshaft position sensor input.

RG41221,00002B0 -19-08MAY02-1/1

000636.08 Camshaft Position Sensor Input Missing Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000636.08 CAMSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the camshaft position sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000636.08 CAMSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make notes of any DTCs, then clear all DTCs 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000636.08 reoccurs: GO TO ❸ 000636.08 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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**③ Camshaft Position
Sensor Test**

NOTE: For wiring and theory of operation information, see DTC 000636.08 CAMSHAFT POSITION SENSOR INPUT MISSING supporting information.

1. Ignition OFF
2. Disconnect camshaft position sensor connector.
3. Using a multimeter, measure resistance between both terminals of the camshaft position sensor.

Between 2500 and 3500 ohms:
GO TO ④

Below 2500 ohms or above 3500 ohms:
Faulty camshaft position sensor.

-- -1/1

**④ Open in Camshaft
Position Input and
Return Circuit Test**

NOTE: For wiring and theory of operation information, see DTC 000636.08 CAMSHAFT POSITION SENSOR INPUT MISSING supporting information.

1. Ignition OFF
2. Disconnect camshaft position sensor connector and the ECU connector #1 (black A-K) on the engine harness.
3. Using a multimeter, measure resistance between:
 - Terminal A of the camshaft position sensor harness connector and terminal K2 in ECU connector #1 on the engine harness.
 - Terminal B of the camshaft position sensor harness connector and terminal K1 in ECU connector #1 on the engine harness.

Both measurements 5 ohms or less:
GO TO ⑤

Either measurement greater than 5 ohms:
Open in camshaft position sensor input wire
OR
Open in camshaft position sensor return wire
OR
Wires in the camshaft position sensor harness connector possibly inverted.

-- -1/1

**⑤ Camshaft Position
Sensor Input Wiring
Harness Test**

NOTE: For wiring and theory of operation information, see DTC 000636.08 CAMSHAFT POSITION SENSOR INPUT MISSING supporting information.

1. Ignition OFF
2. Camshaft Position Sensor connector and ECU connector #1 (black A-K) still disconnected.
3. Disconnect ECU connector #4 (white L-Y) on the engine harness.
4. Using a multimeter measure resistance between terminal K1 in ECU connector #1 and the following:
 - A good chassis ground.
 - All other terminals in both ECU connector #1 and connector #4.

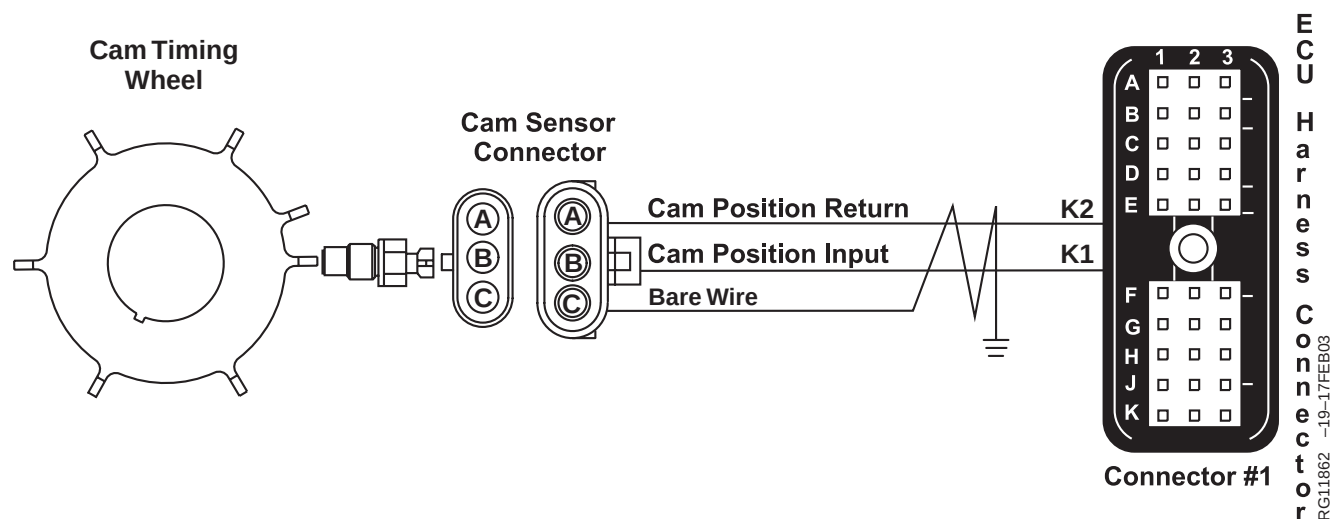
All measurements greater than 2k ohms:
GO TO ⑥

Any measurement less than 2k ohms:
Faulty camshaft position sensor input wiring harness.

-- -1/1

⑥ Camshaft Position Sensor Return Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000636.08 CAMSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> 1. Ignition OFF 2. Camshaft Position Sensor connector and ECU connectors still disconnected. 3. Using a multimeter measure resistance between terminal K2 in ECU connector #1 on the engine harness and the following: • A good chassis ground. • All other terminals in both ECU connector #1 and connector #4.	All measurements greater than 2k ohms: Faulty camshaft position sensor connector OR Faulty camshaft position sensor OR Faulty ECU connector OR Faulty ECU Any measurement less than 2k ohms: Faulty camshaft position sensor return wiring harness.	115,323

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000636.10 — Camshaft Position Sensor Input Pattern Error**Camshaft Position Sensor**

- The camshaft position sensor is located on the front of the engine between the fuel metering block and the timing gear cover. It is an inductive type pickup sensor that detects teeth on the cam timing wheel. The ECU uses the cam input to determine cylinder identification so that it can fire the correct coil. The cam timing wheel is composed of 6 evenly spaced teeth with one additional tooth. The ECU uses the additional tooth to determine cylinder #1 is approaching Top-Dead-Center (TDC). For further camshaft position sensor information, see MEASURING ENGINE SPEED in Group 100 earlier in this manual.

DTC 000636.10 will set if:

- The ECU detects an improper pattern on the camshaft position sensor input.

If DTC 000636.10 sets, the following will occur:

- If a crankshaft position sensor trouble code accompanies DTC 000636.10, the engine will die and won't restart until at least the camshaft sensor code is repaired.
- ECU will use only the crankshaft position sensor input to determine piston position and engine speed.
- The moment that the trouble code sets, the engine may hesitate or die.
- If the engine is not running when the cam signal is lost, the engine will not start.
- ECU will set a SOLID Malfunction light.

RG41221,0000261 -19-08MAY02-1/1

000636.10 — Camshaft Position Sensor Input Pattern Error

The ECU detects an improper pattern on the camshaft position sensor input.

RG41221,00002B1 -19-08MAY02-1/1

000636.10 Camshaft Position Sensor Input Pattern Error Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000636.10 CAMSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the camshaft position sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000636.10 CAMSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make notes of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000636.10 reoccurs: GO TO ❸ 000636.10 does not reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

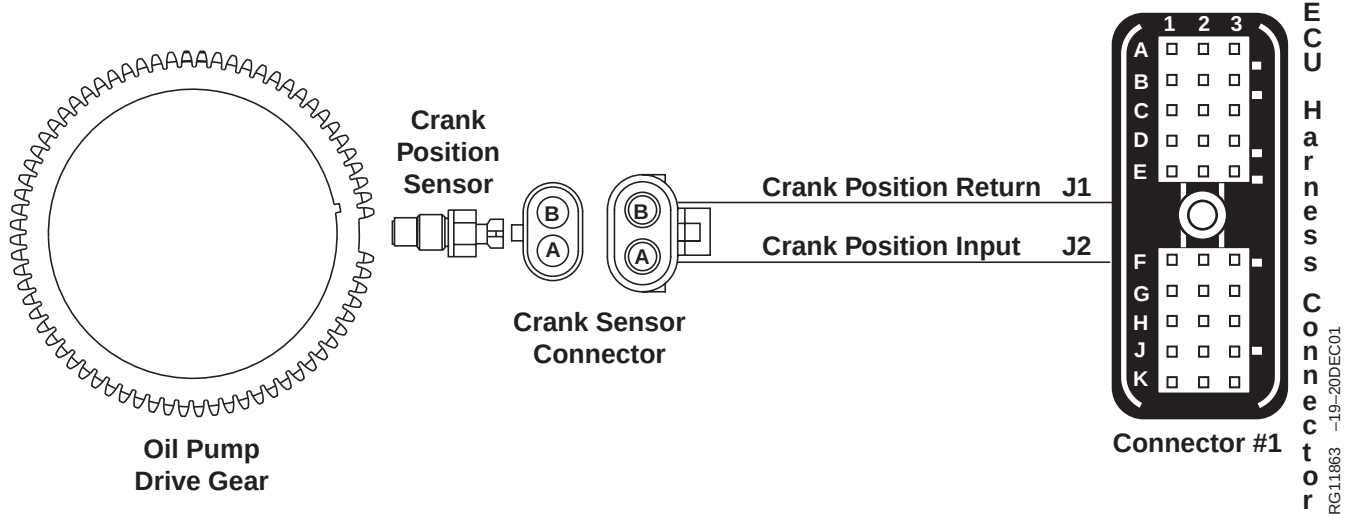
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115 326	③ Camshaft Position Sensor Test	<i>NOTE: For wiring and theory of operation information, see DTC 000636.10 CAMSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> 1. Ignition OFF 2. Disconnect camshaft position sensor connector. 3. Using a multimeter, measure resistance between both terminals of the camshaft position sensor.	Between 2500 and 3500 ohms: GO TO ④ Below 2500 ohms or above 3500 ohms: Faulty camshaft position sensor -- -1/1
	④ Open in Camshaft Position Input and Return Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 000636.10 CAMSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> 1. Ignition OFF 2. Disconnect camshaft position sensor connector and the ECU connector #1 (black A-K). 3. Using a multimeter, measure resistance between: • Terminal A of the camshaft position sensor connector and terminal K2 in ECU connector #1 on the engine harness. • Terminal B of the camshaft position sensor connector and terminal K1 in ECU connector #1 on the engine harness.	Both measurements 5 ohms or less: GO TO ⑤ Either measurement greater than 5 ohms: Open in camshaft position sensor input wire OR Open in camshaft position sensor return wire OR Wires in the camshaft position sensor harness connector possibly inverted. -- -1/1
	⑤ Camshaft Position Sensor Input Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000636.10 CAMSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> 1. Ignition OFF 2. Camshaft Position sensor connector and ECU connector #1 still disconnected. 3. Disconnect ECU connector #4 (white L-Y). 4. Using a multimeter measure resistance between terminal K1 in the harness end of the ECU connector #1 and the following: • A good chassis ground. • All other terminals in both ECU connector #1 and connector #4.	All measurements greater than 2k ohms: GO TO ⑥ Any measurement less than 2k ohms: Faulty camshaft position sensor input wiring harness. -- -1/1

⑥ Camshaft Position Sensor Return Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000636.10 CAMSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> 1. Ignition OFF 2. Camshaft Position Sensor connector and ECU connectors still disconnected. 3. Using a multimeter measure resistance between terminal K2 in the harness end of the ECU connector #1 and the following: • A good chassis ground. • All other terminals in both ECU connector #1 and connector #4.	All measurements greater than 2k ohms: Faulty ECU connector OR Faulty ECU. Any measurement less than 2k ohms: Faulty camshaft position sensor return wiring harness. -- -1/1	115,327

000637.02 — Crankshaft Position Sensor Input Noise**Crankshaft Position Sensor**

- The crankshaft position sensor is an inductive type pickup sensor that detects notches on the oil pump drive gear at the rear of the engine. The ECU uses the crankshaft position input to determine engine speed and precision piston position in relation to TDC. The ECU monitors the camshaft position sensor input to determine piston position in relation to the firing order. Based on information from the crankshaft and camshaft position sensors, the ECU calculates when and how long to fire each of the ignition coils. For further crankshaft position sensor information, see MEASURING ENGINE SPEED in Group 100 earlier in this manual.

DTC 000637.02 will set if:

- The ECU detects excessive noise (extra pulses) on the crankshaft position sensor input.

If DTC 000637.02 sets, the following will occur:

- If a camshaft position sensor trouble code accompanies DTC 000637.02, the engine will die and won't restart until at least the camshaft position sensor code is repaired.
- ECU will use only the camshaft position sensor input to determine piston position and engine speed.
- The moment that the trouble codes sets, the engine may hesitate or die, but it will restart if there are no camshaft position sensor codes.
- Prolonged cranking time may be required to start the engine.
- ECU will set a SOLID Malfunction light.

RG41221,0000262 -19-08MAY02-1/1

000637.02 — Crankshaft Position Sensor Input Noise

The ECU detects excessive noise (extra pulses) on the crankshaft position sensor input.

RG41221,00002B2 -19-08MAY02-1/1

000637.02 Crankshaft Position Sensor Input Noise Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000637.02 CRANKSHAFT POSITION SENSOR INPUT NOISE supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the crankshaft sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.02 CRANKSHAFT POSITION SENSOR INPUT NOISE supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of all DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000637.02 reoccurs: GO TO ❸ 000637.02 does not reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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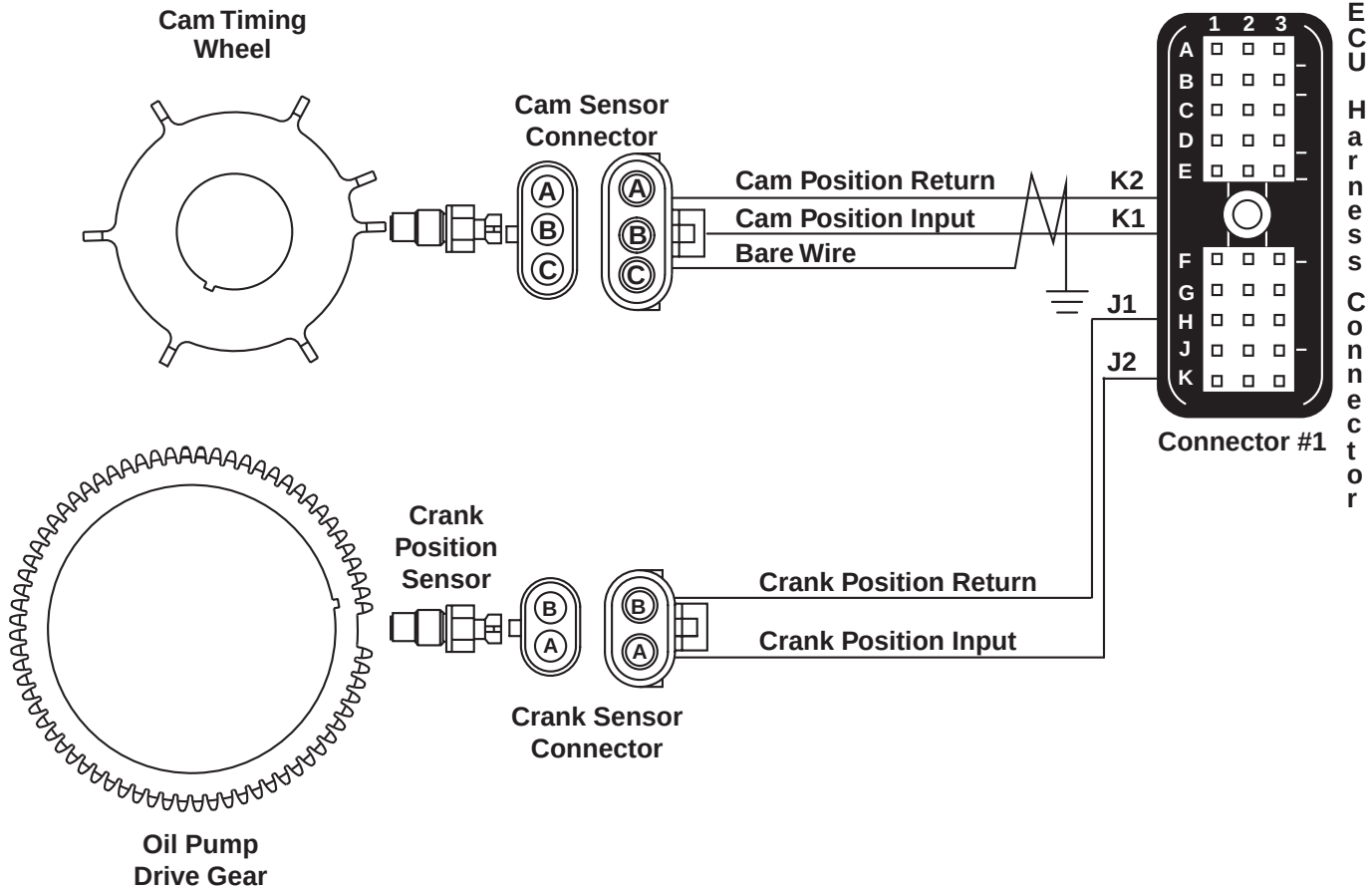
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③ Noise Detection Test

NOTE: For wiring and theory of operation information, see DTC 000637.02 CRANKSHAFT POSITION SENSOR INPUT NOISE supporting information.

1. 000637.02 is most likely caused by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical ground or power connections anywhere on the machine. Things to check:
 - All harness connectors.
 - Alternator connections.
 - Chassis ground connections, battery ground connection.
 - Corrosion, dirt, or paint can cause intermittent and "noisy" connections.
 - Check the wiring for intermittent open and short circuits; particularly the crankshaft sensor wiring.
 - Check wiring for proper pin location in the crankshaft sensor and ECU connectors.
2. Other possible causes of 000637.02:
 - Electromagnetic interference (EMI) from an incorrectly installed 2-way radio.
 - Interference from some radar source.
 - Possible broken teeth on the crankshaft timing ring.

Problem found:
Repair and retest.

000637.07 — Crankshaft Position/Camshaft Position Out of Sync

RG11864 -19-17FEB03

Camshaft Position Sensor and Crankshaft Position Sensor

- The camshaft position and crankshaft position sensors are both inductive type pickup sensors. The camshaft position sensor detects teeth on the cam timing wheel while the crankshaft position sensor detects notches on the oil pump drive gear. The ECU uses the crankshaft position input to determine engine speed and precise piston position in relation to TDC. Using the camshaft position sensor input, the ECU is able to determine when a cylinder is at the end of the compression stroke. Based on this information, the ECU calculates the correct time to energize the ignition coils. A known relationship between the camshaft position sensor signal and the crankshaft position sensor signal allows the ECU to recognize when one signal is not in sync with the other. For further camshaft position and crankshaft

position sensor information, see MEASURING ENGINE SPEED in Group 100 earlier in this manual.

DTC 000637.07 will set if:

- The ECU detects that the camshaft position and crankshaft position inputs are not in sync with each other.

If DTC 000637.07 sets, the following will occur:

- Depending on the cause of the trouble code, the engine may die, and then it may or may not restart.
- If the engine dies and won't restart, it is possible that disconnecting the crankshaft position sensor will allow the engine to start.
- If the engine continues to run, it will develop low power.
- ECU will set a SOLID Warning light.

Continued on next page

RG41221,0000263 -19-08MAY02-1/2

- ECU will set a SOLID Malfunction light.

115
,333

RG41221,0000263 -19-08MAY02-2/2

000637.07 — Crankshaft Position/Camshaft Position Out of Sync

The ECU detects that the camshaft position and crankshaft position inputs are not in sync with each other.

RG41221,00002B3 -19-08MAY02-1/1

000637.07 Crankshaft Position/Camshaft Position Out of Sync Diagnostic Procedure

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, the crankshaft position sensor connector, and the camshaft position sensor connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty Connections Found:
Repair connections and retest.

-- -1/1

❷ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of all DTCs, then clear all DTCs.
5. Ignition ON, engine running or cranking
6. Read DTCs using DST or SERVICE ADVISOR™.

000637.07 reoccurs:
GO TO ❸

000637.07 does not reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

3 Crank Timing Wheel and Sensor Test	NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information. 1. Ignition OFF 2. Inspect oil pump drive gear for broken teeth, nicks burrs, or other damage. 3. Remove crankshaft position sensor. See REMOVE AND INSTALL CRANKSHAFT POSITION SENSOR (HFN04 ENGINE) in Group 45 of 8.1 L Compressed Natural Gas Engine Repair Manual (CTM87). 4. Inspect crankshaft position sensor for cracks, debris, or other damage.	All components OK: Reinstall sensor AND GO TO 4 Faulty component found: Determine cause and replace of faulty component. Retest -- -1/1
4 Crankshaft Position Sensor Test	NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information. 1. Ignition OFF 2. Disconnect crankshaft position sensor connector. 3. Using a multimeter, measure resistance between both terminal of the crankshaft position sensor.	Measurement between 2500 and 3500 ohms: GO TO 5 Measurement below 2500 ohms or above 3500 ohms: Faulty crankshaft position sensor -- -1/1
5 Camshaft Position Sensor Test	NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information. 1. Ignition OFF 2. Disconnect camshaft position sensor connector. 3. Using a multimeter, measure resistance between both terminals of the camshaft position sensor.	Measurement between 2500 and 3500 ohms: GO TO 6 Measurement below 2500 ohms or above 3500 ohms: Faulty camshaft position sensor -- -1/1

6 Open in Crankshaft Position Sensor Input and Return Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information.</i> 1. Ignition OFF 2. Disconnect crank position sensor connector. 3. Disconnect ECU connector #1 (black A-K). 4. Using a multimeter, measure resistance between: • Terminal A of the crank position sensor connector on the engine harness AND terminal J2 in the harness end of ECU connector #1. • Terminal B of the crank position sensor connector on the engine harness AND terminal J1 in the harness end of ECU connector #1.	Both measurements 5 ohms or less: GO TO 7 Either measurement greater than 5 ohms: Open in crank position sensor input wire OR Open in crank position sensor return wire OR Terminals A and B in the crank position sensor connector on the engine harness possibly inverted. -- -1/1
7 Crankshaft Position Sensor Input Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information.</i> 1. Ignition OFF 2. Crankshaft position sensor connector and ECU connector #1 still disconnected. 3. Disconnect ECU connector #4 (white L-Y). 4. Using a multimeter measure resistance between terminal J1 in the harness end of ECU connector #1 and the following: • A good chassis ground. • All other terminals in both ECU connectors.	All measurements greater than 2k ohms: GO TO 8 Any measurement less than 2k ohms: Faulty crankshaft position sensor input wiring harness. -- -1/1
8 Crankshaft Position Sensor Return Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information.</i> 1. Ignition OFF 2. Crank position sensor connector and both ECU connectors still disconnected. 3. Using a multimeter measure resistance between terminal J2 in the harness end of ECU connector #1 and the following: • A good chassis ground. • All other terminals in both ECU connectors.	All measurements greater than 2k ohms: GO TO 9 Any measurement less than 2k ohms: Faulty crank position sensor return wiring harness. -- -1/1

9 Open in Camshaft Position Input and Return Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information.</i> 1. Ignition OFF 2. Disconnect camshaft position sensor connector. 3. Disconnect ECU connector #1 (black A-K). 4. Using a multimeter, measure resistance between: • Terminal A of the camshaft position sensor connector on the engine harness AND terminal K2 in the harness end of the ECU connector #1. • Terminal B of the camshaft position sensor connector on the engine harness AND terminal K1 in the harness end of the ECU connector #1.	Both measurements 5 ohms or less: GO TO 10 Either measurement greater than 5 ohms: Open in camshaft position sensor input wire OR Open in camshaft position sensor return wire OR Terminals A and B in the camshaft position sensor harness connector possibly inverted -- -1/1
10 Camshaft Position Sensor Input Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.07 CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting information.</i> 1. Ignition OFF 2. Camshaft Position Sensor connector and ECU connector #1 still disconnected. 3. Disconnect ECU connector #4 (white L-Y). 4. Using a multimeter measure resistance between terminal K1 in the harness end of the ECU connectors and the following: • A good chassis ground. • All other terminals in both ECU connectors.	All measurements greater than 2k ohms: GO TO 11 Any measurement less than 2k ohms: Faulty camshaft position sensor input wiring harness. -- -1/1

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338

**11 Camshaft Position
Sensor Return
Wiring Harness Test**

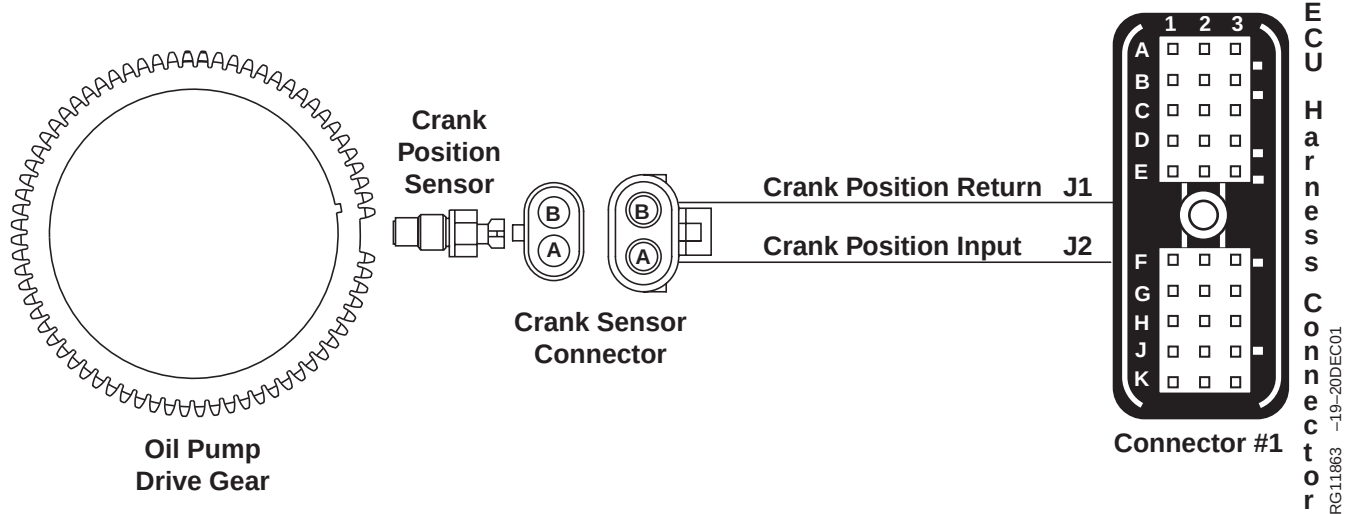
*NOTE: For wiring and theory of operation information, see DTC 000637.07
CRANKSHAFT POSITION/CAMSHAFT POSITION OUT OF SYNC supporting
information.*

1. Ignition OFF
2. Camshaft Position Sensor connector and both ECU connectors still disconnected.
3. Using a multimeter measure resistance between terminal K2 in the harness end of ECU connector #1 and the following:
 - A good chassis ground.
 - All other terminals in both ECU connectors.

**All measurements
greater than 2k ohms:**
Faulty camshaft position
sensor connector
OR
Faulty crankshaft position
sensor connector
OR
Faulty ECU connector
OR
Faulty ECU

**Any measurement less
than 2k ohms:**
Faulty camshaft position
sensor return wiring
harness

-- -1/1

000637.08 — Crankshaft Position Sensor Input Missing**Crankshaft Position Sensor**

- The crankshaft position sensor is an inductive type pickup sensor that detects notches on the oil pump drive gear at the rear of the engine. The ECU uses the crankshaft position input to determine engine speed and precision piston position in relation to TDC. The ECU monitors the camshaft position sensor input to determine piston position in relation to the firing order. Based on information from the crankshaft and camshaft position sensors, the ECU calculates when and how long to fire each of the ignition coils. For further crankshaft position sensor information, see MEASURING ENGINE SPEED in Group 100 earlier in this manual.

DTC 000637.08 will set if:

- The ECU does not detect the crankshaft position sensor input.

If DTC 000637.08 sets, the following will occur:

- If a camshaft position sensor trouble code accompanies DTC 000637.08, the engine will die and won't restart until at least the camshaft position sensor code is repaired.
- ECU will use only the camshaft position sensor input to determine piston position and engine speed.
- The moment that the trouble codes sets, the engine may hesitate or die, but it will restart if there are no camshaft position sensor codes.
- Prolonged cranking time may be required to start the engine.
- ECU will set a SOLID Malfunction light.

RG41221,0000264 -19-08MAY02-1/1

000637.08 — Crankshaft Position Sensor Input Missing

The ECU does not detect the crankshaft position sensor input.

RG41221,00002B4 -19-08MAY02-1/1

000637.08 Crankshaft Position Input Missing Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the crankshaft position sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000637.08 reoccurs: GO TO ❸ 000637.08 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

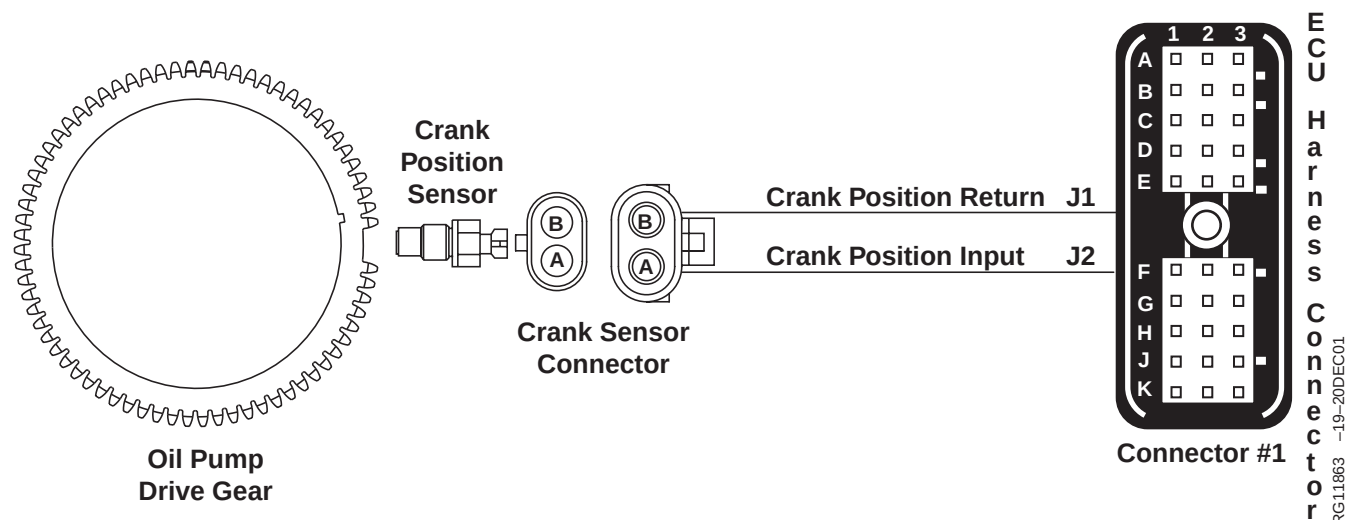
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115 342 ③ Crankshaft Position Sensor Observable Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> 1. Ignition OFF 2. Remove crankshaft position sensor. See REMOVE AND INSTALL CRANKSHAFT POSITION SENSOR (HFN04 ENGINE) in Group 45 of 8.1 L Compressed Natural Gas Engine Repair Manual (CTM87). 3. Inspect sensor tip for damage, such as cracks or debris.	No signs of damage: Reinstall sensor AND GO TO ④ Damage to sensor: Determine and repair the cause of damage to sensor. Replace sensor and retest. -- -1/1
④ Crankshaft Position Sensor Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> 1. Ignition OFF 2. Disconnect crankshaft position sensor connector. 3. Using a multimeter, measure resistance between both terminals of the crankshaft position sensor.	Measurement between 2500 and 3500 ohms: GO TO ⑤ Measurement below 2500 ohms or above 3500 ohms: Faulty crankshaft position sensor. -- -1/1
⑤ Open in Crankshaft Sensor Input and Return Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> 1. Ignition OFF 2. Crankshaft position sensor connector still disconnected. 3. Disconnect ECU connector #1 (black A-K). 4. Using a multimeter, measure resistance between: • Terminal A of the crankshaft position sensor connector on the engine harness and terminal J2 in the harness end of ECU connector #1. • Terminal B of the crankshaft position sensor connector on the engine harness and terminal J1 in the harness end of ECU connector #1	Both measurements 5 ohms or less: GO TO ⑥ Either measurement greater than 5 ohms: Open in crankshaft position sensor input wire OR Open in crankshaft position sensor return wire OR Terminals A and B in the crankshaft position sensor harness connector possibly inverted. -- -1/1

⑥ Crankshaft Sensor Input Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> 1. Ignition OFF 2. Crankshaft position sensor connector and ECU connector #1 still disconnected. 3. Disconnect ECU connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal J2 in the harness end of ECU connector #1 and the following: • A good chassis ground. • All other terminals in both ECU connectors.	All measurements greater than 2k ohms: GO TO ⑦ Any measurement less than 2k ohms: Faulty crankshaft position sensor input wiring harness.	115 ,343
⑦ Crankshaft Sensor Return Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION SENSOR INPUT MISSING supporting information.</i> 1. Ignition OFF 2. Crankshaft position sensor connector and ECU connectors still disconnected. 3. Using a multimeter measure resistance between terminal J1 in the harness end of ECU connector #1 and the following: • A good chassis ground. • All other terminals in both ECU connectors.	All measurements greater than 2k ohms: Faulty crankshaft position sensor connector OR Damaged crankshaft position sensor OR Faulty ECU connector OR Faulty ECU Any measurement less than 2k ohms: Faulty crankshaft position sensor return wiring harness.	

000637.10 — Crankshaft Position Sensor Input Pattern Error**Crankshaft Position Sensor**

- The crankshaft position sensor is an inductive type pickup sensor that detects notches on the oil pump drive gear at the rear of the engine. The ECU uses the crankshaft position input to determine engine speed and precision piston position in relation to TDC. The ECU monitors the camshaft position sensor input to determine piston position in relation to the firing order. Based on information from the crankshaft and camshaft position sensors, the ECU calculates when and how long to fire each of the ignition coils. For further crankshaft position sensor information, see MEASURING ENGINE SPEED in Group 100 earlier in this manual.

DTC 000637.10 will set if:

- The ECU detects an improper pattern on the crankshaft position sensor input.

If DTC 000637.10 sets, the following will occur:

- If a camshaft position sensor trouble code accompanies DTC 000637.10, the engine will die and won't restart until at least the camshaft position sensor code is repaired.
- ECU will use only the camshaft position sensor input to determine piston position and engine speed.
- The moment that the trouble codes sets, the engine may hesitate or die, but it will restart if there are no camshaft position sensor codes.
- Prolonged cranking time may be required to start the engine.
- ECU will set a SOLID Malfunction light.

RG41221,0000265 -19-08MAY02-1/1

000637.10 — Crankshaft Position Sensor Input Pattern Error

The ECU detects an improper pattern on the crankshaft position sensor input.

RG41221,00002B5 -19-08MAY02-1/1

000637.10 Crankshaft Position Sensor Input Pattern Error Diagnostic Procedure

-- -1/1

❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the crankshaft position sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000637.10 reoccurs: GO TO ❸ 000637.10 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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**③ Crankshaft Position
Sensor Test**

NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.

1. Ignition OFF
2. Disconnect crankshaft position sensor connector.
3. Using a multimeter, measure resistance between both terminals of the crankshaft position sensor.

Measurement between 2500 and 3500 ohms:
GO TO ④

Measurement below 2500 ohms or above 3500 ohms:
Faulty crankshaft position sensor.

-- -1/1

**④ Crankshaft Position
Wiring Open Test**

NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.

1. Ignition OFF
2. Crankshaft position sensor connector still disconnected.
3. Disconnect ECU connector #1 (black A-K).
4. Using a multimeter, measure resistance between:
 - Terminal A of the crankshaft position sensor connector on the engine harness and terminal J2 in the harness end of the ECU connector #1.
 - Terminal B of the crankshaft position sensor connector on the engine harness and terminal J1 in the harness end of the ECU connector #1.

Both measurements 5 ohms or less:
GO TO ⑤

Either measurement greater than 5 ohms:
Open in crankshaft position sensor input wire
OR
Open in crankshaft position sensor return wire
OR
Terminals A and B in the crankshaft position sensor harness connector possibly inverted.

-- -1/1

**⑤ Crankshaft Position
Sensor Return Wiring
Harness Test**

NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.

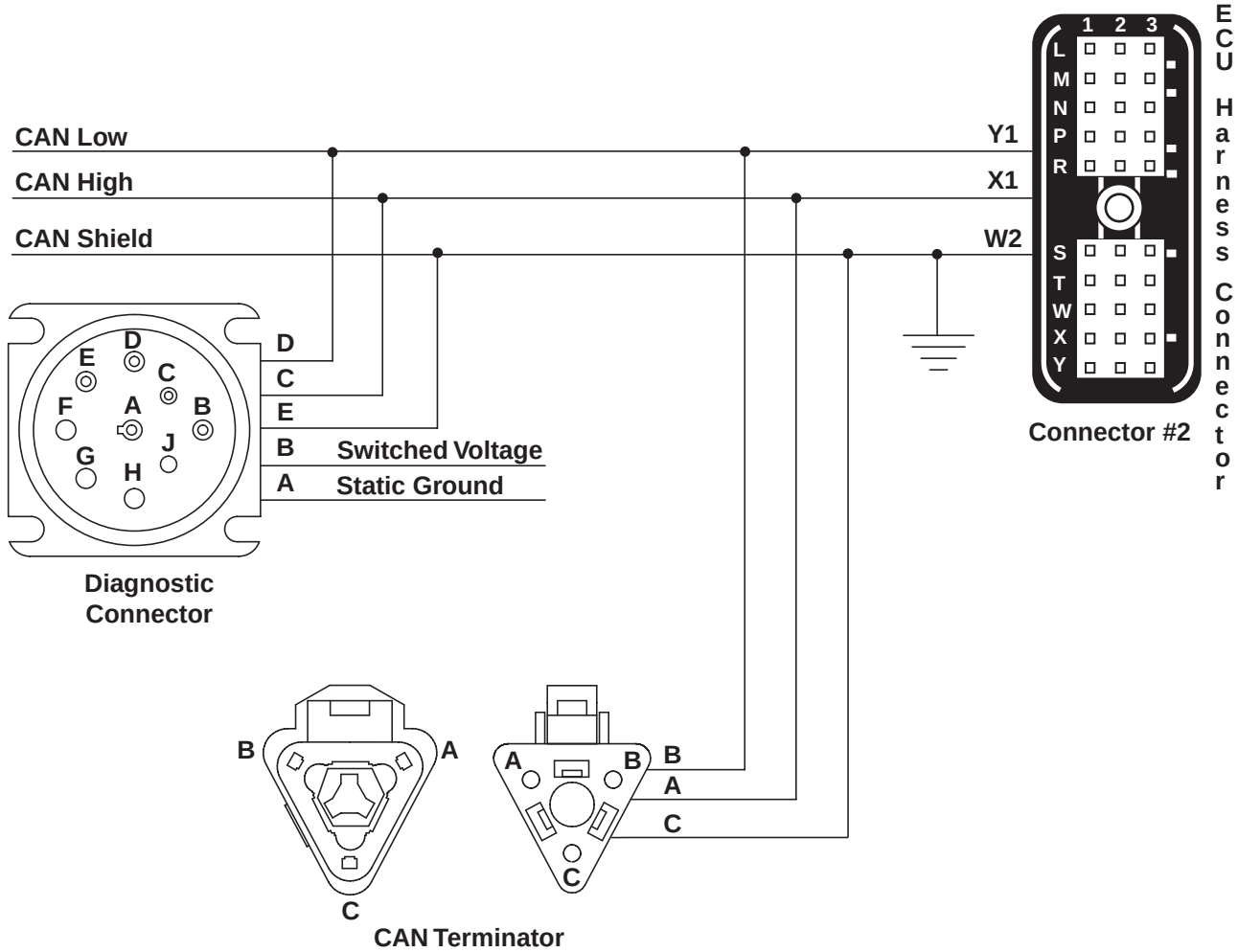
1. Ignition OFF
2. Crankshaft position sensor connector and ECU connector #1 still disconnected.
3. Disconnect ECU connector #4 (white L-Y).
4. Using a multimeter, measure resistance between terminal J2 in the harness end of ECU connector #1 and the following:
 - A good chassis ground.
 - All other terminals in both ECU connectors.

All measurements greater than 2k ohms:
GO TO ⑥

Any measurement less than 2k ohms:
Faulty crankshaft position sensor input wiring harness.

-- -1/1

⑥ Crankshaft Position Sensor Input Wiring Harness Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> 1. Ignition OFF 2. Crankshaft position sensor connector and ECU connectors still disconnected. 3. Using a multimeter, measure resistance between terminal J1 in the harness end of ECU connector #1 and the following: • A good chassis ground. • All other terminals in both ECU connectors.	All measurements greater than 2k ohms: GO TO ⑦ Any measurement less than 2k ohms: Faulty crankshaft position sensor return wiring harness. -- -1/1	115,347
⑦ Crankshaft Sensor Observable Test	<i>NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION SENSOR INPUT PATTERN ERROR supporting information.</i> 1. Remove crankshaft sensor. 2. Inspect sensor for cracks, corrosion, or any foreign material on the end of the sensor. 3. Using a mirror and a flashlight, inspect the teeth on the oil pump drive gear.	All components OK: Faulty crankshaft sensor connector OR Faulty ECU connector OR Faulty ECU Fault found in a component: Repair or replace component as needed. -- -1/1	

000639.13 — CAN Bus Error

RG11865 -19-22JUL02

Controller Area Network (CAN)

- CAN is a network in which the individual controllers on a machine communicate to with each other. The number of controllers communicating on CAN depends on the application. On some applications, the ECU is the only controller on CAN; on other applications, there are many controllers on this network.

DTC 000639.13 will set if:

- The ECU detects a problem communicating on CAN.

If DTC 000639.13 sets, the following will occur:

- Depending on application, engine operation may or may not be effected.
- ECU will set a SOLID Warning light.

RG41221,0000266 -19-08MAY02-1/1

000639.13 — CAN Bus Error

The ECU detects a problem communicating on CAN.

RG41221,00002B6 -19-19SEP01-1/1

000639.13 CAN Bus Error Diagnostic Procedure

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000639.13 CAN BUS ERROR supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, diagnostic connector, and the CAN terminator looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

-- -1/1

❷ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000639.13 CAN BUS ERROR supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

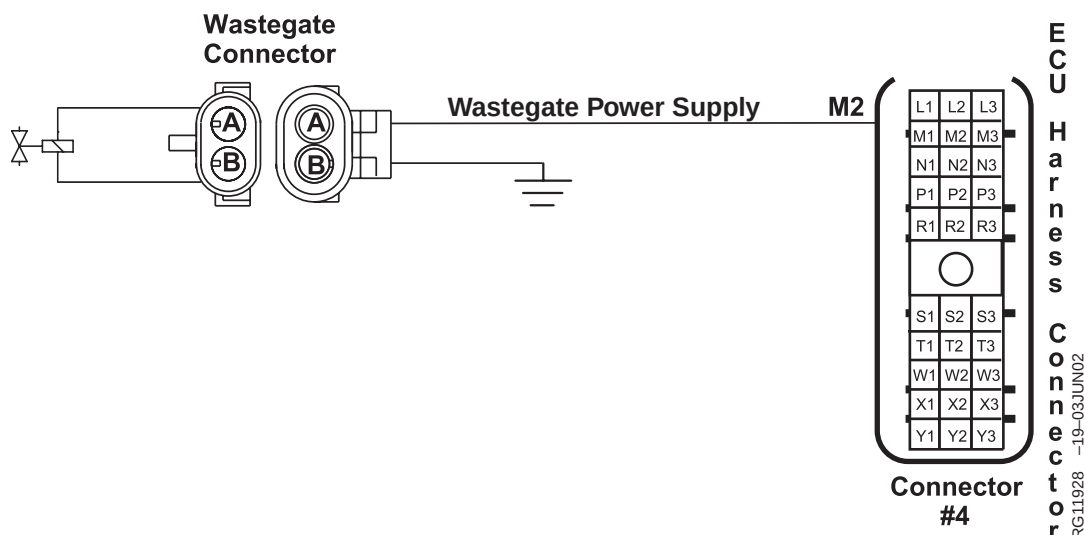
000639.13 reoccurs:
GO TO ❸

000639.13 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 350	③ Application Related DTCs Test	<i>NOTE: For wiring and theory of operation information, see DTC 000639.13 CAN BUS ERROR supporting information.</i> If application has other machine controllers communicating on the CAN bus, check those controllers for CAN related DTCs.	No CAN related DTCs found on other controllers: GO TO ④ Found CAN related DTCs on other controllers: Refer to diagnostic procedures for controller. Repair cause of throttle related DTC and retest. -- -1/1
	④ Resistance Between CAN High and Low Test	<i>NOTE: For wiring and theory of operation information, see DTC 000639.13 CAN BUS ERROR supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #2 (black L-Y). 3. Using a multimeter, measure resistance between terminals X1 and Y1 in the harness end of ECU connector #2.	Between 55-65 ohms: Faulty ECU connector OR Faulty ECU Less than 55 ohms or greater than 65 ohms: Open or short in CAN wiring harness. -- -1/1

000646.02 — Wastegate Control Failure**Wastegate Control Solenoid**

- The wastegate control solenoid is used to control turbo boost pressure by opening and closing the wastegate actuator. The ECU reads MAP, engine speed, and foot pedal position with respect to one another to help control the wastegate solenoid. If the MAP is too high with respect to the commanded value sent by the foot pedal for a certain engine speed, the ECU will then cut electrical power to the wastegate control solenoid which will reduce boost. For further wastegate control solenoid information, see WASTEGATE OPERATION in Group 100 earlier in this manual.

DTC 000646.02 will set if:

- ECU detects an upstream throttle pressure 2.2 psi (15 kPa) (0.15 bar) higher or lower than the commanded value.

If DTC 000646.02 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the upstream throttle pressure returns to a normal operating range, power will be increased 30% per minute until either full power is reached.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000365 -19-08MAY02-1/1

000646.02 — Wastegate Control Failure

The ECU detects an upstream throttle pressure higher or lower than the commanded value.

RG41221.0000366 -19-08MAY02-1/1

000646.02 Wastegate Control Failure Diagnostic Procedure

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000646.02 WASTEGATE CONTROL FAILURE supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the wastegate control solenoid connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

-- -1/1

❷ Wastegate Plumbing Test

NOTE: For wiring and theory of operation information, see DTC 000646.02 WASTEGATE CONTROL FAILURE supporting information.

1. Inspect the air supply line between the wastegate control solenoid and the air inlet tube for damage or restrictions.
2. Inspect the air supply line to the turbo from the wastegate control solenoid for damage or restrictions.

Both lines OK:
GO TO ❸

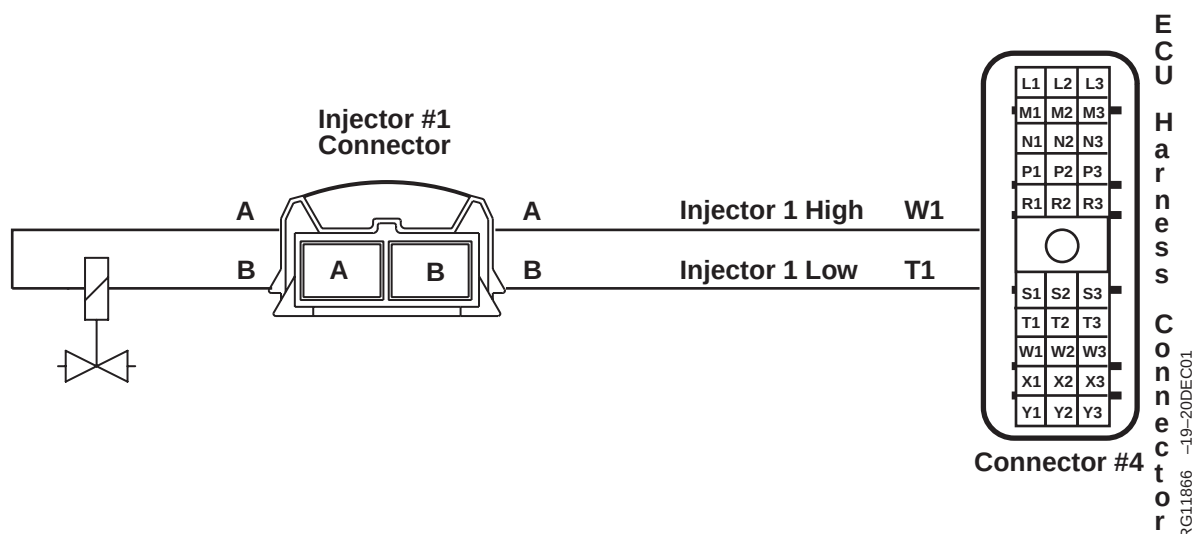
Damage or restriction found:
Repair and retest.

-- -1/1

115 354 ③ Wastegate Control Solenoid Resistance Test	<i>NOTE: For wiring and theory of operation information, see DTC 000646.02 WASTEGATE CONTROL FAILURE supporting information.</i> 1. Ignition OFF 2. Disconnect the wastegate control solenoid connector. 3. Using a multimeter, measure resistance between both terminals in the wastegate control solenoid connector on the wastegate.	Between 15-21 ohms: GO TO ④ Below 15 or above 21 ohms: Faulty wastegate control solenoid. -- -1/1
④ Wastegate Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000646.02 WASTEGATE CONTROL FAILURE supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #4 (white L-Y) and the wastegate connector on the engine harness. 3. Using a multimeter, measure resistance between the following terminals: • Terminal A in the wastegate connector and terminal M2 in the ECU connector. • Terminal B in the wastegate connector and a good chassis ground.	All measurements 5 ohms or less: GO TO ⑤ Any measurement(s) greater than 5 ohms: Short or open in wire that had a resistance greater than 5 ohms. -- -1/1
⑤ Wastegate Control Solenoid Driver Test	<i>NOTE: For wiring and theory of operation information, see DTC 000646.02 WASTEGATE CONTROL FAILURE supporting information.</i> 1. Ignition OFF 2. Disconnect the Wastegate Control Solenoid connector. 3. Connect the Bosch PFI Noid-Light JT07284 to the Wastegate Control Solenoid connector on the engine harness. 4. Ignition ON, engine running 5. Verify the noid-light is ON.	Light ON: GO TO ⑥ Light OFF: Faulty ECU connection OR Faulty ECU -- -1/1
⑥ UTP Desired vs. Actual Test	<i>NOTE: For wiring and theory of operation information, see DTC 000646.02 WASTEGATE CONTROL FAILURE supporting information.</i> 1. Ignition ON, engine running under heavy load. 2. Using the ECU diagnostic software, read Upstream Throttle Pressure - Desired and Upstream Throttle Pressure - Actual.	UTP - Desired 3 psi more than Actual: GO TO ⑦ UTP - Actual 3 psi more than Desired: Faulty wastegate on turbo. Replace and retest. -- -1/1

7 Boost Pressure Test	<i>NOTE: For wiring and theory of operation information, see DTC 000646.02 WASTEGATE CONTROL FAILURE supporting information.</i> 1. Ignition OFF 2. Disconnect wastegate supply line from turbocharger. 3. Ignition ON, engine running under heavy load. 4. Using the ECU diagnostic software, read Manifold Absolute Pressure - Desired and Manifold Absolute Pressure - Actual.	Engine makes boost: Severe exhaust leak in system. Repair and retest. OR Faulty wastegate vent hose. OR Faulty wastegate vent Engine can't make boost: Inspect the turbocharger. See TURBOCHARGER SEVEN-STEP INSPECTION in Group 030 in 8.1L Compressed Natural Gas Engine Repair Manual (CTM 87).	115 ,355

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000651.05 — Injector #1 Circuit Open**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000651.05 will set if:

- The ECU detects an open in the Injector #1 circuit.

If DTC 000651.05 sets, the following will occur:

- Injector #1 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000267 -19-08MAY02-1/1

000651.05 — Injector #1 Circuit Open

The ECU detects an open in the Injector #1 circuit.

RG41221,000002F -19-16SEP02-1/1

000651.05 Injector #1 Circuit Open Diagnostic Procedure

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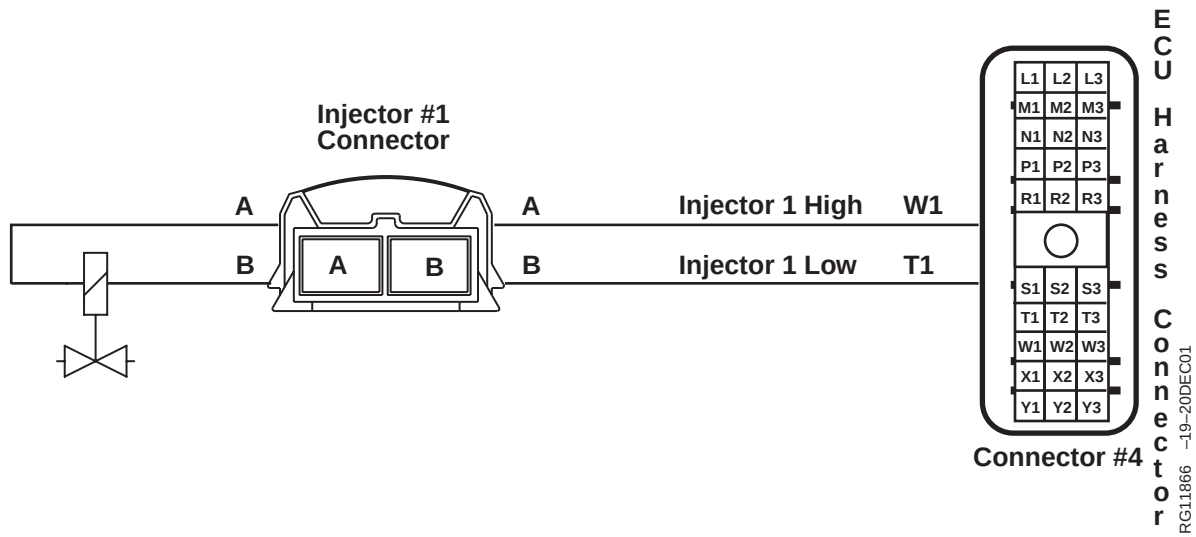
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000651.05 INJECTOR #1 CIRCUIT OPEN supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #1 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000651.05 INJECTOR #1 CIRCUIT OPEN supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000651.05 reoccurs: GO TO ❸ 000651.05 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 ,358	③ Injector #1 Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000651.05 INJECTOR #1 CIRCUIT OPEN supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #1 connector. 3. Disconnect the ECU harness connector #4 (white L-Y). 4. Using a multimeter, measure resistance between: • Terminal A in the Injector #1 connector on the engine harness and terminal W1 in the ECU harness connector #4. • Terminal B in the Injector #1 connector on the engine harness and terminal T1 in the ECU harness connector #4.	Both measurements 5 ohms or less: GO TO ④ Measurement between A to W1 is greater than 5 ohms: Open in Injector #1 High circuit Measurement between B to T1 is greater than 5 ohms: Open in Injector #1 Low circuit
	④ Injector #1 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000651.05 INJECTOR #1 CIRCUIT OPEN supporting information.</i> 1. Injector #1 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #1 • Both terminals on the known good injector. 4. Compare the measurements between the two injectors. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #1

000651.06 — Injector #1 Circuit Shorted**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000651.06 will set if:

- The ECU detects a short in the Injector #1 circuit.

If DTC 000651.06 sets, the following will occur:

- Injector #1 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000268 -19-19SEP01-1/1

000651.06 — Injector #1 Circuit Shorted

The ECU detects a short in the Injector #1 circuit.

RG41221_0000030 -19-16SEP02-1/1

000651.06 Injector #1 Circuit Shorted Diagnostic Procedure

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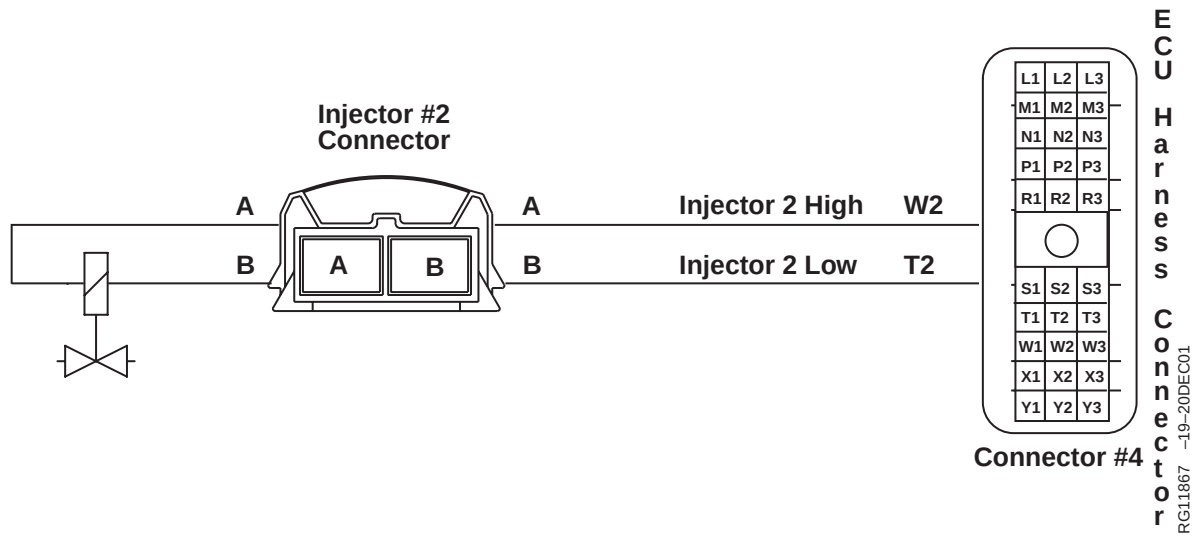
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000651.06 INJECTOR #1 CIRCUIT SHORTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #1 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000651.06 INJECTOR #1 CIRCUIT SHORTED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000651.06 reoccurs: GO TO ❸ 000651.06 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 362	③ Injector #1 High Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000651.06 INJECTOR #1 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #1 harness connector. 3. Disconnect the ECU connector #1 (black A-K) and connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal A in the Injector #1 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ④ Any measurement less than 20k ohms: Injector #1 High circuit shorted to wire that caused low resistance -- -1/1
	④ Injector #1 Low Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000651.06 INJECTOR #1 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Injector #1 harness connector and both ECU connectors still disconnected. 3. Using a multimeter, measure resistance between terminal B in the Injector #1 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ⑤ Any measurement less than 20k ohms: Injector #1 Low circuit shorted to wire that caused low resistance -- -1/1
	⑤ Injector #1 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000651.06 INJECTOR #1 CIRCUIT SHORTED supporting information.</i> 1. Injector #1 harness connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #1 • Both terminals on the known good injector. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #1 -- -1/1

000652.05 — Injector #2 Circuit Open**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000652.05 will set if:

- The ECU detects an open in the Injector #2 circuit.

If DTC 000652.05 sets, the following will occur:

- Injector #2 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000038 -19-16SEP02-1/1

000652.05 — Injector #2 Circuit Open

The ECU detects an open in the Injector #2 circuit.

RG41221,0000032 -19-16SEP02-1/1

000652.05 Injector #2 Circuit Open Diagnostic Procedure

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000652.05 INJECTOR #2 CIRCUIT OPEN supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #2 connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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❷ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000652.05 INJECTOR #2 CIRCUIT OPEN supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

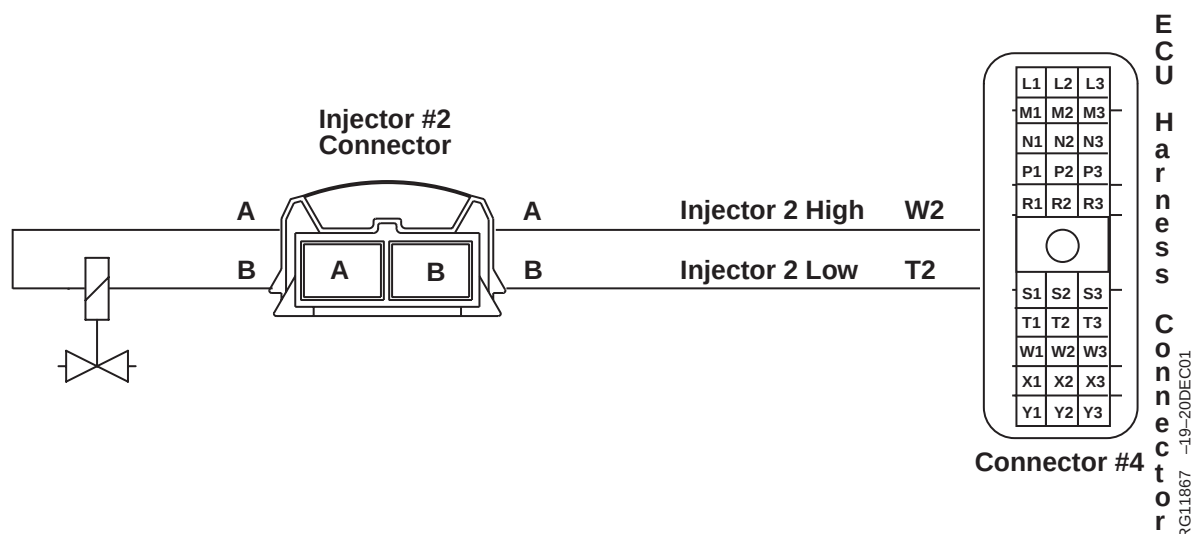
000652.05 reoccurs:
GO TO ❸

000652.05 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 366	③ Injector #2 Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000652.05 INJECTOR #2 CIRCUIT OPEN supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #2 harness connector. 3. Disconnect the ECU connector #4 (white L-Y). 4. Using a multimeter, measure resistance between: • Terminal A in the Injector #2 connector on the engine harness and terminal W2 in the ECU harness connector #4. • Terminal B in the Injector #2 connector on the engine harness and terminal T2 in the ECU harness connector #4.	Both measurements 5 ohms or less: GO TO ④ Measurement between A to W2 is greater than 5 ohms: Open in Injector #2 High circuit Measurement between B to T2 is greater than 5 ohms: Open in Injector #2 Low circuit
	④ Injector #2 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000652.05 INJECTOR #2 CIRCUIT OPEN supporting information.</i> 1. Injector #2 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #2 • Both terminals on the known good injector. 4. Compare the measurements between the two injectors. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #2

000652.06 — Injector #2 Circuit Shorted**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000652.06 will set if:

- The ECU detects a short in the Injector #2 circuit.

If DTC 000652.06 sets, the following will occur:

- Injector #2 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000033 -19-16SEP02-1/1

000652.06 — Injector #2 Circuit Shorted

The ECU detects a short in the Injector #2 circuit.

RG41221,0000034 -19-16SEP02-1/1

000652.06 Injector #2 Circuit Shorted Diagnostic Procedure

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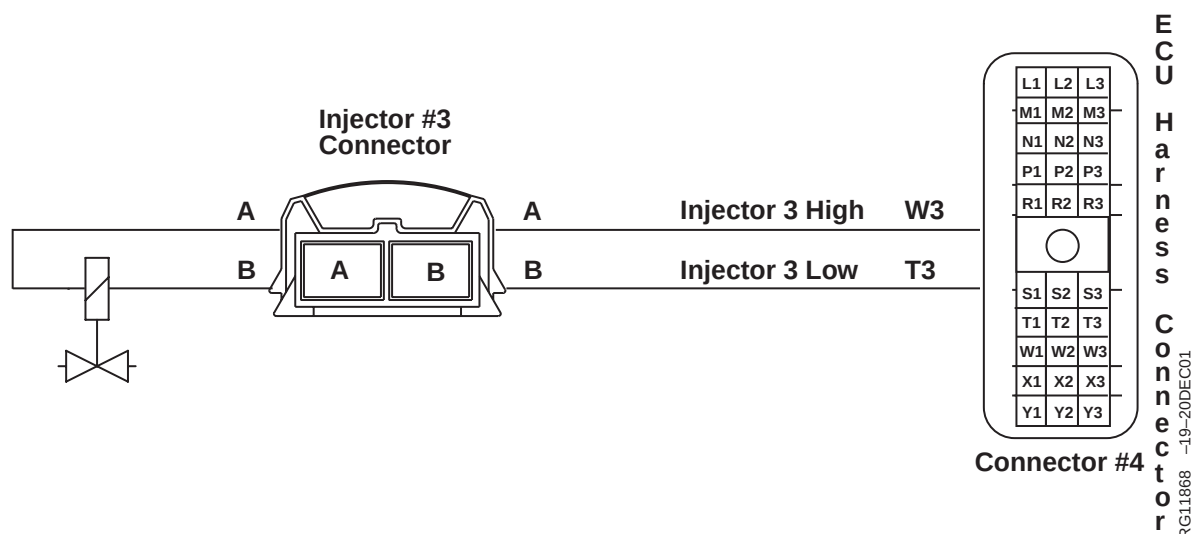
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000652.06 INJECTOR #2 CIRCUIT SHORTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #2 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000652.06 INJECTOR #2 CIRCUIT SHORTED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000652.06 reoccurs: GO TO ❸ 000652.06 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 370	③ Injector #2 High Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000652.06 INJECTOR #2 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #2 harness connector. 3. Disconnect ECU connector #1 (black A-K) and connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal A in the Injector #2 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ④ Any measurement less than 20k ohms: Injector #2 High circuit shorted to wire that caused low resistance -- -1/1
	④ Injector #2 Low Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000652.06 INJECTOR #2 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Injector #2 harness connector and both ECU connectors still disconnected. 3. Using a multimeter, measure resistance between terminal B in the Injector #2 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ⑤ Any measurement less than 20k ohms: Injector #2 Low circuit shorted to wire that caused low resistance -- -1/1
	⑤ Injector #2 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000652.06 INJECTOR #2 CIRCUIT SHORTED supporting information.</i> 1. Injector #2 harness connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #2 • Both terminals on the known good injector. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #2 -- -1/1

000653.05 — Injector #3 Circuit Open**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000653.05 will set if:

- The ECU detects an open in the Injector #3 circuit.

If DTC 000653.05 sets, the following will occur:

- Injector #3 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000035 -19-16SEP02-1/1

000653.05 — Injector #3 Circuit Open

The ECU detects an open in the Injector #3 circuit.

RG41221_0000036 -19-16SEP02-1/1

000653.05 Injector #3 Circuit Open Diagnostic Procedure

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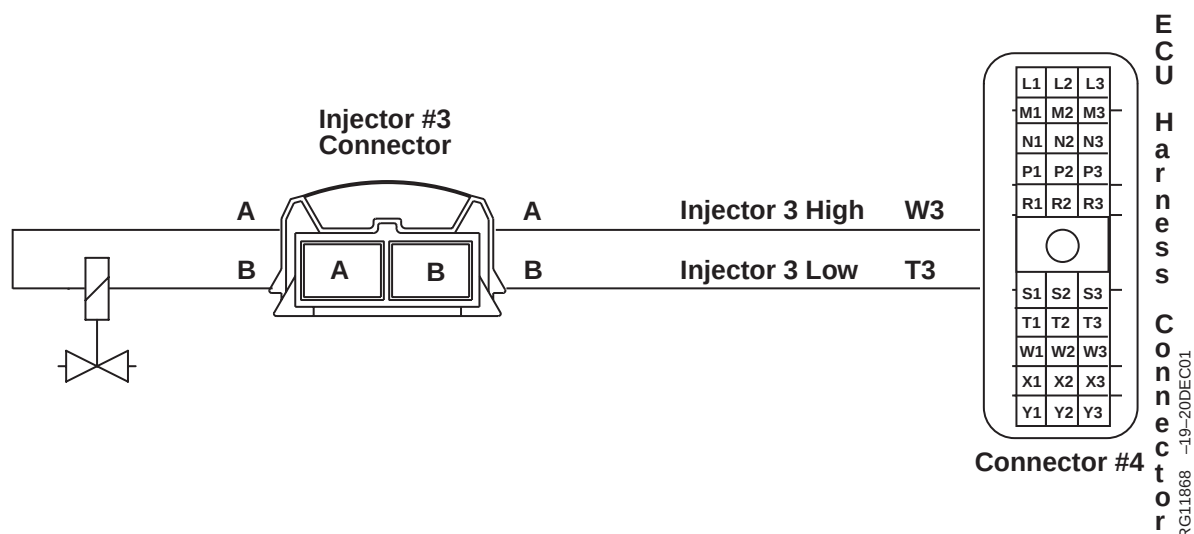
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000653.05 INJECTOR #3 CIRCUIT OPEN supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #3 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000653.05 INJECTOR #3 CIRCUIT OPEN supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000653.05 reoccurs: GO TO ❸ 000653.05 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 374	③ Injector #3 Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000653.05 INJECTOR #3 CIRCUIT OPEN supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #3 harness connector. 3. Disconnect ECU connector #4 (white L-Y). 4. Using a multimeter, measure resistance between: • Terminal A in the Injector #3 connector on the engine harness and terminal W3 in the ECU harness connector #4. • Terminal B in the Injector #3 connector on the engine harness and terminal T3 in the ECU harness connector #4.	Both measurements 5 ohms or less: GO TO ④ Measurement between A to W3 is greater than 5 ohms: Open in Injector #3 High circuit Measurement between B to T3 is greater than 5 ohms: Open in Injector #3 Low circuit -- -1/1
	④ Injector #3 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000653.05 INJECTOR #3 CIRCUIT OPEN supporting information.</i> 1. Injector #3 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #3 • Both terminals on the known good injector. 4. Compare the measurements between the two injectors. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #3 -- -1/1

000653.06 — Injector #3 Circuit Shorted**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000653.06 will set if:

- The ECU detects a short in the Injector #3 circuit.

If DTC 000653.06 sets, the following will occur:

- Injector #3 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000043 -19-16SEP02-1/1

000653.06 — Injector #3 Circuit Shorted

The ECU detects a short in the Injector #3 circuit.

RG41221,0000037 -19-16SEP02-1/1

000653.06 Injector #3 Circuit Shorted Diagnostic Procedure

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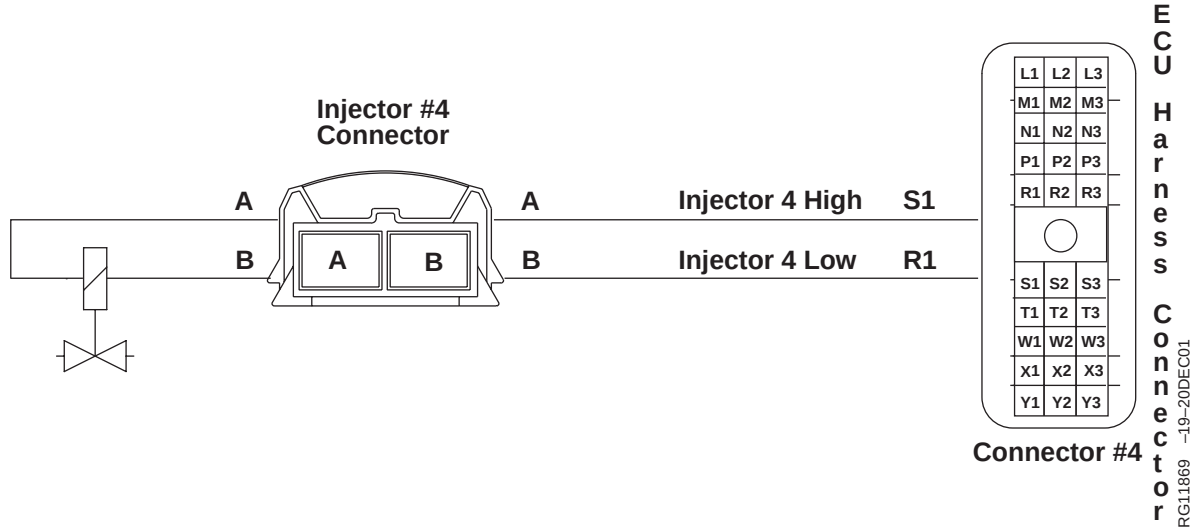
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000653.06 INJECTOR #3 CIRCUIT SHORTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #3 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000653.06 INJECTOR #3 CIRCUIT SHORTED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000653.06 reoccurs: GO TO ❸ 000653.06 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 378	③ Injector #3 High Wiring Test <i>NOTE: For wiring and theory of operation information, see DTC 000653.06 INJECTOR #3 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #3 harness connector. 3. Disconnect the ECU connector #1 (black A-K) and connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal A in the Injector #3 connector on the engine harness and all other terminals in both ECU harness connector #1 and connector #4.	All measurements above 20k ohms: GO TO ④ Any measurement less than 20k ohms: Injector #3 High circuit shorted to wire that caused low resistance -- -1/1
	④ Injector #3 Low Wiring Test <i>NOTE: For wiring and theory of operation information, see DTC 000653.06 INJECTOR #3 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Injector #3 harness connector and both ECU connectors still disconnected. 3. Using a multimeter, measure resistance between terminal B in the Injector #3 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ⑤ Any measurement less than 20k ohms: Injector #3 Low circuit shorted to wire that caused low resistance -- -1/1
	⑤ Injector #3 Test <i>NOTE: For wiring and theory of operation information, see DTC 000653.06 INJECTOR #3 CIRCUIT SHORTED supporting information.</i> 1. Injector #3 harness connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #3 • Both terminals on the known good injector. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #3 -- -1/1

000654.05 — Injector #4 Circuit Open**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000654.05 will set if:

- The ECU detects an open in the Injector #4 circuit.

If DTC 000654.05 sets, the following will occur:

- Injector #4 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000039 -19-16SEP02-1/1

000654.05 — Injector #4 Circuit Open

The ECU detects an open in the Injector #4 circuit.

RG41221,000003E -19-16SEP02-1/1

000654.05 Injector #4 Circuit Open Diagnostic Procedure

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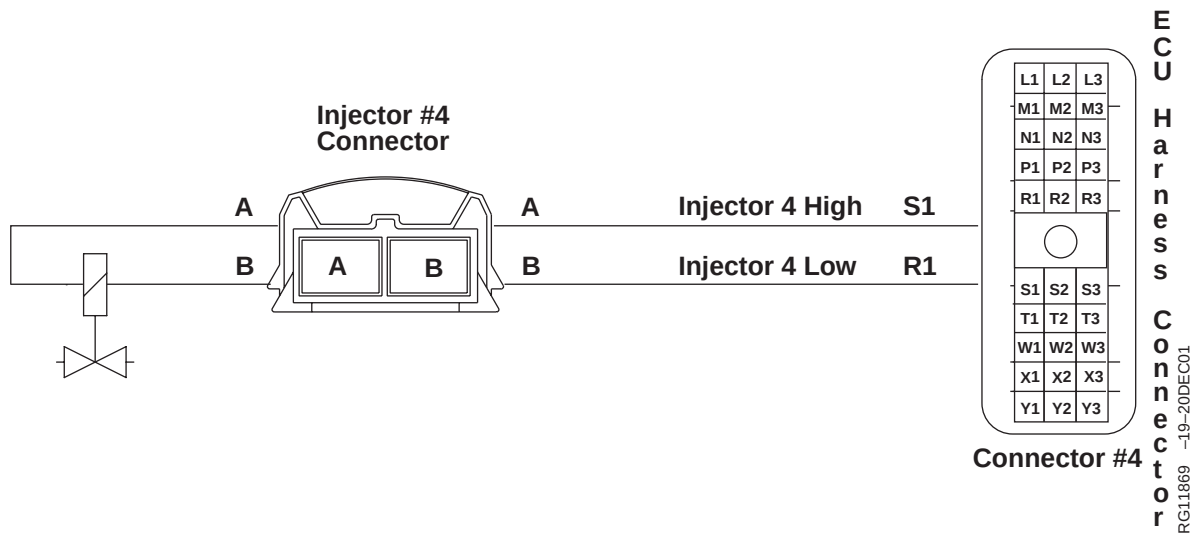
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000654.05 INJECTOR #4 CIRCUIT OPEN supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #4 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000654.05 INJECTOR #4 CIRCUIT OPEN supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000654.05 reoccurs: GO TO ❸ 000654.05 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 ,382	③ Injector #4 Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000654.05 INJECTOR #4 CIRCUIT OPEN supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #4 harness connector. 3. Disconnect the ECU connector #4 (white L-Y). 4. Using a multimeter, measure resistance between: • Terminal A in the Injector #4 connector on the engine harness and terminal S1 in the ECU harness connector #4. • Terminal B in the Injector #4 connector on the engine harness and terminal R1 in the ECU harness connector #4.	Both measurements 5 ohms or less: GO TO ④ Measurement between A to S1 is greater than 5 ohms: Open in Injector #4 High circuit Measurement between B to R1 is greater than 5 ohms: Open in Injector #4 Low circuit	-- -1/1
	④ Injector #4 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000654.05 INJECTOR #4 CIRCUIT OPEN supporting information.</i> 1. Injector #4 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #4 • Both terminals on the known good injector. 4. Compare the measurements between the two injectors. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #4	-- -1/1

000654.06 — Injector #4 Circuit Shorted**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000654.06 will set if:

- The ECU detects a short in the Injector #4 circuit.

If DTC 000654.06 sets, the following will occur:

- Injector #4 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000044 -19-16SEP02-1/1

000654.06 — Injector #4 Circuit Shorted

The ECU detects a short in the Injector #4 circuit.

RG41221,000002A -19-16SEP02-1/1

000654.06 Injector #4 Circuit Shorted Diagnostic Procedure

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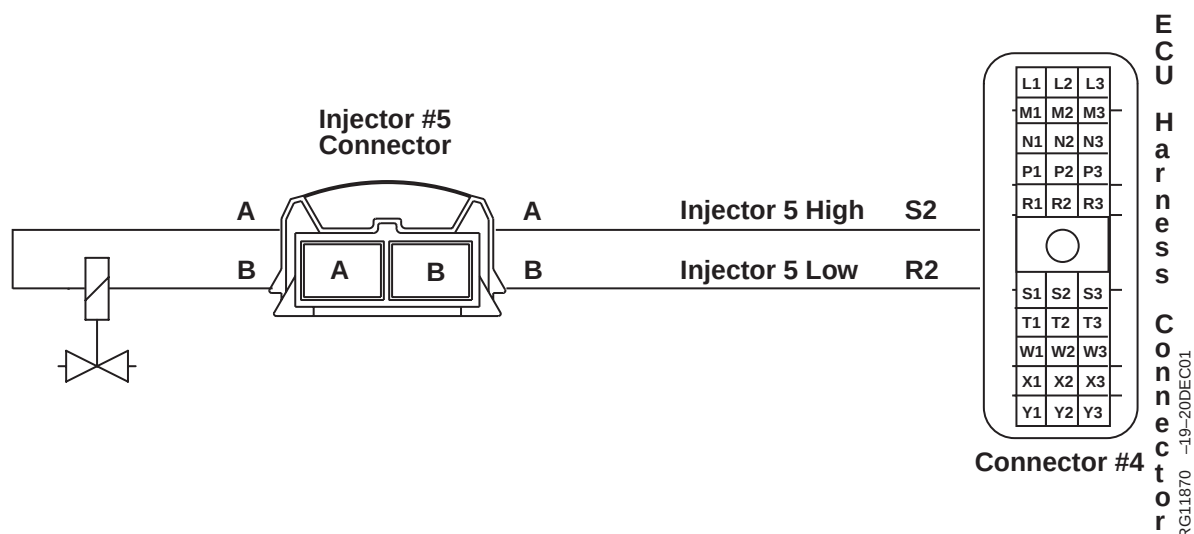
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000654.06 INJECTOR #4 CIRCUIT SHORTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #4 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000654.06 INJECTOR #4 CIRCUIT SHORTED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000654.06 reoccurs: GO TO ❸ 000654.06 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 386 ③ Injector #4 High Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000654.06 INJECTOR #4 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #4 harness connector. 3. Disconnect the ECU connector #1 (black A-K) and connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal A in the Injector #4 connector on the engine harness and all other terminals in both ECU harness connector #1 and connector #4.	All measurements above 20k ohms: GO TO ④ Any measurement less than 20k ohms: Injector #4 High circuit shorted to wire that caused low resistance -- -1/1
④ Injector #4 Low Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000654.06 INJECTOR #4 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Injector #4 harness connector and both ECU connectors still disconnected. 3. Using a multimeter, measure resistance between terminal B in the Injector #4 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ⑤ Any measurement less than 20k ohms: Injector #4 Low circuit shorted to wire that caused low resistance -- -1/1
⑤ Injector #4 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000654.06 INJECTOR #4 CIRCUIT SHORTED supporting information.</i> 1. Injector #4 harness connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #4 • Both terminals on the known good injector. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #4 -- -1/1

000655.05 — Injector #5 Circuit Open**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000655.05 will set if:**If DTC 000655.05 sets, the following will occur:**

- Injector #5 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,000003A -19-16SEP02-1/1

000655.05 — Injector #5 Circuit Open

The ECU detects an open in the Injector #5 circuit.

RG41221,000003F -19-16SEP02-1/1

000655.05 Injector #5 Circuit Open Diagnostic Procedure

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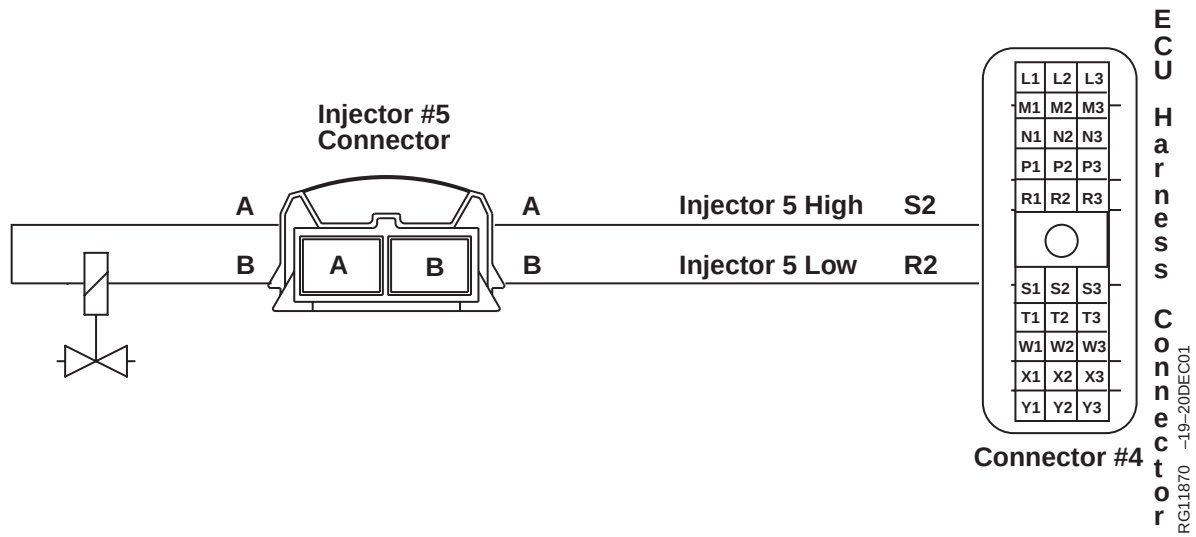
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000655.05 INJECTOR #5 CIRCUIT OPEN supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #5 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000655.05 INJECTOR #5 CIRCUIT OPEN supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000655.05 reoccurs: GO TO ❸ 000655.05 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 390	③ Injector #5 Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000655.05 INJECTOR #5 CIRCUIT OPEN supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #5 harness connector. 3. Disconnect ECU connector #4 (white L-Y). 4. Using a multimeter, measure resistance between: • Terminal A in the Injector #5 connector on the engine harness and terminal S2 in the ECU harness connector #4. • Terminal B in the Injector #5 connector on the engine harness and terminal R2 in the ECU harness connector #4.	Both measurements 5 ohms or less: GO TO ④ Measurement between A to S2 is greater than 5 ohms: Open in Injector #5 High circuit Measurement between B to R2 is greater than 5 ohms: Open in Injector #5 Low circuit	-- -1/1
	④ Injector #5 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000655.05 INJECTOR #5 CIRCUIT OPEN supporting information.</i> 1. Injector #5 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #5 • Both terminals on the known good injector. 4. Compare the measurements between the two injectors. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #5	-- -1/1

000655.06 — Injector #5 Circuit Shorted**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000655.06 will set if:

- The ECU detects a short in the Injector #5 circuit.

If DTC 000655.06 sets, the following will occur:

- Injector #5 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000045 -19-16SEP02-1/1

000655.06 — Injector #5 Circuit Shorted

The ECU detects a short in the Injector #5 circuit.

RG41221,000002B -19-16SEP02-1/1

000655.06 Injector #5 Circuit Shorted Diagnostic Procedure

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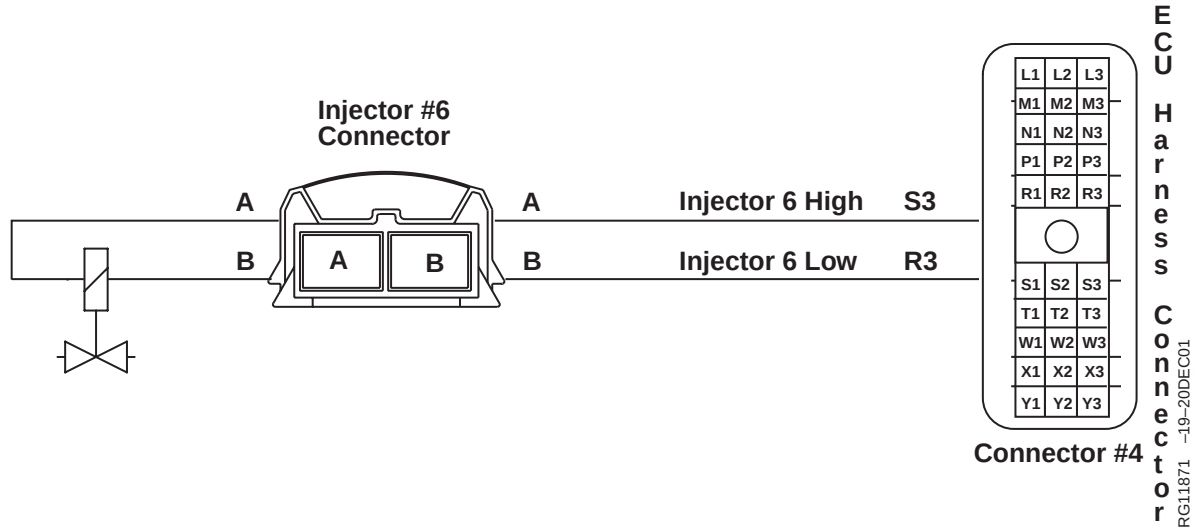
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000655.06 INJECTOR #5 CIRCUIT SHORTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #5 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000655.06 reoccurs: GO TO ❸ 000655.06 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 394 ③ Injector #5 High Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000655.06 INJECTOR #5 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #5 harness connector. 3. Disconnect ECU connector #1 (black A-K) and connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal A in the Injector #5 connector on the engine harness and all other terminals in both ECU harness connector #1 and connector #4.	All measurements above 20k ohms: GO TO ④ Any measurement less than 20k ohms: Injector #5 High circuit shorted to wire that caused low resistance -- -1/1
④ Injector #5 Low Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000655.06 INJECTOR #5 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Injector #5 harness connector and both ECU connectors still disconnected. 3. Using a multimeter, measure resistance between terminal B in the Injector #5 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ⑤ Any measurement less than 20k ohms: Injector #5 Low circuit shorted to wire that caused low resistance -- -1/1
⑤ Injector #5 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000655.06 INJECTOR #5 CIRCUIT SHORTED supporting information.</i> 1. Injector #5 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #5 • Both terminals on the known good injector. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #5 -- -1/1

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396
000656.05 — Injector #6 Circuit Open
**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000656.05 will set if:

- The ECU detects an open in the Injector #6 circuit.

If DTC 000656.05 sets, the following will occur:

- Injector #6 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,000003B -19-16SEP02-1/1

000656.05 — Injector #6 Circuit Open

The ECU detects an open in the Injector #6 circuit.

RG41221,0000040 -19-16SEP02-1/1

000656.05 Injector #6 Circuit Open Diagnostic Procedure

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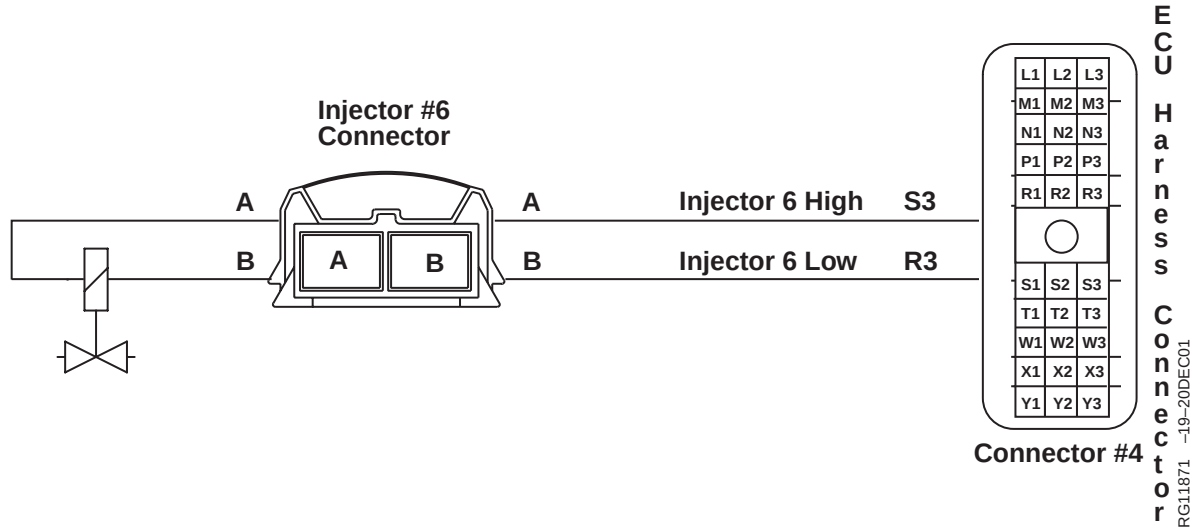
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000656.05 INJECTOR #6 CIRCUIT OPEN supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #6 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000656.05 INJECTOR #6 CIRCUIT OPEN supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000656.05 reoccurs: GO TO ❸ 000656.05 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 398	③ Injector #6 Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000656.05 INJECTOR #6 CIRCUIT OPEN supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #6 harness connector. 3. Disconnect ECU connector #4 (white L-Y). 4. Using a multimeter, measure resistance between: • Terminal A in the Injector #6 connector on the engine harness and terminal S3 in the ECU harness connector #4. • Terminal B in the Injector #6 connector on the engine harness and terminal R3 in the ECU harness connector #4.	Both measurements 5 ohms or less: GO TO ④ Measurement between A to S3 is greater than 5 ohms: Open in Injector #6 High circuit Measurement between B to R3 is greater than 5 ohms: Open in Injector #6 Low circuit	-- -1/1
	④ Injector #6 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000656.05 INJECTOR #6 CIRCUIT OPEN supporting information.</i> 1. Injector #6 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #6 • Both terminals on the known good injector. 4. Compare the measurements between the two injectors. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #6	-- -1/1

000656.06 — Injector #6 Circuit Shorted**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000656.06 will set if:

- The ECU detects a short in the Injector #6 circuit.

If DTC 000656.06 sets, the following will occur:

- Injector #6 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000046 -19-16SEP02-1/1

000656.06 — Injector #6 Circuit Shorted

The ECU detects a short in the Injector #6 circuit.

RG41221.000002C -19-16SEP02-1/1

000656.06 Injector #6 Circuit Shorted Diagnostic Procedure

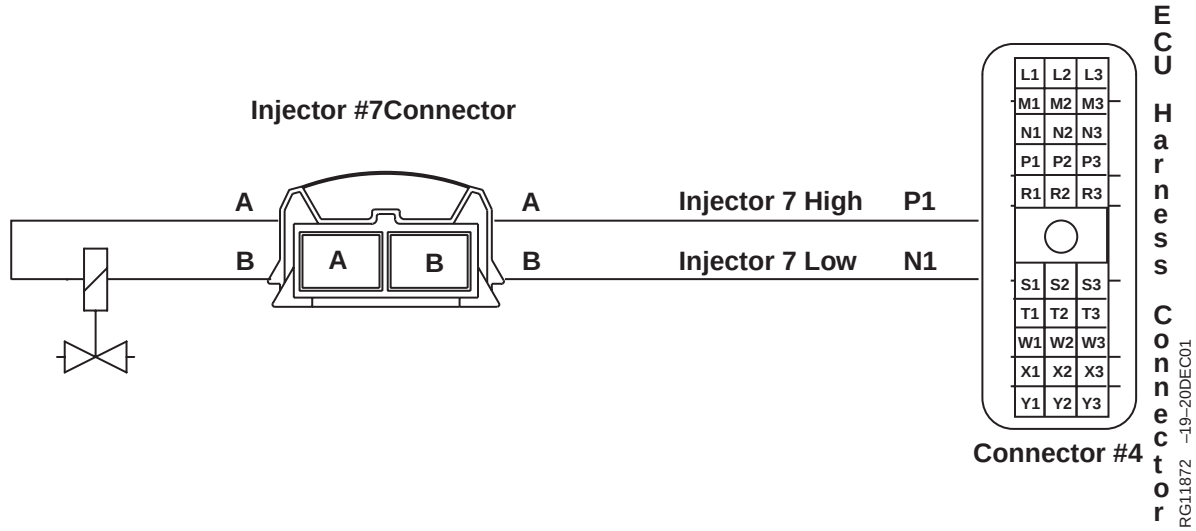
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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000656.06 INJECTOR #6 CIRCUIT SHORTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #6 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000656.06 INJECTOR #6 CIRCUIT SHORTED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000656.06 reoccurs: GO TO ❸ 000656.06 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 402	③ Injector #6 High Wiring Test <i>NOTE: For wiring and theory of operation information, see DTC 000656.06 INJECTOR #6 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #6 harness connector. 3. Disconnect ECU connector #1 (black A-K) and connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal A in the Injector #6 connector on the engine harness and all other terminals in both ECU harness connector #1 and connector #4.	All measurements above 20k ohms: GO TO ④ Any measurement less than 20k ohms: Injector #6 High circuit shorted to wire that caused low resistance -- -1/1
	④ Injector #6 Low Wiring Test <i>NOTE: For wiring and theory of operation information, see DTC 000656.06 INJECTOR #6 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Injector #6 harness connector and both ECU connectors still disconnected. 3. Using a multimeter, measure resistance between terminal B in the Injector #6 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ⑤ Any measurement less than 20k ohms: Injector #6 Low circuit shorted to wire that caused low resistance -- -1/1
	⑤ Injector #6 Test <i>NOTE: For wiring and theory of operation information, see DTC 000656.06 INJECTOR #6 CIRCUIT SHORTED supporting information.</i> 1. Injector #6 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #6 • Both terminals on the known good injector. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #6 -- -1/1

000657.05 — Injector #7 Circuit Open**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000657.05 will set if:

- The ECU detects an open in the Injector #7 circuit.

If DTC 000657.05 sets, the following will occur:

- Injector #7 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,000003C -19-16SEP02-1/1

000657.05 — Injector #7 Circuit Open

The ECU detects an open in the Injector #7 circuit.

RG41221_0000041 -19-16SEP02-1/1

000657.05 Injector #7 Circuit Open Diagnostic Procedure

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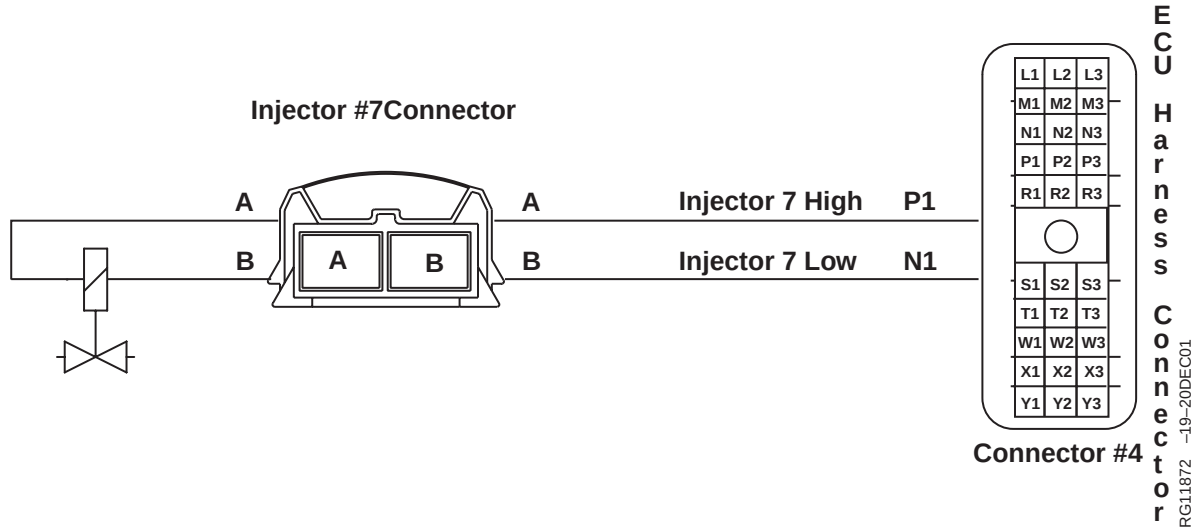
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000657.05 INJECTOR #7 CIRCUIT OPEN supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #7 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000657.05 INJECTOR #7 CIRCUIT OPEN supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000657.05 reoccurs: GO TO ❸ 000657.05 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 406	③ Injector #7 Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000657.05 INJECTOR #7 CIRCUIT OPEN supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #7 harness connector. 3. Disconnect ECU connector #4 (white L-Y). 4. Using a multimeter, measure resistance between: • Terminal A in the Injector #7 connector on the engine harness and terminal P1 in the ECU harness connector #4. • Terminal B in the Injector #7 connector on the engine harness and terminal N1 in the ECU harness connector #4.	Both measurements 5 ohms or less: GO TO ④ Measurement between A to P1 is greater than 5 ohms: Open in Injector #7 High circuit Measurement between B to N1 is greater than 5 ohms: Open in Injector #7 Low circuit	-- -1/1
	④ Injector #7 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000657.05 INJECTOR #7 CIRCUIT OPEN supporting information.</i> 1. Injector #7 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #7 • Both terminals on the known good injector. 4. Compare the measurements between the two injectors. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #7	-- -1/1

000657.06 — Injector #7 Circuit Shorted**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000657.06 will set if:

- The ECU detects a short in the Injector #7 circuit.

If DTC 000657.06 sets, the following will occur:

- Injector #7 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000047 -19-16SEP02-1/1

000657.06 — Injector #7 Circuit Shorted

The ECU detects a short in the Injector #7 circuit.

RG41221.000002D -19-16SEP02-1/1

000657.06 Injector #7 Circuit Shorted Diagnostic Procedure

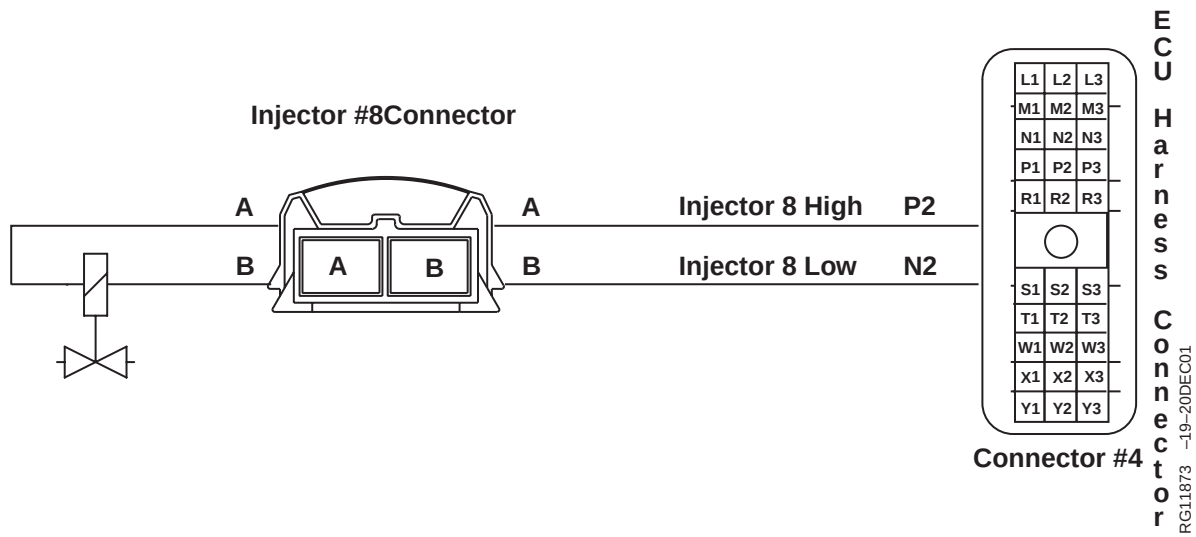
-- -1/1

❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000657.06 INJECTOR #7 CIRCUIT SHORTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #7 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s) Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000657.06 INJECTOR #7 CIRCUIT SHORTED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000657.06 reoccurs: GO TO ❸ 000657.06 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 410 ③ Injector #7 High Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000657.06 INJECTOR #7 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #7 harness connector. 3. Disconnect the ECU connector #1 (black A-K) and connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal A in the Injector #7 connector on the engine harness and all other terminals in both ECU harness connector #1 and connector #4.	All measurements above 20k ohms: GO TO ④ Any measurement less than 20k ohms: Injector #7 High circuit shorted to wire that caused low resistance -- -1/1
④ Injector #7 Low Wiring Test	1. Ignition OFF 2. Injector #7 harness connector and both ECU connectors still disconnected. 3. Using a multimeter, measure resistance between terminal B in the Injector #7 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ⑤ Any measurement less than 20k ohms: Injector #7 Low circuit shorted to wire that caused low resistance -- -1/1
⑤ Injector #7 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000657.06 INJECTOR #7 CIRCUIT SHORTED supporting information.</i> 1. Injector #7 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #7 • Both terminals on the known good injector. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 0.2 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 0.2 ohms: Faulty Injector #7 -- -1/1

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412
000658.05 — Injector #8 Circuit Open
**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000658.05 will set if:

- The ECU detects an open in the Injector #8 circuit.

If DTC 000658.05 sets, the following will occur:

- Injector #8 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,000003D -19-16SEP02-1/1

000658.05 — Injector #8 Circuit Open

The ECU detects an open in the Injector #8 circuit.

RG41221,0000042 -19-16SEP02-1/1

000658.05 Injector #8 Circuit Open Diagnostic Procedure

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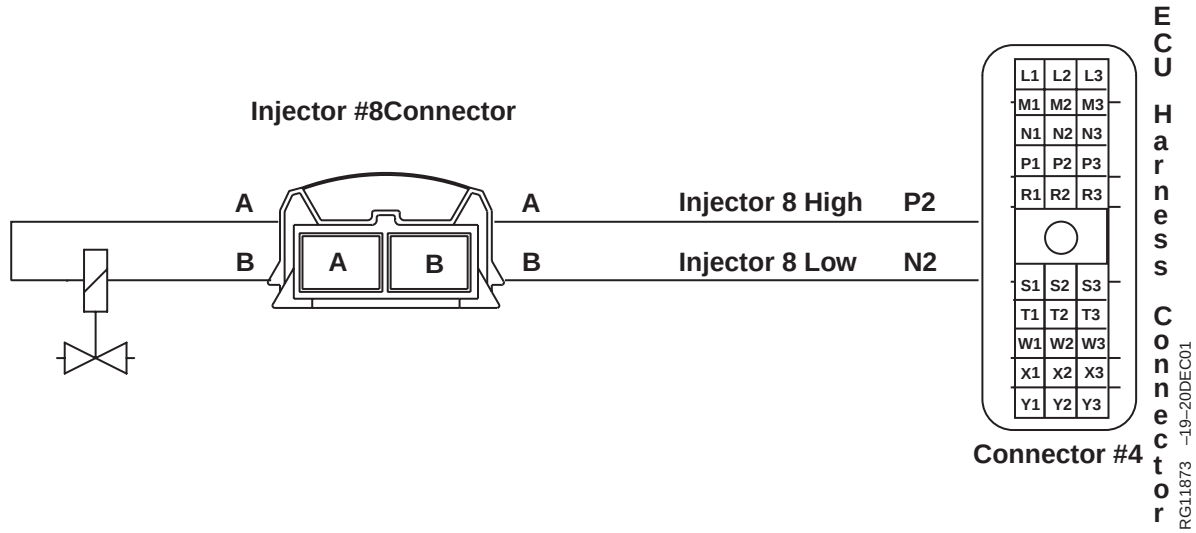
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000658.05 INJECTOR #8 CIRCUIT OPEN supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #8 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000658.05 INJECTOR #8 CIRCUIT OPEN supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000658.05 reoccurs: GO TO ❸ 000658.05 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 414	③ Injector #8 Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000658.05 INJECTOR #8 CIRCUIT OPEN supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #8 harness connector. 3. Disconnect the ECU connector #4 (white L-Y). 4. Using a multimeter, measure resistance between: • Terminal A in the Injector #8 connector on the engine harness and terminal P2 in the ECU harness connector #4. • Terminal B in the Injector #8 connector on the engine harness and terminal N2 in the ECU harness connector #4.	Both measurements 5 ohms or less: GO TO ④ Measurement between A to P2 is greater than 5 ohms: Open in Injector #8 High circuit Measurement between B to N2 is greater than 5 ohms: Open in Injector #8 Low circuit
	④ Injector #8 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000658.05 INJECTOR #8 CIRCUIT OPEN supporting information.</i> 1. Injector #8 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #8 • Both terminals on the known good injector. 4. Compare the measurements between the two injectors. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #8

000658.06 — Injector #8 Circuit Shorted**Injectors**

- The fuel injectors are located in the fuel metering block and are electronically controlled by the ECU. The ECU sends a PWM (pulse width modulated) signal to each injector to control the amount of fuel to the engine. For further fuel injector information, see FUEL INJECTOR OPERATION in Group 100 earlier in this manual.

DTC 000658.06 will set if:

- The ECU detects a short in the Injector #8 circuit.

If DTC 000658.06 sets, the following will occur:

- Injector #8 will not fire.
- Engine could miss or power may be low.
- ECU will set a SOLID Malfunction light.

RG41221,0000048 -19-16SEP02-1/1

000658.06 — Injector #8 Circuit Shorted

The ECU detects a short in the Injector #8 circuit.

RG41221,000002E -19-16SEP02-1/1

000658.06 Injector #8 Circuit Shorted Diagnostic Procedure

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000658.06 INJECTOR #8 CIRCUIT SHORTED supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injector #8 connector looking for dirty, damaged, or poorly positioned terminals.

Connection Check:
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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❷ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000658.06 INJECTOR #8 CIRCUIT SHORTED supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000658.06 reoccurs:
GO TO ❸

000658.06 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 418 ③ Injector #8 High Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000658.06 INJECTOR #8 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Disconnect Injector #8 harness connector. 3. Disconnect the ECU connector #1 (black A-K) and connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal A in the Injector #8 connector on the engine harness and all other terminals in both ECU harness connector #1 and connector #4.	All measurements above 20k ohms: GO TO ④ Any measurement less than 20k ohms: Injector #8 High circuit shorted to wire that caused low resistance -- -1/1
④ Injector #8 Low Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000658.06 INJECTOR #8 CIRCUIT SHORTED supporting information.</i> 1. Ignition OFF 2. Injector #8 harness connector and both ECU connectors still disconnected. 3. Using a multimeter, measure resistance between terminal B in the Injector #8 connector on the engine harness and all other terminals in both ECU connector #1 and connector #4.	All measurements above 20k ohms: GO TO ⑤ Any measurement less than 20k ohms: Injector #8 Low circuit shorted to wire that caused low resistance -- -1/1
⑤ Injector #8 Test	<i>NOTE: For wiring and theory of operation information, see DTC 000658.06 INJECTOR #8 CIRCUIT SHORTED supporting information.</i> 1. Injector #8 connector still disconnected. 2. Find a known good injector and disconnect the harness connector. 3. Using a multimeter, measure resistance between: • Both terminals on Injector #8 • Both terminals on the known good injector. <i>NOTE: Because injector resistance varies with temperature, a comparison is used to compensate for the effects of temperature. Typical injector resistance should be 4.1 - 5.1 ohms at 68°F (20°C).</i>	Difference between measurements 1.0 ohms or less: Faulty ECU connection OR Faulty ECU Difference between measurements greater than 1.0 ohms: Faulty Injector #8 -- -1/1

000724.02 — UEGO Sensor Failure

ECU detects any problem with the UEGO sensor.

RG41221,00002CE -19-12DEC01-1/1

000724.02 UEGO Sensor Failure Diagnostic Procedure

NOTE: If DTC 000724.02 is accompanied with any of the following DTCs, diagnose them first:

- 000724.13
- 001119.00, 001119.01, 001119.16, or 001119.18
- 524283.03 or 524283.04
- 524284.03 or 524284.04
- 524285.03 or 524285.04
- 524286.02
- 524287.03 or 524287.04

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① Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000724.02 UEGO SENSOR FAILURE supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ②

Faulty connection(s):
Repair connections and retest.

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② Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000724.02 UEGO SENSOR FAILURE supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Run engine at low idle for 2 minutes.
6. Read DTCs using DST or SERVICE ADVISOR™.

Only 000724.02 reoccurs:
GO TO ③

Other UEGO DTC(s) and 000724.02 reoccur:
Diagnose other UEGO sensor related DTC first.

000724.02 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ UEGO Sensor Wiring Check

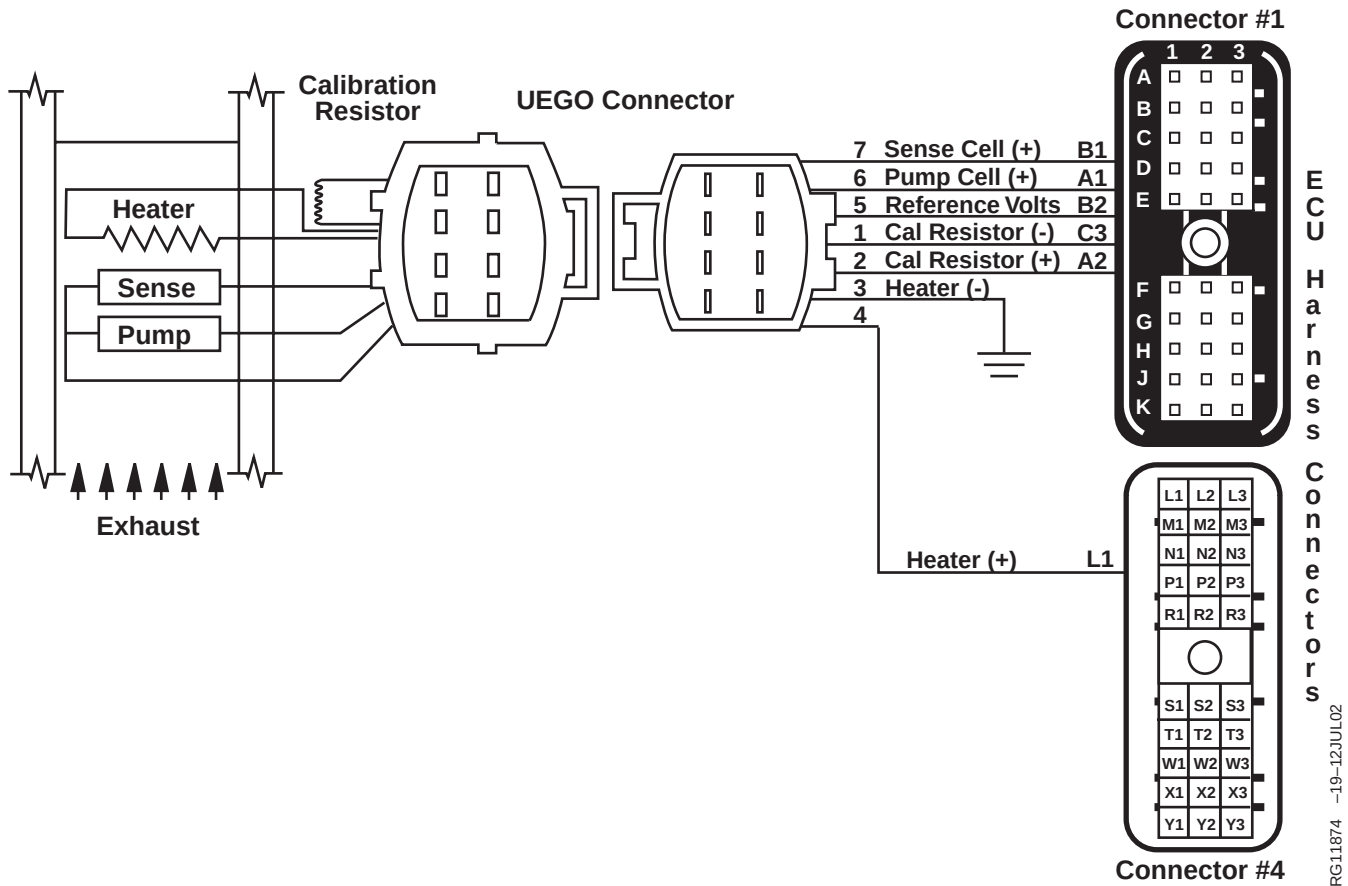
NOTE: For wiring and theory of operation information, see DTC 000724.02 UEGO SENSOR FAILURE supporting information.

1. Ignition OFF
2. Disconnect the UEGO sensor connector.
3. Disconnect ECU connectors #1 (black A-K) and #4 (white L-Y).
4. Using a multimeter, measure resistance between the following terminals:
 - Terminal 1 in the UEGO sensor connector and terminal C3 on ECU connector #1 on the engine harness.
 - Terminal 2 in the UEGO sensor connector and terminal A2 on ECU connector #1 on the engine harness.
 - Terminal 3 in the UEGO sensor connector and a good chassis ground.
 - Terminal 4 in the UEGO sensor connector and terminal L1 on ECU connector #4 on the engine harness.
 - Terminal 5 in the UEGO sensor connector and terminal B2 on ECU connector #1 on the engine harness.
 - Terminal 6 in the UEGO sensor connector and terminal A1 on ECU connector #1 on the engine harness.
 - Terminal 7 in the UEGO sensor connector and terminal B1 on ECU connector #1 on the engine harness.

All measurements 5 ohms or less:
Faulty UEGO sensor.
Replace UEGO sensor and retest.

Any measurement above 5 ohms:
Open or short in wire(s) that caused high resistance. Repair wire and retest.

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000724.13 — UEGO Sensor Calibration Error**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

DTC 000724.13 will set if:

- The ECU checks for gas content in the exhaust while running in a non-fueling condition. The calibration correction multiplier that would be needed to correct the gas content is out of specification. This indicates the UEGO sensor calibration has significantly changed.

If DTC 000724.13 sets, the following will occur:

- DTC 000724.02 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

000724.13 — UEGO Sensor Calibration Error

The UEGO sensor calibration has significantly changed.

RG41221.0000024 -19-20AUG02-1/1

000724.13 UEGO Sensor Calibration Error Diagnostic Procedure

NOTE: If DTC 000724.13 is accompanied with 000724.02, diagnose 0006724.13 first.

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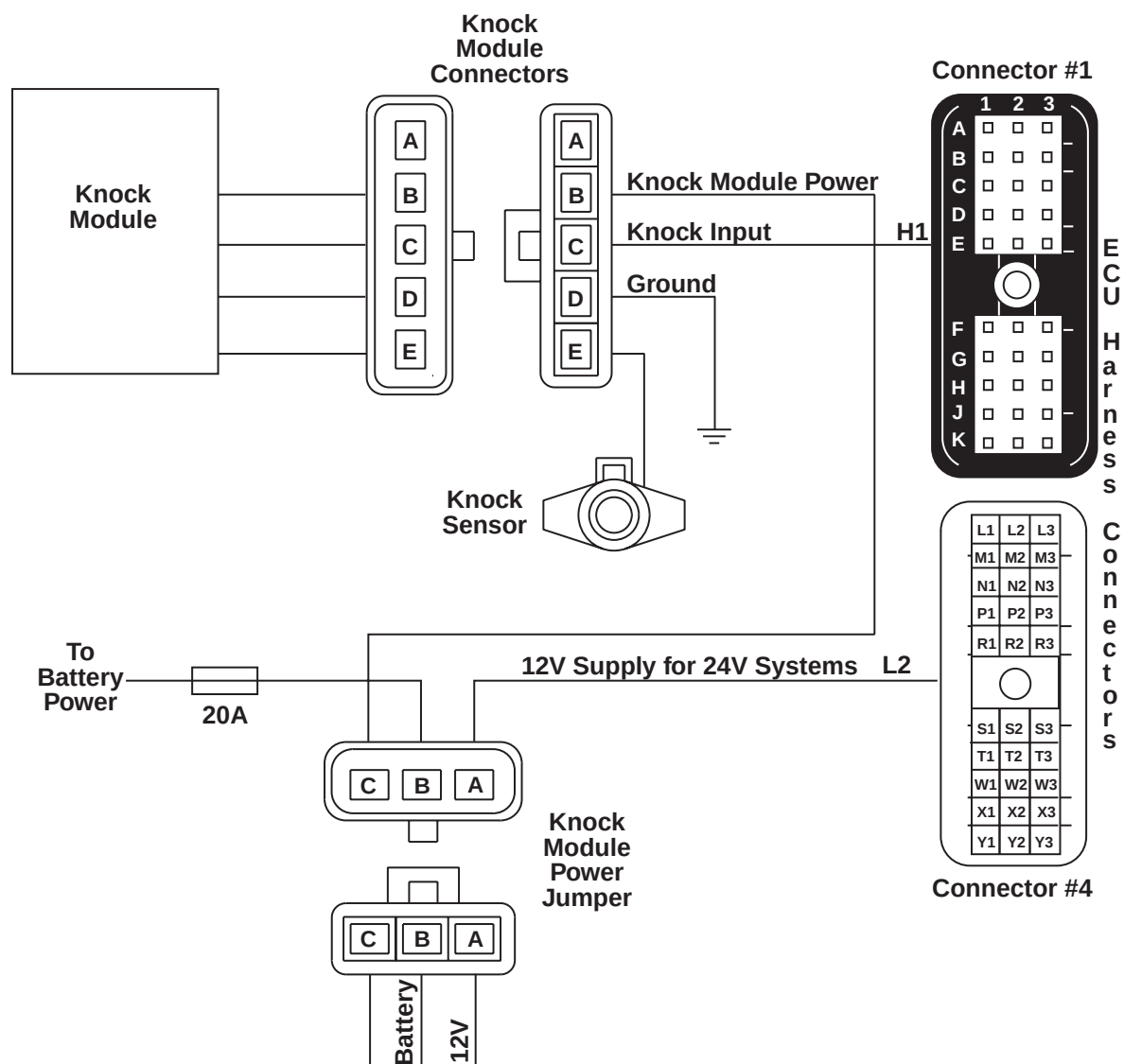
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 000724.13 UEGO SENSOR CALIBRATION ERROR supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, knock module connector, the knock sensor connector, and the knock module power jumper connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000724.13 UEGO SENSOR CALIBRATION ERROR supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine at low idle for 2 minutes. 6. Read DTCs using DST or SERVICE ADVISOR™.	000724.13 reoccurs: GO TO ❸ 000724.13 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 426	③ UEGO Sensor Wiring Check	<i>NOTE: For wiring and theory of operation information, see DTC 000724.13 UEGO SENSOR CALIBRATION ERROR supporting information.</i> 1. Ignition OFF 2. Disconnect the UEGO sensor connector. 3. Disconnect ECU connectors #1 (black A-K) and #4 (white L-Y). 4. Using a multimeter, measure resistance between the following terminals: • Terminal 1 in the UEGO sensor connector and terminal C3 on ECU connector #1 on the engine harness. • Terminal 2 in the UEGO sensor connector and terminal A2 on ECU connector #1 on the engine harness. • Terminal 3 in the UEGO sensor connector and a good chassis ground. • Terminal 4 in the UEGO sensor connector and terminal L1 on ECU connector #4 on the engine harness. • Terminal 5 in the UEGO sensor connector and terminal B2 on ECU connector #1 on the engine harness. • Terminal 6 in the UEGO sensor connector and terminal A1 on ECU connector #1 on the engine harness. • Terminal 7 in the UEGO sensor connector and terminal B1 on ECU connector #1 on the engine harness.	All measurements 5 ohms or less: GO TO ④ Any measurement above 5 ohms: Open or short in wire(s) that caused high resistance. Repair wire and retest. -- -1/1
	④ Injector Test	<i>NOTE: For wiring and theory of operation information, see DTC 000724.13 UEGO SENSOR CALIBRATION ERROR supporting information.</i> A faulty injector could cause fuel to leak into the mixing elbow when the ECU is in a non-fueling condition. See F3 - FUEL INJECTOR DIAGNOSTIC CHECK in Group 105 earlier in this manual.	All injectors working properly: Faulty UEGO sensor. Replace UEGO sensor and retest. Faulty injector(s) found: Replace faulty injector(s) and retest. -- -1/1

000731.00 — Knock Retard Limit Reached

RG11875 -19-03JUL02

Knock Sensor

- The knock sensor is a resonant band pass filter that is very sensitive around 5.8 kHz. The knock module receives a pulse width modulated (PWM) signal from the knock sensor. The signal received is dependent on the amount of knock that is sensed on the engine. As the severity of knock increases, the PWM signal on-time increases. The knock module then translates the PWM signal into a comparative one-shot type signal (0 volts or 12 volts) to the ECU. The ECU uses this information to determine if the engine is seeing knock. Depending on the amount of knock, the ECU retards timing to compensate for the

condition causing knock. For further knock sensor and knock module information, see KNOCK SENSOR or KNOCK MODULE OPERATION in Group 100 earlier in this manual.

DTC 000731.00 will set if:

- ECU detects knock, retards spark timing to maximum allowed limit, and continues to see knock.

If DTC 000731.00 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.

Continued on next page

RG41221,0000278 -19-19SEP01-1/2

- Will derate the engine 30% per minute to a maximum derate of 30%. When the Knock sensor returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the knock falls out of range again.

- DTC 524275.03 or 524275.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

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000731.00 — Knock Retard Limit Reached

The ECU detects knock, retards spark timing to maximum allowed limit, and continues to see knock.

RG41221,00002D3 -19-12DEC01-1/1

000731.00 Knock Retard Limit Reached Diagnostic Procedure

NOTE: If DTC 000731.00 is accompanied with 524275.03 or 524275.04, diagnose them first.

NOTE: Check for any loose components or mechanical failures that could cause excessive engine noise and/or vibration. This could be mistaken as engine knock.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000731.00 KNOCK RETARD LIMIT REACHED supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, knock module connector, the knock sensor connector, and the knock module power jumper connector looking for dirty, damaged, or poorly positioned terminals.

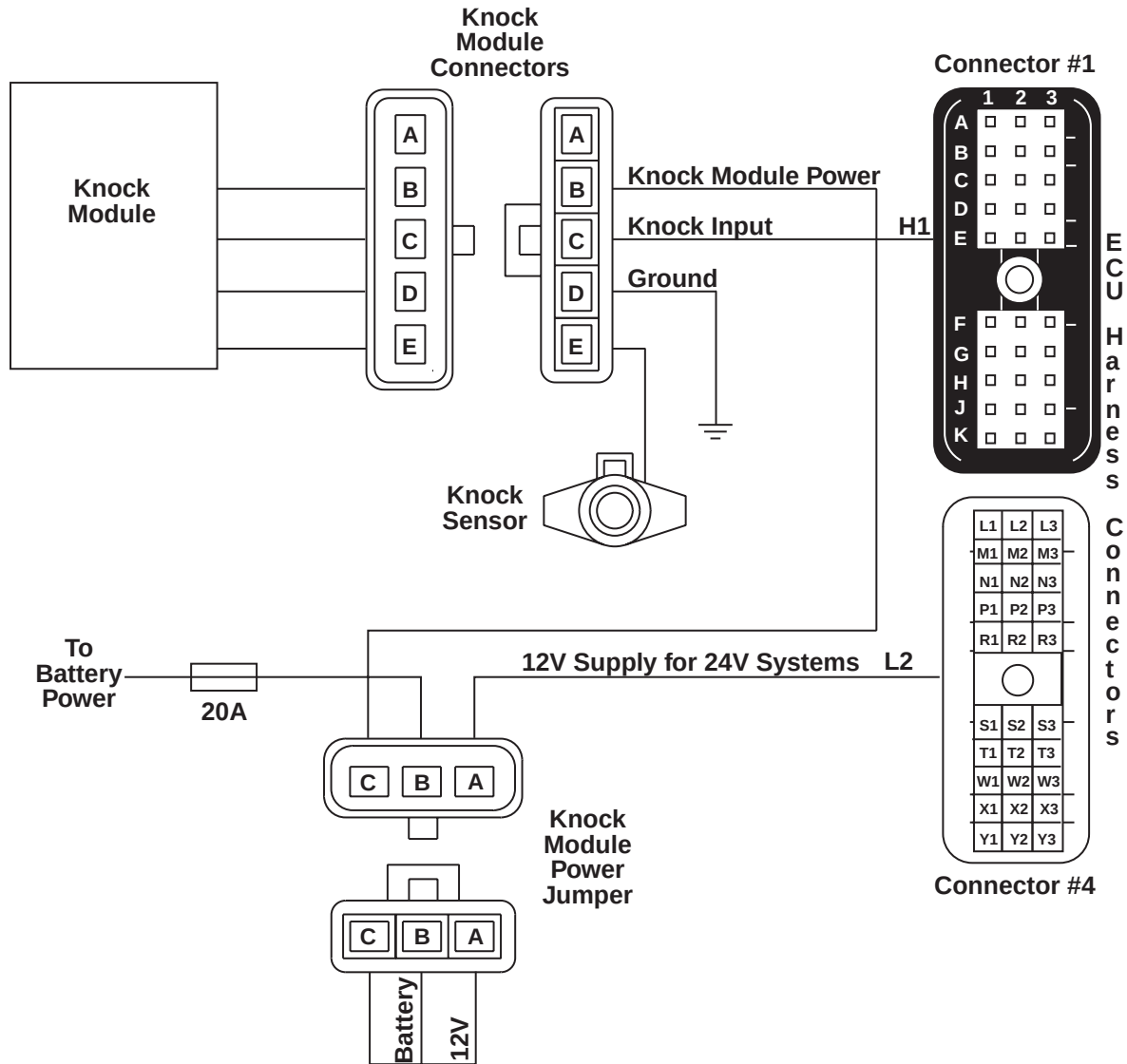
No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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② Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.00 KNOCK RETARD LIMIT REACHED supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine as close to full load rated speed as possible. 6. Read DTCs using DST or SERVICE ADVISOR™.	000731.00 reoccurs: GO TO ③ 000731.00 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.
<i>SERVICE ADVISOR is a trademark of Deere & Company</i> -- -1/1		
③ Knock Input Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.00 KNOCK RETARD LIMIT REACHED supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #1 (black A-K) and knock module connector. 3. Using a multimeter, measure resistance between terminal H1 in the ECU connector and terminal C in the knock module connector on the engine harness.	5 ohms or less: GO TO ④ Greater than 5 ohms: Open in knock module input wire OR Short in knock module input wire -- -1/1
④ Knock Sensor Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.00 KNOCK RETARD LIMIT REACHED supporting information.</i> 1. Ignition OFF 2. Knock module still disconnected. 3. Disconnect knock sensor connector. 4. Using a multimeter, measure resistance between terminal E in the knock module connector and the knock sensor connector terminal on the engine harness.	5 ohms or less: GO TO ⑤ Greater than 5 ohms: Open in knock sensor wire OR Short in knock sensor wire -- -1/1

115 432 5 Knock Module Power Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.00 KNOCK RETARD LIMIT REACHED supporting information.</i> - Knock module still disconnected. - Ignition ON, engine OFF - Probe the knock module power supply wire (terminal B) of the knock module connector on the engine harness with a test light connected to a good chassis ground.	Light ON: GO TO 7 Light OFF: GO TO 6 -- -1/1
6 Knock Module Power Jumper Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.00 KNOCK RETARD LIMIT REACHED supporting information.</i> - Ignition OFF - Disconnect the knock module power jumper connector. - Ignition ON, engine OFF - Probe the knock module power supply wire (terminal B on 12 volt systems) (terminal A on 24 volt systems) of the knock module power jumper connector on the engine harness with a test light connected to a good chassis ground.	Light ON: Open or short in knock module power wire Light OFF on 12 volt system: Blown fuse OR Faulty or missing knock module power jumper OR Open or short in battery power supply wire Light OFF on 24 volt system: Open or short to ground in knock module power supply wire OR Faulty ECU connection OR Faulty ECU -- -1/1
7 Knock Module Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.00 KNOCK RETARD LIMIT REACHED supporting information.</i> - Knock module still disconnected. - Ignition ON, engine OFF - Probe the knock module ground wire (terminal D) of the knock module connector on the engine harness with a test light connected to a battery voltage.	Light ON: Faulty knock module Light OFF: Open or short to power in knock module ground wire. -- -1/1

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000731.02 — Knock Signal Invalid
**Knock Sensor**

- The knock sensor is a resonant band pass filter that is very sensitive around 5.8 kHz. The knock module receives a pulse width modulated (PWM) signal from the knock sensor. The signal received is dependent on the amount of knock that is sensed on the engine. As the severity of knock increases, the PWM signal on-time increases. The knock module then translates the PWM signal into a comparative one-shot type signal (0 volts or 12 volts) to the ECU. The ECU uses this information to determine if the engine is seeing knock. Depending on the amount of

knock, the ECU retards timing to compensate for the condition causing knock. For further knock sensor and knock module information, see KNOCK SENSOR or KNOCK MODULE OPERATION in Group 100 earlier in this manual.

DTC 000731.02 will set if:

- ECU detects knock when the engine is running under conditions that cannot physically produce knock.

If DTC 000731.02 sets, the following will occur:

Continued on next page

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- DTC 000731.16 will also set causing an engine protection derate to occur.
- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 15% per minute to a maximum derate of 15%. When the Knock sensor returns to a normal operating range, power will be increased 15% per minute until either full power is reached or the knock falls out of range again.
- DTC 524275.03 or 524275.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

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**115
436** 000731.02 — Knock Signal Invalid

ECU detects knock when the engine is running under conditions that cannot physically produce knock.

RG41221,00002D4 -19-12DEC01-1/1

000731.02 Knock Signal Invalid Diagnostic Procedure

NOTE: If DTC 000731.02 is accompanied with 524275.03 or 524275.04, diagnose them first.

NOTE: Check for any loose components or mechanical failures that could cause excessive engine noise and/or vibration. This could be mistaken as engine knock.

-- -1/1

❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000731.02 KNOCK SIGNAL INVALID supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, knock module connector, the knock sensor connector, and the knock module power jumper connector looking for dirty, damaged, or poorly positioned terminals.

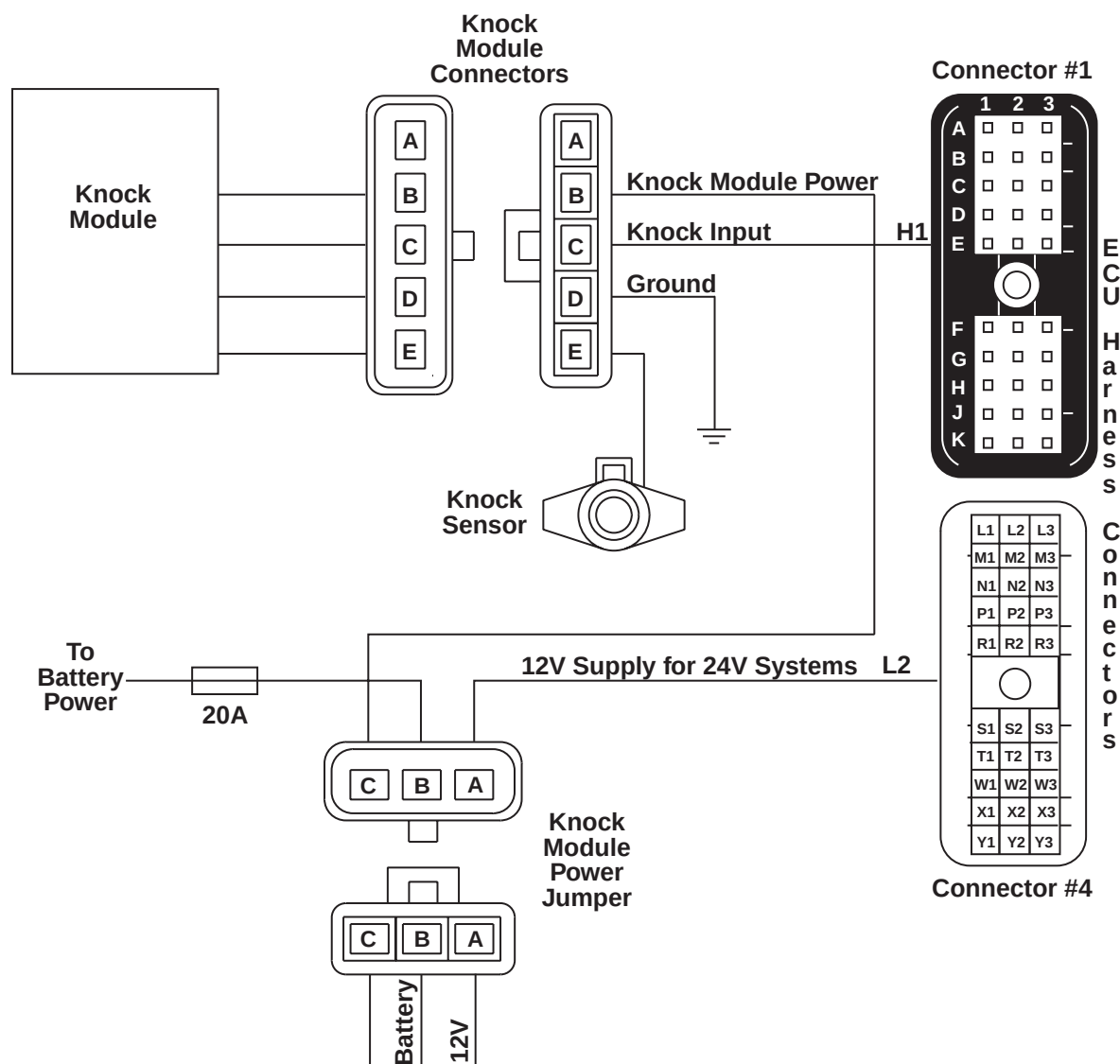
No faulty connection(s):
GO TO **❷**

Faulty connection(s):
Repair connections and retest.

-- -1/1

② Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.02 KNOCK SIGNAL INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	000731.02 reoccurs: GO TO ③ 000731.02 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.	115 437
<i>SERVICE ADVISOR is a trademark of Deere & Company</i> -- -1/1			
③ Vibration Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.02 KNOCK SIGNAL INVALID supporting information.</i> Check engine for loosely installed components on the engine or in the engine compartment that could vibrate on or against the engine and cause a false knocking condition.	No vibration: GO TO ④ Vibration occurs: Tighten or repair loose component and retest. -- -1/1	
④ Knock Module Input Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.02 KNOCK SIGNAL INVALID supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #1 (black A-K) and knock module connector. 3. Using a multimeter, measure resistance between terminal H1 in ECU connector and terminal C in the knock module connector on the engine harness.	5 ohms or less: GO TO ⑤ Greater than 5 ohms: Open in knock module input wire OR Short in knock module input wire. -- -1/1	
⑤ Knock Sensor Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.02 KNOCK SIGNAL INVALID supporting information.</i> 1. Ignition OFF 2. Knock module still disconnected. 3. Disconnect knock sensor connector. 4. Using a multimeter, measure resistance between terminal E in the knock module connector and the knock sensor connector terminal on the engine harness.	5 ohms or less: GO TO ⑥ Greater than 5 ohms: Open in knock sensor wire OR Short in knock sensor wire. -- -1/1	

115 438 6 Knock Module Power Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.02 KNOCK SIGNAL INVALID supporting information.</i> - Knock module still disconnected. - Ignition ON, engine OFF - Probe the knock module power supply wire (terminal B) of the knock module connector on the engine harness with a test light connected to a good chassis ground.	Light ON: GO TO 8 Light OFF: GO TO 7 -- -1/1
7 Knock Module Power Jumper Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.02 KNOCK SIGNAL INVALID supporting information.</i> - Ignition OFF - Disconnect the knock module power jumper connector. - Ignition ON, engine OFF - Probe the knock module power supply wire (terminal B on 12 volt systems) (terminal A on 24 volt systems) of the knock module power jumper connector on the engine harness with a test light connected to a good chassis ground.	Light ON: Open or short in knock module power wire Light OFF on 12 volt system: Blown fuse OR Faulty or missing knock module power jumper OR Open or short in battery power supply wire Light OFF on 24 volt system: Open or short to ground in knock module power supply wire OR Faulty ECU connection OR Faulty ECU -- -1/1
8 Knock Module Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.02 KNOCK SIGNAL INVALID supporting information.</i> - Knock module connector still disconnected. - Ignition ON, engine OFF - Probe the knock module ground wire (terminal D) of the knock module connector on the engine harness with a test light connected to battery voltage.	Light ON: Faulty knock module Light OFF: Open or short to power in knock module ground wire. -- -1/1

000731.04 — Knock Sensor Input Voltage Low

RG11875 -19-03JUL02

Knock Sensor

- The knock sensor is a resonant band pass filter that is very sensitive around 5.8 kHz. The knock module receives a pulse width modulated (PWM) signal from the knock sensor. The signal received is dependent on the amount of knock that is sensed on the engine. As the severity of knock increases, the PWM signal on-time increases. The knock module then translates the PWM signal into a comparative one-shot type signal (0 volts or 12 volts) to the ECU. The ECU uses this information to determine if the engine is seeing knock. Depending on the amount of knock, the ECU retards timing to compensate for the

condition causing knock. For further knock sensor and knock module information, see KNOCK SENSOR or KNOCK MODULE OPERATION in Group 100 earlier in this manual.

DTC 000731.04 will set if:

- ECU senses a constant low voltage from the knock module during all running conditions.

If DTC 000731.04 sets, the following will occur:

- DTC 000731.16 will also set causing an engine protection derate to occur.

Continued on next page

RG41221,000027A -19-19SEP01-1/2

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 15% per minute to a maximum derate of 15%. When the Knock sensor returns to a normal operating range, power will be increased 15% per minute until either full power is reached or the knock falls out of range again.
- DTC 524275.03 or 524275.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

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,441

RG41221.000027A -19-19SEP01-2/2

000731.04 — Knock Sensor Input Voltage Low

The ECU senses a constant low voltage from the knock module during all running conditions.

RG41221,00002D5 –19–12DEC01–1/1

000731.04 Knock Sensor Input Voltage Low Diagnostic Procedure

NOTE: If DTC 000731.04 is accompanied with 524275.03 or 524275.04, diagnose them first.

-- --1/1

❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000731.04 KNOCK SENSOR INPUT VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, knock module connector, the knock sensor connector, and the knock module power jumper connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

-- --1/1

❷ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 000731.04 KNOCK SENSOR INPUT VOLTAGE LOW supporting information.

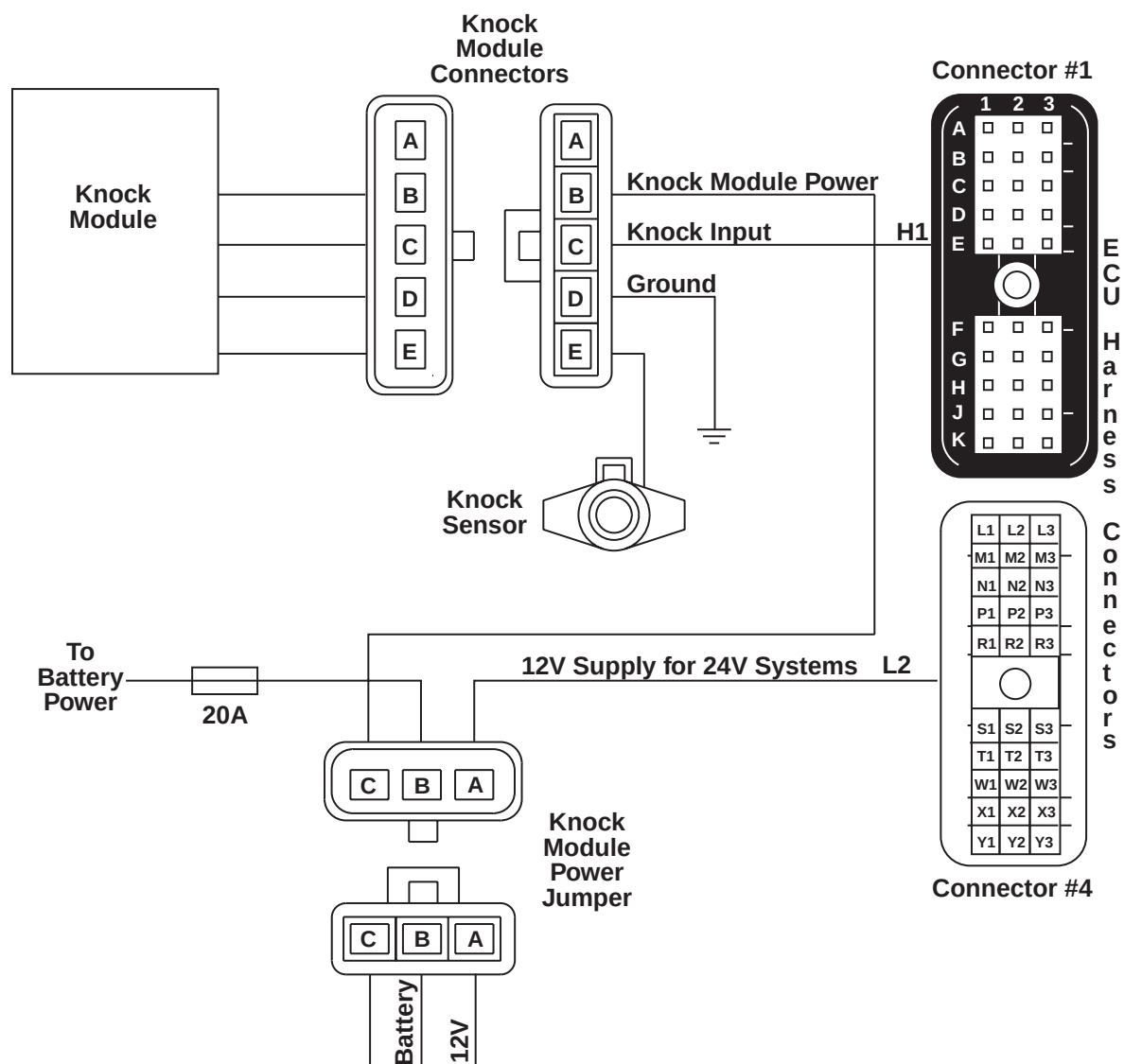
1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000731.04 reoccurs:
GO TO ❸

000731.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

③ Knock Input Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.04 KNOCK SENSOR INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #1 (black A-K) and knock module connector. 3. Using a multimeter, measure resistance between terminal H1 in the ECU connector and terminal C in the knock module connector on the engine harness.	5 ohms or less: GO TO ④ Greater than 5 ohms: Open in knock module input wire OR Short in knock module input wire. -- -1/1
④ Knock Sensor Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.04 KNOCK SENSOR INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Knock module connector still disconnected. 3. Disconnect knock sensor connector. 4. Using a multimeter, measure resistance between terminal E in the knock module connector and knock sensor connector terminal on the engine harness.	5 ohms or less: GO TO ⑤ Greater than 5 ohms: Open in knock sensor wire OR Short in knock sensor wire. -- -1/1
⑤ Knock Module Power Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.04 KNOCK SENSOR INPUT VOLTAGE LOW supporting information.</i> 1. Knock module connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the knock module power supply wire (terminal B) of the knock module connector on the engine harness with a test light connected to a good chassis ground.	Light ON: GO TO ⑦ Light OFF: GO TO ⑥ -- -1/1

115 ,444	6 Knock Module Power Jumper Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.00 KNOCK RETARD LIMIT REACHED supporting information.</i> 1. Ignition OFF 2. Disconnect the knock module power jumper connector. 3. Ignition ON, engine OFF 4. Probe the knock module power supply wire (terminal B on 12 volt systems) (terminal A on 24 volt systems) of the knock module power jumper connector on the engine harness with a test light connected to a good chassis ground.	Light ON: Open or short in knock module power wire Light OFF on 12 volt system: Blown fuse OR Faulty or missing knock module power jumper OR Open or short in battery power supply wire Light OFF on 24 volt system: Open or short to ground in knock module power supply wire OR Faulty ECU connection OR Faulty ECU -- -1/1
	7 Knock Module Test	<i>NOTE: For wiring and theory of operation information, see DTC 000731.04 KNOCK SENSOR INPUT VOLTAGE LOW supporting information.</i> 1. Knock module connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the knock module ground wire (terminal D) of the knock module connector on the engine harness with a test light connected to battery voltage.	Light ON: Faulty knock module Light OFF: Open or short to power in knock module ground wire. -- -1/1

000731.16 — Knock Sensor Error

RG11875 -19-03JUL02

Knock Sensor

- The knock sensor is a resonant band pass filter that is very sensitive around 5.8 kHz. The knock module receives a pulse width modulated (PWM) signal from the knock sensor. The signal received is dependent on the amount of knock that is sensed on the engine. As the severity of knock increases, the PWM signal on-time increases. The knock module then translates the PWM signal into a comparative one-shot type signal (0 volts or 12 volts) to the ECU. The ECU uses this information to determine if the engine is seeing knock. Depending on the amount of knock, the ECU retards timing to compensate for the

condition causing knock. For further knock sensor and knock module information, see KNOCK SENSOR or KNOCK MODULE OPERATION in Group 100 earlier in this manual.

DTC 000731.16 will set if:

- ECU detects knock when the engine is running under conditions that cannot physically produce knock or the ECU senses a constant low voltage from the knock module during all running conditions. This DTC is a redundant code for 000731.02 and 000731.04.

Continued on next page

RG41221.0000025 -19-09JUL03-1/2

If DTC 000731.16 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 15% per minute to a maximum derate of 15%. When the Knock sensor returns to a normal operating range, power will be

increased 15% per minute until either full power is reached or the knock falls out of range again.

- DTC 000731.02 or 000731.04 will also be present. Diagnose other knock DTCs first.
- DTC 524275.03 or 524275.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,0000025 -19-09JUL03-2/2

000731.16 — Knock Sensor Error

The ECU detects knock when the engine is running under conditions that cannot physically produce knock

or the ECU senses a constant low voltage from the knock module during all running conditions.

RG41221.0000027 -19-20AUG02-1/1

000731.16 Knock Sensor Error Diagnostic Procedure

NOTE: If DTC 000731.16 is accompanied with 524275.03 or 524275.04, diagnose them first.

-- -1/1

❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 000731.16 KNOCK SENSOR ERROR supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, knock module connector, the knock sensor connector, and the knock module power jumper connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

-- -1/1

❷ DTC Check

NOTE: For wiring and theory of operation information, see DTC 000731.16 KNOCK SENSOR ERROR supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

000731.02 reoccurs:
See DTC 000731.02 KNOCK SIGNAL INVALID

000731.04 reoccurs:
See DTC 000731.04 KNOCK SENSOR INPUT VOLTAGE LOW

000731.02 or 000731.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

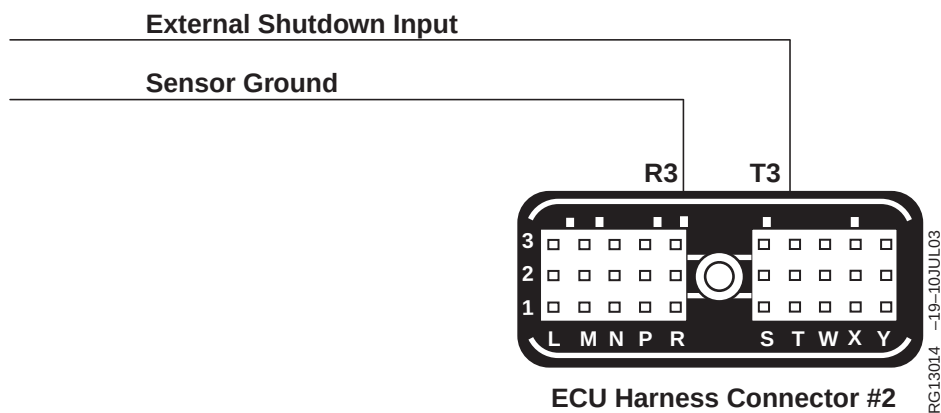
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000970.31 — External Shutdown - Auxiliary Request

The ECU does not read any voltage on the auxiliary request shutdown input.

RG41221,0000171 -19-17JUN03-1/2

**Auxiliary Engine Shutdown Switch**

- The engine shutdown switch is a normally open switch. When the property being measured exceeds a certain value, the switch will close. When the switch is closed, the voltage is grounded, which will cause the ECU to shutdown the engine.

DTC 000970.31 will set if:

- The ECU does not read an input voltage.

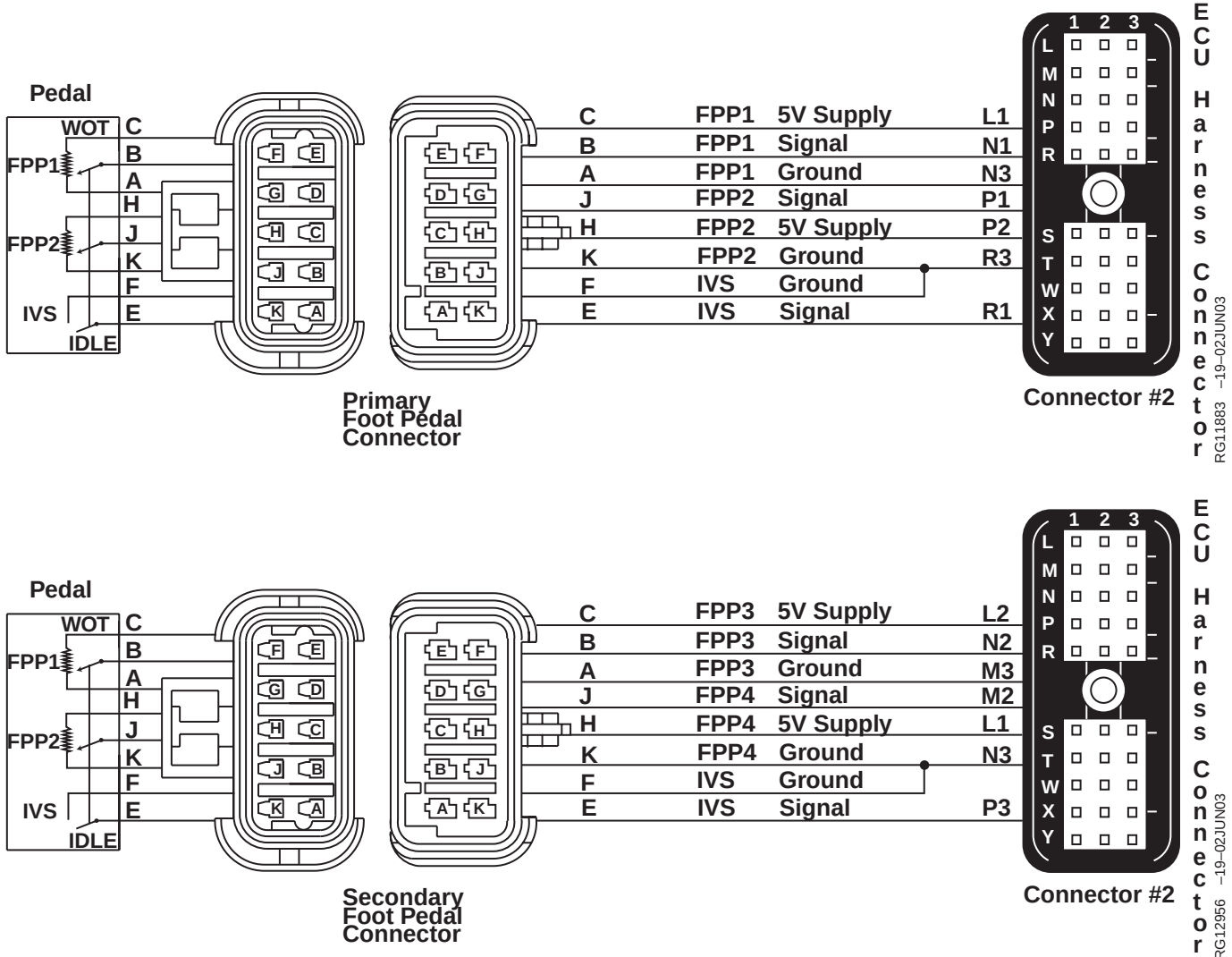
If DTC 000970.31 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.

- With Shutdown Feature: The derate will go into effect when the code is set and the engine will shut down after 30 seconds.
- Will derate the engine 2% per minute to a maximum derate of 10%. When external shutdown signal returns to normal, power will be increased 2% per minute until either full power is reached or if the external shutdown is triggered again.

- DTC 001569.31 will also be present.
- If shutdown feature is available, DTC 001110.31 will also be present.

RG41221,0000171 -19-17JUN03-2/2

001079.03 — Sensor Supply 1 Voltage High**Sensor Supply Voltage**

- The ECU supplies voltage to a few different sensors depending on application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

Sensor Supply 1

- The ECU supplies 5 volts to the Foot Pedal Position 1 sensor.

- The ECU supplies 5 volts to the Foot Pedal Position 4 sensor.

DTC 001079.03 will set if:

- The ECU detects a supply voltage greater than 5.5 volts on the ECU 5 volt supply 1 circuit.

If DTC 001079.03 sets, the following will occur:

- The ECU will use a default value for the FPP1 sensor supply.
- DTC 000028.03 and/or 000091.03 may also be present.
- ECU will set a SOLID Warning light.

Continued on next page

RG41221,000027B -19-19SEP01-1/2

- ECU will set a SOLID Malfunction light.

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RG41221,000027B -19-19SEP01-2/2

001079.03 — Sensor Supply 1 Voltage High

The ECU detects a voltage above specification on the ECU 5 volt sensor supply circuit.

RG41221,00002B7 -19-19SEP01-1/1

001079.03 Sensor Supply 1 Voltage High Diagnostic Procedure

NOTE: If DTC 001079.03 is accompanied with 000028.03 or 000091.03, diagnose 001079.03 first.

-- -1/1

❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001079.03 SENSOR SUPPLY 1 VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the foot pedal connector, and all of the vehicle interconnects looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.

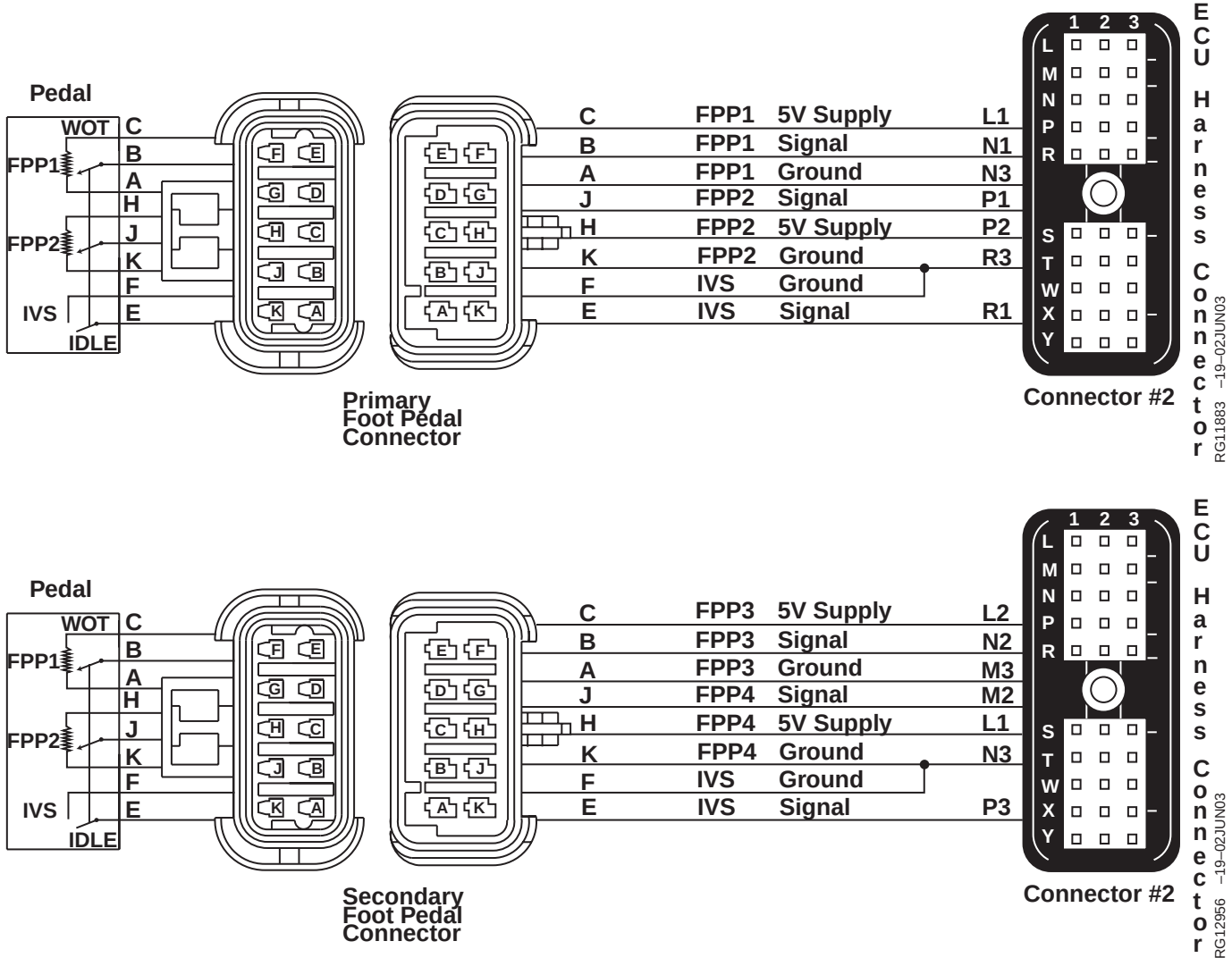
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❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001079.03 SENSOR SUPPLY 1 VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001079.03 reoccurs: GO TO ❸ 001079.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Short in 5V Supply Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 001079.03 SENSOR SUPPLY 1 VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect ECU connector #2 (black L-Y) on the vehicle harness. 3. Using a multimeter, measure resistance between terminal L1 and all other terminals in both ECU connectors on the engine harness.	Greater than 20k ohms on all measurements: Faulty ECU connection OR Faulty ECU Any measurement 20k ohms or less: Sensor 5V supply circuit shorted to power wire in ECU harness that cause low resistance. -- -1/1	115 ,455

001079.04 — Sensor Supply 1 Voltage Low**Sensor Supply Voltage**

- The ECU supplies voltage to a few different sensors depending on application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

Sensor Supply 1

- The ECU supplies 5 volts to the Foot Pedal Position 1 sensor.

- The ECU supplies 5 volts to the Foot Pedal Position 4 sensor.

DTC 001079.04 will set if:

- The ECU detects a voltage less than 4.5 volts on the ECU 5 volt supply 1 circuit.

If DTC 001079.04 sets, the following will occur:

- The ECU will use a default value for the FPP1 sensor supply.
- DTC 000028.04 and/or 000091.04 may also be present.
- ECU will set a SOLID Warning light.

Continued on next page

RG41221,000027C -19-19SEP01-1/2

- ECU will set a SOLID Malfunction light.

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RG41221,000027C -19-19SEP01-2/2

001079.04 — Sensor Supply 1 Voltage Low

The ECU detects a voltage below specification on the ECU 5 volt sensor supply circuit.

RG41221,00002B8 –19–19SEP01–1/1

001079.04 Sensor Supply 1 Voltage Low Diagnostic Procedure

NOTE: If DTC 001079.04 is accompanied with 000028.04 or 000091.04, diagnose 001079.04 first.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 001079.04 SENSOR SUPPLY 1 VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the foot pedal connector, and all of the vehicle interconnects looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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❷ Intermittent Fault Test

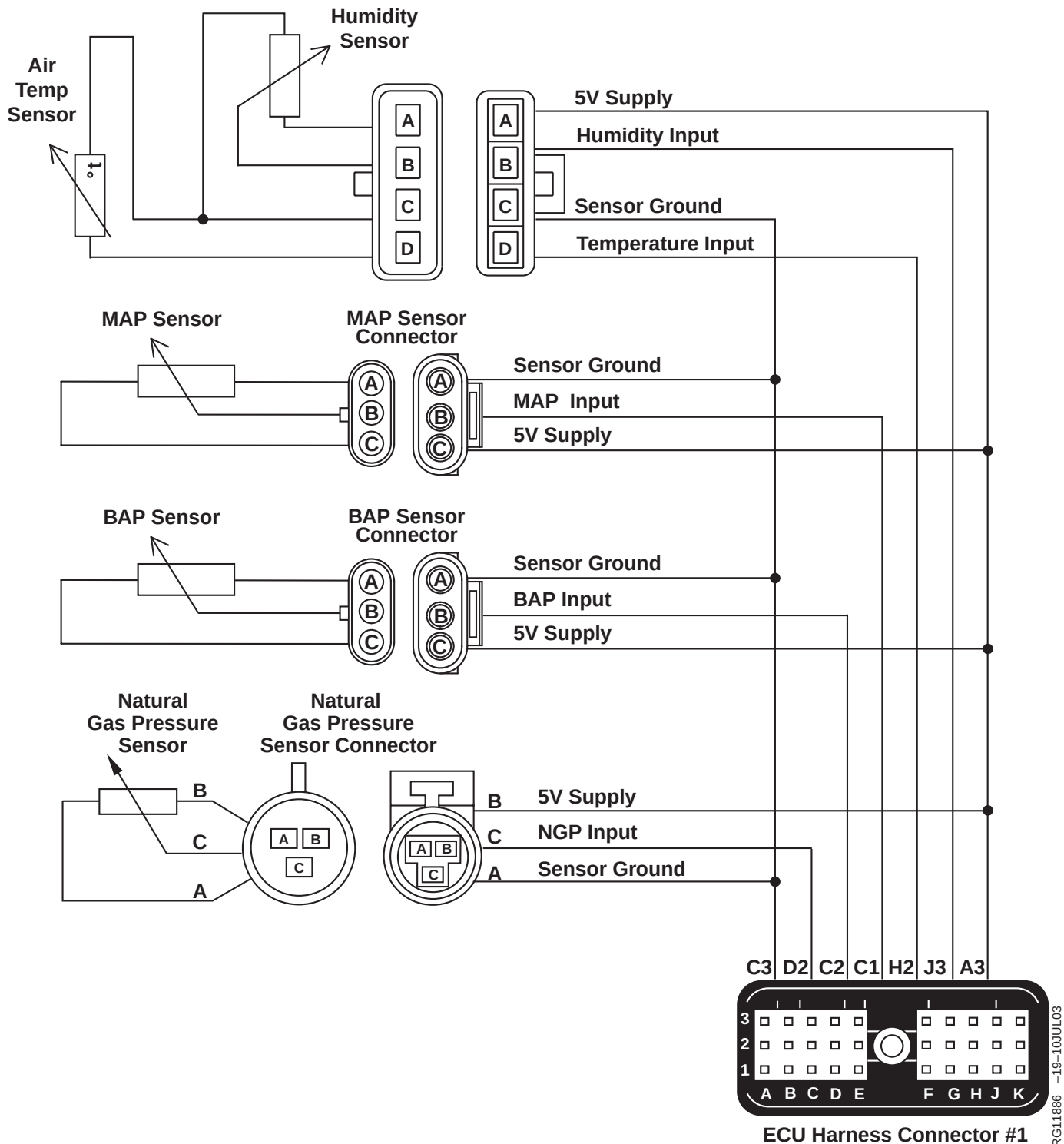
NOTE: For wiring and theory of operation information, see DTC 001079.04 SENSOR SUPPLY 1 VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of all active DTCs, then clear all DTCs.
5. Ignition OFF
6. Disconnect the Foot Pedal harness connector.
7. Ignition ON, engine running
8. Read DTCs using DST or SERVICE ADVISOR™.

001079.04 reoccurs:
GO TO ❸

001079.04 doesn't reoccur:
GO TO ❹

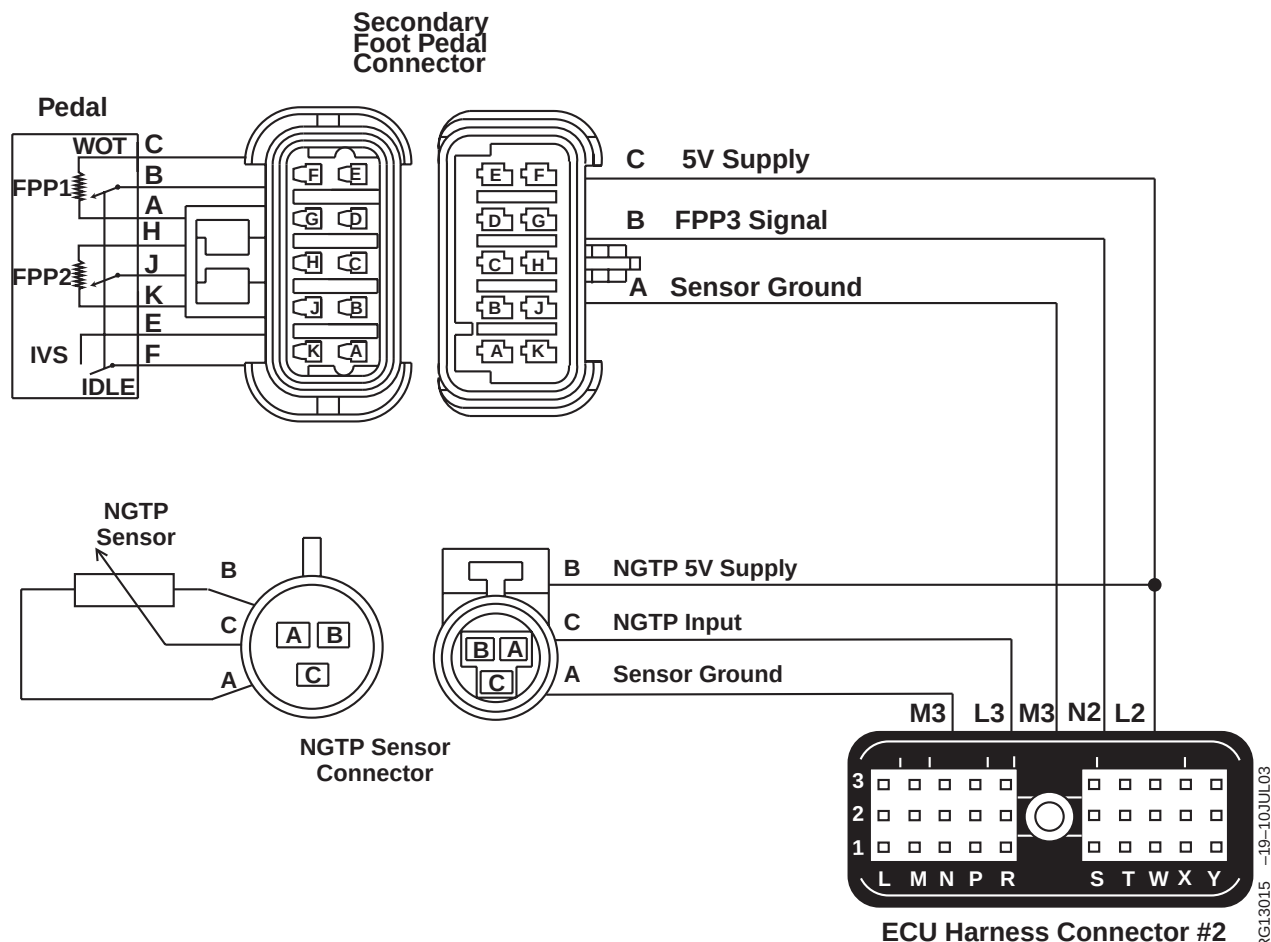
③ 5V Supply Circuit Shorted to Ground Test	<i>NOTE: For wiring and theory of operation information, see DTC 001079.04 SENSOR SUPPLY 1 VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Disconnect the ECU harness connector #2 (black L-Y) and connector #3 (white A-K) on the vehicle harness. 3. Using a multimeter, measure resistance between: • Terminal L1 in the ECU connector #2 on the vehicle harness and: – Terminal M3 in ECU connector #2 – Terminal N3 in ECU connector #2 – Terminal B1 in ECU connector #3 – Terminal B2 in ECU connector #3 – Terminal D2 in ECU connector #3	Greater than 20k ohms on all measurements: Faulty ECU connection OR Faulty ECU Any measurement 20k ohms or less: Sensor 5V supply circuit shorted to ground circuit that measured low resistance. -- -1/1
④ Faulty Sensor Test	<i>NOTE: For wiring and theory of operation information, see DTC 001079.04 SENSOR SUPPLY 1 VOLTAGE LOW supporting information.</i> 1. Ignition ON, engine OFF 2. Reconnect the Foot Pedal connector. 3. Using the ECU diagnostic software, read DTCs. <i>NOTE: Be sure to "Get Codes" after every connection to refresh the list of active codes.</i>	001079.04 reoccurs: Faulty FPP1 sensor 001079.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. -- -1/1

001080.03 — Sensor Supply 2 Voltage High

RG11886 -19-10UUL03

Continued on next page

RG41221,000027D -19-19SEP01-1/2



Sensor Supply Voltage

- The ECU supplies voltage to a few different sensors depending on application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

Sensor Supply 2

- Sensor Supply 2 supplies 5 volts to the following:
 - Humidity Sensor
 - Manifold Absolute Pressure Sensor
 - Barometric Air Pressure Sensor
 - Natural Gas Pressure Sensor

- Foot Pedal Position 3 Sensor
- Natural Gas Tank Pressure Sensor

DTC 001080.03 will set if:

- The ECU detects a supply voltage greater than 5.5 volts on the ECU 5 volt supply 2 circuit.

If DTC 001080.03 sets, the following will occur:

- Depending on the number of components the ECU is supplying 5 volts to, and the cause of the fault, engine operation may not be affected, or there may be problems with the sensors supplied 5 volts by the ECU.
- DTC 000029.03, 000102.03 000108.03, 000159.03, 299745.03, and 524281.03 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

001080.03 — Sensor Supply 2 Voltage High

The ECU detects a voltage above specification on the ECU 5 volt sensor supply circuit.

RG41221,00002B9 -19-19SEP01-1/1

001080.03 Sensor Supply 2 Voltage High Diagnostic Procedure

NOTE: If DTC 001080.03 is accompanied with 000029.03, 000102.03 000108.03, 000159.03, 299745.03, and 524281.03, diagnose 001080.03 first.

-- -1/1

❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001080.03 SENSOR SUPPLY 2 VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and all of the sensor connectors using this 5 volt supply looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.

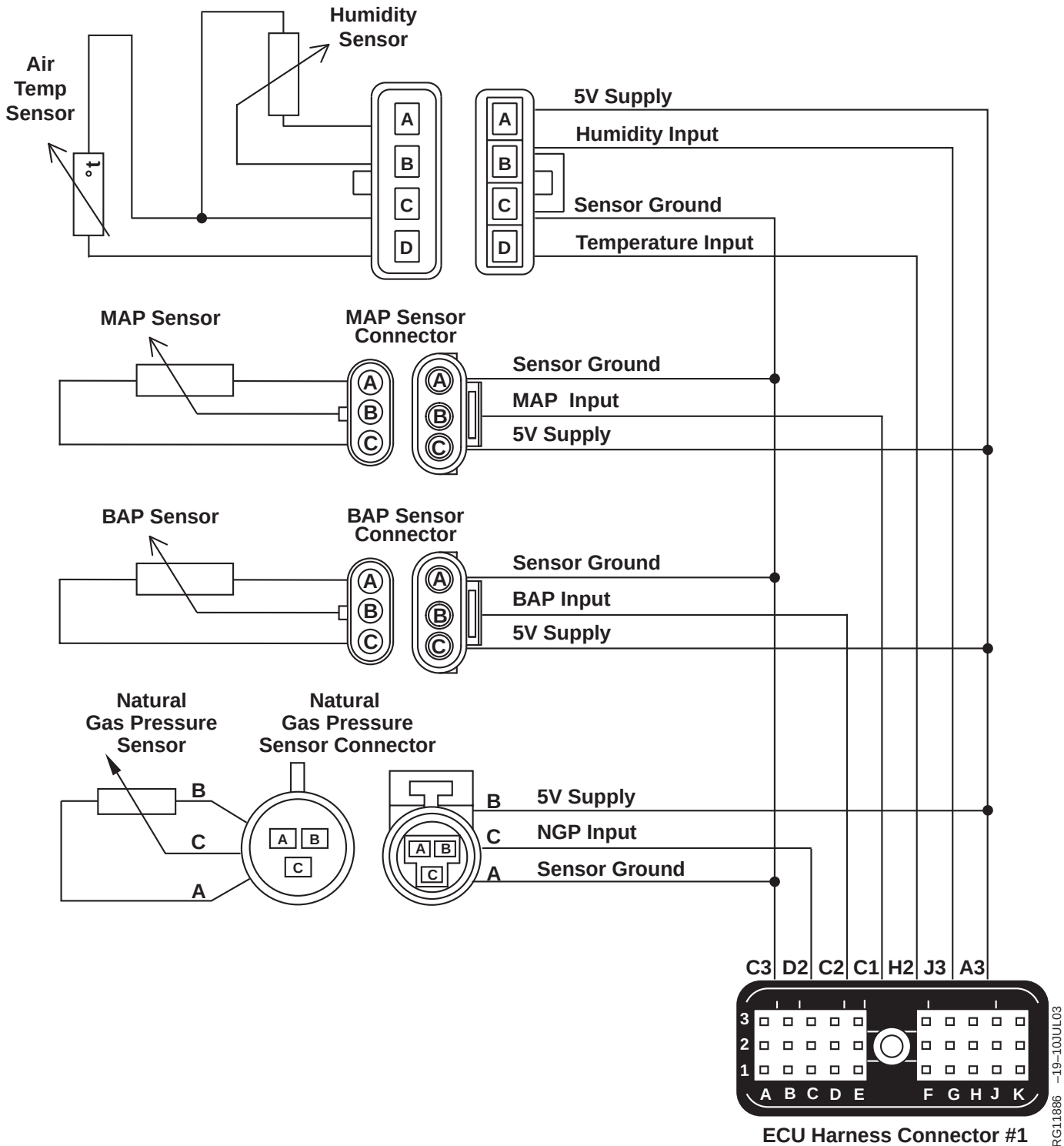
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❷ Intermittent Fault Check	<i>NOTE: For wiring and theory of operation information, see DTC 001080.03 SENSOR SUPPLY 2 VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001080.03 reoccurs: GO TO ❸ 001080.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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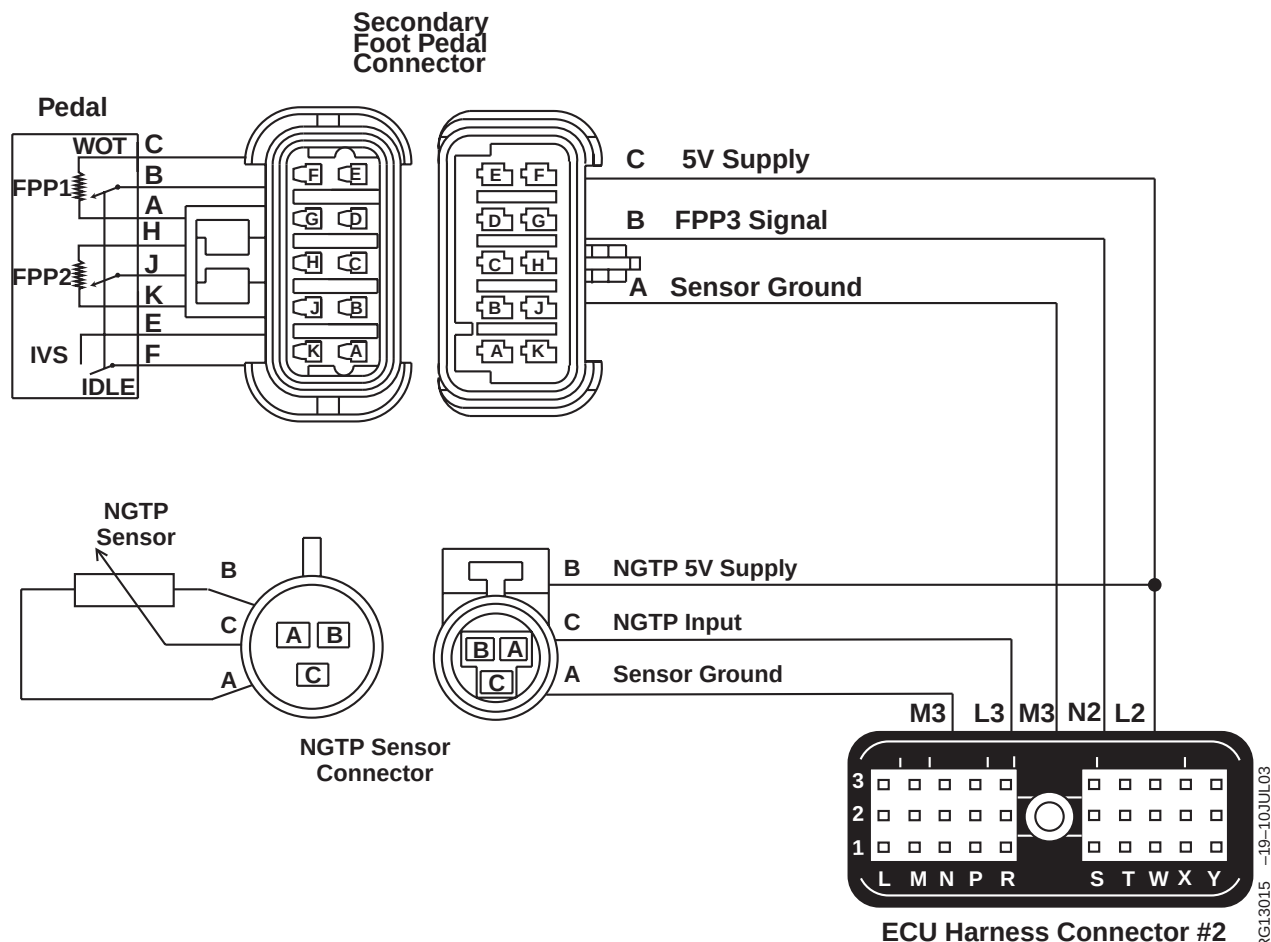
③ Short in 5V Supply Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 001080.03 SENSOR SUPPLY 2 VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect all 4 ECU connectors. 3. Using a multimeter, measure resistance between the following terminals: • Terminal A3 in the ECU connector #1 on the engine harness and all of the other terminals in ECU connector #1 and ECU connector #4. • Terminal L2 in the ECU connector #2 on the vehicle harness and all of the other terminals in ECU connector #2 and ECU connector #3.	Greater than 20k ohms on all measurements: Faulty ECU connection OR Faulty ECU. Any measurement 20k ohms or less: Sensor 5V supply circuit shorted to ECU battery voltage supply circuit. -- -1/1	115 ,463

001080.04 — Sensor Supply 2 Voltage Low

RG11886 -19-10UUL03

Continued on next page

RG41221,000027E -19-19SEP01-1/2



Sensor Supply Voltage

- The ECU supplies voltage to a few different sensors depending on application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

Sensor Supply 2

- Sensor Supply 2 supplies 5 volts to the following:
 - Humidity Sensor
 - Manifold Absolute Pressure Sensor
 - Barometric Air Pressure Sensor
 - Natural Gas Pressure Sensor

- Foot Pedal Position 3 Sensor
- Natural Gas Tank Pressure Sensor

DTC 001080.04 will set if:

- The ECU detects a supply voltage less than 4.5 volts on the ECU 5 volt supply 2 circuit.

If DTC 001080.04 sets, the following will occur:

- Depending on the number of components the ECU is supplying 5 volts to, and the cause of the fault, engine operation may not be affected, or there may be problems with the sensors supplied 5 volts by the ECU.
- DTC 000029.04, 000102.04 000108.04, 000159.04, 299745.04, and 524281.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

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,466

001080.04 — Sensor Supply 2 Voltage Low

The ECU detects a voltage below specification on the ECU 5 volt sensor supply circuit.

RG41221,00002BA -19-19SEP01-1/1

001080.04 Sensor Supply 2 Voltage Low Diagnostic Procedure

NOTE: If DTC 001080.04 is accompanied with 000029.04, 000102.04 000108.04, 000159.04, 299745.04, and 524281.04, diagnose 001080.04 first.

-- -1/1

❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 001080.04 SENSOR SUPPLY 2 VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and all of the sensor connectors using this 5 volt supply looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty Connections Found:
Repair connections and retest.

-- -1/1

② Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001080.04 SENSOR SUPPLY 2 VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of all active DTCs, then clear all DTCs 5. Ignition OFF 6. Disconnect all of the components that are supplied 5 volts by terminal A3 in the ECU harness connector #1 and terminal L2 in the ECU harness connector #2. See DTC 001080.04 SENSOR SUPPLY 2 VOLTAGE LOW supporting information for a list of all of the components. 7. Ignition ON, engine OFF 8. Read DTCs using DST or SERVICE ADVISOR™.	001080.04 reoccurs: GO TO ③ 001080.04 doesn't reoccur: GO TO ④	115 ,467
<i>SERVICE ADVISOR is a trademark of Deere & Company</i> -- -1/1			
③ 5V Supply Circuit Shorted to Ground Test	<i>NOTE: For wiring and theory of operation information, see DTC 001080.04 SENSOR SUPPLY 2 VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Disconnect all 4 ECU connectors. 3. Using a multimeter, measure resistance between: • Terminal A3 in the ECU connector #1 on the engine harness and: – Terminal C3 in ECU connector #1 – Terminal D3 in ECU connector #1 – Terminal B1 in ECU connector #3 – Terminal B2 in ECU connector #3 – Terminal D2 in ECU connector #3 • Terminal L2 in the ECU connector #2 on the vehicle harness and: – Terminal M3 in ECU connector #2 – Terminal N3 in ECU connector #2 – Terminal B1 in ECU connector #3 – Terminal B2 in ECU connector #3 – Terminal D2 in ECU connector #3	Greater than 20k ohms on all measurements: Faulty ECU connection OR Faulty ECU Any measurement 20k ohms or less: Sensor 5V supply circuit shorted to ECU ground circuit. -- -1/1	

④ Faulty Sensor Test

NOTE: For wiring and theory of operation information, see DTC 001080.04 SENSOR SUPPLY 2 VOLTAGE LOW supporting information.

1. Ignition ON, engine OFF
2. Reconnect all of the component connectors one at a time checking for 001080.04 to reoccur after each connection is made.

NOTE: Be sure to "Get Codes" after every connection to refresh the list of active codes.

001080.04 reoccurs:
Sensor that caused 001080.04 to reoccur when it was reconnected is faulty.
Replace and retest.

001080.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

001109.31 — Engine Protection Shutdown Warning

The ECU is going to shut the engine down to protect the engine from damage.

Engine Shutdown Warning:

This code informs the operator that the ECU will shut the engine down because it has detected a condition such as low fuel pressure, water in fuel, low oil pressure, high engine coolant temperature, ECU error or low coolant level. If the ECU is programmed with engine protection with shutdown, the ECU has shut the engine down within 30 seconds. Prior to shutdown, the engine will be derated.

DTC 001109.31 will set if:

- The ECU detects low oil pressure.
- The ECU detects a high engine coolant temperature.
- The ECU detects low coolant level.

If DTC 001109.31 sets, the following will occur:

- If the ECU has engine protection with shutdown, it will derate the engine for 30 seconds and will shut the engine down.

If DTC 001109.31 sets:

- If DTC 000100.01 is active, see DTC 000100.01 ENGINE OIL PRESSURE EXTREMELY LOW DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 000110.00 is active, see DTC 000110.00 ENGINE COOLANT TEMPERATURE EXTREMELY HIGH DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 000111.01 is active, see DTC 000111.01 ENGINE COOLANT LEVEL LOW DIAGNOSTIC PROCEDURE earlier in this Group.

RG41221,0000167 -19-29MAY03-1/1

001110.31 — Engine Protection Shutdown

The ECU shut the engine down to protect the engine from damage.

Engine Protection Shutdown:

This code informs the operator that the ECU shut the engine down because it has detected a condition such as low oil pressure or high engine coolant temperature. If the ECU is programmed with engine protection with shutdown, the ECU has shut the engine down. For further engine protection information, see ENGINE PROTECTION in Group 100 earlier in this manual.

DTC 001110.31 will set if:

- The ECU detects low oil pressure.
- The ECU detects a high engine coolant temperature.
- The ECU detects low coolant level.

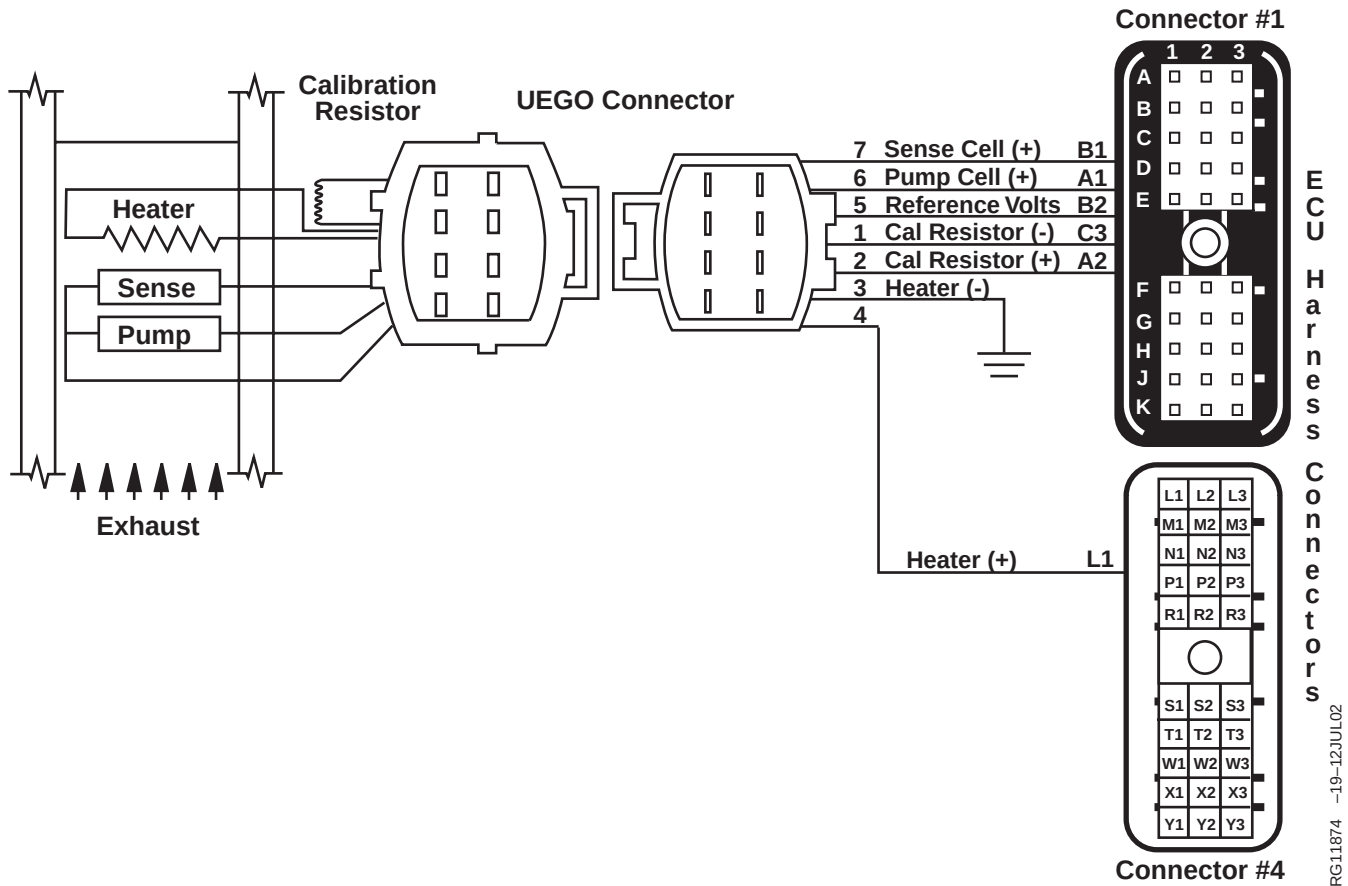
If DTC 001110.31 sets, the following will occur:

- The ECU will have shut the engine down.
- DTC 1109.31 will also be present.
- ECU will set a SOLID STOP light.
- Ignition switch must be cycled OFF and then back ON before ECU will reset.

If DTC 001110.31 sets:

- If DTC 000100.01 is active, see DTC 000100.01 ENGINE OIL PRESSURE EXTREMELY LOW DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 000110.00 is active, see DTC 000110.00 ENGINE COOLANT TEMPERATURE EXTREMELY HIGH DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 000111.01 is active, see DTC 000111.01 ENGINE COOLANT LEVEL LOW DIAGNOSTIC PROCEDURE earlier in this Group.

RG41221.0000369 -19-08MAY02-1/1

001119.00 — Exhaust Extremely Lean**Closed Loop Multiplier**

- When the control system is operating in closed loop, the UEGO sensor is used to determine the air/fuel ratio. When a lean condition is measured, the ECU will increase the amount of fuel delivered; when a rich condition is measured, the ECU will decrease the amount of fuel delivered. The closed loop multiplier is the percent increase or decrease in mass fuel flow that the ECU commands in order to richen or lean the air/fuel mixture.

DTC 001119.00 will set if:

- ECU measures a lean exhaust condition, increased the amount of fuel delivered by increasing the closed loop multiplier, but reached the high limit for normal operation. Desired Phi is 5% or more higher than Actual Phi.

If DTC 001119.00 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 80% per minute to a maximum derate of 40%. When the actual Phi and desired Phi are back within specification, power will NOT increase until key switch is cycled OFF/ON.
- Adaptive learn will be disabled for the remainder of key-ON cycle
- DTC 001119.016 will also be present.
- DTC 000159.18 Natural Gas Pressure Lower Than Expected or other UEGO sensor codes may also be present. Diagnose those codes first.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

001119.00 — Exhaust Extremely Lean

Desired Phi is 5% or more higher than Actual Phi.

RG41221,00002D6 -19-12DEC01-1/1

001119.00 Exhaust Extremely Lean Diagnostic Procedure

NOTE: If DTC 001119.00 is accompanied with any of the following DTCs, diagnose them first:

- 000159.18
- 000174.18
- 000724.02
- 524283.03 or 524283.04
- 524284.03 or 524284.04
- 524285.03 or 524285.04
- 524286.02
- 524287.03 or 524287.04

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 001119.00 EXHAUST EXTREMELY LEAN supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO ❸ of this procedure.

No faulty connection(s):
GO TO ❷

Faulty Connections Found:
Repair connections and retest.

-- -1/1

2 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 001119.00 EXHAUST EXTREMELY LEAN supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Ignition ON, engine running
5. Using DST or SERVICE ADVISOR™, read Phi - Actual and Phi - Desired parameters.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 5 of this procedure.

Phi - Actual is more than 5% more than Phi - Desired:
GO TO 3

Phi - Actual is less than 5% more than Phi - Desired:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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3 Injector Cutout Test

NOTE: For wiring and theory of operation information, see DTC 001119.00 EXHAUST EXTREMELY LEAN supporting information.

Using the ECU diagnostic software, run the Injector Cutout Test. See ENGINE TEST INSTRUCTIONS — INJECTOR CUTOFF TEST earlier in this Group.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 5 of this procedure.

Injectors working properly:
GO TO 4

Faulty injector(s):
See F3 - FUEL INJECTOR DIAGNOSTIC CHECK in Group 105 earlier in this manual.

-- -1/1

4 Injector Clean Test

NOTE: For wiring and theory of operation information, see DTC 001119.00 EXHAUST EXTREMELY LEAN supporting information.

Clean injectors using JT07281 Injector Accessory Kit, JT07282 Fuel Injector Cleaner, and JT07283 Pro Inject-R Kleen. See ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 5 of this procedure.

Engine runs smooth:
Engine is fixed.

Engine still misses/runs rough:
Faulty UEGO sensor
OR
Faulty ECU connection
OR
Faulty ECU

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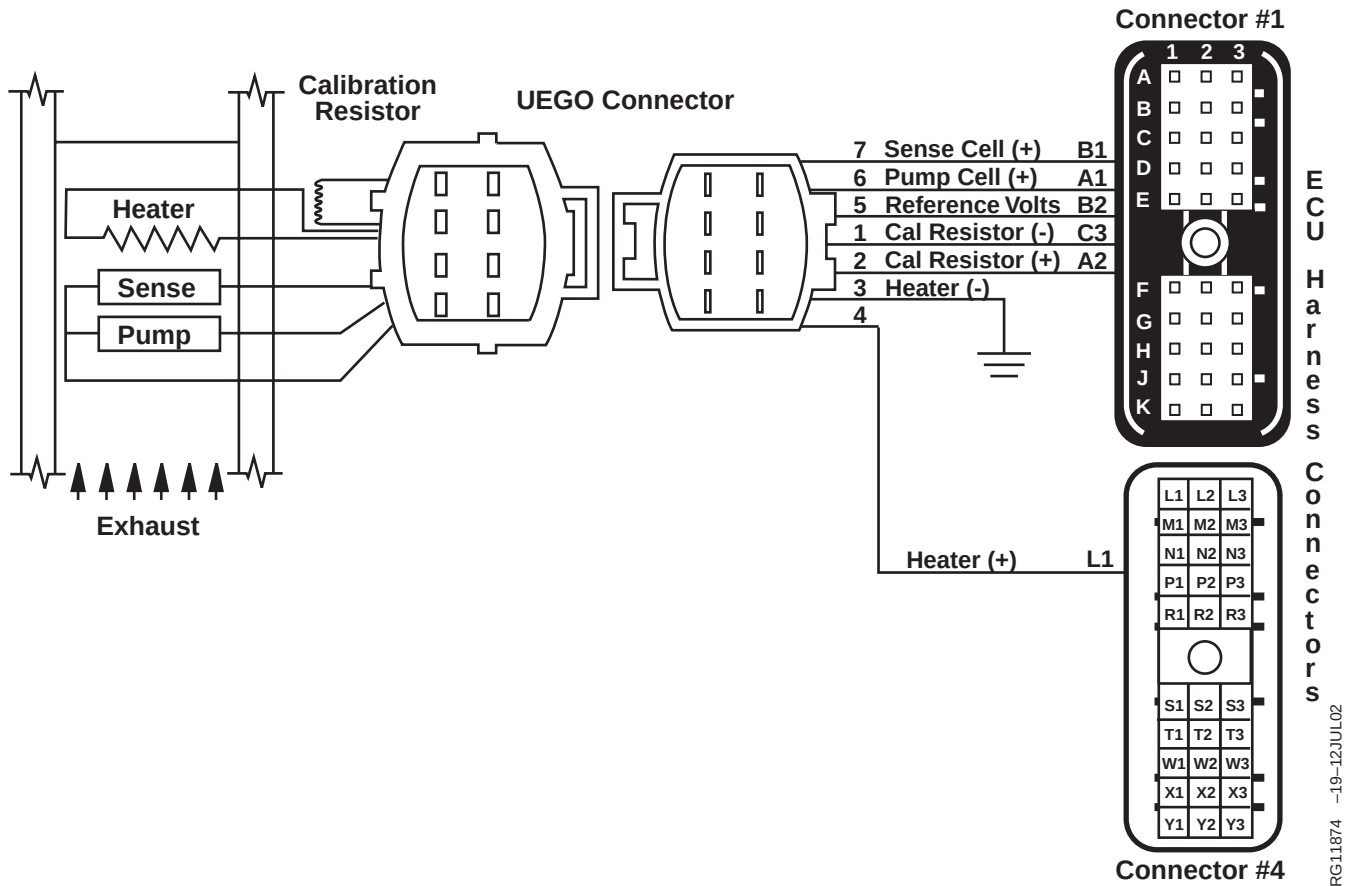
5 Clear Adaptive Learn Table

NOTE: For wiring and theory of operation information, see DTC 001119.00 EXHAUST EXTREMELY LEAN supporting information.

1. Ignition ON, engine OFF
2. Using the ECU diagnostic software, read Adaptive Learn Multiplier.
3. Cycle the foot pedal from 0% to 100% ten times within a ten second interval.
4. Ignition OFF for at least 10 seconds.
5. Key ON, engine running
6. Verify Adaptive Learn Multiplier has been reset to 0%. If not, retry procedure again.

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001119.01 — Exhaust Extremely Rich**Adaptive Learn Multiplier**

- Adaptive learn acts as a fuel correction memory. Each time the closed loop system is “successful” in achieving the optimum air/fuel ratio, the adaptive learn “remembers” the fuel correction and uses it in the future. The adaptive learn multiplier is the percent increase or decrease in mass fuel flow that the ECU commanded in order to richen or lean the air/fuel mixture.

DTC 001119.01 will set if:

- ECU measures a rich exhaust condition, decreased the amount of fuel delivered by decreasing the closed loop multiplier, but reached the high limit for normal operation. Actual Phi is 5% or more higher than Desired Phi.

If DTC 001119.01 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 80% per minute to a maximum derate of 40%. When the actual Phi and desired Phi are back within specification, power will NOT increase until key switch is cycled OFF/ON.
- Adaptive learn will be disabled for the remainder of key-ON cycle
- DTC 000102.02 may also be present.
- DTC 001119.18 will also be present.
- UEGO sensor codes may also be present. Diagnose those codes first.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

001119.01 — Exhaust Extremely Rich

Actual Phi is 5% or more higher than Desired Phi.

RG41221,000031E -19-07JAN02-1/1

001119.01 Exhaust Extremely Rich Diagnostic Procedure

NOTE: If DTC 001119.018 is accompanied with any of the following DTCs, diagnose them first:

- 000102.02
- 000724.02
- 524283.03 or 524283.04
- 524284.03 or 524284.04
- 524285.03 or 524285.04
- 524286.02
- 524287.03 or 524287.04

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 7 of this procedure.

-- -1/1

① Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001119.01 EXHAUST EXTREMELY RICH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals. <i>NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO ⑧ of this procedure.</i>	No faulty connection(s): GO TO ② Faulty Connections Found: Repair connections and retest.

-- -1/1

2 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 001119.01 EXHAUST EXTREMELY RICH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Using DST or SERVICE ADVISOR™, read Phi - Actual and Phi - Desired parameters.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.

Phi - Actual is more than 5% less than Phi - Desired:
GO TO 3

Phi - Actual is not 5% less than Phi - Desired:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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3 Injector Cutout Test

NOTE: For wiring and theory of operation information, see DTC 001119.01 EXHAUST EXTREMELY RICH supporting information.

Using the ECU diagnostic software, run the Injector Cutout Test. See ENGINE TEST INSTRUCTIONS — INJECTOR CUTOFF TEST earlier in this Group.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.

Injectors working properly:
GO TO 4

Faulty injector(s):
See F3 - FUEL INJECTOR DIAGNOSTIC CHECK in Group 105 earlier in this manual.

-- -1/1

4 Spark Cutout Test

NOTE: For wiring and theory of operation information, see DTC 001119.01 EXHAUST EXTREMELY RICH supporting information.

1. Ignition ON, engine running
2. Using the ECU diagnostic software, run the Spark Cutout Test for each coil. See ENGINE TEST INSTRUCTIONS - SPARK CUTOFF TEST in Group 115 later in this manual.

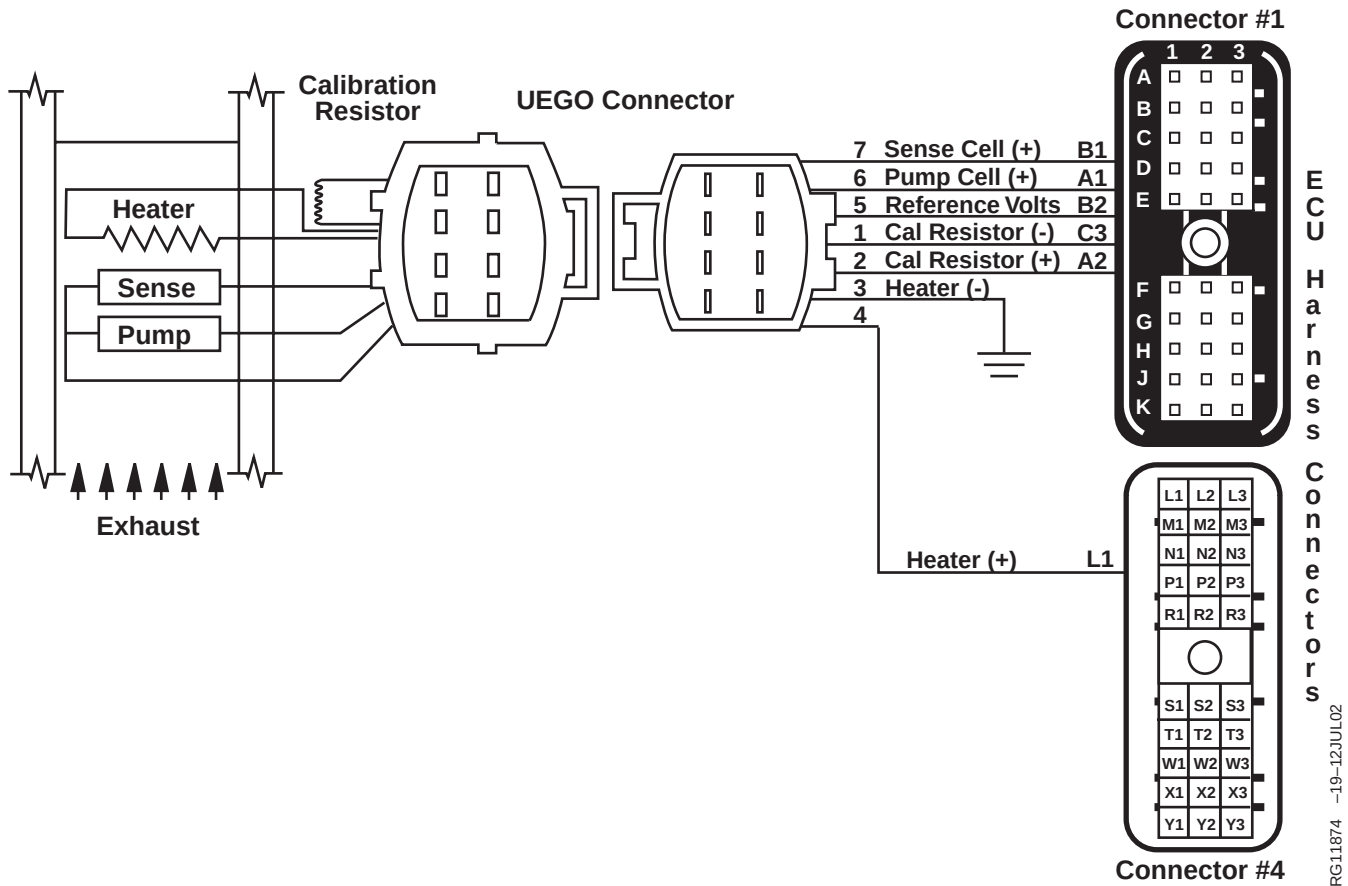
NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.

All coils firing:
GO TO 5

One or more coils not firing:
See F2 - IGNITION SYSTEM TEST later in this Group.

-- -1/1

5 Inlet Air Restriction Test	<i>NOTE: For wiring and theory of operation information, see DTC 001119.01 EXHAUST EXTREMELY RICH supporting information.</i> Check all air supply lines for possible leaks or damage. <i>NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.</i>	No Leaks or damage: GO TO 6 Leaks or damage found: Repair or replace and retest. ---1/1
6 Cross Check Test	<i>NOTE: For wiring and theory of operation information, see DTC 001119.01 EXHAUST EXTREMELY RICH supporting information.</i> 1. Ignition OFF 2. Ignition ON, engine OFF 3. Using the ECU diagnostic software, check for DTC 000102.02 to set. <i>NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.</i>	000102.02 doesn't set: GO TO 7 000102.02 sets: GO TO 000102.02 diagnostic procedure. ---1/1
7 Injector Clean Test	<i>NOTE: For wiring and theory of operation information, see DTC 001119.01 EXHAUST EXTREMELY RICH supporting information.</i> Clean injectors using JT07281 Injector Accessory Kit, JT07282 Fuel Injector Cleaner, and JT07283 Pro Inject-R Kleen. See ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual. <i>NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.</i>	Engine runs smooth: Engine is fixed. Engine still misses/runs rough: Faulty UEGO sensor OR Faulty ECU connection OR Faulty ECU ---1/1
8 Clear Adaptive Learn Table	<i>NOTE: For wiring and theory of operation information, see DTC 001119.01 EXHAUST EXTREMELY RICH supporting information.</i> 1. Ignition ON, engine OFF 2. Using the ECU diagnostic software, read Adaptive Learn Multiplier. 3. Cycle the foot pedal from 0% to 100% ten times within a ten second interval. 4. Ignition OFF for at least 10 seconds. 5. Key ON, engine running 6. Verify Adaptive Learn Multiplier has been reset to 0%. If not, retry procedure again.	---1/1

001119.16 — Exhaust Moderately Lean**Closed Loop Multiplier**

- When the control system is operating in closed loop, the UEGO sensor is used to determine the air/fuel ratio. When a lean condition is measured, the ECU will increase the amount of fuel delivered; when a rich condition is measured, the ECU will decrease the amount of fuel delivered. The closed loop multiplier is the percent increase or decrease in mass fuel flow that the ECU commands in order to richen or lean the air/fuel mixture.

DTC 001119.16 will set if:

- Desired Phi is 2.5% or more higher than Actual Phi.

ECU measures a lean exhaust condition, increased the amount of fuel delivered by increasing the closed loop multiplier, but reached the moderately high limit for normal operation. Actual Phi is > 2.5% more than Desire Phi.

If DTC 001119.16 sets, the following will occur:

- Adaptive learn will be disabled for the remainder of key-ON cycle
- DTC 000159.18 may also be present.
- DTC 000174.18 may also be present.
- DTC 001119.00 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

001119.16 — Exhaust Moderately Lean

Actual Phi is > 2.5% more than Desire Phi.

RG41221,000031F -19-07JAN02-1/1

001119.16 Exhaust Moderately Lean Diagnostic Procedure

NOTE: If DTC 001119.16 is accompanied with any of the following DTCs, diagnose them first:

- 000159.18
- 000174.18
- 000724.02
- 524283.03 or 524283.04
- 524284.03 or 524284.04
- 524285.03 or 524285.04
- 524286.02
- 524287.03 or 524287.04

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO ⑤ of this procedure.

-- -1/1

① Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001119.16 EXHAUST MODERATELY LEAN supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals. <i>NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO ⑤ of this procedure.</i>	No faulty connection(s): GO TO ② Faulty Connections Found: Repair connections and retest.

-- -1/1

2 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 001119.16 EXHAUST MODERATELY LEAN supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running under heavy load.
6. Using DST or SERVICE ADVISOR™, read Phi - Actual and Phi - Desired parameters.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 5 of this procedure.

Phi - Actual is more than 2.5% more than Phi - Desired:
GO TO 3

Phi - Actual is not 2.5% more than Phi - Desired:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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3 Injector Cutout Test

NOTE: For wiring and theory of operation information, see DTC 001119.16 EXHAUST MODERATELY LEAN supporting information.

Using the ECU diagnostic software, run the Injector Cutout Test. See ENGINE TEST INSTRUCTIONS — INJECTOR CUTOUT TEST earlier in this Group.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 5 of this procedure.

Injectors working properly:
GO TO 4

Faulty injector(s):
See F3 - FUEL INJECTOR DIAGNOSTIC CHECK in Group 105 earlier in this manual.

-- -1/1

4 Injector Clean Test

NOTE: For wiring and theory of operation information, see DTC 001119.16 EXHAUST MODERATELY LEAN supporting information.

Clean injectors using JT07281 Injector Accessory Kit, JT07282 Fuel Injector Cleaner, and JT07283 Pro Inject-R Kleen. See ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 5 of this procedure.

Engine runs smooth:
Engine is fixed.

Engine still misses/runs rough:
Faulty UEGO sensor
OR
Faulty ECU connection
OR
Faulty ECU

-- -1/1

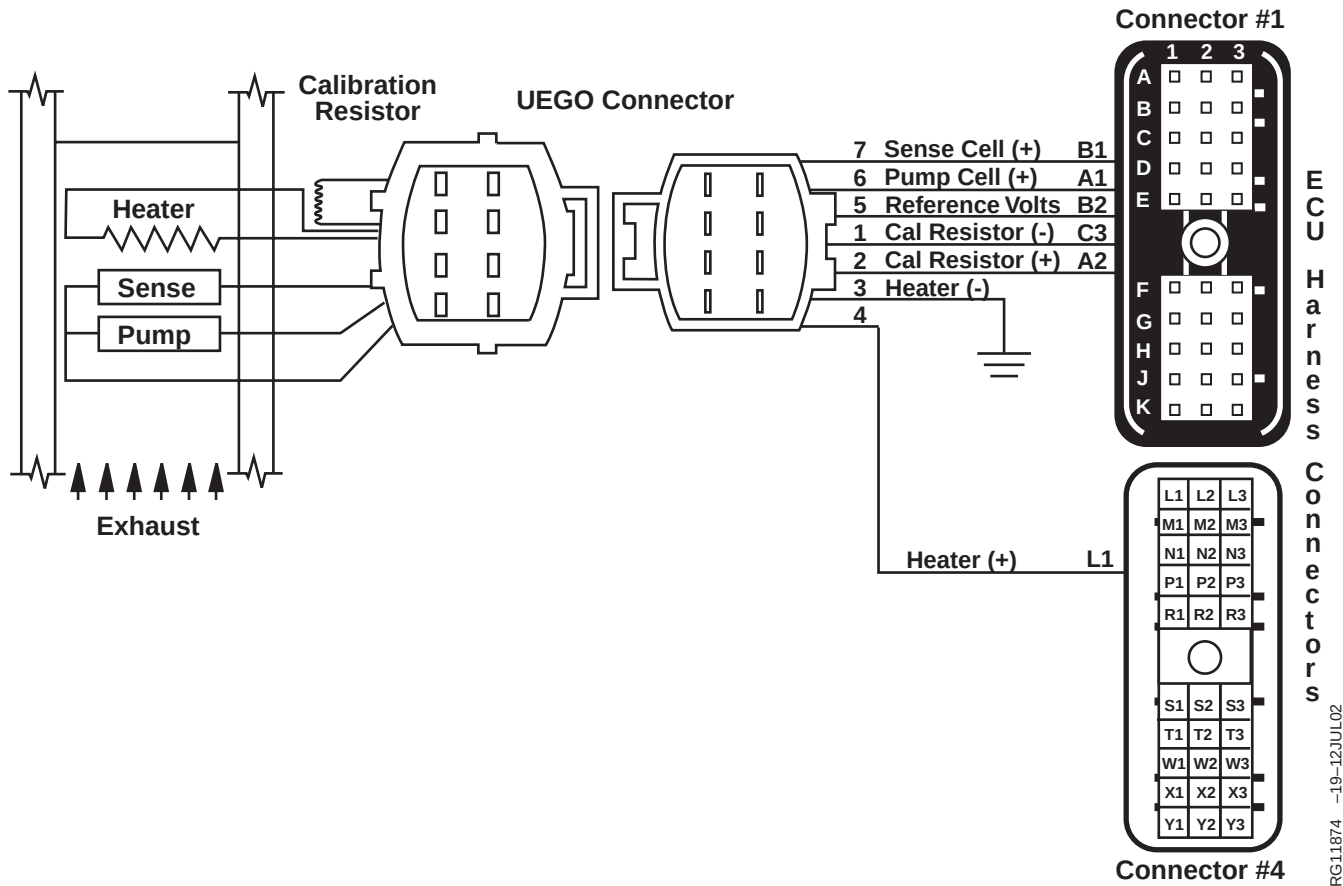
5 Clear Adaptive Learn Table

NOTE: For wiring and theory of operation information, see DTC 001119.16 EXHAUST MODERATELY LEAN supporting information.

1. Ignition ON, engine OFF
2. Using the ECU diagnostic software, read Adaptive Learn Multiplier.
3. Cycle the foot pedal from 0% to 100% ten times within a ten second interval.
4. Ignition OFF for at least 10 seconds.
5. Key ON, engine running
6. Verify Adaptive Learn Multiplier has been reset to 0%. If not, retry procedure again.

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001119.18 — Exhaust Moderately Rich**Adaptive Learn Multiplier**

- Adaptive learn acts as a fuel correction memory. Each time the closed loop system is "successful" in achieving the optimum air/fuel ratio, the adaptive learn "remembers" the fuel correction and uses it in the future. The adaptive learn multiplier is the percent increase or decrease in mass fuel flow that the ECU commanded in order to richen or lean the air/fuel mixture.

DTC 001119.18 will set if:

- ECU measures a rich exhaust condition, decreased the amount of fuel delivered by decreasing the

closed loop multiplier, but reached the moderately high limit for normal operation. Actual Phi is 2.5% or more higher than Desired Phi.

If DTC 001119.18 sets, the following will occur:

- Adaptive learn will be disabled for the remainder of key-ON cycle
- DTC 000102.02 may also be present.
- DTC 001119.1 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

001119.18 — Exhaust Moderately Rich

Actual Phi is 2.5% or more higher than Desired Phi.

RG41221,0000320 -19-07JAN02-1/1

001119.18 Exhaust Moderately Rich Diagnostic Procedure

NOTE: If DTC 001119.18 is accompanied with any of the following DTCs, diagnose them first:

- 000102.02
- 000724.02
- 524283.03 or 524283.04
- 524284.03 or 524284.04
- 524285.03 or 524285.04
- 524286.02
- 524287.03 or 524287.04

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 7 of this procedure.

-- -1/1

1 Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001119.18 EXHAUST MODERATELY RICH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals. <i>NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 7 of this procedure.</i>	No faulty connection(s): GO TO 2 Faulty Connections Found: Repair connections and retest.

-- -1/1

2 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 001119.18 EXHAUST MODERATELY RICH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Ignition ON, engine running
5. Using DST or SERVICE ADVISOR™, read Phi - Actual and Phi - Desired.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.

Phi - Desired is 2.5% or more than Phi - Actual:
GO TO 3

Phi - Desired is not 2.5% or more than Phi - Actual:

Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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3 Injector Cutout Test

NOTE: For wiring and theory of operation information, see DTC 001119.18 EXHAUST MODERATELY RICH supporting information.

Using the ECU diagnostic software, run the Injector Cutout Test. See ENGINE TEST INSTRUCTIONS — INJECTOR CUTOUT TEST earlier in this Group.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.

Injectors working properly:
GO TO 4

Faulty injector(s):

See F3 - FUEL INJECTOR DIAGNOSTIC CHECK in Group 105 earlier in this manual.

-- -1/1

4 Spark Cutout Test

NOTE: For wiring and theory of operation information, see DTC 001119.18 EXHAUST MODERATELY RICH supporting information.

1. Ignition ON, engine running
2. Using the ECU diagnostic software, run the Spark Cutout Test for each coil. See ENGINE TEST INSTRUCTIONS - SPARK CUTOUT TEST in Group 115 later in this manual.

NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.

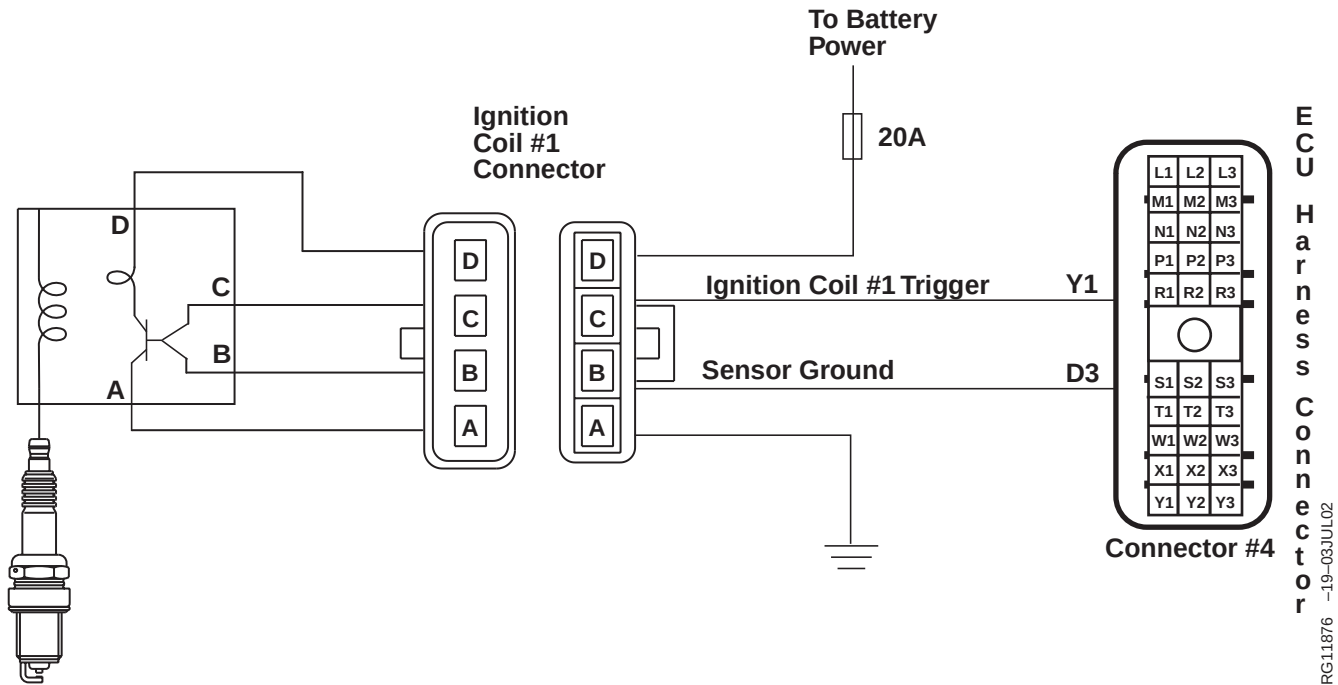
All coils firing:
GO TO 5

One or more coils not firing:

See F2 - IGNITION SYSTEM TEST later in this Group.

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5 Inlet Air Restriction Test	<i>NOTE: For wiring and theory of operation information, see DTC 001119.18 EXHAUST MODERATELY RICH supporting information.</i> Check all air supply lines for possible leaks or damage. <i>NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.</i>	No Leaks or damage: GO TO 5 Leaks or damage found: Repair or replace and retest. -- -1/1
6 Cross Check Test	<i>NOTE: For wiring and theory of operation information, see DTC 001119.18 EXHAUST MODERATELY RICH supporting information.</i> 1. Ignition OFF 2. Ignition ON, engine OFF 3. Using the ECU diagnostic software, check for DTC 000102.02 to set. <i>NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.</i>	000102.02 doesn't set: GO TO 6 000102.02 sets: GO TO 000102.02 diagnostic procedure. -- -1/1
7 Injector Clean Test	<i>NOTE: For wiring and theory of operation information, see DTC 001119.18 EXHAUST MODERATELY RICH supporting information.</i> Clean injectors using JT07281 Injector Accessory Kit, JT07282 Fuel Injector Cleaner, and JT07283 Pro Inject-R Kleen. See ENGINE TEST INSTRUCTIONS — INJECTOR CLEANING in Group 115 later in this manual. <i>NOTE: Once the cause of this code has been repaired, the Adaptive Learn Table will need to be cleared. To clear the Adaptive Learn Table GO TO 8 of this procedure.</i>	Engine runs smooth: Engine is fixed. Engine still misses/runs rough: Faulty UEGO sensor OR Faulty ECU connection OR Faulty ECU -- -1/1
8 Clear Adaptive Learn Table	<i>NOTE: For wiring and theory of operation information, see DTC 001119.18 EXHAUST MODERATELY RICH supporting information.</i> 1. Ignition ON, engine OFF 2. Using the ECU diagnostic software, read Adaptive Learn Multiplier. 3. Cycle the foot pedal from 0% to 100% ten times within a ten second interval. 4. Ignition OFF for at least 10 seconds. 5. Key ON, engine running 6. Verify Adaptive Learn Multiplier has been reset to 0%. If not, retry procedure again.	-- -1/1

001268.03 — Ignition Coil #1 Input Voltage High

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #1 fires cylinder #1.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001268.03 will set if:

The ECU senses an open or short to voltage in the ignition trigger circuit.

If DTC 001268.03 sets, the following will occur:

- Ignition coil #1 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001268.03 — Ignition Coil #1 Input Voltage High

The ECU senses an open or short to voltage in the ignition trigger circuit.

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001268.03 Ignition Coil #1 Input Voltage High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001268.03 IGNITION COIL #1 INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #1 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001268.03 IGNITION COIL #1 INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001268.03 reoccurs: GO TO ❸ 001268.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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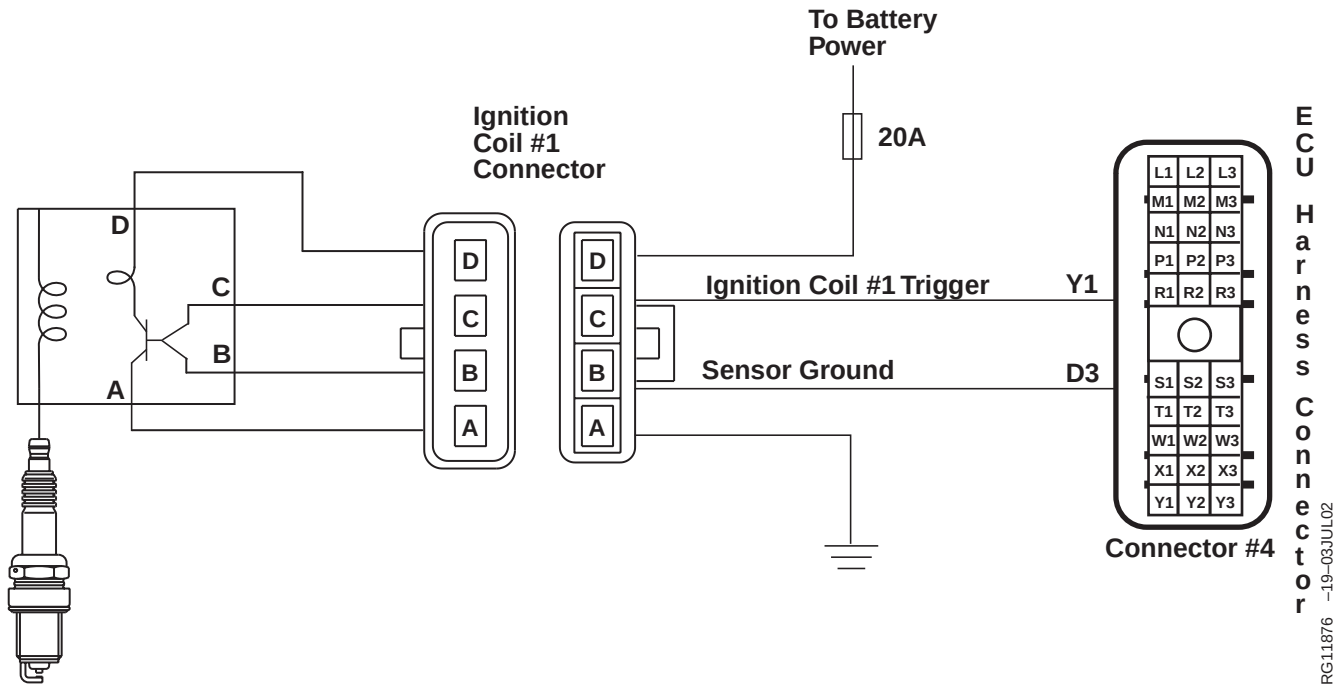
③ Trigger Wire Test

NOTE: For wiring and theory of operation information, see DTC 001268.03 IGNITION COIL #1 INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #4 (white L-Y) and the ignition coil #1 connector.
3. Using a multimeter, measure resistance between terminal Y1 in the ECU connector and terminal C in the ignition coil #1 connector.

5 ohms or less:
Faulty ECU connection
OR
Faulty ignition coil #1
OR
Faulty ECU

Greater than 5 ohms:
Open in the ignition coil
#1 trigger circuit
OR
Short to power in the
ignition coil #1 trigger
circuit

001268.04 — Ignition Coil #1 Input Voltage Low

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #1 fires cylinder #1.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001268.04 will set if:

The ECU senses a short to ground in the ignition trigger circuit.

If DTC 001268.04 sets, the following will occur:

- Ignition coil #1 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001268.04 — Ignition Coil #1 Input Voltage Low

The ECU senses a short to ground in the ignition trigger circuit.

RG41221.00002DC -19-13DEC01-1/1

001268.04 Ignition Coil #1 Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001268.04 IGNITION COIL #1 INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #1 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001268.04 IGNITION COIL #1 INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001268.04 reoccurs: GO TO ❸ 001268.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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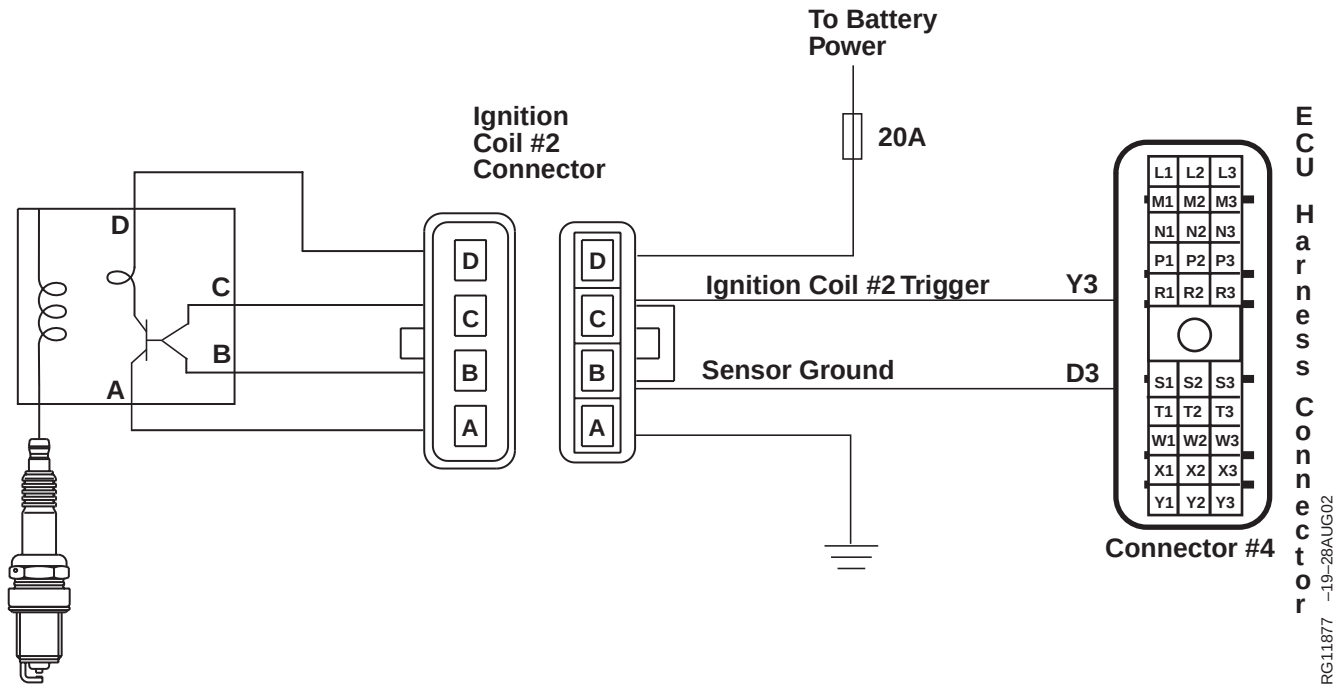
③ Trigger Wire Test

NOTE: For wiring and theory of operation information, see DTC 001268.04 IGNITION COIL #1 INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect ignition coil #1 connector.
3. Using a multimeter, measure resistance between the following:
 - Terminals A and C in the ignition coil #1 connector on the engine harness.
 - Terminals B and C in the ignition coil #1 connector on the engine harness.

5 ohms or less:
Short to ground in the ignition coil #1 trigger circuit

Greater than 5 ohms:
Faulty ECU connection
OR
Faulty ignition coil #1
OR
Faulty ECU

001269.03 — Ignition Coil #2 Input Voltage High

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #2 fires cylinder #2.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001269.03 will set if:

The ECU senses an open or short to voltage in the ignition trigger circuit.

If DTC 001269.03 sets, the following will occur:

- Ignition coil #2 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001269.03 — Ignition Coil #2 Input Voltage High

The ECU senses an open or short to voltage in the ignition trigger circuit.

RG41221,00002DE -19-13DEC01-1/1

001269.03 Ignition Coil #2 Input Voltage High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001269.03 IGNITION COIL #2 INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #2 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001269.03 IGNITION COIL #2 INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001269.03 reoccurs: GO TO ❸ 001269.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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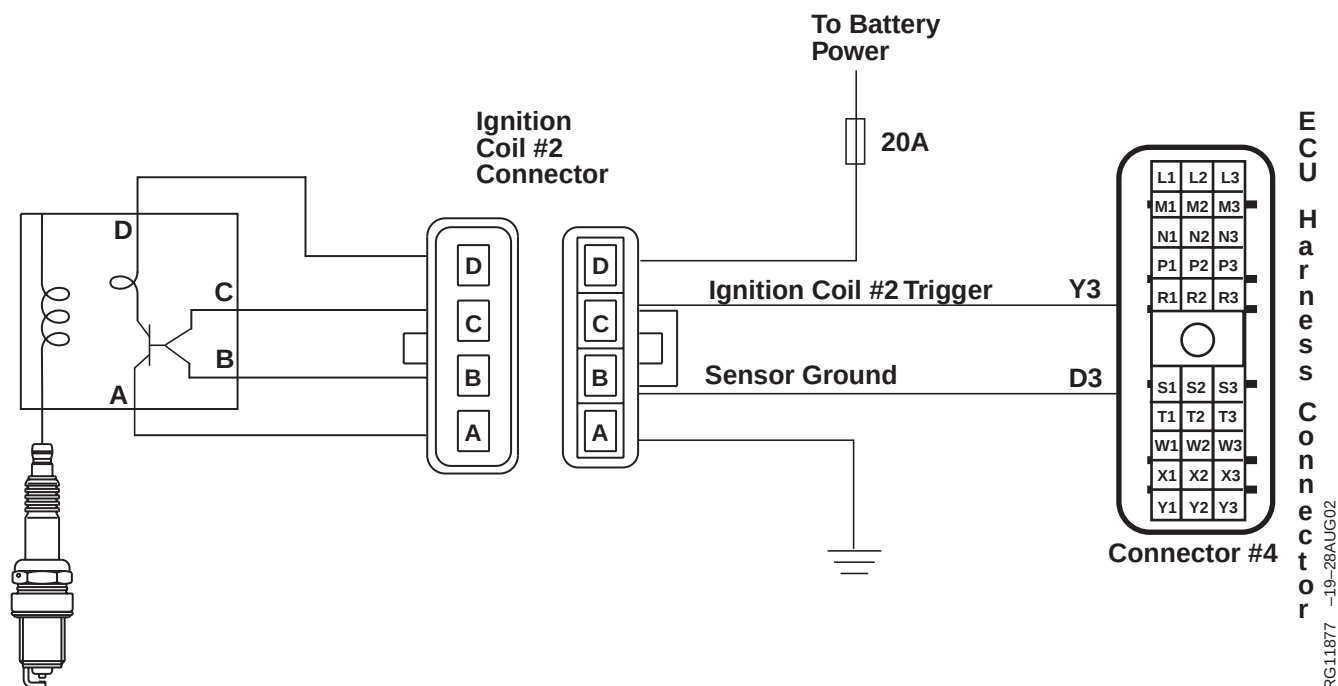
③ Trigger Wire Test

NOTE: For wiring and theory of operation information, see DTC 001269.03 IGNITION COIL #2 INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #4 (white L-Y) and the ignition coil #2 connector.
3. Using a multimeter, measure resistance between terminal Y3 in the ECU connector and terminal C in the ignition coil #2 connector.

5 ohms or less:
Faulty ECU connection
OR
Faulty ignition coil #2
OR
Faulty ECU

Greater than 5 ohms:
Open in the ignition coil
#2 trigger circuit
OR
Short to power in the
ignition coil #2 trigger
circuit

001269.04 — Ignition Coil #2 Input Voltage Low

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #2 fires cylinder #2.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001269.04 will set if:

The ECU senses a short to ground in the ignition trigger circuit.

If DTC 001269.04 sets, the following will occur:

- Ignition coil #2 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001269.04 — Ignition Coil #2 Input Voltage Low

The ECU senses a short to ground in the ignition trigger circuit.

RG41221.00002DD -19-13DEC01-1/1

001269.04 Ignition Coil #2 Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001269.04 IGNITION COIL #2 INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #2 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001269.04 IGNITION COIL #2 INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001269.04 reoccurs: GO TO ❸ 001269.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Trigger Wire Test

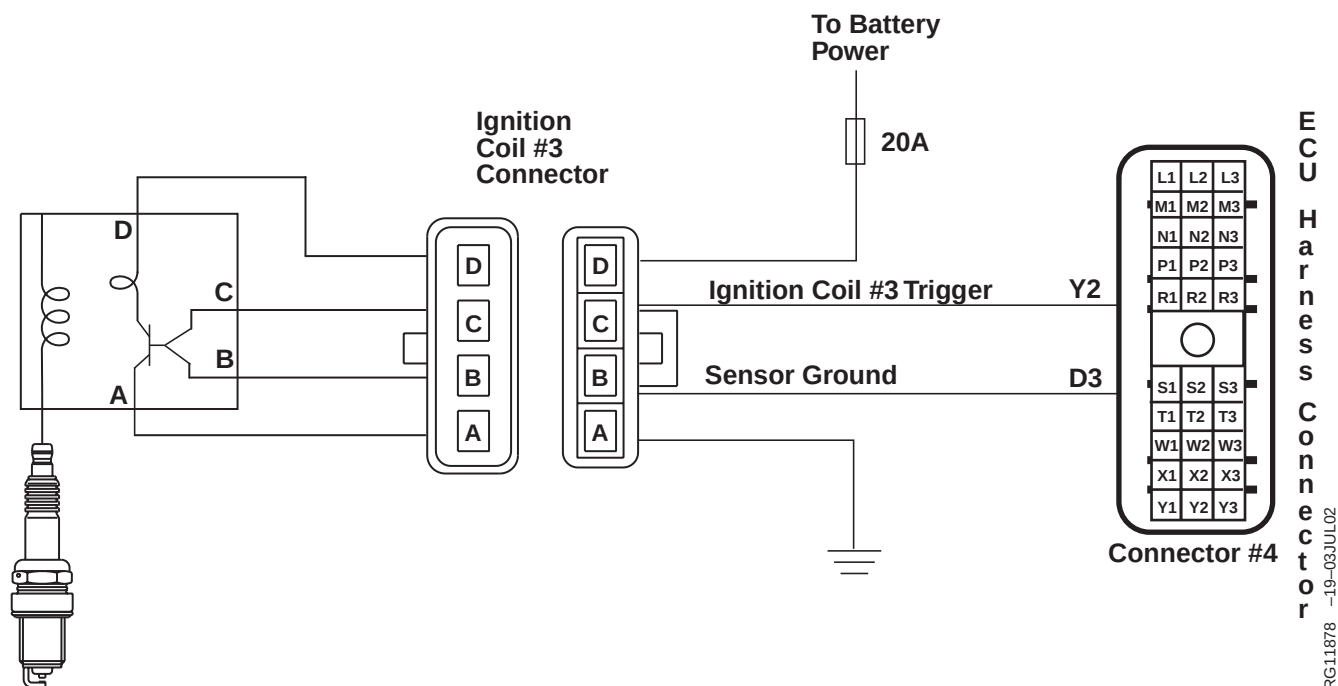
NOTE: For wiring and theory of operation information, see DTC 001269.04 IGNITION COIL #2 INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect ignition coil #2 connector.
3. Using a multimeter, measure resistance between the following:
 - Terminals A and C in the ignition coil #2 connector on the engine harness.
 - Terminals B and C in the ignition coil #2 connector on the engine harness.

5 ohms or less:
Short to ground in the ignition coil #2 trigger circuit

Greater than 5 ohms:
Faulty ECU connection
OR
Faulty ignition coil #2
OR
Faulty ECU

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001270.03 — Ignition Coil #3 Input Voltage High

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #3 fires cylinder #3.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001270.03 will set if:

The ECU senses an open or short to voltage in the ignition trigger circuit.

If DTC 001270.03 sets, the following will occur:

- Ignition coil #3 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001270.03 — Ignition Coil #3 Input Voltage High

The ECU senses an open or short to voltage in the ignition trigger circuit

RG41221,00002DF -19-13DEC01-1/1

001270.03 Ignition Coil #3 Input Voltage High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001270.03 IGNITION COIL #3 INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #3 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001270.03 IGNITION COIL #3 INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001270.03 reoccurs: GO TO ❸ 001270.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Trigger Wire Test

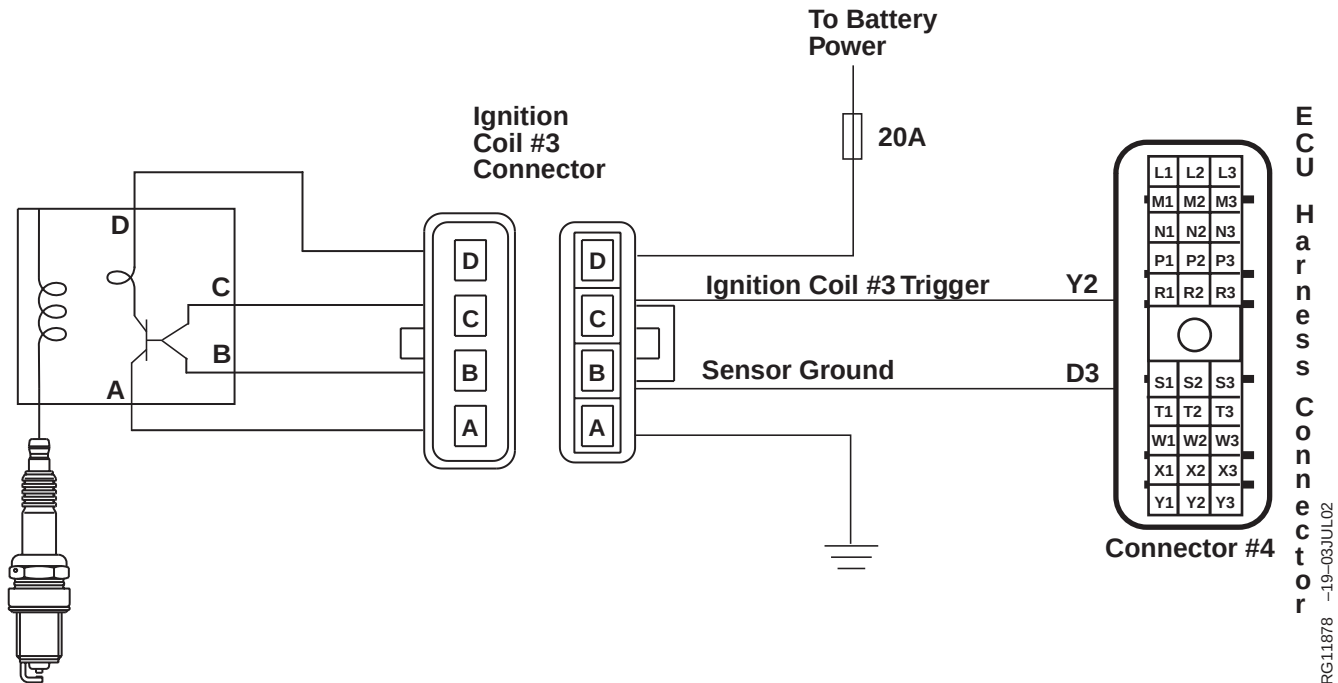
NOTE: For wiring and theory of operation information, see DTC 001270.03 IGNITION COIL #3 INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #4 (white L-Y) and the ignition coil #3 connector.
3. Using a multimeter, measure resistance between terminal Y2 in the ECU connector and terminal C in the ignition coil #3 connector.

5 ohms or less:
Faulty ECU connection
OR
Faulty ignition coil #3
OR
Faulty ECU

Greater than 5 ohms:
Open in the ignition coil
#3 trigger circuit
OR
Short to power in the
ignition coil #3 trigger
circuit

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001270.04 — Ignition Coil #3 Input Voltage Low

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #3 fires cylinder #3.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001270.04 will set if:

The ECU senses a short to ground in the ignition trigger circuit.

If DTC 001270.04 sets, the following will occur:

- Ignition coil #3 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001270.04 — Ignition Coil #3 Input Voltage Low

The ECU senses a short to ground in the ignition trigger circuit.

RG41221,00002E0 -19-13DEC01-1/1

001270.04 Ignition Coil #3 Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001270.04 IGNITION COIL #3 INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #3 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001270.04 IGNITION COIL #3 INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001270.04 reoccurs: GO TO ❸ 001270.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Trigger Wire Test

NOTE: For wiring and theory of operation information, see DTC 001270.04 IGNITION COIL #3 INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect ignition coil #3 connector.
3. Using a multimeter, measure resistance between the following:
 - Terminals A and C in the ignition coil #3 connector on the engine harness.
 - Terminals B and C in the ignition coil #3 connector on the engine harness.

5 ohms or less:
Short to ground in the ignition coil #3 trigger circuit

Greater than 5 ohms:
Faulty ECU connection
OR
Faulty ignition coil #3
OR
Faulty ECU

-- -1/1

001271.03 — Ignition Coil #4 Input Voltage High

The ECU senses an open or short to voltage in the ignition trigger circuit.

RG41221,00002E1 -19-13DEC01-1/1

001271.03 Ignition Coil #4 Input Voltage High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001271.03 IGNITION COIL #4 INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #4 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001271.03 IGNITION COIL #4 INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001271.03 reoccurs: GO TO ❸ 001271.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Trigger Wire Test

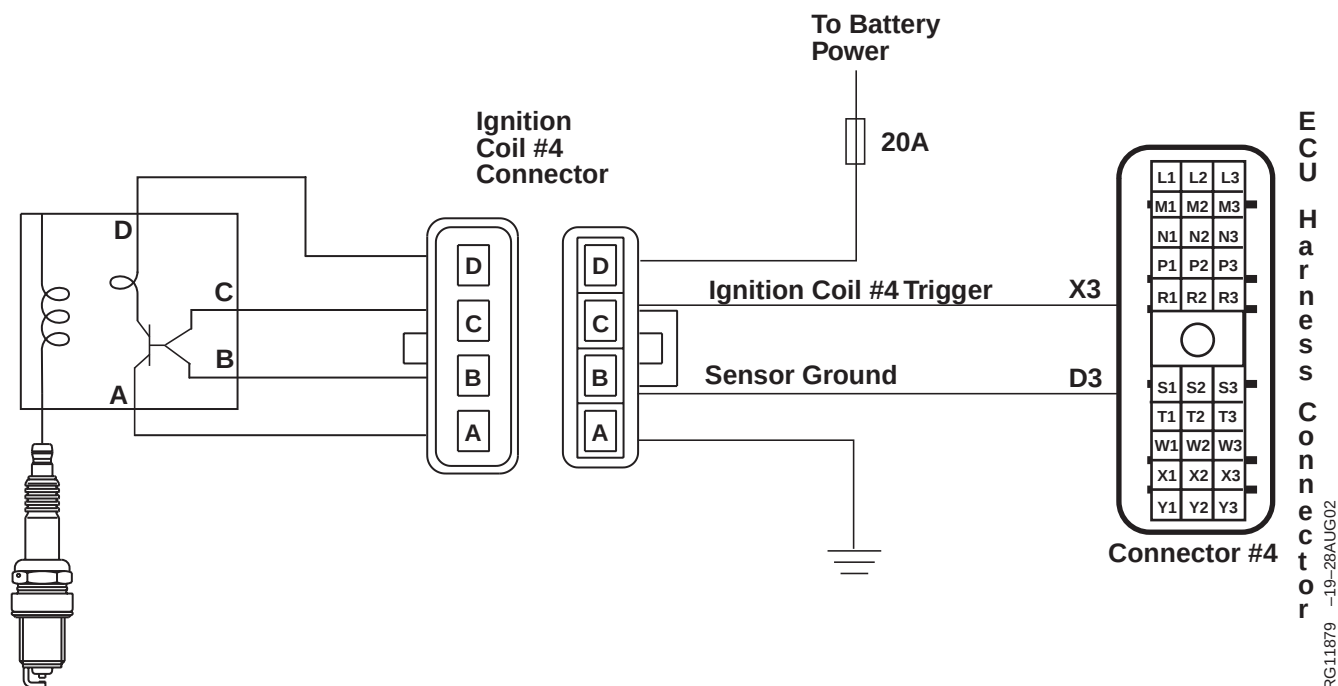
NOTE: For wiring and theory of operation information, see DTC 001271.03 IGNITION COIL #4 INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #4 (white L-Y) and the ignition coil #4 connector.
3. Using a multimeter, measure resistance between terminal X3 in the ECU connector and terminal C in the ignition coil #4 connector.

5 ohms or less:
Faulty ECU connection
OR
Faulty ignition coil #4
OR
Faulty ECU

Greater than 5 ohms:
Open in the ignition coil #4 trigger circuit
OR
Short to power in the ignition coil #4 trigger circuit

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001271.04 — Ignition Coil #4 Input Voltage Low

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #4 fires cylinder #4.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001271.04 will set if:

The ECU senses a short to ground in the ignition trigger circuit.

If DTC 001271.04 sets, the following will occur:

- Ignition coil #4 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001271.04 — Ignition Coil #4 Input Voltage Low

The ECU senses a short to ground in the ignition trigger circuit.

RG41221,00002E2 -19-13DEC01-1/1

001271.04 Ignition Coil #4 Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001271.04 IGNITION COIL #4 INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #4 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001271.04 IGNITION COIL #4 INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001271.04 reoccurs: GO TO ❸ 001271.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Trigger Wire Test

NOTE: For wiring and theory of operation information, see DTC 001271.04 IGNITION COIL #4 INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect ignition coil #4 connector.
3. Using a multimeter, measure resistance between the following:
 - Terminals A and C in the ignition coil #4 connector on the engine harness.
 - Terminals B and C in the ignition coil #4 connector on the engine harness.

5 ohms or less:
Short to ground in the ignition coil #4 trigger circuit

Greater than 5 ohms:
Faulty ECU connection
OR
Faulty ignition coil #4
OR
Faulty ECU

001272.03 — Ignition Coil #5 Input Voltage High

The ECU senses an open or short to voltage in the ignition trigger circuit.

RG41221,00002E3 -19-13DEC01-1/1

001272.03 Ignition Coil #5 Input Voltage High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001272.03 IGNITION COIL #5 INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #5 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001272.03 IGNITION COIL #5 INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001272.03 reoccurs: GO TO ❸ 001272.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Trigger Wire Test

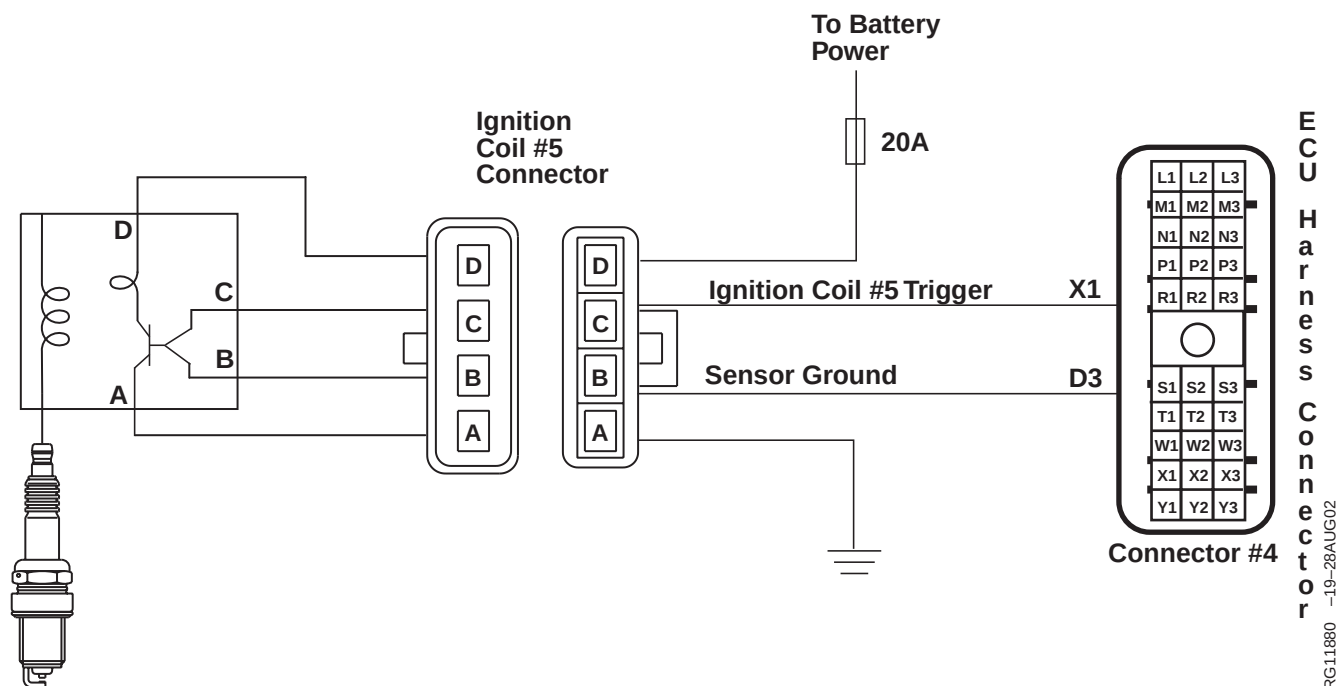
NOTE: For wiring and theory of operation information, see DTC 001272.03 IGNITION COIL #5 INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #4 (white L-Y) and the ignition coil #5 connector.
3. Using a multimeter, measure resistance between terminal X1 in the ECU connector and terminal C in the ignition coil #5 connector.

5 ohms or less:
Faulty ECU connection
OR
Faulty ignition coil #5
OR
Faulty ECU

Greater than 5 ohms:
Open in the ignition coil
#5 trigger circuit
OR
Short to power in the
ignition coil #5 trigger
circuit

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001272.04 — Ignition Coil #5 Input Voltage Low

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #5 fires cylinder #5.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001272.04 will set if:

The ECU senses a short to ground in the ignition trigger circuit.

If DTC 001272.04 sets, the following will occur:

- Ignition coil #5 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001272.04 — Ignition Coil #5 Input Voltage Low

The ECU senses a short to ground in the ignition trigger circuit.

RG41221,00002E4 -19-13DEC01-1/1

001272.04 Ignition Coil #5 Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001272.04 IGNITION COIL #5 INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #5 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001272.04 IGNITION COIL #5 INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001272.04 reoccurs: GO TO ❸ 001272.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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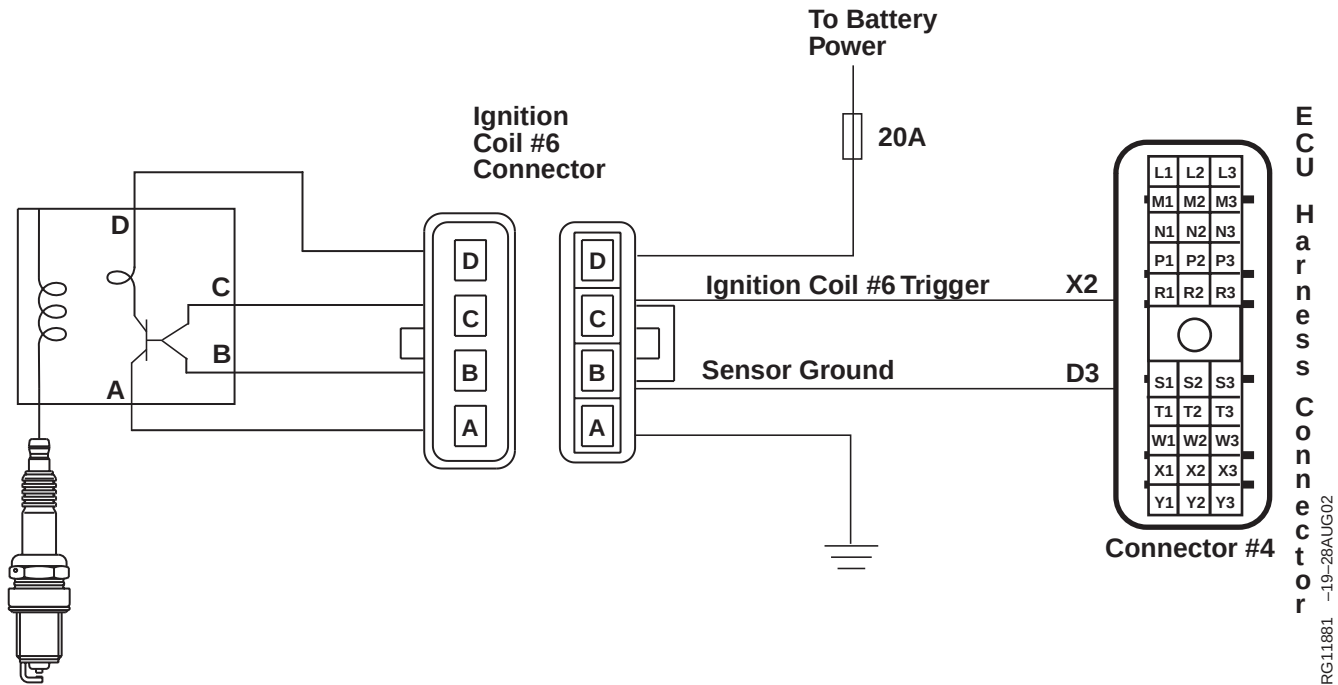
③ Trigger Wire Test

NOTE: For wiring and theory of operation information, see DTC 001272.04 IGNITION COIL #5 INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect ignition coil #5 connector.
3. Using a multimeter, measure resistance between the following:
 - Terminals A and C in the ignition coil #5 connector on the engine harness.
 - Terminals B and C in the ignition coil #5 connector on the engine harness.

5 ohms or less:
Short to ground in the ignition coil #5 trigger circuit

Greater than 5 ohms:
Faulty ECU connection
OR
Faulty ignition coil #5
OR
Faulty ECU

001273.03 — Ignition Coil #6 Input Voltage High

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #6 fires cylinder #6.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001273.03 will set if:

The ECU senses an open or short to voltage in the ignition trigger circuit.

If DTC 001273.03 sets, the following will occur:

- Ignition coil #6 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001273.03 — Ignition Coil #6 Input Voltage High

The ECU senses an open or short to voltage in the ignition trigger circuit.

RG41221,00002E5 -19-13DEC01-1/1

001273.03 Ignition Coil #6 Input Voltage High Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001272.03 IGNITION COIL #6 INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #6 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001272.03 IGNITION COIL #6 INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001273.03 reoccurs: GO TO ❸ 001273.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Trigger Wire Test

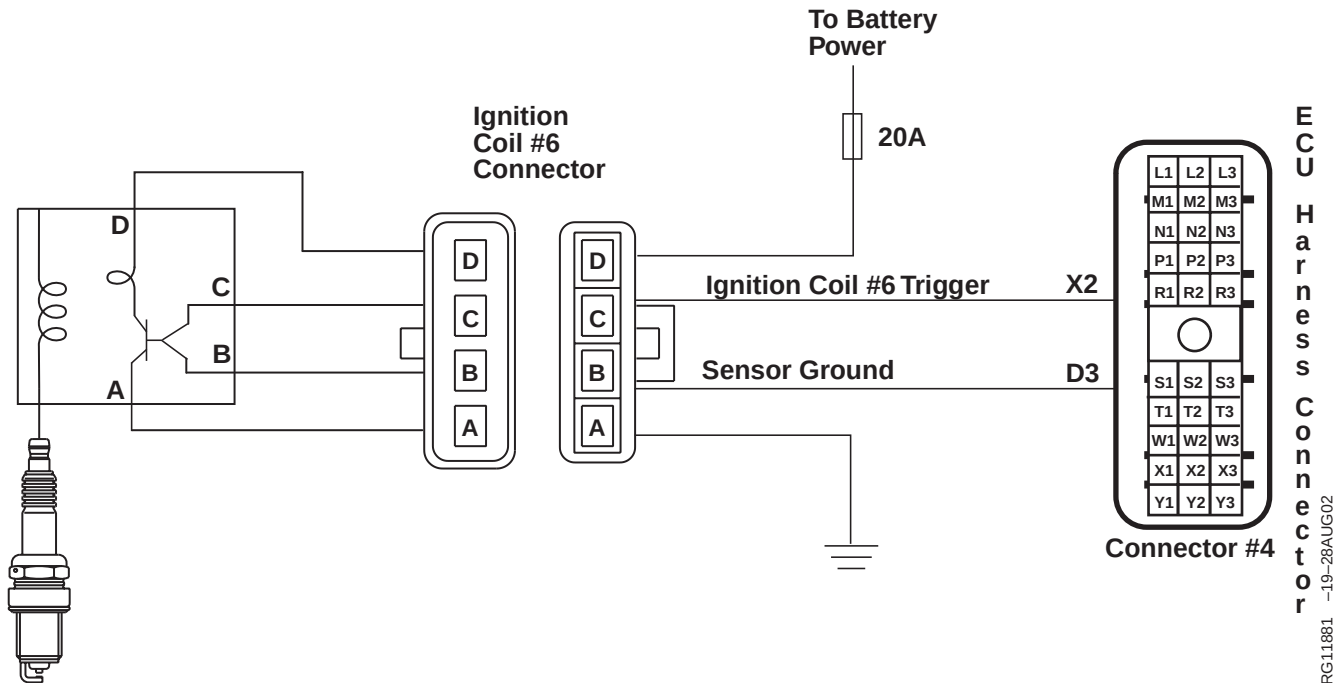
NOTE: For wiring and theory of operation information, see DTC 001272.03 IGNITION COIL #6 INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #4 (white L-Y) and the ignition coil #6 connector.
3. Using a multimeter, measure resistance between terminal X2 in the ECU connector and terminal C in the ignition coil #6 connector.

5 ohms or less:
Faulty ECU connection
OR
Faulty ignition coil #6
OR
Faulty ECU

Greater than 5 ohms:
Open in the ignition coil
#6 trigger circuit
OR
Short to power in the
ignition coil #6 trigger
circuit

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001273.04 — Ignition Coil #6 Input Voltage Low

NOTE: Ignition coil number corresponds to the cylinder number and not the firing order. Ignition coil #6 fires cylinder #6.

Ignition Coil

The ignition coils are used to provide a spark to ignite the air/fuel mixture in each cylinder. The ignition coil is a transformer consisting of two coils; primary and secondary. The primary coil receives a constant low-voltage direct current. The ECU sends a trigger voltage to let the coil know that cylinder will fire next. Once the voltage is removed from the trigger wire, the low-voltage is transformed from the primary coil to a high-voltage current in the secondary coil. The high-voltage current travels out of the secondary coil, through the spark plug wire, and to the spark plug. The

high-voltage current jumps the gap of the spark plug and ignites the air/fuel mixture in the corresponding cylinder. This spark ignites the gas in each cylinder for injection to occur. For further ignition coil information, see IGNITION COIL OPERATION in Group 100 earlier in this manual.

DTC 001273.04 will set if:

The ECU senses a short to ground in the ignition trigger circuit.

If DTC 001273.04 sets, the following will occur:

- Ignition coil #6 will not fire.
- Engine will miss and be low on power.
- ECU will set a SOLID Malfunction light.

001273.04 — Ignition Coil #6 Input Voltage Low

The ECU senses a short to ground in the ignition trigger circuit.

RG41221,00002E6 -19-13DEC01-1/1

001273.04 Ignition Coil #6 Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 001273.04 IGNITION COIL #6 INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition coil #6 connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 001273.04 IGNITION COIL #6 INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	001273.04 reoccurs: GO TO ❸ 001273.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Trigger Wire Test

NOTE: For wiring and theory of operation information, see DTC 001273.04 IGNITION COIL #6 INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect ECU connector #4 (white L-Y) and the ignition coil #6 connector.
3. Using a multimeter, measure resistance between the following:
 - Terminals A and C in the ignition coil #6 connector on the engine harness.
 - Terminals B and C in the ignition coil #6 connector on the engine harness.

5 ohms or less:
Short to ground in the ignition coil #6 trigger circuit

Greater than 5 ohms:
Faulty ECU connection
OR
Faulty ignition coil #6
OR
Faulty ECU

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001569.31 — Fuel Derate

The ECU has commanded a fuel derate for engine protection.

Fuel Derate

- The fuel derate trouble code is information to the operator that the ECU has detected a condition such as throttle position does not match, low fuel pressure, low oil pressure, high throttle charge air temperature, high engine coolant temperature, etc. and is derating the engine by limiting the maximum amount of fuel available to the engine.

DTC 001569.31 will set if:

- ECU detects an invalid throttle position.
- ECU detects a low oil pressure.
- ECU detects a high throttle charge temperature.
- ECU detects a high engine coolant temperature.
- ECU detects a low coolant level.
- ECU detects a low natural gas pressure.
- ECU detects a high exhaust temperature.
- ECU detects a high oil temperature.
- ECU detects a wastegate failure.
- ECU detects a problem with the UEGO sensor.
- ECU detects knock.
- Auxiliary requested engine shutdown
- Closed loop multiplier limits are exceeded.
- ECU detects a low natural gas tank pressure.

If DTC 001569.31 sets, the following will occur:

- The ECU will limit the amount of fuel available to the engine in an attempt to protect the engine.

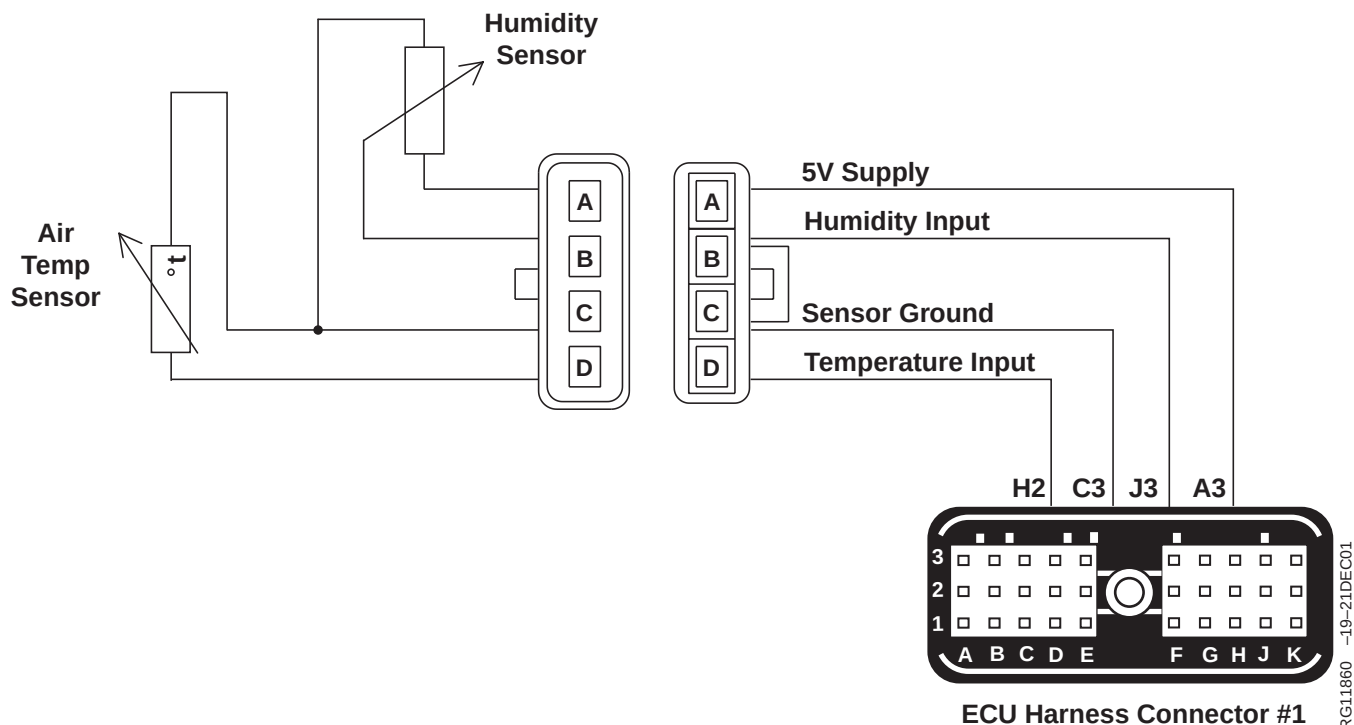
DTC 001569.31 will set with one of the following:

- The ECU detects a manifold absolute pressure that does not match the commanded value (DTC 000051.02 will also be present).
- The ECU senses an oil pressure below the warning value set point in the ECU (DTC 000100.01 or 000100.18 will also be present).

- The ECU senses a throttle charge temperature of 68° C (154° F) (DTC 000105.00 or 000105.16 will also be present).
- The ECU senses a coolant temperature of 105° C (221° F) (DTC 000110.00, 000105.15, or 000105.16 will also be present).
- The ECU senses a low coolant level (DTC 000111.01 will also be present).
- The ECU senses a natural gas pressure below the warning value set point (DTC 000159.18 will also be present).
- The ECU senses an exhaust temperature of 675° C (1274° F) (DTC 000173.00 or 000173.16 will also be present).
- The ECU senses an oil temperature of 125° C (257° F) (DTC 000175.00 or 000175.16 will also be present).
- The ECU detects a failure on the wastegate (DTC 000646.02 will also be present).
- The ECU detects a problem with the UEGO sensor (DTC 000724.02, 000724.13, DTC 524283.03 or 04, DTC 524284.03 or 04, DTC 524285.03 or 04, DTC 524286.02, or DTC 524287.03 or 04 will also be present).
- The ECU detects knock (DTC 000731.00, 000731.02, 000731.04, or 000731.16 will also be present).
- The ECU senses an external shutdown command (DTC 000970.31 will also be present).
- The ECU senses a measured Phi to high or low from desired Phi (DTC 001119.00 or 001119.01 will also be present).
- The ECU detects a natural gas tank pressure lower than 218 psia (1500 kPa) (15 bar) (DTC 524281.18 will also be present).

If DTC 1569 FMI 31 sets:

- Check for other stored or active trouble codes that indicate the reason for the fuel derate. Go to the corresponding diagnostic procedure.
- ECU will set a SOLID Warning light.

299745.03 — Humidity Sensor Input Voltage High**Humidity Sensor**

- The humidity sensor is mounted on the inlet air tube upstream of the crankcase vent between the air cleaner and the turbocharger. The ECU uses the humidity sensor and the inlet air temperature to calculate the specific humidity. For more humidity sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 299745.03 will set if:

- The humidity input voltage exceeds 4.5 volts. This voltage corresponds to a humidity that is higher than what is physically possible for specific humidity.

If DTC 299745.03 sets, the following will occur:

- ECU will default specific humidity to 12g H₂O/kg air.
- Depending on the actual humidity in your location, there may be a slight increase or decrease in power.
- DTC 001080.03 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

299745.03 — Humidity Sensor Input Voltage High

The humidity input voltage exceeds the sensor's high voltage specification.

RG41221,000036F -19-08MAY02-1/1

299745.03 Humidity Sensor Input Voltage High Diagnostic Procedure

NOTE: If DTC 299745.03 is accompanied with 001080.03, diagnose 001080.03 first.

NOTE: Through diagnosing this DTC, 000172.03 and/or 000172.04 may also occur. These codes relate to the inlet air temperature sensor which shares the same connector as the humidity temperature sensor. Through disconnecting the sensor connector, the above codes may set. Once 299745.03 has been repaired and all connections are made, the inlet air temperature sensor codes should also clear. If codes do not clear, go to corresponding diagnostic procedure.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 299745.03 HUMIDITY SENSOR INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the humidity/inlet air temperature sensor connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty Connections Found:
Repair connections and retest.

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2 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 299745.03 HUMIDITY SENSOR INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

299745.03 reoccurs:
GO TO **3**

299745.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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3 Humidity Input Shorted Test

NOTE: For wiring and theory of operation information, see DTC 299745.03 HUMIDITY SENSOR INPUT VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect the Humidity sensor connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read the Humidity Input Voltage.

Below 0.5 V:
GO TO **4**

0.5 V or greater:
Short to voltage in humidity sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

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4 Humidity Ground Circuit Open Test

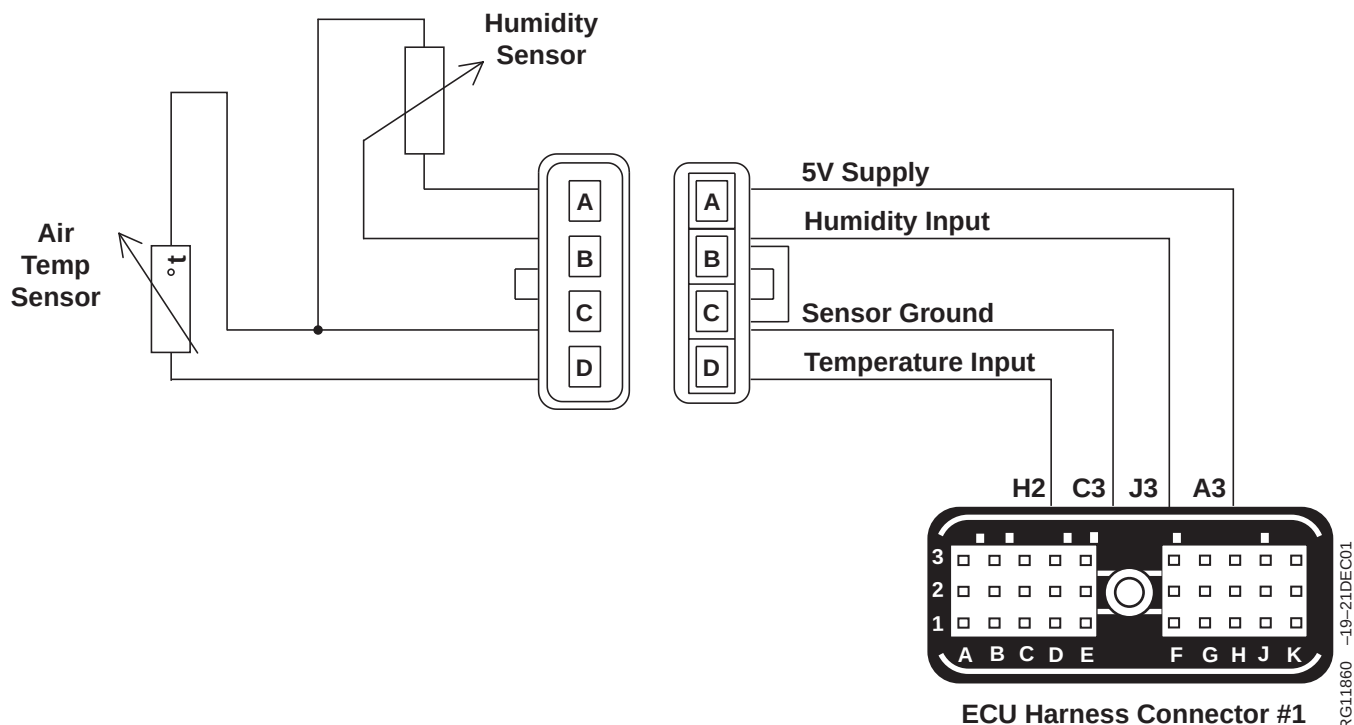
NOTE: For wiring and theory of operation information, see DTC 299745.03 HUMIDITY SENSOR INPUT VOLTAGE HIGH supporting information.

1. Humidity sensor connector still disconnected.
2. Ignition ON, engine OFF
3. Probe the humidity sensor ground (terminal C) of the humidity sensor connector on the engine harness with a test light connected to battery voltage.

Light ON:
Faulty humidity sensor
OR
Faulty ECU connection
OR
Faulty ECU

Light OFF:
Open in humidity sensor ground circuit
OR
Faulty ECU connection
OR
Faulty ECU

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299745.04 — Humidity Sensor Input Voltage Low**Humidity Sensor**

- The humidity sensor is mounted on the inlet air tube upstream of the crankcase vent between the air cleaner and the turbocharger. The ECU uses the humidity sensor and the inlet air temperature to calculate the specific humidity. For more humidity sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 299745.04 will set if:

- The humidity input voltage drops below 0.5 volts. This voltage corresponds to a humidity that is lower than what is physically possible for specific humidity.

If DTC 299745.04 sets, the following will occur:

- ECU will default specific humidity to 12g H₂O/kg air.
- Depending on the actual humidity in your location, there may be a slight increase or decrease in power.
- DTC 001080.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

299745.04 — Humidity Sensor Input Voltage Low

The humidity input voltage drops below the sensor's low voltage specification.

RG41221.0000371 -19-08MAY02-1/1

299745.04 Humidity Sensor Input Voltage Low Diagnostic Procedure

NOTE: If DTC 299745.04 is accompanied with 001080.04, diagnose 001080.04 first.

NOTE: Through diagnosing this DTC, 000172.03 and/or 000172.04 may also occur. These codes relate to the inlet air temperature sensor which shares the same connector as the humidity temperature sensor. Through disconnecting the sensor connector, the above codes may set. Once 299745.04 has been repaired and all connections are made, the inlet air temperature sensor codes should also clear. If codes do not clear, go to corresponding diagnostic procedure.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 299745.04 HUMIDITY SENSOR INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the humidity/inlet air temperature sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.

-- -1/1

2 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 299745.04 HUMIDITY SENSOR INPUT VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

299745.04 reoccurs:
GO TO **3**

299745.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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3 Humidity Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 299745.04 HUMIDITY SENSOR INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect the humidity sensor connector.
3. Install a jumper wire between the humidity 5V supply and input terminals (terminals A and B) in the sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read the Humidity Input Voltage.

Below 4.5 V:
GO TO **4**

4.5 V or greater:
Faulty humidity sensor connector
OR
Faulty humidity sensor

-- -1/1

4 Humidity 5V Supply Test

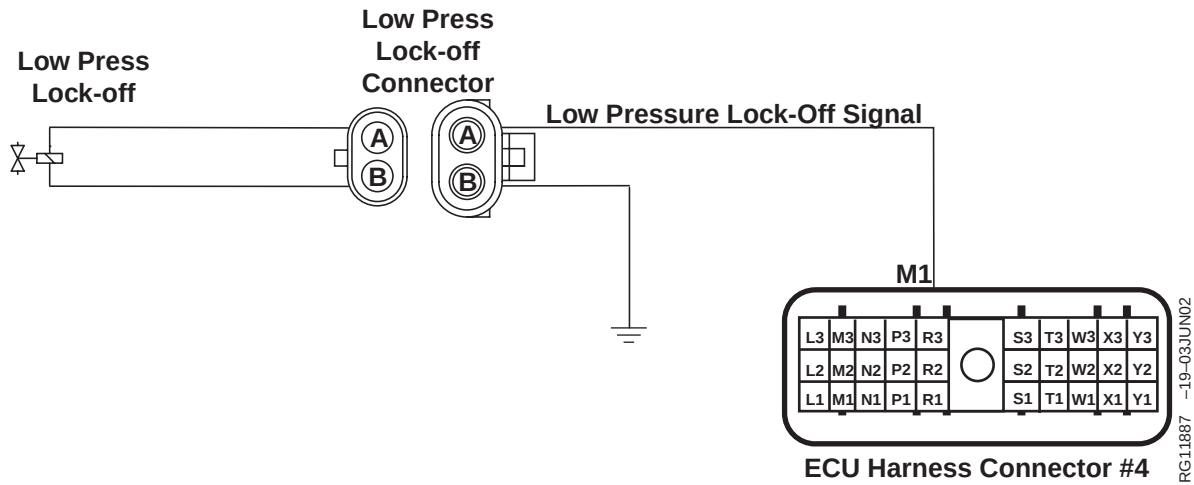
NOTE: For wiring and theory of operation information, see DTC 299745.04 HUMIDITY SENSOR INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Remove the jumper wire
3. Ignition ON, engine OFF
4. Using the multimeter, measure voltage between the 5V supply terminal (terminal A) of the humidity sensor connector on the engine harness and a good chassis ground.

4.0 - 6.0 V:
Open in humidity sensor input circuit
OR
Short to ground in humidity sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

Below 4.0 V:
Open in humidity sensor 5V supply circuit
OR
Short to ground in humidity sensor 5V supply circuit
OR
Faulty ECU connection
OR
Faulty ECU

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299747.02 — Low Pressure Lock-Off Signal Invalid**Low Pressure Lock-Off**

- The low pressure lock-off solenoid is located on the fuel metering block. The ECU controls when the solenoid is energized by supplying voltage. When the low pressure lock-off solenoid is energized, fuel is allowed to flow into the fuel metering block. For further low pressure lock-off solenoid information, see FUEL METERING BLOCK OPERATION in Group 100 earlier in this manual.

DTC 299747.02 will set if:

- The ECU does not detect current on the low pressure lock-off signal wire.

If DTC 299747.02 sets, the following will occur:

- Engine will not start or run if low pressure lock-off solenoid is shut.
- ECU will set a SOLID Warning light.

RG41221,00002F6 -19-13DEC01-1/1

299747.02 — Low Pressure Lock-Off Signal Invalid

The ECU does not detect current on the low pressure lock-off signal wire.

RG41221,00002F9 -19-13DEC01-1/1

299747.02 Low Pressure Lock-Off Signal Invalid Diagnostic Procedure

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 299747.02 LOW PRESSURE LOCK-OFF SIGNAL INVALID supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the low pressure lock-off connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty Connections Found:
Repair connections and retest.

-- -1/1

❷ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 299747.02 LOW PRESSURE LOCK-OFF SIGNAL INVALID supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running or cranking
6. Read DTCs using DST or SERVICE ADVISOR™.

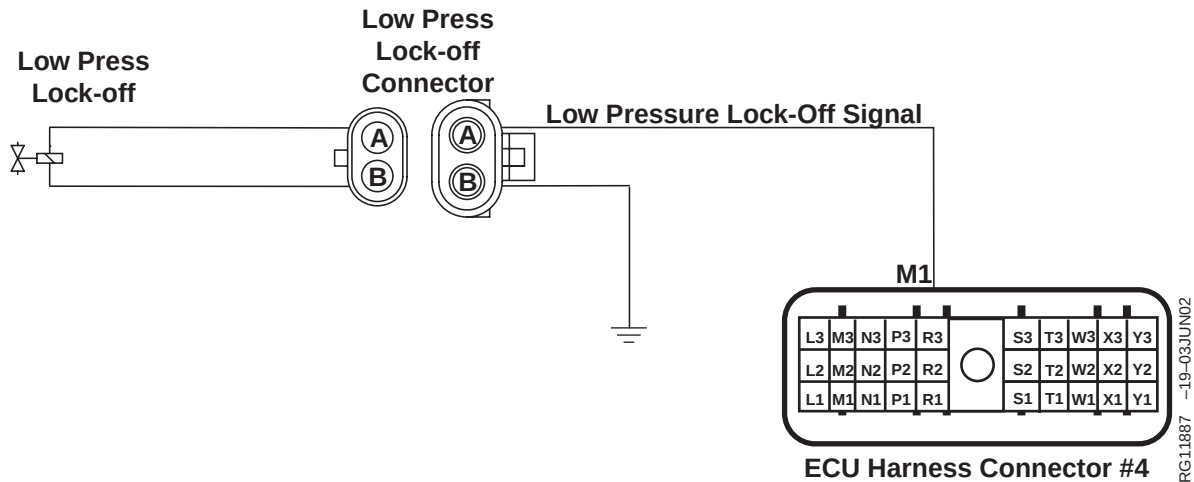
299747.02 reoccurs:
GO TO ❸

299747.02 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 548	③ Low Pressure Lock-Off Ground Test	<i>NOTE: For wiring and theory of operation information, see DTC 299747.02 LOW PRESSURE LOCK-OFF SIGNAL INVALID supporting information.</i> 1. Ignition OFF 2. Disconnect the low pressure lock-off connector. 3. Ignition ON, engine OFF 4. Probe the low pressure lock-off ground (terminal B) of the low pressure lock-off connector on the engine harness with a test light connected to battery voltage.	Light ON: GO TO ④ Light OFF: Open in low pressure lock-off ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ Low Pressure Lock-Off Signal Test	<i>NOTE: For wiring and theory of operation information, see DTC 299747.02 LOW PRESSURE LOCK-OFF SIGNAL INVALID supporting information.</i> 1. Low pressure lock-off connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the low pressure lock-off signal terminal (terminal A) of the low pressure lock-off connector on the engine harness with a test light connected to a good chassis ground.	Light ON: Faulty low pressure lock-off. Replace and retest. Light OFF: Open in low pressure lock-off signal circuit OR Short to ground in low pressure lock-off signal circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

299747.07 — Low Pressure Lock-Off Leak**Low Pressure Lock-Off**

- The low pressure lock-off solenoid is located on the fuel metering block. The ECU controls when the solenoid is energized by supplying voltage. When the low pressure lock-off solenoid is energized, fuel is allowed to flow into the fuel metering block. For further low pressure lock-off solenoid information, see FUEL METERING BLOCK OPERATION in Group 100 earlier in this manual.

DTC 299747.07 will set if:

- When ignition is cycled OFF, the ECU shuts the low pressure lock-off valve, burps the injectors, and looks at natural gas pressure. When the ignition is turned ON, if the natural gas pressure has increased prior to the low pressure lock-off opening, there is a leak.

If DTC 299747.07 sets, the following will occur:

- Engine may start hard.
- ECU will set a SOLID Warning light.

RG41221,000036A -19-08MAY02-1/1

299747.07 — Low Pressure Lock-Off Leak

The ECU detects a leak of natural gas pressure.

RG41221,000036B -19-08MAY02-1/1

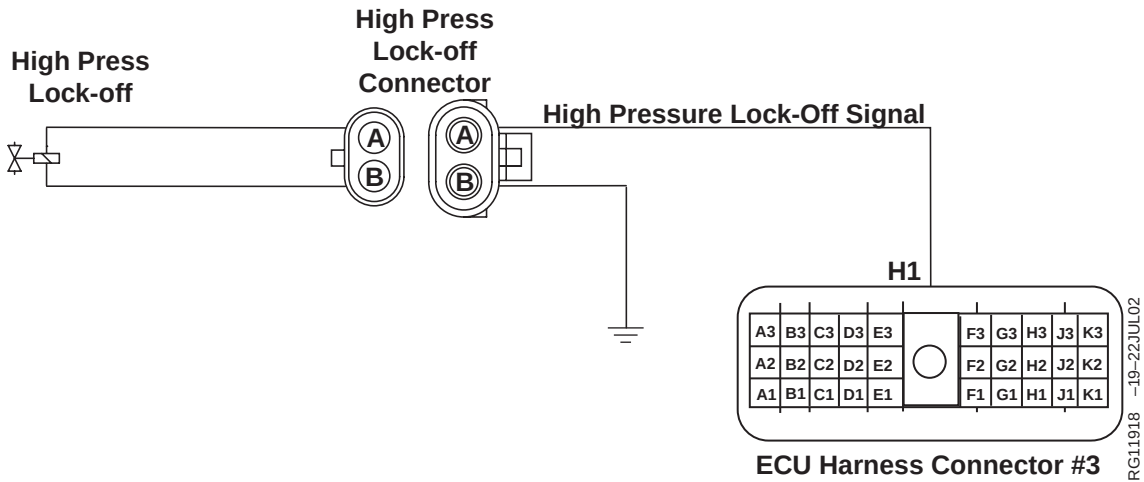
299747.07 Low Pressure Lock-Off Leak Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 299747.07 LOW PRESSURE LOCK-OFF LEAK supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the low pressure lock-off connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Low Pressure Lock-Off Test	<i>NOTE: For wiring and theory of operation information, see DTC 299747.07 LOW PRESSURE LOCK-OFF LEAK supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running for 2 minutes. 6. Ignition OFF for 15 minutes. 7. Ignition ON, engine OFF 8. Read DTCs using DST or SERVICE ADVISOR™.	299747.07 reoccurs: Faulty low pressure lock-off solenoid. 299747.07 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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299748.02 — High Pressure Lock-Off Signal Invalid**High Pressure Lock-Off**

- The high pressure lock-off solenoid is located between the fuel tanks and the high pressure fuel regulator. The ECU controls when the solenoid is energized by supplying it voltage. When the high pressure lock-off solenoid is energized, fuel is allowed to flow to the fuel regulator and onto the fuel metering block.

DTC 299748.02 will set if:

- The ECU does not detect current on the high pressure lock-off signal wire.

If DTC 299748.02 sets, the following will occur:

- Engine will not start or run if high pressure lock-off solenoid is shut.
- ECU will set a SOLID Warning light.

299748.02 — High Pressure Lock-Off Signal Invalid

The ECU does not detect current on the high pressure lock-off signal wire.

RG41221.0000379 -19-30MAY02-1/1

299748.02 High Pressure Lock-Off Signal Invalid Diagnostic Procedure

NOTE: The high pressure lock-off is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the high pressure lock-off is diagnosed to be faulty.

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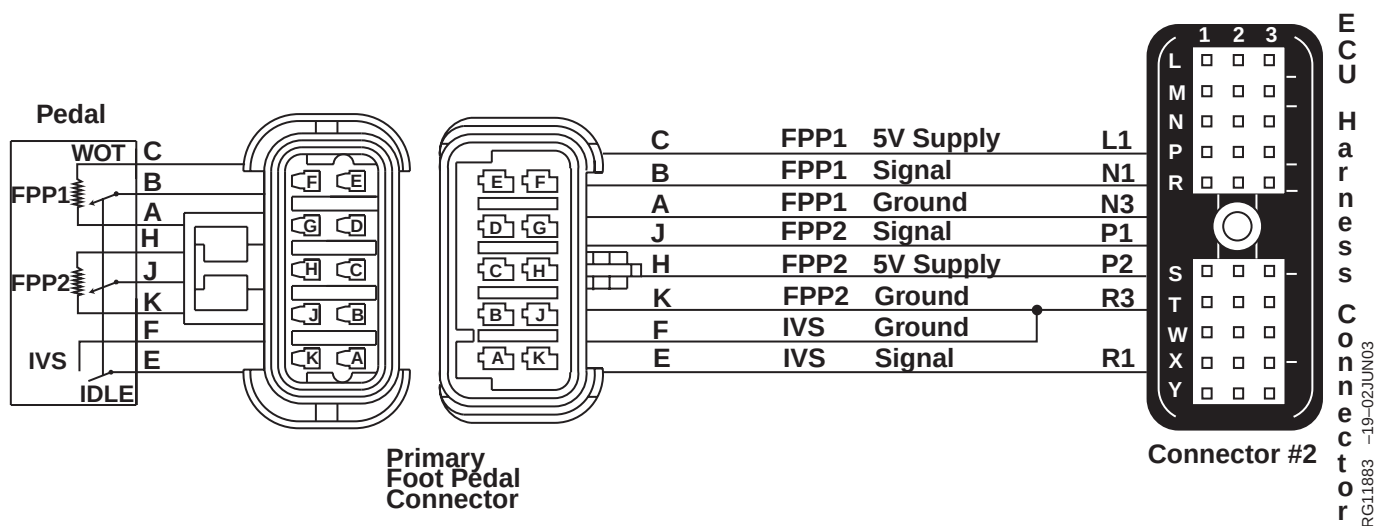
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 299748.02 HIGH PRESSURE LOCK-OFF SIGNAL INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the high pressure lock-off connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty Connections Found: Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 299748.02 HIGH PRESSURE LOCK-OFF SIGNAL INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running or cranking 6. Read DTCs using DST or SERVICE ADVISOR™.	299748.02 reoccurs: GO TO ❸ 299748.02 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 554	③ High Pressure Lock-Off Ground Test	<i>NOTE: For wiring and theory of operation information, see DTC 299748.02 HIGH PRESSURE LOCK-OFF SIGNAL INVALID supporting information.</i> 1. Ignition OFF 2. Disconnect the high pressure lock-off connector. 3. Ignition ON, engine OFF 4. Probe the high pressure lock-off ground terminal (terminal B) of the high pressure lock-off connector on the engine harness with a test light connected to battery voltage.	Light ON: GO TO ④ Light OFF: Open in high pressure lock-off ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ High Pressure Lock-Off Signal Test	<i>NOTE: For wiring and theory of operation information, see DTC 299748.02 HIGH PRESSURE LOCK-OFF SIGNAL INVALID supporting information.</i> 1. High pressure lock-off connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the high pressure lock-off signal terminal (terminal A) of the high pressure lock-off connector on the engine harness with a test light connected to a good chassis ground. <i>NOTE: The high pressure lock-off is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the high pressure lock-off is diagnosed to be faulty.</i>	Light ON: Faulty high pressure lock-off. Replace and retest. Light OFF: Open in high pressure lock-off signal circuit OR Short to ground in high pressure lock-off signal circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

299752.03 — Foot Pedal Position 2 Input Voltage High**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 299752.03 will set if:

- FPP2 input voltage exceeds a maximum voltage threshold of 4.8 volts. This voltage corresponds to a position that is higher than what is physically possible for the foot pedal.

If DTC 299752.03 sets, the following will occur:

- Foot Pedal Position 2 Input Voltage will default to 0 volts.
- The ECU will use the foot pedal position 1 sensor signal.
- DTC 000620.03, 299752.07, and 299752.13 may also be present.
- ECU will set a SOLID Warning light.

RG41221_00002BB -19-01OCT01-1/1

299752.03 — Foot Pedal Position 2 Input Voltage High

FPP2 input voltage exceeds the sensor's high voltage specification.

RG41221,00002BC -19-01OCT01-1/1

299752.03 Foot Pedal Position 2 Input Voltage High Diagnostic Procedure

NOTE: If DTC 299752.03 is accompanied with 000620.03, diagnose 000620.03 first.

NOTE: If DTC 299752.03 is accompanied with 299752.07 or 299752.13, diagnose 299752.03 first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation, see DTC 299752.03 FOOT PEDAL POSITION 2 INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals. There may be several vehicle harness interconnects between the ECU and the foot pedal.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.

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2 DTC Test

NOTE: For wiring and theory of operation, see DTC 299752.03 FOOT PEDAL POSITION 2 INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Foot pedal in low idle position
7. Read DTCs using the DST or SERVICE ADVISOR™.

299752.03 reoccurs:
GO TO **4**

299752.03 doesn't reoccur:
GO TO **3**

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3 Intermittent Fault Test

NOTE: For wiring and theory of operation, see DTC 299752.03 FOOT PEDAL POSITION 2 INPUT VOLTAGE HIGH supporting information.

1. Ignition ON, engine OFF
2. Diagnostic software still communicating with ECU.
3. Slowly depress foot pedal through full travel while watching the Foot Pedal Position 2 Input Voltage on the diagnostic software.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

Goes above 4.8 V:
Faulty foot pedal connection
OR
Faulty FPP2 sensor

Never goes above 4.8 V:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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4 FPP2 Signal Shorted Test

NOTE: For wiring and theory of operation, see DTC 299752.03 FOOT PEDAL POSITION 2 INPUT VOLTAGE HIGH supporting information.

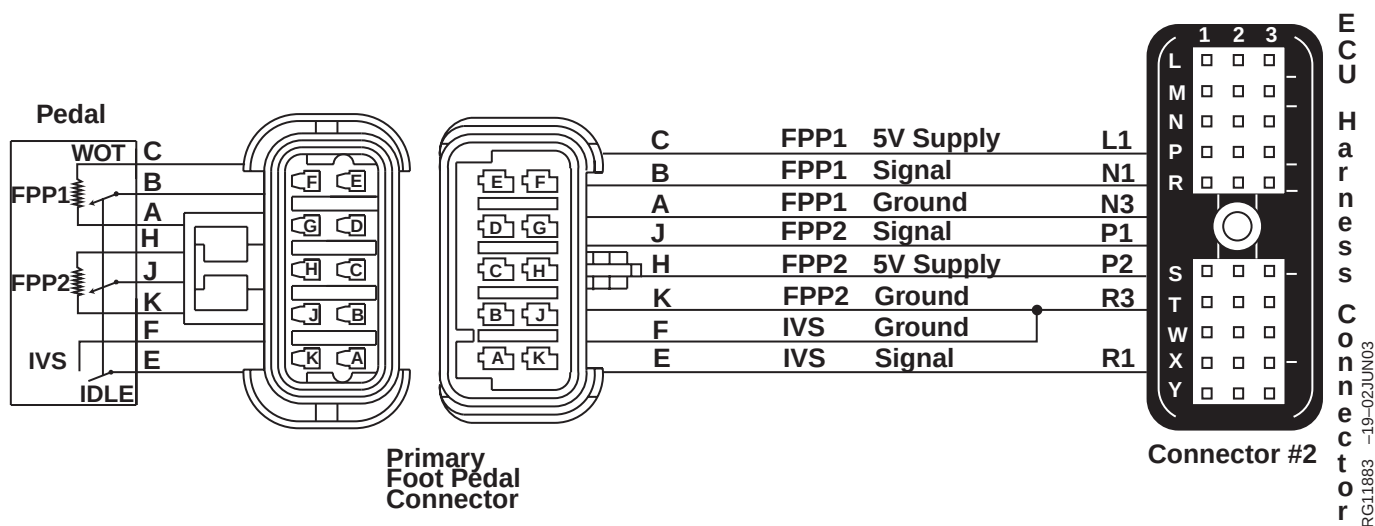
1. Ignition OFF
2. Disconnect the foot pedal connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read DTCs.

299752.04 occurs:
GO TO **5**

299752.04 doesn't occur:
Short to voltage in FPP2 sensor signal circuit

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5 FPP2 Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation, see DTC 299752.03 FOOT PEDAL POSITION 2 INPUT VOLTAGE HIGH supporting information.</i> Probe FPP2 sensor ground (terminal K) of the sensor connector on the vehicle harness with a test light connected to battery voltage. <i>NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.</i>	Light ON: Faulty foot pedal connection OR Faulty FPP2 sensor. Replace foot pedal and retest. OR Faulty ECU connection OR Faulty ECU Light OFF: Open in FPP2 ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

299752.04 — Foot Pedal Position 2 Input Voltage Low**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 299752.04 will set if:

- FPP2 input voltage drops below 0.2 volts. This voltage corresponds to a position that is lower than what is physically possible for the foot pedal.

If DTC 299752.04 sets, the following will occur:

- Foot Pedal Position 2 Input Voltage will default to 0 volts.
- The ECU will use the foot pedal position 1 sensor signal.
- DTC 000620.04, 299752.07, and 299752.13 may also be present.
- ECU will set a SOLID Warning light.

RG41221_00002BE -19-01OCT01-1/1

299752.04 — Foot Pedal Position 2 Input Voltage Low

FPP2 input voltage drops below the sensor's low voltage specification.

RG41221,00002BF -19-01OCT01-1/1

299752.04 Foot Pedal Position 2 Input Voltage Low Diagnostic Procedure

NOTE: If DTC 299752.04 is accompanied with 000620.04, diagnose 000620.04 first.

NOTE: If DTC 299752.04 is accompanied with 299752.07 or 299752.13, diagnose 299752.04 first.

NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connector. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 299752.04 FOOT PEDAL POSITION 2 INPUT VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, the foot pedal connector, and all of the vehicle interconnect connectors looking for dirty, damaged, or poorly positioned terminals. There may be several vehicle harness interconnects between the ECU and the foot pedal.

No faulty connection(s):
GO TO ❷

Faulty Connections Found:
Repair connections and retest.

-- -1/1

2 DTC Test

NOTE: For wiring and theory of operation information, see DTC 299752.04 FOOT PEDAL POSITION 2 INPUT VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

299752.04 reoccurs:
GO TO **4**

299752.04 doesn't reoccur:
GO TO **3**

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3 Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 299752.04 FOOT PEDAL POSITION 2 INPUT VOLTAGE LOW supporting information.

1. Ignition ON, engine OFF
2. Slowly depress foot pedal through full travel.
3. Using the ECU diagnostic software, read DTCs.

299752.04 reoccurs:
GO TO **4**

299752.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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4 FPP2 Sensor Ground Wire Test

NOTE: For wiring and theory of operation information, see DTC 299752.04 FOOT PEDAL POSITION 2 INPUT VOLTAGE LOW supporting information.

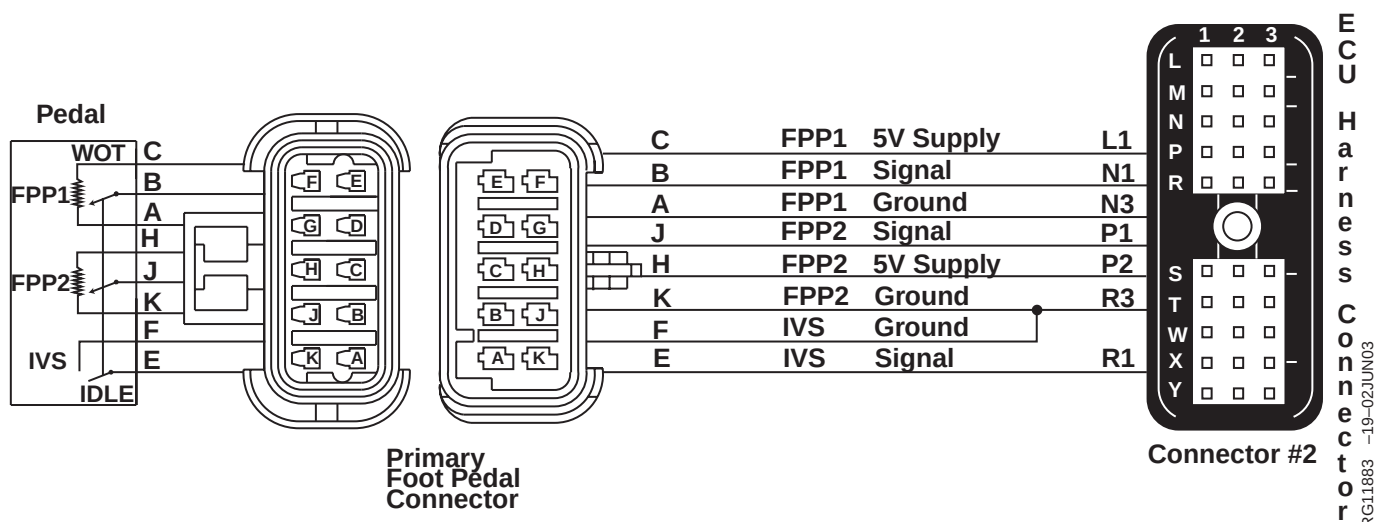
1. Ignition OFF
2. Disconnect the foot pedal connector.
3. Ignition ON, engine OFF
4. Probe the FPP2 sensor ground wire terminal (terminal K) of the foot pedal connector on the vehicle harness with a test light connected to battery voltage.

Light ON:
GO TO **5**

Light OFF:
Open in FPP2 sensor ground circuit
OR
Faulty ECU Connection
OR
Faulty ECU

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5 FPP2 5V Supply Test	<i>NOTE: For wiring and theory of operation information, see DTC 299752.04 FOOT PEDAL POSITION 2 INPUT VOLTAGE LOW supporting information.</i> 1. Foot pedal connector still disconnected. 2. Ignition ON, engine OFF 3. Using a multimeter, measure voltage between the 5V supply (terminal H) of the foot pedal connector on the vehicle harness and a good chassis ground.	4.0 - 6.0 volts: GO TO 6 Below 4.0 volts: Open in FPP2 sensor 5V supply circuit OR Short to ground in FPP2 sensor 5V supply circuit OR Faulty ECU connection OR Faulty ECU -- -1/1	115 ,563
6 FPP2 Signal Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 299752.04 FOOT PEDAL POSITION 2 INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Foot pedal connector still disconnected. 3. Disconnect ECU connector #2 (black L-Y). 4. Using a multimeter, measure resistance between terminal P1 in the ECU connector on the engine harness and terminal J in the foot pedal connector on the vehicle harness. <i>NOTE: The foot pedal is not a John Deere supplied component. See the vehicle manufacturer for replacement parts and service if the foot pedal is diagnosed to be faulty.</i>	5 ohms or less: Faulty Foot Pedal connection OR Faulty FPP2 sensor. Replace foot pedal and retest. Greater than 5 ohms: Short to voltage in FPP2 sensor signal circuit OR Faulty ECU connection OR Faulty ECU -- -1/1	

299752.07 — Foot Pedal Position 2 Input Voltage and Idle Validation Switch Mismatch**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 299752.07 will set if:

- Idle Validation Switch in ON when Foot Pedal Position 2 Input Voltage is 1.35 volts or more.
- Idle Validation Switch in OFF when Foot Pedal Position 2 Input Voltage is 0.1 volts or more.

If DTC 299752.07 sets, the following will occur:

- The ECU will use the foot pedal position sensor 1 signal.
- DTC 299752.03, 299752.04, or 000558.02 may also be present.
- ECU will set a SOLID Warning light.

RG41221,000009B -19-25NOV02-1/1

299752.07 — Foot Pedal Position 2 Input Voltage and Idle Validation Switch Mismatch115
565

The foot pedal position 1 input voltage disagrees with the idle validation switch.

RG41221,000009A -19-25NOV02-1/1

299752.07 Foot Pedal Position 2 Input Voltage and Idle Validation Switch Mismatch Diagnostic Procedure

NOTE: If DTC 299752.07 is accompanied with 000558.02, 299752.03 or 299752.04, diagnose them first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 299752.07 FOOT PEDAL POSITION 2 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas tank temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ DTC Test	<i>NOTE: For wiring and theory of operation information, see DTC 299752.07 FOOT PEDAL POSITION 2 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Slowly depress foot pedal through full travel a couple of times. 7. Read DTCs using DST or SERVICE ADVISOR™.	Only 299752.07 reoccurs: GO TO ❸ 299752.03, 299752.04, or 000558.02 reoccurs: Follow that diagnostic procedure.

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**③ Foot Pedal Position 2
Sensor Wiring Check**

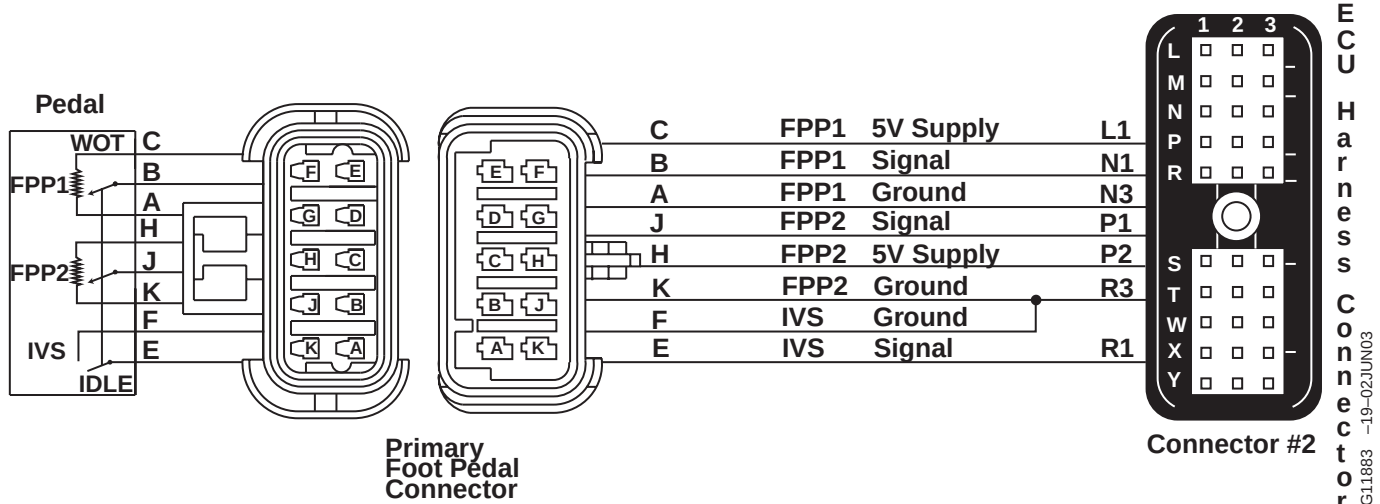
NOTE: For wiring and theory of operation information, see DTC 299752.07 FOOT PEDAL POSITION 2 INPUT VOLTAGE AND IDLE VALIDATION SWITCH MISMATCH supporting information.

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the foot pedal connector.
3. Using a multimeter, measure resistance between the following:
 - Terminal P2 in the ECU connector and terminal H in the foot pedal connector on the vehicle harness.
 - Terminal P1 in the ECU connector and terminal J in the foot pedal connector on the vehicle harness.
 - Terminal R3 in the ECU connector and terminal K in the foot pedal connector on the vehicle harness.

All measurements 5 ohms or less:
Faulty foot pedal.
Replace and retest.

Any measurement greater than 5 ohms less:
Short in wire that produces high resistance.

-- -1/1

299752.13 — Foot Pedal Position 2 Learned Value Error**Foot Pedal Position (FPP) Sensor**

- The foot pedal assembly contains two independent position sensors and an Idle Validation Switch (IVS). The FPP sensors are variable resistors (potentiometers) used to measure the position of the foot pedal. The FPP signal voltages vary as the foot pedal is depressed and released. Less depression of the pedal results in lower signal voltages; greater depression results in higher signal voltages. The two FPP signals are compared to each other and to the IVS status to determine each signal's validity. For further foot pedal position sensor information, see MEASURING THROTTLE POSITION in Group 100 earlier in this manual.

DTC 299752.13 will set if:

- The foot pedal position 2 voltage exceeds the upper learned value or drops below the lower learned value.
 - Foot pedal position 2 voltage exceeds 4.6 volts.
 - Foot pedal position 2 voltage drops below 0.2 volts.

If DTC 299752.13 sets, the following will occur:

- The ECU will use the foot pedal position sensor 1 signal.
- Learned value is reset after key cycle.
- DTC 299752.03, 299752.04, or 000558.02 may also be present.
- ECU will set a SOLID Warning light.

299752.13 — Foot Pedal Position 2 Learned Value Error

The foot pedal position 2 voltage exceeds the upper learned value or drops below the lower learned value.

RG41221,000009D -19-25NOV02-1/1

299752.13 Foot Pedal Position 2 Learned Value Error Diagnostic Procedure

NOTE: If DTC 299752.13 is accompanied with 000558.02, 299752.03 or 299752.04, diagnose them first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 299752.13 FOOT PEDAL POSITION 2 LEARNED VALUE ERROR supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas tank temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ DTC Test	<i>NOTE: For wiring and theory of operation information, see DTC 299752.13 FOOT PEDAL POSITION 2 LEARNED VALUE ERROR supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Slowly depress foot pedal through full travel a couple of times. 7. Read DTCs using DST or SERVICE ADVISOR™.	299752.13 reoccurs: GO TO ❸ 299752.13 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Foot Pedal Position 2
Sensor Wiring Check

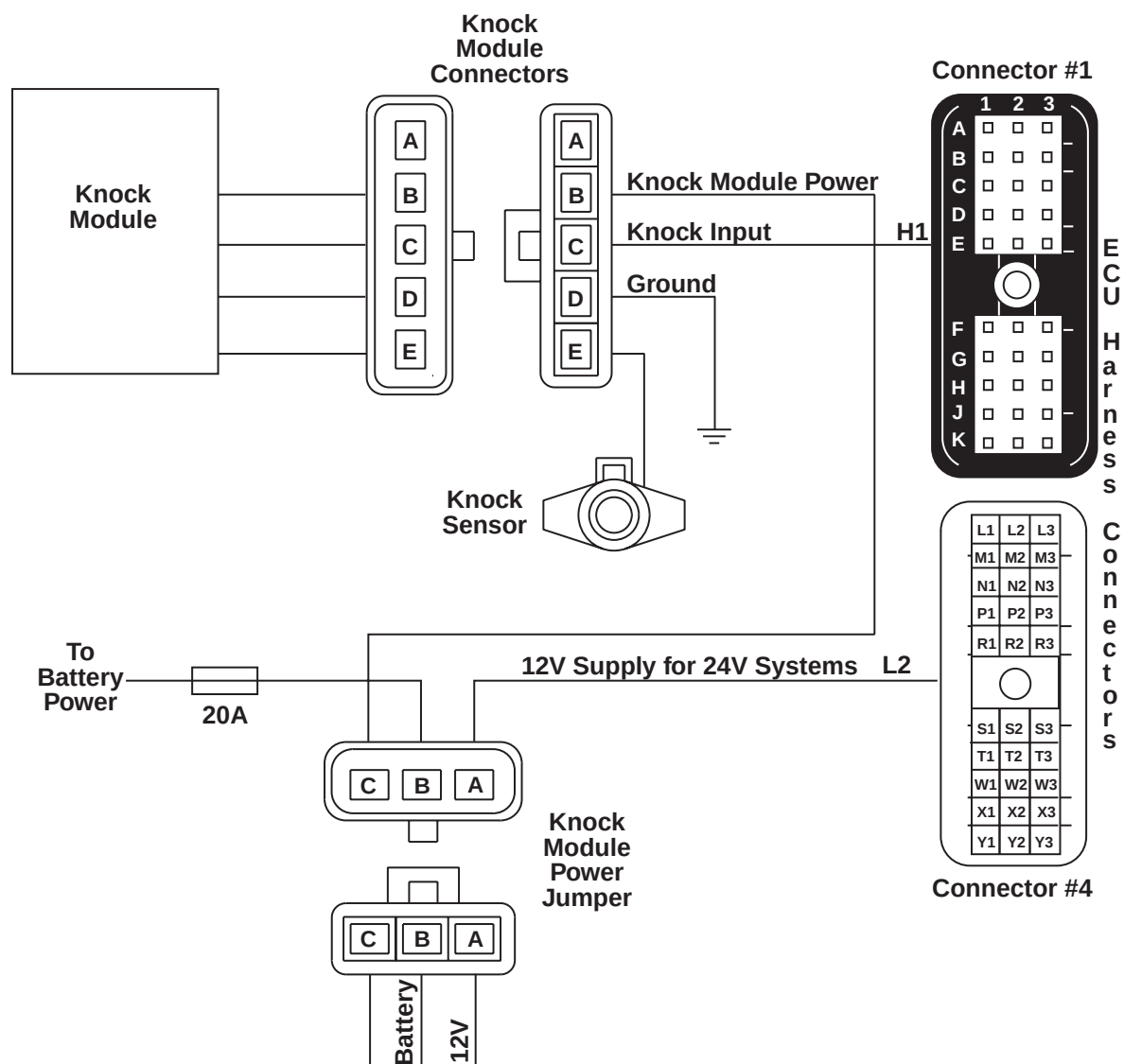
*NOTE: For wiring and theory of operation information, see DTC 299752.13 FOOT
PEDAL POSITION 2 LEARNED VALUE ERROR supporting information.*

1. Ignition OFF
2. Disconnect ECU connector #2 (black L-Y) and the foot pedal connector.
3. Using a multimeter, measure resistance between the following:
 - Terminal P2 in the ECU connector and terminal H in the foot pedal connector on the vehicle harness.
 - Terminal P1 in the ECU connector and terminal J in the foot pedal connector on the vehicle harness.
 - Terminal R3 in the ECU connector and terminal K in the foot pedal connector on the vehicle harness.

**All measurements 5
ohms or less:**
Faulty foot pedal.
Replace and retest.

**Any measurement
greater than 5 ohms
less:**
Short in wire that
produces high resistance.

-- -1/1

524275.03 — Knock Supply Voltage High

RG11875 -19-03JUL02

Knock Sensor

- The knock sensor is a resonant band pass filter that is very sensitive around 5.8 kHz. The knock module receives a pulse width modulated (PWM) signal from the knock sensor. The signal received is dependent on the amount of knock that is sensed on the engine. As the severity of knock increases, the PWM signal on-time increases. The knock module then translates the PWM signal into a comparative one-shot type signal (0 volts or 12 volts) to the ECU. The ECU uses this information to determine if the engine is seeing knock. Depending on the amount of knock, the ECU retards timing to compensate for the

condition causing knock. For further knock sensor and knock module information, see KNOCK SENSOR or KNOCK MODULE OPERATION in Group 100 earlier in this manual.

DTC 524275.03 will set if:

- The ECU detects a supply voltage greater than 13.1 volts on the 12 volt Knock supply circuit.

If DTC 524275.03 sets, the following will occur:

- The ECU will use a default value of 13.1 volts on the 12 volt Knock supply circuit.

Continued on next page

RG41221,000009E -19-25NOV02-1/2

- Other Knock Sensor codes may also be present.
- The Knock Sensor will be disable.
- DTC 000731.00, 000731.02, 000731.04, or 000731.16 may also be present.

- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

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RG41221,000009E -19-25NOV02-2/2

524275.03 — Knock Supply Voltage High

The ECU detects a voltage above specification on the Knock supply circuit.

RG41221,000009F –19–25NOV02–1/1

524275.03 Knock Supply Voltage High Diagnostic Procedure

NOTE: If DTC 524275.03 is accompanied with 000731.00, 000731.02, 000731.04, or 000731.16, diagnose 524275.03 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524275.03 KNOCK SUPPLY VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas tank temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.

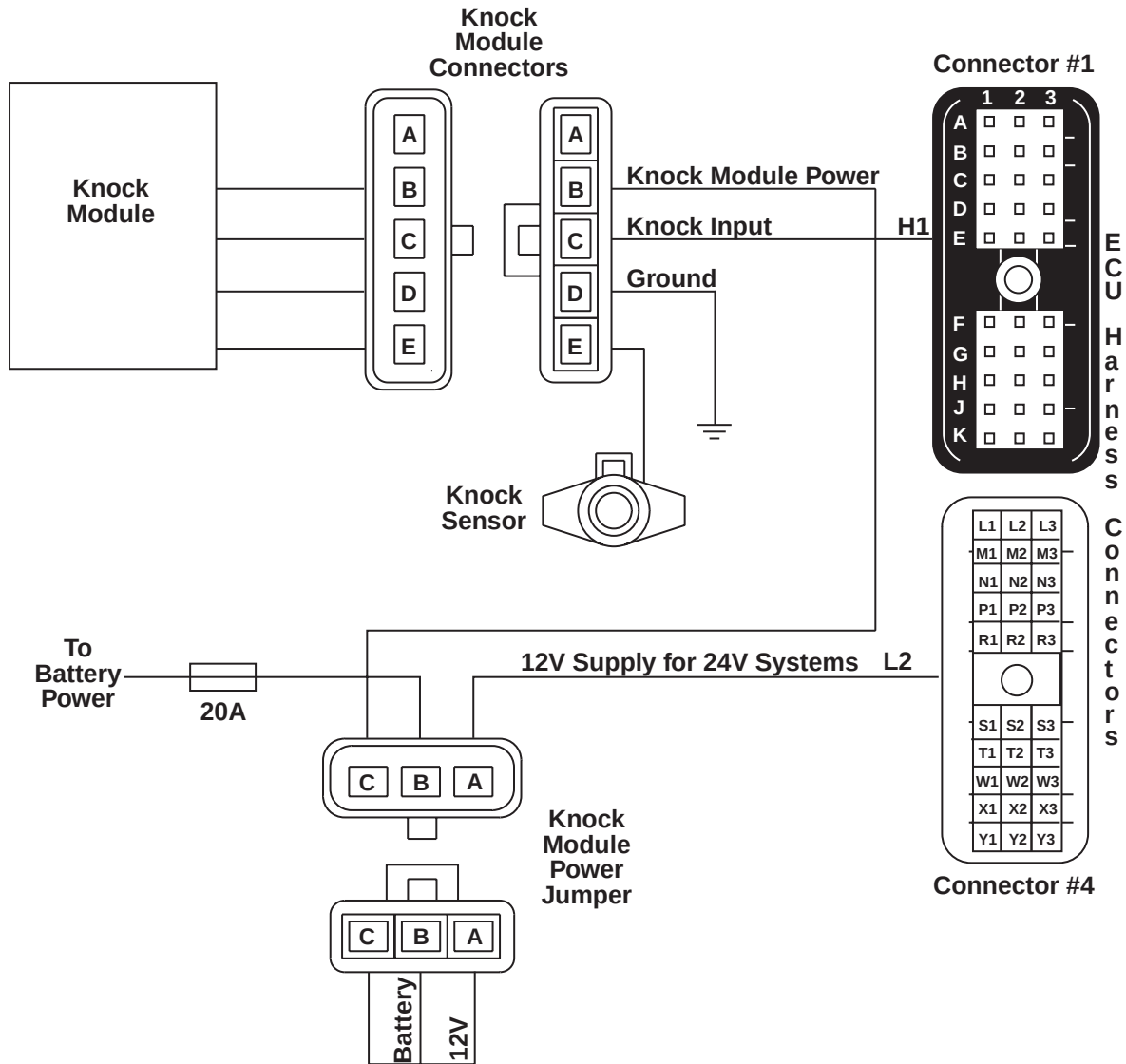
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❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524275.03 KNOCK SUPPLY VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	524275.03 reoccurs: GO TO ❸ 524275.03 doesn't reoccur: Problem is intermittent. If no other codes are present. see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Knock Module Power Jumper Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 524275.03 KNOCK SUPPLY VOLTAGE HIGH supporting information.</i> Verify that the jumper wire is in the correct locations in the Knock Module Power Jumper connector. - On 12 volt systems the jumper should be between terminal B and C in the Knock Module Power Jumper connector on the engine harness. - On 24 volt systems the jumper should be between terminal A and B in the Knock Module Power Jumper connector on the engine harness.	Jumper wire in correct position: GO TO ④ Jumper wire is not in correct position: Move jumper wire to the correct position and retest. -- -1/1
④ Knock Module Power Jumper Wire Resistance Test	<i>NOTE: For wiring and theory of operation information, see DTC 524275.03 KNOCK SUPPLY VOLTAGE HIGH supporting information.</i> - Ignition OFF - Disconnect the knock module power jumper connector. - Using a multimeter, measure resistance between terminals A and B in the knock module power jumper connector on the engine harness.	Greater than 20k ohms: GO TO ⑤ Any measurement 20k ohms or less: Short to battery voltage on the knock supply voltage wire. -- -1/1
⑤ Short in 12V Knock Supply Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 524275.03 KNOCK SUPPLY VOLTAGE HIGH supporting information.</i> - Ignition OFF - Disconnect all 4 ECU connectors from the ECU. - Using a multimeter, measure resistance between terminal L2 in the ECU connector #4 (white L-Y) and all other terminals in all four ECU connectors.	Greater than 20k ohms on all measurements: Faulty ECU connections OR Faulty ECU Any measurement 20k ohms or less: Knock 12 volt supply circuit shorted to power wire that caused lower resistance. -- -1/1

524275.04 — Knock Supply Voltage Low**Knock Sensor**

- The knock sensor is a resonant band pass filter that is very sensitive around 5.8 kHz. The knock module receives a pulse width modulated (PWM) signal from the knock sensor. The signal received is dependent on the amount of knock that is sensed on the engine. As the severity of knock increases, the PWM signal on-time increases. The knock module then translates the PWM signal into a comparative one-shot type signal (0 volts or 12 volts) to the ECU. The ECU uses this information to determine if the engine is seeing knock. Depending on the amount of knock, the ECU retards timing to compensate for the

condition causing knock. For further knock sensor and knock module information, see KNOCK SENSOR or KNOCK MODULE OPERATION in Group 100 earlier in this manual.

DTC 524275.04 will set if:

- The ECU detects a supply voltage less than 0 volts on the 12 volt Knock supply circuit.

If DTC 524275.04 sets, the following will occur:

- The ECU will use a default value of 0 volts on the 12 volt Knock supply circuit.

Continued on next page

RG41221,00000F8 -19-11FEB03-1/2

- Other Knock Sensor codes may also be present.
- The Knock Sensor will be disable.
- DTC 000731.00, 000731.02, 000731.04, or 000731.16 may also be present.

- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

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RG41221,00000F8 -19-11FEB03-2/2

524275.04 — Knock Supply Voltage Low

The ECU detects a voltage below specification on the Knock supply circuit.

RG41221,00000F9 -19-11FEB03-1/1

524275.04 Knock Supply Voltage Low Diagnostic Procedure

NOTE: If DTC 524275.04 is accompanied with 000731.00, 000731.02, 000731.04, or 000731.16, diagnose 524275.04 first.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 524275.04 KNOCK SUPPLY VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas tank temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

-- -1/1

❷ Intermittent Fault Test

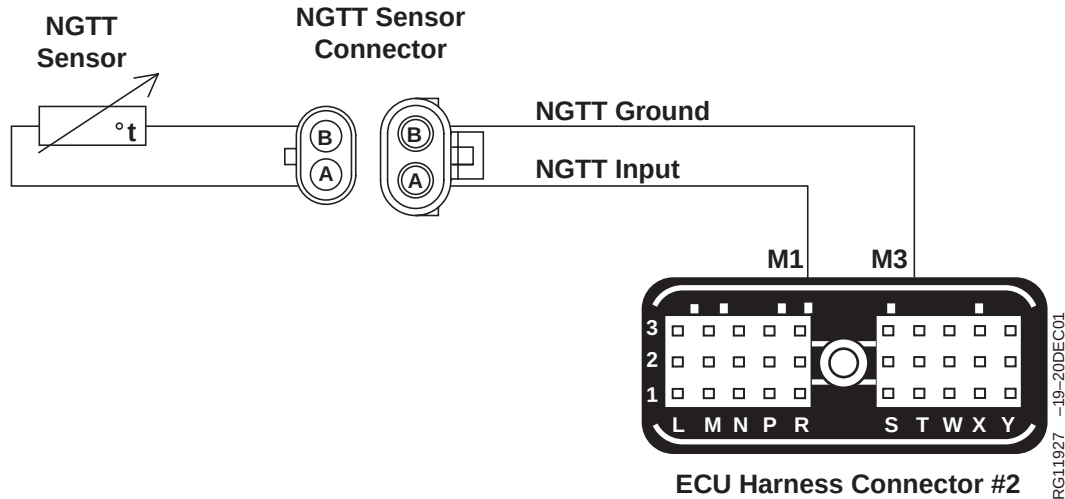
NOTE: For wiring and theory of operation information, see DTC 524275.04 KNOCK SUPPLY VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of all DTCs, then clear all DTCs
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

524275.04 reoccurs:
GO TO ❸

524275.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

③ Knock Module Power Jumper Wire Test	<i>NOTE: For wiring and theory of operation information, see DTC 524275.04 KNOCK SUPPLY VOLTAGE LOW supporting information.</i> Verify that the jumper wire is in the correct locations in the Knock Module Power Jumper connector. - On 12 volt systems the jumper should be between terminal B and C in the Knock Module Power Jumper connector on the engine harness. - On 24 volt systems the jumper should be between terminal A and B in the Knock Module Power Jumper connector on the engine harness.	Jumper wire in correct position: GO TO ④ Jumper wire is not in correct position or missing: Move jumper wire to the correct position and retest. -- -1/1
④ Knock Module Power Jumper Wire Resistance Test	<i>NOTE: For wiring and theory of operation information, see DTC 524275.04 KNOCK SUPPLY VOLTAGE LOW supporting information.</i> - Ignition OFF - Disconnect the knock module power jumper connector. - Using a multimeter, measure resistance between terminals A and B in the knock module power jumper connector on the engine harness.	Greater than 20k ohms: GO TO ⑤ Any measurement 20k ohms or less: Short to battery voltage on the knock supply voltage wire. -- -1/1
⑤ Short in 12V Knock Supply Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 524275.04 KNOCK SUPPLY VOLTAGE LOW supporting information.</i> - Ignition OFF - Disconnect all 4 ECU connectors from the ECU. - Using a multimeter, measure resistance between terminal L2 in the ECU connector #4 (white L-Y) and all other terminals in all four ECU connectors.	Greater than 20k ohms on all measurements: Faulty ECU connections OR Faulty ECU Any measurement 20k ohms or less: Knock 12 volt supply circuit shorted to ground wire that caused lower resistance. -- -1/1

524280.03 — Natural Gas Tank Temperature Input Voltage High**Natural Gas Tank Temperature (NGTT) Sensor**

- The Natural Gas Tank Temperature sensor is a thermistor (temperature sensitive variable resistor) wrapped around the fuel supply line and taped in place. It is used to measure the temperature of the fuel in the storage tanks. The NGTT sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further natural gas temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 524280.03 will set if:

- The natural gas tank temperature sensor input voltage exceeds 4.9 volts. This voltage corresponds to a temperature that is lower than what is physically possible for natural gas temperature.

If DTC 524280.03 sets, the following will occur:

- The ECU will default to an natural gas temperature value of 86°F (30°C).
- ECU will set a SOLID Warning light.

RG41221,00002E7 -19-13DEC01-1/1

524280.03 — Natural Gas Tank Temperature Input Voltage High

The natural gas tank temperature input voltage exceeds the sensor's high voltage specification.

RG41221,00002EB -19-13DEC01-1/1

524280.03 Natural Gas Tank Temperature Input Voltage High Diagnostic Procedure

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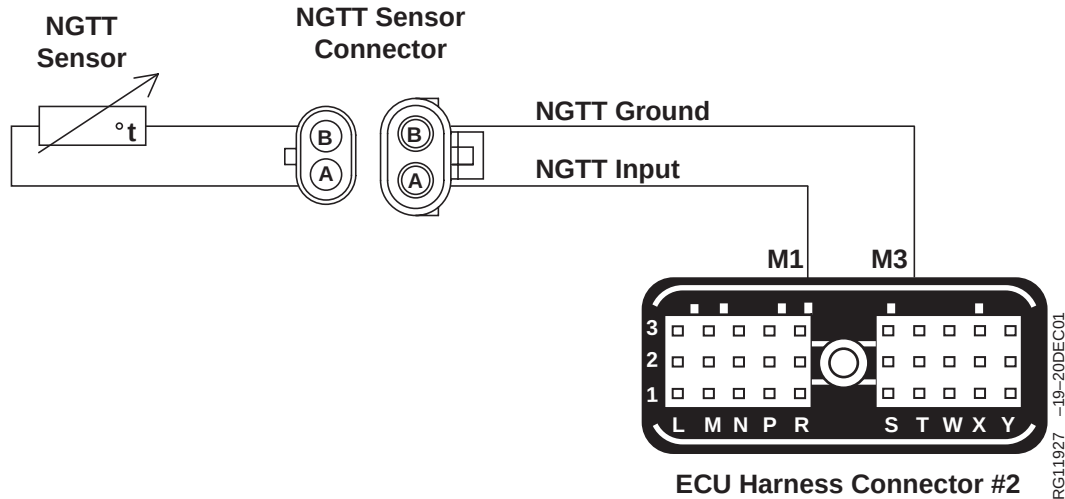
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524280.03 NATURAL GAS TANK TEMPERATURE INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas tank temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524280.03 NATURAL GAS TANK TEMPERATURE INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	524280.03 reoccurs: GO TO ❸ 524280.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 582	③ NGTT Sensor and Connector Test	<i>NOTE: For wiring and theory of operation information, see DTC 524280.03 NATURAL GAS TANK TEMPERATURE INPUT VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect NGTT sensor connector. 3. Install a jumper wire between both terminals in the NGTT sensor connector on the vehicle harness. 4. Ignition ON, engine OFF 5. Using the ECU diagnostic software, read Natural Gas Tank Temperature Input Voltage.	Above 0.1 V: GO TO ④ 0.1 V or below: Faulty NGTT sensor connector OR Faulty NGTT sensor -- -1/1
	④ NGTT Sensor Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 524280.03 NATURAL GAS TANK TEMPERATURE INPUT VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Remove jumper wire. 3. Install a jumper wire between NGTT sensor connector on the vehicle harness input terminal (terminal A) and a good chassis ground. 4. Ignition ON, engine OFF 5. Using the ECU diagnostic software, read Natural Gas Tank Temperature Input Voltage.	Above 0.1 V: Open in NGTT sensor input circuit OR Faulty ECU connection OR Faulty ECU 0.1 V or below: Open in NGTT sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

524280.04 — Natural Gas Tank Temperature Input Voltage Low**Natural Gas Tank Temperature (NGTT) Sensor**

- The Natural Gas Tank Temperature sensor is a thermistor (temperature sensitive variable resistor) wrapped around the fuel supply line and taped in place. It is used to measure the temperature of the fuel in the storage tanks. The NGTT sensor adjust the 5 volts supplied by the ECU according to the temperature. Higher temperatures result in lower voltages, lower temperatures result in higher voltages. For further natural gas temperature sensor information, see MEASURING TEMPERATURE in Group 100 earlier in this manual.

DTC 524280.04 will set if:

- The natural gas tank temperature sensor input voltage drops below 0.1 volts. This voltage corresponds to a temperature that is lower than what is physically possible for natural gas temperature.

If DTC 524280.04 sets, the following will occur:

- The ECU will default to an natural gas temperature value of 86°F (30°C).
- ECU will set a SOLID Warning light.

524280.04 — Natural Gas Tank Temperature Input Voltage Low

The natural gas tank temperature input voltage drops below the sensor's low voltage specification.

RG41221,00002EC -19-13DEC01-1/1

524280.04 Natural Gas Tank Temperature Input Voltage Low Diagnostic Procedure

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524280.04 NATURAL GAS TANK TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas tank temperature sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connection and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524280.04 NATURAL GAS TANK TEMPERATURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	524280.04 reoccurs: GO TO ❸ 524280.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ NGTT Sensor Test

NOTE: For wiring and theory of operation information, see DTC 524280.04 NATURAL GAS TANK TEMPERATURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect NGTT sensor connector
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read Natural Gas Tank Temperature Input Voltage.

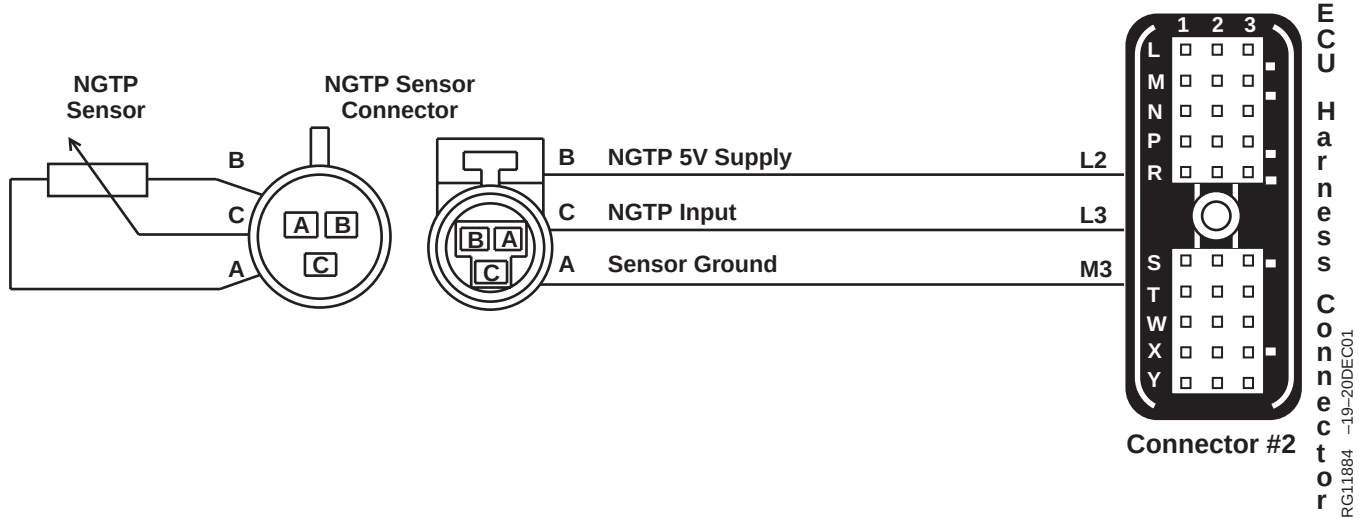
Below 4.9 V:

Short to ground in NGTT sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

4.9 V or greater:

Faulty NGTT sensor connection
OR
Faulty NGTT sensor

-- -1/1

524281.03 — Natural Gas Tank Pressure Input Voltage High**Natural Gas Tank Pressure (NGTP) Sensor**

- The Natural Gas Tank Pressure sensor is a pressure transducer mounted on the inlet side (high pressure side) of the fuel pressure regulator. It is used to measure the gas pressure in the storage tanks. The NGTP signal voltage varies as the fuel pressure in the tanks vary. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further natural gas tank pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 524281.03 will set if:

- NGTP input voltage exceeds a maximum voltage threshold of 4.9 volts. This voltage corresponds to a pressure that is higher than what is physically possible for NGTP.

If DTC 524281.03 sets, the following will occur:

- The ECU will use a default natural gas tank pressure value of 232 psia (1600 kPa) (16 bar).
- DTC 001080.03 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524281.03 — Natural Gas Tank Pressure Input Voltage High

The NGTP input voltage exceeds the sensor's high voltage specification.

RG41221,00002ED -19-13DEC01-1/1

524281.03 Natural Gas Tank Pressure Input Voltage High Diagnostic Procedure

NOTE: If DTC 524281.03 is accompanied with 001080.03, diagnose 524281.03 first.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 524281.03 NATURAL GAS TANK PRESSURE INPUT VOLTAGE HIGH supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas tank pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.

Connection Check:
GO TO ❷

Faulty connection(s):
Repair connection and repair.

-- -1/1

❷ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 524281.03 NATURAL GAS TANK PRESSURE INPUT VOLTAGE HIGH supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

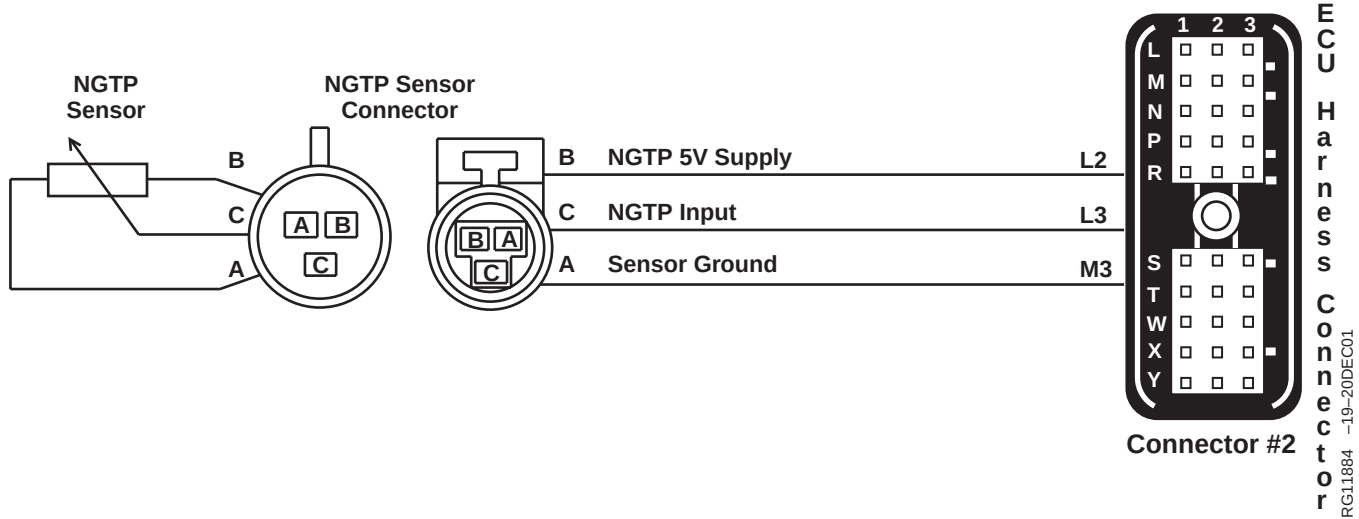
524281.03 reoccurs:
GO TO ❸

524281.03 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 590	③ NGTP Input Shorted Test	<i>NOTE: For wiring and theory of operation information, see DTC 524281.03 NATURAL GAS TANK PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect the NGTP sensor connector. 3. Ignition ON, engine OFF 4. Using the ECU diagnostic software, read Natural Gas Tank Pressure Input Voltage.	Below 0.2 V: GO TO ④ 0.2 V or greater: Short to voltage in NGTP input circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ NGTP Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation information, see DTC 524281.03 NATURAL GAS TANK PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. NGTP sensor connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the NGTP sensor ground terminal (terminal A) of the NGTP sensor connector on the vehicle harness with a test light connected to battery voltage.	Light ON: Faulty NGTP sensor OR Faulty ECU connection OR Faulty ECU Light OFF: Open in NGTP sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

524281.04 — Natural Gas Tank Pressure Input Voltage Low**Natural Gas Tank Pressure (NGTP) Sensor**

- The Natural Gas Tank Pressure sensor is a pressure transducer mounted on the inlet side (high pressure side) of the fuel regulator. It is used to measure the gas pressure in the storage tanks. The NGTP signal voltage varies as the fuel pressure in the tanks vary. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further natural gas tank pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 524281.04 will set if:

- NGTP input voltage drops below 0.2 volts. This voltage corresponds to a pressure that is lower than what is physically possible for NGTP.

If DTC 524281.04 sets, the following will occur:

- The ECU will use a default natural gas tank pressure value of 232 psia (1600 kPa) (16 bar).
- DTC 001080.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524281.04 — Natural Gas Tank Pressure Input Voltage Low

NGTP input voltage drops below the sensor's low voltage specification.

RG41221,00002EE -19-13DEC01-1/1

524281.04 Natural Gas Tank Pressure Input Voltage Low Diagnostic Procedure

NOTE: If DTC 524281.04 is accompanied with 001080.04, diagnose 524281.04 first.

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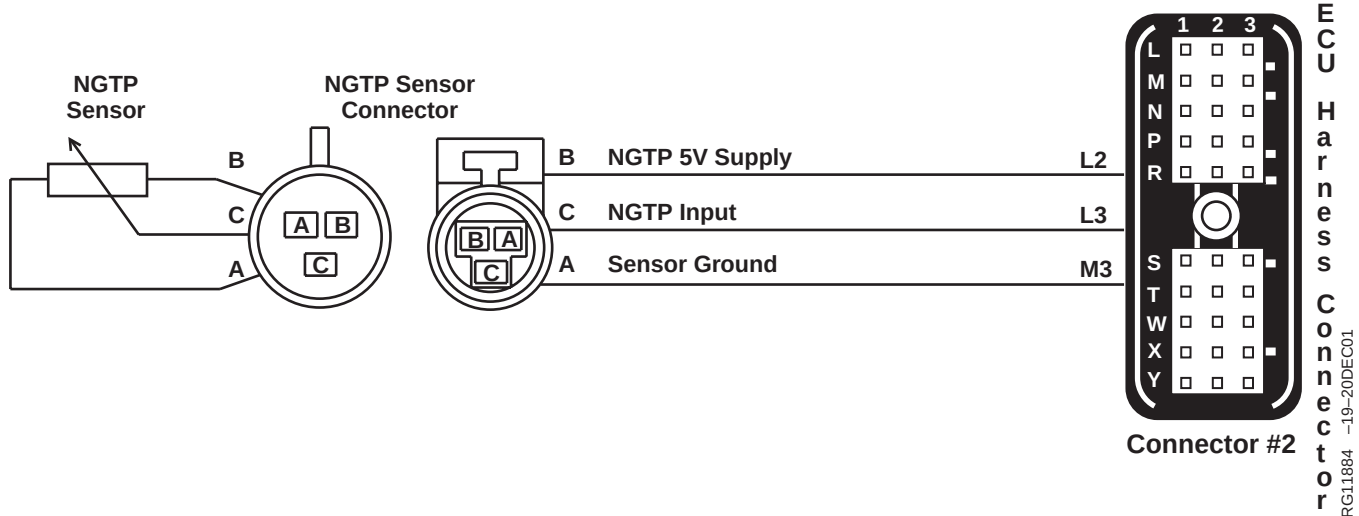
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524281.04 NATURAL GAS TANK PRESSURE INPUT VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas tank pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524281.04 NATURAL GAS TANK PRESSURE INPUT VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	524281.04 reoccurs: GO TO ❸ 524281.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 594	③ NGTP Sensor and Connector Test	<i>NOTE: For wiring and theory of operation information, see DTC 524281.04 NATURAL GAS TANK PRESSURE INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Disconnect the NGTP sensor connector 3. Install a jumper wire between the NGTP 5V supply and the input terminals (terminals B and C) in the sensor connector on the vehicle harness. 4. Ignition ON, engine OFF 5. Using the ECU diagnostic software, read Natural Gas Tank Pressure Input Voltage.	Below 4.9 V: GO TO ④ 4.9 V or greater: Faulty NGTP sensor connection OR Faulty NGTP sensor -- -1/1
	④ NGTP 5V Supply Test	<i>NOTE: For wiring and theory of operation information, see DTC 524281.04 NATURAL GAS TANK PRESSURE INPUT VOLTAGE LOW supporting information.</i> 1. Ignition OFF 2. Remove the jumper wire 3. Ignition ON, engine OFF 4. Using a multimeter, measure voltage between the 5V supply (terminal B) of the NGTP sensor connector on the vehicle harness and a good chassis ground.	4.0 - 6.0 volts: Open in NGTP sensor input circuit OR Short to ground in NGTP sensor input circuit OR Faulty ECU connection OR Faulty ECU Below 4.0 volts: Open in NGTP sensor 5V supply circuit OR Short to ground in NGTP 5V supply circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

524281.18 — Natural Gas Tank Pressure Lower Than Expected**Natural Gas Tank Pressure (NGTP) Sensor**

- The Natural Gas Tank Pressure sensor is a pressure transducer mounted on the inlet side (high pressure side) of the fuel regulator. It is used to measure the gas pressure in the storage tanks. The NGTP signal voltage varies as the fuel pressure in the tanks vary. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further natural gas tank pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 524281.18 will set if:

- The ECU senses natural gas tank pressure below 218 psia (1500 kPa) (15 bar)

If DTC 524281.18 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the natural gas tank pressure increases above the minimum value set point, power will be increased 30% per minute until either full power is reached or the minimum value set point falls out of range again.
- DTC 001569.31 will also be present.
- Depending on length of time this DTC is set, engine could die or not start due to lack of fuel.
- ECU will set a SOLID Warning light.

524281.18 — Natural Gas Tank Pressure Lower Than Expected

The ECU senses natural gas tank pressure below specification.

RG41221,000036D -19-09JUL03-1/1

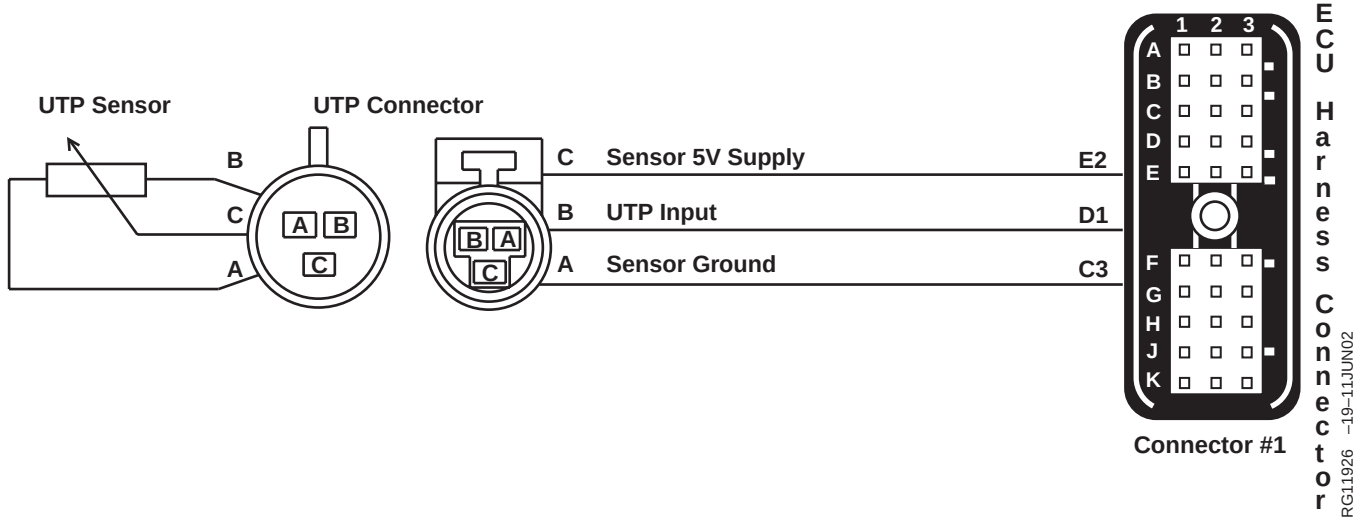
524281.18 Natural Gas Tank Pressure Lower Than Expected Diagnostic Procedure

NOTE: For vehicle that have multiple high pressure lock-offs that experience this DTC, see F4 - HIGH FUEL CONSUMPTION CHECK in Group 105 earlier in this manual.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524281.18 NATURAL GAS TANK PRESSURE LOWER THAN EXPECTED supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the natural gas tank pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Fuel Check	<i>NOTE: For wiring and theory of operation information, see DTC 524281.18 NATURAL GAS TANK PRESSURE LOWER THAN EXPECTED supporting information.</i> 1. Ignition ON, engine OFF 2. Check the fuel gauge to assure that there is fuel in the tanks. 3. Make sure all of the fuel tank shut-off valves are open.	No fuel and valves open: Add fuel to the tanks and retest. Fuel in tanks and valve(s) closed: Open valve(s) and retest. Fuel in tanks and valves open: Verify that the natural gas tank pressure sensor 5 V supply, input, and ground circuits are OK. If natural gas tank pressure sensor circuits are OK, replace sensor and retest.

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524282.02 — Upstream Throttle Pressure Cross Check Invalid**Upstream Throttle Pressure (UTP) Sensor**

- The Upstream Throttle Pressure sensor is a pressure transducer located on the mixing elbow. The ECU uses UTP to measure the air pressure above the throttle plate. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further upstream throttle pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 524282.02 will set if:

The ECU does a cross check between the MAP sensor, the BAP sensor, and the UTP sensor during

start up and then randomly as the engine is running. DTC 524282.02 will set if the ECU senses upstream throttle pressure that is not possible with the current MAP and BAP readings.

If DTC 524282.02 sets, the following will occur:

- Engine can't make desired boost pressure; set UTP to BAP.
- Engine makes desired boost pressure; use MAP to calculate UTP by estimating drop in pressure across throttle.
- DTC 524282.04 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524282.02 — Upstream Throttle Pressure Cross Check Invalid

Cross check shows UTP is out of specification with BAP and MAP.

RG41221.00002F0 -19-13DEC01-1/1

524282.02 Upstream Throttle Pressure Cross Check Invalid Diagnostic Procedure

NOTE: If DTC 524282.02 is accompanied with 524282.04, diagnose 524282.04 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524282.02 UPSTREAM THROTTLE PRESSURE CROSS CHECK INVALID supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the upstream throttle pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524282.02 UPSTREAM THROTTLE PRESSURE CROSS CHECK INVALID supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software. 4. Make note of any DTCs, then clear all DTCs 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	524282.02 reoccurs: GO TO ❸ 524282.02 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ UTP Input Wire Shorted Test

NOTE: For wiring and theory of operation information, see DTC 524282.02 UPSTREAM THROTTLE PRESSURE CROSS CHECK INVALID supporting information.

1. Ignition OFF
2. Disconnect the UTP sensor connector.
3. Disconnect ECU connector #1 (black A-K).
4. Using a multimeter, measure resistance between terminal D1 in the ECU connector and terminal B in the UTP sensor connector on the engine harness.

5 ohms or less:
GO TO **④**

Greater than 5 ohms:
Short or open in UTP
Input wire

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④ UTP Sensor Test

NOTE: For wiring and theory of operation information, see DTC 524282.02 UPSTREAM THROTTLE PRESSURE CROSS CHECK INVALID supporting information.

1. Ignition ON, engine running under conditions that sets code.
2. Using the ECU diagnostic software, read Upstream Throttle Pressure - Actual and Upstream Throttle Pressure Input Voltage. Use the following table for the voltage range at specific pressures.

Pressure	Voltage
10 psia (70 kPa) (0.7 bar)	0.43 to 0.58 volts
13 psia (90 kPa) (0.9 bar)	0.83 to 0.94 volts
26 psia (180 kPa) (1.8 bar)	2.52 to 2.64 volts
43.5 psia (300 kPa) (3.0 bar)	4.75 to 4.94 volts

NOTE: If exact voltage is not included in table, see if relationship between Pressure and Voltage are similar to the table.

Voltage within specification:
GO TO **⑤**

Voltage out of specification:
Faulty UTP sensor

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⑤ Throttle Test

NOTE: For wiring and theory of operation information, see DTC 524282.02 UPSTREAM THROTTLE PRESSURE CROSS CHECK INVALID supporting information.

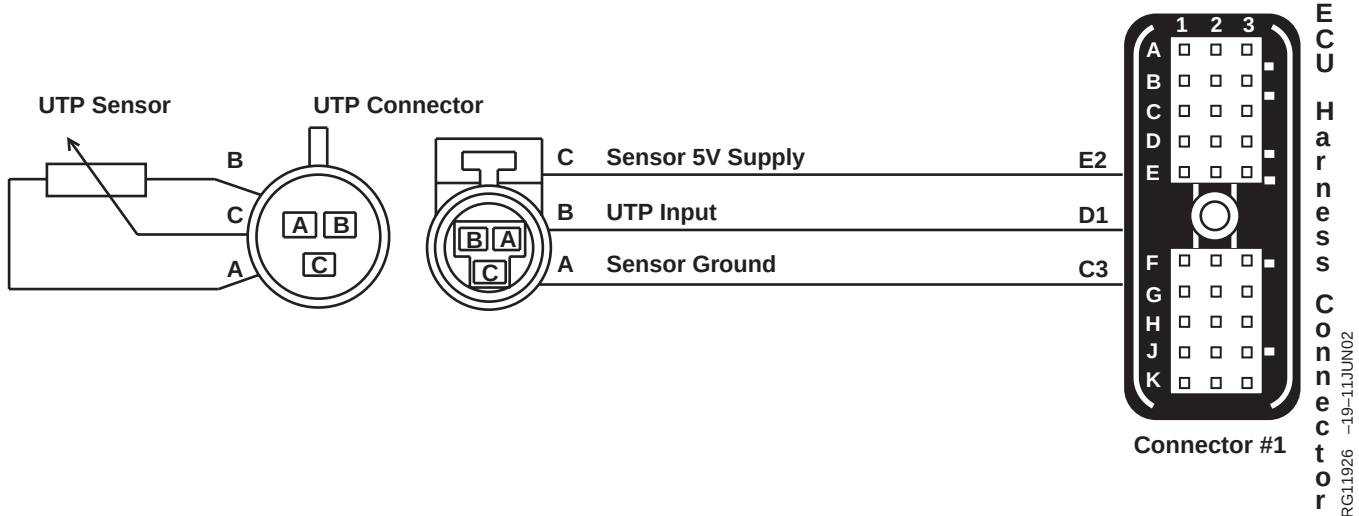
1. Ignition ON, engine running
2. Using the ECU diagnostic software, watch Throttle Position Sensor Command and Throttle Position Sensor Feedback.
3. Slowly move the foot pedal from idle position to fully depressed while watching the TPS parameters

TPS Feedback and TPS Command with 7% of each other:
GO TO **⑥**

TPS Feedback and TPS Command more than 7% of each other:
Faulty throttle

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⑥ Air Leak Test	<i>NOTE: For wiring and theory of operation information, see DTC 524282.02 UPSTREAM THROTTLE PRESSURE CROSS CHECK INVALID supporting information.</i> Check all air lines from the turbocharger outlet to the mixing elbow outlet for air leaks.	No air leaks: Faulty ECU connection OR Faulty ECU Air leak(s): Repair air leaks and retest.	115 601
			-- -1/1

524282.03 — Upstream Throttle Pressure Input Voltage High**Upstream Throttle Pressure (UTP) Sensor**

- The Upstream Throttle Pressure sensor is a pressure transducer located on the mixing elbow. The ECU uses UTP to measure the air pressure above the throttle plate. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further upstream throttle pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 524282.03 will set if:

- The upstream throttle pressure sensor input voltage exceeds 4.9 volts. This voltage corresponds to a pressure that is higher than what is physically possible for UTP.

If DTC 524282.03 sets, the following will occur:

- The ECU will use a default Upstream Throttle Pressure of 29 psia (200 kPa) (2.0 bar).
- DTC 000620.03 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524282.03 — Upstream Throttle Pressure Input Voltage High

The upstream throttle pressure input voltage exceeds the sensor's high voltage specification.

RG41221.00002F3 -19-13DEC01-1/1

524282.03 Upstream Throttle Pressure Input Voltage High Diagnostic Procedure

NOTE: If DTC 524282.03 is accompanied with 000620.03, diagnose 000620.03 first.

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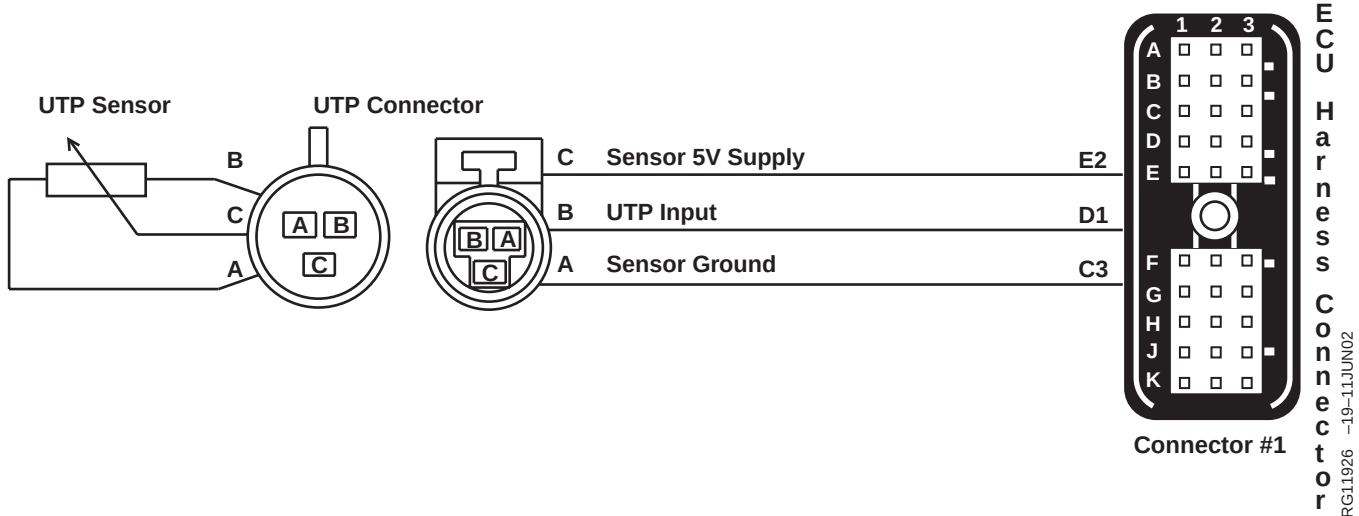
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524282.03 UPSTREAM THROTTLE PRESSURE INPUT VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the upstream throttle pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524282.03 UPSTREAM THROTTLE PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software. 4. Make note of any DTCs, then clear all DTCs. 5. Ignition ON, engine running 6. Read DTCs using DST or SERVICE ADVISOR™.	524282.03 reoccurs: GO TO ❸ 524282.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 604	③ UTP Input Shorted Test	<i>NOTE: For wiring and theory of operation information, see DTC 524282.03 UPSTREAM THROTTLE PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. Disconnect the UTP sensor connector 3. Ignition ON, engine OFF 4. Using the ECU diagnostic software, read the Upstream Throttle Pressure Input Voltage.	Below 0.2 V: GO TO ④ 0.2 V or greater Short to voltage in UTP input circuit OR Faulty ECU connection OR Faulty ECU -- -1/1
	④ UTP Ground Circuit Open Test	<i>NOTE: For wiring and theory of operation information, see DTC 524282.03 UPSTREAM THROTTLE PRESSURE INPUT VOLTAGE HIGH supporting information.</i> 1. UTP sensor connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the UTP sensor ground terminal (terminal A) of the UTP sensor connector on the engine harness with a test light connected to battery voltage.	Light ON: Faulty UTP sensor OR Faulty ECU connection OR Faulty ECU Light OFF: Open in UTP sensor ground circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

524282.04 — Upstream Throttle Pressure Input Voltage Low**Upstream Throttle Pressure (UTP) Sensor**

- The Upstream Throttle Pressure sensor is a pressure transducer located on the mixing elbow. The ECU uses UTP to measure the air pressure above the throttle plate. Higher pressure results in higher voltages to the ECU, lower pressure results in a lower voltage. For further upstream throttle pressure sensor information, see MEASURING PRESSURE in Group 100 earlier in this manual.

DTC 524282.04 will set if:

- The upstream throttle pressure sensor input voltage drops below 0.2 volts. This voltage corresponds to a pressure that is lower than what is physically possible for UTP.

If DTC 524282.04 sets, the following will occur:

- The ECU will use a default Upstream Throttle Pressure of 29 psia (200 kPa) (2.0 bar).
- DTC 000620.04 or 524282.02 may also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

RG41221,00002F2 -19-13DEC01-1/1

524282.04 — Upstream Throttle Pressure Input Voltage Low

The upstream throttle pressure input voltage drops below the sensor's low voltage specification.

RG41221.00002F4 -19-13DEC01-1/1

524282.04 Upstream Throttle Pressure Input Voltage Low Diagnostic Procedure

NOTE: If DTC 524282.04 is accompanied with 524282.02, diagnose 524282.04 first.

NOTE: If DTC 524282.04 is accompanied with 000620.04, diagnose 000620.04 first.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 524282.04 UPSTREAM THROTTLE PRESSURE INPUT VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the upstream throttle pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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② Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 524282.04 UPSTREAM THROTTLE PRESSURE INPUT VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Ignition ON, engine running
6. Read DTCs using DST or SERVICE ADVISOR™.

524282.04 reoccurs:
GO TO ③

524282.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ UTP Sensor and Connector Test

NOTE: For wiring and theory of operation information, see DTC 524282.04 UPSTREAM THROTTLE PRESSURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect the UTP sensor connector.
3. Install a jumper wire between the UTP 5V supply and the input terminals (terminals B and C) in the sensor connector on the engine harness.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read Upstream Throttle Pressure Input Voltage.

Below 4.9 V:
GO TO ④

4.9 V or greater:
Faulty UTP sensor connector
OR
Faulty UTP sensor

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④ UTP 5V Supply Test

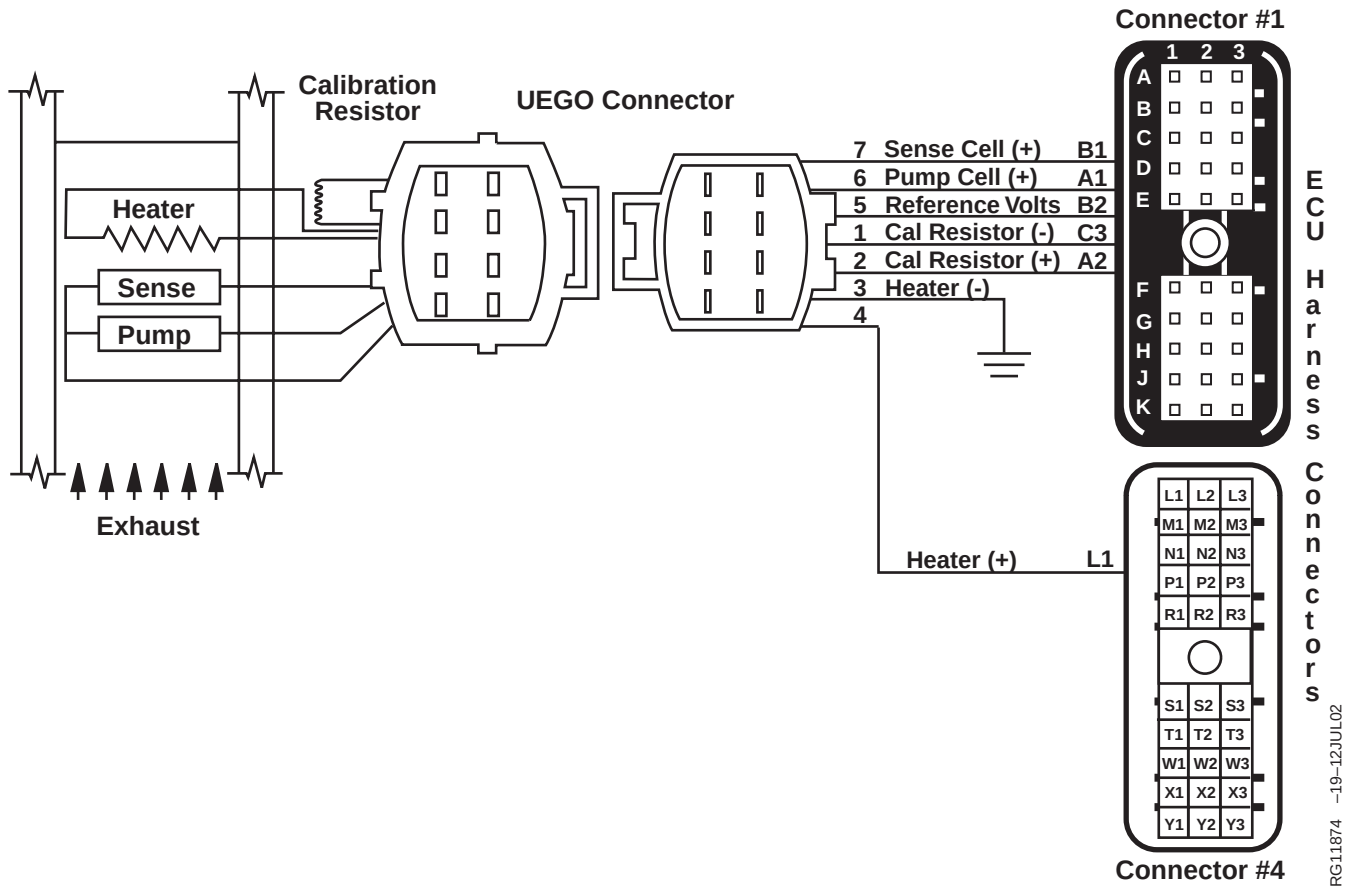
NOTE: For wiring and theory of operation information, see DTC 524282.04 UPSTREAM THROTTLE PRESSURE INPUT VOLTAGE LOW supporting information.

1. Ignition OFF
2. Remove the jumper wire
3. Ignition ON, engine OFF
4. Using a multimeter, measure the voltage between the 5V supply (terminal C) of the UTP sensor connector on the engine harness and a good chassis ground.

4.0 - 6.0 volts:
Open in UTP sensor input circuit
OR
Short to ground in UTP sensor input circuit
OR
Faulty ECU connection
OR
Faulty ECU

Below 4.0 volts:
Open in UTP sensor 5V supply circuit
OR
Short to ground in UTP sensor 5V supply circuit
OR
Faulty ECU connection
OR
Faulty ECU

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524283.03 — UEGO Sense Cell Voltage High**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

DTC 524283.03 will set if:

- The ECU detects a UEGO Sense Cell voltage that exceeds 12.2 volts.

If DTC 524283.03 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the UEGO Sense Cell returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the UEGO Sense Cell falls out of range again.
- DTC 000724.02 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524283.03 — UEGO Sense Cell Voltage High

The ECU detects a UEGO Sense Cell voltage that exceeds specification.

RG41221,00002D0 -19-12DEC01-1/1

524283.03 UEGO Sense Cell Voltage High Diagnostic Procedure

NOTE: If DTC 524283.03 is accompanied with 000724.02, 001119.00, 001119.01, 001119.16, or 001119.18, diagnose 524283.03 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524283.03 UEGO SENSE CELL VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524283.03 UEGO SENSE CELL VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine at low idle for 2 minutes. 6. Read DTCs using DST or SERVICE ADVISOR™.	524283.03 reoccurs: GO TO ❸ 524283.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ Sense Cell Wiring
Test

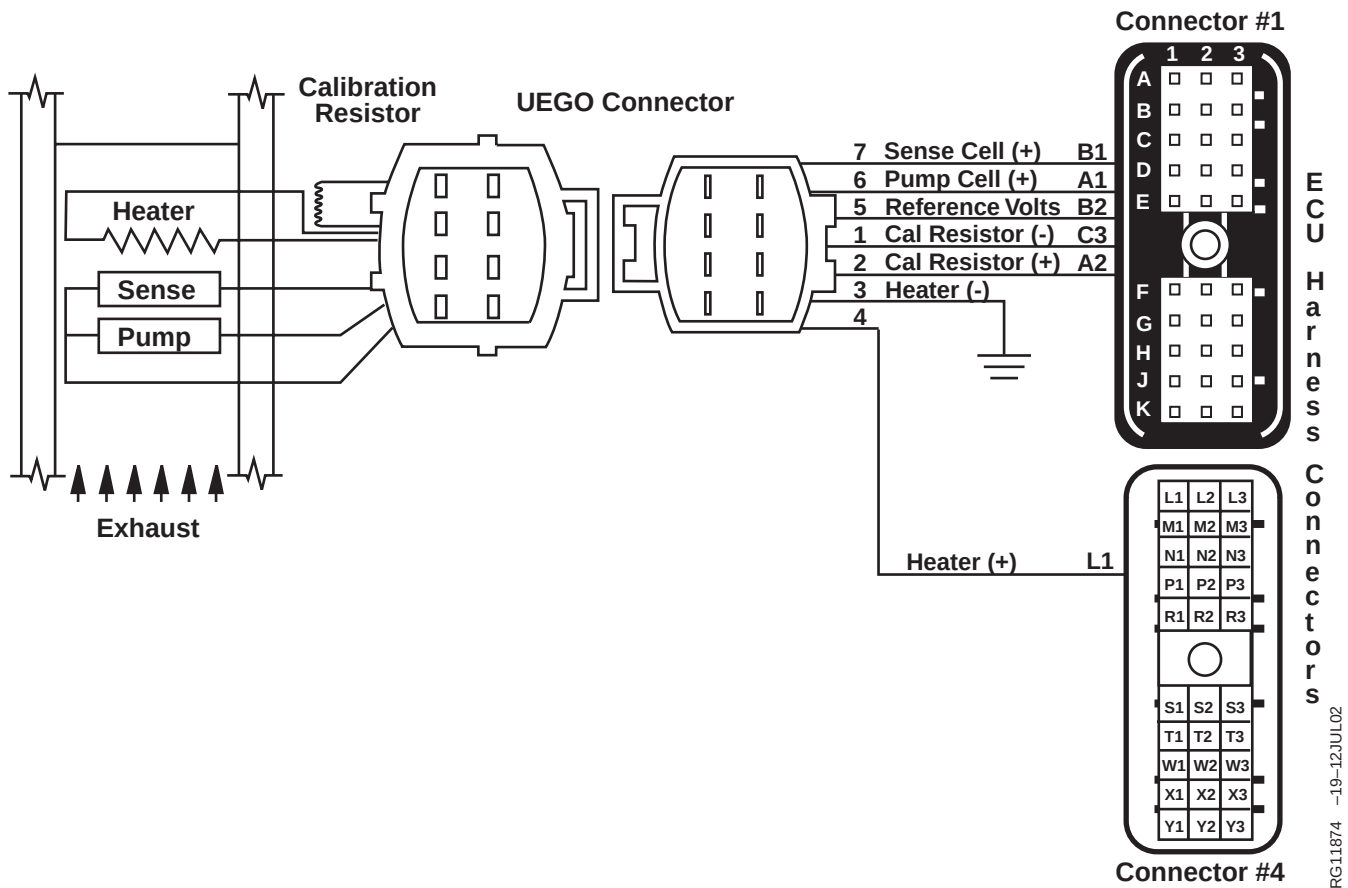
NOTE: For wiring and theory of operation information, see DTC 524283.03 UEGO SENSE CELL VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect the UEGO sensor.
3. Install a jumper wire between Sense Cell (+) terminal (terminal 7) in the UEGO sensor connector on the engine harness and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read UEGO Sense Voltage.

Above 0.2 V:
Short to power in Sense
Cell (+) circuit
OR
Faulty ECU connection
OR
Faulty ECU

0.2 V or below:
Faulty UEGO sensor
connection
OR
Faulty UEGO sensor

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524283.04 — UEGO Sense Cell Voltage Low**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

DTC 524283.04 will set if:

- The ECU detects a UEGO Sense Cell voltage that drops below 0.2 volts.

If DTC 524283.04 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the UEGO Sense Cell returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the UEGO Sense Cell falls out of range again.
- DTC 000724.02 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524283.04 — UEGO Sense Cell Voltage Low

The ECU detects a UEGO Sense Cell voltage that drops below specification.

RG41221,00002D2 -19-12DEC01-1/1

524283.04 UEGO Sense Cell Voltage Low Diagnostic Procedure

NOTE: If DTC 524283.04 is accompanied with 000724.02, 001119.00, 001119.01, 001119.16, or 001119.18, diagnose 524283.04 first.

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❶ Connection Check

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

NOTE: For wiring and theory of operation information, see DTC 524283.04 UEGO SENSE CELL VOLTAGE LOW supporting information.

Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.

No faulty connection(s):
GO TO ❷

Faulty connection(s):
Repair connections and retest.

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❷ Intermittent Fault Test

NOTE: For wiring and theory of operation information, see DTC 524283.04 UEGO SENSE CELL VOLTAGE LOW supporting information.

1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.
2. Ignition ON, engine OFF
3. Start the ECU diagnostic software
4. Make note of any DTCs, then clear all DTCs.
5. Run engine at low idle for 2 minutes.
6. Read DTCs using DST or SERVICE ADVISOR™.

524283.04 reoccurs:
GO TO ❸

524283.04 doesn't reoccur:
Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ UEGO Sensor Test

NOTE: For wiring and theory of operation information, see DTC 524283.04 UEGO SENSE CELL VOLTAGE LOW supporting information.

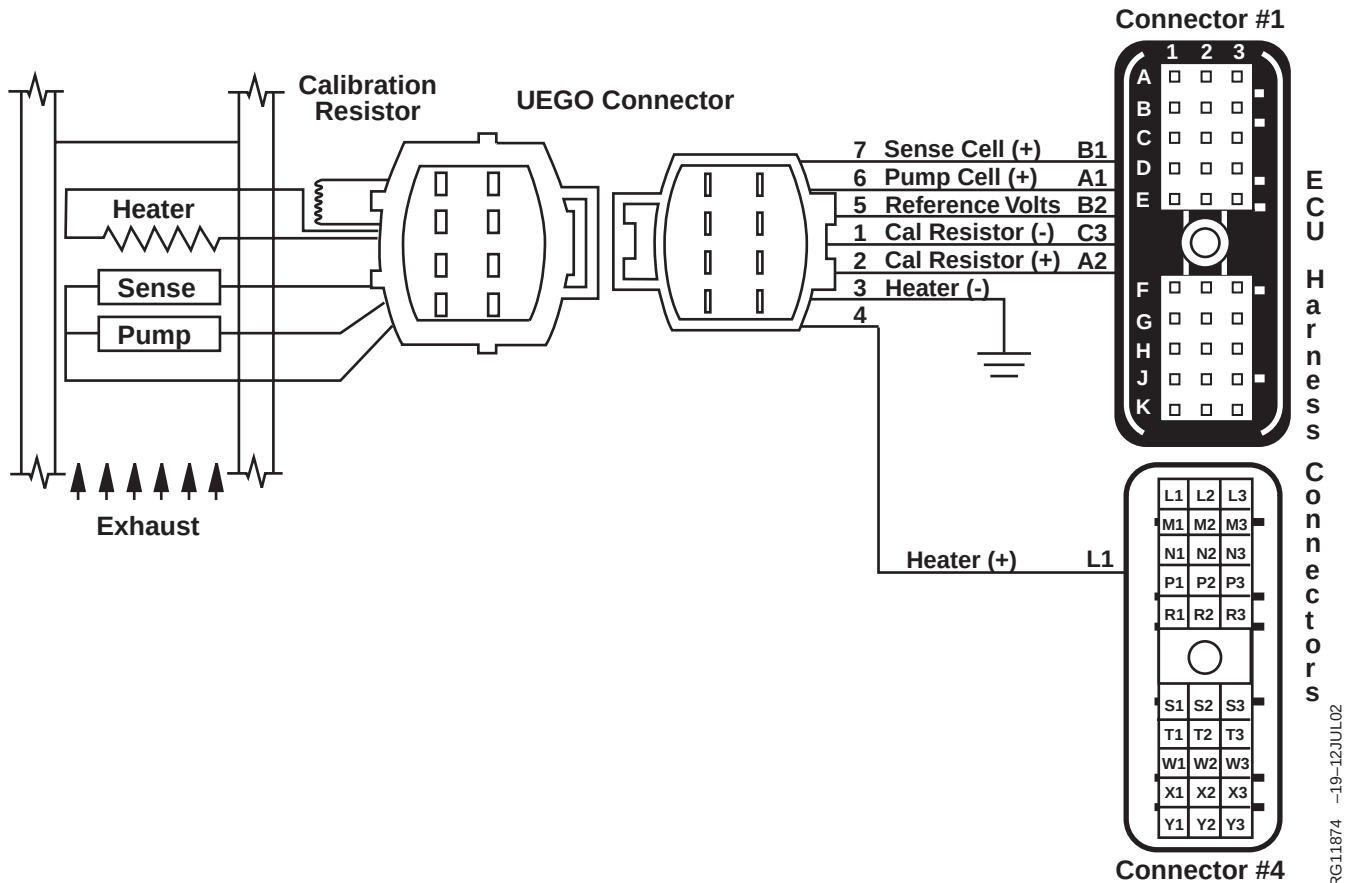
1. Ignition OFF
2. Disconnect the UEGO sensor connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read UEGO Sense Voltage.

Below 5.0 V:
Short to ground in Sense Cell (+) circuit.

OR
Faulty ECU connection
OR
Faulty ECU

5.0 V or greater:
Faulty UEGO sensor connection
OR
Faulty UEGO sensor

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524284.03 — UEGO Calibration Resistor Voltage High**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

DTC 524284.03 will set if:

- The ECU detects a UEGO Calibration Resistor voltage that exceeds 4.9 volts.

If DTC 524284.03 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the UEGO Calibration Resistor returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the UEGO Calibration Resistor falls out of range again.
- DTC 000724.02 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524284.03 — UEGO Calibration Resistor Voltage High

The ECU detects a UEGO Calibration Resistor voltage that exceeds specification.

RG41221,000030E -19-14DEC01-1/1

524284 FMI 3 UEGO Calibration Resistor Voltage High Diagnostic Procedure

NOTE: If DTC 524284.03 is accompanied with 000724.02, 001119.00, 001119.01, 001119.16, or 001119.18, diagnose 524284.03 first.

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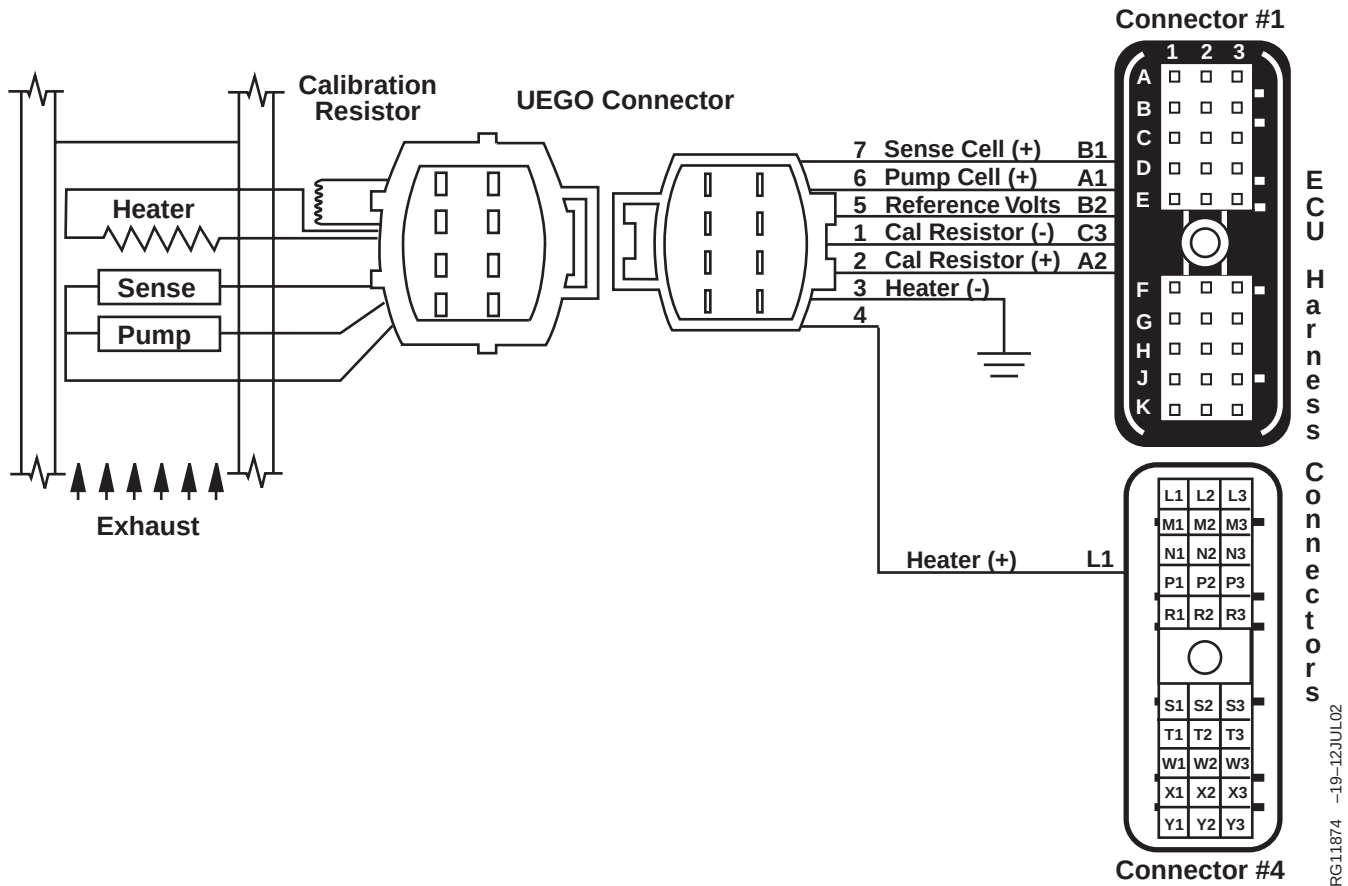
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524284.03 UEGO CALIBRATION RESISTOR VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524284.03 UEGO CALIBRATION RESISTOR VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine at low idle for 2 minutes. 6. Read DTCs using DST or SERVICE ADVISOR™.	524284.03 reoccurs: GO TO ❸ 524284.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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	④ Calibration Resistor Wiring Test	<i>NOTE: For wiring and theory of operation information, see DTC 524284.03 UEGO CALIBRATION RESISTOR VOLTAGE HIGH supporting information.</i> 1. Ignition OFF 2. UEGO sensor still disconnected. 3. Install a jumper wire between the Cal Resistor terminal (terminals 2) in the UEGO sensor connector on the engine harness and a good chassis ground. 4. Ignition ON, engine OFF 5. Using the ECU diagnostic software, read UEGO Calibration Resistor Voltage.	Above 0.1 V: Open in Cal Resistor (+) circuit OR Faulty ECU connection OR Faulty ECU 0.1 V or below: Open in Cal Resistor (-) circuit OR Faulty UEGO sensor connection OR Faulty UEGO sensor -- -1/1

524284.04 — UEGO Calibration Resistor Voltage Low**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

DTC 524284.04 will set if:

- The ECU detects a UEGO Calibration Resistor voltage that drops below 0.1 volts.

If DTC 524284.04 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the UEGO Calibration Resistor returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the UEGO Calibration Resistor falls out of range again.
- DTC 000724.02 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524284.04 — UEGO Calibration Resistor Voltage Low

The ECU detects a UEGO Calibration Resistor voltage that drops below specification.

RG41221,0000310 -19-14DEC01-1/1

524284.04 UEGO Calibration Resistor Voltage Low Diagnostic Procedure

NOTE: If DTC 524284.04 is accompanied with 000724.02, 001119.00, 001119.01, 001119.16, or 001119.18, diagnose 524284.04 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524284.04 UEGO CALIBRATION RESISTOR VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524284.04 UEGO CALIBRATION RESISTOR VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine at low idle for 2 minutes. 6. Read DTCs using DST or SERVICE ADVISOR™.	524284.04 reoccurs: GO TO ❸ 524284.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ UEGO Sensor Test

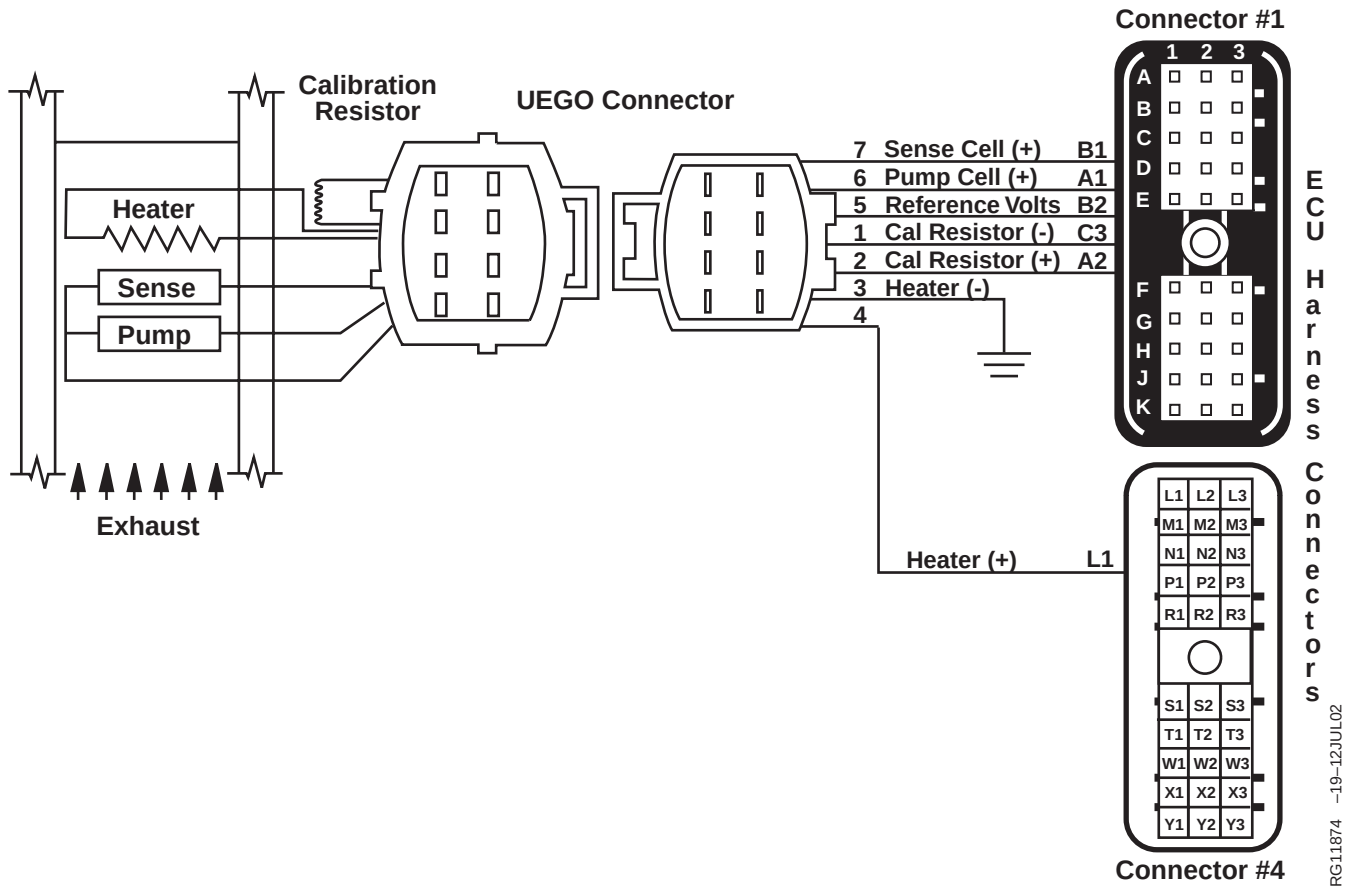
NOTE: For wiring and theory of operation information, see DTC 524284.04 UEGO CALIBRATION RESISTOR VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect the UEGO sensor connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read UEGO Calibration Resistor Voltage.

Below 4.9 V:
Short to ground in Cal
Resistor (+) circuit.
OR
Faulty ECU connection
OR
Faulty ECU

4.9 V or greater:
Faulty UEGO sensor
connection
OR
Faulty UEGO sensor

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524285.03 — UEGO Reference Voltage High**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

The reference voltage is used as a reference for the sense cell voltage and the pump cell voltage. Under normal operating conditions the reference voltage should be around 3.3 volts.

DTC 524285.03 will set if:

- The ECU detects a UEGO Reference Voltage that exceeds 12.2 volts.

If DTC 524285.03 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the UEGO Reference Voltage returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the UEGO Reference Voltage falls out of range again.
- DTC 000724.02 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524285.03 — UEGO Reference Voltage High

The ECU detects a UEGO Reference Voltage that exceeds specification.

RG41221,000037C -19-03JUL02-1/1

524285.03 UEGO Reference Voltage High Diagnostic Procedure

NOTE: If DTC 524285.03 is accompanied with 000724.02, 001119.00, 001119.01, 001119.16, or 001119.18, diagnose 524285.03 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524285.03 UEGO REFERENCE VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524285.03 UEGO REFERENCE VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine at low idle for 2 minutes. 6. Read DTCs using DST or SERVICE ADVISOR™.	524285.03 reoccurs: GO TO ❸ 524285.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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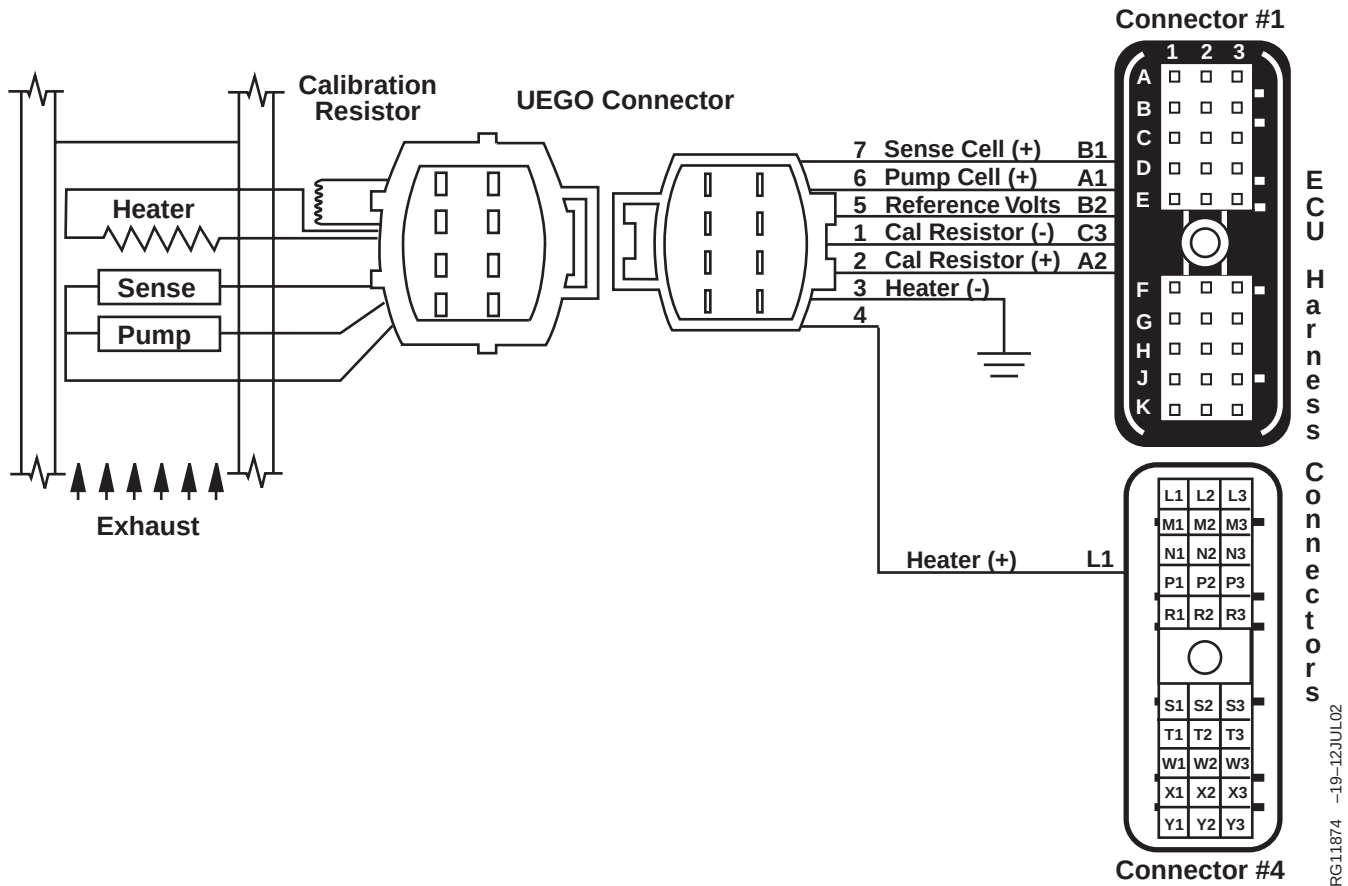
③ Sense Cell Wiring
Test

*NOTE: For wiring and theory of operation information, see DTC 524285.03 UEGO
REFERENCE VOLTAGE HIGH supporting information.*

1. Ignition OFF
2. Disconnect the UEGO sensor.
3. Install a jumper wire between Reference Voltage terminal (terminal 5) in the UEGO
sensor connector on the engine harness and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read UEGO Reference Voltage.

Above 0.2 V:
Short to power in
Reference Voltage circuit
OR
Faulty ECU connection
OR
Faulty ECU

0.2 V or below:
Faulty UEGO sensor
connection
OR
Faulty UEGO sensor

524285.04 — UEGO Reference Voltage Low**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

The reference voltage is used as a reference for the sense cell voltage and the pump cell voltage. Under normal operating conditions the reference voltage should be around 3.3 volts.

DTC 524285.04 will set if:

- The ECU detects a UEGO Reference Voltage that drops below 0.2 volts.

If DTC 524285.04 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the UEGO Reference Voltage returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the UEGO Reference Voltage falls out of range again.
- DTC 000724.02 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524285.04 — UEGO Reference Voltage Low

The ECU detects a UEGO Reference Voltage that drops below specification.

RG41221,000037D -19-03JUL02-1/1

524285.04 UEGO Reference Voltage Low Diagnostic Procedure

NOTE: If DTC 524285.04 is accompanied with 000724.02, 001119.00, 001119.01, 001119.16, or 001119.18, diagnose 524285.04 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524285.04 UEGO REFERENCE VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524285.04 UEGO REFERENCE VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine at low idle for 2 minutes. 6. Read DTCs using DST or SERVICE ADVISOR™.	524285.04 reoccurs: GO TO ❸ 524285.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ UEGO Sensor Test

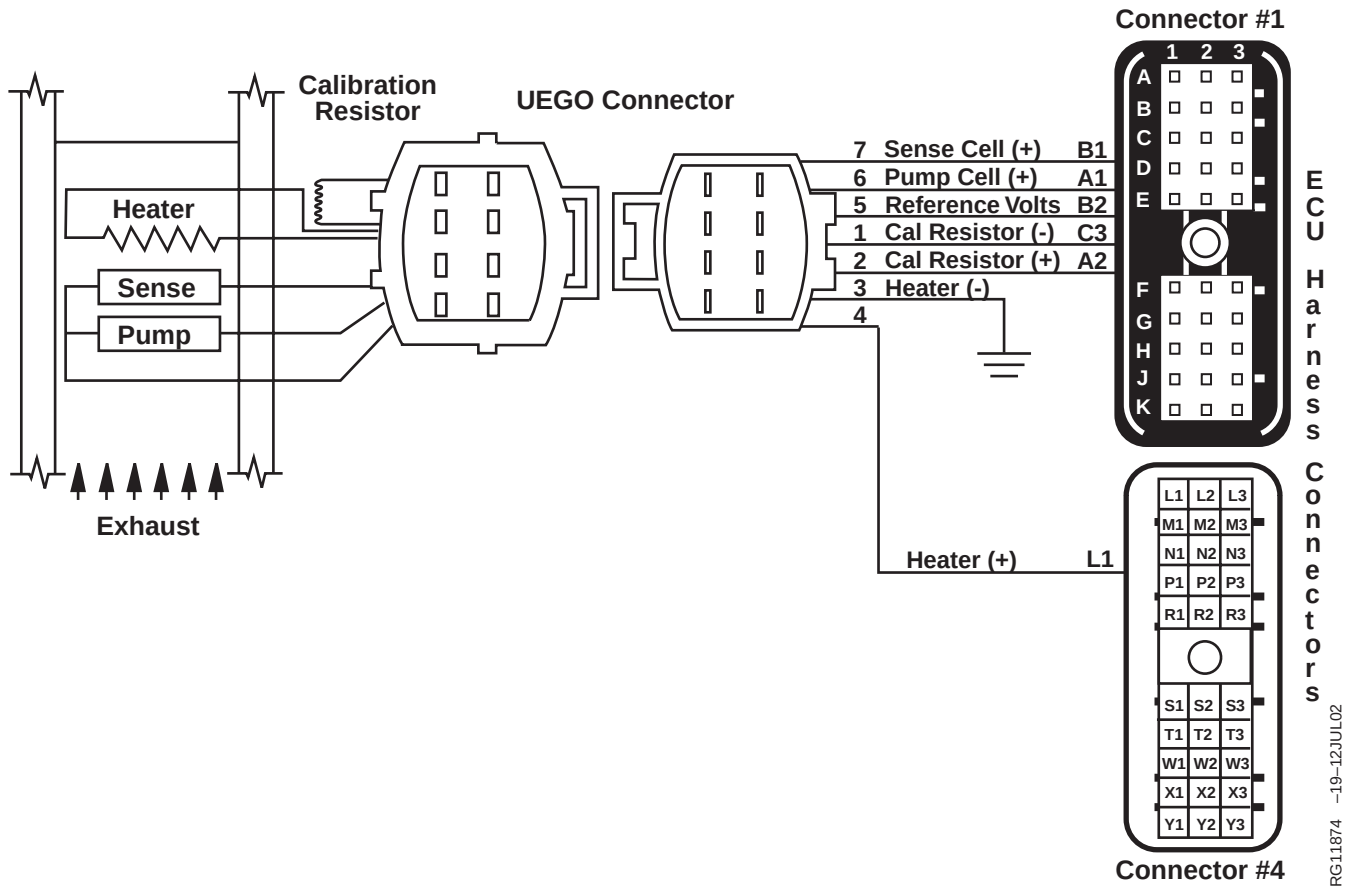
NOTE: For wiring and theory of operation information, see DTC 524285.04 UEGO REFERENCE VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect the UEGO sensor connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read UEGO Reference Voltage.

Below 5.0 V:
Short to ground in
Reference Voltage circuit.
OR
Faulty ECU connection
OR
Faulty ECU

5.0 V or greater:
Faulty UEGO sensor
connection
OR
Faulty UEGO sensor

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524286.02 — UEGO Heater Drive Failure**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

DTC 524286.02 will set if:

- The ECU detects an open in the UEGO Heater Drive circuit.

If DTC 524286.02 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the UEGO Heater Driver returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the UEGO Heater Driver falls out of range again.
- DTC 000724.02 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524286.02 — UEGO Heater Drive Failure

The ECU detects an open in the UEGO Heater Drive circuit.

RG41221,0000306 -19-14DEC01-1/1

524286 FMI 2 UEGO Heater Drive Failure Diagnostic Procedure

NOTE: If DTC 524286.02 is accompanied with 000724.02, 001119.00, 001119.01, 001119.16, or 001119.18, diagnose 524286.02 first.

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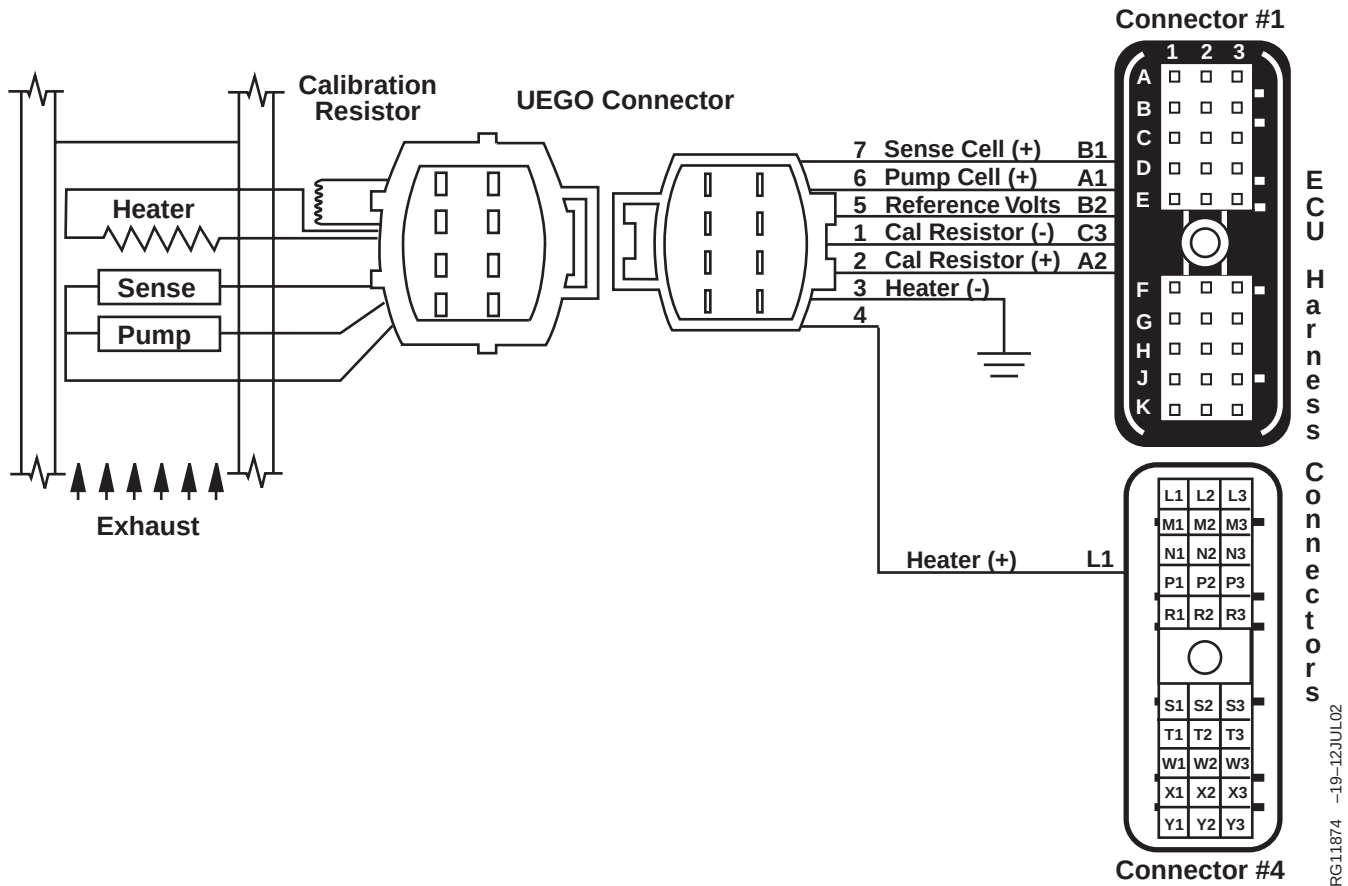
❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524286.02 UEGO HEATER DRIVE FAILURE supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524286.02 UEGO HEATER DRIVE FAILURE supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine at low idle for 2 minutes. 6. Read DTCs using DST or SERVICE ADVISOR™.	524286.02 reoccurs: GO TO ❸ 524286.02 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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115 .636	3 UEGO Heater (+) Circuit Test	<i>NOTE: For wiring and theory of operation information, see DTC 524286.02 UEGO HEATER DRIVE FAILURE supporting information.</i> 1. Ignition OFF 2. Disconnect the UEGO sensor connector. 3. Disconnect the ECU connector #4 (white L-Y). 4. Using a multimeter, measure resistance between terminal L1 in the ECU connector and terminal 4 in the UEGO sensor connector on the engine harness.	5 ohms or less: GO TO 4 Greater than 5 ohms: Open or short in UEGO Heater (+) circuit. -- -1/1
	4 UEGO Sensor Test	<i>NOTE: For wiring and theory of operation information, see DTC 524286.02 UEGO HEATER DRIVE FAILURE supporting information.</i> 1. UEGO sensor connector still disconnected. 2. Ignition ON, engine OFF 3. Probe the UEGO Heater (-) (terminal 3) of the UEGO sensor connector on the engine harness with a test light connected to battery voltage.	Light ON: Faulty UEGO sensor OR Faulty ECU connection OR Faulty ECU Light OFF Open in UEGO Heater (-) circuit OR Faulty ECU connection OR Faulty ECU -- -1/1

524287.03 — UEGO Pump Cell Voltage High**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

DTC 524287.03 will set if:

- The ECU detects a UEGO Pump Cell voltage that exceeds 12.2 volts.

If DTC 524287.03 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the UEGO Pump Cell returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the UEGO Pump Cell falls out of range again.
- DTC 000724.02 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524287.03 — UEGO Pump Cell Voltage High

The ECU detects a UEGO Pump Cell voltage that exceeds specification.

RG41221,00002FE -19-14DEC01-1/1

524287 FMI 3 UEGO Pump Cell Voltage High Diagnostic Procedure

NOTE: If DTC 524287.03 is accompanied with 000724.02, 001119.00, 001119.01, 001119.16, or 001119.18, diagnose 524287.03 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524287.03 UEGO PUMP CELL VOLTAGE HIGH supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.

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❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524287.03 UEGO PUMP CELL VOLTAGE HIGH supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine at low idle for 2 minutes. 6. Read DTCs using DST or SERVICE ADVISOR™.	524287.03 reoccurs: GO TO ❸ 524287.03 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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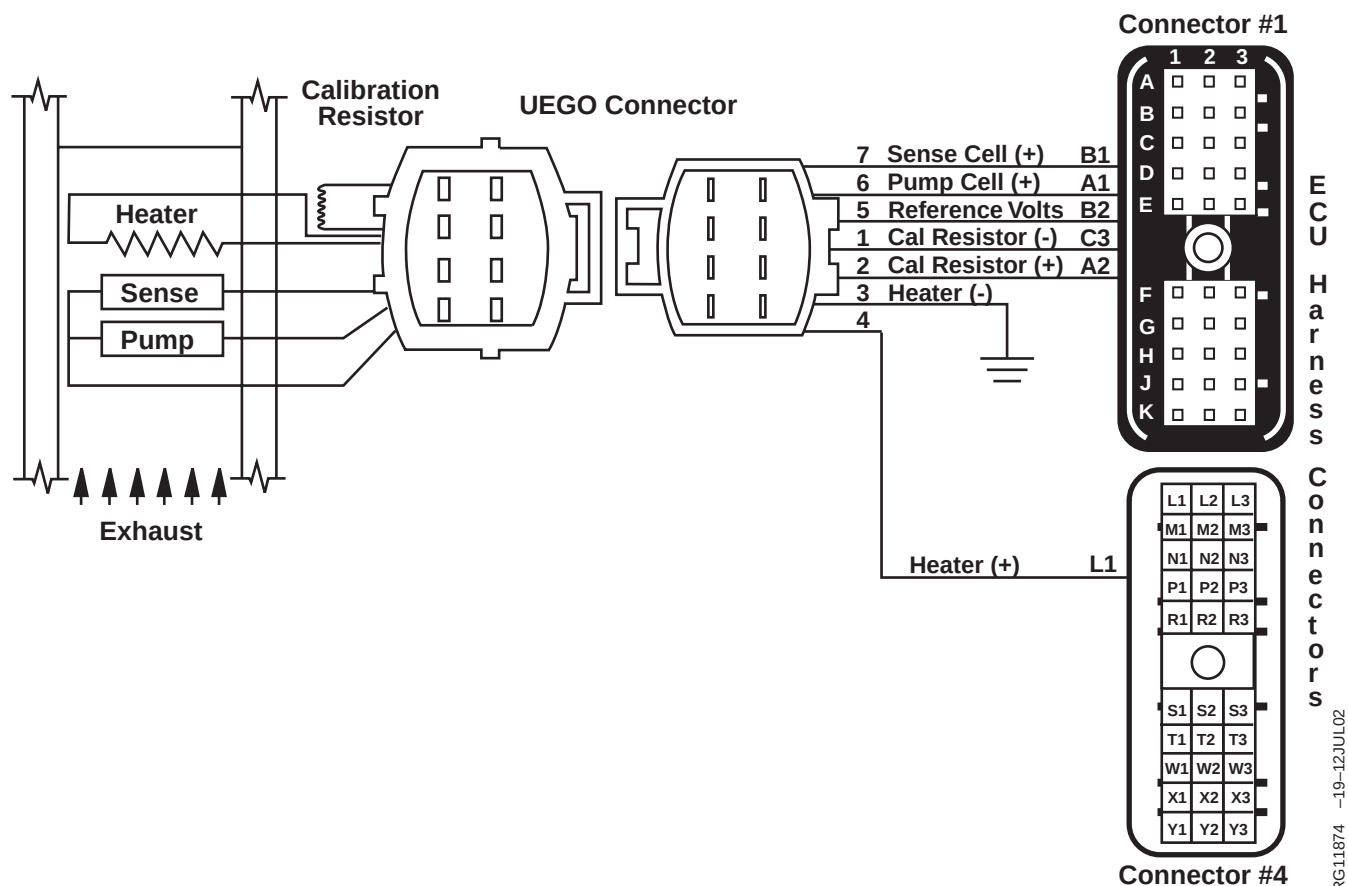
**③ Pump Cell Wiring
Test**

NOTE: For wiring and theory of operation information, see DTC 524287.03 UEGO PUMP CELL VOLTAGE HIGH supporting information.

1. Ignition OFF
2. Disconnect the UEGO sensor connector.
3. Install a jumper wire between the Pump Cell (+) terminal (terminal 6) in the UEGO sensor connector on the engine harness and a good chassis ground.
4. Ignition ON, engine OFF
5. Using the ECU diagnostic software, read UEGO Pump Cell Voltage.

Above 0.1 V:
Short to power in Pump
Cell (+) circuit
OR
Faulty ECU connection
OR
Faulty ECU

0.1 V or below:
Faulty UEGO sensor
connection
OR
Faulty UEGO sensor

524287.04 — UEGO Pump Cell Voltage Low**Universal Exhaust Gas Oxygen (UEGO) Sensor**

- The UEGO sensor is used to determine the amount of oxygen content in the exhaust gas. The amount of oxygen in the exhaust is directly related to the air/fuel ratio. The UEGO sense cell is used in conjunction with the pump cell to measure the exhaust oxygen content. When the engine's control system is operating in closed loop, the ECU uses the information from the UEGO sensor to correct fuel delivery with the Closed Loop multiplier and the Adaptive Learn multiplier. For further UEGO sensor information, see UNIVERSAL EXHAUST GAS OXYGEN (UEGO) SENSOR in Group 100 earlier in this manual.

DTC 524287.04 will set if:

- The ECU detects a UEGO Pump Cell voltage that drops below 0.1 volts.

If DTC 524287.04 sets, the following will occur:

- Engine protection is enabled. See ENGINE PROTECTION in Group 100 earlier in this manual.
 - Will derate the engine 30% per minute to a maximum derate of 30%. When the UEGO Sense Cell returns to a normal operating range, power will be increased 30% per minute until either full power is reached or the UEGO Sense Cell falls out of range again.
- DTC 000724.02 will also be present.
- ECU will set a SOLID Warning light.
- ECU will set a SOLID Malfunction light.

524287.04 — UEGO Pump Cell Voltage Low

The ECU detects a UEGO Pump Cell voltage that drops below specification.

RG41221,0000300 -19-14DEC01-1/1

524287.04 UEGO Pump Cell Voltage Low Diagnostic Procedure

NOTE: If DTC 524287.04 is accompanied with 000724.02, 001119.00, 001119.01, 001119.16, or 001119.18, diagnose 524287.04 first.

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❶ Connection Check	IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur. <i>NOTE: For wiring and theory of operation information, see DTC 524287.04 UEGO PUMP CELL VOLTAGE LOW supporting information.</i> Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the UEGO sensor connector looking for dirty, damaged, or poorly positioned terminals.	No faulty connection(s): GO TO ❷ Faulty connection(s): Repair connections and retest.
❷ Intermittent Fault Test	<i>NOTE: For wiring and theory of operation information, see DTC 524287.04 UEGO PUMP CELL VOLTAGE LOW supporting information.</i> 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group. 2. Ignition ON, engine OFF 3. Start the ECU diagnostic software 4. Make note of any DTCs, then clear all DTCs. 5. Run engine at low idle for 2 minutes. 6. Read DTCs using DST or SERVICE ADVISOR™.	524287.04 reoccurs: GO TO ❸ 524287.04 doesn't reoccur: Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.

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③ UEGO Sensor Test

NOTE: For wiring and theory of operation information, see DTC 524287.04 UEGO PUMP CELL VOLTAGE LOW supporting information.

1. Ignition OFF
2. Disconnect the UEGO sensor connector.
3. Ignition ON, engine OFF
4. Using the ECU diagnostic software, read UEGO Pump Cell Voltage.

Below 5.0 V:

Short to ground in Pump Cell (+) circuit.

OR

Faulty ECU connection

OR

Faulty ECU

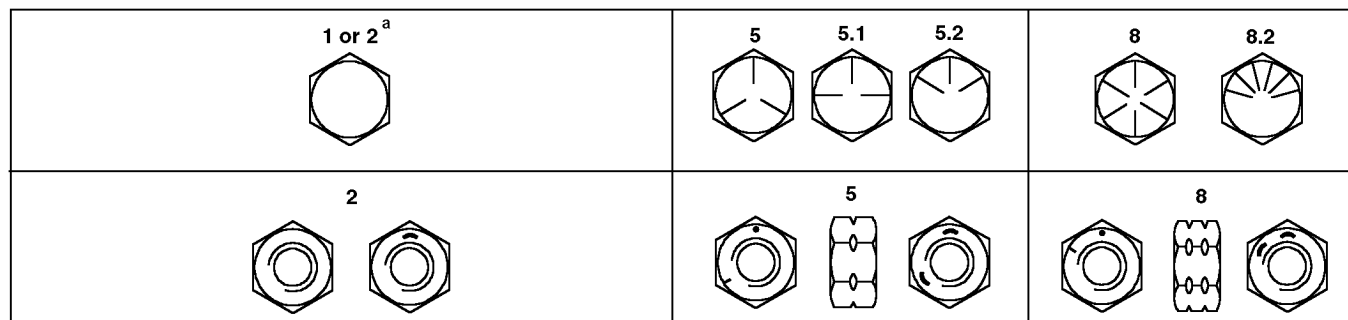
5.0 V or greater:

Faulty UEGO sensor connection

OR

Faulty UEGO sensor

Unified Inch Bolt and Cap Screw Torque Values



Top, SAE Grade and Head Markings; Bottom, SAE Grade and Nut Markings

Size	Grade 1 (No Mark)		Grade 2 ^a (No Mark)		Grade 5, 5.1 or 5.2		Grade 8 or 8.2	
	Lubricated ^b N•m(lb-ft)	Dry ^c N•m(lb-ft)	Lubricated ^b N•m(lb-ft)	Dry ^c N•m(lb-ft)	Lubricated ^b N•m(lb-ft)	Dry ^c N•m(lb-ft)	Lubricated ^b N•m(lb-ft)	Dry ^c N•m(lb-ft)
1/4	3.8 (2.8)	4.7 (3.5)	6 (4.4)	7.5 (5.5)	9.5 (7)	12 (9)	13.5 (10)	17 (12.5)
5/16	7.7 (5.7)	9.8 (7.2)	12 (9)	15.5 (11.5)	19.5 (14.5)	25 (18.5)	28 (20.5)	35 (26)
3/8	13.5 (10)	17.5 (13)	22 (16)	27.5 (20)	35 (26)	44 (32.5)	49 (36)	63 (46)
7/16	22 (16)	28 (20.5)	35 (26)	44 (32.5)	56 (41)	70 (52)	80 (59)	100 (74)
1/2	34 (25)	42 (31)	53 (39)	67 (49)	85 (63)	110 (80)	120 (88)	155 (115)
9/16	48 (35.5)	60 (45)	76 (56)	95 (70)	125 (92)	155 (115)	175 (130)	220 (165)
5/8	67 (49)	85 (63)	105 (77)	135 (100)	170 (125)	215 (160)	240 (175)	305 (225)
3/4	120 (88)	150 (110)	190 (140)	240 (175)	300 (220)	380 (280)	425 (315)	540 (400)
7/8	190 (140)	240 (175)	190 (140)	240 (175)	490 (360)	615 (455)	690 (510)	870 (640)
1	285 (210)	360 (265)	285 (210)	360 (265)	730 (540)	920 (680)	1030 (760)	1300 (960)
1-1/8	400 (300)	510 (375)	400 (300)	510 (375)	910 (670)	1150 (850)	1450 (1075)	1850 (1350)
1-1/4	570 (420)	725 (535)	570 (420)	725 (535)	1280 (945)	1630 (1200)	2050 (1500)	2600 (1920)
1-3/8	750 (550)	950 (700)	750 (550)	950 (700)	1700 (1250)	2140 (1580)	2700 (2000)	3400 (2500)
1-1/2	990 (730)	1250 (930)	990 (730)	1250 (930)	2250 (1650)	2850 (2100)	3600 (2650)	4550 (3350)

^a Grade 2 applies for hex cap screws (not hex bolts) up to 6 in. (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.

^b "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.

^c "Dry" means plain or zinc plated without any lubrication.

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

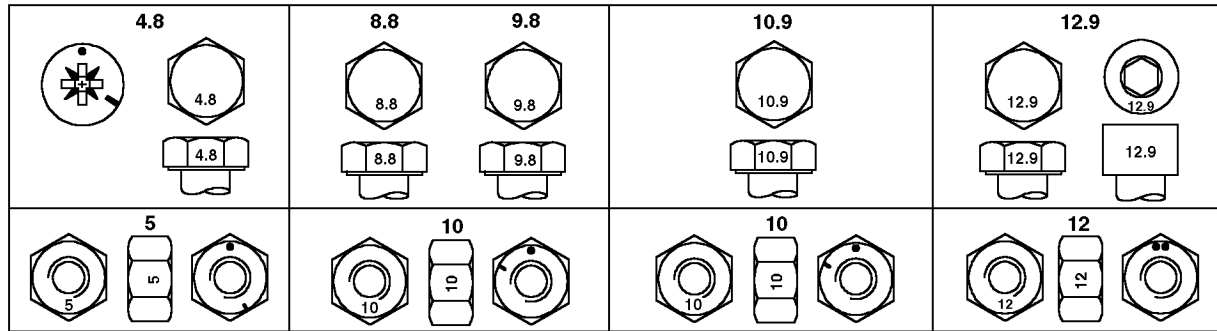
Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

Metric Bolt and Cap Screw Torque Values



Top, Property Class and Head Markings; Bottom, Property Class and Nut Markings

Size	Class 4.8		Class 8.8 or 9.8		Class 10.9		Class 12.9	
	Lubricated ^a N•m(lb-ft)	Dry ^b N•m(lb-ft)	Lubricated ^a N•m(lb-ft)	Dry ^b N•m(lb-ft)	Lubricated ^a N•m(lb-ft)	Dry ^b N•m(lb-ft)	Lubricated ^a N•m(lb-ft)	Dry ^b N•m(lb-ft)
M6	4.7 (3.5)	6 (4.4)	9 (6.6)	11.5 (8.5)	13 (9.5)	16.5 (12.2)	15.5 (11.5)	19.5 (14.5)
M8	11.5 (8.5)	14.5 (10.7)	22 (16)	28 (20.5)	32 (23.5)	40 (29.5)	37 (27.5)	47 (35)
M10	23 (17)	29 (21)	43 (32)	55 (40)	63 (46)	80 (59)	75 (55)	95 (70)
M12	40 (29.5)	50 (37)	75 (55)	95 (70)	110 (80)	140 (105)	130 (95)	165 (120)
M14	63 (46)	80 (59)	120 (88)	150 (110)	175 (130)	220 (165)	205 (150)	260 (190)
M16	100 (74)	125 (92)	190 (140)	240 (175)	275 (200)	350 (255)	320 (235)	400 (300)
M18	135 (100)	170 (125)	265 (195)	330 (245)	375 (275)	475 (350)	440 (325)	560 (410)
M20	190 (140)	245 (180)	375 (275)	475 (350)	530 (390)	675 (500)	625 (460)	790 (580)
M22	265 (195)	330 (245)	510 (375)	650 (480)	725 (535)	920 (680)	850 (625)	1080 (800)
M24	330 (245)	425 (315)	650 (480)	820 (600)	920 (680)	1150 (850)	1080 (800)	1350 (1000)
M27	490 (360)	625 (460)	950 (700)	1200 (885)	1350 (1000)	1700 (1250)	1580 (1160)	2000 (1475)
M30	660 (490)	850 (625)	1290 (950)	1630 (1200)	1850 (1350)	2300 (1700)	2140 (1580)	2700 (2000)
M33	900 (665)	1150 (850)	1750 (1300)	2200 (1625)	2500 (1850)	3150 (2325)	2900 (2150)	3700 (2730)
M36	1150 (850)	1450 (1075)	2250 (1650)	2850 (2100)	3200 (2350)	4050 (3000)	3750 (2770)	4750 (3500)

^a "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.^b "Dry" means plain or zinc plated without any lubrication.

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

TORQ2 -UN-07SEP99

General CNG Engine Specifications

NOTE: For vehicle engines, see Machine Technical Manual.

ITEM

General Data

Engine Type

Aspiration

Number of Cylinders

Bore

Stroke

Displacement

Compression Ratio

Intake Valve Clearance (cold)

Exhaust Valve Clearance (cold)

Spark Plug Gap (John Deere P/N RE51610, Marked RC78PYP)

Physical Dimensions:

Width

Height

Length

Basic Dry Weight

Performance Data (Industrial Applications)

Rated Power - Low output engines

Peak Torque - Low output engines

Rated Power - High output engines

Peak Torque - High output engines

Rated Power - High output engines

Peak Torque - High output engines

Rated Speed

Slow Idle Speed

Lubrication System

Crankcase Capacity with Filter Change

Oil Pressure at Rated rpm

Oil Pressure at Low Idle

Cooling System

Maximum Top Tank Temperature

Thermostat Opening Temperature

Thermostat Fully Open Temperature

Minimum System Pressure

Air System

Maximum Pressure Drop Across Intercooler

Minimum Inlet Air Restriction

6081HFN04

In-line, natural gas

Turbocharged and air-to-air after cooled

6

4.56 in (116 mm)

5.06 in (129 mm)

8.1 L (496 cu in)

11:1

0.015 in (0.38 mm)

0.020 in (0.51 mm)

0.015 in (0.38 mm)

33.7 in (856 mm)

48.3 in (1227 mm)

46.0 in (1168 mm)

1660 lb (753 kg)

250 hp (186 kW)

735 lb-ft (997 N•m) @ 1300 rpm

OR

800 lb-ft (1085 N•m) @ 1400 rpm

275 hp (205 kW)

800 lb-ft (1085 N•m) @ 1400 rpm

280 hp (209 kW)

900 lb-ft (1220 N•m) @ 1500 rpm

2200 rpm

750 rpm

20 qt (18.9 L)

45 ± 15 psi (310 ± 103 kPa)

30 ± 10 psi (207 ± 69 kPa)

221F° (105°C)

192F° (89°C)

212F° (100°C)

10 psi (69 kPa)

19 psi (13 kPa)

4 in (100 mm) H₂O - Clean

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ITEM

Maximum Inlet Air Restriction
(Measured Between Air Cleaner and Turbo)

Exhaust System

Maximum Exhaust Restriction
Maximum Exhaust Restriction if Equipped with Catalyst
Exhaust Temperature

Fuel System

Maximum Regulator Inlet Pressure ^a
Minimum Recommended Regulator Inlet Pressure
Injector Opening Pressure
Minimum Natural Gas Pressure - 250 HP
Minimum Natural Gas Pressure - 275 - 280 HP
Maximum Natural Gas Pressure
^aConsult vehicle owner's manual for proper system pressure.

6081HFN04

12 in (305 mm) H2O - Clean

10 in H2O (2.5 kPa)
28 in H2O (7 kPa)
1085F° (585°C)

3600 psi (24.8 MPa)
218 psi (1.5 MPa)
26,200 psi (181 MPa)
105 psi (724 kPa)
120 psi (827 kPa)
186 psi (1282 kPa)

RG41221,0000312 -19-14DEC01-2/2

Diagnostic Specifications

Item	Measurement	Specification
Mixing Elbow Inlet Line	Torque	20 lb-ft (27 N•m)
Fuel Metering Block Inlet Connector	Torque	20 lb-ft (27 N•m)
Ignition Coil Hold-down Capscrew	Torque	15 lb-ft (20 N•m)
Spark Plug	Torque	28 lb-ft (38 N•m)
Compression Pressure (Wide Open Throttle)	Pressure	155-185 psig (1070-1275 kPa) (10.7-13 bar)
Engine Oil Pressure - Low Idle	Pressure	20 psig (140 kPa) (1.4 bar)
Engine Oil Pressure - Rated Speed	Pressure	58 psig (400 kPa) (4.0 bar)
Compressed Natural Gas Pressure (Absolute) for 250 HP Engines	Pressure	110-155 psia (760-1070 kPa) (7.6-10.7 bar)
Compressed Natural Gas Pressure (Absolute) for 275 and 280 HP Engines	Pressure	120-155 psia (830-1070 kPa) (8.3-10.7 bar)
Compressed Natural Gas Pressure (Gauge) for 250 HP Engines	Pressure	95-140 psig (655-1070 kPa) (6.5-10.7 bar)
Compressed Natural Gas Pressure (Gauge) for 275 and 280 HP Engines	Pressure	105-140 psia (724-1070 kPa) (7.2-10.7 bar)
Liquid Natural Gas Pressure (Absolute) for 250 HP Engines	Pressure	90-115 psia (620-793 kPa) (6.2-7.9 bar)
Liquid Natural Gas Pressure (Absolute) for 275 and 280 HP Engines	Pressure	90-115 psia (620-793 kPa) (6.2-7.9 bar)
Liquid Natural Gas Pressure (Gauge) for 250 HP Engines	Pressure	75-100 psig (517-689 kPa) (5.1-6.9 bar)
Liquid Natural Gas Pressure (Gauge) for 275 and 280 HP Engines	Pressure	75-100 psig (517-689 kPa) (5.1-6.9 bar)

Derate Specifications

The engine derate will be activated if one or more of the following occur. If more than one occur, the Diagnostic Trouble codes that has the most severe derate will be used.

Continued on next page

RG41221,000037A -19-03JUN02-1/3

Specifications

SPN	FMI	Cause	Max Fuel Derate	Fuel Derate Rate (% per min)	Recovery Rate (% per min)
000051	02	The ECU detects a manifold absolute pressure that does not match the commanded value.	30%	30%	30%
000100	01	The ECU senses an oil pressure below the warning value set point in the ECU.	60%	40%	20%
000100	18	The ECU senses an oil pressure below the warning value set point in the ECU.	10%	2%	2%
000105	00	The ECU senses a throttle charge temperature of 74° C (165° F.)	30%	30%	30%
000105	16	The ECU senses a throttle charge temperature of 68° C (154° F.)	15%	15%	15%
000110	00	The ECU senses a coolant temperature of 115° C (239° F.)	60%	40%	40%
000110	15	The ECU senses a coolant temperature of 105° C (221° F.)	10%	2%	2%
000110	16	The ECU senses a coolant temperature of 110° C (230° F.)	40%	20%	20%
000111	01	The ECU senses a low coolant level or faulty wiring to the coolant level sensor.	30%	30%	30%
000159	18	The ECU senses a natural gas pressure lower than 105 psia (724 kPa) (7.2 bar) for 250 hp CNG engines and 120 psia (827 kPa) (8.2 bar) for 275 and 280 hp CNG engines. The ECU senses a natural gas pressure lower than 80 psia (550 kPa) (5.5 bar) for all LNG engines.	30%	30%	30%
000173	00	ECU senses an exhaust temperature of 725° C (1337° F.)	30%	30%	30%
000173	16	ECU senses an exhaust temperature of 675° C (1247° F.)	10%	2%	2%
000175	00	ECU senses an engine oil temperature of 135° C (275° F.)	30%	30%	30%
000175	16	ECU senses an engine oil temperature of 125° C (257° F.)	10%	2%	2%
000646	02	The ECU senses an upstream throttle pressure of 2.2 psi (15 kPa) (0.15 bar) higher or lower than the commanded value.	30%	30%	30%
000724	02	The ECU detects a problem with the UEGO sensor.	30%	30%	30%
000724	13	The ECU detects a calibration error in the UEGO sensor. This derate is triggered from 000724.02.	30%	30%	30%
000731	00	The ECU detects knock after the ECU has retarded the timing the maximum amount to compensate for the knock.	30%	30%	30%
000731	02	The ECU detects knock under conditions that cannot physically produce knock. This derate is triggered from 000731.16.	15%	15%	15%
000731	04	The ECU detects constant low voltage from the knock module during all running conditions. This derate is triggered from 000731.16.	15%	15%	15%
000731	16	The ECU detects knock when the engine is running under conditions that cannot physically produce knock.	15%	15%	15%
000970	31	The ECU is signaled by an auxiliary input to shut the engine down.	10%	2%	2%
001119	00	The ECU senses a measured Phi higher than desired Phi	40%	80%	0%
001119	01	The ECU senses a measured Phi lower than desired Phi	40%	80%	0%
524281	18	The ECU detects a natural gas tank pressure lower than 218 psia (1500 kPa) (15 bar).	30%	30%	30%
524283	03	The ECU detects a UEGO Sense Cell voltage above 12.2 volts. This derate is triggered from 000724.02.	30%	30%	30%
524283	04	The ECU detects a UEGO Sense Cell voltage below 0.2 volts.	30%	30%	30%

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RG41221,000037A -19-03JUN02-2/3

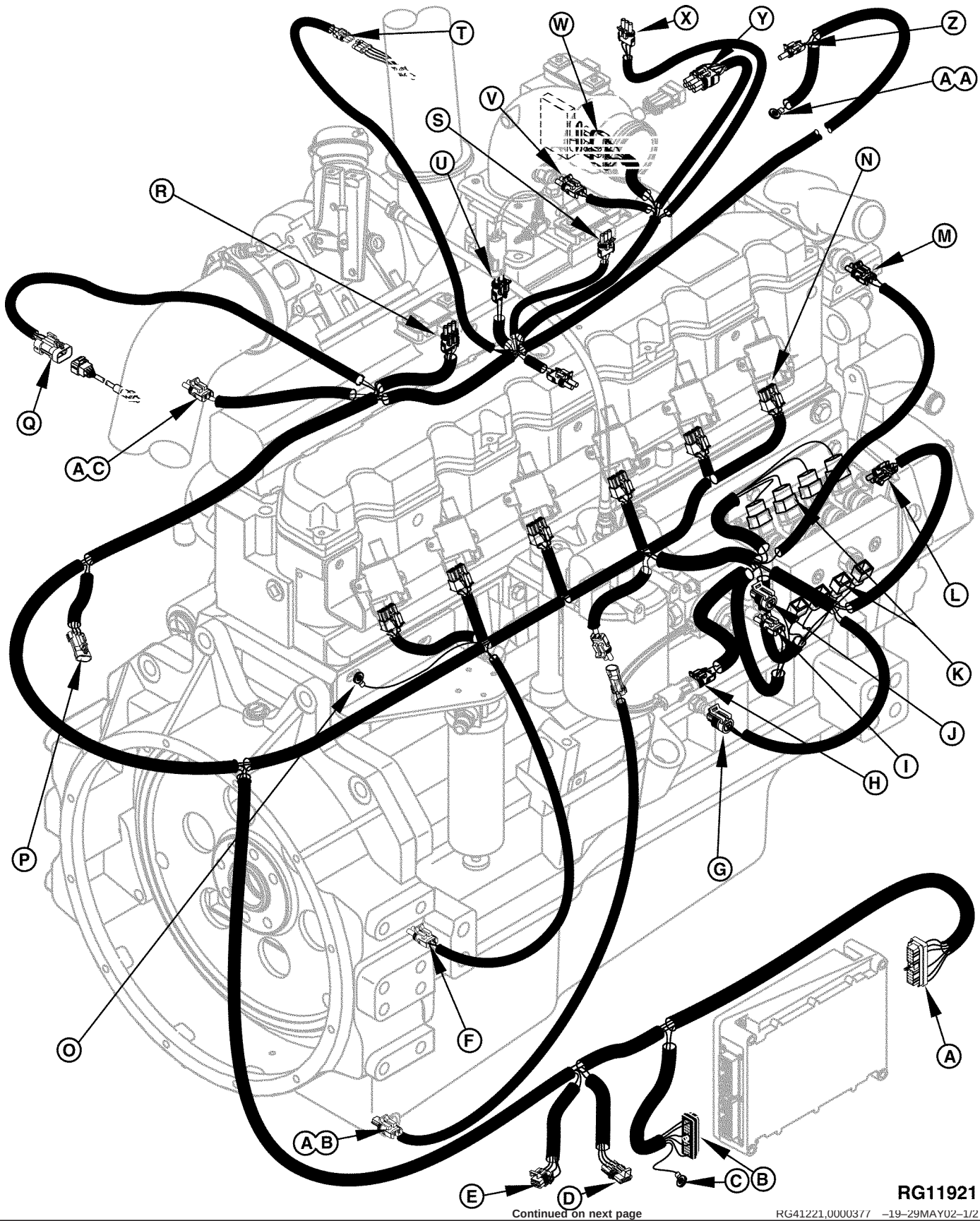
Specifications

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524284	03	The ECU detects a UEGO Calibration Resistor voltage above 4.9 volts. This derate is triggered from 000724.02.	30%	30%	30%
524284	04	The ECU detects a UEGO Calibration Resistor voltage below 0.1 volts. This derate is triggered from 000724.02.	30%	30%	30%
524285	03	The ECU detects a UEGO Reference voltage above 12.2 volts. This derate is triggered from 000724.02.	30%	30%	30%
524285	04	The ECU detects a UEGO Reference voltage below 0.2 volts. This derate is triggered from 000724.02.	30%	30%	30%
524286	02	The ECU detects a UEGO Heater Drive failure. This derate is triggered from 000724.02.	30%	30%	30%
524287	03	The ECU detects a UEGO Pump Cell voltage above 12.2 volts. This derate is triggered from 000724.02.	30%	30%	30%
524287	04	The ECU detects a UEGO Pump Cell voltage below 0.1 volts. This derate is triggered from 000724.02.	30%	30%	30%

RG41221,000037A -19-03JUN02-3/3

Electronic Control System Wiring and Component Location



Continued on next page

RG11921

RG41221.0000377 -19-29MAY02-1/2

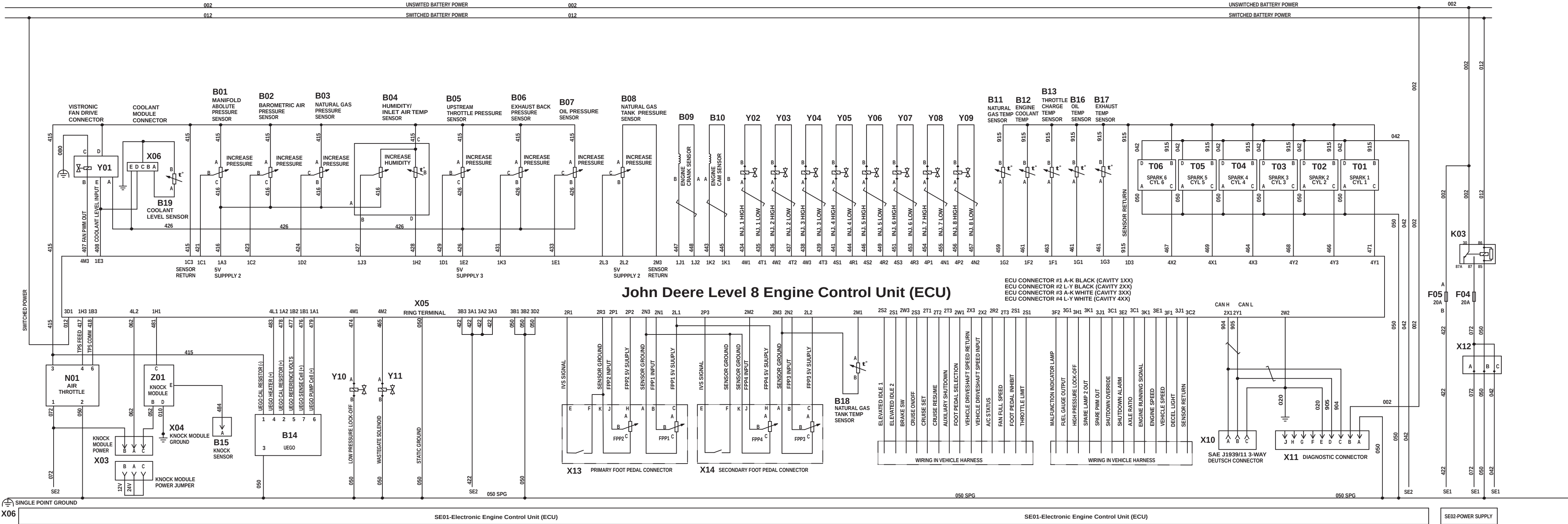
RG11921 -UN-08AUG03

Specifications			
A—ECU Connector #4 B—ECU Connector #1 C—ECU Ground Terminal D—Power Connector E—Fan Drive Connector F—Crankshaft Position Sensor Connector G—Oil Pressure Sensor Connector H—Low Pressure Lock-Off I—Natural Gas Temperature Sensor Connector J—Natural Gas Pressure Sensor Connector	K—Fuel Injectors Connectors (8) L—Camshaft Position Sensor Connector M—Engine Coolant Temperature Sensor Connector N—Ignition Coil Connectors (6) O—Single Point Ground P—Exhaust Back Pressure Sensor Connector	Q—UEGO Sensor Connector R—Manifold Absolute Pressure Sensor Connector S—Barometric Air Pressure Sensor Connector T—Humidity/Inlet Air Temperature Sensor Connector U—Wastegate Control Solenoid Connector V—Throttle Charge Temperature Sensor Connector	W—Knock Module Connector X—Upstream Throttle Pressure Sensor Connector Y—Throttle Connector Z—Knock Sensor Connector AA—Knock Module Ground Terminal AB—Oil Temperature Sensor AC—Exhaust Temperature Sensor Interconnect
RG41221_0000377 –19–29MAY02–2/2			

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Electronic Control System Wiring Diagram

RG11925 -19-10JUL03



Electronic Control System Wiring Schematic

B01—Manifold Absolute Pressure Sensor	B10—Camshaft Position Sensor	F05—Fuse (20 Amp)	X13—Primary Foot Pedal Connector
B02—Barometric Air Pressure Sensor	B11—Natural Gas Temperature Sensor	K03—Relay	X14—Secondary Foot Pedal Connector
B03—Natural Gas Pressure Sensor	B12—Engine Coolant Temperature Sensor	N01—Throttle	Y01—Vistronic Fan Drive
B04—Humidity/Inlet Air Temperature Sensor	B13—Throttle Charge Temperature Sensor	T01—Ignition Coil #1	Y02—Injector #1
B05—Upstream Throttle Pressure Sensor	B14—UEGO Sensor	T02—Ignition Coil #2	Y03—Injector #2
B06—Exhaust Back Pressure Sensor	B15—Knock Sensor	T03—Ignition Coil #3	Y04—Injector #3
B07—Oil Pressure Sensor	B16—Oil Temperature Sensor	T04—Ignition Coil #4	Y05—Injector #4
B08—Natural Gas Tank Pressure Sensor	B17—Exhaust Temperature Sensor	T05—Ignition Coil #5	Y06—Injector #5
B09—Crankshaft Position Sensor	B18—Natural Gas Tank Temperature Sensor	T06—Ignition Coil #6	Y07—Injector #6
	B19—Coolant Level Sensor	X03—Knock Module Power Jumper	Y08—Injector #7
	F04—Fuse (20 Amp)	X04—Knock Module Ground	Y09—Injector #8
		X05—Single Point Ground	Y10—Low Pressure Lock-Off
		X06—Coolant Level Module	Y11—Wastegate Control Solenoid
		X10—CAN Terminator	Z01—Knock Module
		X11—Diagnostic Connector	
		X12—Power Connector	

RG41221,0000311 -19-14DEC01-2/2

ECU Terminal Identification

ECU Terminal Function	ECU Connector #	ECU Connector Color	ECU Terminal #	Component Connector Terminal #	Circuit #	Wire Color
A/C Status	2	Black (L-Y)	R2	NAa	NAa	NAa
Auxiliary Shutdown	2	Black (L-Y)	T3	NAa	NAa	NAa
Axle Ratio	3	White (A-K)	C1	NAa	NAa	NAa
BAP Sensor 5V Supply	1	Black (A-K)	A3	C	416	Blue
BAP Sensor Ground	1	Black (A-K)	C3	A	415	Green
BAP Sensor Input Voltage	1	Black (A-K)	C2	B	423	Orange
Battery Power	3	White (A-K)	A1	Battery (+)	422	Red
Battery Power	3	White (A-K)	A2	Battery (+)	422	Red
Battery Power	3	White (A-K)	A3	Battery (+)	422	Red
Battery Power	3	White (A-K)	B3	Battery (+)	422	Red
Brake Switch	2	Black (L-Y)	W3	NAa	NAa	NAa
Camshaft Position Sensor Input	1	Black (A-K)	K1	B	445	Orange
Camshaft Position Sensor Return	1	Black (A-K)	K2	A	443	Green
CAN High	2	Black (L-Y)	X1	NAa	904	Yellow
CAN Low	2	Black (L-Y)	Y1	NAa	905	Green
CAN Shield	2	Black (L-Y)	W2	NAa	20	Black
Coolant Level 5V Supply	1	Black (A-K)	E2	E	NAa	NAa
Coolant Level Input	1	Black (A-K)	E3	D	NAa	NAa
Coolant Level Sensor Ground	1	Black (A-K)	NAa	C	NAa	NAa
Crankshaft Position Sensor Input	1	Black (A-K)	J1	B	447	Violet
Crankshaft Position Sensor Return	1	Black (A-K)	J2	A	448	Gray
Cruise ON/OFF	2	Black (L-Y)	S3	NAa	NAa	NAa
Cruise Resume	2	Black (L-Y)	T2	NAa	NAa	NAa
Cruise Set	2	Black (L-Y)	T1	NAa	NAa	NAa
Decel Light	3	White (A-K)	J1	NAa	NAa	NAa
Door Interlock	2	Black (L-Y)	S1	NAa	NA	NA
EBP Sensor 5V Supply	1	Black (A-K)	E2	B	426	Blue
EBP Sensor Ground	1	Black (A-K)	C3	A	415	Green
EBP Sensor Input	1	Black (A-K)	K3	C	431	Brown
ECT Sensor Ground	1	Black (A-K)	D3	B	915	Green
ECT Sensor Input	1	Black (A-K)	F2	A	461	Brown
Elevated Idle 1	2	Black (L-Y)	S2	NAa	NAa	NAa
Elevated Idle 2	2	Black (L-Y)	S1	NAa	NAa	NAa
Engine Running Signal	3	White (A-K)	K1	NAa	NAa	NAa
Engine Speed	3	White (A-K)	E1	NAa	NAa	NAa

Continued on next page

RG41221.0000317 -19-09JUL03-1/4

Specifications

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Exhaust Temperature Sensor Ground	1	Black (A-K)	D3	B	915	Green
Exhaust Temperature Sensor Input	1	Black (A-K)	G3	A	NAa	NAa
Fan Drive Solenoid Control	4	White (L-Y)	M3	4	407	Violet
Fan Full Speed	2	Black (L-Y)	T3	NAa	NAa	NAa
Foot Pedal Inhibit	2	Black (L-Y)	S1	NAa	NAa	NAa
Foot Pedal Selection	2	Black (L-Y)	W1	NAa	NAa	NAa
FPP1 5V Supply	2	Black (L-Y)	L1	C	NAa	NAa
FPP1 Ground	2	Black (L-Y)	N3	A	NAa	NAa
FPP1 Input	2	Black (L-Y)	N1	B	NAa	NAa
FPP2 5V Supply	2	Black (L-Y)	P2	H	NAa	NAa
FPP2 Ground	2	Black (L-Y)	R3	K	NAa	NAa
FPP2 Input	2	Black (L-Y)	P1	J	NAa	NAa
FPP3 5V Supply	2	Black (L-Y)	L2	C	NAa	NAa
FPP3 Ground	2	Black (L-Y)	M3	A	NAa	NAa
FPP3 Input	2	Black (L-Y)	N2	B	NAa	NAa
FPP4 5V Supply	2	Black (L-Y)	L1	H	NAa	NAa
FPP4 Ground	2	Black (L-Y)	N3	K	NAa	NAa
FPP4 Input	2	Black (L-Y)	M2	J	NAa	NAa
Fuel Gauge Output	3	White (A-K)	G1	NAa	NAa	NAa
Ground Chassis)	3	White (A-K)	B1	Battery (-)	NAa	NAa
Ground Chassis)	3	White (A-K)	B2	Battery (-)	NAa	NAa
Ground Chassis)	3	White (A-K)	D2	Battery (-)	NAa	NAa
High Pressure Lock-Off	3	White (A-K)	H1	NAa	NAa	NAa
Humidity Sensor 5V Supply	1	Black (A-K)	A3	A	416	Blue
Humidity Sensor Ground	1	Black (A-K)	C3	C	415	Green
Humidity Sensor Input	1	Black (A-K)	J3	B	427	Violet
Ignition Coil #1 Trigger	4	White (L-Y)	Y1	C	471	Brown
Ignition Coil #2 Trigger	4	White (L-Y)	Y3	C	466	Blue
Ignition Coil #3 Trigger	4	White (L-Y)	Y2	C	468	Gray
Ignition Coil #4 Trigger	4	White (L-Y)	X3	C	464	Yellow
Ignition Coil #5 Trigger	4	White (L-Y)	X1	C	469	White
Ignition Coil #6 Trigger	4	White (L-Y)	X2	C	467	Violet
Ignition Coils Ground	1	Black (A-K)	D3	B	915	Green
Injector 1 High	4	White (L-Y)	W1	A	434	Yellow
Injector 1 Low	4	White (L-Y)	T1	B	435	Green
Injector 2 High	4	White (L-Y)	W2	A	436	Blue
Injector 2 Low	4	White (L-Y)	T2	B	437	Violet
Injector 3 High	4	White (L-Y)	W3	A	438	Gray
Injector 3 Low	4	White (L-Y)	T3	B	439	White
Injector 4 High	4	White (L-Y)	S1	A	441	Brown

Continued on next page

RG41221,0000317 -19-09JUL03-2/4

Specifications

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Injector 4 Low	4	White (L-Y)	R1	B	444	Yellow
Injector 5 High	4	White (L-Y)	S2	A	446	Blue
Injector 5 Low	4	White (L-Y)	R2	B	449	White
Injector 6 High	4	White (L-Y)	S3	A	451	Brown
Injector 6 Low	4	White (L-Y)	R3	B	453	Orange
Injector 7 High	4	White (L-Y)	P1	A	454	Yellow
Injector 7 Low	4	White (L-Y)	N1	B	455	Green
Injector 8 High	4	White (L-Y)	P2	A	456	Blue
Injector 8 Low	4	White (L-Y)	N2	B	457	Violet
Inlet Air Temperature Ground	1	Black (A-K)	C3	C	415	Green
Inlet Air Temperature Input	1	Black (A-K)	H2	D	428	Gray
Knock Module Power	4	White (L-Y)	L2	B	62	Red
Knock Sensor Input	1	Black (A-K)	H1	C	481	Brown
Low Pressure Lock-Off	4	White (L-Y)	M1	A	474	Yellow
Malfunction Indicator Lamp	3	White (A-K)	F2	NAa	NAa	NAa
MAP Sensor 5V Supply	1	Black (A-K)	A3	C	416	Blue
MAP Sensor Ground	1	Black (A-K)	C3	A	415	Green
MAP Sensor Input	1	Black (A-K)	C1	B	421	Brown
NGP Sensor 5V Supply	1	Black (A-K)	A3	B	416	Blue
NGP Sensor Ground	1	Black (A-K)	C3	A	415	Green
NGP Sensor Input	1	Black (A-K)	D2	C	424	Yellow
NGT Sensor Ground	1	Black (A-K)	D3	B	915	Green
NGT Sensor Input	1	Black (A-K)	G2	A	459	White
NGTP Sensor 5V Supply	2	Black (L-Y)	L2	B	NAa	NAa
NGTP Sensor Ground	2	Black (L-Y)	M3	A	NAa	NAa
NGTP Sensor Input	2	Black (L-Y)	L3	C	NAa	NAa
NGTT Sensor Ground	2	Black (L-Y)	M3	B	NAa	NAa
NGTT Sensor Input	2	Black (L-Y)	M1	A	NAa	NAa
Oil Pressure Sensor 5V Supply	1	Black (A-K)	E2	B	426	Blue
Oil Pressure Sensor Ground	1	Black (A-K)	C3	A	415	Green
Oil Pressure Sensor Input	1	Black (A-K)	E1	C	433	Orange
Oil Temperature Sensor Ground	1	Black (A-K)	D3	B	915	Green
Oil Temperature Sensor Input	1	Black (A-K)	G1	A	NAa	NAa
Primary Foot Pedal IVS Ground	2	Black (L-Y)	R3	F	NAa	NAa
Primary Foot Pedal IVS Input	2	Black (L-Y)	R1	E	NAa	NAa
Secondary Foot Pedal IVS Ground	2	Black (L-Y)	N3	F	NAa	NAa
Secondary Foot Pedal IVS Input	2	Black (L-Y)	P3	E	NAa	NAa
Shutdown Alarm	3	White (A-K)	E2	NAa	NAa	NAa
Shutdown Override	3	White (A-K)	C1	NAa	NAa	NAa
Spare Lamp Output	3	White (A-K)	K1	NAa	NAa	NAa

Continued on next page

RG41221.0000317 -19-09JUL03-3/4

Specifications

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Spare PWM Output	3	White (A-K)	J1	NAa	NAa	NAa
Switched Voltage	3	White (A-K)	D1	NAa	NAa	NAa
TCT Sensor Ground	1	Black (A-K)	D3	B	915	Green
TCT Sensor Input	1	Black (A-K)	F1	A	463	Orange
Throttle Limit	2	Black (L-Y)	S1	NAa	NAa	NAa
TPS Command	1	Black (A-K)	B3	6	418	Gray
TPS Feedback	1	Black (A-K)	H3	4	417	Violet
UEGO Calibration Resistor (-)	1	Black (A-K)	C3	1	415	Green
UEGO Calibration Resistor (+)	1	Black (A-K)	A2	2	478	Gray
UEGO Heater (-)	NAa	NAa	NAa	3	50	Black
UEGO Heater (+)	4	White (L-Y)	L1	4	483	Orange
UEGO Pump Cell (+)	1	Black (A-K)	A1	6	479	White
UEGO Reference Voltage	1	Black (A-K)	B2	5	477	Violet
UEGO Sense Cell (+)	1	Black (A-K)	B1	7	476	Blue
UTP Sensor 5V Supply	1	Black (A-K)	E2	C	426	Blue
UTP Sensor Ground	1	Black (A-K)	C3	A	415	Green
UTP Sensor Input	1	Black (A-K)	D1	B	429	White
Vehicle Driveshaft Speed Ground	2	Black (L-Y)	X3	NAa	NAa	NAa
Vehicle Driveshaft Speed Input	2	Black (L-Y)	X2	NAa	NAa	NAa
Vehicle Speed	3	White (A-K)	F1	NAa	NAa	NAa
Wastegate Solenoid	4	White (L-Y)	M2	A	465	Green

RG41221,0000317 -19-09JUL03-4/4

Group 105 Engine Diagnostic and Testing Procedure Tools

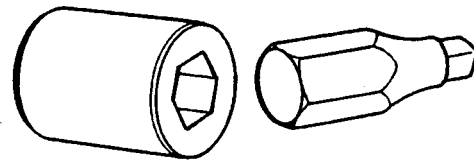
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

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RG41221,000005E -19-14SEP01-1/9

Oil Galley Plug Tool. JDG782

Used to remove and install oil galley plug.

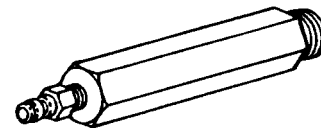


RG6612 -UN-29JAN93

RG41221,000005E -19-14SEP01-2/9

Compression Test Adapter 6081 JDG814

Used with JT01682¹ (D114547BA)² Gauge and Hose Assembly to test compression pressure.



RG6759 -UN-30APR93

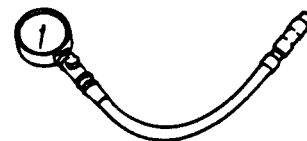
¹Part of JT01674 (D14546BA) Compression Test Kit

²Use with JT01681 Special Adapter for quick coupler connection.

RG41221,000005E -19-14SEP01-3/9

Compression Test Kit. JT01674 (D14546BA)

Use with JDG814 Compression Test Adapter to test compression pressure.



RG6760 -UN-30APR93

RG41221,000005E -19-14SEP01-4/9

Gauge and Hose Assembly. JT01682 (D14547BA)

Use with JDG814 Compression Test Adapter to test compression pressure.

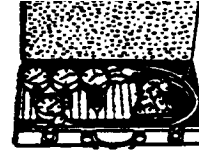
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RG41221,000005E -19-14SEP01-5/9

RG5162 -UN-23AUG88

Universal Pressure Test Kit JT05470 (D15027NU)

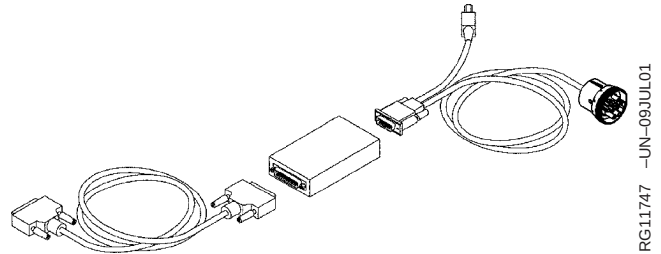
Used for testing engine oil pressure.



RG41221,000005E -19-14SEP01-6/9

ECU Communication Hardware Kit JDIS121

Used with ECU Communication Software Kit. Together, the kits enable a Windows ('95, '98, 2000, ME, and XP) or NT compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a 486/66 with 8 MB of RAM and an IEEE 1284 compliant parallel port. This kit allows communication with all John Deere applications that use one of the following diagnostic connectors: black 9-pin Deutsch diagnostic connector, gray 9-pin Deutsch diagnostic connector (early 8000 series tractors), or the flat 6-pin Weatherpack diagnostic connector (Lucas controllers). Not all of the components in this kit are shown to the right.

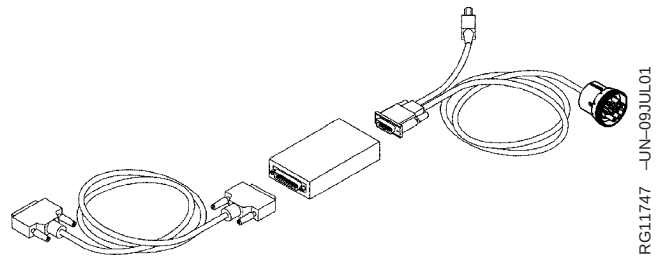


RG11747 -UN-09JUL01

RG41221,000005E -19-14SEP01-7/9

ECU Communication Hardware Kit DS10023

Used with ECU Communication Software Kit. Together, the kits enable a Windows ('95, '98, 2000, ME, and XP) or NT compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a 486/66 with 8 MB of RAM and an IEEE 1284 compliant parallel port. This kit allows communication with all John Deere applications that use the black 9-pin Deutsch diagnostic connector. All of the components in this kit are shown to the right.



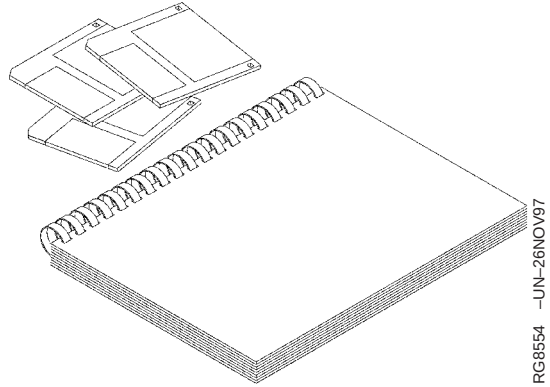
RG11747 -UN-09JUL01

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RG41221,000005E -19-14SEP01-8/9

ECU Communication Software Kit.

Please refer to the John Deere website (www.johndeere.com/cngdiagnostics) or contact your local John Deere dealer for information on obtaining the latest version of software and information on the hardware kit.



RG41221,000005E -19-14SEP01-9/9

Group 110 Starting and Charging System Diagnostic Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

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RG41221,0000319 -19-14DEC01-1/2

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.



RG41221,0000319 -19-14DEC01-2/2

Group 115 Electronic Engine Controls Diagnostic Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

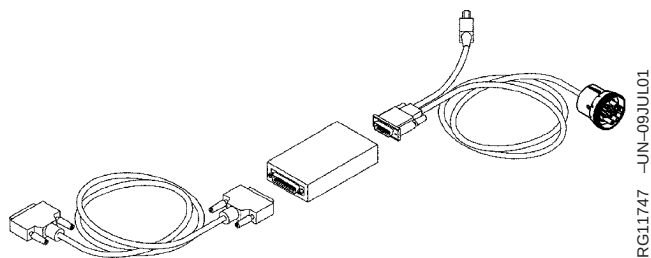
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Continued on next page

RG41221,000031A -19-14DEC01-1/12

ECU Communication Hardware Kit JDIS121

Used with ECU Communication Software Kit. Together, the kits enable a Windows ('95, '98, 2000, ME, and XP) or NT compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a 486/66 with 8 MB of RAM and an IEEE 1284 compliant parallel port. This kit allows communication with all John Deere applications that use one of the following diagnostic connectors: black 9-pin Deutsch diagnostic connector, gray 9-pin Deutsch diagnostic connector (early 8000 series tractors), or the flat 6-pin Weatherpack diagnostic connector (Lucas controllers). Not all of the components in this kit are shown to the right.

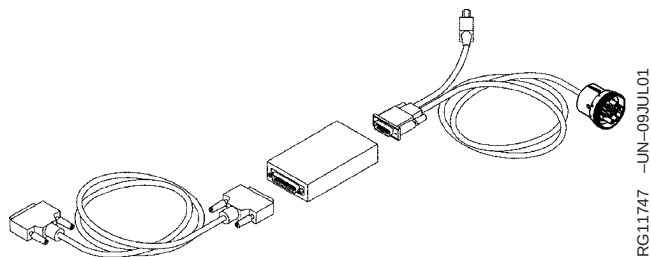


RG11747 -UN-09JUL01

RG41221.000031A -19-14DEC01-2/12

ECU Communication Hardware Kit DS10023

Used with ECU Communication Software Kit. Together, the kits enable a Windows ('95, '98, 2000, ME, and XP) or NT compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a 486/66 with 8 MB of RAM and an IEEE 1284 compliant parallel port. This kit allows communication with all John Deere applications that use the black 9-pin Deutsch diagnostic connector. All of the components in this kit are shown to the right.

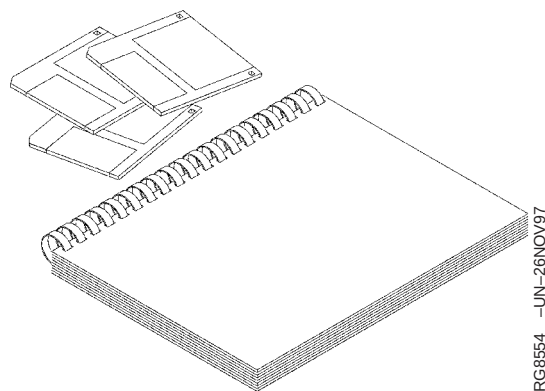


RG11747 -UN-09JUL01

RG41221.000031A -19-14DEC01-3/12

ECU Communication Software Kit.

Please refer to the John Deere website (www.johndeere.com/cngdiagnostics) or contact your local John Deere dealer for information on obtaining the latest version of software and information on the hardware kit.



RG8554 -UN-26NOV97

Continued on next page

RG41221.000031A -19-14DEC01-4/12

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.



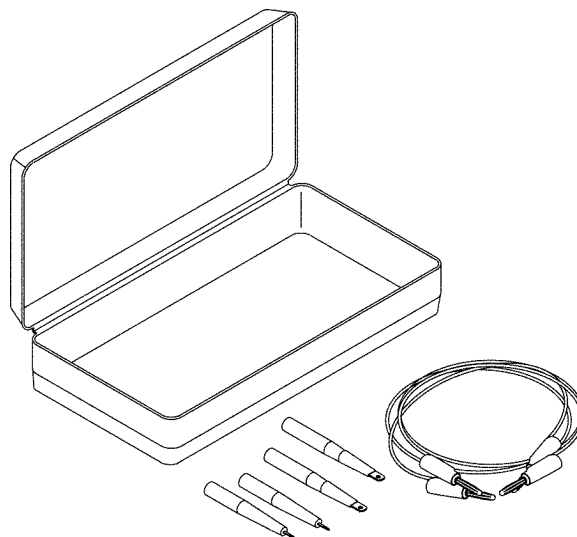
RW11274 -UN-12DEC88

RG41221,000031A -19-14DEC01-5/12

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5

Connector Adapter Test Kit JT07328

Used with JT05791 Digital Multimeter to make voltage and resistance measurements in control system wiring harness connectors. Can also be used to test terminals for proper fit.

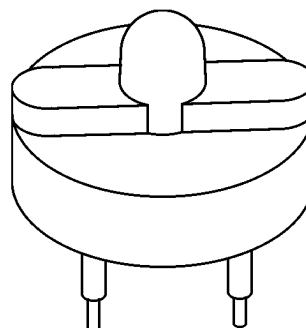


RG8803 -UN-26NOV97

RG41221,000031A -19-14DEC01-6/12

Bosch PFI Noid-Light JT07284

Used to test fuel injector drive operation.



RG8136 -UN-20AUG98

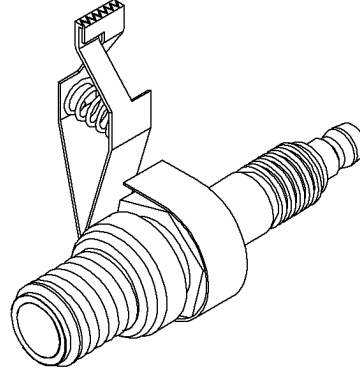
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RG41221,000031A -19-14DEC01-7/12

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Electronic Ignition Spark Tester JT07285

Used to check for ignition system spark.

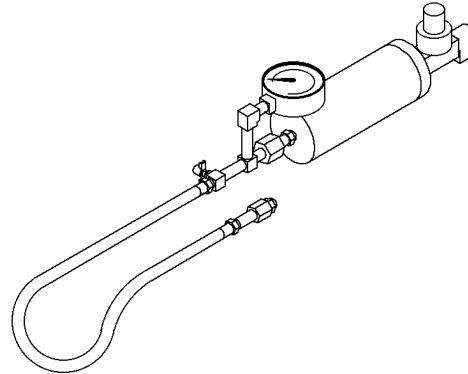


RG8137 -UN-20AUG98

RG41221,000031A -19-14DEC01-8/12

Fuel Injector Cleaner JT07282

Used with JT07281 Injector Cleaner Accessory Kit and JT07283 Pro Inject-R Kleen fluid to clean fuel injectors.



RG8138 -UN-20AUG98

RG41221,000031A -19-14DEC01-9/12

Injector Cleaner Accessory Kit JT07281

Used with JT07283 Pro Inject-R Kleen to clean fuel injectors.

RG41221,000031A -19-14DEC01-10/12

Pro Inject-R Kleen JT07283

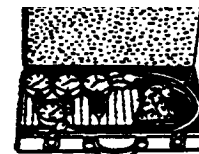
Used with JT07282 Fuel Injector Cleaner and JT07281 Injector Cleaner Accessory Kit to clean fuel injectors.

RG41221,000031A -19-14DEC01-11/12

RG5162 -UN-23AUG88

Universal Pressure Test Kit JT05470 (D15027NU)

Used with JT01735¹ Gas Cock to test natural gas fuel pressure.



¹Part of JT07281 Injector Cleaner Accessory Kit

RG41221,000031A -19-14DEC01-12/12

Other Material			199 7
Number	Name	Use	
	O-Ring Lubricant	Lubricate natural gas fuel line fitting O-rings.	
RG41221,000031B -19-14DEC01-1/1			

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