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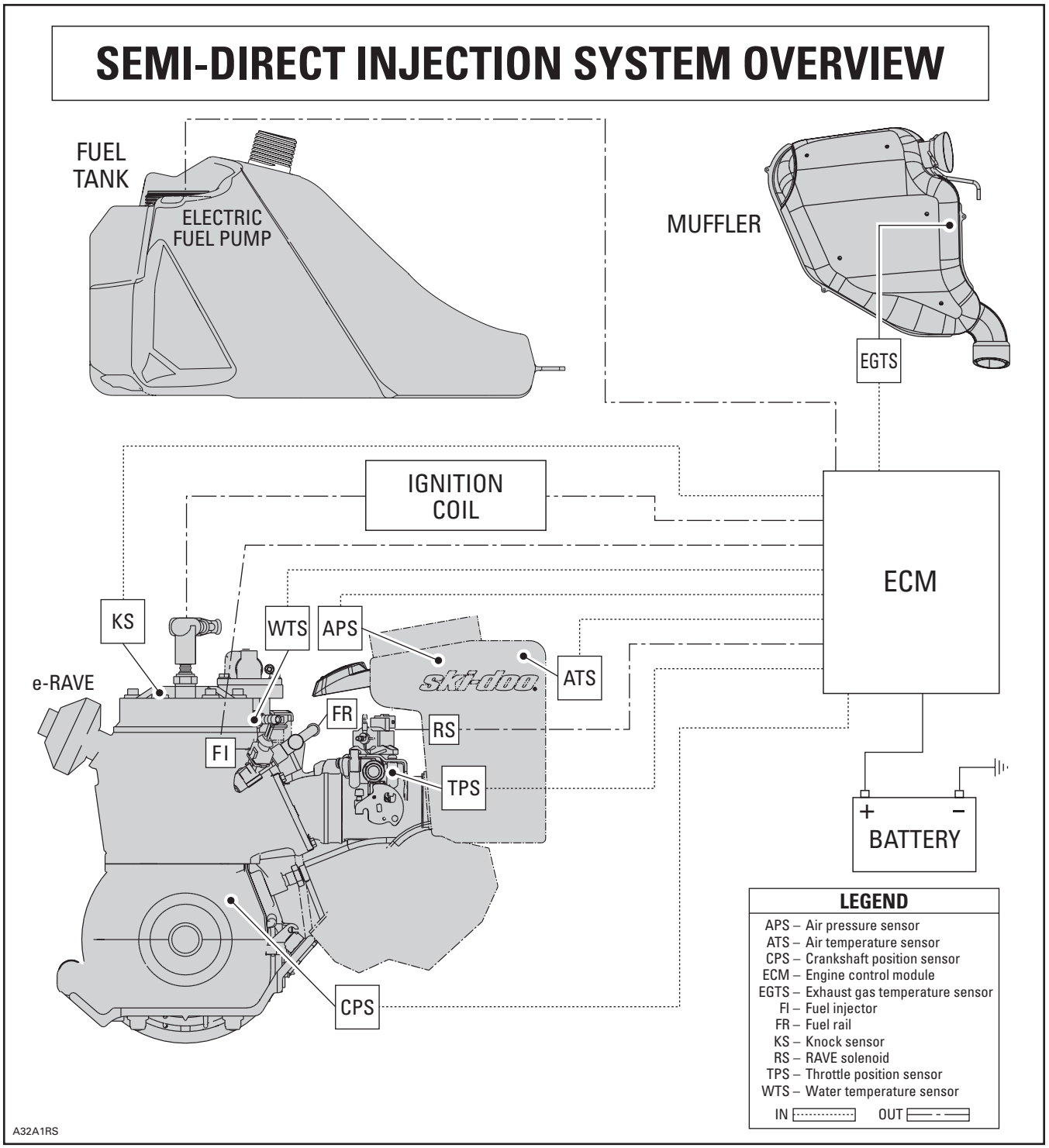
SEMI-DIRECT INJECTION SYSTEM OVERVIEW
FUEL TANK
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BATTERY
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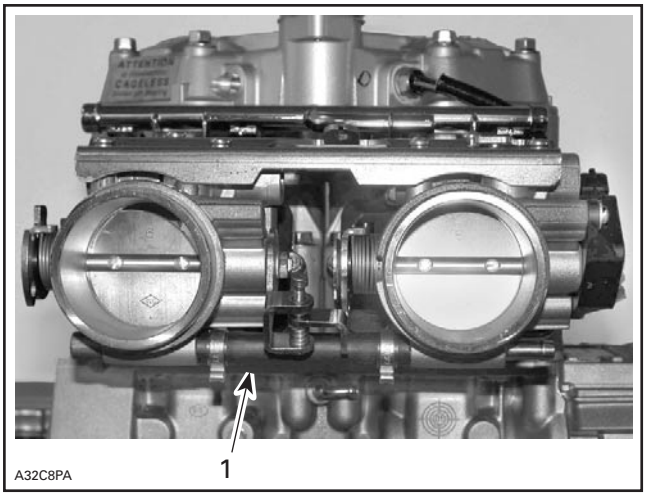
APS – Air pressure sensor
ATS – Air temperature sensor
CPS – Crankshaft position sensor
ECM – Engine control module
EGTS – Exhaust gas temperature sensor
FI – Fuel injector
FR – Fuel rail
KS – Knock sensor
RS – RAVE solenoid
TPS – Throttle position sensor
WTS – Water temperature sensor
IN
OUT
A32A1RS

OPERATING PRINCIPLE

For this 793 SDI 2-stroke engine, a highly advanced engine management system (EMS) has been used to ensure a high power output compared with cleanest combustion.An ECM (Engine Control Module) calculates the proper air/fuel mixture and ignition timing for each cylinder separately. The fuel is injected into the transfer port of each cylinder.

AIR INDUCTION

Through air filters mounted on dash, air goes into air silencer. The ECM measures at this point air pressure and temperature. Then, air for combustion is drawn through two 52 mm throttle bodies. The air flow is controlled by two throttle plates. The air continues through the reed valves into the cylinder base then the crankcase.



TWO 52 mm THROTTLE BODY ASSEMBLY
1. Coolant-heated line

FUEL DELIVERY SYSTEM

GENERAL

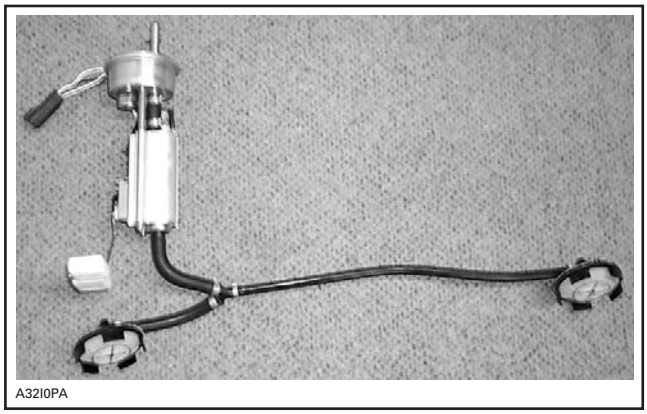
When the piston reaches the correct position, the ECM opens the fuel injectors and fuel is discharged into the transfer ports of cylinders.This air/fuel mixture is then ignited by the spark plug.

COMPONENT DESCRIPTION

Fuel Pump and Fuel Pressure Regulator

They provide fuel pressure and flow rate to the system.

The fuel pump module is located inside the fuel tank. The module includes the fuel pump and the fuel level sensor.



The fuel pressure regulator controls the pressure in the system and allows the excess of fuel to return to the fuel tank. The fuel pressure regulator regulates the fuel pressure at approximately 400 kPa (58 PSI).

Fuel Rail

The fuel rail is a small tube on which the four injectors are mounted. It ensures at all times that enough fuel at the right pressure can be delivered to the fuel injectors. The fuel rail is fed by the fuel pump with a fuel pressure of approximately 400 kPa (58 PSI).

Fuel Injectors

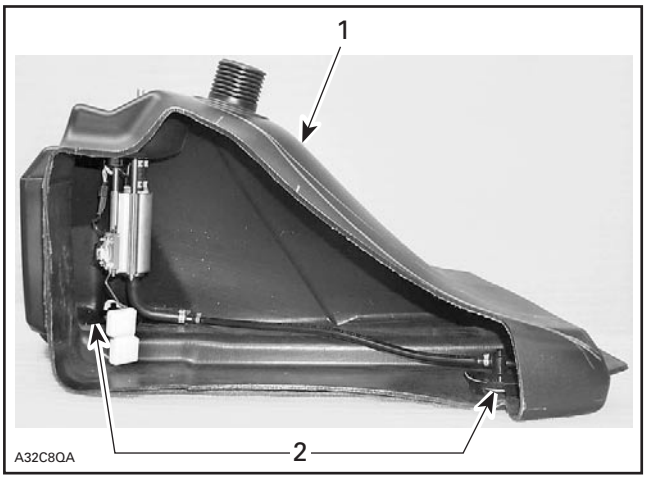
Fuel injectors (two per cylinder) are used to inject fuel into the transfer port of cylinder.

Throttle Body

It is a 52 mm dual throttle body mounted on the engine intake side. Fitted on this dual throttle body, there is a TPS (Throttle Position Sensor) that sends information to the ECM.

Fuel Pickups

The two fuel pickups come with 50 microns filter. One is located at the front right side of the fuel tank and the other at the rear left side.



1. Fuel tank
2. Fuel pickups

In-Line Fuel Filter

The in-line fuel filter is fastened under the steering console. It comes as a complete assembly.

ENGINE MANAGEMENT SYSTEM (EMS)

The EMS (Engine Management System) is equipped with an ECM which controls. The ignition system, the vehicle electrical system, the fuel injection system and the electronically controlled RAVE.

TYPICAL — ECM

The ECM is mounted in the front of the vehicle, beside injection oil tank.

The ECM is directly powered by the battery. It is responsible for the following engine management/ electrical functions:

– interpreting information
– distributing information
– start/stop function
– DESS (Digitally Encoded Security System)
– ignition control
– injection control

NOTE: The ECM applies the proper maps (injection and ignition) for optimum engine operation in all conditions.

– engine RPM limiter
– RER (Rotax Electronic Reverse)
– etc.

The ECM features a permanent memory that will keep the programmed tether cord cap(s) active, fault codes and other vehicle information, even when the battery is removed from the vehicle.

EMS — General Functions

Automatic Power Shut-Down

The ECM is equipped with an automatic power shut-down. This feature prevents the battery from losing its charge if the tether cord cap is left on the post when the engine is not running for more then 30 seconds. The ECM will remain offline until the electric starter or the rewind starter is activated. The ECM will shut down all outputs after 5 seconds when the tether cord cap is removed.

Antidrive Feature

This system allows the engine to reach pulley engagement speed only if a programmed tether cord cap is installed on DESS post. See below for details.

Digitally Encoded Security System (DESS)

The following components are specially designed for this system: ECM, tether cord cap and DESS post.

The tether cord cap contains a magnet and a ROM chip. The magnet actually closes the reed switch inside the post which is the equivalent of a mechanical ON/OFF switch. The chip has a unique digital code.

NOTE: Actually, it is the memory of the ECM which is programmed to recognize the digital code of the tether cord cap. This is achieved with the MPEM programmer (P/N 529 035 878) or the VCK (Vehicle Communication Kit P/N 529 035 844). Refer to their operation manual or help system to program a tether cord cap.

The system is quite flexible. Up to 8 tether cord caps may be programmed in the memory of the vehicle ECM. They can also be erased individually.

NOTE: If desired, a tether cord cap can be used on other vehicle equipped with the DESS. It only needs to be programmed for that vehicle.

When waking up the ECM with a tether cord cap on the post, the DESS is activated and will emit audible signals:

– 2 short beeps indicate a working tether cord cap. Engine starting can take place.
– 1 short beep indicates a wrong tether cord cap is being used or that something is defective. Engine starting is not allowed.

The memory of the ECM features two self-diagnostic modes for the DESS operation. Refer to DIAGNOSTIC PROCEDURES section for more information.

The memory of the ECM is permanent. If the battery is disconnected, no information is lost.

Note that the DESS anti-drive circuitry is already activated on all new ECMs.

Gauges Current Supply

The purpose of this function is to allow reading of gauges without the engine running. It will give access to most functions of the information center gauge without starting the engine.

Gauges are supplied with current for 30 seconds when connecting the tether cord cap on its post and pressing the START/RER switch.

NOTE: Each time the tether cord cap is connected to the post, the fuel pump is activated for 2 seconds to build up pressure in the fuel injection system.

Engine Starting

If the ECM recognizes a valid tether cord cap, it allows engine to rev about 3000 RPM.

If the tether cord cap is left on the DESS post for more than 30 seconds after stopping the engine, the ECM will shut down. The current supply to gauges will be stopped as explained in the ANTI-DRIVE FEATURE section.

Engine RPM Limiter

The ECM will limit the maximum engine speed.

Low-Oil Level Warning Device

When the oil falls under a certain level, the low oil level LED will be illuminated.

High Coolant Temperature Warning Device

When the coolant temperature is getting to high, the ECM sends out signals to the buzzer, the high temperature LED and to the check engine LED.

Power Distribution

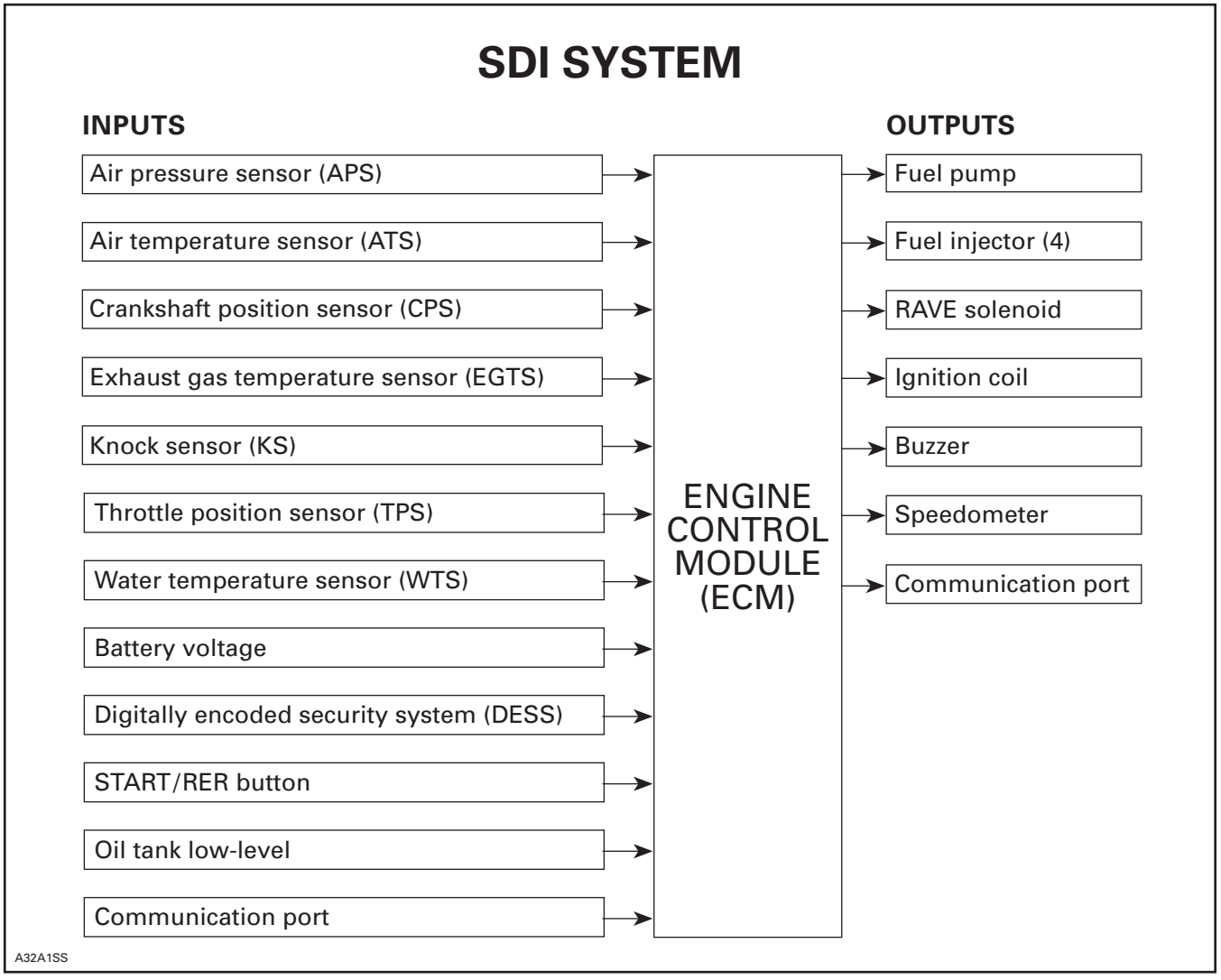
The ECM distributes power from battery to all accessories. Accessories are protected by fuses located in the fuse holder. Fuses are identified besides their holder.

IMPORTANT: The sensors and injectors are continuously powered with the supply from the battery. **The** ECM **switches the ground to complete the electrical circuits it controls.** Take this into account when troubleshooting the electrical system.

The system uses 3 relays: a main relay, a second for the headlights and a third for the accessories.

If a problem occurs with the magneto system, the ECM will turn off the accessories relay to distribute the remaining voltage to the main systems.

ECU — Engine Management Functions



This engine management system controls the fuel injection, the ignition timing and the electronically controlled RAVE.

As shown in the SDI CONTROL SYSTEM illustration, the ECM is the central point of the fuel injection system. It reads the inputs, makes computations, uses pre-determined parameters and sends the proper signals to the outputs for proper engine management.

The ECM also stores the fault codes and general information such as: operating conditions, vehicle hours, serial numbers, customer and maintenance information.

Electronic Fuel Injection

The ECM receives the signals from different sensors which indicate engine operating conditions at millisecond intervals.

Signals from sensors are used by the ECM to determine the injection parameters (fuel maps) required for optimum air-fuel ratio.

The CPS and TPS are the primary sensors used to control the injection and ignition timing. Other sensors are used for secondary input.

Ignition Timing

The ECM is programmed with data (it contains ignition mappings) for optimum ignition timing under all operating conditions. Using engine operating conditions provided by the sensors, the ECM controls the ignition timing for optimum engine operation.

Electronically Controlled RAVE

The electronically controlled RAVE (e-R.A.V.E.) offers two performance enhancements to conventional RAVE system.

– The opening of the valve is now activated electronically. A solenoid holds the valve closed. The ECM monitors altitude, engine temperature, throttle position and RPM, and operates the solenoid in optimal conditions.
– The valve is now opened by crankcase pressure, as opposed to exhaust pressure. The greater and more constant pressure from the crankcase opens the valve more crisply.

NOTE: An electric heating element has been added to the RAVE solenoid to ensure proper function in very cold weather.

Knock Sensor

A knock sensor is mounted on top of the cylinder head. It detects specific vibration that would be typically generated by engine detonation. If detonation occurs, the knock sensor detects it and the ECMs retards the ignition advance and extend the injection period temporarily (it goes in a specific mode) until detonation stops.

Engine Modes of Operation

The ECM controls different operation modes of the engine to allow proper operation for all possible conditions: Cranking, start up, idle, warm up, normal operation, engine speed limiter, flooded engine and limp home (see below).

Flooded Engine (drowned mode)

If the engine does not start and it is fuel-flooded, this special mode can be activated to prevent fuel injection and ignition while cranking. Proceed as follows:

With tether cord cap on its post while engine is stopped, press completely and HOLD throttle lever.

Press the START/RER button. The mode is now on.

The engine should be cranked for 20 seconds.

NOTE: No spark occurs on drowned mode.

Release START/RER button and throttle lever. Try to start the engine normally.

If the engine does not start, it may be necessary to remove the spark plugs and crank the engine with rags over spark plug holes. Refer to COMPONENT INSPECTION AND ADJUSTMENT.

Monitoring System

The ECM monitors the electronic components of the fuel injection system and some components of the electrical system.

When a fault occurs, it sends visual messages through the referring LED and/or audible signals through a buzzer to inform you of a particular condition. Refer to the DIAGNOSTIC PROCEDURES section for the referring LED and the buzzer coded signals chart.

Limp Home Modes

Besides the signals as seen above, the ECM may automatically set default parameters to the engine management to ensure the adequate operation of the vehicle if a component of the fuel injection system is not operating properly.

NOTE: Sensor failures will not lead to a limp home mode, warning will follow by the check engine LED and the buzzer.

When minor fault occurs, the fault and message/ buzzer will disappear automatically, when the condition disappears.

Depending on the severity of the malfunction, the vehicle speed may be reduced and not allowed to reach its usual top speed.

The engine RPM may be limited if some critical components fail. In this case, releasing throttle and letting the engine returning to idle speed may allow normal operation to come back. If does not work, try removing and reinstalling the tether cord cap on DESS post.

These performance-reduced modes allow the rider to go back home which would not be possible without this advanced system. Refer to the DIAGNOSTIC PROCEDURES for a complete chart.

If a fault occurs and involves a limp home mode operation, the engine management system will reduce engine RPM gradually to the proper level.

Diagnostic Mode

The malfunctions are recorded in the memory of the ECM. The memory of the ECM can be checked using the VCK (Vehicle Communication Kit) (P/N 529 035 844) to see the fault codes. Refer to the DIAGNOSTIC PROCEDURES section.

The ECM and the VCK are able to communicate through a connector on the vehicle. The B.U.D.S. software, version G2.00, P2.00 or up must be used for this system.

CHARGING SYSTEM

The ignition system consists of different subsystems where some are interrelated.

Unregulated AC current is produced by the magneto. AC current is rectified and regulated between 13.4 and 15 volts for the vehicle electrical system.

Vehicle 12-volt battery supplies the ECM with DC current.

Refer to MAGNETO SYSTEM.

The following type of ignition system is used:

– Digital Inductive System.

Magneto System

The magneto is the primary source of electrical energy. It transforms magnetic field into electric current (AC).

The magneto has a 3 phases, delta wound stator on 18 poles. Capacity is 480 watts.

Double Ignition Coil

Double ignition coil has two separate windings, one for each spark plug.

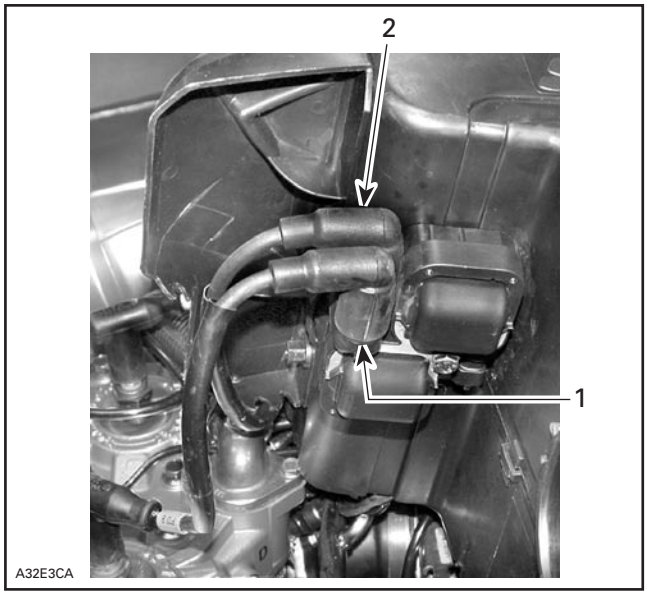
Ignition coil induces voltage to a high level in the secondary windings to produce a spark at the spark plug.

Two separate windings receive input from the ECM. Each winding provides high voltage to its corresponding spark plug.

This ignition system allows spark plugs to spark independently.

CAUTION: Do not interchange spark plug cables. Match reference (PTO or MAG printed on high tension cable yellow tag) with corresponding cylinder spark plug.

Double ignition coil is located underneath air silencer.



TYPICAL

1. *PTO side high tension cable*
2. *MAG side high tension cable*

Trigger coil

Trigger coil is used for:

1. Forward engine rotation.
2. Reverse engine rotation.
3. As a crankshaft position sensor (CPS). This information is sent to the ECM.

COMPONENT INSPECTION AND ADJUSTMENT

GENERAL

Engine problems are not necessarily related to the electronic fuel injection system.

It is important to ensure that the mechanical integrity of the engine/propulsion system is present:

– good transmission system operation
– good engine compression and properly operating mechanical components, no leaks etc.
– fuel pump connection and fuel lines without leaks.

Check the chart in TROUBLESHOOTING section to have an overview of problems and suggested solutions.

When replacing a component, always check its operation after installation.

FUEL SYSTEM

⚠ WARNING

The fuel system of a fuel injection system holds much more pressure than that of a carbureted snowmobile. Prior to disconnecting a hose or to removing a component from the fuel system, follow the recommendation described here. Pay attention that some hoses may have more than one clamp at their ends. Ensure to reinstall the same quantity of clamps at assembly.

– Use the VCK (Vehicle Communication Kit) (P/N 529 035 844) to release the fuel pressure in the system. Look in the **Activation** section of the software B.U.D.S. (version G 2.0, P 2.0 or higher).

⚠ WARNING

Fuel lines remain under pressure at all times. Always proceed with care and use appropriate safety equipment when working on pressurized fuel system. Wear safety glasses and work in a well ventilated area. Do not allow fuel to spill on hot engine parts and/or on electrical connectors. Proceed with care when removing/installing high pressure test equipment or disconnecting fuel line connections. Use the VCK to release fuel pressure prior to removing a hose. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to minimize spilling. Wipe off any fuel spillage in the engine compartment. Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area. Always disconnect battery prior to working on the fuel system. After performing a pressure test, release the pressure.

– Always disconnect battery properly prior to working on the fuel system. Refer to BATTERY section.

When the job is done, ensure that hoses from fuel rail going to fuel pump are properly secured in their supports. Then, pressurize the fuel system. Perform the high pressure test as explained in this section.

Properly reconnect the battery.

⚠ WARNING

Ensure to verify fuel line connections for damage and that NO fuel line is disconnected prior to installing the tether cord cap on the DESS post. Always perform the high pressure test if any component has been removed. A pressure test must be done before connecting the tether cord cap. The fuel pump is started and pressure quickly builds-up each time the tether cord cap is installed and the START/RER button is depressed (or rewind starter is pulled).

To check fuel rail for leaks, first pressurize the system then spray soapy water on all hose connections, regulators and injectors. Air bubbles will show the leaking area. Check also for leaking fuel or fuel odor.

⚠ WARNING

Never use a hose pincher on high pressure hoses.

ELECTRICAL SYSTEM

It is important to check if the electrical system works properly:

– battery
– fuses
– DESS
– ignition (spark)
– ground connections
– wiring connectors.

It is possible that a component seems to operate in static condition but in fact, it is defective. In this case, the best way to solve this problem is to remove the original part and replace it with one in good condition.

Never use a battery charger to substitute temporarily the battery, as it may cause the ECM (Engine Control Module) to work erratically or not to work at all. Check related-circuit fuse solidity and condition with an ohmmeter. Visual inspection could lead to false results.

⚠ WARNING

All electrical actuators (injectors, fuel pump, ignition coils and starter solenoid) may be suddenly supplied by the battery when the tether cord cap is installed and the start button is depressed or if engine is rotated (manually or with the rewind starter). Even a small movement of the crankshaft or the usage of the supply cable (P/N 529 035 869) will automatically activate the actuators. Always disconnect the tether cord cap and the battery prior to disconnecting any electric or electronic parts.

To perform verifications, a good quality multimeter such as Fluke 111 (P/N 529 035 868) should be used.

Pay particular attention to ensure that pins are not out of their connectors or out of shape. The troubleshooting procedures cover problems not resulting from one of these causes.

CAUTION: Ensure all terminals are properly crimped on wires and connector housings are properly fastened.

Before replacing a ECM, always check electrical connections. Make sure that they are very tight and they make good contact and that they are corrosion-free. Particularly check ECM ground connections. Ensure that contacts are good and clean. A "defective module" could possibly be repaired simply by unplugging and replugging the ECM. The voltage and current might be too weak to go through dirty wire pins. Check carefully if pins show signs of moisture, corrosion or if they look dull. Clean pins properly and then coat them prior to assembling as follows:

Apply a silicon-based dielectric grease or other appropriate lubricant. If the newly replaced ECM works, try the old one and recheck if it works.

Ensure that all electronic components are genuine — any modification on the wiring harness may lead to generate fault codes or bad operation.

NOTE: For diagnostics purposes, use Vehicle Communication Kit (VCK). See DIAGNOSTIC PROCEDURES subsection.

After a problem has been solved, ensure to clear the fault(s) in the ECM using the VCK. Refer to DIAGNOSTIC PROCEDURES subsection.

Resistance Measurement

When measuring the resistance with an ohmmeter, all values are given for a temperature of 20°C (68°F). The resistance value of a resistance varies with the temperature. The resistance value for usual resistor or windings (such as injectors) **increases** as the temperature increases. However, our temperature sensors are NTC types (Negative Temperature Coefficient) and work the opposite which means that the resistance value **decreases** as the temperature increases. Take it into account when measuring at temperatures different from 20°C (68°F). Use this table for resistance variation relative to temperature for **temperature** sensors.

TEMPERATURE SENSOR TABLE					
Temperature		**Resistance (ohms)**			
°C	°F	ATS	EGTS	GAUGE	ECM
- 40	- 40		169.7		72412
- 35	- 31				52637
- 30	- 22	28000			38681
- 25	- 13				28718
- 20	- 4	14500	185.1	733.8	21529
- 15	5			587.7	16288
- 10	14			474	12431
- 5	23			384.8	9565
0	32	5500	200.5	314.3	7418
5	41			258.4	5807
10	50			213.7	4582
15	59			177.7	3644
20	68	2500		148.7	2919
25	77		219.6	125	2355
30	86			105.6	1912
35	95			98.69	1562
40	104	1200		76.5	1284
45	113			65.54	1062
50	122		238.5	56.38	882.6
55	131			48.72	738.9
60	140	600		42.28	622
65	149			36.82	526.3
70	158			32.19	447.5
75	167			28.24	382.3
80	176	320		24.86	328.1
85	185			21.95	282.8
90	194			19.45	244.8
95	203			17.28	212.8
100	212	180	275.9	15.4	185.6
105	221				162.4
110	230				142.7

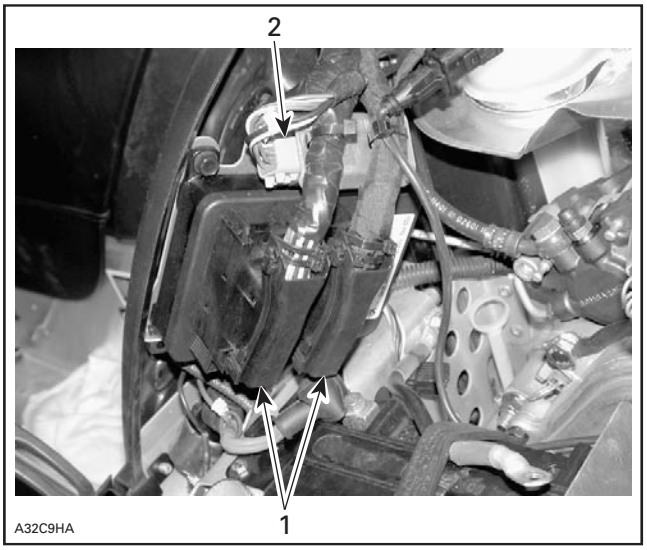
TEMPERATURE SENSOR TABLE					
Temperature		**Resistance (ohms)**			
°C	°F	ATS	EGTS	GAUGE	ECM
115	239				125.9
120	248				111.5
125	257				99.02
130	266	90			88.26
135	275				78.93
140	284				70.81
145	293				63.71
150	302		312.7		57.49
200	392		349.0		
250	482		384.6		
300	572		419.7		
350	662		454.2		
400	752		488.1		
450	842		521.4		
500	932		554.1		
600	1112		617.8		
700	1292		679.2		
800	1472		738.2		
900	1652		794.9		
1000	1832		849.2		

The resistance value of a temperature sensor may test good at a certain temperature but it might be defective at other temperatures. If in doubt, try a new sensor.

Also remember this validates the operation of the sensor at room temperature. It does not validate the over temperature functionality. To test it, the sensor could be removed from the engine/air silencer and heated with a heat gun while it is still connected to the harness to see if the ECM will detect the high temperature condition and generate a fault code.

ENGINE CONNECTOR PIN-OUT

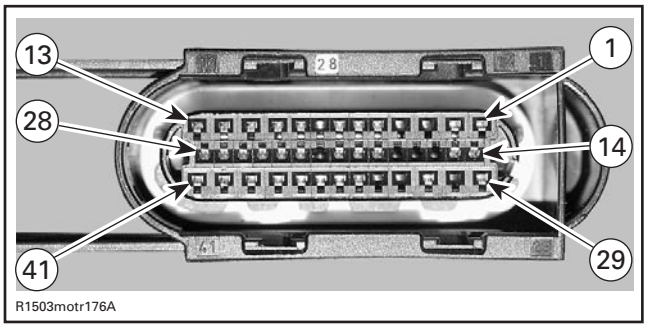
Connector Position



1. ECM connectors
2. Engine connector

ECM Connector

Use this diagram to locate the pin numbers on the ECM connector of the wiring harness when performing tests.



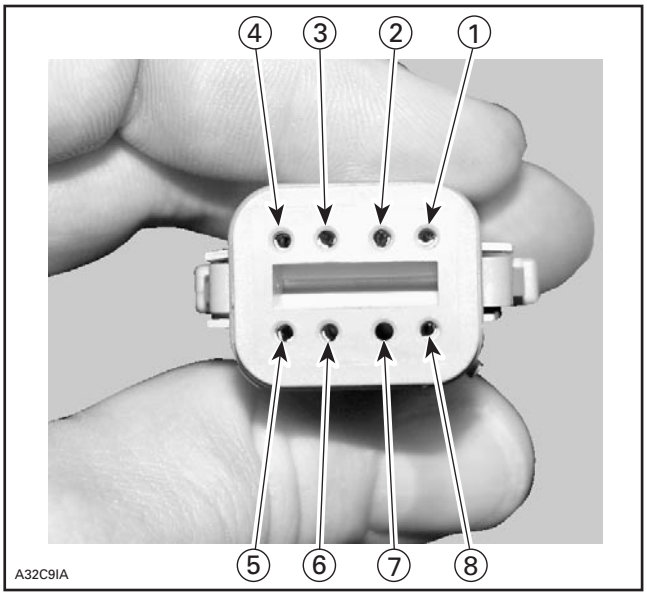
ECM CONNECTOR PIN-OUT (WIRING HARNESS SIDE)

CAUTION: Probe on top of terminal only. Do not try to probe inside terminal or to use a paper clip to probe inside terminal, it will damage the square-shaped terminal.

CAUTION: Do not disconnect the ECM connector needlessly. They are not designed to be disconnected/reconnected repeatedly.

Engine Connector

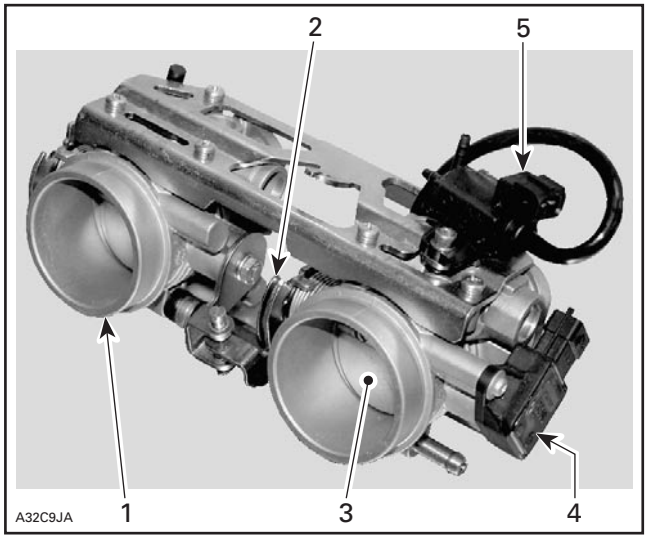
Use this illustration to locate the pin numbers on the engine connector of the wiring harness when performing tests.



ENGINE CONNECTOR PIN-OUT (WIRING HARNESS SIDE)

AIR INDUCTION SYSTEM

THROTTLE BODY



1. Throttle body
2. Throttle cable attachment
3. Throttle plate
4. TPS
5. E-RAVE solenoid

Mechanical Inspection

Check that the throttle plate moves freely and smoothly when depressing throttle lever. Take this opportunity to lubricate the throttle cable.

IMPORTANT: The throttle body is designed to be tamper proof. Changing the idle stop or modifying it in any way will not increase performance or change the idle speed but may cause poor start-ability and erratic idling.

Before replacing any part, check the following as these could be causing the fault. Perform the test while the engine is not running.

– Throttle cable adjustment too tight. Not returning fully to idle stop.
– Throttle body idle set screw is loose or worn.
– Throttle linkage between the two throttles has moved.
– TPS is loose.
– Corroded or damaged wiring or connectors.
– Throttle body has been replaced and the **Closed Throttle** reset has not been performed.
– ECM has been replaced and the **Closed Throttle** reset has not been performed.

Electrical Inspection

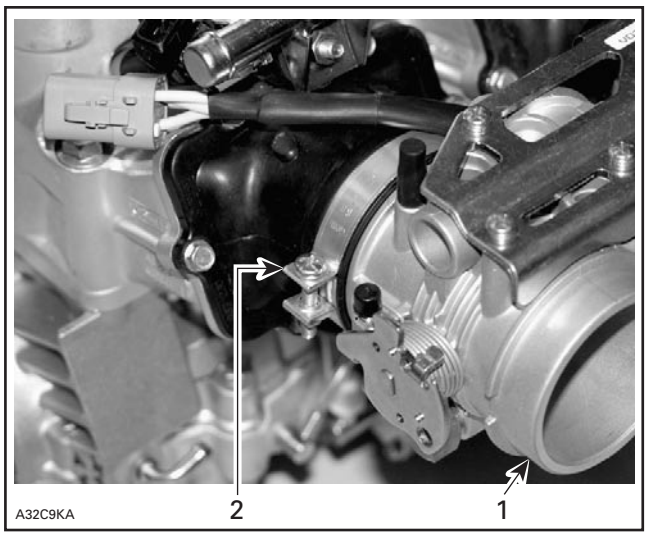
Refer to THROTTLE POSITION SENSOR (TPS) in ELECTRONIC MANAGEMENT below.

Replacement

Removal

To remove the throttle body from engine, proceed as follows:

– Disconnect connectors from ATS (Air Temperature Sensor) and APS (Air Pressure Sensor).
– Disconnect air intake silencer from throttle body. Move boot away.
– Drain cooling system.
– Remove clamps and hoses for throttle body heating from nipples.
– Disconnect connectors and hoses from e-RAVE solenoid and TPS.
– Disconnect throttle cable.
– Unscrew retaining clamps of throttle body.



1. Throttle body
2. Clamp

– Slightly pull throttle body out.

Installation

Installation of the new throttle body is the reverse of the removal procedure. Pay attention to the following details.

Refill and bleed the cooling system, refer to LIQUID COOLING SYSTEM.

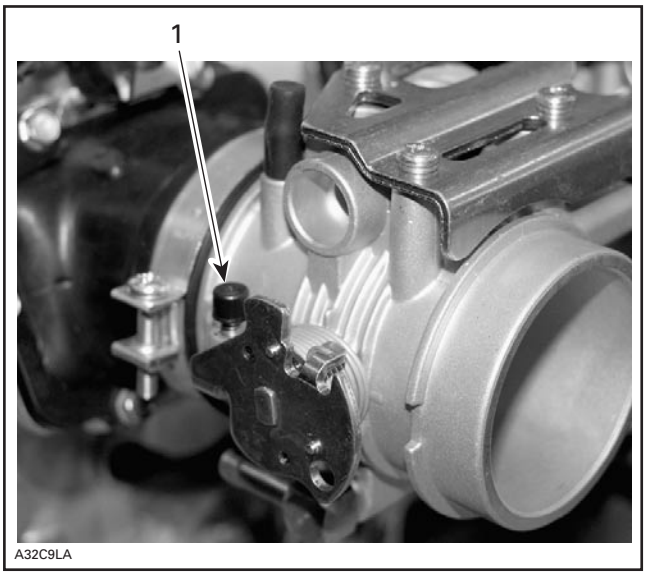
For TPS and e-RAVE solenoid replacement procedures, refer to the respective paragraph in ELECTRONIC MANAGEMENT below.

Adjustment

Throttle Body Synchronization

CAUTION: It is not allowed to perform any change on the synchronization screw.

NOTE: The throttle body is designed as a single part for both cylinders. No synchronization is required as it has already been done at the factory. However, proceed with throttle cable and closed TPS adjustments as described below.

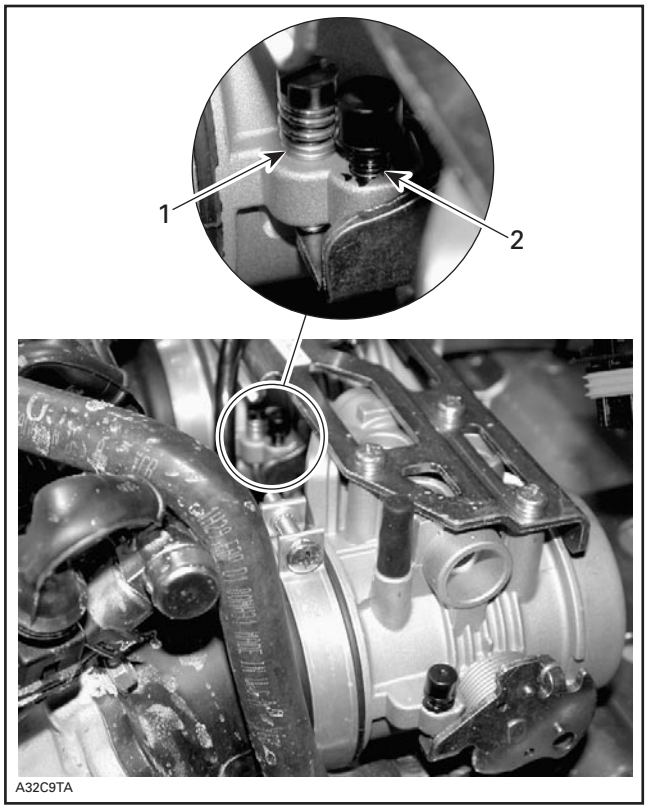


THROTTLE BODY
1. Zero position stopper screw

CAUTION: It is not allowed to perform any change on the zero position stopper screw.

The adjustment of the zero position stopper screw is optimized by the throttle body manufacturer and locked to prevent any modification.

CAUTION: Never attempt to adjust the zero position stopper screw (the capped one) or the idle speed adjustment would be impaired. Besides, no adjustment could be performed by the dealer nor the factory to correct the zero position stopper screw. The throttle body would need to be replaced.



1. Idle speed screw
2. Zero position stopper screw

CAUTION: Do not alter or tamper with throttle cable adjustment or routing. It may cause poor startability and erratic idling.

The only screw that has to be adjusted is the idle speed screw and it has to be adjusted only with the closed throttle reset procedure. This has to be done only if the ECM or throttle body are replaced or if screw has been tampered with by mistake. Refer to THROTTLE POSITION SENSOR (TPS) in ELECTRONIC MANAGEMENT below.

Throttle Cable Adjustment

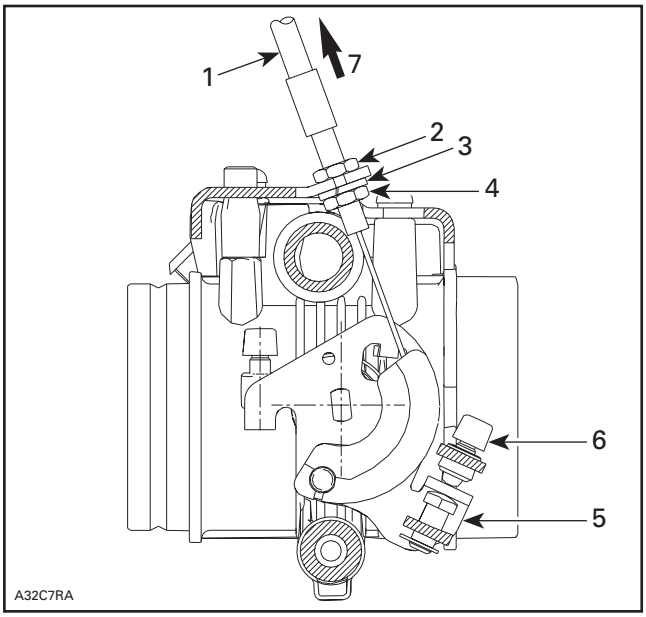
Mechanically adjust the throttle cable.

Handlebar and throttle cable must be at their normal position.

Apply full throttle.

Pull on cable sheath with a force of 50 N (11 lbf). Tighten top nut to 1 N•m (9 lbf•**in**).

Tighten bottom nut to 4.5 N•m (40 lbf•**in**).



1. Cable sheath
2. Upper nut
3. Lock washer
4. Lower nut
5. Throttle lever
6. Adjusting screw
7. Pull in this direction

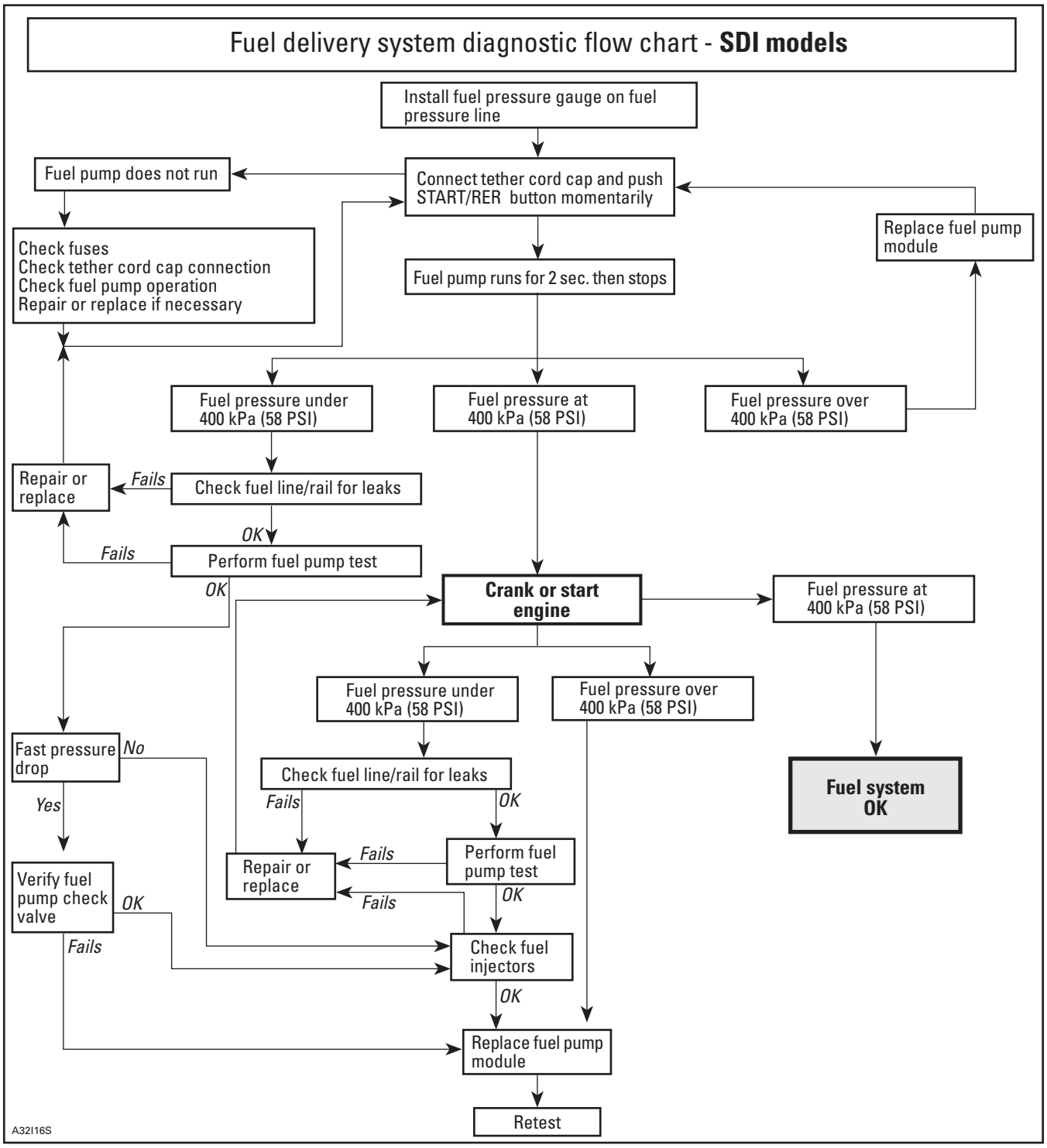
Activate the throttle lever a few times. Make sure throttle cam of throttle body rests against idle speed screw without any tension on the cable.

Using the VCK with B.UD.S., perform the wide open verification. In monitoring tab check if throttle opening is within 84° to 86° when in wide open position on throttle lever.

Closed Throttle Reset

Perform the **Closed Throttle** reset as described in THROTTLE POSITION SENSOR (TPS) in ELECTRONIC MANAGEMENT below.

FUEL DELIVERY



FUEL PUMP

Before proceeding to the pressure test, ensure the battery is fully charged. Battery voltage must be over 12 volts.

Release the fuel pressure in the system using B.U.D.S. Refer to the **Activation** tab.

⚠ WARNING

The fuel hose may be under pressure. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to release the pressure. Wipe off any fuel spillage inside engine compartment.

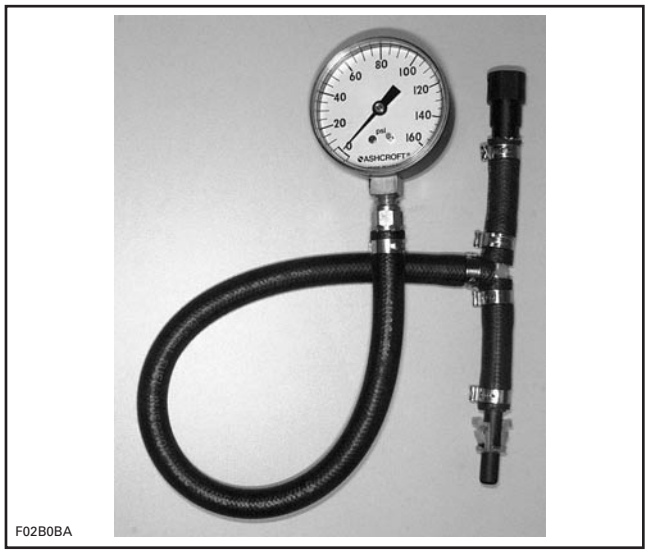
The pressure test will show the available pressure at the fuel pump outlet. It validates the pressure regulator, the fuel pump and leaks in the system.

Ensure there is no leak from hoses and fittings. Repair any leak.

Ensure there is enough gas in fuel tank.

Disconnect outlet hose from fuel pump.

Install fuel pressure gauge (P/N 529 035 591) between disconnected hose (inline installation).



FUEL PRESSURE GAUGE (P/N 529 035 591)

Remove tether cord cap. Depress START/RER button and observe fuel pressure. **Do not crank engine.** Repeat twice. Release pressure using B.U.D.S. between tests so that the gauge is "reset" to zero (0).

FUEL PRESSURE (when depressing START/RER button)
400 kPa (58 PSI)

Crank or start engine and observe fuel pressure. The fuel pressure should be the same as above.

If pressure is within limits, fuel pump and pressure regulator are working adequately.

A rapid pressure drop indicates leakage either from the fuel rail or from the fuel pump check valve. Check fuel rail for leaks. If it is not leaking then replace fuel pump.

A slow pressure drop indicates leakage either from the fuel injector or from the fuel pressure regulator. Check fuel injector for leaks (see below). If it is not leaking then replace fuel pump module.

Release fuel pressure in the system using B.U.D.S. Look in the **Activation** tab.

Remove pressure gauge and reinstall fuel hose.

⚠ WARNING

Wipe off any fuel spillage in the engine compartment. Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area.

Reinstall removed parts.

Electrical Test

When depressing the START/RER button, the fuel pump should run for 2 seconds to build up the pressure in the system.

If the pump does not work, disconnect the plug connector from the fuel pump.

Install a temporary connector to the fuel pump connector and apply voltage (12 V) to this test harness.

NOTE: Place the (+) on pin 4 and the (-) on pin 3.

If pump does not run, replace the fuel pump module.

Otherwise, probe terminals 4 and battery ground of fuel pump connector on vehicle harness side. When depressing the START/RER button, you should read battery voltage for approximately 2 seconds (then, the voltage will drop). If battery voltage does not appear, the problem can be in harness or in fuel pump connector. Repair or replace appropriate part (fuel pump may be blown).

Check continuity between terminal 3 of the fuel pump connector on the vehicle harness side and terminal 29 of the ECM connector B. If there is no continuity the problem is in the harness.

Fuel Pump Module Replacement

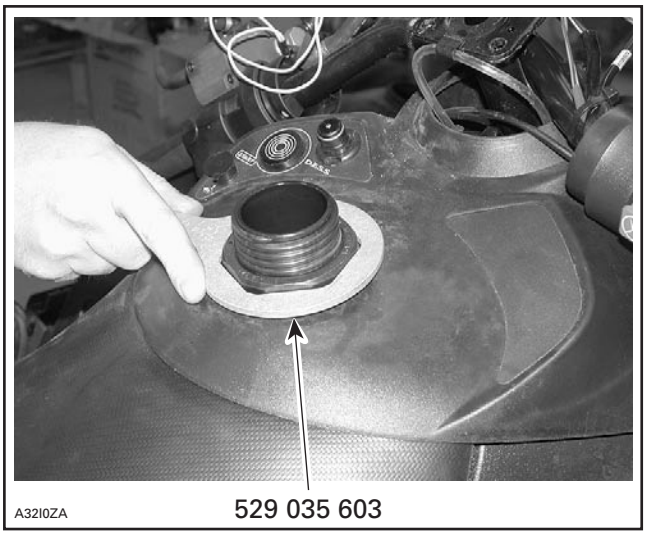
Removal

Open hood. Connect VCK (P/N 529 035 844). Use B.U.D.S. to release fuel pressure.

Drain fuel tank as much as possible.

Remove steering pad. Unbolt handlebar and move it forward.

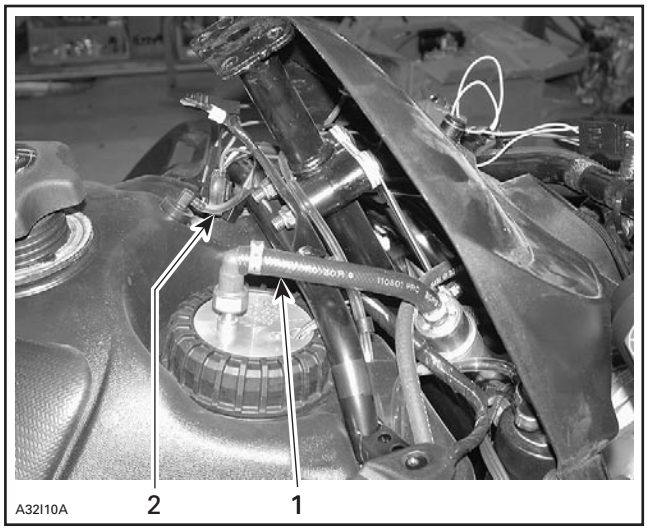
Unscrew fuel tank nut using wrench (P/N 529 035 603).



Unbolt console then, move it forward.

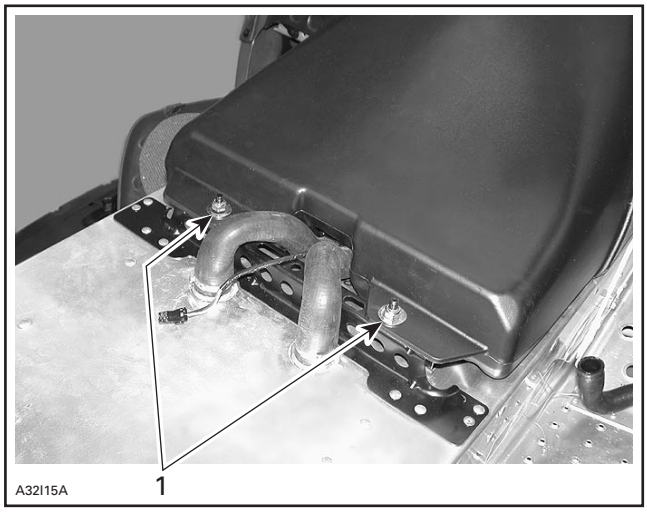
Disconnect fuel supply hose from fuel pump module.

Disconnect vent tube from vent elbow.



1. *Fuel supply hose*
2. *Vent tube*

Remove seat. Unbolt fuel tank.



1. *Fuel tank retaining screws*

Move fuel tank rearward then, unplug the fuel pump module electric connector.

With two screwdrivers holding the flange unscrew fuel pump nut using fuel pump nut wrench (P/N 529 035 899).


A32I11A

Pull fuel pump module out of fuel tank to expose sensor body. Unclip retainer from sensor body then, remove float ass'y from sensor body.


A32I12A

FLOAT ASS'Y REMOVAL

Remove fuel pump module. Guide fuel pickups when pulling out fuel pickup hoses.


A32I13A

Installation

For installation, reverse the removal process but pay attention to the following.

Install a new gasket.

Align the arrow on fuel pump module with the one on fuel tank. Keep arrows aligned during fuel pump module nut tightening.

A32I14A

1. Arrows

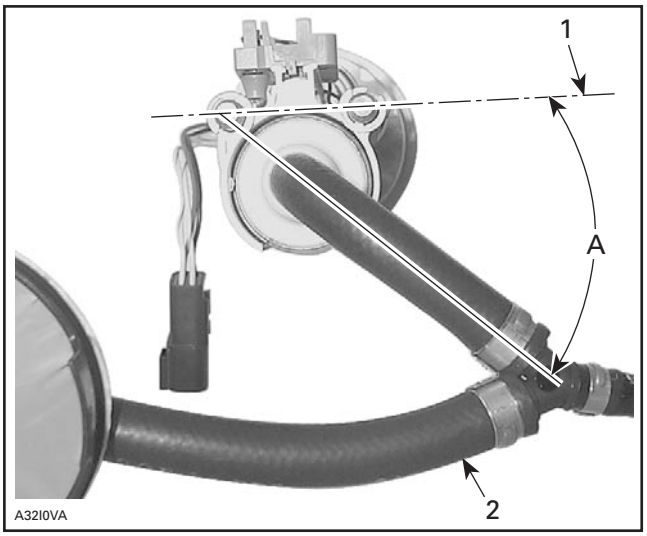
Install a torque wrench perpendicularly (90°) to fuel pump nut wrench (P/N 529 035 899). Torque fuel pump nut to 27 - 30 N•m (20 - 22 lbf•ft).

Fuel Hose Kit (P/N 861 301 700)

Remove fuel pump module as explained above.

Unfasten blue hose clamp retaining old fuel hose ass'y to pump inlet nipple. Remove old fuel hose ass'y.

Install fuel hose ass'y to pump at an angle of 46 ± 3° from retaining rods axis.



1. Retaining rods axis
2. Fuel hose ass'y
A. 46 ± 3°

Install a new blue hose clamp on fuel hose ass'y.

Install a new gasket then, reinstall fuel pump module as explained above.

Resistor Card Ass'y Kit (P/N 861 301 800)

Remove fuel pump module as explained above.

Unclip retainer from sensor body then, remove float ass'y from sensor body.

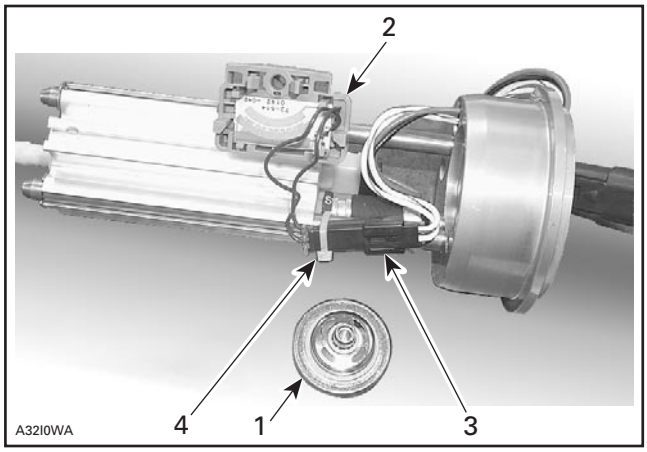
Loosen screw retaining lock plate. Slide lock plate out of aluminum extrusion.

Cut locking tie retaining electric connectors of resistor card ass'y. Unplug the connectors.

Remove regulator from pump module flange to make room for resistor card ass'y removal.

Slide old resistor card ass'y out of aluminum extrusion.

Reverse removal procedure for installation.



1. Fuel regulator removed
2. Resistor card ass'y ready to be installed
3. Connectors to be unplugged
4. Locking tie to be cut

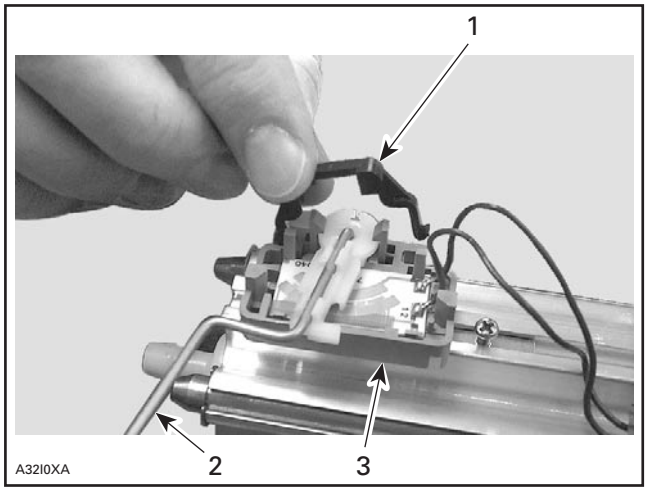
Install a new gasket then, reinstall fuel pump module as explained above.

Float Ass'y Kit (P/N 861 301 900)

Remove fuel pump module as explained above.

Unclip retainer from sensor body then, remove old float ass'y from sensor body.

Install new float ass'y on sensor body then, install new retainer.



1. Retainer
2. Float ass'y
3. Sensor body

Install a new gasket then, reinstall fuel pump module as explained above.

Pump Ass'y Kit (P/N 861 302 000)

Remove fuel pump module as explained above.

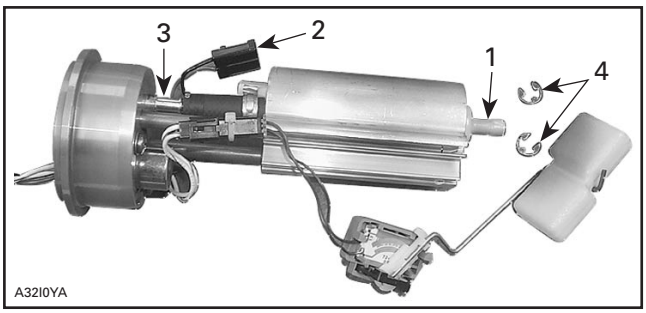
Disconnect fuel hose from pump inlet nipple.

Unlock and remove lock plate of resistor card ass'y.

Disconnect pump electric connector.

Disconnect pump outlet hose from pump module flange nipple.

Remove E-clips. Slide pump ass'y out of retaining rods. Make sure that resistor card ass'y slides along the aluminum extrusion.



1. *Pump inlet nipple*
2. *Pump electric connector*
3. *Pump module flange nipple*
4. *E-clips*

Reverse removal procedure for installation.

Install a new gasket then, reinstall fuel pump module as explained above.

Regulator Kit (P/N 861 302 100)

Remove fuel pump module as explained above.

Remove 2 screws retaining regulator to pump module flange.

Replace O-rings with new ones. Install them in pump module flange bore.

CAUTION: Regulator O-rings must be installed in pump module flange bore.

Reverse removal procedure for installation.

Install a new gasket then, reinstall fuel pump module as explained above.

FUEL RAIL

Pressure at fuel rail is supplied and controlled by the fuel pump module. Refer to FUEL PUMP for pressure test.

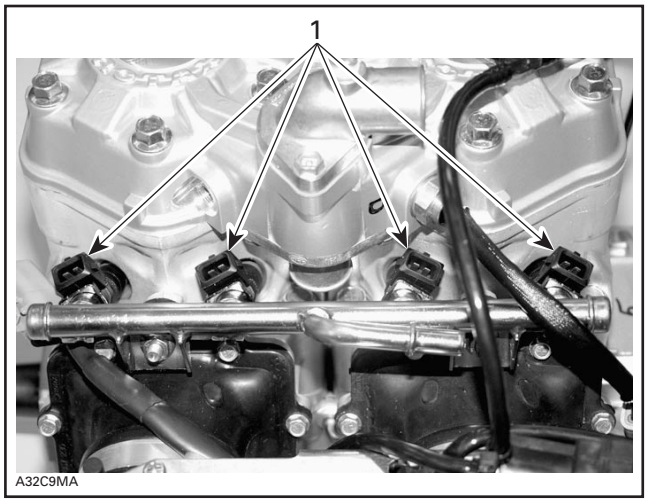
Fuel Rail Replacement

Removal

Release the fuel pressure in the system using B.U.D.S. Look in the **Activation** tab.

Disconnect fuel hose at the connector.

Wrap a rag around the hose end to prevent rail draining.



1. *Fuel injectors*

Disconnect wiring harness from the four fuel injectors.

Cut tie raps and remove the wiring harness from the fuel rail.

Unscrew rail retaining nuts.

Gently pull rail up by hand, working each side slightly at a time.

Pull rail out with fuel injectors.

If necessary remove fuel injectors as described below.

Installation

For installation, reverse the removal process but pay attention to the following.

A thin film of injection oil should be applied to O-rings of fuel injectors to ease installation in intake manifold.

Torque rail retaining nuts to 10 N•m (89 lbf•**in**).

When installing fuel line connector to the fuel rail, put some oil on the O-ring to ease installation.

⚠ WARNING

Perform a fuel pressure test and ensure that there is no leak. Refer to FUEL PUMP above. Run engine and check for leaks.

FUEL INJECTORS

Leakage Test

To perform a leakage test, the injectors and fuel rail have to be removed from the engine. Refer to REMOVAL in FUEL RAIL REPLACEMENT for the procedure.

NOTE: Do not detach injectors from the fuel rail.

Reconnect the fuel line and the wiring harness.

Place each injector in a clean bowl.

Install the tether cord cap on the DESS post and press the engine START/RER button to activate the fuel pump.

Check for fuel leakage from the injector nozzle. There should be less than 1 drop per minute. Perform the test for 2 minutes.

If not within specification, replace the fuel injector(s).

The leakage test is validated when performing the FUEL DELIVERY SYSTEM DIAGNOSTIC FLOW CHART elsewhere in this section.

Electrical Test

Tether cord cap must be on DESS post.

Using the vehicle communication kit (VCK) with the B.U.D.S. software, energize the fuel injector from the **Activation** section.

If the injector does not work, disconnect the plug connector from the injector.

Install a temporary connector to the injector with wires long enough to make the connection outside the engine compartment and apply voltage (12 V) to this test harness.

This will validate the injector mechanical and electrical operation.

If it does not work, replace it.

Using B.U.D.S., activate injector while probing pin 1 (of injector on harness side) and battery ground.

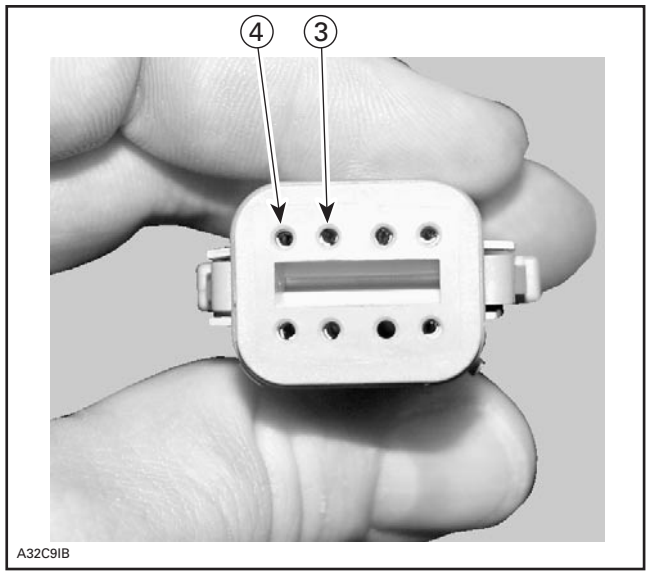
If 12 V is read, check continuity of circuit as per following table.

CIRCUIT NUMBER (ECM CONNECTOR "A")	INJECTOR NUMBER
A-15	1/1 (MAG external)
A-33	2/1 (PTO external)
A-14	1/2 (MAG internal)
A-30	2/2 (PTO internal)

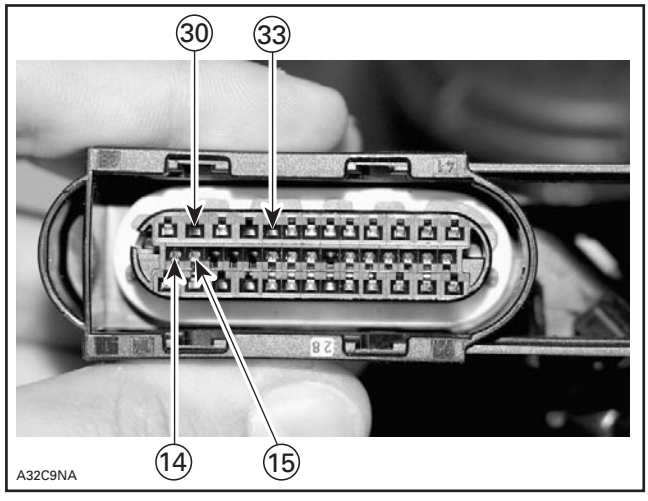
If it is good, check the resistance of the fuel injector circuit.

Reconnect the injector and disconnect the connector A from the ECM as well as the engine connector.

Using a multimeter, check resistance value between terminals as follows.



ENGINE CONNECTOR



ECM CONNECTOR

COMPONENT	CONTACT LOCATION
Fuel injector 1 cylinder 1	3 (engine connector) and A-15 (ECM connector)
Fuel injector 2 cylinder 1	3 (engine connector) and A-14 (ECM connector)
Fuel injector 1 cylinder 2	4 (engine connector) and A-33 (ECM connector)
Fuel injector 2 cylinder 2	4 (engine connector) and A-30 (ECM connector)

The resistance should be around 14.5 Ω.

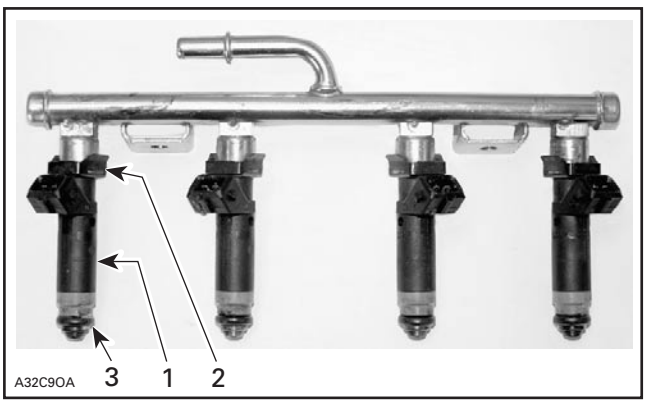
If resistance value is correct, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

If resistance value is incorrect, repair the wiring harness/connectors or replace the wiring harness between ECM connector and fuel injector or replace the injector.

Fuel Injector Replacement

Removal

Before removing the injectors, the fuel rail has to be removed from the engine. Refer to REMOVAL in FUEL RAIL REPLACEMENT for the procedure.



FUEL RAIL ASS'Y

1. *Fuel injector*
2. *Injector clip*
3. *O-ring*

Then remove the injector clip. Now the fuel injector can be easily pulled out of the fuel rail.

Installation

For the installation, reverse the removal procedure. Pay attention to the following details.

If you reinstall a used injector, insert it with your hand. Do not use any tool. Ensure clip and injector are properly installed.

NOTE: A thin film of engine oil should be applied to O-rings to ease insertion in rail.

Torque rail retaining nuts to 10 N•m (89 lbf•**in**).

⚠ WARNING

Perform a fuel pressure test and ensure that there is no leak. Refer to FUEL PUMP above. Run engine and check for leaks.

ELECTRONIC MANAGEMENT

ECM REPLACEMENT

General

Prior to replacing a suspected ECM, ensure that all the recommendations in the general introduction of this section have been followed.

IMPORTANT: When the ECM is replaced, the tether cord cap(s) and the **Closed Throttle** must be reprogrammed/reset. Refer to their specific section for adjustment.

To allow transferring the previous recorded information from the old ECM to the new one, use the vehicle communication kit (VCK) with the B.U.D.S. software. Use **Replace ECM** in the **ECM** menu. Follows the instructions provided by the help system.

NOTE: If the old ECM can still communicate, it must be read inside B.U.D.S. prior to removing it from the vehicle to carry vehicle information and history to the new ECM.

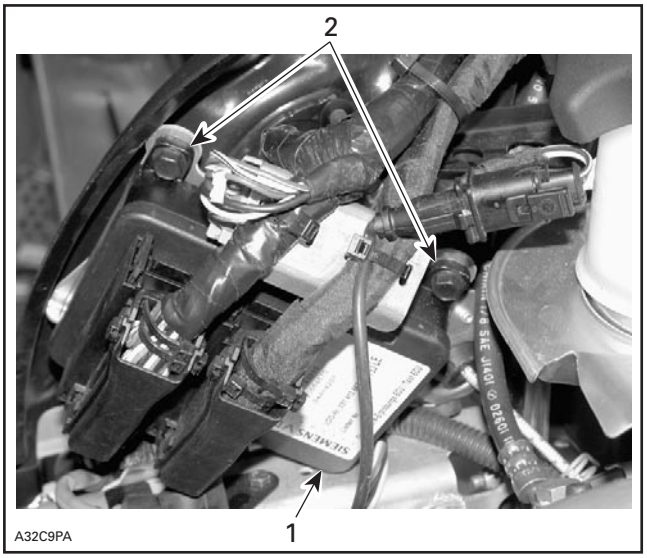
ECM Replacement

Disconnect battery cables.

⚠ WARNING

Battery BLACK (-) cable must always be disconnected first and connected last.

Disconnect both connectors from ECM.



1. ECM
2. Retaining screws

Unscrew all retaining screws and remove the engine ECM from its support.

Install the new ECM to the support.

Reconnect ECM connectors to ECM then battery cables.

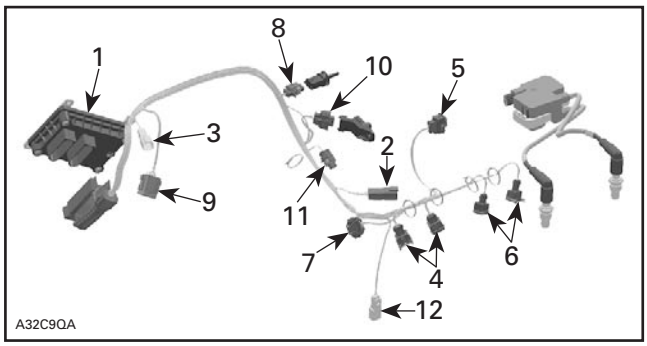
Transfer the data from the previous ECM to the new one using B.U.D.S. then proceed with the required resets and reprogram tether cord cap(s), if you were unable to transfer the data.

NOTE: If data cannot be transferred, manually enter information in **Vehicle** tab.

After performing the required resets, ensure to clear all faults from the newly replaced ECM.

Start the engine and increase engine speed above 5000 RPM to be sure no fault appears.

ENGINE WIRING HARNESS



1. ECM
2. WTS connector
3. EGTS connector
4. Fuel injector connector (cylinder MAG side)
5. Ignition coil connector
6. Fuel injector connector (cylinder PTO side)
7. TPS connector
8. ATS connector
9. Engine connector
10. APS connector
11. KS connector
12. CPS connector

Resistance Test

Check continuity of the circuits according to the wiring diagram in the WIRING DIAGRAMS section of this manual.

If wiring harness is good, check the respective sensor/actuator as described in this section.

Otherwise, repair the connectors, replace the wiring harness or the ECM as diagnosed.

Removal

Remove air intake silencer.

Disconnect the wiring harness from all sensors/actuators.

Disconnect the connector from the ECM.

Cut all locking tie which are holding the wiring harness in position.

Remove complete wiring harness.

Installation

First connect the connector A to the ECM and the engine connector to the vehicle wiring harness.

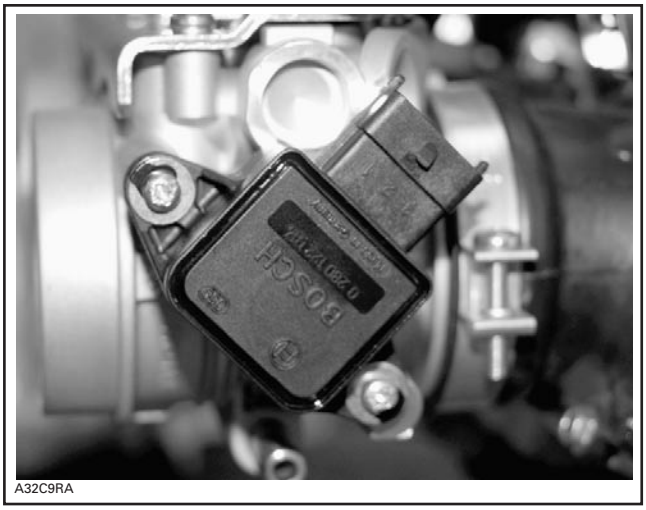
Reconnect the wiring harness to all sensors/actuators and reinstall all locking tie that have been removed.

Install all remaining parts, which has been removed.

THROTTLE POSITION SENSOR (TPS)

General

The throttle position sensor (TPS) is a potentiometer that sends a signal to the ECM which is proportional to the throttle shaft angle.



THROTTLE POSITION SENSOR (TPS)

IMPORTANT: Prior to testing the TPS, ensure that mechanical components/adjustments are adequate according to THROTTLE BODY in AIR INDUCTION SYSTEM above.

The ECM may generate several fault codes pertaining to the TPS. Refer to SYSTEM FAULT CODES in DIAGNOSTIC PROCEDURES section for more information.

Wear Test

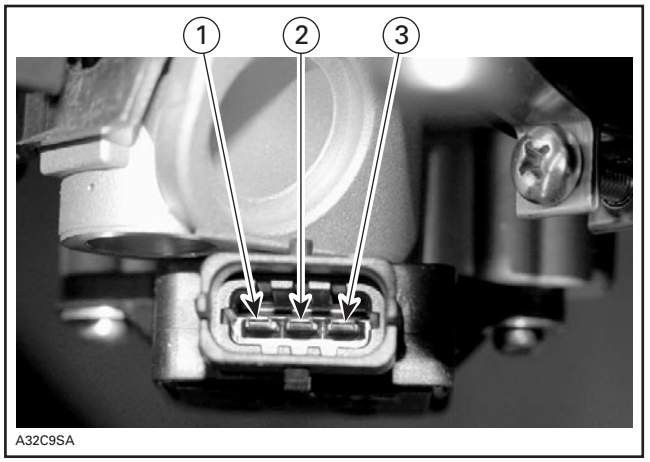
While engine is not running, activate throttle and pay attention for smooth operation without physical stops of the cable.

Using the vehicle communication kit (VCK) with the B.U.D.S. software, use the **Throttle Opening** display under **Monitoring**.

Slowly and regularly depress the throttle. Observe the needle movement. It must change gradually and regularly as you move the throttle. If the needle "sticks", bounces, suddenly drops or if any discrepancy between the throttle movement and the needle movement is noticed, it indicates a worn TPS that needs to be replaced.

Voltage Test

Check the voltage output from ECM to the desired throttle position sensor.



TPS

Disconnect plug connector from throttle position sensor. To unlock connector, insert a small screwdriver between the folded tab. To see the connector pin-out and its pin numbers, temporarily remove the connector shield joining the harness. Connect a voltmeter between pin 1 and 2 in the wiring harness.

Install the tether cord cap and push START/RER button momentarily to activate the ECM.

Check the voltage readings as follows.

CONNECTION	VOLTAGE
Pin 1 with engine ground	0 V
Pin 2 with engine ground	5 V

Check the continuity between pin 3 on wiring harness TPS connector and pin 24 on wiring harness ECM connector.

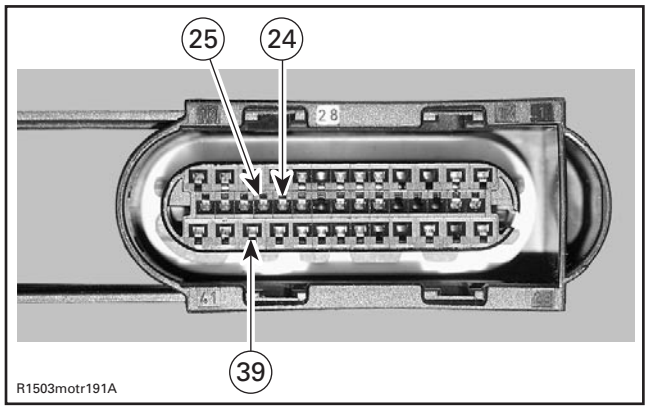
If tests are good, replace the TPS.

If voltage tests are not good, continue to check the resistance of the rest of the TPS circuit.

Resistance Test

Reconnect the TPS.

Disconnect the connector A on the ECM.



Using a multimeter, check resistance value between terminal A-25 and A-39.

The resistance should be 1600 - 2400 Ω in any throttle position.

Check the resistance between terminal A-24 and terminal A-39 with the throttle plate in **idle** position.

The resistance should be approximately 1000 Ω.

Check the resistance between terminal A-24 and terminal A-39 with the throttle plate in **wide open** position.

The resistance should be approximately 2500 Ω.

Check the resistance between terminal A-24 and A-25 with throttle plate in **idle** position.

The resistance should be approximately 2500 Ω.

Now check the resistance with the throttle plate in **wide open** position.

The resistance should be approximately 1000 Ω.

NOTE: When measuring between pins A-24 and A-39, resistance **value increases** while depressing throttle lever. When measuring between pins A-24 and A-25, resistance **value decreases** while depressing throttle lever. The resistance value should change smoothly and proportionally to the throttle movement. Otherwise, replace TPS.

If resistance values are correct, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

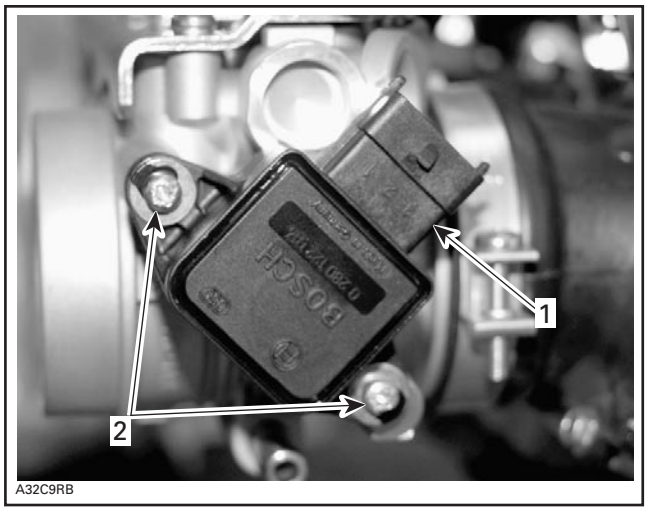
If resistance values are incorrect, repair connector or replace the wiring harness between ECM connector and the TPS.

Replacement

Remove the throttle body as described above.

Loosen two screws retaining the TPS.

Remove TPS.



THROTTLE BODY

1. *Throttle position sensor (TPS)*
2. *Screws*

Install the new TPS.

Apply Loctite 243 on the TPS retaining screws then torque them to 3 N•m (27 lbf•**in**).

Reinstall remaining removed parts.

Proceed with the **Closed Throttle Reset**. See below.

Closed Throttle Reset

NOTE: This operation performs a reset of the values in the ECM.

This reset is very important. The setting of the TPS will determine the basic parameters for all fuel mapping and several ECM calculations in idle speed control of the engine.

NOTE: Reset must be done each time the throttle position sensor (TPS) is loosened or removed or throttle body or ECM is replaced.

CAUTION: An improperly set TPS may lead to poor engine performance.

Use the vehicle communication kit (VCK) with the B.U.D.S. software to perform this adjustment.

Unscrew idle speed screw until the throttle body plate stop lever rest against its zero position stopper screw (capped screw). If necessary, loosen the throttle cable. Open throttle approximately one quarter then quickly release. Repeat 2 - 3 times to settle throttle plate.

Push the **Reset** button in the **Setting** section of B.U.D.S.

The following message will be displayed:

Make sure the idle screw is not in contact with the throttle stopper. Click OK to continue.

Follow instructions and click OK.

Another message will appear to ask you to perform a ECU tracking shut down to save the changes into the ECU permanent memory.

Remove the tether cord cap from the DESS post and wait until the message disappears before reinserting the tether cord cap.

Re-power up the ECM by pushing the START/RER button momentarily.

The throttle opening displayed in B.U.D.S. should be 0.00 (0.05 maximum).

If TPS is not within the allowed range while resetting the **Closed Throttle**, the ECM will generate a fault code and will not accept the setting.

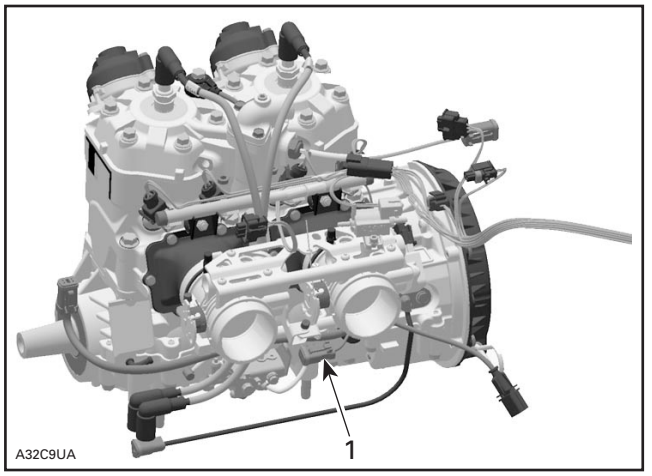
Now, the idle speed screw has to be adjusted. To do this, screw in the idle speed screw until B.U.D.S. throttle opening displays 2.85° (or within a range of 2.70° to 3.00°).

If throttle cable has been loosened during the procedure, adjust a throttle cable.

Start engine and make sure it operates normally through its full engine RPM range. If fault codes appear, refer to SYSTEM FAULT CODES in DIAGNOSTIC PROCEDURES section for more information.

CRANKSHAFT POSITION SENSOR (CPS)

NOTE: The CPS is the trigger coil used for forward and reverse.



1. CPS connector

NOTE: Take into account that a CPS fault can be triggered by missing encoder wheel teeth. First check fault codes then check the teeth condition if necessary. See below.

Disconnect CPS wiring harness connector. Probe terminals coming from CPS while cranking engine. Voltage should be within 1-2 Vac. Otherwise, inspect wiring and replace CPS if wiring is good.

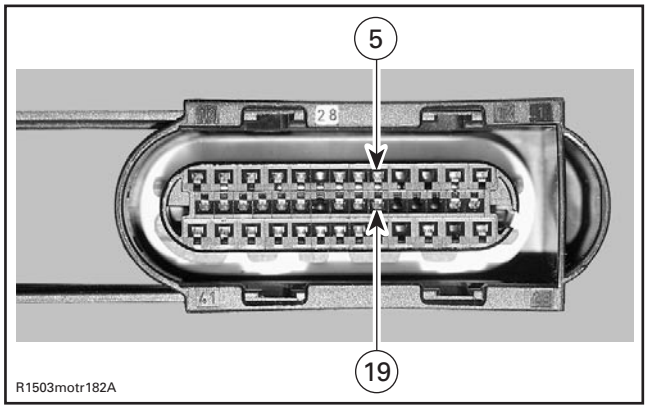
Resistance Test

Disconnect the CPS plug connector from the wiring harness and check the resistance of the sensor itself.

The resistance should be between 190 Ω and 300 Ω.

Otherwise, replace the CPS.

If resistance tests are good, **reconnect** the CPS and disconnect the connector A on the ECM.



Using a multimeter, recheck resistance value between terminals 5 and 19.

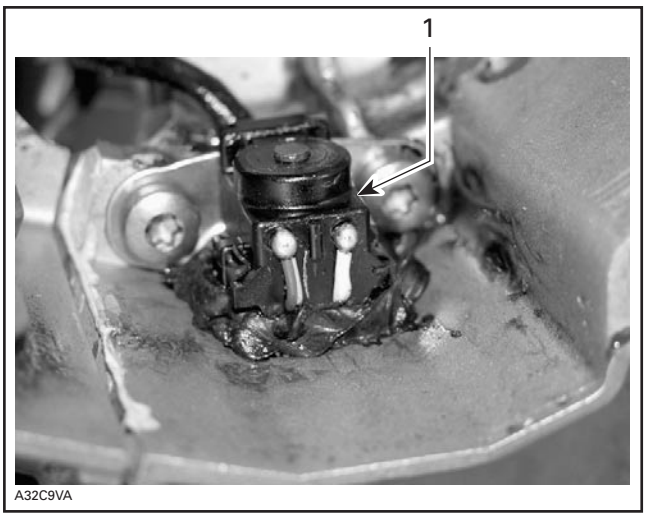
If resistance value is correct, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CPS.

Replacement

Disconnect connectors and remove the rewind starter, then the magneto flywheel. Refer to MAGNETO SYSTEM.

Remove CPS.



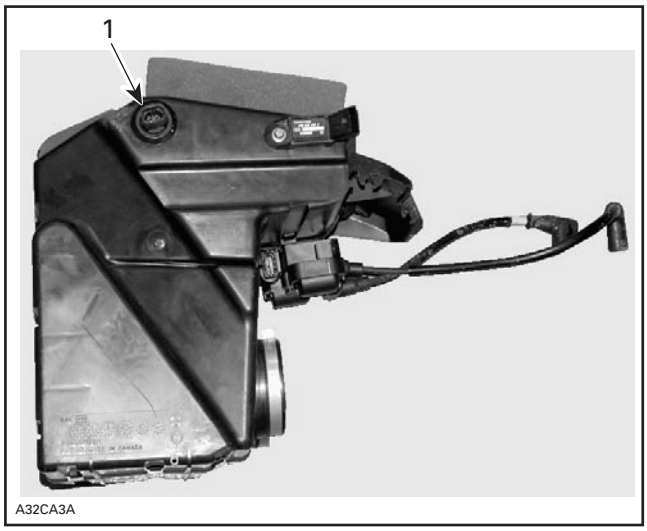
1. CPS inside crankcase

When installing new CPS apply Loctite 5910 between CPS and crankcase.

Torque to 8 N•m (71 lbf•**in**).

Reinstall remaining removed parts.

AIR TEMPERATURE SENSOR (ATS)



1. Air temperature sensor (ATS)

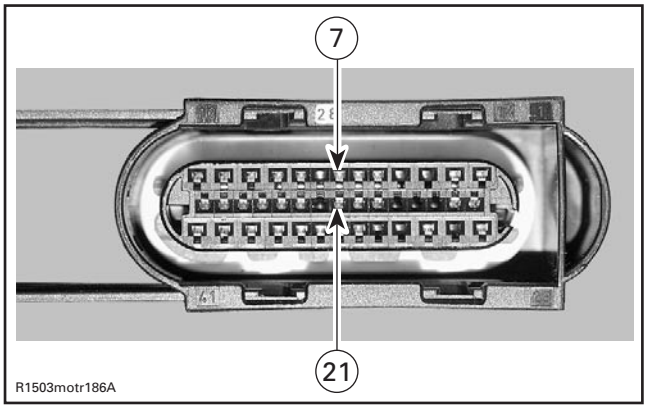
Resistance Test

Disconnect the plug connector from the ATS and check the resistance of the sensor itself.

Refer to TEMPERATURE SENSOR TABLE at the beginning of this section to find the corresponding resistance value for this sensor temperature.

If out of specification, replace the sensor.

If resistance tests good, **reconnect** the ATS and disconnect the connector A on the ECM.



Using a multimeter, recheck resistance value between terminals 7 and 21.

If resistance value is correct, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the ATS.

Replacement

Disconnect the connector of the ATS.

Pull the ATS out of the air intake silencer.

Follow this procedure to install the ATS.

First, install the ATS rubber ring.

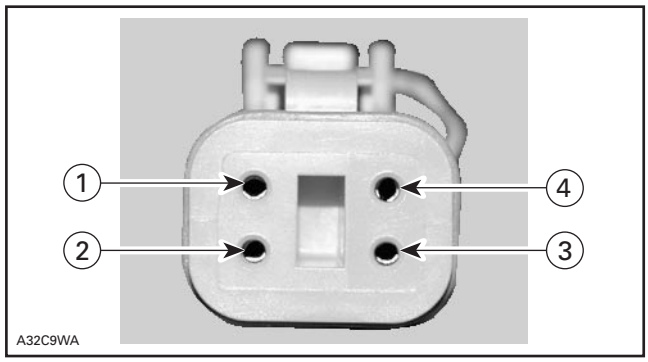
NOTE: If the rubber ring is installed on ATS sensor, remove it before ATS installing.

Spray soapy water on ring. Install ring on air intake silencer then push the sensor in place. Reconnect it.

WATER TEMPERATURE SENSOR (WTS)

Resistance Test

Disconnect the plug connector from the WTS and check the resistance of the sensor itself.



The resistance between pin 1 and 2 is used for temperature gauge.

Refer to TEMPERATURE SENSOR TABLE at the beginning of this section to find the corresponding resistance value for this sensor temperature.

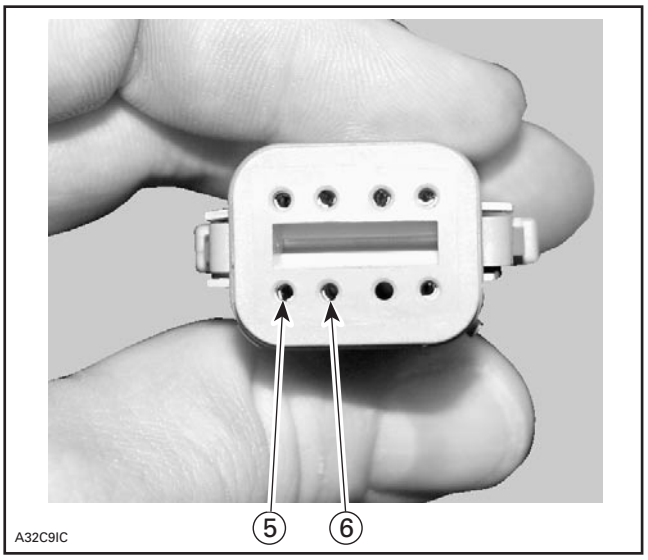
If out of specification, replace the sensor.

The resistance between pin 3 and 4 is used for ECM.

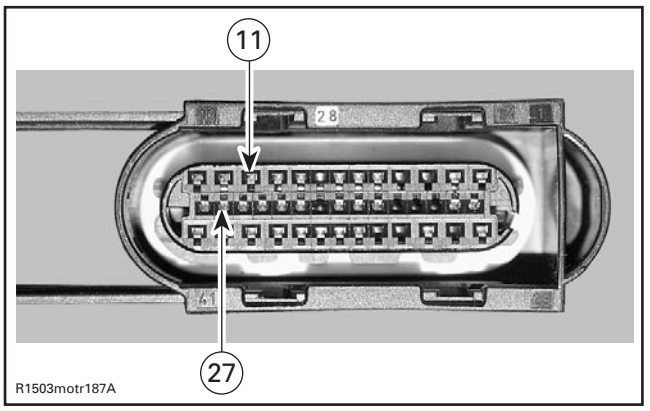
Refer to TEMPERATURE SENSOR TABLE at the beginning of this section to find the corresponding resistance value for this sensor temperature.

If out of specification, replace the sensor.

If resistance tests good, **reconnect** the WTS and disconnect the connector A on the ECM as well as the engine connector.



ENGINE CONNECTOR



ECM CONNECTOR A

Using a multimeter, recheck resistance value between terminals 5 and 6 on engine connector. This resistance is used for temperature gauge.

Refer to TEMPERATURE SENSOR TABLE at the beginning of this section to find the corresponding resistance value for this sensor temperature.

Recheck also resistance value between terminals 11 and 27 on ECM connector A. This resistance is used for ECM.

Refer to TEMPERATURE SENSOR TABLE at the beginning of this section to find the corresponding resistance value for this sensor temperature.

If resistance value is correct, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the WTS.

Replacement

Drain cooling system.

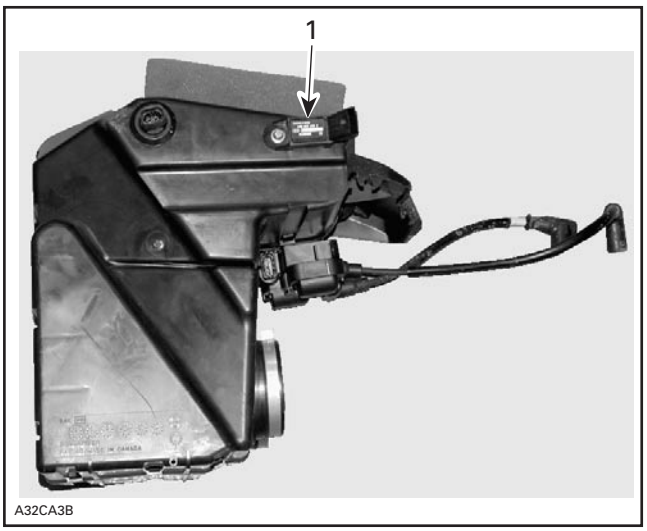
Disconnect WTS connector and remove WTS.

Install the new WTS and torque to 12 N•m (106 lbf•**in**).

Reinstall remaining removed parts.

Refill engine coolant and bleed cooling system. Refer to LIQUID COOLING SYSTEM section.

AIR PRESSURE SENSOR (APS)



1. Air pressure sensor (APS)

Ensure sensor is correctly installed on air intake silencer. Otherwise, the APS could generate a fault code. Remove sensor and check for oil or dirt on its end and if problem persists, check the wiring harness. Perform the following tests.

Voltage Test

Check the voltage output from ECM to the APS.

Disconnect plug connector from APS and connect a voltmeter between pin 1 and 2 of wiring harness.

Remove and reinstall the **tether cord cap and connect the VCK** to activate the ECM.

CONNECTION	VOLTAGE
Pin 1 with ground	5 V
Pin 2 with ground	0 V

Check the continuity between pin 3 on APS connector and pin 18 on ECM connector.

If tests are good, replace the APS.

If tests are not good, continue to check the continuity of the rest of the APS circuit.

Resistance Test

Disconnect the connector A on the ECM.

Using a multimeter, check continuity of circuits 3, 4 and 18.

If wiring harness is good, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

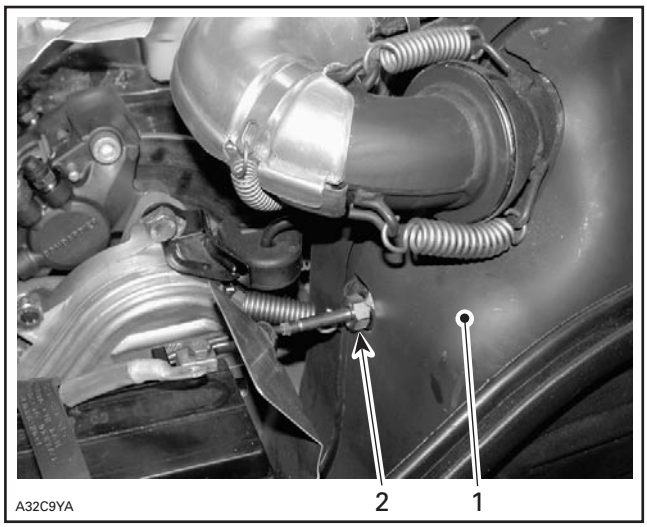
Otherwise, repair the connectors or replace the wiring harness between ECM connector and the APS.

Replacement

Disconnect APS connector and remove the APS. The ATS is retained with a screw.

Install the new APS.

EXHAUST GAS TEMPERATURE SENSOR (EGTS)



1. Muffler
2. Exhaust gas temperature sensor (EGTS)

Resistance Test

Disconnect the plug connector from the EGTS and check sensor resistance.

Refer to TEMPERATURE SENSOR TABLE at the beginning of this section to find the corresponding resistance value for this sensor temperature.

If out of specification, replace the sensor.

If resistance tests good, **reconnect** the EGTS and disconnect the connector A on the ECM.

Using a multimeter, recheck resistance value between terminals 10 and 26.

If resistance value is correct, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

If resistance value is incorrect, repair the connector or replace the wiring harness between ECM connector and the EGTS.

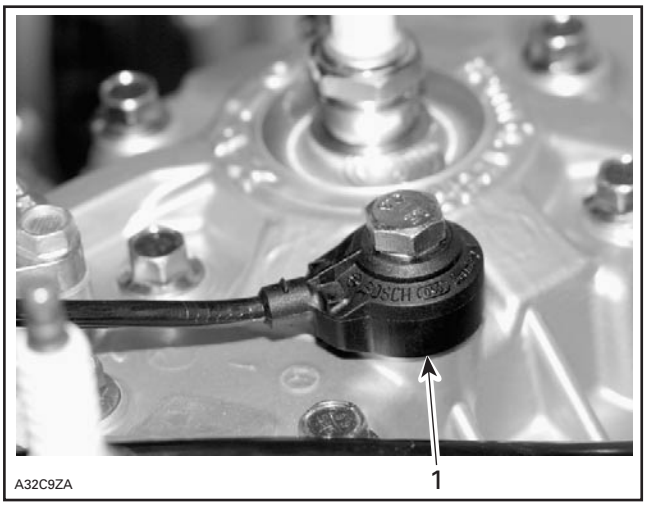
Replacement

Disconnect EGTS connector and remove EGTS.

Torque the new EGTS to 45 N•m (33 lbf•ft).

Replug connector.

KNOCK SENSOR (KS)



1. Knock sensor (KS)

Dynamic Test

Using the vehicle communication kit (VCK) with the B.U.D.S. software, monitor the knock sensor using the **Faults** section.

Start the engine and bring engine RPM above 5000 RPM. If no fault code occurs, the knock sensor is good.

Otherwise, do the following.

Ensure sensor and head contact surfaces are clean and mounting bolt and washer are correct and properly torqued down.

Check the knock sensor resistance.

Disconnect the connector from knock sensor harness.

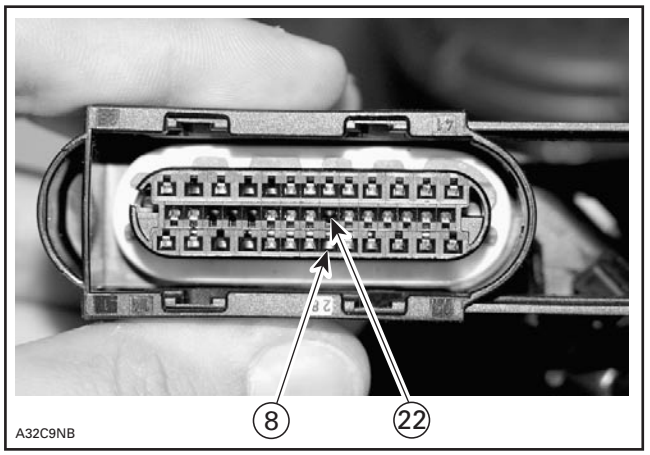
Static Resistance Test

Using a multimeter, check the resistance between both terminals on the knock sensor harness side.

The resistance should be approximately 5 MΩ.

If resistance is not good, replace knock sensor.

If resistance is good, reconnect the knock sensor connector and disconnect the connector A from the ECM.



Using a multimeter, recheck resistance value between terminals 8 and 22.

If wiring harness is good, try a new ECM. Refer to ECM REPLACEMENT procedures elsewhere in this section.

Otherwise, repair the connector or replace the wiring harness between ECM connector and knock sensor.

Replacement

Unscrew and remove knock sensor from cylinder head.

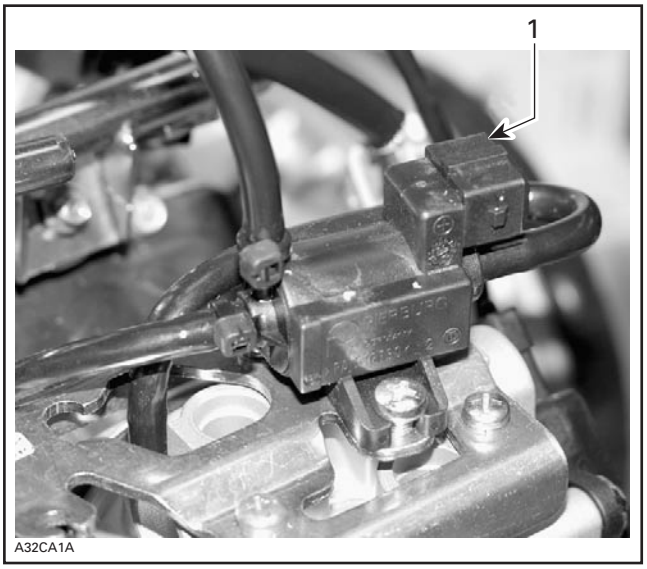
Clean contact surface, then install the new knock sensor.

Torque screw to 24 N•m (18 lbf•ft).

CAUTION: Improper torque might prevent sensor to work properly and lead engine to severe damage of internal components.

Replug connector.

E-RAVE SOLENOID



1. E-RAVE solenoid

Resistance Test

Disconnect the solenoid connector.

Check resistance value between both terminals of the solenoid.

The resistance value should be approximately 30 Ω.

Voltage Test

Install the tether cord cap and push the START/RER button momentarily to activate ECM.

Battery voltage should be present on VIOLET/GREY wire. If test fail, fuse may be blown.

Continuity Test

BROWN/WHITE wire must show continuity between solenoid connector and pin 15 on connector B from the ECM.

If test fail, repair connector or replace wiring harness between ECM connector and solenoid.

Replacement

Remove the air intake silencer.

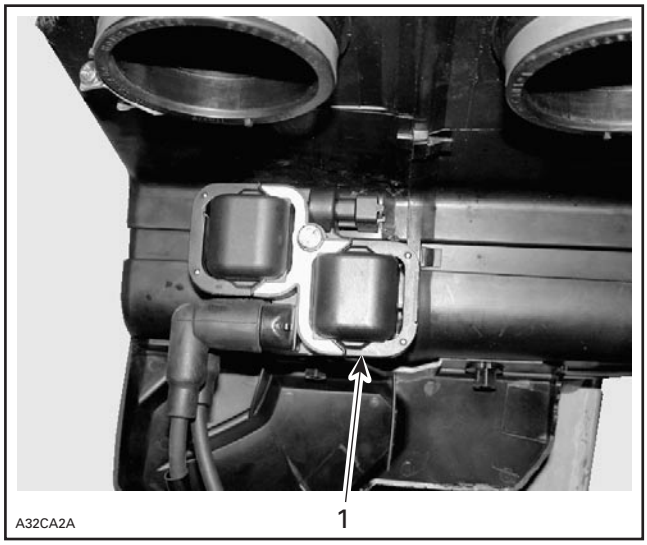
Unplug the solenoid connector and all hoses.

NOTE: Mark hose locations for installation.

Remove solenoid screws then the solenoid.

For installation, reverse the removal procedure.

DOUBLE IGNITION COIL



1. Ignition coil

NOTE: The ECM energizes the primary side of each ignition coil individually. It can detect open and short circuit in the primary winding but it does not check the secondary winding.

Using the vehicle communication kit (VCK) with the B.U.D.S. software, energize the ignition coil from the **Activation** section.

You should hear the spark occurring. In doubt, use an inductive spark tester or a sealed tester – available from after-market tool/equipment suppliers – to prevent spark occurring in the engine compartment. Otherwise, perform the following checks.

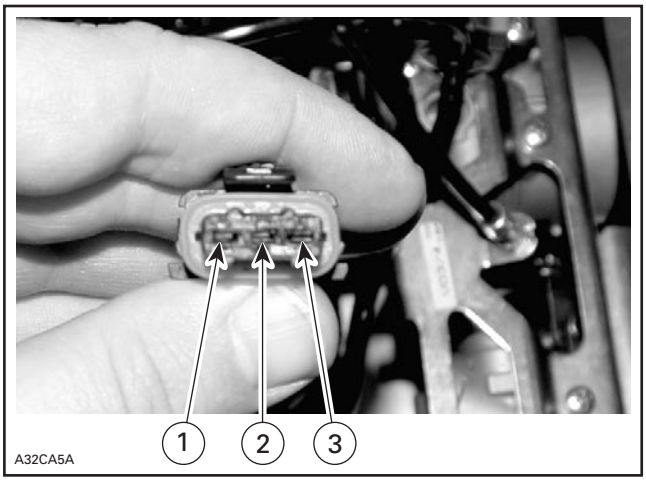
An ignition coil with good resistance measurement can still be faulty. Voltage leak can occur at high voltage level which is not detectable with an ohmmeter. Replacing the ignition coil may be necessary as a test.

Voltage Test

⚠ WARNING

When disconnecting coil from spark plug, always disconnect coil from main harness first. Never check for engine ignition spark from an open coil and/or spark plug in the engine compartment as spark may cause fuel vapor to ignite.

Disconnect the plug connector from the ignition coil and check the voltage supplied by the battery.



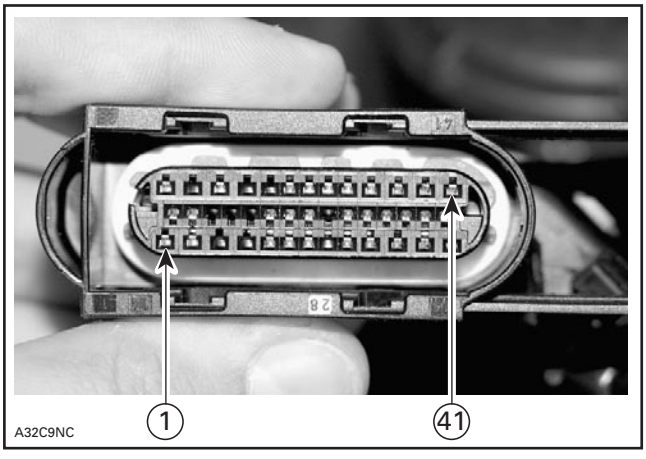
Install **tether cord cap** on the DESS post and push the START/RER button momentarily to activate the ECM.

Check voltage between terminal 2 of ignition coil connector on the wiring harness and battery ground.

Battery voltage should be present.

If 12 V is NOT read, check continuity between terminal 2 of ignition coil and the corresponding fuse. Otherwise repair wiring harness.

If 12 V is read, disconnect the connector A from the ECM and check the continuity of appropriate circuit 41 (cylinder 1) or 1 (cylinder 2) and of ignition coil connector, pin 3 and pin 1 respectively.



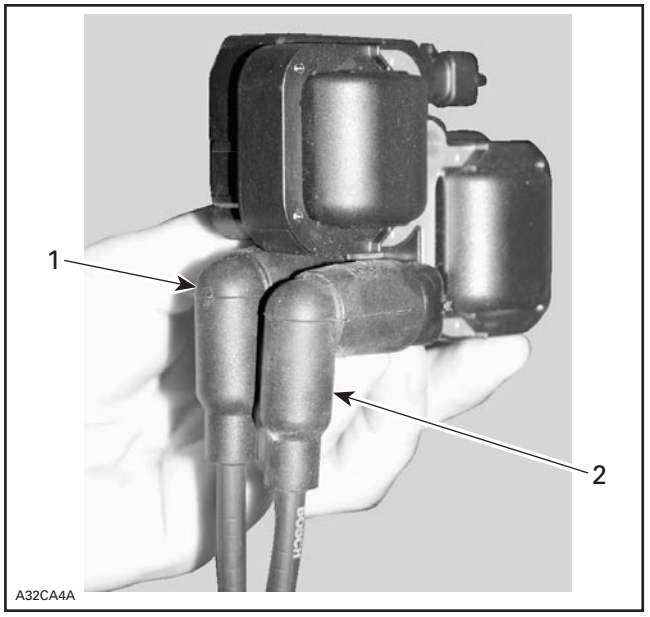
ECM CONNECTOR

If wiring harness is defective, repair the connector or replace the wiring harness between ECM connector and the ignition coil.

If wiring harness is good, test resistance of primary and secondary winding of ignition coil.

Resistance Test

Remove spark plug cables from ignition coil.



1. Spark plug terminal 4a
2. Spark plug terminal 4b

Using a multimeter, check the resistance in both primary and secondary windings.

For primary winding, check the resistance between terminal 15 and terminal 1a (cylinder 1) of the ignition coil and between terminal 15 and terminal 1b (cylinder 2) respectively.

The resistance should be between 0.40 and 1.15 Ω at 20°C (68°F).

The resistance should be between 9.2 and 13.8 kΩ at 20°C (68°F).

If the resistance of one of both windings is not good, replace the ignition coil.

If the windings test good, try a new ECM.

⚠ WARNING

Always reconnect ignition coil cables at the same spark plugs where they come from. Otherwise, severe backfire may occur with possible damage to exhaust system components.

TDC SETTING (Top Dead Center)

Refer to IGNITION TIMING section.

ENGINE START/RER BUTTON VERIFICATION

A quick operation test can be done using the vehicle communication kit (VCK) with the B.U.D.S. software, using the **Monitoring** section. Press the START/RER button and look at the START/RER button LED. It should turn on, indicating the starting system is working on the input side of the starting system (START/RER button, ECM and wiring). You know now the problem is on the output side of the starting system (ECM output signal to starting solenoid, wiring harness going to the solenoid and starter motor. Refer to STARTING SYSTEM for testing procedures). Otherwise, check the input side as follows.

This is piezo electric-type switch.

NOTE: You will not feel any movement when you press this kind of button.

Disconnect the START/RER button connector. Using an ohmmeter, connect test probes to RED/BROWN and BEIGE wires.

Measure resistance, it must be at least 5 MΩ an open circuit (switch is normally open). Depress and hold button, the ohmmeter should read lower than 300 ohms during 2 seconds. Otherwise, replace switch. Reconnect connector.

Test continuity of circuit B-19. If it is good, try a new ECM. Otherwise, repair harness/connectors.

DESS SWITCH VERIFICATION

If 2 short beeps are not heard when starting the engine, refer to DIAGNOSTIC PROCEDURES.

The following continuity tests can also be performed using an ohmmeter.

Disconnect switch wires.

Tether Cord Cap Removed

Connect test probes to switch BLACK/GREEN and BLACK/WHITE wires. Measure resistance, there should be NO continuity (open circuit).

Connect one test probe to the WHITE/GREY wire and the other test probe to the switch top terminal. Measure resistance, it must be close to 0 ohm.

Connect one test probe to the BLACK/GREEN wire and the other test probe to the switch ring. Measure resistance, it must be close to 0 ohm.

Tether Cord Cap on Switch

Connect test probes to switch BLACK/GREEN and BLACK/WHITE wires. Measure resistance, it must be close to 0 ohm.

SPARK PLUGS

Disassembly

⚠ WARNING

Never remove ignition coil from the spark plug without disconnecting it from the wiring harness. Flammable vapors may be present in the engine compartment and ignited by a spark which could cause an explosion.

Disconnect the spark plug cable from the spark plug.

First unscrew the spark plug one turn.

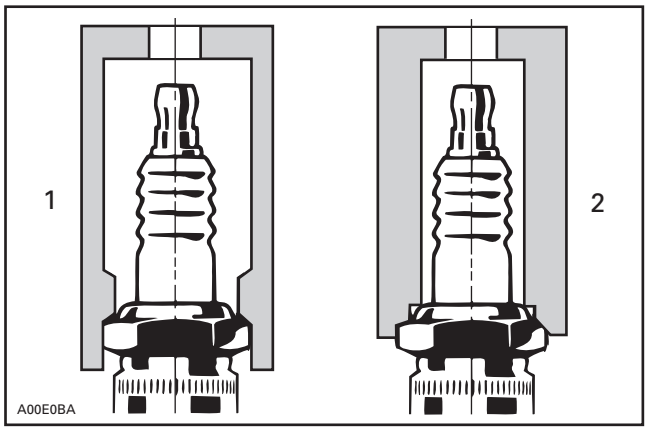
Clean the spark plug and cylinder head with pressurize air then completely unscrew.

Spark Plug Installation

Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, set electrode gap according to the following chart.
2. Apply anti-seize lubricant over the spark plug threads to prevent possible seizure.

3. Hand screw spark plug into cylinder head. Then, tighten the spark plug clockwise an additional 1/4 turn with a proper socket.



1. Proper socket
2. Improper socket

ENGINE	SPARK PLUG	TORQUE	GAP mm (in)
793 SDI 2-TEC	NGK DCPR8-ES	Hand tighten + 1/4 turn with a socket	0.6 (.24)

CRANKING SYSTEM

See above for START/STOP switch and the DESS post testing. Refer to STARTING SYSTEM section for other tests.

DIAGNOSTIC PROCEDURES

GENERAL

Here is the basic order suggested to diagnose a suspected engine management or fuel injection related problem:

– Check the chart in TROUBLESHOOTING section to have an overview of problems and suggested solutions.
– Check if the engine management system (EMS) pilot lamp lights up. If so, use the VCK (Vehicle Communication Kit) and look for fault codes to diagnose the trouble.
– Check all fuses.
– Check fuel pressure.
– Check spark plugs condition.
– Check all connections of the wiring harness.

Refer to COMPONENT INSPECTION AND ADJUSTMENT section for procedures.

TROUBLESHOOTING

The following chart is provided to help in diagnosing the probable source of simple troubles.

Monitoring Beeper Coded Signals

CODED SIGNALS	POSSIBLE CAUSE	REMEDY
2 short beeps (when engine is started). DESS/RER pilot lamp also blinks.	• Confirms that proper tether cord cap is installed.	• Engine can rev above clutch engagement.
1 short beep every 1.5 seconds (when engine is started). DESS/RER pilot lamp also blinks. Engine cannot reach pulley engagement speed. Vehicle cannot be driven.	• Bad DESS system connection. • Defective tether cord cap. • Dirt or snow in tether cord cap. • Defective DESS post.	• Reinstall tether cord cap correctly over post. • Use another programmed tether cord cap. • Clean tether cord cap. • Replace DESS post.
1 long beep per second.	• Reverse is selected.	• Vehicle can be driven in reverse.
3 short beeps per second. DESS/RER pilot lamp also blinks. Engine cannot reach pulley engagement speed. Vehicle cannot be driven.	• Wrong tether cord cap is installed.	• Install proper tether cord cap. • Program key into ECM.
3 short beeps per second. Engine overheating pilot lamp also blinks.	• Engine is overheating.	• Stop engine immediately and allow to cool. Check cooling system.
3 short beeps per second.	• Low battery voltage.	• Check battery and charging system.
4 short beeps every 2 minutes. Oil pilot lamp also lights up.	• Low oil level on 2-TEC models.	• Check oil level and replenish as soon as possible.
Battery pilot lamp lights up.	• No charging.	• Check battery and charging system.
4 short beeps every 2 minutes.	• Too high battery voltage. • DESS system has detected a shorted key installed on DESS post.	• Check battery and charging system. • Use another programmed tether cord cap.

P CODE	ENGINE PILOT LAMP	BUZZER	DESCRIPTION	CAUSES AND ACTIONS
P0337	OFF	OFF	No crankshaft signal detected.	Damaged wires, damaged CPS or damaged tooth wheel. • Check resistance (190 to 290 Ω) between terminals A-5 and A-19 of ECM connector. • Check for 2 Vac while cranking the engine.
P0339	OFF	OFF	Crankshaft signal fault.	CPS signal not plausible, damaged wires, damaged connector or damaged tooth wheel. • Check resistance (190 to 290 Ω) between terminals A-5 and A-19 of ECM connector. • Check for 2 Vac while cranking the engine.
P0513	OFF	OFF	Incorrect DESS key.	DESS key not programmed, wrong DESS key used, bad contact on the DESS key. DESS key failure. • Clean DESS key and post contacts. • Program DESS key.
P0616	OFF	OFF	Starter relay open circuit or shorted to ground.	Damaged or disconnected starter relay, damaged ECM output pin or blown fuse (F4). • Check for 12 V on terminal 2 of the starter relay.
P0617	OFF	OFF	Starter relay shorted to battery.	Damaged solenoid, damaged circuit wires, damaged connector or damaged ECM output pins. • Verify if circuit B-31 is shorted to 12 V.
P0650	OFF	OFF	Warning lamp shorted to battery.	Damaged wires, damaged speedometer. • Verify if circuit B-33 is shorted to 12 V.
P0650	OFF	OFF	Warning lamp open circuit or shorted to ground.	Damaged wires, disconnected wires or connector on speedometer or cab, damaged ECM output pins. • Check system circuit B-33.
P0654	OFF	OFF	Tachometer RPM signal shorted to battery.	Damaged wires, damaged speedometer. • Check system circuit B-4.
P0654	OFF	OFF	Tachometer RPM signal open circuit or shorted to ground.	Damaged wires, disconnected wires or connector on speedometer or cab, damaged ECM output pins. • Check system circuit B-4.
P1611	OFF	OFF	P+ Test of ISC output signal failed.	Intake pressure sensor or TPS failure, sensors power line shorted to ground or to 12 V, damaged ECM. • Key on and off. • Reset closed TPS. • Check battery voltage. • Replace TPS.
P1655	OFF	OFF	DESS shorted to battery.	Damaged wires or mixed up connections. • Check system circuit B-26, B-38 and B-39.
P1656	OFF	OFF	DESS line shorted to ground.	Damaged wires or mixed up connections. • Check system circuit B-26, B-38 and B-39.
P1104	OFF	2 s/15 mn ③	Throttle position sensor adaptation cancelled.	No initialisation after throttle body or ECM change or throttle idle stop drifted. • Check cable adjustment. • Check idle stop for wear. • Make sure that the throttle plate is against the throttle stop. • Check throttle angle at idle. • Reset closed TPS.

P CODE	ENGINE PILOT LAMP	BUZZER	DESCRIPTION	CAUSES AND ACTIONS
P0111	BLINKS ①	OFF	Air temperature sensor functional problem.	Damaged sensor, circuit wires, connector or damaged ECM terminals. • Measure ATS's resistance (2280 to 2736 Ω) at 20°C (68°F). • Measure resistance between pins A-7 and A-21 (2280 to 2736 Ω) at 20°C (68°F). • Replace ATS and measure the resistance. If the second measure is wrong check for bad wires or terminals in system circuit A-7 and A-21.
P0648	BLINKS ①	OFF	DESS lamp shorted to battery.	Damaged wires, damaged speedometer. • Verify if circuit B-3 is shorted to 12 V.
P0648	BLINKS ①	OFF	DESS lamp open circuit or shorted to ground.	Damaged wires, disconnected wires or connector on speedometer or cab, damaged ECM output pins. • Check system circuit B-3.
P0655	BLINKS ①	OFF	Engine temperature lamp shorted to battery.	Damaged wires, damaged speedometer. • Verify if circuit B-5 is shorted to 12 V.
P0655	BLINKS ①	OFF	Engine temperature lamp open circuit or shorted to ground.	Damaged wires, disconnected wires or connector on speedometer or cab, damaged ECM output pins. • Check system circuit B-5.
P1148	BLINKS ①	OFF	Safety fuel cut off detected.	Idle bypass valve wrong reference, TPS adaptation failure, TPS failure or battery voltage out of range.
P1646	BLINKS ①	OFF	Engine temperature lamp shorted to battery.	Damaged wires, damaged speedometer. • Verify if circuit B-5 is shorted to 12 V.
P1647	BLINKS ①	OFF	Engine temperature lamp open circuit or shorted to ground.	Damaged wires, disconnected wires or connector on speedometer or cab, damaged ECM output pins. • Check system circuit B-5.
P1648	BLINKS ①	OFF	Battery lamp shorted to battery.	Damaged wires, damaged speedometer. • Verify if circuit A-32 is shorted to 12 V.
P1649	BLINKS ①	OFF	Battery lamp open circuit or shorted to ground.	Damaged wires, disconnected wires or connector on speedometer or cab, damaged ECM output pins. • Check system circuit A-32.
P1670	BLINKS ①	OFF	Buzzer shorted to battery.	Damaged wires, damaged buzzer. • Disconnect the buzzer and check for a change in the error code. If the code stay the same, check the wires, if the code changes, install a new buzzer. • Verify if circuit B-18 is shorted to 12 V.
P1671	BLINKS ①	OFF	Buzzer open circuit or shorted to ground.	Damaged wires, disconnected wires or connector on buzzer or cab, damaged ECM output pins. • Check system circuit B-18.
P0079	BLINKS ①	2 s/mn ②	RAVE solenoid open circuit or shorted to ground.	Damaged or disconnected RAVE solenoid, blown fuse (F9). • Check system circuit B-15.
P0080	BLINKS ①	2 s/mn ②	RAVE solenoid shorted to battery.	Damaged wires, damaged RAVE solenoid. • Disconnect the RAVE solenoid and check for a change in the error code. If the code stay the same check the wires, if it changes change the RAVE solenoid. • Verify if system circuit B-15 is shorted to 12 V.

P CODE	ENGINE PILOT LAMP	BUZZER	DESCRIPTION	CAUSES AND ACTIONS
P0107	BLINKS ①	2 s/mn ②	Air pressure sensor voltage too low.	Bad or disconnected air pressure sensor. Bad connection between sensor and ECM. • Make sure the connector on the sensor is fully inserted. • Check the voltage on the sensor's connector, you must have close to 5 volts between pins 1 and 2. • Check system circuit A-3, A-4 and A-18.
P0108	BLINKS ①	2 s/mn②	Air pressure sensor voltage too low.	Bad or disconnected air pressure sensor. Bad connection between sensor and ECM. • Make sure the connector on the sensor is fully inserted. • Check the voltage on the sensor's connector, you must have close to 5 volts between pins 1 and 2. • Check system circuit A-3, A-4 and A-18.
P0116	BLINKS ①	2 s/mn ②	Engine temperature sensor functional problem.	Damaged engine temperature sensor, terminals. • Replace the engine temperature sensor. • Disconnect the sensor, if the error code is different, change the sensor. • Check system circuit A-11 and A-27.
P0117	BLINKS ①	2 s/mn ②	Engine temperature sensor voltage too low.	Engine temperature sensor or wires shorted to ground. • Disconnect the sensor, if the error code stay the same, look for short circuit on the harness. • Measure the engine temperature sensor's resistance (2280 to 2736 Ω) at 20°C (68°F). Replace if necessary. • Check system circuit A-11 and A-27.
P0118	BLINKS ①	2 s/mn ②	Engine temperature sensor voltage too high.	Disconnected sensor or sensor's resistance too high. • Check for disconnected engine temperature sensor. • Measure the engine temperature sensor's resistance (2280 to 2736 Ω) at 20°C (68°F). Replace if necessary. • Check system circuit A-11 and A-27.
P0122	BLINKS ①	2 s/mn ②	Throttle position sensor voltage too low.	Damaged wires, damaged throttle position sensor or damaged ECM pins. • Check system circuit A-24, A-25 and A-39.
P0123	BLINKS ①	2 s/mn ②	Throttle position sensor voltage too high.	Damaged wires, damaged throttle position sensor or damaged ECM pins. • Check system circuit A-24, A-25 and A-40.
P0231	BLINKS ①	2 s/mn ②	Fuel pump open circuit or shorted to ground.	Disconnected or damaged fuel pump, wires, connectors or terminals. • Check for approximately 1 ohm between pins PE-3 and PE-4 of the fuel pump connector. • Check for damaged circuit wires. Check for approximately 1 ohm between pins F3-A and B-29. • Check for damaged connector, damaged ECM output pins or ECM failure.

P CODE	ENGINE PILOT LAMP	BUZZER	DESCRIPTION	CAUSES AND ACTIONS
P0232	BLINKS ①	2 s/mn ②	Fuel pump shorted to battery.	Damaged fuel pump, wires, connectors or terminals. • Check for approximately 1 ohm between pins PE-3 and PE-4 of the fuel pump connector. • Check for damaged circuit wires. Check for approximately 1 ohm between pins F3-A and B-29. • Check for damaged connector, damaged ECM output pins or ECM failure.
P0261	BLINKS ①	2 s/mn ②	Outer MAG injector open circuit or shorted to ground.	Damaged wires, damaged injector or blown fuse (F1). • Check fuse F1. • Check connections on injector. • Check system circuit A-15.
P0262	BLINKS ①	2 s/mn ②	Outer MAG injector shorted to battery.	Damaged wires, shorted injector. • Verify if circuit A-15 is shorted to 12 V.
P0264	BLINKS ①	2 s/mn ②	Outer PTO injector open circuit or shorted to ground.	Damaged outer PTO injector or blown fuse (F2). • Check fuse F2. • Check connections on injector. • Check system circuit A-33.
P0265	BLINKS ①	2 s/mn ②	Outer PTO injector shorted to battery.	Damaged wires, shorted injector. • Verify if circuit A-33 is shorted to 12 V.
P0267	BLINKS ①	2 s/mn ②	Inner MAG injector open circuit or shorted to ground.	Damaged inner MAG injector or blown fuse (F1). • Check fuse F1. • Check connections on injector. • Check system circuit A-14.
P0268	BLINKS ①	2 s/mn ②	Inner MAG injector shorted to battery.	Damaged wires, shorted injector. • Verify if circuit A-14 is shorted to 12 V.
P0270	BLINKS ①	2 s/mn ②	Inner PTO injector open circuit or shorted to ground.	Damaged inner PTO injector or blown fuse (F2). • Check fuse F2. • Check connections on injector. • Check system circuit A-30.
P0271	BLINKS ①	2 s/mn ②	Inner PTO injector shorted to battery.	Damaged wires, shorted injector. • Verify if circuit A-30 is shorted to 12 V.
P0351	BLINKS ①	2 s/mn ②	No MAG ignition output stage.	Blown fuse, damaged wires, damaged ignition coil or damaged connector. • Check F1 and/or F2. • Check system circuit A-41.
P0352	BLINKS ①	2 s/mn ②	No PTO ignition output stage.	Blown fuse, damaged wires, damaged ignition coil or damaged connector. • Check F1 and/or F2. • Check system circuit A-1.
P0562	BLINKS ①	2 s/mn ②	Battery voltage too low.	Battery failure, rectifier failure, damaged circuit wires or connection, damaged magneto or damaged connectors. • Check battery voltage for 11 to 13 volts with engine not running. • Check battery voltage for 14.1 to 14.7 volts with engine idling. • Check both connectors on regulator, check ground and positive connections near the starter relay.

P CODE	ENGINE PILOT LAMP	BUZZER	DESCRIPTION	CAUSES AND ACTIONS
P1502	BLINKS ①	2 s/mn ②	T.O.P.S. functional problem.	Damage circuit wire, damaged connector or damaged ECM output pin. • Check for continuity between pin B-9 and ground.
P0106	BLINKS ①	2 s/15 mn ③	Air pressure sensor voltage out of range.	Sensing port dirty or blocked, sensor failure or unexpected reading at idle, sensor fallen out of airbox. • Make sure the connector on the sensor is fully inserted. • Check the voltage on the sensor's connector for 5 volts between pins 1 and 2. • Check system circuit A-3, A-4 and A-18.
P0112	BLINKS ①	2 s/15 mn ③	Air temperature sensor voltage too low.	Air temperature sensor or wires shorted to ground. • Disconnect the sensor, if the error code stay the same, look for short circuit on the harness. • Disconnect the sensor, if the error code is different, change the sensor. • Check system circuit A-7 and A-21.
P0113	BLINKS ①	2 s/15 mn ③	Air temperature sensor voltage too high.	Disconnected sensor or sensor's resistance too high. • Check for disconnected air temperature sensor on the airbox. • Measure the air temperature sensor's resistance (2280 to 2736 Ω) at 20°C (68°F). Replace if necessary. • Check system circuit A-7 and A-21.
P0326	BLINKS ①	2 s/15 mn ③	Knock sensor below minimum noise.	Damaged wires, damaged knock sensor. • Check system circuit A-8 and A-22.
P0336	BLINKS ①	2 s/15 mn ③	High engine RPM detected.	CPS signal not plausible, damaged wires, damaged connector or damaged tooth wheel. • Measure resistance (190 to 290 Ω) between terminals A-5 and A-19 of ECM connector. • Check for 2 volts AC while cranking the engine.
P0426	BLINKS ①	2 s/15 mn ③	Exhaust temperature sensor functional problem.	Damaged wires, damaged sensor. • Measure the exhaust temperature sensor's resistance (215 to 225 Ω) at 20°C (68°F). • Check system circuit A-10 and A-27.
P0427	BLINKS ①	2 s/15 mn ③	Exhaust temperature sensor voltage too low.	Sensor shorted to ground, damaged wires, damaged sensor or damaged connector. • Measure the exhaust temperature sensor's resistance (215 to 225 Ω) at 20°C (68°F). • Check for leakage between sensor's connection and ground. • Check system circuit A-10 and A-26.
P0428	BLINKS ①	2 s/15 mn ③	Exhaust temperature sensor voltage too high.	Disconnected or damaged sensor. • Measure the exhaust temperature sensor's resistance (215 to 225 Ω) at 20°C (68°F). • Check system circuit A-10 and A-26.

P CODE	ENGINE PILOT LAMP	BUZZER	DESCRIPTION	CAUSES AND ACTIONS
P0563	BLINKS ①	2 s/15 mn ③	Battery voltage too high.	Damaged regulator. External battery charger may have been used. • Check battery voltage for 14.1 to 14.7 volts with engine idling. • Check both connectors on regulator, check ground and positive connections near the starter relay.
P0601	BLINKS ①	2 s/15 mn ③	TPS learns unlikely or checksum fault.	ECM not coded, damaged ECM or TPS not initialized. • Check cable adjustment. • Check idle stop for wear. • Check throttle angles at idle. • Reset closed TPS.
P0601	BLINKS ①	2 s/15 mn ③	Module call monitoring.	Damaged ECM or faulty programming.
P0602	BLINKS ①	2 s/15 mn ③	ECM not coded.	Damaged ECM or faulty programming.
P0604	BLINKS ①	2 s/15 mn ③	RAM fault.	Damaged ECM or faulty programming. • Try reflashing the ECM, if problem persist, replace the ECM.
P0605	BLINKS ①	2 s/15 mn ③	EEPROM fault.	Damaged ECM or faulty programming.
P0605	BLINKS ①	2 s/15 mn ③	EEPROM checksum fault.	Damaged ECM or faulty programming.
P0605	BLINKS ①	2 s/15 mn ③	Coding ID checksum fault.	Damaged ECM or faulty programming.
P0605	BLINKS ①	2 s/15 mn ③	Coding checksum fault.	Damaged ECM or faulty programming.
P0605	BLINKS ①	2 s/15 mn ③	Programming checksum fault.	Damaged ECM or faulty programming.
P0608	BLINKS ①	2 s/15 mn ③	Sensor's power supply voltage too low.	Damaged wires, shorted air pressure sensor or TPS. • Check system circuit A-3, A-4, A-18, A-24, A-25 and A-39.
P0608	BLINKS ①	2 s/15 mn ③	Sensor's power supply voltage too high.	Damaged wires, open air pressure sensor or TPS. • Check system circuit A-3, A-4, A-18, A-24, A-25 and A-39.
P1102	BLINKS ①	2 s/15 mn ③	Throttle position sensor adaptation failure.	No initialisation after throttle body or ECN change or throttle idle stop drifted. • Check cable adjustment. • Check idle stop for wear. • Make sure that the throttle plate is against the throttle stop. • Check throttle angles at idle. • Reset closed TPS.
P1654	BLINKS ①	2 s/15 mn ③	Oil lamp shorted to battery.	Damaged wires, damaged speedometer. • Verify if circuit A-17 is shorted to 12 V.
P1658	BLINKS ①	2 s/15 mn ③	Oil lamp open circuit or shorted to ground.	Damaged wires, disconnected wires or connector on speedometer or cab, damaged ECM output pin. • Check system circuit A-17.

P CODE	ENGINE PILOT LAMP	BUZZER	DESCRIPTION	CAUSES AND ACTIONS
P1675	BLINKS ①	2 s/15 mn ③	Relay 2 shorted to battery.	Damaged circuit wires, shorted relay. • Verify if circuit B-16 is shorted to 12 V.
P1676	BLINKS ①	2 s/15 mn ③	Relay 2 open circuit or shorted to ground.	Damaged circuit wires, damaged or disconnected relay. Blown fuse (F4). • Check fuse F4. • Check system circuit A-17.
P1677	BLINKS ①	2 s/15 mn ③	Relay 3 shorted to battery.	Damaged circuit wires, shorted relay. • Verify if circuit B-14 is shorted to 12 V.
P1678	BLINKS ①	2 s/15 mn ③	Relay 3 open circuit or shorted to ground.	Damaged or disconnected relay. Blown fuse (F4). • Check fuse F4. • Check system circuit B14.

① Engine pilot lamp is on for half a second and off for half a second
② Buzzer sounds for 2 seconds every minute
③ Buzzer sounds for 2 seconds every 15 minutes

VCK (vehicle communication kit)

The VCK (Vehicle Communication Kit) (P/N 529 035 844) is the primary tool to diagnose engine management and fuel injection related problems.

NOTE: The MPEM programmer does not work on SDI models.

The SDI models requires B.U.D.S. version G2.0 or P2.0 or above.

B.U.D.S. (Bombardier utility and diagnostic software) is designed to allow actuators, sensors and electronic equipments inspection, diagnostic options and reset such as the closed throttle and idle actuator.

For more information pertaining to the use of the software B.U.D.S., use its help which contains detailed information on its functions.

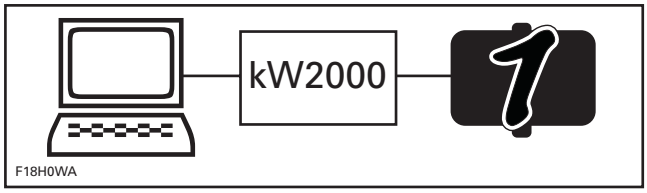
⚠ WARNING

If the computer you are using is connected to the power outlet, there is a potential risk of electrocution when working in contact with water. Be careful not to touch water while working with the VCK.

IMPORTANT: When using the software B.U.D.S., with the SDI engine, ensure that the protocol "kW2000" is properly selected in "MPI" under "Choose protocol".

When B.U.D.S. is connected to the vehicle, the status bar shows the protocol (kW2000) and the number 1 to the right. To communicate with the ECM, number 1 must be displayed.

Number 1 means that one ECM is connected.



ONE ECM IS CONNECTED

If an "X" is shown, this means that no communication between the MPI and the ECM is possible. In this case possible causes are:

– ECM is not powered-up
– wrong protocol is used
– bad connection between MPI and module.

ECM Supply

To power-up the ECM, push the START button shortly while the engine cut-out switch is OFF and the tether cord cap installed on DESS post.

The supply cable (P/N 529 035 869) may also be used. Just the fact to connect it between MPI and vehicle will power-up the ECM.

VCK Supply

The VCK (MPI box) can use the vehicle power for its supply. Four AA batteries or an AC/DC power supply can also be used. Make sure to respect MPI specification if a power supply is used.

Writing in ECM

When writing in ECM through B.U.D.S., there will be an "EMS Tracking" message that will say "Remove key from vehicle". When this occurs, remove the tether cord cap from its post and wait until the message disappears (it lasts approximately 15 seconds after tether cord cap removal).

2-TEC SYSTEM FAULT CODES

General

The faults registered in the ECM (engine control module) are kept when the battery is disconnected.

IMPORTANT: After a problem has been solved, ensure to clear the fault(s) in the ECM using the VCK. This will properly reset the appropriate counter(s). This will also records that the problem has been fixed in the ECM memory.

Many fault codes at the same time is likely to be burnt fuse(s).

For more information pertaining to the code faults (state, count, first, etc.) and report, refer to B.U.D.S. online help.

Supplemental Information for Some Specific Faults

– Electrical noise is picked up by the ECM. Ensure that all connections are in good condition, also grounds (battery, ECM, engine and ignition system), they are clean and well tightened and that all electronic components are genuine — particularly in the ignition system. Installing non-resistive spark plugs may lead to generate this fault code.
– Electrical noise might also lead engine to occasional cutout without generating a fault code when engine is restarted. When looking at the fault code, pay attention to the "count" value in the software B.U.D.S. A value between 1 and 9 confirms an electrical noise problem. A value of 10 and above will generate a fault code.
– If everything is in good condition, try a new ECM.

When using the service action suggested in the Fault section of B.U.D.S., the system circuits are referred as A-41, which means connector "A" on the ECM and the circuit 41.

TPS (Throttle Position Sensor) Faults

Faults which are reported in B.U.D.S. fall into two groups TPS faults and adaption faults. These are displayed on the B.U.D.S. system as TPS OUT OF RANGE and TPS ADAPTION FAILURE.

TPS "OUT OF RANGE" Fault

It is caused by the sensor reading going out of its allowable range. This fault can occur during the whole range of movement of the throttle.

To diagnose this fully, it is recommended to operate the throttle through its full range. It is also recommended to release the throttle quickly as this may also show up a fault that is intermittent.

POSSIBLE CAUSES	RESULT	ACTION
Check if connector is disconnected from TPS	Yes	• Fix.
Check if sensor is loose	Yes	• Fix and reset **Closed Throttle and Idle Actuator**.
Inspect sensor for damage or corrosion	Yes	• Replace and reset **Closed Throttle and Idle Actuator**.
Inspect wiring (voltage test)	Failed	• Repair.
Inspect wiring and sensor (resistance test)	Failed	• If bad wiring, repair. • If bad TPS, replace and reset **Closed Throttle and Idle Actuator**.
Test sensor operation (wear test)		• Replace and reset **Closed Throttle and Idle Actuator**.

TPS "ADAPTATION FAILURE" Fault

It is caused by the idle position moving out of an acceptable range.

Following failures can be effected by a TPS "Adaption Failure":

- Idle speed is out of range.
- Engine stops, when throttle is released quickly.
- Engine runs inconsistent in low partload or low RPM.

POSSIBLE CAUSES	RESULT	ACTION
Sensor has been replaced and TPS closed position not reset	Yes	• Reset **Closed Throttle and Idle Actuator**.
Throttle body has been replaced and TPS closed position not reset	Yes	• Reset **Closed Throttle and Idle Actuator**.
ECM has been replaced and TPS closed position not reset	Yes	• Reset **Closed Throttle and Idle Actuator**.
Throttle cable too tight	Yes	• Fix and reset **Closed Throttle and Idle Actuator**.
Sensor is loose	Yes	• Fix and reset **Closed Throttle and Idle Actuator**.
Throttle bracket is loose	Yes	• Fix and reset **Closed Throttle and Idle Actuator**.
Adjustment screw worn or loose	Yes	• Change throttle body.